Mullard

technical handbook

Book 2

Electronic tubes

Part 2b

Geiger-Müller tubes

1986

GEIGER–MÜLLER TUBES

Book 2 Part 2b

Electronic tubes

Geiger-Müller tubes

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The Mullard technical handbook system....

The Mullard Technical Handbook is made up of four sets of Books, each comprising several parts:-

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Book 3 (green)	Components, Materials and Assemblies
Book 4 (purple or dark blue)	Integrated Circuits

Book 2, Valves and Tubes, comprises the following parts:-

Part 1a	Picture tubes and components
Part 1b	Cathode-ray tubes
Part 1c	Monochrome tubes and deflection units
Part 1d	Wirewound components for tv and monitors
Part 2a	Plumbicon camera tubes and accessories
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Part 2c	Vidicon and Newvicon camera tubes and deflection units
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Part 4a	Tubes for r.f. heating
Part 4b	Transmitting tubes for communications
Part 4c	High-power klystrons
Part 4d	Magnetrons

.....a comprehensive data library

Most of the devices for which full data is given in these books are those around which we would recommend equipment to be designed. Where appropriate, other types no longer recommended for new equipment designs but generally available for equipment production, are listed separately. Data sheets for these types may be obtained on request. Older devices for which data may be obtained on request are also included in the index of the appropriate part of each book.

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The data contained in these books is as accurate and up to date as possible at the time of going to press. It must be understood, however, that no guarantee can be given on the availability of the various devices, or that their specifications may not be changed before the next edition is published.

Each part is reviewed regularly, and revised and re-issued where necessary. Revisions to previous data are indicated by an arrow in the margin.

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Technical Publications Department, Mullard Limited, New Road, Mitcham, Surrey CR4 4XY. Telex 22194.

Prices and availability information for Mullard components should be obtained from Mullard House, or from one of the Mullard Distributors listed on the back cover.

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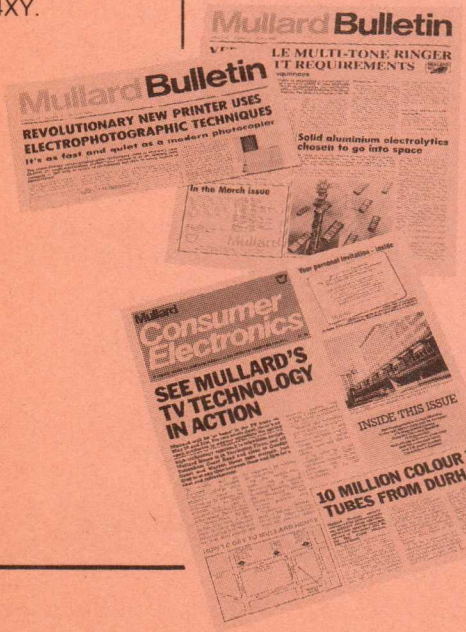
Regular Publications

Mullard Bulletin

A must for designers, this bi-monthly, newspaper-style publication briefly describes new components and offers further information on subjects of interest.

Consumer Electronics

A review, in newspaper style, published every four months. Articles and features of interest to those in the consumer electronics industry, with emphasis on television technology and allied subjects.



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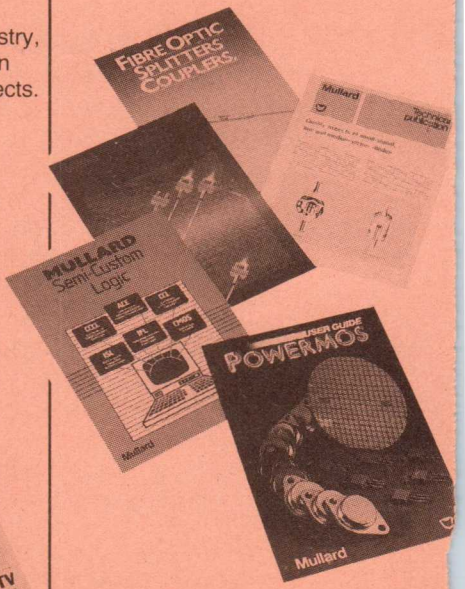
Make sure your name is on the mailing list for the Mullard Bulletin, which describes and offers new publications.



Prestel too!

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The Mullard Data Base begins, on page 556201.

Electronic Components and Applications

A quarterly technical journal covering, in depth, developments in electronics based on the work of Philips, Signetics and Mullard laboratories. Please ask for a sample copy and subscription form.

Quick Reference Guide

All products marketed by Mullard are listed alpha-numerically and described briefly in our Quick Reference Guide.

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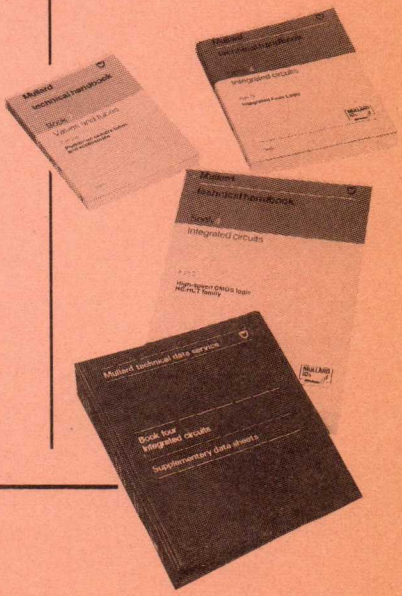
Subscribers to any or all of the four handbook sections receive all relevant handbooks, looseleaf binders, monthly mailings of new data sheets, and new handbook parts as they are published.

For those not wishing to subscribe to the Data Service, handbook parts can be purchased individually.

Individual data sheets are available free-of-charge, and can be obtained by quoting the type number.



Mullard Data Base: Prestel 556201

GENERAL SAFETY RECOMMENDATIONS

ELECTRONIC TUBES

1. GENERAL

When properly used and handled, electronic tubes do not constitute a risk to health or to the environment.
However, certain hazards may arise and it is important that the following recommendations are observed. Care should be taken to ensure that all personnel who may handle, use or dispose of these products are aware of the necessary safety precautions.
Individual product data sheets may indicate if any of the specific hazards given in sections 2 to 9 are likely to be present.

1.1 Breakage

If a tube is broken or otherwise damaged, precautions must be taken against the following hazards which may arise:

- Broken glass or ceramics (see section 4). Protective clothing such as gloves should be worn.
- Contamination by toxic materials and vapours. In particular skin contact and inhalation should be avoided.

1.2 Disposal

These products should be disposed of in accordance with relevant legislation; in the United Kingdom the Deposit of Poisonous Waste Act 1972 and the Control of Pollution Act 1974 apply. Most electronic tubes contain toxic materials, therefore, particularly when disposing of large quantities, the advice of the manufacturer's service department should be sought.

1.3 Fire

Electronic tubes themselves do not present a fire hazard.
However, since most packaging materials are flammable, care should be taken in the disposal of such materials; some of which will emit toxic fumes if burned.
If packaged tubes are involved in a fire, implosion may occur (see section 7), together with the consequent release of toxic vapours and materials.

2. X-RADIATION

All high voltage electronic tubes produce progressively more dangerous X-rays as the operating voltage is increased. The tube envelope usually provides limited protection; however, further shielding may be required in the equipment if the voltage exceeds 10 kV. Should such shielding be required to reduce the X-ray dose rate to below the permitted limit of 0.5 mR/h, this will be indicated on the individual data sheets.
Under some equipment fault conditions, the X-ray hazard may be considerably increased.
This hazard may be present only when the tube is energized.

3. RADIO FREQUENCY (R.F.) AND MICROWAVE RADIATION

Exposure to r.f. fields may be a hazard even at relatively low frequencies. Absorbtion of r.f. energy by the human body is dependent on frequency. Although at frequencies below 30 MHz most energy passes straight through the body with little heating effect it may still represent a hazard. At microwave frequencies a power density above 1 mW/sq cm may comprise a definite hazard, particularly to the eyes.

3. RADIO FREQUENCY (R.F.) AND MICROWAVE RADIATION (Continued)

For this reason care should be exercised when using r.f. and microwave tubes. All r.f. connectors and cavities must be correctly fitted before operation so that no leakage of energy may occur and the r.f. energy must be coupled efficiently to the load. It is particularly dangerous to look into open waveguide, coaxial feeders or transmitter antennae while the tube is energized.
Power klystrons must not be operated without a suitable load at the output and at any intermediate cavities.
Screening of terminal insulators on some high power tubes may be necessary.
This hazard may be present only when the tube is energized.

4. BERYLLIUM OXIDE CERAMICS

The insulators of some microwave power tubes are made of beryllium oxide. Beryllium oxide dust is toxic if inhaled or if particles enter a cut or an abrasion. Avoid handling beryllium oxide ceramics; if they are touched the hands must be thoroughly washed with soap and water. Do nothing to beryllium oxide ceramics which may produce dust or fumes.
All tubes containing beryllium oxide are marked as such. Care should be taken upon eventual disposal that they are not thrown out with general industrial waste. Devices requiring disposal may be handled by the manufacturer's service department. Users seeking disposal of tubes incorporating beryllium oxide ceramics should first take advice from the manufacturer's service department.
This hazard is present at all times from receipt to disposal of tubes.

5. CADMIUM COMPOUNDS

Cadmium compounds are toxic. In the event of accidental breakage, cadmium dust may be released. Gloves should be worn and the dust should be mopped up with a damp cloth. On disposal the cloth should be sealed in a plastic bag and the hands thoroughly washed with soap and water.
Controlled disposal of tubes containing cadmium compounds should be conducted in the open air or in a well ventilated area.
Inhalation of cadmium dust must be avoided.
This hazard is present, if breakage occurs, at all times from receipt to disposal of tubes.

6. MERCURY

Mercury is a toxic substance, especially in the vapour phase. Should breakage occur, gloves should be worn and all droplets brushed up as soon as possible and placed in an airtight container for disposal. Afterwards the hands must be thoroughly washed with soap and water. Direct contact with the skin should be avoided.
This hazard is present, if breakage occurs, at all times from receipt to disposal of tubes.

7. IMPLOSION – HANDLING OF TELEVISION PICTURE AND CATHODE RAY TUBES

All vacuum tubes store potential energy by virtue of their vacuum. The energy level is low in small tubes but represents a hazard in the larger sizes of tubes.
Some modern tubes are provided with integral implosion protection which conforms to IEC65, clause 18. With these tubes, no additional protection is needed. For those tubes without integral implosion protection, precautions taken during manufacture reduce the possibility of spontaneous implosion to a minimum. However, additional stresses due to mishandling may considerably increase the risk of implosion. Implosions may occur immediately or may be delayed.
The strength of the glass envelope will inevitably be impaired by surface damage, such as scratches or bruises (localized surface cracks caused by impact). When a tube is not in its equipment or original packing, it should be placed faceplate downwards on a pad of suitable ribbed material which is kept free from abrasive substances.
Under no circumstances should any attempt be made to move the bonded faceplate or integral implosion protection band when fitted to a tube.

Stresses on the neck of the tube must be avoided. Handle by the recommended methods illustrated for those tubes which have relatively small necks with large envelopes.

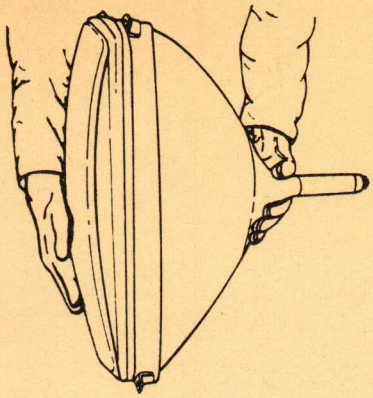


Fig.1 – Lifting tube from edge-down position.

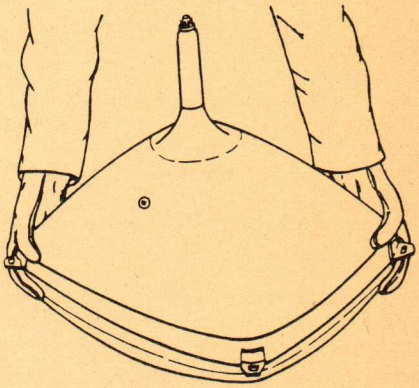


Fig.2 – Lifting tube from face-down position.

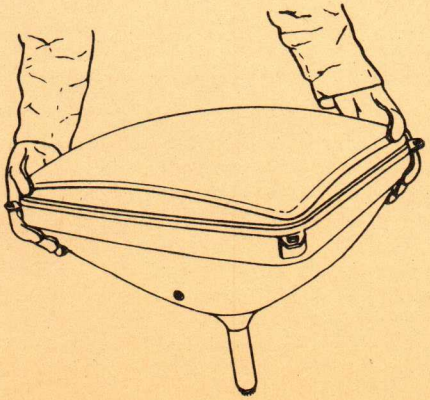


Fig.3 – Lifting tube from face-up position.

Tube on one edge

To lift a tube from the edge-down position, one hand should be placed around the parabolic section of the cone and the other hand should be placed near (slightly below) the centre of the faceplate as shown in Fig.1 **UNDER NO CIRCUMSTANCES SHOULD ANY FORCE BE APPLIED TO THE NECK OF THE TUBE.**

Tube face-down

To lift a tube from the face-down position, the hands should be placed under the areas of faceplate close to the fixing lugs (if fitted), at diagonally opposite corners of the faceplate as shown in Fig.2. The tube must not be lifted from this position by the lugs themselves. **UNDER NO CIRCUMSTANCES SHOULD ANY FORCE BE APPLIED TO THE NECK OF THE TUBE.**

Tube face-up

To lift a tube from the face-up position, the hands should be placed under the areas of the cone close to the fixing lugs (if fitted), at diagonally opposite corners of the cone as shown in Fig.3. The tube must not be lifted from this position by the lugs themselves. **UNDER NO CIRCUMSTANCES SHOULD ANY FORCE BE APPLIED TO THE NECK OF THE TUBE.**

If the handling procedures for tubes prior to insertion in the equipment are such that there is a risk of personal injury as a consequence of severe accidental damage to the tube, then it is recommended that protective clothing should be worn, particularly eye shielding.

When fitted, lugs are primarily provided for fixing in equipment and must not be subjected to excessive forces while the tube is being handled. Adequate protection must be provided if there is a possibility of the tube falling as a result of failure of a lug or lugs.

8 HIGH VOLTAGE – TELEVISION PICTURE AND CATHODE RAY TUBES

Attention is called to the fact that a high voltage may be carried by the internal coductive coating which is connected to the final anode connector and also by the external coating if not earthed, even after a tube has been removed from equipment. Anyone handling such a tube may receive an electric shock which, while generally not dangerous to the person, might cause an involuntary reaction resulting in damage to the tube which might, for example, be dropped. When it is required to discharge the tube capacitance, connection should be made via a resistor of not less than 10 kΩ which is capable of withstanding high voltages.

In equipment where the chassis can be connected directly to the mains, there is a risk of electric shock if access can be gained to the metal rimband through the aperture at the front of the equipment. In order to reduce the magnitude of the shock it is recommended that a 2 MΩ resistor, capable of withstanding peak voltages of e.h.t. values (as specified in IEC65, clause 14.1) is inserted between rimband and the braided earth contact to the external coating. This safety arrangement will provide substantial separation from the mains.

An appreciable capacitance is formed between the rimband and the internal conductive layer of the tube. In the event of flashover, high voltages of low energy will be induced on the rimband. In order to bypass these voltages, an extra-high-voltage low-inductance capacitor of a few nanofarads (in compliance with IEC65, clause 14.2) should be inserted between the rimband and the braided earth contact to the external coating.

9 STRONG MAGNETIC FIELDS

Some electronic tubes use permanent magnets in their operation. When handling or mounting such tubes, a distance of at least 5 cm should be maintained between the magnet and any piece of magnetic material to avoid mechanical shock to the magnet or to the glass or ceramic seals. For this reason it is recommended that non-magnetic tools are used during installation, such as non-magnetic stainless steel, brass, beryllium copper and aluminium. Furthermore, the user should be aware of the detrimental influence of the strong magnetic field around the magnet on compass, electrical meters, watches and

other precision instruments.
Packaged tubes must be stored in such a way as to prevent a decrease of the field strength of the magnets due to interaction with adjacent magnets. Unless otherwise stated on the data sheet, a minimum distance of 15 cm should be maintained between the tubes.
The best protection for the tube is its original packing because this ensures an adequate spacing between the tubes and ferrous objects, and moreover protects the tube against reasonable vibration and shock. Despite this controlled spacing, magnetically-sensitive instruments such as compasses, electrical meters, watches and other precision instruments should not be brought close to a bank of packaged tubes.

UNPACKED PERMANENT MAGNET TUBES SHOULD NEVER BE PLACED ON STEEL BENCHES OR SHELVES.

SAFETY RECOMMENDATIONS

SUMMARY

HAZARD:	X-radiation	Radio frequency (R.F.) and microwave radiation	Beryllium oxide ceramics	Cadmium compounds	Mercury	Implosion	High voltage	Strong magnetic fields
TELEVISION PICTURE AND CATHODE RAY TUBES	X			X		X	X	
RECTIFIERS					X			
THYRATRONS					X			
TRANSMITTING TUBES	X	X						
HIGH POWER KLYSTRONS	X	X	X					
MAGNETRONS		X						X
TRAVELLING WAVE TUBES		X						X
IGNITRONS					X			
REFER TO:	Section 2	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8	Section 9

Safety recommendations under the heading GENERAL (section 1) refer to all electronic tubes.

SELECTION GUIDE

Cylindrical tubes

type number	sensitive for α	sensitive for β	sensitive for γ	counting rate at 10^{-2} mGy/h[1] (^{137}Cs) count/s	sensitive length mm	plateau threshold V	max. plateau length V	max. plateau slope %/V	max. dead time μs	background shielded count/min	dose rate range mGy/h
ZP1200			●	28	40	400	200	0.04	90	10	$10^{-3} - 10^{2}$
ZP1201[3]			●	20	40	400	200	0.04	110	10	$10^{-3} - 40$
ZP1210			●	110	140	400	100	0.15	200	70	$3 \times 10^{-4} - 10$
ZP1220			●	180	240	400	100	0.15	210	90	$2 \times 10^{-4} - 3$
ZP1250		●	●	10^{2}	0.5	420	80	0.40	10	1	$1 - 3 \times 10^{5}$
ZP1300			●	300[2]	8	500	100	0.30	11	1	$10^{-1} - 2 \times 10^{4}$
ZP1301[3]			●	350[2]	8	500	100	0.30	13	1	$10^{-1} - 2 \times 10^{4}$
ZP1302[3]			●	350[2]	8	500	100	0.30	13	9	$10^{-1} - 2 \times 10^{4}$
ZP1310			●	1600[2]	16	500	150	0.15	15	2	$2 \times 10^{-2} - 4 \times 10^{3}$
ZP1313[3]			●	1600[2]	16	500	150	0.15	15	2	$10^{-2} - 3 \times 10^{3}$
ZP1320		○	●	9	28	500	150	0.08	45	12	$3 \times 10^{-3} - 2 \times 10^{2}$
ZP1321[2]		○	●	9	28	500	150	0.08	45	12	$3 \times 10^{-3} - 10^{2}$
ZP1330		○	●	65	75	450	350	0.02	70	30	$6 \times 10^{-4} - 10$

Window tubes

type number	sensitive for α	sensitive for β	sensitive for γ	counting rate at 10^{-2} mGy/h (^{137}Cs)[1] count/s	window ϕ/type mm	plateau threshold V	max. plateau length V	max. plateau slope %/V	max. dead time μs	background shielded count/min	dose rate range mGy/h
ZP1400		●	●	25	9 c	400	200	0.04	90	10	$10^{-3} - 10$
ZP1401	●	●	○	25	9 a	400	200	0.04	90	10	$10^{-3} - 10$
ZP1410	●	●	○	32	19.8 a	450	250	0.02	175	15	$10^{-3} - 10$
ZP1430	●	●	○	44	27.8 a	450	250	0.04	190	25	$6 \times 10^{-4} - 6$
ZP1431		●	○	44	27.8 c	450	250	0.04	190	25	$6 \times 10^{-4} - 6$
ZP1441	●	●	○	16	19.8 a	500	200	0.09	65	5	$3 \times 10^{-3} - 10^{2}$
ZP1442		●	○	16	19.8 c	500	200	0.09	65	8	$3 \times 10^{-3} - 10^{2}$
ZP1451	●	●	○	29	27.8 a	500	250	0.07	60	9	$10^{-3} - 20$
ZP1452		●	○	29	27.8 c	500	250	0.07	60	18	$10^{-3} - 20$
ZP1470		●	●	38	24.1 b	550	150	0.15	70	25	$10^{-3} - 20$
ZP1480		●	○	24	17 d	400	100	0.20	120	30	$10^{-3} - 20$
ZP1481		●	○	24	17 d	400	100	0.20	120	30	$10^{-3} - 20$
ZP1490	●	●	●	29	28 a	450	250	0.05	30	15	$10^{-3} - 20$

Notes
1. 1R = 8.69 mGy
2. Counting rate at 10 mGy
3. With compensating filter

Window thickness (mg/cm^2)
a: 1.5 to 2.0
b: 1.5 to 2.5
c: 2.0 to 3.0
d: 2.5 to 3.0
e: 2.5 to 3.5
f: 3.5 to 4.0

X-ray sensitive tubes

type number	sensitive for α	β	γ	counting rate at 10^{-2} mGy/h[1] (^{137}Cs) count/s	window φ/type mm	plateau threshold V	max. plateau length V	max. plateau slope %/V	max. dead time μs	background shielded count/min	dose rate range mGy/h
ZP1600	6.0 – 20*			660	19.8 e	1600	400	0.07	110	25	–
ZP1610	2.5 – 40*			–	7 x 18 f	–	operating voltage 1550 V				–

*keV

Cosmic ray guard tube

ZP1700			•	–	–	800	400	0.03	1000	70	$3 \times 10^{-4} - 3 \times 10^{-1}$

High temperature tubes

type number	sensitive for α	β	γ	counting rate at 10^{-2} mGy/h[1] (^{137}Cs) count/s	sensitive length mm	plateau threshold V	max. plateau length V	max. plateau slope %/V	max. dead time μs	background shielded count/min	dose rate range mGy/h
ZP1800			•	190	419	700	150	0.08	75	28	$2 \times 10^{-4} - 4$
ZP1810			•	13	51	650	250	0.08	75	25	$3 \times 10^{-3} - 40$
ZP1820			•	110	203	450	250	0.06	100	65	$3 \times 10^{-4} - 4$
ZP1830			•	170	313	450	250	0.06	100	100	$2 \times 10^{-4} - 2$
ZP1840			•	8	32	850	200	0.08	50	15	$4 \times 10^{-3} - 10^{2}$
ZP1850	•		•	36	89	875	200	0.10	100	50	$10^{-3} - 20$
ZP1860	•		•	80	22	875	200	0.10	100	75	$4 \times 10^{-4} - 4$

Notes
1. 1R = 8.69 mGy
2. Counting rate at 10 mGy
3. With compensating filter

Window thickness (mg/cm^2)
a: 1.5 to 2.0
b: 1.5 to 2.5
c: 2.0 to 3.0
d: 2.5 to 3.0
e: 2.5 to 3.5
f: 3.5 to 4.0

GENERAL

GEIGER-MÜLLER TUBES
CROSS REFERENCE GUIDE

ZP type no.	185 type no.	MX type no.	US type no.
ZP1200	18503	MX146	–
ZP1210	18520	MX120/01	–
ZP1220	18545	MX145	–
ZP1230*†	–	MX180	–
ZP1240*†	–	MX119	–
ZP1300	18529	MX163	–
ZP1310	18509	MX151	–
ZP1311*††	–	MX189	–
ZP1311*††	–	ZP1100	–
ZP1320	18550	MX164	–
ZP1330	18555	MX177	–
ZP1400	18504	MX147	–
ZP1410	18505	MX148	–
ZP1430	18526	MX169	–
ZP1431	18506	MX149	–
ZP1441	18515	MX152	–
ZP1451	18536	MX166	–
ZP1460*†	18546/01	MX167/01	–
ZP1470	–	MX123	–
ZP1480	–	MX168/02	–
ZP1481	–	MX168	–
ZP1500*†	–	ZP1083	–
ZP1501*†	–	ZP1080	–
ZP1520*†	18525	MX124/01	–
ZP1530*†	–	MX142	–
ZP1600	18507	MX159	–
ZP1610	18511	MX161	–
ZP1700	18518	MX155	–
ZP1800	–	–	171G
ZP1810	–	–	181G2
ZP1820	–	–	78L
ZP1830	–	–	79L
ZP1840	–	–	560N
ZP1850	–	–	90NB3
ZP1860	–	–	912NB3

* data available on request
† obsolete
†† obsolescent

GEIGER-MÜLLER TUBES
CROSS REFERENCE GUIDE

185 type no.	ZP type no.
18503	ZP1200
18504	ZP1400
18505	ZP1410
18506	ZP1431
18507	ZP1600
18509	ZP1310
18511	ZP1610
18515	ZP1441
18518	ZP1700
18520	ZP1210
18525	ZP1520*†
18526	ZP1430
18529	ZP1300
18536	ZP1451
18548	ZP1220
18546/01	ZP1460*†
18550	ZP1320
18555	ZP1330

MX type no.	ZP type no.
MX119	ZP1240*†
MX120/01	ZP1210
MX123	ZP1470
MX124/01	ZP1520*†
MX142	ZP1530*†
MX145	ZP1220
MX146	ZP1200
MX147	ZP1400
MX148	ZP1410
MX149	ZP1431
MX151	ZP1320
MX152	ZP1441
MX155	ZP1700
MX159	ZP1600
MX161	ZP1610
MX163	ZP1300
MX164	ZP1320
MX166	ZP1451
MX167/01	ZP1460*†
MX168	ZP1481
MX168/02	ZP1480
MX169	ZP1430
MX177	ZP1330
MX180	ZP1230*†
MX189	ZP1311*††
ZP1080	ZP1501*†
ZP1083	ZP1500*†
ZP1100	ZP1311*††

US type no.	ZP type no.
171G	ZP1800
181G2	ZP1810
78L	ZP1820
79L	ZP1830
560N	ZP1840
90NB3	ZP1850
912NB3	ZP1860

* data available on request
† obsolete
†† obsolescent

RADIATION QUANTITIES AND UNITS

In previous issues of this handbook, the (exposure) dose rate has been given as röntgen/hr (R/hr), but this unit is being phased out internationally.

Absorbed dose will be used in future, expressed in the new unit gray (Gy).

Absorbed dose is a measure of energy deposition in any medium by all types of ionizing radiation and

1 Gy = 1 J/kg in SI units

Since an exposure of 1 R results in an energy deposition of 869×10^{-5} J/kg in air it follows that 1 R is equivalent to 869×10^{-5} Gy or 8.69 mGy.

Consequently this handbook gives data for the counting rate as a function of the absorbed dose rate in air as:

count/s and mGy/h

quantity	old unit	new unit	relationship
exposure dose	röntgen	no special unit	1 R = produces in air ions carrying a charge of: 2.58×10^{-4} C/kg
absorbed dose	rad	gray	1 rad = 10^{-2} J/kg 1 Gy = 1 J/kg = 100 rad 1 mGy = 100 mrad

GENERAL INFORMATION
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 termination of the ionization current pulse in a G.M. tube. Effective quenching in our tubes is determined by the combination of the quenching gas properties and the value of the 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 anode resistor. 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.

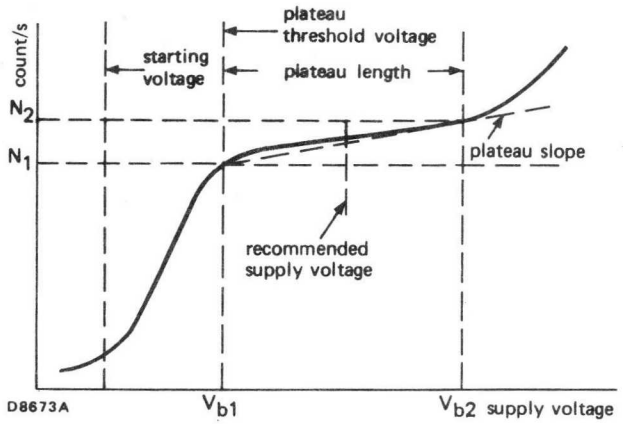


Fig.1

Plateau length: $V_{plateau} = V_{b2} - V_{b1}$ V

Plateau slope (over the plateau length):

$$\frac{N_2 - N_1}{0.5\,(N_1 + N_2)} \times \frac{1}{V_{plateau}} \times 100 \quad \%/V$$

where N_1 is the counting rate at V_{b1}, and
N_2 is the counting rate at V_{b2}

4. MEASURING CIRCUITS

4.1 The measuring equipment used to establish the G.M. tube data consists of the circuit given in the data, an emitter follower with a pulse shaper, a limiting amplifier and a scaler.

4.2 **Measuring circuit A**

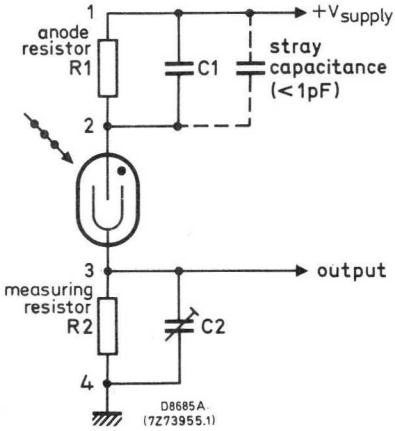


Fig.2

Notes:

1. The input resistance and capacitance of the measuring equipment are represented by R2 and C2 respectively.
2. 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 x (C1 + stray capacitance) = R2 x C2.

4.3 **Measuring circuit B**

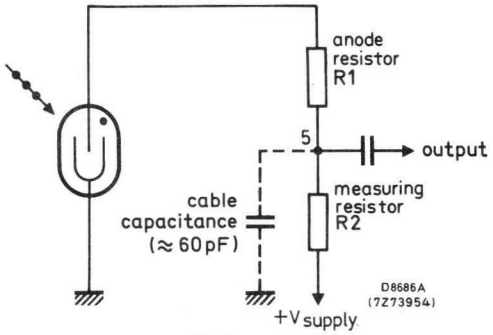


Fig.3

Tapping the load resistor at 5 in fig.3 reduces the influence of a capacitive load.

5. NOTES

5.1 **Resolution (resolving) time** (of a counting system or a counter).

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:

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

where P = pulse amplitude

$$b = \frac{R_2}{R_1 + R_2}$$ See measuring circuits

V_{supply} = anode supply voltage

$V_{starting}$ = starting voltage

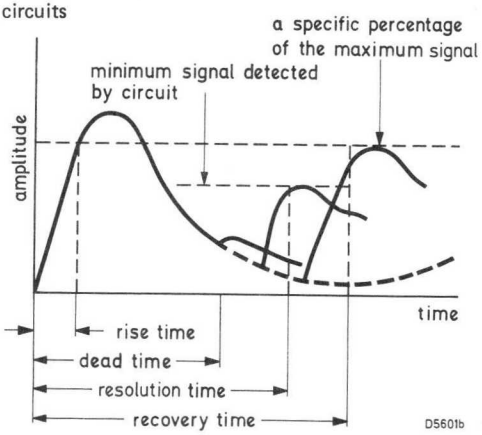


Fig.4

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 excessively increase the capacitive load on the tube. An increase in capacitive load may increase the pulse amplitude, the pulse duration, the dead time and the plateau slope. In addition the plateau will be shortened appreciably. Shunt capacitances as high as 20 pF may **destroy** the tube, but lower values are also dangerous.

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. In extreme cases the time constant RC (see fig.2) may exceed the dead time of the tube. If this is so, Cl may be omitted, thus reducing the RC product. However, this could cause calibration problems in series equipment production if the stray capacitances in individual instruments show wide variations.

5.6 **Tube sensitivity at extremely high dose rates.**

At dose rates exceeding the recommended maximum, a G.M. tube will produce the maximum number of counting pulses per second, limited by its dead time and the circuit in which it is incorporated.
However, due to the characteristics of a specific circuit, the **indicated** counting rate may fall appreciably, even to zero.
If dose rates exceeding 10 times the recommended maximum for window tubes, or 100 times for cylinder tubes, are likely to be encountered, it is advisable to use a circuit that continuously indicates saturation.

5.7 **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 $\tau = 20\ \mu s$, an inaccuracy of 1% is reached at a counting rate of approximately 500 count/s.

5.8 **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. The values given in the data in count per minute are derived from averages over a longer duration.

5.9 **Counting rate/dose rate curves**

These are measured with the source perpendicular to the tube axis, at the recommended supply voltage. The curves shown are typical and are measured at room temperature. Deviation of approximately ± 10% may occur.

5.10 **Current/dose rate curves**

These are measured with the source perpendicular to the tube axis. The curves shown are typical. Deviation of approximately ± 20% may occur.

5.11 **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 longer dead time.

NOTES (continued)

5.12 **Energy response curves**

These represent the energy sensitivity as a function of the radiation energy, measured in the recommended circuit and in the linear part of the counting rate/dose rate curve. The curves shown are typical.

5.13 **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.

→ 5.14 **Environmental**

Tubes are submitted to shock and vibration tests. The values which are given for each tube are not limiting values.

→ 5.15 **Temperature**

The temperature range over which the tubes work satisfactorily is given for each type. When working at low temperatures it is recommended that the tube is operated in the first third of the plateau.

→ 5.16. **Beta response.**

This is measured using a point source ($^{90}Sr/^{90}Y$) in direct contact with the tube and an extended source ($^{90}Sr/^{90}Y$, area 10 cm^2) at a distance of 1 cm from the tube.
For the point source the response is expressed in counts per second per Becquerel (c/s/Bq).
For the extended source the response is expressed in counts per second per Becquerel/cm^2 (c/s/Bq cm^{-2}). (One Becquerel is equivalent to one disintegration per second)

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.
Note: When operated at a limiting value the tubes may not be expected to function in accordance with the published operating characteristics. Under operating conditions where limiting values coincide or are combined with extreme counting rates, the tubes may not function in a typical way.

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 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 may **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 the appropriate connector (see fig.5). This must be used.

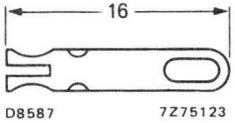


Fig.5

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. Also it should be noted that tubes should not be subjected to substantial changes in air pressure. ←

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 characterisitic 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.

Warning: generally, life end of a G.M. tube is indicated by an increasing slope and a shorter plateau. For older tubes, operation is recommended at the first third of the plateau. ←

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 reduction of the plateau length, and, for a given working voltage, to an increased counting rate. This will culminate 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

NOTES (continued)

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.

Exceeding the LIMITING VALUES
Soldering to the tube body or pin
Bending the anode pin
Touching the mica window

may destroy the tube

12. 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 tube type numbers		ZP1401 ZP1410 ZP1430 ZP1441 ZP1451	ZP1400 ZP1431 ZP1442 ZP1452 ZP1470 ZP1480 ZP1481	ZP1461	ZP1320 ZP1850 ZP1860	ZP1330	ZP1300 ZP1310

DEVICE DATA

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube.

QUICK REFERENCE DATA

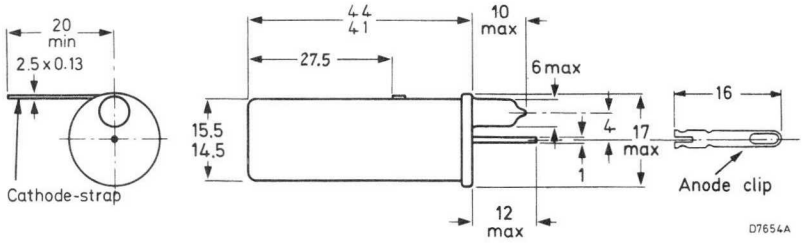
Dose rate range	10^{-3} to 10^{2}	mGy/h
	10^{-4} to 10	R/h
Plateau threshold voltage	400	V
Plateau length	200	V
Recommended supply voltage	500	V
Chrome-iron cathode	250	mg/cm²

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



CATHODE

Thickness	250	mg/cm²
Sensitive length	40	mm
Material	chrome-iron	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s²
Vibration (50 Hz continues sine wave) - acceleration	24.5	m/s²

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.1	pF

TUBE WEIGHT

7 g

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

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF*

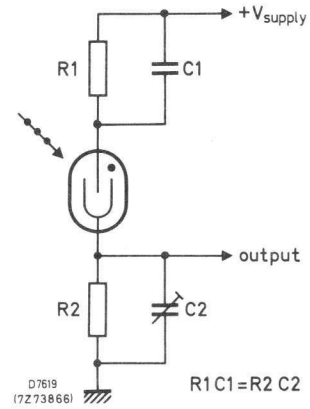
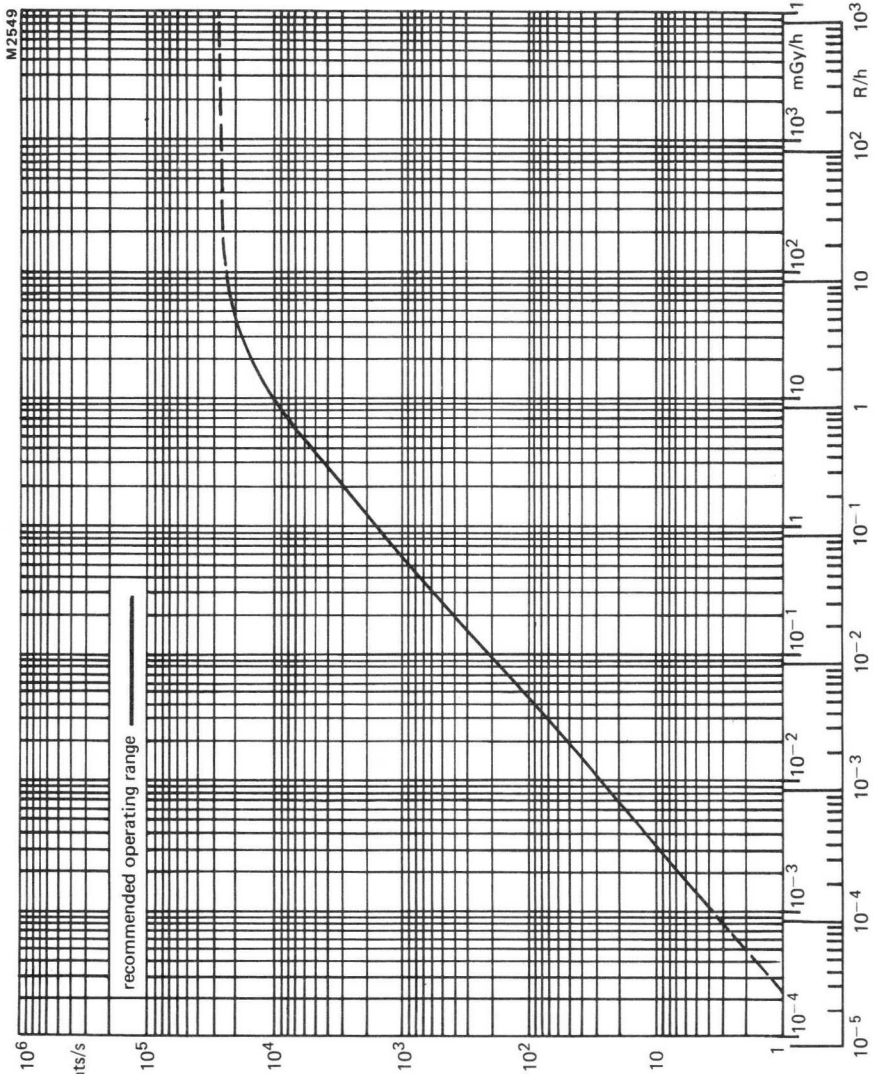
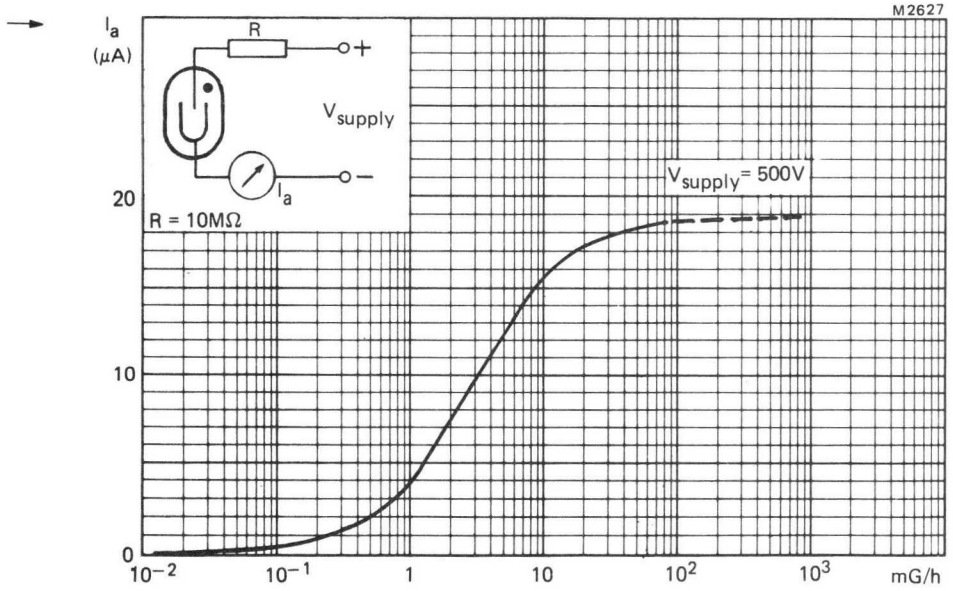


Fig.2

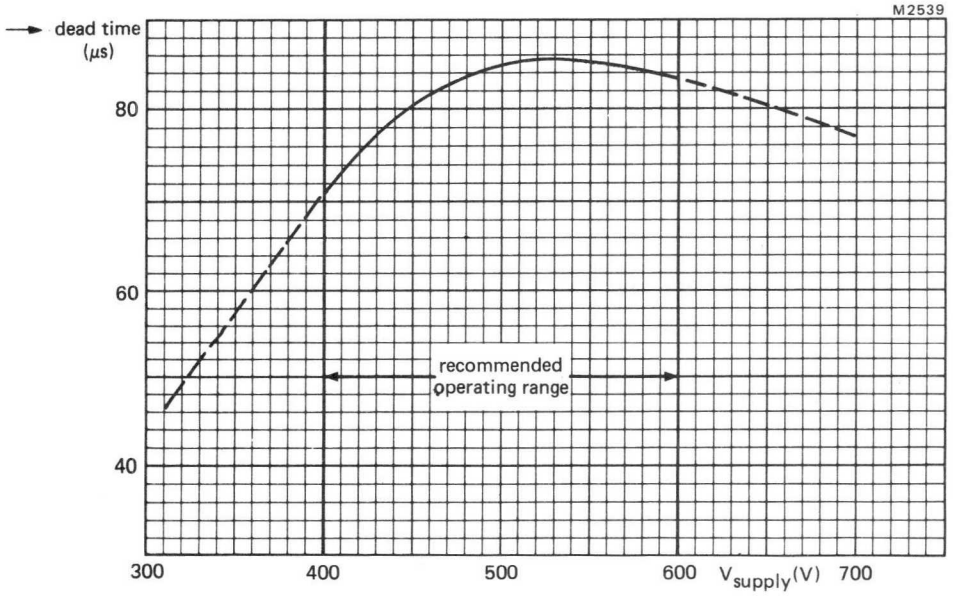
*See General Information (paragraph 5.5)



Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube fitted in a filter. The energy response is flat to within $^{+25}_{-15}$ % over the range 50 keV to 1.25 MeV referred to ^{137}Cs (661 keV). The ZP1201 is an energy compensated version of the ZP1200.

QUICK REFERENCE DATA

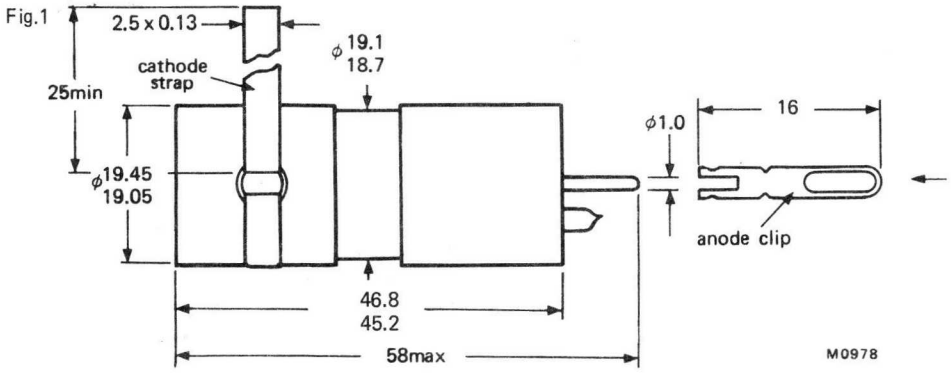
Dose rate range	10^{-3} to 40	mGy/h
	10^{-4} to 5	R/h
Plateau threshold voltage	400	V
Plateau length	200	V
Recommended supply voltage	500	V
Chrome-iron cathode	250	mg/cm²

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



note: cathode strap should be connected to the tube as shown

CATHODE (ZP1200)

Thickness	250	mg/cm²
Sensitive length	40	mm
Material	chrome-iron	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s²

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.2	pF

TUBE WEIGHT

38 g

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.	110	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

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF*

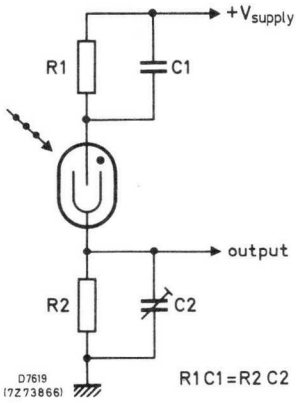
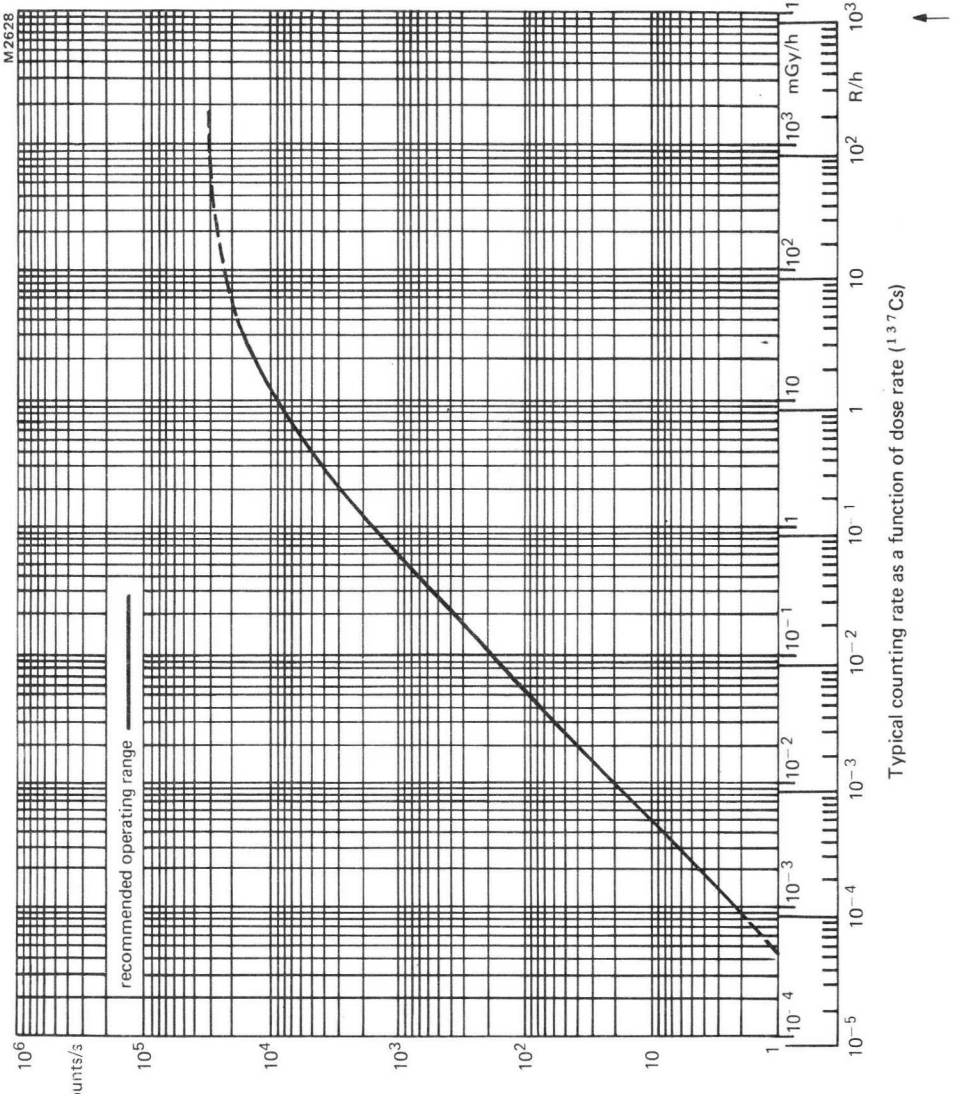
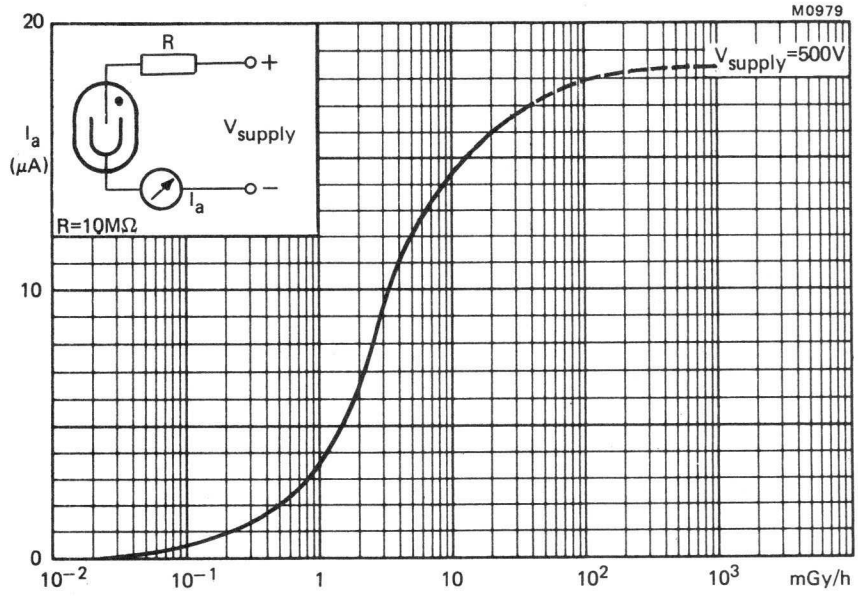


Fig.2

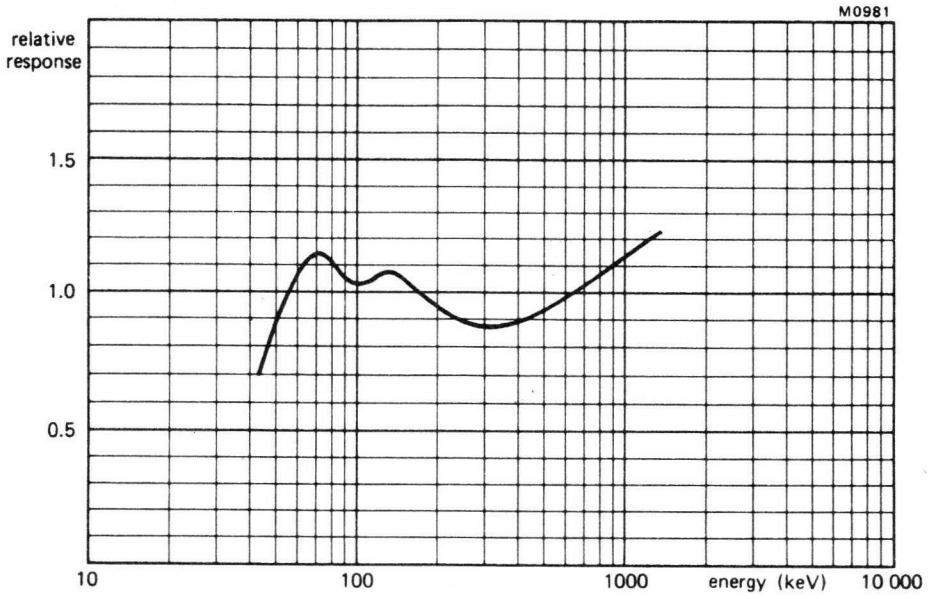
*See General Information (paragraph 5.5)



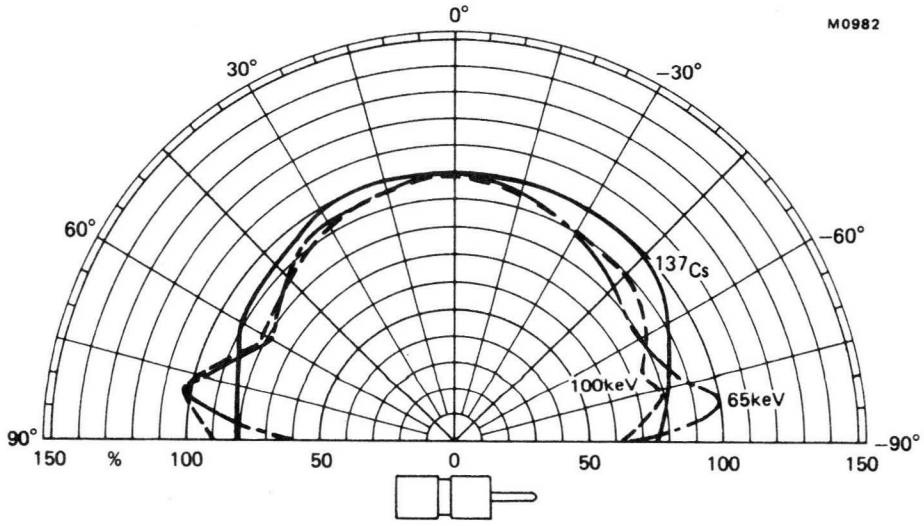
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical energy response relative to ^{137}Cs



Typical polar responses (normalised to 100% at 0°)

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube. Also available in low background version ZP1210/01.

QUICK REFERENCE DATA

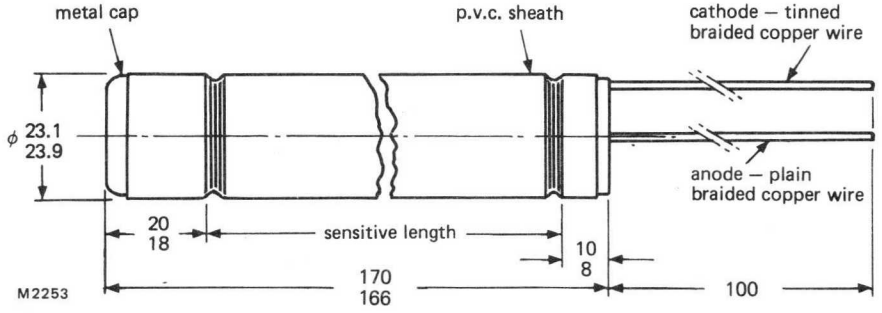
Dose rate range	3×10^{-4} to 10	mGy/h
	4×10^{-5} to 1	R/h
Plateau threshold voltage	400	V
Plateau length	100	V
Recommended supply voltage	450	V
Chrome-iron cathode	525	mg/cm^2

This data must be read in conjunction with General Information 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	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s^2

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	4.5	pF

TUBE WEIGHT

85 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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.	70	count/min.
Dead time, at recommended supply voltage	max.	200	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.7	MΩ
Anode voltage	max.	500	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

MEASURING CIRCUIT

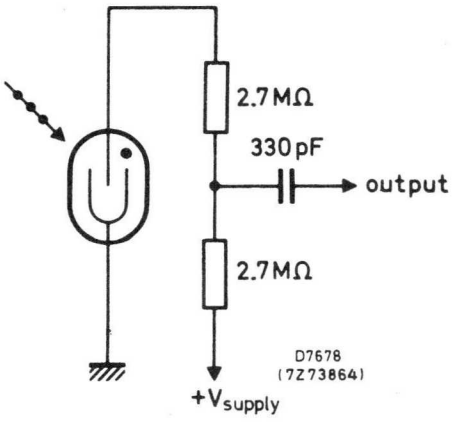
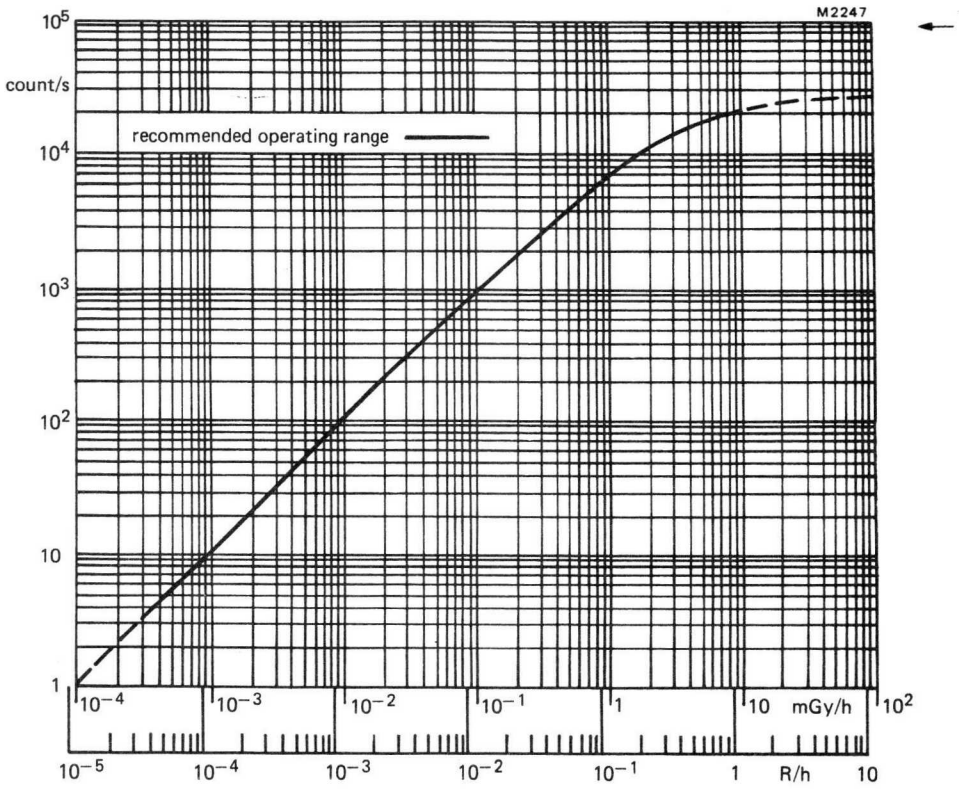
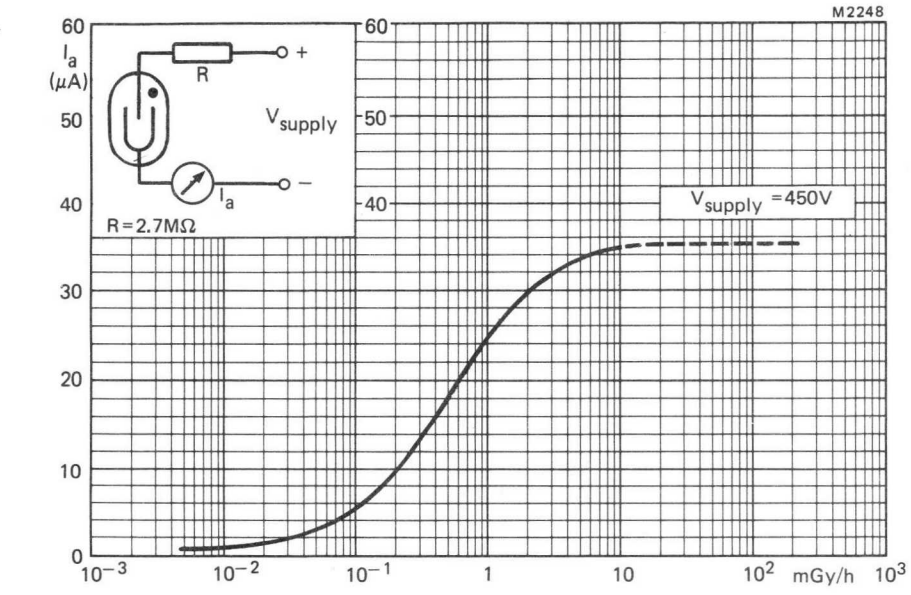


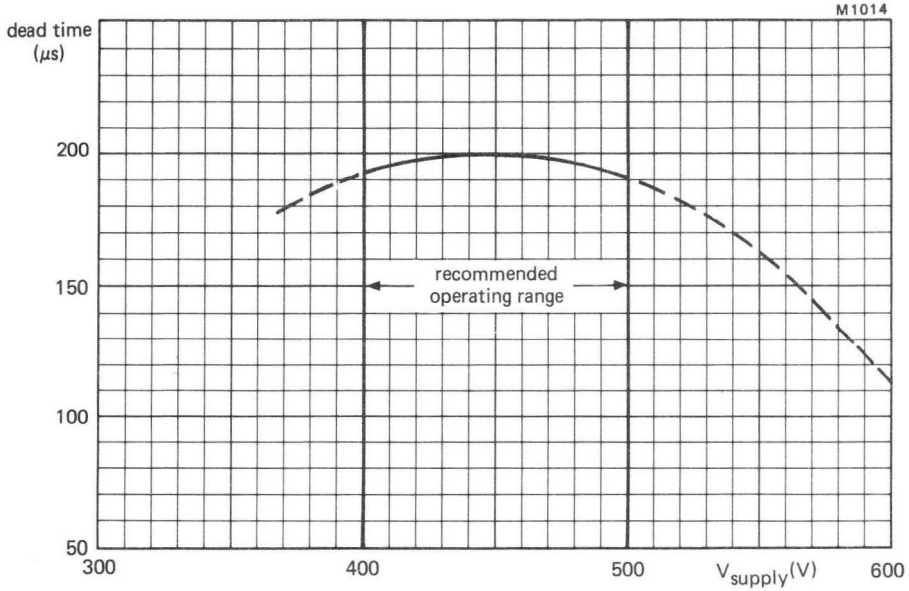
Fig.2



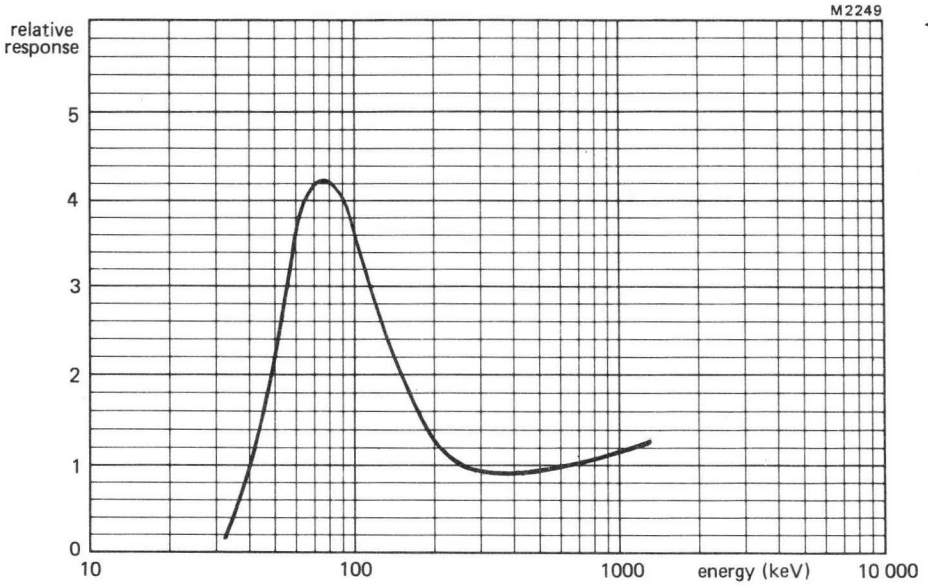
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube. Also available in low background version ZP1220/01.

QUICK REFERENCE DATA

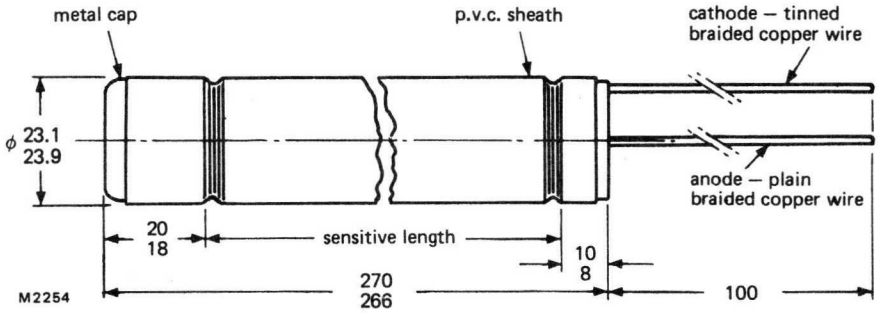
Dose rate range	2×10^{-4} to 3	mGy/h
	2×10^{-5} to 3×10^{-1}	R/h
Plateau threshold voltage	400	V
Plateau length	100	V
Recommended supply voltage	450	V
Chrome-iron cathode	525	mg/cm^2

This data must be read in conjunction with General Information 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	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s^2

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	10	pF

TUBE WEIGHT

140 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	500	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

MEASURING CIRCUIT

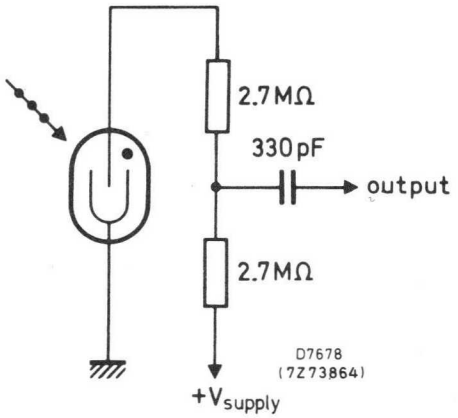
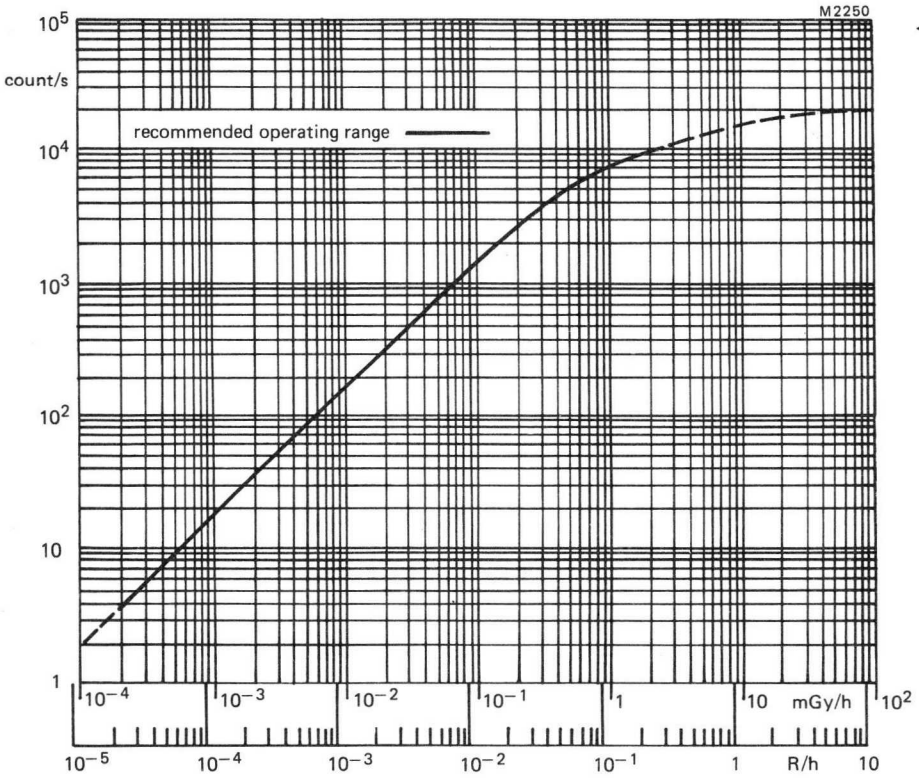
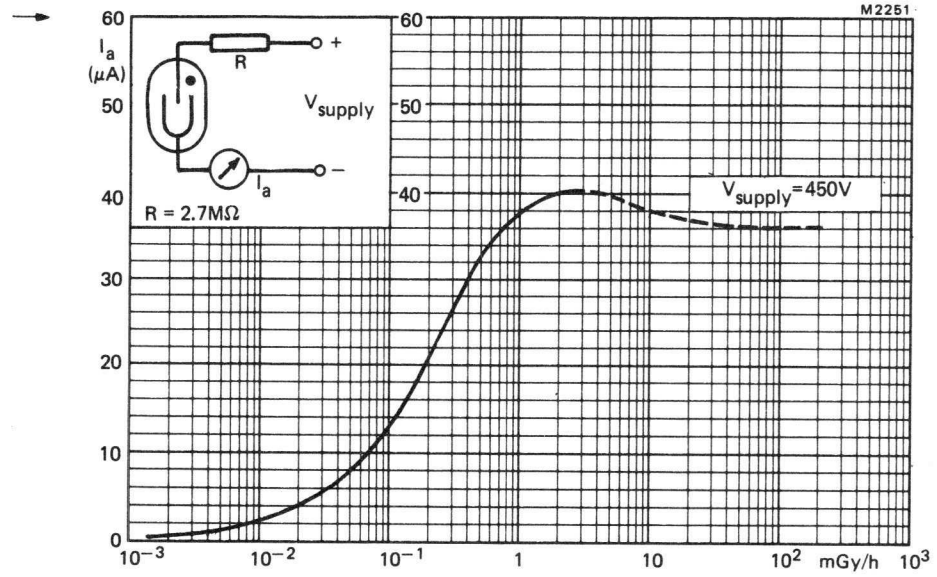


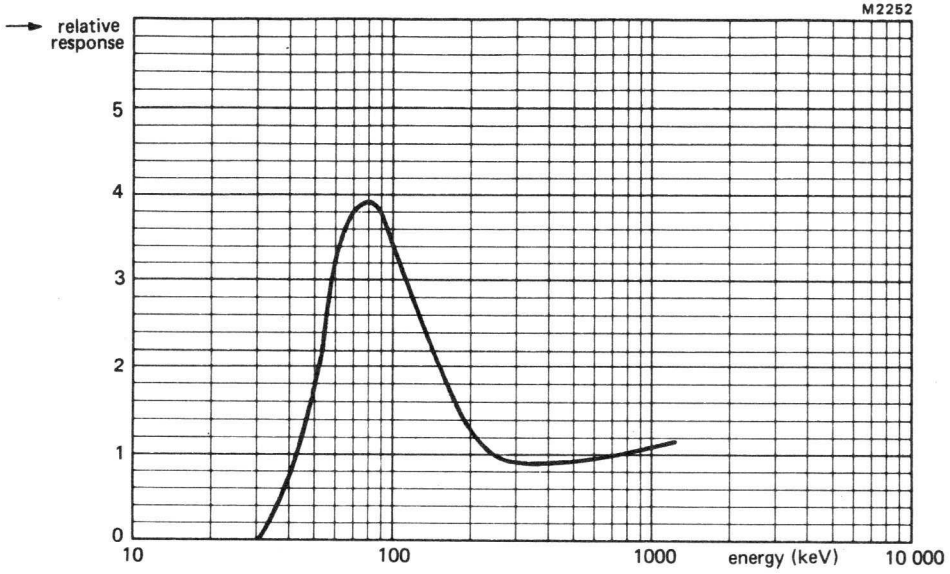
Fig.2



Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

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

QUICK REFERENCE DATA

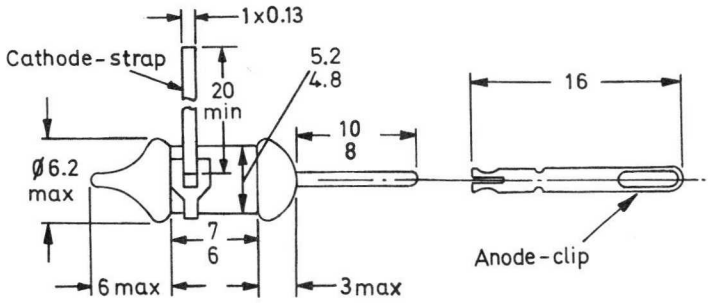
Dose rate range	10^{-1} to 2×10^4	mGy/h
	10^{-2} to 2×10^3	R/h
Plateau threshold voltage	500	V
Plateau length	100	V
Recommended supply voltage	550	V
Chrome-iron cathode	80 to 100	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



D7076A

CATHODE

Thickness	80 to 100	mg/cm^2
Sensitive length	7	mm
Material	chrome-iron	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s^2
Vibration (50 Hz continuous sine wave) - acceleration	49	m/s^2

FILLING

helium, neon, halogen

CAPACITANCE

Anode to cathode	0.7	pF

TUBE WEIGHT

0.5 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	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

MEASURING CIRCUIT

R_1 = 2.2 MΩ
R_2 = 47 kΩ
C_1 = 1 pF*

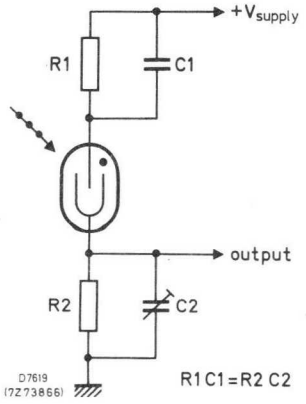
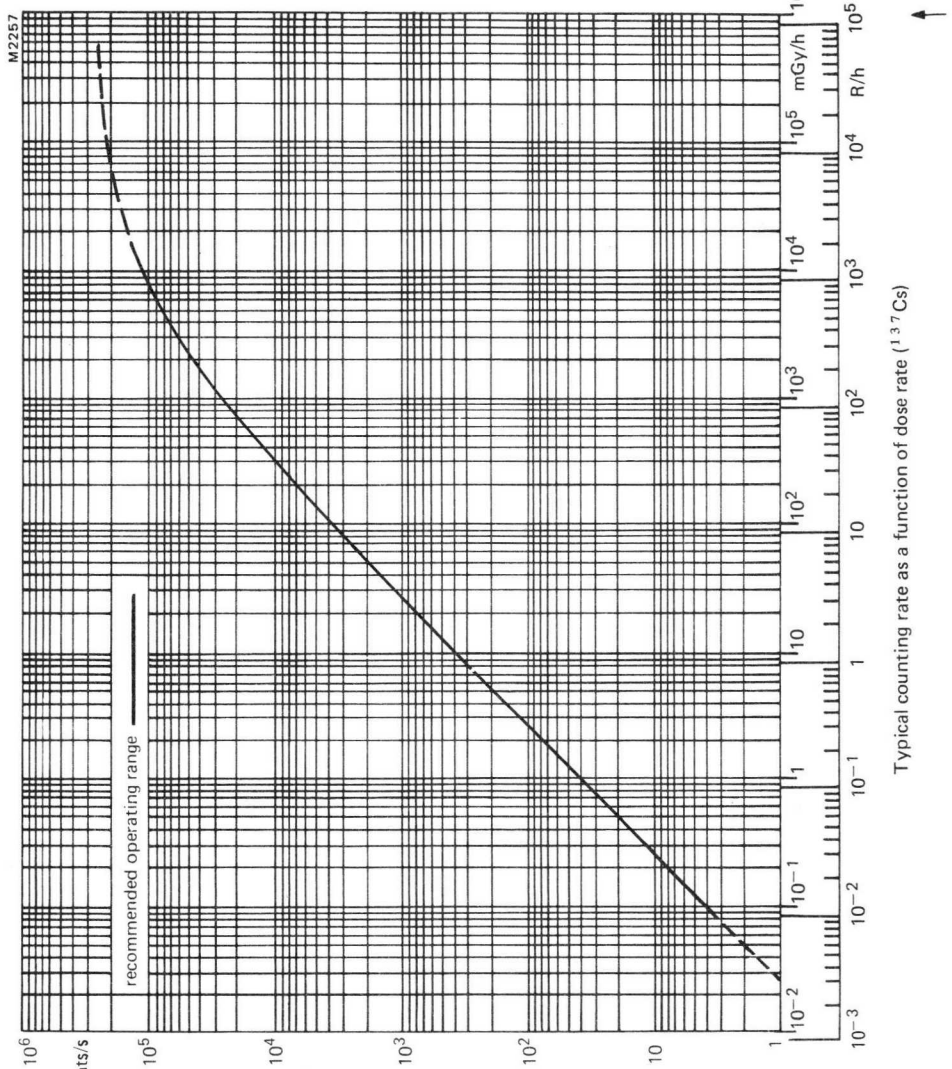
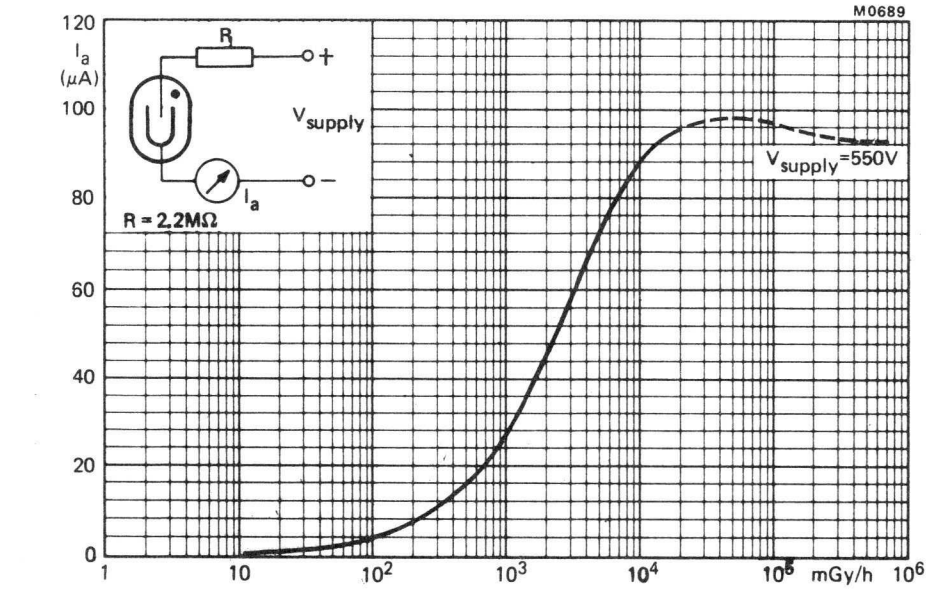


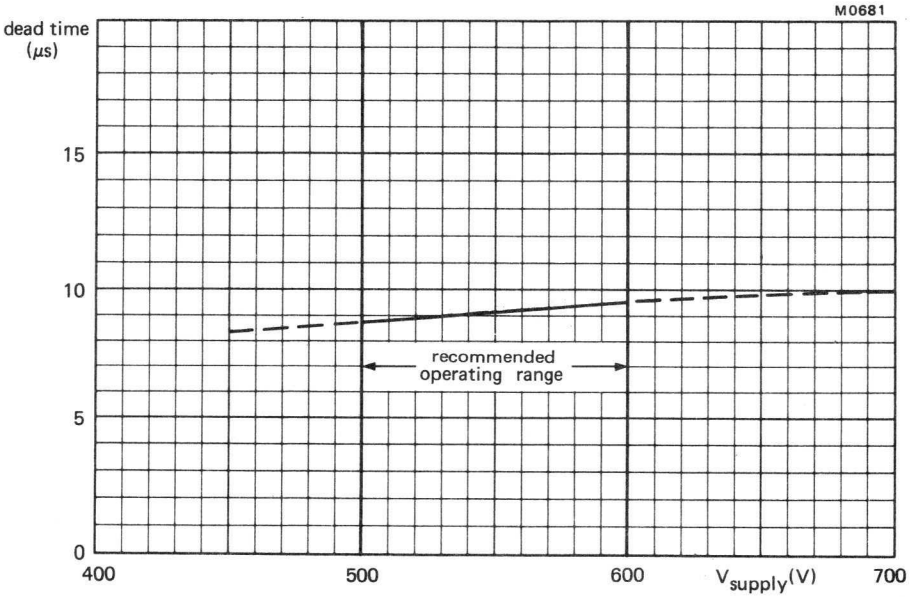
Fig.2

*See General Information (paragraph 5.5)

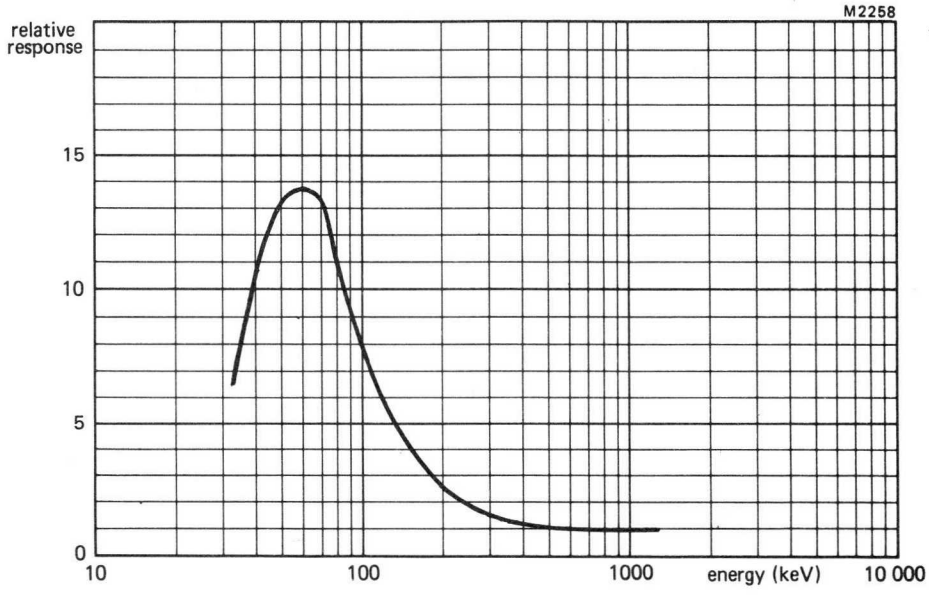

M2257
counts/s
10^6
10^5
10^4
10^3
10^2
10
1
recommended operating range
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
10^5
10^6
mGy/h
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
10^5
R/h
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube fitted in a filter. The energy response is flat to within ± 15% over the range 80 keV to 1.25 MeV referred to ^{137}Cs (661 keV). The ZP1301 is an energy compensated version of the ZP1300. Also available with long life artificial background as ZP1302.

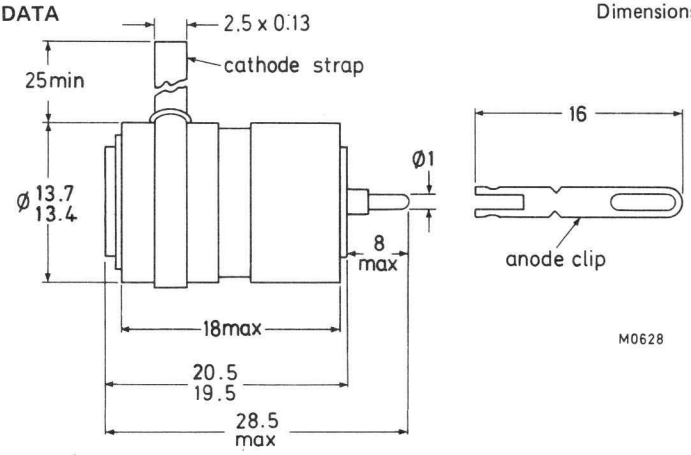
QUICK REFERENCE DATA

Dose rate range	10^{-1} to 2 x 10^{4}	mGy/h
	10^{-2} to 2 x 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 Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm



note: cathode strap should be connected to the tube as shown

CATHODE (ZP1300)

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

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s^2

FILLING helium, neon, halogen

CAPACITANCE

Anode to cathode	0.95	pF

TUBE WEIGHT 20 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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 550 V	max.	1	count/min
Dead time at 550 V	max.	13	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	MΩ
Anode voltage	max.	600	V
Ambient temperature	max.	+70	°C
continuous operating	min.	−40	°C
storage	max.	+75	°C

LIFE EXPECTANCY

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

MEASURING CIRCUIT

R_1 = 2.2 MΩ

R_2 = 47 kΩ

C_1 = 1 pF*

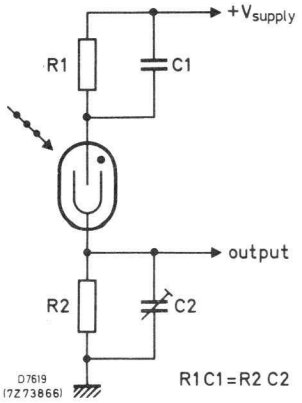
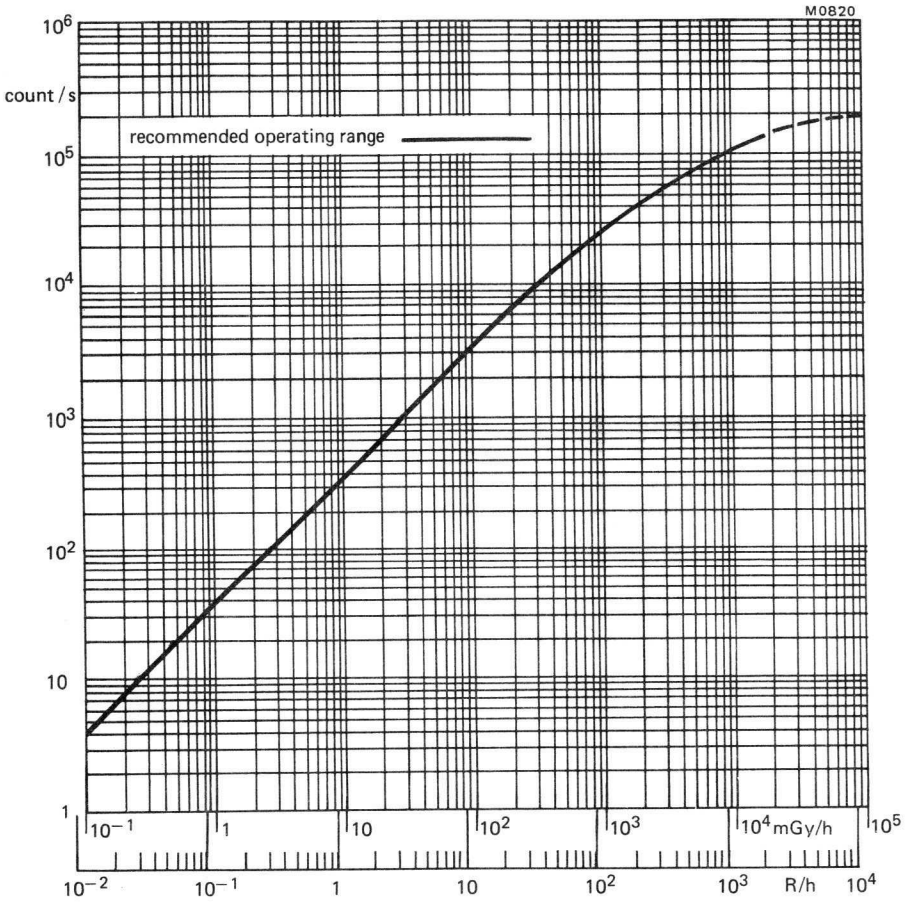
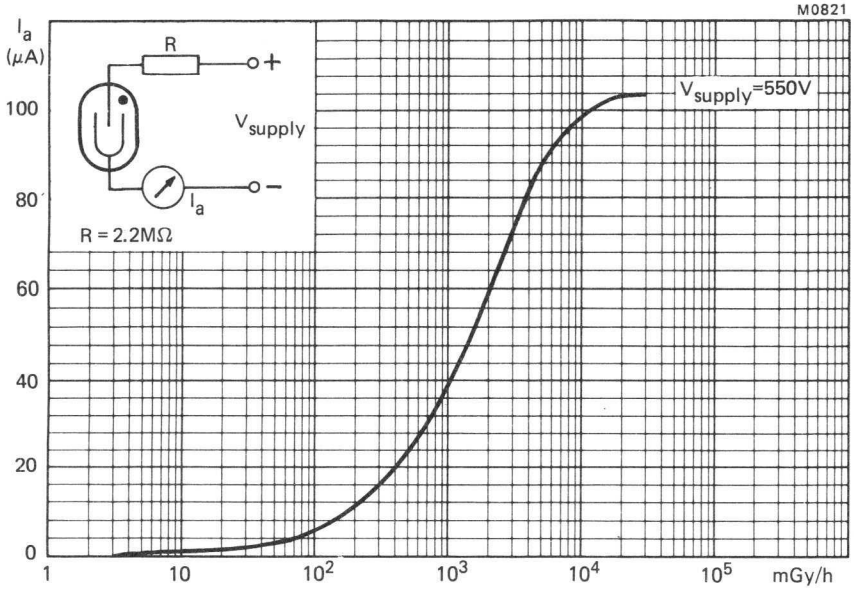


Fig.2

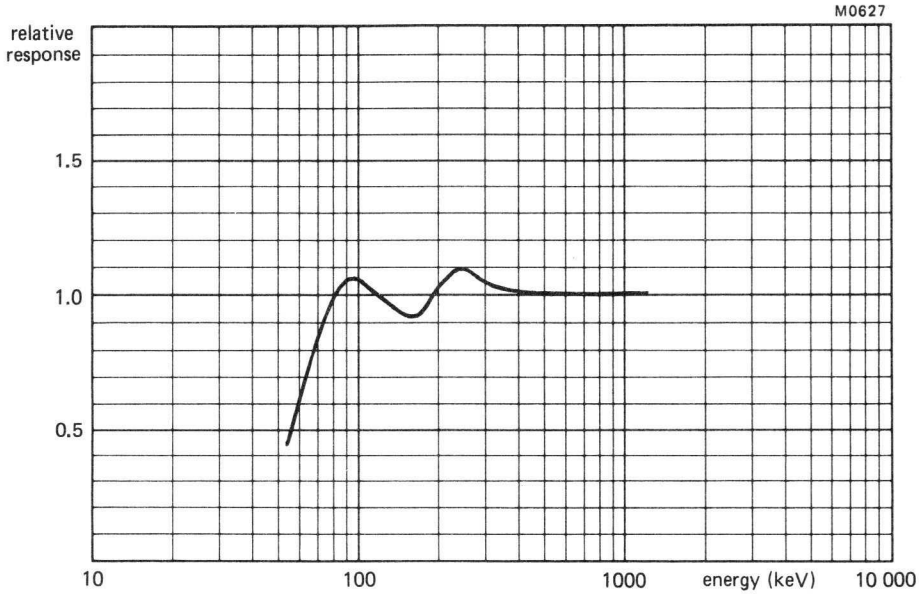
*See General Information (paragraph 5.5)



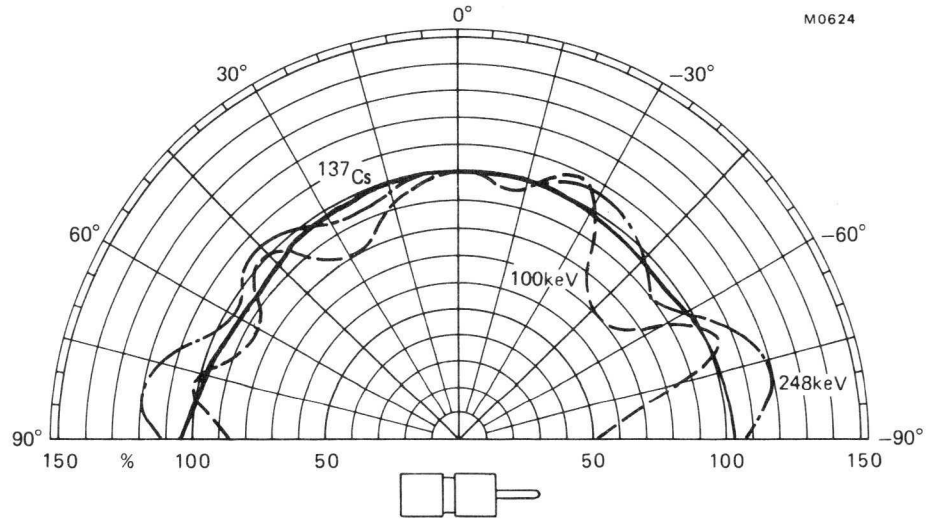
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical energy response relative to ^{137}Cs



Typical polar responses (normalised to 100% at 0^{o})

GEIGER-MÜLLER TUBE

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

QUICK REFERENCE DATA

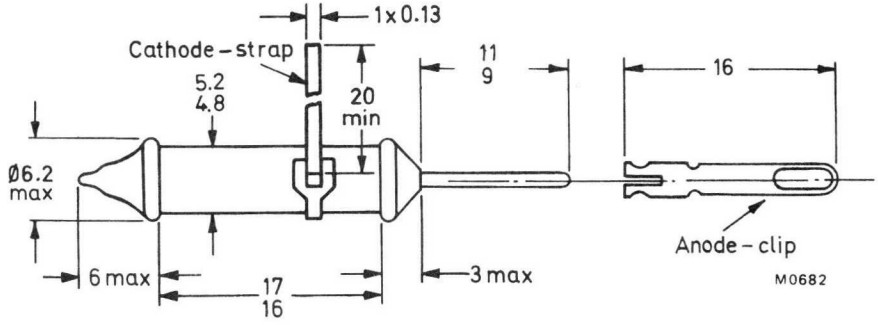
Dose rate range	2×10^{-2} to 4×10^{3}	mGy/h
	2×10^{-3} to 5×10^{2}	R/h
Plateau threshold voltage	500	V
Plateau length	150	V
Recommended supply voltage	575	V
Chrome-iron cathode	80 to 100	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



CATHODE

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

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s^2

FILLING

helium, neon, halogen

CAPACITANCE

Anode to cathode	1.2	pF

TUBE WEIGHT

0.7 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	650	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

MEASURING CIRCUIT

R_1 = 2.2 MΩ

R_2 = 47 kΩ

C_1 = 1 pF*

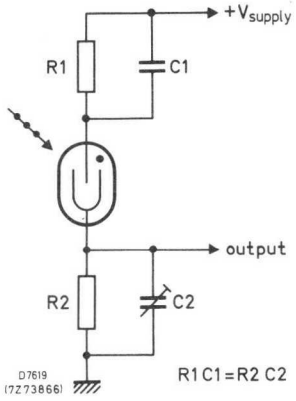
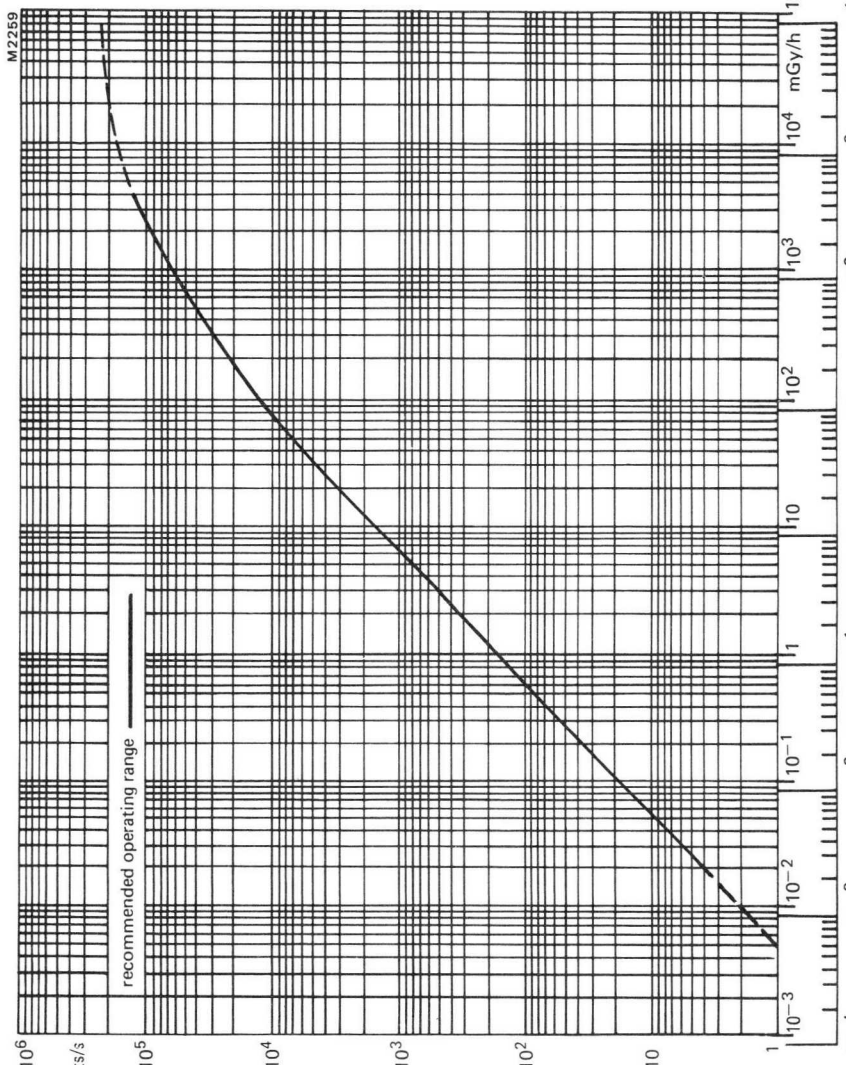
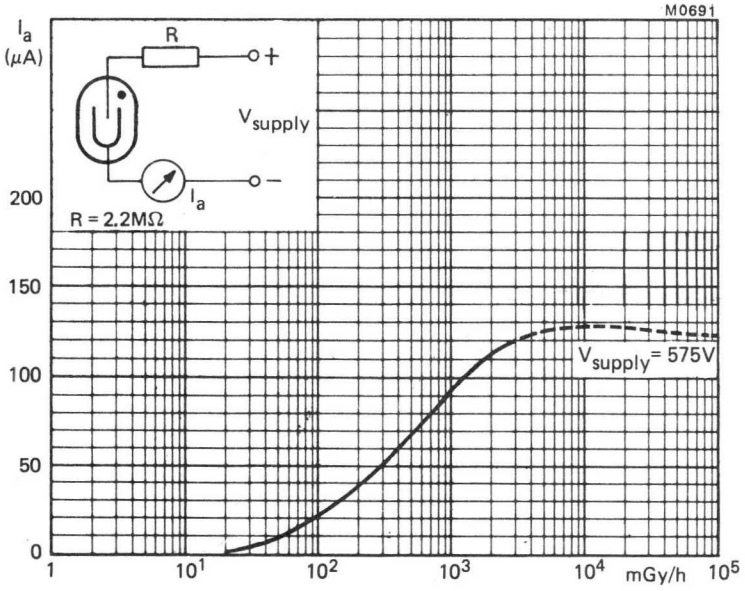


Fig.2

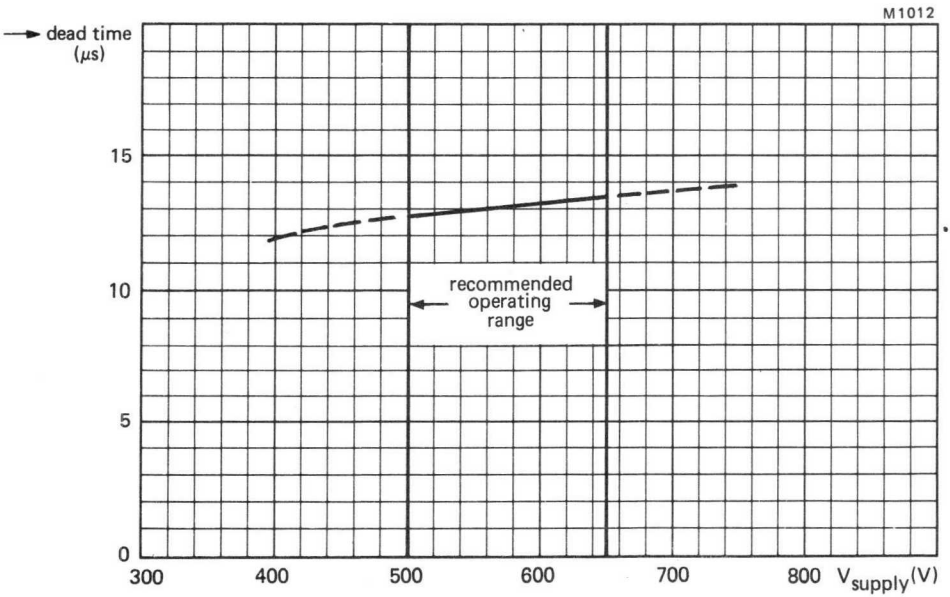
*See General Information (paragraph 5.5)



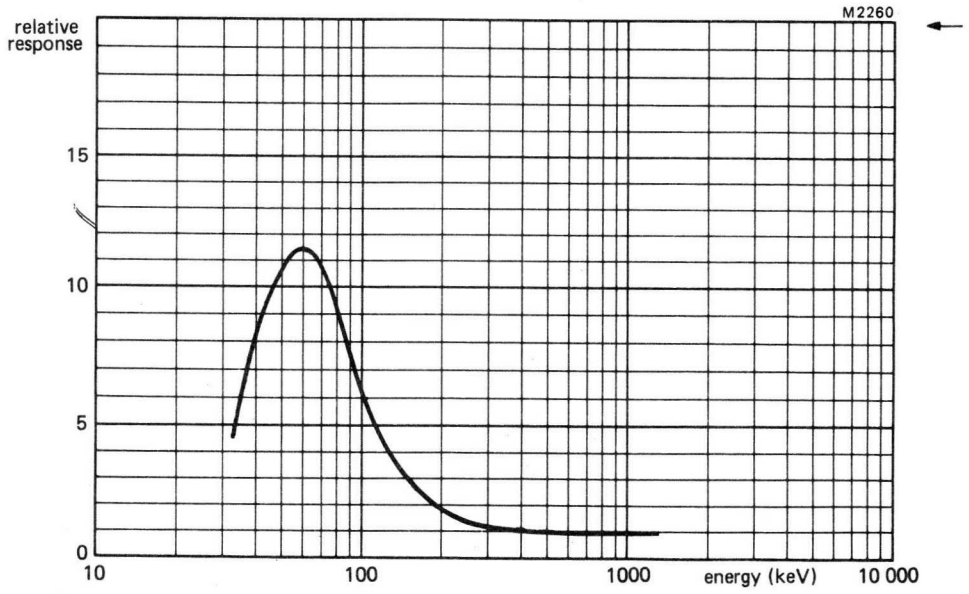
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube fitted in a filter. The energy response is flat to within ±15% over the range 50 keV to 1.25 MeV referred to ^{137}Cs (661 keV).
The ZP1313 is an energy compensated version of the ZP1310.

QUICK REFERENCE DATA

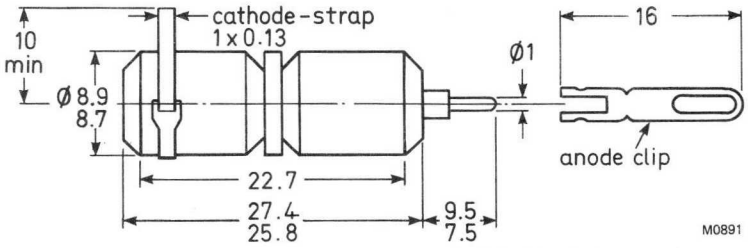
Dose rate range	10^{-2} to 3 x 10^{3}	mGy/h
	10^{-3} to 4 x 10^{2}	R/h
Plateau threshold voltage	500	V
Plateau length	150	V
Recommended supply voltage	575	V
Chrome-iron cathode	80 to 100	mg/cm²

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



note: cathode strap should be connected to the tube as shown

CATHODE (ZP1310)

Thickness	80 to 100	mg/cm²
Sensitive length	16	mm
Material	chrome-iron	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s²

FILLING

helium, neon, halogen

CAPACITANCE

Anode to cathode	2.0	pF

TUBE WEIGHT

7.0 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	650	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

MEASURING CIRCUIT

R_1 = 2.2 MΩ

R_2 = 47 kΩ

C_1 = 1 pF*

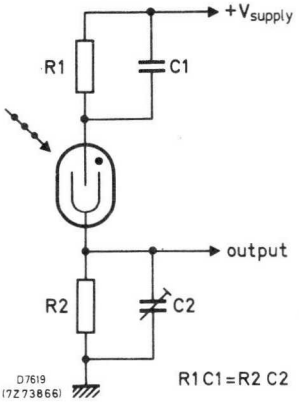
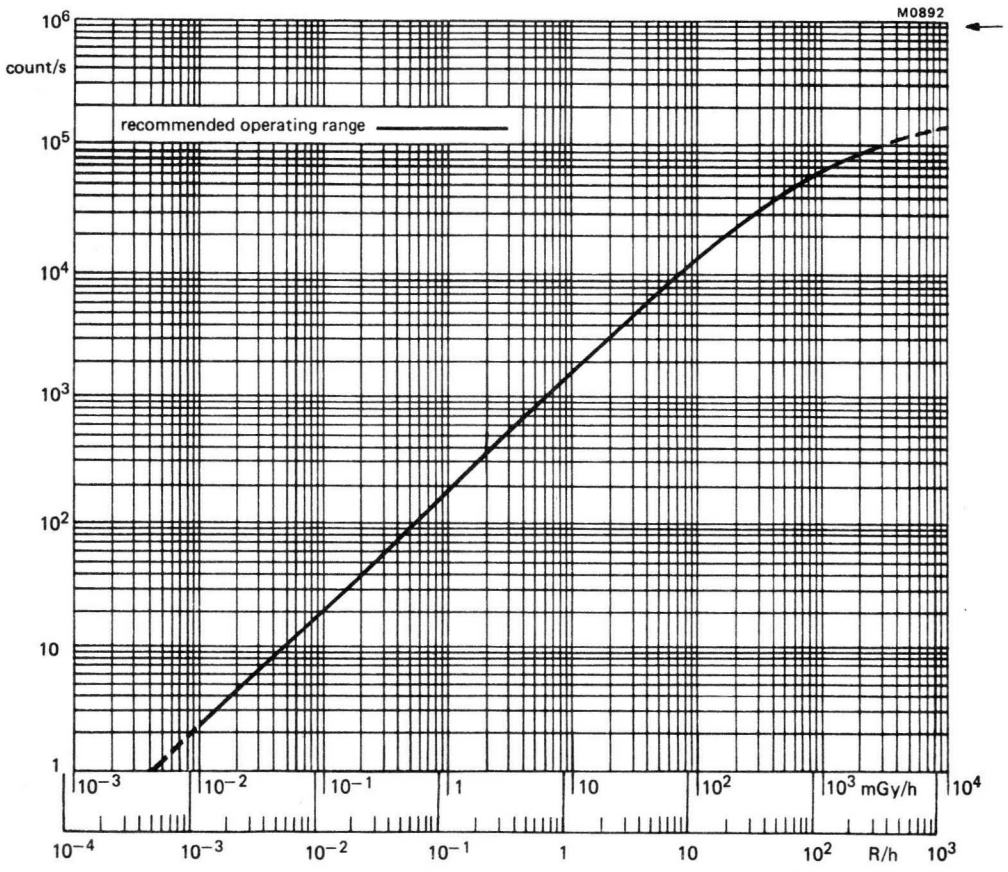
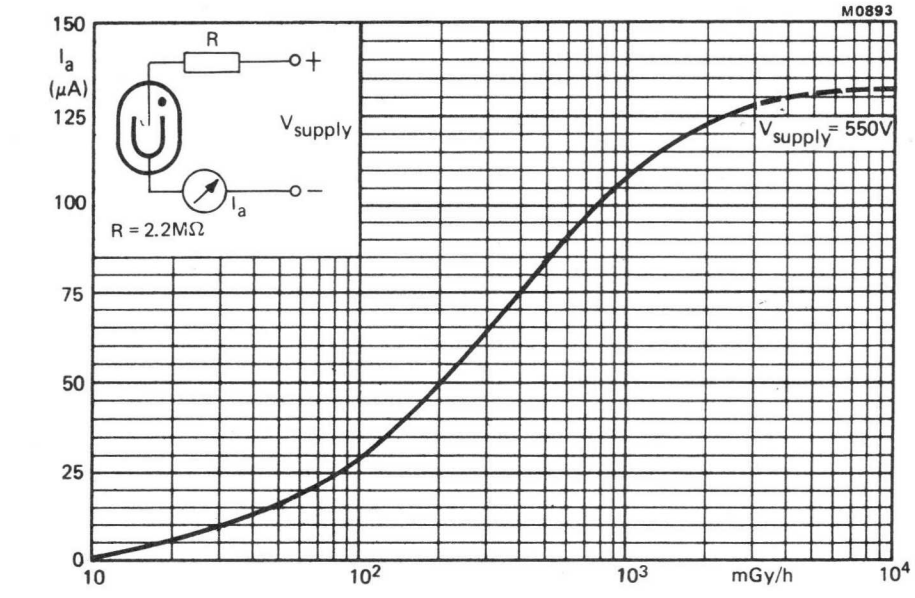


Fig.2

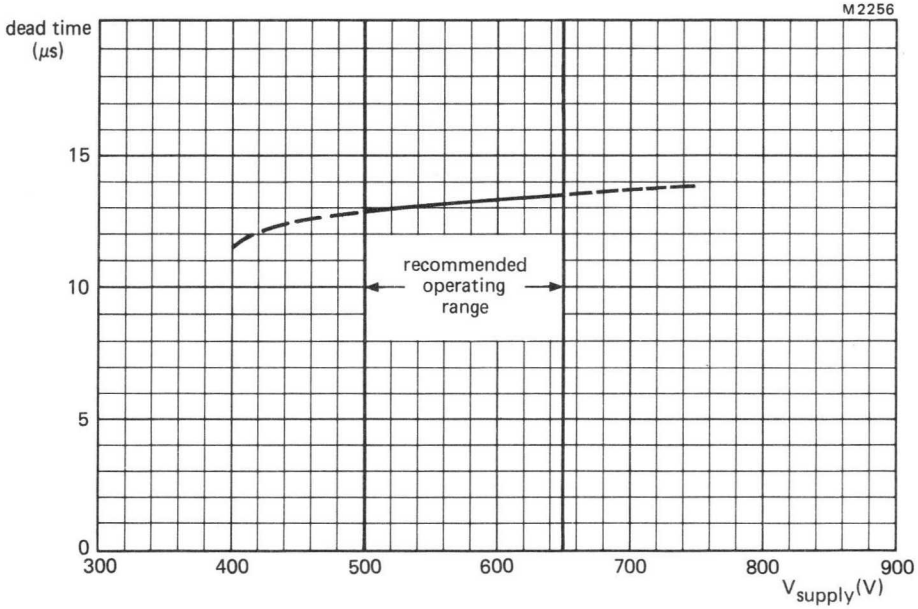
*See General Information (paragraph 5.5)



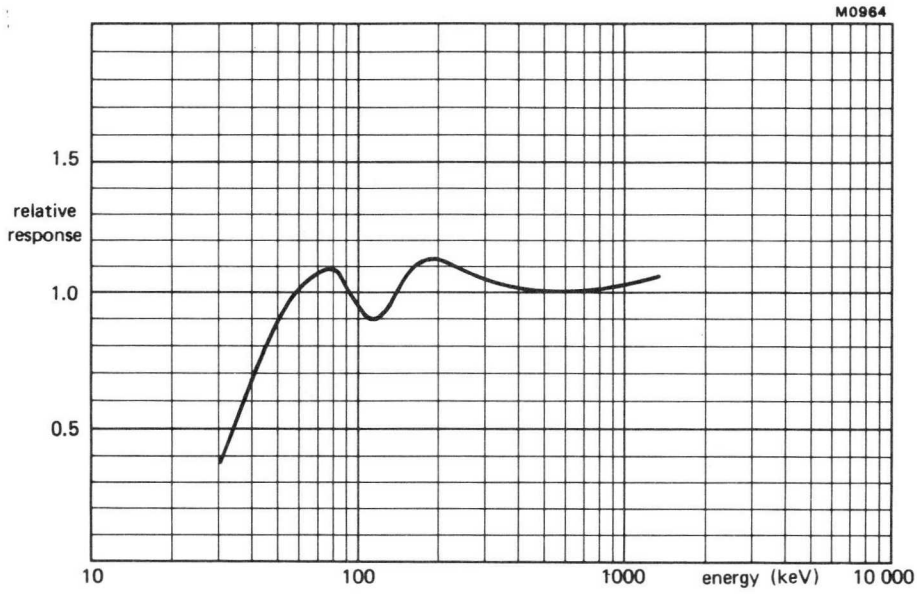
Typical counting rate as a function of dose rate (^{137}Cs)



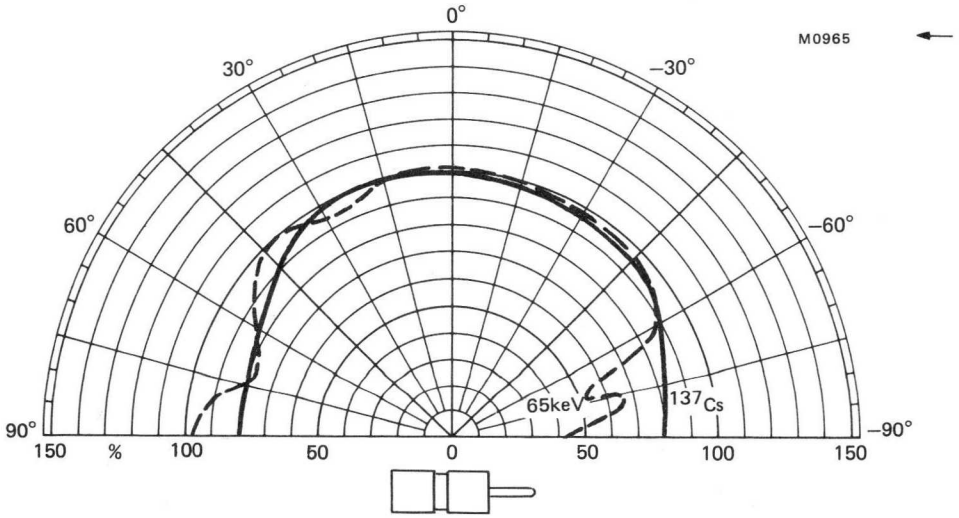
Typical current as a function of dose rate (^{137}Cs)



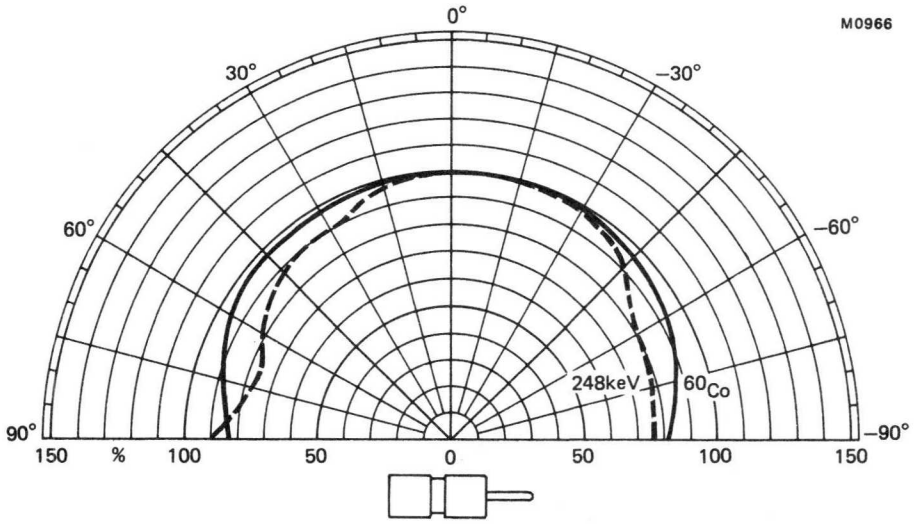
Typical dead time as a function of supply voltage



Typical energy response (side response) relative to ^{137}Cs



Typical polar responses (normalised to 100% at 0°)



Typical polar responses (normalised to 100% at 0°)

GEIGER-MÜLLER TUBE

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

QUICK REFERENCE DATA

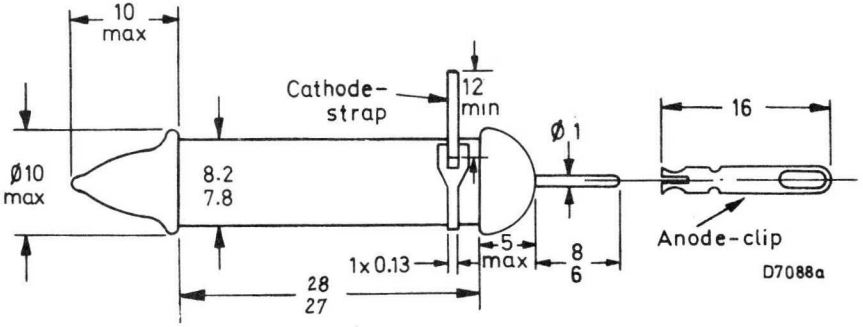
Dose rate range	3×10^{-3} to 2×10^{2}	mGy/h
	4×10^{-4} to 20	R/h
Plateau threshold voltage	500	V
Plateau length	150	V
Recommended supply voltage	575	V
Chrome-iron cathode	32 to 40	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



CATHODE

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

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s^2

FILLING	neon, argon, halogen	
CAPACITANCE		
Anode to cathode	1.1	pF
TUBE WEIGHT	1.0	g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	650	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

MEASURING CIRCUIT

R_1 = 4.7 MΩ

R_2 = 100 kΩ

C_1 = 1 pF*

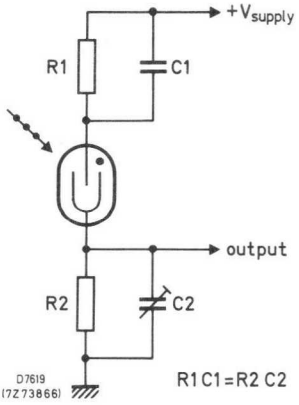
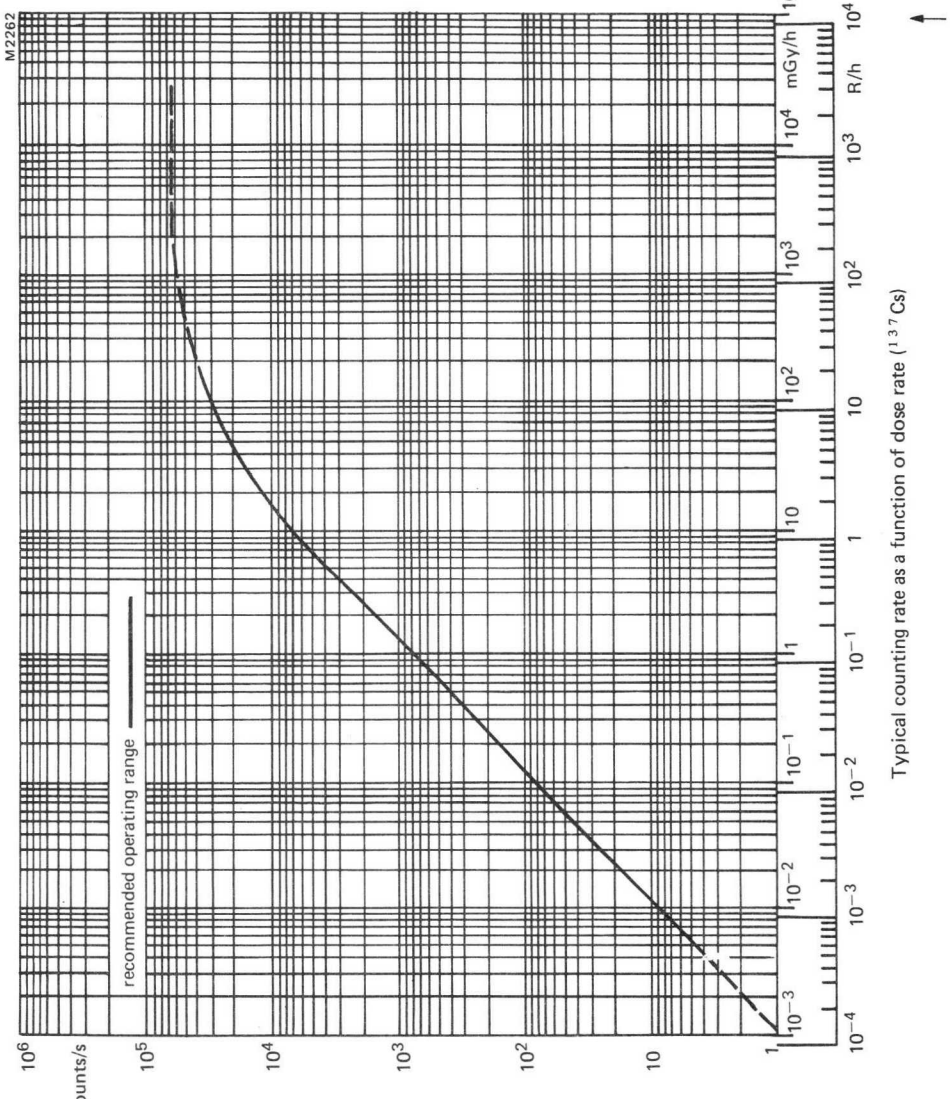
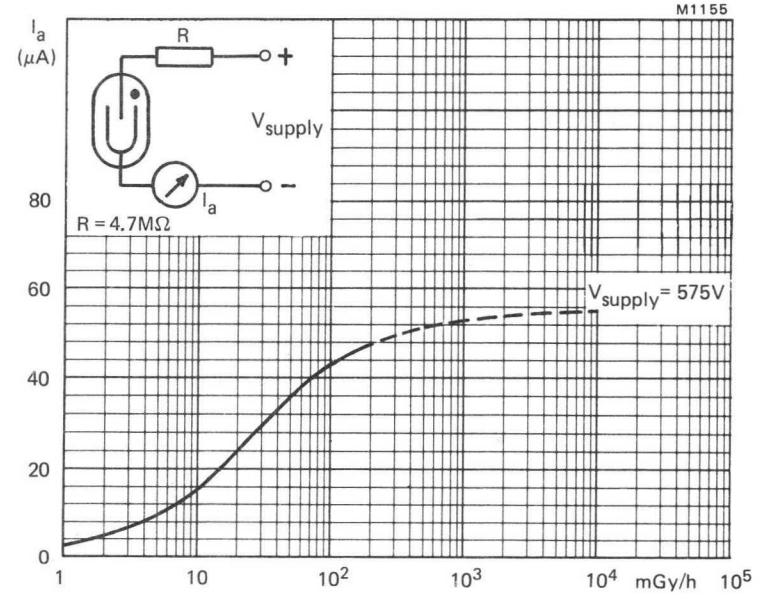


Fig.2

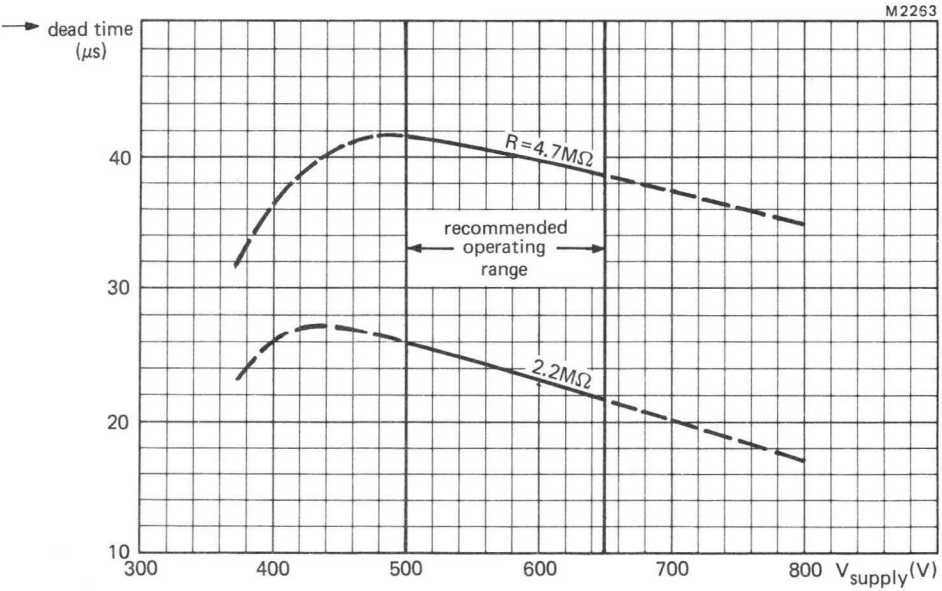
*See General Information (paragraph 5.5)



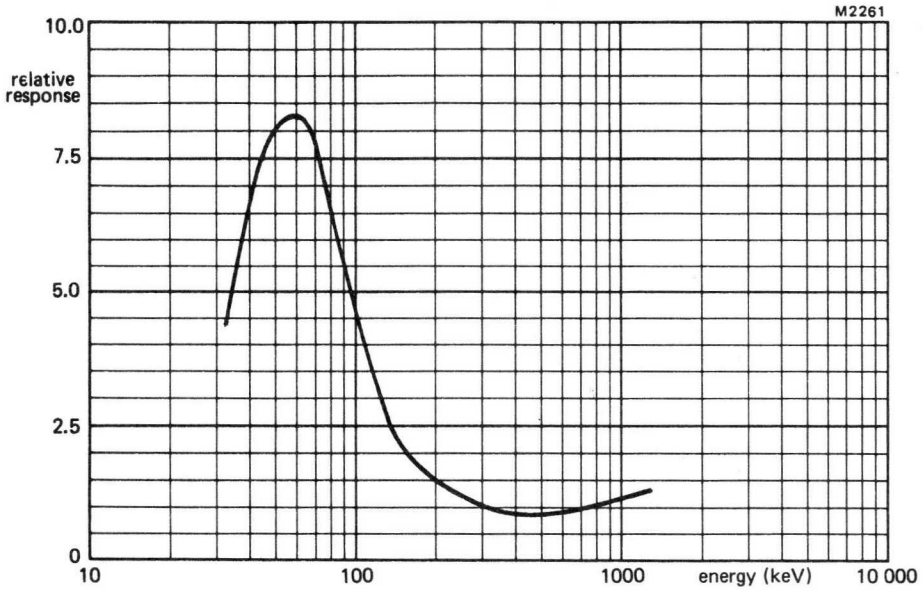
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube fitted in a filter. The energy response is flat to within $^{+20}_{-20}$ % over the range 40 keV to 1.25 MeV referred to ^{137}Cs (661 keV). The ZP1321 is an energy compensated version of the ZP1320.

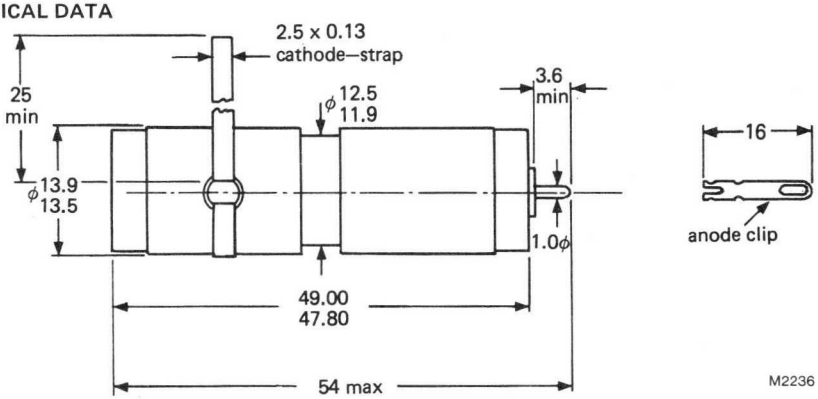
QUICK REFERENCE DATA

Dose rate range	3×10^{-3} to 10^{2}	mGy/h
	4×10^{-4} to 10	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 Information Geiger-Müller tubes.

MECHANICAL DATA

Fig.1



CATHODE (ZP1320)

Thickness	32 to 40	mg/cm^2
Sensitive length	27	mm
Material	chrome-iron	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s^2

FILLING neon, argon, halogen

CAPACITANCE

Anode to cathode	1.3	pF

TUBE WEIGHT 23 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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.	15	count/min
Dead time, at recommended supply voltage	max.	55	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.2	MΩ
Anode voltage	max.	650	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

MEASURING CIRCUIT

R_1 = 4.7 MΩ

R_2 = 100 kΩ

C_1 = 1 pF*

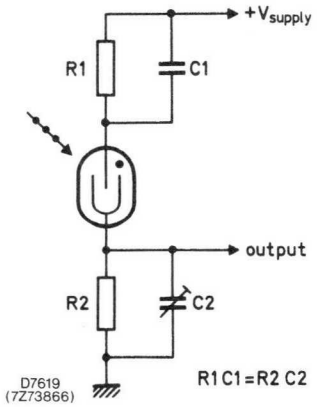
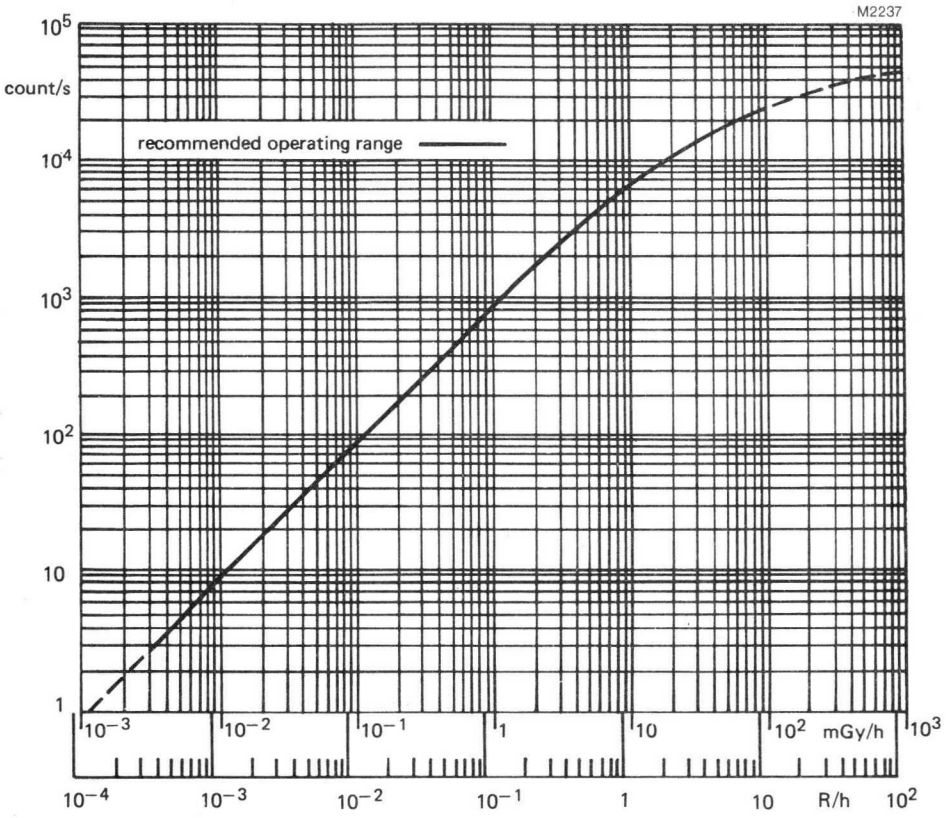
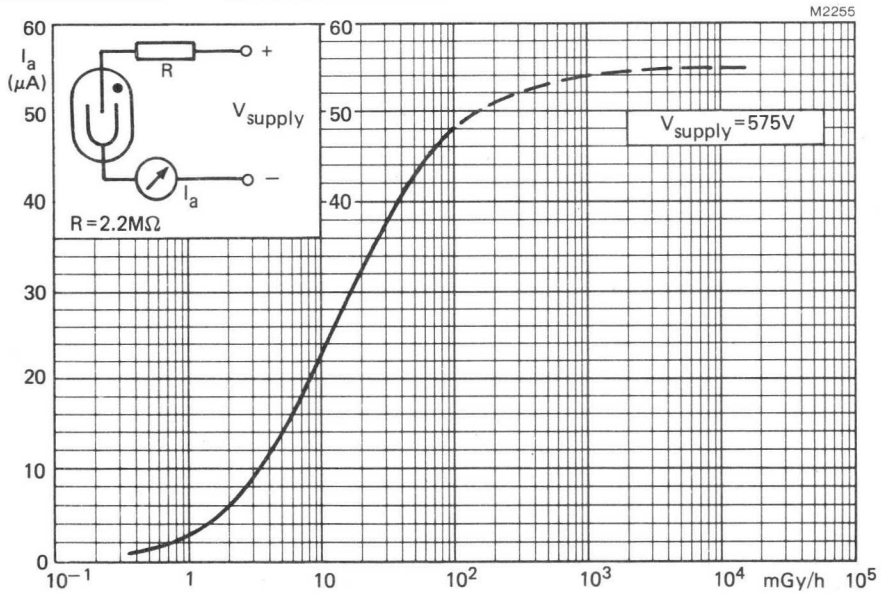


Fig.2

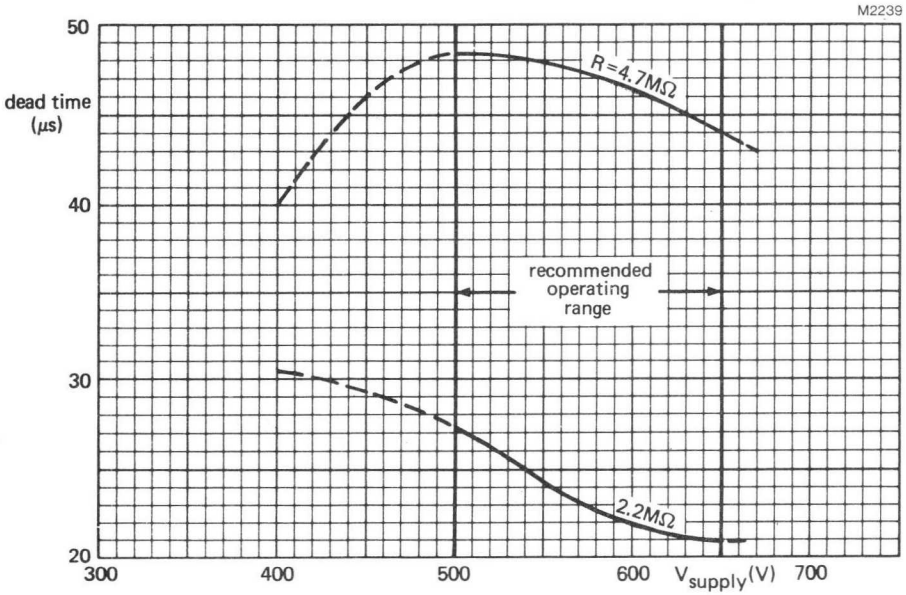
*See General Information (paragraph 5.5)



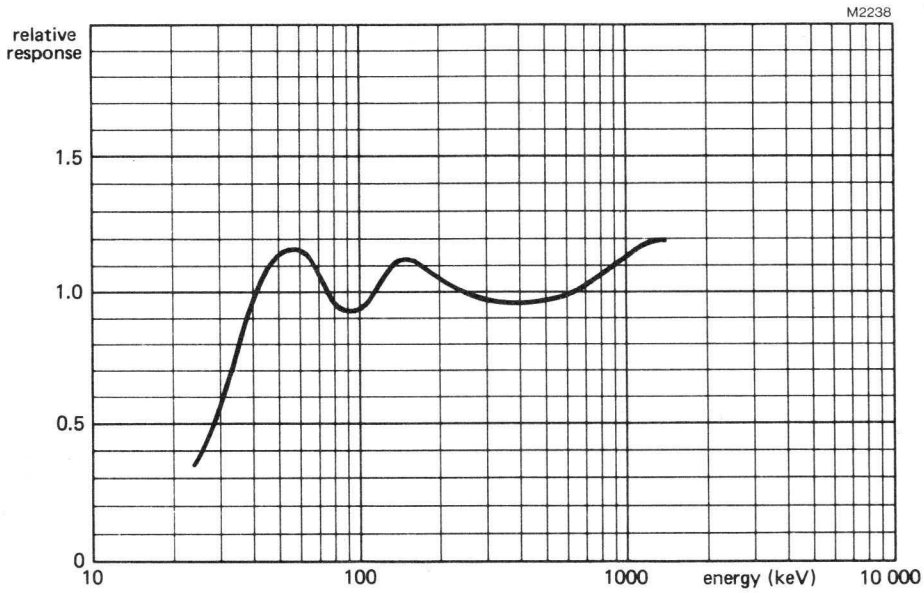
Typical counting rate as a function of dose rate (^{137}Cs)



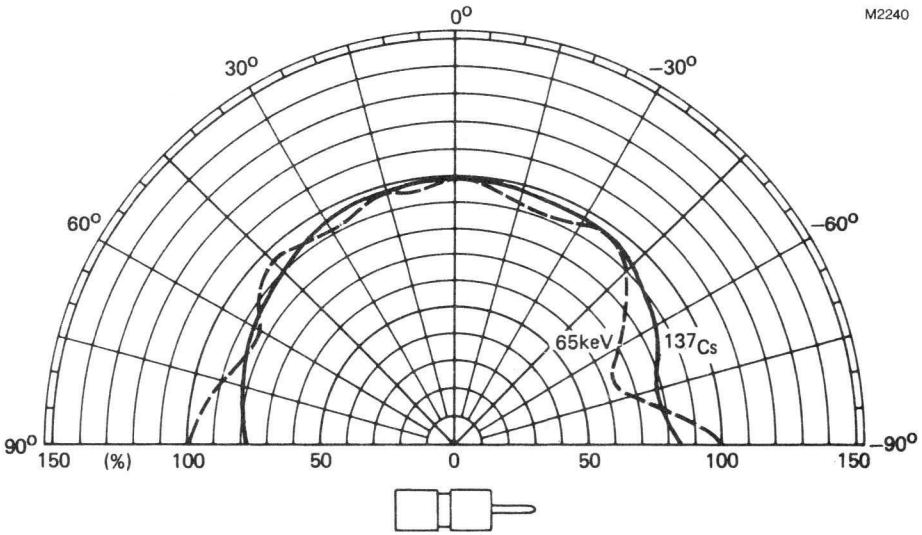
Typical current as a function of dose rate (^{137}Cs)

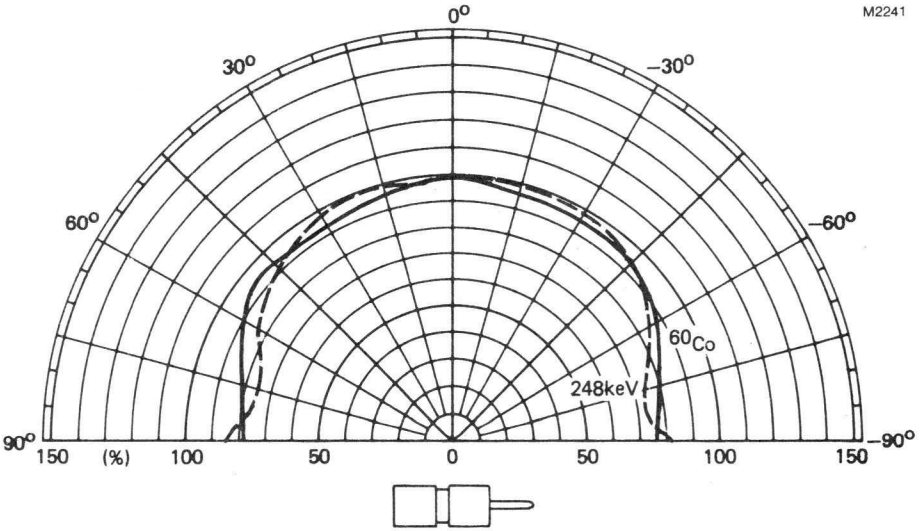


Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs





Typical polar responses
(normalised to 100% at 0°)

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

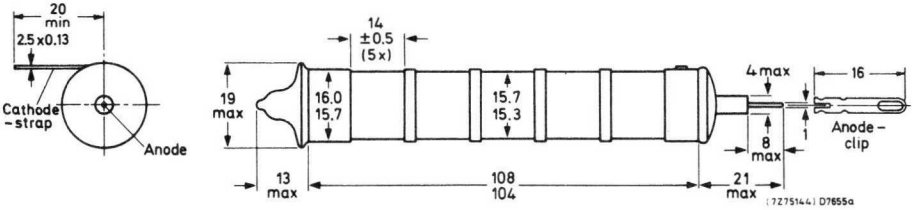
Dose rate range	6×10^{-4} to 10 7×10^{-5} to 1	mGy/h R/h
Plateau threshold voltage	450	V
Plateau length	350	V
Recommended supply voltage	625	V
Chrome-iron cathode	40 to 60	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



The cathode is covered with a corrosion resistant coating.

CATHODE

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

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s^2

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	4.0	pF

TUBE WEIGHT

9.0 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	800	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

→ BETA RESPONSE

Point source ($^{90}Sr/^{90}Y$) between ribs:	0.24	c/s/Bq
Extended source ($^{90}Sr/^{90}Y$) in direct contact:	2.1	c/s/Bq cm^{-2}

→ MEASURING CIRCUITS

R = 2.2 MΩ

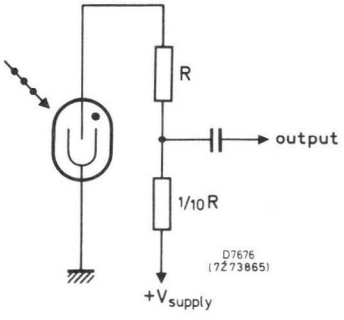


Fig.2 Manufacturer's measuring circuit

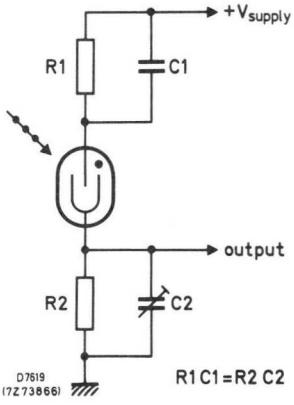
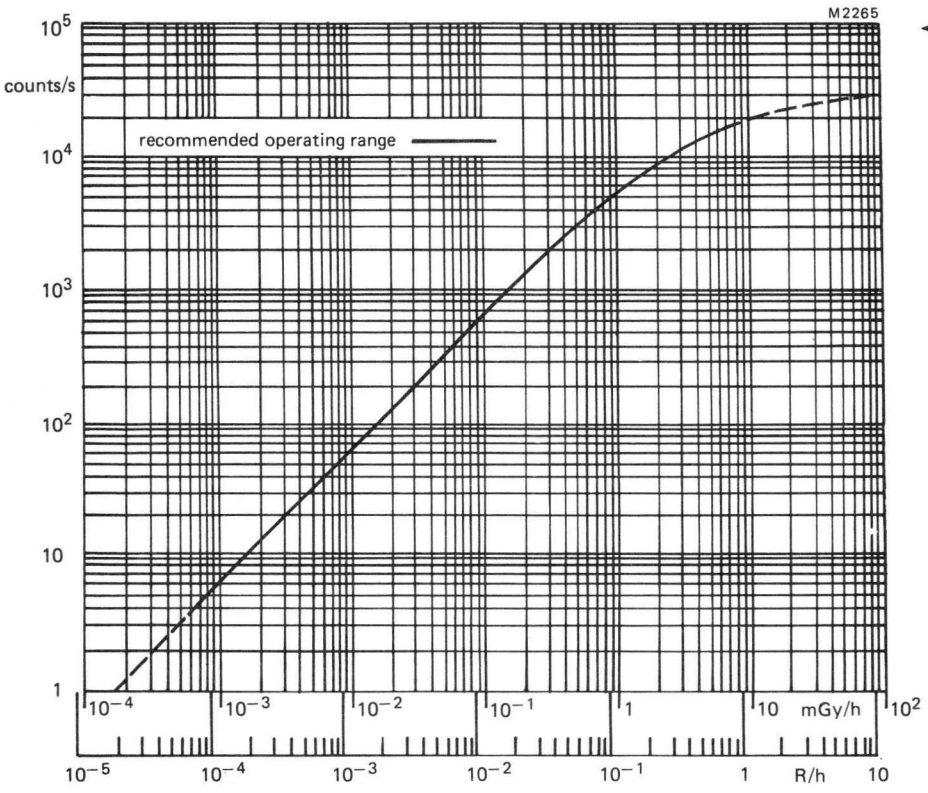
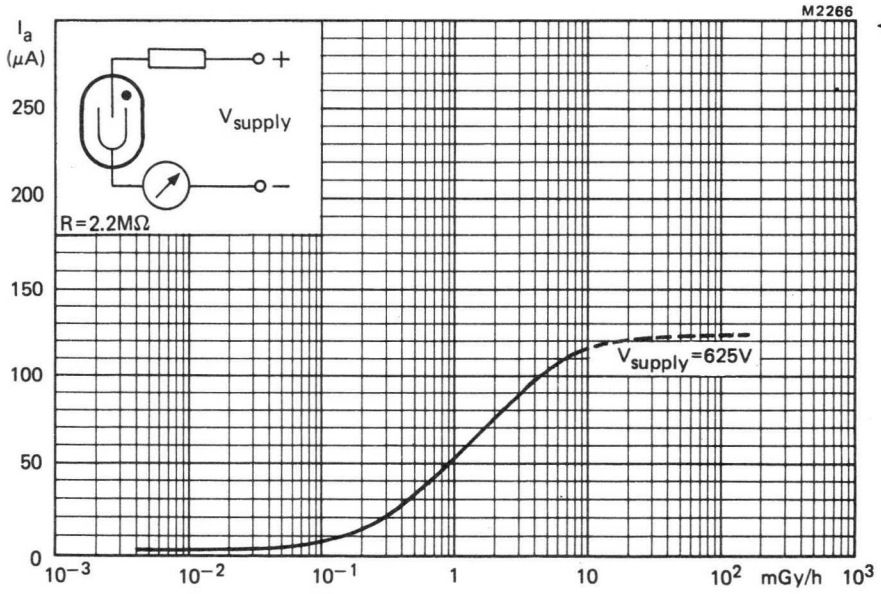


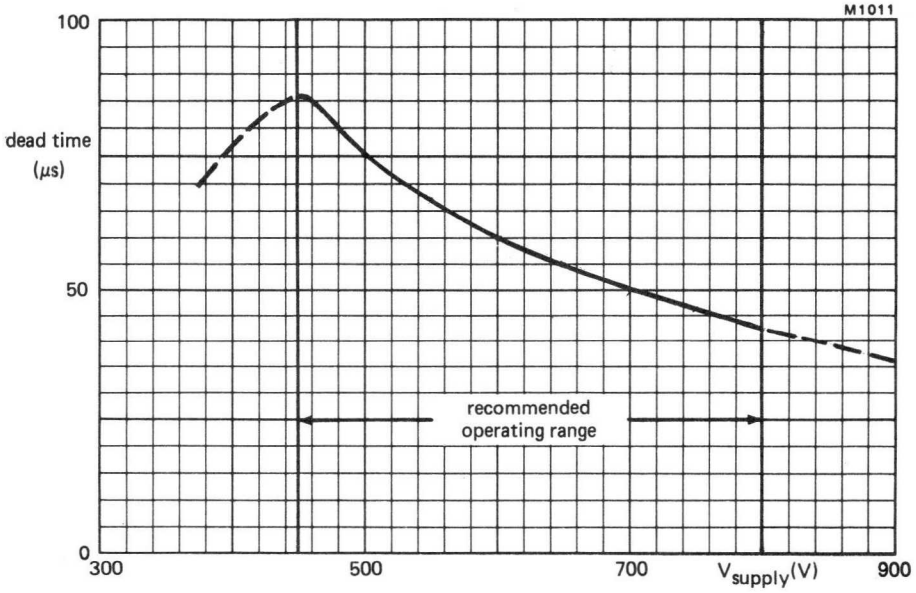
Fig.3 For optimum performance at very high dose rates this circuit may be used



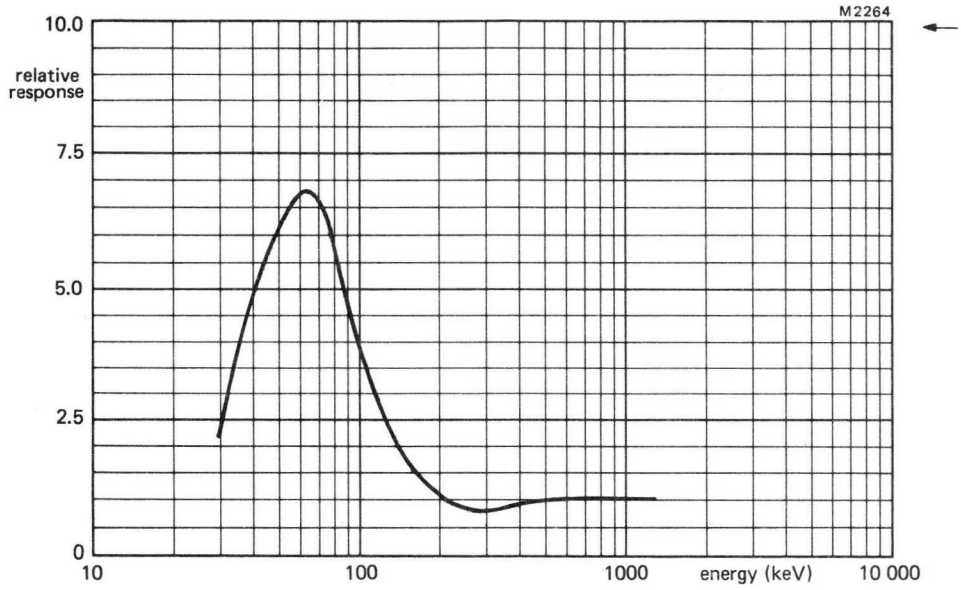
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

End window halogen quenched β and γ radiation counter tube.

QUICK REFERENCE DATA

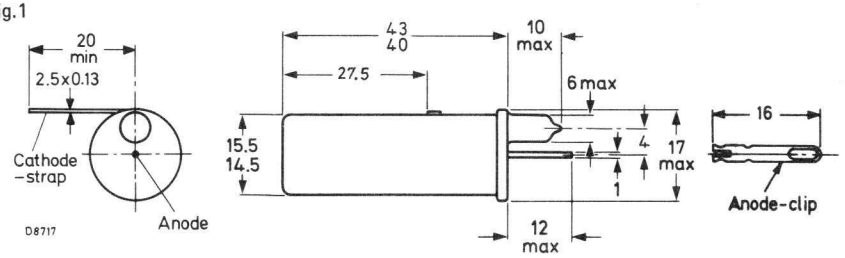
Dose rate range	10^{-3} to 10^{2}	mGy/h
	10^{-4} to 10	R/h
Plateau threshold voltage	400	V
Plateau length	200	V
Recommended supply voltage	500	V
Chrome-iron cathode	250	mg/cm^2
Mica window (9 mm diameter)	2.0 to 3.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



WINDOW

Thickness	2.0 to 3.0	mg/cm^2
Useful diameter	9	mm
Material	mica	

CATHODE

Thickness	250	mg/cm^2
Sensitive length	39	mm
Material	chrome-iron	

ENVIRONMENTAL

Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s^2
Vibration (50 Hz continuous sine wave) - acceleration	24.5	m/s^2

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.1	pF

TUBE WEIGHT

7.0 g

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

BETA RESPONSE

Point source ($^{90}Sr/^{90}Y$)		0.25	c/s/Bq
Extended source ($^{90}Sr/^{90}Y$)		0.42	c/s/Bq cm^{-2}

MEASURING CIRCUIT

R_1 = 10 MΩ
R_2 = 220 kΩ
C_1 = 1 pF*

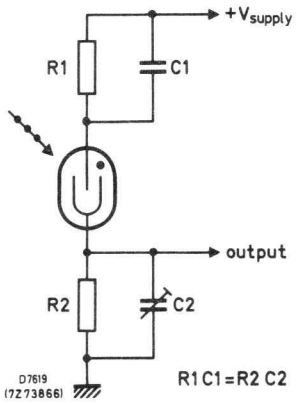
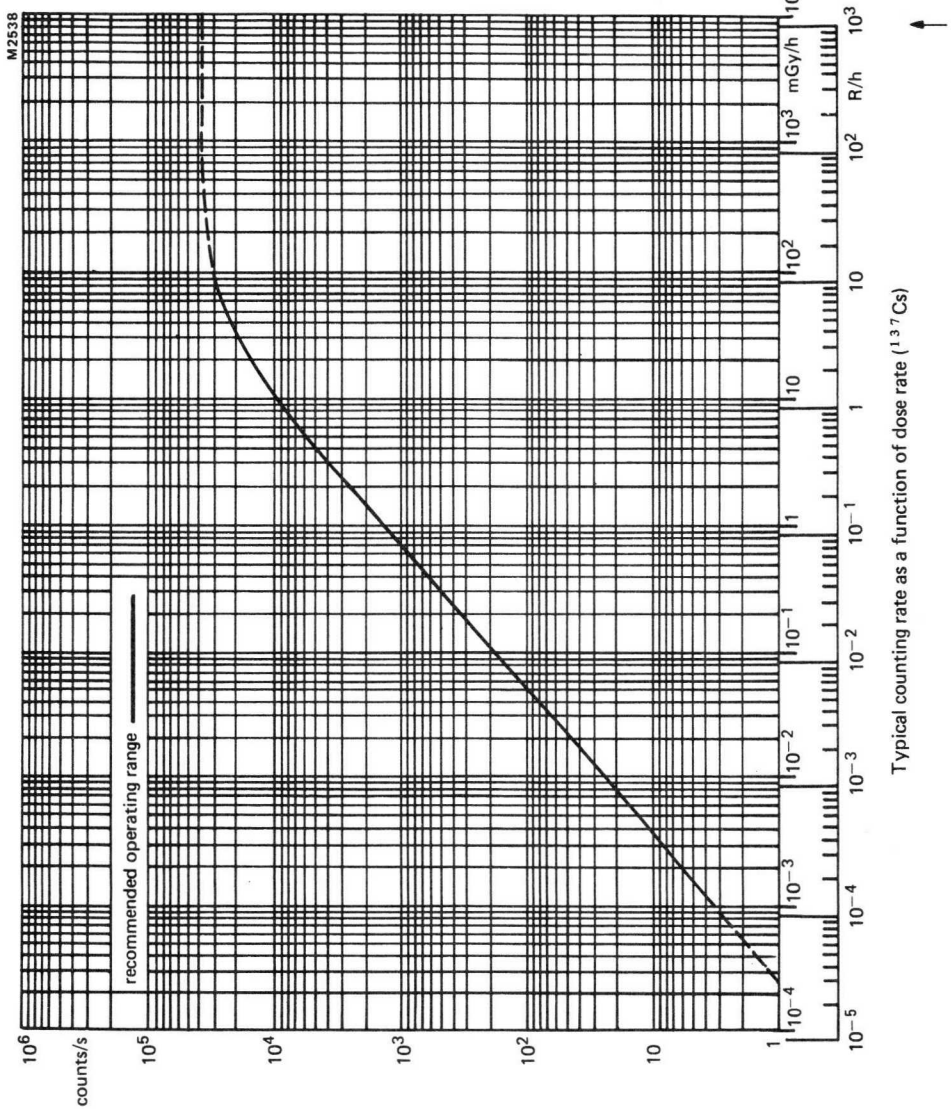
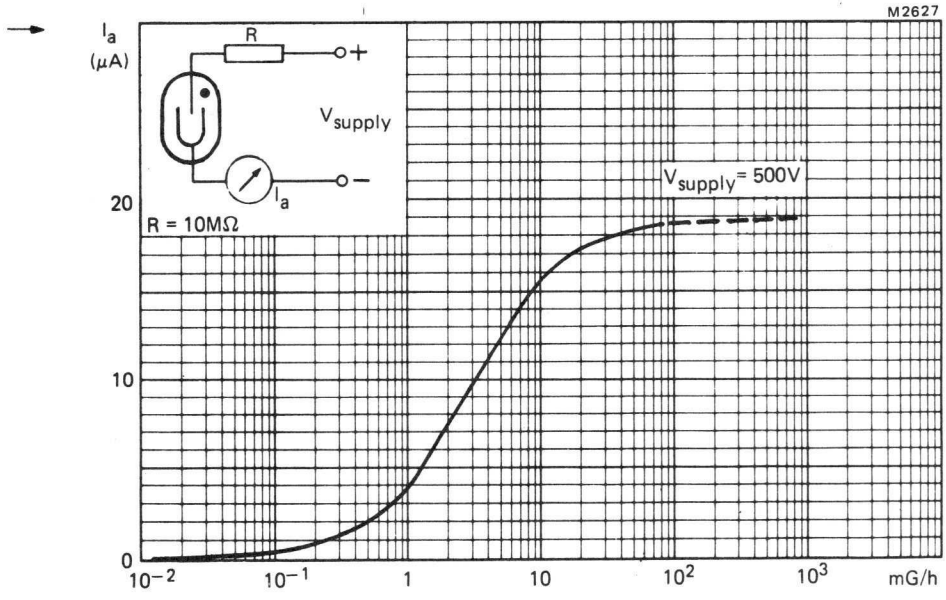


Fig.2

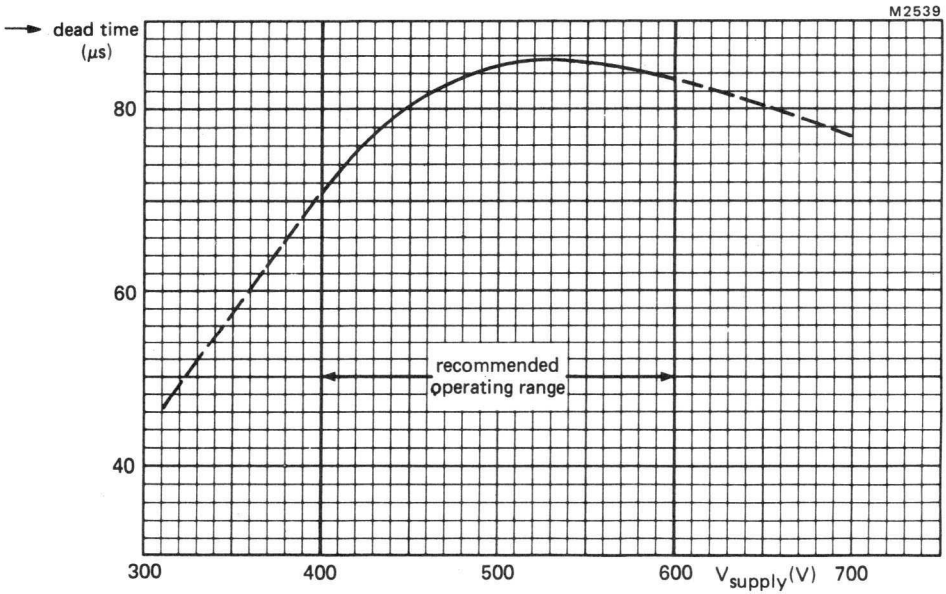
*See General Information (paragraph 5.5)



Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

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

QUICK REFERENCE DATA

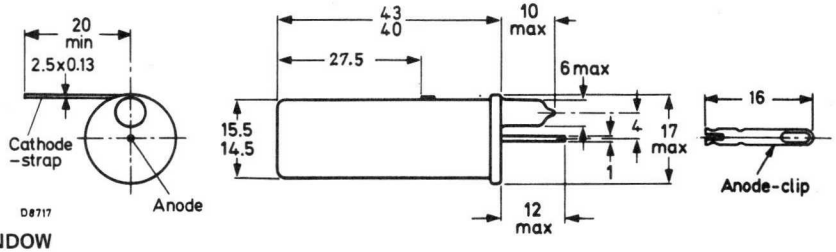
Dose rate range	10^{-3} to 10^{2}	mGy/h
	10^{-4} to 10	R/h
Plateau threshold voltage	400	V
Plateau length	200	V
Recommended supply voltage	500	V
Chrome-iron cathode	250	mg/cm^2
Mica window (9 mm diameter)	1.5 to 2.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



WINDOW

Thickness	1.5 to 2.0	mg/cm^2
Useful diameter	9	mm
Material	mica	

CATHODE

Thickness	250	mg/cm^2
Sensitive length	39	mm
Material	chrome-iron	

ENVIRONMENTAL

Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s^2
Vibration (50 Hz continuous sine wave) - acceleration	24.5	m/s^2

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.1	pF

TUBE WEIGHT

7.0 g

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

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF*

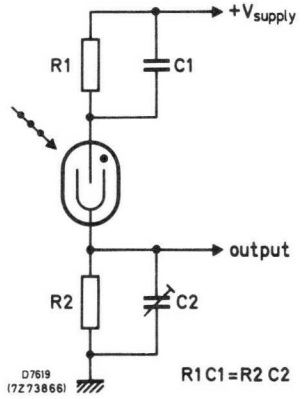
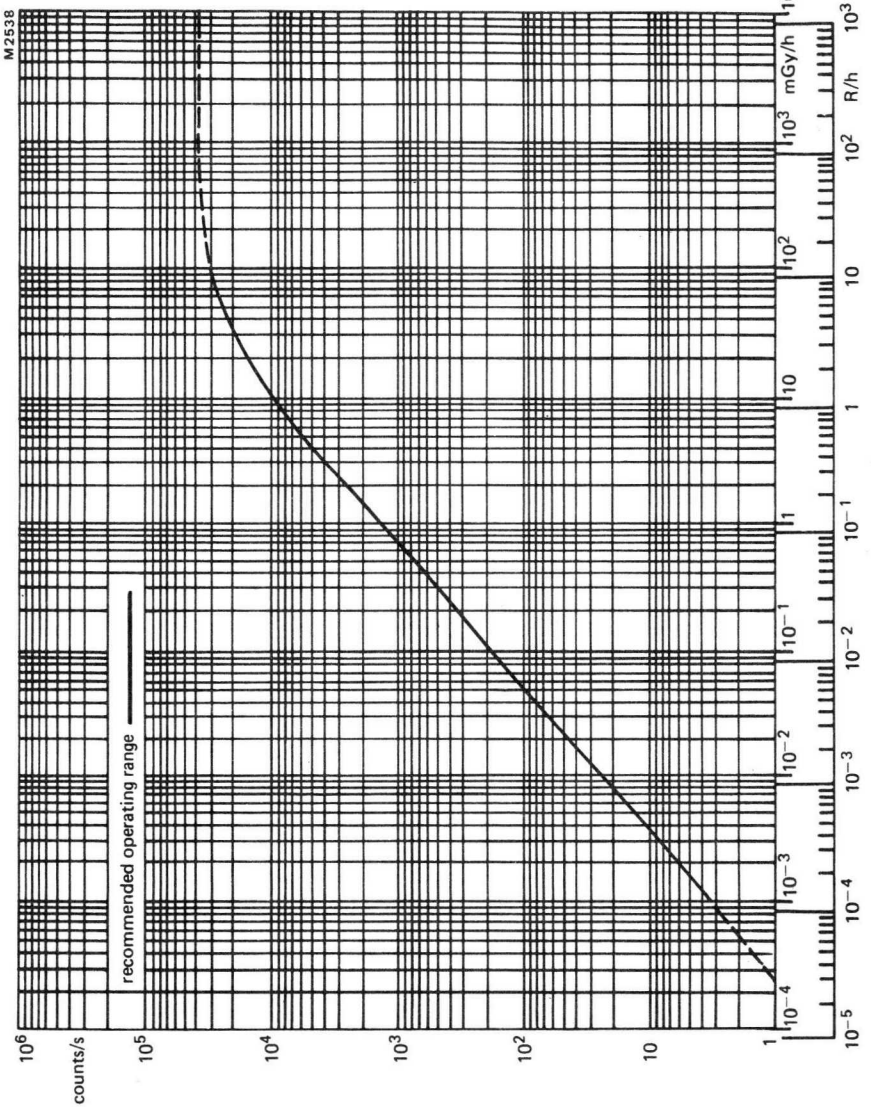
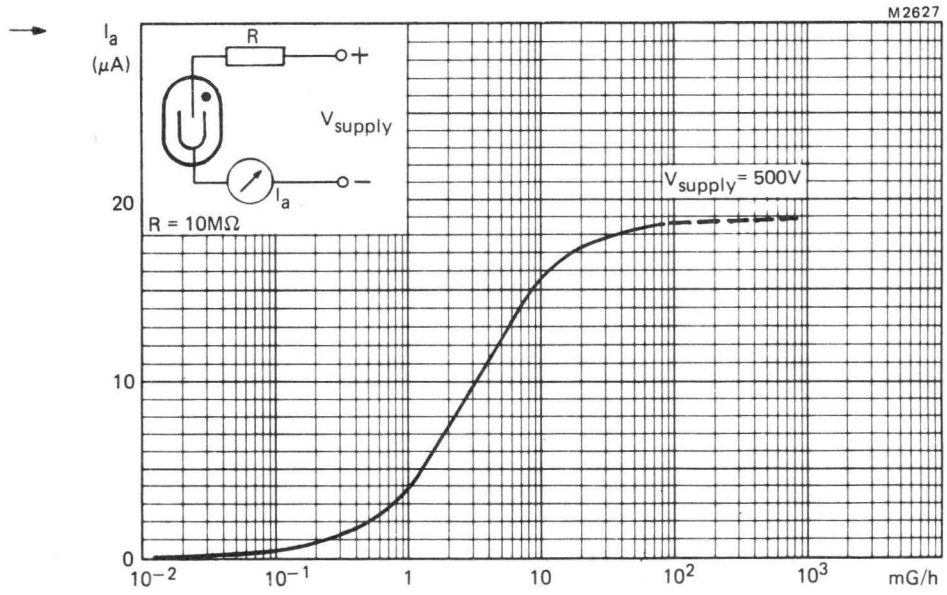


Fig.2

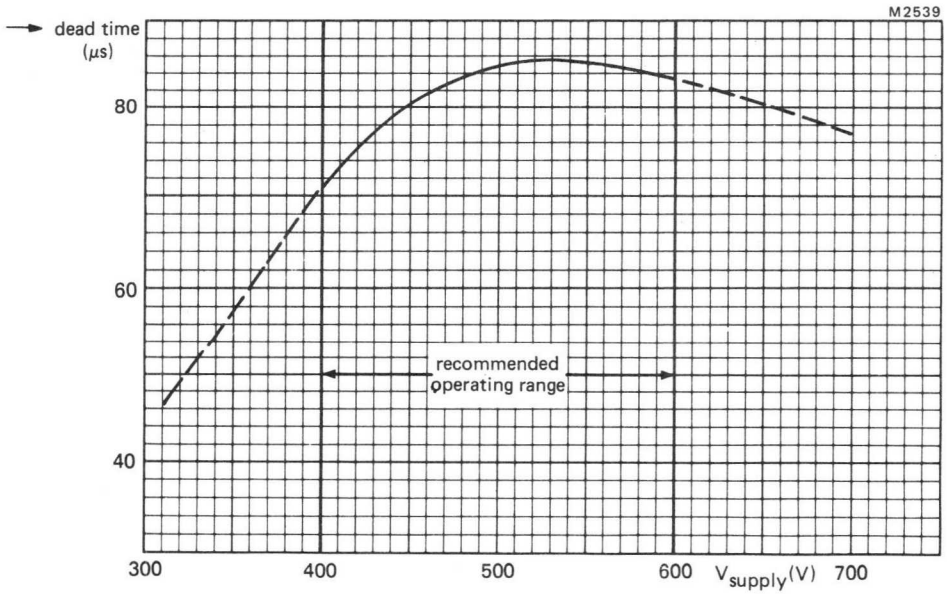
*See General Information (paragraph 5.5)



Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

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

QUICK REFERENCE DATA

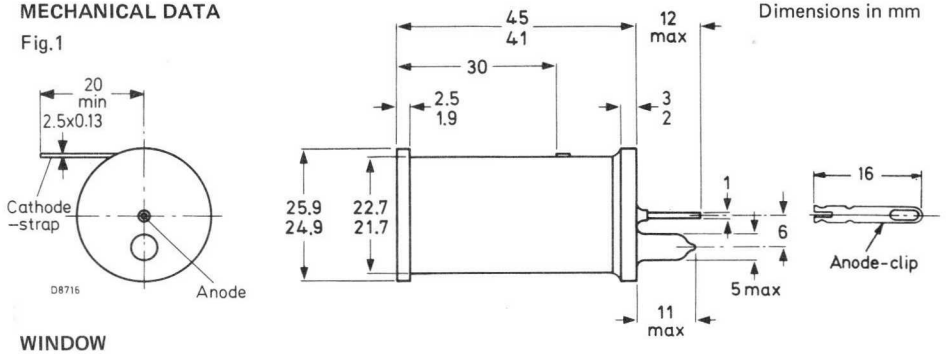
Dose rate range	10^{-3} to 10	mGy/h
	10^{-4} to 1	R/h
Plateau threshold voltage	450	V
Plateau length	250	V
Recommended supply voltage	575	V
Chrome-iron cathode	910	mg/cm^2
Mica window (19.8 mm diameter)	1.5 to 2.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



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	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s^2

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	2.5	pF

TUBE WEIGHT

34 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	700	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

→ **MEASURING CIRCUITS**

R = 10 MΩ

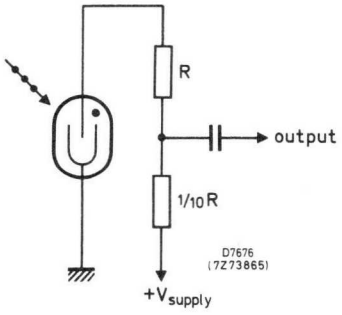


Fig.2 Manufacturer's measuring circuit

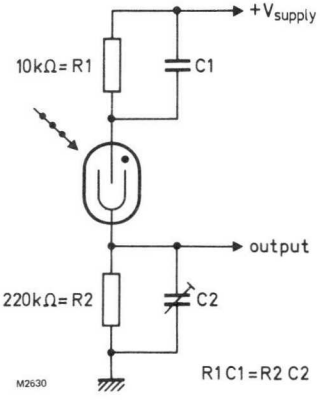
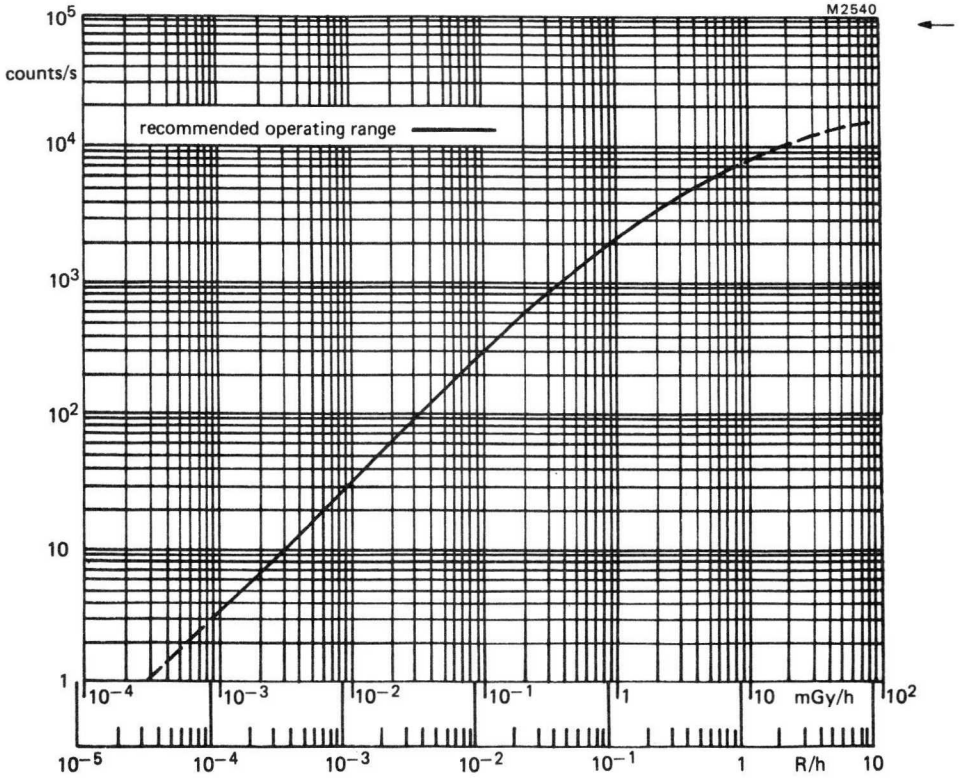
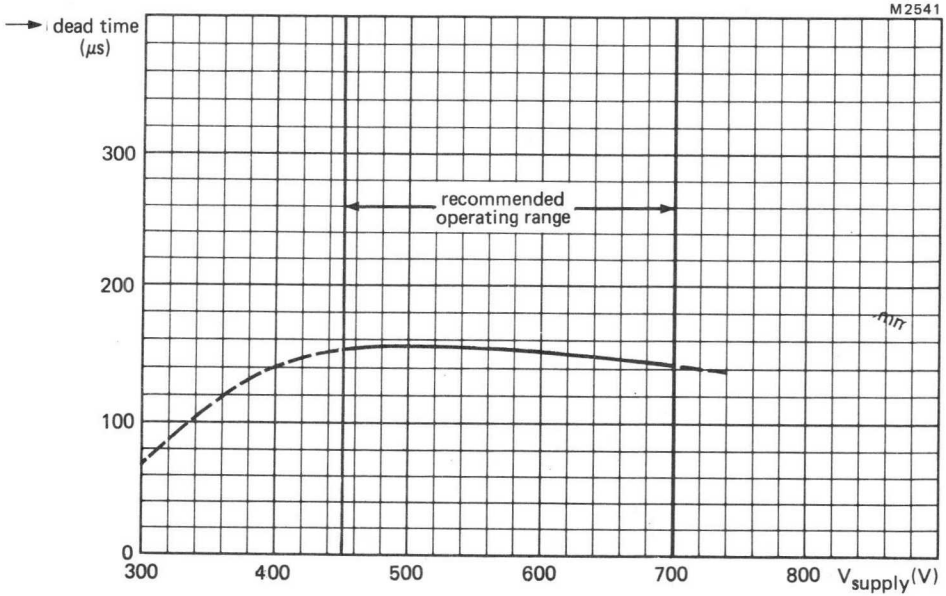


Fig.3 For optimum performance at very high dose rates this circuit may be used



Typical counting rate as a function of dose rate (^{137}Cs)


M2541
dead time (μs)
300
200
100
0
recommended operating range
300
400
500
600
700
800
V_{supply}(V)

GEIGER-MÜLLER TUBE

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

QUICK REFERENCE DATA

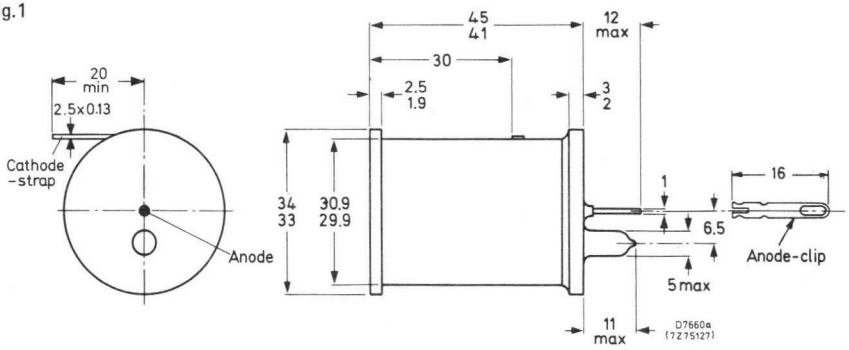
Dose rate range	6×10^{-4} to 6 7×10^{-5} to 7×10^{-1}	mGy/h R/h
Plateau threshold voltage	450	V
Plateau length	250	V
Recommended supply voltage	575	V
Chrome-iron cathode	980	mg/cm^2
Mica window (27.8 mm diameter)	1.5 to 2.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



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	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s^2

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	3.5	pF

TUBE WEIGHT

51 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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.	230	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	4.7	MΩ
Anode voltage	max.	700	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

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF*

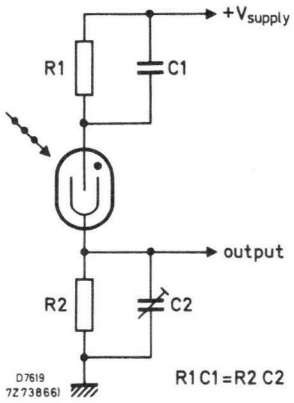
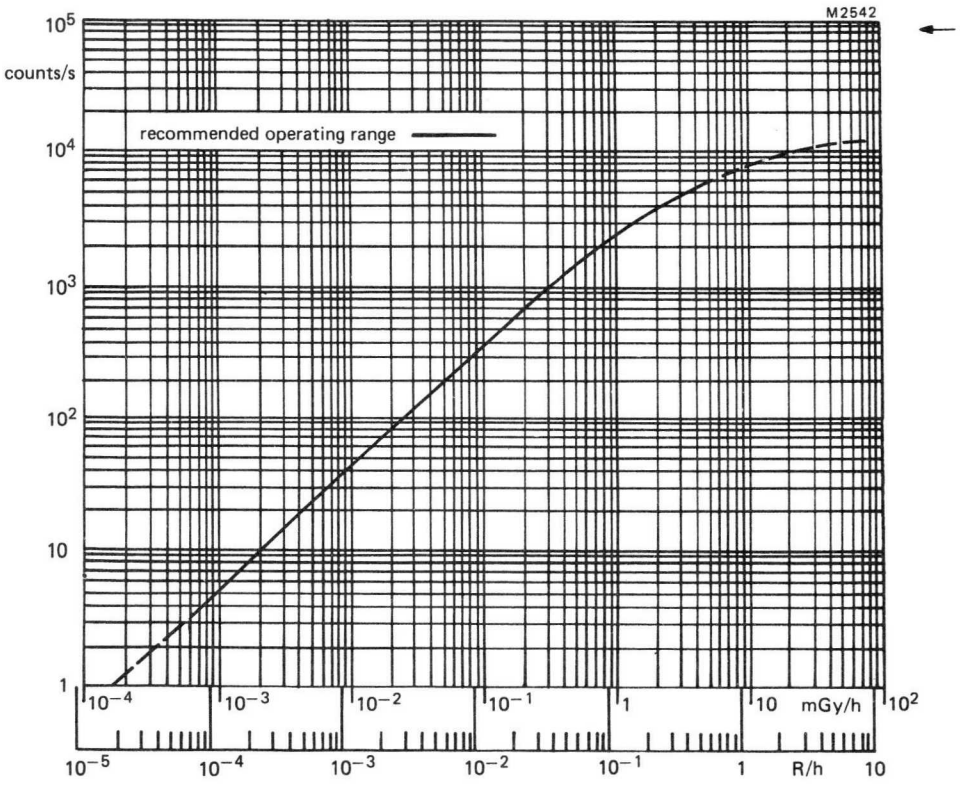
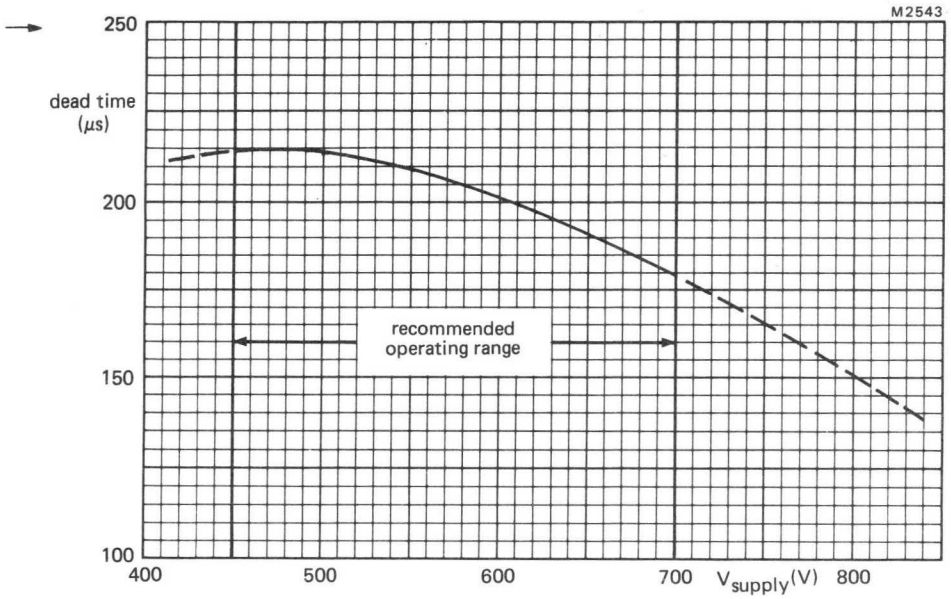


Fig.2

*See General Information (paragraph 5.5)



Typical counting rate as a function of dose rate (^{137}Cs)



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

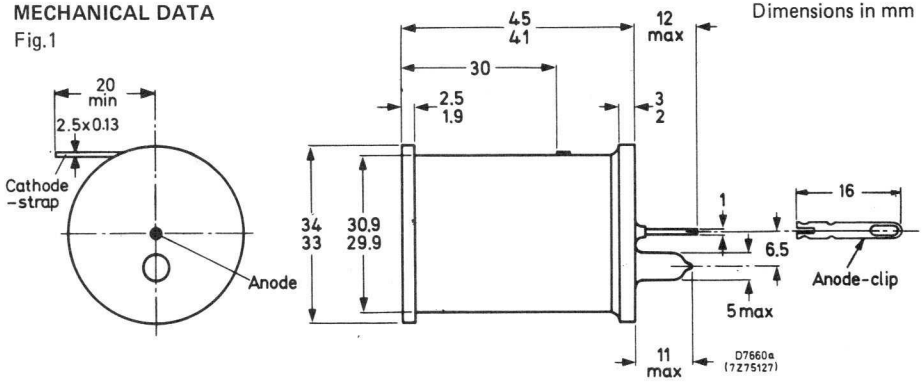
Dose rate range	6×10^{-4} to 6	mGy/h
	7×10^{-5} to 7×10^{-1}	R/h
Plateau threshold voltage	450	V
Plateau length	250	V
Recommended supply voltage	575	V
Chrome-iron cathode	980	mg/cm^2
Mica window (27.8 mm diameter)	2.0 to 3.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



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	37	mm
Material	chrome-iron	
ENVIRONMENTAL (Manufacturer's test conditions)		
Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s^2
FILLING	neon, argon, halogen	
CAPACITANCE		
Anode to cathode	3.5	pF
TUBE WEIGHT	51	g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	700	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

BETA RESPONSE

Point source ($^{90}Sr/^{90}Y$)		0.32	c/s/Bq
Extended source ($^{90}Sr/^{90}Y$)		2.05	c/s/Bq cm^{-2}

MEASURING CIRCUIT

R_1 = 10 MΩ
R_2 = 220 kΩ
C_1 = 1 pF *

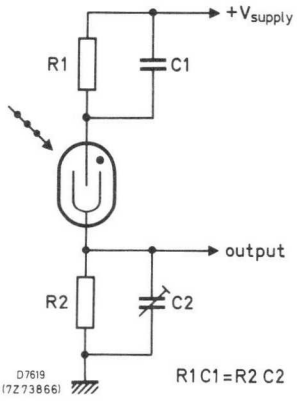
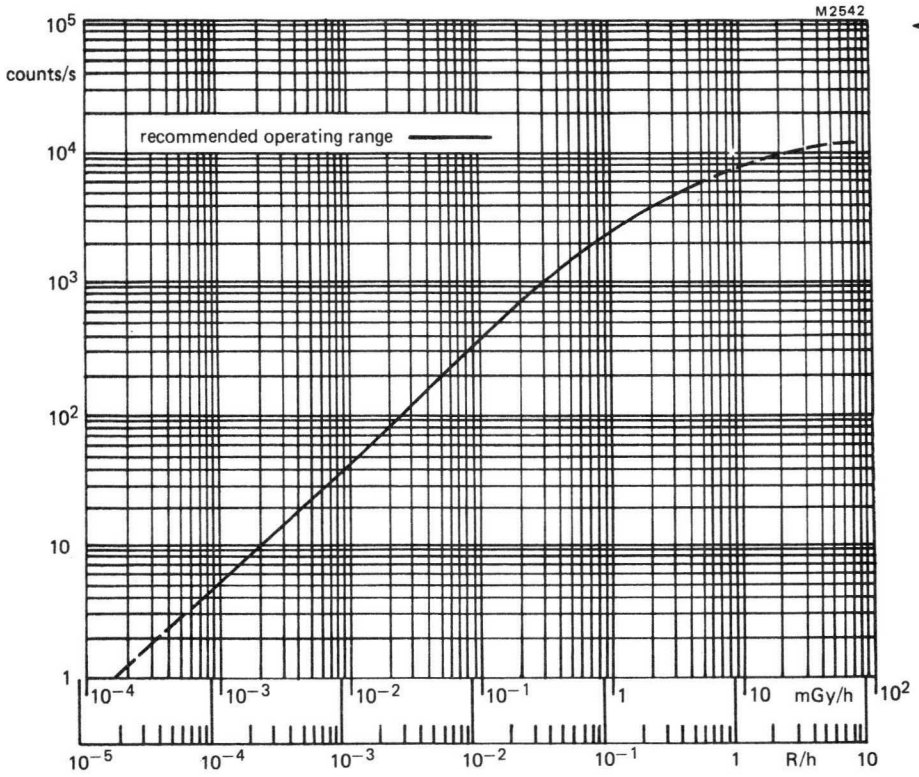
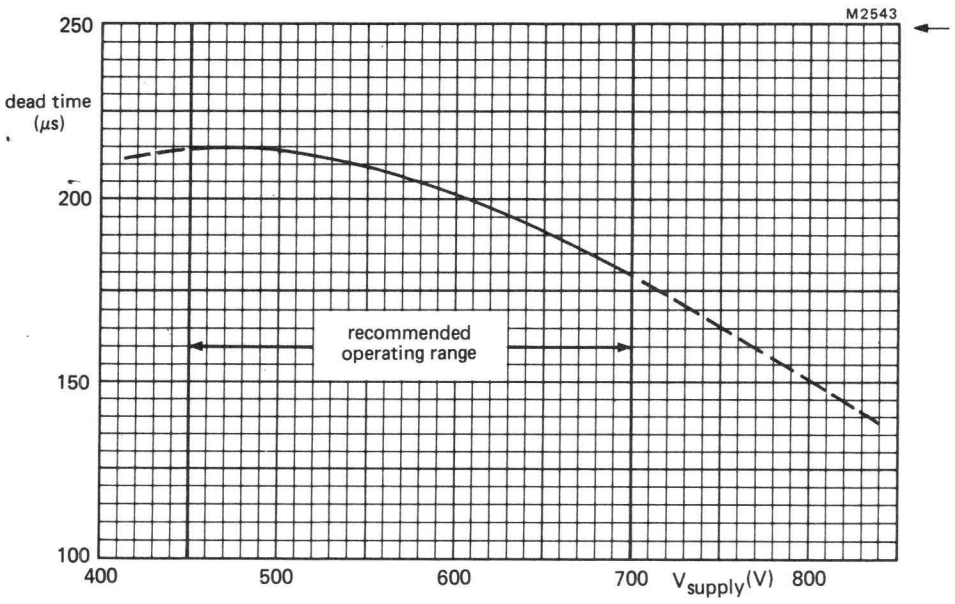


Fig.2

*See General Information (paragraph 5.5)



Typical counting rate as a function of dose rate (^{137}Cs)



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

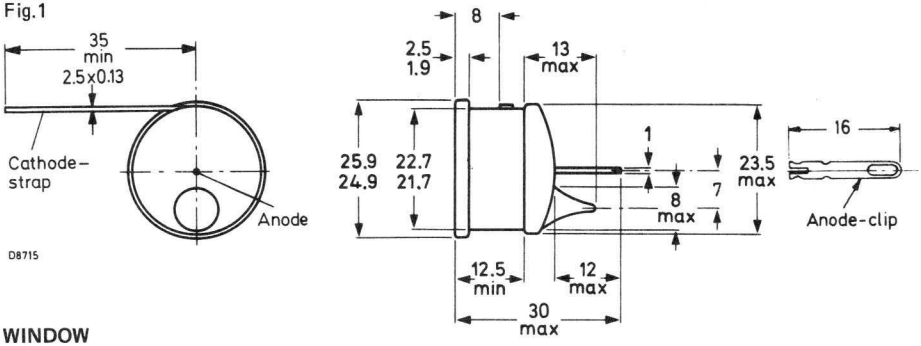
Dose rate range	3×10^{-3} to 10^{2}	mGy/h
	3×10^{-4} to 10	R/h
Plateau threshold voltage	500	V
Plateau length	200	V
Recommended supply voltage	600	V
Chrome-iron cathode	910	mg/cm^2
Mica window (19.8 mm diameter)	1.5 to 2.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



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	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s^2

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.0	pF

TUBE WEIGHT

14 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	700	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

MEASURING CIRCUIT

R_1 = 4.7 MΩ
R_2 = 100 kΩ
C_1 = 1 pF*

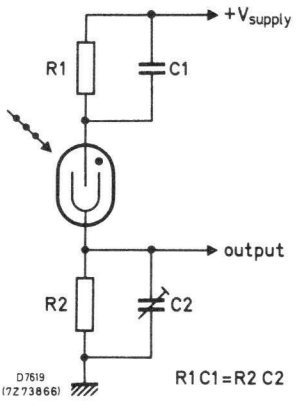
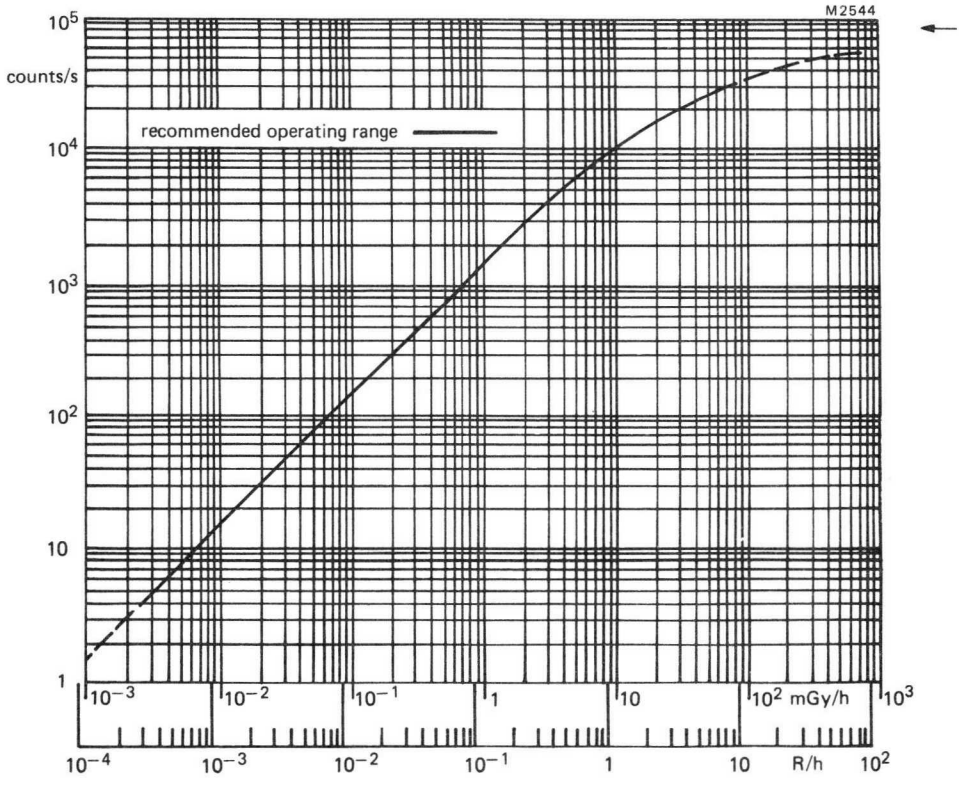
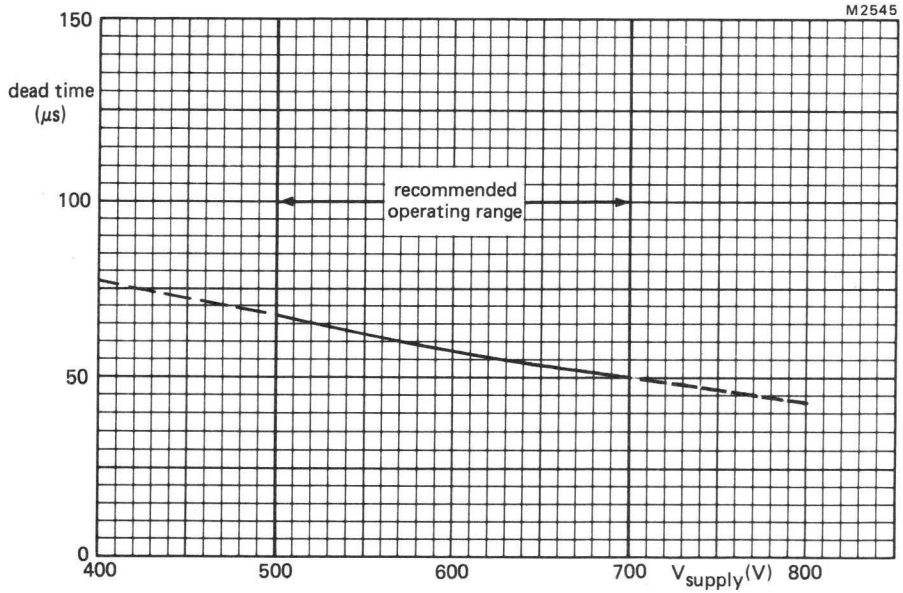


Fig.2

*See General Information (paragraph 5.5)



Typical counting rate as a function of dose rate (^{137}Cs)



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

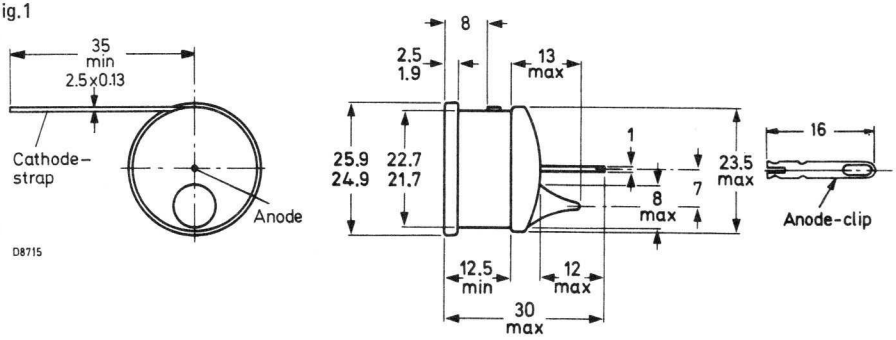
Dose rate range	3×10^{-3} to 10^{2}	mGy/h
	3×10^{-4} to 10	R/h
Plateau threshold voltage	500	V
Plateau length	200	V
Recommended supply voltage	600	V
Chrome-iron cathode	910	mg/cm²
Mica window (19.8 mm diameter)	2.0 to 3.0	mg/cm²

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



WINDOW

Thickness	2.0 to 3.0	mg/cm²
Useful diameter	19.8	mm
Material	mica	

CATHODE

Thickness	910	mg/cm²
Sensitive length	12	mm
Material	chrome-iron	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s²

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.0	pF

TUBE WEIGHT

14 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	700	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

→ BETA RESPONSE

Point source ($^{90}Sr/^{90}Y$)	0.41	c/s/Bq
Extended source ($^{90}Sr/^{90}Y$)	1.13	c/s/Bq cm^{-2}

MEASURING CIRCUIT

R_1 = 4.7 MΩ
R_2 = 100 kΩ
C_1 = 1 pF *

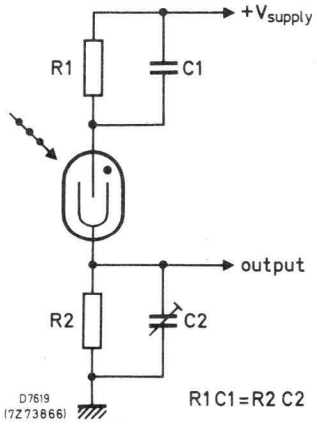
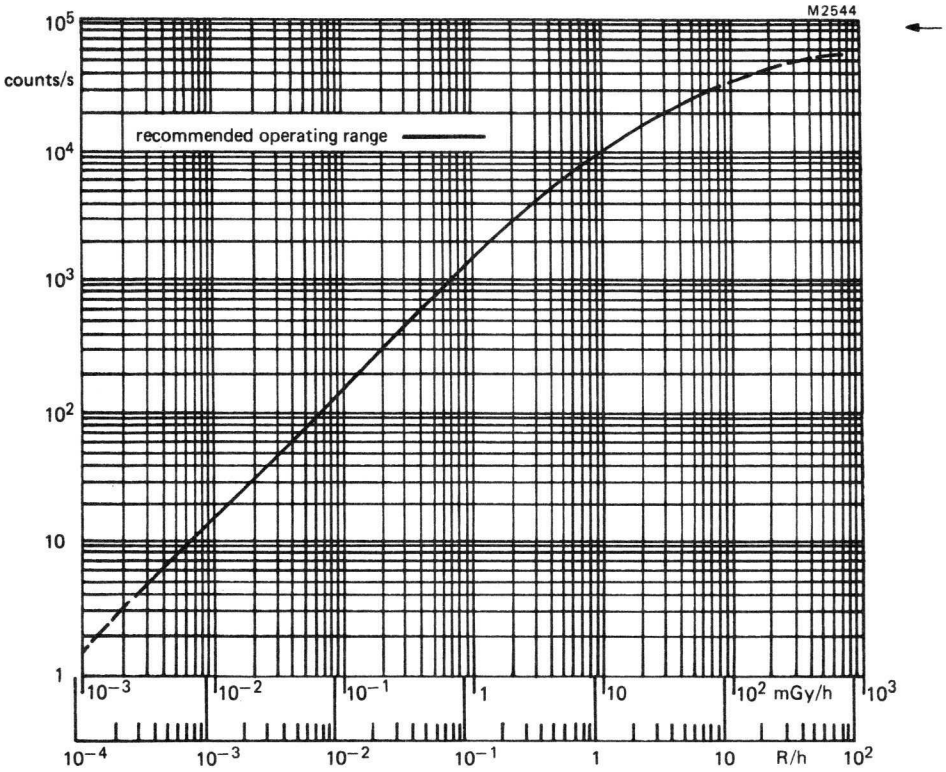
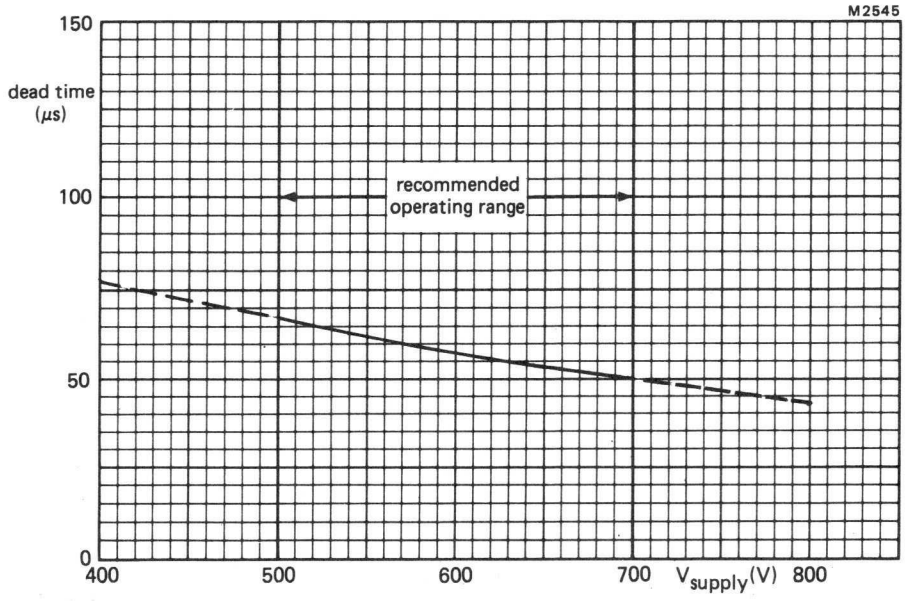


Fig.2

*See General Information (paragraph 5.5)



Typical counting rate as a function of dose rate (^{137}Cs)



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

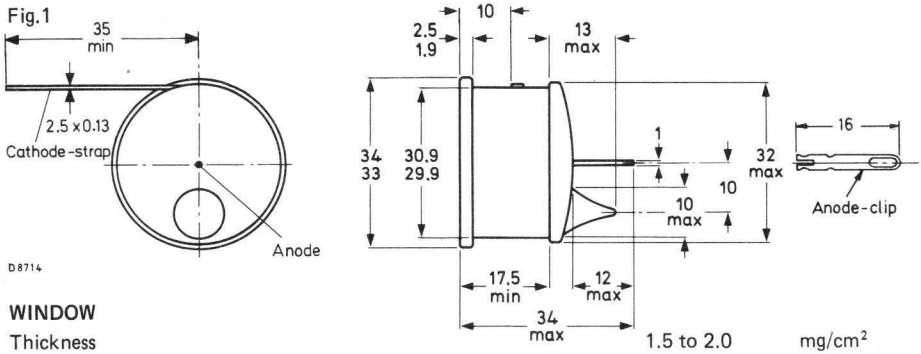
Dose rate range	10^{-3} to 20	mGy/h
	10^{-4} to 2	R/h
Plateau threshold voltage	500	V
Plateau length	250	V
Recommended supply voltage	625	V
Chrome-iron cathode	980	mg/cm^2
Mica window (27.8 mm diameter)	1.5 to 2.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



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	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s^2

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	1.4	pF

TUBE WEIGHT

22 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	750	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

MEASURING CIRCUIT

R_1 = 10 MΩ
R_2 = 220 kΩ
C_1 = 1 pF*

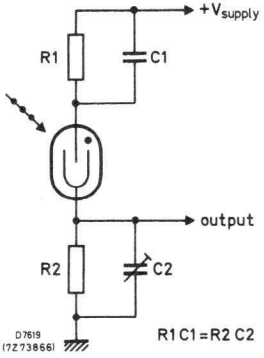
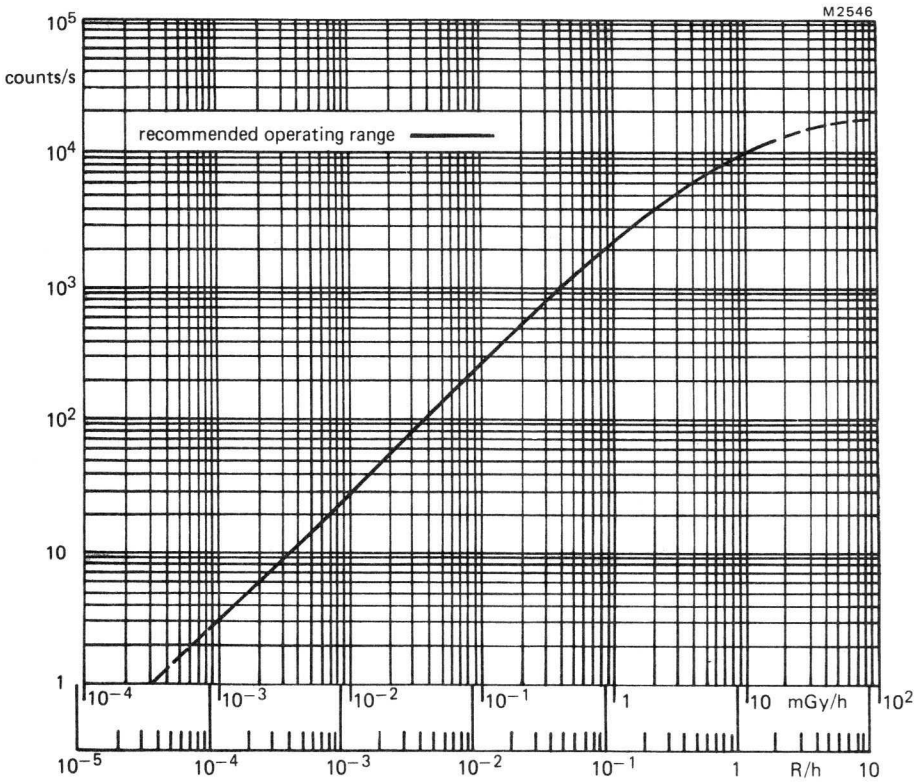
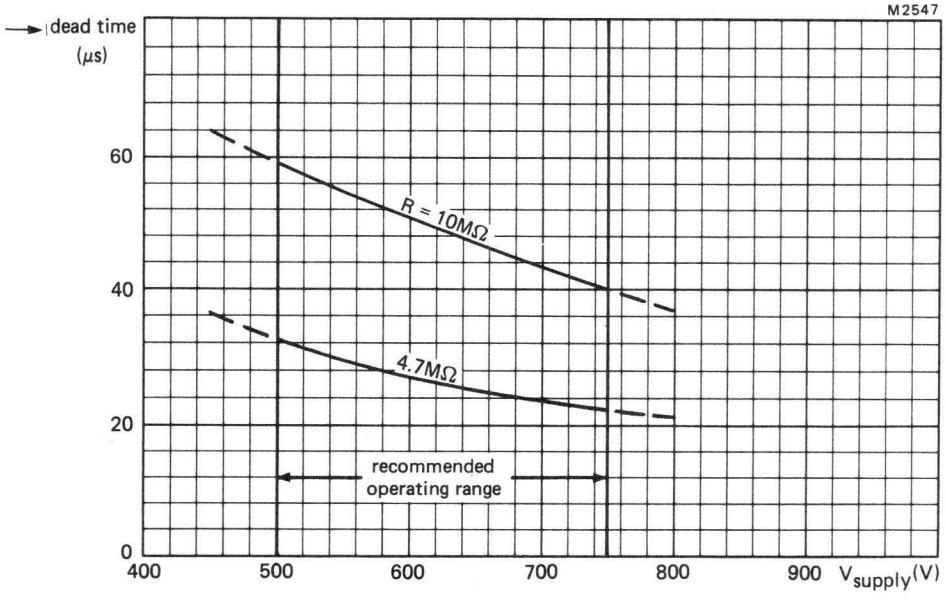


Fig.2

*See General Information (paragraph 5.5)



Typical counting rate as a function of dose rate (^{137}Cs)



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

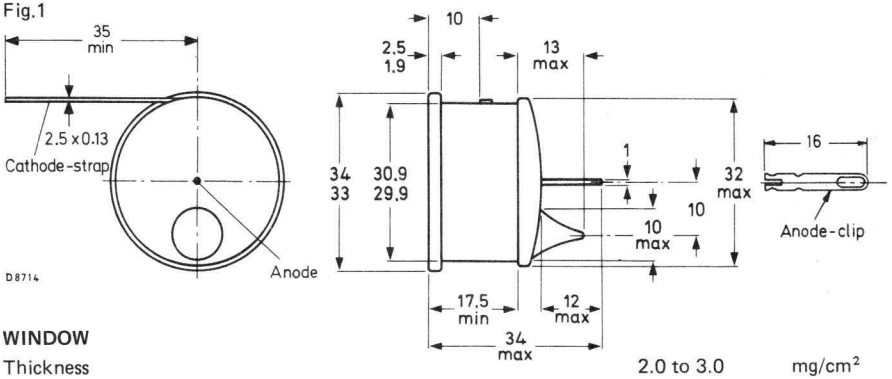
Dose rate range	10^{-3} to 20	mGy/h
	10^{-4} to 2	R/h
Plateau threshold voltage	500	V
Plateau length	250	V
Recommended supply voltage	625	V
Chrome-iron cathode	980	mg/cm^2
Mica window (27.8 mm diameter)	2.0 to 3.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



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	
ENVIRONMENTAL (Manufacturer's test conditions)		
Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s^2
FILLING	neon, argon, halogen	
CAPACITANCE		
Anode to cathode	1.4	pF
TUBE WEIGHT	22	g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	750	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

BETA RESPONSE

Point source ($^{90}Sr/^{90}Y$)	0.38	c/s/Bq
Extended source ($^{90}Sr/^{90}Y$)	2.27	c/s/Bq cm^{-2}

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF*

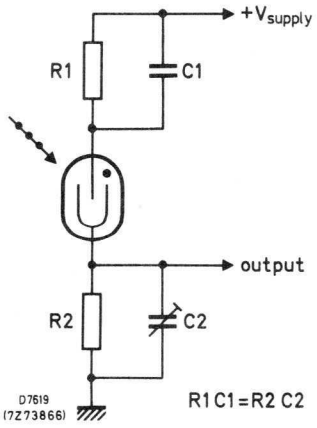
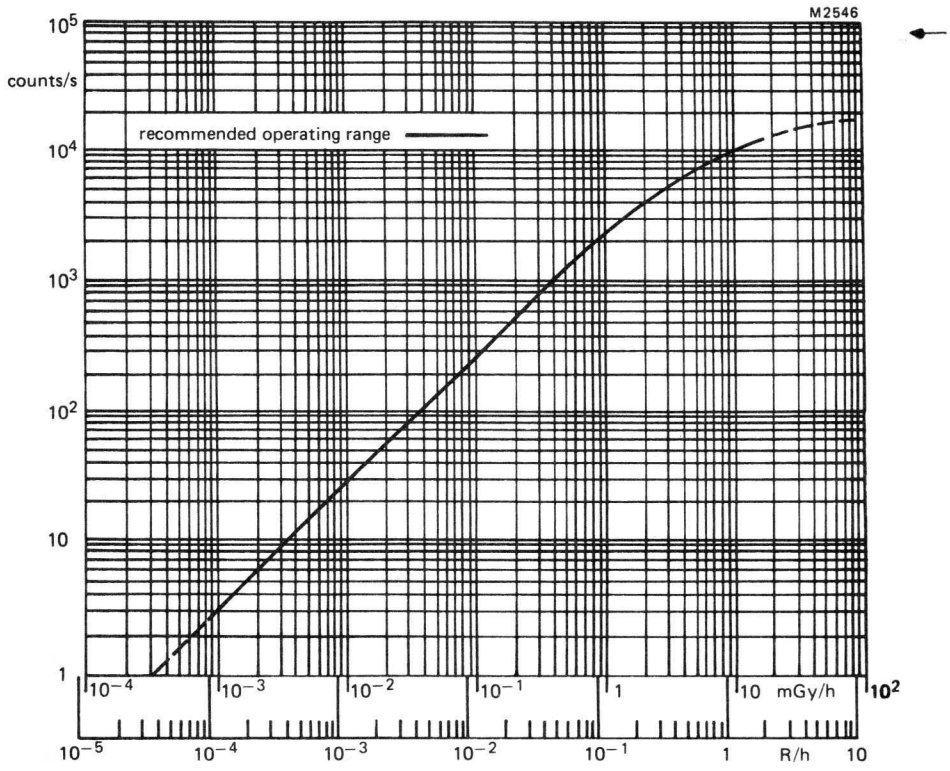
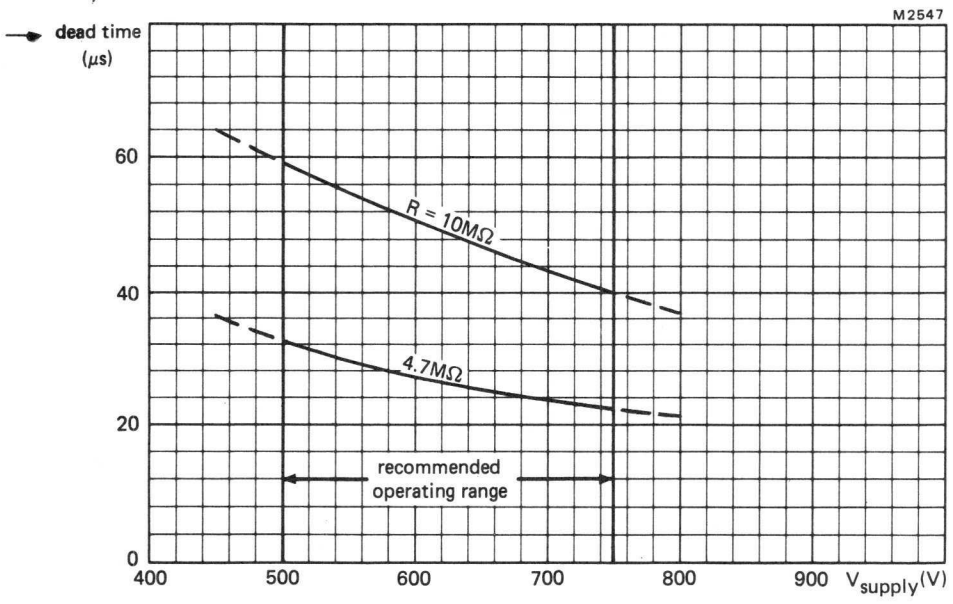


Fig.2

*See General Information (paragraph 5.5)



Typical counting rate as a function of dose rate (^{137}Cs)



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

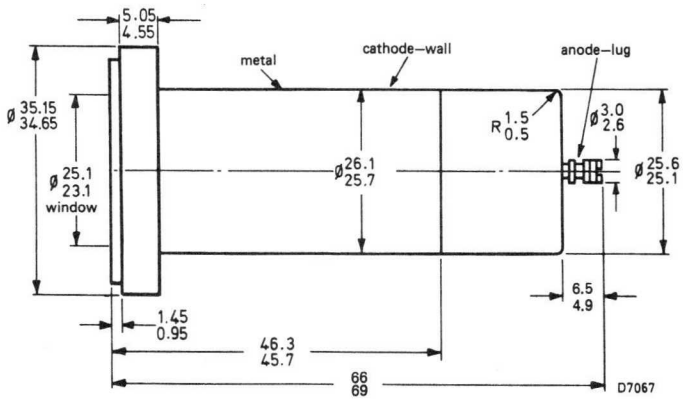
Dose rate range	10^{-3} to 2 x 10	mGy/h
	10^{-4} to 2	R/h
Threshold voltage	550	V
Plateau length	150	V
Recommended supply voltage	600	V
Chrome-iron cathode	690	mg/cm²
Mica window thickness (24.1 mm diameter)	1.5 to 2.5	mg/cm²

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



WINDOW

Thickness	1.5 to 2.5	mg/cm²
Effective diameter	24.1	mm
Material	mica	

CATHODE

Thickness	690	mg/cm²
Sensitive length	26	mm
Material	chrome-iron	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) - peak acceleration	392	m/s²

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode		5.0	pF

→ **TUBE WEIGHT** 63 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	500	V
Threshold voltage	max.	550	V
Plateau length	min.	150	V
→ Recommended supply voltage (mid-plateau)		625	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.	25	count/min
Dead time, at recommended supply voltage	max.	70	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	2.7	MΩ
Anode voltage	max.	700	V
Ambient temperature	max.	+70	°C
continuous operating	min.	−40	°C
storage	max.	+75	°C

LIFE EXPECTANCY

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

→ **BETA RESPONSE**

Point source ($^{90}Sr/^{90}Y$)	0.35	c/s/Bq
Extended source ($^{90}Sr/^{90}Y$)	2.44	c/s/Bq cm^{-2}

→ **MEASURING CIRCUITS**

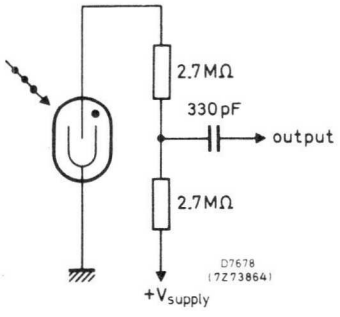


Fig.2 Manufactuer's measuring circuit

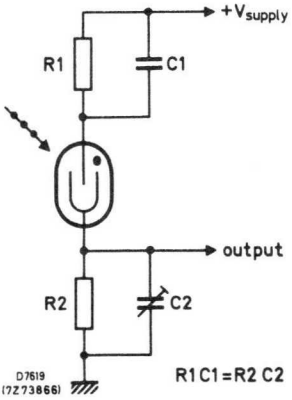
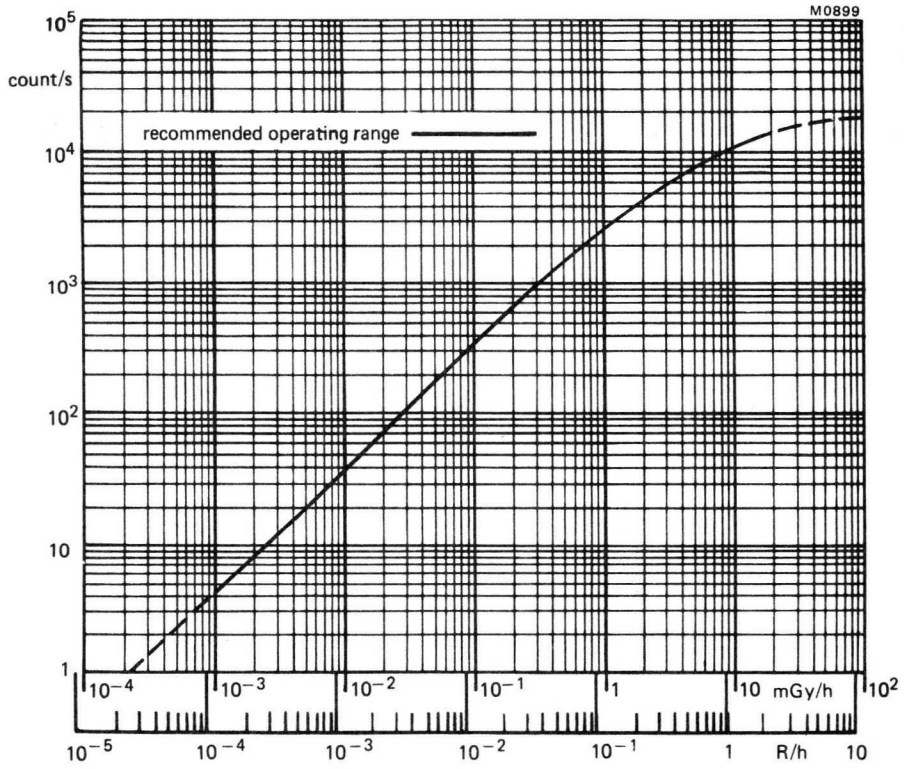
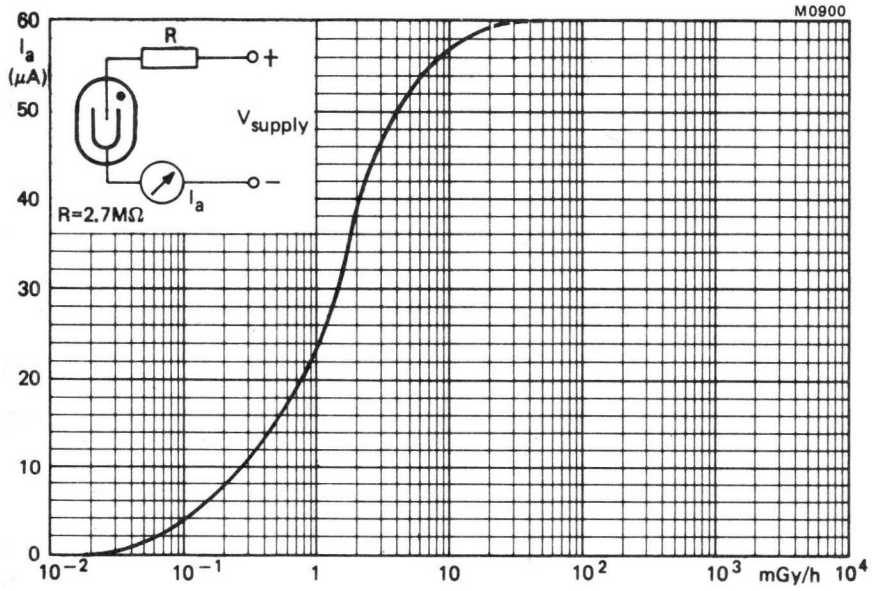


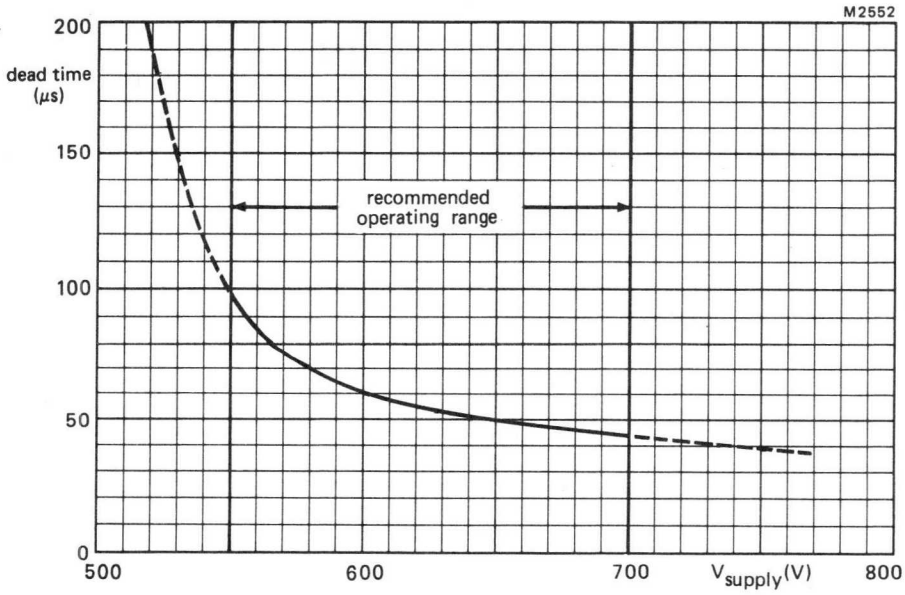
Fig.3 For optimum performance at very high dose rates this circuit may be used



Typical current as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

End window halogen quenched β and γ radiation counter tubes.

QUICK REFERENCE DATA

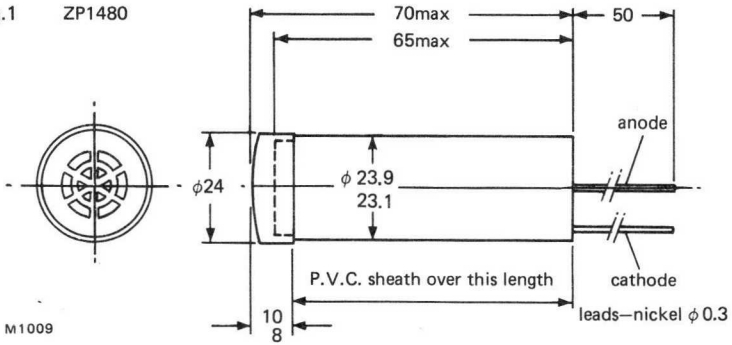
Dose rate range	10^{-3} to 2 x 10	mGy/h
	10^{-4} to 2	R/h
Plateau threshold voltage	400	V
Plateau length	100	V
Recommended supply voltage	450	V
Chrome-iron cathode	2000	mg/cm^2
Mica window (17 mm diameter)	2.5 to 3.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

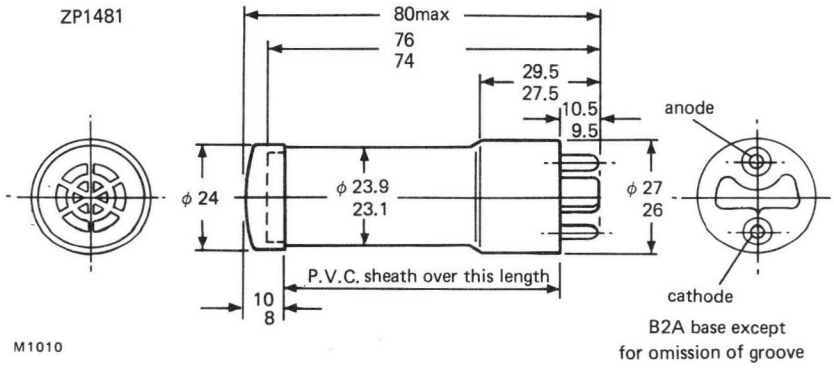
MECHANICAL DATA

Dimensions in mm

Fig.1 ZP1480



ZP1481



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

WINDOW			
Thickness		2.5 to 3.0	mg/cm^2
Useful diameter		17	mm
Material		mica	
CATHODE			
Thickness		2000	mg/cm^2
Sensitive length		38	mm
Material		chrome-iron	
→ **ENVIRONMENTAL** (Manufacturer's test conditions)			
Shock (half sine wave 3 ms duration) – peak acceleration		392	m/s^2
FILLING		neon, argon, halogen	
CAPACITANCE			
Anode to cathode		3.5	pF
→ **TUBE WEIGHT**	ZP1480:	74	g
	ZP1481:	76	g
OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	500	V
Ambient temperature			
continuous operating	max.	+70	°C
	min.	−40	°C
storage	max.	+75	°C
LIFE EXPECTANCY			
Life expectancy at ≈ 25 °C		5 x 10^{10}	count

MEASURING CIRCUIT

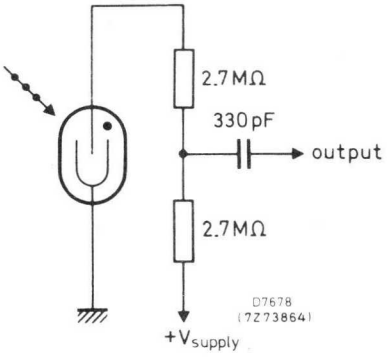
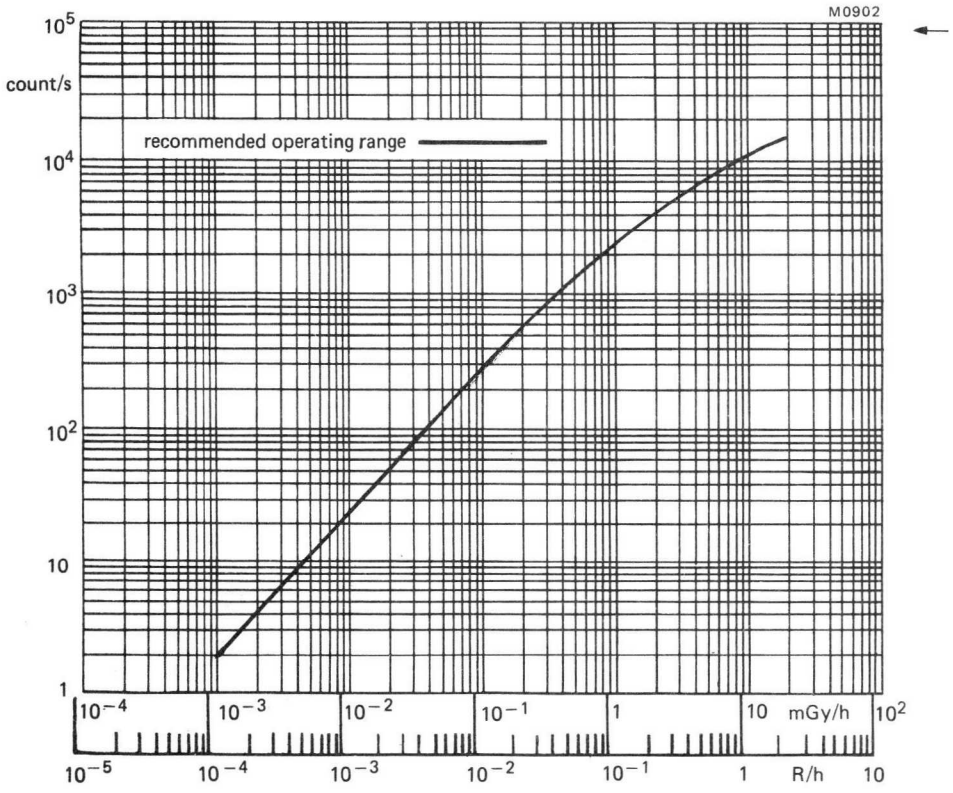
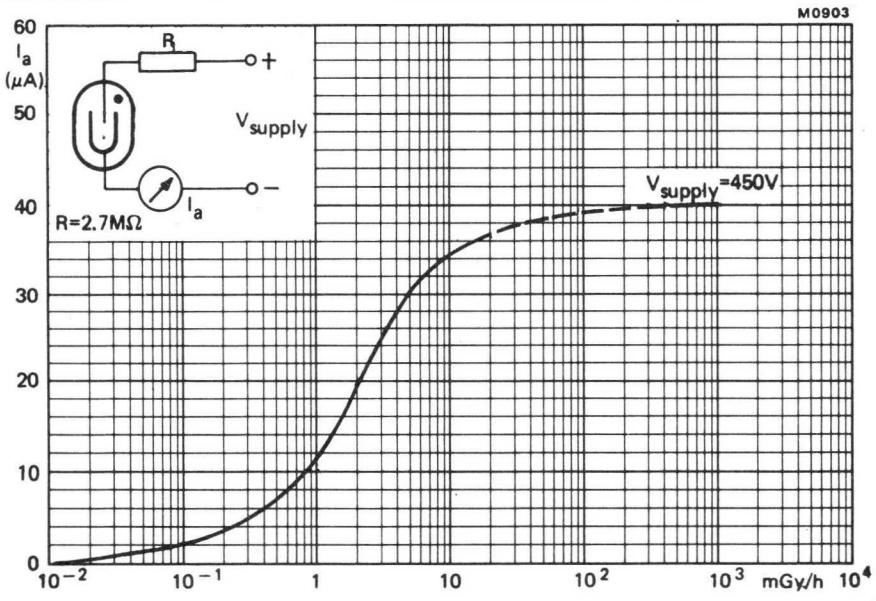


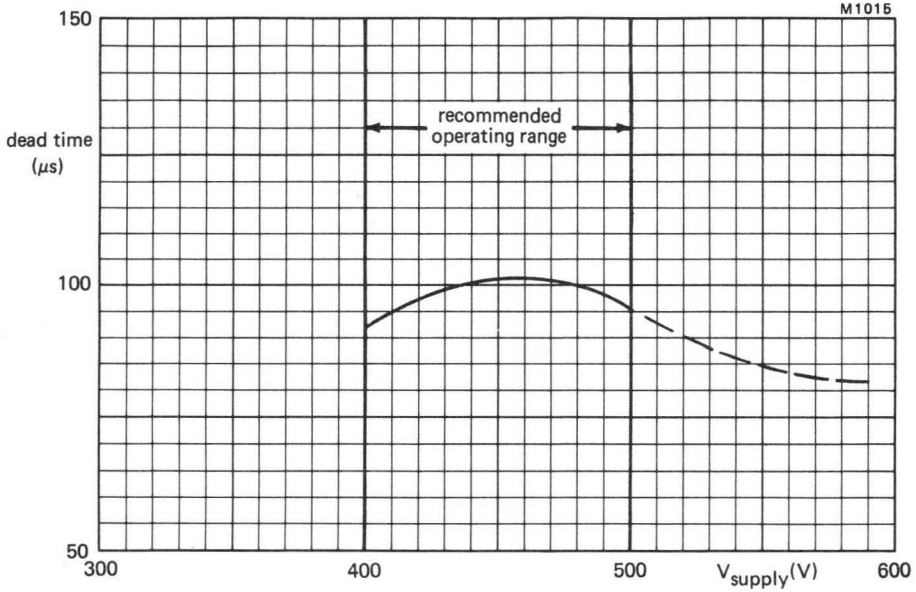
Fig.2



Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



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.

QUICK REFERENCE GUIDE

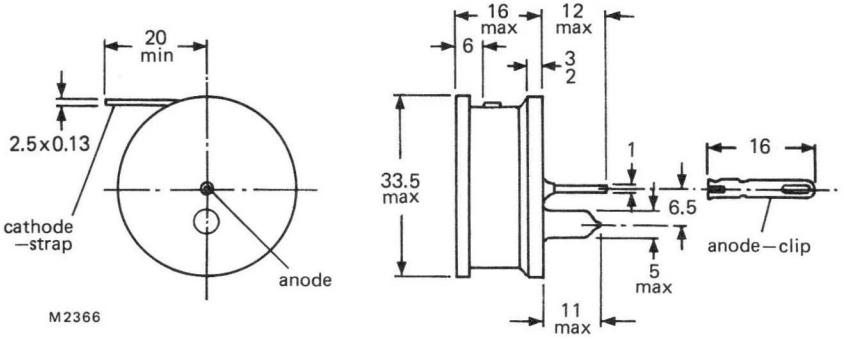
Dose rate range		10^{-3} to 20 10^{-4} to 2	mGy/h R/h
Plateau threshold voltage		450	V
Plateau length		250	V
Recommended supply voltage		575	V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al)	max.	15	count/min.
Chrome iron cathode		900	mg/cm^2
Mica window (28 mm diameter)		1.5 to 2.0	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



WINDOW

Thickness	1.5 to 2.0	mg/cm^2
Useful diameter	28	mm
Material	mica	

CATHODE

Sensitive length	8	mm
Material	chrome-iron	

FILLING neon, argon, halogen

TUBE WEIGHT 20 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	370	V
Plateau threshold voltage	max.	450	V
Plateau length		250	V
Recommended supply voltage		575	V
Plateau slope	max.	0.06	%/V
Background (shielded with 50 mm Pb with an inner liner of 3 mm Al)	max.	15	count/min
Dead time, at recommended supply voltage	max.	55	μs

LIMITING VALUES (Absulute max. rating system)

Anode resistor	min.	4.7	MΩ
Anode voltage	max.	700	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

MEASURING CIRCUIT

R_1 = 4.7 MΩ

R_2 = 220 kΩ

C_1 = 1 pF*

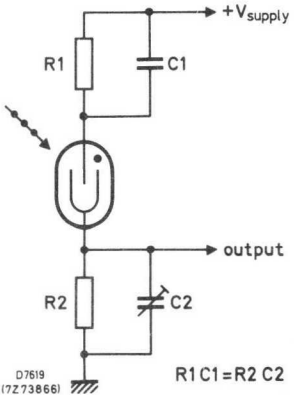


Fig.2

*See General Information (paragraph 5.5)

Graphs will be published in due course

GEIGER-MÜLLER TUBE

End window halogen quenched X-ray counter tube.

QUICK REFERENCE DATA

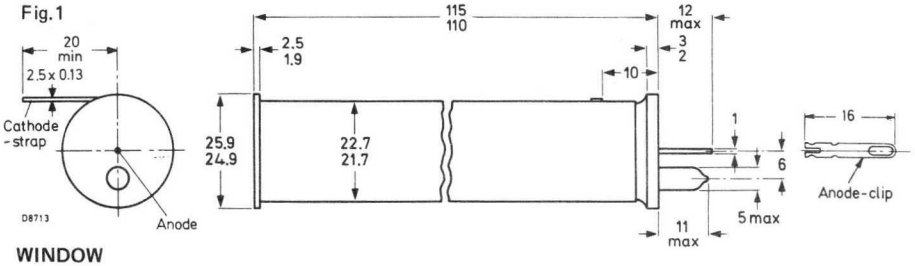
Energy range	6.0 to 20	keV
Wavelength range	0.06 to 0.2	nm
Plateau threshold voltage	1600	V
Plateau length	400	V
Recommended supply voltage	1800	V
Chrome-iron cathode	910	mg/cm^2
Mica window (19.8 mm diameter)	2.5 to 3.5	mg/cm^2

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



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	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s^2

FILLING

argon, halogen

Gas pressure*	80	kPa

CAPACITANCE

Anode to cathode	2.8	pF

TUBE WEIGHT

65 g

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

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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	MΩ
Anode voltage	max.	2000	V
Ambient temperature			
continuous operating	max.	+70	°C
	min.	0	°C
storage	max.	+75	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C		10^{10}	count

MEASURING CIRCUIT

R = 4.7 MΩ

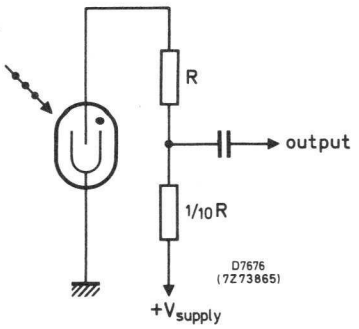
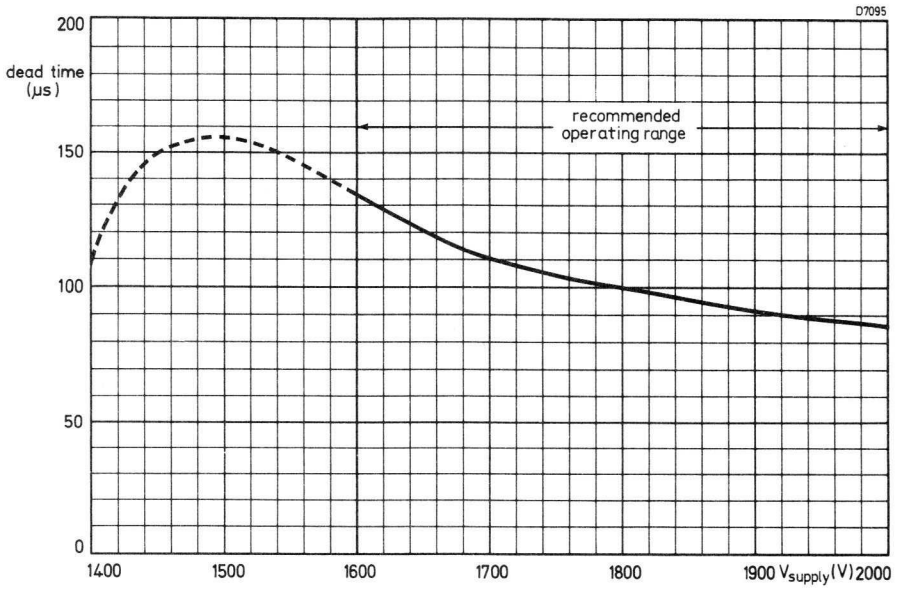


Fig.2



Typical dead time as a function of supply voltage

GEIGER-MÜLLER TUBE

Side window organically quenched X-ray counter tube.

QUICK REFERENCE DATA

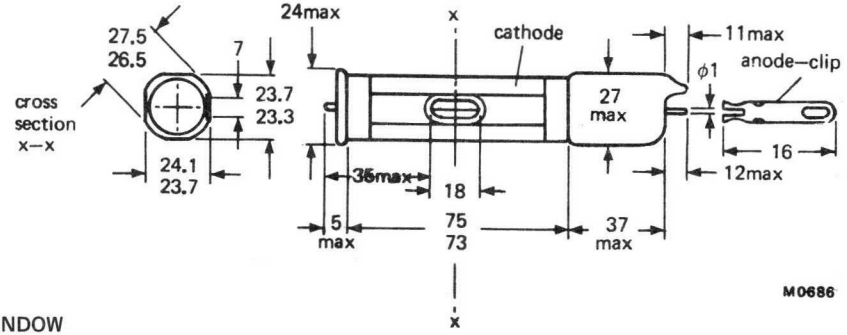
Energy range	2.5 to 40	keV
Wavelength range	0.03 to 0.5	nm
Operating voltage range	1500 to 1800	V
Chrome-iron cathode		
Mica window (7 x 18 mm)	2.0 to 2.5	mg/cm²

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm ←

Fig.1



WINDOW

Thickness	2.0 to 2.5	mg/cm²
Dimensions	7 x 18	mm
Material	mica	

CATHODE

Sensitive length	67	mm
Material	chrome-iron	

ENVIRONMENTAL (Manufacturer's test conditions) ←

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s²

FILLING

	xenon and organic vapour	
Gas pressure	40	kPa

CAPACITANCE

Anode to cathode	2.0	pF

TUBE WEIGHT

89 g ←

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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 $V_p \approx 1$ mV (note 2)		1460 to 1540	V
Operating voltage for pulse amplitude where $V_p \approx 10$ mV (note 2)		1690 to 1770	V
Energy resolution (notes 2 and 3) see page 3	max.	22	%

LIMITING VALUES (Absolute max. rating system)

Anode voltage	max.	1850	V
Ambient temperature			
continuous operating	max.	+50	°C
	min.	−20	°C
storage	max.	+50	°C

MEASURING CIRCUIT

$R_1 = 2.2$ kΩ

$R_2 = 100$ kΩ

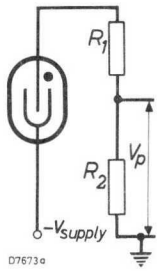
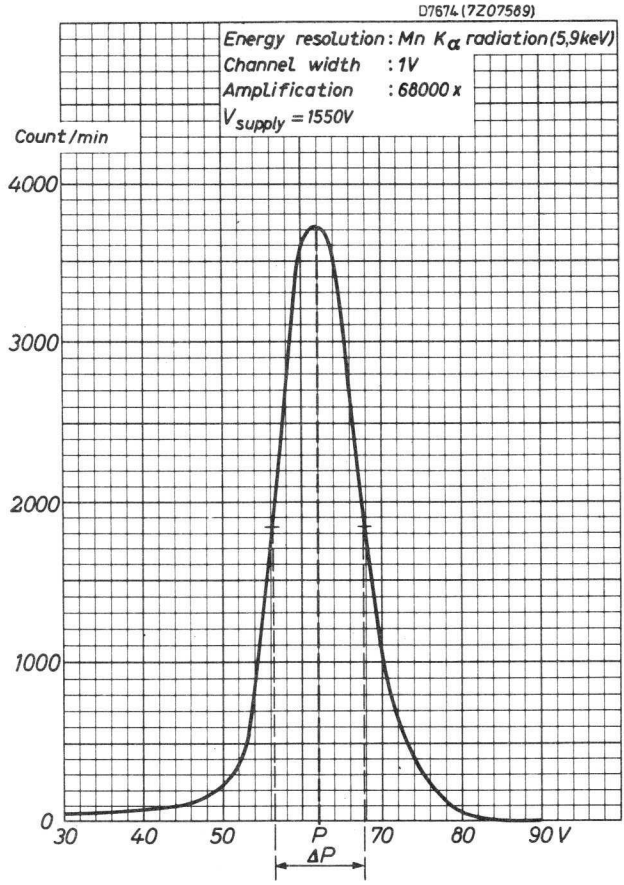


Fig.2

NOTES

1. For maximum tube life, the supply voltage should be kept as low as possible.
2. For Mn Kα 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

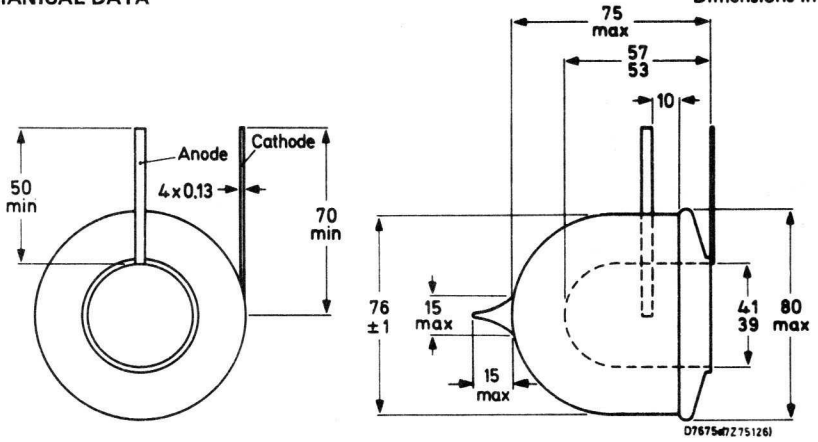
Dose rate range	3×10^{-4} to 3×10^{-1} 4×10^{-5} to 3×10^{-2}	mGy/h R/h
Plateau threshold voltage	800	V
Plateau length	400	V
Recommended supply voltage	1000	V
Chrome-iron cathode	760	mg/cm²

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm

Fig.1



CATHODE AND ANODE

Thickness	760	mg/cm²
Material	chrome-iron	

ENVIRONMENTAL (Manufacturer's test conditions)

Shock (half sine wave 3 ms duration) – peak acceleration	392	m/s²

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	8.0	pF

TUBE WEIGHT

186 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °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 an inner liner of 30 mm Pb), at recommended supply voltage, Fe outside	max.	70	count/min
Dead time, at recommended supply voltage	max.	1000	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	10	MΩ
Anode voltage	max.	1200	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

MEASURING CIRCUITS

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

R = 10 MΩ

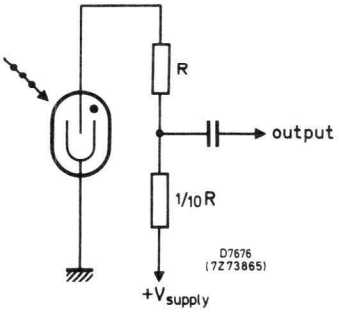


Fig.2

$R_1 = R_2 = 10$ MΩ

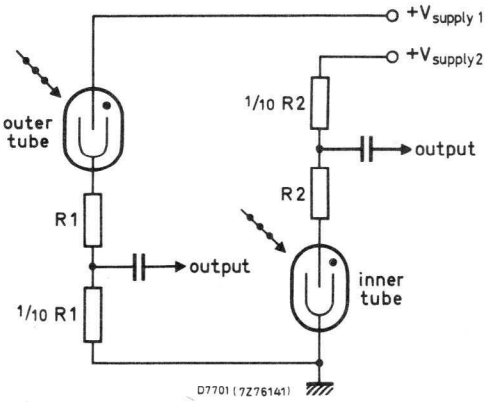
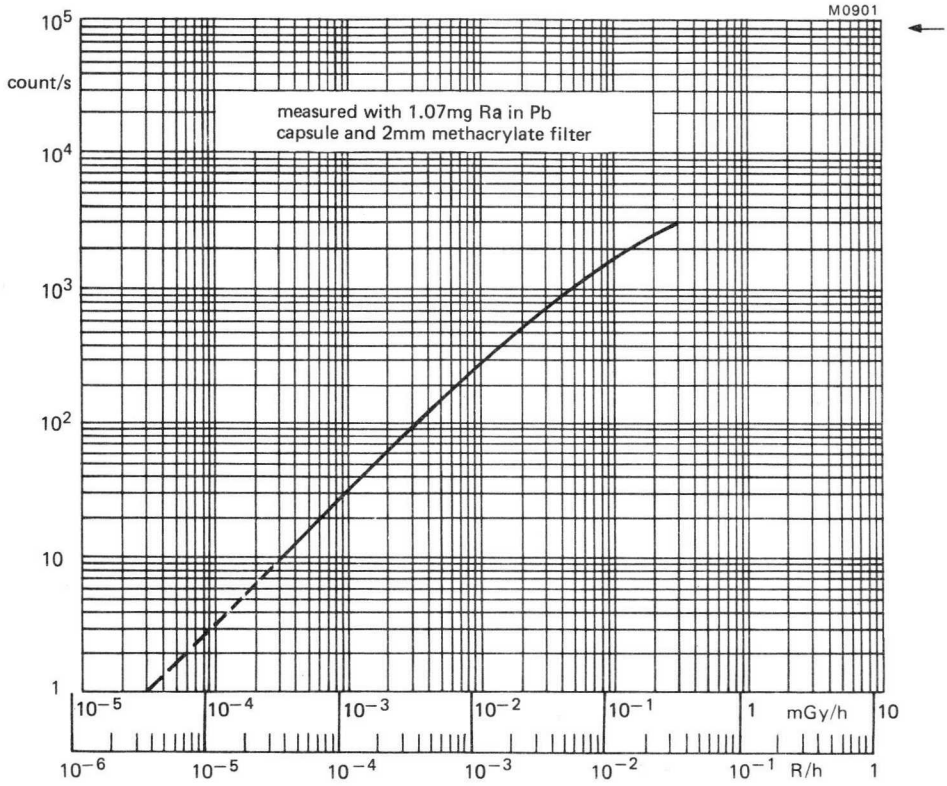


Fig.3



Typical counting rate as a function of dose rate

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube for use at temperatures up to 200 °C. The temperature response is flat to within 8% over the range −40 °C to +200 °C.

QUICK REFERENCE DATA

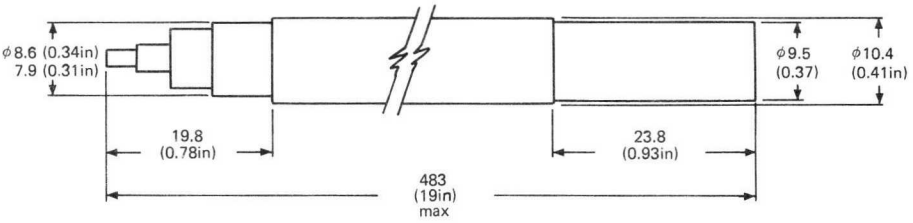
Dose rate range	2×10^{-4} to 4 2×10^{-5} to 5×10^{-1}	mGy/h R/h
Plateau threshold voltage	700	V
Plateau length	150	V
Recommended supply voltage	775	V
Chrome-iron cathode, platinum plated		

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm (and inches)

Fig.1



tube must not be clamped within 80mm of either end

M2693

CATHODE

Thickness	0.5	mm
Sensitive length	419 16.5	mm inches
Material	chrome iron, platinum plated	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	11	pF

TUBE WEIGHT

57 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	630	V
Plateau threshold voltage	max.	700	V
Plateau length		150	V
Recommended supply voltage		775	V
Plateau slope	max.	0.08	%/V
Background (shielded with 50 mm Pb with an inner liner of 6 mm Al), at recommended supply voltage	max.	25	count/min
Dead time, at recommended supply voltage	max.	75	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	0	MΩ
Anode voltage	max.	850	V
Ambient temperature			
continuous operating	max.	+200	°C
	min.	−40	°C
storage	max.	+150	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C		10^{10}	count

MEASURING CIRCUIT

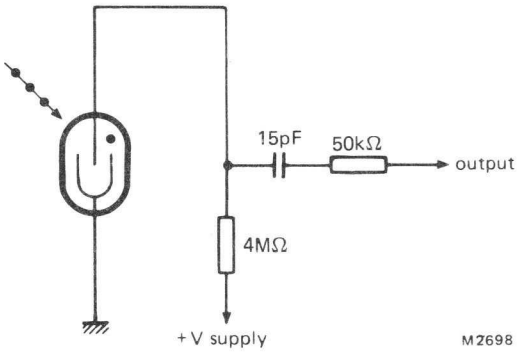
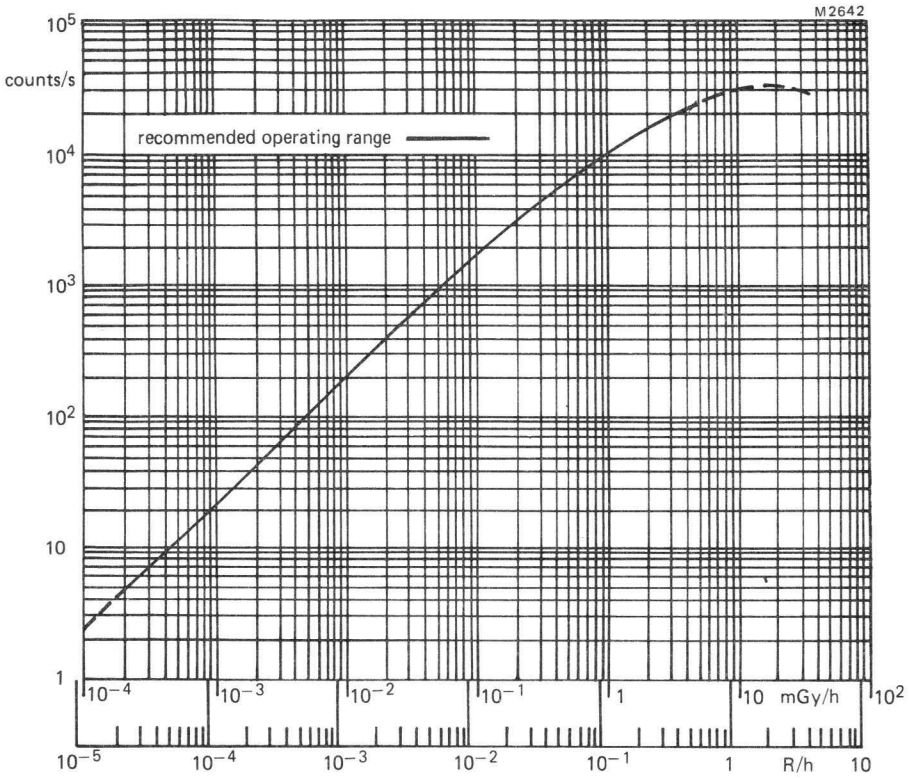
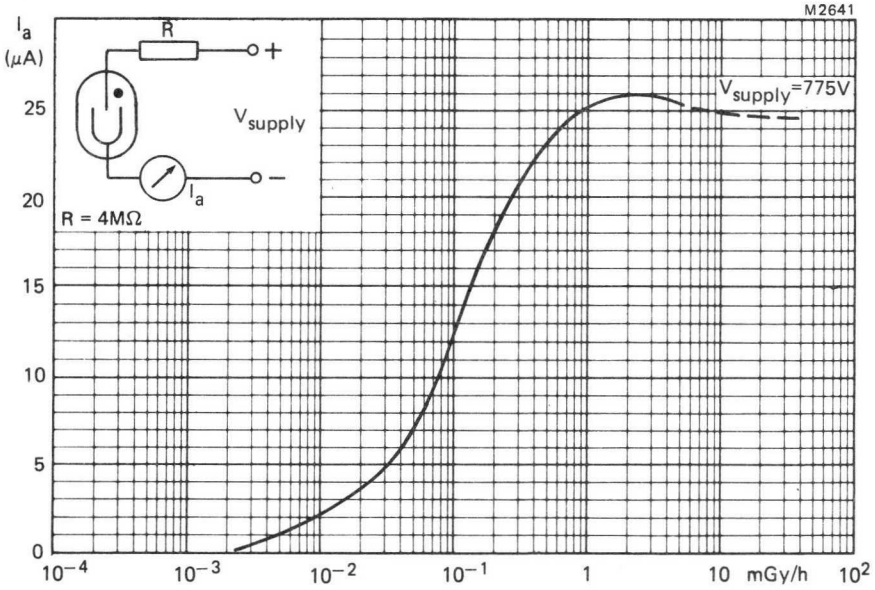


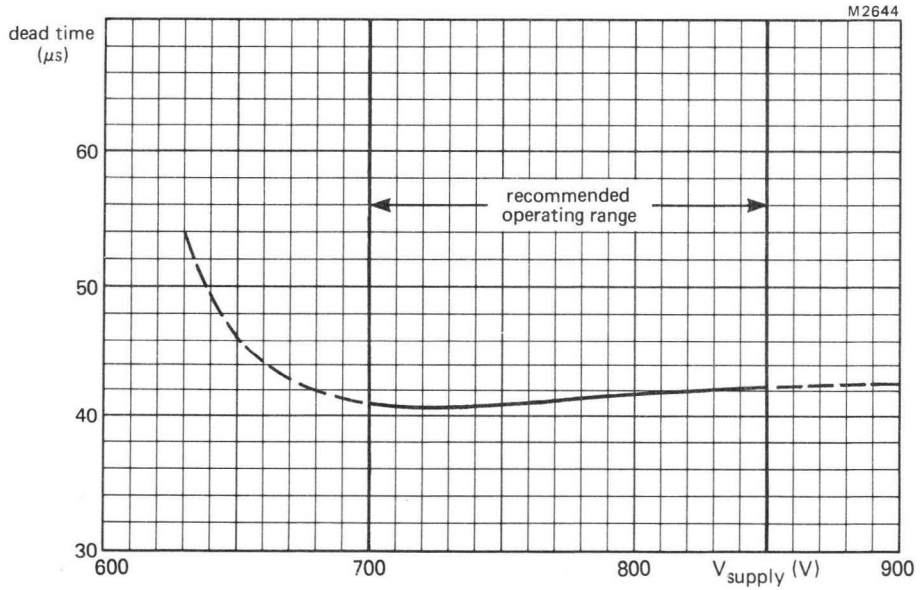
Fig.2



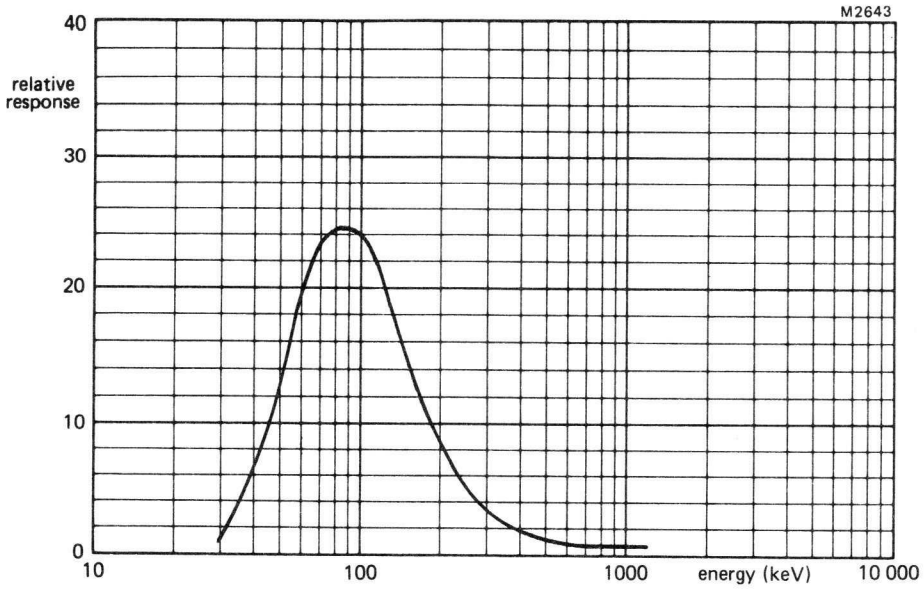
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube for use at temperatures up to 200 °C. The temperature response is flat to within 8% over the range −40 °C to +200 °C.

QUICK REFERENCE DATA

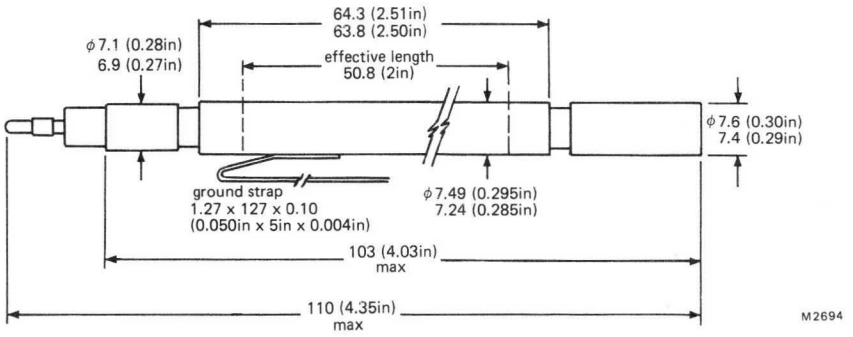
Dose rate range	3×10^{-3} to 40 3×10^{-4} to 5	mGy/h R/h
Plateau threshold voltage	650	V
Plateau length	250	V
Recommended supply voltage	775	V
Chrome-iron cathode		

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm (and inches)

Fig.1



tube must not be clamped within 20mm of either end

CATHODE

Thickness	0.5	mm
Sensitive length	51	mm
	2	inches
Material	chrome iron, platinum plated	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	3	pF

TUBE WEIGHT

10 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	630	V
Plateau threshold voltage	max.	650	V
Plateau length		250	V
Recommended supply voltage		775	V
Plateau slope	max.	0.08	%/V
Background (shielded with 50 mm Pb with an inner liner of 6 mm Al), at recommended supply voltage	max.	25	count/min
Dead time, at recommended supply voltage	max.	75	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	0	MΩ
Anode voltage	max.	900	V
Ambient temperature			
continuous operating	max.	+200	°C
	min.	−40	°C
storage	max.	+150	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C		10^{10}	count

MEASURING CIRCUIT

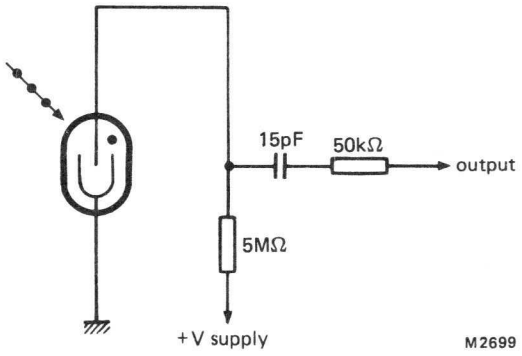
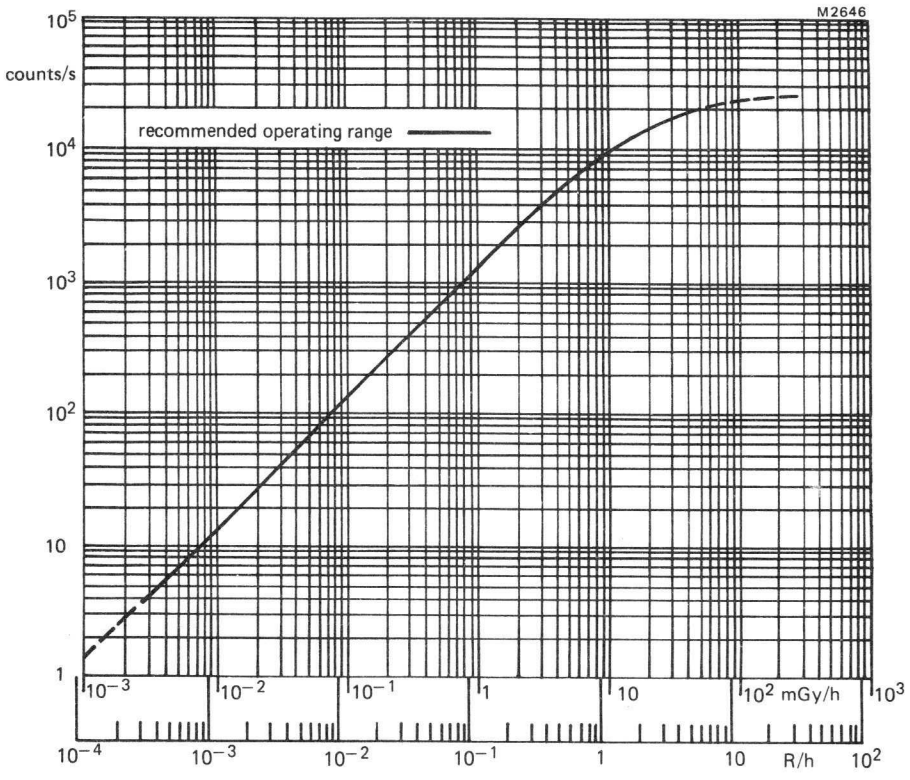
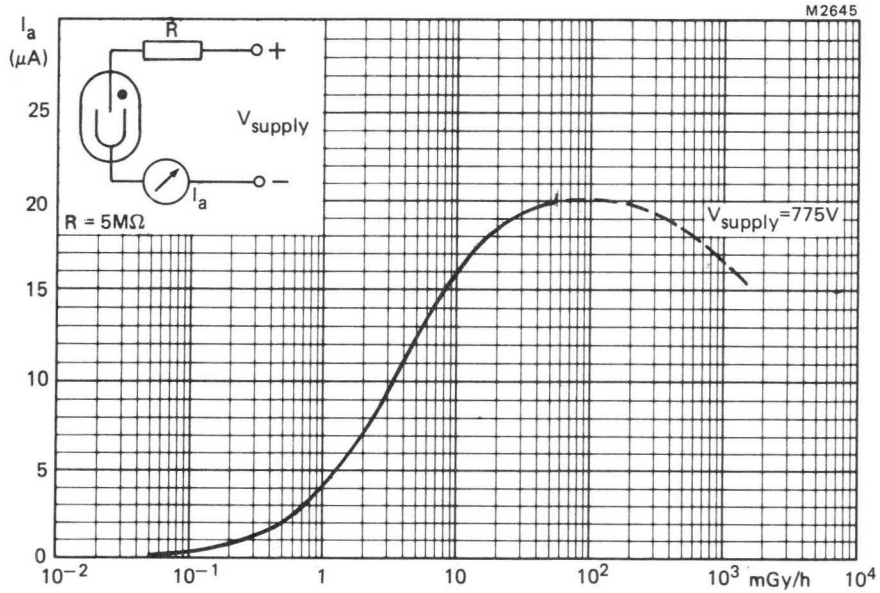


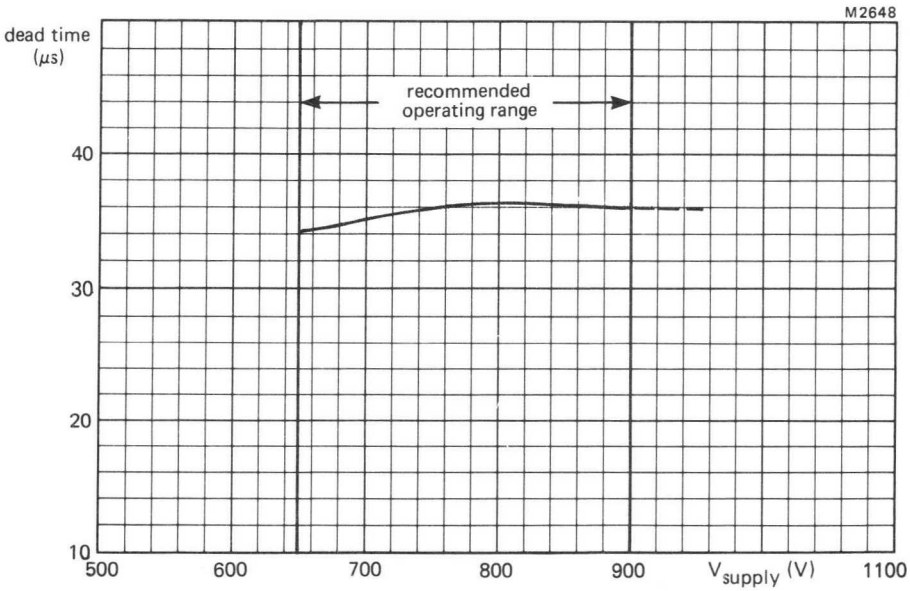
Fig.2



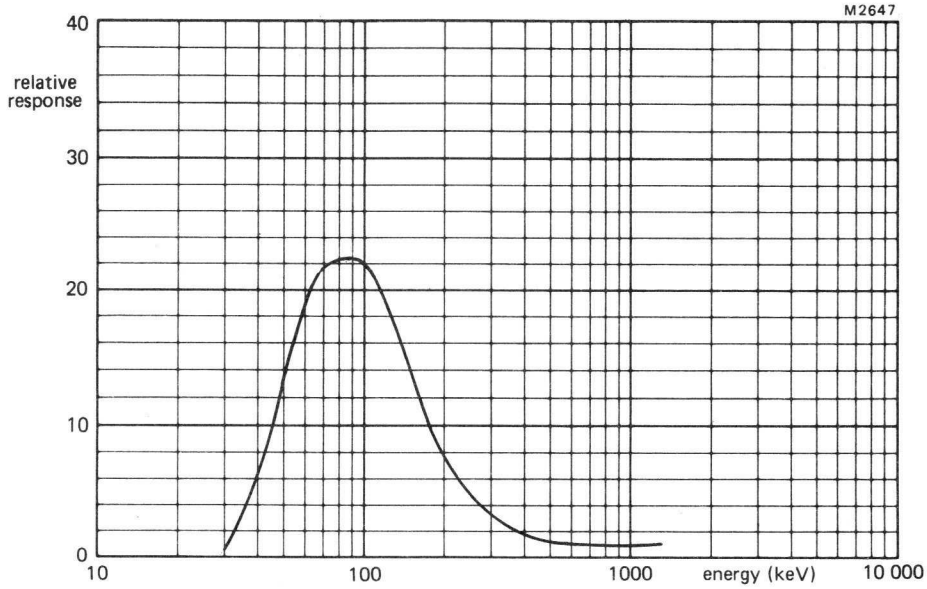
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube for use at temperatures up to 100 °C. The temperature response is flat to within 10% over the range −40 °C to +100 °C.

QUICK REFERENCE DATA

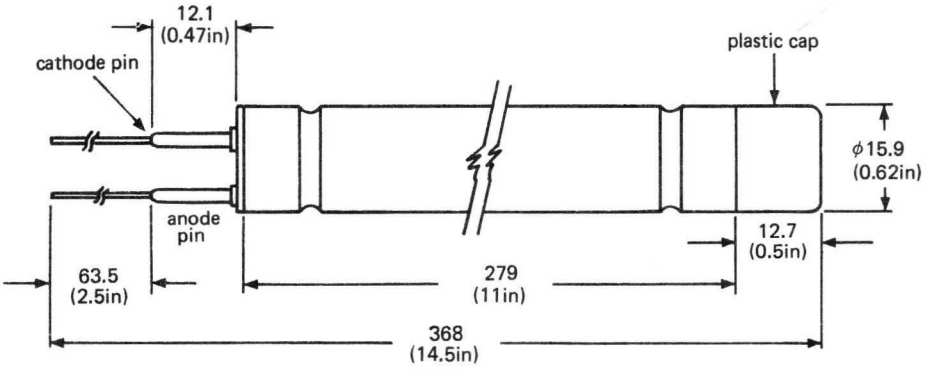
Dose rate range	3×10^{-4} to 4 3×10^{-5} to 4×10^{-1}	mGy/h R/h
Plateau threshold voltage	450	V
Plateau length	250	V
Recommended supply voltage	575	V
Chrome-iron cathode		

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm (and inches)

Fig.1



tube must not be clamped within 60mm of either end

M2690

CATHODE

Thickness	0.25	mm
Sensitive length	203 8	mm inches
Material	chrome iron	

FILLING neon, argon, halogen

CAPACITANCE

Anode to cathode	6	pF

TUBE WEIGHT 34 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	400	V
Plateau threshold voltage	max.	450	V
Plateau length		250	V
Recommended supply voltage		575	V
Plateau slope	max.	0.06	%/V
Background (shielded with 50 mm Pb with an inner liner of 6 mm Al), at recommended supply voltage	max.	65	count/min
Dead time, at recommended supply voltage	max.	100	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	10	MΩ
Anode voltage	max.	700	V
Ambient temperature			
continuous operating	max.	+100	°C
	min.	−40	°C
storage	max.	+75	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C		10^{10}	count

MEASURING CIRCUIT

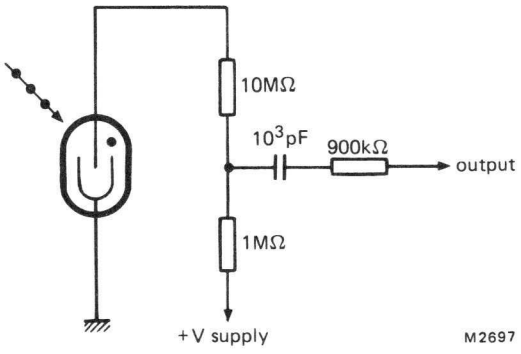
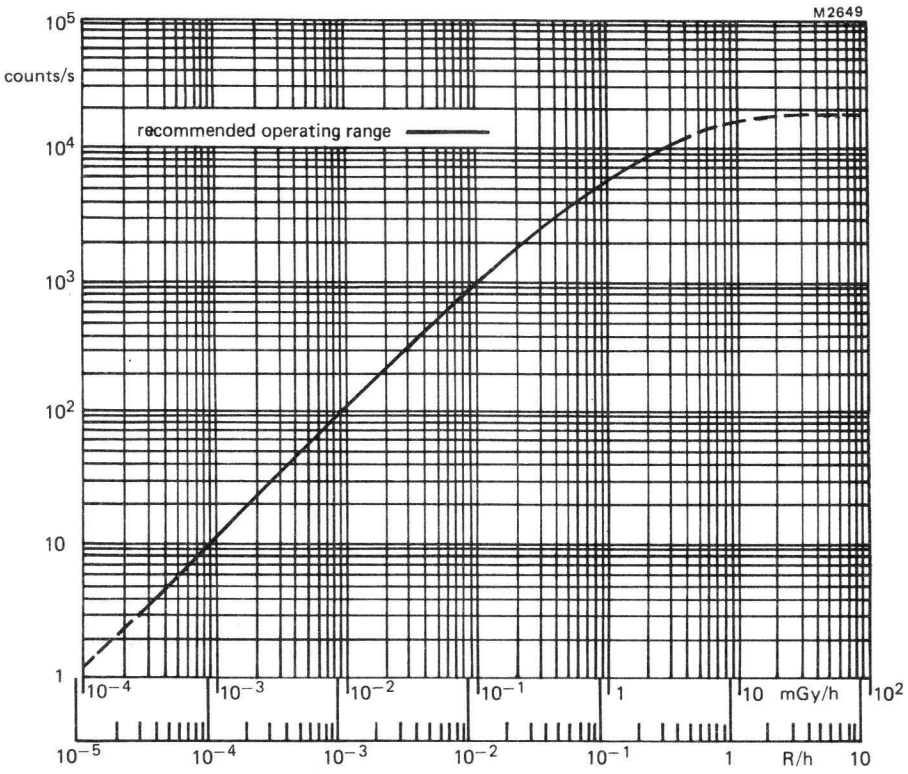
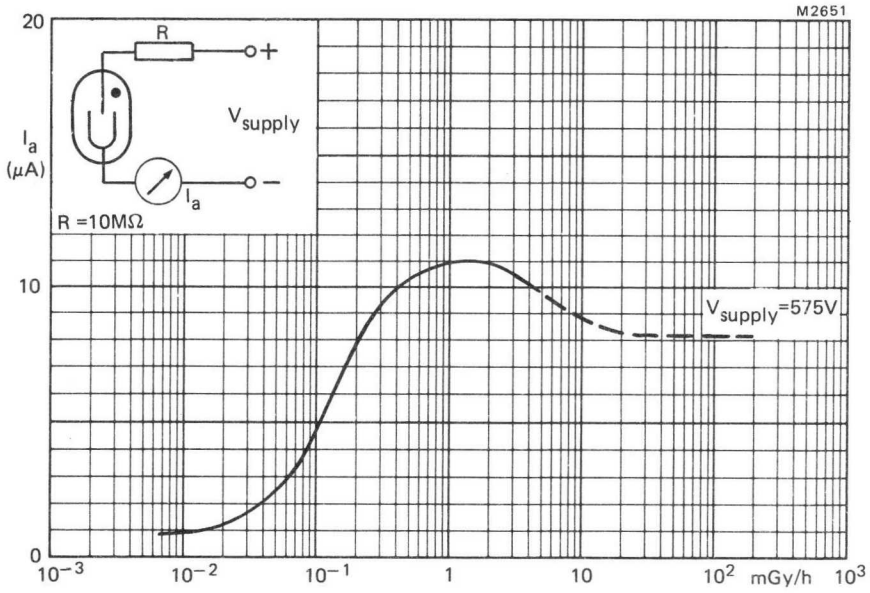


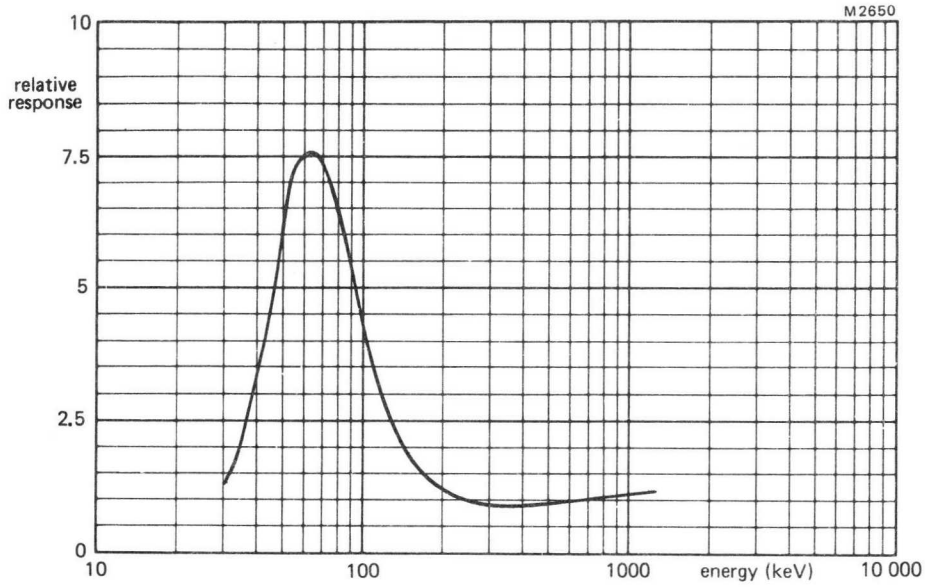
Fig.2



Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube for use at temperatures up to 100 °C. The temperature response is flat to within 10% over the range −40 °C to +100 °C.

QUICK REFERENCE DATA

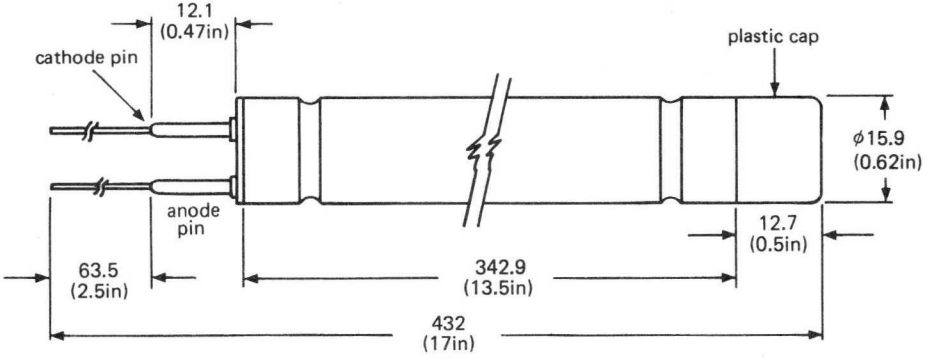
Dose rate range	2×10^{-4} to 2 2×10^{-5} to 2×10^{-1}	mGy/h R/h
Plateau threshold voltage	450	V
Plateau length	250	V
Recommended supply voltage	575	V
Chrome-iron cathode		

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm (and inches)

Fig.1



tube must not be clamped within 75 mm of either end

M2691

CATHODE

Thickness	0.25	mm
Sensitive length	313 12.3	mm inches
Material	chrome iron	

FILLING neon, argon, halogen

CAPACITANCE

Anode to cathode	8	pF

TUBE WEIGHT 45 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	400	V
Plateau threshold voltage	max.	450	V
Plateau length		250	V
Recommended supply voltage		575	V
Plateau slope	max.	0.06	%/V
Background (shielded with 50 mm Pb with an inner liner of 6 mm Al), at recommended supply voltage	max.	100	count/min
Dead time, at recommended supply voltage	max.	100	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	10	MΩ
Anode voltage	max.	700	V
Ambient temperature			
continuous operating	max.	+100	°C
	min.	−40	°C
storage	max.	+75	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C		10^{10}	count

MEASURING CIRCUIT

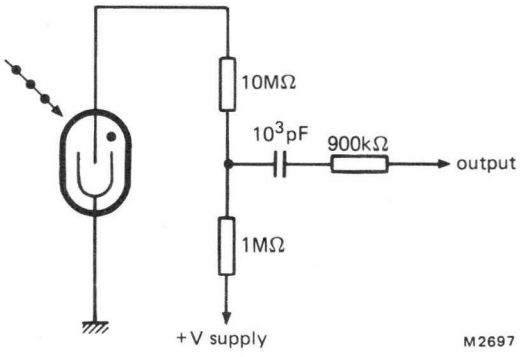
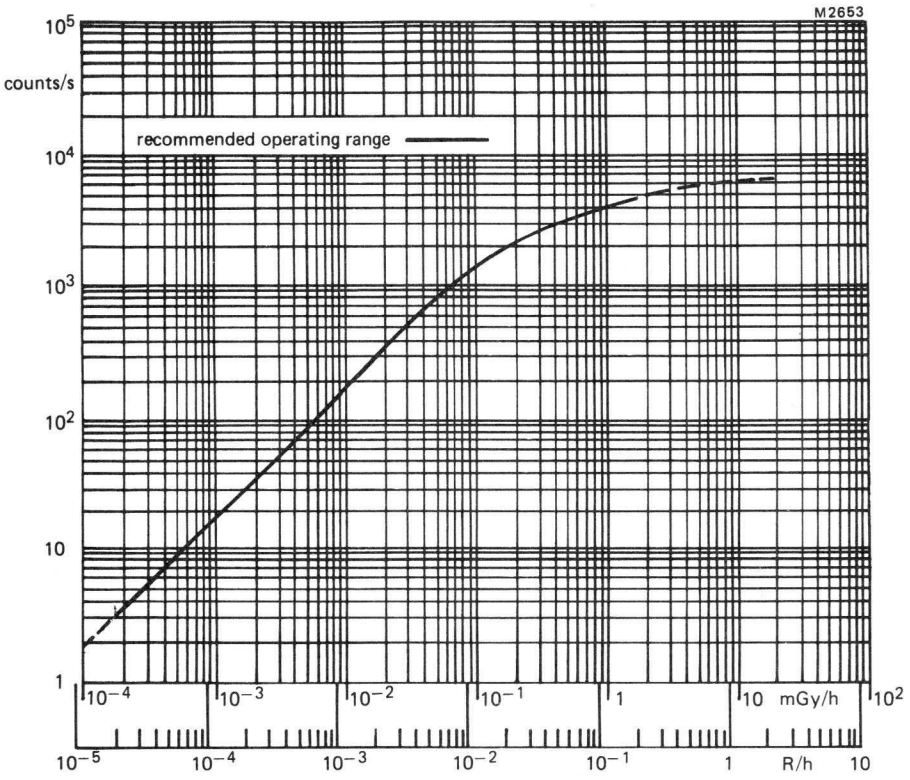
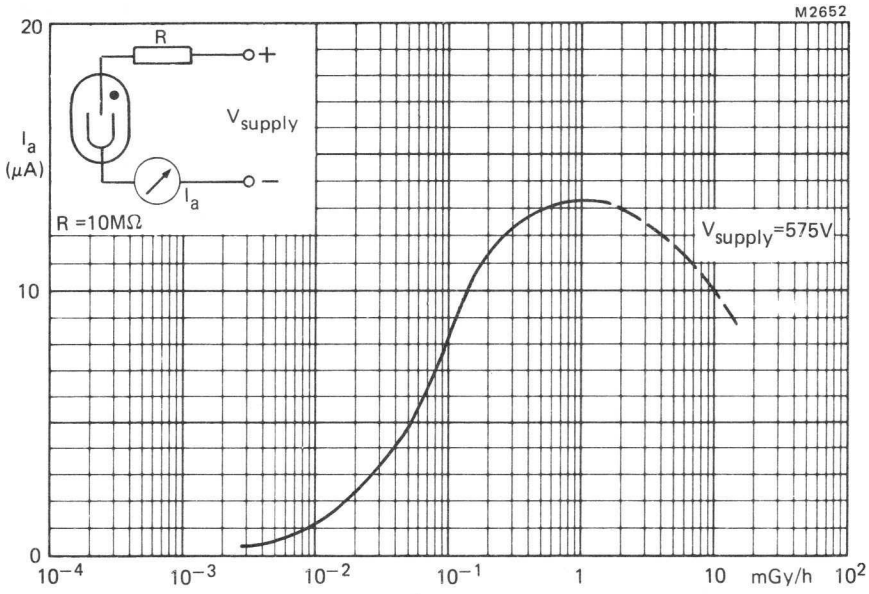


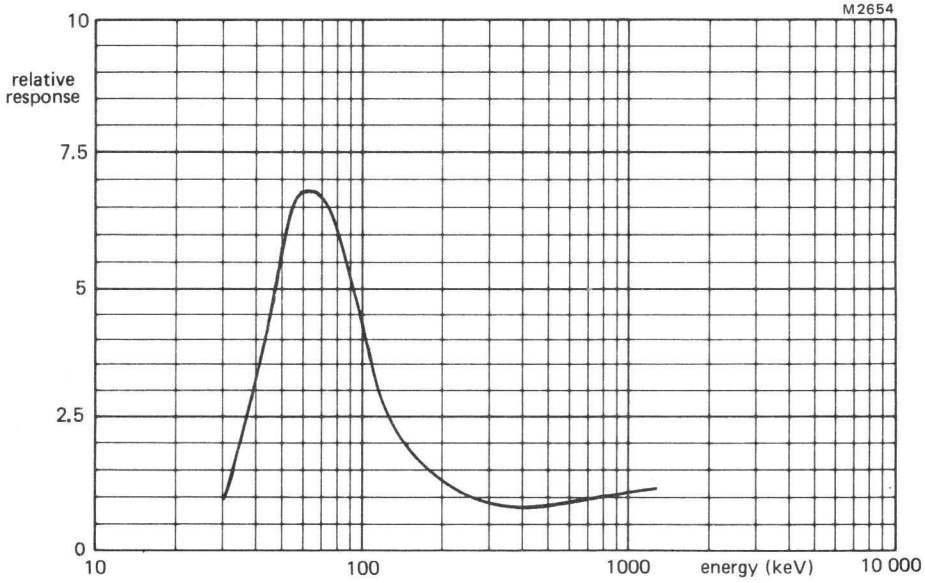
Fig.2



Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched γ radiation counter tube for use at temperatures up to 175 °C. The temperature response is flat to within 5% over the range −20 °C to +175 °C.

QUICK REFERENCE DATA

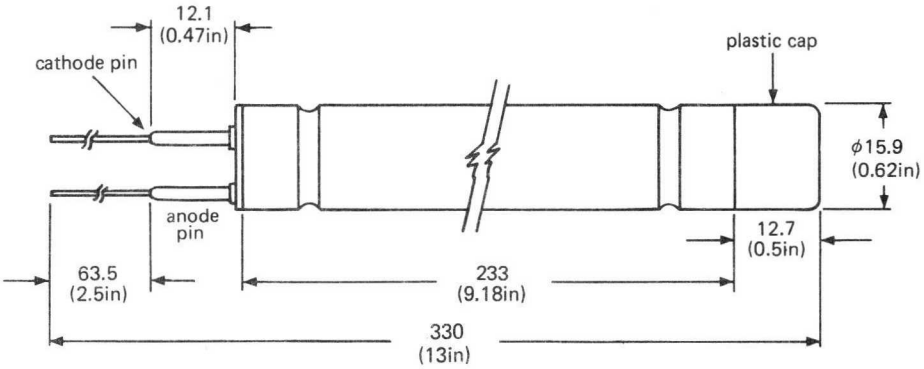
Dose rate range	4×10^{-3} to 10^2 5×10^{-4} to 10	mGy/h R/h
Plateau threshold voltage	850	V
Plateau length	200	V
Recommended supply voltage	950	V
Chrome-iron cathode, platinum plated		

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm (and inches)

Fig.1



tube must not be clamped within 15mm of either end

M2692

CATHODE

Thickness	1.2	mm
Sensitive length	32 1.25	mm inches
Material	chrome iron, platinum plated	

FILLING neon, argon, halogen

CAPACITANCE

Anode to cathode	2.5	pF

TUBE WEIGHT 14 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	825	V
Plateau threshold voltage	max.	850	V
Plateau length		200	V
Recommended supply voltage		950	V
Plateau slope	max.	0.08	%/V
Background (shielded with 50 mm Pb with an inner liner of 6 mm Al), at recommended supply voltage	max.	15	count/min
Dead time, at recommended supply voltage	max.	50	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	1	MΩ
Anode voltage	max.	1050	V
Ambient temperature			
continuous operating	max.	+175	°C
	min.	−40	°C
storage	max.	+125	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C		10^{10}	count

MEASURING CIRCUIT

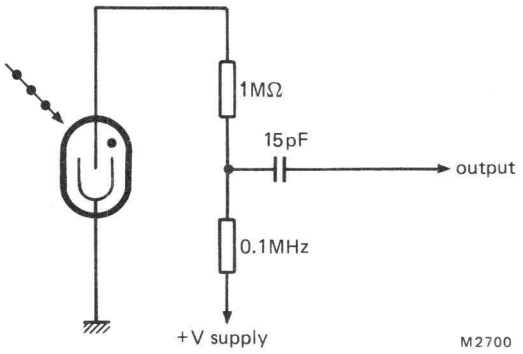
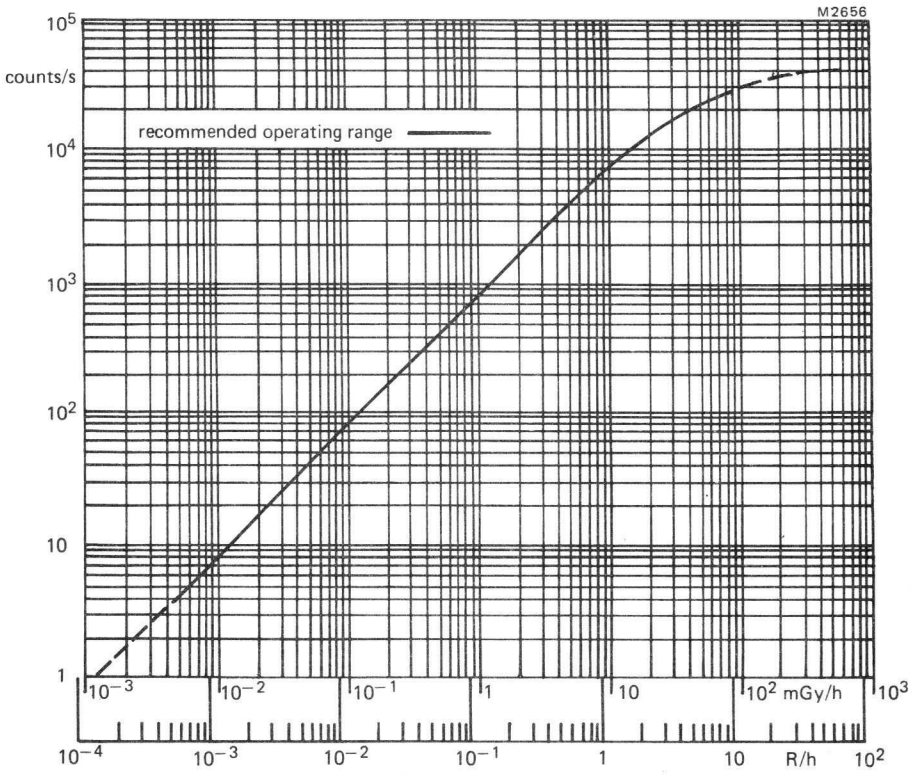
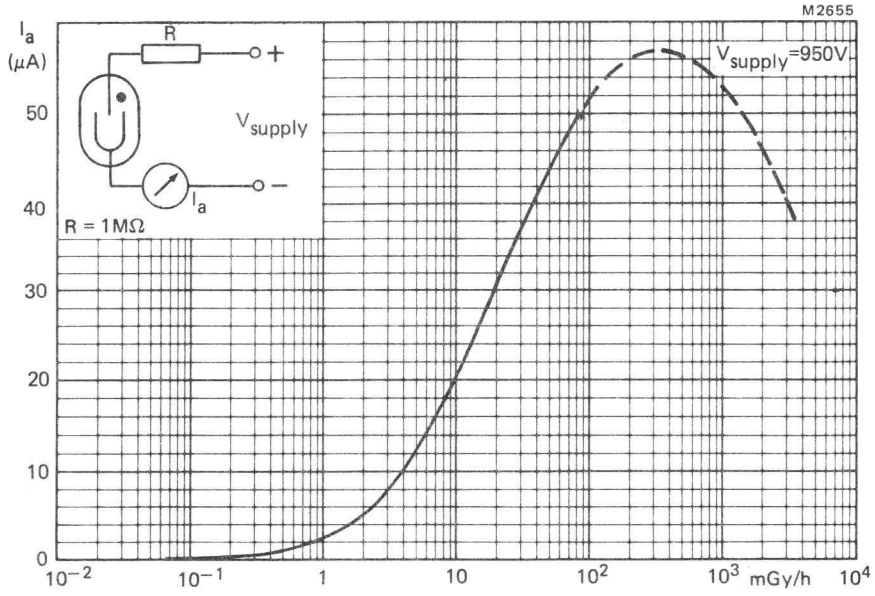


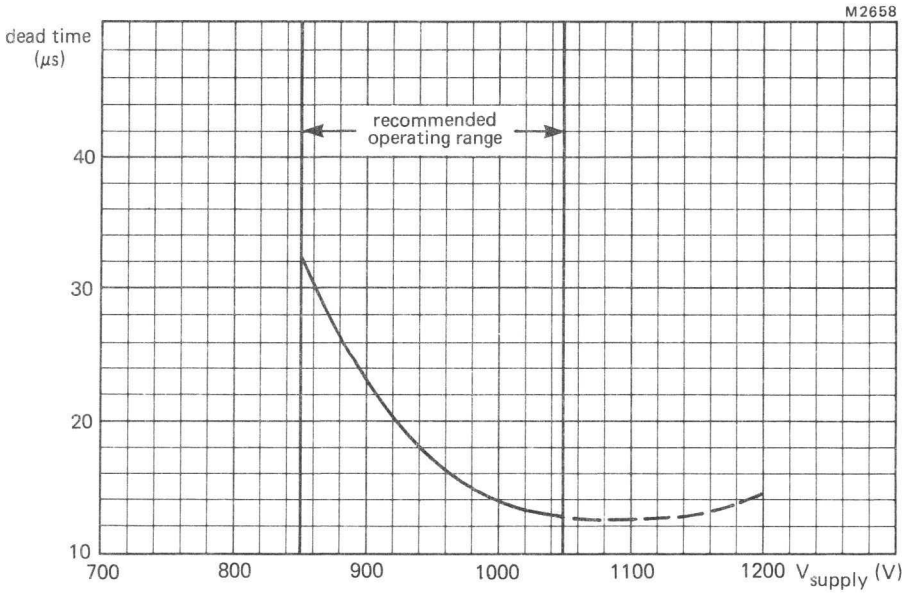
Fig.2



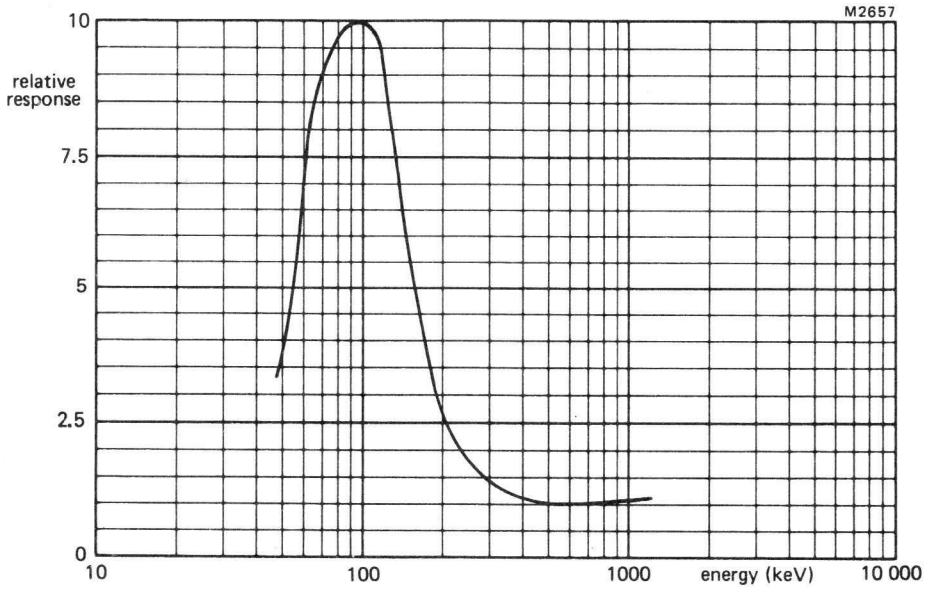
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched β and γ radiation counter tube for use at temperatures up to 75 °C. The temperature response is flat to within 7% over the range −35 °C to +75 °C.

QUICK REFERENCE DATA

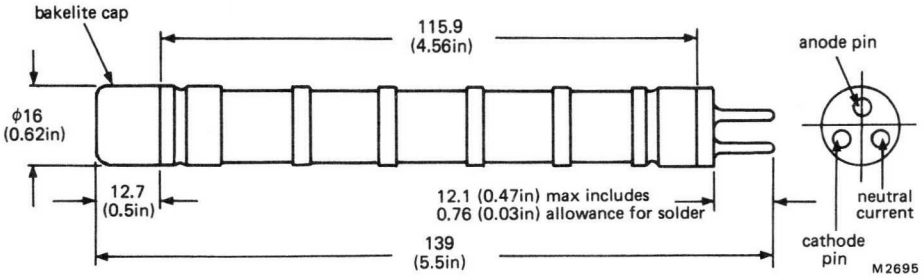
Dose rate range	10^{-3} to 20 10^{-4} to 2	mGy/h R/h
Plateau threshold voltage	875	V
Plateau length	200	V
Recommended supply voltage	975	V
Chrome-iron cathode		

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm (and inches)

Fig.1



tube must not be clamped within 30mm of either end

CATHODE

Thickness	30 – 40	mg/cm^2
Sensitive length	89 3.5	mm inches
Material	chrome iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	4	pF

TUBE WEIGHT

15 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2

Starting voltage	max.	825	V
Plateau threshold voltage	max.	875	V
Plateau length		200	V
Recommended supply voltage		975	V
Plateau slope	max.	0.1	%/V
Background (shielded with 50 mm Pb with an inner liner of 6 mm Al), at recommended supply voltage	max.	50	count/min
Dead time, at recommended supply voltage	max.	100	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	0	MΩ
Anode voltage	max.	1075	V
Ambient temperature			
continuous operating	max.	+75	°C
	min.	−35	°C
storage	max.	+75	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C		10^{10}	count

MEASURING CIRCUIT

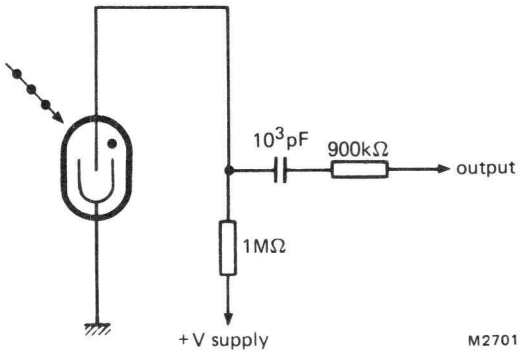
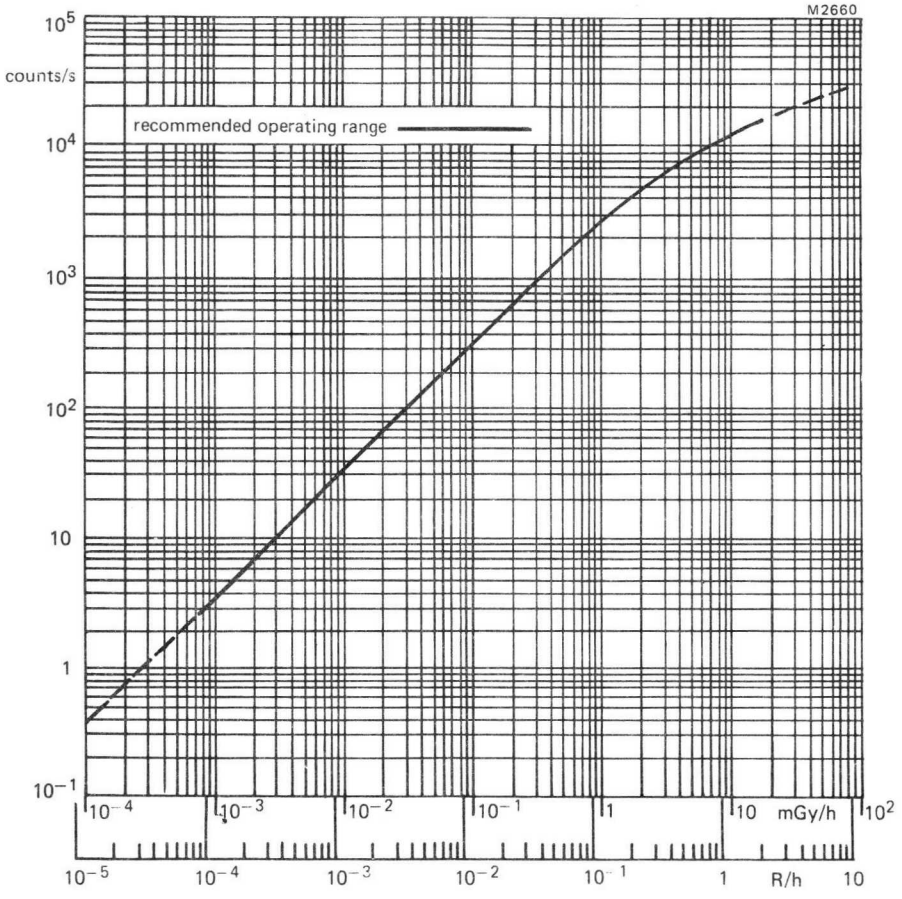
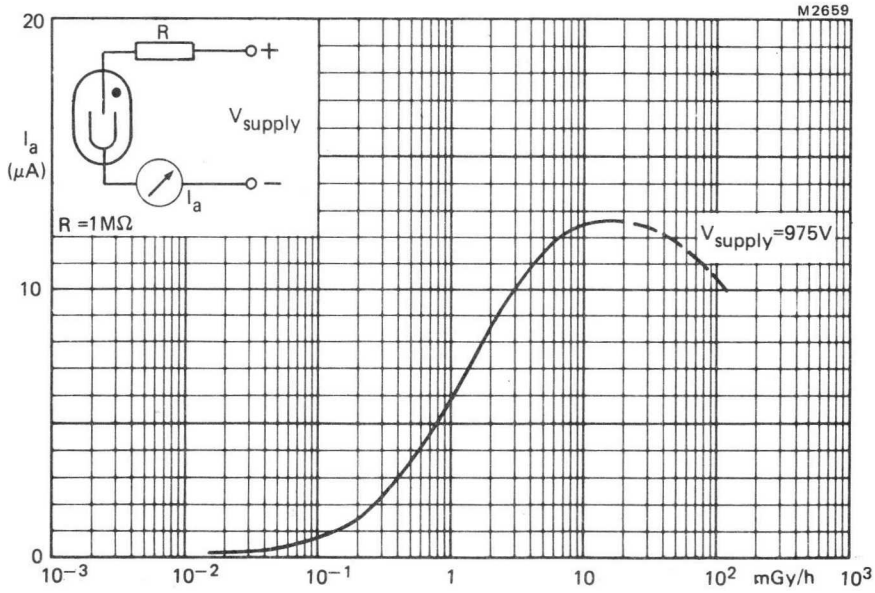


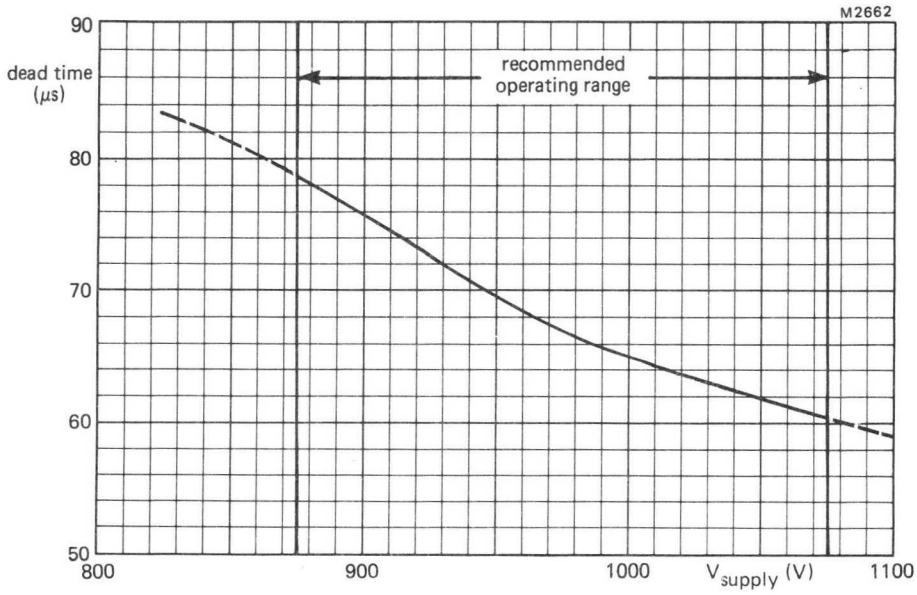
Fig.2



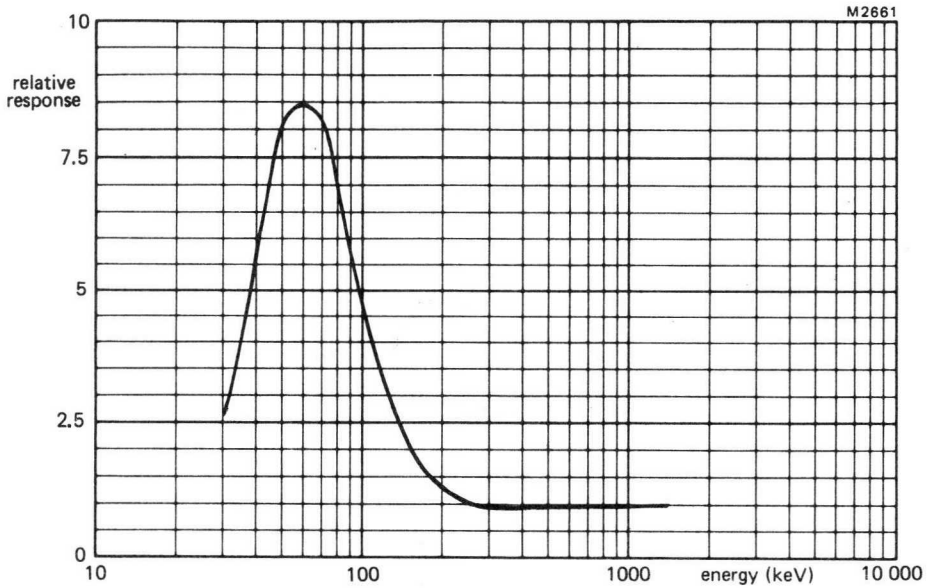
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

GEIGER-MÜLLER TUBE

Halogen quenched β and γ radiation counter tube for use at temperatures up to 75 °C. The temperature response is flat to within 7% over the range –35 °C to +75 °C.

QUICK REFERENCE DATA

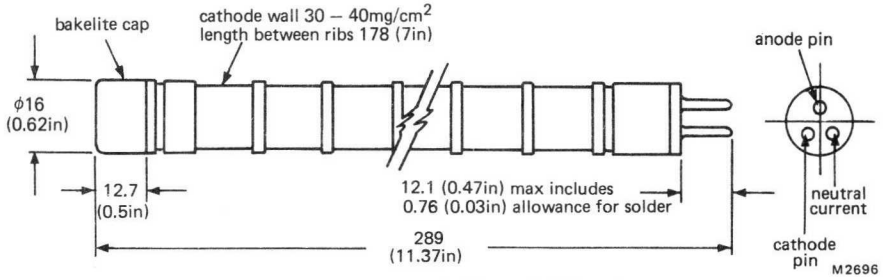
Dose rate range	4×10^{-4} to 4 5×10^{-5} to 4×10^{-1}	mGy/h R/h
Plateau threshold voltage	875	V
Plateau length	200	V
Recommended supply voltage	975	V
Chrome-iron cathode		

This data must be read in conjunction with General Information Geiger-Müller tubes.

MECHANICAL DATA

Dimensions in mm (and inches)

Fig.1



tube must not be clamped within 50mm of either end

CATHODE

Thickness	30 – 40	mg/cm²
Sensitive length	220 8.7	mm inches
Material	chrome iron	

FILLING

neon, argon, halogen

CAPACITANCE

Anode to cathode	6	pF

TUBE WEIGHT

20 g

OPERATING CHARACTERISTICS (Ambient temperature ≈ 25 °C)

Measured in circuit of Fig.2			
Starting voltage	max.	825	V
Plateau threshold voltage	max.	875	V
Plateau length		200	V
Recommended supply voltage		975	V
Plateau slope	max.	0.1	%/V
Background (shielded with 50 mm Pb with an inner liner of 6 mm Al), at recommended supply voltage	max.	75	count/min
Dead time, at recommended supply voltage	max.	100	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	min.	0	MΩ
Anode voltage	max.	1075	V
Ambient temperature			
continuous operating	max.	+75	°C
	min.	−35	°C
storage	max.	+75	°C

LIFE EXPECTANCY

Life expectancy at ≈ 25 °C		10^{10}	count

MEASURING CIRCUIT

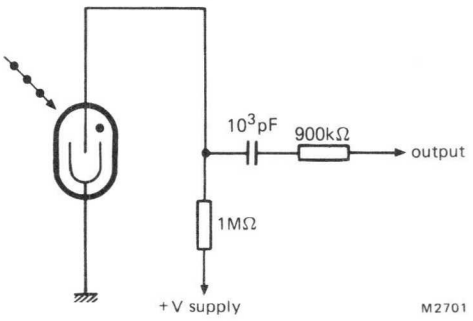
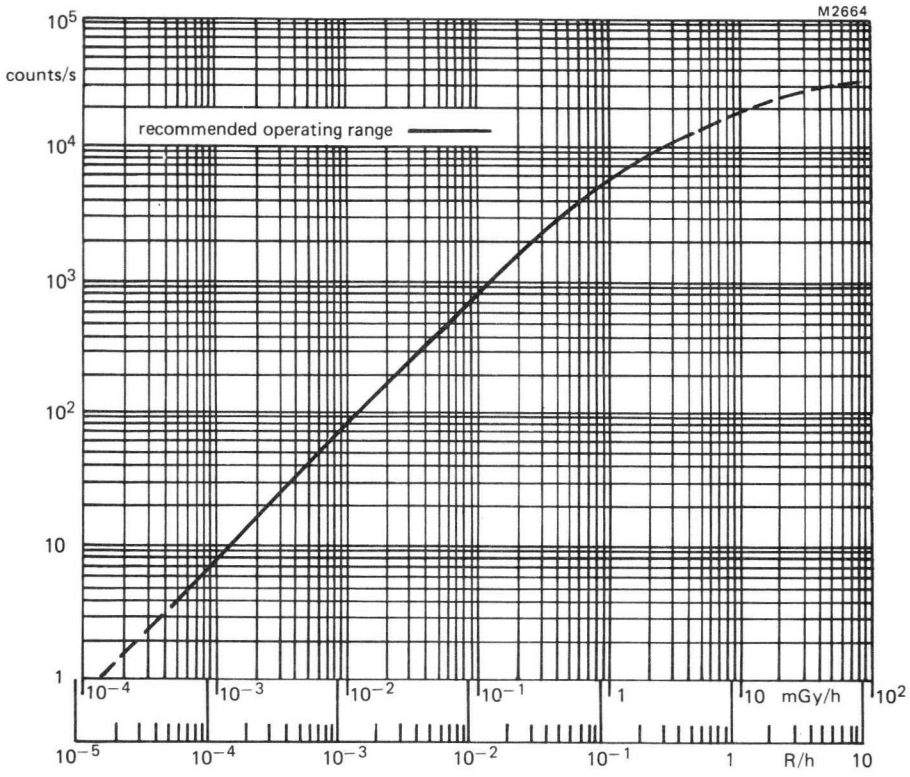
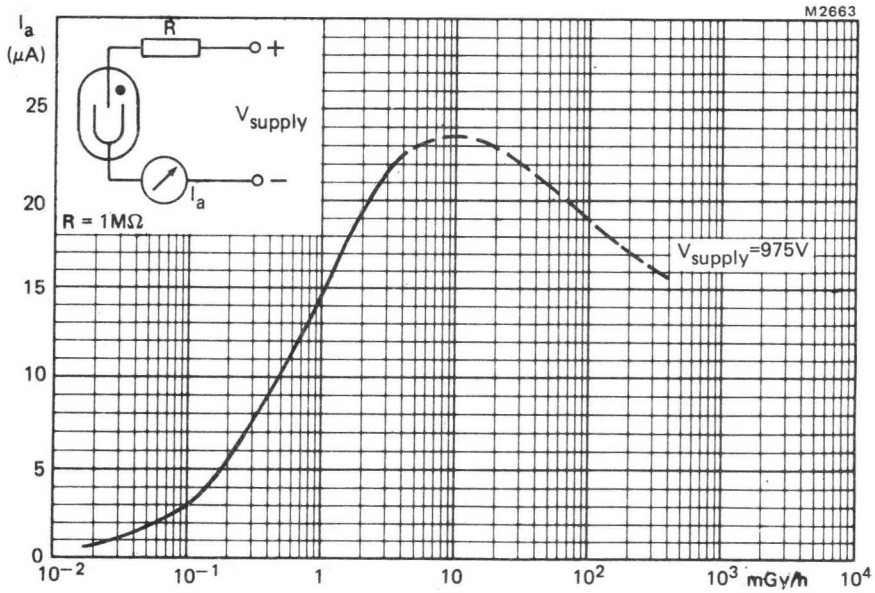


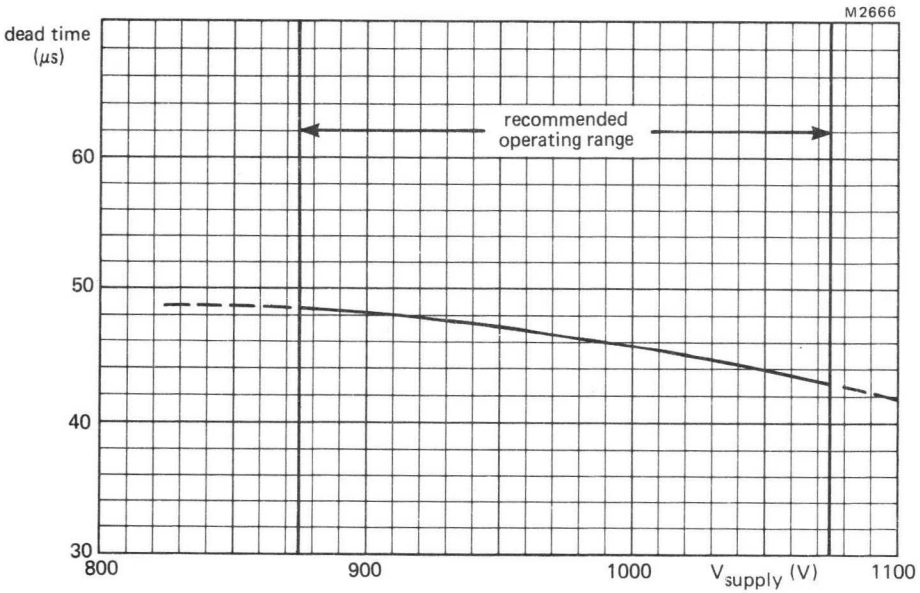
Fig.2



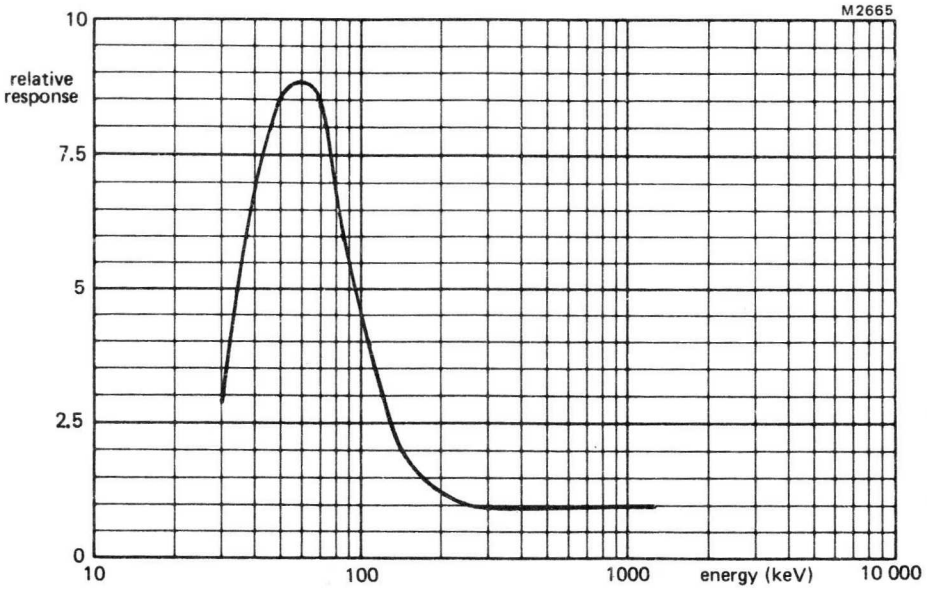
Typical counting rate as a function of dose rate (^{137}Cs)



Typical current as a function of dose rate (^{137}Cs)



Typical dead time as a function of supply voltage



Typical energy response relative to ^{137}Cs

Mullard

technical handbook

Book 2

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