PHILIPS

Data handbook

Electronic components and materials

Electron tubes

Part 6 July 1975

Channel electron multipliers

Geiger-Mueller tubes

Neutron tubes

Semiconductor radiation detectors

ELECTRON TUBES

Part 6 **July 1975**

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CARACAS

DATA HANDBOOK SYSTEM

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

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

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

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

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

December 1972

ELECTRON TUBES (BLUE SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1a Transmitting tubes for communications and Tubes for r.f. heating Types PB2/500 ÷ TBW15/125 — **April 1973**

Part 1b Transmitting tubes for communication
Tubes for r.f. heating
Amplifier circuit assemblies — **August 1974**

Part 2 Microwave products — **October 1974**

Communication magnetrons
Magnetrons for micro-wave heating
Klystrons
Traveling-wave tubes
Diodes
Triodes
T-R Switches
Microwave Semiconductor devices
Isolators Circulators

Part 3 Special Quality tubes;
Miscellaneous devices — **January 1975**

Part 4 Receiving tubes — **March 1975**

Part 5a Cathode-ray tubes — **April 1975**

Part 5b Camera tubes; Image intensifier tubes — **May 1975**

Part 6 Products for nuclear technology
Photodiodes — **July 1975**

Neutron tubes
Channel electron multipliers
Geiger-Mueller tubes
N.B. Photomultiplier tubes and Photo diodes will be issued in Part 9

Part 7 Gas-filled tubes — **February 1974**

Voltage stabilizing and reference tube
Counter, selector, and indicator tubes
Trigger tubes
Switching diodes
Thyratrons
Ignitrons
Industrial rectifying tubes
High-voltage rectifying tubes

Part 8 T.V. Picture tubes — **May 1974**

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1a Rectifier diodes and thyristors — **June 1974**

Rectifier diodes
Voltage regulator diodes (> 1,5 W)
Transient suppressor diodes
Thyristors, diacs, triacs
Rectifier stacks

Part 1b Diodes — **July 1974**

Small signal germanium diodes
Small signal silicon diodes
Special diodes
Voltage regulator diodes (< 1,5 W)
Voltage reference diodes
Tuner diodes

Part 2 Low frequency transistors — **July 1974**

Part 3 High frequency and switching transistors — **October 1974**

Part 4a Special semiconductors — **November 1974**

Transmitting transistors
Microwave devices
Field-effect transistors
Dual transistors
Microminiature devices for thick- and thin-film circuits

Part 4b Devices for opto-electronics — **December 1974**

Photosensitive diodes and transistors
Light emitting diodes
Photocouplers
Infra-red sensitive devices
Photoconductive devices

Part 5 Linear integrated circuits — **March 1975**

Part 6 Digital integrated circuits — **April 1974**

DTL (FC family)
CML (GX family)
MOS (FD family)
MOS (FE family)

COMPONENTS AND MATERIALS (GREEN SERIES)

These series consists of the following parts, issued on the dates indicated.

Part 1 Functional units, Input/output devices, Electro-mechanical components, Peripheral devices — **June 1974**

- High noise immunity logic FZ/30-Series
- Circuit blocks 40-Series and CSA70
- Counter modules 50-Series
- Norbits 60-Series, 61-Series
- Circuit blocks 90-Series
- Input/output devices
- Electro-mechanical components
- Peripheral devices

Part 2a Resistors — **September 1974**

- Fixed resistors
- Variable resistors
- Voltage dependent resistors (VDR)
- Light dependent resistors (LDR)
- Negative temperature coefficient thermistors (NTC)
- Positive temperature coefficient thermistors (PTC)
- Test switches

Part 2b Capacitors — **November 1974**

- Electrolytic and solid capacitors
- Paper capacitors and film capacitors
- Ceramic capacitors
- Variable capacitors

Part 3 Radio, Audio, Television — **February 1975**

- FM tuners
- Loudspeakers
- Television tuners, aerial input assemblies
- Components for black and white television
- Components for colour television *)

Part 4a Soft ferrites — **April 1975**

- Ferrites for radio, audio and television
- Beads and chokes
- Ferroxcube potcores and square cores
- Ferroxcube transformer cores

Part 4b Piezoelectric ceramics, Permanent magnet materials — **May 1975**

Part 5 Ferrite core memory products — **July 1975**

- Ferroxcube memory cores
- Matrix planes and stacks
- Core memory systems **)

Part 6 Electric motors and accessories — **March 1974**

- Small synchronous motors
- Stepper motors
- Miniature direct current motors

Part 7 Circuit blocks — **September 1971**

- Circuit blocks 100 kHz-Series
- Circuit blocks 1-Series
- Circuit blocks 10-Series
- Circuit blocks for ferrite core memory drive

Part 8 Variable mains transformers — **July 1975**

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*) Deflection assemblies for camera tubes are now included in handbook series "Electron tubes", Part 5b.

**) For detailed information on "Piezoelectric quartz devices" consult the Product

Channel electron multipliers

GENERAL EXPLANATORY NOTES CHANNEL ELECTRON MULTIPLIERS

DESCRIPTION

A channel electron multiplier is a small curved glass tube, the inside wall of which is coated with a resistive material. When a potential is applied between the ends of the tube the resistive surface forms a continuous dynode, analagous to the separate dynodes of a conventional photomultiplier together with its associated resistive chain.
An electron entering the negative potential end of the multiplier generates secondary electrons on collision with the wall of the tube. These are accelerated along the tube until they strike the wall again where they generate further secondary electrons. This avalanching process continues along the length of the tube producing a large pulse of electrons at the positive end of the tube.
The channel electron multiplier must operate in a vacuum. For space research, the environmental vacuum is sufficient but in the laboratory the multiplier must be used in a vacuum chamber.

DEFINITIONS

Gain

The output pulse corresponding to one input electron will show a statistical spread. Due to saturation effects in the multiplier this spread is approximately Gaussian and the gain is defined as its median value.

For a gain of $1,0 \times 10^8$ a single input electron will produce an output of 16 picocoulombs.

The gain is constant up to a count rate of 1000 pulses per second. Above this the gain falls by approximately 3 dB per octave. The count rate capability of the system may be increased by lowering the measuring threshold.

Background

The background pulse count rate is the number of pulses detected per second above the specified threshold and operating voltage when the input end of the multiplier is closed. There is no appreciable variation of background count rate when either the applied voltage or ambient temperature is changed.

Starting voltage

The starting voltage is the operating voltage at which 90% of the output pulses from single electron inputs exceed the specified threshold.

Resolution

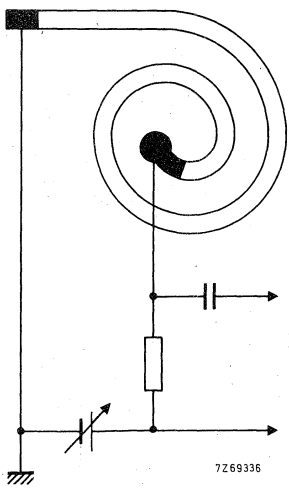
The resolution of the multiplier is calculated from the pulse height distribution by taking the full width half maximum (F.W.H.M.) spread divided by its median value. This is expressed as a percentage.

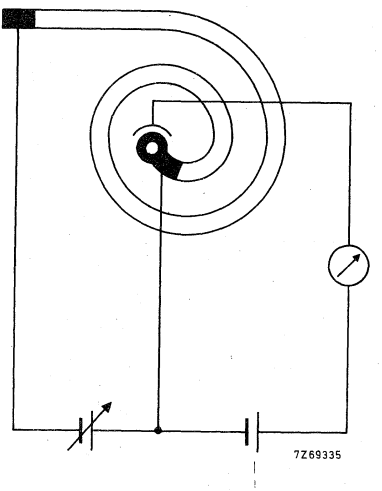
Effective input aperture

The effective input aperture is defined as the boundary within which the count above the equivalent threshold remains greater than 50% of its maximum value.

MODE OF OPERATION

The multiplier is most commonly used with pulse counting circuits to detected individual particles of quanta. For this application closed end multipliers are recommended. A typical circuit is shown in Figure 1. The output pulse is capacitively coupled into a suitable charge sensitive pulse amplifier and discrimator. Under certain circumstances the multiplier may be used as a current amplifier. In this case an openended multiplier is necessary, the output being collected at a separate electrode as shown in Figure 2.





The collector electrode is biased positively to ensure collection of all output electrons. For satisfactory linearity the multiplier should be operated with a gain of less than 1×10^5 and the output current should not exceed 1% of the standing current.

OPERATIONAL NOTES

Mounting

It is recommended that, in general, the leads are not used for mounting the device as sustained vibration may result in fracture of the electrical connections.

Vacuum environment

Normal vacuum precautions should be observed. In particular gross contamination with hydrocarbon vapours will cause rapid loss of gain and should be avoided. If necessary the device may be cleaned in iso-propyl alcohol and air dried at a temperature not exceeding 70 ^{o}C.
The device is stable in air and may be vacuum cycled repeatedly without damage.

Baking conditions

The specified baking conditions apply when the device is under vacuum. The temperature must not exceed the specified maximum operating and storage temperature unless the pressure is less than 50 mN/m^2 (3,7 x 10^{-4} torr). No voltage should be applied to the device during bake-out.

Thermal stability

Due to negative temperature coefficient of resistance of the devices thermal runaway is possible. Operation below the maximum voltage and temperature limits specified will ensure that this does not occur.

Choice of operating voltage

Use of an operating voltage approximately 500 volts greater than the starting voltage will ensure that all output pulses exceed the threshold and are recorded. If, as a result of prolonged use the median gain of the multiplier falls, the operating voltage may be increased in order to restore the gain to its original value.

CHANNEL ELECTRON MULTIPLIER

Channel electron multiplier in the form of a glass planar spiral tube.

QUICK REFERENCE DATA		
The B310AL/01 has an open-ended output.		
The B310BL/01 has a closed output.		
Typical gain at 3.0 kV	1.3×10^8	
Typical resistance	3.0×10^9	Ω
Maximum operating voltage	4.0	kV

Unless otherwise stated, data is applicable to both types

This data should be read in conjunction with
GENERAL EXPLANATORY NOTES - CHANNEL ELECTRON MULTIPLIERS

CHARACTERISTICS (measured at 3.0 kV and 1000 pulse/s where applicable)

	Min.	Typ.	Max.	
Resistance	2.0	3.0	5.0	$\times 10^9$ Ω
Gain, see note 1)	1.0	1.3	–	$\times 10^8$
Background above an equivalent threshold of 2.0×10^7 electrons	–	0.1	0.2	pulse/s
Starting voltage with an equivalent threshold of 2.0×10^7 electrons	2.0	2.5	2.6	kV
Resolution (F.W.H.M.) at a modal gain of 1.0×10^8	–	50	70	%
Effective input diameter	1.1	1.25	–	mm

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	4.0	kV
Temperature, operating and storage	max.	70	°C
Bake temperatures, see note 2)	max.	400	°C
Ambient pressure with high voltage applied	max.	50 3.7×10^{-4}	mN/m^2 torr

MASS 1.0 g

MOUNTING POSITION

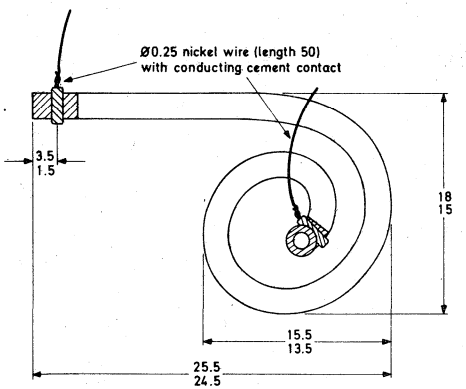
Any. In environments where vibration may be encountered the device should not be supported by the leads alone.

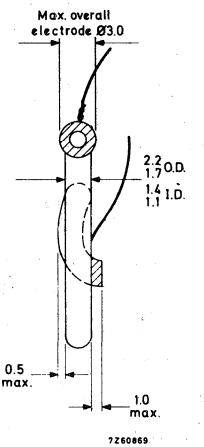
NOTES

1) The gain of a typical multiplier will increase by a factor of 2 for an increase of operating voltage of 500 V.

2) Baking will cause a permanent slight loss in gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 °C will reduce gain by approximately a factor of 2.

DIMENSIONS AND CONNECTIONS Dimensions in mm





CHANNEL ELECTRON MULTIPLIER

Channel electron multiplier in the form of a glass planar spiral tube with a rectangular-section input cone 2.0 x 8.0 mm.

QUICK REFERENCE DATA		
The B312AL/01 has an open-ended output.		
The B312BL/01 has a closed output.		
Typical gain at 3.0 kV	1.3×10^8	
Typical resistance	3.0×10^9	Ω
Maximum operating voltage	4.0	kV

Unless otherwise stated, data is applicable to both types

This data should be read in conjunction with
GENERAL EXPLANATORY NOTES - CHANNEL ELECTRON MULTIPLIERS

CHARACTERISTICS (measured at 3.0 kV and 1000 pulse/s where applicable)

	Min.	Typ.	Max.	
Resistance	2.0	3.0	5.0	$\times 10^9$ Ω
Gain, see note 1)	1.0	1.3	–	$\times 10^8$
Background above an equivalent threshold of 2.0×10^7 electrons	–	0.2	0.5	pulse/s
Starting voltage with an equivalent threshold of 2.0×10^7 electrons	2.0	2.5	2.6	kV
Resolution (F.W.H.M.) at a modal gain of 1.0×10^8	–	50	70	%
Effective input aperture	1.7 x 7.5	2.0 x 8.0	–	mm

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	4.0	kV
Temperature, operating and storage	max.	70	°C
Bake temperatures, see note 2)	max.	400	°C
Ambient pressure with high voltage applied	max.	50	mN/m^2
		3.7×10^{-4}	torr

MASS 1.0 g

MOUNTING POSITION

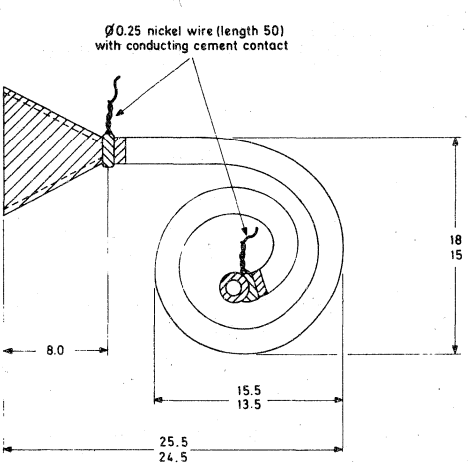
Any. In environments where vibration may be encountered the device should not be supported by the leads alone.

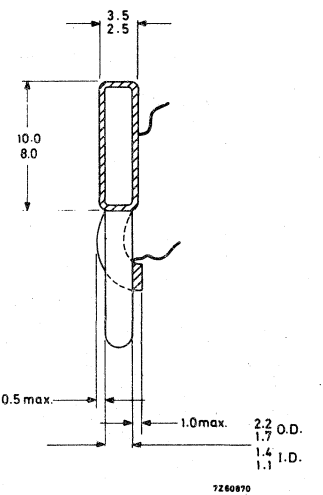
NOTES

1) The gain of a typical multiplier will increase by a factor of 2 for an increase of operating voltage of 500 V.

2) Baking will cause a permanent slight loss in gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 °C will reduce gain by approximately a factor of 2.

DIMENSIONS AND CONNECTIONS Dimensions in mm





CHANNEL ELECTRON MULTIPLIER

Channel electron multiplier in the form of a glass planar spiral tube with a 5.0 mm diameter input cone.

QUICK REFERENCE DATA		
The B318AL/01 has an open-ended output.		
The B318BL/01 has a closed output.		
Typical gain at 3.0 kV	1.3×10^8	
Typical resistance	3.0×10^9	Ω
Maximum operating voltage	4.0	kV

Unless otherwise stated, data is applicable to both types

This data should be read in conjunction with
GENERAL EXPLANATORY NOTES - CHANNEL ELECTRON MULTIPLIERS

CHARACTERISTICS (measured at 3.0 kV and 1000 pulse/s where applicable)

	Min.	Typ.	Max.	
Resistance	2.0	3.0	5.0	$\times 10^9$ Ω
Gain, see note 1)	1.0	1.3	–	$\times 10^8$
Background above an equivalent threshold of 2.0×10^7 electrons	–	0.25	0.5	pulse/s
Starting voltage with equivalent threshold of 2.0×10^7 electrons	2.0	2.5	2.6	kV
Resolution (F.W.H.M.) at a modal gain 1.0×10^8	–	50	70	%
Effective cone diameter	4.0	5.0	–	mm

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	4.0	kV
Temperature, operating and storage	max.	70	°C
Bake temperatures, see note 2)	max.	400	°C
Ambient pressure with high voltage applied	max.	50	mN/m²
		3.7×10^{-4}	torr

MASS 1.3 g

MOUNTING POSITION

Any. In environments where vibration may be encountered the device should not be supported by the leads alone.

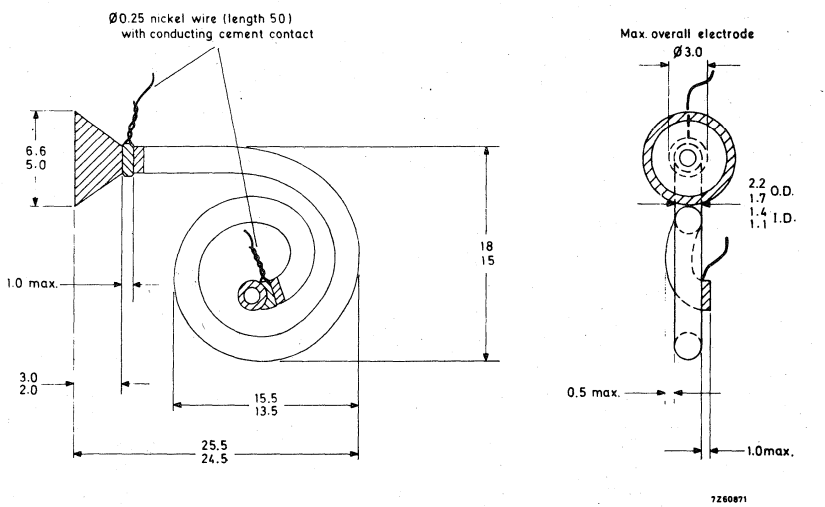
NOTES

1) The gain of a typical multiplier will increase by a factor of 2 for an increase of operating voltage of 500 V.

2) Baking will cause a permanent slight loss in gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 °C will reduce gain by approximately a factor of 2.

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CHANNEL ELECTRON MULTIPLIER

Channel electron multiplier in the form of a glass C-shaped tube.

QUICK REFERENCE DATA		
The B330AL/01 has an open-ended output.		
The B330BL/01 has a closed output.		
Typical gain at 3.0 kV	1.5×10^8	
Typical resistance	3.0×10^9	Ω
Maximum operating voltage	4.0	kV

Unless otherwise stated, data is applicable to both types

This data should be read in conjunction with
GENERAL EXPLANATORY NOTES - CHANNEL ELECTRON MULTIPLIERS

CHARACTERISTICS (measured at 3.0 kV and 1000 pulse/s where applicable)

	Min.	Typ.	Max.	
Resistance	2.0	3.0	5.0	$\times 10^9$ Ω
Gain, see note 1)	1.0	1.5	–	$\times 10^8$
Background above an equivalent threshold of 2.0×10^7 electrons	–	0.1	0.2	pulse/s
Starting voltage with an equivalent threshold of 2.0×10^7 electrons	2.0	2.5	2.6	kV
Resolution (F.W.H.M.) at a modal gain of 1.0×10^8	–	50	70	%
Effective input diameter	1.1	1.25	–	mm

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	4.0	kV
Temperature, operating and storage	max.	70	°C
Bake temperatures, see note 2)	max.	400	°C
Ambient pressure with high voltage applied	max.	50 3.7×10^{-4}	mN/m^2 torr

MASS	1.3	g

MOUNTING POSITION

Any. In environments where vibration may be encountered the device should not be supported by the leads alone.

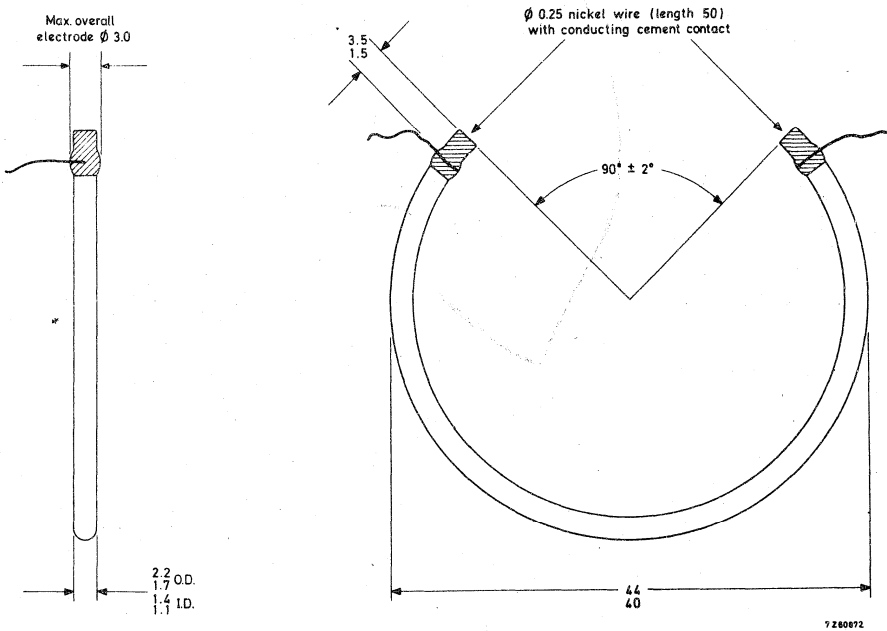
NOTES

1) The gain of a typical multiplier will increase by a factor of 2 for an increase of operating voltage of 500 V.

2) Baking will cause a permanent slight loss in gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 °C will reduce gain by approximately a factor of 2.

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CHANNEL ELECTRON MULTIPLIER

Channel electron multiplier in the form of a glass planar spiral tube.

QUICK REFERENCE DATA		
The B410AL/01 has an open-ended output.		
The B410BL/01 has a closed output.		
Typical gain at 2.5 kV	1.5×10^8	
Typical resistance	3.0×10^9	Ω
Maximum operating voltage	3.5	kV

Unless otherwise stated, data is applicable to both types

This data should be read in conjunction with
GENERAL EXPLANATORY NOTES - CHANNEL ELECTRON MULTIPLIERS

CHARACTERISTICS (measured at 2.5 kV and 1000 pulse/s where applicable)

	Min.	Typ.	Max.	
Resistance	2.0	3.0	5.0	$\times 10^9$ Ω
Gain, see note 1)	1.0	1.5	–	$\times 10^8$
Background above an equivalent threshold of 2.0×10^7 electrons	–	0.1	0.2	pulse/s
Starting voltage with an equivalent threshold of 2.0×10^7 electrons	1.7	2.0	2.2	kV
Resolution (F.W.H.M.) at a modal gain of 1.0×10^8	–	50	70	%
Effective input diameter	2.0	2.2	–	mm

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	3.5	kV
Temperature, operating and storage	max.	70	°C
Bake temperatures, see note 2)	max.	400	°C
Ambient pressure with high voltage applied	max.	50 3.7×10^{-4}	mN/m^2 torr

MASS	3.0	g

MOUNTING POSITION

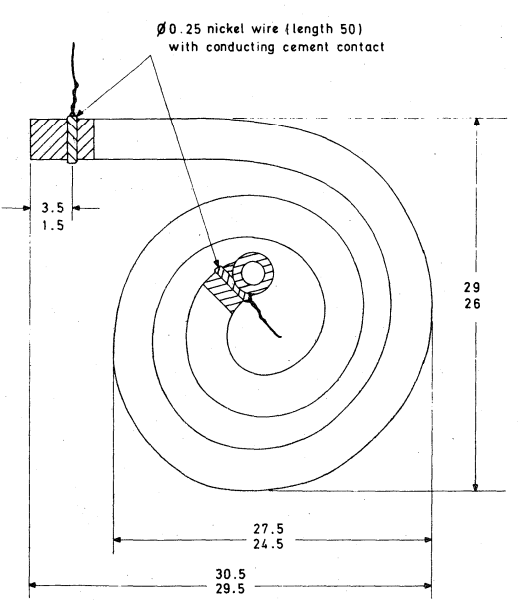
Any. In environments where vibration may be encountered the device should not be supported by the leads alone.

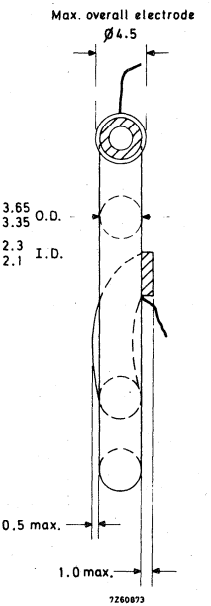
NOTES

1) The gain of a typical multiplier will increase by a factor of 2 for an increase of operating voltage of 500 V.

2) Baking will cause a permanent slight loss in gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 °C will reduce gain by approximately a factor of 2.

DIMENSIONS AND CONNECTIONS Dimensions in mm





CHANNEL ELECTRON MULTIPLIER

Channel electron multiplier in the form of a glass planar spiral tube with a rectangular-section input cone 3.5 x 15.5 mm.

QUICK REFERENCE DATA		
The B413AL/01 has an open-ended output		
The B413BL/01 has a closed output		
Typical gain at 2.5 kV	1.7×10^8	
Typical resistance	3.0×10^9	Ω
Maximum operating voltage	3.5	kV

Unless otherwise stated, data is applicable to both types

This data should be read in conjunction with
GENERAL EXPLANATORY NOTES - CHANNEL ELECTRON MULTIPLIERS

CHARACTERISTICS (measured at 2.5 kV and 1000 pulse/s where applicable)

	Min.	Typ.	Max.	
Resistance	2.0	3.0	5.0	$\times 10^9$ Ω
Gain, see note 1)	1.0	1.7	–	$\times 10^8$
Background above an equivalent threshold of 2.0×10^7 electrons	–	0.25	0.5	pulse/s
Starting voltage with an equivalent threshold of 2.0×10^7 electrons	1.7	2.0	2.2	kV
Resolution (F.W.H.M.) at a modal gain of 1.0×10^8	–	50	70	%
Effective input aperture	3.0 x 14.5	3.5 x 15.5	–	mm

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	3.5	kV
Temperature, operating and storage	max.	70	°C
Bake temperature, see note 2)	max.	400	°C
Ambient pressure with high voltage applied	max.	50	mN/m^2
		3.7×10^{-4}	torr

MASS 4.0 g

MOUNTING POSITION

Any. In environments where vibration may be encountered the device should not be supported by the leads alone.

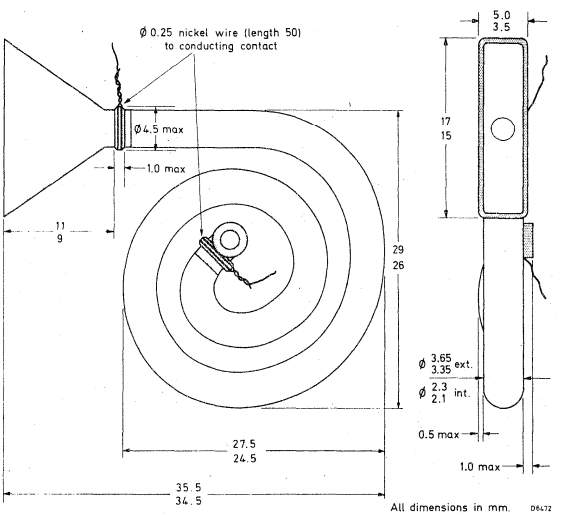
NOTES

1) The gain of a typical multiplier will increase by a factor of 2 for an increase of operating voltage of 500 V.

2) Baking will cause a permanent slight loss in gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 °C will reduce gain by approximately a factor of 2.

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CHANNEL ELECTRON MULTIPLIER

Channel electron multiplier in the form of a glass planar spiral tube with a 10 mm diameter input cone.

QUICK REFERENCE DATA		
The B419AL/01 has an open-ended output.		
The B419BL/01 has a closed output.		
Typical gain at 2.5 kV	1.7×10^8	
Typical resistance	3.0×10^9	Ω
Maximum operating voltage	3.5	kV

Unless otherwise stated, data is applicable to both types

This data should be read in conjunction with
GENERAL EXPLANATORY NOTES - CHANNEL EL ECTRON MULTIPLIERS

CHARACTERISTICS (measured at 2.5 kV and 1000 pulse/s where applicable)

	Min.	Typ.	Max.	
Resistance	2.0	3.0	5.0	$\times 10^9$ Ω
Gain, see note 1)	1.0	1.7	-	$\times 10^8$
Background above an equivalent threshold of 2.0×10^7 electrons	-	0.25	0.5	pulse/s
Starting voltage with an equivalent threshold of 2.0×10^7 electrons	1.7	2.0	2.2	kV
Resolution (F.W.H.M.) at a modal gain of 1.0×10^8	-	50	70	%
Effective input diameter	9.0	10.0	-	mm

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	3.5	kV
Temperature, operating and storage	max.	70	°C
Bake temperatures, see note 2)	max.	400	°C
Ambient pressure with high voltage applied	max.	50	mN/m^2
		3.7×10^{-4}	torr

MASS 4.0 g

MOUNTING POSITION

Any. In environments where vibration may be encountered the device should not be supported by the leads alone.

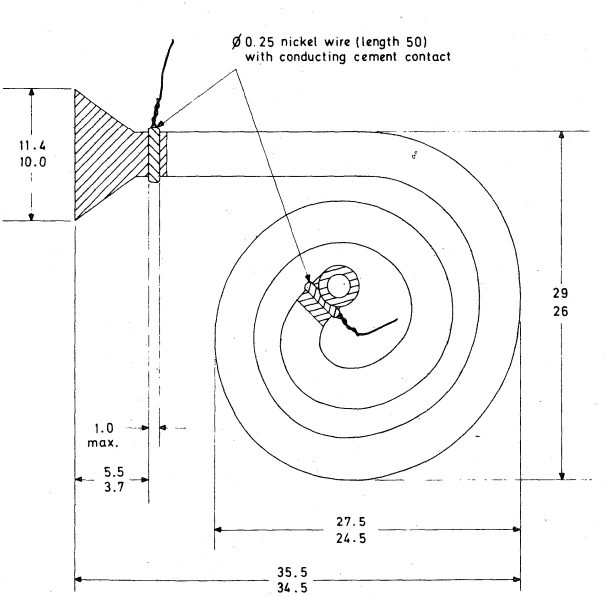
NOTES

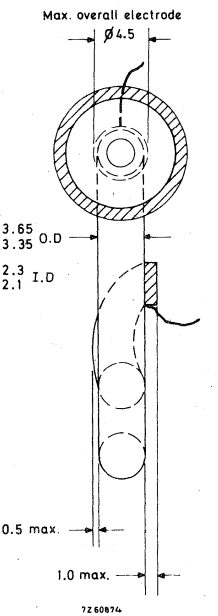
1) The gain of a typical multiplier will increase by a factor of 2 for an increase of operating voltage of 500 V.

2) Baking will cause a permanent slight loss in gain and it is advisable to keep the baking time to a minimum, for example, baking for 16 hours at 400 °C will reduce gain by approximately a factor of 2.

DIMENSIONS AND CONNECTIONS

Dimensions in mm





CHANNEL ELECTRON MULTIPLIER PLATE

An array of channel electron multipliers fused into the shape of a disc. The multipliers are electrically connected in parallel by means of nickel-chromium electrodes evaporated on to the faces of the disc.

SPECIFICATION

Diameter of disc		27,1 ± 0,1	mm
Useful diameter	min.	26,5	mm
Thickness of disc		1,0 ± 0,1	mm
Channel diameter		25	μm
Channel pitch		31	μm
Open area	approx.	60	%
Electrode material		nickel-chromium	
Electrical resistance between electrodes	approx.	50	MΩ
Current gain at 1 kV	min.	1000	

For linear relationship between input and output the output current must not exceed 0,1 of the standing current.

The plates are cut such that the channel electron multipliers form an angle of 13° to the perpendicular axis of the plate.

APPLICATIONS

These devices must operate in a vacuum, and may be used to detect electrons, ions, soft X-rays and ultra-violet photons falling on the input face of the disc, by producing electron pulses from the output face of the corresponding channel.

For space experiments the environmental vacuum is adequate for their operation.

In laboratory use they must be incorporated in a vacuum chamber, where they will have important applications in field ion microscopy, electron microscopy and allied areas of work.

Data based on pre-production devices

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	2	kV
Temperature, operating and storage [1]	max.	70	°C
Bake temperature	max.	300	°C
Ambient pressure with high voltage applied	max.	13, 3 (10^{-4} torr)	mPa
Diameter of plate clamping rings	max.	26, 6	mm

[1] The plate should be stored in a dry or vacuum environment.

CHANNEL ELECTRON MULTIPLIER PLATE

An array of channel electron multipliers fused into the shape of a disc. The multipliers are electrically connected in parallel by means of nickel-chromium electrodes evaporated on to the faces of the disc.

SPECIFICATION

Diameter of disc		$53,0\ ^{+0}_{-0,2}$	mm
Useful diameter	min.	51,8	mm
Thickness of disc		$1,0 \pm 0,1$	mm
Channel diameter		25	µm
Channel pitch		31	µm
Open area	approx.	60	%
Electrode material		nickel-chromium	
Electrical resistance between electrodes	approx.	10	MΩ
Current gain at 1 kV	min.	1000	

For linear relationship between input and output the output current must not exceed 0,1 of the standing current.

The plates are cut such that the channel electron multipliers form an angle of 13^{o} to the perpendicular axis of the plate.

APPLICATIONS

These devices must operate in a vacuum, and may be used to detect electrons, ions, soft X-rays and ultra-violet photons falling on the input face of the disc, by producing electron pulses from the output face of the corresponding channel.

For space experiments the environmental vacuum is adequate for their operation.

In laboratory use they must be incorporated in a vacuum chamber, where they will have important applications in field ion microscopy, electron microscopy and allied areas of work.

Data based on pre-production devices.

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	2	kV
Temperature, operating and storage [1]	max.	70	°C
Bake temperature	max.	300	°C
Ambient pressure with high voltage applied	max.	13, 3	mPa
		(10^{-4} torr)	
Diameter of plate clamping rings	max.	52, 4	mm

[1]) The plate should be stored in a dry or vacuum enviroment.

CHANNEL ELECTRON MULTIPLIER PLATE

An array of channel electron multipliers fused into the shape of a disc. The multipliers are electrically connected in parallel by means of nickel-chromium electrodes evaporated on to the faces of the disc.

SPECIFICATION

Diameter of disc		$70,0\ ^{+0}_{-0,2}$	mm
Useful diameter	min.	68	mm
Thickness of disc		$1,0 \pm 0,1$	mm
Channel diameter		25	μm
Channel pitch		31	μm
Open area	approx.	60	%
Electrode material		nickel-chromium	
Electrical resistance between electrodes	approx.	5	MΩ
Current gain at 1 kV	min.	1000	

For linear relationship between input and output the output current must not exceed 0,1 of the standing current.

The plates are cut such that the channel electron multipliers form an angle of 13^{o} to the perpendicular axis of the plate.

APPLICATIONS

These devices must operate in a vacuum, and may be used to detect electrons, ions, soft X-rays and ultra-violet photons falling on the input face of the disc, by producing electron pulses from the output face of the corresponding channel.

For space experiments the environmental vacuum is adequate for their operation.

In laboratory use they must be incorporated in a vacuum chamber, where they will have important applications in field ion microscopy, electron microscopy and allied areas of work.

Data based on pre-production devices.

LIMITING VALUES (Absolute max. rating system)

Operating voltage	max.	2	kV
Temperature, operating and storage [1])	max.	70	°C
Bake temperature	max.	300	°C
Ambient pressure with high voltage applied	max.	13,3	mPa
		(10^{-4} torr)	
Diameter of plate clamping rings	max.	68,5	mm

[1]) The plate should be stored in a dry or vacuum environment.

Geiger-Mueller tubes

GEIGER-MUELLER TUBES

SURVEY OF TYPES

Type number	Status	Application
End-window types		
18504	P	β, γ
18505	P	α, β, γ
18506	P	β, γ
18515	M	α, β
18515/01	P	α, β
18526	P	α, β, γ
18536	M	α, β
18536/01	P	α, β
18546/01	P	β
Cylinder counter tubes		
ZP1100	P	γ
18503	P	γ
18509	P	γ- count or current $\leq$ 300 R/h, β > 0,5 MeV
18520	P	γ
19529	P	γ- count or current $\leq$ 1000 R/h, β > 0,5 MeV
18545	P	γ
18550	P	γ- count or current, > 0,25 MeV
18553	P	β > 0,3 MeV, γ
18555	P	β > 0,3 MeV, γ
Cosmic-ray guard tubes		
18518	M	in anti-coincidence with 18536 or 18515
X-ray window counter tubes		
18507	P	X-ray end window counter 2,5 to 20 KeV 0,06 to 0,5 nm
18511	C	X-ray, side window proportional counter 2,5 to 40 KeV, 0,03 to 0,5 nm
Dip counter tubes		
ZP1080	C	β, γ
ZP1083	C	β, γ

P = Preferred type. Recommended for new equipment design.

C = Current type. Available for equipment production and maintenance. No longer recommended for equipment design.

M = Maintenance type. Available for equipment maintenance. No longer recommended for equipment production.

Some devices are labelled

Maintenance type

Obsolescent type

or

Obsolete type

Maintenance type - Available for equipment maintenance
No longer recommended for equipment production.

Obsolescent type - Available until present stocks are exhausted.

Obsolete type - No longer available.

GEIGER-MUELLER TUBES
LIST OF SYMBOLS

Anode supply voltage	V_b
Voltage at the beginning of the plateau	V_{b_1}
Voltage at the end of the plateau	V_{b_2}
Plateau length (= $V_{b_2} - V_{b_1}$)	V_{pl}
Starting voltage	V_{ign}
Count rate (= counts/unit of time)	N
Count rate at V_{b_1}	N_1
Count rate at V_{b_2}	N_2
Background	N_o
Plateau slope (= $\frac{N_2 - N_1}{0,5\,(N_1+N_2)} \times \frac{1}{V_{pl}} \times 100\ \%$)	S_{pl}
Dead time	τ
Capacitance (anode to cathode)	C_{ak}
Ambient temperature	t_{amb}
Gas multiplication factor	A

GENERAL OPERATIONAL RECOMMENDATIONS
GEIGER-MUELLER TUBES

1. GENERAL

1.1 A Geiger-Mueller tube (GM tube) is a gas-filled device which reacts to individual ionizing events, thus enabling them to be counted.

1.2 A Geiger-Mueller tube basically consists 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.
Quanta or particles may enter the tube either through a foil (the window), or through the cylinder wall itself.

1.3 Typical radiations are:

alpha;
beta;
gamma or X-ray ;
thermal neutrons.

1.4 The gas filling normally consists of a mixture of rare gasses and a quenching agent.

1.5 Quenching is the process of terminating a pulse of ionization current in a counter tube.

2 CAPACITANCE

The capacitance of a GM tube is the capacitance between anode and cathode, the connections being completely shielded.

3 OPERATING CHARACTERISTICS

3.1 **Starting voltage** This is the minimum anode supply voltage applied to a GM tube at which pulses of 1 V amplitude appear across the tube.

3.2 **Operating voltage** This is the anode supply voltage at which the GM tube should be used.
If this is not quoted, the middle of the minimum plateau (i.e. $\frac{V_{b1} + V_{b2}}{2}$) should be regarded as the recommended operating voltage.

3.3 **Plateau** The range of anode supply voltage values for which the count rate varies relatively little under constant conditions of irradiation. Unless otherwise stated, the plateau is measured at a count rate of approximately 100 counts/s.

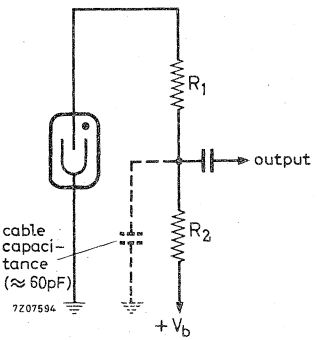
3.4 **Plateau slope** The percentage change in count rate for a given change (usually 1 V) in anode supply voltage.

3.5 **Background** The count rate of a GM tube in the absence of radiation which the tube is meant to measure.

3.6 **Dead time** This is the time interval after the initiation of a voltage pulse during which (assuming no interference by an external circuit) a subsequent ionizing event does not produce a discharge.
Unless otherwise stated the dead time curve is given at a count rate of 100 counts/s.

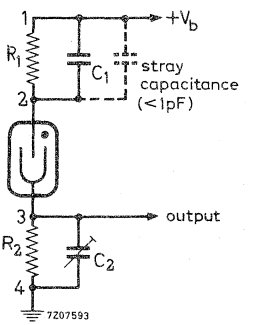
MEASURING CIRCUITS

4.1 **Measuring circuit A**



Note: The value of R_1 should not be lower than the value specified by the manufacturer and mounted close to the anode connector.

4.2 **Measuring circuit B**



Notes:
1. The input resistance and the input capacitance of the measuring equipment are incorporated in R_2 and C_2, respectively.
2. R_1 should be as specified by the manufacturer and mounted close to the anode connector.
3. When applying a rectangular pulse at "1" with the tube inserted but short-circuited, capacitor C_2 should be so adjusted that the pulse at "3" is undistorted.
Under these conditions $R_1.(C_1 + \text{stray capacitance}) = R_2.C_2$.
4. The measuring equipment consists of a "cathode follower" with a pulse shaper, a

limiting amplifier and a scaler.

Unless otherwise stated, the tubes are measured with the measuring circuit given in the data sheet and with a ^{60}Co source at

$V_b = \frac{V_{b_1} + V_{b_2}}{2}$ and at $t_{amb} = 25\ ^{o}C$

5. OPERATIONAL NOTES

5.1 **Pulse amplitude** The pulse amplitude of the GM tubes may be estimated generally at $P = b.(V_b - V_{ign})$. In this formula V_b is the anode supply voltage and V_{ign} the starting voltage of the tube. The factor b originates from the tap on the anode resistor, as indicated in the recommended measuring circuit. The influence of the connected capacitive load is thus minimized.

5.2 **Scaler** The resolving time of the scaler should be shorter than the minimum dead time of the counter tube. For normal use and at moderate count rates an input sensitivity of approximately 0,5 V will be sufficient. At very high count rates the mean level of the anode voltage of the counter tube will drop appreciably below V_b, and the pulse amplitude will decrease accordingly so that the smallest pulses will be lost at the input of the scaler. In this case it is possible to increase the sensitivity of the measuring equipment by means of a pulse amplifier combined with a pulse shaper.

5.3 **Pulse shaper and amplifier** The circuit should have a resolving time shorter than the minimum dead time of the counter tube. The pulse amplitude should not be influenced by the pulse shaper. Pulse amplification should be sufficiently high and the rise time of the amplifier should be considerably smaller than the rise time of the pulse from the counter tube.

5.4 **Load** Normally the tubes should be operated with an anode resistor having a value as indicated in the data sheets or higher. Decreasing the resistance of the anode resistor not only decreases the dead time, but also the plateau length. A decrease in resistance below the indicated minimum value may affect tube life and even lead to its early destruction. The anode resistor should be connected direct to the anode connector (terminal) of the tube to ensure that parasitic capacitances of leads will not considerably increase the capacitive load on the tube. An increase in capacitive load has the tendency of increasing the pulse amplitude, the pulse duration, the dead time, and the plateau slope, whereas the plateau length will be shortened appreciably. Shunt capacitances of 20 pF or more may destroy the tube.

5.5 **Count rate** After every pulse the tube is temporarily insensitive during a period called dead time. Consequently, the pulses that occur during this period are not counted. At a count rate of N counts/s the tube will be insensitive during $100\,N\tau\,\%$ of the time, so that approximately $100\,N\tau\,\%$ of the counts will be lost. If the counting losses should not exceed 1%, N should be less than $0,01\,\tau$ counts/s. The maximum count rate is approximately $1/\tau$. For continuous stable operation it is recommended that the count rate be adjusted to a value in the linear part of the count rate/dose rate curve.

5.6 **Count rate/dose rate curves** are measured with ^{60}Co perpendicular to the tube axis, at an operating voltage in the middle of the plateau, unless otherwise stated.

5.7 **Current/dose rate curves** are measured with ^{60}Co perpendicular to the tube axis, unless otherwise stated.

6 LIMITING VALUES

6.1 The limiting values of radiation counter 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 values for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

6.2 The ambient temperature is the temperature of the surroundings of the tube.

7 MOUNTING

7.1 Unless otherwise stated, any mounting position is permissible.

7.2 Low capacitance mounting of the tube is required (**shortest possible** connection between anode terminal and load resistor; low capacitance between anode and cathode leads).

7.3 Soldering to the cathode can or the anode pin will **destroy** the tube.

8 STORAGE AND HANDLING

8.1 The tube should not be stored at ambient temperatures outside the limits given under the heading "Limiting values" on the data sheets.

8.2 To prevent leakage between anode and cathode the tube should be dry and clean.

8.3 Condensation of water vapour may cause a short circuit between anode and cathode.

8.4 Some types of tube have thin windows and/or thin cathode walls.
To prevent damage, these tubes should be handled and mounted with utmost care.
The mica-window types are provided with a cap to protect the window when not in operation.

9. OUTSIDE PRESSURE

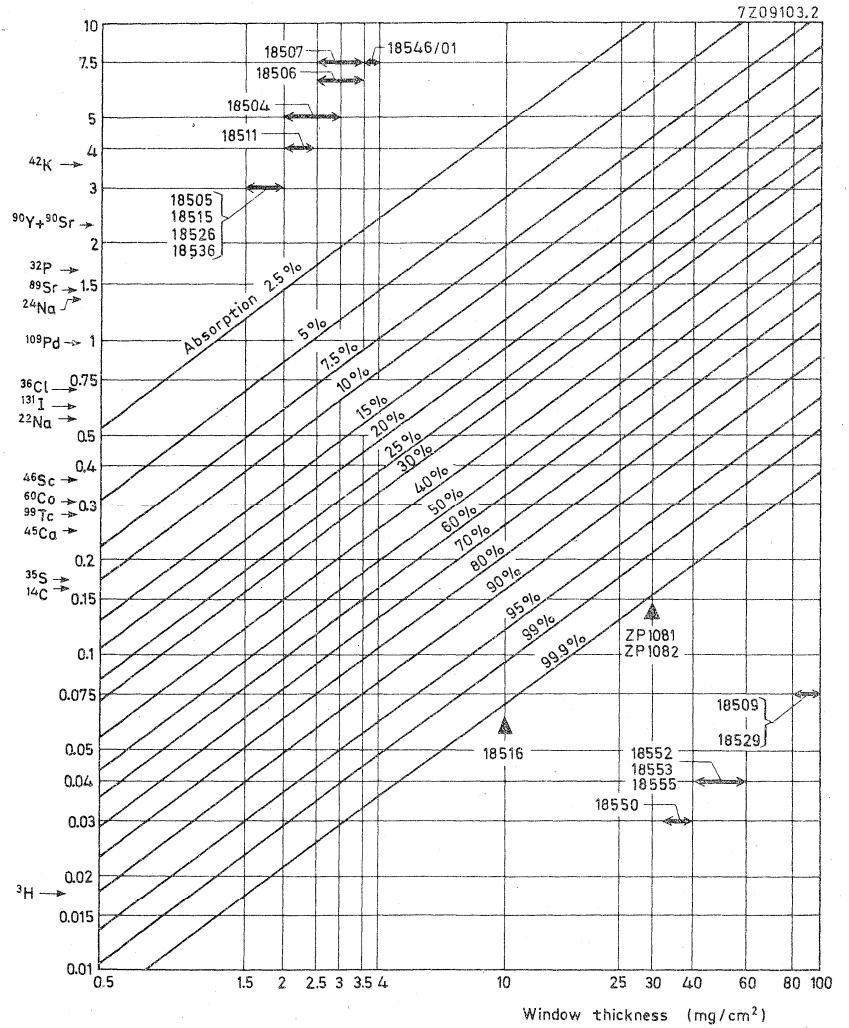
9.1 In tubes provided with a window the gas pressure outside the tube should be neither lower than 33,3 kPa (≈ 25 cm Hg) nor higher than the atmospheric pressure (unless otherwise stated) and variations in pressure should be gradual.

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

10. OUTLINE DIMENSIONS

The outline dimensions are given in mm.

Never:
1. exceed the Limiting values
2. solder to the tube
3. bend the anode pin
4. touch the mica window



Beta-ray absorption in window or wall

BETA AND GAMMA RADIATION COUNTER TUBE

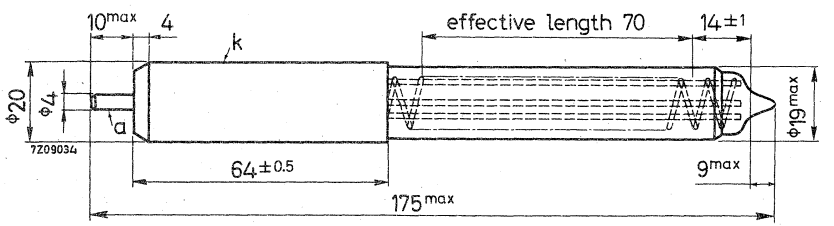
Glass wall halogen quenched β and γ radiation dip-counter tube with a DIN base.

QUICK REFERENCE DATA	
Effective range	3×10^{-4} to 1 R/h
Plateau	450 to 600 V
Recommended operating voltage	525 V
Glass bulb	30 mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm

Base matched to socket DIN 44421



GLASS WALL

Thickness		30 mg/cm^2
Effective length		70 mm

FILLING

Ne, A, halogen

CAPACITANCES

Anode to cathode 1	C_{ak}	1,5 pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of Fig. 1.

Starting voltage	V_{ign}	≤ 360	V
Recommended operating voltage	V_b	arbitrary within plateau	
Plateau	V_{pl}	450 to 600	V
Plateau slope	S_{pl}	≤ 0,15	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b = 525 V	N_o	≤ 50	counts/min.
Dead time at V_b = 525 V	τ	≤ 60	μs
Sensitivity (10 μCi/litre H_2O)			
for ^{90}Sr		32,5 x 10^3	counts/min
for ^{32}P		20 x 10^3	counts/min
for ^{137}Cs		5,2 x 10^3	counts/min
for ^{36}Cl		3,8 x 10^3	counts/min
for ^{40}K		13 x 10^3	counts/min

LIMITING VALUES (Absolute max. rating system)

Anode voltage	V_a	max. 600	V
Ambient temperature	t_{amb}	min. −50	°C
		max. +75	°C
for continuous operation		max. +50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 2000 c/s		5 x 10^{10}	counts

MEASURING CIRCUIT

R_1 = 3,9 MΩ

R_2 = 68 kΩ

$R_1 C_{stray} = R_2 C_2$

(R_1 mounted in tube base)

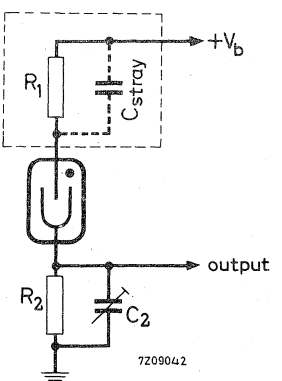
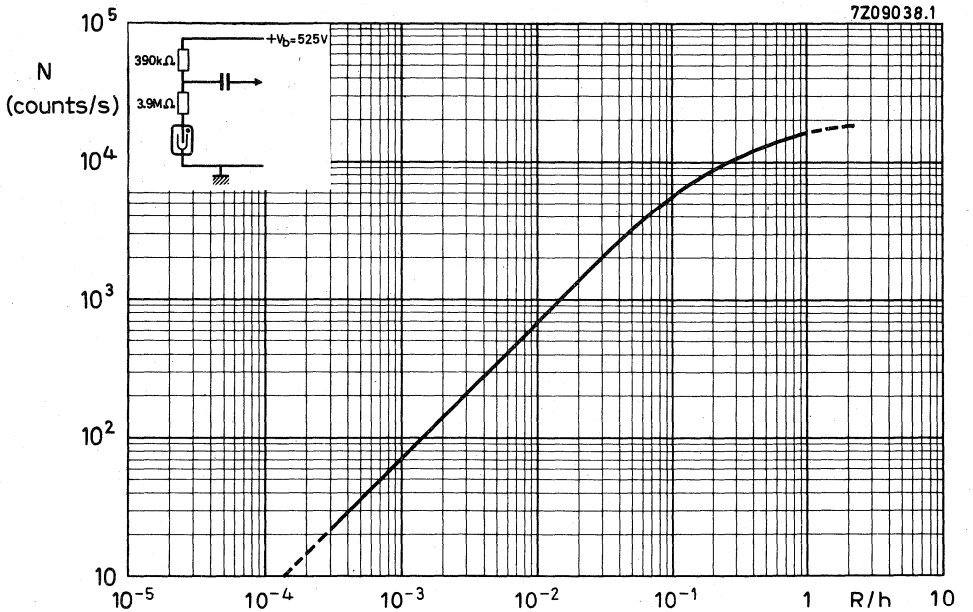


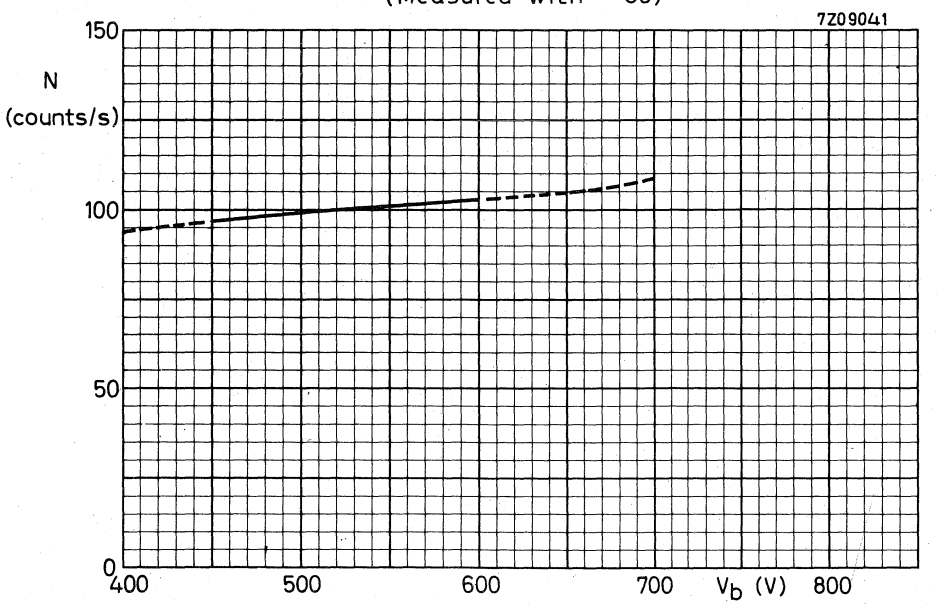
Fig. 1

REMARK

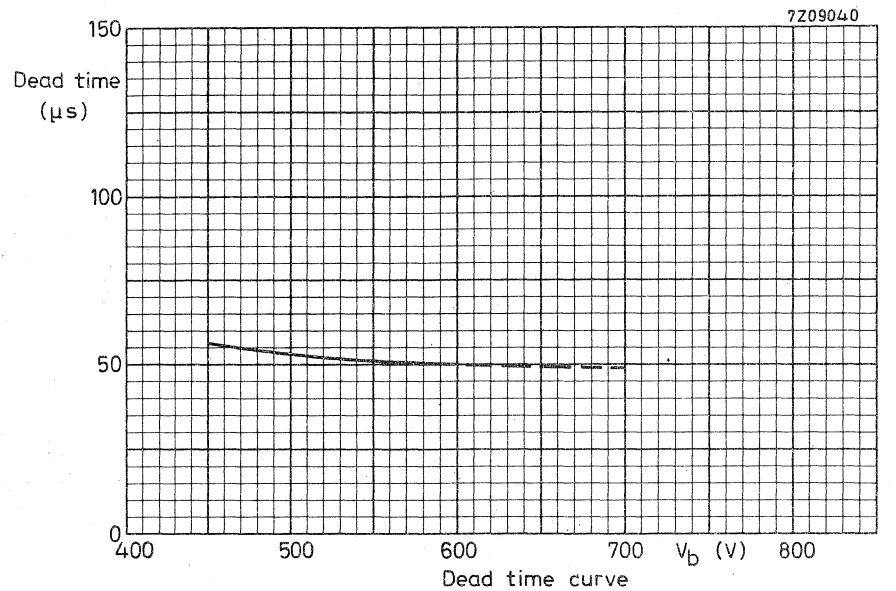
The glass wall may become contaminated during use. It is therefore recommended to check the background level of the tube and, if necessary, clean the bulb.



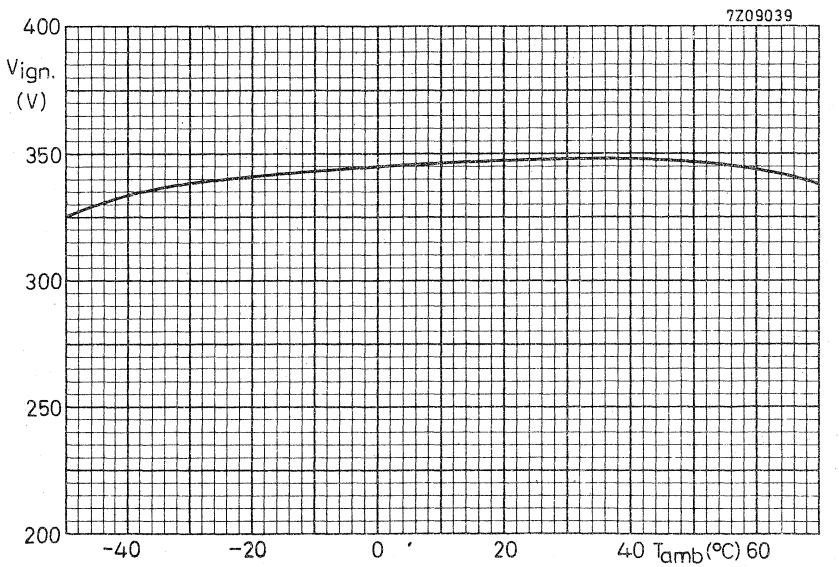
Count rate as function of dose rate
(Measured with ^{60}Co)



Plateau curve



Dead time curve



Starting voltage as function of ambient temperature

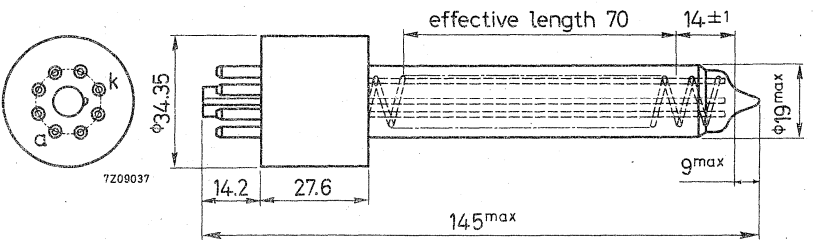
BETA AND GAMMA RADIATION COUNTER TUBE

Glass wall halogen quenched β and γ radiation dip-counter tube with an octal base.

QUICK REFERENCE DATA		
Effective range	3×10^{-4} to 1	R/h
Plateau	450 to 600	V
Recommended operating voltage	525	V
Glass bulb	30	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



GLASS WALL

Thickness	30	mg/cm^2
Effective length	70	mm

FILLING

Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	1,5	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of Fig. 1

Starting voltage	V_{ign}	⩽	360	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	450 to 600		V
Plateau slope	S_{pl}	⩽	0,15	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b = 525 V	N_o	⩽	50	counts/min
Dead time at V_b = 525 V	τ	⩽	60	µs
Sensitivity (10 µCi/litre H_2O)				
for ^{90}Sr			32,5 x 10^3	counts/min
for ^{32}P			20 x 10^3	counts/min
for ^{137}Cs			5,2 x 10^3	counts/mir
for ^{36}Cl			3,8 x 10^3	counts/min
for ^{40}K			13 x 10^3	counts/min

LIMITING VALUES (Absolute max. rating system)

Anode voltage	V_a	max.	600	V
Ambient temperature	t_{amb}	min.	−50	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 2000 c/s	5 x 10^{10}	counts

MEASURING CIRCUIT

R_1 = 3,9 MΩ

R_2 = 68 kΩ

$R_1C_{stray} = R_2C_2$

(R_1 mounted in tube base)

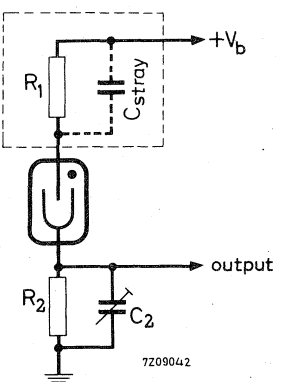


Fig. 1

REMARK Curves see ZP1080

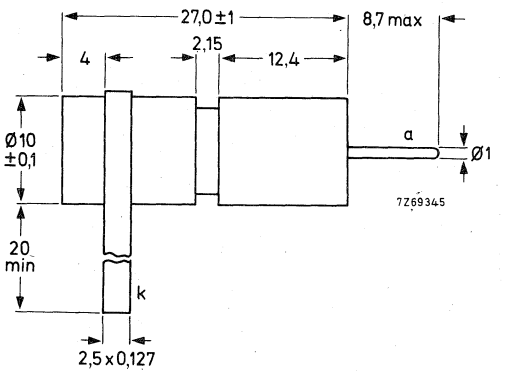
The glass wall may become contaminated during use. It is therefore redommended to check the background level of the tube and, if necessary, clean the bulb.

GAMMA RADIATION COUNTER TUBE

Halogen quenched radiation counter tube for the measurement of γ radiation.
The tube is provided with a filter. The energy reaponse is flat within 15% referred to the 1, 33 MeV point.

QUICK REFERENCE DATA		
Effective range	10^{-3} to 3 x 10^{2}	R/h
Energy range	40 to 3000	KeV
Plateau	500 to 650	V
Recommended operating voltage	575	V
Cr Fe cathode	80 to 100	mg/cm^2
Sn filter	2	mm

DIMENSIONS AND CONNECTIONS



FILTER

Thickness	2	mm
Material	Sn	

CATHODE

Thickness	80 to 100	mg/cm^2
Effective length	16	mm
Material	28% Cr, 72% Fe	

FILLING He, Ne, halogen

CAPACITANCES

Anode to cathode	C_{ak}	2	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C)

Measured in circuit of fig. 1

Starting voltage	V_{ign}	≤ 380	V
Recommended operating voltage	V_b	arbitrary within plateau	
Plateau	V_{pl}	500 to 650	V
Plateau slope	S_{pl}	≤ 0,15	%/V
Background, shielded with 50 mm Pb at V_b = 575 V	N_0	≤ 2	counts/min.
Dead time at V_b = 600 V	τ	≤ 15	µs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min. 2,2	MΩ
Anode voltage	V_a	max. 650	V
Ambient temperature for continuous operation	t_{amb}	min. −40	°C
		max. +75	°C
		max. +50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 4500 c/s: 5×10^{10} counts

MEASURING CIRCUITS

R_1 = 2,2 MΩ

R_2 = 56 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

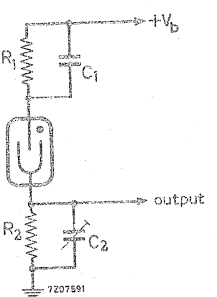
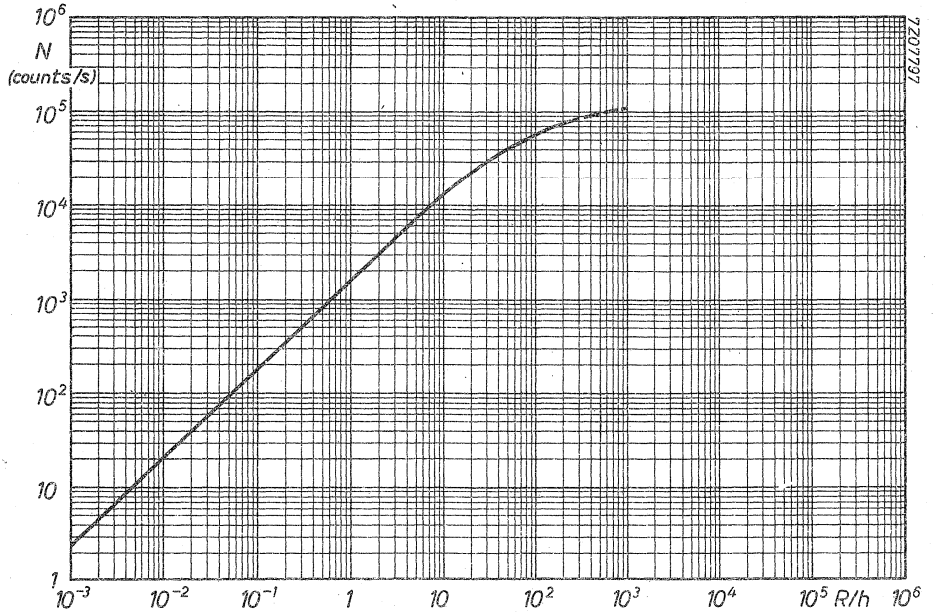
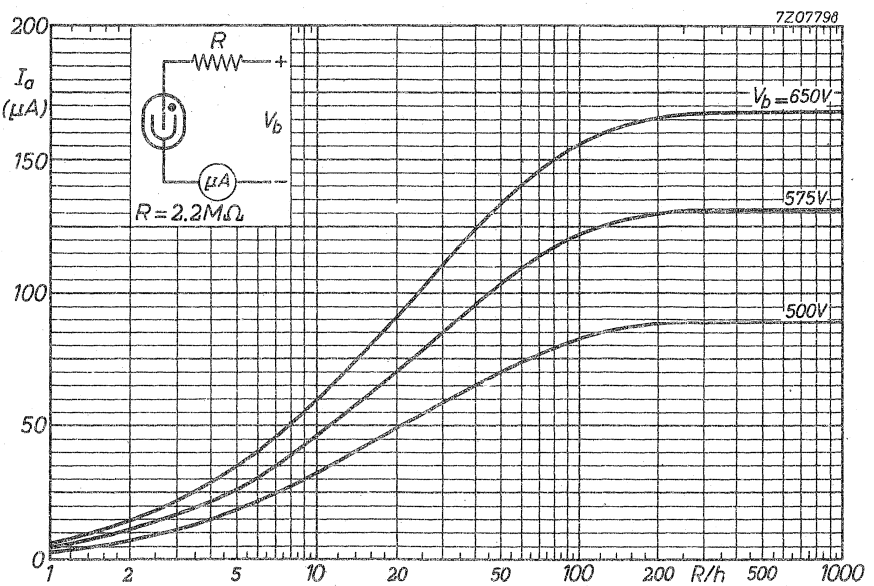


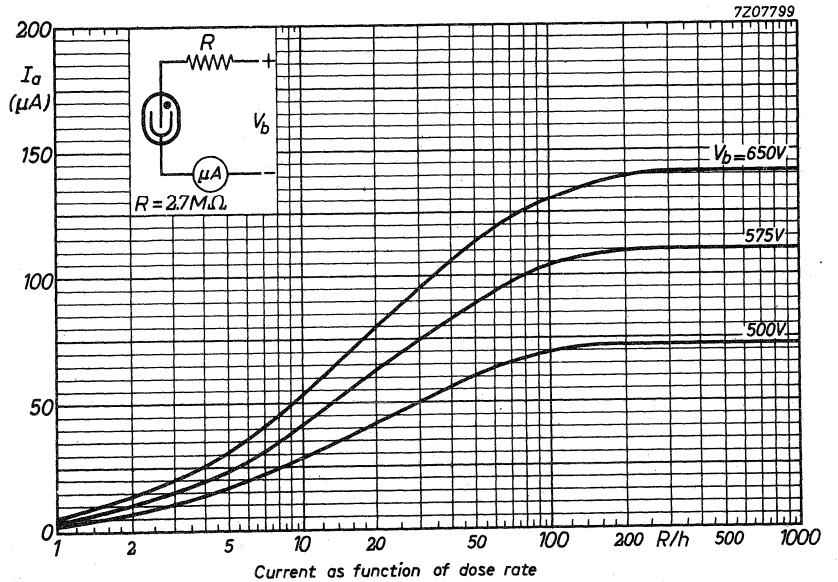
Fig. 1



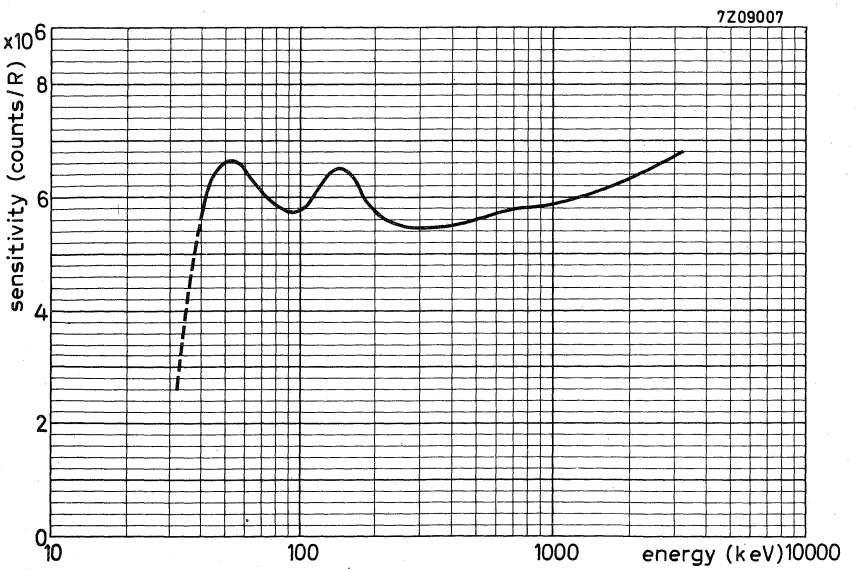
Count rate as function of dose rate



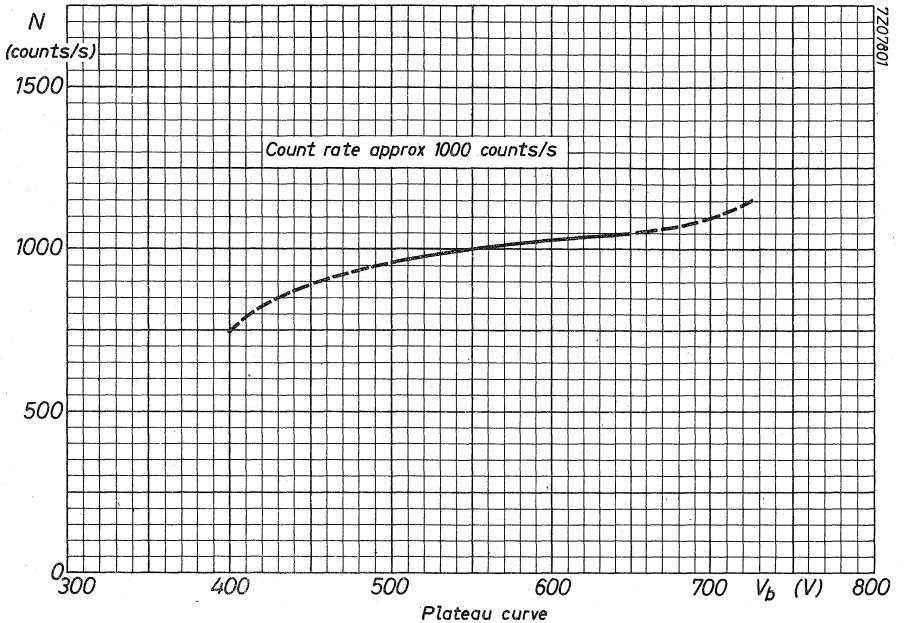
Current as function of dose rate



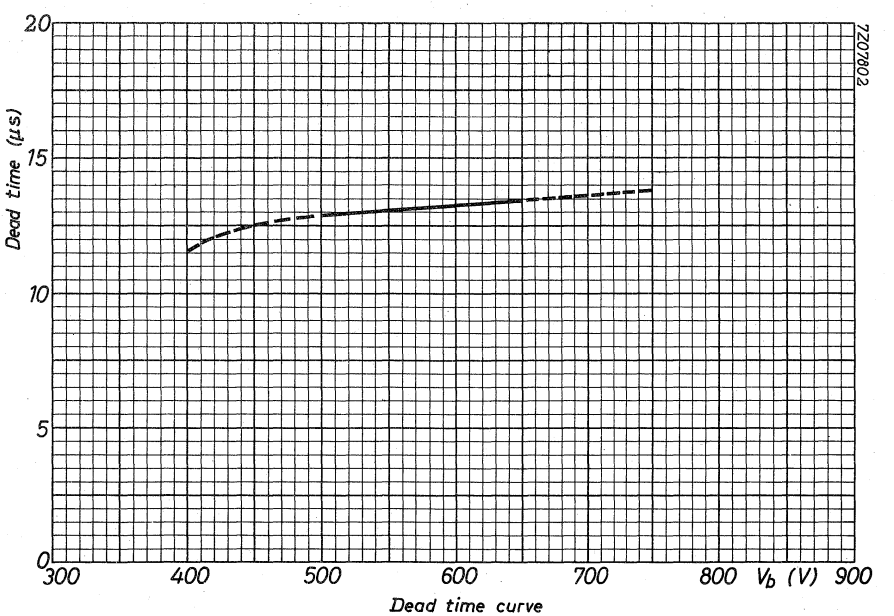
Current as function of dose rate



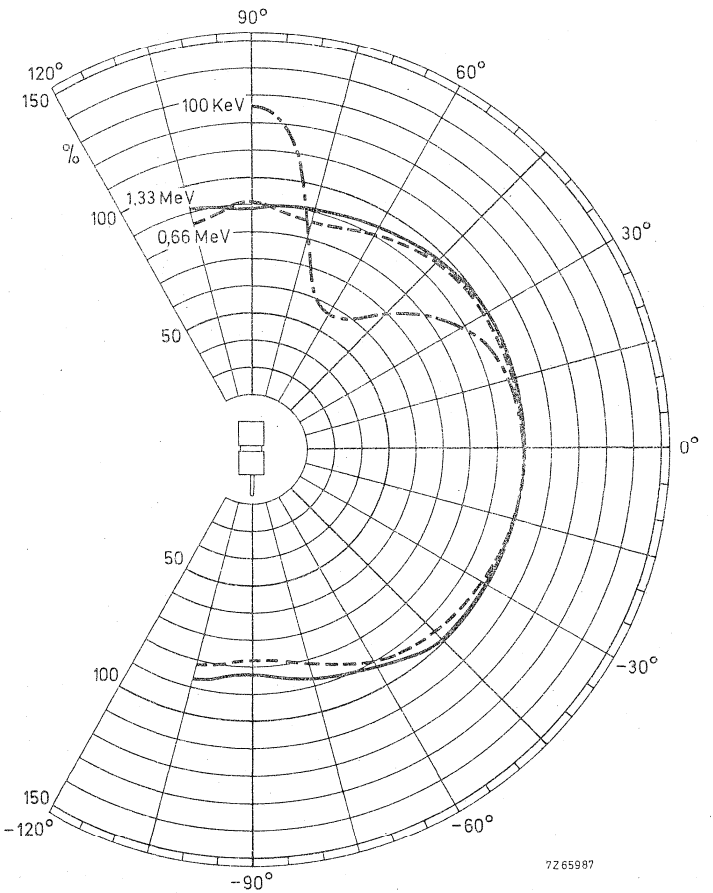
Energy response curve (side response)



Plateau curve



Dead time curve


90°
120°
60°
150
100 KeV
%
1,33 MeV
100
0,66 MeV
30°
50
0°
50
100
-30°
150
-120°
-60°
-90°
7Z65987

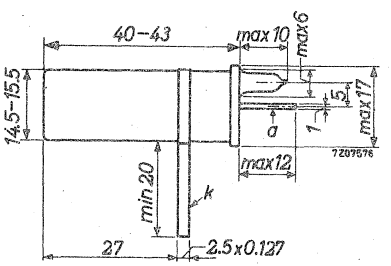
GAMMA RADIATION COUNTER TUBE

Halogen quenched γ radiation counter tube.

QUICK REFERENCE DATA			
Effective range	10^{-4} to	1	R/h
Plateau	400 to	600	V
Recommended operating voltage		500	V
Cr Fe cathode		250	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CATHODE

Thickness		250	mg/cm^2
Effective length		40	mm
Material			28% Cr, 72% Fe

FILLING

Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	2	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) measured in circuit of fig.1

Starting voltage	V_{ign}	max. 325	V [1]
Recommended operating voltage	V_b	arbitrary within plateau	
Plateau	V_{pl}	400 to 600	V
Plateau slope	S_{pl}	max. 0.04	%/V
Background, shielded with 50 mm Pb, at V_b=500V	N_o	max. 10	counts/min.
Dead time at V_b = 500 V	τ	max. 90	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min. 4.7	MΩ
Anode voltage	V_a	max. 600	V
Ambient temperature	t_{amb}	min. −50	°C
		max. +75	°C
for continuous operation		max. +50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 1200 c/s 5.10^{10} counts

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

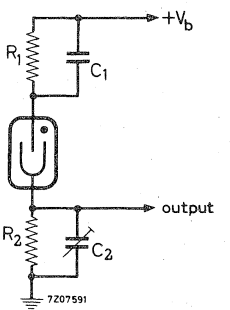
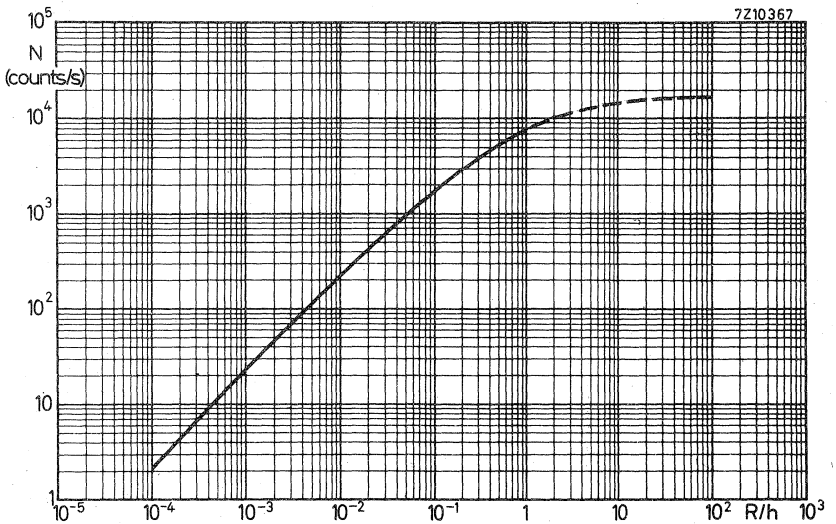
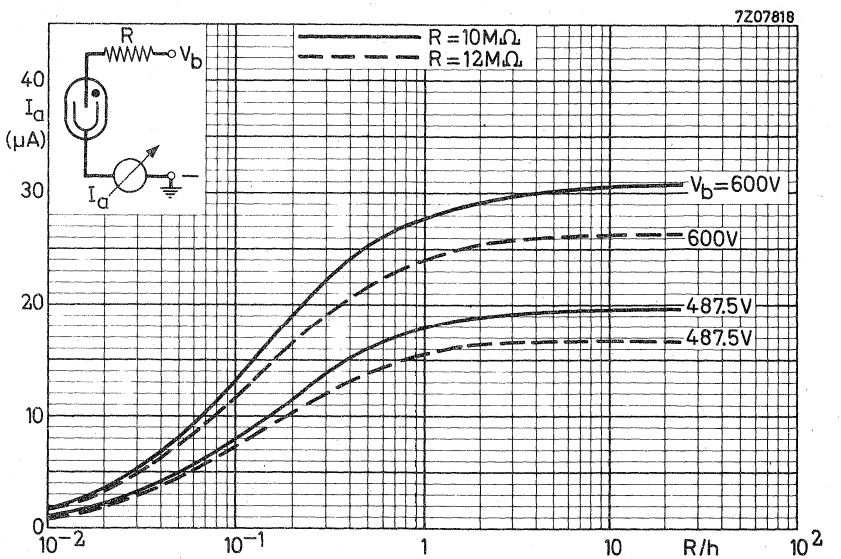


Fig.1

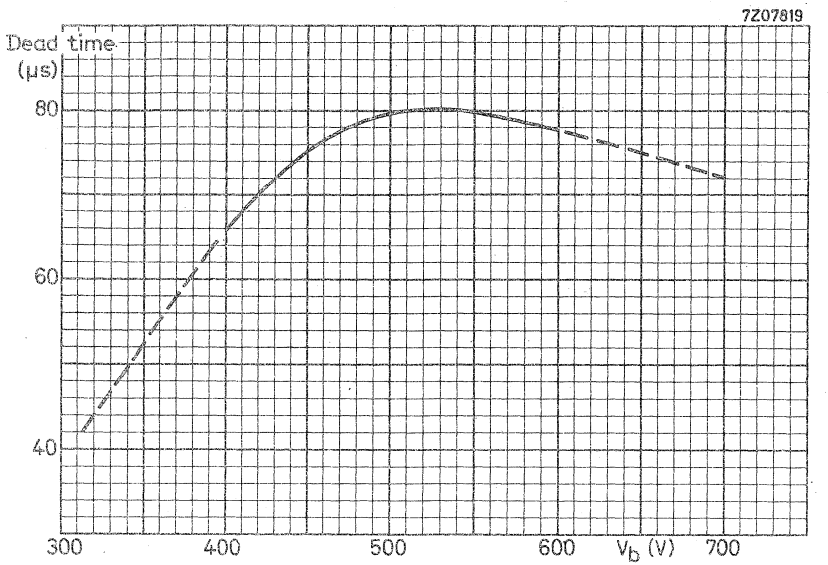
1) Temperature coefficient of starting voltage = 0.5 V/°C



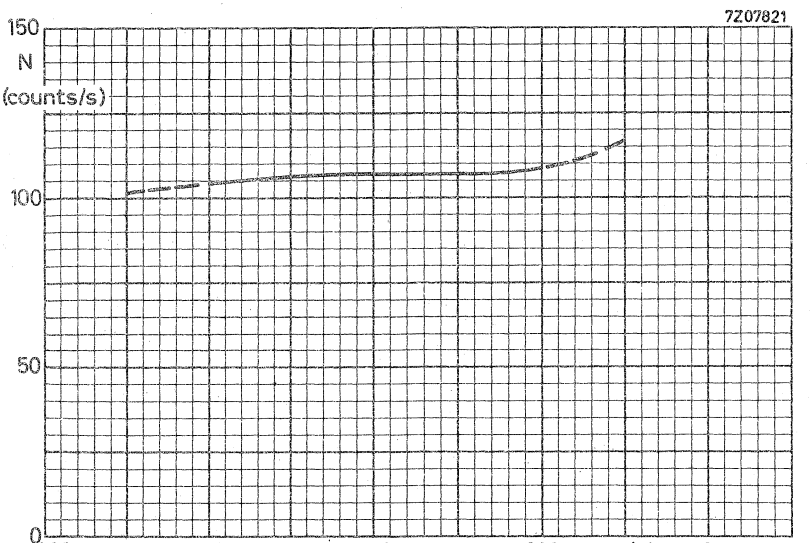
Count rate as function of dose rate



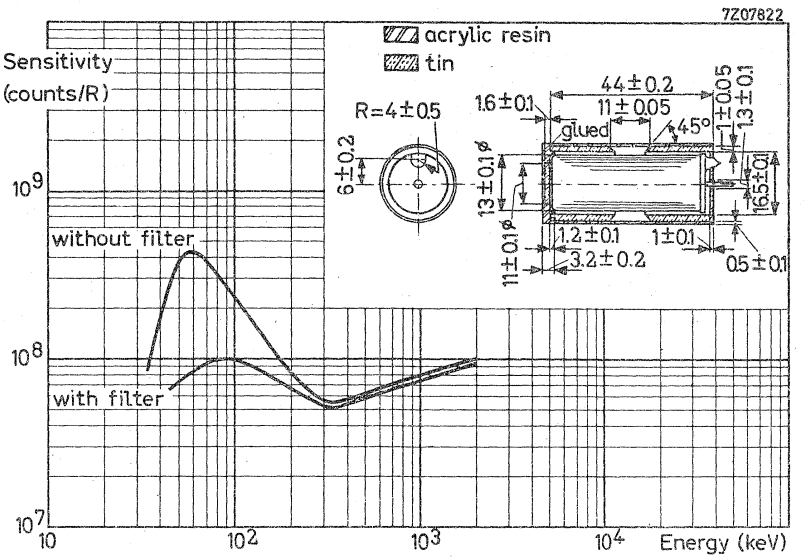
Current as function of dose rate



Dead time curve



Plateau curve



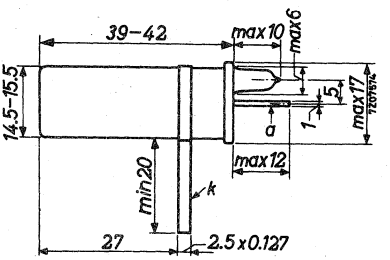
Energy response curve (side response), measured with suggested filter

BETA AND GAMMA RADIATION COUNTER TUBE

End window halogen quenched β and γ radiation counter tube.

QUICK REFERENCE DATA			
Effective range	10^{-4} to 1	R/h	
Plateau	400 to 600	V	
Recommended operating voltage	500	V	
Cr Fe cathode	250	mg/cm^2	
Mica window (Ø 9 mm)	2,0 to 3,0	mg/cm^2	

DIMENSIONS AND CONNECTIONS Dimensions in mm



WINDOW

Thickness	2,0 to 3,0	mg/cm^2	
Effective diameter	9	mm	
Material	mica		

CATHODE

Thickness	250	mg/cm^2	
Effective length	39	mm	
Material	28% Cr, 72% Fe		

FILLING Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	2	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) measured in circuit of fig. 1

Starting voltage	V_{ign}	max.	325	V [1]
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	400 to 600		V
Plateau slope	S_{pl}	max.	0.04	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b = 500V	N_o	max.	10	counts/min.
Dead time at V_b = 500 V	τ	max.	90	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R_1	min.	4.7	MΩ
Anode voltage	V_a	max.	600	V
Ambient temperature	t_{amb}	min.	−50	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 1200 c/s 5.10^{10} counts

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

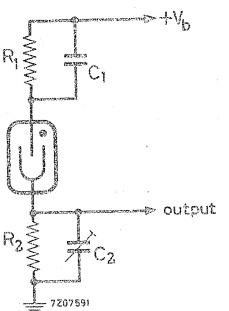
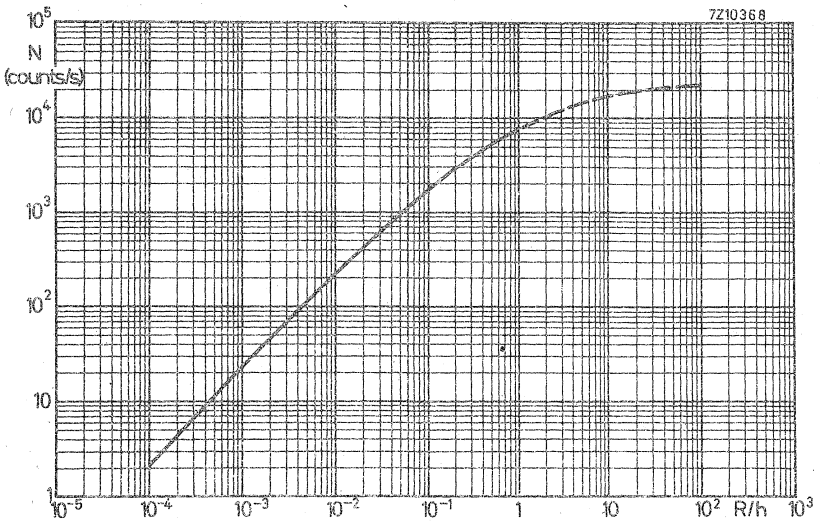
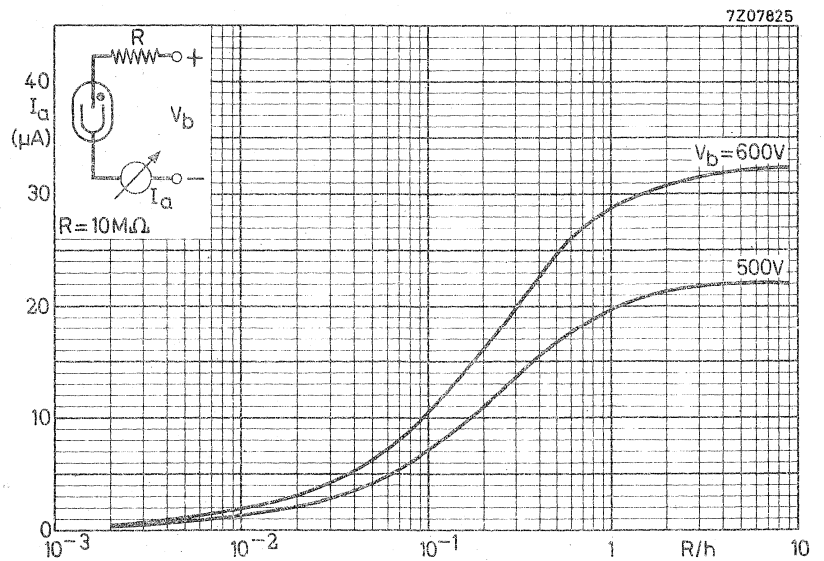


Fig. 1

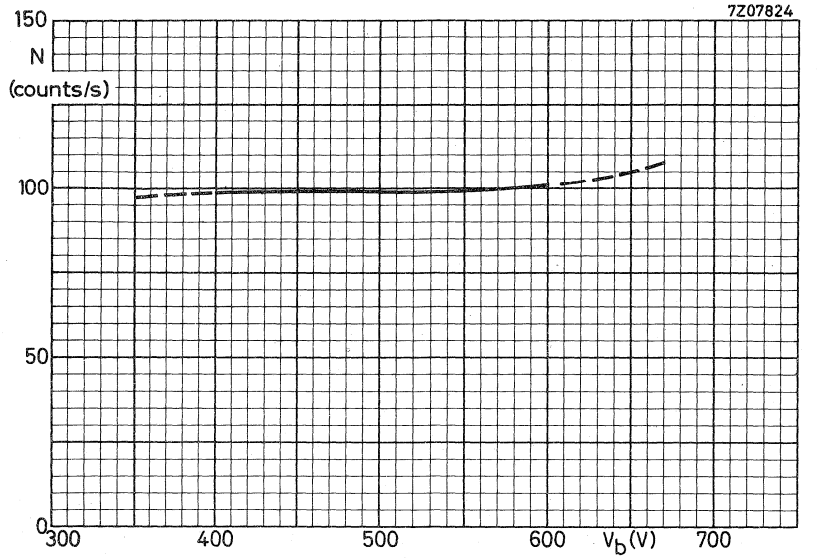
[1]) Temperature coefficient of starting voltage = 0.5 V/°C



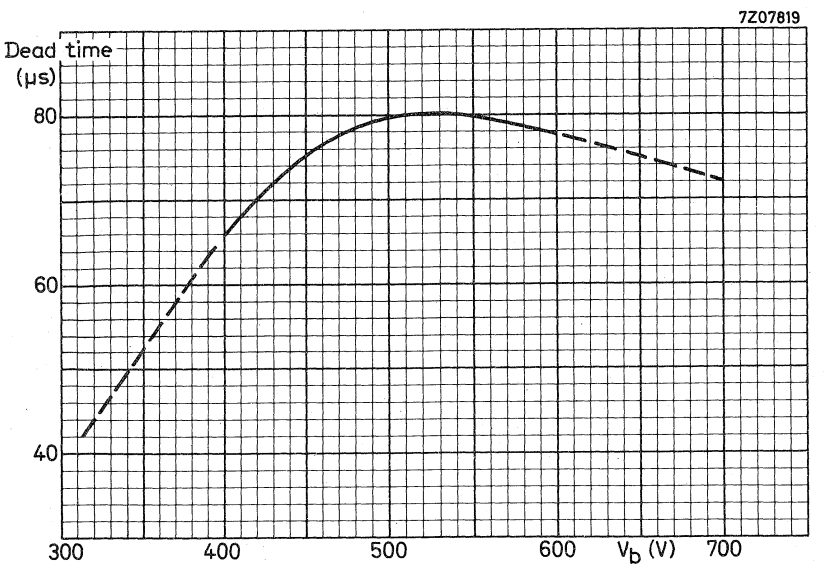
Count rate as function of dose rate



Current as function of dose rate



Plateau curve



Dead time curve

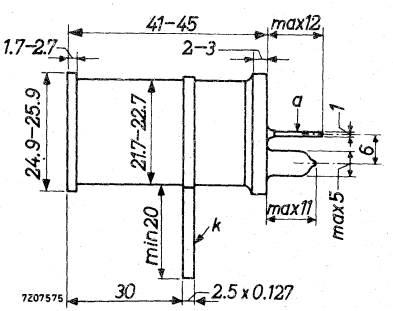
ALPHA, BETA AND GAMMA RADIATION COUNTER TUBE

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

QUICK REFERENCE DATA		
Effective range	10^{-4} to 3	R/h
Plateau	450 to 700	V
Recommended operating voltage	575	V
Cr Fe cathode	910	mg/cm^2
Mica window (Ø 19, 8 mm)	1, 5 to 2, 0	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



WINDOW

Thickness	1, 5 to 2, 0	mg/cm^2
Effective diameter	19, 8	mm
Material	mica	

CATHODE

Thickness	910	mg/cm^2
Effective length	37	mm
Material	28% Cr, 72% Fe	

FILLING

Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	2, 5	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) measured in circuit of fig.1

Starting voltage	V_{ign}	max. 350	V
Recommended operating voltage	V_b	arbitrary within plateau	
Plateau	V_{pl}	450 to 700	V
Plateau slope	S_{pl}	max. 0.02	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b=575V	N_o	max. 15	counts/min.
Dead time at V_b = 500 V	τ	max. 175	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R_1	min. 2.2	MΩ
Anode voltage	V_a	max. 700	V
Ambient temperature	t_{amb}	min. −50	°C
		max. +75	°C
for continuous operation		max. +50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 500 c/s 5.10^{10} counts

MEASURING CIRCUIT

R = 10 MΩ

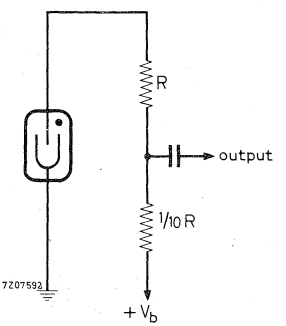
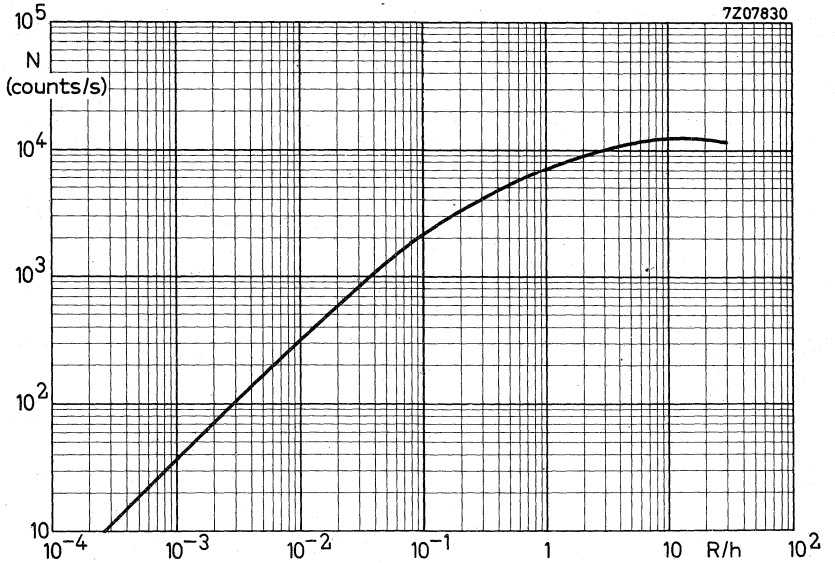
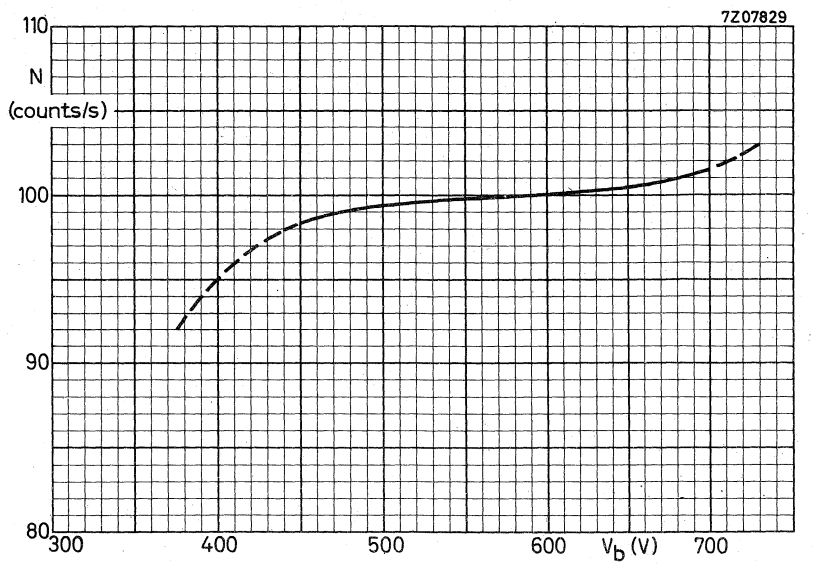


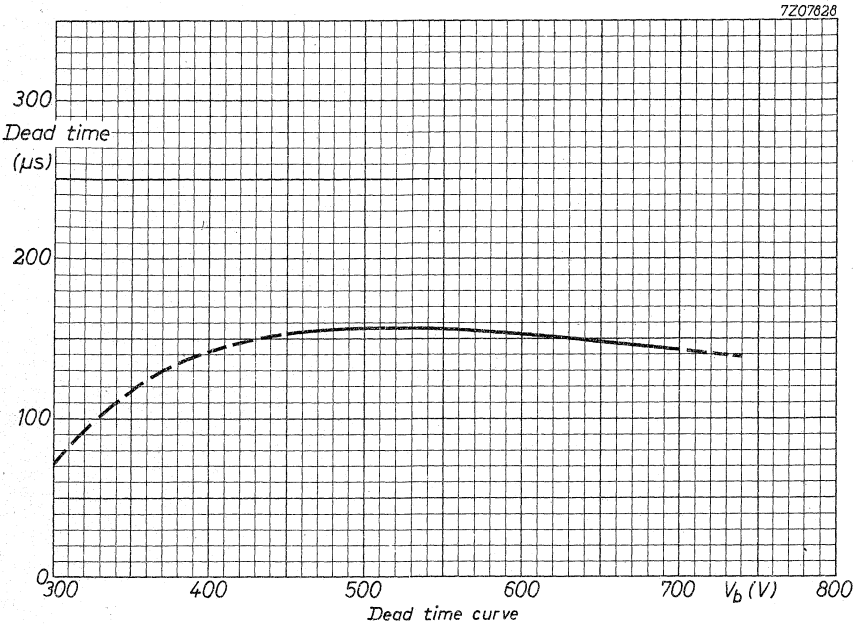
Fig.1



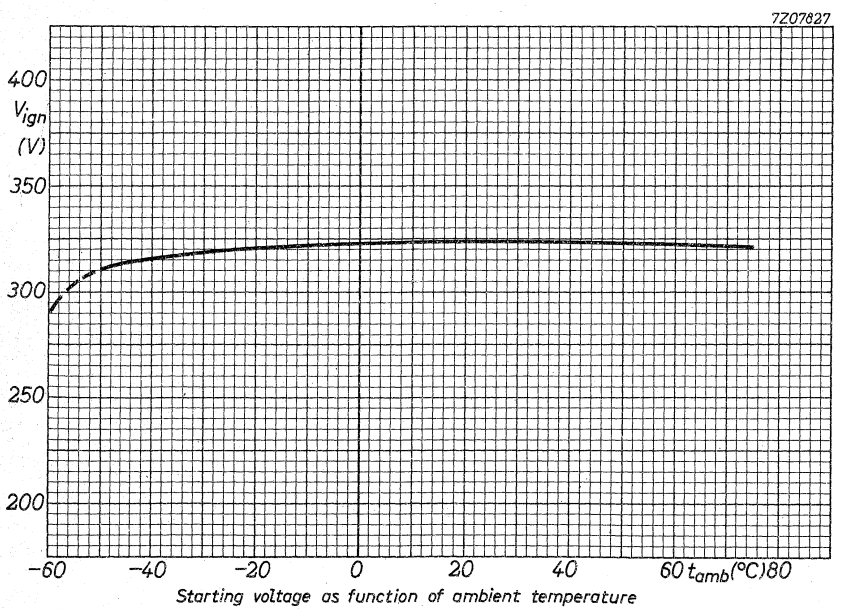
Count rate as function of dose rate



Plateau curve



Dead time curve



Starting voltage as function of ambient temperature

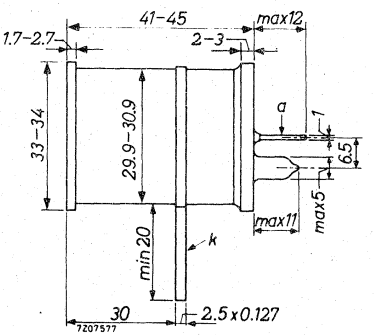
BETA AND GAMMA RADIATION COUNTER TUBE

End window halogen quenched β and γ radiation counter tube.

QUICK REFERENCE DATA			
Effective range	10^{-4} to	2	R/h
Plateau	450 to	700	V
Recommended operating voltage		575	V
Cr Fe cathode		980	mg/cm^2
Mica window (Ø 27, 8 mm)	2, 5 to	3, 5	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



WINDOW

Thickness	2, 5 to 3, 5	mg/cm^2
Effective diameter	27, 8	mm
Material	mica	

CATHODE

Thickness	980	mg/cm^2
Effective length	37	mm
Material	28% Cr, 72 Fe	

FILLING Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	3.5	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of fig.1.

Starting voltage	V_{ign}	max.	375	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	450 to	700	V
Plateau slope	S_{pl}	max.	0.035	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b = 575 V	N_o	max.	25	counts/min.
Dead time at V_b = 575 V	τ	max.	190	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R_1	min.	2.2	MΩ
Anode voltage	V_a	max.	700	V
Ambient temperature	t_{amb}	min.	−50	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 2200 c/s		5.10^{10}	counts

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

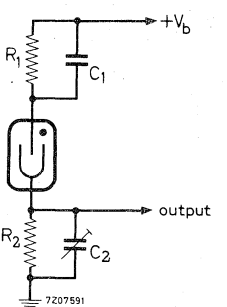
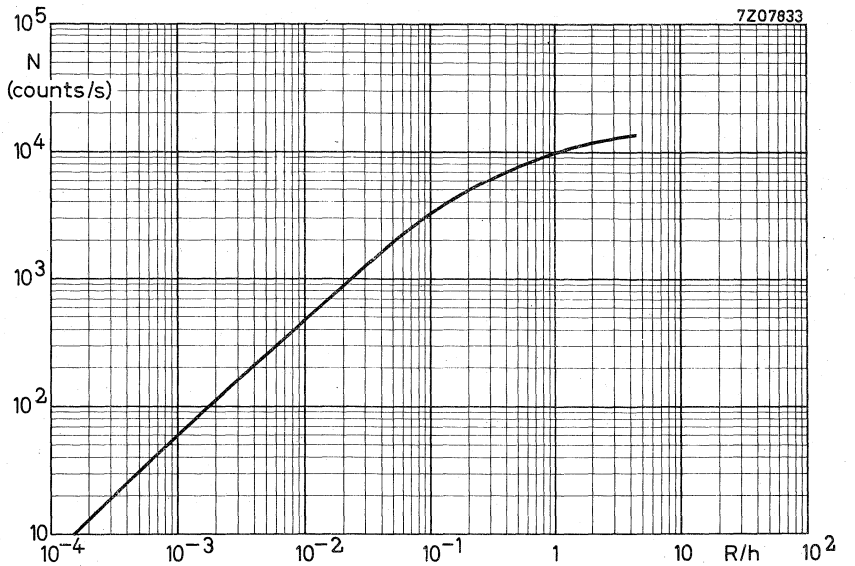
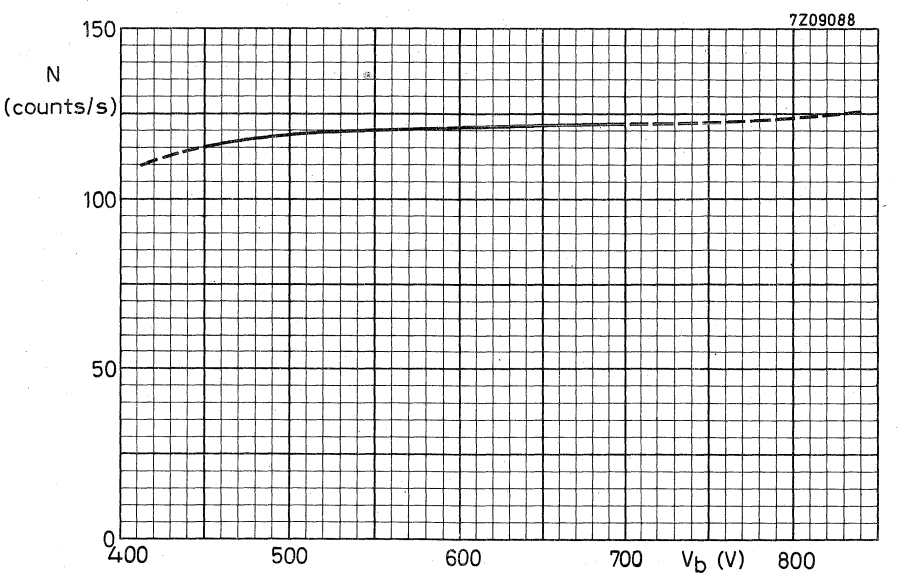


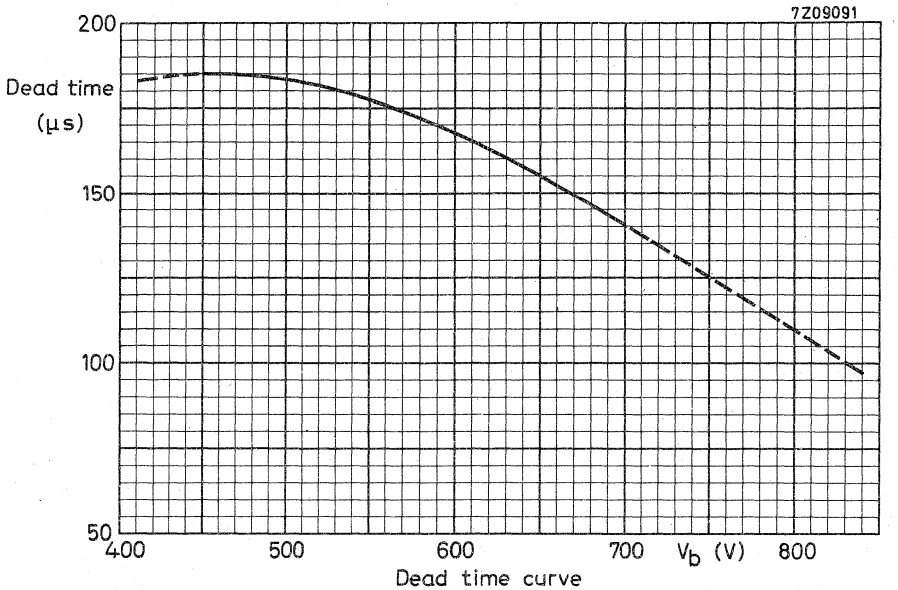
Fig.1



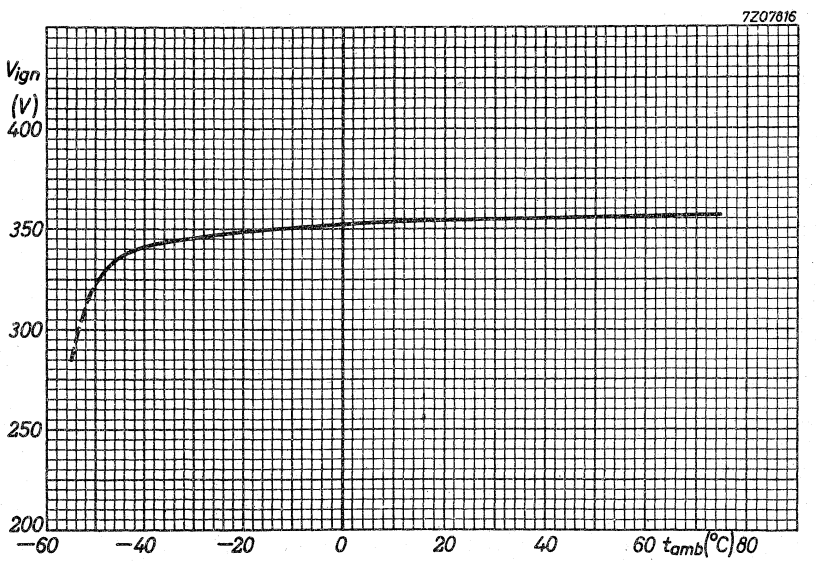
Count rate as function of dose rate (side response)



Plateau curve



Dead time curve



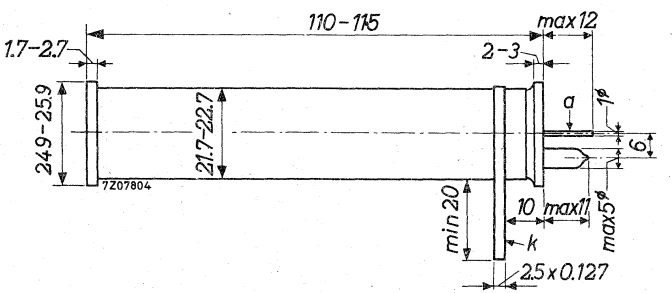
Starting voltage as function of ambient temperature

X-RAY COUNTER TUBE

End window halogen quenched X-ray counter tube.

QUICK REFERENCE DATA			
Energy range	2,5 to 20	KeV	
Wavelength	0,06 to 0,5	nm	
Plateau	1600 to 2000	V	
Recommended operating voltage	1800	V	
Cr Fe cathode	910	mg/cm^2	
Mica window (Ø 19,8 mm)	2,5 to 3,5	mg/cm^2	

DIMENSIONS AND CONNECTIONS Dimensions in mm



WINDOW

Thickness	2,5 to 3,5	mg/cm^2
Effective diameter	19,8	mm
Material	mica	

CATHODE

Thickness	910	mg/cm^2
Effective length	107	mm
Material	28% Cr, 72% Fe	

FILLING A, halogen

Gas pressure 62,7 kPa (47 cm Hg)

Caution: Air transport in airtight boxes only

CAPACITANCE

Anode to cathode	C_{ak}	2,8	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C). Measured in circuit of fig.1.

Starting voltage	V_{ign}	max.	1450	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	1600 to 2000		V
Plateau slope	S_{pl}	max.	0.04	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b=1800V	N_o	max.	25	counts/min.
Dead time at V_b = 1800 V	τ	max.	110	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	5	MΩ
Anode voltage	V_a	max.	2000	V
Ambient temperature	t_{amb}	min.	0	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 900 c/s 10^{10} counts

MEASURING CIRCUIT

R = 5 MΩ

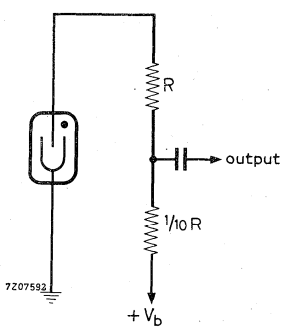
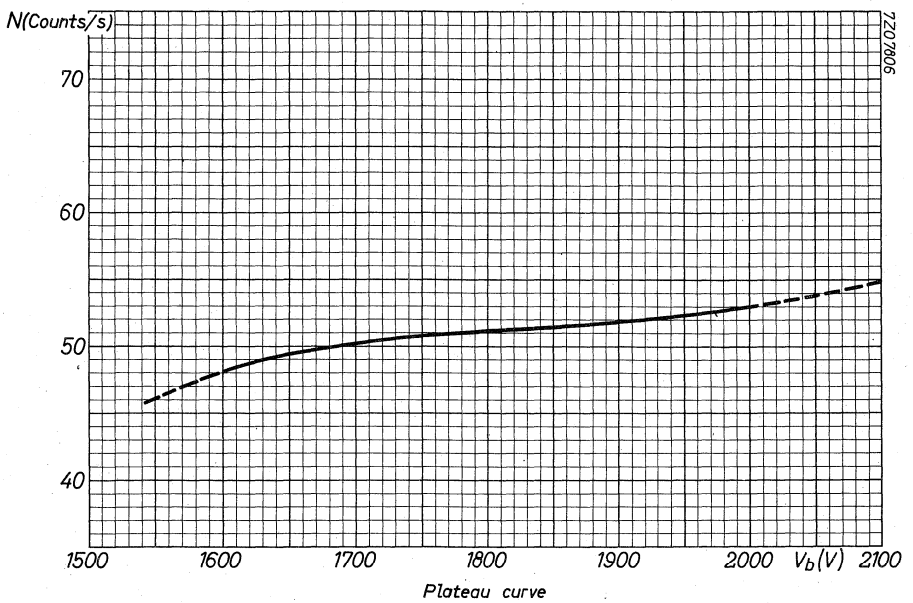
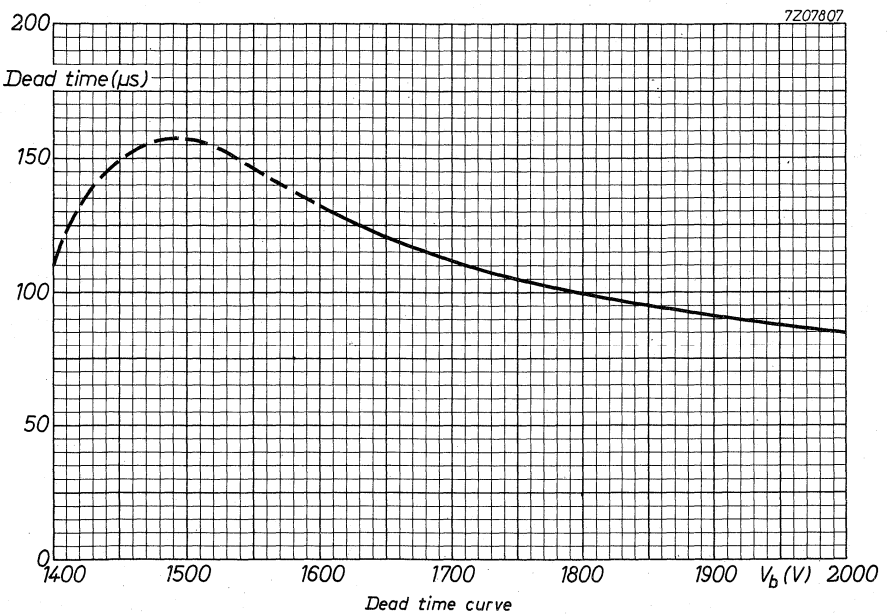


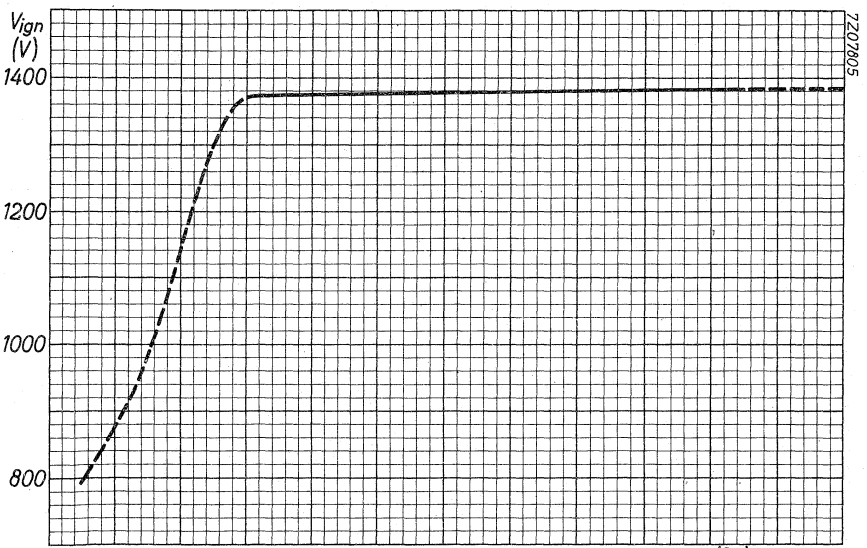
Fig.1



Plateau curve



Dead time curve



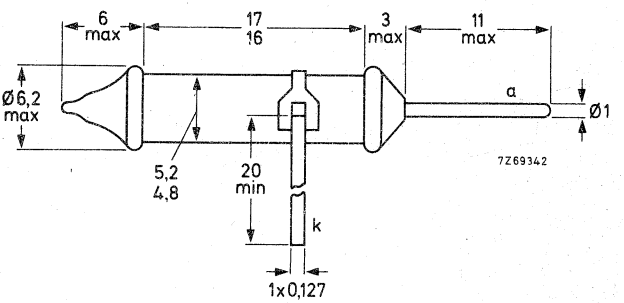
Starting voltage as function of temperature

BETA AND GAMMA RADIATION COUNTER TUBE

Halogen quenched radiation counter tube for the measurement of γ and high energy β ($> 0,5$ Me V) radiation.

QUICK REFERENCE DATA		
Effective range	10^{-3} to 3 x 10^{2}	R/h
Plateau	500 to 650	V
Recommended operating voltage	575	V
Cr Fe cathode	80 to 100	mg/cm^2

DIMENSIONS AND CONNECTIONS Dimensions in mm



CATHODE

Thickness		80 to 100	mg/cm^2
Effective length		16	mm
Material		28% Cr, 72% Fe	

FILLING He, Ne, halogen

CAPACITANCE

Anode to cathode	C_{ak}	1	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of fig.1

Starting voltage	V_{ign}	max. 380 V
Recommended operating voltage	V_b	arbitrary within plateau
Plateau	V_{pl}	500 to 650 V
Plateau slope	S_{pl}	max. 0.15 %/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b=575V	N_o	max. 2 counts/min.
Dead time at V_b = 600 V	τ	max. 15 μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min. 2.2 MΩ
Anode voltage	V_a	max. 650 V
Ambient temperature	t_{amb}	min. −40 °C
		max. +75 °C
for continuous operation		max. +50 °C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 4500 c/s 5.10^{10} counts

MEASURING CIRCUIT

R_1 = 2.2 MΩ

R_2 = 56 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

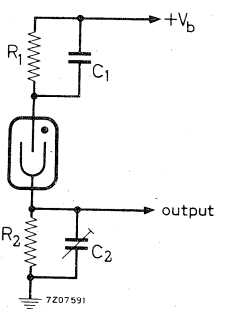
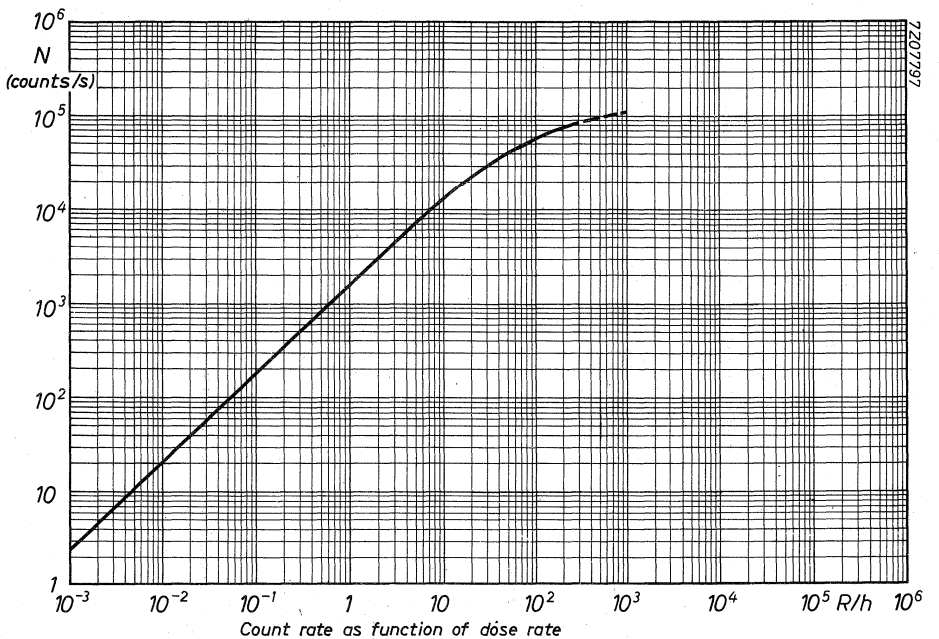
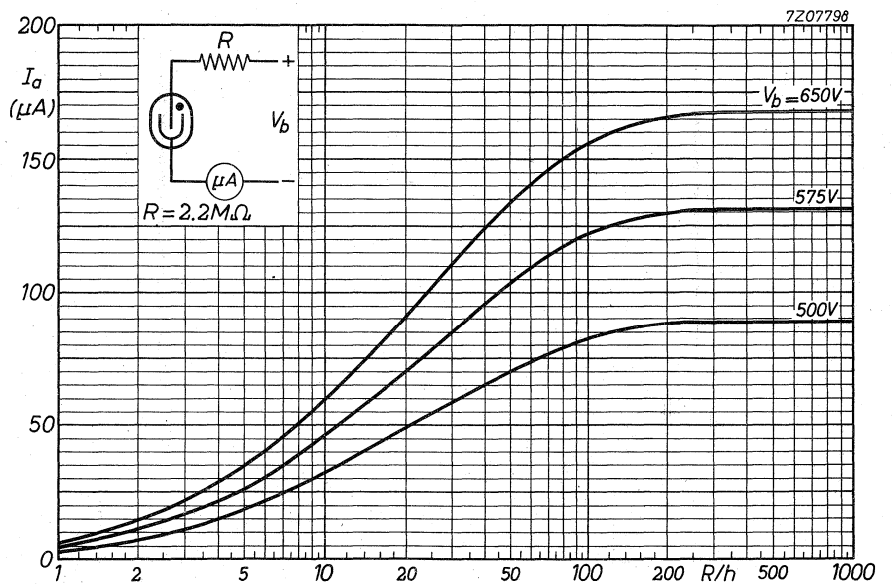


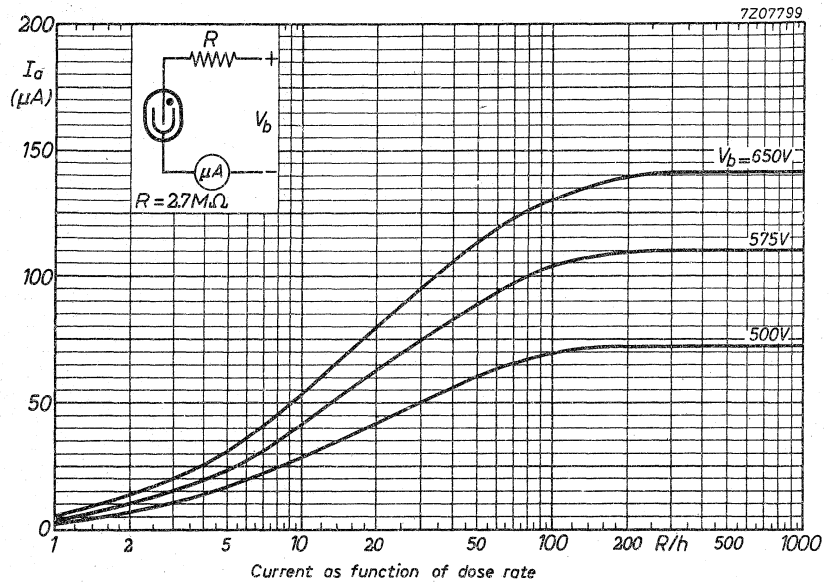
Fig.1



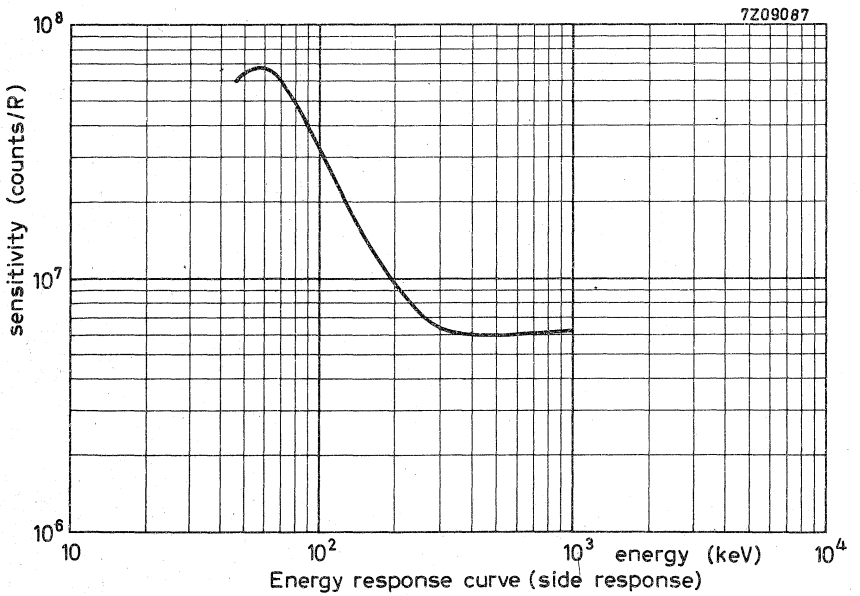
Count rate as function of dose rate



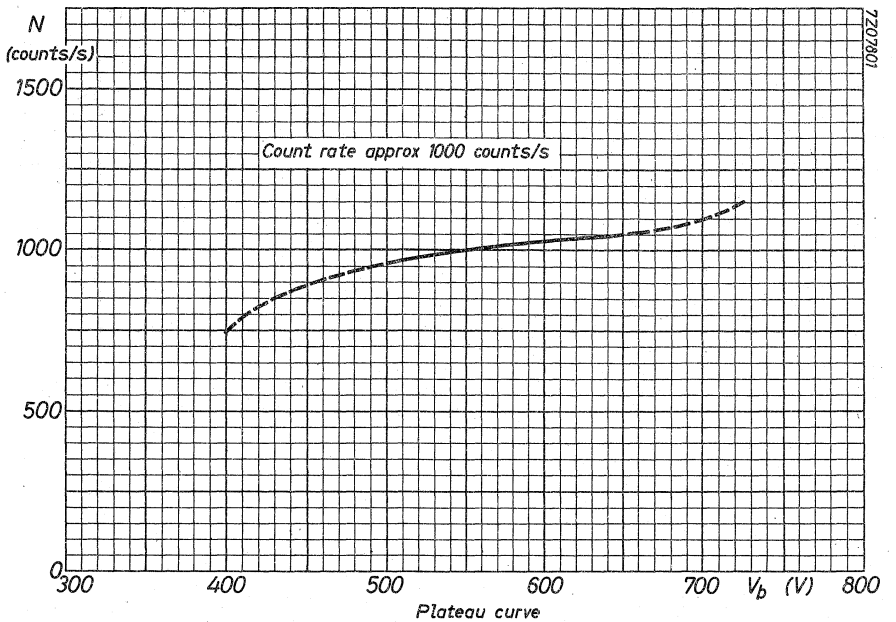
Current as function of dose rate



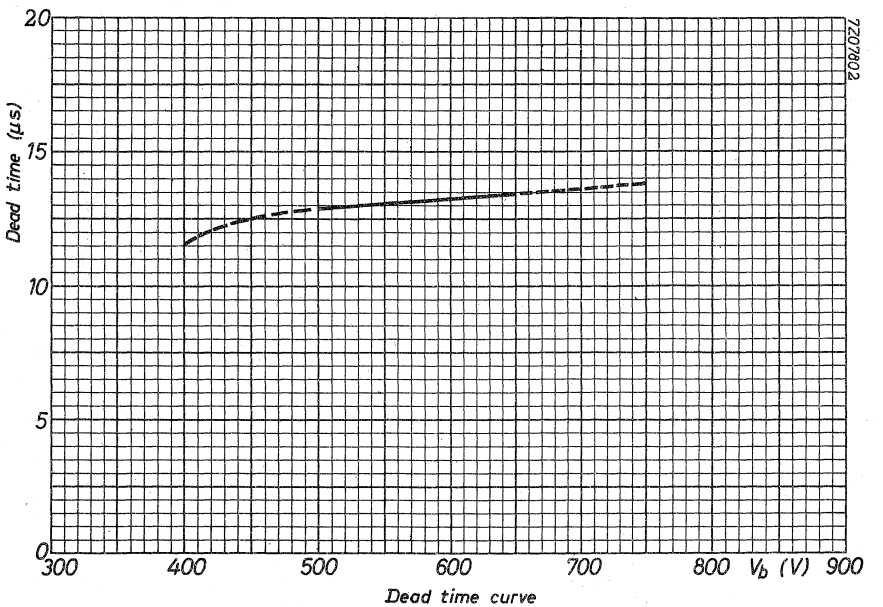
Current as function of dose rate



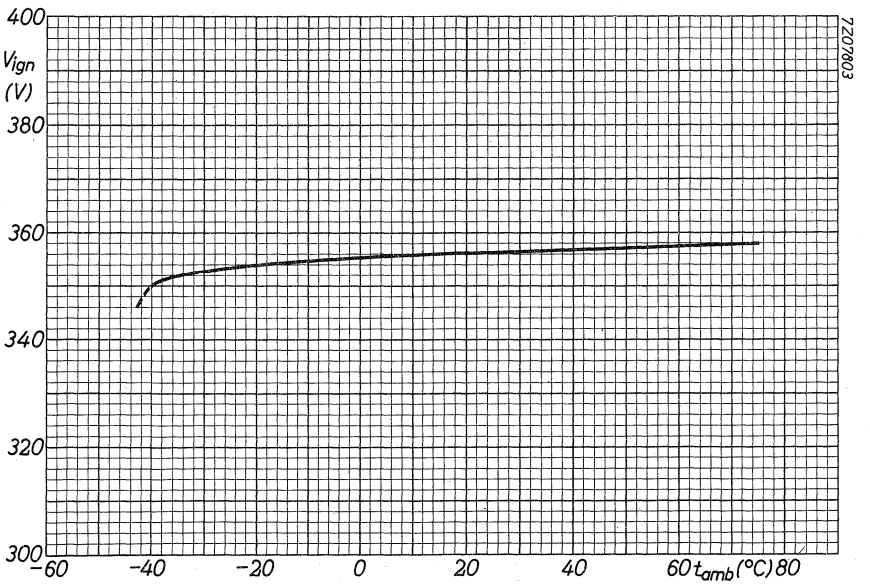
Energy response curve (side response)



Plateau curve



Dead time curve



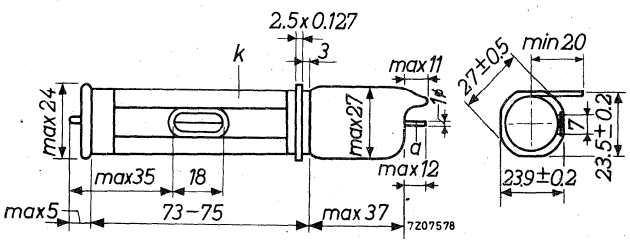
Starting voltage as function of ambient temperature

X-RAY COUNTER TUBE

Side window organic quenched X-ray counter tube

QUICK REFERENCE DATA		
Energy range	2,5 to 40	KeV
Wavelength	0,03 to 0,5	nm
Operating voltage range	1500 to 1800	V
Mica window (7 x 18 mm)	2,0 to 2,5	mg/cm^2

DIMENSIONS AND CONNECTIONS Dimensions in mm



WINDOW

Thickness	2,0 to 2,5	mg/cm^2
Dimensions	7 x 18	mm^2
Material	mica	

CATHODE

Effective length	67	mm
Material	28% Cr, 72% Fe	

FILLING Xenon, organic vapour

Xenon pressure 25 cm Hg

CAPACITANCE

Anode to cathode	C_{ak}	2	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of fig.1.

Operating voltage	V_b	1500 to 1850	V	1)
Geiger threshold		min. 1900	V	
Operating voltage for pulse amplitude V_p = 1 mV	V_b	1460 to 1540	V	2)
Operating voltage for pulse amplitude V_p = 10 mV	V_b	1690 to 1770	V	2)
Energy resolution (See page 3)	$\Delta P/P$	max. 22	%	2)3)
Integrated background for pulses 50% of the pulse amplitude P (unshielded), at V_b = 1550 V		15	counts/min.	2)

LIMITING VALUES (Absolute max. rating system)

Anode voltage	V_a	max. 1850	V	
Ambient temperature	t_{amb}	min. −20	°C	
		max. +50	°C	

MEASURING CIRCUIT

R_1 = 2.2 kΩ

R_2 = 0.1 MΩ

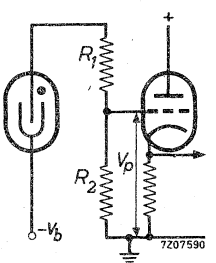
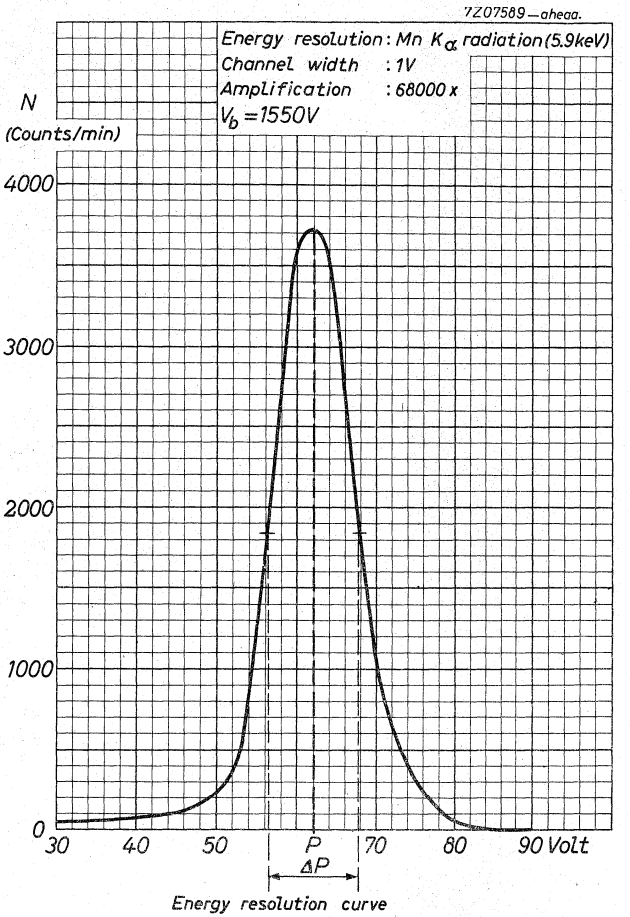


Fig.1

1) To obtain max. tube life V_b should be kept as low as possible.
2) For Mn Kα radiation (5.9 keV)
3) P= average pulse height, ΔP = width of the pulse height distribution at half of the max. value.

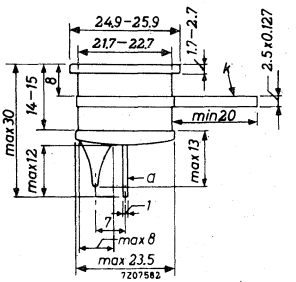

7Z07589—aheaa.
Energy resolution: Mn K_α radiation (5.9keV)
Channel width : 1V
Amplification : 68000 x
V_b = 1550V
N
(Counts/min)
4000
3000
2000
1000
0
30
40
50
P
70
80
90 Volt
ΔP
Energy resolution curve

ALPHA AND BETA RADIATION COUNTER TUBE

End window halogen quenched α and β radiation counter tube for low level measurements in combination with a guard counter (e.g. type 18518).

QUICK REFERENCE DATA		
Effective range	10^{-2} to 10	R/h
Plateau	500 to 700	V
Recommended operating voltage	600	V
Cr Fe cathode	910	mg/cm^2
Mica window (Ø 19, 8 mm)	1, 5 to 2, 0	mg/cm^2

DIMENSIONS AND CONNECTIONS Dimensions in mm



WINDOW		
Thickness	1, 5 to 2, 0	mg/cm^2
Effective diameter	19, 8	mm
Material	mica	
CATHODE		
Thickness	910	mg/cm^2
Effective length	13	mm
Material	28% Cr, 72% Fe	
FILLING	Ne, A, halogen	
CAPACITANCE		
Anode to cathode	C_{ak} 1	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of fig. 1

Starting voltage	V_{ign}	max.	350	V
Recommended operating voltage	V_b	arbitrary within plateau [1]		
Plateau	V_{pl}	500 to 700		V
Plateau slope	S_{pl}	max.	0.09	%/V
Background, shielded with 100 mm Fe and 30 mm Pb, Fe outside, at V_b = 600 V	N_o	max.	5	counts/min.
Background in anticoincidence circuit with guard counter 18518, shielded with 100 mm Fe and 30 mm Pb, Fe outside, at V_b = 600 V	N_o	max.	1.2	counts/min.
Dead time at V_b = 600 V	τ	max.	65	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	2.2	MΩ
Anode voltage	V_a	max.	700	V
Ambient temperature	t_{amb}	min.	-50	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 4300 c/s: 5.10^{10} counts

MEASURING CIRCUIT

R_1 = 4.7 MΩ

R_2 = 100 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

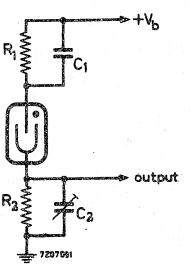
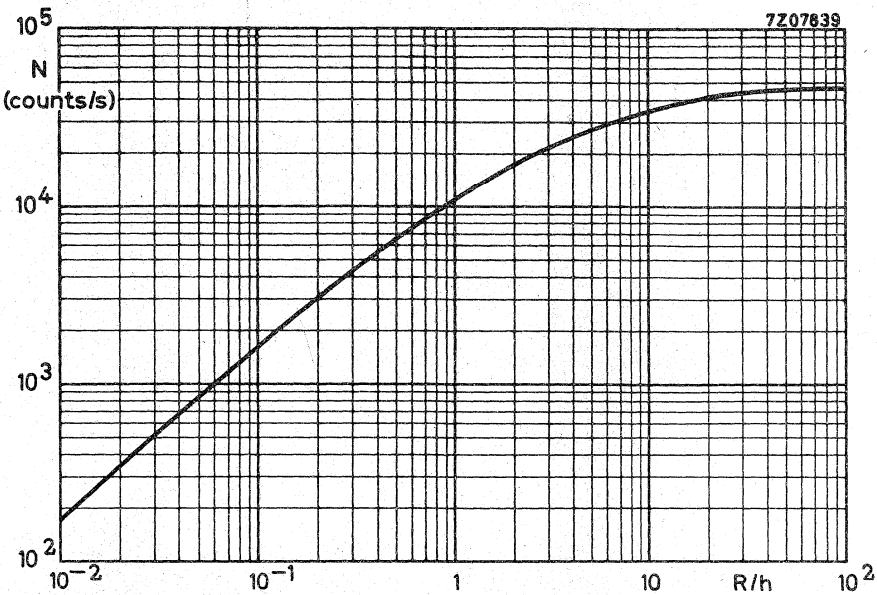


Fig. 1

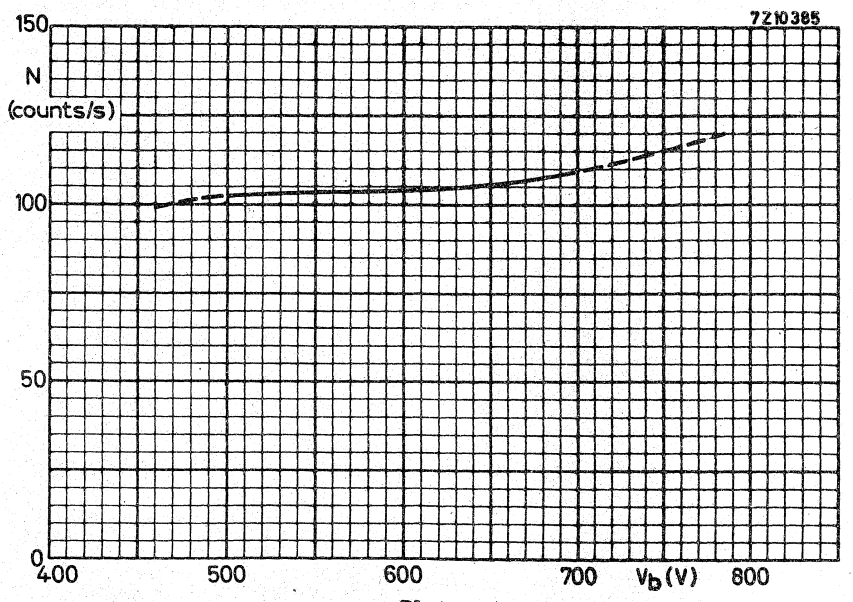
REMARK

In order to prevent leakage the tube should be kept dry and well cleaned.

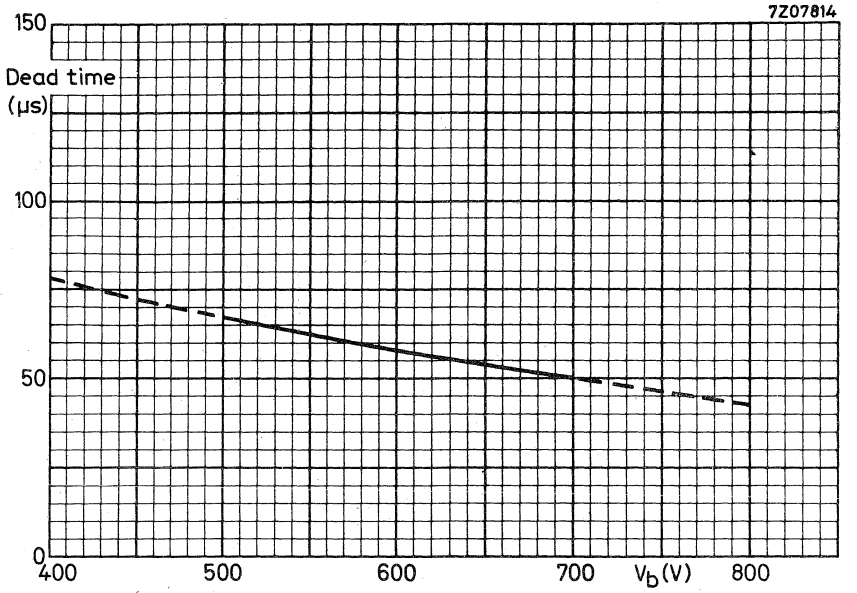
[1]) For application in anticoincidence circuits the recommended value of V_b = 600 V.



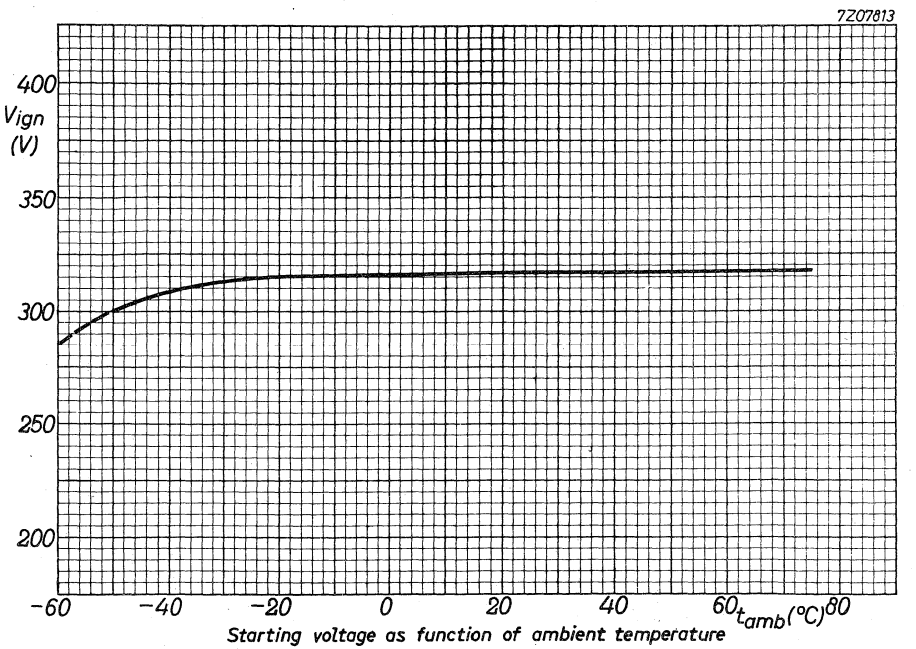
Count rate as function of dose rate



Plateau curve



Dead time curve



Starting voltage as function of ambient temperature

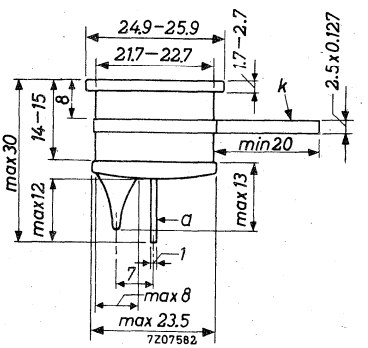
ALPHA AND BETA RADIATION COUNTER TUBE

End window halogen quenched α and β radiation counter tube.

QUICK REFERENCE DATA				
Effective range	10^{-2}	to	10	R/h
Plateau	500	to	700	V
Recommended operating voltage			600	V
Cr Fe cathode			910	mg/cm^2
Mica window (Ø 19, 8 mm)	1, 5	to	2, 0	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



WINDOW				
Thickness	1, 5	to	2, 0	mg/cm^2
Effective diameter			19, 8	mm
Material			mica	
CATHODE				
Thickness			910	mg/cm^2
Effective length			13	mm
Material	28 % Cr, 72 % Fe			
FILLING	Ne, A, halogen			
CAPACITANCE				
Anode to cathode	C_{ak}		1	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of Fig.1.

Starting voltage	V_{ign}	≤ 350	V
Recommended operating voltage	V_b	arbitrary within plateau	
Plateau	V_{pl}	500 to 700	V
Plateau slope	S_{pl}	≤ 0,09	%/V
Background, shielded with 100 mm Fe and 30 mm Pb, Fe outside, at V_b = 600 V	N_o	≤ 8	counts/min
Dead time at V_b = 600 V	τ	≤ 65	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min. 2,2	MΩ
Anode voltage	V_a	max. 700	V
Ambient temperature	t_{amb}	max. +75 min. -50	°C °C
for continuous operation	t_{amb}	max. +50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 4300 c/s: 5×10^{10} counts

MEASURING CIRCUIT

R_1 = 4,7 MΩ

R_2 = 100 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

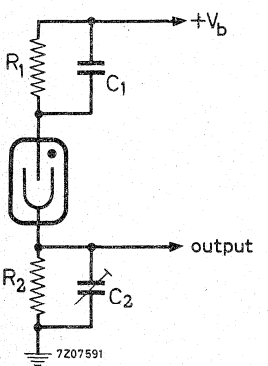
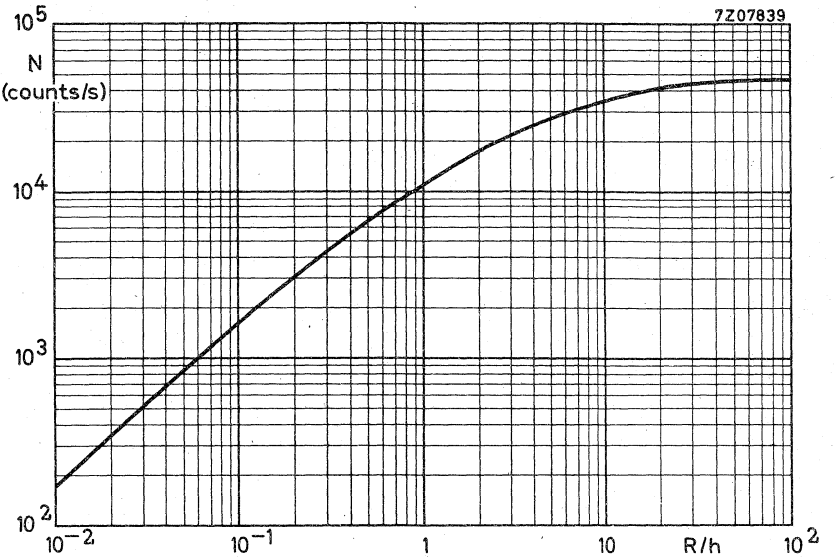


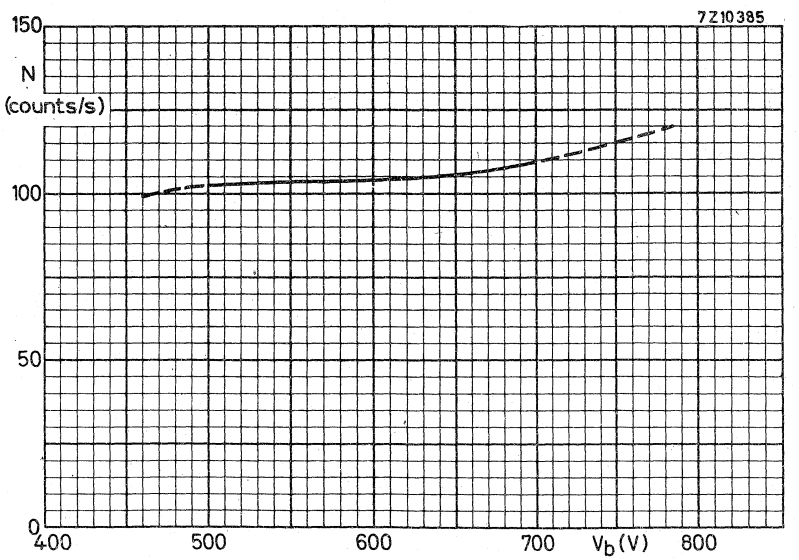
Fig. 1

REMARK

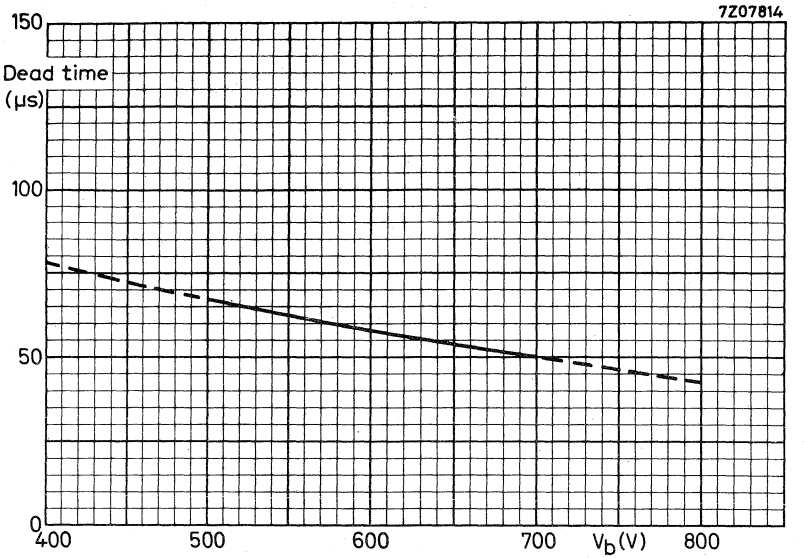
In order to prevent leakage the tube should be kept dry and clean.



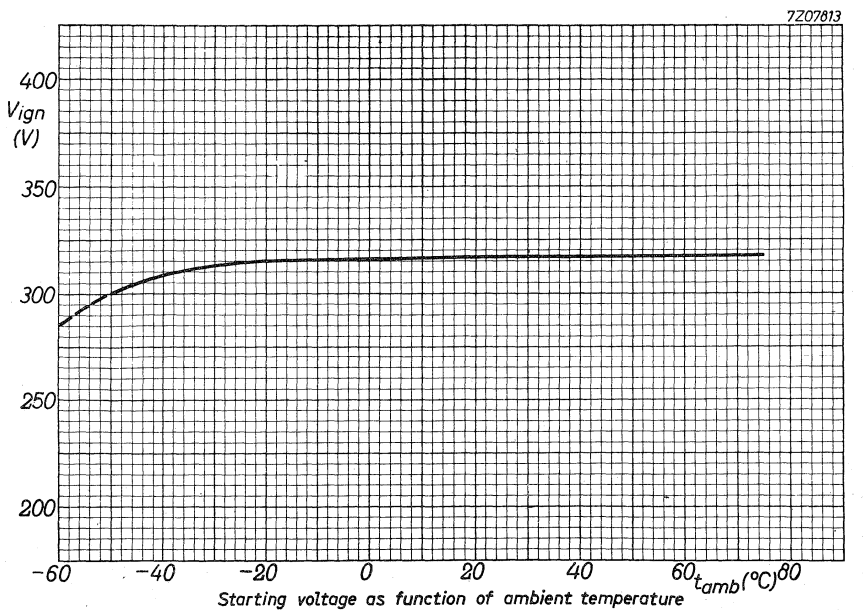
Count rate as function of dose rate
(measured with ^{60}Co)



Plateau curve



Dead time curve



Starting voltage as function of ambient temperature

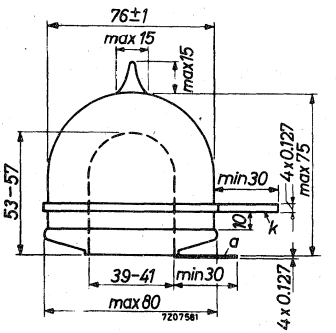
COSMIC RAY GUARD COUNTER TUBE

Halogen quenched cosmic ray guard counter tube for low background measurements in combination with β counter (e.g. type 18515 or 18536) in an anticoincidence circuit. It can also be used in combination with a gas-flow counter.

QUICK REFERENCE DATA		
Effective range	4×10^{-2} to 10	mR/h
Plateau	800 to 1200	V
Recommended operating voltage	1000	V
Cr Fe cathode	760	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CATHODE AND ANODE

Thickness	760	mg/cm^2
Material	28% Cr, 72% Fe	

FILLING

Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	8	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of fig.1

Starting voltage	V_{ign}	max.	650	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau (at 50 counts/s)	V_{pl}	800 to 1200		V
Plateau slope (at 50 counts/s)	S_{pl}	max.	0.03	%/V
Background, shielded with 100 mm Fe and 30 mm Pb, Fe outside, at V_b = 1000V	N_o	max.	70	counts/min.
Dead time (at 50 counts/s)	τ	max.	1	ms

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	10	MΩ
Anode voltage	V_a	max.	1200	V
Ambient temperature	t_{amb}	min.	-50	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 1300 c/s 5.10^{10} counts

MEASURING CIRCUIT

For use as guard counter tube in anticoincidence circuits in combination with 18515 or 18536: recommended circuit see fig.2.

R = 10 MΩ

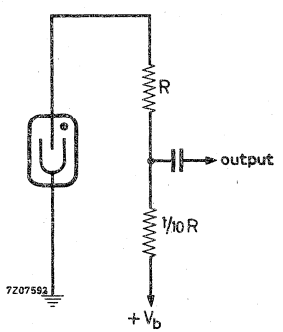


Fig.1

R_1 = 10 MΩ

R_2 = 10 MΩ

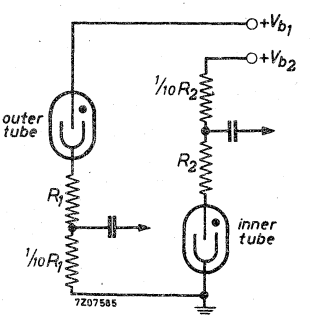
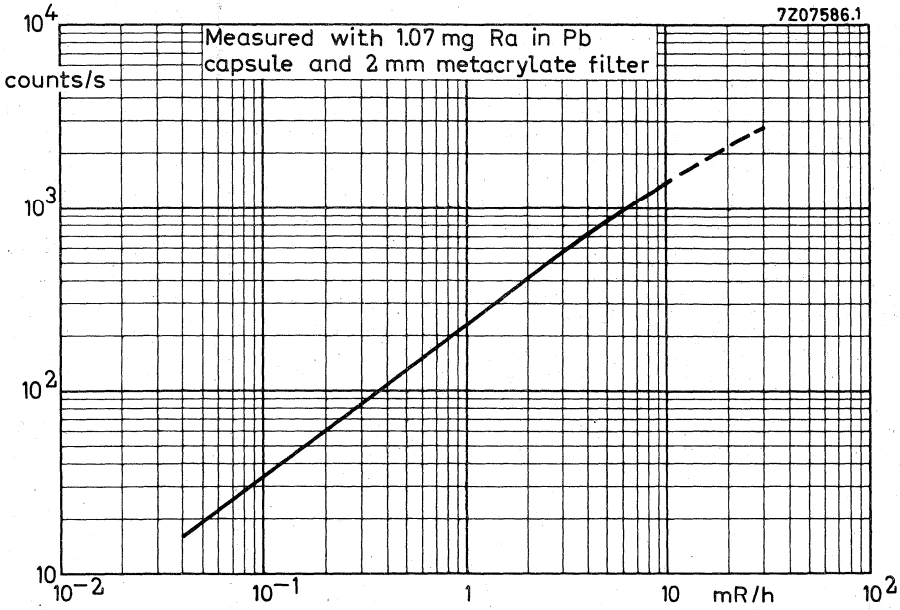
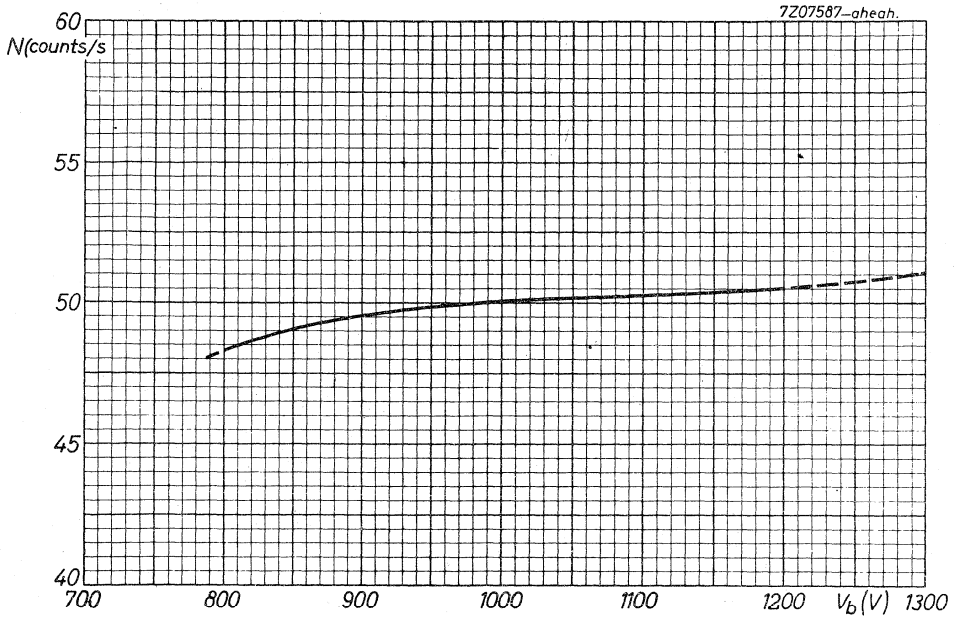


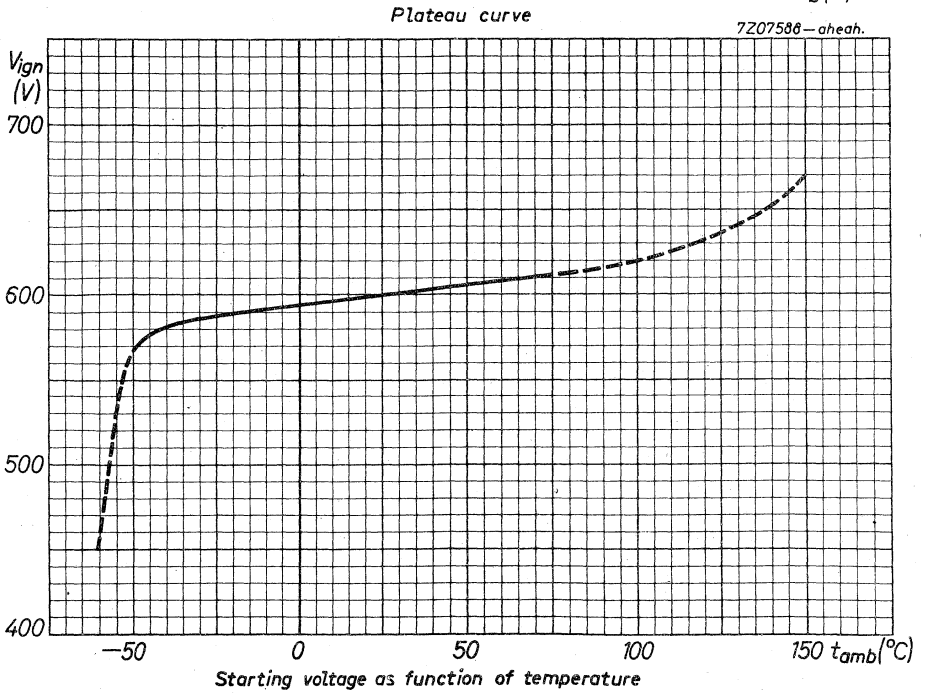
Fig.2



Count rate as function of dose rate



Plateau curve



Starting voltage as function of temperature

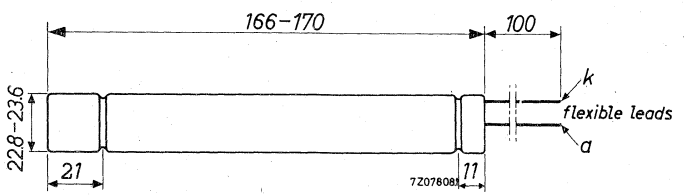
GAMMA RADIATION COUNTER TUBE

Halogen quenched γ radiation counter tube.

QUICK REFERENCE DATA		
Effective range	4×10^{-4} to 2×10^{-1}	R/h
Plateau	375 to 475	V
Recommended operating voltage	420	V
Cr Fe cathode	525	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CATHODE

Thickness		525	mg/cm^2
Effective length		140	mm
Material		27% Cr, 73% Fe	

FILLING

Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	4,5	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C). Measured in circuit of fig. 1.

Starting voltage	V_{ign}	≤	360	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	375 to 475		V
Plateau slope	S_{pl}	≤	0,15	%/V
Background, shielded with 50 mm Pb, at Vb = 420 V	N_o	≤	50	counts/min.
Dead time at V_b = 420 V	τ	≤	200	µs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	2,2	MΩ
Anode voltage	V_a	max.	475	V
Ambient temperature	t_{amb}	min.	−50	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C: 5×10^{10} counts

MEASURING CIRCUIT

R = 2,7 MΩ

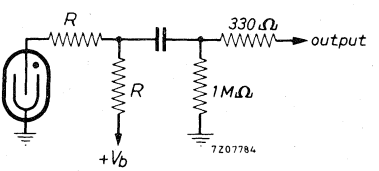
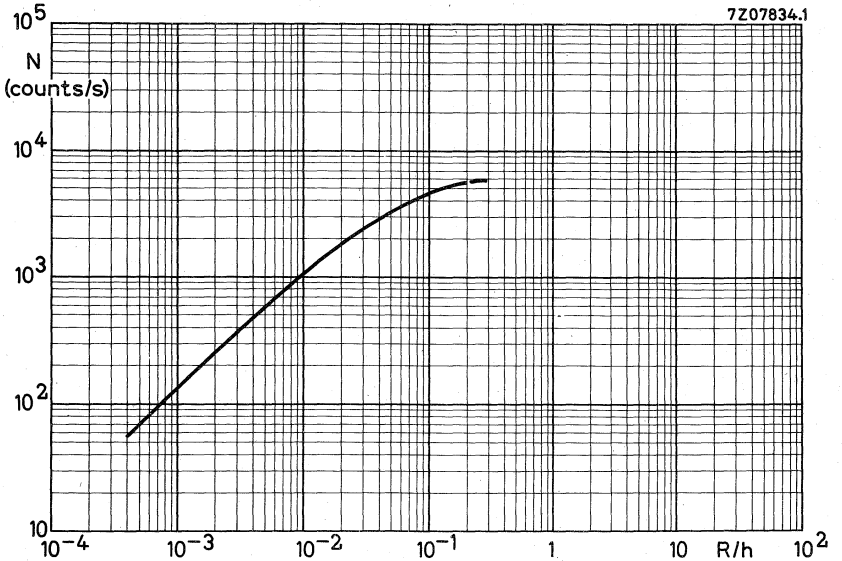
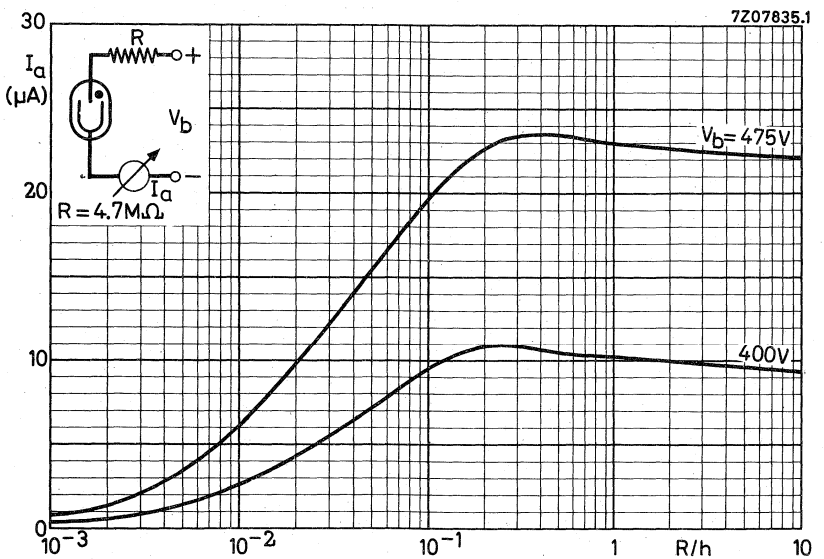


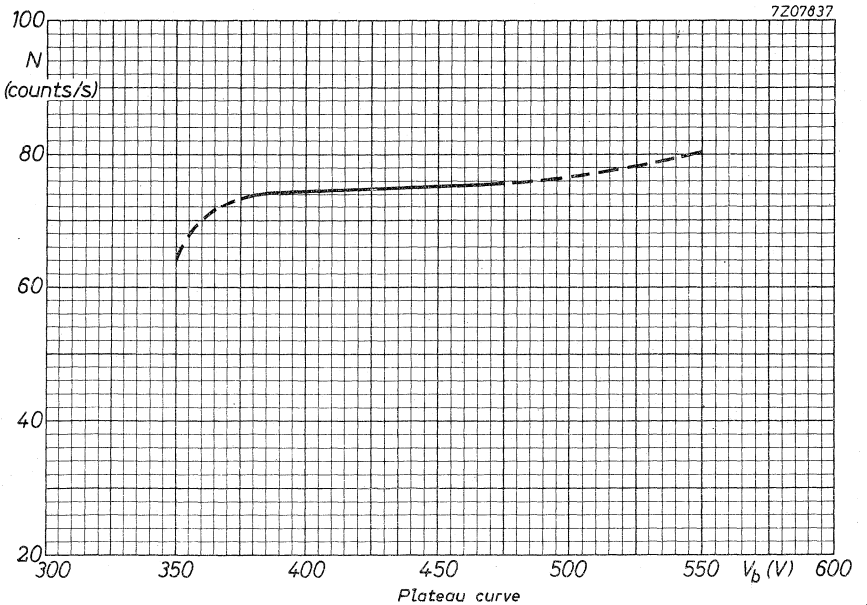
Fig. 1



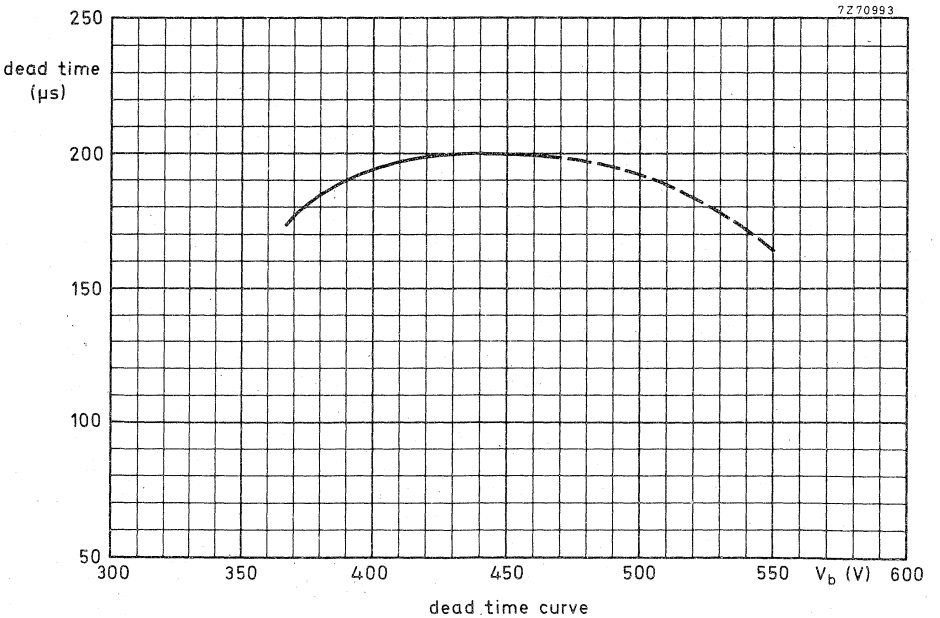
Count rate as function of dose rate



Current as function of dose rate



Plateau curve



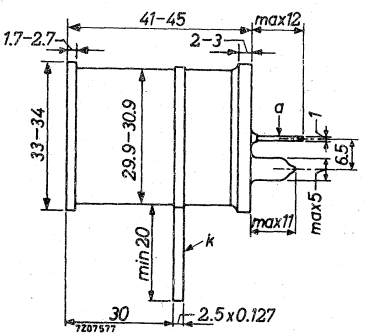
dead time curve

ALPHA, BETA AND GAMMA RADIATION COUNTER TUBE

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

QUICK REFERENCE DATA		
Effective range	10^{-4} to 2	R/h
Plateau	450 to 700	V
Recommended operating voltage	575	V
Cr Fe cathode	980	mg/cm^2
Mica window (Ø 27, 8 mm)	1, 5 to 2, 0	mg/cm^2

DIMENSIONS AND CONNECTIONS Dimensions in mm



cathode connector
0, 127 mm thick

WINDOW

Thickness	1, 5 to 2, 0	mg/cm^2
Effective diameter	27, 8	mm
Material	mica	

CATHODE

Thickness	980	mg/cm^2
Effective length	37	mm
Material	28% Cr, 72% Fe	

FILLING Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}		3,5	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C)

Measured in circuit of fig.1

Starting voltage	V_{ign}	≤	375	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	450 to	700	V
Plateau slope	S_{pl}	≤	0,035	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b = 575 V	N_o	≤	25	counts/min.
Dead time at V_b = 575 V	$\bar{\tau}$	≤	190	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	2,2	MΩ
Anode voltage	V_a	max.	700	V
Ambient temperature	t_{amb}	min.	−50	°C
		max.	+75	°C
for continuous operation	t_{amb}	max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 2200 c/s: 5×10^{10} counts

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

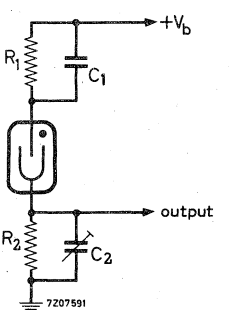
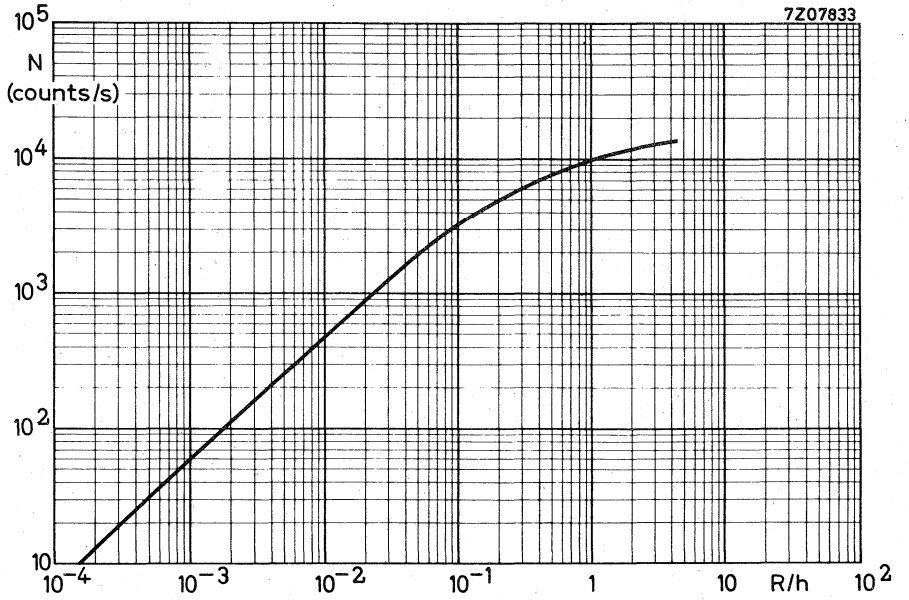
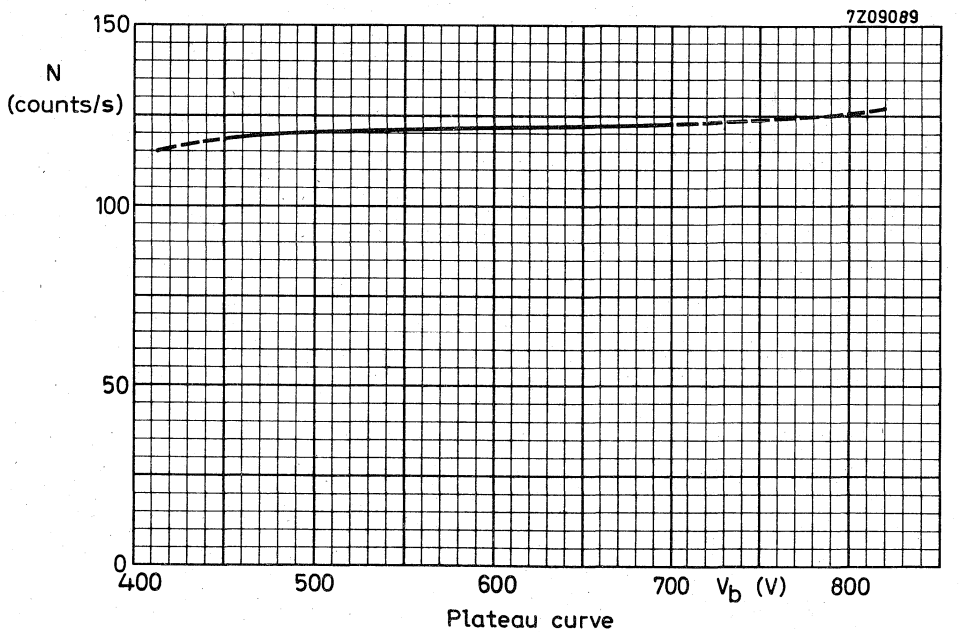


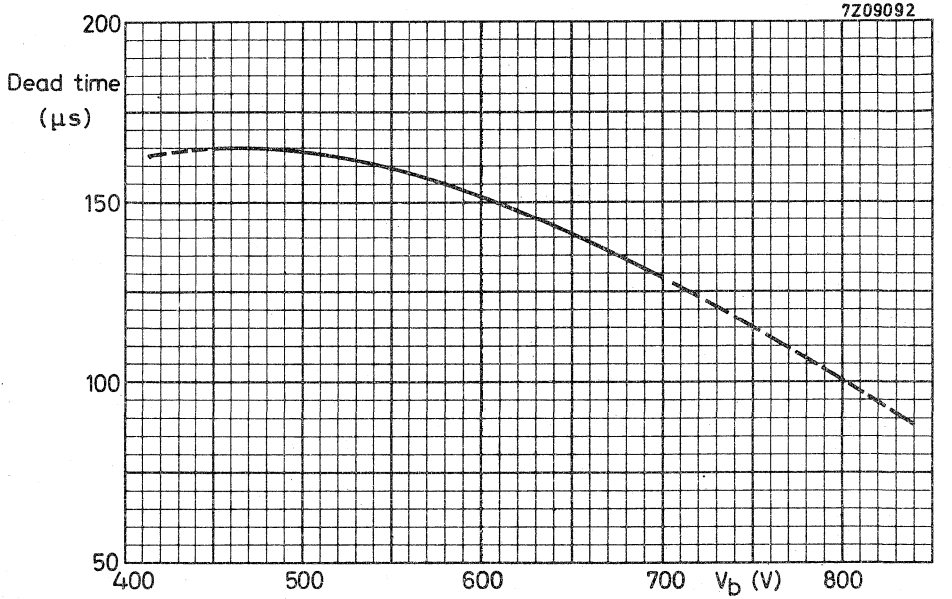
Fig.1



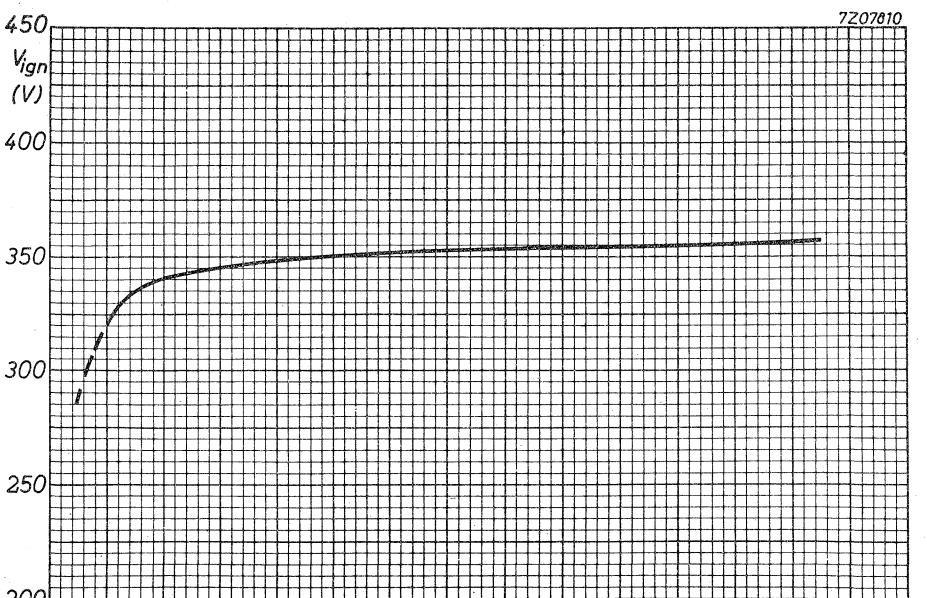
Count rate as function of dose rate (side response)
(measured with ^{60}Co)



Plateau curve



Dead time curve



Starting voltage as function of ambient temperature

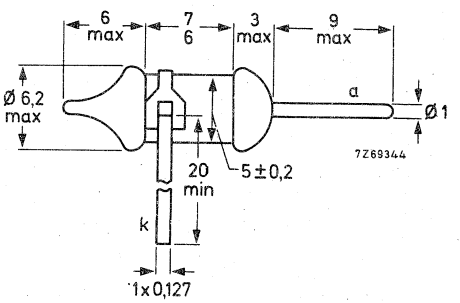
BETA AND GAMMA RADIATION COUNTER TUBE

Halogen quenched radiation counter tube for the measurement of γ and high energy β (> 0,5 MeV) radiation.

QUICK REFERENCE DATA		
Effective range	10^{-2} to 2 x 10^{3}	R/h
Plateau	500 to 600	V
Recommended operating voltage	550	V
Cr Fe cathode	80 to 100	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CATHODE

Thickness	80 to 100	mg/cm^2
Effective length	8	mm
Material	28% Cr, 72% Fe	

FILLING

He, Ne, halogen

CAPACITANCE

Anode to cathode	C_{ak}	0,7	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C)

Measured in circuit of fig.1

Starting voltage	V_{ign}	max.	400	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	500 to 600		V
Plateau slope	S_{pl}	max.	0.3	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b = 550V	N_o	max.	1	count/min.
Dead time at V_b = 550 V	τ	max.	11	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	2.2	MΩ
Anode voltage	V_a	max.	600	V
Ambient temperature	t_{amb}	min.	-40	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 3200 c/s 10^{10} counts

MEASURING CIRCUIT

R_1 = 2.2 MΩ

R_2 = 47 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

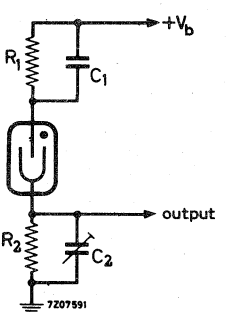
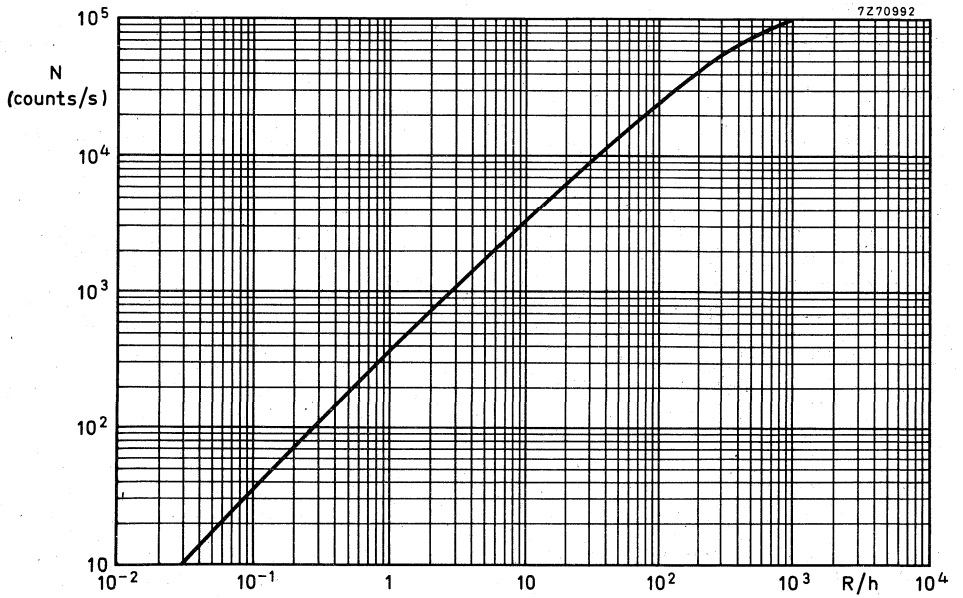
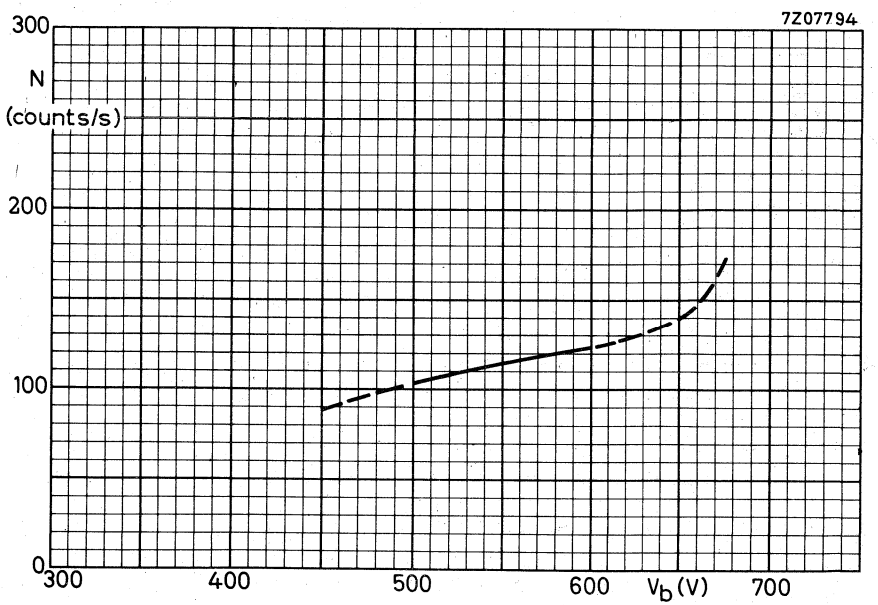


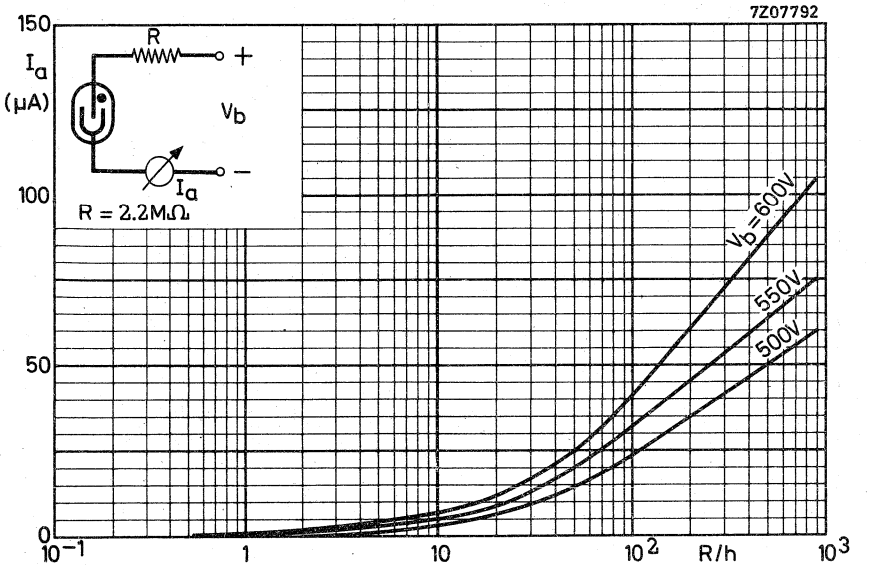
Fig.1



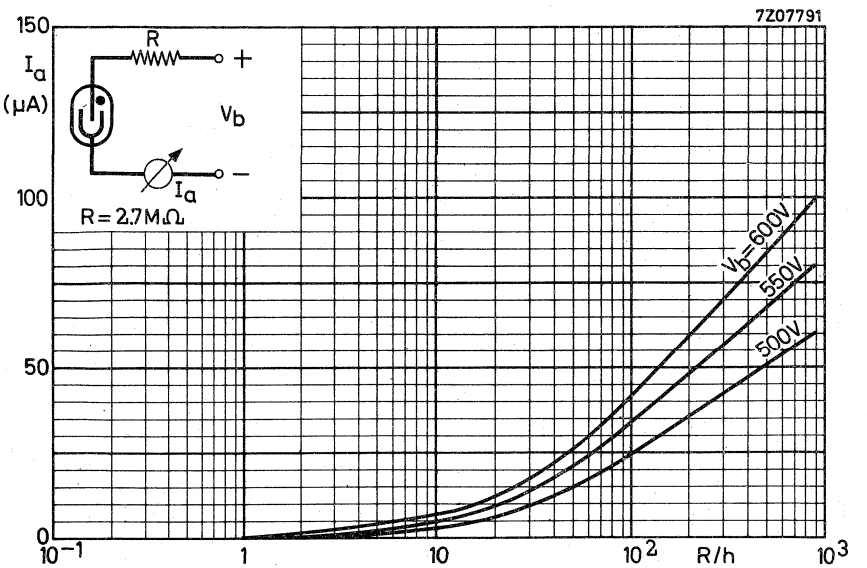
count rate as function of dose rate
(measured with ^{60}Co)



Plateau curve

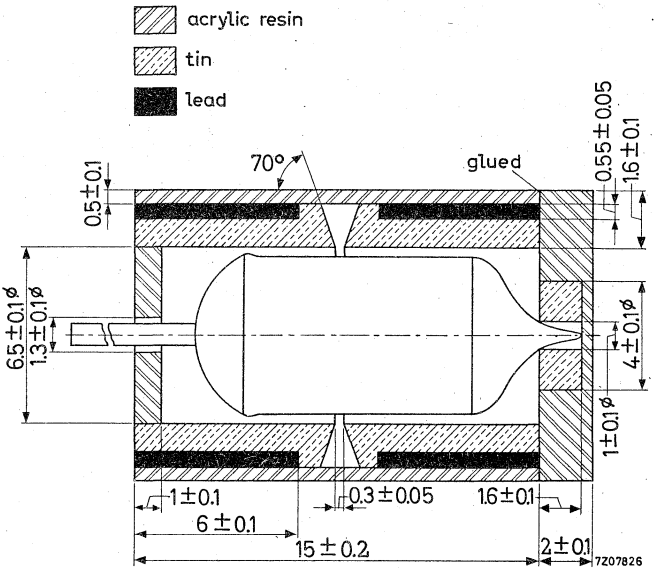


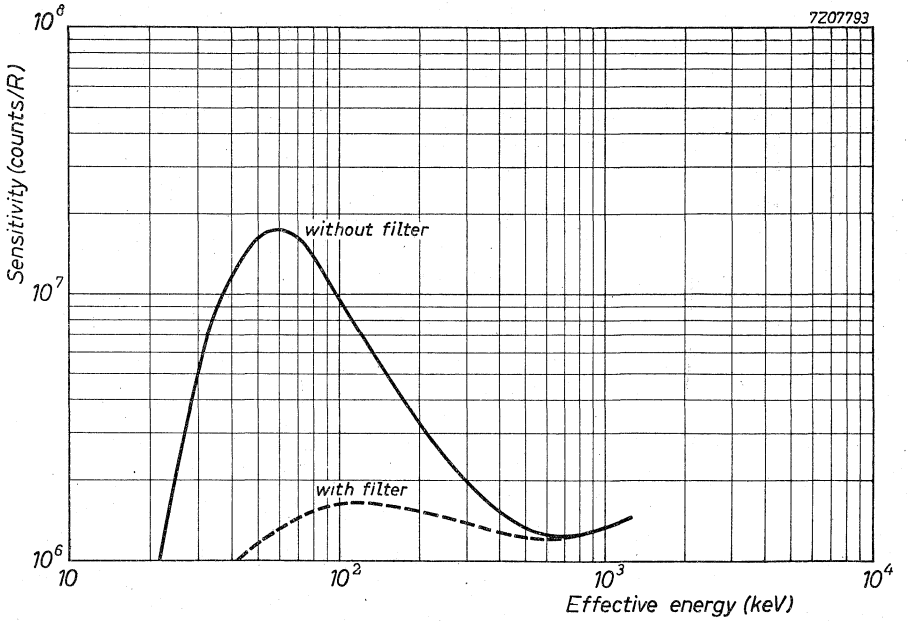
Current as function of dose rate



Current as function of dose rate

SUGGESTED FILTER





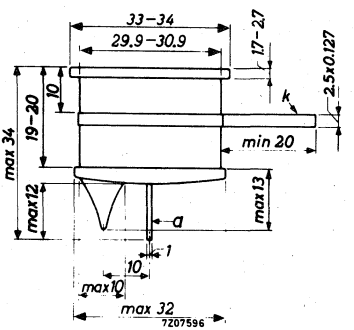
Energy response curve (side response)

ALPHA AND BETA RADIATION COUNTER TUBE

End window halogen quenched α and β radiation counter tube, for low level measurements in combination with a guard counter (e.g. type 18518)

QUICK REFERENCE DATA		
Effective range	10^{-4} to 3	R/h
Plateau	500 to 750	V
Recommended operating voltage	600	V
Cr Fe cathode	980	mg/cm^2
Mica window (Ø 27, 8 mm)	1, 5 to 2, 0	mg/cm^2

DIMENSIONS AND CONNECTIONS Dimensions in mm



WINDOW

Thickness	1, 5 to 2, 0	mg/cm^2
Effective diameter	27, 8	mm
Material	mica	

CATHODE

Thickness	980	mg/cm^2
Effective length	18	mm
Material	28% Cr, 72% Fe	

FILLING Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	1, 4	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C)

Measured in circuit of fig.1

Starting voltage	V_{ign}	max. 375	V
Recommended operating voltage	V_b	arbitrary within plateau [1]	
Plateau	V_{pl}	500 to 750	V
Plateau slope	S_{pl}	max. 0.07	%/V
Background, shielded with 100 mm Fe and 30 mm Pb, Fe outside, at V_b = 600 V	N_o	max. 9	counts/min.
Background in anticoincidence circuit with guard counter 18518, shielded with 100 mm Fe and 30 mm Pb, Fe outside, at V_b = 600 V	N_o	max. 2	counts/min.
Dead time at V_b = 600 V	τ	max. 60	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min. 4.7	MΩ
Anode voltage	V_a	max. 750	V
Ambient temperature	t_{amb}	min. −50	°C
		max. +75	°C
for continuous operation		max. +50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 3200 c/s 5.10^{10} counts

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

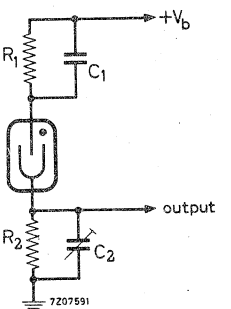
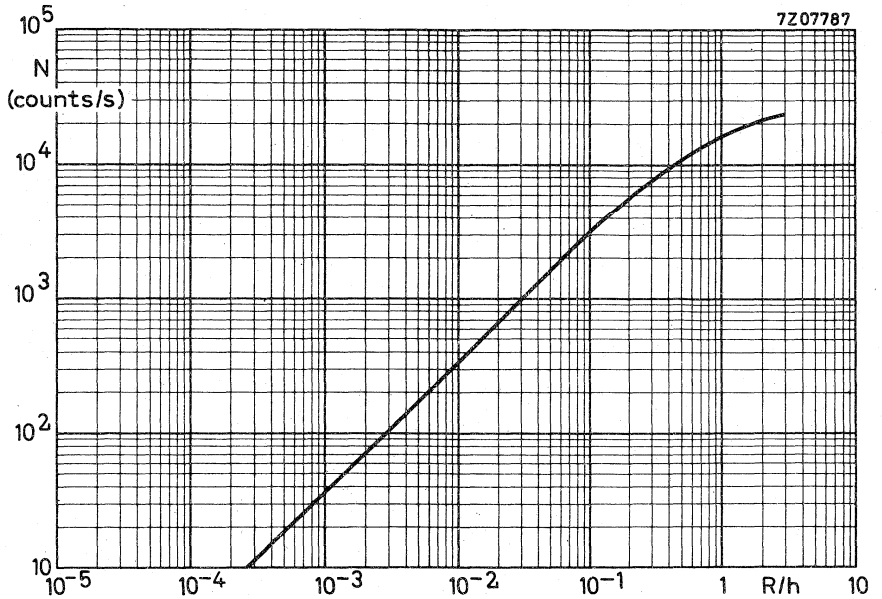
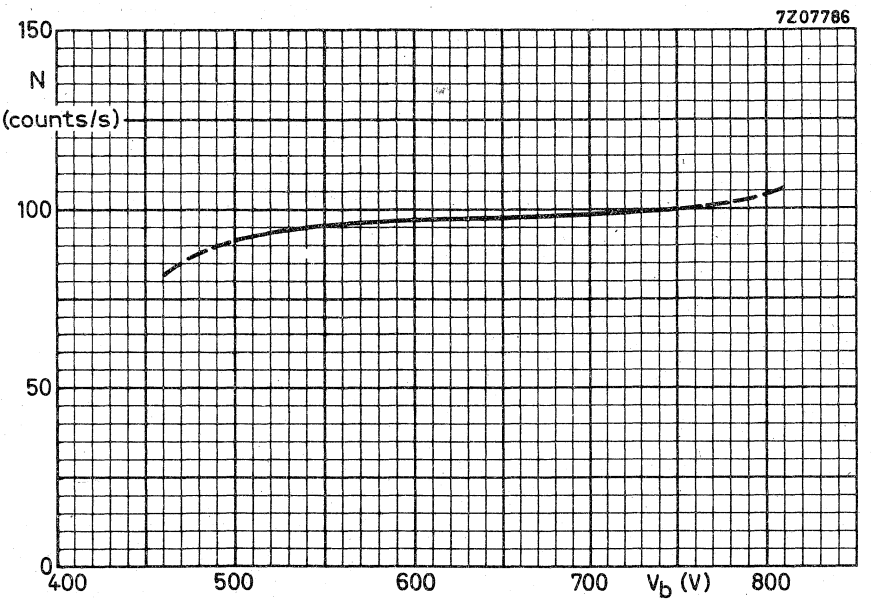


Fig.1

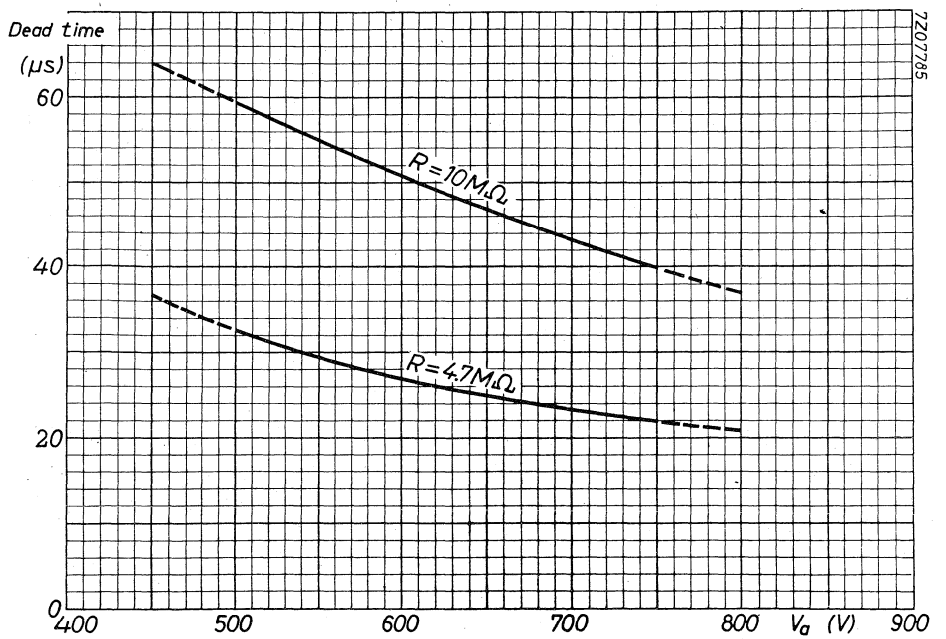
[1]) For application in anticoincidence circuits the recommended value of V_b = 600 V



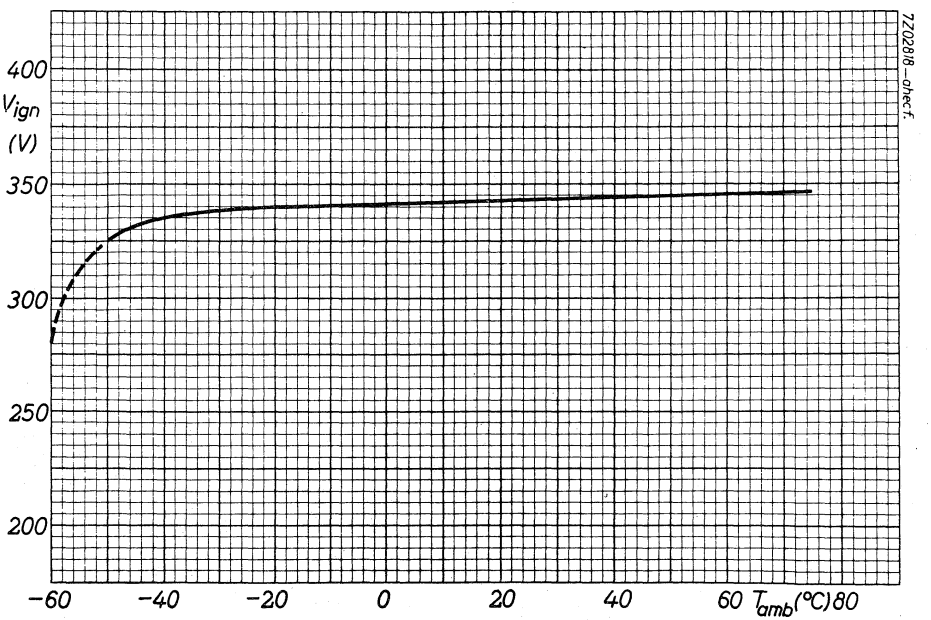
Count rate as function of dose rate



Plateau curve



Dead time curve



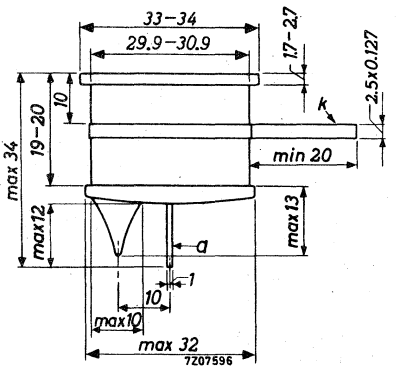
Starting voltage as function of ambient temperature

ALPHA AND BETA RADIATION COUNTER TUBE

End window halogen quenched α and β radiation counter tube for low level measurements.

QUICK REFERENCE DATA		
Effective range	10^{-4} to 3	R/h
Plateau	500 to 750	V
Recommended operating voltage	600	V
Cr Fe cathode	980	mg/cm^2
Mica window (Ø 27, 8 mm)	1,5 to 2,0	mg/cm^2

DIMENSIONS AND CONNECTIONS Dimensions in mm



WINDOW		
Thickness	1,5 to 2,0	mg/cm^2
Effective diameter	27,8	mm
Material	mica	
CATHODE		
Thickness	980	mg/cm^2
Effective length	18	mm
Material	28 % Cr, 72 % Fe	
FILLING	Ne, A, halogen	
CAPACITANCE		
Anode to cathode	C_{ak} 1,4	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of Fig. 1.

Starting voltage	V_{ign}	≤	375	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	500 to	750	V
Plateau slope	S_{pl}	≤	0,07	%/V
Background, shielded with 100 mm Fe and 30 mm Pb, Fe outside, at V_b = 600 V	N_o	≤	18	counts/min
Dead time at V_b = 600 V	τ	≤	60	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	4,7	MΩ
Anode voltage	V_a	max.	750	V
Ambient temperature	t_{amb}	max.	+75	°C
		min.	-50	°C
for continuous operation	t_{amb}	max.	50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 3200 c/s: 5×10^{10} counts

MEASURING CIRCUIT

R_1 = 10 MΩ

R_2 = 220 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

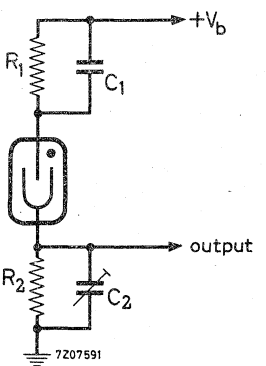
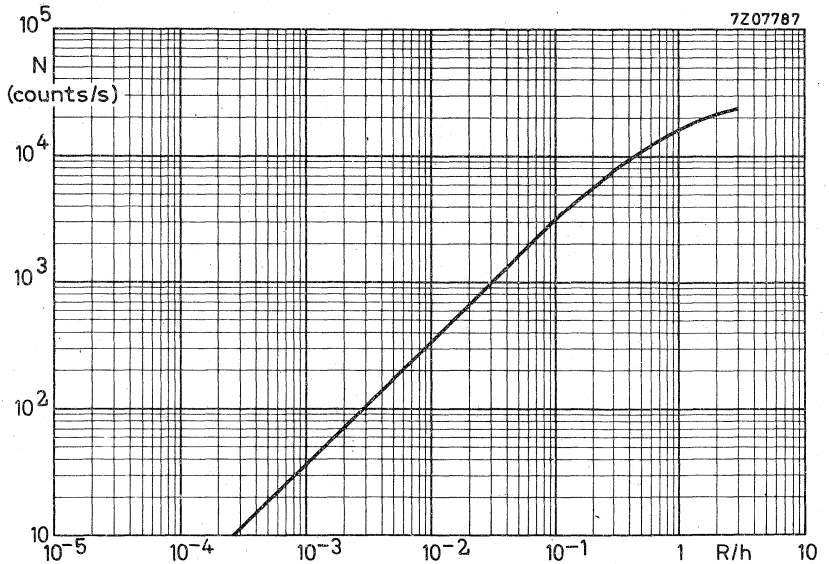
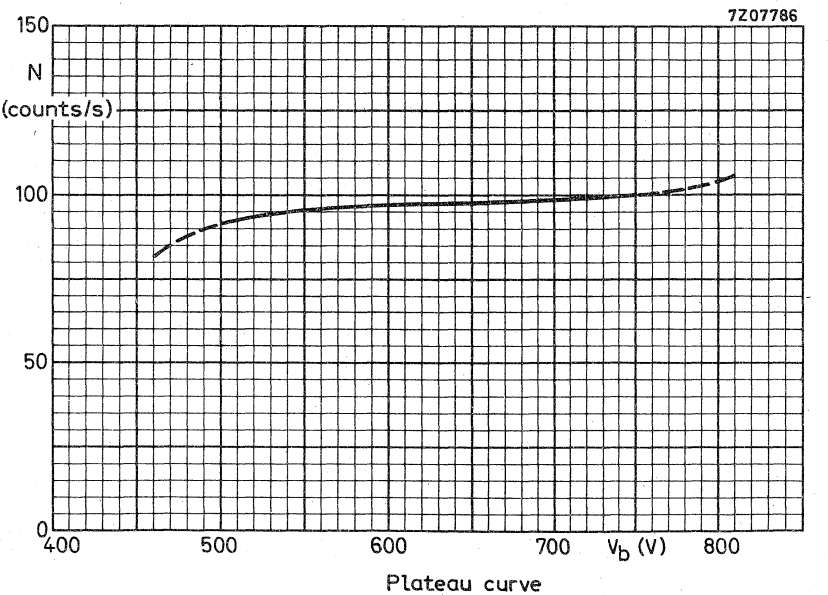


Fig. 1

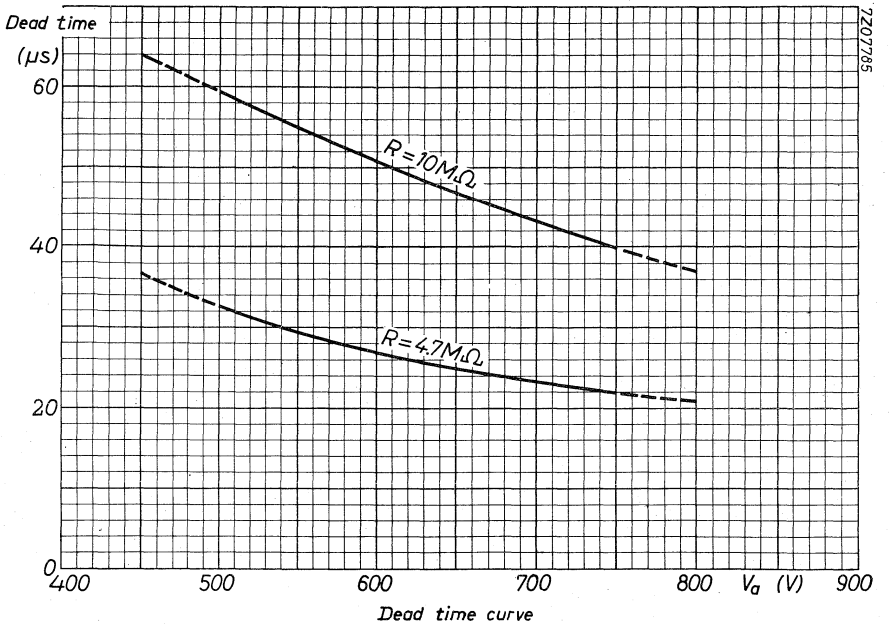


Count rate as function of dose rate

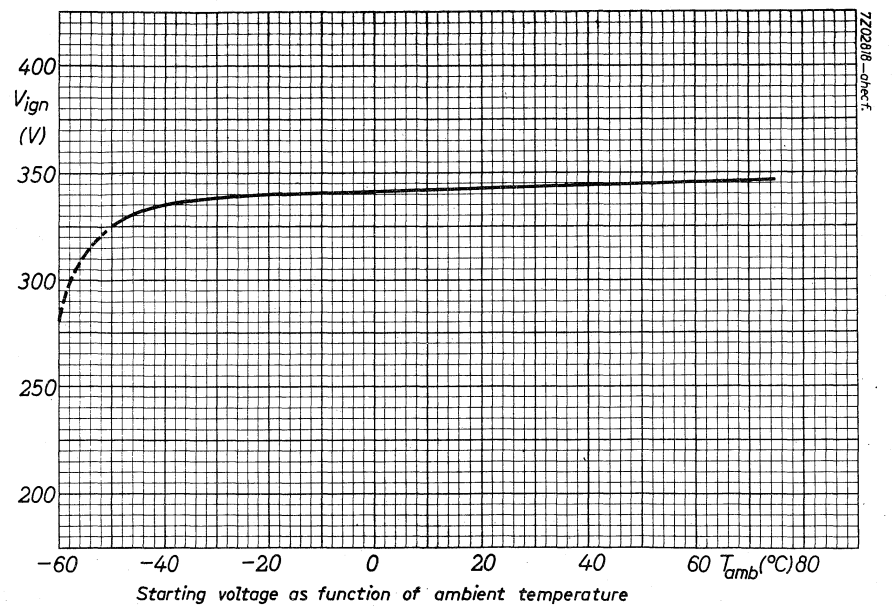
(measured with ^{60}Co)



Plateau curve



Dead time curve



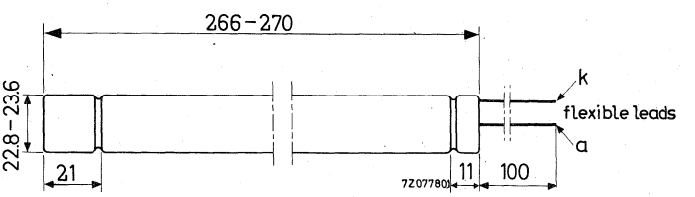
Starting voltage as function of ambient temperature

GAMMA RADIATION COUNTER TUBE

Halogen quenched γ radiation counter tube

QUICK REFERENCE DATA		
Effective range	10^{-4} to 10^{-1}	R/h
Plateau	380 to 480	V
Recommended operating voltage	420	V
Cr Fe cathode	525	mg/cm^2

DIMENSIONS AND CONNECTIONS Dimensions in mm



CATHODE

Thickness	525	mg/cm^2
Effective length	240	mm
Material	27% Cr, 73% Fe	

FILLING Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	10	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C). Measured in circuit of Fig. 1.

Starting voltage	V_{ign}	≤	360	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	380 to 480		V
Plateau slope	S_{pl}	≤	0,10	%/V
Background, shielded with 50 mm Pb and 6 mm Al, at V_b = 420 V	N_o	≤	90	counts/min.
Dead time at V_b = 420 V	τ	≤	200	µs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	2,7	MΩ
Anode voltage	V_a	max.	480	V
Ambient temperature	t_{amb}	min.	−50	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C: 5×10^{10} counts

MEASURING CIRCUIT

R = 2,7 MΩ

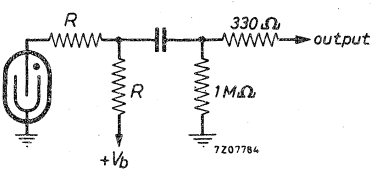
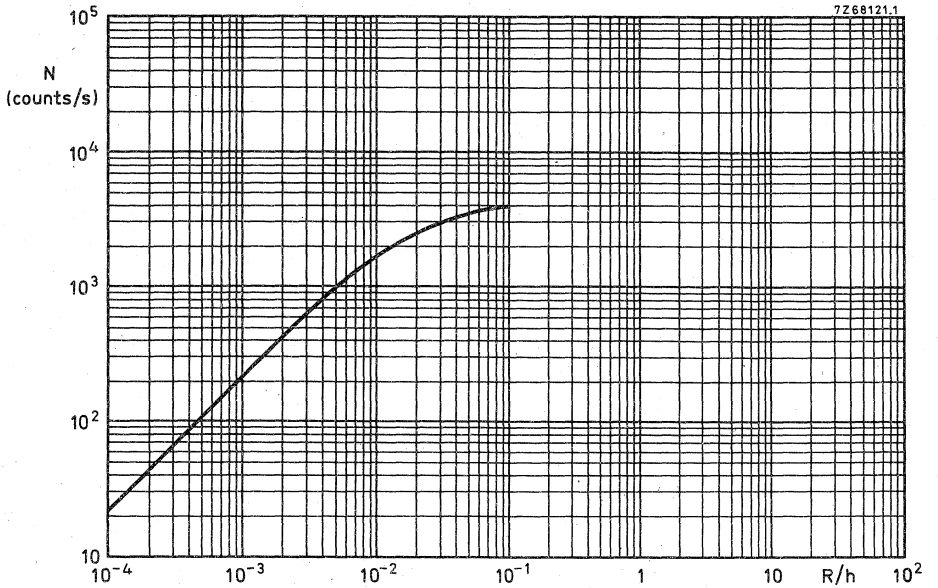
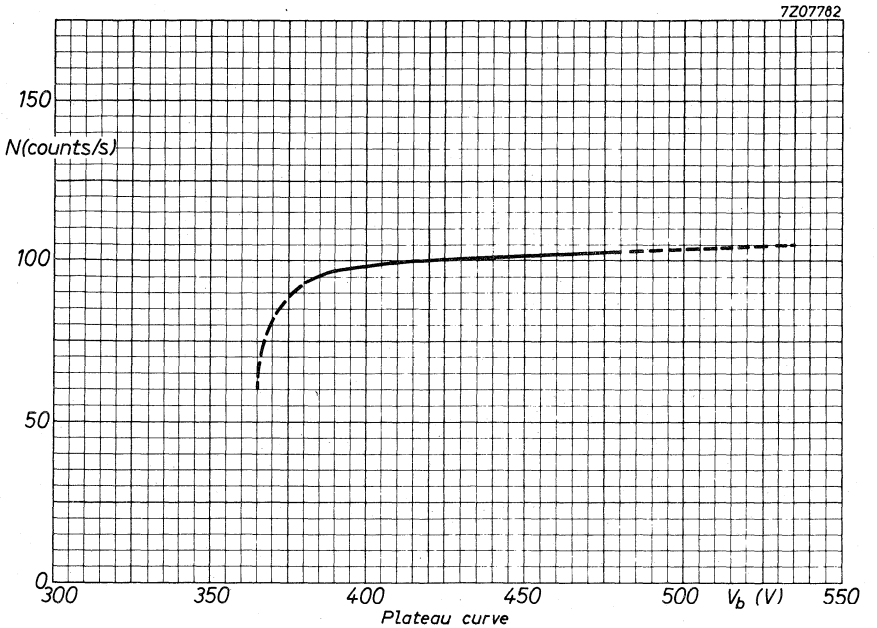


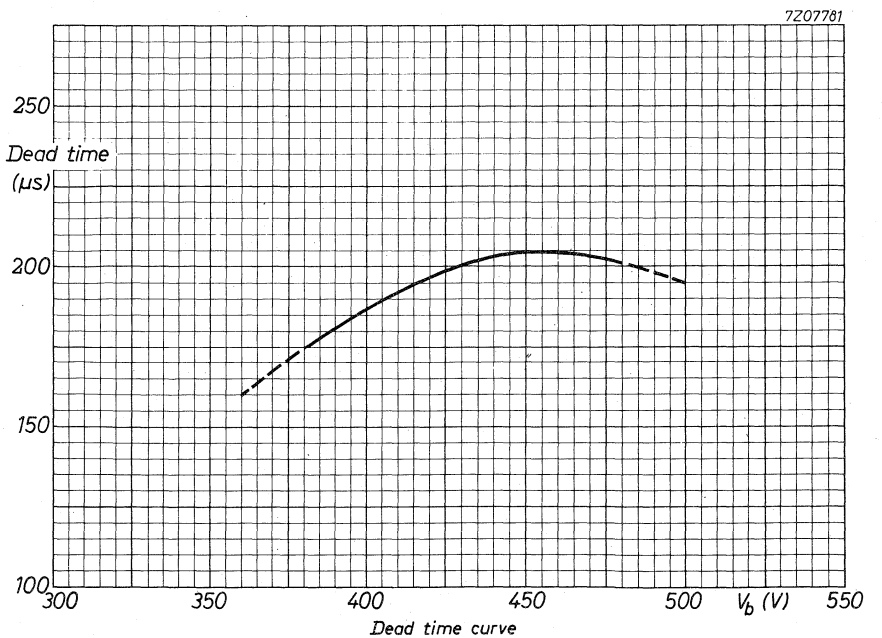
Fig. 1



Count rate as function of dose rate



Plateau curve



Dead time curve

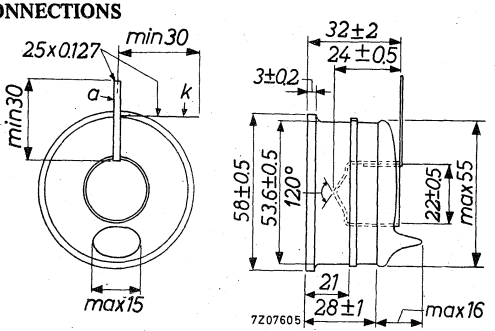
BETA RADIATION COUNTER TUBE

End window halogen quenched β radiation counter tube.

QUICK REFERENCE DATA		
Effective range	3×10^{-2} to 100	mR/h
Plateau	700 to 1100	V
Recommended operating voltage	900	V
Cr Fe cathode	950	mg/cm^2
Mica window (Ø 51 mm)	3,5 to 4,0	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



WINDOW

Thickness	3,5 to 4	mg/cm^2
Effective diameter	51	mm
Material	mica	

CATHODE

Thickness	950	mg/cm^2
Effective length	25	mm
Material	28 % Cr, 72 % Fe	

FILLING Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak} 5	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of Fig. 1

Starting voltage	V_{ign}	≤	400	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	700 to 1100		V
Plateau slope	S_{pl}	≤	0,04	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b = 900 V	N_o	≤	45	counts/min
Dead time at V_b = 900 V	τ	≤	45	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	3,9	MΩ
Anode voltage	V_a	max.	1100	V
Ambient temperature	t_{amb}	min.	-50	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 2500 c/s 5.10^{10} counts

MEASURING CIRCUIT

R = 4,7 MΩ

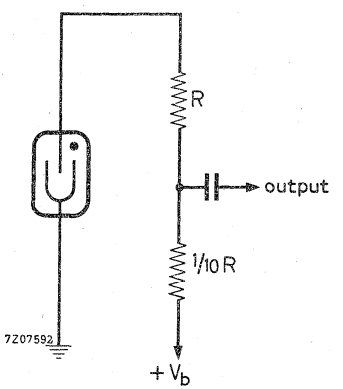
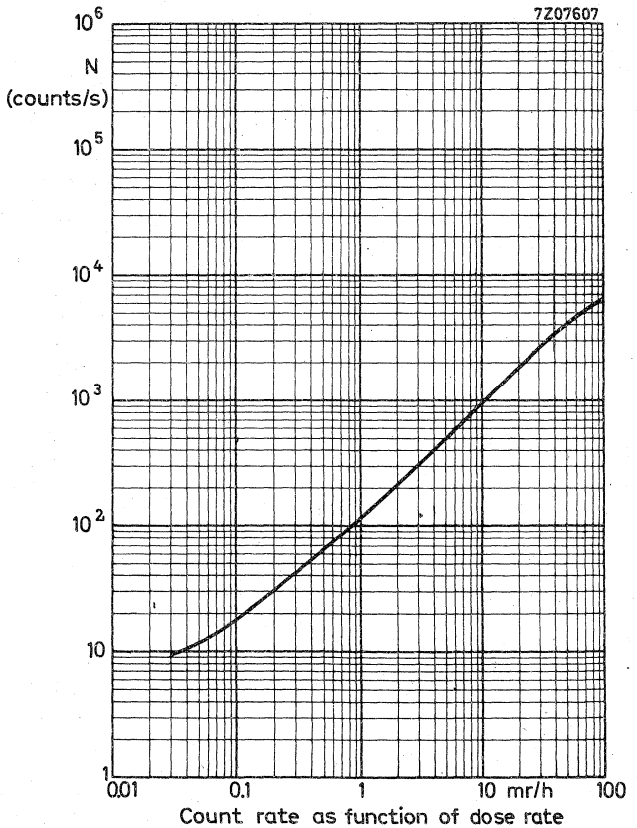
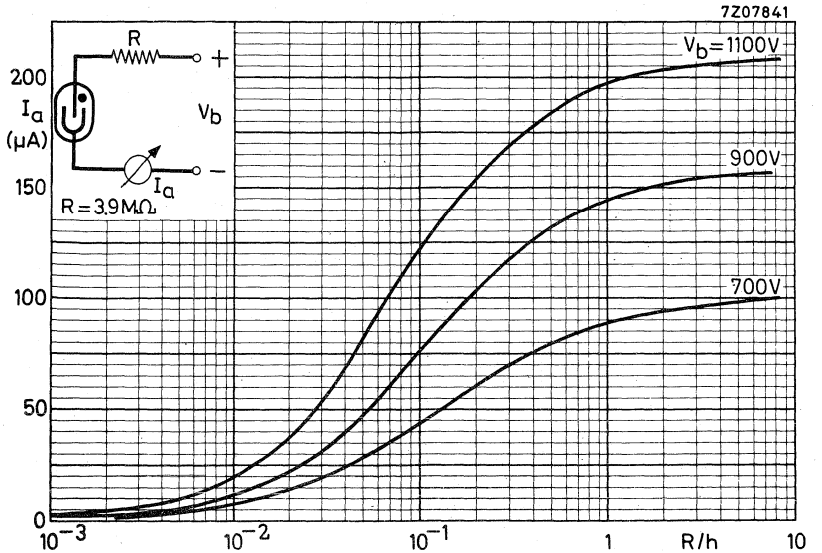


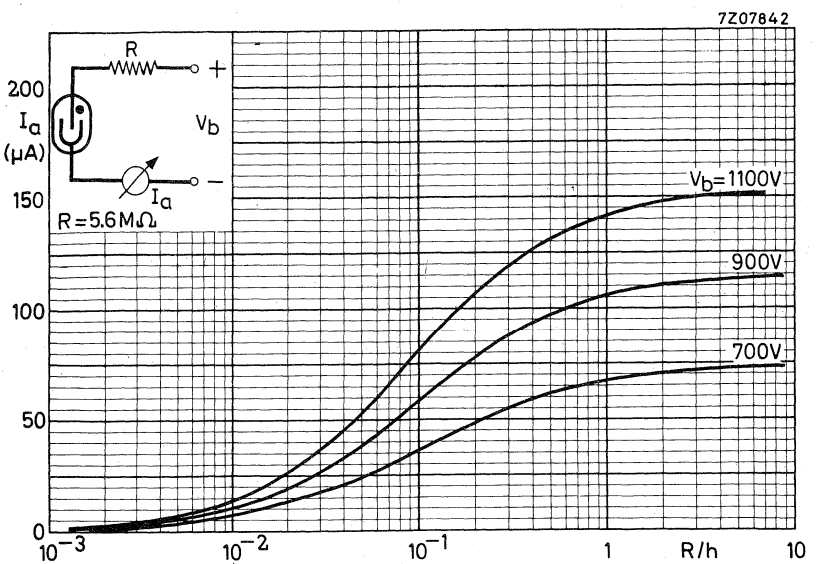
Fig. 1



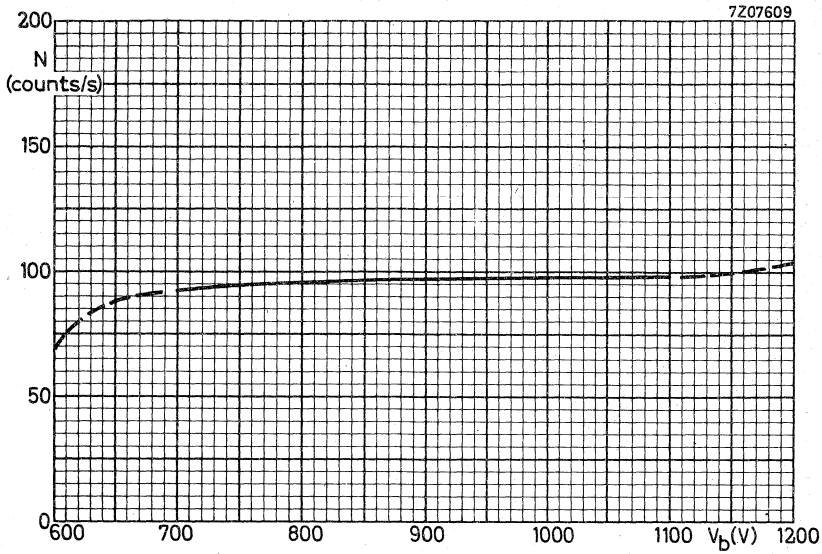
Count rate as function of dose rate



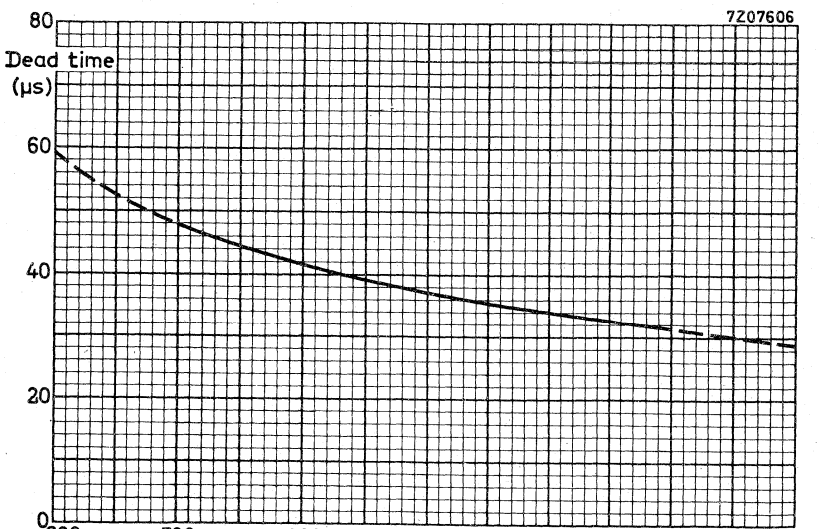
Current as function of dose rate



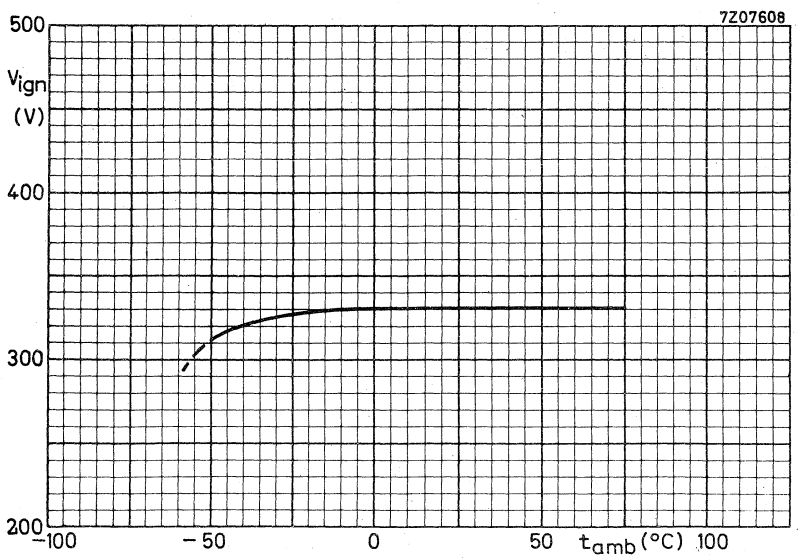
Current as function of dose rate



Plateau curve



Dead time curve



Starting voltage as function of ambient temperature

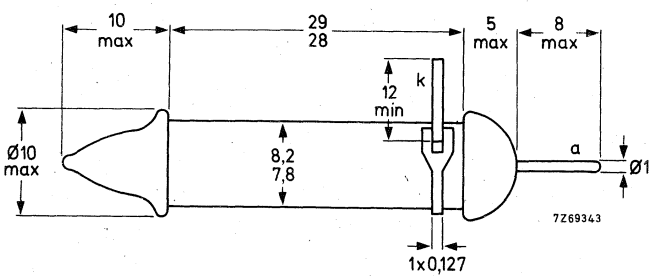
BETA AND GAMMA RADIATION COUNTER TUBE

Halogen quenched β (> 0,25 MeV) and γ radiation counter tube.

QUICK REFERENCE DATA		
Effective range	10^{-3} to 10^{2}	R/h
Plateau	500 to 650	V
Recommended operating voltage	575	V
Cr Fe cathode	32 to 40	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CATHODE

Thickness	32 to 40	mg/cm^2
Effective length	28	mm
Material	28% Cr, 72% Fe	

FILLING

Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	1,1	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C)

Measured in circuit of fig.1

Starting voltage	V_{ign}	max. 380	V
Recommended operating voltage	V_b	arbitrary within plateau	
Plateau	V_{pl}	500 to 650	V
Plateau slope	S_{pl}	max. 0.08	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b = 575 V	N_o	max. 12	counts/min.
Dead time at V_b = 600 V	τ	max. 45	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min. 2.2	MΩ
Anode voltage	V_a	max. 650	V
Ambient temperature	t_{amb}	min. −50	°C
		max. +75	°C
for continuous operation		max. +50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 800 c/s 5.10^{10} counts

MEASURING CIRCUITS

R_1 = 4.7 MΩ

R_2 = 100 kΩ

C_1 = 1 pF

$R_1C_1 = R_2C_2$

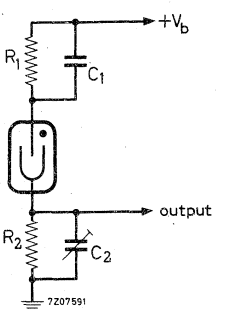
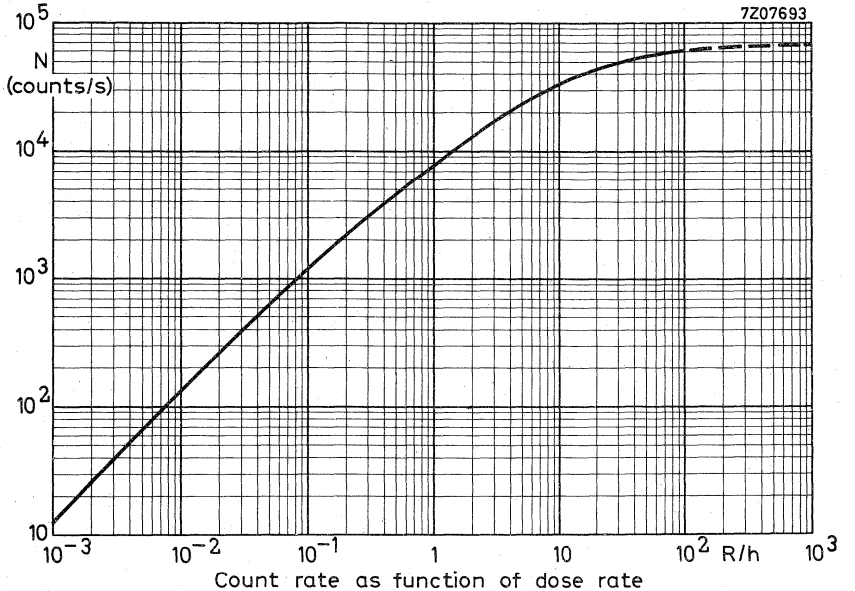
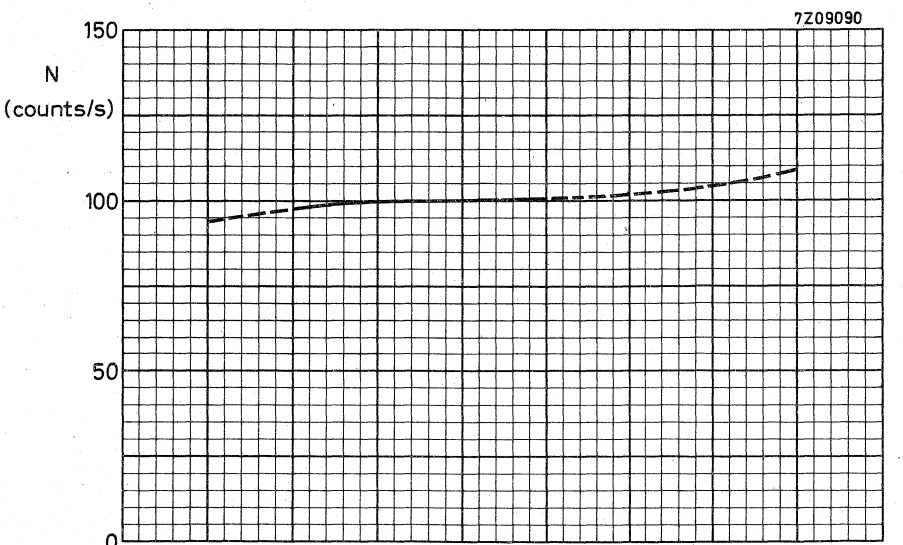


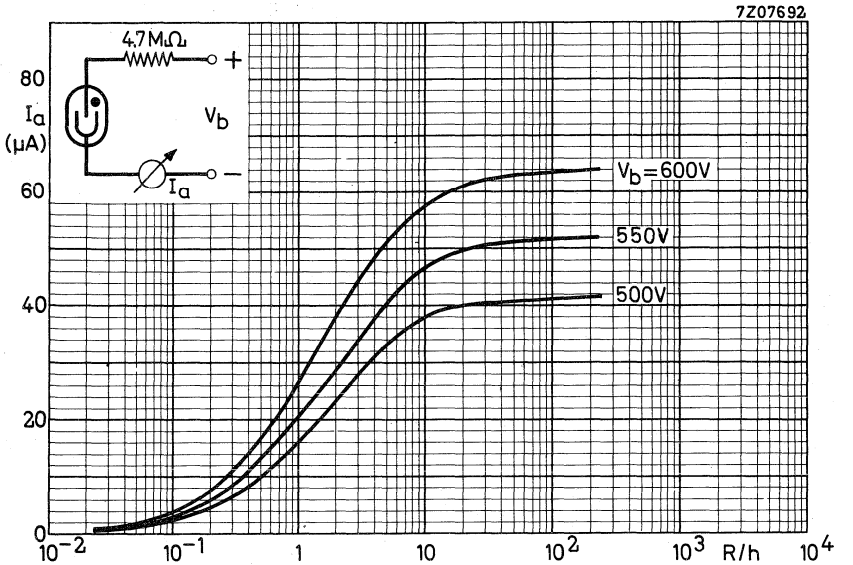
Fig.1



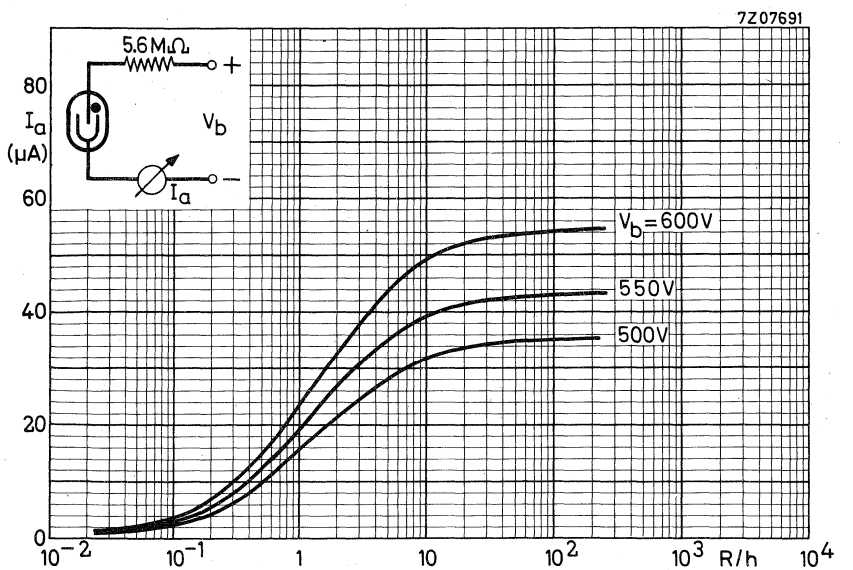
Count rate as function of dose rate



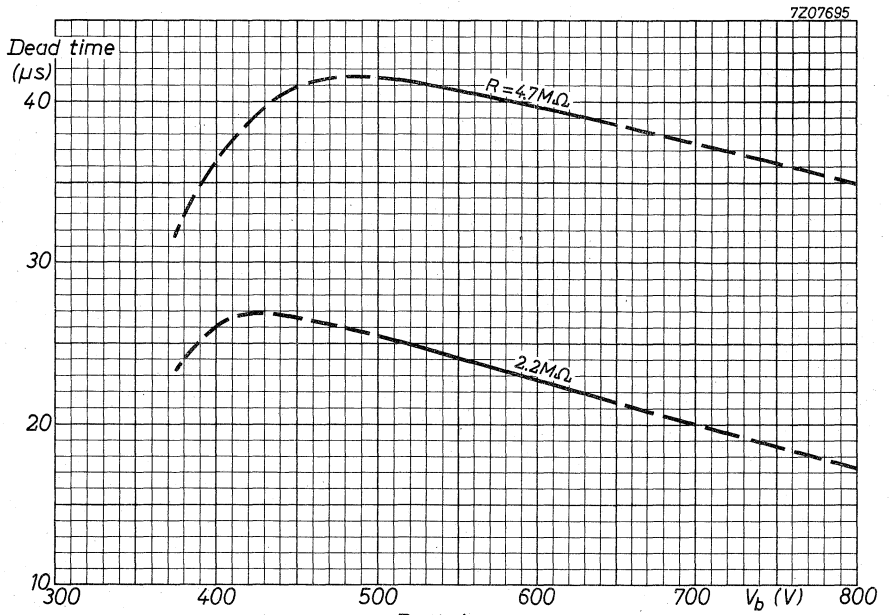
Plateau curve



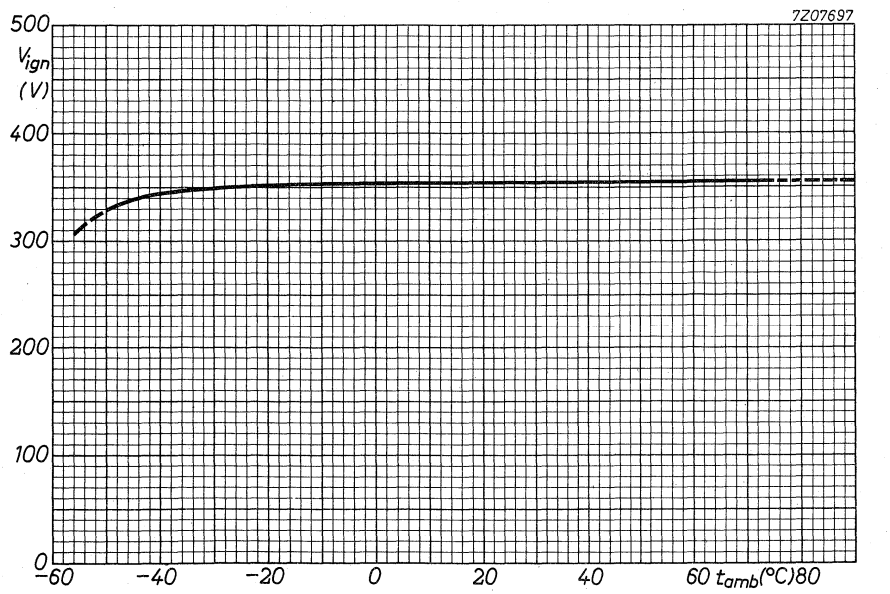
Current as function of dose rate



Current as function of dose rate

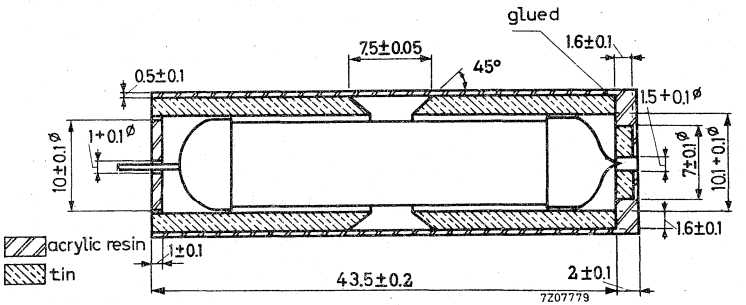


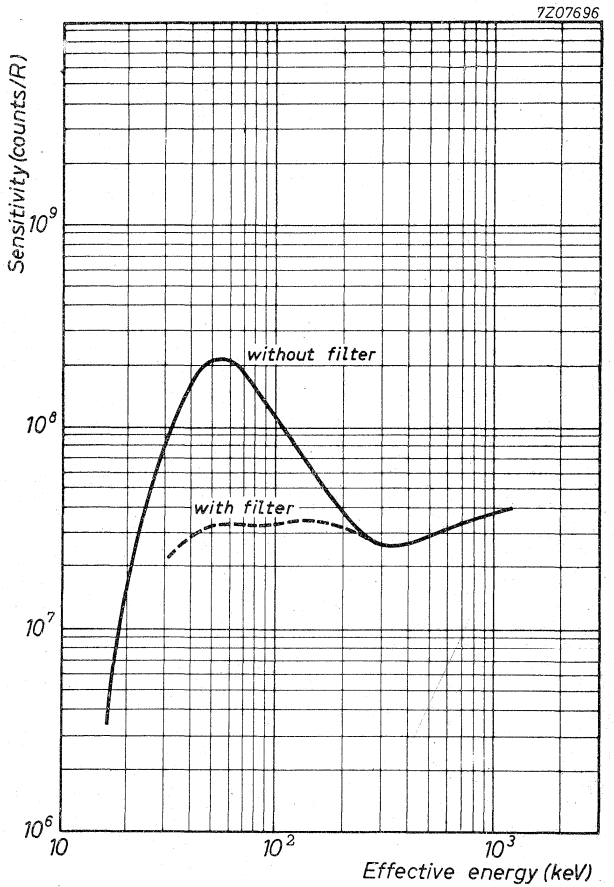
Dead time curve



Starting voltage as function of ambient temperature

SUGGESTED FILTER





Energy response curve (side response)
Measured with suggested filter

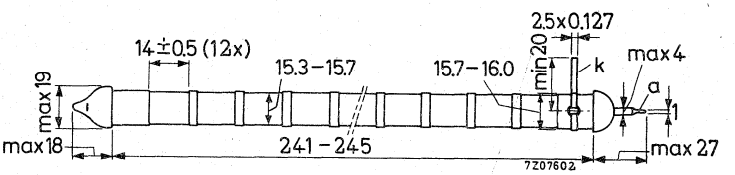
BETA AND GAMMA RADIATION COUNTER TUBE

Halogen quenched β (> 0, 3 MeV) and γ radiation counter tube

QUICK REFERENCE DATA		
Effective range	10^{-4} to 1	R/h
Plateau	450 to 800	V
Recommended operating voltage	625	V
Cr Fe cathode	40 to 60	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CATHODE

Construction		cylindrical wall with strengthening rings	
Thickness between the strengthening rings		40 to 60	mg/cm^2
Total effective length between the strengthening rings		185	mm
Material		28% Cr, 72% Fe	

FILLING

Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	10	pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C)

Measured in circuit of fig.1

Starting voltage	V_{ign}	max. 400	V
Recommended operating voltage	V_b	arbitrary within plateau	
Plateau	V_{pl}	450 to 800	V
Plateau slope	S_{pl}	max. 0.02	%/V
Background, shielded with 50 mm Pb and 3 mm Al, at V_b = 625 V	N_o	max. 60	counts/min.
Dead time at V_b = 600 V	τ	max. 100	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min. 2.2	MΩ
Anode voltage	V_a	max. 800	V
Ambient temperature	t_{amb}	min. −50	°C
		max. +75	°C
for continuous operation		max. +50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 600 c/s 5.10^{10} counts

MEASURING CIRCUIT

R = 2.2 MΩ

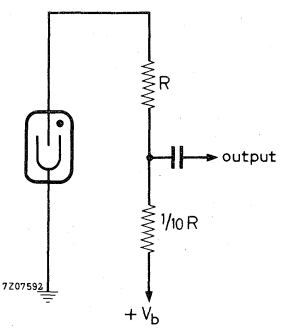
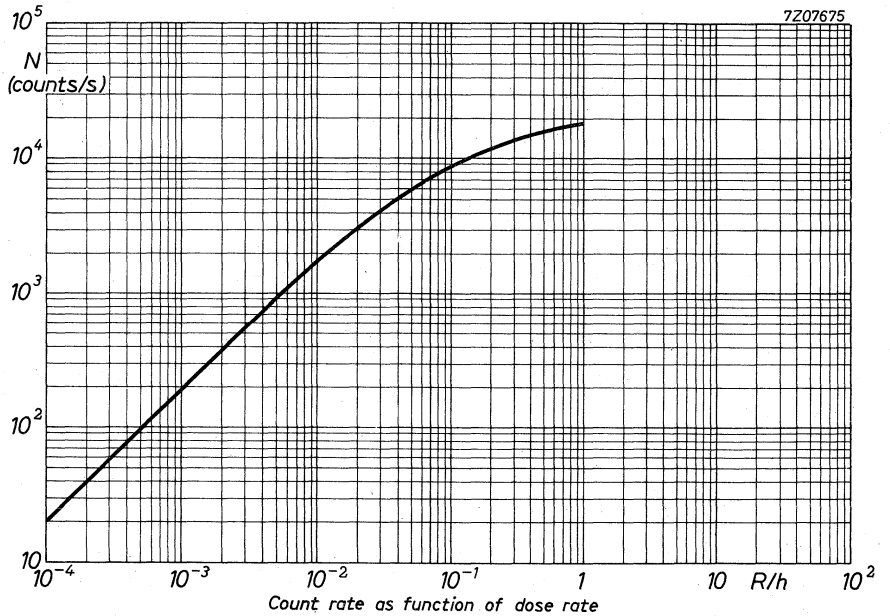
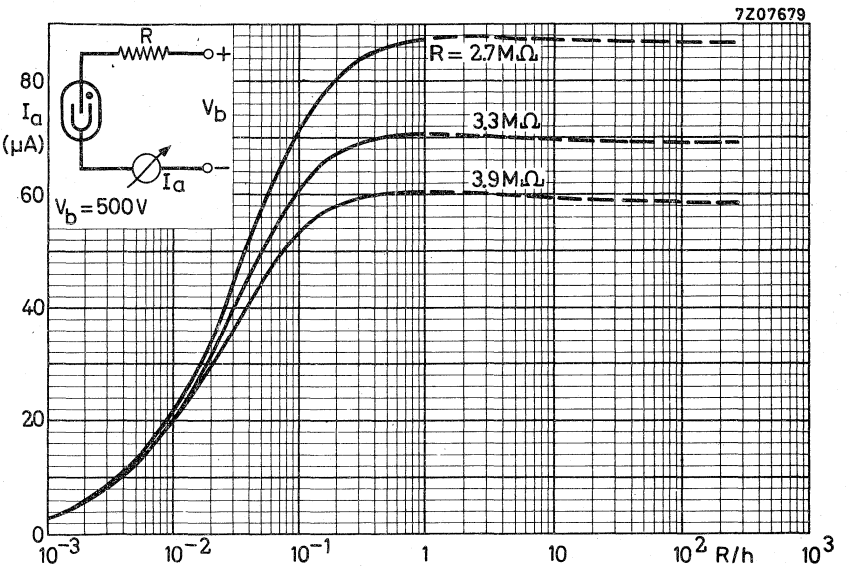


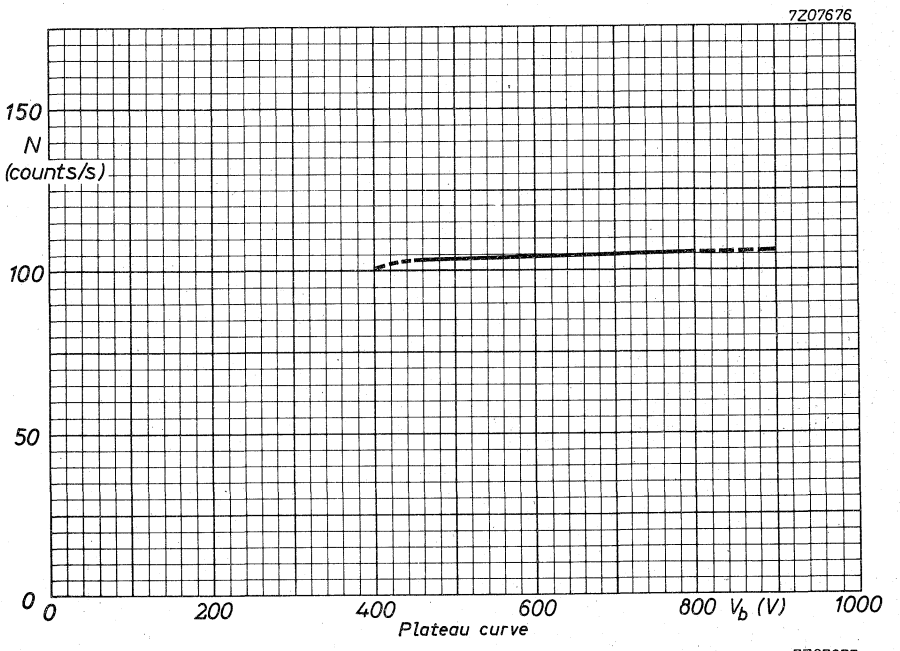
Fig.1



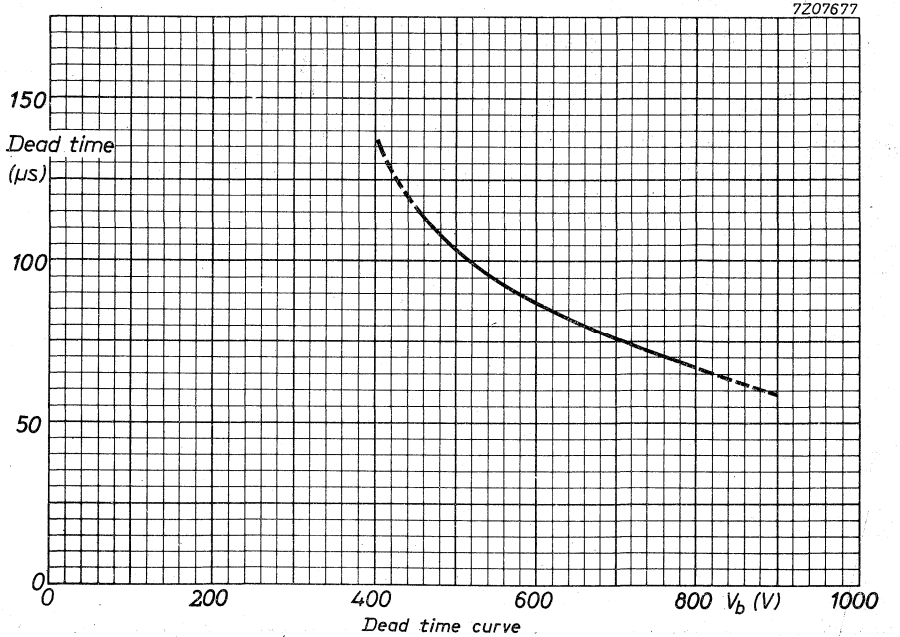
Count rate as function of dose rate



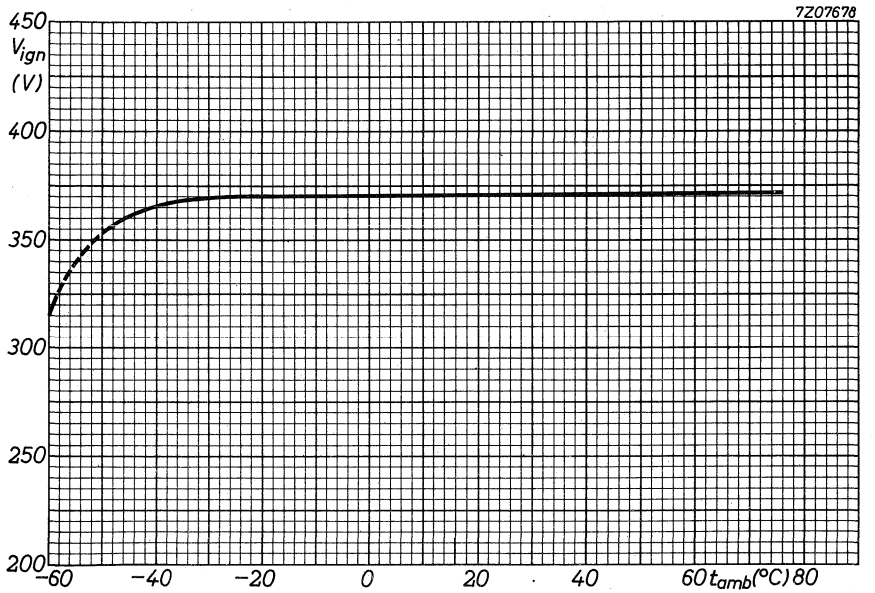
Current as function of dose rate



Plateau curve



Dead time curve



Starting voltage as function of ambient temperature

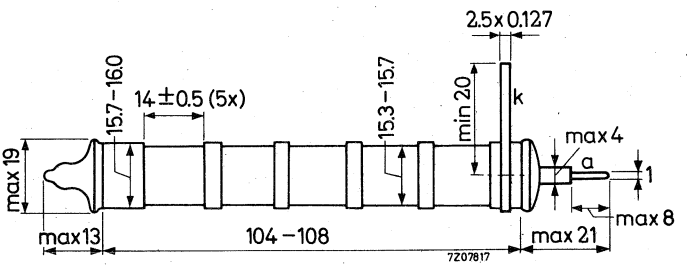
BETA AND GAMMA RADIATION COUNTER TUBE

Halogen quenched β (> 0,3 MeV) and γ radiation counter tube suitable for use in damp and/or saline atmosphere.

QUICK REFERENCE DATA		
Effective range	10^{-3} to 10	R/h
Plateau	450 to 800	V
Recommended operating voltage	625	V
Cr Fe cathode	40 to 60	mg/cm^2

DIMENSIONS AND CONNECTIONS

Dimensions in mm



CATHODE

Construction		cylindrical wall with strengthening rings
Thickness between the strengthening rings		40 to 60 mg/cm^2
Total effective length		75 mm
Material		28% Cr, 72% Fe

FILLING

Ne, A, halogen

CAPACITANCE

Anode to cathode	C_{ak}	4 pF

OPERATING CHARACTERISTICS (t_{amb} = 25 °C) Measured in circuit of fig.1.

Starting voltage	V_{ign}	max.	400	V
Recommended operating voltage	V_b	arbitrary within plateau		
Plateau	V_{pl}	450 to	800	V
Plateau slope	S_{pl}	max.	0.02	%/V
Background shielded with 50 mm Pb and 3 mm Al, at V_b = 625 V	N_o	max.	30	counts/min.
Dead time at V_b = 600 V	τ	max.	70	μs

LIMITING VALUES (Absolute max. rating system)

Anode resistor	R	min.	1	MΩ
Anode voltage	V_a	max.	800	V
Ambient temperature	t_{amb}	min.	−50	°C
		max.	+75	°C
for continuous operation		max.	+50	°C

LIFE EXPECTANCY

Life expectancy at t_{amb} = 25 °C, count rate 600 c/s 5.10^{10} counts

MEASURING CIRCUIT

R = 2.2 MΩ

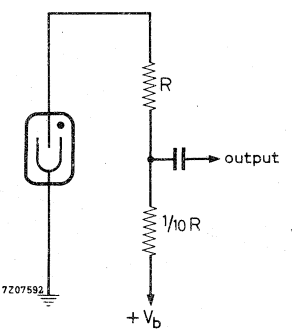
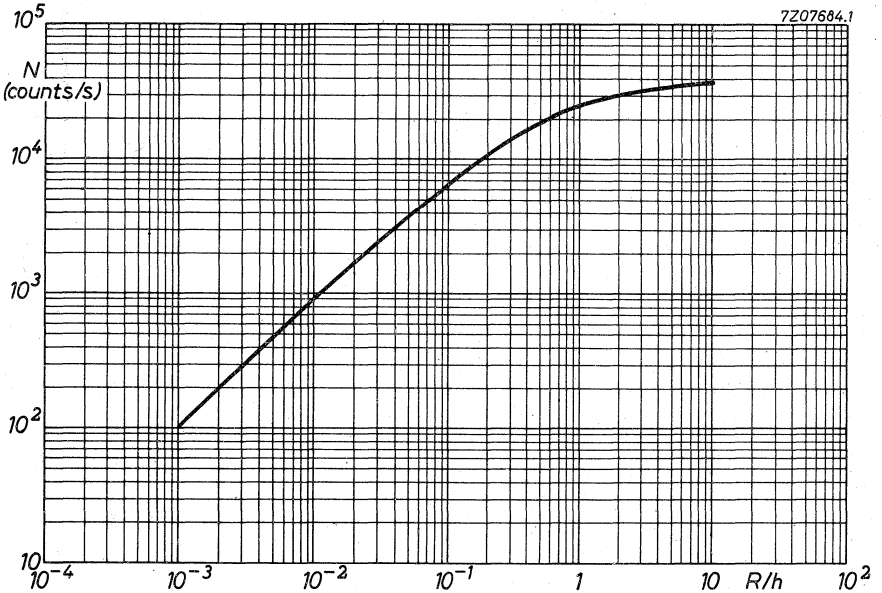


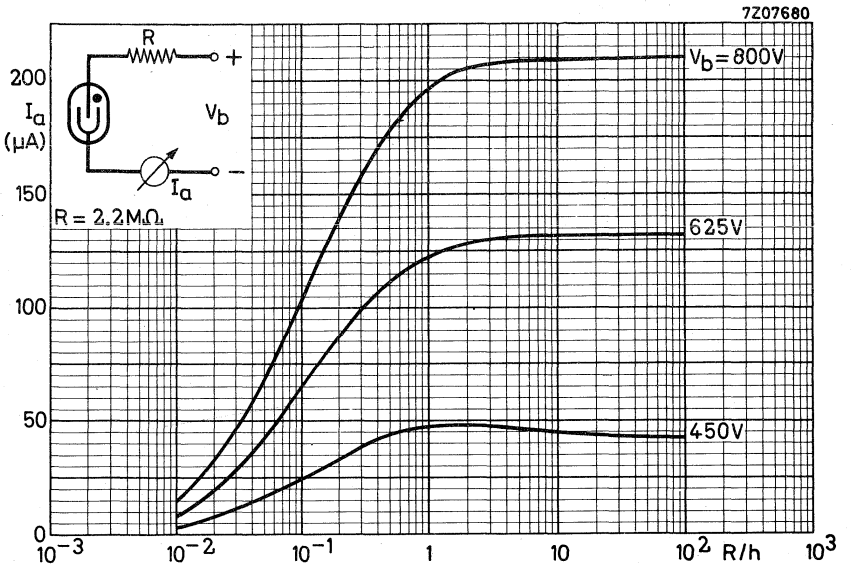
Fig.1

REMARK

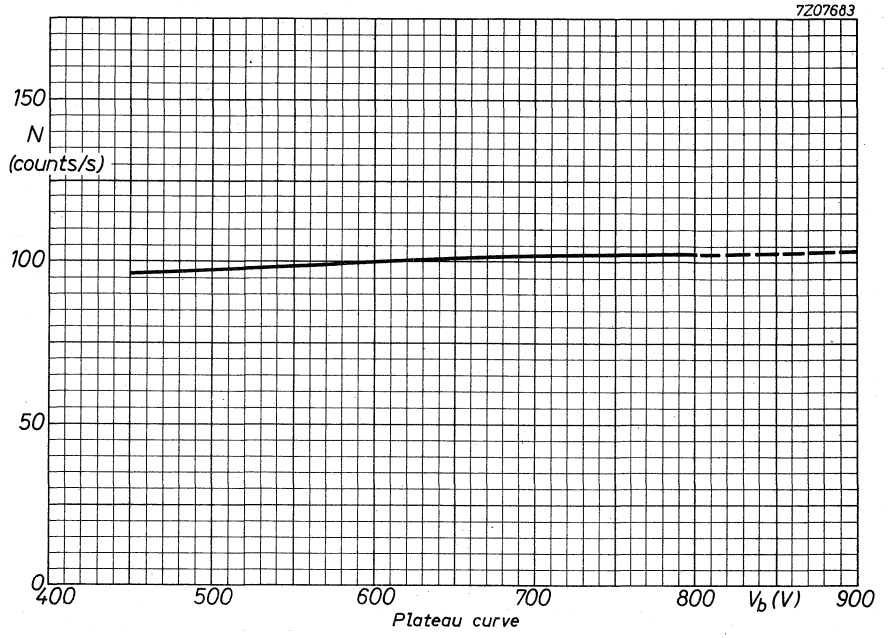
The cathode is covered with a corrosion resistive coating of lacquer, fulfilling the conditions of salt spray testing according to ASTM B117-49T and PNX41-002.



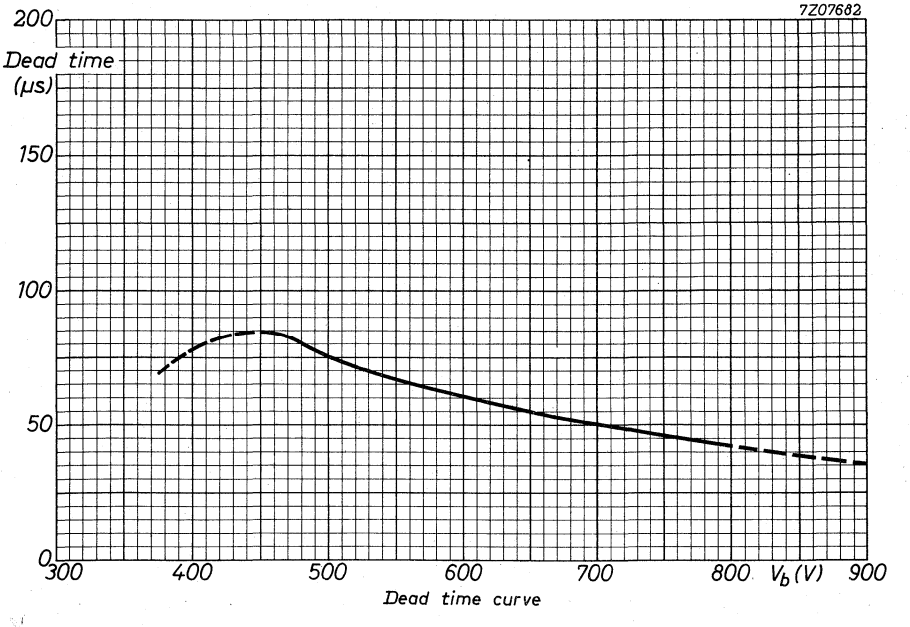
Count rate as function of dose rate
(Measured with ^{60}Co)



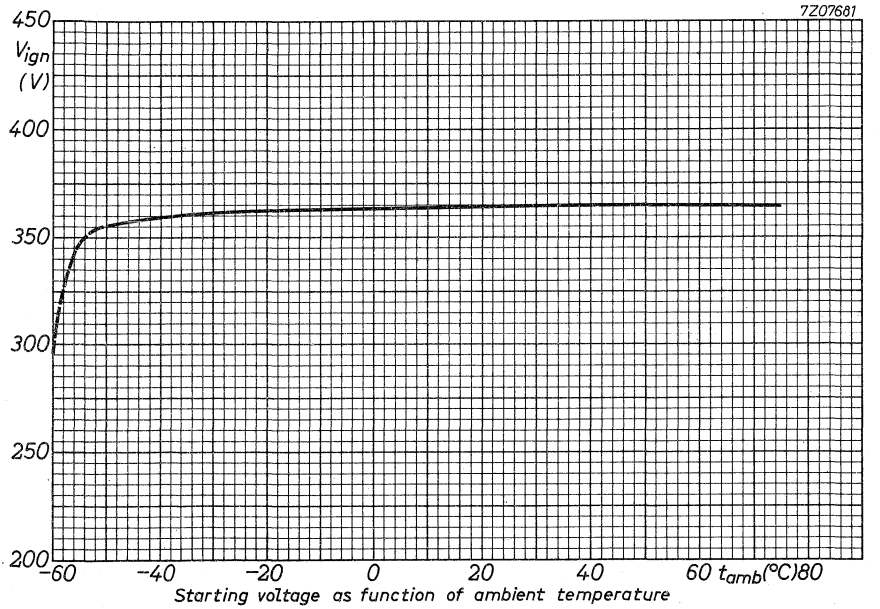
Current as function of dose rate



Plateau curve



Dead time curve



Starting voltage as function of ambient temperature

Neutron tubes

NEUTRON TUBES

Sealed-off accelerating tubes generating 14 MeV neutrons on the basis of the ^{3}H (d, n) ^{4}He reaction.

The gas filling (a mixture of deuterium and tritium) is controlled by a pressure regulator. Deuterium and tritium ions emitted from a Penning ion source are accelerated towards a titanium/tritium target bringing about the ^{3}H (d, n) ^{4}He reaction whilst replenishing the tritium in the target. This guarantees a lasting and even target performance throughout tube life.

Applications a. o.:

Activation analysis
Radio biology
Radio chemistry
Neutron radiography
Neutron dosimetry
Investigation of neutron collimation
Investigation of shielding
Investigation of radiation damage
Isotope production
Fast reactor control
Nuclear physics research
Solid state phisics
Education
Nuclear safeguards

NEUTRON TUBE TYPES	Minimum output (n/s)	
	continuous	pulse
18600R	1×10^{8}	-
18601C	1×10^{8}	5×10^{9}
18602	1×10^{10}	-
18603	1×10^{8}	5×10^{9}

Further particulars on request.

Semiconductor radiation detectors

SEMICONDUCTOR RADIATION DETECTORS

Energy range	*Application*	*Technology*		*Basic types*
		Lithium drifted germanium		
10 keV to 10 MeV γ	High resolution gamma and X-ray spectrometry in nuclear science (e.g. decay schemes) and industrial research (e.g. activation analysis)	coaxial	double open-ended	APY21 to APY27
40 keV to 10 MeV γ	High resolution gamma and X-ray spectrometry in nuclear science (e.g. decay schemes) and industrial research (e.g. activation analysis)	coaxial	single open-ended	APY41 to APY49
40 keV to 10 MeV γ	Virtually 4 π measurement of gamma radiation and X-rays in: • absolute activity measurement • source calibration • sum peak coincidence experiments	coaxial	well-type	APY56 to APY59
40 keV to 8 MeV γ	Gamma and high energy X-ray spectrometry	planar		APY16 to APY19
		High purity germanium		
1 keV to 2 MeV γ	Gamma and X-ray spectrometry Industrial process control	planar		APY60 to APY63
		Silicon surface barrier		
< 80 MeV α < 1,5 MeV β	Spectrometry of alpha and low energy beta radiation, particles and fission products. Particle identification systems	partially depleted	circular	BPY51 to BPY57 BPW25
< 80 MeV α < 1,2 MeV β		partially depleted	annular	BPY58 to BPY59
< 75 MeV α < 1,2 MeV β	Spectrometry of alpha and low energy beta radiation, particles and fission products. Particle identification systems	totally depleted	circular	BPY81 to BPY87
< 75 MeV α < 1,2 MeV β		totally depleted	annular	BPY88, BPY89

For detailed information please ask for the "Product Survey Semiconductor Radiation Detectors".

Index

INDEX OF TYPENUMBERS

C.E.M. = Channel electron multipliers

G.M.T. = Geiger-Mueller tubes

N.T. = Neutron tubes

S.R.D. = Semiconductor radiation detectors

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