PHILIPS

Data handbook

PHILIPS Electronic components and materials

Electron tubes

Part 7b May 1979

Segment indicator tubes

Indicator tubes

Switching diodes

Dry reed contact units

ELECTRON TUBES

Part 7b **May 1979**

RATING SYSTEM

(in accordance with IEC Publication 134)

ABSOLUTE MAXIMUM RATING SYSTEM

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

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

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply 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.

Some devices are labelled **"MAINTENANCE TYPE"** or **"OBSOLESCENT TYPE"**

Maintenance type	- Available for equipment maintenance. No longer recommended for equipment production.
Obsolescent type	- Available until present stocks are exhausted.

DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, sub-assemblies and materials; it is made up of 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.

ELECTRON TUBES (BLUE SERIES)

Part 1a	**December 1975**	**ET1a 12-75**	**Transmitting tubes for communication, tubes for r.f. heating** Types PE05/25 to TBW15/25
Part 1b	**August 1977**	**ET1b 08-77**	**Transmitting tubes for communication, tubes for r.f. heating, amplifier circuit assemblies**
Part 2a	**November 1977**	**ET2a 11-77**	**Microwave tubes** Communication magnetrons, magnetrons for microwave heating, klystrons, travelling-wave tubes, diodes, triodes T-R switches
Part 2b	**May 1978**	**ET2b 05-78**	**Microwave semiconductors and components** Gunn, Impatt and noise diodes, mixer and detector diodes, backward diodes, varactor diodes, Gunn oscillators, sub-assemblies, circulators and isolators
Part 3	**January 1975**	**ET3 01-75**	**Special Quality tubes, miscellaneous devices**
Part 4	**March 1975**	**ET4 03-75**	**Receiving tubes**
Part 5a	**March 1978**	**ET5a 03-78**	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
Part 5b	**December 1978**	**ET5b 12-78**	**Camera tubes and accessories, image intensifiers**
Part 6	**January 1977**	**ET6 01-77**	**Products for nuclear technology** Channel electron multipliers, neutron tubes, Geiger-Müller tubes
Part 7a	**March 1977**	**ET7a 03-77**	**Gas-filled tubes** Thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes
Part 7b	**May 1979**	**ET7b 05-79**	**Gas-filled tubes** Segment indicator tubes, indicator tubes, switching diodes, dry reed contact units
Part 8	**May 1977**	**ET8 05-77**	**TV picture tubes**
Part 9	**March 1978**	**ET9 03-78**	**Photomultiplier tubes; phototubes**

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

Part 1a	August 1978	SC1a 08-78	**Rectifier diodes, thyristors, triacs** Rectifier diodes, voltage regulator diodes (> 1,5 W), transient suppressor diodes, rectifier stacks, thyristors, triacs
Part 1b	May 1977	SC1b 05-77	**Diodes** Small signal germanium diodes, small signal silicon diodes, special diodes, voltage regulator diodes (< 1,5 W), voltage reference diodes, tuner diodes
Part 2	November 1977	SC2 11-77	**Low-frequency and dual transistors**
Part 3	January 1978	SC3 01-78	**High-frequency, switching and field-effect transistors**
Part 4a	December 1978	SC4a 12-78	**Transmitting transistors and modules**
Part 4b	September 1978	SC4b 09-78	**Devices for optoelectronics** Photosensitive diodes and transistors, light emitting diodes, photocouplers, infrared sensitive devices, photoconductive devices
Part 4c	July 1978	SC4c 07-78	**Discrete semiconductors for hybrid thick and thin-film circuits**
Part 5a	November 1976	SC5a 11-76	**Professional analogue integrated circuits**
Part 5b	March 1977	SC5b 03-77	**Consumer integrated circuits** Radio-audio, television
Part 6	October 1977	SC6 10-77	**Digital integrated circuits** LOCMOS HE4000B family
Signetics integrated circuits 1978			Bipolar and MOS memories Bipolar and MOS microprocessors Analogue circuits Logic - TTL

COMPONENTS AND MATERIALS (GREEN SERIES)

Part 1	**June 1977**	**CM1 06-77**	**Assemblies for industrial use** High noise immunity logic FZ/30-series, counter modules 50-series, NORbits 60-series, 61-series, circuit blocks 90-series, circuit block CSA70(L), PLC modules, input/output devices, hybrid circuits, peripheral devices, ferrite core memory products
Part 2a	**October 1977**	**CM2a 10-77**	**Resistors** 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	**February 1978**	**CM2b 02-78**	**Capacitors** Electrolytic and solid capacitors, film capacitors, ceramic capacitors, variable capacitors
Part 3	**January 1977**	**CM3 01-77**	**Radio, audio, television** Components for black and white television, components for colour television
Part 3a	**September 1978**	**CM3a 09-78**	**FM tuners, television tuners, surface acoustic wave filters**
Part 3b	**October 1978**	**CM3b 10-78**	**Loudspeakers**
Part 4a	**November 1978**	**CM4a 11-78**	**Soft ferrites** Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferrocube transformer cores
Part 4b	**February 1979**	**CM4b 02-79**	**Piezoelectric ceramics, permanent magnet materials**
Part 6	**April 1977**	**CM6 04-77**	**Electric motors and accessories** Small synchonous motors, stepper motors, miniature direct current motors
Part 7	**September 1971**	**CM7 09-71**	**Circuit blocks** Circuit blocks 100 kHz-series, circuit blocks 1-series, circuit blocks 10-series, circuit blocks for ferrite core memory drive
Part 7a	**January 1979**	**CM7a 01-79**	**Assemblies** Circuit blocks 40-series and CSA70 (L), counter modules 50-series, input/output devices
Part 8	**June 1979**	**CM8 06-79**	**Variable mains transformers**
Part 9	**March 1976**	**CM9 03-76**	**Piezoelectric quartz devices**
Part 10	**April 1978**	**CM10 04-78**	**Connectors**

Segment indicator tubes A

DUAL 7-SEGMENT INDICATOR TUBE

suitable for direct drive with 30 V ICs

Long-life segmented dual cold-cathode gas-filled indicator tube in a flat envelope for in-line numeric display applications, such as in digital measuring equipment, clocks, cash registers, weighing machines etc. The tube is suitable for soldering into the circuit. Two or more tubes may be stacked horizontally.

QUICK REFERENCE DATA

Character height	15 mm
Characters	formed by 7 segments
Number of decades	2
Decimal point	to the lower right of the characters
Decade pitch (also for stacked tubes)	17,78 mm (0,7 in)

MECHANICAL DATA

Mounting position: any

The tube is provided with dual in-line tinned dip-solder pins for insertion in a printed-wiring board (e = 2,54 mm). It may also be plugged into a socket.

Mechanical strength

The robustness of the pins is tested according to IEC 68–2–21, test 3.4.2.1, method 1.

Soldering

The dip-solder pins may be soldered for 5 s in solder of max. 260 °C.

CHARACTERISTICS

Ignition voltage, first ignition, 25 lx	V_{ign}		<	165 V
Ignition delay, first ignition, V_{ba} = 165 V, 25 lx	T_d	typ.	<	1 s
Ignition voltage, subsequent ignitions within 10 ms	V_{ign}		<	145 V
Primed ignition voltage	$V_{ign\ pr}$		⩽	140 V *
Maintaining voltage			see graph	
Extinction voltage	V_{ext}		⩾	120 V
Luminous intensity per segment				10 mcd/mA

* Primed ignition voltage is the minimum anode to cathode voltage to ensure that any selected numeral (including decimal point) is completed after ignition of one segment.

LIMITING VALUES (Absolute maximum rating system)

		segments	decimal points	
Cathode current, d.c.	max.	0,7	max. 0,25	mA
	min.	0,25	min. 0,1	mA
Cathode current, peak	max.	3	max. 1,1	mA
$T_{imp} \geq 0,2$ ms	min.	0,35	min. 0,1	mA
Cathode current, mean T_{av} = max. 25 ms	max.	0,5	max. 0,2	mA

Voltage between any two segments and/or decimal points	max.	120	V
Voltage between screen and any other electrode (tube ignited)	max.	120	V
Ambient temperature	max.	100	^{o}C *
	min.	−50	^{o}C **

RECOMMENDED OPERATING CONDITIONS

If the tube is used within its limiting values and according to the conditions below, a high-quality display is obtained and interdigit discharges are prevented, even with the worst combination of parameters.

For many applications the worst parameter combination will not occur. In those cases the conditions recommended below may be changed which may result in a cheaper drive circuit. These changes should, however, only be made after consulting the tube manufacturer.

Static operation see Fig. 1

Anode supply voltage	V_{ba}	max.	350	V
		min.	165	V

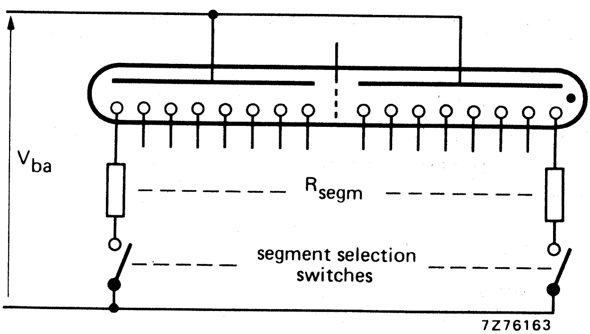


Fig. 1.

* Bulb temperatures above 70 ^{o}C result in changes in colour.
** Bulb temperatures below 10 ^{o}C result in a reduced life expectancy and changes in characteristics.

Dynamic operation see Fig. 2

Anode supply	V_{ba}	max.	185	V
		min.	165	V
Screen supply voltage ($R_{screen} < 10\ k\Omega$)	V_{bs}	max.	60	V
		min.	50	V
	V_{ba} off	max.	125	V
		min.	115	V

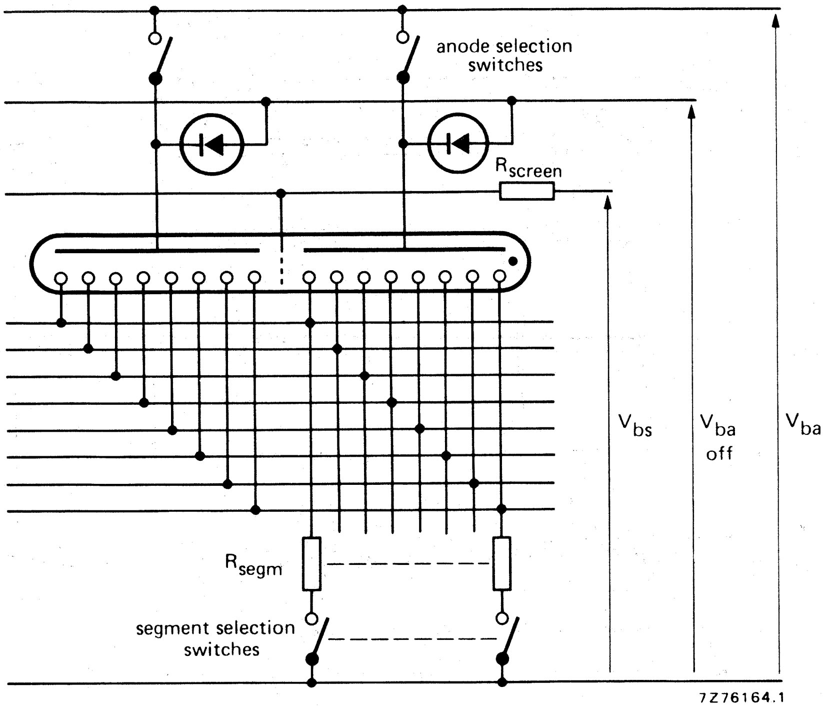


Fig. 2.

Shock and vibration

Samples are taken from the normal production line and are subjected to the following tests:

Shock: 50 g (peak), 1000 shocks in one of the three positions of the tube

Vibration: (–1) 2,5 g (peak), –50 Hz for 2 hours
(–2) 2,5 g (peak), –50 Hz for 96 hours (32 hours in each direction)

Acceptable quality level: 0,65

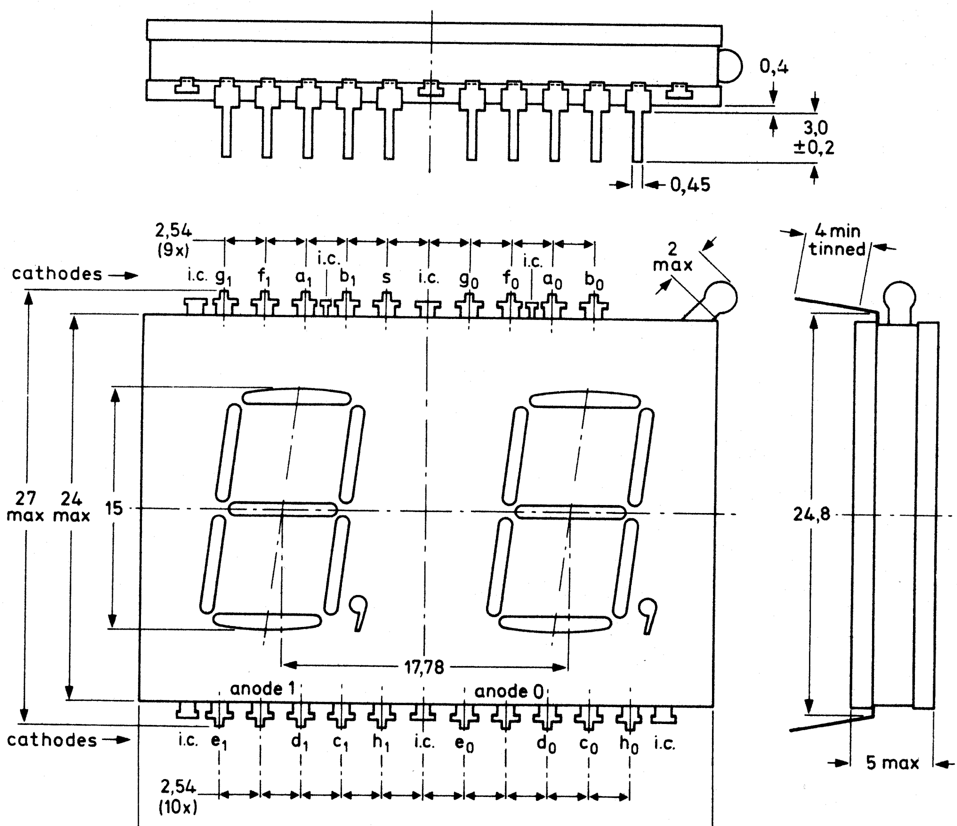
Life expectancy > 50 000 h at max. cathode current

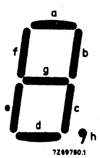
End of life is reached when: (1) the light output is 50% below the initial output, or (2) the min. cover current is 10% higher than the initial min. cover current.

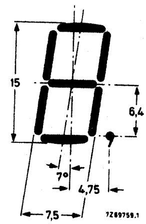
Life with respect to the min. cover current criterion may be reduced for segments not regularly activated. Please consult the manufacturer.

DIMENSIONS AND CONNECTIONS

Dimensions in mm







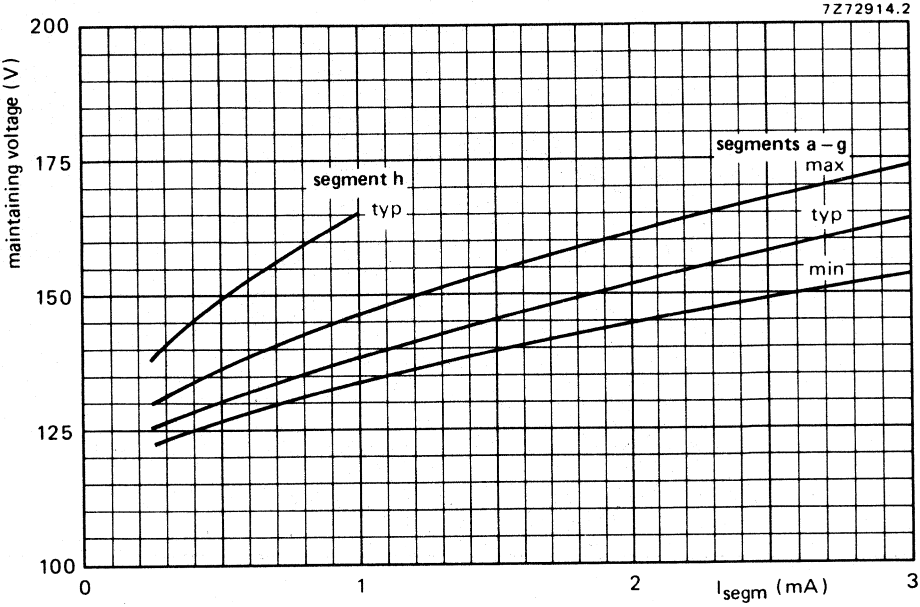


Fig. 4 Maintaining voltage as a function of segment current.

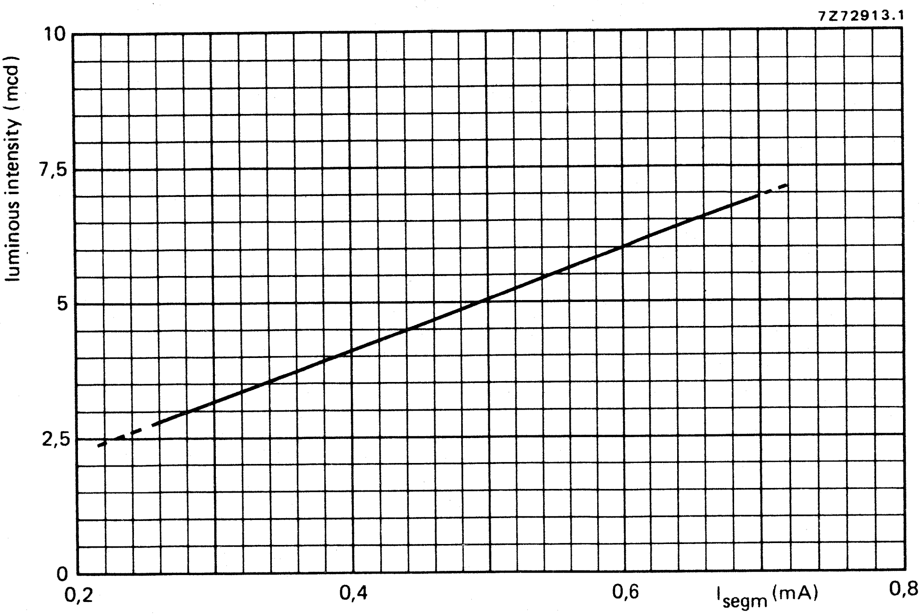


Fig. 5 Luminous intensity as a function of d.c. segment current.

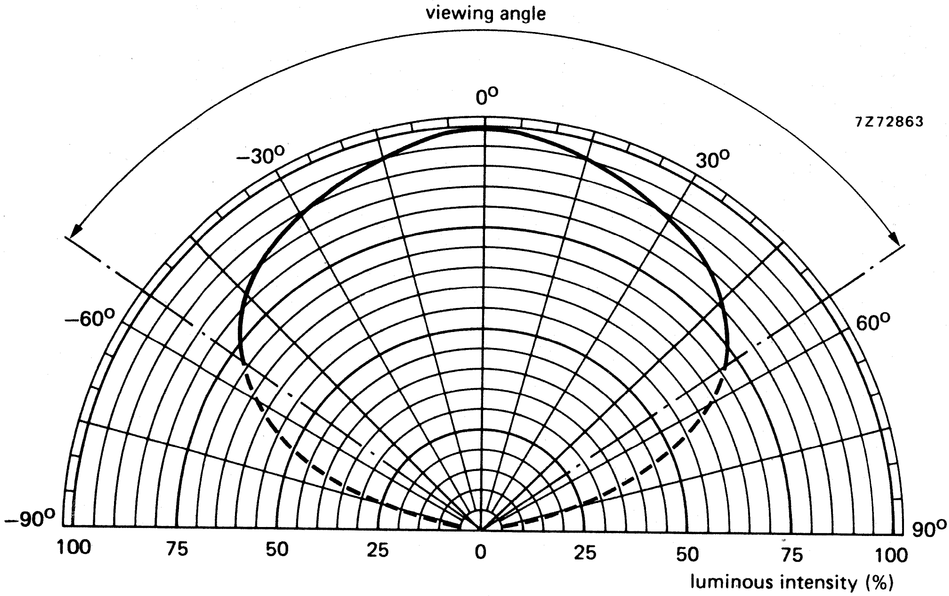


Fig. 6 Relative luminous intensity as a function of the direction of viewing.

7-SEGMENT 1½ DIGIT INDICATOR TUBE

Long-life segmented cold-cathode gas-filled indicator tube in a flat envelope for in-line display applications, such as in digital measuring equipment.
The tube can be stacked with the ZM1550.

QUICK REFERENCE DATA

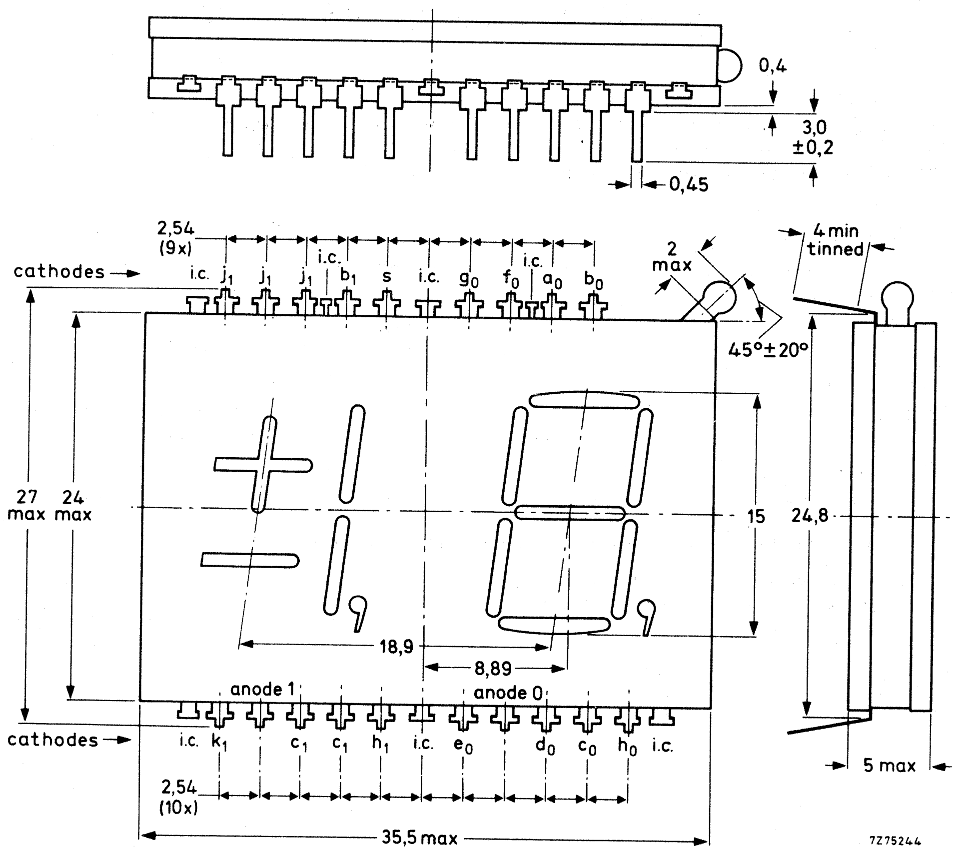
Character height		15 mm
Characters	left compartment	+ – 1
	right compartment	formed by 7 segments
Number of decades		1,5
Decimal sign		to the lower right of the characters
Decade pitch		17,78 mm (0,7 in)

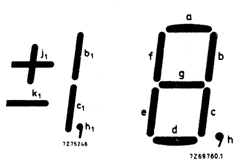
CHARACTERISTICS, OPERATING CONDITIONS, AND LIMITING VALUES

These are the same as of type ZM1550.
The + sign should be considered as consisting of 1½ segments.

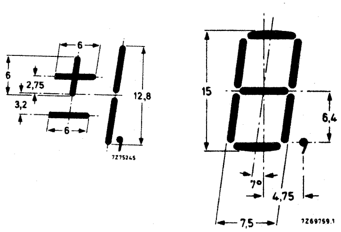
DIMENSIONS AND CONNECTIONS

Dimensions in mm





segment designation



DUAL 7-SEGMENT INDICATOR TUBE

suitable for direct drive with 30 V ICs; fast ignition type

The tube is identical to ZM1550 but contains 150 nCi promethium 147. The ignition delay (first ignition) is max. 0,5 s at 0 lx and V_{ba} = 165 V. The tube is marked Pm 147.

7-SEGMENT 1½ DIGIT INDICATOR TUBE
fast ignition type

The tube is identical to ZM1551 but contains 150 nCi promethium 147. The ignition delay (first ignition) is max. 0,5 s at 0 lx and V_{ba} = 165 V. The tube is marked Pm 147.

Indicator tubes B

COLD CATHODE INDICATOR TUBES

TERMS AND DEFINITIONS

1. Indicator tube.
An indicator tube is a glow discharge tube designed to give a visual indication of the presence of an electrical signal.

A numerical indicator tube is one in which the indication is given in the form of numerals.

In a point indicator tube the indication is given by the position of the glow.

In a segment indicator tube the indication is given in the form of one of more segments, forming a character.

2. Ignition.

2.1 Ignition voltage (symbol V_{ign})
The ignition voltage is the lowest direct potential, which when applied to a particular anode-cathode gap in the presence of some primary ionisation, will cause a self sustaining discharge to start in that anode-cathode gap.

2.2 Ignition delay
The ignition delay is the time interval between the application of a direct potential (equal to or exceeding the ignition voltage) to a particular anode-cathode gap and the establishment of a self sustaining discharge in that gap.

The figure quoted applies to a tube which has been inoperative for a time long in comparision with the deionisation time.

3. Maintaining voltage (symbol V_m)
The maintaining voltage is the voltage between an anode and that cathode carrying the main discharge.

4. Extinguishing voltage (symbol V_{ext})
The extinguishing voltage is the voltage between anode and cathode below which the glow discharge extinguishes and is equal to the lowest possible value of the maintaining voltage.

5. "On" cathode.
The "on" cathode is the cathode (numeral) which is required to be displaid and thus carries the main discharge.

6. "Off" cathode.
The "off" cathodes are the cathodes which are not required for display and thus act as probes in the main discharge.

7. Cathode selecting voltage (symbol V_{kk})
The cathode selecting voltage is the cathode voltage difference which is used for discrimination between the "off" cathodes and the "on" cathode.

8. Anode selecting voltage (symbol V_{aa})
The anode selecting voltage is the anode voltage difference which is used to select the "on" cathode out of a group of cathodes.

9. Anode to cathode bias voltage (bias voltage) (symbol V_{bias})
The anode to cathode bias voltage is the anode to cathode voltage before any cathode has been ignited. This voltage serves to reduce the required selecting voltage.

10. Shield voltage (symbol V_s)
The shield voltage is the voltage difference between the shield electrode and the "on" cathode and is used to prevent the penetration of the discharge from one compartment into another which is separated from the former by said shield.

11. Cathode current (symbol I_k)
The cathode current is the current flowing to the "on" cathode.

11.1 Minimum cathode current for coverage (symbol $I_{k\,min.}$)
The minimum cathode current is the current necessary to ensure full coverage of the "on" cathode by the glow.

11.2 Maximum cathode current (symbol $I_{k\,max.}$)
The maximum cathode current is the current at which the glow is still restricted to the "on" cathode.
If this current is exceeded the glow may spread to connecting leads or other elements.

12. Probe current (symbol I_{kk})
A probe current is the current flowing to or from an electrode which does not form part of the main discharge gap.
(The magnitude and direction of this current will be dependent on the position of this electrode with respect to the main discharge and on the external circuit conditions).

13. Anode current (symbol I_a)
The anode current is the algebraic sum of cathode current and all probe currents.

14. Life expectancy.
End of life is reached when the characteristics of any one numeral surpass the stated limits.

SHOCK AND VIBRATION

An indication for the ruggedness of the tube is the fact that 95% of the items sampled from normal production pass the shock and vibration tests specified below without perceplible damage.
These tests are carried out on non operating tubes.

Shock: 25 g_{peak}, 1000 shocks in one of the three positions of the tube.

Vibration: 2.5 g_{peak}, 50 Hz, during 32 hours in each of the three positions of the tube.

INDICATOR TUBE

Long-life cold-cathode ten-digit indicator tube for side viewing.

QUICK REFERENCE DATA				
Numeral height		approx.	14	mm
Numerals		0 1 2 3 4 5 6 7 8 9		
Decimal point		to the left of the numerals		
Supply voltage	V_{ba}	min.	170	V
Anode current, average	I_a		2,5	mA
peak	I_{ap}	max.	12	mA

GENERAL

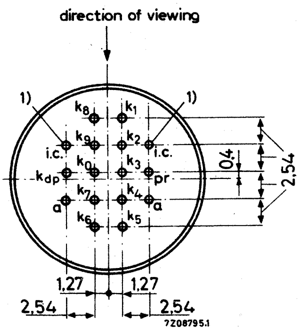
The numerals are 14 mm high and appear on the same base line allowing in-line read out.

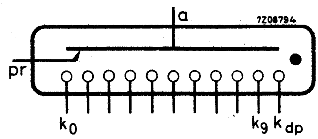
PRINCIPLE OF OPERATION

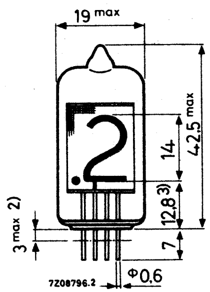
The tube contains ten cathodes in the form of ten numerals and one in the form of a decimal point, a primer, and one common anode. By applying a suitable voltage between the anode and one of the cathodes the corresponding numeral or the decimal point will be covered by a red neon glow.
The primer allows ionization without delay in strobe type or blanking applications.

DIMENSIONS AND CONNECTIONS

Dimensions in mm







1) Length of i.c. pins max. 2,8 mm.
2) Not tinned.
3) Standard deviation 0,13 mm.

The deviations of the axis of the pins with respect to the true geometrical position cover an area of max. 0.3 mm diameter. The pin configuration is compatible with the reference grid for printed wiring according to IEC Publication 97 (0.1 in).

Mounting position: Any

Soldering

The pins may be dip-soldered at a solder temperature of max. 240 °C for maximum 10 seconds up to a point 5 mm from the seals.

Natural frequency

The natural frequencies of the numeral cathodes lie within the range from 300 Hz to 800 Hz.

ACCESSORIES

55701 Printed wiring mounting board (19 x 100 mm) on which the ZM1000 can be soldered; afterwards the combination can be mounted on a vertical printed wiring board carrying, e.g., the drive circuit. Can also be used with the snap-fit tube holder 55703.

55702 Tube socket (for 0.1 in grid). Phenolic. Tinned contacts.

55703 Snap-fit tube holder.

55704 Set of one left-hand and one right-hand end piece to complete the snap-fit indicator tube assembly.

CHARACTERISTICS AND OPERATING CONDITIONS

Ignition voltage	V_{ign}	max.	170	V
Maintaining voltage	V_m	see page 4		
Anode current for coverage	I_a	min.	1.5	mA
(with or without decimal point and	I_a	max.	4.5	mA
$V_{kk} = V_{kk_{min}} - V_{fl}$, see page 5)				
Cathode selecting voltage	V_{kk}	see page **B9**		
Cathode resistor, decimal point	R_{dp}		100	kΩ ± 10% [1]
Primer resistor	R_{pr}		10	MΩ ± 10%
Extinction voltage	V_{ext}	min.	118	V

[1]) Lower values of this resistor are permitted. The anode current should be increased by the increase of decimal point current resulting from the decrease of this resistor.

Typical operation over full temperature range 0 °C to +70 °C.

D.C. operation see pages B8 B9, B10 and B11.

Pulse operation

Peak currents up to 12 mA can be allowed provided the average current value does not exceed 2.5 mA.
To avoid excessive glow on "off" cathodes, the cathode selecting voltage should exceed 65 V. Minimum pulse duration 100 μs.
For further information consult the manufacturer.

LIFE EXPECTANCY at I_a = 2.5 mA

This tube is manufactured on the same physical principles as other tubes in this category and it is expected that the life will be comparable, viz:

sequentially changing the display from one digit to the others every 1000 h or less		100 000	h
Mean time between failures	min.	200 000	h

LIMITING VALUES (Absolute max. rating system)

Anode voltage necessary for ignition	V_a	min.	170	V
Anode current,				
average during any conduction period	I_a	min.	1.5	mA
average (T_{av} = 20 ms)	I_a	max.	4.5	mA
peak	I_{a_p}	max.	12	mA
Cathode selecting voltage	V_{kk}	see page B9		
Bias voltage between anode and "off" cathodes	V_{bias}	max.	$V_{floating}$	
Ambient temperature	t_{amb}	min.	-50	°C [1]
	t_{amb}	max.	+70	°C

SHOCK AND VIBRATION

An indication for the ruggedness of the tube is the fact that 95% of the items sampled from the normal production line pass the shock and vibration tests specified below without perceptible damage.

Shock: 25 g_{peak}, 1000 shocks in one of the three positions of the tube.

Vibration: 2.5 g_{peak}, 50 Hz, during 32 hours in each of the three positions of the tube.

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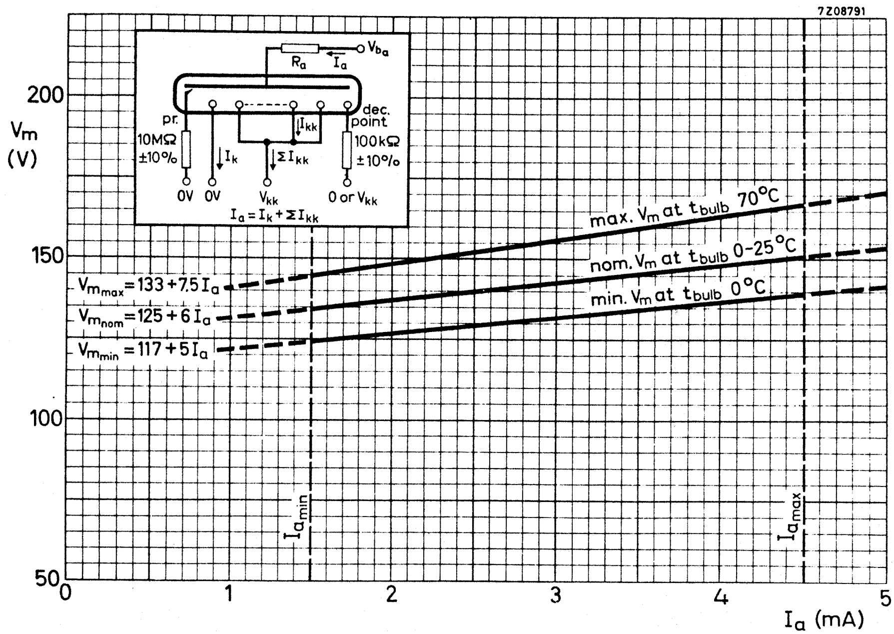
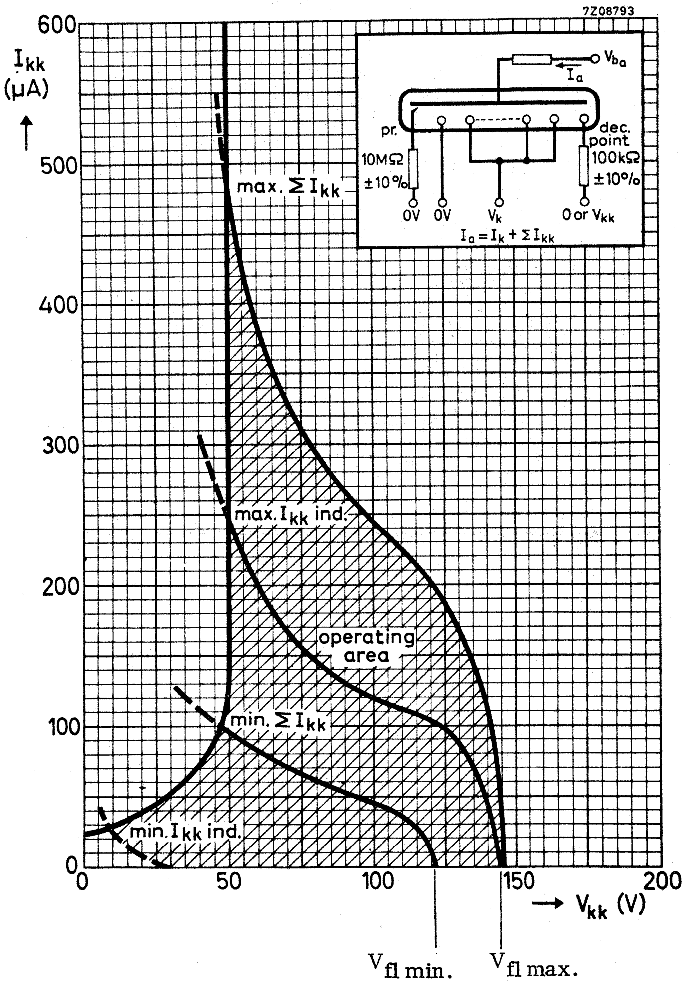
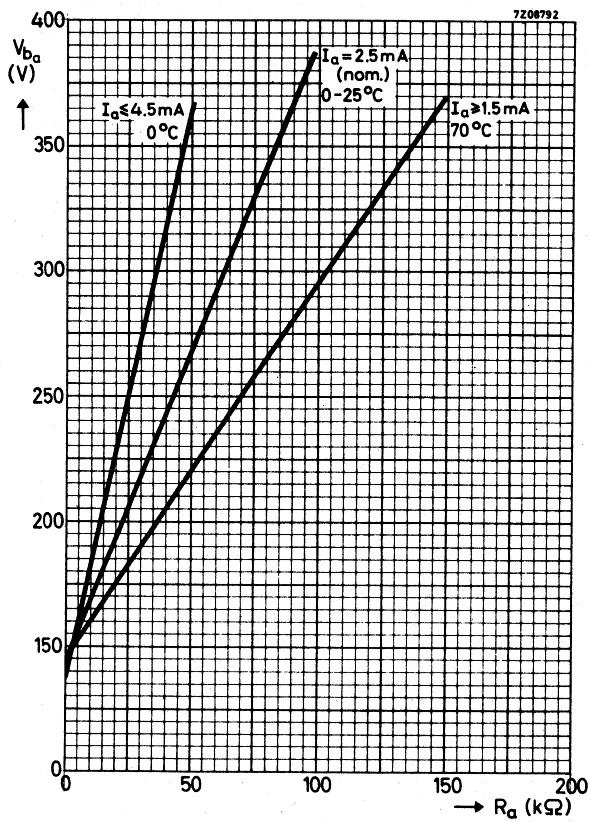
[1] Bulb temperatures below 10 °C result in a reduced life expectancy and changes in characteristics (see page B8).
For equipment to be used over a wide temperature range, "constant current operation" (high supply voltage with a high anode series resistor) is recommended.


7Z08791
V_{b_a}
R_a
I_a
pr.
dec. point
10MΩ ±10%
100kΩ ±10%
I_k
I_{kk}
ΣI_{kk}
0V
0V
V_{kk}
0 or V_{kk}
$I_a = I_k + \Sigma I_{kk}$
V_m (V)
max. V_m at t_{bulb} 70°C
nom. V_m at t_{bulb} 0-25°C
min. V_m at t_{bulb} 0°C
$V_{m_{max}} = 133 + 7.5\,I_a$
$V_{m_{nom}} = 125 + 6\,I_a$
$V_{m_{min}} = 117 + 5\,I_a$
$I_{a_{min}}$
$I_{a_{max}}$
I_a (mA)

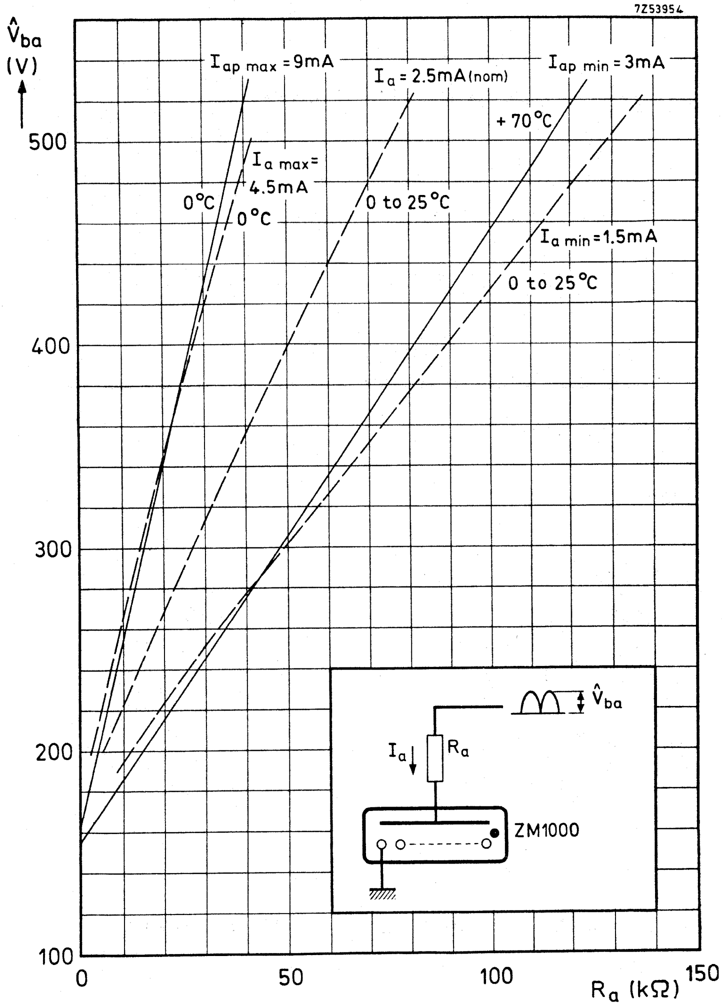


I_{kk} individual and ΣI_{kk} versus cathode selecting voltage V_{kk} at I_a = 2.5 mA.
I_{kk} and ΣI_{kk} are proportional to the anode current within the operating range of I_a and with V_{kk} = 0 V to 100 V.

The curves are valid for instantaneous values and for average values of anode current.



Graph denoting the relationships of D.C. anode supply voltage and required anode resistor to remain within the recommended operating region.


7Z53954
$\hat{V}_{ba}$ (V)
$I_{ap\ max}$ = 9mA
I_a = 2.5mA (nom)
$I_{ap\ min}$ = 3mA
+ 70 °C
$I_{a\ max}$ = 4.5mA
0 °C
0 °C
0 to 25 °C
$I_{a\ min}$ = 1.5mA
0 to 25 °C
500
400
300
200
100
0
50
100
150
R_a (kΩ)
$\hat{V}_{ba}$
I_a
R_a
ZM1000

INDICATOR TUBE

Long-life cold-cathode character indicator tube for side viewing.

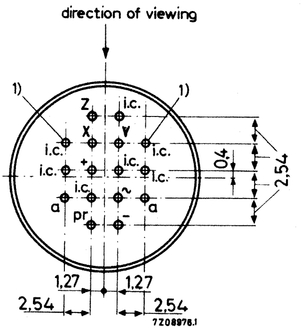
QUICK REFERENCE DATA				
Character height		approx.	10 to 14	mm
Characters	+, −, ~, X, Y, Z			
Supply voltage	V_{ba}	min.	170	V
Anode current	I_a		2.5	mA

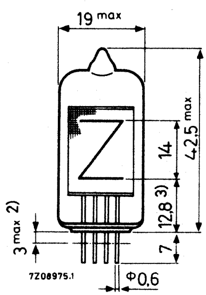
GENERAL

Character indicator tube to be used in conjunction with ZM1000 numerical indicator tube for in-line read-out in e.g. digital instruments or numerical control applications.

DIMENSIONS AND CONNECTIONS

Dimensions in mm





Mounting and Accessories : see ZM1000

CHARACTERISTICS, OPERATING CONDITIONS AND LIMITING VALUES

These are essential the same as of type ZM1000.

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1) Length of these i.c. pins max. 2.8 mm.
2) Not tinned.
3) Standard deviation 0.13 mm.

INDICATOR TUBE

Long-life cold-cathode character indicator tube for side viewing.

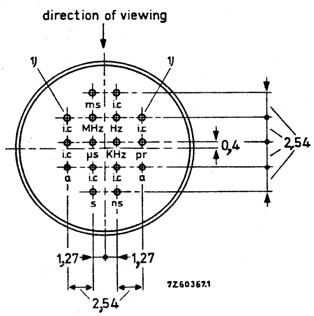
QUICK REFERENCE DATA				
Character height		approx.	9 to 13	mm
Characters		ns, µs, ms, s, Hz, kHz, MHz		
Supply voltage	V_{ba}	min.	170	V
Anode current	I_a		4	mA

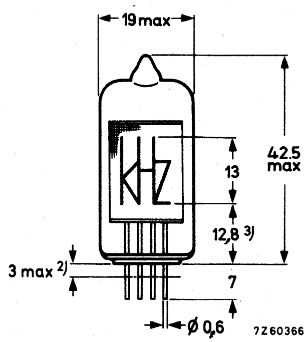
GENERAL

Character indicator tube to be used in conjunction with ZM1000 numerical indicator tube for in-line read-out in e.g. digital instruments such as frequency and time interval measuring apparatus.

DIMENSIONS AND CONNECTIONS

Dimensions in mm





Mounting and Accessories : see ZM1000

1) Length of these i.c. pins max. 2,8 mm.
2) Not tinned.
3) Standard deviation 0,13 mm.

INDICATOR TUBE

Long-life cold-cathode character indicator tube for side-viewing.

QUICK REFERENCE DATA				
Character height		approx.	9 to 14	mm
Characters		℘ 1 - ~		
Supply voltage	V_{ba}	min.	170	V
Anode current	I_a		2,5	mA

PRINCIPLE OF OPERATION

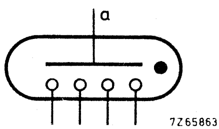
By applying a suitable voltage between the anode and one of the cathodes the corresponding character will be covered by a red neon glow.

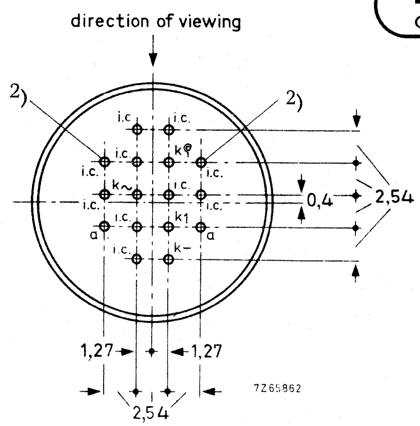
CHARACTERISTICS, OPERATING CONDITIONS AND LIMITING VALUES

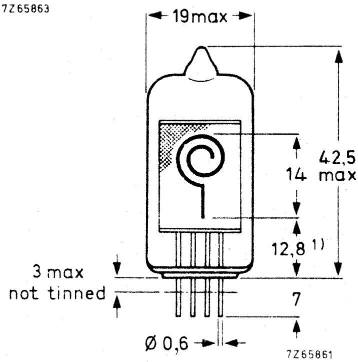
These are essentially the same as of type ZM1010.

DIMENSIONS AND CONNECTIONS

Dimensions in mm







1) Standard deviation 0,13 mm.
2) Length of i.c. pins max. 2,8 mm.

INDICATOR TUBE

Long-life cold-cathode ten-digit indicator tube for side viewing.
The tube is designed for time-sharing (pulse) applications.

QUICK REFERENCE DATA				
Numeral height		approx.	14	mm
Numerals		0 1 2 3 4 5 6 7 8 9		
Decimal point		to the left of the numerals		
Supply voltage	$V_{ba(pulse)}$	min.	170	V
Anode current, peak	I_{ap}	min.	6	mA
	I_{ap}	max.	20	mA
average	I_a	max.	2,5	mA

GENERAL

The numerals are 14 mm high and appear on the same base line allowing in-line read-out.

PRINCIPLE OF OPERATION

The tube contains ten cathodes in the form of ten numerals and one in the form of a decimal point; a primer, and one common anode. By applying a suitable voltage between the anode and one of the cathodes the corresponding numeral or the decimal point will be covered by a red neon glow.
The primer allows ionization without delay in strobe type or blanking applications.

SHOCK AND VIBRATION

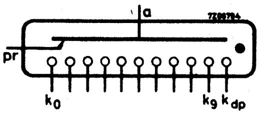
An indication for the ruggedness of the tube is the fact that 95% of the items sampled from the normal production line pass the shock and vibration tests specified below without perceptible damage.

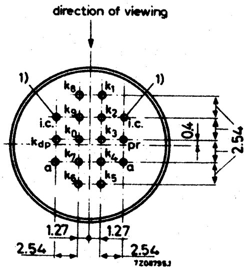
Shock: 25 g_{peak}, 1000 shocks on one of the three positions of the tube.

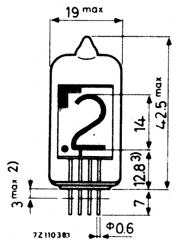
Vibration: 2,5 g_{peak}, 50 Hz, during 32 hours in each of the three positions of the tube.

DIMENSIONS AND CONNECTIONS

Dimensions in mm







The deviation of the axes of the pins with respect to the true geometrical position cover an area of 0.3 mm diameter. The pin configuration is compatible with the reference grid for printed wiring according to IEC Publication 97 (0.1 in).

Mounting position: any

Soldering

The pins may be dip-soldered at a solder temperature of max. 240 °C for maximum 10 seconds up to a point 3 mm from the seals.

Natural frequency

The natural frequencies of the numeral cathodes lie within the range from 300 Hz to 800 Hz.

ACCESSORIES

55702 Tube socket (for 0.1 in grid). Phenolic. Tinned contacts.

55703 Snap-fit tube holder.

55704 Set of one left-hand and one right-hand end piece to complete the snap-fit indicator tube assembly.

1) i.c. pins max. length 2.8 mm
2) Not tinned
3) Standard deviation 0.13 mm

CHARACTERISTICS AND OPERATING CONDITIONS

Ignition voltage	V_{ign}	max.	170	V
Maintaining voltage	V_m	see page 4		
Anode current, average (T_{av} = max. 20 ms)	I_a	max.	2.5	mA
peak	I_{ap}	min.	6	mA
(with or without decimal point)	I_{ap}	max.	20	mA
Pulse duration	T_{imp}	min.	50	μs [1]
Cathode selecting voltage	V_{kk}	min.	70	V [2]
	V_{kk}	max.	115	V
Cathode resistor, decimal point	R_{dp}		10	k$\Omega \pm 10\%$ [3]
Primer resistor (anode to primer supply voltage min. 170 V)	R_{pr}		10	M$\Omega \pm 10\%$
Extinguishing voltage	V_{ext}	min.	118	V

LIFE EXPECTANCY at I_a = 2 mA

The life expectancy is dependent on the instantaneous and average values of anode current:

sequentially changing the display from one digit to the others every 100 h or less, I_{ap} = 10 mA	100 000	h
I_{ap} = 20 mA	20 000	h
Mean time between failures	min. 200 000	h

LIMITING VALUES (Absolute max. rating system)

Anode voltage necessary for ignition, pulse	V_{ap}	min.	170	V
Anode current, average (T_{av} = 20 ms)	I_a	max.	2.5	mA
peak	I_{ap}	min.	6	mA
	I_{ap}	max.	20	mA
Pulse duration	T_{imp}	min.	10	μs
Cathode selecting voltage	V_{kk}	min.	70	V
	V_{kk}	max.	115	V
"Off" anode voltage	$V_{a''off''}$	max.	115	V
Ambient temperature	t_{amb}	min.	−50	°C [4]
	t_{amb}	max.	+70	°C

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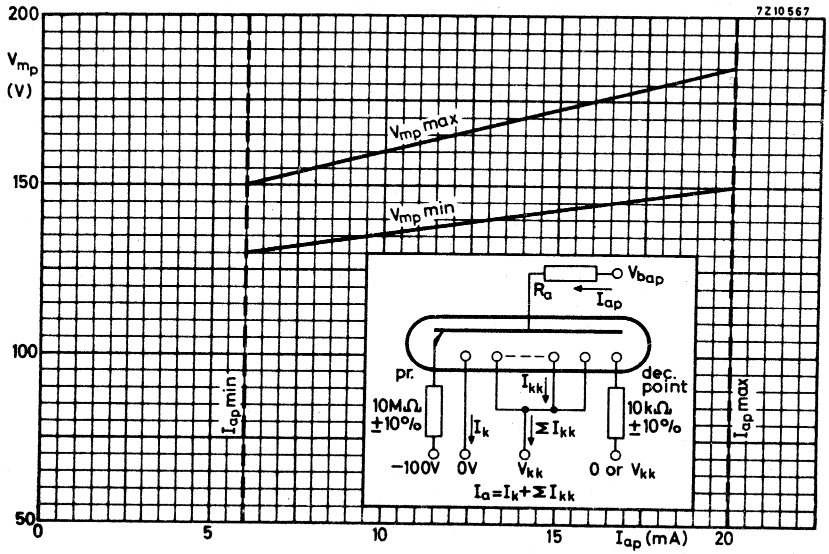
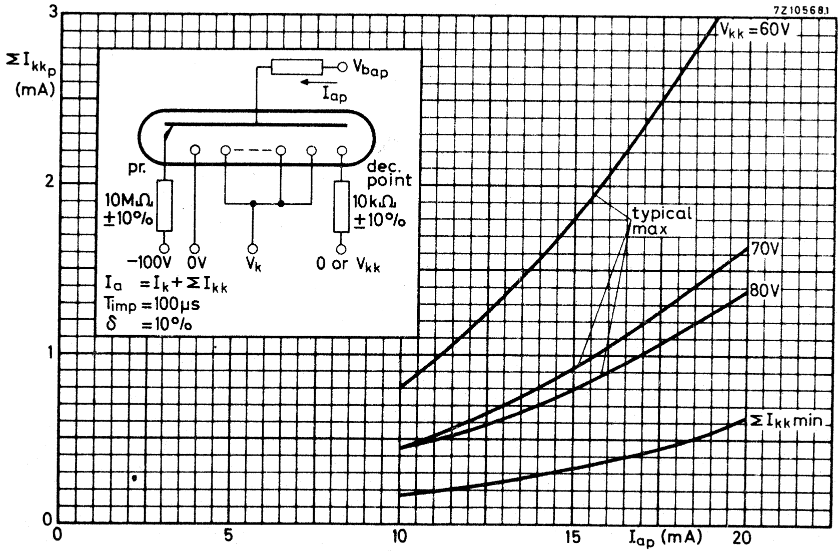
1) Pulse durations down to 10 μs are allowed provided the minimum peak anode current is not less than 10 mA.

2) Lower values of V_{kk} result in increasing background glow impairing readability.

3) The decimal point cathode may not be operated without extra current limiting resistor unless a numeral cathode is operated simultaneously.

4) Bulb temperatures below 10 °C result in a reduced life expectancy and changes in characteristics.
For equipment to be used over a wide temperature range, "constant current operation" is recommended.


7Z10567
200
V_{m_p}
(V)
150
100
50
0
5
10
15
20
I_{ap} (mA)
V_{mp} max
V_{mp} min
I_{ap} min
I_{ap} max
V_{bap}
R_a
I_{ap}
pr.
dec. point
I_{kk}
10 MΩ ±10%
10 kΩ ±10%
I_k
ΣI_{kk}
−100V
0V
V_{kk}
0 or V_{kk}
$I_a = I_k + \Sigma I_{kk}$


7Z10568.1
3
ΣI_{kk_p}
(mA)
2
1
0
5
10
15
20
I_{ap} (mA)
V_{kk} = 60V
70V
80V
typical
max
ΣI_{kk} min
V_{bap}
I_{ap}
pr.
dec. point
10 MΩ ±10%
10 kΩ ±10%
−100V
0V
V_k
0 or V_{kk}
$I_a = I_k + \Sigma I_{kk}$
T_{imp} = 100 μs
δ = 10%

INDICATOR TUBE

Long-life cold-cathode ten-digit indicator tube for side-viewing.

QUICK REFERENCE DATA				
Numeral height		approx.	14	mm
Numerals		0 1 2 3 4 5 6 7 8 9		
Decimal point		to the left of the numerals		
Supply voltage	V_{ba}	min.	170	V
Anode current	I_a		2,5	mA

GENERAL

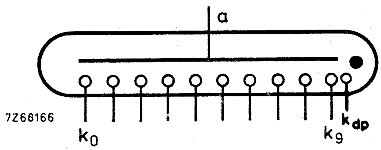
The numerals are 14 mm high and appear on the same base line allowing in-line read out.

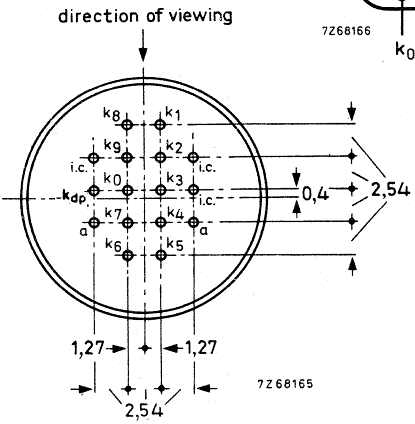
PRINCIPLE OF OPERATION

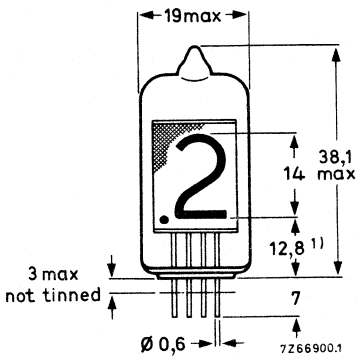
By applying a suitable voltage between the anode and one of the cathodes the corresponding numeral or the decimal point will be covered by a red neon glow.

DIMENSIONS AND CONNECTIONS

Dimensions in mm







1) Standard deviation 0, 13 mm.

The deviations of the axis of the pins with respect to the true geometrical position cover an area of max. 0, 3 mm diameter. The pin configuration is compatible with the reference grid for printed wiring according to IEC Publication 97 (0, 1 in).

Mounting position: Any

Soldering:

The pins may be dip-soldered at a solder temperature of max. 240 °C for maximum 10 s up to a point 5 mm from the seals.

ACCESSORIES

55701 Printed wiring mounting board (19 x 100 mm) on which the tube can be soldered; afterwards the combination can be mounted on a vertical printed wiring board carrying, e.g., the drive circuit.

55702 Tube socket compatible with IEC reference grid for printed wiring (0, 1 in). Phenolic. Tinned pins.

CHARACTERISTICS AND OPERATING CONDITIONS

Ignition voltage	V_{ign}	max.	170	V
Maintaining voltage	V_m	see page	4	
Anode current for coverage	I_a	max. min.	3, 5 1, 5	mA mA
Cathode selecting voltage	V_{kk}	see page	4	
Extinction voltage	V_{ext}	min.	118	V

LIFE EXPECTANCY at I_a = 2, 5 mA

The tube is manufactured on the same physical principles as other tubes in this category and it is expected that the life will be comparable, viz:

Sequentially changing the display from one digit to the others every 1000 h or less		100 000	h
Mean time between failures	min.	200 000	h

LIMITING VALUES (Absolute max. rating system)

Anode voltage necessary for ignition	V_a	min.	170	V
Anode current	I_a	max. min.	3, 5 1, 5	mA mA
Cathode selecting voltage	V_{kk}	max. min.	100 60	V V
Ambient temperature	t_{amb}	max. min.	+70 -50	°C °C

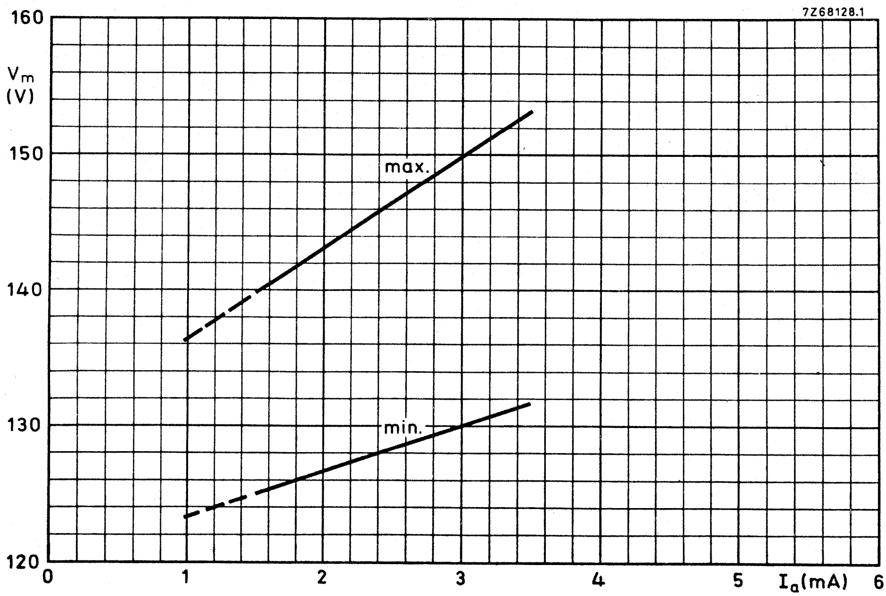
Bulb temperatures below 10 °C result in a reduced life expectancy and changes in characteristics.

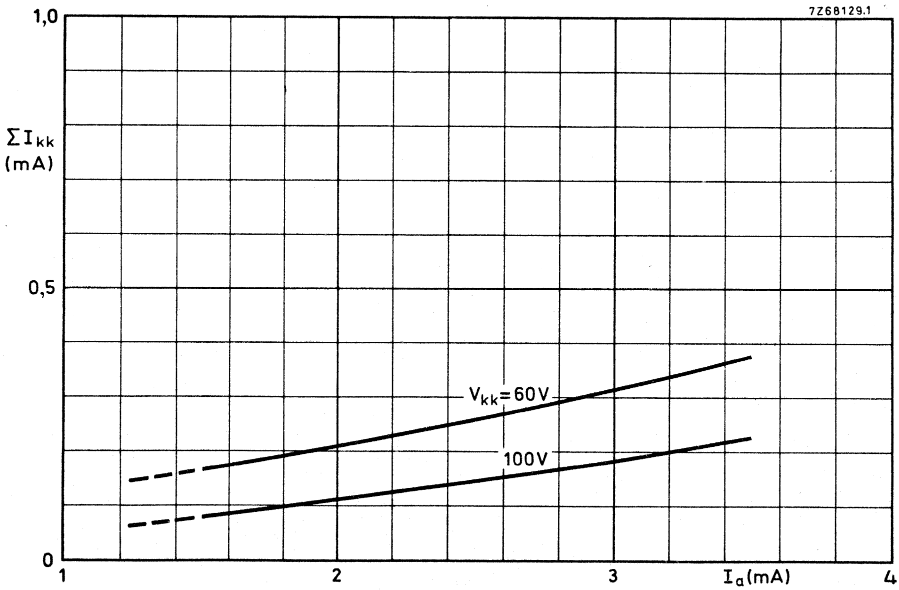
SHOCK AND VIBRATION

An indication for the ruggedness of the tube is the fact that 95% of the items sampled from the normal production line pass the shock and vibration test specified below without perceptible damage.

Shock 25 g_{peak}, 1000 shocks in one of the three positions of the tube.

Vibration 2, 5 g_{peak}, 50 Hz, during 32 hours in each of the three positions of the tube.


7Z68128.1
160
150
140
130
120
Vm
(V)
max.
min.
0
1
2
3
4
5
6
Ia(mA)


7Z68129.1
1,0
0,5
0
ΣIkk
(mA)
Vkk=60V
100V
1
2
3
4
Ia(mA)

INDICATOR TUBE

Long-life cold-cathode nine-digit indicator tube for side-viewing.

QUICK REFERENCE DATA				
Numeral height		approx.	14	mm
Numerals		0 1 2 3 4 5 6 7 8		
Supply voltage	V_{ba}	min.	170	V
Anode current	I_a		2,5	mA

GENERAL

The numerals are 14 mm high and appear on the same base line allowing in-line read out.

PRINCIPLE OF OPERATION

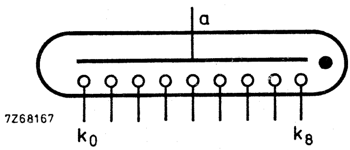
By applying a suitable voltage between the anode and one of the cathodes the corresponding numeral will be covered by a red neon glow.

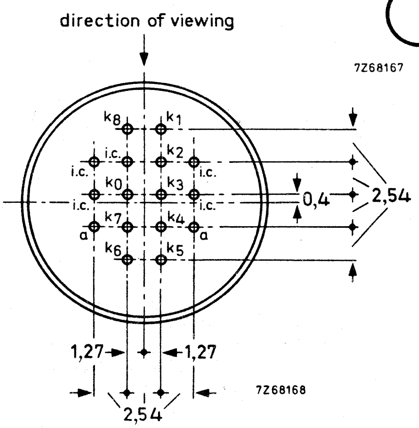
CHARACTERISTICS, OPERATING CONDITIONS AND LIMITING VALUES

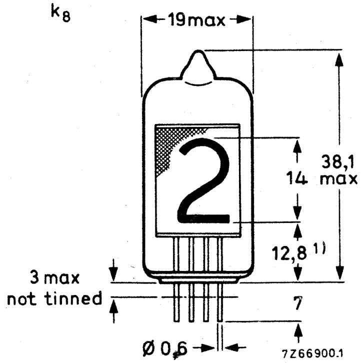
These are essentially the same as of type ZM1010.

DIMENSIONS AND CONNECTIONS

Dimensions in mm







1) Standard deviation 0, 13 mm.

INDICATOR TUBE

Long life cold-cathode eight-digit indicator tube for side-viewing.

QUICK REFERENCE DATA				
Numeral height		approx.	14	mm
Numerals		1 2 3 4 5 6 7 8		
Supply voltage	V_{ba}	min.	170	V
Anode current	I_a		2,5	mA

GENERAL

The numerals are 14 mm high and appear on the same base line allowing in-line read out.

PRINCIPLE OF OPERATION

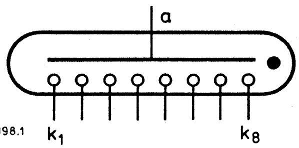
By applying a suitable voltage between the anode and one of the cathodes the corresponding numeral will be covered by a red neon glow.

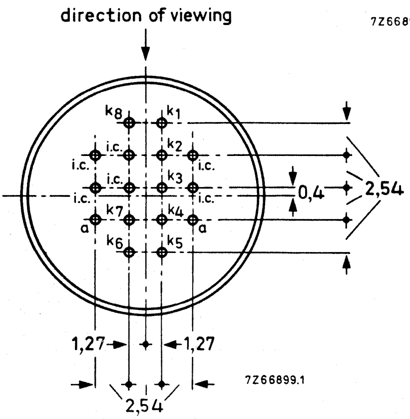
CHARACTERISTICS, OPERATING CONDITIONS AND LIMITING VALUES

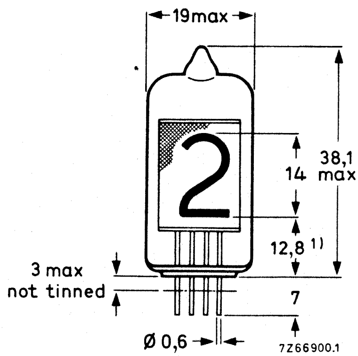
These are essentially the same as of type ZM1010.

DIMENSIONS AND CONNECTIONS

Dimensions in mm







1) Standard deviation 0,13 mm

INDICATOR TUBE

Long-life cold-cathode seven-digit indicator tube for side-viewing.

QUICK REFERENCE DATA				
Numeral height		approx.	14	mm
Numerals		0 1 2 3 4 5 6		
Supply voltage	V_{ba}	min.	170	V
Anode current	I_a		2,5	mA

GENERAL

The numerals are 14 mm high and appear on the same base line allowing in-line read out.

PRINCIPLE OF OPERATION

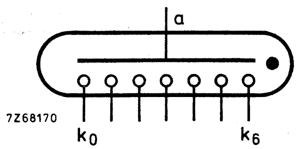
By applying a suitable voltage between the anode and one of the cathodes the corresponding numeral will be covered by a red neon glow.

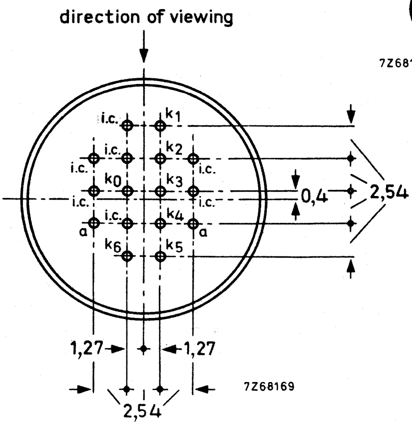
CHARACTERISTICS, OPERATING CONDITIONS AND LIMITING VALUES

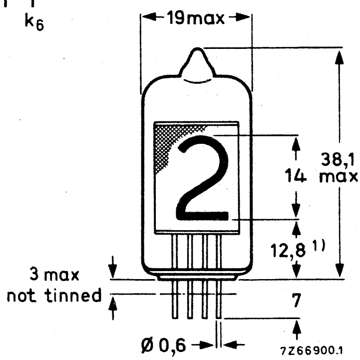
These are essentially the same as of type ZM1010.

DIMENSIONS AND CONNECTIONS

Dimensions in mm







1) Standard deviation 0,13 mm.

INDICATOR TUBE

Long life cold-cathode six-digit indicator tube for side-viewing

QUICK REFERENCE DATA				
Numeral height		approx.	14	mm
Numerals		1 2 3 4 5 6		
Supply voltage	V_{ba}	min.	170	V
Anode current	I_a		2,5	mA

GENERAL

The numerals are 14 mm high and appear on the same base line allowing in-line read out.

PRINCIPLE OF OPERATION

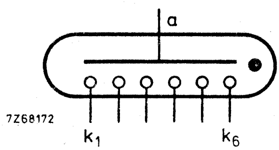
By applying a suitable voltage between the anode and one of the cathodes the corresponding numeral will be covered by a red neon glow.

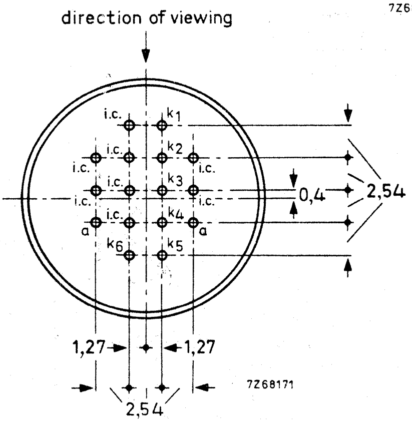
CHARACTERISTICS, OPERATING CONDITIONS AND LIMITING VALUES

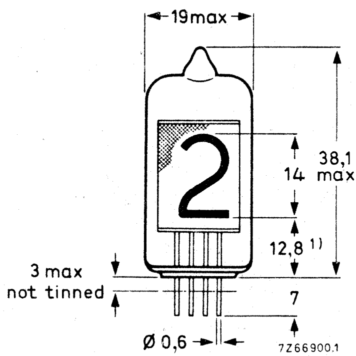
These are essentially the same as of type ZM1010.

DIMENSIONS AND CONNECTIONS

Dimensions in mm







1) Standard deviation 0, 13 mm

INDICATOR TUBE

Long-life cold-cathode eight-digit indicator tube for side-viewing.

QUICK REFERENCE DATA				
Numeral height		approx.	14	mm
Numerals			1 2 3 4 5 6 7 8	
Supply voltage	V_{ba}	min.	170	V
Anode current	I_a		2,5	mA

GENERAL

The numerals are 14 mm high and appear on the same base line allowing in-line read out.

PRINCIPLE OF OPERATION

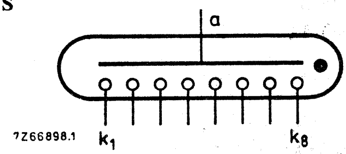
By applying a suitable voltage between the anode and one of the cathodes the corresponding numeral will be covered by a red neon glow.

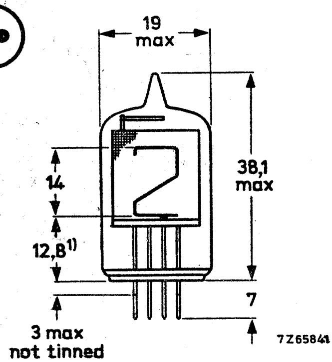
CHARACTERISTICS, OPERATING CONDITIONS AND LIMITING VALUES

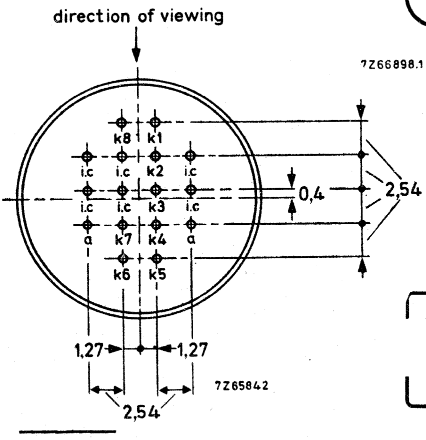
These are essentially the same as of type ZM1010.

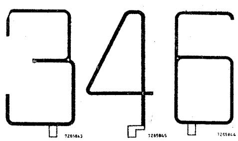
DIMENSIONS AND CONNECTIONS

Dimensions in mm









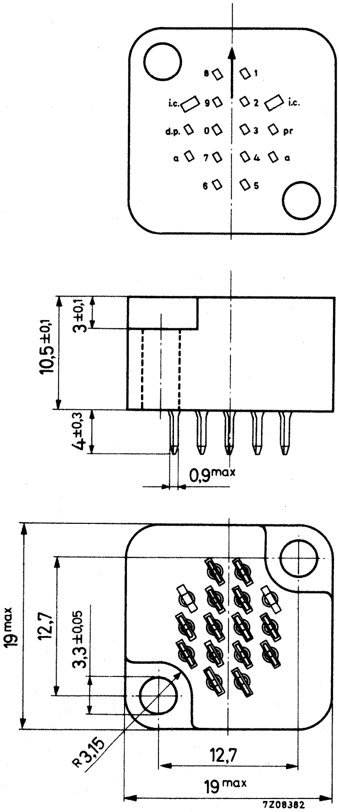
1) Standard deviation 0,13 mm.

14 PIN TUBE SOCKET

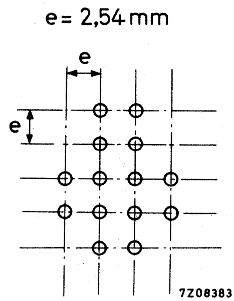
Socket for over-chassis mounting and mounting on a printed-wiring board with reference grid according to IEC publication 97.
The socket is compatible with 14 pin base (e.g. ZM1000).

MECHANICAL DATA

Dimensions in mm



Hole pattern in printed wiring board
(for bottom view of socket)



Material : Phenolic
Contacts : Fork shaped, silver plated

INDICATOR TUBE

Long life cold cathode ten digit numeral indicator tube for top viewing.

QUICK REFERENCE DATA			
Numeral height		15	mm
Numerals	1 2 3 4 5 6 7 8 9 0		
Supply voltage	min.	170	V
Anode current		2	mA

GENERAL

The numerals are 15 mm high and appear on the same base line allowing in-line read out. The ZM1020 is provided with a red contrast filter.
The ZM1020/01 is identical with the ZM1020 but has tinned pins.

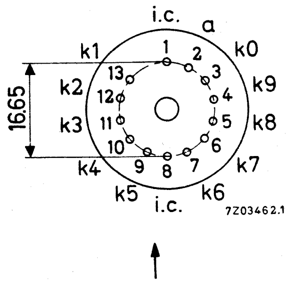
PRINCIPLE OF OPERATION

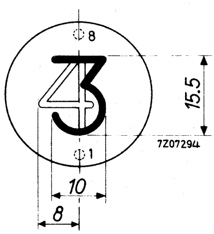
The tube contains ten cathodes in the form of ten figures and one common anode. By applying a suitable voltage between the anode and one of the ten cathodes the corresponding numeral will be covered by a red neon glow.

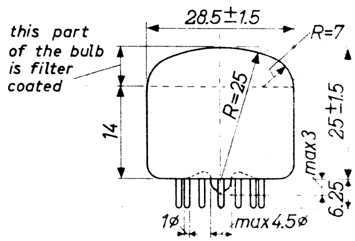
DIMENSIONS AND CONNECTIONS

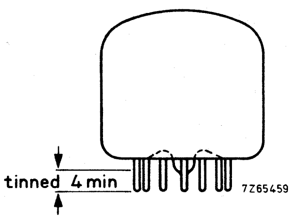
Dimensions in mm

Base: B13B









ZM1020/01

Mounting position: any

The numerals are viewed through the dome of the envelope. The numerals will appear upright (within 1.5°) when the tube is mounted with the line through pins 1 and 8 vertical, pin 8 being uppermost.

Accessories

Socket	type	2422 505 00001
		or
		2422 505 00002

CHARACTERISTICS AND OPERATING CONDITIONS
(Valid over life and full temperature range)

Ignition voltage	V_{ign}	max.	170	V
Maintaining voltage	V_m	see page B32		
Anode current for coverage, averaged during any conduction period	I_a	min.	1	mA
Anode current,				
average (T_{av} = max. 20 ms)	I_a	max.	3	mA
peak	I_{ap}	max.	6	mA
Cathode selecting voltage	V_{kk}	see page B33		
Extinguishing voltage	V_{ext}	min.	118	V

Typical operation [1])

D.C. operation

See pages B33 and B34

A.C. operation

See pages B33 and B35

[1]) Bulb temperatures below 10 °C result in a reduced life expectancy and changes in characteristics (see page B32).
In designing equipment to be used over a wide temperature range the use of "constant current operation" (high supply voltage with a high anode series resistor) is recommended.

LIFE EXPECTANCY AND RELIABILITY (at I_a = 2 mA)

Sequentially changing the display from one digit to the others every 1000 h. or less	100.000 h

The reliability has been assessed in a life test programme totalling 4.5 x 10^6 tube hours. The longest test period was 50.000 hrs on 47 tubes. No failures have been found. The Mean Time between Failures is better than 10^6 hrs which corresponds with a failure rate of less than 0.1 % per 1000 hrs at a confidence level of 95 %.

LIMITING VALUES (Absolute max. rating system)

Anode voltage necessary for ignition	V_a	min.	170	V
Anode current, D.C.	I_a	min.	1	mA
rectified A.C. and pulse	I_{a_p}	min.	2	mA
average (T_{av} = max. 20 ms)	I_a	max.	3	mA
peak	I_{a_p}	max.	10	mA [1]
Cathode selecting voltage	V_{kk}	see lines N and W on page B33		
Bias voltage between anode and "off" cathodes (see page B33)	V_{bias}	max.	$V_{floating}$	
Ambient temperature	t_{amb}	min.	-50	°C
		max.	+70	°C

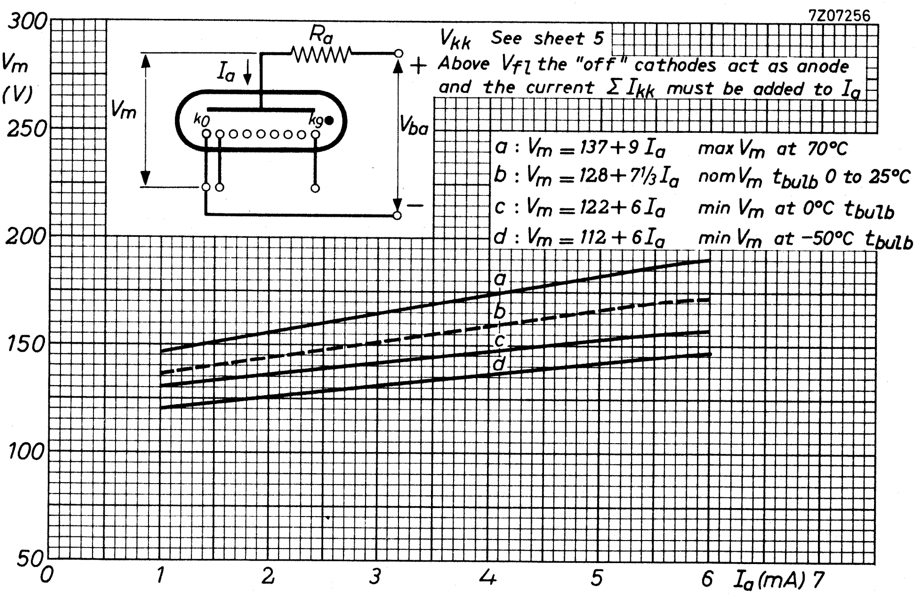
SHOCK AND VIBRATION

An indication for the ruggedness of the tube is the fact that 95% of the items sampled from the normal production line pass the shock and vibration tests specified below without perceptible damage.

Shock: 25 g_{peak}, 1000 shocks in one of the three positions of the tube.

Vibration: 2.5 g_{peak}, 50 Hz, during 32 hours in each of the three positions of the tube.

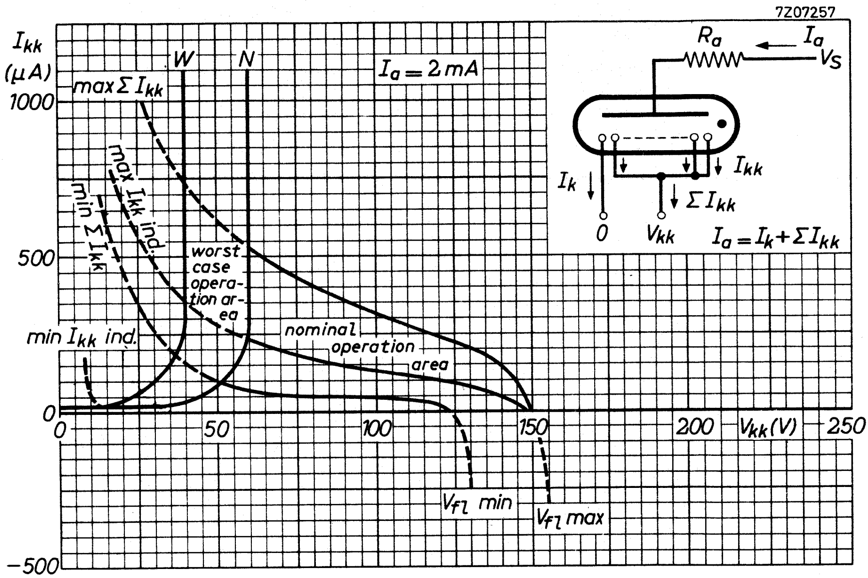
[1]) Above I_a = 6 mA the connecting wires and eyelets may be covered by the glow.


7Z07256
300
250
200
150
100
50
Vm
(V)
0
1
2
3
4
5
6
Ia (mA) 7
Ra
Ia
Vm
k0
k9
Vba
+
−
Vkk See sheet 5
Above Vfl the "off" cathodes act as anode and the current Σ Ikk must be added to Ia
a : Vm = 137 + 9 Ia max Vm at 70°C
b : Vm = 128 + 7 1/3 Ia nom Vm tbulb 0 to 25°C
c : Vm = 122 + 6 Ia min Vm at 0°C tbulb
d : Vm = 112 + 6 Ia min Vm at −50°C tbulb
a
b
c
d

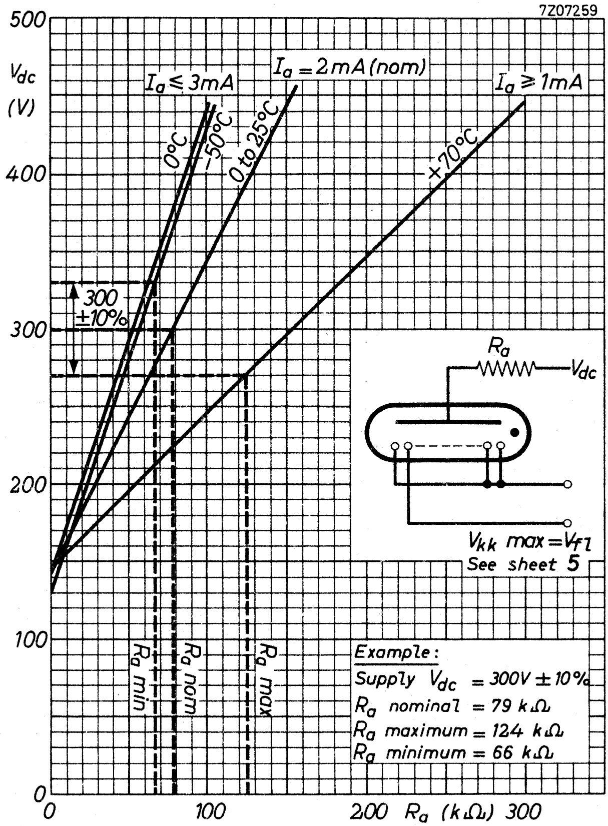
I_{kk} individual and ΣI_{kk} versus cathode selecting voltage V_{kk} at I_a = 2 mA.
I_{kk} and ΣI_{kk} are proportional to anode current in the range V_{kk} = 0 to 100 V.

The range of V_{fl} (I_{kk} = 0) shifts to the right/left at increasing/decreasing anode current (8 V/mA).

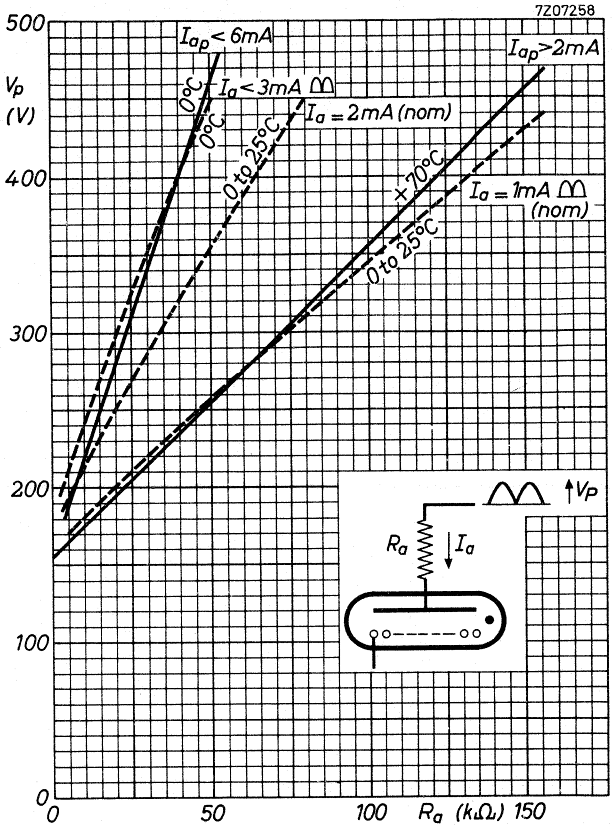
The curves are valid for instantaneous and for average values of anode current.



For low cathode selecting voltages the current I_{kk} to the "off" cathodes will increase and the readability of the "on" cathode will be affected. It is therefore recommended to use a nominal operating point to the right of line N.
Under the worst operating conditions the operating point should never reach the area left of line W.



Graph denoting the relationship of D.C. anode supply voltage and required anode resistor to remain within the recommended operating region.



Graph denoting the relationship of the peak value of full-wave unsmoothed rectified A.C. anode supply voltage and the required anode resistor to remain within the recommended operating area.

INDICATOR TUBE

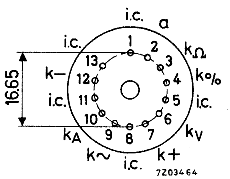
Cold cathode character indicator tube for top viewing.

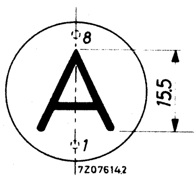
QUICK REFERENCE DATA		
Character height		15 mm
Characters		A, V, Ω, %, , +, -, ~
Supply voltage	min.	170 V
Anode current		2 mA

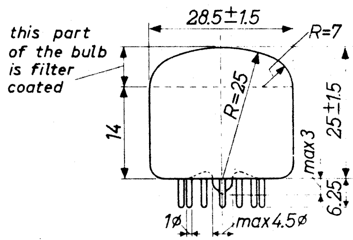
DIMENSIONS AND CONNECTIONS

Dimensions in mm

Base: B13B







CHARACTERISTICS, OPERATING CONDITIONS AND LIMITING VALUES

These are essentially the same as those of type ZM1020.

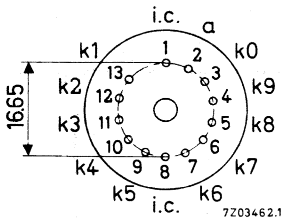
INDICATOR TUBE

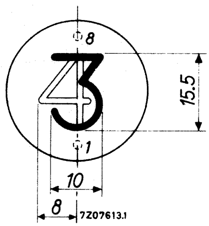
The type ZM1022 is electrically identical with type ZM1020 but has no filter coating.
The use of a separate amber filter (i.e. blue absorbing) is recommended.

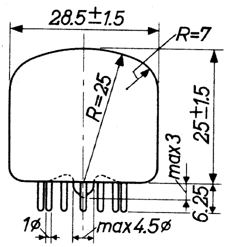
DIMENSIONS AND CONNECTIONS

Dimensions in mm

Base: B13B







INDICATOR TUBE

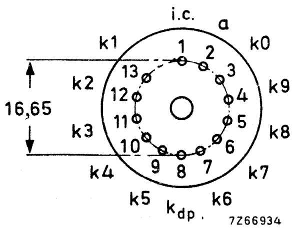
Cold cathode numerical indicator tube for top viewing, electrically identical to type ZM1022 but provided with a decimal point to the left of the numerals.
The use of a separate amber filter (i.e. blue absorbing) is recommended.

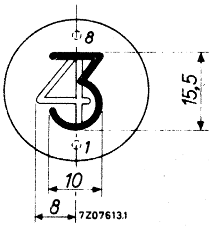
QUICK REFERENCE DATA			
Numeral height		15	mm
Numerals	1 2 3 4 5 6 7 8 9 0		
Decimal point	to the left of the numerals		
Supply voltage	min.	170	V
Anode current, numerals		2	mA
decimal point		0, 25	mA

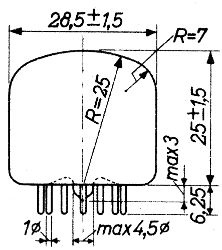
DIMENSIONS AND CONNECTIONS

Dimensions in mm

Base: B13B







CHARACTERISTICS, OPERATING CONDITIONS, AND LIMITING VALUES

For the numerals, are essentially the same as those of type ZM1020.

LIMITING VALUES decimal point (Absolute max. rating system)

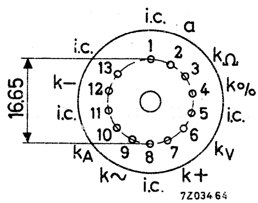
Anode current, decimal point	max.	0, 5	mA
	min.	0, 1	mA

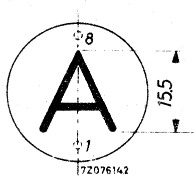
INDICATOR TUBE

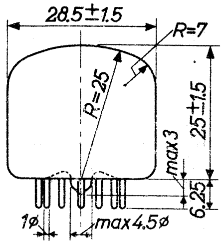
The type ZM1023 is electrically identical with type ZM1021 but has no filter coating. The use of a separate amber filter (i. e. blue absorbing) is recommended.

DIMENSIONS AND CONNECTIONS Dimensions in mm

Base : B13B







INDICATOR TUBE

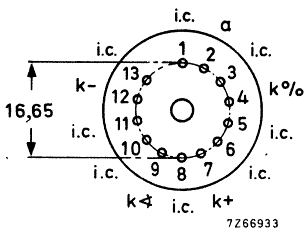
Cold cathode sign indicator tube.
The use of a separate amber filter (i. e. blue absorbing) is recommended.

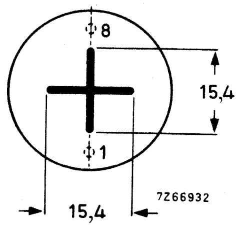
QUICK REFERENCE DATA			
Sign height		15	mm
Signs		⊀ % + -	
Supply voltage	min.	170	V
Anode current		2	mA

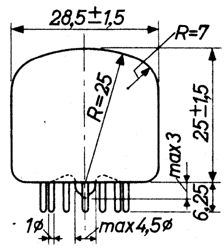
DIMENSIONS AND CONNECTIONS

Dimensions in mm

Base: B13B







CHARACTERISTICS, OPERATING CONDITIONS, AND LIMITING VALUES

These are essentially the same as those of type ZM1020.

INDICATOR TUBE

Cold cathode ten digit numeral indicator tube for side viewing.

QUICK REFERENCE DATA				
Numeral height			30	mm
Numerals	1 2 3 4 5 6 7 8 9 0			
Supply voltage	V_{ba}	min.	170	V
Cathode current	I_k		4.5	mA

GENERAL

The numerals are 30 mm high and appear on the same base line allowing in-line read out. The ZM1040 is provided with a red contrast filter.

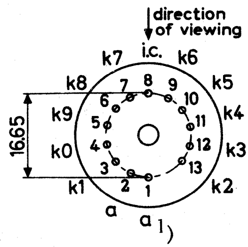
PRINCIPLE OF OPERATION

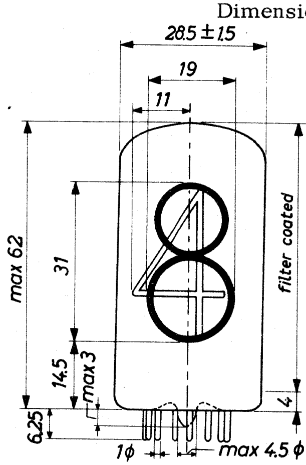
The tube contains ten cathodes in the form of ten figures and one common anode. By applying a suitable voltage between the anode and one of the ten cathodes the corresponding numeral will be covered by a red neon glow.

DIMENSIONS AND CONNECTIONS

Dimensions in mm

Base: B13B





7Z00969.1

1) Pins 1 and 2 to be interconnected externally.

Mounting position: any

The numerals are viewed through the side of the envelope. The numerals will appear upright (within 1.5°) when the tube is mounted vertically.

Accessories		
Socket	type	2422 505 00001 or 2422 505 00002

CHARACTERISTICS AND OPERATING CONDITIONS

Ignition voltage	V_{ign}	max.	170	V
Maintaining voltage	V_m	see page B45		
Cathode current for coverage, average, during any conduction period	I_k	min.	3	mA
Cathode current, average (T_{av} = 20 ms)	I_k	max.	6	mA
peak	I_{kp}	max.	20	mA
Cathode selecting voltage	V_{kk}	see page B46		
Extinguishing voltage	V_{ext}	min.	120	V

Typical operation at temperatures t_{amb} = 10 to 50 °C

D.C. operation with or without V_{kk}

(See fig.1 and 3 and pages B45 and B46)

Anode supply voltage	V_{ba}	200	250	300	350	V
Maintaining voltage	V_m	140±10	140±10	140±10	140±10	V
Anode series resistor	R_a	15	27	39	47	kΩ
Cathode selecting voltage	V_{kk}			min.	60	V [1])

A.C. half-wave rectified operation with or without V_{kk}

(See fig.2 and 4 and page B45)

Secondary transformer voltage	V_{tr}	170	220	250	300	V
Anode series resistor	R_a	5.6	12	18	27	kΩ
Cathode selecting voltage	V_{kk}			min.	60	V [1])

[1]) With low cathode selecting voltages the current I_{kk} to the "off" cathodes will increase and the readability of the "on" cathode will be affected. It is therefore recommended to use a voltage V_{kk} in excess off the stated minimum value.

LIFE EXPECTANCY at I_k = 4.5 mA

Sequentially changing the display from one digit to the others every 1000 hours or less	100 000 h

LIMITING VALUES (Absolute max. rating system)

Anode voltage necessary for ignition	V_a	min.	170	V
Cathode current,				
average during any conduction period	I_k	min.	3	mA
average (T_{av} = 20 ms)	I_k	max.	6	mA
peak	I_{kp}	max.	20	mA
Cathode selection voltage	V_{kk}	min.	60	V
Bias voltage between anode and "off" cathodes	V_{bias}	max.	120	V
Bulb temperature	t_{bulb}	min.	0	°C 1)
		max.	+70	°C

SHOCK AND VIBRATION

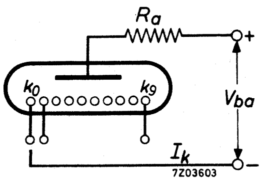
An indication for the ruggedness of the tube is the fact that 95% of the items sampled from the normal production line pass the shock and vibration tests specified below without perceptible damage.

Shock: 25 g_{peak}, 1000 shocks in one of the three positions of the tube.

Vibration: 2.5 g_{peak}, 50 Hz, during 32 hours in each of the three positions of the tube.

1) Bulb temperatures below 0 °C result in a reduced life expectancy and changes in characteristics (see page B47)
In designing equipment to be used over a wide temperature range the use of "constant current operation" (high supply voltage with a high anode series resistor) is recommended.

Fig.1



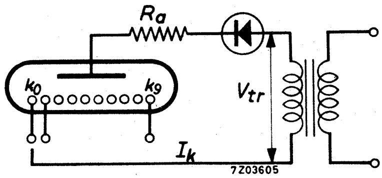


Fig.2

Fig.3

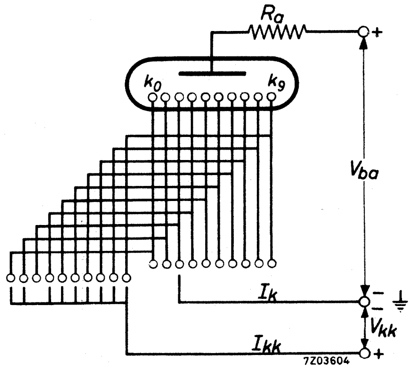
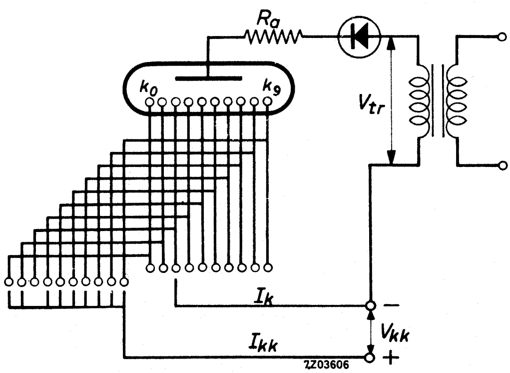
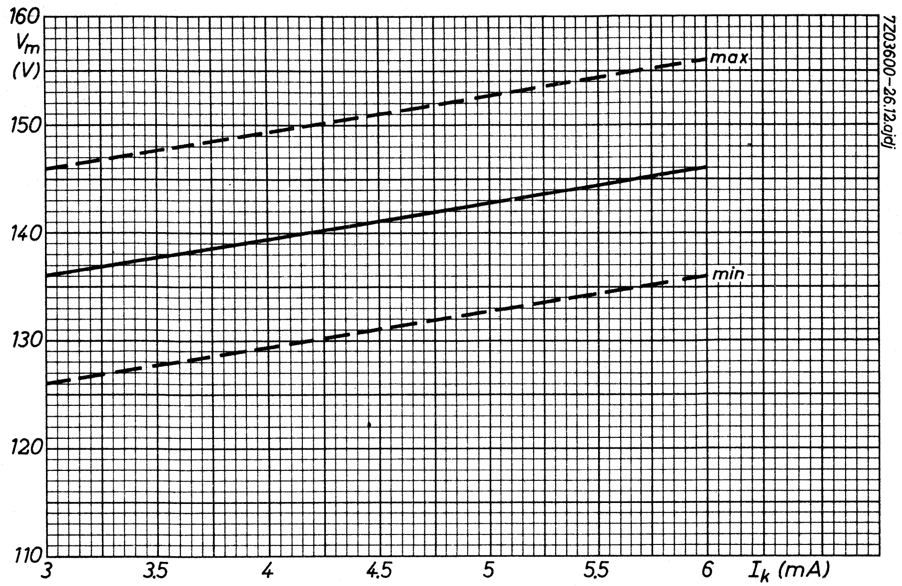
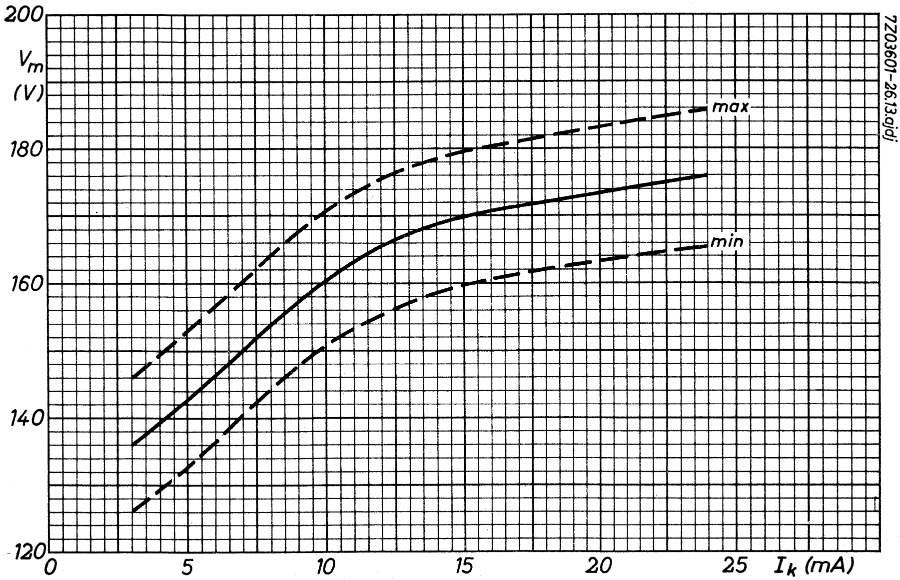
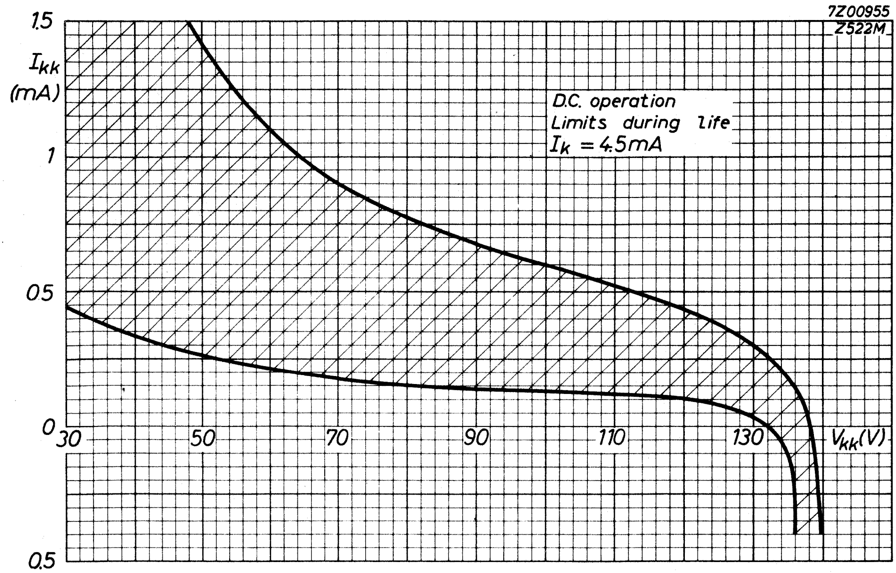


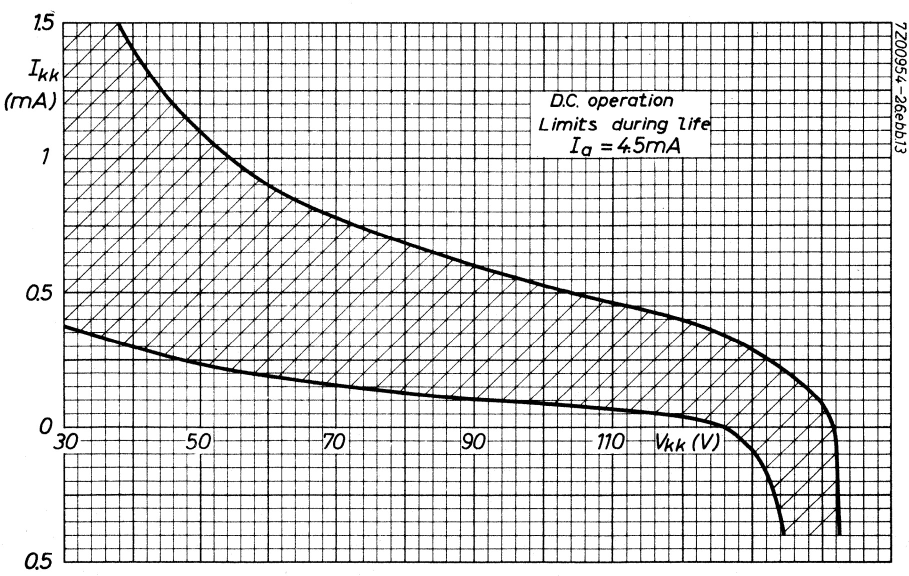
Fig.4

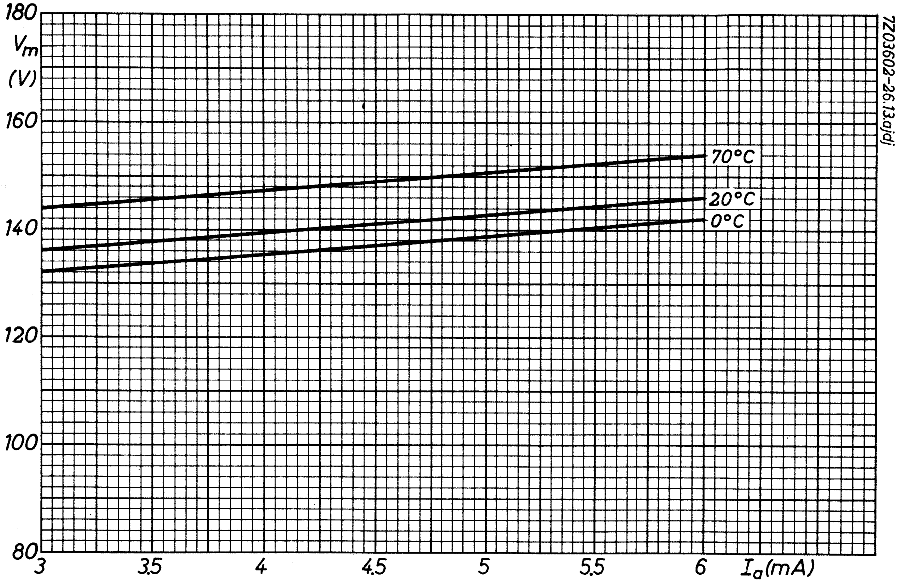



160
V_m
(V)
150
140
130
120
110
3
3.5
4
4.5
5
5.5
6
I_k (mA)
max
min
7Z03600-26.12.ajdj


200
V_m
(V)
180
160
140
120
0
5
10
15
20
25
I_k (mA)
max
min
7Z03601-26.13.ajdj


7Z00955
Z522M
1.5
I_{kk}
(mA)
1
0.5
0
0.5
30
50
70
90
110
130
V_{kk}(V)
D.C. operation
Limits during life
$I_k = 4.5mA$


7Z00954-26eb13
1.5
I_{kk}
(mA)
1
0.5
0
0.5
30
50
70
90
110
V_{kk} (V)
D.C. operation
Limits during life
$I_a = 4.5mA$



180
V_m
(V)
160
140
120
100
80
3
3.5
4
4.5
5
5.5
6
I_a(mA)
70°C
20°C
0°C
7Z03602-26.13a(d)

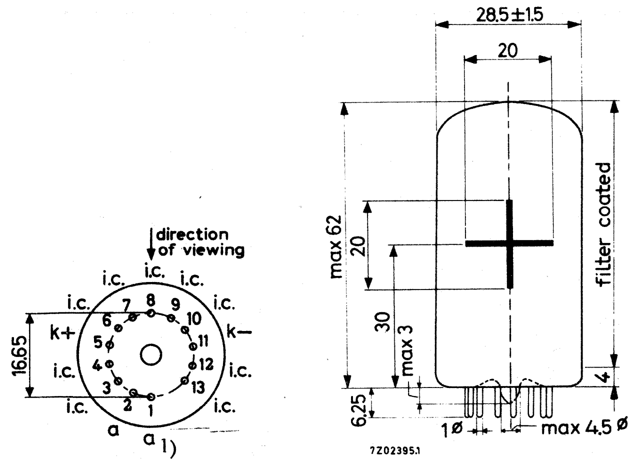
INDICATOR TUBE

Cold cathode sign indicator tube for side viewing.

QUICK REFERENCE DATA		
Sign height	20	mm
Signs	+ -	
Supply voltage	170	V
Cathode current	4.5	mA

DIMENSIONS AND CONNECTIONS Dimensions in mm

Base: B13B



GENERAL

The tube has the same physical dimensions as the ZM1040 numeral indicator tube. The ZM1041 is provided with a red contrast filter.

1) Pins 1 and 2 to be interconnected externally.

CHARACTERISTICS

Ignition voltage	V_{ign}	max.	170	V
Maintaining voltage	V_m	see pages B51 and B52		
Extinguishing voltage	V_{ext}	min.	120	V
"Off" cathode probe current characteristic		see page B52		

PRINCIPLE OF OPERATION

The tube contains two cathodes, in the form of the signs + and −, and a common anode. By applying a suitable voltage between the anode and one of the cathodes the corresponding sign will be covered by a red neon glow.

ACCESSORIES

Socket 2422 505 00001 or 2422 505 00002

MOUNTING POSITION

Any
The signs are vieuwed through the side of the envelope.

LIMITING VALUES (Absolute max. rating system)

Anode voltage necessary for ignition	V_a	min.	170	V	
Cathode current,					
average during any conduction period	I_k	min.	3	mA	
average (T_{av} = 20 ms)	I_k	max.	6	mA	
peak	I_{kp}	max.	20	mA	
Impulse duration	T_{imp}	min.	80	μs	
Cathode selecting voltage	V_{kk}	min.	60	V	
Bias voltage between anode and "off" cathode	V_{bias}	max.	120	V	
Bulb temperature	t_{bulb}	max.	+70	^{o}C	1)
		min.	−50	^{o}C	

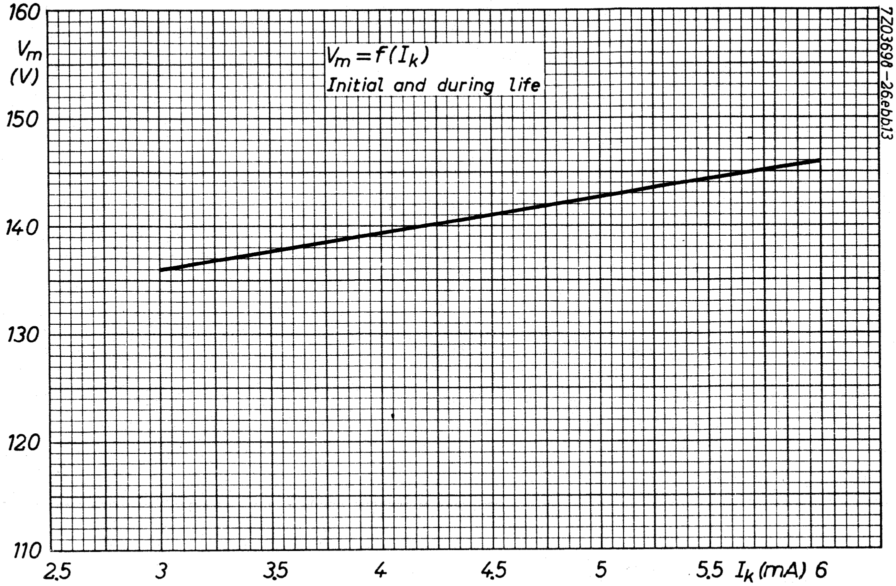
SHOCK AND VIBRATION

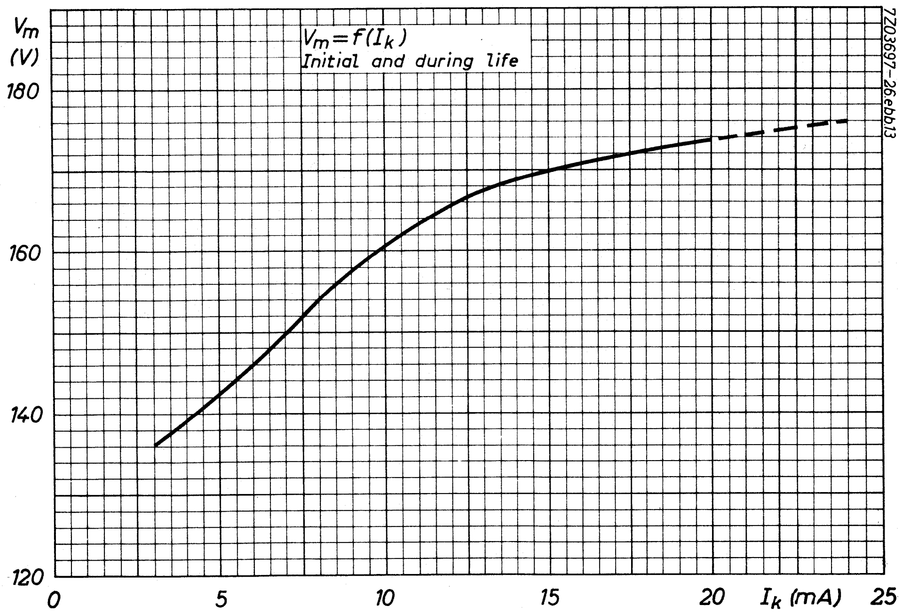
An indication for the ruggedness of the tube is the fact that 95% of the items sampled from the normal production line pass the shock and vibration tests specified below without perceptible damage.

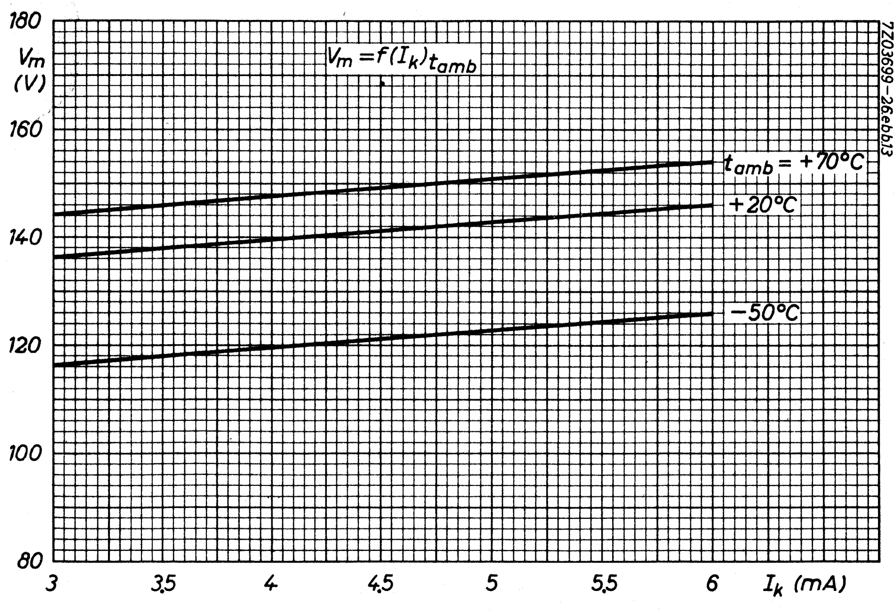
Shock: 25 g_{peak}, 1000 shocks in one of the three positions of the tube.

Vibration: 2.5 g_{peak}, 50 Hz, during 32 hours in each of the three positions of the tube.

[1]) Bulb temperatures below 10 ^{o}C result in a reduced life expectanxy and changes in characteristics (see page B52).
In designing equipment to be used within a wide temperature range the use of "constant current operation" (high supply voltage with a high anode series resistor) is recommended.


7Z03698-26ebb13
$V_m = f(I_k)$
Initial and during life
V_m (V)
160
150
140
130
120
110
2.5
3
3.5
4
4.5
5
5.5
I_k (mA)
6


7Z03697-26ebb13
$V_m = f(I_k)$
Initial and during life
V_m (V)
180
160
140
120
0
5
10
15
20
I_k (mA)
25


180
160
140
120
100
80
V_m
(V)
$V_m = f(I_k)t_{amb}$
$t_{amb} = +70°C$
+20°C
−50°C
3
3.5
4
4.5
5
5.5
6
I_k (mA)
7Z03699−26ebb13

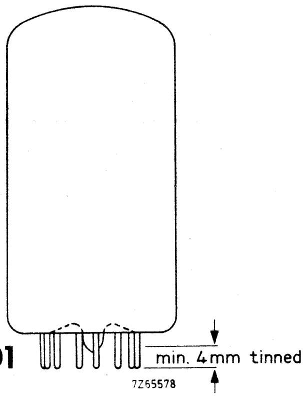
INDICATOR TUBE

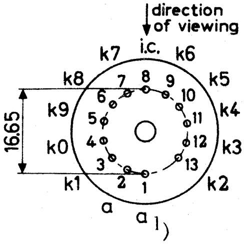
Cold cathode ten digit numeral indicator tube for side viewing.
The types ZM1042 and ZM1042/01 are identical with type ZM1040 but have no filter coating. ; the ZM1042/01 has tinned pins .
The use of a separate blue absorbing, e.g. circular polarized, amber filter is recommended.

DIMENSIONS AND CONNECTIONS

Dimensions in mm

ZM1042/01





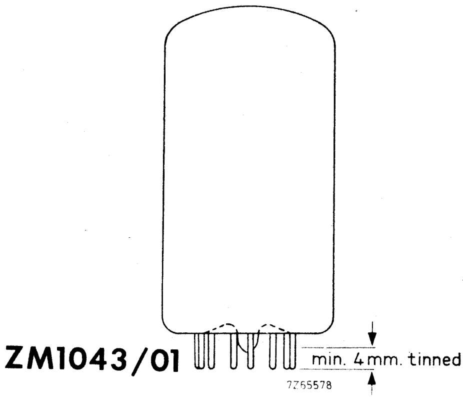
1) Pins 1 and 2 to be connected externally.

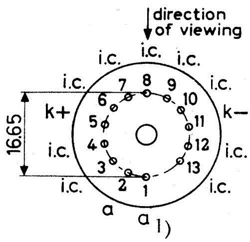
INDICATOR TUBE

Cold cathode sign indicator tube for side viewing.
The types ZM1043 and ZM1043/01 are identical with type ZM1041 but have no filter coating; the ZM1043/01 has tinned pins.
The use of a separate blue absorbing, e.g. circular polarized, amber filter is recommended.

DIMENSIONS AND CONNECTIONS

Dimensions in mm





1) Pins 1 and 2 to be connected externally.

Switching diodes

C

SWITCHING AND LIGHT DIODE

Cold cathode neon filled subminiature switching and light diode with a large and stable difference between ignition and maintaining voltage intended for low speed switching and counting e.g. in combination with CdS photo sensitive devices. The tube is shock and vibration resistant.

QUICK REFERENCE DATA			
Ignition voltage	V_{ign}	170	V
Maintaining voltage	V_m	109	V
Cathode current	I_k	3.5	mA

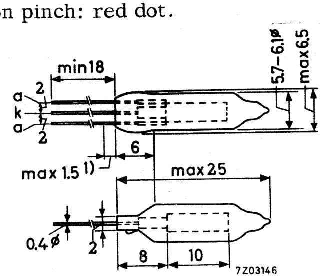
OPERATING PRINCIPLE

The diode contains a rod shaped molybdenum cathode and a concentric gauze anode. By applying a suitable voltage between the electrodes, a glow discharge occurs and its red light is available outside the tube.

DIMENSIONS AND CONNECTIONS

Dimensions in mm

Colour type indication on pinch: red dot.



MOUNTING

The tube may be soldered directly into the circuit but heat conducted to the glass to metal seals should be kept to a minimum by the use of a thermal shunt. The leads may be dip-soldered to a minimum of 5 mm from the seals at a solder temperature of 240 °C during max. 10 s. Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

1) This part of the leads is not tinned.

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

(Valid over the first 15000 hours operation within the preferred current range and at t_{amb} = room. The electrical characteristics are independent of ambient illumination).

Non conduction

Anode voltage below which ignition will not occur in any tube	$V_{ign\,min}$		163	V
Insulation resistance	r_{isol}	>	300	MΩ

Ignition

Anode voltage to ensure ignition	$V_{ign\,max}$		178	V
Ignition delay	See pages C7 and C8			
Typical max. individual variation of ignition voltage during life	ΔV_{ign}	<	5	V
Typical temperature coefficient of ignition voltage, averaged over the range −55 °C to +70 °C	$\frac{\Delta V_{ign}}{\Delta t_{bulb}}$	<	±15	mV/°C

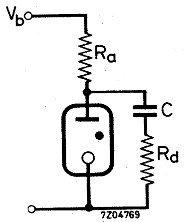
Conduction

Cathode current, average during any conduction period	I_k	>	2.2	mA
average (T_{av} = max. 1 s)	I_k	<	4.5	mA
peak (See "Reliability and life expectancy)	I_{kp}	<	50	mA
Typical rise in bulb temperature	$\frac{\Delta t_{bulb}}{\Delta I_k}$		10	°C/mA
Maintaining voltage	See page C7			
Typical max. individual variation of maintaining voltage during life	ΔV_m	<	+2 -4	V
Typical max. temperature coefficient of maintaining voltage, averaged over the range −55 °C to +70 °C	$\frac{\Delta V_m}{\Delta t_{bulb}}$	<	±15	mV/°C
Light intensity [1][2]	E	>	20	lux/mA
Typical variation of light intensity	ΔE	<	-3	%/1000 h

[1][2] See page C5

Extinction

Typical min. RC components to ensure self extinction at V_b = 250 V for different values of current limiting resistance R_d.



R_d	0	1	10	47	100	kΩ
R_a	1	1	1.5	2	3	MΩ
C	5	22	22	22	22	nF

RELIABILITY AND LIFE EXPECTANCY

Reliability has been assessed in a life test programme totalling 5.10^6 tube hours on 400 tubes. The longest test periode being 15000 hours on 100 tubes. A total of 7 failures result in a failure rate of better than 0.15% per 1000 h. This failure rate is not expected to increase over the next period of 15000 h.

Life expectancy: 30000 operating hours within the preferred current range
or
2.4×10^6 ignitions discharging a capacitor of max. 16 μF with suitable series impedance to limit the peak current to max. 50 mA.

---

1) Light intensity measured over an angle of 70° at a distance of 3.6 mm from the tube axis opposite the anode cylinder.

2) Measured with a Standard Weston Cell adopted to eye sensitivity.
Because the light emission of the neon discharge is mainly contained in the red region, the illumination resistance of a CdS cell will be 1.5 to 2 times lower than in case of irradiation by a 2700 °K incandescent light source. The exact conversion factor depends on the type of CdS cell used.

LIMITING VALUES (Absolute max. rating system)

Cathode current, average for continuous conduction	I_k	min.	2.2	mA [1]
average (T_{av} = max. 1 s)	I_k	max.	4.5	mA [1]
peak	I_{kp}	max.	50	mA
Anode voltage, negative peak	$-V_{ap}$	max.	200	V
Bulb temperature	t_{bulb}	min.	-55	°C
		max.	+70	°C
Altitude	h	max.	24	km

SHOCK AND VIBRATION RESISTANCE

These conditions are solely used to assess the mechanical quality of the tube. The tube must not be continuously operated under these conditions.

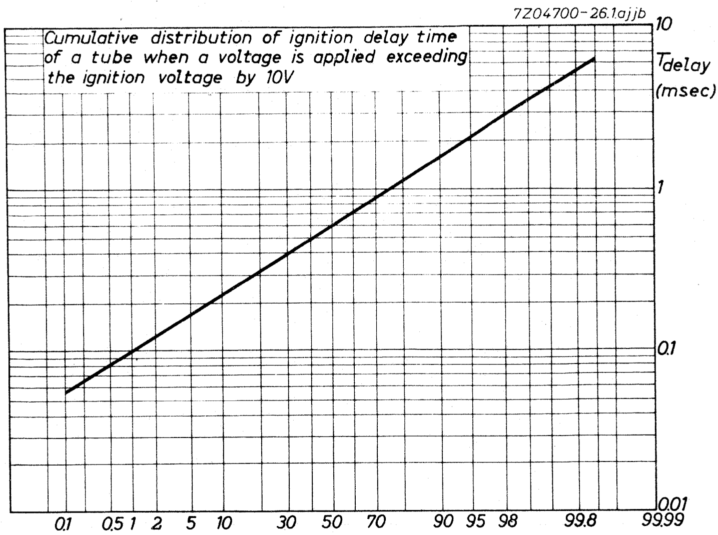
Shock resistance 500 g

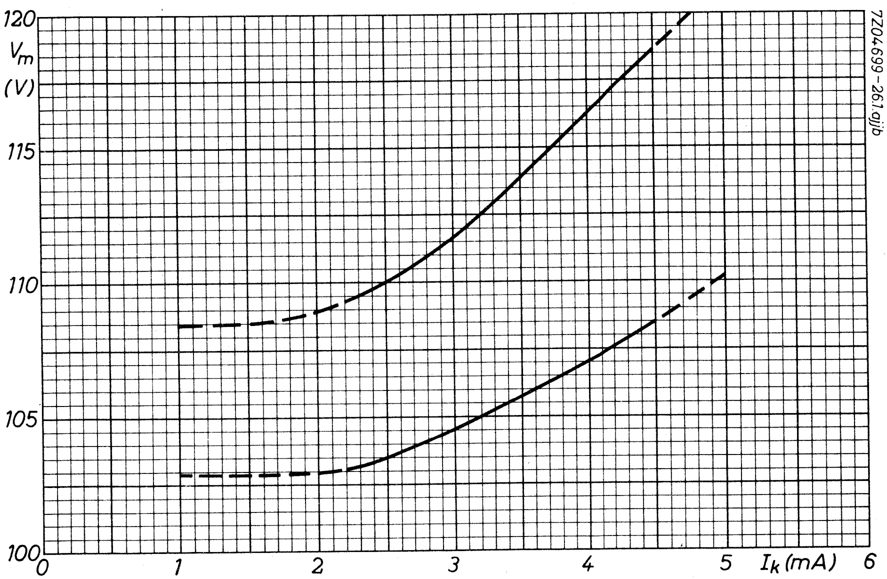
Forces as applied by the NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30° in each of 4 positions of the tube.

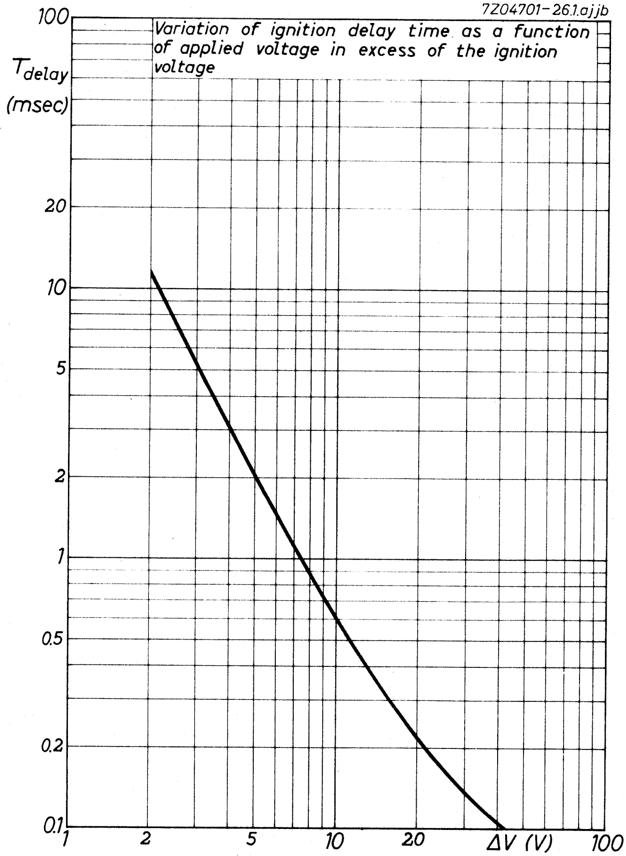
Vibration resistance 2.5 $g_{(peak)}$

Vibrational forces for a period of 32 hours at a frequency of 50 Hz in each of 3 directions.

[1] Current excursions down to 1 mA and up to 5 mA are permitted under conditions of e.g. extreme supply voltage variations. The excursion times should preferably be as short as possible but never exceed 24 hours.


7Z04700-26.1.ajjb
Cumulative distribution of ignition delay time of a tube when a voltage is applied exceeding the ignition voltage by 10V
T_{delay} (msec)
10
1
0.1
0.01
0.1
0.5
1
2
5
10
30
50
70
90
95
98
99.8
99.99


7Z04699-26.1.ajjb
V_m (V)
120
115
110
105
100
0
1
2
3
4
5
6
I_k (mA)


7Z04701-26.1.ajjb
Variation of ignition delay time as a function of applied voltage in excess of the ignition voltage
100
T_{delay}
(msec)
20
10
5
2
1
0.5
0.2
0.1
1
2
5
10
20
ΔV (V)
100

GAS FILLED INDICATOR DIODE

Shock and vibration resistant cold-cathode gas-filled subminiature diode with visible glow-discharge for read-out purposes.
The tube contains two electrodes, a rod shaped molybdenum cathode and a concentric gauze anode.

APPLICATION

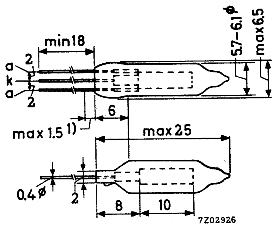
Indicator in low voltage transistor circuits. The diode can be used in combination with CdS photoconductive cells and it can be controlled by voltage signals down to 3 V.

QUICK REFERENCE DATA				
Ignition voltage	V_{ign}	=	90	V
Extinction voltage	V_{ext}	>	83.5	V
Cathode current	I_k	=	1	mA
Light intensity at I_k = 1 mA	E	=	60	lux

MECHANICAL DATA

Dimensions in mm

Type indication on pinch: yellow dot.



MOUNTING

The tube may be soldered directly into the circuit, but heat conducted to the glass-to-metall seals should be kept to a minimum by the use of a thermal shunt.
The leads may be dip-soldered to a minimum of 5 mm from the glass-to-metal seals at a solder temperature of 240 °C during max. 10 seconds.
If the tube is held in its position by the leads only, the connection of both anode leads is recommended.
Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

1) Not tinned

SHOCK AND VIBRATION RESISTANCE

These conditions are solely used to assess the mechanical quality of the tube. The tube must not be continuously operated under these conditions.

Shock resistance 500 g

Forces as applied by the NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30^{o} in each of 4 positions of the tube.

Vibration resistance 2.5 g (peak)

Vibrational forces for a period of 32 hours at a frequency of 50 Hz in each of 3 directions.

CHARACTERISTICS

Valid over 15000 operating hours within the preferred current range and at room temperature unless otherwise stated.
The electrical characteristics are independent of ambient illumination.

Non conduction

Anode voltage below which ignition will not occur in any tube	$V_{ign\,min.}$	=	88	V	
Insulation resistance	r_{isol}	>	300	MΩ	

Ignition

Ignition voltage,					
upper limit	$V_{ign\,max.}$	=	93	V	1)
individual variation during life	ΔV_{ign}	<	2.5	V	
Ignition delay at V_{ba} = 93 V	T_{delay}	≐	0.05	s	2)
Temperature coefficient of ignition voltage	$\frac{\Delta V_{ign}}{\Delta t_{bulb}}$	<	−15	mV/^{o}C	3)
Reignition voltage in case of full wave rectified a.c. supply	V_{reign}	<	101	V	4)
		>	96.5	V	4)

1) The ignition and extinction voltage depression (hysteresis) is max. 0.75 V per mA prior current measured 50 ms after cessation of conduction.
2) Due to the statistical nature of ignition delay values of delay time > 1 s may occasionally occur.
3) Characteristic range value for equipment design.
4) These values apply to 220 V (+10 %, −15 %), 50 Hz to 60 Hz full-wave rectified unsmoothed supply and assume conduction in the course of the preceeding half cycle, so that residual ionization eliminates delay of the following ignition.

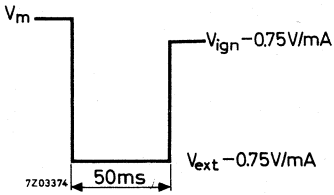
CHARACTERISTICS (continued)

Conduction

Cathode current,					
preferred range	I_k	=	0.4 to 2	mA	5)
peak	I_{kp}	=	3	mA	
Maintaining voltage	V_m	<	86 V + 4.25	V/mA	6)
		>	83 V + 2.5	V/mA	7)
Individual variation during life	ΔV_m	<	1.5	V	
Temperature coefficient of maintaining voltage	$\frac{\Delta V_m}{\Delta t_{bulb}}$	<	-15	mV/°C	3)
Rise in bulb temperature	$\frac{\Delta t_{bulb}}{\Delta I_k}$	=	10	°C/mA	
Light intensity,	E	>	30	lux/mA	8) 9)
individual minimum, measured over an angle of 70° averaged over the full circumference of the tube	E_{av}	>	60	lux/mA	8) 9)

Extinction

Extinction voltage	V_{ext}	>	83.5	V	1)



5) Current excursions during ignition and extinction are not taken into account.
6) Valid within the range 0.1 mA to 3 mA.
7) Valid within the range 0.2 mA to 3 mA. Between 0.05 mA and 0.2 mA $V_{m\,min.} = V_{ext} = 83.5$ V.
8) Light intensity at a distance of 3.6 mm from the tube axis opposite the anode cylinder, measured with a standard Weston cell adopted to eye sensitivity. Because the emission of the neon discharge is mainly contained in the red region the illumination resistance of a CdS cell will be 1.5 to 2 times lower than in case of irradiation by a 2700 °K incandescent light source. The exact conversion factor depends on the type of CdS cell used.
9) At least 90% of the tubes will meet the figure stated.

RELIABILITY AND LIFE EXPECTANCY

The electrical characteristics have been assessed in a life test programme, totalling 3.0×10^6 tube hours with no failures, denoting a failure rate of better than 0.1 % per 1000 hours. The maximum test period was 19000 hours on 22 tubes. This failure rate is not expected to increase over the first 25000 hours of continuous operation within the preferred current range.

LIMITING VALUES (Absolute maximum rating system)

Cathode current, averaging time = 5 s	I_k	= max.	2.5	mA	
Cathode current during conduction	I_k	= min.	0.1	mA	1)
Cathode current, peak	I_{kp}	= max.	3	mA	
Anode voltage, negative peak	$-V_{ap}$	= max.	70	V	
Bulb temperature	t_{bulb}	= min.	-55	$^{\circ}C$	
		= max.	70 $^{\circ}C$ + 10	$^{\circ}C/mA$	
Altitude	h	= max.	24	km	

READ-OUT CIRCUIT BISTABLE MULTIVIBRATORS

Principle of operation

The figures 1 and 2 show equivalent circuits for bistable multivibrators, equipped with p-n-p- and n-p-n transistors respectively, to which a read-out circuit has been added. The transistors are replaced by ideal switches, the voltage source V_T represents the available voltage that controls the diodes 2) and R_T is the output resistance as measured at the collector of the cut-off transistor.

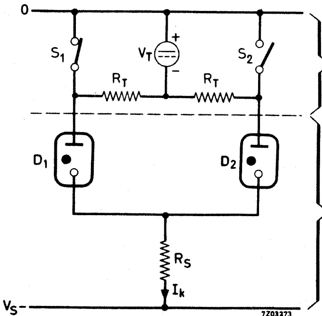


Fig. 1

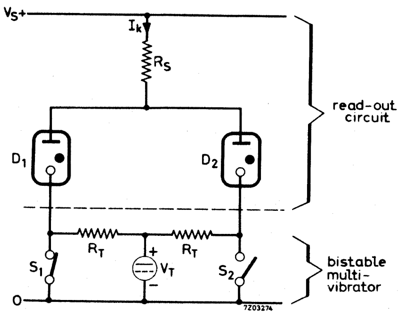


Fig. 2

1) Current excursions down to 50 μA with a duration < 1 s are permitted.

2) $V_T = V_{c.o.} - V_{sat}$ (V) in which

$V_{c.o.}$ = voltage between collector of the cut-off transistor and the common terminal (absolute value).

V_{sat} = voltage across the bottomed transistor (absolute value).

READ-OUT CIRCUIT BISTABLE MULTIVIBRATORS (continued)

Correct read-out is obtained when only the diode corresponding to the bottomed transistor conducts. For this the following conditions must be met: [1]

(I) Ignition of the correct diode, corresponding to the bottomed transistor, when the other diode is conducting.

Thus: $V_{m\,min.} + I_k R_T + V_T > V_{ign\,max}$,

resulting in $I_k > \dfrac{10 - V_T}{R_T + 2.5} \quad \dfrac{(V)}{(k\Omega)}$ for $I_k > 0.2$ mA

(II) Extinction of the diode corresponding to the cut-off transistor, when the correct diode is conducting.

Thus: $V_{m\,max.} - V_T < V_{ext\,min}$,

resulting in $I_k < \dfrac{V_T - 2.5}{5} \quad \dfrac{(V)}{(k\Omega)}$ for $I_k > 0.1$ mA

(III) Non-ignition of the diode corresponding to the cut-off transistor when the correct diode is conducting.

Thus: $V_{m\,max.} - V_T < V_{ign\,min}$,

resulting in $I_k < \dfrac{V_T + 2}{5} \quad \dfrac{(V)}{(k\Omega)}$ for $I_k > 0.1$ mA

These conditions are shown graphically on page A below.

Condensed instructions for designing the read-out circuit. [2]

The following directives are based on the requirement that correct read-out shall be ensured under worst case conditions, after the instant that the bistable circuit has reached its final stationary state. It is irrelevant whether the read-out diodes follow the changes of state of the multivibrator during its dynamic operation or not.

A choice can be made between the following modes of operating the diodes, namely by means of:

(A) a constant direct current
(B) a constant direct current on which a pulse is superimposed prior to reading-out. Three kinds of pulses are possible:
  a) a positive going pulse;
  b) a negative going pulse;
  c) a positive going pulse followed by a negative going one
(C) an unsmoothed current supplied by a full wave rectifier.

---

[1] It is assumed that the supply voltage V_s exceeds the ignition voltage of the gas diodes, so that ignition of at least one diode is ensured; the most adverse situation being that only the wrong diode conducts.

[2] For a detailed analysis of the design procedure please apply to the manufacturer.

READ-OUT CIRCUIT BISTABLE MULTIVIBRATORS (continued)

In fig. 3, schematically representing these waveforms, the required minimum duration of the superimposed pulses is indicated;
t_s denotes the instant at which the bistable circuit reaches its final state.

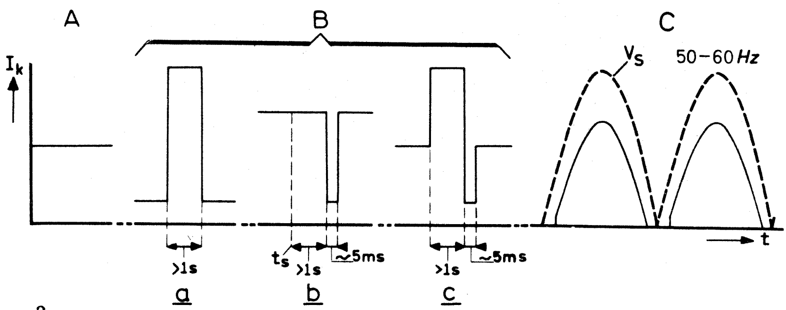


Fig. 3

The conditions to be obeyed by the current I_k are specified in the table below:

Mode of operation	Values of I_k lower limit	Values of I_k upper limit	V_T
(A) constant direct current	(I)	(II)	> 5 V
(B) direct current with superimposed:			
(a) positive going pulses – steady state current	–	(II)	> 4.5 V
(a) positive going pulses – pulse current	(I)	–	
(b) negative going pulses – steady state current	(I)	(III)	> 3 V
(b) negative going pulses – pulse current	–	(II)	
(c) positive and negative going pulses – steady state current	–	(III)	> 3 V
(c) positive and negative going pulses – positive going pulse	(I)	–	
(c) positive and negative going pulses – negative going pulse	–	(II)	
(C) rectified alternating current, peak value of I_k	(I)	(III)	> 4.5 V [1]
This table should be read in conjunction with the specified recommended operating conditions and limiting values.			

[1] Since both diodes are extinguished at the end of each half cycle of the supply voltage, condition (II) is not required, and is replaced by the condition that only the correct diode will reignite. The lower limit is thus given by the spread of the reignition voltage (e.i. 4.5 V).

READ-OUT CIRCUIT BISTABLE MULTIVIBRATORS (continued)

The minimum available value of V_T being known, the points of intersection with the curves I, II and III on page 8, and hence the limits of I_k (I_{kI}, I_{kII} and I_{kIII}) can be determined. This having been done, the required values of $V_{S\,min}$ and R_S can be evaluated from the following expressions: [1])

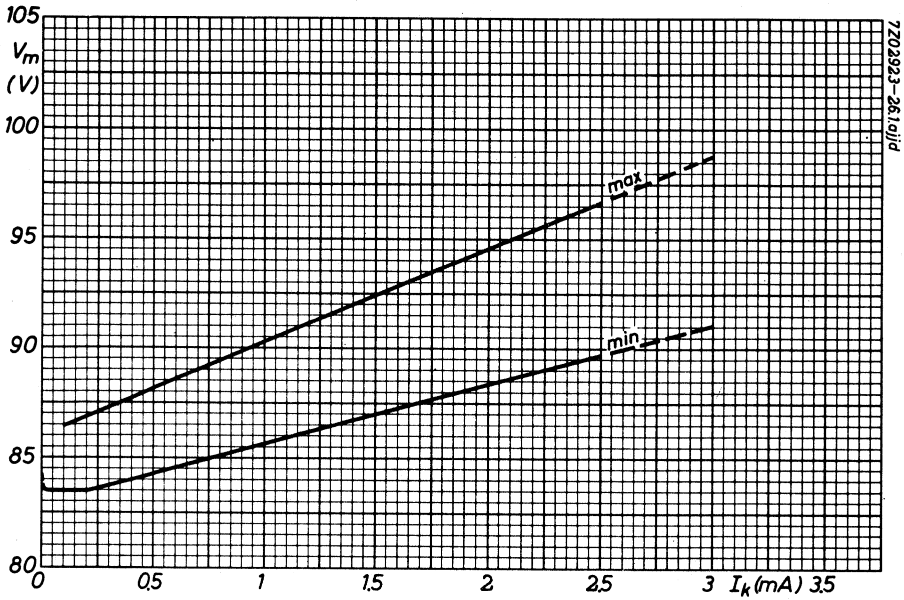
$$\frac{V_{S\,min} - V_{ign\,max}}{R_{S\,max}} = I_{kI} \qquad (1)$$

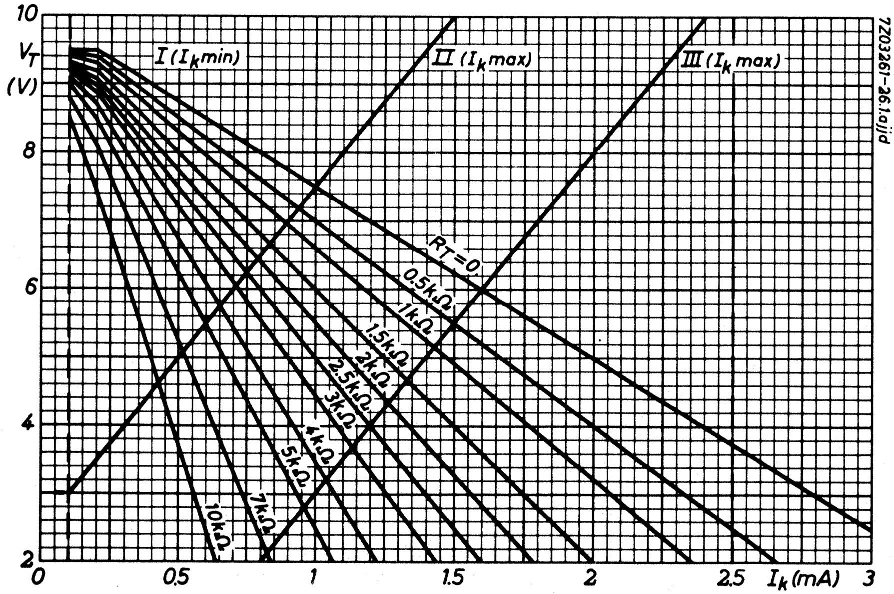
$$\frac{V_{S\,max} - V_{ext\,min} - V_T}{R_{S\,min}} = I_{kII} \qquad (2)$$

$$\frac{V_{S\,max} - V_{ign\,min} - V_T}{R_{S\,min}} = I_{kIII} \qquad (3)$$

In these expressions the suffices min and max denote the worst case limits of the quantities concerned.
For mode of operation (C) the peak value of the supply voltage must be substituted for V_S in the above expressions.

[1]) The use of equivalent circuits for establishing the exact conditions I, II, and III leads to a negligible error in the expressions (1), (2) and (3).


105
V_m
(V)
100
95
90
85
80
0
0.5
1
1.5
2
2.5
3
3.5
I_k(mA)
max
min
7Z02923-26.1.ajid


10
V_T
(V)
8
6
4
2
0
0.5
1
1.5
2
2.5
3
I_k(mA)
I ($I_k$min)
II ($I_k$max)
III ($I_k$max)
R_T=0
0.5kΩ
1kΩ
1.5kΩ
2kΩ
2.5kΩ
3kΩ
4kΩ
5kΩ
7kΩ
10kΩ
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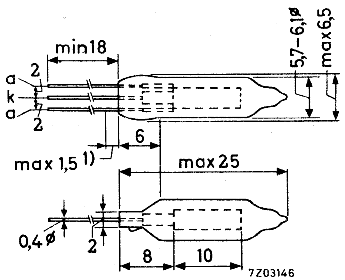
SWITCHING AND LIGHT DIODE

Long-life cold-cathode neon-filled subminiature switching and light diode with a large and stable difference between ignition and maintaining voltage intended for touch control applications e.g. in variable capacitance diode controlled radio or television tuners. The tube is shock and vibration resistant.

QUICK REFERENCE DATA			
Ignition voltage	V_{ign}	172	V
Maintaining voltage	V_m	107	V
Cathode current	I_k	3	mA

DIMENSIONS AND CONNECTIONS

Dimensions in mm



MOUNTING

The tube may be soldered directly into the circuit, but heat conducted to the glass to metal seals should be kept to a minimum by using a thermal shunt. The leads may be dip-soldered to a minimum of 5 mm from the seals at a solder temperature of 240 °C during max. 10 s. Care should be taken not to bend the leads closer than 1,5 mm to the seals.

1) This part of the leads is not tinned.

CHARACTERISTICS AND OPERATING CONDITIONS

Valid over life and full temperature range unless otherwise stated.
The electrical characteristics are independent of ambient illumination.

Non conduction				
Anode voltage below which ignition will not occur	$V_{ign_{min.}}$		161	V
Insulation resistance	r_{ins}	>	300	MΩ
Ignition				
Anode voltage to ensure ignition	$V_{ign_{max.}}$		183	V
Ignition delay at V_{ign} + 10 V	T_{delay}	<	50	ms
at V_{ign} + 20 V	T_{delay}	<	20	ms
Typical max. individual variation of ignition voltage during life, within the V_{ign} limits given above	ΔV_{ign}	<	5	V
Conduction				
Cathode current, average during any conduction period	I_k	>	2, 2	mA
average (T_{av} = max. 1 s)	I_k	<	4, 5	mA
Maintaining voltage at I_k = 3 mA	V_m	≥	103	V
		≤	111	V
Typical max. individual variation of maintaining voltage during life, within the V_m limits given above	ΔV_m	<	+2	V
			−4	V
Extinction				
Extinction voltage	V_{ext}	>	100	V

LIMITING VALUES (Absolute max. rating system)

Cathode current, average for				
continuous conduction	I_k	min.	2, 2	mA
average (T_{av} = max. 1 s)	I_k	max.	4, 5	mA
Anode voltage, negative peak	$-V_{ap}$	max.	200	V
Bulb temperature	t_{bulb}	min.	-55	^{o}C
		max.	+70	^{o}C

SHOCK AND VIBRATION RESISTANCE

These conditions are solely used to assess the mechanical quality of the tube. The tube must not be continuously operated under these conditions.

Shock resistance 500 g

Forces as applied by NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30^{o} in each of 4 positions of the tube.

Vibration resistance 2, 5 $g_{(peak)}$

Vibrational forces for a period of 32 hours at a frequency of 50 Hz in each of 3 directions.

Dry reed contact units D

GENERAL

REED CONTACT UNITS

Definitions

Reed contact unit

A reed contact unit is an assembly containing contact blades, some or all of magnetic material, sealed in an envelope.

Must-not-operate value

The must-not-operate value is the stated limit of the magnetic field at which the reed contact unit shall not physically operate.

Must-operate value

The must-operate value is the stated limit of the magnetic field at which the reed contact unit shall physically operate.

Operate time

The operate time is the time between the instant of the application of a specified magnetic field to a specific contact circuit and the instant of the first physical closing (or opening) of this specific contact circuit. The operate time does not include bounce time (unless otherwise indicated).

Bounce

Bounce is a momentary reopening of a contact after initial physical closing, or a momentary reclosing after initial physical opening.

Bounce time

The bounce time is the interval of time between the instant of first physical closing (or opening) and the instant of the final physical closing (or opening) of a specific contact circuit).

Contact circuit

A contact circuit is the whole of the electrically conductive parts of a reed contact unit which are intended to be connected in an external circuit.

Characteristic non-release value

The characteristic non-release value is the stated value of the magnetic field above which the operated reed contact unit fulfills specified qualities, e.g. contact resistance, noise characteristics etc.

Contact circuit resistance (also contact resistance)

The contact circuit resistance is the resistance of the contact circuit under specified conditions of measurement.

Must-not-release value

The must-not-release value is the stated limit of the applied magnetic field at which the operated reed contact unit shall remain physically operated.

Must-release value

The must-release value is the stated limit of the magnetic field at which the operated reed contact unit shall physically release.

Release time

The release time is the time between the instant of the disconnection of a specific magnetic applied field to a specific contact circuit and the instant of the first opening (or closing) of this specific contact circuit. The release time does not include bounce time.

Saturation

The saturation is the magnetic condition, arbitrarily defined, at which the performance of the reed contact unit is unaffected by further increase of the applied magnetic field.

Saturate value

The saturate value is the arbitrarily defined value of the magnetic field at which the reed contact unit reaches saturation.

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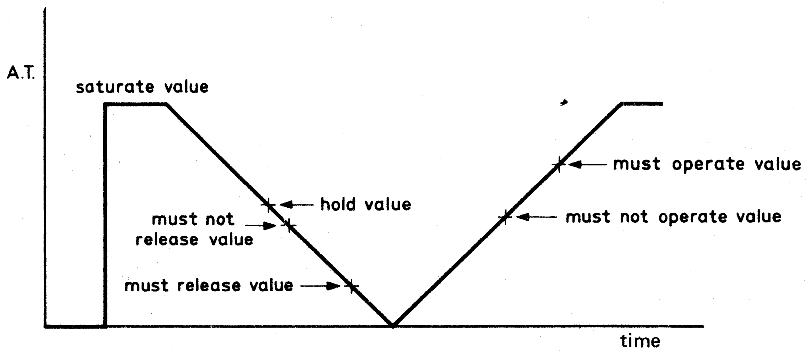


DRY REED CONTACT UNIT

Micro dry reed contact unit hermetically sealed in a gas-filled glass capsule.
Single-pole, single-throw type, having normally open contacts, and containing two magnetically actuated reeds. The contact unit is of the double-ended type and may be actuated by means of either an electromagnet or a permanent magnet or combinations of both.
The device is intended for use in push buttons, relays or in similar devices, in conjunction with semiconductor devices.

QUICK REFERENCE DATA

Contact	S.P.S.T. normally open		
Switched power	max.	10	W
Switched voltage, d.c.	max.	150	V
a.c. (r.m.s.)	max.	110	V
Switched current, d.c. or a.c. (r.m.s.)	max.	500	mA
Contact resistance (initial)		140	mΩ

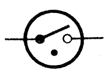
The RI-20 series comprises the types RI-20/3A, RI-20/3B, and RI-20/3C with the following basic magnetic characteristics, measured with the Standard coil.

	RI-20/3A	RI-20/3B	RI-20/3C
Operate range (At)	20 to 32	28 to 52	46 to 70
Release range (At)	8 to 22	12 to 32	12 to 32

MECHANICAL DATA

Dimensions in mm

Contact arrangement	normally open
Lead finish	tinned
Resonant frequency of single reed	approx. 2900 Hz
Net mass	approx. 0,16 g
Mounting position	any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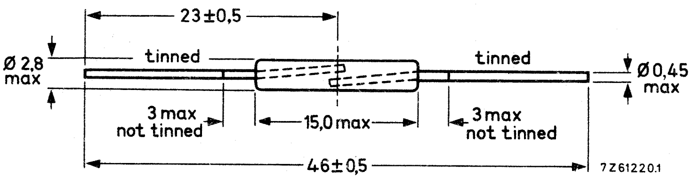

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Mechanical strength

The robustness of terminations is tested according to IEC Publication 68-2-21, test Ua (load 2 kg), Ub (load 0,5 kg, 2 bends), and Uc (3 x 360°).

Mounting

The leads should not be bent nearer than 1 mm to the glass-to-metal seals.
Stress on the seals should be avoided.
Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions.

Soldering

The contact unit may be soldered direct into the circuit but heat conducted to the glass-to-metal seals should be kept to a minimum by the use of a thermal shunt.
Dip-soldering is permitted to a minimum of 3 mm from the seals at a solder temperature of 240 ^{o}C during maximum 10 s.

Solderability

Solderability is tested according to IEC Publication 68-2-20, test T, solder globule method.

Weldability

The leads are weldable.

The RI-20 SERIES comprises three types: RI-20/3A, RI-20/3B, and RI-20/3C,

CHARACTERISTICS RI-20/3A

Not-operate

Breakdown voltage	min.	400	V
Insulation resistance, initial	min.	10^3	MΩ
Capacitance, without test coil	max.	0, 25	pF

		coil I	coil II	coil III [1]	
Must-not-operate value	max.	20	13	18	At
Operate					
Must-operate value	max.	32	18	26	At
Operate time, including bounce	typ.	0, 5 [2]			ms
	max.	1, 0 [2]			ms
Bounce time	typ.	0, 4 [2]			ms
	max.	0, 7 [2]			ms
Contact resistance, initial	typ.	140 [3]			mΩ
	max.	300 [3]			mΩ
Not-release					
Must-not-release value	min.	22	13	18	At
Release					
Must-release value	max.	8	6	8	At
Release time	max.	50 [2]			μs

Notes: see page D7.

CHARACTERISTICS RI-20/3B

Not-operate

Breakdown voltage	min.		400		V
Insulation resistance	min.		10^3		MΩ
Capacitance, without test coil	max.		0,25		pF

		coil I	coil II	coil III [1]	
Must-not-operate value	max.	28	16	23	At
Operate					
Must-operate value	max.	52	25	40	At
Operate time, including bounce	typ.	0,5 [2]			ms
	max.	1,0 [2]			ms
Bounce time	typ.	0,4 [2]			ms
	max.	0,7 [2]			ms
Contact resistance, initial	typ.	140 [3]			mΩ
	max.	300 [3]			mΩ
Not-release					
Must-not-release value	min.	32	18	26	At
Release					
Must-release value	max.	12	8	11	At
Release time	max.	50 [2]			µs

[1] Coil I : Standard coil.
Coil II : Recommended coil. see page D10
Coil III: Miniature coil A according to MIL-S-55433B

[2] Measured with 100 At.

[3] Measured with 70 At, distance between measuring points: 41 mm.
Wire resistance typ. 2,5 mΩ/mm.

CHARACTERISTICS RI-20/3C

Not-operate					
Breakdown voltage	min.		400		V
Insulation resistance, initial	min.		10^3		MΩ
Capacitance, without test coil	max.		0,25		pF
		coil I	coil II	coil III	
Must-not-operate value	max.	46	23	36	At
Operate					
Must-operate value	max.	70	31	53	At
Operate time, including bounce	typ.	0,5 [2])			ms
	max.	1,0 [2])			ms
Bounce time	typ.	0,4 [2])			ms
	max.	0,7 [2])			ms
Contact resistance, initial	typ.	140 [3])			mΩ
	max.	300 [3])			mΩ
Not-release					
Must-not-release value	min.	32	18	26	At
Release					
Must-release value	max.	12	8	11	At
Release time	max.	50 [2])			μs

Notes: see page D7.

LIMITING VALUES (Absolute max. rating system)

Switched power	max.	10	W
Switched voltage, d.c.	max.	150	V
a.c. (r.m.s.)	max.	110	V
Switched current, d.c. or a.c. (r.m.s.)	max.	500	mA
Current through closed contacts, d.c. or a.c. (r.m.s.)	max.	1	A
Temperature, storage and operating	max.	125	°C [1]
	min.	-55	°C

LIFE EXPECTANCY AND RELIABILITY

For life expectancy data end of life is defined as being reached when:

either a) the contact resistance once exceeds 1 Ω for no-load conditions or 10 Ω for loaded conditions, measured 5 ms after energizing coil;

or b) the release time once exceeds 5 ms after de-energizing the coil (latching or contact sticking).

No-load conditions (operating frequency 50 Hz).

Life expectancy min. 10^8 operations with a failure rate of less than 10^{-8} with a confidence level of 90%.
After each operation a) and b) are tested.

Loaded conditions (Resistive load: 12 V, 2 mA, operating frequency 50 Hz).

Life expectancy min. 10^7 operations with a failure rate of less than 10^{-8} with a confidence level of 90%.
After each operation points a) and b) are tested.

Note

Switching other loads involves different life expectancy and reliability. Consult us beforehand.

SHOCK AND VIBRATION

Impact: Acceleration 50 g during 11 ms, due to a force perpendicular to the flat sides of the reeds.
Such an impact will not cause an open contact (no magnetic field present) to close, nor a contact kept closed by an 80 At coil to open.

Vibration: Frequency range 50 Hz to 2000 Hz, acceleration 10 g due to a force perpendicular to the flat sides of the reeds.
Such a vibration will not cause an open contact (no magnetic field present) to close, nor a contact kept closed by an 80 At coil to open.

[1]) Excursions up to 150 °C may be permissible. Consult us.

COILS

Coil I: Standard coil

5000 turns of 42 SWG single enamelled copper wire on a coil former of 25,4 mm winding length and a core diameter of 8,75 mm.

Coil II; Recommended coil

5000 turns of 46 SWG single enamelled copper wire on a coil former of 7,1 mm winding length, a core diameter of 3,7 mm and an outer diameter of 8,3 mm.

Coil III: Miniature coil A according to MIL-S-55433B

10 000 turns of 48 SWG single enamelled copper wire on a coil former of 19,05 mm winding length and a core diameter of 4,32 mm.

DRY REED CONTACT UNITS

Micro dry reed contact unit hermetically sealed in a gas-filled glass capsule. Single-pole, single-throw type, having normally open contacts, and containing two magnetically actuated reeds. The contact unit is of the double-ended type and may be actuated by means of either an electromagnet or a permanent magnet or combinations of both. The device is intended for use in push buttons, relays or in similar devices, in conjunction with semiconductor devices.

QUICK REFERENCE DATA

Contact	S.P.S.T. normally open		
Switched power	max.	10	W
Switched voltage			
d.c.	max.	200	V
a.c. (r.m.s.)	max.	110	V
Switched current, d.c. or a.c. (r.m.s.)	max.	500	mA
Contact resistance (initial)	typ.	60	mΩ

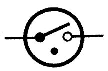
The RI-22 series comprises the types RI-22/3A, RI-22/3B, and RI-22/3C with the following basic magnetic characteristics, measured with the Standard coil.

		RI-22/3A	RI-22/3B	RI-22/3C
Operate range	(At)	18 to 32	28 to 52	46 to 70
Release range	(At)	8 to 22	12 to 32	12 to 32

MECHANICAL DATA

Dimensions in mm

Contact arrangement	normally open
Lead finish	tinned
Resonant frequency of single reed	approx. 5600 Hz
Net mass	approx. 0,21 g
Mounting position	any



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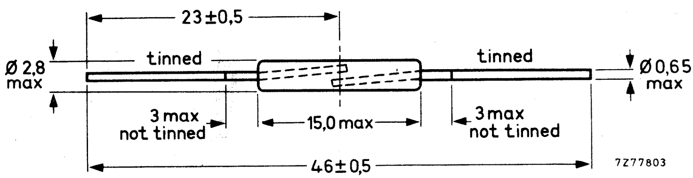

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Mechanical strength

The robustness of terminations is tested according to IEC publication 68-2-21, test Ua (load 10 N).

Mounting

The leads should not be bent nearer than 1 mm to the glass-to-metal seals. Stress on the seals should be avoided. Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions.

Soldering

The contact unit may be soldered direct into the circuit but heat conducted to the glass-to-metal seals should be kept to a minimum by the use of a thermal shunt. Dip-soldering is permitted to a minimum of 3 mm from the seals at a solder temperature of 240 °C during maximum 10 s.

Solderability

Solderability is tested according to IEC publication 68-2-20, test T, solder globule method.

Weldability

The leads are weldable.

The RI-22 series comprises three types: RI-22/3A, RI-22/3B, and RI-22/3C.

CHARACTERISTICS RI-22/3A

Not-operate

Breakdown voltage		see relevant graph			
Insulation resistance, initial	min.	10^3			MΩ
Capacitance, without test coil	max.	0,25			pF
		coil I	coil II	coil III	(note 1)
Must-not-operate value	max.	18	14	16	At
Operate					
Must-operate value	max.	32	23	27	At
Operate time, including bounce	typ.	0,25 (note 2)			ms
	max.	0,5 (note 2)			ms
Bounce time	typ.	0,15 (note 2)			ms
	max.	0,3 (note 2)			ms
Contact resistance, initial	typ.	60 (note 3)			mΩ
	max.	90 (note 3)			mΩ
Not-release					
Must-not-release value	min.	22	16	19	At
Release					
Must-release value	max.	8	6	7	At
Release time	max.	30 (note 2)			μs

CHARACTERISTICS RI-22/3B

		coil I	coil II	coil III	(note 1)
Not-operate					
Breakdown voltage		see relevant graph			
Insulation resistance	min.	10^3			MΩ
Capacitance, without test coil	max.	0,25			pF
Must-not-operate value	max.	28	20	23	At
Operate					
Must-operate value	max.	52	32	39	At
Operate time, including bounce	typ.	0,25 (note 2)			ms
	max.	0,5 (note 2)			ms
Bounce time	typ.	0,15 (note 2)			ms
	max.	0,3 (note 2)			ms
Contact resistance, initial	typ.	60 (note 3)			mΩ
	max.	90 (note 3)			mΩ
Not-release					
Must-not-release value	min.	32	23	27	At
Release					
Must-release value	max.	12	9	10	At
Release time	max.	30 (note 2)			μs

Notes
1. Coil I : Standard coil.
   Coil II : Recommended coil.
   Coil III: Miniature coil A according to MIL-S-55433B.
   } See also page D16.
2. Measured with 100 At.
3. Measured with 70 At, distance between measuring points: 41 mm. Wire resistance typ. 1,0 mΩ/mm.

CHARACTERISTICS RI-22/3C

Not-operate

Breakdown voltage		see relevant graph			
Insulation resistance, initial	min.	10^3			MΩ
Capacitance, without test coil	max.	0,25			pF

		coil I	coil II	coil III	(note 1)
Must-not-operate value	max.	46	30	37	At
Operate					
Must-operate value	max.	70	39	55	At
Operate time, including bounce	typ.	0,25 (note 2)			ms
	max.	0,5 (note 2)			ms
Bounce time	typ.	0,15 (note 2)			ms
	max.	0,3 (note 2)			ms
Contact resistance, initial	typ.	60 (note 3)			mΩ
	max.	90 (note 3)			mΩ
Not-release					
Must-not-release value	min.	32	23	27	At
Release					
Must-release value	max.	12	9	10	At
Release time	max.	30 (note 2)			μs

Notes: see page D13

LIMITING VALUES

Absolute maximum rating system

Switched power	max.	10 W
Switched voltage		
d.c.	max.	200 V
a.c. (r.m.s.)	max.	110 V
Switched current, d.c. or a.c. (r.m.s.)	max.	500 mA
Current through closed contacts, d.c. or a.c. (r.m.s.)	max.	2 A
Temperature, storage and operating	max.	125 °C *
	min.	−55 °C

LIFE EXPECTANCY AND RELIABILITY

For life expectancy data end of life is defined as being reached when either:

(a) the contact resistance once exceeds 1 Ω for no-load conditions or 10 Ω for loaded conditions, measured 5 ms after energizing coil; or

(b) the release time once exceeds 5 ms after de-energizing the coil (latching or contact sticking).

No-load conditions (operating frequency 50 Hz)

Life expectancy min. 10^8 operations with a failure rate of less than 10^{-9} with a confidence level of 90%. After each operation (a) and (b) are tested.

Loaded conditions (resistive load; 12 V, 2 mA; operating frequency 50 Hz)

Life expectancy min. 10^7 operations with a failure rate of less than 10^{-8} with a confidence level of 90%. After each operation points (a) and (b) are tested.

Note
Switching other loads involves different life expectancy and reliability. Consult us beforehand.

SHOCK AND VIBRATION

Impact

Acceleration 150 g during 11 ms, due to a force perpendicular to the flat sides of the reeds. Such an impact will not cause an open contact (no magnetic field present) to close, nor a contact kept closed by an 80 At coil to open.

Vibration

Frequency range 10 Hz to 1500 Hz, acceleration 10 g due to a force perpendicular to the flat sides of the reeds. Such a vibration will not cause an open contact (no magnetic field present) to close, nor a contact kept closed by an 80 At coil to open.

* Excursions up to 150 °C may be permissible. Consult us.

COILS

Coil I: Standard coil

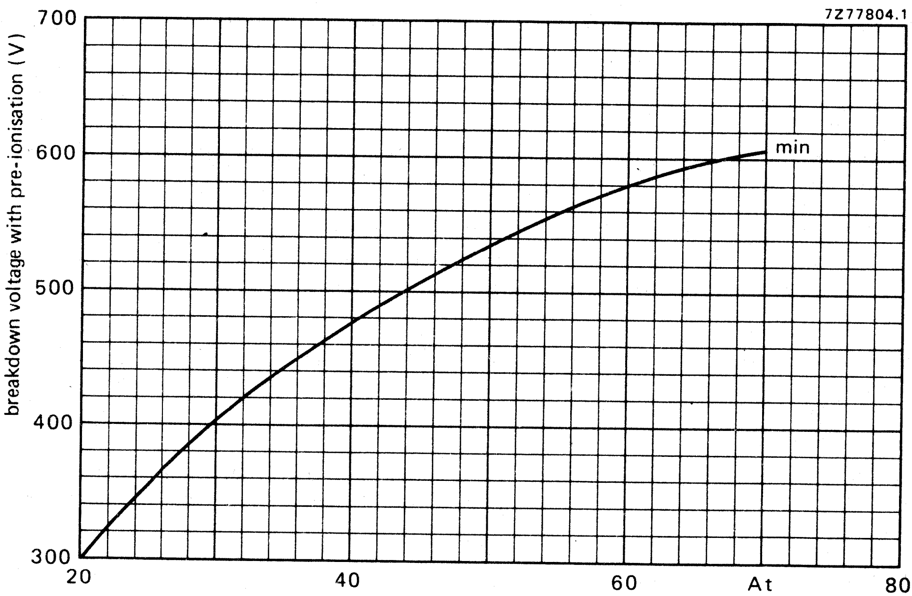
5000 turns of 42 SWG single enamelled copper wire on a coil former of 25,4 mm winding length and a core diameter of 8,75 mm.

Coil II: Recommended coil

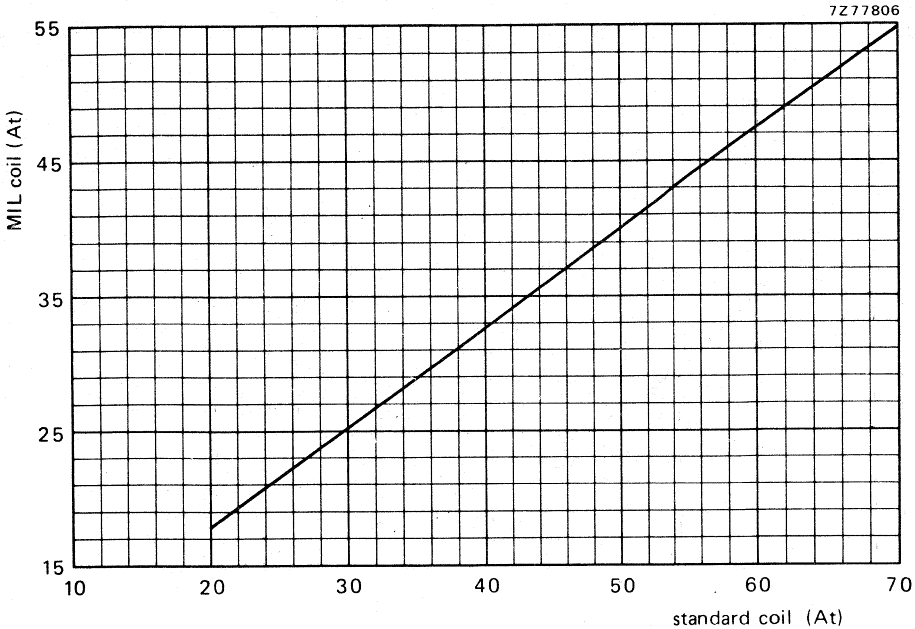
5000 turns of 46 SWG single enamelled copper wire on a coil former of 7,1 mm winding length, a core diameter of 3,7 mm and an outer diameter of 12,5 mm.

Coil III: Miniature coil A according to MIL-S-55433B

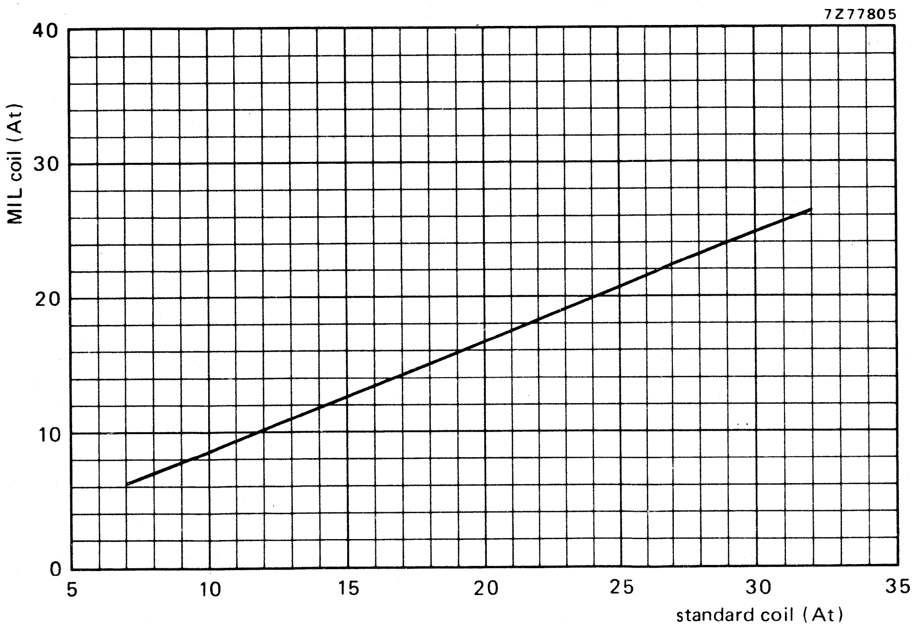
10 000 turns of 48 SWG single enamelled copper wire on a coil former of 19,05 mm winding length and a core diameter of 4,32 mm.



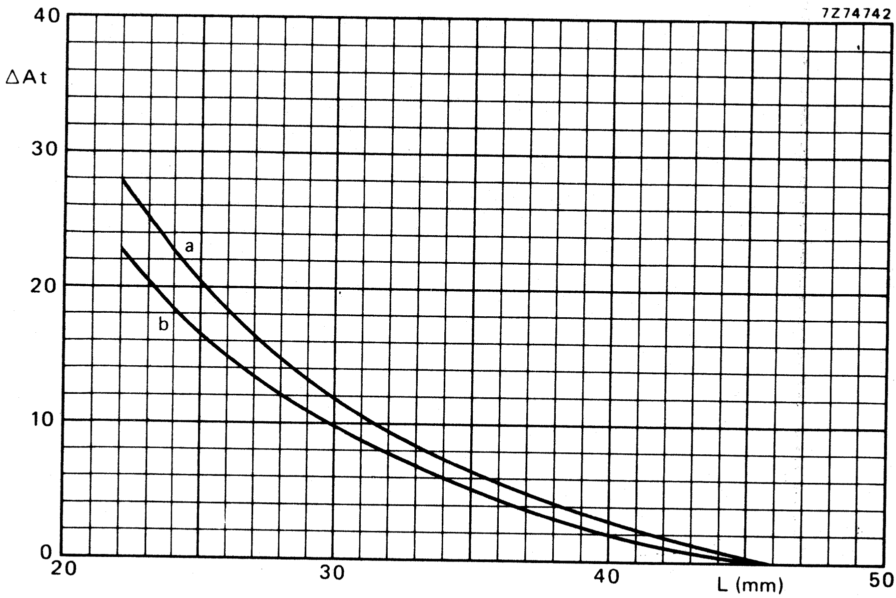
Breakdown voltage (d.c.) as a function of ampere-turns.



Correlation of At operate in standard coil and MIL coil.



Correlation of At release in standard coil and MIL coil.



ΔAt (typical) as a function of total length.
a: **ΔAt operate**
b: **ΔAt release.**

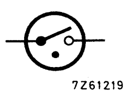
DRY REED CONTACT UNIT

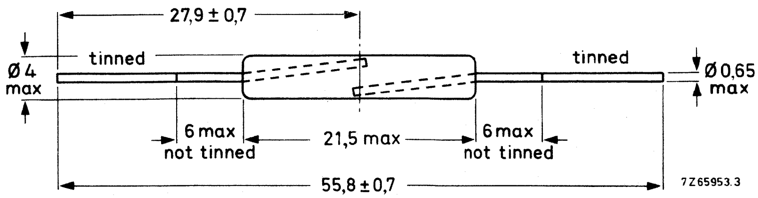
Mini dry reed contact unit hermetically sealed in a gas-filled glass capsule.
Single-pole, single-throw type, having normally open contacts, and containing two magnetically actuated reeds. The contact unit is of the double-ended type and may be actuated by means of either an electromagnet or a permanent magnet or combinations of both. The device is intended for use in relays, push buttons or similar devices in conjunction with semiconductor circuits.

QUICK REFERENCE DATA				
Contact	S.P.S.T. normally open			
Switched power	max.		10	W
Switched voltage, d.c.	max.		350	V
a.c. (r.m.s.)	max.		220	V
Switched current	max.		500	mA
Contact resistance, initial	max.		100	mΩ
Basic magnetic characteristics, measured with the Standard coil				
Operate range	30	to	70	At
Release range	9,5	to	21	At

MECHANICAL DATA Dimensions in mm

Contact arrangement	normally open
Lead finish	tinned
Resonant frequency of single reed	approx. 2000 Hz
Net mass	approx. 0,3 g
Mounting position	any





Mechanical strength

The robustness of terminations is tested according to IEC Publication 68-2-21, test Ua (load 3, 5 kg), Ub (load 0, 5 kg, 2 bends), and Uc (3 x 360^o).

Mounting

The leads should not be bent nearer than 2 mm to the glass-to-metal seals. Stress on the seals should be avoided.
Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions.

Soldering

The contact unit may be soldered direct into the circuit but heat conducted to the glass-to-metal seals should be kept to a minimum by the use of a thermal shunt.
Dip-soldering is permitted to a minimum of 6 mm from the seals at a solder temperature of 240 ^oC during maximum 10 s.

Solderability

Solderability is tested according to IEC Publication 68-2-20, test T, solder globule method.

Weldability

The leads are weldable.

CHARACTERISTICS See also "General Reed contact units"

Not-operate

Breakdown voltage	min.	750		V 5)
	min.	1000		V 6)
Insulation resistance, initial	min.	10^3		MΩ
Capacitance, without test coil	max.	1		pF

		coil I	coil II	
Must-not-operate value	max.	30	31	At
Operate				
Must-operate value	max.	70	75	At
Operate time, including bounce	typ.	0, 6 2)		ms
	max.	1, 0 2)		ms
Bounce time	typ.	0, 3 2)		ms
	max.	0, 5 2)		ms
Contact resistance, initial	typ.	70 3)		mΩ
	max.	100 3)		mΩ

Notes: see page D22

Not-release

Must-not-release value	min.	21	22	At

Release

Must-release value	max.	9, 5	9, 5	At
Release time	max.	50 2)		μs

LIMITING VALUES (Absolute max. rating system)

Switched power	max.	10	W
Switched voltage, d.c.	max.	350	V
a.c. (r.m.s.)		220	V
Switched current, d.c. or a.c. (r.m.s.)	max.	500	mA 4)
Current through closed contact, d.c. or a.c. (r.m.s.)	max.	1, 5	A
Temperature, storage and operation	max.	125	°C
	min.	−55	°C

LIFE EXPECTANCY AND RELIABILITY

For life expectancy data end of life is defined as being reached when:
either a) the contact resistance exceeds 1 Ω for no load conditions or 5 Ω for loaded conditions, measured 5 ms after energizing coil I to 100 At.
or b) the release time once exceeds 5 ms (latching or contact sticking), after de-energizing coil I to 4 At.

No-load conditions

Operating frequency 50 Hz.
Life expectancy min. 10^8 operations with a failure rate of less than 10^{-8} with a confidence level of 90%.
After each operation a) and b) are tested.

Loaded conditions

Resistive load: 12 V, 100 mA, operating frequency 50 Hz.
Life expectancy min. 10^7 operations with a failure rate of less than 10^{-8} with a confidence level of 90%.
After each operation a) and b) are tested.

Notes: see page D22

SHOCK AND VIBRATION

Mechanical shock is tested according to IEC Publication 68-2-27, test Ea (peak acceleration 500 g, half sine-wave).
Such a mechanical shock will not cause an open contact (no magnetic field present) to close, nor a contact kept closed by an 80 At coil to open.

Vibration is tested according to IEC Publication 68-2-6, test Fe, procedure B4 (acceleration 10 g, below cross-over frequency amplitude 0,75 mm, frequency range 10-500 Hz, duration 90 min.). Such a vibration will not cause an open contact (no magnetic field present) to close, nor a contact kept closed by an 80 At coil to open.

COILS

Coil I : Standard coil

5000 turns of 42 SWG single enamelled copper wire on a coil former of 25,4 mm winding length and a core diameter of 8,75 mm.

Coil II : Intermediate coil C according to MIL-S-55433B

10 000 turns of 41 SWG single enamelled copper wire on a coil former of 25,4 mm winding length and a core diameter of 7,62 mm.

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1) Coil I : Standard coil.
Coil II: Intermediate coil C according to MIL-S-55433B.

2) Measured with 100 At.

3) Measured with 32 At, distance between measuring points 41 mm.

4) Surges (e.g. due to stray capacitances of cables) up to 1,5 A are permissible provided these surges decay to values within the limiting values in less than 0,8 μs. Submicrosecond surges may shorten contact life significantly.

5) Measured after pre-ionization.

6) Measured without pre-ionization.

DRY REED CONTACT UNIT

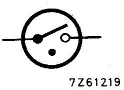
Miniature dry reed contact unit hermetically sealed in a gas-filled glass capsule. Single-pole, single-throw type, having normally open contacts, and containing two magnetically actuated reeds. The contact unit is of the double-ended type and may be actuated by means of either an electromagnet or a permanent magnet or combinations of both. The device is intended for use in telephone exchange relays.

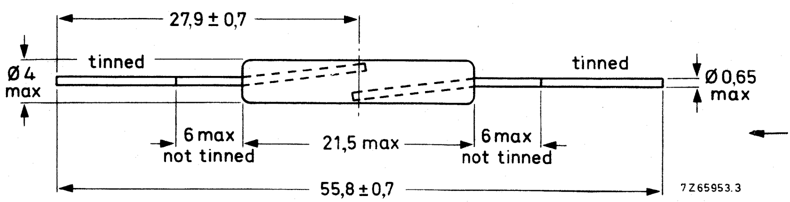
QUICK REFERENCE DATA					
Contact	S.P.S.T. normally open				
Switched power	max.		10	W
Switched voltage	max.		200	V
Switched current	max.		500	mA
Contact resistance (initial)	max.		100	mΩ
Basic magnetic characteristics, measured with the Standard coil				
Operate range	30	to	70	At
Release range	9,5	to	21	At

MECHANICAL DATA

Dimensions in mm

Contact arrangement	normally open		
Lead finish	tinned		
Resonant frequency of single reed	approx.	2000	Hz
Net mass	approx.	0,3	g
Mounting position	any		





Mechanical strength

The robustness of terminations is tested according to IEC Publication 68-2-21, test Ua (load 3,5 kg), Ub (load 0,5 kg, 2 bends) and Uc (3 x 360°).

Mounting

The leads should not be bent nearer than 2 mm to the glass-to-metal seals. Stress on the seals should be avoided.
Care must be taken to prevent stray magnetic fields from influencing the operating and measuring conditions.

Soldering

The contact unit may be soldered direct into the circuit but heat conducted to the glass-to-metal seals should be kept to a minimum by the use of a thermal shunt.
Dip-soldering is permitted to a minimum of 6 mm from the seals at a solder temperature of 240 °C during maximum 10 s.

Solderability

Solderability is tested according to IEC Publication 68-2-20, test T, solder globule method.

Weldability

The leads are weldable.

CHARACTERISTICS

Not-operate

Breakdown voltage	min.		750		V 5)
	min.		1000		V 6)
Insulation resistance, initial	min.		10^3		MΩ
		coil I	coil II	coil III	
Must-not-operate value	max.	30	21	31	At
Operate					
Must-operate value	max.	70	37	75	At
Operate time, including bounce	max.		1,1 2)		ms
Bounce time	typ.		0,3 2)		ms
	max.		0,4 2)		ms
Hold					
Hold value	min.	32	20,5	33	At
Contact resistance, initial	max.		100 3)		mΩ
Not-release					
Must-not-release value	min.	21	13	22	At
Release					
Must-release value	max.	9,5	5	9,5	At
Release time	max.		0,1 2)		ms

LIMITING VALUES (Absolute max. rating system)

Switched power	max.	10	W
Switched voltage	max.	200	V
Switched current	max.	500	mA [4])
Current through closed contact	max.	1, 5	A
Temperature, storage and operating	max.	125	^{o}C
	min.	−55	^{o}C

LIFE EXPECTANCY

For life expectancy data end of life is defined as being reached when within 0, 1 x the typical number of operations:

either a) the contact resistance more than once exceeds 1 Ω for no load conditions and 10 Ω for loaded conditions, measured 5 ms after energizing the coil;

or b) the release time more than once exceeds 2 ms after de-energizing the coil (contact sticking).

No load conditions

Typical number of operations: 10^8 Operating frequency 50 Hz.

Loaded conditions

p) Resistance load: 50 V, 100 mA Operating frequency 20 Hz.
Minimum number of operations: 2×10^6

q) Resistive load: 50 V, 50 mA connected to the contacts by means of the following cables:

Surge impedance (Ω)	Cable length (m)
45	20; 100
75	20; 100
140	20; 100

Minimum number of operations: $0,5 \times 10^6$ Operating frequency 20 Hz.

r) Discharge of the following floating cables, previously charged to 50 V:

Surge impedance (Ω)	Cable length (m)
45	1; 10; 100
75	1; 10; 100
140	1; 10; 100

Minimum number of operations: 3×10^6 Operating frequency 20 Hz.

General: After each operation points a) and b) are tested.

Note: Switching other loads involves different life expectancy and reliability. Consult us beforehand.

SHOCK AND VIBRATION

Mechanical shock is tested according to IEC Publication 68-2-27, test Ea (peak acceleration 500 g, half sine-wave).
Such a mechanical shock will not cause an open contact (no magnetic field present) to close, nor a contact kept closed by an 80 At coil II to open.

Vibration is tested according to IEC Publication 68-2-6, test Fc, procedure B4 (acceleration 10 g, below cross-over frequency amplitude 0, 75 mm, frequency range 10-500 Hz, duration 90 minutes).
Such a vibration will not cause an open contact by an 80 At coil II to open.

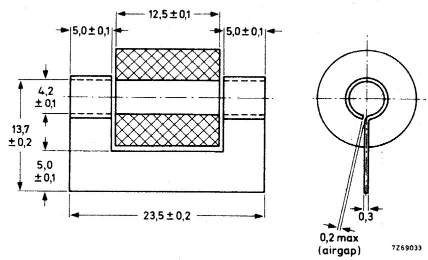
COILS

Coil I: Standard coil

5000 turns of 42 SWG single enamelled copper wire on a coil former of 25, 4 mm winding length and a core diameter of 8, 75 mm.

Coil II: Recommended coil

2000 turns of 42 SWG single enamelled copper wire on a coil former of 12, 5 mm winding length and a core diameter of 4, 2 mm with a return circuit of annealed soft iron (80 A/m < H_c < 96 A/m).



Coil III: Intermediate coil C according to MIL-S55433B

10 000 turns of 41 SWG single enamelled copper wire on a coil former of 25, 4 mm winding length and a core diameter of 7, 62 mm.

1) Coil I : Standard coil.
Coil II : Recommended coil.
Coil III: Intermediate coil C according to MIL-S-55433B.

2) Measured with 50 At

3) Measured with 20 At, distance between measuring points: 38 mm.

4) Surges (e.g. due to stray capacitances of cables) up to 1, 5 A are permissible provided these surges decay to values within the limiting values in less than 0, 8 μs. Submicrosecond surges may shorten contact life significantly.

5) Measured after pre-ionization.

6) Measured without pre-ionization.

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INDEX OF TYPE NUMBERS

A = Segment indicator tubes
B = Indicator tubes
C = Switching diodes
D = Dry reed contact units

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