PHILIPS

Data handbook

Electronic
components
and materials

Semiconductors and integrated circuits

Part 4b December 1974

Photosensitive diodes and transistors

Light emitting diodes

Photocouplers

Infra-red sensitive devices

Photoconductive devices

SEMICONDUCTORS AND INTEGRATED CIRCUITS

Part 4 b **December 1974**

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CARACAS

DATA HANDBOOK SYSTEM

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

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

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

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

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

December 1972

ELECTRON TUBES (BLUE SERIES)

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

Part 1a	**Transmitting tubes for communications and Tubes for r.f. heating Types PB2/500 ÷ TBW15/125**	**April 1973**
Part 1b	**Transmitting tubes for communication** **Tubes for r.f. heating** **Amplifier circuit assemblies**	**August 1974**
Part 2	**Microwave products**	**October 1974**
	Communication magnetrons Magnetrons for micro-wave heating Klystrons Traveling-wave tubes	Diodes Triodes T-R Switches Microwave Semiconductor devices Isolators Circulators
Part 3	**Special Quality tubes;** **Miscellaneous devices**	**March 1972**
Part 4	**Receiving tubes**	**September 1973**
Part 5a	**Cathode-ray tubes**	**November 1973**
Part 5b	**Camera tubes; Image intensifier tubes**	**December 1973**
Part 6	**Products for nuclear technology** **Photodiodes**	**January 1974**
	Photomultiplier tubes Channel electron multipliers Geiger-Mueller tubes	Neutron tubes Photo diodes
Part 7	**Gas-filled tubes**	**February 1974**
	Voltage stabilizing and reference tubes Counter, selector, and indicator tubes Trigger tubes Switching diodes	Thyratrons Ignitrons Industrial rectifying tubes High-voltage rectifying tubes
Part 8	**T.V. Picture tubes**	**May 1974**

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

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

Part 1a Rectifier diodes and thyristors

June 1974

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

Part 1b Diodes

July 1974

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

Part 2 Low frequency transistors

July 1974

Part 3 High frequency and switching transistors

October 1974

Part 4a Special semiconductors

November 1974

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

Part 4b Devices for opto-electronics

December 1974

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

Part 5 Linear integrated circuits

July 1973

Part 6 Digital integrated circuits

April 1974

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

COMPONENTS AND MATERIALS (GREEN SERIES)

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

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

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

Part 2a Resistors **September 1974**

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

Part 2b Capacitors **December 1974**

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

Part 3 Radio, Audio, Television **June 1973**

- FM tuners
- Loudspeakers
- Television tuners, aerial input assemblies
- Components for black and white TV
- Components for colour television
- Deflection assemblies for camera tubes

Part 4a Soft ferrites **October 1973**

- Ferrites for radio, audio and television
- Small coils
- Ferroxcube potcores and square cores
- Ferroxcube transformer cores

Part 4b Piezoelectric ceramics, Permanent magnet materials **October 1973**

Part 5 Ferrite core memory products **January 1974**

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

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

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

Part 7 Circuit blocks **September 1971**

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

General

Type designation
Rating systems
Letter symbols
Definitions applying to photosensitive devices

PRO ELECTRON TYPE DESIGNATION CODE

FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete devices and to multiple devices [1]

The type designation consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

The first letter gives an indication of the material

A	Material with a band gap of 0.6 to 1.0 eV, such as germanium
B	Material with a band gap of 1.0 to 1.3 eV, such as silicon
C	Material with a band gap of 1.3 eV and more, such as gallium arsenide
D	Material with a band gap of less than 0.6 eV, such as indium antimonide
R	Compound material as employed in Hall generators and photoconductive cells

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[1] A multiple device is defined as a combination of similar or dissimilar active devices, contained in a common encapsulation that cannot be dismantled, and of which all electrodes of the individual devices are accessible from the outside.

Multiples of similar devices as well as multiples consisting of a main device and an auxiliary device are designated according to the code for discrete devices described above.
Multiples of dissimilar devices of other nature are designated by the second letter G.

The second letter indicates primarily the main application respectively main application and construction if a further differentiation is essential

A	Detection diode, switching diode, mixer diode
B	Variable capacitance diode
C	Transistor for a.f. applications ($R_{th\ j-mb} > 15\ ^{o}C/W$)
D	Power transistor for a.f. applications ($R_{th\ j-mb} \leq 15\ ^{o}C/W$)
E	Tunnel diode
F	Transistor for h.f. applications ($R_{th\ j-mb} > 15\ ^{o}C/W$)
G	Multiple of dissimilar devices (see note on page 1); Miscellaneous
H	Magnetic sensitive diode; Field probe
K	Hall generator in an open magnetic circuit, e.g. magnetogram or signal probe
L	Power transistor for h.f. applications ($R_{th\ j-mb} \leq 15\ ^{o}C/W$)
M	Hall generator in a closed electrically energised magnetic circuit, e.g. Hall modulator or multiplier
N	Photocoupler
P	Radiation sensitive device 1)
Q	Radiation generating device
R	Electrically triggered controlling and switching device having a breakdown characteristic ($R_{th\ j-mb} > 15\ ^{o}C/W$)
S	Transistor for switching applications ($R_{th\ j-mb} > 15\ ^{o}C/W$)
T	Electrically, or by means of light, triggered controlling and switching power device having a breakdown characteristic ($R_{th\ j-mb} \leq 15\ ^{o}C/W$) 1)
U	Power transistor for switching applications ($R_{th\ j-mb} \leq 15\ ^{o}C/W$)
X	Multiplier diode, e.g. varactor, step recovery diode
Y	Rectifying diode, booster diode, efficiency diode 1)
Z	Voltage reference or voltage regulator diode 1)

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1) For the type designation of a range see page 4.

The serial number consists of:

Three figures for semiconductor devices designed primarily for use in domestic equipment

One letter and two figures for semiconductor devices designed primarily for use in professional equipment

VERSION LETTER

A version letter can be used, for instance, for a diode with up-rated voltage, for a sub-division of a transistor type in different gain ranges, a low noise version of an existing transistor and for a diode, transistor, or thyristor with minor mechanical differences, such as finish of the leads, length of the leads etc. The letters never have a fixed meaning, the only exception being the letter R.

TYPE DESIGNATION FOR A RANGE OF SEMICONDUCTOR DEVICES

The type designation of a range of variants of:

a) voltage reference or voltage regulator diodes (second letter Z)

b) rectifier diodes (second letter Y)

c) thyristors (second letter T)

d) radiation detectors

distinctly belonging to one basic type may be qualified by a suffix part which is clearly separated from the basic part by a hyphen (-)

THE BASIC PART being the same for the whole range, is in accordance with the designation code for discrete devices.

THE SUFFIX PART consists of:

a) **for voltage reference or voltage regulator diodes**

one letter followed by the typical working voltage and where appropriate the letter R [1]
The first letter indicates the nominal tolerance of the working voltage in %.

A	1%
B	2%
C	5%
D	10%
E	15%

The typical working voltage is related to the nominal current rating for the whole range. The letter V is used to denote the decimal comma when this occurs.

b) **for rectifier diodes**

a number and where appropriate the letter R [1]
The number generally indicates the maximum repetitive peak reverse voltage.
For controlled avalanche types it indicates the maximum crest working reverse voltage.

c) **for thyristors**

a number and where appropriate the letter R [1]
The number generally indicates either the maximum repetitive peak reverse voltage or the maximum repetitive peak off-state voltage, whichever is lower.
For controlled avalanche types it indicates the maximum crest working reverse voltage.

d) **for radiation detectors**

a figure giving the depth of the depletion layer in μm and where appropriate a version letter if there are differences in resolution.

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[1] The letter R indicates reverse polarity (anode to stud). The normal polarity (cathode to stud) and symmetrical versions are not specially indicated.

RATING SYSTEMS

ACCORDING TO I.E.C. PUBLICATION 134

1. DEFINITIONS OF TERMS USED

1.1 Electronic device. An electronic tube or valve, transistor or other semiconductor device.

Note: This definition excludes inductors, capacitors, resistors and similar components.

1.2 Characteristic. A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic, or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

1.3 Bogey electronic device. An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

1.4 Rating. A value which establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms.

Note: Limiting conditions may be either maxima or minima.

1.5 Rating system. The set of principles upon which ratings are established and which determine their interpretation.

Note: The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

2. 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.

p.t.o.

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

3. DESIGN MAXIMUM RATING SYSTEM

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and 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 responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

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

4. DESIGN CENTRE RATING SYSTEM

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

NOTE

It is common use to apply the Absolute Maximum System in semiconductor published data.

LETTER SYMBOLS FOR TRANSISTORS AND SIGNAL DIODES

based on IEC Publication 148

LETTER SYMBOLS FOR CURRENTS, VOLTAGES AND POWERS

Basic letters

The basic letters to be used are:

I, i = current
V, v = voltage
P, p = power.

Lower-case basic letters shall be used for the representation of instantaneous values which vary with time.
In all other instances upper-case basic letters shall be used.

Subscripts

A, a	Anode terminal
(AV), (av)	Average value
B, b	Base terminal, for MOS devices: Substrate
(BR)	Breakdown
C, c	Collector terminal
D, d	Drain terminal
E, e	Emitter terminal
F, f	Forward
G, g	Gate terminal
K, k	Cathode terminal
M, m	Peak value
O, o	As third subscript: The terminal not mentioned is open circuited
R, r	As first subscript: Reverse. As second subscript: Repetitive. As third subscript: With a specified resistance between the terminal not mentioned and the reference terminal.
(RMS), (rms)	R.M.S. value
S, s	As first or second subscript: Source terminal (for FETS only) As second subscript: Non-repetitive (not for FETS) As third subscript: Short circuit between the terminal not mentioned and the reference terminal
X, x	Specified circuit
Z, z	Replaces R to indicate the actual working voltage, current or power of voltage reference and voltage regulator diodes.

Note: No additional subscript is used for d.c. values.

Upper-case subscripts shall be used for the indication of:

a) continuous (d.c.) values (without signal)

Example I_B

b) instantaneous total values

Example i_B

c) average total values

Example $I_{B(AV)}$

d) peak total values

Example I_{BM}

e) root-mean-square total values

Example $I_{B(RMS)}$

Lower-case subscripts shall be used for the indication of values applying to the varying component alone:

a) instantaneous values

Example i_b

b) root-mean-square values

Example $I_{b(rms)}$

c) peak values

Example I_{bm}

d) average values

Example $I_{b(av)}$

Note: If more than one subscript is used, subscript for which both styles exist shall either be all upper-case or all lower-case.

Additional rules for subscripts

Subscripts for currents

Transistors: If it is necessary to indicate the terminal carrying the current, this should be done by the first subscript (conventional current flow from the external circuit into the terminal is positive).

Examples: I_B, i_B, i_b, I_{bm}

Diodes: To indicate a forward current (conventional current flow into the anode terminal) the subscript F or f should be used; for a reverse current (conventional current flow out of the anode terminal) the subscript R or r should be used.

Examples: I_F, I_R, i_F, $I_{f(rms)}$

Subscripts for voltages

Transistors: If it is necessary to indicate the points between which a voltage is measured, this should be done by the first two subscripts. The first subscript indicates the terminal at which the voltage is measured and the second the reference terminal or the circuit node. Where there is no possibility of confusion, the second subscript may be omitted.

Examples: V_{BE}, v_{BE}, v_{be}, V_{bem}

Diodes: To indicate a forward voltage (anode positive with respect to cathode), the subscript F or f should be used; for a reverse voltage (anode negative with respect to cathode) the subscript R or r should be used.

Examples: V_F, V_R, v_F, V_{rm}

Subscripts for supply voltages or supply currents

Supply voltages or supply currents shall be indicated by repeating the appropriate terminal subscript.

Examples: V_{CC}, I_{EE}

Note: If it is necessary to indicate a reference terminal, this should be done by a third subscript

Example : V_{CCE}

Subscripts for devices having more than one terminal of the same kind

If a device has more than one terminal of the same kind, the subscript is formed by the appropriate letter for the terminal followed by a number; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

Examples: I_{B2} = continuous (d.c.) current flowing into the second base terminal

V_{B2-E} = continuous (d.c.) voltage between the terminals of second base and emitter

Subscripts for multiple devices

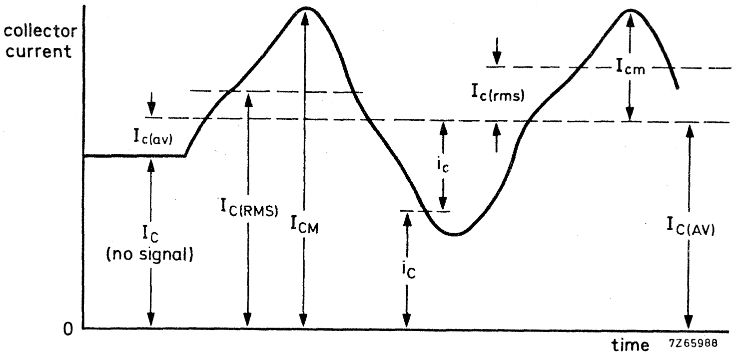
For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

Examples: I_{2C} = continuous (d.c.) current flowing into the collector terminal of the second unit

V_{1C-2C} = continuous (d.c.) voltage between the collector terminals of the first and the second unit.

Application of the rules

The figure below represents a transistor collector current as a function of time. It consists of a continuous (d.c.) current and a varying component.



LETTER SYMBOLS FOR ELECTRICAL PARAMETERS

Definition

For the purpose of this Publication, the term "electrical parameter" applies to four-pole matrix parameters, elements of electrical equivalent circuits, electrical impedances and admittances, inductances and capacitances.

Basic letters

The following is a list of the most important basic letters used for electrical parameters of semiconductor devices.

B, b = susceptance; imaginary part of an admittance
C = capacitance
G, g = conductance; real part of an admittance
H, h = hybrid parameter
L = inductance
R, r = resistance; real part of an impedance
X, x = reactance; imaginary part of an impedance
Y, y = admittance;
Z, z = impedance;

Upper-case letters shall be used for the representation of:

a) electrical parameters of external circuits and of circuits in which the device forms only a part;

b) all inductances and capacitances.

Lower-case letters shall be used for the representation of electrical parameters inherent in the device (with the exception of inductances and capacitances).

Subscripts

General subscripts

The following is a list of the most important general subscripts used for electrical parameters of semiconductor devices:

F, f = forward; forward transfer
I, i (or 1) = input
L, l = load
O, o (or 2) = output
R, r = reverse; reverse transfer
S, s = source

Examples: Z_S, h_f, h_F

The upper-case variant of a subscript shall be used for the designation of static (d.c.) values.

Examples : h_{FE} = static value of forward current transfer ratio in common-emitter configuration (d.c. current gain)
R_E = d.c. value of the external emitter resistance.

Note: The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

The lower-case variant of a subscript shall be used for the designation of small-signal values.

Examples: h_{fe} = small-signal value of the short-circuit forward current transfer ratio in common-emitter configuration
$Z_e = R_e + jX_e$ = small-signal value of the external impedance

Note: If more than one subscript is used, subscripts for which both styles exist shall either be all upper-case or all lower-case

Examples: h_{FE}, y_{RE}, h_{fe}

Subscripts for four-pole matrix parameters

The first letter subscript (or double numeric subscript) indicates input, output, forward transfer or reverse transfer

Examples: h_i (or h_{11})
h_o (or h_{22})
h_f (or h_{21})
h_r (or h_{12})

A further subscript is used for the identification of the circuit configuration. When no confusion is possible, this further subscript may be omitted.

Examples: h_{fe} (or h_{21e}), h_{FE} (or h_{21E})

Distinction between real and imaginary parts

If it is necessary to distinguish between real and imaginary parts of electrical parameters, no additional subscripts should be used. If basic symbols for the real and imaginary parts exist, these may be used.

Examples: $Z_i = R_i + jX_i$
$y_{fe} = g_{fe} + jb_{fe}$

If such symbols do not exist or if they are not suitable, the following notation shall be used:

Examples: Re (h_{ib}) etc. for the real part of h_{ib}
Im (h_{ib}) etc. for the imaginary part of h_{ib}

DEFINITIONS APPLYING TO PHOTOSENSITIVE DEVICES

to IEC 306

DEFINITIONS AND UNITS OF RADIATION AND LIGHT QUANTITIES

Radiant flux: radiant power

Power emitted, transferred or received in the form of radiation.

Symbols: ϕ_e, ϕ, P $\phi_e = \frac{dQ_e}{dt}$; unit: watt, W.

Radiant intensity

The radiant intensity of a source in a given direction is the quotient of (1) the radiant flux leaving the source propagated in an element of solid angle containing the given direction, by (2) the element of solid angle.

Symbols: I_e, I $I_e = \frac{d\phi_e}{d\Omega}$; unit: watt per steradian, W/sr.

Irradiance

The irradiance at a point of a surface is the quotient of (1) the radiant flux incident on an element of the surface containing the point, by (2) the area of that element.

Symbols: E_e, E $E_e = \frac{d\phi_e}{dA}$; unit: watt per square metre, W/m^2.

Light

Radiation capable of stimulating the organ of vision. 1) ←

Luminous flux

Quantity derived from radiant flux by evaluating the radiation according to its action upon a selective receptor, the spectral sensitivity of which is defined by the standard spectral luminous efficiency.

Symbols: ϕ_v, ϕ; unit: lumen, lm.

Lumen

SI unit of luminous flux: luminous flux emitted within unit solid angle (one steradian) by a point source having a uniform intensity of 1 candela. (An isotropic source of intensity 1 candela emits 4π lumens of luminous flux.)

Symbol: lm.

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1) For convenience, exceptions from this definition are made in the data sheets, e.g. dark and light currents (excluding and including respectively near infrared radiation) of a phototransistor, light rise time of a near-infrared light emitting diode.

Luminous intensity

The luminous intensity of a source in a given direction is the quotient of (1) the luminous flux leaving the source propagated in an element of solid angle containing the given direction, by (2) the element of solid angle.

Symbols: I_V, I $\quad I_V = \frac{d\phi_V}{d\Omega}$; unit: candela, cd.

Candela

SI unit of luminous intensity: Luminous intensity, in the perpendicular direction, of a surface of 1/600 000 square metre of a black body at the temperature of freezing platinum under a pressure of 101 235 newtons per square metre.

Symbols: cd; 1 cd = 1 lm/sr.

Illuminance

At a point of a surface, the quotient of (1) the luminous flux incident on an element of the surface containing the point, by (2) the area of that element.

Symbols: E_V, E $\quad E_V = \frac{d\phi_V}{dA}$; unit: lux, lx.

Lux; lumen per square metre

SI unit of illuminance: illuminance produced by a luminous flux of 1 lumen uniformly distributed over a surface of area 1 square metre.

Symbol: lx ; 1 lx = 1 lm/m^2.

Distribution temperature

Temperature of the full radiator for which the ordinates of the spectral distribution curve of its radiance are proportional, in the visible region, to those of the distribution curve of the radiation cosidered.

The unit of measurement is degree Kelvin (K).

Colour temperature

For the purpose of this Recommendation, colour temperature is the distribution temperature of the radiation source.

The unit of measurement is degree Kelvin.

DEFINITIONS OF ELECTRICAL QUANTITIES

Photocurrent

The change in output current from the photocathode caused by incident radiation.

Frequency response characteristic

Relation, usually shown by a graph, between the radiant (or luminous) dynamic sensitivity and the modulation frequency of the incident radiation.

Dark current

The current flowing in a photoelectric device in the absence of irradiation.

Equivalent dark-current irradiation

The incident radiation required to give a d.c. signal output current equal to the dark current.

Equivalent noise irradiation

The value of incident radiation which, when modulated in a stated manner, produces a signal output power equal to the noise power, both in a stated bandwidth.

Quantum efficiency

The ratio of (1) the number of emitted photoelectrons to (2) the number of incident photons.

Quantum efficiency (Q.E.) at a given wavelength of incident radiation may be computed from:

$$\text{Q.E.} = \frac{\text{const.} \times s_k}{\lambda}$$

where:
s_k = spectral sensitivity (amperes per watt) at wavelength λ
λ = wavelength of incident radiation (nanometres)
const. = hc_o/e = 1.24×10^3 W.nm/A
h = Planck constant
c_o = speed of propagation of electromagnetic waves in vacuo
e = elementary charge

Saturation voltage

The lowest operating voltage which causes no change, or only a slight change, of the photocurrent when this voltage is increased under conditions of given constant radiation.

Saturation current

The output current of a photosensitive device which is not changed, or only insignificantly changed, by an increase of either:
a) the irradiance under constant operating conditions; or
b) the operating voltage under constant irradiance.

Note. — The context should make clear which definition is applicable.

DEFINITIONS OF SENSITIVITY

These definitions apply more directly to photocathode sensitivity. For devices in which it is necessary to define the anode (over-all) sensitivity, signal output current should be considered instead of photocurrent.

Radiant sensitivity

a) The quotient of (1) the photocurrent of the device by (2) the incident radiant power, expressed in amperes per watt.

b) The quotient of (1) the photocurrent of the device by (2) the incident irradiance, expressed in amperes per watt/m^2.

Absolute spectral sensitivity

The radiant sensitivity for monochromatic radiation of a stated wavelength.

Relative spectral sensitivity

The ratio of (1) the radiant sensitivity at any considered wavelength to (2) the radiant sensitivity at a certain wavelength taken as reference, usually the wavelength of maximum response.

Note. — For non-linear detectors, it is neccessary to refer to constant photocurrent at all wavelengths.

Luminous sensitivity

a) The quotient of (1) the photocurrent of the device by (2) the incident luminous flux, expressed in amperes per lumen.

b) The quotient of (1) the photocurrent of the device by (2) the incident illuminance, expressed in amperes per lux.

Dynamic sensitivity

Under stated conditions of operation, the quotient of (1) the variation of the photocurrent of the device by (2) the initiating small variation of the incident radiant power (or luminous)

Note. — Distinction is made between "luminous dynamic sensitivity" and "radiant sensitivity."

Spectral sensitivity characteristic

The relation, usually shown by a graph, between wavelength and absolute or relative spectral sensitivity.

Absolute spectral sensitivity characteristic

The relation, usually shown by a graph, between wavelength and absolute spectral sensitivity.

Relative spectral sensitivity characteristic

The relation between wavelength and relative spectral sensitivity.

Quantum efficiency characteristic

The relation, usually shown by a graph, between wavelength and quantum efficiency.

DEFINITIONS OF TIME QUANTITIES

Rise time

The time required for the photocurrent to rise from a stated low percentage to a stated higher percentage of the maximum value when a steady state of radiation is instantaneously applied.

It is usual to consider the 10 % and 90 % levels.

Fall time

The time required for the photocurrent to fall from a stated high percentage to a stated lower percentage of the maximum value when the steady state of radiation is instantaneously removed.

It is usual to consider the 90 % and 10 % levels.

Photosensitive diodes and transistors

SILICON PLANAR EPITAXIAL PHOTOTRANSISTORS

General purpose n-p-n silicon phototransistors in TO-18.
The BPX25 has a lens, the BPX29 has a plane window.

QUICK REFERENCE DATA

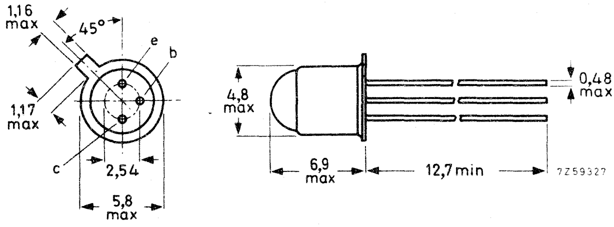
Collector-emitter voltage (open base)	V_{CEO}	max.	32		V
Collector current (peak value)	I_{CM}	max.	200		mA
Junction temperature	T_j	max.	150		°C
Collector dark current $I_B = 0$; $V_{CE} = 24$ V	$I_{CEO(D)}$	<	500		nA
			BPX25	BPX29	
Collector light current $I_B = 0$; $V_{CE} = 6$ V; at 1000 lx	$I_{CEO(L)}$	typ.	13	0,8	mA
Wavelength at peak response	λ_{pk}	typ.	800		nm

MECHANICAL DATA

Dimensions in mm

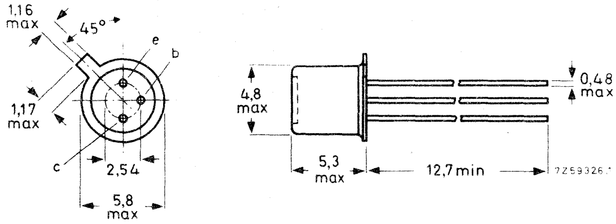
BPX25

TO-18, except for lens
Collector connected to case



BPX29

TO-18, except for window
Collector connected to case



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	32	V
Collector-emitter voltage (open base)	V_{CEO}	max.	32	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Current

Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	300	mW

Temperatures

Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,4	°C/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0,15	°C/mW

→ CHARACTERISTICS

$T_{amb} = 25\ ^oC$ unless otherwise specified

Collector dark current

$I_B = 0$; $V_{CE} = 24$ V	$I_{CEO(D)}$	typ. <	100 500	nA nA
$I_B = 0$; $V_{CE} = 24$ V; $T_{amb} = 100\ ^oC$	$I_{CEO(D)}$	typ. <	15 100	µA µA

Collector light current

			BPX25	BPX29	
$I_B = 0$; $V_{CE} = 6$ V; tungsten filament lamp source with $T_c = 2700$ K; $E_v = 1000$ lx (7,7 mW/cm^2)	$I_{CEO(L)}$	> typ.	5 13	0,25 0,8	mA mA

D.C. current gain

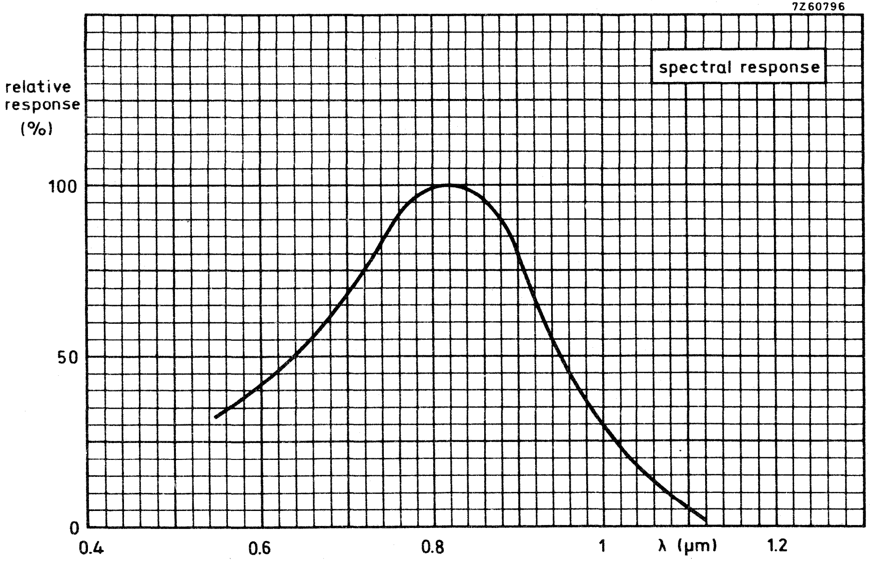
			BPX25	BPX29	
$I_C = 2$ mA; $V_{CE} = 6$ V	h_{FE}	typ.	500	500	

Cut-off frequency

			BPX25	BPX29	
Source : modulated GaAs; 0,4 mW/cm^2 Load : optimum (50 Ω); $V_{CE} = 24$ V	f_{co}	typ.	200	150	kHz

CHARACTERISTICS (continued)

			BPX25	BPX29	
Switching times [1]					
Delay time	t_d	typ.	1,0	2,5	µs
		<	3,0	5,0	µs
Rise time	t_r	typ.	1,5	2,5	µs
		<	3,0	5,0	µs
Storage time	t_s	typ.	0,2	0,2	µs
		<	0,4	0,4	µs
Fall time	t_f	typ.	1,5	3,5	µs
		<	4,0	8,0	µs
Wavelength at peak response	λ_{pk}	typ.	800	800	nm



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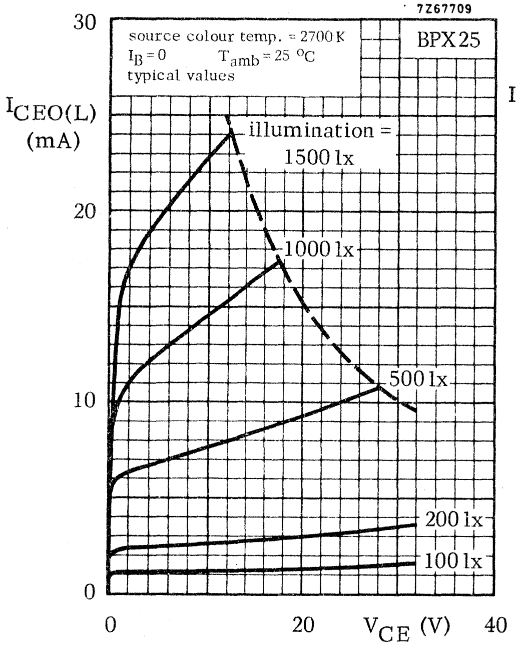
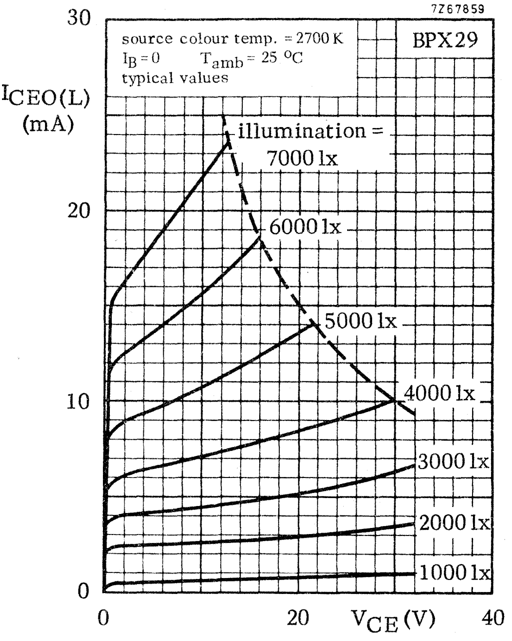
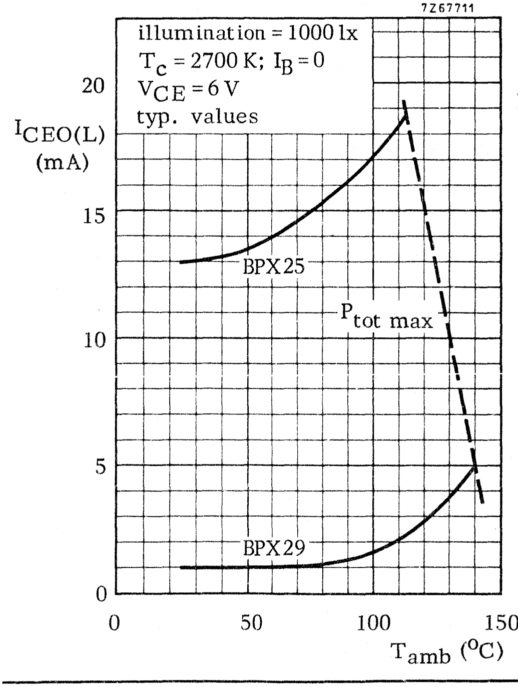
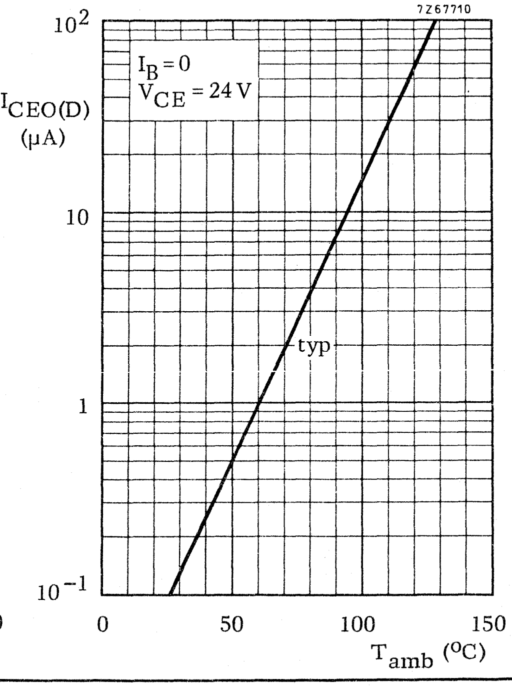
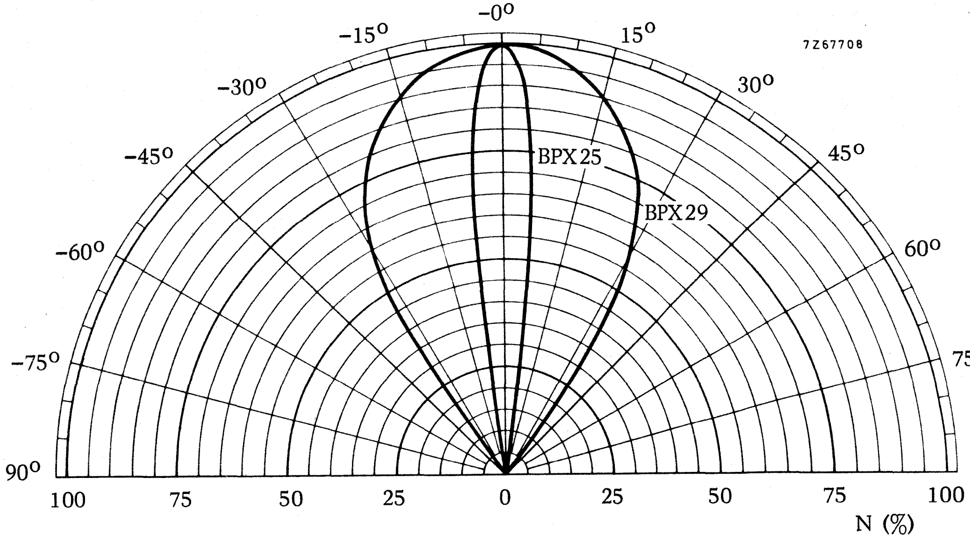
[1] Source: modulated GaAs: 0,4 mW/cm^2
Load: optimum (50 Ω)
V_{CE} = 24 V
Improved switching times can be obtained by a quiescent bias current.
I.e. I_B = 2 µA: t_d < 0,2 µs.


7Z67709
source colour temp. = 2700 K
$I_B = 0$ $T_{amb} = 25\ ^oC$
typical values
BPX25
$I_{CEO(L)}$ (mA)
illumination = 1500 lx
1000 lx
500 lx
200 lx
100 lx
0
10
20
30
0
20
40
V_{CE} (V)


7Z67859
source colour temp. = 2700 K
$I_B = 0$ $T_{amb} = 25\ ^oC$
typical values
BPX29
$I_{CEO(L)}$ (mA)
illumination = 7000 lx
6000 lx
5000 lx
4000 lx
3000 lx
2000 lx
1000 lx
0
10
20
30
0
20
40
V_{CE} (V)


7Z67711
illumination = 1000 lx
$T_c = 2700$ K; $I_B = 0$
$V_{CE} = 6$ V
typ. values
$I_{CEO(L)}$ (mA)
BPX25
$P_{tot\ max}$
BPX29
0
5
10
15
20
0
50
100
150
T_{amb} (°C)


7Z67710
$I_B = 0$
$V_{CE} = 24$ V
$I_{CEO(D)}$ (μA)
typ
10^{-1}
1
10
10^2
0
50
100
150
T_{amb} (°C)


7Z67708
-0°
-15°
15°
-30°
30°
-45°
45°
-60°
60°
-75°
75°
90°
90°
BPX25
BPX29
100
75
50
25
0
25
50
75
100
N (%)

SILICON PLANAR PHOTODIODE

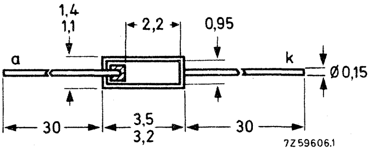
Unencapsulated photodiode for general purpose applications.

QUICK REFERENCE DATA

Reverse voltage	V_R	max.	18	V
Light sensitivity V_R = 15 V; E = 1000 lx	N	typ.	14	nA/lx
Dark reverse current at V_R = 15 V	I_d	<	0,5	µA
Wavelength at peak response	λpk	typ.	800	nm

MECHANICAL DATA

Dimensions in mm



Slice thickness 0,27 mm

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage				
Reverse voltage	V_R	max.	18	V
Currents				
Forward current	I_F	max.	5	mA
Dark reverse current	I_R	max.	2	mA
Temperatures				
Storage temperature	T_{stg}	−65 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

CHARACTERISTICS $T_{amb} = 25\ ^oC$ unless otherwise specified

Dark reverse current				
$V_R = 15$ V	I_d	typ. <	0,01 0,5	μA μA
$V_R = 15$ V; $T_{amb} = 100\ ^oC$	I_d	typ. <	0,6 4,0	μA μA
Photovoltaic mode				
E = 1000 lx; $T_c = 2700$ K (equivalent to 7,7 mW/cm^2)				
Light reverse current; V = 0	I_l	> typ.	10 13	μA μA
Forward voltage; I = 0	V_F	> typ.	330 350	mV mV
Light sensitivity with external voltage [1]				
$V_R = 15$ V; E = 1000 lx; $T_c = 2700$ K (equivalent to 7,7 mW/cm^2)	N	> typ.	10,5 14	nA/lx nA/lx
Wavelength at peak response	λ_{pk}	typ.	800	nm
Diode capacitance; f = 500 kHz				
$V_R = 15$ V	C_d	typ.	90	pF
$V_R = 0$	C_d	typ.	300	pF
→ Cut-off frequency (modulated GaAs source)	f_{co}	typ.	500	kHz

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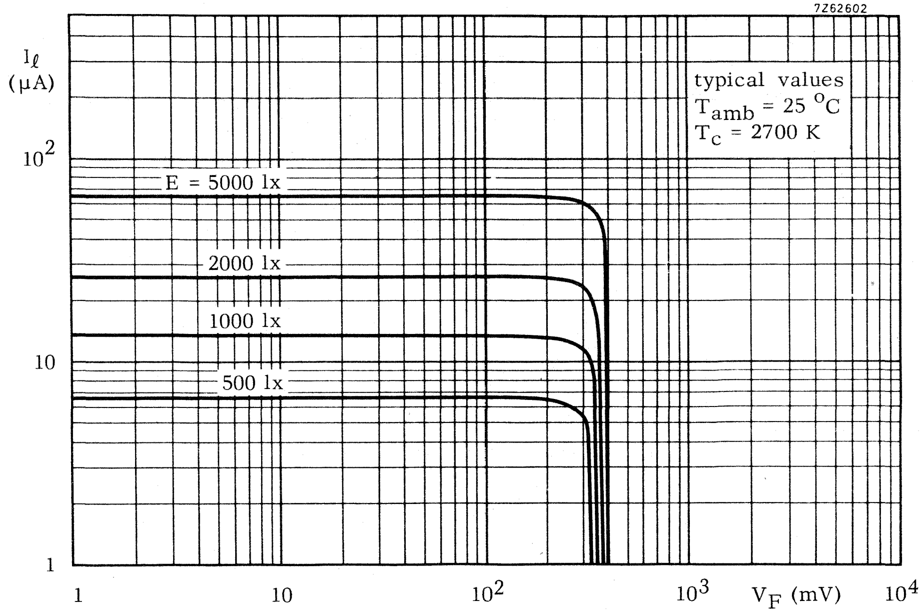
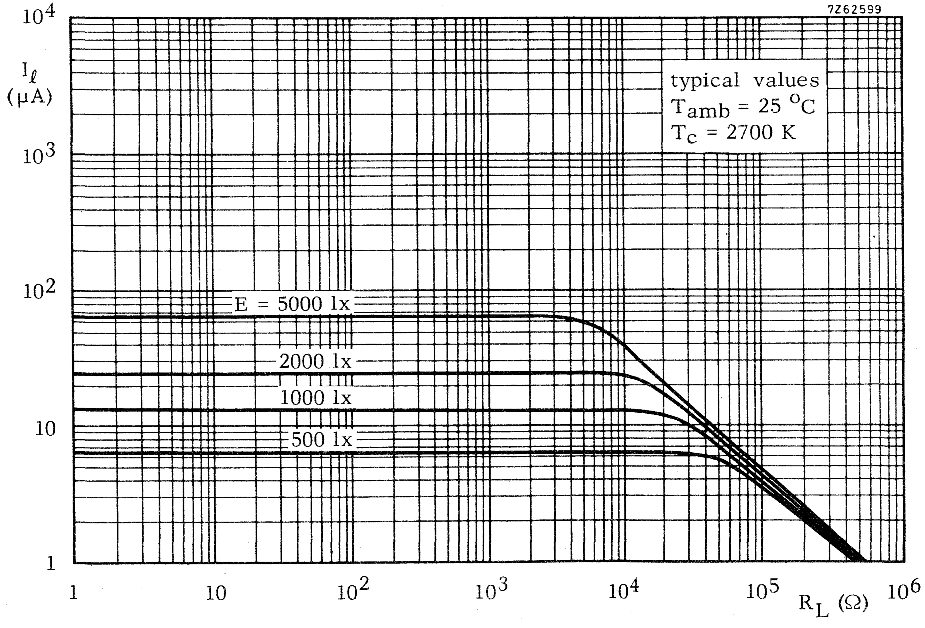
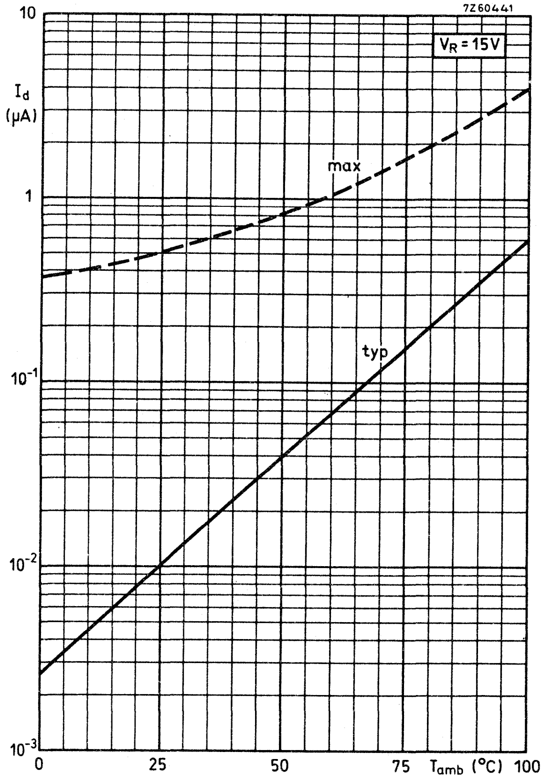
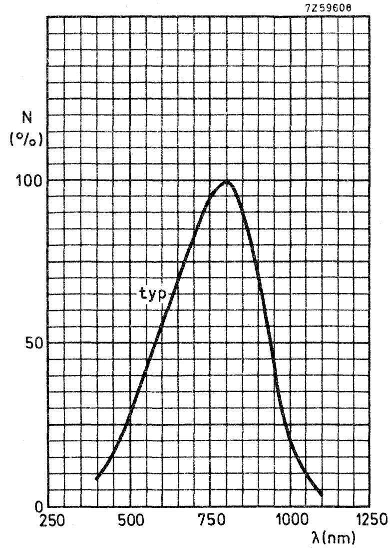
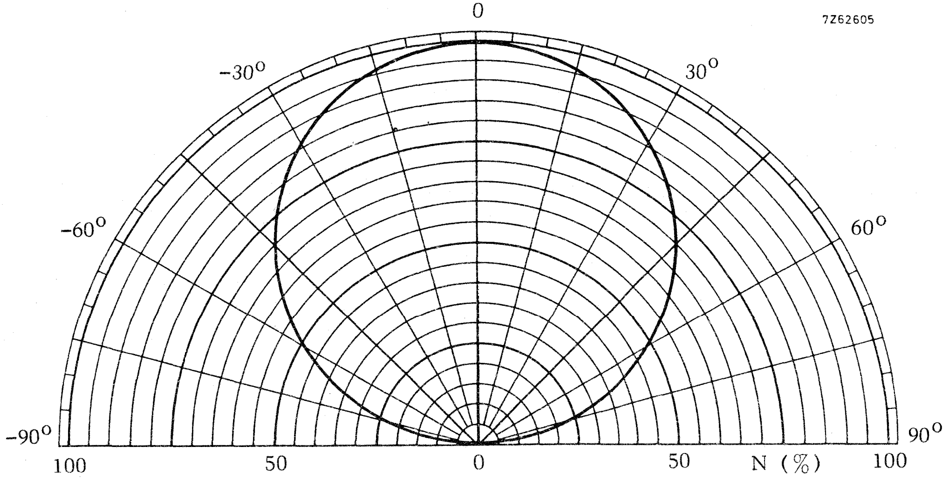
[1] The value of light current increases with temperature by an amount approximately equal to the increase in dark current.


7Z62602
I_ℓ (μA)
10^2
10
1
1
10
10^2
10^3
V_F (mV)
10^4
typical values
T_{amb} = 25 °C
T_c = 2700 K
E = 5000 lx
2000 lx
1000 lx
500 lx


7Z62599
10^4
I_ℓ (μA)
10^3
10^2
10
1
1
10
10^2
10^3
10^4
10^5
R_L (Ω)
10^6
typical values
T_{amb} = 25 °C
T_c = 2700 K
E = 5000 lx
2000 lx
1000 lx
500 lx


7Z60441
$V_R = 15V$
I_d (μA)
10
1
10^{-1}
10^{-2}
10^{-3}
max
typ
0
25
50
75
T_{amb} (°C)
100


7Z59608
N
(%)
100
50
0
typ
250
500
750
1000
1250
λ(nm)


0
7Z62605
−30°
30°
−60°
60°
−90°
90°
100
50
0
50
N (%)
100

SILICON PLANAR PHOTODIODE

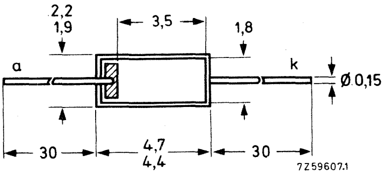
Unencapsulated photodiode for general purpose applications.

QUICK REFERENCE DATA

Reverse voltage	V_R	max.	18	V
Light sensitivity V_R = 15 V; E = 1000 lx	N	typ.	40	nA/lx
Dark reverse current at V_R = 15 V	I_d	<	1	µA
Wavelength at peak response	λ_{pk}	typ.	800	nm

MECHANICAL DATA

Dimensions in mm



Slice thickness 0,27 mm

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage				
Reverse voltage	V_R	max.	18	V
Currents				
Forward current	I_F	max.	10	mA
Dark reverse current	I_R	max.	5	mA
Temperatures				
Storage temperature	T_{stg}	-65 to $+125$		^{o}C
Junction temperature	T_j	max.	125	^{o}C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,5	$^{o}C/mW$

CHARACTERISTICS $T_{amb} = 25\ ^{o}C$ unless otherwise specified

Dark reverse current				
$V_R = 15$ V	I_d	typ. <	0,02 1,0	µA µA
$V_R = 15$ V; $T_{amb} = 100\ ^{o}C$	I_d	typ. <	1,2 8,0	µA µA
Photovoltaic mode				
$E = 1000$ lx; $T_c = 2700$ K (equivalent to 7,7 mW/cm^2)				
Light reverse current; $V = 0$	I_1	> typ.	30 38	µA µA
Forward voltage; $I = 0$	V_F	> typ.	330 350	mV mV
Light sensitivity with external voltage [1]				
$V_R = 15$ V; $E = 1000$ lx; $T_c = 2700$ K (equivalent to 7,7 mW/cm^2)	N	> typ.	31 40	nA/lx nA/lx
Wavelength at peak response	λ_{pk}	typ.	800	nm
Diode capacitance; f = 500 kHz				
$V_R = 15$ V	C_d	typ.	250	pF
$V_R = 0$	C_d	typ.	800	pF
→ Cut-off frequency (modulated GaAs source)	f_{co}	typ.	500	kHz

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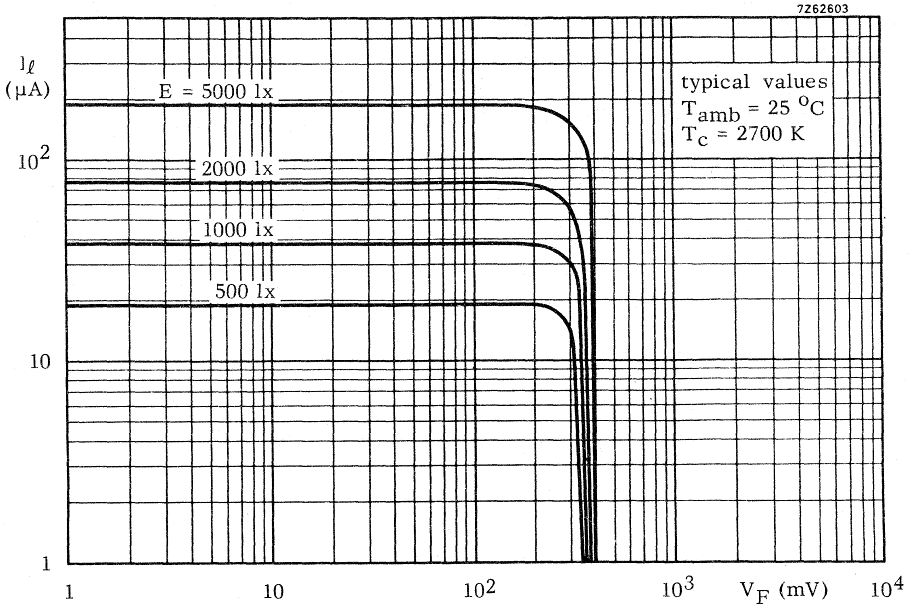
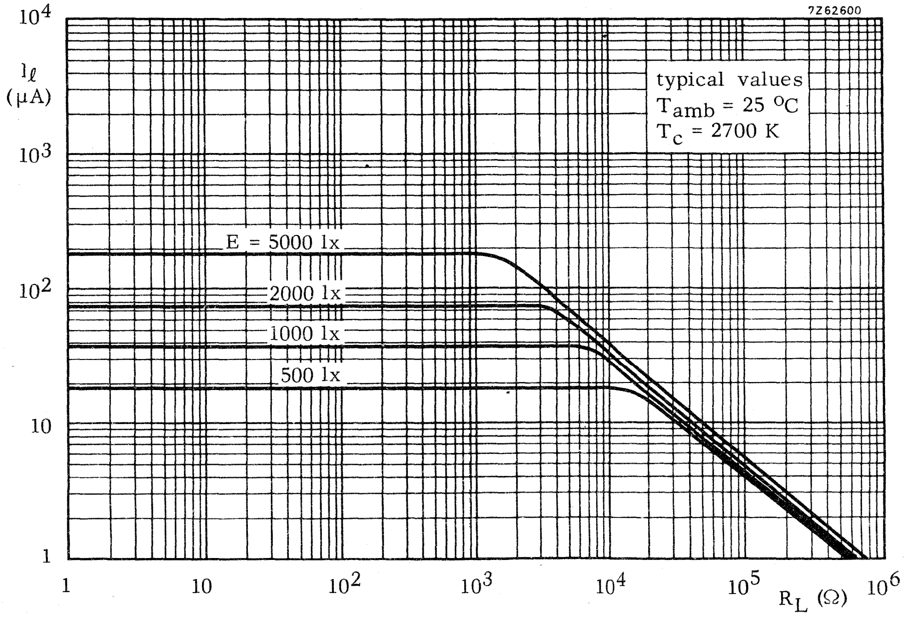
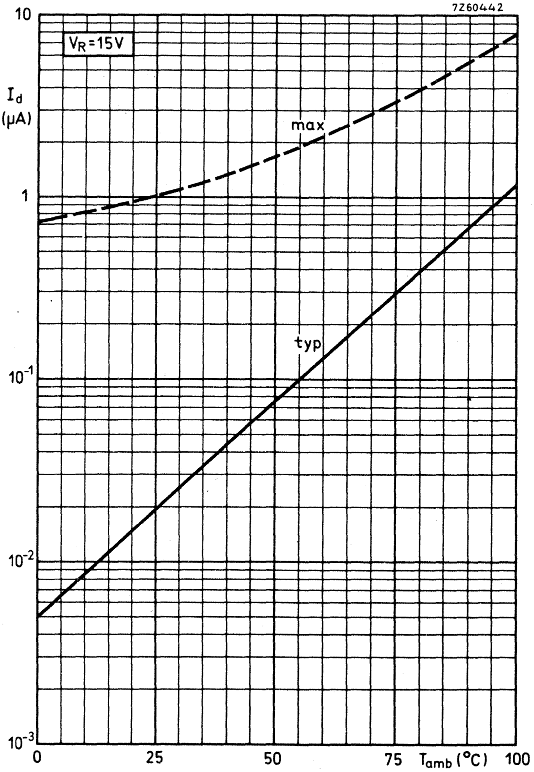
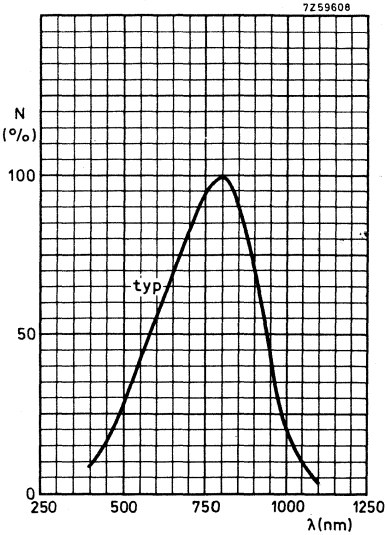
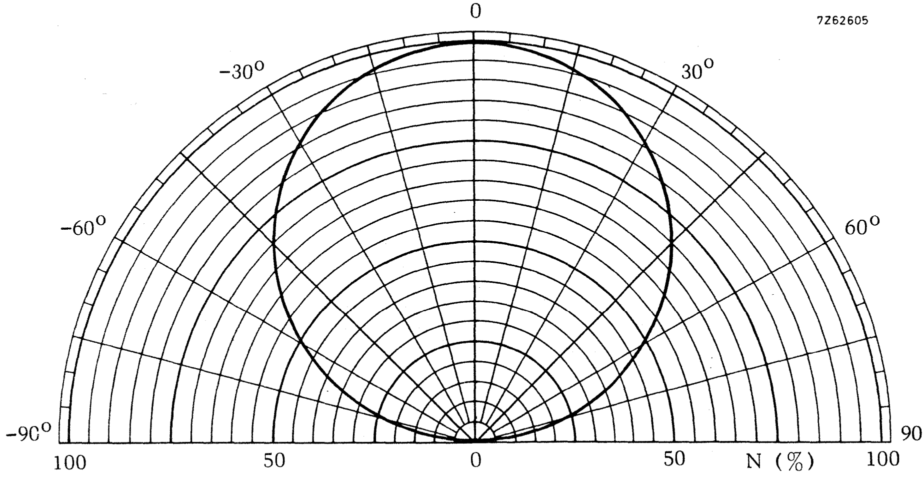
[1] The value of light current increases with temperature by an amount approximately equal to the increase in dark current.


7Z62603
I_ℓ (μA)
10^2
10
1
E = 5000 lx
2000 lx
1000 lx
500 lx
typical values
T_{amb} = 25 °C
T_c = 2700 K
1
10
10^2
10^3
V_F (mV)
10^4


7Z62600
10^4
I_ℓ (μA)
10^3
10^2
10
1
E = 5000 lx
2000 lx
1000 lx
500 lx
typical values
T_{amb} = 25 °C
T_c = 2700 K
1
10
10^2
10^3
10^4
10^5
R_L (Ω)
10^6


7Z60442
$V_R = 15V$
I_d (μA)
10
1
10^{-1}
10^{-2}
10^{-3}
max
typ
0
25
50
75
T_{amb} (°C)
100


7Z59608
N
(%)
100
50
0
typ
250
500
750
1000
1250
λ(nm)


0
7Z62605
-30°
30°
-60°
60°
-90°
90°
100
50
0
50
N (%)
100

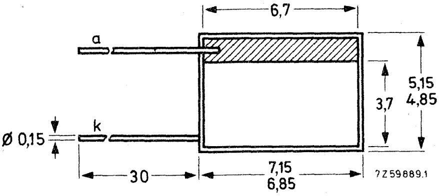
SILICON PLANAR PHOTODIODE

Unencapsulated photodiode for general purpose applications.

QUICK REFERENCE DATA				
Reverse voltage	V_R	max.	12	V
Light sensitivity V_R = 10 V; E = 1000 lx	N	typ.	150	nA/lx
Dark reverse current at V_R = 10 V	I_d	<	5	µA
Wavelength at peak response	λ_{pk}	typ.	800	nm

MECHANICAL DATA

Dimensions in mm



Slice thickness 0,27 mm

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage				
Reverse voltage	V_R	max.	12	V
Currents				
Forward current	I_F	max.	50	mA
Dark reverse current	I_R	max.	20	mA
Temperatures				
Storage temperature	T_{stg}	−65 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0, 3	°C/mW

CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

Dark reverse current				
V_R = 10 V	I_d	typ. <	0, 1 5, 0	µA µA
V_R = 10 V; T_{amb} = 100 °C	I_d	typ. <	6, 0 40	µA µA
Photovoltaic mode				
E = 1000 lx; T_c = 2700 K (equivalent to 7, 7 mW/cm^2)				
Light reverse current; V = 0	I_l	> typ.	110 140	µA µA
Forward voltage; I = 0	V_F	> typ.	330 350	mV mV
Light sensitivity with external voltage [1]				
V_R = 10 V; E = 1000 lx; T_c = 2700 K (equivalent to 7, 7 mW/cm^2)	N	> typ.	120 150	nA/lx nA/lx
Wavelength at peak response	λ_{pk}	typ.	800	nm
Diode capacitance; f = 500 kHz				
V_R = 10 V	C_d	typ.	1000	pF
V_R = 0	C_d	typ.	3000	pF
→ Cut-off frequency (modulated GaAs source)	f_{co}	typ.	500	kHz

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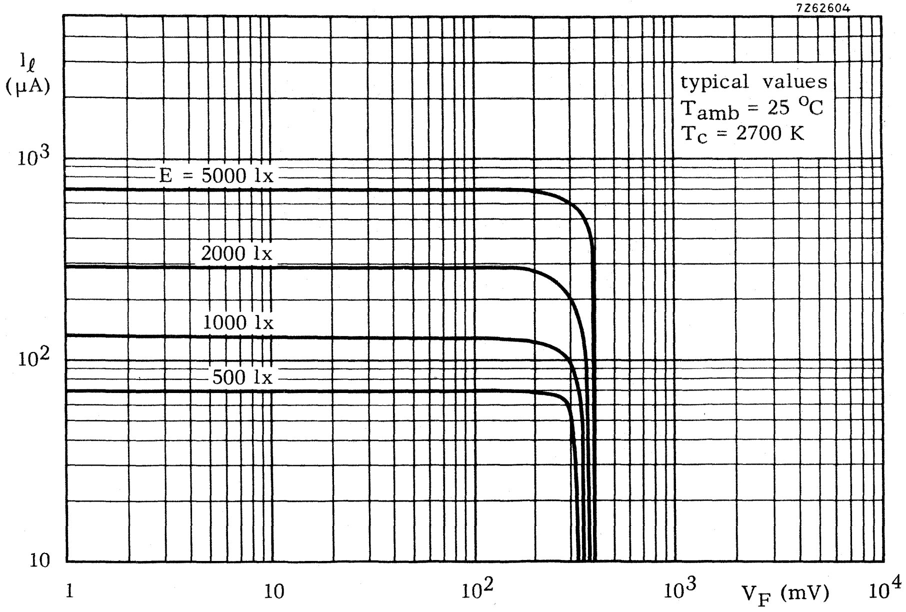
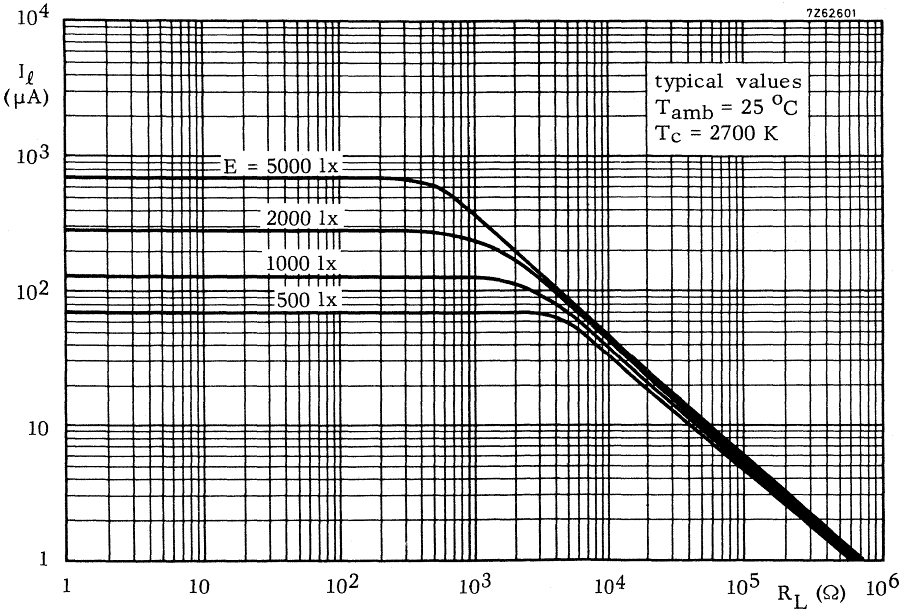
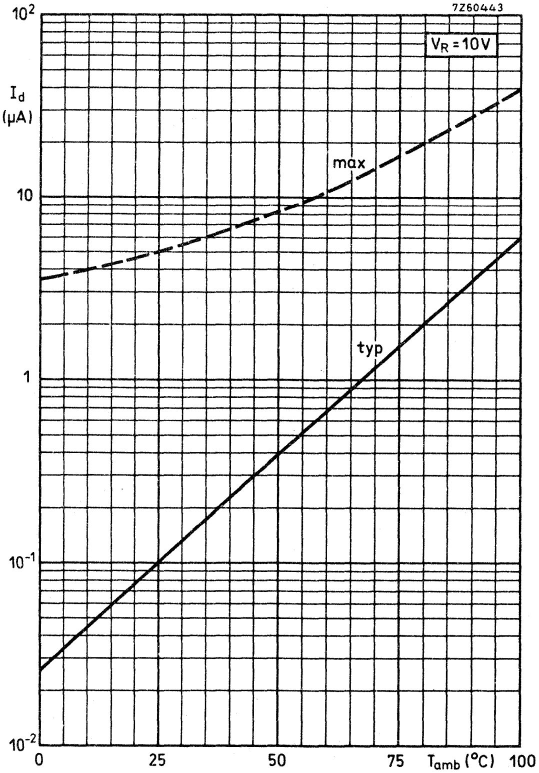
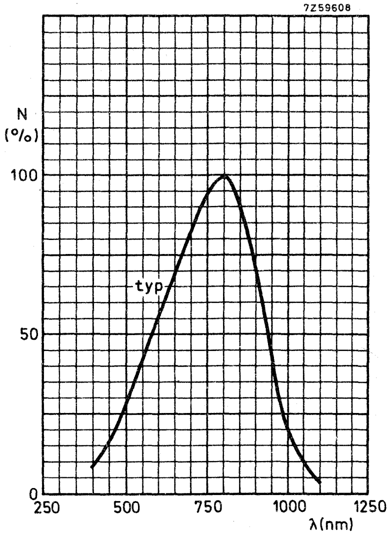
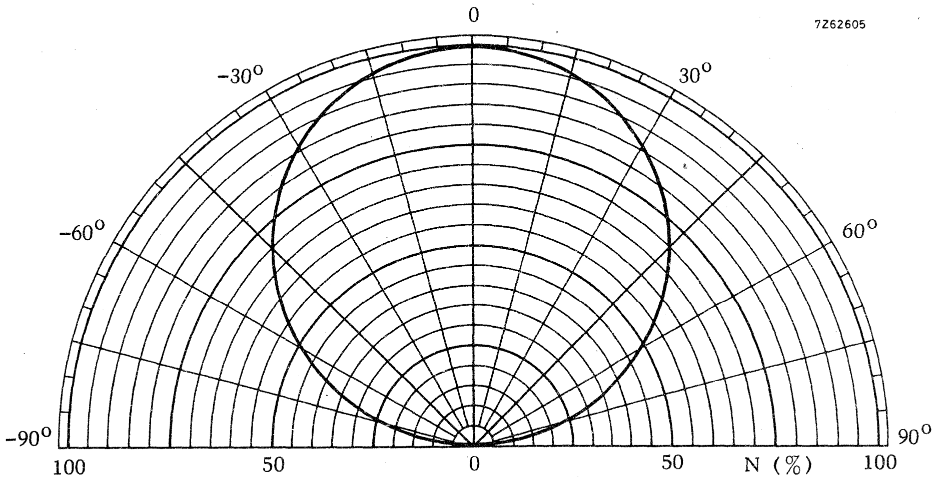
[1] The value of light current increases with temperature by an amount approximately equal to the increase in dark current.


7Z62604
I_ℓ (μA)
10^3
10^2
10
1
10
10^2
10^3
V_F (mV)
10^4
typical values
T_{amb} = 25 °C
T_c = 2700 K
E = 5000 lx
2000 lx
1000 lx
500 lx


7Z62601
I_ℓ (μA)
10^4
10^3
10^2
10
1
1
10
10^2
10^3
10^4
10^5
R_L (Ω)
10^6
typical values
T_{amb} = 25 °C
T_c = 2700 K
E = 5000 lx
2000 lx
1000 lx
500 lx


7Z60443
$V_R = 10V$
I_d (μA)
10^2
10
1
10^{-1}
10^{-2}
max
typ
0
25
50
75
T_{amb} (°C)
100


7Z59608
N
(%)
100
50
0
250
500
750
1000
1250
λ(nm)
typ


0
7Z62605
-30°
30°
-60°
60°
-90°
90°
100
50
0
50
N (%)
100

LIGHT ACTIVATED SCS

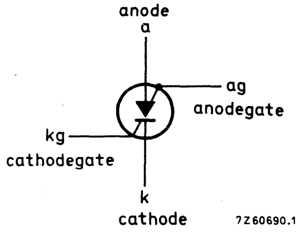
Planar p-n-p-n light activated SCS in a hermetically sealed metal envelope corresponding to TO-72 but with flat glass window. It is capable of switching currents up to 10 A.
With this component it is possible to build relatively simple circuits which will trigger at a light intensity of 100 lux.
The device is an integrated pnp-npn transistor of which all electrodes are accessible.

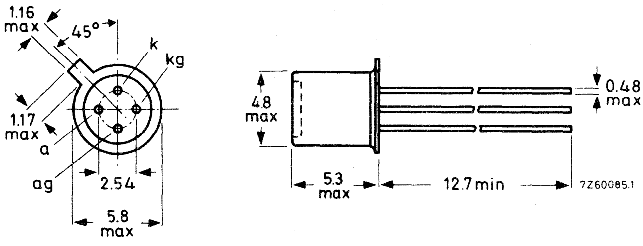
QUICK REFERENCE DATA

Anode-cathode voltage (forward and reverse)	$V_D = V_R$	max.	70	V
D.C. on-state current	I_T	max.	150	mA
Repetitive peak on-state cathode current $t_p = 1\ \mu s$; $\delta = 10^{-6}$	I_{TRM}	max.	10	A
Spread The ratio of minimum light level at which any specimen is ON to maximum light level at which any specimen is OFF			3	
Irradation level to trigger all devices $V_D = 70$ V; $I_{AG} = 0$; $T_j = 25\ ^{\circ}C$ $R_{KG\text{-}K} = 1\ M\Omega$; $\lambda = 800$ nm	E_e	>	1.5	mW/cm^2
Irradiation level not to trigger any device $V_D = 70$ V; $I_{AG} = 0$; $T_j = 25\ ^{\circ}C$ $R_{KG\text{-}K} = 1\ M\Omega$; $\lambda = 800$ nm	E_e	<	0.5	mW/cm^2
Peak spectral response	λ_m	typ.	800	nm

MECHANICAL DATA

Dimensions in mm





The anodegate is connected to the case.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

<u>Voltage</u>				
Anode-cathode voltage (forward and reverse)	$V_D = V_R$	max.	70	V
Reverse cathodegate-cathode voltage (peak value)	V_{RGKM}	max.	5	V
Reverse anode-anodegate voltage (peak value)	V_{RAGM}	max.	70	V
<u>Currents</u>				
D.C. on-state current	I_T	max.	150	mA
Repetitive peak on-state current				
$t \leq 10\ \mu s,\ \delta = 0.01$	I_{TRM}	max.	2.5	A
$t \leq 1\ \mu s,\ \delta = 10^{-6}$	I_{TRM}	max.	10	A [1]
Anodegate current (peak value)	I_{FGAM}	max.	100	mA
<u>Power dissipation</u>				
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	250	mW
<u>Temperatures</u>				
Storage temperature	T_{stg}		−65 to +100	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	0.5	$^oC/mW$

---

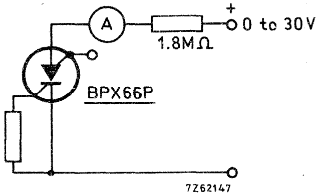
[1] This value holds for the use of the device in circuit 1b on page 9

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Forward on-state voltage				
I_T = 100 mA; R_{KG-K} = 1 MΩ; I_{AG} = 0	V_T	<	1.5	V
Dark current (cathodegate current)				
V_D = 70 V; I_{AG} = 0; $V_{KG-K} \leq$ 25 mV; T_j = 25 °C	$I_{KG(d)}$	<	1	nA
V_D = 15 V; I_{AG} = 0; $V_{KG-K} \leq$ 25 mV; T_j = 25 °C	$I_{KG(d)}$	<	0.3	nA
V_D = 70 V; I_{AG} = 0; $V_{KG-K} \leq$ 25 mV; T_j = 100 °C	$I_{KG(d)}$	<	100	nA
Cathodegate trigger voltage				
V_D = 70 V; I_{AG} = 0; R_{KG-K} = 1 MΩ; T_j = 25 °C	V_{GKT}		200 to 500	mV
Holding current (anode current)				
I_{AG} = 0; R_{KG-K} = 1 MΩ	I_H	<	10	μA

Test circuit:



Light current (cathodegate current)				
V_D = 70 V; I_{AG} = 0; T_j = 25 °C				
E_e = 1.5 mW/cm²; λ = 800 nm	$I_{KG(\ell)}$		400 to 1200	nA
Irradiation level to trigger all devices				
V_D = 70 V; I_{AG} = 0; T_j = 25 °C				
R_{KG-K} = 1 MΩ; λ = 800 nm	E_e	>	1.5	mW/cm²
Irradation level not to trigger any device				
V_D = 70 V; I_{AG} = 0; T_j = 25 °C				
R_{KG-K} = 1 MΩ; λ = 800 nm	E_e	<	0.5	mW/cm²

CHARACTERISTICS (continued)

Turn-on time

$V_D = 70$ V, $I_{AG} = 0$; $R_{KG-K} = 1$ MΩ

The irradiance is switched from

$E_e = 0$ to $E_e = 1,5$ mW/cm^2; $\lambda = 800$ nm — t_{on} typ. 30 µs

$E_e = 0$ to $E_e = 2,5$ mW/cm^2; $\lambda = 800$ nm — t_{on} typ. 20 µs, $<$ 50 µs

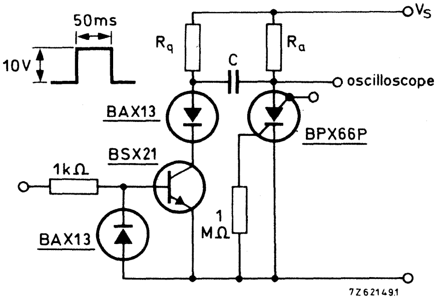
Turn-off time

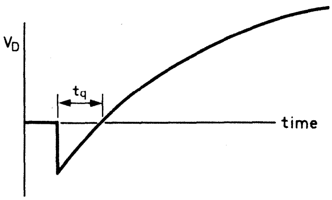
$I_{AG} = 0$; $R_{KG-K} = 1$ MΩ; $E_e = 0$

$V_S = 70$ V; $R_a = 50$ kΩ; $R_q = 3,9$ kΩ — t_q typ. 450 µs

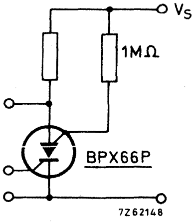
$V_S = 12$ V; $R_a = 10$ kΩ; $R_q = 2,7$ kΩ — t_q typ. 100 µs

Test circuit:





The turn-off time decreases a factor 10 by connecting to anodegate to the supply voltage via 1 MΩ. See adjacent figure.



Wavelength at peak response — λ_{pk} typ. 800 nm

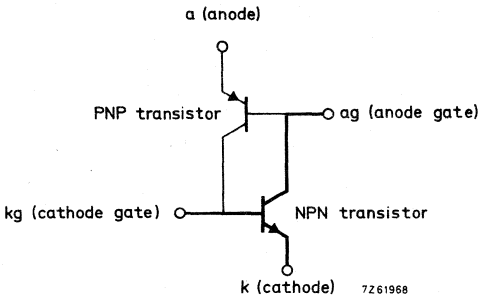
Conversion of lux into mW/cm^2

Each 1000 lux of 2856 K may be substituted by an irradiance of 1,2 mW/cm^2 for monochromatic light with a wavelength of 800 nm (only valid for this device).

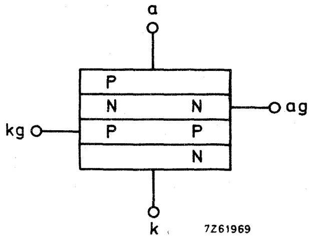
OPERATING PRINCIPLE

The BPX66P can be thought of as two transistors connected as shown below. It will trigger when the forward cathodegate-cathode voltage has a sufficient high value (approx. 0.3 V)

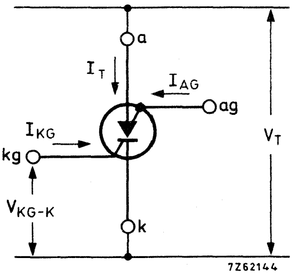
2 transistors equivalent circuit



p-n-p-n SCS equivalent circuit



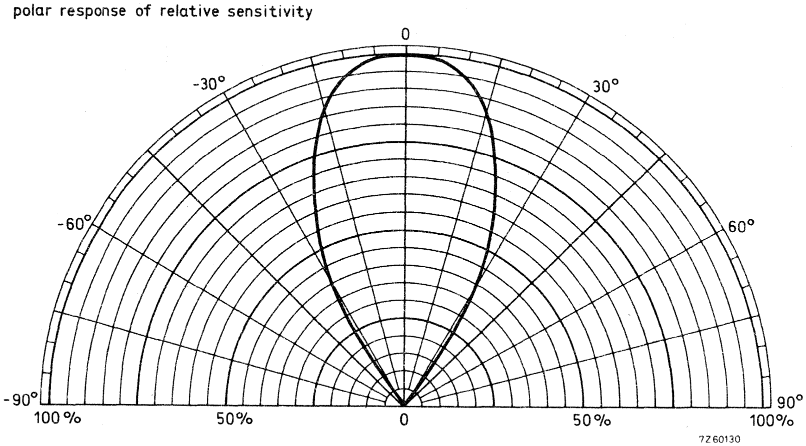
Symbol

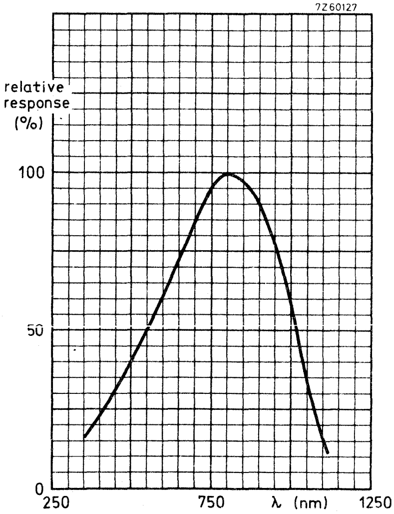


Consider the situation in which the anodegate is left floating. Illumination gives rise to a photocurrent in the p-n-p transistor which will trigger the device into conduction unless there is a bypass (e.g. a resistor) between cathodegate and cathode. If there is such a bypass, triggering will occur when the photocurrent is sufficient to cause a voltage drop across it corresponding to the triggering voltage of 0.3 to 0.4 V. The irradiation value at which the device will trigger varies inversely as the impedance of the bypass.

Two factors set a practical limit to the minimum triggering irradiation threshold:
- the leakage current across the base-collector junction of the p-n-p transistor;
- the maximum practical bypass impedance (the higher the impedance, the more vulnerable it is to moisture contamination, and the more sensitive the circuit is to switching transients).

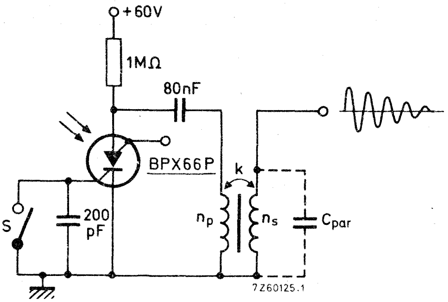
Once triggered into conduction, the device can be returned to the non-conducting state by switching-off the supply voltage, an a.c. voltage reversal, or a negative voltage pulse on the anode.


polar response of relative sensitivity
0
-30°
30°
-60°
60°
-90°
90°
100 %
50%
0
50 %
100%
7Z60130


7Z60127
relative response (%)
100
50
0
250
750
λ (nm)
1250

APPLICATION INFORMATION

1. D.C. supply-Circuit for igniting a quench tube in photoflash equipment



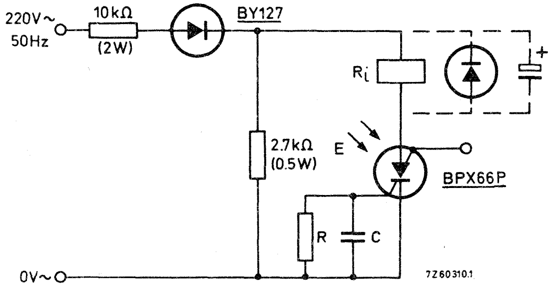
Transformer data:
n_p = 15 turns (2 μH)
n_s = 1215 turns (13, 1 mH)
k = 0,68
C_{par} = 10,6 pF

Performance:
repetition frequency 1 Hz
number of discharge > 10^4

Firing the photoflash opens switch S; the BPX66P and the capacitor of 200 pF then start to register the incident illumination E. When $\int E\,dt$ reaches a predetermined value, the BPX66P is triggered and feeds a 1 μs pulse of 10 A through the primary of the transformer; the resulting high voltage across the secondary triggers the quench tube, extinguishing the photoflash tube.

2. A.C. supply - light activated relay circuits

a. 220 V



R_ℓ = d.c. relay

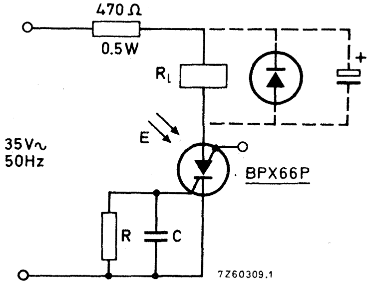
Coil resistance		12 kΩ
I_{on}	<	3 mA
I_{off}		1 mA

R and C must be chosen to meet requirements as to illumination levels E_{in} and E_{out}. The values are practically the same as in the table below.

For gradually changing light levels the relay should be shunted by a capacitor (e.g. 10 μF, 64 V) to prevent chatter; for suddenly changing light levels (on-off) it may be shunted by a diode.

APPLICATION INFORMATION (continued)

b. 35 V



R_ℓ = d.c. relay

Coil resistance	2 kΩ
I_{on}	8,5 mA
I_{off}	2,2 mA

R and C must be chosen to meet requirements as to illumination levels E_{in} and E_{out}; see table below.
For gradually changing light levels the relay should be shunted by a capacitor (e.g. 100 μF, 40 V); for suddenly changing light levels (on-off) it may be shunted by a diode.

R(MΩ)	C(nF)	E_{in}(lx)	E_{out}(lx)
3,3	10	1150	750
3,3	1	450	400
1	0,5	820	800

The values are average values that can be expected at a colour temperature of 2856 K; at other colour temperatures large deviations from these values may be observed.

Caution:

To avoid difficulties with temperature dependence it is generally advantageous to design a circuit for higher values of E_{in} and E_{out}, for then R can be given a lower value.

PHOTOTRANSISTOR

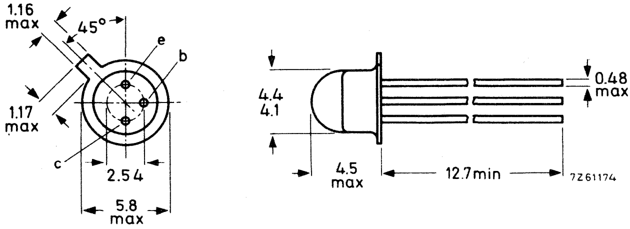
General purpose n-p-n silicon phototransistor with a plastic lens.

QUICK REFERENCE DATA

Collector-emitter voltage (open base)		V_{CEO}	max.	30	V
Collector current (d.c.)		I_C	max.	25	mA
Junction temperature		T_j	max.	125	^oC
Collector dark current (open base) V_{CE} = 20 V		I_d	<	100	nA
Collector light current (open base) V_{CE} = 5 V; E = 1000 lx (4,75 mW/cm^2)	BPX70	I_1		100 to 700	µA
	BPX70C	I_1		100 to 300	µA
	BPX70D	I_1		200 to 400	µA
	BPX70E	I_1		300 to 700	µA
Wavelength at peak response		λ_{pk}	typ.	800	nm
Angle between half-sensitivity directions		$\alpha_{50\%}$	typ.	120°	

MECHANICAL DATA Dimensions in mm

SOT-70



Max. lead diameter is guaranteed only for 12,7 mm

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Emitter-collector voltage (open base)	V_{ECO}	max.	6	V

Currents

Collector current (d.c.)	I_C	max.	25	mA
Collector current (peak value) $t_p < 50\ \mu s$; $\delta < 0,1$	I_{CM}	max.	50	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	180	mW

Temperatures

Storage temperature	T_{stg}		−40 to + 125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0,55	°C/mW

CHARACTERISTICS $I_B = 0$; $T_{amb} = 25\ ^oC$ unless otherwise specified

Collector dark current

$V_{CE} = 20$ V	I_d	typ.	10	nA
		<	100	nA
$V_{CE} = 20$ V; $T_j = 100\ ^oC$	I_d	typ.	10	µA
		<	100	µA

Collector light current

$V_{CE} = 5$ V; tungsten filament lamp source with colour temperature 2856 K;

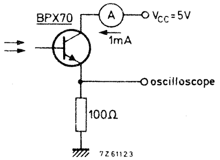
$E_v = 1000$ lx ($E_e = 4,75$ mW/cm^2)	I_l		100 to 700	µA [1]
$E_v = 2500$ lx ($E_e = 12$ mW/cm^2)	I_l	>	300	µA

---

[1] Available selections: BPX70C: 100 to 300 µA
BPX70D: 200 to 400 µA
BPX70E: 300 to 700 µA

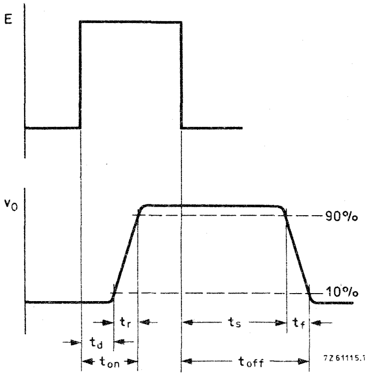
CHARACTERISTICS (continued)

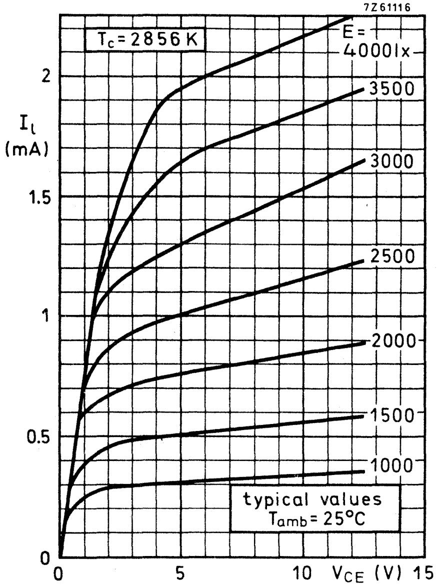
Breakdown voltages				
Collector-base voltage $E = 0$; $I_C = 0,1$ mA	$V_{(BR)CBO}$	>	40	V
Collector-emitter voltage $E = 0$; $I_C = 1$ mA	$V_{(BR)CEO}$	>	30	V
Emitter-collector voltage $E = 0$; $I_C = 0,1$ mA	$V_{(BR)ECO}$	>	6	V
Collector capacitance				
$I_E = I_e = 0$; $V_{CB} = 20$ V	C_c	typ.	3,5	pF
Wavelength at peak response	λ_{pk}	typ.	800	nm
Bandwidth at half height	$B_{50\%}$	typ.	300	nm
Switching times				
$I_{Con} = 1$ mA; $V_{CC} = 5$ V; $R_L = 100\ \Omega$				
Delay time	t_d	typ. <	1,5 3,0	µs µs
Rise time	t_r	typ. <	3,0 10	µs µs
Storage time	t_s	typ. <	1,5 3,0	µs µs
Fall time	t_f	typ. <	2,0 10	µs µs

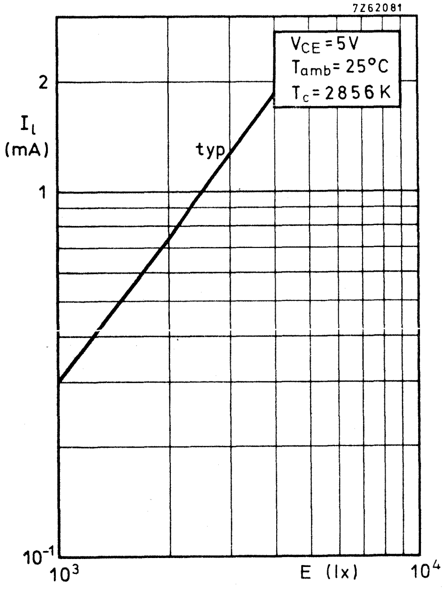


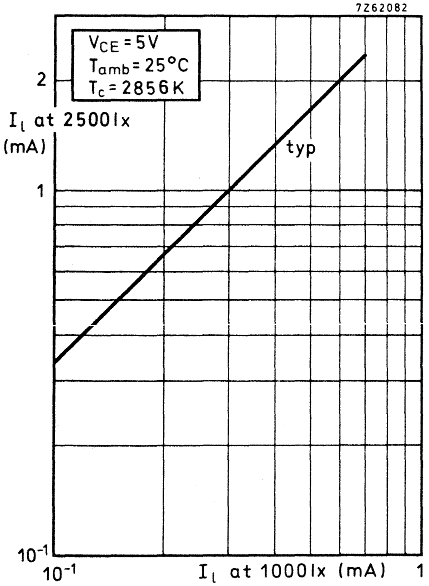
Light input pulse:

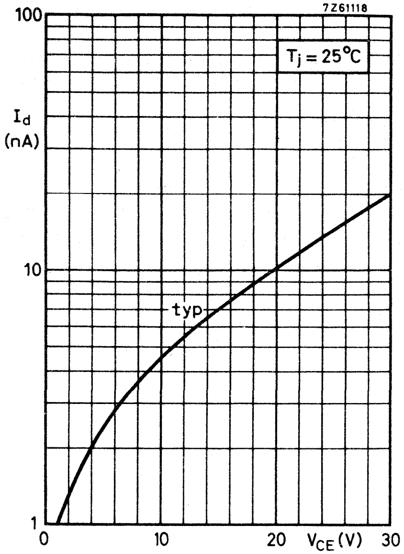
$t_r = t_f = 20$ ns
$t_p = 20$ µs
$f = 500$ Hz
$\lambda = 800$ nm

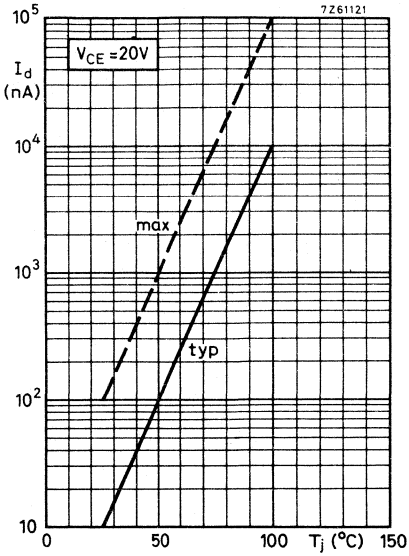


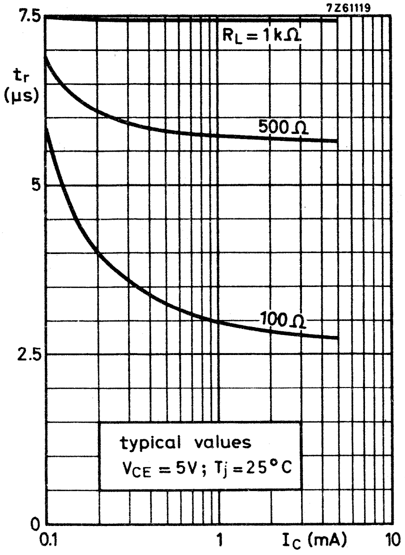

7Z61116
T_c = 2856 K
E = 4000 lx
3500
3000
2500
2000
1500
1000
typical values
T_amb = 25°C
I_l (mA)
0
0.5
1
1.5
2
0
5
10
V_CE (V)
15

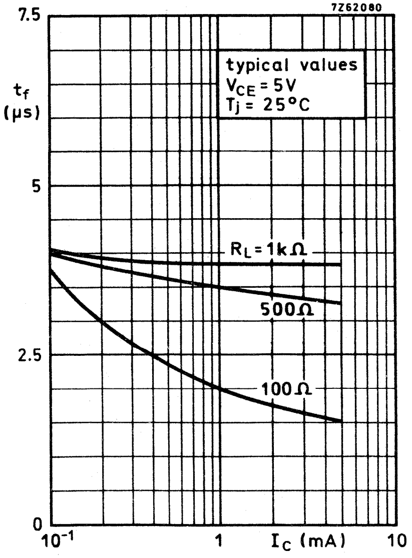

7Z62081
V_CE = 5V
T_amb = 25°C
T_c = 2856 K
typ
I_l (mA)
2
1
10^-1
10^3
E (lx)
10^4

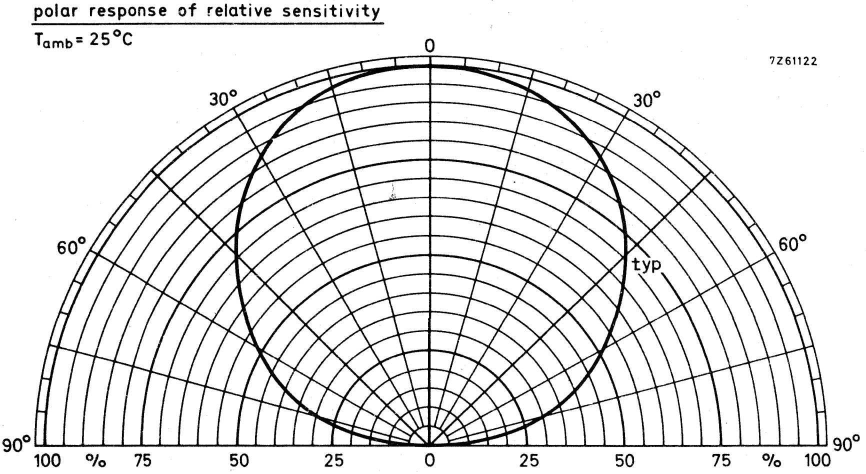

7Z62082
V_CE = 5V
T_amb = 25°C
T_c = 2856 K
typ
I_l at 2500 lx (mA)
2
1
10^-1
10^-1
I_l at 1000 lx (mA)
1

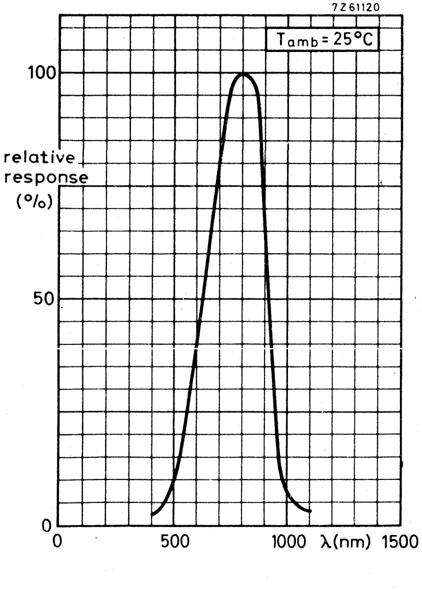

7Z61118
$T_j = 25°C$
I_d (nA)
100
10
1
typ
0
10
20
V_{CE} (V)
30

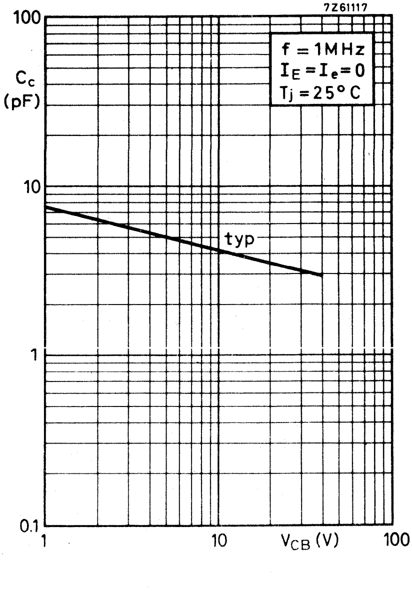

7Z61121
$V_{CE} = 20V$
I_d (nA)
10^5
10^4
10^3
10^2
10
max
typ
0
50
100
T_j (°C)
150


7Z61119
$R_L = 1 k\Omega$
$500\,\Omega$
$100\,\Omega$
t_r (μs)
7.5
5
2.5
0
typical values
$V_{CE} = 5V$; $T_j = 25°C$
0.1
1
I_C (mA)
10


7Z62080
typical values
$V_{CE} = 5V$
$T_j = 25°C$
t_f (μs)
7.5
5
2.5
0
$R_L = 1 k\Omega$
$500\,\Omega$
$100\,\Omega$
10^{-1}
1
I_C (mA)
10


polar response of relative sensitivity
T_{amb} = 25 °C
7Z61122
0
30°
30°
60°
60°
90°
90°
typ
100
%
75
50
25
0
25
50
75
%
100


7Z61120
T_{amb} = 25 °C
100
relative response (%)
50
0
0
500
1000
λ(nm)
1500


7Z61117
100
C_c (pF)
10
1
0.1
f = 1 MHz
$I_E = I_e = 0$
T_j = 25 °C
typ
1
10
V_{CB} (V)
100

PHOTOTRANSISTOR

General purpose n-p-n silicon phototransistor with a glass lens. Inaccessable base.

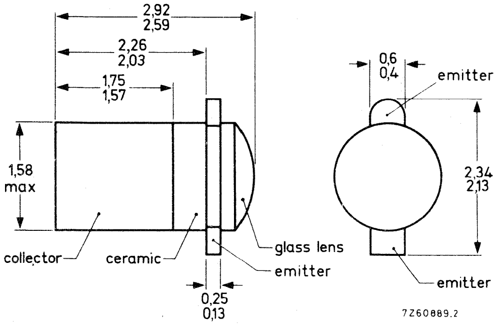
QUICK REFERENCE DATA

Collector-emitter voltage		V_{CEO}	max.	50	V
Collector current (d.c.)		I_C	max.	20	mA
Junction temperature		T_j	max.	150	^oC
Collector dark current $V_{CE} = 30$ V		I_d	<	25	nA
Collector light current $V_{CE} = 5$ V; $E_e = 20$ mW/cm^2	BPX71	I_l		0,5 to 15	mA
	BPX71-201	I_l		0,5 to 3	mA
	BPX71-202	I_l		2 to 5	mA
	BPX71-203	I_l		4 to 8	mA
	BPX71-204	I_l		7 to 15	mA
Wavelength at peak response		λ_{pk}	typ.	800	nm
Angle between half-sensitivity directions		$\alpha_{50\%}$	typ.	40°	

MECHANICAL DATA

Dimensions in mm

DO-31



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-emitter voltage	V_{CEO}	max.	50	V
Emitter-collector voltage	V_{ECO}	max.	7	V

Currents

Collector current (d.c.)	I_C	max.	20	mA
Collector current (peak value) $t_p < 50$ μs; $\delta < 0,1$	I_{CM}	max.	50	mA

Power dissipation

Total power dissipation up to $T_{amb} = 50$ °C	P_{tot}	max.	50	mW
up to $T_{mb} = 55$ °C	P_{tot}	max.	100	mW

Temperatures

Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	2	°C/mW
From junction to mounting base	$R_{th\ j-mb}$	=	0,95	°C/mW

CHARACTERISTICS $T_{amb} = 25$ °C unless otherwise specified

Collector dark current

$V_{CE} = 30$ V	I_d	<	25	nA
$V_{CE} = 30$ V; $T_{amb} = 100$ °C	I_d	<	100	μA

Collector light current

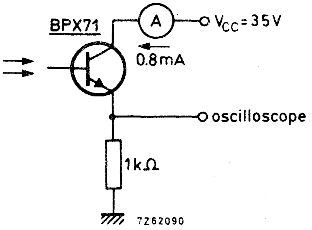
$V_{CE} = 5$ V; tungsten filament lamp source with colour temperature 2856 K; $E_e = 4,75$ mW/cm^2	I_ℓ	typ.	1	mA
$E_e = 20$ mW/cm^2	I_ℓ		0,5 to 15	mA (1)

---

(1) Available selections:
BPX71-201: 0,5 to 3 mA
BPX71-202: 2 to 5 mA
BPX71-203: 4 to 8 mA
BPX71-204: 7 to 15 mA

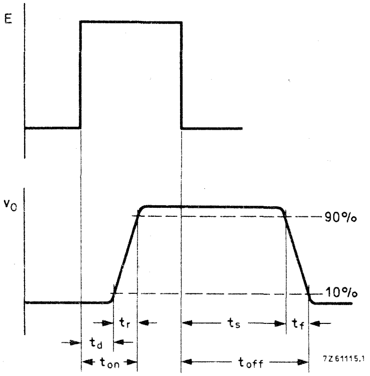
CHARACTERISTICS (continued)

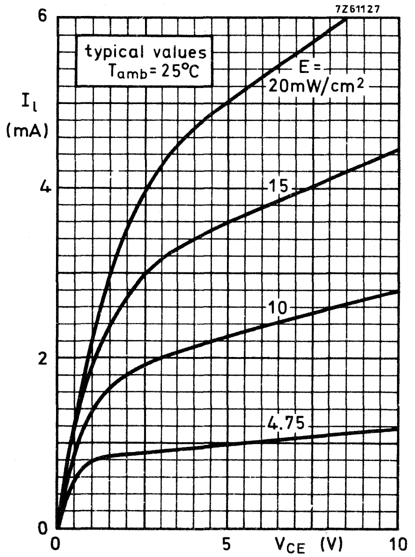
Breakdown voltages				
Collector-emitter voltage E = 0; I_C = 0,5 mA	$V_{(BR)CEO}$	>	50	V
Emitter-collector voltage E = 0; I_C = 0,1 mA	$V_{(BR)ECO}$	>	7	V
Collector-emitter light saturation voltage				
I_C = 0,4 mA; E_e = 20 mW/cm^2; T_c = 2856 K	$V_{CEsat(\ell)}$	typ. <	150 400	mV mV
Wavelength at peak response	λ_{pk}	typ.	800	nm
Bandwidth at half height	$B_{50\%}$	typ.	400	nm
Switching times				
I_{Con} = 0,8 mA; V_{CC} = 35 V; R_L = 1 kΩ				
Delay time	t_d	typ. <	2,0 20	µs µs
Rise time	t_r	typ. <	3,0 30	µs µs
Storage time	t_s	typ. <	0,1 2,0	µs µs
Fall time	t_f	typ. <	2,5 20	µs µs

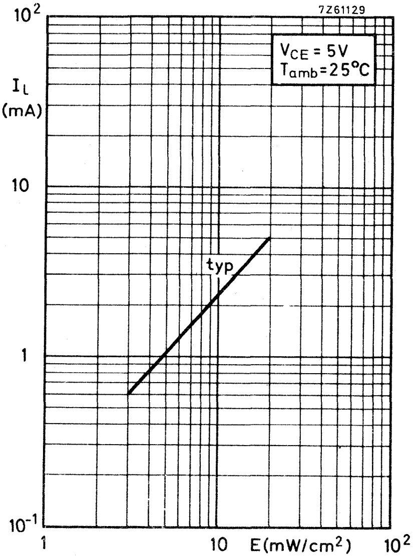


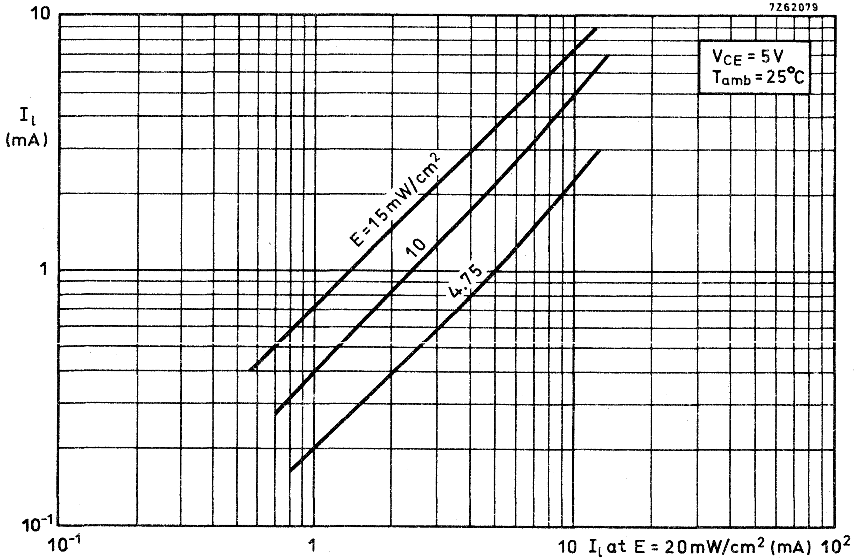
Light input pulse:

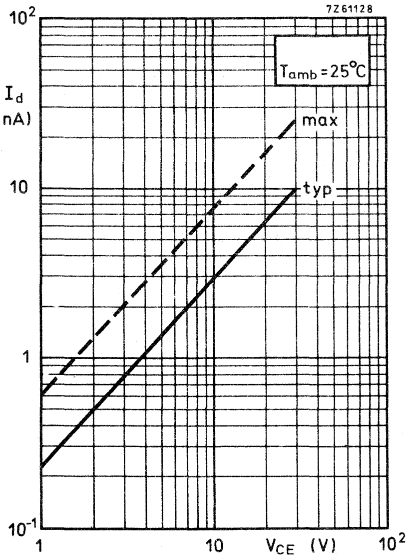
$t_r = t_f$ = 20 ns
t_p = 20 µs
f = 500 Hz
λ = 800 nm

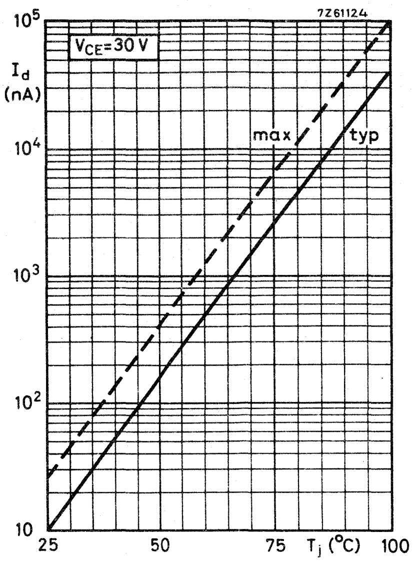


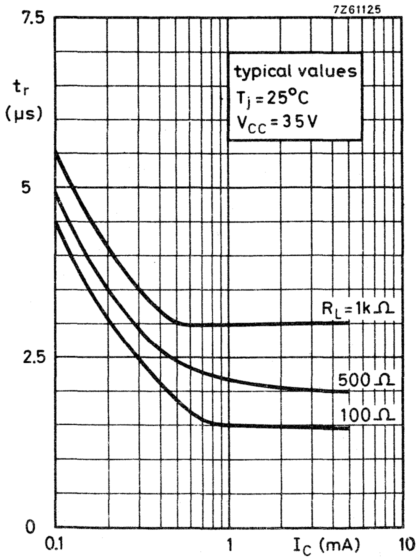

7Z61127
typical values
T_{amb} = 25°C
I_l (mA)
E = 20mW/cm²
15
10
4.75
0
2
4
6
0
5
10
V_{CE} (V)

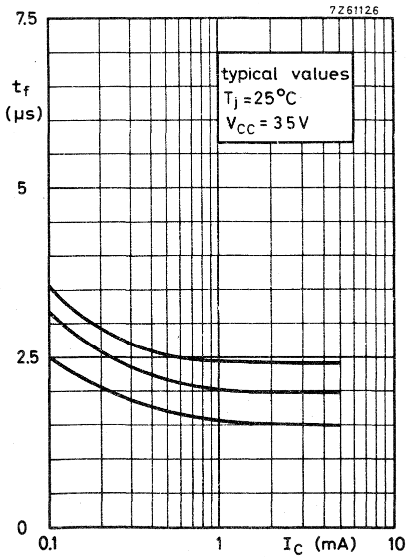

7Z61129
V_{CE} = 5V
T_{amb} = 25°C
I_l (mA)
typ
10^{-1}
1
10
10^2
1
10
E(mW/cm²)
10^2


7Z62079
V_{CE} = 5V
T_{amb} = 25°C
I_l (mA)
E = 15mW/cm²
10
4.75
10^{-1}
1
10
10^{-1}
1
10
I_l at E = 20mW/cm² (mA)
10^2


7Z61128
I_d (nA)
10^2
10
1
10^{-1}
1
10
V_{CE} (V)
10^2
$T_{amb} = 25°C$
max
typ

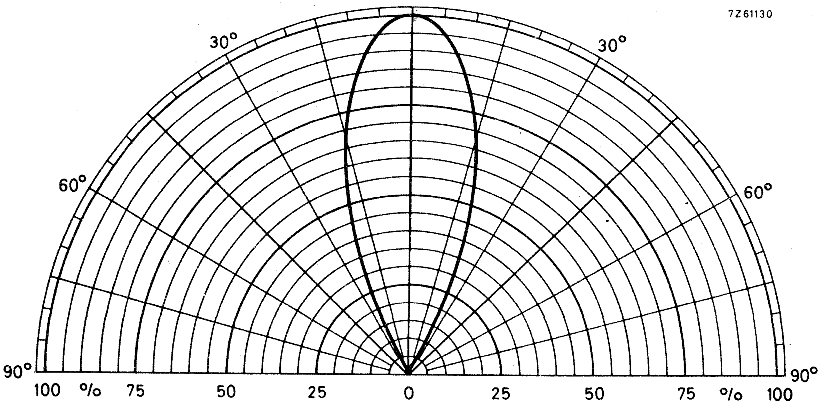

7Z61124
I_d (nA)
10^5
10^4
10^3
10^2
10
25
50
75
T_j (°C)
100
$V_{CE} = 30$ V
max
typ

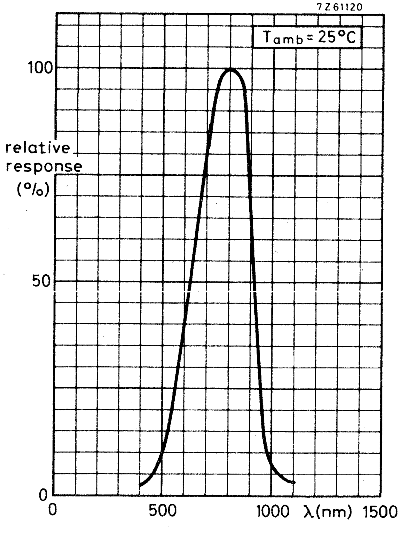

7Z61125
t_r (µs)
7.5
5
2.5
0
0.1
1
I_C (mA)
10
typical values
$T_j = 25°C$
$V_{CC} = 35$ V
$R_L = 1$ kΩ
500 Ω
100 Ω


7Z61126
t_f (µs)
7.5
5
2.5
0
0.1
1
I_C (mA)
10
typical values
$T_j = 25°C$
$V_{CC} = 35$ V

polar response of relative sensitivity

$T_{amb} = 25\,^{\circ}C$





PHOTOTRANSISTOR

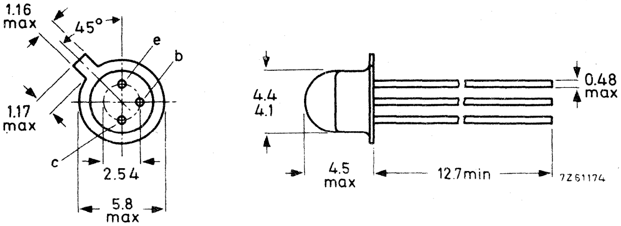
General purpose n-p-n silicon phototransistor with a plastic lens.

QUICK REFERENCE DATA					
Collector-emitter voltage (open base)		V_{CEO}	max.	30	V
Collector current (d.c.)		I_C	max.	25	mA
Junction temperature		T_j	max.	125	^oC
Collector dark current (open base) V_{CE} = 20 V		I_d	<	100	nA
Collector light current (open base) V_{CE} = 5 V; E = 1000 lx (4,75 mW/cm^2)	BPX72	I_l		500 to 3000	µA
	BPX72C	I_l		500 to 1200	µA
	BPX72D	I_l		850 to 2000	µA
	BPX72E	I_l		1400 to 3000	µA
Wavelength at peak response		λ_{pk}	typ.	800	nm
Angle between half-sensitivity directions		$\alpha_{50\%}$	typ.	120^o	

MECHANICAL DATA

Dimensions in mm

SOT-70



Max. lead diameter is guaranteed only for 12,7 mm

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Emitter-collector voltage (open base)	V_{ECO}	max.	6	V

Currents

Collector current (d.c.)	I_C	max.	25	mA
Collector current (peak value) $t_p \leq 50$ μs; $\delta \leq 0,1$	I_{CM}	max.	50	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	180	mW

Temperatures

Storage temperature	T_{stg}	−40 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,55	°C/mW

CHARACTERISTICS

$I_B = 0$; $T_{amb} = 25$ °C unless otherwise specified

Collector dark current

$V_{CE} = 20$ V	I_d	typ. <	10 100	nA nA
$V_{CE} = 20$ V; $T_j = 100$ °C	I_d	typ. <	10 100	μA μA

Collector light current

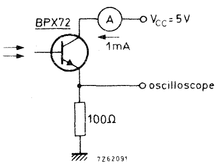
$V_{CE} = 5$ V; tungsten filament lamp source with colour temperature 2856 K;

$E_v = 1000$ lx ($E_e = 4,75$ mW/cm^2)	I_l	500 to 3000		μA [1]
$E_v = 2500$ lx ($E_e = 12$ mW/cm^2)	I_l	typ.	3000	μA

→ [1] Available selections: BPX72C: 500 to 1200 μA
BPX72D: 850 to 2000 μA
BPX72E: 1400 to 3000 μA

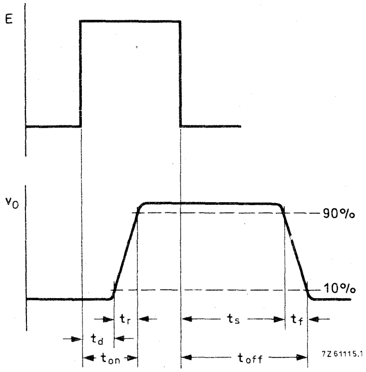
CHARACTERISTICS (continued)

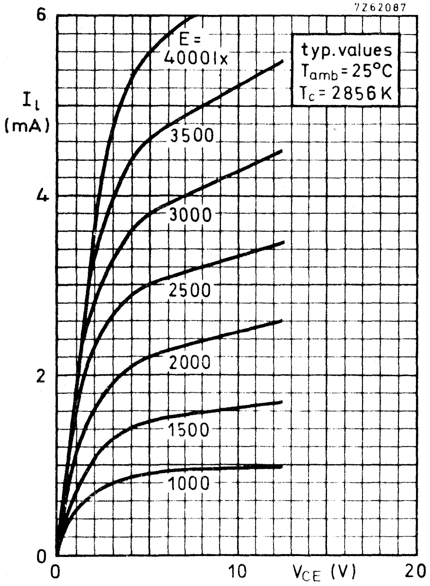
Breakdown voltages				
Collector-base voltage $E = 0$; $I_C = 0,1$ mA	$V_{(BR)CBO}$	>	40	V
Collector-emitter voltage $E = 0$; $I_C = 1$ mA	$V_{(BR)CEO}$	>	30	V
Emitter-collector voltage $E = 0$; $I_C = 0,1$ mA	$V_{(BR)ECO}$	>	6	V
Collector capacitance $I_E = I_e = 0$; $V_{CB} = 20$ V	C_c	typ.	3,5	pF
Wavelength at peak response	λ_{pk}	typ.	800	nm
Bandwidth at half height	$B_{50\%}$	typ.	300	nm
Switching times $I_{Con} = 1$ mA; $V_{CC} = 5$ V; $R_L = 100\ \Omega$				
Delay time	t_d	typ. <	3,0 6,0	µs µs
Rise time	t_r	typ. <	6,0 20	µs µs
Storage time	t_s	typ. <	1,5 3,0	µs µs
Fall time	t_f	typ. <	4,0 20	µs µs

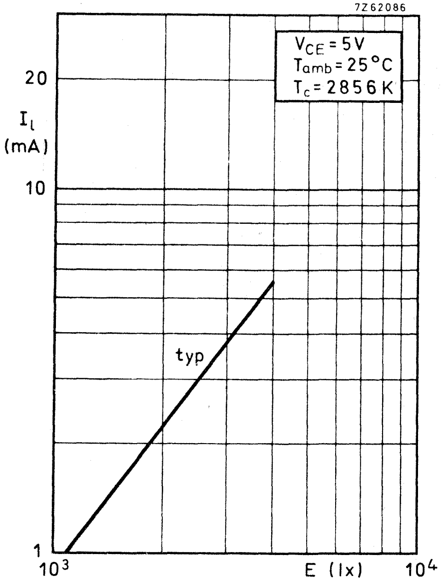


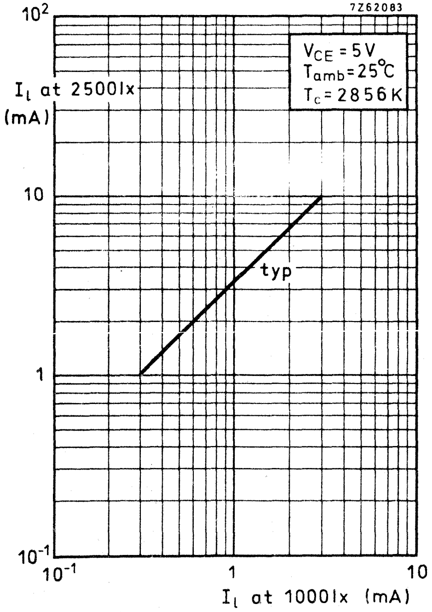
Light input pulse:

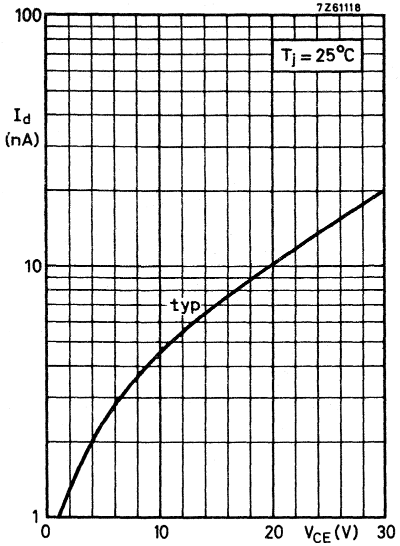
$t_r = t_f =$ 20 ns
$t_p =$ 20 µs
$f =$ 500 Hz
$\lambda =$ 800 nm

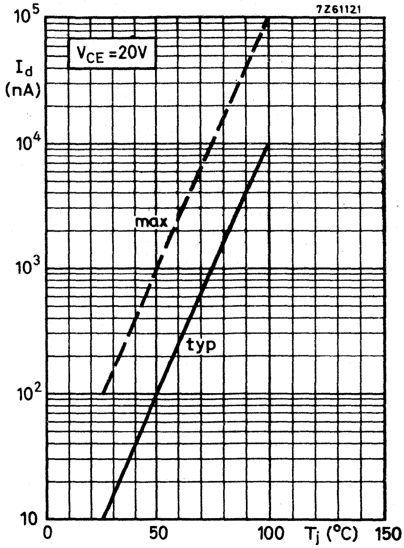


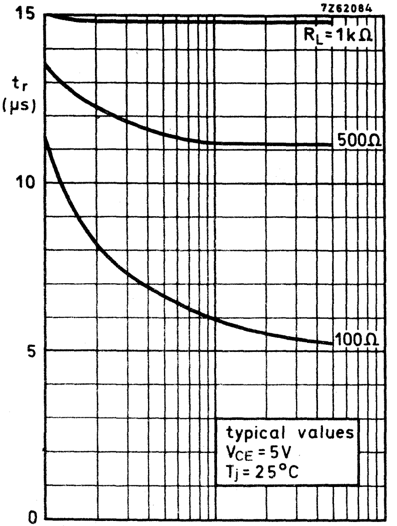

7Z62087
typ. values
$T_{amb} = 25°C$
$T_c = 2856 K$
I_L (mA)
E = 4000 lx
3500
3000
2500
2000
1500
1000
0
2
4
6
0
10
20
V_{CE} (V)

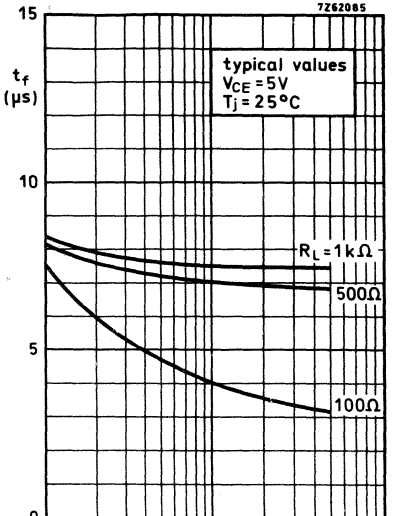

7Z62086
$V_{CE} = 5 V$
$T_{amb} = 25°C$
$T_c = 2856 K$
I_L (mA)
1
10
20
typ
10^3
E (lx)
10^4


7Z62083
$V_{CE} = 5 V$
$T_{amb} = 25°C$
$T_c = 2856 K$
I_L at 2500 lx (mA)
10^2
10
1
10^{-1}
typ
10^{-1}
1
10
I_L at 1000 lx (mA)


7Z61118
$T_j = 25^{\circ}C$
I_d (nA)
100
10
1
typ
0
10
20
V_{CE} (V)
30

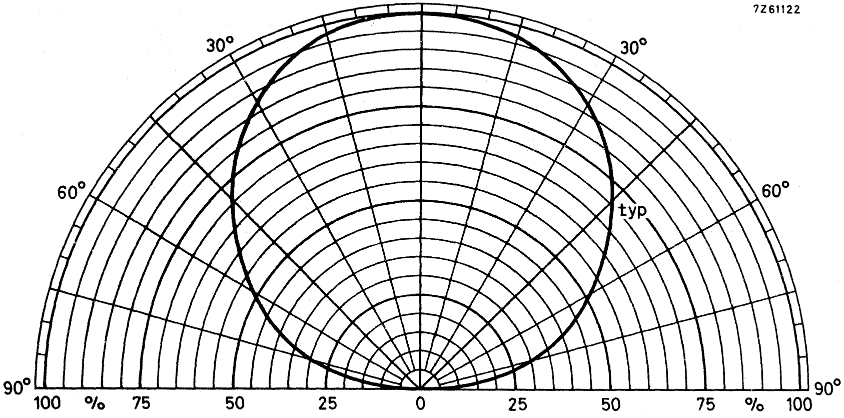

7Z61121
$V_{CE} = 20V$
I_d (nA)
10^5
10^4
10^3
10^2
10
max
typ
0
50
100
T_j (°C)
150

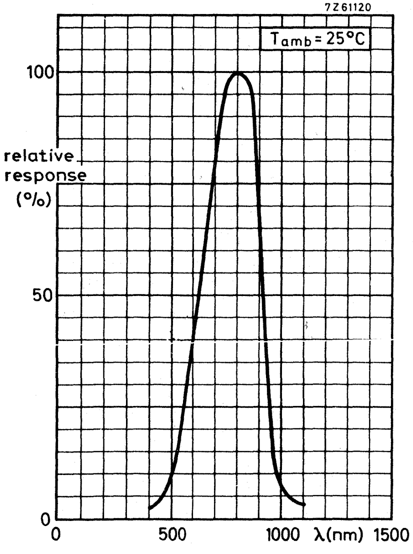

7Z62084
t_r (μs)
15
10
5
0
$R_L = 1k\Omega$
500Ω
100Ω
typical values
$V_{CE} = 5V$
$T_j = 25°C$
10^{-1}
1
I_C (mA)
10

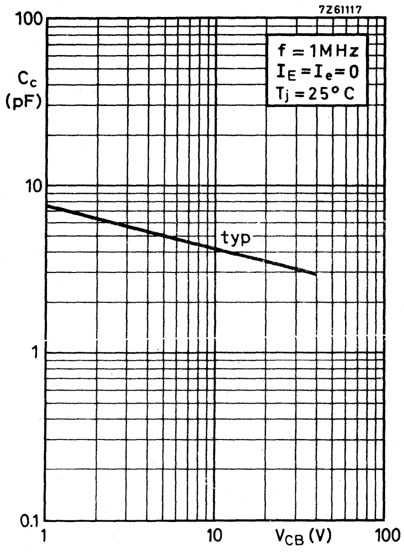

7Z62085
t_f (μs)
15
10
5
0
typical values
$V_{CE} = 5V$
$T_j = 25°C$
$R_L = 1k\Omega$
500Ω
100Ω
10^{-1}
1
I_C (mA)
10

polar response of relative sensitivity

T_{amb} = 25 °C







SILICON PLANAR EPITAXIAL PHOTOTRANSISTOR

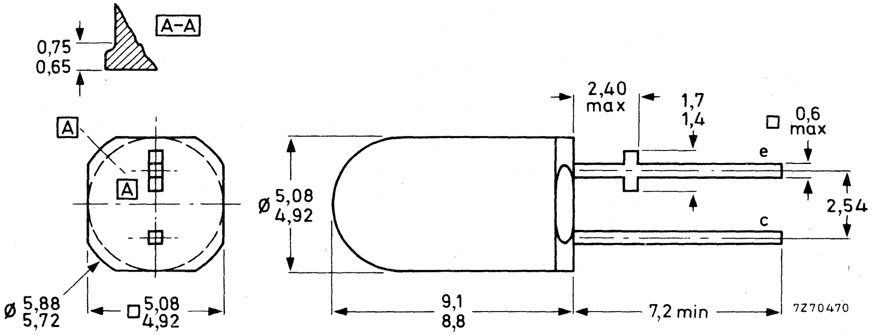
General purpose n-p-n silicon phototransistor in clear resin envelope. The base is inaccessible.

QUICK REFERENCE DATA

Collector-emitter voltage	V_{CEO}	max.	30	V
Collector current (d.c.)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100	mW
Collector dark (cut-off) current V_{CE} = 20 V	$I_{CEO(D)}$	<	100	nA
Collector light (cut-off) current V_{CE} = 5 V; E_V = 1000 lx	$I_{CEO(L)}$	>	5	mA
Wavelength at peak response	λ_{pk}	typ.	800	nm

MECHANICAL DATA Dimensions in mm

SOD-39B



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-emitter voltage	V_{CEO}	max.	30	V
Emitter-collector voltage	V_{ECO}	max.	5	V

Current

Collector current (d.c.)	I_C	max.	25	mA
Collector current (peak value) $t_p = 50\ \mu s,\ \delta = 0,1$	I_{CM}	max.	50	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	100	mW

Temperatures

Storage temperature	T_{stg}		−40 to +100	^oC
Junction temperature	T_j	max.	100	^oC

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j-a}$	=	0,75	$^oC/mW$
From junction to ambient, device mounted on a p.c. board [1]	$R_{th\ j-a}$	=	0,5	$^oC/mW$

CHARACTERISTICS $T_j = 25\ ^oC$ unless otherwise specified

Collector dark (cut-off) current

$V_{CE} = 20$ V	$I_{CEO(D)}$	<	100	nA

Collector light (cut-off) current ($T_{amb} = 25\ ^oC$)

$V_{CE} = 5$ V; $E_v = 1000$ lx; $T_c = 2856$ K [2]	$I_{CEO(L)}$	>	5	mA

Collector-emitter saturation voltage

$I_C = 3$ mA; $E_v = 1000$ lx; $T_c = 2856$ K	V_{CEsat}	<	0,4	V

---

[1] With copper islands of 0,8 x 1,3 mm diameters on both sides of 1,6 mm glass-epoxy printed circuit board; thickness of copper 35 μm.

[2] Unfiltered tungsten filament lamp.

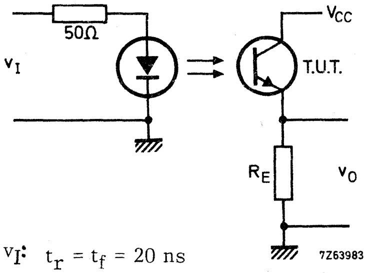
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Wavelength at peak response	λ_{pk}	typ.	800	nm
Bandwidth at half height	$B_{50\%}$	typ.	400	nm
Angle between half-sensitivity directions (I_C = 1 mA; E_v = 1000 lx)	$\alpha_{50\%}$	typ.	25°	
Receiving area		typ.	1	mm^2 ←

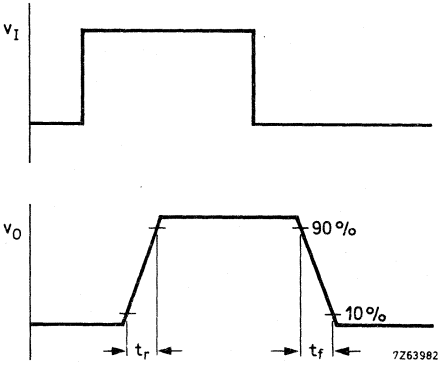
Switching times

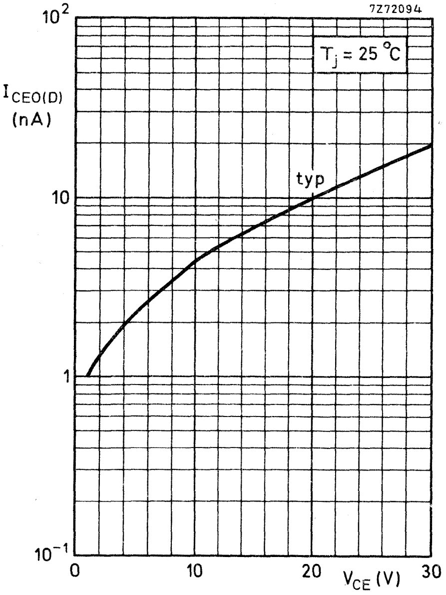
I_{CM} = 1 mA, V_{CC} = 5 V; R_E = 100 Ω ; T_{amb} = 25 °C
(see circuit below)

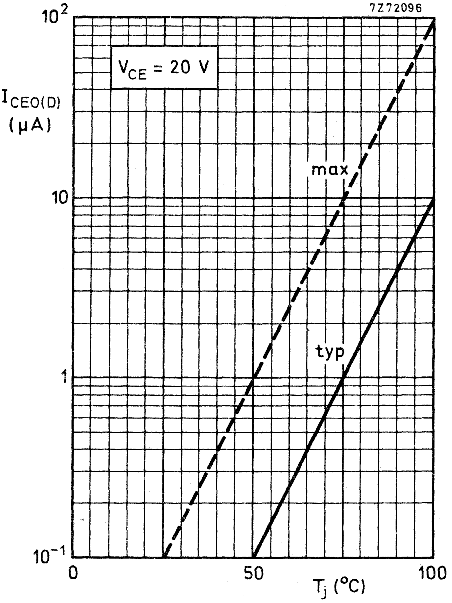
Light current rise time	t_r	typ.	3	µs
Light current fall time	t_f	typ.	2	µs

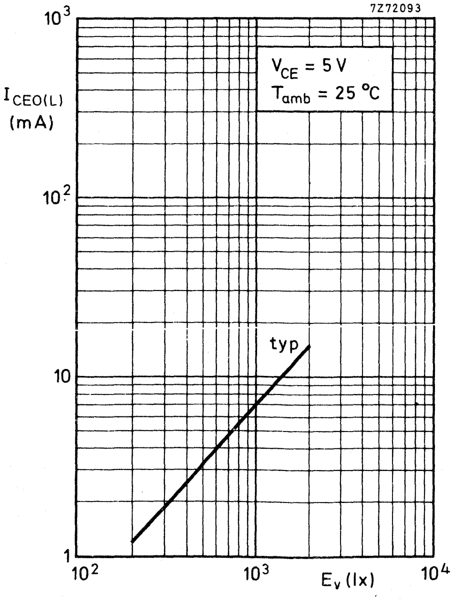


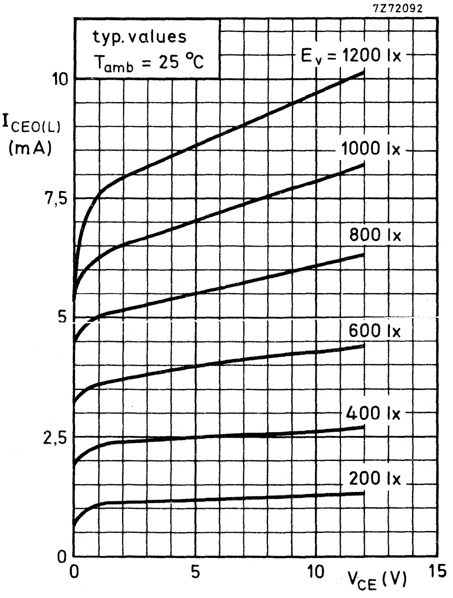
v_I: $t_r = t_f$ = 20 ns
t_p = 20 µs
f = 500 Hz

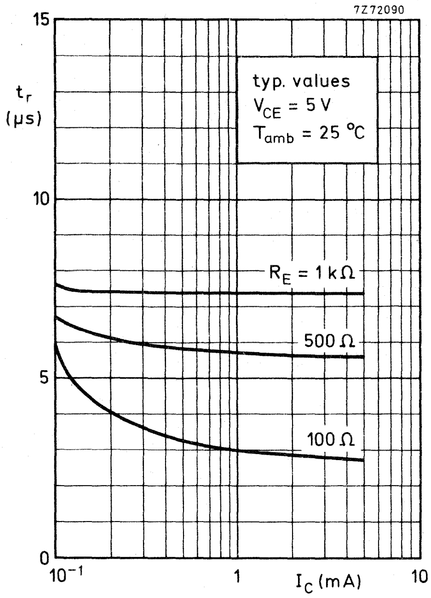


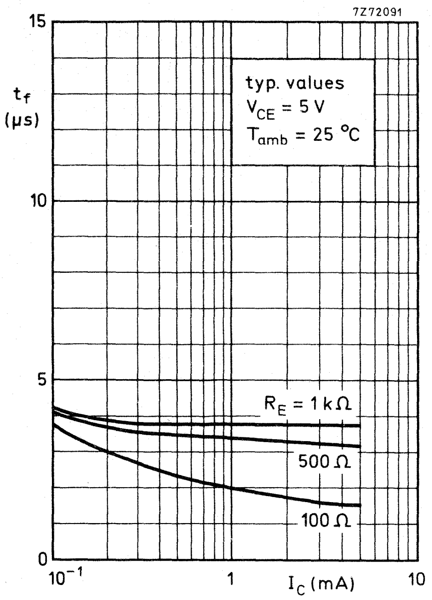

7Z72094
$T_j = 25\ ^\circ C$
$I_{CEO(D)}$ (nA)
10^2
10
1
10^{-1}
typ
0
10
20
V_{CE} (V)
30

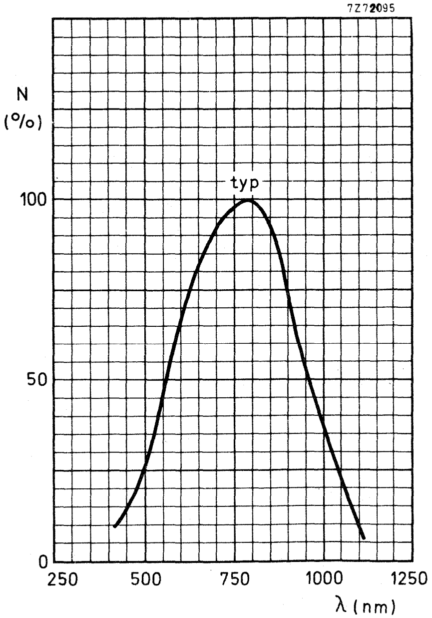

7Z72096
$V_{CE} = 20$ V
$I_{CEO(D)}$ (μA)
10^2
10
1
10^{-1}
max
typ
0
50
100
T_j (°C)

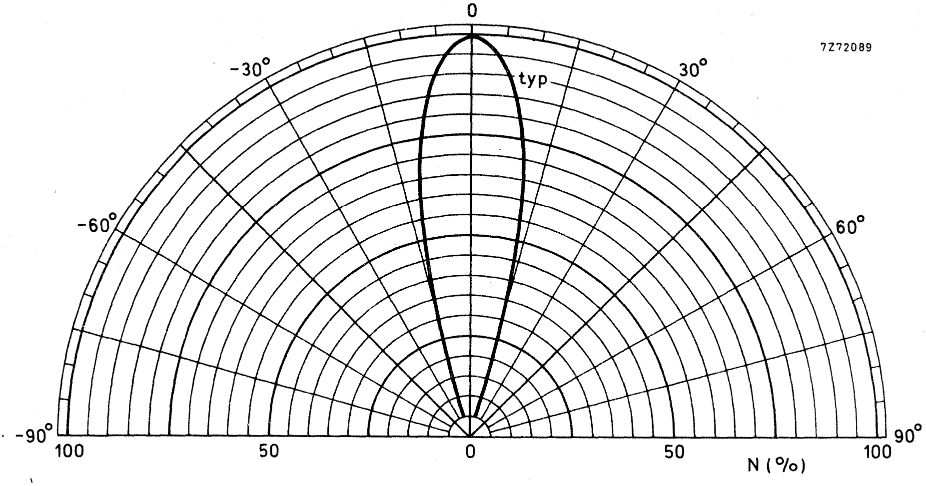

7Z72093
$V_{CE} = 5$ V
$T_{amb} = 25\ ^\circ C$
$I_{CEO(L)}$ (mA)
10^3
10^2
10
1
typ
10^2
10^3
E_v (lx)
10^4


7Z72092
typ. values
$T_{amb} = 25\ ^\circ C$
$E_v = 1200$ lx
1000 lx
800 lx
600 lx
400 lx
200 lx
$I_{CEO(L)}$ (mA)
10
7,5
5
2,5
0
0
5
10
V_{CE} (V)
15


7Z72090
typ. values
V_{CE} = 5 V
T_{amb} = 25 °C
t_r (μs)
15
10
5
0
R_E = 1 kΩ
500 Ω
100 Ω
10^{-1}
1
I_C (mA)
10


7Z72091
typ. values
V_{CE} = 5 V
T_{amb} = 25 °C
t_f (μs)
15
10
5
0
R_E = 1 kΩ
500 Ω
100 Ω
10^{-1}
1
I_C (mA)
10


7Z72095
N (%)
100
50
0
typ
250
500
750
1000
1250
λ (nm)


0
7Z72089
-30°
30°
typ
-60°
60°
-90°
90°
100
50
0
50
100
N (%)

Light emitting diodes

GaAs LIGHT EMITTING DIODE

Gallium arsenide light emitting diode intended for optical coupling and encoding. It emits radiation in the near infrared when forward biased. The diode is provided with a flat glass window.

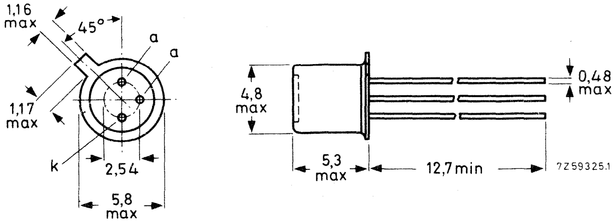
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value) $t_p = 100\ \mu s;\ \delta = 0,1$	I_{FM}	max.	200	mA
Total power dissipation up to $T_{amb} = 95\ ^oC$	P_{tot}	max.	50	mW
Total radiant power at $I_F = 20$ mA	ϕ_e	$>$ typ.	60 100	µW µW
Radiant intensity (on-axis) at $I_F = 20$ mA	I_e	typ.	64	µW/sr
Light rise time at $I_{F\ on} = 20$ mA	t_r	$<$	100	ns
Light fall time at $I_{F\ on} = 20$ mA	t_f	$<$	100	ns
Wavelength at peak emission	λ_{pk}	typ.	880	nm
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0,6	$^oC/mW$

MECHANICAL DATA

Dimensions in mm

TO-18, except for window



Max. lead diameter is guaranteed only for 12,7 mm

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage

Continuous reverse voltage	V_F	max.	2	V

Current

Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value) $t_p = 100\ \mu s;\ \delta = 0,1$	I_{FM}	max.	200	mA

Power dissipation

Total power dissipation up to $T_{amb} = 95\ ^oC$	P_{tot}	max.	50	mW

Temperature

Storage temperature	T_{stg}		−55 to + 150	^oC
Operating junction temperature	T_j	max.	125	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,6	$^oC/mW$
From junction to case	$R_{th\ j\text{-}c}$	=	0,22	$^oC/mW$

CHARACTERISTICS $T_{amb} = 25\ ^oC$ unless otherwise specified

Forward voltage at $I_F = 30$ mA	V_F	typ. <	1,3 1,6	V V
$I_{FM} = 0,2$ A	V_F	typ.	1,5	V
Reverse current at $V_R = 2$ V	I_R	<	0,5	mA
Diode capacitance at f = 1 MHz; $V_R = 0$	C_d	typ.	65	pF

CHARACTERISTICS (continued) T_{amb} = 25 °C unless otherwise specified

Radiant output power at I_F = 20 mA	ϕ_e	>	60	μW
		typ.	100	μW
I_F = 20 mA; T_j = 100 °C	ϕ_e	typ.	50	μW
I_F = 200 mA [1]	ϕ_e	typ.	1, 16	mW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	typ.	64	μW/sr
Radiance at I_F = 20 mA	L_e	typ.	1, 6	mW/mm²sr
I_F = 200 mA [1]	L_e	typ.	15	mW/mm²sr
Emissive area	A_e	typ.	0, 04	mm²
Wavelength at peak emission	λ_{pk}	typ.	880	nm
Bandwidth at half height	$\Delta\lambda$	typ.	40	nm
Light rise time at I_{Fon} = 20 mA	t_r	typ.	30	ns
		<	100	ns
Light fall time at I_{Fon} = 20 mA	t_f	typ.	30	ns
		<	100	ns

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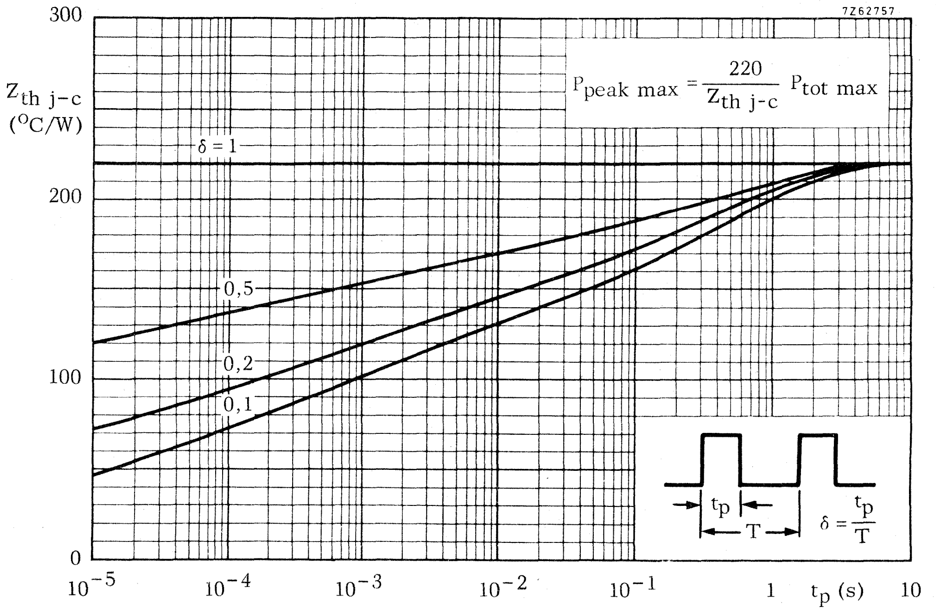
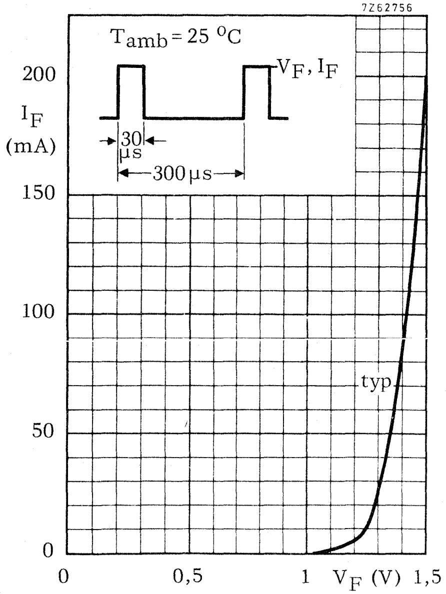
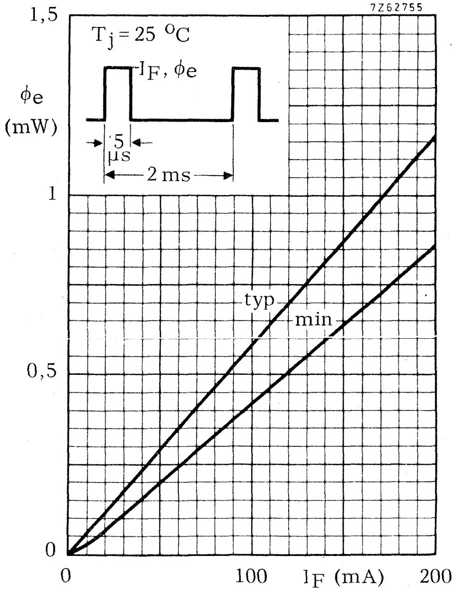
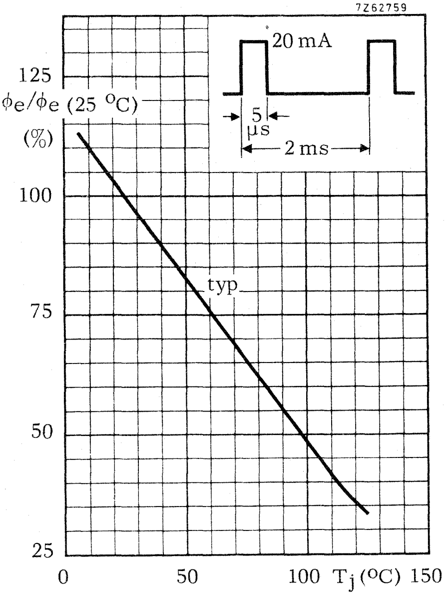
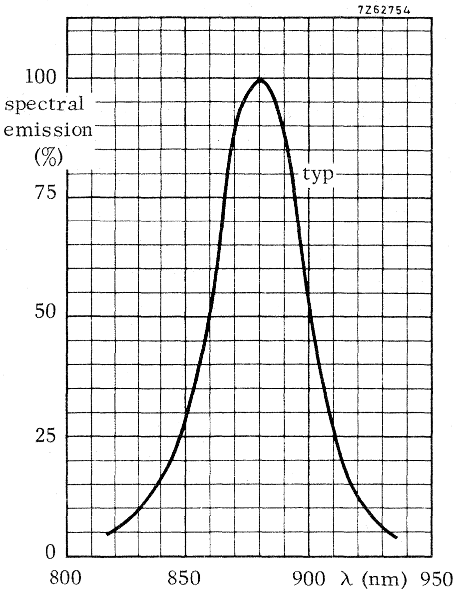
[1] t_p = 100 μs; δ = 0, 1.

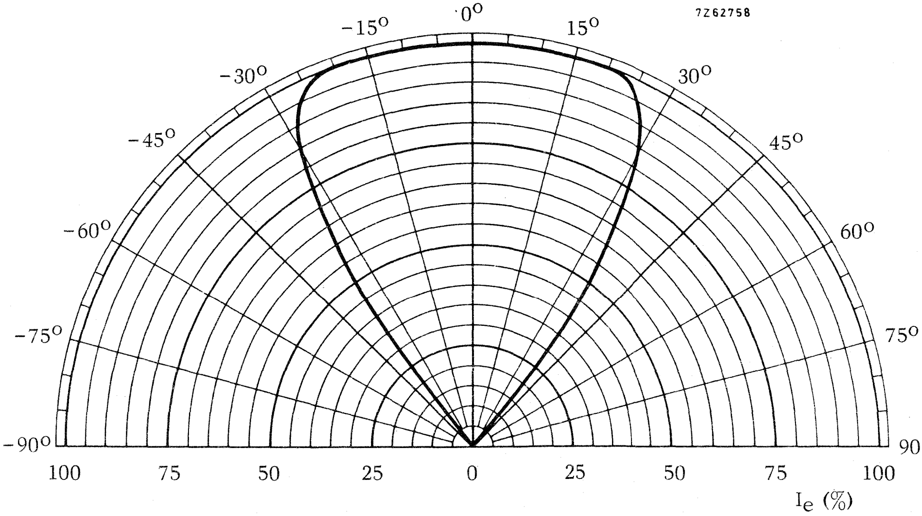

7Z62757
300
200
100
0
Z_th j-c
(°C/W)
δ = 1
0,5
0,2
0,1
P_peak max = 220 / Z_th j-c P_tot max
t_p
T
δ = t_p / T
10^-5
10^-4
10^-3
10^-2
10^-1
1
t_p (s)
10


7Z62756
T_amb = 25 °C
V_F, I_F
30 µs
300 µs
200
I_F
(mA)
150
100
50
0
typ
0
0,5
1
V_F (V)
1,5


7Z62755
T_j = 25 °C
I_F, ϕe
5 µs
2 ms
1,5
ϕe
(mW)
1
0,5
0
typ
min
0
100
I_F (mA)
200


7Z62759
20 mA
5 μs
2 ms
125
φe/φe (25 °C)
(%)
100
75
50
25
typ
0
50
100
Tj (°C)
150


7Z62754
100
spectral emission
(%)
75
50
25
0
typ
800
850
900
λ (nm)
950


7Z62758
0°
-15°
15°
-30°
30°
-45°
45°
-60°
60°
-75°
75°
-90°
90°
100
75
50
25
0
25
50
75
100
Ie (%)

GALLIUM ARSENIDE LIGHT EMITTING DIODE

Gallium arsenide light emitting diode intended for optical coupling and encoding. It emits radiation in the near infrared when forward biased. Suitable for combination with phototransistor BPX25 or BPX72.

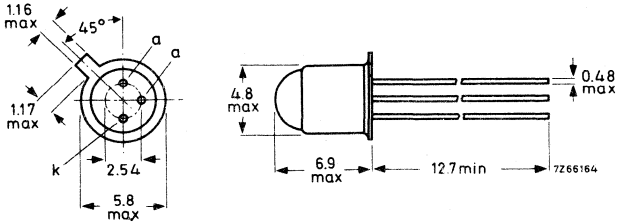
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 95 °C	P_{tot}	max.	50	mW
Total radiant power at I_F = 20 mA	ϕe	typ.	50	μW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	typ.	1,25	mW/sr
Light rise time at I_{Fon} = 20 mA	t_r	<	100	ns
Light fall time at I_{Fon} = 20 mA	t_f	<	100	ns
Wavelength at peak emission	λ_{pk}	typ.	880	nm
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0,6	°C/mW

MECHANICAL DATA

Dimensions in mm

TO-18, except for lens



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage				
Continuous reverse voltage	V_R	max.	2	V
Current				
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value) t_p = 100 µs; δ = 0,1	I_{FM}	max.	200	mA
Power dissipation				
Total power dissipation up to T_{amb} = 95 °C	P_{tot}	max.	50	mW
Temperature				
Storage temperature	T_{stg}		−55 to + 150	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,6	°C/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0,22	°C/mW

CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

Forward voltage				
I_F = 30 mA	V_F	typ. <	1,3 1,6	V V
I_{FM} = 200 mA	V_F	typ.	1,5	V
Reverse current				
V_R = 2 V	I_R	<	0,5	mA
Diode capacitance				
V_R = 0; f = 20 MHz	C_d	typ.	25	pF
Total radiant power				
I_F = 20 mA	ϕ_e	typ.	50	µW
Radiant intensity (on-axis)				
I_F = 20 mA	I_e	typ.	1,25	mW/sr

CHARACTERISTICS (continued)

Mean irradiance on a receiving area with D = 2 mm at a distance a = 10 mm and at I_F = 20 mA, measured as below	E_e	> typ.	0,28 0,50	mW/cm^2 mW/cm^2 [1]

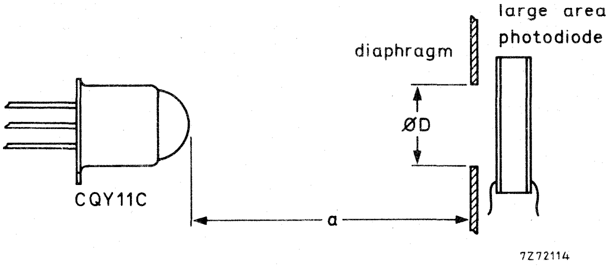


Fig. 1

Decrease of radiant power with temperature	$\frac{\Delta\phi e}{\Delta T_j}$	typ.	0,7	%/^{o}C
Cross section of the radiant beam between 0 to 10 mm from the lens	A_{beam}	typ.	7	mm^2
Angle between optical and mechanical axis			6^o	
Wavelength at peak emission	λ_{pk}	typ.	880	nm
Bandwidth at half height	$B_{50\%}$	typ.	40	nm
Light rise time at I_{Fon} = 20 mA	t_r	typ. <	30 100	ns ns
Light fall time at I_{Fon} = 20 mA	t_f	typ. <	30 100	ns ns

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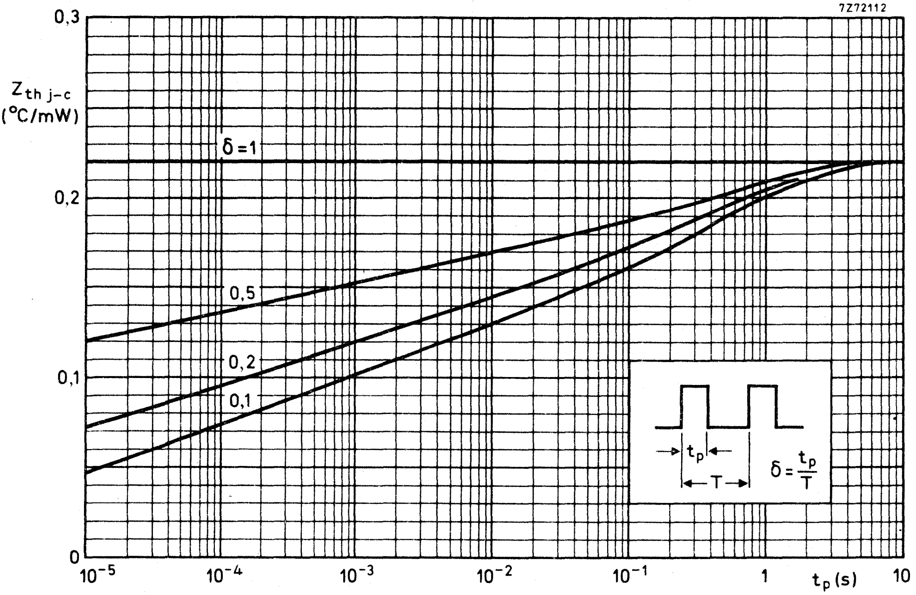
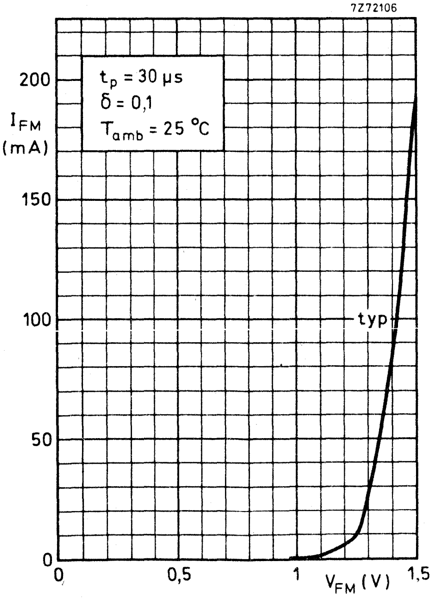
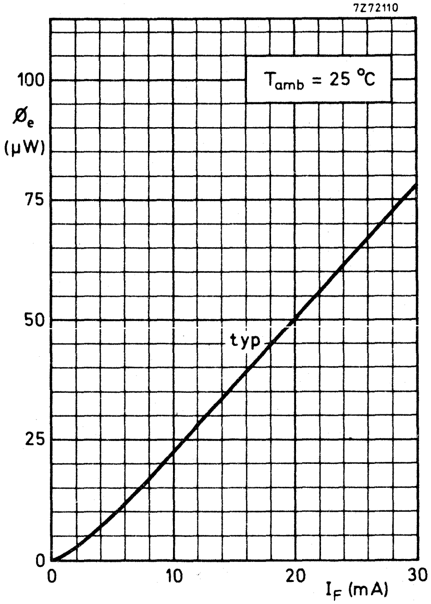
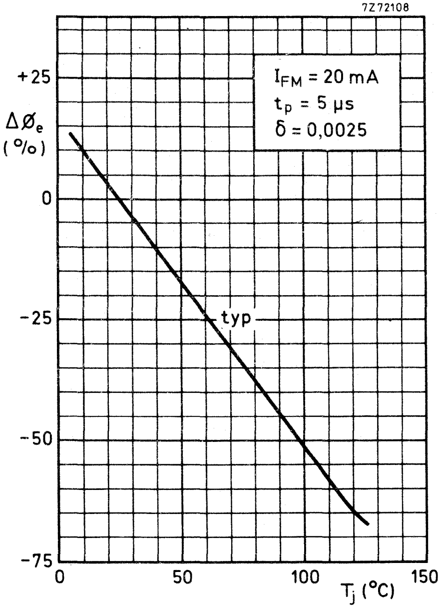
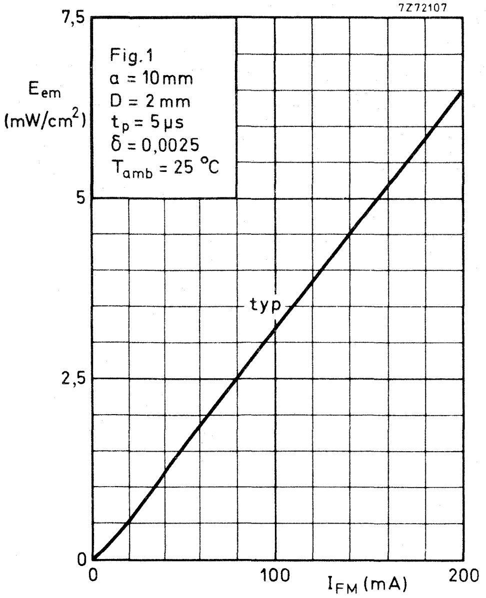
[1] This corresponds typically with $I_{CEO(L)}$ = 0,4 mA in a phototransistor BPX25 and with 200 μA in a phototransistor BPX72.

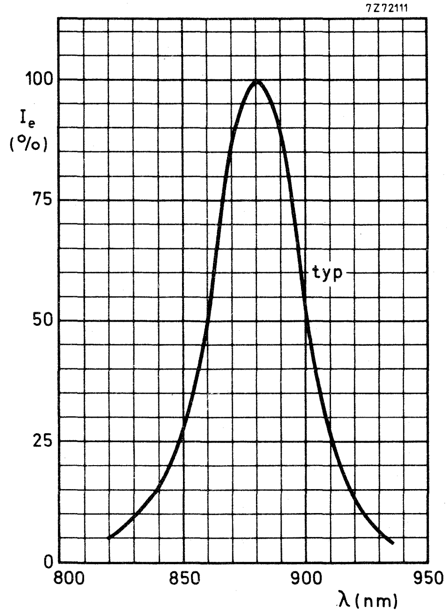

7Z72112
$Z_{th\ j-c}$ (°C/mW)
0,3
0,2
0,1
0
δ = 1
0,5
0,2
0,1
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
t_p (s)
t_p
T
$\delta = \frac{t_p}{T}$

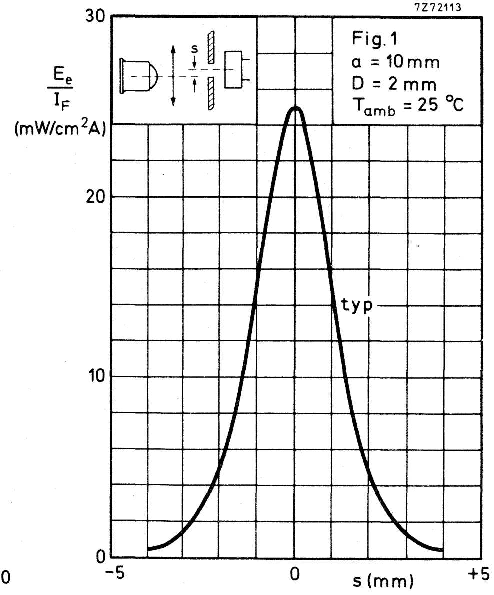

7Z72106
t_p = 30 μs
δ = 0,1
T_{amb} = 25 °C
I_{FM} (mA)
200
150
100
50
0
typ
0
0,5
1
1,5
V_{FM} (V)

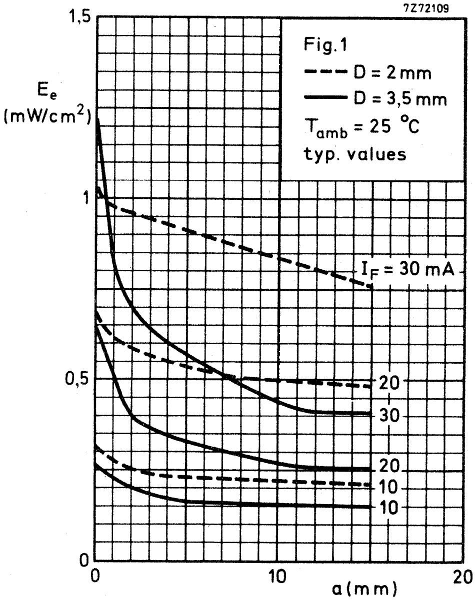

7Z72110
T_{amb} = 25 °C
$\varnothing_e$ (μW)
100
75
50
25
0
typ
0
10
20
30
I_F (mA)

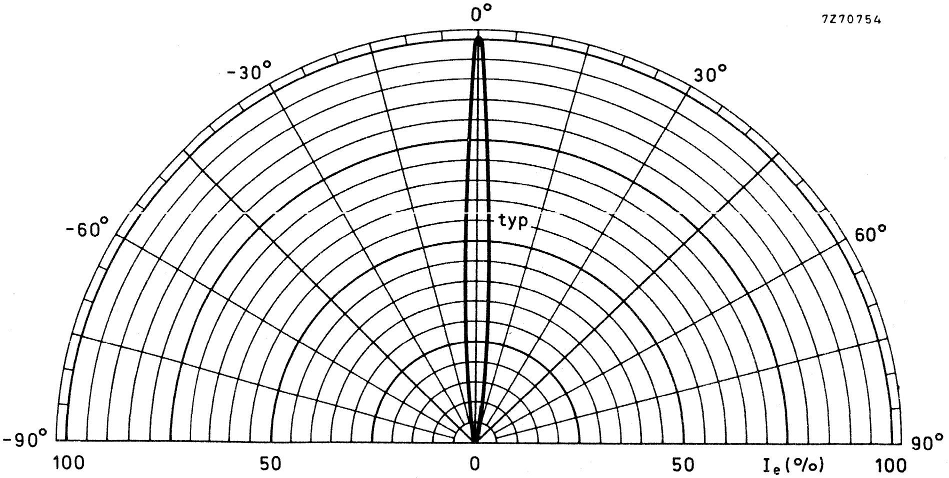

7Z72108
I_{FM} = 20 mA
t_p = 5 µs
δ = 0,0025
$\Delta\Phi_e$ (%)
+25
0
−25
−50
−75
typ
0
50
100
150
T_j (°C)


7Z72107
Fig. 1
a = 10 mm
D = 2 mm
t_p = 5 µs
δ = 0,0025
T_{amb} = 25 °C
E_{em} (mW/cm^2)
7,5
5
2,5
0
typ
0
100
200
I_{FM} (mA)


7Z72111
I_e (%)
100
75
50
25
0
typ
800
850
900
950
λ (nm)


7Z72113
s
Fig. 1
a = 10 mm
D = 2 mm
T_{amb} = 25 °C
$\frac{E_e}{I_F}$ (mW/cm^{2}A)
30
20
10
0
typ
−5
0
+5
s (mm)


7Z72109
Fig.1
D = 2 mm
D = 3,5 mm
T_{amb} = 25 °C
typ. values
E_e (mW/cm²)
1,5
1
0,5
0
I_F = 30 mA
20
30
20
10
10
0
10
20
a (mm)


7Z70754
0°
-30°
30°
-60°
60°
-90°
90°
typ
100
50
0
50
I_e (%)
100

GaAsP RED LIGHT EMITTING DIODES

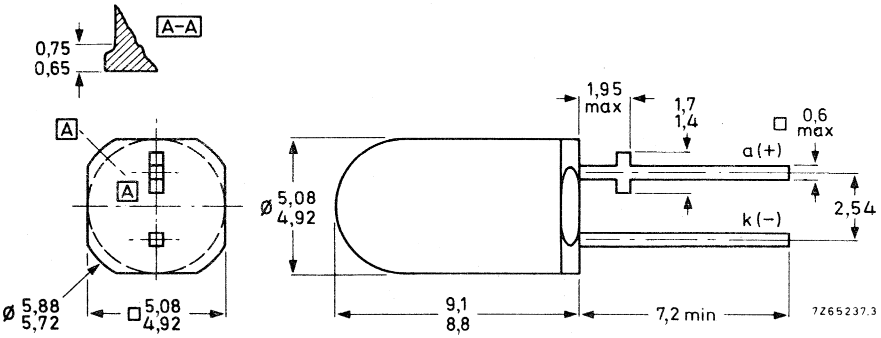
Gallium arsenide phosphide light emitting diodes which emit visible red light when forward biased. The envelopes are light diffusing, CQY24 of red, CQY61 of colourless plastic.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	50	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	100	mW
Luminous intensity (on-axis) at $I_F = 20$ mA	I_v	> typ.	0, 5 1, 5	mcd mcd
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	70°	
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0, 75	$^oC/mW$

MECHANICAL DATA

Dimensions in mm

SOD-39A



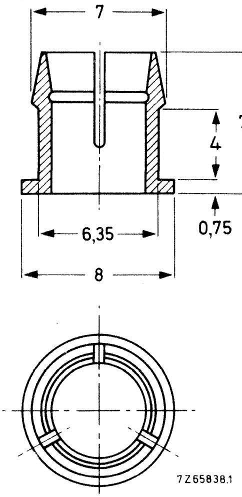
CQY24 : light diffusing red plastic

CQY71 : light diffusing colourless plastic

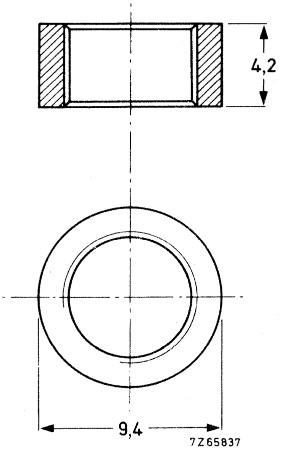
Accessories for panel mounting (panel thickness < 4 mm)

Plastic clip and ring, black: type RTC757
colourless: type RTC758

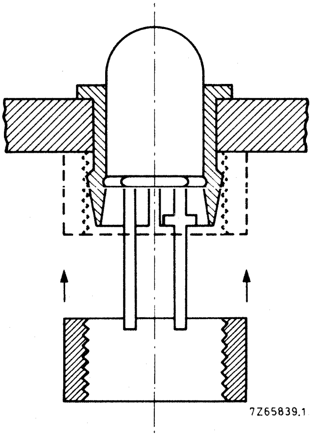
Hole diameter 6,4 mm for panel thickness < 3 mm
6,5 mm for panel thickness > 3 mm



7Z65838.1



7Z65837



7Z65839.1

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage

Continuous forward voltage	V_F	max.	2	V
Continuous reverse voltage	V_R	max.	3	V

Current

Forward current (d.c.)	I_F	max.	50	mA
Forward current (peak value) $t_p = 10\ \mu s$; $\delta = 0{,}1$	I_{FM}	max.	200	mA

Temperature

Storage temperature	T_{stg}		−40 to +100	°C
Junction temperature	T_j	max.	100	°C

Power dissipation

Total power dissipation up to $T_{amb} = 25\ ^{\circ}C$	P_{tot}	max.	100	mW

THERMAL RESISTANCE

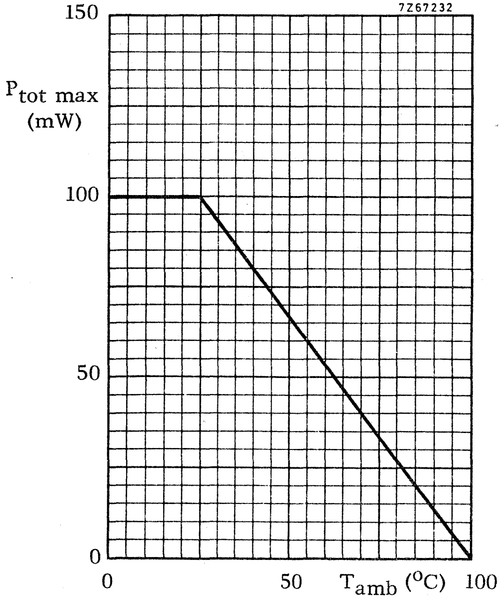
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,75	°C/mW

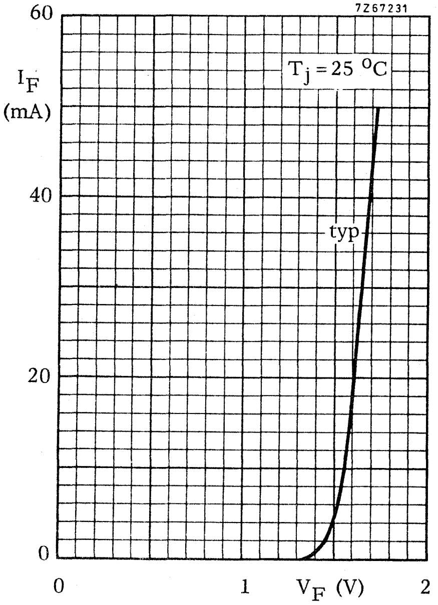
CHARACTERISTICS $T_j = 25\ ^{\circ}C$ unless otherwise specified

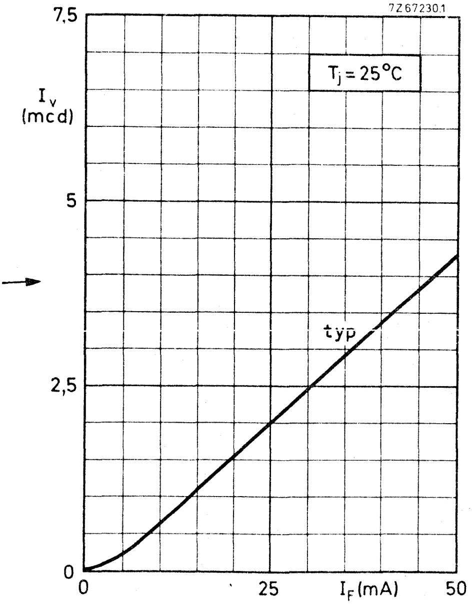
Forward voltage at $I_F = 20$ mA	V_F	typ. <	1,6 2	V V
→ Negative temperature coefficient of V_F				
$I_F = 20$ mA	$\frac{-\Delta V_F}{\Delta T_j}$	typ.	1,6	mV/°C
$I_F = 2$ mA	$\frac{-\Delta V_F}{\Delta T_j}$	typ.	2	mV/°C
Reverse current at $V_R = 3$ V	I_R	<	25	μA
Luminous flux at $I_F = 20$ mA	ϕ_v	typ.	1,5	mlm
Luminous intensity (on-axis) at $I_F = 20$ mA	I_v	> typ.	0,5 1,5	mcd mcd
Luminance (on-axis) at $I_F = 20$ mA	L_v	> typ.	170 510	$\mathrm{cd/m^2}$ 1) $\mathrm{cd/m^2}$ 2)
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Bandwidth at half height	$B_{50\%}$	typ.	20	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	70°	

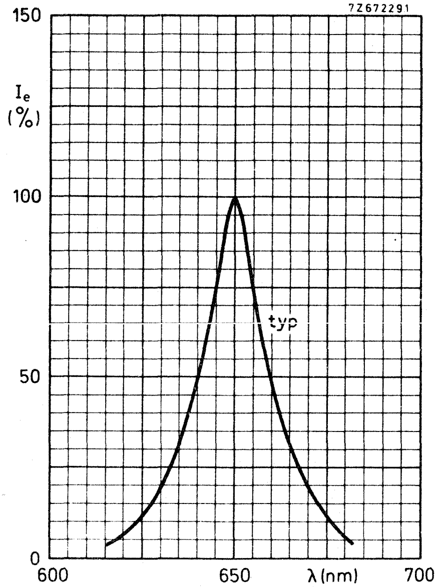
---

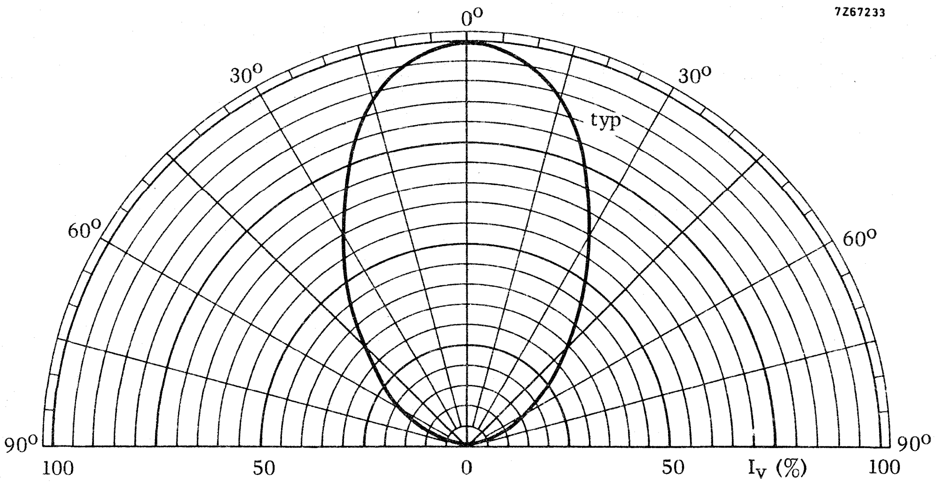
1) 2) >50 and typ. 150 footlamberts, respectively.


7Z67232
150
Ptot max
(mW)
100
50
0
0
50
Tamb (°C)
100


7Z67231
60
IF
(mA)
Tj = 25 °C
typ
40
20
0
0
1
VF (V)
2


7Z67230.1
7,5
Iv
(mcd)
Tj = 25°C
5
typ
2,5
0
0
25
IF (mA)
50


7Z672291
150
Ie
(%)
100
typ
50
0
600
650
λ (nm)
700


7Z67233
0°
30°
30°
60°
60°
90°
90°
typ
100
50
0
50
I_V (%)
100

GaAsP RED LIGHT EMITTING DIODES

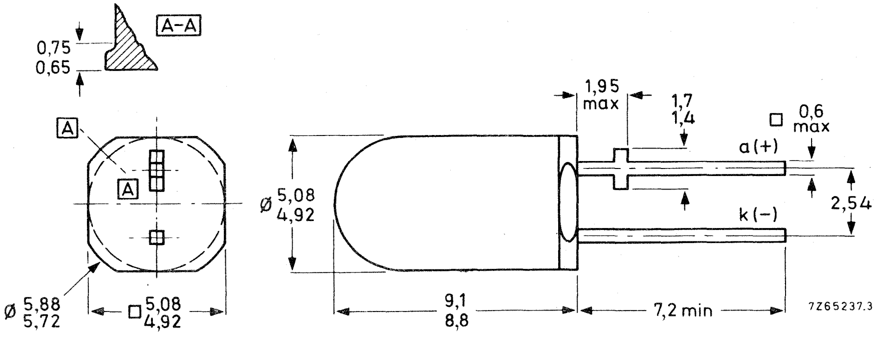
Gallium arsenide phosphide light emitting diodes which emit visible red light when forward biased.

The envelopes are of clear, non-diffusing resin: red for CQY46, colourless for CQY47, both showing a clearly defined point of light.
CQY46 has better contrast, CQY47 shows no red reflections from sunlight or incandescent light sources.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	50	mA
Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	100	mW
Luminous intensity (on-axis) at I_F = 20 mA	I_v	> typ.	0,4 0,8	mcd mcd
Angle between half-intensity directions	$\alpha_{50\%}$	typ.	100°	
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0,75	°C/mW

MECHANICAL DATA Dimensions in mm

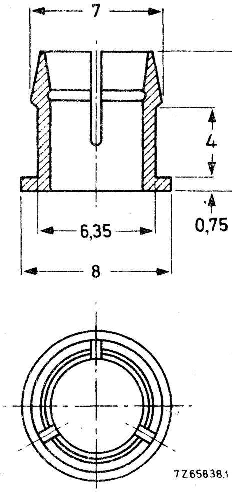
SOD-39A



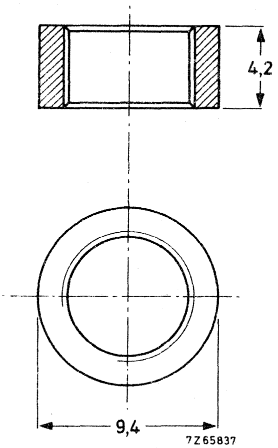
Accessories for panel mounting (panel thickness < 4 mm)

Plastic clip and ring, black: type RTC757
colourless: type RTC758

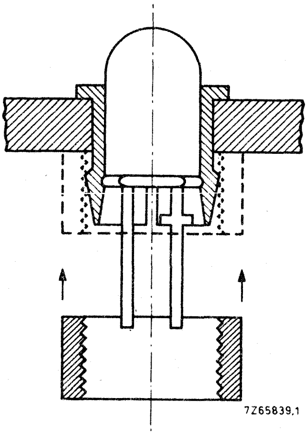
Hole diameter 6,4 mm for panel thickness < 3 mm
6,5 mm for panel thickness > 3 mm



7Z65838.1



7Z65837



7Z65839.1

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage

Continuous forward voltage	V_F	max.	2	V
Continuous reverse voltage	V_R	max.	3	V

Current

Forward current (d.c.)	I_F	max.	50	mA
Forward current (peak value) t_p = 10 μs; δ = 0,1	I_{FM}	max.	500	mA

Temperature

Storage temperature	T_{stg}		−40 to + 100	°C
Junction temperature	T_j	max.	100	°C

Power dissipation

Total power dissipation up to T_{amb} = 25 °C; or mounted: up to T_{amb} = 50 °C [1]	P_{tot}	max.	100	mW

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0,75	°C/mW
From junction to ambient, device mounted on a p.c. board [1]	$R_{th\ j-a}$	=	0,5	°C/mW

---

1) With copper islands of 0,8 x 1,3 mm diameters on both sides of 1,6 mm glass-epoxy printed circuit board; thickness of copper 35 μm.

CHARACTERISTICS

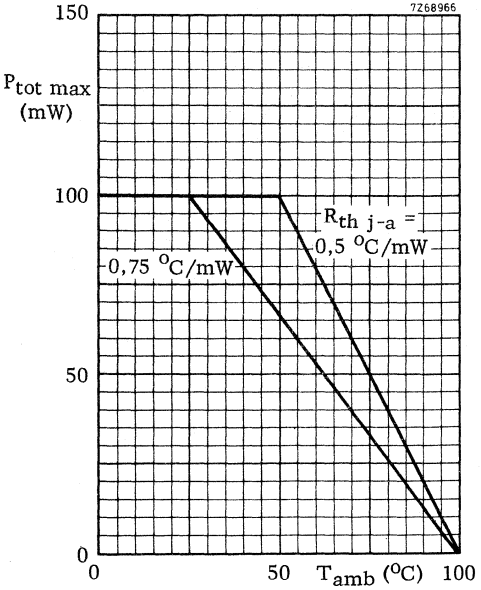
T_j = 25 °C unless otherwise specified

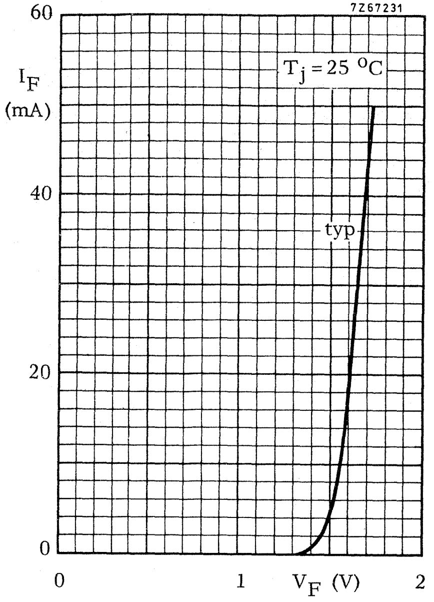
Forward voltage				
I_F = 20 mA	V_F	typ. <	1,6 2	V V
Reverse current				
V_R = 3 V	I_R	<	25	µA
Luminous flux				
I_F = 20 mA	ϕ_v	typ.	2,5	mlm
Luminous intensity (on-axis)				
I_F = 20 mA	I_v	> typ.	0,4 0,8	mcd mcd
Luminance (on-axis)				
I_F = 20 mA	L_v	> typ.	1020 2380	cd/m² 1) cd/m² 2)
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Bandwidth at half height	$B_{50\%}$	typ.	20	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	100°	
Apparent luminous area	A_{app}	typ.	0,35	mm²

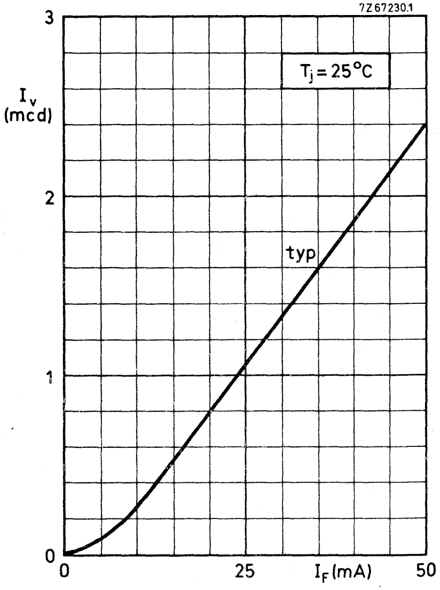
---

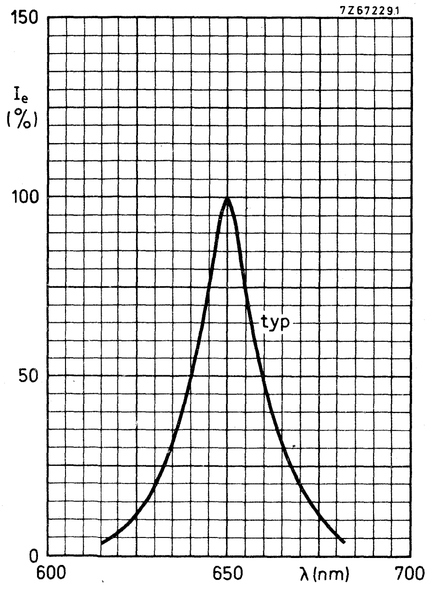
1) > 300 ft-L

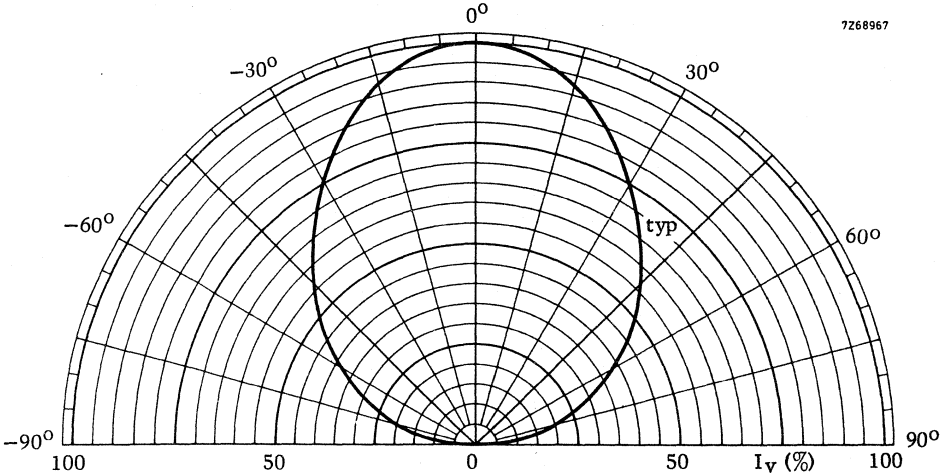
2) 700 ft-L


7Z68966
150
$P_{tot\ max}$ (mW)
100
50
0
$R_{th\ j\text{-}a}$ = 0,5 °C/mW
0,75 °C/mW
0
50
T_{amb} (°C)
100


7Z67231
60
I_F (mA)
40
20
0
T_j = 25 °C
typ
0
1
V_F (V)
2


7Z67230.1
3
I_v (mcd)
2
1
0
T_j = 25°C
typ
0
25
I_F (mA)
50


7Z67229.1
150
I_e (%)
100
50
0
typ
600
650
λ (nm)
700


0°
7Z68967
−30°
30°
−60°
60°
typ
−90°
90°
100
50
0
50
I_V (%)
100

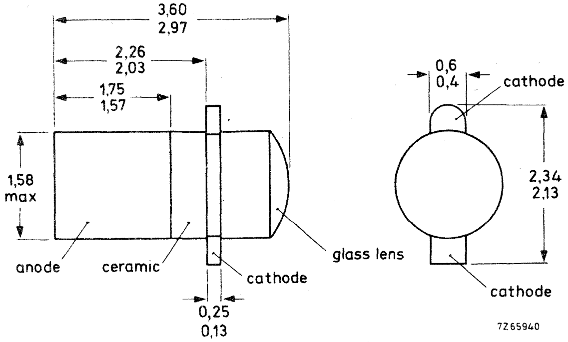
GaAs LIGHT EMITTING DIODES

Gallium arsenide light emitting diodes which emit near-infrared light when forward biased. Ceramic-metal envelope with glass lens like BPX71, suitable for matrix layout on printed circuit boards. In conjunction with BPX71 also suitable for punched card reading.

QUICK REFERENCE DATA					
Continuous reverse voltage	V_R	max.	2		V
Forward current (d.c.)	I_F	max.	100		mA
Total power dissipation up to T_{amb} = 25 °C mounted on printed circuit board	P_{tot}	max.	150		mW
			CQY50	CQY52	
Total radiant power at I_F = 20 mA	ϕ_e	>	160	400	µW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	>	180	450	µW/sr
Wavelength at peak emission	λ_{pk}	typ.	930		nm

MECHANICAL DATA Dimensions in mm

DO-31 except for length



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage				
Continuous reverse voltage	V_R	max.	2	V
Current				
Forward current (d.c.)	I_F	max.	100	mA
Forward current (peak value) t_p = 10 μs; δ = 0,01	I_{FM}	max.	500	mA
Temperature				
Storage temperature	T_{stg}		−65 to +150	°C
Operating junction temperature	T_j	max.	125	°C
Power dissipation				
Total power dissipation up to T_{amb} = 25 °C device mounted on p.c. board 1)	P_{tot}	max.	150	mW

THERMAL RESISTANCE

From junction to ambient, device mounted on p.c. board 1)	$R_{th\ j\text{-}a}$	=	0,66	°C/mW

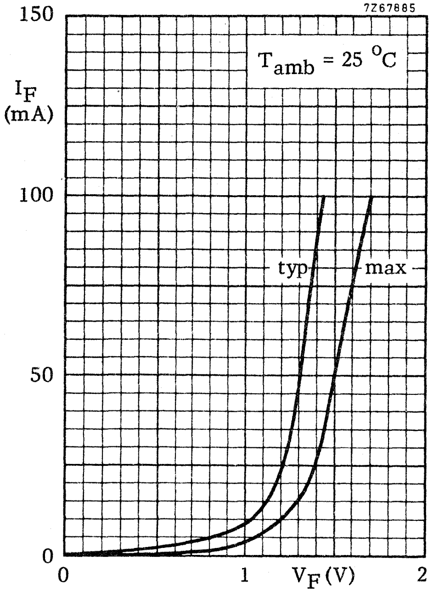
---

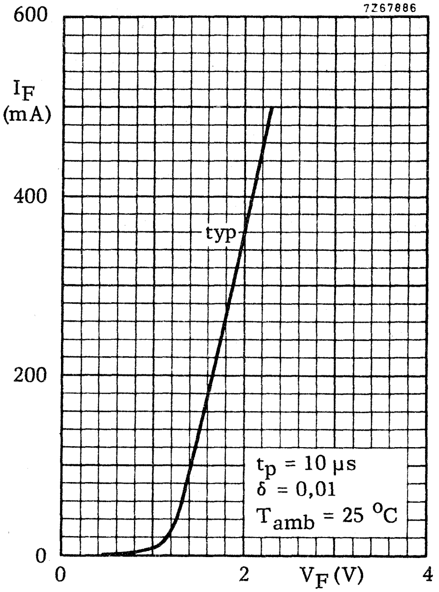
1) With copper islands of 6 x 2 mm on both sides of 1,6 mm glass-epoxy printed circuit board; thickness of copper 35 μm.

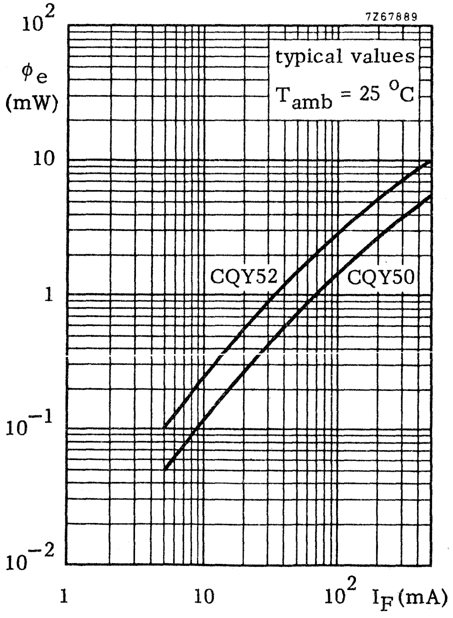
CHARACTERISTICS

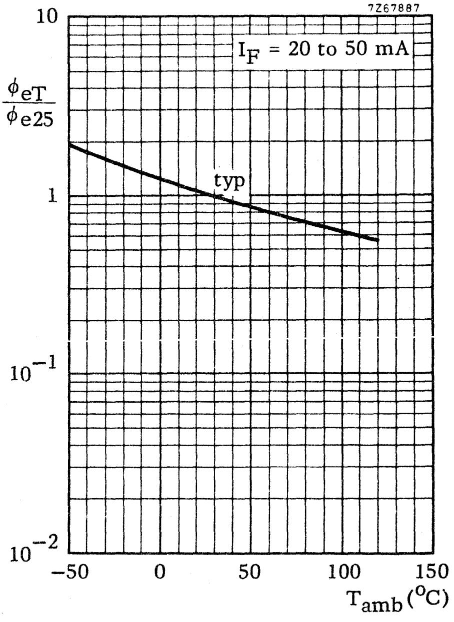
T_{amb} = 25 °C unless otherwise specified

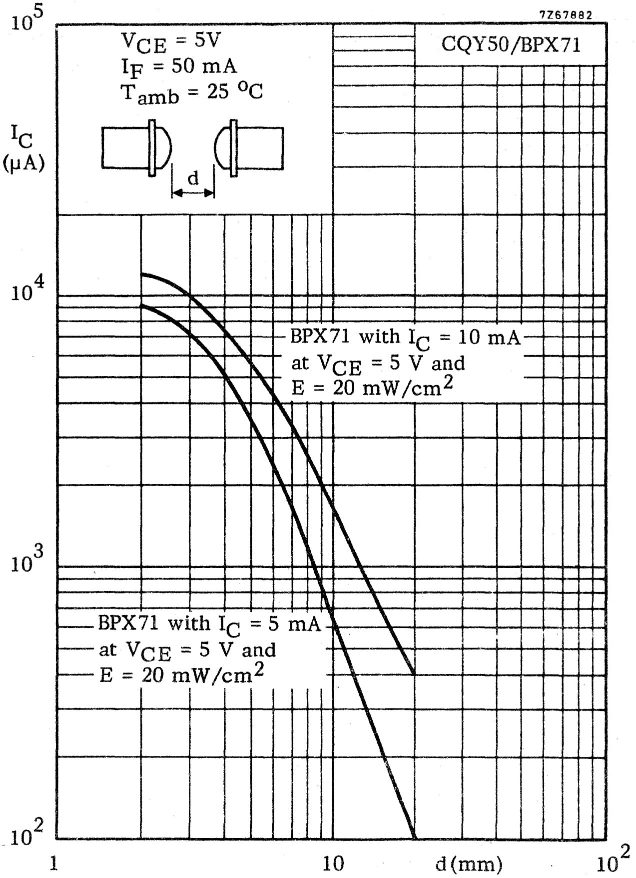
			CQY50	CQY52	
Forward voltage					
I_F = 50 mA	V_F	typ.	1,3	1,3	V
		$<$	1,5	1,5	V
I_F = 500 mA; t_p = 10 µs; δ = 0,01	V_F	typ.	2,3	2,3	V
Reverse current					
V_R = 2 V	I_R	$<$	100	100	µA
Diode capacitance					
V_R = 0; f = 1 MHz	C_d	typ.	45	45	pF
Total radiant power					
I_F = 20 mA	ϕ_e	$>$	160	400	µW
I_F = 50 mA	ϕ_e	typ.	700	1500	µW
Radiant intensity (on-axis)					
I_F = 20 mA	I_e	$>$	180	450	µW/sr
Wavelength at peak emission	λ_{pk}	typ.	930	930	nm
Bandwidth at half height	$B_{50\%}$	typ.	40	40	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	35°	35°	
Switching times					
I_{Fon} = 20 mA; t_p = 2 µs; f = 45 kHz					
Light rise time	t_r	typ.	600	600	ns
Light fall time	t_f	typ.	350	350	ns

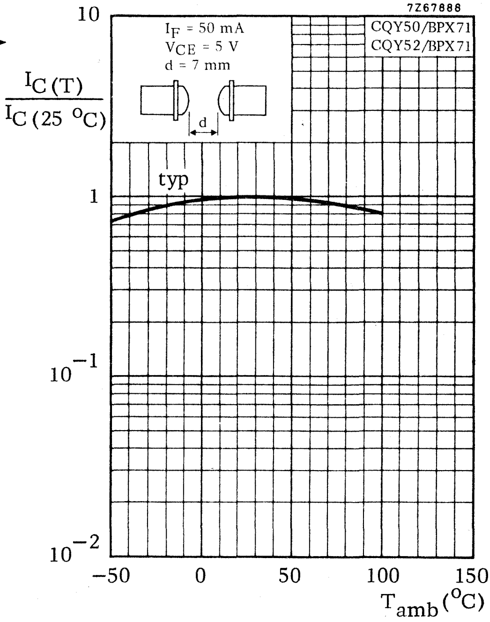

7Z67885
150
I_F (mA)
100
50
0
T_{amb} = 25 °C
typ
max
0
1
V_F (V)
2

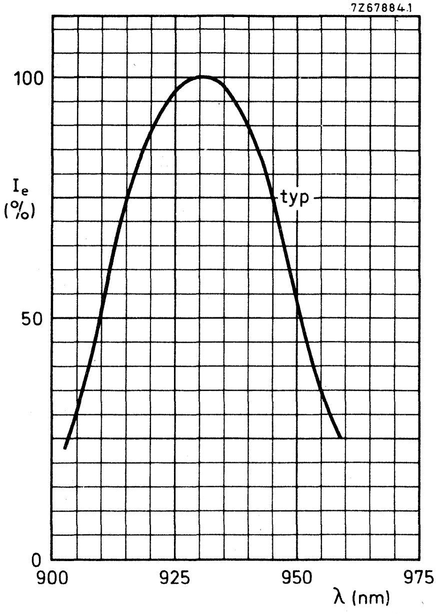

7Z67886
600
I_F (mA)
400
200
0
typ
t_p = 10 μs
δ = 0,01
T_{amb} = 25 °C
0
2
V_F (V)
4

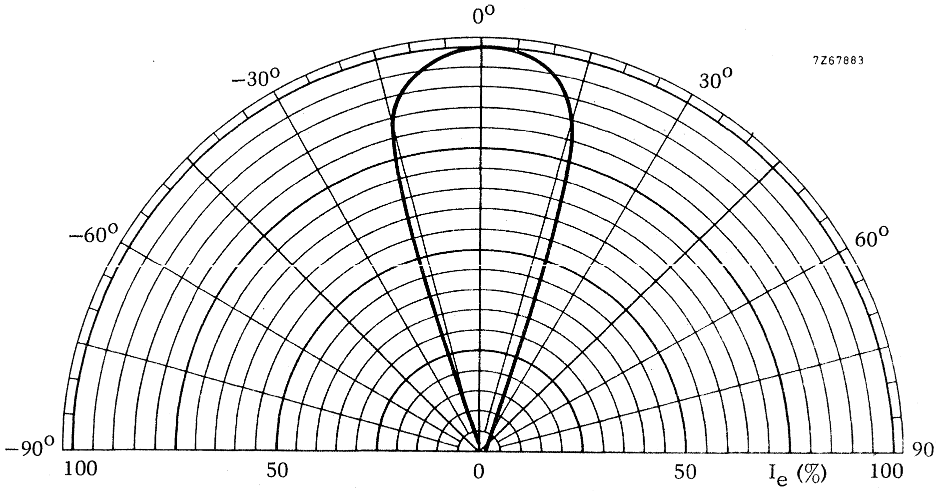

7Z67889
10^2
ϕ_e (mW)
10
1
10^{-1}
10^{-2}
typical values
T_{amb} = 25 °C
CQY52
CQY50
1
10
10^2
I_F (mA)


7Z67887
10
$\frac{\phi_{eT}}{\phi_{e25}}$
1
10^{-1}
10^{-2}
I_F = 20 to 50 mA
typ
−50
0
50
100
150
T_{amb} (°C)


7Z67882
CQY50/BPX71
V_{CE} = 5V
I_F = 50 mA
T_{amb} = 25 °C
d
I_C
(μA)
10^5
10^4
10^3
10^2
BPX71 with I_C = 10 mA
at V_{CE} = 5 V and
E = 20 mW/cm^2
BPX71 with I_C = 5 mA
at V_{CE} = 5 V and
E = 20 mW/cm^2
1
10
d (mm)
10^2


7Z67888
IF = 50 mA
VCE = 5 V
d = 7 mm
d
CQY50/BPX71
CQY52/BPX71
IC (T) / IC (25 °C)
10
1
10−1
10−2
typ
−50
0
50
100
150
Tamb (°C)


7Z67884.1
Ie (%)
100
50
0
typ
900
925
950
975
λ (nm)


7Z67883
0°
−30°
30°
−60°
60°
−90°
90°
100
50
0
50
Ie (%)
100

GaAsP RED LIGHT EMITTING DIODE

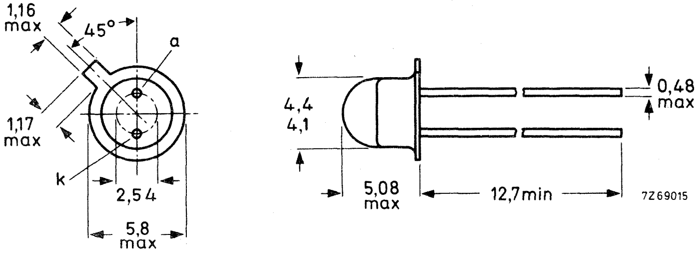
Gallium arsenide phosphide light emitting diode which emits visible red light when forward biased. Metal envelope with clear plastic lens.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max	3	V
Forward current (d.c.)	I_F	max.	70	mA
Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	125	mW
Luminous intensity (on-axis) at I_F = 10 mA	I_v	>	115	µcd
Wavelength at peak emission	λ_{pk}	>	630	nm
		<	690	nm
Angle between half-intensity directions	$\alpha_{50\%}$	typ.	110°	
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0, 32	°C/mW

MECHANICAL DATA Dimensions in mm

SOT-70B



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

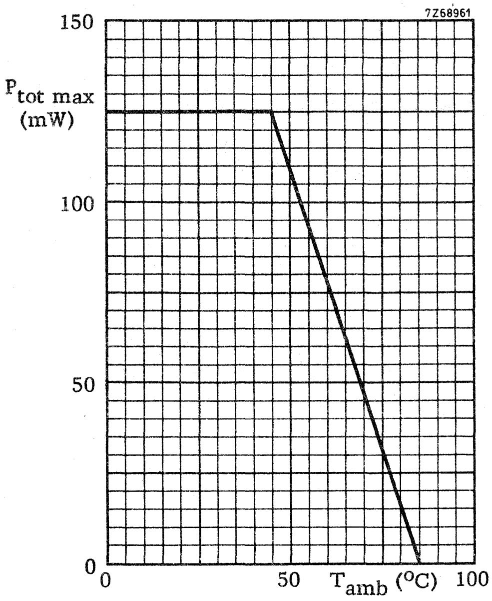
Voltage				
Continuous forward voltage	V_F	max.	1,75	V
Continuous reverse voltage	V_R	max.	3	V
Current				
Forward current (d.c.)	I_F	max.	70	mA
Temperature				
Storage temperature	T_{stg}		−40 to + 100	^{o}C
Operating junction temperature	T_j	max.	85	^{o}C
Power dissipation				
Total power dissipation up to $T_{amb} = 45\ ^{o}C$	P_{tot}	max.	125	mW
Soldering time				
$T_{sld} = 260\ ^{o}C$	t_{sld}	max.	7	s

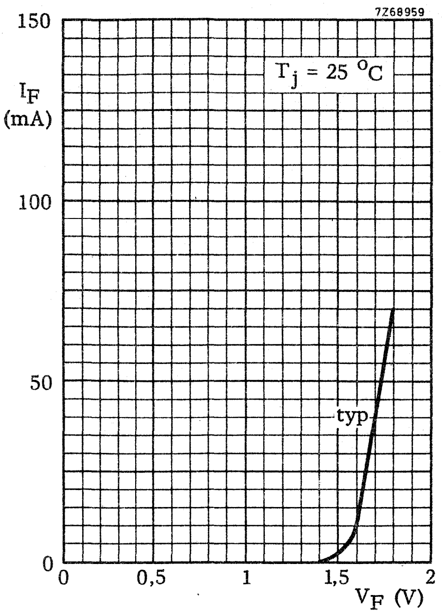
THERMAL RESISTANCE

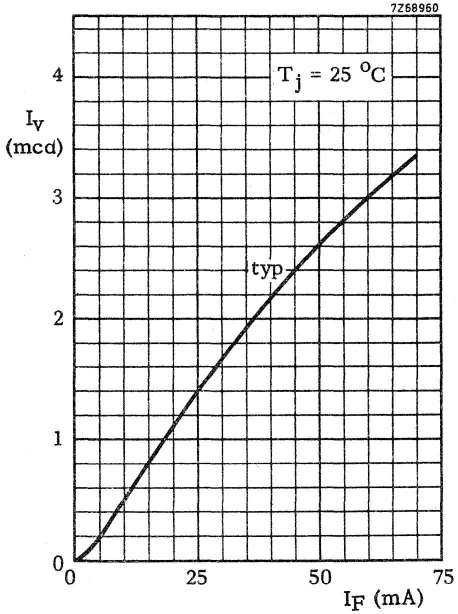
Fro junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,32	$^{o}C/mW$

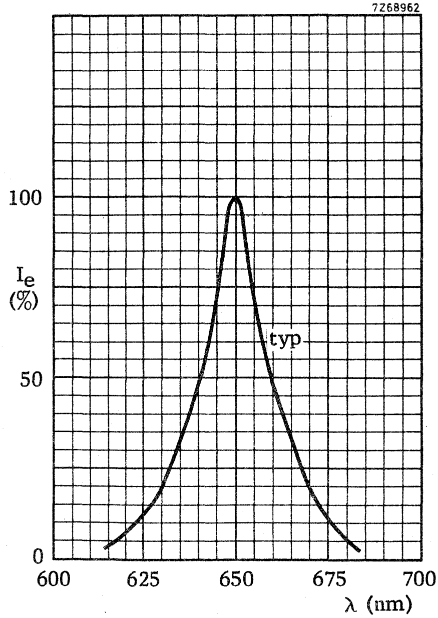
CHARACTERISTICS $T_j = 25\ ^{o}C$ unless otherwise specified

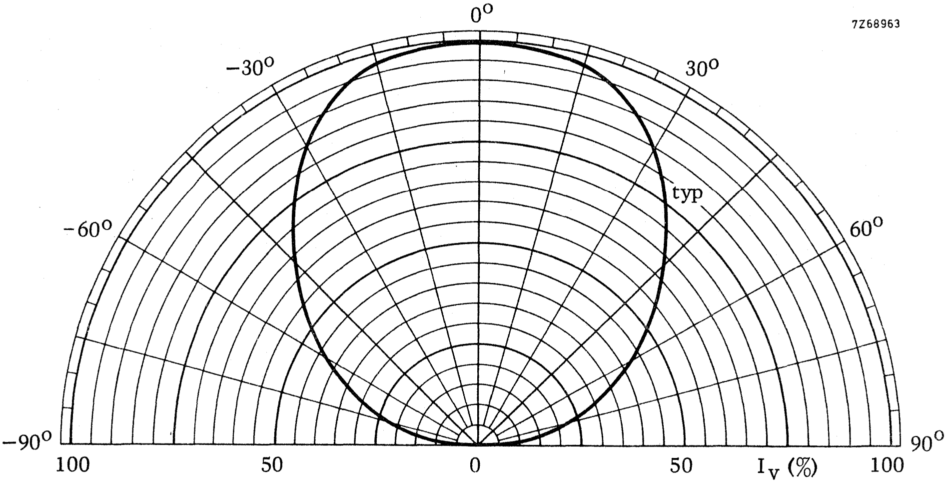
Forward voltage				
$I_F = 0,1$ mA	V_F	>	1	V
$I_F = 10$ mA	V_F	> <	1,5 1,75	V V
Reverse current				
$V_R = 3$ V	I_R	<	100	µA
Luminous intensity (on-axis)				
$I_F = 10$ mA	I_v	>	115	µcd
Wavelength at peak emission	λ_{pk}	> <	630 690	nm nm
Bandwidth at half height	$B_{50\%}$	typ. <	20 40	nm nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	> typ.	90^{o} 110^{o}	


7Z68961
150
100
50
0
$P_{tot\ max}$ (mW)
0
50
100
T_{amb} (°C)


7Z68959
T_j = 25 °C
150
100
50
0
I_F (mA)
typ
0
0,5
1
1,5
2
V_F (V)


7Z68960
T_j = 25 °C
4
3
2
1
0
I_V (mcd)
typ
0
25
50
75
I_F (mA)


7Z68962
100
50
0
I_e (%)
typ
600
625
650
675
700
λ (nm)


7Z68963
0°
−30°
30°
−60°
60°
−90°
90°
typ
100
50
0
50
100
I_V (%)

GaAsP RED LIGHT EMITTING DIODE

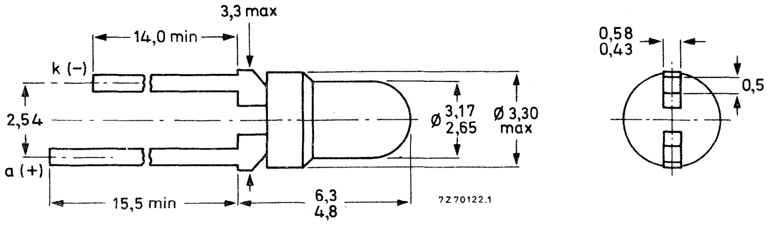
Gallium arsenide phosphide light emitting diode which emits visible red light when forward biased. The envelope is of light-diffusing red plastic, and has been designed for high-density arrays.

QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	50	mA
Total power dissipation up to T_{amb} = 37,5 °C	P_{tot}	max.	100	mW
Luminous intensity (on-axis) I_F = 20 mA	I_v	typ.	0,9	mcd
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Angle between half-intensity directions	$\alpha_{50\%}$	typ.	80°	
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0,625	°C/mW

MECHANICAL DATA

Dimensions in mm



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

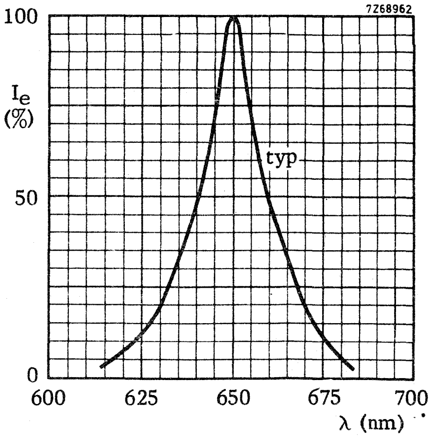
Voltage				
Continuous reverse voltage	V_R	max.	3	V
Current				
Forward current (d.c.)	I_F	max.	50	mA
Forward current (peak value) $t_p = 1\ \mu s$; $f = 300$ Hz	I_{FM}	max.	1000	mA
Temperature				
Storage temperature	T_{stg}		−55 to +100	°C
Junction temperature	T_j	max.	100	°C
Power dissipation				
Total power dissipation up to $T_{amb} = 37,5$ °C	P_{tot}	max.	100	mW

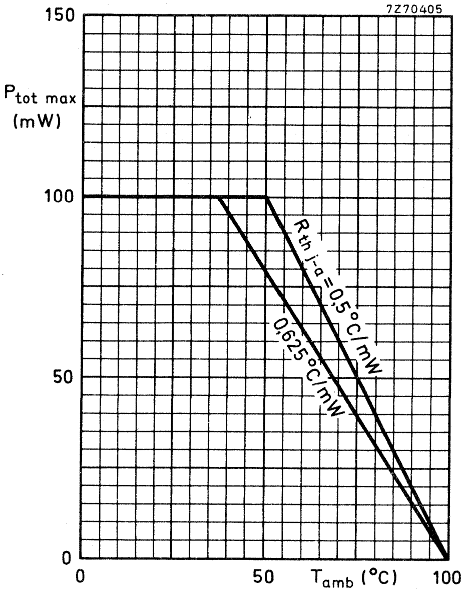
THERMAL RESISTANCE

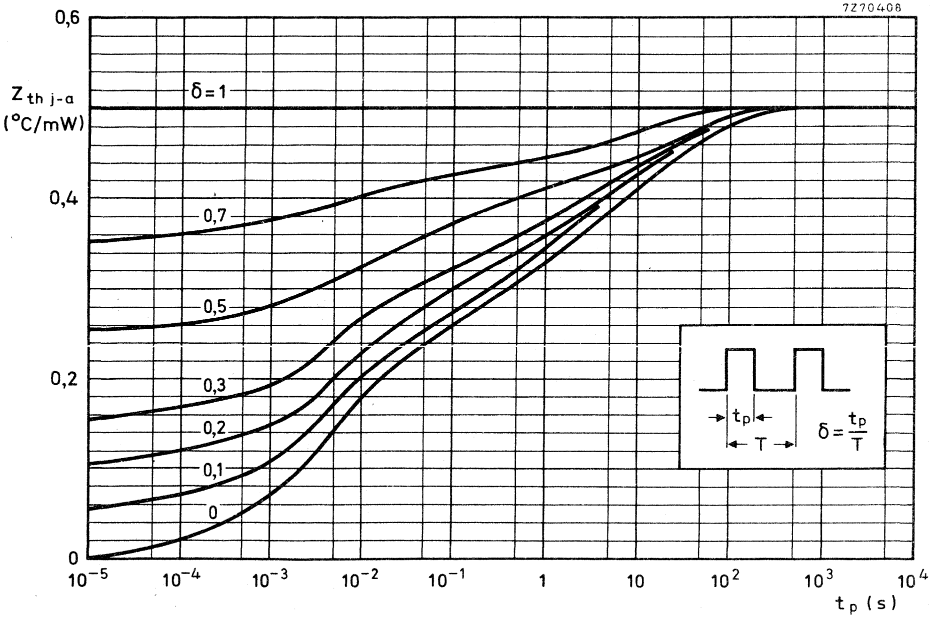
From junction to ambient, in free air	$R_{th\ j\text{-}a}$	=	0,625	°C/mW
mounted on a p.c. board	$R_{th\ j\text{-}a}$	=	0,500	°C/mW

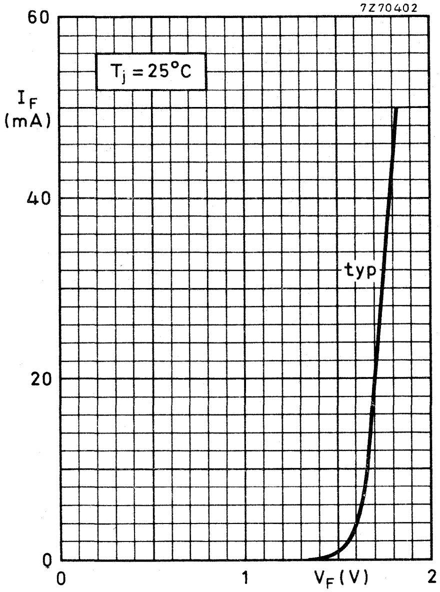
CHARACTERISTICS T_j = 25 °C unless otherwise specified

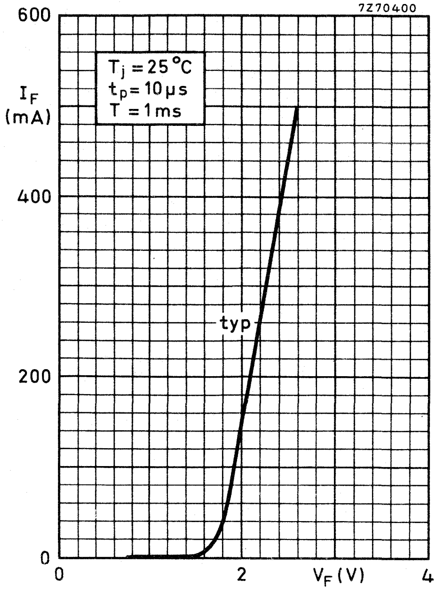
Forward voltage				
I_F = 20 mA	V_F	typ. <	1,7 2	V V
Negative temperature coefficient of V_F				
I_F = 20 mA	$\frac{-\Delta V_F}{\Delta T_j}$	typ.	1,6	mV/°C
I_F = 2 mA	$\frac{-\Delta V_F}{\Delta T_j}$	typ.	2	mV/°C
Reverse current				
V_R = 3 V	I_R	<	100	µA
Luminous intensity (on axis)				
I_F = 20 mA	I_v	typ.	0,9	mcd
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	typ.	60	pF
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Bandwidth at half height	$B_{50\%}$	typ.	20	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	80°	

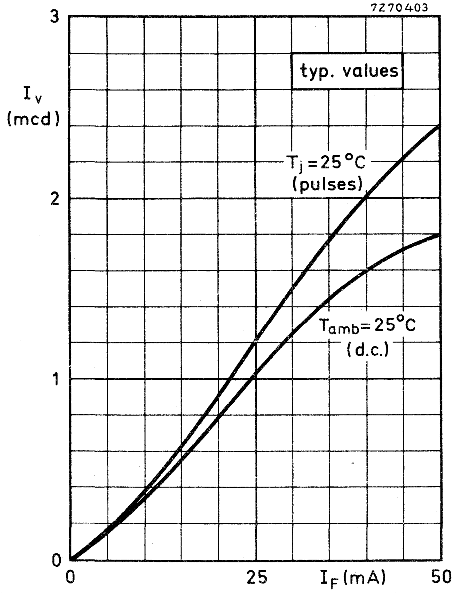


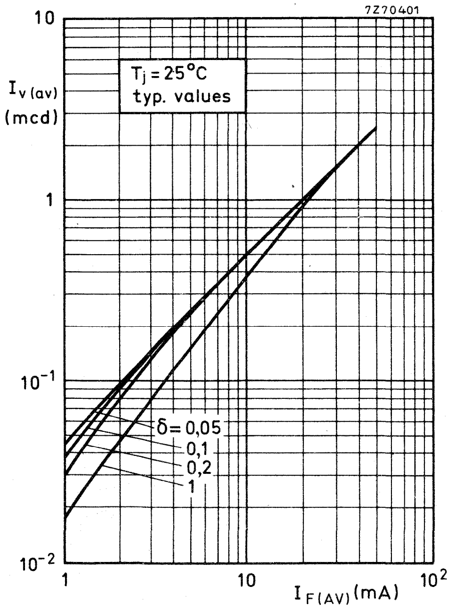

7Z70405
$P_{tot\ max}$ (mW)
150
100
50
0
0
50
T_{amb} (°C)
100
$R_{th\ j\text{-}a}$ = 0,5°C/mW
0,625°C/mW

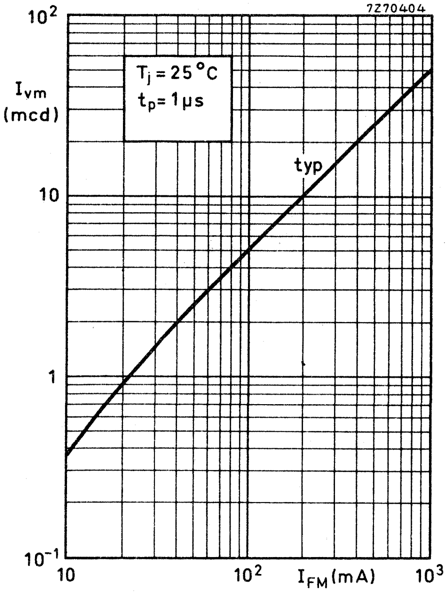

7Z70408
$Z_{th\ j\text{-}a}$ (°C/mW)
0,6
0,4
0,2
0
δ = 1
0,7
0,5
0,3
0,2
0,1
0
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
10^{3}
10^{4}
t_p (s)
t_p
T
$\delta = \frac{t_p}{T}$

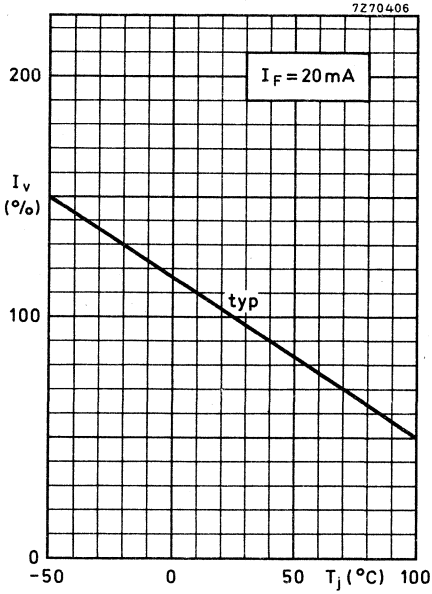

7Z70402
Tj = 25°C
IF (mA)
60
40
20
0
typ
0
1
VF (V)
2

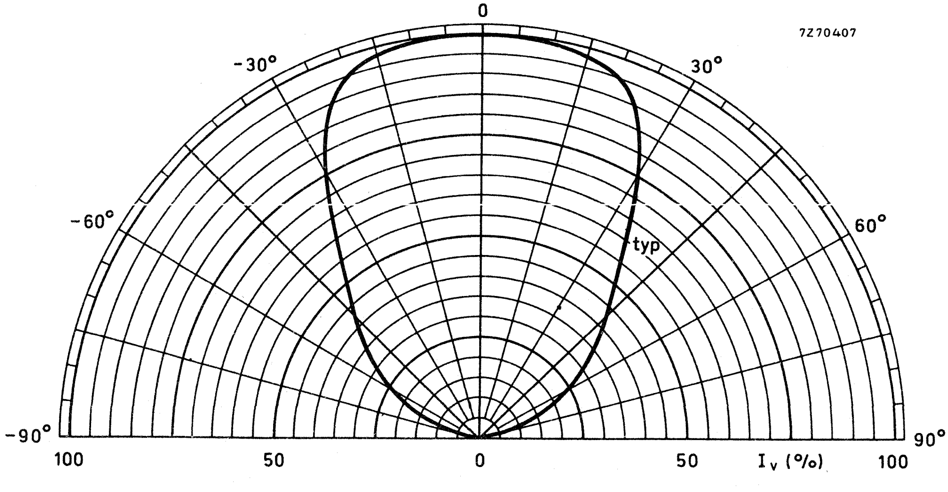

7Z70400
Tj = 25°C
tp = 10 μs
T = 1 ms
IF (mA)
600
400
200
0
typ
0
2
VF (V)
4


7Z70403
typ. values
Iv (mcd)
3
2
1
0
Tj = 25°C (pulses)
Tamb = 25°C (d.c.)
0
25
IF (mA)
50


7Z70401
Tj = 25°C
typ. values
Iv (av) (mcd)
10
1
10⁻¹
10⁻²
δ = 0,05
0,1
0,2
1
1
10
10²
IF(AV) (mA)


7Z70404
10^2
I_{vm} (mcd)
$T_j = 25\,°C$
$t_p = 1\,\mu s$
typ
10
1
10^{-1}
10
10^2
I_{FM} (mA)
10^3


7Z70406
200
$I_F = 20\,mA$
I_v (%)
typ
100
0
−50
0
50
T_j (°C)
100


0
7Z70407
−30°
30°
−60°
60°
typ
−90°
90°
100
50
0
50
I_v (%)
100

GaAsP RED LIGHT EMITTING DIODE

See data CQY24 ; CQY 61.

Photocouplers

PHOTOCOUPLERS

Optically coupled isolators consisting of an infra-red emitting GaAs diode and a silicon n-p-n phototransistor. Plastic envelopes. Suitable for TTL integrated circuits.
The CNY22 is the 5 pin version with an accessable transistor base; the CNY42 is the 4 pin version without accessable base.

QUICK REFERENCE DATA

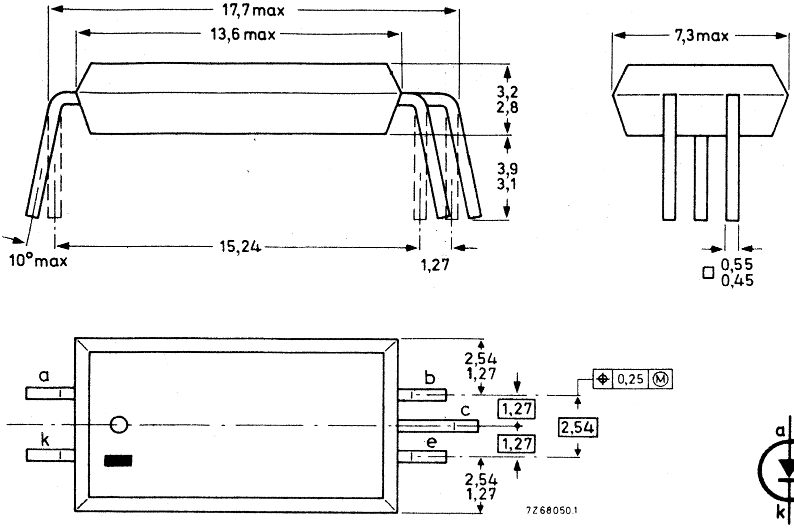
Diode				
Reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} =65 °C	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector cut-off current (dark) V_{CE} = 10 V; diode: $I_F = 0$	I_{CEO}	<	100	nA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Photocoupler				
Output/input d.c. current transfer ratio I_F = 8 mA; V_{CE} = 5 V; (I_B = 0)	I_C/I_F	>	0,25	
Collector-emitter saturation voltage I_F = 8 mA; I_C = 2 mA; (I_B = 0)	V_{CEsat}	<	0,4	V
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	2800	V

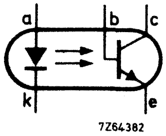
MECHANICAL DATA See page 2.

MECHANICAL DATA

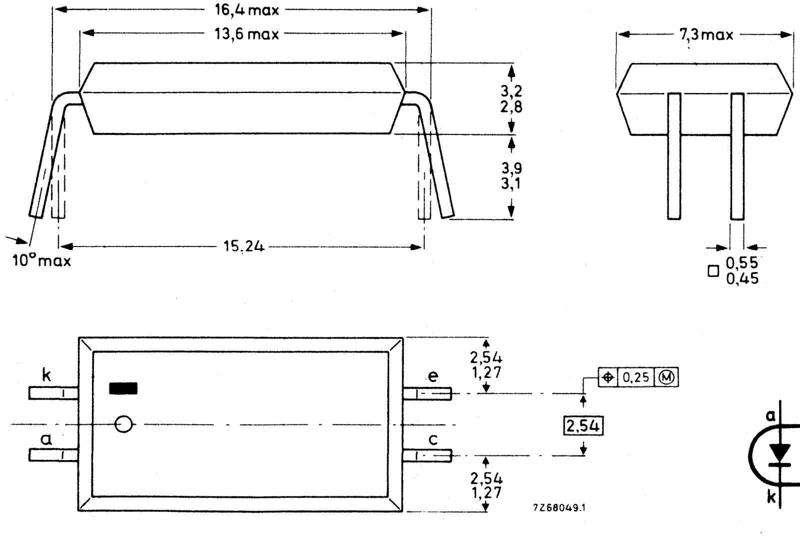
Dimensions in mm

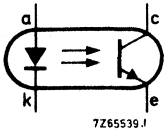
CNY22





CNY42





RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Diode

Reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 65 °C	P_{tot}	max.	50	mW
Junction temperature	T_j	max.	125	°C

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector-base voltage (open emitter) (CNY22)	V_{CBO}	max.	50	V
Emitter-collector voltage (open base)	V_{ECO}	max.	6	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Junction temperature	T_j	max.	125	°C

Photocoupler

Storage temperature	T_{stg}	-55 to +125 °C

THERMAL RESISTANCE

From junction to ambient in free air

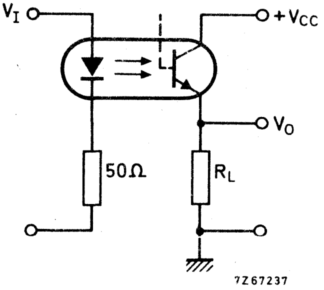
-diode	$R_{th\ j-a}$	1,2 °C/mW
-transistor	$R_{th\ j-a}$	0,5 °C/mW

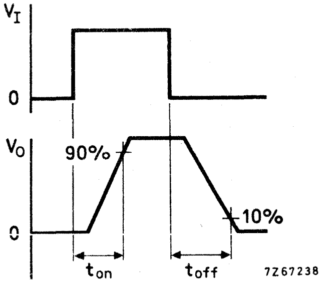
CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode				
Forward voltage, I_F = 8 mA	V_F	typ. <	1,2 1,6	V V
Reverse current, V_R = 2 V	I_R	<	100	μA
Transistor (I_B = 0)				
Collector cut-off current (dark) V_{CE} = 10 V; diode: I_F = 0	I_{CEO}	< typ.	100 5	nA nA
Photocoupler (I_B = 0) 1)				
Output/input d.c. current transfer ratio I_F = 8 mA; V_{CE} = 5 V	I_C/I_F	> typ.	0,25 0,5	2) 3)
Collector-emitter saturation voltage I_F = 8 mA; I_C = 2 mA; T_{amb} = 25 °C	V_{CEsat}	typ. <	0,17 0,4	V V
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	2800	V 4)
Capacitance between input and output I_F = 0; V = 0; f = 1 MHz	C_{io}	typ.	1	pF
Insulation resistance between input and output V_{IO} = 1000 V	r_{IO}	> typ.	10^{10} 10^{12}	Ω Ω
Turn-on time (circuit below) I_{CM} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω	t_{on}	typ.	5	μs
Turn-off time (circuit below) I_{CM} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω	t_{off}	typ.	5	μs

Data on V_I:
$t_r = t_f$ = 20 ns
t_p = 30 μs
f = 500 Hz





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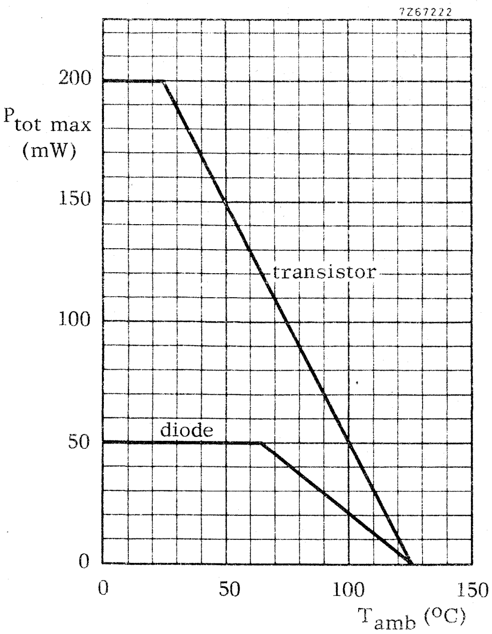
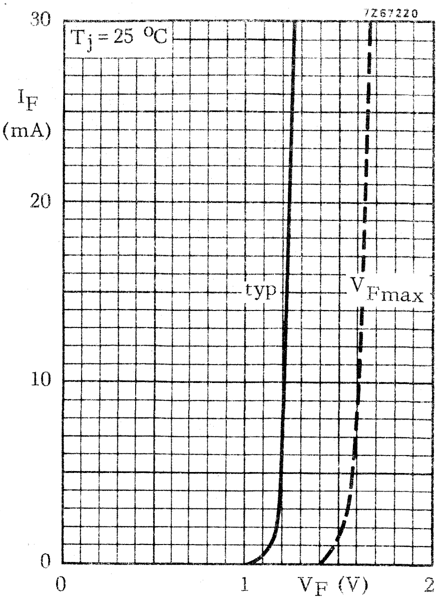
1) Where the phototransistor receives light from the diode the O (for open base) has been omitted from the symbols.

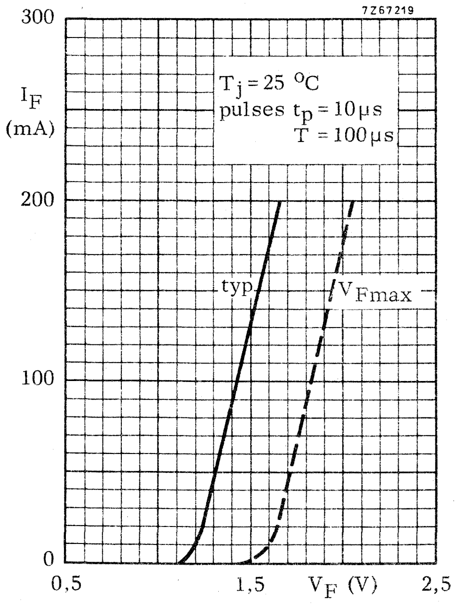
2) Measured with pulses: t_p = 100 μs; T = 1 ms.

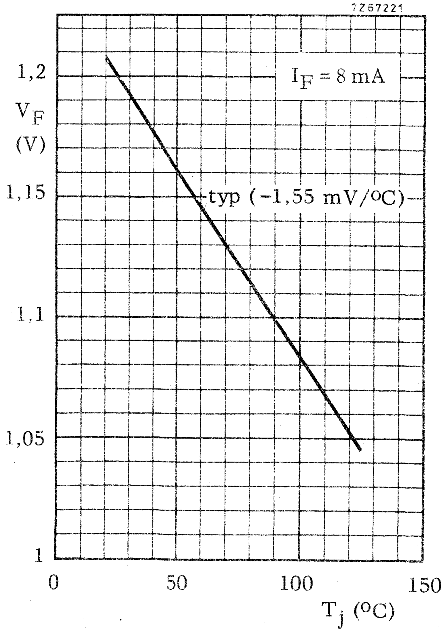
3) Aging of the light-emitting diode decreases the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

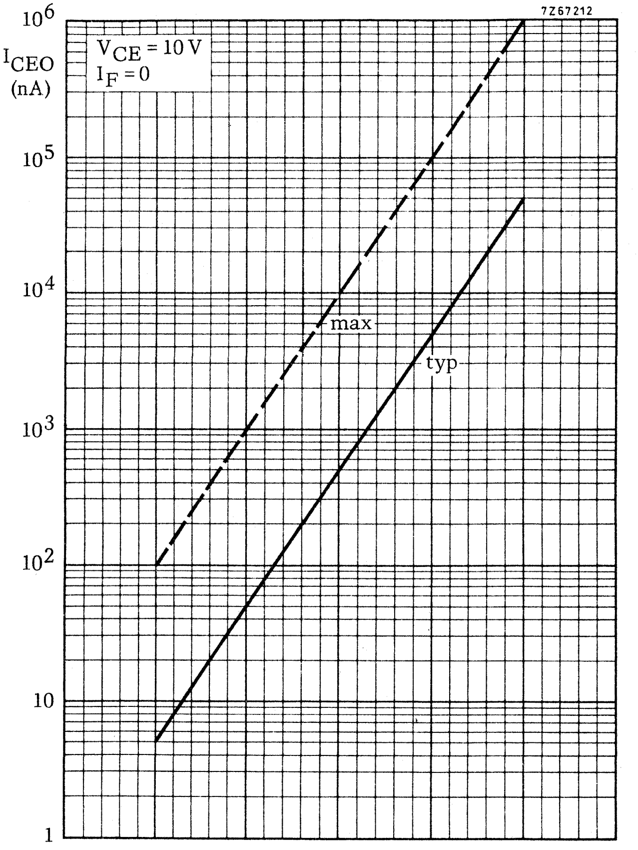
4) Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

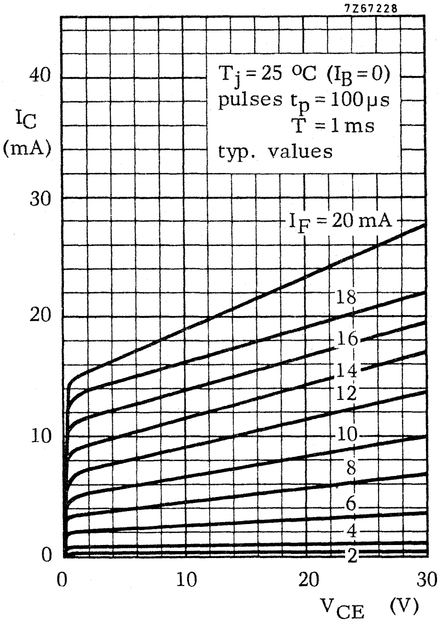

7Z67222
$P_{tot\ max}$ (mW)
200
150
100
50
0
transistor
diode
0
50
100
150
T_{amb} (°C)

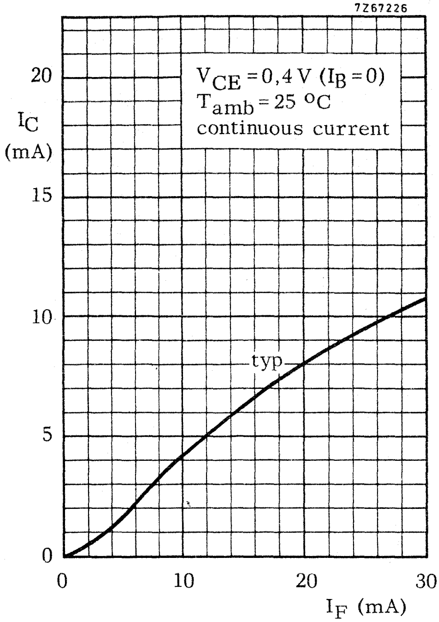

7Z67220
$T_j = 25$ °C
I_F (mA)
30
20
10
0
typ
V_{Fmax}
0
1
V_F (V)
2

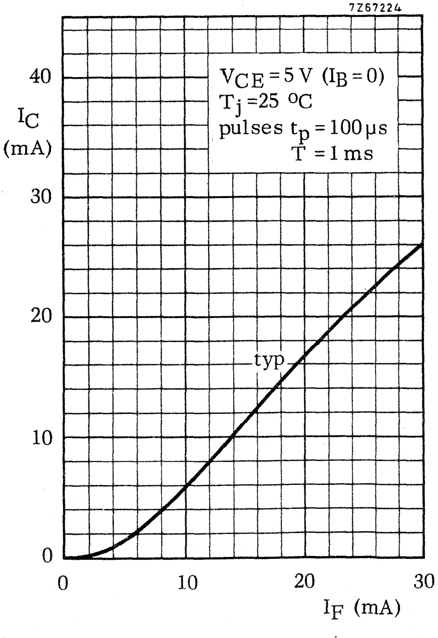

7Z67219
300
I_F (mA)
200
100
0
$T_j = 25$ °C
pulses $t_p = 10\,\mu s$
$T = 100\,\mu s$
typ
V_{Fmax}
0,5
1,5
V_F (V)
2,5

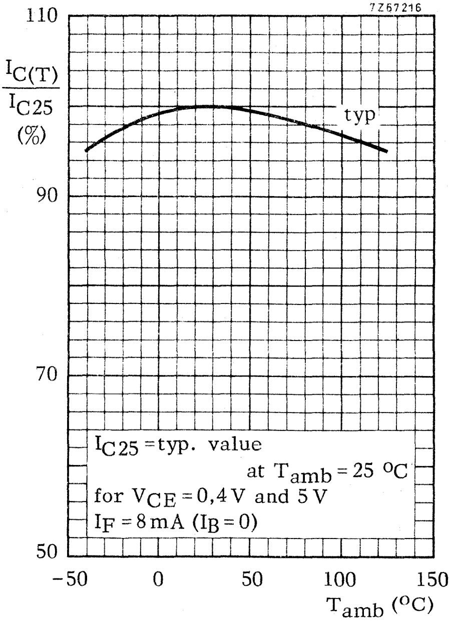

7Z67221
1,2
V_F (V)
1,15
1,1
1,05
1
$I_F = 8$ mA
typ (−1,55 mV/°C)
0
50
100
150
T_j (°C)

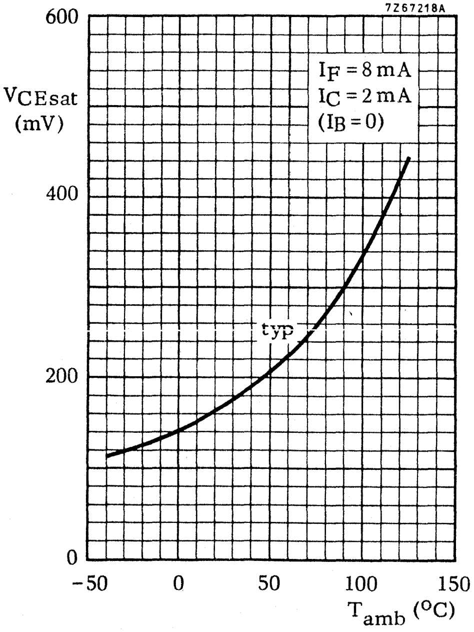

7Z67212
I_{CEO}
(nA)
$V_{CE} = 10\,V$
$I_F = 0$
10^6
10^5
10^4
10^3
10^2
10
1
max
typ
0
50
100
T_j (°C)
150


7Z67228
T_j = 25 °C (I_B = 0)
pulses t_p = 100 µs
T = 1 ms
typ. values
I_C (mA)
V_{CE} (V)
I_F = 20 mA
18
16
14
12
10
8
6
4
2
0
10
20
30
40


7Z67226
V_{CE} = 0,4 V (I_B = 0)
T_{amb} = 25 °C
continuous current
I_C (mA)
I_F (mA)
typ
0
5
10
15
20
0
10
20
30


7Z67224
V_{CE} = 5 V (I_B = 0)
T_j = 25 °C
pulses t_p = 100 µs
T = 1 ms
I_C (mA)
I_F (mA)
typ
0
10
20
30
40


7Z67216
110
90
70
50
$\frac{I_{C(T)}}{I_{C25}}$ (%)
typ
I_{C25} = typ. value at T_{amb} = 25 °C
for V_{CE} = 0,4 V and 5 V
I_F = 8 mA (I_B = 0)
−50
0
50
100
150
T_{amb} (°C)


7Z67218A
600
400
200
0
V_{CEsat} (mV)
I_F = 8 mA
I_C = 2 mA
(I_B = 0)
typ
−50
0
50
100
150
T_{amb} (°C)

PHOTOCOUPLERS

Optically coupled isolators consisting of an infra-red emitting GaAs diode and a silicon n-p-n phototransistor. Plastic envelopes. Suitable for TTL integrated circuits.
The CNY23 is the 5 pin version with an accessable transistor base; the CNY43 is the 4 pin version without accessable base.

QUICK REFERENCE DATA

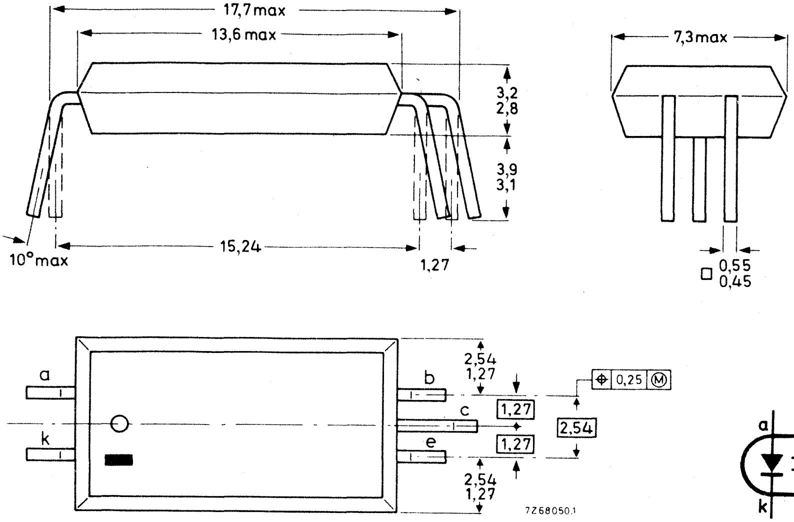
Diode				
Reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 65 °C	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector cut-off current (dark) V_{CE} = 10 V; diode: I_F = 0	I_{CEO}	<	100	nA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Photocoupler				
Output/input d.c. current transfer ratio I_F = 8 mA; V_{CE} = 5 V; (I_B = 0)	I_C/I_F	>	0,5	
Collector-emitter saturation voltage I_F = 8 mA; I_C = 4 mA; (I_B =0)	V_{CEsat}	<	0,4	V
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	2000	V

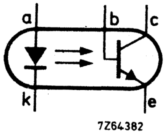
MECHANICAL DATA See page 2.

MECHANICAL DATA

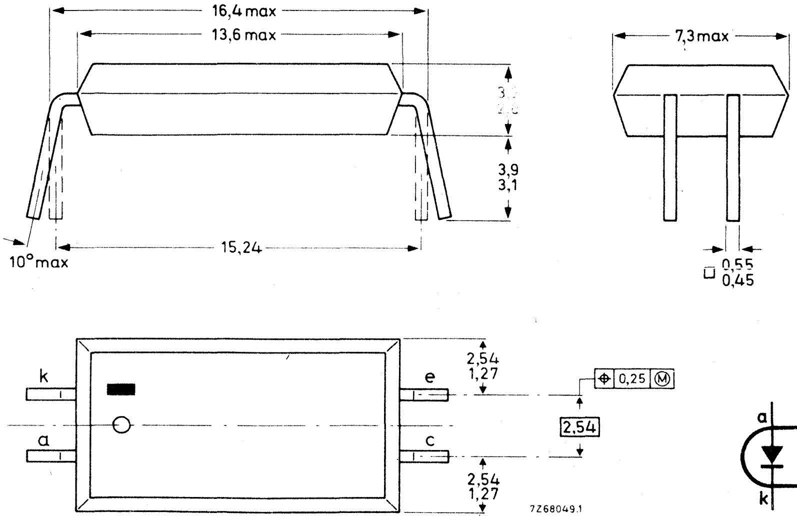
Dimensions in mm

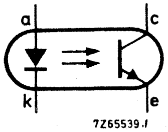
CNY23





CNY43





RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Diode				
Reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 65 °C	P_{tot}	max.	50	mW
Junction temperature	T_j	max.	125	°C
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter) (CNY23)	V_{CBO}	max.	40	V
Emitter-collector voltage (open base)	V_{ECO}	max.	6	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max	200	mW
Junction temperature	T_j	max.	125	°C
Photocoupler				
Storage temperature	T_{stg}		−55 to +125 °C	

THERMAL RESISTANCE

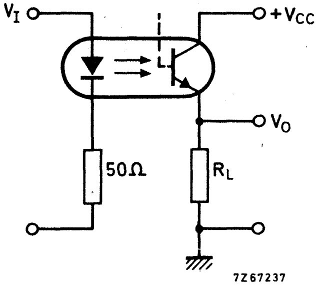
From junction to ambient in free air		
−diode	$R_{th\ j\text{-}a}$	1,2 °C/mW
−transistor	$R_{th\ j\text{-}a}$	0,5 °C/mW

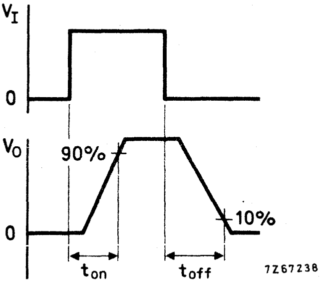
CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode					
Forward voltage, I_F = 8 mA	V_F	typ.	1,2	V	
		<	1,6	V	
Reverse current, V_R = 2 V	I_R	<	100	μA	
Transistor (I_B = 0)					
Collector cut-off current (dark) V_{CE} = 10 V; diode: I_F = 0	I_{CEO}	<	100	nA	
		typ.	5	nA	
Photocoupler (I_B = 0) ¹)					
Output/input d.c. current transfer ratio I_F = 8 mA; V_{CE} = 5 V	I_C/I_F	>	0,5		²) ³)
		typ.	1		
Collector-emitter saturation voltage I_F = 8 mA; I_C = 4 mA; T_{amb} = 25 °C	V_{CEsat}	typ.	0,17	V	
		<	0,4	V	
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	2000	V	⁴)
Capacitance between input and output I_F = 0; V = 0; f = 1 MHz	C_{io}	typ.	1	pF	
Insulation resistance between input and output V_{IO} = 1000 V	r_{IO}	>	10^{10}	Ω	
		typ.	10^{12}	Ω	
Turn-on time (circuit below) I_{CM} = 4 mA; V_{CC} = 5 V; R_L = 100 Ω	t_{on}	typ.	5	μs	
Turn-off time (circuit below) I_{CM} = 4 mA; V_{CC} = 5 V; R_L = 100 Ω	t_{off}	typ.	5	μs	

Data on V_I:
$t_r = t_f$ = 20 ns
t_p = 30 μs
f = 500 Hz





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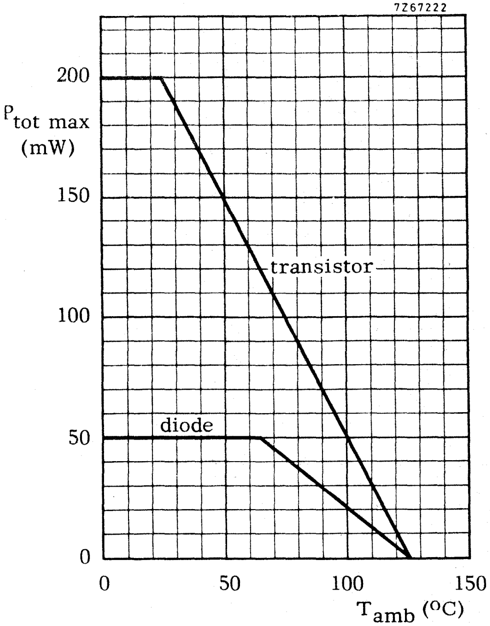
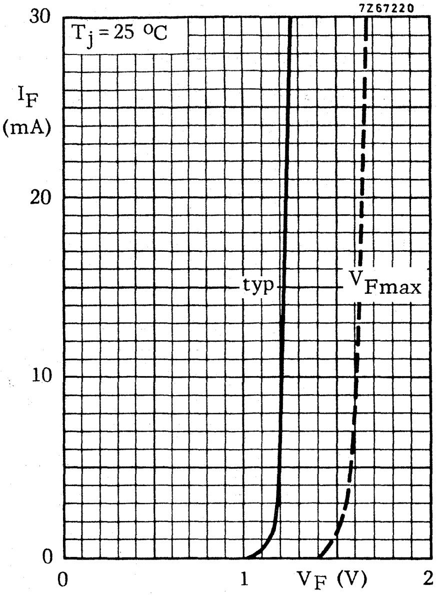
¹) Where the phototransistor receives light from the diode the O (for open base) has been omitted from the symbols.

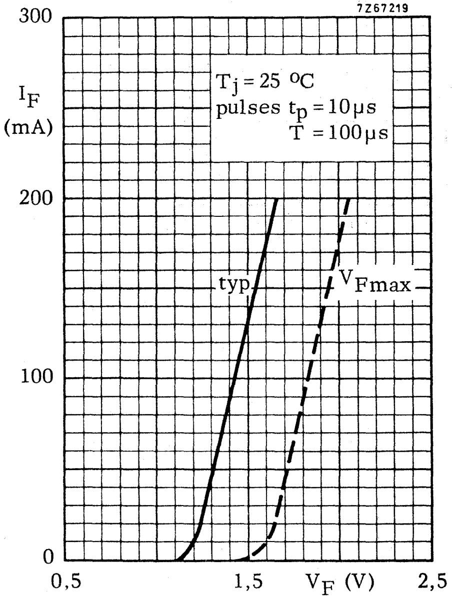
²) Measured with pulses: t_p = 100 μs; T = 1 ms.

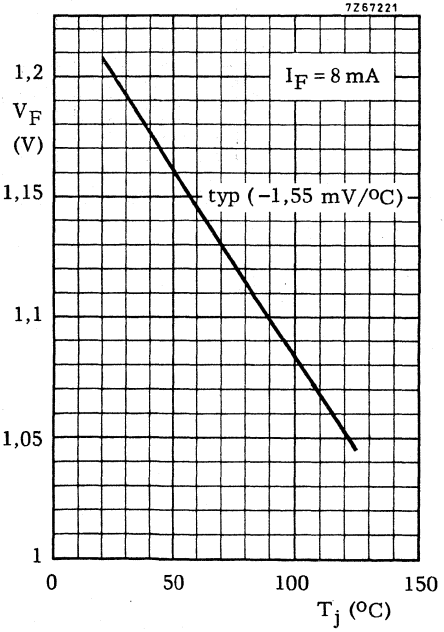
³) Aging of the light-emitting diode decreases the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

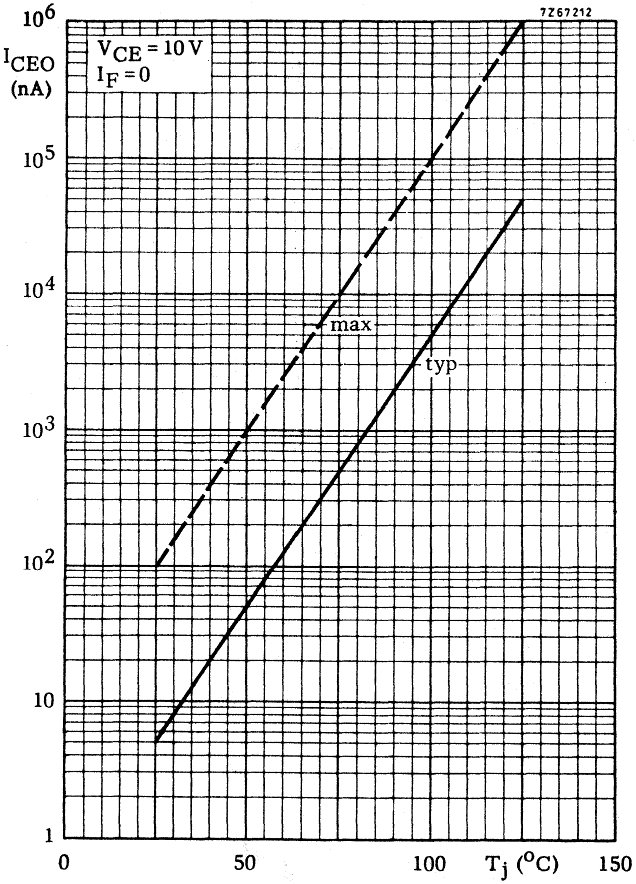
⁴) Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

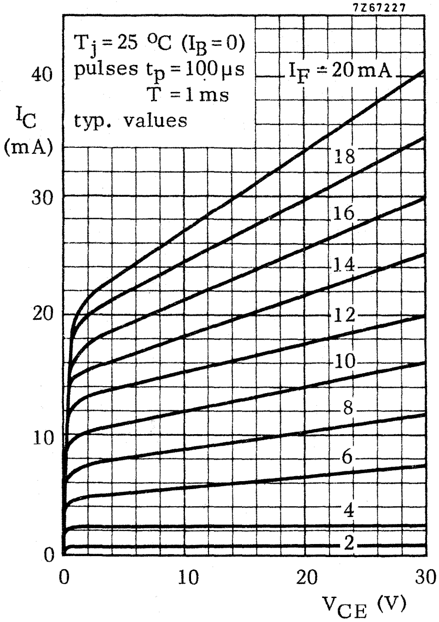

7Z67222
$P_{tot\ max}$ (mW)
200
150
100
50
0
transistor
diode
0
50
100
150
T_{amb} (°C)

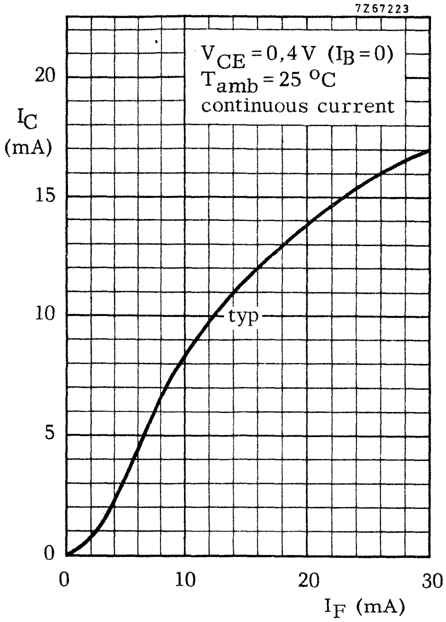

7Z67220
$T_j = 25$ °C
I_F (mA)
30
20
10
0
typ
V_{Fmax}
0
1
V_F (V)
2

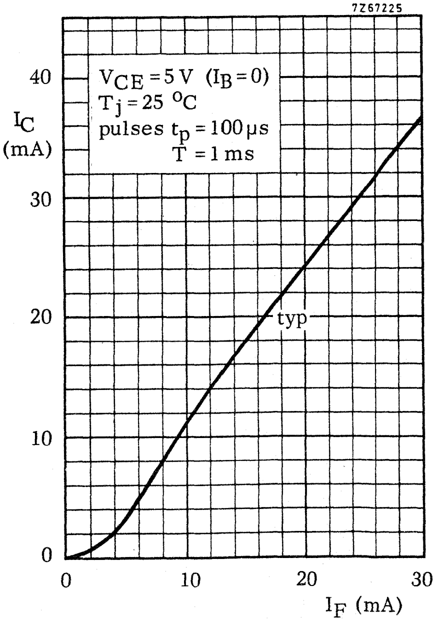

7Z67219
I_F (mA)
300
200
100
0
$T_j = 25$ °C
pulses $t_p = 10\,\mu s$
$T = 100\,\mu s$
typ
V_{Fmax}
0,5
1,5
V_F (V)
2,5

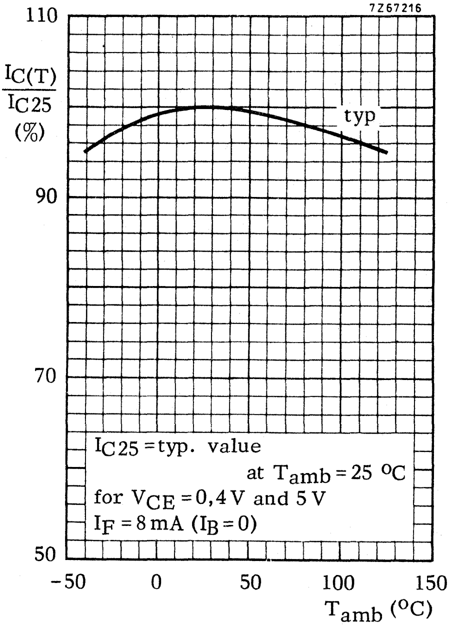

7Z67221
V_F (V)
1,2
1,15
1,1
1,05
1
$I_F = 8$ mA
typ (−1,55 mV/°C)
0
50
100
150
T_j (°C)

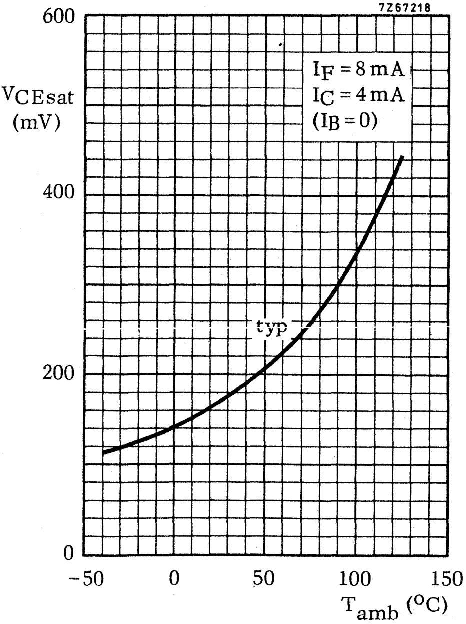

7Z67212
10^6
I_{CEO}
(nA)
$V_{CE} = 10\,V$
$I_F = 0$
10^5
10^4
10^3
10^2
10
1
max
typ
0
50
100
T_j (°C)
150


7Z67227
$T_j = 25\ ^oC$ ($I_B = 0$)
pulses $t_p = 100\,\mu s$
$T = 1\,ms$
typ. values
$I_F = 20\,mA$
18
16
14
12
10
8
6
4
2
I_C (mA)
0
10
20
30
40
0
10
20
30
V_{CE} (V)


7Z67223
$V_{CE} = 0{,}4\,V$ ($I_B = 0$)
$T_{amb} = 25\ ^oC$
continuous current
typ
I_C (mA)
0
5
10
15
20
0
10
20
30
I_F (mA)


7Z67225
$V_{CE} = 5\,V$ ($I_B = 0$)
$T_j = 25\ ^oC$
pulses $t_p = 100\,\mu s$
$T = 1\,ms$
typ
I_C (mA)
0
10
20
30
40
0
10
20
30
I_F (mA)


7Z67216
110
90
70
50
$\frac{I_{C(T)}}{I_{C25}}$ (%)
typ
I_{C25} = typ. value at T_{amb} = 25 °C
for V_{CE} = 0,4 V and 5 V
I_F = 8 mA (I_B = 0)
−50
0
50
100
150
T_{amb} (°C)


7Z67218
600
400
200
0
V_{CEsat} (mV)
I_F = 8 mA
I_C = 4 mA
(I_B = 0)
typ
−50
0
50
100
150
T_{amb} (°C)

PHOTOCOUPLER

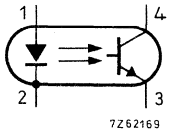
Optically coupled isolater consisting of an infra-red emitting GaAs diode and a silicon n-p-n phototransistor. TO-12 envelope. Suitable for TTL integrated circuits.

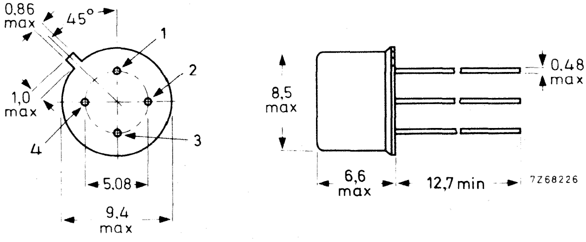
QUICK REFERENCE DATA

Diode				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 100 °C	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector cut-off current (dark) V_{CE} = 15 V; diode: I_F = 0	I_{CEO}	<	100	nA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	80	mW
Photocoupler				
Output/input d.c. current transfer ratio I_F = 10 mA; V_{CE} = 10 V	I_C/I_F	>	0, 3	
Collector-emitter saturation voltage I_F = 10 mA; I_C = 3 mA	V_{CEsat}	<	0, 4	V
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	1000	V

MECHANICAL DATA Dimensions in mm

TO-12





Cathode (2) connected to case

Max. lead diameter is guaranteed only for 12,7 mm.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Diode

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 100 °C	P_{tot}	max.	50	mW
Junction temperature	T_j	max.	125	°C

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Emitter-collector voltage (open base)	V_{ECO}	max.	8	V
Collector current (d.c.)	I_C	max.	30	mA
→ Collector current (peak value)	I_{CM}	max.	40	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	80	mW
Junction temperature	T_j	max	125	°C

Photocoupler

Storage temperature	T_{stg}		−55 to +125	°C
Solder temperature ($t < 10$ s)	T	max.	260	°C

THERMAL RESISTANCE

From junction to ambient in free air			
- diode	$R_{th\ j\text{-}a}$	0, 5	°C/mW
- transistor	$R_{th\ j\text{-}a}$	1, 2	°C/mW
From junction to case, diode	$R_{th\ j\text{-}c}$	0, 15	°C/mW

CHARACTERISTICS

$T_j = 25\ ^{\circ}C$ unless otherwise specified

Diode

Forward voltage, $I_F = 10$ mA	V_F		1 to 1,5	V	
		typ.	1,2	V	
$I_F = 30$ mA	V_F	typ.	1,3	V	
		<	1,6	V	
$I_F = 200$ mA	V_F	typ.	1,5	V	
Reverse current, $V_R = 3$ V	I_R	<	20	µA	
Diode capacitance, f = 1 MHz; V = 0	C_d	typ.	50	pF	

Transistor

Collector cut-off current (dark) at $I_F = 0$					
$V_{CE} = 5$ V	I_{CEO}	typ.	3	nA	
$V_{CE} = 15$ V	I_{CEO}	typ.	10	nA	
		<	100	nA	
$V_{CE} = 15$ V; $T_j = 85\ ^{\circ}C$	I_{CEO}	typ.	10	µA	
		<	100	µA	

Photocoupler [1]

Output/input d.c. current transfer ratio $I_F = 10$ mA; $V_{CE} = 10$ V $t_p = 80$ µs; T = 10 ms	I_C/I_F	>	0,3		[2]
		typ.	0,6		
Collector-emitter saturation voltage					
$I_F = 10$ mA; $I_C = 3$ mA; $T_{amb} = 25\ ^{\circ}C$	V_{CEsat}	<	0,4	V	
$I_F = 15$ mA; $I_C = 4,6$ mA; $T_{amb} = 25\ ^{\circ}C$	V_{CEsat}	<	0,4	V	
Forward voltage for $I_C = 10$ µA; $V_{CE} = 10$ V	V_F	>	0,9	V	
		typ.	1,0	V	
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	1000	V	[3]
Insulation resistance between input and output $V_{IO} = 500$ V	r_{IO}	>	10^{10}	Ω	
		typ.	10^{11}	Ω	

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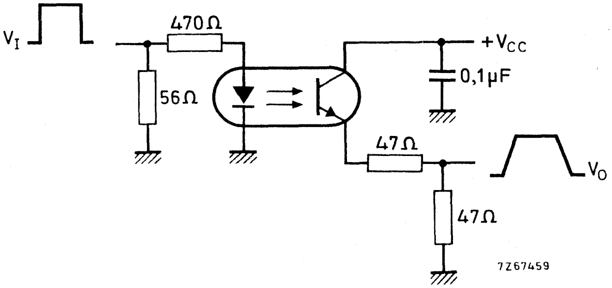
[1] Where the phototransistor receives light from the diode, the O (for open base) has been omitted from the symbols.

[2] Aging of the light-emitting diode reduces the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

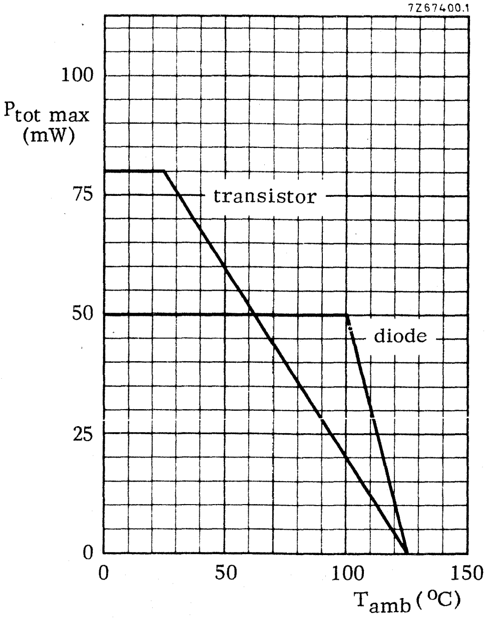
[3] Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Rise time of output voltage (circuit below) I_{CM} = 2 mA; V_{CC} = 10 V	t_r	typ.	2	µs [1]
Fall time of output voltage (circuit below) I_{CM} = 2 mA; V_{CC} = 10 V	t_f	typ.	2	µs [1]



Data on V_I:
$t_r = t_f$ = 20 ns [1]
t_p = 30 µs
f = 500 Hz



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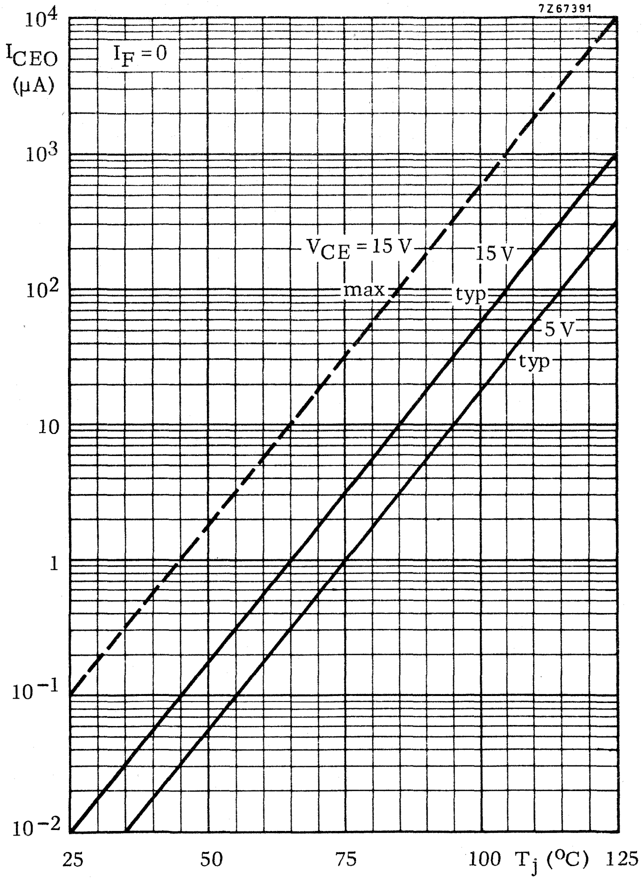
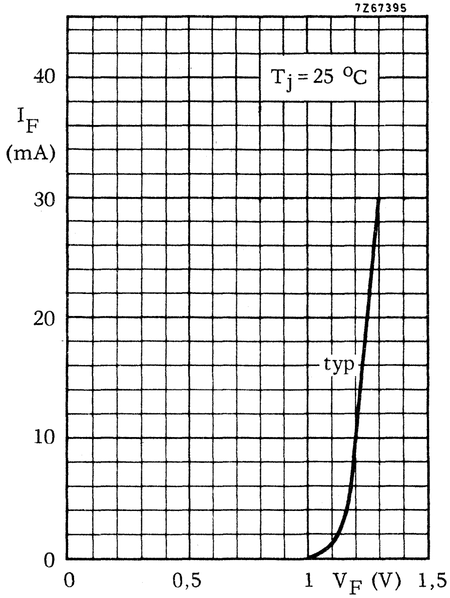
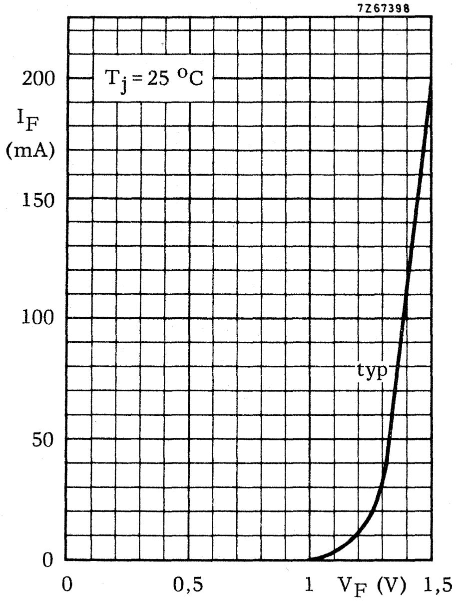
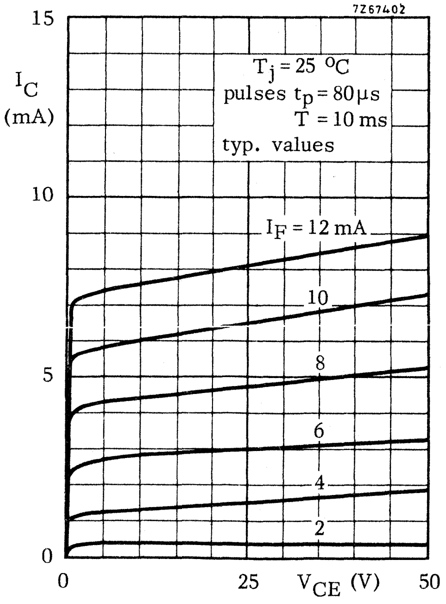
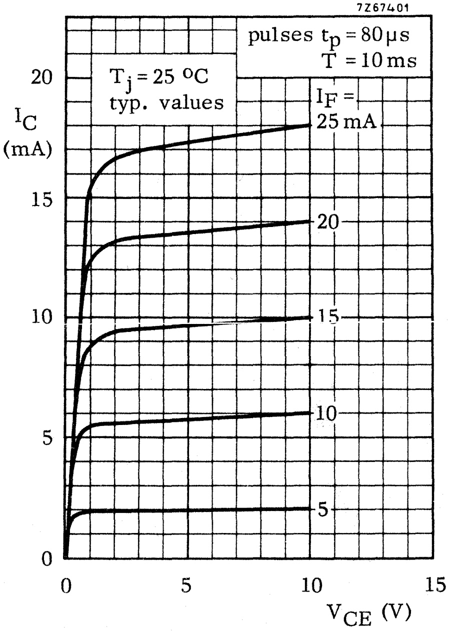
[1] Between the 10% and 90% of the edges.

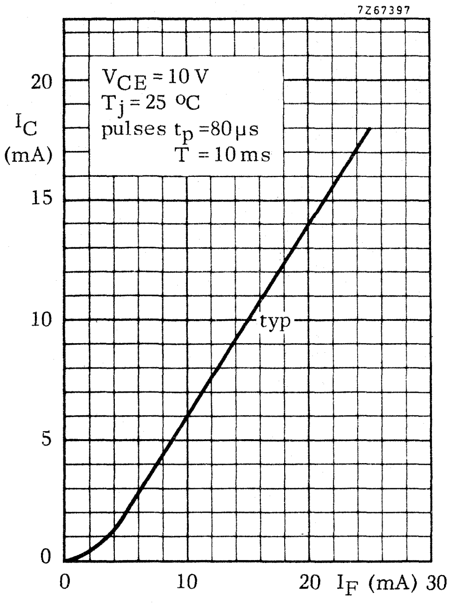

7Z67391
I_{CEO} (μA)
10^4
10^3
10^2
10
1
10^{-1}
10^{-2}
$I_F = 0$
$V_{CE} = 15$ V
max
15 V
typ
5 V
typ
25
50
75
100
T_j (°C)
125

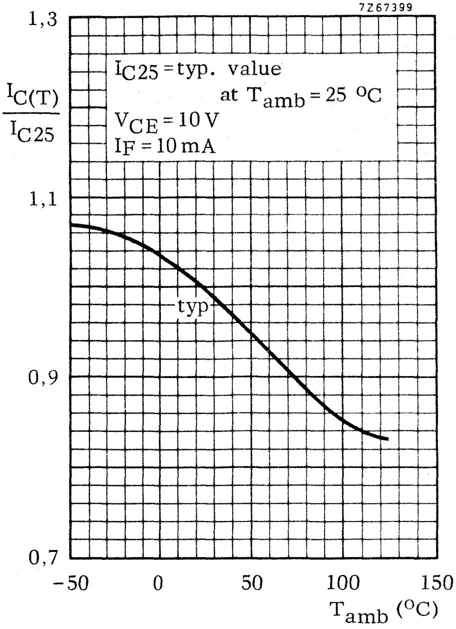

7Z67395
$T_j = 25\ ^oC$
I_F (mA)
40
30
20
10
0
typ
0
0,5
1
V_F (V)
1,5

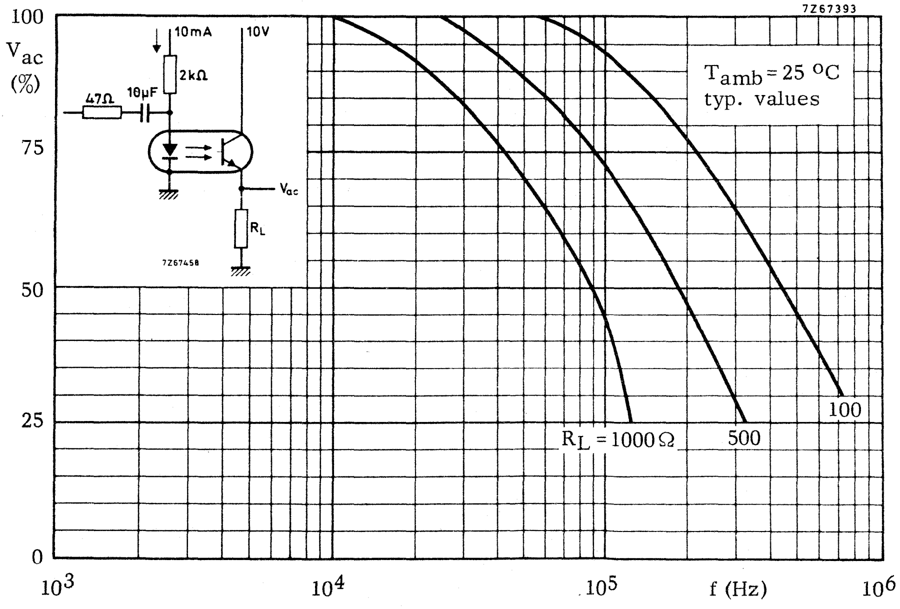

7Z67398
$T_j = 25\ ^oC$
I_F (mA)
200
150
100
50
0
typ
0
0,5
1
V_F (V)
1,5

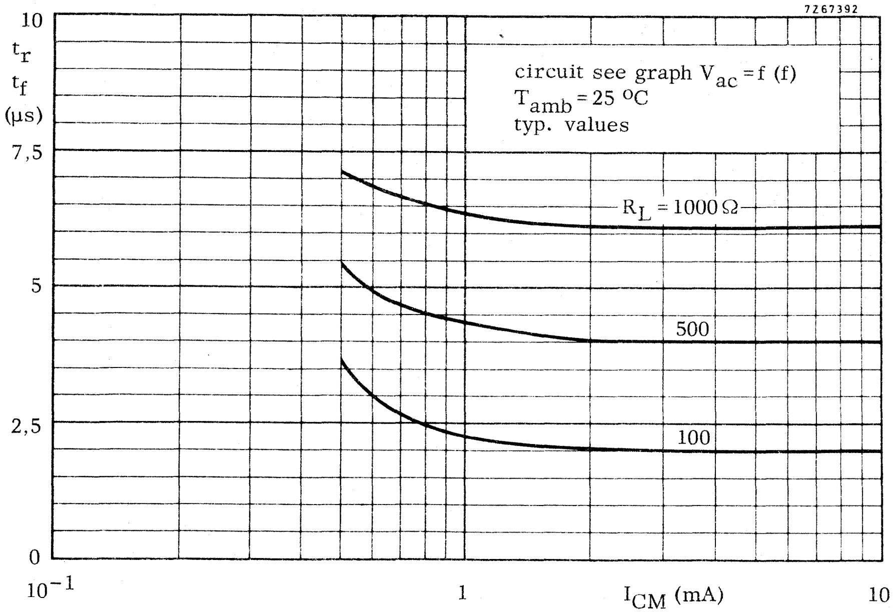

7Z67402
$T_j = 25\ ^oC$
pulses $t_p = 80\,\mu s$
$T = 10$ ms
typ. values
I_C (mA)
15
10
5
0
$I_F = 12$ mA
10
8
6
4
2
0
25
V_{CE} (V)
50

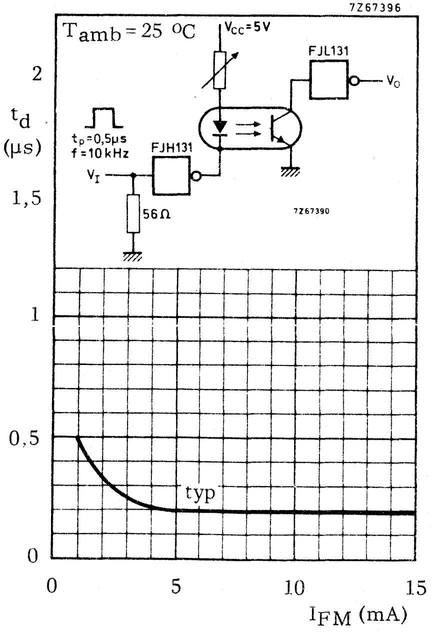

7Z67401
pulses $t_p = 80\,\mu s$
$T = 10$ ms
$T_j = 25\ ^oC$
typ. values
$I_F =$
25 mA
20
15
10
5
I_C (mA)
20
15
10
5
0
0
5
10
15
V_{CE} (V)

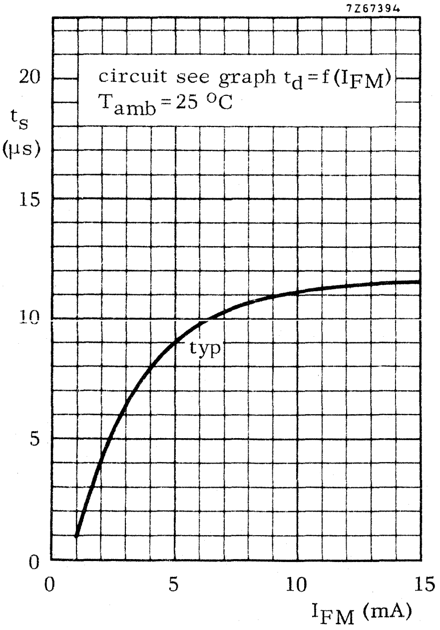

7Z67397
$V_{CE} = 10$ V
$T_j = 25$ °C
pulses $t_p = 80$ µs
$T = 10$ ms
I_C (mA)
20
15
10
5
0
typ
0
10
20
I_F (mA)
30


7Z67399
I_{C25} = typ. value at $T_{amb} = 25$ °C
$V_{CE} = 10$ V
$I_F = 10$ mA
$\frac{I_{C(T)}}{I_{C25}}$
1,3
1,1
0,9
0,7
typ
−50
0
50
100
150
T_{amb} (°C)


7Z67393
$T_{amb} = 25$ °C
typ. values
V_{ac} (%)
100
75
50
25
0
10mA
10V
2kΩ
47Ω
10µF
V_{ac}
R_L
7Z67458
$R_L = 1000\,\Omega$
500
100
10^3
10^4
10^5
f (Hz)
10^6


7Z67392
10
t_r
t_f
(μs)
7,5
5
2,5
0
10^{-1}
1
10
I_{CM} (mA)
circuit see graph V_{ac} = f (f)
T_{amb} = 25 °C
typ. values
R_L = 1000 Ω
500
100


7Z67396
T_{amb} = 25 °C
V_{CC} = 5V
FJL131
V_O
t_p = 0,5μs
f = 10 kHz
FJH131
V_I
56 Ω
7Z67390
2
t_d
(μs)
1,5
1
0,5
0
typ
0
5
10
15
I_{FM} (mA)


7Z67394
circuit see graph t_d = f (I_{FM})
T_{amb} = 25 °C
20
t_s
(μs)
15
10
5
0
typ
0
5
10
15
I_{FM} (mA)

PHOTOCOUPLER

Optically coupled isolater consisting of an infra-red emitting GaAs diode and a silicon n-p-n phototransistor. TO-12 envelope. Suitable for TTL integrated ciruits. Only difference between CNY44 and CNY46 is in the pin connections.

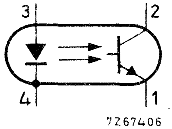
QUICK REFERENCE DATA

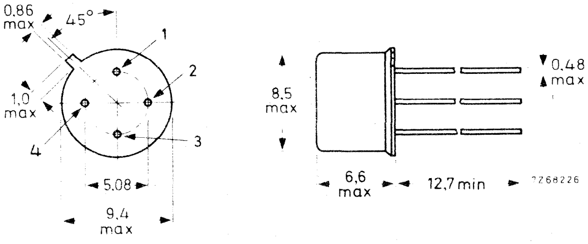
Diode				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 100 °C	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector cut-off current (dark) V_{CE} = 15 V; diode: I_F = 0	I_{CEO}	<	100	nA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	80	mW
Photocoupler				
Output/input d.c. current transfer ratio I_F = 10 mA; V_{CE} = 10 V	I_C/I_F	>	0,3	
Collector-emitter saturation voltage I_F = 10 mA; I_C = 3 mA	V_{CEsat}	<	0,4	V
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	1000	V

MECHANICAL DATA

Dimensions in mm

SOT-5/28 (TO-12)





Cathode (4) connected to case.

Max. lead diameter is guaranteed only for 12,7 mm.

ALL OTHER DATA IDENTICAL TO CNY44

PHOTOCOUPLERS

Optically coupled isolators consisting of an infra-red emitting GaAs diode and a silicon n-p-n phototransistor. Plastic 6 lead dual in-line envelopes. Suitable for TTL integrated circuits.

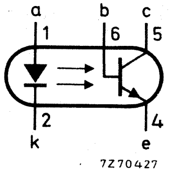
QUICK REFERENCE DATA

Diode					
Continuous reverse voltage	V_R	max.	3		V
Forward current (d.c.)	I_F	max.	30		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100		mW
Transistor					
Collector-emitter voltage (open base)	V_{CEO}	max.	30		V
Collector cut-off current (dark) V_{CE} = 10 V; diode: I_F = 0	I_{CEO}	<	100		nA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150		mW
Photocoupler			CNY47	CNY47A	
Output/input d.c. current transfer ratio I_F = 10 mA; I_B = 0; V_{CE} = 0,4 V	I_C/I_F	>	0,2	0,4	
Collector-emitter saturation voltage I_F = 10 mA; I_B = 0; I_C = 2 mA	V_{CEsat}	<	0,4		V
I_F = 10 mA; I_B = 0; I_C = 4 mA	V_{CEsat}	<		0,4	V
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	2000	2000	V

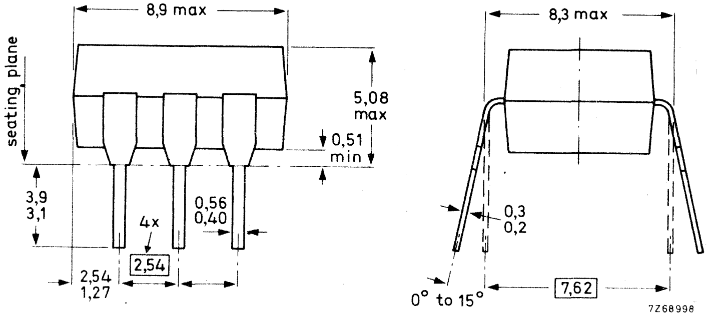
MECHANICAL DATA See page 2.

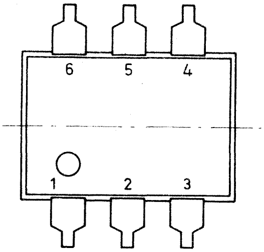
MECHANICAL DATA

Dimensions in mm



3 = n.c.





RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Diode				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value) → $t_p < 10\ \mu s;\ \delta < 0,1$	I_{FM}	max.	200	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	100	mW
Operating junction temperature	T_j	max.	100	^oC
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	50	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	150	mW
Operating junction temperature	T_j	max.	100	^oC
Photocoupler				
Storage temperature	T_{stg}		−55 to +150	^oC

THERMAL RESISTANCE

From junction to ambient in free air			
- diode	$R_{th\ j-a}$	0,75	$^oC/mW$
- transistor	$R_{th\ j-a}$	0,5	$^oC/mW$
From junction to ambient, device mounted on a p.c. board (1)			
- diode	$R_{th\ j-a}$	0,6	$^oC/mW$
- transistor	$R_{th\ j-a}$	0,4	$^oC/mW$

---

1) With copper islands of 1,5 mm diameter around each terminal, on one side of 1,6 mm glass-epoxy printed circuit board; thickness of copper 35 µm; pins fully inserted (i.e. to seating plane, see drawing).

CHARACTERISTICS

Diode $T_j = 25\ ^oC$				
Forward voltage, $I_F = 10$ mA	V_F	typ. <	1,2 1,5	V V
Reverse current, $V_R = 3$ V	I_R	<	100	μA
Transistor (diode: $I_F = 0$) $T_j = 25\ ^oC$				
Collector cut-off current (dark)				
$V_{CE} = 10$ V	I_{CEO}	typ. <	5 100	nA nA
$V_{CB} = 10$ V	I_{CBO}	<	20	nA
Output capacitance at f = 1 MHz $V_{CB} = 10$ V	$C_{b,c}$	typ.	4	pF

Photocoupler ($I_B = 0$, $T_{amb} = 25\ ^oC$ unless otherwise specified) [1]

			CNY47	CNY47A		
Output/input d.c. current transfer ratio $I_F = 10$ mA; $V_{CE} = 0,4$ V	I_C/I_F	> typ. <	0,2 0,3 0,6	0,4 0,6		2)
Collector-emitter saturation voltage						
$I_F = 10$ mA; $I_C = 2$ mA	V_{CEsat}	typ. <	0,2 0,4		V V	
$I_F = 10$ mA; $I_C = 4$ mA	V_{CEsat}	typ. <		0,2 0,4	V V	
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	2000	2000	V	3)
Capacitance between input and output $I_F = 0$; $V = 0$; $f = 1$ MHz	C_{io}	typ.	1	1	pF	

---

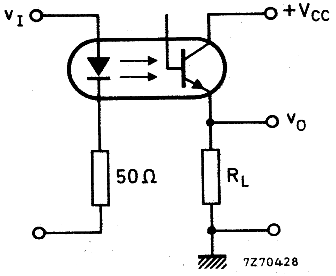
1) Where the phototransistor receives light from the diode, the O (for open terminal) has been omitted from the symbols.

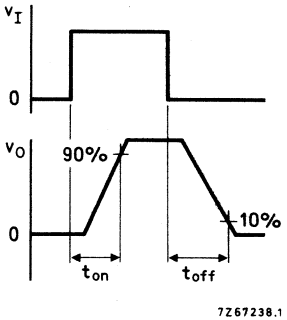
2) Aging of the light-emitting diode reduces the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

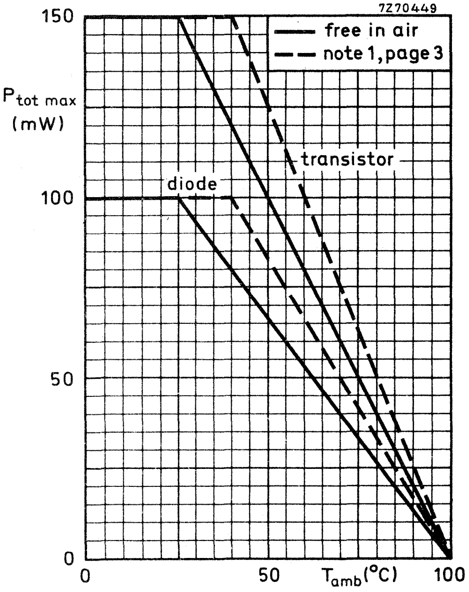
3) Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

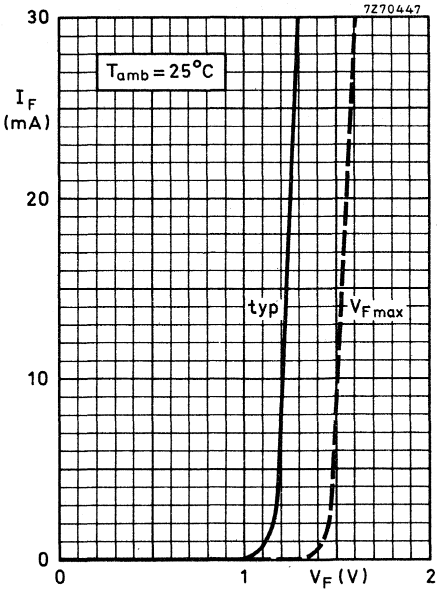
CHARACTERISTICS (continued)

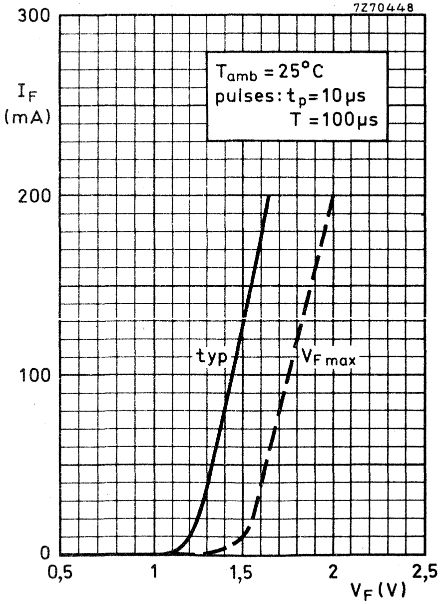
			CNY47	CNY47A	
Insulation resistance between input and output					
V_{IO} = 500 V	r_{IO}	>	10^{11}	10^{11}	Ω
		typ.	10^{12}	10^{12}	Ω
Switching times (circuit below)					
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.	3		µs
Turn-off time	t_{off}	typ.	3		µs
I_{Con} = 4 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.		5	µs
Turn-off time	t_{off}	typ.		5	µs

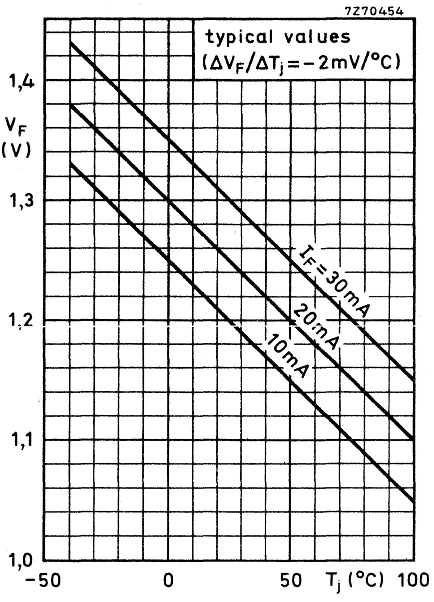


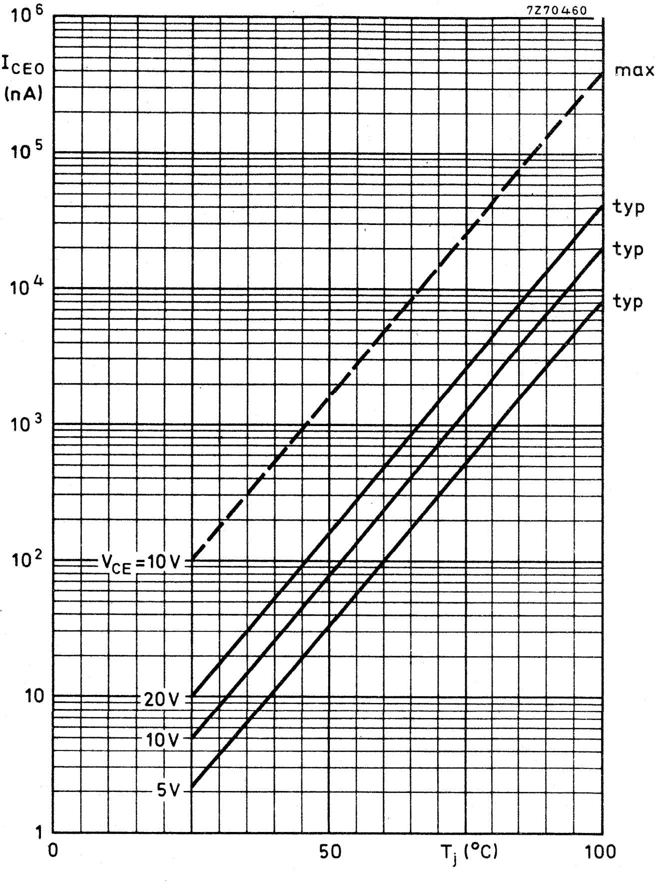


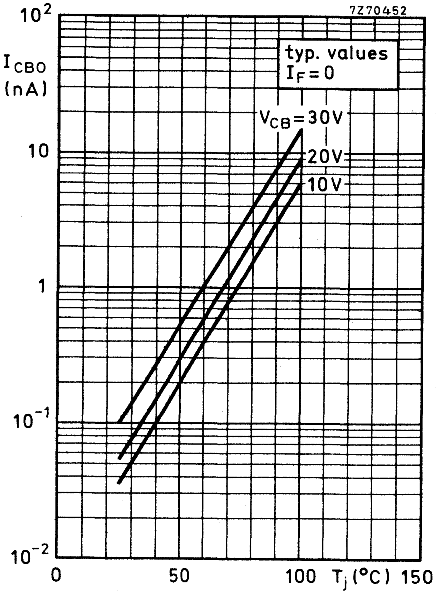

7Z70449
$P_{tot\,max}$ (mW)
150
100
50
0
free in air
note 1, page 3
transistor
diode
0
50
T_{amb} (°C)
100

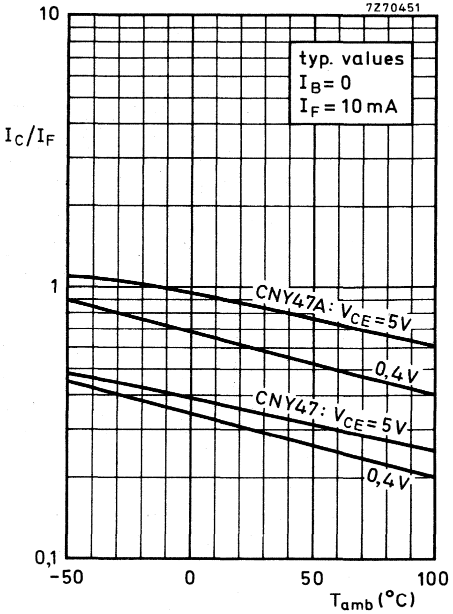

7Z70447
I_F (mA)
30
20
10
0
$T_{amb} = 25°C$
typ
$V_{F\,max}$
0
1
V_F (V)
2

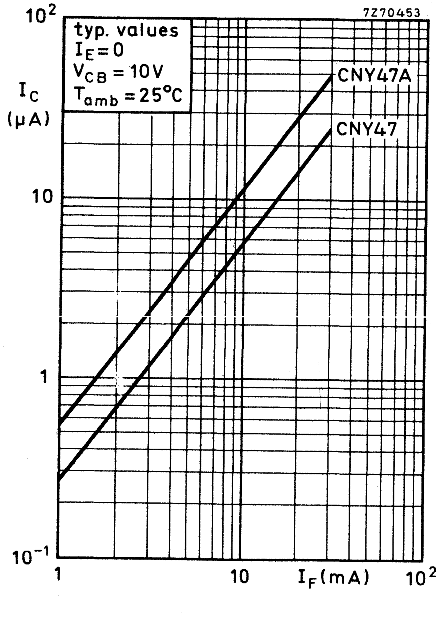

7Z70448
I_F (mA)
300
200
100
0
$T_{amb} = 25°C$
pulses: $t_p = 10\,\mu s$
$T = 100\,\mu s$
typ
$V_{F\,max}$
0,5
1
1,5
2
2,5
V_F (V)

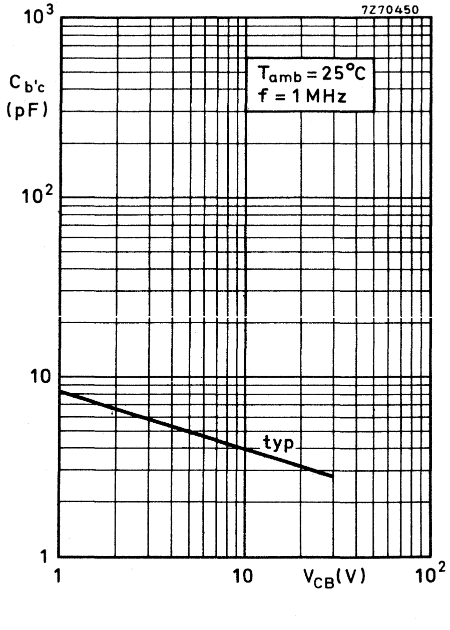

7Z70454
typical values
($\Delta V_F/\Delta T_j = -2\,mV/°C$)
V_F (V)
1,4
1,3
1,2
1,1
1,0
$I_F = 30\,mA$
20mA
10mA
−50
0
50
T_j (°C)
100

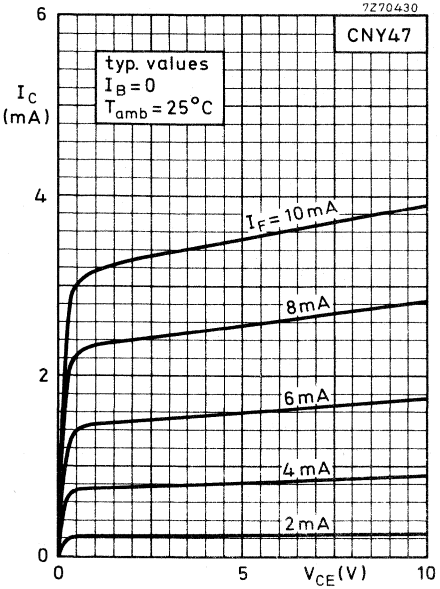

7Z70460
10^6
I_{CEO} (nA)
10^5
10^4
10^3
10^2
10
1
0
50
T_j (°C)
100
max
typ
typ
typ
V_{CE} = 10 V
20 V
10 V
5 V

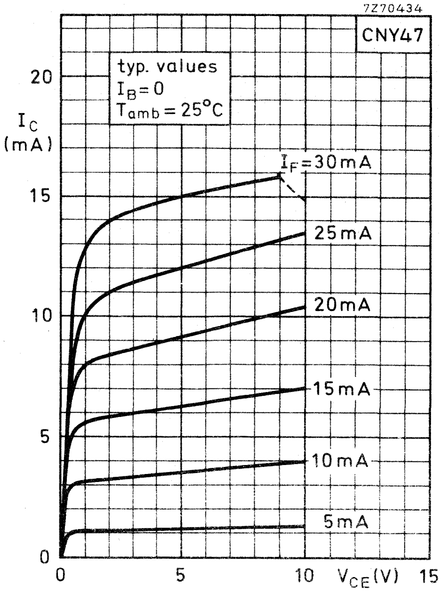

7Z70452
I_{CBO} (nA)
10^2
10
1
10^{-1}
10^{-2}
typ. values
$I_F = 0$
$V_{CB} = 30$ V
20 V
10 V
0
50
100
T_j (°C)
150

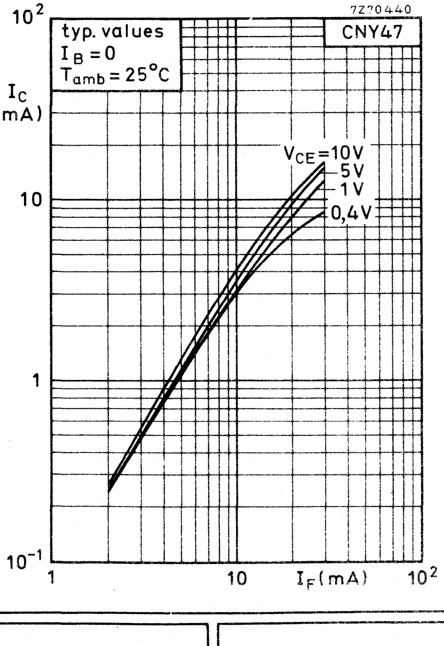

7Z70451
I_C/I_F
10
1
0,1
typ. values
$I_B = 0$
$I_F = 10$ mA
CNY47A: $V_{CE} = 5$ V
0,4 V
CNY47: $V_{CE} = 5$ V
0,4 V
−50
0
50
100
T_{amb} (°C)

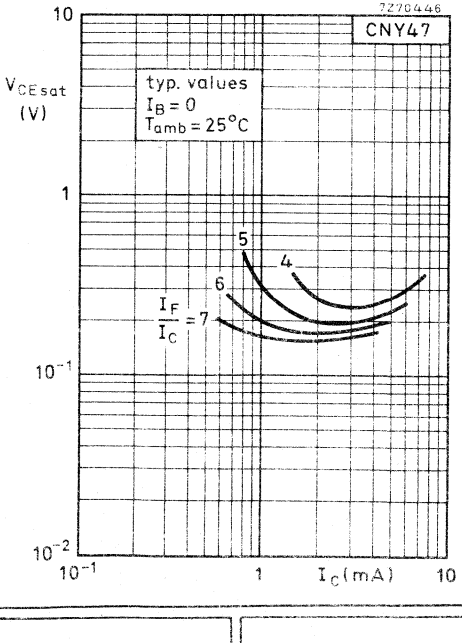

7Z70453
I_C (μA)
10^2
10
1
10^{-1}
typ. values
$I_E = 0$
$V_{CB} = 10$ V
$T_{amb} = 25$ °C
CNY47A
CNY47
1
10
I_F (mA)
10^2

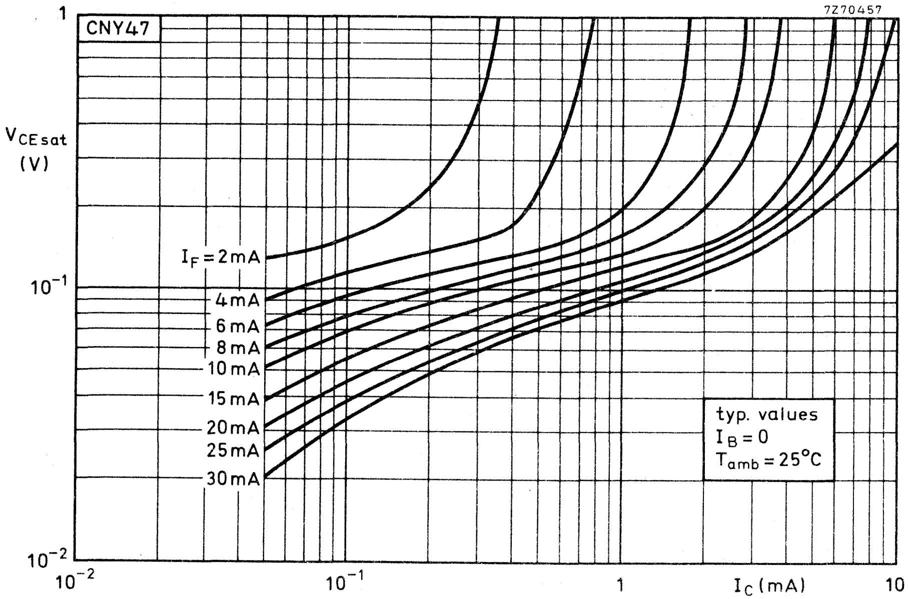

7Z70450
$C_{b'c}$ (pF)
10^3
10^2
10
1
$T_{amb} = 25$ °C
f = 1 MHz
typ
1
10
V_{CB} (V)
10^2

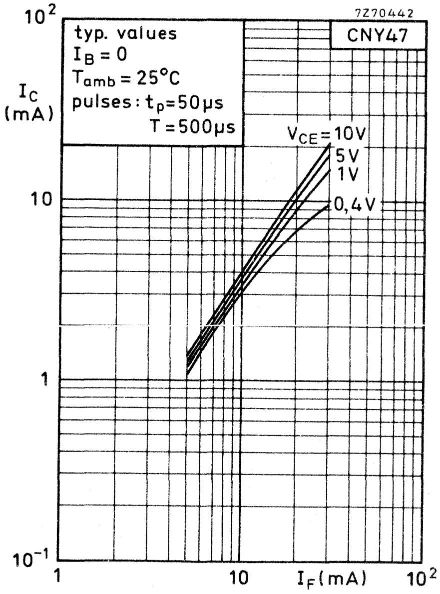

7Z70430
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25^{\circ}C$
I_C (mA)
6
4
2
0
$I_F = 10$ mA
8 mA
6 mA
4 mA
2 mA
0
5
V_{CE} (V)
10

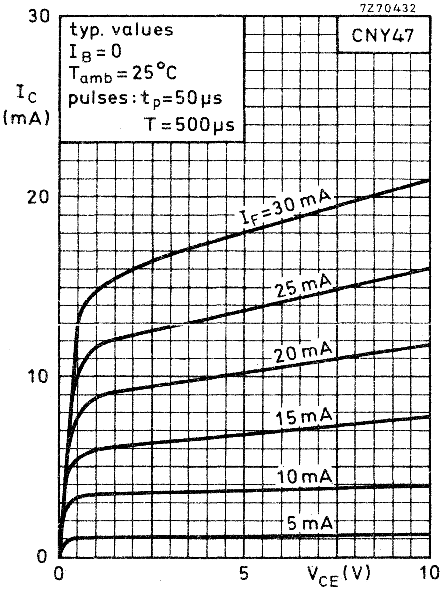

7Z70434
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25^{\circ}C$
I_C (mA)
20
15
10
5
0
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
0
5
10
V_{CE} (V)
15

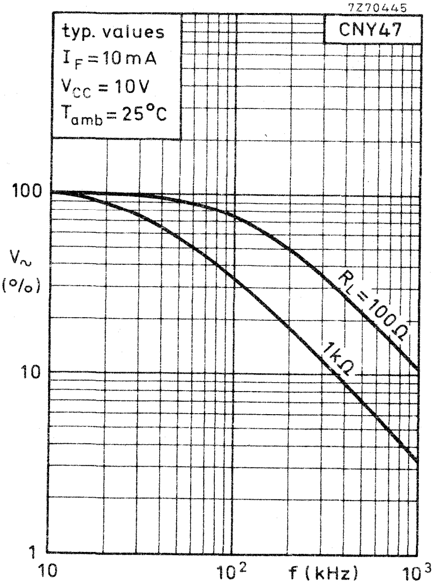

7Z70440
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25^{\circ}C$
I_C (mA)
10^2
10
1
10^{-1}
$V_{CE} = 10$ V
5 V
1 V
0,4 V
1
10
I_F (mA)
10^2

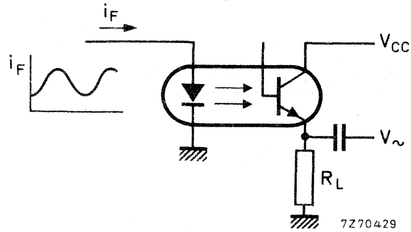

7Z70446
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25^{\circ}C$
V_{CEsat} (V)
10
1
10^{-1}
10^{-2}
5
4
6
$\frac{I_F}{I_C} = 7$
10^{-1}
1
I_C (mA)
10

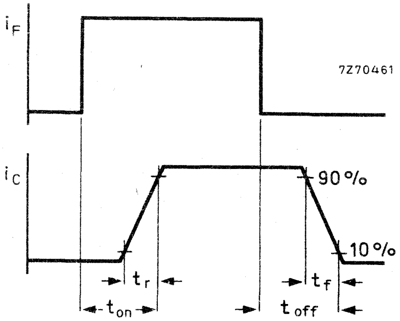

7Z70457
CNY47
V_{CEsat} (V)
1
10^{-1}
10^{-2}
$I_F = 2mA$
4 mA
6 mA
8 mA
10 mA
15 mA
20 mA
25 mA
30 mA
typ. values
$I_B = 0$
$T_{amb} = 25°C$
10^{-2}
10^{-1}
1
I_C (mA)
10

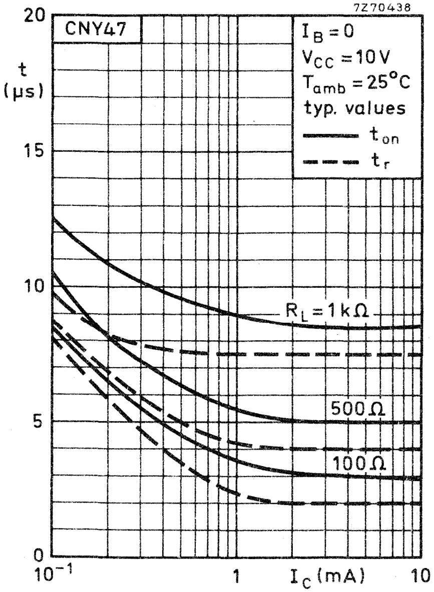

7Z70442
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: $t_p = 50 μs$
$T = 500 μs$
I_C (mA)
10^2
10
1
10^{-1}
$V_{CE} = 10V$
5V
1V
0,4V
1
10
I_F (mA)
10^2

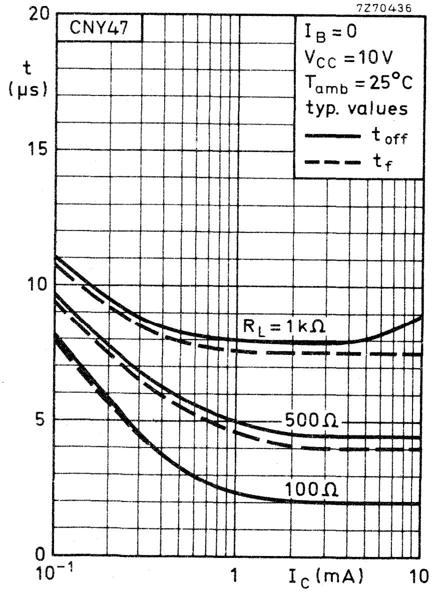

7Z70432
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: $t_p = 50 μs$
$T = 500 μs$
I_C (mA)
30
20
10
0
$I_F = 30 mA$
25 mA
20 mA
15 mA
10 mA
5 mA
0
5
V_{CE} (V)
10

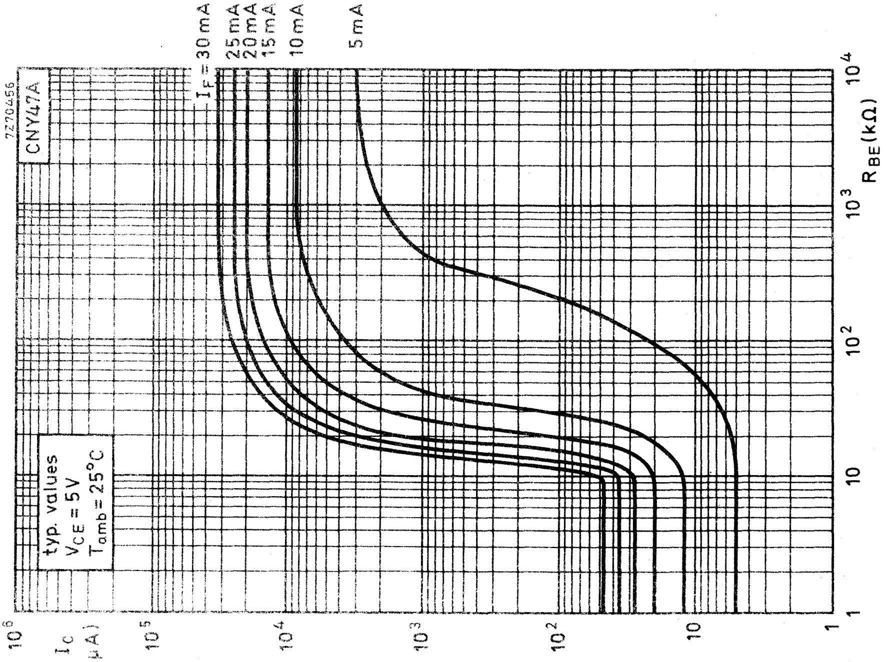

7Z70445
typ. values
$I_F = 10\,mA$
$V_{CC} = 10\,V$
$T_{amb} = 25\,°C$
CNY47
100
$V_\sim$
(%)
10
1
10
10^2
f (kHz)
10^3
$R_L = 100\,\Omega$
$1\,k\Omega$

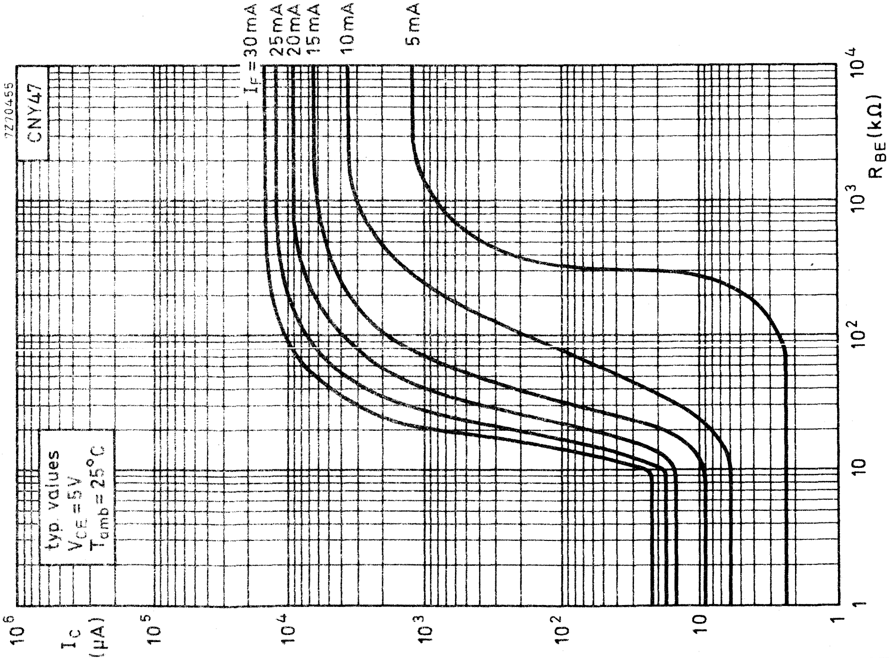

i_F
i_F
V_{CC}
$V_\sim$
R_L
7Z70429

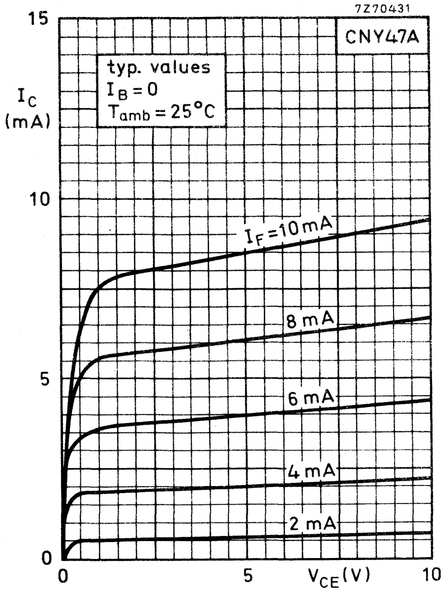

i_F
7Z70461
i_C
90 %
10 %
t_r
t_f
t_{on}
t_{off}

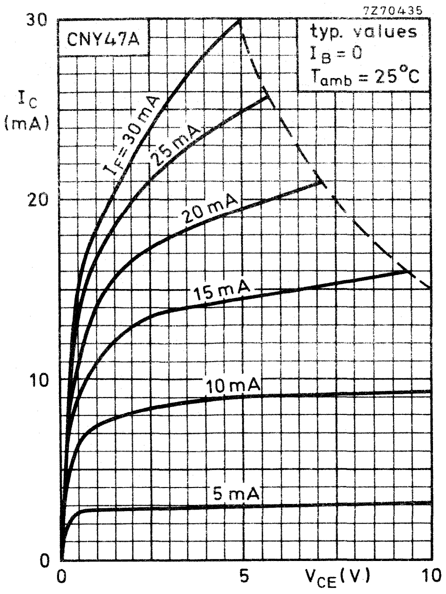

7Z70438
20
CNY47
$I_B = 0$
$V_{CC} = 10\,V$
$T_{amb} = 25\,°C$
typ. values
t_{on}
t_r
t
(μs)
15
10
5
0
$R_L = 1\,k\Omega$
$500\,\Omega$
$100\,\Omega$
10^{-1}
1
I_C (mA)
10

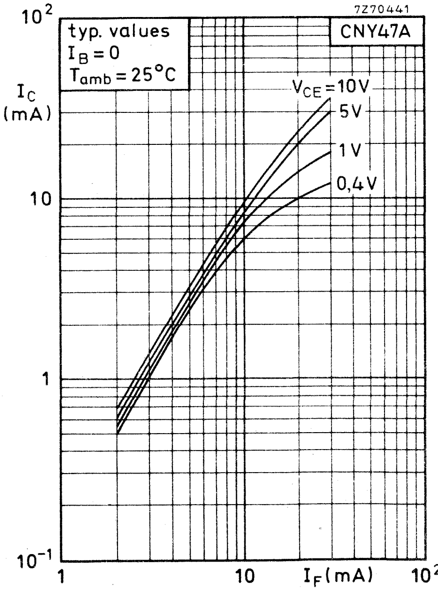

7Z70436
20
CNY47
$I_B = 0$
$V_{CC} = 10\,V$
$T_{amb} = 25\,°C$
typ. values
t_{off}
t_f
t
(μs)
15
10
5
0
$R_L = 1\,k\Omega$
$500\,\Omega$
$100\,\Omega$
10^{-1}
1
I_C (mA)
10

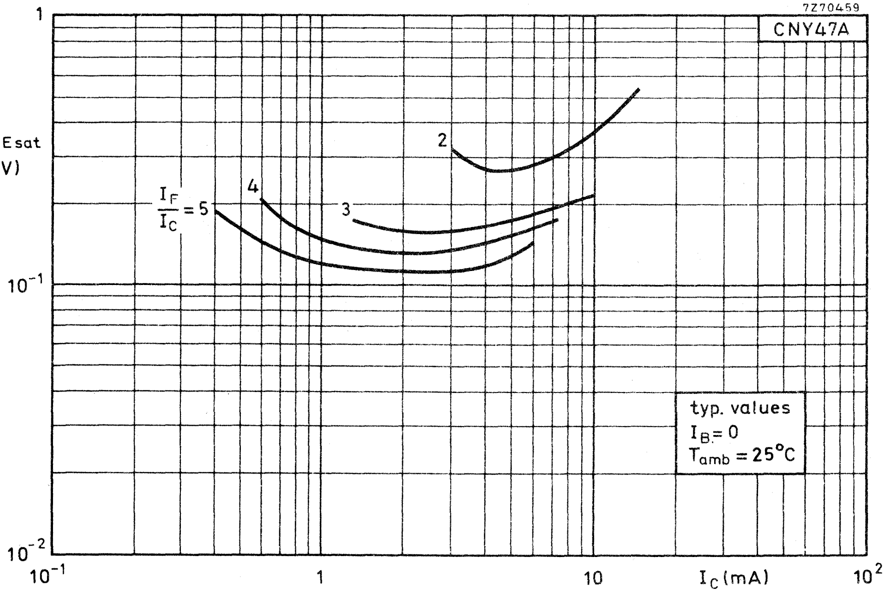

7Z70456
CNY47A
typ. values
V_{CE} = 5 V
T_{amb} = 25°C
I_F = 30 mA
25 mA
20 mA
15 mA
10 mA
5 mA
I_C (μA)
10^6
10^5
10^4
10^3
10^2
10
1
R_{BE} (kΩ)
1
10
10^2
10^3
10^4

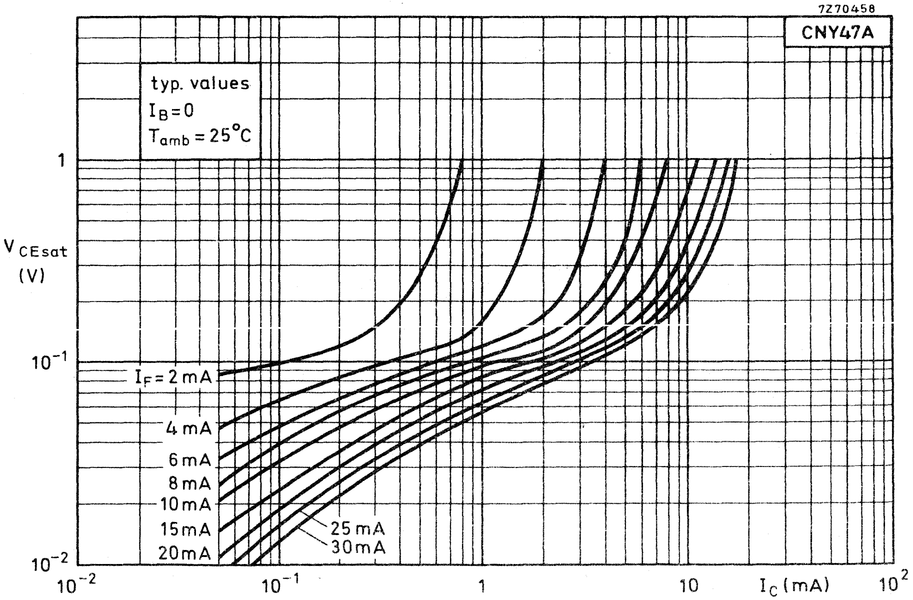

7Z70455
CNY47
typ. values
V_{CE} = 5 V
T_{amb} = 25°C
I_F = 30 mA
25 mA
20 mA
15 mA
10 mA
5 mA
I_C (μA)
10^6
10^5
10^4
10^3
10^2
10
1
R_{BE} (kΩ)
1
10
10^2
10^3
10^4

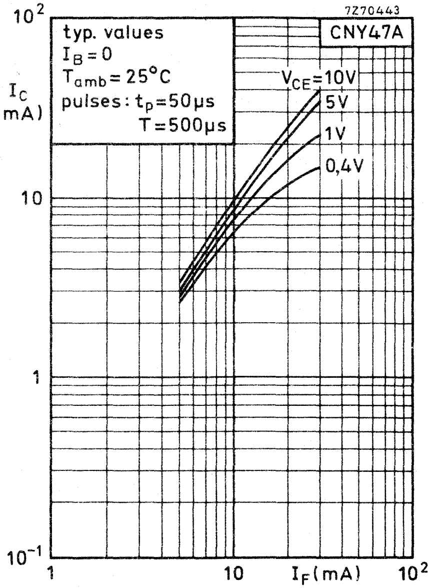

7Z70431
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
15
10
5
0
I_F = 10 mA
8 mA
6 mA
4 mA
2 mA
0
5
V_{CE} (V)
10

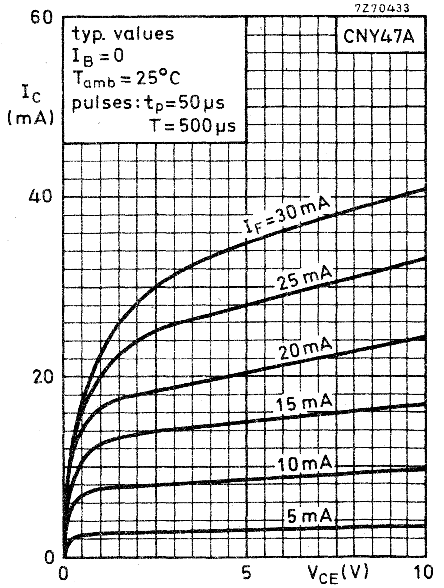

7Z70435
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
30
20
10
0
I_F = 30 mA
25 mA
20 mA
15 mA
10 mA
5 mA
0
5
V_{CE} (V)
10

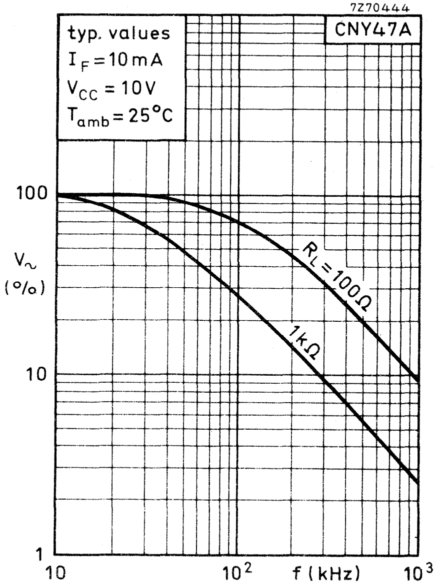

7Z70441
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
10^2
10
1
10^{-1}
V_{CE} = 10 V
5 V
1 V
0,4 V
1
10
I_F (mA)
10^2

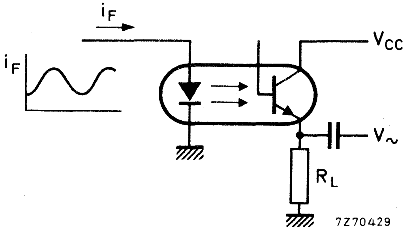

7Z70459
CNY47A
V_{CEsat} (V)
1
10^{-1}
10^{-2}
$\frac{I_F}{I_C} = 5$
4
3
2
typ. values
$I_B = 0$
$T_{amb} = 25^{\circ}C$
10^{-1}
1
10
I_C (mA)
10^2

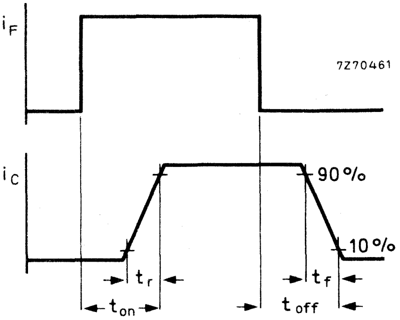

7Z70458
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25^{\circ}C$
V_{CEsat} (V)
1
10^{-1}
10^{-2}
$I_F = 2$ mA
4 mA
6 mA
8 mA
10 mA
15 mA
20 mA
25 mA
30 mA
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2

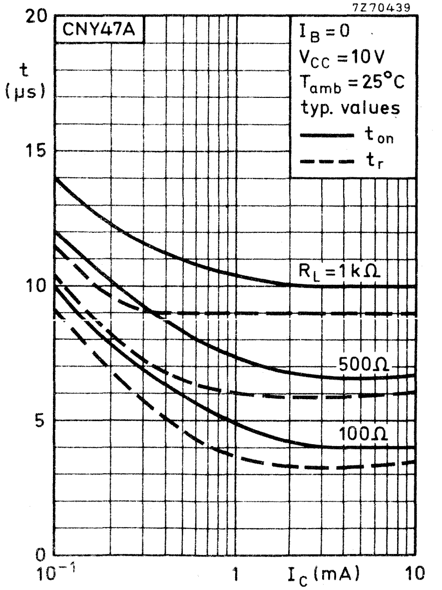

7Z70443
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: $t_p = 50 \mu s$
$T = 500 \mu s$
CNY47A
I_C (mA)
10^2
10
1
10^{-1}
$V_{CE} = 10V$
5V
1V
0,4V
1
10
I_F (mA)
10^2

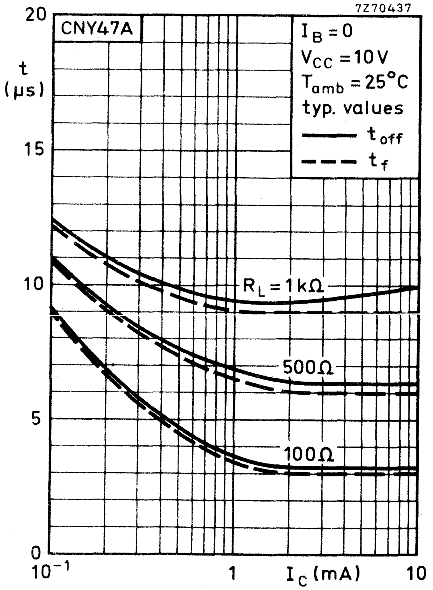

7Z70433
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: $t_p = 50 \mu s$
$T = 500 \mu s$
CNY47A
I_C (mA)
60
40
20
0
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
0
5
V_{CE} (V)
10


7Z70444
typ. values
$I_F = 10$ mA
$V_{CC} = 10$ V
$T_{amb} = 25$ °C
CNY47A
$V_{\sim}$
(%)
100
10
1
$R_L = 100\,\Omega$
1 kΩ
10
10^2
f (kHz)
10^3


i_F
i_F
V_{CC}
$V_{\sim}$
R_L
7Z70429


i_F
7Z70461
i_C
90 %
10 %
t_r
t_f
t_{on}
t_{off}


7Z70439
20
CNY47A
$I_B = 0$
$V_{CC} = 10$ V
$T_{amb} = 25$ °C
typ. values
t_{on}
t_r
t
(μs)
15
10
$R_L = 1\,k\Omega$
500Ω
5
100Ω
0
10^{-1}
1
I_C (mA)
10


7Z70437
20
CNY47A
$I_B = 0$
$V_{CC} = 10$ V
$T_{amb} = 25$ °C
typ. values
t_{off}
t_f
t
(μs)
15
10
$R_L = 1\,k\Omega$
500Ω
5
100Ω
0
10^{-1}
1
I_C (mA)
10

Infra-red sensitive devices

PHOTOCONDUCTIVE CELL

Indium antimonide photoconductive element mounted on a copper heatsink, recommended for operation at a temperature of 20 °C.
Sensitive to infra-red radiation extending to 7.5 μm and intended for use with modmodulated or pulsed radiation.

RATINGS (Limiting values) [1]

Bias current at T_{amb} = 20 °C	I	max.	100	mA
Temperatures				
Operating ambient temperature	T_{amb}	max.	70	°C
Storage temperature	T_{stg}		- 50 to + 70	°C

CHARACTERISTICS T_{amb} = 20 °C unless otherwise specified

Peak spectral response	λ		6.0 to 6.3	μm
Spectral response range	from visible to		7.5	μm
Cell resistance	r_1		30 to 120	Ω
Time constant			0.1	μs
Sensitive area			6.0 x 0.5	mm^2
Sensitivity (6.0 μm radiation)		>	0.4	μV/μW
		typ.	1.0	μV/μW
(500 °K radiation)		typ.	0.3	μV/μW
D * (6.0 μm, 800 Hz, 1 Hz)	see notes 1 and 2	>	8.5×10^7	$cm\sqrt{Hz}/W$
		typ.	2.0×10^8	$cm\sqrt{Hz}/W$
(500 °K, 800 Hz, 1 Hz)	see notes 1 and 2	typ.	6.0×10^7	$cm\sqrt{Hz}/W$
Noise equivalent power (N.E.P.)				
(6.0 μm, 800 Hz, 1 Hz)	see notes 1 and 2	typ.	8.6×10^{-10}	W
		<	2.0×10^{-9}	W
(500 °K, 800 Hz, 1 Hz)	see notes 1 and 2	typ.	2.5×10^{-9}	W

MECHANICAL DATA (see page 2)

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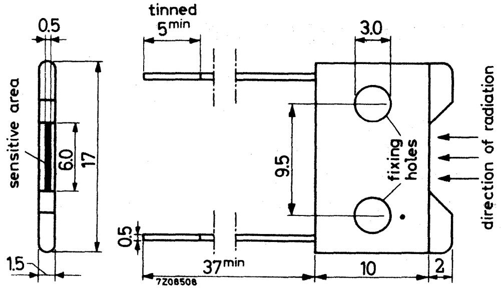
[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

MECHANICAL DATA

Dimensions in mm



NOTES

1. Measuring conditions.

The detector is attached to a heatsink which is maintained at a temperature of 20 °C and a bias current of 50 mA is applied. A parallel beam of monochromatic radiation of wavelength 4.4 μm, which would produce a steady irradiance of 68 $\mu W/cm^2$ at the sensitive element, is chopped at 800 Hz, giving an actual r.m.s. power at the element which amounts to

$$\frac{68}{2.2} = 31\ \mu W/cm^2$$

Measurements of the detector output are made with an amplifier tuned to 800 Hz and with a bandwidth of 50 Hz, and are referred to open circuit conditions i.e. correction is made for the shunting effects of the bias supply impedance and the amplifier input impedance. Under these test conditions, the ORP10 will exhibit a minimum signal-to-noise ratio of 45 and typical of 105. The sensitivities quoted at the wavelength of peak response and under black body conditions are calculated from these measurements, assuming the detector to have a typical response curve.

2. D* and N.E.P.

These are figures of merit for the materials of detectors.
D* is defined in the expression:

$$D^* = \frac{\frac{V_s}{V_n} \times \sqrt{A(\Delta f)}}{W}$$

where: V_s = signal voltage across detector terminals
V_n = noise voltage across detector terminals
A = detector area
(Δf) = bandwidth of measuring amplifier
W = radiation power incident on detector sensitive element in watts.

NOTES (continued)

The figures in brackets which follow D* refer to the measuring conditions e.g. D* (5.3 μm, 800 Hz, 1 Hz) denotes monochromatic radiation incident on the detector of wavelength 5.3 μm, chopping frequency 800 Hz, bandwidth 1 Hz.

The Noise Equivalent Power (N.E.P.) is related to D* by the expression:

$$\text{N.E.P.} = \frac{\sqrt{A}}{D^*} .$$

3. Variation of performance with bias current.

Both signal and noise vary with bias current. Typical curves are shown on page 5. At high currents the noise increases more rapidly than the signal, and therefore the signal-to-noise ratio has a peak value at some optimum current, which will vary slightly from cell to cell. A typical value is 50 mA. In addition the ohmic heating caused by bias currents above 60 mA causes the temperature of the element to become significantly greater than the substrate so that the signal decreases as described in note 4.

4. Variation of performance with element temperature.

As with all semiconductor photocells, the performance depends on the temperature of the sensitive element. In the case of the ORP10 this is influenced by the ambient temperature and ohmic heating caused by the d.c. bias current. To minimise fluctuations, the element is mounted on a copper base from which it is insulated by a layer of aluminium oxide, and can readily be attached to a large heatsink.

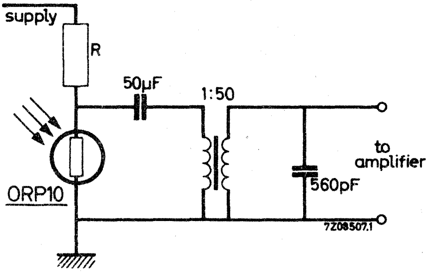
A typical variation of performance with temperature is given on page 5. The curve on page 5 shows the decrease in signal caused by the high current raising the temperature of the element.

On cooling, indium antimonide exhibits improved sensitivity and increased resistance. Below 15 °C this is impractical with the ORP10 unless special precautions are taken to prevent condensation and icing on the exposed element.

5. Warning.

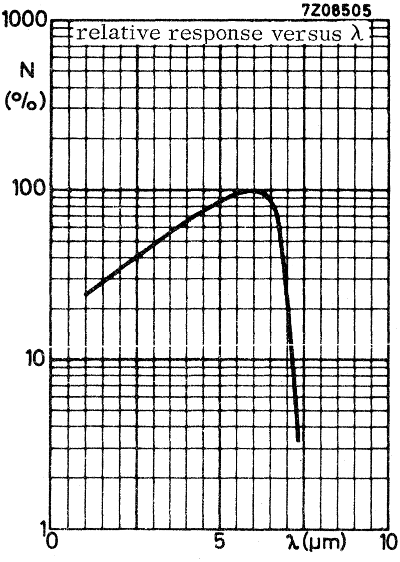
The sensitive surface is unprotected and should not be touched. It is stable in normal atmospheres but should not be exposed to high concentrations of the vapours of organic solvents. Care should be taken to avoid strain when attaching cells to heatsinks.

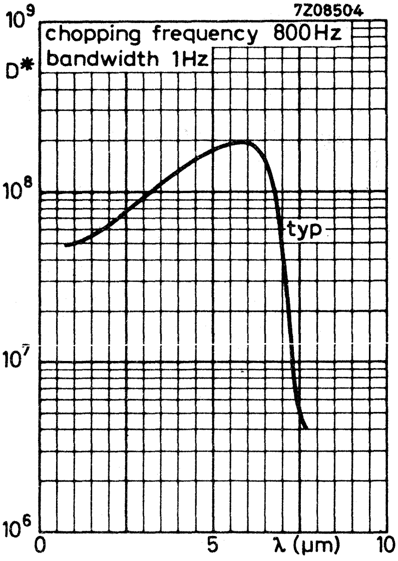
Recommended circuit for use with radiation chopped at 800 Hz.

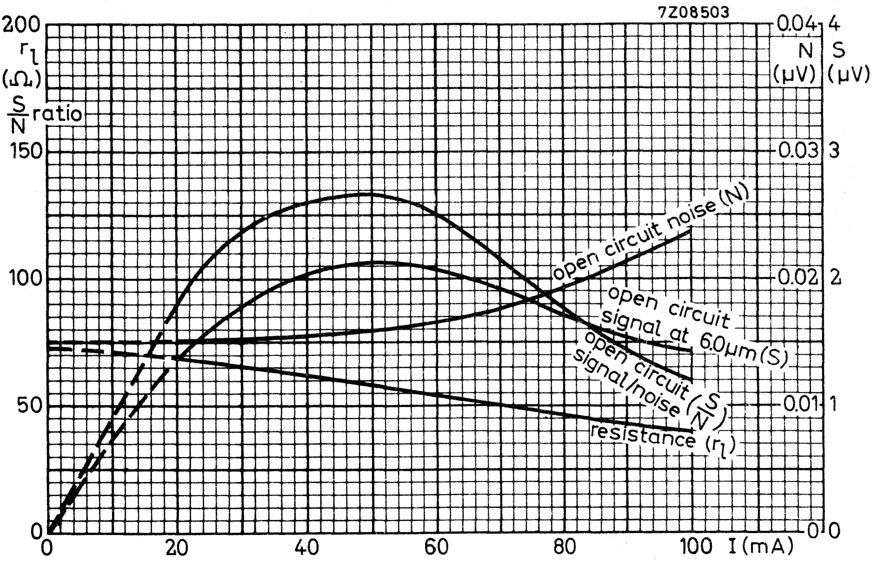


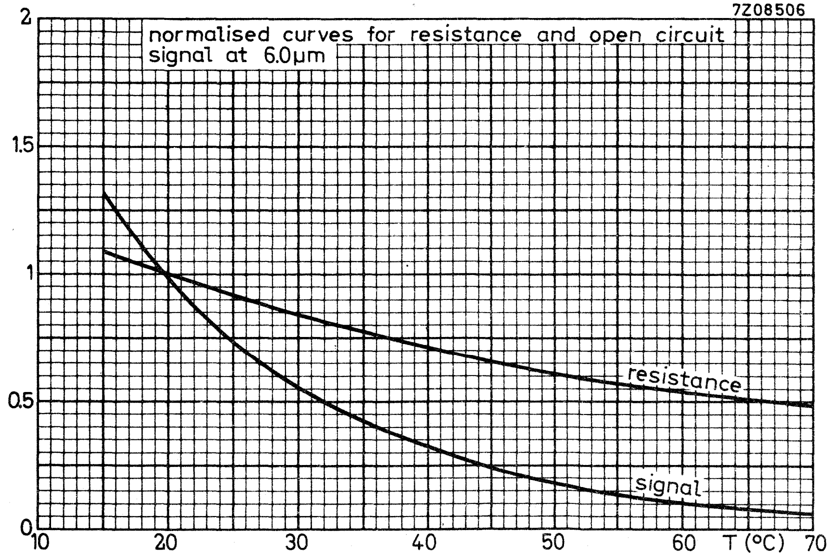
CIRCUIT NOTES

The transformer should be adequately screened to prevent stray pick-up.
The resistor R should be wire wound to minimise noise. It must be substantially larger than the cell resistance and its actual value will depend upon the supply voltage and the cell currents required. The 560 pF capacitor tunes the secondary to 800 Hz.






7Z08503
200
r_l (Ω)
S/N ratio
150
100
50
0
0.04
N (μV)
S (μV)
4
0.03
3
0.02
2
0.01
1
0
0
0
20
40
60
80
100
I (mA)
open circuit noise (N)
open circuit signal at 6.0μm (S)
open circuit signal/noise (S/N)
resistance (r_l)


7Z08506
normalised curves for resistance and open circuit signal at 6.0μm
2
1.5
1
0.5
0
10
20
30
40
50
60
70
T (°C)
resistance
signal

PHOTOCONDUCTIVE CELL

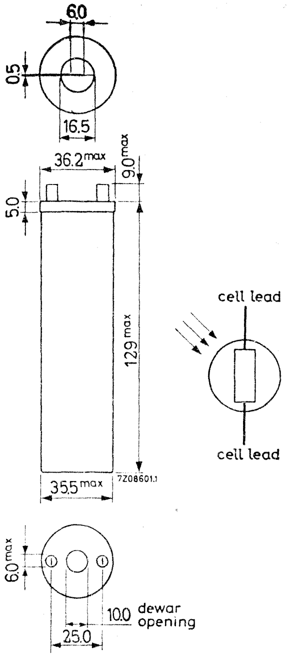
Indium antimonide photoconductive element mounted in a glass dewar vessel and cooled by liquid nitrogen or liquid air. Sensitive to infrared radiation extending to 5.6µm an intended for use with modulated or pulsed radiation.

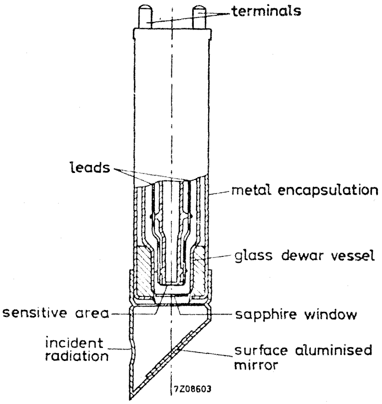
QUICK REFERENCE DATA				
Peak spectral response	λ_m		5.3	µm
Operating temperature	T		77	K
Responsivity (5.3 µm, 800 Hz)		typ.	35	mV/µW
D^* (5.3 µm, 800 Hz, 1 Hz)		typ.	5.5×10^{10}	cm $\sqrt{Hz}$/W
Time constant		typ.	5	µs
Sensitive area			6.0 x 0.5	mm^2

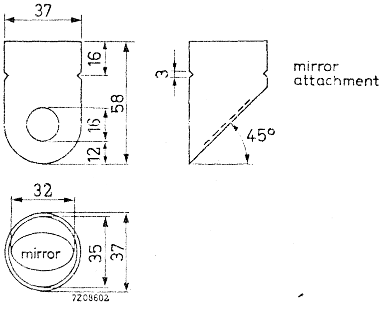
MECHANICAL DATA see page 2

MECHANICAL DATA

Dimensions in mm







RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Bias current at $T_{amb} = 77$ K	I	max.	30	mA
Temperatures				
Storage temperature	T_{stg}		−55 to +55	°C

CHARACTERISTICS (see note 1 on page 4)

Peak spectral response	λ_m		5.3	µm
Spectral response range			from visible to 5.6	µm
Cell resistance	r_ℓ		20 to 60	kΩ
Time constant		typ.	5	µs
Boil-off time of bulk liquid nitrogen		>	90	min
		typ.	120	min

Performance

1. Black body source measurement
   colour temperature : 500 K
   chopping frequency : 800 Hz
   bandwidth : 1 Hz

Responsivity	>	4	mV/µW
	typ.	7	mV/µW
D*	>	5×10^9	cm $\sqrt{\text{Hz}}$/W
	typ.	7.5×10^9	cm $\sqrt{\text{Hz}}$/W
N.E.P.	typ.	16	pW
	<	35	pW

2. Monochromatic source measurement
   radiation : 5.3 µm
   chopping frequency : 800 Hz
   bandwidth : 1 Hz

Responsivity	typ.	35	mV/µW
D*	typ.	55×10^9	cm $\sqrt{\text{Hz}}$/W
N.E.P.	typ.	3.2	pW

NOTES

1. Test conditions

The detector is cooled to 77K by filling the dewar vessel with liquid nitrogen, or by use of a liquid transfer system. An optimum bias of 250 to 500μA is applied. The sensitive element is situated at a distance of 264mm from a black body source limited by an aperture of 3mm diameter.

The radiation path is interrupted at 800Hz by a chopper blade at ambient temperature. Under these conditions the r.m.s. power at the element (chopping factor 2.2) is 4.5μW/cm^2.

Measurements of the detector output are made with an amplifier tuned to 800Hz with a bandwidth of 50Hz, and referred to open-circuit conditions, i.e., correction is made for the shunting effects of the bias supply impedance and the amplifier impedance.

2. D* and N.E.P.

These are figures of merit for the materials of detectors.

The detectivity D* is defined in the expression:

$$D^* = \frac{\frac{V_s}{V_n}\sqrt{A(\Delta f)}}{W}$$

where: V_s = signal voltage across detector terminals
V_n = noise voltage across detector terminals
A = detector area
(Δf) = bandwidth of measuring amplifier
W = radiation power incident on detector sensitive element in r.m.s. watts.

The Noise Equivalent Power (N.E.P.) is related to D* by the expression:

$$\text{N.E.P.} = \frac{\sqrt{A}}{D^*}$$

3. Time constant

Detector time constant figures are based on the response to a step function in the incident radiation. Quoted times indicate the interval between the moment the radiation is cut off and the output falling to 63% of its peak value.

4. Variation of performance with bias current

Both signal and noise vary with current in this type of cell. At high currents the noise increases more rapidly than the signal, and therefore the signal-to-noise ratio has a peak value at some optimum current, which will vary slightly from cell to cell.

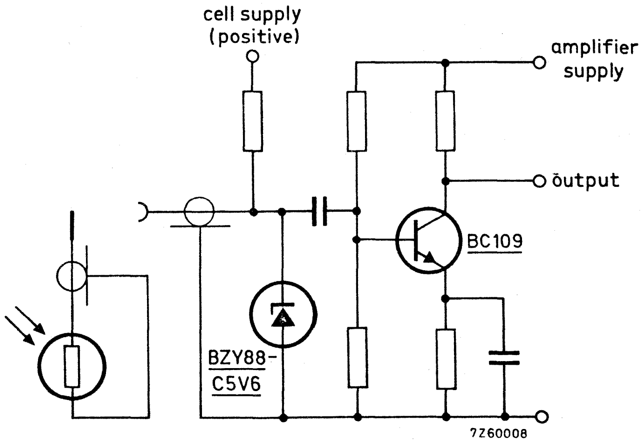
NOTES (continued)

5. Warnings

a. The resistance of the cell at room temperature is three orders of magnitude less than at the operating temperature (77K). Care should therefore be taken to ensure that the device is not allowed to reach room temperature while still biased, if any form of low impedance biasing is employed.

b. If provision is made for cells to be plugged into the bias current and amplifier, steps must be taken to limit the current available from the amplifier input capacitor. This current can be excessive at the instant of plugging in the cell.

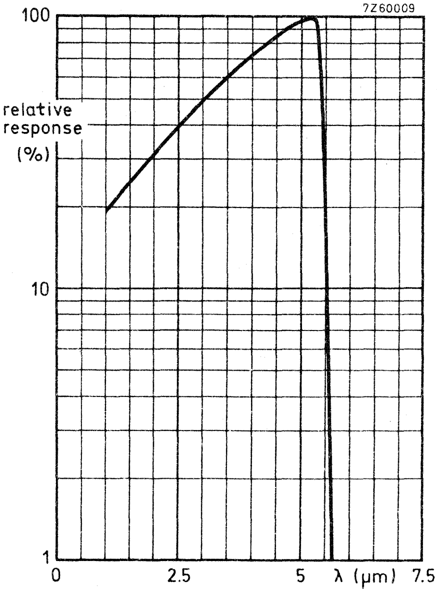
A zener diode can be used to limit the voltage developed across the input capacitor as shown in the diagram.

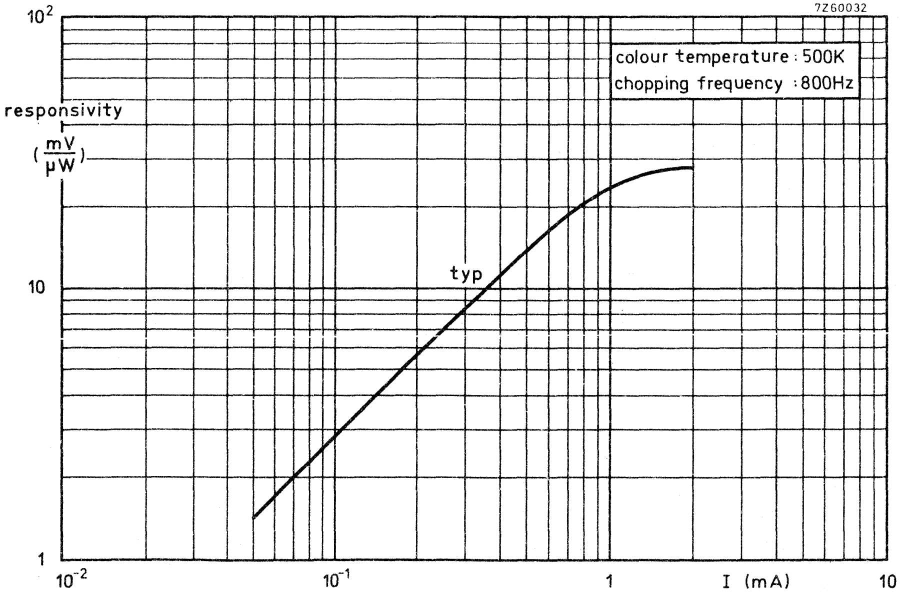


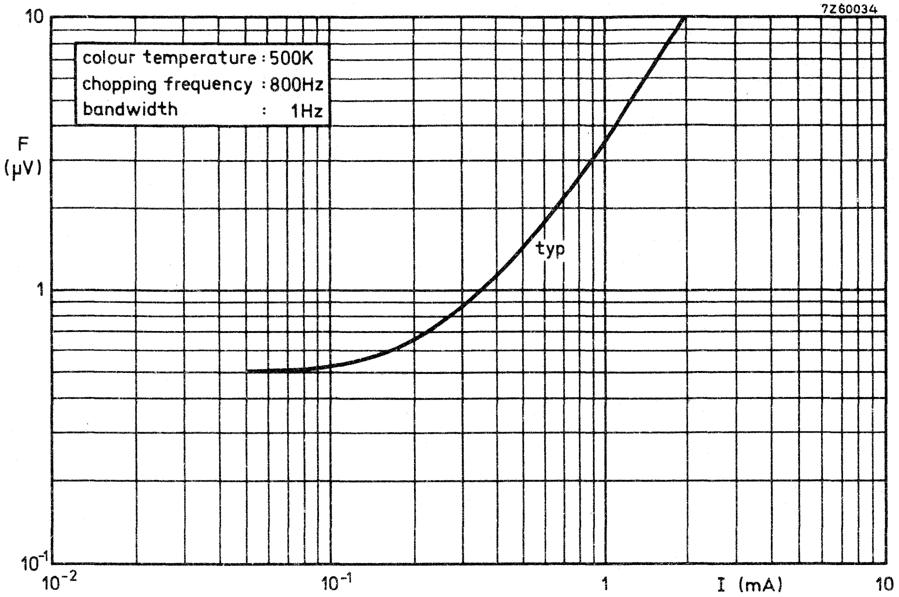
c. The dewar vessel must always be completely dry before being refilled with liquid nitrogen. In humid conditions, water vapour may condense at the top of the dewar. Should this occur, the remaining liquid nitrogen should be allowed to boil off, the ice should be removed carefully and precautions taken to avoid a recurrence. In very humid conditions the window should be purged with a claen dry gas.

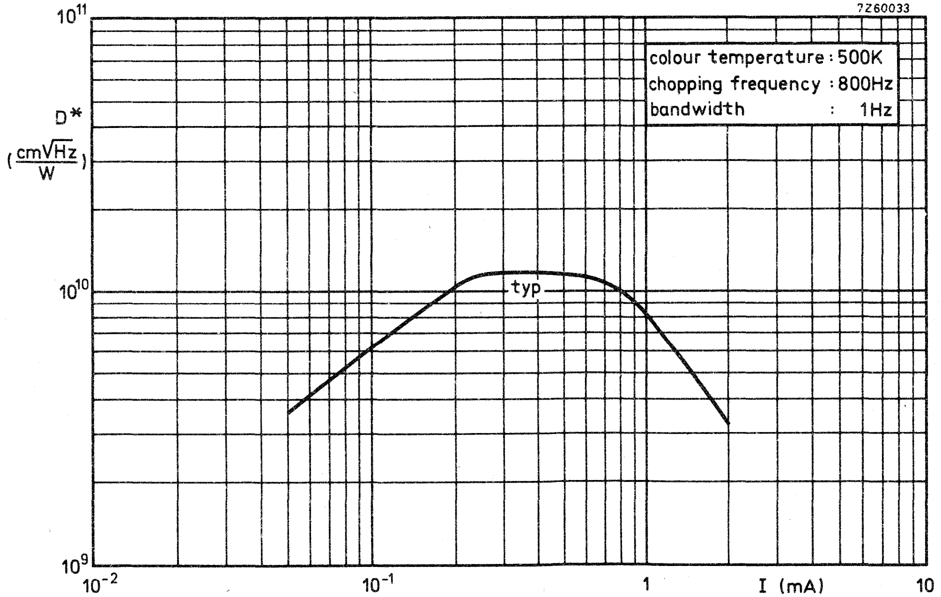
6. Low frequency noise

This will be minimised by use of non-absorbent cotton wool placed in the bottom of the dewar. The recommended quantity is 40mg.


7Z60009
100
relative response (%)
10
1
0
2.5
5
λ (μm)
7.5


7Z60032
10^2
responsivity $\left(\frac{mV}{\mu W}\right)$
colour temperature : 500K
chopping frequency : 800Hz
typ
10
1
10^{-2}
10^{-1}
1
I (mA)
10


7Z60034
colour temperature : 500K
chopping frequency : 800Hz
bandwidth : 1Hz
F
(μV)
10
1
10^-1
typ
10^-2
10^-1
1
I (mA)
10


7Z60033
colour temperature : 500K
chopping frequency : 800Hz
bandwidth : 1Hz
D*
(cm√Hz / W)
10^11
10^10
10^9
typ
10^-2
10^-1
1
I (mA)
10

RPY 76A

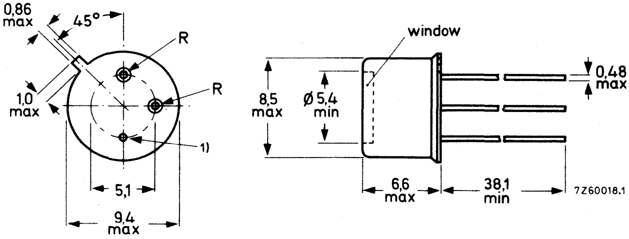
PHOTOCONDUCTIVE CELL

Lead sulphide, chemically deposited, photoconductive cell recommended for room temperature operation.
It is encapsulated in a hermetically sealed TO-5 envelope with an end viewing window.
It has a germanium filter to cut off radiation below 1.5 µm and therefore it may be exposed continuously to visible radiation.

QUICK REFERENCE DATA

Peak spectral response	λ_m	typ.	1.9	µm
Spectral response range	λ		1.5 to 3.0	µm
Responsivity (2.0µm, 800 Hz)		>	200	mA/W
Responsivity (500K, 800 Hz)		>	2.0	mA/W
D^* (500K, 800 Hz, 1 Hz)			$>1.0 \times 10^8$	$\mathrm{cm}\sqrt{\mathrm{Hz}}/\mathrm{W}$
Time constant		typ.	250	µs
Sensitive area			1.0×1.0	mm^2

MECHANICAL DATA



1) Connected to case

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Power dissipation	P	max.	20	mW
Temperatures				
Storage temperature	T_{stg}	−20 to +50		°C
Operating ambient temperature	T_{amb}	max.	50	°C

CHARACTERISTICS at T_{amb} = 20 °C (see notes on pages 3 and 4)

Peak spectral response	λ_m	typ.	1.9	µm
Spectral response range	λ		1.5 to 3.0	µm
Cell resistance	r_ℓ	>	200	kΩ
		typ.	600	kΩ
Time constant		typ.	250	µs
		<	400	µs

Performance

1. Black body source measurement

colour temperature : 500 K
chopping frequency : 800 Hz
bandwidth : 1 Hz

Responsivity	>	2.0	mA/W
D^*	>	1.0×10^8	$\text{cm}\sqrt{\text{Hz}}/\text{W}$
N.E.P.	<	1.0	nW

2. Monochromatic source measurement

radiation : 2.0 µm
chopping frequency : 800 Hz
bandwidth : 1 Hz

Responsivity	>	200	mA/W
D^*	>	1.0×10^{10}	$\text{cm}\sqrt{\text{Hz}}/\text{W}$
N.E.P.	<	10	pW

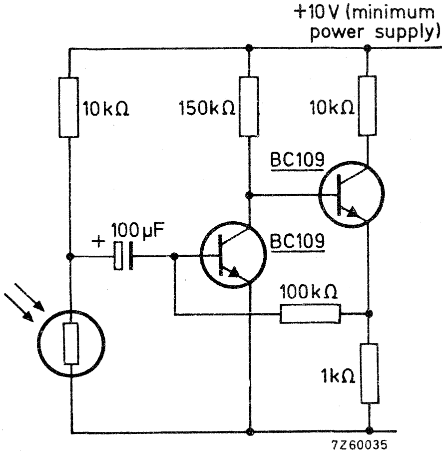
NOTES

1. Test conditions

The cell is operated at a temperature of 20 °C. The sensitive element is situated at a distance of 264 mm from a black body source limited by an aperture of 3 mm diameter.

The radiation path is interrupted at 800 Hz by a chopper blade at ambient temperature. Under these conditions the r. m. s. power at the element (chopping factor 2.2) is 4.5 $\mu W/cm^2$.

A bias voltage of 24 V is applied to the cell. Measurements of the detector output are made using a low value resistive load, followed by a current pre-amplifier, as shown below. The output is fed into an amplifier tuned to 800 Hz with a bandwidth of 50 Hz.



2. D* and N.E.P.

These are figures of merit for the materials of detectors.
The detectivity D* is defined in the expression:

$$D^* = \frac{\frac{V_s}{V_n} \sqrt{A(\Delta f)}}{W}$$

where: V_s = signal voltage across detector terminals
V_n = noise voltage across detector terminals
A = detector area
(Δf) = bandwidth of measuring amplifier
W = radiation power incident on detector sensitive element in r. m. s. watts.

The Noise Equivalent Power (N.E.P.) is related to D* by the expression:

$$\text{N.E.P.} = \frac{\sqrt{A}}{D^*}$$

NOTES (continued)

3. Time constant

Detector time constant figures are based on the response to a step function in the incident radiation. Quoted times indicate the interval between the moment the radiation is cut off and the output falling to 63% of its peak value.

4. a. Variation of performance with bias

Both signal and noise vary with bias in this type of cell. At bias levels at which the cell dissipation is less than 2.5 mW the maximum level of D* is maintained. At higher levels the noise increases more rapidly than the signal so that although the responsivity increases, D* falls. The maximum responsivity typically occurs at a dissipation level of 10 mW, beyond which heating occurs with a consequent reduction in responsivity.

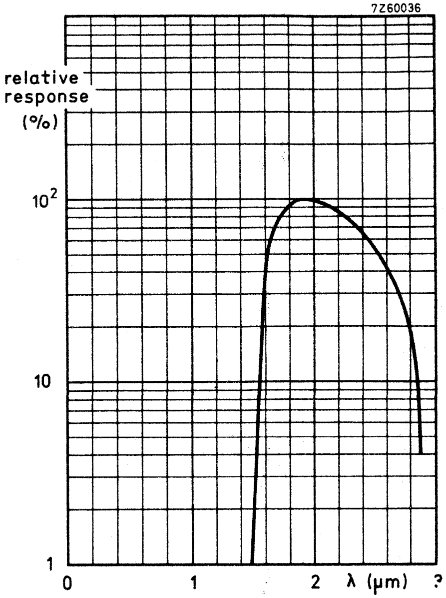
b. Variation of performance with temperature/life

Resistance, responsivity and D* are dependent on the previous temperature/life history of the cell. The quoted values are the minimum which may be expected after storage or operation up to 35 °C. These values may decrease by 50% after storage or operation at temperatures up to the absolute maximum temperature of 50 °C.

5. Recommended operating conditions

In order to minimise the effects of parameter variations with temperature and life it is recommended that a constant voltage bias is used. A suitable circuit is shown on page 3. With this mode of operation the signal is the short-circuit current, which is related to the open-circuit cell voltage by the expression:

$$V_{oc} = I_{sc} \times r_{\ell}$$


7Z60036
relative response (%)
10²
10
1
0
1
2
λ (μm)
3

PHOTOCONDUCTIVE CELL

Evaporated lead sulphide photoconductive cell with sensitive element mounted in a glass dewar, encapsulated in an envelope for room temperature operation.
Also available without envelope for cooled operation.
The cells are intended for use with pulsed or modulated radiation.

QUICK REFERENCE DATA

Peak spectral response	λ_m		2.2	μm
Spectral response range	λ		0.3 to 3.5	μm
Internal resistance	r_i	typ.	1.5	MΩ
Responsivity (radiation 2.0 μm)		typ.	80	mV/μW
D^* (2.0 μm, 800 Hz, 1 Hz)		typ.	4×10^{10}	cm $\sqrt{\text{Hz}}$/W
Time constant		typ.	100	μs
Sensitive area			6.0 x 6.0	mm^2

MECHANICAL DATA

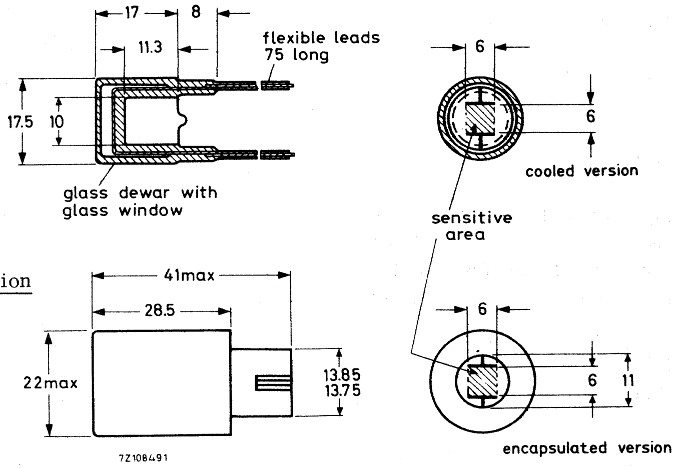
Dimensions in mm

Cooled version

Code No.
9330 200 30

Encapsulated version

Code No.
9332 401 30



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage (bidirectional)		V	max.	250	V
Current (bidirectional)		I	max.	0.5	mA
Temperatures					
Storage temperature	encapsulated version	T_{stg}		−55 to +60	°C
	cooled version	T_{stg}		−80 to +60	°C
Operating ambient temperature		T_{amb}	max.	60	°C

CHARACTERISTICS at T_{amb} = 20 °C (see note 1 on page 3)

Peak spectral response	λ_m		2.2	μm
Spectral response range	λ		0.3 to 3.5	μm
Internal resistance	r_i	typ.	1.5	MΩ
			1.0 to 4.0	MΩ
Time constant		typ.	100	μs
Noise voltage		typ.	8.5	μV
Performance				

1. Black body source
   colour temperature : 500 K
   chopping frequency : 800 Hz
   bandwidth : 1 Hz

Responsivity	>	**0.2**	mV/μW
	typ.	1.3	mV/μW
D*	>	**2.0** x 10^8	cm $\sqrt{Hz}$/W
	typ.	6.5 x 10^8	cm $\sqrt{Hz}$/W
N.E.P.	typ.	0.92	nW
	<	**3.0**	nW

2. Monochromatic source
   radiation : 2.0 μm
   chopping frequency: 800 Hz
   bandwidth : 1 Hz

Responsivity	typ.	80	mV/μW
D*	typ.	4 x 10^{10}	cm $\sqrt{Hz}$/W
N.E.P.	typ.	15	pW

NOTES

1. Test conditions

The characteristics are measured with the cell biased from a 200 V d.c. supply in series with a 1.0 MΩ load resistor. No correction is made for the loading effect of the 1.0 MΩ resistor, i.e. open circuit characteristics are not given.

The sensitive element is situated at a distance of 264 mm a black body source limited by an aperture of 3 mm. The radiation path is interrupted at 800 Hz by a chopper blade at ambient temperature. Under these conditions the r.m.s. power at the element (chopping factor 2.2) is 4.5 $\mu W/cm^2$.

Measurements of the detector output are made with an amplifier tuned to 800 Hz with a bandwidth of 50 Hz.

2. D^* and N.E.P.

These are figures of merit for the materials of detectors.

The detectivity D^* is defined in the expression:

$$D^* = \frac{\frac{V_s}{V_n}\sqrt{A(\Delta f)}}{W}$$

where: V_s = signal voltage across detector terminals
V_n = noise voltage across detector terminals
A = detector area
(Δf) = bandwidth of measuring amplifier
W = radiation power incident on detector sensitive element in r.m.s. watts.

The Noise Equivalent Power (N.E.P.) is related to D^* by the expression:

$$N.E.P. = \frac{\sqrt{A}}{D^*}$$

3. Time constant

Detector time constant figures are based on the response to a step function in the incident radiation. Quoted times indicate the interval between the moment the radiation is cut off and the output falling to 63% of its peak value.

4. Variation of performance with bias current.

Both signal and noise vary with current in this type of cell. At high currents the noise increases more rapidly than the signal, and therefore the signal-to-noise ratio has a peak value at some optimum current, which will vary slightly from cell to cell.

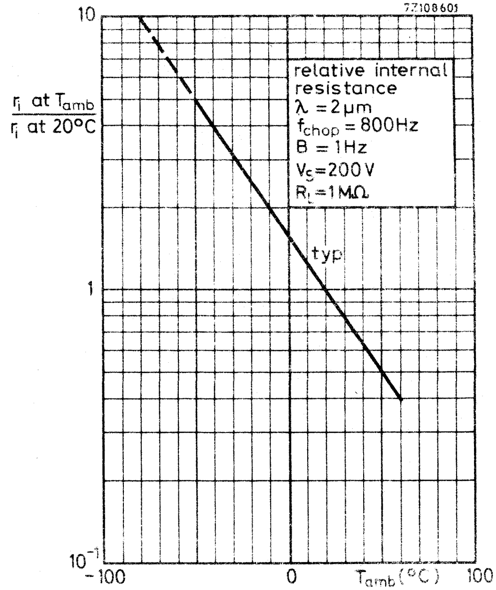
NOTES (continued)

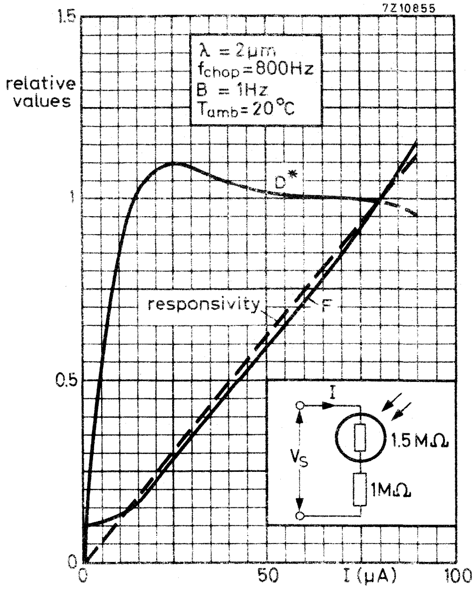
5. Effect of ambient radiation

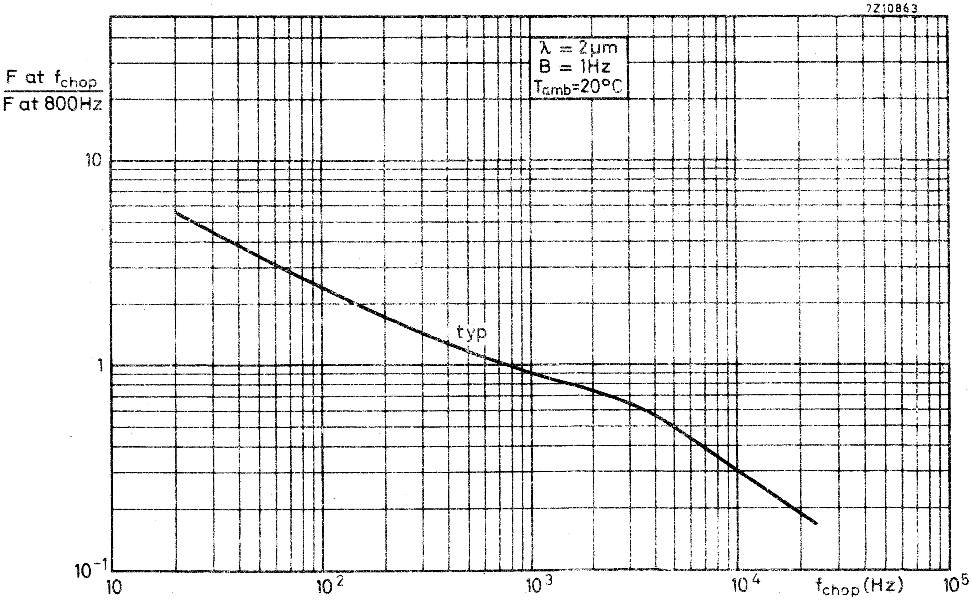
Care should be taken to avoid the incidence on the cell of appreciable radiation in the visible range. Such radiation will cause a decrease in the cell resistance and signal as long as the cell is kept cool. Normal daylight can cause this effect if seen for more than a few minutes. Precautions should be taken to prevent visible light reaching the sensitive element via the liquid nitrogen compartment.

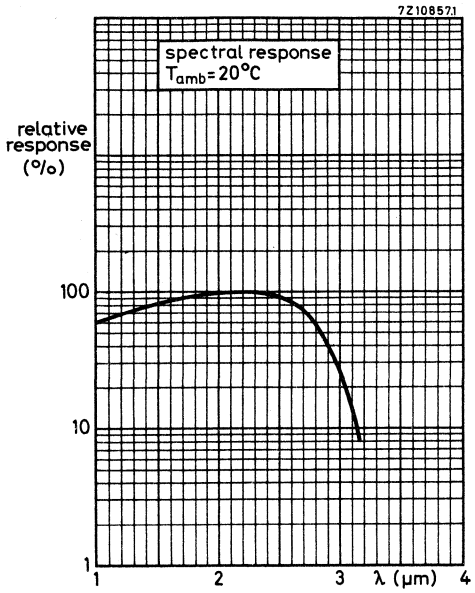
6. Warning

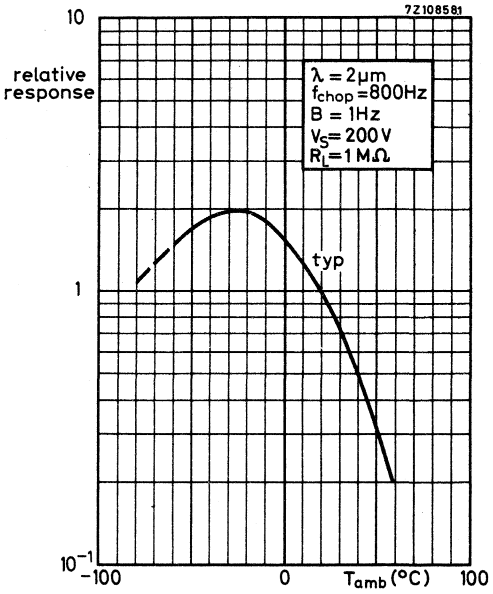
Care should be taken to ensure that the device is not allowed to reach room temperature while still biased.
The dewar vessel must always be completely dry before being refilled with liquid nitrogen. In very humid conditions, water vapour may condense at the top of the dewar vessel. Should this occur, the remaining liquid nitrogen should be allowed to boil off, the ice should be removed and precautions taken to avoid a recurrence.

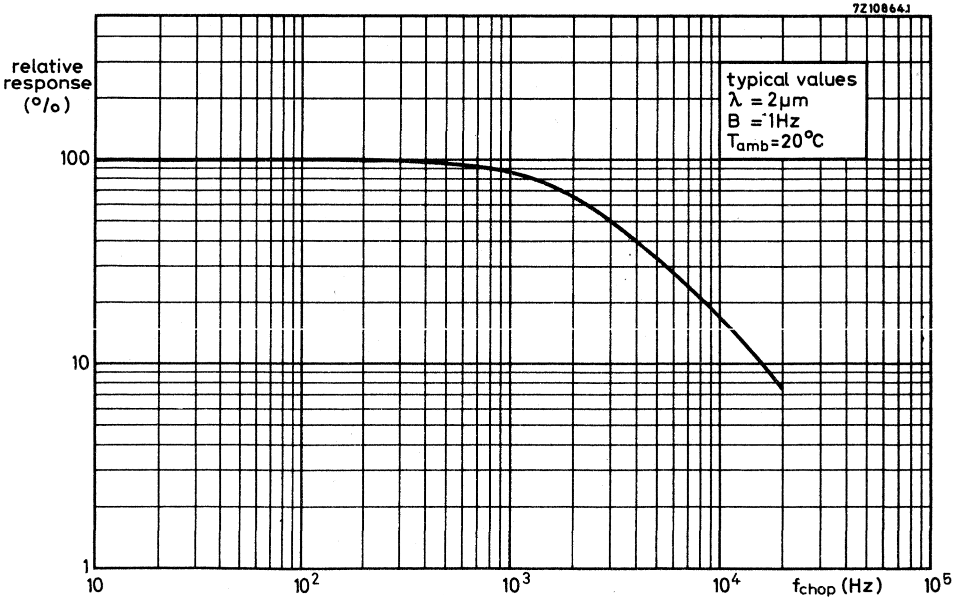

7Z10860
relative internal resistance
$\lambda = 2\,\mu m$
$f_{chop} = 800 Hz$
$B = 1 Hz$
$V_S = 200 V$
$R_L = 1 M\Omega$
typ
$\frac{r_i \text{ at } T_{amb}}{r_i \text{ at } 20°C}$
10
1
10^{-1}
−100
0
100
T_{amb} (°C)

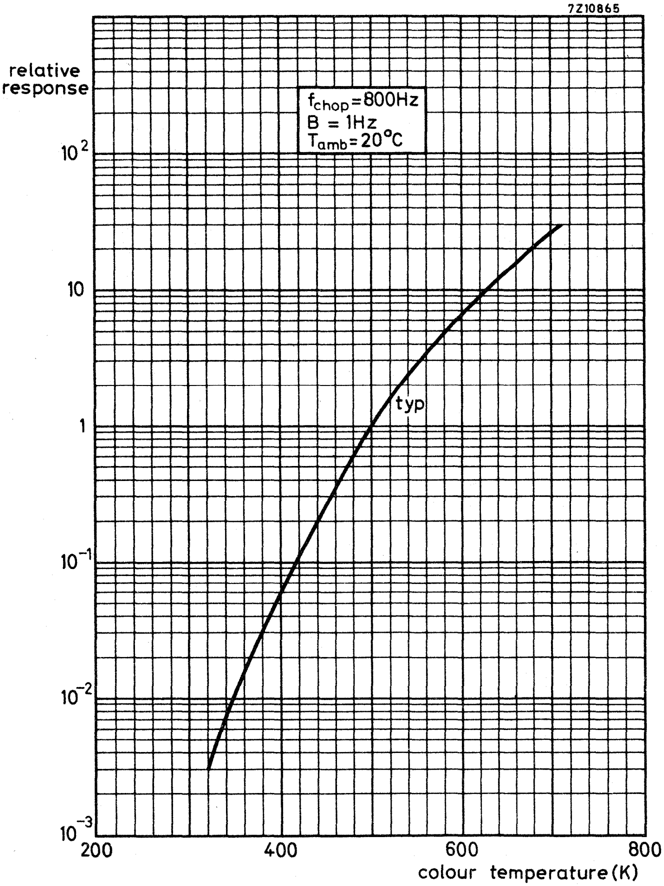

7Z10855
$\lambda = 2\,\mu m$
$f_{chop} = 800 Hz$
$B = 1 Hz$
$T_{amb} = 20°C$
relative values
D^*
responsivity
F
1.5
1
0.5
0
0
50
100
I (μA)
I
V_S
1.5 MΩ
1 MΩ

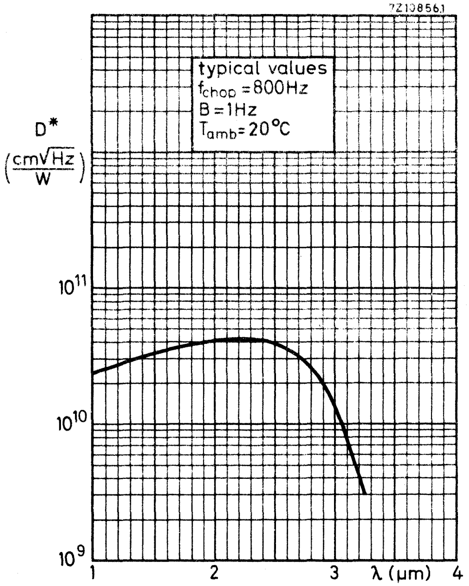

7Z10863
$\lambda = 2\,\mu m$
$B = 1 Hz$
$T_{amb} = 20°C$
$\frac{F \text{ at } f_{chop}}{F \text{ at } 800 Hz}$
typ
10
1
10^{-1}
10
10^2
10^3
10^4
10^5
f_{chop} (Hz)

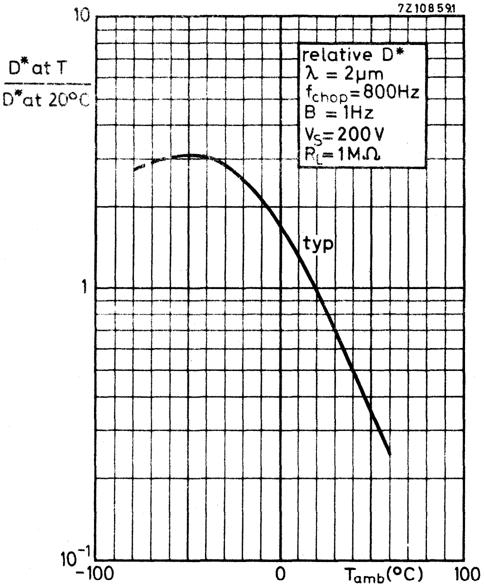

7Z10857.1
spectral response
T_{amb} = 20°C
relative response (%)
100
10
1
1
2
3
λ (μm)
4

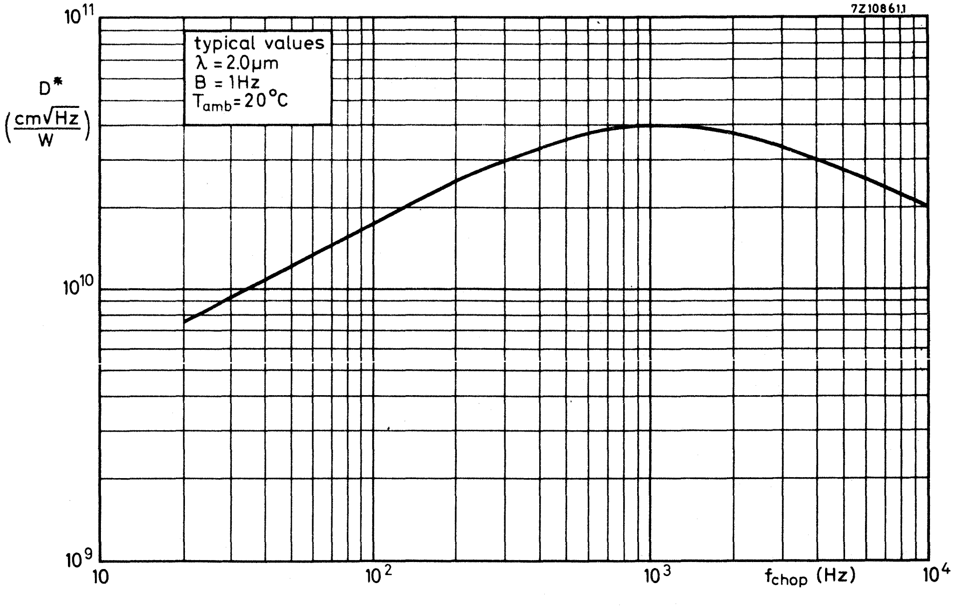

7Z10858.1
relative response
10
1
10^{-1}
λ = 2μm
f_{chop} = 800Hz
B = 1Hz
V_S = 200 V
R_L = 1 MΩ
typ
−100
0
T_{amb} (°C)
100

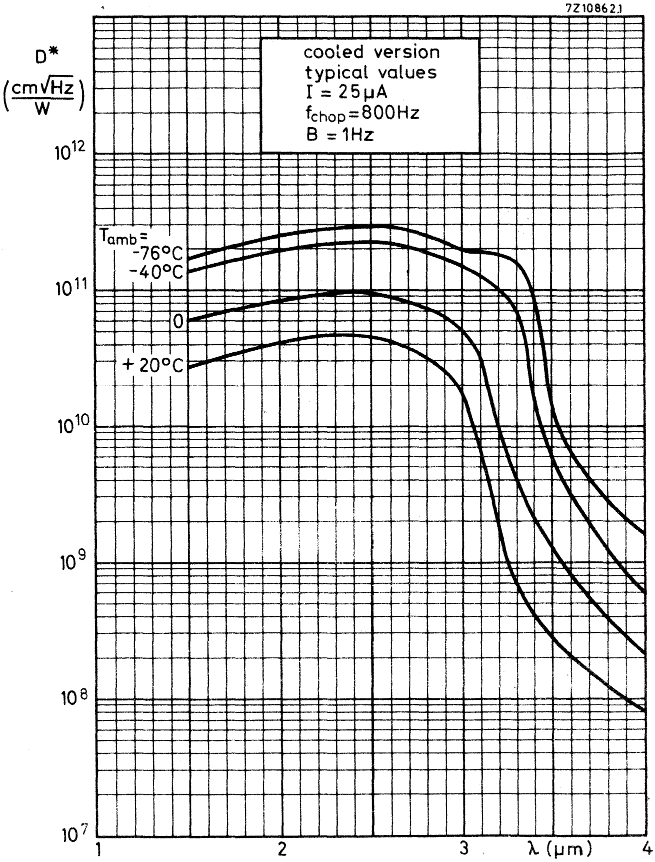

7Z10864.1
relative response (%)
typical values
λ = 2μm
B = 1Hz
T_{amb} = 20°C
100
10
1
10
10^2
10^3
10^4
f_{chop} (Hz)
10^5


7Z10865
relative response
f_{chop}=800Hz
B = 1Hz
T_{amb}=20°C
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
typ
200
400
600
800
colour temperature (K)


7Z10856.1
typical values
f_{chop} = 800Hz
B = 1Hz
T_{amb} = 20°C
D*
(cm√Hz / W)
10^{11}
10^{10}
10^{9}
1
2
3
λ (μm)
4


7Z10859.1
10
D* at T / D* at 20°C
relative D*
λ = 2μm
f_{chop} = 800Hz
B = 1Hz
V_S = 200 V
R_L = 1MΩ
typ
1
10^{-1}
−100
0
T_{amb}(°C)
100


7Z10861.1
10^{11}
typical values
λ = 2.0μm
B = 1Hz
T_{amb} = 20°C
D*
(cm√Hz / W)
10^{10}
10^{9}
10
10^{2}
10^{3}
f_{chop} (Hz)
10^{4}


7Z10862.1
cooled version
typical values
I = 25 μA
f_chop = 800Hz
B = 1Hz
D*
(cm√Hz / W)
10^12
10^11
10^10
10^9
10^8
10^7
T_amb =
-76°C
-40°C
0
+ 20°C
1
2
3
λ (μm)
4

Photoconductive devices

TYPE SELECTION CHART

	P_{max} at T_{amb} = 25 °C (mW)	on-off services	measuring purposes
hermetically sealed	10		RPY33
	70	ORP60, ORP61, ORP66	
	100	ORP62, ORP68, ORP69	
	400	ORP52	
	500	RPY18, RPY19	
	1000	ORP23, ORP90, RPY20, RPY55	
plastic	50		RPY71
	100	RPY58A	
lacquered	300	RPY82	
	500	RPY85	
	750	RPY84	

GENERAL OPERATIONAL RECOMMENDATIONS PHOTOCONDUCTIVE DEVICES

1. GENERAL

1.1 These application directions are valid for all types of photoconductive cells, unless otherwise stated on the individual technical data sheets.

1.2 A photoconductive device is a light-sensitive device whose resistance varies with the illumination on the device.

1.3 Where the term illumination is used in the following sections it shall be taken to mean the radiant energy which is normally used to excite the device.

1.4 Also in the following sections, history is taken to mean the duration of the specified conditions plus a sufficient description of previous conditions.

2. OPERATING CHARACTERISTICS

2.1 The data given on the individual technical data sheets are based on the devices being uniformly illuminated.

2.2 The illumination resistance is the ratio of the voltage across the device to the current through the device when illumination is applied to the device.

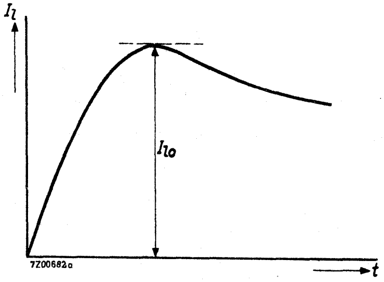
2.2.1 For a particular set of conditions the equilibrium illumination resistance is the illumination resistance after such a time under these conditions that the rate of change of the illumination resistance is less than 1% per 5 minutes.

2.2.2 For a particular set of conditions the initial illumination resistance is the first virtually constant value of the illumination resistance after a period of storage or other operating conditions.
The initial illumination resistance usually occurs after a few seconds under the specified conditions.

2.3 The illumination current is the current which passes when a voltage and illumination are applied to the device.

2.3.1 For a particular set of conditions the equilibrium illumination current is the illumination current after such a time under these conditions that the rate of change of the illumination current is less than 1% per 5 minutes.

2.3.2 For a particular set of conditions the initial illumination current is the first virtually constant value of the illumination current after a period of storage or other operating conditions.
The initial illumination current usually occurs after a few seconds under the specified conditions.



2.4 The dark resistance is the resistance of the device in the absence of illumination.

2.4.1 For a particular set of conditions the equilibrium dark resistance is the dark resistance after such a time under these conditions that the rate of change of the dark resistance is less than 2% per 5 minutes.

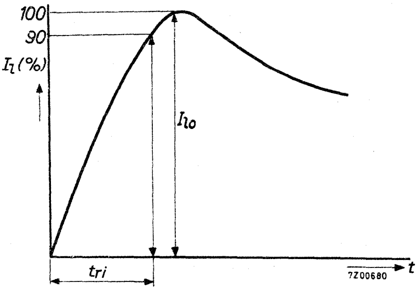
2.4.2 For a particular set of conditions the initial dark resistance is the dark resistance after a specified time under these conditions following a specified history.

2.5 The dark current is the current which passes when a voltage is applied to the device in the absence of illumination.

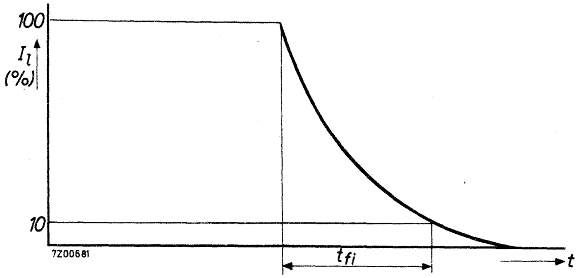
2.5.1 For a particular set of conditions the equilibrium dark current is the dark current after such a time under these conditions that the rate of change of the dark current is less than 2% per 5 minutes.

2.5.2 For a particular set of conditions the initial dark current is the dark current after a specified time under these conditions immediately following a specified history.

2.6.1 For a particular set of conditions and history the current rise time is the time taken for the current through the device to rise to 90% to its initial illumination current measured from the instant of starting the illumination.



2.6.2 For a particular set of conditions and history the current decay time is the time taken for the current through the device to fall to 10% of its value at the instant of stopping the illumination, measured from that instant.



2.7 The illumination sensitivity is the quotient of illumination current by the incident illumination.

2.8 The illumination resistance (current) temperature response is the relationship between the illumination resistance (current) and the ambient temperature of the device under constant illumination and voltage conditions.

2.9 For a particular set of conditions the initial drift is the difference between the equilibrium and initial illumination current, expressed as a percentage of the initial illumination current.

2.10 The illumination response is the relationship between the initial illumination resistance and the illumination, defined as $\frac{\Delta \log r_{lo}}{\Delta \log E}$

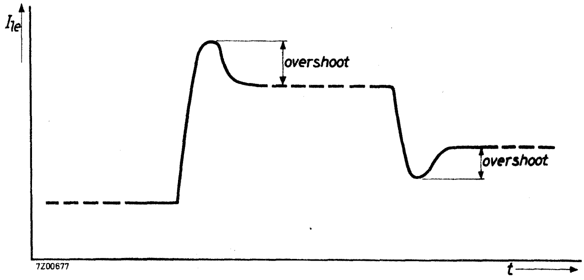
3. THERMAL DATA

3.1 Ambient temperature. The ambient temperature of a device is the temperature of the surrounding air of that device in its practical situation, which means that other elements in the same space or apparatus must have their normal maximum dissipation and that the same apparatus envelope must be used. This ambient temperature can normally be measured by using a mercury thermometer the mercury container of which has been blackened, placed at a distance of 5 mm from the envelope in the horizontal plane through the centre of the effective area of the CdS tablet.
It shall be exposed to substantially the same radiant energy as that incident on the CdS tablet.

3.2 The thermal resistance of a device is defined as the temperature difference between the hottest point of the device and the dissipating medium, divided by the power dissipated in the device.

4. OPERATIONAL NOTES

4.1 When a photoconductive device is subjected to a change of operating conditions there may be a transient change of current in excess of that due to the difference between the equilibrium illumination currents. This transient change is called overshoot.



4.2 Direct sunlight irradiation should be avoided.

5. MOUNTING

5.1 If no restrictions are made on the individual published data sheets, the device may be mounted in any position.

5.2 Most of the photoconductive devices may be soldered directly into the circuit, which is indicated on the individual published data sheets. However, the heat conducted to the seal of the device should be kept to a minimum by the use of a thermal shunt. If not otherwise indicated, the device may be dip-soldered at a solder temperature of 240 °C for a maximum of 10 seconds up to a point 5 mm from the seals.

6. STORAGE

It is recommended that the devices be stored in the dark. At any rate direct sunlight irradiation should be avoided.

7. LIMITING VALUES

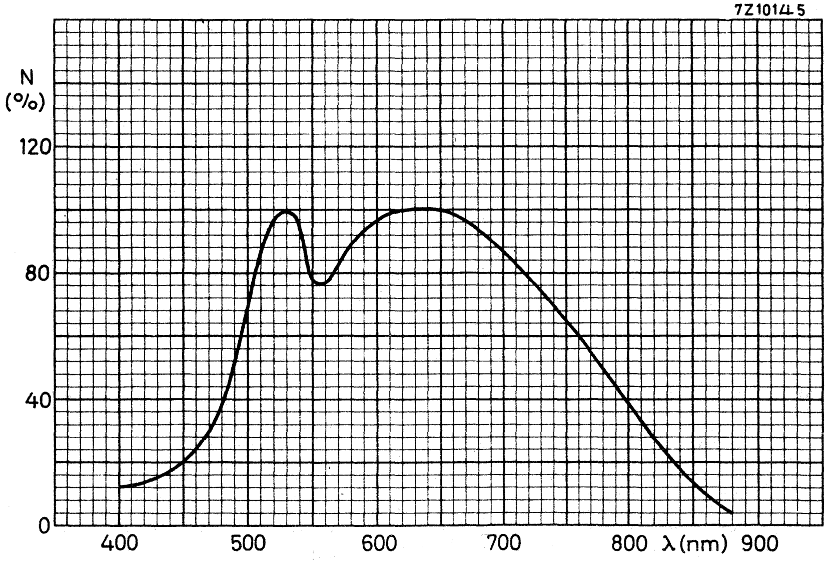
The limiting values of photoconductive devices are given in the absolute maximum rating system.

8. OUTLINE DIMENSIONS

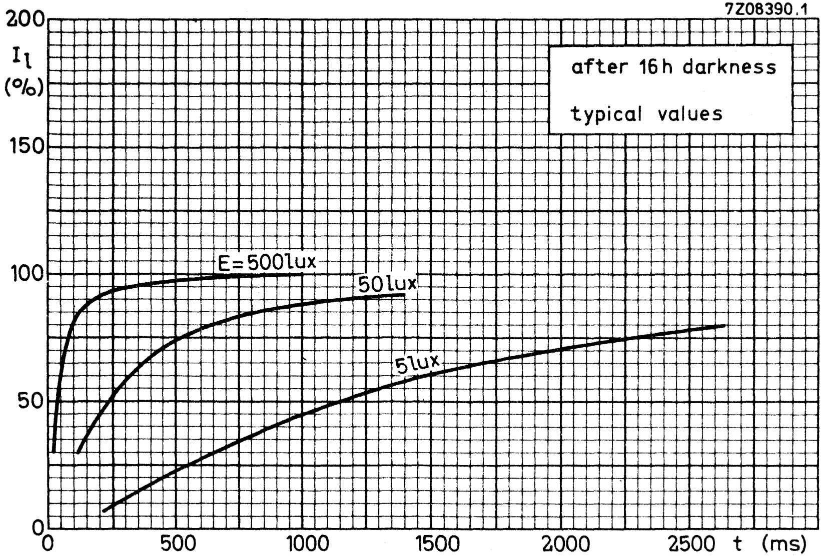
The outline dimensions are given in mm.

9. MECHANICAL ROBUSTNESS

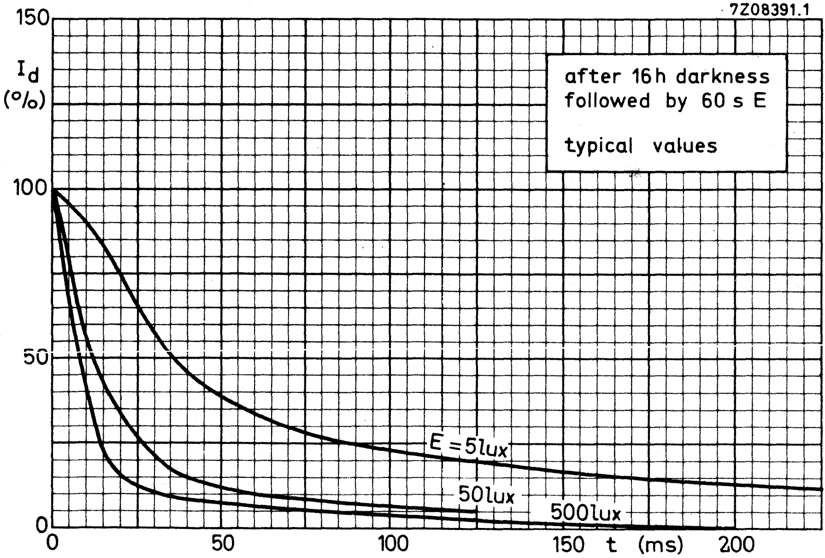
The conditions for shock and vibration given on the individual data sheets are intended only to give an indication of the mechanical quality of the device. It is not advisable to subject the device to such conditions.



Type D response curve



Current rise curves for cells with type D response curve



Current decay curves for cells with type D response curve

LIST OF SYMBOLS

Cell voltage	V
Cell current	I
Illumination current	I_l
Initial illumination current	I_{lo}
Equilibrium illumination current	I_{le}
Dark current	I_d
Initial dark current	I_{do}
Equilibrium dark current	I_{de}
Illumination resistance	r_l
Initial illumination resistance	r_{lo}
Equilibrium illumination resistance	r_{le}
Dark resistance	r_d
Initial dark resistance	r_{do}
Equilibrium dark resistance	r_{de}
Current rise time	t_{ri}
Current decay time	t_{fi}
Pulse duration	t_p
Averaging time	t_{av}
Pulse repetition rate	Prr
Illumination sensitivity	N
Illumination response	γ
Voltage response	α
Ambient temperature	T_{amb}
Thermal resistance	R_{th}
Temperature of CdS tablet	T_{tablet}
Colour temperature	T_c (T_K)
Dissipation	P
Illumination	E
Initial drift	D_o
Peak value (subscript)	M

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

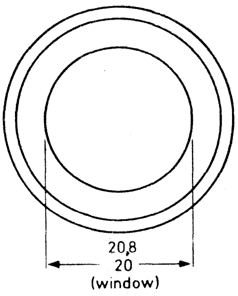
Top sensitive cadmium sulphide photoconductive cell in hermetically sealed metal envelope with glass window intended for use in general control circuits such as twilight switches and flame failure circuits.
The cell is shock and vibration resistant.

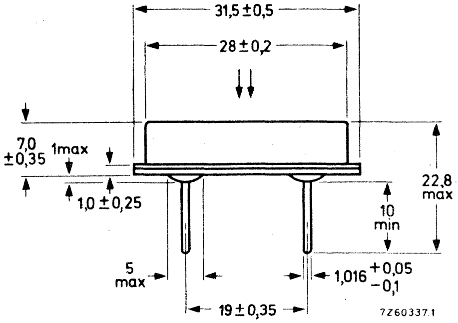
QUICK REFERENCE DATA

Power dissipation at T_{amb} = 25 °C	P	max.	1	W
Cell voltage, d.c. and repetitive peak	V	max.	400	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{lo}	typ.	3,3	kΩ
Spectral response, current rise and decay curves			type D	
Outline dimensions		max.	32 dia. x 7,6	mm

MECHANICAL DATA

Dimensions in mm





ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and the time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic charactersitics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery

Initial dark resistance measured with 400 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	10	MΩ	1)
Equilibrium dark resistance measured with 400 V d.c. applied via 1 MΩ, 30 min after switching off the illumination	r_{de}	>	80	MΩ	1)
Initial illumination resistance measured with 10 V d.c., illumination = 50 lx, after 16 h in darkness 2)	r_{lo}		2 to 8,9	kΩ	
		typ.	3,3	kΩ	
Equilibrium illumination resistance measured with 10 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}		2 to 12,2	kΩ	
		typ.	4,2	kΩ	
Negative temperature response of illumination resistance		typ.	0,2	%/°C	
		<	0,5	%/°C	
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 10 V d.c.}}$		typ.	1,05		
Insulation resistance between cell and envelope, measured with 400 V d.c. via 1 MΩ	r_{ins}	>	200	MΩ	

---

1) The spread of the dark resistance is large and values higher than 100 MΩ and 1000 MΩ are possible for the initial dark resistance and the equilibrium dark resistance respectively.

2) After 16 hours in darkness changes in the CdS material are still ocurring but have only insignificant effect on the illumination resistance.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak	V	max.	400	V
Cell voltage, pulse, $t_p \leq 5$ ms $p_{rr} \leq$ once per minute	V_M	max.	1500	V
Insulation voltage, d.c. and repetitive peak	V_{ins}	max.	400	V
Insulation voltage, pulse, between cell and envelope, $t_p \leq 5$ ms, $p_{rr} \leq$ once per min	V_{ins}	max.	1500	V
Power dissipation (t_{av} = 2 s) see graph P_{max}				
Power dissipation, pulse	P_M	max.	5 x P_{max}	
Cell current, d.c. and repetitive peak	I	max.	150	mA
Illumination	E	max.	50 000	lx
Temperature CdS tablet, operating	T_{tablet}	max.	85	°C
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C
storage	T_{stg}	max.	50	°C [1]
operating	T_{amb}	max.	70	°C

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −30 % to +70 % (typ. +40 %) do not impair the circuit performance. Direct irradiation by sunlight should be avoided.

MECHANICAL ROBUSTNESS

An indication for the ruggedness of the cell is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95 % of the devices pass these tests without perceptible damage.

Shock

25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

Vibration

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

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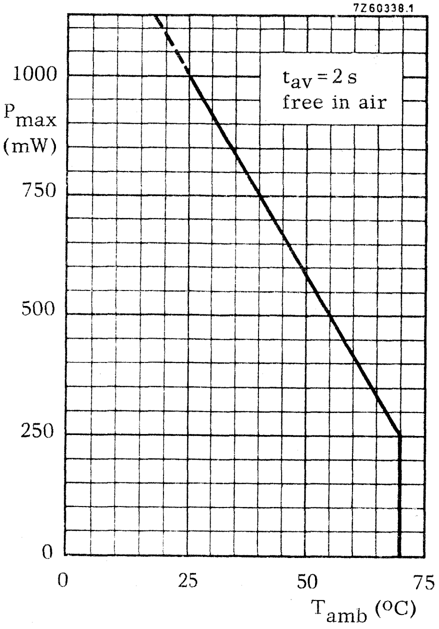
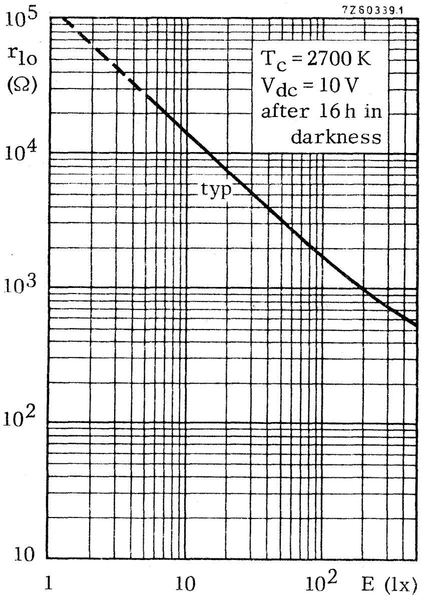
[1] Operating of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z60338.1
t_{av} = 2 s
free in air
P_{max} (mW)
1000
750
500
250
0
0
25
50
75
T_{amb} (°C)


7Z60339.1
r_{lo} (Ω)
10^5
10^4
10^3
10^2
10
T_c = 2700 K
V_{dc} = 10 V
after 16 h in darkness
typ
1
10
10^2
E (lx)

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

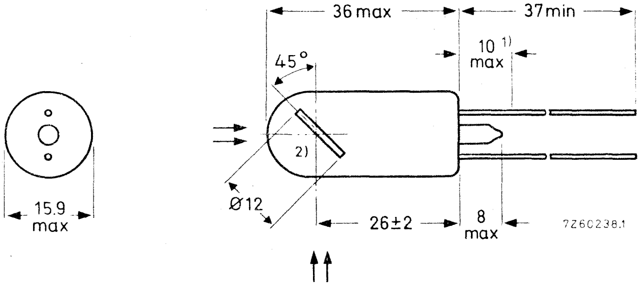
Top and side sensitive cadmium sulphide photoconductive cell in hermetically sealed all-glass envelope intended for on-off applications such as flame failure circuits.
The cell is shock and vibration resistant.

QUICK REFERENCE DATA

Power dissipation at $T_{amb} = 25\ ^oC$	P	max.	0,4	W
Cell voltage, d.c. and repetitive peak	V	max.	200	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{lo}	typ.	1200	Ω
Spectral response, current rise and decay curves			type D	
Outline dimensions		max.	15,9 dia. x 44	mm

MECHANICAL DATA

Dimensions in mm



Soldering

The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 °C for maximum 10 s up to a point 5 mm from the seals.

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[1] Not tinned.

[2] Centre of sensitive area.

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery

Initial dark resistance measured with 200 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	4	MΩ [1]
Equilibrium dark resistance measured with 200 V d.c. applied via 1 MΩ, 30 min after switching off the illumination	r_{de}	>	100	MΩ [1]
Initial illumination resistance measured with 10 V d.c., illumination = 50 lx, after 16 h in darkness [2] [3]	r_{lo}	 typ.	750 to 3000 1200	Ω Ω
Equilibrium illumination resistance measured with 10 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}	 typ.	750 to 4100 1500	Ω Ω
Negative temperature response of illumination resistance		typ. <	0,2 0,5	%/°C %/°C
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 10 V d.c.}}$		typ.	1,05	

---

[1] The spread of the dark resistance is large and values higher than 100 MΩ and 1000 MΩ are possible for the initial dark resistance and the equilibrium dark resistance respectively.

[2] After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

[3] Measured at top sensitivity.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak	V	max.	200	V
Cell voltage, pulse, $t_p \leq 5$ ms $p_{rr} \leq$ once per minute	V_M	max.	500	V
Power dissipation (t_{av} = 2 s) see graph P_{max}				
Power dissipation, pulse	P_M	max.	5 x P_{max}	
Cell current, d.c. and repetitive peak	I	max.	100	mA
Illumination	E	max.	50 000	lx
Temperature CdS tablet, operating	T_{tablet}	max.	85	°C
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C
storage	T_{stg}	max.	50	°C [1]
operating	T_{amb}	max.	70	°C

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −30 % to +70 % (typ. +40 %) do not impair the circuit performance. Direct irradiation by sunlight should be avoided.

MECHANICAL ROBUSTNESS

An indication for the ruggedness of the cell is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95 % of the devices pass these tests without perceptible damage.

Shock

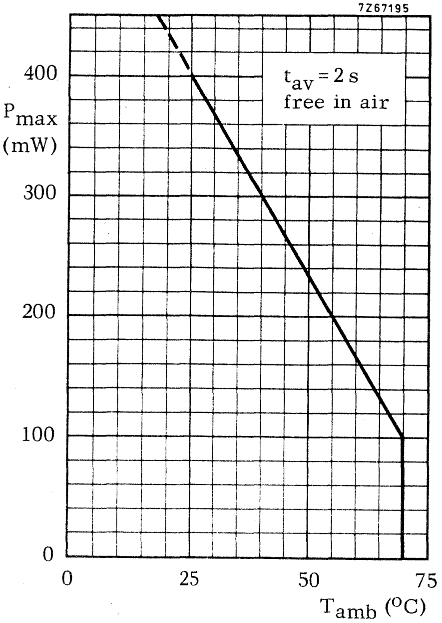
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

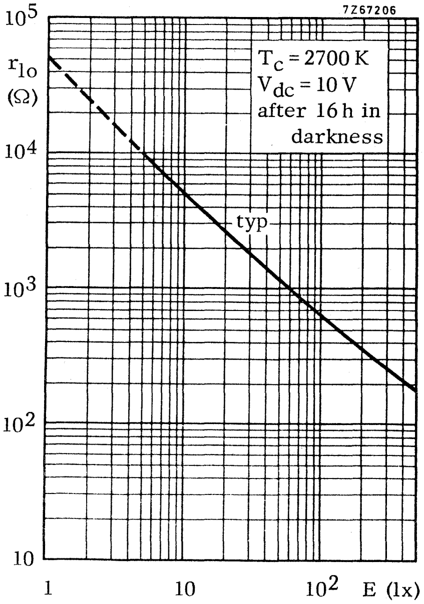
Vibration

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

---

[1] Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z67195
t_{av} = 2 s
free in air
P_{max}
(mW)
400
300
200
100
0
0
25
50
75
T_{amb} (°C)


7Z67206
T_c = 2700 K
V_{dc} = 10 V
after 16 h in
darkness
r_{lo}
(Ω)
10^5
10^4
10^3
10^2
10
typ
1
10
10^2
E (lx)

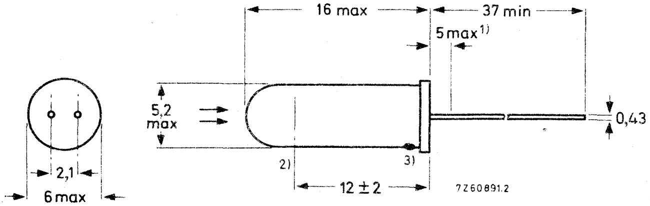
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

Top sensitive cadmium sulphide photoconductive cells in hermetically sealed all-glass envelope intended for on-off applications such as flame failure circuits, and for automatic brightness and contrast control in television receivers.
The cells are shock and vibration resistant.

QUICK REFERENCE DATA				
Power dissipation at $T_{amb} = 25\ ^{o}C$	P	max.	70	mW
Cell voltage, d.c. and repetitive peak	V	max.	350	V
Cell resistance at 50 lx, 2700 K colour temperature, ORP60	r_{lo}	typ.	60	kΩ
ORP66	r_{lo}	<	55	kΩ
Spectral response, current rise and decay curves			type D	
Outline dimensions		max.	6 dia. x 16	mm

MECHANICAL DATA

Dimensions in mm



Soldering

The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 °C for maximum 10 s up to a point 5 mm from the seals.

---

[1] Not tinned.

[2] Sensitive surface.

[3] Blue dot on ORP66.

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery

			ORP60	ORP66	
Initial dark resistance measured at 300 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	200	200	MΩ [1]
Initial illumination resistance measured at 30 V d.c., illumination = 50 lx, after 16 hrs in darkness [2]		>	37,5	–	kΩ
	r_{lo}	typ.	60	–	kΩ
		<	150	55	kΩ
Equilibrium illumination resistance measured at 30 V d.c., illumination = 50 lx, after 15 min under the measuring conditions		>	37,5	–	kΩ
	r_{le}	typ.	75	–	kΩ
		<	190	90	kΩ
Negative temperature response of illumination resistance		typ.	0,2		%/°C
		<	0,5		%/°C
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 30 V d.c.}}$	α	typ.	1,5		

---

[1] The spread of the dark resistance is large and values higher than 1000 MΩ are possible for the initial dark resistance.

[2] After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage d.c. and repetitive peak	V	max.	350	V	
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute	V_M	max.	500	V	
Power dissipation ($t_{av} = 2$ s) see graph P_{max}					
Power dissipation, pulse	P_M	max.	$5 \times P_{max}$		
Illumination	E	max.	50 000	lx	
Temperature CdS tablet, operating	T_{tablet}	max.	85	°C	
Ambient temperature, storage and operation	T_{amb}	min.	−40	°C	
storage	T_{stg}	max.	50	°C	1)
operating	T_{amb}	max.	70	°C	

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −50 % to +100 % (typ. +50 % do not impair the circuit performance. Direct irradiation by sunlight should be avoided.

MECHANICAL ROBUSTNESS

An indication for the ruggedness of the device is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95 % of the devices pass these tests without perceptible damage.

Shock

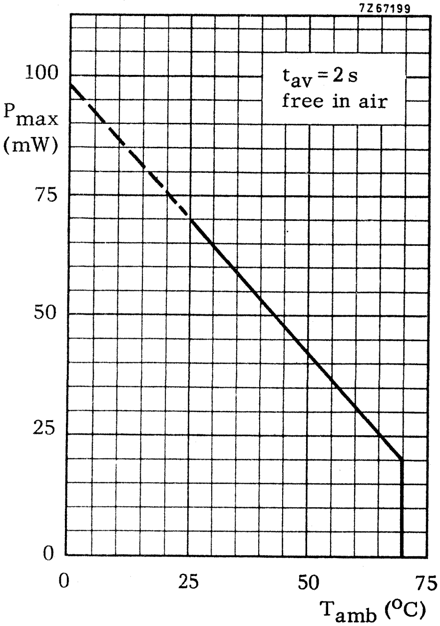
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

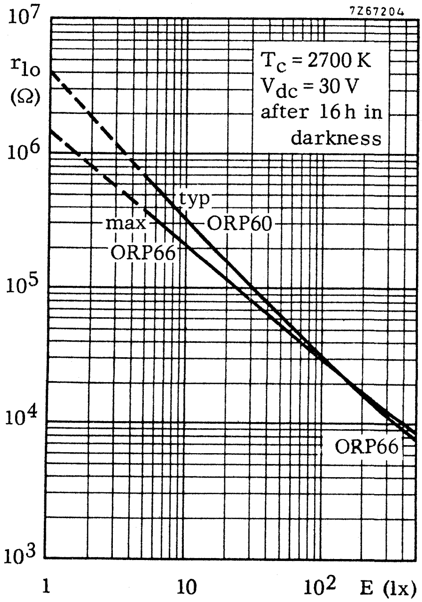
Vibration

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

---

1) Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z67199
t_{av} = 2 s
free in air
P_{max} (mW)
100
75
50
25
0
0
25
50
75
T_{amb} (°C)


7Z67204
10^7
r_{lo} (Ω)
10^6
10^5
10^4
10^3
T_c = 2700 K
V_{dc} = 30 V
after 16 h in darkness
typ
ORP60
max
ORP66
ORP66
1
10
10^2
E (lx)

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

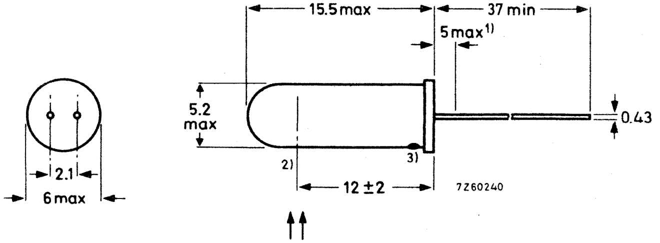
Side sensitive cadmium sulphide photoconductive cells in hermetically sealed all-glass envelope intended for on-off applications such as flame failure circuits, and for automatic brightness and contrast control in television receivers.
The cells are shock and vibration resistant.

QUICK REFERENCE DATA

			ORP61	ORP62	
Power dissipation at T_{amb} = 25 °C	P	max.	70	100	mW
Cell voltage, d.c. and repetitive peak	V	max.	350	350	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{lo}	typ.	60	45	kΩ
Spectral response, current rise and decay curves			type D		
Outline dimensions		max.	6 dia. x 15,5 mm		

MECHANICAL DATA

Dimensions in mm



Soldering

The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 °C for maximum 10 s up to a point 5 mm from the seals.

---

1) Not tinned
2) Centre of sensitive area
3) ORP61 brown dot; ORP62 red dot.

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery.

			ORP61	ORP62	
Initial dark resistance measured at 300 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	200	150	MΩ [1]
Initial illumination resistance measured at 30 V d.c., illumination = 50 lx, after 16 hrs in darkness [2]	r_{lo}	>	37,5	30	kΩ
		typ.	60	45	kΩ
		<	150	100	kΩ
Equilibrium illumination resistance measured at 30 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}	>	37,5	30	kΩ
		typ.	75	60	kΩ
		<	190	170	kΩ
Negative temperature response of illumination resistance		typ.	0,2	0,2	%/°C
		<	0,5	0,5	%/°C
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 30 V d.c.}}$	α	typ.	1,5	1,4	

---

1) The spread of the dark resistance is large and values higher than 1000 MΩ are possible for the initial dark resistance.

2) After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak	V	max.	350	V	
Cell voltage, pulse, $t_p \leq 5$ ms, $P_{rr} \leq$ once per minute – ORP61	V_M	max.	500	V	
ORP62	V_M	max.	1000	V	
Power dissipation (t_{av} =2 s) see graph P_{max}					
Power dissipation, pulse	P_M	max.	5 x P_{max}		
Illumination	E	max.	50 000	lx	
Temperature CdS tablet, operating	T_{tablet}	max.	85	°C	
Ambient temperature, storage and operation	T_{amb}	min.	-40	°C	
storage	T_{stg}	max.	50	°C	1)
operating	T_{amb}	max.	70	°C	

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that under rated load, during life, changes in illumination resistance - for ORP61 from -50 % to +100 % (typ. +50 %) and for ORP62 from -30 % to +70 % (typ. +40 %) - do not impair the circuit performance.
Direct irradiation by sunlight should be avoided.

MECHANICAL ROBUSTNESS

An indication for the ruggedness of the device is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95 % of the devices pass these tests without perceptible damage.

Shock

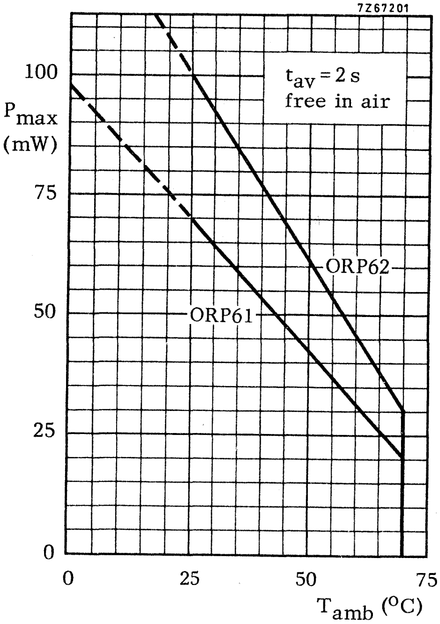
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

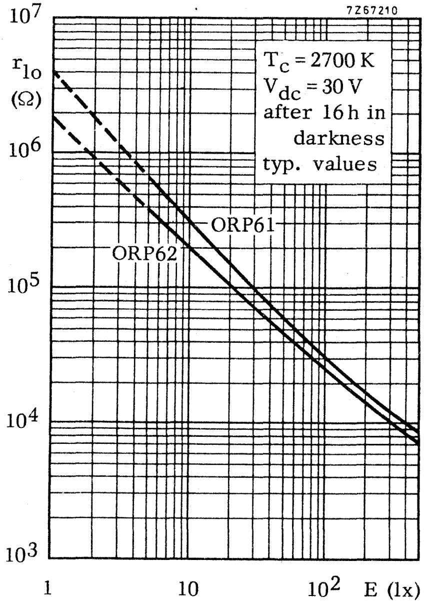
Vibration

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

---

1) Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z67201
P_{max} (mW)
100
75
50
25
0
$t_{av} = 2$ s
free in air
ORP62
ORP61
0
25
50
75
T_{amb} (°C)


7Z67210
r_{lo} (Ω)
10^7
10^6
10^5
10^4
10^3
$T_c = 2700$ K
$V_{dc} = 30$ V
after 16 h in darkness
typ. values
ORP61
ORP62
1
10
10^2
E (lx)

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

See data ORP60; ORP66

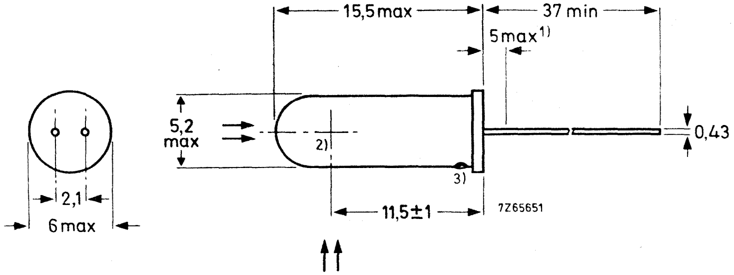
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

Top and side sensitive cadmium sulphide photoconductive cells in hermetically sealed all-glass envelope intended for on-off applications such as flame failure circuits, and for automatic brightness and contrast control in television receivers.
The cells are shock and vibration resistant.

QUICK REFERENCE DATA				
Power dissipation at T_{amb} = 25 °C	P	max.	100	mW
Cell voltage, d.c. and repetitive peak	V	max.	350	V
Cell resistance at 50 lx, 2700 K colour temperature, ORP68	r_{lo}	typ.	64	kΩ
ORP69	r_{lo}	typ.	30	kΩ
Spectral response, current rise and decay curves			type D	
Outline dimensions		max.	6 dia. x 15,5	mm

MECHANICAL DATA

Dimensions in mm



Soldering

The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 °C for maximum 10 s up to a point 5 mm from the seals.

---

1) Not tinned.

2) Centre of sensitive area.

3) ORP68: gray dot; ORP69: white dot.

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and the time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery

			ORP68	ORP69	
Initial dark resistance measured with 300 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	150	100	MΩ 1)
Initial illumination resistance measured at 30 V d.c., illumination = 50 lx, after 16 h in darkness 2) 3)	r_{lo}	>	30	20	kΩ
		typ.	46	30	kΩ
		<	100	60	kΩ
Equilibrium illumination resistance measured at 30 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}	>	30	27	kΩ
		typ.	60	46	kΩ
		<	170	115	kΩ
Negative temperature response of illumination resistance		typ.	0,2		%/°C
		<	0,5		%/°C
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 30 V d.c.}}$		typ.	1,4		

---

1) The spread of the dark resistance is large and values higher than 1000 MΩ are possible for the initial dark resistance.

2) After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

3) Measured at top sensitivity.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak	V	max.	350	V
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute - ORP68	V_M	max.	1000	V
ORP69	V_M	max.	700	V
Power dissipation (t_{av} = 2 s) see graph P_{max}				
Power dissipation, pulse	P_M	max.	5 x P_{max}	
Illumination	E	max.	50 000	lx
Temperature of CdS tablet, operating	T_{tablet}	max.	+85	°C
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C
storage	T_{stg}	max.	+50	°C 1)
operating	T_{amb}	max.	+70	°C

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be so designed that changes in illumination resistance of the cells during life under rated load from −30 % to +70 % (typ. +40 %) do not impair the circuit performance. Direct irradiation by sunlight should be avoided.

MECHANICAL ROBUSTNESS

An indication of the ruggedness of the device is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95 % of the devices pass these tests without perceptible damage.

Shock

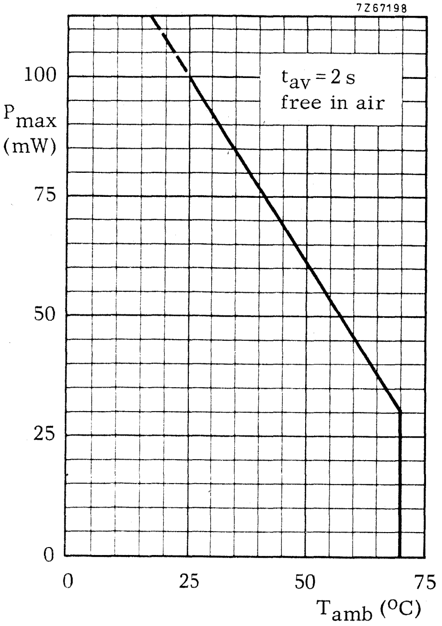
25 g_{peak}, 10 000 shocks in one of the three positions of the cell

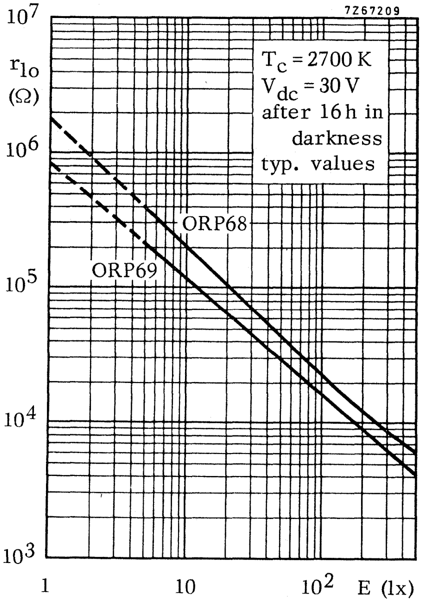
Vibration

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

---

1) Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z67198
100
75
50
25
0
Pmax
(mW)
t_{av} = 2 s
free in air
0
25
50
75
T_{amb} (°C)


7Z67209
10^7
10^6
10^5
10^4
10^3
r_{lo}
(Ω)
T_c = 2700 K
V_{dc} = 30 V
after 16 h in
darkness
typ. values
ORP68
ORP69
1
10
10^2
E (lx)

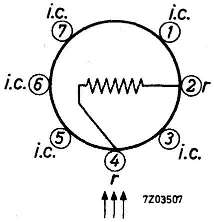
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

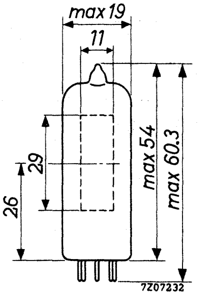
Side sensitive cadmium sulphide photoconductive cell in hermetically sealed all-glass envelope intended for use in flame control, smoke detector or industrial on-off switching applications.
The cell is shock and vibration resistant.

QUICK REFERENCE DATA				
Power dissipation at T_{amb} = 25 °C	P	max.	1	W
Cell voltage, d.c. and repetitive peak	V	max.	350	V
Cell resistance at 50 lx, 2700 K colour temperature,	r_{lo}	typ.	1500	Ω
Spectral response, current rise and decay curves		type D		
Outline dimensions		max. 19 dia.x 60,3 mm		

MECHANICAL DATA

Dimensions in mm





Base : 7 p. miniature

Total area to be illuminated 1, 1 x 2, 9 cm^2

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery.

Initial dark resistance measured with 300 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	42	MΩ 1)
Equilibrium dark resistance measured with 300 V d.c. applied via 1 MΩ, 30 min after switching off the illumination	r_{de}	>	120	MΩ 1)
Initial illumination resistance measured at 10 V d.c., illumination = 50 lx, after 16 hrs in darkness 2)	r_{lo}		700 to 3300	Ω
		typ.	1500	Ω
Equilibrium illumination resistance measured at 10 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}		700 to 4100	Ω
		typ.	1900	Ω
Negative temperature response of illumination resistance		typ.	0,2	%/°C
		<	0,5	%/°C
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 10 V d.c.}}$	α	typ.	1,05	
Initial illumination resistance measured at 10 V d.c., illumination = 50 lx, T_C = 1500 K, after 16 hrs in darkness 2)	r_{lo}		325 to 1650	Ω
		typ.	500	Ω

---

1) The spread of the dark resistance is large and values higher than 100 MΩ and 1000 MΩ are possible for the initial dark resistance and the equilibrium dark resistance respectively.

2) After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134) ←

Cell voltage, d.c. and repetitive peak	V	max.	350	V	
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute	V_M	max.	500	V	
Power dissipation (t_{av} = 2 s) see graph P_{max}					
Power dissipation, pulse	P_M	max.	5 x P_{max}		
Cell current, d.c. and repetitive peak	I	max.	500	mA	
Illumination	E	max.	50 000	lx	
Temperature CdS tablet, operating	T_{tablet}	max.	85	°C	
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C	
storage	T_{stg}	max.	50	°C	1)
operating	T_{amb}	max.	70	°C	

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −30% to +70% (typ. +40%) do not impair the circuit performance. Direct sunlight irradiation should be avoided.

MECHANICAL ROBUSTNESS

An indication for the ruggedness of the cell is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95% of the devices pass these tests without perceptible damage.

Shock

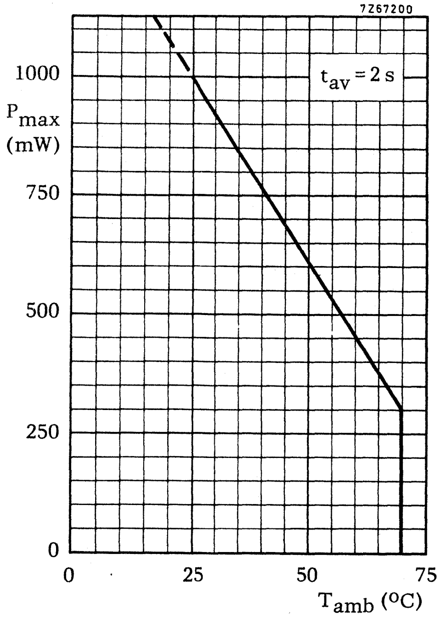
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

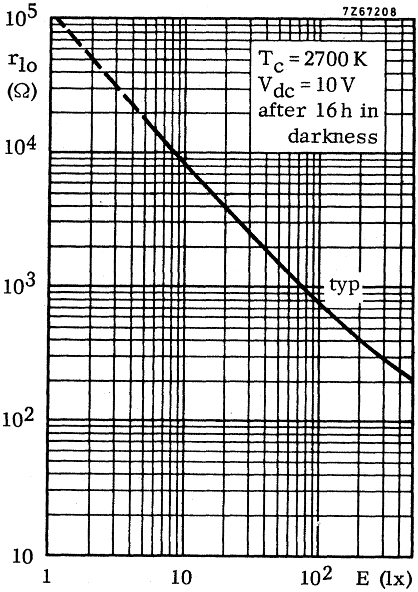
Vibration

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

---

1) Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z67200
$t_{av} = 2$ s
P_{max} (mW)
1000
750
500
250
0
0
25
50
75
T_{amb} (°C)


7Z67208
r_{lo} (Ω)
10^5
10^4
10^3
10^2
10
$T_c = 2700$ K
$V_{dc} = 10$ V
after 16 h in darkness
typ
1
10
10^2
E (lx)

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

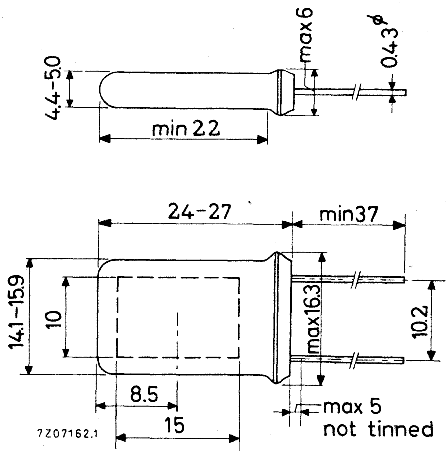
Side sensitive cadmium sulphide photoconductive cells in hermetically sealed all-glass envelope intended for general control circuits such as twilight switches and flame failure circuits. The high voltage type can be connected direct to the mains.
The cells are shock and vibration resistant.

QUICK REFERENCE DATA

			RPY18	RPY19	
Power dissipation at T_{amb} = 25 °C	P	max.	0,5	0,5	W
Cell voltage, d.c. and repetitive peak	V	max.	100	400	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{lo}	typ.	400	3000	Ω
Spectral response, current rise and decay curves			type D		
Outline dimensions		max.	27 x 16,3 x 6 mm		

MECHANICAL DATA

Dimensions in mm



Soldering

The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 °C for maximum 10 s up to a point 5 mm from the seals.

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery

			RPY18	RPY19		
Initial dark resistance V_{dc} = 100 V (RPY18) or 300 V (RPY19) applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	5,6	10	MΩ	1)
Equilibrium dark resistance V_{dc} = 100 V (RPY18) or 300 V (RPY19) applied via 1 MΩ, 30 min after switching off the illumination	r_{de}	>	50	200	MΩ	1)
Initial illumination resistance measured at 10 V d.c., illumination = 50 lx, after 16 hrs in darkness 2)	r_{lo}	>	235	1400	Ω	
		typ.	400	3000	Ω	
		<	1200	6600	Ω	
measured at 1 V d.c., illumination = 5000 lx, after 16 hrs in darkness 2)	r_{lo}	typ.	25	-	Ω	
		<	35 3)	-	Ω	
Equilibrium illumination resistance measured at 10 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}	>	235	1400	Ω	
		typ.	480	3800	Ω	
		<	1560	9000	Ω	
measured at 1 V d.c., illumination = 5000 lx, after 15 min under the measuring conditions	r_{le}	<	35 3)	-	Ω	
Negative temperature response of illumination resistance		typ.	0,2	0,2	%/°C	
		<	0,5	0,5	%/°C	
Voltage response $\frac{r \text{ at } 0,5 \text{ V d.c.}}{r \text{ at } 10 \text{ V d.c.}}$	α	typ.	1,1	1,05		

---

1) The spread of the dark resistance is large and values higher than 100 MΩ and 1000 MΩ are possible for the initial dark resistance and the equilibrium dark resistance respectively .

2) After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

3) During life < 40 Ω.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak	RPY18	V	max.	100	V	
	RPY19	V	max.	400	V	
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute	RPY18	V_M	max.	250	V	
	RPY19	V_M	max.	1000	V	
Power dissipation (t_{av} = 2 s) see graph P_{max}						
Power dissipation, pulse		P_M	max.	5 x P_{max}		
Cell current, d.c. and repetitive peak		I	max.	250	mA	
Illumination		E	max.	50 000	lx	
Temperature CdS tablet, operating		T_{tablet}	max.	85	°C	
Ambient temperature, storage and operating		T_{amb}	min.	−40	°C	
storage		T_{stg}	max.	50	°C	1)
operating		T_{amb}	max.	70	°C	

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −30% to +70% (typ. +40%) do not impair the circuit performance. Direct sunlight irradiation should be avoided.

MECHANICAL ROBUSTNESS

An indication for the ruggedness of the cell is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95 % of the devices pass these tests without perceptible damage.

Shock

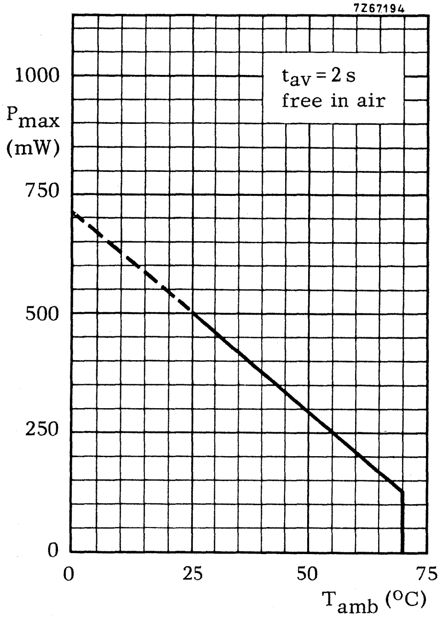
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

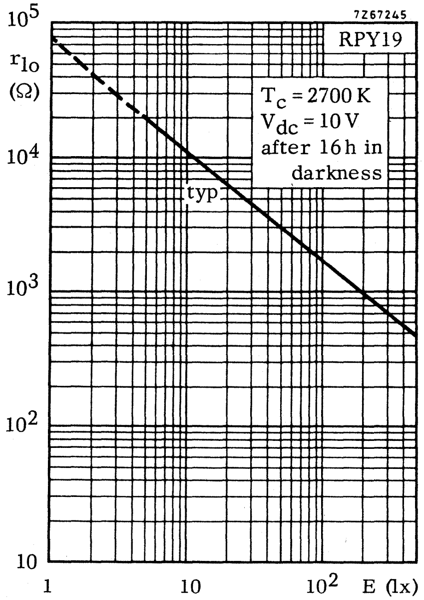
Vibration

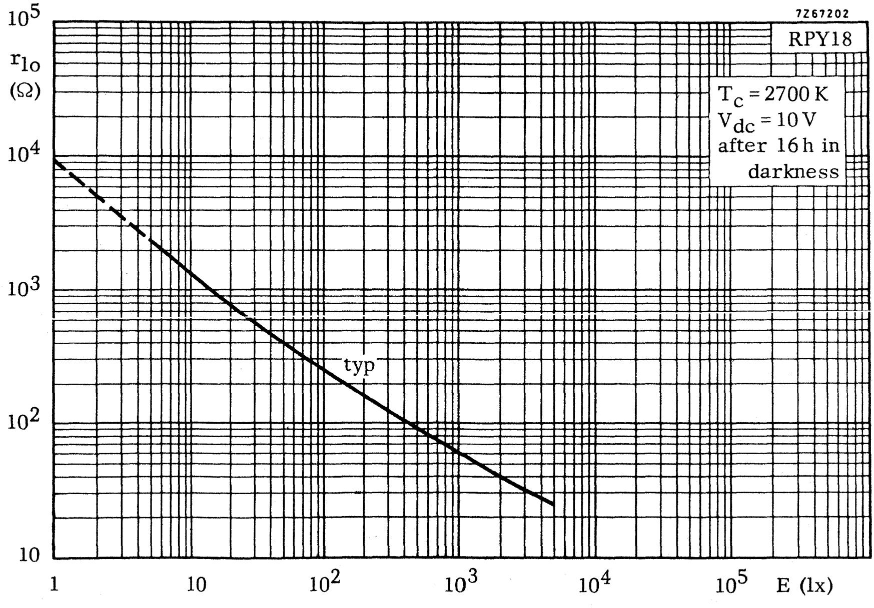
2,5 g_{peak}, 50 Hz, during 32 hours in each of the three positions of the cell.

---

1) Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z67194
1000
750
500
250
0
P_{max} (mW)
$t_{av} = 2$ s
free in air
0
25
50
75
T_{amb} (°C)


7Z67245
10^5
10^4
10^3
10^2
10
r_{lo} (Ω)
RPY19
$T_c = 2700$ K
$V_{dc} = 10$ V
after 16 h in darkness
typ
1
10
10^2
E (lx)


7Z67202
10^5
10^4
10^3
10^2
10
r_{lo} (Ω)
RPY18
$T_c = 2700$ K
$V_{dc} = 10$ V
after 16 h in darkness
typ
1
10
10^2
10^3
10^4
10^5
E (lx)

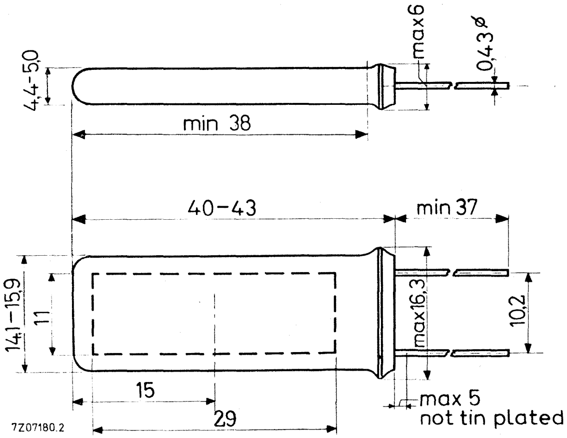
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

Side sensitive cadmium sulphide photoconductive cell in hermetically sealed all-glass envelope intended for general control circuits such as twilight switches and flame failure circuits. This high voltage type can be connected direct to the mains.
The cell is shock and vibration resistant.

QUICK REFERENCE DATA				
Power dissipation at T_{amb} = 25 °C	P	max.	1	W
Cell voltage, d.c. and repetitive peak	V	max.	400	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{lo}	typ.	1500	Ω
Spectral response, current rise and decay curves			type D	
Outline dimensions		max.	43 x 16,3 x 6	mm

MECHANICAL DATA

Dimensions in mm



Soldering

The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 °C for maximum 10 s to a point 5 mm from the seals.

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characterictics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery

Initial dark resistance measured with 300 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	6,5	MΩ	1)
Equilibrium dark resistance measured with 300 V d.c. applied via 1 MΩ, 30 min after switching off the illumination	r_{de}	>	120	MΩ	1)
Initial illumination resistance measured at 10 V d.c., illumination = 50 lx,	r_{lo}		700 to 3300	Ω	
after 16 hours in darkness 2)		typ.	1500	Ω	
Equilibrium illumination resistance measured at 10 V d.c., illumination= 50 lx,	r_{le}		700 to 4500	Ω	
after 15 min under the measuring conditions		typ.	1900	Ω	
Negative temperature response of		typ.	0,2	%/°C	
illumination resistance		<	0,5	%/°C	
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 10 V d.c.}}$	α	typ.	1,05		

---

1) The spread of the dark resistance is large and values higher than 100 MΩ and 1000 MΩ are possible for the initial dark resistance and the equilibrium dark resistance respectively.

2) After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak	V	max.	400	V	
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute	V_M	max.	1000	V	
Power dissipation (t_{av} = 2 s) see graph P_{max}					
Power dissipation, pulse	P_M	max.	5 x P_{max}		
Cell current d.c. and repetitive peak	I	max.	500	mA	
Illumination	E	max.	50 000	lx	
Temperature CdS tablet operating	T_{tablet}	max.	85	°C	
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C	
storage	T_{stg}	max.	50	°C	1)
operating	T_{amb}	max.	70	°C	

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −30% to +70% (typ.+40%) do not impair the circuit performance. Direct sunlight irradiation should be avoided.

MECHANICAL ROBUSTNESS

An indication for the ruggedness of the cell is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95 % of the devices pass these tests without perceptible damage.

Shock

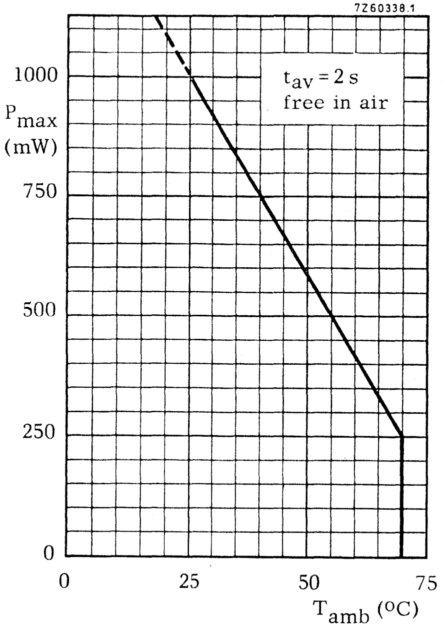
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

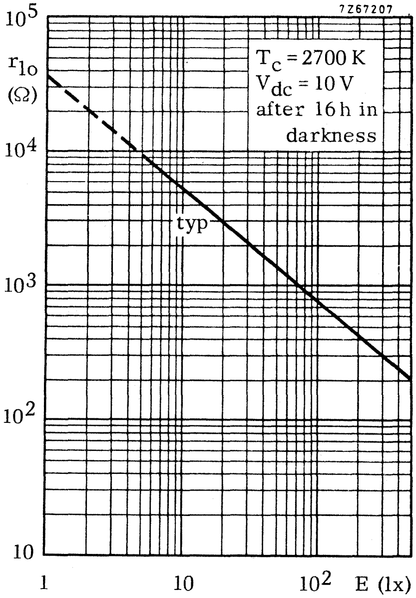
Vibration

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

---

1) Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z60338.1
P_{max} (mW)
1000
750
500
250
0
0
25
50
75
T_{amb} (°C)
t_{av} = 2 s
free in air


7Z67207
r_{lo} (Ω)
10^5
10^4
10^3
10^2
10
1
10
10^2
E (lx)
T_c = 2700 K
V_{dc} = 10 V
after 16 h in darkness
typ

CADMIUM SULPHO-SELENIDE PHOTOCONDUCTIVE CELL

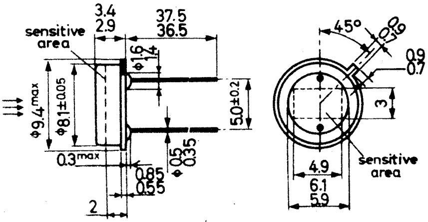
Cadmium sulpho-selenide photoconductive device with top sensitivity intended for use in exposure meters, light-control equipment and for general industrial use. The device is tropic proof, shock and vibration resistant. The envelope is hermetically sealed and has a plane glass window.

QUICK REFERENCE DATA

Power dissipation, as measuring device	P	max.	10	mW
for general use	P	max.	75	mW
Cell voltage, d.c. and repetitive peak	V	max.	50	V
Outline dimensions	max. 3.4 xdia 9.4			mm
Light sensitive area	4.9 mm x 3 mm			

MECHANICAL DATA

Dimensions in mm



Soldering

The device may be soldered direct into the circuit but heat conducted to the seals should be kept at a minimum by the use of a thermal shunt. Dipsoldering at a solder temperature of 245 °C may be employed for a maximum of 10 s up to a point 5 mm from the seals of for maximum 3 s up to a point 1.5 mm from the seals. At a solder temperature between 245 °C and 400 °C the soldering time is maximum 5 s up to a point 5 mm from the seals.
The leads should not be bent less than 1.5 mm from the seals.

ELECTRICAL DATA

Basic characteristics at T_{amb} = 25 °C

Pre-conditioning > 1 h illumination with 300 lx (fluorescent light)

	symbol	min.	typical	max.	unit
Initial dark resistance measured at 50 $V_{d.c.}$, 20 s after stopping the illumination of 25.6 lx	r_{do}	100			kΩ
Initial illumination resistance measured at 1 $V_{d.c.}$, illumination 25.6 lx, colour temperature 4700 °K	r_{lo}	**1.65**		**5.1**	kΩ
Current decay time: time to reach 10% of the current at the instant of stopping the illumination of 5 lx	t_{fi}		3		s
Gamma between E_1 = 0.4 lx and E_2 = 25.6 lx [1]	γ	**0.60**	0.75	**0.84**	
Shift in illumination current, measured with E = 50 lx, t = 10 min				10	
Pre-conditioning factor [2]		0.9		1.2	
Actinism $\frac{\text{Illumination at 2700 °K}}{\text{Illumination at 4700 °K}}$ (referred to the same cell current)			0.9		

---

[1] $\gamma = \frac{\log r1 - \log r2}{\log E_2 - \log E_1}$

[2] Pre-conditioning factor $= \frac{\text{Cell current at 0.4 lx, after 3 days in darkness}}{\text{Cell current at 0.4 lx after 1 h pre-conditioning at 300 lx (fluorescent light)}}$

SHOCK AND VIBRATION

An indication of the ruggedness of the device is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95% of the devices pass these tests without perceptible damage.

Shock

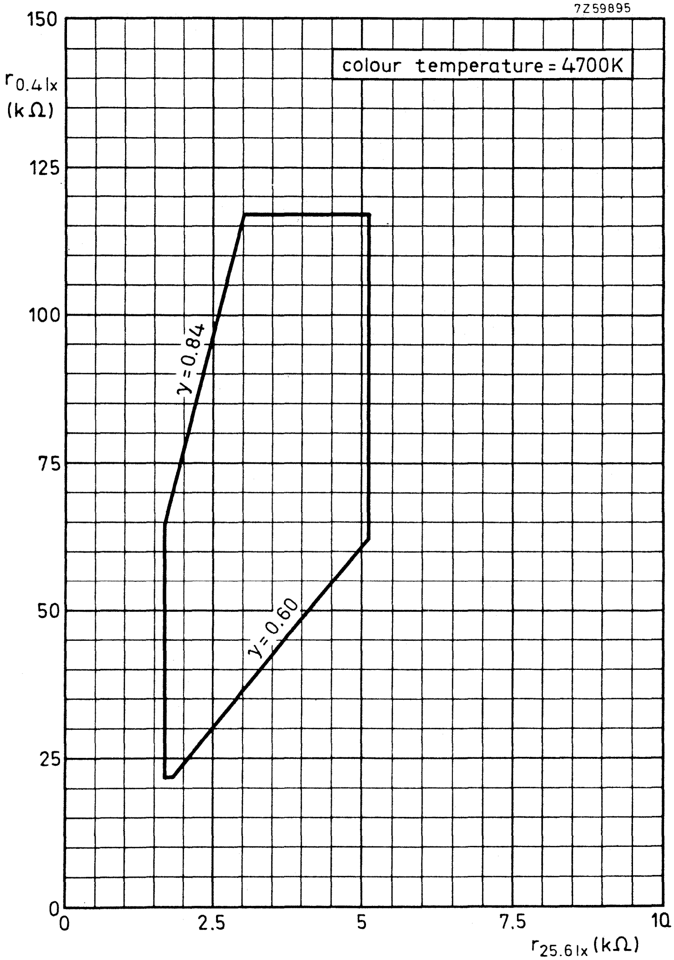
50 g_{peak}, 5 shocks in each of the four positions of the device.

Vibration

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

LIMITING VALUES (Absolute max. rating system)

Cell voltage, d.c. and repetitive peak	V	max.	50	V
Power dissipation, for use as measuring device	P	max.	10	mW
for general use	P	max.	75	mW
Ambient temperature	T_{amb}	max.	+60	^{o}C
	T_{amb}	min.	-40	^{o}C



Area of illumination resistance ratio

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

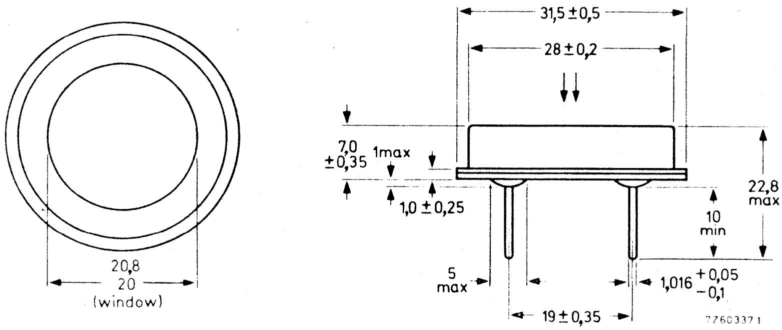
Top sensitive cadmium sulphide photoconductive cell in hermetically sealed metal envelope with a glass window intended for general control circuits such as twilight switches and flame failure circuits. The high voltage type can be connected direct to the mains. The cell is shock and vibration resistant.

QUICK REFERENCE DATA

Power dissipation at T_{amb} = 25 °C	P	max.	1	W
Cell voltage, d.c. and repetitive peak	V	max.	200	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{1o}	typ.	420	Ω
Spectral response, current rise and decay curves			type D	
Outline dimensions		max.	32 dia. x 7,6	mm

MECHANICAL DATA

Dimensions in mm



ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery.

Initial dark resistance V_{dc} = 200 V applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	3	MΩ	1)
Equilibrium dark resistance V_{dc} = 200 V applied via 1 MΩ, 30 min after switching off the illumination	r_{de}	>	50	MΩ	1)
Initial illumination resistance		>	250	Ω	
measured at 10 V d.c., illumination = 50 lx,	r_{lo}	typ.	420	Ω	
after 16 hrs in darkness 2)		<	1250	Ω	
Equilibrium illumination resistance		>	250	Ω	
measured at 10 V d.c., illumination = 50 lx,	r_{le}	typ.	530	Ω	
after 15 min under the measuring conditions		<	1700	Ω	
Negative temperature response of		typ.	0,2	%/°C	
illumination resistance		<	0,5	%/°C	
Voltage response $\frac{\text{r at } 0,5 \text{ V d.c.}}{\text{r at } 10 \text{ V d.c.}}$	α	typ.	1,05		

---

1) The spread of the dark resistance is large and values higher than 100 MΩ and 1000 MΩ are possible for the initial dark resistance and the equilibrium dark resistance respectively.

2) After 16 hours in darkness changes in the CdS material are still occuring but have only insignificant effect on the illumination resistance.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak,	V	max.	200	V	
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute	V_M	max.	500	V	
Power dissipation (t_{av} = 2 s) see graph P_{max}					
Power dissipation, pulse	P_M	max.	5 x P_{max}		
Cell current, d.c. and repetitive peak	I	max.	250	mA	
Illumination	E	max.	50 000	lx	
Temperature CdS tablet, operating	T_{tablet}	max.	85	°C	
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C	
storage	T_{stg}	max.	50	°C	1)
operating	T_{amb}	max.	70	°C	

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −30% to +70% (typ. +40%) do not impair the circuit performance. Direct sunlight irradiation should be avoided.

MECHANICAL ROBUSTNESS

An indication for the ruggedness of the cell is the following:
Samples taken from normal production are submitted to shock and vibration tests mentioned below. More than 95 % of the devices pass these tests without perceptible damage.

Shock

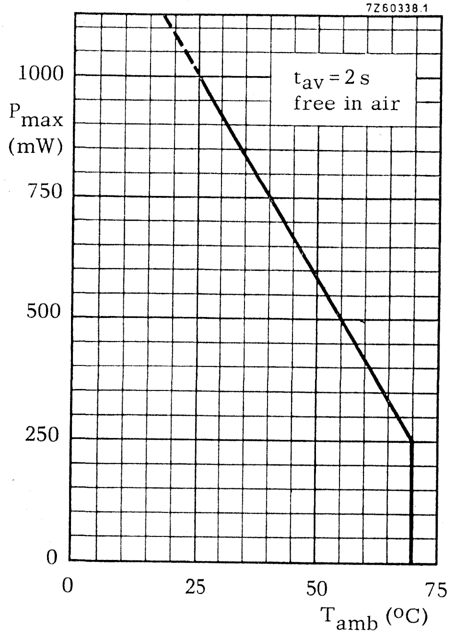
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

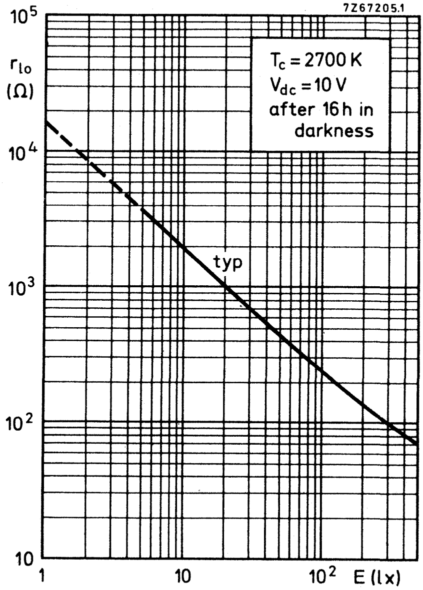
Vibration

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

---

1) Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z60338.1
t_{av} = 2 s
free in air
1000
P_{max}
(mW)
750
500
250
0
0
25
50
75
T_{amb} (°C)


7Z67205.1
10^5
r_{lo}
(Ω)
10^4
10^3
10^2
10
T_c = 2700 K
V_{dc} = 10 V
after 16 h in
darkness
typ
1
10
10^2
E (lx)

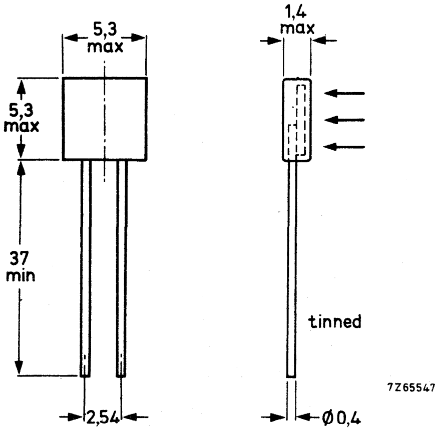
CADMIUM SULPHIDE PHOTOCONDUCTIVE DEVICE

Cadmium sulphide photoconductive device with side sensitivity in plastic encapsulation. The device consists of two cells connected in series and is intended for general applications.

QUICK REFERENCE DATA				
Power dissipation at $T_{amb} \leq 25\ ^{o}C$	P		100	mW
Voltage, d.c. and repetitive peak	V	max.	50	V
Resistance at 50 lux, $T_c = 2700\ ^{o}K$	r_{l_o}		600	Ω
Wavelengths at 50 % sensitivity	λ		500 and 675	nm
Outline dimensions		max.	5,3 x 5,3 x 1,4	mm

MECHANICAL DATA

Dimensions in mm



Soldering

The device may be soldered direct into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt.
It may be dip-soldered at a solder temperature of 270 °C for a maximum of 2 s up to a point 6 mm from the envelope.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Cell voltage, d.c. and repetitive peak	V	max.	50	V
Cell voltage, $p_{rr} \leq$ once per minute, $t_p \leq 5$ ms	V_M	max.	100	V
Power dissipation, $t_{av} = 0,5$ s, $T_{amb} \leq 25\ ^oC$	P	max.	100	mW
Cell current, d.c. and repetitive peak	I	max.	25	mA
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C
storage	T_{stg}	max.	+50	°C
Temperature of CdS tablet	T_{tablet}	max.	+70	°C

THERMAL RESISTANCE

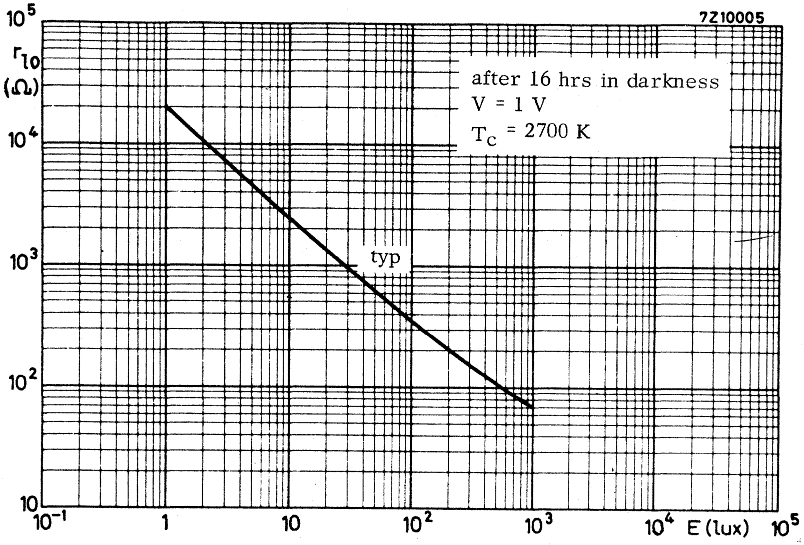
Thermal resistance from CdS tablet to ambient	$R_{th\ t\text{-}a}$	=	0,45	°C/mW

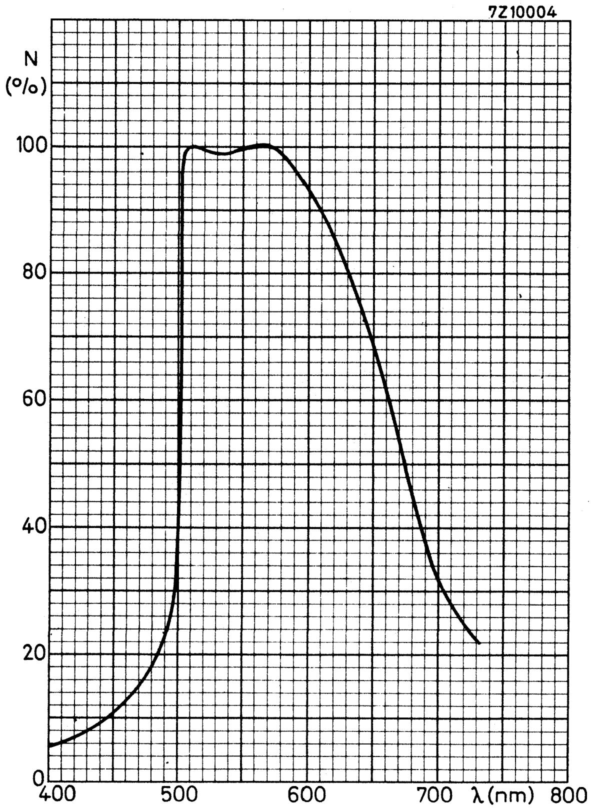
CHARACTERISTICS

Initial dark resistance, measured with 50 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	200	kΩ
Initial ilumination resistance measured at 1 V d.c., illumination 50 lx, $T_c = 2700$ K	r_{lo}	typ.	0,6	kΩ
			0,35-1,4	kΩ
Initial drift	D_o	typ.	0	%
F_{4700} (= $\frac{r_l \text{ at } 4700\text{ K}}{r_l \text{ at } 2856\text{ K}}$ at constant illumination and using a Davis-Gibson filter)		typ.	1,2	

OPERATING NOTES

1. The device consits of two photoconductive cells connected in series. The resistance of the device is mainly governed by the resistance of that cell receiving the lower luminous flux.
   If it is required for any application that the device is partly shaded, the shadow line should be perpendicular to the axis of the device.
2. For optimum heat dissipation use the shortest permissible lead length.


7Z10005
r_{10} (Ω)
10^5
10^4
10^3
10^2
10
after 16 hrs in darkness
V = 1 V
T_c = 2700 K
typ
10^{-1}
1
10
10^2
10^3
10^4
E (lux)
10^5


7Z10004
N
(%)
100
80
60
40
20
0
400
500
600
700
λ (nm)
800

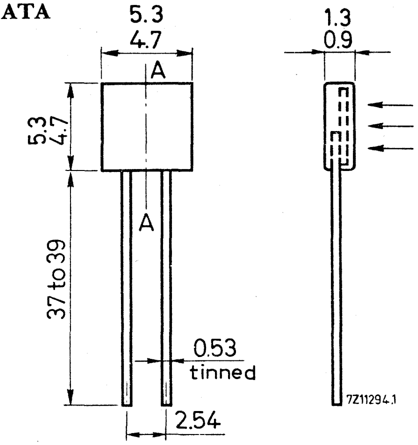
CADMIUM SULPHIDE PHOTOCONDUCTIVE DEVICE

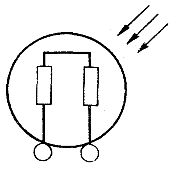
Cadmium sulphide photoconductive cell with side sensitivity in a plastic encapsulation. The device consists of two cells in series and is intended for use in cameras, exposure meters, light control equipment and for general industrial use.

QUICK REFERENCE DATA				
Power dissipation	P	max.	50	mW
Cell voltage, d.c. and repetitive peak	V	max.	50	V
Cell resistance at 10 lux, 2700 °K	r_{10}		3 to 6	kΩ
Outline dimensions			5 mm x 5 mm x 1	mm

MECHANICAL DATA

Dimensions in mm





Soldering

The device may be soldered direct into the circuit but heat conducted to the seals should be kept at a minimum by the use of a thermal shunt. Dip soldering at a solder temperature of 270 °C may be employed for a maximum of 2 s up to a point 6 mm from the seals.

ELECTRICAL DATA

Basic characteristics at T_{amb} = 25 °C, illumination with 2700 K c.t.

Pre-conditioning 1 h illumination with 300 lx (fluorescent light)

	symbol	min.	typical	max.	unit
Initial dark resistance measured with 50 $V_{d.c.}$ applied via 1 MΩ, 20 s after stopping the illumination of 10 lx	r_{do}	0.6			MΩ
Initial illumination resistance measured at V = 1 $V_{d.c.}$, illumination 10 lx	r_{lo}	2.4		6.0	kΩ
Illumination response [1] measured at 1 $V_{d.c.}$ between 0.1 lx and 10 lx	$\gamma_{0.1-10}$	0.94		1.12	
Negative temperature response of illumination resistance between −10 °C and +40 °C at 1 lx, V = 1 V	$r_l/\Delta T$			0.5	%/°C
Pre-conditioning factor [2]		0.9		1.1	
Actinism $\frac{\text{Illumination at 2700 K}}{\text{Illumination at 4700 K}}$ (referred to the same cell current)		0.9		1.1	

---

[1] $\gamma = \frac{\log r1 - \log r2}{\log E2 - \log E1}$ where E1 = 0.1 lx and E2 = 10 lx

[2] Pre-conditioning factor = $\frac{\text{Cell current at 1 lx, after 3 days in darkness}}{\text{Cell current at 1 lx, after 1 h pre-conditioning at 300 lx (fluorescent light)}}$

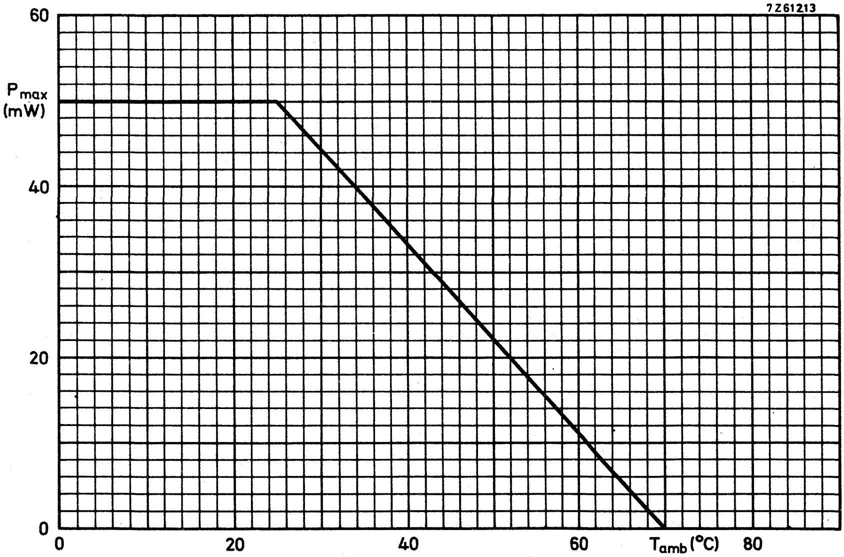
measured when a stable current is reached

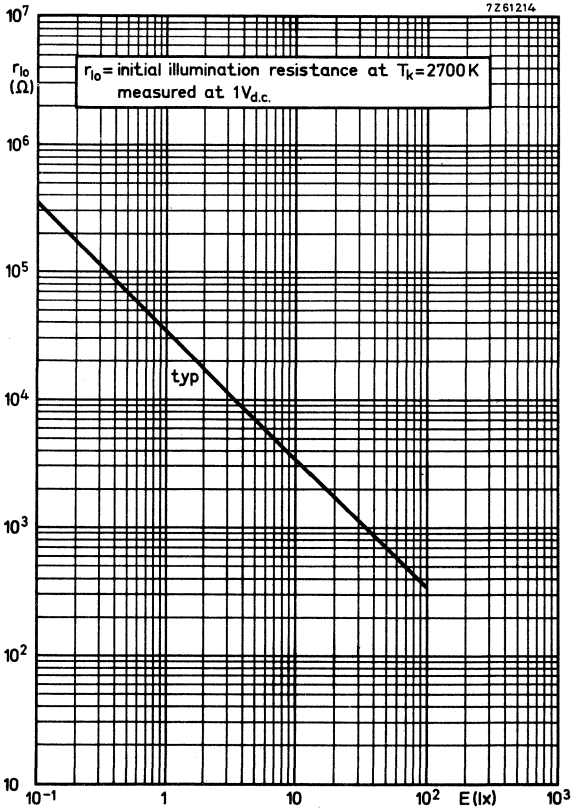
LIMITING VALUES (Absolute max. rating system)

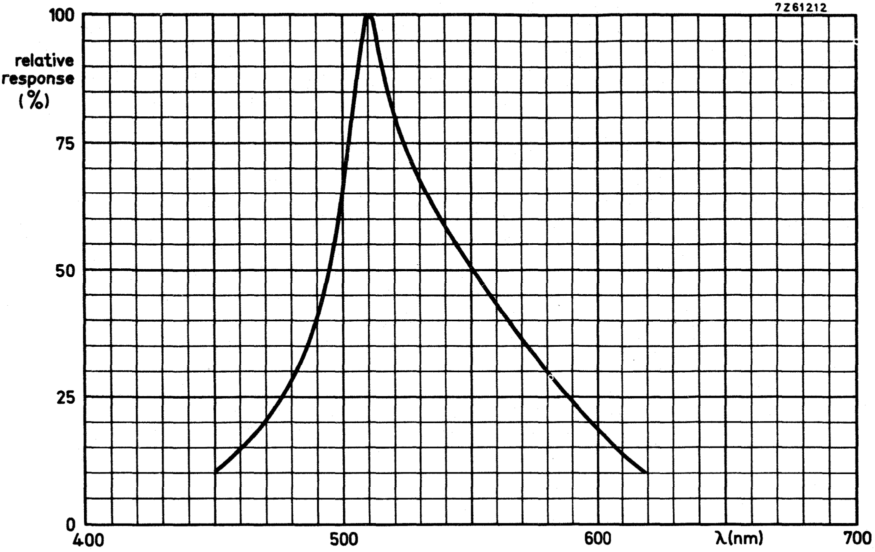
Cell voltage, d.c. and repetitive peak	V	max.	50	V
Power dissipation	P	max.	50	mW
Cell current, d.c. and repetitive peak	I	max.	20	mA
Operating ambient temperature	T_{amb}		−40 to +70	°C
Storage temperature	T_{stg}		−40 to +70	°C

OPERATING NOTE

The device consists of two photoconductive cells connected in series.
The resistance of the device is mainly governed by the resistance of that cell receiving the lowest luminous flux.
If it is essential for the application that the device is partly shaded off, the shadow line should be perpendicular to the axis A-A of the device.




7Z61214
r_{lo} = initial illumination resistance at T_k = 2700 K
measured at 1 $V_{d.c.}$
r_{lo} (Ω)
10^7
10^6
10^5
10^4
10^3
10^2
10
typ
10^{-1}
1
10
10^2
E (lx)
10^3


7Z61212
relative response (%)
100
75
50
25
0
400
500
600
λ(nm)
700

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

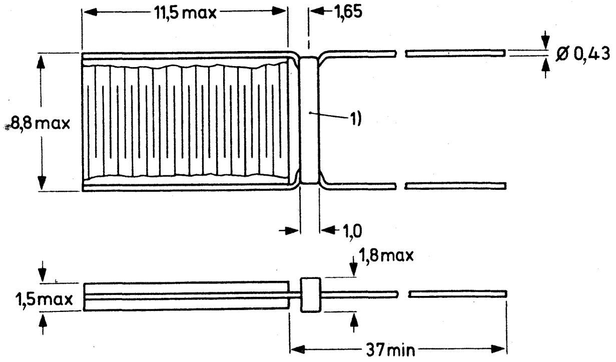
Side sensitive cadmium sulphide photoconductive cell protected by a lacquer coating. The device withstands the steady state damp heat test of IEC Publication 68-2-3 (test Ca: severity 56 days).

QUICK REFERENCE DATA

Power dissipation at T_{amb} = 25 °C	P	max.	0, 30	W
Cell voltage, d.c. and repetitive peak	V	max.	100	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{lo}		950	Ω
Spectral response, current rise and decay curves		type D		
Outline dimensions		max.	11,5 x 8,8 x 1,5	mm

MECHANICAL DATA

Dimensions in mm



Soldering

The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 °C for maximum 10 s up to a point 5 mm from the stress relief band.

Mounting

The cell is not insulated electrically and should be mounted accordingly.

Notice

If the cell is to be encapsulated, request manufacturer's instructions.

---

1) Stress relief band.

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery

Initial dark resistance measured with 100 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	6	MΩ [1]
Equilibrium dark resistance measured with 100 V d.c. applied via 1 MΩ, 30 minutes after switching off the illumination	r_{de}	>	50	MΩ [1]
Initial illumination resistance measured at 10 V d.c., illumination = 50 lx, after 16 hrs in darkness [2]	r_{lo}	 typ.	560 to 2800 950	Ω Ω
Equilibrium illumination resistance measured at 10 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}	 typ.	560 to 3800 1200	Ω Ω
Negative temperature response of illumination resistance		< typ.	0,5 0,2	%/°C %/°C
Voltage response $\frac{\text{r at } 0,5 \text{ V d.c.}}{\text{r at } 10 \text{ V d.c.}}$	α	typ.	1,05	

---

[1] The spread of the dark resistance is large and values higher than 100 MΩ and 1000 MΩ are possible for the initial dark resistance and the equilibrium dark resistance respecitively.

[2] After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak	V	max.	100	V
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute	V_M	max.	250	V
Power dissipation (t_{av} = 2 s) see graph P_{max}				
Power dissipation, pulse	P_M	max.	$5 \mathrm{x} P_{max}$	
Cell current, d.c. and repetitive peak	I	max.	100	mA
Illumination	E	max.	50 000	lx
Temperature CdS tablet, operating	T_{tablet}	max.	+85	°C
Ambient temperature, storage and operation	T_{amb}	min.	−40	°C
storage	T_{stg}	max.	+50	°C [1]
operating	T_{amb}	max.	+70	°C

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −30 % to +70 % (typ. +40 %) do not impair the circuit performance. Direct sunlight irradiation should be avoided.

CLIMATIC DATA

The device withstands the damp heat test Ca (steady state) of IEC Publication 68-2-3: severity 56 days, under no-load conditions or under continuous load conditions such that the tablet temperature is ≥ 5 °C above ambient temperature.

MECHANICAL ROBUSTNESS

Tensile test

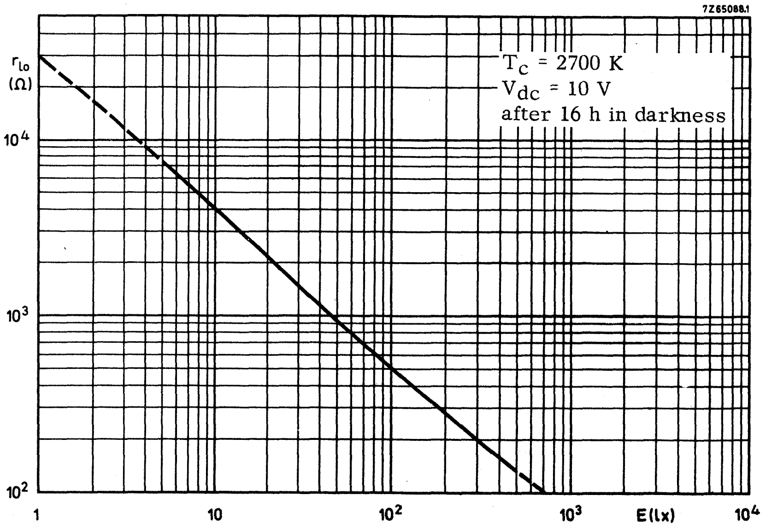
The device withstands the tensile test of IEC Publication 68-2-21, Test Ua: loading weight 500 g.

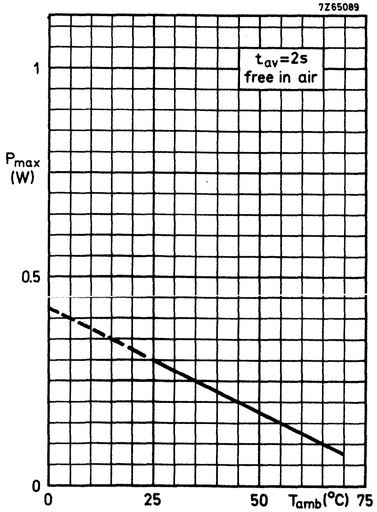
Pull test

The device withstands the following test: The leads are bent outwards over an angle of 90° at 2 mm from the stress relief band; a pulling force of 500 g is then applied at the end of the leads.

---

[1] Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z65088.1
r_{lo} (Ω)
10^4
10^3
10^2
1
10
10^2
10^3
E (lx)
10^4
T_c = 2700 K
V_{dc} = 10 V
after 16 h in darkness


7Z65089
P_{max} (W)
1
0.5
0
0
25
50
T_{amb} (°C)
75
t_{av}=2s
free in air

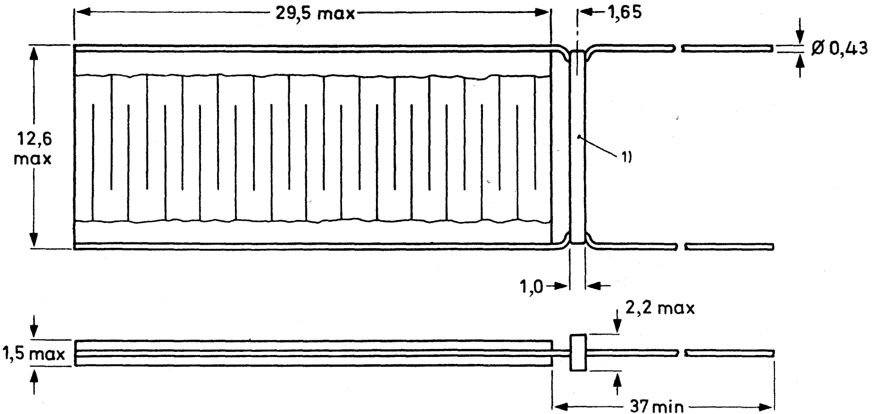
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

Side sensitive cadmium sulphide photoconductive cell protected by a lacquer coating. The device withstands the steady state damp heat test of IEC publication 68-2-3 (test Ca: severity 56 days).

QUICK REFERENCE DATA				
Power dissipation at T_{amb} = 25 °C	P	max.	0, 75	W
Cell voltage, d.c. and repetitive peak	V	max.	400	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{lo}	typ.	1150	Ω
Spectral response, current rise and decay curves		type D		
Outline dimensions		max.	29,5 x 12,6 x 1,5	mm

MECHANICAL DATA

Dimensions in mm



Soldering

The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 °C for maximum 10 s up to a point 5 mm from the stress relief band.

Mounting

The cell is not insulated electrically and should be mounted accordingly.

Notice

If the cell is to be encapsulated, request manufacturer's instructions.

---

1) Stress relief band.

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery

Initial dark resistance measured with 400 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	9	MΩ [1]
Equilibrium dark resistance measured with 400 V d.c. applied via 1 MΩ, 30 minutes after switching off the illumination	r_{de}	>	200	MΩ [1]
Initial illlumination resistance measured at 10 V d.c., illumination = 50 lx, after 16 hrs in darkness [2]	r_{lo}	700 to typ.	3300 1150	Ω Ω
Equilibrium illumination resistance measured at 10 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}	700 to typ.	4100 1450	Ω Ω
Negative temperature response of illumination resistance		typ. <	0, 2 0, 5	%/°C %/°C
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 10 V d.c.}}$	α	typ.	1, 05	

---

[1] The spread of the dark resistance is large and values higher than 100 MΩ and 1000 MΩ are possible for the initial dark resistance and the equilibrium dark resistance respecitively.

[2] After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak	V	max.	400	V	
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute	V_M	max.	1000	V	
Power dissipation (t_{av} = 2 s) see graph P_{max}					
Power dissipation, pulse	P_M	max.	$5 \times P_{max}$		
Cell current, d.c. and repetitive peak	I	max.	500	mA	
Illumination	E	max.	50 000	lx	
Temperature CdS tablet, operating	T_{tablet}	max.	+85	°C	
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C	
storage	T_{stg}	max.	+50	°C	1)
operating	T_{amb}	max.	+70	°C	

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −30 % to +70 % (typ. +40 %) do not impair the circuit performance. Direct sunlight irradiation should be avoided.

CLIMATIC DATA

The device withstands the damp heat test Ca (steady state) of IEC Publication 68-2-3: severity 56 days, under no-load conditions or under continuous load conditions such that the tablet temperature is ≥ 5 °C above ambient temperature.

MECHANICAL ROBUSTNESS

Tensile test

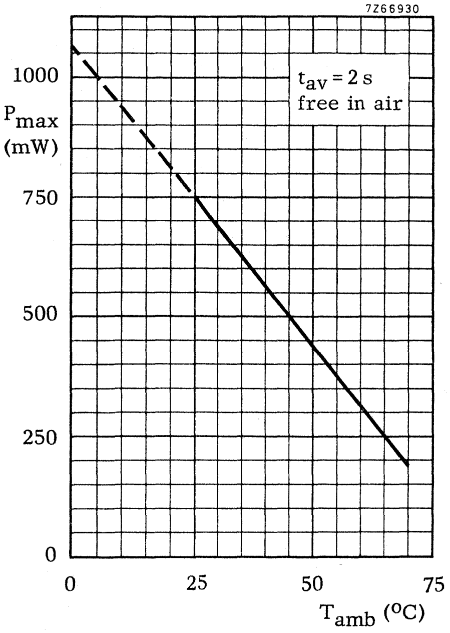
The device withstands the tensile test of IEC Publication 68-2-21, Test Ua: loading weight 500 g.

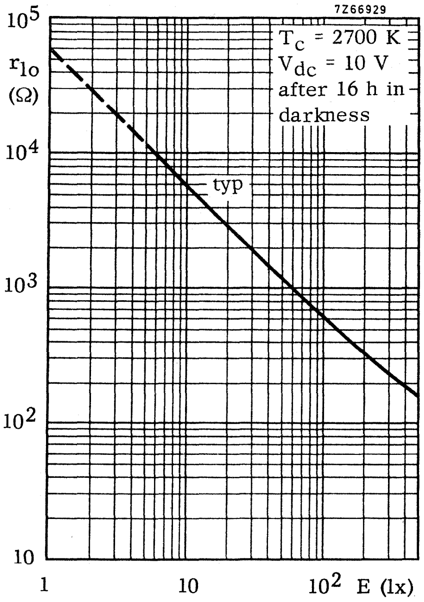
Pull test

The device withstands the following test: The leads are bent outwards over an angle of 90° at 2 mm from the stress relief band; a pulling force of 500 g is then applied at the end of the leads.

---

1) Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z66930
1000
750
500
250
0
P_max (mW)
t_av = 2 s
free in air
0
25
50
75
T_amb (°C)


7Z66929
10^5
10^4
10^3
10^2
10
r_lo (Ω)
T_c = 2700 K
V_dc = 10 V
after 16 h in darkness
typ
1
10
10^2
E (lx)

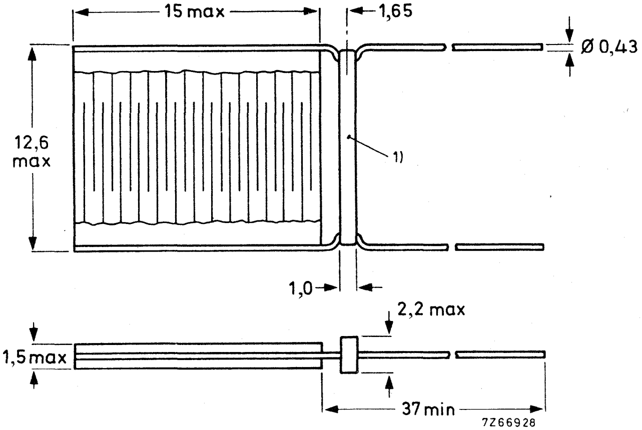
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

Side sensitive cadmium sulphide photoconductive cell protected by a lacquer coating. The device withstands the steady state damp heat test of IEC publication 68-2-3 (test Ca: severity 56 days).

QUICK REFERENCE DATA				
Power dissipation at T_{amb} = 25 °C	P	max.	0,500	W
Cell voltage, d.c. and repetitive peak	V	max.	200	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{lo}	typ.	1150	Ω
Spectral response, current rise and decay curves		type D		
Outline dimensions		max.	15 x 12, 6 x 1, 5	mm

MECHANICAL DATA

Dimensions in mm



Soldering

The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 °C for maximum 10 s up to a point 5 mm from the stress relief band.

Mounting

The cell is not insulated electrically and should be mounted accordingly.

Notice

If the cell is to be encapsulated, request manufacturer's instructions.

---

1) Stress relief band.

ELECTRICAL DATA

General

The electrical properties of CdS cells are dependent on many factors such as illumination, colour temperature of the light source, voltage, current, temperature, total time of operation in the circuit and time of operation during the last 24 hours prior to the measurement. The following basic characteristics are therefore only check points of the electrical properties of these devices measured with defined values of the various conditions and at delivery.

Basic characteristics at T_{amb} = 25 °C, illumination with colour temperature of 2700 K and at delivery

Initial dark resistance measured with 200 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	9	MΩ [1]
Equilibrium dark resistance measured with 200 V d.c. applied via 1 MΩ, 30 minutes after switching off the illumination	r_{de}	>	100	MΩ [1]
Initial illumination resistance measured at 10 V d.c., illumination = 50 lx, after 16 hrs in darkness [2]	r_{lo}	700 to typ.	3300 1150	Ω Ω
Equilibrium illumination resistance measured at 10 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}	700 to typ.	4100 1450	Ω Ω
Negative temperature response of illumination resistance		< typ.	0,5 0,2	%/°C %/°C
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 10 V d.c.}}$	α	typ.	1,05	

---

[1] The spread of the dark resistance is large and values higher than 100 MΩ and 1000 MΩ are possible for the initial dark resistance and the equilibrium dark resistance respecitively.

[2] After 16 hours in darkness changes in the CdS material are still occurring but have only insignificant effect on the illumination resistance.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Cell voltage, d.c. and repetitive peak		V	max.	200	V
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute		V_M	max.	500	V
Power dissipation ($t_{av} = 2$ s) see graph P_{max}					
Power dissipation, pulse		P_M	max.	$5 \times P_{max}$	
Cell current, d.c. and repetitive peak		I	max.	250	mA
Illumination		E	max.	50 000	lx
Temperature CdS tablet, operating		T_{tablet}	max.	+85	°C
Ambient temperature,	storage and operation	T_{amb}	max.	−40	°C
	storage	T_{stg}	max.	+50	°C 1)
	operating	T_{amb}	max.	+70	°C

DESIGN CONSIDERATIONS

Apparatus with CdS cells should be designed so that changes in illumination resistance of the cells during life under rated load from −30 % to +70 % (typ. +40 %) do not impair the circuit performance. Direct sunlight irradiation should be avoided.

CLIMATIC DATA

The device withstands the damp heat test Ca (steady state) of IEC Publication 68-2-3: severity 56 days, under no-load conditions or under continuous load conditions such that the tablet temperature is ≥ 5 °C above ambient temperature.

MECHANICAL ROBUSTNESS

Tensile test

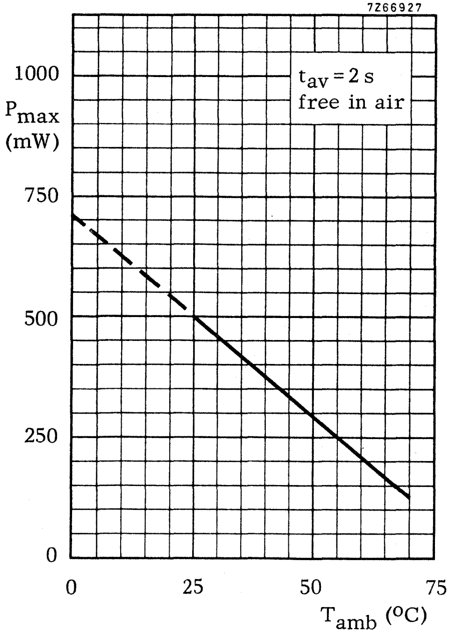
The device withstands the tensile test of IEC Publication 68-2-21, Test Ua: loading weight 500 g.

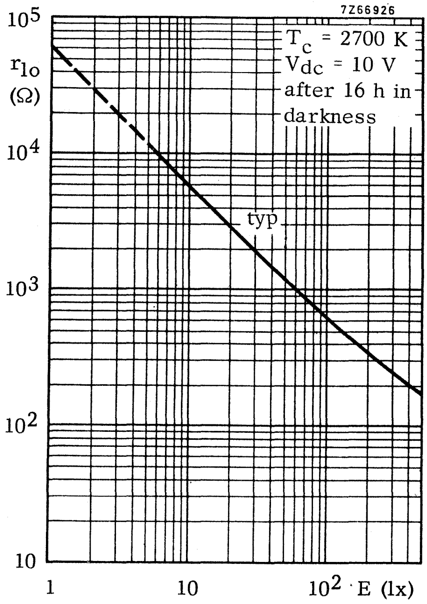
Pull test

The device withstands the following test: The leads are bent outwards over an angle of 90° at 2 mm from the stress relief band; a pulling force of 500 g is then applied at the end of the leads.

---

1) Operation of the cell counteracts the deteriorating effect of long periods at high temperature. The maximum operating temperature is therefore higher than the maximum storage temperature.


7Z66927
t_{av} = 2 s
free in air
P_{max} (mW)
1000
750
500
250
0
0
25
50
75
T_{amb} (°C)


7Z66926
T_c = 2700 K
V_{dc} = 10 V
after 16 h in darkness
r_{lo} (Ω)
10^5
10^4
10^3
10^2
10
typ
1
10
10^2
E (lx)

INDEX OF TYPE NUMBERS

The inclusion of a type number in this publication does not necessarily imply its availability.

AD = Silicon alloyed diodes
GB = Germanium gold bonded diodes
HF = High frequency transistors
LF = Low frequency transistors
Mm = Microminiature devices for thick-and thin-film circuits
Mw = Microwave devices

P = Low frequency power transistors
PC = Germanium point contact diodes
R = Rectifier diodes
Sp = Special diodes
Sw = Switching transistors
T = Tuner diodes
WD = Silicon whiskerless diodes

DT = Dual transistors
FET = Field-effect transistors
LF = Low frequency transistors
Mm = Microminiature devices for thick-and thin-film circuits
Mw = Microwave devices
P = Low frequency power transistors
T = Tuner diodes
WD = Silicon whiskerless diodes

FET = Field-effect transistors
HF = High frequency transistors
P = Low frequency power transistors

Type No.	Part	Section
BF451	3	HF
BF457	3	HF
BF458	3	HF
BF459	3	HF
BF480	3	HF
BF494	3	HF
BF495	3	HF
BFQ10	4a	FET
BFQ11	4a	FET
BFQ12	4a	FET
BFQ13	4a	FET
BFQ14	4a	FET
BFQ15	4a	FET
BFQ16	4a	FET
BFR29	4a	FET
BFR30	4a	Mm
BFR31	4a	Mm
BFR53	4a	Mm
BFR63	3	HF
BFR64	3	HF
BFR65	3	HF
BFR90	3	HF
BFR91	3	HF
BFR92	4a	Mm
BFR93	4a	Mm
BFR94	3	HF
BFS17	4a	Mm
BFS18	4a	Mm
BFS19	4a	Mm
BFS20	4a	Mm
BFS21	4a	FET
BFS21A	4a	FET
BFS22A	4a	Tr
BFS23A	4a	Tr
BFS28	4a	FET
BFS92	3	HF
BFS93	3	HF
BFS94	3	HF
BFS95	3	HF
BFT24	3	HF
BFT25	3	Mm
BFW10	4a	FET
BFW11	4a	FET
BFW12	4a	FET
BFW13	4a	FET
BFW16A	3	HF
BFW17A	3	HF
BFW30	3	HF
BFW45	3	HF
BFW61	4a	FET
BFW92	3	HF
BFW93	3	HF
BFX34	3	Sw
BFX44	3	HF
BFX89	3	HF
BFY50	3	HF
BFY51	3	HF
BFY52	3	HF
BFY55	3	HF
BFY90	3	HF
BG1895-541	1a	R
BG1895-641	1a	R
BLW60	4a	Tr
BLX13	4a	Tr
BLX14	4a	Tr
BLX15	4a	Tr
BLX65	4a	Tr
BLX66	4a	Tr
BLX67	4a	Tr
BLX68	4a	Tr
BLX69	4a	Tr
BLX91	4a	Tr
BLX92	4a	Tr
BLX93	4a	Tr
BLX94A	4a	Tr
BLX95	4a	Tr
BLX96	4a	Tr
BLX97	4a	Tr
BLY83	4a	Tr
BLY84	4a	Tr
BLY87A	4a	Tr
BLY88A	4a	Tr
BLY89A	4a	Tr
BLY90	4a	Tr
BLY91A	4a	Tr
BLY92A	4a	Tr
BLY93A	4a	Tr
BLY94	4a	Tr
BPX25; BPX29	4b	PDT
BPX40	4b	PDT
BPX41	4b	PDT
BPX42	4b	PDT
BPX66P	4b	PDT
BPX70	4b	PDT
BPX71	4b	PDT
BPX72	4b	PDT
BPX95	4b	PDT
BR100	1a	Th
BR101	3	Sw
BRY39	1a	Th
BRY39 (SCS)	3	Sw
BRY39 (PUT)	3	Sw
BSS27	3	Sw
BSS28	3	Sw
BSS29	3	Sw

FET = Field-effect transistors
HF = High frequency transistors
Mm = Microminiature devices for thick-and thin-film circuits
PDT = Photodiodes or transistors
R = Rectifier diodes
Sw = Switching transistors
Th = Thyristors, diacs, triacs
Tr = Transmitting transistors

FET = Field-effect transistors
Mm = Microminiature devices for thick-and thin-film circuits
P = Low frequency power transistors
R = Rectifier diodes
Sw = Switching transistors
Th = Thyristors, diacs, triacs
TS = Transient suppressor diodes
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes

INDEX

AD = Silicon alloyed diodes
GB = Germanium gold bonded diodes
I = Infrared devices
LED = Light emitting diodes
Mw = Microwave devices
PC = Germanium point contact diodes

Ph = Photoconductive devices
PhC = Photocouplers
St = Rectifier stacks
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes
WD = Silicon whiskerless diodes

A = Accessories
FET = Field-effect transistors
HF = High frequency transistors
I = Infrared devices
LF = Low frequency transistors

Mw = Microwave devices
P = Low frequency power transistors
Sw = Switching transistors
Tr = Transmitting transistors
Vrg = Voltage regulator diodes

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A = Accessories
DH = Diecast heatsinks
HE = Heatsink extrusions
HF = High frequency transistors

MAINTENANCE TYPE LIST

The types listed below are not included in this handbook.

Detailed information will be supplied on request.

BPY68
BPY69
BPY76
BPY77
OAP12
OCP70
ORP30N
ORP50
RPY13
RPY17
RPY27
RPY41

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