PHILIPS

Data handbook

Electronic components and materials

Semiconductors and integrated circuits

Part 4b July 1976

Photosensitive diodes and transistors

Light emitting diodes

Displays

Photocouplers

Infrared sensitive devices

Photoconductive devices

SEMICONDUCTORS AND INTEGRATED CIRCUITS

Part 4b | July 1976

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.

ELECTRON TUBES (BLUE SERIES)

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

Part 1a	Transmitting tubes for communication and Tubes for r.f. heating Types PE05/25 – TBW15/125	December 1975
Part 1b	Transmitting tubes for communication Tubes for r.f. heating Amplifier circuit assemblies	January 1976
Part 2	Microwave products Communication magnetrons Magnetrons for microwave heating Klystrons Travelling-wave tubes Diodes Triodes T-R Switches Microwave semiconductor devices Isolators – circulators	May 1976
Part 3	Special Quality tubes; Miscellaneous devices	January 1975
Part 4	Receiving tubes	March 1975
Part 5a	Cathode-ray tubes	April 1975
Part 5b	Camera tubes; Image intensifier tubes	May 1975
Part 6	Products for nuclear technology Channel electron multipliers Geiger-Mueller tubes Neutron tubes	July 1975
Part 7	Gas-filled tubes Voltage stabilizing and reference tubes Counter, selector, and indicator tubes Trigger tubes Switching diodes Thyratrons Ignitrons Industrial rectifying tubes High-voltage rectifying tubes	August 1975
Part 8	TV Picture tubes	October 1975
Part 9	Photomultiplier tubes Phototubes (diodes)	June 1976

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

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

Part 1a	**Rectifier diodes, thyristors, triacs**		**March 1976**
	Rectifier diodes Voltage regulator diodes (> 1,5 W) Transient suppressor diodes	Rectifier stacks Thyristors Triacs	
Part 1b	**Diodes**		**October 1975**
	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**		**December 1975**
Part 3	**High-frequency and switching transistors**		**April 1976**
Part 4a	**Special semiconductors**		**June 1976**
	Transmitting transistors Microwave devices Field-effect transistors	Dual transistors Microminiature devices for thick- and thin-film circuits	
Part 4b	**Devices for optoelectronics**		**July 1976**
	Photosensitive diodes and transistors Light emitting diodes Displays	Photocouplers Infrared sensitive devices Photoconductive devices	
Part 5	**Linear integrated circuits**		**March 1975**
Part 6	**Digital integrated circuits**		**May 1976**
	LOCMOS HE family GZ family		

COMPONENTS AND MATERIALS (GREEN SERIES)

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

Part 1 — Functional units, Input/output devices, Peripheral devices — **November 1975**

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
Hybrid integrated circuits
Peripheral devices

Part 2a — Resistors — **February 1976**

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 — **April 1976**

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

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

FM tuners
Loudspeakers
Television tuners and aerial input assemblies
Components for black and white television
Components for colour television

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

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

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

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

Ferroxcube memory cores
Matrix planes and stacks
Core memory systems

Part 6 — Electric motors and accessories — **September 1975**

Small synchronous motors
Stepper motors
Miniature direct current motors

Part 7 — Circuit blocks — **September 1971**

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

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

Part 9 — Piezoelectric quartz devices — **March 1976**

Part 10 — Connectors — **November 1975**

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

[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 ($R_{th\ j\text{-}mb} > 15\ ^oC/W$)
- D Power transistor for a.f. applications ($R_{th\ j\text{-}mb} \leq 15\ ^oC/W$)
- E Tunnel diode
- F Transistor for h.f. applications ($R_{th\ j\text{-}mb} > 15\ ^oC/W$)
- 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 ($R_{th\ j\text{-}mb} \leq 15\ ^oC/W$)
- 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 ($R_{th\ j\text{-}mb} > 15\ ^oC/W$)
- S Transistor for switching applications ($R_{th\ j\text{-}mb} > 15\ ^oC/W$)
- T Electrically, or by means of light, triggered controlling and switching power device having a breakdown characteristic ($R_{th\ j\text{-}mb} \leq 15\ ^oC/W$)[1]
- U Power transistor for switching applications ($R_{th\ j\text{-}mb} \leq 15\ ^oC/W$)
- 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]

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.

---

[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

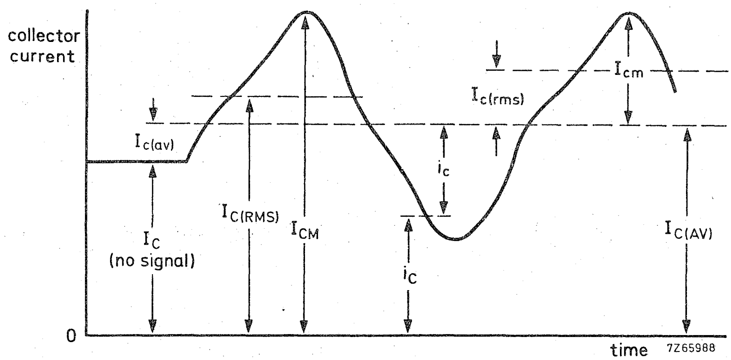
For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

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.

[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 $I_V = \frac{d\phi_V}{d\Omega}$; 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 $E_V = \frac{d\phi_V}{dA}$; 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:

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

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

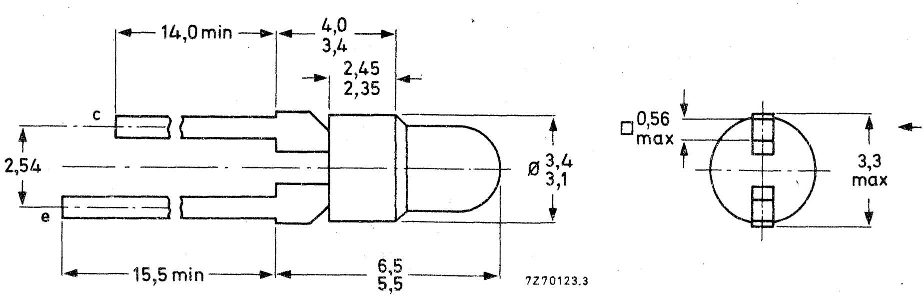
SILICON PHOTOTRANSISTOR

N-P-N silicon phototransistor in epoxy resin encapsulation intended to be used in combination with the infrared LED CQY58. 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.	50	mW
Collector dark current V_{CE} = 20 V ; E = 0	$I_{CEO(D)}$	<	100	nA
Collector light current V_{CE} = 5 V; E_e = 5 mW/cm²; λpk = 875 nm	$I_{CEO(L)}$	>	6	mA
Wavelength at peak response	λpk	typ.	800	nm

MECHANICAL DATA Dimensions in mm

SOD-53B



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

Voltage

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)	I_{CM}	max.	50	mA

Power dissipation

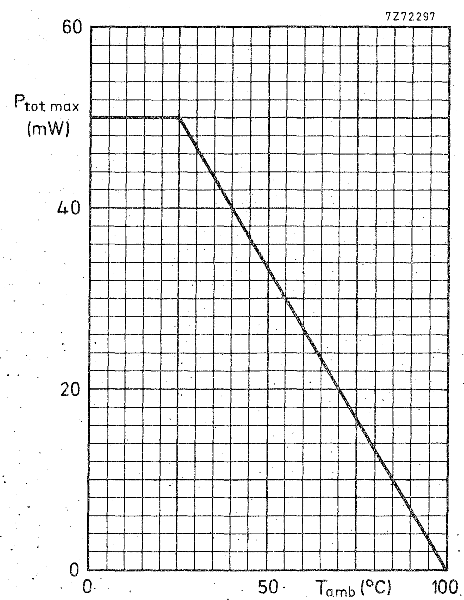
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	50	mW

Temperature

Storage temperature	T_{stg}		−55 to +100	°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature > 3 mm from the body; t_{sld} < 7 s	T_{sld}	max.	230	°C

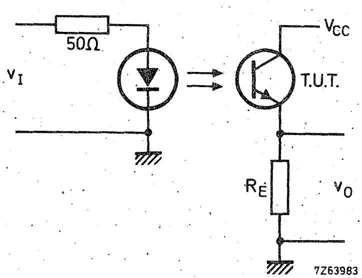
THERMAL RESISTANCE

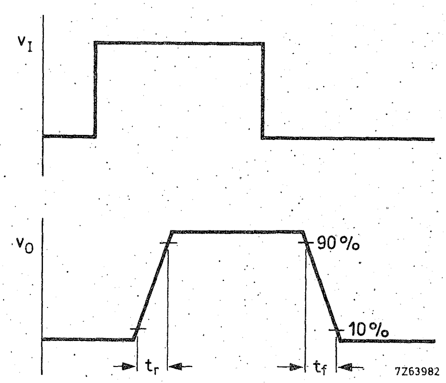
From junction to ambient, device mounted on printed-circuit board	$R_{th\ j-a}$	=	1,5	°C/mW



CHARACTERISTICS T_j = 25 °C unless otherwise specified

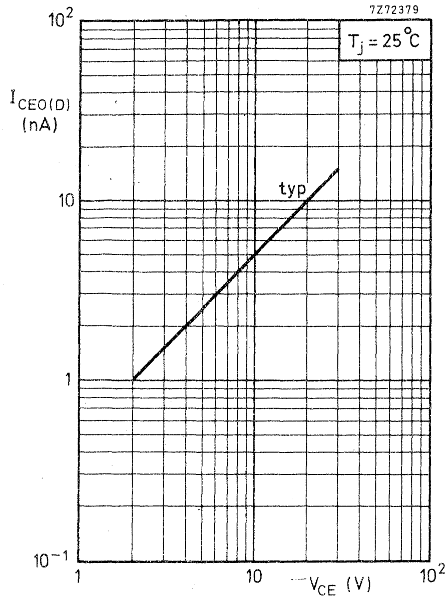
Collector dark current				
V_{CE} = 20 V ; E = 0	$I_{CEO(D)}$	<	100	nA
Collector light current				
V_{CE} = 5 V; E_e = 5 mW/cm²; λpk = 875 nm [1]	$I_{CEO(L)}$	> typ.	6 15	mA mA
Collector-emitter saturation voltage				
I_C = 4 mA; E_e = 5 mW/cm²; λpk = 875 nm [1]	V_{CEsat}	<	0,4	V
Wavelength at peak response	λpk	typ.	800	nm
Bandwidth at half height	$B_{50\%}$	typ.	400	nm
Beamwidth between half sensitivity directions	$\alpha_{50\%}$	typ.	10°	
Switching times (circuit below)				
I_{Con} = 1 mA; V_{CC} = 20 V; R_E = 1 kΩ; T_{amb} = 25 °C				
Rise time	t_r	typ.	7,5	μs
Fall time	t_f	typ.	7,5	μs

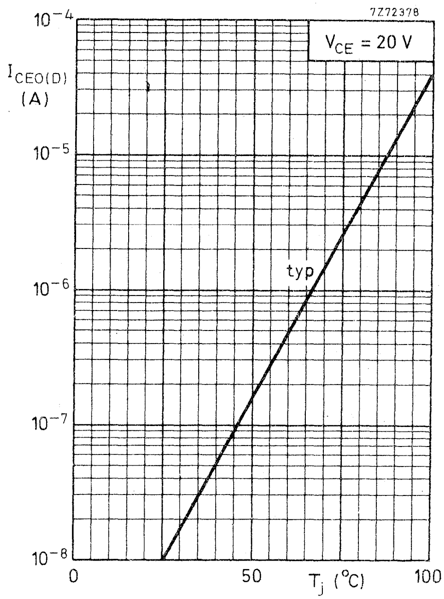


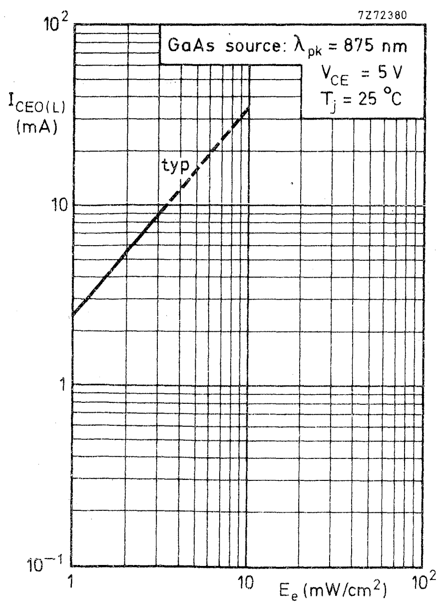


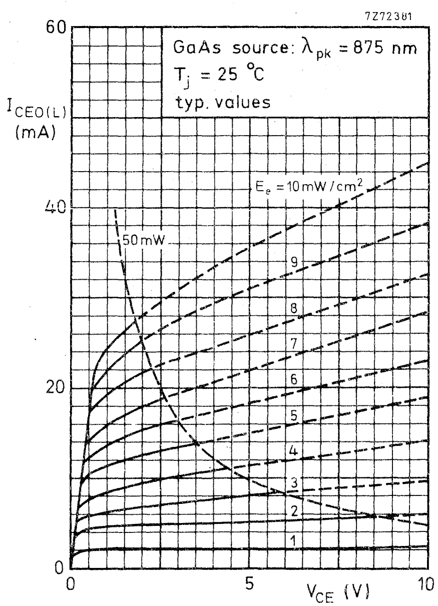
LED = CQY58
T.U.T. = BPW22

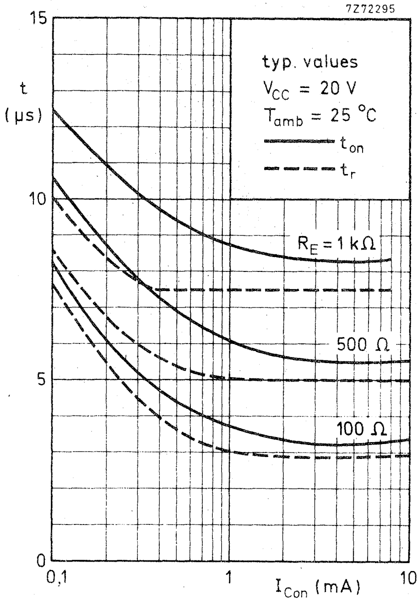
[1]) Measured with pulsed GaAs light source.

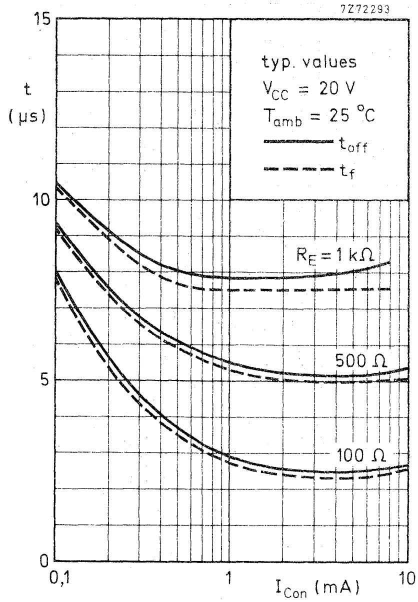

7Z72379
$T_j = 25\ ^\circ C$
$I_{CEO(D)}$ (nA)
typ
10^2
10
1
10^{-1}
1
10
10^2
V_{CE} (V)

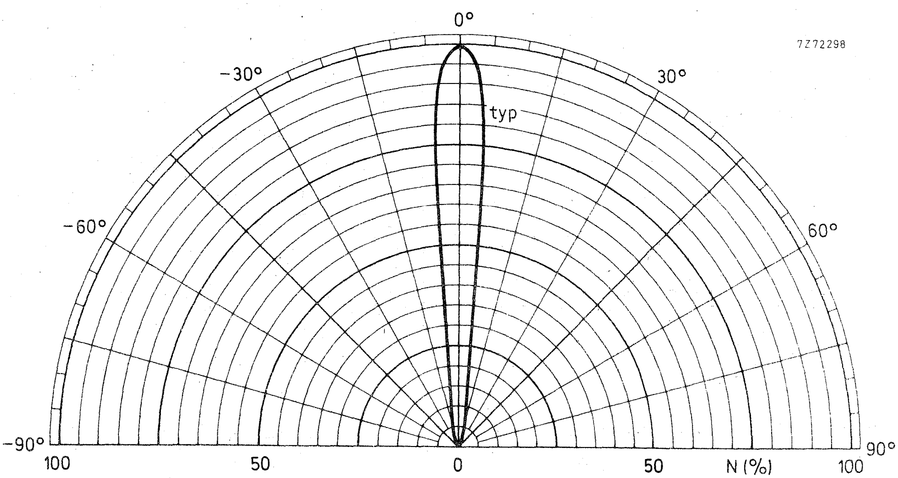

7Z72378
$V_{CE} = 20\ V$
$I_{CEO(D)}$ (A)
typ
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
0
50
100
T_j (°C)

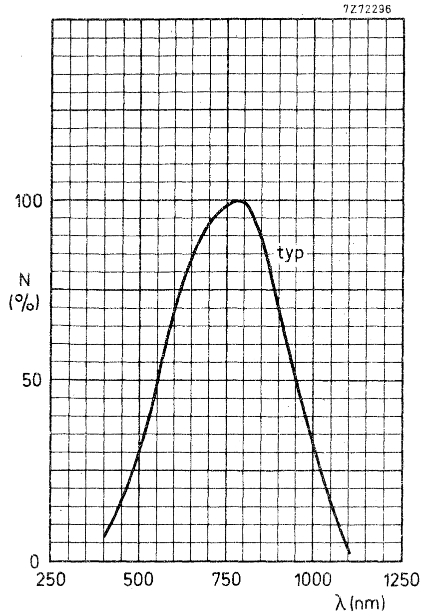

7Z72380
GaAs source: $\lambda_{pk} = 875$ nm
$V_{CE} = 5$ V
$T_j = 25\ ^\circ C$
$I_{CEO(L)}$ (mA)
typ
10^2
10
1
10^{-1}
1
10
10^2
E_e (mW/cm^2)

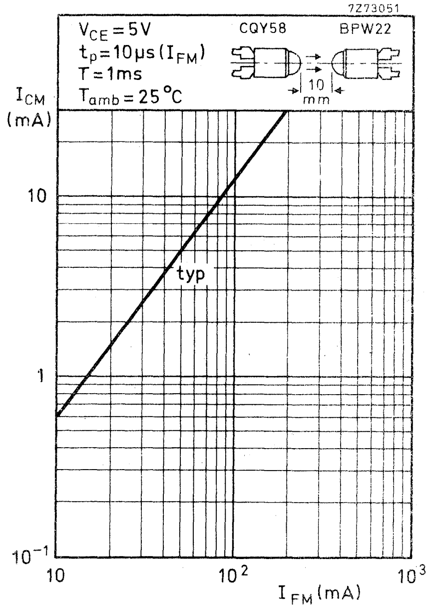

7Z72381
GaAs source: $\lambda_{pk} = 875$ nm
$T_j = 25\ ^\circ C$
typ. values
$I_{CEO(L)}$ (mA)
$E_e = 10$ mW/cm^2
50 mW
9
8
7
6
5
4
3
2
1
60
40
20
0
0
5
10
V_{CE} (V)

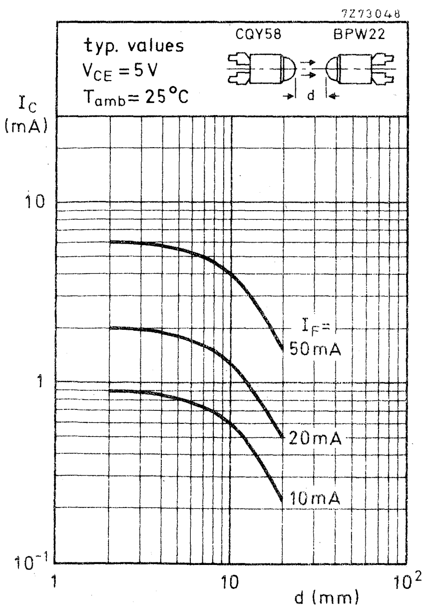

7Z72295
typ. values
V_{CC} = 20 V
T_{amb} = 25 °C
t_{on}
t_r
t
(μs)
R_E = 1 kΩ
500 Ω
100 Ω
I_{Con} (mA)
15
10
5
0
0,1
1
10

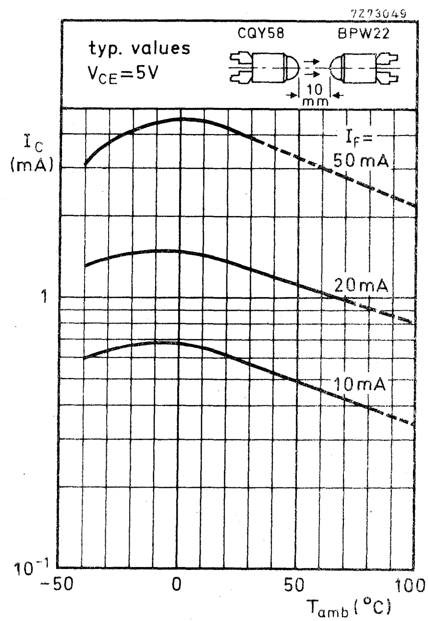

7Z72293
typ. values
V_{CC} = 20 V
T_{amb} = 25 °C
t_{off}
t_f
t
(μs)
R_E = 1 kΩ
500 Ω
100 Ω
I_{Con} (mA)
15
10
5
0
0,1
1
10


0°
7Z72298
−30°
30°
typ
−60°
60°
−90°
90°
100
50
0
50
N (%)
100


7Z72296
100
N
(%)
50
0
250
500
750
1000
1250
λ (nm)
typ


7Z73051
V_{CE} = 5 V
t_p = 10 μs (I_{FM})
T = 1 ms
T_{amb} = 25 °C
CQY58
BPW22
10 mm
I_{CM} (mA)
10
1
10^{-1}
10
10^2
10^3
I_{FM} (mA)
typ


7Z73048
typ. values
V_{CE} = 5 V
T_{amb} = 25 °C
CQY58
BPW22
d
I_C (mA)
10
1
10^{-1}
1
10
10^2
d (mm)
I_F =
50 mA
20 mA
10 mA


7Z73049
typ. values
V_{CE} = 5 V
CQY58
BPW22
10 mm
I_C (mA)
1
10^{-1}
−50
0
50
100
T_{amb} (°C)
I_F =
50 mA
20 mA
10 mA

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

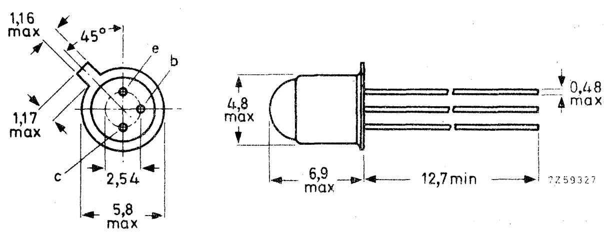
Collector-emitter voltage (open base)	V_{CEO}	max.	32		V
Collector current (peak value)	I_{CM}	max.	200		mA
Junction temperature	T_j	max.	150		°C
Collector dark current $I_B = 0$; $V_{CE} = 24$ V	$I_{CEO(D)}$	<	500		nA
			BPX25	BPX29	
Collector light current $I_B = 0$; $V_{CE} = 6$ V; at 1000 lx	$I_{CEO(L)}$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

MECHANICAL DATA

Dimensions in mm

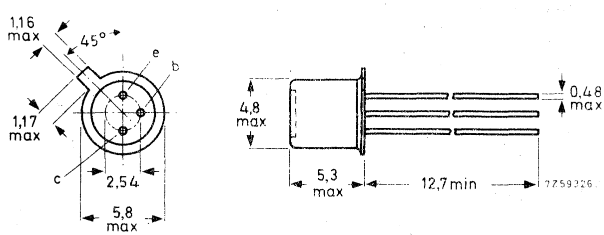
BPX25

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 °C	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 °C unless otherwise specified

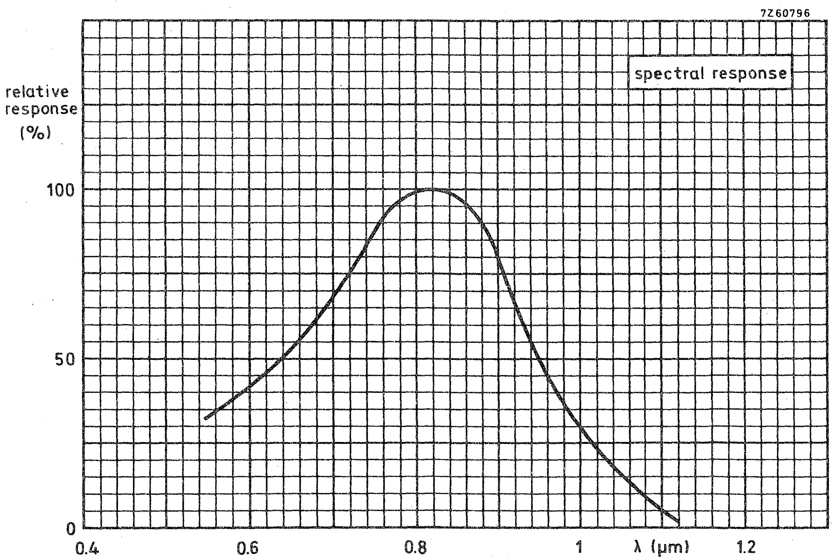
Collector dark current

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

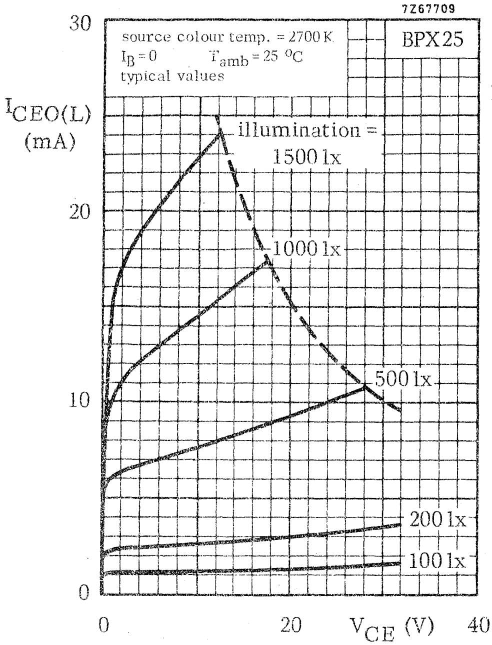
			BPX25	BPX29	
Collector light current					
$I_B = 0$; V_{CE} = 6 V; tungsten filament lamp source with T_c = 2700 K; E_V = 1000 lx (7,7 mW/cm²)	$I_{CEO(L)}$	>	5	0,25	mA
		typ.	13	0,8	mA
D.C. current gain					
I_C = 2 mA; V_{CE} = 6 V	h_{FE}	typ.	500	500	
Cut-off frequency					
Source: modulated GaAs; 0,4 mW/cm² Load: optimum (50 Ω); V_{CE} = 24 V	f_{co}	typ.	200	150	kHz

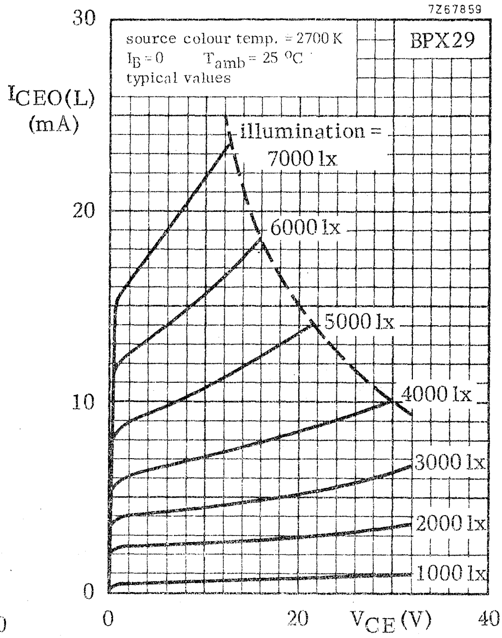
CHARACTERISTICS (continued)

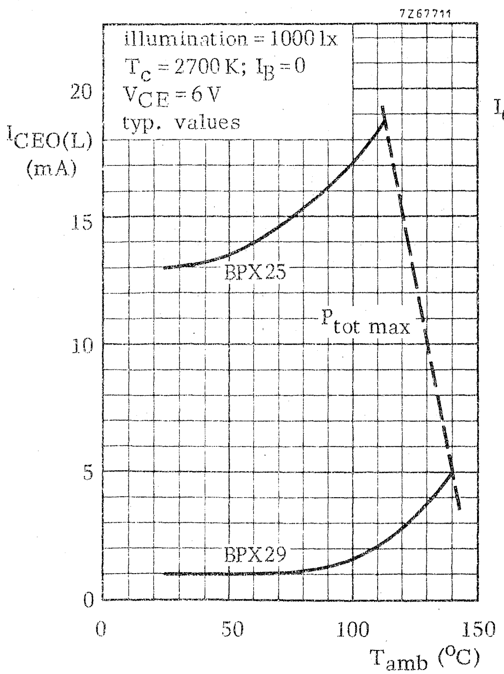
			BPX25	BPX29	
Switching times [1]					
Delay time	t_d	typ.	1,0	2,5	μs
		<	3,0	5,0	μs
Rise time	t_r	typ.	1,5	2,5	μs
		<	3,0	5,0	μs
Storage time	t_s	typ.	0,2	0,2	μs
		<	0,4	0,4	μs
Fall time	t_f	typ.	1,5	3,5	μs
		<	4,0	8,0	μs
Wavelength at peak response	λ_{pk}	typ.	800	800	nm

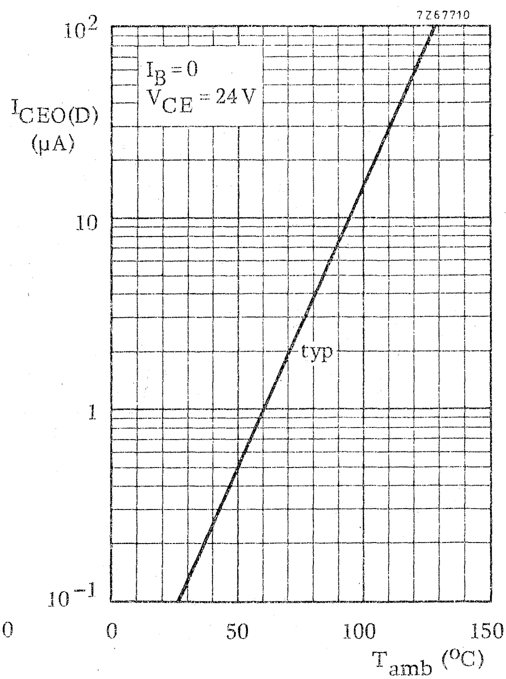


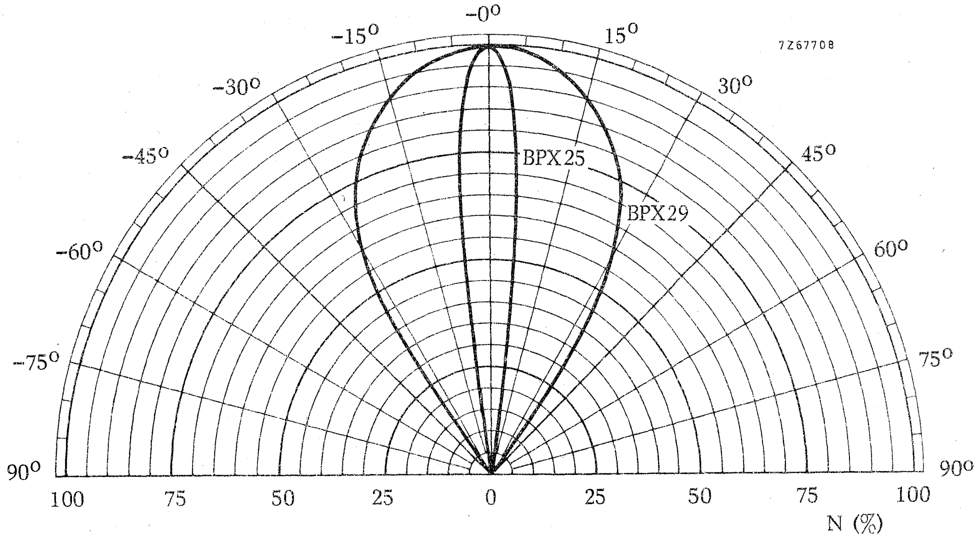
[1]) Source: modulated GaAs: 0,4 mW/cm^2
Load: optimum (50 Ω)
V_{CE} = 24 V
Improved switching times can be obtained by a quiescent bias current.
I.e. I_B = 2 μA: t_d < 0,2 μs.


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


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


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
T_{amb} (°C)
0
5
10
15
20
50
100
150


7Z67710
$I_B = 0$
$V_{CE} = 24$ V
$I_{CEO(D)}$ (μA)
typ
10^2
10
1
10^{-1}
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 (%)

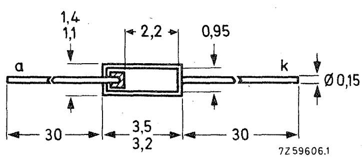
SILICON PLANAR PHOTODIODE

Unencapsulated photodiode for general purpose applications.

QUICK REFERENCE DATA				
Reverse voltage	V_R	max.	18	V
Luminous 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	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.	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

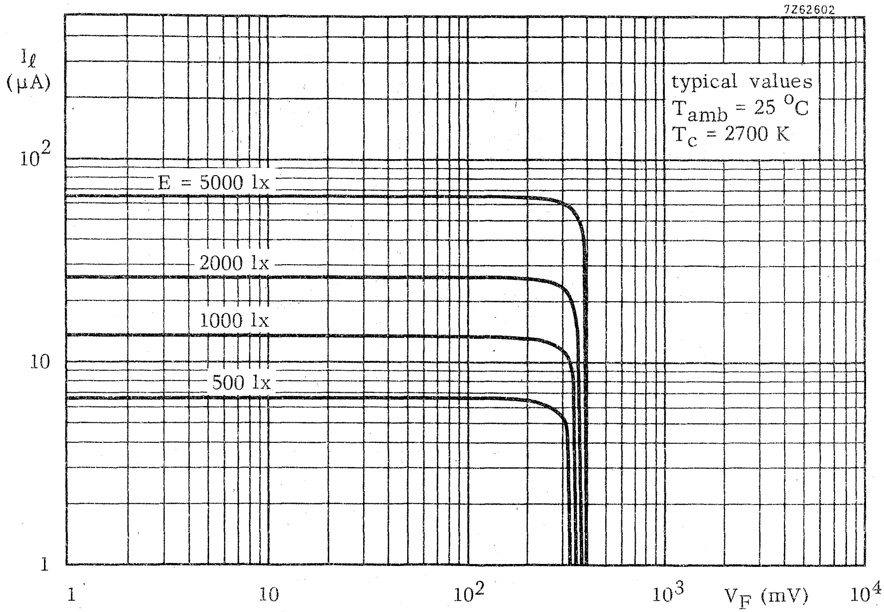
THERMAL RESISTANCE

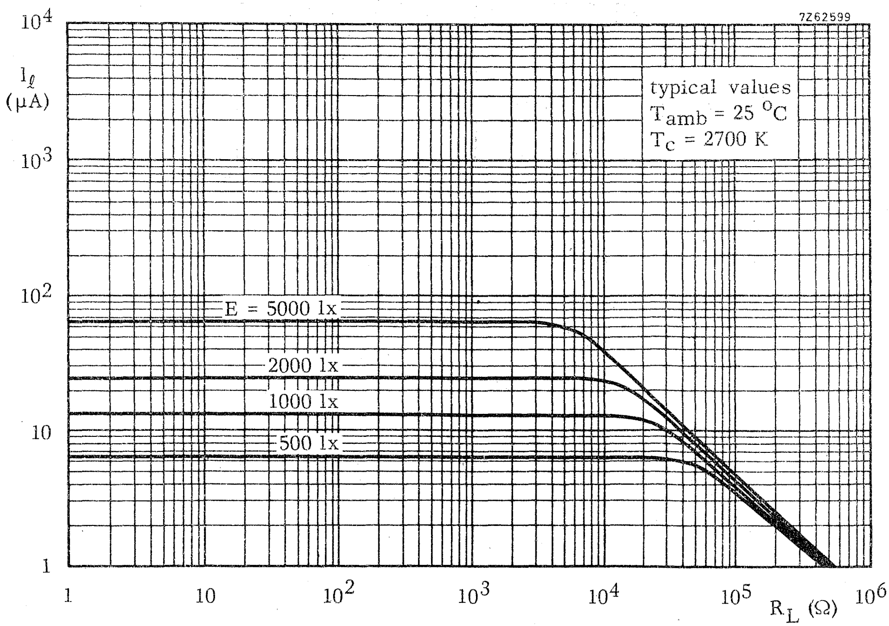
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

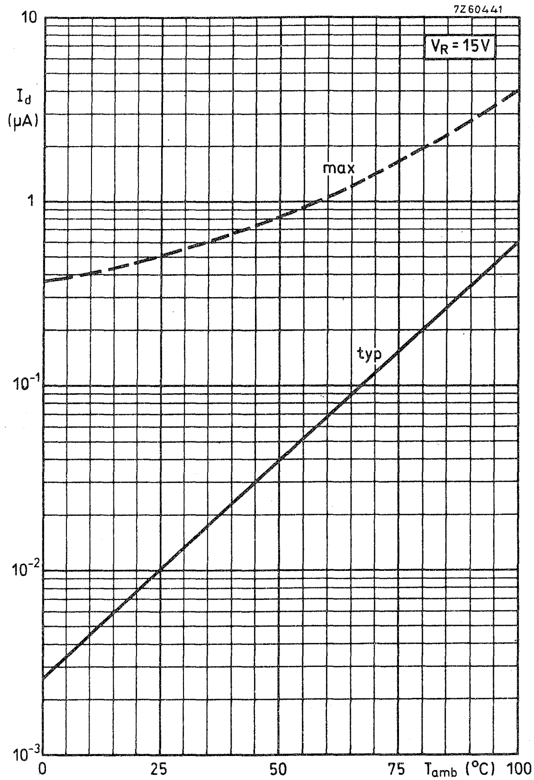
CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

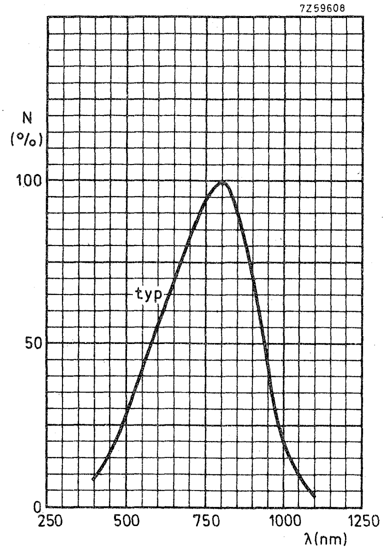
Dark reverse current				
V_R = 15 V	I_d	typ.	0,01	µA
		<	0,5	µA
V_R = 15 V; T_{amb} = 100 °C	I_d	typ.	0,6	µA
		<	4,0	µA
Photovoltaic mode				
E = 1000 lx; T_c = 2700 K (equivalent to 7,7 mW/cm^2)				
Light reverse current; V = 0	I_l	>	10	µA
		typ.	13	µA
Forward voltage; I = 0	V_F	>	330	mV
		typ.	350	mV
Luminous sensitivity with external voltage [1]				
V_R = 15 V; E = 1000 lx; T_c = 2700 K (equivalent to 7,7 mW/cm^2)	N	>	10,5	nA/lx
		typ.	14	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

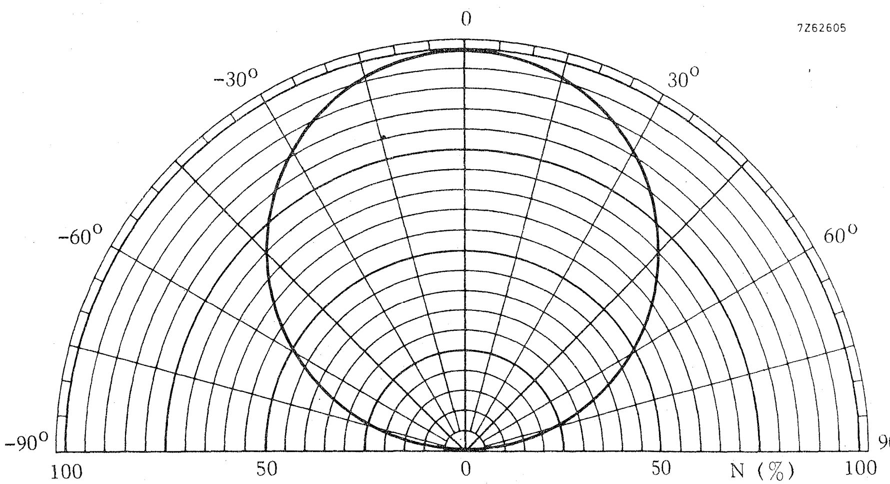
[1]) The value of light current increases with temperature by an amount approximately equal to the increase in dark current.


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


7Z62599
I_ℓ (μA)
typical values
T_{amb} = 25 °C
T_c = 2700 K
E = 5000 lx
2000 lx
1000 lx
500 lx
R_L (Ω)


7Z60441
10
1
10^{-1}
10^{-2}
10^{-3}
I_d
(μA)
$V_R = 15V$
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
100
N (%)

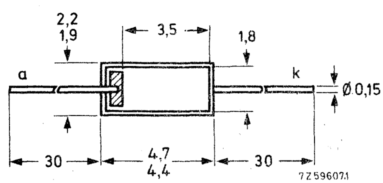
SILICON PLANAR PHOTODIODE

Unencapsulated photodiode for general purpose applications.

QUICK REFERENCE DATA				
Reverse voltage	V_R	max.	18	V
Luminous 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		°C
Junction temperature	T_j	max.	125	°C

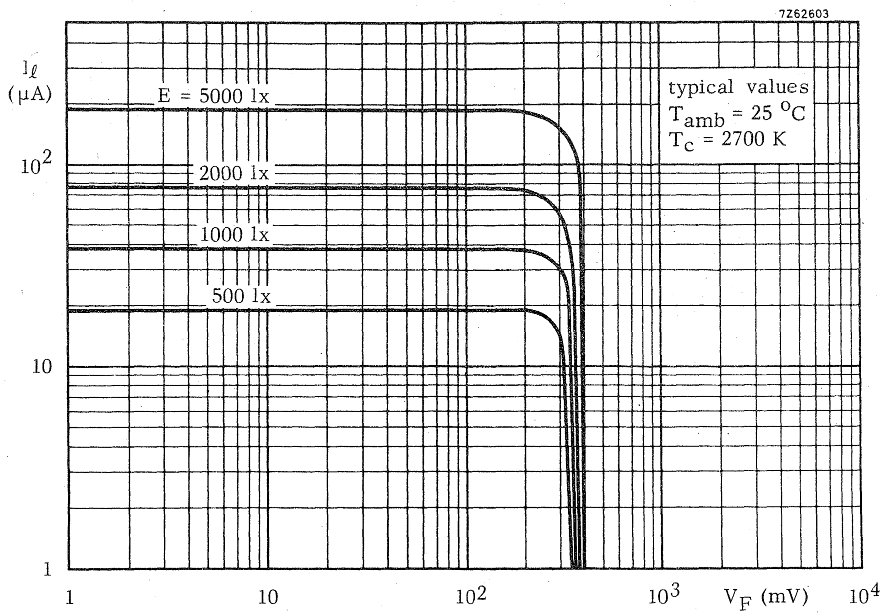
THERMAL RESISTANCE

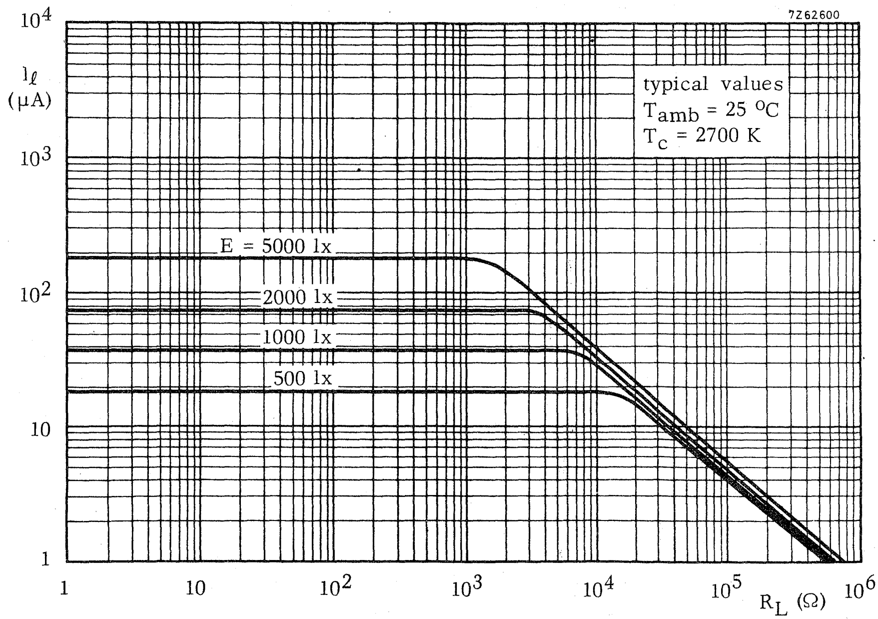
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

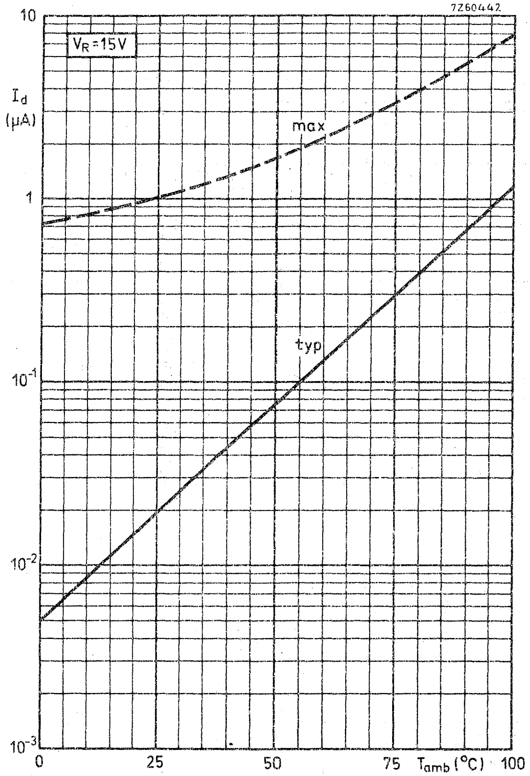
CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

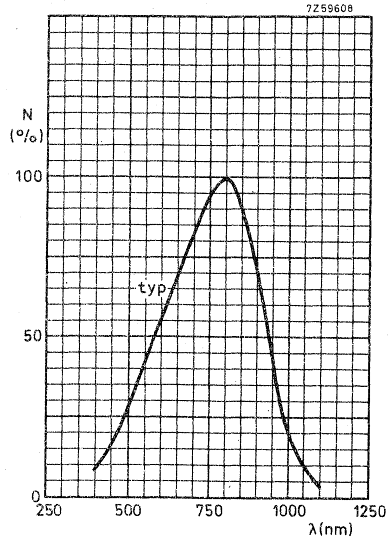
Dark reverse current				
V_R = 15 V	I_d	typ.	0,02	µA
		<	1,0	µA
V_R = 15 V; T_{amb} = 100 °C	I_d	typ.	1,2	µA
		<	8,0	µA
Photovoltaic mode				
E = 1000 lx; T_c = 2700 K (equivalent to 7,7 mW/cm²)				
Light reverse current; V = 0	I_l	>	30	µA
		typ.	38	µA
Forward voltage; I = 0	V_F	>	330	mV
		typ.	350	mV
Luminous sensitivity with external voltage [1]				
V_R = 15 V; E = 1000 lx; T_c = 2700 K (equivalent to 7,7 mW/cm²)	N	>	31	nA/lx
		typ.	40	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

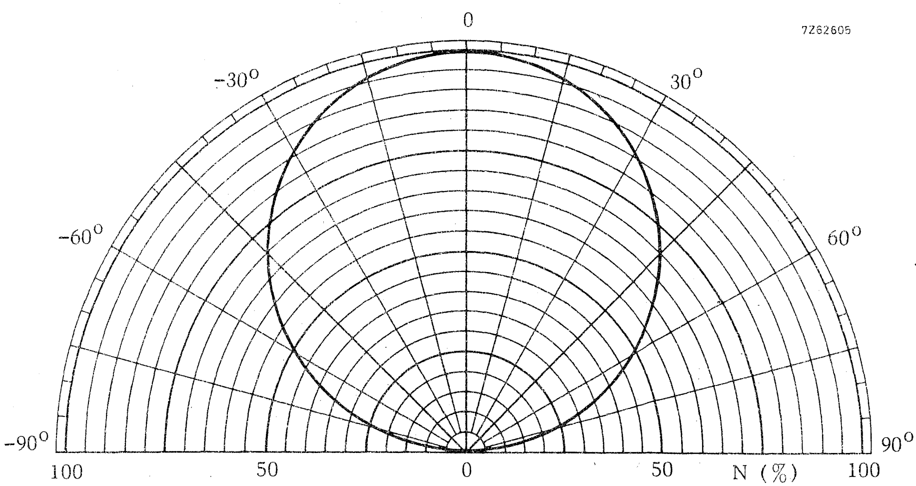
[1]) The value of light current increases with temperature by an amount approximately equal to the increase in dark current.


7Z62603
I_ℓ (μA)
E = 5000 lx
2000 lx
1000 lx
500 lx
typical values
T_{amb} = 25 °C
T_c = 2700 K
10^2
10
1
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
10
V_R=15V
I_d
(μA)
max
1
typ
10^{-1}
10^{-2}
10^{-3}
0
25
50
75
T_{amb} (°C)
100


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


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

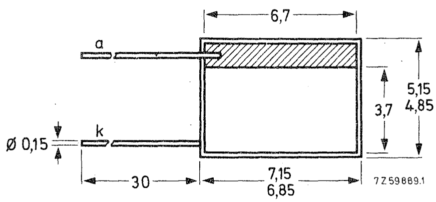
SILICON PLANAR PHOTODIODE

Unencapsulated photodiode for general purpose applications.

QUICK REFERENCE DATA				
Reverse voltage	V_R	max.	12	V
Luminous 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

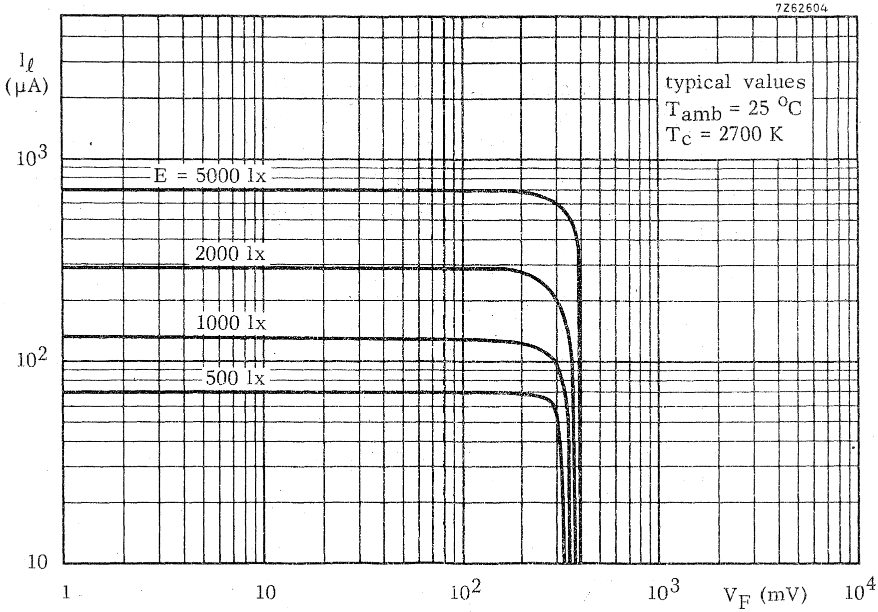
THERMAL RESISTANCE

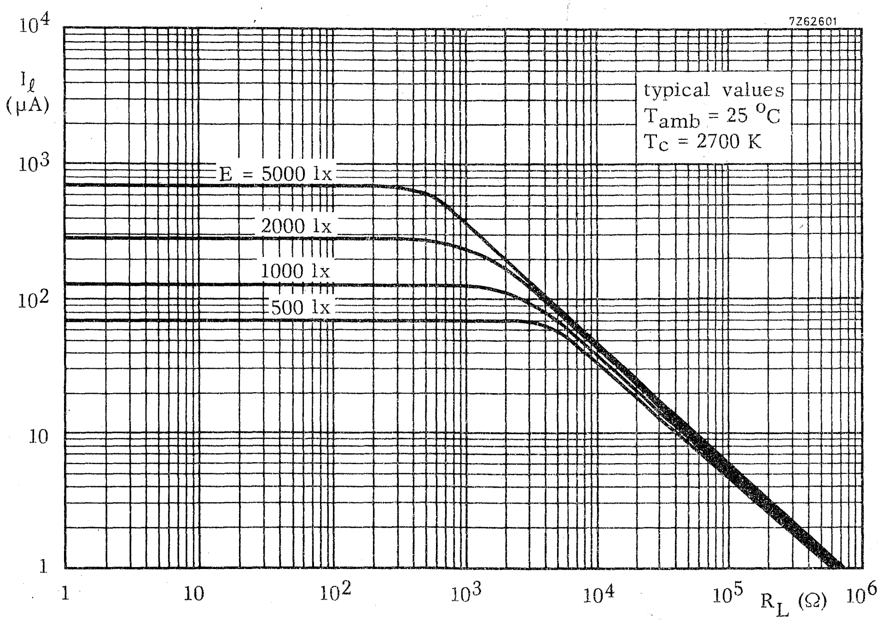
From junction to ambient in free air	$R_{th\ j-a}$	=	0,3	°C/mW

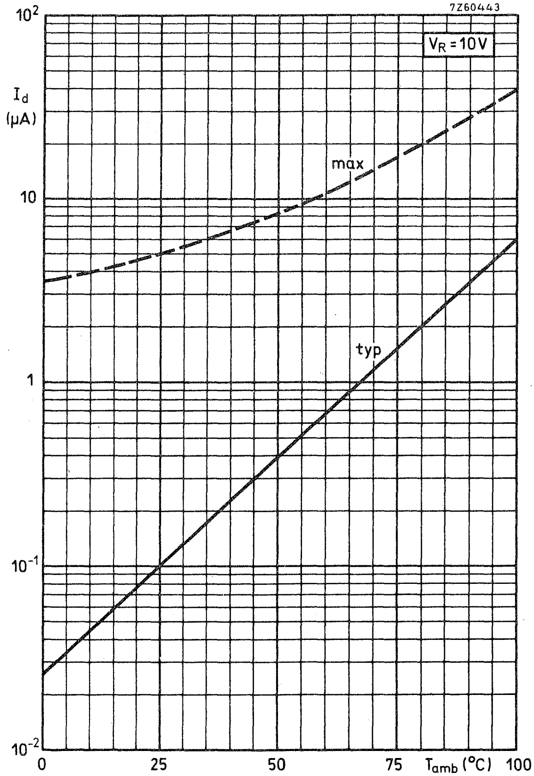
CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

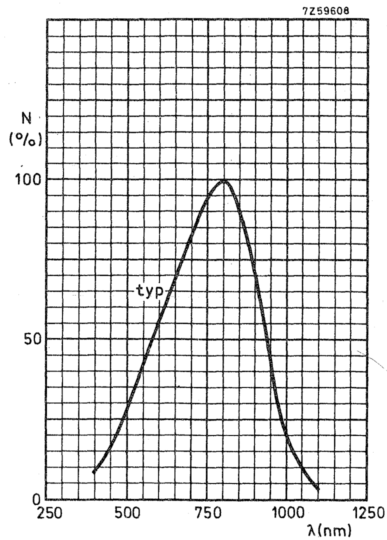
Dark reverse current				
V_R = 10 V	I_d	typ.	0,1	μA
		<	5,0	μA
V_R = 10 V; T_{amb} = 100 °C	I_d	typ.	6,0	μA
		<	40	μA
Photovoltaic mode				
E = 1000 lx; T_c = 2700 K (equivalent to 7,7 mW/cm^2)				
Light reverse current; V = 0	I_1	>	110	μA
		typ.	140	μA
Forward voltage; I = 0	V_F	>	330	mV
		typ.	350	mV
Luminous sensitivity with external voltage [1]				
V_R = 10 V; E = 1000 lx; T_c = 2700 K (equivalent to 7,7 mW/cm^2)	N	>	120	nA/lx
		typ.	150	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

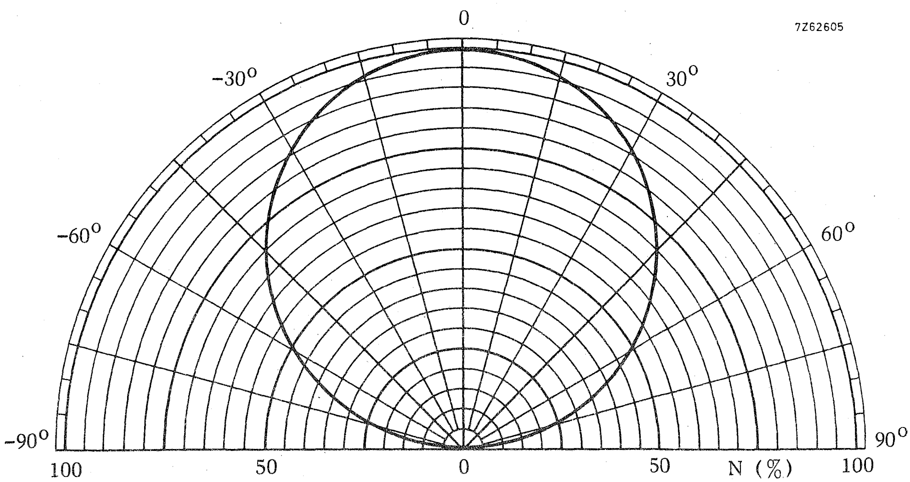
[1]) The value of light current increases with temperature by an amount approximately equal to the increase in dark current.


7Z62604
I_ℓ (μA)
10^3
10^2
10
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


7Z62601
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


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

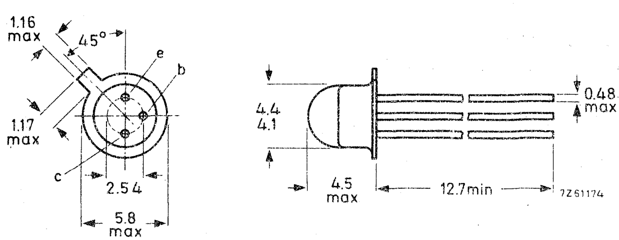
PHOTOTRANSISTOR

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	°C
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_l		100 to 700	µA
	BPX70C	I_l		100 to 300	µA
	BPX70D	I_l		200 to 400	µA
	BPX70E	I_l		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) $t_p < 50$ µs; $\delta < 0,1$	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	$R_{th\ j-a}$	=	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	nA
		<	100	nA
$V_{CE} = 20$ V; $T_j = 100$ °C	I_d	typ.	10	µA
		<	100	µA

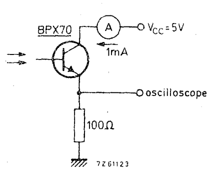
Collector light current

$V_{CE} = 5$ 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

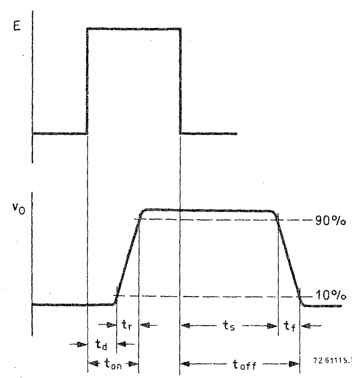
CHARACTERISTICS (continued)

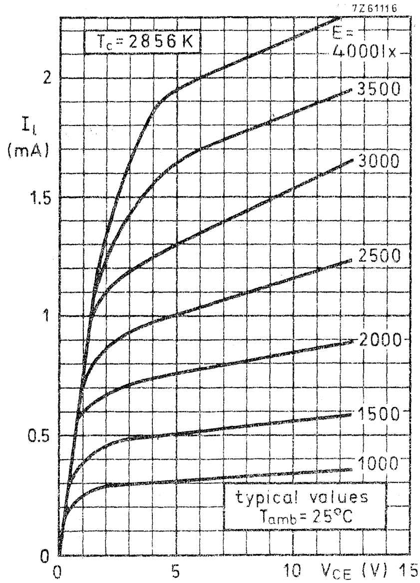
Breakdown voltages				
Collector-base voltage $E = 0$; $I_C = 0,1$ mA	$V_{(BR)CBO}$	>	40	V
Collector-emitter voltage $E = 0$; $I_C = 1$ mA	$V_{(BR)CEO}$	>	30	V
Emitter-collector voltage $E = 0$; $I_C = 0,1$ mA	$V_{(BR)ECO}$	>	6	V
Collector capacitance				
$I_E = I_e = 0$; $V_{CB} = 20$ V	C_c	typ.	3,5	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

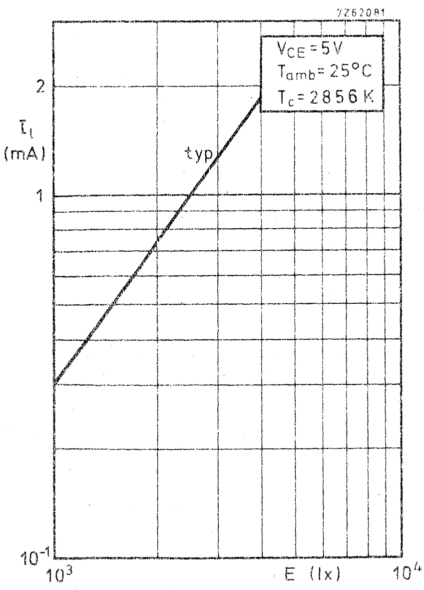


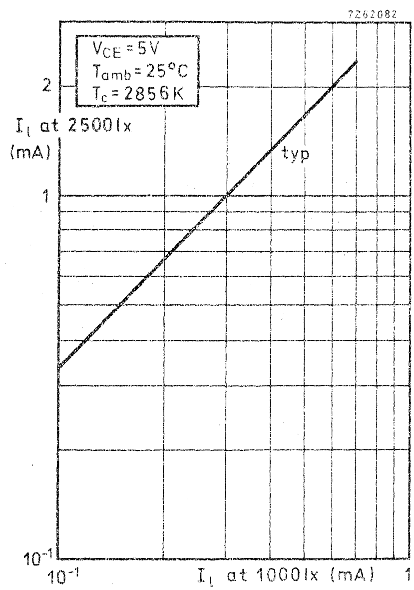
Light input pulse:

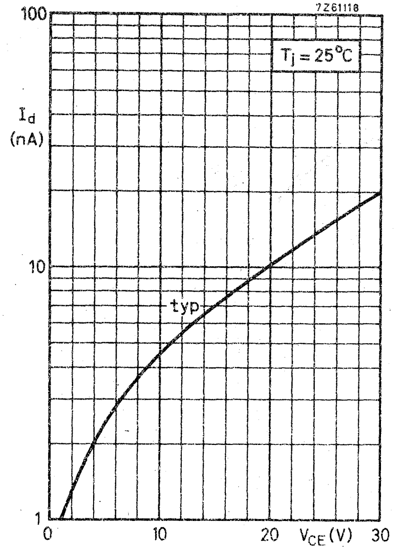
$t_r = t_f =$ 20 ns
$t_p =$ 20 µs
$f =$ 500 Hz
$\lambda =$ 800 nm

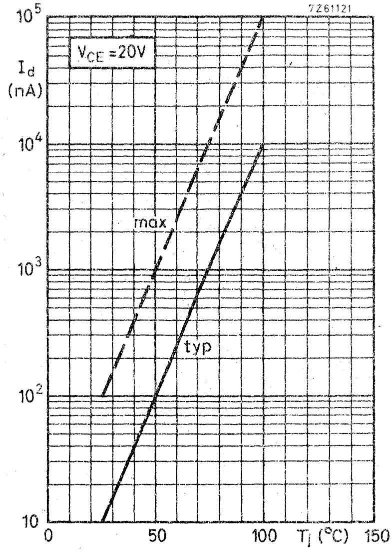


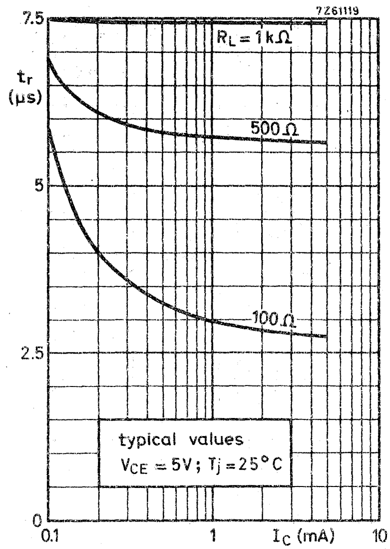

7Z61116
Tc = 2856 K
E = 4000 lx
3500
3000
2500
2000
1500
1000
typical values
Tamb = 25°C
IL (mA)
2
1.5
1
0.5
0
0
5
10
VCE (V) 15

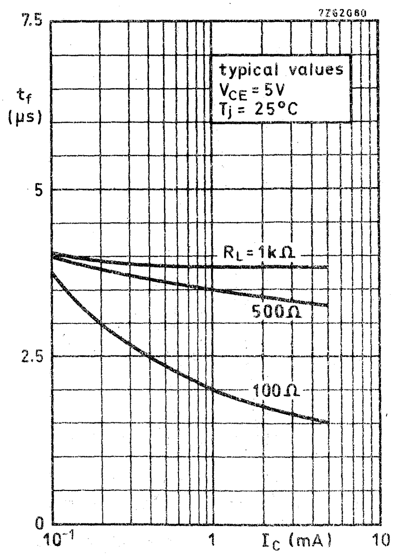

7Z62081
VCE = 5 V
Tamb = 25°C
Tc = 2856 K
IL (mA)
typ
2
1
10-1
10³
E (lx)
10⁴


7Z62082
VCE = 5 V
Tamb = 25°C
Tc = 2856 K
IL at 2500 lx (mA)
typ
2
1
10-1
10-1
IL at 1000 lx (mA)
1

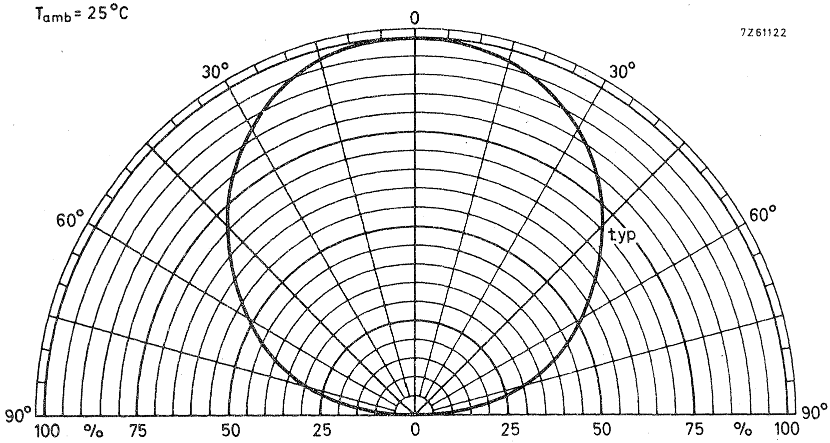

7Z61118
Tj = 25°C
Id
(nA)
typ
VCE (V)

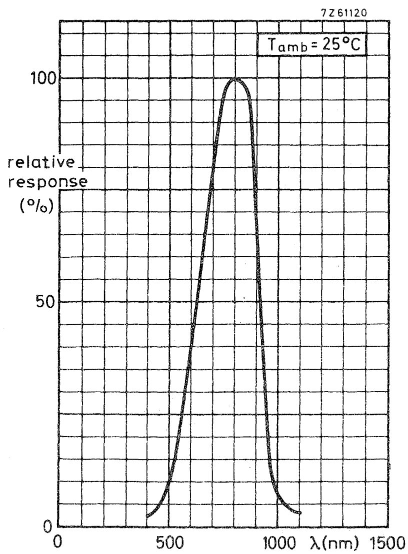

7Z61121
VCE = 20V
Id
(nA)
max
typ
Tj (°C)

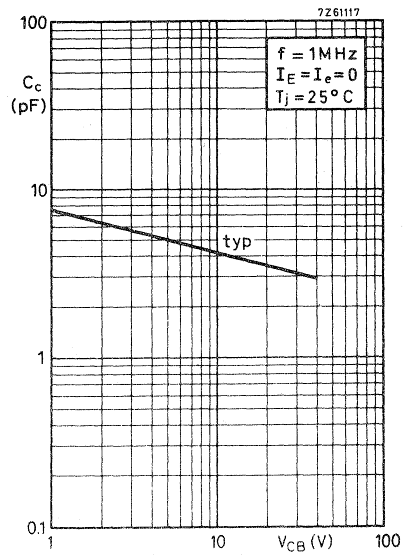

7Z61119
RL = 1kΩ
tr
(μs)
500Ω
100Ω
typical values
VCE = 5V; Tj = 25°C
IC (mA)


7Z62080
typical values
VCE = 5V
Tj = 25°C
tf
(μs)
RL = 1kΩ
500Ω
100Ω
IC (mA)

polar response of relative sensitivity







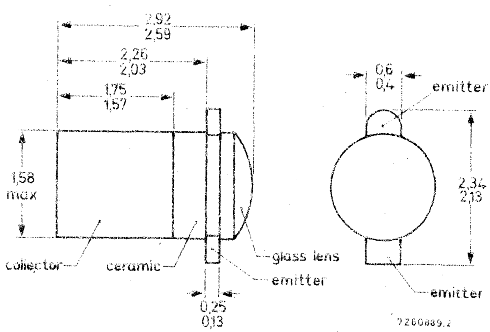
PHOTOTRANSISTOR

General purpose n-p-n silicon phototransistor with a glass lens. Inaccessible 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	°C
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	$R_{th\ j\text{-}a}$	=	2	°C/mW
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0,95	°C/mW

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

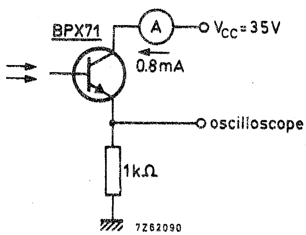
Collector dark current				
$V_{CE} = 30$ V	I_d	<	25	nA
$V_{CE} = 30$ V; $T_{amb} = 100$ °C	I_d	<	100	µA
Collector light current				
$V_{CE} = 5$ V; tungsten filament lamp source with colour temperature 2856 K; $E_e = 4,75$ mW/cm^2	I_ℓ	typ.	1	mA
$E_e = 20$ mW/cm^2	I_ℓ		0,5 to 15	mA [1]

[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)

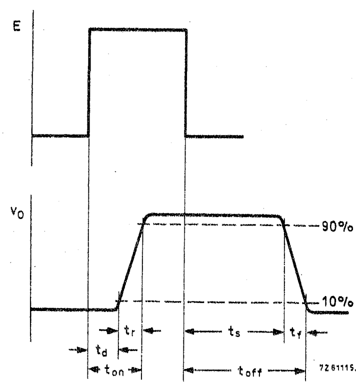
Breakdown voltages

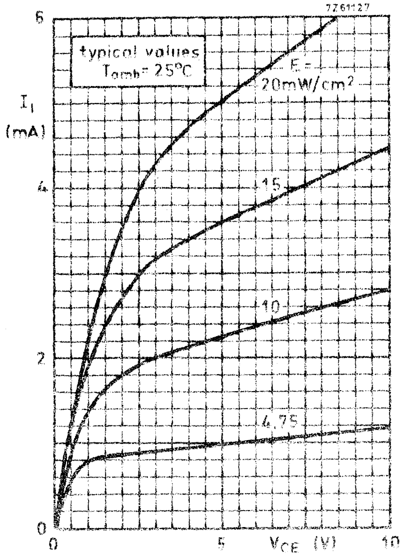
Collector-emitter voltage $E = 0$; $I_C = 0,5$ mA	$V_{(BR)CEO}$	>	50	V
Emitter-collector voltage $E = 0$; $I_C = 0,1$ mA	$V_{(BR)ECO}$	>	7	V
Collector-emitter light saturation voltage				
$I_C = 0,4$ mA; $E_e = 20$ mW/cm^2; $T_c = 2856$ K	V_{CEsat}	typ.	150	mV
		<	400	mV
Wavelength at peak response	λ_{pk}	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	µs
		<	20	µs
Rise time	t_r	typ.	3,0	µs
		<	30	µs
Storage time	t_s	typ.	0,1	µs
		<	2,0	µs
Fall time	t_f	typ.	2,5	µs
		<	20	µs

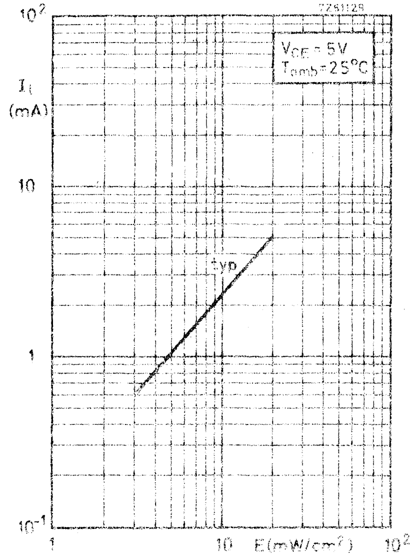


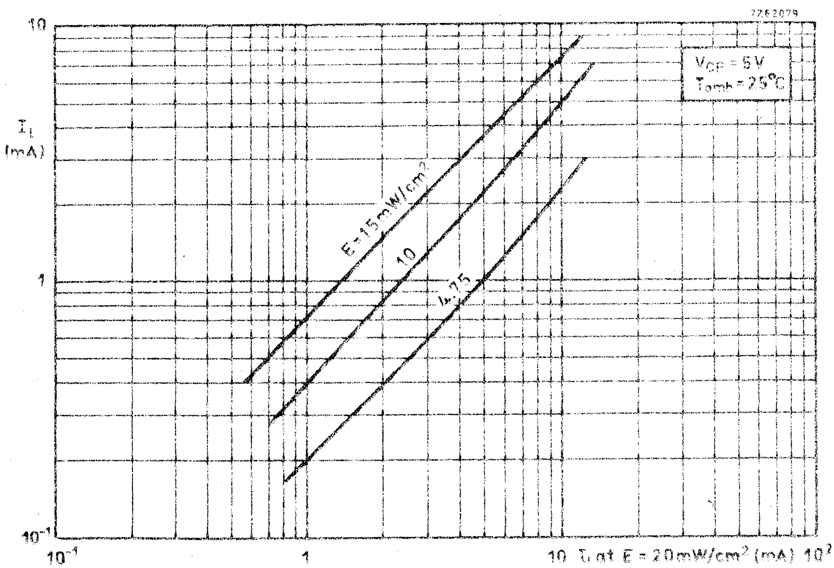
Light input pulse:

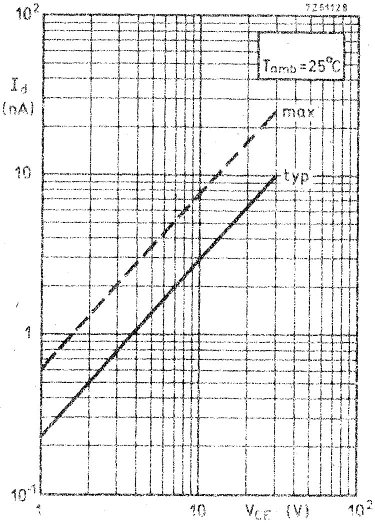
$t_r = t_f = 20$ ns
$t_p = 20$ µs
$f = 500$ Hz
$\lambda = 800$ nm

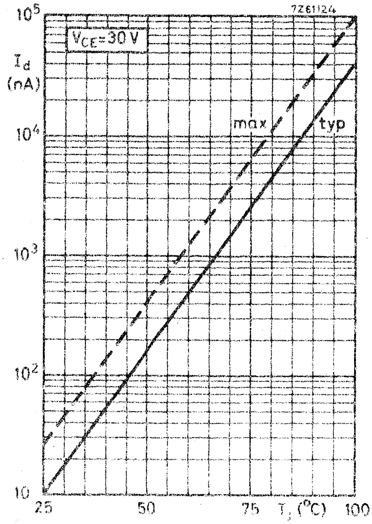


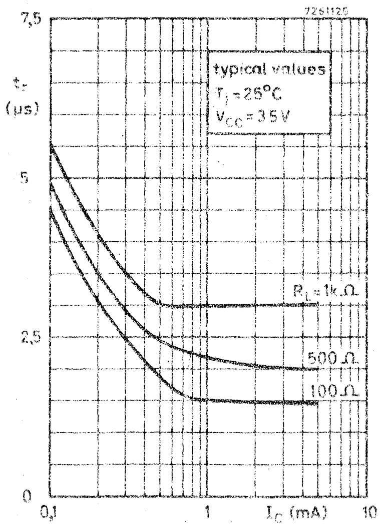

7Z61127
typical values
T_{amb} = 25 °C
E = 20mW/cm²
15
10
4.75
I_l (mA)
6
4
2
0
5
V_{CE} (V)
10

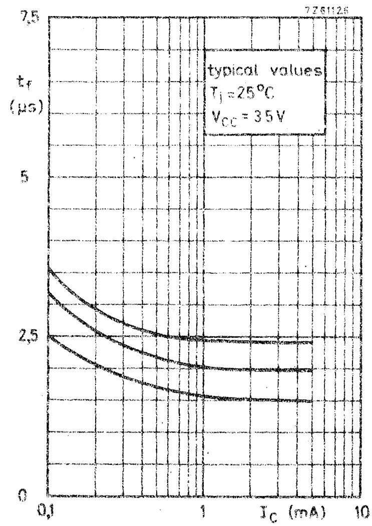

7Z61128
V_{CE} = 5 V
T_{amb} = 25 °C
I_l (mA)
typ
10^2
10
1
10^{-1}
1
10
E(mW/cm²)
10^2


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

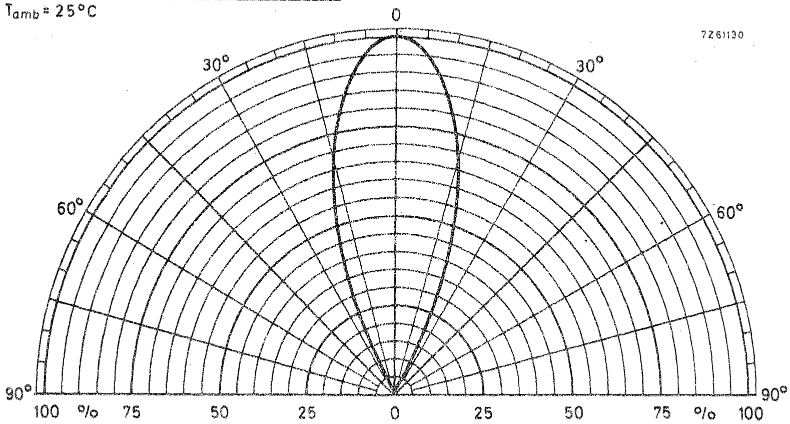

7Z61128
I_d
(nA)
$T_{amb}=25°C$
max
typ
V_{CE} (V)

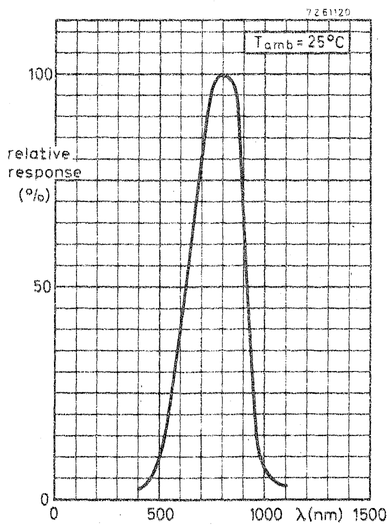

7Z61124
I_d
(nA)
$V_{CE}=30$ V
max
typ
T_j (°C)


7Z61125
t_r
(μs)
typical values
$T_j=25°C$
$V_{CC}=35$ V
$R_L=1k\Omega$
500 Ω
100 Ω
I_C (mA)


7Z61126
t_f
(μs)
typical values
$T_j=25°C$
$V_{CC}=35$ V
I_C (mA)

polar response of relative sensitivity





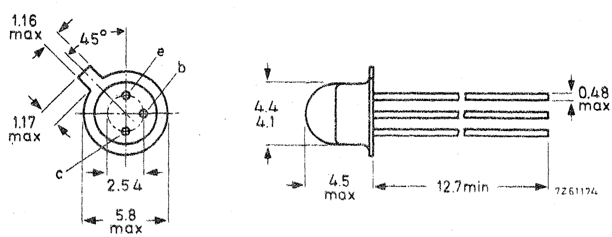
PHOTOTRANSISTOR

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

Collector light current

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

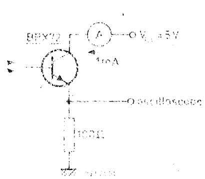
$E_v = 1000$ lx ($E_e = 4.75$ mW/cm^2)	I_l		500 to 3000	µA [1]
$E_v = 2500$ lx ($E_e = 12$ mW/cm^2)	I_l	typ.	3000	µA

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

CHARACTERISTICS (continued)

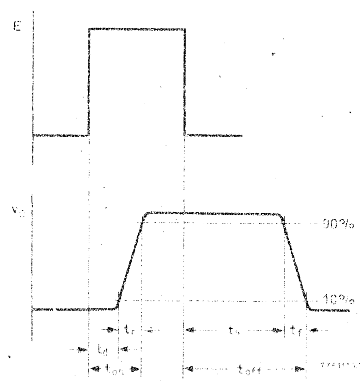
Breakdown voltages

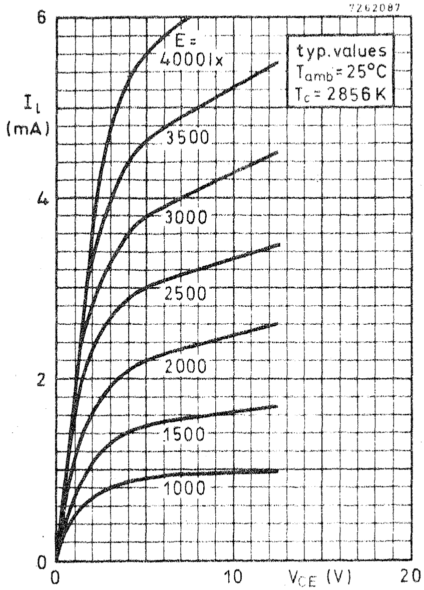
Collector-base voltage $E = 0$; $I_C = 0.1$ mA	$V_{(BR)CBO}$	>	40	V
Collector-emitter voltage $E = 0$; $I_C = 1$ mA	$V_{(BR)CEO}$	>	30	V
Emitter-collector voltage $E = 0$; $I_C = 0.1$ mA	$V_{(BR)ECO}$	>	6	V
Collector capacitance				
$I_E = I_e = 0$; $V_{CB} = 20$ V	C_c	typ.	3.5	pF
Wavelength at peak response	λ_{pk}	typ.	800	nm
Baudwidth 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	µs
		<	6.0	µs
Rise time	t_r	typ.	6.0	µs
		<	20	µs
Storage time	t_s	typ.	1.5	µs
		<	3.0	µs
Fall time	t_f	typ.	4.0	µs
		<	20	µs

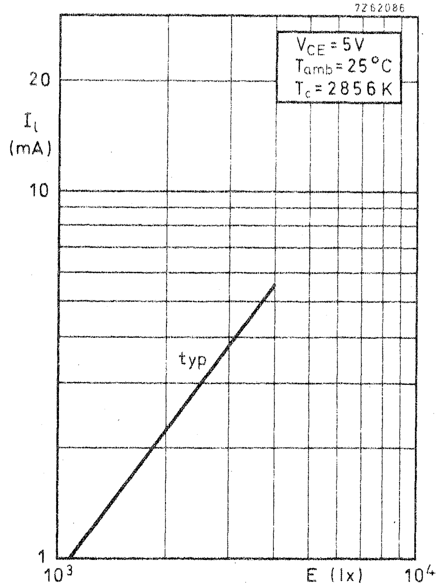


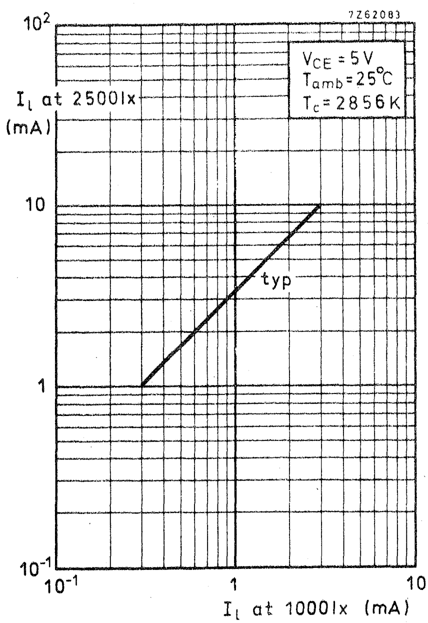
Light input pulse:

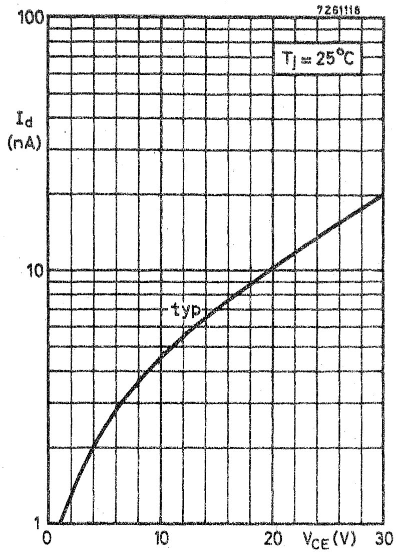
$t_r = t_f =$ 20 ns
$t_p =$ 20 µs
$f =$ 500 Hz
$\lambda =$ 800 nm

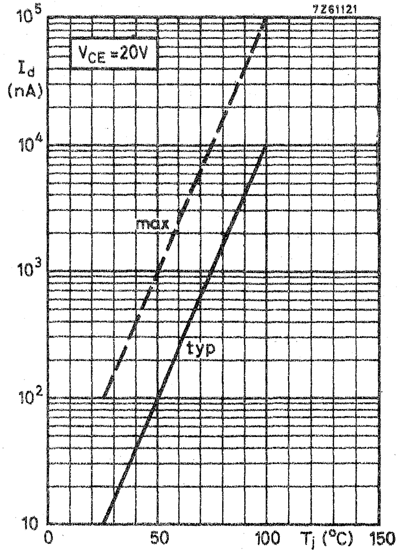


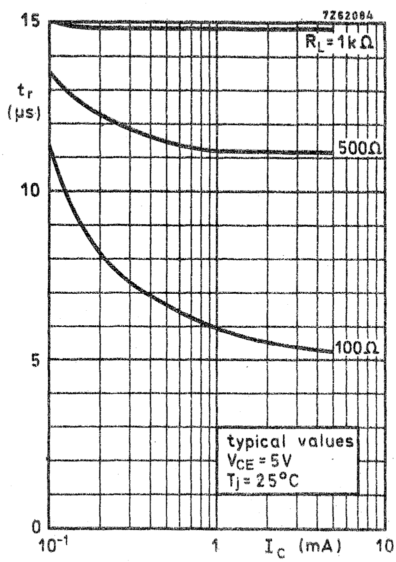

7Z62087
typ. values
T_{amb} = 25°C
T_c = 2856 K
I_l (mA)
E = 4000 lx
3500
3000
2500
2000
1500
1000
0
2
4
6
10
20
V_{CE} (V)

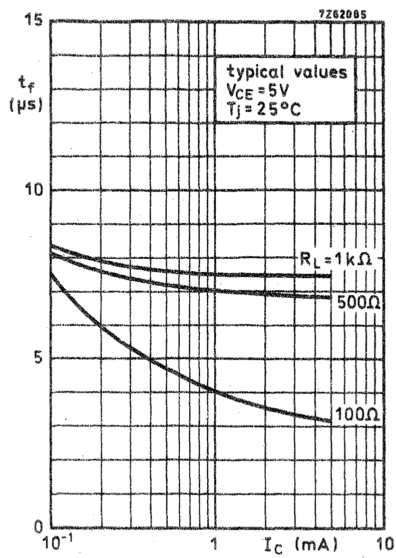

7Z62086
V_{CE} = 5 V
T_{amb} = 25 °C
T_c = 2856 K
I_l (mA)
typ
1
10
20
10^3
E (lx)
10^4


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

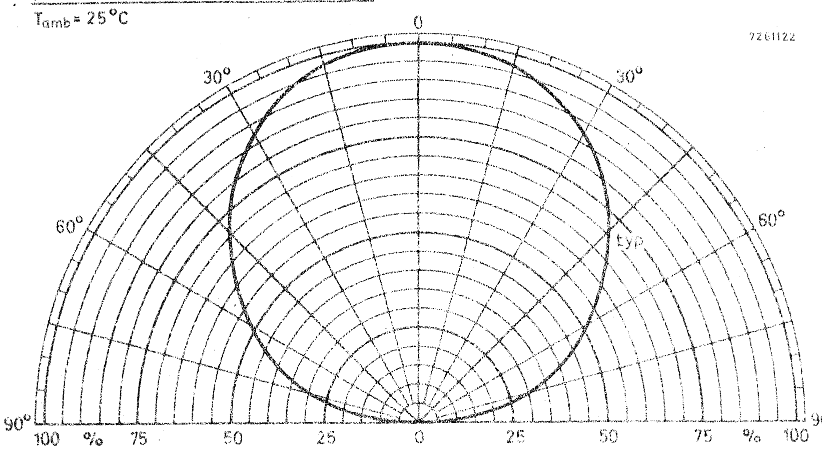

7Z61116
100
$T_j = 25°C$
I_d
(nA)
10
typ
1
0
10
20
V_{CE} (V)
30

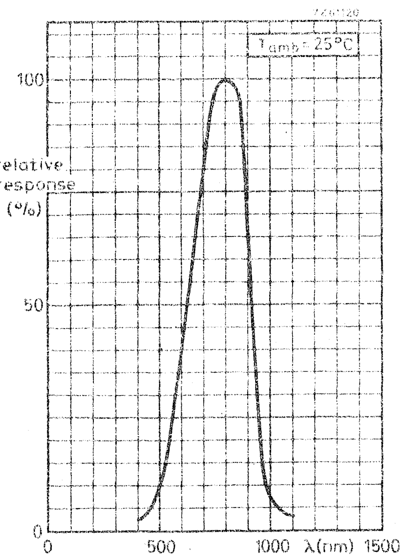

7Z61121
10^5
$V_{CE} = 20V$
I_d
(nA)
10^4
max
10^3
typ
10^2
10
0
50
100
T_j (°C)
150

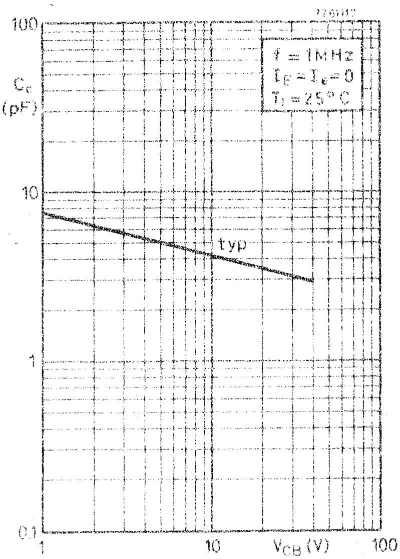

7Z62084
15
$R_L = 1 k\Omega$
t_r
(μs)
500Ω
10
5
100Ω
typical values
$V_{CE} = 5V$
$T_j = 25°C$
0
10^{-1}
1
I_C (mA)
10


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

polar response of relative sensitivity







SILICON PHOTODIODE

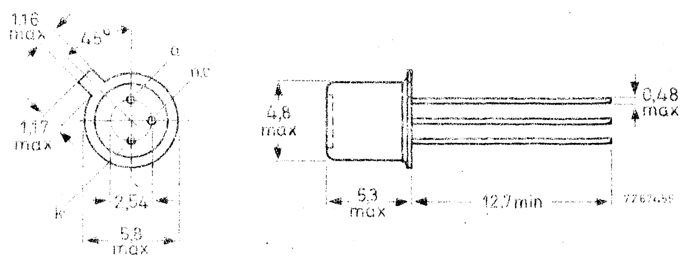
Silicon photodiode with low N.E.P. for detection of very low light levels: for use in conjunction with an operational amplifier.

QUICK REFERENCE DATA			
Continuous reverse voltage	V_R	max.	18 V
Dark reverse current (V_R = 1 V)	$I_{R(D)}$	typ.	100 pA
Luminous sensitivity V_R = 0; T_c = 2700 K	N	typ. typ.	8 nA 1 μA/mW/cm^2
Wavelength at peak response	λ_{pk}	typ.	800 mm
Beamwidth between half-sensitivity directions	$\alpha_{50\%}$	typ.	63 °
Sensitive area	A	typ.	1,2 mm x 1,2 mm

MECHANICAL DATA Dimensions in mm

TO-18, except for window

Cathode connected to case



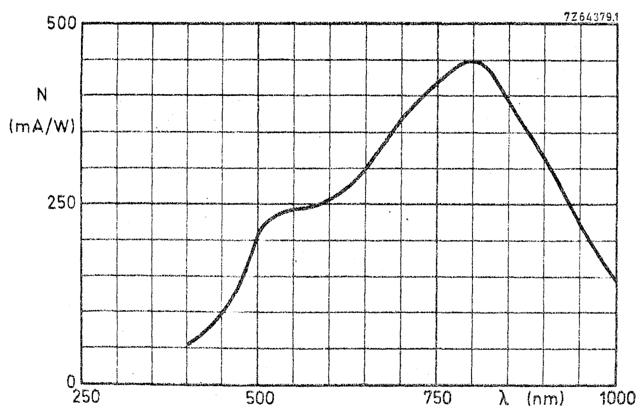
Sensitive area 1,2 mm x 1,2 mm

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

Continuous reverse voltage	V_R	max.	18	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

CHARACTERISTICS T_{amb} = 25 °C

Dark reverse current				
V_R = 1 V	$I_{R(D)}$	typ.	100	pA
Luminous sensitivity (in photovoltaic mode)				
V_R = 0; T_c = 2700 K [1]	N	typ.	8	nA/lx
		typ.	1	μA/mW/cm²
V_R = 0; λ = 780 nm	N	typ.	0,5	A/W
Wavelength at peak response	λ_{pk}	typ.	800	nm
Beamwidth between half-sensitivity directions	$\alpha_{50\%}$	typ.	63	°
Diode capacitance				
V_R = 0	C_d	typ.	200	pF
V_R = 15 V	C_d	typ.	45	pF



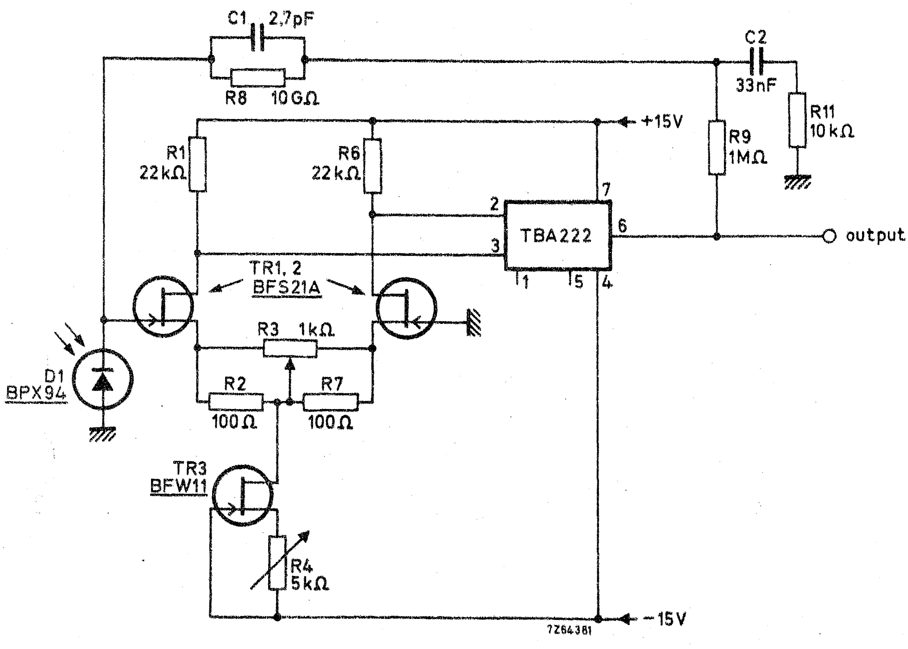
[1]) Unfiltered tungsten lamp.

APPLICATION INFORMATION

Owing to the improvement over the last few years in the properties of both devices, the photodiode/op amp sensor has become a powerful competitor of the photomultiplier tube. Benefits over the latter are:

- greater range of incident light intensity over which non-linearity is 1% or less: nine decades, as compared to seven decades for the photomultiplier.
- drift in sensitivity over six months about 0, 5%, as against 1% to 2% for photomultipliers selected for low drift.
- wide range of spectral response (400 nm to 1200 nm) covered with a single detector: better ability to withstand over-current due to excessive radiation.
- high shock and vibration resistance.
- cheaper power supply (15 V unstabilized as compared to an accurately stabilized high-voltage supply - 1000 V - for photomultiplier.

It has been found that the following circuit with an operational amplifier and a balanced pre-amplifier FET stage is suitable for measuring very low light levels:



This is an example of an extremely sensitive circuit. Where the amplification may be lower, the value of R_8 can be reduced. The output voltage drops 3 dB at 1 kHz.

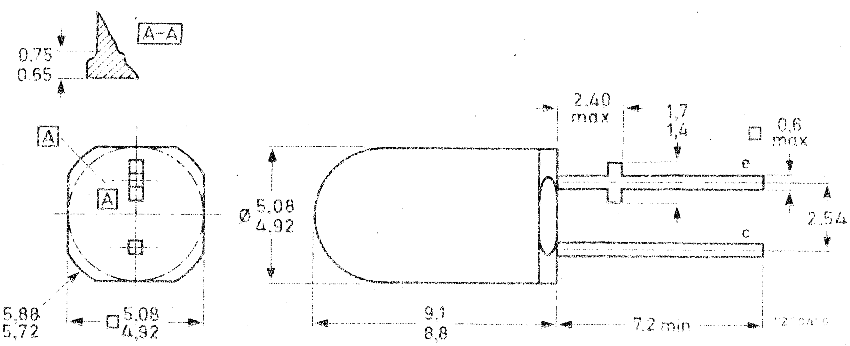
SILICON PLANAR EPITAXIAL PHOTOTRANSISTOR

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 $T_{amb} = 25\ ^oC$	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.

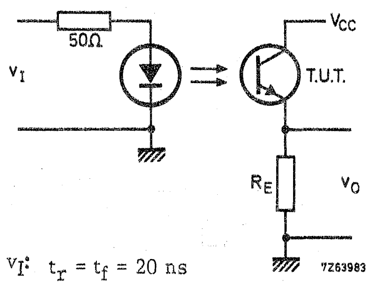
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

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	mm²

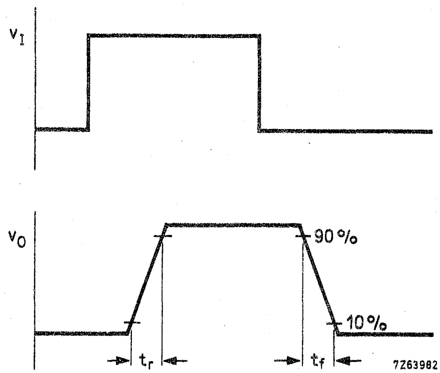
Switching times

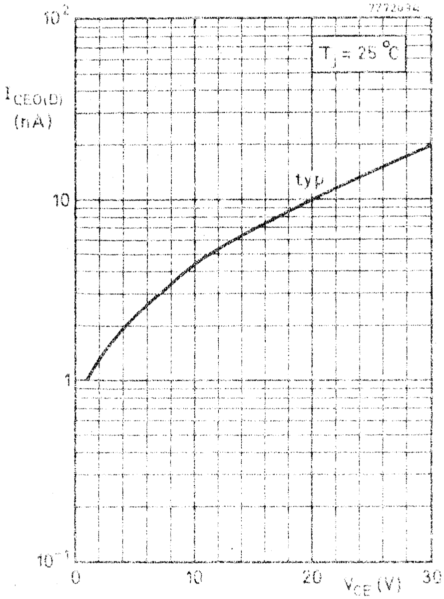
I_{CM} = 1 mA, V_{CC} = 5 V; R_E = 100 Ω ; T_{amb} = 25 °C
(see circuit below)

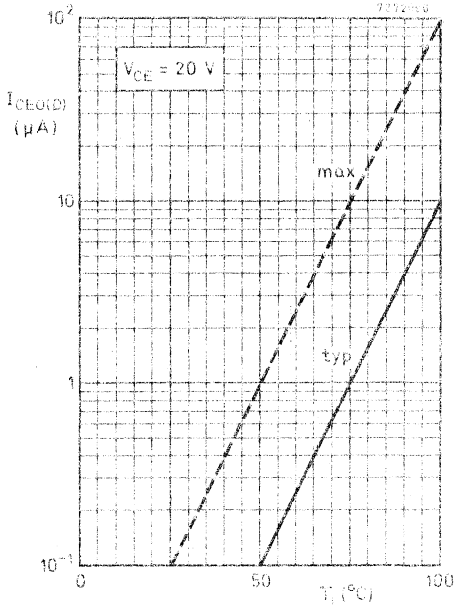
Light current rise time	t_r	typ.	3	µs
Light current fall time	t_f	typ.	2	µs

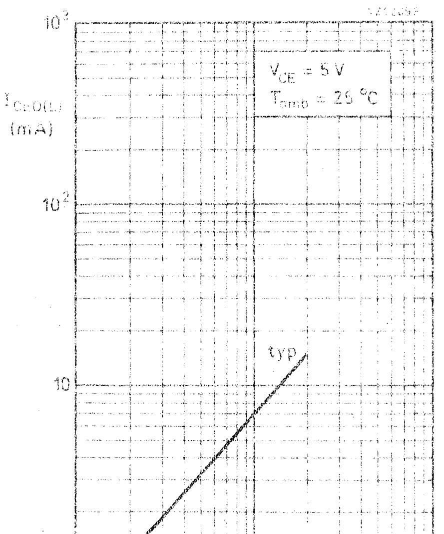


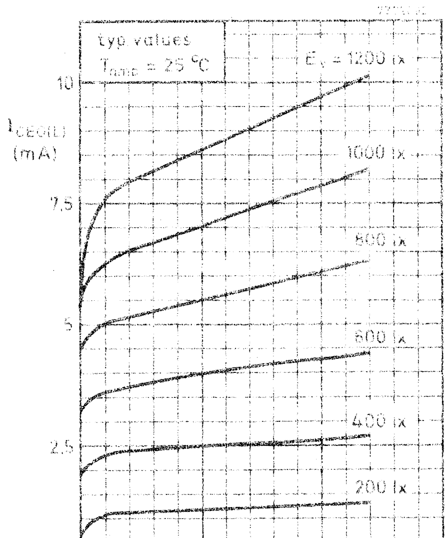
V_I: t_r = t_f = 20 ns
t_p = 20 µs
f = 500 Hz

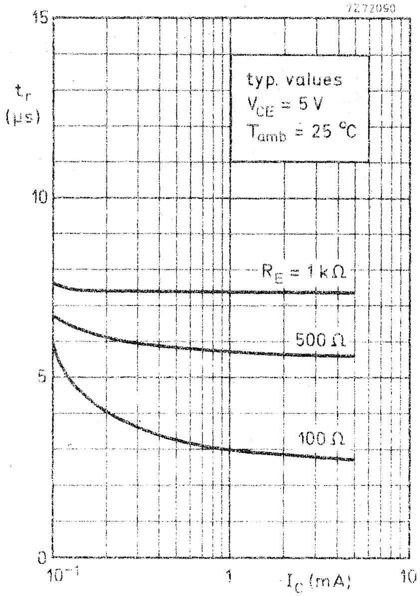


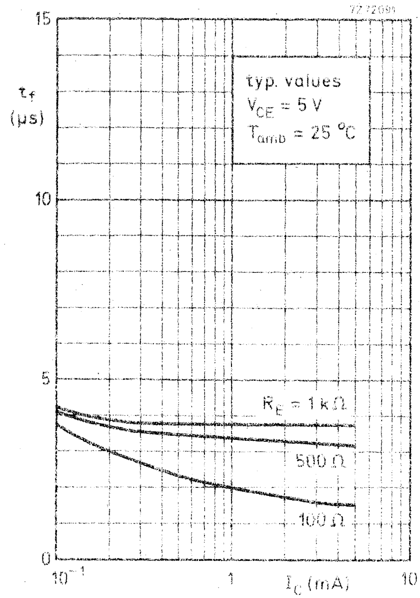

7Z72034
$T_j = 25\,^{\circ}C$
$I_{CEO(D)}$ (nA)
typ
10^2
10
1
10^{-1}
0
10
20
30
V_{CE} (V)

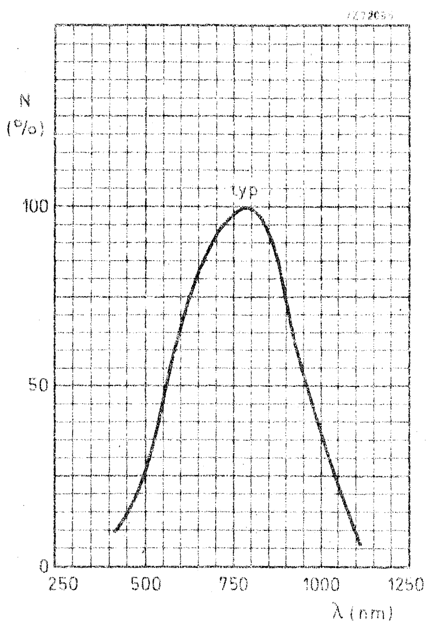

$V_{CE} = 20$ V
$I_{CEO(D)}$ (μA)
max
typ
10^2
10
1
10^{-1}
0
50
100
T_j (°C)

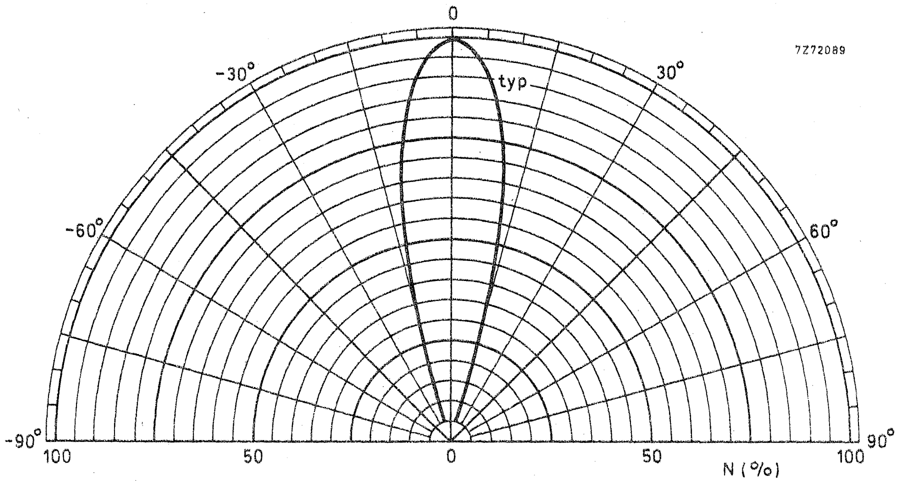

$V_{CE} = 5$ V
$T_{amb} = 25\,^{\circ}C$
$I_{CEO(L)}$ (mA)
typ
10^3
10^2
10
1
10^2
10^3
10^4
E_v (lx)


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
15
V_{CE} (V)


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


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


N
(%)
typ
100
50
0
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.

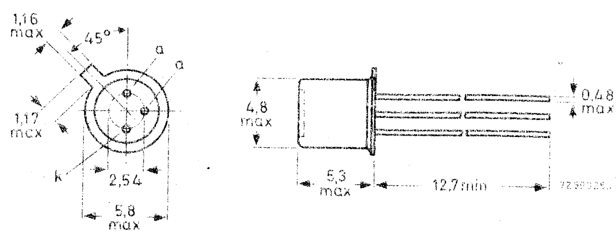
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value) t_p = 100 µs; δ = 0,1	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	φ_e	>	60	µW
		typ.	100	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	°C/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_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
Operating 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

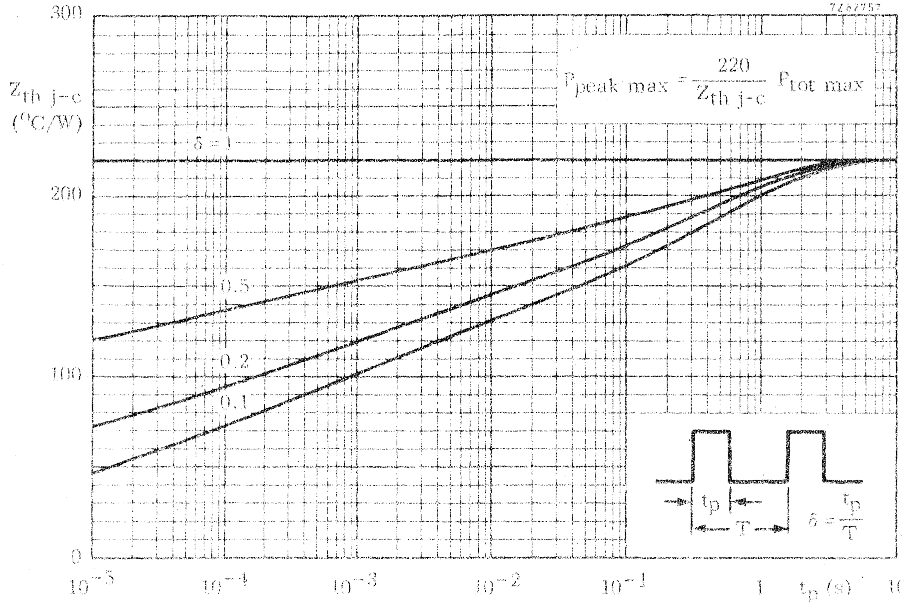
CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

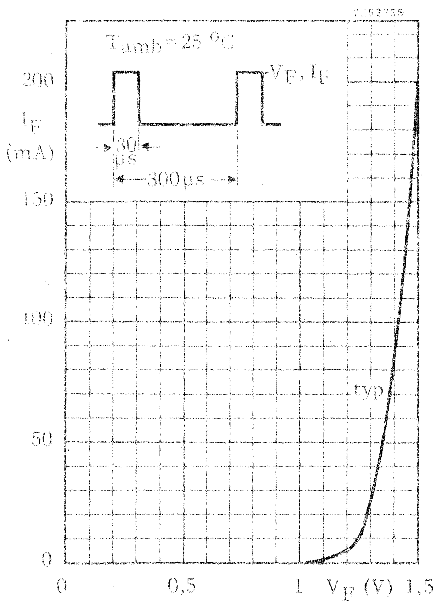
Forward voltage at I_F = 30 mA	V_F	typ.	1,3	V
		<	1,6	V
I_{FM} = 0,2 A	V_F	typ.	1,5	V
Reverse current at V_R = 2 V	I_R	<	0,5	mA
Diode capacitance at f = 1 MHz; V_R = 0	C_d	typ.	65	pF

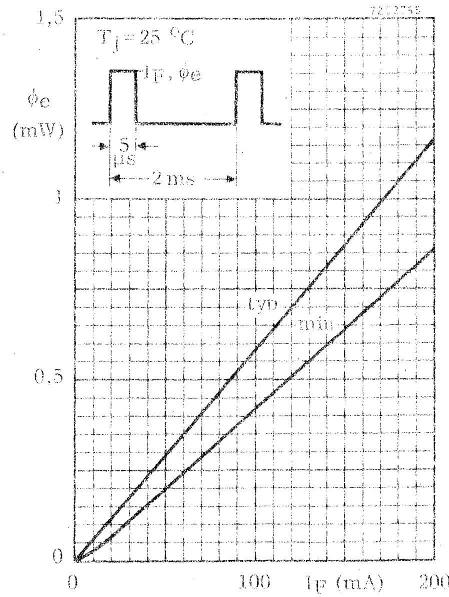
CHARACTERISTICS (continued) T_{amb} = 25 °C unless otherwise specified

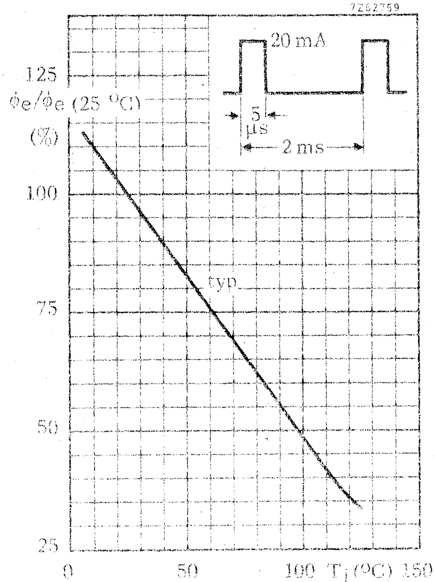
Radiant output power at I_F = 20 mA	ϕ_e	>	60	μW
		typ.	100	μW
I_F = 20 mA; T_j = 100 °C	ϕ_e	typ.	50	μW
I_F = 200 mA [1]	ϕ_e	typ.	1,16	mW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	typ.	64	μW/sr
Radiance at I_F = 20 mA	L_e	typ.	1,6	mW/mm^2sr
I_F = 200 mA [1]	L_e	typ.	15	mW/mm^2sr
Emissive area	A_e	typ.	0,04	mm^2
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

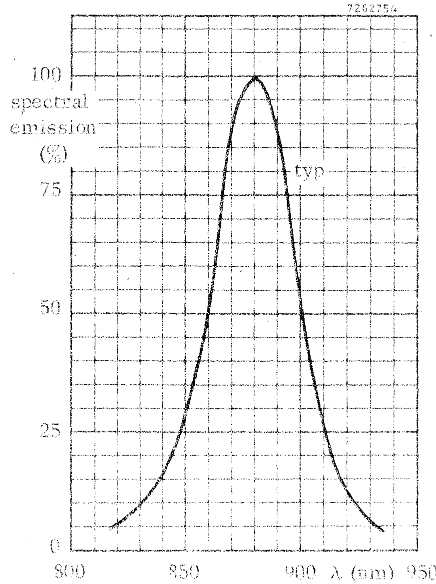
[1] t_p = 100 μs; δ = 0,1.

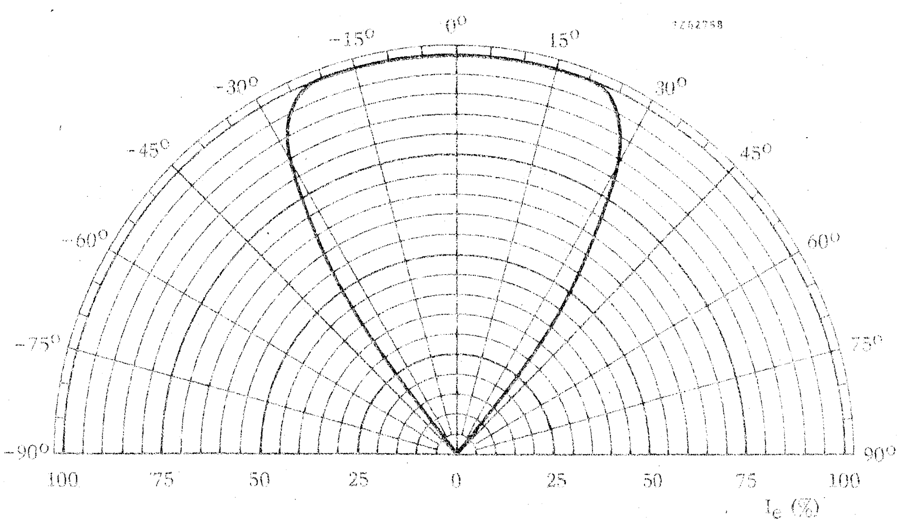

7Z67757
300
200
100
0
$Z_{th\ j-c}$
(^oC/W)
$P_{peak\ max} = \frac{220}{Z_{th\ j-c}} P_{tot\ max}$
δ = 1
0,5
0,2
0,1
t_p
T
$\delta = \frac{t_p}{T}$
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
t_p (s)
10


T_{amb} = 25 ^oC
V_F, I_F
30 µs
300 µs
200
150
100
50
0
I_F
(mA)
typ
0
0,5
1
V_F (V)
1,5


T_j = 25 ^oC
I_F, ϕ_e
5 µs
2 ms
1,5
1
0,5
0
ϕ_e
(mW)
typ
min
0
100
I_F (mA)
200


7Z62759
20 mA
5 μs
2 ms
125
ϕ_e/ϕ_e (25 °C)
(%)
100
75
50
25
typ
0
50
100
T_j (°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
I_e (%)

GALLIUM ARSENIDE LIGHT EMITTING DIODE

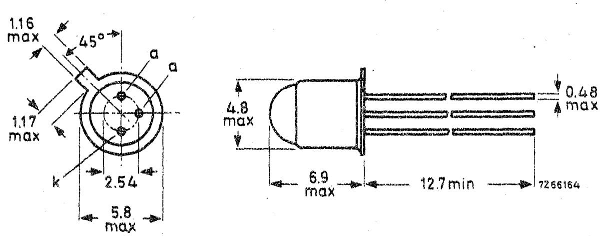
Gallium arsenide light emitting diode intended for optical coupling and encoding. It emits radiation in the near infrared when forward biased. Suitable for combination with photo-transistor BPX25 or BPX72.

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

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

Forward voltage

I_F = 30 mA	V_F	typ.	1,3	V
		<	1,6	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	>	0,28	mW/cm^2
		typ.	0,50	mW/cm^2 [1])

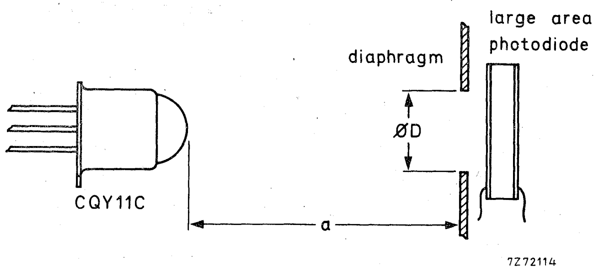
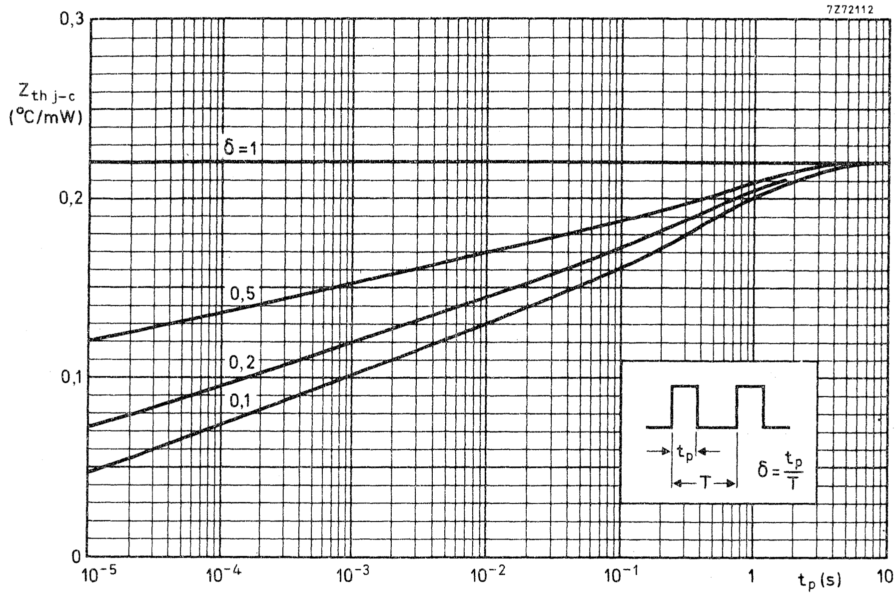
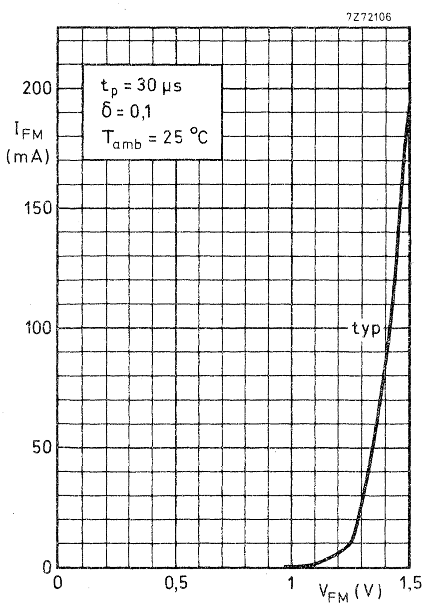


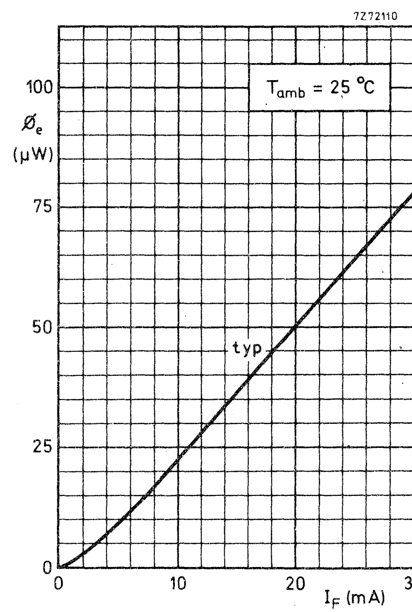
Fig. 1

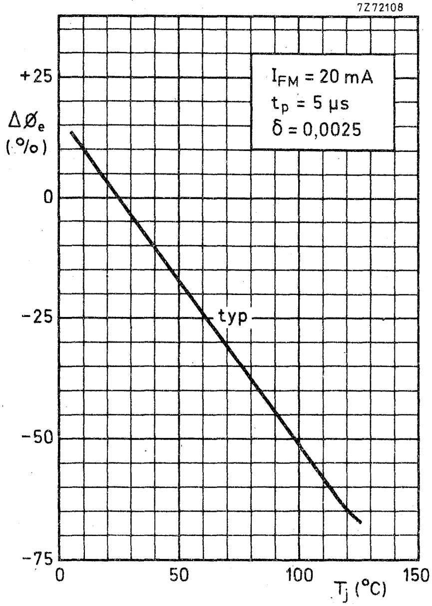
Decrease of radiant power with temperature	$\frac{\Delta\phi e}{\Delta T_j}$	typ.	0,7	%/°C
Cross section of the radiant beam				
between 0 to 10 mm from the lens	A_{beam}	typ.	7	mm^2
Angle between optical and mechanical axis			6°	
Wavelength at peak emission	λ_{pk}	typ.	880	nm
Bandwidth at half height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

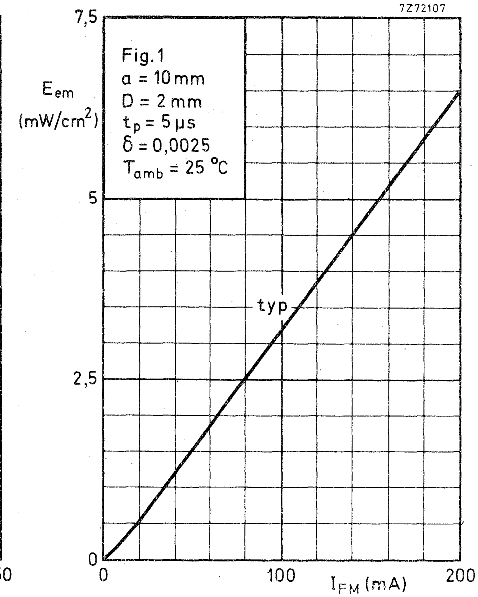
1) This corresponds typically with $I_{CEO(L)}$ = 0,4 mA in a phototransistor BPX25 and with 200 µA in a phototransistor BPX72.

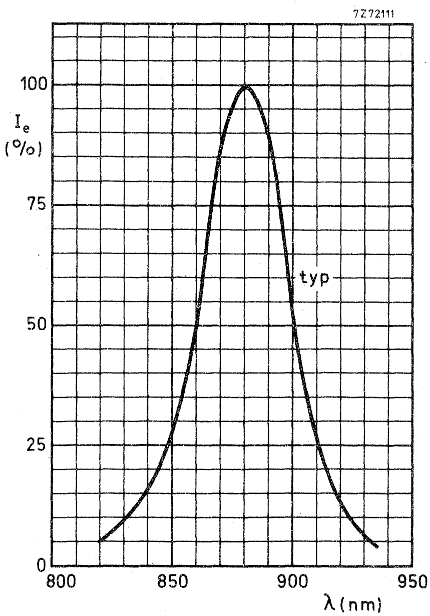

7Z72112
0,3
$Z_{th\ j-c}$
(°C/mW)
δ = 1
0,2
0,5
0,2
0,1
0,1
0
t_p
T
$\delta = \frac{t_p}{T}$
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
t_p (s)
10

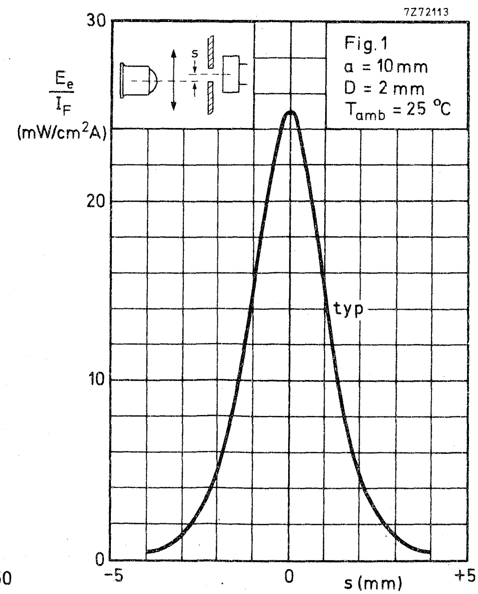

7Z72106
t_p = 30 µs
δ = 0,1
T_{amb} = 25 °C
200
I_{FM}
(mA)
150
100
typ
50
0
0
0,5
1
V_{FM} (V)
1,5

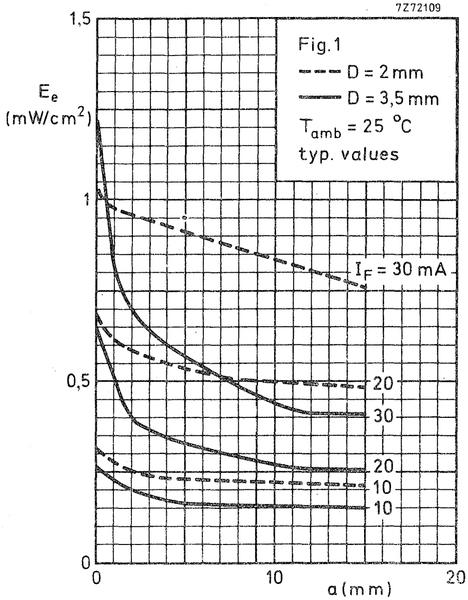

7Z72110
T_{amb} = 25 °C
100
$Ø_e$
(µW)
75
50
typ
25
0
0
10
20
I_F (mA)
30

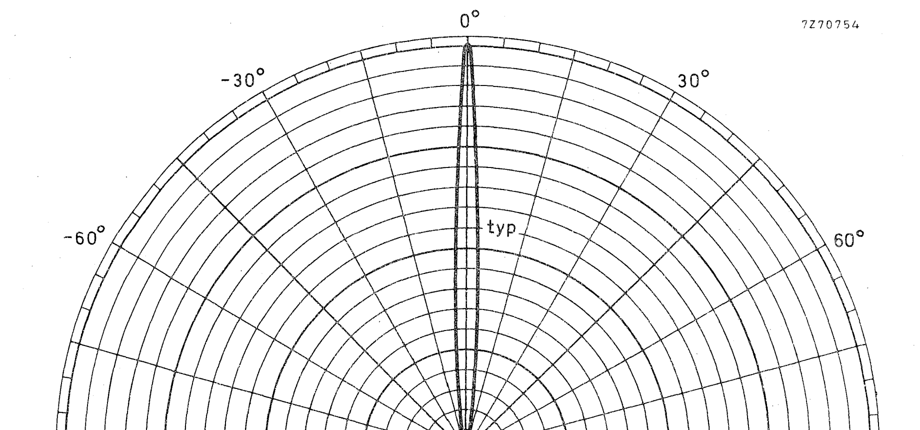

7Z72108
I_{FM} = 20 mA
t_p = 5 µs
δ = 0,0025
$\Delta \emptyset_e$ (%)
+25
0
−25
−50
−75
typ
0
50
100
150
T_j (°C)


7Z72107
Fig. 1
a = 10 mm
D = 2 mm
t_p = 5 µs
δ = 0,0025
T_{amb} = 25 °C
E_{em} (mW/cm²)
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/cm²A)
30
20
10
0
typ
−5
0
+5
s (mm)


7Z72109
Fig.1
D = 2 mm
D = 3,5 mm
Tamb = 25 °C
typ. values
Ee
(mW/cm2)
1,5
1
0,5
0
IF = 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
Ie (%)
100

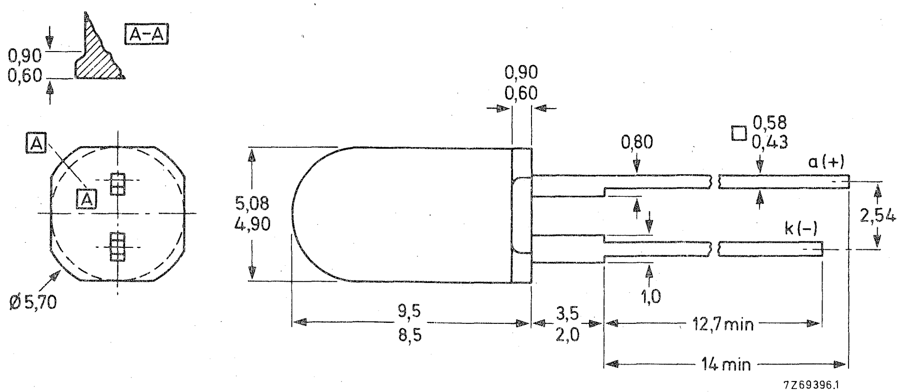
GaAsP RED LIGHT EMITTING DIODE

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	CQY24A	I_V	>	0,3	mcd
	CQY24A-I	I_V		0,5 to 1,8	mcd
	CQY24A-II	I_V		1 to 3	mcd
	CQY24A-III	I_V	>	1,6	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		$R_{th\ j-a}$	=	0,625	°C/mW

MECHANICAL DATA Dimensions in mm

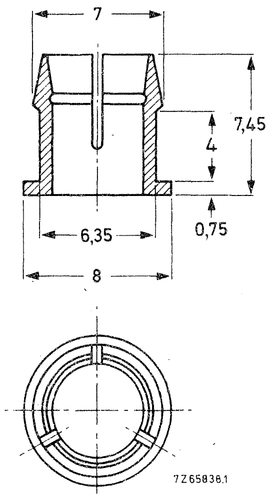
SOD-39C

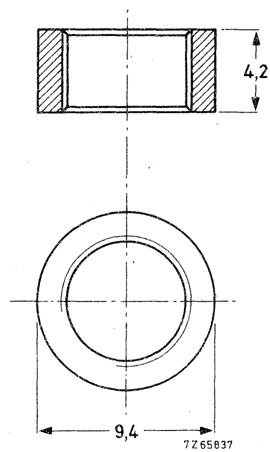


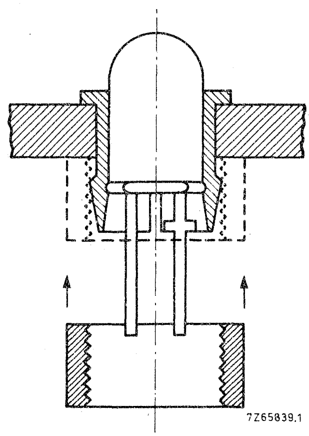
Accessories for panel mounting (panel thickness < 4 mm)

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







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

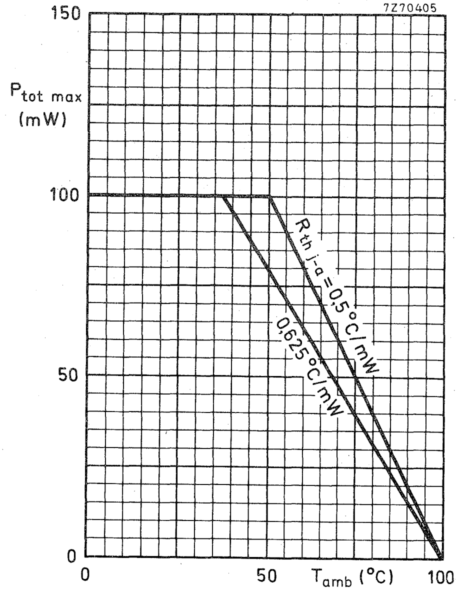
Voltage				
Continuous reverse voltage	V_R	max.	3	V
Current				
Forward current (d.c.)	I_F	max.	50	mA
Forward current (peak value) t_p = 1 µs; f = 300 Hz	I_{FM}	max.	1	A
Temperature				
Storage temperature	T_{stg}		−55 to + 100	°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature up to seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260	°C
Power dissipation				
Total power dissipation up to T_{amb} = 37,5 °C	P_{tot}	max.	100	mW

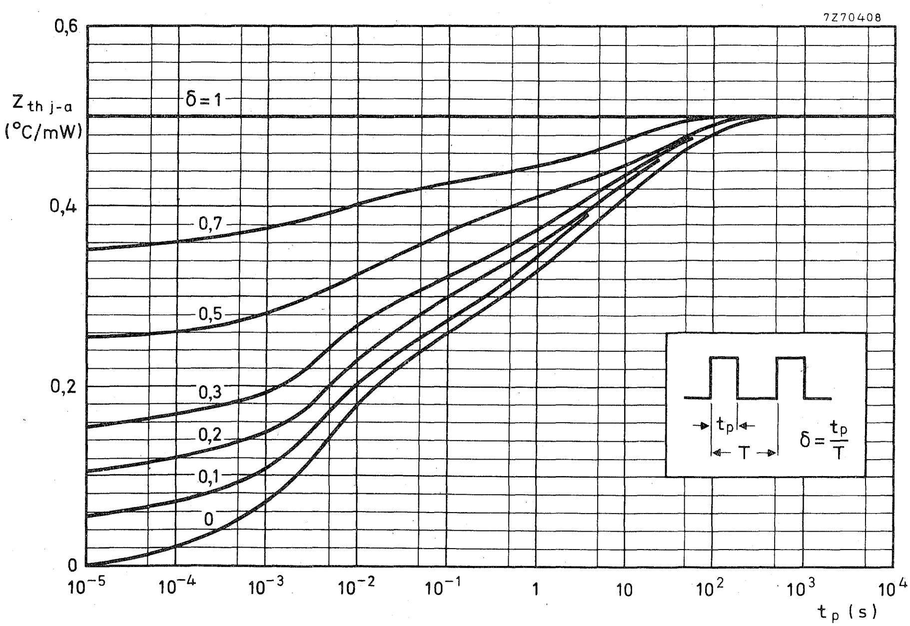
THERMAL RESISTANCE

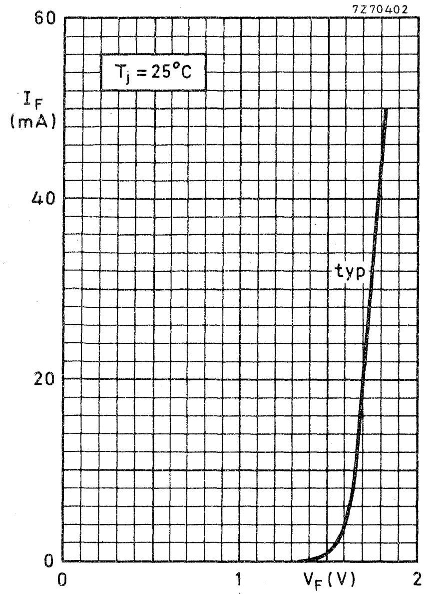
From junction to ambient, in free air	$R_{th\ j\text{-}a}$	=	0,625	°C/mW
mounted on printed-circuit board	$R_{th\ j\text{-}a}$	=	0,500	°C/mW

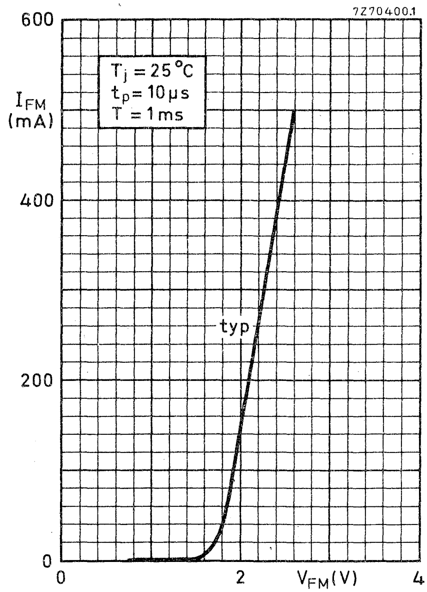
CHARACTERISTICS T_j = 25 °C unless otherwise specified

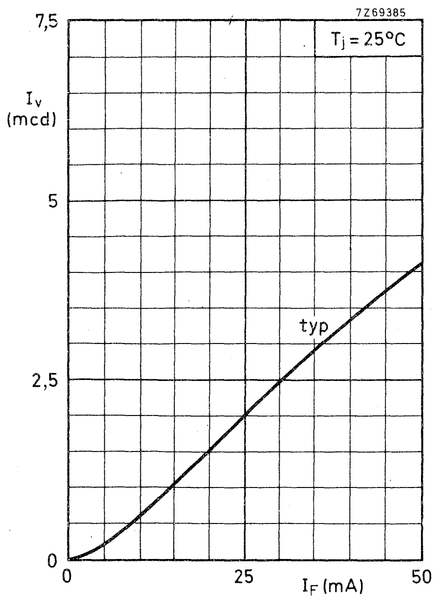
Forward voltage					
I_F = 20 mA		V_F	typ.	1,7	V
			<	2	V
Negative temperature coefficient of V_F					
I_F = 20 mA		$\frac{-\Delta V_F}{\Delta T_j}$	typ.	1,6	mV/°C
I_F = 2 mA		$\frac{-\Delta V_F}{\Delta T_j}$	typ.	2	mV/°C
Reverse current					
V_R = 3 V		I_R	<	100	μA
Luminous intensity (on-axis)					
I_F = 20 mA	CQY24A	I_v	>	0,3	mcd
	CQY24A-I	I_v		0,5 to 1,8	mcd
	CQY24A-II	I_v		1 to 3	mcd
	CQY24A-III	I_v	>	1,6	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.	70°	

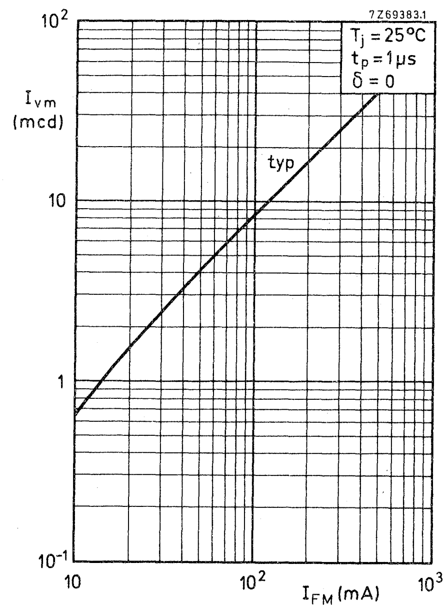

7Z70405
150
Ptot max
(mW)
100
50
0
0
50
Tamb (°C)
100
Rth j-a = 0,5 °C/mW
0,625 °C/mW

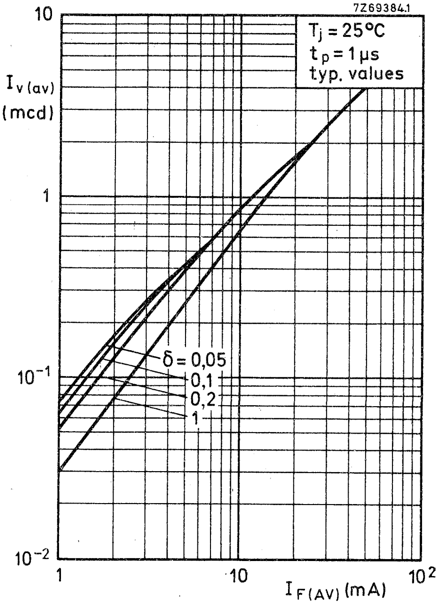

7Z70408
0,6
Zth j-a
(°C/mW)
δ = 1
0,4
0,7
0,5
0,2
0,3
0,2
0,1
0
0
10−5
10−4
10−3
10−2
10−1
1
10
10²
10³
10⁴
tp (s)
tp
T
δ = tp/T

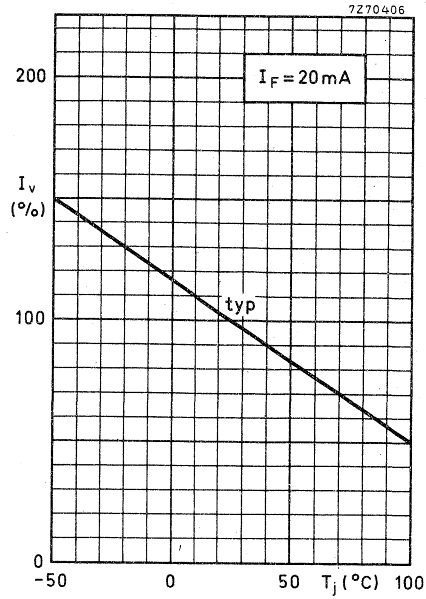

7Z70402
$T_j = 25°C$
I_F (mA)
60
40
20
0
0
1
V_F (V)
2
typ

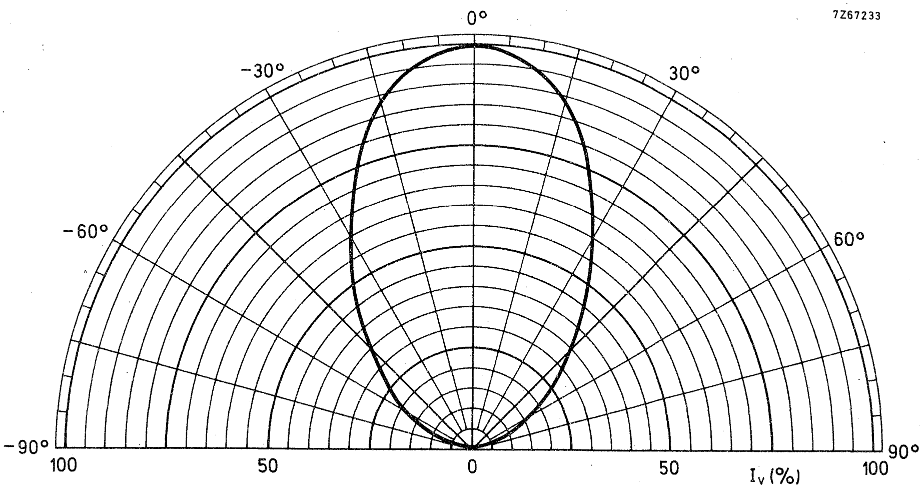

7Z70400.1
$T_j = 25°C$
$t_p = 10 \mu s$
T = 1 ms
I_{FM} (mA)
600
400
200
0
0
2
V_{FM} (V)
4
typ


7Z69385
$T_j = 25°C$
I_v (mcd)
7,5
5
2,5
0
0
25
I_F (mA)
50
typ


7Z69383.1
$T_j = 25°C$
$t_p = 1 \mu s$
$\delta = 0$
I_{vm} (mcd)
10^2
10
1
10^{-1}
10
10^2
I_{FM} (mA)
10^3
typ


7Z69384.1
T_j = 25 °C
t_p = 1 µs
typ. values
$I_{v(av)}$
(mcd)
10
1
10^{-1}
10^{-2}
δ = 0,05
0,1
0,2
1
1
10
10^2
$I_{F(AV)}$ (mA)


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


7Z67233
0°
−30°
30°
−60°
60°
−90°
90°
100
50
0
50
100
I_v (%)

GaAsP RED LIGHT EMITTING DIODES

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

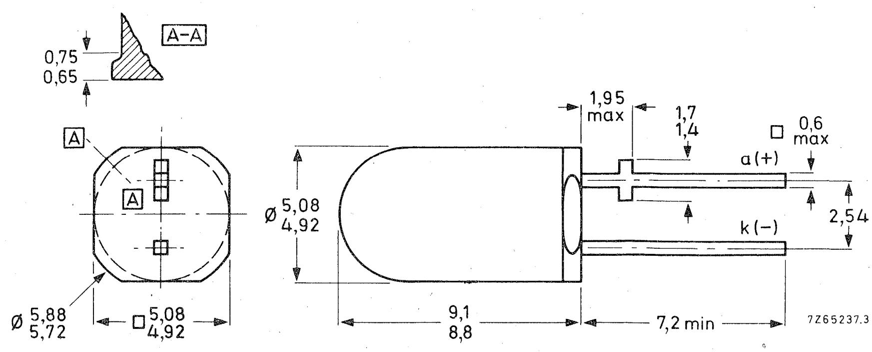
The envelopes are of clear, non-diffusing resin: red for CQY46, colourless for CQY47, both showing a clearly defined point of light.
CQY46 has better contrast, CQY47 shows no red reflections from sunlight or incandescent light sources.

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	>	0,4	mcd
		typ.	0,8	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

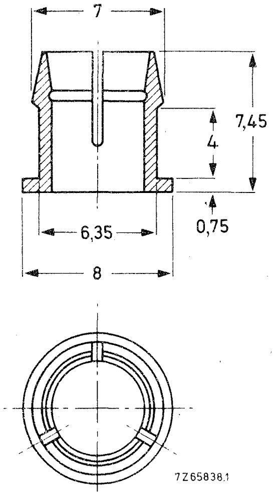
SOD-39A

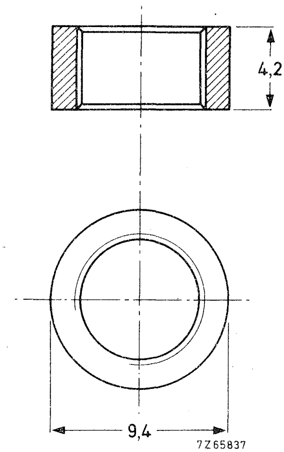


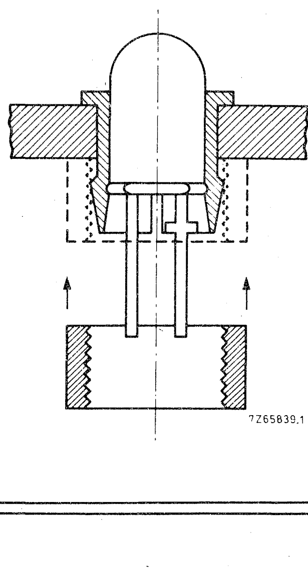
Accessories for panel mounting (panel thickness < 4 mm)

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







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

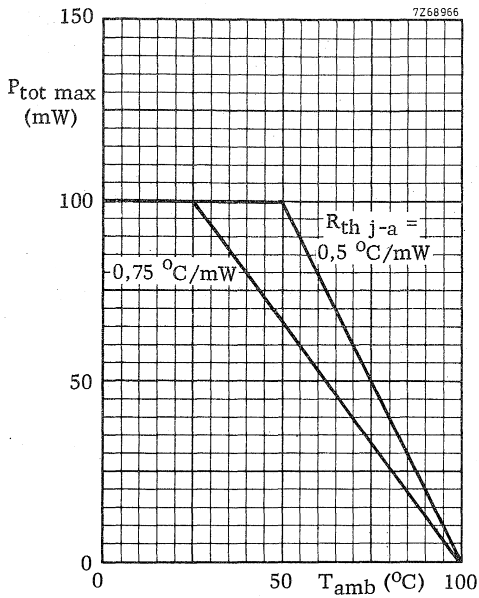
CHARACTERISTICS

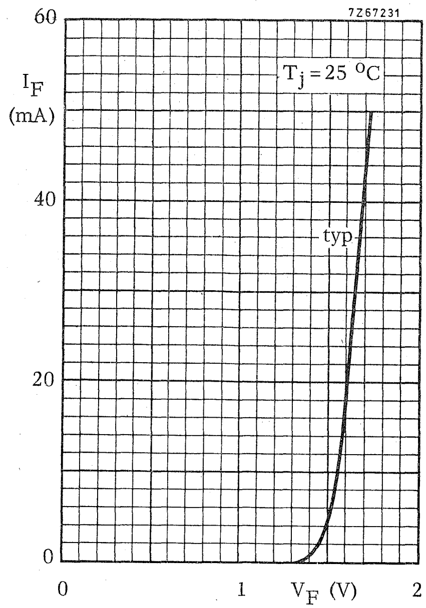
T_j = 25 °C unless otherwise specified

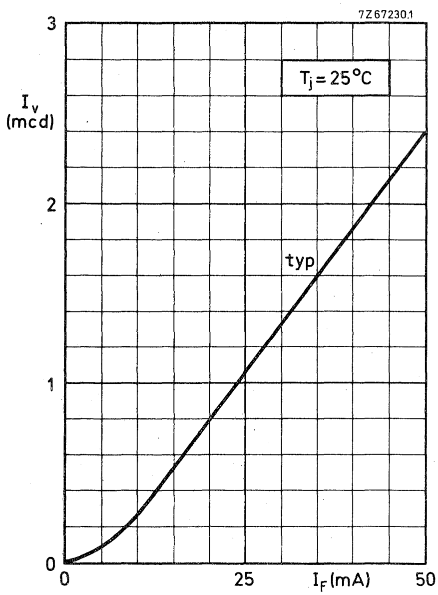
Forward voltage				
I_F = 20 mA	V_F	typ. <	1,6 2	V V
Reverse current				
V_R = 3 V	I_R	<	25	µA
Luminous flux				
I_F = 20 mA	ϕ_v	typ.	2,5	mlm
Luminous intensity (on-axis)				
I_F = 20 mA	I_v	> typ.	0,4 0,8	mcd mcd
Luminance (on-axis)				
I_F = 20 mA	L_v	> typ.	1020 2380	cd/m² 1) cd/m² 2)
Wavelength at 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

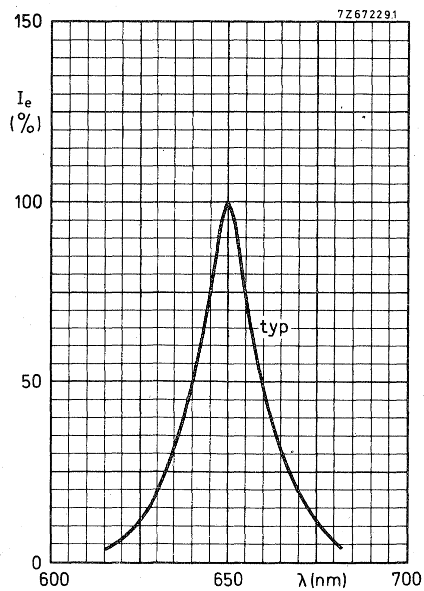
1) > 300 ft-L

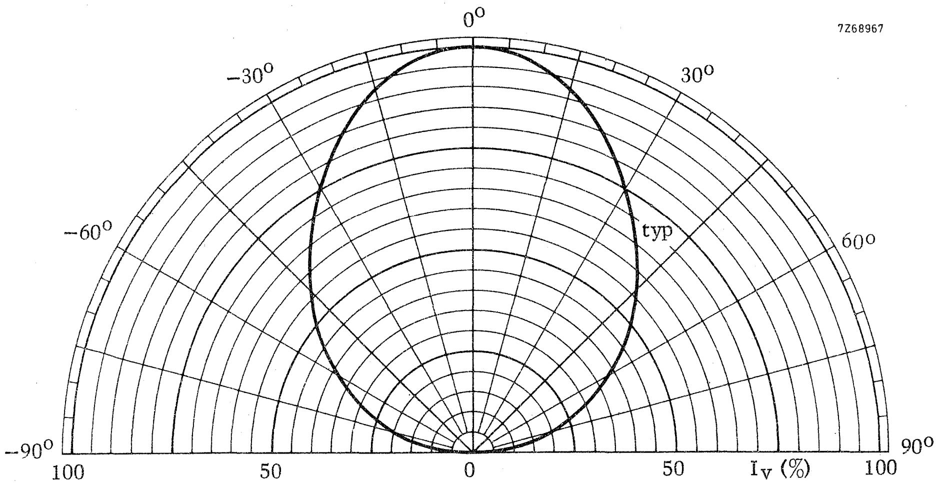
2) 700 ft-L


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


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


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


7Z67229.1
150
I_e
(%)
100
typ
50
0
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

Epitaxial gallium arsenide light emitting diodes intended for optical coupling and encoding. They emit radiation in the near infrared when forward biased. Envelopes like TO-18. Suitable for combination with phototransistors BPX25 and BPX72.

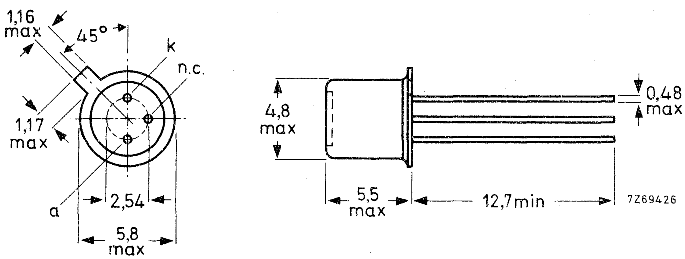
QUICK REFERENCE DATA					
Continuous reverse voltage		V_R	max.	2	V
Forward current (d.c.)		I_F	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	150	mW
Radiant intensity (on-axis) at I_F = 50 mA	CQY49B	I_e	>	0,3	mW/sr
	CQY49C	I_e	>	3	mW/sr
Wavelength at peak emission		λ_{pk}	typ.	930	nm
Thermal resistance from junction to ambient		$R_{th\ j-a}$	=	0,665	°C/mW

Red Binder, Tab 6

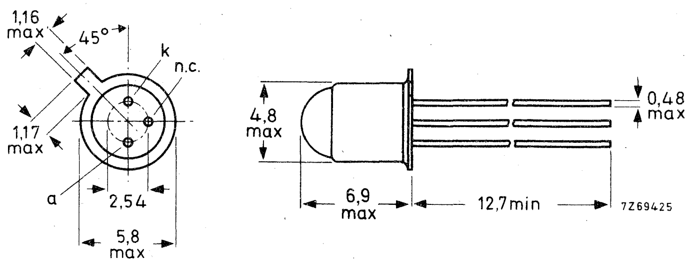
MECHANICAL DATA

Dimensions in mm

CQY49B : TO-18 except for window



CQY49C : 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.	100	mA
Forward current (peak value) $t_p < 10\ \mu s$; $\delta < 0{,}01$	I_{FM}	max.	1	A
Power dissipation				
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	150	mW
Temperature				
Storage temperature	T_{stg}		−40 to + 100	^oC
Operating junction temperature	T_j	max.	125	^oC
Lead soldering temperature > 1,5 mm from the body; $t_{sld} < 10$ s	T_{sld}	max.	260	^oC

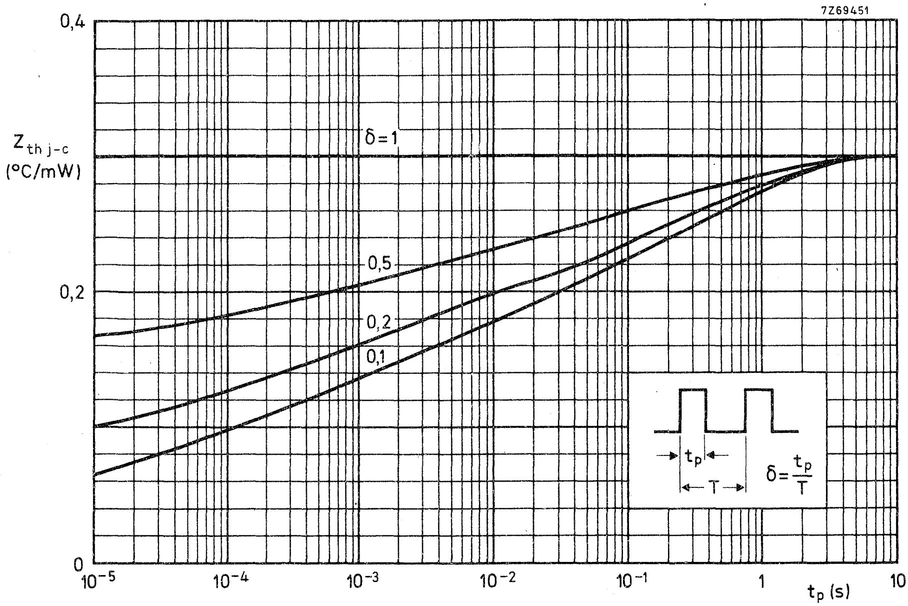
THERMAL RESISTANCE

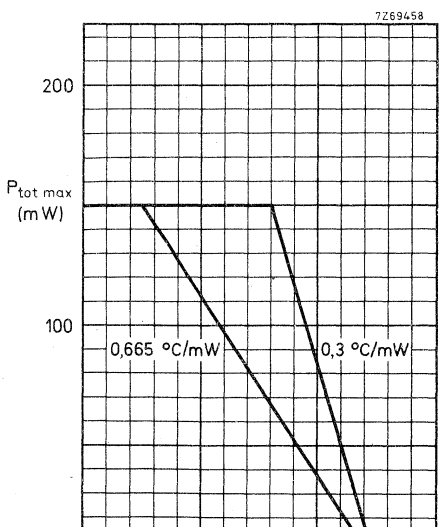
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,665	^oC/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0,3	^oC/mW

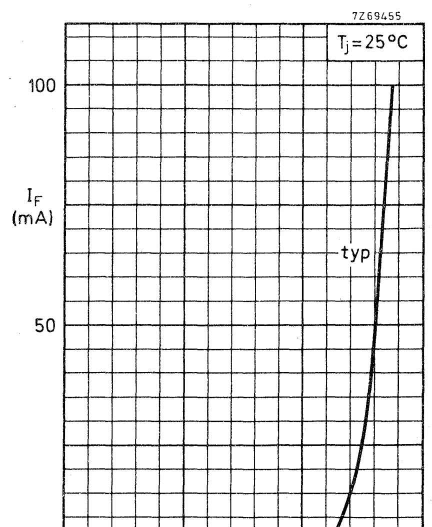
CHARACTERISTICS

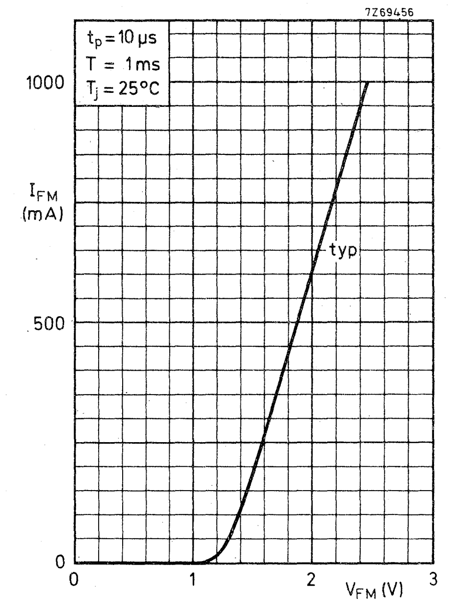
T_j = 25 °C unless otherwise specified

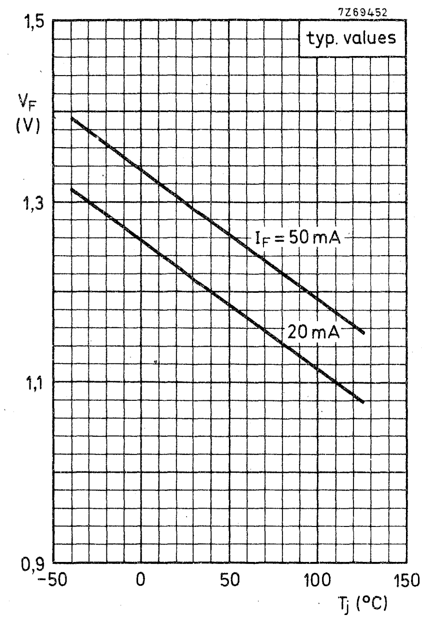
			CQY49B	CQY49C	
Forward voltage at I_F = 50 mA	V_F	typ.	1,3		V
		<	1,5		V
Reverse current at V_R = 2 V	I_R	<	100		μA
Diode capacitance					
V_R = 0; f = 1 MHz	C_d	typ.	55		pF
Radiant intensity (on-axis) at I_F = 50 mA	I_e	>	0,3	3	mW/sr
		typ.	0,5	5	mW/sr
Wavelength at peak emission	λ_{pk}	typ.	930		nm
Bandwidth at half height	$B_{50\%}$	typ.	50		nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	80°	15°	
Angle between optical and mechanical axis		typ.	–	6°	
Switching times					
I_{Fon} = 50 mA; t_p = 2 μs; f = 45 kHz					
Light rise time	t_r	typ.	600		ns
Light fall time	t_f	typ.	350		ns

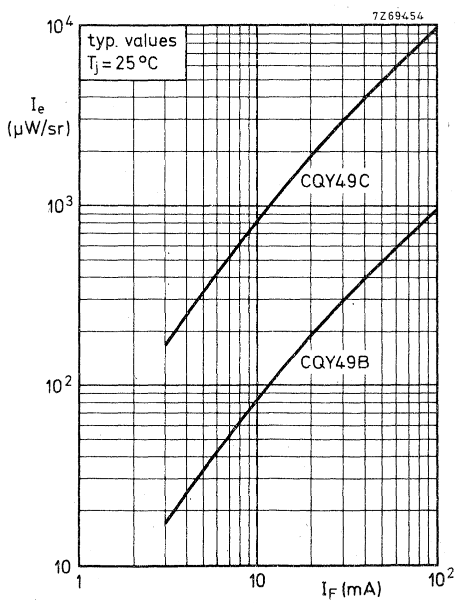

7Z69451
0,4
0,2
0
$Z_{th\ j-c}$ (°C/mW)
δ=1
0,5
0,2
0,1
t_p
T
$δ = \frac{t_p}{T}$
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
t_p (s)

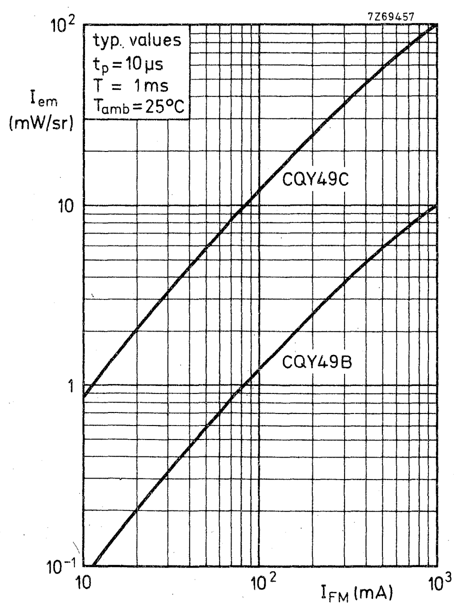

7Z69458
$P_{tot\ max}$ (mW)
200
100
0
0,665 °C/mW
0,3 °C/mW
0
50
100
150
T (°C)

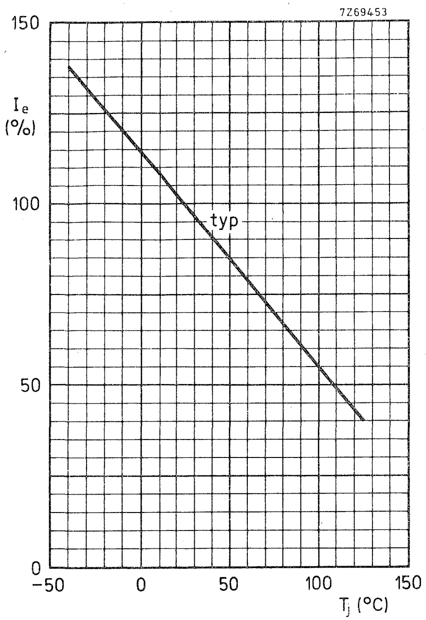

7Z69455
T_j = 25 °C
I_F (mA)
100
50
0
typ
0
0,5
1
1,5
V_F (V)

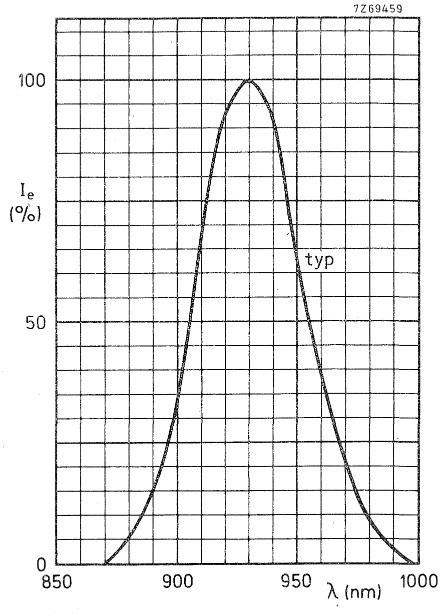

7Z69456
$t_p = 10\ \mu s$
$T = 1\ ms$
$T_j = 25\,°C$
I_{FM} (mA)
1000
500
0
typ
0
1
2
3
V_{FM} (V)

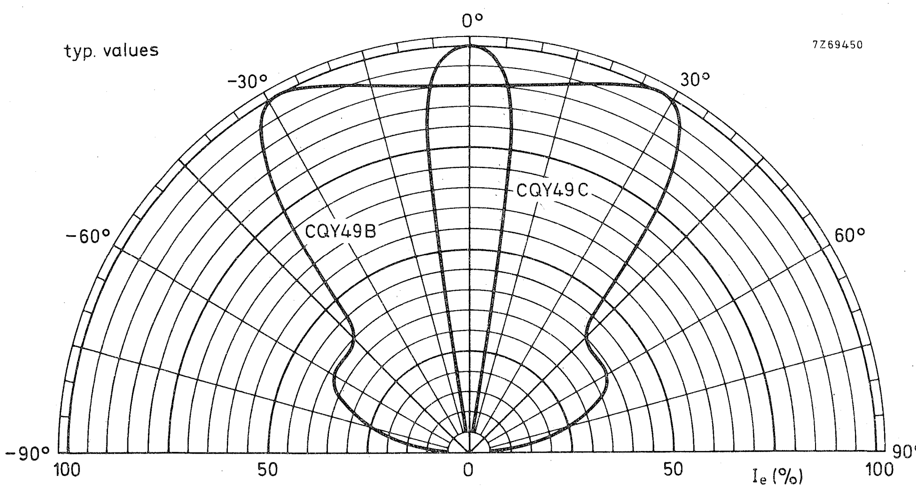

7Z69452
typ. values
V_F (V)
1,5
1,3
1,1
0,9
$I_F = 50\ mA$
20 mA
−50
0
50
100
150
T_j (°C)


7Z69454
typ. values
$T_j = 25\,°C$
I_e (μW/sr)
10^4
10^3
10^2
10
CQY49C
CQY49B
1
10
10^2
I_F (mA)


7Z69457
typ. values
$t_p = 10\ \mu s$
$T = 1\ ms$
$T_{amb} = 25\,°C$
I_{em} (mW/sr)
10^2
10
1
10^{-1}
CQY49C
CQY49B
10
10^2
10^3
I_{FM} (mA)


7Z69453
150
100
50
0
−50
0
50
100
150
I_e
(%)
typ
T_j (°C)


7Z69459
100
50
0
850
900
950
1000
I_e
(%)
typ
λ (nm)


typ. values
7Z69450
0°
−30°
30°
−60°
60°
−90°
90°
CQY49C
CQY49B
100
50
0
50
100
I_e (%)

GaAs LIGHT EMITTING DIODES

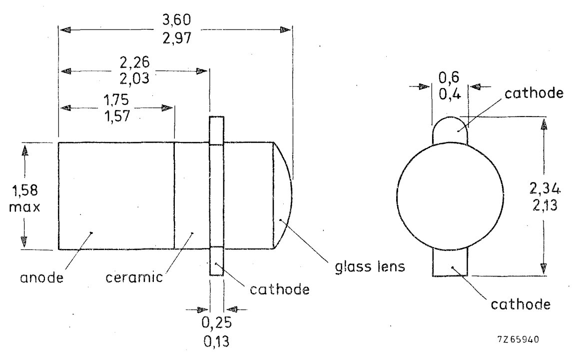
Gallium arsenide light emitting diodes which emit near-infrared light when forward biased. Ceramic-metal envelope with glass lens like BPX71, suitable for matrix layout on printed circuit boards. In conjunction with BPX71 also suitable for punched card reading.

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 ^{o}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	^oC
Operating junction temperature	T_j	max.	125	^oC
Power dissipation				
Total power dissipation up to T_{amb} = 25 ^oC device mounted on p.c. board [1]	P_{tot}	max.	150	mW

THERMAL RESISTANCE

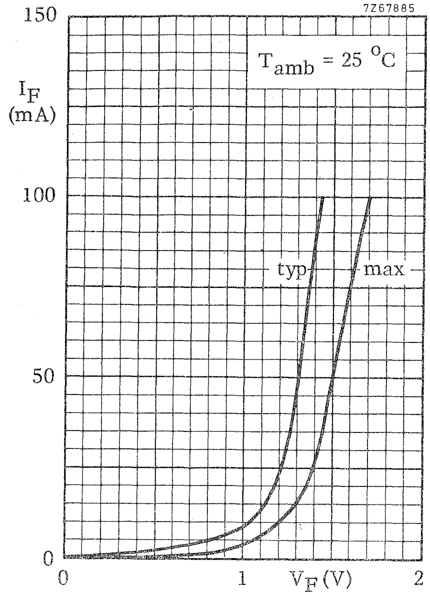
From junction to ambient, device mounted on p.c. board [1]	$R_{th\ j\text{-}a}$	=	0,66	^oC/mW

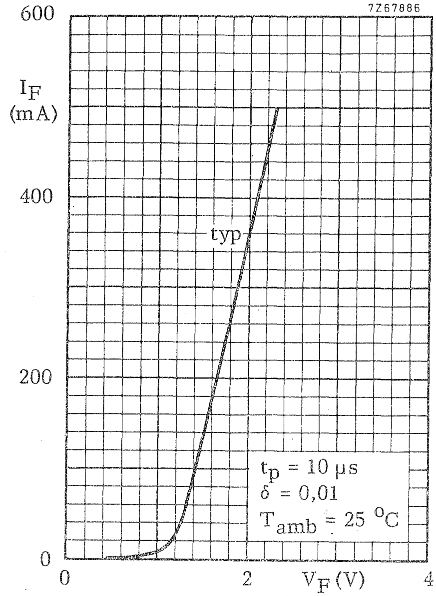
[1]) With copper islands of 6 x 2 mm on both sides of 1,6 mm glass-epoxy printed circuit board; thickness of copper 35 μm.

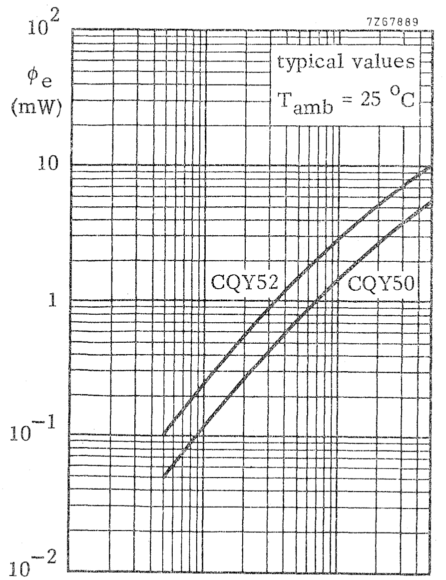
CHARACTERISTICS

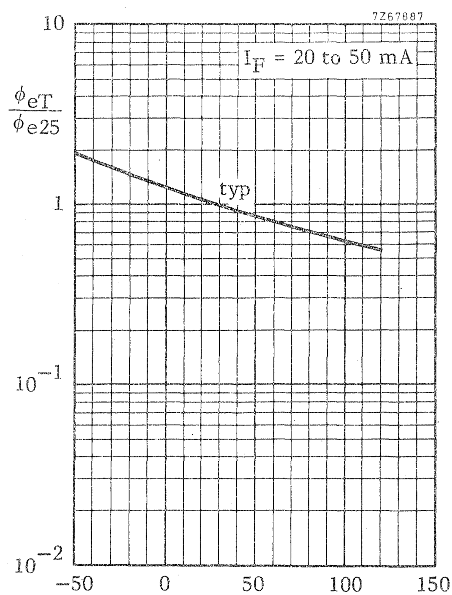
T_{amb} = 25 °C unless otherwise specified

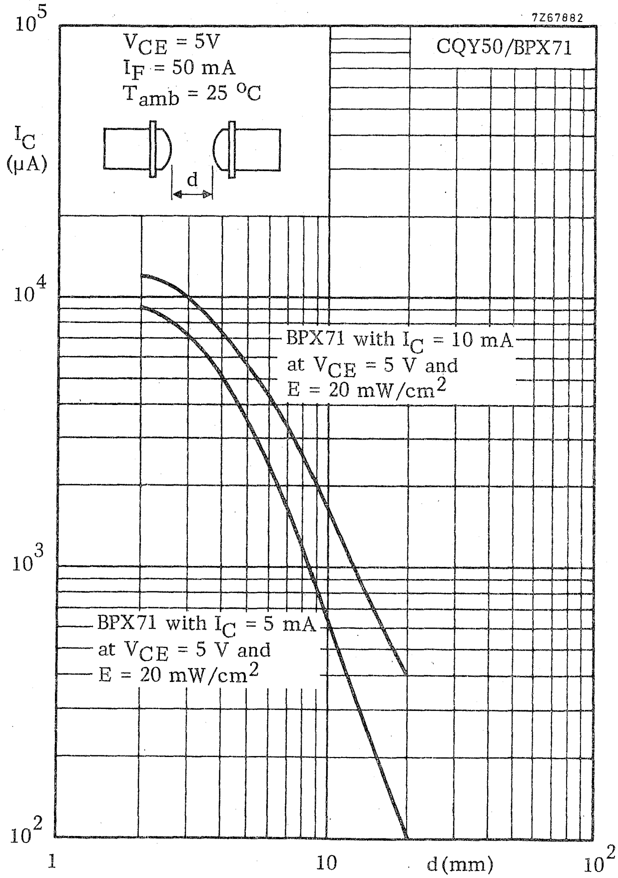
			CQY50	CQY52	
Forward voltage					
I_F = 50 mA	V_F	typ.	1,3	1,3	V
		<	1,5	1,5	V
I_F = 500 mA; t_p = 10 µs; δ = 0,01	V_F	typ.	2,3	2,3	V
Reverse current					
V_R = 2 V	I_R	<	100	100	µA
Diode capacitance					
V_R = 0; f = 1 MHz	C_d	typ.	45	45	pF
Total radiant power					
I_F = 20 mA	ϕ_e	>	160	400	µW
I_F = 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					
$I_{F on}$ = 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

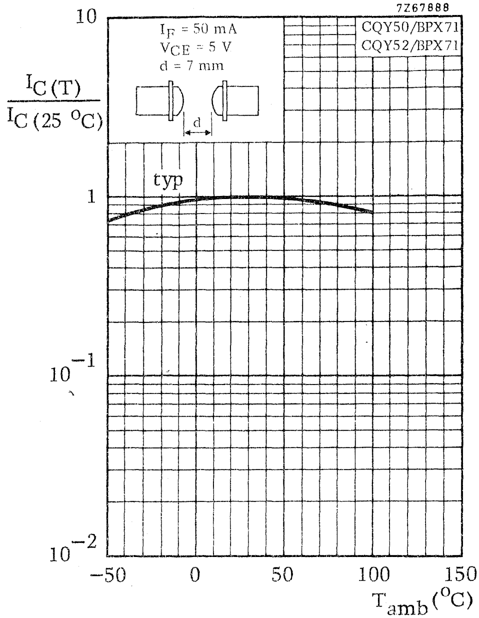

7Z67885
T_{amb} = 25 °C
I_F (mA)
150
100
50
0
typ
max
0
1
2
V_F (V)

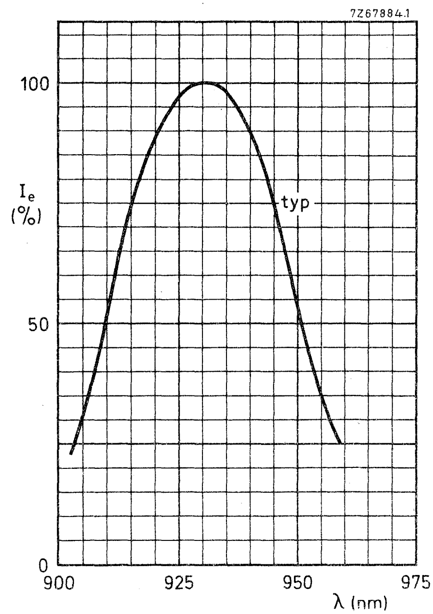

7Z67886
I_F (mA)
600
400
200
0
typ
t_p = 10 μs
δ = 0,01
T_{amb} = 25 °C
0
2
4
V_F (V)

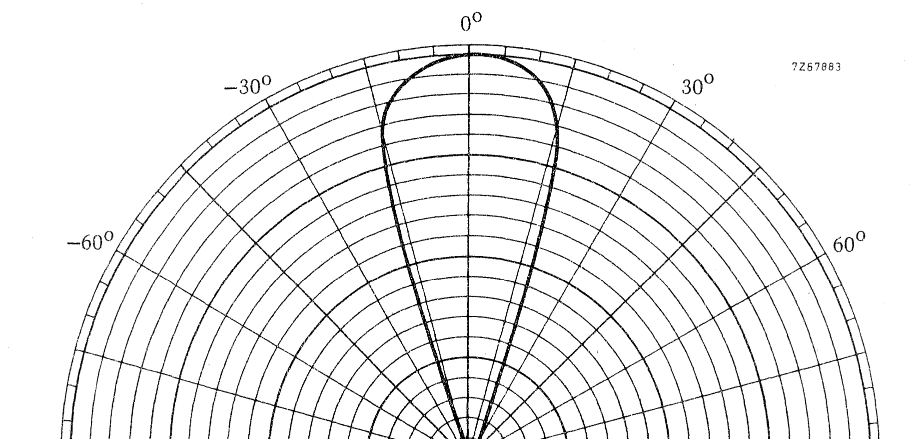

7Z67889
10^2
ϕ_e (mW)
typical values
T_{amb} = 25 °C
10
1
10^{-1}
10^{-2}
CQY52
CQY50
1
10
10^2
I_F (mA)


7Z67887
10
I_F = 20 to 50 mA
$\frac{\phi_{eT}}{\phi_{e25}}$
typ
1
10^{-1}
10^{-2}
−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
I_F = 50 mA
V_{CE} = 5 V
d = 7 mm
d
CQY50/BPX71
CQY52/BPX71
$\frac{I_C(T)}{I_C(25\ ^oC)}$
typ
10
1
10^{-1}
10^{-2}
−50
0
50
100
150
T_{amb} (°C)


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


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

GaAsP RED LIGHT EMITTING DIODE

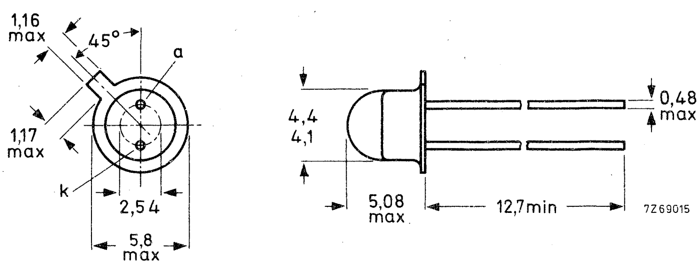
Gallium arsenide phosphide light emitting diode which emits visible red light when forward biased. Metal envelope with clear plastic lens.

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	°C
Operating junction temperature	T_j	max.	85	°C

Power dissipation

Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	125	mW

Soldering time

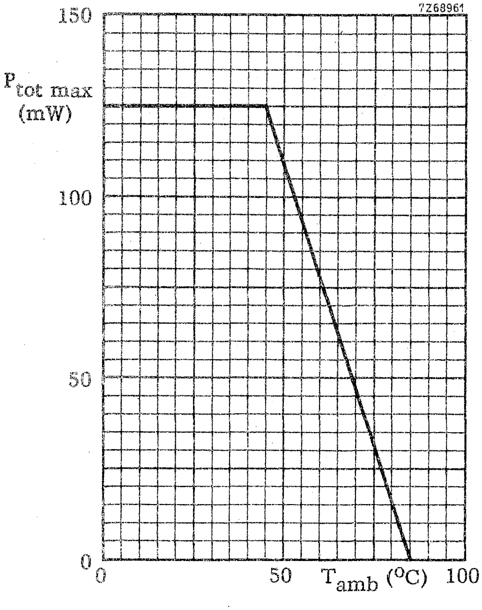
T_{sld} = 260 °C	t_{sld}	max.	7	s

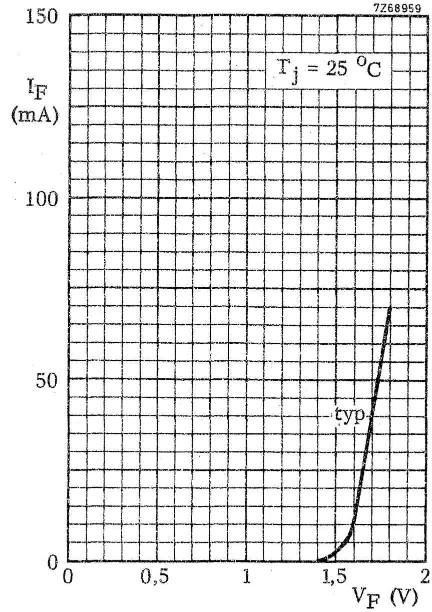
THERMAL RESISTANCE

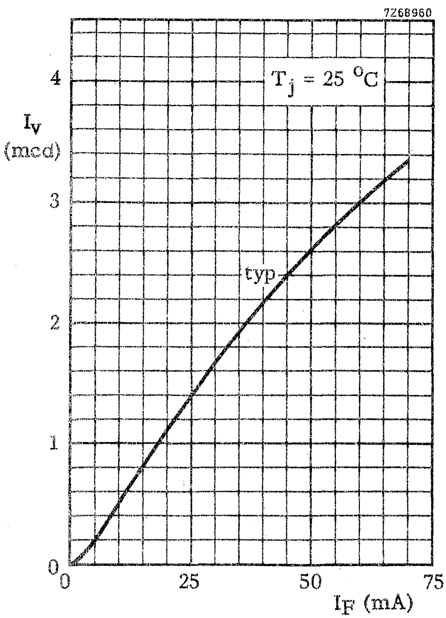
Fro junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,32	°C/mW

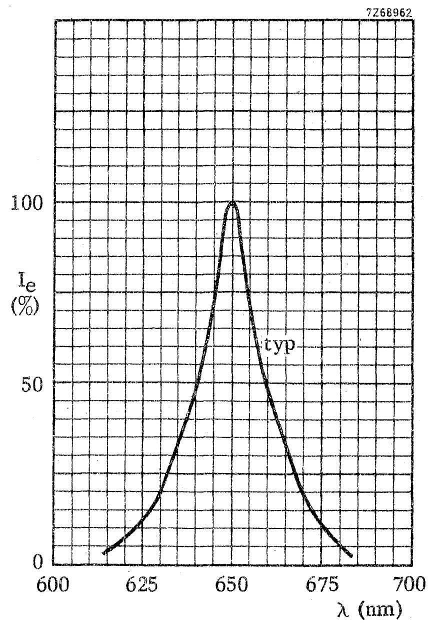
CHARACTERISTICS T_j = 25 °C unless otherwise specified

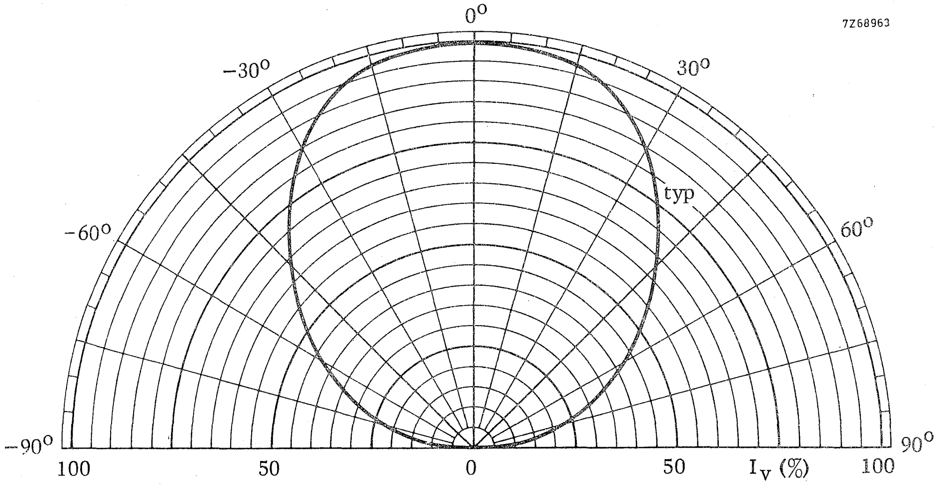
Forward voltage				
I_F = 0,1 mA	V_F	>	1	V
I_F = 10 mA	V_F	>	1,5	V
		<	1,75	V
Reverse current				
V_R = 3 V	I_R	<	100	µA
Luminous intensity (on-axis)				
I_F = 10 mA	I_v	>	115	µcd
Wavelength at peak emission	λ_{pk}	>	630	nm
		<	690	nm
Bandwidth at half height	$B_{50\%}$	typ.	20	nm
		<	40	nm
Beamwidth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


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


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


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


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


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

GaAsP RED LIGHT EMITTING DIODE

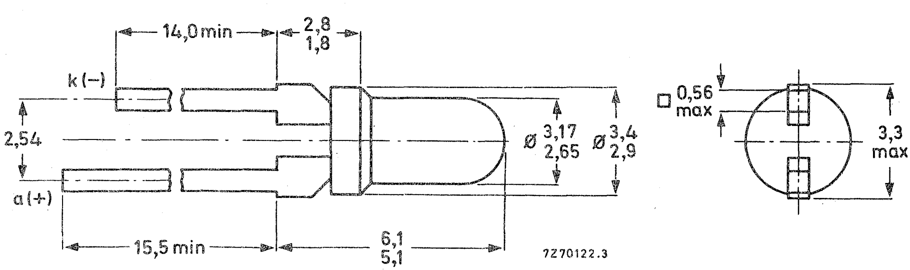
Gallium arsenide phosphide light emitting diode which emits visible red light when forward biased. The envelope is of light-diffusing red plastic, and has been designed for high-density arrays.

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
Beamwidth 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

SOD-53A

Dimensions in mm



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

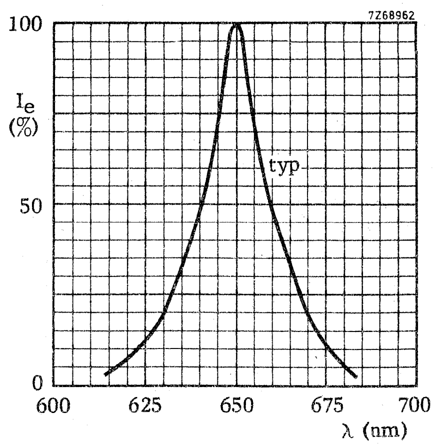
Voltage				
Continuous reverse voltage	V_R	max.	3	V
Current				
Forward current (d.c.)	I_F	max.	50	mA
Forward current (peak value) t_p = 1 μs; f = 300 Hz	I_{FM}	max.	1000	mA
Temperature				
Storage temperature	T_{stg}		−55 to +100	°C
Junction temperature	T_j	max.	100	°C
Power dissipation				
Total power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

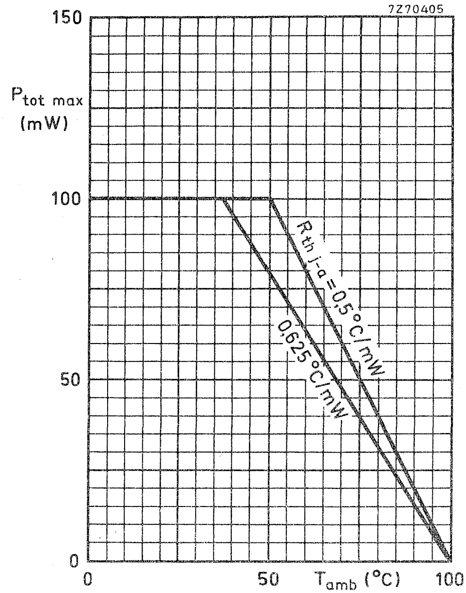
THERMAL RESISTANCE

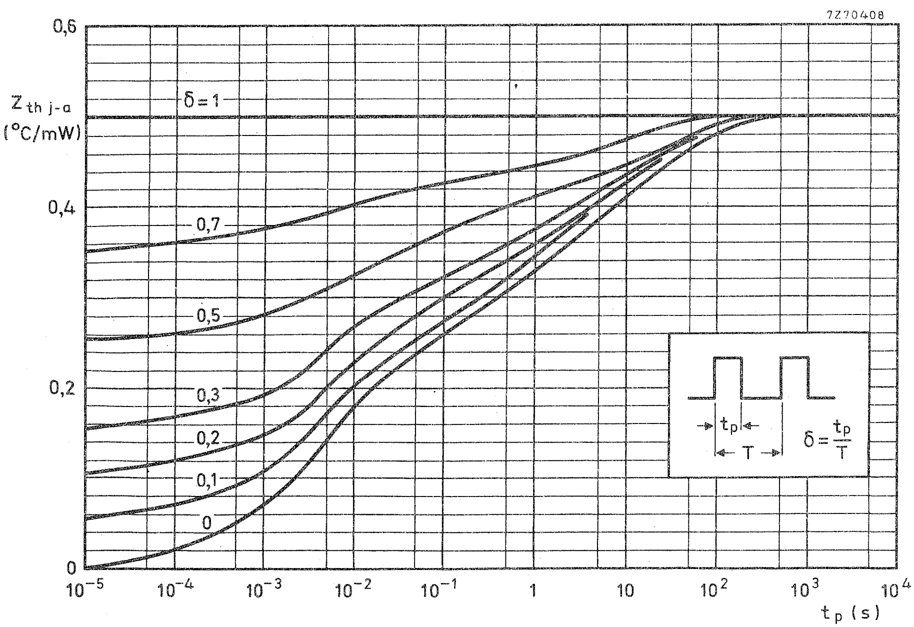
From junction to ambient, in free air	$R_{th\ j\text{-}a}$	=	0,625	°C/mW
mounted on a p.c. board	$R_{th\ j\text{-}a}$	=	0,500	°C/mW

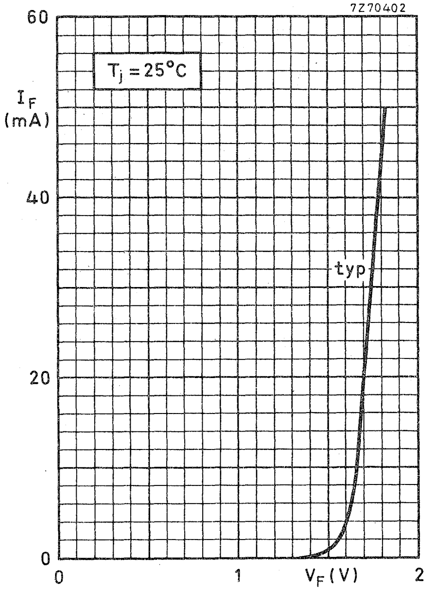
CHARACTERISTICS T_j = 25 °C unless otherwise specified

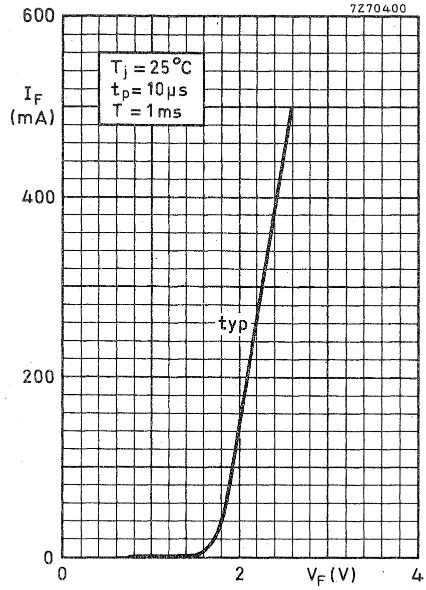
Forward voltage				
I_F = 20 mA	V_F	typ.	1,7	V
		<	2	V
Negative temperature coefficient of V_F				
I_F = 20 mA	$\frac{-\Delta V_F}{\Delta T_j}$	typ.	1,6	mV/°C
I_F = 2 mA	$\frac{-\Delta V_F}{\Delta T_j}$	typ.	2	mV/°C
Reverse current				
V_R = 3 V	I_R	<	100	μA
Luminous intensity (on axis)				
I_F = 20 mA	I_v	>	0,3	mcd
		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°	

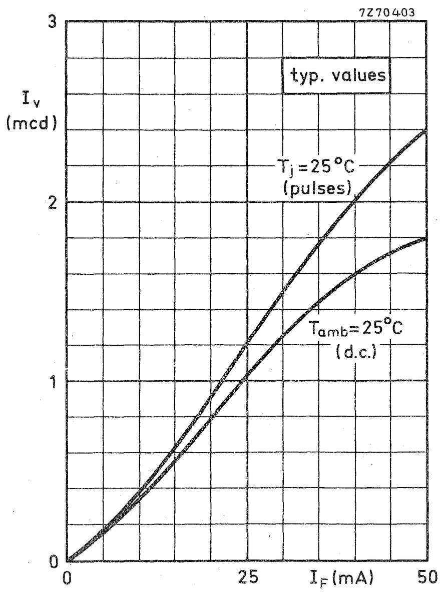


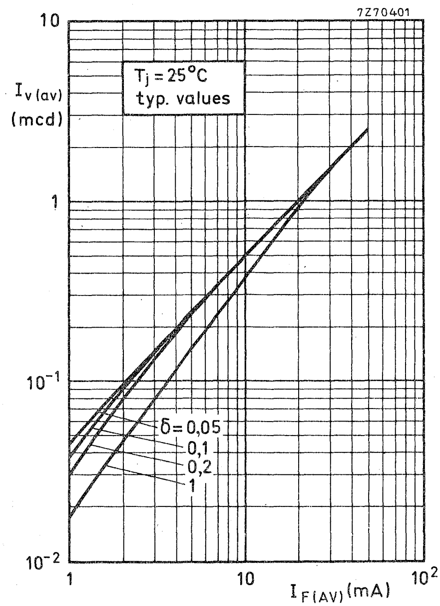

7Z70405
150
$P_{tot\ max}$ (mW)
100
50
0
0
50
T_{amb} (°C)
100
$R_{th\ j\text{-}a}$ = 0,5 °C/mW
0,625 °C/mW

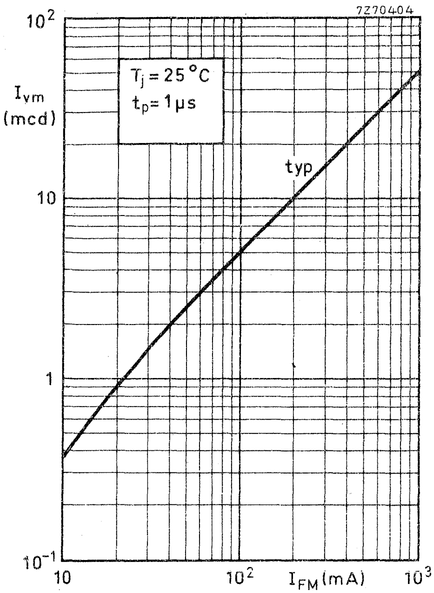

7Z70408
0,6
$Z_{th\ j\text{-}a}$ (°C/mW)
δ = 1
0,4
0,7
0,5
0,2
0,3
0,2
0,1
0
0
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
10^{3}
10^{4}
t_p (s)
t_p
T
$\delta = \frac{t_p}{T}$

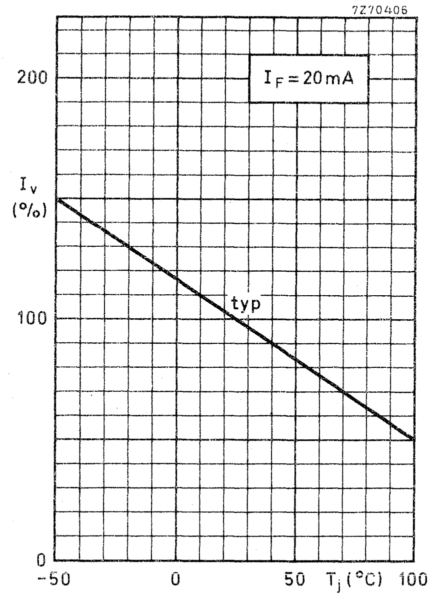

7Z70402
60
40
20
0
I_F (mA)
$T_j = 25°C$
typ
0
1
V_F (V)
2

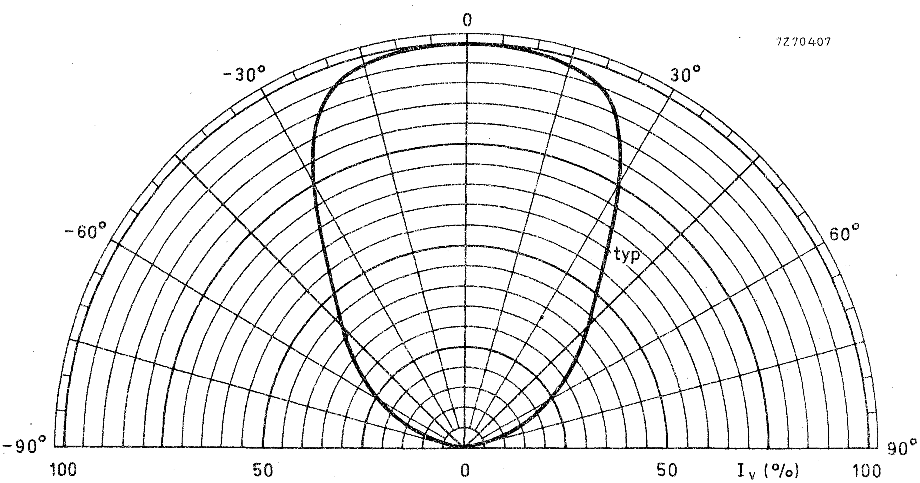

7Z70400
600
400
200
0
I_F (mA)
$T_j = 25°C$
$t_p = 10 μs$
$T = 1 ms$
typ
0
2
V_F (V)
4


7Z70403
3
2
1
0
I_v (mcd)
typ. values
$T_j = 25°C$ (pulses)
$T_{amb} = 25°C$ (d.c.)
0
25
I_F (mA)
50


7Z70401
10
1
10^{-1}
10^{-2}
$I_{v(av)}$ (mcd)
$T_j = 25°C$
typ. values
δ = 0,05
0,1
0,2
1
1
10
10^2
$I_{F(AV)}$ (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

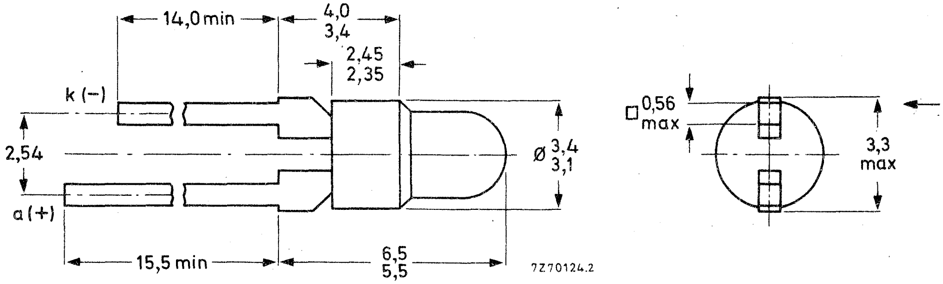
GaAs LIGHT EMITTING DIODE

Diffused planar gallium arsenide light emitting diode intended for optical coupling and encoding. It emits radiation in the near infrared when forward biased. Red epoxy resin envelope with lens. Combination with phototransistor BPW22 is recommended.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	75	mW
Radiant output power at I_F = 20 mA	ϕ_e	typ.	500	μW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	>	400	μW/sr
Wavelength at peak emission	λ_{pk}	typ.	875	nm
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	1	°C/mW

MECHANICAL DATA Dimensions in mm

SOD-53B



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

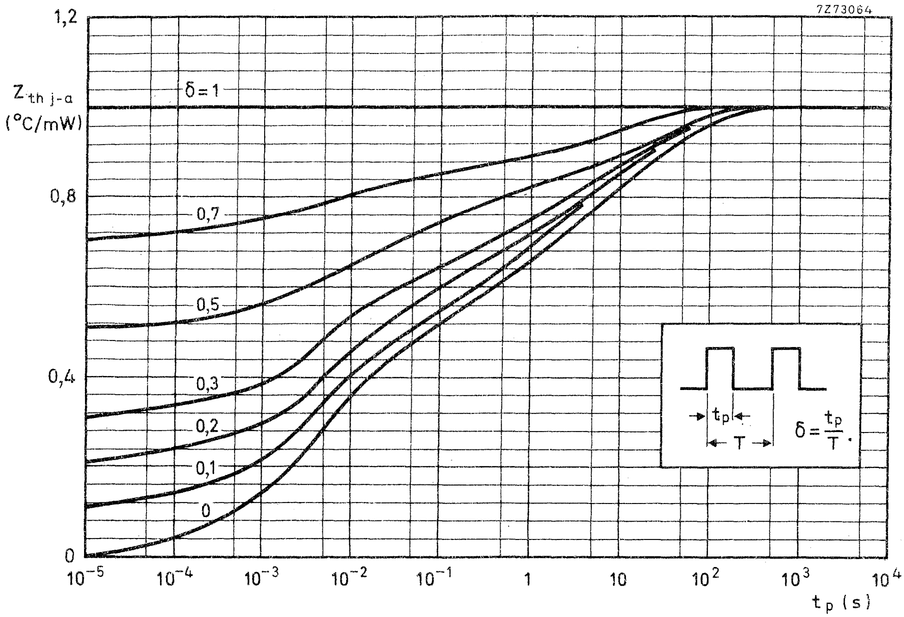
Voltage				
Continuous reverse voltage	V_R	max.	2	V
Current				
Forward current (d.c.)	I_F	max.	50	mA
Forward current (peak value) t_p = 10 µs; δ = 0,01	I_{FM}	max.	200	mA
Temperature				
Storage temperature	T_{stg}		−55 to +100	°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature > 3 mm from the body; $t_{sld} < 7 s$	T_{sld}	max.	230	°C
Power dissipation				
Total power dissipation up to T_{amb} = 25 °C, device mounted on printed-circuit board	P_{tot}	max.	75	mW

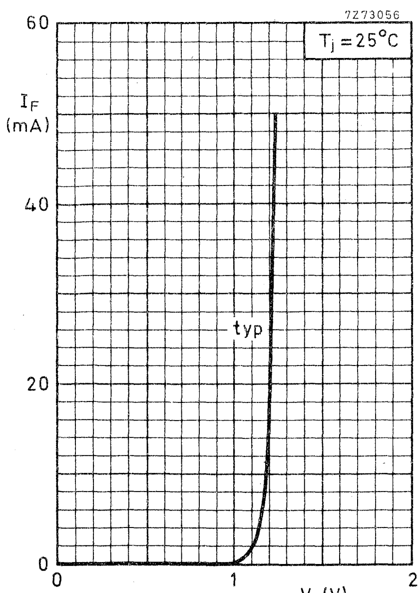
THERMAL RESISTANCE

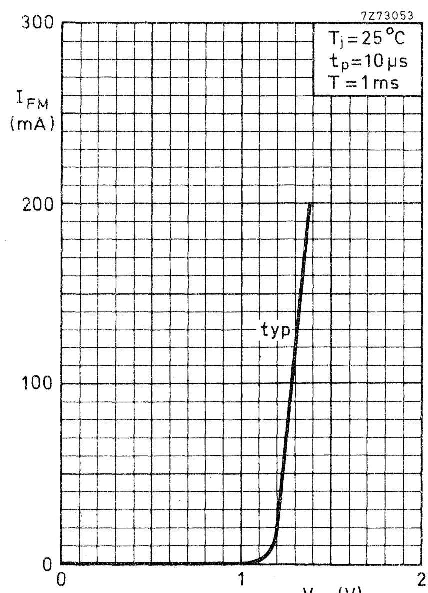
From junction to ambient, device mounted on printed-circuit board	$R_{th\ j\text{-}a}$	=	1	°C/mW

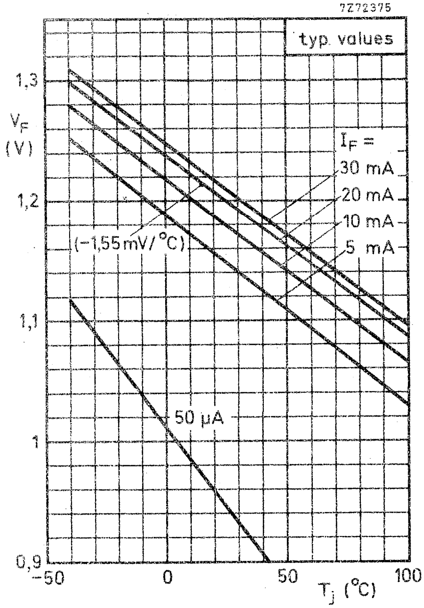
CHARACTERISTICS $T_j = 25\ ^oC$ unless otherwise specified

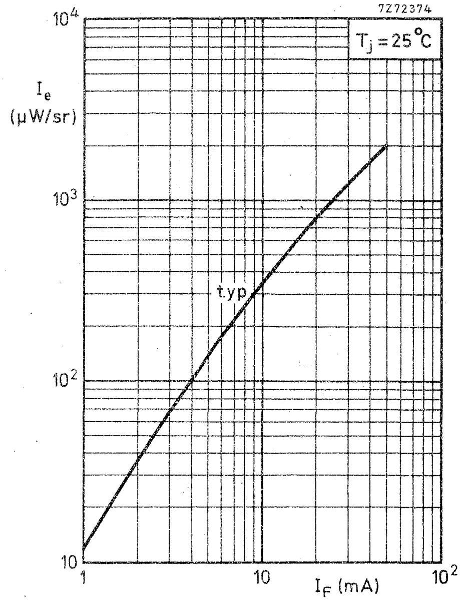
Forward voltage				
$I_F = 20$ mA	V_F	typ.	1,2	V
		<	1,5	V
Reverse current				
$V_R = 2$ V	I_R	<	100	µA
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	typ.	80	pF
Total radiant power				
$I_F = 20$ mA	ϕ_e	typ.	500	µW
Radiant intensity (on-axis)				
$I_F = 20$ mA	I_e	>	400	µW/sr
		typ.	800	µW/sr
Wavelength at peak emission	λ_{pk}	typ.	875	nm
Bandwidth at half height	$B_{50\%}$	typ.	50	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	10^o	
Switching times				
$I_{Fon} = 50$ mA; $t_p = 100$ ns; f = 100 kHz				
Light rise time	t_r	typ.	20	ns
Light fall time	t_f	typ.	20	ns

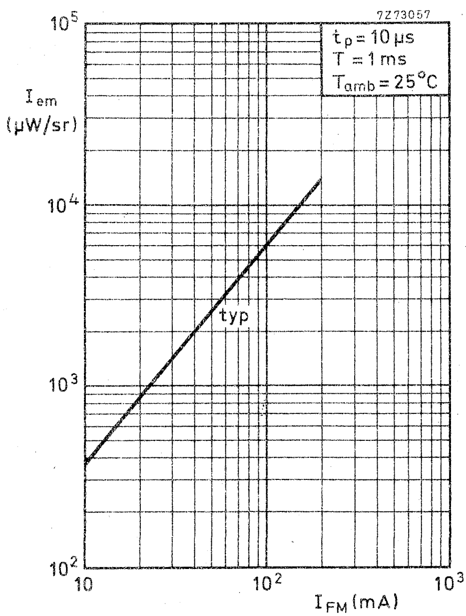

7Z73064
1,2
0,8
0,4
0
$Z_{th\ j\text{-}a}$
(°C/mW)
δ = 1
0,7
0,5
0,3
0,2
0,1
0
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
10^{3}
10^{4}
t_p (s)
t_p
T
$\delta = \frac{t_p}{T}$.

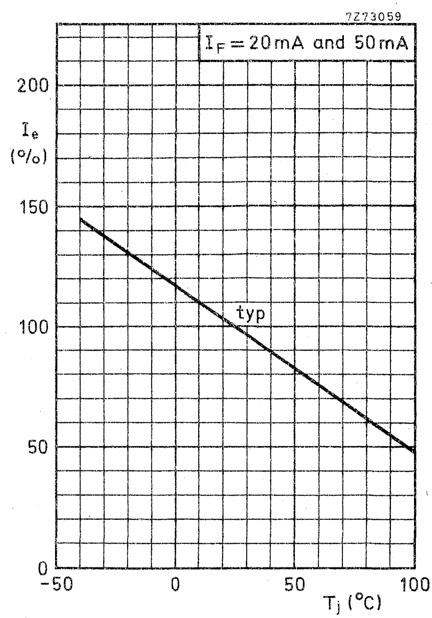

7Z73056
$T_j = 25\,°C$
60
40
20
0
I_F
(mA)
typ
0
1
2
V_F(V)

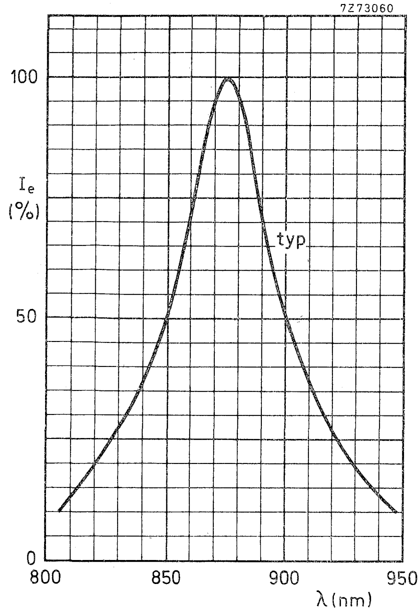

7Z73053
$T_j = 25\,°C$
$t_p = 10\,\mu s$
T = 1 ms
300
200
100
0
I_{FM}
(mA)
typ
0
1
2
V_{FM}(V)

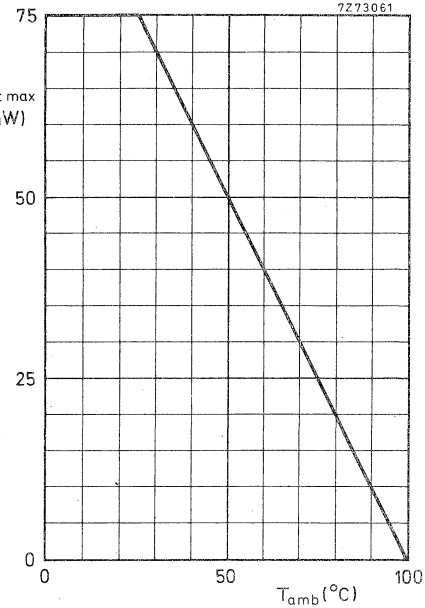

7Z72375
typ. values
V_F (V)
1,3
1,2
1,1
1
0,9
I_F =
30 mA
20 mA
10 mA
5 mA
(−1,55 mV/°C)
50 μA
−50
0
50
100
T_j (°C)

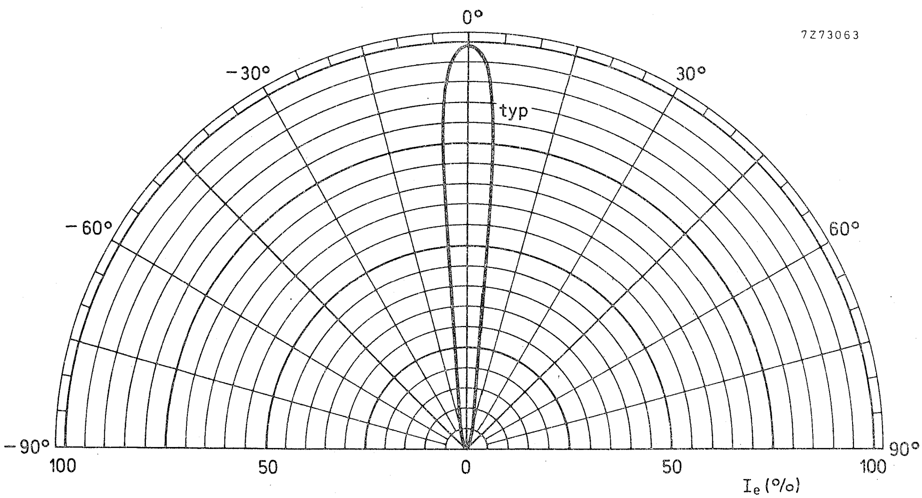

7Z72374
T_j = 25 °C
I_e (μW/sr)
10^4
10^3
10^2
10
typ
1
10
10^2
I_F (mA)

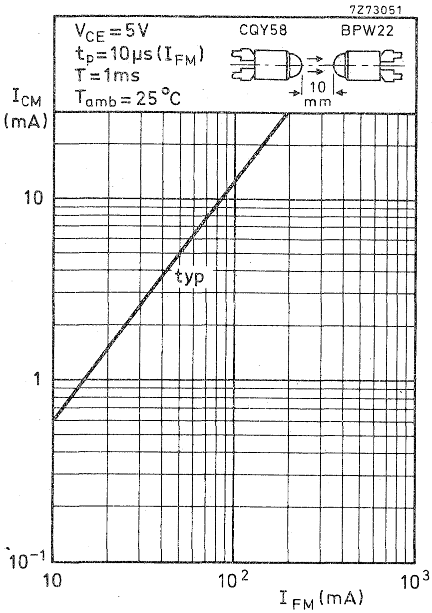

7Z73057
t_p = 10 μs
T = 1 ms
T_{amb} = 25 °C
I_{em} (μW/sr)
10^5
10^4
10^3
10^2
typ
10
10^2
10^3
I_{FM} (mA)

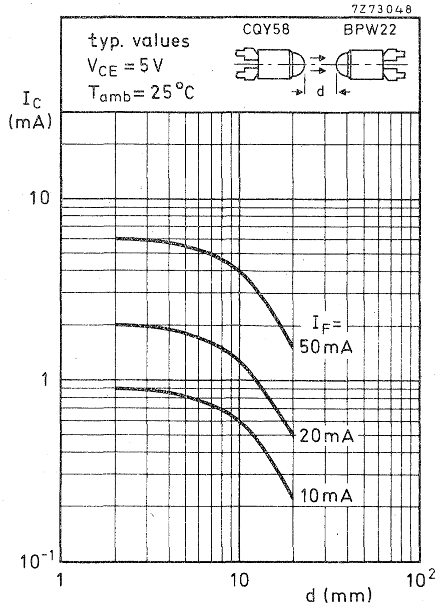

7Z73059
I_F = 20 mA and 50 mA
I_e (%)
200
150
100
50
0
typ
−50
0
50
100
T_j (°C)

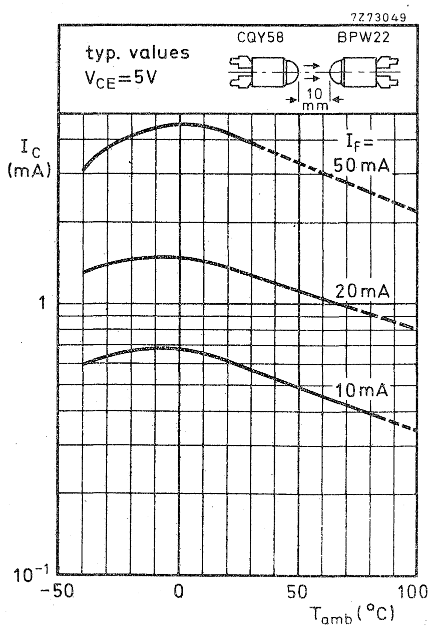

7Z73060
100
I_e
(%)
typ
50
0
800
850
900
950
λ (nm)


7Z73061
75
$P_{tot\ max}$
(mW)
50
25
0
0
50
100
T_{amb} (°C)


0°
7Z73063
−30°
30°
typ
−60°
60°
−90°
90°
100
50
0
50
100
I_e (%)


7Z73051
V_{CE} = 5 V
t_p = 10 µs (I_{FM})
T = 1 ms
T_{amb} = 25 °C
CQY58
BPW22
10 mm
I_{CM} (mA)
10
1
10^{-1}
typ
10
10^2
10^3
I_{FM} (mA)


7Z73048
typ. values
V_{CE} = 5 V
T_{amb} = 25 °C
CQY58
BPW22
d
I_C (mA)
10
1
10^{-1}
I_F =
50 mA
20 mA
10 mA
1
10
10^2
d (mm)


7Z73049
typ. values
V_{CE} = 5 V
CQY58
BPW22
10 mm
I_C (mA)
1
10^{-1}
I_F =
50 mA
20 mA
10 mA
−50
0
50
100
T_{amb} (°C)

GaAsP RED LIGHT EMITTING DIODE

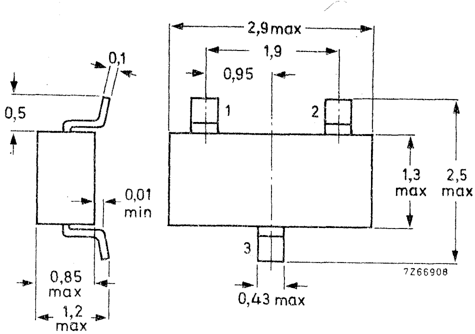
Gallium arsenide phosphide light emitting diode which emits visible red light when forward biased. The SOT-23 envelope is of clear red epoxy resin, and has been designed for thick and thin-film circuits.

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 °C	P_{tot}	max.	100	mW
Luminous intensity (on-axis) I_F = 20 mA	I_v	typ.	0, 4	mcd
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	140°	
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0, 75	°C/mW

MECHANICAL DATA

Dimensions in mm

SOT-23



1 = a (+)
2 = a (+)
3 = k (–)

For soldering recommendations see Handbook SC4a, section Microminiature devices for thick and thin-film circuits.

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

Voltage

Continous reverse voltage	V_R	max.	3	V

Current

Forward current (d.c.)	I_F	max.	50	mA
Forward current (peak value) t_p = µs ; f = 300 Hz	I_{FM}	max.	1	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	P_{tot}	max.	100	mW

Temperatures

Storage temperature	T_{stg}	−55 to	+100	°C
Junction temperature	T_j	max.	100	°C

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	$R_{th\ j-a}$	=	0,75	°C/mW

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

Forward voltage

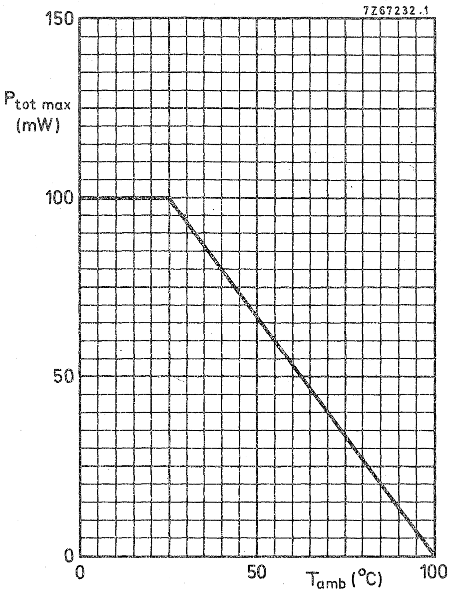
I_F = 20 mA	V_F	typ.	1,6	V
		<	2	V

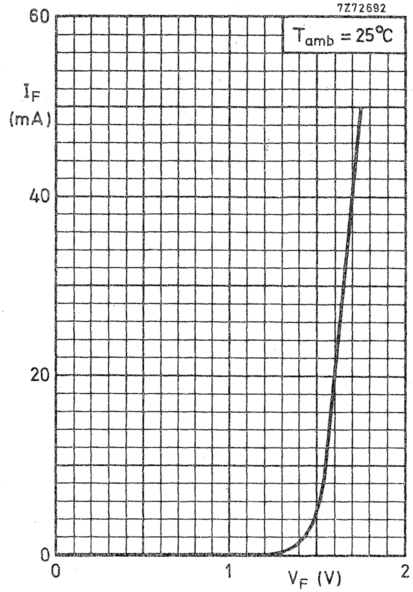
Reverse current

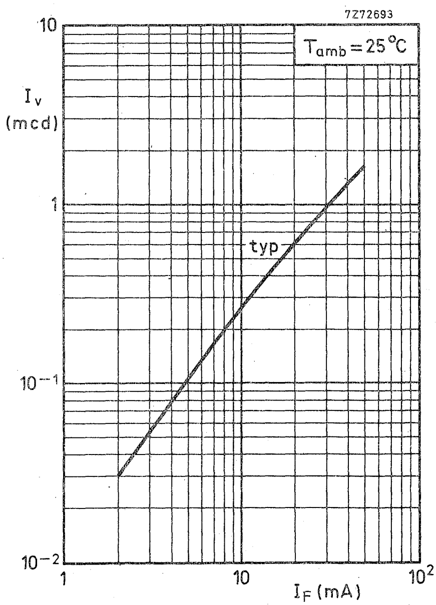
V_R = 3 V	I_R	<	100	µA

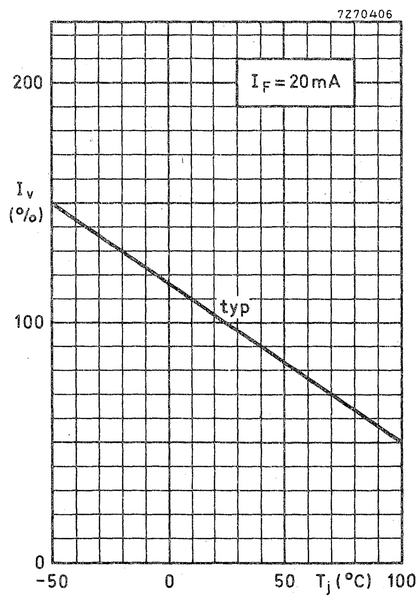
Luminous intensity (on-axis)

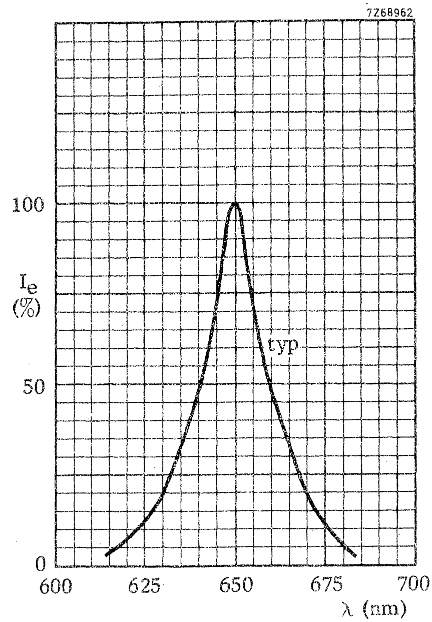
I_F = 20 mA	I_v	typ.	0,4	mcd
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	140°	

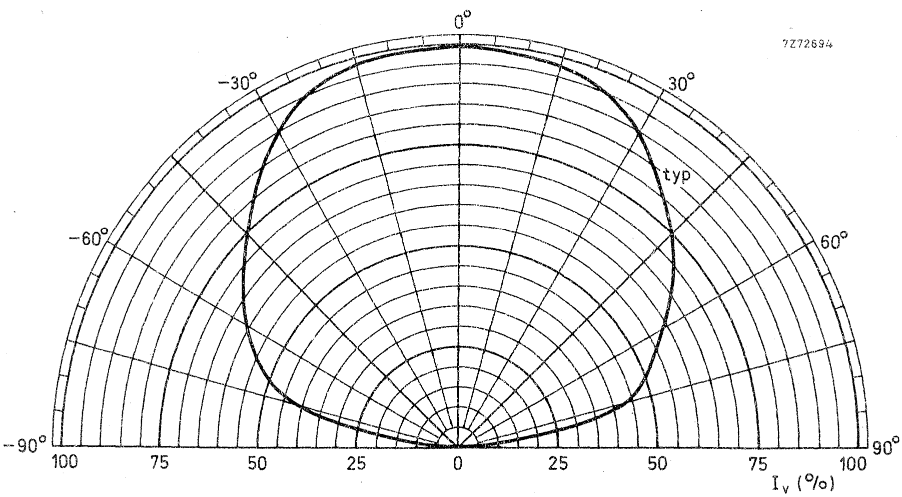

7Z67232.1
150
Ptot max
(mW)
100
50
0
0
50
Tamb (°C)
100


7Z72692
Tamb = 25°C
60
IF
(mA)
40
20
0
0
1
VF (V)
2


7Z72693
Tamb = 25°C
10
Iv
(mcd)
1
typ
10−1
10−2
1
10
10²
IF (mA)


7Z70406
IF = 20 mA
200
Iv
(%)
typ
100
0
−50
0
50
Tj (°C)
100


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


0°
7Z72694
−30°
30°
typ
−60°
60°
−90°
90°
100
75
50
25
0
25
50
75
100
I_v (%)

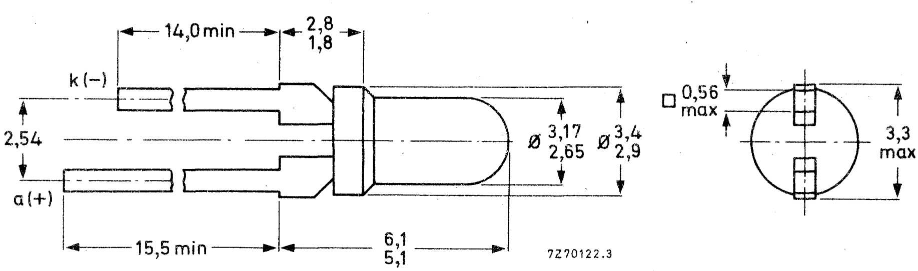
GaAsP RED LIGHT EMITTING DIODE

Gallium arsenide phosphide light emitting diode which emits visible red light when forward biased. The envelope is of non-diffusing red plastic. It is intended for low-current drive (5 mA) applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	10	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	20	mW
Luminous intensity (on-axis) I_F = 5 mA	I_V	>	0,3	mcd
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	50°	
Thermal resistance from junction to ambient in free air	$R_{th\ j\text{-}a}$	=	2	°C/mW

MECHANICAL DATA — Dimensions in mm

SOD-53A



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

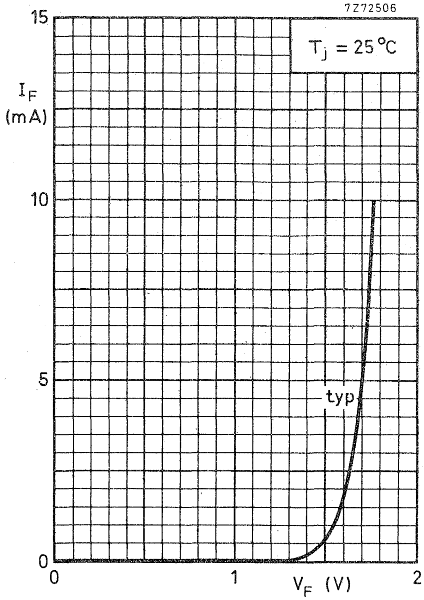
Voltage				
Continuous reverse voltage	V_R	max.	3	V
Current				
Forward current (d.c.)	I_F	max.	10	mA
Forward current (peak value) t_p = 1 μs; f = 300 Hz	I_{FM}	max.	100	mA
Power dissipation				
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	20	mW
Temperatures				
Storage temperature	T_{stg}		-55 to +100	°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature > 3 mm from the body; t_{sld} < 7 s	T_{sld}	max.	230	°C

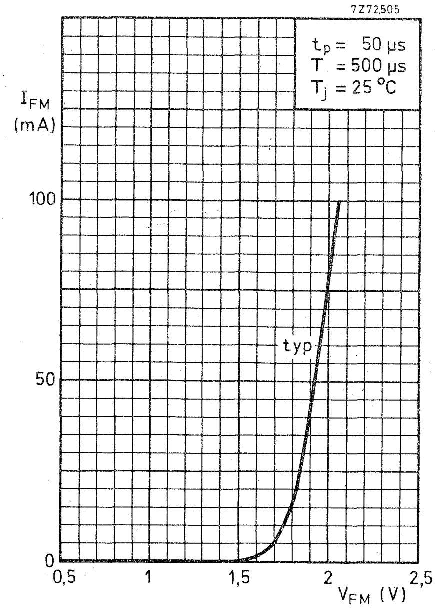
THERMAL RESISTANCE

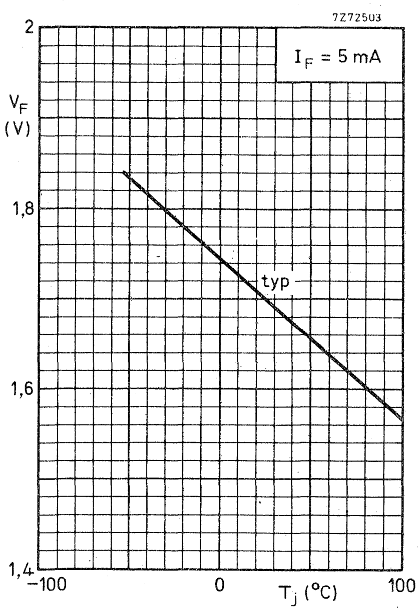
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	2	°C/mW

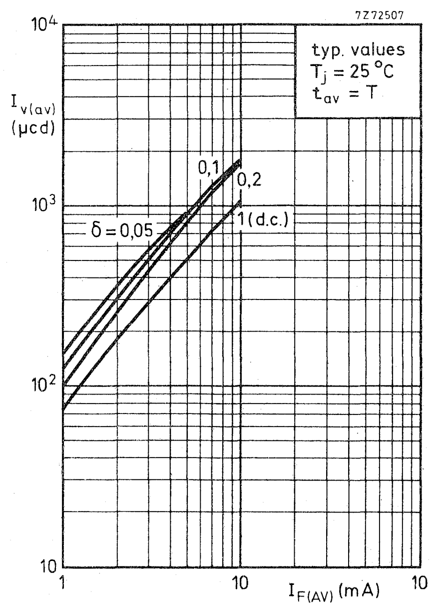
CHARACTERISTICS

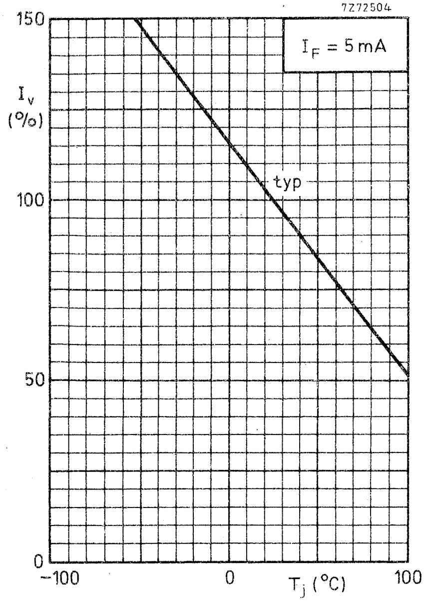
Forward voltage				
I_F = 5 mA	V_F	typ.	1,7	V
		<	2	V
Reverse current				
V_R = 3 V	I_R	<	100	μA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	typ.	30	pF
Luminous intensity (on-axis)				
I_F = 5 mA	I_v	>	0,3	mcd
		typ.	0,5	mcd
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Bandwidth at half height	$B_{50\%}$	typ.	20	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	50°	

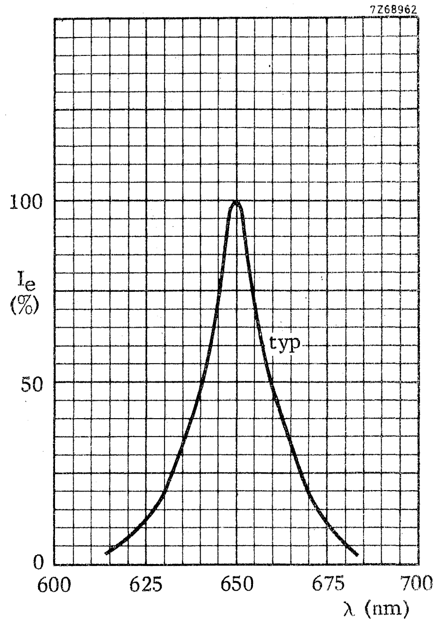

7Z72506
T_j = 25 °C
I_F (mA)
15
10
5
0
typ
0
1
2
V_F (V)

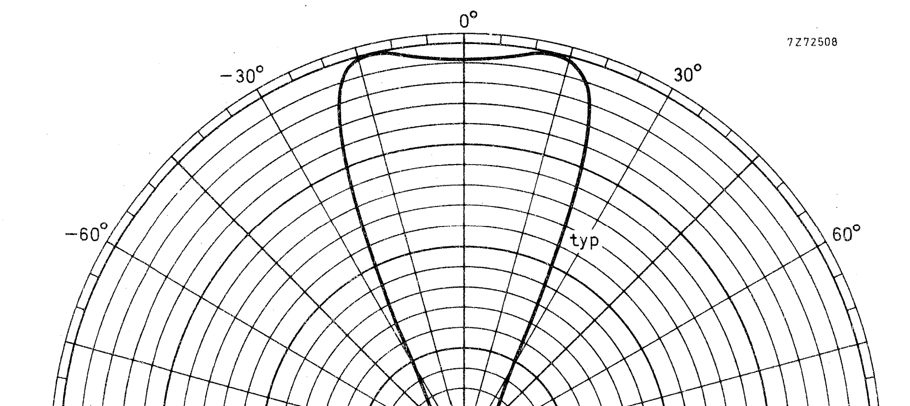

7Z72505
t_p = 50 µs
T = 500 µs
T_j = 25 °C
I_{FM} (mA)
100
50
0
typ
0,5
1
1,5
2
2,5
V_{FM} (V)


7Z72503
I_F = 5 mA
V_F (V)
2
1,8
1,6
1,4
typ
−100
0
100
T_j (°C)


7Z72507
typ. values
T_j = 25 °C
t_{av} = T
$I_{v(av)}$ (µcd)
10^4
10^3
10^2
10
δ = 0,05
0,1
0,2
1 (d.c.)
1
10
10^2
$I_{F(AV)}$ (mA)


7Z72504
I_F = 5 mA
I_v
(%)
150
100
50
0
typ
−100
0
100
T_j (°C)


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


7Z72508
0°
−30°
30°
−60°
60°
−90°
90°
typ
100
50
0
50
100
I_v (%)

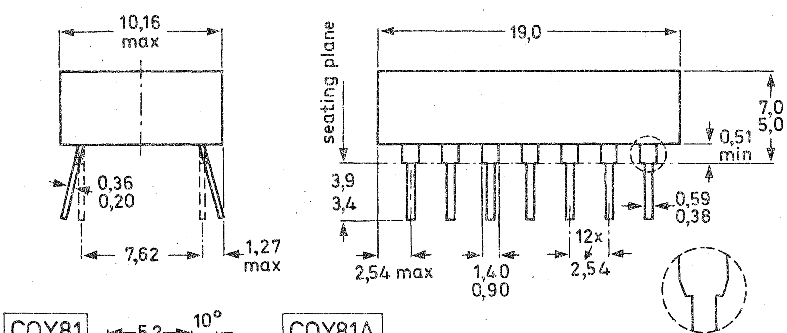
Displays

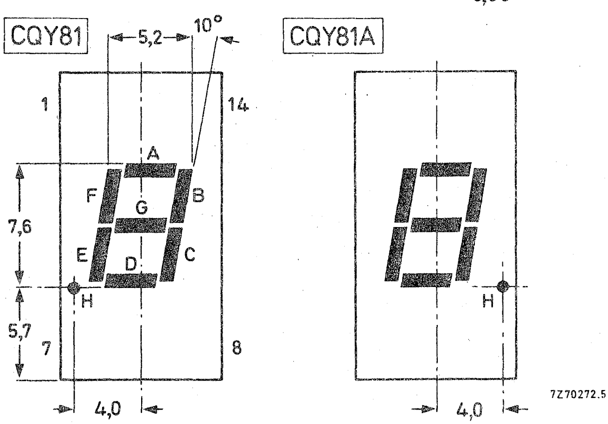
GaAsP 7-SEGMENT DISPLAYS

Gallium arsenide phosphide seven diode segment displays for the numerals 0 to 9 and a decimal point, or the letters A, C, E, F, H, J, L, P and U. Red light emission. Dual in-line plastic encapsulations. CQY81: decimal point on the left; CQY81A : on the right.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.) per segment or decimal point	I_F	max.	30	mA
Luminous intensity (of segment, normal to surface) I_F = 20 mA	I_v	>	100	µcd
		typ.	250	µcd
Beamwidth between half-intensity directions	α50%	typ.	90°	

MECHANICAL DATA Dimensions in mm





1 Cathode A
2 Cathode F
3 Common anode
4 No pin
5 No pin
6 Cathode H (d.p.)
7 Cathode E
8 Cathode D
9 Not connected
10 Cathode C
11 Cathode G
12 No pin
13 Cathode B
14 Common anode

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

Voltage				
Continuous reverse voltage	V_R	max.	3	V
Current				
Total forward current (d. c.)	I_{Ftot}	max.	240	mA
Forward current per segment or decimal point – d. c value	I_F	max.	30	mA
– peak value, t_p = 1 ms; δ = 0, 125	I_{FM}	max.	160	mA
Power dissipation				
Total power dissipation – per segment or decimal point, up to T_{amb} = 30 °C	P_{tot}	max.	65	mW
– in whole device, up to T_{amb} = 35 °C	P_{tot}	max.	400	mW
Temperatures				
Storage temperature	T_{stg}		−20 to +85	°C
Operating junction temperature	T_j	max.	95	°C
Lead soldering temperature > 1, 5 mm from seating plane; t_{sld} < 5 s	T_{sld}	max.	230	°C

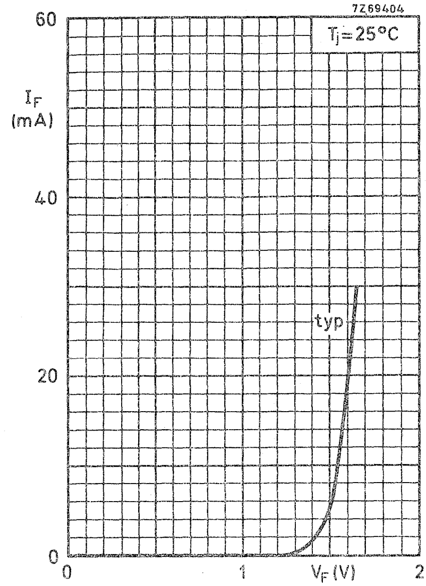
THERMAL RESISTANCE

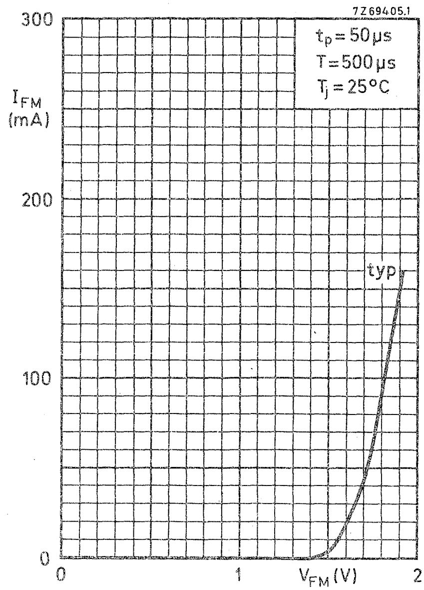
From junction to ambient, all diodes operating at the same power and device mounted on a printed-circuit board

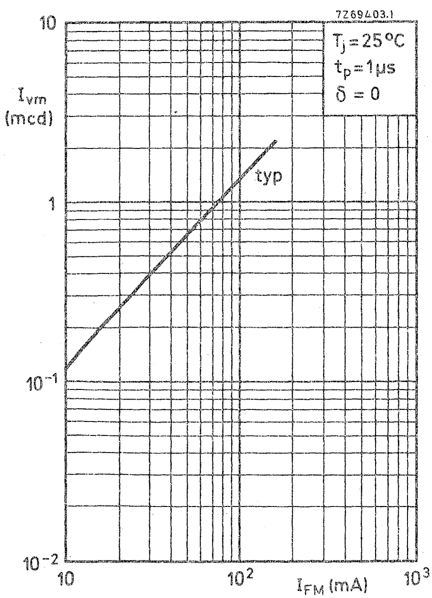
– per segment or decimal point	$R_{th\ j\text{-}a}$	=	1	°C/mW
– for whole device	$R_{th\ j\text{-}a}$	=	0, 15	°C/mW

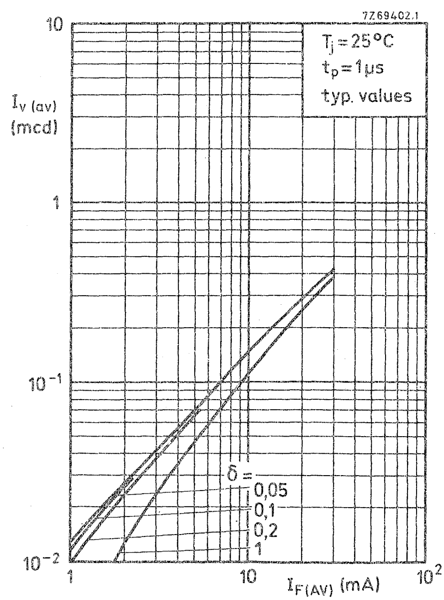
CHARACTERISTICS (single segment and decimal point, unless otherwise specified)
T_{amb} = 25 °C unless otherwise specified

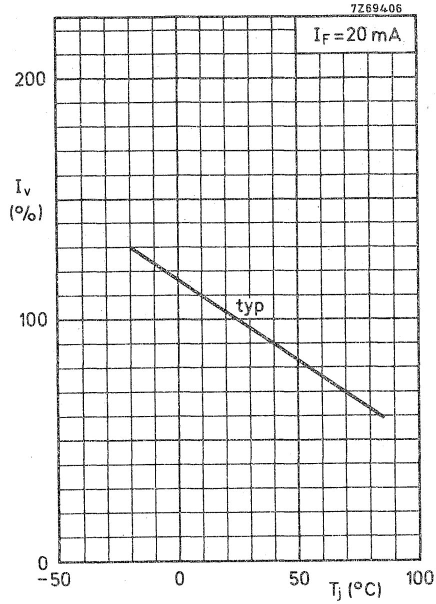
Forward voltage				
I_F = 20 mA	V_F	typ.	1,6	V
		<	2	V
Reverse current				
V_R = 3 V	I_R	max.	50	µA
Series resistance at f = 1 kHz				
I_F = 20 mA	r_D	typ.	2	Ω
Diode capacitance at f = 1 MHz				
V_R = 0	C_d	typ.	60	pF
Luminous intensity (of segment, normal to the surface)				
I_F = 20 mA	I_V	>	100	µcd
		typ.	250	µcd
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.	90°	

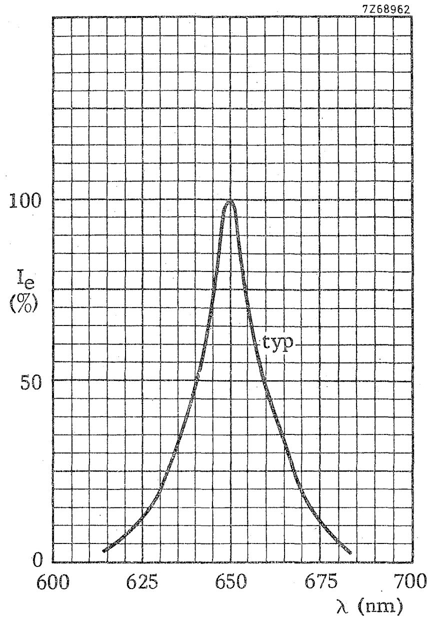

7Z69404
$T_j = 25°C$
I_F (mA)
typ
V_F (V)
0
20
40
60
1
2

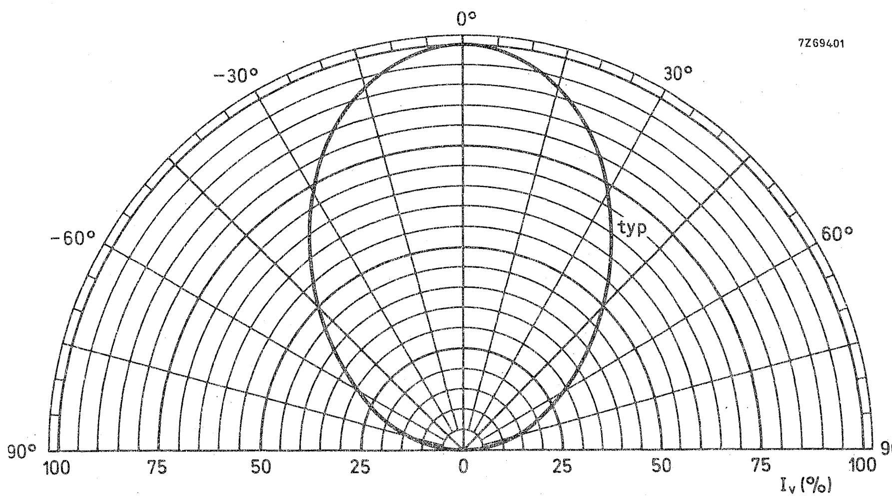

7Z69405.1
$t_p = 50 \mu s$
$T = 500 \mu s$
$T_j = 25°C$
I_{FM} (mA)
typ
V_{FM} (V)
0
100
200
300
1
2


7Z69403.1
$T_j = 25°C$
$t_p = 1 \mu s$
$\delta = 0$
I_{vm} (mcd)
typ
I_{FM} (mA)
10^{-2}
10^{-1}
1
10
10^2
10^3


7Z69402.1
$T_j = 25°C$
$t_p = 1 \mu s$
typ. values
$I_{v\,(av)}$ (mcd)
$\delta =$
0,05
0,1
0,2
1
$I_{F(AV)}$ (mA)
10^{-2}
10^{-1}
1
10
10^2


7Z69406
I_F = 20 mA
I_v (%)
200
100
0
typ
−50
0
50
100
T_j (°C)


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


7Z69401
0°
−30°
30°
−60°
60°
90°
90°
typ
100
75
50
25
0
25
50
75
100
I_v (%)

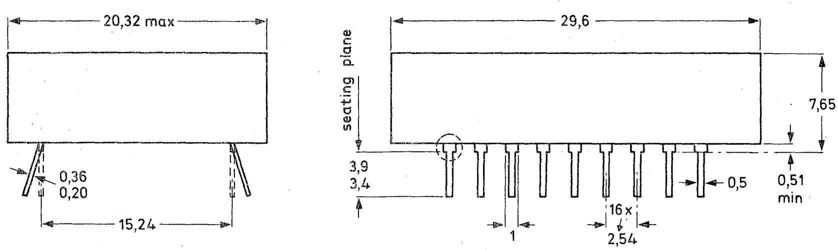
GaAsP 7-SEGMENT DISPLAY

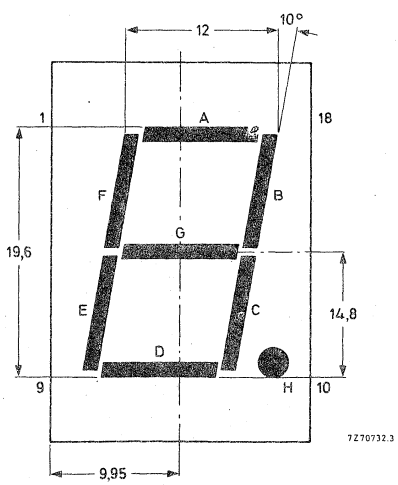
Gallium arsenide phosphide seven diode segment display for the numerals 0 to 9 and a decimal point, or the letters A, C, E, F, H, J, L, P and U. Red light emission. Dual in-line plastic encapsulation.

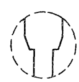
QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.) per segment or decimal point	I_F	max.	30	mA
Luminous intensity (of segment, normal to surface) I_F = 20 mA	I_V	>	100	μcd

MECHANICAL DATA

Dimensions in mm







1. Anode (common)
2. Cathode A
3. Cathode F
4. Anode
5. No pin
6. No pin
7. No pin
8. Cathode E
9. Anode
10. Anode
11. No pin
12. Cathode H
13. Cathode D
14. Cathode C
15. Cathode G
16; No pin
17. Cathode B
18. Anode

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

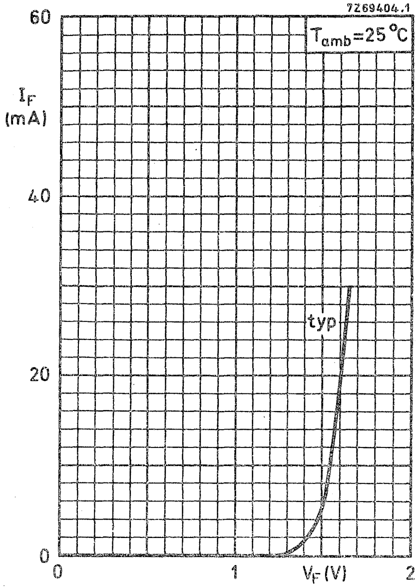
Voltage				
Continuous reverse voltage	V_R	max.	3	V
Current				
Total forward current (d.c.)	I_{Ftot}	max.	240	mA
Forward current per segment or decimal point – d.c. value	I_F	max.	30	mA
– peak value, t_p = 1 ms; δ = 0,125	I_{FM}	max.	160	mA
Power dissipation				
Total power dissipation up to T_{amb} = 30 °C per segment or decimal point	P_{tot}	max.	65	mW
Temperatures				
Storage temperature	T_{stg}		−20 to +85	°C
Operating junction temperature	T_j	max.	95	°C
Lead soldering temperature > 1,5 mm from seating plane; t_{sld} < 5 s	T_{sld}	max.	230	°C

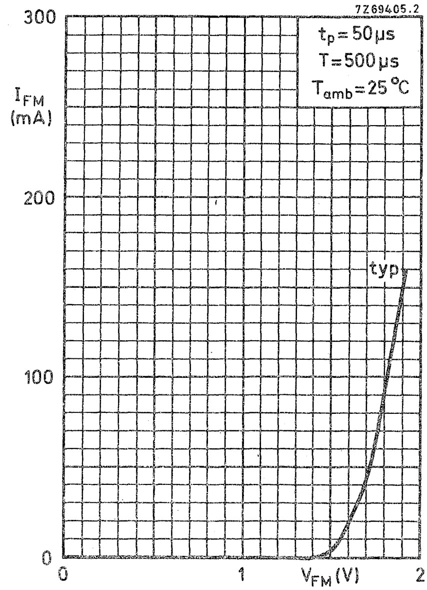
THERMAL RESISTANCE

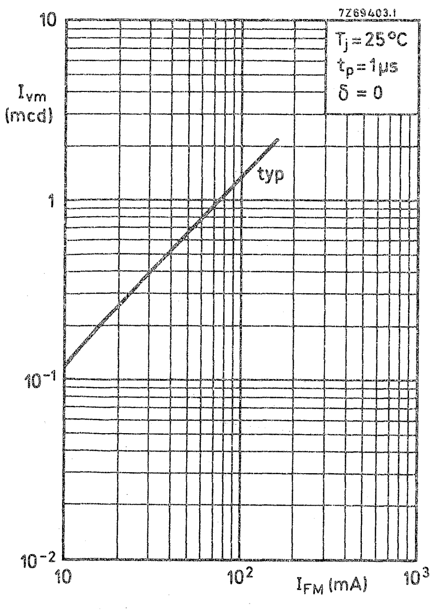
From junction to ambient, all diodes operating at the same power and device mounted on a printed-circuit board – per segment or decimal point	$R_{th\ j\text{-}a}$	=	1	°C/mW

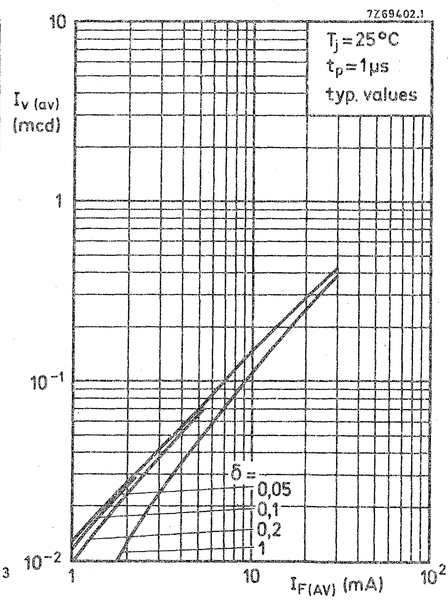
CHARACTERISTICS (single segment and decimal point, unless otherwise specified)
T_{amb} = 25 °C unless otherwise specified

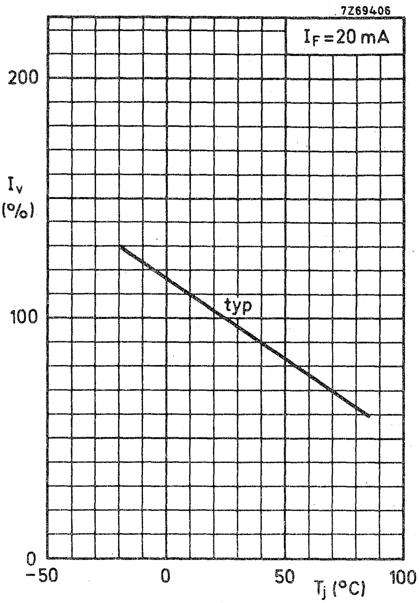
Forward voltage				
I_F = 20 mA	V_F	typ.	1,6	V
		<	2	V
Reverse current				
V_R = 3 V	I_R	max.	100	µA
Diode capacitance at f = 1 MHz				
V_R = 0	C_d	typ.	60	pF
Luminous intensity (of segment, normal to the surface)				
I_F = 20 mA	I_v	>	100	µcd
		typ.	250	µcd
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Bandwidth at half height	$B_{50\%}$	typ.	20	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	90°	

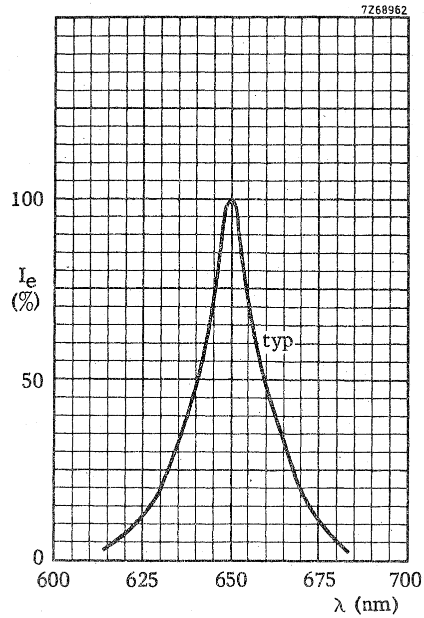

7Z69404.1
Tamb=25 °C
IF (mA)
60
40
20
0
typ
0
1
VF (V)
2

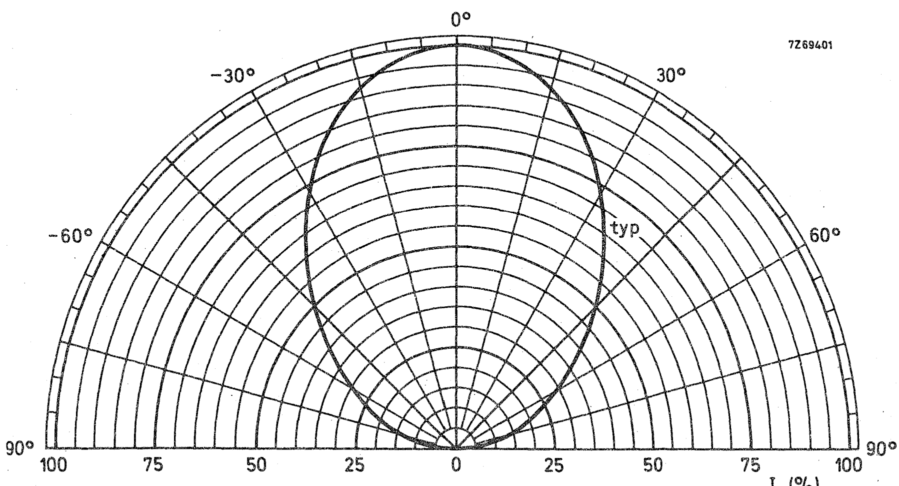

7Z69405.2
tp=50 µs
T=500 µs
Tamb=25 °C
IFM (mA)
300
200
100
0
typ
0
1
VFM (V)
2


7Z69403.1
Tj=25 °C
tp=1 µs
δ = 0
Ivm (mcd)
10
1
10⁻¹
10⁻²
typ
10
10²
IFM (mA)
10³


7Z69402.1
Tj=25 °C
tp=1 µs
typ. values
Iv (av) (mcd)
10
1
10⁻¹
10⁻²
δ =
0,05
0,1
0,2
1
1
10
IF(AV) (mA)
10²


7Z69406
$I_F = 20$ mA
200
I_v
(%)
typ
100
0
−50
0
50
100
T_j (°C)


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


0°
7Z69401
−30°
30°
−60°
typ
60°
90°
90°
100
75
50
25
0
25
50
75
100
I_v (%)

Photocouplers

PHOTOCOUPLERS

Optically coupled isolators consisting of an infrared 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 accessible transistor base; the CNY42 is the 4 pin version without accessible base.

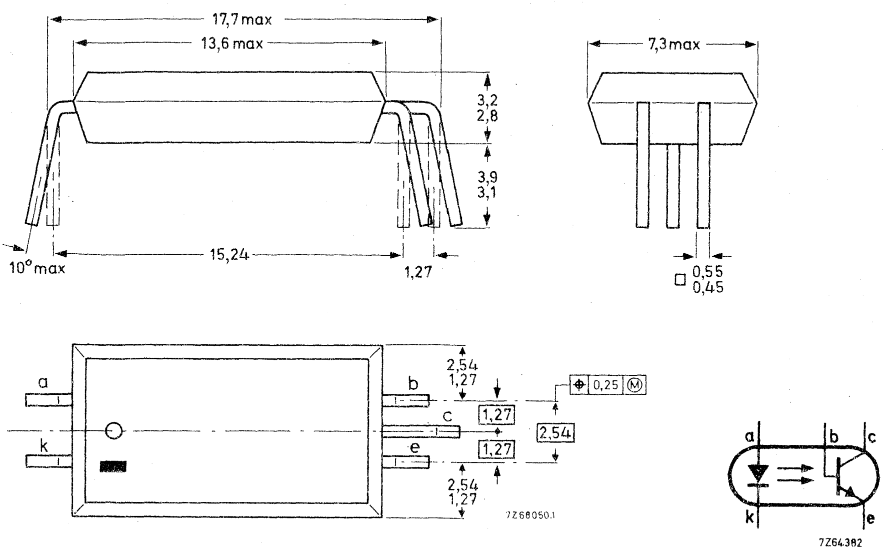
QUICK REFERENCE DATA

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

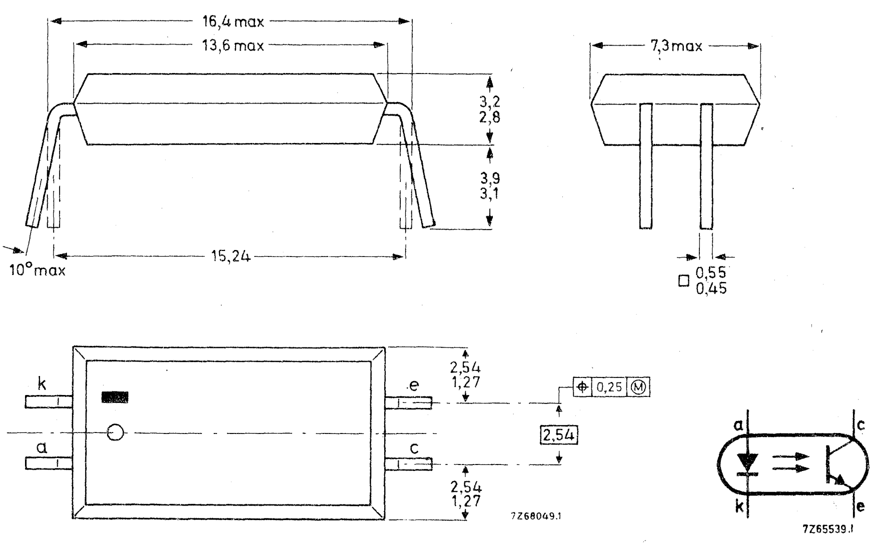
MECHANICAL DATA See page 2.

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

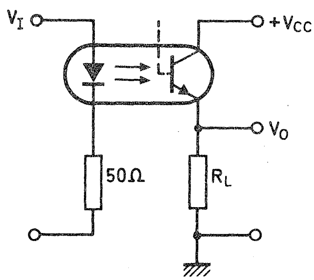
From junction to ambient in free air

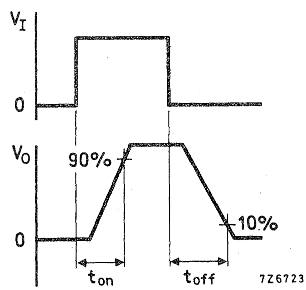
-diode	$R_{th\ j-a}$	1,2 °C/mW
-transistor	$R_{th\ j-a}$	0,5 °C/mW

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



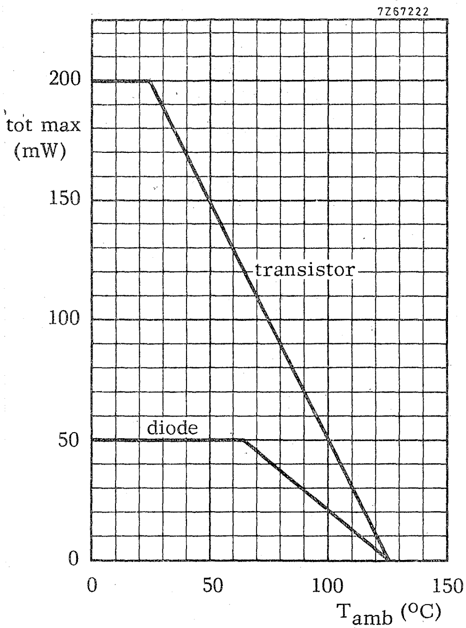


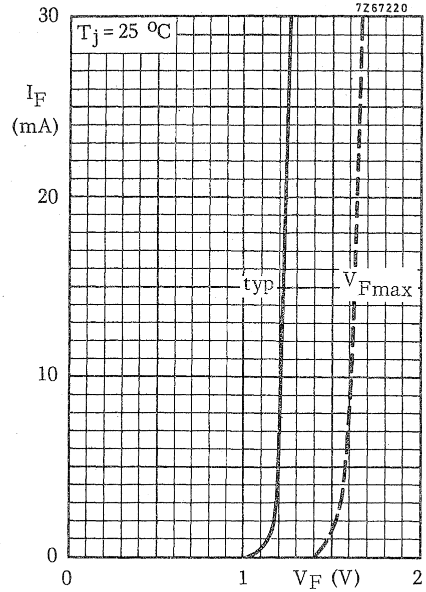
1) Where the phototransistor receives light from the diode the O (for open base) has been omitted from the symbols.

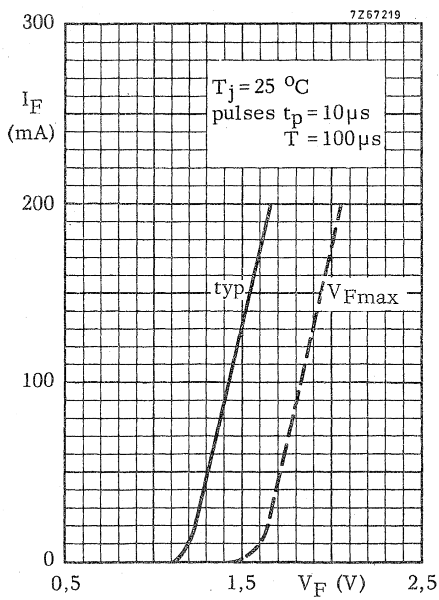
2) Measured with pulses: t_p = 100 μs; T = 1 ms.

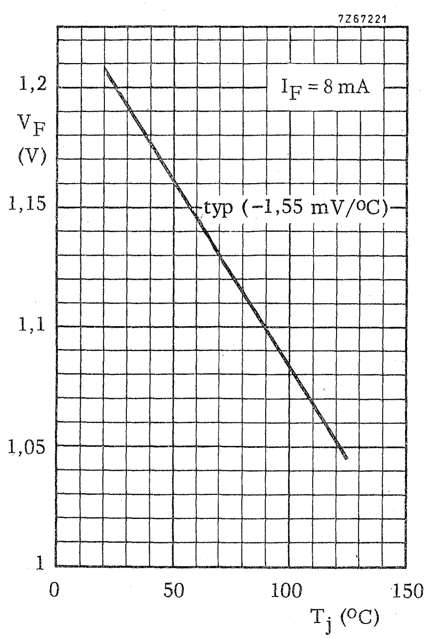
3) Aging of the light-emitting diode decreases the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

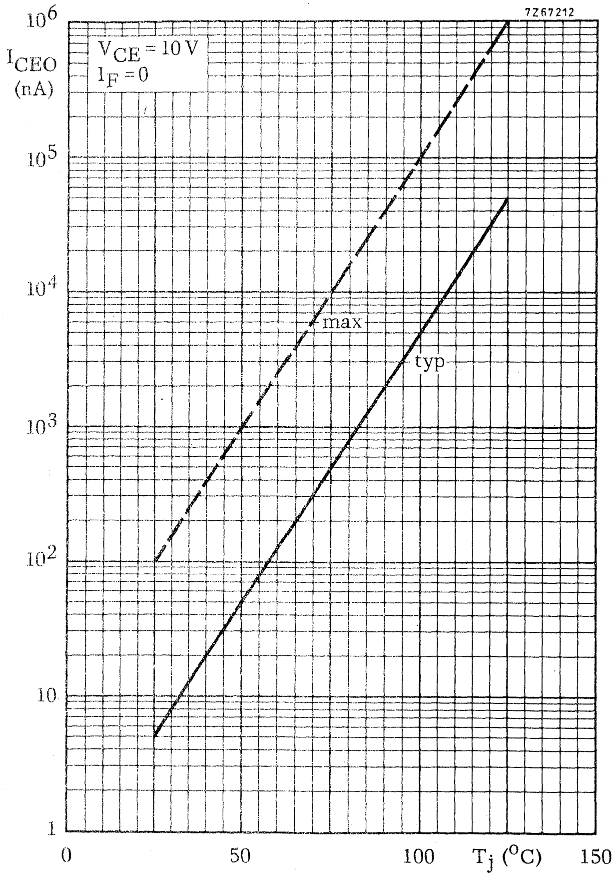
4) Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

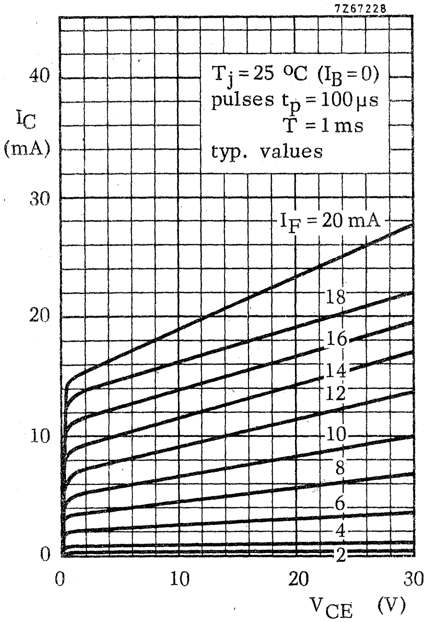

7Z67222
tot max
(mW)
200
150
100
50
0
transistor
diode
0
50
100
150
Tamb (°C)

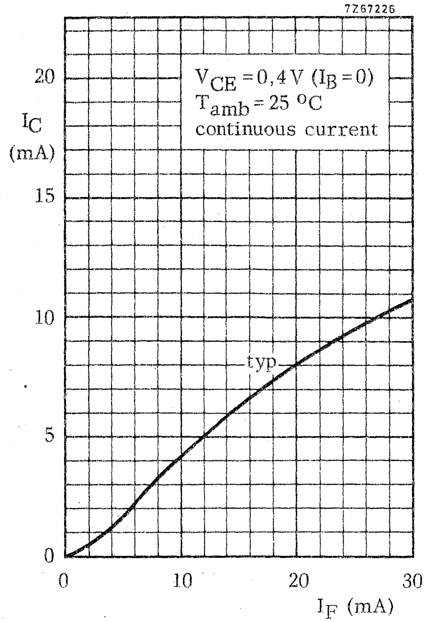

7Z67220
Tj = 25 °C
IF
(mA)
30
20
10
0
typ
VFmax
0
1
VF (V)
2

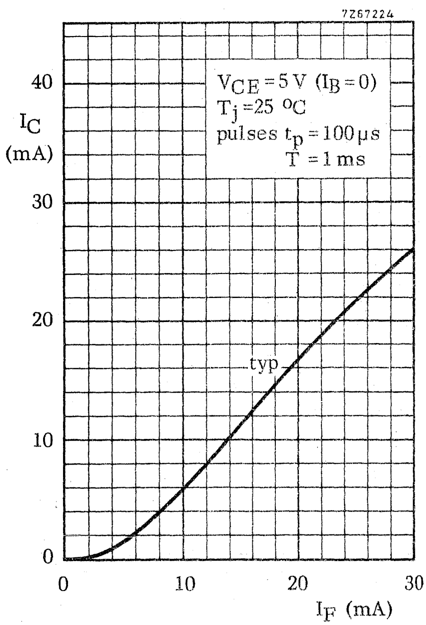

7Z67219
Tj = 25 °C
pulses tp = 10 μs
T = 100 μs
IF
(mA)
300
200
100
0
typ
VFmax
0,5
1,5
VF (V)
2,5

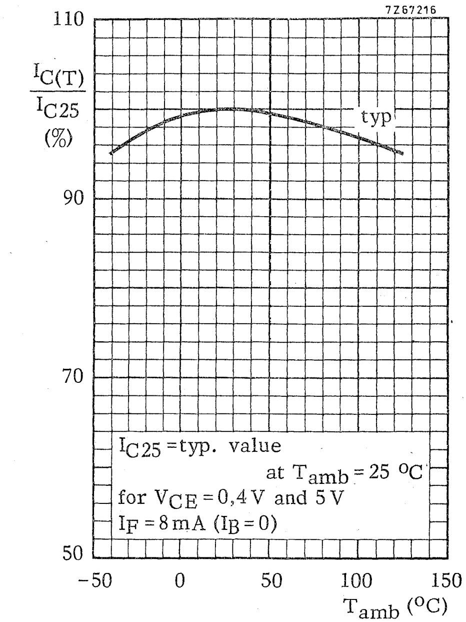

7Z67221
IF = 8 mA
VF
(V)
1,2
1,15
1,1
1,05
1
typ (−1,55 mV/°C)
0
50
100
150
Tj (°C)

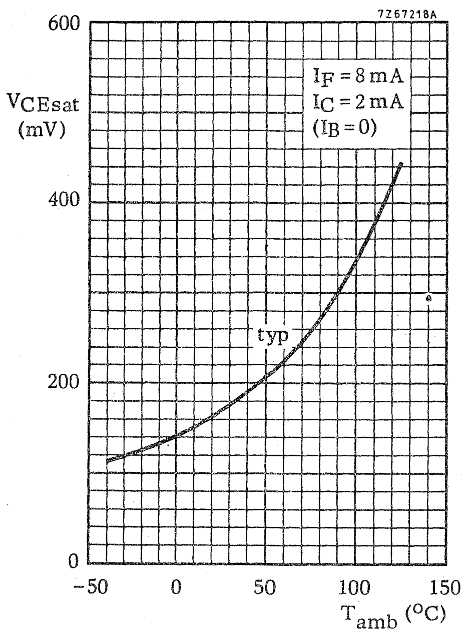

7Z67212
10^6
I_{CEO}
(nA)
$V_{CE} = 10\,V$
$I_F = 0$
10^5
10^4
max
typ
10^3
10^2
10
1
0
50
100
T_j (°C)
150


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


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


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


7Z67216
110
$I_{C(T)}$ / I_{C25}
(%)
typ
90
70
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
−50
0
50
100
150
T_{amb} (°C)


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

PHOTOCOUPLERS

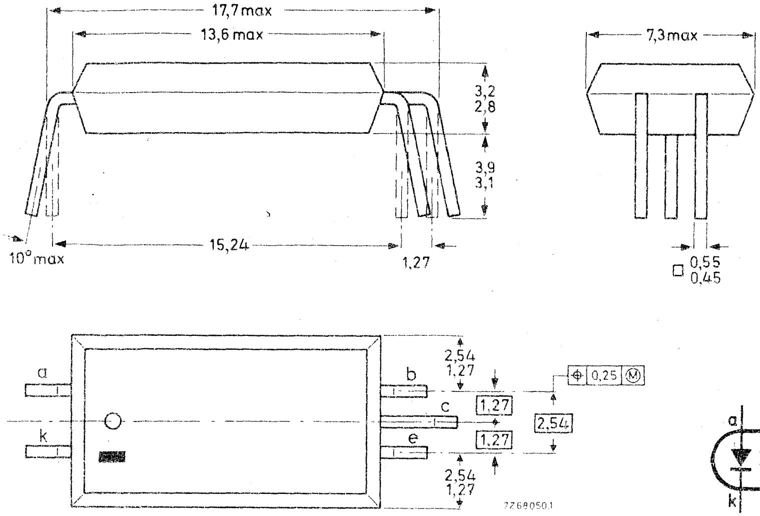
Optically coupled isolators consisting of an infrared emitting GaAs diode and a silicon n-p-n phototransistor. Plastic envelopes. Suitable for TTL integrated circuits.
The CNY23 is the 5 pin version with an accessible transistor base; the CNY43 is the 4 pin version without accessible base.

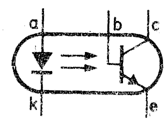
QUICK REFERENCE DATA				
Diode				
Reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 65 °C	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector cut-off 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

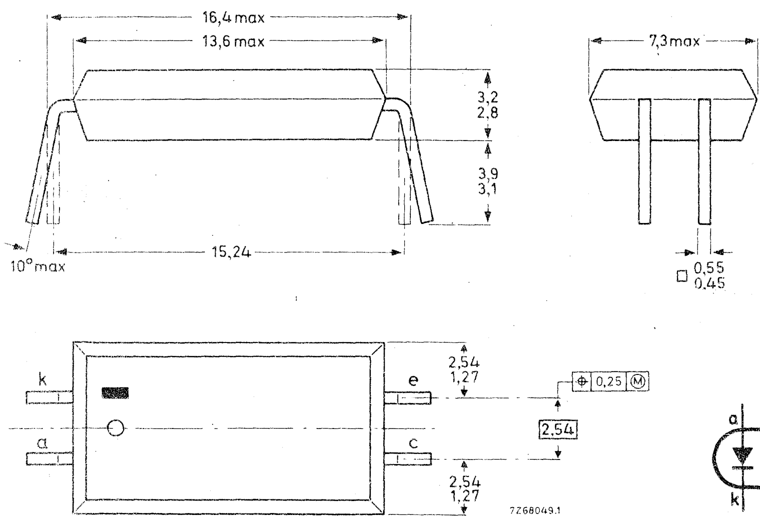
CNY23

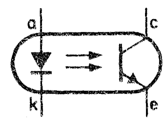




7Z64382

CNY43





7Z65539.1

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

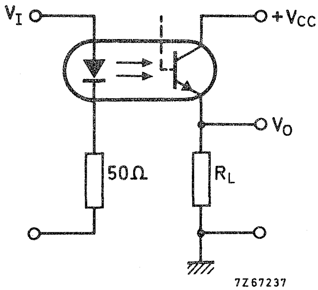
From junction to ambient in free air

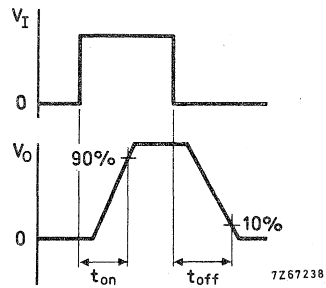
−diode	$R_{th\ j\text{-}a}$	1,2 °C/mW
−transistor	$R_{th\ j\text{-}a}$	0,5 °C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

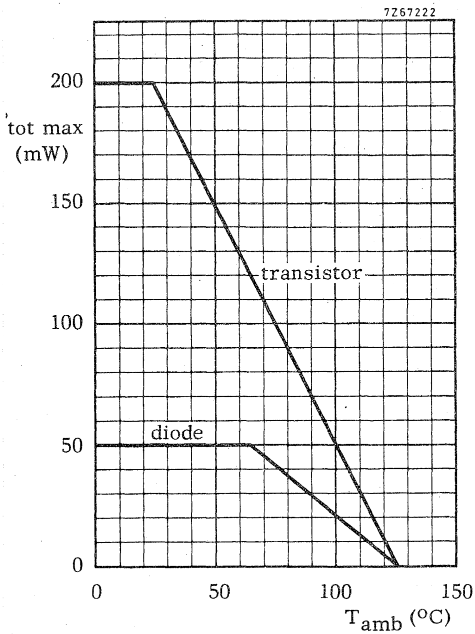
Diode				
Forward voltage, I_F = 8 mA	V_F	typ.	1,2	V
		<	1,6	V
Reverse current, V_R = 2 V	I_R	<	100	µA
Transistor (I_B = 0)				
Collector cut-off current (dark) V_{CE} = 10 V; diode: I_F = 0	I_{CEO}	<	100	nA
		typ.	5	nA
Photocoupler (I_B = 0) [1]				
Output/input d.c. current transfer ratio I_F = 8 mA; 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

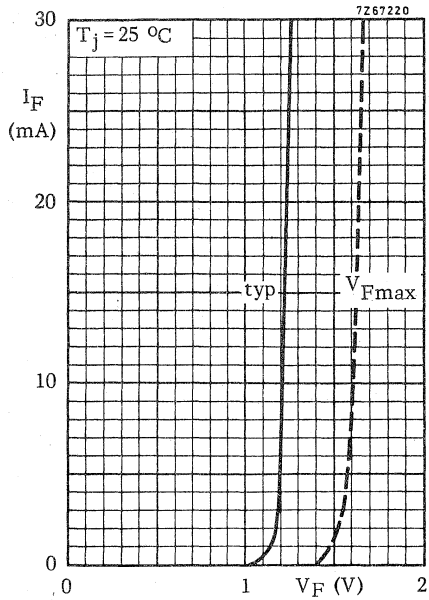
Data on V_I:
$t_r = t_f$ = 20 ns
t_p = 30 µs
f = 500 Hz

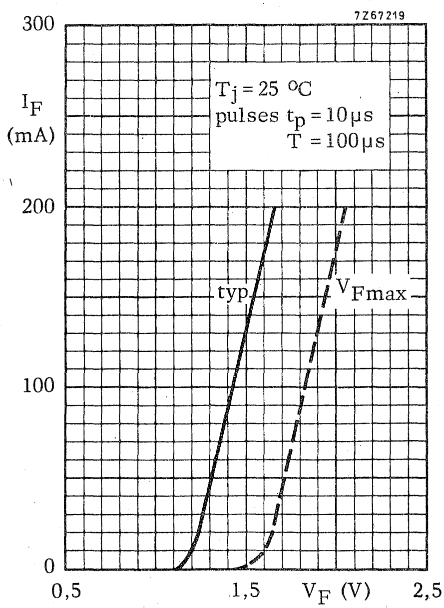


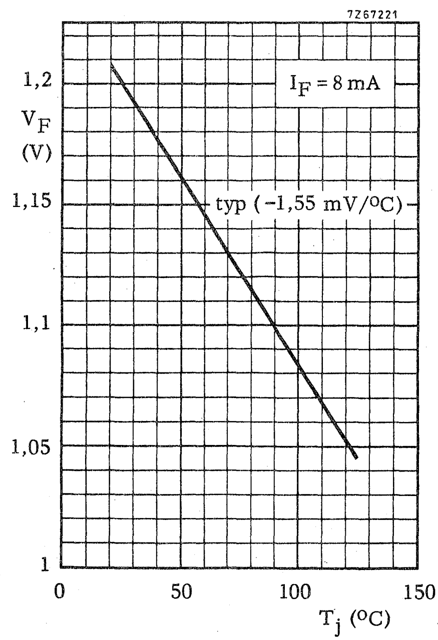


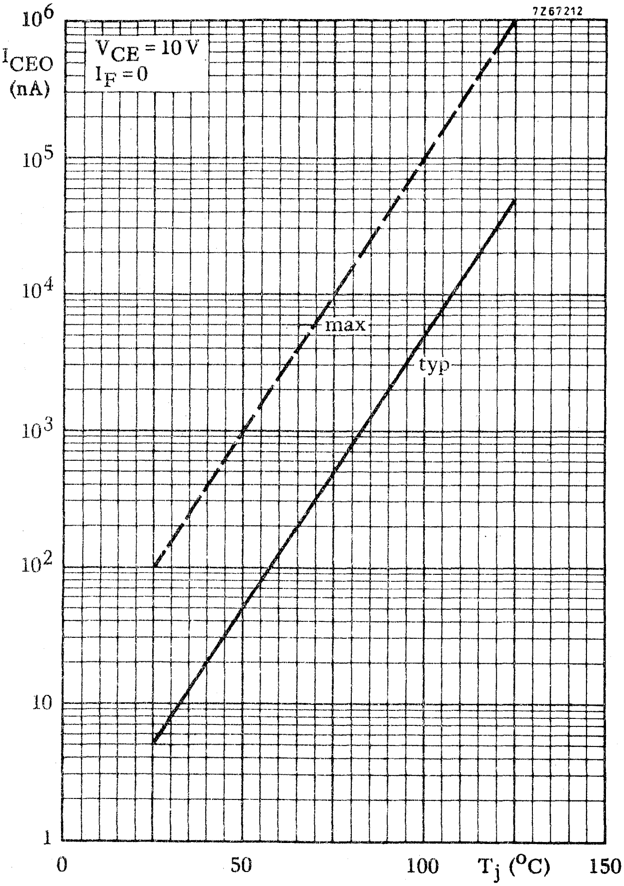
1) Where the phototransistor receives light from the diode the O (for open base) has been omitted from the symbols.
2) Measured with pulses: t_p = 100 µs; T = 1 ms.
3) Aging of the light-emitting diode decreases the transfer ratio at a rate proportional to current and operating time. In circuits that 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.

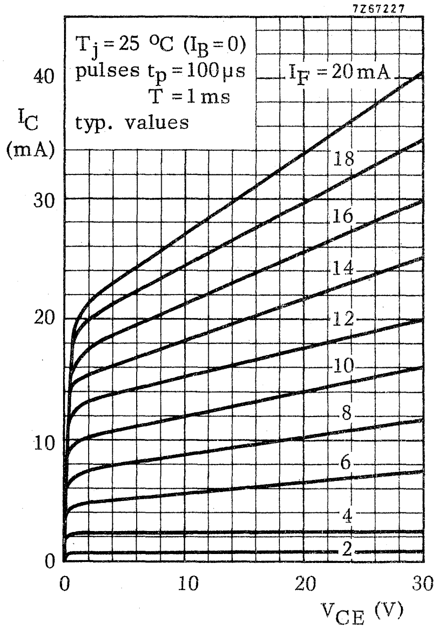

7Z67222
P
tot max
(mW)
200
150
100
50
0
transistor
diode
0
50
100
150
T
amb
(°C)

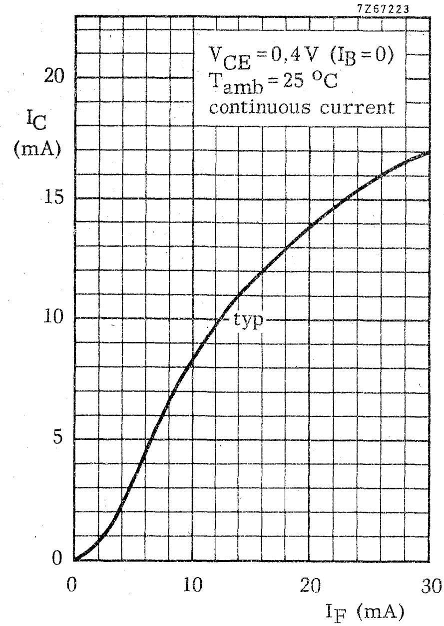

7Z67220
30
20
10
0
I
F
(mA)
T
j
= 25 °C
typ
V
Fmax
0
1
V
F
(V)
2

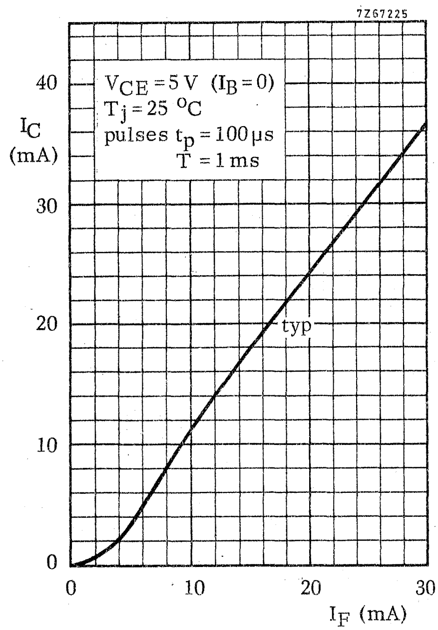

7Z67219
300
200
100
0
I
F
(mA)
T
j
= 25 °C
pulses t
p
= 10 μs
T = 100 μs
typ
V
Fmax
0,5
1,5
V
F
(V)
2,5

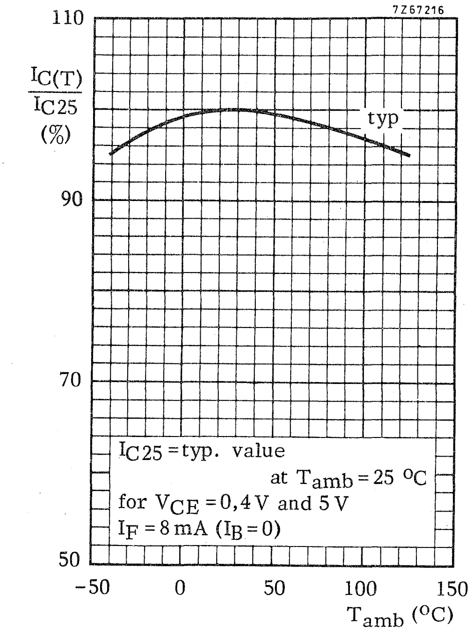

7Z67221
1,2
1,15
1,1
1,05
1
V
F
(V)
I
F
= 8 mA
typ (−1,55 mV/°C)
0
50
100
150
T
j
(°C)

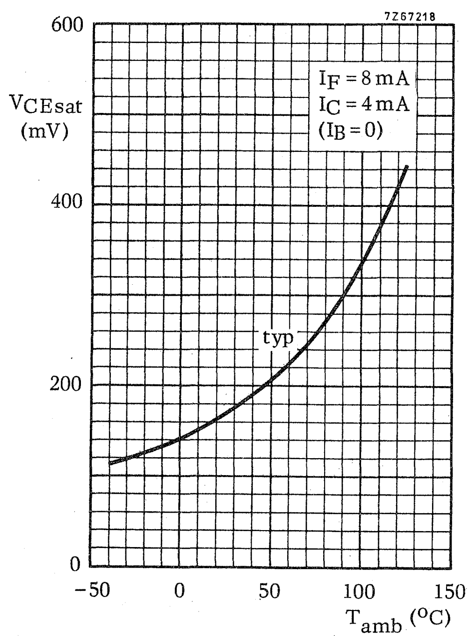

7Z67212
10^6
I_{CEO}
(nA)
$V_{CE} = 10$ V
$I_F = 0$
10^5
10^4
10^3
10^2
10
1
max
typ
0
50
100
T_j (°C)
150


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


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


7Z67225
$V_{CE} = 5$ V ($I_B = 0$)
$T_j = 25$ °C
pulses $t_p = 100$ µs
T = 1 ms
typ
I_C (mA)
I_F (mA)
0
10
20
30
40


7Z67216
110
$\frac{I_{C(T)}}{I_{C25}}$
(%)
typ
90
70
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
−50
0
50
100
150
T_{amb} (°C)


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

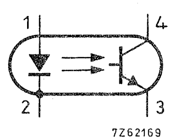
PHOTOCOUPLER

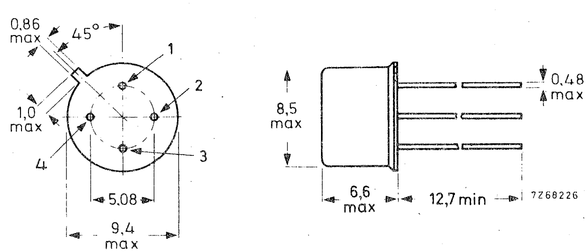
Optically coupled isolater consisting of an infra-red emitting GaAs diode and a silicon n-p-n phototransistor. TO-12 envelope. Suitable for TTL integrated circuits.

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

CHARACTERISTICS

T_j = 25 °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 °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 °C	V_{CEsat}	<	0,4	V	
I_F = 15 mA; I_C = 4,6 mA; T_{amb} = 25 °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	

---

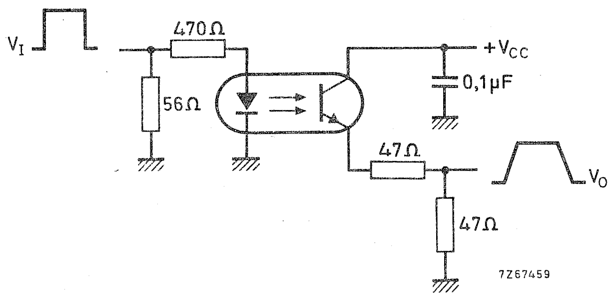
[1] Where the phototransistor receives light from the diode, the O (for open base) has been omitted from the symbols.

[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.

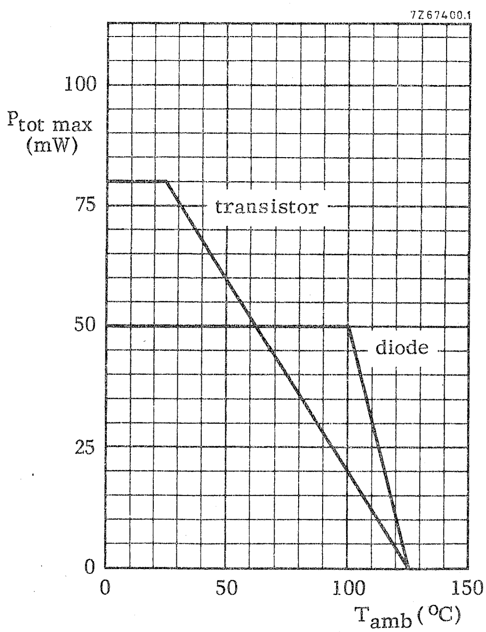
[3] Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

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

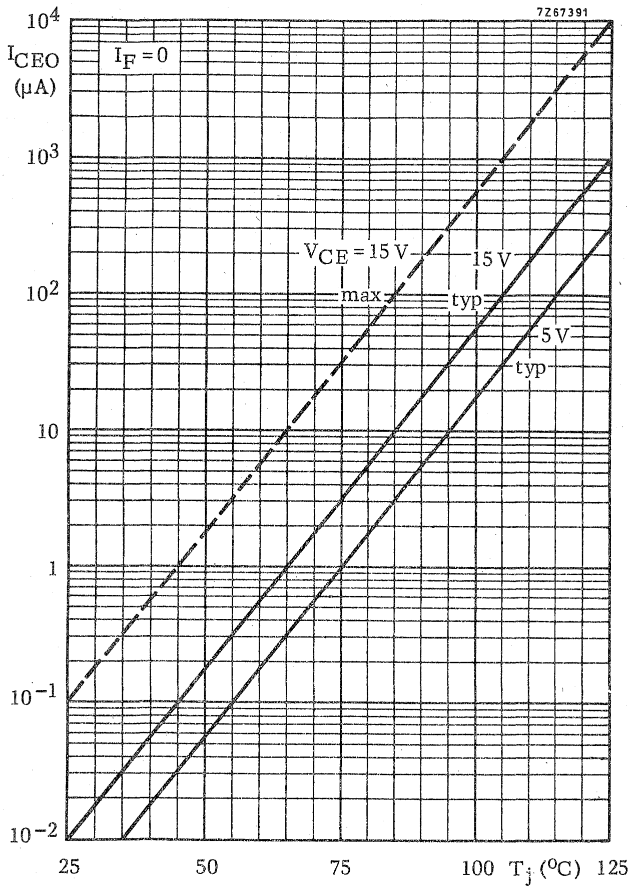
Rise time of output voltage (circuit below) I_{CM} = 2 mA; V_{CC} = 10 V	t_r	typ.	2	μs [1]
Fall time of output voltage (circuit below) I_{CM} = 2 mA; V_{CC} = 10 V	t_f	typ.	2	μs [1]

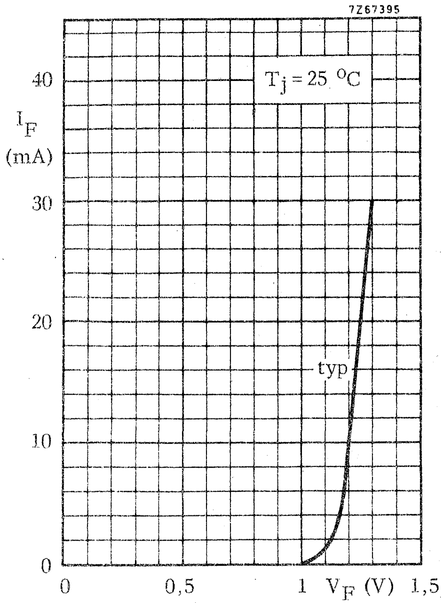


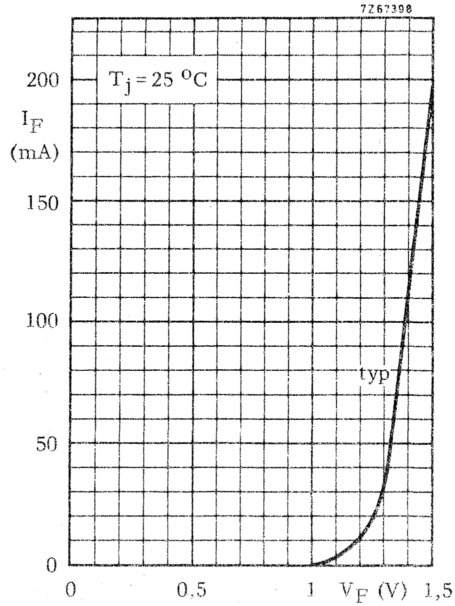
Data on V_I:
$t_r = t_f$ = 20 ns [1]
t_p = 30 μs
f = 500 Hz

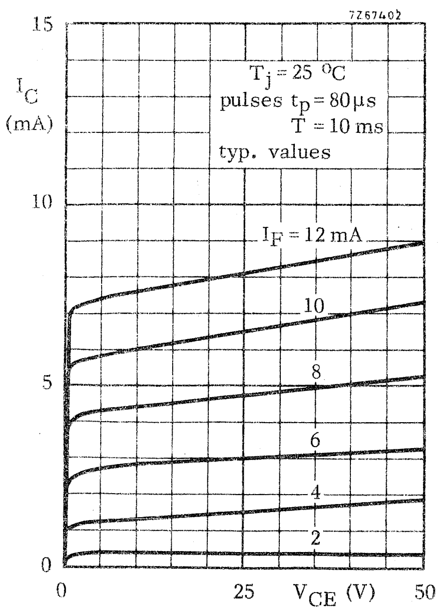


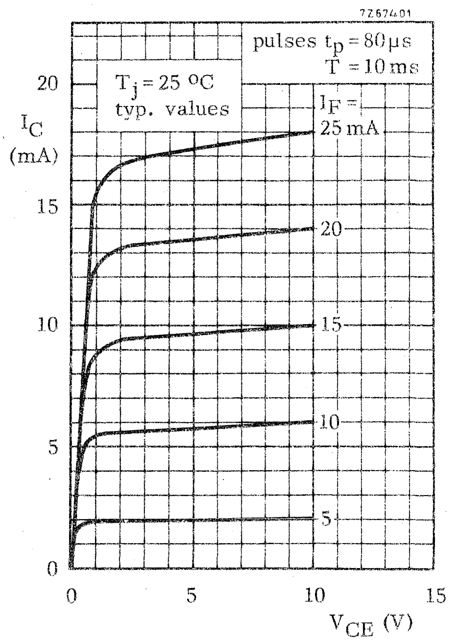
[1] Between the 10% and 90% of the edges.

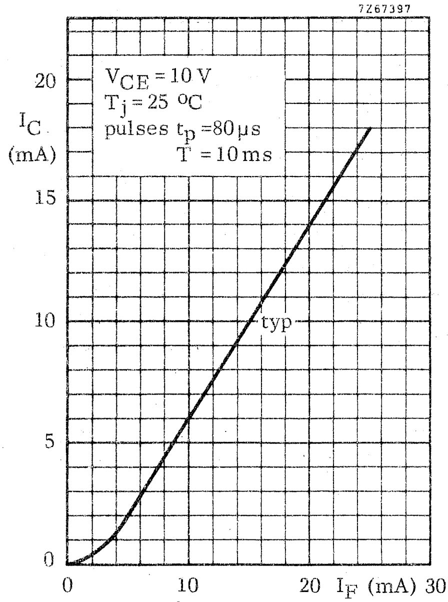

7Z67391
10^4
I_{CEO}
(μA)
$I_F = 0$
10^3
$V_{CE} = 15$ V
max
15 V
typ
10^2
5 V
typ
10
1
10^{-1}
10^{-2}
25
50
75
100
T_j (°C)
125

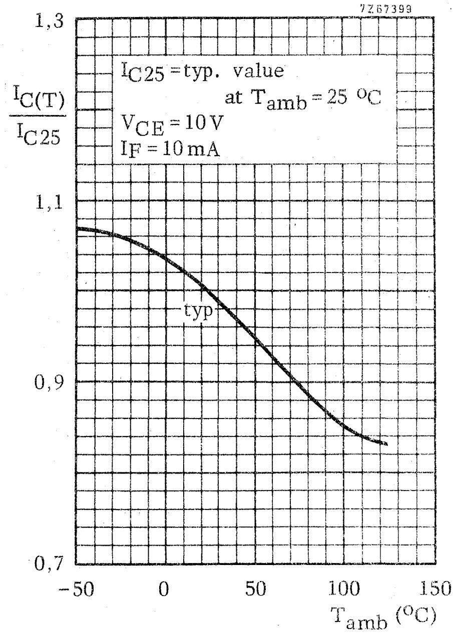

7Z67395
$T_j = 25\ ^oC$
I_F (mA)
40
30
20
10
0
typ
0
0,5
1
V_F (V)
1,5

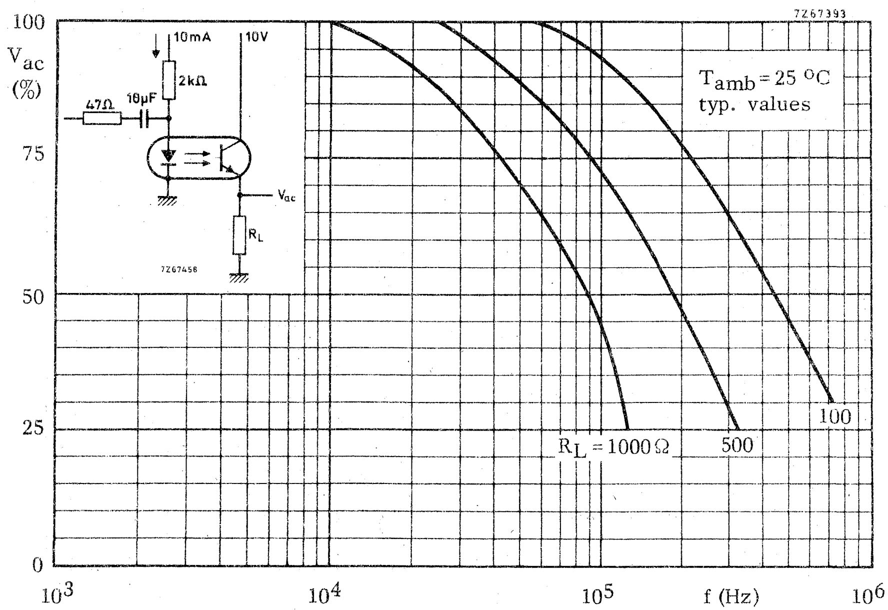

7Z67398
$T_j = 25\ ^oC$
I_F (mA)
200
150
100
50
0
typ
0
0,5
1
V_F (V)
1,5

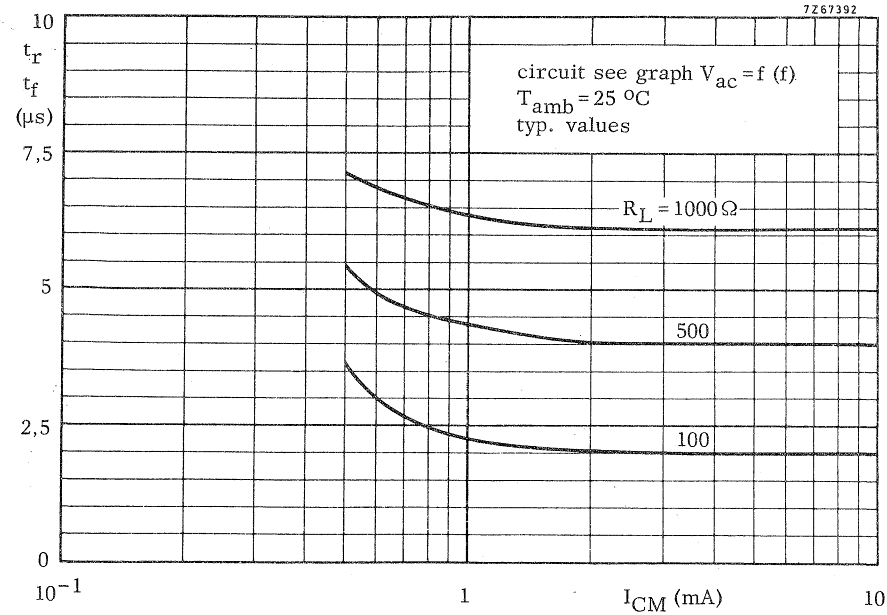

7Z67402
15
I_C (mA)
10
5
0
$T_j = 25\ ^oC$
pulses $t_p = 80\ \mu s$
T = 10 ms
typ. values
I_F = 12 mA
10
8
6
4
2
0
25
V_{CE} (V)
50

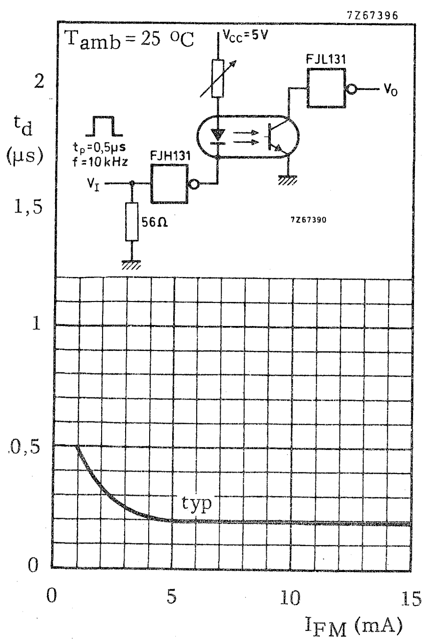

7Z67401
pulses $t_p = 80\ \mu s$
T = 10 ms
$T_j = 25\ ^oC$
typ. values
I_F =
25 mA
20
15
10
5
I_C (mA)
20
15
10
5
0
0
5
10
15
V_{CE} (V)

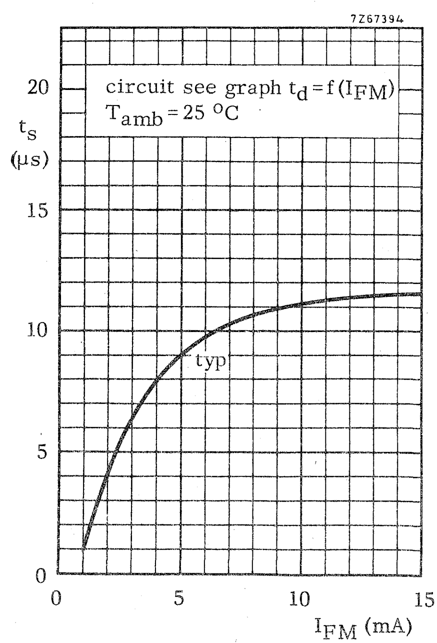

7Z67397
VCE = 10 V
Tj = 25 oC
pulses tp = 80 µs
T = 10 ms
IC
(mA)
typ
20
15
10
5
0
0
10
20
IF (mA)
30


7Z67399
IC25 = typ. value
at Tamb = 25 oC
VCE = 10 V
IF = 10 mA
IC(T)
IC25
typ
1,3
1,1
0,9
0,7
−50
0
50
100
150
Tamb (oC)


7Z67393
Vac
(%)
100
75
50
25
0
10mA
10V
2kΩ
47Ω
10µF
Vac
RL
7Z67456
Tamb = 25 oC
typ. values
RL = 1000 Ω
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
circuit see graph $V_{ac} = f$ (f)
$T_{amb} = 25$ °C
typ. values
$R_L = 1000\,\Omega$
500
100
10^{-1}
1
I_{CM} (mA)
10


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


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

PHOTOCOUPLER

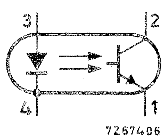
Optically coupled isolater consisting of an infrared emitting GaAs diode and a silicon n-p-n phototransistor. TO-12 envelope. Suitable for TTL integrated ciruits. Only difference between CNY44 and CNY46 is in the pin connections.

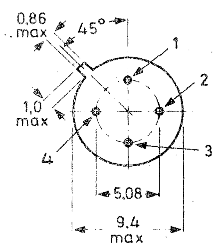
QUICK REFERENCE DATA				
Diode				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 100 °C	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector 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

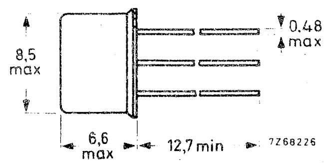
MECHANICAL DATA

Dimensions in mm

TO-12







Cathode (4) connected to case.

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

ALL OTHER DATA IDENTICAL TO CNY44

PHOTOCOUPLERS

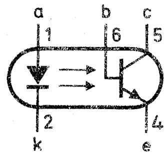
Optically coupled isolators consisting of an infra-red emitting GaAs diode and a silicon n-p-n phototransistor. Plastic 6 lead dual in-line envelopes. Suitable for TTL integrated circuits.

QUICK REFERENCE DATA

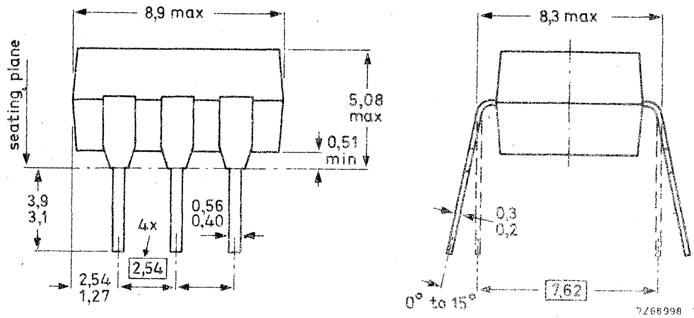
Diode					
Continuous reverse voltage	V_R	max.	3		V
Forward current (d.c.)	I_F	max.	30		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100		mW
Transistor					
Collector-emitter voltage (open base)	V_{CEO}	max.	30		V
Collector cut-off current (dark) V_{CE} = 10 V; diode: I_F = 0	I_{CEO}	<	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

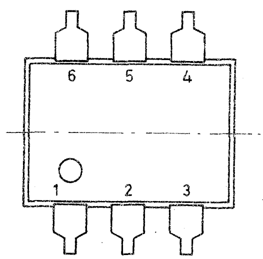
MECHANICAL DATA See page 2.

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 μs; $\delta < 0,1$	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100	mW
Operating junction temperature	T_j	max.	100	°C

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 °C	P_{tot}	max.	150	mW
Operating junction temperature	T_j	max.	100	°C

Photocoupler

Storage temperature	T_{stg}	−55 to +150	°C

THERMAL RESISTANCE

From junction to ambient in free air - diode	$R_{th\ j-a}$	0,75	°C/mW
- transistor	$R_{th\ j-a}$	0,5	°C/mW
From junction to ambient, device mounted on a p.c. board [1]) - diode	$R_{th\ j-a}$	0,6	°C/mW
- transistor	$R_{th\ j-a}$	0,4	°C/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	V
		<	1,5	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	nA
		<	100	nA
$V_{CB} = 10$ V	I_{CBO}	<	20	nA

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	>	0,2	0,4	
		typ.	0,3	0,6	[2]
Collector-emitter saturation voltage					
$I_F = 10$ mA; $I_C = 2$ mA	V_{CEsat}	typ.	0,2		V
		<	0,4		V
$I_F = 10$ mA; $I_C = 4$ mA	V_{CEsat}	typ.		0,2	V
		<		0,4	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

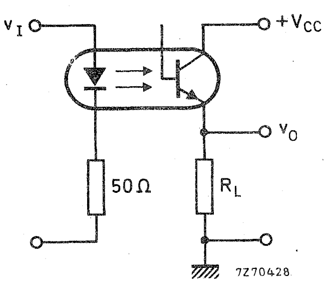
[1] Where the phototransistor receives light from the diode, the O (for open terminal) has been omitted from the symbols.

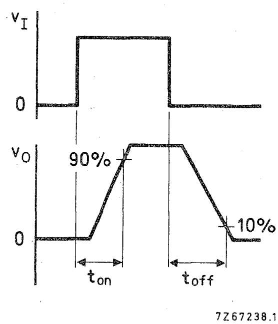
[2] Aging of the light-emitting diode reduces the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

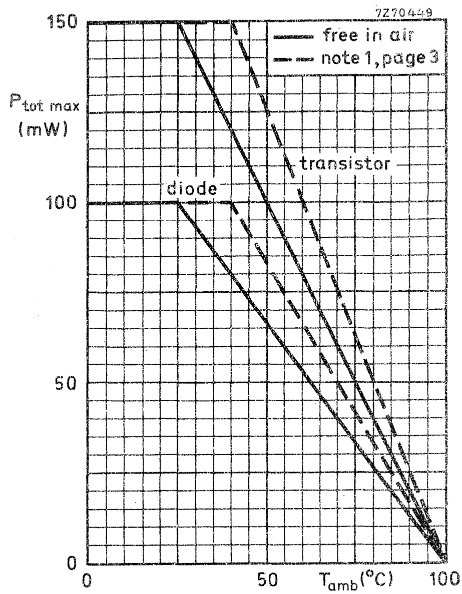
[3] Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

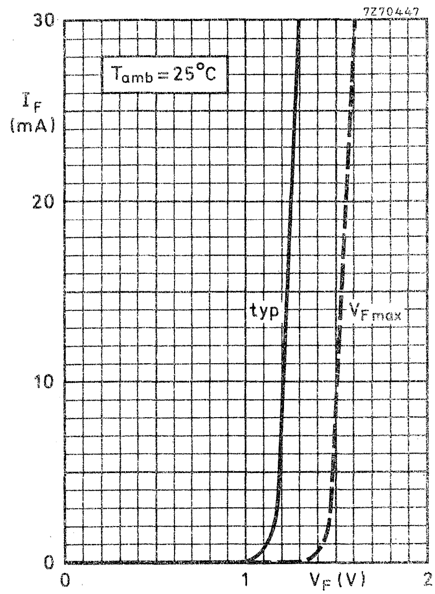
CHARACTERISTICS (continued)

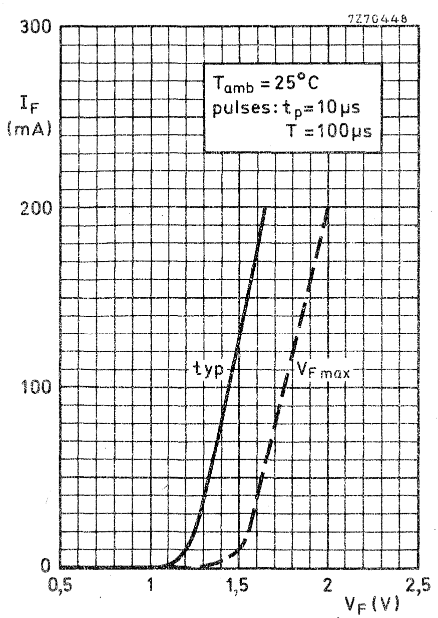
			CNY47	CNY47A	
Insulation resistance between input and output					
V_{IO} = 500 V	r_{IO}	>	10^{11}	10^{11}	Ω
		typ.	10^{12}	10^{12}	Ω
Switching times (circuit below)					
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.	3		μs
Turn-off time	t_{off}	typ.	3		μs
I_{Con} = 4 mA; V_{CC}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

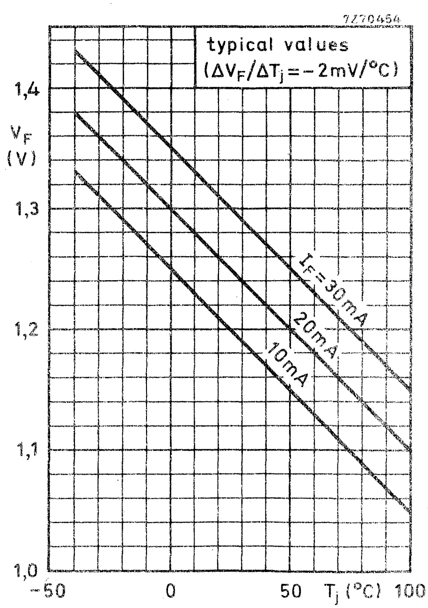


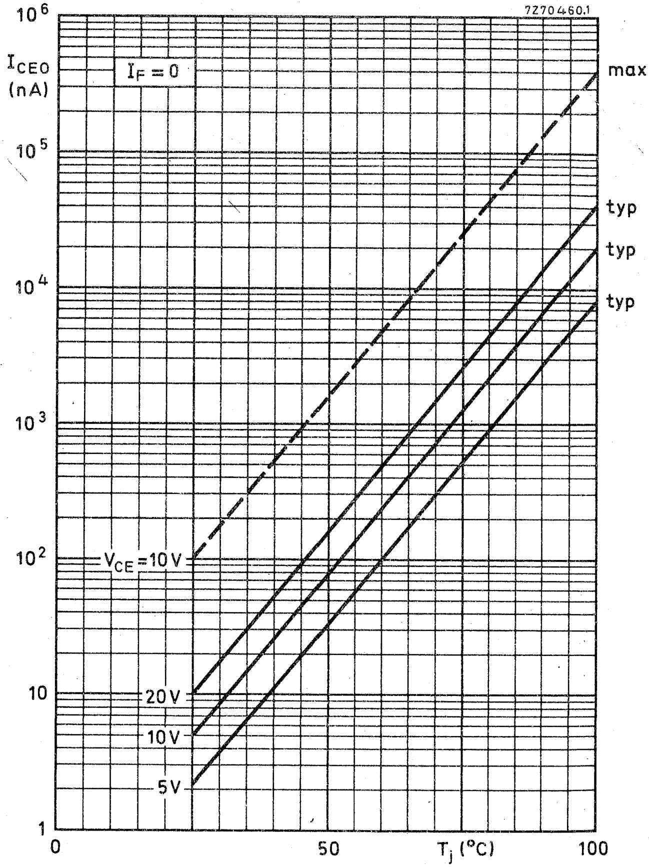


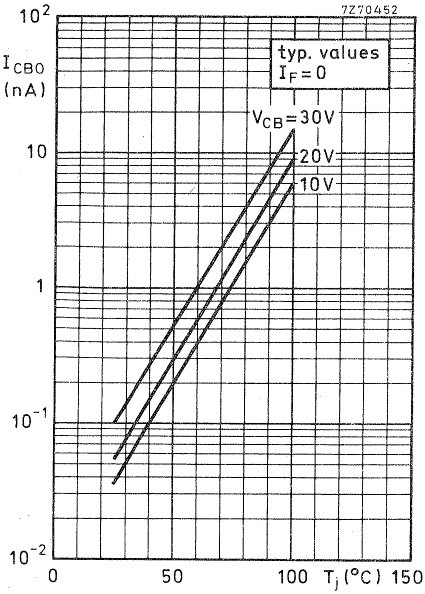

7Z70449
free in air
note 1, page 3
$P_{tot\ max}$ (mW)
transistor
diode
150
100
50
0
0
50
T_{amb} (°C)
100

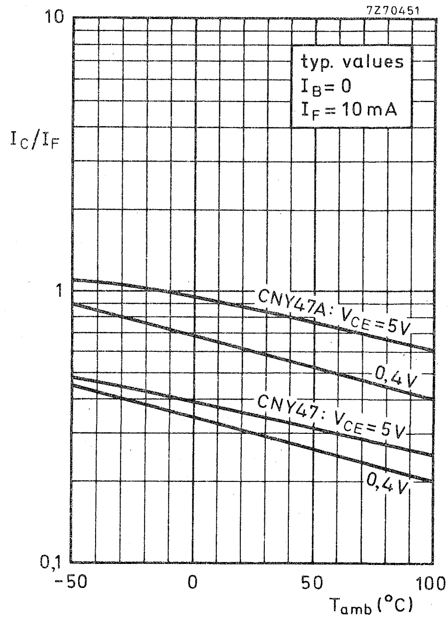

7Z70447
$T_{amb} = 25\,°C$
I_F (mA)
typ
$V_{F\,max}$
30
20
10
0
0
1
V_F (V)
2

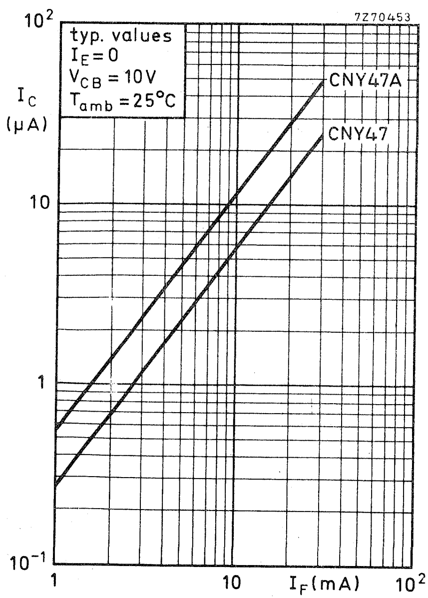

7Z70448
$T_{amb} = 25\,°C$
pulses: $t_p = 10\,\mu s$
$T = 100\,\mu s$
I_F (mA)
typ
$V_{F\,max}$
300
200
100
0
0,5
1
1,5
2
2,5
V_F (V)

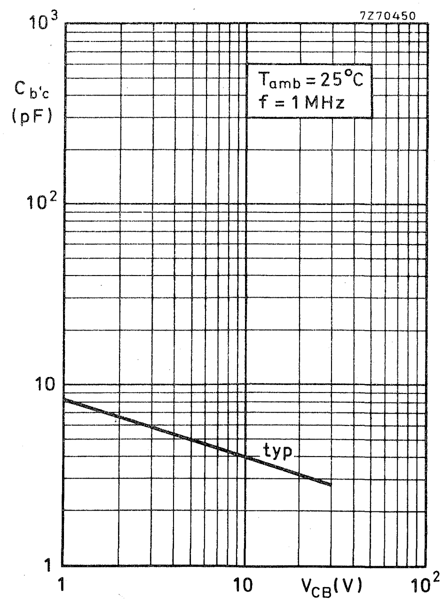

7Z70454
typical values
($\Delta V_F/\Delta T_j = -2\,mV/°C$)
V_F (V)
$I_F = 30\,mA$
20mA
10mA
1,4
1,3
1,2
1,1
1,0
−50
0
50
T_j (°C)
100

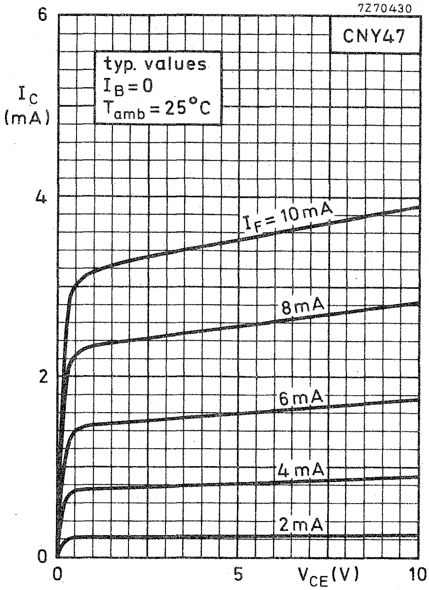

7Z70460.1
I_{CEO} (nA)
$I_F = 0$
10^6
10^5
10^4
10^3
10^2
10
1
max
typ
typ
typ
V_{CE} = 10 V
20 V
10 V
5 V
0
50
T_j (°C)
100

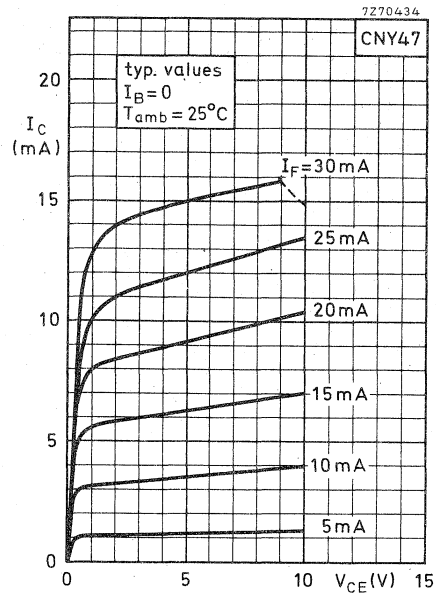

7Z70452
typ. values
$I_F = 0$
I_{CBO} (nA)
$V_{CB} = 30V$
20V
10V
10^2
10
1
10^{-1}
10^{-2}
0
50
100
T_j (°C)
150

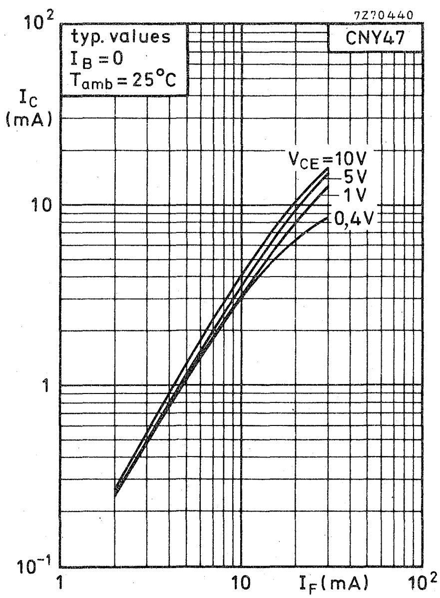

7Z70451
typ. values
$I_B = 0$
$I_F = 10$ mA
I_C/I_F
CNY47A: $V_{CE} = 5V$
0,4V
CNY47: $V_{CE} = 5V$
0,4V
10
1
0,1
−50
0
50
100
T_{amb} (°C)

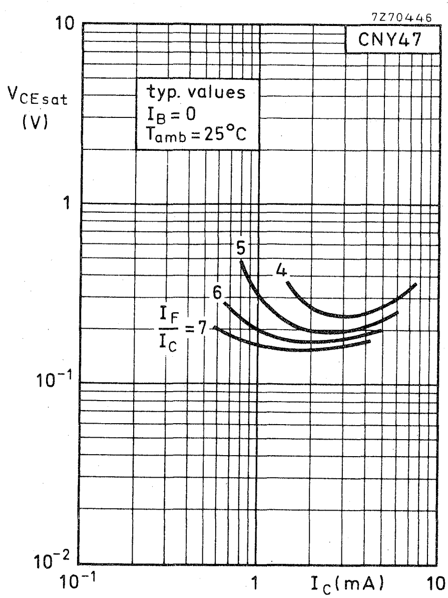

7Z70453
typ. values
$I_E = 0$
$V_{CB} = 10V$
$T_{amb} = 25°C$
I_C (µA)
CNY47A
CNY47
10^2
10
1
10^{-1}
1
10
I_F (mA)
10^2

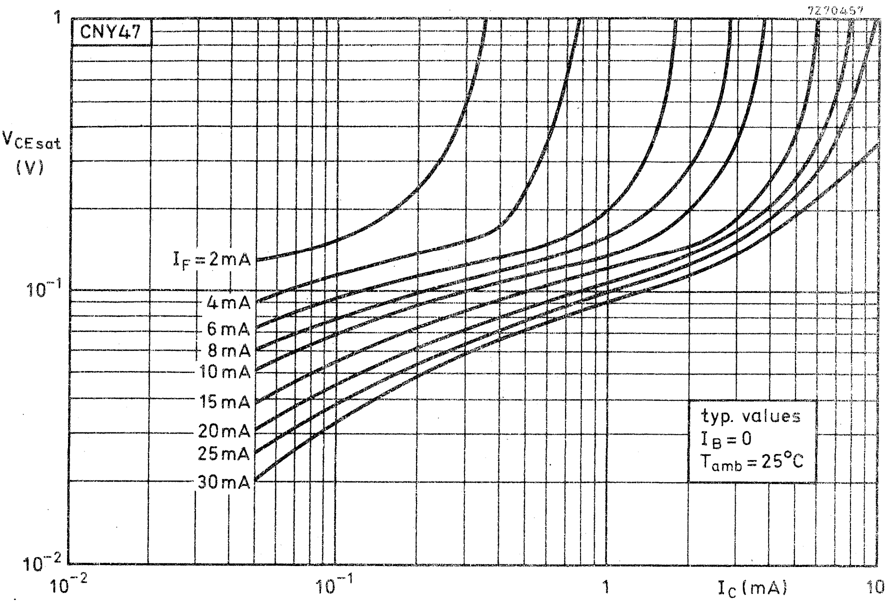

7Z70450
$T_{amb} = 25°C$
f = 1 MHz
$C_{b'c}$ (pF)
typ
10^3
10^2
10
1
1
10
V_{CB} (V)
10^2

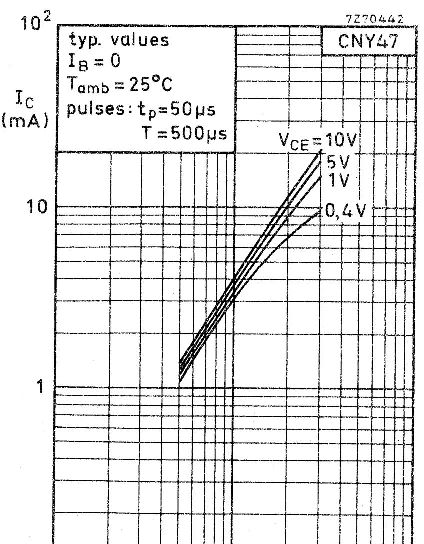

7Z70430
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
$I_F = 10$ mA
8 mA
6 mA
4 mA
2 mA
V_{CE} (V)
0
2
4
6
5
10

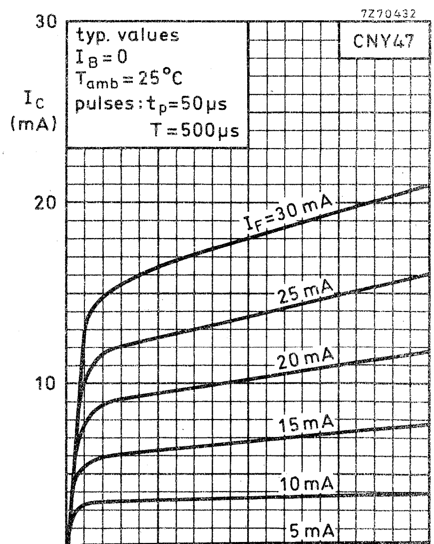

7Z70434
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
V_{CE} (V)
0
5
10
15
20

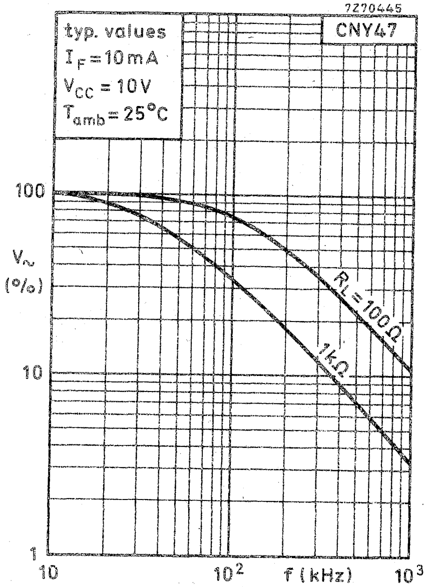

7Z70440
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
$V_{CE} = 10$ V
5 V
1 V
0,4 V
I_F (mA)
10^{-1}
1
10
10^2

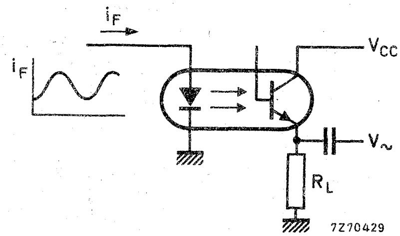

7Z70446
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
V_{CEsat} (V)
$\frac{I_F}{I_C} = 7$
6
5
4
I_C (mA)
10^{-2}
10^{-1}
1
10

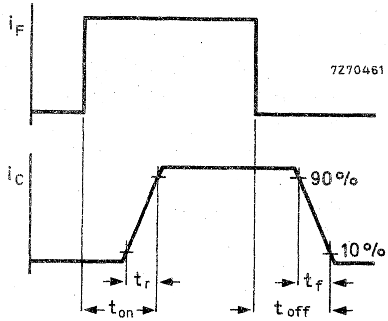

7Z70457
CNY47
V_{CEsat}
(V)
$I_F = 2mA$
4 mA
6 mA
8 mA
10 mA
15 mA
20 mA
25 mA
30 mA
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)

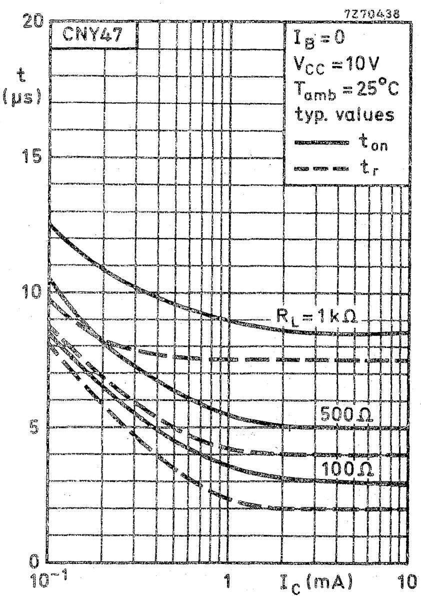

7Z70442
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: t_p=50μs
T = 500μs
I_C
(mA)
V_{CE} = 10V
5V
1V
0,4V
I_F (mA)

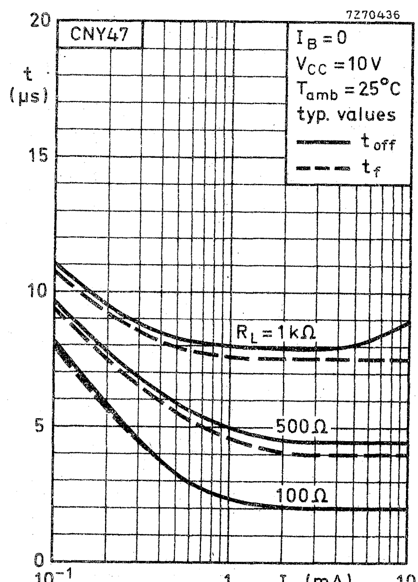

7Z70432
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: t_p=50μs
T = 500μs
I_C
(mA)
I_F=30 mA
25 mA
20 mA
15 mA
10 mA
5 mA
V_{CE} (V)

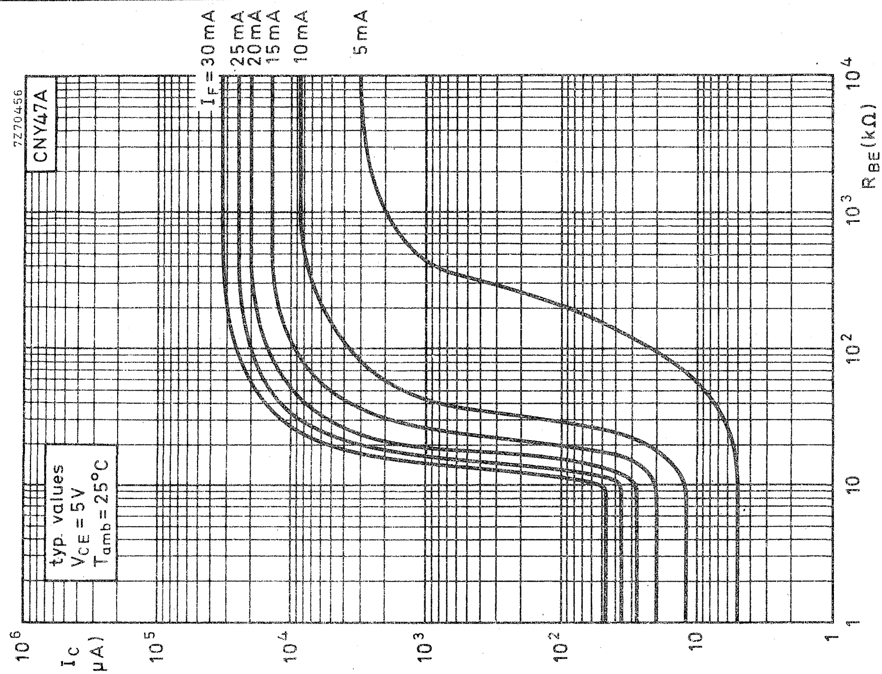

7Z70445
typ. values
$I_F = 10\,mA$
$V_{CC} = 10\,V$
$T_{amb} = 25\,^{\circ}C$
CNY47
$V_{\sim}$
(%)
$R_L = 100\,\Omega$
$1\,k\Omega$
100
10
1
10
10^2
f (kHz)
10^3

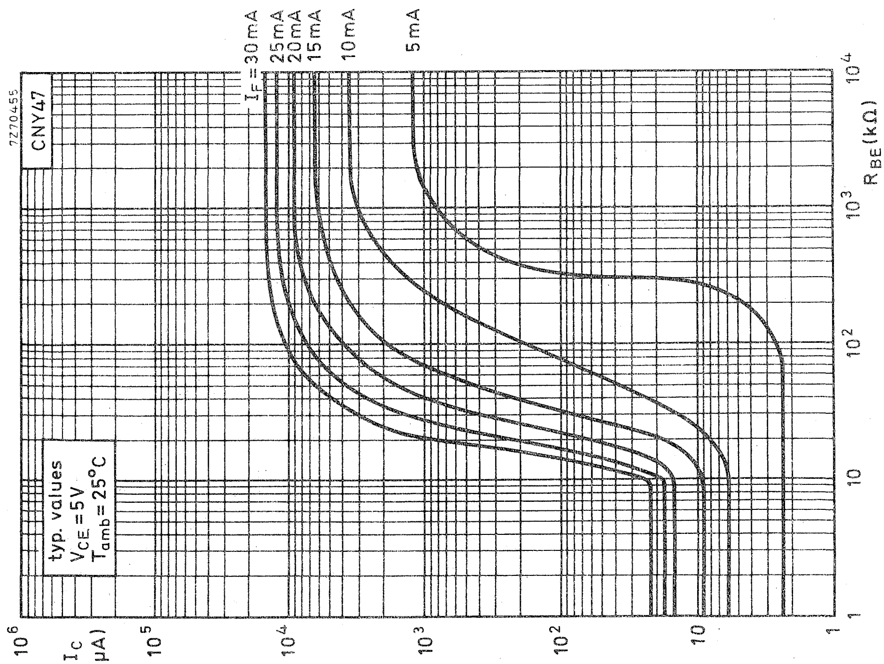

i_F
V_{CC}
$V_{\sim}$
R_L
7Z70429

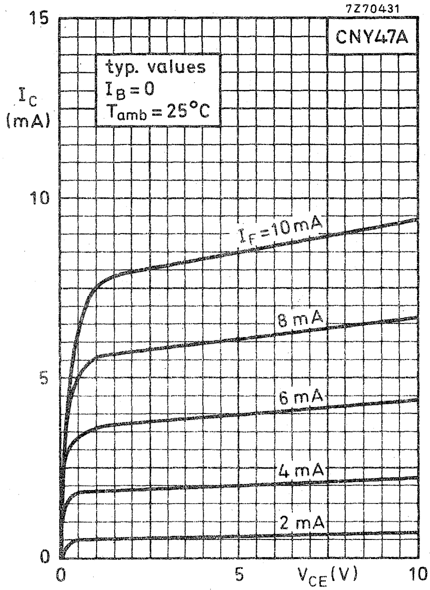

i_F
7Z70461
i_C
90 %
10 %
t_r
t_f
t_{on}
t_{off}

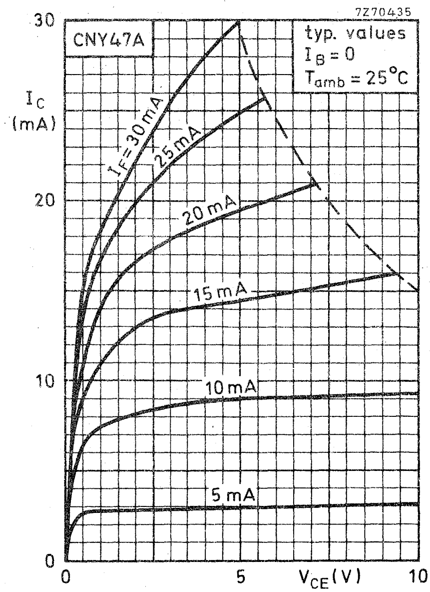

7Z70438
CNY47
$I_B = 0$
$V_{CC} = 10\,V$
$T_{amb} = 25\,^{\circ}C$
typ. values
t_{on}
t_r
t
(μs)
$R_L = 1\,k\Omega$
$500\,\Omega$
$100\,\Omega$
20
15
10
5
0
10^{-1}
1
I_C (mA)
10

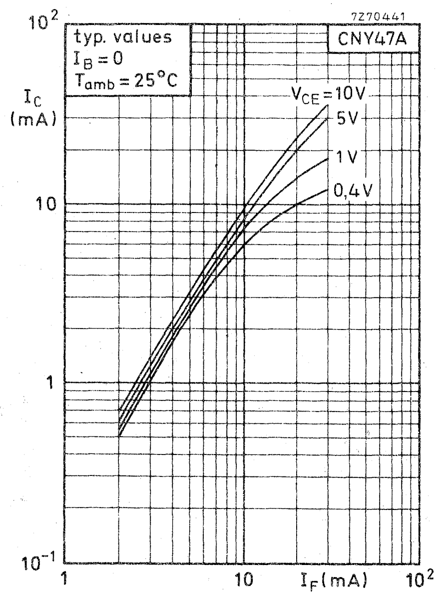

7Z70436
CNY47
$I_B = 0$
$V_{CC} = 10\,V$
$T_{amb} = 25\,^{\circ}C$
typ. values
t_{off}
t_f
t
(μs)
$R_L = 1\,k\Omega$
$500\,\Omega$
$100\,\Omega$
20
15
10
5
0
10^{-1}
1
I_C (mA)
10

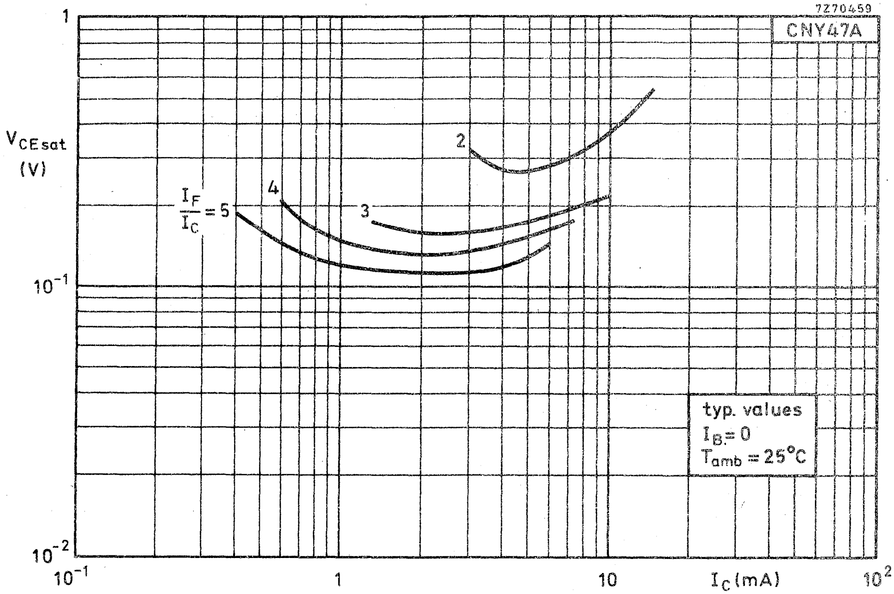

7Z70456
CNY47A
typ. values
V_{CE} = 5V
T_{amb} = 25°C
I_F = 30 mA
25 mA
20 mA
15 mA
10 mA
5 mA
I_C (μA)
10^6
10^5
10^4
10^3
10^2
10
1
R_{BE} (kΩ)
1
10
10^2
10^3
10^4

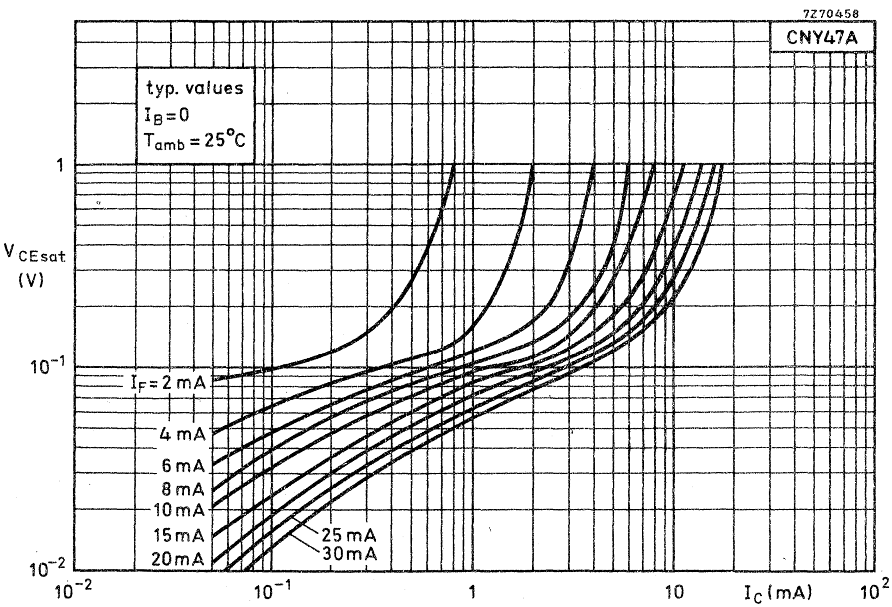

7Z70455
CNY47
typ. values
V_{CE} = 5V
T_{amb} = 25°C
I_F = 30 mA
25 mA
20 mA
15 mA
10 mA
5 mA
I_C (μA)
10^6
10^5
10^4
10^3
10^2
10
1
R_{BE} (kΩ)
1
10
10^2
10^3
10^4

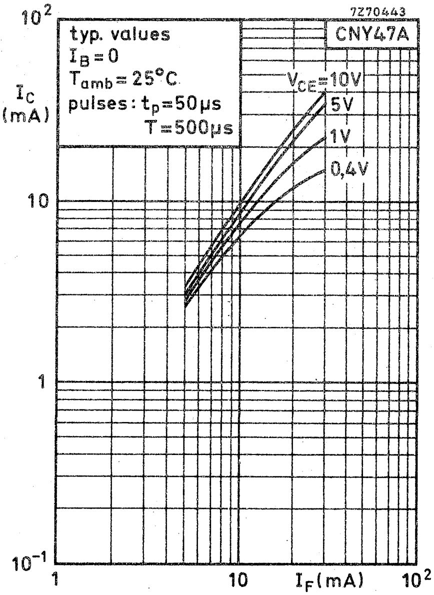

7Z70431
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
$I_F = 10$ mA
8 mA
6 mA
4 mA
2 mA
V_{CE} (V)
0
5
10
15

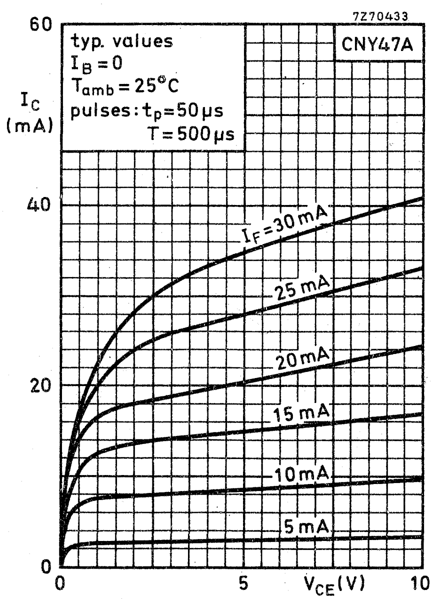

7Z70435
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
V_{CE} (V)
0
5
10
20
30

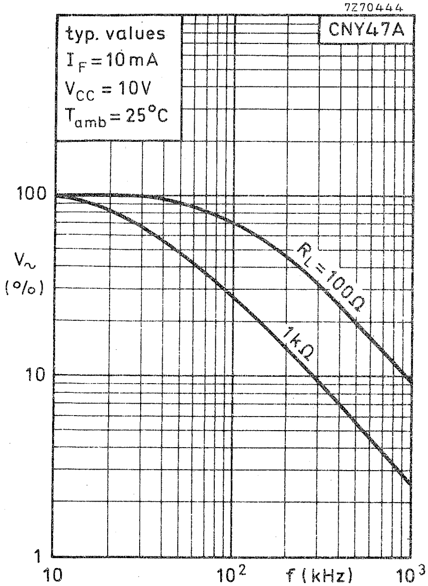

7Z70441
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
$V_{CE} = 10$ V
5V
1V
0,4V
I_F (mA)
10^{-1}
1
10
10^2

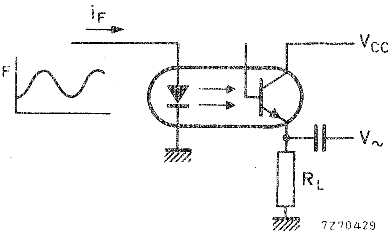

7Z70459
CNY47A
V_{CEsat} (V)
1
10^{-1}
10^{-2}
2
3
4
$\frac{I_F}{I_C} = 5$
typ. values
$I_B = 0$
$T_{amb} = 25°C$
10^{-1}
1
10
I_C (mA)
10^2

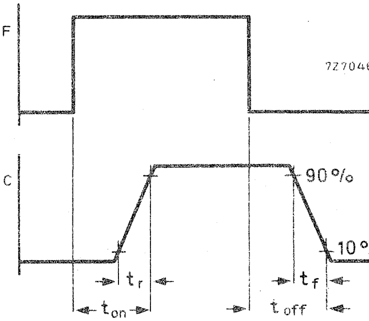

7Z70458
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
V_{CEsat} (V)
1
10^{-1}
10^{-2}
$I_F = 2$ mA
4 mA
6 mA
8 mA
10 mA
15 mA
20 mA
25 mA
30 mA
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2

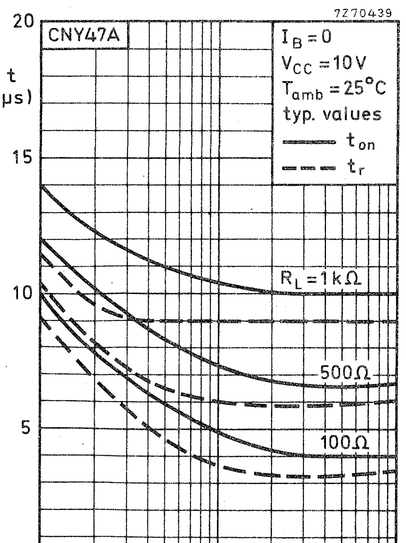

7Z70443
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: $t_p = 50 \mu s$
$T = 500 \mu s$
I_C (mA)
$V_{CE} = 10V$
5V
1V
0,4V
10^2
10
1
10^{-1}
1
10
I_F (mA)
10^2

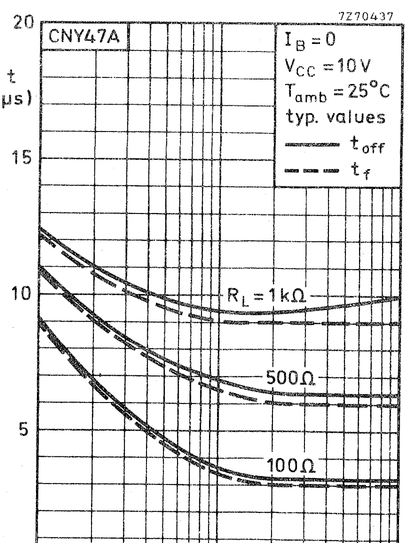

7Z70433
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: $t_p = 50 \mu s$
$T = 500 \mu s$
I_C (mA)
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
60
40
20
0
0
5
V_{CE} (V)
10


7Z70444
typ. values
I_F = 10 mA
V_{CC} = 10 V
T_{amb} = 25 °C
CNY47A
$V_\sim$ (%)
100
10
1
R_L = 100 Ω
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
CNY47A
I_B = 0
V_{CC} = 10 V
T_{amb} = 25 °C
typ. values
t_{on}
t_r
t (μs)
20
15
10
5
0
R_L = 1 kΩ
500 Ω
100 Ω
10^{-1}
1
I_C (mA)
10


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

PHOTOCOUPLER

Optically coupled isolator consisting of an infrared emitting GaAs diode and a silicon n-p-n Darlington phototransistor. Plastic 6 lead dual-in line envelope. Suitable for TTL integrated circuits.

QUICK REFERENCE DATA

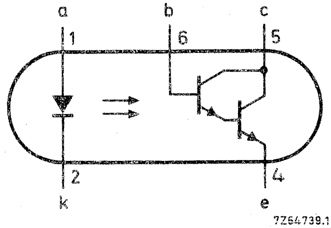
Diode				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	60	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector cut-off current (dark) V_{CE} = 10 V; diode : I_F = 0	I_{CEO}	<	100	nA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150	mW
Photocoupler				
Output/input d.c. current transfer ratio I_F = 10 mA; I_B = 0; V_{CE} = 1 V	I_C/I_F	>	6	
Collector-emitter saturation voltage I_F = 5 mA; I_B = 0; I_C = 10 mA	V_{CEsat}	<	0,8	V
I_F = 10 mA; I_B = 0; I_C = 60 mA	V_{CEsat}	<	1,0	V
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	>	1500	V

MECHANICAL DATA See page 2.

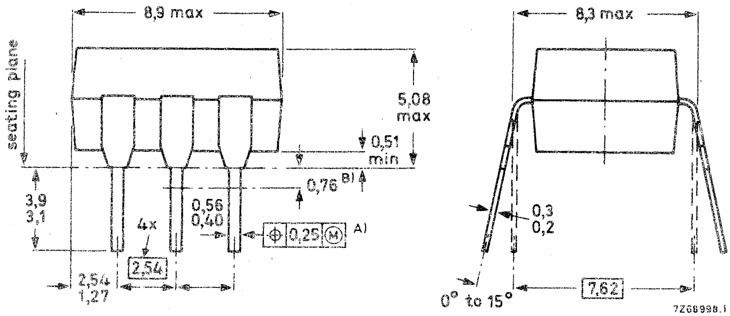
MECHANICAL DATA

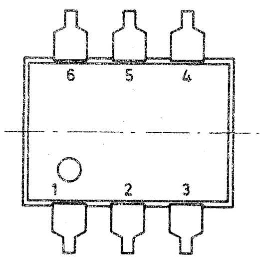
Dimensions in mm

SOT-90



3 = n. c.





A) Centre lines of all leads are within ±0, 127 mm of the nominal positions shown: in the worst case, the spacing between adjacent leads may deviate from nominal by ±0, 254 mm.

B) Tolerances of note A within this distance.

⊕ Locational truth

Ⓜ Maximum Material Condition

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.	60	mA
Forward current (peak value) t_p < 10 μs; f = 300 Hz	I_{FM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100	mW
Junction temperature	T_j	max.	100	°C

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	V
Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value) t_p < 100 μs; T = 1 ms	I_{CM}	max.	150	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150	mW
Junction temperature	T_j	max.	100	°C

Photocoupler

Storage temperature	T_{stg}	−55 to +100	°C

THERMAL RESISTANCE

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

CHARACTERISTICS

Diode $T_j = 25\ ^oC$					
Forward voltage, $I_F = 10$ mA	V_F	typ.	1,2	V	
		$<$	1,5	V	
Reverse current, $V_R = 3$ V	I_R	$<$	10	µA	
Diode capacitance, $V_R = 0$; f = 1 MHz	C_d	typ.	80	pF	
Transistor (diode: $I_F = 0$) $T_j = 25\ ^oC$					
Collector cut-off current (dark)					
$V_{CE} = 10$ V	I_{CEO}	$<$	100	nA	
Photocoupler ($I_B = 0$, $T_{amb} = 25\ ^oC$ unless otherwise specified) [1]					
Output/input d.c. current transfer ratio					
$I_F = 10$ mA; $V_{CE} = 1$ V	I_C/I_F	$>$	6		[2]
Collector-emitter saturation voltage					
$I_F = 5$ mA; $I_C = 10$ mA	V_{CEsat}	$<$	0,8	V	
$I_F = 10$ mA; $I_C = 60$ mA	V_{CEsat}	$<$	1	V	
Isolation voltage, r.m.s. value	$V_{IO(RMS)}$	$>$	1500	V	[3]
Capacitance between input and output $I_F = 0$; V = 0; f = 1 MHz	C_{io}	typ.	1	pF	

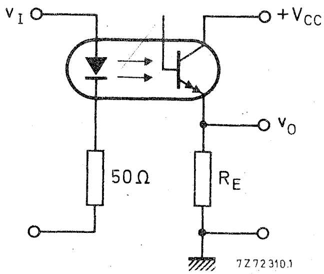
1) Where the phototransistor receives light from the diode, the O (for open terminal) has been omitted from the symbols.

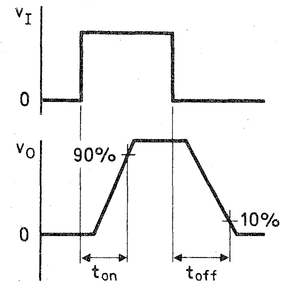
2) Aging of the light-emitting diode reduces the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

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

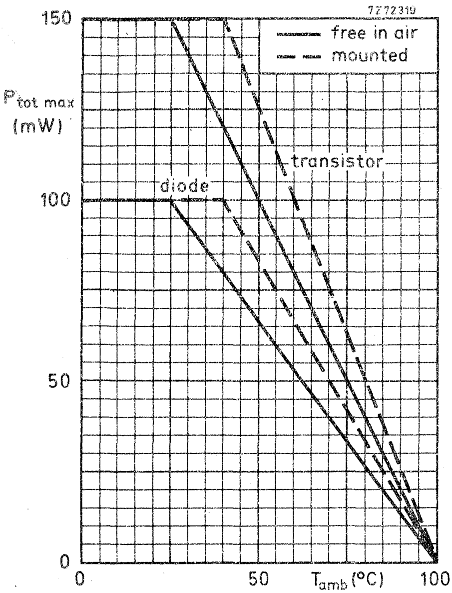
CHARACTERISTICS (continued) T_{amb} = 25 °C, unless otherwise specified

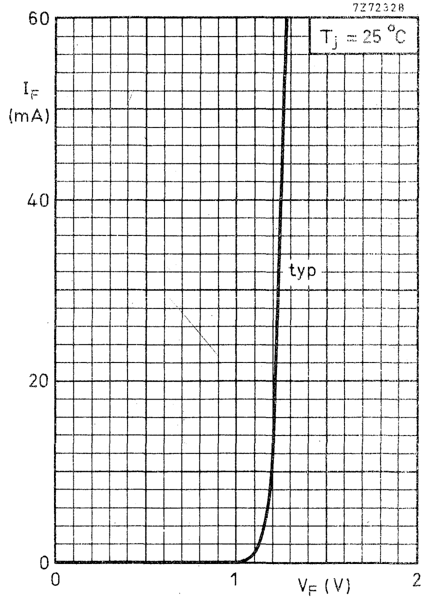
Insulation resistance between input and output				
V_{IO} = 1500 V	r_{IO}	typ.	10^{11}	Ω
Switching times (circuit below)				
I_{Con} = 10 mA; V_{CC} = 10 V; R_E = 100 Ω				
Turn-on time	t_{on}	typ.	68	µs
Turn-off time	t_{off}	typ.	37	µs

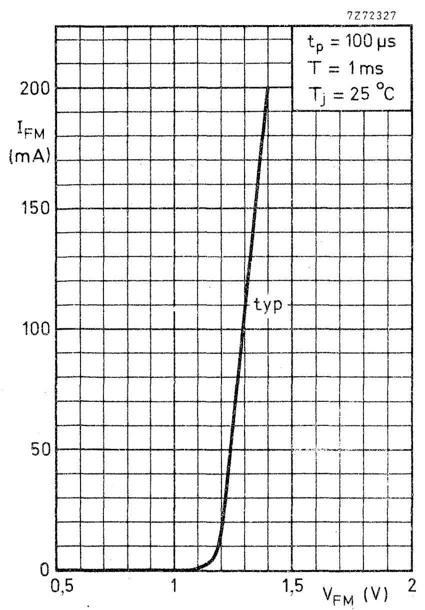


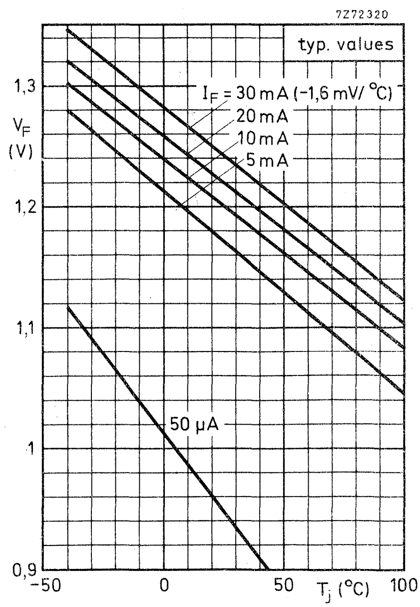


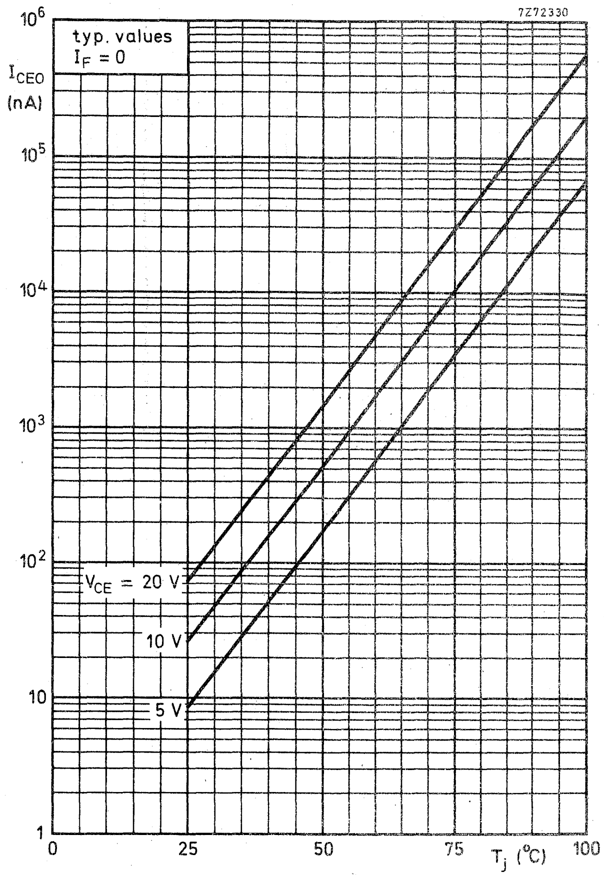
7Z67238.1

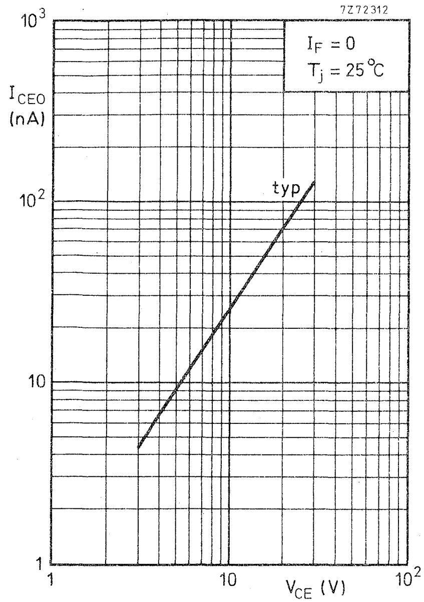

7Z72319
free in air
mounted
$P_{tot\ max}$ (mW)
150
100
50
0
transistor
diode
0
50
T_{amb} (°C)
100

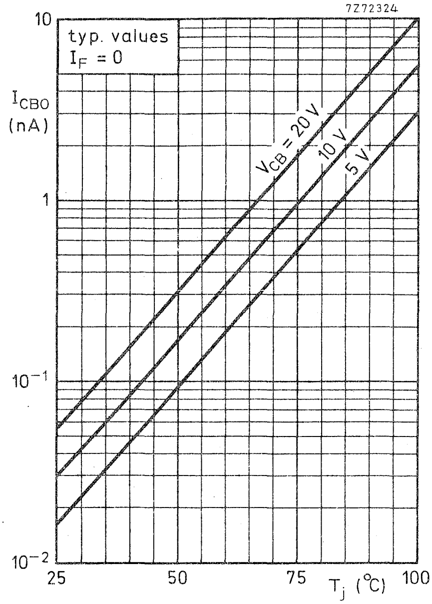

7Z72328
$T_j = 25\ ^\circ C$
I_F (mA)
60
40
20
0
typ
0
1
V_F (V)
2

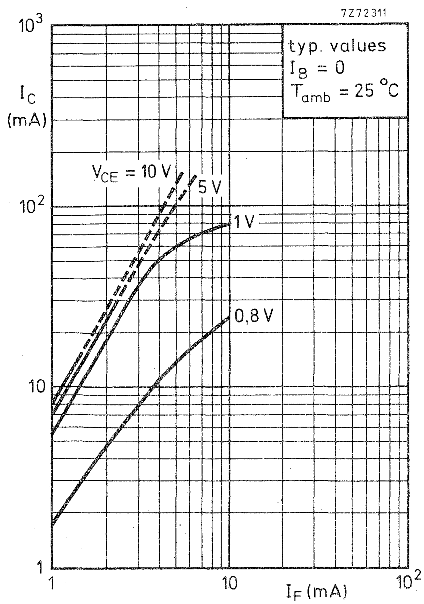

7Z72327
$t_p = 100\ \mu s$
$T = 1\ ms$
$T_j = 25\ ^\circ C$
200
I_{FM} (mA)
150
100
50
0
typ
0,5
1
1,5
V_{FM} (V)
2

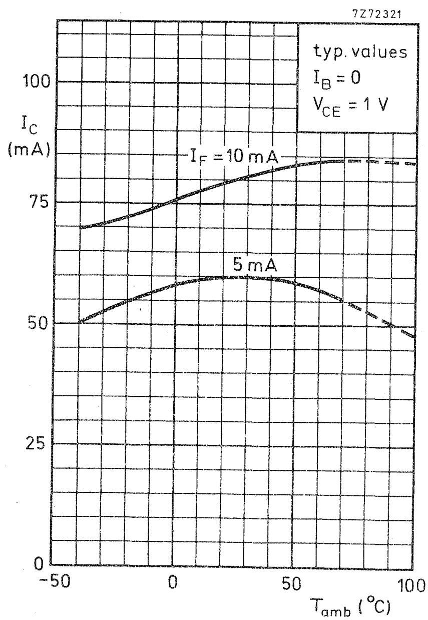

7Z72320
typ. values
1,3
I_F = 30 mA (−1,6 mV/ °C)
20 mA
10 mA
5 mA
V_F (V)
1,2
1,1
50 µA
1
0,9
−50
0
50
T_j (°C)
100

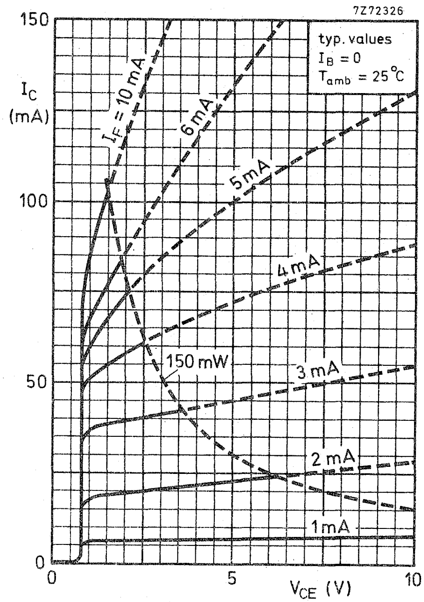

7Z72330
typ. values
$I_F = 0$
I_{CEO}
(nA)
10^6
10^5
10^4
10^3
10^2
10
1
V_{CE} = 20 V
10 V
5 V
0
25
50
75
100
T_j (°C)

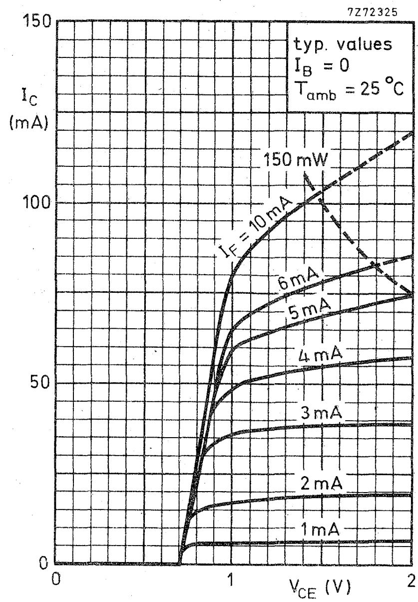

7Z72312
I_F = 0
T_j = 25 °C
I_{CEO} (nA)
typ
V_{CE} (V)

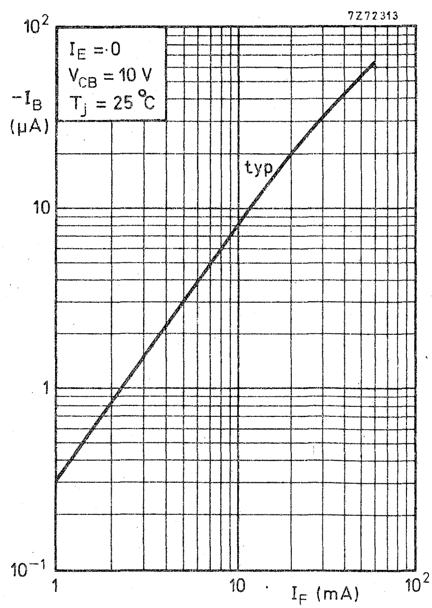

7Z72324
typ. values
I_F = 0
I_{CBO} (nA)
V_{CB} = 20 V
10 V
5 V
T_j (°C)

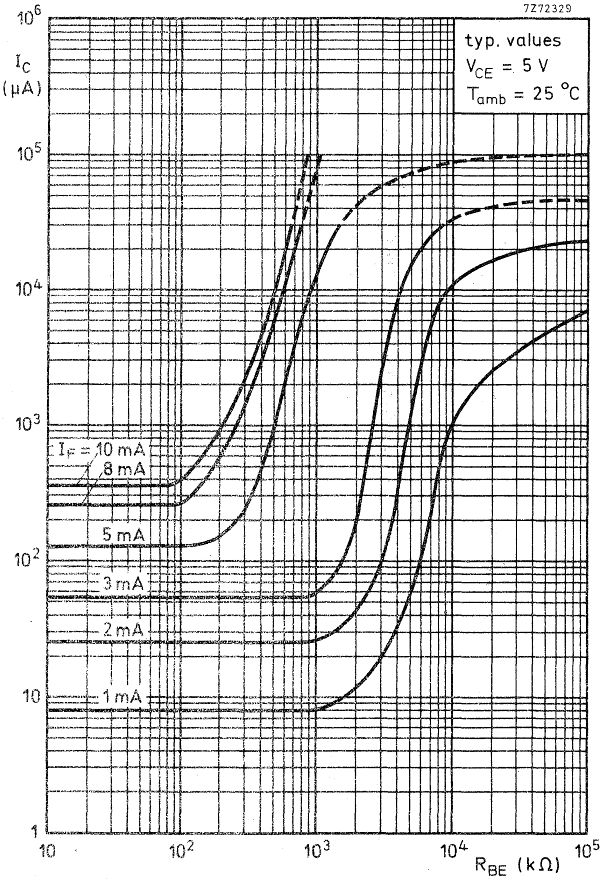

7Z72311
typ. values
I_B = 0
T_{amb} = 25 °C
I_C (mA)
V_{CE} = 10 V
5 V
1 V
0,8 V
I_F (mA)

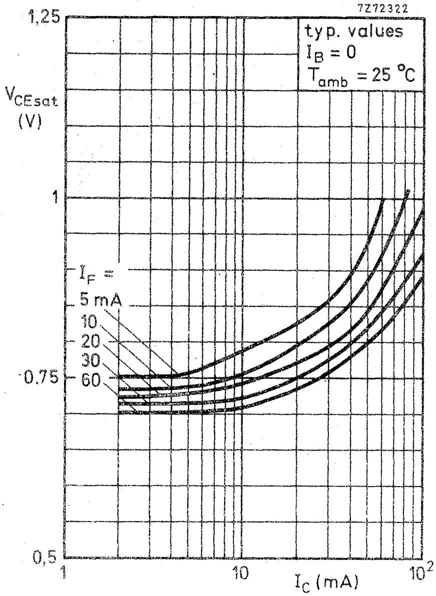

7Z72321
typ. values
I_B = 0
V_{CE} = 1 V
I_C (mA)
I_F = 10 mA
5 mA
T_{amb} (°C)

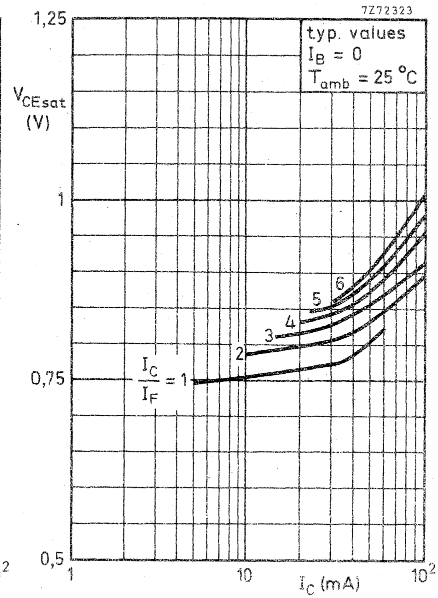

7Z72326
150
100
50
0
I_C (mA)
typ. values
$I_B = 0$
$T_{amb} = 25\,^{\circ}C$
$I_F = 10$ mA
6 mA
5 mA
4 mA
3 mA
2 mA
1 mA
150 mW
0
5
10
V_{CE} (V)

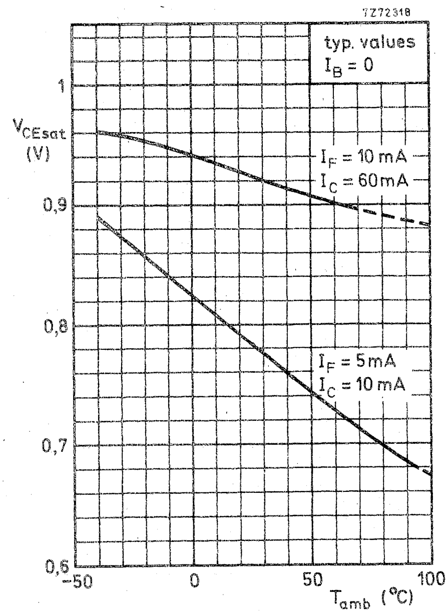

7Z72325
150
100
50
0
I_C (mA)
typ. values
$I_B = 0$
$T_{amb} = 25\,^{\circ}C$
150 mW
$I_F = 10$ mA
6 mA
5 mA
4 mA
3 mA
2 mA
1 mA
0
1
2
V_{CE} (V)

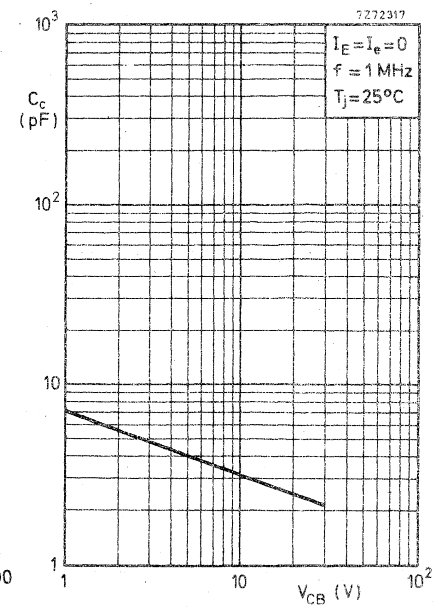

7Z72313
10^2
10
1
10^{-1}
$-I_B$ (μA)
$I_E = 0$
$V_{CB} = 10$ V
$T_j = 25\,^{\circ}C$
typ
1
10
10^2
I_F (mA)

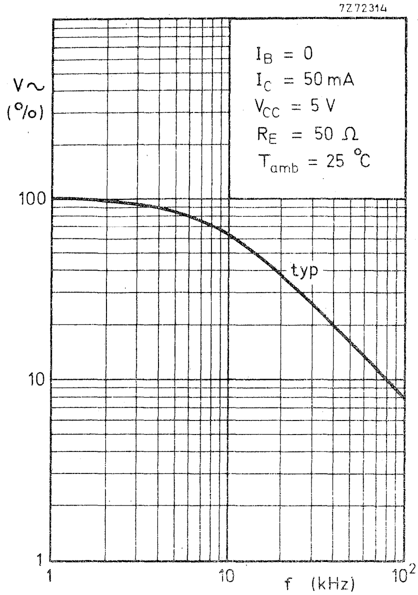

7Z72329
typ. values
V_{CE} = 5 V
T_{amb} = 25 °C
I_C (μA)
10^6
10^5
10^4
10^3
10^2
10
1
I_F = 10 mA
8 mA
5 mA
3 mA
2 mA
1 mA
10
10^2
10^3
10^4
10^5
R_{BE} (kΩ)

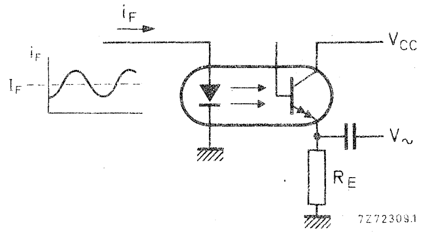

7Z72322
typ. values
$I_B = 0$
$T_{amb} = 25\ ^\circ C$
V_{CEsat} (V)
I_F =
5 mA
10
20
30
60
1,25
1
0,75
0,5
1
10
10^2
I_C (mA)

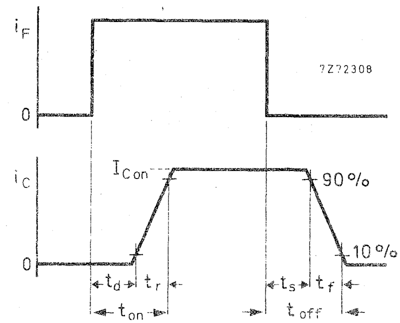

7Z72323
typ. values
$I_B = 0$
$T_{amb} = 25\ ^\circ C$
V_{CEsat} (V)
$\frac{I_C}{I_F} = 1$
2
3
4
5
6
1,25
1
0,75
0,5
1
10
10^2
I_C (mA)

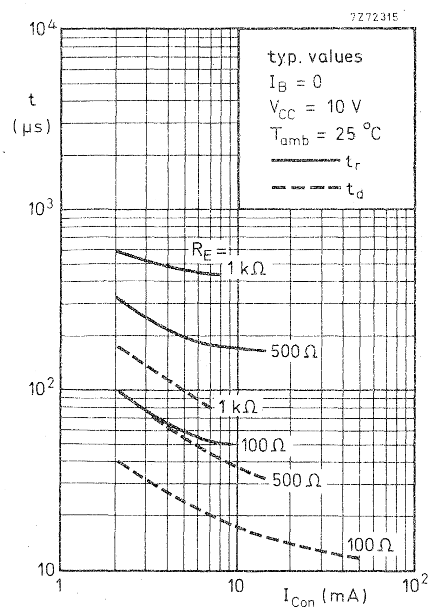

7Z72318
typ. values
$I_B = 0$
V_{CEsat} (V)
$I_F = 10$ mA
$I_C = 60$ mA
$I_F = 5$ mA
$I_C = 10$ mA
1
0,9
0,8
0,7
0,6
−50
0
50
100
T_{amb} (°C)

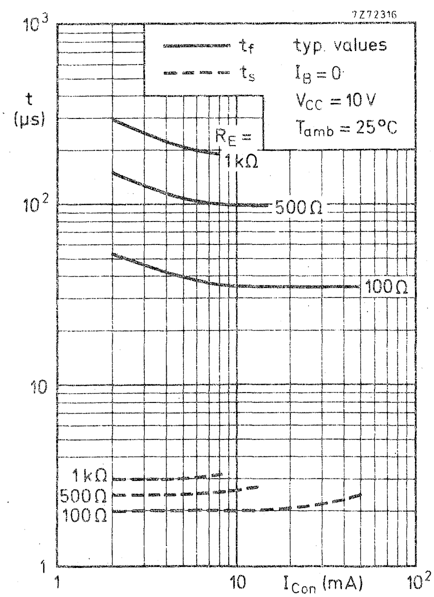

7Z72317
$I_E = I_e = 0$
f = 1 MHz
$T_j = 25^\circ C$
C_c (pF)
10^3
10^2
10
1
1
10
10^2
V_{CB} (V)


7Z72314
I_B = 0
I_C = 50 mA
V_CC = 5 V
R_E = 50 Ω
T_amb = 25 °C
V~
(%)
100
10
1
typ
1
10
10^2
f (kHz)


i_F
I_F
V_CC
V~
R_E
7Z72309.1


i_F
0
7Z72308
i_C
I_Con
90 %
10 %
0
t_d
t_r
t_s
t_f
t_on
t_off


7Z72315
typ. values
I_B = 0
V_CC = 10 V
T_amb = 25 °C
t_r
t_d
t
(μs)
10^4
10^3
10^2
10
R_E =
1 kΩ
500 Ω
1 kΩ
100 Ω
500 Ω
100 Ω
1
10
10^2
I_Con (mA)


7Z72316
t_f
t_s
typ. values
I_B = 0
V_CC = 10 V
T_amb = 25 °C
t
(μs)
10^3
10^2
10
1
R_E =
1 kΩ
500 Ω
100 Ω
1 kΩ
500 Ω
100 Ω
1
10
10^2
I_Con (mA)

Infrared 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

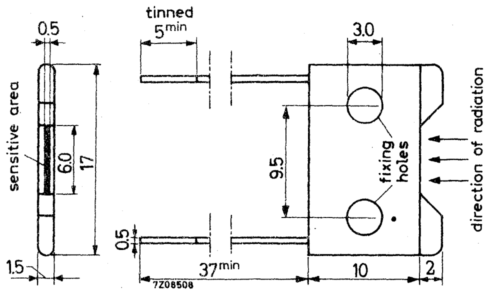
Peak spectral response	λ		6.0 to 6.3	μm
Spectral response range	from visible to		7.5	μm
Cell resistance	r_1		30 to 120	Ω
Time constant			0.1	μs
Sensitive area			6.0 x 0.5	mm^2
Sensitivity (6.0 μm radiation)		>	0.4	μV/μW
		typ.	1.0	μV/μW
(500 °K radiation)		typ.	0.3	μV/μW
D * (6.0 μm, 800 Hz, 1 Hz)	see 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)		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)		typ.	2.5×10^{-9}	W

MECHANICAL DATA (see page 2)

[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.

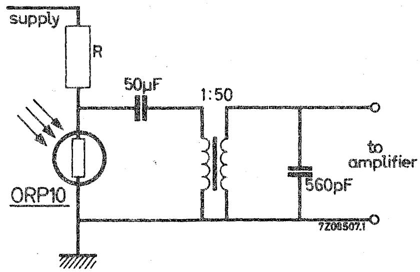
4. Variation of performance with element temperature.

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 ^{o}C this is impractical with the ORP10 unless special precautions are taken to prevent condensation and icing on the exposed element.

5. Warning.

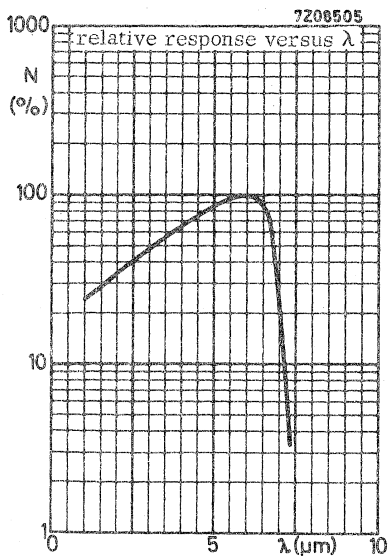
The sensitive surface is unprotected and should not be touched. It is stable in normal atmospheres but should not be exposed to high concentrations of the vapours of organic solvents. Care should be taken to avoid strain when attaching cells to heatsinks.

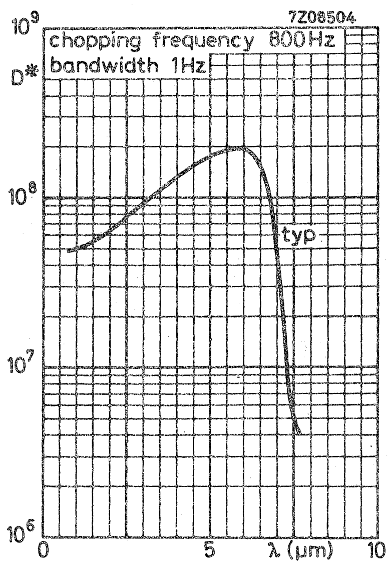
Recommended circuit for use with radiation chopped at 800 Hz.

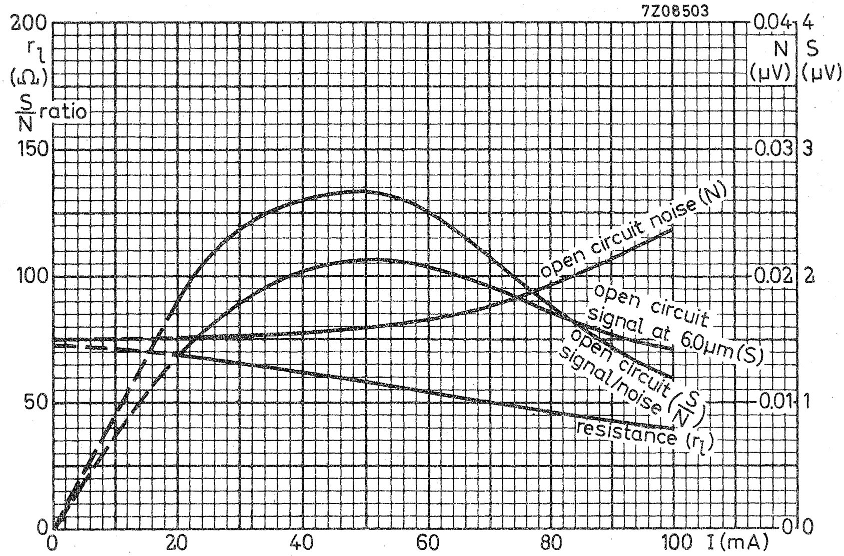


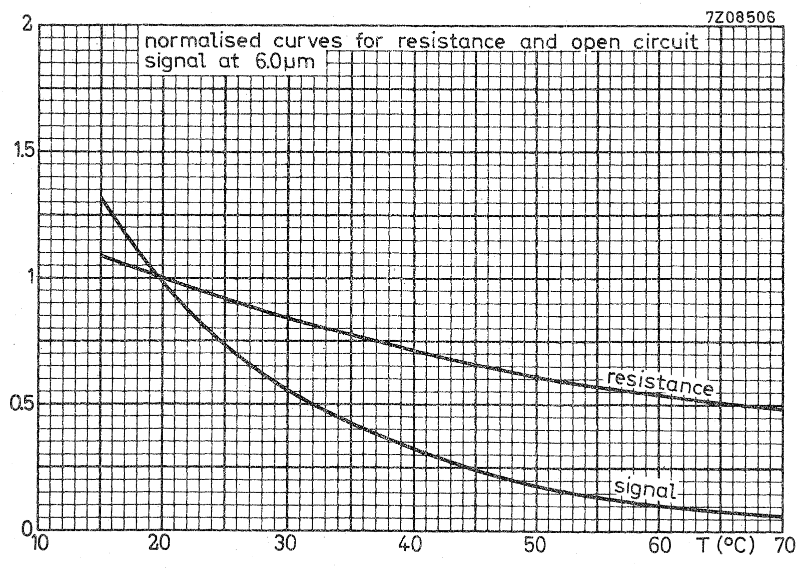
CIRCUIT NOTES

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)
$\frac{S}{N}$ ratio
150
100
50
0
0.04
N (µV)
S (µV)
0.03
0.02
0.01
0
4
3
2
1
0
0
20
40
60
80
100
I (mA)
open circuit noise (N)
open circuit signal at 6.0µm (S)
open circuit signal/noise ($\frac{S}{N}$)
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

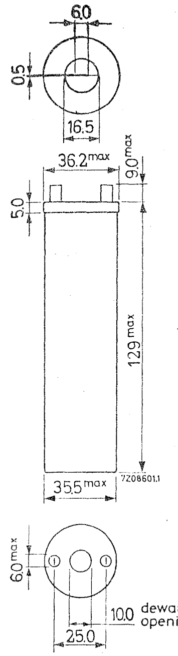
Indium antimonide photoconductive element mounted in a glass dewar vessel and cooled by liquid nitrogen or liquid air. Sensitive to infrared radiation extending to 5.6μm an intended for use with modulated or pulsed radiation.

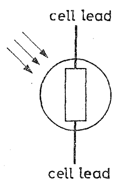
QUICK REFERENCE DATA				
Peak spectral response	λ_m		5.3	μm
Operating temperature	T		77	K
Responsivity (5.3 μm, 800 Hz)		typ.	35	mV/μW
D* (5.3 μm, 800 Hz, 1 Hz)		typ.	5.5×10^{10}	cm $\sqrt{Hz}$/W
Time constant		typ.	5	μs
Sensitive area			6.0 x 0.5	mm^2

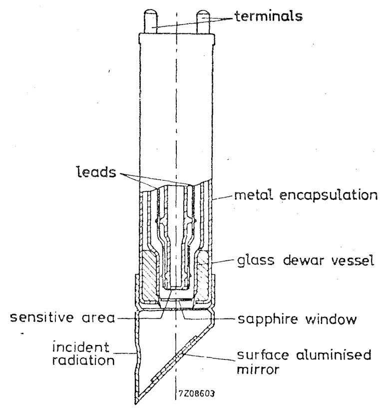
MECHANICAL DATA see page 2

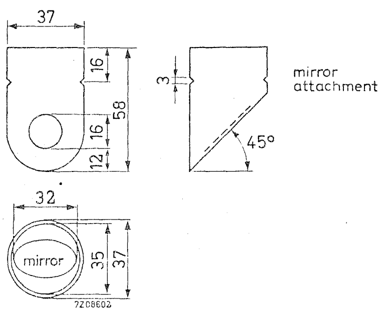
MECHANICAL DATA

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	^{o}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 $\sqrt{Hz}$/W
	typ.	7.5×10^9	cm $\sqrt{Hz}$/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 $\sqrt{Hz}$/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 $4.5\mu W/cm^2$.

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.

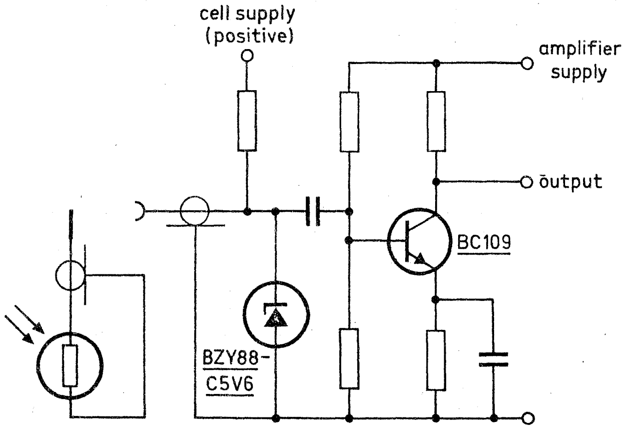
NOTES (continued)

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.

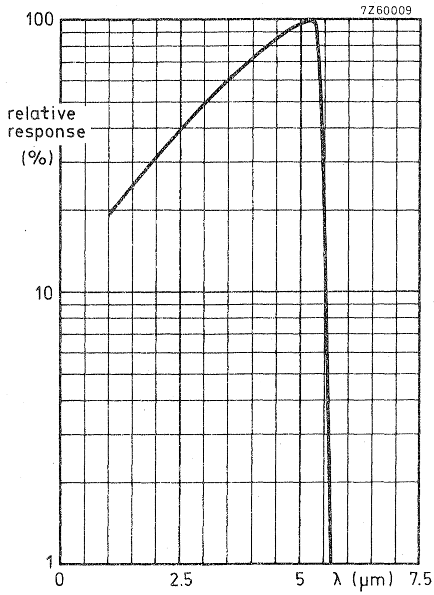
A zener diode can be used to limit the voltage developed across the input capacitor as shown in the diagram.

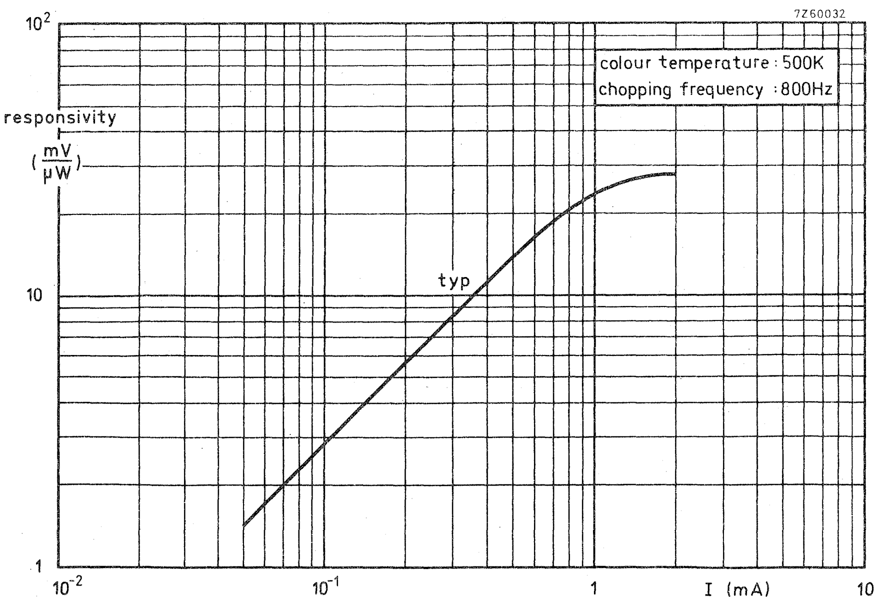


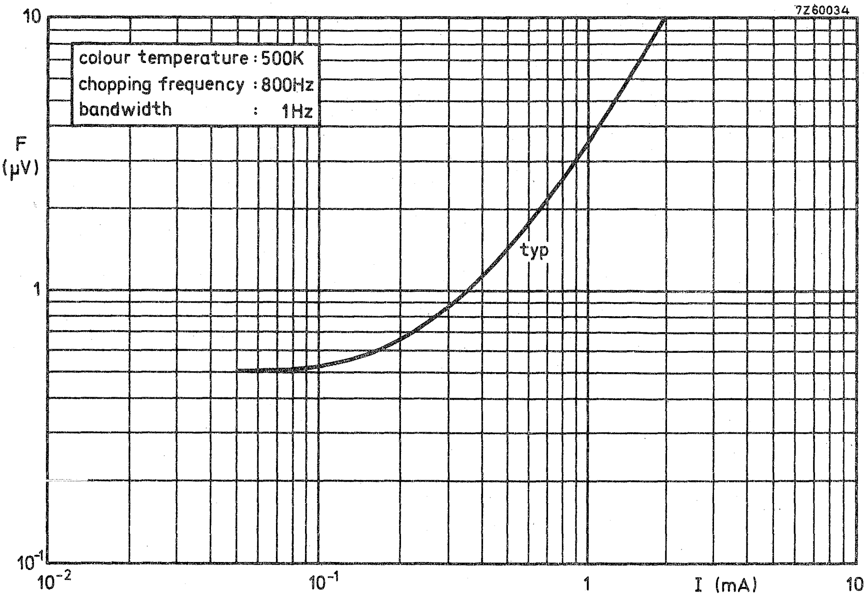
c. The dewar vessel must always be completely dry before being refilled with liquid nitrogen. In humid conditions, water vapour may condense at the top of the dewar. Should this occur, the remaining liquid nitrogen should be allowed to boil off, the ice should be removed carefully and precautions taken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

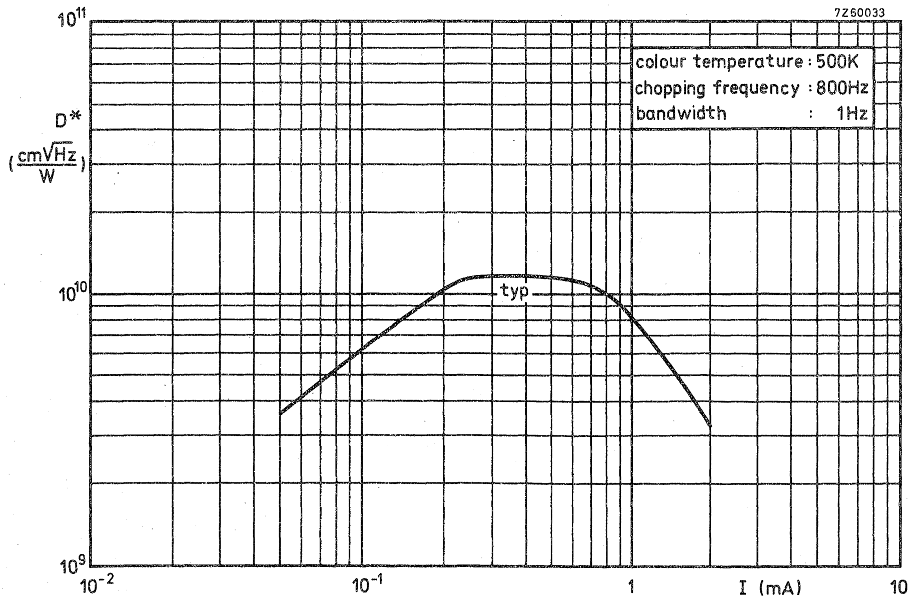
6. Low frequency noise

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
colour temperature : 500K
chopping frequency : 800Hz
responsivity
(mV/μW)
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

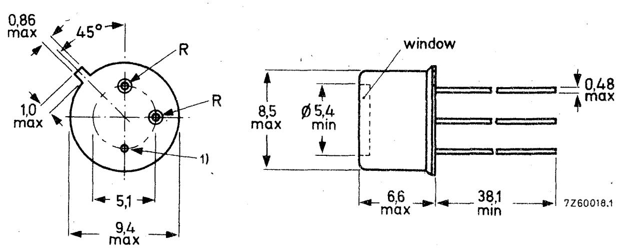

7Z60033
colour temperature : 500K
chopping frequency : 800Hz
bandwidth : 1Hz
D*
(cm√Hz / W)
10¹¹
10¹⁰
10⁹
typ
10⁻²
10⁻¹
1
I (mA)
10

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)		>	1.0×10^8	$cm\sqrt{Hz}/W$
Time constant		typ.	250	μs
Sensitive area			1.0 x 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		^oC
Operating ambient temperature	T_{amb}	max.	50	^oC

CHARACTERISTICS at T_{amb} = 20 ^oC (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	cm $\sqrt{Hz}$/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}	cm $\sqrt{Hz}$/W
N.E.P.	<	10	pW

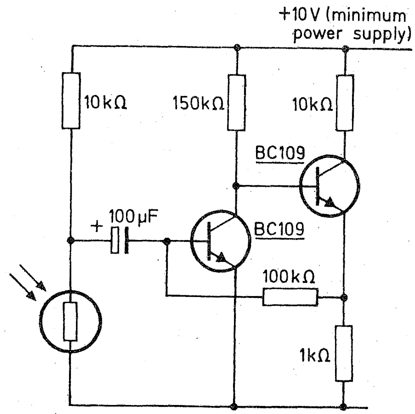
NOTES

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 μW/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.

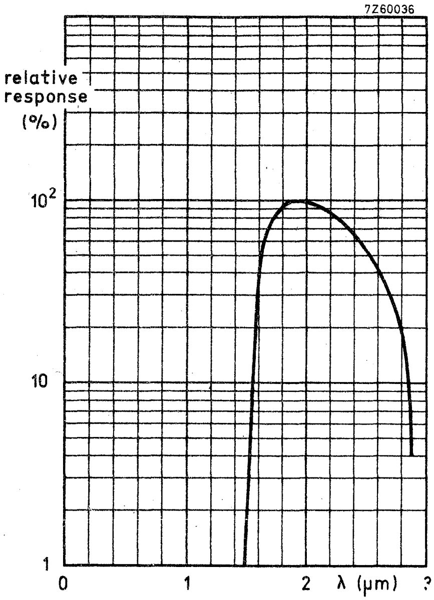
   b. Variation of performance with temperature/life

   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}	$cm\sqrt{Hz}/W$
Time constant		typ.	100	μs
Sensitive area			6.0 x 6.0	mm^2

MECHANICAL DATA

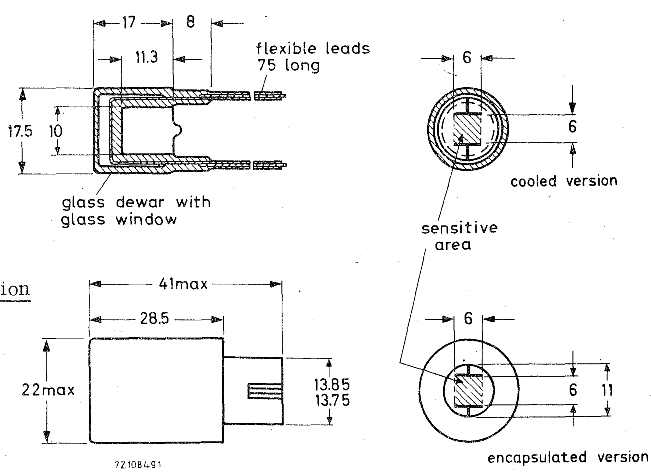
Dimensions in mm

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.

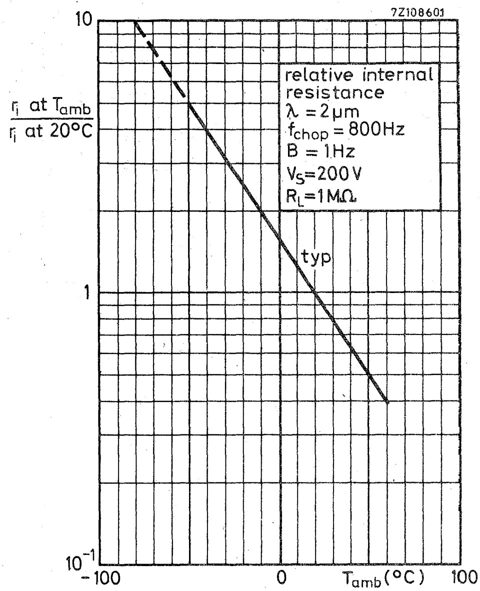
NOTES (continued)

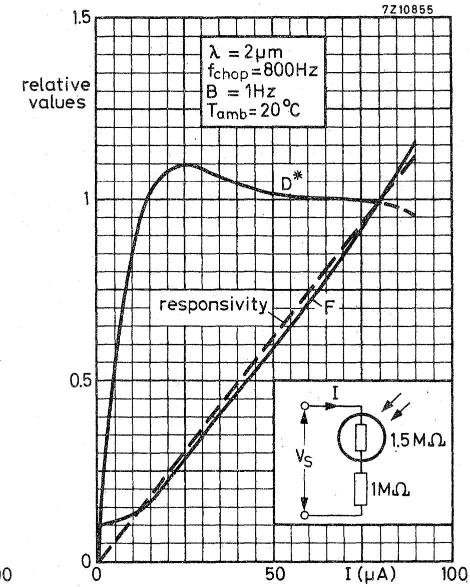
5. Effect of ambient radiation

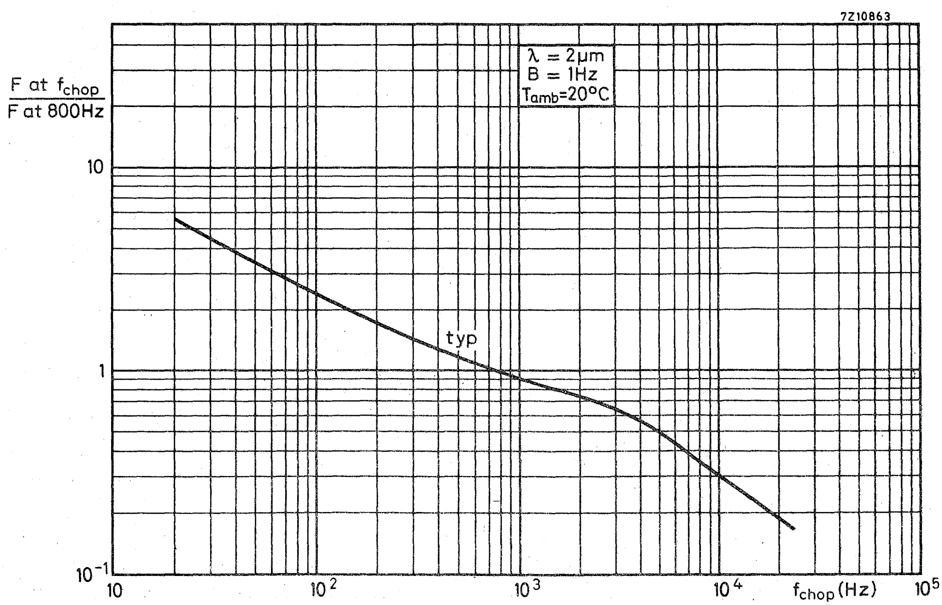
Care should be taken to avoid the incidence on the cell of appreciable radiation in the visible range. Such radiation will cause a decrease in the cell resistance and signal as long as the cell is kept cool. Normal daylight can cause this effect if seen for more than a few minutes. Precautions should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

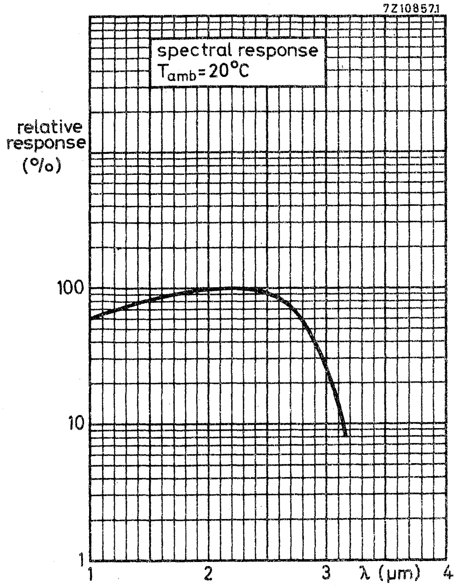
6. Warning

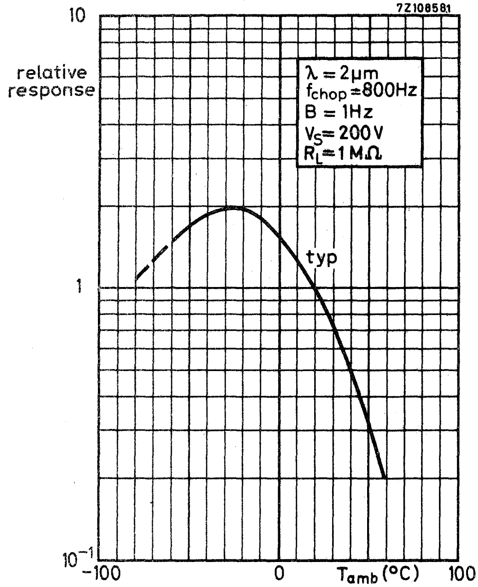
Care should be taken to ensure that the device is not allowed to reach room temperature while still biased.
The dewar vessel must always be completely dry before being refilled with liquid nitrogen. In very humid conditions, water vapour may condense at the top of the dewar vessel. Should this occur,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

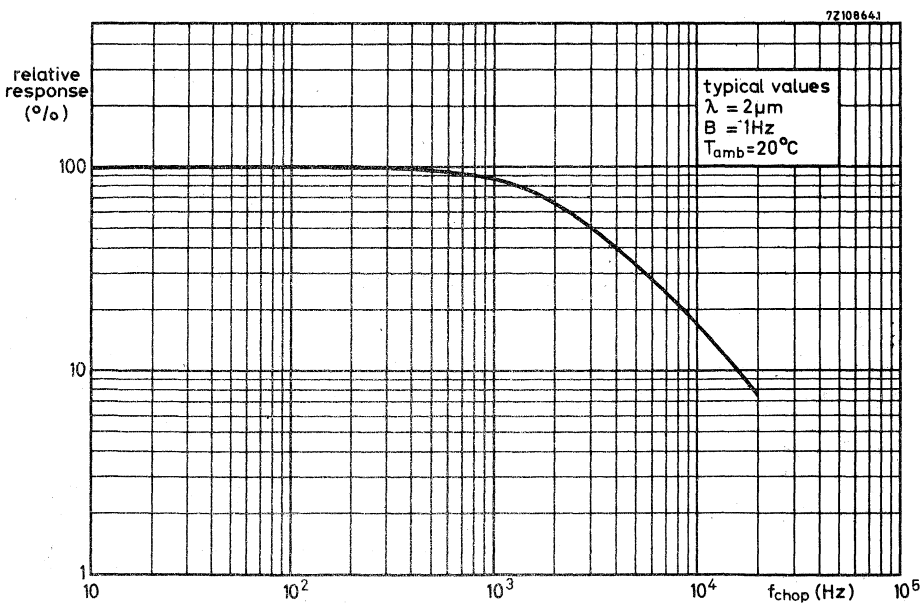

7Z108601
$\frac{r_i \text{ at } T_{amb}}{r_i \text{ at } 20°C}$
relative internal resistance
λ = 2 μm
f_{chop} = 800 Hz
B = 1 Hz
V_S = 200 V
R_L = 1 MΩ
typ
10
1
10^{-1}
−100
0
T_{amb} (°C)
100

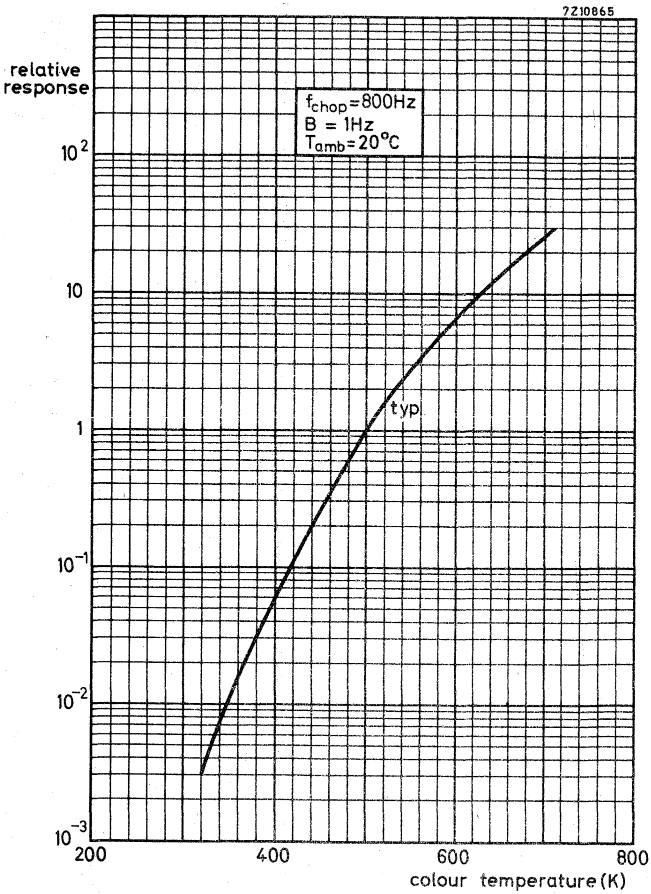

7Z10855
relative values
λ = 2 μm
f_{chop} = 800 Hz
B = 1 Hz
T_{amb} = 20 °C
D*
responsivity
F
I
V_S
1.5 MΩ
1 MΩ
1.5
1
0.5
0
0
50
I (μA)
100

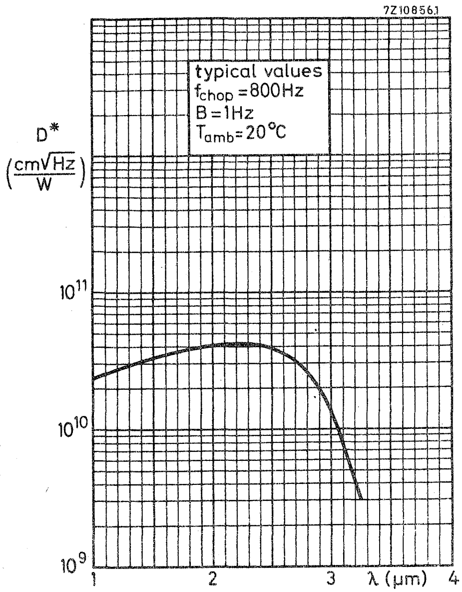

7Z10863
$\frac{F \text{ at } f_{chop}}{F \text{ at } 800 Hz}$
λ = 2 μm
B = 1 Hz
T_{amb} = 20 °C
typ
10
1
10^{-1}
10
10^2
10^3
10^4
f_{chop} (Hz)
10^5

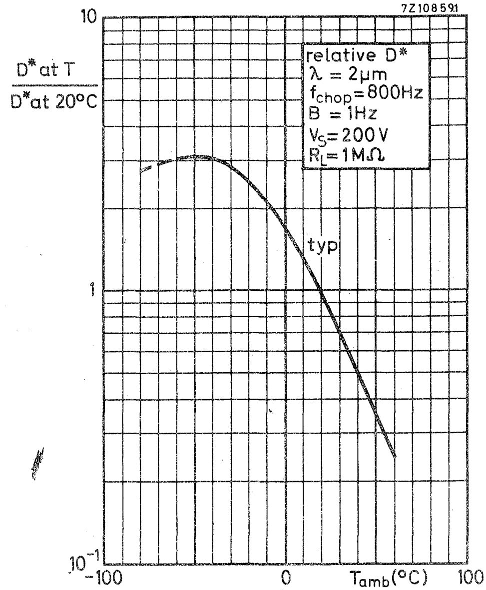

7Z10857.1
spectral response
T_{amb} = 20°C
relative response (%)
100
10
1
1
2
3
λ (μm)
4

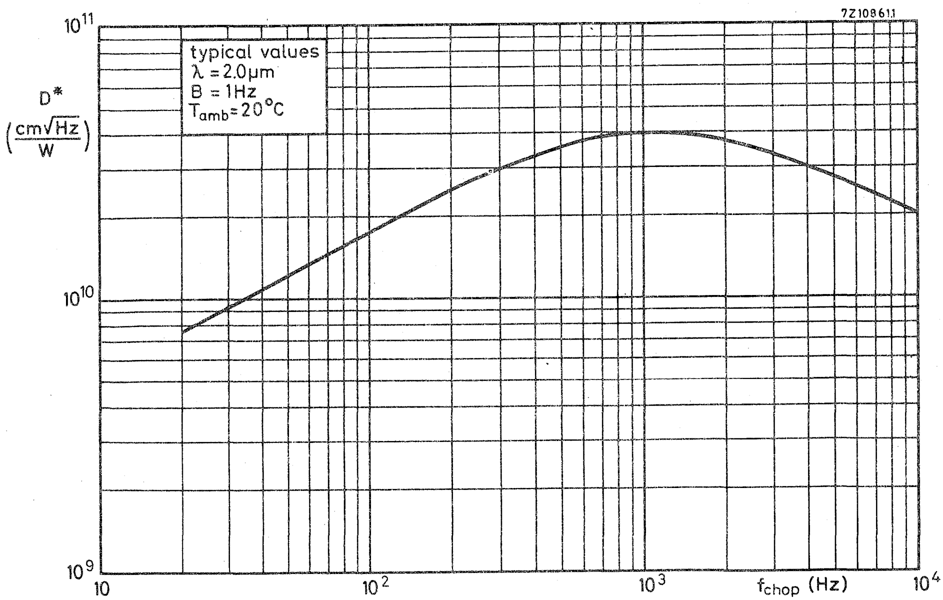

7Z10858.1
10
relative response
λ = 2μm
f_{chop} = 800Hz
B = 1Hz
V_S = 200V
R_L = 1MΩ
typ
1
10^{-1}
−100
0
T_{amb} (°C)
100

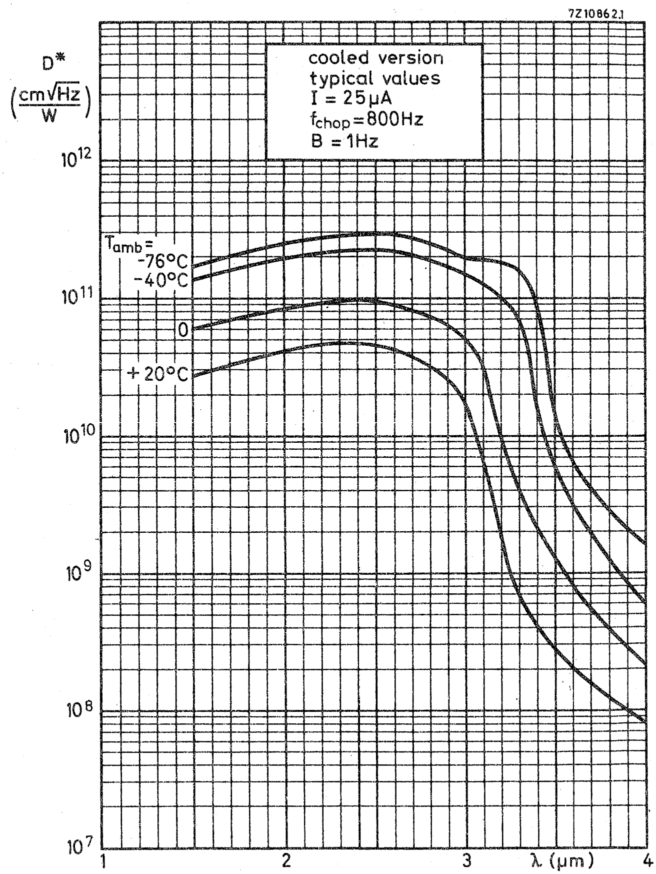

7Z10864.1
relative response (%)
typical values
λ = 2μm
B = 1Hz
T_{amb} = 20°C
100
10
1
10
10^2
10^3
10^4
f_{chop} (Hz)
10^5


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
fchop = 800Hz
B = 1Hz
D*
(cm√Hz / W)
10^12
10^11
10^10
10^9
10^8
10^7
Tamb =
-76°C
-40°C
0
+20°C
1
2
3
λ (μm)
4

Photoconductive devices

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

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.

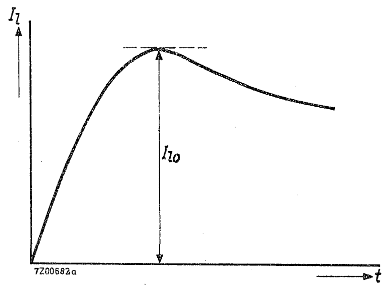
2.2.1 For a particular set of conditions the equilibrium illumination resistance is the illumination resistance after such a time under these conditions that the rate of change of the illumination resistance is less than 1% per 5 minutes.

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.

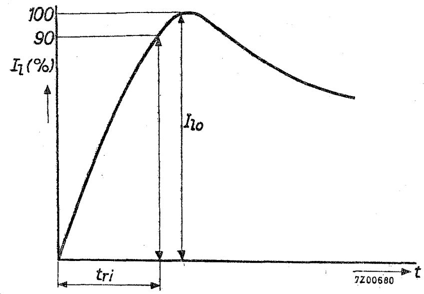
2.4.2 For a particular set of conditions the initial dark resistance is the dark resistance after a specified time under these conditions following a specified history.

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

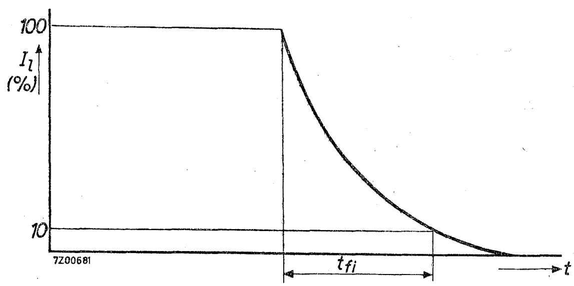
2.5.1 For a particular set of conditions the equilibrium dark current is the dark current after such a time under these conditions that the rate of change of the dark current is less than 2% per 5 minutes.

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 $\frac{\Delta \log r_{lo}}{\Delta \log E}$

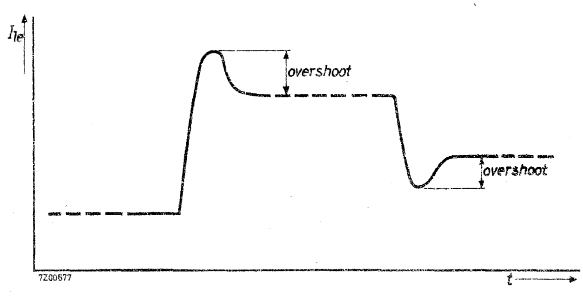
3. THERMAL DATA

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**

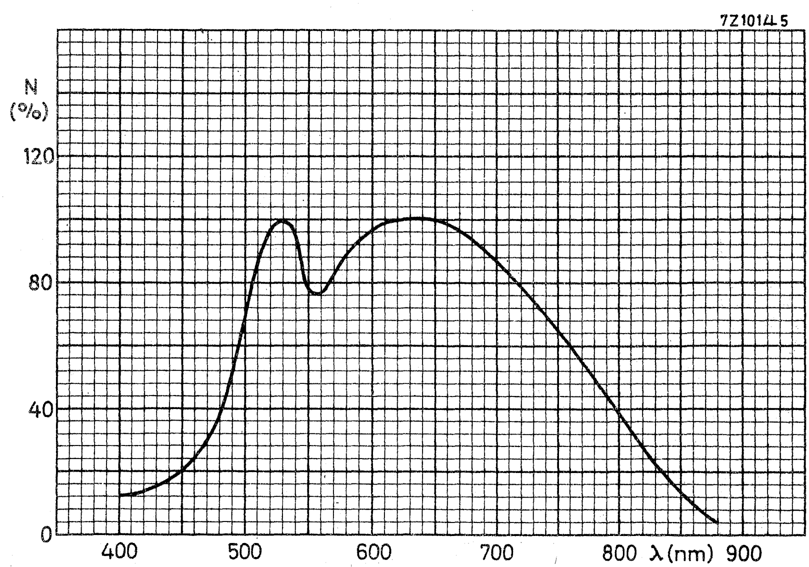
The limiting values of photoconductive devices are given in the absolute maximum rating system.

8. **OUTLINE DIMENSIONS**

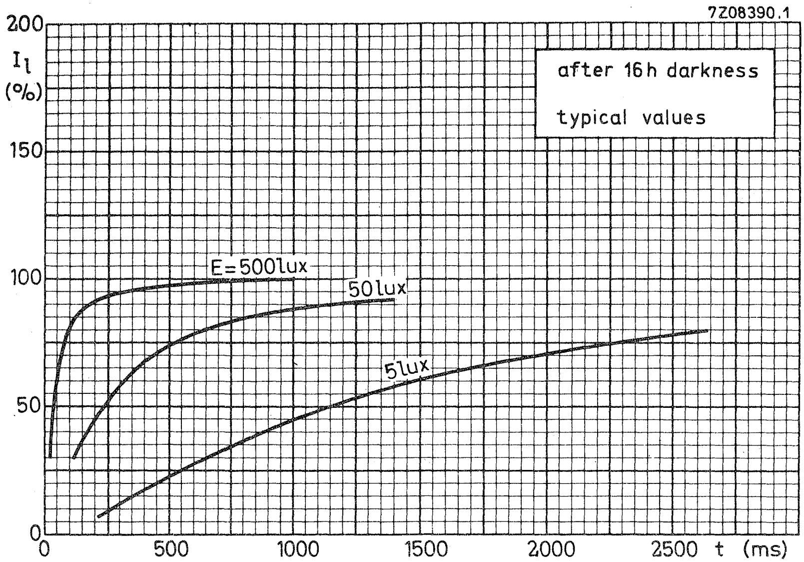
The outline dimensions are given in mm.

9. **MECHANICAL ROBUSTNESS**

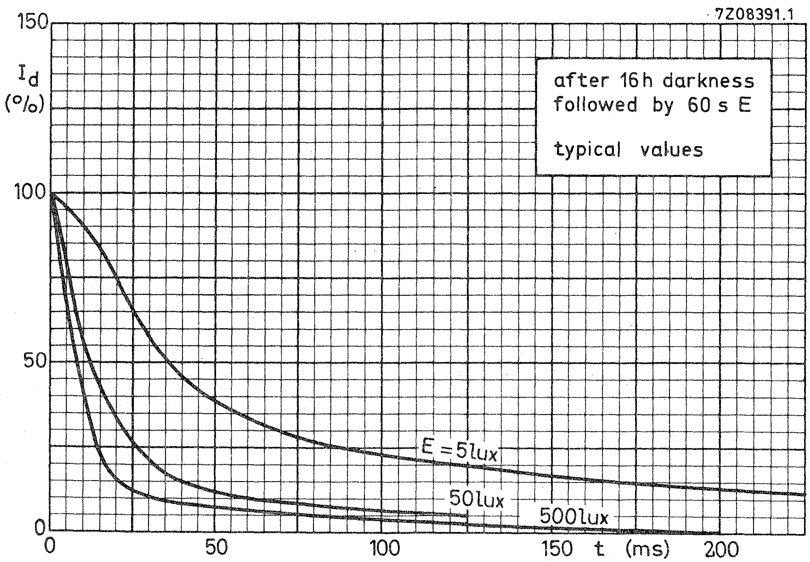
The conditions for shock and vibration given on the individual data sheets are intended only to give an indication of the mechanical quality of the device. It is not advisable to subject the device to such conditions.



Type D response curve



Current rise curves for cells with type D response curve



Current decay curves for cells with type D response curve

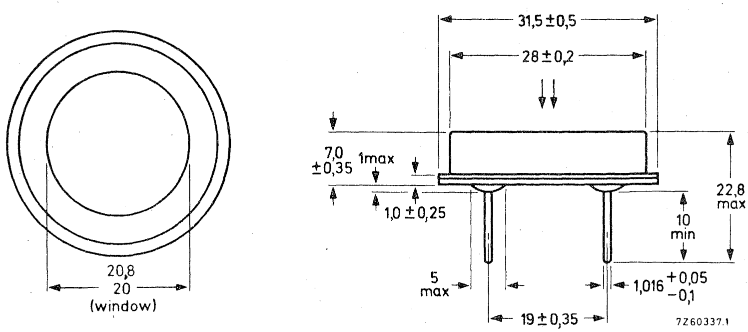
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

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_{10}	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



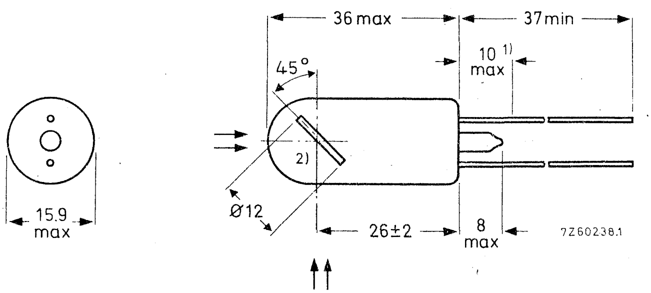
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

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 °C	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.

1) Not tinned.
2) Centre of sensitive area.

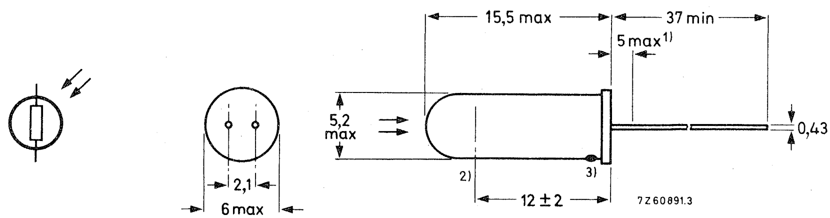
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

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 °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 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 dip-soldered 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 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 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.

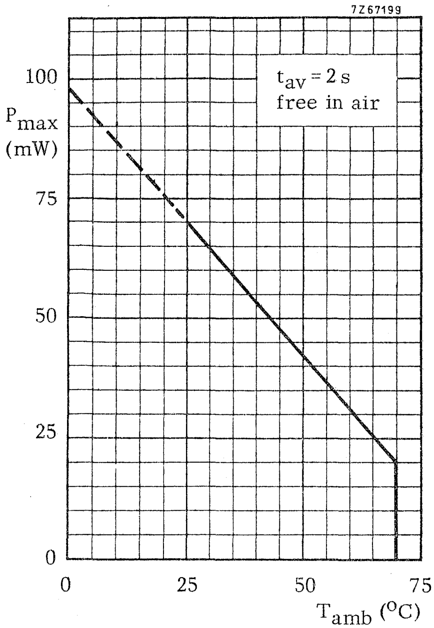
Shock

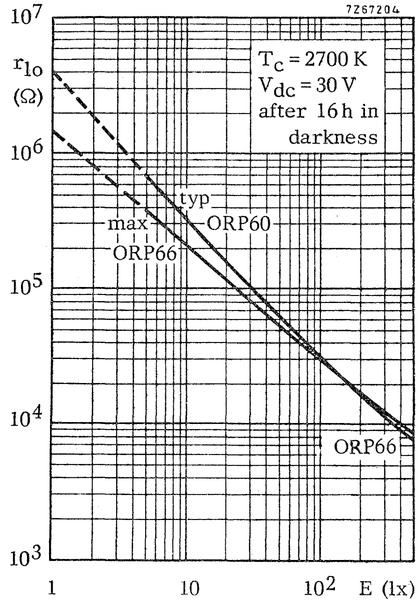
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

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
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
max
ORP60
ORP66
ORP66
1
10
10^2
E (lx)

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

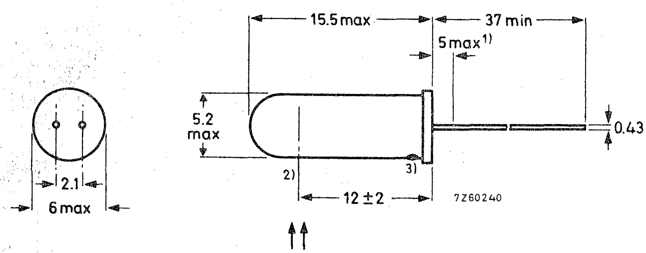
Side sensitive cadmium sulphide photoconductive cells in hermetically sealed all-glass envelope intended for on-off applications such as flame failure circuits, and for automatic brightness and contrast control in television receivers.
The cells are shock and vibration resistant.

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 $\frac{r \text{ at } 0,5 \text{ V d.c.}}{r \text{ at } 30 \text{ V d.c.}}$	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.	$5 \times P_{max}$		
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 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.

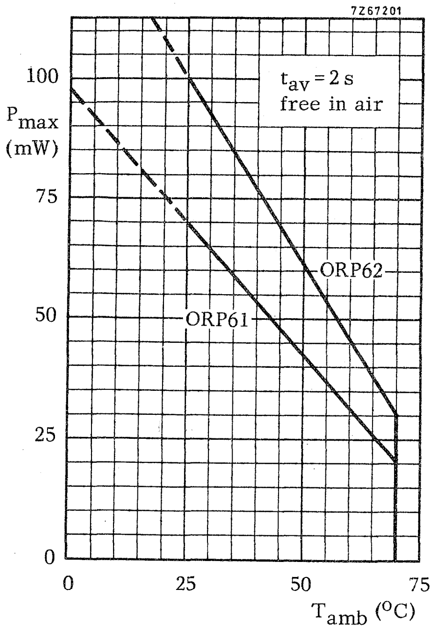
Shock

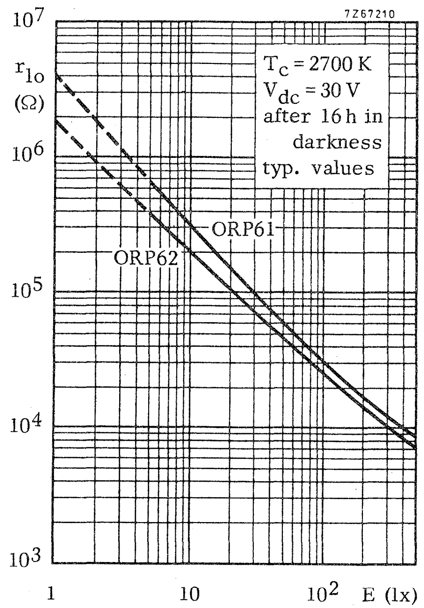
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

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


7Z67210
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. values
ORP61
ORP62
1
10
10^2
E (lx)

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

See data ORP60

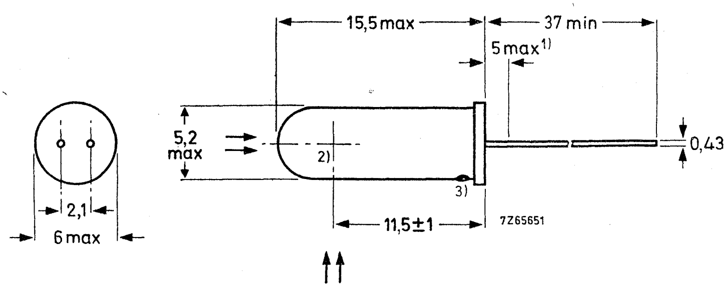
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

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		>	30	20	kΩ
measured at 30 V d.c., illumination = 50 lx,	r_{lo}	typ.	46	30	kΩ
after 16 h in darkness [2] [3]		<	100	60	kΩ
Equilibrium illumination resistance		>	30	27	kΩ
measured at 30 V d.c., illumination = 50 lx,	r_{le}	typ.	60	46	kΩ
after 15 min under the measuring conditions		<	170	115	kΩ
Negative temperature response of		typ.	0,2		%/°C
illumination resistance		<	0,5		%/°C
Voltage response $\frac{r \text{ at } 0,5 \text{ V d.c.}}{r \text{ at } 30 \text{ V d.c.}}$		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	^oC
Ambient temperature, storage and operating	T_{amb}	min.	−40	^oC
storage	T_{stg}	max.	+50	^oC [1]
operating	T_{amb}	max.	+70	^oC

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.

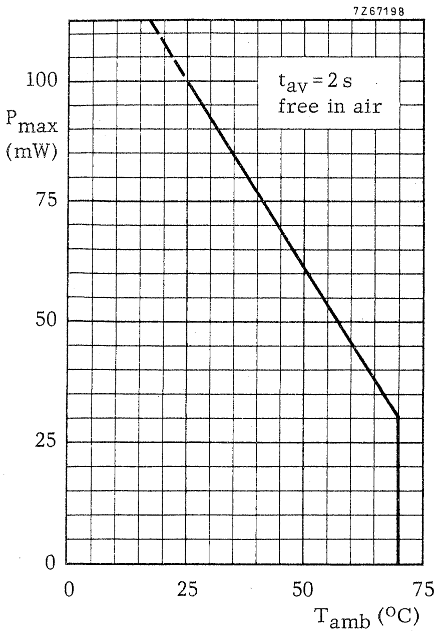
Shock

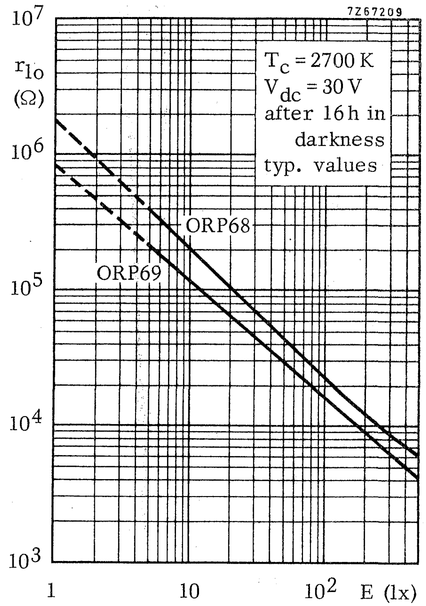
25 g_{peak}, 10 000 shocks in one of the three positions of the cell

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


7Z67209
10^7
r_{lo}
(Ω)
10^6
10^5
10^4
10^3
1
10
10^2
E (lx)
T_c = 2700 K
V_{dc} = 30 V
after 16 h in
darkness
typ. values
ORP68
ORP69

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

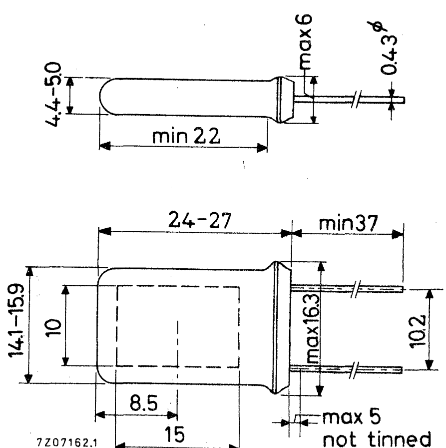
Side sensitive cadmium sulphide photoconductive cells in hermetically sealed all-glass envelope intended for general control circuits such as twilight switches and flame failure circuits. The high voltage type can be connected direct to the mains.
The cells are shock and vibration resistant.

QUICK REFERENCE DATA

			RPY 18	RPY 19	
Power dissipation at T_{amb} = 25 ^{o}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

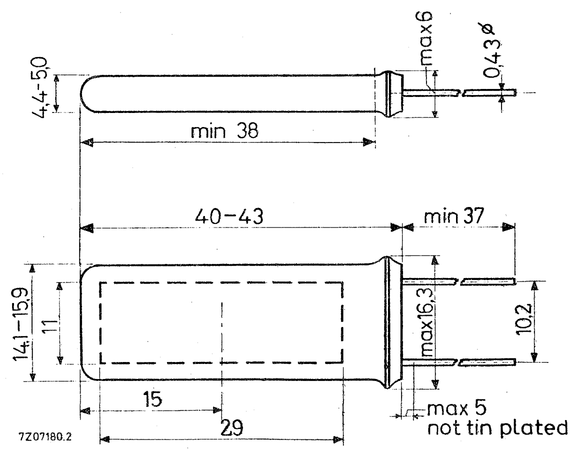
The cell may be soldered directly into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt. The cell may be dipsoldered at a solder temperature of 240 ^{o}C for maximum 10 s up to a point 5 mm from the seals.

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.

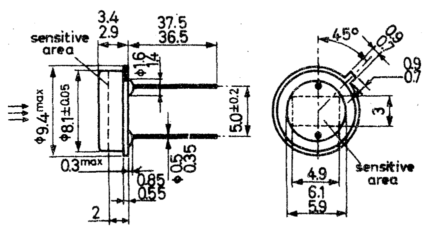
CADMIUM SULPHO-SELENIDE PHOTOCONDUCTIVE CELL

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.

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

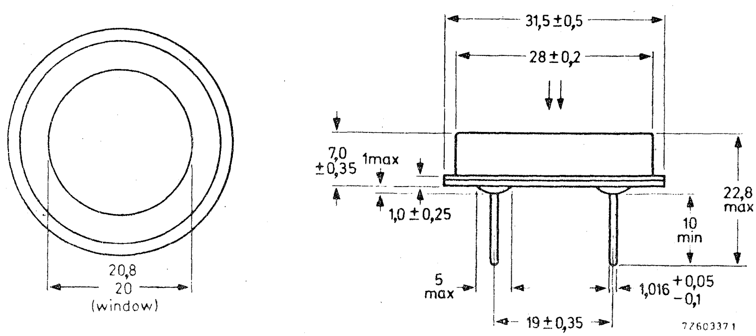
Top sensitive cadmium sulphide photoconductive cell in hermetically sealed metal envelope with a glass window intended for general control circuits such as twilight switches and flame failure circuits. The high voltage type can be connected direct to the mains. The cell is shock and vibration resistant.

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_{10}	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



CADMIUM SULPHIDE PHOTOCONDUCTIVE DEVICE

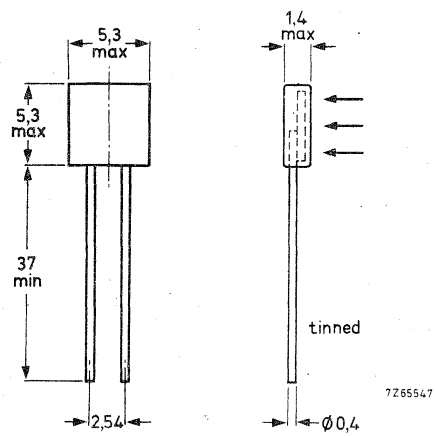
Cadmium sulphide photoconductive device with side sensitivity in plastic encapsulation. The device consists of two cells connected in series and is intended for general applications.

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 ^{o}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} ≤ once per minute, t_p ≤ 5 ms	V_M	max.	100	V
Power dissipation, t_{av} = 0,5 s, T_{amb} ≤ 25 °C	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

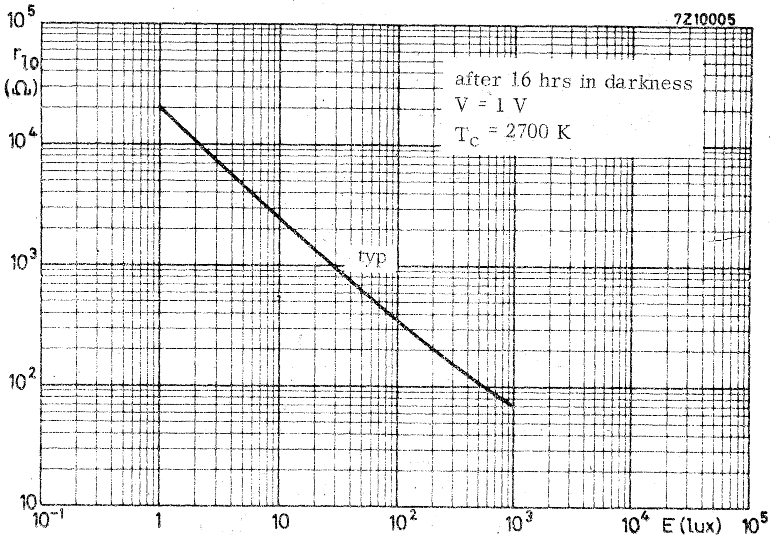
Thermal resistance from CdS tablet to ambient	$R_{th\ t-a}$	=	0,45	°C/mW

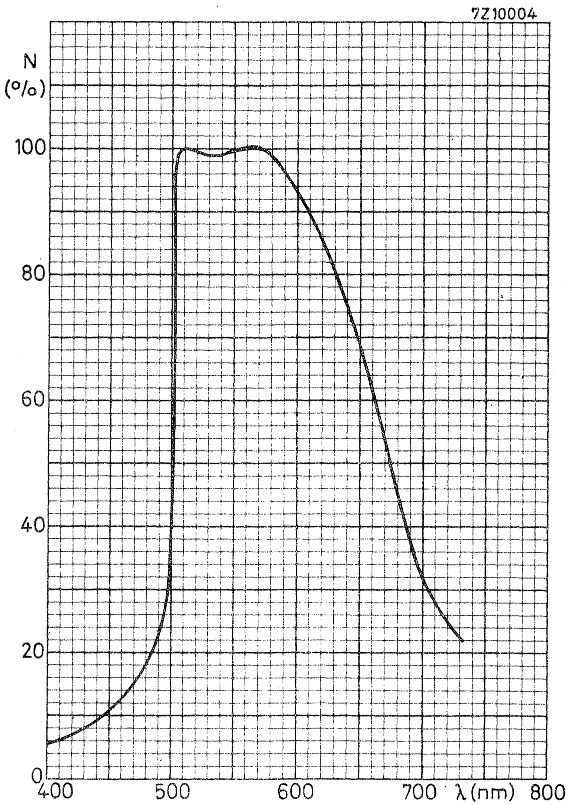
CHARACTERISTICS

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
10^5
r_{10}
(Ω)
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

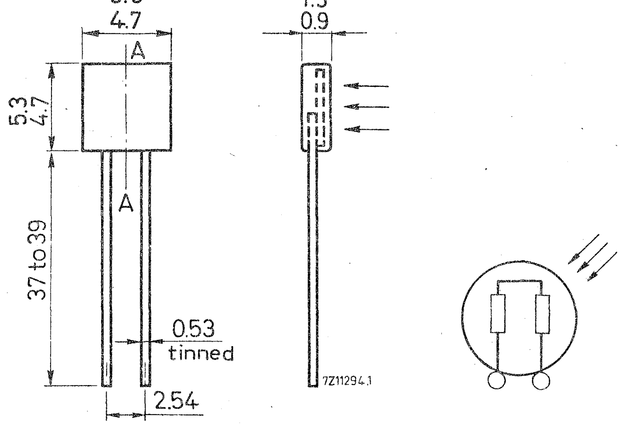
CADMIUM SULPHIDE PHOTOCONDUCTIVE DEVICE

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	$r_1/\Delta T$			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 = $\frac{\text{Cell current at 1 lx, after 3 days in darkness}}{\text{Cell current at 1 lx, after 1 h pre-conditioning at 300 lx (fluorescent light)}}$

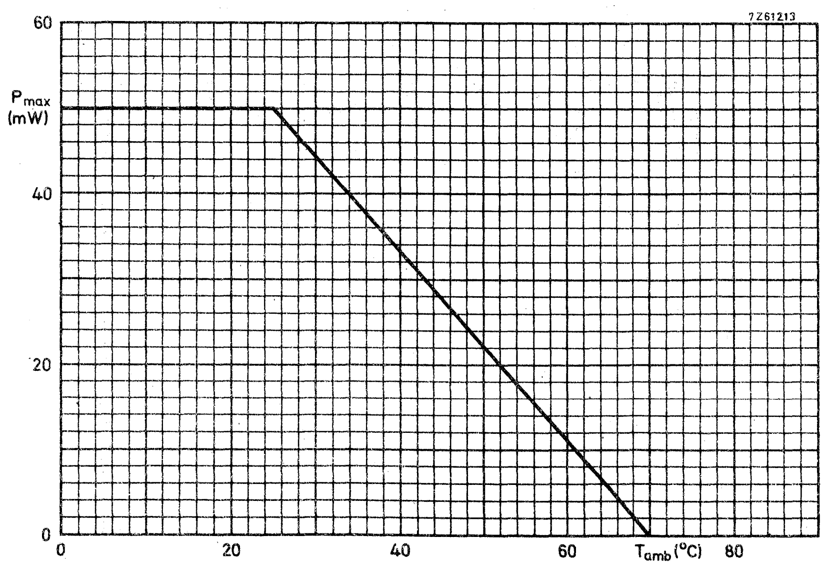
measured when a stable current is reached

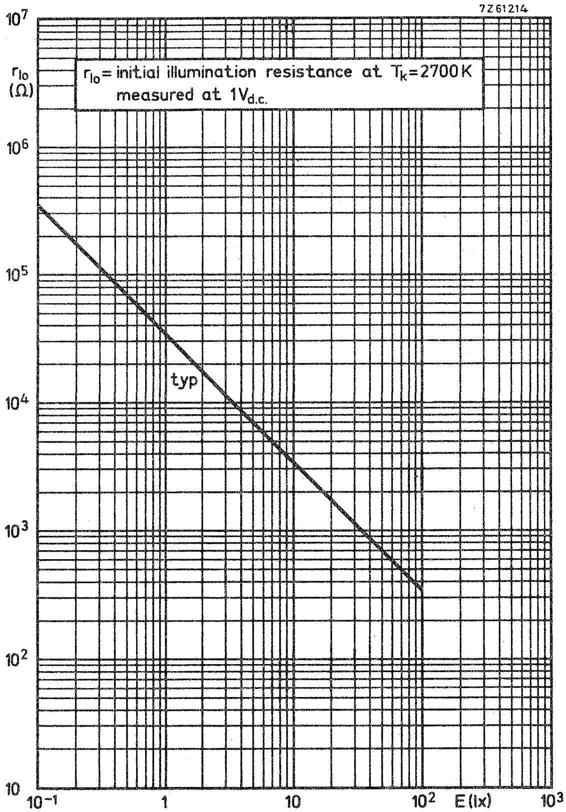
LIMITING VALUES (Absolute max. rating system)

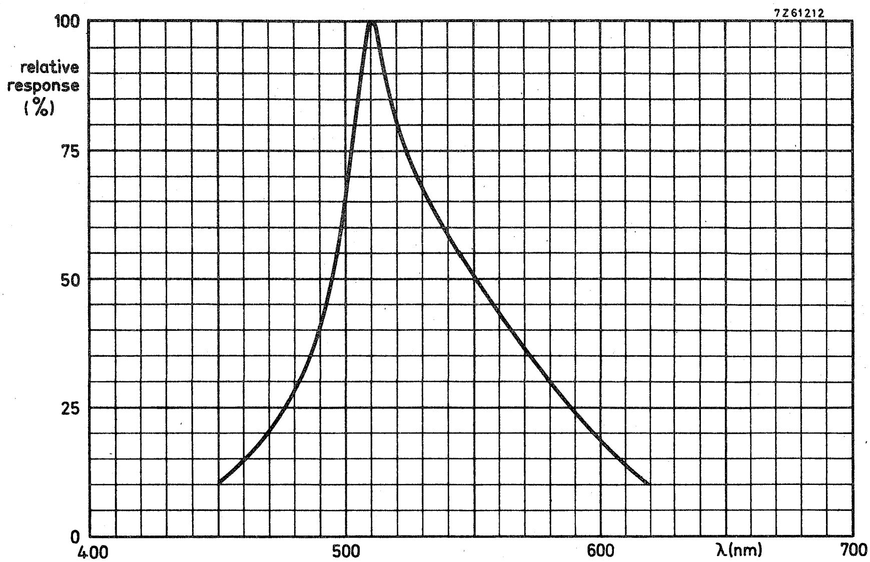
Cell voltage, d.c. and repetitive peak	V	max. 50	V
Power dissipation	P	max. 50	mW
Cell current, d.c. and repetitive peak	I	max. 20	mA
Operating ambient temperature	T_{amb}	−40 to +70	°C
Storage temperature	T_{stg}	−40 to +70	°C

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
100
relative
response
(%)
75
50
25
0
400
500
600
λ(nm)
700

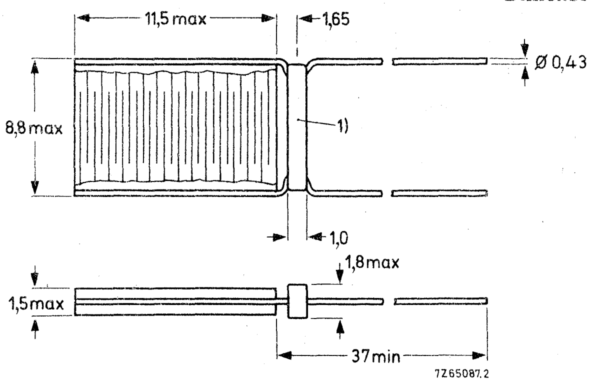
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

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}		560 to 2800	Ω
		typ.	950	Ω
Equilibrium illumination resistance measured at 10 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}		560 to 3800	Ω
		typ.	1200	Ω
Negative temperature response of illumination resistance		<	0,5	%/°C
		typ.	0,2	%/°C
Voltage response $\frac{r \text{ at } 0,5 \text{ V d.c.}}{r \text{ at } 10 \text{ V d.c.}}$	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.	$5xP_{max}$	
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

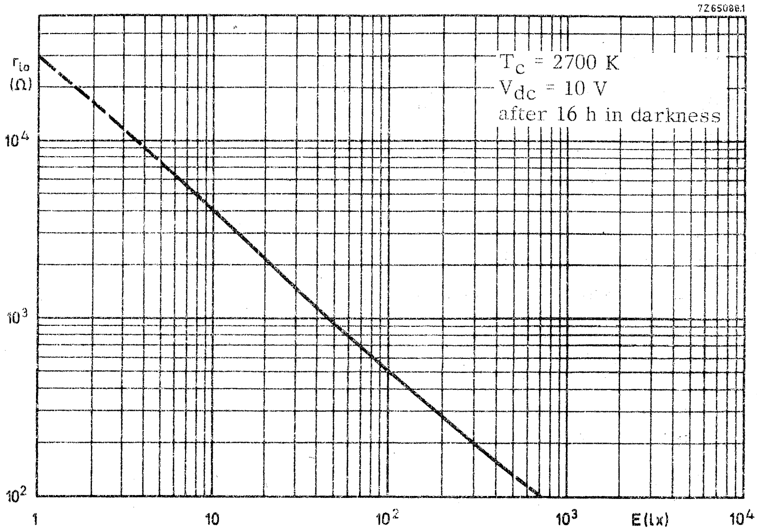
Tensile test

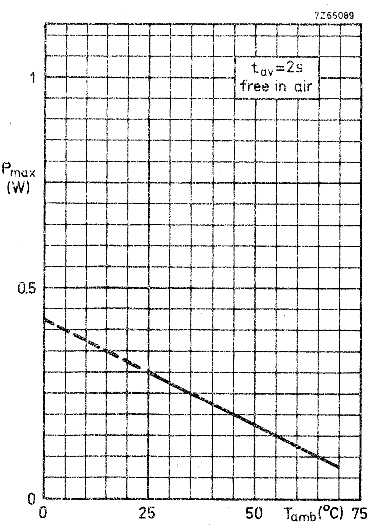
The device withstands the tensile test of IEC Publication 68-2-21, Test Ua: loading weight 500 g.

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

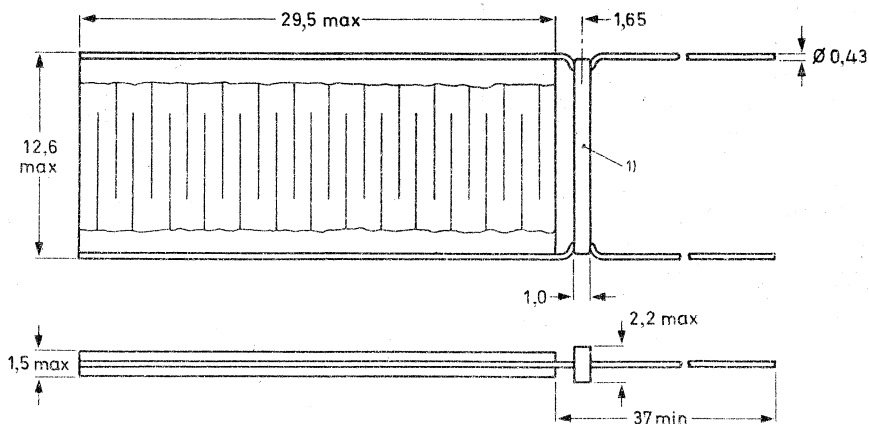
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

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_{10}	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	3300	Ω
		typ.	1150	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.	1450	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	

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

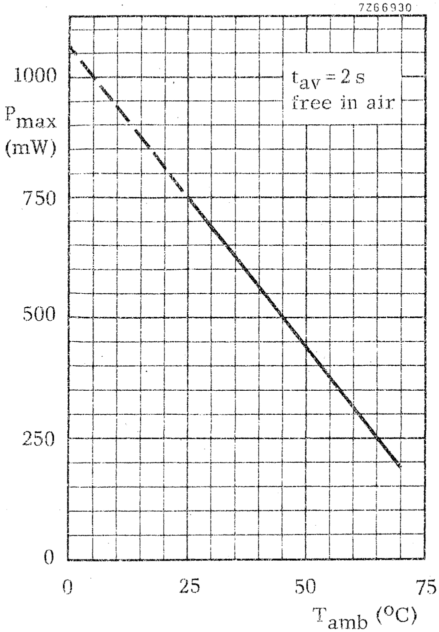
Tensile test

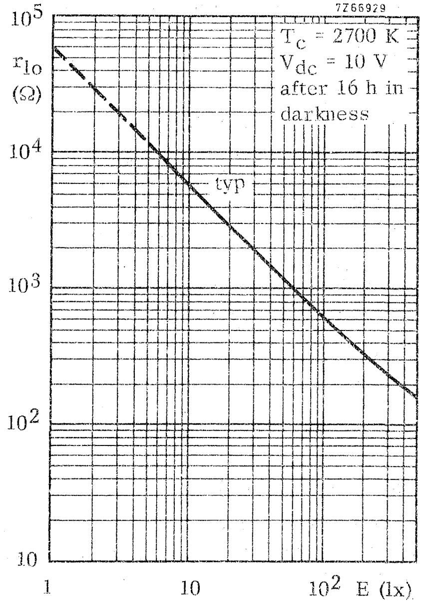
The device withstands the tensile test of IEC Publication 68-2-21, Test Ua: loading weight 500 g.

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
Pmax
(mW)
tav = 2 s
free in air
0
25
50
75
Tamb (°C)


7Z66929
10^5
10^4
10^3
10^2
10
rlo
(Ω)
Tc = 2700 K
Vdc = 10 V
after 16 h in
darkness
typ
1
10
10^2
E (lx)

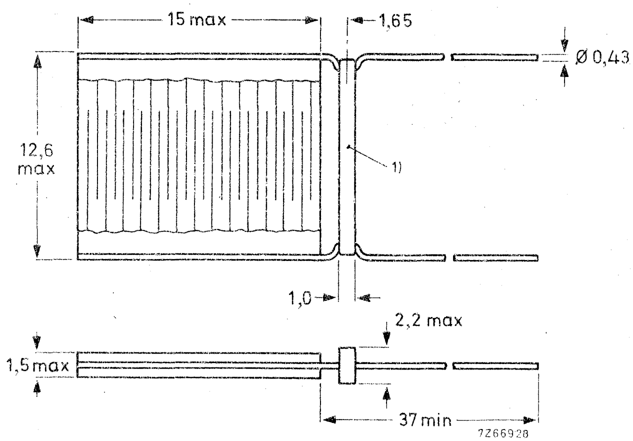
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

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

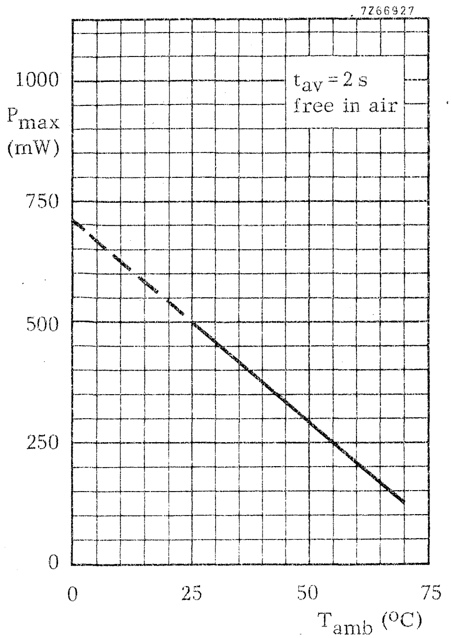
Tensile test

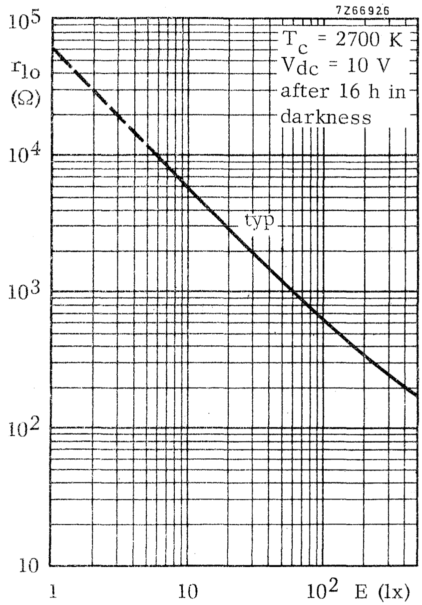
The device withstands the tensile test of IEC Publication 68-2-21, Test Ua: loading weight 500 g.

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


7Z66926
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)

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
P = Low-frequency power transistors
PC = Germanium point contact diodes
R = Rectifier diodes
Sp = Special diodes
Sw = Switching transistors
T = Tuner diodes
Vrg = Voltage regulator 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
P = Low-frequency power transistors

FET = Field-effect transistors
HF = High-frequency transistors
P = Low-frequency power transistors

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
Tra = 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
Tri = Triacs

AD = Silicon alloyed diodes
D = Displays
GB = Germanium gold-bonded diodes
I = Infrared devices
LED = Light emitting diodes
Mm = Microminiature devices for thick- and thin-film circuits

PC = Germanium point contact diodes
Ph = Photoconductive devices
PhC = Photocouplers
St = Rectifier stacks
TS = Transient suppressor diodes
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes

Type No.	Part	Section	Type No.	Part	Section	Type No.	Part	Section
RPY76A	4b	I	1N5743B	1b	Vrg	2N2222	3	Sw
RPY82	4b	Ph	1N5744B	1b	Vrg	2N2222A	3	Sw
RPY84	4b	Ph	1N5745B	1b	Vrg	2N2297	3	HF
RPY85	4b	Ph	1N5746B	1b	Vrg	2N2368	3	Sw
1N821	1b	Vrf	1N5747B	1b	Vrg	2N2369	3	Sw
1N823	1b	Vrf	1N5748B	1b	Vrg	2N2369A	3	Sw
1N825	1b	Vrf	1N5749B	1b	Vrg	2N2483	3	HF
1N827	1b	Vrf	1N5750B	1b	Vrg	2N2484	3	HF
1N829	1b	Vrf	1N5751B	1b	Vrg	2N2894	3	Sw
1N914	1b	WD	1N5752B	1b	Vrg	2N2894A	3	Sw
1N914A	1b	WD	1N5753B	1b	Vrg	2N2904	3	Sw
1N916	1b	WD	1N5754B	1b	Vrg	2N2904A	3	Sw
1N916A	1b	WD	1N5755B	1b	Vrg	2N2905	3	Sw
1N916B	1b	WD	1N5756B	1b	Vrg	2N2905A	3	Sw
1N4009	1b	WD	1N5757B	1b	Vrg	2N2906	3	Sw
1N4148	1b	WD	2N918	3	HF	2N2906A	3	Sw
1N4150	1b	WD	2N929	2	LF	2N2907	3	Sw
1N4151	1b	WD	2N930	2	LF	2N2907A	3	Sw
1N4154	1b	WD	2N1302	3	Sw	2N3019	3	Sw
1N4446	1b	WD	2N1303	3	Sw	2N3020	3	Sw
1N4448	1b	WD	2N1304	3	Sw	2N3055	2	P
1N5729B	1b	Vrg	2N1305	3	Sw	2N3375	4a	Tra
1N5730B	1b	Vrg	2N1306	3	Sw	2N3442	2	P
1N5731B	1b	Vrg	2N1307	3	Sw	2N3553	4a	Tra
1N5732B	1b	Vrg	2N1308	3	Sw	2N3632	4a	Tra
1N5733B	1b	Vrg	2N1309	3	Sw	2N3819	4a	FET
1N5734B	1b	Vrg	2N1613	3	HF	2N3823	4a	FET
1N5735B	1b	Vrg	2N1711	3	HF	2N3866	4a	Tra
1N5736B	1b	Vrg	2N1893	3	HF	2N3924	4a	Tra
1N5737B	1b	Vrg	2N2218	3	Sw	2N3926	4a	Tra
1N5738B	1b	Vrg	2N2218A	3	Sw	2N3927	4a	Tra
1N5739B	1b	Vrg	2N2219	3	Sw	2N3966	4a	FET
1N5740B	1b	Vrg	2N2219A	3	Sw	2N4036	3	Sw
1N5741B	1b	Vrg	2N2221	3	Sw	2N4091	4a	FET
1N5742B	1b	Vrg	2N2221A	3	Sw	2N4092	4a	FET

FET = Field-effect transistors
HF = High-frequency transistors
I = Infrared devices
LF = Low-frequency transistors
P = Low-frequency power transistors
Ph = Photoconductive devices
Sw = Switching transistors
Tra = Transmitting transistors
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes
WD = Silicon whiskerless diodes

A = Accessories
DH = Diecast heatsinks
FET = Field-effect transistors
HE = Heatsink extrusions
HF = High-frequency transistors
I = Infrared devices
LF = Low-frequency transistors
P = Low-frequency power transistors
Tra = Transmitting transistors

MAINTENANCE TYPE LIST

The type numbers listed below are not included in this handbook except for those marked with an asterisk.

Detailed information will be supplied on request.

OAP12	* RPY18
OCP70	* RPY19
* ORP23	* RPY20
* ORP52	* RPY33
RPY13	* RPY55

Electronic components and materials for professional, industrial and consumer uses from a world-wide Group of Companies

Argentina: FAPESA I.y.C., Av. Crovara 2550, Tablada, Prov. de BUENOS AIRES, Tel. 652-7438/7478.
Australia: PHILIPS INDUSTRIES HOLDINGS LTD., Elcoma Division, 67 Mars Road, LANE COVE, 2066, N.S.W., Tel. 42 1261.
Austria: ÖSTERREICHISCHE PHILIPS BAUELEMENTE Industrie G.m.b.H., Zieglergasse 6, A-1072 WIEN, Tel. 93 26 22.
Belgium: M.B.L.E., 80, rue des Deux Gares, B-1070 BRUXELLES, Tel 523 00 00.
Brazil: IBRAPE S.A., Caixa Postal 7383, Av. Paulista 2073-S/Loja, SAO PAULO, SP, Tel. 287-7144, 01311.
Canada: PHILIPS ELECTRONICS INDUSTRIES LTD., Electron Devices Div., 116 Vanderhoof Ave., TORONTO 17, Ontario, Tel. 425-5161.
Chile: PHILIPS CHILENA S.A., Av. Santa Maria 0760, SANTIAGO, Tel. 39-40 01.
Colombia: SADAPE S.A., P.O. Box 9805 Calle 13, No. 51 + 39, BOGOTA D.E. 1., Tel. 600 600.
Denmark: MINIWATT A/S, Emdrupvej 115A, DK-2400 KØBENHAVN NV., Tel. (01) 69 16 22.
Finland: OY PHILIPS AB, Elcoma Division, Kaivokatu 8, SF-00100 HELSINKI 10, Tel. 1 72 71.
France: R.T.C. LA RADIOTECHNIQUE-COMPELEC, 130 Avenue Ledru Rollin, F-75540 PARIS 11, Tel. 355-44-99.
Germany: VALVO, UB Bauelemente der Philips G.m.b.H., Valvo Haus, Burchardstrasse 19, D-2 HAMBURG 1, Tel. (040) 3296-1.
Greece: PHILIPS S.A. HELLENIQUE, Elcoma Division, 52, Av. Syngrou, ATHENS, Tel. 915 311.
Hong Kong: PHILIPS HONG KONG LTD., Components Dept., 11th Fl., Din Wai Ind. Bldg., 49 Hoi Yuen Rd, KWUNTONG, Tel. K-42 72 32.
India: PHILIPS INDIA LTD., Elcoma Div., Band Box House, 254-D, Dr. Annie Besant Rd., Prabhadevi, BOMBAY-25-DD, Tel. 457 311-5.
Indonesia: P.T. PHILIPS-RALIN ELECTRONICS, Elcoma Division, 'Timah' Building, Jl. Jen. Gatot Subroto, JAKARTA, Tel. 44 163.
Ireland: PHILIPS ELECTRICAL (IRELAND) LTD., Newstead, Clonskeagh, DUBLIN 14, Tel. 69 33 55.
Italy: PHILIPS S.P.A., Sezione Elcoma, Piazza IV Novembre 3, I-20124 MILANO, Tel. 2-6994.
Japan: NIHON PHILIPS CORP., 32nd Fl., World Trade Center Bldg., 5, 3-chome, Shiba Hamamatsu-cho, Minato-ku, TOKYO, Tel. 03-435-5268.
Korea: PHILIPS ELECTRONICS (KOREA) LTD., Philips House, 260-199 Itaewon-dong, Yongsan-ku, C.P.O. Box 3680, SEOUL, Tel. 44-4202.
Mexico: ELECTRONICA S.A. de C.V., Varsovia No. 36, MEXICO 6, D.F., Tel. 5-33-11-80.
Netherlands: PHILIPS NEDERLAND B.V., Afd. Elonco, Boschdijk 525, NL-4510 EINDHOVEN, Tel. (040) 79 33 33.
New Zealand: EDAC LTD., 70-72 Kingsford Smith Street, WELLINGTON, Tel. 873 159.
Norway: ELECTRONICA A/S., Vitaminveien 11, P.O. Box 29, Grefsen, OSLO 4, Tel. (02) 15 05 90.
Peru: CADESA, Jr. Ilo, No. 216, Apartado 10132, LIMA, Tel. 27 73 17.
Philippines: ELDAC, Philips Industrial Dev. Inc., 2246 Pasong Tamo, MAKATI-RIZAL, Tel. 86-89-51 to 59.
Portugal PHILIPS PORTUGESA S.A.R.L., Av. Eng. Duharte Pacheco 6, LISBOA 1, Tel. 68 31 21.
Singapore: PHILIPS SINGAPORE PTE LTD., Elcoma Div., POB 340, Toa Payoh CPO, Lorong 1, Toa Payoh, SINGAPORE 12, Tel. 53 88 11.
South Africa: EDAC (Pty.) Ltd., South Park Lane, New Doornfontein, JOHANNESBURG, Tel. 24/6701-2.
Spain: COPRESA S.A., Balmes 22, BARCELONA 7, Tel. 301 63 12.
Sweden: A.B. ELCOMA, Lidingövägen 50, S-10 250 STOCKHOLM 27, Tel. 08/67 97 80.
Switzerland: PHILIPS A.G., Elcoma Dept., Edenstrasse 20, CH-8027 ZÜRICH, Tel. 01/44 22 11.
Taiwan: PHILIPS TAIWAN LTD., 3rd Fl., San Min Building, 57-1, Chung Shan N. Rd, Section 2, P.O. Box 22978, TAIPEI, Tel. 5513101-5.
Turkey: TÜRK PHILIPS TICARET A.S., EMET Department, Gümüssuyu Cad. 78-80, Beyoglü, ISTANBUL, Tel. 45 32 50.
United Kingdom: MULLARD LTD., Mullard House, Torrington Place, LONDON WC1E 7HD, Tel. 01-580 6633.
United States: NORTH AMERICAN PHILIPS ELECTRONIC COMPONENT CORP., 230, Duffy Avenue, HICKSVILLE, N.Y. 11802, Tel. (516) 931-6200.
IC Products: SIGNETICS CORPORATION, 811 East Arques Avenue, SUNNYVALE, California 94086, Tel. (408) 739-7700.
Uruguay: LUZILECTRON S.A., Rondeau 1567, piso 5, MONTEVIDEO, Tel. 9 43 21.
Venezuela: IND. VENEZOLANAS PHILIPS S.A., Elcoma Dept., A. Ppal de los Ruices, Edif. Centro Colgate, Apdo 1167, CARACAS, Tel. 36 05 11.

Printed in The Netherlands

9399 251 26201