Semiconductors and integrated circuits

Part 4b September 1978

Photosensitive diodes and transistors

Light emitting diodes

Photocouplers

Infrared sensitive devices

Photoconductive devices

SEMICONDUCTORS AND INTEGRATED CIRCUITS

PART 4b — SEPTEMBER 1978

DEVICES FOR OPTOELECTRONICS

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)

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

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

Part 1a	**August 1978**	**SC1a 08-78**	**Rectifier diodes, thyristors, triacs** Rectifier diodes, voltage regulator diodes (> 1,5 W), transient suppressor diodes, rectifier stacks, thyristors, triacs
Part 1b	**May 1977**	**SC1b 05-77**	**Diodes** Small signal germanium diodes, small signal silicon diodes, special diodes, voltage regulator diodes (< 1,5 W), voltage reference diodes, tuner diodes
Part 2	**November 1977**	**SC2 11-77**	**Low-frequency and dual transistors**
Part 3	**January 1978**	**SC3 01-78**	**High-frequency, switching and field-effect transistors**
Part 4a	**June 1976**	**SC4a 06-76**	**Special semiconductors*** Transmitting transistors, field-effect transistors, dual transistors, microminiature devices for thick and thin-film circuits
Part 4b	**September 1978**	**SC4b 09-78**	**Devices for optoelectronics** Photosensitive diodes and transistors, light emitting diodes, photocouplers, infrared sensitive devices, photoconductive devices
Part 4c	**July 1978**	**SC4c 07-78**	**Discrete semiconductors for hybrid thick and thin-film circuits**
Part 5a	**November 1976**	**SC5a 11-76**	**Professional analogue integrated circuits**
Part 5b	**March 1977**	**SC5b 03-77**	**Consumer integrated circuits** Radio-audio, television
Part 6	**October 1977**	**SC6 10-77**	**Digital integrated circuits** LOCMOS HE4000B family
Signetics integrated circuits 1978			Bipolar and MOS memories Bipolar and MOS microprocessors Analogue circuits

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* The most recent information on field-effect transistors can be found in SC3 01-78, on dual transistors in SC2 11-77, and on microminiature devices in SC4c 07-78.

COMPONENTS AND MATERIALS (GREEN SERIES)

Part 1	**June 1977**	**CM1 06-77**	**Assemblies for industrial use** High noise immunity logic FZ/30-series, counter modules 50-series, NORbits 60-series, 61-series, circuit blocks 90-series, circuit block CSA70(L), PLC modules, input/output devices, hybrid circuits, peripheral devices, ferrite core memory products
Part 2a	**October 1977**	**CM2a 10-77**	**Resistors** Fixed resistors, variable resistors, voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC), test switches
Part 2b	**February 1978**	**CM2b 02-78**	**Capacitors** Electrolytic and solid capacitors, film capacitors, ceramic capacitors, variable capacitors
Part 3	**January 1977**	**CM3 01-77**	**Radio, audio, television** Loudspeakers, components for black and white television, components for colour television
Part 3a	**September 1978**	**CM3a 09-78**	**FM tuners, television tuners, surface acoustic wave filters**
Part 4a	**September 1978**	**CM4a 09-78**	**Soft ferrites** Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferroxcube transformer cores
Part 4b	**December 1976**	**CM4b 12-76**	**Piezoelectric ceramics, permanent magnet materials**
Part 6	**April 1977**	**CM6 04-77**	**Electric motors and accessories** Small synchronous motors, stepper motors, miniature direct current motors
Part 7	**September 1971**	**CM7 09-71**	**Circuit blocks** Circuit blocks 100 kHz-series, circuit blocks 1-series, circuit blocks 10-series, circuit blocks for ferrite core memory drive
Part 8	**February 1977**	**CM8 02-77**	**Variable mains transformers**
Part 9	**March 1976**	**CM9 03-76**	**Piezoelectric quartz devices**
Part 10	**April 1978**	**CM10 04-78**	**Connectors**

INDEX OF TYPE NUMBERS

Data Handbooks SC1a to SC4c

The inclusion of a type number in this publication does not necessarily imply its availability.

type no.	part	section
AA119	1b	PC
AAZ15	1b	GB
AAZ17	1b	GB
AAZ18	1b	GB
AC125	2	LF
AC126	2	LF
AC127	2	LF
AC128	2	LF
AC128/01	2	LF
AC132	2	LF
AC187	2	LF
AC187/01	2	LF
AC188	2	LF
AC188/01	2	LF
AD161	2	P
AD162	2	P
AF367	3	HFSW
ASZ15	2	P
ASZ16	2	P
ASZ17	2	P
ASZ18	2	P
BA100	1b	AD
BA102	1b	T
BA145	1a	R
BA148	1a	R
BA157	1a	R
BA158	1a	R
BA159	1a	R
BA182	1b	T
BA216	1b	WD
BA217	1b	WD
BA218	1b	WD
BA219	1b	WD
BA220	1b	WD
BA221	1b	WD
BA222	1b	WD
BA243	1b	T
BA244	1b	T
BA280	1b	T
BA314	1b	Vrg
BA314A	1b	Vrg
BA315	1b	Vrg
BA316	1b	WD
BA317	1b	WD
BA318	1b	WD
BA379	1b	T
BAS16	4c	Mm
BAT17	4c	Mm
BAT18	4c	Mm
BAV10	1b	WD
BAV18	1b	WD
BAV19	1b	WD
BAV20	1b	WD
BAV21	1b	WD
BAV45	1b	Sp
BAV70	4c	Mm
BAV99	4c	Mm
BAW21A	1b	WD
BAW21B	1b	WD
BAW56	4c	Mm
BAW62	1b	WD
BAX12	1b	WD
BAX12A	1b	WD
BAX13	1b	WD
BAX14	1b	WD
BAX14A	1b	WD
BAX15	1b	WD
BAX16	1b	WD
BAX17	1b	WD
BAX18	1b	WD
BAX18A	1b	WD
BB105A	1b	T
BB105B	1b	T
BB105G	1b	T
BB106	1b	T
BB110B	1b	T
BB110G	1b	T
BB117	1b	T
BB119	1b	T
BB204B	1b	T
BB204G	1b	T
BB205A	1b	T
BB205B	1b	T
BB205G	1b	T
BBY31	4c	Mm
BC107	2	LF
BC108	2	LF
BC109	2	LF
BC140	2	LF
BC141	2	LF

AD = Silicon alloyed diodes
GB = Germanium gold bonded diodes
HFSW = High-frequency and switching transistors
LF = Low-frequency transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors

PC = Germanium point contact diodes
R = Rectifier diodes
Sp = Special diodes
T = Tuner diodes
Vrg = Voltage regulator diodes
WD = Silicon whiskerless diodes

INDEX

DT = Dual transistors
FET = Field-effect transistors
LF = Low-frequency transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors

FET = Field-effect transistors
HFSW = High-frequency and switching transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors

INDEX

FET = Field-effect transistors
HFSW = High-frequency and switching transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
PDT = Photodiodes or transistors
R = Rectifier diodes
Th = Thyristors
Tra = Transmitting transistors

+ = series.

FET = Field-effect transistors
HFSW = High-frequency and switching transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors
R = Rectifier diodes

Th = Thyristors
Tri = Triacs

+ = series.

GB = Germanium gold bonded diodes
LED = Light-emitting diodes
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
PhC = Photocouplers
R = Rectifier diodes
TS = Transient suppressor diodes
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes

AD = Silicon alloyed diodes
HFSW = High-frequency and switching transistors
I = Infrared devices
LF = Low-frequency transistors
PC = Germanium point contact diodes
Ph = Photoconductive devices

R = Rectifier diodes
St = Rectifier stacks
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes
WD = Silicon whiskerless diodes

INDEX

A = Accessories
DH = Diecast heatsinks
FET = Field-effect transistors
HE = Heatsink extrusions
HFSW = High-frequency and switching transistors
I = Infrared devices
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.

  BPX66P
  OAP12
  OCP70
* ORP23
* ORP52
  RPY13

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 semiconductor devices – as opposed to integrated circuits –, multiples of such devices and semiconductor chips.

A basic type number consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

FIRST LETTER

The first letter gives information about the material used for the active part of the devices.

A. GERMANIUM or other material with band gap of 0,6 to 1,0 eV.
B. SILICON or other material with band gap of 1,0 to 1,3 eV.
C. GALLIUM-ARSENIDE or other material with band gap of 1,3 eV or more.
R. COMPOUND MATERIALS (e.g. Cadmium-Sulphide).

SECOND LETTER

The second letter indicates the function for which the device is primarily designed.

A. DIODE; signal, low power
B. DIODE; variable capacitance
C. TRANSISTOR; low power, audio frequency ($R_{th\,j\text{-}mb} > 15$ °C/W)
D. TRANSISTOR; power, audio frequency ($R_{th\,j\text{-}mb} \leqslant 15$ °C/W)
E. DIODE; tunnel
F. TRANSISTOR; low power, high frequency ($R_{th\,j\text{-}mb} > 15$ °C/W)
G. MULTIPLE OF DISSIMILAR DEVICES – MISCELLANEOUS; e.g. oscillator
H. DIODE; magnetic sensitive
L. TRANSISTOR; power, high frequency ($R_{th\,j\text{-}mb} \leqslant 15$ °C/W)
N. PHOTO-COUPLER
P. RADIATION DETECTOR; e.g. high sensitivity phototransistor
Q. RADIATION GENERATOR; e.g. light-emitting diode (LED)
R. CONTROL AND SWITCHING DEVICE; e.g. thyristor, low power ($R_{th\,j\text{-}mb} > 15$ °C/W)
S. TRANSISTOR; low power, switching ($R_{th\,j\text{-}mb} > 15$ °C/W)
T. CONTROL AND SWITCHING DEVICE; e.g. thyristor, power ($R_{th\,j\text{-}mb} \leqslant 15$ °C/W)
U. TRANSISTOR; power, switching ($R_{th\,j\text{-}mb} \leqslant 15$ °C/W)
X. DIODE: multiplier, e.g. varactor, step recovery
Y. DIODE; rectifying, booster
Z. DIODE; voltage reference or regulator (transient suppressor diode, with third letter W)

SERIAL NUMBER

Three figures, running from 100 to 999, for devices primarily intended for consumer equipment.
One letter (Z, Y, X, etc.) and two figures, running from 10 to 99, for devices primarily intended for industrial/professional equipment.
This letter has no fixed meaning except W, which is used for transient suppressor diodes.

VERSION LETTER

It indicates a minor variant of the basic type either electrically or mechanically. The letter never has a fixed meaning, except letter R, indicating reverse voltage, e.g. collector to case or anode to stud.

SUFFIX

Sub-classification can be used for devices supplied in a wide range of variants called associated types. Following sub-coding suffixes are in use:

1. VOLTAGE REFERENCE and VOLTAGE REGULATOR DIODES: *ONE LETTER and ONE NUMBER*
   The LETTER indicates the nominal tolerance of the Zener (regulation, working or reference) voltage
   A. 1% (according to IEC 63: series E96)
   B. 2% (according to IEC 63: series E48)
   C. 5% (according to IEC 63: series E24)
   D. 10% (according to IEC 63: series E12)
   E. 20% (according to IEC 63: series E6)
   The number denotes the typical operating (Zener) voltage related to the nominal current rating for the whole range.
   The letter 'V' is used instead of the decimal point.

2. TRANSIENT SUPPRESSOR DIODES: *ONE NUMBER*
   The NUMBER indicates the maximum recommended continuous reversed (stand-off) voltage V_R. The letter 'V' is used as above.

3. CONVENTIONAL and CONTROLLED AVALANCHE RECTIFIER DIODES and THYRISTORS: *ONE NUMBER*
   The NUMBER indicates the rated maximum repetitive peak reverse voltage (V_{RRM}) or the rated repetitive peak off-state voltage (V_{DRM}), whichever is the lower. Reversed polarity is indicated by letter R, immediately after the number.

4. RADIATION DETECTORS: *ONE NUMBER,* preceded by a hyphen (–)
   The NUMBER indicates the depletion layer in μm. The resolution is indicated by a version LETTER.

5. ARRAY OF RADIATION DETECTORS and GENERATORS: *ONE NUMBER,* preceded by a stroke (/).
   The NUMBER indicates how many basic devices are assembled into the array.

RATING SYSTEMS

The rating systems described are those recommended by the International Electrotechnical Commission (IEC) in its Publication 134.

DEFINITIONS OF TERMS USED

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

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

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.

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.

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.

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.

ABSOLUTE MAXIMUM RATING SYSTEM

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

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

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

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.

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.

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

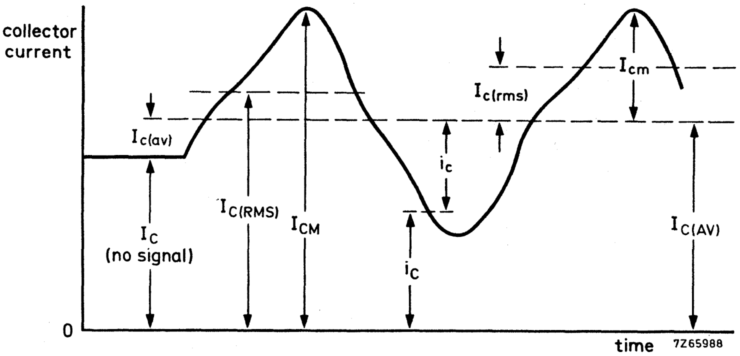
For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

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 $\phi_e = \frac{dQe}{dt}$; unit: watt, W.

Radiant intensity

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

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

Irradiance

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

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

Light

Radiation capable of stimulating the organ of vision. 1)

Luminous flux

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

Symbols: ϕ_v, ϕ; unit: lumen, lm.

Lumen

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

Symbol: lm.

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

Luminous intensity

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

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

SAFETY

The most modern high technology materials have been used in these components to ensure the highest performance for the user. Some of them are toxic to man but the quantity used in a single device is so small that the risk of toxic effects are negligible even in extreme circumstances.

PHOTOSENSITIVE DIODES AND TRANSISTORS

SILICON PHOTOTRANSISTOR

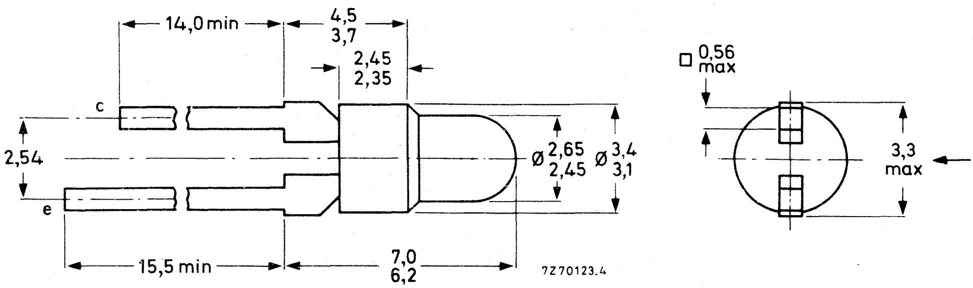
N-P-N silicon phototransistor in epoxy resin encapsulation intended to be used in combination with the infrared LED CQY58. The base is inaccessible.

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 $T_{amb} = 25\ ^oC$	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/cm^2; λpk = 875 nm	$I_{CEO(L)}$	>	6	mA
Wavelength at peak response	λpk	typ.	800	nm

MECHANICAL DATA

Dimensions in mm

SOD-53D



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

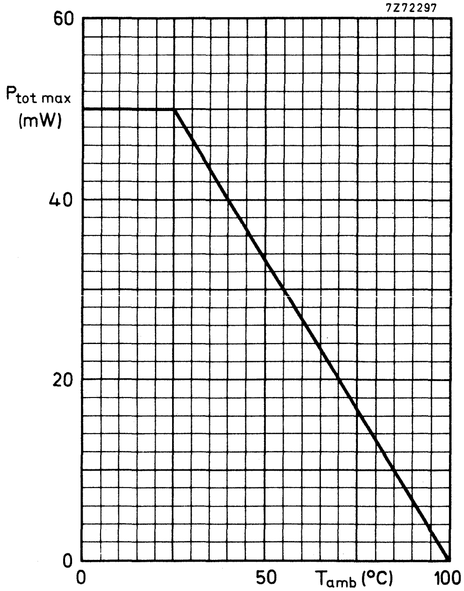
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	50	mW

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

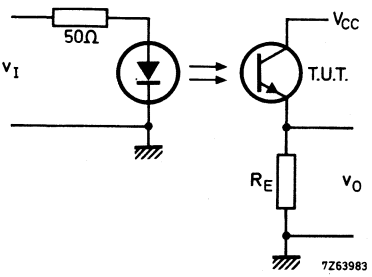
From junction to ambient, device mounted on printed-circuit board	$R_{th\ j\text{-}a}$	=	1,5	°C/mW



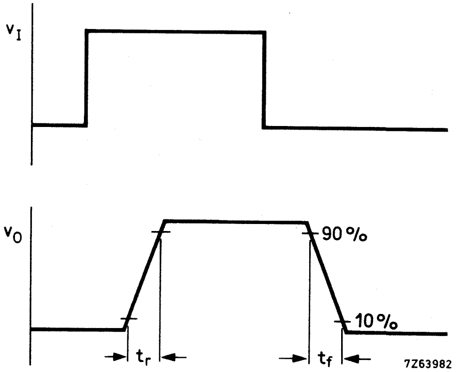
CHARACTERISTICS

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/cm^2; λpk = 875 nm ¹)	$I_{CEO(L)}$	> typ.	6 15	mA mA
Collector-emitter saturation voltage				
I_C = 4 mA; E_e = 5 mW/cm^2; 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



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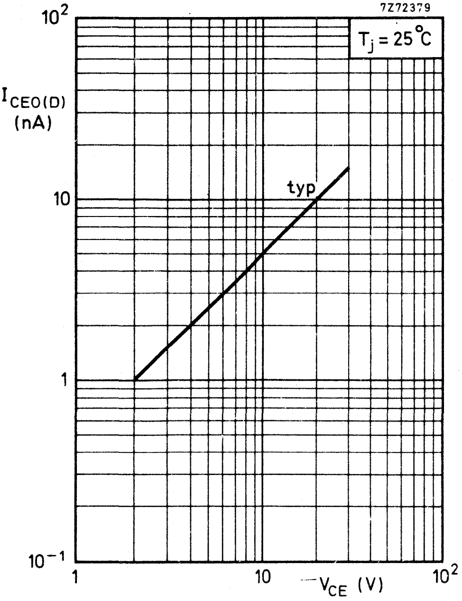
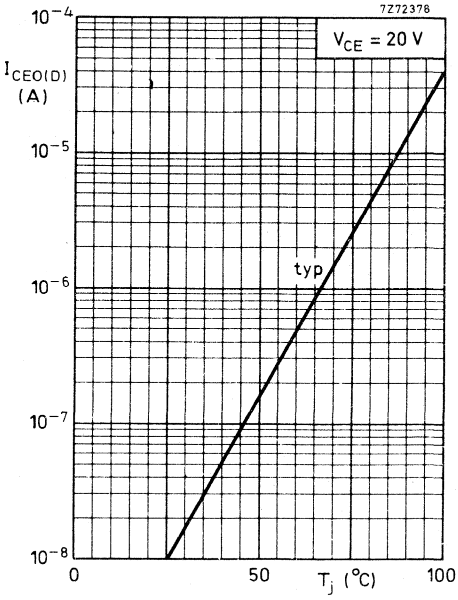
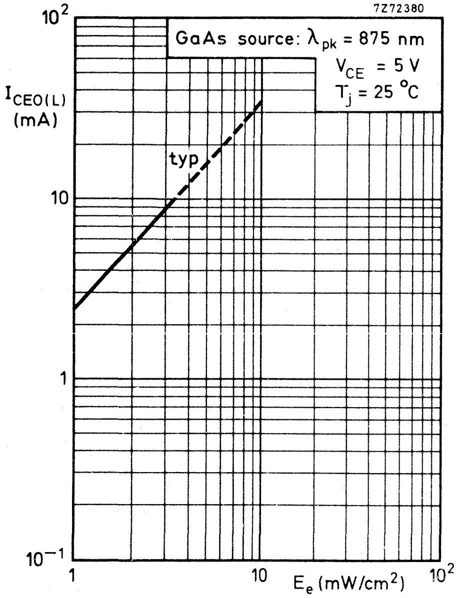
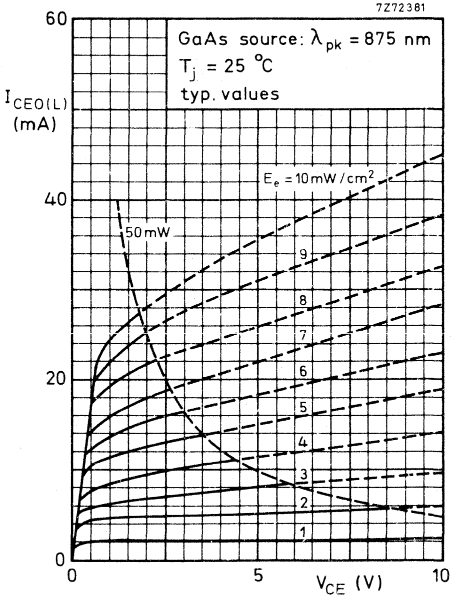
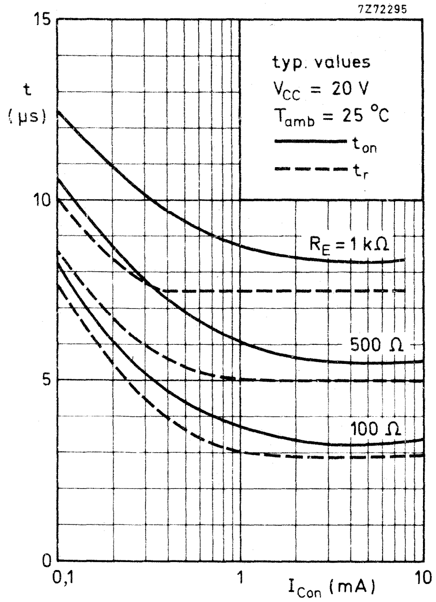
¹) Measured with pulsed GaAs light source.

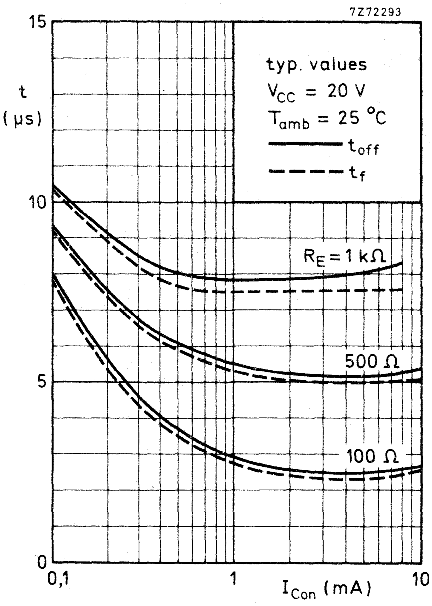

7Z72379
$T_j = 25\,^{\circ}C$
$I_{CEO(D)}$ (nA)
10^2
10
1
10^{-1}
typ
1
10
10^2
V_{CE} (V)

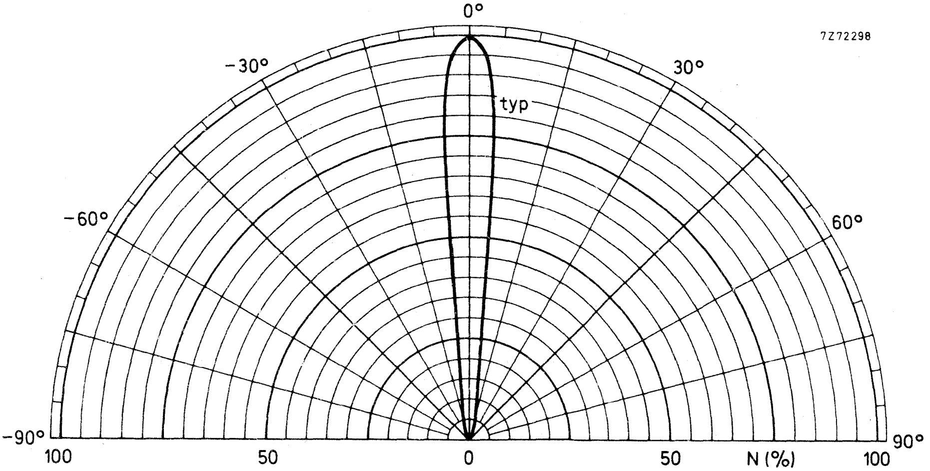

7Z72378
$V_{CE} = 20$ V
$I_{CEO(D)}$ (A)
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
typ
0
50
100
T_j (°C)

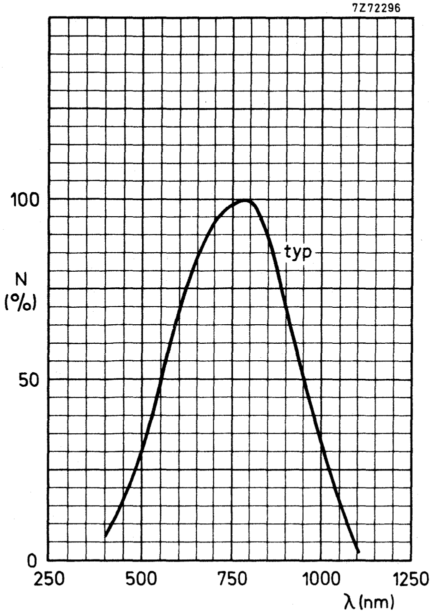

7Z72380
GaAs source: $\lambda_{pk} = 875$ nm
$V_{CE} = 5$ V
$T_j = 25\,^{\circ}C$
$I_{CEO(L)}$ (mA)
10^2
10
1
10^{-1}
typ
1
10
10^2
E_e (mW/cm^2)

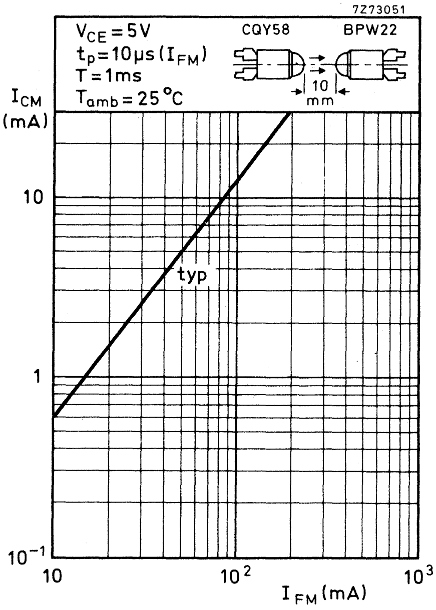

7Z72381
GaAs source: $\lambda_{pk} = 875$ nm
$T_j = 25\,^{\circ}C$
typ. values
$I_{CEO(L)}$ (mA)
60
40
20
0
$E_e = 10$ mW/cm^2
50 mW
9
8
7
6
5
4
3
2
1
0
5
10
V_{CE} (V)

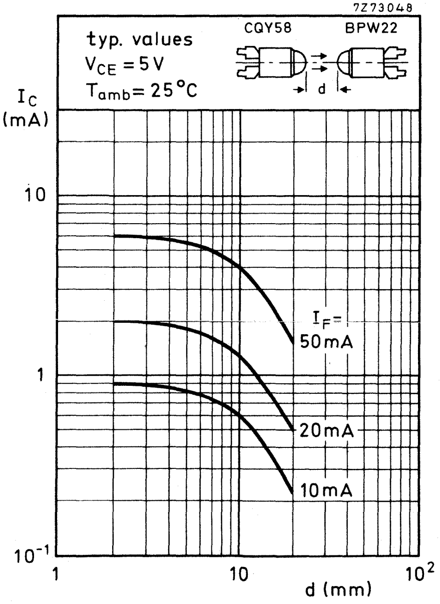

7Z72295
t
(μs)
15
10
5
0
0,1
1
10
I_Con (mA)
typ. values
V_CC = 20 V
T_amb = 25 °C
t_on
t_r
R_E = 1 kΩ
500 Ω
100 Ω

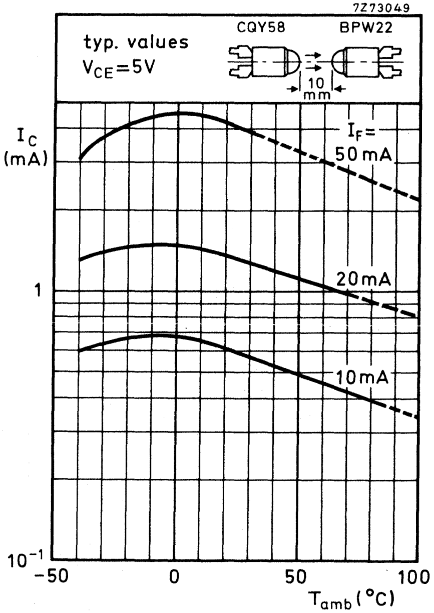

7Z72293
t
(μs)
15
10
5
0
0,1
1
10
I_Con (mA)
typ. values
V_CC = 20 V
T_amb = 25 °C
t_off
t_f
R_E = 1 kΩ
500 Ω
100 Ω


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


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


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} = 5V
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)

SILICON PHOTODIODE

Silicon planar photodiode for infrared remote control, infrared sound transmission, and general purposes. The rectangular shape of its envelope, the square sensitive area of 2,75 mm x 2,75 mm, and the pin distance of 5,08 mm, render it suitable for use on a printed-circuit board.

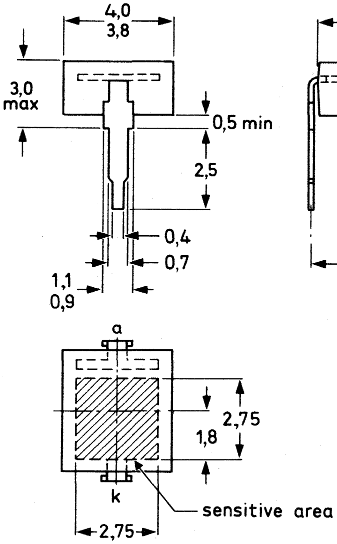
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	32	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150	mW
Junction temperature	T_j	max.	90	°C
Dark reverse current V_R = 10 V	$I_{R(D)}$	$<$	30	nA
Light sensitivity V_R = 5 V; T_c = 2856 K	N	$>$	50	nA/lx
Wavelength at peak response V_R = 5 V	λ_{pk}	typ.	850	nm

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-62A.



RATINGS

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

Continuous reverse voltage	V_R	max.	32	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150	mW
Storage temperature	T_{stg}		−30 to +90	°C
Junction temperature	T_j	max.	90	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	435	°C/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Dark reverse current V_R = 10 V; E_v = 0	$I_{R(D)}$	typ. $<$	2 30	nA nA
Light reverse current V_R = 0; E_v = 100 Lx; T_c = 2856 K *	$I_{R(L)}$	typ.	6,5	µA
Photovoltaic mode at T_c = 2856 K * Open-circuit voltage (light forward voltage)				
I = 0; E_v = 100 lx	$V_{F(L)}$	typ.	240	mV
I = 0; E_v = 1000 lx	$V_{F(L)}$	typ.	350	mV
Temperature coefficient of open-circuit voltage	$\frac{\Delta V_{F(L)}}{\Delta T_{amb}}$	typ.	−2,6	mV/°C
Temperature coefficient of short-circuit current	$\frac{\Delta I_{R(L)}}{\Delta T_{amb}}$	typ.	0,2	%/°C
Light sensitivity with external voltage V_R = 5 V; E_v = 1000 lx; T_c = 2856 K *	N	$>$ typ.	50 70	nA/lx nA/lx
Wavelength at peak response V_R = 5 V	λ_{pk}	typ.	850	nm
Diode capacitance V_R = 3 V	C_d	typ. $<$	25 40	pF pF
V_R = 0	C_d	typ.	72	pF
Light switching times (see Figs 2 and 3) Rise time and fall time				
V_{KK} = 5 V; R_A = 1 kΩ **	t_r, t_f	typ.	50	ns
V_{KK} = 0; R_A = 1 kΩ **	t_r, t_f	typ.	125	ns

* Unfiltered tungsten filament lamp source.

** V_{KK} is cathode supply voltage; R_A is anode series resistance.

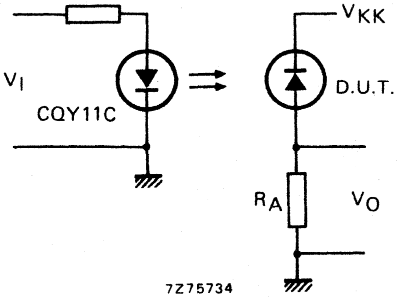


Fig. 2. Switching circuit.

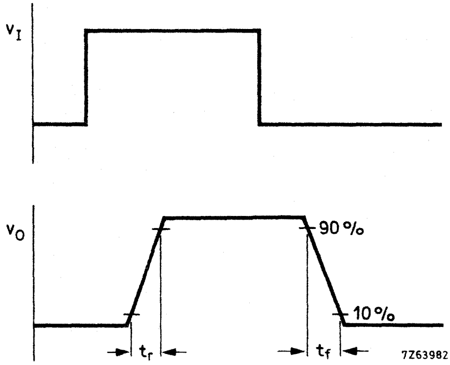


Fig. 3 Input and output switching waveforms.

Fig. 2 E = 0; T_{amb} = 25 °C.

Fig. 3 Typical values; E = 0.

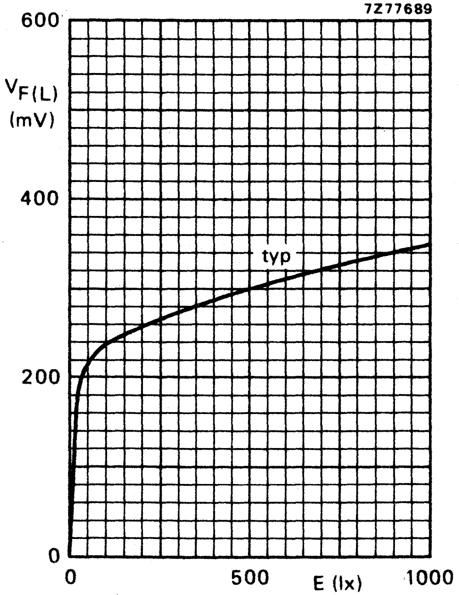


Fig. 4 I = 0; T_{amb} = 25 °C.

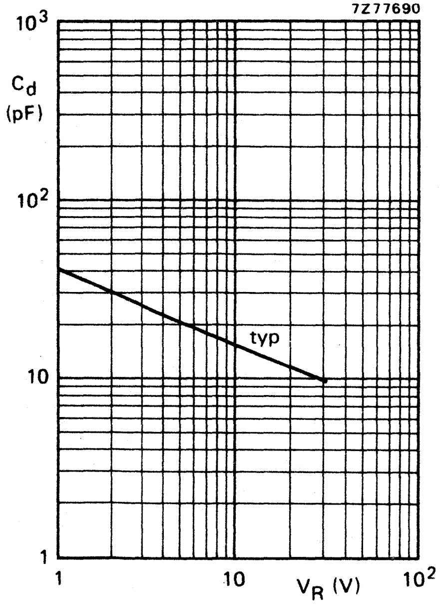


Fig. 5 T_{amb} = 25 °C.

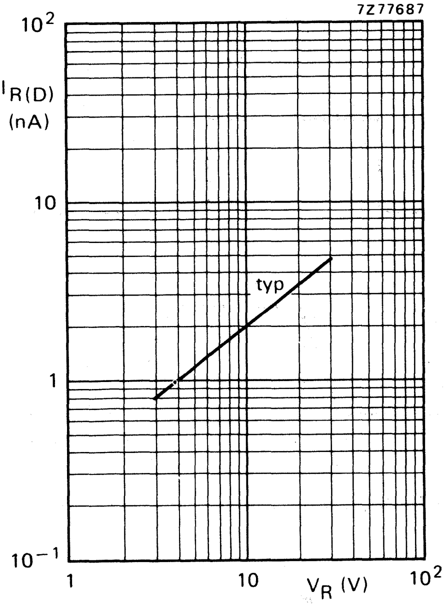


Fig. 6 E = 0; T_{amb} = 25 °C.

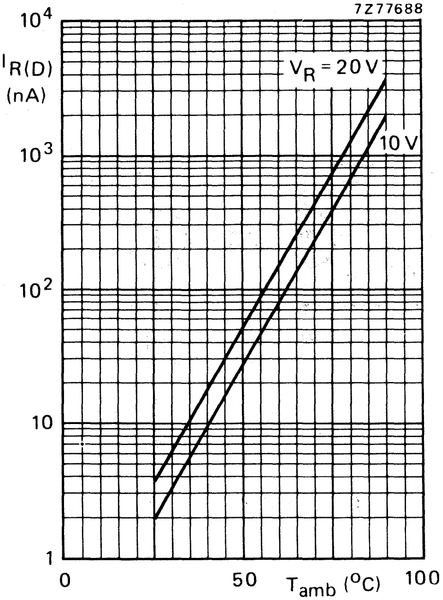


Fig. 7 Typical values; E = 0.

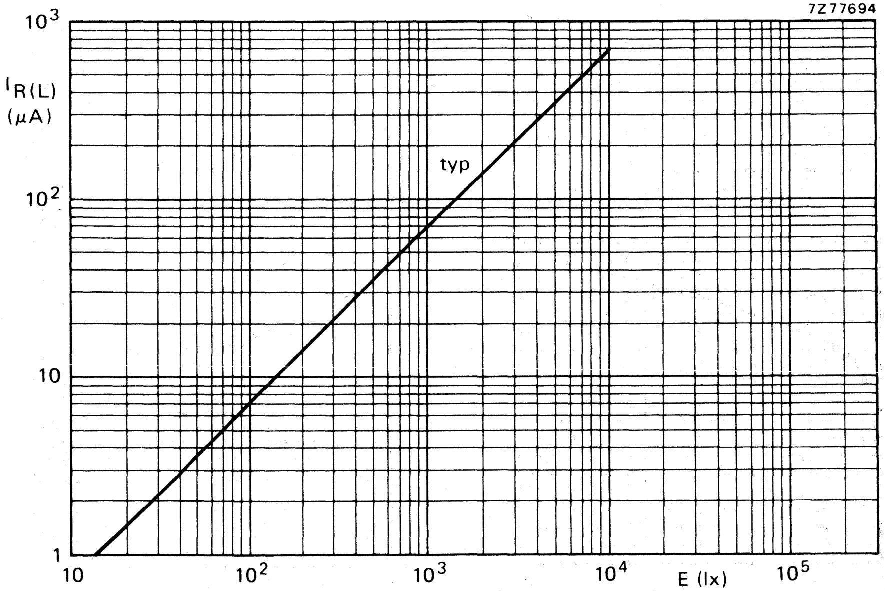


Fig. 8 V_R = 5 V; T_{amb} = 25 °C.

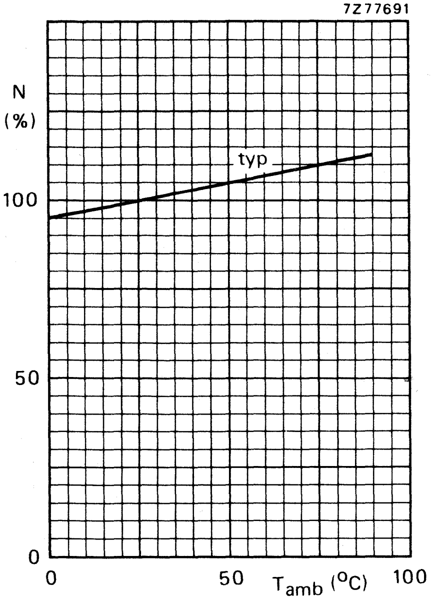


Fig.9 $V_R = 5$ V; $E_v = 1000$ lx.

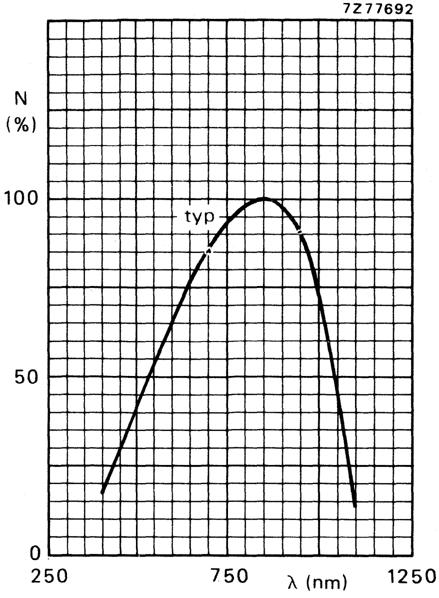


Fig.10.

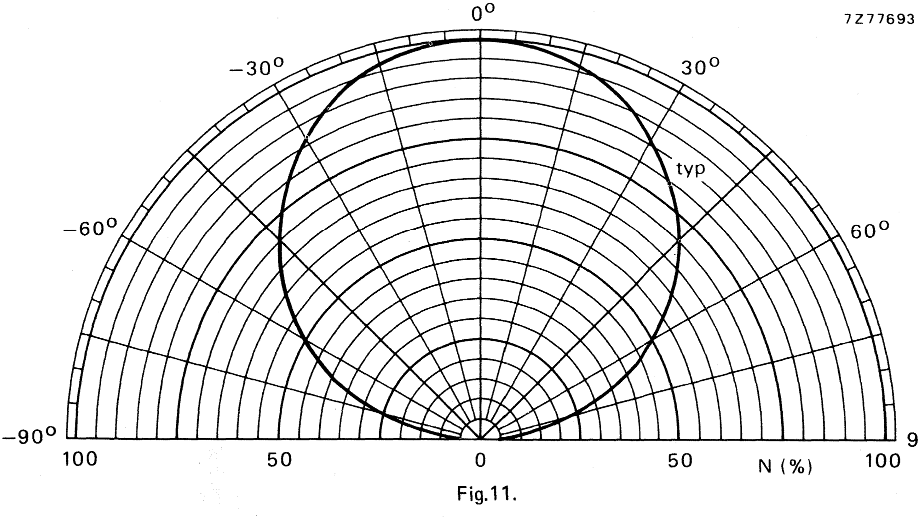


Fig.11.

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

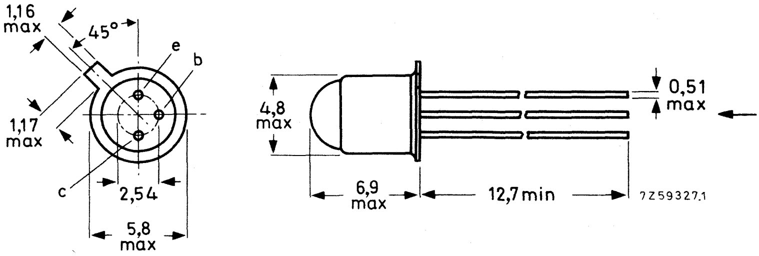
Collector-emitter voltage (open base)	V_{CEO}	max.	32		V
Collector current (peak value)	I_{CM}	max.	200		mA
Junction temperature	T_j	max.	150		^{o}C
Collector dark current $I_B = 0$; $V_{CE} = 24$ V	$I_{CEO(D)}$	<	500		nA
			BPX25	BPX29	
Collector light current $I_B = 0$; $V_{CE} = 6$ V; at 1000 lx	$I_{CEO(L)}$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

MECHANICAL DATA

Dimensions in mm

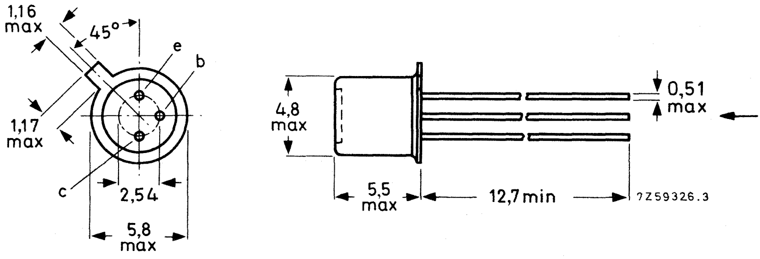
BPX25

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 $T_{amb} = 25\ ^{o}C$	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 $T_{amb} = 25\ ^{o}C$ 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; $T_{amb} = 100\ ^{o}C$	$I_{CEO(D)}$	typ.	15	µA
		<	100	µA

Collector light current

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

D.C. current gain

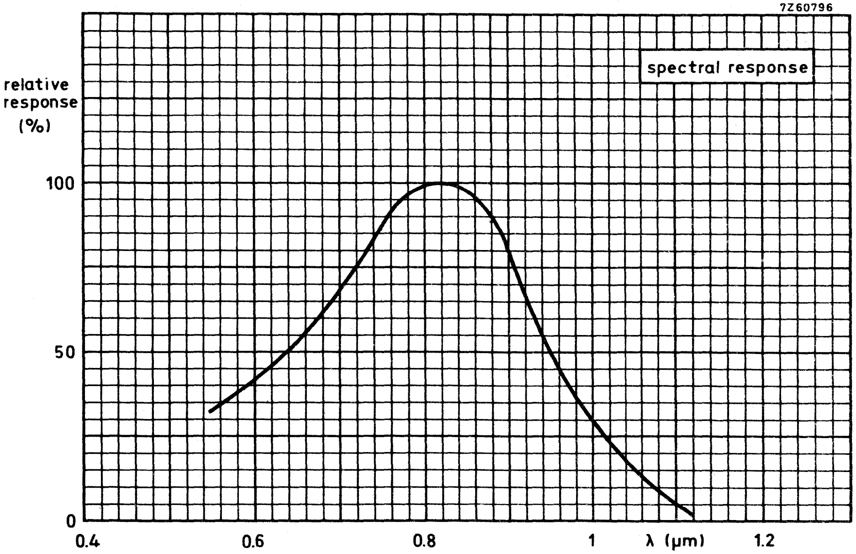
			BPX25	BPX29	
$I_C = 2$ mA; $V_{CE} = 6$ V	h_{FE}	typ.	500	500	

Cut-off frequency

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

CHARACTERISTICS (continued)

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



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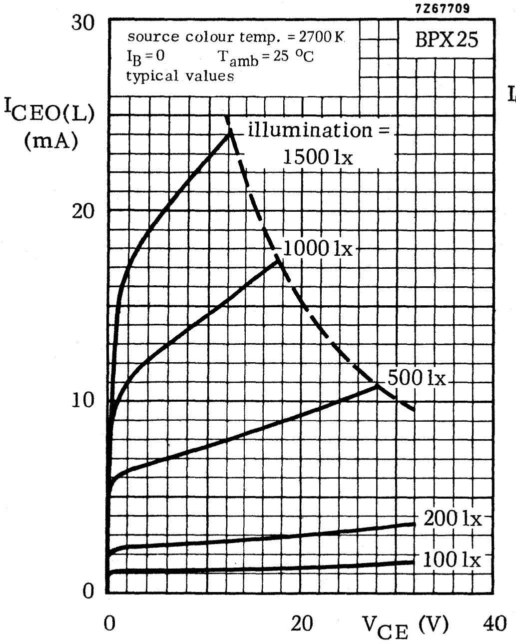
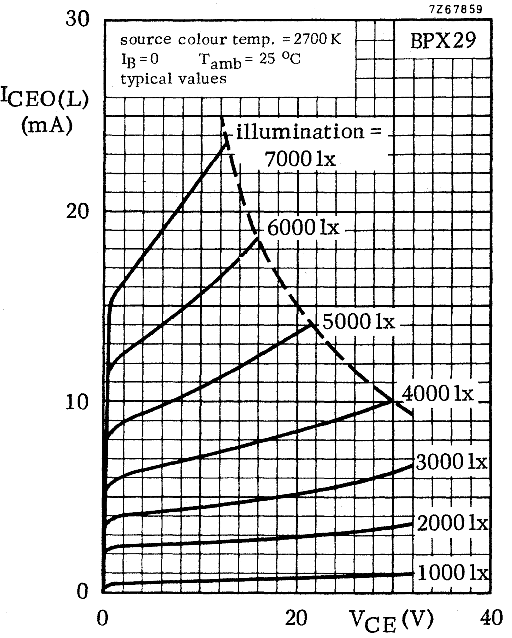
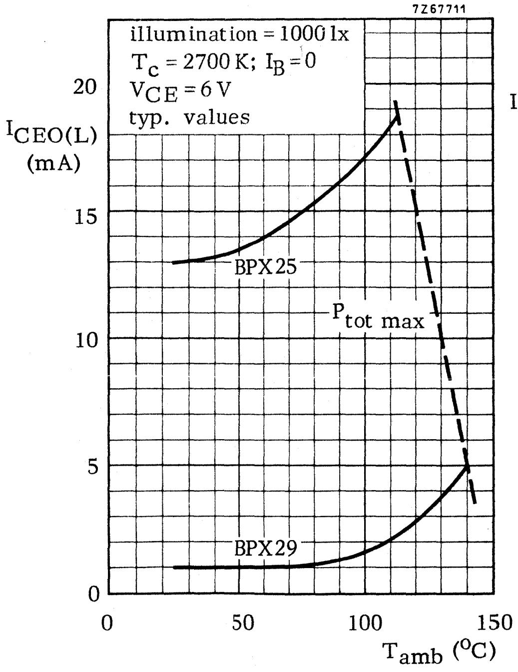
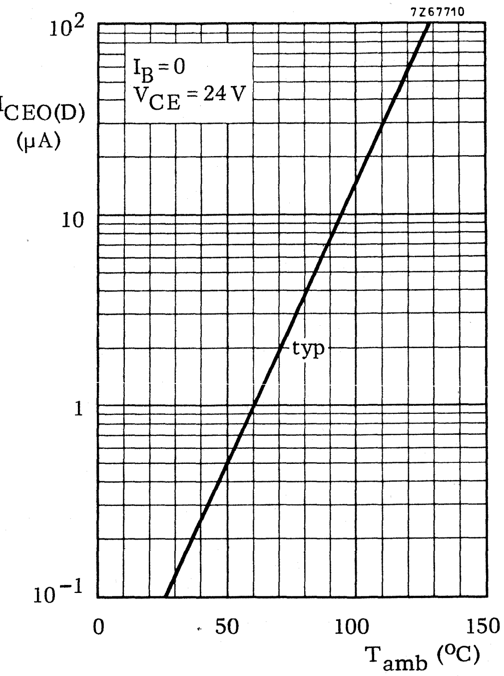
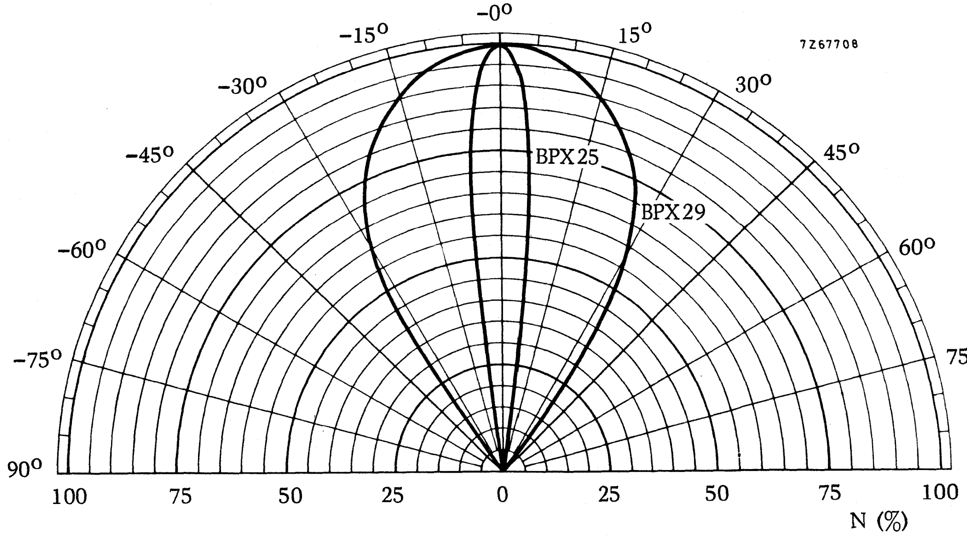
[1] Source: modulated GaAs: 0,4 mW/cm^2
Load: optimum (50 Ω)
V_{CE} = 24 V
Improved switching times can be obtained by a quiescent bias current.
I.e. I_B = 2 μA: t_d < 0,2 μs.


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


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
30
20
10
0
0
20
40
V_{CE} (V)


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


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

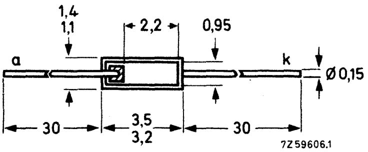
Unencapsulated photodiode for general purpose applications.

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		^oC
Junction temperature	T_j	max.	125	^oC

THERMAL RESISTANCE

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

CHARACTERISTICS

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

Dark reverse current				
$V_R = 15$ V	I_d	typ. <	0,01 0,5	μA μA
$V_R = 15$ V; $T_{amb} = 100\ ^oC$	I_d	typ. <	0,6 4,0	μA μA
Photovoltaic mode				
E = 1000 lx; $T_c = 2700$ K (equivalent to 7,7 mW/cm^2)				
Light reverse current; V = 0	I_1	> typ.	10 13	μA μA
Forward voltage; I = 0	V_F	> typ.	330 350	mV 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	> typ.	10,5 14	nA/lx nA/lx
Wavelength at peak response	λ_{pk}	typ.	800	nm
Diode capacitance; f = 500 kHz				
$V_R = 15$ V	C_d	typ.	90	pF
$V_R = 0$	C_d	typ.	300	pF
Cut-off frequency (modulated GaAs source)	f_{co}	typ.	500	kHz

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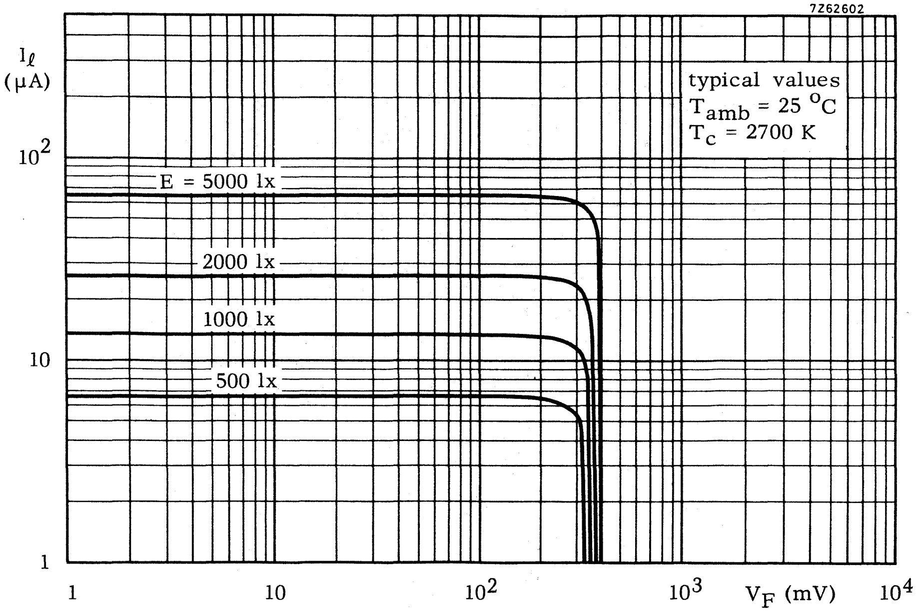
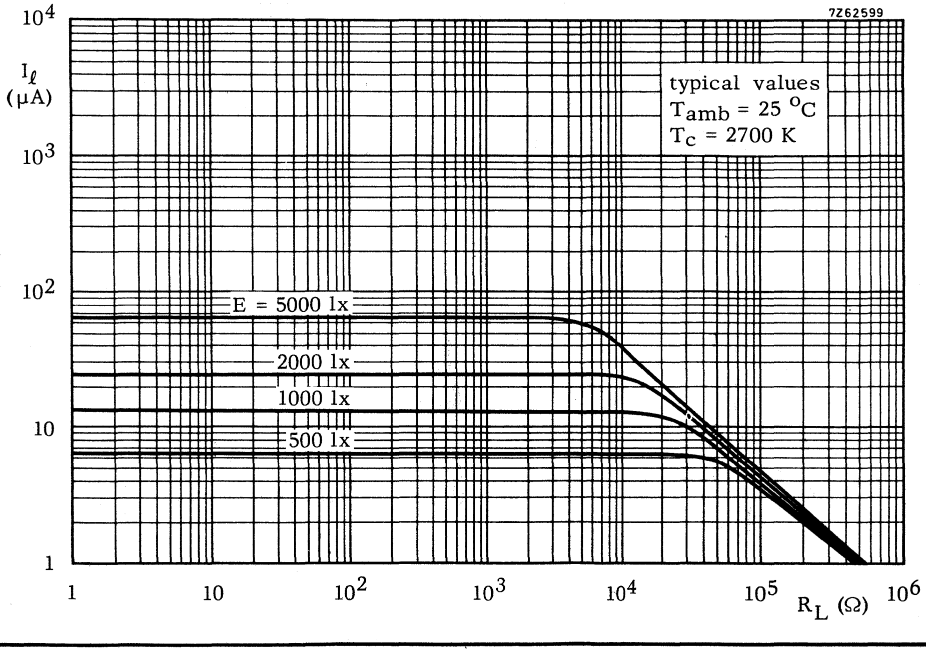
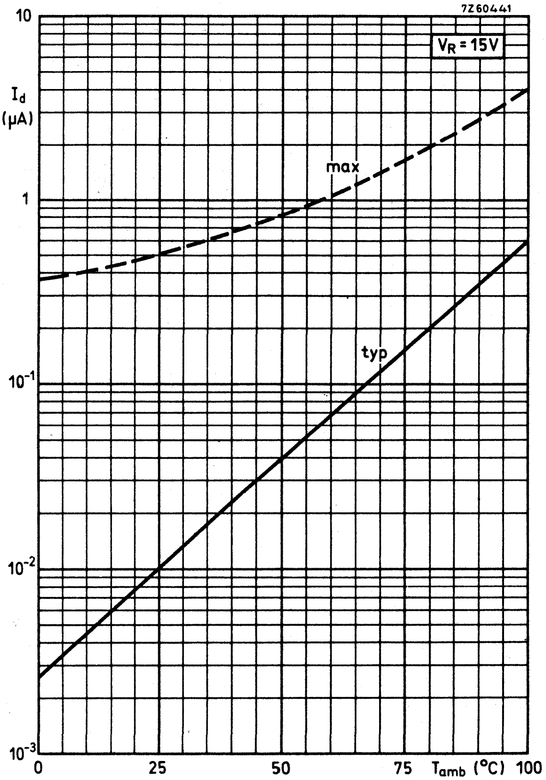
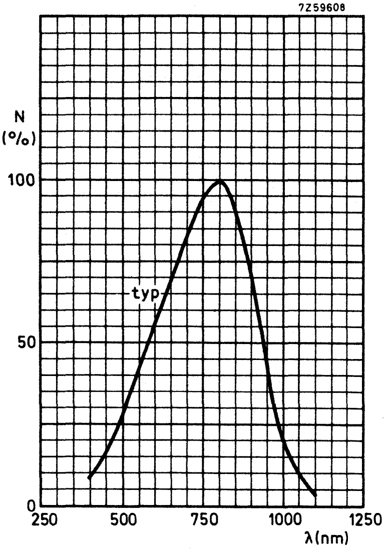
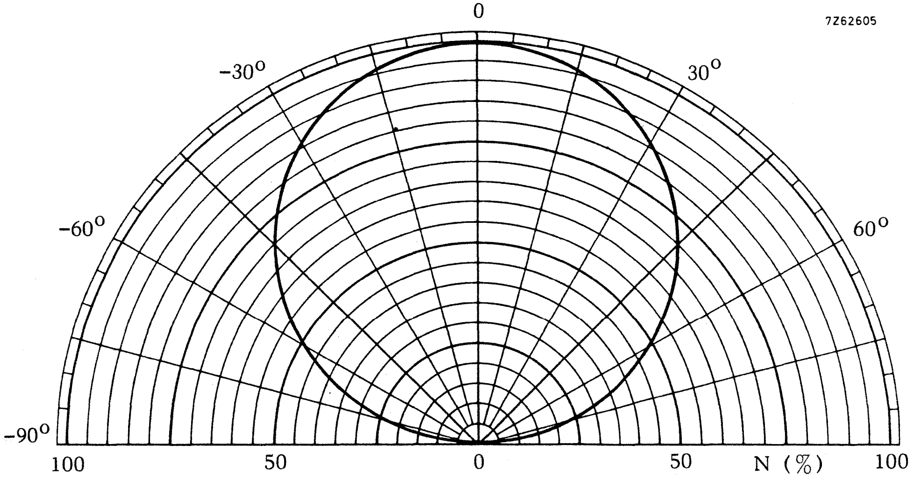
¹) The value of light current increases with temperature by an amount approximately equal to the increase in dark current.


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


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


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


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


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

SILICON PLANAR PHOTODIODE

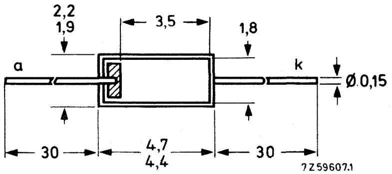
Unencapsulated photodiode for general purpose applications.

QUICK REFERENCE DATA

Reverse voltage	V_R	max.	18	V
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 1,0	µA µA
V_R = 15 V; T_{amb} = 100 °C	I_d	typ. <	1,2 8,0	µA µA
Photovoltaic mode				
E = 1000 lx; T_c = 2700 K (equivalent to 7,7 mW/cm^2)				
Light reverse current; V = 0	I_l	> typ.	30 38	µA µA
Forward voltage; I = 0	V_F	> typ.	330 350	mV 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	> typ.	31 40	nA/lx nA/lx
Wavelength at peak response	λ_{pk}	typ.	800	nm
Diode capacitance; f = 500 kHz				
V_R = 15 V	C_d	typ.	250	pF
V_R = 0	C_d	typ.	800	pF
Cut-off frequency (modulated GaAs source)	f_{co}	typ.	500	kHz

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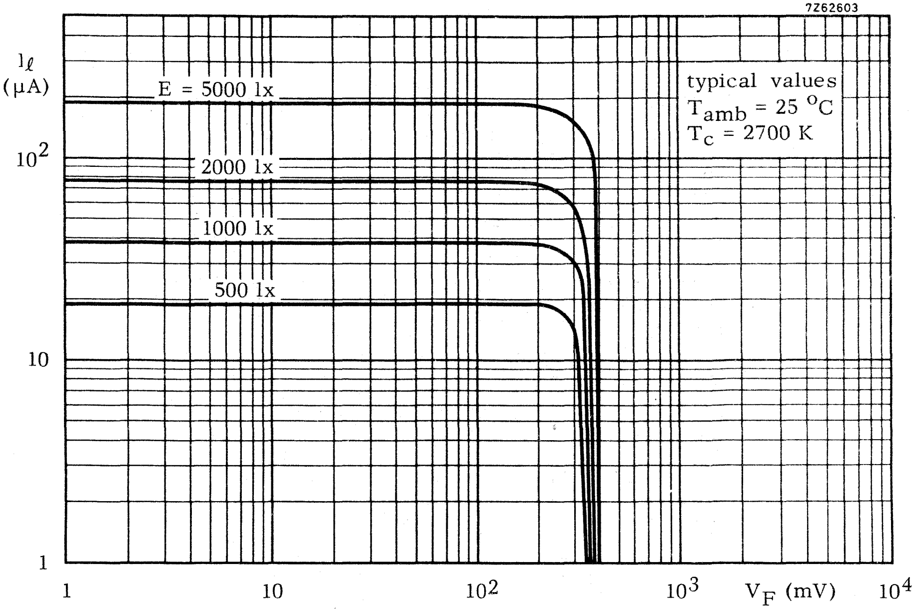
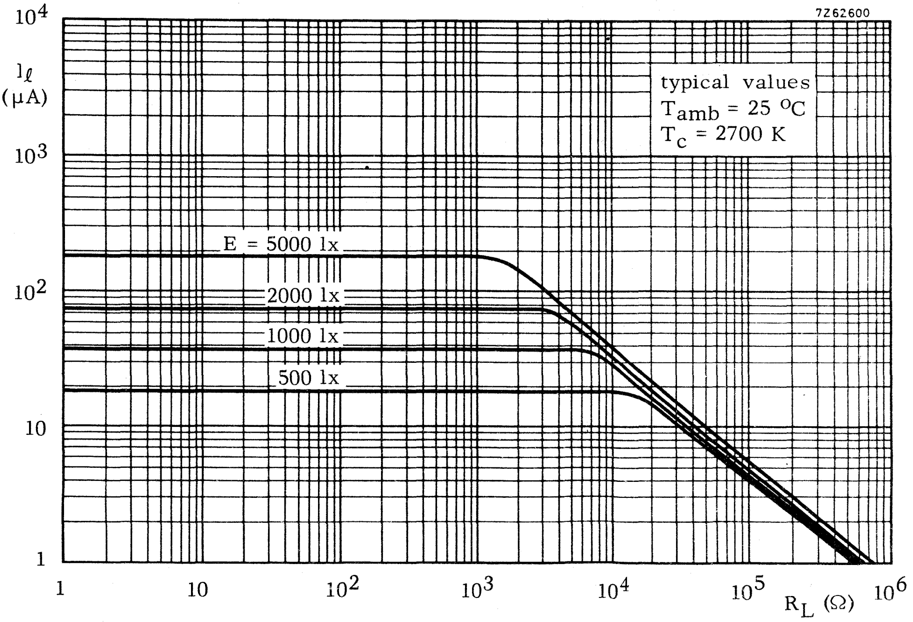
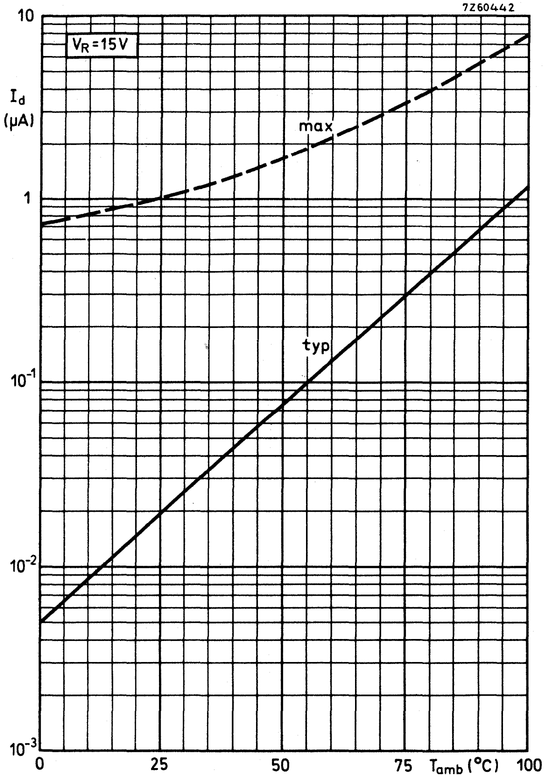
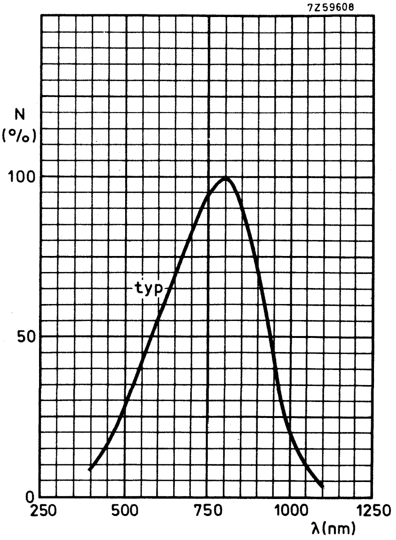
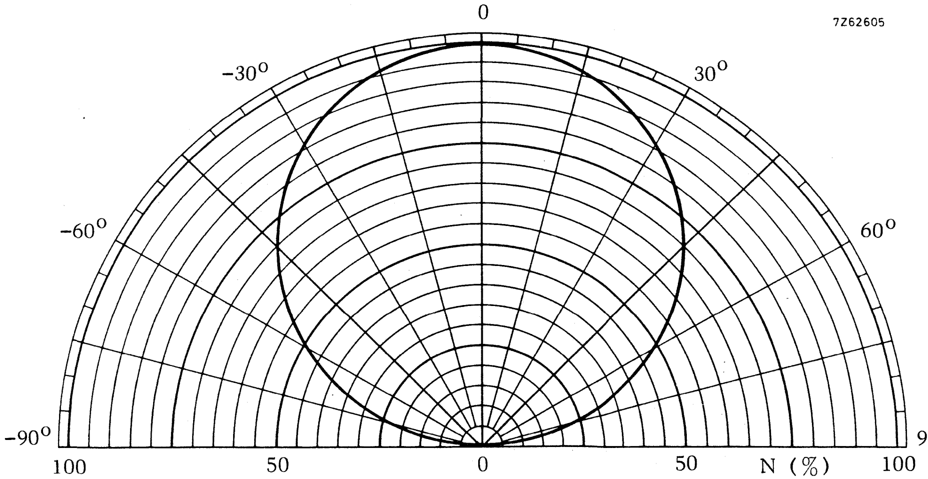
[1] The value of light current increases with temperature by an amount approximately equal to the increase in dark current.


7Z62603
I_ℓ
(μA)
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)
typical values
T_{amb} = 25 °C
T_c = 2700 K
10^3
E = 5000 lx
2000 lx
1000 lx
500 lx
10^2
10
1
1
10
10^2
10^3
10^4
10^5
R_L (Ω)
10^6


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


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


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

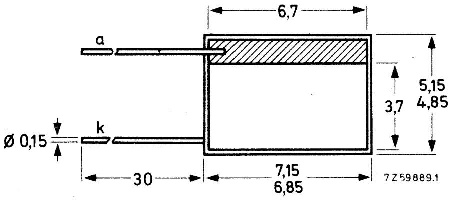
SILICON PLANAR PHOTODIODE

Unencapsulated photodiode for general purpose applications.

QUICK REFERENCE DATA				
Reverse voltage	V_R	max.	12	V
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

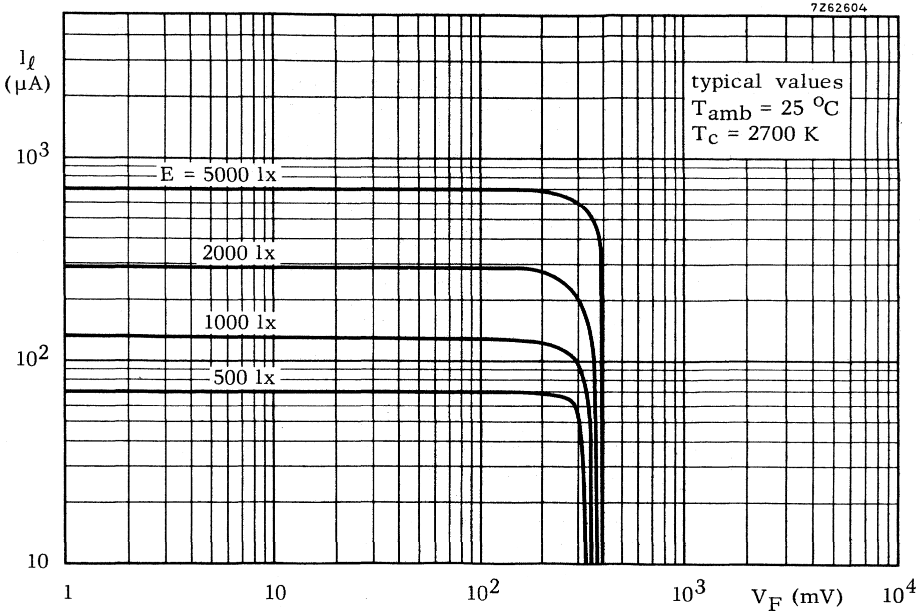
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0, 3	°C/mW

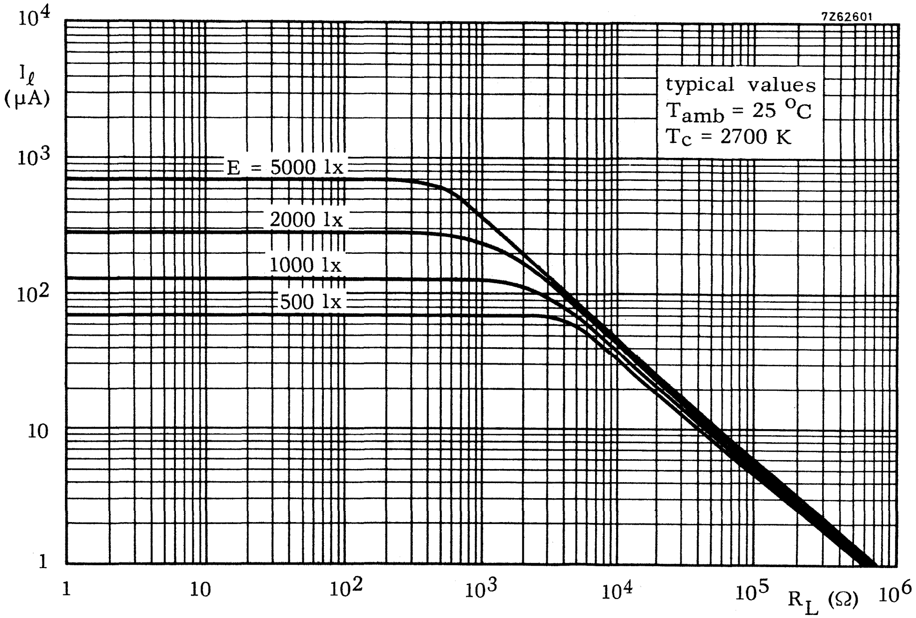
CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

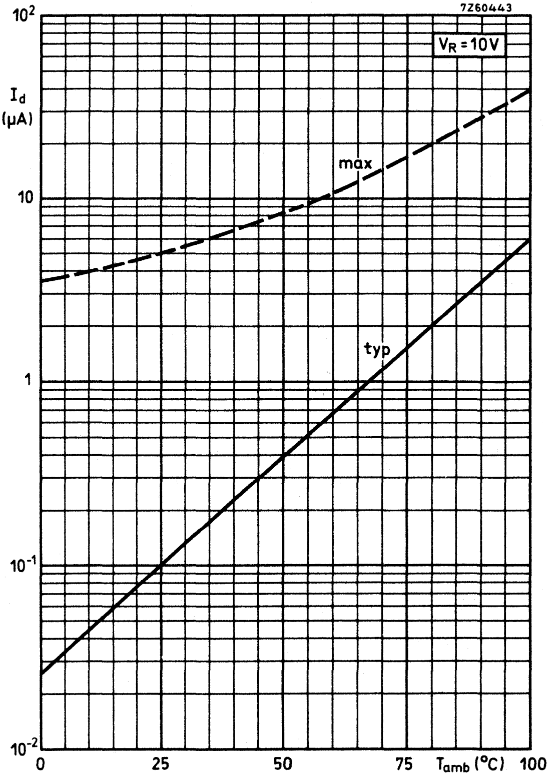
Dark reverse current				
V_R = 10 V	I_d	typ. <	0, 1 5, 0	μA μA
V_R = 10 V; T_{amb} = 100 °C	I_d	typ. <	6, 0 40	μA μA
Photovoltaic mode				
E = 1000 lx; T_c = 2700 K (equivalent to 7, 7 mW/cm^2)				
Light reverse current; V = 0	I_1	> typ.	110 140	μA μA
Forward voltage; I = 0	V_F	> typ.	330 350	mV mV
Luminous sensitivity with external voltage [1]				
V_R = 10 V; E = 1000 lx; T_c = 2700 K (equivalent to 7, 7 mW/cm^2)	N	> typ.	120 150	nA/lx nA/lx
Wavelength at peak response	λ_{pk}	typ.	800	nm
Diode capacitance; f = 500 kHz				
V_R = 10 V	C_d	typ.	1000	pF
V_R = 0	C_d	typ.	3000	pF
Cut-off frequency (modulated GaAs source)	f_{co}	typ.	500	kHz

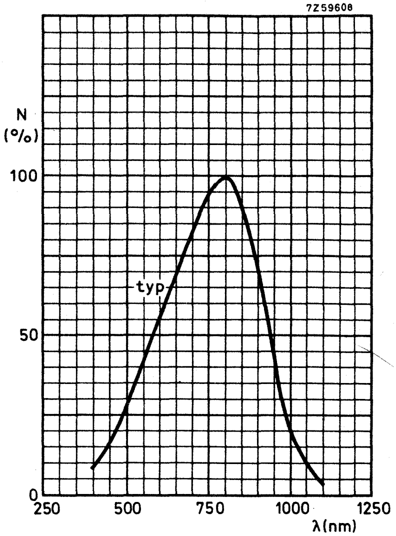
---

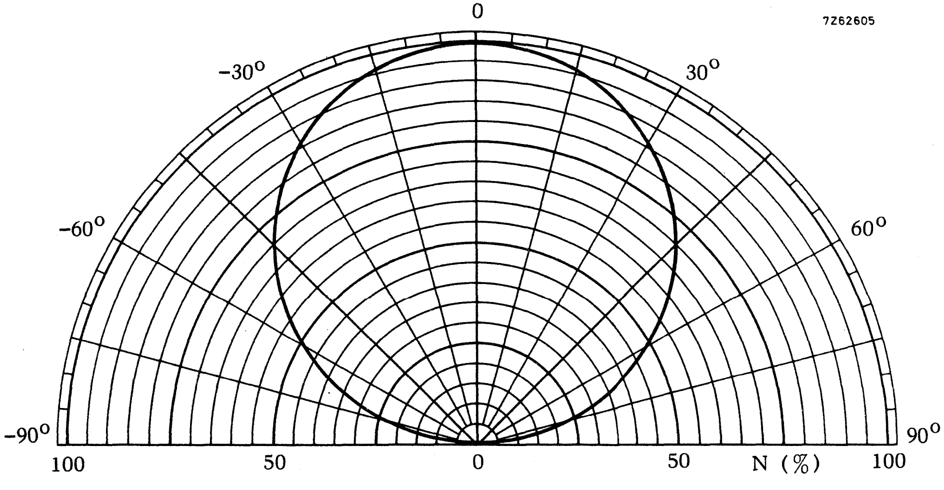
[1] The value of light current increases with temperature by an amount approximately equal to the increase in dark current.


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


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


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


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


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

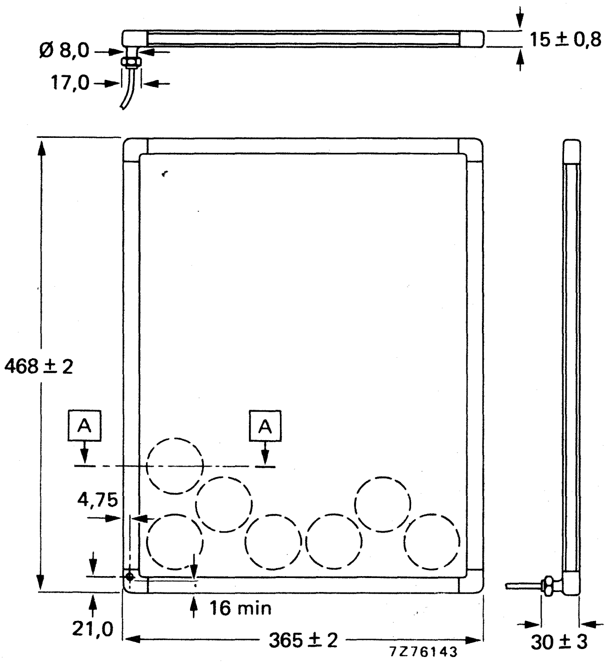
TERRESTRIAL SOLAR MODULE

Module for direct conversion of solar energy into electrical energy. The module contains 34 series-connected solar cells of 57 mm diameter, moulded in transparent resin and mounted between two glass plates. The transparent structure ensures low heating by solar radiation, which maintains efficiency.
The module is suitable for use under severe environmental conditions.

QUICK REFERENCE DATA				
At E_e = 1 kW/m^2 (irradiance from the sun at sea level) and 25 °C :				
Optimum power output at 15,5 V	P_{Lopt}	typ.	11	W
Output voltage at optimum operation	V_{opt}	typ.	15,5	V
Output current at optimum operation	I_{opt}	typ.	700	mA
Dimensions	468 mm x 365 mm x 15			mm

MECHANICAL DATA

Dimensions in mm



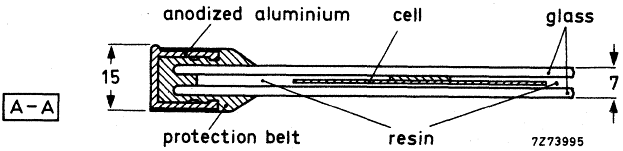
Panel thickness	15	mm
Cable		
length	1	m
diameter	5,5	mm
collar diameter	17	mm
core diameter (two wires)	1,8	mm

Polarity indications:
black = −
red = +

Mass:	2,4	kg

For mechanical detail see page 2.

MECHANICAL DATA (continued). Dimensions in mm



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

Storage temperature	T_{stg}	−40 to +85	°C

CHARACTERISTICS at E_e = 1 kW/m^2 (irradiance from the sun at sea level; A.M. 1)

Cell temperature	T_{cell}		0	25	60	°C
Optimum output power	P_{Lopt}	typ.	12	11	9,7	W
Voltage	V_{opt}	typ.	18	15,5	14,3	V
Current	I_{opt}	typ.	665	>645 700	680	mA
Open-circuit voltage	V_{oc}	typ.	22,2	20,5	18,2	V
Short-circuit current	I_{sc}	typ.	700	720	740	mA
Temperature coefficient of open-circuit voltage	dV_{oc}/dT			typ.	−74	mV/°C
Temperature coefficient of short-circuit current	dI_{sc}/dT			typ.	0,64	mA/°C

TYPICAL OPERATION BPX47A coupled to a 12 V battery

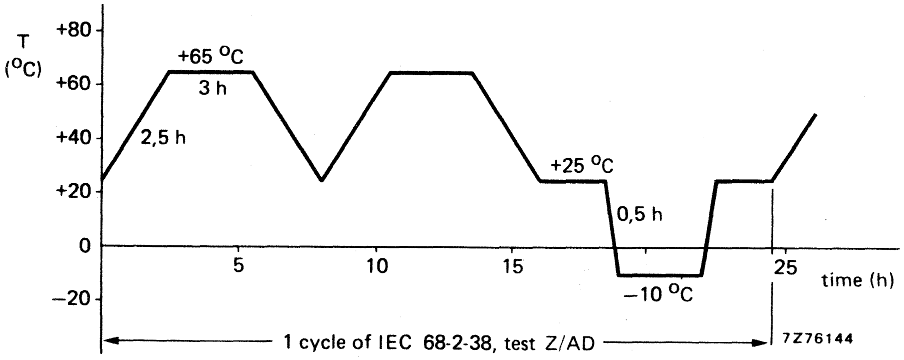
Irradiance from the sun	E_e	1	kW/m^2
Operating voltage (12 V nominal lead-acid battery; end-of-charge voltage 13,5 V; +0,8 V for blocking diode)	V	14,3	V
At an irradiance of 1 kW/m^2 the cell temperature rise is		15	°C

At an ambient temperature of 45 °C (cell temperature = 45 + 15 = 60 °C) the module can supply a current of 680 mA to the load.

ENVIRONMENTAL TESTS

The modules are subjected to the following IEC tests and some additional tests:

Test	In accordance with	Conditions
Cold	IAC68-2-1, test Ab	Temperature: −40 °C, duration: 16 h
Rapid change of temperature	IEC68-2-14, test Na	Low temperature: −40 °C High temperature: +85 °C Number of cycles: 10 Duration of exposures: 30 min
Dry heat	IEC68-2-2, test Bb	Temperature: +85 °C Duration: 16 h
Composite temperature/ humidity cyclic test	IEC68-2-38, test Z/AD	10 cycles, +25 °C, +65 °C, −10 °C
Salt mist	IEC68-2-11, test Ka	Temperature: +35 °C Duration: 48 h
Wind	–	Pressure equivalent to an air velocity of 280 km/h
Sand blown	AIR 7.303	
Frost with water	–	High temperature: +25 °C Low temperature: −40 °C Duration: 16 h

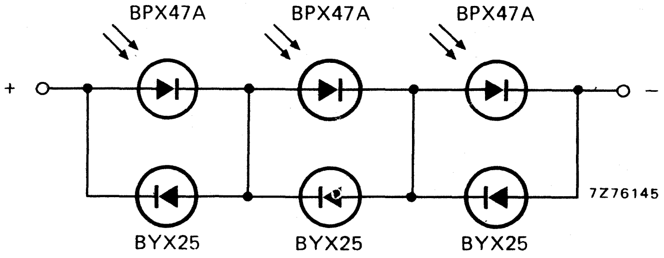


MOUNTING INSTRUCTIONS

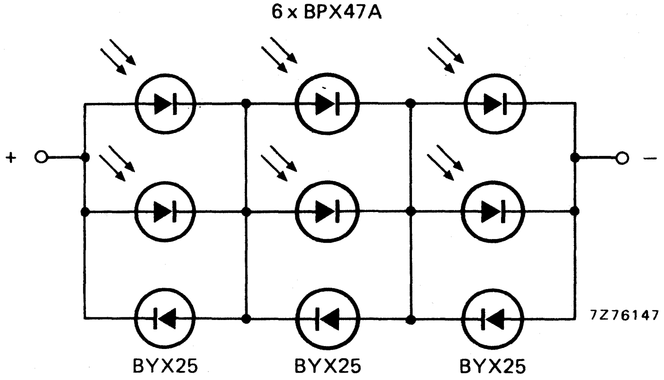
1. The solar panel should be mounted in a metal frame in such a way that only its four metal sides are used for clamping and not the rubber corners. The panel should be electrically insulated from the mounting frame to prevent corrosion.
2. Installation should allow at least a 50 cm space behind the panel to permit a free circulation of air for cooling.
3. The panel should not be installed above hot objects such as roofs.

MOUNTING INSTRUCTIONS (continued)

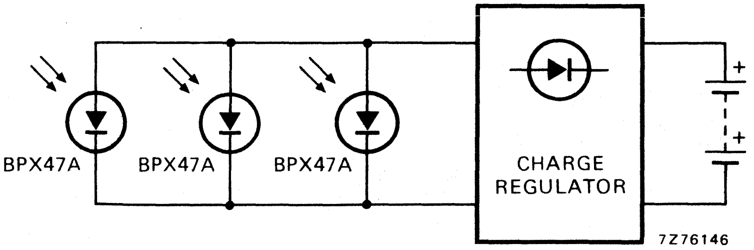
4. Diode protection is imperative in the series connection of a chain of panels to prevent voltage inversion due to partial shadowing effects.

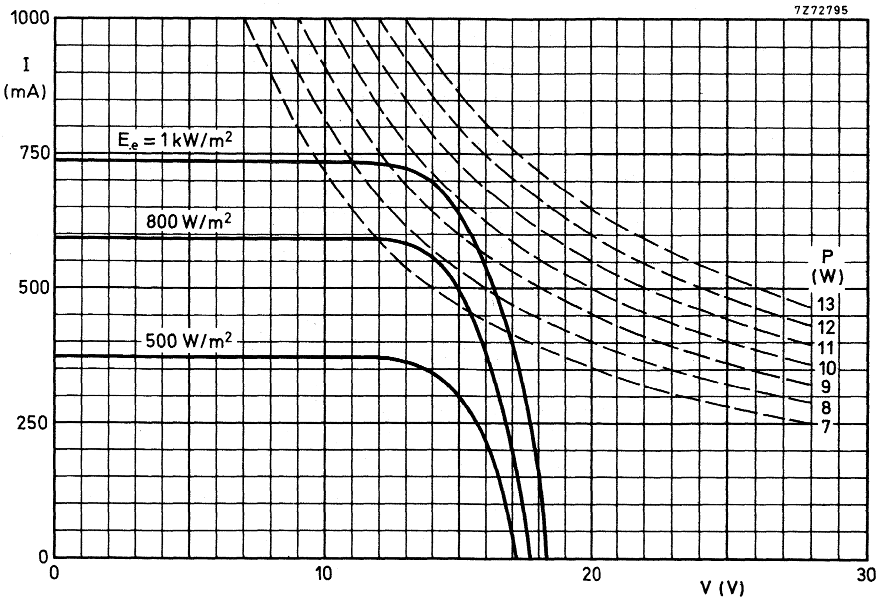


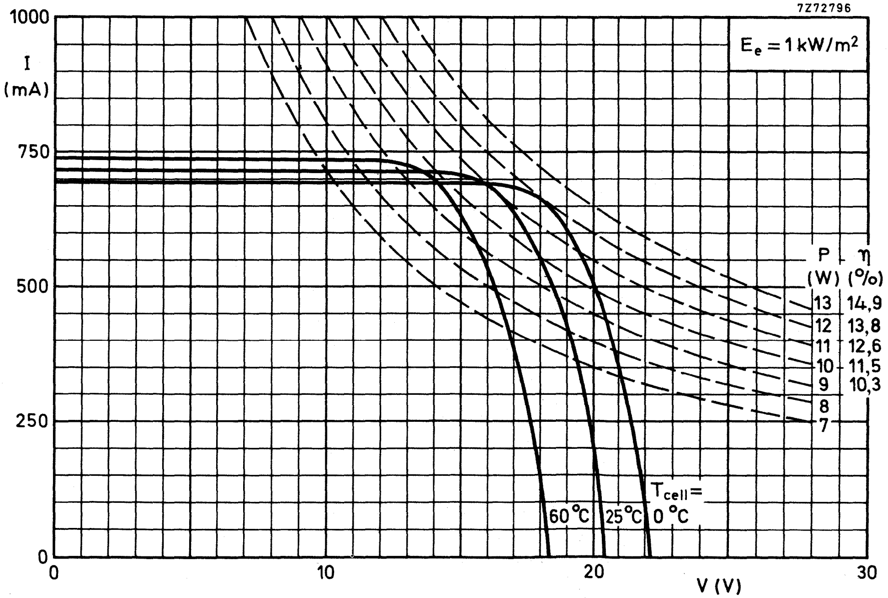
5. If series-connected chains are joined in parallel and diode protected, a matrix interconnection is necessary.

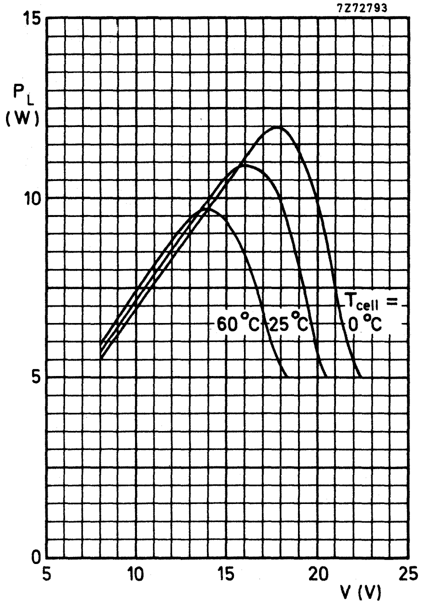


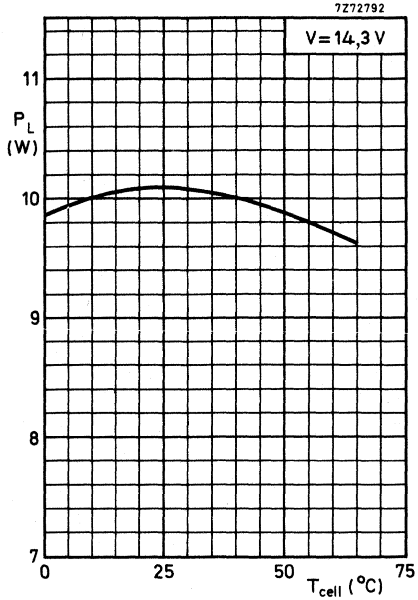
6. A charge regulator containing a series protection diode must be used when connecting panels to a lead-acid battery.




7Z72795
I
(mA)
1000
750
500
250
0
0
10
20
30
V (V)
$E_e = 1\,kW/m^2$
$800\,W/m^2$
$500\,W/m^2$
P
(W)
13
12
11
10
9
8
7


7Z72796
$E_e = 1\,kW/m^2$
I
(mA)
1000
750
500
250
0
0
10
20
30
V (V)
P
(W)
η
(%)
13 14,9
12 13,8
11 12,6
10 11,5
9 10,3
8
7
$T_{cell} =$
60 °C
25 °C
0 °C


7Z72793
15
10
5
0
P
L
(W)
5
10
15
20
25
V (V)
60 °C
25 °C
T
cell
=
0 °C


7Z72792
V = 14,3 V
11
10
9
8
7
P
L
(W)
0
25
50
75
T
cell
(°C)

PHOTOTRANSISTOR

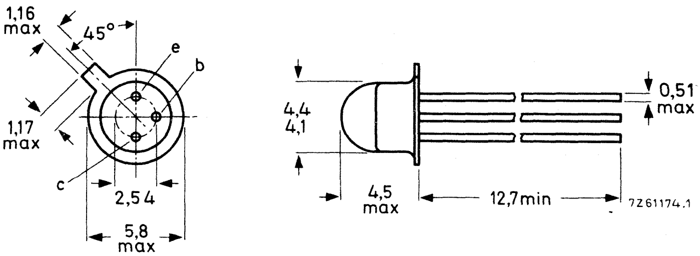
General purpose n-p-n silicon phototransistor with a plastic lens.

QUICK REFERENCE DATA

Collector-emitter voltage (open base)		V_{CEO}	max.	30	V
Collector current (d.c.)		I_C	max.	25	mA
Junction temperature		T_j	max.	125	^{o}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

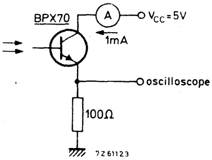
$V_{CE} = 5$ V; tungsten filament lamp source with colour temperature 2856 K;				
$E_v = 1000$ lx ($E_e = 4,75$ mW/cm^2)	I_l		100 to 700	µA [1]
$E_v = 2500$ lx ($E_e = 12$ mW/cm^2)	I_l	>	300	µA

---

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

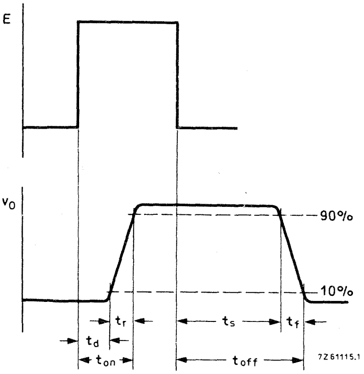
CHARACTERISTICS (continued)

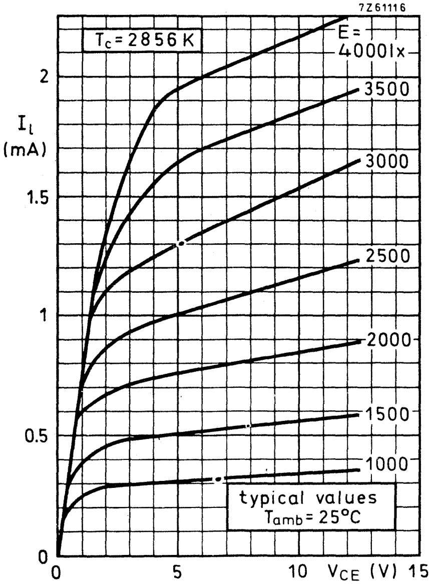
Breakdown voltages				
Collector-base voltage $E = 0$; $I_C = 0,1$ mA	$V_{(BR)CBO}$	>	40	V
Collector-emitter voltage $E = 0$; $I_C = 1$ mA	$V_{(BR)CEO}$	>	30	V
Emitter-collector voltage $E = 0$; $I_C = 0,1$ mA	$V_{(BR)ECO}$	>	6	V
Collector capacitance				
$I_E = I_e = 0$; $V_{CB} = 20$ V	C_c	typ.	3,5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

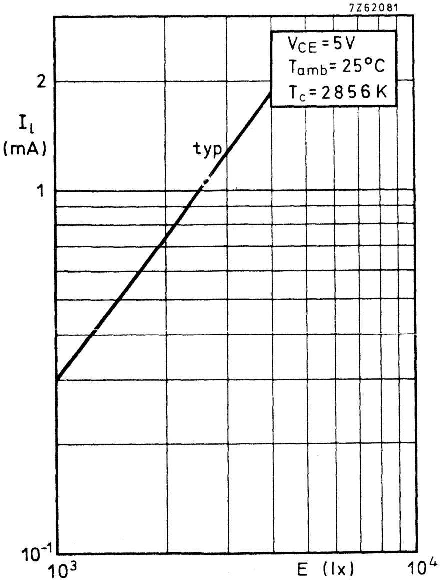


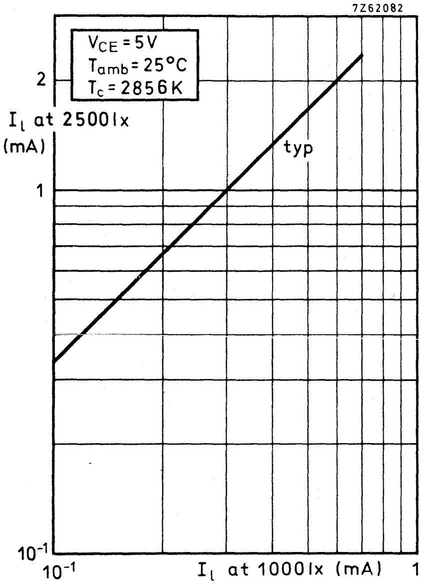
Light input pulse:

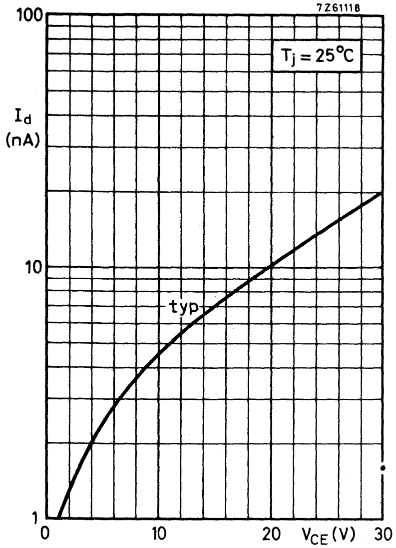
$t_r = t_f = $ 20 ns
$t_p = $ 20 µs
f = 500 Hz
λ = 800 nm

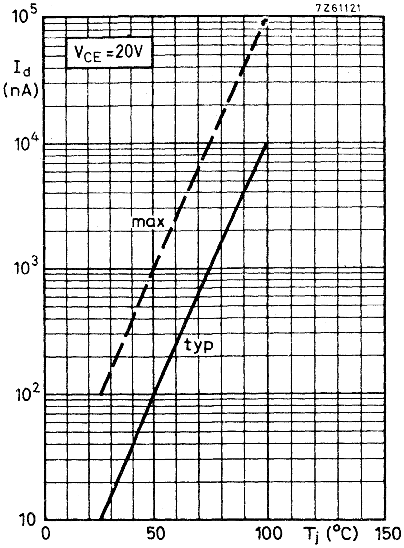


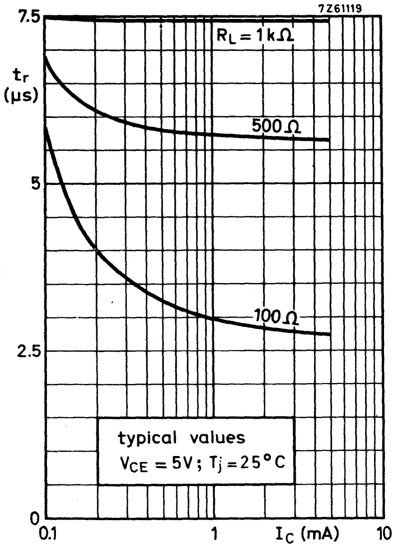

7Z61116
$T_c = 2856$ K
I_l (mA)
2
1.5
1
0.5
0
E = 4000 lx
3500
3000
2500
2000
1500
1000
typical values
$T_{amb} = 25$°C
0
5
10
V_{CE} (V)
15

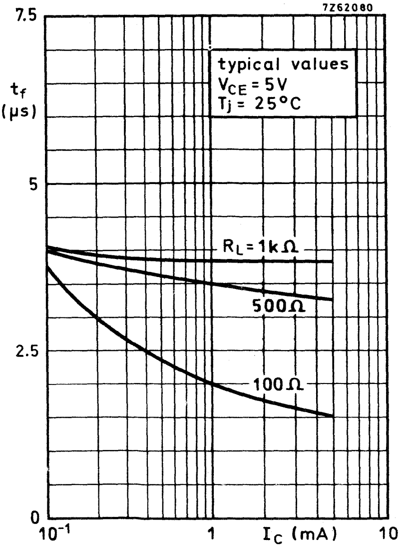

7Z62081
$V_{CE} = 5$ V
$T_{amb} = 25$°C
$T_c = 2856$ K
I_l (mA)
2
1
10^{-1}
typ
10^3
E (lx)
10^4


7Z62082
$V_{CE} = 5$ V
$T_{amb} = 25$°C
$T_c = 2856$ K
I_l at 2500 lx (mA)
2
1
10^{-1}
typ
10^{-1}
I_l at 1000 lx (mA)
1


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

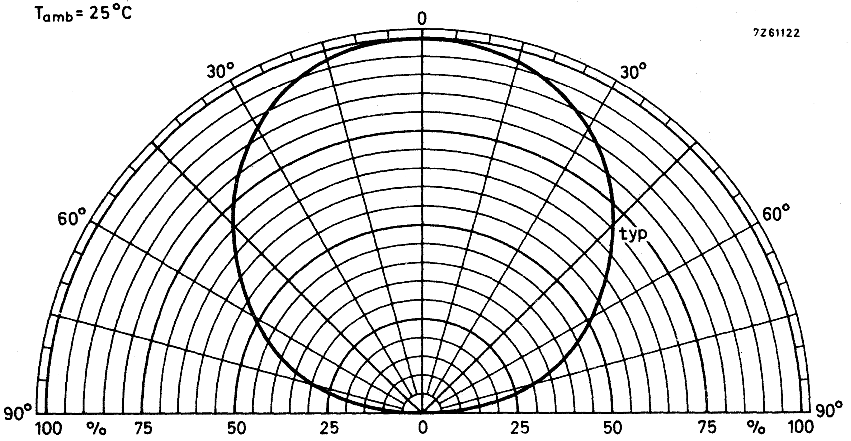

7Z61121
10^5
10^4
10^3
10^2
10
I_d (nA)
$V_{CE} = 20V$
max
typ
0
50
100
T_j (°C)
150

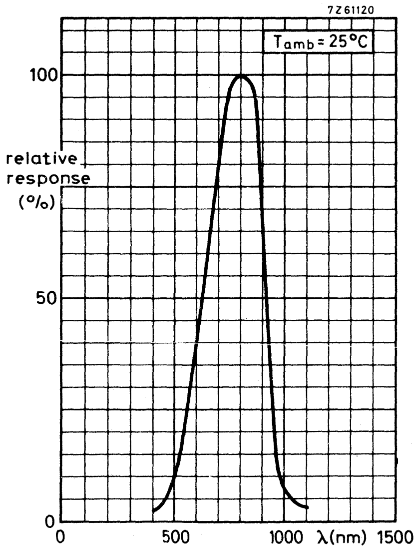

7Z61119
7.5
5
2.5
0
t_r (μs)
$R_L = 1k\Omega$
500 Ω
100 Ω
typical values
$V_{CE} = 5V$; $T_j = 25°C$
0.1
1
I_C (mA)
10

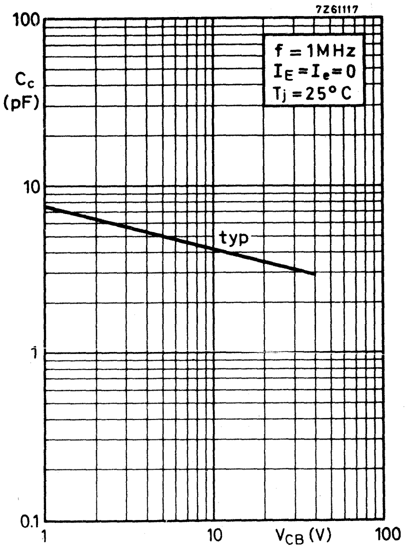

7Z62080
7.5
5
2.5
0
t_f (μs)
typical values
$V_{CE} = 5V$
$T_j = 25°C$
$R_L = 1k\Omega$
500 Ω
100 Ω
10^{-1}
1
I_C (mA)
10

polar response of relative sensitivity

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







PHOTOTRANSISTOR

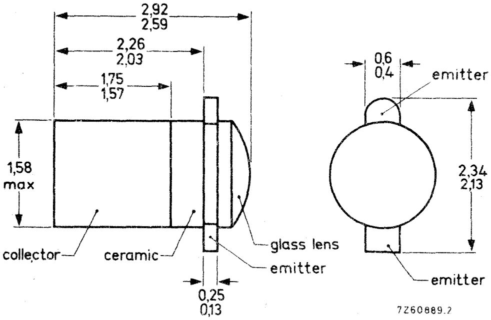
General purpose n-p-n silicon phototransistor with a glass lens. Inaccessable base.

QUICK REFERENCE DATA

Collector-emitter voltage		V_{CEO}	max.	50	V
Collector current (d.c.)		I_C	max.	20	mA
Junction temperature		T_j	max.	150	°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 $T_{amb} = 50\ ^{o}C$	P_{tot}	max.	50	mW
up to $T_{mb} = 55\ ^{o}C$	P_{tot}	max.	100	mW

Temperatures

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

THERMAL RESISTANCE

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

CHARACTERISTICS

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

Collector dark current

$V_{CE} = 30$ V	I_d	<	25	nA
$V_{CE} = 30$ V; $T_{amb} = 100\ ^{o}C$	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]

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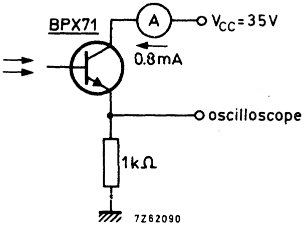
[1] Available selections: BPX71-201: 0,5 to 3 mA
BPX71-202: 2 to 5 mA
BPX71-203: 4 to 8 mA
BPX71-204: 7 to 15 mA

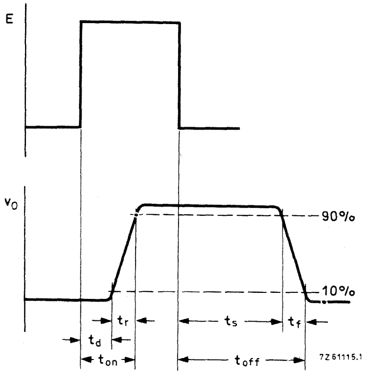
CHARACTERISTICS (continued)

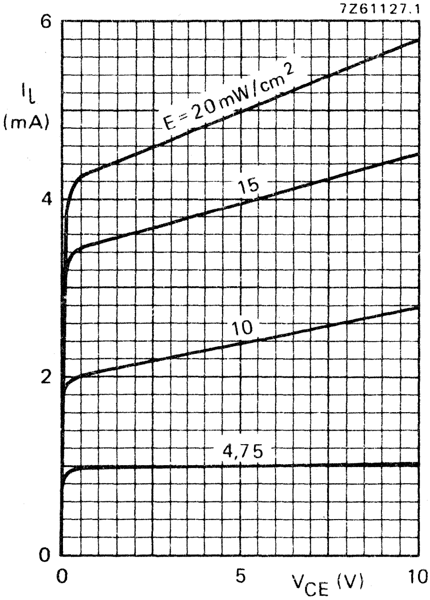
Breakdown voltages				
Collector-emitter voltage E = 0; I_C = 0,5 mA	$V_{(BR)CEO}$	>	50	V
Emitter-collector voltage E = 0; I_C = 0,1 mA	$V_{(BR)ECO}$	>	7	V
Collector-emitter light saturation voltage				
I_C = 0,4 mA; E_e = 20 mW/cm^2; T_c = 2856 K	V_{CEsat}	typ. <	150 400	mV mV
Wavelength at peak response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



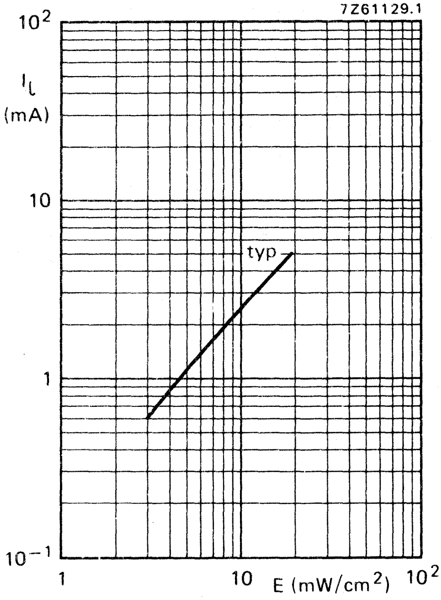
Light input pulse:

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

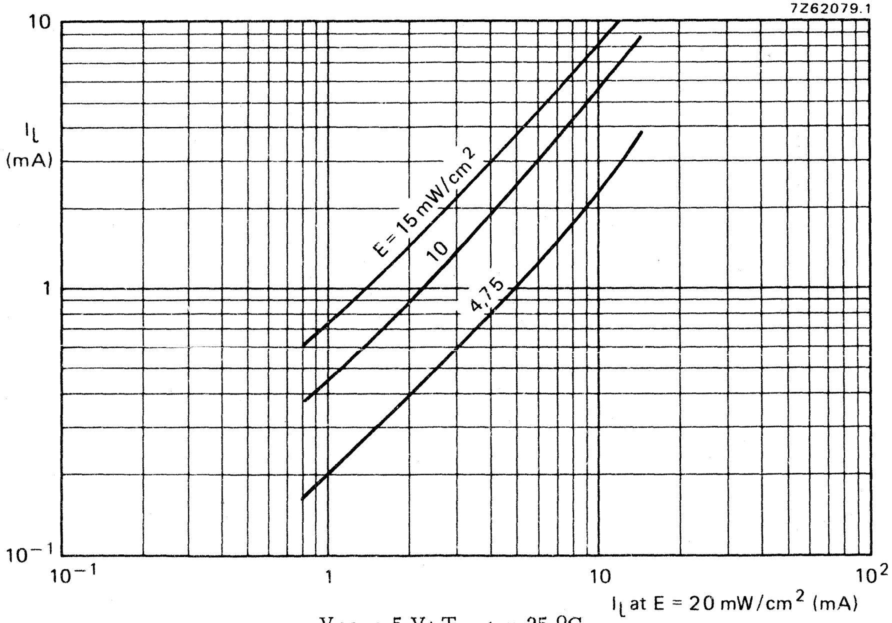




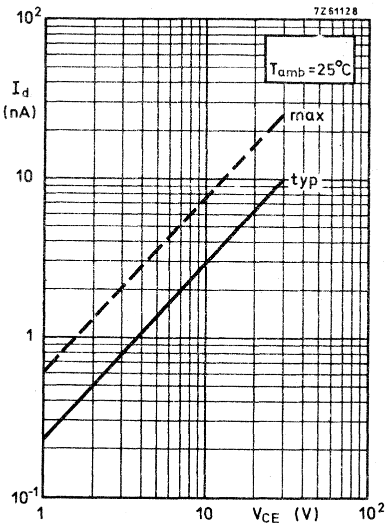
Typical values; T_{amb} = 25 °C.

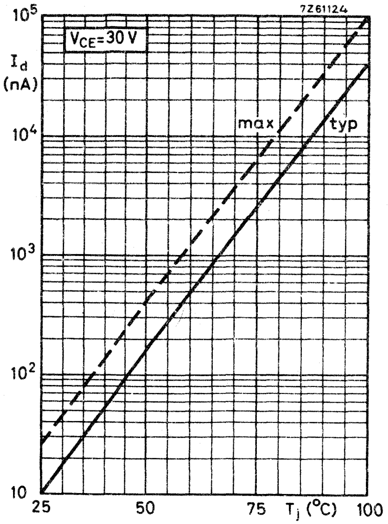


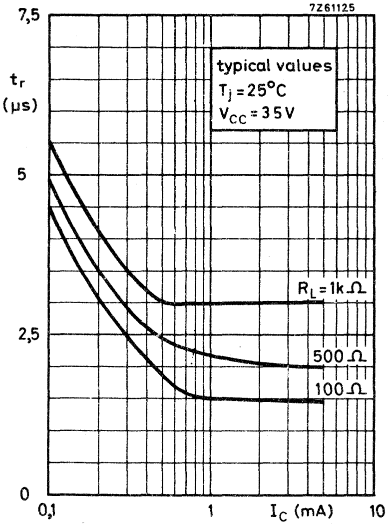
V_{CE} = 5 V; T_{amb} = 25 °C.

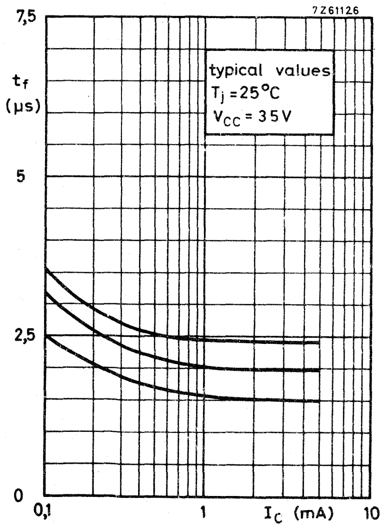


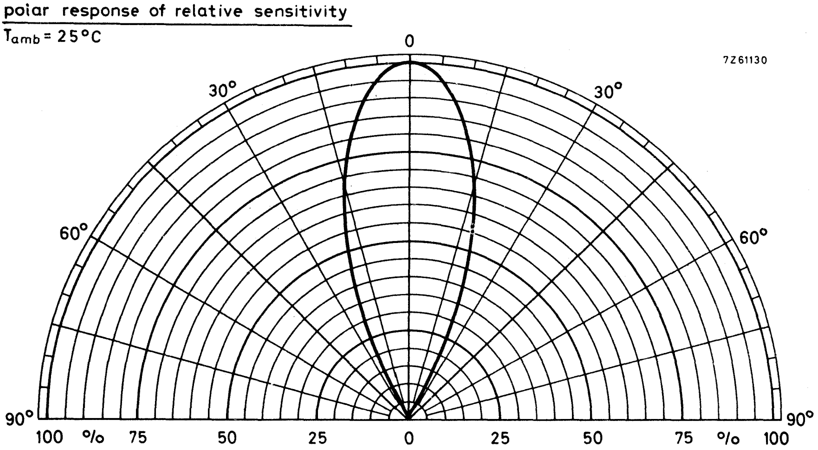
V_{CE} = 5 V; T_{amb} = 25 °C.

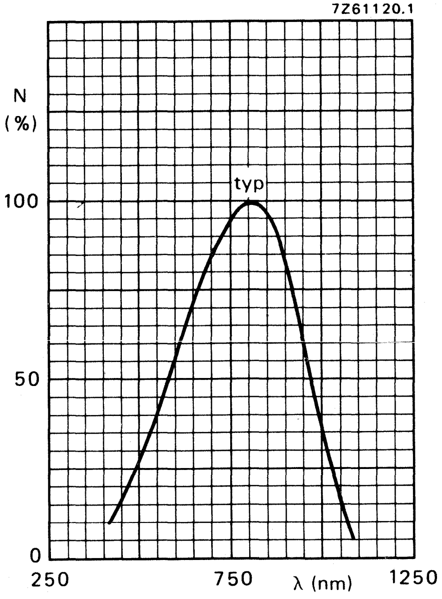

7Z61128
T_{amb} = 25°C
I_d (nA)
10^2
10
1
10^{-1}
max
typ
1
10
V_{CE} (V)
10^2


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


7Z61125
typical values
T_j = 25°C
V_{CC} = 35 V
t_r (μs)
7,5
5
2,5
0
R_L = 1k Ω
500 Ω
100 Ω
0,1
1
I_C (mA)
10


7Z61126
typical values
T_j = 25°C
V_{CC} = 35 V
t_f (μs)
7,5
5
2,5
0
0,1
1
I_C (mA)
10


poiar response of relative sensitivity
T_{amb} = 25°C
7Z61130
0
30°
30°
60°
60°
90°
90°
100
%
75
50
25
0
25
50
75
%
100


7Z61120.1
N
(%)
typ
100
50
0
250
750
λ (nm)
1250

PHOTOTRANSISTOR

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

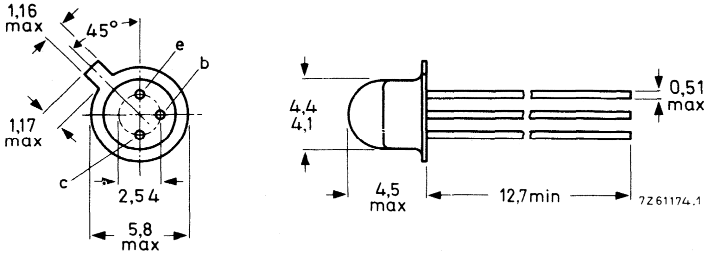
QUICK REFERENCE DATA

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)	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°	

MECHANICAL DATA

Dimensions in mm

SOT-70



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

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

Voltages				
Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Emitter-collector voltage (open base)	V_{ECO}	max.	6	V
Currents				
Collector current (d.c.)	I_C	max.	25	mA
Collector current (peak value) $t_p \leq 50$ µs; $\delta \leq 0,1$	I_{CM}	max.	50	mA
Power dissipation				
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	180	mW
Temperatures				
Storage temperature	T_{stg}		−40 to + 125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

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

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

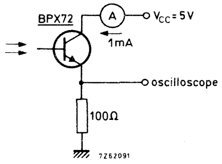
Collector dark current					
$V_{CE} = 20$ V	I_d	typ. <	10 100	nA nA	
$V_{CE} = 20$ V; $T_j = 100$ °C	I_d	typ. <	10 100	µA µA	
Collector light current					
$V_{CE} = 5$ V; tungsten filament lamp source with colour temperature 2856 K;					
$E_v = 1000$ lx ($E_e = 4,75$ mW/cm^2)	I_l		500 to 3000	µA	[1]
$E_v = 2500$ lx ($E_c = 12$ mW/cm^2)	I_l	typ.	3000	µA	

---

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

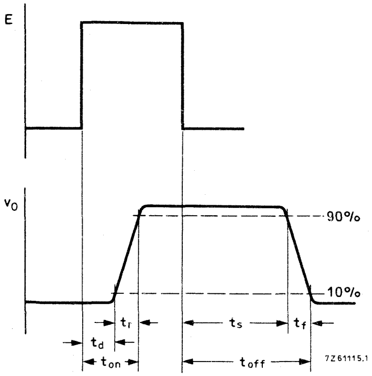
CHARACTERISTICS (continued)

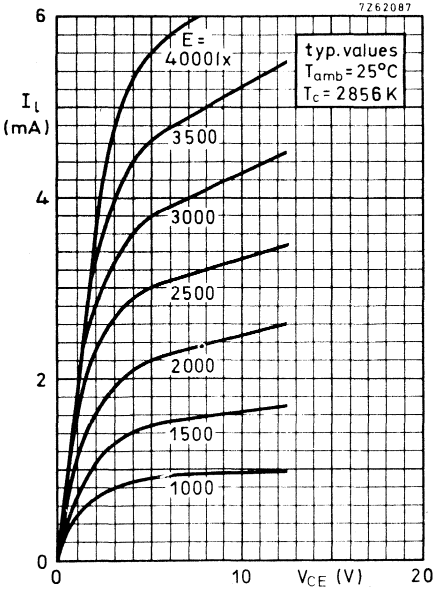
Breakdown voltages				
Collector-base voltage E = 0; I_C = 0,1 mA	$V_{(BR)CBO}$	>	40	V
Collector-emitter voltage E = 0; I_C = 1 mA	$V_{(BR)CEO}$	>	30	V
Emitter-collector voltage E = 0; I_C = 0,1 mA	$V_{(BR)ECO}$	>	6	V
Collector capacitance				
$I_E = I_e = 0$; V_{CB} = 20 V	C_c	typ.	3,5	pF
Wavelength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

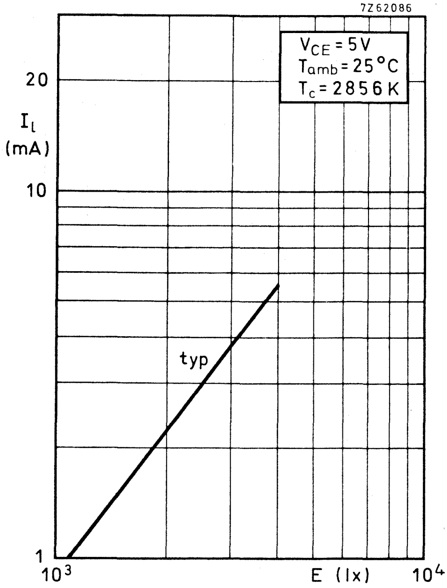


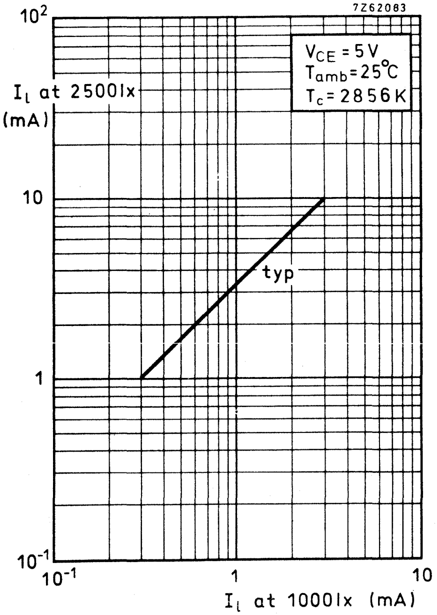
Light input pulse:

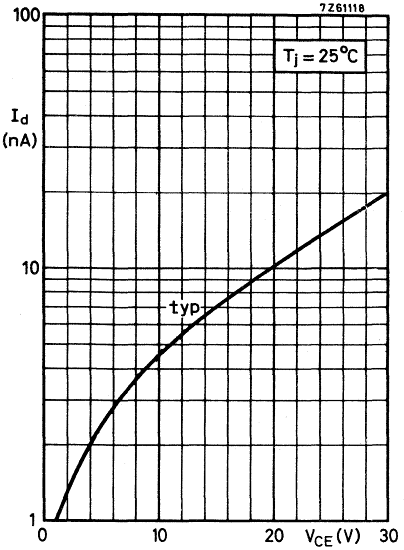
$t_r = t_f$ = 20 ns
t_p = 20 µs
f = 500 Hz
λ = 800 nm

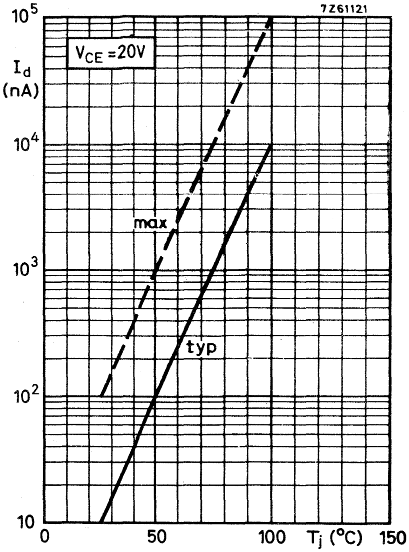


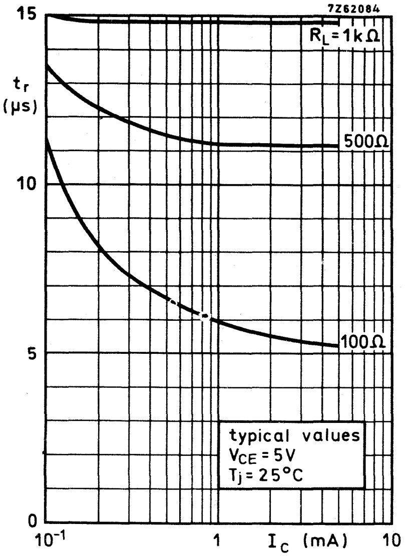

7Z62087
typ. values
T_{amb} = 25 °C
T_c = 2856 K
I_l (mA)
E = 4000 lx
3500
3000
2500
2000
1500
1000
0
2
4
6
0
10
20
V_{CE} (V)

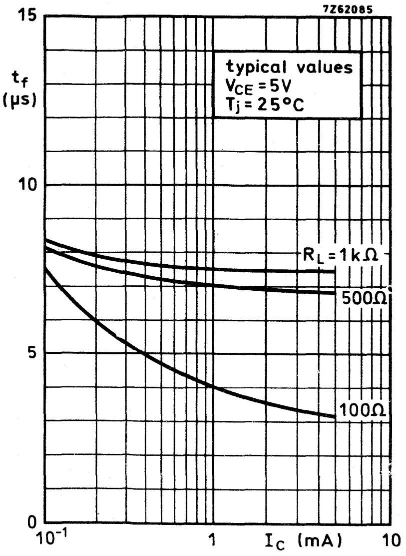

7Z62086
V_{CE} = 5 V
T_{amb} = 25 °C
T_c = 2856 K
I_l (mA)
20
10
1
10^3
E (lx)
10^4
typ

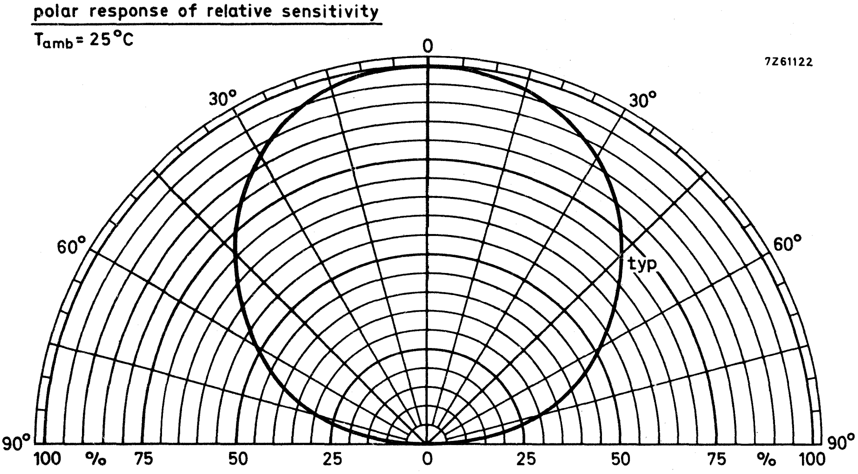

7Z62083
V_{CE} = 5 V
T_{amb} = 25 °C
T_c = 2856 K
I_l at 2500 lx (mA)
10^2
10
1
10^{-1}
10^{-1}
1
10
I_l at 1000 lx (mA)
typ

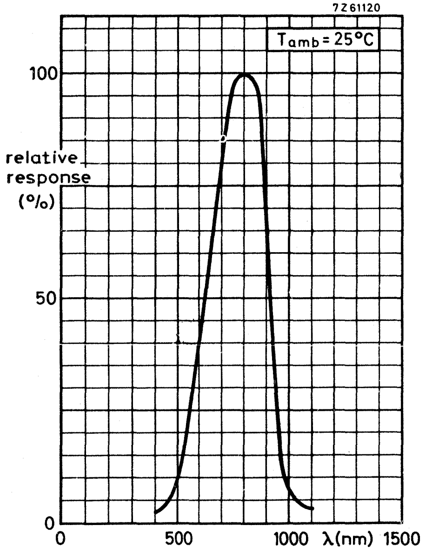

7Z61118
$T_j = 25°C$
I_d (nA)
100
10
1
typ
0
10
20
V_{CE} (V)
30

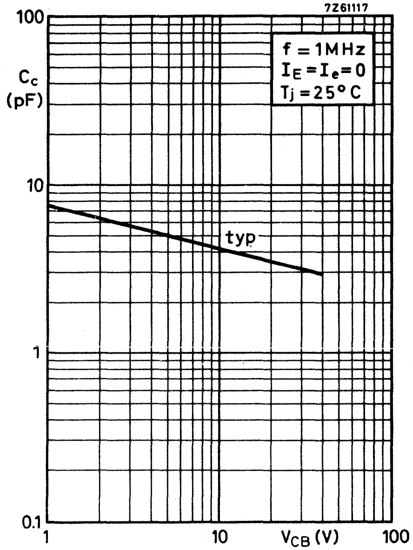

7Z61121
$V_{CE} = 20V$
I_d (nA)
10^5
10^4
10^3
10^2
10
max
typ
0
50
100
T_j (°C)
150


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


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


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


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


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

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

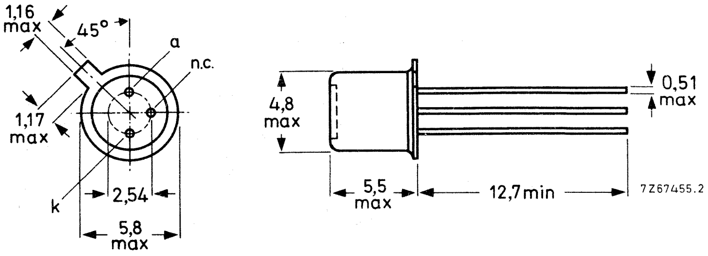
Continuous reverse voltage	V_R	max.	18 V
Dark reverse current (V_R = 1 V)	$I_{R(D)}$	typ.	100 pA
Luminous sensitivity $V_R = 0$; $T_c = 2700$ K	N	typ. typ.	8 nA 1 μA/mW/cm^2
Wavelength at peak response	λ_{pk}	typ.	800 mm
Beamwidth between half-sensitivity directions	$\alpha_{50\%}$	typ.	63 °
Sensitive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

MECHANICAL DATA

Dimensions in mm

TO-18, except for window

Cathode connected to case



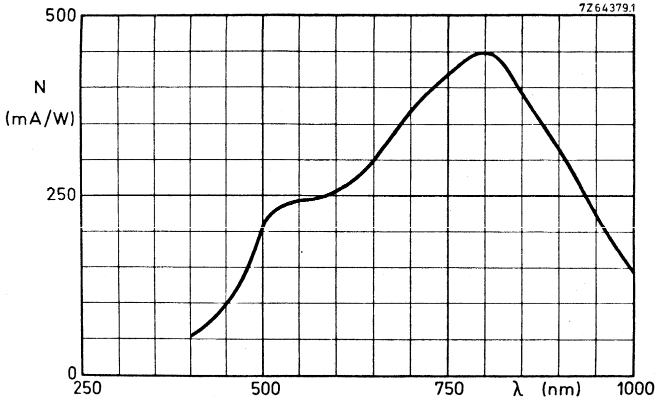
Sensitive area 1,2 mm x 1,2 mm

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. typ.	8 1	nA/lx μA/mW/cm^2
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



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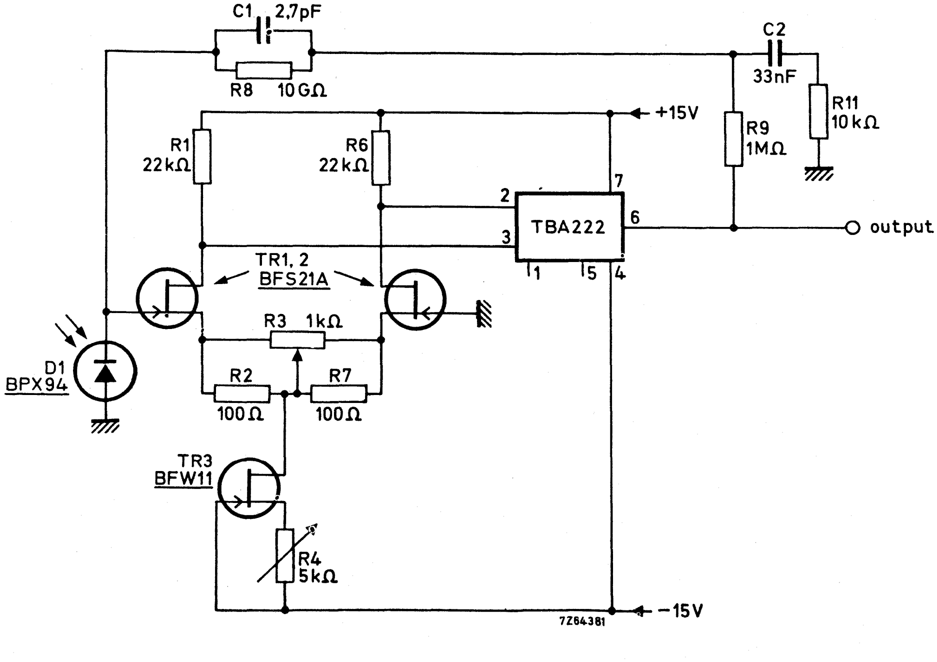
[1] Unfiltered tungsten lamp.

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

N-P-N phototransistor designed for use as detector. Clear epoxy encapsulation.

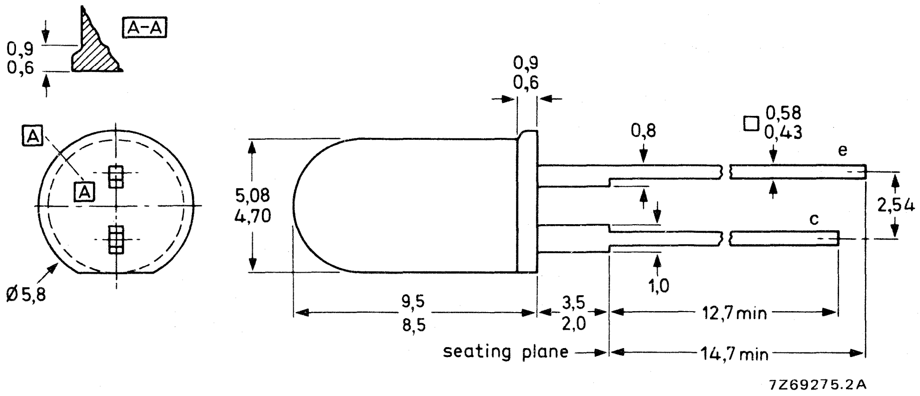
QUICK REFERENCE DATA

Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector current (d.c.)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100	mW
Collector 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

Fig. 1 SOD-63.



RATINGS

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

Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Emitter-collector voltage (open base)	V_{ECO}	max.	5	V
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
Total power dissipation up to $T_{amb} = 25\ ^{o}C$	P_{tot}	max.	100	mW
Storage temperature	T_{stg}	−40 to +100		^{o}C
Junction temperature	T_j	max.	100	^{o}C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	240	^{o}C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	0,75	$^{o}C/mW$
From junction to ambient, device mounted on a printed-circuit board (note 1)	$R_{th\ j\text{-}a}$	=	0,50	$^{o}C/mW$

CHARACTERISTICS

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

Collector dark (cut-off) current $V_{CE} = 20$ V	$I_{CEO(D)}$	<	100	nA
Collector light (cut-off) current at $T_{amb} = 25\ ^{o}C$ $V_{CE} = 5$ V; $E_V = 1000$ lx; $T_c = 2854$ K (note 2)	$I_{CEO(L)}$	>	5	mA
Collector-emitter saturation voltage $I_C = 3$ mA; $E_V = 1000$ lx; $T_c = 2854$ K (note 2)	V_{CEsat}	<	0,4	V
Wavelength at peak response	λ_{pk}	typ.	800	nm
Bandwidth at half height	$B_{50\%}$	typ.	400	nm
Angle between half-sensitivity directions (note 3)	$\alpha_{50\%}$	typ.	25^{o}	
Receiving area		typ.	1	mm^2

Notes

1. With copper island rings of 0,8 mm and 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.
3. Measured at $I_C = 1$ mA; $E_V = 1000$ lx.

Switching times (see Figs 2 and 3)

I_{Con} = 1 mA; V_{CC} = 5 V; R_E = 100 Ω; T_{amb} = 25 °C

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

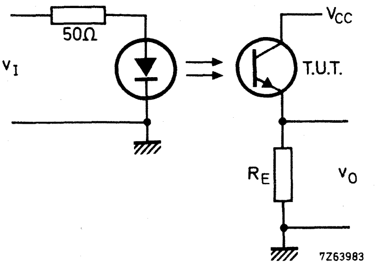


Fig. 2 Switching circuit.

Pulse generator:
f = 500 Hz
t_p = 20 μs
t_r = t_f = 20 ns

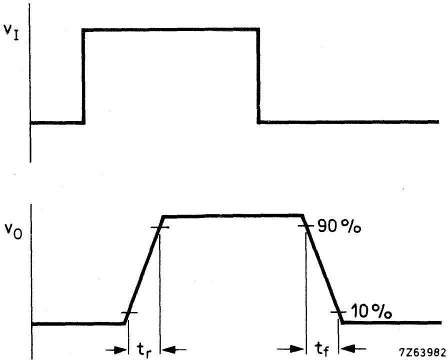


Fig. 3 Input and output switching waveforms.

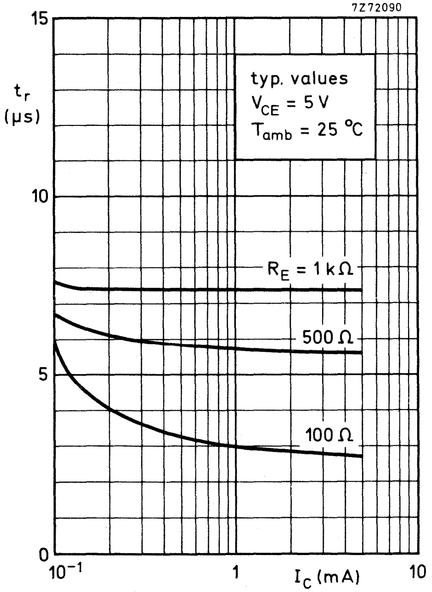


Fig. 4.

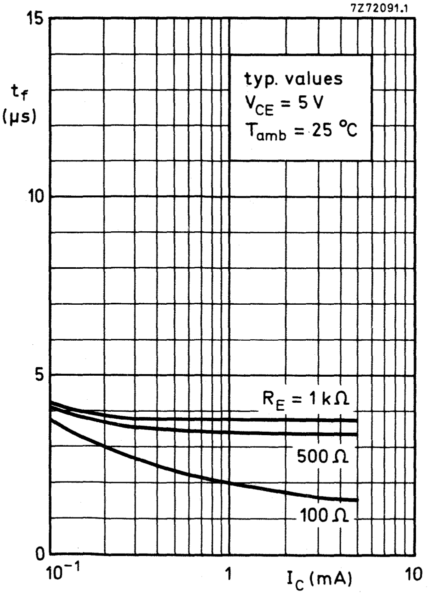


Fig. 5.

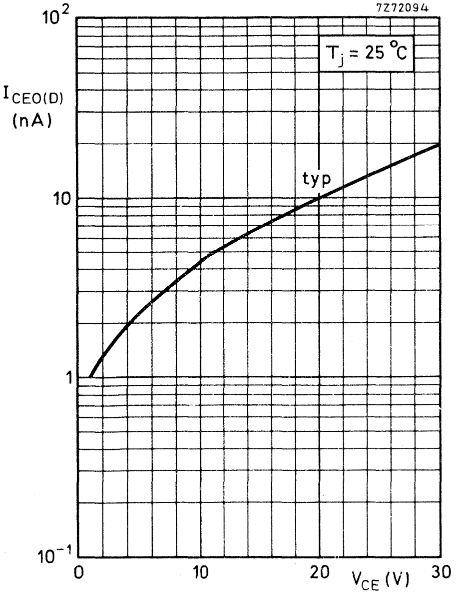


Fig. 6.

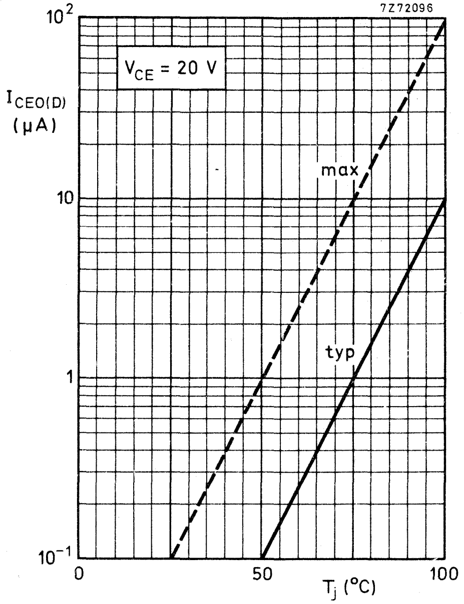


Fig. 7.

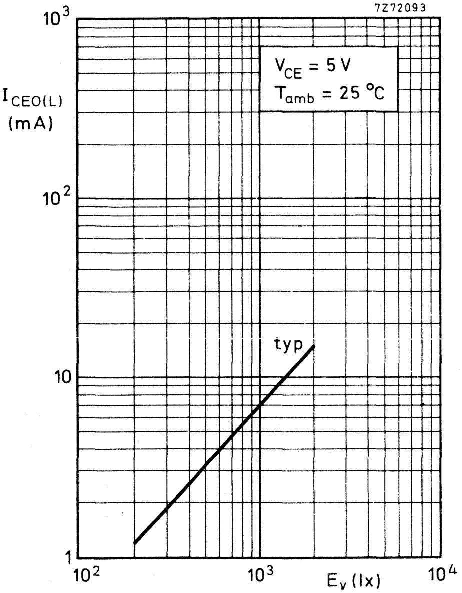


Fig. 8.

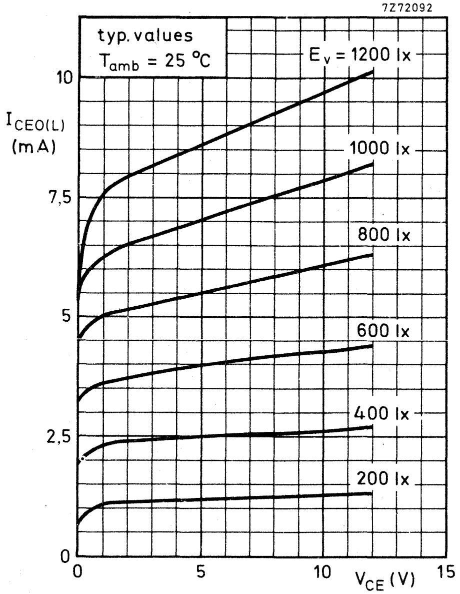


Fig. 9.

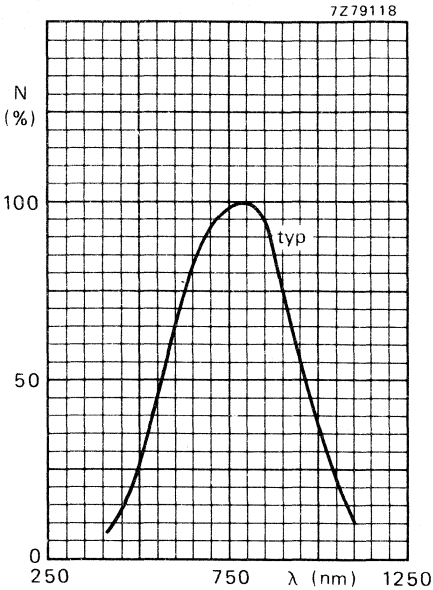

7Z79118
N
(%)
100
50
0
250
750
λ (nm)
1250
typ

Fig. 10.

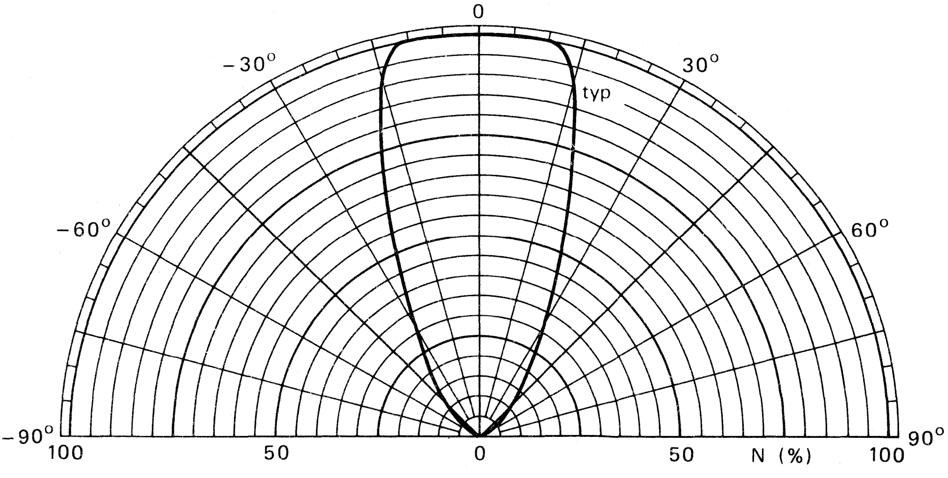

0
−30°
30°
−60°
60°
−90°
90°
100
50
0
50
N (%)
100
typ

Fig. 11.

7Z79119

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.

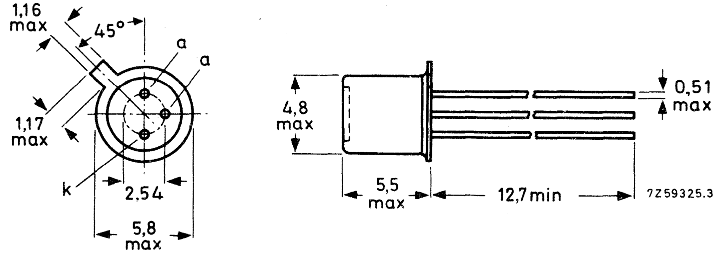
QUICK REFERENCE DATA

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

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

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

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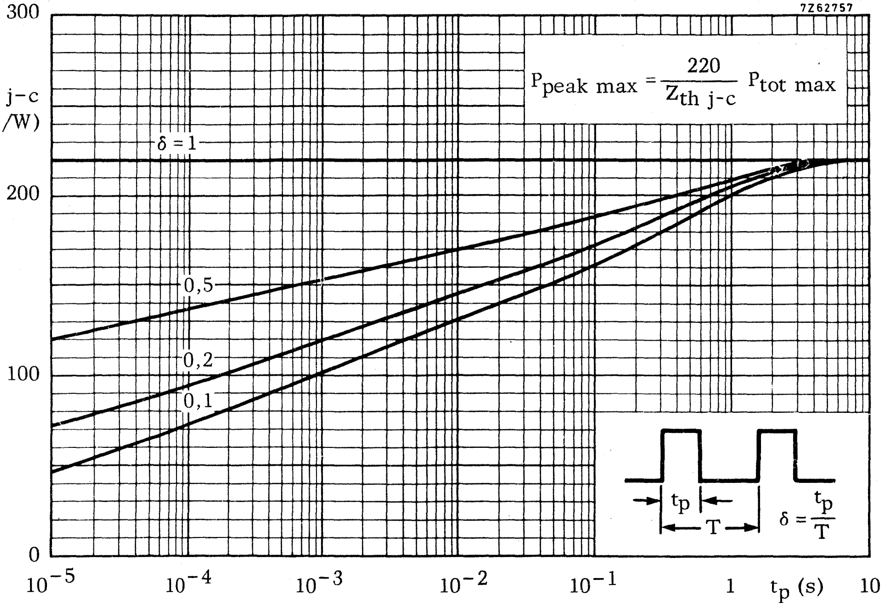
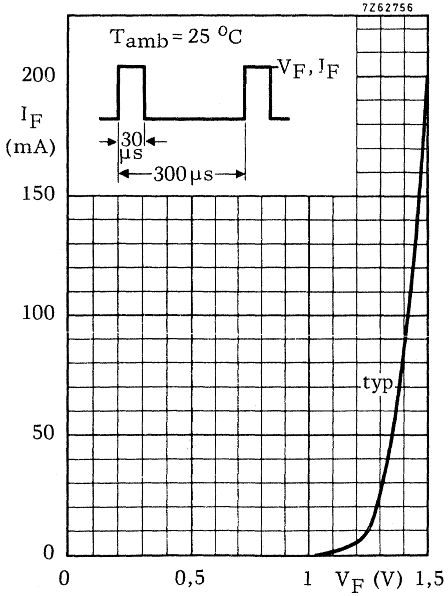
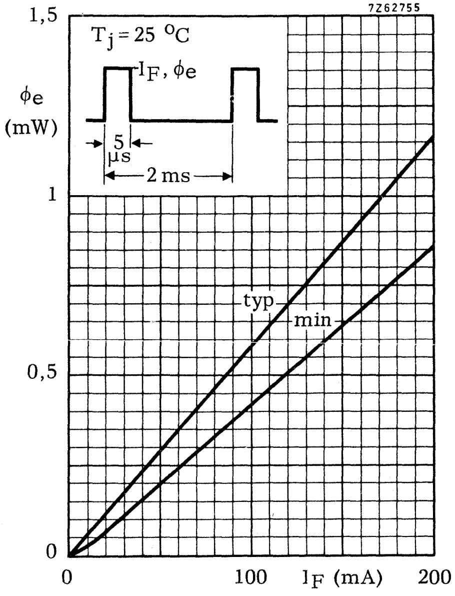
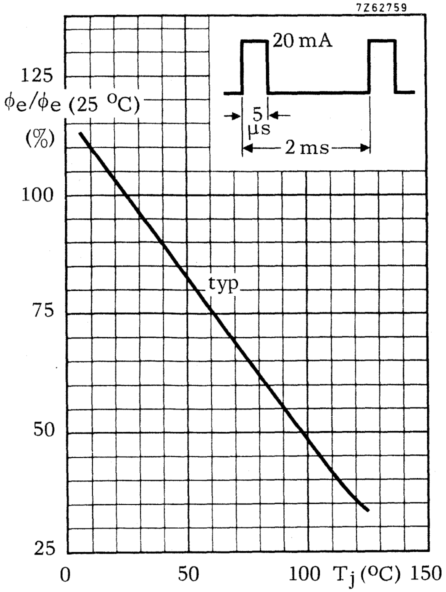
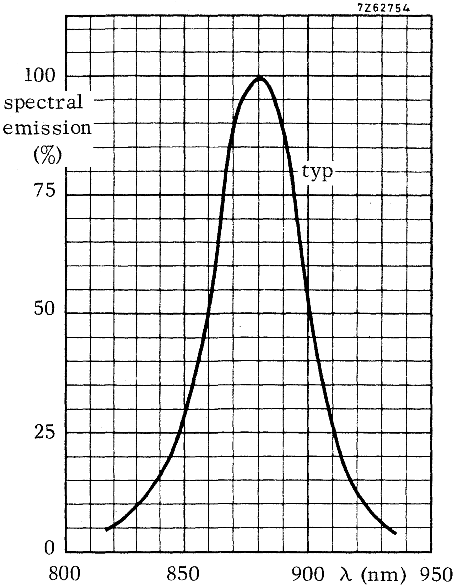
[1] t_p = 100 µs; δ = 0, 1.

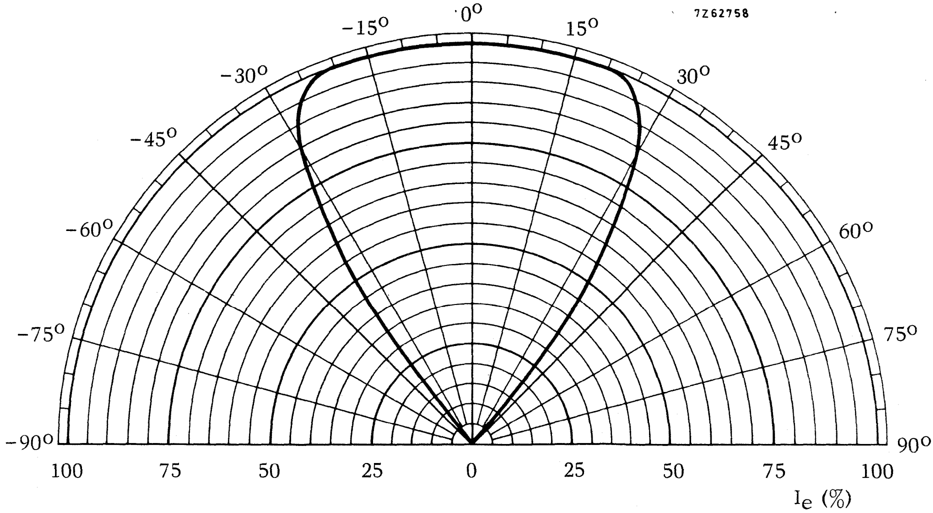

7Z62757
$Z_{th\ j-c}$ (°C/W)
300
200
100
0
$P_{peak\ max} = \frac{220}{Z_{th\ j-c}} P_{tot\ max}$
δ = 1
0,5
0,2
0,1
t_p
T
$\delta = \frac{t_p}{T}$
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
t_p (s)
10


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


7Z62755
T_j = 25 °C
I_F, ϕ_e
5 μs
2 ms
ϕ_e (mW)
1,5
1
0,5
0
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

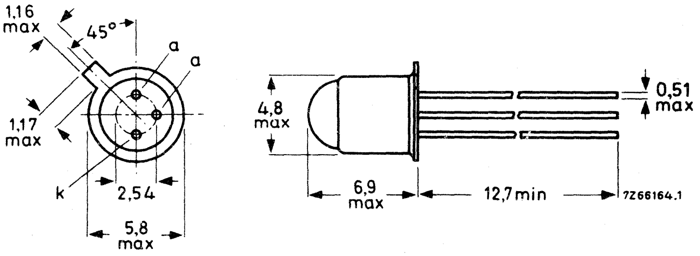
Gallium arsenide light emitting diode intended for optical coupling and encoding. It emits radiation in the near infrared when forward biased. Suitable for combination with phototransistor BPX25 or BPX72.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 95 °C	P_{tot}	max.	50	mW
Total radiant power at I_F = 20 mA	ϕe	typ.	50	μW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	typ.	1, 25	mW/sr
Light rise time at I_{Fon} = 20 mA	t_r	<	100	ns
Light fall time at I_{Fon} = 20 mA	t_f	<	100	ns
Wavelength at peak emission	λ_{pk}	typ.	880	nm
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	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	$R_{th\ j\text{-}a}$	=	0,6	°C/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0,22	°C/mW

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

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

CHARACTERISTICS (continued)

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

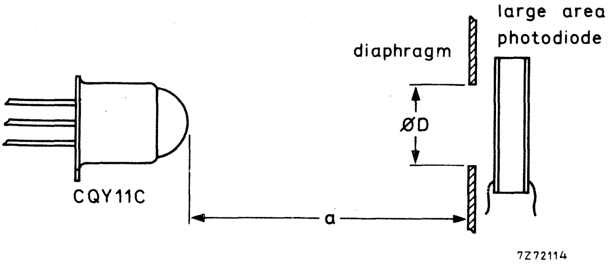


Fig. 1

Decrease of radiant power with temperature	$\frac{\Delta\phi e}{\Delta T_j}$	typ.	0,7	%/°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. <	30 100	ns ns
Light fall time at I_{Fon} = 20 mA	t_f	typ. <	30 100	ns ns

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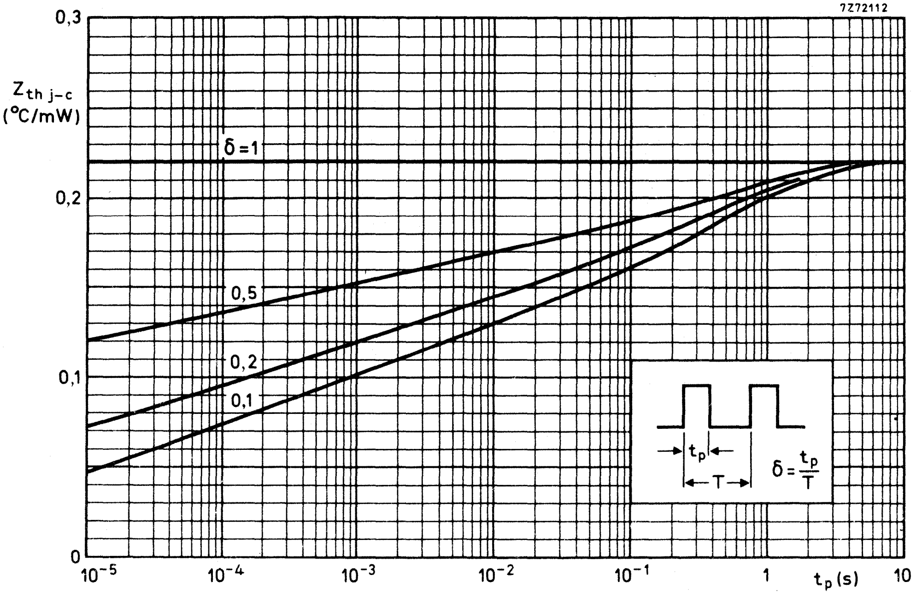
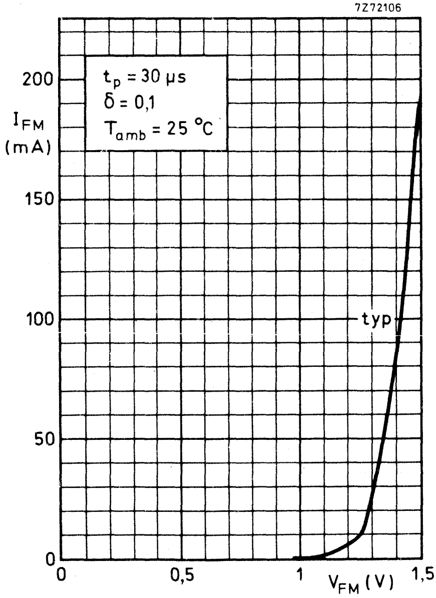
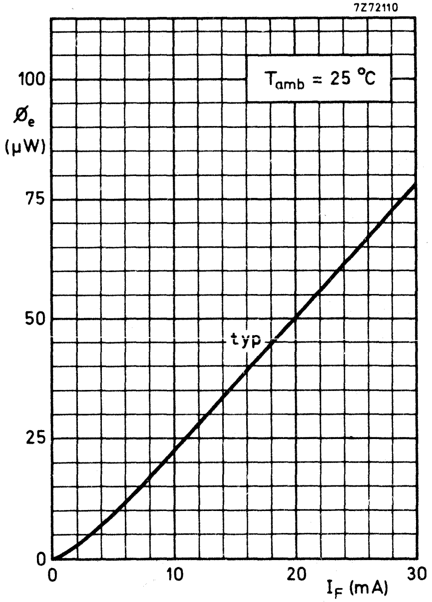
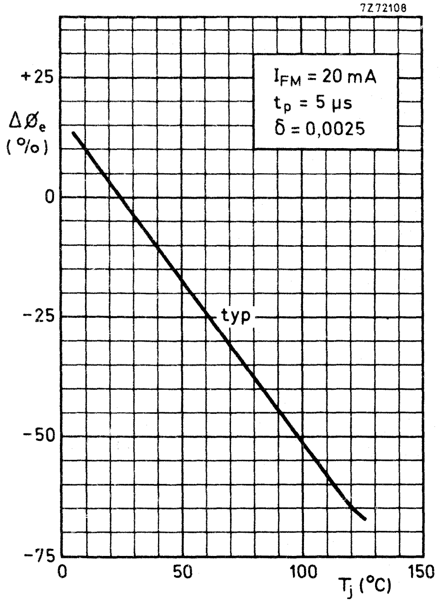
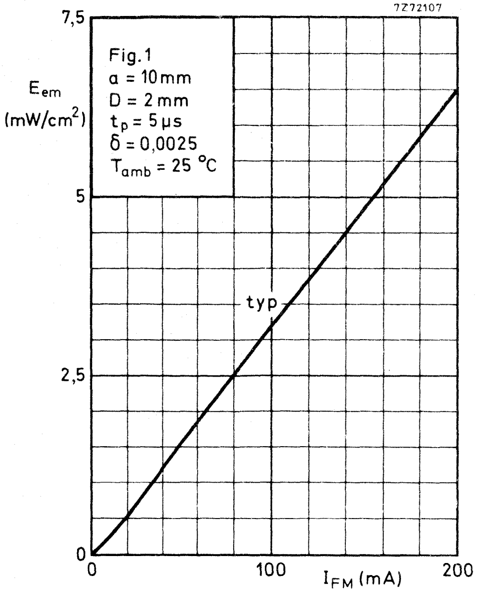
[1] This corresponds typically with $I_{CEO(L)}$ = 0,4 mA in a phototransistor BPX25 and with 200 μA in a phototransistor BPX72.

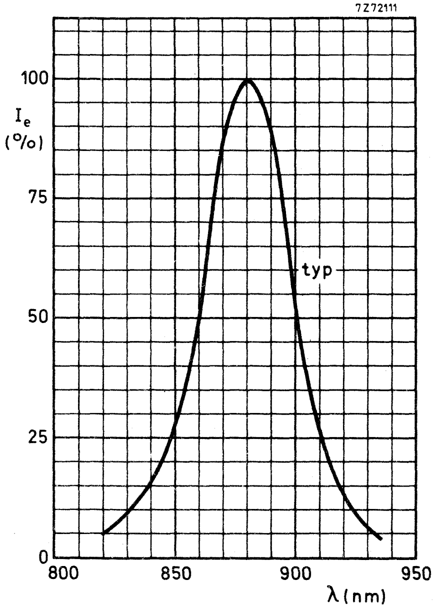

7Z72112
0,3
$Z_{th\ j-c}$ (°C/mW)
δ = 1
0,2
0,5
0,2
0,1
0,1
0
t_p
T
δ = $\frac{t_p}{T}$
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
t_p (s)
10

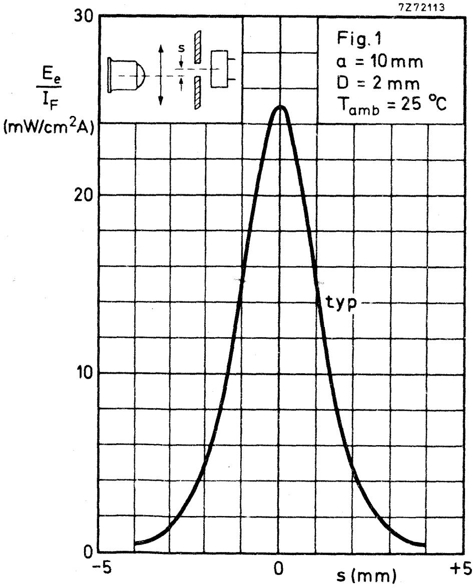

7Z72106
t_p = 30 μs
δ = 0,1
T_{amb} = 25 °C
200
I_{FM} (mA)
150
100
typ
50
0
0
0,5
1
V_{FM} (V)
1,5

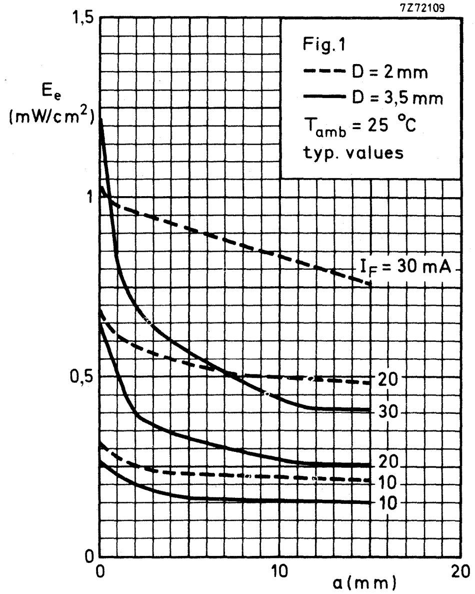

7Z72110
T_{amb} = 25 °C
100
$Ø_e$ (μW)
75
50
typ
25
0
0
10
20
I_F (mA)
30

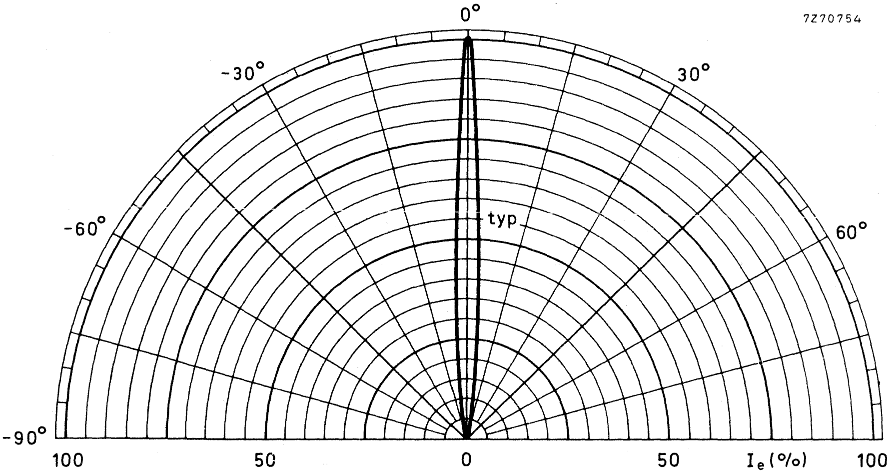

7Z72108
I_FM = 20 mA
t_p = 5 µs
δ = 0,0025
ΔØe (%)
+25
0
-25
-50
-75
typ
0
50
100
150
Tj (°C)


7Z72107
Fig. 1
a = 10 mm
D = 2 mm
t_p = 5 µs
δ = 0,0025
T_amb = 25 °C
Eem (mW/cm²)
7,5
5
2,5
0
typ
0
100
200
I_FM (mA)


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


7Z72113
Fig. 1
a = 10 mm
D = 2 mm
T_amb = 25 °C
s
Ee/IF (mW/cm²A)
30
20
10
0
typ
-5
0
+5
s (mm)


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


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

GaAsP RED LIGHT EMITTING DIODE

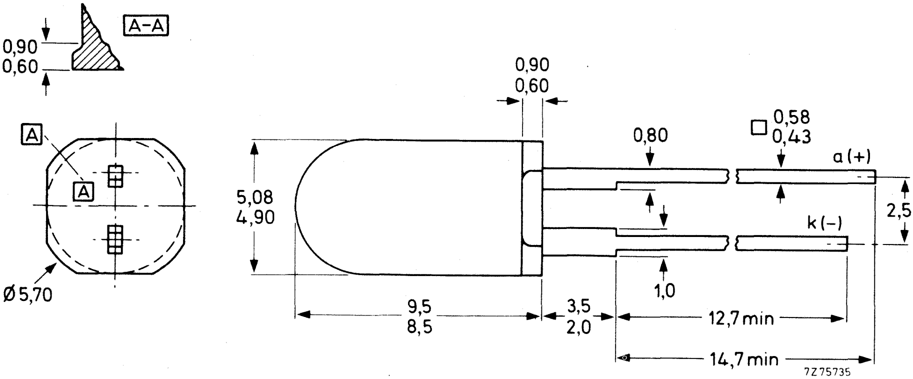
Gallium arsenide phosphide light emitting diode which emits visible red light when forward biased. The envelope is of light-diffusing red plastic, and has been designed for high-density arrays.

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		0,7 to 1,6	mcd
	CQY24A-II	I_V		1 to 2,2	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

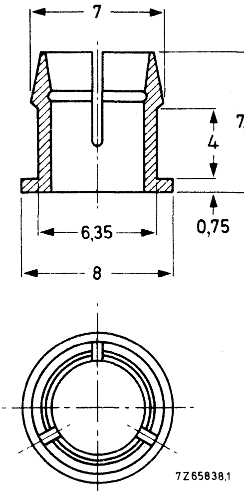
Fig. 1 SOD-39C.

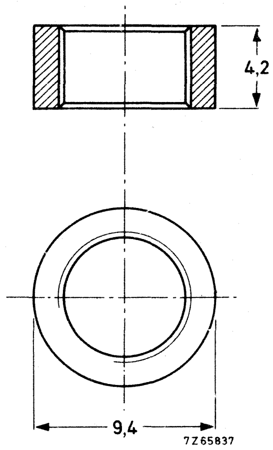


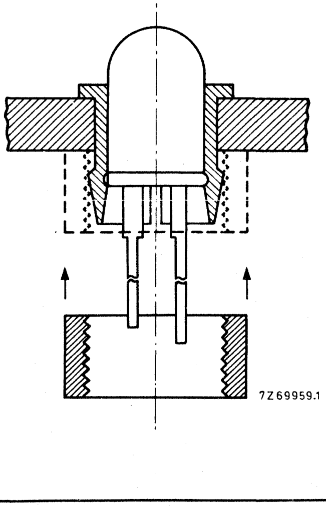
Accessories for panel mounting (panel thickness < 4 mm)

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

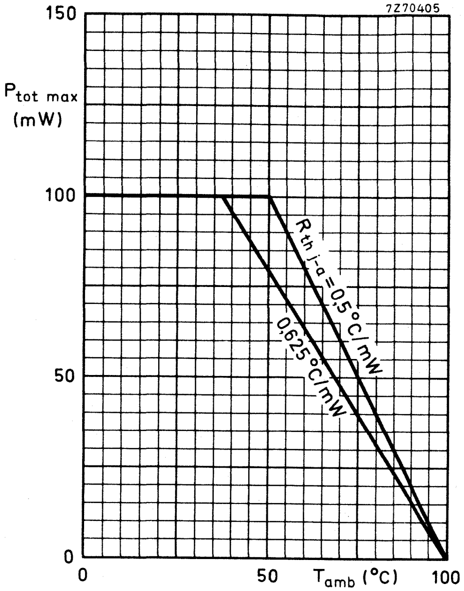
THERMAL RESISTANCE

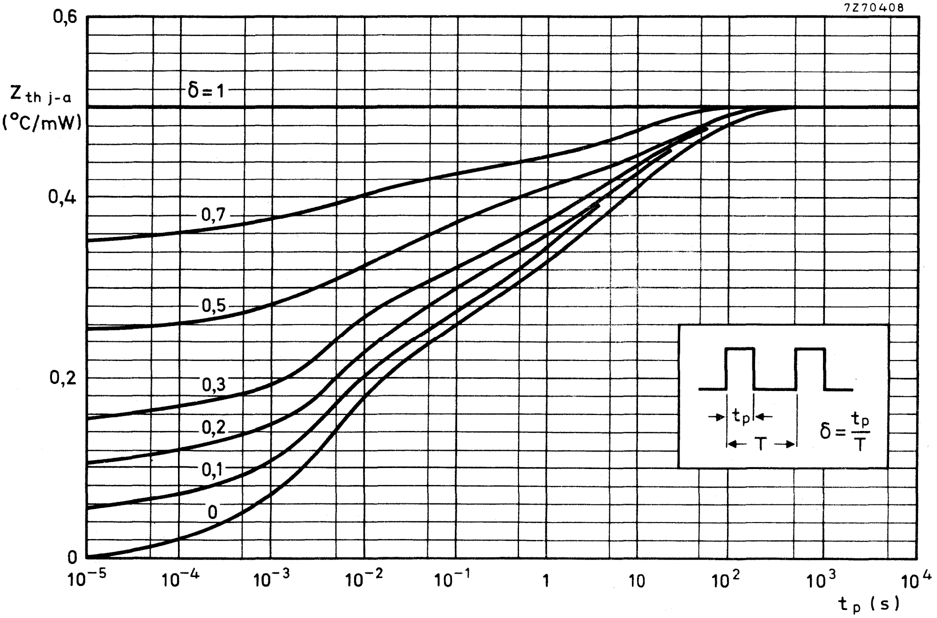
From junction to ambient, in free air	$R_{th\ j\text{-}a}$	=	0,625	°C/mW
mounted on printed-circuit board	$R_{th\ j\text{-}a}$	=	0,500	°C/mW

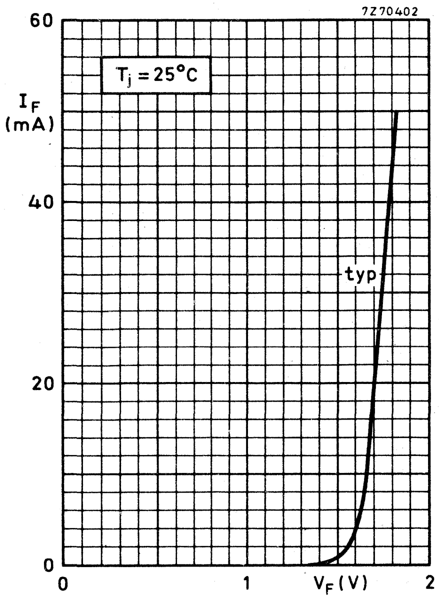
CHARACTERISTICS

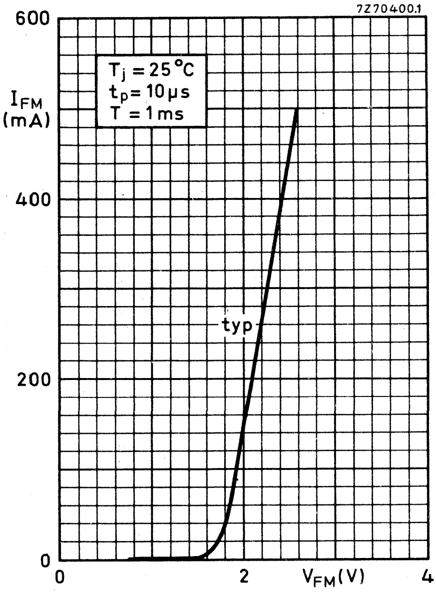
T_j = 25 °C unless otherwise specified

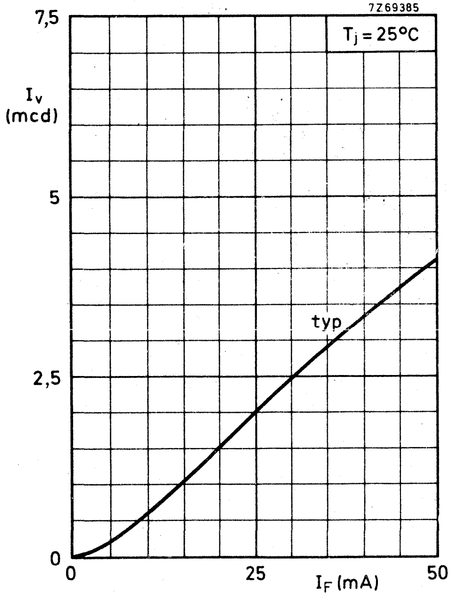
Forward voltage					
I_F = 20 mA		V_F	typ. <	1,7 2	V V
Negative temperature coefficient of V_F					
I_F = 20 mA		$\frac{-\Delta V_F}{\Delta T_j}$	typ.	1,6	mV/°C
I_F = 2 mA		$\frac{-\Delta V_F}{\Delta T_j}$	typ.	2	mV/°C
Reverse current					
V_R = 3 V		I_R	<	100	µA
→ Luminous intensity (on-axis)					
I_F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

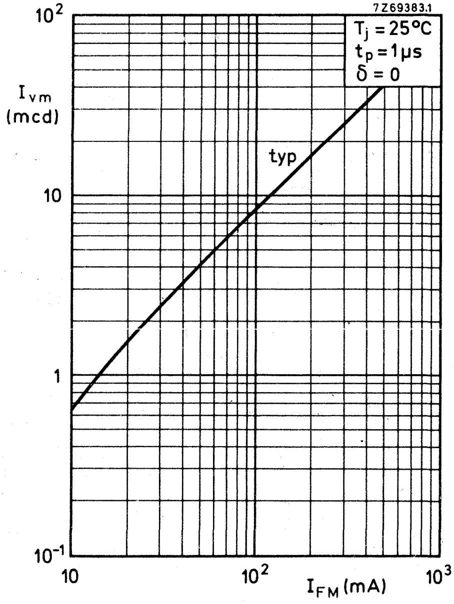

7Z70405
150
100
50
0
$P_{tot\ max}$ (mW)
$R_{th\ j-a}$ = 0,5 °C/mW
0,625 °C/mW
0
50
T_{amb} (°C)
100

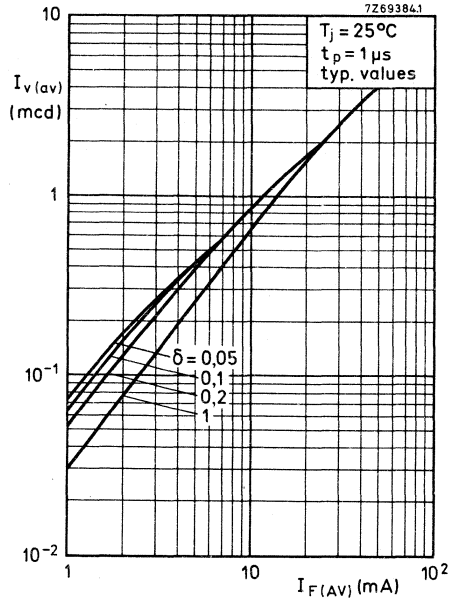

7Z70408
0,6
0,4
0,2
0
$Z_{th\ j-a}$ (°C/mW)
δ = 1
0,7
0,5
0,3
0,2
0,1
0
t_p
T
$\delta = \frac{t_p}{T}$
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
t_p (s)

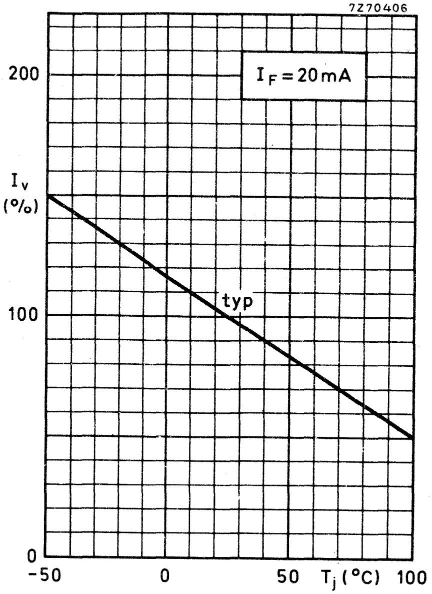

7Z70402
$T_j = 25\,^\circ C$
I_F (mA)
60
40
20
0
typ
0
1
V_F (V)
2

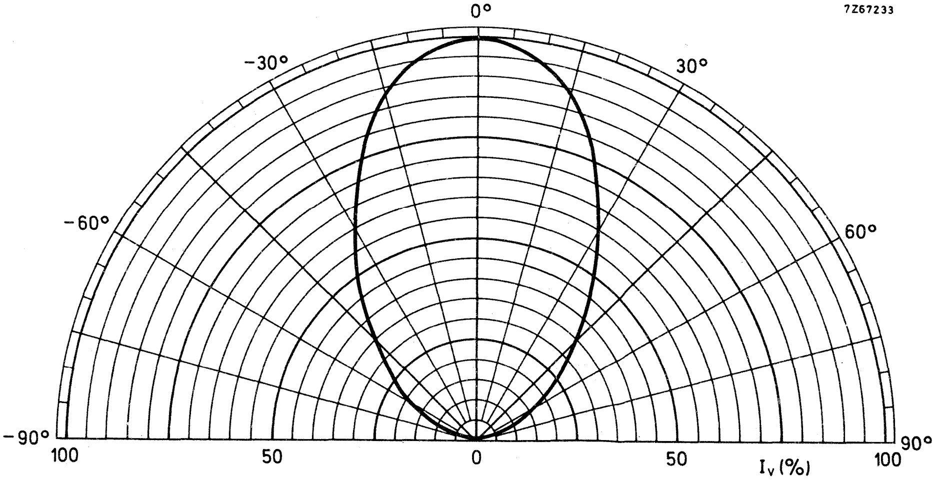

7Z70400.1
$T_j = 25\,^\circ C$
$t_p = 10\,\mu s$
$T = 1\,ms$
I_{FM} (mA)
600
400
200
0
typ
0
2
V_{FM} (V)
4


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


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


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


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 CQY46A, colourless for CQY47A, both showing a clearly defined point of light.

CQY46A has better contrast, CQY47A shows no red reflections from sunlight or incandescent light sources.

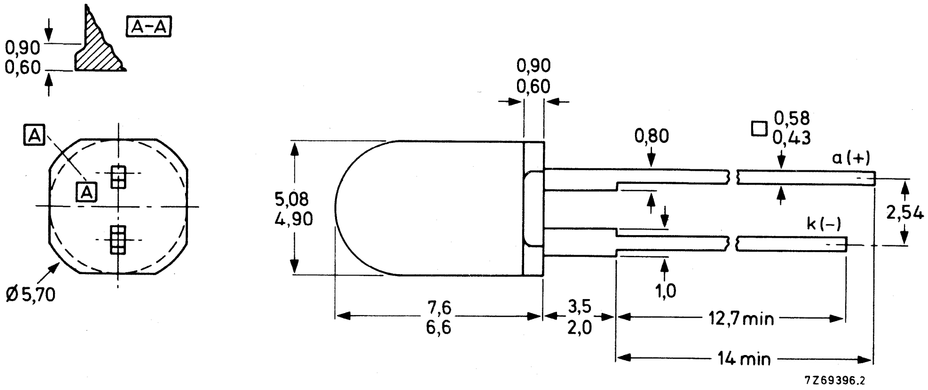
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	50	mA
Total power dissipation up to $T_{amb} = 37,5\ ^oC$	P_{tot}	max.	100	mW
Junction temperature	T_j	max.	100	^oC
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0,625	^oC/mW
Luminous intensity (on-axis) at $I_F = 20$ mA	I_v	>	0,4	mcd
Angle between half-intensity directions	$\alpha_{50\%}$	typ.	100°	
Wavelength at peak emission	λ_{pk}	typ.	650	nm

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-39D



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

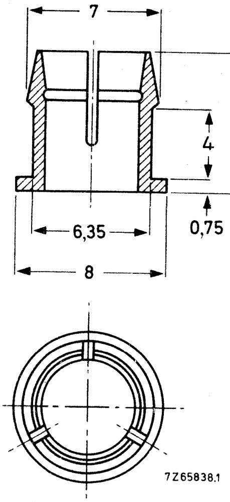


Fig. 2.

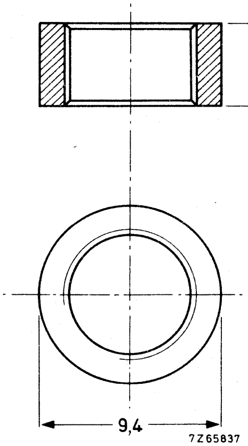


Fig. 3.

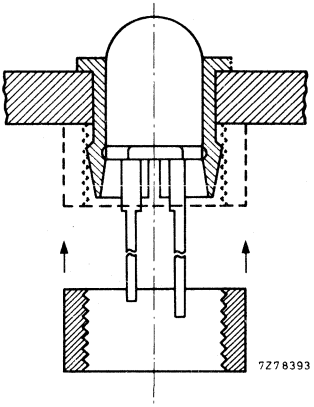


Fig. 4.

RATINGS

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

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	50	mA
Forward current (peak value) t_p = 1 μs; δ = 0,0003	I_{FM}	max.	1000	mA
Power dissipation up to T_{amb} = 37,5 °C	P_{tot}	max.	100	mW
Storage temperature	T_{stg}	−55 to	+100	°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	0,625	°C/mW
From junction to ambient device mounted on a printed-circuit board *	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage I_F = 20 mA	V_F	typ. <	1,7 2,0	V V
Reverse current V_R = 3 V	I_R	<	100	μA
Diode capacitance V_R = 0; f = 1 MHz	C_d	typ.	60	pF
Luminous intensity (on-axis) I_F = 20 mA; T_{amb} = 25 °C	I_v	> typ.	0,4 1,3	mcd mcd
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	100°	

---

* With copper island rings of 0,8 mm and 1,3 mm diameters on both sides of 1,6 mm glass-epoxy printed-circuit board; thickness of copper 35 μm.

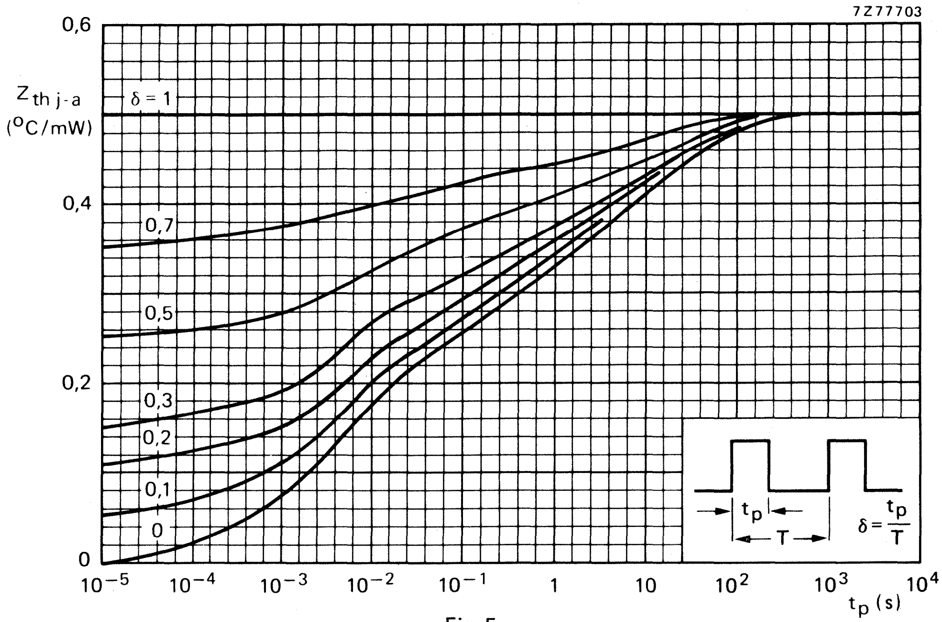


Fig. 5.

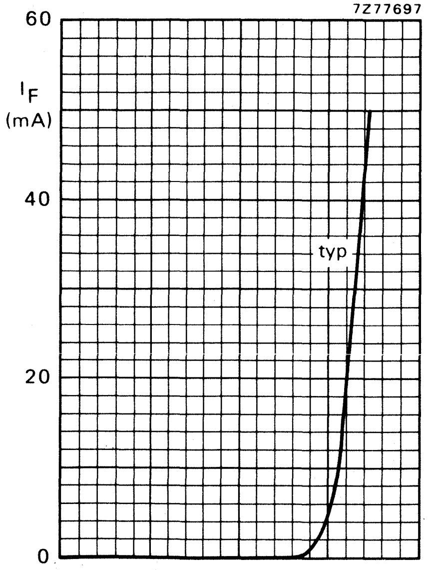


Fig. 6 T_j = 25 ^{o}C.

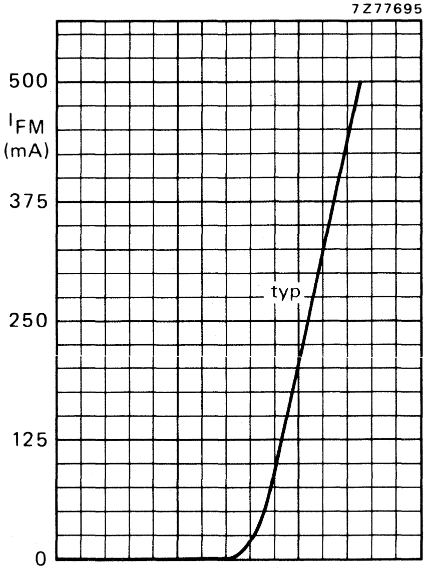


Fig. 7 T_j = 25 ^{o}C; t_p = 10 μs; T = 1 ms.

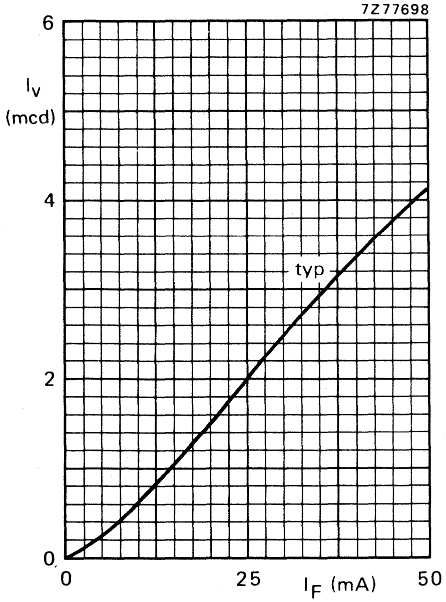


Fig. 8 $T_j = 25\ ^oC$.

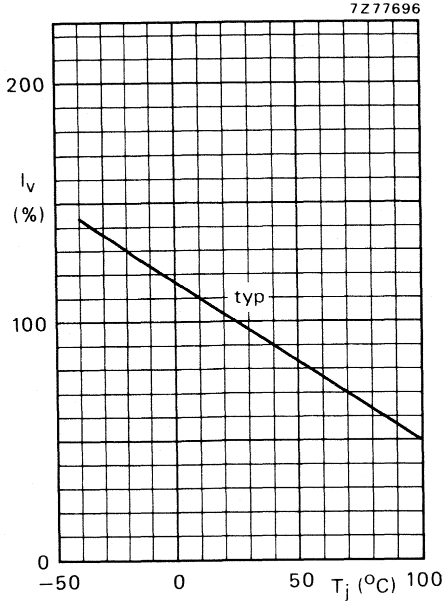


Fig. 9 $I_F = 20$ mA.

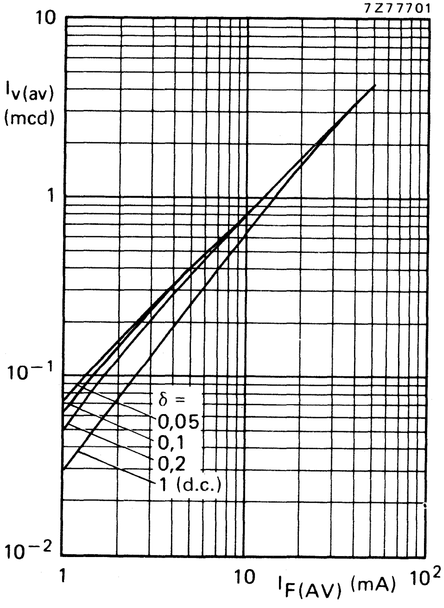


Fig. 10 Typical values; $T_j = 25\ ^oC$; $t_{av} = T$.

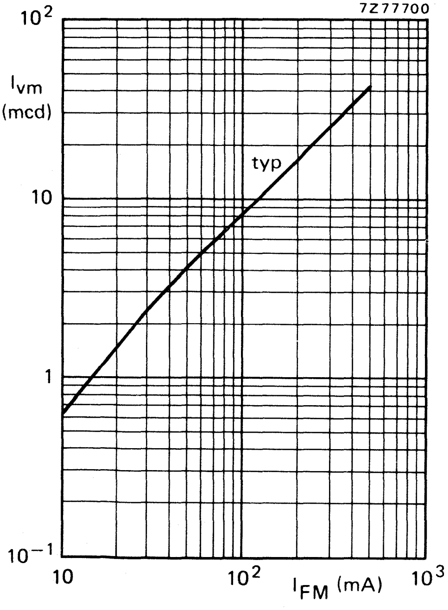


Fig. 11 $T_j = 25\ ^oC$; $t_p = 1\ \mu s$; $\delta = 0$.

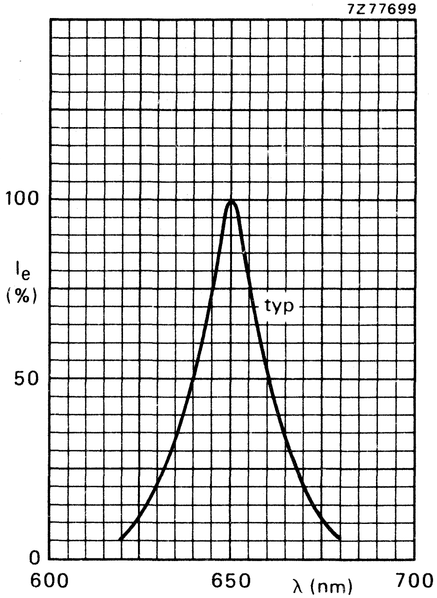

7Z77699
100
I_e
(%)
typ
50
0
600
650
λ (nm)
700

Fig. 12.

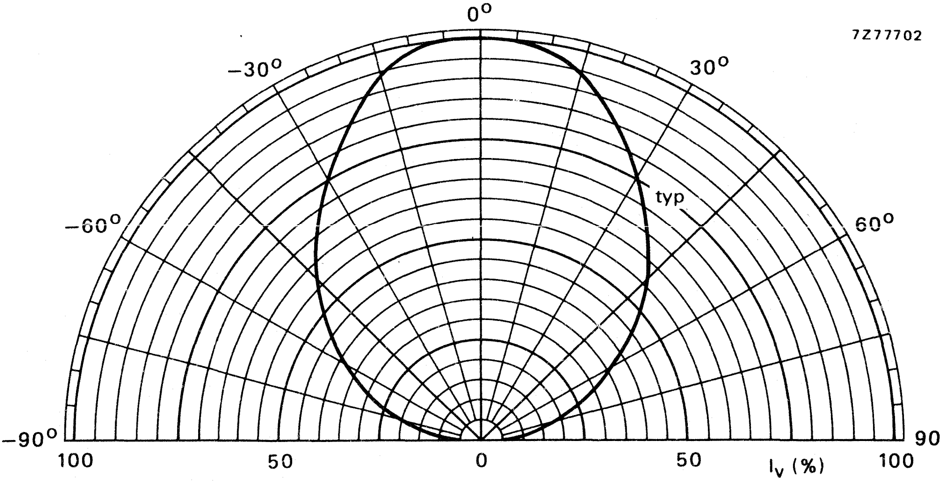

0°
7Z77702
−30°
30°
typ
−60°
60°
−90°
90°
100
50
0
50
I_v (%)
100

Fig. 13.

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.

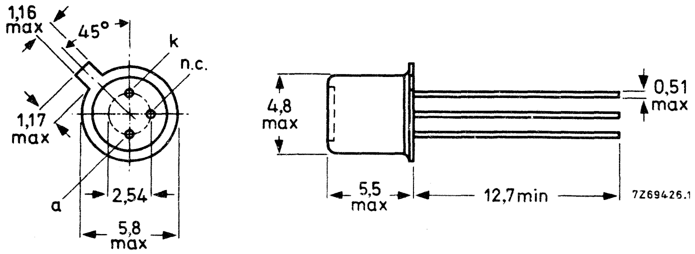
QUICK REFERENCE DATA

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

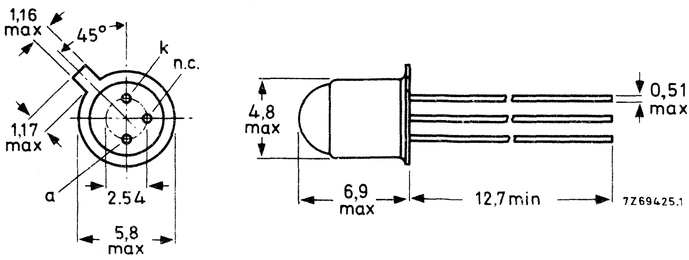
MECHANICAL DATA

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

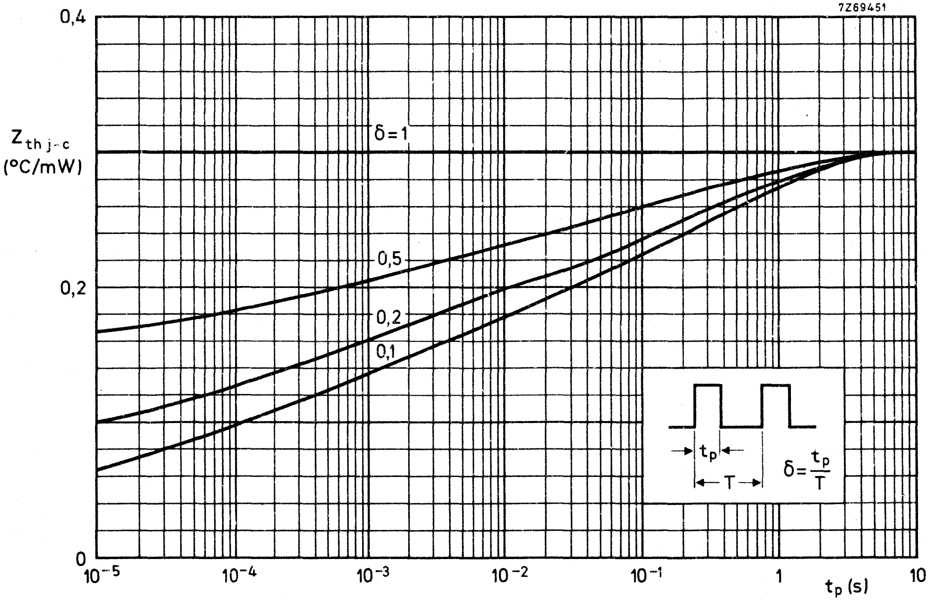
THERMAL RESISTANCE

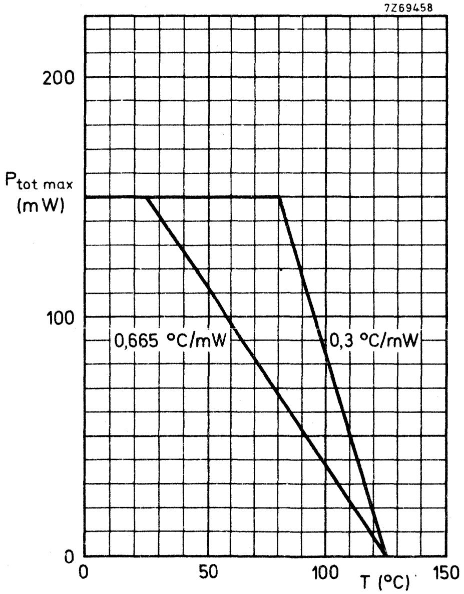
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,665	^oC/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0,3	^oC/mW

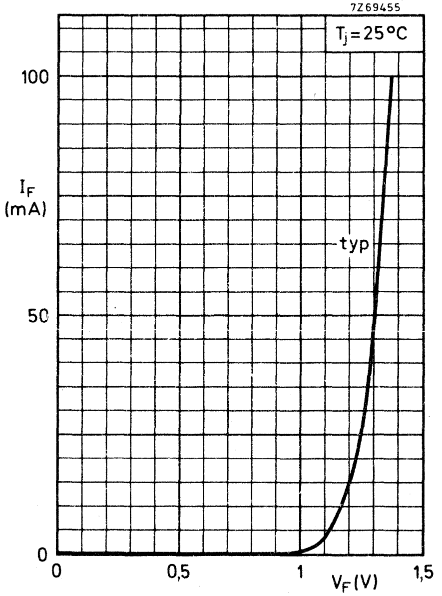
CHARACTERISTICS

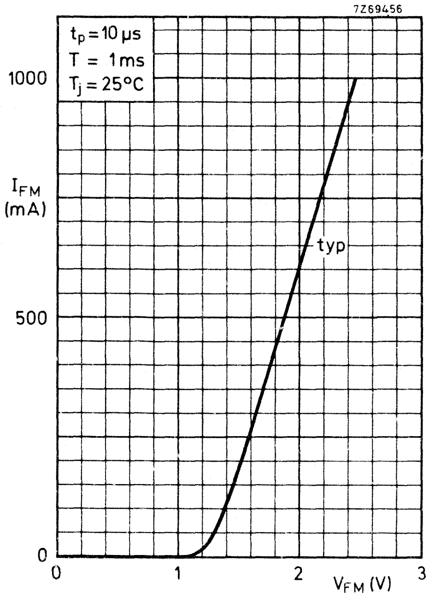
T_j = 25 °C unless otherwise specified

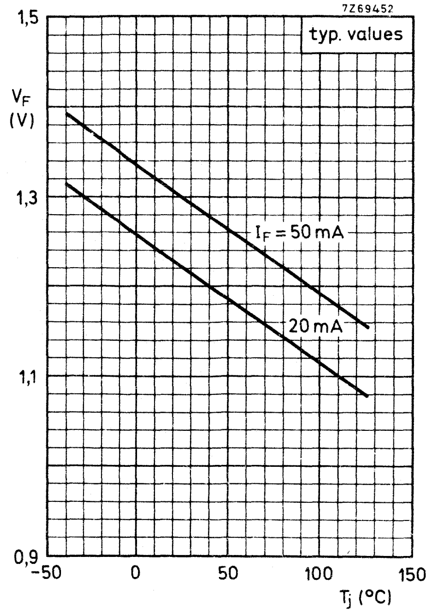
			CQY49B	CQY49C	
Forward voltage at I_F = 50 mA	V_F	typ.	1,3		V
		<	1,5		V
Reverse current at V_R = 2 V	I_R	<	100		μA
Diode capacitance					
V_R = 0; f = 1 MHz	C_d	typ.	55		pF
Radiant intensity (on-axis) at I_F = 50 mA	I_e	>	0,3	3	mW/sr
		typ.	0,5	5	mW/sr
Wavelength at peak emission	λ_{pk}	typ.	930		nm
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

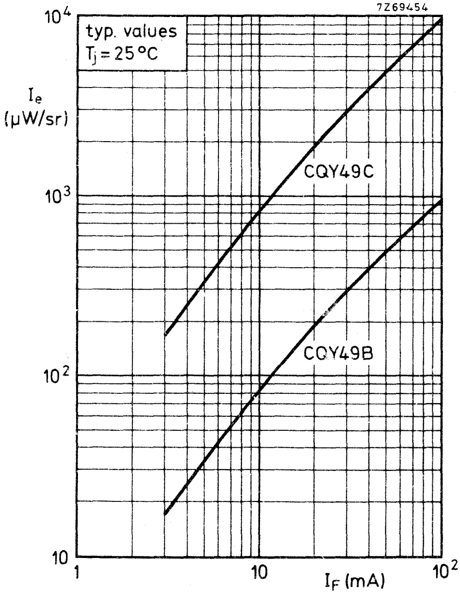

7Z69451
Z th j-c
(°C/mW)
0,4
0,2
0
δ = 1
0,5
0,2
0,1
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
t_p (s)
t_p
T
δ = t_p / T

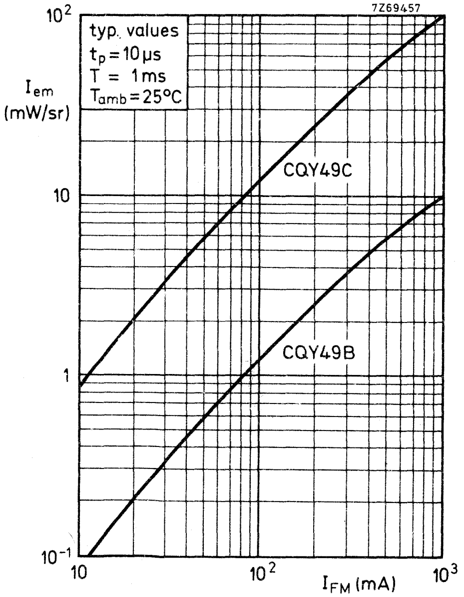

7Z69458
P tot max
(mW)
200
100
0
0,665 °C/mW
0,3 °C/mW
0
50
100
150
T (°C)

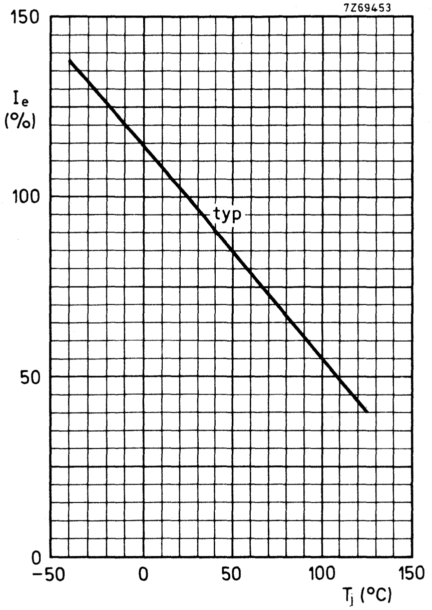

7Z69455
T_j = 25 °C
I_F
(mA)
100
50
0
typ
0
0,5
1
1,5
V_F (V)

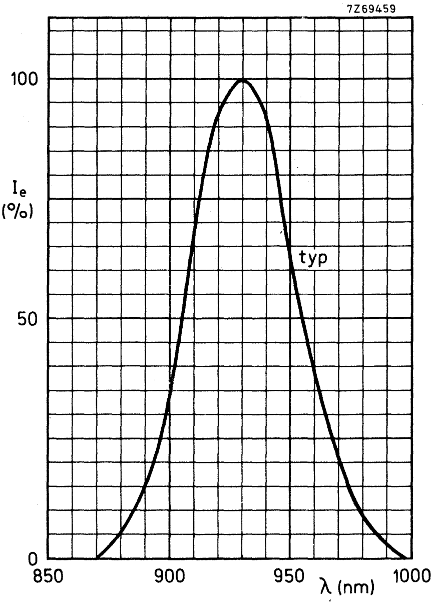

7Z69456
$t_p = 10\ \mu s$
T = 1 ms
$T_j = 25\ °C$
I_{FM} (mA)
1000
500
0
typ
0
1
2
3
V_{FM} (V)

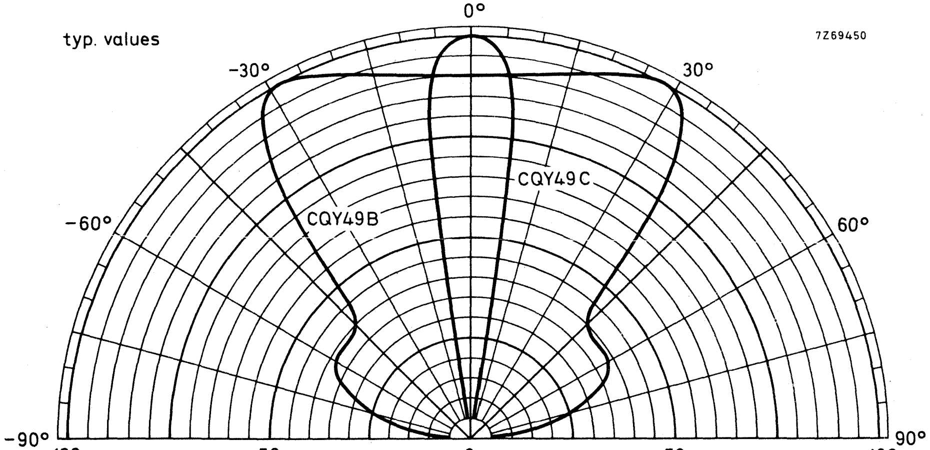

7Z69452
typ. values
V_F (V)
1,5
1,3
1,1
0,9
$I_F = 50$ mA
20 mA
−50
0
50
100
150
T_j (°C)


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
I_{FM} (mA)
10^3


7Z69453
150
Ie
(%)
100
typ
50
0
−50
0
50
100
150
Tj (°C)


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


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

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.

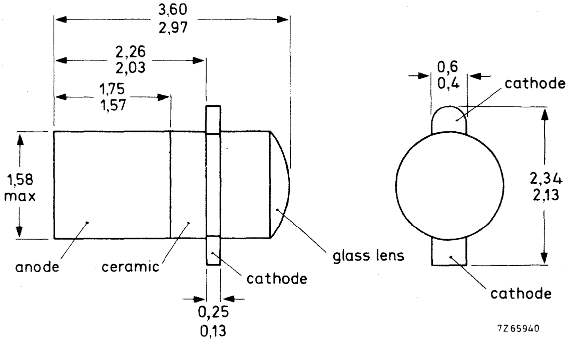
QUICK REFERENCE DATA

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 ^oC mounted on printed circuit board	P_{tot}	max.	150		mW
			CQY50	CQY52	
Total radiant power at I_F = 20 mA	ϕ_e	>	160	400	μW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	>	180	450	μW/sr
Wavelength at peak emission	λ_{pk}	typ.	930		nm

MECHANICAL DATA

Dimensions in mm

DO-31 except for length



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

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

THERMAL RESISTANCE

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

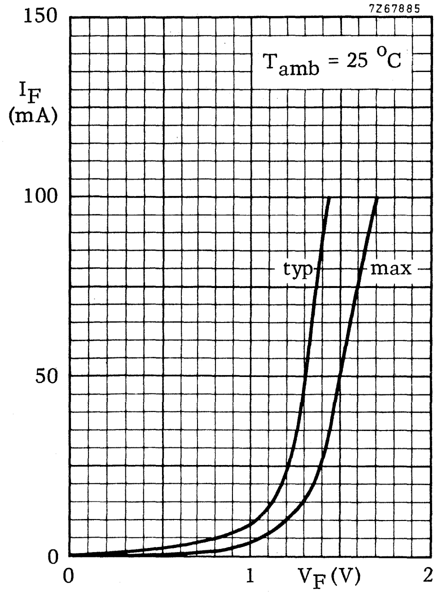
---

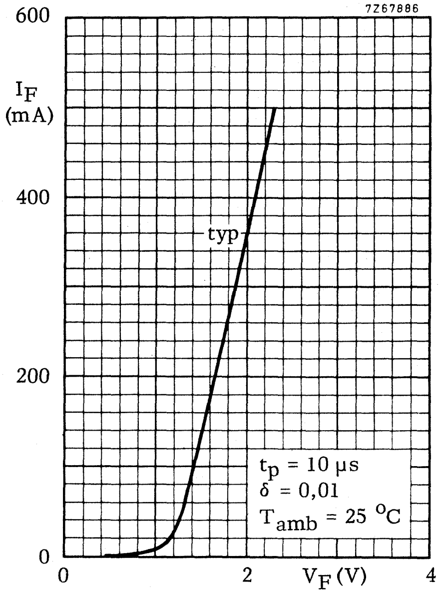
[1] With copper islands of 6 x 2 mm on both sides of 1,6 mm glass-epoxy printed circuit board; thickness of copper 35 μm.

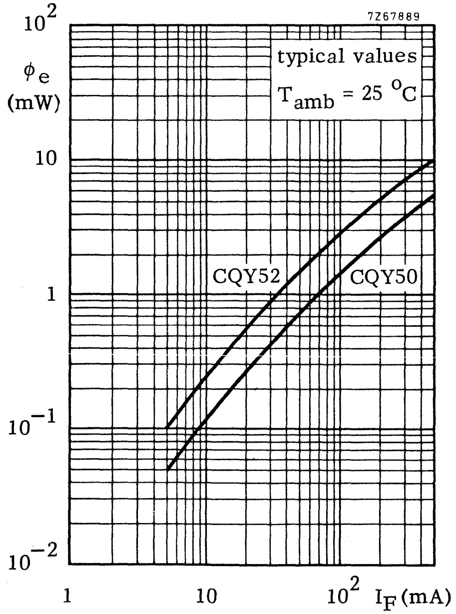
CHARACTERISTICS

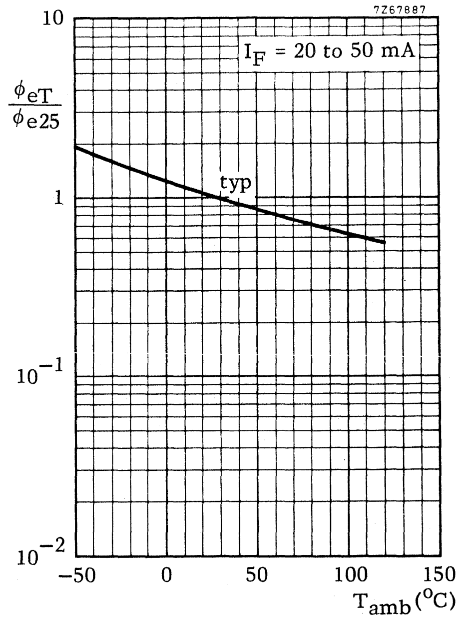
T_{amb} = 25 °C unless otherwise specified

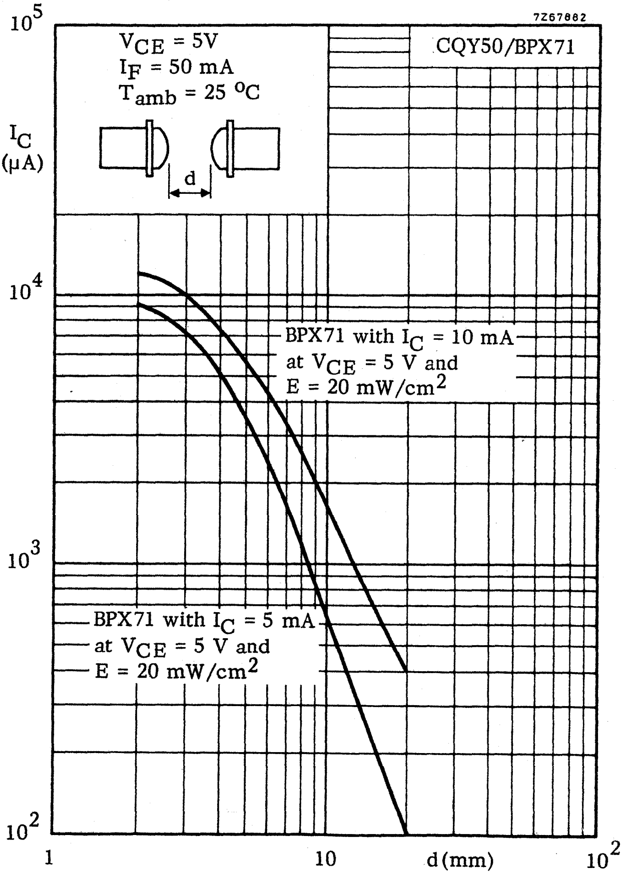
			CQY50	CQY52	
Forward voltage					
I_F = 50 mA	V_F	typ.	1,3	1,3	V
		<	1,5	1,5	V
I_F = 500 mA; t_p = 10 µs; δ = 0,01	V_F	typ.	2,3	2,3	V
Reverse current					
V_R = 2 V	I_R	<	100	100	µA
Diode capacitance					
V_R = 0; f = 1 MHz	C_d	typ.	45	45	pF
Total radiant power					
I_F = 20 mA	ϕ_e	>	160	400	µW
I_F =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

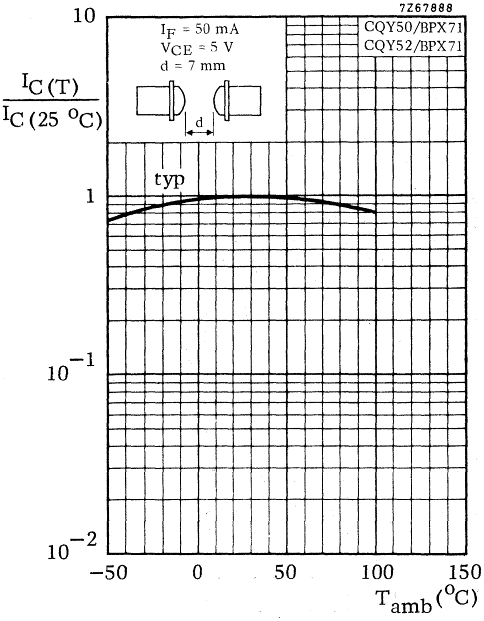

7Z67885
150
I_F (mA)
T_{amb} = 25 °C
100
typ
max
50
0
0
1
V_F (V)
2

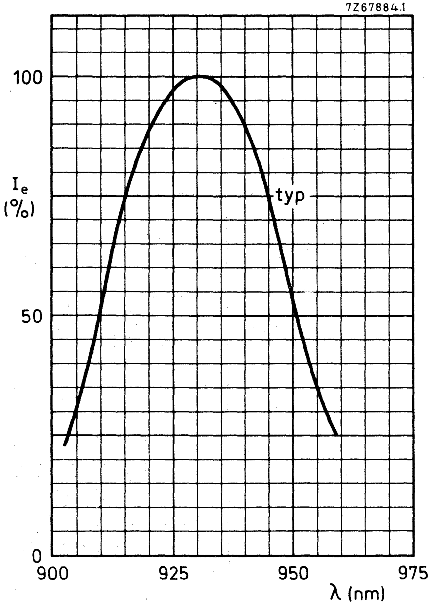

7Z67886
600
I_F (mA)
400
typ
200
t_p = 10 μs
δ = 0,01
T_{amb} = 25 °C
0
0
2
V_F (V)
4

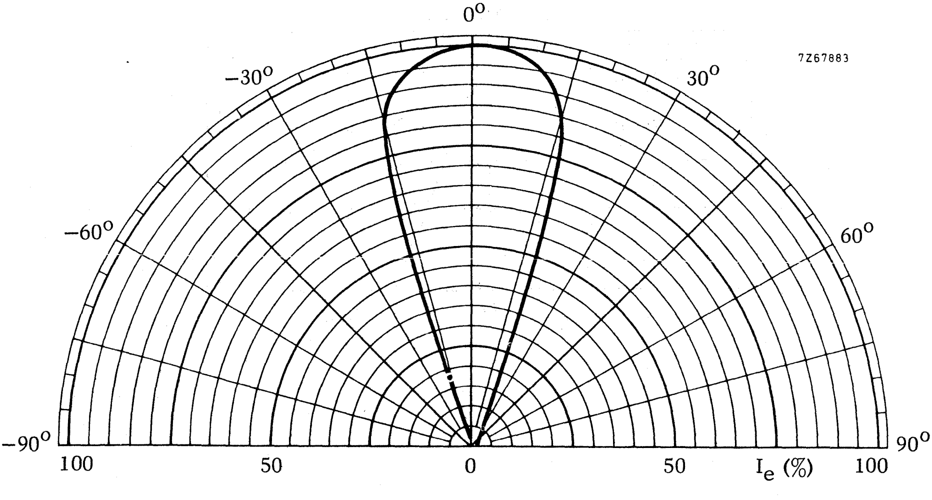

7Z67889
10^2
ϕ_e (mW)
typical values
T_{amb} = 25 °C
10
1
CQY52
CQY50
10^{-1}
10^{-2}
1
10
10^2
I_F (mA)


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


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


0°
7Z67883
−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. The envelope is of light-diffusing red plastic, and has been designed for high-density arrays.

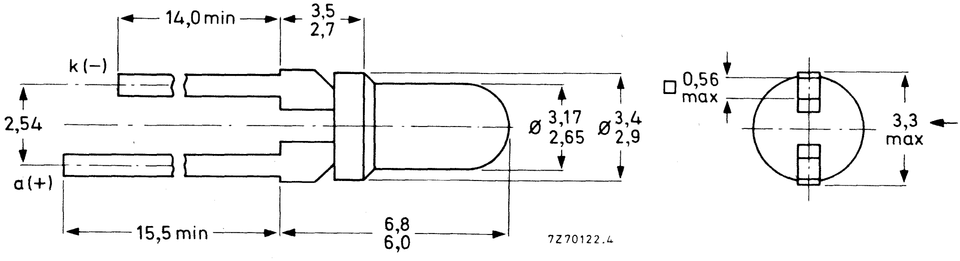
QUICK REFERENCE DATA

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	CQY54	I_v	>	0,3	mcd
	CQY54-I	I_v		0,7 to 1,6	mcd
	CQY54-II	I_v		1 to 2,2	mcd
	CQY54-III	I_v	>	1,6	mcd
Wavelength at peak emission		λ_{pk}	typ.	650	nm
Beamwidth between half-intensity directions		$\alpha_{50\%}$	typ.	80°	

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-53C.



RATINGS

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

Continuous reverse voltage	V_R	max.	3	V
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
Storage temperature	T_{stg}	–55 to +100		°C
Junction temperature	T_j	max.	100	°C
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

$T_j = 25\ ^oC$

Forward voltage $I_F = 20$ mA		V_F	typ. <	1,7 2,0	V V
Negative temperature coefficient of V_F $I_F = 20$ mA		$\frac{-\Delta V_F}{\Delta T_j}$	typ.	1,6	mV/°C
		$\frac{-\Delta V_F}{\Delta T_j}$	typ.	2	mV/°C
Reverse current $V_R = 3$ V		I_R	<	100	µA
Luminous intensity (on-axis) $I_F = 20$ mA	CQY54	I_v	>	0,3	mcd
	CQY54-I	I_v		0,7 to 1,6	mcd
	CQY54-II	I_v		1 to 2,2	mcd
	CQY54-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.	80°	

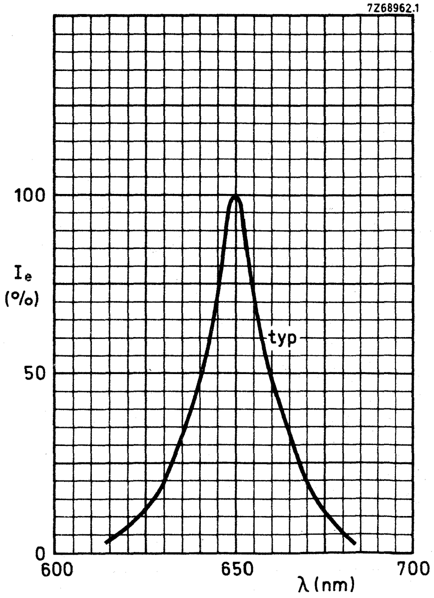
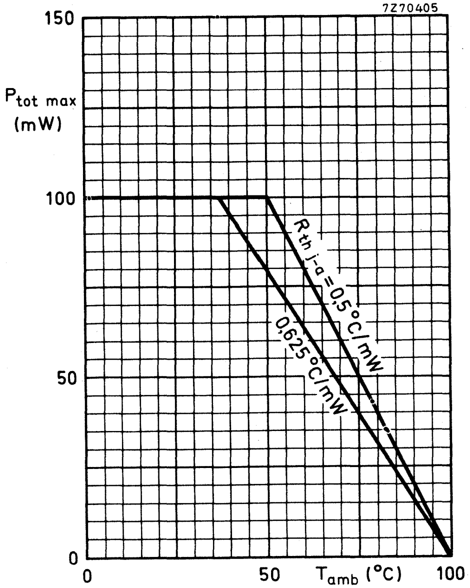
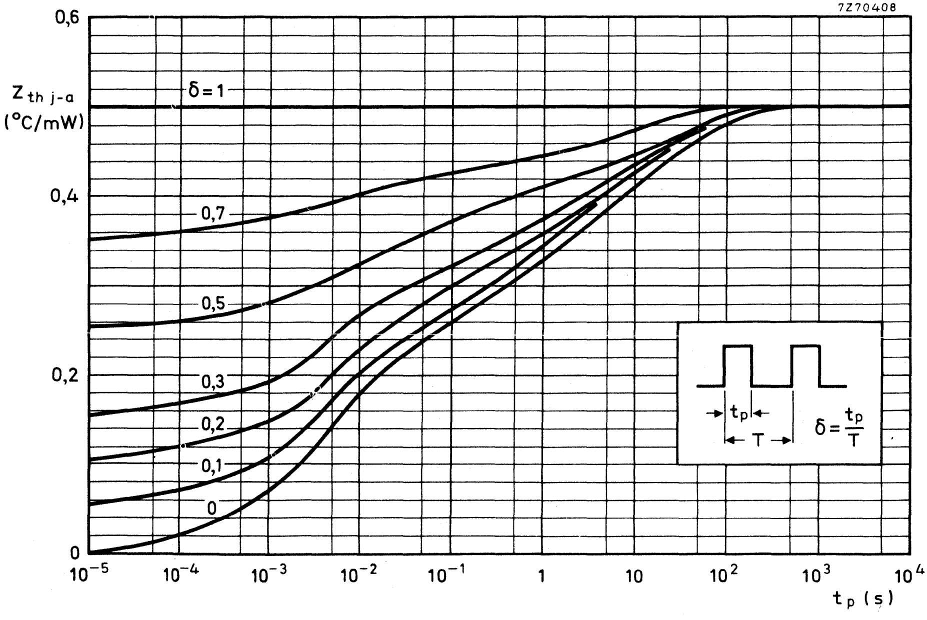
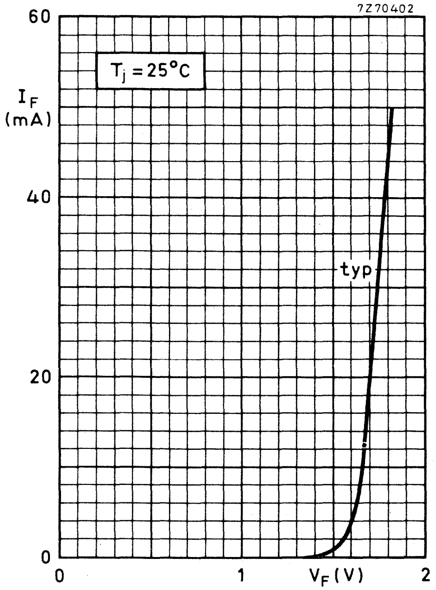
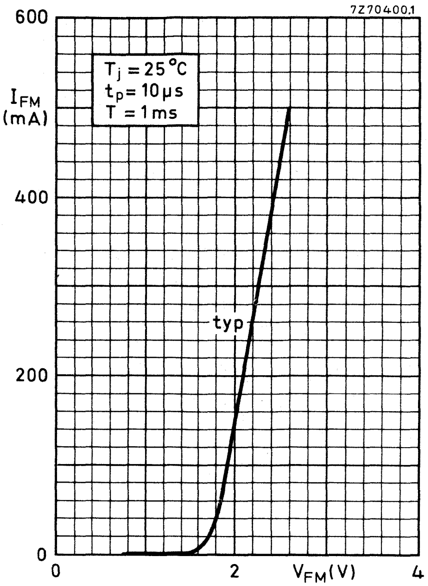


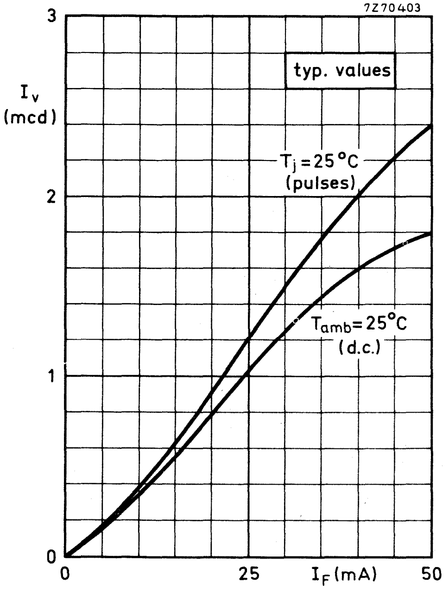
Fig. 2.

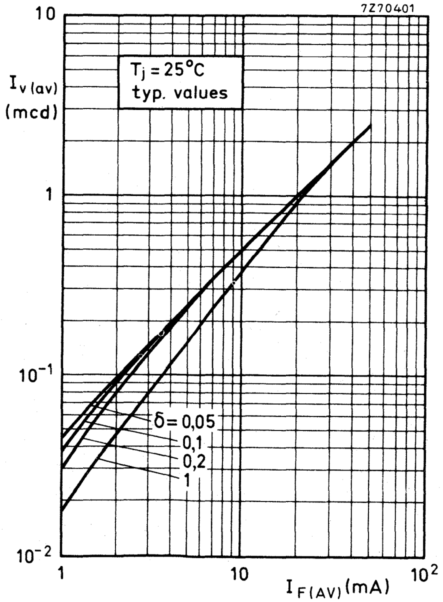

7Z70405
150
$P_{tot\ max}$
(mW)
100
50
0
0
50
T_{amb} (°C)
100
$R_{th\ j\text{-}a}$ = 0,5 °C/mW
0,625 °C/mW

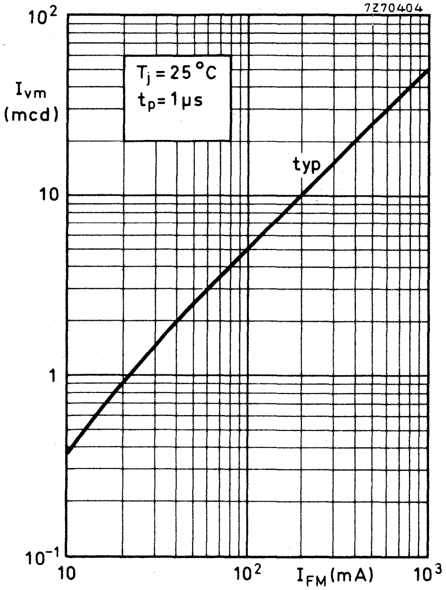

7Z70408
0,6
$Z_{th\ j\text{-}a}$
(°C/mW)
0,4
0,2
0
δ = 1
0,7
0,5
0,3
0,2
0,1
0
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
10^{3}
10^{4}
t_p (s)
t_p
T
$\delta = \frac{t_p}{T}$

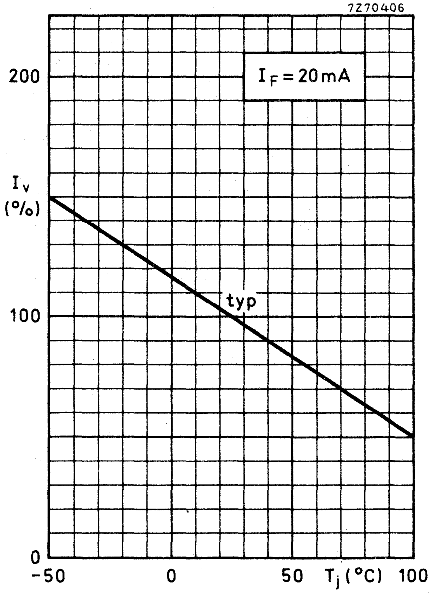

7Z70402
$T_j = 25\,°C$
I_F (mA)
60
40
20
0
typ
0
1
2
V_F (V)

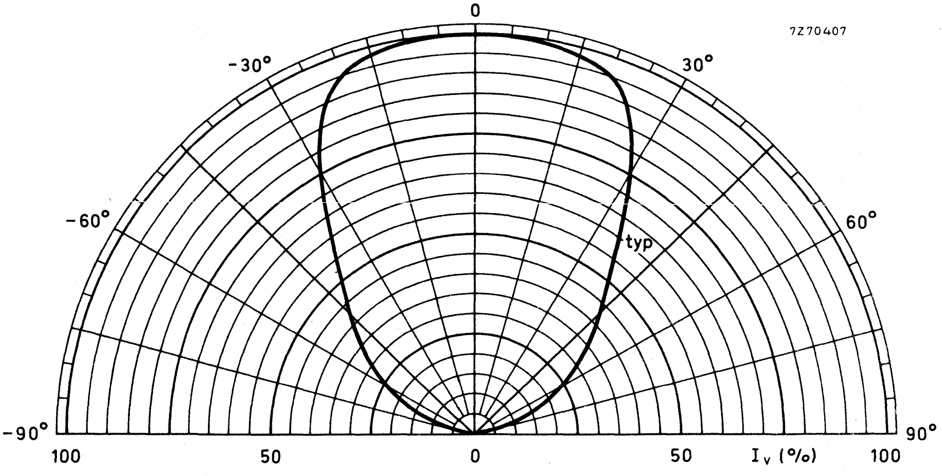

7Z70400.1
$T_j = 25\,°C$
$t_p = 10\,\mu s$
$T = 1\,ms$
I_{FM} (mA)
600
400
200
0
typ
0
2
4
V_{FM} (V)


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


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


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


7Z70406
$I_F = 20\,mA$
I_v (%)
typ
200
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

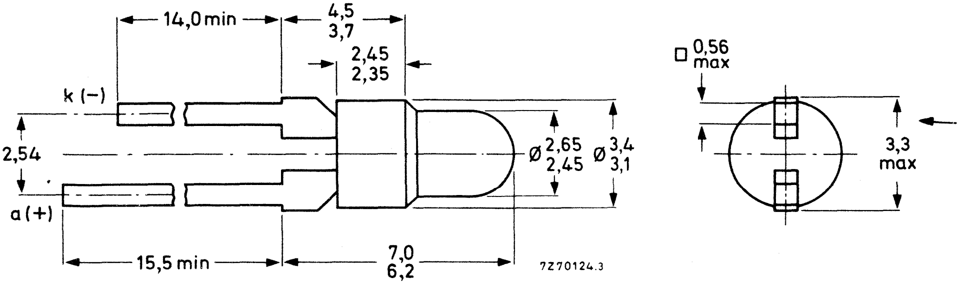
Diffused planar gallium arsenide light emitting diode intended for optical coupling and encoding. It emits radiation in the near infrared when forward biased. Red epoxy resin envelope with lens. Combination with phototransistor BPW22 is recommended.

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-53D



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) $t_p = 10\ \mu s$; $\delta = 0,01$	I_{FM}	max.	200	mA

Temperature

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

Power dissipation

Total power dissipation up to $T_{amb} = 25\ ^oC$, device mounted on printed-circuit board	P_{tot}	max.	75	mW

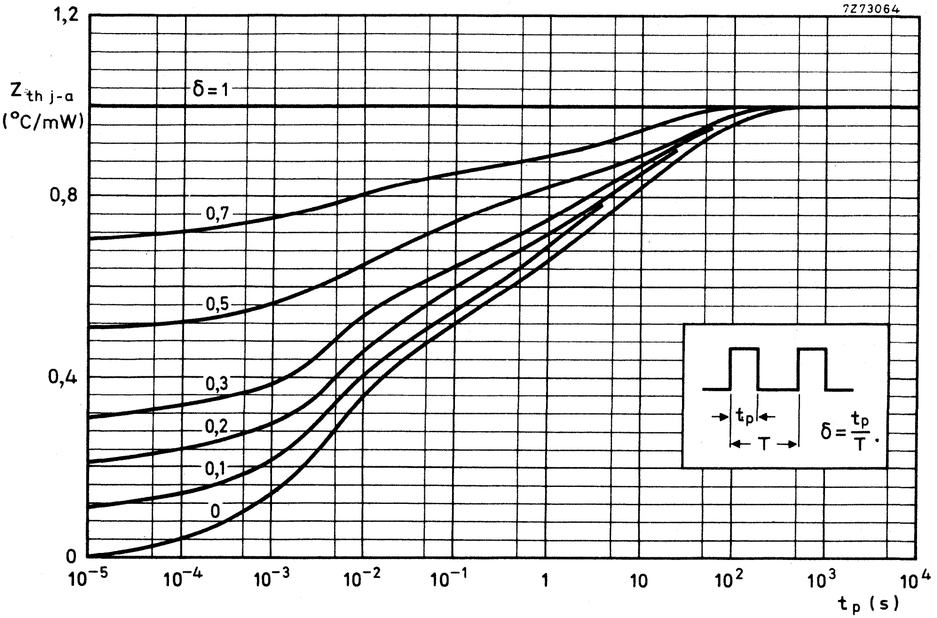
THERMAL RESISTANCE

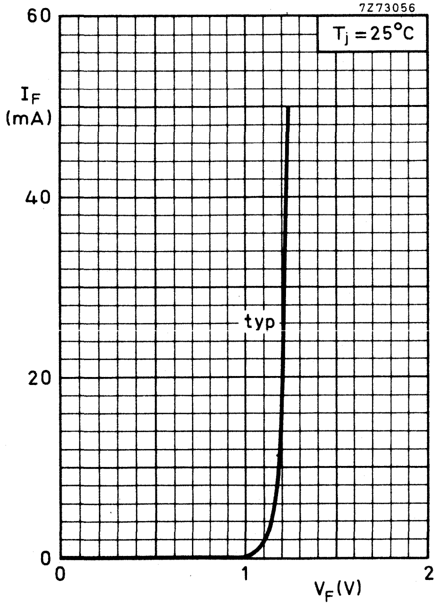
From junction to ambient, device mounted on printed-circuit board	$R_{th\ j\text{-}a}$	=	1	$^oC/mW$

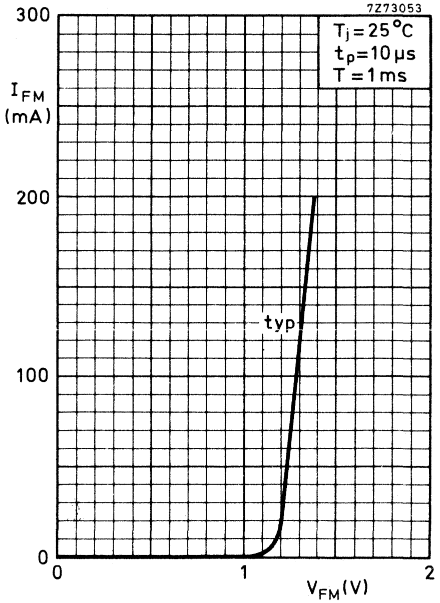
CHARACTERISTICS

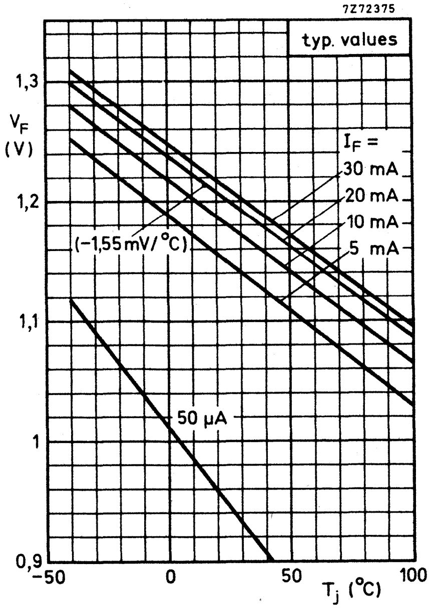
T_j = 25 °C unless otherwise specified

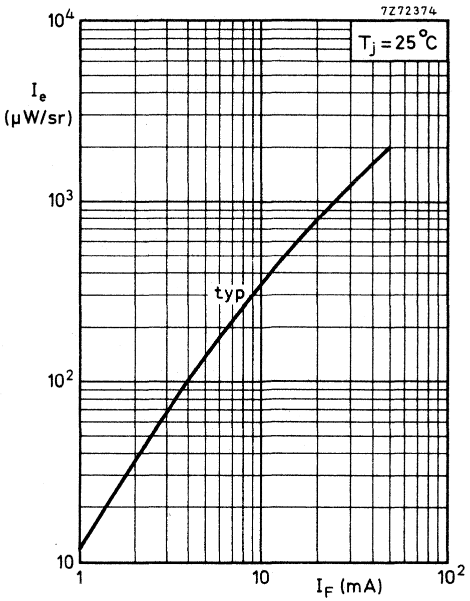
Forward voltage				
I_F = 20 mA	V_F	typ.	1,2	V
		<	1,5	V
Reverse current				
V_R = 2 V	I_R	<	100	µA
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	typ.	80	pF
Total radiant power				
I_F = 20 mA	ϕ_e	typ.	500	µW
Radiant intensity (on-axis)				
I_F = 20 mA	I_e	>	400	µW/sr
		typ.	800	µW/sr
Wavelength at peak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

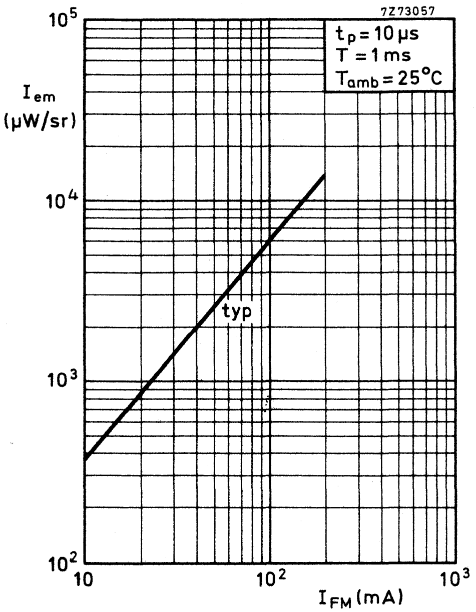

7Z73064
1,2
0,8
0,4
0
$Z_{th\ j-a}$
(°C/mW)
δ = 1
0,7
0,5
0,3
0,2
0,1
0
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
10^4
t_p (s)
t_p
T
$\delta = \frac{t_p}{T}$.

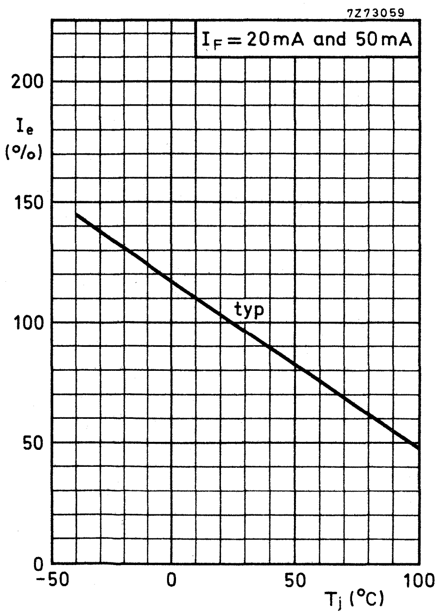

7Z73056
$T_j = 25°C$
60
40
20
0
I_F
(mA)
typ
0
1
2
V_F (V)

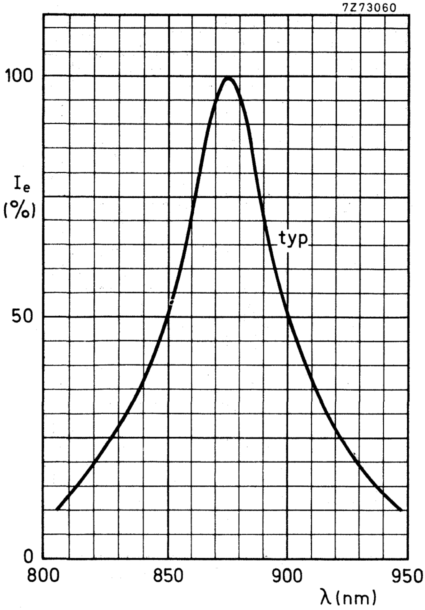

7Z73053
$T_j = 25°C$
$t_p = 10\ \mu s$
T = 1 ms
300
200
100
0
I_{FM}
(mA)
typ
0
1
2
V_{FM} (V)

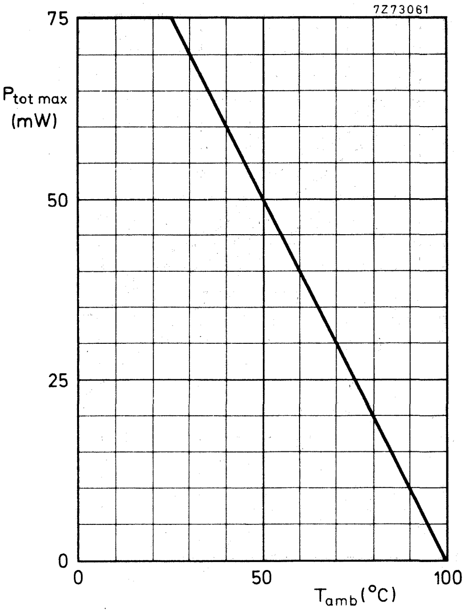

7Z72375
typ. values
V_F (V)
1,3
1,2
1,1
1
0,9
I_F =
30 mA
20 mA
10 mA
5 mA
(−1,55 mV/°C)
50 μA
−50
0
50
100
T_j (°C)

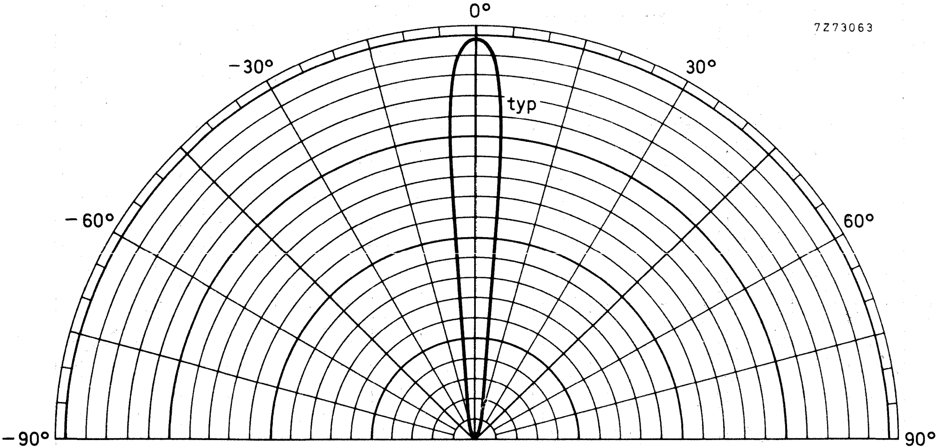

7Z72374
$T_j = 25$ °C
I_e (μW/sr)
10^4
10^3
10^2
10
typ
1
10
10^2
I_F (mA)

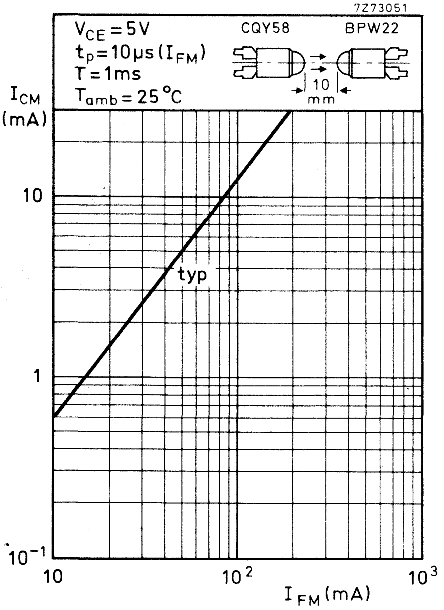

7Z73057
$t_p = 10$ μs
$T = 1$ ms
$T_{amb} = 25$ °C
I_{em} (μW/sr)
10^5
10^4
10^3
10^2
typ
10
10^2
10^3
I_{FM} (mA)

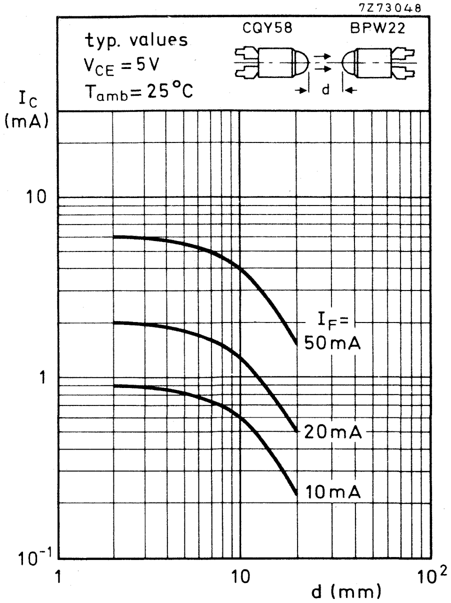

7Z73059
$I_F = 20$ mA and 50 mA
I_e (%)
200
150
100
50
0
typ
−50
0
50
100
T_j (°C)

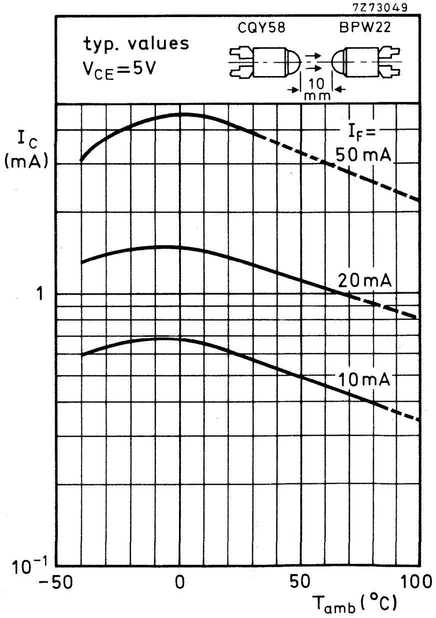

7Z73060
100
Ie
(%)
50
0
typ
800
850
900
950
λ (nm)


7Z73061
75
Ptot max
(mW)
50
25
0
0
50
100
Tamb (°C)


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


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


7Z73048
typ. values
$V_{CE} = 5V$
$T_{amb} = 25°C$
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
$V_{CE} = 5V$
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)

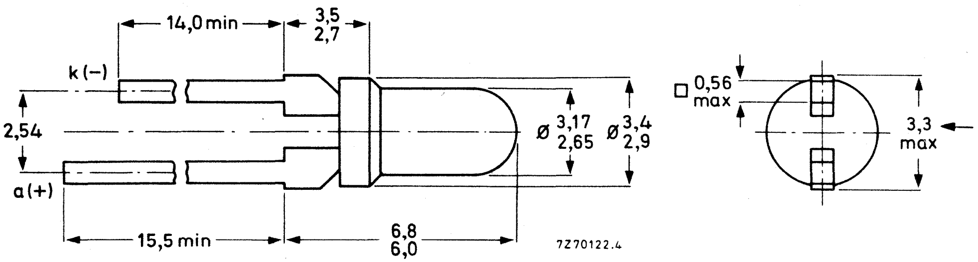
GaAsP RED LIGHT EMITTING DIODE

Gallium arsenide phosphide light emitting diode which emits visible red light when forward biased. The 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	$R_{th\ j-a}$	=	2	°C/mW

MECHANICAL DATA Dimensions in mm

SOD-53C



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

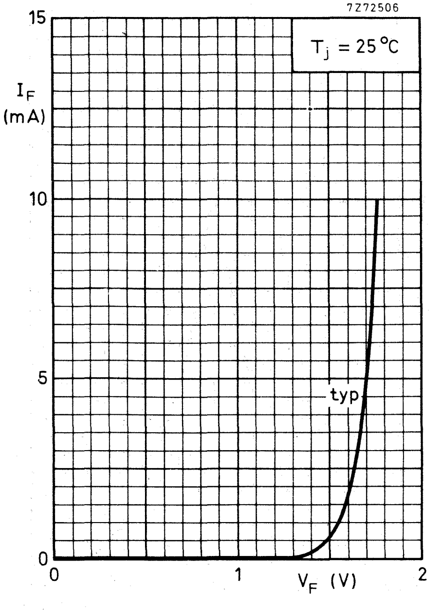
Diode capacitance

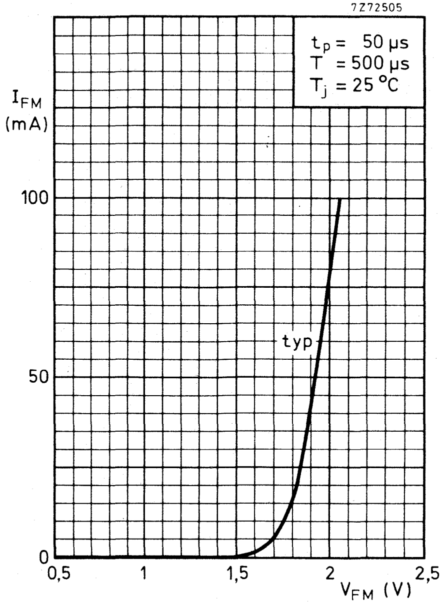
V_R = 0; f = 1 MHz	C_d	typ.	30	pF

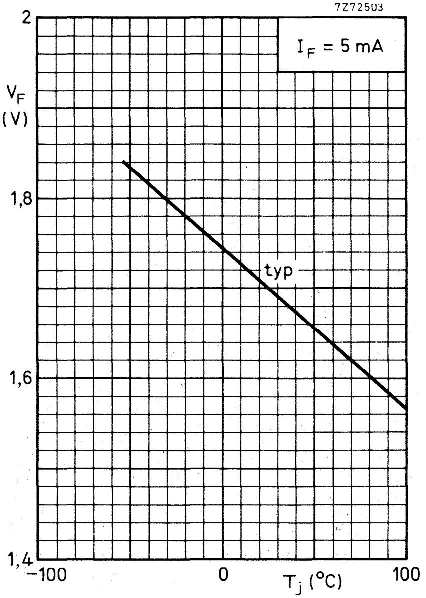
Luminous intensity (on-axis)

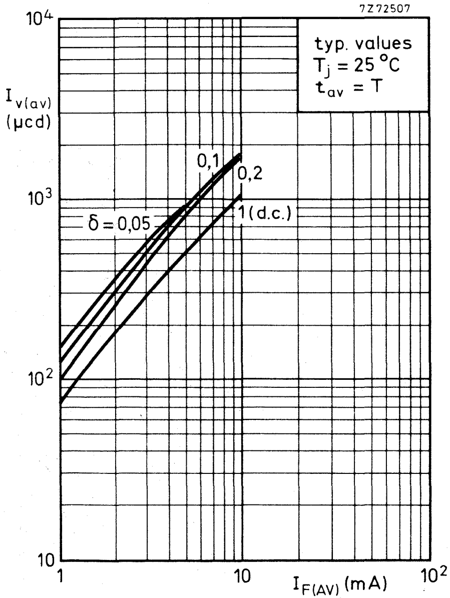
I_F = 5 mA	I_v	>	0,3	mcd
		typ.	0,5	mcd

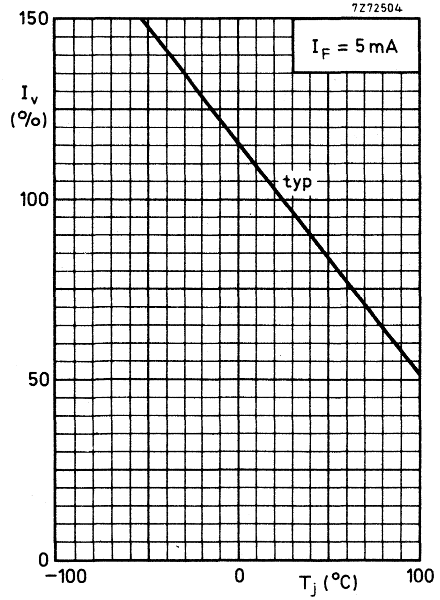
Wavelength at peak emission	λ_{pk}	typ.	650	nm
Bandwidth at half height	$B_{50\%}$	typ.	20	nm
Beamwidth between half-intensity directions	$\alpha_{50\%}$	typ.	50°	

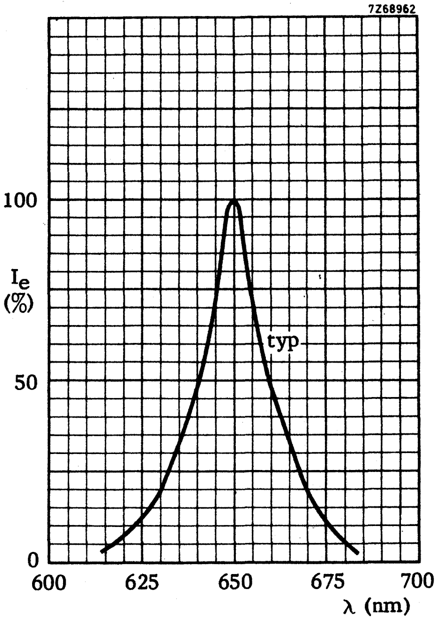

7Z72506
T_j = 25 °C
I_F (mA)
15
10
5
0
typ
0
1
2
V_F (V)

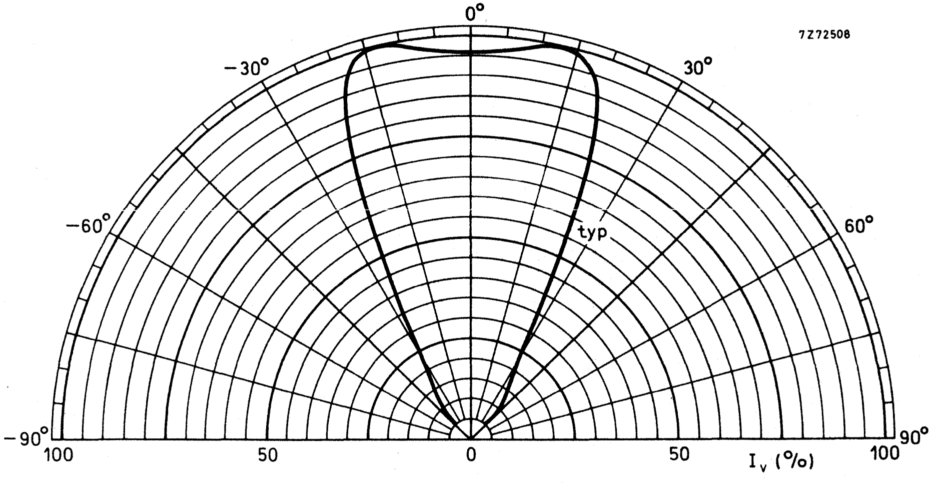

7Z72505
t_p = 50 μs
T = 500 μs
T_j = 25 °C
I_{FM} (mA)
100
50
0
typ
0,5
1
1,5
2
2,5
V_{FM} (V)


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 (%)

GaAs LIGHT EMITTING DIODE

Epitaxial gallium arsenide light emitting diode intended for remote-control applications. It emits radiation in the near infrared when forward biased. Clear epoxy encapsulation.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	5	V
Forward current (d.c.)	I_F	max.	130	mA
Junction temperature	T_j	max.	100	°C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	215	mW
Radiant intensity (on-axis) at I_F = 100 mA	I_e	>	7	mW/sr
Wavelength at peak emission	λ_{pk}	typ.	930	nm

MECHANICAL DATA

Dimensions in mm

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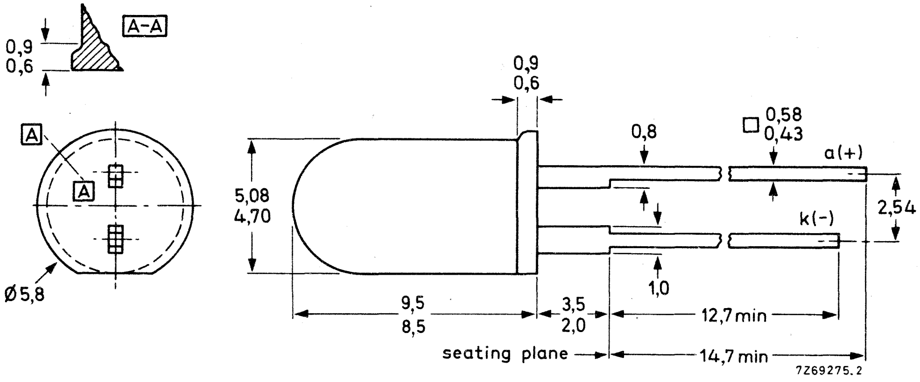


RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage				
Continuous reverse voltage	V_R	max.	5	V
Current				
Forward current (d. c.)	I_F	max.	130	mA
Forward current (peak value) $t_p \leq 50\ \mu s$; $\delta = 0,05$	I_{FM}	max.	1000	mA
Non-repetitive peak forward current ($t_p \leq 10\ \mu s$)	I_{FSM}	max.	2500	mA
Power dissipation				
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	215	mW
Temperatures				
Storage temperature	T_{stg}	-55 to +100		^oC
Junction temperature	T_j	max.	100	^oC
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260	^oC

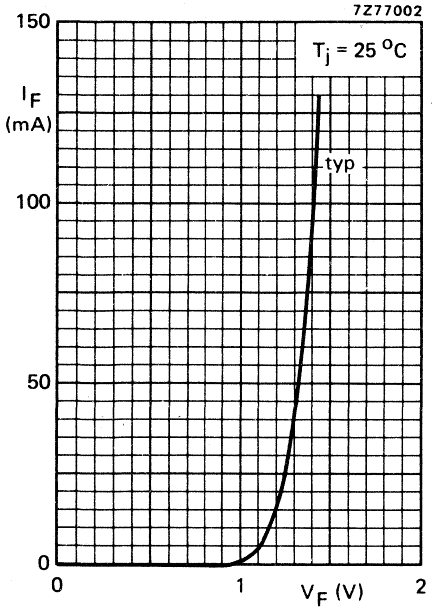
THERMAL RESISTANCE

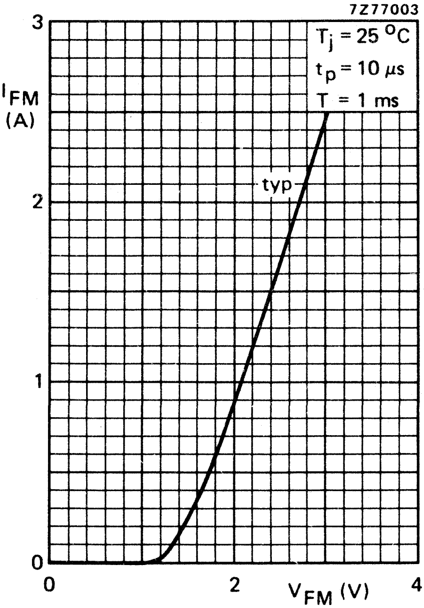
From junction to ambient mounted on a printed-circuit board	$R_{th\ j\text{-}a}$	=	0, 35	$^oC/mW$

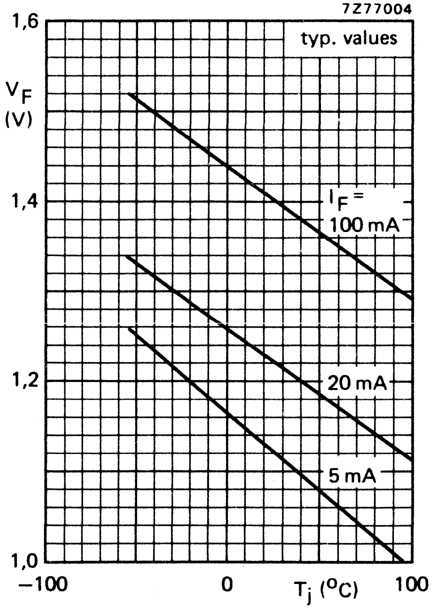
CHARACTERISTICS

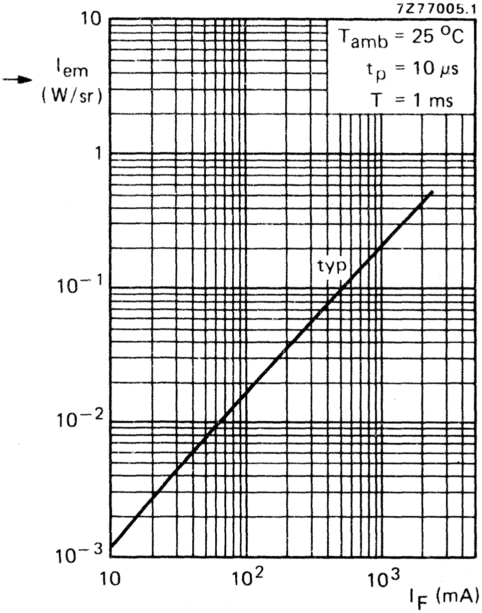
T_j = 25 °C unless otherwise specified

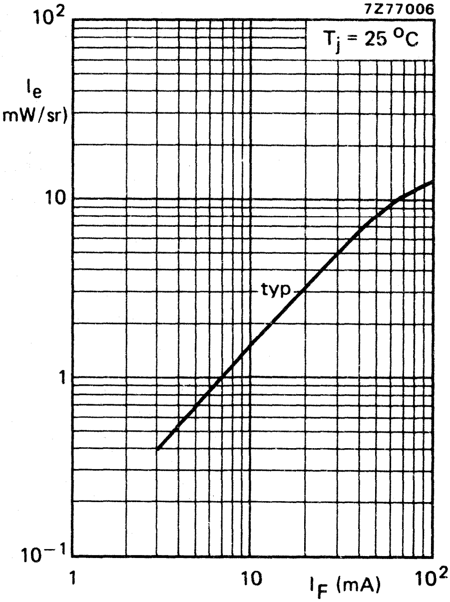
Forward voltage				
I_F = 100 mA	V_F	typ. <	1,4 1,6	V V
I_{FM} = 1500 mA; t_p = 20 µs; δ = 0,033	V_{FM}	typ.	2,4	V
Reverse current				
V_R = 5 V	I_R	<	100	µA
Diode capacitance				
V_R = 0: f = 1 MHz	C_d	typ.	40	pF
Total radiant power				
I_F = 100 mA	ϕ_e	> typ.	5 8	mW mW
Decrease of radiant power with temperature				
I_F = 100 mA	$\frac{\Delta\phi_e}{\Delta T_j}$	typ.	1	%/°C
Radiant intensity (on-axis)				
I_F = 100 mA	I_e	> typ.	7 12	mW/sr mW/sr
Wavelength at peak emission				
I_F = 100 mA	λ_{pk}	typ.	930	nm
Bandwidth at half height				
I_F = 100 mA	$B_{50\%}$	typ.	50	nm
Beamwidth between half-intensity directions				
I_F = 100 mA	$\alpha_{50\%}$	typ.	30°	

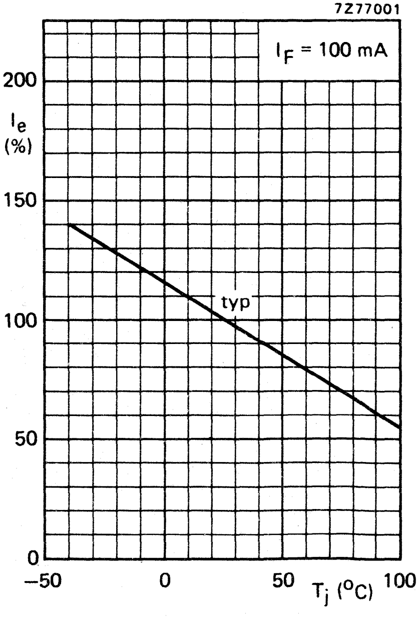

7Z77002
T_j = 25 °C
I_F (mA)
150
100
50
0
typ
0
1
2
V_F (V)

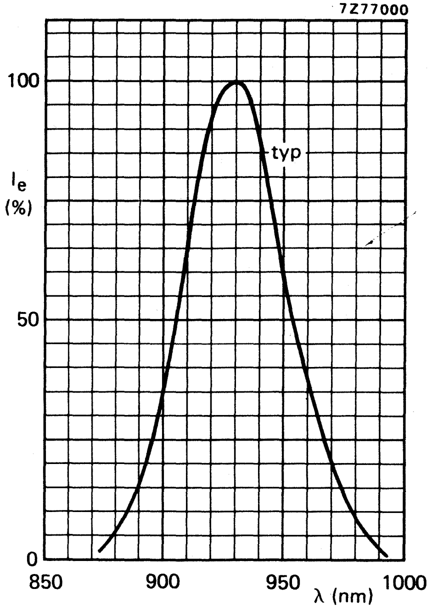

7Z77003
T_j = 25 °C
t_p = 10 μs
T = 1 ms
I_{FM} (A)
3
2
1
0
typ
0
2
4
V_{FM} (V)

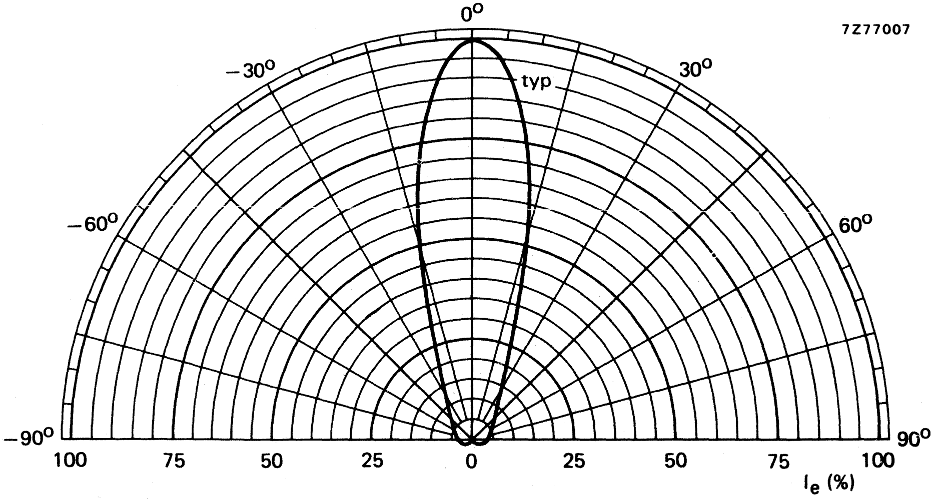

7Z77004
typ. values
V_F (V)
1,6
1,4
1,2
1,0
I_F = 100 mA
20 mA
5 mA
−100
0
100
T_j (°C)


7Z77005.1
Iem (W/sr)
10
1
10⁻¹
10⁻²
10⁻³
Tamb = 25 °C
tp = 10 μs
T = 1 ms
typ
10
10²
10³
IF (mA)


7Z77006
Ie mW/sr)
10²
10
1
10⁻¹
Tj = 25 °C
typ
1
10
IF (mA)
10²


7Z77001
Ie (%)
200
150
100
50
0
IF = 100 mA
typ
−50
0
50
Tj (°C)
100


7Z77000
100
50
0
I_e
(%)
typ
850
900
950
1000
λ (nm)


7Z77007
0°
−30°
30°
−60°
60°
−90°
90°
typ
100
75
50
25
0
25
50
75
100
I_e (%)

GaP GREEN LIGHT EMITTING DIODE

Gallium phosphide light emitting diode which emits green light when forward biased. Green, light-diffusing plastic envelope.

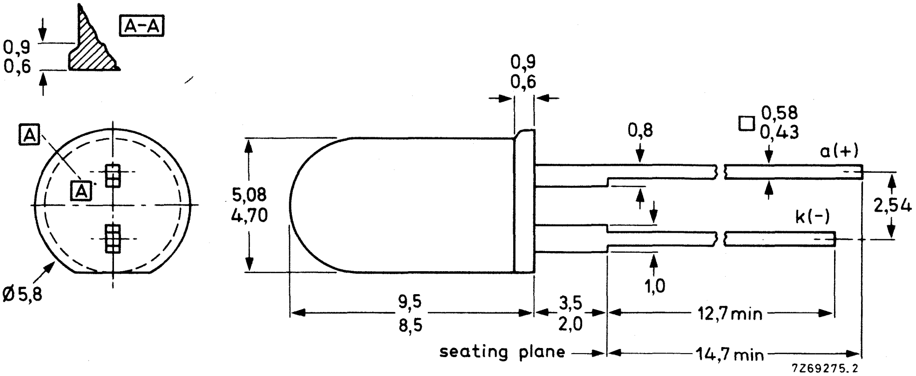
QUICK REFERENCE DATA

Continuous reverse voltage		V_R	max.	3	V
Forward current (d.c.)		I_F	max.	20	mA
Total power dissipation up to T_{amb} = 55 °C		P_{tot}	max.	60	mW
Luminous intensity (on-axis) at I_F = 10 mA	CQY94	I_v	>	0,3	mcd
	CQY94-I	I_v	0,7 to	1,6	mcd
	CQY94-II	I_v	1,0 to	2,2	mcd
	CQY94-III	I_v	>	1,6	mcd
Wavelength at peak emission		λ_{pk}	typ.	560	nm
Beamwidth between half-intensity directions		$\alpha_{50\%}$	typ.	60°	

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-63.



RATINGS

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

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	20	mA
Forward current (peak value)				
$t_p < 1$ ms; $f < 300$ Hz	I_{FM}	max.	60	mA
$t_p < 1$ μs ; $f < 300$ Hz	I_{FM}	max.	1000	mA
Total power dissipation up to $T_{amb} = 55$ °C	P_{tot}	max.	60	mW
Storage temperature	T_{stg}	max.	100	°C
Junction temperature	T_j		−55 to + 100	°C
Lead soldering temperature				
$>$ 1,5 mm from the seating plane; $t_{sld} < 7$ s	T_{sld}	max.	230	°C

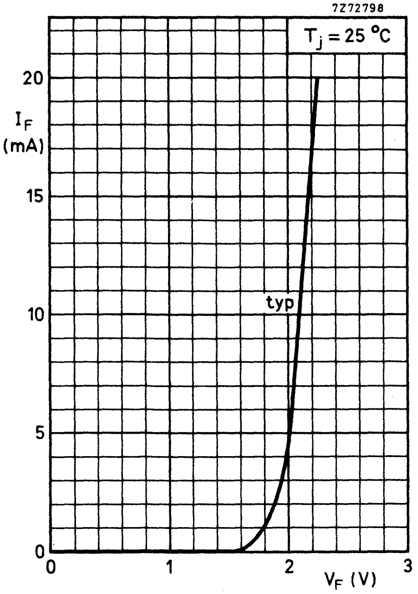
THERMAL RESISTANCE

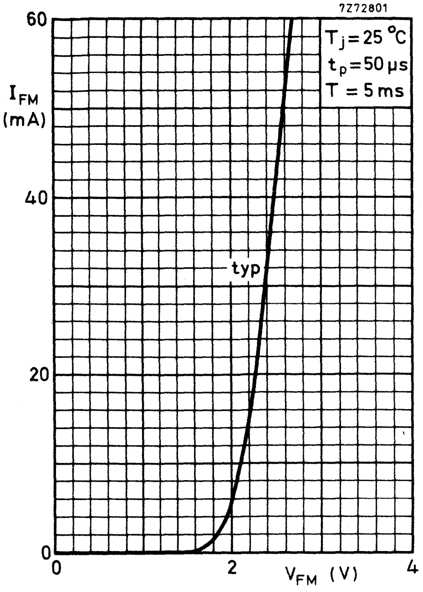
From junction to ambient				
in free air	$R_{th\ j\text{-}a}$	=	0,75	°C/mW
mounted on a printed-circuit board	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

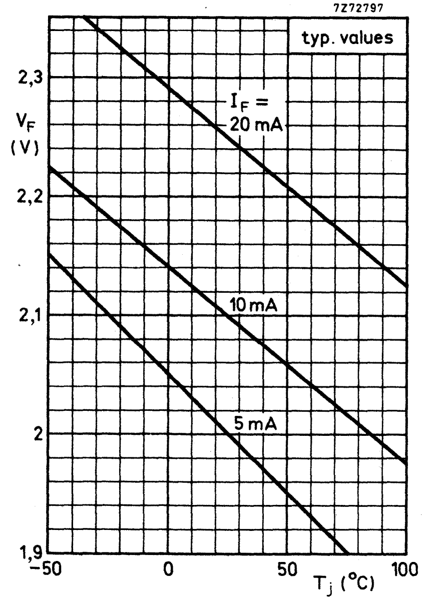
CHARACTERISTICS

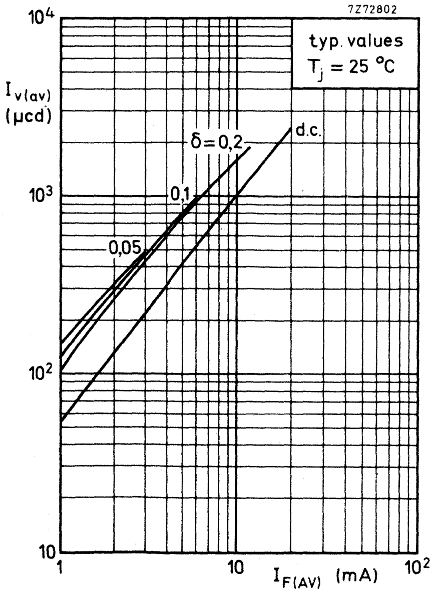
$T_j = 25$ °C unless otherwise specified

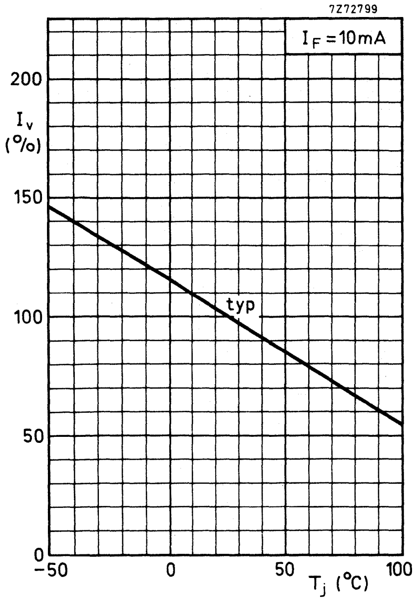
Forward voltage					
$I_F = 10$ mA		V_F	typ.	2,1	V
			$<$	3	V
Reverse current					
$V_R = 3$ V		I_R	$<$	100	μA
Diode capacitance					
$V_R = 0$; $f = 1$ MHz		C_d	typ.	35	pF
Luminous intensity (on-axis)					
$I_F = 10$ mA	CQY94	I_v	$>$	0,3	mcd
	CQY94-I	I_v		0,7 to 1,6	mcd
	CQY94-II	I_v		1,0 to 2,2	mcd
	CQY94-III	I_v	$>$	1,6	mcd
Wavelength at peak emission		λ_{pk}	typ.	560	nm
Bandwidth at half height		$B_{50\%}$	typ.	30	nm
Beamwidth between half-intensity directions		$\alpha_{50\%}$	typ.	60°	

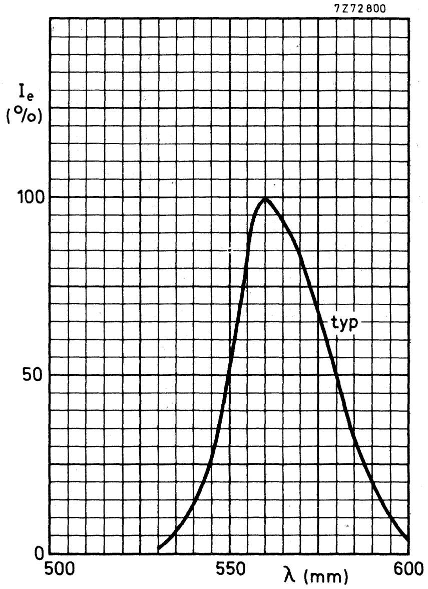

7Z72798
$T_j = 25$ °C
I_F (mA)
0
5
10
15
20
typ
0
1
2
3
V_F (V)

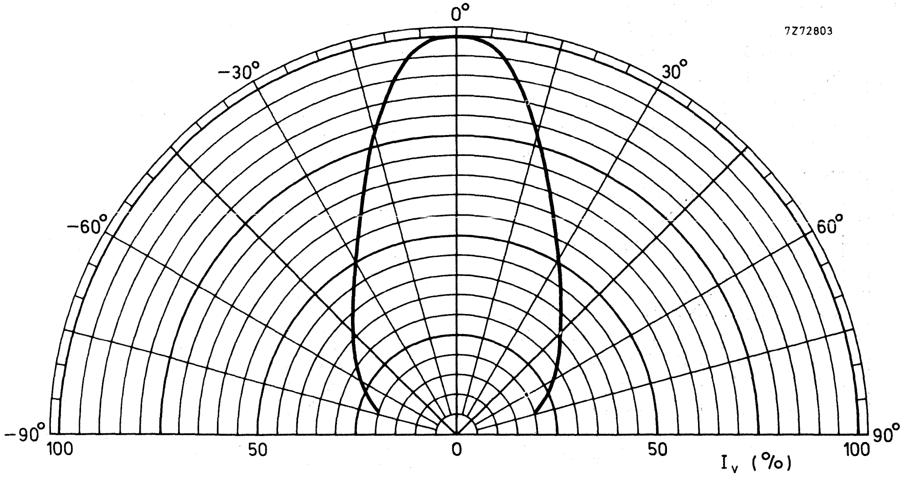

7Z72801
$T_j = 25$ °C
$t_p = 50$ μs
T = 5 ms
I_{FM} (mA)
0
20
40
60
typ
0
2
4
V_{FM} (V)


7Z72797
typ. values
V_F (V)
1,9
2
2,1
2,2
2,3
I_F = 20 mA
10 mA
5 mA
−50
0
50
100
T_j (°C)


7Z72802
typ. values
$T_j = 25$ °C
$I_{v(av)}$ (μcd)
10
10^2
10^3
10^4
δ = 0,2
0,1
0,05
d.c.
1
10
10^2
$I_{F(AV)}$ (mA)


7Z72799
I_F = 10mA
I_v
(%)
200
150
100
50
0
typ
−50
0
50
100
T_j (°C)


7Z72800
I_e
(%)
100
50
0
typ
500
550
600
λ (mm)


0°
7Z72803
−30°
30°
−60°
60°
−90°
90°
100
50
0
50
100
I_v (%)

GaP GREEN LIGHT EMITTING DIODE

Gallium phosphide light emitting diode which emits green light when forward biased. Green, light-diffusing plastic envelope.

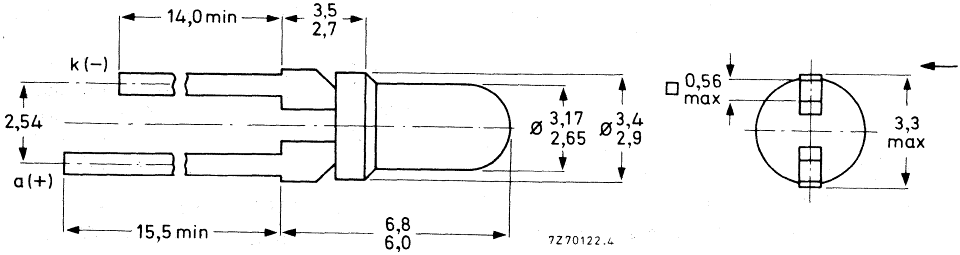
QUICK REFERENCE DATA

Continuous reverse voltage		V_R	max.	3	V
Forward current (d.c.)		I_F	max.	20	mA
Total power dissipation up to T_{amb} = 55 °C		P_{tot}	max.	60	mW
Luminous intensity (on-axis) at I_F = 10 mA	CQY95	I_V	>	0,3	mcd
	CQY95-I	I_V	0,7 to	1,6	mcd
	CQY95-II	I_V	1,0 to	2,2	mcd
	CQY95-III	I_V	>	1,6	mcd
Wavelength at peak emission		λ_{pk}	typ.	560	nm
Beamwidth between half-intensity directions		$\alpha_{50\%}$	typ.	60°	

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-53C.



RATINGS

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

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	20	mA
Forward current (peak value)				
$t_p < 1$ ms; $f < 300$ Hz	I_{FM}	max.	60	mA
$t_p < 1$ µs ; $f < 300$ Hz	I_{FM}	max.	1000	mA
Total power dissipation up to $T_{amb} = 55$ °C	P_{tot}	max.	60	mW
Storage temperature	T_{stg}	−55 to + 100		°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature				
> 3 mm from the seating plane; $t_{sld} < 7$ s	T_{sld}	max.	230	°C

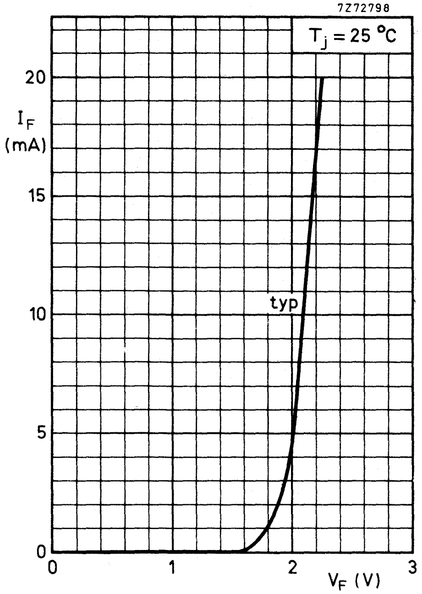
THERMAL RESISTANCE

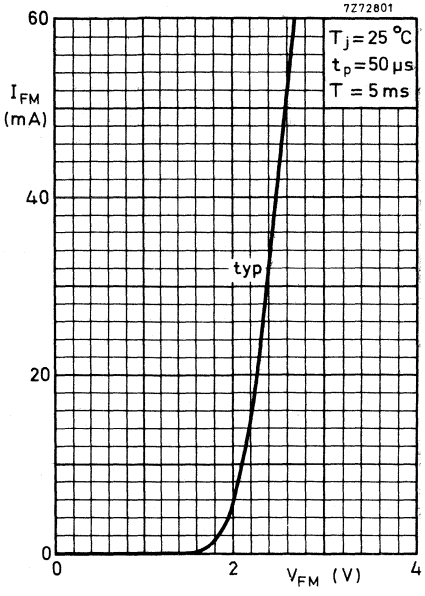
From junction to ambient				
in free air	$R_{th\ j\text{-}a}$	=	0,75	°C/mW
mounted on a printed-circuit board	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

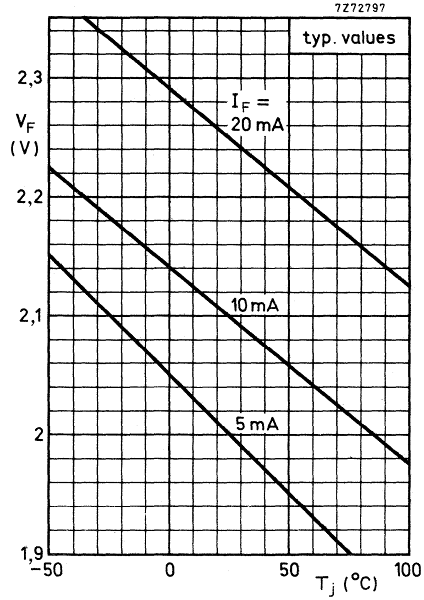
CHARACTERISTICS

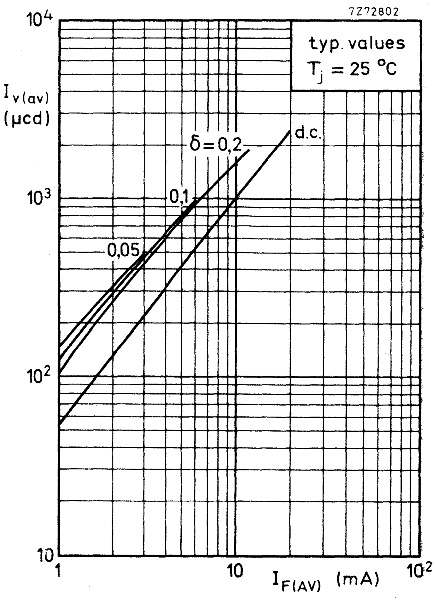
$T_j = 25$ °C unless otherwise specified

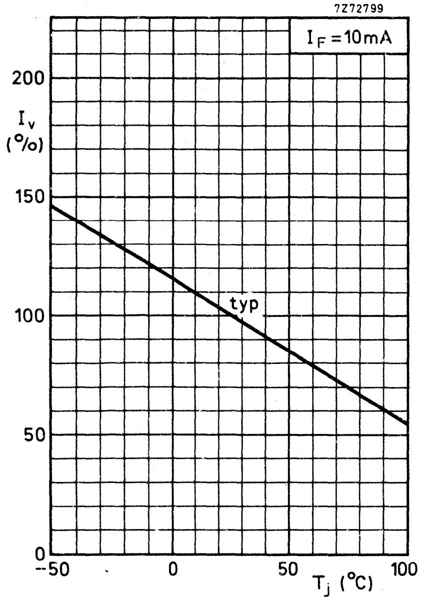
Forward voltage					
$I_F = 10$ mA		V_F	typ. <	2,1 3	V V
Reverse current					
$V_R = 3$ V		I_R	<	100	µA
Diode capacitance					
$V_R = 0$; $f = 1$ MHz		C_d	typ.	35	pF
→ Luminous intensity (on-axis)					
$I_F = 10$ mA	CQY95	I_v	>	0,3	mcd
	CQY95-I	I_v		0,7 to 1,6	mcd
	CQY95-II	I_v		1,0 to 2,2	mcd
	CQY95-III	I_v	>	1,6	mcd
Wavelength at peak emission		λ_{pk}	typ.	560	nm
Bandwidth at half height		$B_{50\%}$	typ.	30	nm
Beamwidth between half-intensity directions		$\alpha_{50\%}$	typ.	60°	

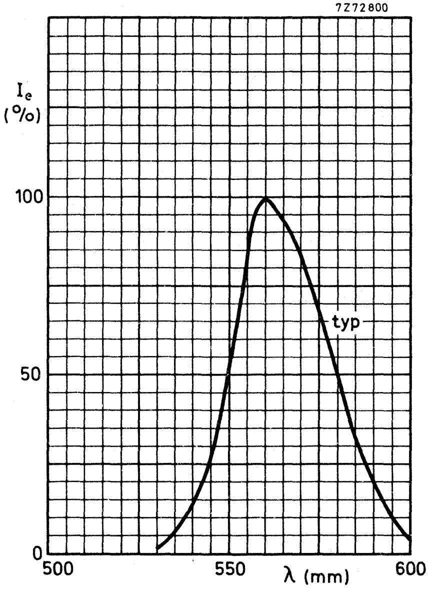

7Z72798
$T_j = 25$ °C
I_F (mA)
20
15
10
5
0
typ
0
1
2
3
V_F (V)

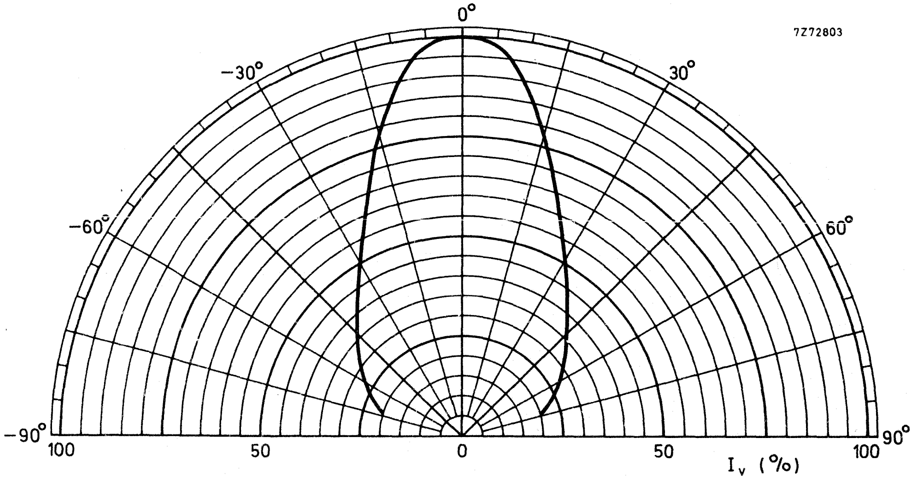

7Z72801
$T_j = 25$ °C
$t_p = 50$ µs
$T = 5$ ms
I_{FM} (mA)
60
40
20
0
typ
0
2
4
V_{FM} (V)


7Z72797
typ. values
V_F (V)
2,3
2,2
2,1
2
1,9
$I_F =$ 20 mA
10 mA
5 mA
−50
0
50
100
T_j (°C)


7Z72802
typ. values
$T_j = 25$ °C
$I_{v(av)}$ (µcd)
10^4
10^3
10^2
10
δ = 0,2
0,1
0,05
d.c.
1
10
10^2
$I_{F(AV)}$ (mA)


7Z72799
$I_F = 10$ mA
200
I_v (%)
150
100
50
0
typ
−50
0
50
100
T_j (°C)


7Z72800
I_e (%)
100
50
0
typ
500
550
600
λ (mm)


7Z72803
0°
−30°
30°
−60°
60°
−90°
90°
100
50
0
50
100
I_v (%)

GaAsP YELLOW LIGHT EMITTING DIODE

Gallium arsenide phosphide light emitting diode which emits yellow light when forward biased. Yellow, light-diffusing plastic envelope.

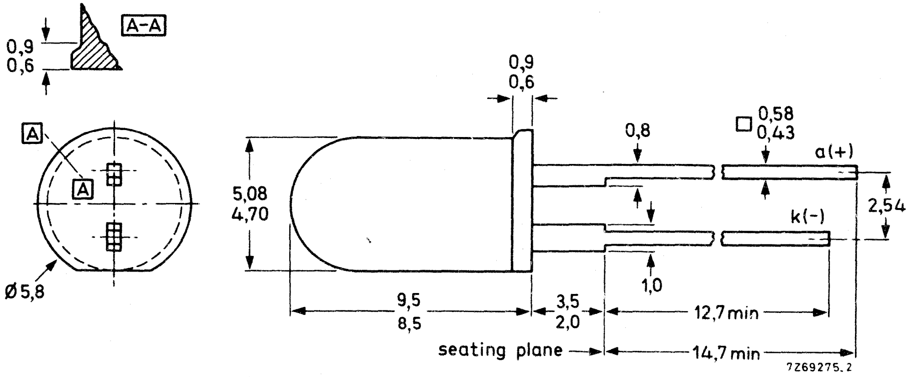
QUICK REFERENCE DATA

Continuous reverse voltage		V_R	max.	3	V
Forward current (d.c.)		I_F	max.	20	mA
Total power dissipation up to T_{amb} = 55 °C		P_{tot}	max.	60	mW
Luminous intensity (on-axis) at I_F = 10 mA	CQY96	I_v	>	0,5	mcd
	CQY96-I	I_v	0,7 to	1,6	mcd
	CQY96-II	I_v	1,0 to	2,2	mcd
	CQY96-III	I_v	>	1,6	mcd
Wavelength at peak emission		λ_{pk}	typ.	590	nm
Beamwidth between half-intensity directions		$\alpha_{50\%}$	typ.	60°	

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-63.



RATINGS

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

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	20	mA
Forward current (peak value)				
$t_p < 1$ ms; $f < 300$ Hz	I_{FM}	max.	60	mA
$t_p < 1$ μs ; $f < 300$ Hz	I_{FM}	max.	1000	mA
Total power dissipation up to $T_{amb} = 55$ °C	P_{tot}	max.	60	mW
Storage temperature	T_{stg}	−55 to + 100		°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature				
$> 1,5$ mm from the seating plane; $t_{sld} < 7$ s	T_{sld}	max.	230	°C

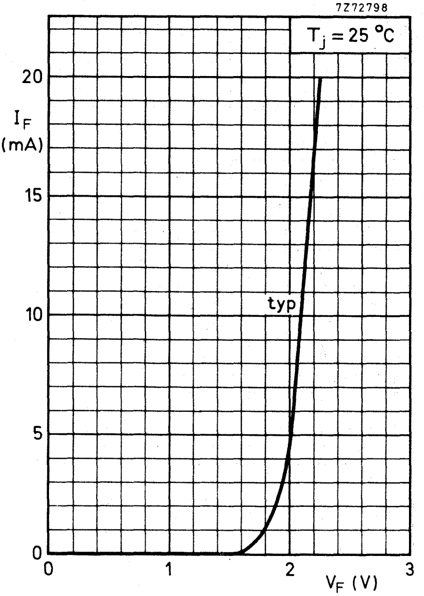
THERMAL RESISTANCE

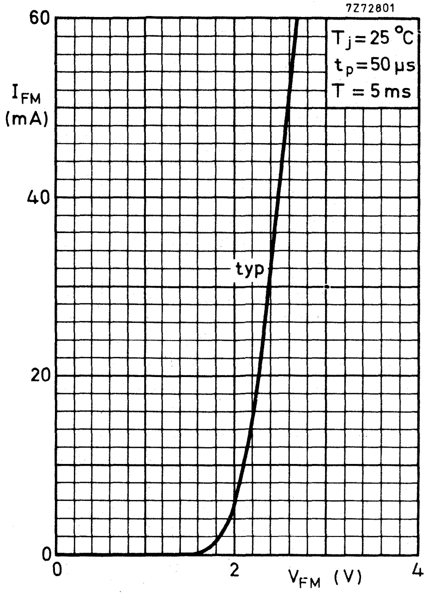
From junction to ambient				
in free air	$R_{th\ j\text{-}a}$	=	0,75	°C/mW
mounted on a printed board	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

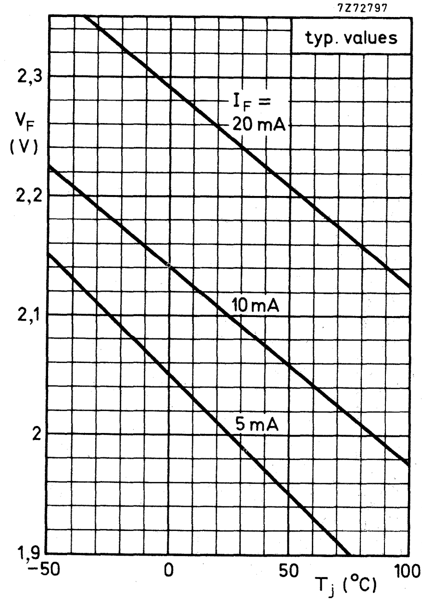
CHARACTERISTICS

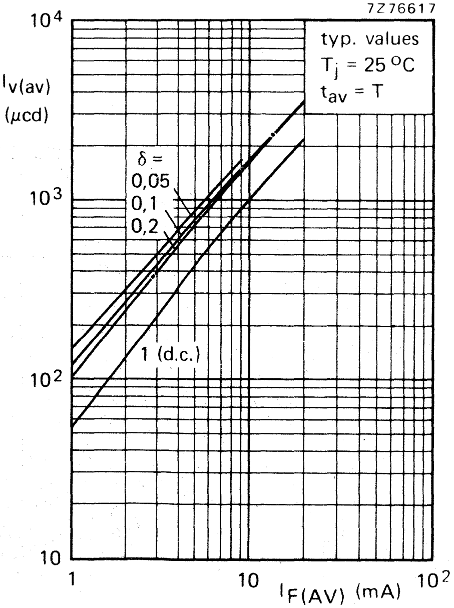
$T_j = 25$ °C unless otherwise specified

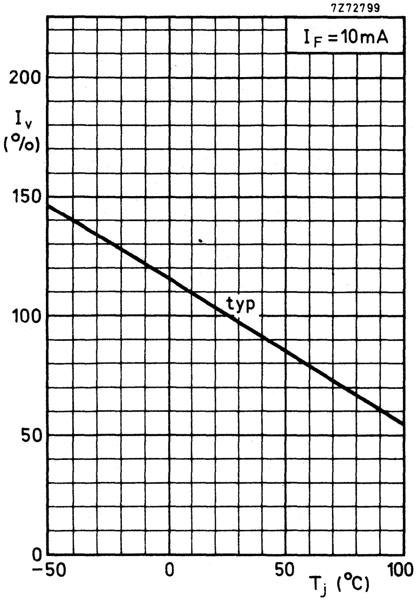
Forward voltage					
$I_F = 10$ mA		V_F	typ. <	2,1 3	V V
Reverse current					
$V_R = 3$ V		I_R	<	100	μA
Diode capacitance					
$V_R = 0$; $f = 1$ MHz		C_d	typ.	35	pF
Luminous intensity (on-axis)					
$I_F = 10$ mA	CQY96	I_v	>	0,5	mcd
	CQY96-I	I_v		0,7 to 1,6	mcd
	CQY96-II	I_v		1,0 to 2,2	mcd
	CQY96-III	I_v	>	1,6	mcd
Wavelength at peak emission		λ_{pk}	typ.	590	nm
Bandwidth at half height		$B_{50\%}$	typ.	38	nm
Beamwidth between half-intensity directions		$\alpha_{50\%}$	typ.	60°	

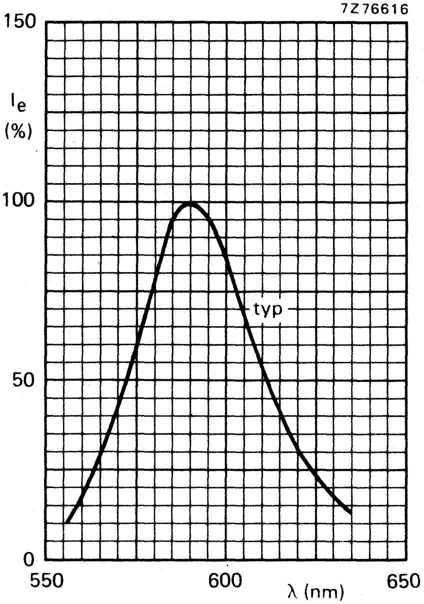

7Z72798
Tj = 25 °C
IF (mA)
20
15
10
5
0
typ
0
1
2
3
VF (V)

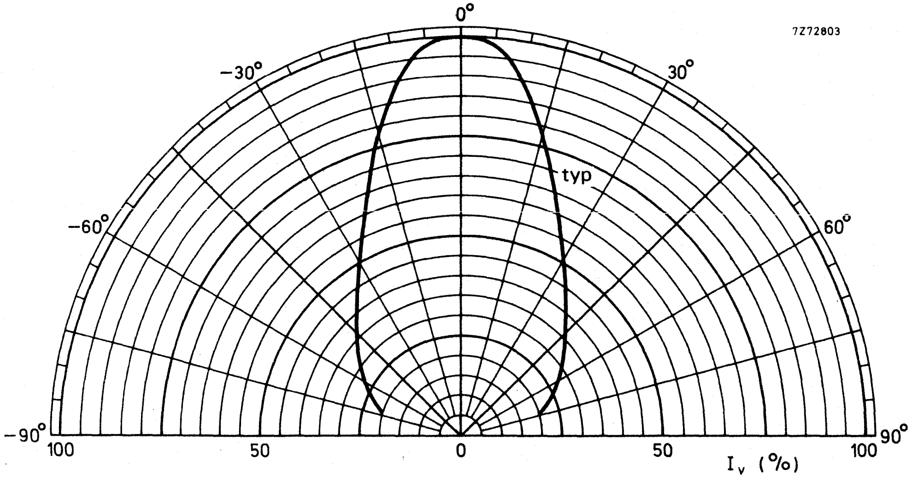

7Z72801
Tj = 25 °C
tp = 50 µs
T = 5 ms
IFM (mA)
60
40
20
0
typ
0
2
4
VFM (V)


7Z72797
typ. values
VF (V)
2,3
2,2
2,1
2
1,9
IF = 20 mA
10 mA
5 mA
−50
0
50
100
Tj (°C)


7Z76617
typ. values
Tj = 25 °C
tav = T
Iv(av) (µcd)
10^4
10^3
10^2
10
δ =
0,05
0,1
0,2
1 (d.c.)
1
10
10^2
IF(AV) (mA)


7Z72799
I_F = 10mA
I_v
(%)
200
150
100
50
0
typ
−50
0
50
100
T_j (°C)


7Z76616
150
I_e
(%)
100
50
0
typ
550
600
650
λ (nm)


0°
7Z72803
−30°
30°
typ
−60°
60°
−90°
90°
100
50
0
50
100
I_v (%)

GaAsP YELLOW LIGHT EMITTING DIODE

Gallium arsenide phosphide light emitting diode which emits yellow light when forward biased.
Yellow, light-diffusing plastic envelope.

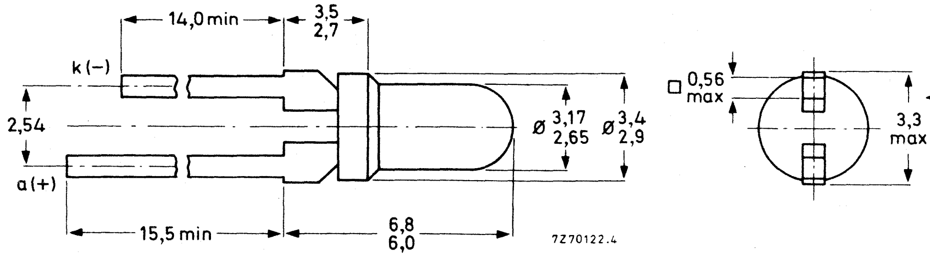
QUICK REFERENCE DATA

Continuous reverse voltage		V_R	max.	3	V
Forward current (d.c.)		I_F	max.	20	mA
Total power dissipation up to T_{amb} = 55 °C		P_{tot}	max.	60	mW
Luminous intensity (on-axis) at I_F = 10 mA	CQY97	I_v	$>$	0,3	mcd
	CQY97-I	I_v	0,7 to	1,6	mcd
	CQY97-II	I_v	1,0 to	2,2	mcd
	CQY97-III	I_v	$>$	1,6	mcd
Wavelength at peak emission		λ_{pk}	typ.	590	nm
Beamwidth between half-intensity directions		$\alpha_{50\%}$	typ.	60°	

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-53C.



RATINGS

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

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	20	mA
Forward current (peak value)				
$t_p < 1$ ms; $f < 300$ Hz	I_{FM}	max.	60	mA
$t_p < 1$ μs ; $f < 300$ Hz	I_{FM}	max.	1000	mA
Total power dissipation up to $T_{amb} = 55$ °C	P_{tot}	max.	60	mW
Storage temperature	T_{stg}		−55 to + 100	°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature > 3 mm from the seating plane; $t_{sld} < 7$ s	T_{sld}	max.	230	°C

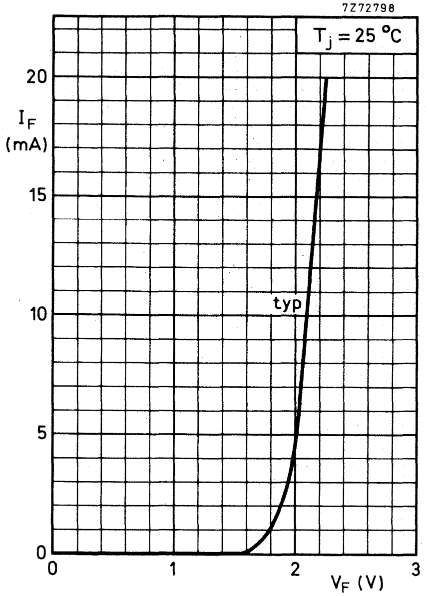
THERMAL RESISTANCE

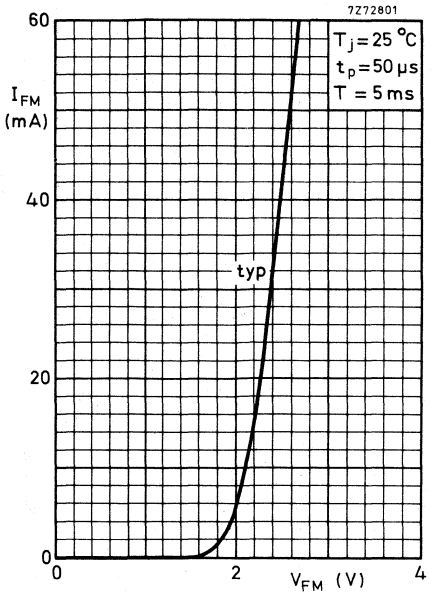
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,75	°C/mW
mounted on a printed board	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

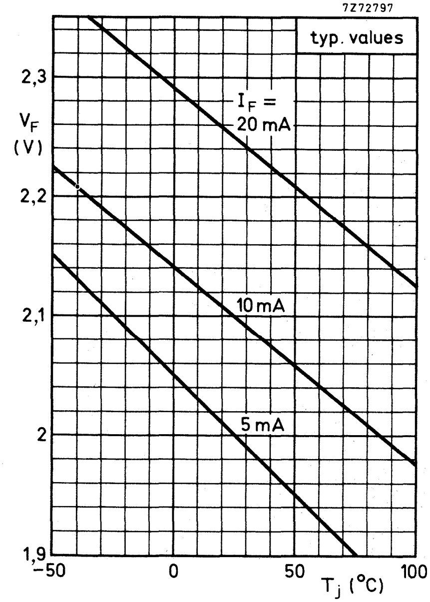
CHARACTERISTICS

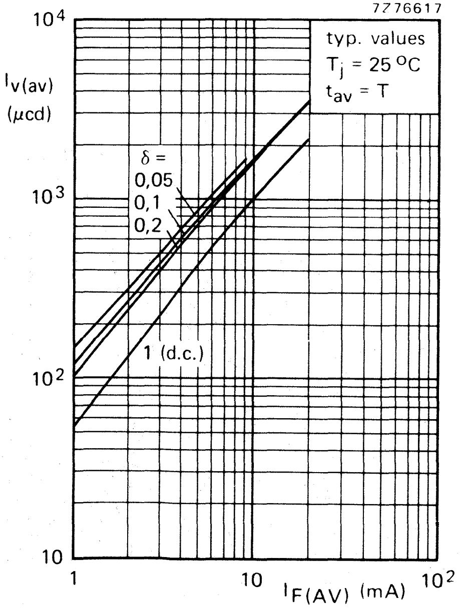
$T_j = 25$ °C unless otherwise specified

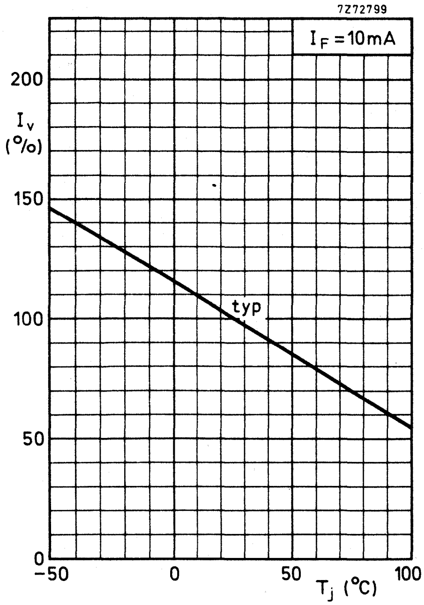
Forward voltage $I_F = 10$ mA		V_F	typ. <	2,1 3	V V
Reverse current $V_R = 3$ V		I_R	<	100	μA
Diode capacitance $V_R = 0$; $f = 1$ MHz		C_d	typ.	35	pF
→ Luminous intensity (on-axis) $I_F = 10$ mA	CQY97	I_v	>	0,3	mcd
	CQY97-I	I_v		0,7 to 1,6	mcd
	CQY97-II	I_v		1,0 to 2,2	mcd
	CQY97-III	I_v	>	1,6	mcd
Wavelength at peak emission		λ_{pk}	typ.	590	nm
Bandwidth at half height		$B_{50\%}$	typ.	38	nm
Beamwidth between half-intensity directions		$\alpha_{50\%}$	typ.	60°	

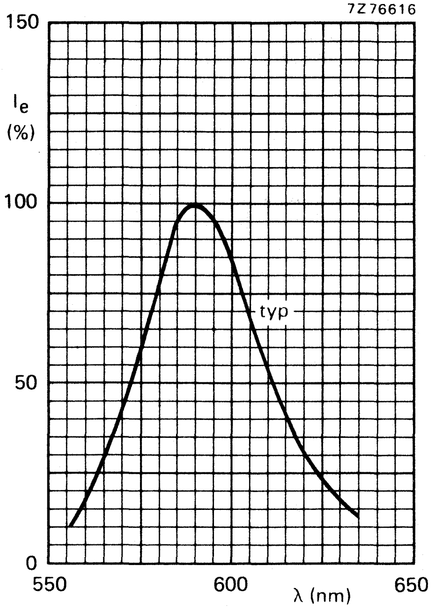

7Z72798
$T_j = 25\ ^\circ C$
I_F (mA)
20
15
10
5
0
typ
0
1
2
3
V_F (V)

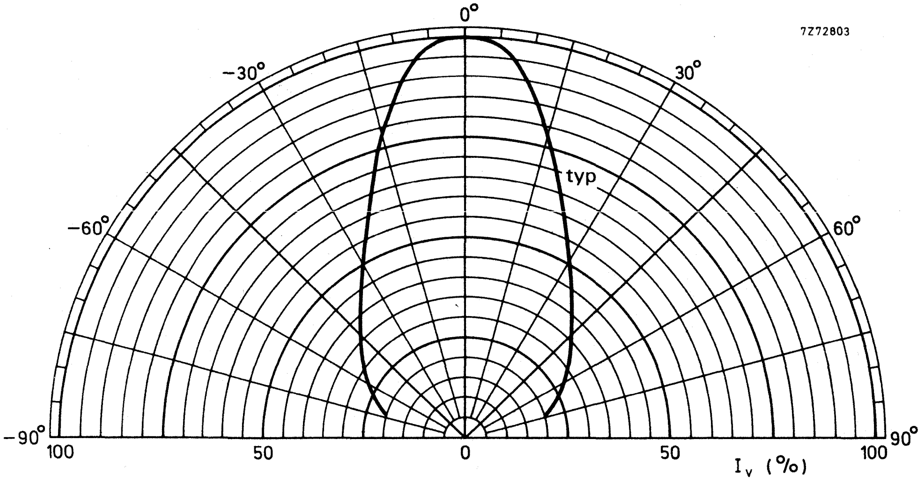

7Z72801
$T_j = 25\ ^\circ C$
$t_p = 50\ \mu s$
$T = 5$ ms
I_{FM} (mA)
60
40
20
0
typ
0
2
4
V_{FM} (V)


7Z72797
typ. values
V_F (V)
2,3
2,2
2,1
2
1,9
$I_F =$ 20 mA
10 mA
5 mA
−50
0
50
100
T_j (°C)


7Z76617
typ. values
$T_j = 25\ ^\circ C$
$t_{av} = T$
$I_{v(av)}$ (μcd)
10^4
10^3
10^2
10
$\delta =$
0,05
0,1
0,2
1 (d.c.)
1
10
10^2
$I_{F(AV)}$ (mA)


7Z72799
I_F = 10 mA
I_v (%)
200
150
100
50
0
typ
−50
0
50
100
T_j (°C)


7Z76616
I_e (%)
150
100
50
0
typ
550
600
650
λ (nm)


7Z72803
0°
−30°
30°
−60°
60°
−90°
90°
typ
100
50
0
50
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.

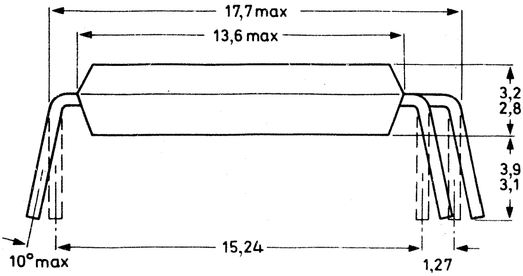
QUICK REFERENCE DATA

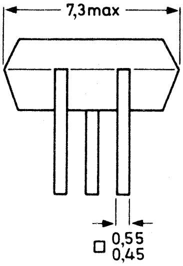
Diode				
Reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 65 °C	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector cut-off current (dark) V_{CE}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

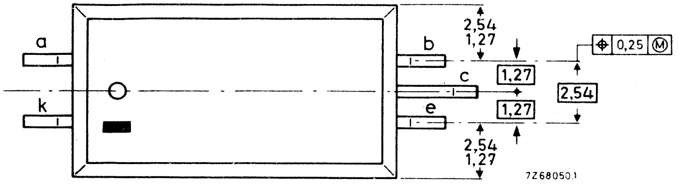
MECHANICAL DATA See page 2.

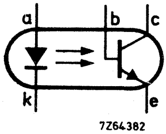
MECHANICAL DATA Dimensions in mm

CNY22

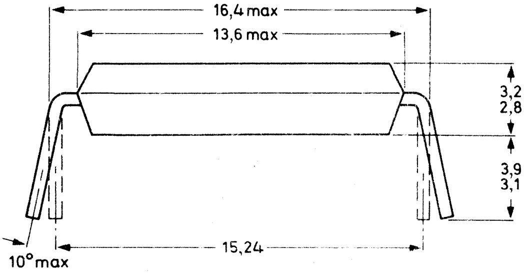


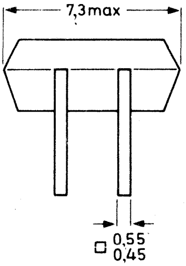


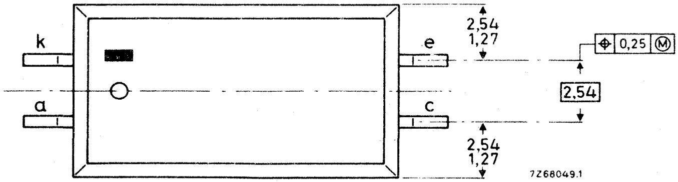


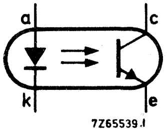


CNY42









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

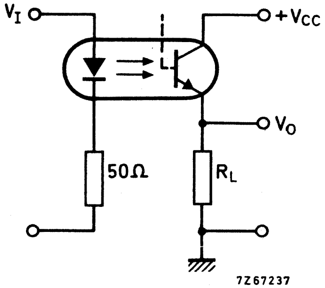
-diode	$R_{th\ j\text{-}a}$	1,2 °C/mW
-transistor	$R_{th\ j\text{-}a}$	0,5 °C/mW

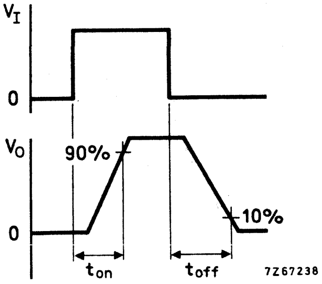
CHARACTERISTICS

T_j = 25 °C unless otherwise specified

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

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





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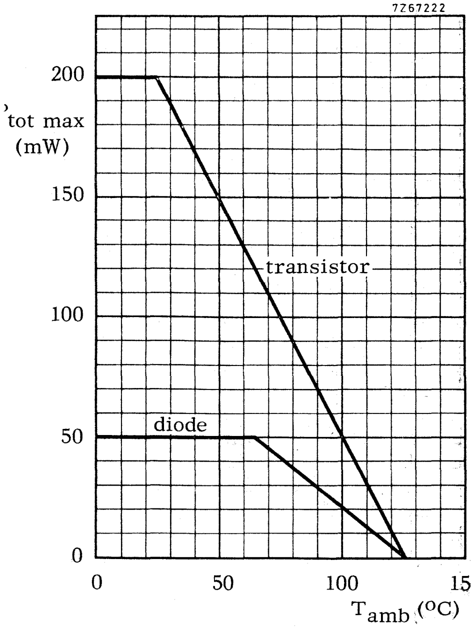
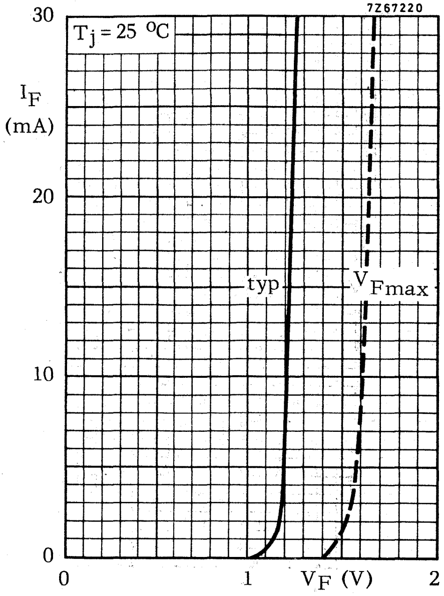
[1] Where the phototransistor receives light from the diode the O (for open base) has been omitted from the symbols.

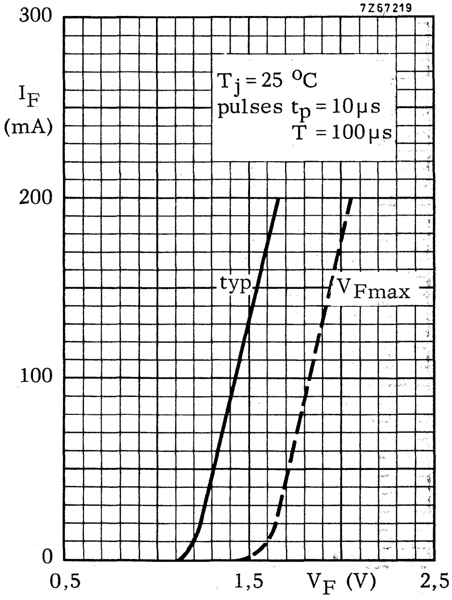
[2] Measured with pulses: t_p = 100 µs; T = 1 ms.

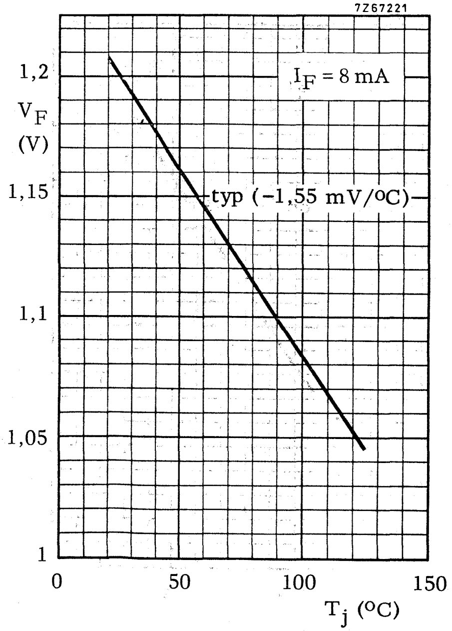
[3] Aging of the light-emitting diode decreases the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

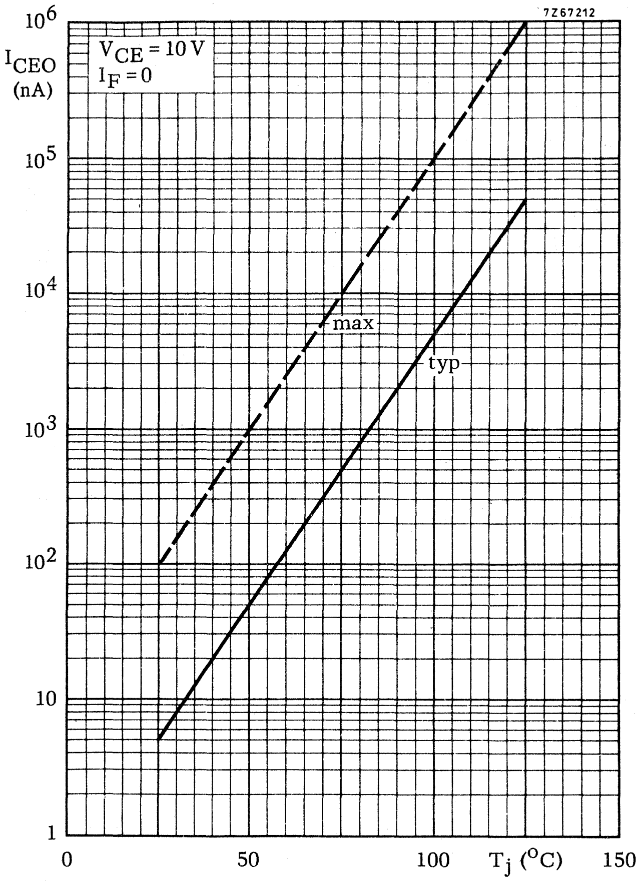
[4] Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

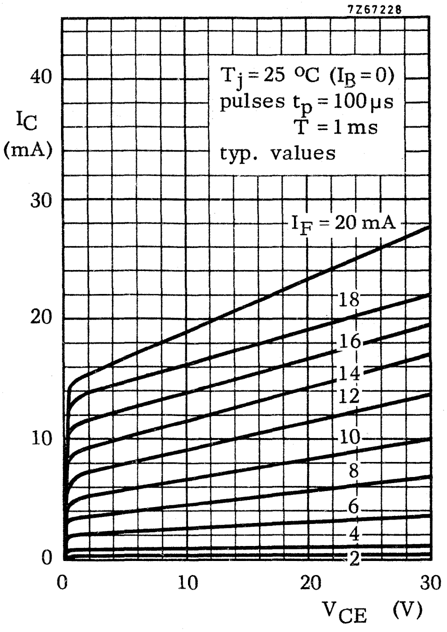

7Z67222
200
tot max
(mW)
150
100
50
0
transistor
diode
0
50
100
150
T_{amb} (°C)

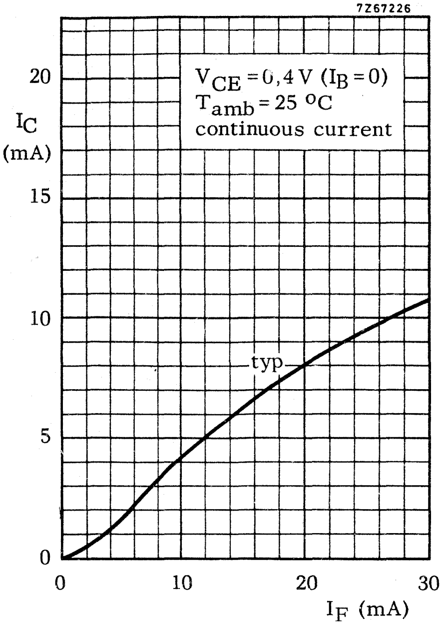

7Z67220
30
$T_j = 25$ °C
I_F
(mA)
20
10
0
typ
V_{Fmax}
0
1
V_F (V)
2

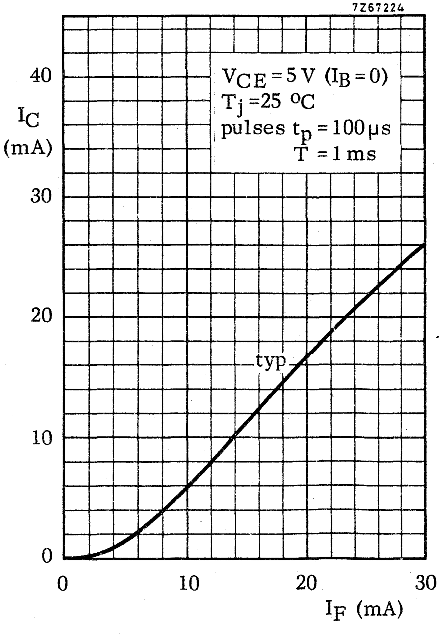

7Z67219
300
$T_j = 25$ °C
pulses $t_p = 10 \mu s$
$T = 100 \mu s$
I_F
(mA)
200
typ
V_{Fmax}
100
0
0,5
1,5
V_F (V)
2,5

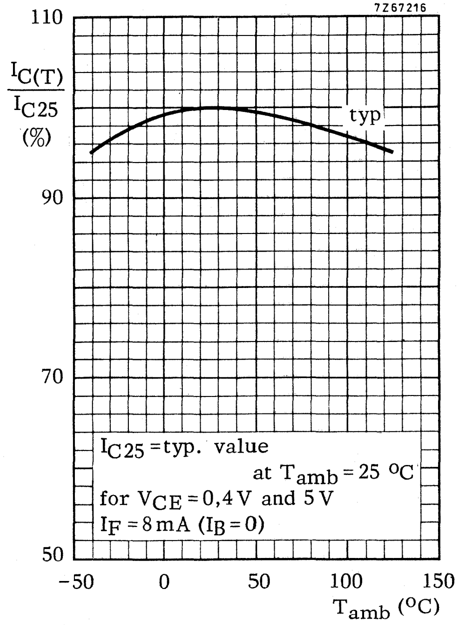

7Z67221
1,2
$I_F = 8$ mA
V_F
(V)
1,15
typ (−1,55 mV/°C)
1,1
1,05
1
0
50
100
150
T_j (°C)

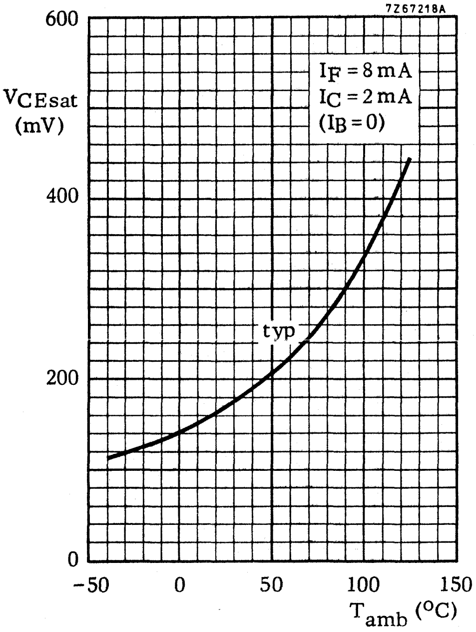

7Z67212
10^6
10^5
10^4
10^3
10^2
10
1
I_{CEO}
(nA)
$V_{CE} = 10\ V$
$I_F = 0$
max
typ
0
50
100
150
T_j (°C)


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


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


7Z67224
$V_{CE} = 5$ V $(I_B = 0)$
$T_j = 25\ ^oC$
pulses $t_p = 100\ \mu s$
$T = 1$ ms
typ
I_C (mA)
0
10
20
30
40
0
10
20
30
I_F (mA)


7Z67216
110
$\frac{I_{C(T)}}{I_{C25}}$ (%)
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)


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

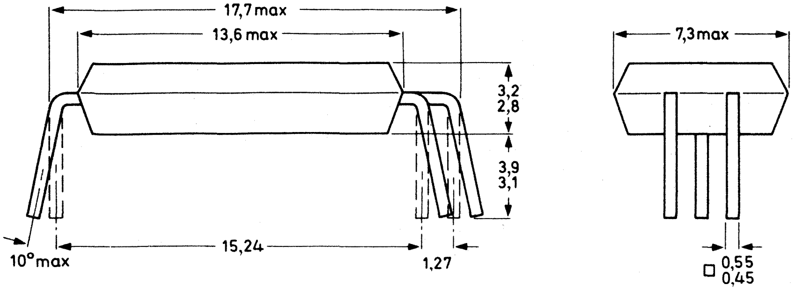
Diode				
Reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to $T_{amb} = 65\ ^{o}C$	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector cut-off current (dark) $V_{CE}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

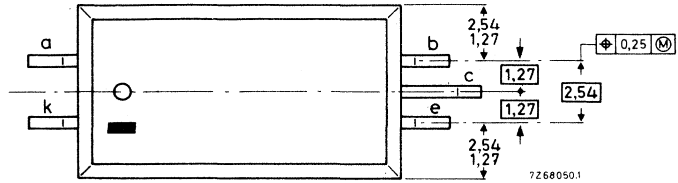
MECHANICAL DATA See page 2.

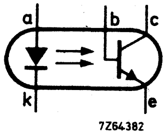
MECHANICAL DATA

Dimensions in mm

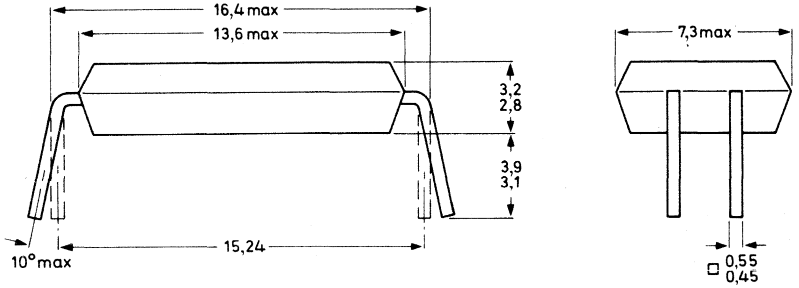
CNY23

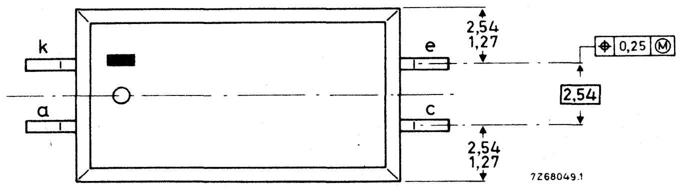


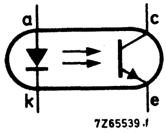




CNY43







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

Diode

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

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter) (CNY23)	V_{CBO}	max.	40	V
Emitter-collector voltage (open base)	V_{ECO}	max.	6	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max	200	mW
Junction temperature	T_j	max.	125	°C

Photocoupler

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

THERMAL RESISTANCE

From junction to ambient in free air

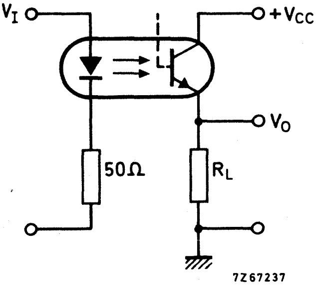
–diode	R_{th} j-a	1,2 °C/mW
–transistor	R_{th} j-a	0,5 °C/mW

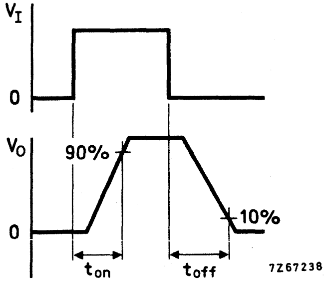
CHARACTERISTICS

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.	0,5 1		^{2}) ^{3})
Collector-emitter saturation voltage I_F = 8 mA; I_C = 4 mA; T_{amb} = 25 °C	V_{CEsat}	typ. <	0,17 0,4	V 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}	> typ.	10^{10} 10^{12}	Ω Ω	
Turn-on time (circuit below) I_{CM} = 4 mA; V_{CC} = 5 V; R_L = 100 Ω	t_{on}	typ.	5	μs	
Turn-off time (circuit below) I_{CM} = 4 mA; V_{CC} = 5 V; R_L = 100 Ω	t_{off}	typ.	5	μs	

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





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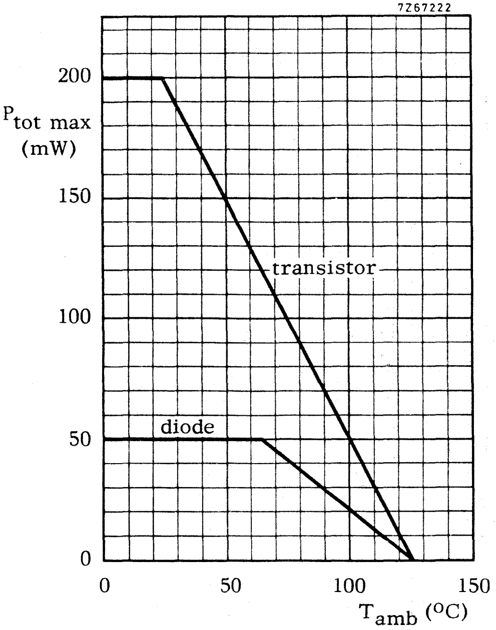
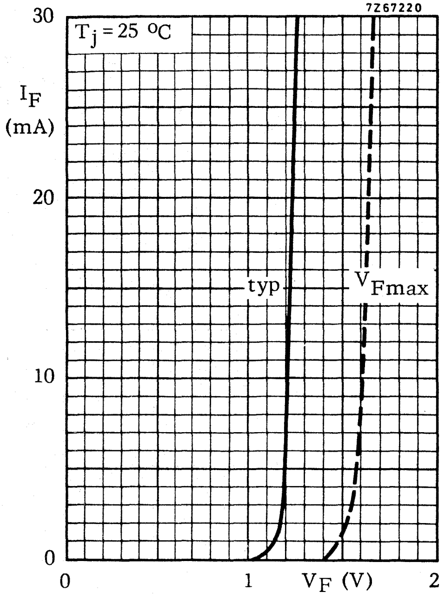
[1] Where the phototransistor receives light from the diode the O (for open base) has been omitted from the symbols.

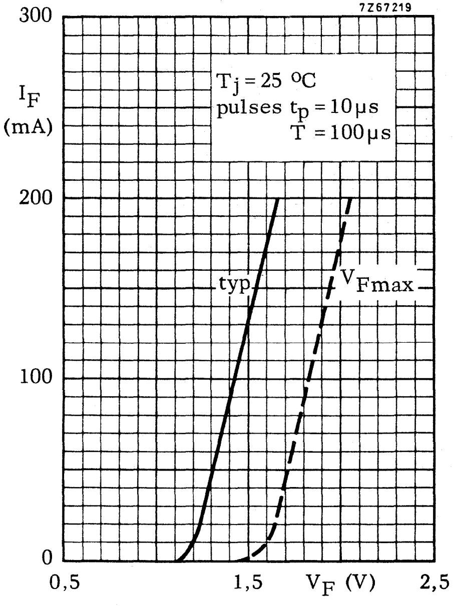
[2] Measured with pulses: t_p = 100 μs; T = 1 ms.

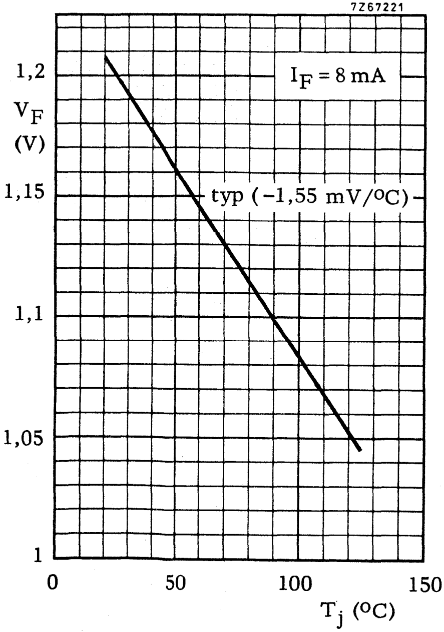
[3] Aging of the light-emitting diode decreases the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

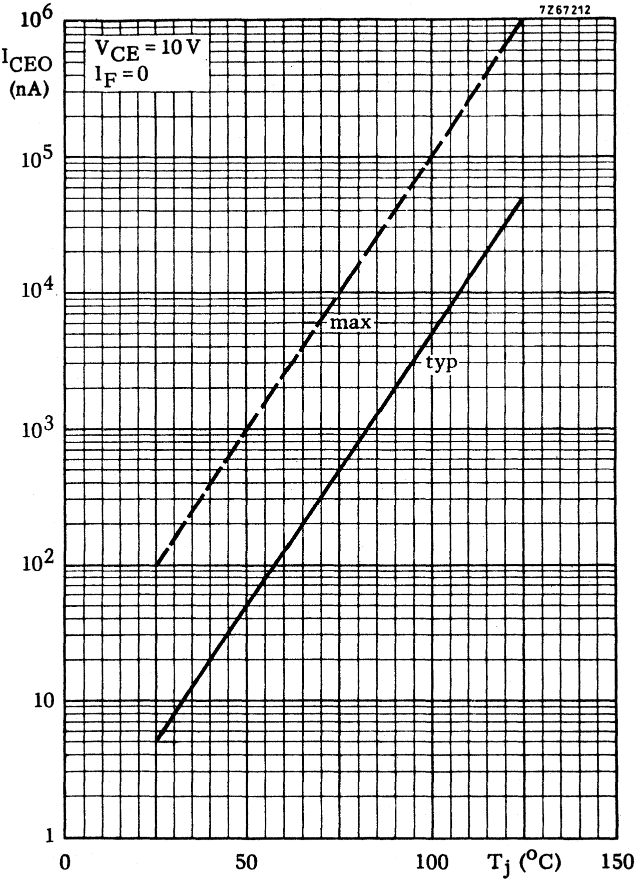
[4] Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

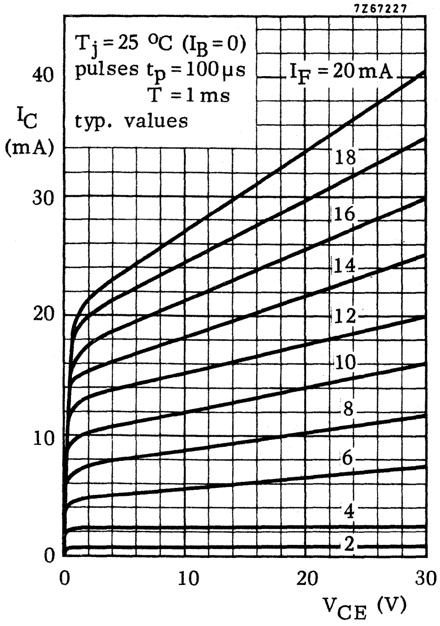

7Z67222
Ptot max (mW)
200
150
100
50
0
transistor
diode
0
50
100
150
Tamb (°C)

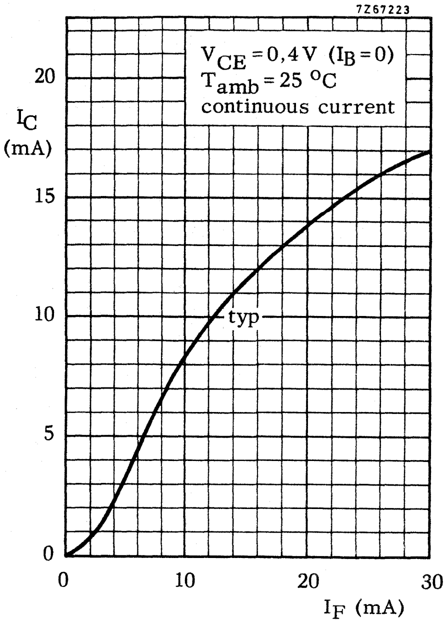

7Z67220
Tj = 25 °C
IF (mA)
30
20
10
0
typ
VFmax
0
1
VF (V)
2

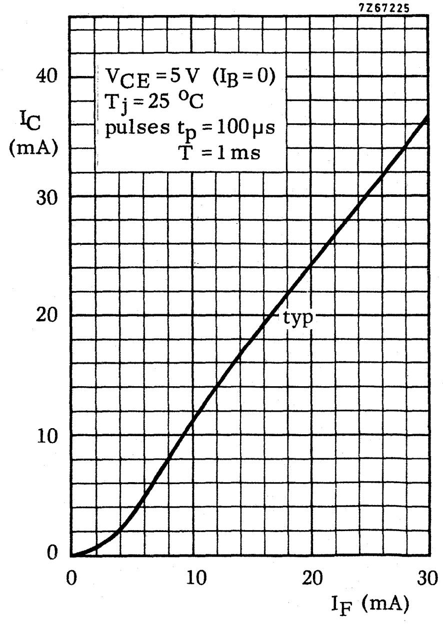

7Z67219
IF (mA)
300
200
100
0
Tj = 25 °C
pulses tp = 10 μs
T = 100 μs
typ
VFmax
0,5
1,5
VF (V)
2,5

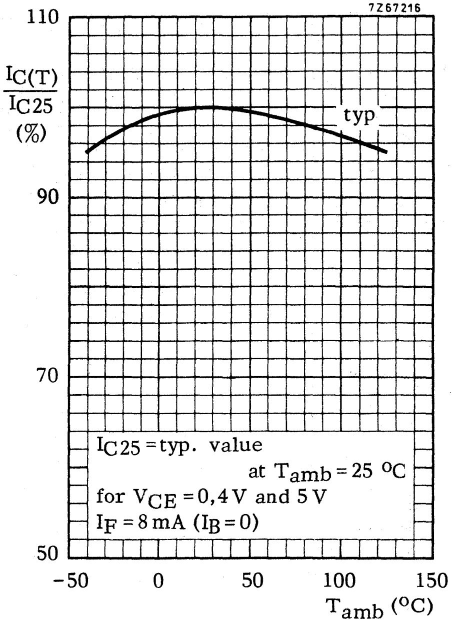

7Z67221
VF (V)
1,2
1,15
1,1
1,05
1
IF = 8 mA
typ (−1,55 mV/°C)
0
50
100
150
Tj (°C)

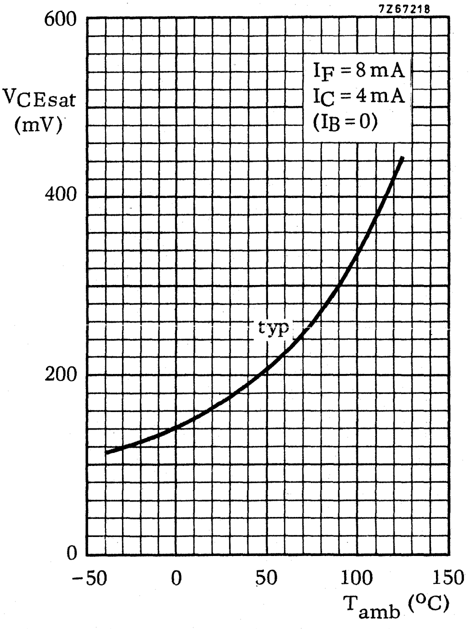

7Z67212
I_{CEO} (nA)
$V_{CE} = 10$ V
$I_F = 0$
10^6
10^5
10^4
10^3
10^2
10
1
max
typ
0
50
100
150
T_j (°C)


7Z67227
Tj = 25 °C (IB = 0)
pulses tp = 100 µs
T = 1 ms
typ. values
IF = 20 mA
18
16
14
12
10
8
6
4
2
IC
(mA)
40
30
20
10
0
0
10
20
30
VCE (V)


7Z67223
VCE = 0,4 V (IB = 0)
Tamb = 25 °C
continuous current
typ
IC
(mA)
20
15
10
5
0
0
10
20
30
IF (mA)


7Z67225
VCE = 5 V (IB = 0)
Tj = 25 °C
pulses tp = 100 µs
T = 1 ms
typ
IC
(mA)
40
30
20
10
0
0
10
20
30
IF (mA)


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


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

PHOTOCOUPLER

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

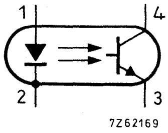
QUICK REFERENCE DATA

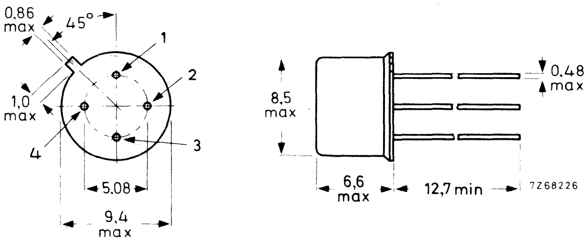
Diode				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 100 °C	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector cut-off current (dark)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

MECHANICAL DATA

Dimensions in mm

TO-12





Cathode (2) connected to case

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

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

Diode

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to $T_{amb} = 100\ ^oC$	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 $T_{amb} = 25\ ^oC$	P_{tot}	max.	80	mW
Junction temperature	T_j	max	125	°C

Photocoupler

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

THERMAL RESISTANCE

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

CHARACTERISTICS T_j = 25 °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	

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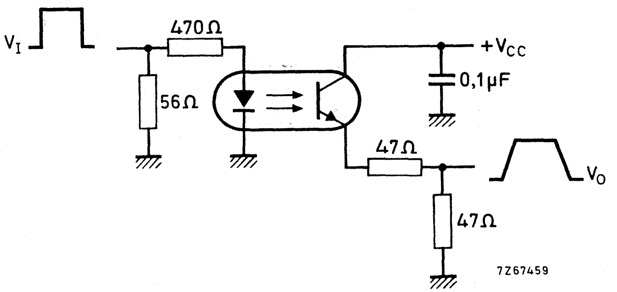
[1] Where the phototransistor receives light from the diode, the O (for open base) has been omitted from the symbols.

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

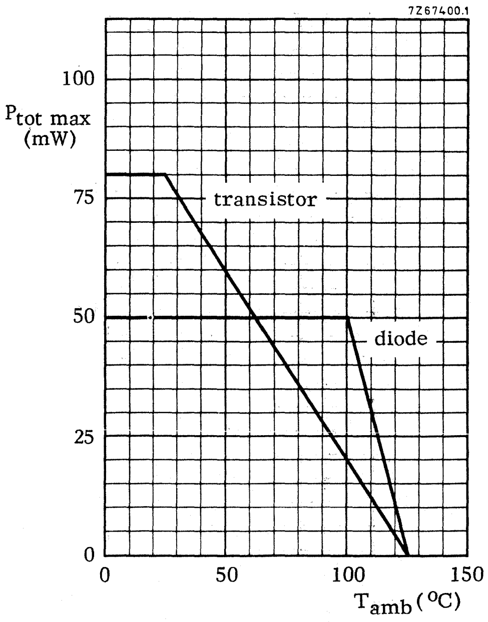
[3] Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

CHARACTERISTICS (continued) $T_j = 25\ ^\circ C$ unless otherwise specified

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



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



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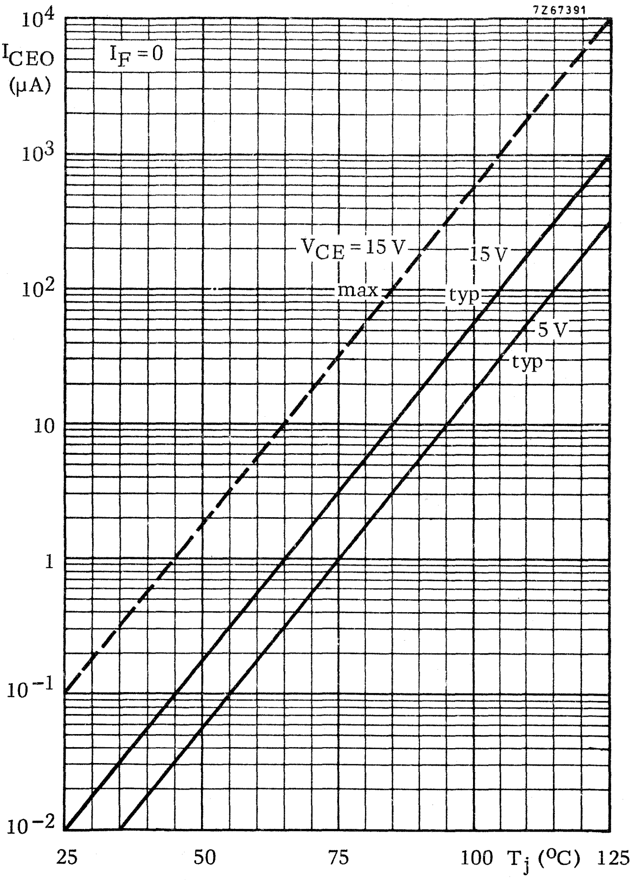
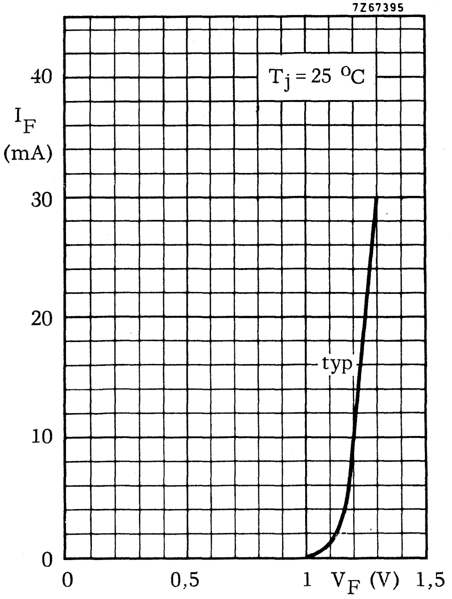
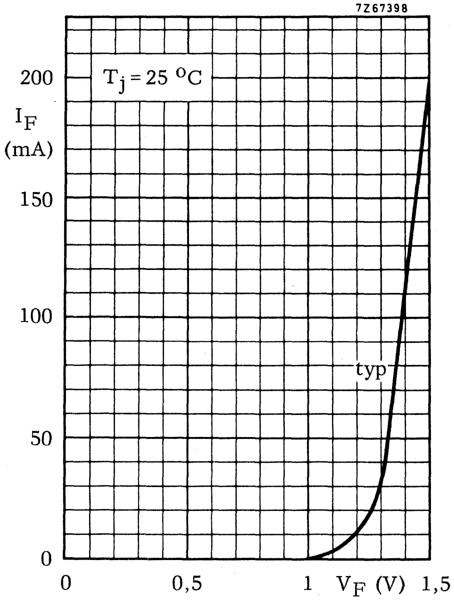
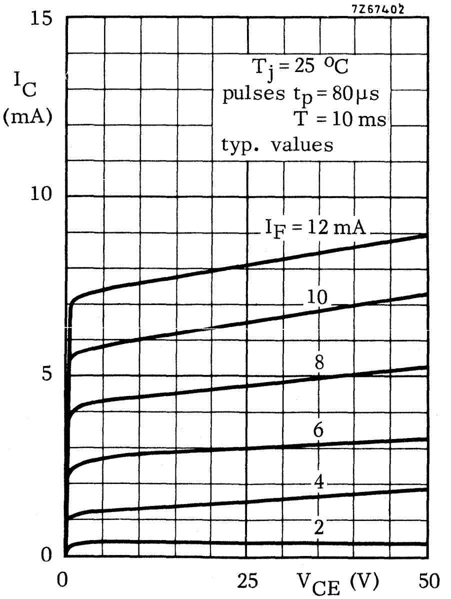
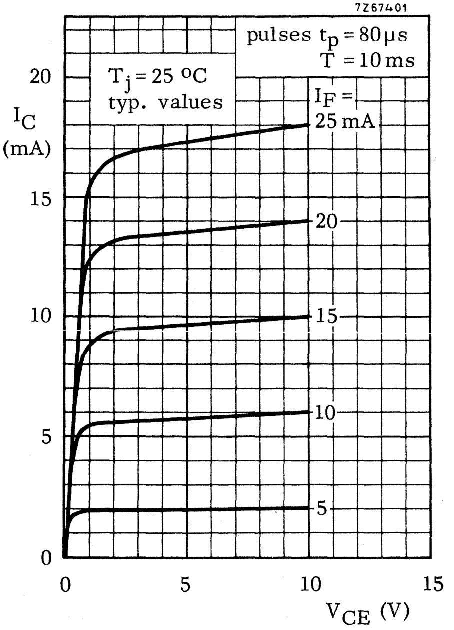
[1] Between the 10% and 90% of the edges.

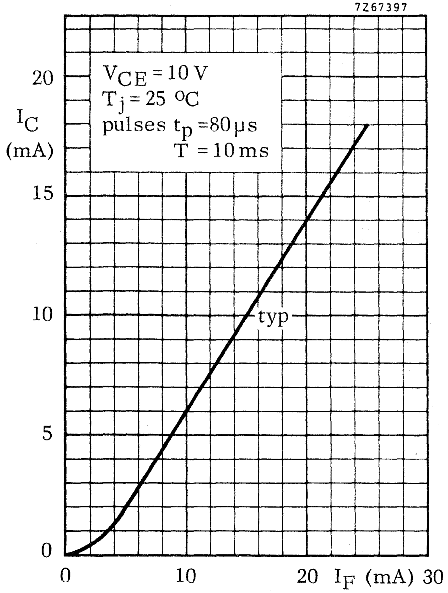

7Z67391
10^4
I_{CEO} (µA)
$I_F = 0$
10^3
$V_{CE} = 15$ V
max
15 V
typ
5 V
typ
10^2
10
1
10^{-1}
10^{-2}
25
50
75
100
T_j (°C)
125

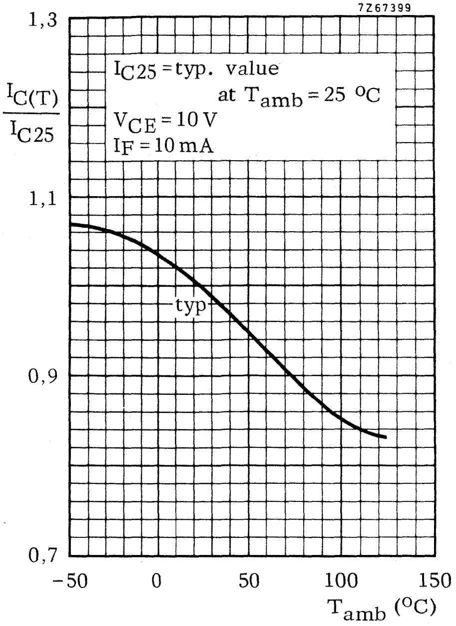

7Z67395
T_j = 25 °C
I_F (mA)
40
30
20
10
0
typ
0
0,5
1
V_F (V)
1,5

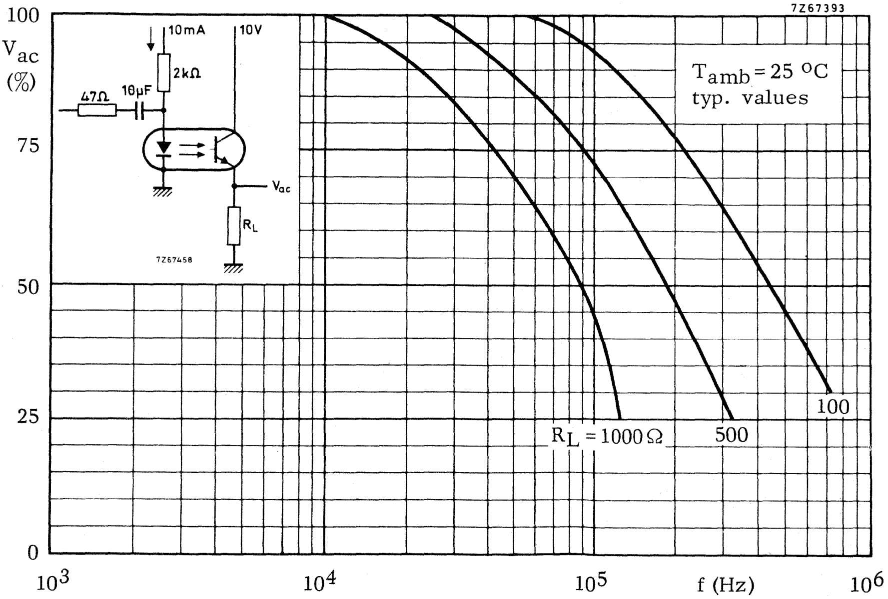

7Z67398
T_j = 25 °C
I_F (mA)
200
150
100
50
0
typ
0
0,5
1
V_F (V)
1,5

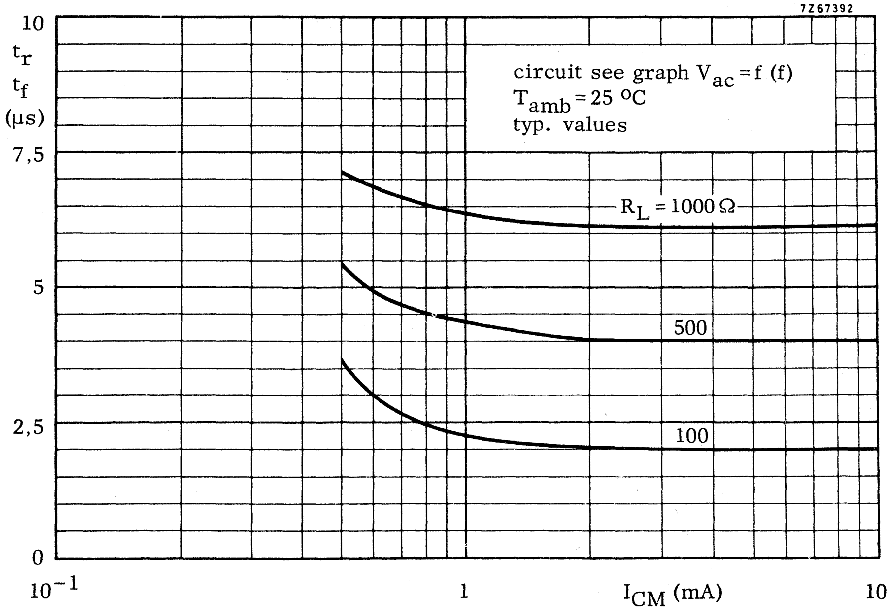

7Z67402
T_j = 25 °C
pulses t_p = 80 μs
T = 10 ms
typ. values
I_C (mA)
15
10
5
0
I_F = 12 mA
10
8
6
4
2
0
25
V_{CE} (V)
50

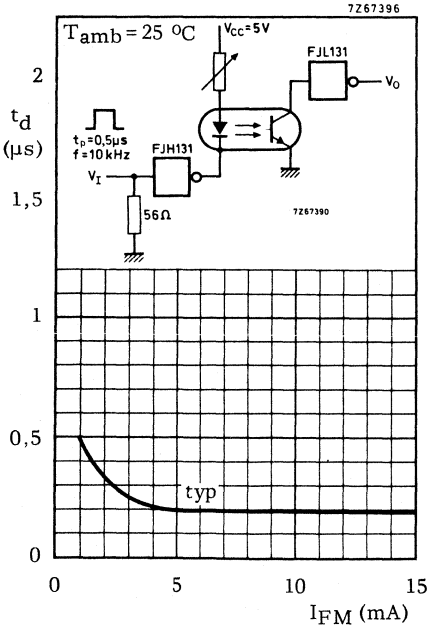

7Z67401
pulses t_p = 80 μs
T = 10 ms
T_j = 25 °C
typ. values
I_C (mA)
20
15
10
5
0
I_F = 25 mA
20
15
10
5
0
5
10
15
V_{CE} (V)

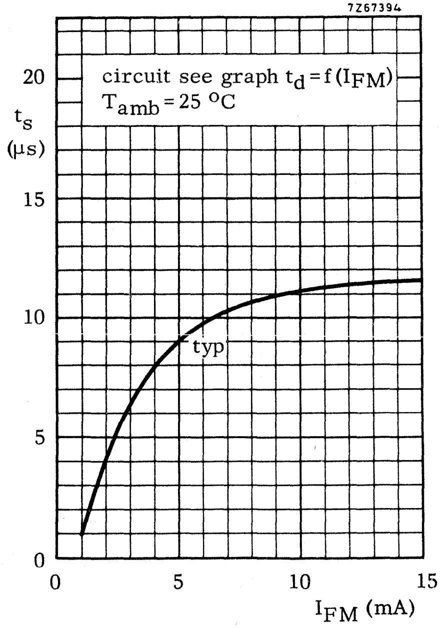

7Z67397
$V_{CE} = 10\ V$
$T_j = 25\ ^oC$
pulses $t_p = 80\ \mu s$
$T = 10\ ms$
I_C (mA)
0
5
10
15
20
typ
0
10
20
I_F (mA)
30


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


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


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


7Z67396
$T_{amb} = 25\ ^{\circ}C$
$V_{CC} = 5V$
FJL131
V_O
$t_p = 0{,}5\mu s$
$f = 10\ kHz$
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 $t_d = f(I_{FM})$
$T_{amb} = 25\ ^{\circ}C$
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.

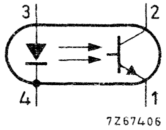
QUICK REFERENCE DATA

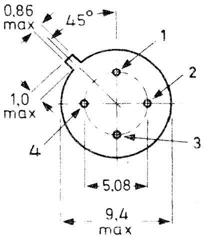
Diode				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	30	mA
Forward current (peak value)	I_{FM}	max.	200	mA
Total power dissipation up to T_{amb} = 100 °C	P_{tot}	max.	50	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	50	V
Collector cut-off current (dark)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

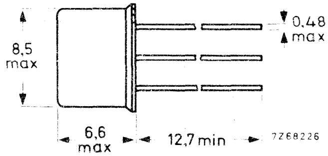
MECHANICAL DATA

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.

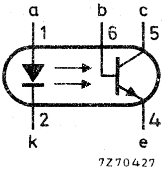
QUICK REFERENCE DATA

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

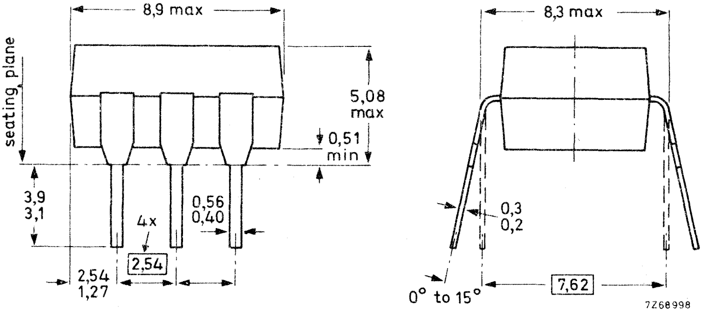
MECHANICAL DATA See page 2.

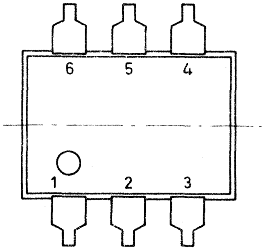
MECHANICAL DATA

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

THERMAL RESISTANCE

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

---

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

CHARACTERISTICS

Diode T_j = 25 °C

Forward voltage, I_F = 10 mA	V_F	typ. <	1,2 1,5	V V
Reverse current, V_R = 3 V	I_R	<	100	μA

Transistor (diode: I_F = 0) T_j = 25 °C

Collector cut-off current (dark)

V_{CE} = 10 V	I_{CEO}	typ. <	5 100	nA nA
V_{CB} = 10 V	I_{CBO}	<	20	nA

Photocoupler (I_B = 0, T_{amb} = 25 °C unless otherwise specified) [1]

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

---

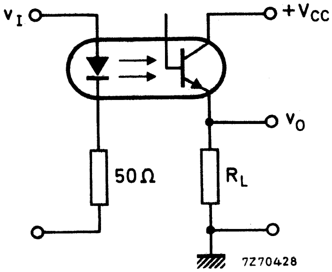
[1] Where the phototransistor receives light from the diode, the O (for open terminal) has been omitted from the symbols.

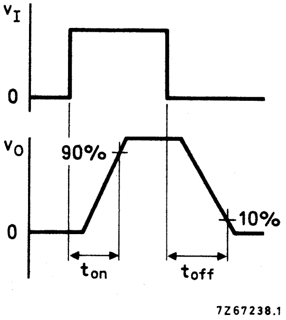
[2] Aging of the light-emitting diode reduces the transfer ratio at a rate proportional to current and operating time. In circuits that operate for long periods, therefore, the duty factor of the couplers should be kept as low as possible. This can often be done with the aid of an inverter.

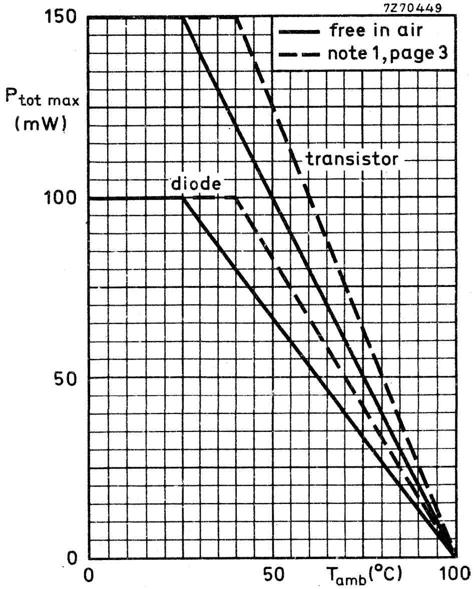
[3] Tested with a 50 Hz a.c. voltage for 1 minute between shorted input leads and shorted output leads.

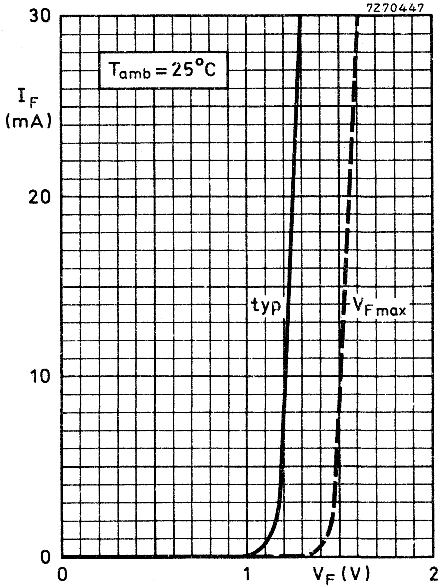
CHARACTERISTICS (continued)

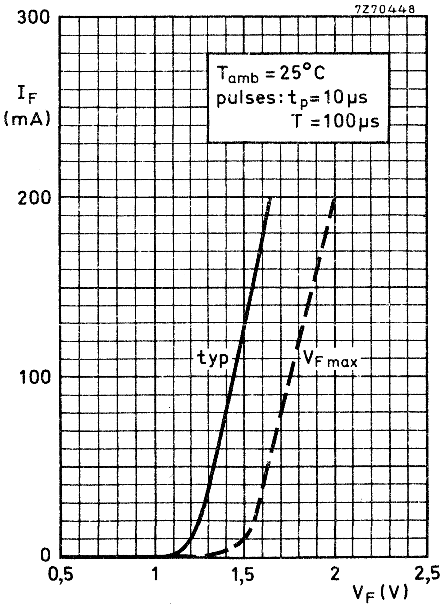
			CNY47	CNY47A	
Insulation resistance between input and output					
V_{IO} = 500 V	r_{IO}	>	10^{11}	10^{11}	Ω
		typ.	10^{12}	10^{12}	Ω
Switching times (circuit below)					
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.	3		μs
Turn-off time	t_{off}	typ.	3		μs
I_{Con} = 4 mA; V_{CC}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

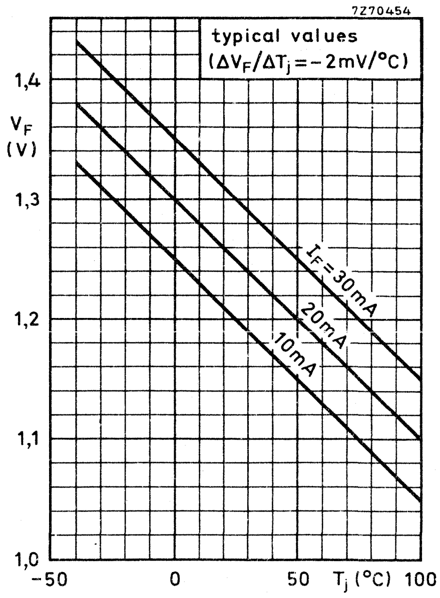


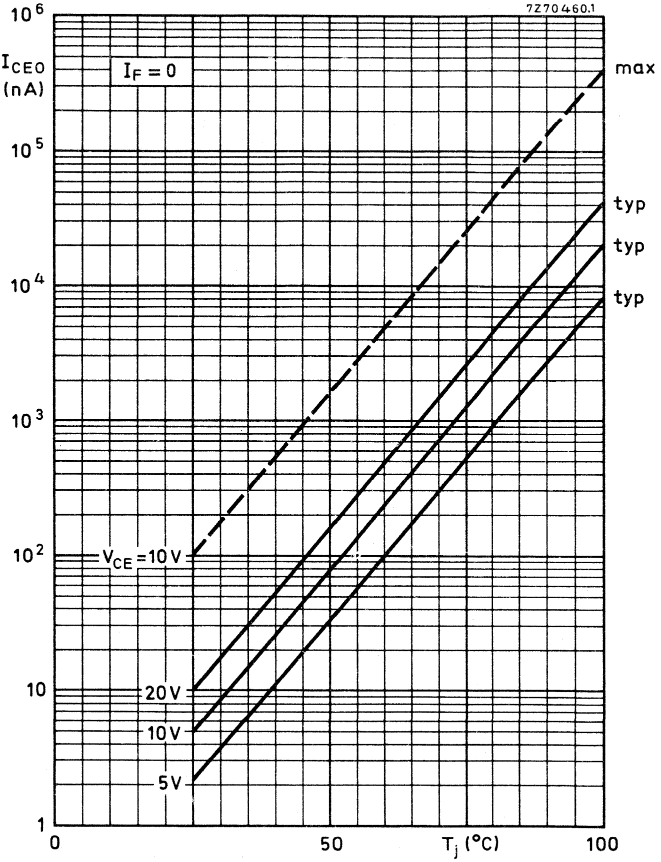


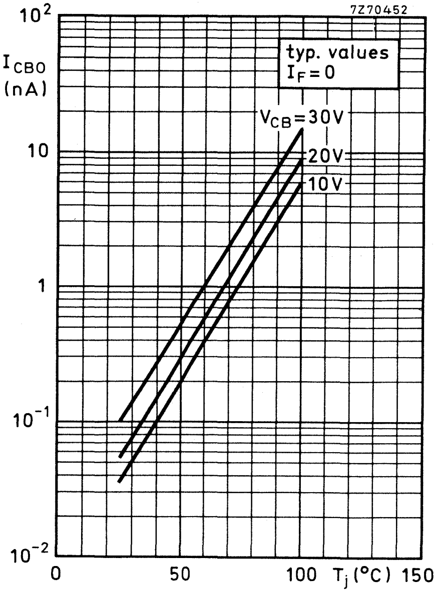

7Z70449
Ptot max
(mW)
150
100
50
0
0
50
Tamb(°C)
100
free in air
note 1, page 3
transistor
diode

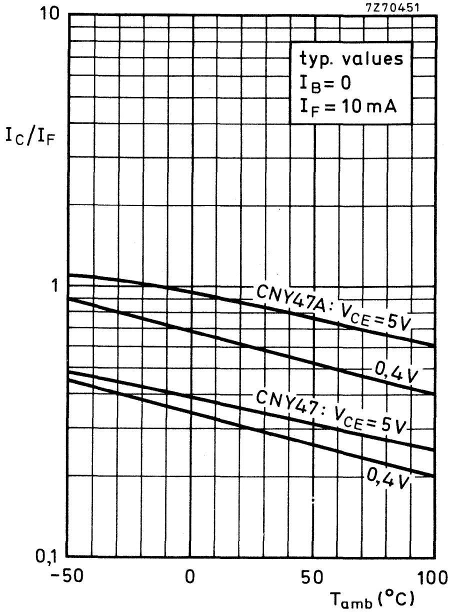

7Z70447
IF
(mA)
30
20
10
0
0
1
VF (V)
2
Tamb = 25°C
typ
VF max

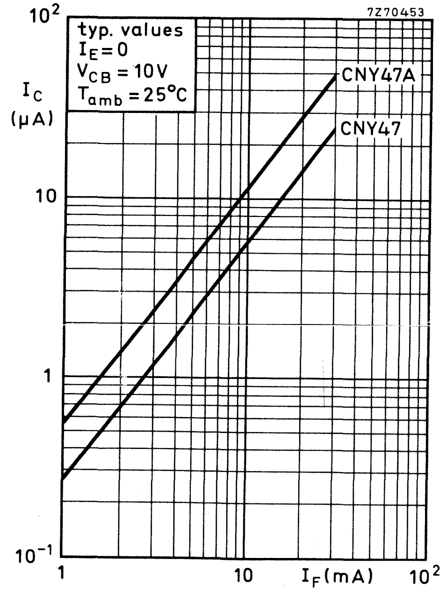

7Z70448
IF
(mA)
300
200
100
0
0,5
1
1,5
2
2,5
VF (V)
Tamb = 25°C
pulses: tp = 10 μs
T = 100 μs
typ
VF max

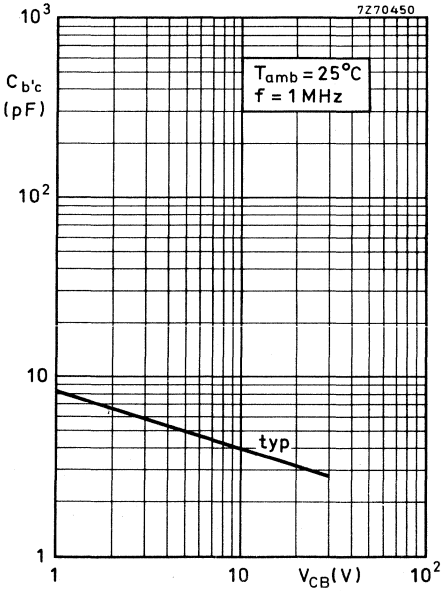

7Z70454
typical values
(ΔVF/ΔTj = −2mV/°C)
VF
(V)
1,4
1,3
1,2
1,1
1,0
−50
0
50
Tj (°C)
100
IF = 30mA
20mA
10mA

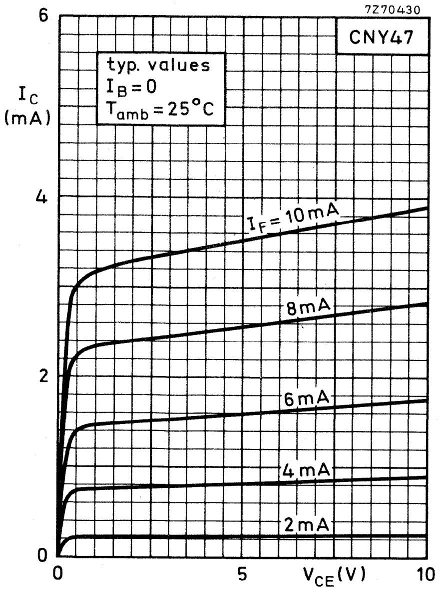

7Z70460.1
10^6
10^5
10^4
10^3
10^2
10
1
I_{CEO} (nA)
$I_F = 0$
max
typ
typ
typ
$V_{CE} = 10$ V
20 V
10 V
5 V
0
50
T_j (°C)
100

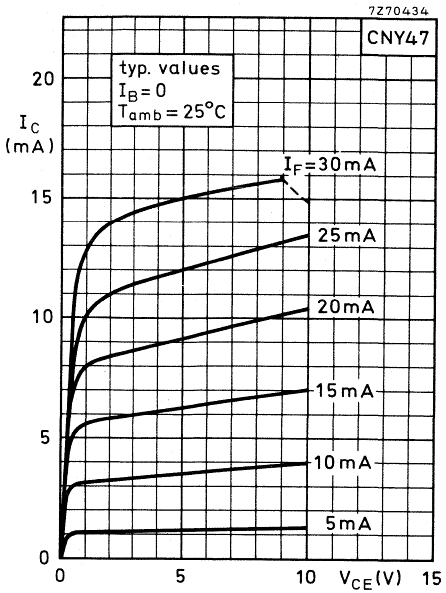

7Z70452
typ. values
$I_F = 0$
I_{CBO} (nA)
10^2
10
1
10^{-1}
10^{-2}
$V_{CB} = 30V$
20V
10V
0
50
100
T_j (°C)
150

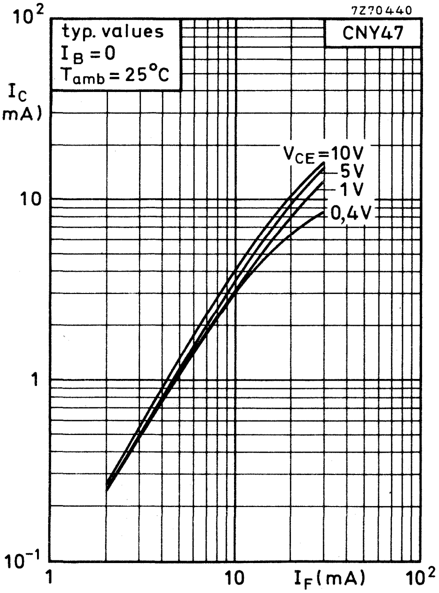

7Z70451
typ. values
$I_B = 0$
$I_F = 10 mA$
I_C/I_F
10
1
0,1
CNY47A: $V_{CE} = 5V$
0,4V
CNY47: $V_{CE} = 5V$
0,4V
−50
0
50
100
T_{amb} (°C)

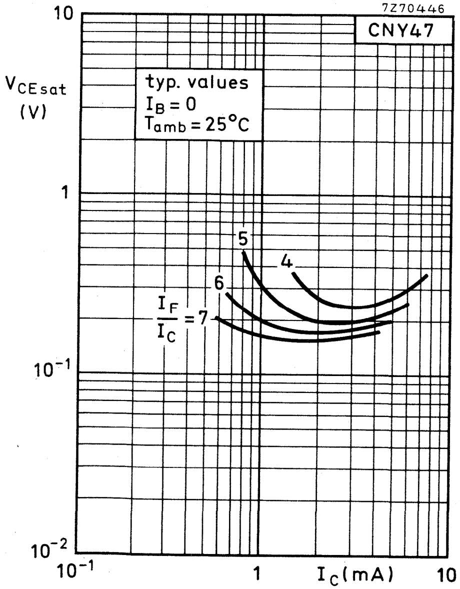

7Z70453
typ. values
$I_E = 0$
$V_{CB} = 10V$
$T_{amb} = 25°C$
I_C (μA)
10^2
10
1
10^{-1}
CNY47A
CNY47
1
10
I_F (mA)
10^2

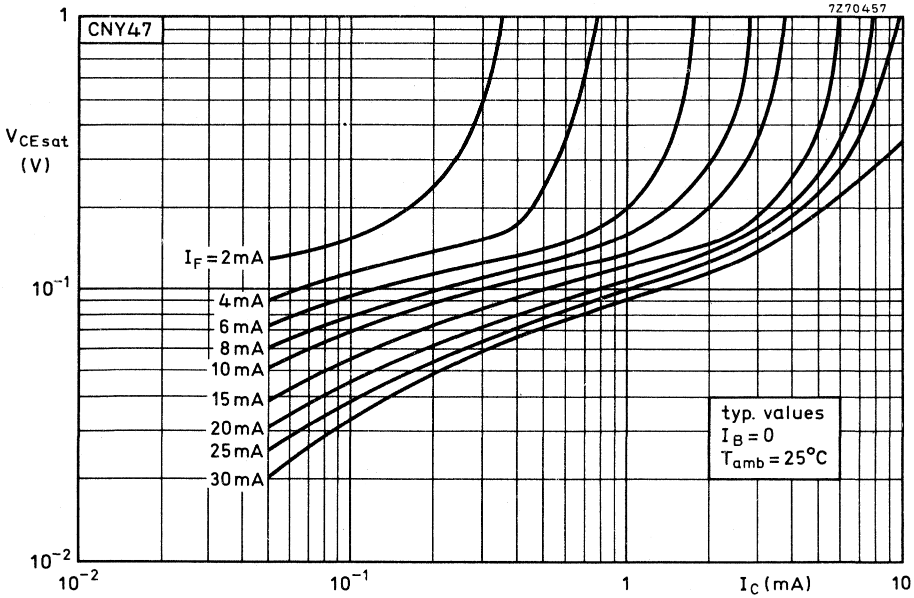

7Z70450
$T_{amb} = 25°C$
f = 1 MHz
$C_{b'c}$ (pF)
10^3
10^2
10
1
typ
1
10
V_{CB} (V)
10^2

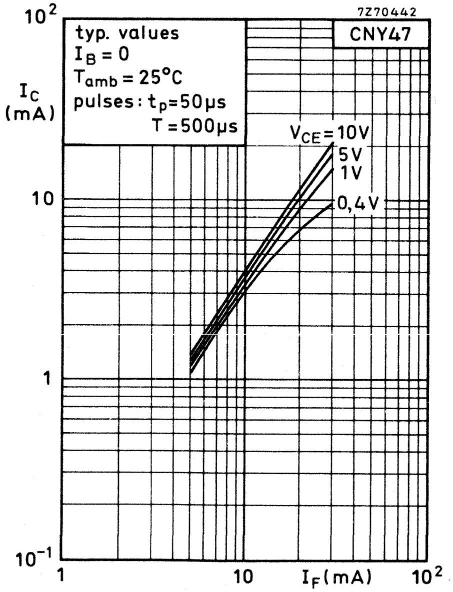

7Z70430
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
6
4
2
0
$I_F = 10$ mA
8 mA
6 mA
4 mA
2 mA
0
5
V_{CE} (V)
10

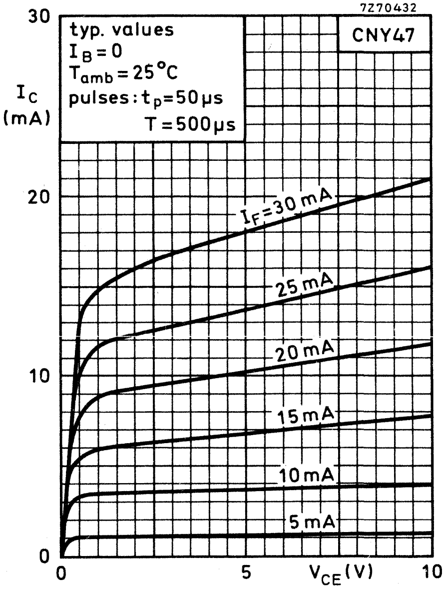

7Z70434
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
20
15
10
5
0
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
0
5
10
V_{CE} (V)
15

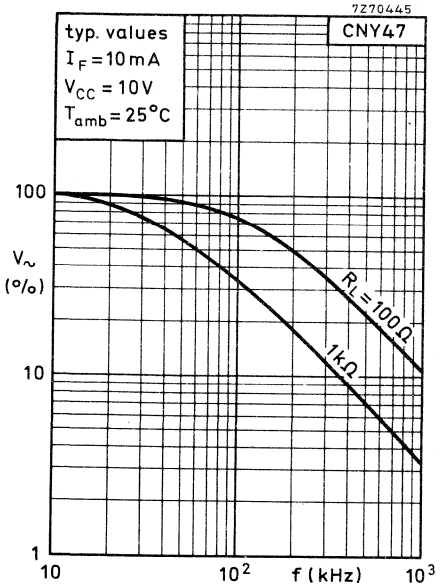

7Z70440
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
10^2
10
1
10^{-1}
$V_{CE} = 10$ V
5 V
1 V
0,4 V
1
10
I_F (mA)
10^2

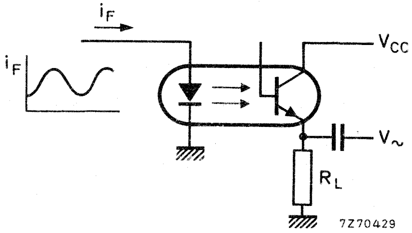

7Z70446
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25°C$
V_{CEsat} (V)
10
1
10^{-1}
10^{-2}
5
4
6
$\frac{I_F}{I_C} = 7$
10^{-1}
1
I_C (mA)
10

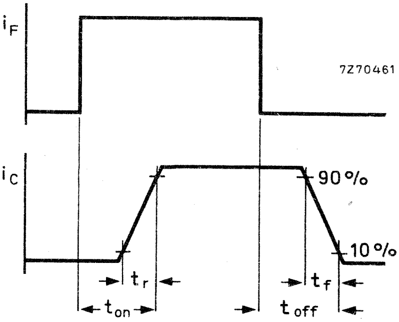

7Z70457
CNY47
V_{CEsat} (V)
1
10^{-1}
10^{-2}
$I_F = 2$ mA
4 mA
6 mA
8 mA
10 mA
15 mA
20 mA
25 mA
30 mA
typ. values
$I_B = 0$
$T_{amb} = 25$°C
10^{-2}
10^{-1}
1
I_C (mA)
10

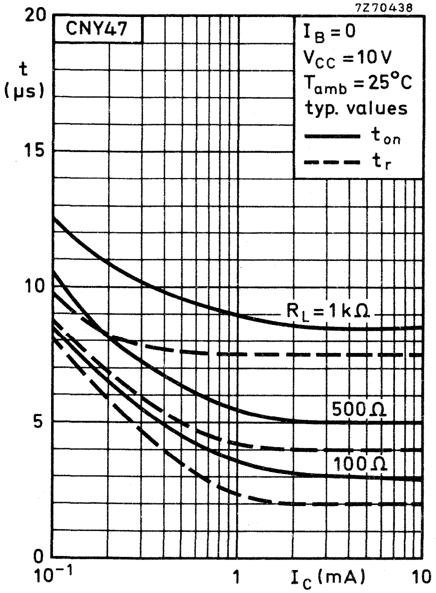

7Z70442
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25$°C
pulses: $t_p = 50$ µs
$T = 500$ µs
I_C (mA)
10^2
10
1
10^{-1}
$V_{CE} = 10$ V
5 V
1 V
0,4 V
1
10
I_F (mA)
10^2

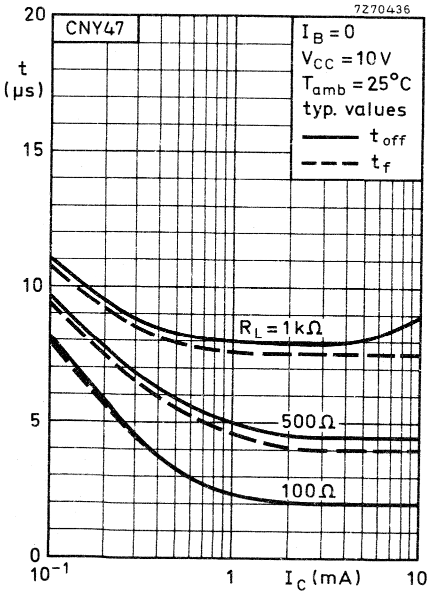

7Z70432
CNY47
typ. values
$I_B = 0$
$T_{amb} = 25$°C
pulses: $t_p = 50$ µs
$T = 500$ µs
I_C (mA)
30
20
10
0
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
0
5
V_{CE} (V)
10

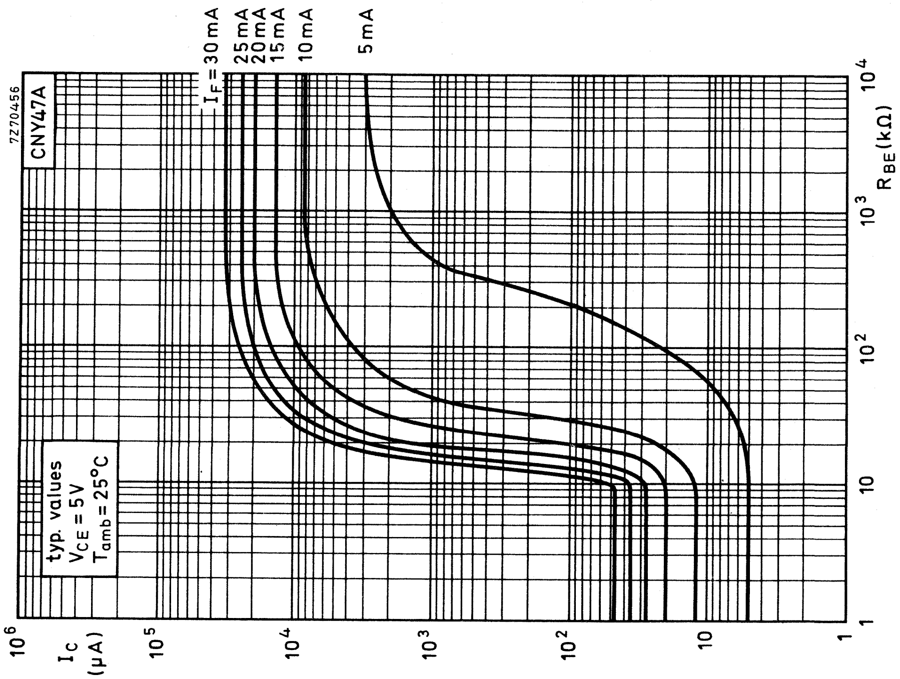

7Z70445
typ. values
$I_F = 10$ mA
$V_{CC} = 10$ V
$T_{amb} = 25$ °C
CNY47
$V_\sim$ (%)
100
10
1
$R_L = 100\,\Omega$
1 kΩ
10
10^2
f (kHz)
10^3

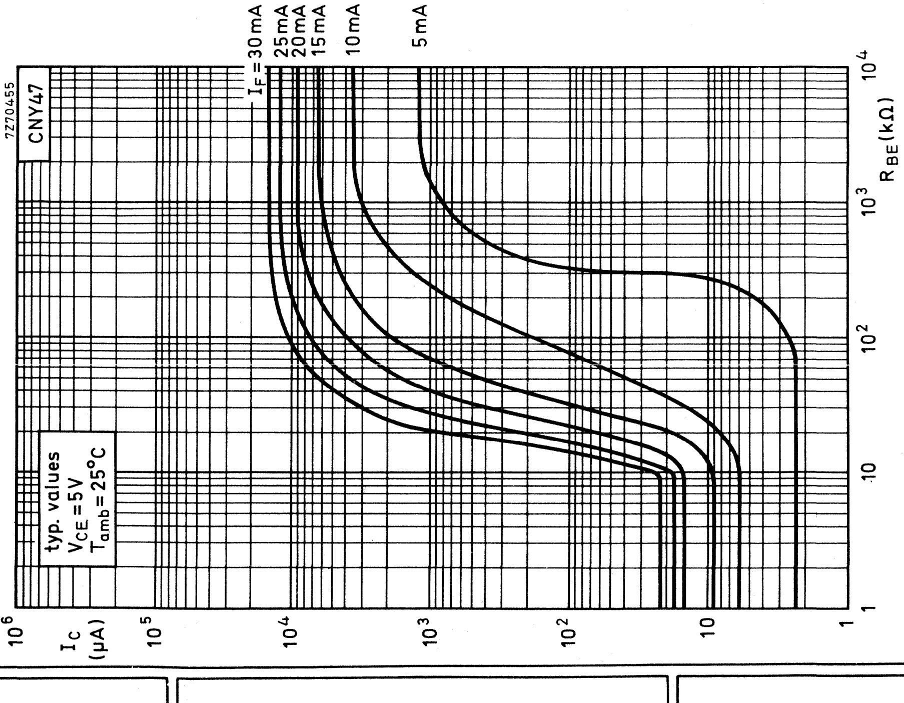

i_F
i_F
V_{CC}
$V_\sim$
R_L
7Z70429

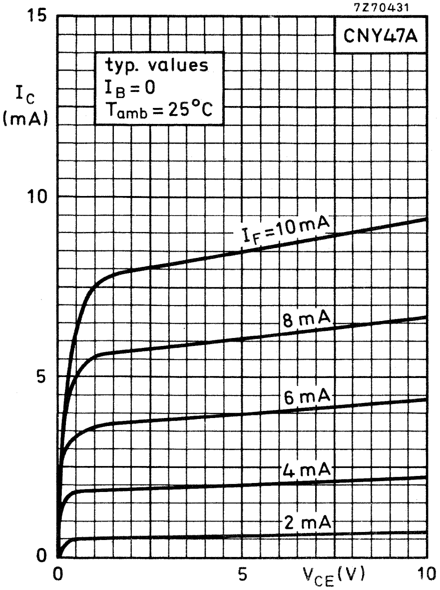

i_F
7Z70461
i_C
90 %
10 %
t_r
t_f
t_{on}
t_{off}

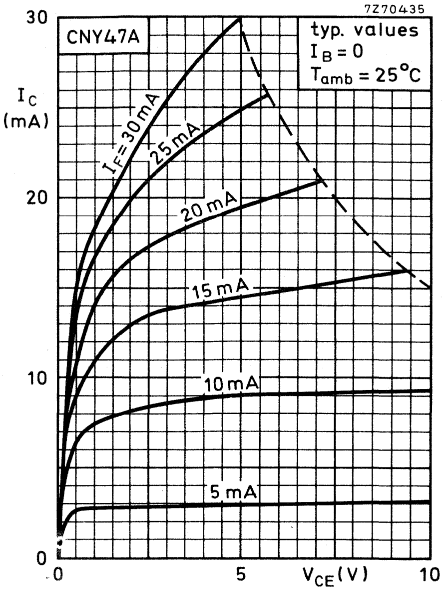

7Z70438
CNY47
$I_B = 0$
$V_{CC} = 10$ V
$T_{amb} = 25$ °C
typ. values
t_{on}
t_r
t (μs)
20
15
10
5
0
$R_L = 1$ kΩ
500 Ω
100 Ω
10^{-1}
1
I_C (mA)
10

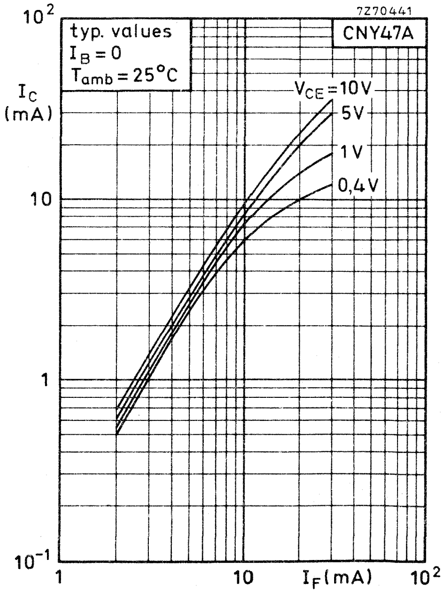

7Z70436
CNY47
$I_B = 0$
$V_{CC} = 10$ V
$T_{amb} = 25$ °C
typ. values
t_{off}
t_f
t (μs)
20
15
10
5
0
$R_L = 1$ kΩ
500 Ω
100 Ω
10^{-1}
1
I_C (mA)
10

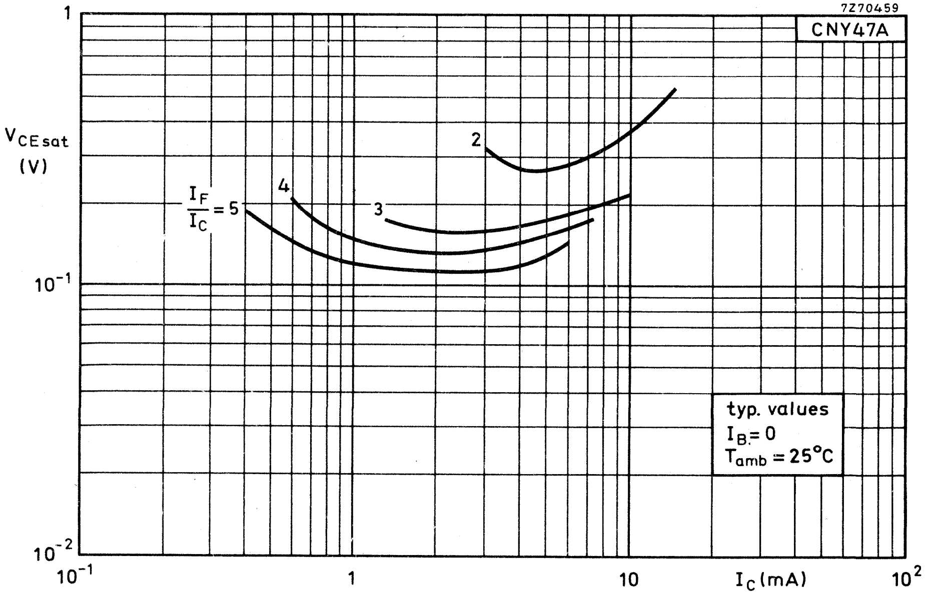

7Z70456
CNY47A
typ. values
$V_{CE} = 5V$
$T_{amb} = 25^{\circ}C$
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
I_C (µA)
10^6
10^5
10^4
10^3
10^2
10
1
R_{BE} (kΩ)
1
10
10^2
10^3
10^4

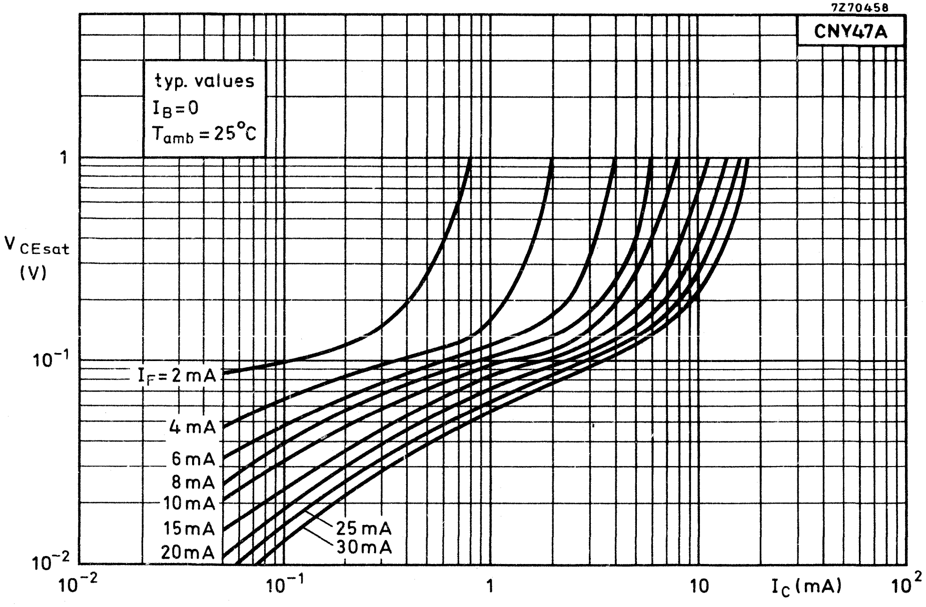

7Z70455
CNY47
typ. values
$V_{CE} = 5V$
$T_{amb} = 25^{\circ}C$
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
I_C (µA)
10^6
10^5
10^4
10^3
10^2
10
1
R_{BE} (kΩ)
1
10
10^2
10^3
10^4

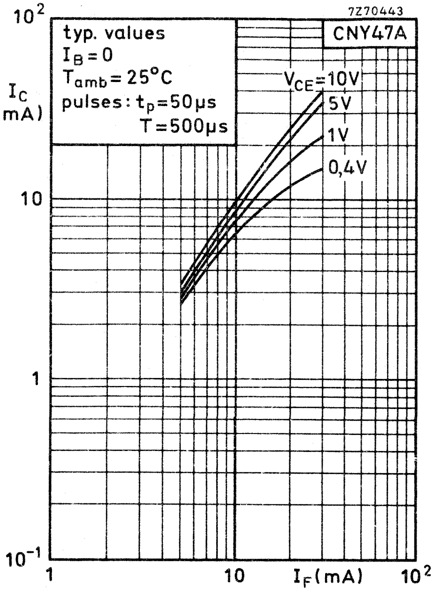

7Z70431
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
15
10
5
0
$I_F = 10$ mA
8 mA
6 mA
4 mA
2 mA
0
5
V_{CE} (V)
10

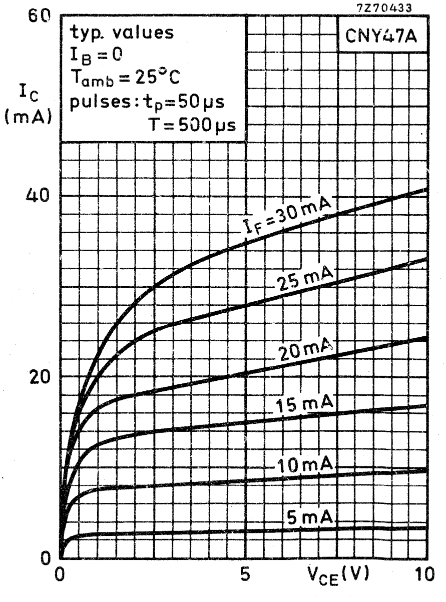

7Z70435
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
30
20
10
0
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
0
5
V_{CE} (V)
10

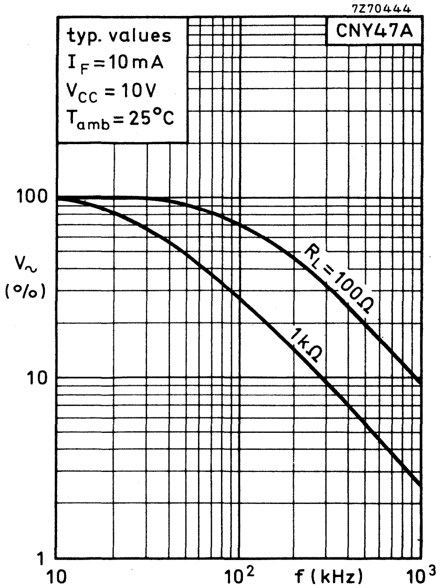

7Z70441
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
I_C (mA)
10^2
10
1
10^{-1}
$V_{CE} = 10$ V
5 V
1 V
0,4 V
1
10
I_F (mA)
10^2

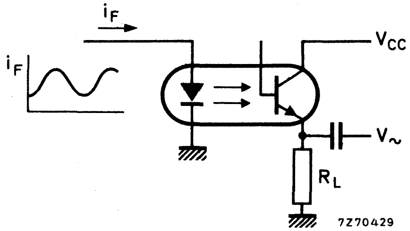

7Z70459
CNY47A
V_{CEsat} (V)
1
10^{-1}
10^{-2}
$\frac{I_F}{I_C} = 5$
4
3
2
typ. values
$I_B = 0$
$T_{amb} = 25°C$
10^{-1}
1
10
I_C (mA)
10^2

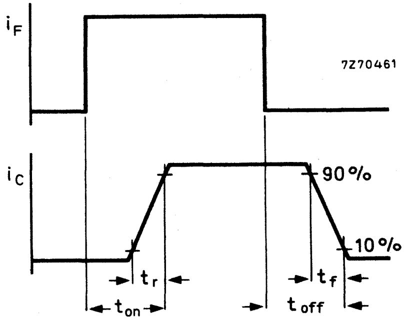

7Z70458
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
V_{CEsat} (V)
1
10^{-1}
10^{-2}
$I_F = 2$ mA
4 mA
6 mA
8 mA
10 mA
15 mA
20 mA
25 mA
30 mA
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2

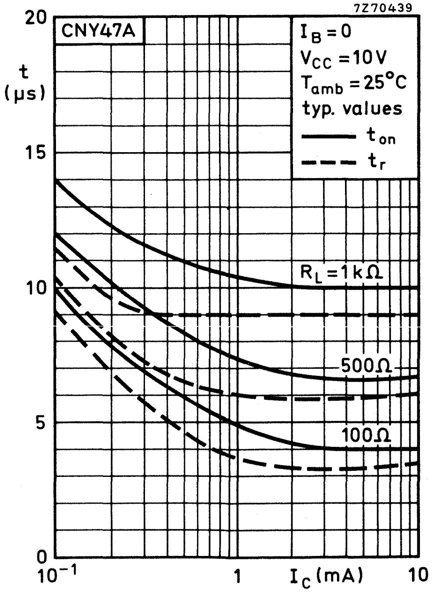

7Z70443
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: $t_p = 50 \mu s$
$T = 500 \mu s$
I_C (mA)
10^2
10
1
10^{-1}
$V_{CE} = 10V$
5V
1V
0,4V
1
10
I_F (mA)
10^2

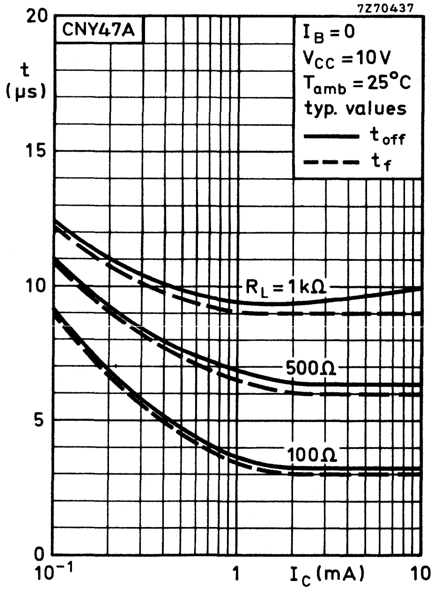

7Z70433
CNY47A
typ. values
$I_B = 0$
$T_{amb} = 25°C$
pulses: $t_p = 50 \mu s$
$T = 500 \mu s$
I_C (mA)
60
40
20
0
$I_F = 30$ mA
25 mA
20 mA
15 mA
10 mA
5 mA
0
5
V_{CE} (V)
10


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


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


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


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
10^{-1}
1
I_C (mA)
10
$R_L = 1\,k\Omega$
500Ω
100Ω


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
10^{-1}
1
I_C (mA)
10
$R_L = 1\,k\Omega$
500Ω
100Ω

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.

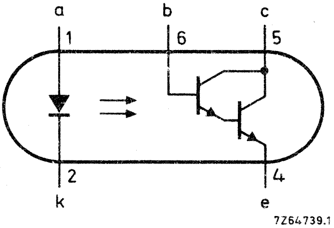
QUICK REFERENCE DATA				
Diode				
Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	60	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	100	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector cut-off current (dark) $V_{CE} = 10$ V; diode : $I_F = 0$	I_{CEO}	<	100	nA
Total power dissipation up to $T_{amb} = 25\ ^oC$	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.

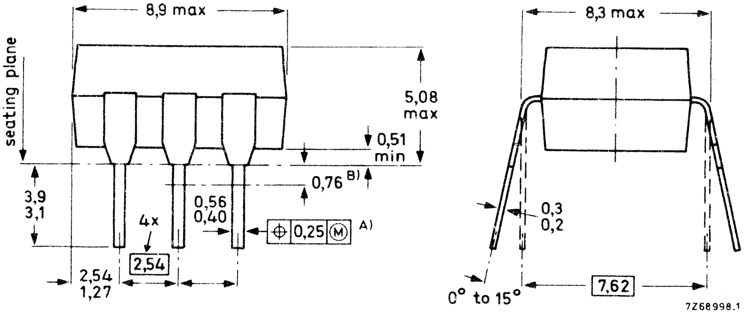
MECHANICAL DATA

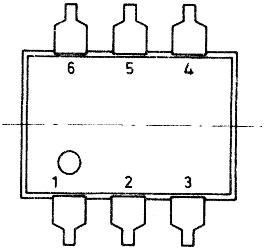
Dimensions in mm

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) $t_p < 10\ \mu s$; 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) $t_p < 100\ \mu s$; 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 $T_j = 25\ ^{\circ}C$					
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: $I_F = 0$) $T_j = 25\ ^{\circ}C$					
Collector cut-off current (dark)					
$V_{CE} = 10$ V	I_{CEO}	<	100	nA	
Photocoupler ($I_B = 0$, $T_{amb} = 25\ ^{\circ}C$ 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

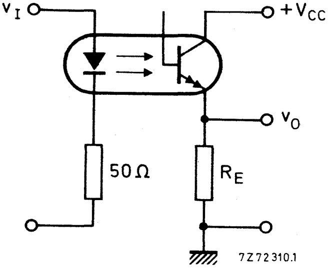
Insulation resistance between input and output

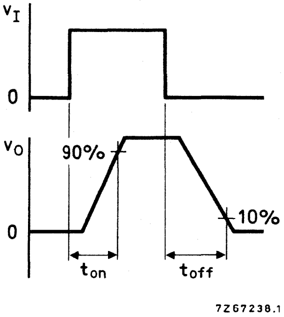
V_{IO} = 1500 V	r_{IO}	typ.	10^{11}	Ω

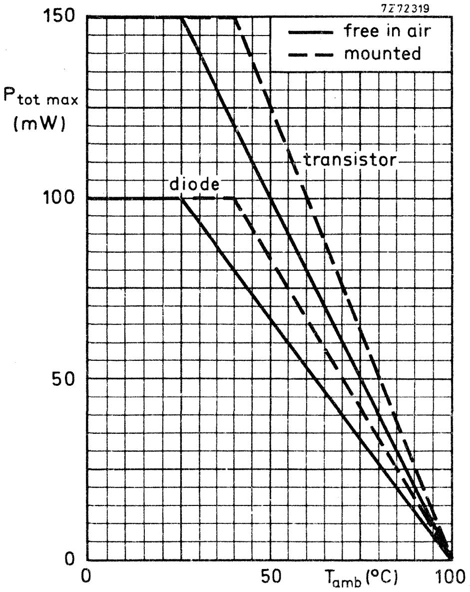
Switching times (circuit below)

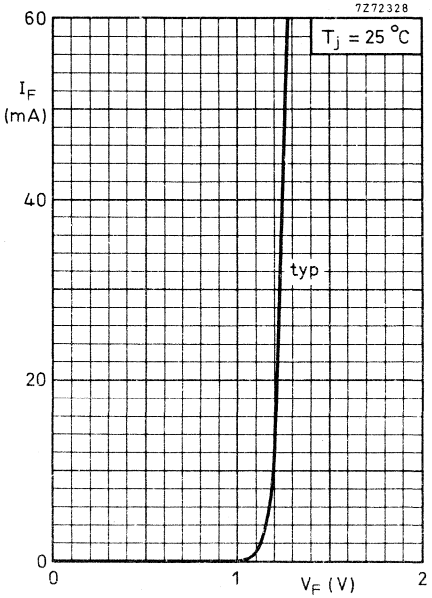
I_{Con} = 10 mA; V_{CC} = 10 V; R_E = 100 Ω

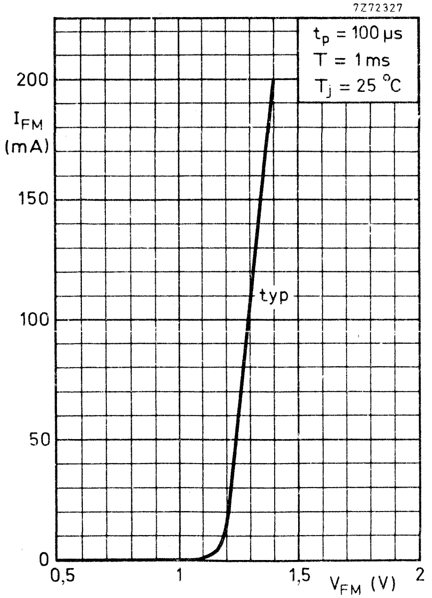
Turn-on time	t_{on}	typ.	68	µs
Turn-off time	t_{off}	typ.	37	µs

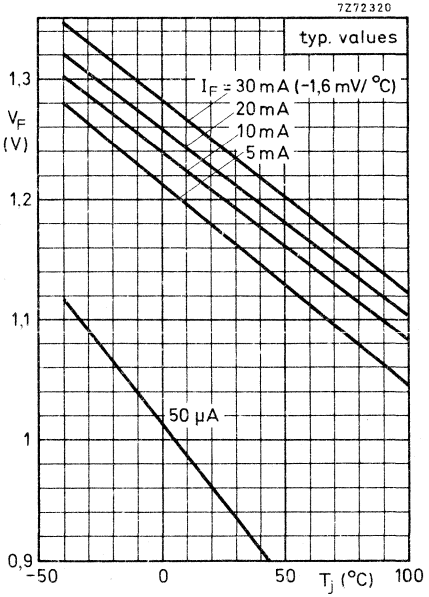


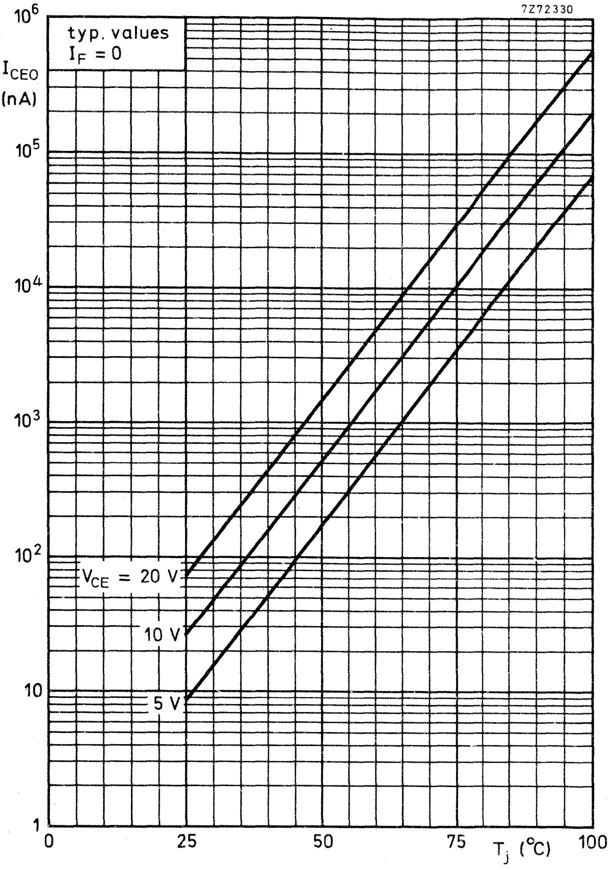


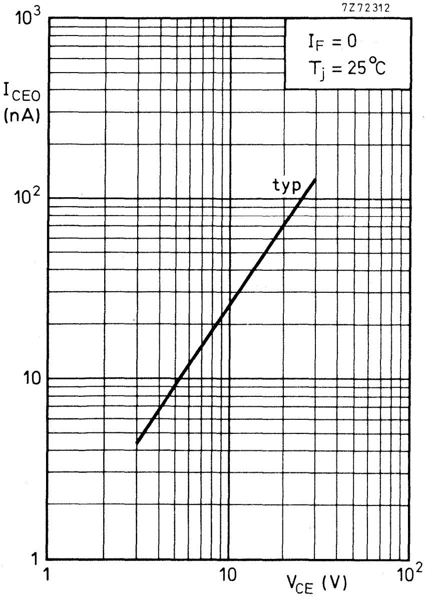

7Z72319
150
100
50
0
Ptot max
(mW)
free in air
mounted
transistor
diode
0
50
Tamb (°C)
100

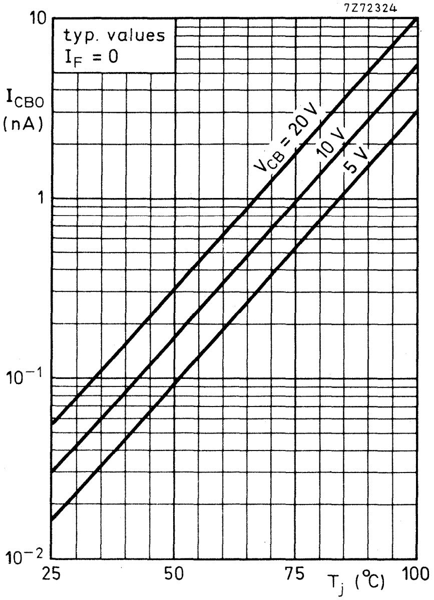

7Z72328
Tj = 25 °C
60
40
20
0
IF
(mA)
typ
0
1
VF (V)
2

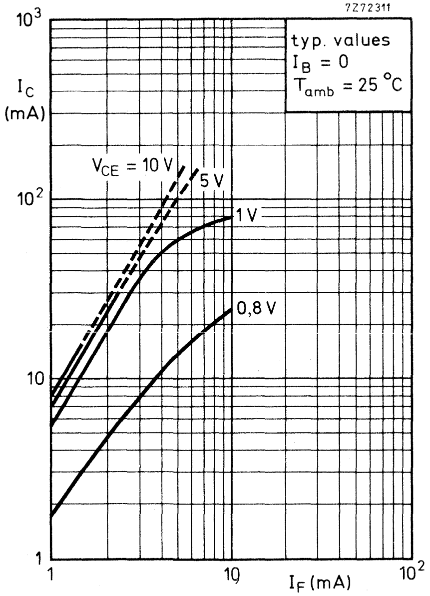

7Z72327
tp = 100 µs
T = 1 ms
Tj = 25 °C
200
150
100
50
0
IFM
(mA)
typ
0,5
1
1,5
VFM (V)
2

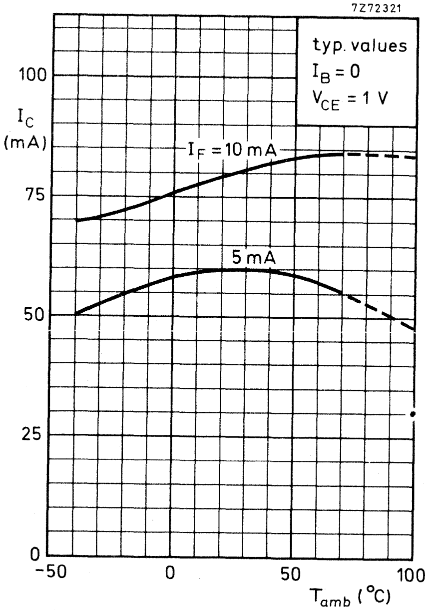

7Z72320
typ. values
IF = 30 mA (−1,6 mV/ °C)
20 mA
10 mA
5 mA
50 µA
1,3
1,2
1,1
1
0,9
VF
(V)
−50
0
50
Tj (°C)
100

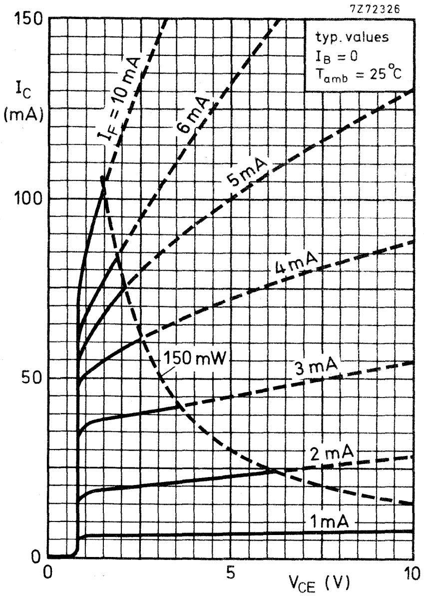

7Z72330
typ. values
$I_F = 0$
I_{CEO} (nA)
10^6
10^5
10^4
10^3
10^2
10
1
V_{CE} = 20 V
10 V
5 V
0
25
50
75
100
T_j (°C)

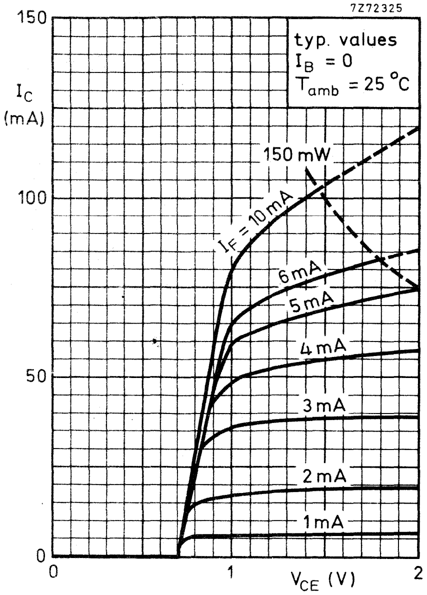

7Z72312
$I_F = 0$
$T_j = 25\,^\circ C$
I_{CEO} (nA)
10^3
10^2
10
1
typ
1
10
V_{CE} (V)
10^2

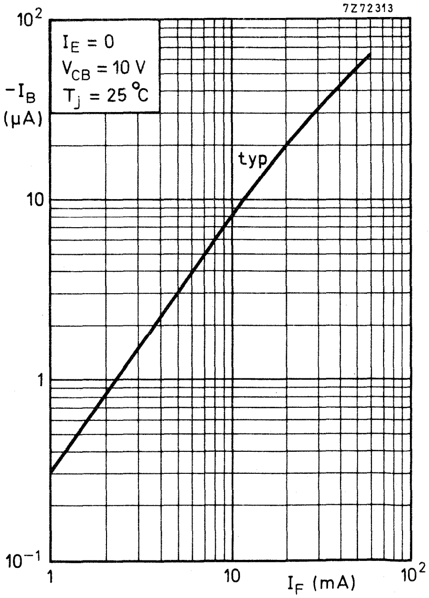

7Z72324
typ. values
$I_F = 0$
I_{CBO} (nA)
10
1
10^{-1}
10^{-2}
$V_{CB} = 20$ V
10 V
5 V
25
50
75
T_j (°C)
100

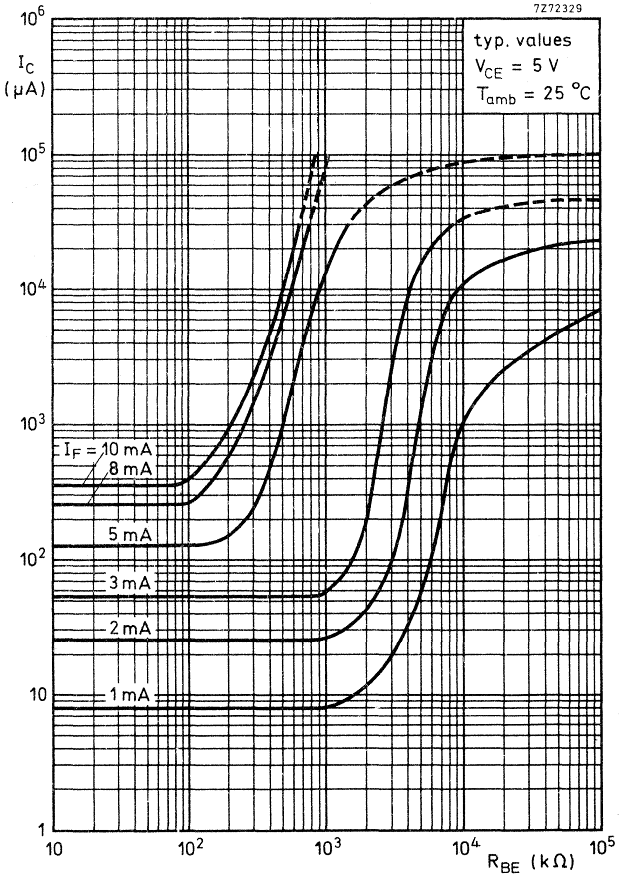

7Z72311
typ. values
$I_B = 0$
$T_{amb} = 25\,^\circ C$
I_C (mA)
10^3
10^2
10
1
$V_{CE} = 10$ V
5 V
1 V
0,8 V
1
10
I_F (mA)
10^2

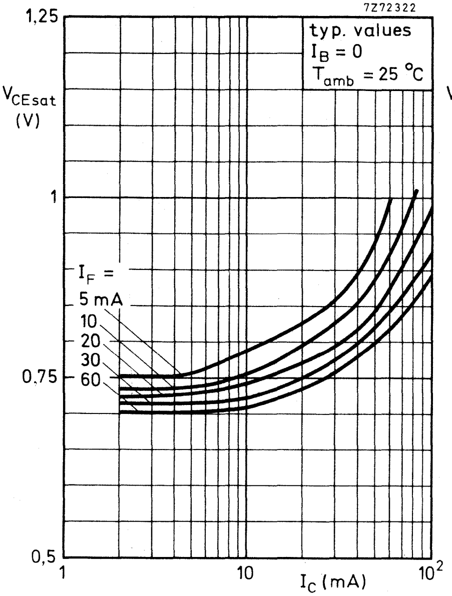

7Z72321
typ. values
$I_B = 0$
$V_{CE} = 1$ V
I_C (mA)
100
75
50
25
0
$I_F = 10$ mA
5 mA
−50
0
50
100
T_{amb} (°C)

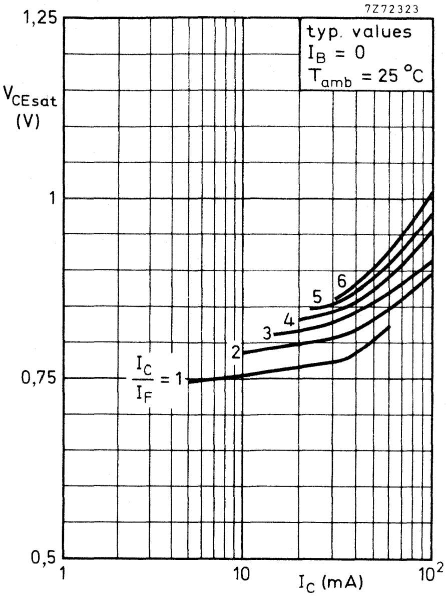

7Z72326
typ. values
$I_B = 0$
$T_{amb} = 25\ ^{\circ}C$
I_C (mA)
150
100
50
0
$I_F = 10$ mA
6 mA
5 mA
4 mA
3 mA
2 mA
1 mA
150 mW
0
5
10
V_{CE} (V)

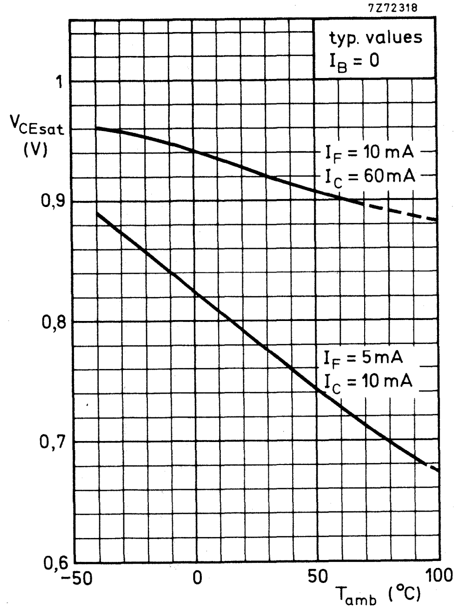

7Z72325
typ. values
$I_B = 0$
$T_{amb} = 25\ ^{\circ}C$
I_C (mA)
150
100
50
0
150 mW
$I_F = 10$ mA
6 mA
5 mA
4 mA
3 mA
2 mA
1 mA
0
1
2
V_{CE} (V)

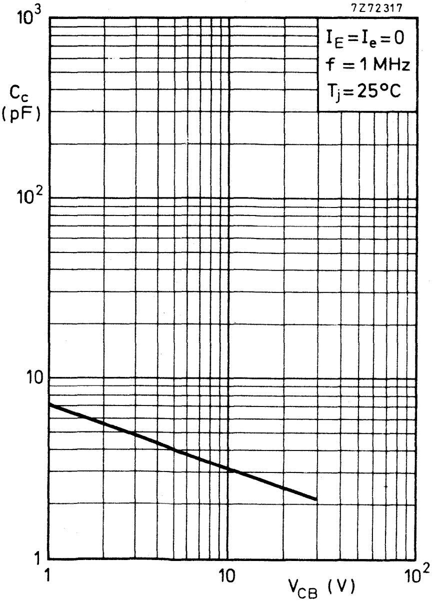

7Z72313
$I_E = 0$
$V_{CB} = 10$ V
$T_j = 25\ ^{\circ}C$
$-I_B$ (μA)
10^2
10
1
10^{-1}
typ
1
10
10^2
I_F (mA)

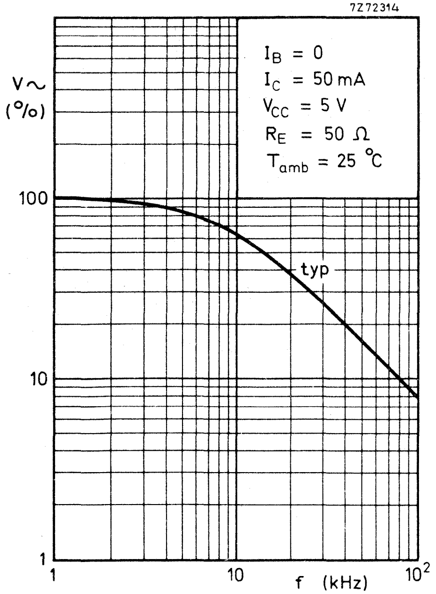

7Z72329
typ. values
V_{CE} = 5 V
T_{amb} = 25 °C
I_C (μA)
10^6
10^5
10^4
10^3
10^2
10
1
I_F = 10 mA
8 mA
5 mA
3 mA
2 mA
1 mA
10
10^2
10^3
10^4
10^5
R_{BE} (kΩ)

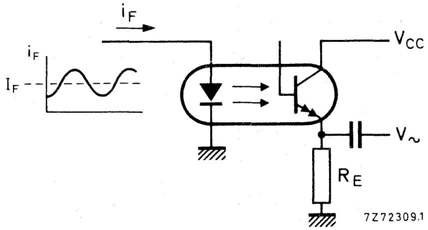

7Z72322
typ. values
$I_B = 0$
$T_{amb} = 25\ ^\circ C$
V_{CEsat} (V)
1,25
1
0,75
0,5
I_F =
5 mA
10
20
30
60
1
10
10^2
I_C (mA)

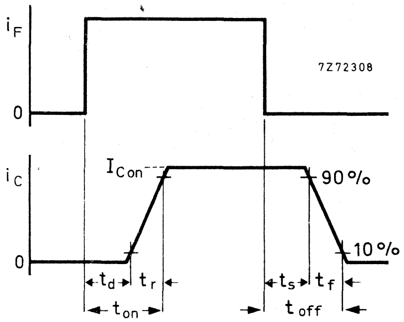

7Z72323
typ. values
$I_B = 0$
$T_{amb} = 25\ ^\circ C$
V_{CEsat} (V)
1,25
1
0,75
0,5
$\frac{I_C}{I_F} = 1$
2
3
4
5
6
1
10
10^2
I_C (mA)

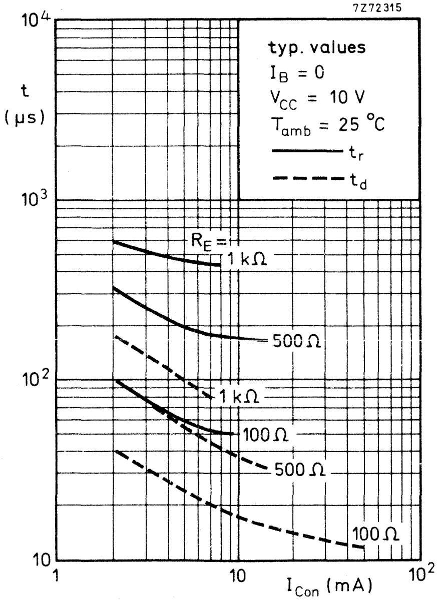

7Z72318
typ. values
$I_B = 0$
V_{CEsat} (V)
1
0,9
0,8
0,7
0,6
$I_F = 10$ mA
$I_C = 60$ mA
$I_F = 5$ mA
$I_C = 10$ mA
−50
0
50
100
T_{amb} (°C)

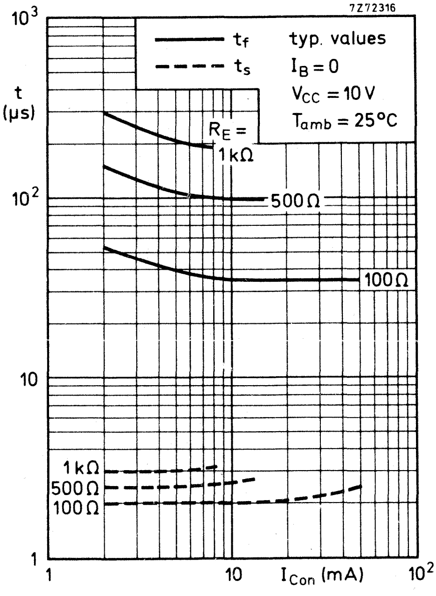

7Z72317
$I_E = I_e = 0$
f = 1 MHz
$T_j = 25°C$
C_c (pF)
10^3
10^2
10
1
1
10
10^2
V_{CB} (V)


7Z72314
V~ (%)
$I_B = 0$
$I_C = 50$ mA
$V_{CC} = 5$ V
$R_E = 50\ \Omega$
$T_{amb} = 25\ ^\circ C$
typ
100
10
1
1
10
10^2
f (kHz)


i_F
i_F
I_F
V_{CC}
V~
R_E
7Z72309.1


i_F
7Z72308
0
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
$T_{amb} = 25\ ^\circ C$
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
$T_{amb} = 25\ ^\circ C$
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√Hz/W
		typ.	2.0×10^8	cm√Hz/W
(500 °K, 800 Hz, 1 Hz)		typ.	6.0×10^7	cm√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)

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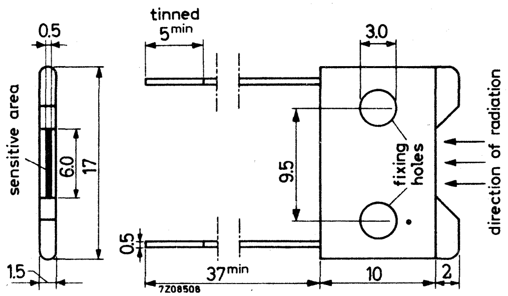
[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

MECHANICAL DATA

Dimensions in mm



NOTES

1. Measuring conditions.

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

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

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

2. D* and N.E.P.

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

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

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

NOTES (continued)

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

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

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

3. Variation of performance with bias current.

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

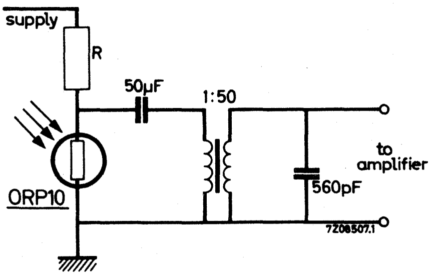
4. Variation of performance with element temperature.

As with all semiconductor photocells, the performance depends on the temperature of the sensitive element. In the case of the ORP10 this is influenced by the ambient temperature and ohmic heating caused by the d.c. bias current. To minimise fluctuations, the element is mounted on a copper base from which it is insulated by a layer of aluminium oxide, and can readily be attached to a large heatsink.
A typical variation of performance with temperature is given on page 5. The curve on page 5 shows the decrease in signal caused by the high current raising the temperature of the element.
On cooling, indium antimonide exhibits improved sensitivity and increased resistance. Below 15 °C this is impractical with the ORP10 unless special precautions are taken to prevent condensation and icing on the exposed element.

5. Warning.

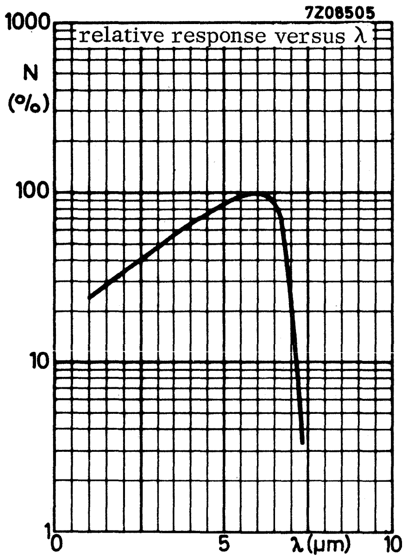
The sensitive surface is unprotected and should not be touched. It is stable in normal atmospheres but should not be exposed to high concentrations of the vapours of organic solvents. Care should be taken to avoid strain when attaching cells to heatsinks.

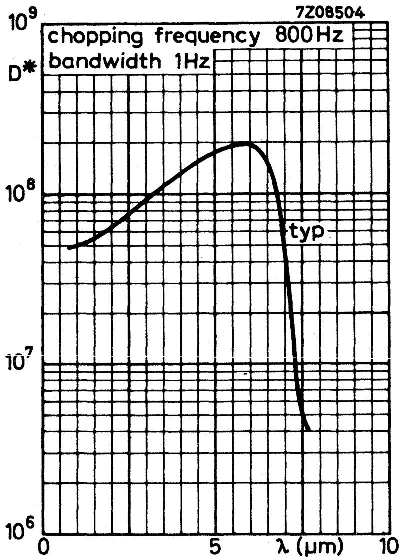
Recommended circuit for use with radiation chopped at 800 Hz.

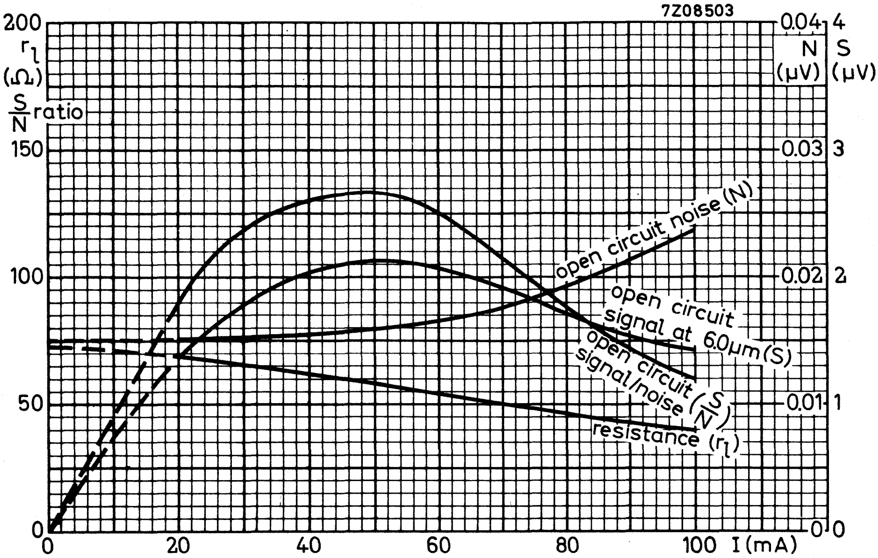


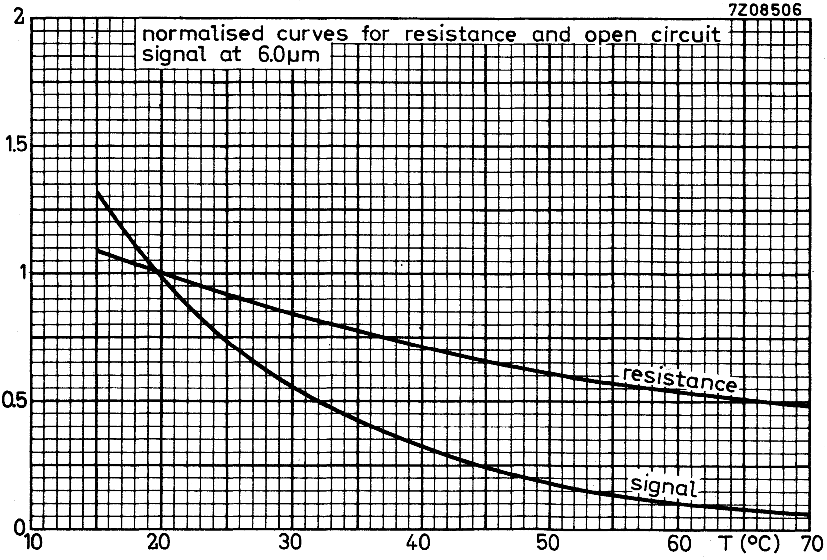
CIRCUIT NOTES

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






7Z08503
200
r_l (Ω)
$\frac{S}{N}$ ratio
150
100
50
0
0
20
40
60
80
100
I (mA)
0.04
0.03
0.02
0.01
0
N (µV)
4
3
2
1
0
S (µV)
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
T (°C)
70
resistance
signal

PHOTOCONDUCTIVE CELL

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

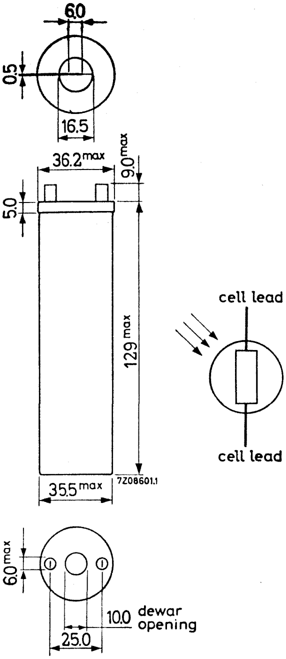
QUICK REFERENCE DATA

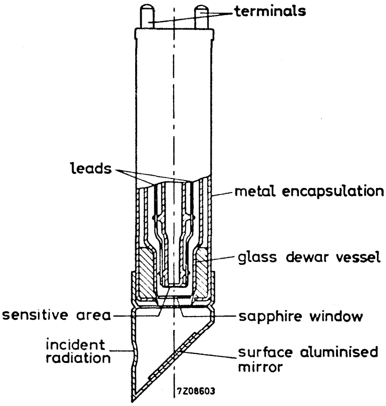
Peak spectral response	λ_m		5.3	µm
Operating temperature	T		77	K
Responsivity (5.3 µm, 800 Hz)		typ.	35	mV/µW
D^* (5.3 µm, 800 Hz, 1 Hz)		typ.	5.5×10^{10}	cm $\sqrt{Hz}$/W
Time constant		typ.	5	µs
Sensitive area			6.0 x 0.5	mm^2

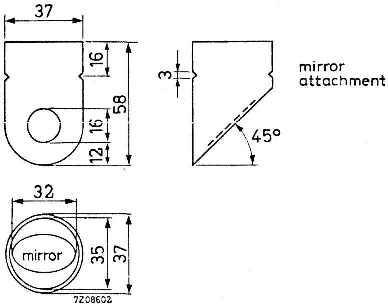
MECHANICAL DATA see page 2

MECHANICAL DATA

Dimensions in mm







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

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

CHARACTERISTICS (see note 1 on page 4)

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

Performance

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

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

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

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

NOTES

1. Test conditions

The detector is cooled to 77K by filling the dewar vessel with liquid nitrogen, or by use of a liquid transfer system. An optimum bias of 250 to 500 μA 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.

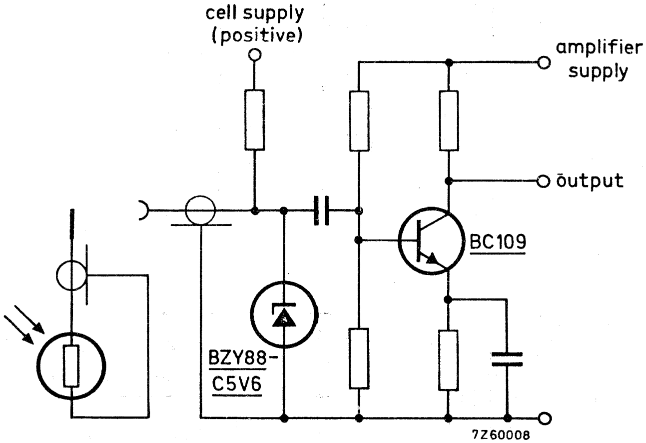
NOTES (continued)

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.

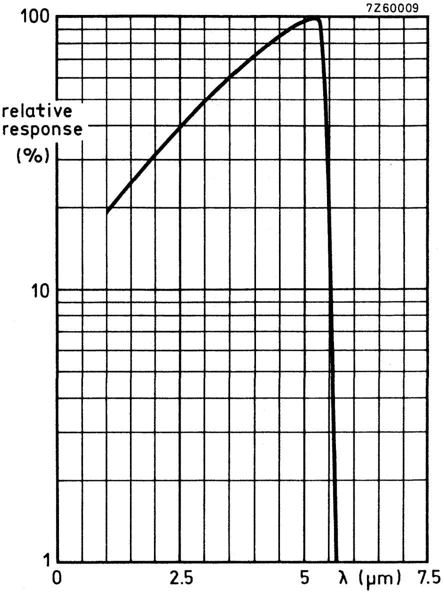
A zener diode can be used to limit the voltage developed across the input capacitor as shown in the diagram.

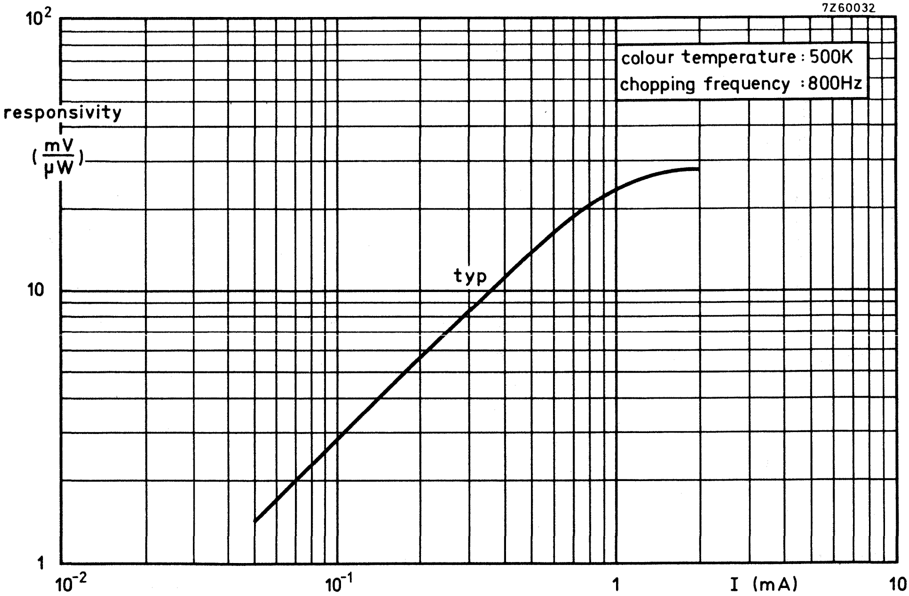


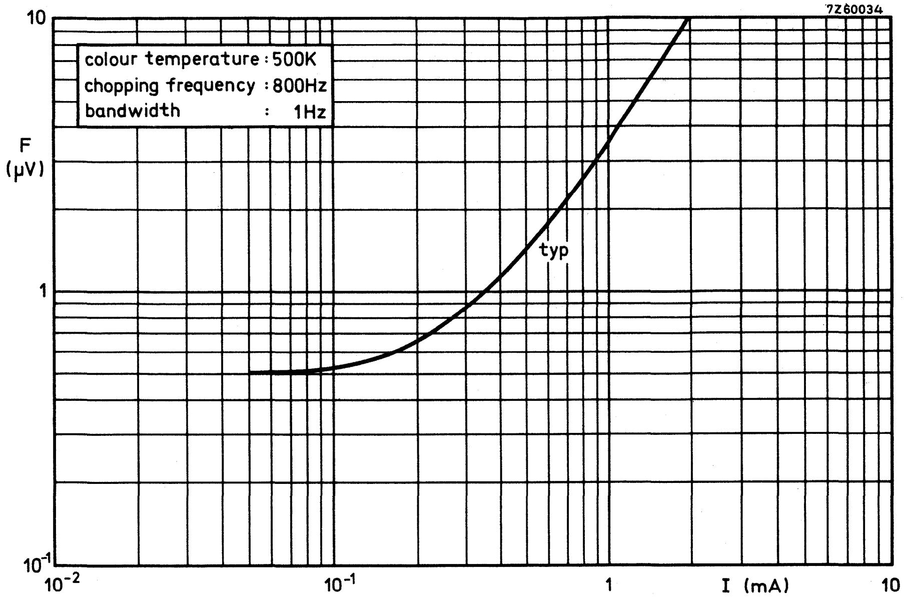
c. The dewar vessel must always be completely dry before being refilled with liquid nitrogen. In humid conditions, water vapour may condense at the top of the dewar. Should this occur, the remaining liquid nitrogen should be allowed to boil off, the ice should be removed carefully and precautions taken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

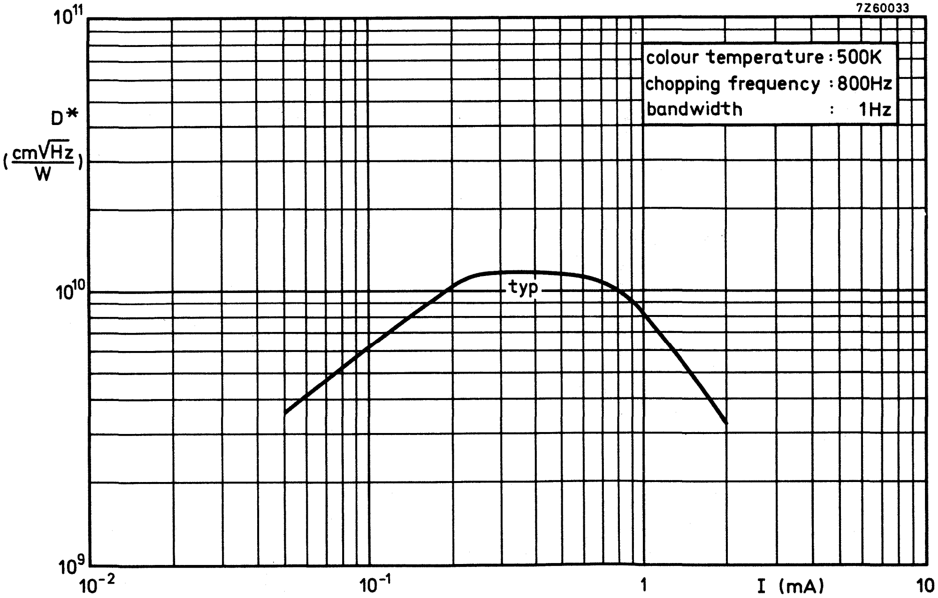
6. Low frequency noise

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


7Z60032
colour temperature : 500K
chopping frequency : 800Hz
responsivity (mV/μW)
10^2
10
1
typ
10^{-2}
10^{-1}
1
I (mA)
10


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


7Z60033
colour temperature : 500K
chopping frequency : 800Hz
bandwidth : 1Hz
D*
$\left(\frac{\mathrm{cm}\sqrt{\mathrm{Hz}}}{\mathrm{W}}\right)$
10^{11}
10^{10}
10^{9}
10^{-2}
10^{-1}
1
I (mA)
10
typ

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.

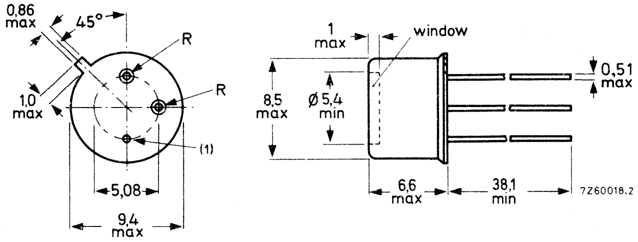
QUICK REFERENCE DATA

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 x 10^8	$\mathrm{cm}\sqrt{\mathrm{Hz}}/\mathrm{W}$
Time constant		typ.	250	μs
Sensitive area			1,0 x 1,0	mm^2

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-5 (except for window).



(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		^{o}C
Operating ambient temperature	T_{amb}	max.	50	^{o}C

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

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

Performance

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

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

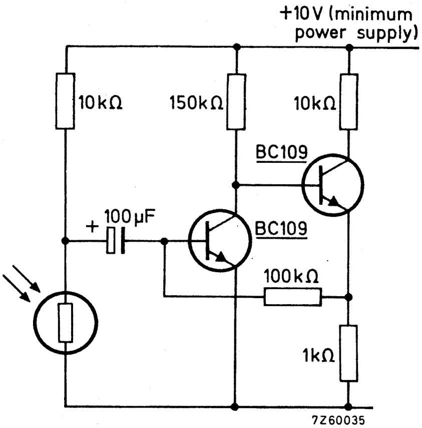
NOTES

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.

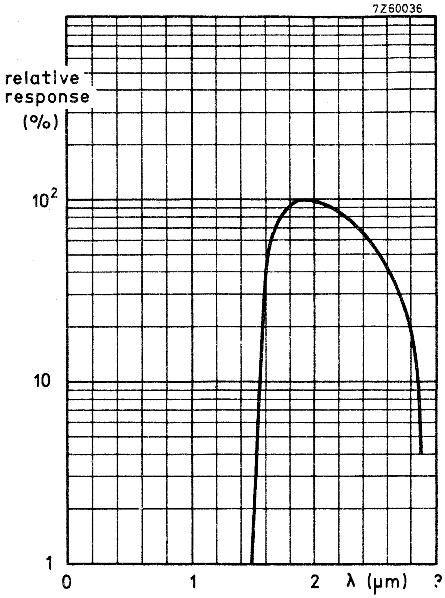
b. Variation of performance with temperature/life

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 (%)
10^2
10
1
0
1
2
λ (μm)
3

PYROELECTRIC INFRARED DETECTORS

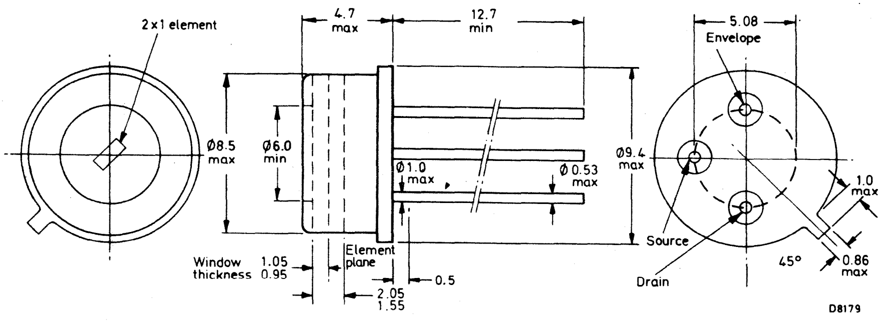
This is an infrared sensitive device, combined with a pre-amplifier which is stabilized to overcome d.c. drift due to thermal changes. It is hermetically sealed with a choice of window in a low-profile TO-5 can.

QUICK REFERENCE DATA

	RPY86	RPY87	
Spectral response	6.5 to 14	1.0 to 15	µm
Responsivity, typ.	(10 µm, 10) 640	(6 µm, 10) 500	 VW^{-1}
Noise Equivalent Power (N.E.P.), typ.	(10 µm, 10, 1) 1.3×10^{-9}	(6 µm, 10, 1) 1.7×10^{-9}	 $WHz^{-1/2}$
Element dimensions	2 × 1		mm
Field of view (to centre of element) typ.	145		degrees
Operating voltage	9		V
Operating frequency	0.01 to 1000		Hz

MECHANICAL DATA Dimensions in mm

SOT-49D



Soldering

1. When making soldered connections to the leads, a thermal shunt must be used.
2. It is essential that any mains operated soldering iron used should be both screened and earthed. Failure to observe these precautions could lead to the introduction of line voltage and possible damage to the device.

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

Operating voltage at 100 °C	max.	30	V
Temperature, operating	max.	+100	°C
	min.	-20	°C
Temperature, storage	max.	+100	°C
	min.	-20	°C

CHARACTERISTICS (at 25 ± 3 °C and with recommended test circuit)

RPY86	min.	typ.	max.	
N.E.P. (500 K, 10, 1)		2.0×10^{-9}		$\mathrm{WHz}^{-1/2}$
N.E.P. (10 μm, 10, 1) 1)		1.3×10^{-9}	3×10^{-9}	$\mathrm{WHz}^{-1/2}$
Responsivity (500 K, 10)		430		VW^{-1}
Responsivity (10 μm, 10) 1)		640		VW^{-1}
Spectral response	6.5 ± 0.5		>14	μm
Field of view (from centre of element)	135	145	155	degrees
Operating voltage 2)	8	9	10	V

RPY87	min.	typ.	max.	
N.E.P. (500 K, 10, 1) or (6 μm, 10, 1)		1.7×10^{-9}	3×10^{-9}	$\mathrm{WHz}^{-1/2}$
Responsivity (500 K, 10) or (6 μm, 10)		500		VW^{-1}
Spectral response	1.0		>15	μm
Field of view (from centre of element)	135	145	155	degrees
Operating voltage 2)	8	9	10	V

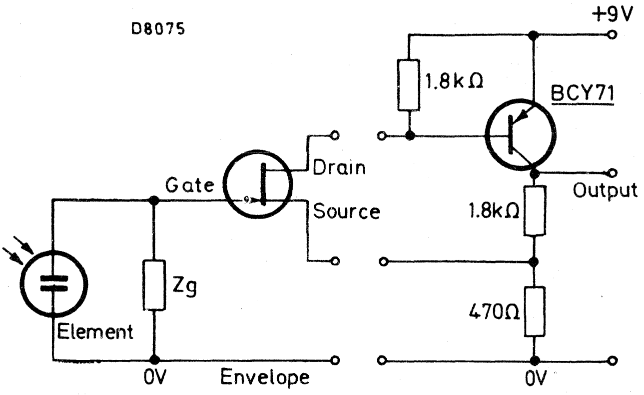
---

1) These characteristics apply throughout the spectral response range.

2) The detector will operate outside the quoted range but may have a degraded performance.

3) For performance as a function of frequency, see pages 6 and 8.

Test circuit



OPERATING NOTES

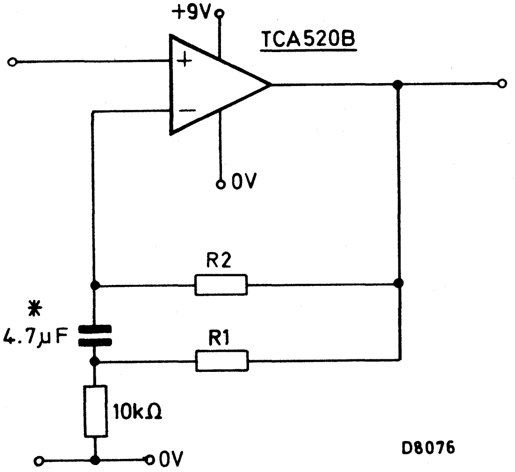
1. The detector is supplied with a black plastic cap to protect the window. This cap must be removed before operation.
2. The case potential must not be allowed to become positive with respect to the other two terminals.
3. The shape of the electrical output waveform is the integral of the incident radiation waveform.
4. It is inadvisable to operate the detector at mains related frequencies.
5. To avoid the possibility of optical microphony, the detector must be firmly mounted.
6. Use recommended circuit for low noise operation.
7. An increase in temperature of the element will produce a negative going signal at the output.

DEFINITIONS

1. N.E.P. (Noise Equivalent Power), $WHz^{-\frac{1}{2}}$
   This is the r.m.s. value of the incident, chopped, radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $VHz^{-\frac{1}{2}}$
2. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped, radiant power.

APPLICATION INFORMATION

1. Optional additional stage for extra gain.

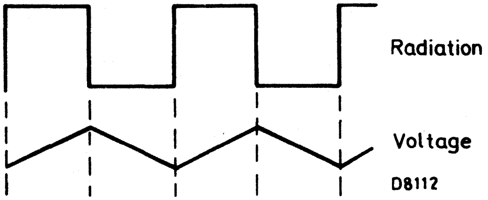


*this capacitor must be a low leakage type e.g. our 344 series

The following table gives recommended component values for various gains.

Gain ×	R1 kΩ	R2 MΩ
50	560	5.6
20	220	2.2
10	100	1.0

2. The pyroelectric element may be considered as a capacitor whose charge state changes with temperature. It also behaves as a normal capacitor, i.e. its voltage changes with charge. Thus a change of temperature results in a change of charge. It can be seen that, for a given change in amplitude of incident radiation, the resulting change in temperature will decrease as the chopping frequency increases. Thus the voltage change will also decrease with frequency. In addition, there is a 90^{0} phase lag between the thermal and electrical signals. The voltage signal therefore becomes the integral of the radiation signal.



3. Temperature slew

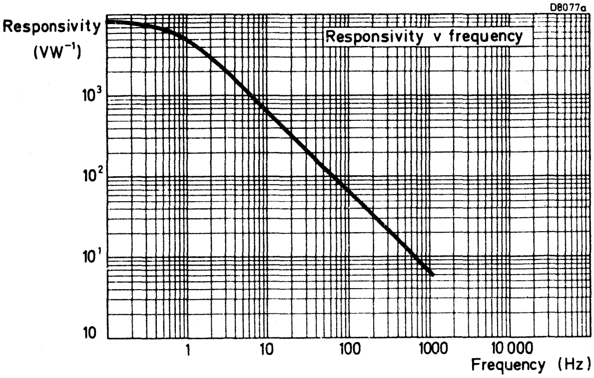
The FET used with a pyroelectric detector requires a gate leakage resistor to earth in parallel with the element. This stabilizes its working point. The pyroelectric voltage appearing across this resistor is proportional to the rate of change of temperature.

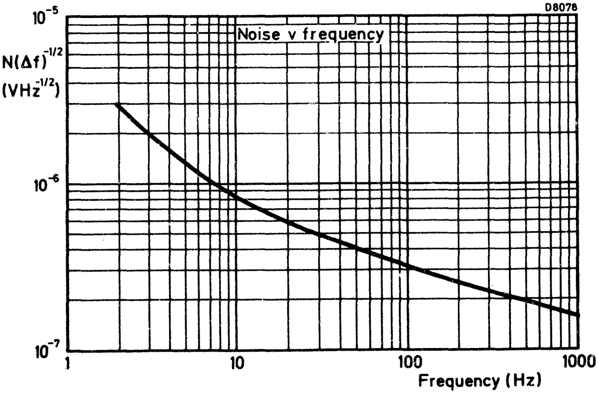
To ensure a low level of noise current from this resistor, its value should be of the order of 3×10^{10} Ω. When the temperature slew rate is 1 °C/minute, the pyroelectric voltage produced is 1 Volt. In a system which is designed to sense microvolts, this is almost certain to cause overload and any a.c. signal superimposed on this d.c. shift will be lost.

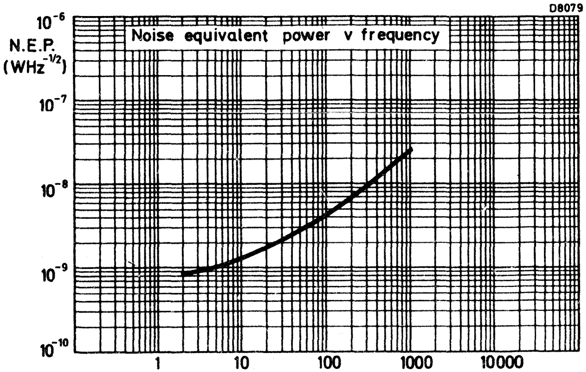
Our detectors incorporate a bleed system which acts progressively on the d.c. shift caused by temperature slew. The law is logarithmic.

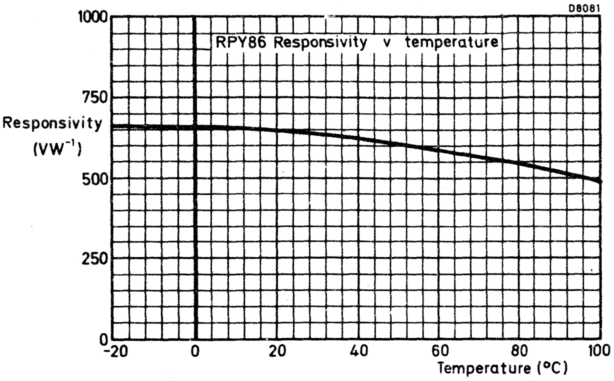
Thus a slew rate of 0.1 °C/minute may produce an offset across the sensing element of 200 millivolts, 1 °C/minute 280 millivolts and 10 °C/minute 360 millivolts.

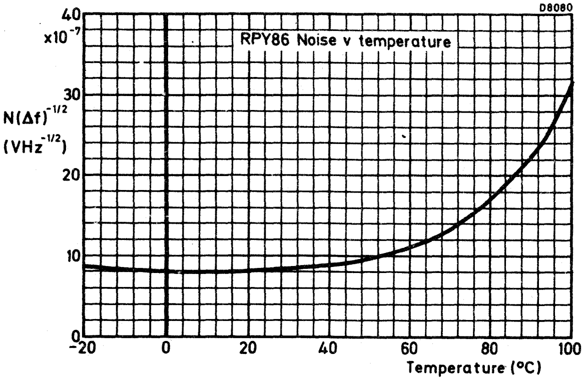
RPY86

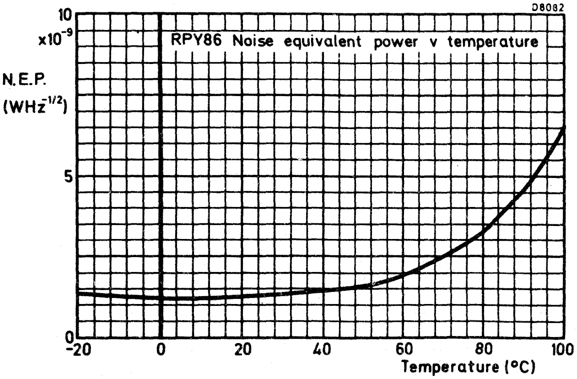

D8077a
Responsivity v frequency
Responsivity
(VW^{-1})
10^3
10^2
10^1
10
1
10
100
1000
10 000
Frequency (Hz)


D8078
Noise v frequency
10^{-5}
N(Δf)$^{-1/2}$
(VHz$^{-1/2}$)
10^{-6}
10^{-7}
1
10
100
1000
Frequency (Hz)

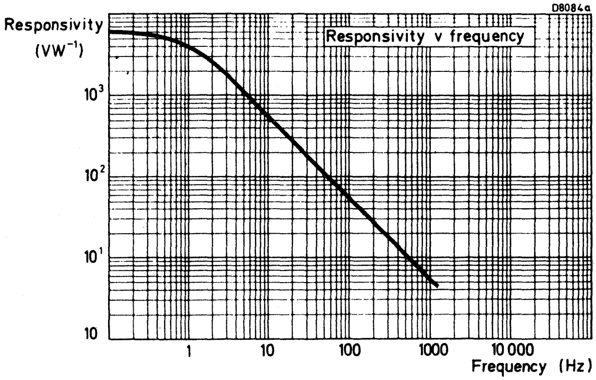

D8079
Noise equivalent power v frequency
10^{-6}
N.E.P.
(WHz$^{-1/2}$)
10^{-7}
10^{-8}
10^{-9}
10^{-10}
1
10
100
1000
10000
Frequency (Hz)

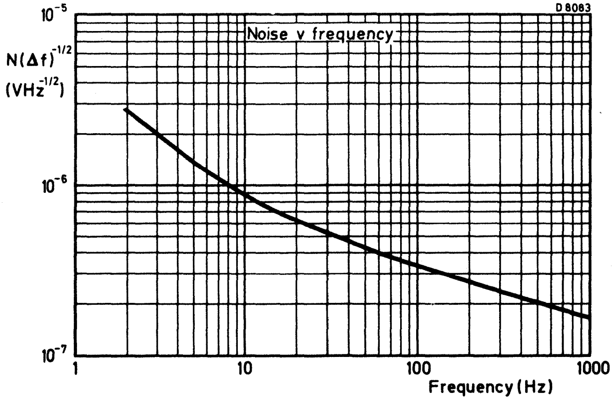

D8081
RPY86 Responsivity v temperature
Responsivity
(VW⁻¹)
1000
750
500
250
0
-20
0
20
40
60
80
100
Temperature (°C)

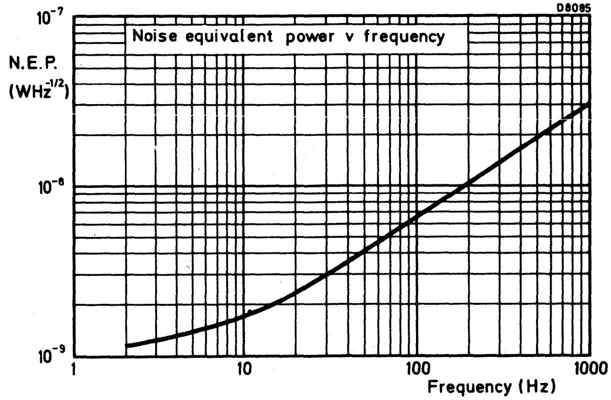

D8080
RPY86 Noise v temperature
40
x10⁻⁷
30
N(Δf)⁻¹ᐟ²
(VHz⁻¹ᐟ²)
20
10
0
-20
0
20
40
60
80
100
Temperature (°C)

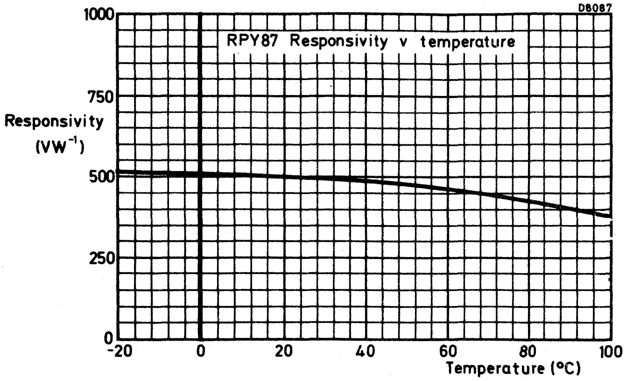

D8082
RPY86 Noise equivalent power v temperature
10
x10⁻⁹
N.E.P.
(WHz⁻¹ᐟ²)
5
0
-20
0
20
40
60
80
100
Temperature (°C)

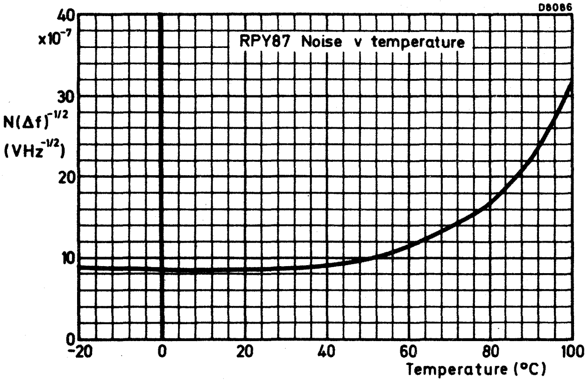
RPY87

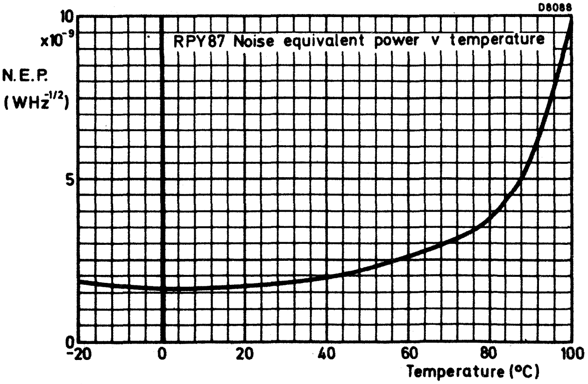

D8084a
Responsivity
(VW^{-1})
Responsivity v frequency
10^3
10^2
10^1
10
1
10
100
1000
10 000
Frequency (Hz)

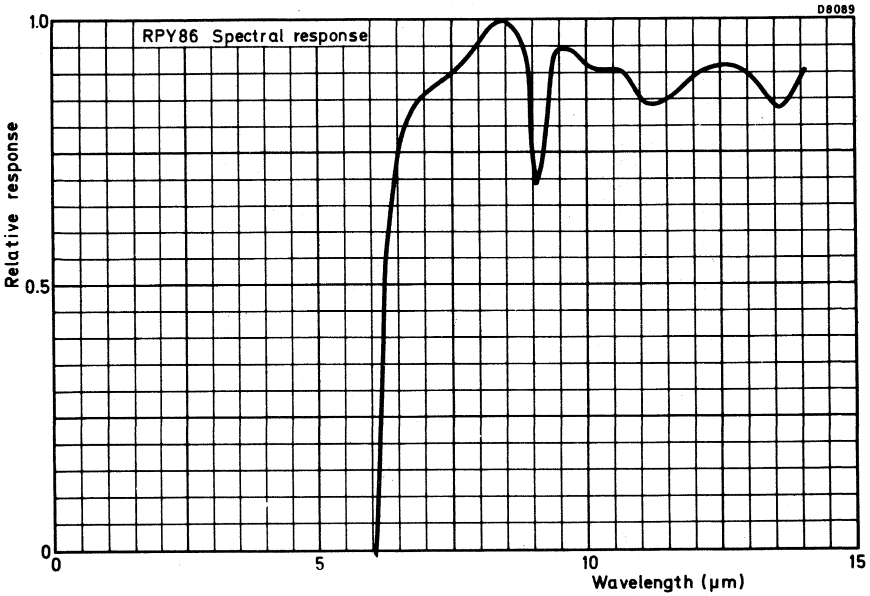

D 8083
10^{-5}
N(Δf)$^{-1/2}$
(VHz$^{-1/2}$)
Noise v frequency
10^{-6}
10^{-7}
1
10
100
1000
Frequency (Hz)

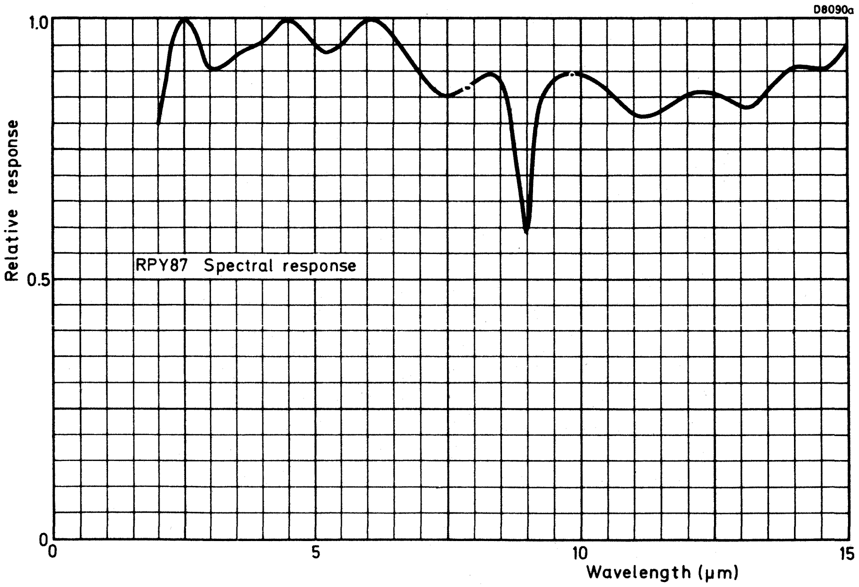

D8085
10^{-7}
Noise equivalent power v frequency
N.E.P.
(WHz$^{-1/2}$)
10^{-8}
10^{-9}
1
10
100
1000
Frequency (Hz)


D8087
RPY87 Responsivity v temperature
Responsivity (VW^{-1})
1000
750
500
250
0
-20
0
20
40
60
80
100
Temperature (°C)


D8086
RPY87 Noise v temperature
$N(\Delta f)^{-1/2}$ (VHz$^{-1/2}$)
40 x10^{-7}
30
20
10
0
-20
0
20
40
60
80
100
Temperature (°C)


D8088
RPY87 Noise equivalent power v temperature
N.E.P. (WHz$^{-1/2}$)
10 x10^{-9}
5
0
-20
0
20
40
60
80
100
Temperature (°C)


D8089
RPY86 Spectral response
Relative response
1.0
0.5
0
0
5
10
15
Wavelength (μm)


D8090a
RPY87 Spectral response
Relative response
1.0
0.5
0
0
5
10
15
Wavelength (μm)

PYROELECTRIC INFRARED DETECTORS

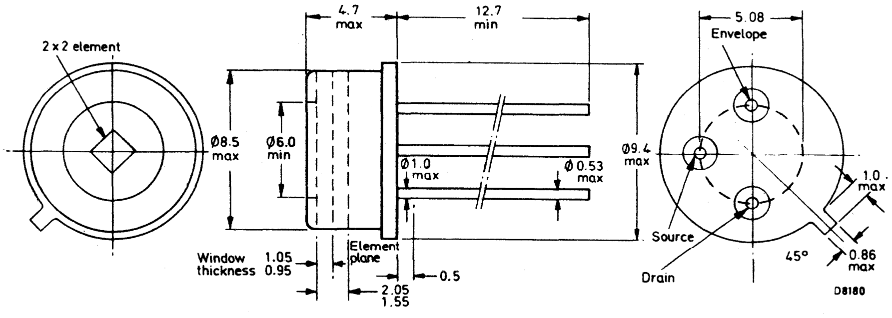
This is an infrared sensitive device, combined with a pre-amplifier which is stabilized to overcome d.c. drift due to thermal changes. It is hermetically sealed with a choice of window in a low-profile TO-5 can.

QUICK REFERENCE DATA

	RPY88	RPY89	
Spectral response	6.5 to 14	1.0 to 15	μm
Responsivity,	(10 μm, 10)	(6 μm, 10)	
typ.	320	250	VW^{-1}
Noise Equivalent Power (N.E.P.)	(10 μm, 10, 1)	(6 μm, 10, 1)	
typ.	2.0×10^{-9}	2.5×10^{-9}	$WHz^{-½}$
Element dimensions	2 × 2		mm
Field of view (to centre of element)			
typ.	145		degrees
Operating voltage	9		V
Operating frequency	0.01 to 1000		Hz

MECHANICAL DATA Dimensions in mm

SOT-49D



Soldering

1. When making soldered connections to the leads, a thermal shunt must be used.
2. It is essential that any mains operated soldering iron used should be both screened and earthed. Failure to observe these precautions could lead to the introduction of line voltage and possible damage to the device.

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

Operating voltage at 100 °C	max.	30	V
Temperature, operating	max. min.	+100 -20	°C °C
Temperature, storage	max. min.	+100 -20	°C °C

CHARACTERISTICS (at 25 ± 3 °C and with recommended test circuit)

RPY88	min.	typ.	max.	
N.E.P. (500 K, 10, 1)		3.0×10^{-9}		$\mathrm{WHz}^{-1/2}$
N.E.P. (10 μm, 10, 1) 1)		2.0×10^{-9}	3×10^{-9}	$\mathrm{WHz}^{-1/2}$
Responsivity (500 K, 10)		215		VW^{-1}
Responsivity (10 μm, 10) 1)		320		VW^{-1}
Spectral response	6.5 ± 0.5		>14	μm
Field of view (from centre of element)	135	145	155	degrees
Operating voltage 2)	8	9	10	V

RPY89	min.	typ.	max.	
N.E.P. (500 K, 10, 1) or (6 μm, 10, 1)		2.5×10^{-9}	3×10^{-9}	$\mathrm{WHz}^{-1/2}$
Responsivity (500 K, 10) or (6 μm, 10)		250		VW^{-1}
Spectral response	1.0		>15	μm
Field of view (from centre of element)	135	145	155	degrees
Operating voltage 2)	8	9	10	V

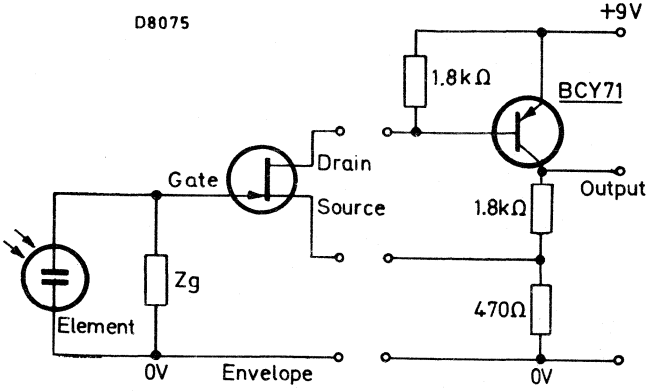
---

1) These characteristics apply throughout the spectral response range.

2) The detector will operate outside the quoted range but may have a degraded performance.

3) For performance as a function of frequency, see pages 6 and 8.

Test circuit



OPERATING NOTES

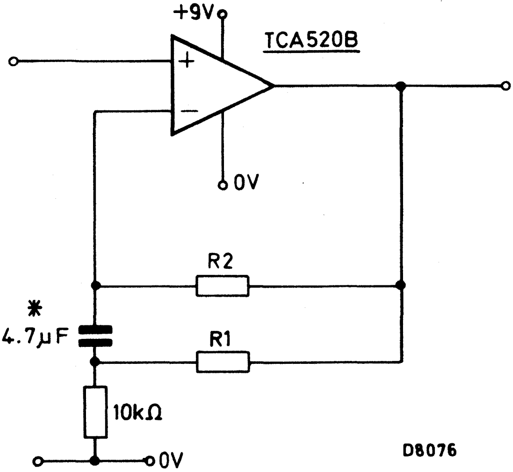
1. The detector is supplied with a black plastic cap to protect the window. This cap must be removed before operation.
2. The case potential must not be allowed to become positive with respect to the other two terminals.
3. The shape of the electrical output waveform is the integral of the incident radiation waveform.
4. It is inadvisable to operate the detector at mains related frequencies.
5. To avoid the possibility of optical microphony, the detector must be firmly mounted.
6. Use recommended circuit for low noise operation.
7. An increase in temperature of the element will produce a negative going signal at the output.

DEFINITIONS

1. N.E.P. (Noise Equivalent Power), $\mathrm{WHz}^{-\frac{1}{2}}$
   This is the r.m.s. value of the incident, chopped, radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $\mathrm{VHz}^{-\frac{1}{2}}$
2. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped, radiant power.

APPLICATION INFORMATION

1. Optional additional stage for extra gain.

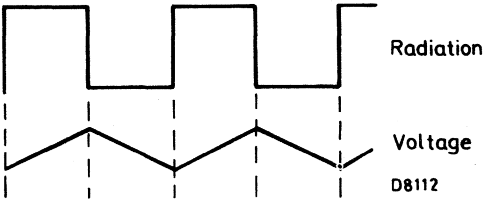


*this capacitor must be a low leakage type e.g. our 344 series

The following table gives recommended component values for various gains.

Gain ×	R1 kΩ	R2 MΩ
50	560	5.6
20	220	2.2
10	100	1.0

2. The pyroelectric element may be considered as a capacitor whose charge state changes with temperature. It also behaves as a normal capacitor, i.e. its voltage changes with charge. Thus a change of temperature results in a change of charge.
   It can be seen that, for a given change in amplitude of incident radiation, the resulting change in temperature will decrease as the chopping frequency increases. Thus the voltage change will also decrease with frequency. In addition, there is a 90° phase lag between the thermal and electrical signals. The voltage signal therefore becomes the integral of the radiation signal.



3. Temperature slew

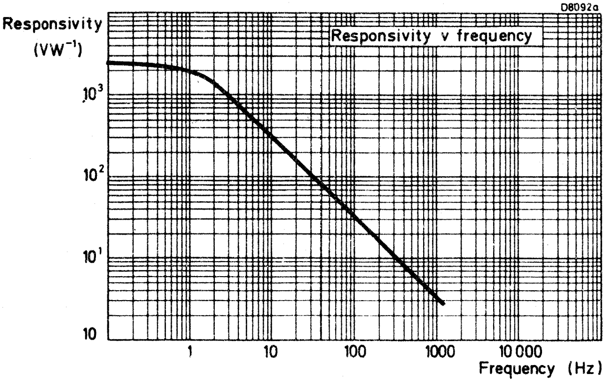
The FET used with a pyroelectric detector requires a gate leakage resistor to earth in parallel with the element. This stabilizes its working point. The pyroelectric voltage appearing across this resistor is proportional to the rate of change of temperature.

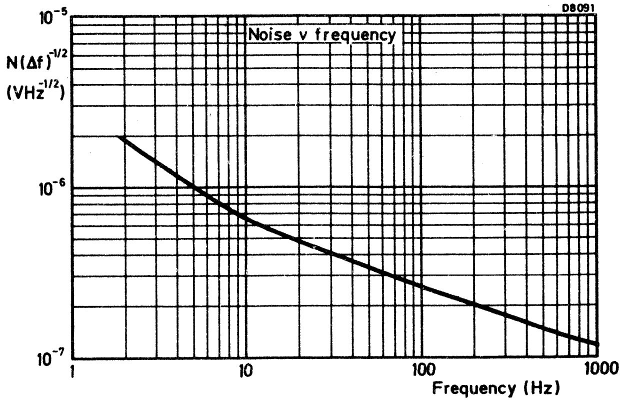
To ensure a low level of noise current from this resistor, its value should be of the order of $3 \times 10^{10}\ \Omega$. When the temperature slew rate is 1 °C/minute, the pyroelectric voltage produced is 1 Volt. In a system which is designed to sense microvolts, this is almost certain to cause overload and any a.c. signal superimposed on this d.c. shift will be lost.

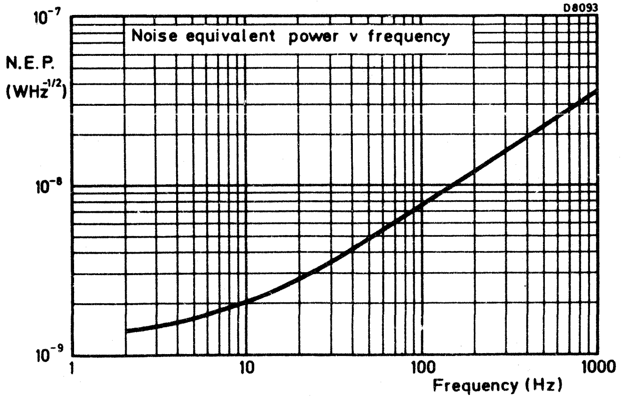
Our detectors incorporate a bleed system which acts progressively on the d.c. shift caused by temperature slew. The law is logarithmic.

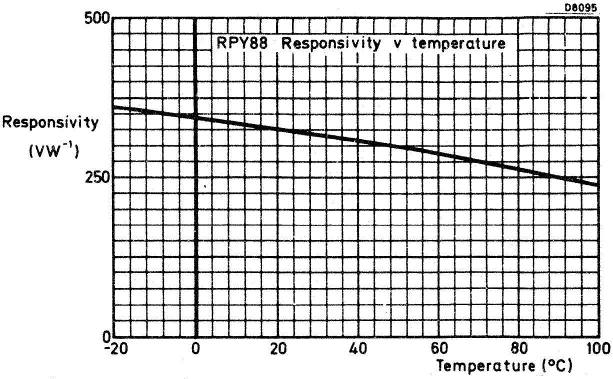
Thus a slew rate of 0.1 °C/minute may produce an offset across the sensing element of 200 millivolts, 1 °C/minute 280 millivolts and 10 °C/minute 360 millivolts.

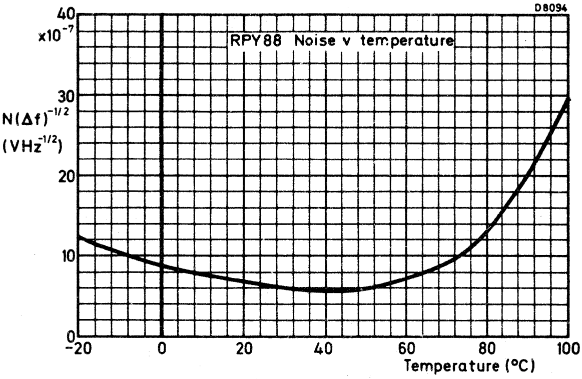
RPY88

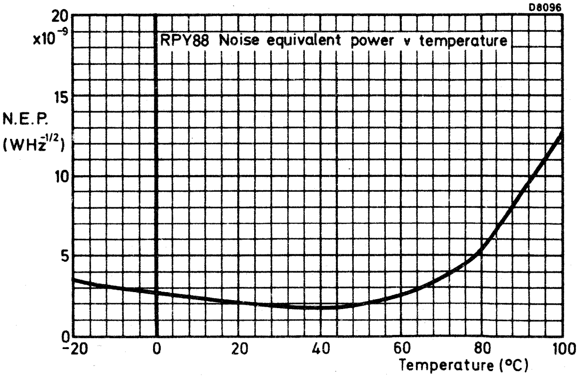

D8092a
Responsivity v frequency
Responsivity
(VW⁻¹)
10³
10²
10¹
10
1
10
100
1000
10 000
Frequency (Hz)


D8091
Noise v frequency
10⁻⁵
N(Δf)⁻¹ᐟ²
(VHz⁻¹ᐟ²)
10⁻⁶
10⁻⁷
1
10
100
1000
Frequency (Hz)

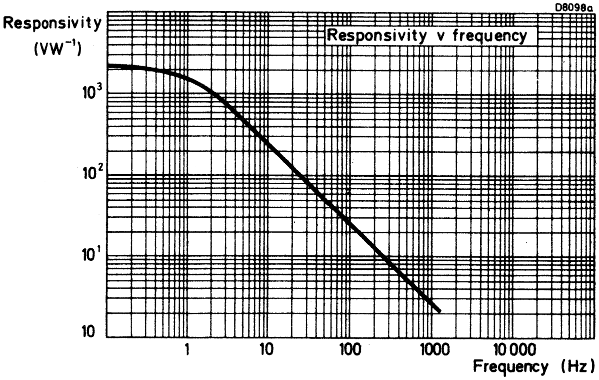

D8093
Noise equivalent power v frequency
10⁻⁷
N.E.P.
(WHz⁻¹ᐟ²)
10⁻⁸
10⁻⁹
1
10
100
1000
Frequency (Hz)

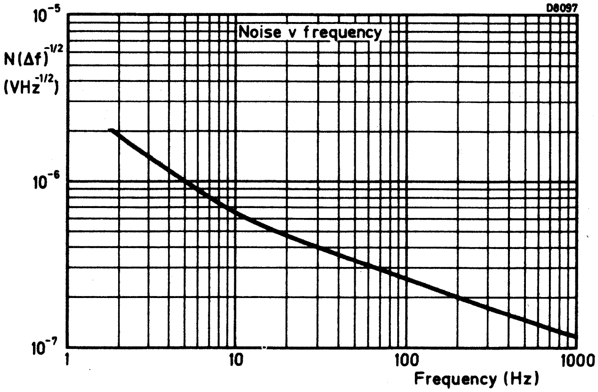

D8095
RPY88 Responsivity v temperature
Responsivity
(VW⁻¹)
500
250
0
-20
0
20
40
60
80
100
Temperature (°C)

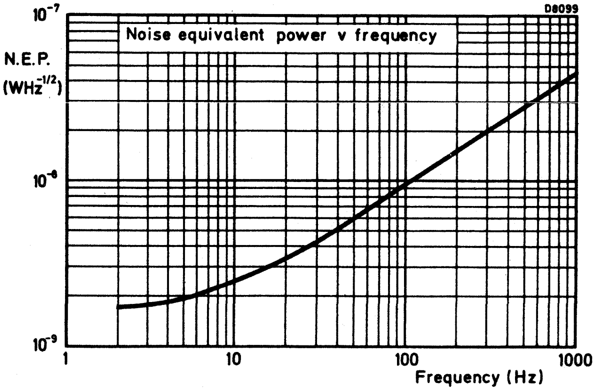

D8094
RPY88 Noise v temperature
N(Δf)^-1/2
(VHz^-1/2)
40
x10^-7
30
20
10
0
-20
0
20
40
60
80
100
Temperature (°C)

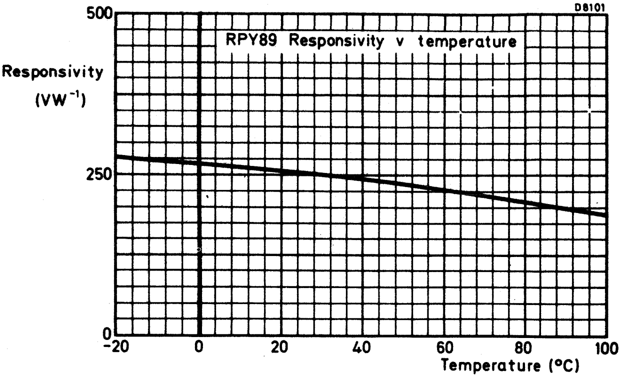

D8096
RPY88 Noise equivalent power v temperature
N.E.P.
(WHz^-1/2)
20
x10^-9
15
10
5
0
-20
0
20
40
60
80
100
Temperature (°C)

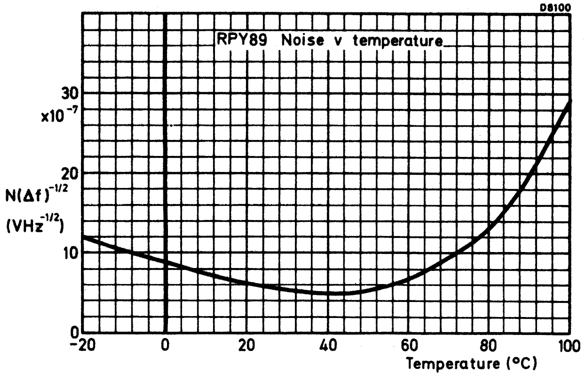
RPY89

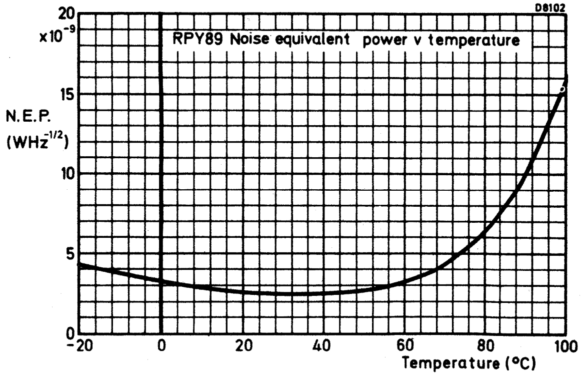

D8098a
Responsivity (VW^{-1})
Responsivity v frequency
10^3
10^2
10^1
10
1
10
100
1000
10 000
Frequency (Hz)

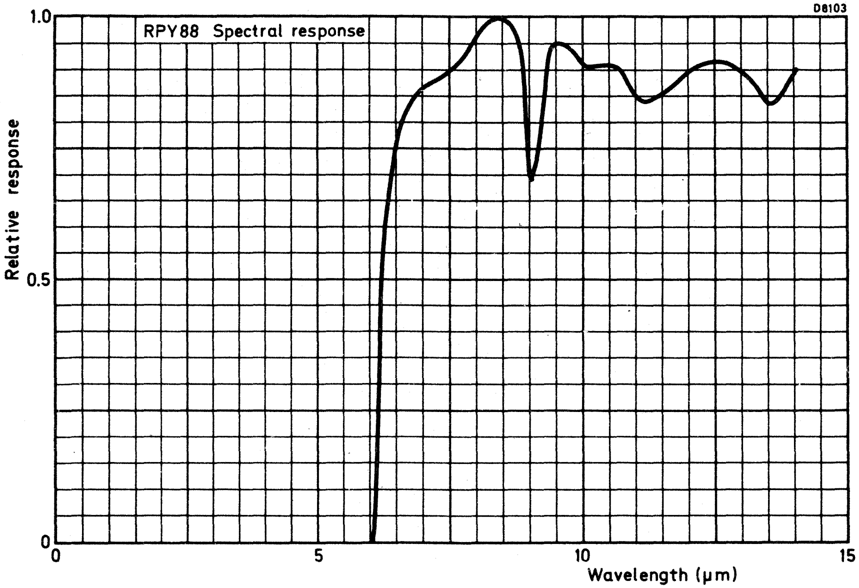

D8097
10^{-5}
N(Δf)$^{-1/2}$ (VHz$^{-1/2}$)
Noise v frequency
10^{-6}
10^{-7}
1
10
100
1000
Frequency (Hz)

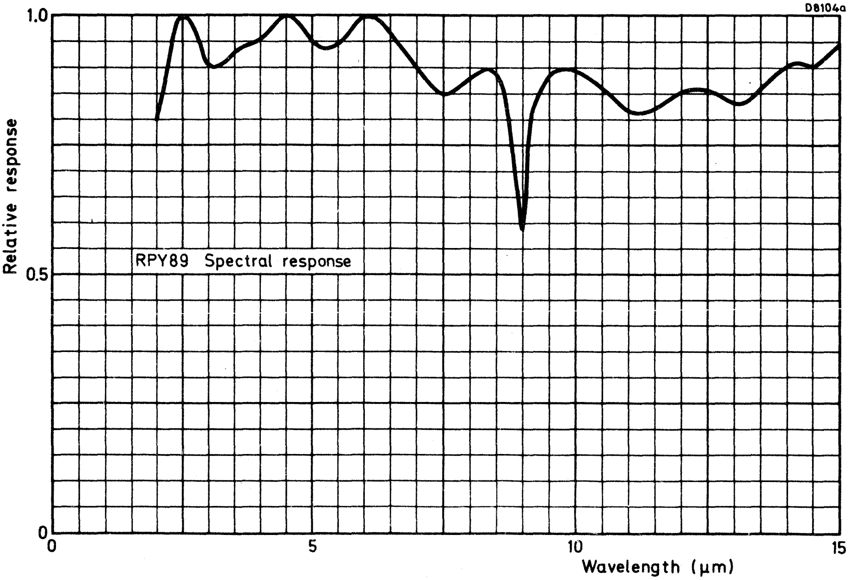

D8099
10^{-7}
N.E.P. (WHz$^{-1/2}$)
Noise equivalent power v frequency
10^{-8}
10^{-9}
1
10
100
1000
Frequency (Hz)


D8101
RPY89 Responsivity v temperature
Responsivity
(VW^{-1})
500
250
0
-20
0
20
40
60
80
100
Temperature (°C)


D8100
RPY89 Noise v temperature
30
x10^{-7}
20
N(Δf)$^{-1/2}$
(VHz$^{-1/2}$)
10
0
-20
0
20
40
60
80
100
Temperature (°C)


D8102
RPY89 Noise equivalent power v temperature
20
x10^{-9}
15
N.E.P.
(WHz$^{-1/2}$)
10
5
0
-20
0
20
40
60
80
100
Temperature (°C)


D8103
RPY88 Spectral response
Relative response
1.0
0.5
0
0
5
10
15
Wavelength (µm)


D8104a
RPY89 Spectral response
Relative response
1.0
0.5
0
0
5
10
15
Wavelength (µm)

PHOTOCONDUCTIVE CELL

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

QUICK REFERENCE DATA

Peak spectral response	λ_m		2,2	μm
Spectral response range	λ		0,3 to 3,5	μm
Internal resistance	r_i	typ.	1,5	MΩ
Responsivity (radiation 2,0 μm)		typ.	80	mV/μW
D^* (2,0 μm, 800 Hz, 1 Hz)		typ.	4×10^{10}	cm $\sqrt{\text{Hz}}$/W
Time constant		typ.	100	μs
Sensitive area			6,0 x 6,0	mm^2

MECHANICAL DATA

Dimensions in mm

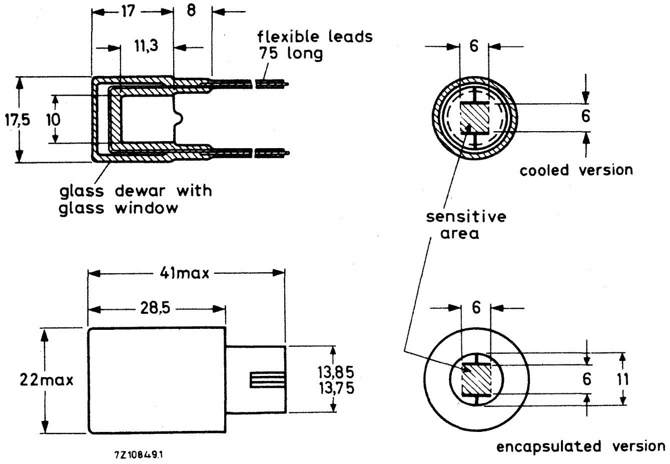
Fig. 1.

Cooled version

Code No.
9332 401 30

Encapsulated version

Code No.
9330 200 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*	>	**2.0×10^8**	cm $\sqrt{\text{Hz}}$/W
	typ.	6.5×10^8	cm $\sqrt{\text{Hz}}$/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.	4×10^{10}	cm $\sqrt{\text{Hz}}$/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:

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

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)

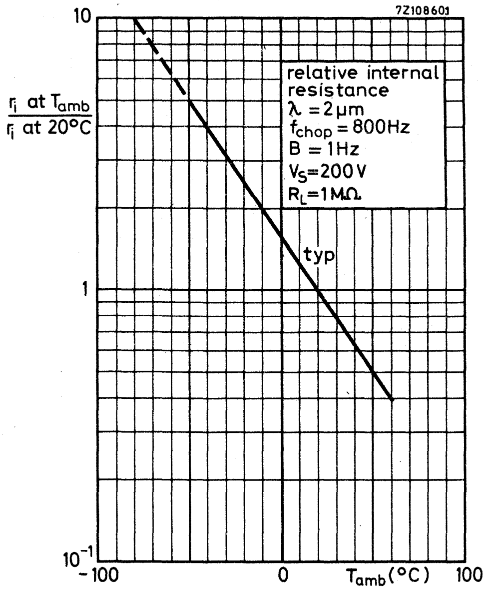
5. Effect of ambient radiation

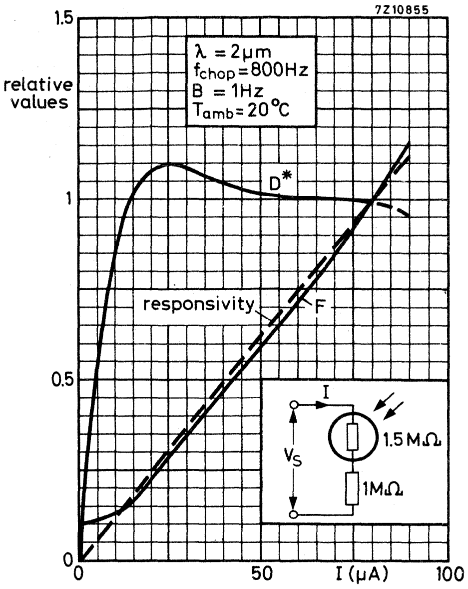
   Care should be taken to avoid the incidence on the cell of appreciable radiation in the visible range. Such radiation will cause a decrease in the cell resistance and signal as long as the cell is kept cool. Normal daylight can cause this effect if seen for more than a few minutes. Precautions should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

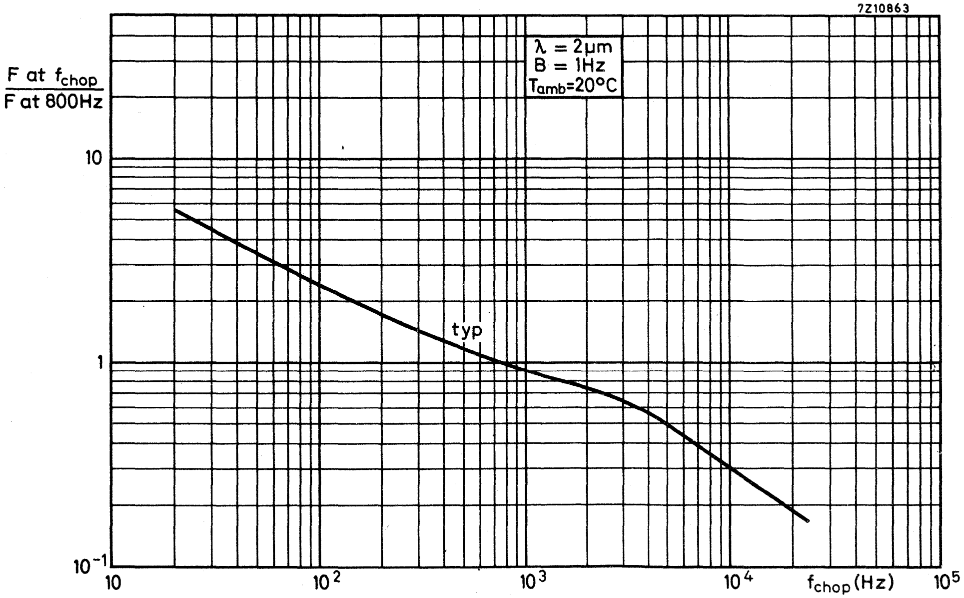
6. Warning

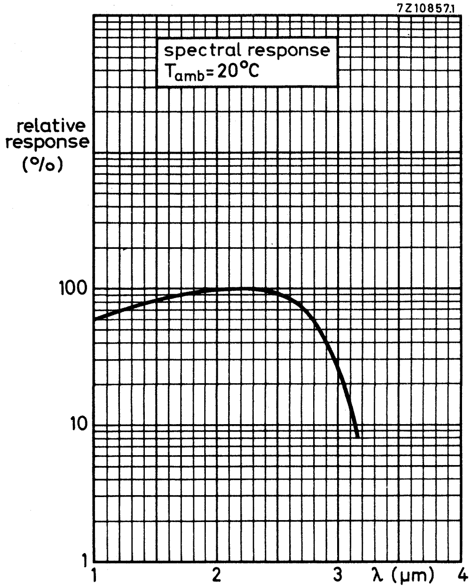
   Care should be taken to ensure that the device is not allowed to reach room temperature while still biased.

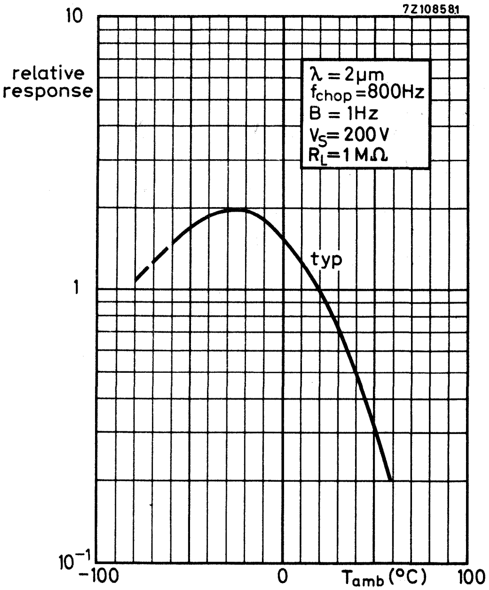
   The dewar vessel must always be completely dry before being refilled with liquid nitrogen. In very humid conditions, water vapour may condense at the top of the dewar vessel. Should this occur, the remaining liquid nitrogen should be allowed to boil off, the ice should be removed and precautions taken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

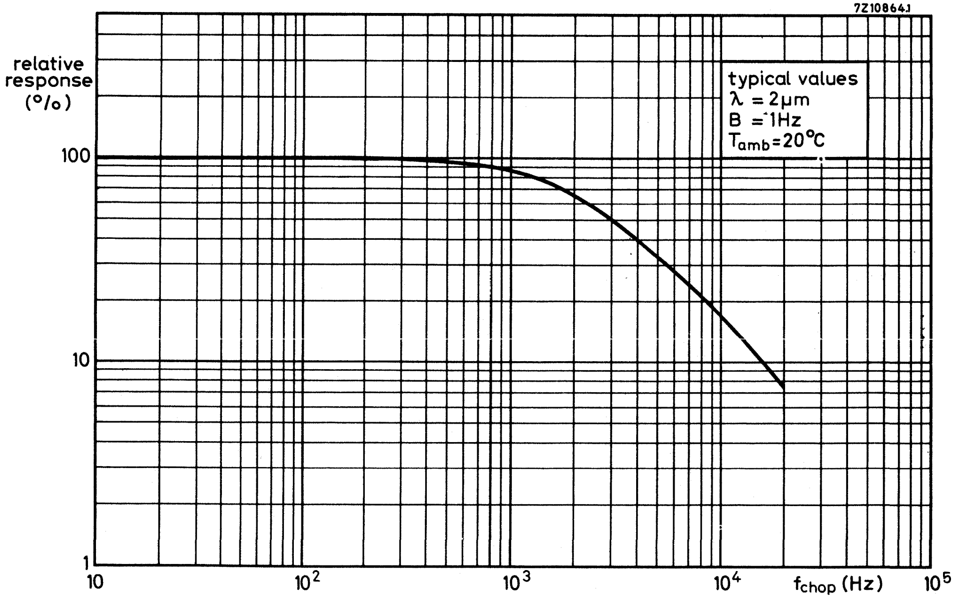

7Z10860
relative internal resistance
λ = 2 μm
f_chop = 800 Hz
B = 1 Hz
V_S = 200 V
R_L = 1 MΩ
r_i at T_amb / r_i at 20°C
typ
10
1
10^-1
-100
0
T_amb (°C)
100

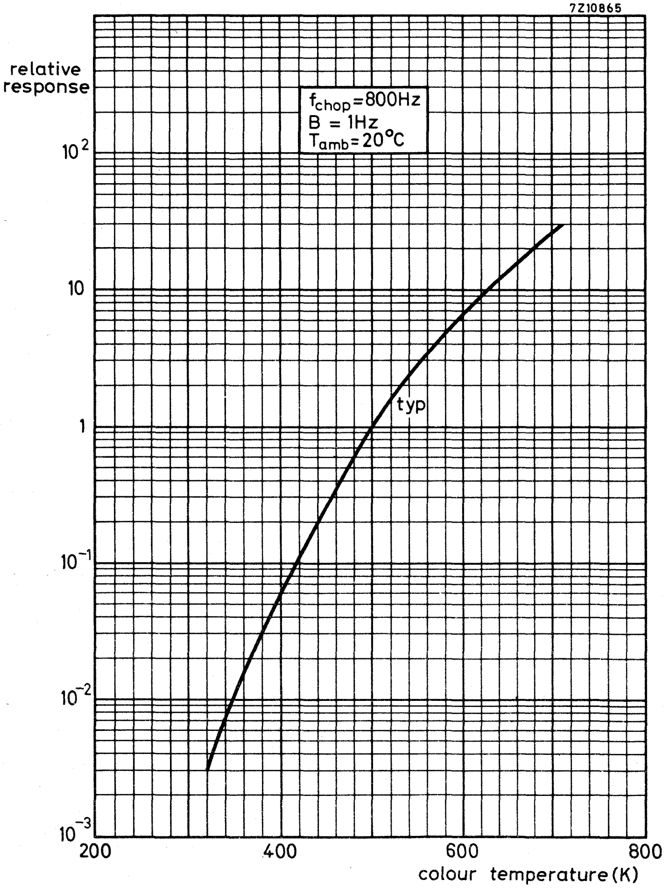

7Z10855
λ = 2 μm
f_chop = 800 Hz
B = 1 Hz
T_amb = 20°C
relative values
D*
responsivity
F
I
V_S
1.5 MΩ
1 MΩ
1.5
1
0.5
0
0
50
I (μA)
100

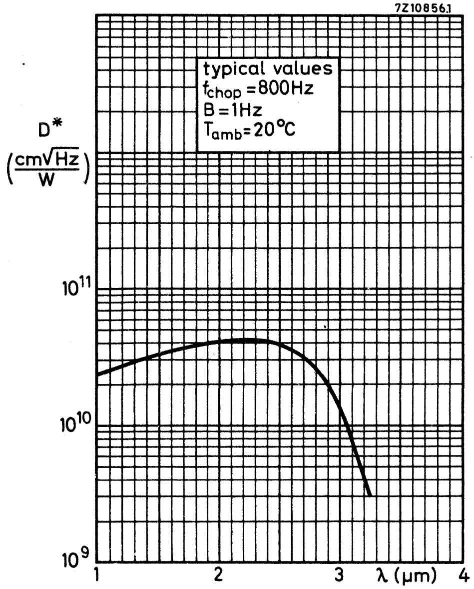

7Z10863
λ = 2 μm
B = 1 Hz
T_amb = 20°C
F at f_chop / F at 800 Hz
typ
10
1
10^-1
10
10^2
10^3
10^4
f_chop (Hz)
10^5

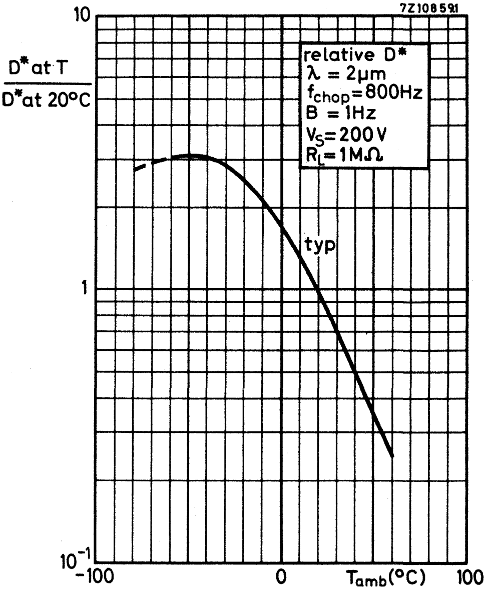

7Z10857.1
spectral response
T_{amb} = 20°C
relative response (%)
100
10
1
1
2
3
λ (μm)
4

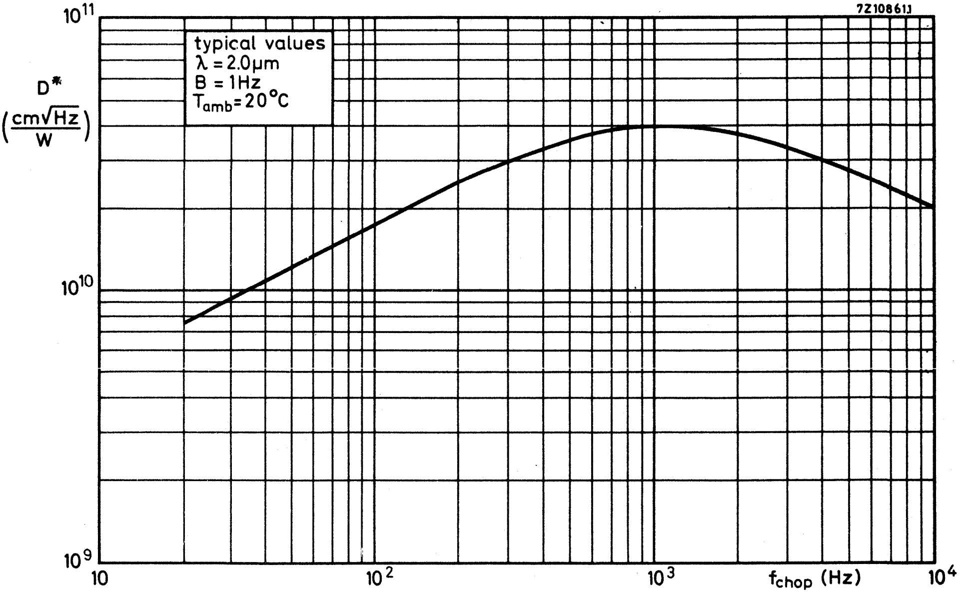

7Z10858.1
relative response
10
1
10^{-1}
λ = 2μm
f_{chop} = 800Hz
B = 1Hz
V_S = 200 V
R_L = 1 MΩ
typ
−100
0
T_{amb} (°C)
100

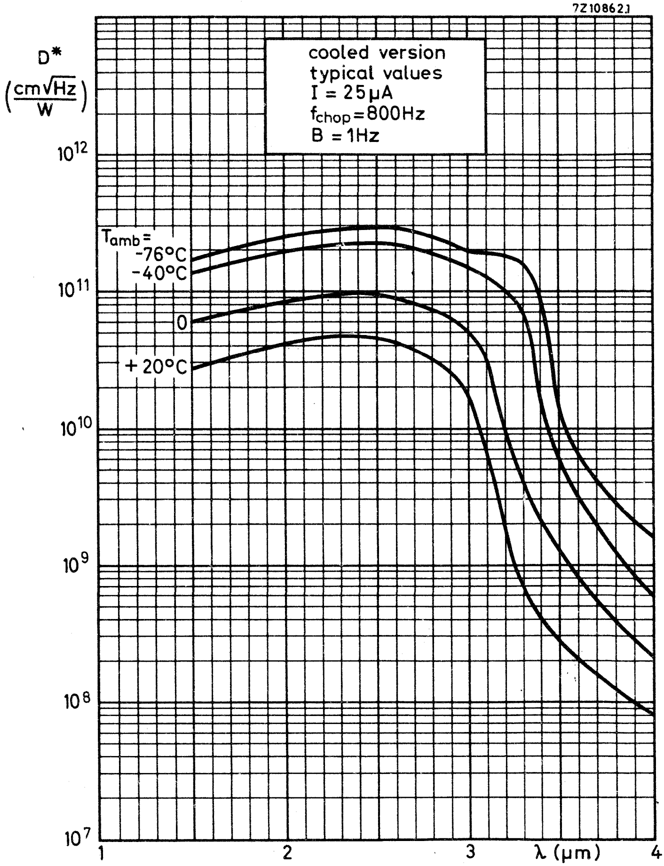

7Z10864.1
relative response (%)
100
10
1
typical values
λ = 2μm
B = 1Hz
T_{amb} = 20°C
10
10^2
10^3
10^4
f_{chop} (Hz)
10^5


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


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


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

PHOTOCONDUCTIVE DEVICES

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	rlo
Equilibrium illumination resistance	rle
Dark resistance	r_d
Initial dark resistance	rdo
Equilibrium dark resistance	rde
Current rise time	tri
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.

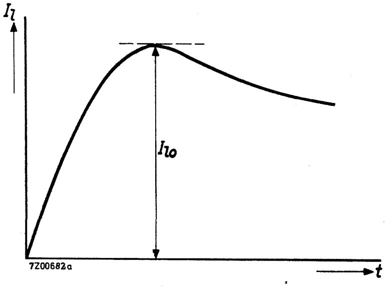
2.2.1 For a particular set of conditions the equilibrium illumination resistance is the illumination resistance after such a time under these conditions that the rate of change of the illumination resistance is less than 1% per 5 minutes.

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.

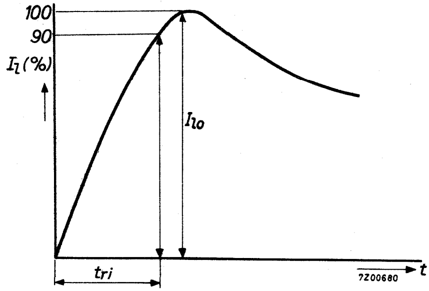
2.4.2 For a particular set of conditions the initial dark resistance is the dark resistance after a specified time under these conditions following a specified history.

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

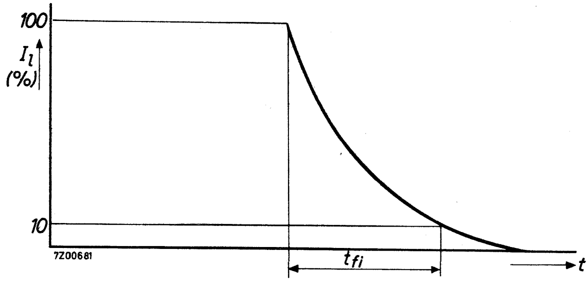
2.5.1 For a particular set of conditions the equilibrium dark current is the dark current after such a time under these conditions that the rate of change of the dark current is less than 2% per 5 minutes.

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

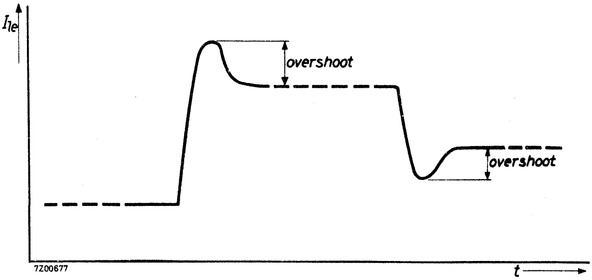
3. THERMAL DATA

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

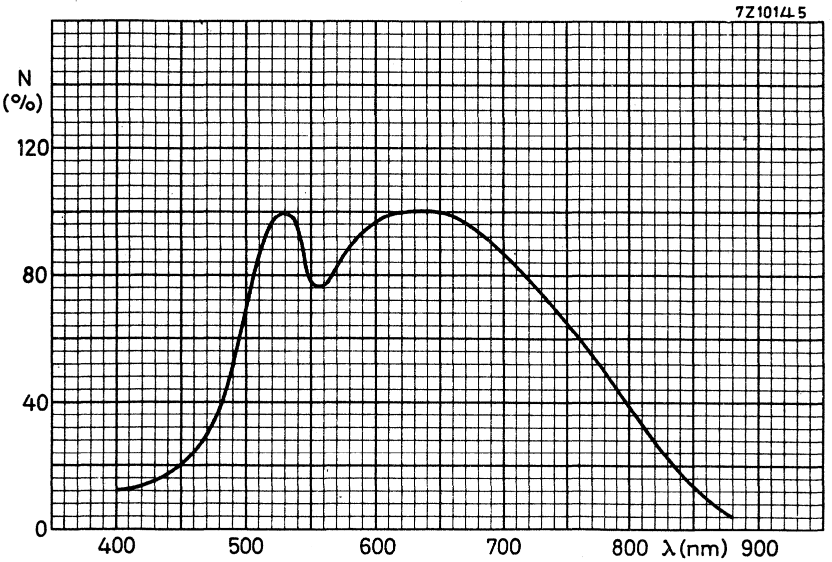
The limiting values of photoconductive devices are given in the absolute maximum rating system.

8. OUTLINE DIMENSIONS

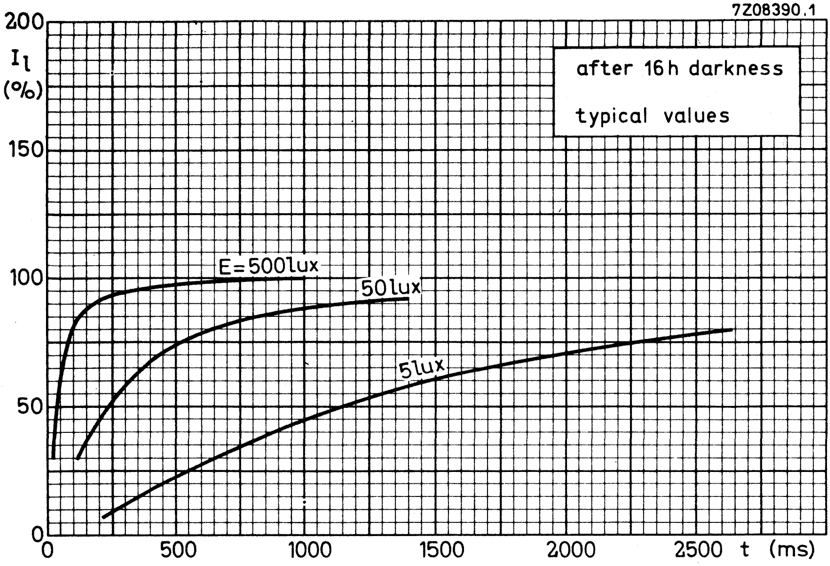
The outline dimensions are given in mm.

9. MECHANICAL ROBUSTNESS

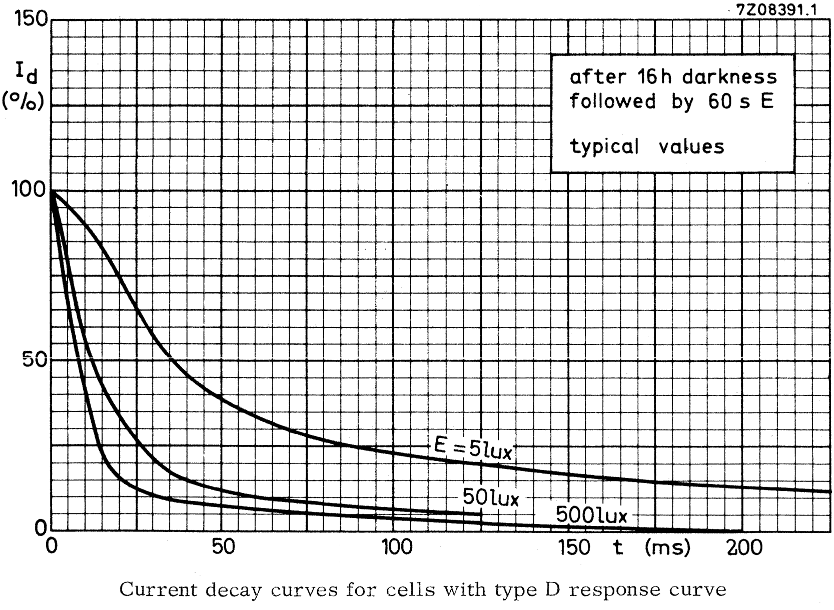
The conditions for shock and vibration given on the individual data sheets are intended only to give an indication of the mechanical quality of the device. It is not advisable to subject the device to such conditions.



Type D response curve



Current rise curves for cells with type D response curve



Current decay curves for cells with type D response curve

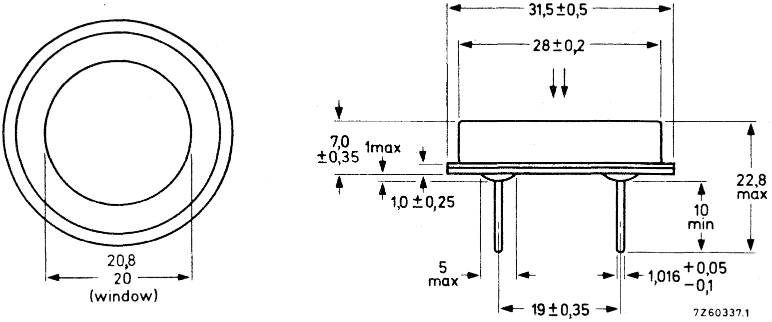
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

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_{lo}	typ.	3,3	kΩ
Spectral response, current rise and decay curves			type D	
Outline dimensions		max.	32 dia. x 7,6	mm

MECHANICAL DATA

Dimensions in mm



CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

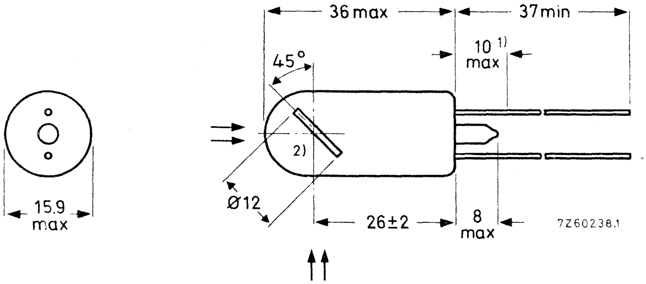
Top and side sensitive cadmium sulphide photoconductive cell in hermetically sealed all-glass envelope intended for on-off applications such as flame failure circuits.
The cell is shock and vibration resistant.

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.

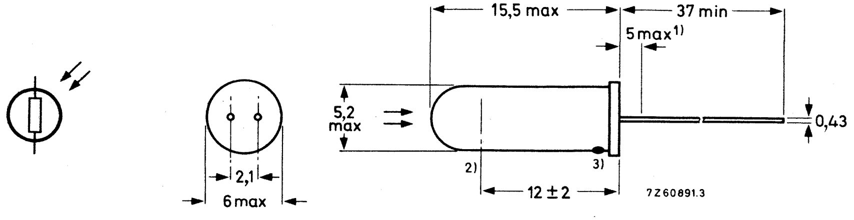
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

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,		>	37,5	-	kΩ
after 16 hrs in darkness [2]	r_{lo}	typ.	60	-	kΩ
		<	150	55	kΩ
Equilibrium illumination resistance measured at 30 V d.c., illumination = 50 lx,		>	37,5	-	kΩ
after 15 min under the measuring conditions	r_{le}	typ.	75	-	kΩ
		<	190	90	kΩ
Negative temperature response of illumination resistance		typ.	0,2		%/°C
		<	0,5		%/°C
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 30 V d.c.}}$	α	typ.	1,5		

---

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

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

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

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

DESIGN CONSIDERATIONS

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

MECHANICAL ROBUSTNESS

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

Shock

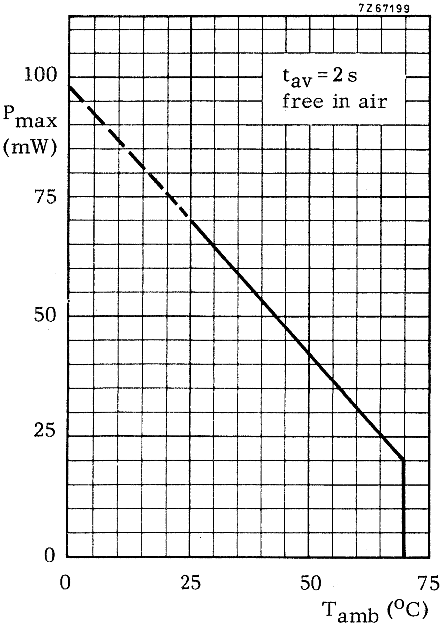
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

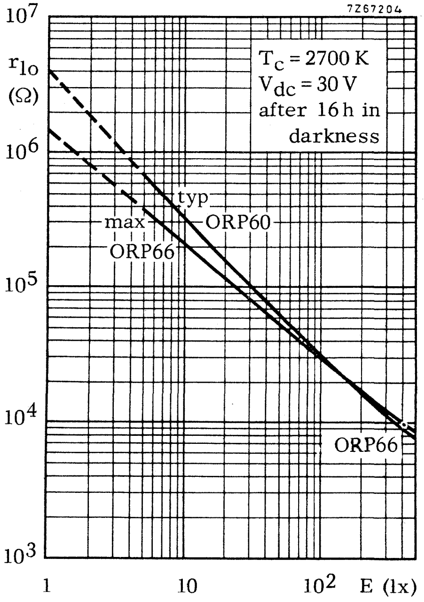
Vibration

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

---

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


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


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

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

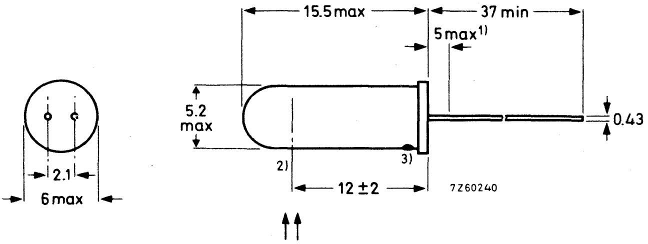
Side sensitive cadmium sulphide photoconductive cells in hermetically sealed all-glass envelope intended for on-off applications such as flame failure circuits, and for automatic brightness and contrast control in television receivers.
The cells are shock and vibration resistant.

QUICK REFERENCE DATA

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

MECHANICAL DATA

Dimensions in mm



Soldering

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

---

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

ELECTRICAL DATA

General

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

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

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

---

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

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

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

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

DESIGN CONSIDERATIONS

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

MECHANICAL ROBUSTNESS

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

Shock

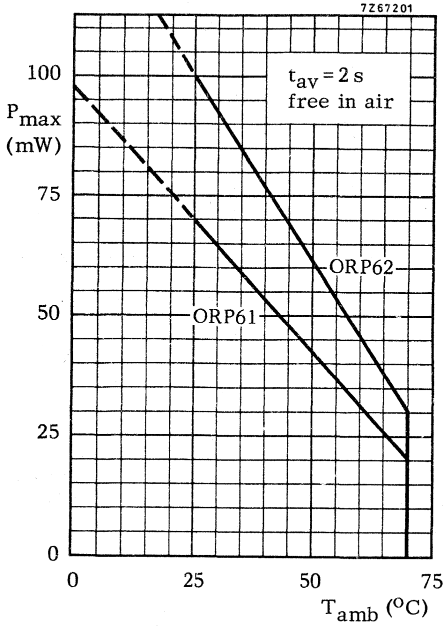
25 g_{peak}, 10 000 shocks in one of the three positions of the cell.

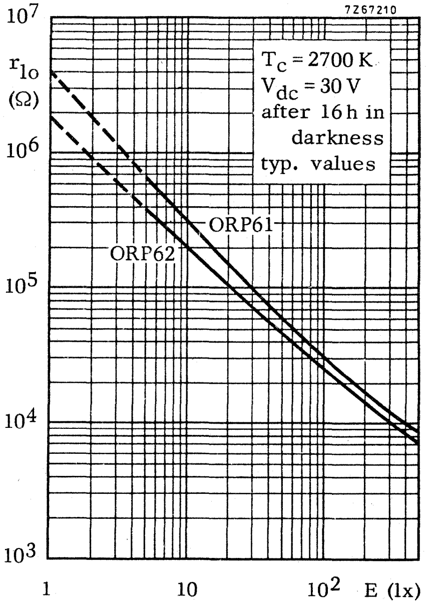
Vibration

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

---

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


7Z67201
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
T_c = 2700 K
V_{dc} = 30 V
after 16 h in
darkness
typ. values
r_{lo}
(Ω)
10^7
10^6
10^5
10^4
10^3
ORP61
ORP62
1
10
10^2
E (lx)

CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

See data ORP60

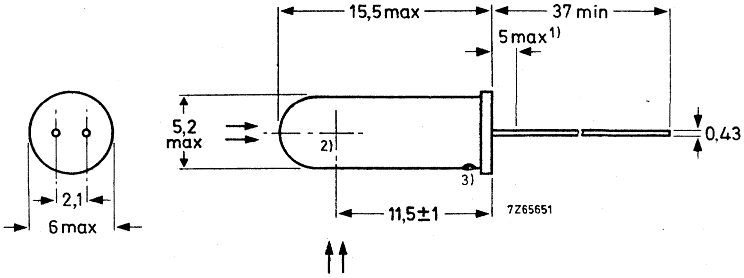
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELLS

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 $T_{amb} = 25\ ^{o}C$, 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 $\frac{\text{r at 0,5 V d.c.}}{\text{r at 30 V d.c.}}$		typ.	1,4		

---

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

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

[3] Measured at top sensitivity.

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

Cell voltage, d.c. and repetitive peak	V	max.	350	V
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute - ORP68	V_M	max.	1000	V
ORP69	V_M	max.	700	V
Power dissipation (t_{av} = 2 s) see graph P_{max}				
Power dissipation, pulse	P_M	max.	5 x P_{max}	
Illumination	E	max.	50 000	lx
Temperature of CdS tablet, operating	T_{tablet}	max.	+85	°C
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C
storage	T_{stg}	max.	+50	°C [1]
operating	T_{amb}	max.	+70	°C

DESIGN CONSIDERATIONS

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

MECHANICAL ROBUSTNESS

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

Shock

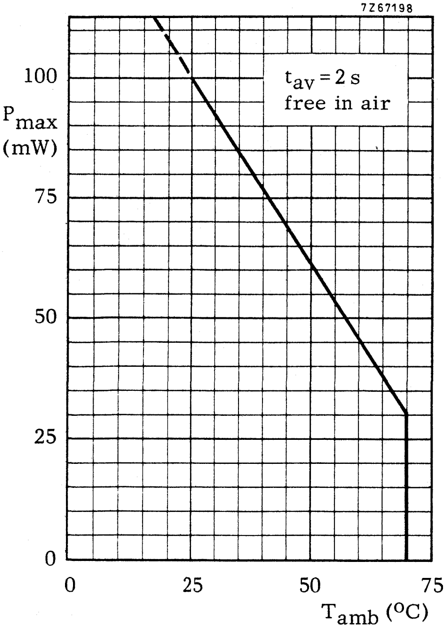
25 g_{peak}, 10 000 shocks in one of the three positions of the cell

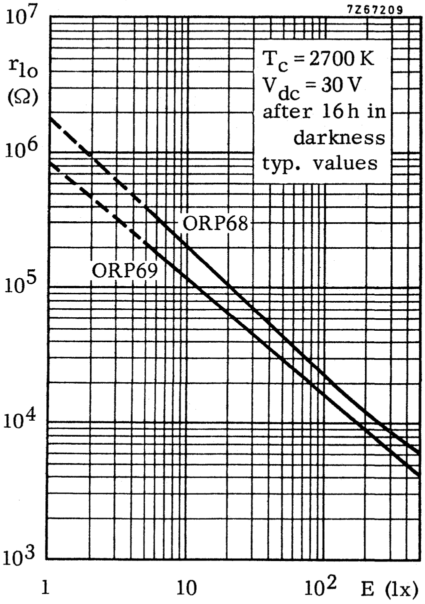
Vibration

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

---

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


7Z67198
t_{av} = 2 s
free in air
P_{max}
(mW)
100
75
50
25
0
0
25
50
75
T_{amb} (°C)


7Z67209
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
ORP68
ORP69
1
10
10^2
E (lx)

CADMIUM SULPHIDE PHOTOCONDUCTIVE DEVICE

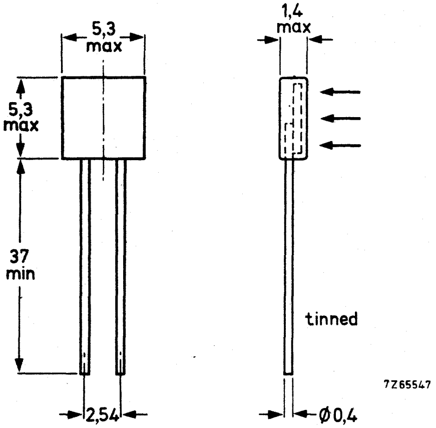
Cadmium sulphide photoconductive device with side sensitivity in plastic encapsulation. The device consists of two cells connected in series and is intended for general applications.

QUICK REFERENCE DATA

Power dissipation at $T_{amb} \leq 25$ °C	P		100	mW
Voltage, d.c. and repetitive peak	V	max.	50	V
Resistance at 50 lux, $T_c = 2700$ °K	r_{lo}		600	Ω
Wavelengths at 50% sensitivity	λ		500 and 675	nm
Outline dimensions		max.	5,3 x 5,3 x 1,4	mm

MECHANICAL DATA

Dimensions in mm



Soldering

The device may be soldered direct into the circuit but heat conducted to the tablet should be kept to a minimum by the use of a thermal shunt.
It may be dip-soldered at a solder temperature of 270 °C for a maximum of 2 s up to a point 6 mm from the envelope.

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

Cell voltage, d.c. and repetitive peak	V	max.	50	V
Cell voltage, $P_{rr} \leq$ once per minute, $t_p \leq 5$ ms	V_M	max.	100	V
Power dissipation, $t_{av} = 0,5$ s, $T_{amb} \leq 25$ °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

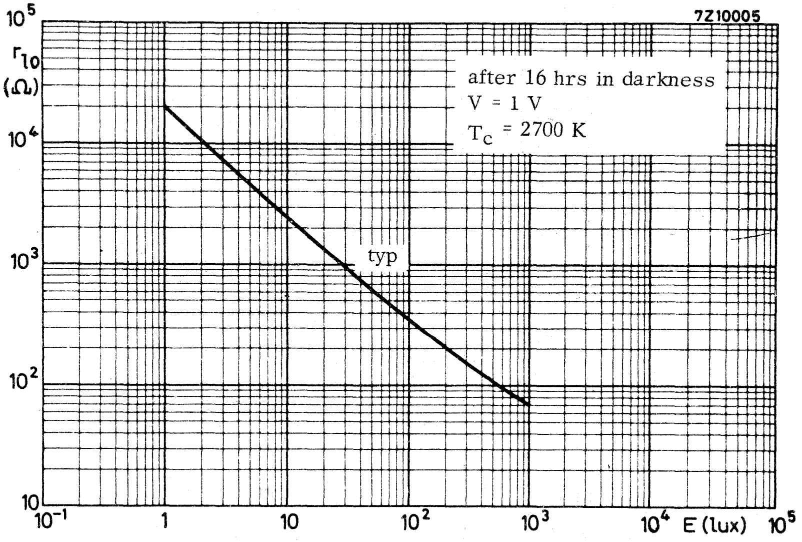
Thermal resistance from CdS tablet to ambient	$R_{th\,t\text{-}a}$	=	0,45	°C/mW

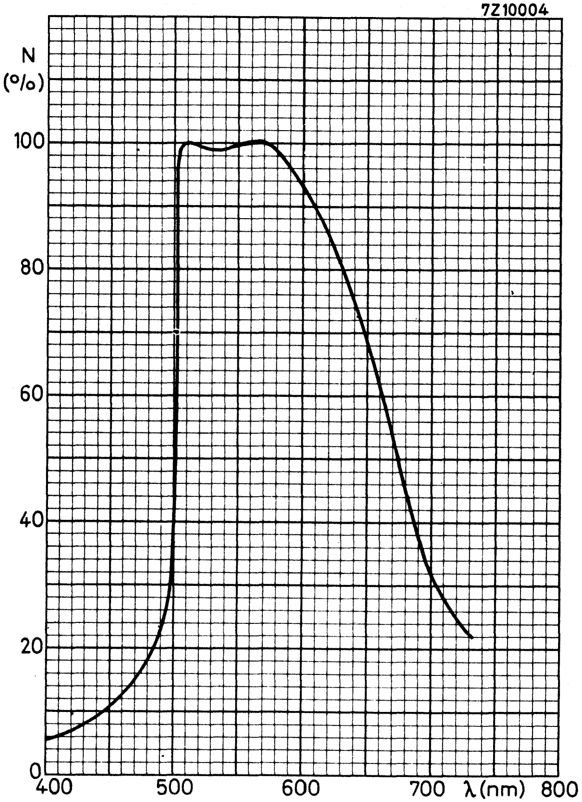
CHARACTERISTICS

Initial dark resistance, measured with 50 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	200	kΩ
Initial ilumination resistance measured at 1 V d.c., illumination 50 lx, $T_c = 2700$ K	r_{lo}	typ.	0,6	kΩ
			0,35-1,4	kΩ
Initial drift	D_o	typ.	0	%
F_{4700} (= $\dfrac{r_l \text{ at } 4700\text{ K}}{r_l \text{ at } 2856\text{ K}}$ 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
10^{-1}
1
10
10^2
10^3
10^4
E (lux)
10^5
after 16 hrs in darkness
V = 1 V
T_c = 2700 K
typ


7Z10004
N
(%)
100
80
60
40
20
0
400
500
600
700
λ (nm)
800

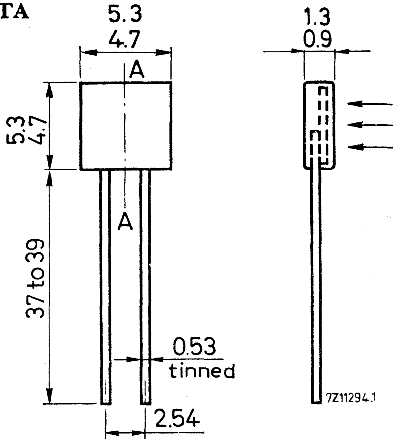
CADMIUM SULPHIDE PHOTOCONDUCTIVE DEVICE

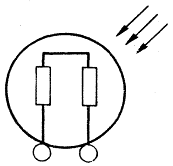
Cadmium sulphide photoconductive cell with side sensitivity in a plastic encapsulation. The device consists of two cells in series and is intended for use in cameras, exposure meters, light control equipment and for general industrial use.

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_{lo}		3 to 6	kΩ
Outline dimensions			5 mm x 5 mm x 1	mm

MECHANICAL DATA

Dimensions in mm





Soldering

The device may be soldered direct into the circuit but heat conducted to the seals should be kept at a minimum by the use of a thermal shunt. Dip soldering at a solder temperature of 270 °C may be employed for a maximum of 2 s up to a point 6 mm from the seals.

ELECTRICAL DATA

Basic characteristics at T_{amb} = 25 °C, illumination with 2700 K c.t.

Pre-conditioning 1 h illumination with 300 lx (fluorescent light)

	symbol	min.	typical	max.	unit
Initial dark resistance measured with 50 $V_{d.c.}$ applied via 1 MΩ, 20 s after stopping the illumination of 10 lx	r_{do}	0.6			MΩ
Initial illumination resistance measured at V = 1 $V_{d.c.}$, illumination 10 lx	r_{lo}	2.4		6.0	kΩ
Illumination response [1] measured at 1 $V_{d.c.}$ between 0.1 lx and 10 lx	$\gamma_{0.1-10}$	0.94		1.12	
Negative temperature response of illumination resistance between −10 °C and +40 °C at 1 lx, V = 1 V	$r_l/\Delta T$			0.5	%/°C
Pre-conditioning factor [2]		0.9		1.1	
Actinism $\frac{\text{Illumination at 2700 K}}{\text{Illumination at 4700 K}}$ (referred to the same cell current)		0.9		1.1	

---

[1] $\gamma = \frac{\log r1 - \log r2}{\log E2 - \log E1}$ where E1 = 0.1 lx and E2 = 10 lx

[2] Pre-conditioning factor = $\frac{\text{Cell current at 1 lx, after 3 days in darkness}}{\text{Cell current at 1 lx, after 1 h pre-conditioning at 300 lx (fluorescent light)}}$

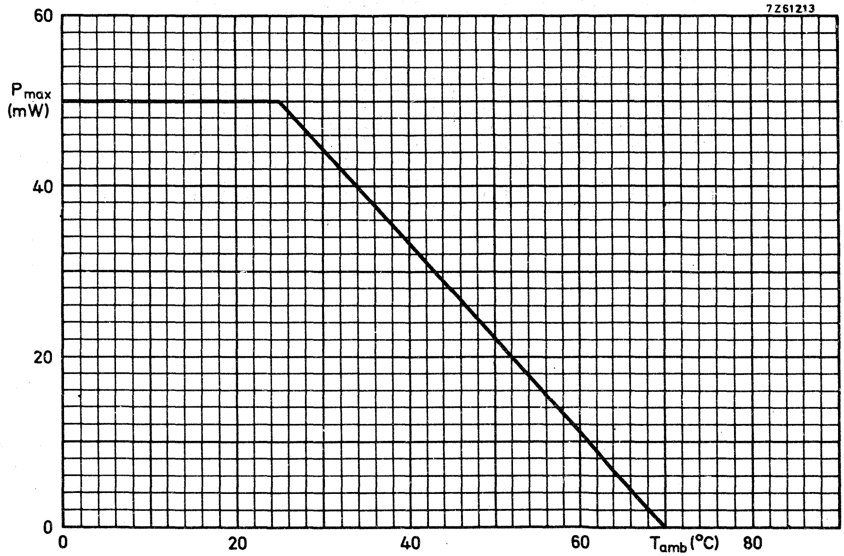
measured when a stable current is reached

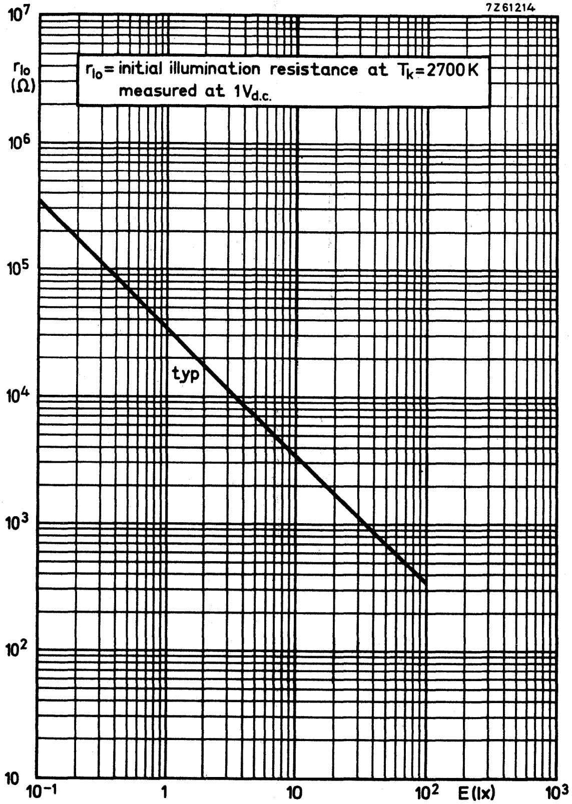
LIMITING VALUES (Absolute max. rating system)

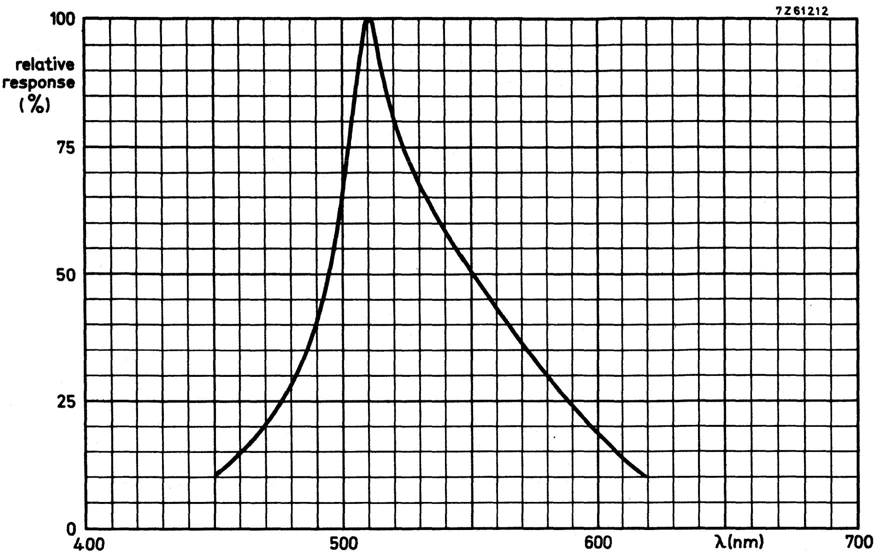
Cell voltage, d.c. and repetitive peak	V	max. 50	V
Power dissipation	P	max. 50	mW
Cell current, d.c. and repetitive peak	I	max. 20	mA
Operating ambient temperature	T_{amb}	−40 to +70	°C
Storage temperature	T_{stg}	−40 to +70	°C

OPERATING NOTE

The device consists of two photoconductive cells connected in series.
The resistance of the device is mainly governed by the resistance of that cell receiving the lowest luminous flux.
If it is essential for the application that the device is partly shaded off, the shadow line should be perpendicular to the axis A-A of the device.




7Z61214
10^7
r_{lo} (Ω)
r_{lo} = initial illumination resistance at T_k = 2700 K measured at 1 $V_{d.c.}$
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

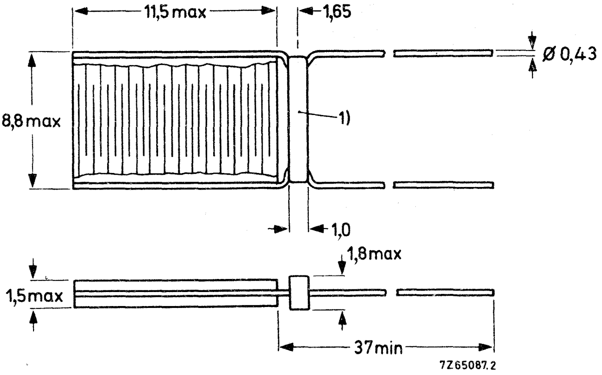
Side sensitive cadmium sulphide photoconductive cell protected by a lacquer coating. The device withstands the steady state damp heat test of IEC Publication 68-2-3 (test Ca: severity 56 days).

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

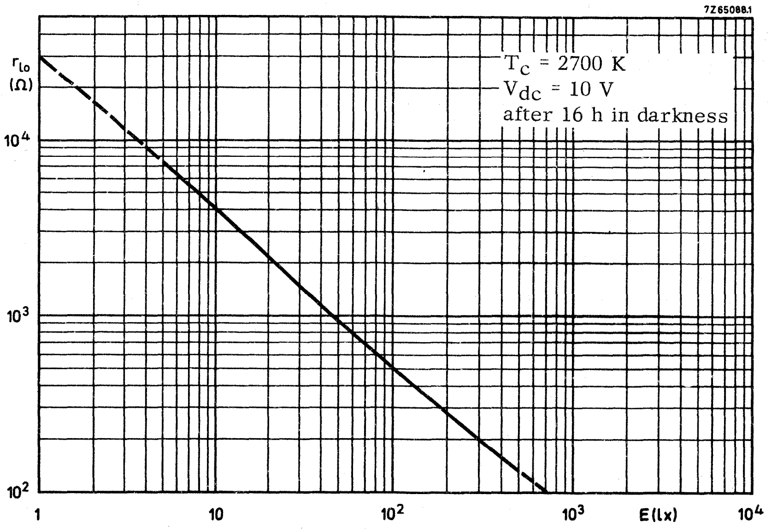
The device withstands the tensile test of IEC Publication 68-2-21, Test Ua: loading weight 500 g.

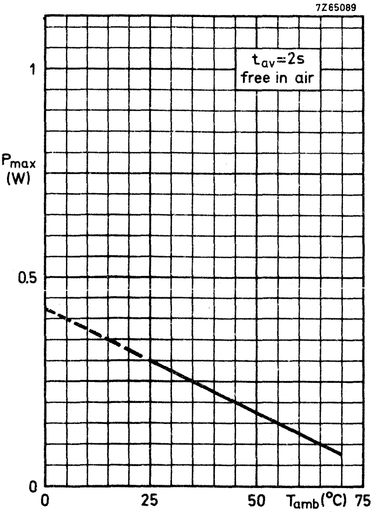
Pull test

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
1
P_{max}
(W)
0.5
0
0
25
50
T_{amb}(°C)
75
t_{av}=2s
free in air

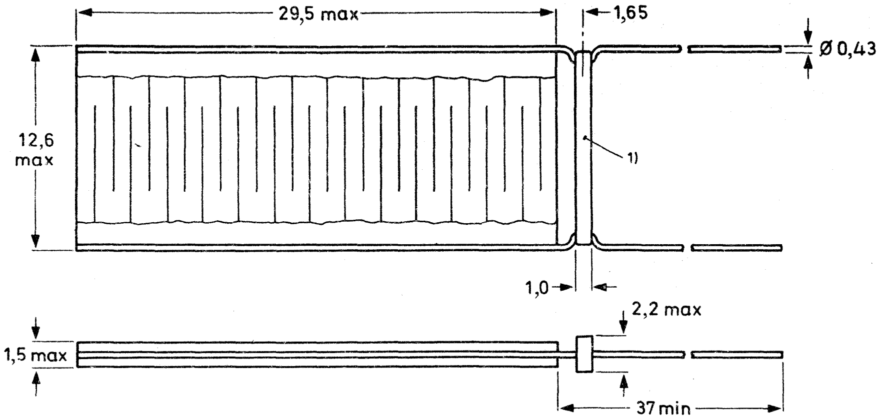
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

Side sensitive cadmium sulphide photoconductive cell protected by a lacquer coating. The device withstands the steady state damp heat test of IEC publication 68-2-3 (test Ca: severity 56 days).

QUICK REFERENCE DATA				
Power dissipation at T_{amb} = 25 °C	P	max.	0, 75	W
Cell voltage, d.c. and repetitive peak	V	max.	400	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{lo}	typ.	1150	Ω
Spectral response, current rise and decay curves		type D		
Outline dimensions		max.	29,5 x 12,6 x 1,5	mm

MECHANICAL DATA

Dimensions in mm



Soldering

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

Mounting

The cell is not insulated electrically and should be mounted accordingly.

Notice

If the cell is to be encapsulated, request manufacturer's instructions.

---

1) Stress relief band.

ELECTRICAL DATA

General

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

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

Initial dark resistance measured with 400 V d.c. applied via 1 MΩ, 20 s after switching off the illumination	r_{do}	>	9	MΩ [1]
Equilibrium dark resistance measured with 400 V d.c. applied via 1 MΩ, 30 minutes after switching off the illumination	r_{de}	>	200	MΩ [1]
Initial illlumination resistance measured at 10 V d.c., illumination = 50 lx, after 16 hrs in darkness [2]	r_{lo}	700 to typ.	3300 1150	Ω Ω
Equilibrium illumination resistance measured at 10 V d.c., illumination = 50 lx, after 15 min under the measuring conditions	r_{le}	700 to typ.	4100 1450	Ω Ω
Negative temperature response of illumination resistance		typ. <	0, 2 0, 5	%/°C %/°C
Voltage response $\frac{\text{r at 0,5 V d.c.}}{\text{r at 10 V d.c.}}$	α	typ.	1, 05	

---

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

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

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

Cell voltage, d.c. and repetitive peak	V	max.	400	V
Cell voltage, pulse, $t_p \leq 5$ ms, $p_{rr} \leq$ once per minute	V_M	max.	1000	V
Power dissipation (t_{av} = 2 s) see graph P_{max}				
Power dissipation, pulse	P_M	max.	$5 \times P_{max}$	
Cell current, d.c. and repetitive peak	I	max.	500	mA
Illumination	E	max.	50 000	lx
Temperature CdS tablet, operating	T_{tablet}	max.	+85	°C
Ambient temperature, storage and operating	T_{amb}	min.	−40	°C
storage	T_{stg}	max.	+50	°C 1)
operating	T_{amb}	max.	+70	°C

DESIGN CONSIDERATIONS

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

CLIMATIC DATA

The device withstands the damp heat test Ca (steady state) of IEC Publication 68-2-3: severity 56 days, under no-load conditions or under continuous load conditions such that the tablet temperature is ≥ 5 °C above ambient temperature.

MECHANICAL ROBUSTNESS

Tensile test

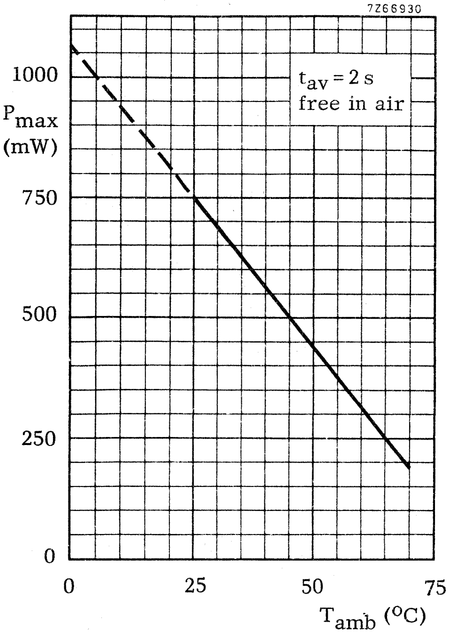
The device withstands the tensile test of IEC Publication 68-2-21, Test Ua: loading weight 500 g.

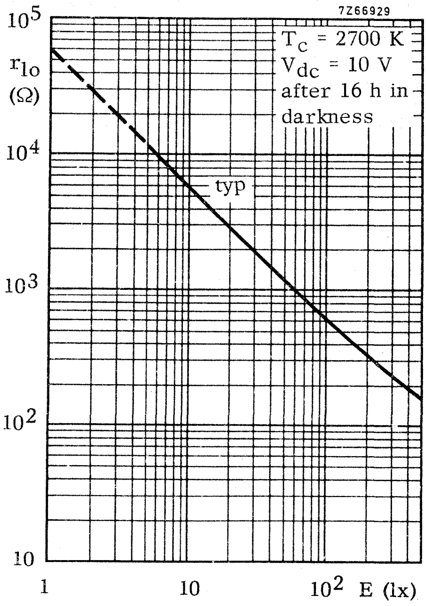
Pull test

The device withstands the following test: The leads are bent outwards over an angle of 90° at 2 mm from the stress relief band; a pulling force of 500 g is then applied at the end of the leads.

---

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


7Z66930
1000
750
500
250
0
P_{max}
(mW)
$t_{av} = 2$ s
free in air
0
25
50
75
T_{amb} (°C)


7Z66929
10^5
10^4
10^3
10^2
10
r_{lo}
(Ω)
T_c = 2700 K
V_{dc} = 10 V
after 16 h in darkness
typ
1
10
10^2
E (lx)

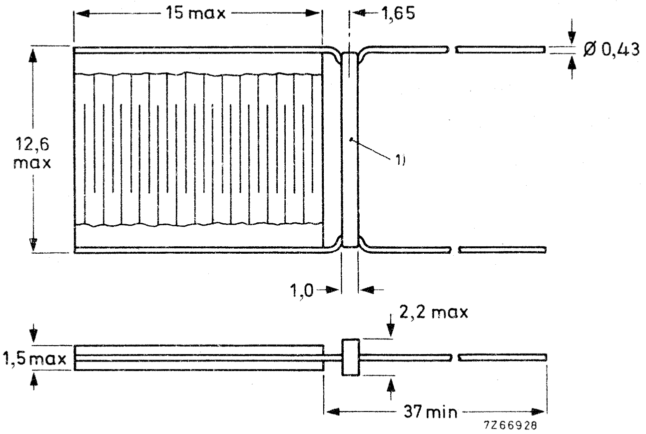
CADMIUM SULPHIDE PHOTOCONDUCTIVE CELL

Side sensitive cadmium sulphide photoconductive cell protected by a lacquer coating. The device withstands the steady state damp heat test of IEC publication 68-2-3 (test Ca: severity 56 days).

QUICK REFERENCE DATA				
Power dissipation at T_{amb} = 25 °C	P	max.	0, 500	W
Cell voltage, d.c. and repetitive peak	V	max.	200	V
Cell resistance at 50 lx, 2700 K colour temperature	r_{10}	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 $\frac{\text{r at } 0,5 \text{ V d.c.}}{\text{r at } 10 \text{ V d.c.}}$	α	typ.	1,05	

---

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

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

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

Cell voltage, d.c. and repetitive peak	V	max.	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

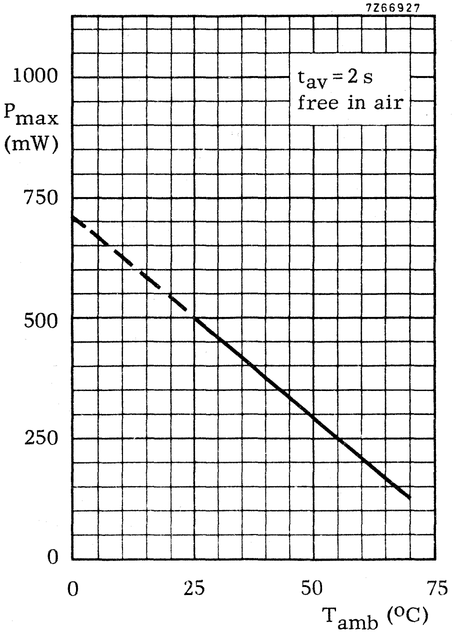
The device withstands the tensile test of IEC Publication 68-2-21, Test Ua: loading weight 500 g.

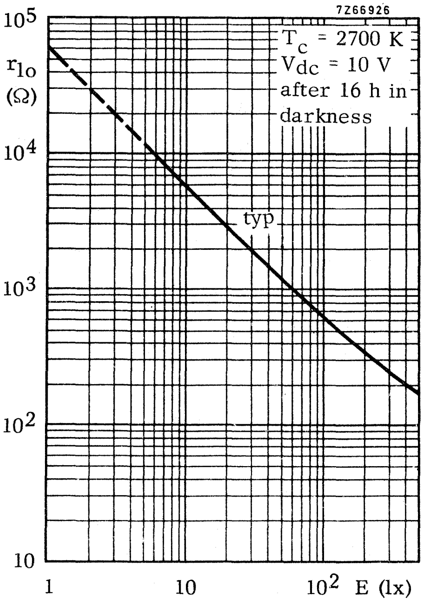
Pull test

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
0
25
50
75
T_amb (°C)
t_av = 2 s
free in air


7Z66926
10^5
r_lo
(Ω)
10^4
10^3
10^2
10
1
10
10^2
E (lx)
T_c = 2700 K
V_dc = 10 V
after 16 h in
darkness
typ

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