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Silicon Photodetectors and Infrared Emitters

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(according to the size of their radiant-sensitive area)

Type	Chip dimensions $l \times w$ mm	Radiant sensitive area A mm²	Spectral sensitivity (standard light A, T = 2856 K) S nA/lx	Package	Page
BPY 11 P IV	2.15 × 4.65	8.7	60 (≥28)	Chip with leads	71
BPY 11 P V	2.15 × 4.65	8.7	60 (≥28)	Chip with leads	71
BPX 79	5.0 × 5.0	20	170 (≥100)	Chip with litz wires	67
BPY 64 P	6.2 × 6.2	36	250 (≥180)	Chip with litz wires	85
BPY 48 P	6.2 × 12.6	74	500 (≥350)	Chip with litz wires	78
BPY 63 P	10.0 × 10.0	96	650 (≥450)	Chip with litz wires	81
TP 60 P	Hexagon	130	1000 (≥700)	Package	88
TP 61 P	Hexagon	130	1000 (≥700)	Chip with litz wires	92
BPY 47 P	10.0 × 20.0	193	1400 (≥900)	Chip with litz wires	75

Summary of Types

Silicon photodiodes, metal case (with filter)

Type	Spectral sensitivity (standard light A, T = 2856 K) S nA/lx	Radiant sensitive area ($l \times w$) A mm	Package, characteristics, technology	Page
BPW 21	10 (≥5.5)	2.71 × 2.71	TO 5, planar λ = 555 nm Low reverse current	109

Silicon photodiodes, metal case (without filter)
(according to the size of their radiant-sensitive area)

Type	Spectral sensitivity (standard light A, T = 2856 K) S nA/lx	Radiant sensitive area ($l \times w$) A mm	Package characteristics, technology	Page
BPX 63	10 (≥8)	0.985 × 0.985	TO 18; planar, low reverse current	154
BPX 65	11 (≥5.5)	0.985 × 0.985	TO 18; PIN planar	159
BPX 66	11 (≥5.5)	0.985 × 0.985	TO 18; PIN planar	164
SFH 219	7 (≥5)	0.985 × 0.985	TO 18; planar, low reverse current	239
SFH 212	25 (≥20)	0.985 × 0.985	TO 18; planar, low reverse current	224
SFH 216	50 (≥35)	0.985 × 0.985	TO 18; PIN planar	229
BPX 60	70 (≥35)	2.71 × 2.71	TO 5; planar, low reverse current	144
BPX 61	70 (≥50)	2.71 × 2.71	TO 5; PIN planar	149
SFH 221	24 (≥15)	2 × 2.2 × 0.7	TO 5; planar, differential	243

Silicon photodiodes, plastic package (with filter)
(according to the size of their radiant-sensitive area)

Type	Spectral sensitivity (λ = 950 nm; 0.5 mW/cm^2) S µA	Radiant sensitive area ($l \times w$) A mm	Technology, characteristics	Page
SFH 217 F	3 (≥1.8)	0.985 × 0.985	PIN planar	234
SFH 2030 F	25 (≥15)	0.985 × 0.985	PIN planar	258
BPX 90 K	13 (≥8)	1.65 × 3.05	Planar	174
BP 104	17 (≥12.5)	2.2 × 2.2	PIN planar	99
BP 104 BS	25 (≥15)	2.71 × 2.71	PIN planar	104
BPW 34 F	25 (≥15)	2.71 × 2.71	PIN planar	134
SFH 205	25 (≥15)	2.71 × 2.71	PIN planar	207
SFH 205 Q2	25 (≥15)	2.71 × 2.71	PIN planar	211
SFH 206	25 (≥16)	2.71 × 2.71	PIN planar	215
SFH 230	26 (≥16)	2.71 × 2.71	PIN planar	248
SFH 230 F	24 (≥15)	2.71 × 2.71	PIN planar	248
SFH 248 F	7.5 (≥4)	2 × 2.2 × 0.7	Planar, differential	253

Summary of Types

Silicon photodiodes, plastic package (without filter)
(according to the size of their radiant-sensitive area)

Type	Spectral sensitivity (standard light A, T = 2856 K) S nA/lx	Radiant sensitive area ($l \times w$) A mm	Technology, characteristics	Page
SFH 217	9.5 (≥5)	0.985 × 0.985	PIN planar	234
SFH 2030	80 (≥50)	0.985 × 0.985	PIN planar	258
BPW 32	10 (≥7)	0.985 × 0.985	Planar, low reverse current	114
BPX 92	9.5 (≥4)	0.82 × 1.27	Planar	183
SFH 200	20 (≥14)	1.0 × 2.0	Planar, low reverse current	198
BPX 90	45 (≥25)	1.65 × 3.05	Planar	169
BPW 33	75 (≥35)	2.71 × 2.71	Planar, low reverse current	119
BPX 91 B	65 (≥35)	2.71 × 2.71	Planar, high blue sensitivity	179
BPW 34	80 (≥50)	2.71 × 2.71	PIN planar	124
SFH 206 K	80 (≥50)	2.71 × 2.71	PIN planar	219
BPW 34 B	75 (≥50)	2.71 × 2.71	PIN planar, blue sensitivity	129
BPY 12	180 (≥100)	4.47 × 4.47	PIN planar	188
SFH 100	175 (≥150)	8.7 × 2.7	Planar, low reverse current	193
SFH 204	0.13 (≥0.08)	4 × 0.1 × 0.1	Planar, four quadrants	202
BPX 48	24 (≥15)	2 × 2.2 × 0.7	Planar, differential	139
SFH 248	24 (≥15)	2 × 2.2 × 0.7	Planar, differential	253

Phototransistors, metal case
(NPN planar technology)

Type	Photocurrent (1000 lx; standard light A, T = 2856 K) I_P mA	Package	Half angle φ degree	Page
BP 103 II[1]	0.25...0.5	TO 18; plastic lens	±55	265
BP 103 III[1]	0.4...0.8			
BP 103 IV[1]	≥0.63			
BPX 38 II[1]	0.63...1.25	TO 18	±40	272
BPX 38 III[1]	1.0...2.0			
BPX 38 IV[1]	≥1.6			
BPX 43 II[1]	2.5...5.0	TO 18	±20	277
BPX 43 III[1]	4.0...8.0			
BPX 43 IV[1]	≥6.3			
BPY 62 II[1]	2.0...4.0	TO 18	± 8	290
BPY 62 III[1]	≥3.2			

[1] with base connection

Summary of Types

Phototransistors, plastic package, epoxy resin (with filter)
(NPN planar technology)

Type	Photocurrent (λ = 950 nm; 0.5 mW/cm^2) I_P mA	Package	Half angle φ degree	Page
SFH 303 F[1]	2	T 1¾; 5 mm dia	±20	295
SFH 309 F	1.5	T 1; 3 mm dia	±16	304
SFH 317 F[1]	0.2	T1¾; 5 mm dia	±60	309

Phototransistors, plastic package, epoxy resin (without filter)
(NPN planar technology)

Type	Photocurrent (1000 lx; standard light A, T = 2856 K) I_P mA	Package	Half angle φ degree	Page
BP 103 B II	2.5...5.0	T 1¾; 5 mm dia	±16	269
BP 103 B III	4.0...8.0			
BP 103 B IV	≥6.3			
BPX 81 II[2]	1.0...2.0	Miniature	±18	282
BPX 81 III	1.6...3.2			
BPX 81 IV	≥2.5			
SFH 303[1]	13	T 1¾; 5 mm dia	±20	295
SFH 305 II	≤2.0	Subminiature	±20	300
SFH 305 III	≥1.6			
SFH 309	5	T 1; 3 mm dia	±20	304
SFH 317[1]	1.8	T 1¾; 5 mm dia	±60	309

[1] with base connection, [2] array with 2...10 transistors also available, refer to page 286

Photo IC

Type	Spectral sensitivity (standard light A, T = 2856 K) S µA/lx	Radiant sensitive area ($l \times w$) A mm	Technology, characteristics	Page
TFA 1001 W	5	1.4 × 1.35	Bipolar photodiode with amplifier	315

Custom-designed optoelectronic multichip arrays (KOM)

Type	Photocurrent (1000 lx; standard light A, T = 2856 K) I_P µA	Radiant sensitive area ($l \times w$) A mm	Technology, characteristics	Page
KOM 0622033 A	26.5 (≥15)	1 × 2.5	General-purpose 6-chip special array for shaft encoders	324
KOM 0622045	18 (≥12)	1.25 × 2	General-purpose 8-chip linear array	326
KOM 0622059	2.5 (≥1.8)	0.12 × 1	General-purpose 64-element circular array	328

Summary of Types

GaAs IR emitters (IREDs), epoxy package (λ_{peak} = 950 nm)

Type	Radiant intensity (I_F = 100 mA; t_p = 20 ms; Ω = 0.01 sr) I_e mW/sr	Half angle φ degrees	Package	Page
LD 261 IV[1]	2...4[2]	±30	Lead frame epoxy resin	338
LD 261 V	3.2...6.3[2]			
LD 261 VI	≥5[2]			
LD 271	15 (≥10)	±25	T 1¾, 5 mm dia epoxy resin	348
LD 271 H	≥16			
LD 271 L	15 (≥10)	±25	T 1¾,, 5 mm dia epoxy resin	353
LD 271 LH	≥16			
LD 273	≥25	±25	5 mm dia	358
LD 274	60 (≥30)	±10	T 1¾, 5 mm dia	363
SFH 405 II	1.6...3.2	±16	Lead frame epoxy resin	383
SFH 405 III	≥2.5[3]			
SFH 409	15 (≥6)	±20	T 1, 3 mm dia	388

GaAs IR emitters (IREDs), metal case (λ_{peak} = 950 nm)

Type	Radiant intensity (I_F = 100 mA; t_p = 20 ms; Ω = 0.01 sr) I_e mW/sr	Half angle φ degrees	Package	Page
LD 242 II	4...8	±40	TO 18, epoxy lens	333
LD 242 III	≥6.3			
SFH 400 II	20...40	± 6	TO 18, glass lens	368
SFH 400 III	≥32			
SFH 401 II	10...20	±15	TO 18, glass lens	373
SFH 401 III	≥16			
SFH 402 II	2.5...5.0	±40	TO 18, glass lens	378
SFH 402 III	≥4			

[1] array with 2...10 transistors also available, refer to page 343
[2] I_F = 50 mA, [3] I_F = 40 mA

GaAlAs IR emitters (IREDs), plastic package (λ_{peak} = 880 nm)

Type	Radiant intensity (I_F = 100 mA, t_p = 20 ms, Ω = 0.01 sr) I_e mW/sr	Half angle φ degrees	Package	Page
SFH 484	100 (≥50)	± 8	T 1¾, 5 mm dia	408
SFH 485	40 (≥16)	±20	T 1¾, 5 mm dia	413
SFH 485 P	6 (≥ 3)	±40	5 mm dia	418
SFH 487	30 (≥12.5)	±20	T 1, 3 mm dia	423
SFH 487 P	4 (≥ 2)	±65	3 mm dia	428

GaAlAs I_R emitters (IREDs), metal case (λ_{peak} = 880 nm)

Type	Radiant intensity (I_F = 100 mA, t_p = 20 ms, Ω = 0.01 sr) I_e mW/sr	Half angle φ degrees	Package	Page
SFH 480	50 (≥25)	± 6	TO 18, glass lens	393
SFH 481	20 (≥10)	±15	TO 18, glass lens	398
SFH 482	6 (≥ 3)	±30	TO 18, glass lens	403

Symbols and Terms

A	Radiant sensitive area
B	Base terminal
C	Collector terminal
C	Capacitance
C_0	Capacitance at V_R = 10 V
C_{10}	Capacitance at V_R = 10 V
C_{CB}	Collector-base capacitance
C_{CE}	Collector-emitter capacitance
C_{EB}	Emitter-base capacitance
C_j	Junction capacitance
D	Duty cycle = $\frac{\tau}{T} = \frac{\text{Pulse duration}}{\text{Cycle time}}$
D^*	Detection limit
E	Emitter terminal
E_e	Irradiance (mW/cm^2)
E_v	Iluminance (lx)
η	Quantum yield
f	Frequency
f_{CO}	Cut-off frequency
I_B	Base current
I_C	Collector current
I_{CE0}	Collector-emitter reverse current
I_{Cpeak}	Collector peak current
I_{EB0}	Emitter-base reverse current (open collector, I_C = 0)
I_e	Radiant intensity (W/sr)
I_F	Forward current
i_{FS}	Surge current
I_P	Photocurrent
I_{PCB}	Photocurrent of collector-base photodiode
I_{PCE}	Photocurrent of collector-emitter photodiode
$\frac{I_{PCE}}{I_{PCB}}$	Current gain
I_R	Reverse current, dark current
I_{rel}	Relative spectral emission
I_{SC}	Short-circuit current
$I_{SC\ 25}$	Short-circuit current at T_A = 25 °C
I_v	Luminous intensity (cd or mcd)
λ	Wavelength (nm)
$\Delta\lambda$	Spectral bandwidth
λ_{peak}	Wavelength at peak emission (radiation at I_{max})
λ_{csmax}	Wavelength of the max sensitivity
NEP	Noise equivalent power
Ω	Solid angle
P_{tot}	Total power dissipation
φ	Half angle
Φ_e	Total radiant flux

R_L	Load resistance
R_{thJA}	Thermal resistance, junction (heat source) to static ambient air
R_{thJC}	Thermal resistance, junction to case
S	Sensitivity
$S\lambda$	Spectral sensitivity
S_{max}	Max. sensitivity
S_{rel}	Relative spectral sensitivity
T	Cycle time
T	Temperature
T_A	Ambient temperature
T_C	Case temperature
TC_I	Temperature coefficient for I_{SC}
TC_λ	Temperature coefficient for λ_{peak}
TC_V	Temperature coefficient for V_o
T_j	Junction temperature
T_{op}	Operating temperature
T_{sold}	Soldering temperature
T_{sold}	Soldering temperature at dip soldering
T_{sold}	Soldering temperature at iron soldering
T_{stg}	Storage temperature
t	Time
t_f	Fall time
t_r	Rise time
τ	Cycle duration
V_{BE}	Base-emitter voltage
V_{BR}	Breakdown voltage
V_{CB}	Collector-base voltage
V_{CE}	Collector-emitter voltage
V_{CEO}	Collector-emitter voltage (open base, $I_B = 0$)
V_{CEsat}	Collector-emitter saturation voltage
V_{EB}	Emitter-base voltage
V_{EBO}	Emitter-base voltage (open collector, $I_C = 0$)
V_F	Forward voltage
V_o	Open-circuit voltage
$V_{o\ 25}$	Open-circuit voltage of $T_A = 25$ °C
V_R	Reverse voltage

Refer also to “Technical Explanations”, section 5:

Technical Explanations

1 General

Optoelectronic components have found wide acceptance in modern electronics and thus in almost all areas of our life. They are, to a great extent, partly responsible for the change from mechanical components to electronic components and, thanks to their function as converters of optical signals or energy into electrical signals or energy, have only just enabled us to find the solutions to many modern electronic problems.

Light reflecting switches for production checks and as safety devices, light control and regulating equipment like twilight switches, fire detectors and facilities for optical heat monitoring, punched card readers and tape readers, positioning of machine tools (for measuring length, angle, and position), of optical apparatus and ignition processes, signal transmission with electrically isolated inputs and outputs, as well as conversion of light into electrical energy are only some examples of classical applications.

In the photographic industry, aperture and exposure control in cameras and movie cameras as well as automatic electronic flashes are already standard applications. Automatic range metering and setting, improved light metering by discrete measurement of the picture center and picture edge brightnesses are more modern trends. Infrared audio transmission and infrared remote control have not only come into the HiFi and television industry, but have also found acceptance for simultaneous interpreter systems at conferences and for the remote control of machines, garage doors, lighting systems, etc. Of particular advantage in this case is the fact that the control function of the infrared remote control can be safeguarded against unauthorized operation by the possibility of coding (modulation).

Whether photovoltaic cells, photodiodes or phototransistors are best suited depends on the application.

Photovoltaic cells are recommended if large light-sensitive surfaces are required, for example for checking wide webs in the paper and textiles industry for flaws. If fast responses and linearities are required over wide irradiance and illuminance ranges, photodiodes are suitable for use both as cells and as diodes. Phototransistors are best suited for digital applications and when high gain is required with minimum space requirements.

Below, further explanations of the individual fields of application are given, with detailed reference to technology, special characteristics, and possible applications. The next chapter concerns the measurement techniques of optoelectronic components, linked with the most important tables and work diagrams. This is concluded by information on quality, as well as installation, and soldering specifications.

2 **Detectors** (Radiation-sensitive components)

2.1 Charge carrier generation in a photodiode

Figure 1 shows the basic design of a planar silicon photodiode with an abrupt pn transition. Due to the differing carrier concentrations, a field region free of mobile carriers, the space charge region,

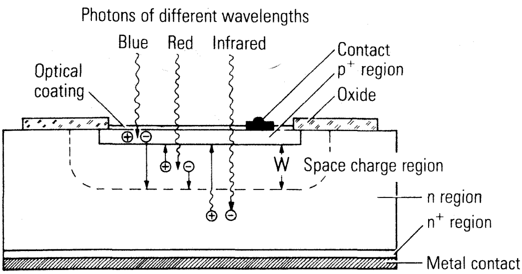


Figure 1
Planar silicon photodiode (schematic)

builds up between the p^+ and n region, which only reaches into the n region if there is an abrupt p^+ n transition. The following applies to the width of the space charge region:

$$w \sim \sqrt{\frac{V_{diff} + V}{n_D}}\,. \tag{1}$$

In this case, V_{diff} is the diffusion voltage, V is the external voltage and n_D is the donor concentration on the n side. For the junction capacitance $C_j \sim \frac{1}{w}$ with w from equation (1) the following is obtained:

$$C_j \sim \sqrt{\frac{n_D}{V_{diff} + V}}\,. \tag{2}$$

If photons with an energy $h\,\nu \geq E_g$ penetrate into the diode, electron hole pairs are generated on both sides of the pn junction. The energy difference ($h\,\nu - E_g$) is dissipated to the grid in the form of heat. The electrical field in the space charge region repels the majority carriers and attracts the minority carriers on the other respective side (thus, holes from the n side to the p side and, vice versa, electrons from the p side to the n side). In this way, the charge carrier pairs are separated and a photocurrent flows through an external circuit, also without an additional voltage (photovoltaic effect). Carriers occurring in the space charge region are immediately sucked off due to the field prevailing in this layer. The carriers from the other regions must first of all diffuse into the space charge region in order to be separated. If they recombine beforehand, they are lost with respect to the photocurrent. Thus, the photocurrent I_p consists of a drift current I_{drift} of the space charge region and of a diffusion current I_{diff} from the remaining regions.

Should the p^+ region be far thinner than the penetration depth $\frac{1}{\alpha_\lambda}$ (α_λ = absorption coefficient) of the radiation, the photocurrent from the p^+ region can be neglected and the following relationship can be derived for the photocurrent I_p.

$$I_p = q\,\Phi_o \left[1 - \frac{e^{-\alpha\lambda\,w}}{1 + \alpha_\lambda\, L_{diff}} \right]. \tag{3}$$

L_{diff} is the diffusion length of the holes in the n region, q is the elementary charge and Φ_o the radiant flux. The absorption coefficient α_λ is the only variable in the equation which depends on the wavelength. It predominantly determines the spectral characteristic of the diode's photosensitivity. In accordance with equation (1), the space charge region width w depends on the voltage and the doping which, in addition to the crystal quality, also influences L_{diff}. High sensitivity is achieved with high values for w and/or L_{diff}.

With respect to the electrical mode of operation, we differentiate between diode mode (with bias voltage) and cell mode (without bias voltage). In cell mode, the diode acts as a current generator which converts the radiant energy into electrical energy. If the photodiode is considered as a current source with the photocurrent I_p and a diode of equal polarity is connected in parallel to the load resistance R_{LE} (idealized equivalent circuit diagram), the relationship between the current and voltage can be expressed as follows:

$$I = I_{sat}\,[e^{\frac{V}{n \cdot V_T}} - 1] - I_p. \tag{4}$$

In this case, I_p is the photocurrent, I_{sat} the saturation current, V the voltage between the p and n contact, V_T the voltage equivalent of the temperature and n is the diode factor. In the case of I_p = 0, equation (4) is reduced to a normal diode equation and describes the dark characteristic ($E_v = 0$). When subjected to light, the characteristic is shifted downwards corresponding to the illuminance. The open-circuit voltage

$$V_L = n\,V_T\,\ln\left[1 + \frac{I_p}{I_{sat}} \right] \tag{5}$$

belongs to $V = 0$ ($R_{LE} = \infty$) and the short-circuit current $I_{sat} = -\,I_p$ belongs to $V = 0$ ($R_{LE} = 0$).

There is a linear relationship, depending on the diode type, between the illuminance E_v and the photocurrent I_p, which covers several powers of ten (eight and more). However, due to $I_p \sim E_v$ and $I_p > I_{sat}$, a logarithmic relationship prevails between the open-circuit voltage V_L and the illuminance E_v. The forward current I_F belonging to the open-circuit voltage V_o is equal to the impressed photocurrent. In diode mode, the photocurrent of one or the other diode type may slightly change together with the applied voltage. This is due to the voltage dependence of the space charge region. In the case of silicon photodiodes, the dark current (first term in equation [4]) once again only plays a role with extremely low illuminances (in the millilux range).

2.2 Detectors

2.2.1 Spectral sensitivity

Figure 2 shows the graph of the spectral sensitivity of a silicon and a germanium photodiode. The positions of the emission maxima of the most important light emitting diodes and the sensitivity of the human eye are also shown.

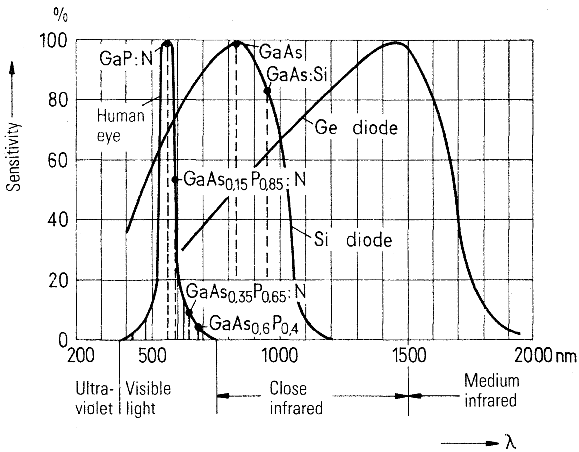


Figure 2
Relative sensitivity of a silicon and a germanium diode

The two photodiodes cover the wavelength band from approximately 300 to 1800 mm. In this case, the silicon diode is of greater significance; it covers the visible range and, with its maximum sensitivity in the near infrared area, is well matched to the GaAs infrared emitting diode, whose best-known field of application covers IR remote controls and light barriers.

The sensitivity limit of semiconductor detectors in the long wave spectral wave band λ_g is determined by the energy gap E_g.

$$\lambda_g\,[\text{nm}] = \frac{h \cdot c}{E_g} = \frac{1.24}{E_g\,[\text{eV}]}$$

The run of the spectral sensitivity curve in the remaining wave band is determined by the absorption coefficient α_λ and the recombination relationships in the interior and on the surface of the semiconductor (carrier loss). The drop in the curve towards shorter wavelengths is due to the higher absorption for shortwave radiation; for this reason, carrier pairs are only generated in the regions near the surface but, due to the high prevalent recombination rate, are mostly lost with respect to the photocurrent.

2.2.2 Photodiodes (PN and PIN diodes)

Photodiodes can optimally be matched to the desired application by choosing the correct mode of operation and by means of a suitable internal structure. In addition to the schematic structure of each individual diode type, figure 3 shows the doping behavior and the field pattern as well as the region in which the avalanche effect takes place at a sufficiently high voltage (ionization region).

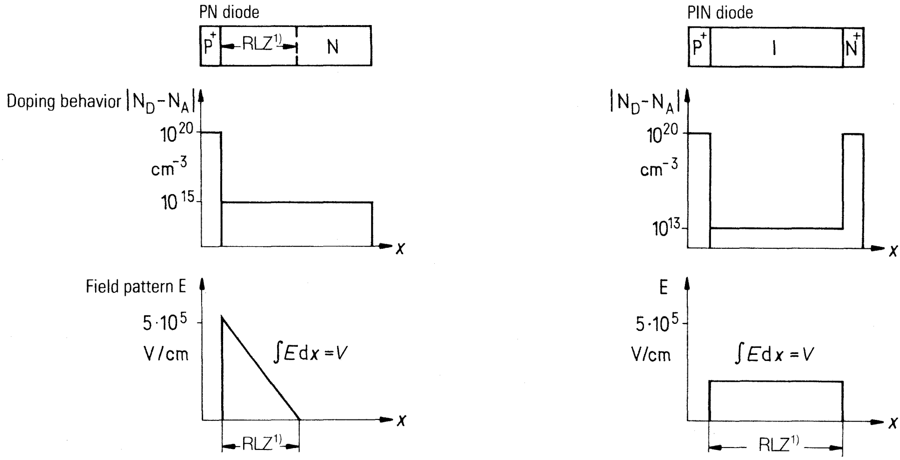


Figure 3
Doping behavior and field pattern of photodiodes

In the case of the *PN photodiode,* the radiation which, as a rule, enters the p^+ region vertically, is absorbed in the mainly quasi-neutral p and n regions due to the narrow space charge region; thus, the photocurrent predominantly consists of the diffusion current. As the characters are diffused relatively slowly, PN diodes are frequently used in applications in which the stress is placed rather more on low dark currents than on high speed. (For complete diffusion of a 5 μm thick p layer, an electron needs 3 ns, and a hole needs 15 ns for the same distance in the n region). Therefore, silicon PN diodes can be found in exposure meters which still operate perfectly under starlight; this presupposes dark currents of less than approximately 10^{-11} A/mm^2. Solar cells also belong to the group of PN photodiodes.

Contrary to the PN diode, in the case of *PIN photodiodes* most of the light is absorbed in the space charge region. These photodiodes are mostly used in applications requiring high speeds. In order to achieve a large space charge region, if possible, in accordance with equation (2), the semiconductor material must be intrinsic (intrinsic I) (mostly weak n or weak p doped) into which a p^+ region is diffused on the one side and an n^+ region is diffused on the other side. A P^+IN^+ structure (“sandwich” structure) is obtained.

[1] RLZ = space charge region

In accordance with equation (3), the junction capacitance C_j is low due to the large space charge region of the PIN diode. C_j values are used between a few picofarad and a few tenths of a picofarad. The product from C_j and R_L (load resistance) is the time constant of the measurement circuit.

In order to achieve PIN diodes which are as "fast" as possible, the voltage is increased to such an extent that the carriers drift through the space charge region at saturation speed V_{sat}. In silicon and germanium, a saturation speed V_{sat} from 5×10^6 to 1×10^7 cm/sec is achieved with fields of approximately 2×10^4 V/cm. Accordingly, a carrier requires approximately 50 ps to completeley drift through a 5 μm thick region.

2.2.3 Photovoltaic cells

Voltaic cells are active dipole components which convert optical energy into electrical energy without requiring an external voltage source.

The properties of a voltaic cell are essentially characterized by the open-circuit voltage and the short-circuit current. In the case of a short circuit ($V = 0$), the current I_{SC} is a linear function of the illuminance and thus also proportional to the area subjected to radiation. The open-circuit voltage V_o initially increases logarithmically with the luminous intensity.

This is independent of the size of the cell and amounts to approximately 0.5 V at 1000 lx. In order to extract the maximum amount of energy from a voltaic cell, the load resistance R_L must lie in the order of magnitude of $R_i = V_o/I_{SC}$. The internal resistance R_i of a voltaic cell should be as low as possible in order to prevent unnecessary loss.

In order to measure the luminous intensity, the proportional relationship between the optical and electrical signals is important, and in practice, this applies up to a load resistance of $R_i \approx V_o/2\ I_{SC}$.

In principle, voltaic cells can also be operated in diode mode by applying a voltage in reverse direction. Obviously, this voltage must not exceed the maximum reverse voltage.

2.2.4 Phototransistors

In principle, a phototransistor corresponds to a photodiode (collector-base diode) with a series-connected transistor as amplifier. The phototransistor is the simplest integrated photoelectric component. Figure 4 shows one of the practical designs of a bipolar phototransistor (cross-section and view) with emitter (n^+), base (p) and collector (n); the latter is mostly subdivided into a

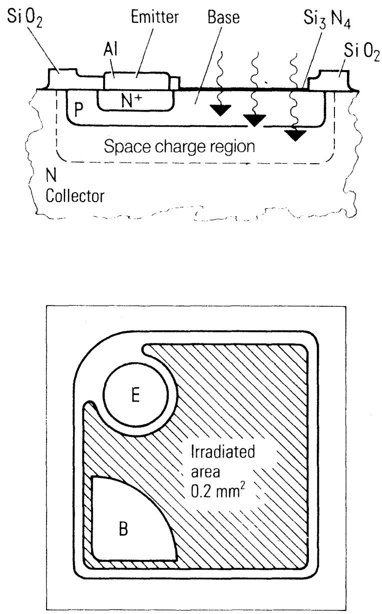


Figure 4
Bipolar phototransistor

weakly doped n and a highly doped n^+ region. As the diffusion length L_{diff} of the holes in the n^+ region is low due to the high amount of doping, only the p and n regions provide the maximum amount to the primary photocurrent I_{CB} of the collector-base diode. This is due to the low photosensitivity (also in comparison with photodiodes) of expitaxial transistors in the long wave band. A large part of the long-wave radiation is absorbed in the n^+ region as the n region is mostly extremely thin (10 to 20 µm) as a result of the requirement for extremely low conductor resistances. The view of the transistor shows a base with a large area in which the emitter and also the base connection are attached to the side; in this way, a surface sensitivity as uniform as possible is achieved. The gain of phototransistors normally lies between 100 and 1000. Gain deviations from the linearity and thus from the linear relationship between the illuminance and the photocurrent amount to (over approximately four powers of ten of the photocurrent I_p, from some 100 nA to some mA) less than 20% and mostly less than 10%. With regard to dynamic behavior, phototransistors are less favorable than photodiodes as, in addition to the collecting and charging processes in photodiodes, there is also a delay due to the amplification mechanism (Miller effect). In addition to the rise and fall times t_r and t_f, the transistor also has the delay time t_d. This is the time required until the photocurrent has reached 10% of its final value after activation of an optical square-wave pulse. For the rise and fall times of a phototransistor, the following relationship applies:

$$t_{r,\,f} = \sqrt{\left(\frac{1}{2_{f_T}}\right)^2 + a\,(R \cdot C_{CB} \cdot G)^2}$$

In this case, f_T is the transition frequency, R is the load resistance, C_{CB} is the collector-base capacitance, G is the gain, a is a constant whose value lies between four and five. The rise and fall times of usual phototransistors range from 1 to approximately 30 µs with 1 kOhm load resistance. Therefore, they are particularly suitable for use within a frequency range up to some 100 kHz, which suffices for important applications such as light rejecting switches, punch tapes, and punch card readers.

3 **Emitters** (Radiation emitting components)

3.1 Light emitting diodes (IREDs)

3.1.1 Definitions

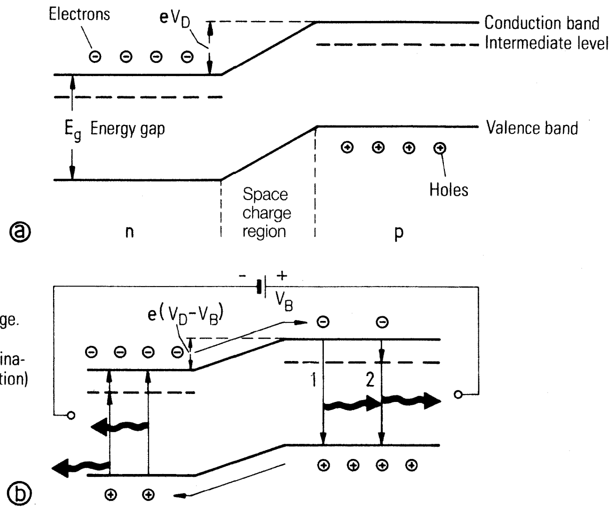
Light emitting diodes are semiconductor diodes which emit electromagnetic radiation when operated in forward direction. Contrary to that of a filament lamp, the radiation spectrum is limited to a narrow wave band. The wavelength of the emitted radiation is essentially determined by the semiconductor material used.

Gallium arsenide (GaAs)-based or gallium aluminum arsenide (GaAlAs)-based infrared emitting diodes emit radiation in the near infrared range of the spectrum (IRED). They are used in light-reflecting switches, punch card readers, in infrared remote controls, infrared range metering, and in optocouplers. Silicon photodetectors are used as receivers as their sensitivity is well-matched to the emission spectrum of IREDs.

The advantages of these semiconductor radiation sources are essentially low operating temperatures, high mechanical stability, e.g. insensitivity to mechanical vibrations or shocks, small dimensions and, last but not least, easy modulation of emission. A further advantage is their TTL compatibility.

3.1.2 Principle of operation and materials

Light emitting diodes operate in accordance with the principle of injection luminescence. Through a pn junction operated in forward direction, n-type charge carriers are injected into the neutral n and p region where they partially recombine for emission, sending out a photon with the energy $h\nu = hc/\lambda \leq E_g$ (h = Planck's constant, ν = frequency, c = speed of light, λ = wavelength, E_g = energy gap). This is shown in figure 5 in the energy diagram for a pn junction.



ⓐ without external voltage
ⓑ with externally applied voltage. Diode operated in forward direction (1 ≙ direct recombination. 2 ≙ indirect recombination)

Figure 5
The pn junction of a light emitting diode

The probability of radiant recombination essentially depends on the band structure type of the corresponding semiconductor material. In the case of direct semiconductors with GaAs as the most important representative, an electron can directly fall from the conduction band into a free state in the valence band (hole), in which case the released energy is given off as a photon (cp figure 6 left). In the case of the so-called indirect semiconductors with Si, Ge, and GaP as the most important representatives, however, this transition is linked with a pulse change of the electron. Recombination is then only possible with the participation of third partners, for example, phonons or impurities. These must ensure pulse compensation. The energy released during the transition is mainly dissipated as heat to the grid. In indirect semiconductors, this leads to the probability of radiant recombination being less by orders of magnitude than in direct semiconductors. Nevertheless, effective radiant recombination can be generated in some indirect semiconductors. This is achieved by doping with isoelectronic impurities. The two most efficient isoelectronic impurities in GaP are the nitrogen atom and the zinc-oxygen pair. Radiant recombination is then achieved by way of the decay of an electron hole pair (exciton) bonded to the isoelectronic impurity (cp figure 6 right).

A high degree of crystal perfection is a precondition for the creation of effectively radiant recombination as crystal defects act as centers for non-radiating recombination. For this reason, the active layers of light emitting diodes are produced epitaxially at temperatures far below the melting point of the semiconductor material.

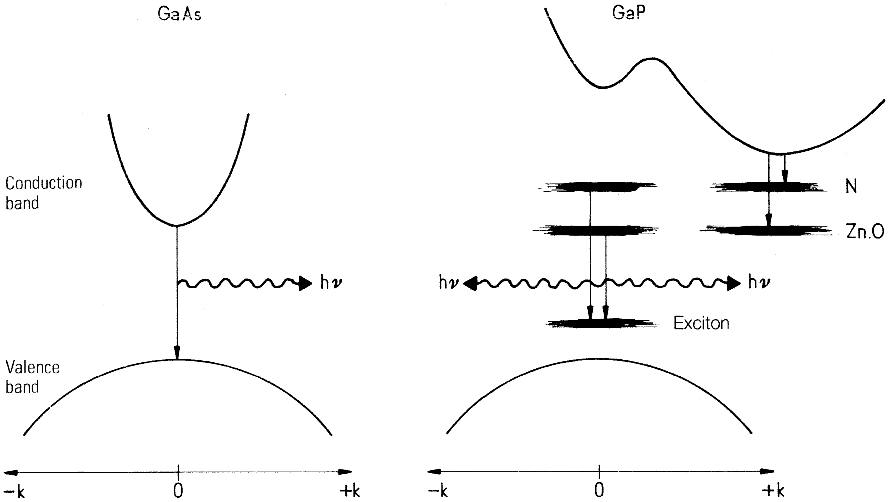
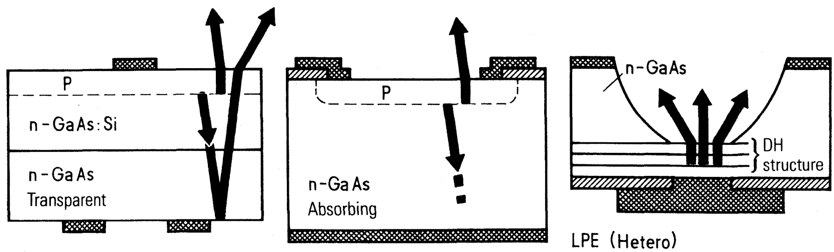


Figure 6
Dependence of energy states on the wave number vector k in the case of direct (GaAs) and indirect (GaP) semiconductors

III–V compound semiconductors and mixtures of these can be used as materials for light emitting diodes as their energy gaps cover a wide spectrum and the band structure, contrary to the classical semiconductors Si and Ge, enable the creation of effective radiant recombination. Above all the semiconductors GaAs, and GaAlAs have practical significance.

3.1.3 Infrared emitters (IREDs)

IR emitters are based on GaAs which has an energy gap of approximately 1.43 eV, corresponding to emission of approximately 900 nm. Higher external quantum efficiencies can be achieved with these diodes than with light emitting diodes for the visible wave band. The left-hand side of figure 7 shows the schematic of the diode body of a silicon-doped GaAs IRED. By means of liquid phase epitaxy (LPE), the active layer with a high crystal perfection can be grown onto a GaAs substrate. Due to the amphoteric characteristic of the silicon impurity, the pn junction forms automatically during the process of epitaxy. Due to the silicon doping, the emission lies at 950 nm and is thus so far underneath the band edge that the radiation created in the diode body is only absorbed to a slight extent. Part of the radiation leaves the diode body on a direct path through the near surface. However, radiation emitted in the direction of the substrate is also useful. For this purpose, the rear of the diode body is mirrored and serves as a reflection surface.



	IR (950nm)	IR (900nm)	IR (820-880nm)
Epitaxy	LPE	—	LPE (Hetero)
pn junction	LPE	Diffusion	LPE (Hetero)
Technology	GaAs-IRED	Diffused GaAs IRED	Burrus type
Switching time (typical)	1000 ns	50 ns	15 ns

Semiconductor — Contact — Oxide

LPE = liquid phase epitaxy

Figure 7
Structure of the diode body of an IRED

IREDs are fitted in plastic packages or in hermetically sealed glass-metal housings. In the case of types in a plastic package (3 and 5 mm) in addition to the required protective function contrary to other semiconductor components, the additional function of beam decoupling and beam guidance is performed by the transparent plastic body.

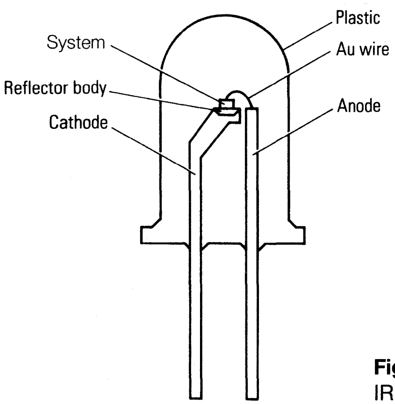


Figure 8
IRED in plastic package

On the one hand, the critical angle of total reflection for the beam leaving the diode body is reduced by the plastic, thus increasing coupling out of the beam and, on the other hand, the bent plastic surface acts as a lens and thus influences the radiation characteristic.

An essential piece of information for the user is the radiation characteristic. If the light emitting diodes are used in an arrangement without optical lenses, for example, in a tape reading head, the radiation should have a small half angle.

In conjunction with optical lens systems, designs are preferred in which the radiation leaves the component through a flat window.

Array designs are suitable for a wide range of applications as they can be arranged in any configuration.

Ongoing developments in the field of silicon-doped liquid phase epitaxial IREDs is aimed at expanding the wave band. The amphoteric character of silicon doping is retained in the terniary mixed crystal (GaAl) As in that the energy gap can be varied by means of the amount of Al. In this way, it is possible to produce emission wave bands between 850 and 900 nm and to tune the emitter diodes to the maximum detector sensitivity. With selectively sensitive detectors, it would be possible to create transmission systems with two (or more) optically separate channels.

3.1.4 Electrical and optical characteristics of IREDs

Figure 9 shows the emission spectrum of the IRED relative to the sensitivity curve of the silicon photodiode.

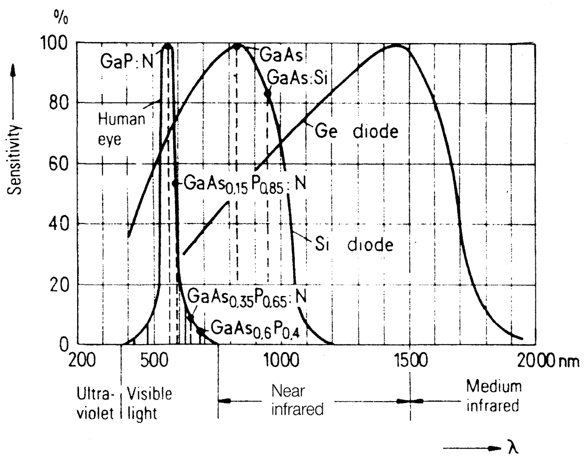


Figure 9
Relative sensitivity of a silicon and a germanium diode

In the case of GaAs diodes and GaAlAs diodes, the emitted radiation of IREDs changes in the normal operating range in a linear relationship with the forward current.

If the forward current is very high, the curve asymptotically approaches a threshold value. This is caused by a strong heating of the semiconductor system. The linearity range can be widened by switching from static to pulse operation. Non-linearity also turns up at small forward currents. It is caused by excess current not contributing to the radiation and cannot be influenced by the customer. Figure 10 shows the radiant power versus the forward current.

At constant current, the radiant intensity decreases with rising temperature. The temperature coefficient is –0.7% per degree (°C) for GaAs and –0.5% per degree (°C) for GaAlAs. This is negligible for many applications. If the temperature dependence proves disturbing it can widely be eliminated by compensation circuits.

The radiant power emitted by LEDs declines with increasing length of operation ("aging"). In the case of IREDs the average life dependent on the operating current and ambient temperature is approximately 10^5 h (extrapolated from continuous tests). Refer to figure 11.

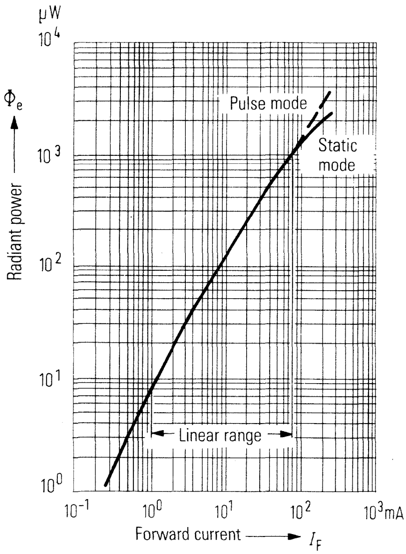


Figure 10
Radiant power versus forward current

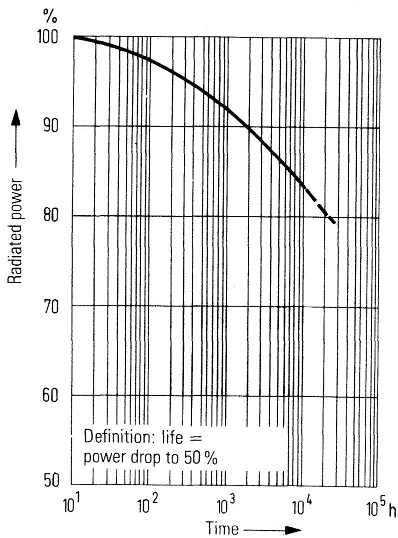


Figure 11
Radiated power versus operating life

4 Measuring technique

Optoelectronic semiconductor devices, photovoltaic cells, photodiodes, phototransistors etc. are special versions of standard semiconductor devices which were developed in view of their particular field of application. Their measuring technique includes and is based on the conventional and well-known one of diodes and transistors. It is supplemented by a special optoelectronic measuring technique. Irrespective of the fact whether the objects to be measured are radiation sensitive (detectors) or radiation emitting (emitters) components or a combination of both (e.g. optoelectronic couplers), the measuring system radiator/receiver remains the same, only the object to be measured changes its place. The essential difference to the standard measuring method lies in the broadband of the measuring system and the pronounced spectral characteristics of emitters and detectors as well as in the problem of an exact description of these characteristics and their reproducibility in order to achieve coinciding results at any time and in any place. This requires the observation of the following instructions.

4.1 Detectors (radiation sensitive components)

Radiation-sensitive semiconductor devices serve to convert radiation energy into electrical one. Radiation energy can be offered to the component in manifold forms, depending on the source of radiation. For measuring purposes only such radiation sources can be taken into consideration which, in their spectral energy distribution, can easily be covered and are reproducible, i.e. thermic radiation sources like the tungsten filament lamp, which at least in the wavelength range here of interest comes very close to the black body and monochromatic light sources that means those emitting radiation of only one wavelength or at least of a very narrow wavelength range, above all light emitting diodes and a combination of any emitters with narrow band filters. Especially for applications with infrared emitting diodes (IREDs), this measurement of the spectral photosensitivity is increasingly gaining significance and is taking the place of integral measurement with standard light A.

Because of its high energy, the tungsten filament lamp is mainly used for measuring the radiation sensitivity when set to a "color temperature" of 2856 K, corresponding to standard light A as per IEC 306-1 part 1 and DIN 5033 while light emitting diodes are primarily employed for cut-off frequency and switching time measurements as they can be modulated or pulsed up to high frequencies. At this instance, we want to draw your attention to the following. The definition of "color temperature" (see paragr. 5.1) shows that for the field of optoelectronic measuring technique it is basically only useful to a very limited extent, in a way as an auxiliary. But unfortunately the term has come to stay. In practice the lamps are not calibrated to color temperature but to "relative temperature in the visible range", mostly to a green-red relation. An extension to a red-green-infrared relation and thus an approach to the, for our measuring technique solely correct, "distribution temperature" in the wavelength range 350 to 1200 nm, or even better 300 to 1800 nm, is desirable. This still meets with objections on the part of lamp manufacturers since it necessitates an extension of calibration equipment and results in a relatively small quantity of lamps required.

The tungsten filament lamps used for measuring purposes have to be set to a relative spectral energy distribution corresponding to that of the black body at a temperature of normally 2856 K at least in the wavelength range 350 to 1200 nm, and have to be operated under very stable conditions. It is necessary to have the lamp operated with constant current, the deviation from the rated value must be kept less than ± 0.1%. This requirement seems to be very high, but one has to consider that a deviation of the lamp current by 0.1% brings about a change of the radiant intensity by 0.7% and, of the color temperature, by 2 K. Naturally, the lamp can also be operated with a constant voltage but this is hard to realize in practice because of the inevitable and varying contact resistances in the lamp socket, therefore an operation with constant current is to be preferred.

A lamp voltage check at the same time permits a control of the lamp with regard to a change in its characteristics for example by evaporating of coiled filament material which would point to the fact that the lamp is no longer suitable for measuring purposes and has either to be replaced or calibrated anew. This check is mainly recommended for the "standard lamps" which are standard for color temperature, radiant and/or luminous intensity.

For general measuring purposes, serial measurements in particular, the standard lamps gauged by the PTB or the manufacturer are usually not used because of the calibration costs. Therefore, the service lamps are set to the given ratings by a comparison with these standard lamps. The procedure is as follows:

4.1.1 Setting of color temperature

The standard lamp is set to current and/or voltage according to the material test certificate. So as to obtain exact and reproducible values, the coil filament of the lamp has to be adjusted precisely to vertical with a tolerance of ± 1°. After a heating period of approximately 30 minutes the photocurrent of a linear receiver, usually the short-circuit current of a photoelectric device, is measured behind a narrow-band filter with a transmission wavelength of approximately 500 nm or 900 nm respectively. Care should be taken that the filters have no further pass band. The relation of these 2 measured values characterizes the spectral energy distribution of the black body at the given temperature. Now, the lamp current of the lamp to be calibrated is changed until the ratio of the photocurrent measured behind the 2 filters coincides with that measured before at the standard lamp. Thus, the service lamp has the same color temperature (or to be more precise, ratio temperature) as the standard lamp. It should be mentioned here that the lamp has to be calibrated in the case in which it will be operated later on since different heat conditions and reflexions in the case may lead to considerable changes in the radiation characteristics of the lamp.

4.1.2 Setting the standard lamp
(for testing the irradiance)

The material test certificate of the standard lamp usually states the radiant intensity (I_e) or the luminous intensity (I_v), respectively, for the direction vertical to the coiled filament. At a sufficiently large distance from the coiled filament, at least ten times the maximum filament dimension, the following applies to the irradiance E_e (in mW/cm^2) or for the illuminance E_v (in lux), respectively:

$E = I/R^2$, from which the distance for the required value of E can be derived in accordance with $R = \sqrt{I/E}$. Figure 13 illustrates this relationship. Now, the photocurrent of the photovoltaic cell is measured at this distance from the coiled filament of the standard lamp and then by means of the voltaic cell, the distance to the service lamp at which the same photocurrent flows is set. In case a sufficiently precise luxmeter (e.g. Osram Centra-V [λ] Si photovoltaic cell) or a power meter of an adequate bandwidth is available the adjustment can, of course, be done by them. When irradiance measuring instruments are used one has to take into consideration that, in general, it is impossible to cover the entire range of the spectral energy distribution of the (black) emitter because, for example, of the installation of the thermocoupler behind a quartz-window. Consequently the measured irradiance E_e is too low compared to the black body. As a result the object is measured at too high an irradiance when E_e has been adjusted by this instrument (shortened spacing from body) although the object itself is insensitive to the spectral range filtered off in the radiant intensity meter. This can lead to differences in the photocurrent up to 20%. For this reason, in the case of the irradiance the measuring device used must be mentioned in order to enable comparison of measurement results (spectral sensitivity curve, window material, etc.). In addition, the color temperature of the correction factor must be given, referred to the black body.

The radiant intensities given in this book were measured with the power measuring instrument RK 5100, measuring head RKP 545 of Laser Precision Corp.

At the moment the PTB and/or lamp manufacturers gauge standard lamps only at color and/or ratio temperature in the visible range. Caused by the structure of a standard lamp, in particular by uneven temperature distribution over the coiled filament (heat dissipation by suspension), these gaugings do not even for lamps of the same type guarantee the same shape of spectral energy distribution in the infrared where the components to be measured usually have their maximum. Depending on type of lamp this is expressed in differences of the photocurrent of some % up to more than 10% under the same measuring conditions (e.g. E_v = 100 lx and T_F = 2856 K). Lamps with filament or double filament show this particularly strong. Merely the new version Wi 41 G of Osram with its detached coiled filament is an exception. The scattering from lamp to lamp is only some per mills as measurements of a large quantity of lamps proved and it can therefore be recommended as standard lamp in connection with semiconductor photoelectric components.

4.1.3 Spectral sensitivity

For spectral sensitivity measurements (photocurrent or photovoltage) the components to be measured are placed at the position predetermined for the specific irradiance and there they are held in such a way that the radiant sensitive surface of the semiconductor chip is vertical to the direction of light. Cylindric components such as in TO 18, TO 5 or similar plastic packages are put up so that the package axis coincide with the direction of radiation. This is of prime importance for components with a highly focusing lens. A holder with a sliding socket for the terminal wires proved useful (see figure 12).

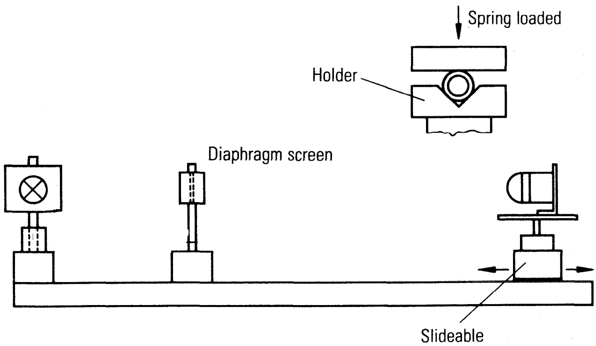


Figure 12
I_p test set-up for photoelectric devices

4.1.4 Solid angle

The solid angle is a part of space. It is limited by all the beams which radiate conically from one point (radiation source) and which end on a closed curve in the space. If this closed curve lies on the unitary sphere (radius R = 1 m) and envelops an area of 1 m², and if all rays originate from the center point of the unitary sphere, the solid angle is one sterad (sr).

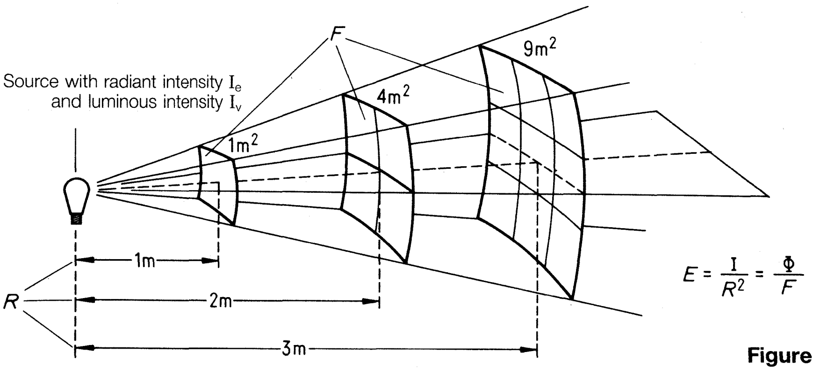


Figure 13
Solid angle (1 sterad)

4.1.5. Short-circuit current

When measuring the short-circuit current I_{SC} of photovoltaic cells care has to be taken that the internal resistance of the measuring instrument used is small enough compared to the internal resistance of the photovoltaic cell. The same applies to measuring the open circuit, the internal resistance of the measuring instrument is large compared to the internal resistance of the photvoltaic cell. Fig. 14 shows this connection for the photovoltaic cell BPY 11 P for E_v = 100 lx.

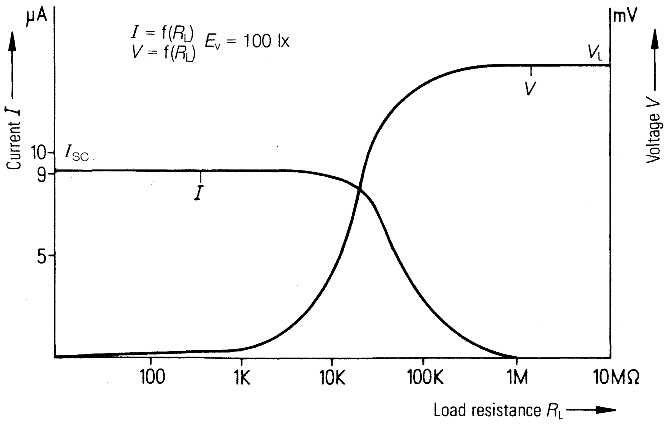


Figure 14
I or *V* versus load resistance for photovoltaic cell BPY 11 P

4.1.6 Switching times

The switching times are measured oscillographically by a set-up as shown in the circuit diagram below (fig. 15) by means of a pulsed, radiation emitting diode as measuring source and a double-beam oscillograph. The switching times of the GaAs must, of course, be small compared to the switching times of the component to be measured.

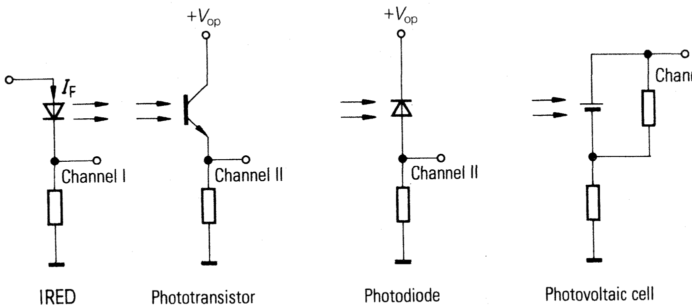


Figure 15
Measuring the switching times of detectors

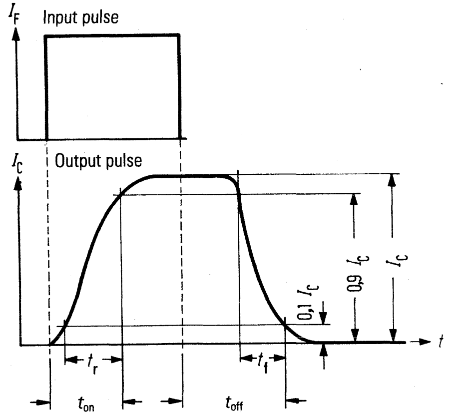


Figure 16
Switching time definitions

Turn-on time t_{on}:
The time in which the collector current I_c rises to 90% of its maximum value after activation of the drive current I_F.

Rise time t_r:
The time in which the collector current I_c rises from 10% to 90% of its final value.

Turn-off time t_{off}:
The time in which the collector current I_c drops to 10% of its maximum value after deactivation of the drive current I_F.

Fall time t_f:
The time in which the collector current I_c drops from 90% to 10% of its maximum value.

4.2 Emitters (radiation-emitting components)

4.2.1 Radiation in the infrared range – IRED –

The radiant intensity I_e in the direction of the case axis should be measured by a wavelength-independent detector (thermocouple element) but low sensitivity, inertia, and temperature sensitivity cause difficulties. For this reason, one usually measures with a correspondingly calibrated photovoltaic cell. In such a case, the spectral sensitivity curve of the photovoltaic cell has to be considered and the measuring result corrected with regard to the deviations in the emitted wavelength of the radiator to be measured (for example IRED with different production technology). The total radiation of the component is measured by means of an Ulbricht sphere-type photometer.

The power radiated by the object of measurement into the sphere-type photometer is reflected from the walls of the photometer thus resulting in a uniformly illuminated photometer. As no direct radiation from the emitter impinges on the detector (e. g. photodiode), this measurement is largely independent of the radiation characteristic of the emitter (for measuring circuit see figure 17).

I_e measurement

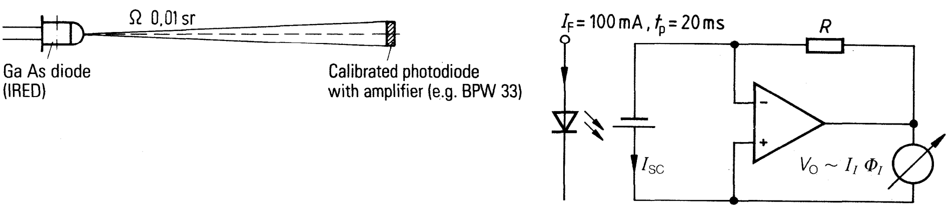


Figure 17 Calibrated photodiode (for example BPW 33) with amplifier and test circuit

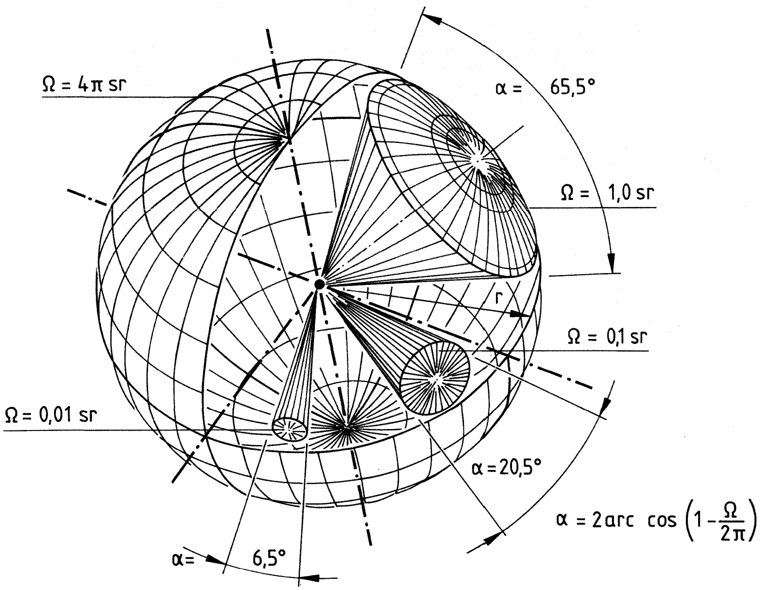


Figure 18 Definition of solid angle (steradian)

4.2.2 Measuring the radiant intensity of narrow-beam IR emitters

IR emitters are used in remote control systems, light reflecting switches, control circuits, alarm systems etc.

There is an increasing demand for emitters with higher intensity, as they enable longer distances to be covered. This is achieved by beam focussing, i. e. by reducing the emission angle (approx. ± 10 degrees), which, however, may lead to incorrect I_e measurements.

The radiation power is measured in the direction of the IRED's axis and expressed in mW/sr (sr = steradian) illustrated in figure 18.

Using common measuring methods, the IRED's radiant power is measured in axial direction at a distance of 10 cm with the aid of a detector having an area of 1 cm^2. This corresponds to 0.01 sr or a beam angle of 6.5 degrees. This method produces acceptable results for IREDs with a half angle >20 degrees (error of measurement <10%); with smaller half angles, however, the error rate may increase.

The following points can be sources of error affecting measurement:

1. Accuracy of impressed current
2. Detector, amplifier (linearity, noise etc)
3. Display errors
4. Varying temperature
5. Outside light
6. Misalignment as regards axial direction

Points 1 to 4 hardly contribute to the total error. Provided that the signal is strong enough, they are <1%.

Reflection is avoided by means of shutters, outside light is subdued to a negligible value by a lighttight set-up (measuring tube) as shown in figure 19.

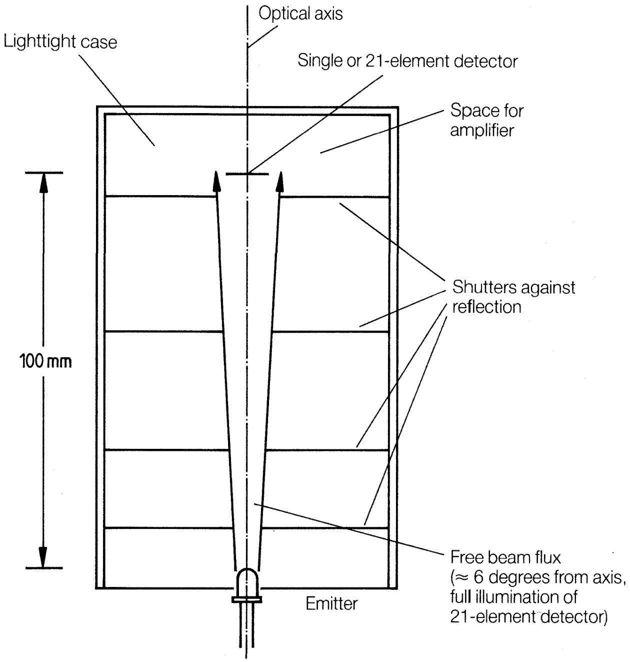


Figure 19 Schematic set-up with single- or multi-detector

Misalignment of the IRED's optical axis has the worst effect on measurement. A misalignment of not more than 2 to 3 degrees of components with a half angle of 20 degrees may result in measuring errors of up to 10%, since the major lobe of the beam does not fully hit the detector area (figure 20). Practice has shown that this error can reach 30% with narrow-beam IREDs (half angle approx. 10 degrees) as shown in figure 21. Reproducible measurement is no longer possible.

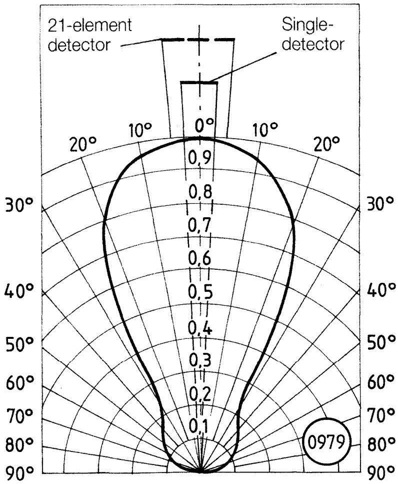


Figure 20 Idealized radiation characteristic of the LD 271
Measuring angle covered by a single-detector and a 21-element detector

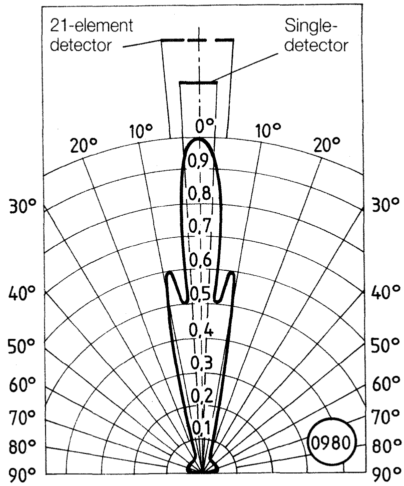


Figure 21 Idealized radiation characteristic of the LD 274
Measuring angle covered by a single-detector and a 21-element detector

A possible solution is the use of longer detectors, which ensure that the major lobe in any case hits the radiation sensitive area. Unfortunately, with this method IREDs with very different beam angles produce the same output signal as the detector does. This makes the method useless for narrow-beam IREDs, since the intensity of the beam lobe is the principal advantage of narrow-beam diodes.

On the other hand, similar I_e values can be expected for IREDs of the same type or chips with the same total radiant power (Φ_e).

Therefore a measuring system has been developed that is reproducible and suitable for practical application. For this method a detector array with 21 single diodes is used (figure 22). Each silicon photodiode is 3 mm × 3 mm in size, hence the total size of the radiation sensitive area is 15 mm × 15 mm. The detectors in the four corners are not connected. Thus, at a measuring distance of 10 cm and a beam angle of ± 4.3 degrees the maximum intensity is detected.

Silicon detector with 1 cm edge length (10 mm × 10 mm ≙0.01 sr at 10 cm measuring distance)

Silicon 21-element detector
21 single-chips, each with 3 mm edge length
(3 mm × 3 mm ≙0.009 sr at 10 cm measuring distance)

Figure 22 Comparison of detector sizes

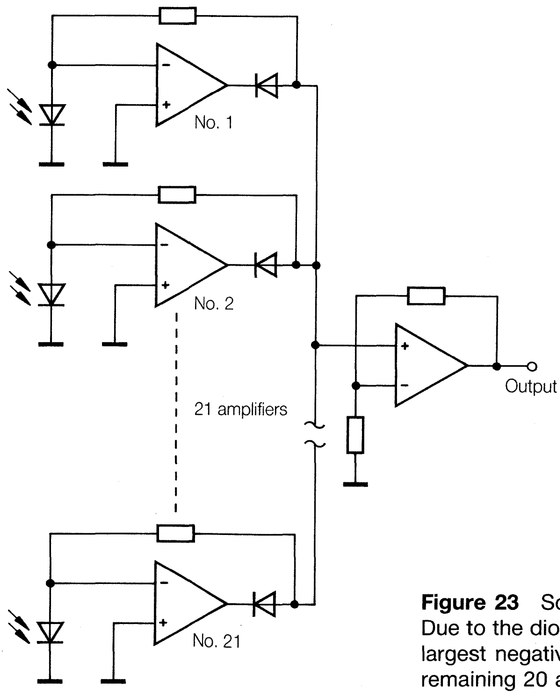


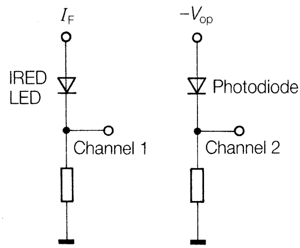
Figure 23 Schematic diagram of 21-element circuit
Due to the diodes at the output, the amplifier with the largest negative signal suppresses the signals of the remaining 20 amplifiers.

A larger angle cannot be recommended, since this may result in positive evaluation of "squint" parts (e.g. due to center offset).

One amplifier is assigned to each silicon diode. Variations in this radiant sensitivity are compensated by adjusting the amplifiers. The individual amplifier outputs are connected such that the maximum value is indicated at the output (figure 23).

4.2.3 Measurement of switching times

For measuring the same applies as to the radiant sensitive components except that now a photodiode serves as detector and its switching time must be small compared to that of the IRED or LED to be measured.



5 Terms, Definitions, Standards

5.1 Terms of temperature for optical radiations

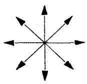
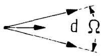
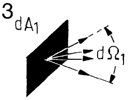
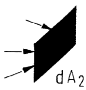
Serial No.	Term	Symbol	Relation to Planckian Radiation	Definition
Temperature that may be allied to any optical radiation				
1	Radiance temperature	T_s	Equality of the spectral radiance of a selected wavelength	The spectral radiance of any wavelength of a radiation to be denoted may be correlated with that Planckian temperature at which it has the same radiance at the same wavelength. Pyrometry formula (Acc. to Wien): $\frac{1}{T_s} - \frac{1}{T} = \frac{\lambda}{c_2} \ln (\varepsilon \cdot \tau)$
Temperatures that may be allied only to optical radiations having certain characteristics				
2	Color temperature	T_f	Equality of color	When a radiation has a color equalling that of a Planckian radiation the temperature of the latter is the color temperature of the radiation to be denoted.
3	Correlated color temperature	T_n	As large a color similarity as possible	When radiation has a color not equalling that of a Planckian radiation but – assessed acc. to sensation – comes close to it, the temperature of the closest Planckian radiation is the correlated color temperature of the radiation to be denoted.
4	Distribution temperature	T_v	Equality of the relative spectral radiation distribution between λ_1 and λ_2	If radiation in a wavelength region to be stated has a spectral distribution between λ_1 and λ_2 which is proportional to a Planckian radiation distribution the temperature of the latter is the distribution temperature of the radiation to be denoted.
5	Ratio temperature	T_r	Equality of the radiation quotient of two selected wavelengths	When the quotient Q of the radiation of two (close) wavelengths (ranges) λ_1 and λ_2 of a radiation to be denoted equals the corresponding quotient of a Planckian radiation, the temperature of the latter is the ratio temperature of the radiation to be denoted. Q between 0 ($\triangleq T = 0$) and $\lambda_2^4 : \lambda_1^4$ ($\triangleq T = \infty$) with $\lambda_1 < \lambda_2$.

DIN 5496, DIN 5033, DIN 5031.
International Dictionary of Light Engineering, 3rd Ed. 1970, publ. by CIE and IEC.

Application	Notes
Pyrometry	Visual pyrometry usually operates with an effective wavelength of about 650 nm. In general, the radiance temperature depends on the wavelength. It is always lower than the real temperature.
Color measurements	In general, T_f may **not** be used to draw any conclusion as to spectral distribution. In case of mere temperature radiations T_f usually equals approx. T_v in the visible region.
Color measurements	In general, T_n may **not** be used to draw any conclusion as to spectral distribution. The statement of the correlated color temperature only makes sense if the color of the radiation to be denoted is less than about 10...15 thresholds of sensation away from the Planckian curve shape. If the color difference approaches zero T_n switches to T_f.
Spectral measurements	If the range of spectral proportionality covers the visible T_f equals T_v. As there are no radiation sources which strictly meet the spectral proportionality condition over a long wavelength range, in practice deviations of up to a few per cent are allowed so that, for instance, $T_f \approx T_v$ applies to a tungsten radiation in the wavelength range between about 400 and 50 nm.
"Blue/Red" measurements	In general T_r may **not** be used to draw any conclusion as to the spectral distribution. In case of mere temperature radiation T_r between λ_1 and λ_2 is usually approximately T_v if the spacing between the two wavelengths is within reasonable bounds.

In case of a grey body characterized by a total emissivity independent of wavelength $\varepsilon(\lambda)$ = constant, the numerical values of several temperatures will coincide with the real temperature $T = T_w = T_r = T_f = T_n = T_v$ (exception: $T_s < T$).

5.2 Radiation and light measurements

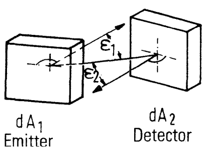
	Radiometric terms				
No.	Term	Sym-bol	Unit	Relation	Simplified definition
1 	Radiant power	Φ_e, P	W		Radiant power is the total power given in the form of radiation
	Emitter				
2 	Radiant intensity	I_e	$\frac{W}{sr}$	$I_e = \frac{d\Phi_e}{d\Omega_1}$	Radiant intensity is radiant power per solid angle
3 	Radiance	L_e	$\frac{W}{m^2\ sr}$	$L_e = \frac{d^2\Phi_e}{dA_1 \cdot d\Omega_1}$	Radiance is radiant power per area and solid angle
	Sensor				
4 	Irradiance	E_e	$\frac{W}{m^2}$	$E_e = \frac{d\Phi_e}{dA_2}$	Irradiance is incident radiant power per (sensor) surface

Indices “e” (= energetic) and “v” (= visual) may be omitted unless danger of confusion

DIN 1301, DIN 1304, DIN 5031, DIN 5496

International Dictionary of Light Engineering, 3rd Ed. publ. by CIE and IEC

Spectral radiometric terms			Photometric terms		
Term	Symbol	Unit	Term	Symbol	Unit
Spectral radiant power distribution	$\Phi_{e\lambda}$	$\frac{W}{nm}$	Luminous flux	Φ_v	lm Lumen
Spectral radiant intensity distribution	$I_{e\lambda}$	$\frac{W}{sr\ nm}$	Luminous intensity	I_v	$\frac{lm}{sr} = cd$ Candela
Spectral radiance distribution	$L_{e\lambda}$	$\frac{W}{cm^2\ sr\ nm}$	Luminance	L_v	$\frac{cd}{cm^2} = sb$ Stilb
Spectral irradiance distribution	$E_{e\lambda}$	$\frac{W}{m^2\ nm}$	Illuminance	E_v	$\frac{lm}{m^2} = lx$ Lux



Photometric Basic Law

$$d^2\Phi = L\,\frac{dA_1 \cdot \cos\varepsilon_1 \cdot dA_2 \cdot \cos\varepsilon_2}{R^2}\,\Omega_0$$

Inverse Square Law

$$E = \frac{I}{R^2}\cos\varepsilon_2\Omega_0$$

(r should be 10 times the max. spacing of emitter-detector to keep error below 1%).

dA_1 = element of area of emitter
dA_2 = element of area of detector
ε_1 = angle of radiation
ε_2 = angle of irradiation
R = spacing emitter-detector
Ω_0 = sr

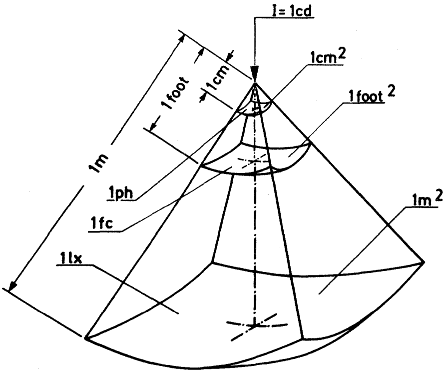
5.3 Radiation characteristics

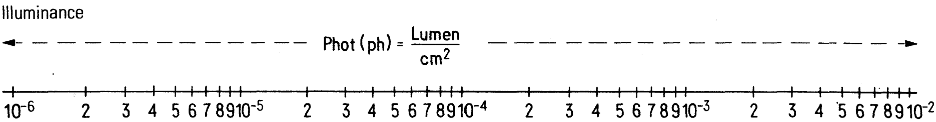
Designation	Symbol	Meas. quant.	Abbr.
Quantity of radiation	Q	Joule Wattsecond	J Ws
Radiant power	Φ	Watt	W
Point source of radiation	–	–	–
Solid angle	Ω	Sterad	sr
Radiant intensity	I	$\frac{\text{Watt}}{\text{sterad}}$	$\frac{\text{W}}{\text{sr}}$
Total radiant power of a source	Φ_{tot}	Watt	W
Irradiance	E	$\frac{\text{Watt}}{\text{meter}^2}$	$\frac{\text{W}}{\text{m}^2}$
Radiance	L	$\frac{\text{Watt}}{\text{m}^2\ \text{sterad}}$	$\frac{\text{W}}{\text{m}^2\ \text{sr}}$
Sensitivity of detector	$S = \frac{I}{E}$	$\frac{\text{Ampere}}{\text{irradiance}}$	$\frac{\text{A} \cdot \text{m}^2}{\text{W}}$

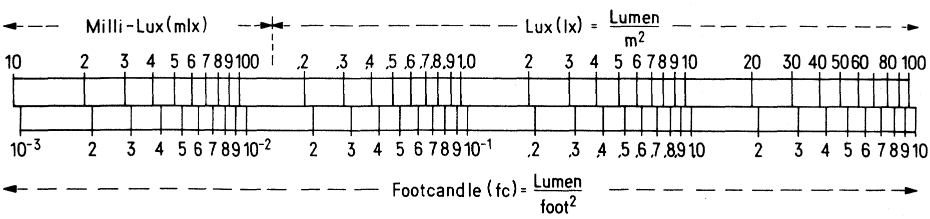
Definition
Quantity of radiation through a surface
Quantity of radiation Q per second through a surface
... is a source viewed from such a great distance R that all rays seem to emanate from one point. The max. linear expansion of the source must be substantially smaller than the distance R (example: sun for observer on earth).
$\Omega = \frac{A_1}{R_1^2} = \frac{A_2}{R_2^2} = \frac{A_3}{R_3^2} = \frac{A}{R^2}$; the radiant power Φ[W] of a point source is constant in solid angle. (Prerequisite: homogenous, undamping medium.) $\Omega = 1$ is $A = R^2$ so that $\Omega_{hemisphere} = \Omega_{\bigtriangleup} = 2\pi$ sr; $\Omega_{full\ sphere} = \Omega_{\ominus} = 4\pi$ sr
... is the solid angle density of the radiant power $\left(\frac{d\Phi}{d\Omega}\right)$ I of one source generally varies depending upon viewing direction. I only defined when $R \to \infty$
$\Phi_{tot} = \int_0^{4.7} I \, d\Omega$
... is the surface density of the radiant power (spherical surface) for a point source. $E = \frac{d\Phi}{dA}$; $dA = R^2 \, d\Omega$ $E = \frac{d\Phi}{d\Omega \, R^2} = \frac{I}{R^2}$; $I = ER^2$
... is the radiant intensity referred to the radiant surface viewed by the observer. (Surface projection $A_p = A \cos \varepsilon$, when ε is the angle by which the radiant surface is rotated against the connecting line to viewer. $L = \frac{I}{A_p} = \frac{I}{A \cos \varepsilon}$). Important optical quantity. 1) In an undamped beam path L is maintained and cannot be increased by any optical measure. 2) The human eye sees differences in radiance as differences in brightness.
Electrical quantity (current, voltage or resistance) in relation to irradiance

5.4 Illuminance (units and conversion factors)

		lx	mlx	ph	fc
1 Lux = lx	=	1	10^{-3}	10^{-4}	9.29×10^{-2}
1 Millilux = mlx	=	10^{-3}	1	10^{-7}	9.29×10^{-5}
1 Phot = ph	=	10^{4}	10^{7}	1	929
1 Footcandle = fc[1])	=	10.76	10760	1.076×10^{-3}	1







[1]) equivalent footcandle / apparent footcandle } footlambert (Luminous density) ≙ footcandle (Illuminance).

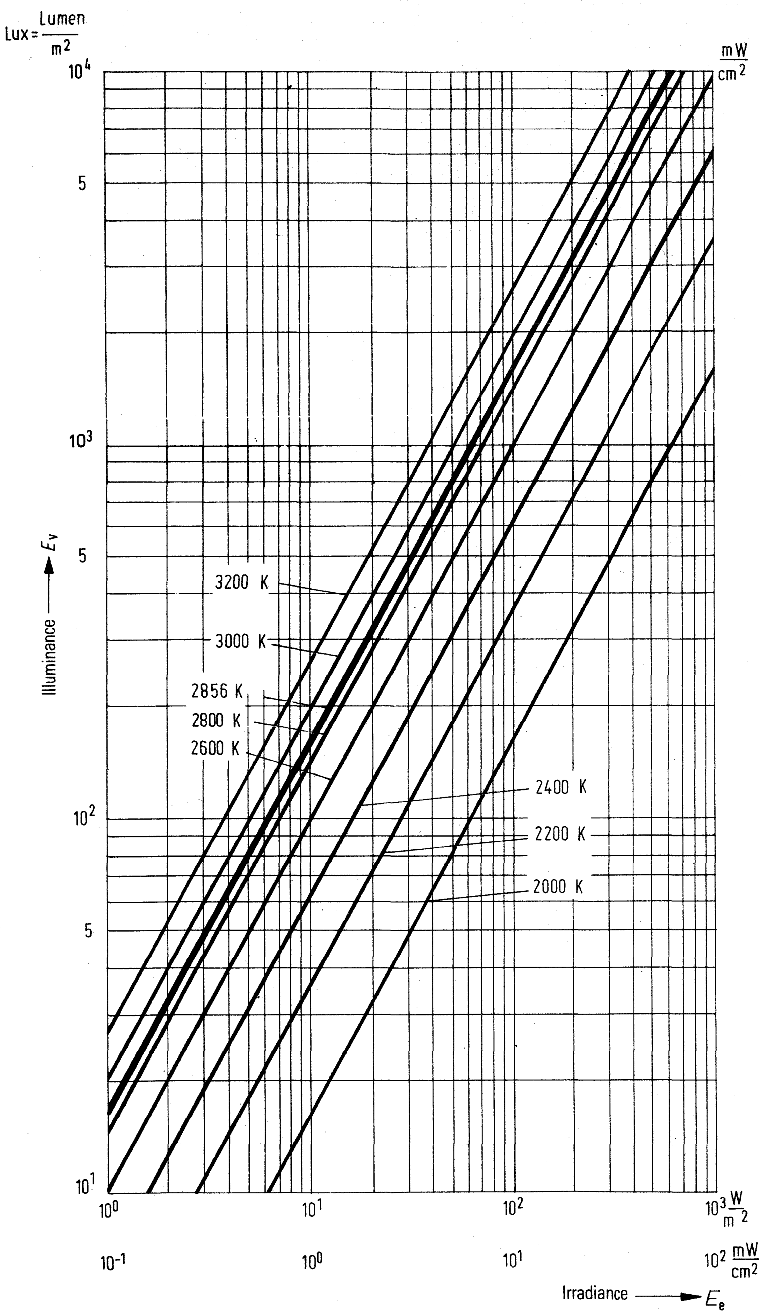


Figure 24
Conversion of illuminance E_v into irradiance E_e
(Planck's black body)

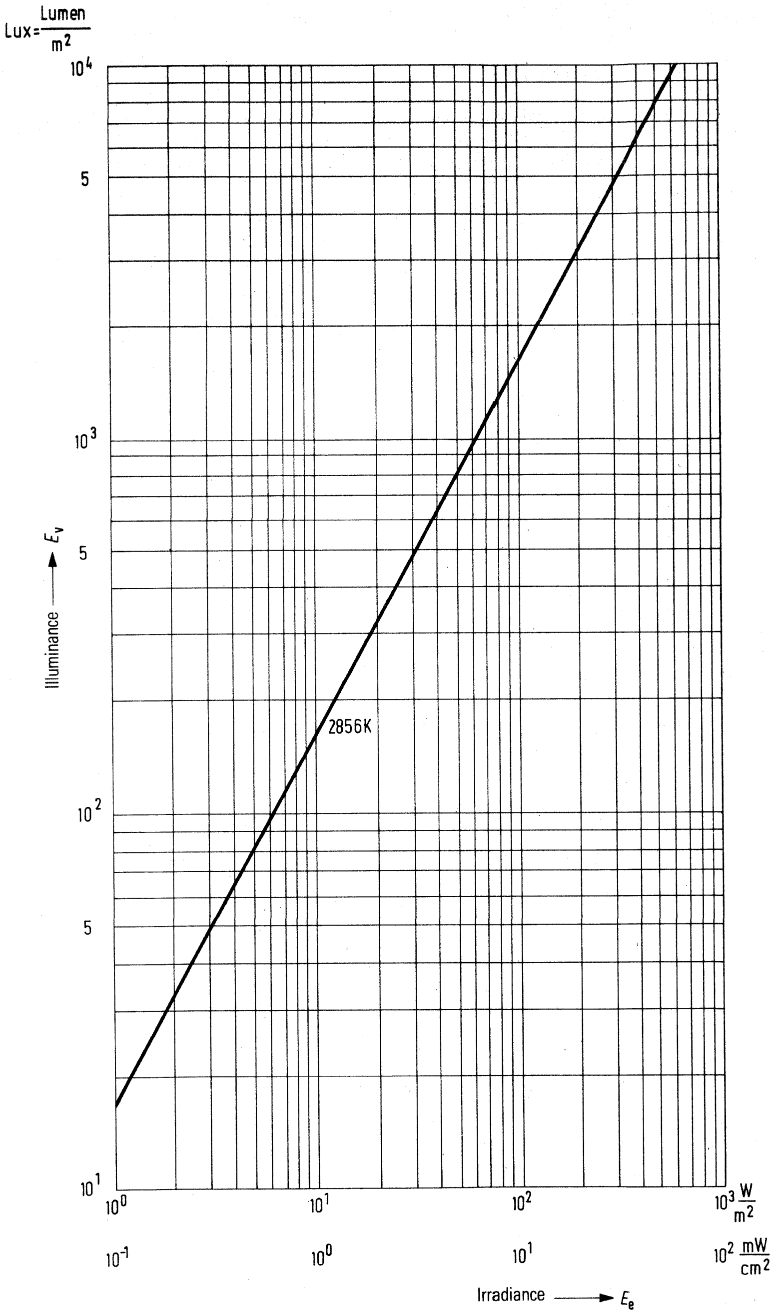
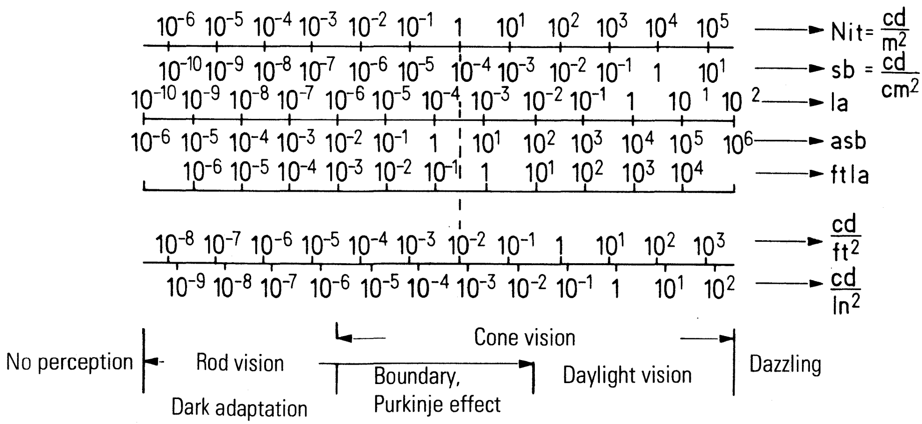


Figure 25
Conversion of illuminance E_v into irradiance E_e at 2856 K
(Planck's black body)

5.5 Luminous density (units and conversion factors)

Units		sb	cd/m²	cd/ft²
1 Stilb = cd/cm² = sb	=	1	10^4	929
1 cd/m² = Nit = nt	=	10^{-4}	1	9.29×10^{-2}
1 cd/ft²	=	1.076×10^{-3}	10.76	1
1 cd/in²	=	0.155	1550	144
1 Apostilb = asb	=	3.18×10^{-5}	0.318	2.96×10^{-2}
1 Lambert = L or la	=	0.318	3183	296
1 mL or mla	=	3.18×10^{-4}	3.18	0.296
1 footlambert	=			
1 equivalent footcandle	=			
1 apparent footcandle ftL or ftla	=	3.43×10^{-4}	3.43	0.318



cd/in^2	asb	L	Lm	ftL
6.45	31400	3.14	3140	2920
6.45×10^{-4}	3.14	3.14×10^{-4}	0.314	0.292
6.94×10^{-3}	33.8	3.38×10^{-3}	3.38	3.14
1	4870	0.487	487	452
2.05×10^{-4}	1	10^{-4}	0.1	9.29×10^{-2}
2.05	10^4	1	10^3	929
2.05×10^{-3}	10	10^{-3}	1	0.929
2.21×10^{-3}	10.76	1.076×10^{-3}	1.076	1

5.6 Electromagnetic radiation

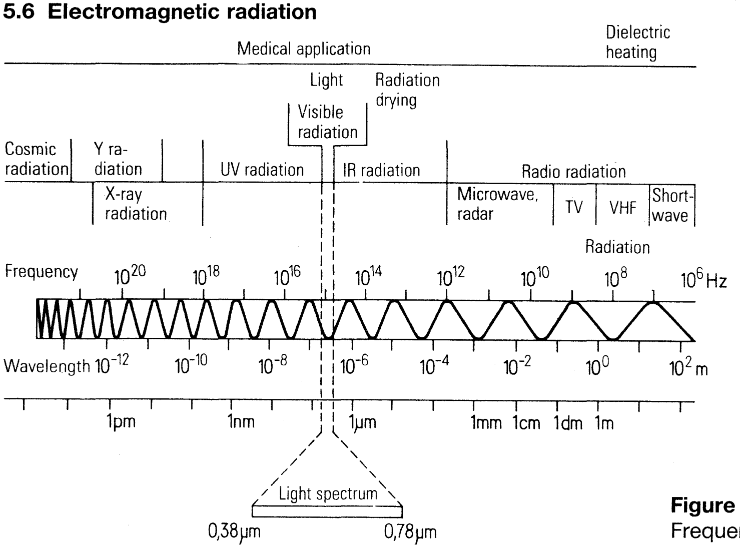


Figure 26
Frequency and wave bands

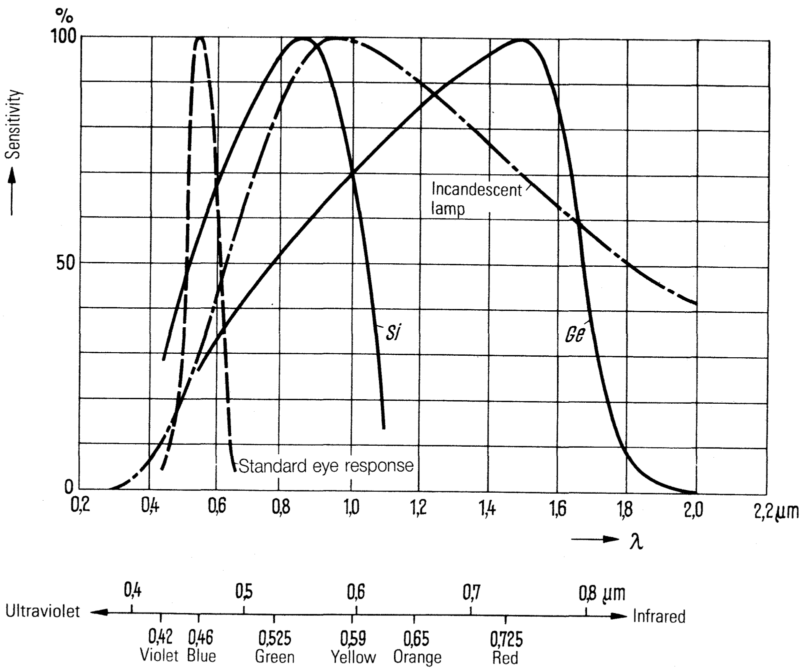


Figure 27
Relative sensitivity of different light-sensitive detectors

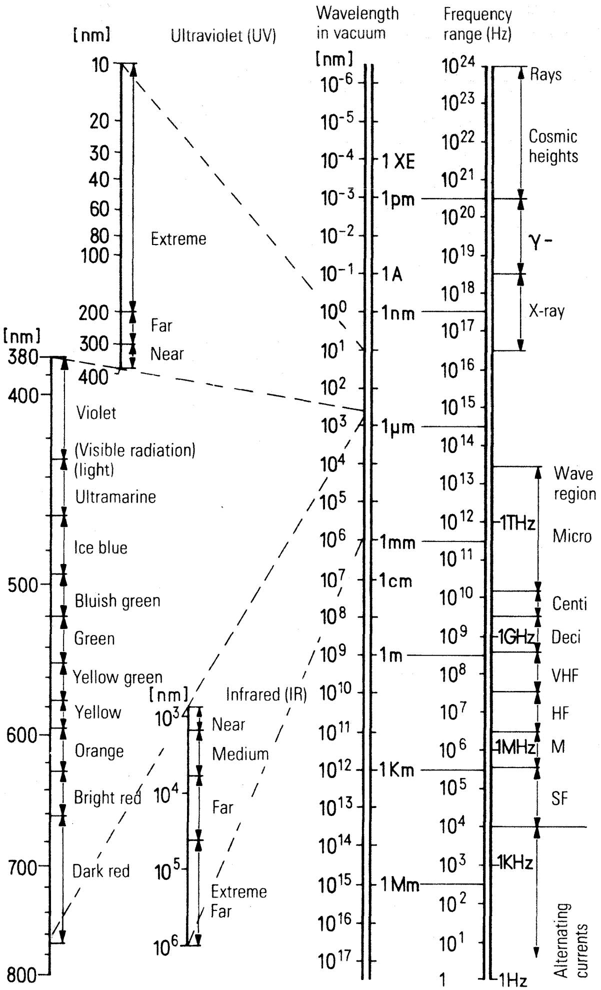


Figure 28
Nomogram for electromagnetic radiation

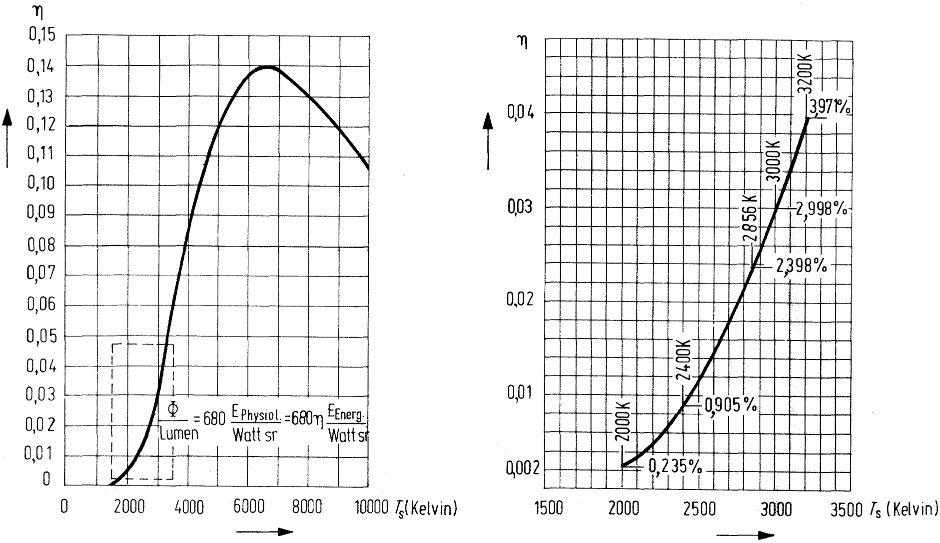


Figure 29
Visual efficiency η of the total radiation of a black body versus temperature

6 Delivery quality

In this book the **delivery quality** of semiconductor components is defined by the **maximum ratings** and the **variation limits** of the **characteristics.** Assessment of the **acceptable quality level (AQL)** of a delivery lot is based on AQL values specified for sampling tests of the component attributes.

These attribute inspections are subject to the single sampling plan for normal inspection, inspection level II, in accordance with DIN 40080 (or IEC 410, ABS STD-105D).

A defect exists if a component characteristic does not correspond to the specifications stated in the data sheets. The **defects** are classified by the **type** and **extent of defect.**

Type of defect
- Defect of package or leads (mechanical)
- Defect in electrical features

Extent of defect
- A defect exists if a characteristic does not correspond to the specified value
- A total defect excludes any functional application of the component

AQL Table

Total defect (mechanical and electrical)	AQL: 0.1
Sum of defects in electrical characteristics	AQL: 0.4*)
Sum of defects in packages and leads	AQL: 0.4**)

*) Dynamic characteristics (e.g. noise, switching time, max. cutoff frequency) AQL: 1.5
**) For all encapsulated components the package dimensions are production-related.

The AQL values are no evidence for the real quality of a delivery lot; they are only used in conjunction with sampling inspection plans to decide on acceptance or rejection. Generally, the average defect percentage remains below the AQL values.

7 Mounting and soldering instructions

7.1 General

The component can be mounted in any position. Bending of the leads is allowed up to a distance of 1.5 mm from the case provided the diameter of the leads does not exceed 0.5 mm. While bending the leads no mechanical forces must be applied to the case. Leads with a diameter larger than 0.55 mm should not be bent.

If the device is to be mounted near heat generating components, the increased ambient temperature has to be considered in the calculation of the junction temperature.

7.1.1 Silicon photovoltaic cells and photodiodes in open design (without housing)

Due to the brittleness of silicon, a photoelectric component must not be subjected to pressure or tension. The contacts are subject to a particular risk in this respect. If tensile forces act upon the leads, these may only run in parallel to the surface and must not exceed 2N. Leads must only be bent 3 mm from the outer edge of the photovoltaic cell.

Photovoltaic cells can be fixed on metal or plastic mounting assemblies whereby the expansion coefficient of the material must be taken into consideration in order to prevent mechanical stresses between the mounting assembly and photovoltaic cell in the event of temperature changes.

For casting photovoltaic cells, a cast resin must be used which is transparent and which does not darken. After hardening, the cast resin must be free of gas bubbles (stray effect). Cast resins with epoxy resin as the base material are suitable for casting photovoltaic cells. All materials to be cast must be dry, dust and grease-free before handling. Cold or warm hardening resins can be used. The maximum hardening temperature lies at 80 °C. The hardening and safety specifications of the plastic manufacturer must be observed.

Adhesives based on cyan acrylate are suitable for bonding silicon diodes or photovoltaic cells in open design. The surface of the photovoltaic cell must be provided with a protective coating which must not be damaged and must not be soiled on the light-sensitive side.

7.2 Soldering instructions

When soldering the component into position, make sure that it is not thermally overloaded. The maximum space charge region temperature may only be exceeded briefly (for no more than 1 min).

Summary of (maximum) permissible soldering temperatures and soldering times

	Dip soldering			Iron soldering (with 1.5 mm iron tip)		
	Temperature of the soldering bath	Max. permissible soldering time	Distance from soldering point to housing	Temperature of soldering iron	Max. permissible soldering time	Distance from soldering point to housing
Metal or **glass housing**	235 °C 260 °C	5 s 3 s	≥1.5 mm	300 °C	5 s	≥1.5 mm
Plastic package 3 and 5 mm	235 °C 260 °C	8 s 5 s	≥2 mm	300 °C	3 s	≥2 mm
Other housing types	235 °C 260 °C	5 s 3 s	≥2 mm	300 °C	3 s	≥2 mm

7.2.1 Cleaning solvents

Organic solvents consisting of alcohols or certain fluorocarbons or a mixture of both groups are suitable for cleaning flux residues and similar residues from soldered-in components. In no way should solvents or solvent mixtures be used which contain chlorinated carbons or ketones. This type of solvents may attack or corrode the display housing or casting.

Suitable solvents are, for example:
- Ethyl alcohol
- Isopropyl alcohol
- Trifluor trichloroethane
- Mixtures of the above-mentioned components

Unsuitable solvents are, for example:
- Chlorinated carbons
- (Methylene chloride, trichloroethylene, 1,1,1 trichloroethane and similar)
- Ketones (acetone, methyl ethyl ketone and similar)
- Mixtures of the above components with fluorized carbons

The following tables give a selection of solvents which are presently commercially available. In using solvents, please note the safety specifications.

Presently available trifluor trichloroethanes (selection)

Designation	Manufacturer
Freon TF	Du Pont
Frigen 113 TR	Hoechst
Arklone P	ICI
Kaltron 113 MDR	Kali-Chemie
Flugene 113	Rhone-Progil

Presently available solvent mixtures of the components ethyl alcohol, isopropyl alcohol and trifluor trichloroethane (selection)

Designation	Manufacturer
Freon TE; Freon TP 35; Freon TMS	Du Pont
Frigen 113 TR-E; Frigen 113 TR-P; Frigen 113 TR-M	Hoechst
Arklone A; Arklone F; Arklone L; Arklone K	ICI
Kaltron 113 MDA; Kaltron 113 MDI; Kaltron 113 MDM	Kali-Chemie
Flugene 113 E; Flugene 113 IPA; Flugene 113 M	Rhone-Progil

Presently available solvent mixtures of chlorinated carbons and ketones with fluorized carbons (selection)

Designation	Manufacturer
Freon TMC; Freon TA; Freon TC	Du Pont
Arklone E	ICI
Kaltron 113 MDD; Kaltron 113 MDK	Kali-Chemie
Flugene 113 CM	Rhone-Progil

Photovoltaic Cells

Silicon Photovoltaic Cell

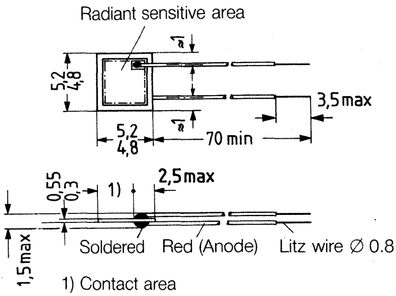
BPX 79

BPX 79 is a silicon photovoltaic cell in planar technology. The n-Si material used results in a positive front and negative back contact. The Si chip is provided with 2 leads and coated with a humidity-proof protective layer.

Application Control and drive circuits, light pulse scanning and quantitative light measurements in the visible light and near infrared range.

Features

- High reliability
- No testable degradation
- High packing density
- Wide temperature range
- Simple mounting (gluing technique)



Approx. weight 0.2 g
Dimensions in mm

Type	Ordering code
BPX 79	Q62702-P51

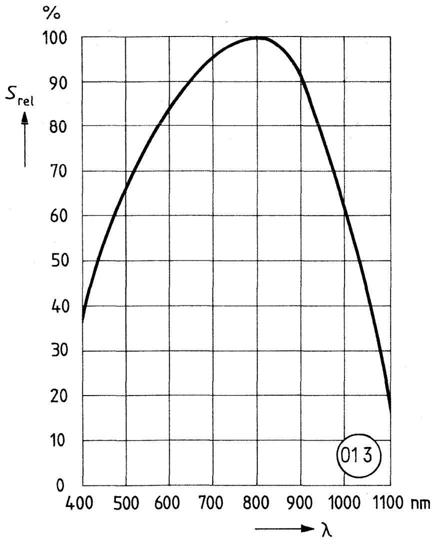
Maximum ratings

Operating and storage temperature range	T_{op}; T_{stg}	–55...+100	°C
Reverse voltage	V_R	1	V

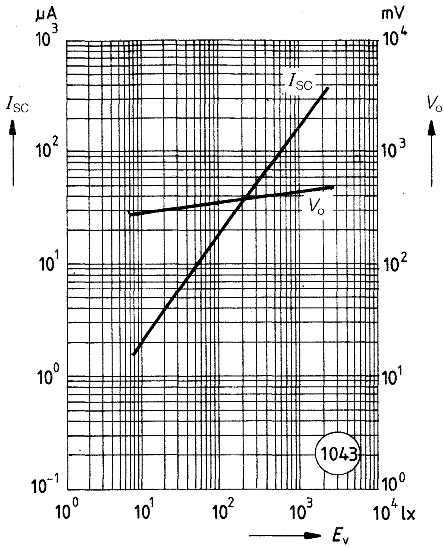
Characteristics (T_A = 25 °C)

Spectral sensitivity (standard light A, T = 2856 K)	S	170 (≥100)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	800	nm
Spectral range of sensitivity (S = 10% of S_{max})	λ	350...1100	nm
Radiant sensitive area	A	20	mm^2
Dimensions of radiant sensitive area	$L \times W$	4.47 × 4.47	mm
Half angle	φ	±60	deg
Dark current (V_R = 1 V; E = 0)	I_R	0.3 (≤50)	µA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Quantum yield (λ = 850 nm)	η	0.80	Electrons / Photon
Open-circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥310)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	170 (≥100)	µA
Rise and fall time of the photocurrent from 10% to 90%, or from 90% to 10% of the final value (R_L = 1 kΩ; V_R = 1 V; λ = 950 nm; I_P = 150 µA)	t_r, t_f	6	µs
Temperature coefficient of V_O	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E_v = 0 lx)	C_0	2500	pF
(V_R = 1 V; f = 1 MHz; E_v = 0 lx)	C_1	1800	pF

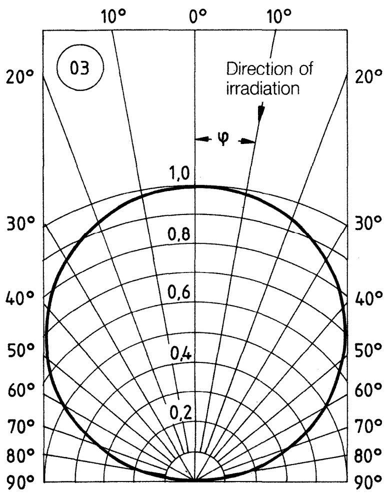
Relative spectral sensitivity versus wavelength



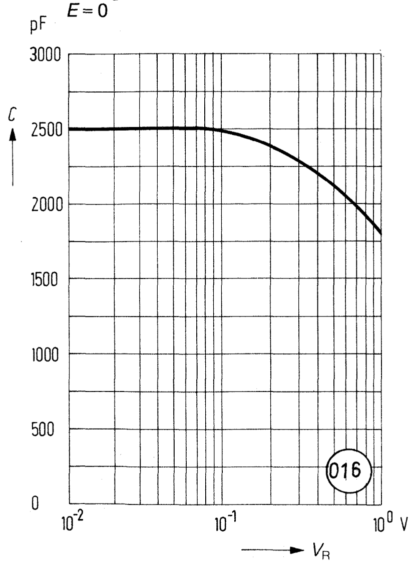
Open-circuit voltage and short-circuit current versus illuminance



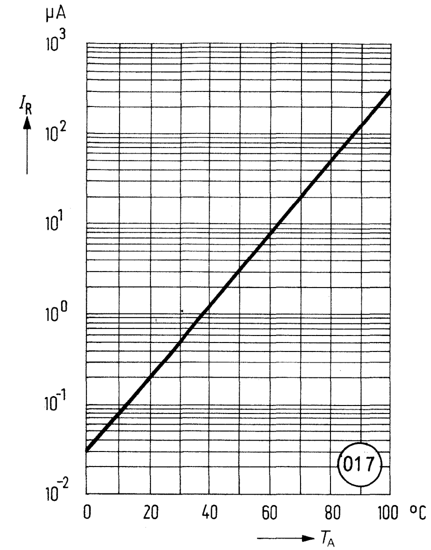
Directional characteristic
Relative spectral sensitivity versus half angle



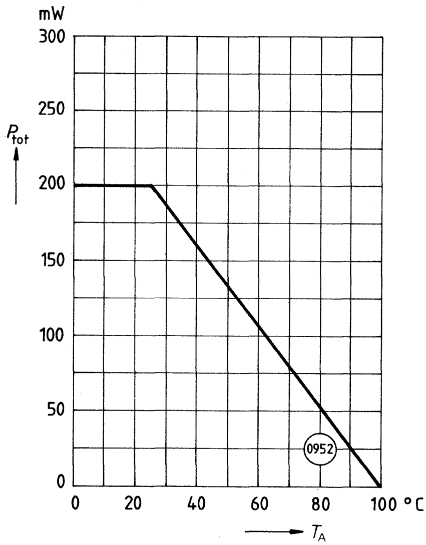
Capacitance versus reverse voltage
$E = 0$



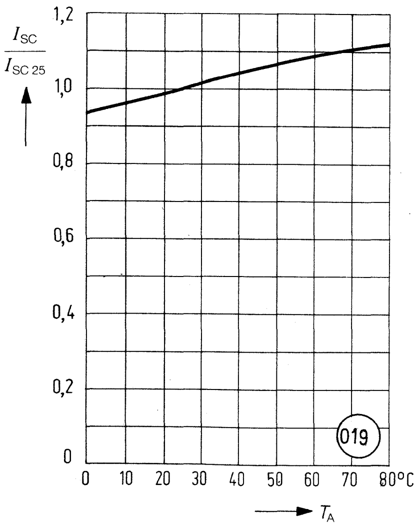
Dark current versus ambient temperature



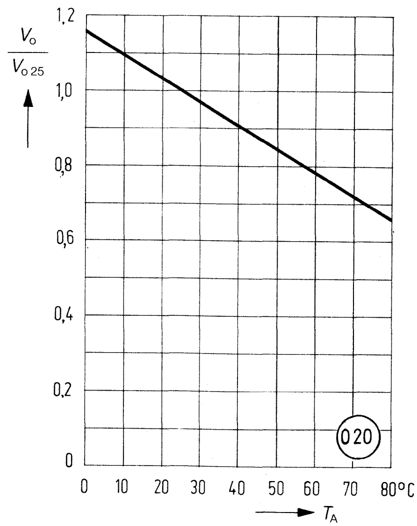
Total power dissipation versus ambient temperature



Short-circuit current versus ambient temperature



Open-circuit voltage versus ambient temperature



Silicon Photovoltaic Cell

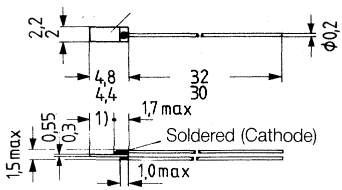
BPY 11 P

BPY 11 P is a silicon photovoltaic cell in planar technology. The n-Si material used results in a positive front and negative back contact. The Si chip is provided with 2 leads and coated with a humidity-proof protective layer.

Application Control and drive circuits, light pulse scanning and quantitative light measurements in the visible light and near infrared range.

Features

- High reliability
- No testable degradation
- High packing density
- Wide temperature range
- Simple mounting (gluing technique)
- Available in groups



1) Contact area 2.7 min

Approx. weight 0.1 g
Dimensions in mm

Type	Ordering code
BPY 11 P IV	Q60215-Y111-S4
BPY 11 P V	Q60215-Y111-S5

Maximum ratings

Operating and storage temperature range	T_{op}; T_{stg}	–55...+100	°C
Reverse voltage	V_R	1	V

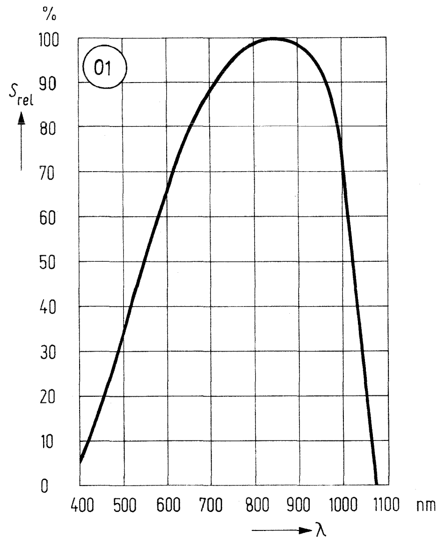
Characteristics (T_A = 25 °C)

Spectral sensitivity (standard light A, T = 2856 K)	S	60 (≥28)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Spectral range of sensitivity (S = 10% of S_{max})	λ	420...1060	nm
Radiant sensitive area	A	8.7	mm^2
Dimensions of radiant sensitive area	$L \times W$	1.95 × 4.45	mm
Half angle	φ	±60	deg
Dark current (V_R = 1 V; E = 0)	I_R	1 (≤10)	µA
(V_R = 1 V; E = 0; T_A = 50 °C)	I_R	2.5	µA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Quantum yield (λ = 850 nm)	η	0.80	$\frac{\text{Electrons}}{\text{Photon}}$
Open-circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	440 (≥260)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	60 (≥28)	µA
Rise and fall time of the photocurrent from 10% to 90%, or from 90% to 10% of the final value (R_L = 1 kΩ; V_R = 1 V; λ = 840 nm; I_P = 60 µA)	t_r, t_f	3	µs
Temperature coefficient of V_O	TC	–2.9	mV/K
Temperature coefficient of I_{SC}	TC	0.12	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E_v = 0 lx)	C_0	0.8	nF

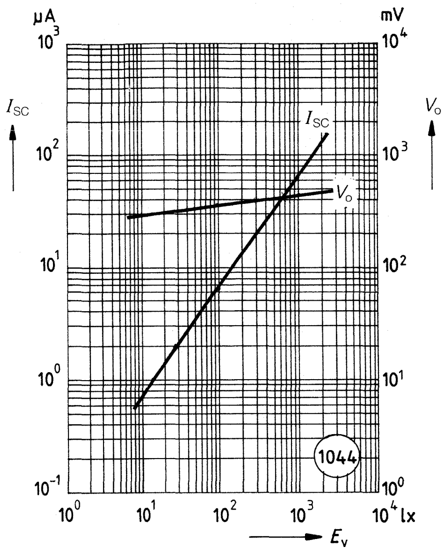
Spectral sensitivity groups

Type	I_{SC} (E_v = 1000 lx, standard light A, T = 2856 K)
BPY 11 P IV	47...63 µA
BPY 11 P V	≥56 µA

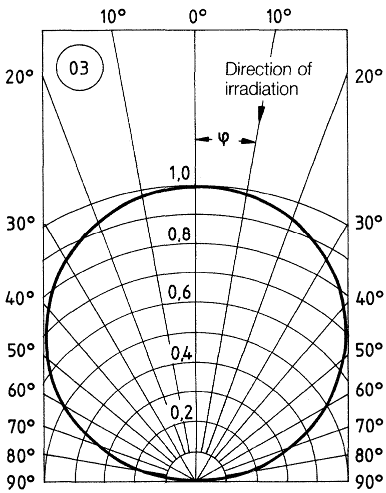
Relative spectral sensitivity versus wavelength



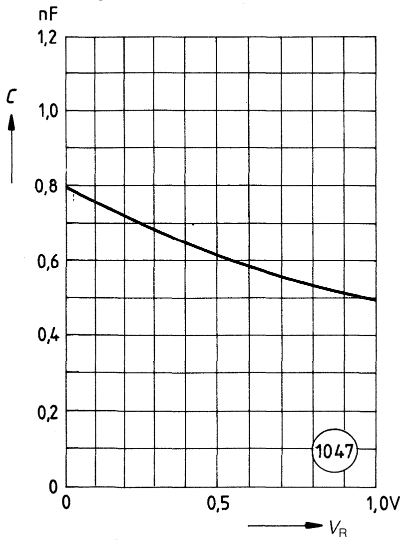
Open-circuit voltage and short-circuit current versus illuminance



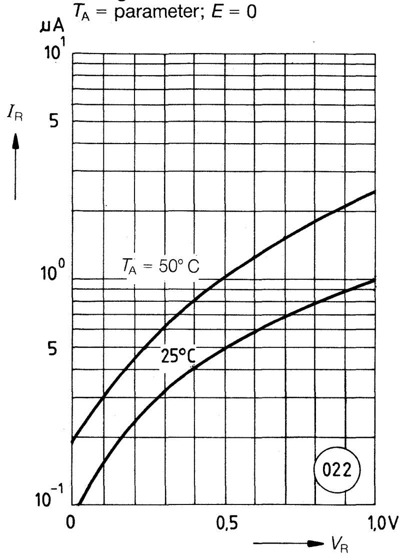
Directional characteristic
Relative spectral sensitivity versus half angle



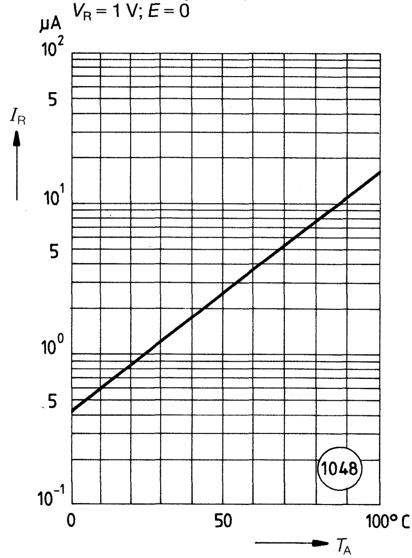
Capacitance versus reverse voltage
$E = 0$



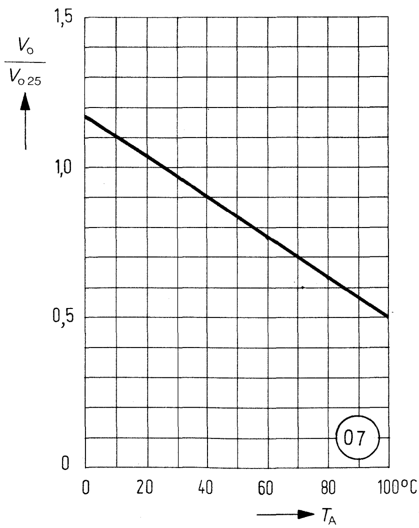
Dark current versus reverse voltage
T_A = parameter; E = 0



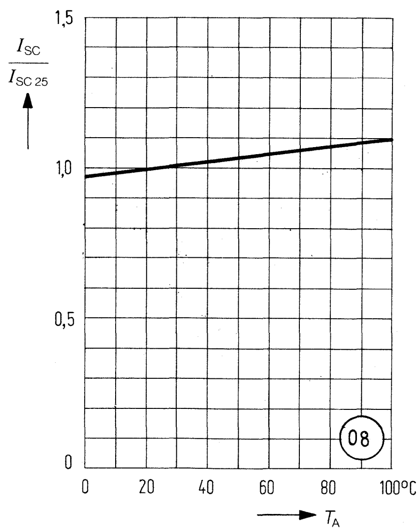
Dark current versus ambient temperature
V_R = 1 V; E = 0



Open-circuit voltage versus ambient temperature



Short-circuit current versus ambient temperature

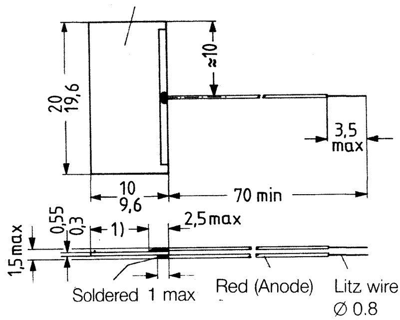


BPY 47 P is a silicon photovoltaic cell in planar technology. The n-Si material used results in a positive front and negative back contact. The Si chip is provided with 2 leads and coated with a humidity-proof protective layer.

Application Control and drive circuits, light pulse scanning and quantitative light measurements in the visible light and near infrared range.

Features

- High reliability
- No testable degradation
- High packing density
- Wide temperature range
- Simple mounting (gluing technique)



1) Contact area 7.1 min

Approx. weight 0.3 g
Dimensions in mm

Type	Ordering code
BPY 47 P	Q60215-Y66

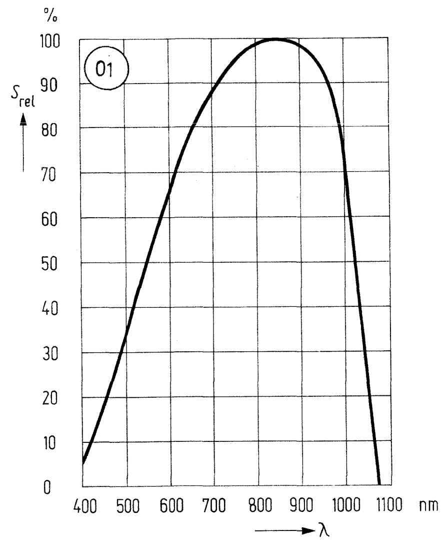
Maximum ratings

Operating and storage temperature range	T_{op}; T_{stg}	–55...+100	°C
Reverse voltage	V_R	1	V

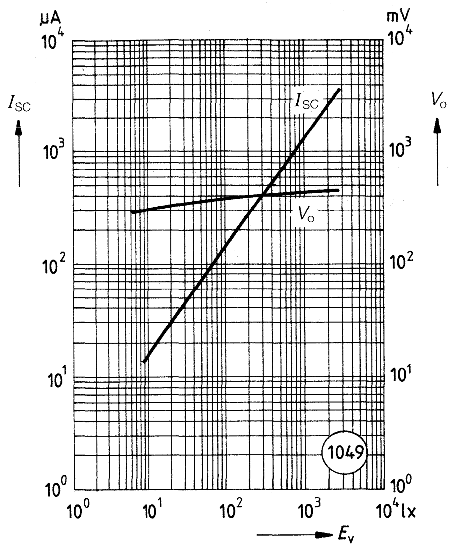
Characteristics (T_A = 25 °C)

Spectral sensitivity (standard light A, T = 2856 K)	S	1.4 (≥0.9)	µA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Spectral range of sensitivity (S = 10% of S_{max})	λ	420...1060	nm
Radiant sensitive area	A	1.9	cm^2
Dimensions of radiant sensitive area	$L \times W$	9.78 × 19.78	mm
Half angle	φ	±60	deg
Dark current (V_R = 1 V; E = 0)	I_R	25	µA
(V_R = 1 V; E = 0; T_A = 50 °C)	I_R	70	µA
Spectral sensitivity (λ = 850 nm)	S_λ	0.51	A/W
Quantum yield (λ = 850 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Open-circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥280)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	1.4 (≥0.9)	mA
Rise and fall time of the photocurrent from 10% to 90%, or from 90% to 10% of the final value (R_L = 1 kΩ; V_R = 1 V; λ = 840 nm; I_P = 1 mA)	t_r, t_f	23	µs
Temperature coefficient of V_O	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E_v = 0 lx)	C_0	16	nF

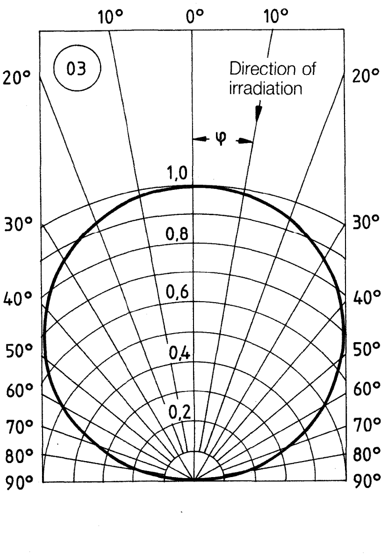
Relative spectral sensitivity versus wavelength



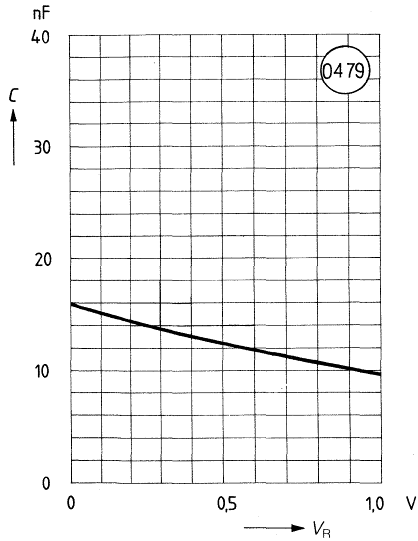
Open-circuit voltage and short-circuit current versus illuminance



Directional characteristic
Relative spectral sensitivity versus half angle



Capacitance versus reverse voltage
$E = 0$

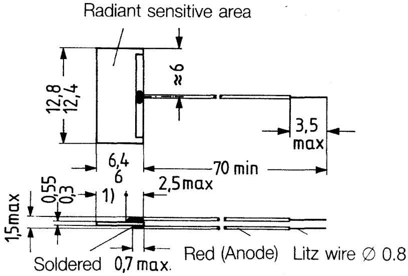


BPY 48 P is a silicon photovoltaic cell in planar technology. The n-Si material used results in a positive front and negative back contact. The Si chip is provided with 2 leads and coated with a humidity-proof protective layer.

Application Control and drive circuits, light pulse scanning and quantitative light measurements in the visible light and near infrared range.

Features

- High reliability
- No testable degradation
- High packing density
- Wide temperature range
- Simple mounting (gluing technique)



1) Contact area 3.5 min

Approx. weight 0.25 g
Dimensions in mm

Type	Ordering code
BPY 48 P	Q60215-Y65

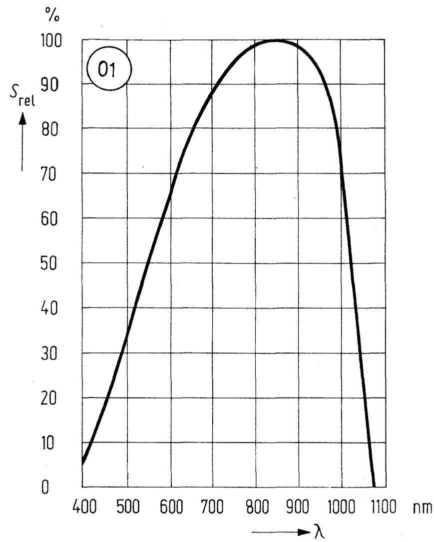
Maximum ratings

Operating and storage temperature range	T_{op}; T_{stg}	–55...+100	°C
Reverse voltage	V_R	1	V

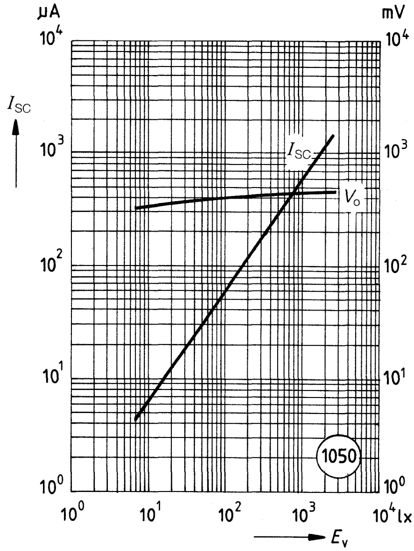
Characteristics (T_A = 25 °C)

Spectral sensitivity (standard light A, T = 2856 K)	S	0.5 (≥0.35)	μA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Spectral range of sensitivity (S = 10% of S_{max})	λ	420...1060	nm
Radiant sensitive area	A	0.74	cm^2
Dimensions of radiant sensitive area	$L \times W$	5.98 × 12.38	mm
Half angle	φ	±60	deg
Dark current (V_R = 1 V; E = 0)	I_R	10	μA
(V_R = 1 V; E = 0; T_A = 50 °C)	I_R	25	μA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Quantum yield (λ = 850 nm)	η	0.80	$\frac{\text{Electrons}}{\text{Photon}}$
Open-circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	460 (≥280)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	0.5 (≥0.35)	mA
Rise and fall time of the photocurrent from 10% to 90%, or from 90% to 10% of the final value (R_L = 1 kΩ; V_R = 1 V; λ = 840 nm; I_p = 500 μA)	t_r, t_f	10	μs
Temperature coefficient of V_O	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E_v = 0 lx)	C_0	6	nF

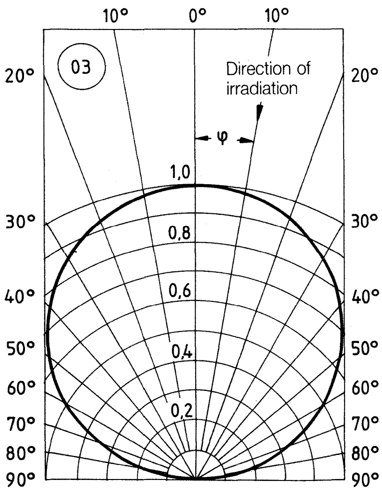
Relative spectral sensitivity versus wavelength



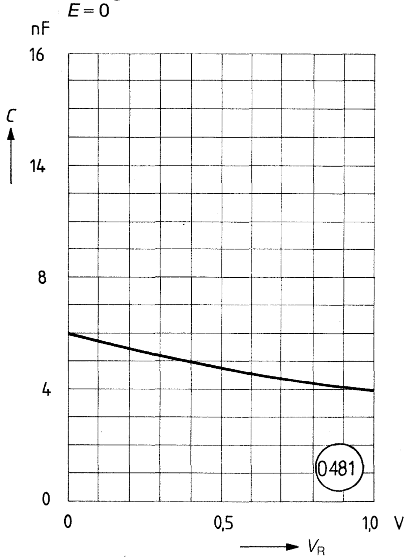
Open-circuit voltage and short-circuit current versus illuminance



Directional characteristic
Relative spectral sensitivity versus half angle



Capacitance versus reverse voltage
E = 0

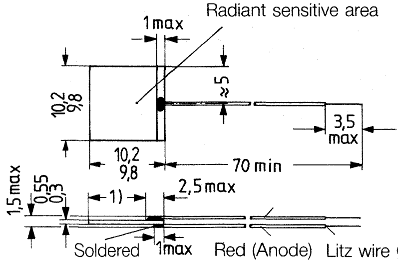


BPY 63 P is a silicon photovoltaic cell in planar technology. The n-Si material used results in a positive front and negative back contact. The Si chip is provided with 2 leads and coated with a humidity-proof protective layer.

Application Control and drive circuits, light pulse scanning and quantitative light measurements in the visible light and near infrared range.

Features

- High reliability
- No testable degradation
- High packing density
- Wide temperature range
- Simple mounting (gluing technique)



1) Contact area 7.3 min

Approx. weight 0.25 g
Dimensions in mm

Type	Ordering code
BPY 63 P	Q60215-Y63-S1

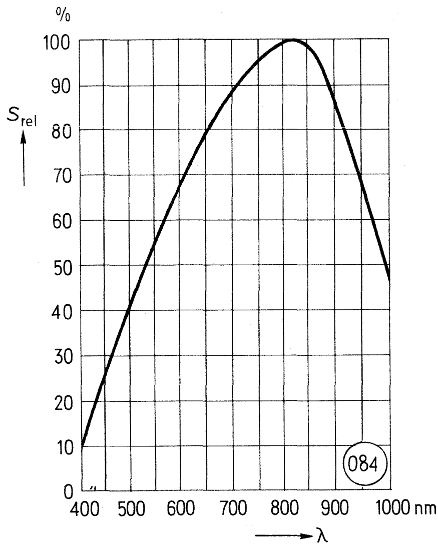
Maximum ratings

Operating and storage temperature range	T_{op}; T_{stg}	–55...+100	°C
Reverse voltage	V_R	1	V

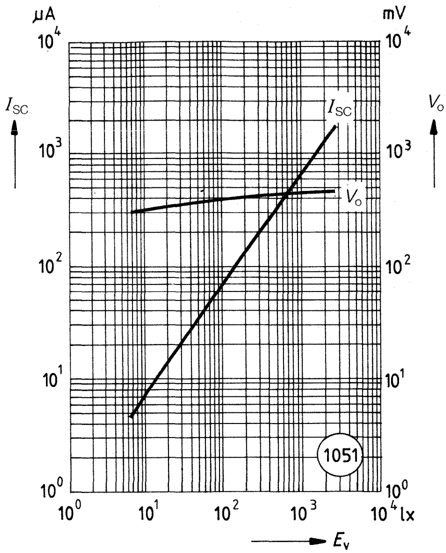
Characteristics (T_A = 25 °C)

Spectral sensitivity (standard light A, T = 2856 K)	S	0.65 (≥0.45)	μA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Spectral range of sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	0.96	cm^2
Dimensions of radiant sensitive area	$L \times W$	9.78 × 9.78	mm
Half angle	φ	±60	deg
Dark current (V_R = 1 V; E = 0)	I_R	10	μA
Spectral sensitivity (λ = 850 nm)	S_λ	0.5	A/W
Quantum yield (λ = 850 nm)	η	0.72	$\frac{\text{Electrons}}{\text{Photon}}$
Open-circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	430 (≥280)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	0.65 (≥0.45)	mA
Rise and fall time of the photocurrent from 10% to 90%, or from 90% to 10% of the final value (R_L = 1 kΩ; V_R = 1 V; λ = 840 nm; I_P = 500 μA)	t_r, t_f	11	μs
Temperature coefficient of V_O	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E_v = 0 lx)	C_0	8	nF

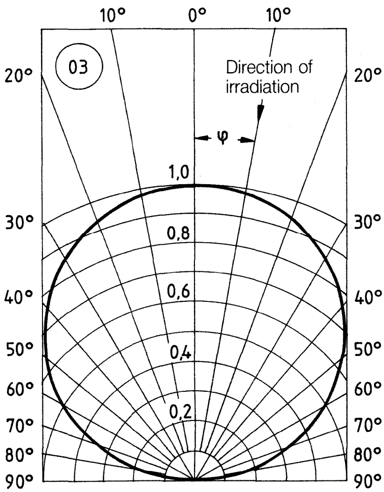
Relative spectral sensitivity versus wavelength



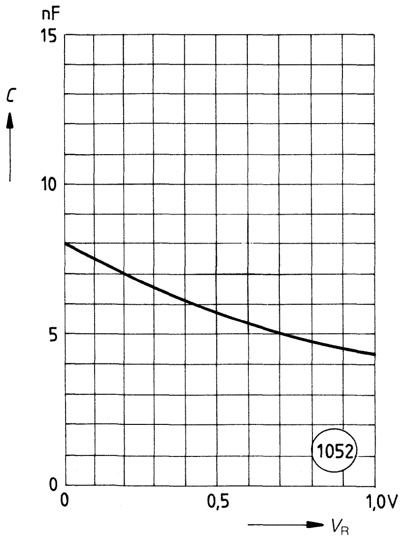
Open-circuit voltage and short-circuit current versus illuminance



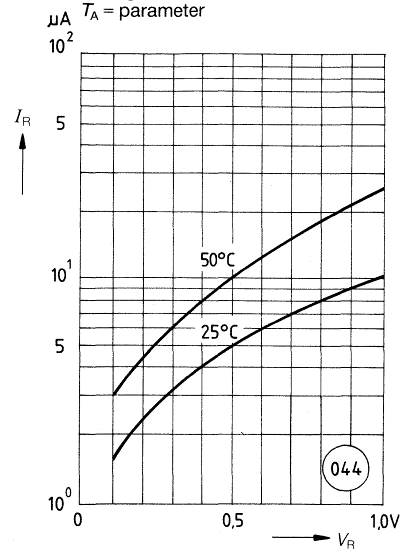
Directional characteristic
Relative spectral sensitivity versus half angle



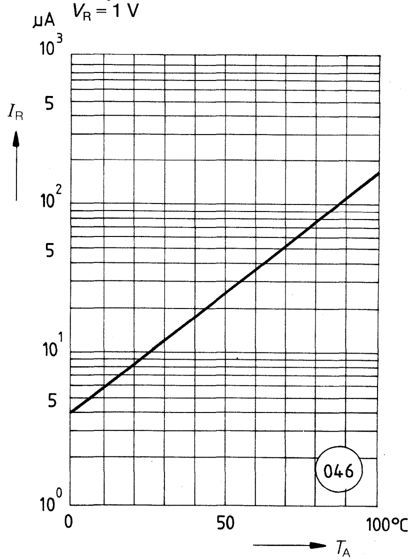
Capacitance versus reverse voltage
$E = 0$ lx



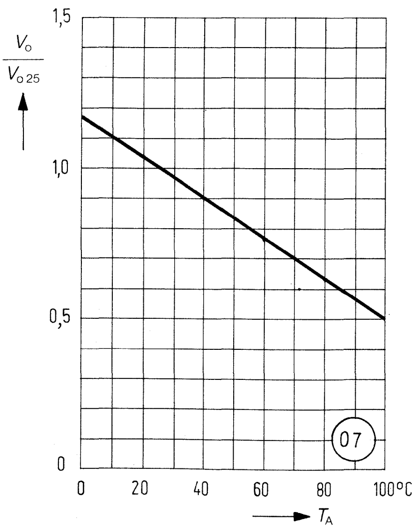
Dark current versus reverse voltage
T_A = parameter



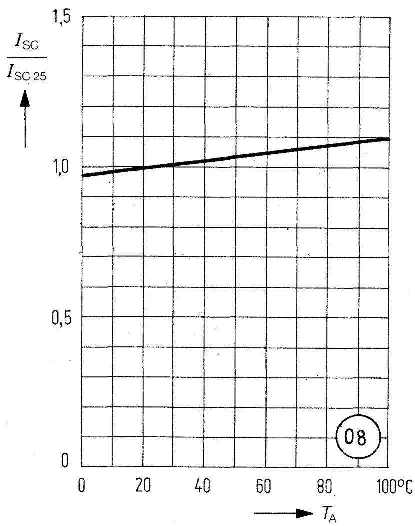
Dark current versus ambient temperature
V_R = 1 V



Open-circuit voltage versus ambient temperature



Short-circuit current versus ambient temperature

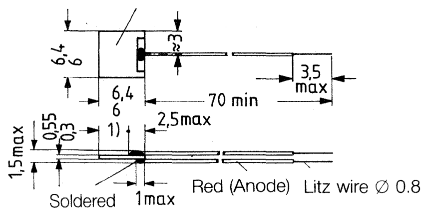


BPY 64 P is a silicon photovoltaic cell in planar technology. The n-Si material used results in a positive front and negative back contact. The Si chip is provided with 2 leads and coated with a humidity-proof protective layer.

Application Control and drive circuits, light pulse scanning and quantitative light measurements in the visible light and near infrared range.

Features

- High reliability
- No testable degradation
- High packing density
- Wide temperature range
- Simple mounting (gluing technique)



1) Contact area 3.5 min

Approx. weight 0.2 g
Dimensions in mm

Type	Ordering code
BPY 64 P	Q60215-Y67

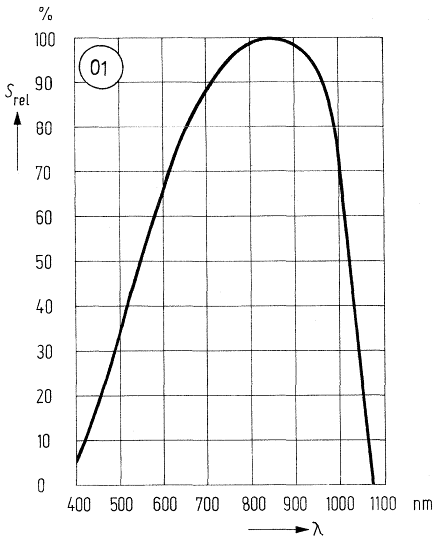
Maximum ratings

Operating and storage temperature range	T_{op}; T_{stg}	–55...+100	°C
Reverse voltage	V_R	1	V

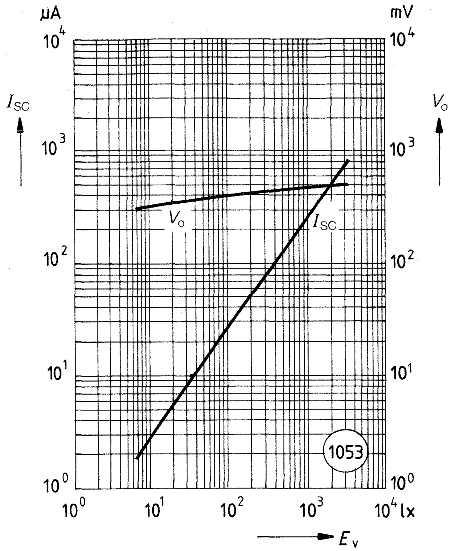
Characteristics (T_A = 25 °C)

Spectral sensitivity (standard light A, T = 2856 K)	S	0.25 (≥0.18)	µA/lx
Wavelength of max. sensitivity	$\lambda_{S\,max}$	850	nm
Spectral range of sensitivity (S = 10% of S_{max})	λ	420...1060	nm
Radiant sensitive area	A	0.36	cm^2
Dimensions of radiant sensitive area	$L \times W$	5.98 × 5.98	mm
Half angle	φ	±60	deg
Dark current (V_R = 1 V; E = 0)	I_R	4	µA
(V_R = 1 V; E = 0; T_A = 50 °C)	I_R	10	µA
Spectral sensitivity (λ = 850 nm)	S_λ	0.50	A/W
Quantum yield (λ = 850 nm)	η	0.72	$\frac{\text{Electrons}}{\text{Photon}}$
Open-circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥280)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	0.25 (≥0.18)	mA
Rise and fall time of the photocurrent from 10% to 90%, or from 90% to 10% of the final value (R_L = 1 kΩ; V_R = 1 V; λ = 840 nm; I_P = 250 µA)	t_r, t_f	5	µs
Temperature coefficient of V_O	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Capacitance (V_R = 0 V; f = 1 MHz; E_v = 0 lx)	C_0	3	nF

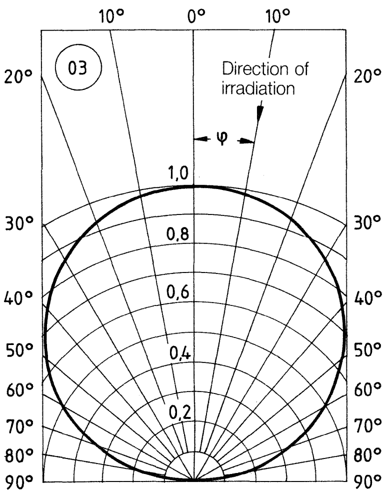
Relative spectral sensitivity versus wavelength



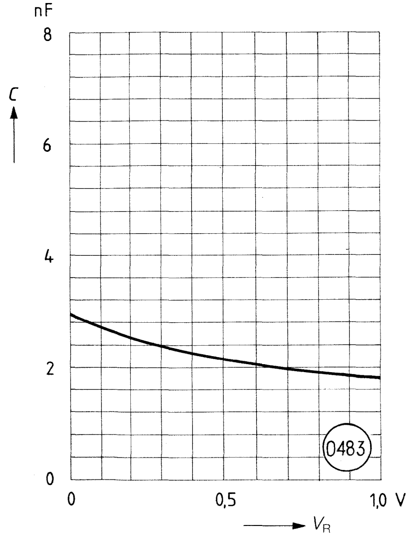
Open-circuit voltage and short-circuit current versus illuminance



Directional characteristic
Relative spectral sensitivity versus half angle



Capacitance versus reverse voltage
$E = 0$

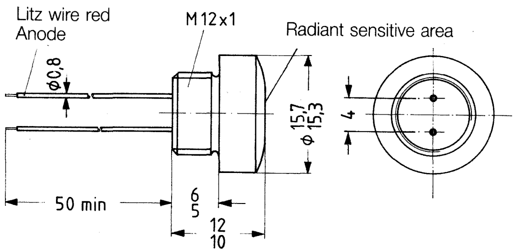


TP 60 P is a silicon photovoltaic cell in planar technology. The n-Si material used results in a positive front and negative back contact. The Si chip is provided with 2 leads and coated with a humidity-proof protective layer or built into a plastic package.

Application Control and drive circuits, light pulse scanning and quantitative light measurements in the visible light and near infrared range.

Features

- High reliability
- No testable degradation
- High packing density
- Wide temperature range
- Simple mounting (gluing technique)
- Mounting by bolt/nut



Approx. weight 1.8 g
Dimensions in mm

Type	Ordering code
TP 60 P	Q62607-S60

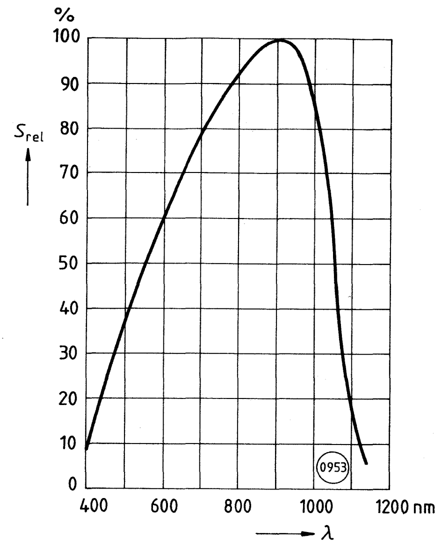
Maximum ratings

Operating and storage temperature range	T_{op}; T_{stg}	–40...+80	°C
Reverse voltage	V_R	1	V

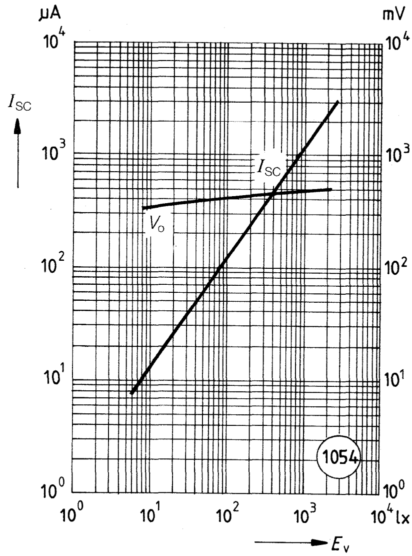
Characteristics (T_A = 25 °C)

Spectral sensitivity (standard light A, T = 2856 K)	S	1 (≥0.7)	μA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Spectral range of sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	1.3	cm^2
Form of radiant sensitive area		hexagon	
Half angle	φ	±60	deg
Dark current (V_R = 1 V)	I_R	0.1 (≤2)	μA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Quantum yield (λ = 850 nm)	η	0.80	$\frac{\text{Electrons}}{\text{Photon}}$
Open-circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥270)	mV
(E_e = 0.5 mW/cm^2; λ = 850 nm)	V_o	430 (≥250)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	1 (≥0.7)	mA
(E_e = 0.5 mW/cm^2; λ = 850 nm)	I_{SC}	380 (≥180)	μA
Rise and fall time of the photocurrent from 10% to 90%, or from 90% to 10% of the final value (R_L = 1 kΩ; V_R = 1 V; λ = 840 nm; I_P = 1 mA)	t_r, t_f	18	μs
Temperature coefficient of V_O	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.12	%/K
Capacitance (V_R = 1 V; f = 1 MHz; E_v = 0 lx)	C_1	11	nF

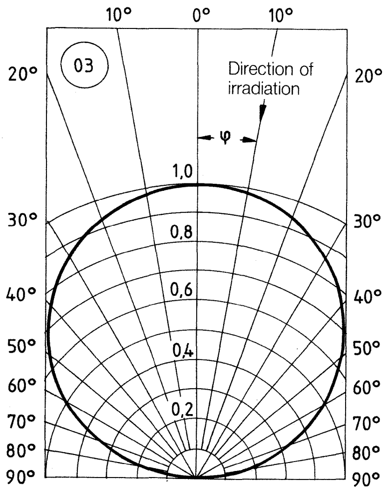
Relative spectral sensitivity versus wavelength



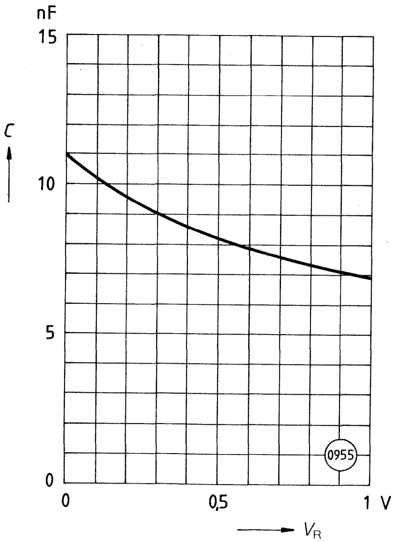
Open-circuit voltage and short-circuit current versus illuminance



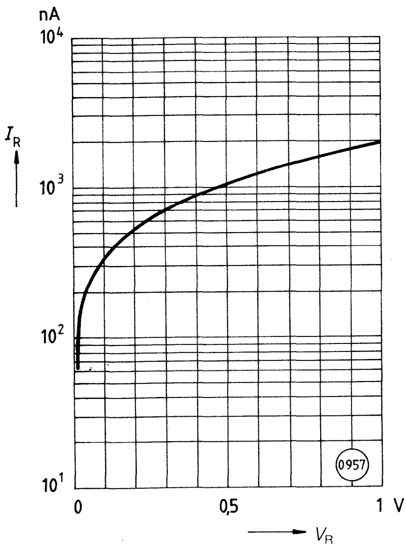
Directional characteristic
Relative spectral sensitivity versus half angle



Capacitance versus reverse voltage



Dark current versus reverse voltage

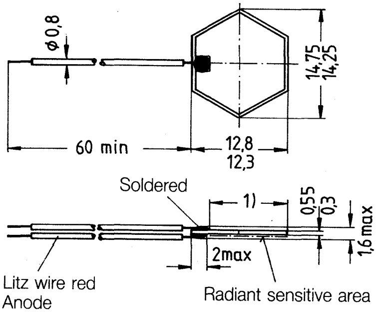


TP 61 P is a silicon photovoltaic cell in planar technology. The n-Si material used results in a positive front and negative back contact. The Si chip is provided with 2 leads and coated with a humidity-proof protective layer or built into a plastic package.

Application Control and drive circuits, light pulse scanning and quantitative light measurements in the visible light and near infrared range.

Features

- High reliability
- No testable degradation
- High packing density
- Wide temperature range
- Simple mounting (gluing technique)
- Mounting by bolt/nut



1) Contact area 9.5 min

Approx. weight 0.3 g
Dimensions in mm

Type	Ordering code
TP 61 P	Q62607-S61

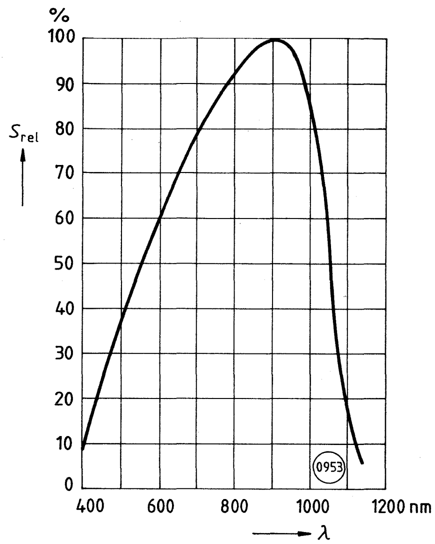
Maximum ratings

Operating and storage temperature range	T_{op}; T_{stg}	–55...+100	°C
Reverse voltage	V_R	1	V

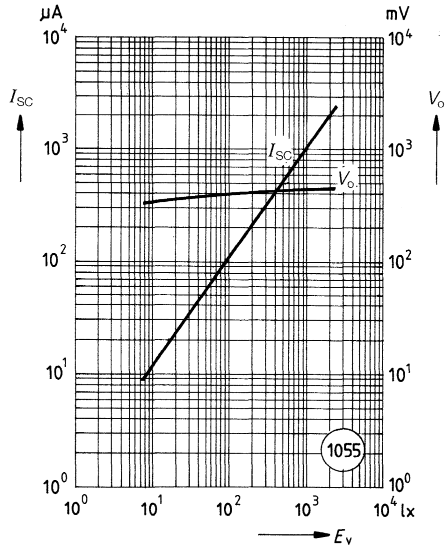
Characteristics (T_A = 25 °C)

Spectral sensitivity (standard light A, T = 2856 K)	S	1 (≥0.7)	µA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Spectral range of sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	1.3	cm^2
Form of radiant sensitive area		hexagon	
Half angle	φ	60	deg
Dark current (V_R = 1 V)	I_R	0.1 (≤2)	µA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Quantum yield (λ = 850 nm)	η	0.80	Electrons / Photon
Open-circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥270)	mV
(E_e = 0.5 mW/cm^2; λ = 850 nm)	V_o	430 (≥250)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	1 (≥0.7)	mA
(E_e = 0.5 mW/cm^2; λ = 850 nm)	I_{SC}	380 (≥180)	µA
Rise and fall time of the photocurrent from 10% to 90%, or from 90% to 10% of the final value (R_L = 1 kΩ; V_R = 1 V; λ = 840 nm; I_P = 1 mA)	t_r, t_f	18	µs
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.12	%/K
Capacitance (V_R = 1 V; f = 1 MHz; E_v = 0 lx)	C_1	11	nF

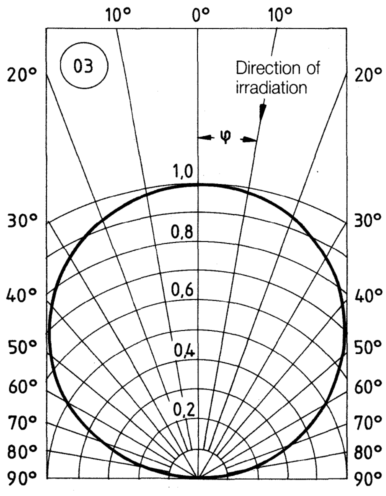
Relative spectral sensitivity versus wavelength



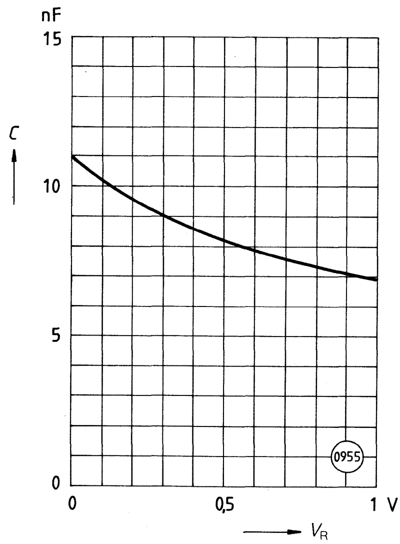
Open-circuit voltage and short-circuit current versus illuminance



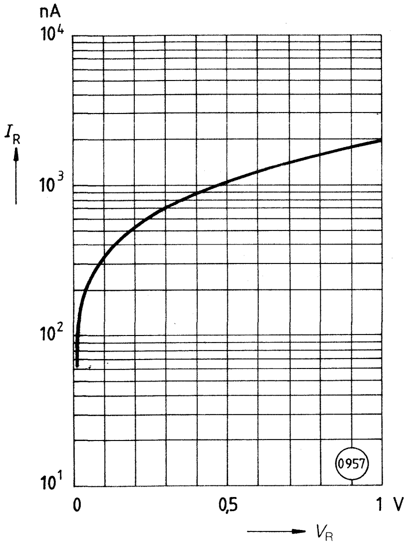
Directional characteristic
Relative spectral sensitivity versus half angle



Capacitance versus reverse voltage



Dark current versus reverse voltage



Photodiodes

Silicon PIN Photodiode

BP 104

BP 104 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

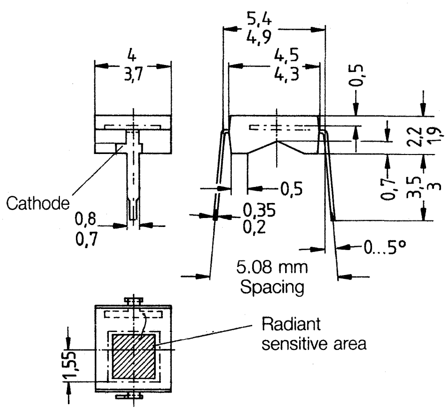
Package Lead frame, black epoxy resin, daylight-rejecting filter, solder tabs, 5.08 mm (²⁄₁₀″) lead spacing.

Cathode marking Projection at solder tab

Application IR remote control of hi-fi and TV sets, video tape recorders, dimmers, remote controls of various equipment, light reflecting switches for steady or varying intensity.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the near infrared range



Approx. weight 0.1 g
Dimensions in mm

Type	Ordering code
BP 104	Q62702-P84

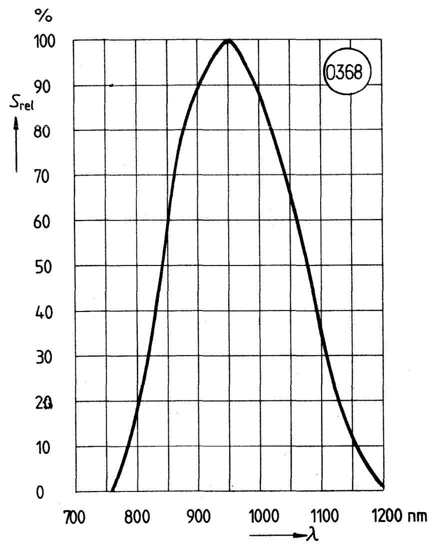
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	20	V
Total power dissipation (T_A = 25 °C)	P_{tot}	150	mW

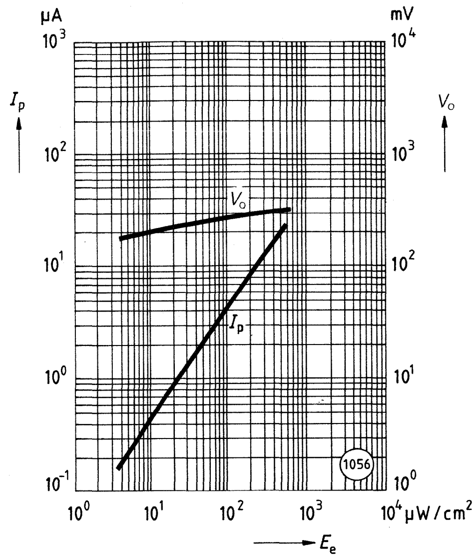
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm²)	S	17 (≥12.5)	µA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	950	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	800...1100	nm
Radiant sensitive area	A	4.84	mm²
Dimension of radiant sensitive area	$L \times W$	2.20 × 2.20	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 950 nm)	S_λ	0.70	A/W
Quantum yield (λ = 950 nm)	η	0.90	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_e = 0.5 mW/cm²; λ = 950 nm)	V_o	327 (≥250)	mV
Short-circuit current (E_e = 0.5 mW/cm²; λ = 950 nm)	I_{SC}	17 (≥12.5)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 17 µA)	t_r, t_f	125	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	48	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	3.6×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	6.1×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

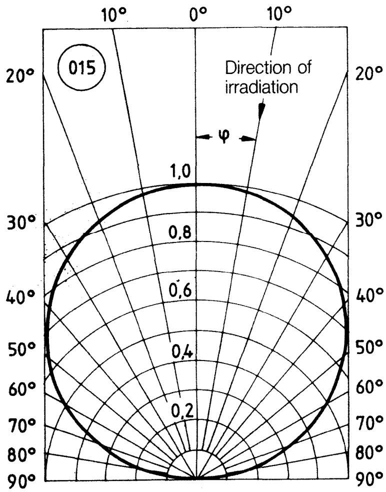
Relative spectral sensitivity versus wavelength



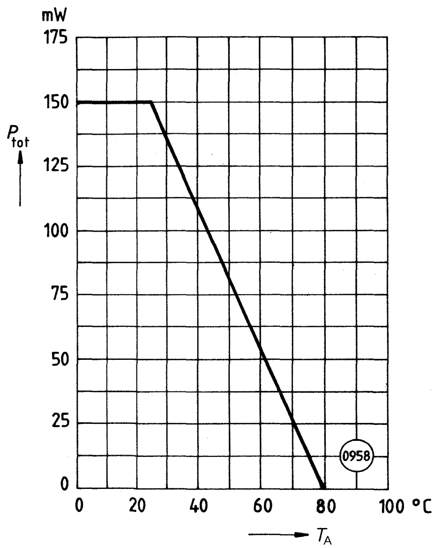
Photocurrent, open-circuit voltage versus irradiance



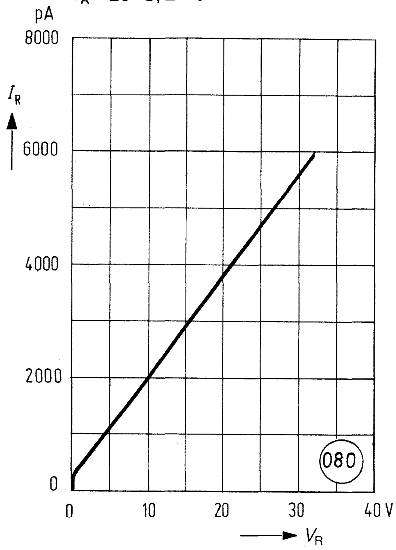
Directional characteristic
Relative spectral sensitivity versus half angle



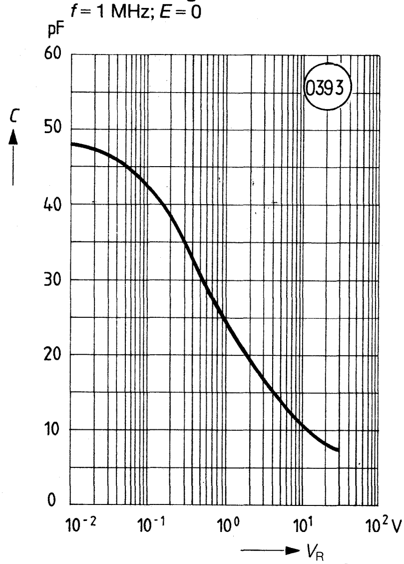
Total power dissipation versus ambient temperature



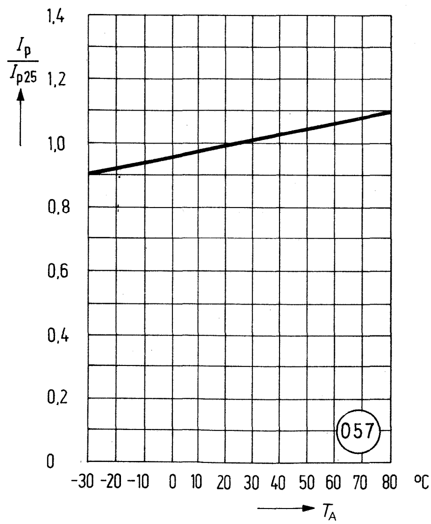
Dark current versus reverse voltage
$T_A = 25\ °C$; $E = 0$



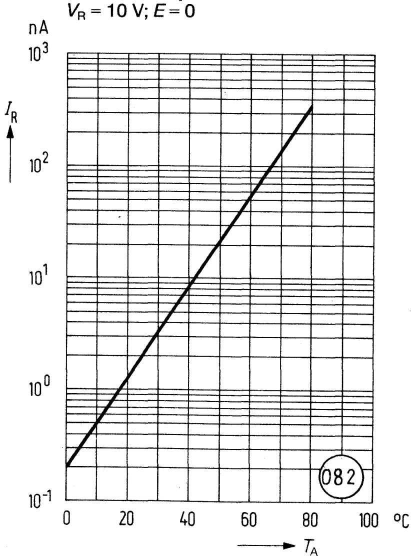
Capacitance versus reverse voltage
$f = 1\ MHz$; $E = 0$



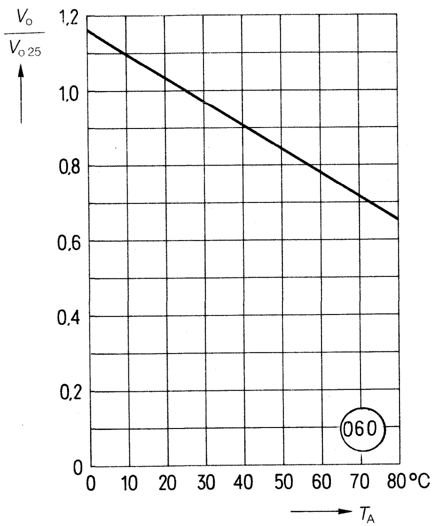
Photocurrent versus ambient temperature



Dark current versus ambient temperature
$V_R = 10\ V$; $E = 0$



Open-circuit voltage versus ambient temperature



Silicon PIN Photodiode with Daylight Filter for Film Circuits

BP 104 BS

BP 104 BS is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

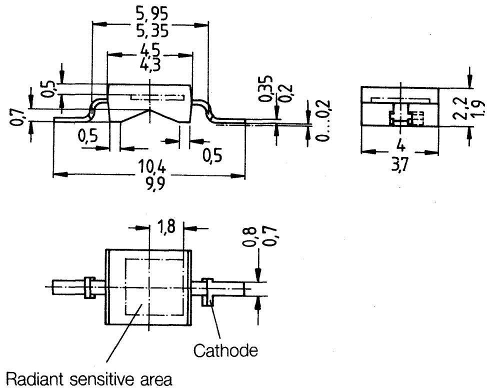
Package Lead frame, black epoxy resin, daylight filter, solder tabs, suitable for surface mounting (SMD).

Cathode marking Projection at solder tab

Application IR remote control of hi-fi and TV sets, video tape recorders, dimmers, remote controls of various equipment, light reflecting switches for steady or varying intensity.

Features

- High reliability
- No testable degradation
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the near infrared range



Type	Ordering code
BP 104 BS	Q62702-P917

Approx. weight 0.1 g
Dimensions in mm

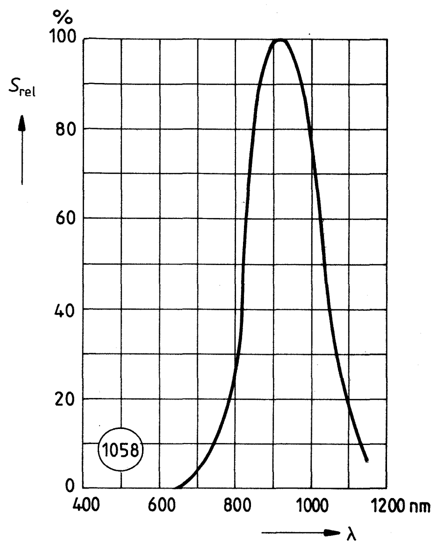
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	−40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	20	V
Total power dissipation	P_{tot}	15	mW

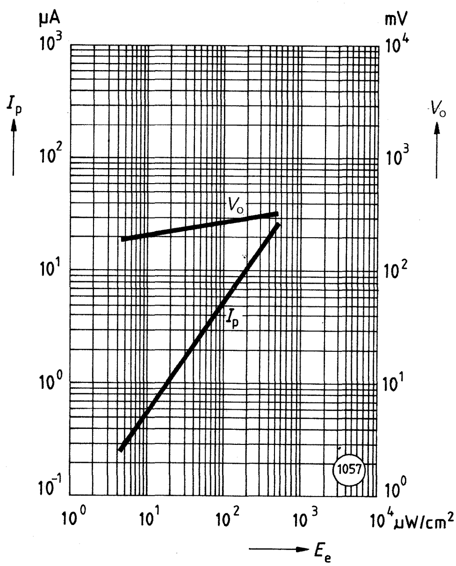
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm^2)	S	25 (≥15)	µA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	920	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	800...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 950 nm)	S_λ	0.68	A/W
Quantum yield (λ = 950 nm)	η	0.90	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_e = 0.5 mW/cm^2; λ = 950 nm)	V_o	327 (≥250)	mV
Short-circuit current (E_e = 0.5 mW/cm^2; λ = 950 nm)	I_{SC}	25 (≥15)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 25 µA)	t_r, t_f	400	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	72	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	3.7×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 1 V)	D^*	7.3×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

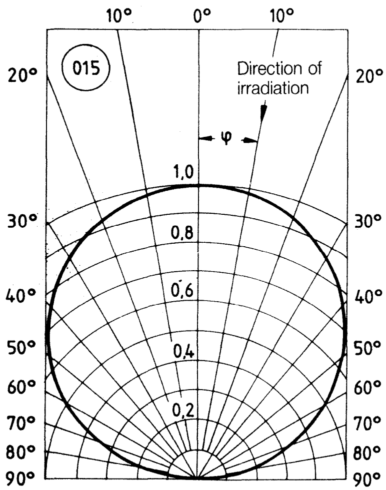
Relative spectral sensitivity versus wavelength



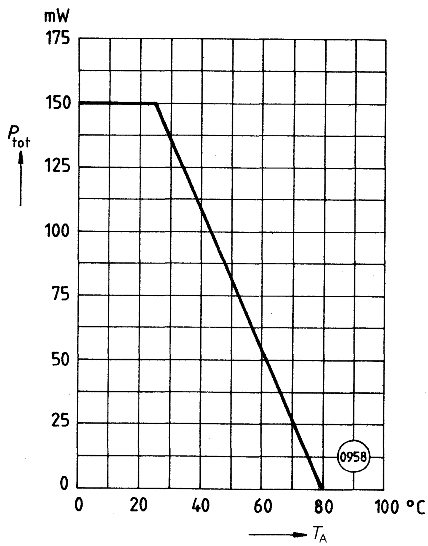
Photocurrent, open-circuit voltage versus irradiance



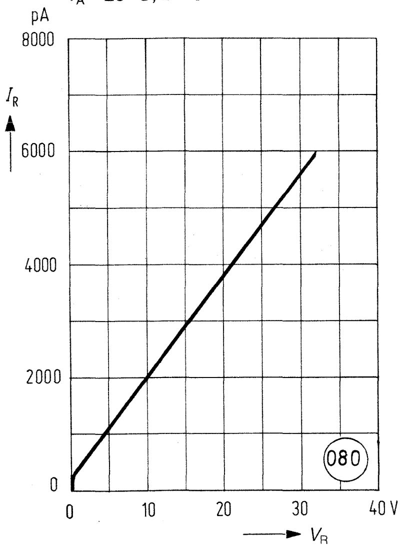
Directional characteristic
Relative spectral sensitivity versus half angle



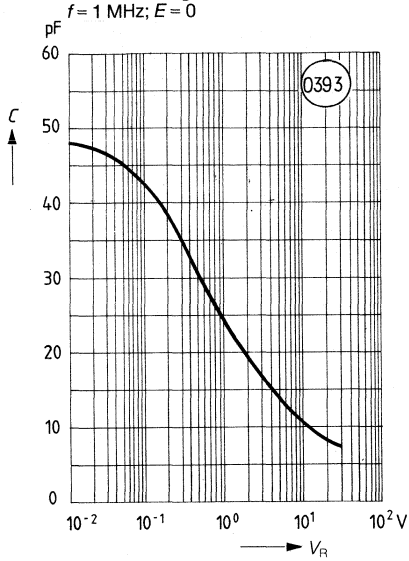
Total power dissipation versus ambient temperature



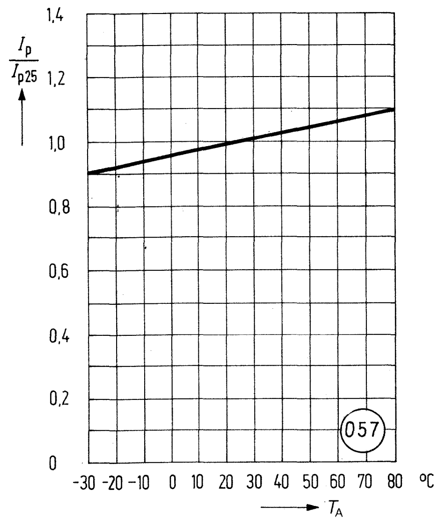
Dark current versus reverse voltage
$T_A = 25\,°C$; $E = 0$



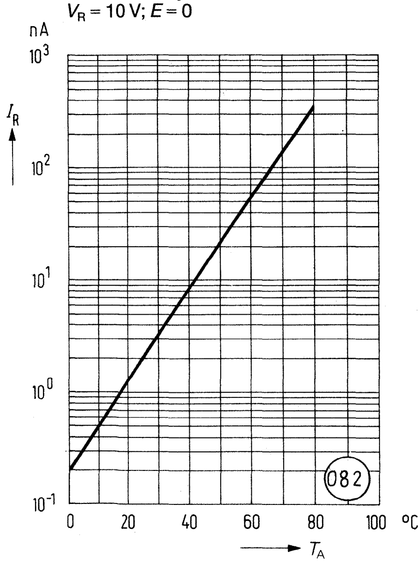
Capacitance versus reverse voltage
$f = 1$ MHz; $E = 0$



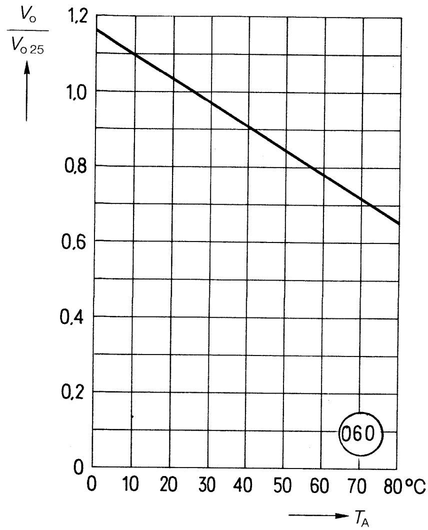
Photocurrent versus ambient temperature



Dark current versus ambient temperature
$V_R = 10$ V; $E = 0$



Open-circuit voltage versus ambient temperature



Silicon Photodiode with Built-in V_λ Filter

BPW 21 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

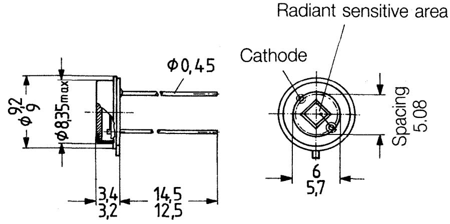
Package Hermetically sealed package, similar to TO 5, solder tabs, glass lens (SCHOTT BG 18/0.3 mm).

Cathode marking Projection at package bottom

Application Exposure meter for daylight as well as for artificial light of high color temperature in photographic fields and color analysis.

Features

- High reliability
- No testable degradation
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Strong logarithmic relation between V_o or I_{SC} and illuminance of 10^{-2} to 10^5 lx
- Wide temperature range
- Suitable for use in the visible light



Approx. weight 1.5 g
Dimensions in mm

Type	Ordering code
BPW 21	Q62702-P885

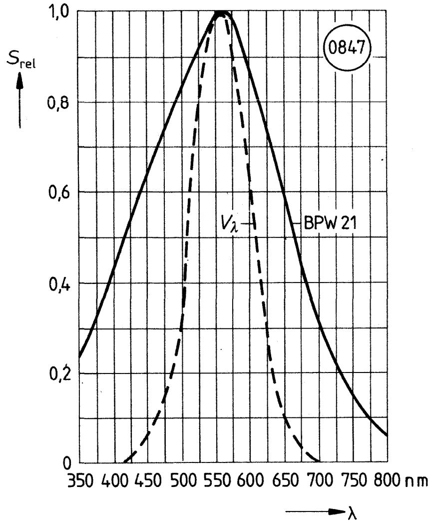
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 1.5 mm distance from case bottom ($t \leq 5$ s)	T_{sold}	235	°C
Reverse voltage	V_R	10	V
Total power dissipation (T_A = 25 °C)	P_{tot}	250	mW
Thermal resistance	R_{thJA}	300	K/W
	R_{thJC}	80	K/W

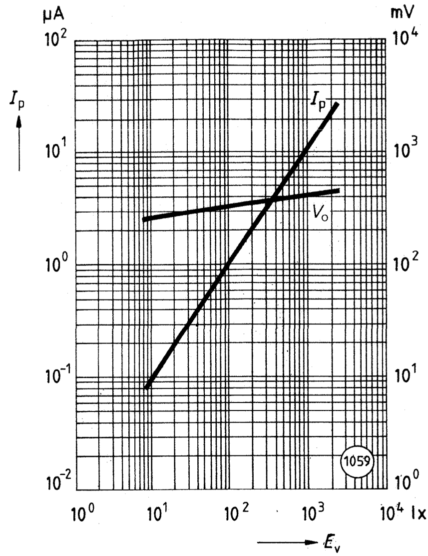
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	10 (≥5.5)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	550	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...775	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case top edge	D	1.9...2.3	mm
Half angle	φ	±60	deg.
Dark current (V_R = 5 V)	I_R	2 (≤30)	nA
(V_R = 10 mV)	I_R	8 (≤200)	pA
Spectral sensitivity (λ = 520 nm)	S_λ	0.34	A/W
Quantum yield (λ = 550 nm)	η	0.80	Electrons / Photon
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	400 (≥320)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	10 (≥5.5)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 550 nm, I_P = 10 µA)	t_r, t_f	1.5	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.2	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	580	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.12	%/K

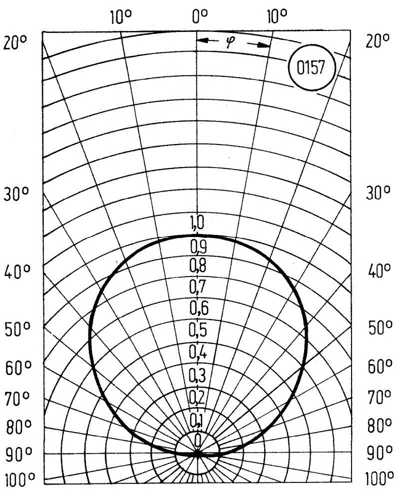
Relative spectral sensitivity versus wavelength



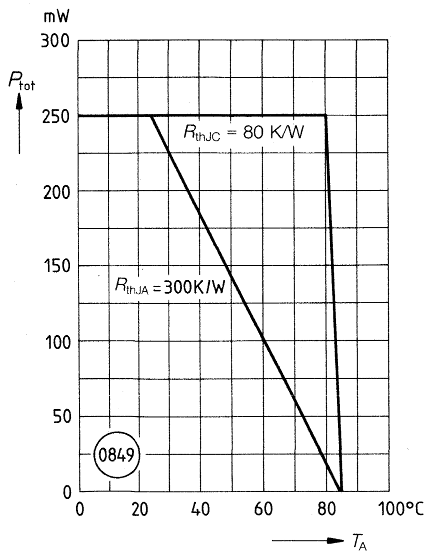
Photocurrent, open-circuit voltage versus illuminance



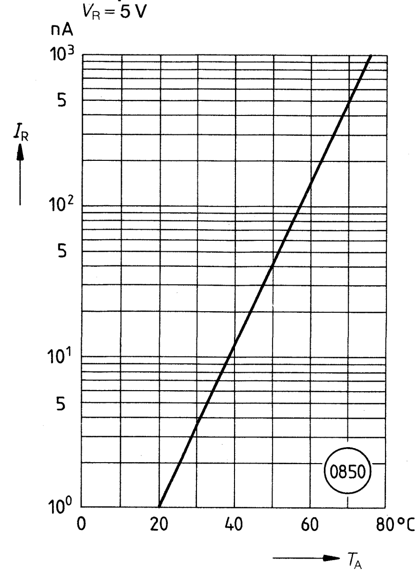
Directional characteristic
Relative spectral sensitivity versus half angle



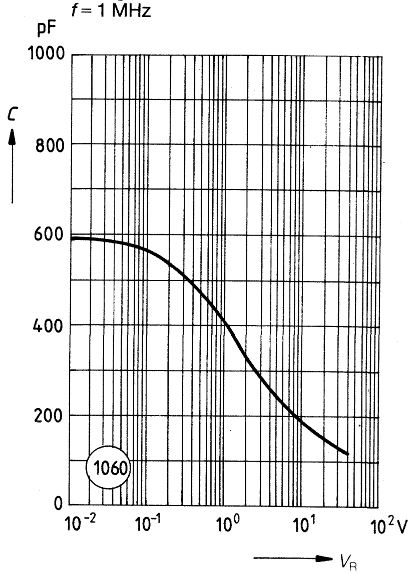
Total power dissipation versus ambient temperature



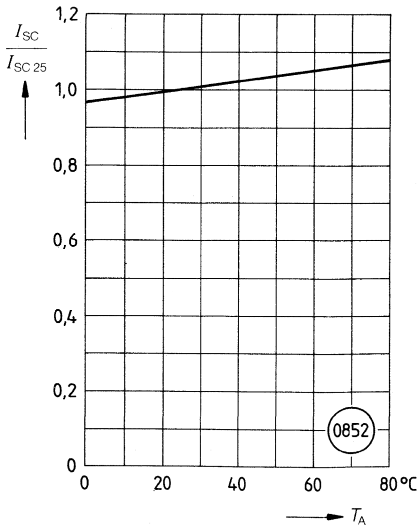
Dark current versus ambient temperature
$V_R = 5$ V



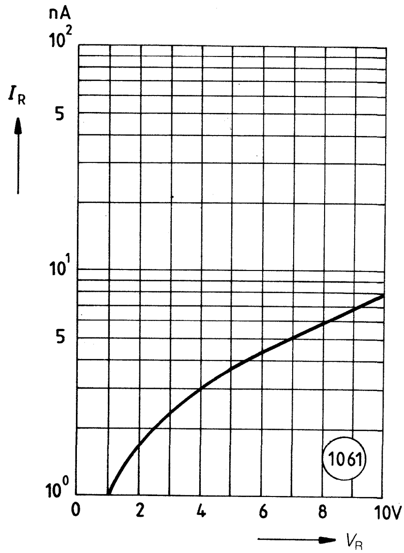
Capacitance versus reverse voltage
$f = 1$ MHz



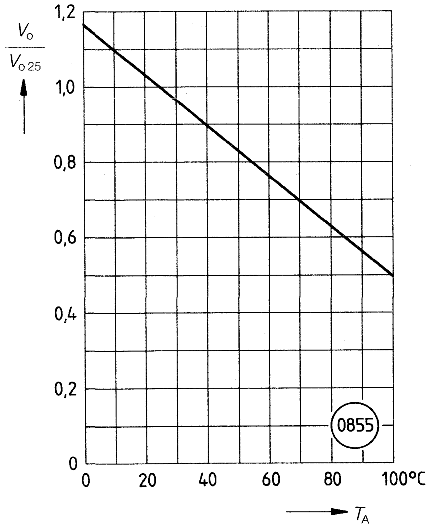
Short-circuit current versus ambient temperature



Dark current versus reverse voltage



Open-circuit voltage versus ambient temperature



Silicon Photodiode with Very Low Dark Current **BPW 32**

BPW 32 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

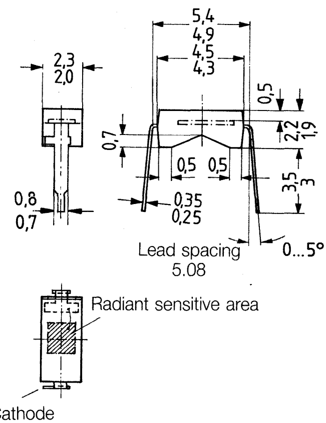
Package Lead frame, transparent epoxy resin, solder tabs, 5.08 mm (2/10″) lead spacing.
For surface mounting the component is also available with gull-wing solder tabs (example BP 104 BS).

Cathode marking Projection at solder tab

Application Exposure meters and automatic exposure timers, color analysis.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.05 g
Dimensions in mm

Type	Ordering code
BPW 32	Q62702-P74

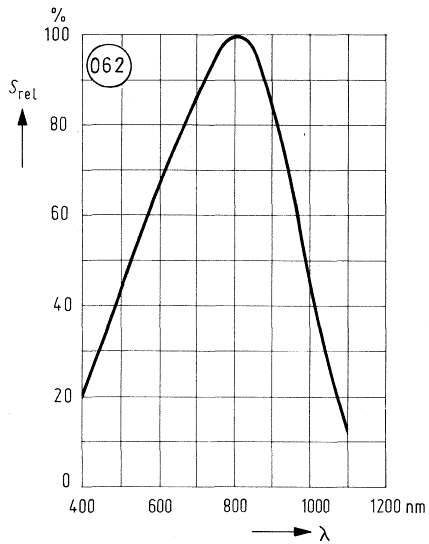
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	7	V
Total power dissipation (T_A = 25 °C)	P_{tot}	100	mW

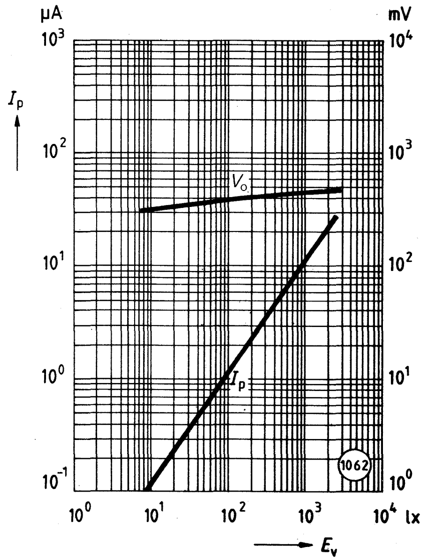
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	10 (≥7)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	800	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...1100	nm
Radiant sensitive area	A	0.97	mm^2
Dimension of radiant sensitive area	$L \times W$	0.985 × 0.985	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 1 V)	I_R	5 (≤20)	pA
Spectral sensitivity (λ = 850 nm)	S_λ	0.50	A/W
Zero crossover (E_e = 0; T_A = 50 °C)	S_0	≥0.5	mV/pA
Quantum yield (λ = 800 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥380)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	10 (≥7)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 10 µA)	t_r, t_f	1.3	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	100	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Noise equivalent power (V_R = 1 V)	NEP	2.5×10^{-15}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 1 V)	D^*	3.9×10^{13}	$\frac{cm \cdot \sqrt{Hz}}{W}$

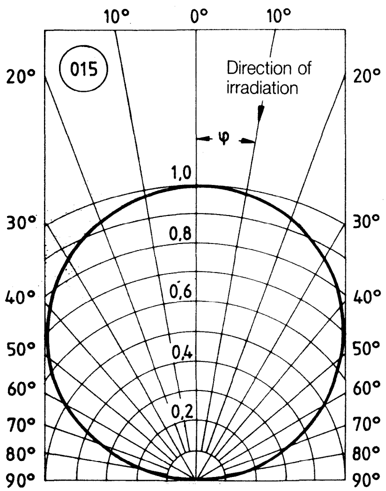
Relative spectral sensitivity versus wavelength



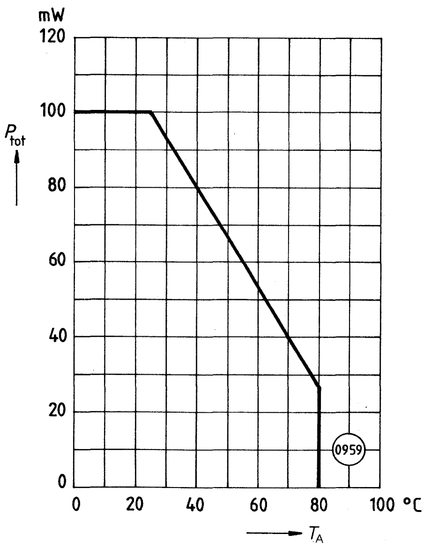
Photocurrent, open-circuit voltage versus illuminance



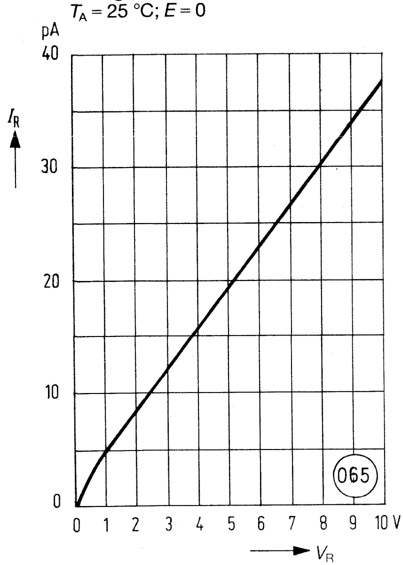
Directional characteristic
Relative spectral sensitivity versus half angle



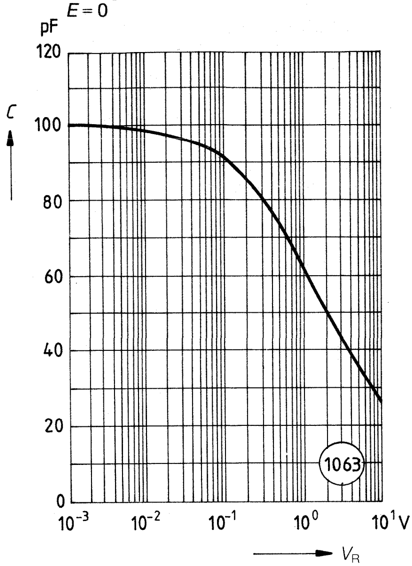
Total power dissipation versus ambient temperature



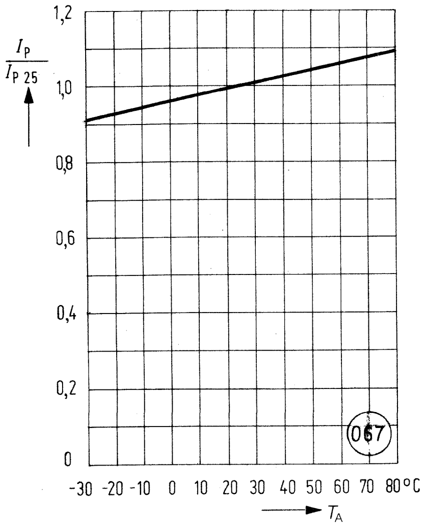
Dark current versus reverse voltage
$T_A = 25\ °C;\ E = 0$



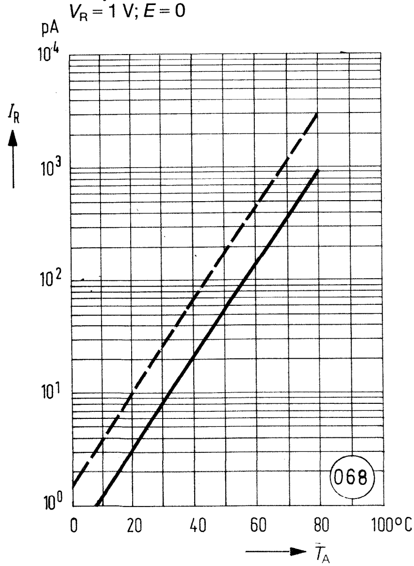
Capacitance versus reverse voltage
$E = 0$



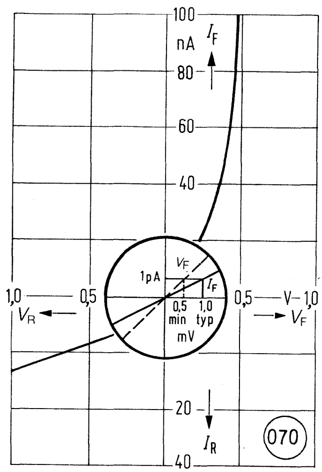
Photocurrent versus ambient temperature



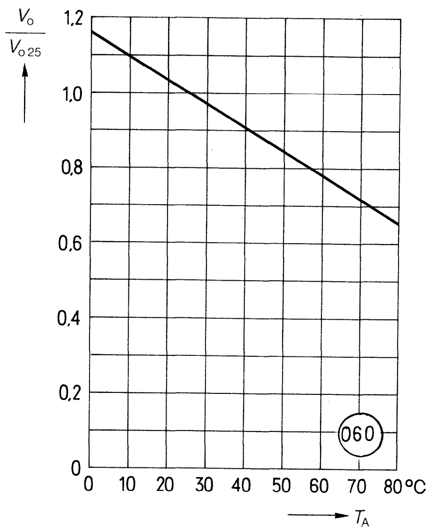
Dark current versus ambient temperature
$V_R = 1\ V;\ E = 0$



Zero crossover S_0



Open-circuit voltage versus ambient temperature



BPW 33 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

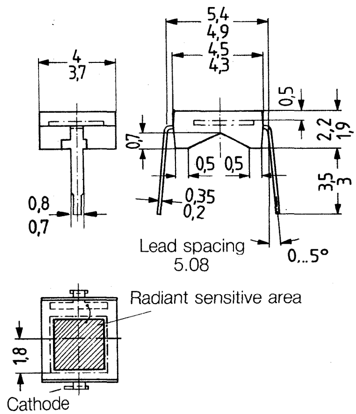
Package Lead frame, transparent epoxy resin, solder tabs, 5.08 mm (2/10″) lead spacing.
For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application Exposure meters and automatic exposure timers, color analysis.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Strong logarithmic relation between V_o or I_{SC} and illuminance of 10^{-2} to 10^5 lx
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.1 g
Dimensions in mm

Type	Ordering code
BPW 33	Q62702-P76

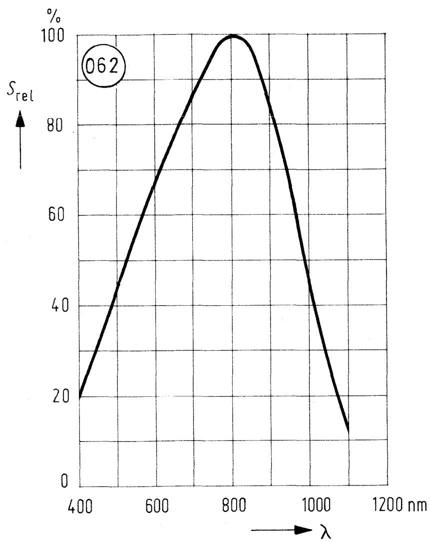
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	7	V
Total power dissipation (T_A = 25 °C)	P_{tot}	150	mW

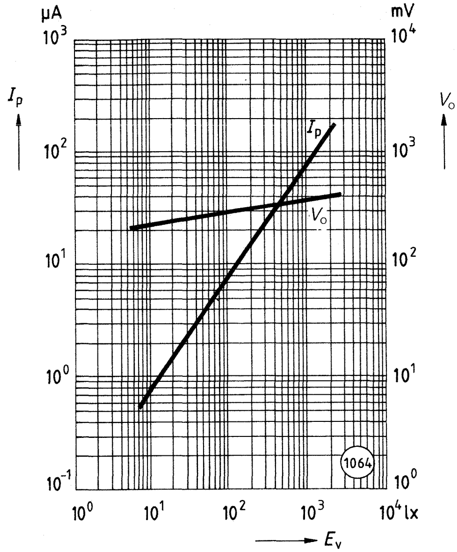
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	75 (≥35)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	800	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 1 V)	I_R	20 (≤100)	pA
Spectral sensitivity (λ = 850 nm)	S_λ	0.59	A/W
Zero crossover (E_e = 0; T_A = 50 °C)	S_0	≥0.05	mV/pA
Quantum yield (λ = 800 nm)	η	0.86	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	440 (≤375)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	72 (≥35)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 70 µA)	t_r, t_f	1.5	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	630	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Noise equivalent power (V_R = 1 V)	NEP	4.3×10^{-15}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 1 V)	D^*	6.3×10^{13}	$\frac{cm \cdot \sqrt{Hz}}{W}$

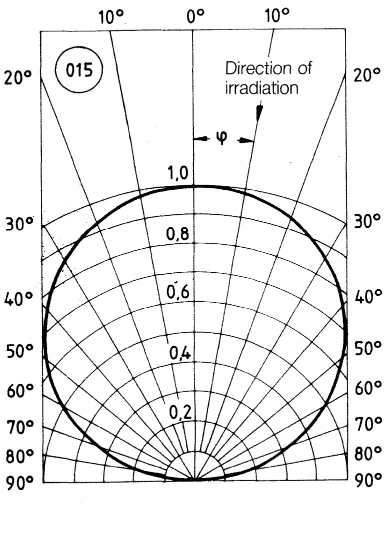
Relative spectral sensitivity versus wavelength



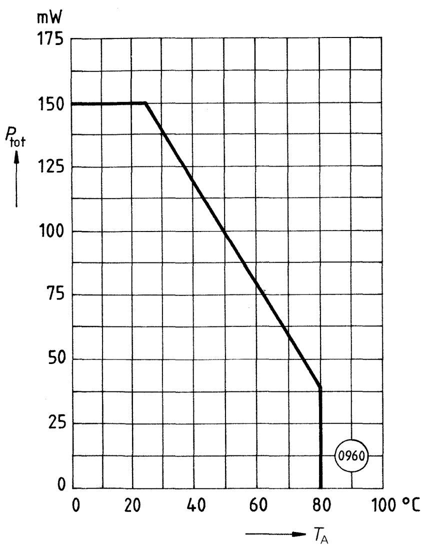
Photocurrent, open-circuit voltage versus illuminance



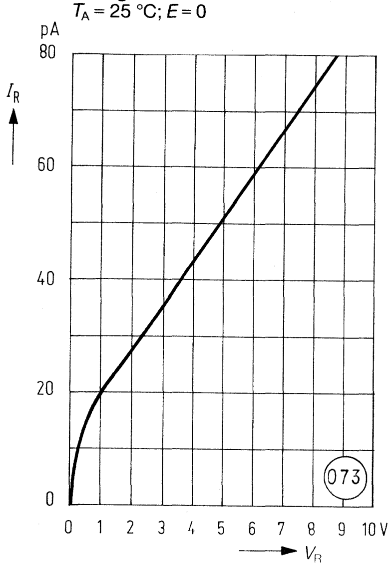
Directional characteristic
Relative spectral sensitivity versus half angle



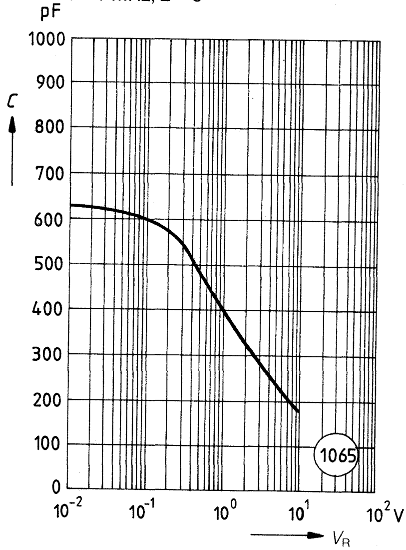
Total power dissipation versus ambient temperature



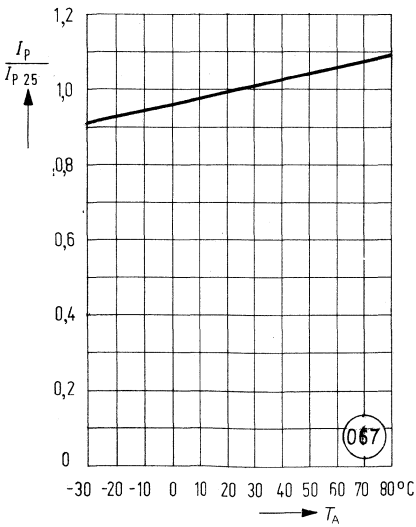
Dark current versus reverse voltage
$T_A = 25\ °C$; $E = 0$



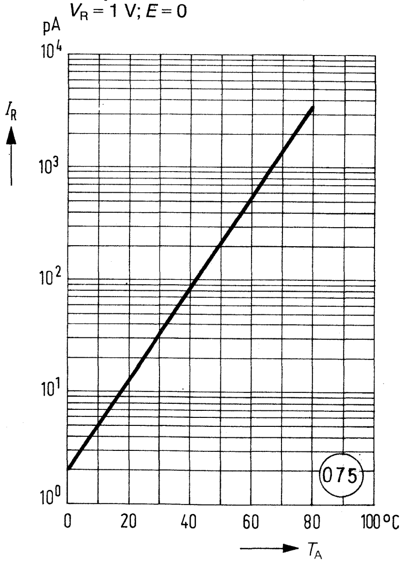
Capacitance versus reverse voltage
$f = 1$ MHz; $E = 0$



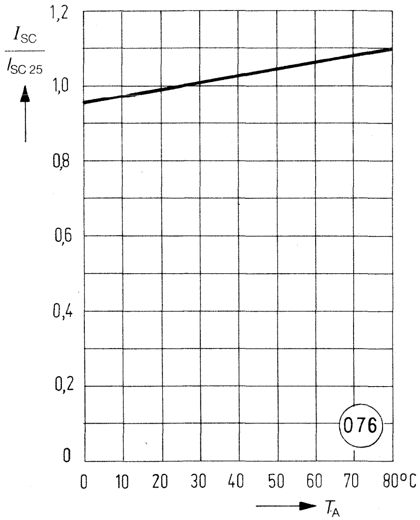
Photocurrent versus ambient temperature



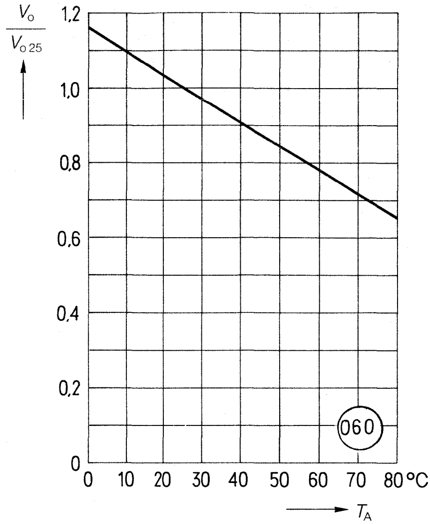
Dark current versus ambient temperature
$V_R = 1$ V; $E = 0$



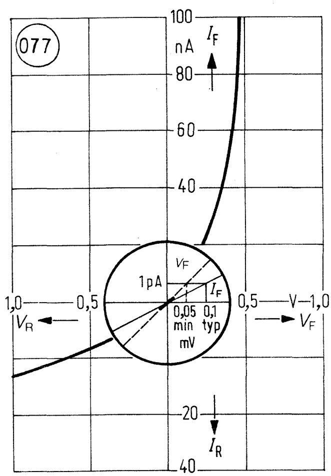
Short-circuit current versus ambient temperature



Open-circuit voltage versus ambient temperature



Zero crossover



BPW 34 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

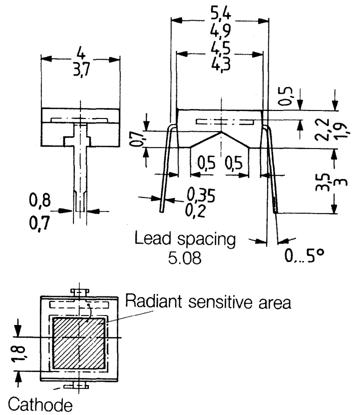
Package Lead frame, transparent epoxy resin, solder tabs, 5.08 mm (²⁄₁₀″) lead spacing.
For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application Light reflecting switches for steady and varying intensity, IR-remote controls, industrial electronics, “measuring and controlling”.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.1 g
Dimensions in mm

Type	Ordering code
BPW 34	Q62702-P73

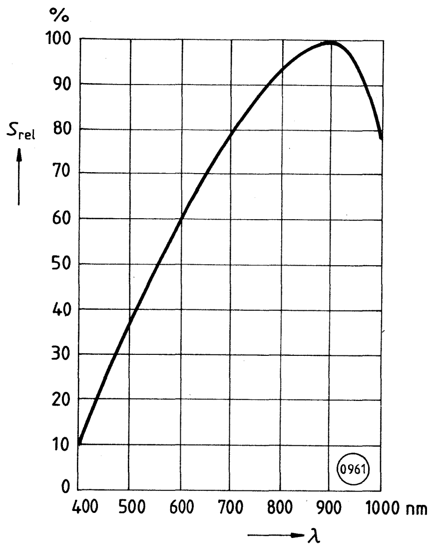
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	32	V
Total power dissipation (T_A = 25 °C)	P_{tot}	150	mW

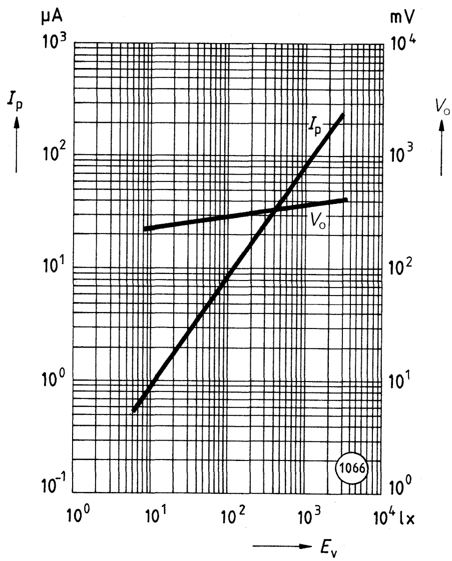
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	80 (≥50)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\,max}$	880	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.62	A/W
Quantum yield (λ = 850 nm)	η	0.90	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	365 (≥300)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T =2856 K)	I_{SC}	80 (≥50)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 70 µA)	t_r, t_f	350	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	72	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	4.1×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	6.6×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

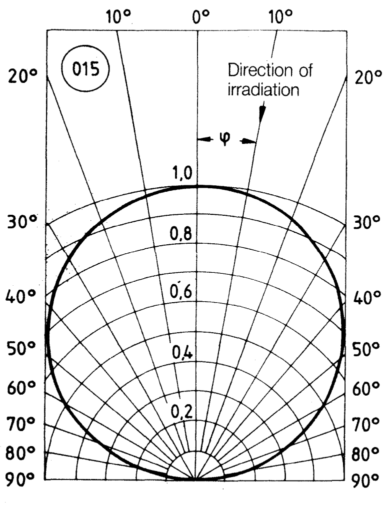
Relative spectral sensitivity versus wavelength



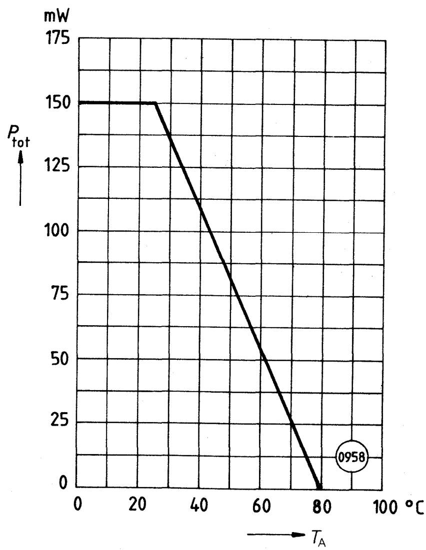
Photocurrent, open-circuit voltage versus illuminance



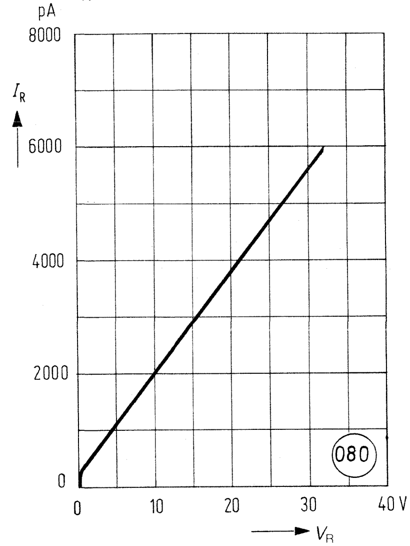
Directional characteristic
Relative spectral sensitivity versus half angle



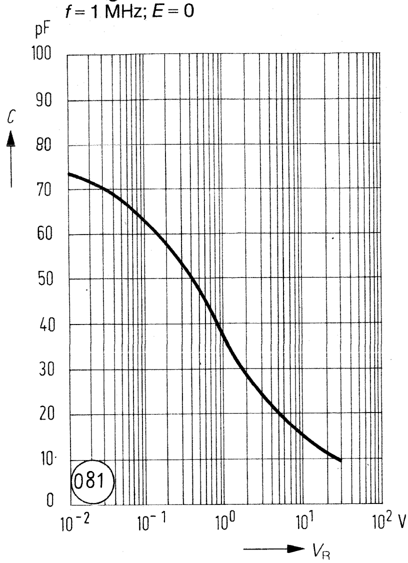
Total power dissipation versus ambient temperature



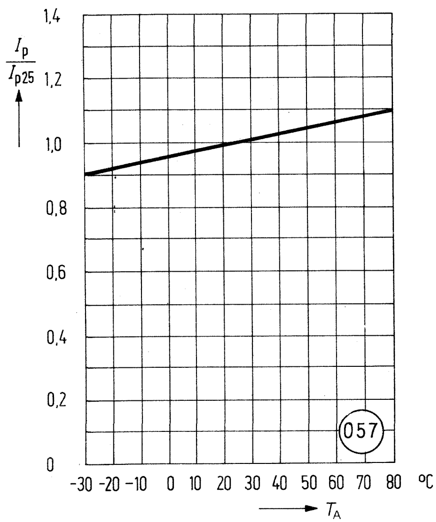
Dark current versus reverse voltage
$T_A = 25\,°C$; $E = 0$



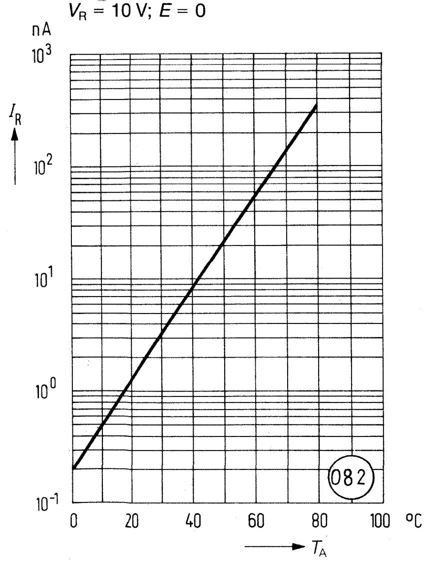
Capacitance versus reverse voltage
$f = 1$ MHz; $E = 0$



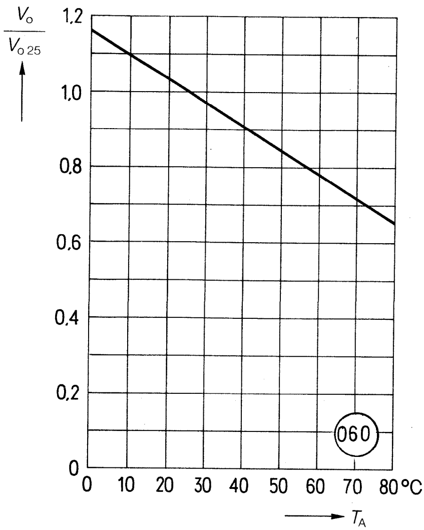
Photocurrent versus ambient temperature



Dark current versus ambient temperature
$V_R = 10$ V; $E = 0$



Open-circuit voltage versus ambient temperature



Silicon PIN Photodiode with Increased Blue Sensitivity

BPW 34 B

Preliminary Data

BPW 34 B is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

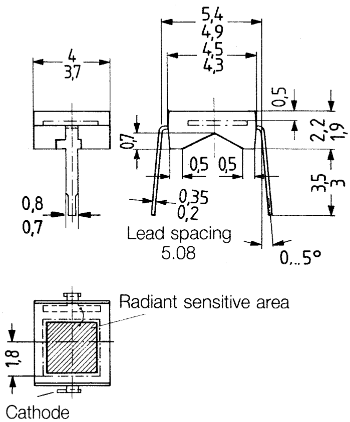
Package Lead frame, transparent epoxy resin, solder tabs, 5.08 mm (2/10″) lead spacing.
For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application Light reflecting switches for steady and varying intensity in the visible light range, industrial electronics, "measuring and controlling"

Features

- High reliability
- No testable degradation
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.1 g
Dimensions in mm

Type	Ordering code
BPW 34 B	Q62702-P945

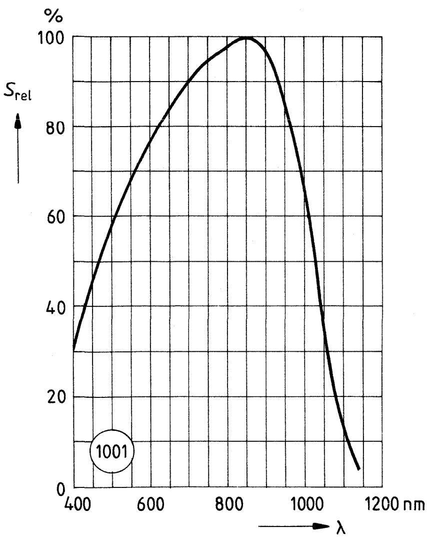
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	32	V
Total power dissipation	P_{tot}	150	mW

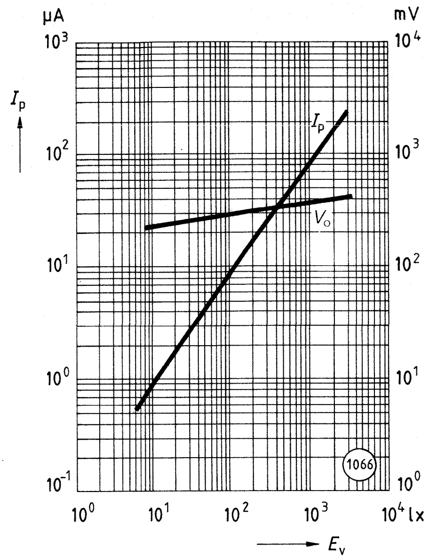
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	75 (≥50)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.62	A/W
Quantum yield (λ = 850 nm)	η	0.90	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	390 (≥320)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	75 (≥50)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 70 µA)	t_r, t_f	350	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	72	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	4.2×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	6.3×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

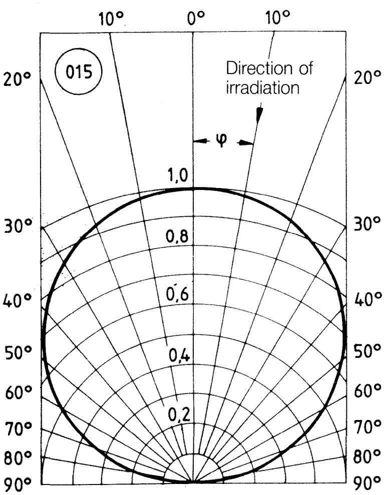
Relative spectral sensitivity versus wavelength



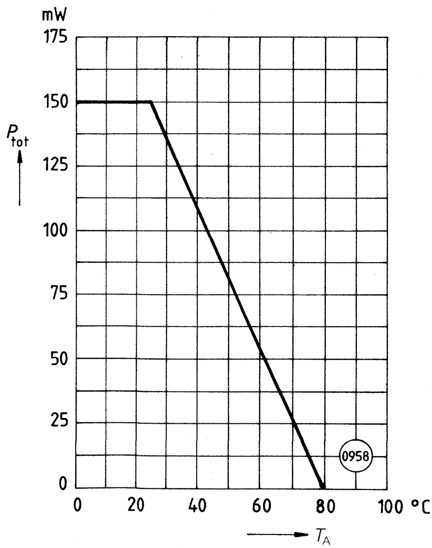
Photocurrent, open-circuit voltage versus illuminance



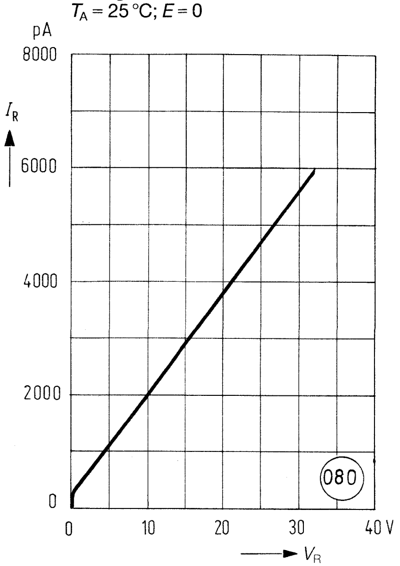
Directional characteristic
Relative spectral sensitivity versus half angle



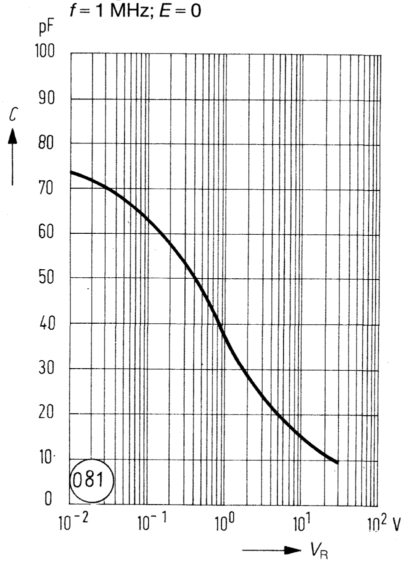
Total power dissipation versus ambient temperature



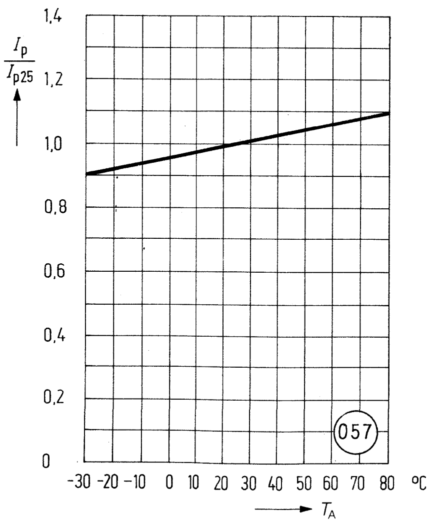
Dark current versus reverse voltage
$T_A = 25\,°C$; $E = 0$



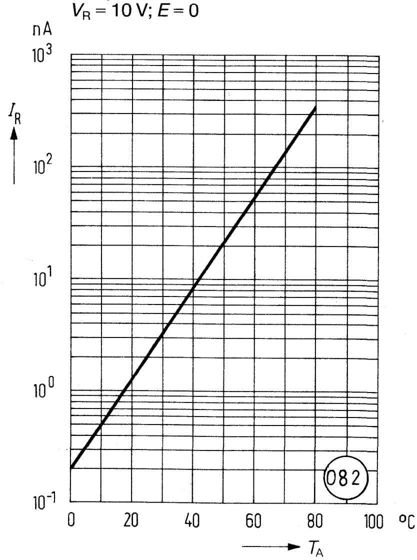
Capacitance versus reverse voltage
$f = 1$ MHz; $E = 0$



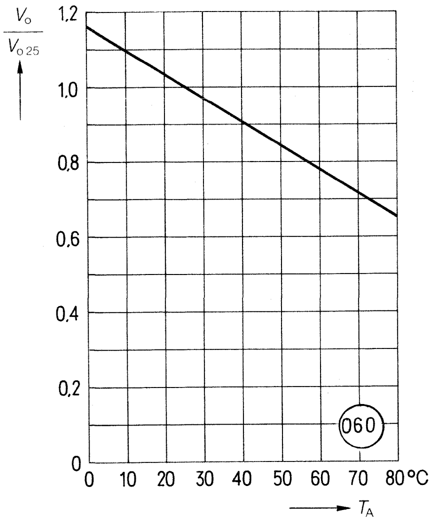
Photocurrent versus ambient temperature



Dark current versus ambient temperature
$V_R = 10$ V; $E = 0$



Open-circuit voltage versus ambient temperature



BPW 34 F is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

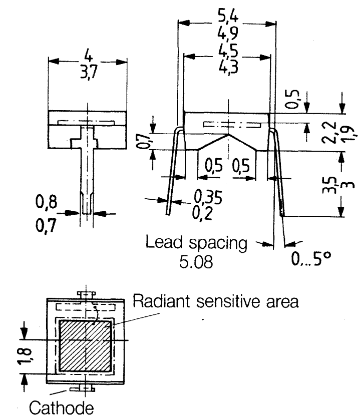
Package Lead frame, black epoxy resin, daylight filter, solder tabs, 5.08 mm (2⁄10″) lead spacing.
For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application IR-remote control of hi-fi and TV sets, video tape recorders, dimmers, remote controls of various equipment, light reflecting switches for steady and varying intensity.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the near infrared range



Approx. weight 0.1 g
Dimensions in mm

Type	Ordering code
BPW 34 F	Q62702-P929

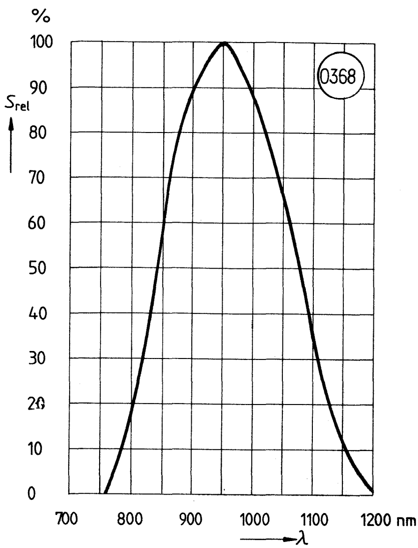
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	32	V
Total power dissipation	P_{tot}	150	mW

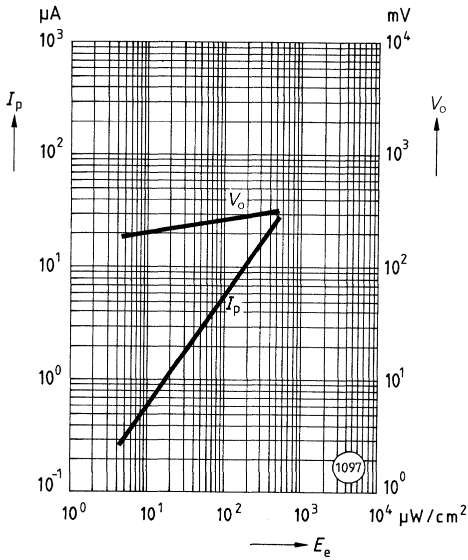
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm^2)	S	25 (≥15)	µA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	950	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	800...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 950 nm)	S_λ	0.68	A/W
Quantum yield (λ = 950 nm)	η	0.90	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_e = 0.5 mW/cm^2; λ = 950 nm)	V_o	327 (≥275)	mV
Short-circuit current (E_e = 0.5 mW/cm^2; λ = 950 nm)	I_{SC}	25 (≥15)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 25 µA)	t_r, t_f	400	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	72	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	3.7×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	7.3×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

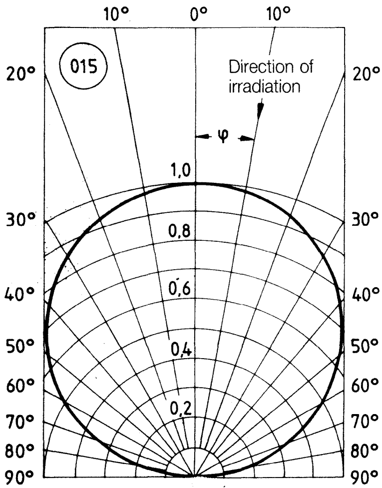
Relative spectral sensitivity versus wavelength



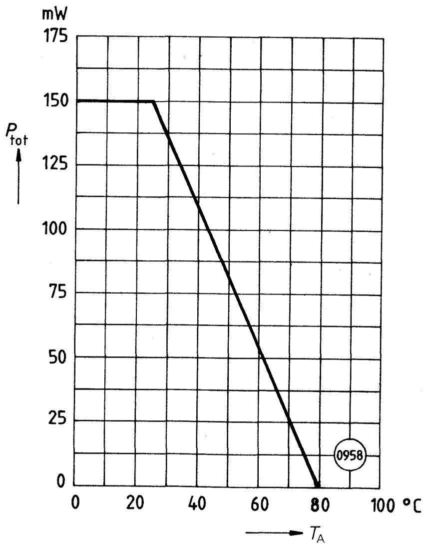
Photocurrent, open-circuit voltage versus irradiance



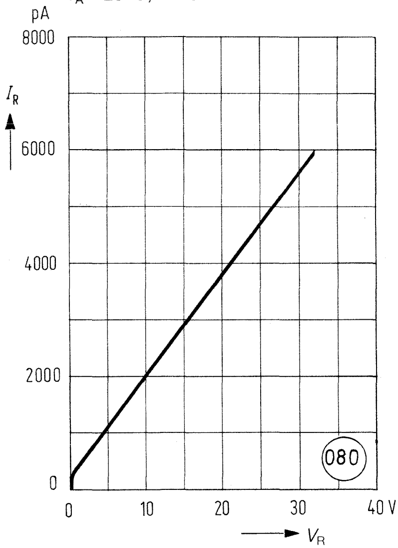
Directional characteristic
Relative spectral sensitivity versus half angle



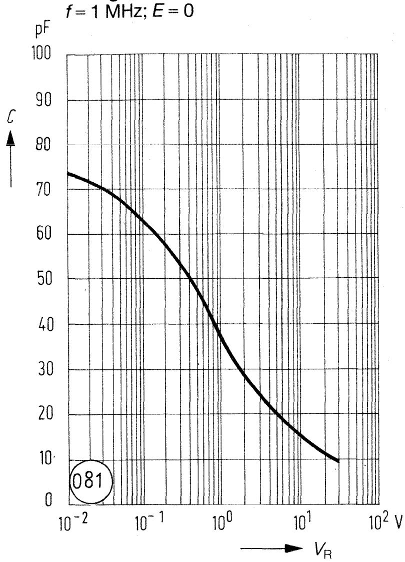
Total power dissipation versus ambient temperature



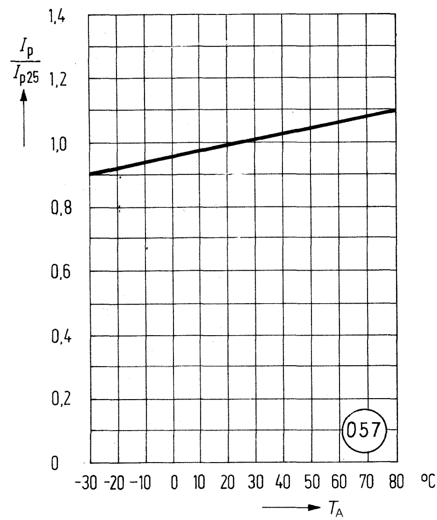
Dark current versus reverse voltage
$T_A = 25\,°C$; $E = 0$



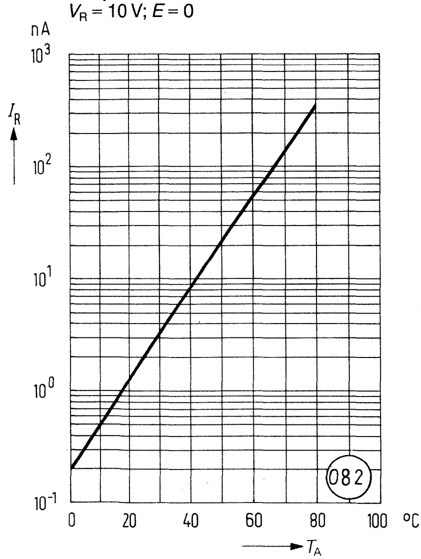
Capacitance versus reverse voltage
$f = 1$ MHz; $E = 0$



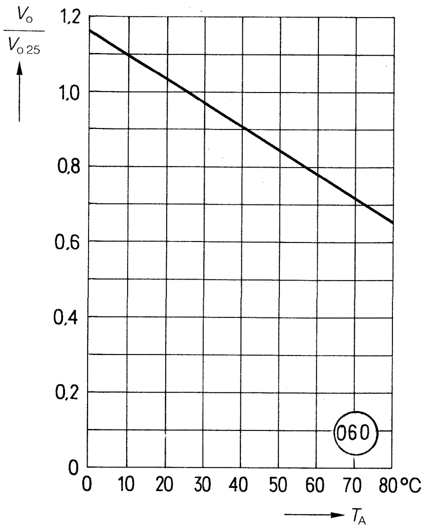
Photocurrent versus ambient temperature



Dark current versus ambient temperature
$V_R = 10$ V; $E = 0$



Open-circuit voltage versus ambient temperature



BPX 48 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

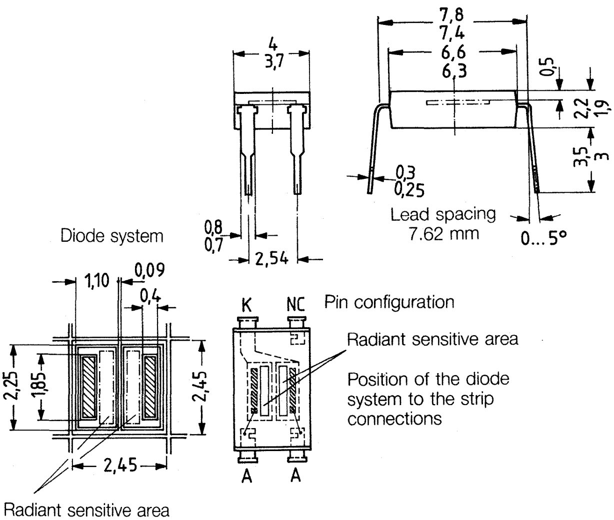
Package Lead frame, transparent epoxy resin, solder tabs, lead spacing 7.62 mm. For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application Follow-up control, edge control, path and angle scanning, industrial electronic applications, “measuring and controlling”.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.1 g
Dimensions in mm

Type	Ordering code
BPX 48	Q62702-P17-S1

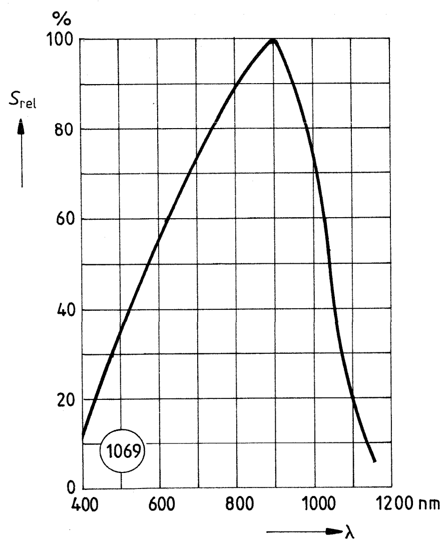
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	10	V
Total power dissipation (T_A = 25 °C)	P_{tot}	50	mW

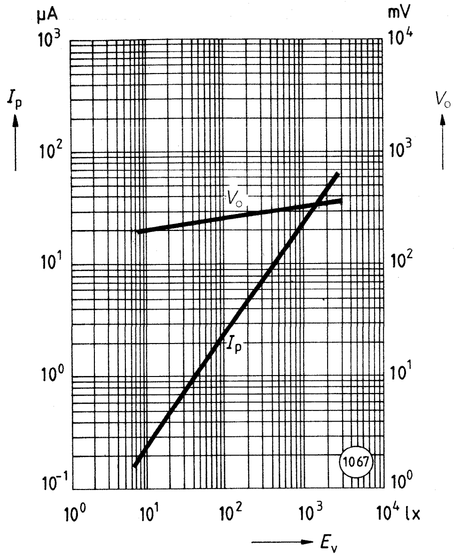
Characteristics (T_A = 25 °C)
(This data refers to **one** system of the photodiode)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	24 (≥15)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	430...1150	nm
Radiant sensitive area	A	1.54	mm^2
Dimension of radiant sensitive area	$L \times W$	0.7 × 2.2	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	100 (≤200)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Max. deviation of the spectral sensitivity of the systems from the mean value	Δ_s	±5	%
Quantum yield (λ = 850 nm)	η	0.80	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	330 (≥280)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	24 (≥15)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 20 µA)	t_r, t_f	≤500	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	25	pF
(V_R = 10 V, f = 1 MHz, E_v = 0 lx)	C_{10}	6	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K

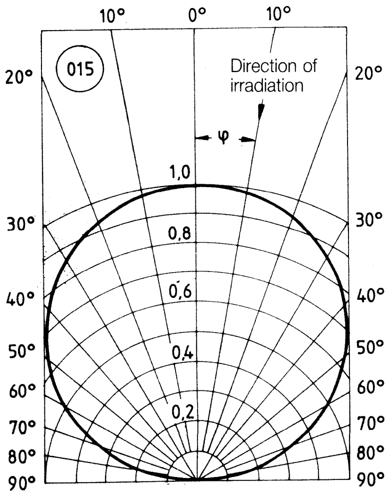
Relative spectral sensitivity versus wavelength



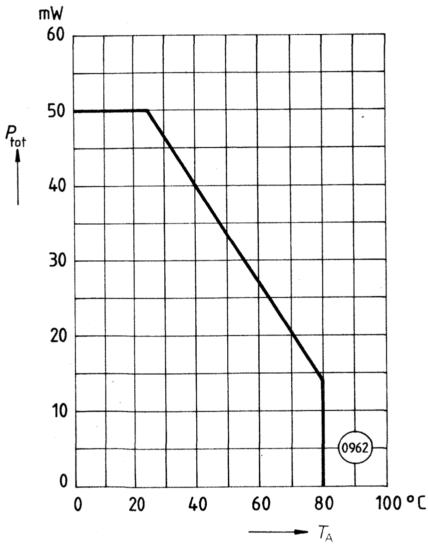
Photocurrent, open-circuit voltage versus illuminance



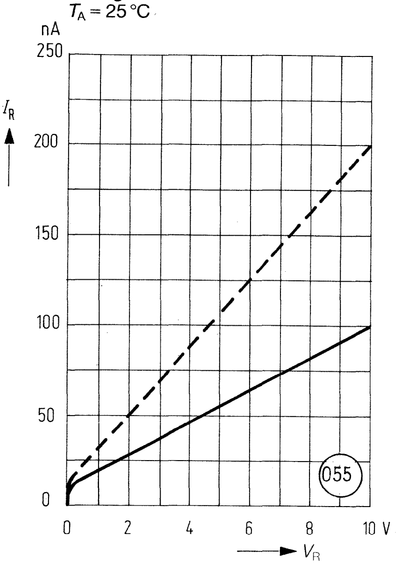
Directional characteristic
Relative spectral sensitivity versus half angle



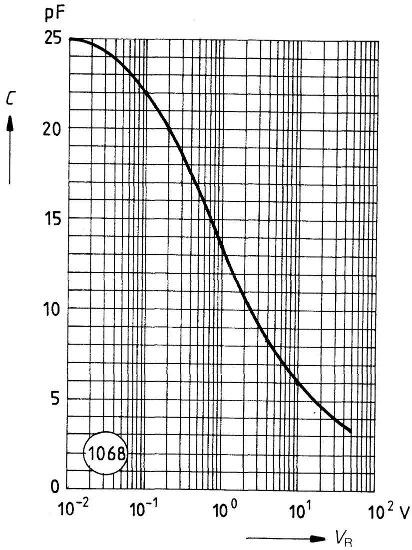
Total power dissipation versus ambient temperature



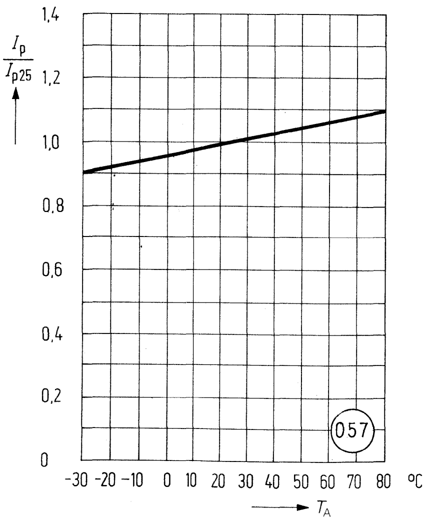
Dark current versus reverse voltage
$T_A = 25\,°C$



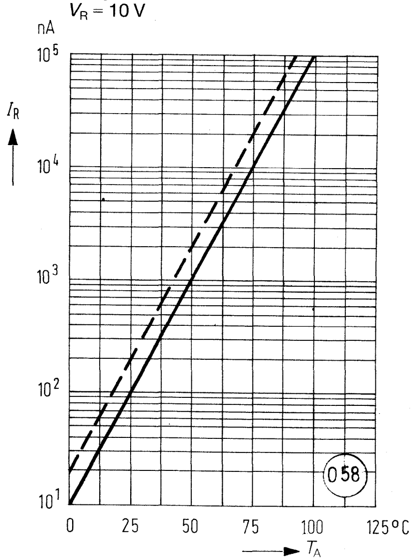
Diode capacitance versus reverse voltage



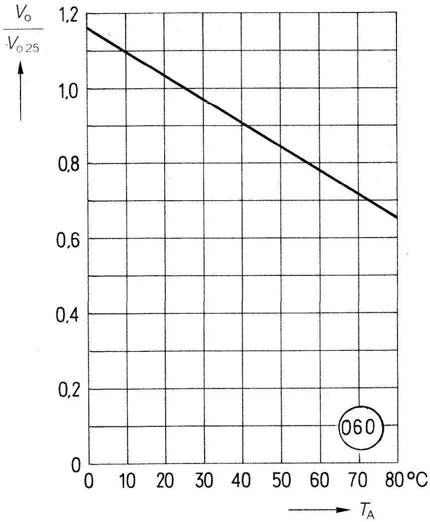
Photocurrent versus ambient temperature



Dark current versus ambient temperature
$V_R = 10\,V$



Open-circuit voltage versus ambient temperature



Silicon Photodiode **BPX 60**

BPX 60 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

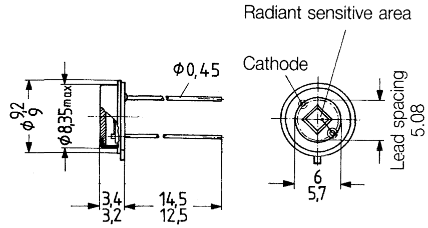
Package Hermetically sealed package, similar to TO 5, solder tabs, lead spacing 5.08 mm (²⁄₁₀″).

Cathode marking Projection at case bottom

Application Light reflecting switches for steady and varying intensity, industrial electronics, “measuring and controlling”.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 1.5 g
Dimensions in mm

Type	Ordering code
BPX 60	Q62702-P54

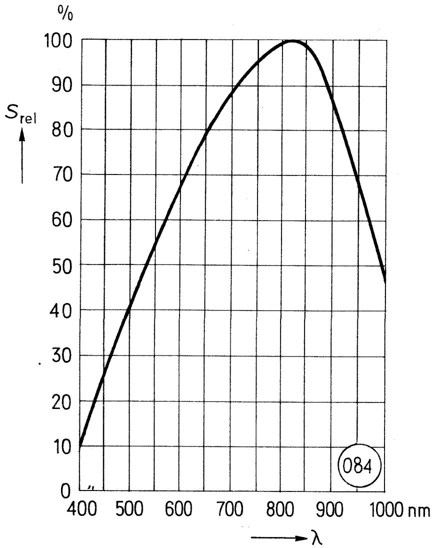
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	32	V
Total power dissipation (T_A = 25 °C)	P_{tot}	325	mW
Thermal resistance	R_{thJA}	300	K/W
	R_{thJC}	80	K/W

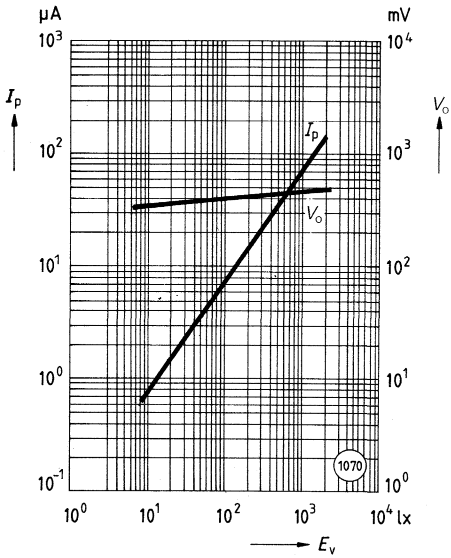
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	70 (≥35)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case top edge	D	1.9...2.3	mm
Half angle	φ	±55	deg.
Dark current (V_R = 10 V)	I_R	7 (≤300)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.50	A/W
Quantum yield (λ = 850 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	460 (≥390)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	70 (≥35)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 70 µA)	t_r, t_f	3.0	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	580	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K

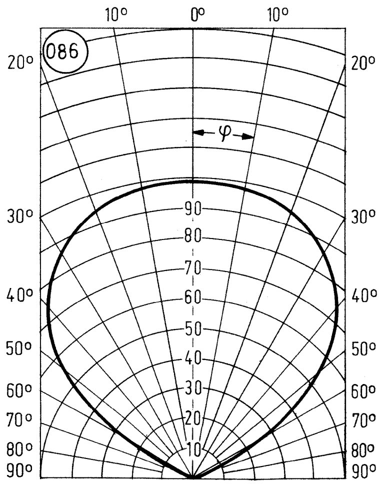
Relative spectral sensitivity versus wavelength



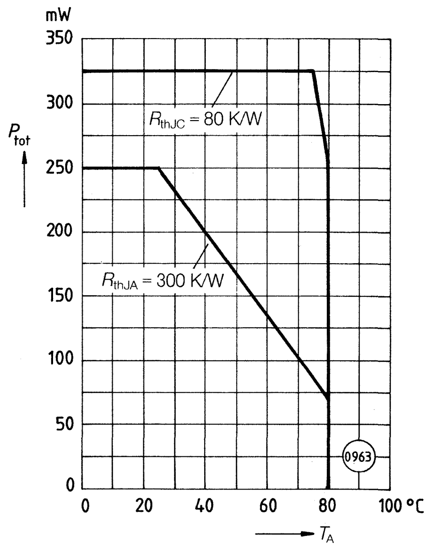
Photocurrent, open-circuit voltage versus illuminance



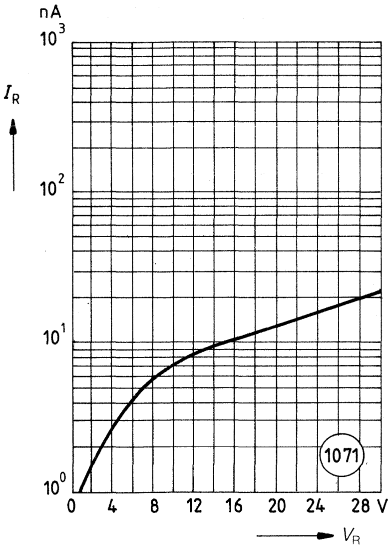
Directional characteristic
Relative spectral sensitivity versus half angle



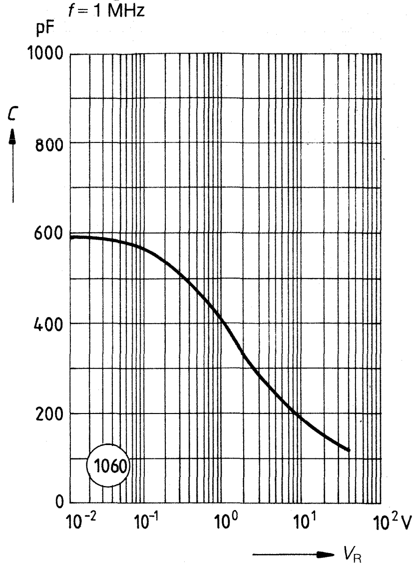
Total power dissipation versus ambient temperature



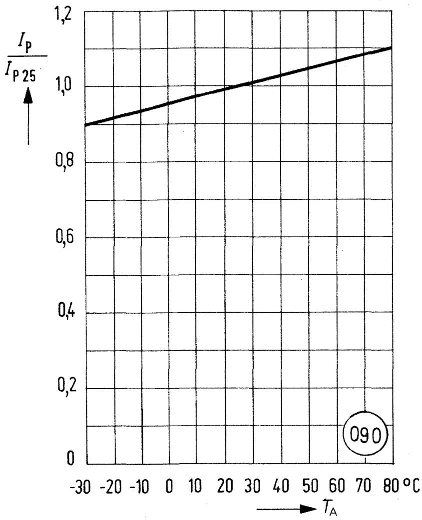
Dark current versus reverse voltage



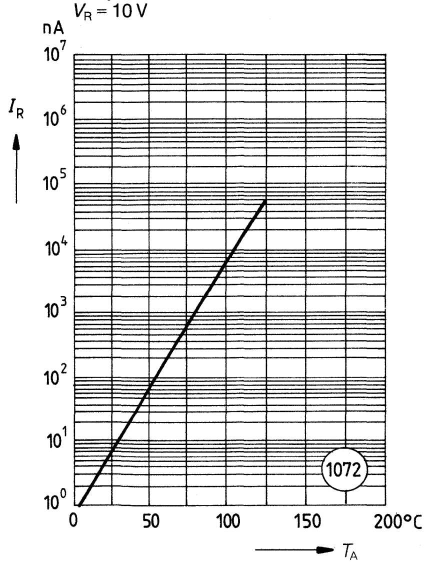
Capacitance versus reverse voltage
$f = 1$ MHz



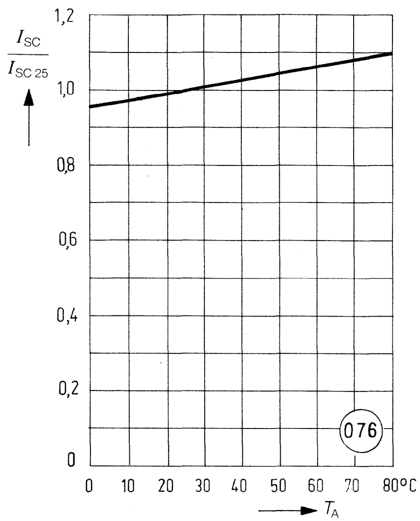
Photocurrent versus ambient temperature



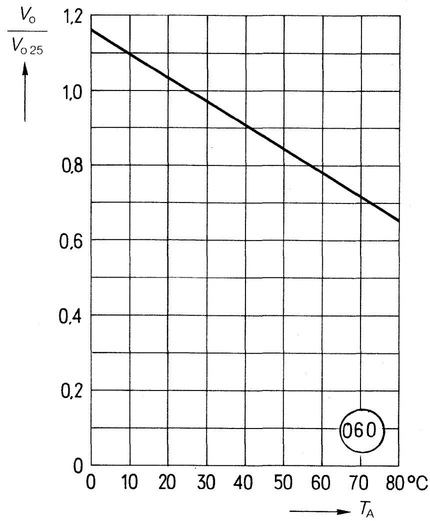
Dark current versus ambient temperature
$V_R = 10$ V



Short-circuit current versus ambient temperature



Open-circuit voltage versus ambient temperature



BPX 61 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

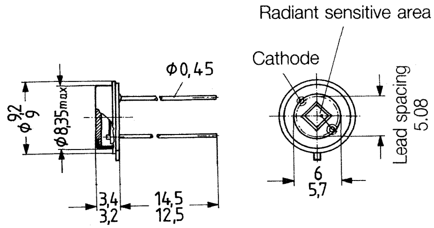
Package Hermetically sealed package, similar to TO 5, solder tabs, lead spacing 5.08 mm.

Cathode marking Projection at case bottom

Application Light-reflecting switches for steady and varying intensity, IR-remote controls, industrial electronic applications, “measuring and controlling”.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 1.5 g
Dimensions in mm

Type	Ordering code
BPX 61	Q62705-P25

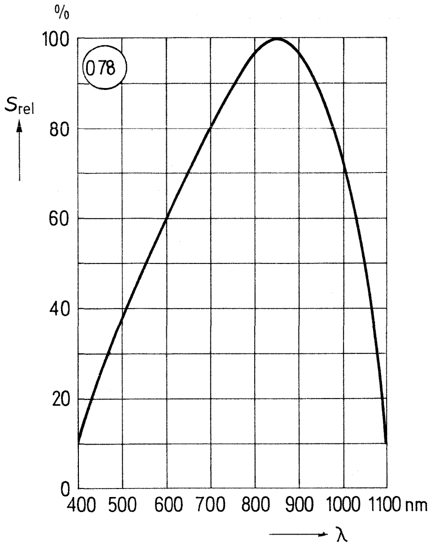
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	32	V
Total power dissipation (T_A = 25 °C)	P_{tot}	325	mW
Thermal resistance	R_{thJA}	300	K/W
	R_{thJC}	80	K/W

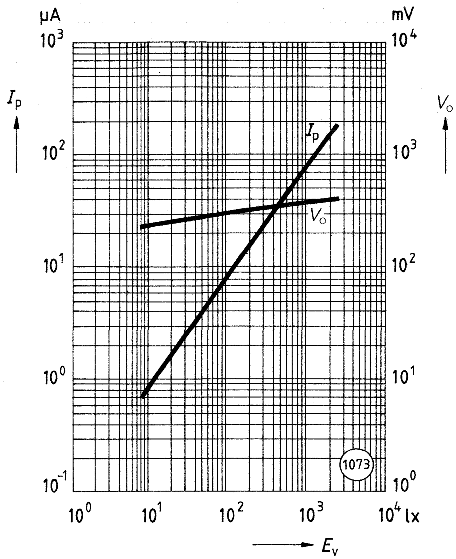
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	70 (≥50)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case top edge	D	1.9...2.3	mm
Half angle	φ	±55	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.62	A/W
Quantum yield (λ = 850 nm)	η	0.90	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	375 (≥320)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	70 (≥50)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 70 µA)	t_r, t_f	350	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	72	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	4.1×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	6.6×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

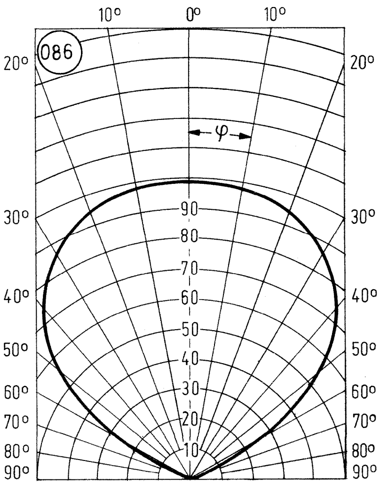
Relative spectral sensitivity versus wavelength



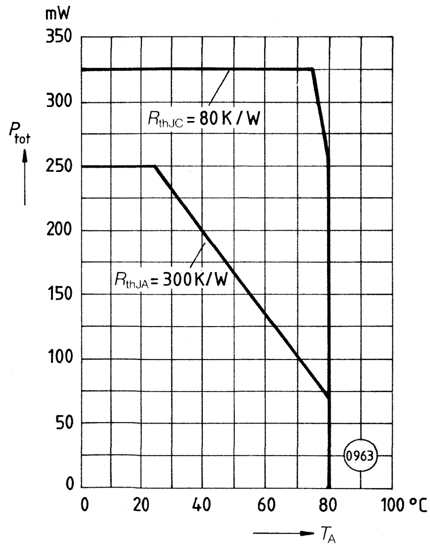
Photocurrent, open-circuit voltage versus illuminance



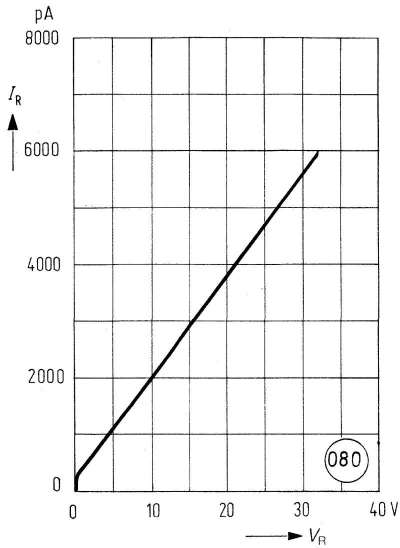
Directional characteristic
Relative spectral sensitivity versus half angle



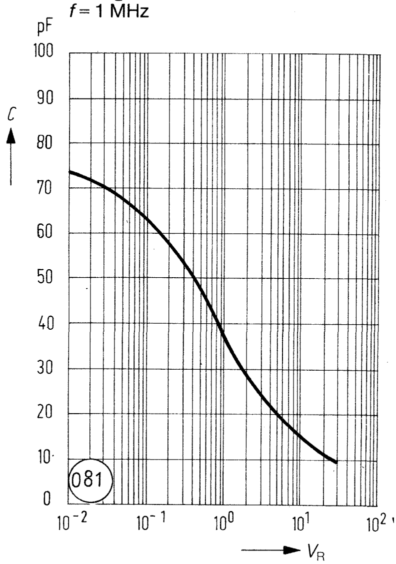
Total power dissipation versus ambient temperature



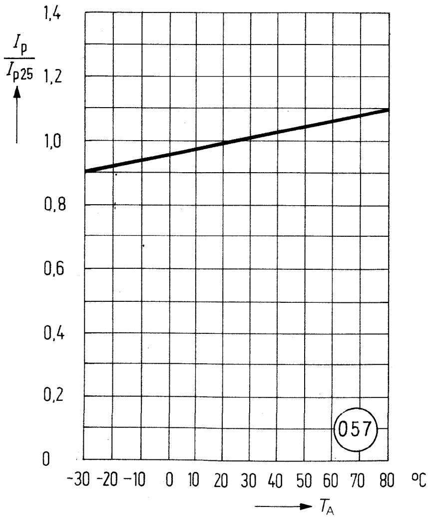
Dark current versus reverse voltage



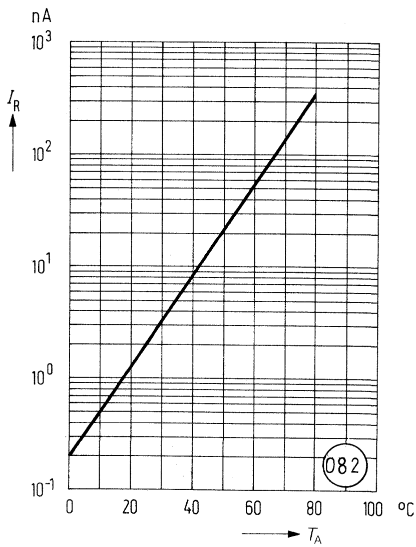
Capacitance versus reverse voltage
f = 1 MHz



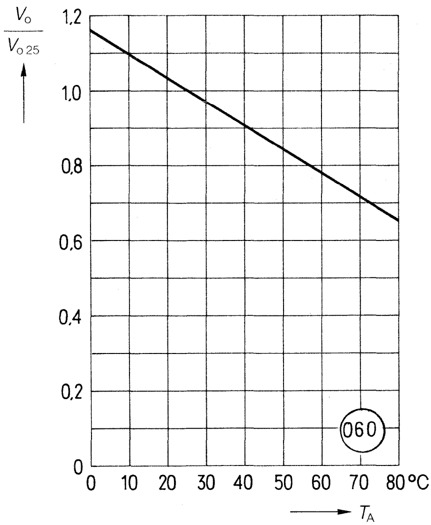
Photocurrent versus ambient temperature



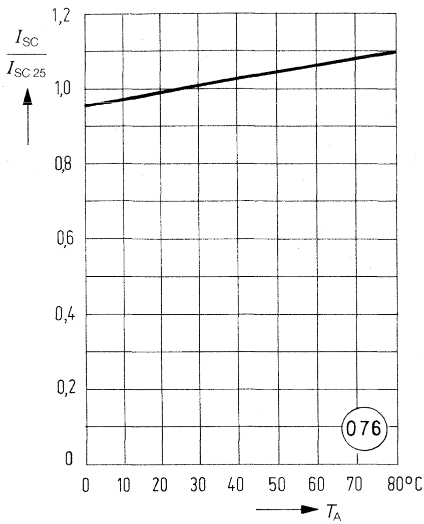
Dark current versus ambient temperature



Open-circuit voltage versus ambient temperature



Short-circuit current versus ambient temperature



Silicon Photodiode with Very Low Dark Current **BPX 63**

BPX 63 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

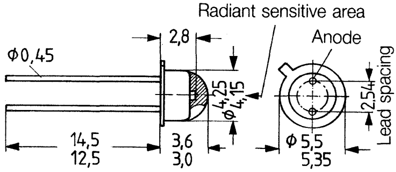
Package 18 A3 DIN 41870 (TO 18) base plate, transparent epoxy resin lens, solder tabs, lead spacing 2.54 mm (1/10″).

Anode marking Projection at case bottom

Application Exposure meters, automatic exposure timers.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
BPX 63	Q62702-P55

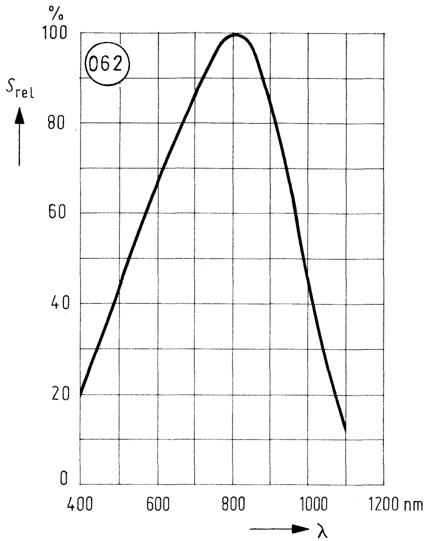
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	7	V
Total power dissipation (T_A = 25 °C)	P_{tot}	200	mW

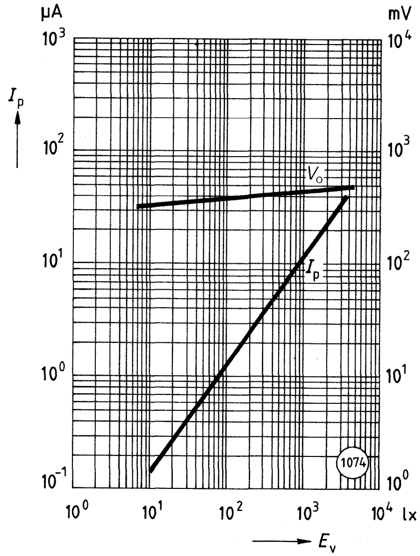
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	10 (≥8)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	800	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...1100	nm
Radiant sensitive area	A	0.97	mm^2
Dimension of radiant sensitive area	$L \times W$	0.985 × 0.985	mm
Distance chip surface to case surface	D	0.2...0.8	mm
Half angle	φ	±75	deg.
Dark current (V_R = 1 V)	I_R	5 (≤20)	pA
Spectral sensitivity (λ = 850 nm)	S_λ	0.50	A/W
Zero crossover (E_e = 0; T_A = 25 °C)	S_0	≥0.5	mV/pA
Quantum yield (λ = 800 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥380)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	10 (≥8)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 10 µA)	t_r, t_f	1.3	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	100	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.16	%/K
Noise equivalent power (V_R = 1 V)	NEP	2.5×10^{-15}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 1 V)	D^*	3.9×10^{13}	$\frac{cm \cdot \sqrt{Hz}}{W}$

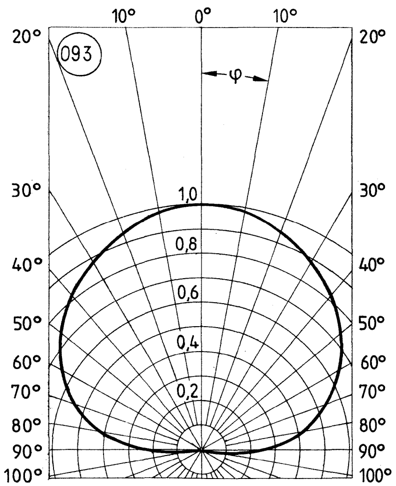
Relative spectral sensitivity versus wavelength



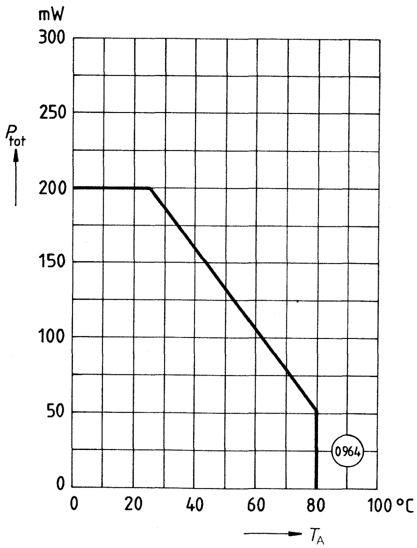
Photocurrent, open-circuit voltage versus illuminance



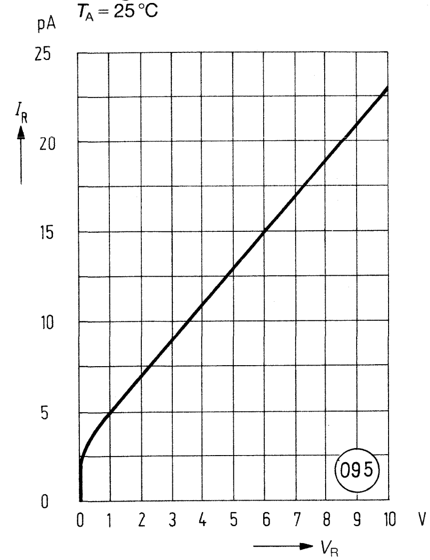
Directional characteristic
Relative spectral sensitivity versus half angle



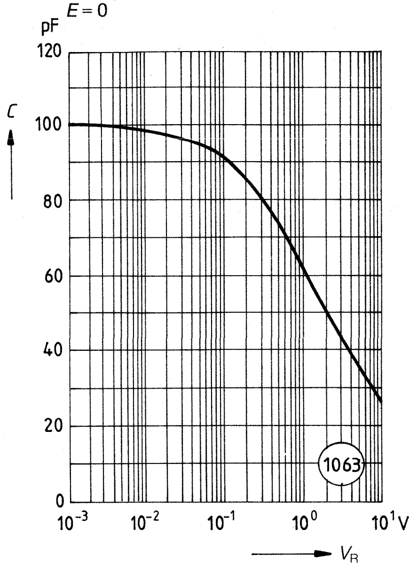
Total power dissipation versus ambient temperature



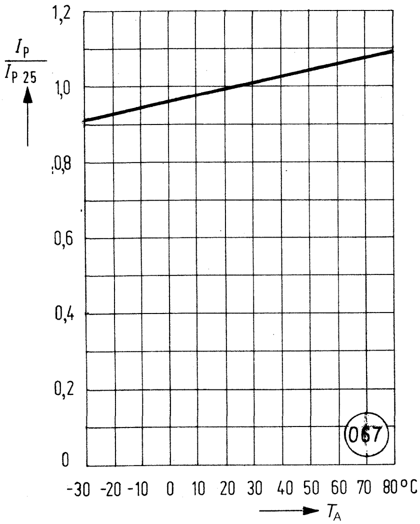
Dark current versus reverse voltage
$T_A = 25\ °C$



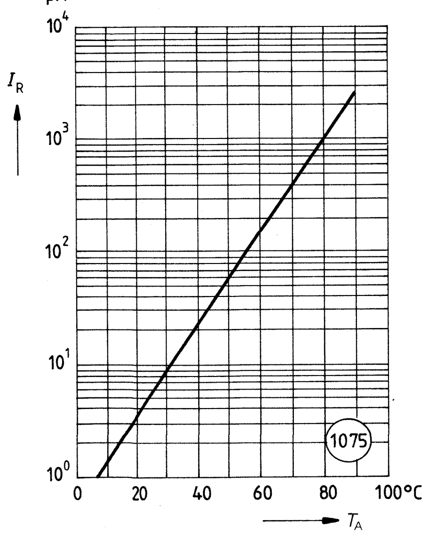
Capacitance versus reverse voltage
$E = 0$



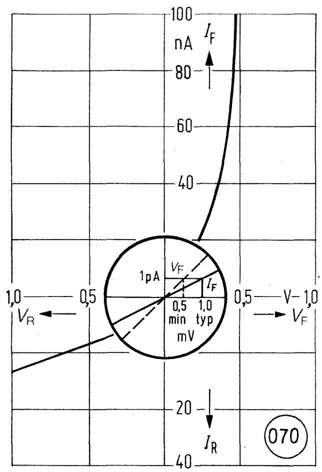
Photocurrent versus ambient temperature



Dark current versus ambient temperature
$E_v = 0$; $V_R = 1\ V$



Zero crossover



BPX 65 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

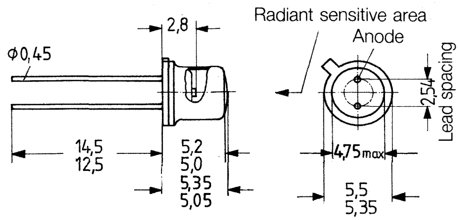
Package 18 A3 DIN 41870 (TO 10), flat glass lens, hermetically sealed case, solder tabs, lead spacing 2.54 mm (1/10″).

Anode marking Projection at case bottom

Application Optical sensor of high modulation bandwidth.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
BPX 65	Q62702-P27

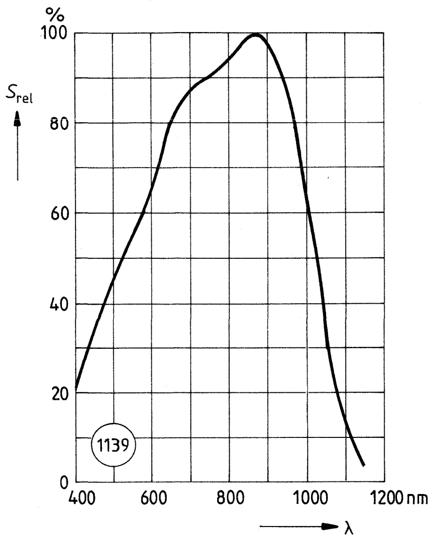
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	50	V
Total power dissipation (T_A = 25 °C)	P_{tot}	230	mW

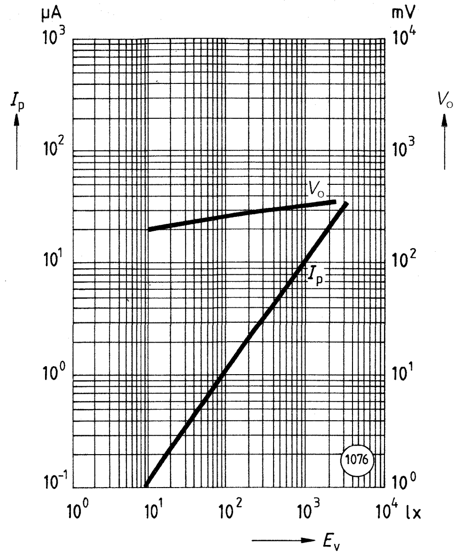
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	11 (≥5.5)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...1100	nm
Radiant sensitive area	A	0.97	mm^2
Dimension of radiant sensitive area	$L \times W$	0.985 × 0.985	mm
Distance chip surface to case surface	D	2.25...2.55	mm
Half angle	φ	±40	deg.
Dark current (V_R = 20 V)	I_R	1 (≤5)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Quantum yield (λ = 850 nm)	η	0.80	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	320 (≥270)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	10 (≥5.5)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 50 Ω, V_R = 5 V, λ = 880 nm, I_P = 15 µA)	t_r	30	ns
	t_f	80	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	11	pF
(V_R = 1 V, f = 1 MHz, E_v = 0 lx)	C_1	6.4	pF
(V_R = 20 V, f = 1 MHz, E_v = 0 lx)	C_{20}	2.4	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Noise equivalent power (V_R = 20 V)	NEP	3.3×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 20 V)	D^*	3.1×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

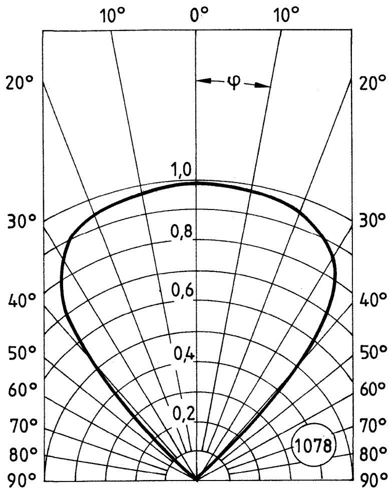
Relative spectral sensitivity versus wavelength



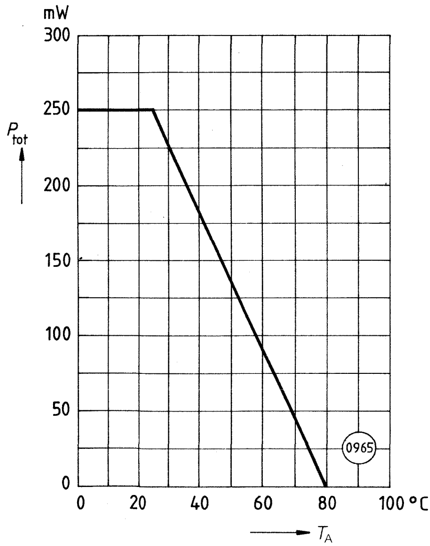
Photocurrent, open-circuit voltage versus illuminance



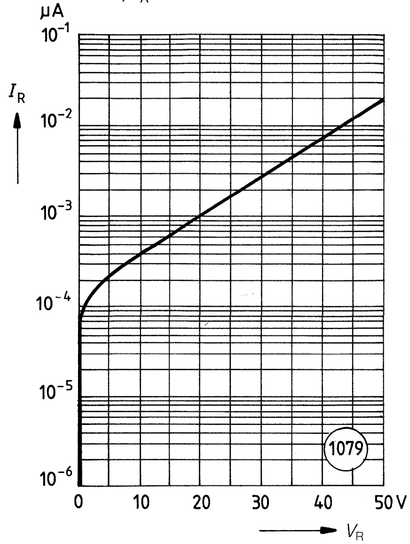
Directional characteristic Relative spectral sensitivity versus half angle



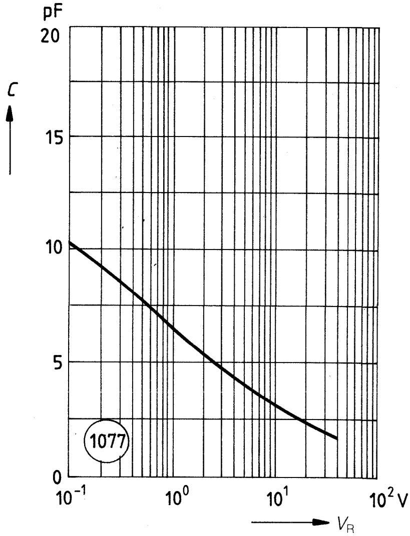
Total power dissipation versus ambient temperature



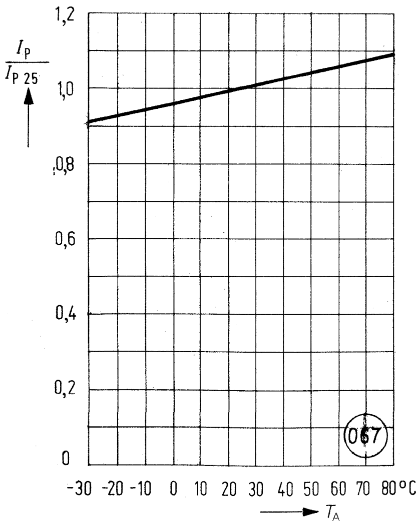
Dark current versus reverse voltage
$E = 0$; $T_A = 25\,°C$



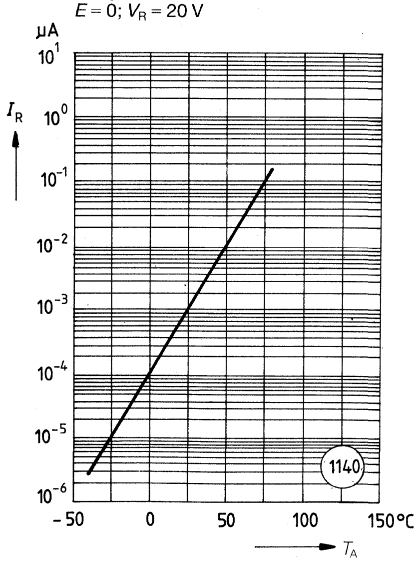
Junction capacitance versus reverse voltage
$E = 0$; measuring frequency $f = 1$ MHz



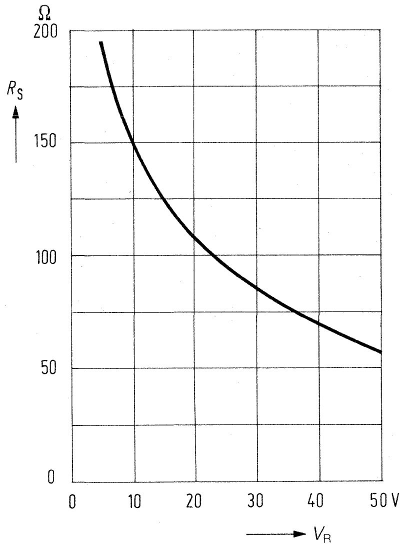
Photocurrent versus ambient temperature



Dark current versus ambient temperature
$E = 0$; $V_R = 20$ V



Series resistance versus reverse voltage
$E = 0$; measuring frequency $f = 100$ MHz



BPX 66 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

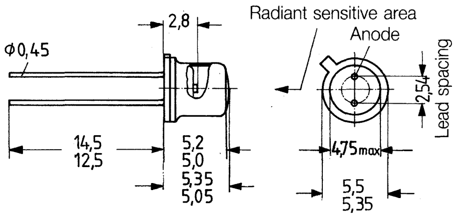
Package 18 A3 DIN 41870 (TO 18), flat glass lens, hermetically sealed package, solder tabs, lead spacing 2.54 mm (1/10").

Anode marking Projection at case bottom

Application Optical sensor of high modulation bandwidth.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
BPX 66	Q62702-P80

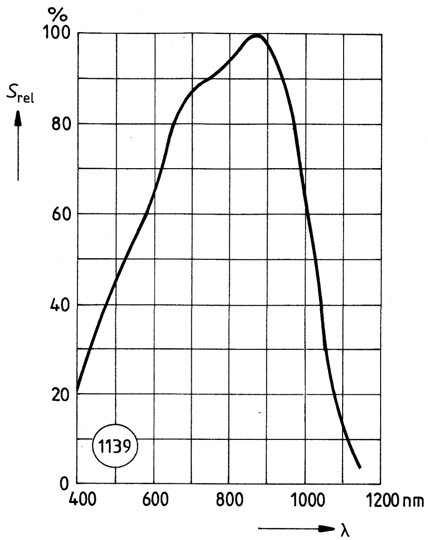
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	50	V
Total power dissipation (T_A = 25 °C)	P_{tot}	250	mW

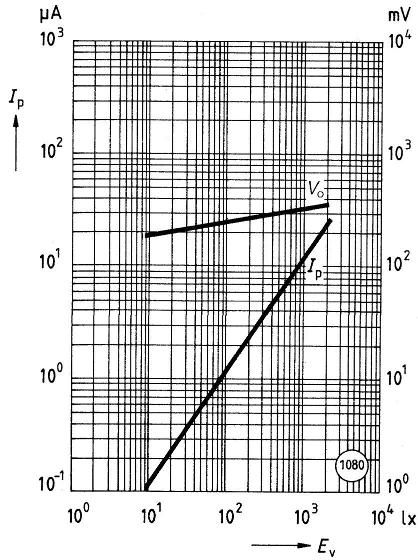
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	11 (≥5.5)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...1100	nm
Radiant sensitive area	A	0.97	mm^2
Dimension of radiant sensitive area	$L \times W$	0.985 × 0.985	mm
Distance chip surface to case surface	D	2.25...2.55	mm
Half angle	φ	±40	deg.
Dark current (V_R = 1 V)	I_R	0.15 (≤0.3)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Quantum yield (λ = 850 nm)	η	0.80	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	330 (≥280)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	10 (≥5.5)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 50 Ω, V_R = 5 V, λ = 880 nm, I_P = 10 µA)	t_r	30	ns
	t_f	80	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	11	pF
(V_R = 1 V, f = 1 MHz, E_v = 0 lx)	C_1	6.4	pF
(V_R = 20 V, f = 1 MHz, E_v = 0 lx)	C_{20}	2.4	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Noise equivalent power (V_R = 20 V)	NEP	3.3×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 20 V)	D^*	3.1×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

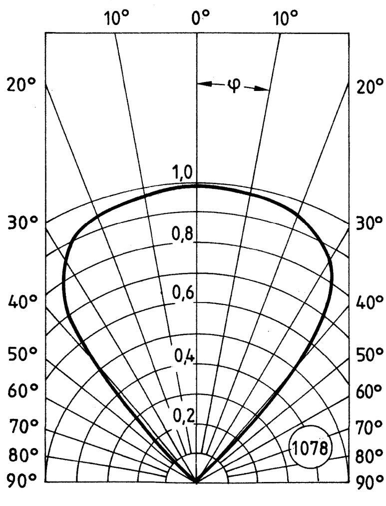
Relative spectral sensitivity versus wavelength



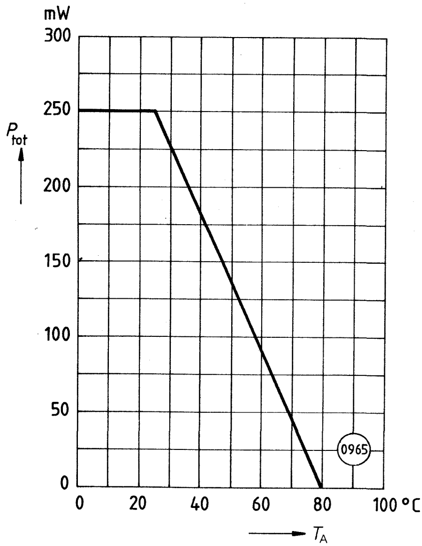
Photocurrent, open-circuit voltage versus illuminance



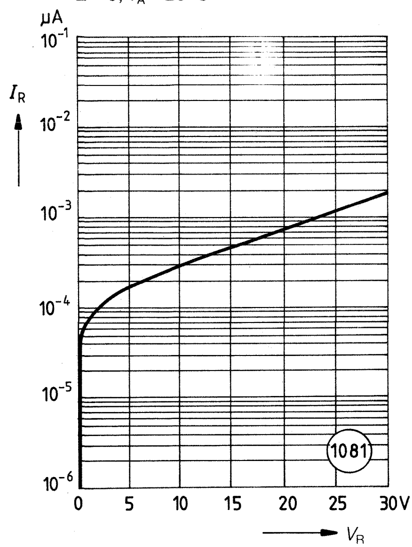
Directional characteristic
Relative spectral sensitivity versus half angle



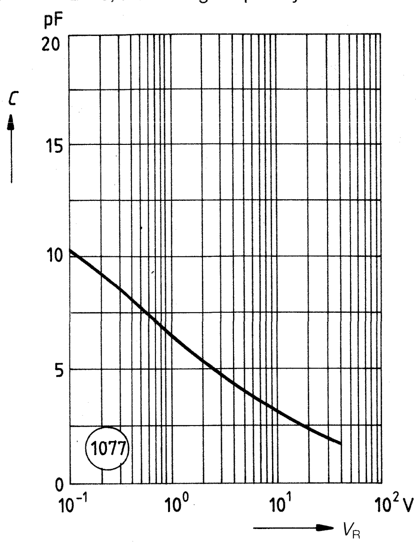
Total power dissipation versus ambient temperature



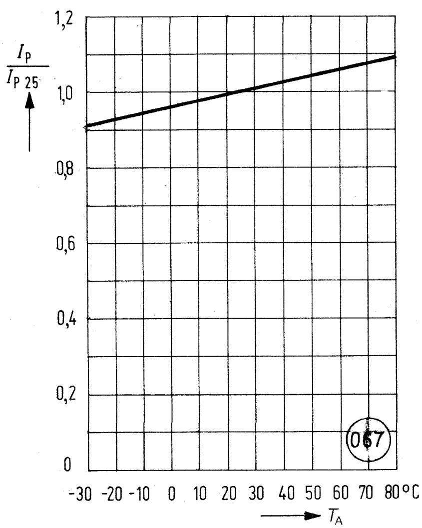
Dark current versus reverse voltage
$E = 0$; $T_A = 25\,°C$



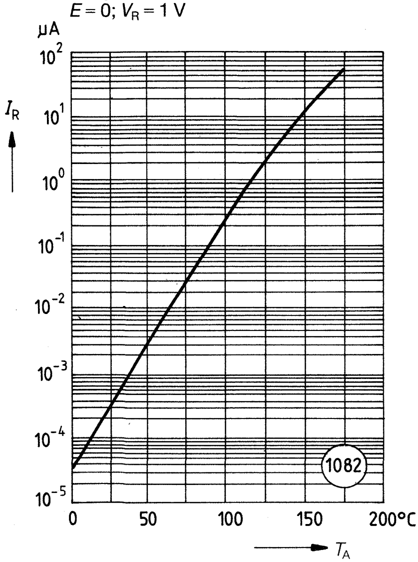
Junction capacitance versus reverse voltage
$E = 0$; measuring frequency $f = 1$ MHz



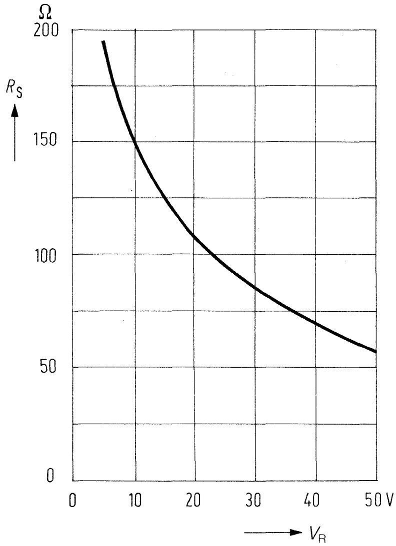
Photocurrent versus ambient temperature



Dark current versus ambient temperature
$E = 0$; $V_R = 1$ V



Series resistance versus reverse voltage
$E = 0$; measuring frequency $f = 100$ MHz



BPX 90 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

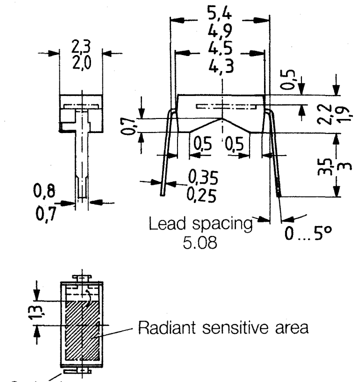
Package Lead frame, transparent epoxy resin, solder tabs, lead spacing 5.08 mm. For surface mounting the component is also available with gull-wing solder tabs (example: PB 104 BS).

Cathode marking Projection at solder tab

Application Industrial electronics, “measuring and controlling”.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.05 g
Dimensions in mm

Type	Ordering code
BPX 90	Q62702-P47

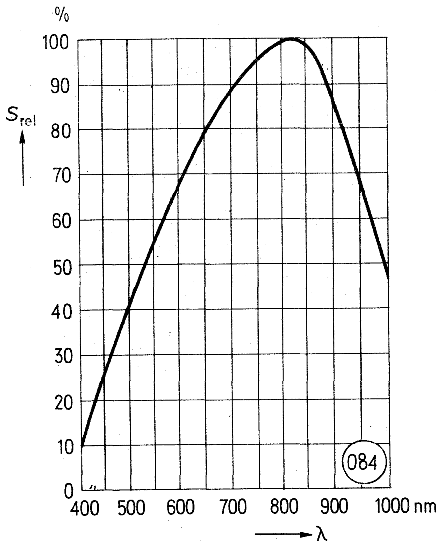
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	32	V
Total power dissipation (T_A = 25 °C)	P_{tot}	100	mW

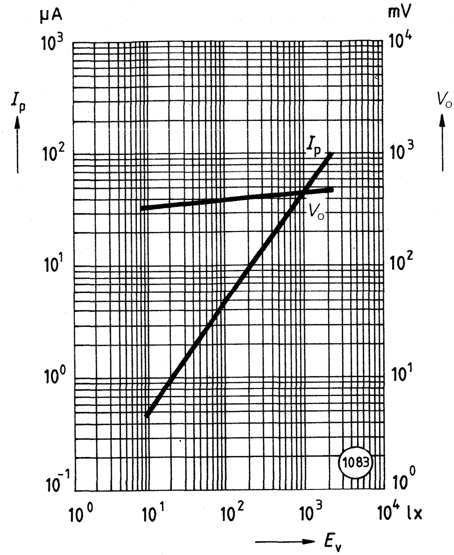
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	45 (≥25)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	5	mm^2
Dimension of radiant sensitive area	$L \times W$	1.65 × 3.05	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	5 (≤200)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.50	A/W
Quantum yield (λ = 850 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥380)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	45 (≥25)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 45 µA)	t_r, t_f	1.3	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	430	pF
(V_R = 10 V, f = 1 MHz, E_v = 0 lx)	C_{10}	100	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K

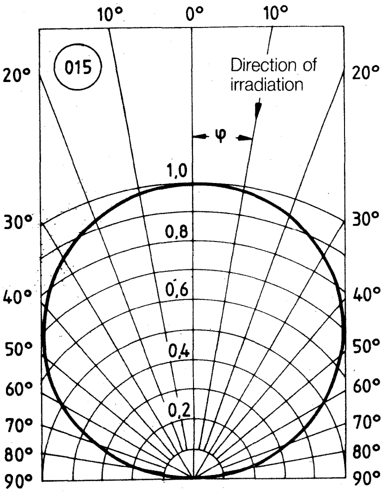
Relative spectral sensitivity versus wavelength



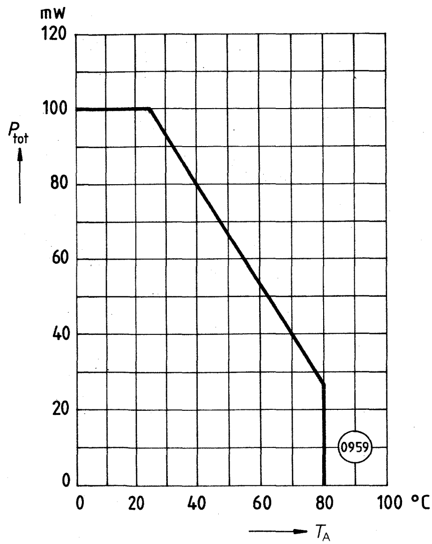
Photocurrent, open-circuit voltage versus illuminance



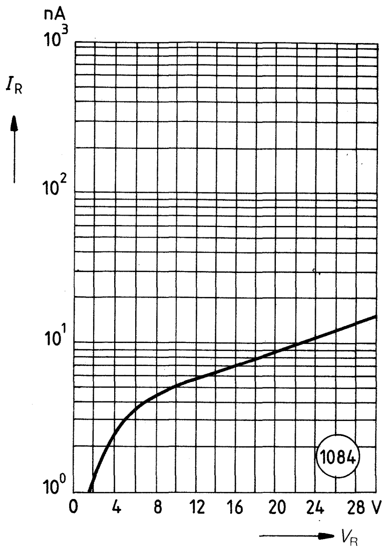
Directional characteristic
Relative spectral sensitivity versus half angle



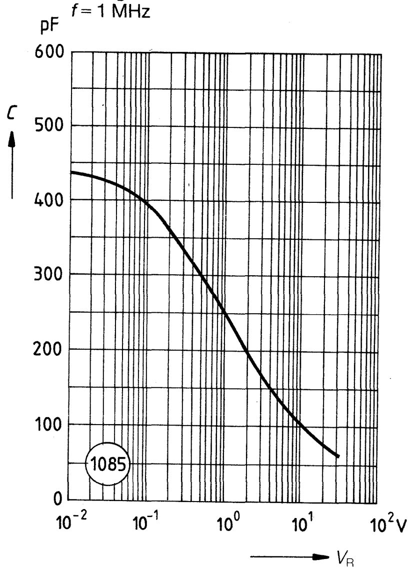
Total power dissipation versus ambient temperature



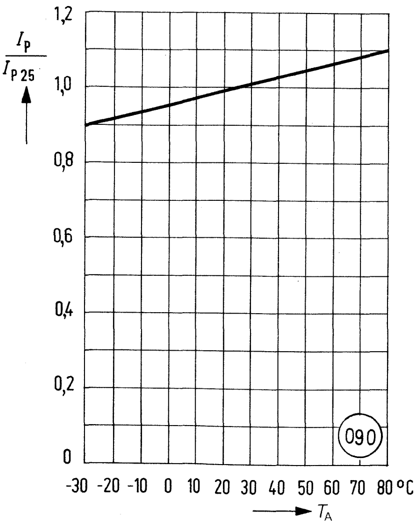
Dark current versus reverse voltage



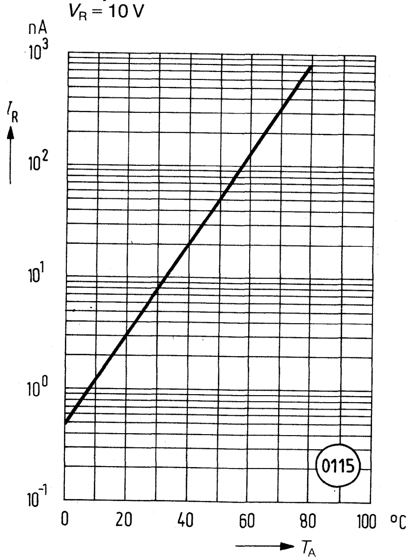
Capacitance versus reverse voltage
f = 1 MHz



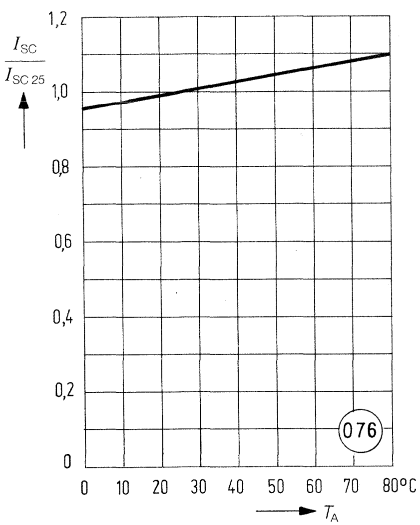
Photocurrent versus ambient temperature



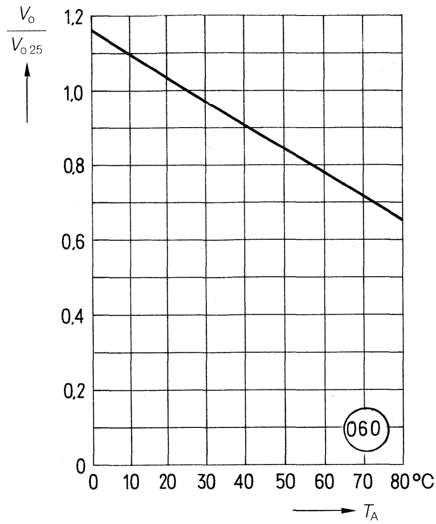
Dark current versus ambient temperature
V_R = 10 V



Short-circuit current versus ambient temperature



Open-circuit voltage versus ambient temperature



BPX 90 K is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

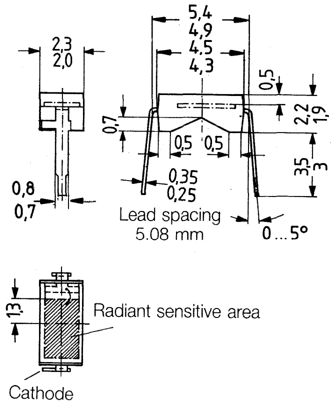
Package Lead frame, black epoxy resin, daylight filter, solder tabs, 5.08 mm lead spacing.
For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application Industrial electronics, “measuring and controlling”.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.05 g
Dimensions in mm

Type	Ordering code
BPX 90 K	Q62702-P928

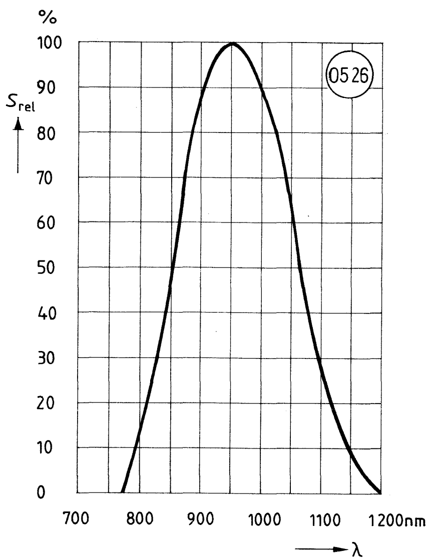
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	−40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	32	V
Total power dissipation (T_A = 25 °C)	P_{tot}	100	mW

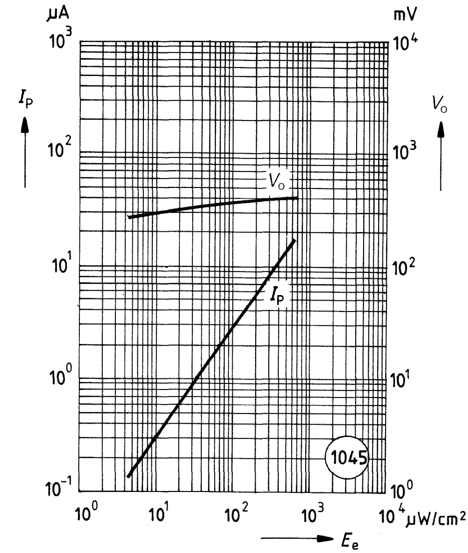
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm²)	S	13 (≥8)	μA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	950	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	800...1150	nm
Radiant sensitive area	A	5	mm²
Dimension of radiant sensitive area	$L \times W$	1.65 × 3.05	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	5 (≤200)	nA
Spectral sensitivity (λ = 950 nm)	S_λ	0.48	A/W
Quantum yield (λ = 950 nm)	η	0.62	Electrons / Photon
Open circuit voltage (E_e = 0.5 mW/cm²; λ = 950 nm)	V_o	400 (≥340)	mV
Short-circuit current (E_e = 0.5 mW/cm²; λ = 950 nm)	I_{SC}	13 (≥8)	μA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 30 μA)	t_r, t_f	1.3	μs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	430	pF
(V_R = 10 V, f = 1 MHz, E_v = 0 lx)	C_{10}	100	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K

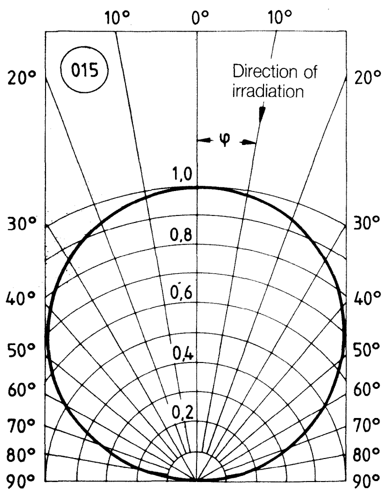
Relative spectral sensitivity versus wavelength



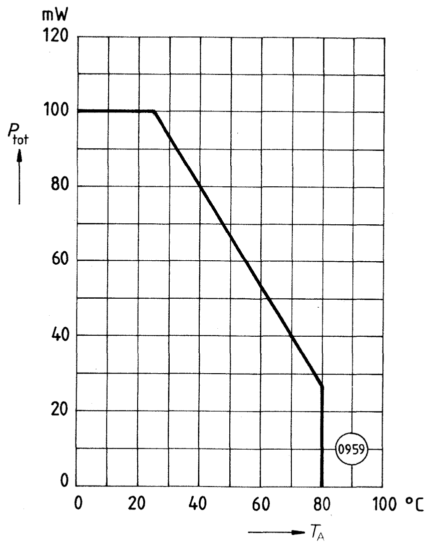
Photocurrent, open-circuit voltage versus irradiance



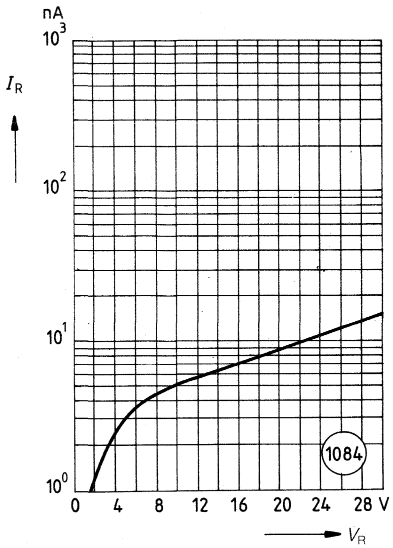
Directional characteristic
Relative spectral sensitivity versus half angle



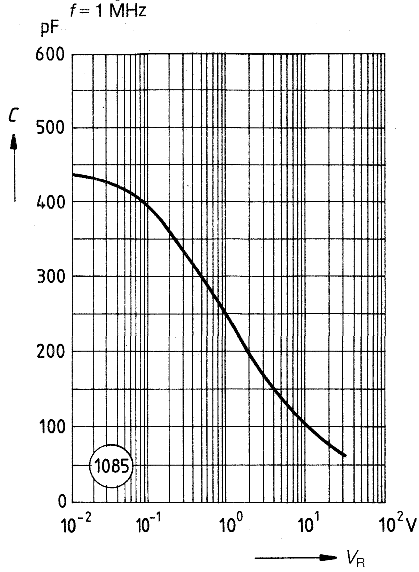
Total power dissipation versus ambient temperature



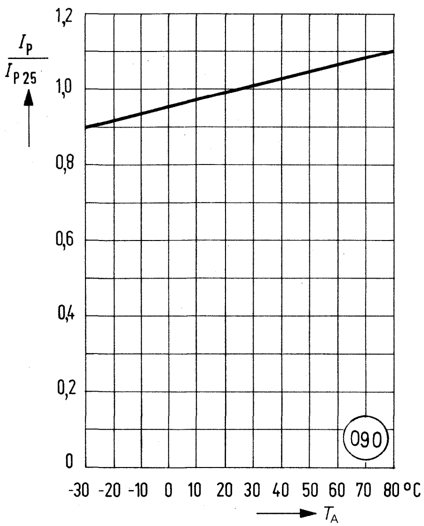
Dark current versus reverse voltage



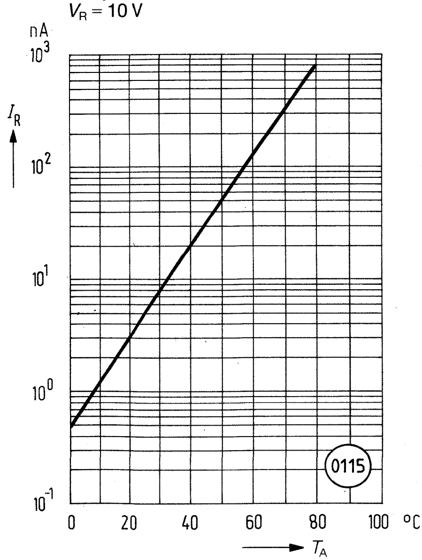
Capacitance versus reverse voltage
$f = 1$ MHz



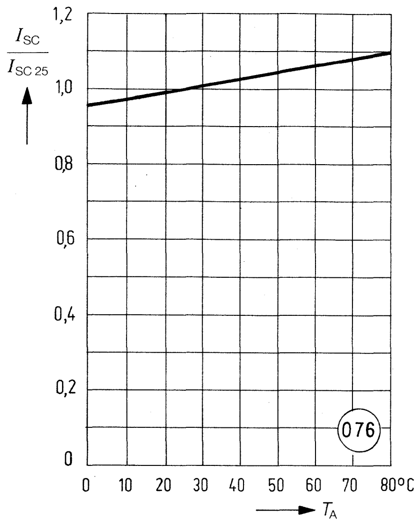
Photocurrent versus ambient temperature



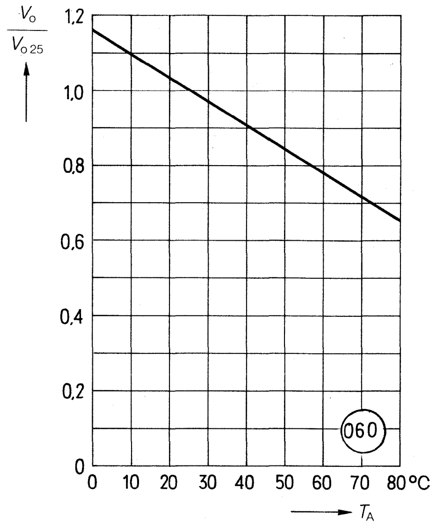
Dark current versus ambient temperature
$V_R = 10$ V



Short-circuit current versus ambient temperature



Open-circuit voltage versus ambient temperature



Silicon Photodiode with High Blue Sensitivity and Low Dark Current

BPX 91 B

BPX 91 B is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

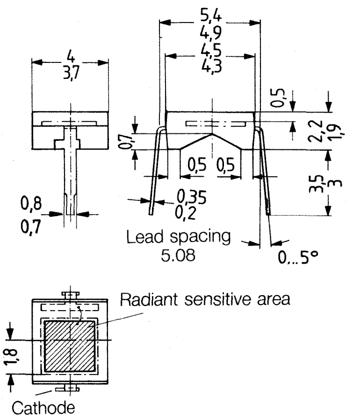
Package Lead frame, transparent epoxy resin, solder tabs, lead spacing 5.08 mm (2/10″).
For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application Exposure meters, automatic exposure timers, color analysis.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.1 g
Dimensions in mm

Type	Ordering code
BPX 91 B	Q62702-P48-S

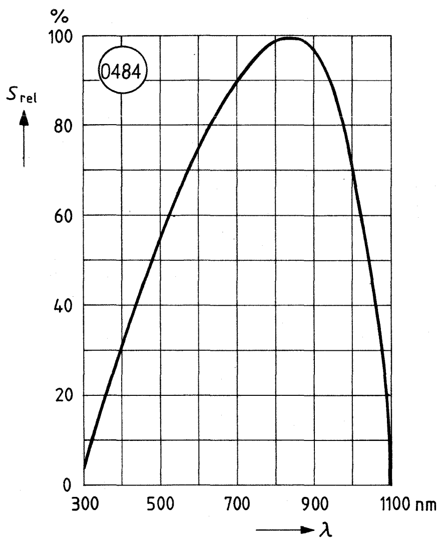
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	10	V
Total power dissipation (T_A = 25 °C)	P_{tot}	150	mW

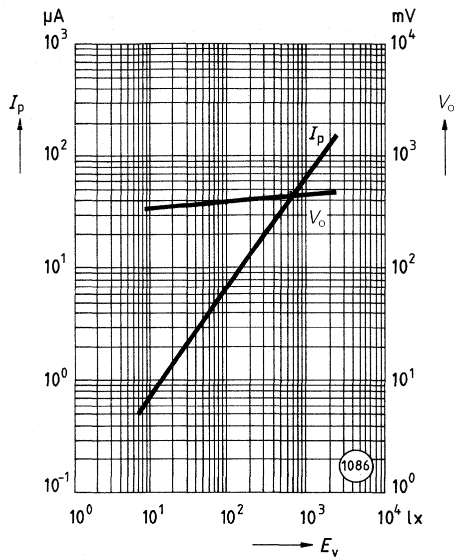
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	65 (≥35)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	320...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	7 (≤300)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.60	A/W
Quantum yield (λ = 850 nm)	η	0.86	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥380)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	65 (≥35)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 65 µA)	t_r, t_f	1.6	s
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	580	pF
(V_R = 10 V, f = 1 MHz, E_v = 0 lx)	C_{10}	180	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K

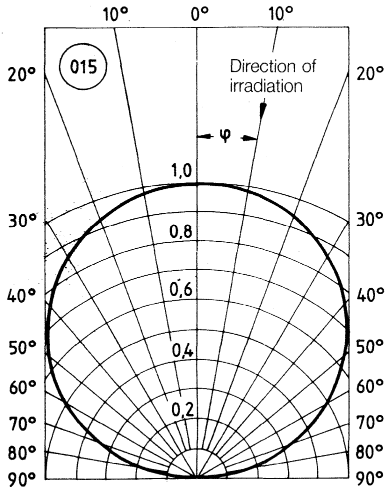
Relative spectral sensitivity versus wavelength



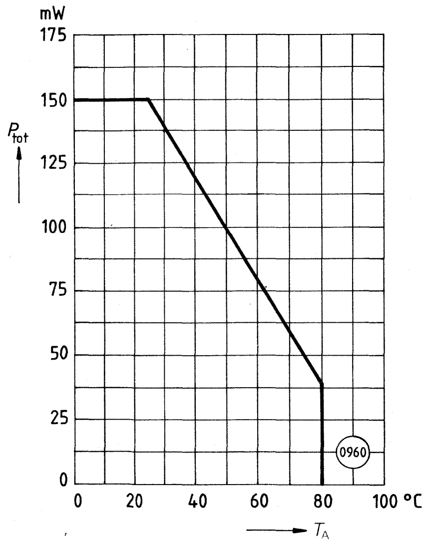
Photocurrent, open-circuit voltage versus illuminance



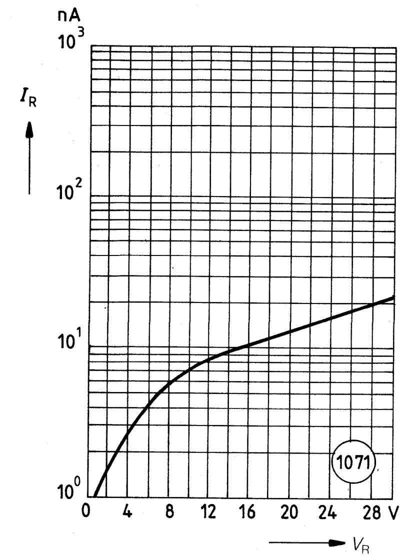
Directional characteristic
Relative spectral sensitivity versus half angle



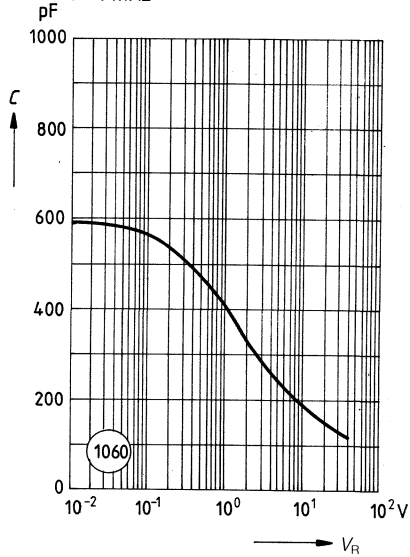
Total power dissipation versus ambient temperature



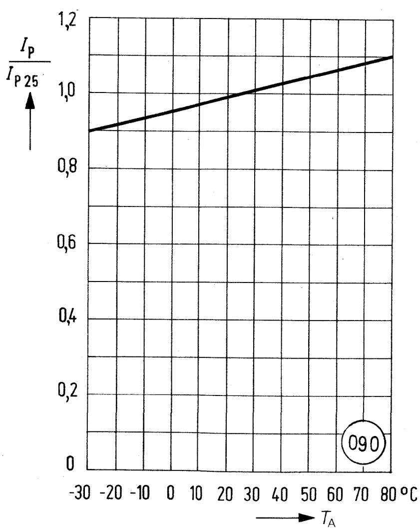
Dark current versus reverse voltage



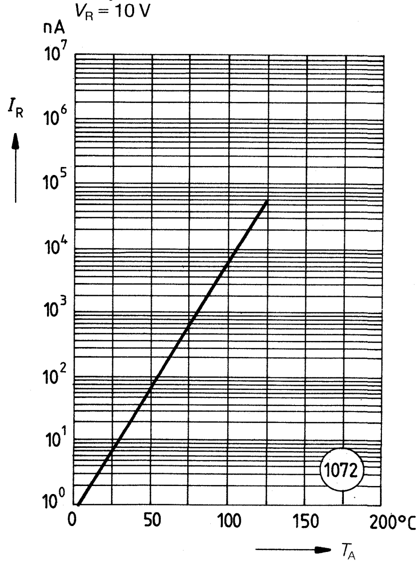
Capacitance versus reverse voltage
f = 1 MHz



Photocurrent versus ambient temperature



Dark current versus ambient temperature
V_R = 10 V



Silicon Photodiode

BPX 92

BPX 92 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

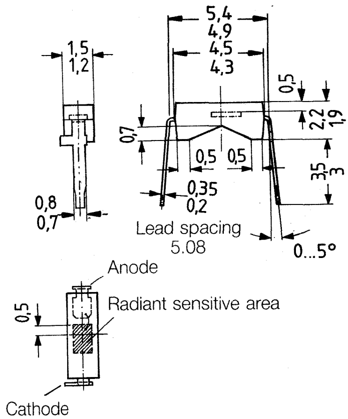
Package Lead frame, transparent epoxy resin, solder tabs, lead spacing 5.08 mm. For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application Industrial electronics, "measuring and controlling".

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.03 g
Dimensions in mm

Type	Ordering code
BPX 92	Q62702-P49

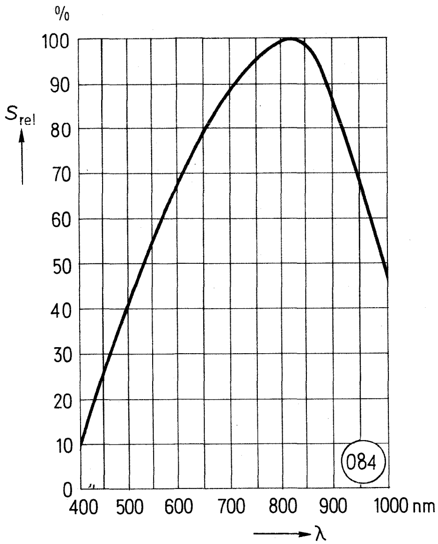
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	32	V
Total power dissipation (T_A = 25 °C)	P_{tot}	50	mW

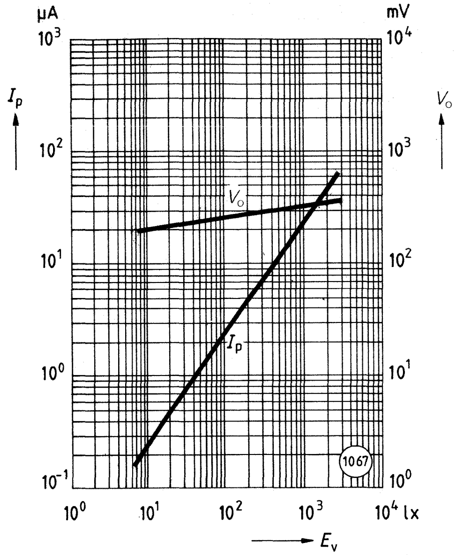
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	9.5 (≥4)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	1	mm^2
Dimension of radiant sensitive area	$L \times W$	0.82 × 1.27	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	1 (≤100)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.50	A/W
Quantum yield (λ = 850 nm)	η	0.73	Electrons / Photon
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	440 (≥370)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	9.5 (≥4)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 20 µA)	t_r, t_f	1.2	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	90	pF
(V_R = 10 V, f = 1 MHz, E_v = 0 lx)	C_{10}	23	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K

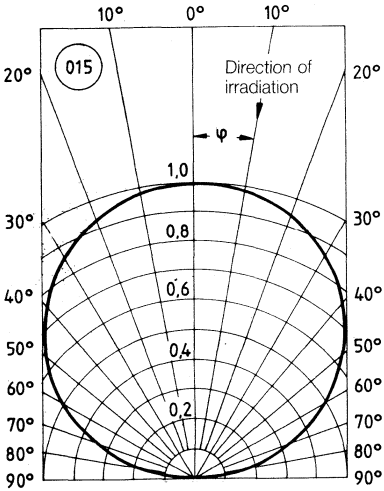
Relative spectral sensitivity versus wavelength



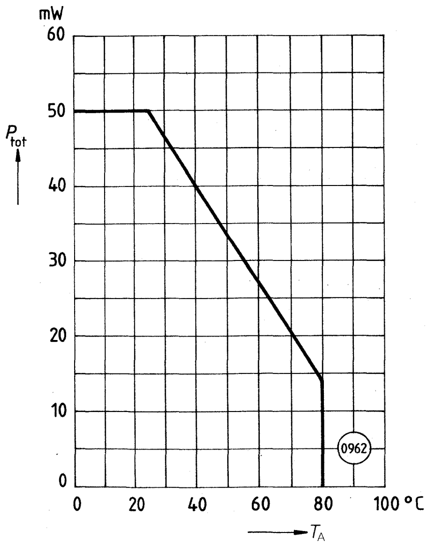
Photocurrent, open-circuit voltage versus illuminance



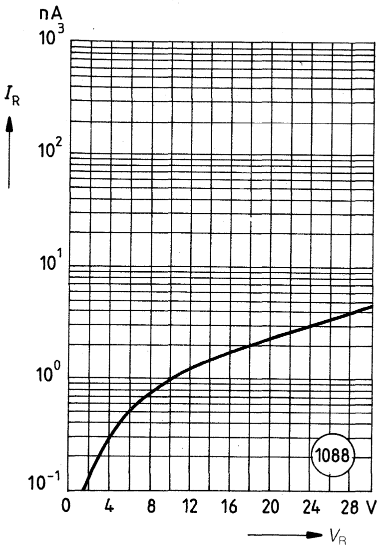
Directional characteristic Relative spectral sensitivity versus half angle



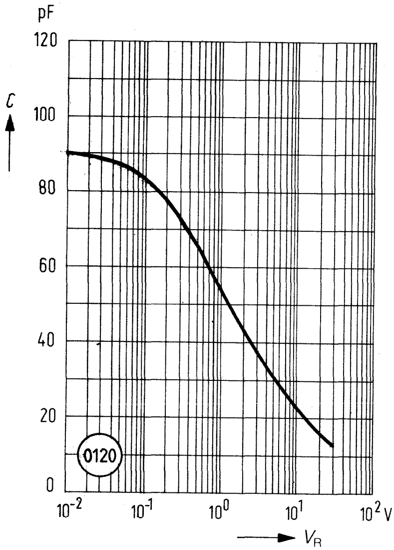
Total power dissipation versus ambient temperature



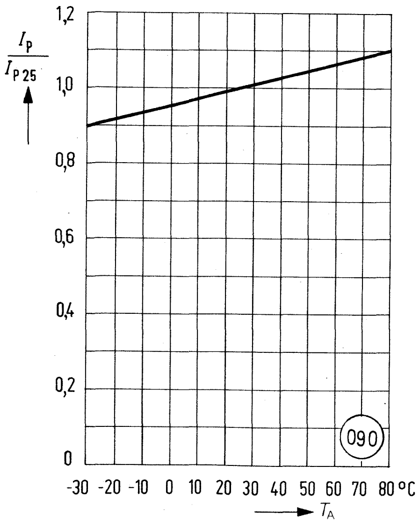
Dark current versus reverse voltage



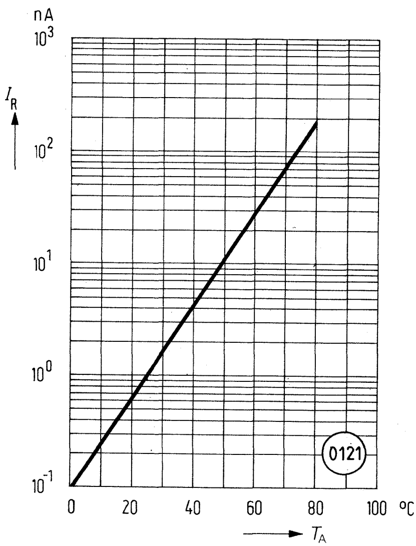
Capacitance versus reverse voltage



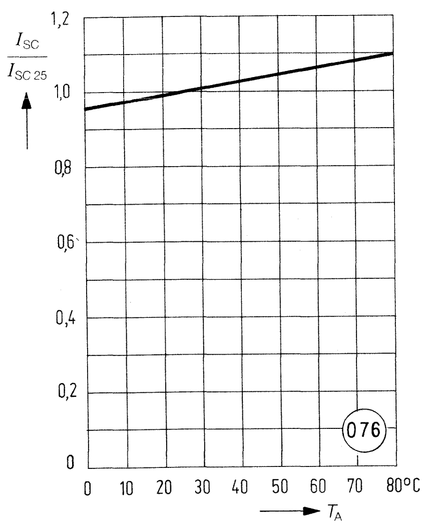
Photocurrent versus ambient temperature



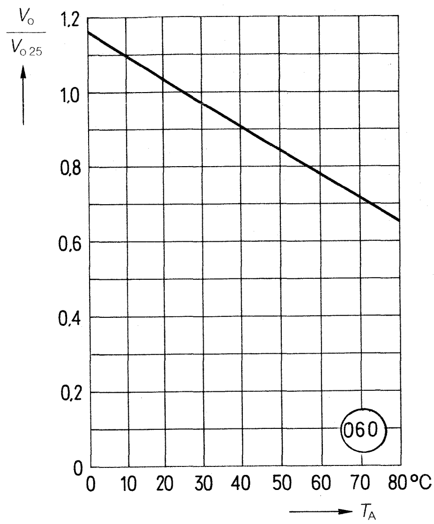
Dark current versus ambient temperature



Short-circuit current versus ambient temperature



Open-circuit voltage versus ambient temperature



Silicon PIN Photodiode

BPY 12

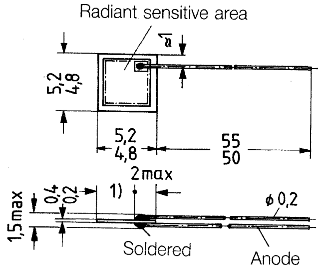
BPY 12 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

Package Silicon chip with 2 leads

Application Industrial electronics, "measuring and controlling"

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



1) Contact area 2.8 min

Approx. weight 0.15 g
Dimensions in mm

Type	Ordering code
BPY 12	Q62702-P9

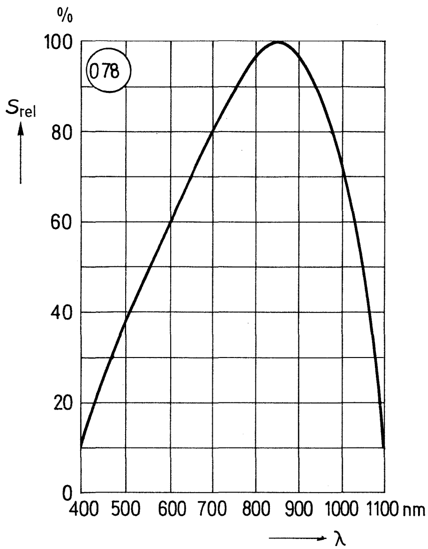
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–55...+100	°C
Reverse voltage	V_R	20	V
Total power dissipation (T_A = 25 °C)	P_{tot}	150	mW

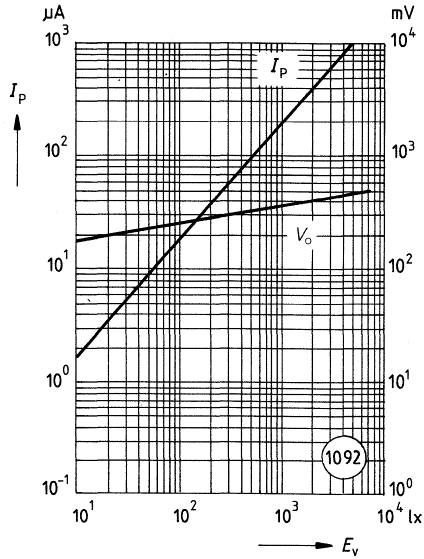
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	180 (≥100)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	20	mm^2
Dimension of radiant sensitive area	$L \times W$	4.47 × 4.47	mm
Half angle	φ	±60	deg.
Dark current (V_R = 20 V)	I_R	100 (≤1000)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.60	A/W
Quantum yield (λ = 850 nm)	η	0.86	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	365 (≥310)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	180 (≥100)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 150 µA)	t_r, t_f	2	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	140	pF
(V_R = 20 V, f = 1 MHz, E_v = 0 lx)	C_{20}	25	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.15	%/K
Noise equivalent power (V_R = 20 V)	NEP	3.0×10^{-13}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 20 V)	D^*	1.5×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

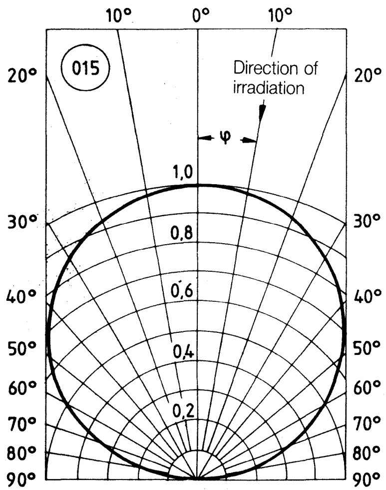
Relative spectral sensitivity versus wavelength



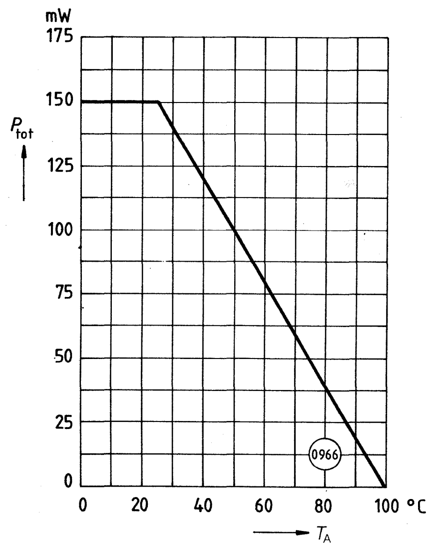
Photocurrent, open-circuit voltage versus illuminance



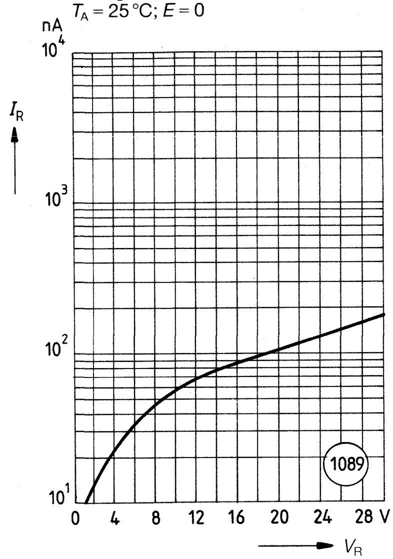
Directional characteristic
Relative spectral sensitivity versus half angle



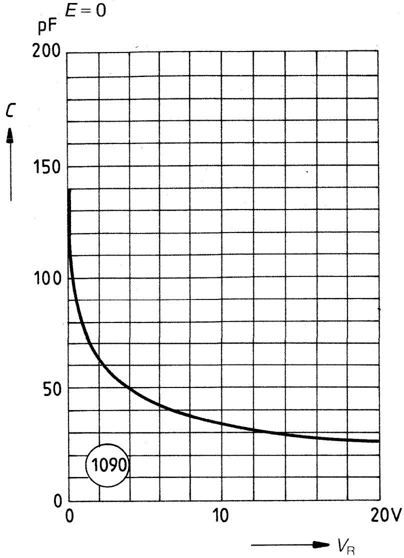
Total power dissipation versus ambient temperature



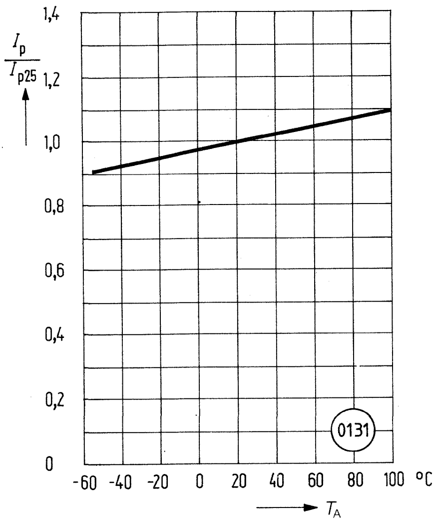
Dark current versus reverse voltage
$T_A = 25\,°C$; $E = 0$



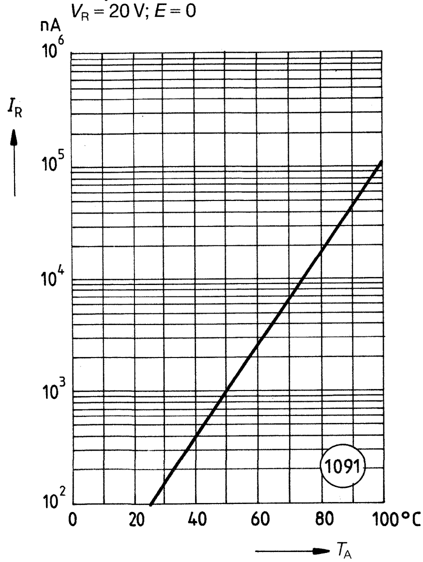
Capacitance versus reverse voltage
$E = 0$



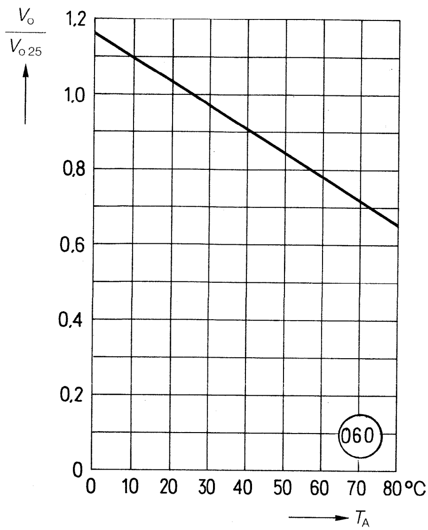
Photocurrent versus ambient temperature
$E = 0$



Dark current versus ambient temperature
$V_R = 20\,V$; $E = 0$



Open-circuit voltage versus ambient temperature



Silicon Photodiode with High Blue Sensitivity and Very Low Dark Current

SFH 100

SFH 100 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

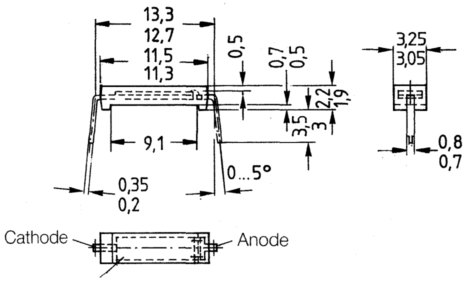
Package Lead frame, transparent epoxy resin, solder tabs, lead spacing 12.7 mm. For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application Exposure meters, industrial electronics, “measuring and controlling”

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Strong logarithmic relation between V_o or I_{SC} and illuminance of 10^{-2} to 10^{5} lx
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.15 g

Dimensions in mm

Type	Ordering code
SFH 100	Q62702-F595

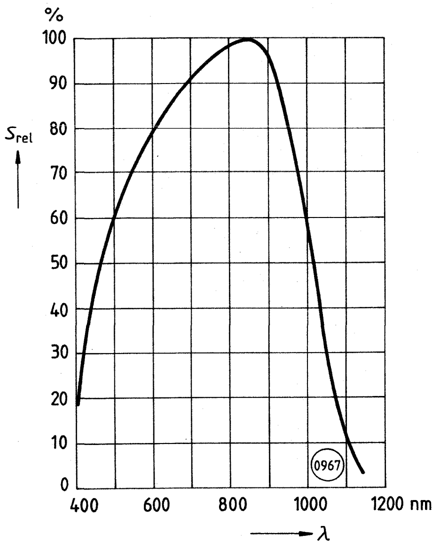
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	7	V
Total power dissipation (T_A = 25 °C)	P_{tot}	100	mW

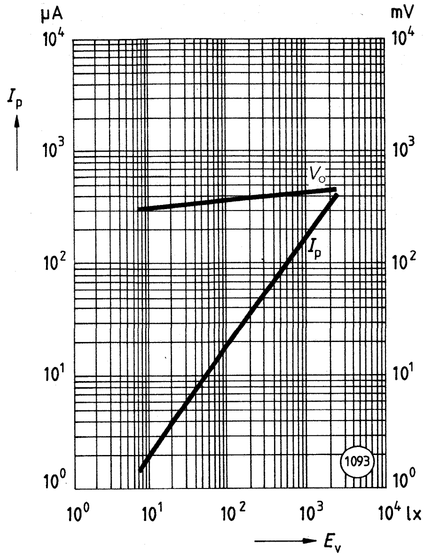
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	175 (≥150)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	300...1000	nm
Radiant sensitive area	A	23.5	mm^2
Dimension of radiant sensitive area	$L \times W$	8.7 × 2.7	mm
Distance chip surface to case top edge	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 7 V)	I_R	0.4 (≤10)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.5	A/W
Quantum yield (λ = 850 nm)	η	0.88	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	430 (≥350)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	175 (≥150)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 200 µA)	t_r, t_f	1.8	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	1000	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K

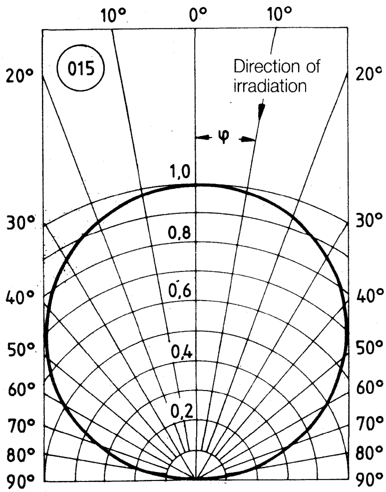
Relative spectral sensitivity versus wavelength



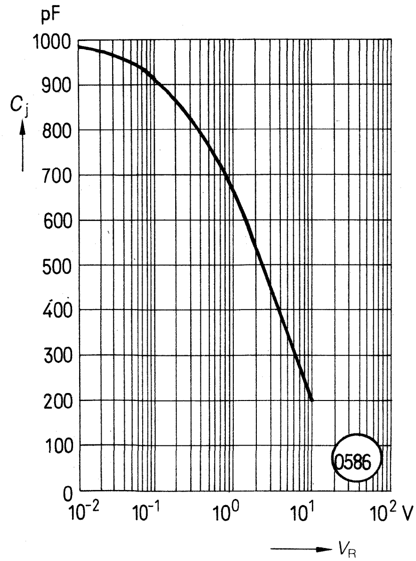
Photocurrent, open-circuit voltage versus illuminance



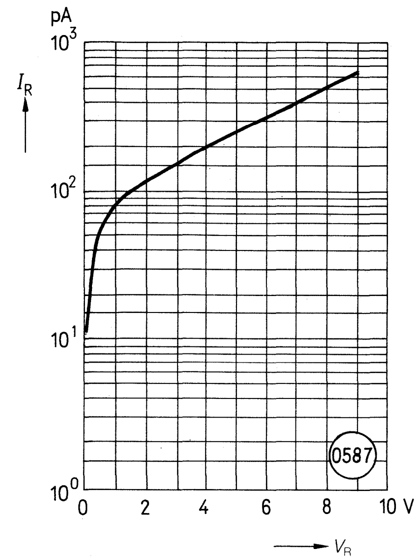
Directional characteristic Relative spectral sensitivity versus half angle



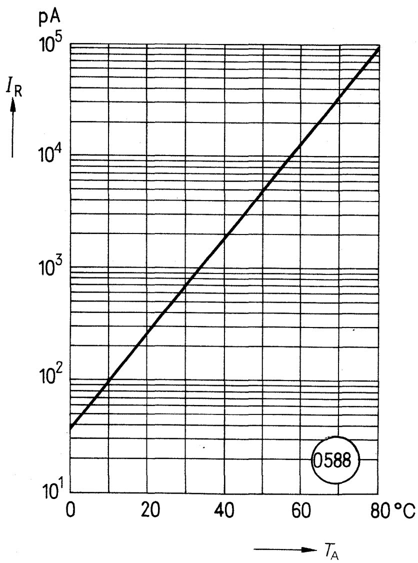
Junction capacitance versus reverse voltage



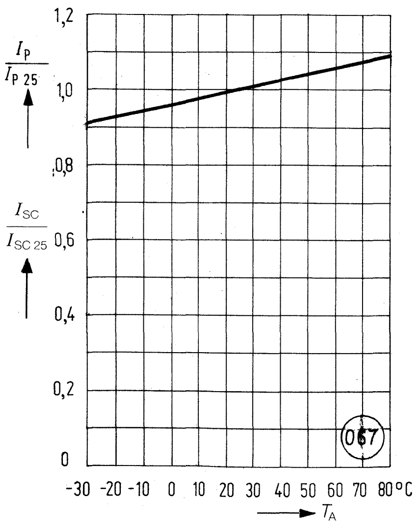
Dark current versus reverse voltage



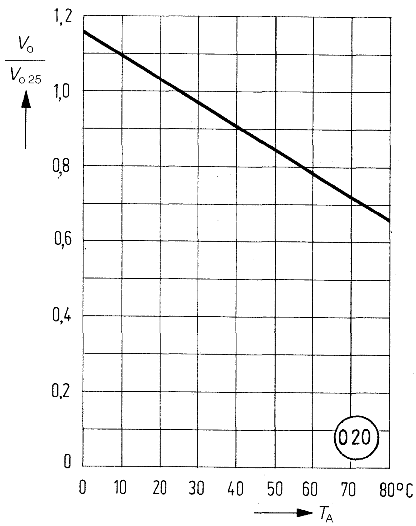
Dark current versus ambient temperature



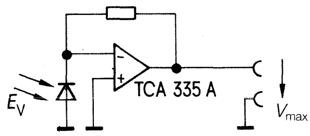
Photocurrent, short-circuit current versus ambient temperature



Open-circuit voltage versus ambient temperature



Circuit diagram



$$R = \frac{V_{max}}{I_{SC\,max}}$$

$$I_{SC\,max} = E_{V\,max} \times 175$$
$(E_{V\,max}$ in Lux $\rightarrow I_{V\,max}$ in nA)

A type with low input current should be used as operational amplifier.

Silicon Photodiode with a Very Large Zero-Crossover SFH 200

SFH 200 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

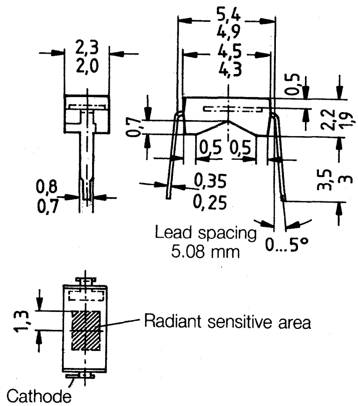
Package Lead frame, transparent epoxy resin, solder tabs, lead spacing 5.08 mm (2/10″).
For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab

Application Exposure meter, industrial electronics, "measuring and controlling"

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.05 g
Dimensions in mm

Type	Ordering code
SFH 200	Q62702-P86

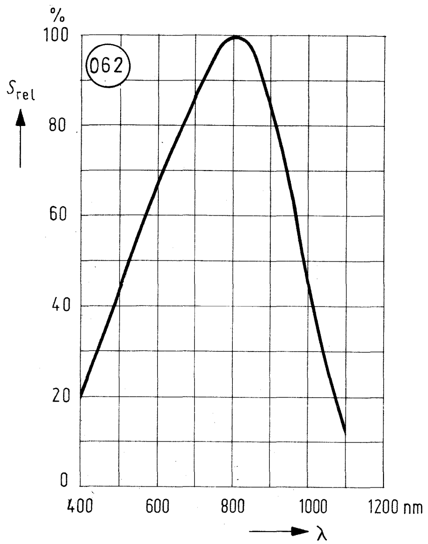
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	1	V
Total power dissipation (T_A = 25 °C)	P_{tot}	100	mW

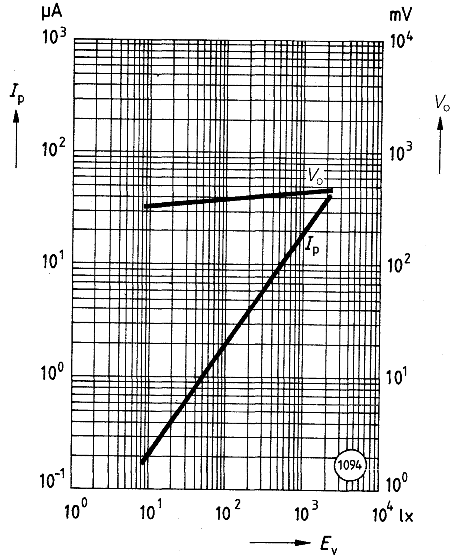
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	20 (≥14)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	800	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...1100	nm
Radiant sensitive area	A	2	mm^2
Dimension of radiant sensitive area	$L \times W$	1 × 2	mm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 1 V)	I_R	5 (≤40)	pA
Spectral sensitivity (λ = 850 nm)	S_λ	0.5	A/W
Zero crossover (E_e = 0; T_A = 40 °C)	S_0	≤1	mV/pA
Quantum yield (λ = 800 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥380)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	20 (≥14)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 20 µA)	t_r, t_f	1.5	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	180	pF
(V_R = 3 V, f = 1 MHz, E_v = 0 lx)	C_3	70	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K

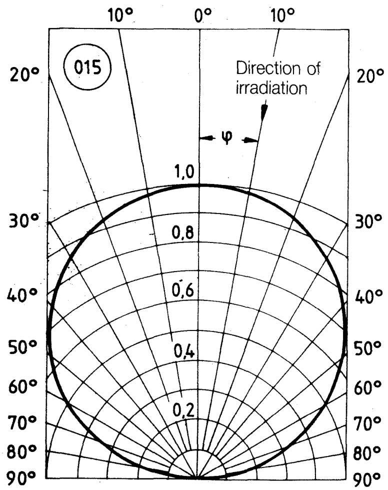
Relative spectral sensitivity versus wavelength



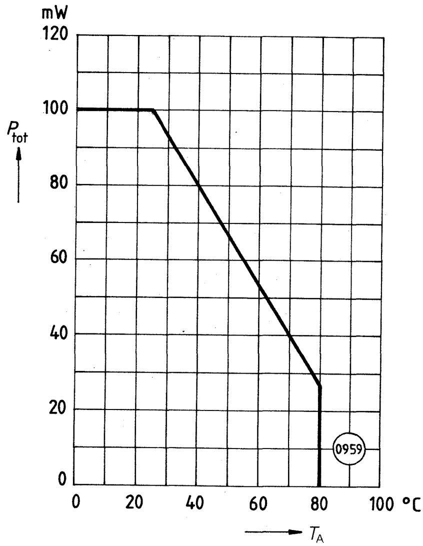
Photocurrent, open-circuit voltage versus illuminance



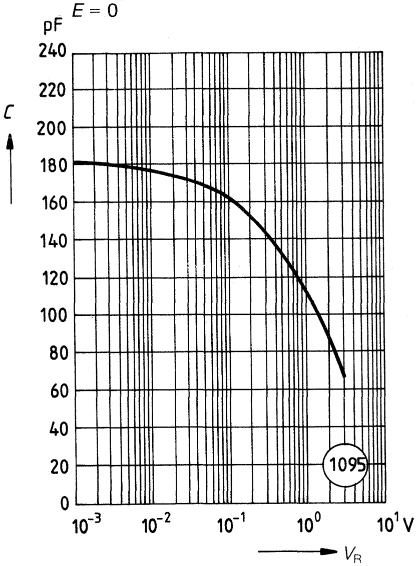
Directional characteristic
Relative spectral sensitivity versus half angle



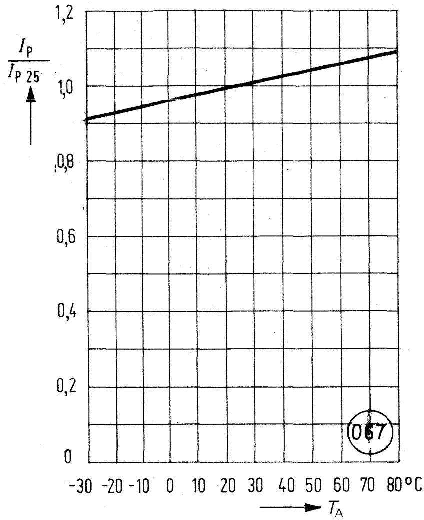
Total power dissipation versus ambient temperature



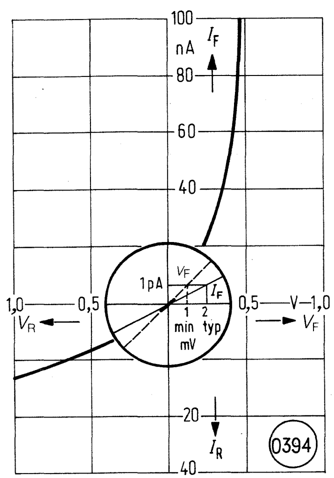
Capacitance versus reverse voltage
$E = 0$



Photocurrent versus ambient temperature



Zero crossover



SFH 204 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

Package Lead frame, transparent epoxy resin, solder tabs, lead spacing 5.08 mm (2⁄10″).
For surface mounting the component is also available with gull-wing solder tabs (example: BP 104 BS).

Cathode marking Projection at solder tab, notch at case surface

Application Follow-up control, edge drive, positioning, path and corner scanning, industrial electronics, “measuring and controlling”.

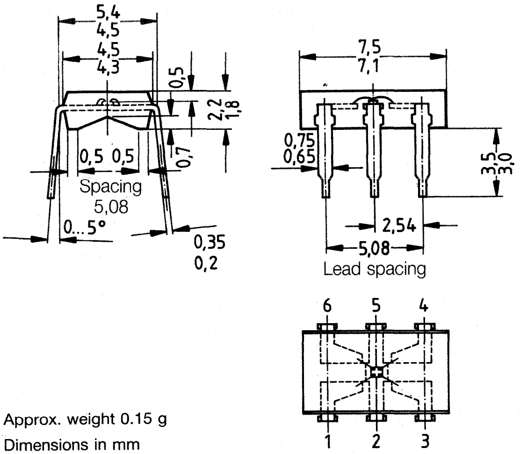
Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range

Type	Ordering code
SFH 204	Q62702-P89

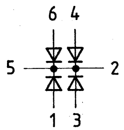
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	12	V
Total power dissipation (T_A = 25 °C)	P_{tot}	40	mW

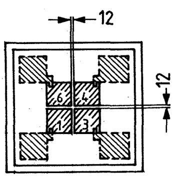


Approx. weight 0.15 g
Dimensions in mm

Pin diagram



Diode system with
radiant sensitive areas

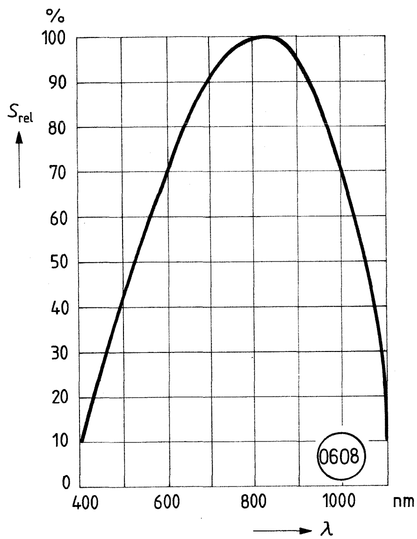


Dimension in µm

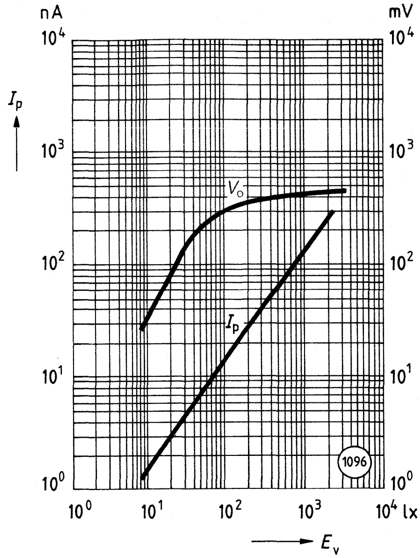
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	0.13 (≥0.08)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	4 × 0.01	mm^2
Dimension of radiant sensitive area	$L \times W$	100 × 100	µm
Distance chip surface to case surface	D	0.5	mm
Half angle	φ	±60	deg.
Dark current (V_R = 10 V)	I_R	0.1 (≤2)	nA
Spectral sensitivity (λ = 950 nm)	S_λ	>0.35	A/W
Max. deviation of the spectral sensitivity of the systems from the mean value	Δ_s	±10	%
Quantum yield (λ = 950 nm)	η	0.45	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	450 (≥380)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	130 (≥80)	nA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 10 µA)	t_r, t_f	3	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	2.0	pF
(V_R = 10 V, f = 1 MHz, E_v = 0 lx)	C_{10}	1.0	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K

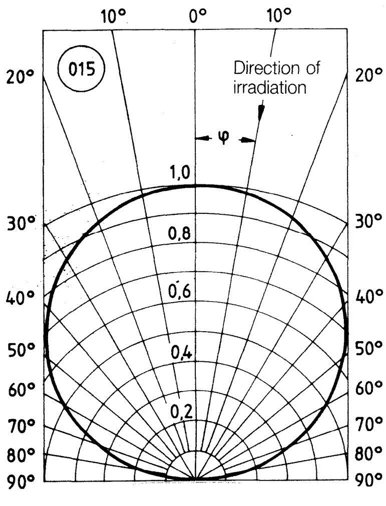
Relative spectral sensitivity versus wavelength



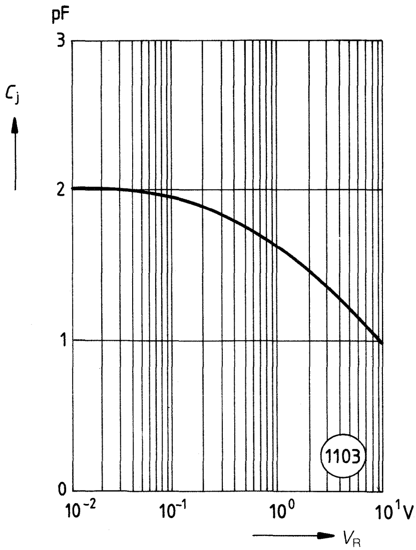
Photocurrent, open-circuit voltage versus illuminance



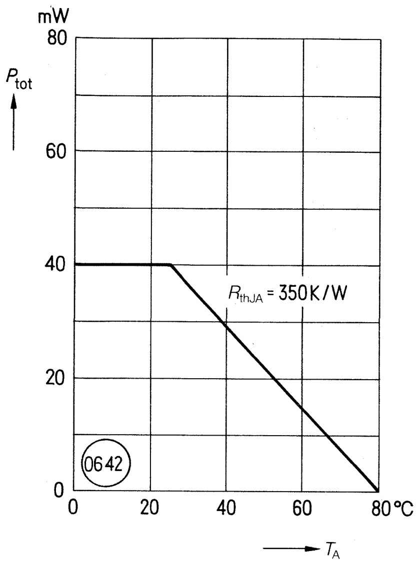
Directional characteristic
Relative spectral sensitivity versus half angle



Junction capacitance versus reverse voltage



Total power dissipation versus ambient temperature



SFH 205 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

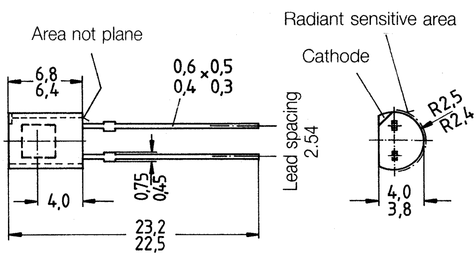
Package 10 A3 DIN 41868 (similar to TO-92), black epoxy resin, daylight filter solder tabs, lead spacing 2.54 mm (1/10″).

Cathode marking Notch at case

Application IR-remote control of hi-fi and TV sets, video tape recorders, dimmers, remote control of various equipment, light-reflecting switches for steady and varying intensity.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the near infrared range



Approx. weight 0.25 g
Dimensions in mm

Type	Ordering code
SFH 205	Q62702-P102

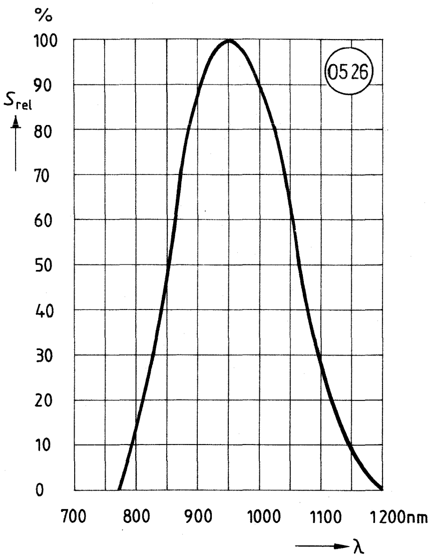
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	20	V
Total power dissipation (T_A = 25 °C)	P_{tot}	150	mW

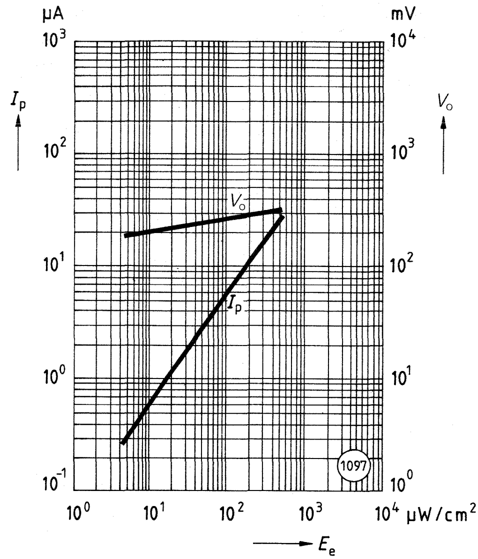
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm^2)	S	25 (≥15)	µA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	950	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	800...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	2.3...2.5	mm
Half angle	φ	±70	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 950 nm)	S_λ	0.68	A/W
Quantum yield (λ = 950 nm)	η	0.90	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_e = 0.5 mW/cm^2; λ = 950 nm)	V_o	327 (≥250)	mV
Short-circuit current (E_e = 0.5 mW/cm^2; λ = 950 nm)	I_{SC}	25 (≥15)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 25 µA)	t_r, t_f	350	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	72	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	3.7×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	7.3×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

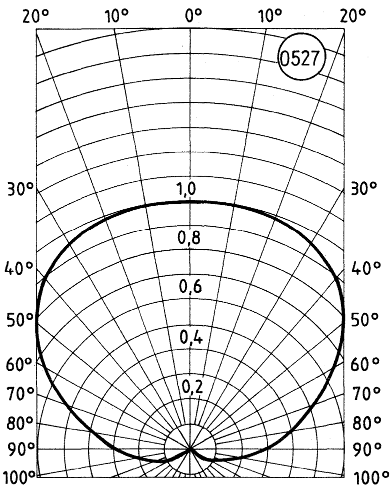
Relative spectral sensitivity versus wavelength



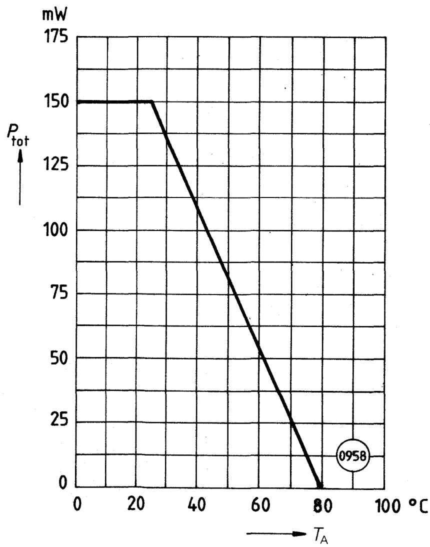
Photocurrent, open-circuit voltage versus irradiance



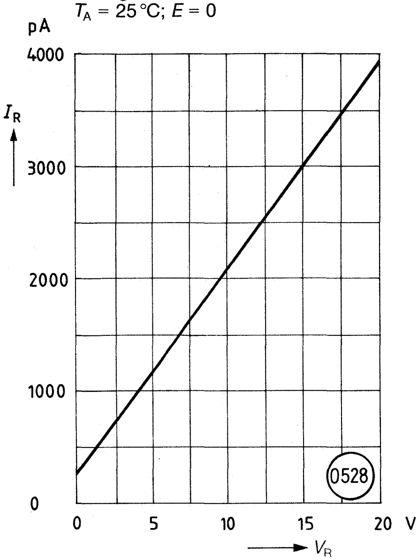
Directional characteristic
Relative spectral sensitivity versus half angle



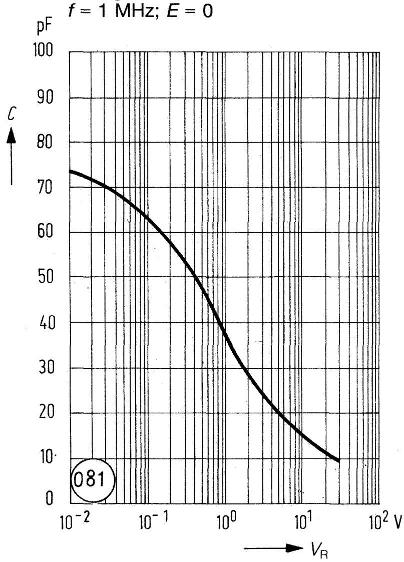
Total power dissipation versus ambient temperature



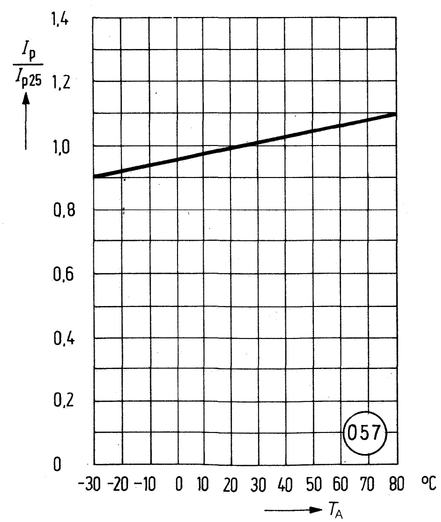
Dark current versus reverse voltage
T_A = 25 °C; E = 0



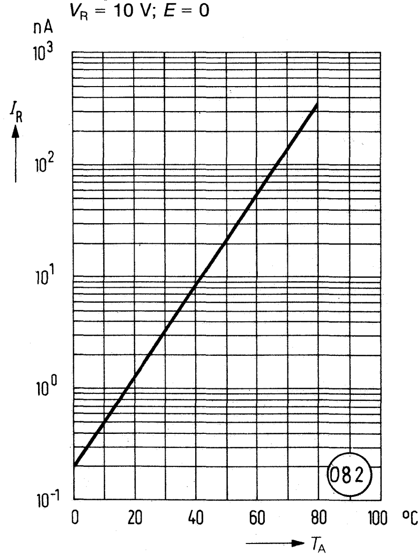
Capacitance versus reverse voltage
f = 1 MHz; E = 0



Photocurrent versus ambient temperature



Dark current versus ambient temperature
V_R = 10 V; E = 0



SFH 205 Q2 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

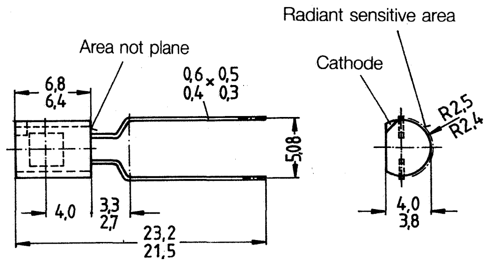
Package 10 A3 DIN 41868 (similar to TO-92), black epoxy resin, daylight filter, solder tabs, lead spacing 5.08 mm (2/10″).

Cathode marking Notch at case

Application IR-remote control of hi-fi and TV sets, video tape recorders, dimmers, remote control for various equipment, light-reflecting switches for steady and varying intensity.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the near infrared range



Approx. weight 0.25 g
Dimensions in mm

Type	Ordering code
SFH 205 Q2	Q62702-P896

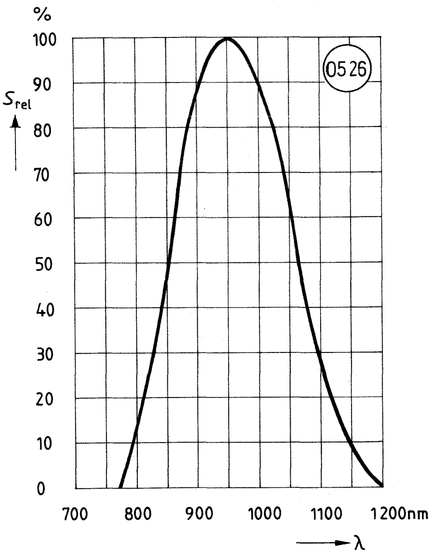
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	20	V
Total power dissipation (T_A = 25 °C)	P_{tot}	150	mW

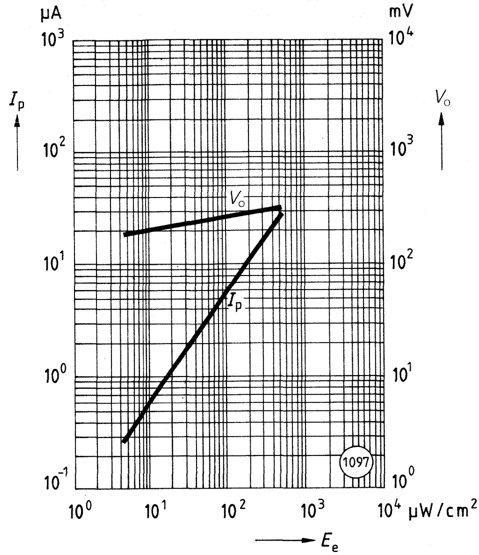
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm^2)	S	25 (≥15)	µA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	950	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	800...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	2.3...2.5	mm
Half angle	φ	±70	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 950 nm)	S_λ	0.68	A/W
Quantum yield (λ = 950 nm)	η	0.90	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_e = 0.5 mW/cm^2; λ = 950 nm)	V_o	327 (≥250)	mV
Short-circuit current (E_e = 0.5 mW/cm^2; λ = 950 nm)	I_{SC}	25 (≥15)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 25 µA)	t_r, t_f	350	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	72	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	3.7×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	7.3×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

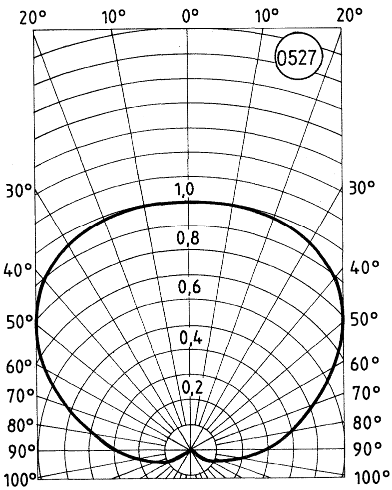
Relative spectral sensitivity versus wavelength



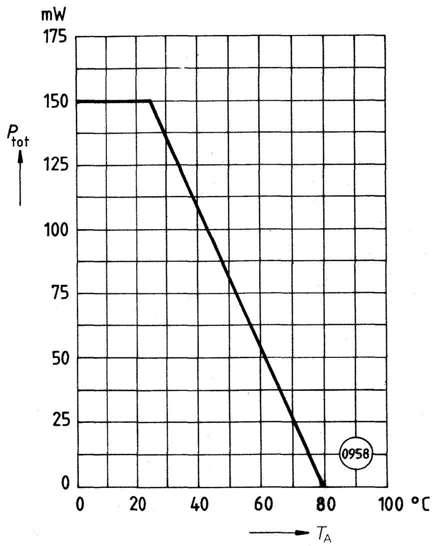
Photocurrent, open-circuit voltage versus irradiance λ = 950 nm



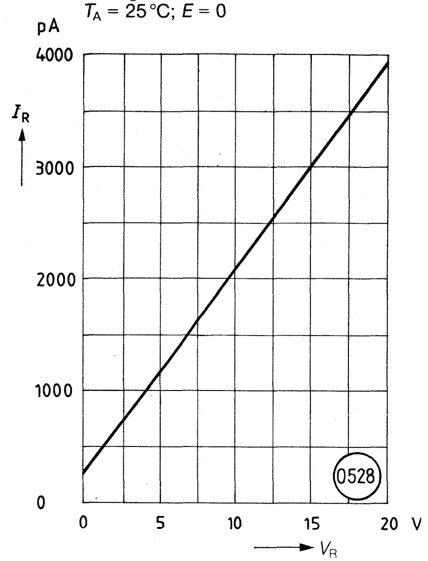
Directional characteristic
Relative spectral sensitivity versus half angle



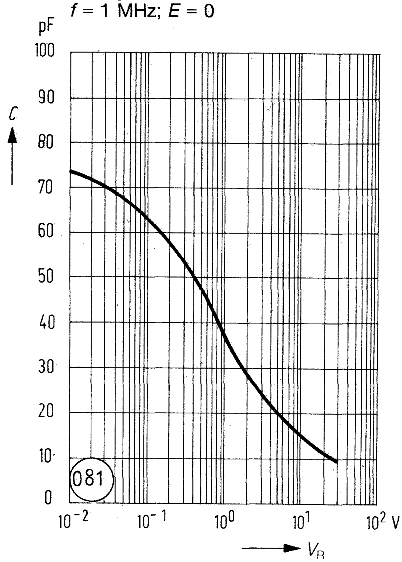
Total power dissipation versus ambient temperature



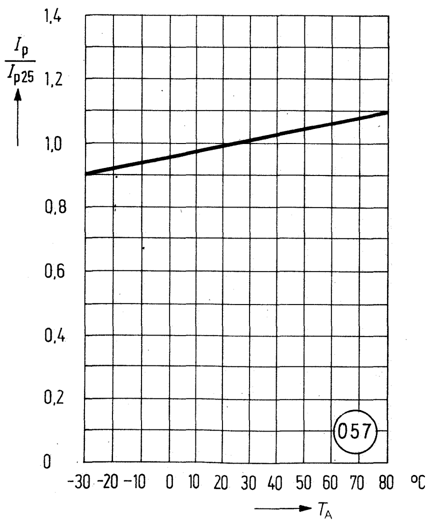
Dark current versus reverse voltage
T_A = 25 °C; E = 0



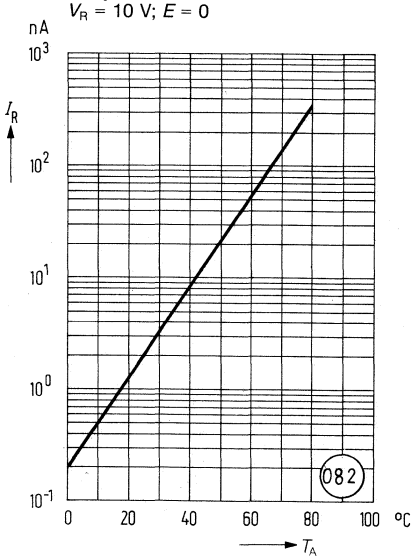
Capacitance versus reverse voltage
f = 1 MHz; E = 0



Photocurrent versus ambient temperature



Dark current versus ambient temperature
V_R = 10 V; E = 0



Silicon PIN Photodiode with Daylight Filter SFH 206

SFH 206 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

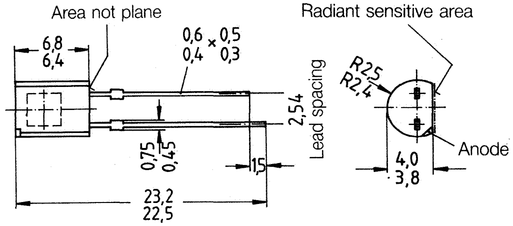
Package 10 A3 DIN 41868 (similar to TO-92), black epoxy resin, daylight filter, solder tabs, lead spacing 2.54 mm (1/10″).

Anode marking Notch at case

Application IR-remote control of hi-fi and TV sets, video tape recorders, dimmers, remote control of various equipment, light-reflecting switches for steady and varying intensity.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the near infrared range



Approx. weight 0.25 g
Dimensions in mm

Type	Ordering code
SFH 206	Q62702-P128

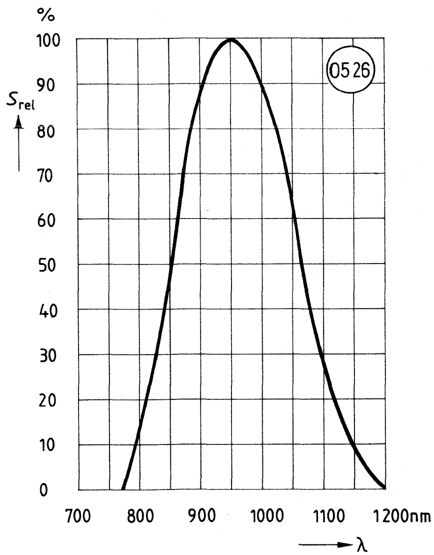
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	−40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	20	V
Total power dissipation (T_A = 25 °C)	P_{tot}	150	mW

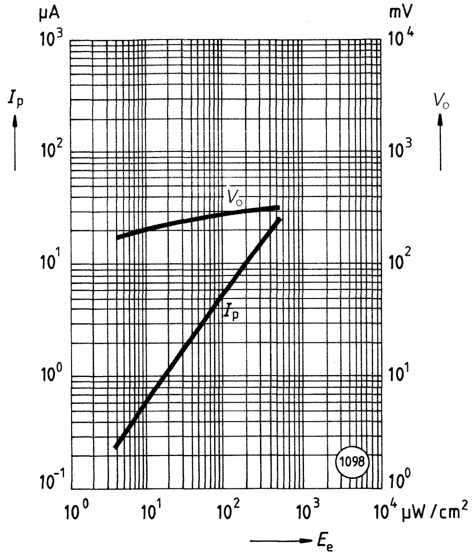
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm²)	S	25 (≥16)	μA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	950	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	800...1100	nm
Radiant sensitive area	A	7.34	mm²
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	1.2...1.4	mm
Half angle	φ	±70	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 950 nm)	S_λ	0.68	A/W
Quantum yield (λ = 950 nm)	η	0.90	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_e = 0.5 mW/cm²; λ = 950 nm)	V_o	327 (≥250)	mV
Short-circuit current (E_e = 0.5 mW/cm²; λ = 950 nm)	I_{SC}	25 (≥16)	μA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 25 μA)	t_r, t_f	350	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	72	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	3.7×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	7.3×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

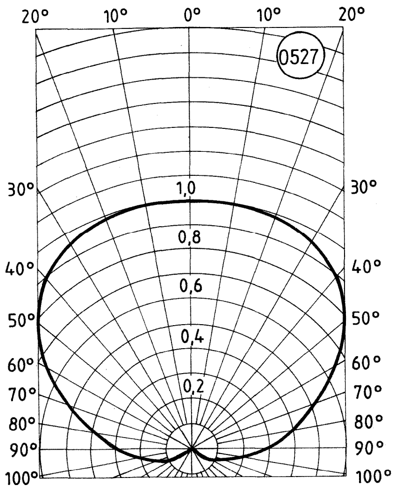
Relative spectral sensitivity versus wavelength



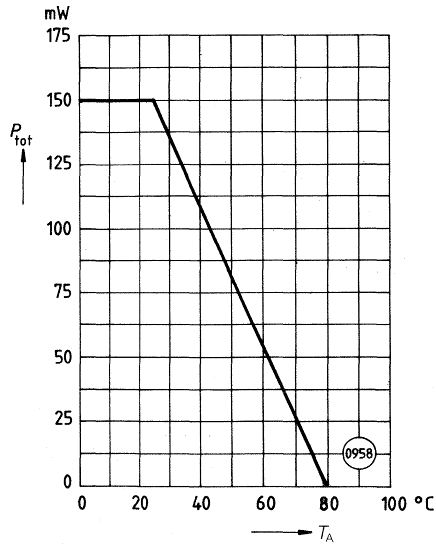
Photocurrent, open-circuit voltage versus irradiance



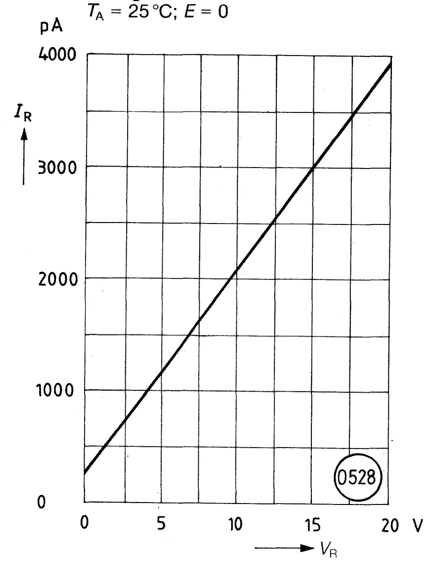
Directional characteristic
Relative spectral sensitivity versus half angle



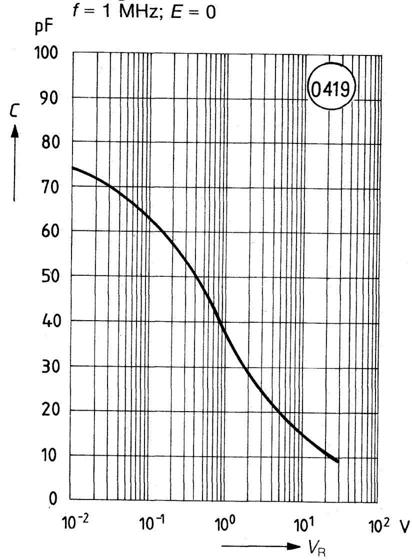
Total power dissipation versus ambient temperature



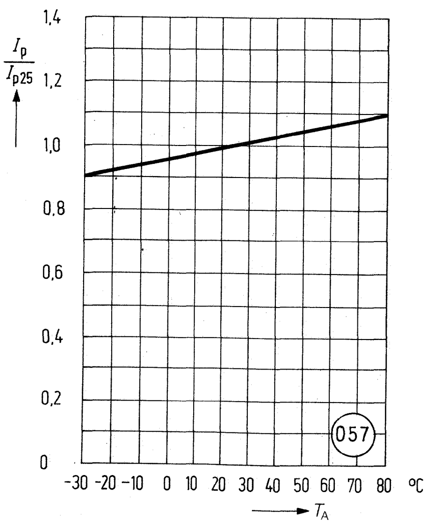
Dark current versus reverse voltage
T_A = 25 °C; E = 0



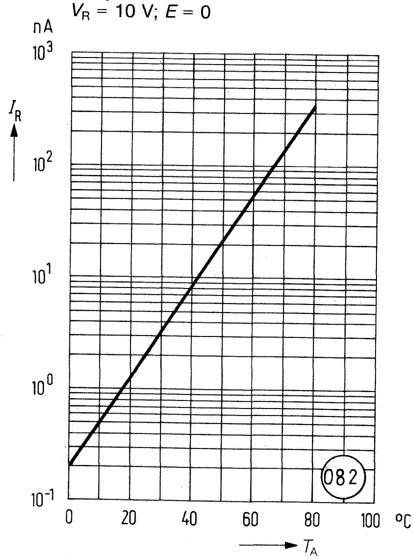
Capacitance versus reverse voltage
f = 1 MHz; E = 0



Photocurrent versus ambient temperature



Dark current versus ambient temperature
V_R = 10 V; E = 0



SFH 206 K is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

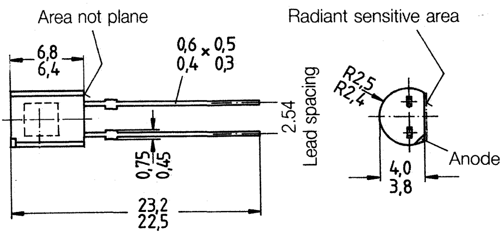
Package 10 A3 DIN 41868 (similar to TO-92), transparent epoxy resin, solder tabs, lead spacing 2.54 mm (1/10").

Anode marking Notch at case

Application Computer-controlled flashes, light-reflecting switches for steady and varying intensity, industrial electronics, "measuring and controlling".

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.25 g
Dimensions in mm

Type	Ordering code
SFH 206 K	Q62702-P129

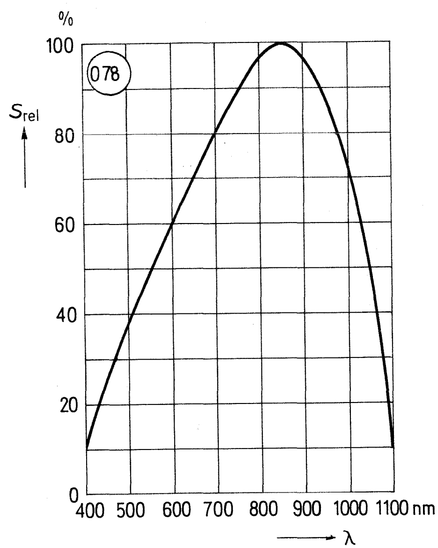
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	−40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	20	V
Total power dissipation (T_A = 25 °C)	P_{tot}	150	mW

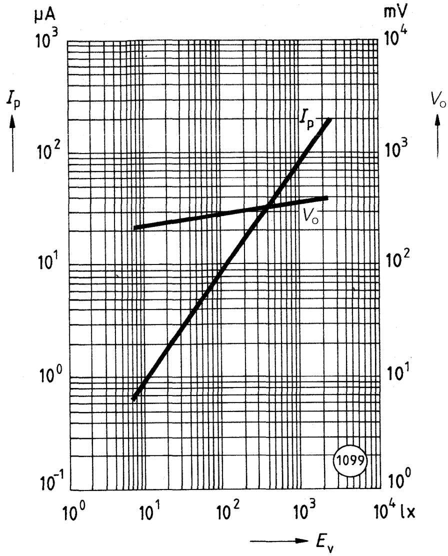
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	80 (≥50)	μA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	7.34	mm^2
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	mm
Distance chip surface to case surface	D	1.2...1.4	mm
Half angle	φ	±70	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.60	A/W
Quantum yield (λ = 850 nm)	η	0.88	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	365 (≥310)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	80 (≥50)	μA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 80 μA)	t_r, t_f	350	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	72	pF
Temperature coefficient of V_o	TC	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	4.2×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	6.3×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

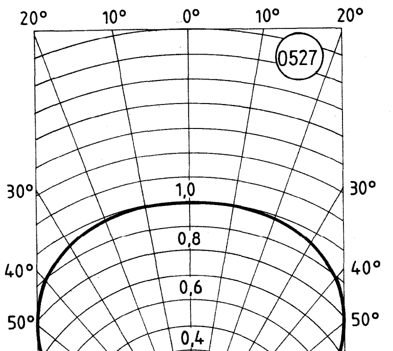
Relative spectral sensitivity versus wavelength



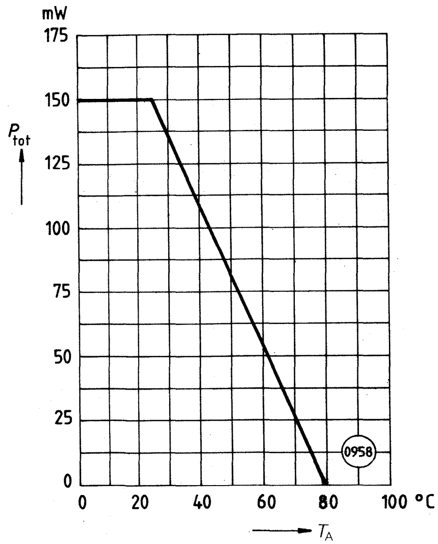
Photocurrent, open-circuit voltage versus illuminance



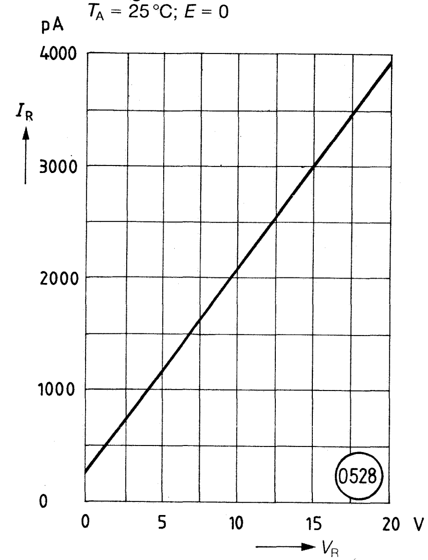
Directional characteristic
Relative spectral sensitivity versus half angle



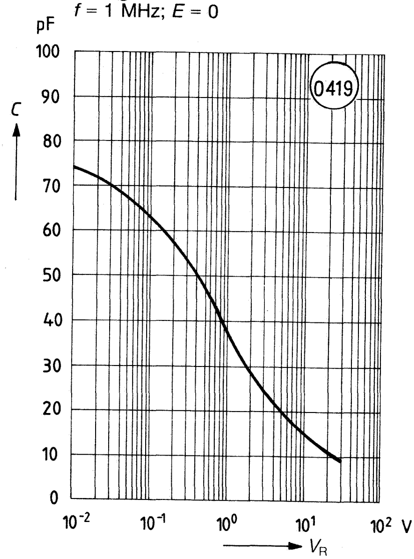
Total power dissipation versus ambient temperature



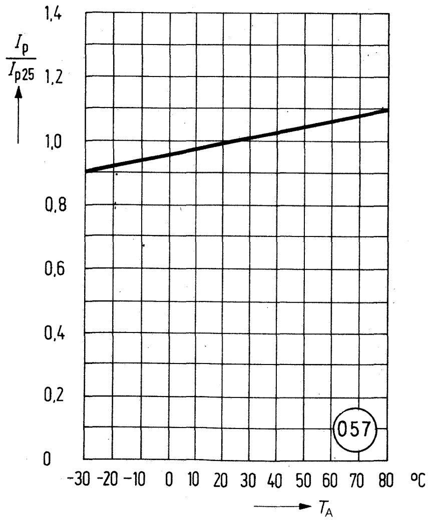
Dark current versus reverse voltage
T_A = 25 °C; E = 0



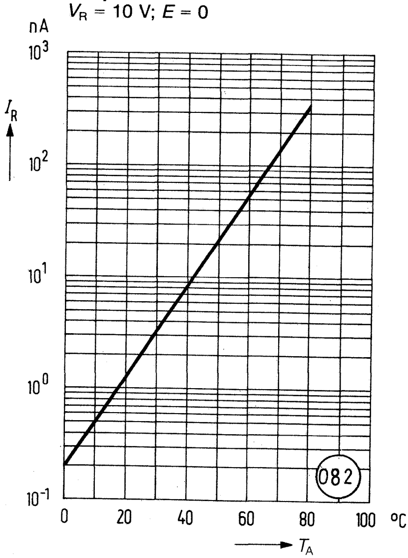
Capacitance versus reverse voltage
f = 1 MHz; E = 0



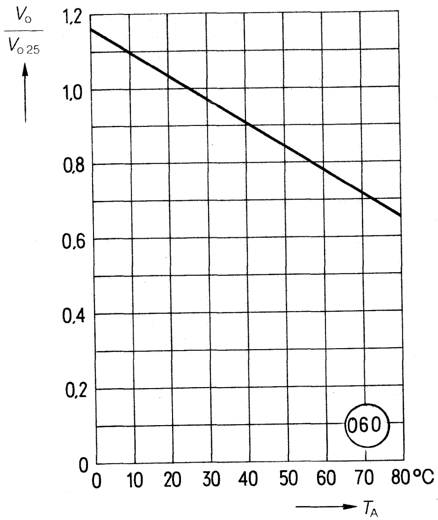
Photocurrent versus ambient temperature



Dark current versus ambient temperature
V_R = 10 V; E = 0



Open-circuit voltage versus ambient temperature



Silicon Photodiode with Very Low Dark Current **SFH 212**

SFH 212 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

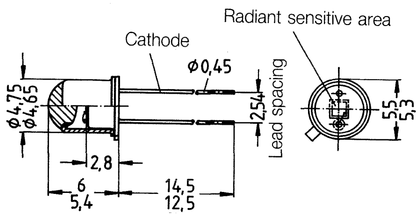
Package 18 A3 DIN 41870 (TO 18), glass lens, hermetically sealed package, solder tabs, lead spacing 2.54 mm (1/10″).

Anode marking Projection at case bottom

Application Exposure meters, automatic exposure timers.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 212	Q62702-P145

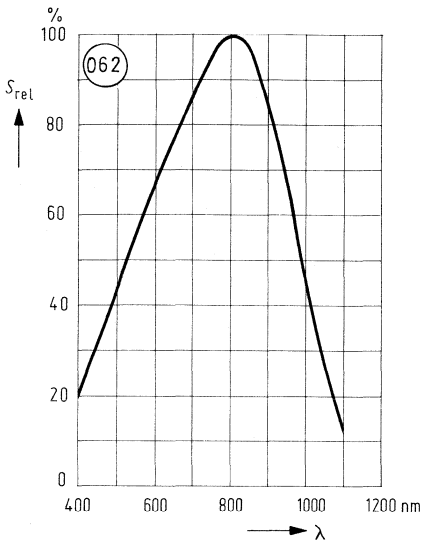
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	−40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	7	V
Total power dissipation (T_A = 25 °C)	P_{tot}	200	mW

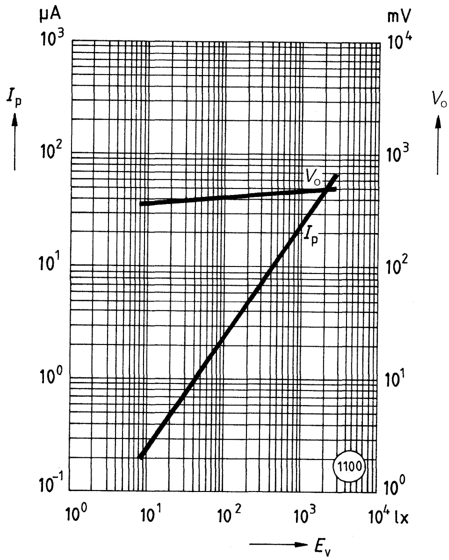
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	25 (≥20)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	800	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...1100	nm
Radiant sensitive area	A	1	mm^2
Dimension of radiant sensitive area	$L \times W$	1 × 1	mm
Distance chip surface to case surface	D	2.6...3.2	mm
Half angle	φ	±15	deg.
Dark current (V_R = 1 V)	I_R	5 (≤20)	pA
Spectral sensitivity (λ = 850 nm)	S_λ	0.50	A/W
Zero crossover (E_e = 0; T_A = 25 °C)	S_0	≥0.5	mV/pA
Quantum yield (λ = 800 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	470 (≥400)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	25 (≥20)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 25 µA)	t_r, t_f	1.3	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	100	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.16	%/K
Noise equivalent power (V_R = 1 V)	NEP	2.5×10^{-15}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 1 V)	D^*	4.0×10^{13}	$\frac{cm \cdot \sqrt{Hz}}{W}$

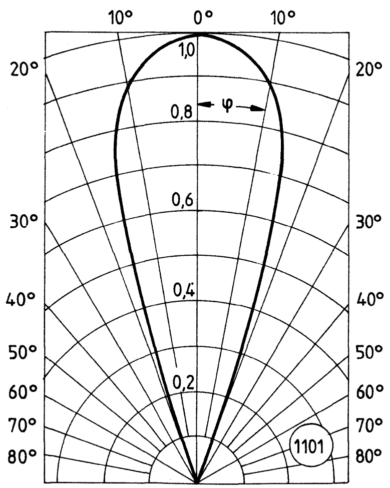
Relative spectral sensitivity versus wavelength



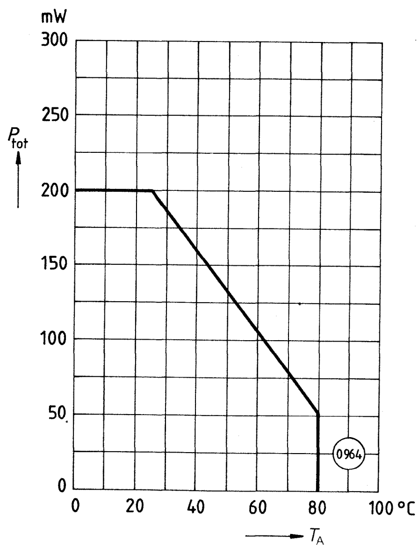
Photocurrent, open-circuit voltage versus illuminance



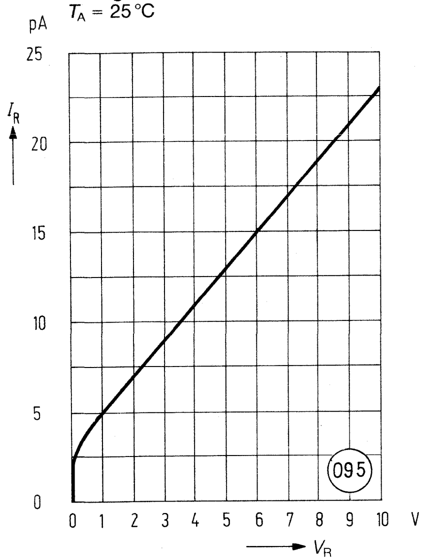
Directional characteristic
Relative spectral sensitivity versus half angle



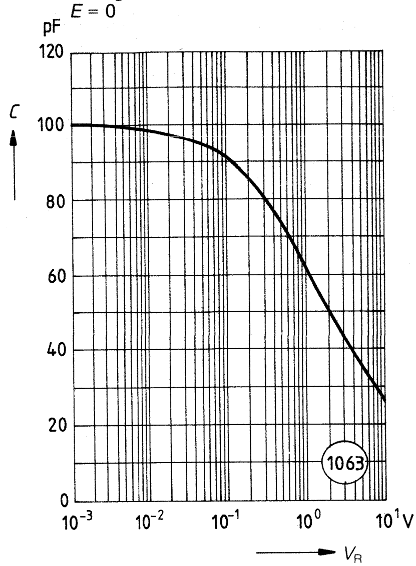
Total power dissipation versus ambient temperature



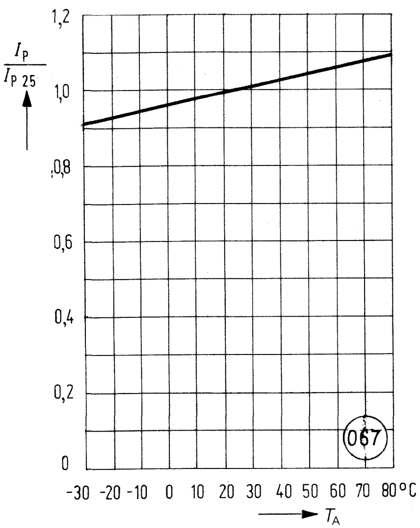
Dark current versus reverse voltage
T_A = 25 °C



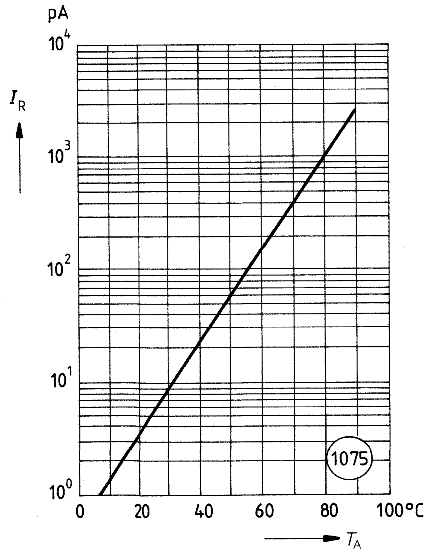
Capacitance versus reverse voltage
E = 0



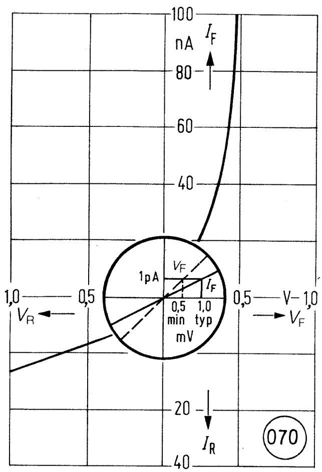
Photocurrent versus ambient temperature



Dark current versus ambient temperature



Zero crossover



SFH 216 is a Silicon Photodiode in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

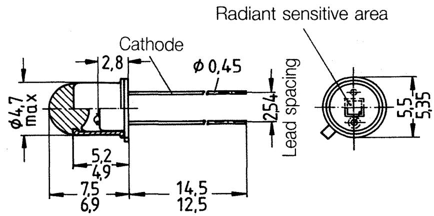
Package 18 A3 DIN 41870 (TO 18), glass lens, hermetically sealed package, solder tabs, lead spacing 2.54 mm (1/10″).

Anode marking Projection at case bottom

Application Optical sensor of high modulation bandwidth for light pens.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.5 g

Dimensions in mm

Type	Ordering code
SFH 216	Q62702-P936

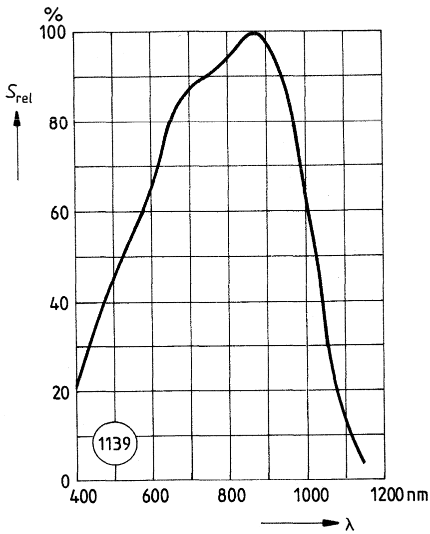
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	50	V
Total power dissipation (T_A = 25 °C)	P_{tot}	230	mW

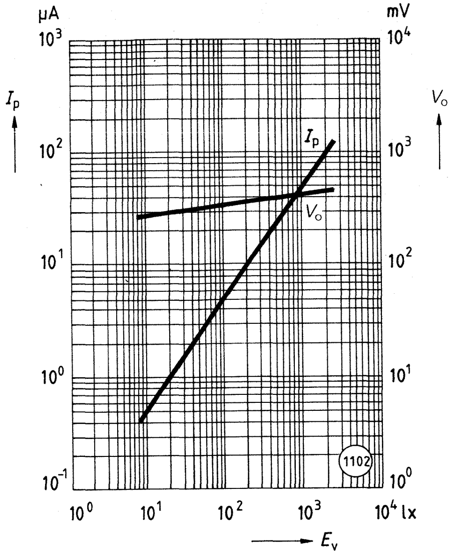
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	50 (≥35)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	350...1150	nm
Radiant sensitive area	A	0.97	mm^2
Dimension of radiant sensitive area	$L \times W$	0.985 × 0.985	mm
Distance chip surface to case top edge	D	4.2...5.0	mm
Half angle	φ	±12	deg.
Dark current (V_R = 20 V)	I_R	1 (≤5)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Quantum yield (λ = 850 nm)	η	0.80	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	410 (≥350)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	50 (≥35)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 50 Ω, V_R = 5 V, λ = 880 nm, I_P = 50 µA)	t_r	30	ns
	t_f	80	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	11	pF
(V_R = 1 V, f = 1 MHz, E_v = 0 lx)	C_1	6.4	pF
(V_R = 20 V, f = 1 MHz, E_v = 0 lx)	C_{20}	2.4	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	%/K
Noise equivalent power (V_R = 20 V)	NEP	3.3×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 20 V)	D^*	3.1×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

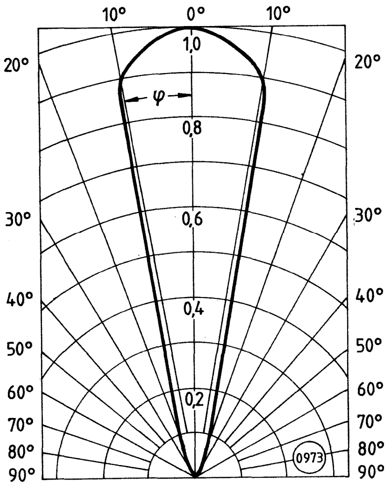
Relative spectral sensitivity versus wavelength



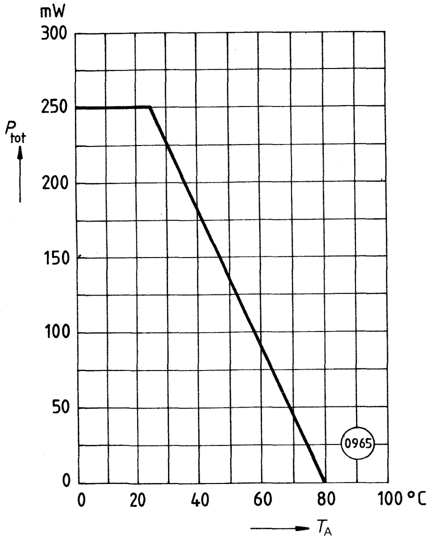
Photocurrent, open-circuit voltage versus illuminance



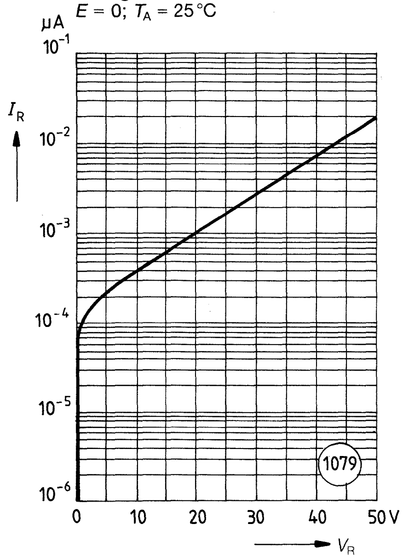
Directional characteristic
Relative spectral sensitivity versus half angle



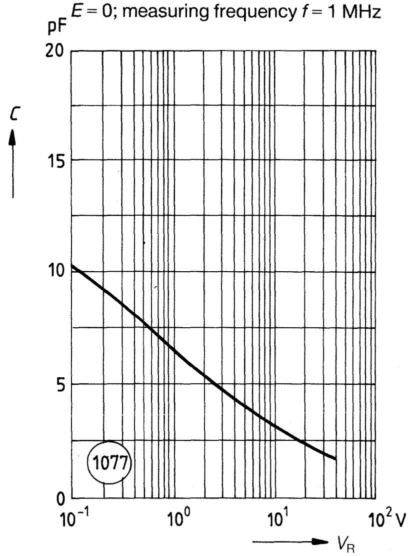
Total power dissipation versus ambient temperature



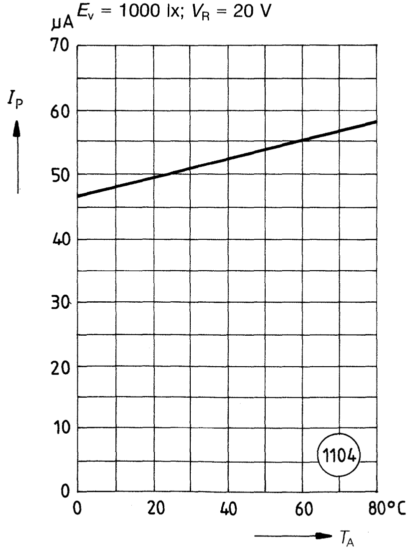
Dark current versus reverse voltage
$E = 0$; $T_A = 25\,°C$



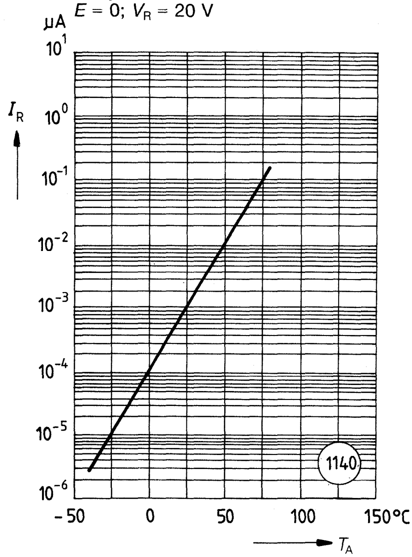
Capacitance versus reverse voltage
$E = 0$; measuring frequency $f = 1$ MHz



Photocurrent versus ambient temperature
$E_v = 1000$ lx; $V_R = 20$ V

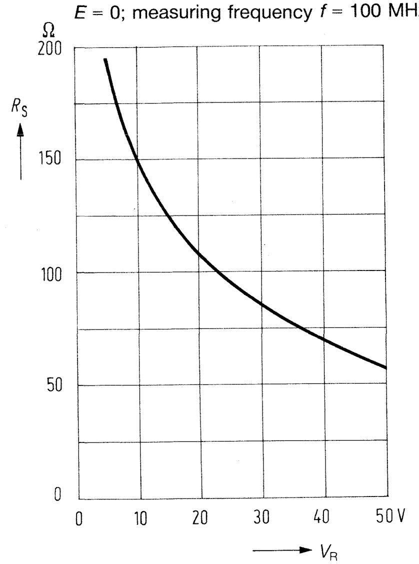


Dark current versus ambient temperature
$E = 0$; $V_R = 20$ V



Series resistance versus reverse voltage

E = 0; measuring frequency f = 100 MHz



Silicon PIN Photodiode
Silicon PIN Photodiode with Daylight Filter

SFH 217
SFH 217 F

Preliminary Data

SFH 217 and SFH 217 F are Silicon Photodiodes in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

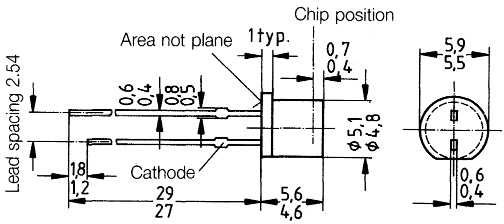
Package 5 mm LED package, plane, transparent epoxy resin (black epoxy resin for SFH 217 F), solder tabs, lead spacing 2.54 mm (1/10″).

Cathode marking Short solder tab

Application Industrial electronics, “measuring and controlling”, light-reflecting switches for steady and varying intensity, fiber optic transmission systems.

Features

- High reliability
- No testable degradation
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range
- Daylight filter (SFH 217 F)
- Same package as of phototransistor SFH 317, SFH 317 F, IRED SFH 485 P



Approx. weight 0.4 g
Dimensions in mm

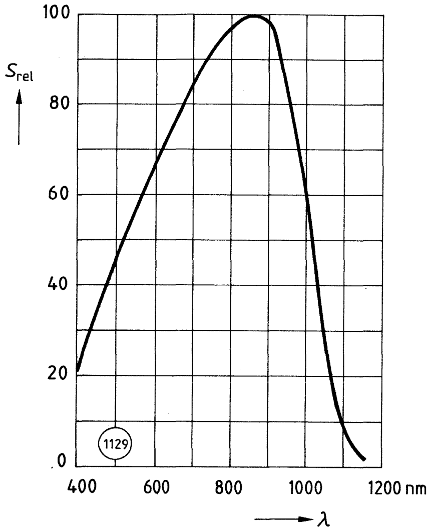
Type	Ordering code
SFH 217	Q62702-P946
SFH 217 F	Q62702-P947

Maximum ratings

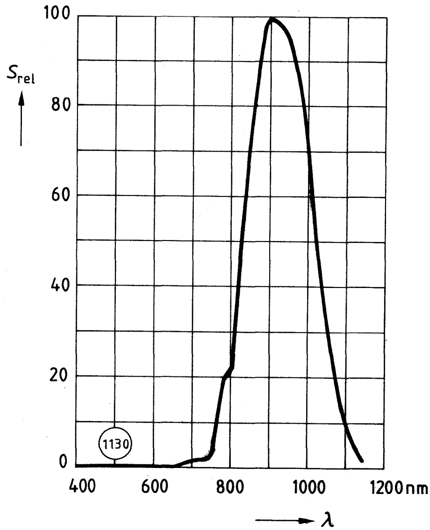
Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	300	°C
Reverse voltage	V_R	30	V
Total power dissipation	P_{tot}	100	mW

Characteristics (T_A = 25 °C)		SFH 217	SFH 217 F	
Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	9.5 (≥5)	–	nA/lx
Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm^2)	S	–	3.0 (≥1.8)	µA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	900	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	800...1100	nm
Radiant sensitive area	A	1	1	mm^2
Dimension of radiant sensitive area	$L \times W$	0.985 × 0.985	0.985 × 0.985	mm
Distance chip surface to case surface	D	0.4...0.7	0.4...0.7	mm
Half angle	φ	±60	±60	deg.
Dark current (V_R = 20 V)	I_R	1 (≤10)	1 (≤10)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.62	0.62	A/W
Quantum yield (λ = 850 nm)	η	0.89	0.89	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	350 (≥300)	–	mV
(E_e = 0.5 mW/cm^2; λ = 950 nm)	V_o	–	300 (≥250)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	9.3 (≥5)	–	µA
(E_e = 0.5 mW/cm^2; λ = 950 nm)	I_{SC}	–	3.1 (≥1.8)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 50 Ω, V_R = 5 V, λ = 880 nm, I_P = 14 µA)	t_r, t_f	2 (≤4)	2 (≤4)	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	11	11	pF
Temperature coefficient of V_o	TC	−2.6	−2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	0.2	%/K
Noise equivalent power (V_R = 20 V)	NEP	2.9×10^{-14}	2.9×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 20 V)	D^*	3.5×10^{12}	3.5×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

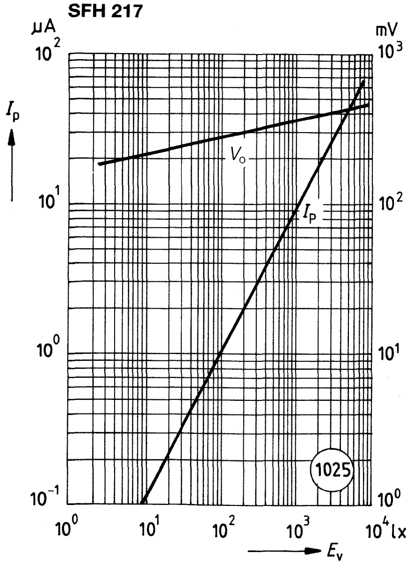
Relative spectral sensitivity versus wavelength
SFH 217



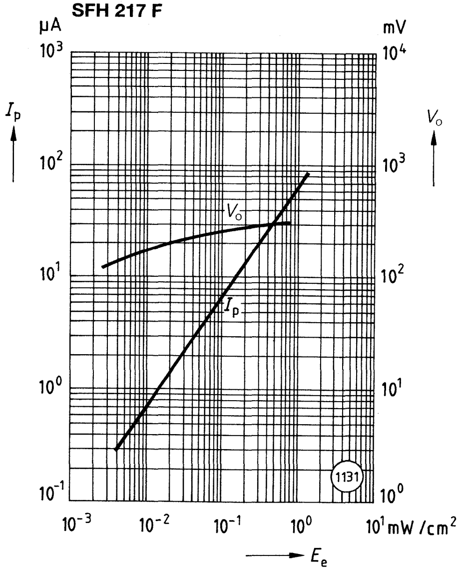
Relative spectral sensitivity versus wavelength
SFH 217 F



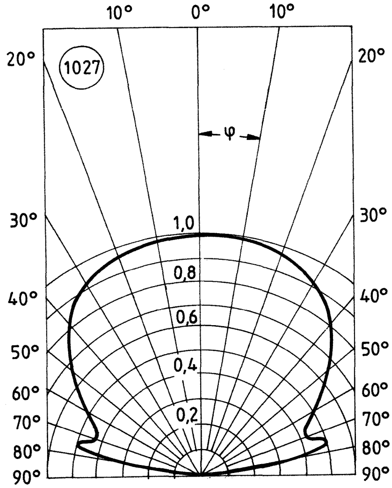
Photocurrent, open-circuit voltage versus illuminance
SFH 217



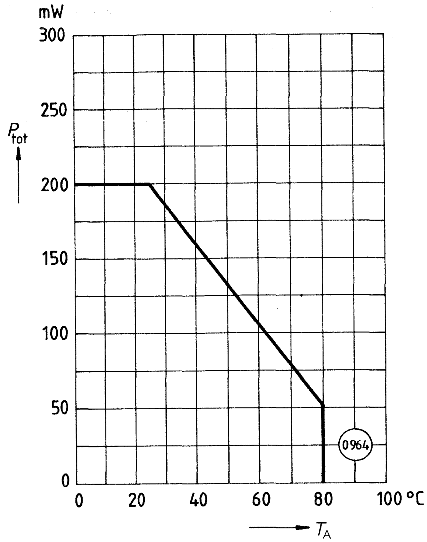
Photocurrent, open-circuit voltage versus irradiance
SFH 217 F



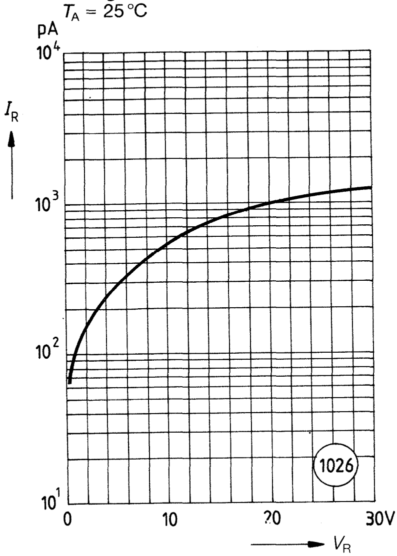
Directional characteristic
Relative spectral sensitivity versus half angle



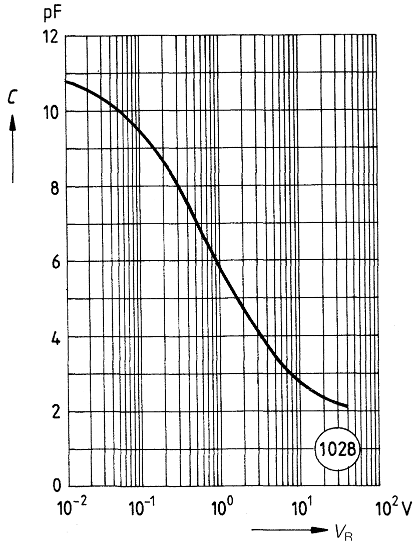
Total power dissipation versus ambient temperature



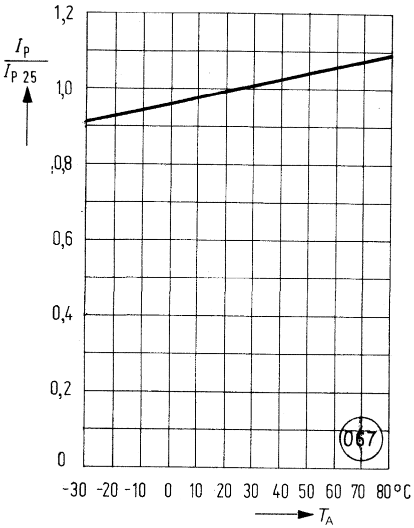
Dark current versus reverse voltage
T_A = 25 °C



Capacitance versus reverse voltage



Photocurrent versus ambient temperature



Silicon Photodiode with a Very Low Dark Current

SFH 219

Preliminary Data

SFH 219 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

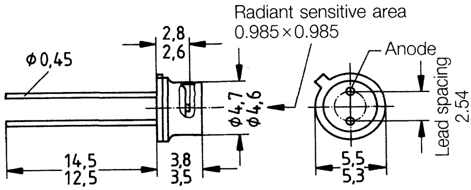
Package 18 A3 DIN 41870 (TO 18), plane glass lens, short hermetically sealed package, lead spacing 2.54 mm (1/10″).

Anode marking Projection at case bottom

Application Exposure meters, automatic exposure timers, industrial electronics, "measuring and controlling".

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High spectral sensitivity
- Strong logarithmic relation between V_o or I_{SC} and illuminance of 10^{-2} to 10^5 lx
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 219	Q62702-P948

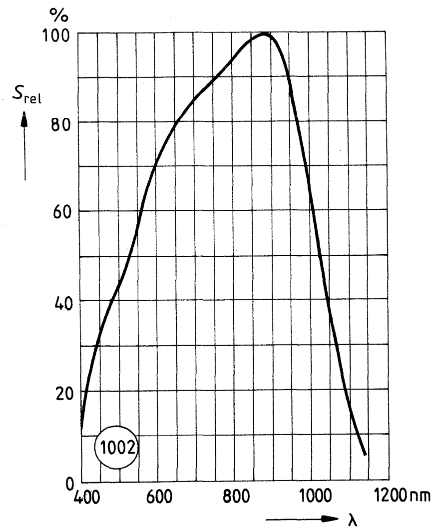
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	−40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	7	V
Total power dissipation	P_{tot}	200	mW

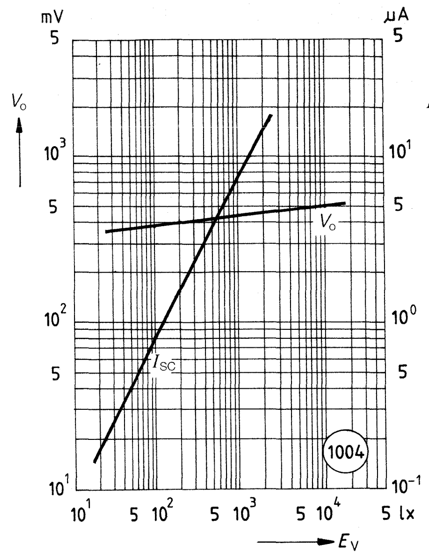
Characteristics (T_A = 25 °C)

Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	7 (≥5)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	nm
Radiant sensitive area	A	1	mm^2
Dimension of radiant sensitive area	$L \times W$	0.985 × 0.985	mm
Distance chip surface to case surface	D	1...1.2	mm
Half angle	φ	±60	deg.
Dark current (V_R = 1 V)	I_R	5 (≤20)	pA
Spectral sensitivity (λ = 850 nm)	S_λ	≥0.5	A/W
Quantum yield (λ = 800 nm)	η	0.73	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	390 (≥320)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	7 (≥5)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 5 V, λ = 830 nm, I_P = 7 µA)	t_r, t_f	1.3	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	90	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.16	%/K
Noise equivalent power (V_R = 1 V)	NEP	2.7×10^{-15}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 1 V)	D^*	3.7×10^{13}	$\frac{cm \cdot \sqrt{Hz}}{W}$

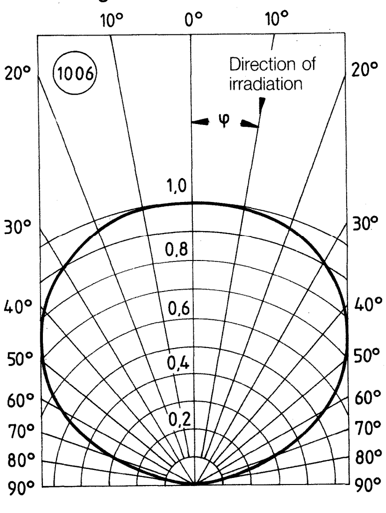
Relative spectral sensitivity versus wavelength



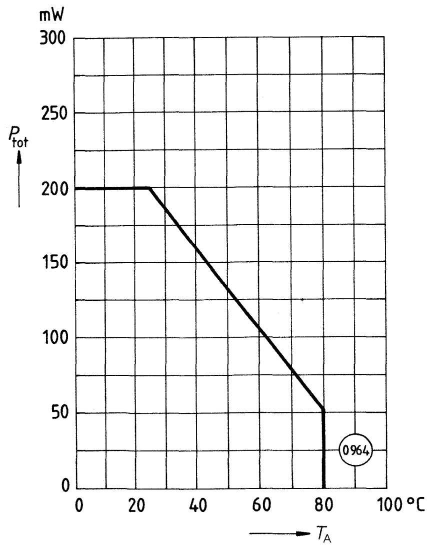
Open-circuit voltage and short-circuit current versus illuminance



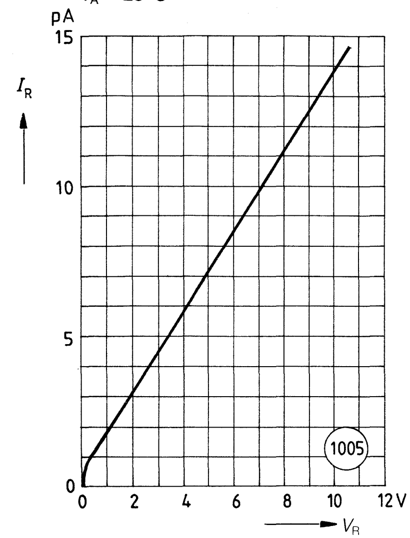
Directional characteristic
Relative spectral sensitivity versus half angle



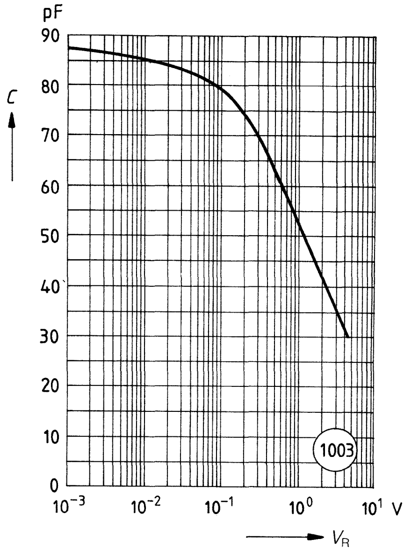
Total power dissipation versus ambient temperature



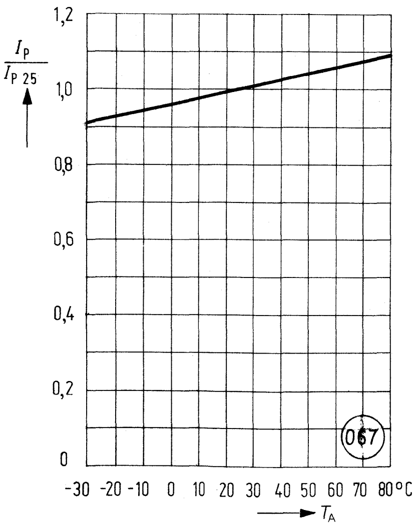
Dark current versus reverse voltage
T_A = 25 °C



Capacitance versus reverse voltage



Photocurrent versus ambient temperature



Preliminary Data

SFH 221 is a Silicon Photodiode in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

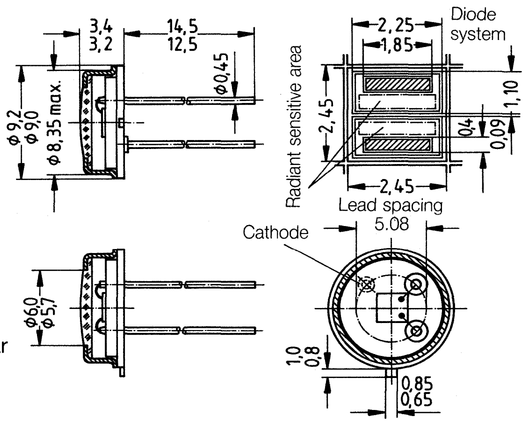
Package Hermetically sealed package, similar to TO 5, solder tabs, lead spacing 5.08 mm (2/10″).

Cathode marking Projection at case bottom

Application Follow-up controls, edge drives, path and corner scanning, industrial electronics, “measuring and controlling”.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range



Approx. weight 2 g
Dimensions in mm

Type	Ordering code
SFH 221	Q62702-P950

Maximum ratings

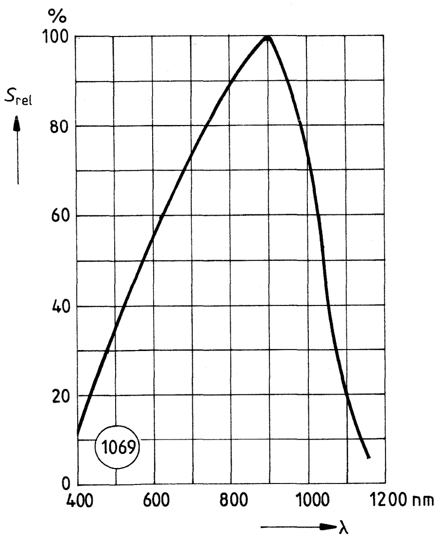
Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	10	V
Total power dissipation	P_{tot}	50	mW

Characteristics (T_A = 25 °C)

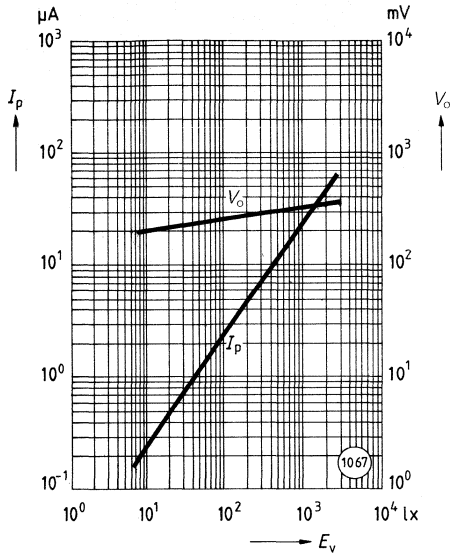
(This data refers to one system of the photodiode)

Spectral sensitivity (V_R = 5 V; standard light A, T = 2856 K)	S	24 (≥15)	nA/lx
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	430...1150	nm
Radiant sensitive area	A	1.54	mm^2
Dimension of radiant sensitive area	$L \times W$	0.7 × 2.2	mm
Distance chip surface to case top edge	D	1.9...2.3	mm
Half angle	φ	±55	deg.
Dark current (V_R = 10 V)	I_R	100 (≤200)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	A/W
Max. deviation of the spectral sensitivity of the systems from the mean	Δ_s	±0.5	%
Quantum yield (λ = 850 nm)	η	0.80	Electrons / Photon
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	330 (≥280)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	24 (≥15)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 5 kΩ, V_R = 0 V, λ = 830 nm, I_P = 20 µA)	t_r, t_f	≤500	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	40	pF
(V_R = 10 V, f = 1 MHZ, E_v = 0 lx)	C_{10}	10	pF
Temperature coefficient of V_o	TC	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	%/K

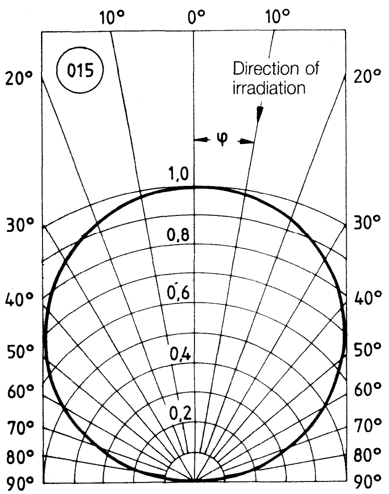
Relative spectral sensitivity versus wavelength



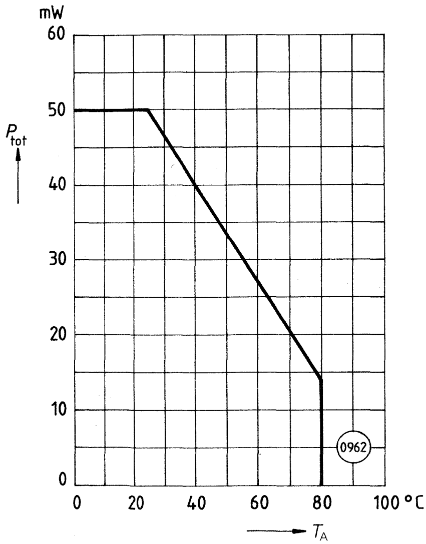
Photocurrent, open-circuit voltage versus illuminance



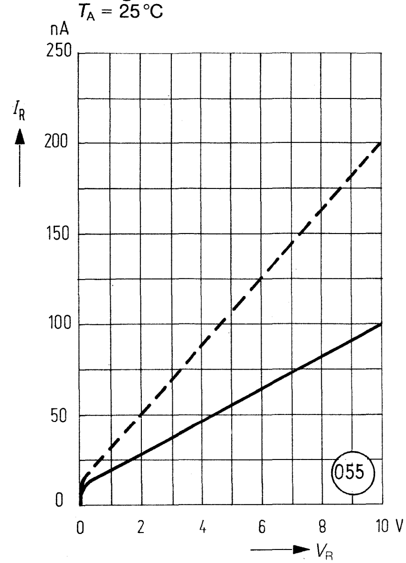
Directional characteristic
Relative spectral sensitivity versus half angle



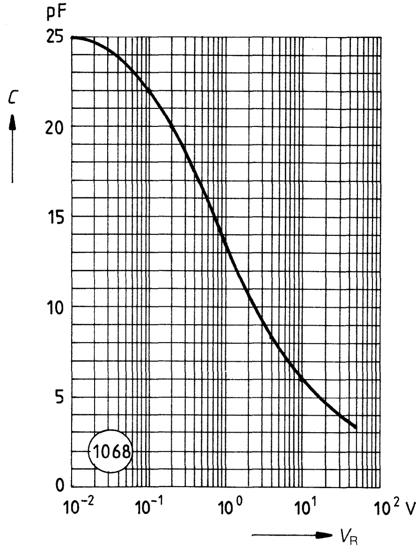
Total power dissipation versus ambient temperature



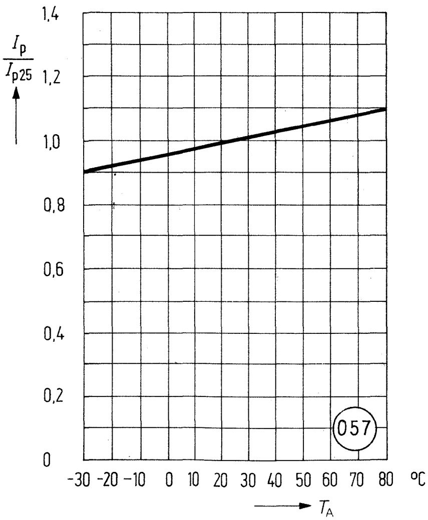
Dark current versus reverse voltage
T_A = 25 °C



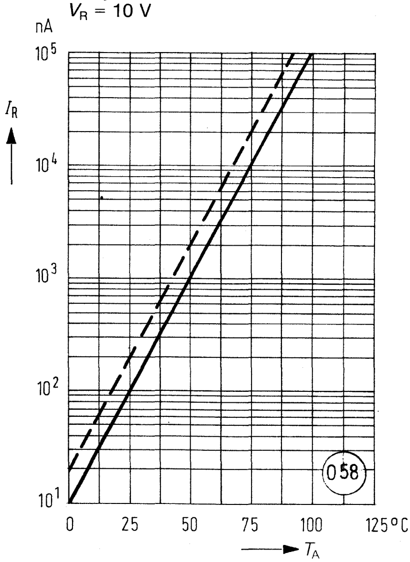
Diode capacitance versus reverse voltage



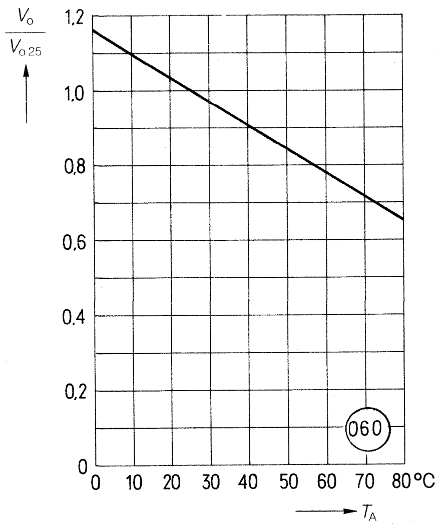
Photocurrent versus ambient temperature



Dark current versus ambient temperature
V_R = 10 V



Open-circuit voltage versus ambient temperature



Silicon PIN Photodiode with Daylight Filter
Silicon PIN Photodiode with Additional Filter

SFH 230
SFH 230 F

Preliminary Data

SFH 230 and SFH 230 F are Silicon Photodiodes in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

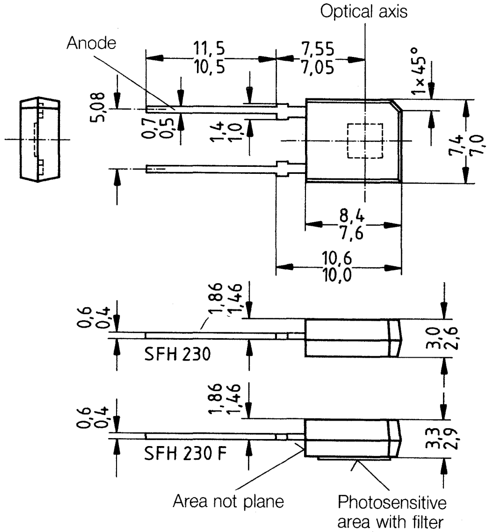
Package Lead frame, black epoxy resin, daylight filter (SFH 230 F with additional filter), solder tabs, lead spacing 5.08 mm (2/10").

Anode marking Notch at case

Application IR-remote control of hi-fi and TV sets, video tape recorders, dimmers, remote control of various equipment, light-reflecting switches for steady and varying intensity.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the near infrared range
- Daylight filter



Approx. weight 0.4 g
Dimensions in mm

Type	Ordering code
SFH 230	Q62702-P951
SFH 230 F	Q62702-P952

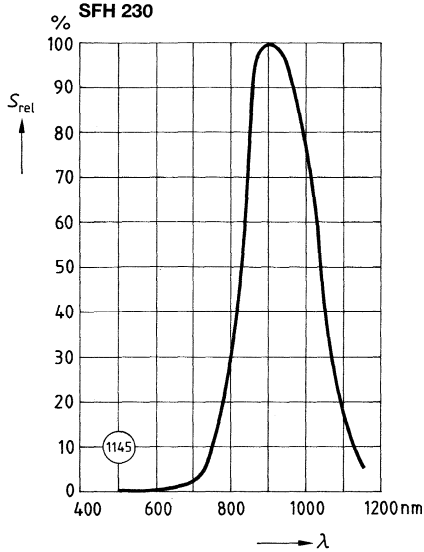
Maximum ratings

Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	20	V
Total power dissipation	P_{tot}	150	mW

Characteristics (T_A = 25 °C)		**SFH 230**	**SFH 230 F**	
Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm²)	S	26 (≥16)	24 (≥15)	µA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	900	950	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	750...1100	840...1100	nm
Radiant sensitive area	A	7.34	7.34	mm²
Dimension of radiant sensitive area	$L \times W$	2.71 × 2.71	2.71 × 2.71	mm
Distance chip surface to case top edge	D	0.3	0.4	mm
Half angle	φ	±60	±60	deg.
Dark current (V_R = 10 V)	I_R	2 (≤30)	2 (≤30)	nA
Spectral sensitivity (λ = 950 nm)	S_λ	0.68	0.64	A/W
Quantum yield (λ = 950 nm)	η	0.89	0.83	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_e = 0.5 mW/cm²; λ = 950 nm)	V_o	330 (≥260)	330 (≥260)	mV
Short-circuit current (E_e = 0.5 mW/cm²; λ = 950 nm)	I_{SC}	24 (≥16)	22.5 (≥15)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 0 V, λ = 950 nm, I_P = 25 µA)	t_r, t_f	125	125	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	69	69	pF
Temperature coefficient of V_o	TC	–2.6	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	0.18	%/K
Noise equivalent power (V_R = 10 V)	NEP	3.7×10^{-14}	4×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 10 V)	D^*	7.2×10^{12}	6.6×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

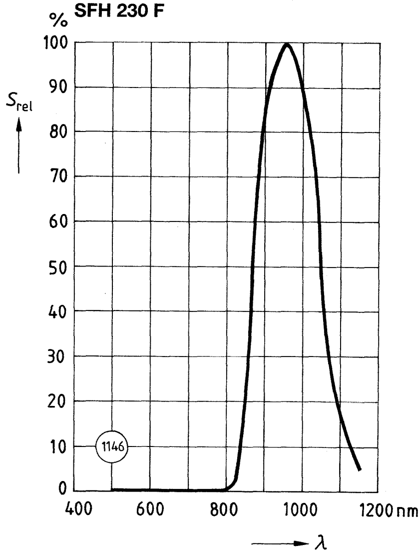
Relative spectral sensitivity versus wavelength

SFH 230



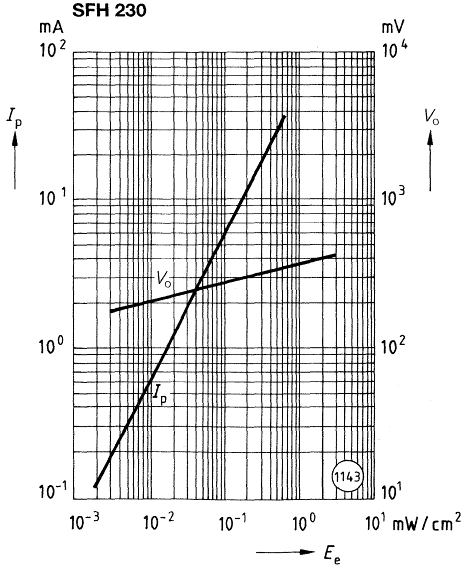
Relative spectral sensitivity versus wavelength

SFH 230 F



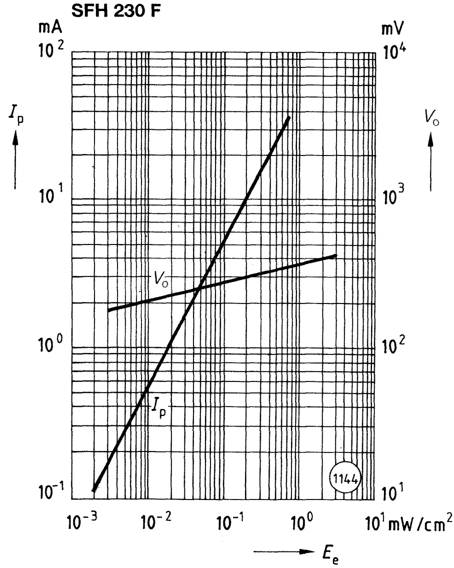
Photocurrent versus irradiance

SFH 230

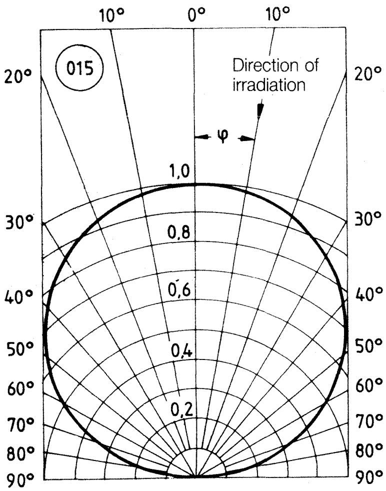


Photocurrent versus irradiance

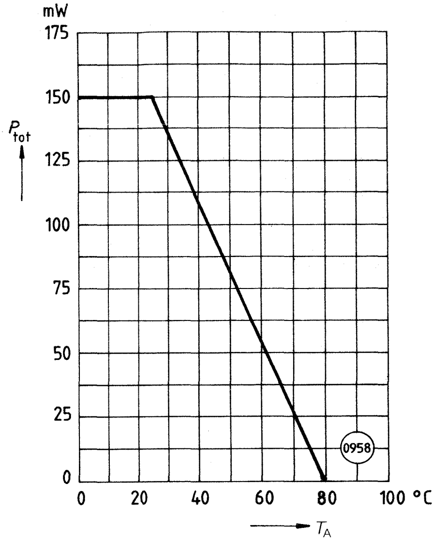
SFH 230 F



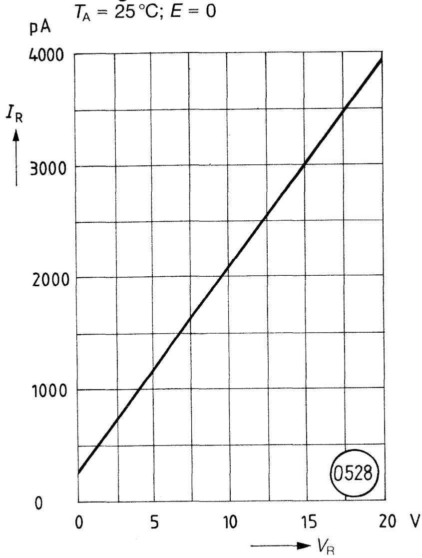
Directional characteristic
Relative spectral sensitivity versus half angle



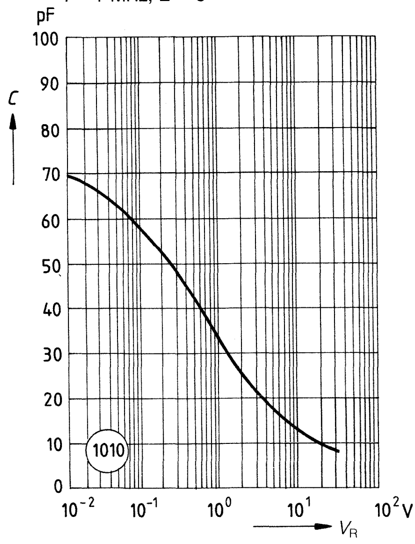
Total power dissipation versus ambient temperature



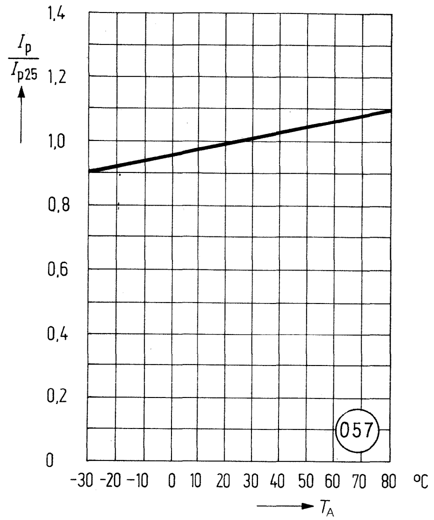
Dark current versus reverse voltage
T_A = 25 °C; E = 0



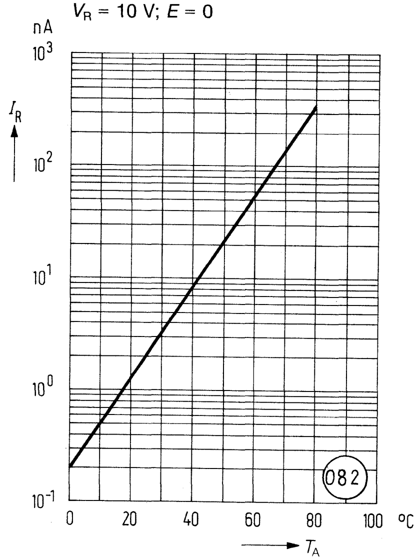
Diode capacitance versus reverse voltage
f = 1 MHz; E = 0



Photocurrent versus ambient temperature



Dark current versus ambient temperature
V_R = 10 V; E = 0



Silicon Differential Photodiode
Silicon Differential Photodiode with Daylight Filter

SFH 248
SFH 248 F

Preliminary Data

SFH 248 and SFH 248 F are Silicon differential Photodiodes in planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

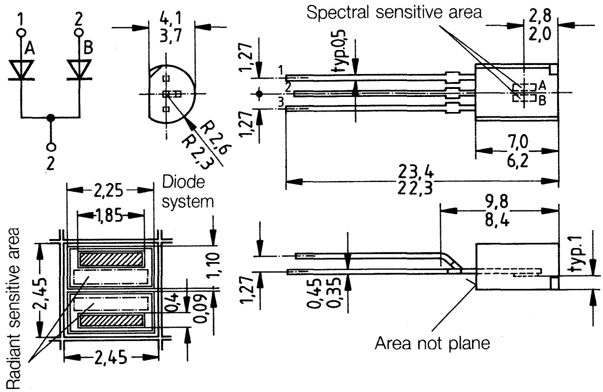
Package 10 A3 DIN 41868 (similar to TO 92), solder tabs, lead spacing 2.54 mm (1/10″), transparent epoxy resin (black epoxy resin for SFH 248 F).

Cathode marking Notch at case

Application Follow-up control, edge drive, path and corner scanning, industrial electronics, "measuring and controlling".

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range
- Daylight filter



Approx. weight 0.5 g
Dimensions in mm

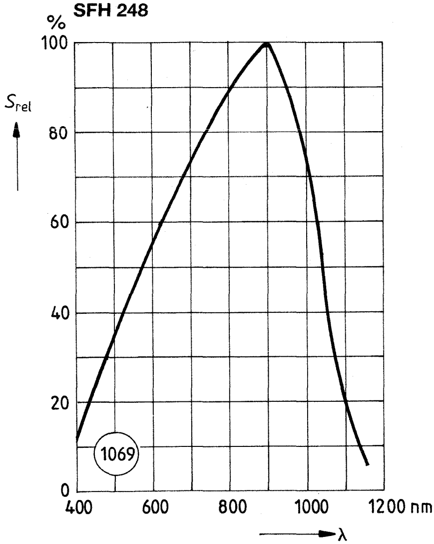
Type	Ordering code
SFH 248	Q62702-P953
SFH 248 F	Q62702-P954

Maximum ratings

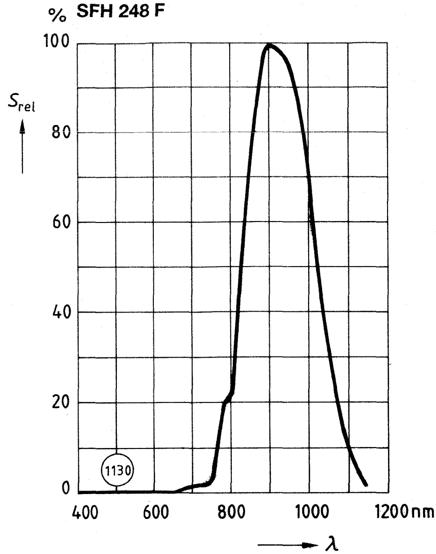
Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	230	°C
Reverse voltage	V_R	10	V
Total power dissipation	P_{tot}	50	mW

Characteristics (T_A = 25 °C)		SFH 248	SFH 248 F	
(This data refers to one system of the photodiode)				
Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	24 (≥15)	–	nA/lx
Spectral sensitivity (V_R = 5 V; λ = 950 nm; E_e = 0.5 mW/cm^2)	S	–	7.5 (≥4)	µA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	950	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	430...1150	800...1150	nm
Radiant sensitive area	A	1.54	1.54	mm^2
Dimension of radiant sensitive area	$L \times W$	0.7 × 2.2	0.7 × 2.2	mm
Distance chip surface to case surface	D	1	1	mm
Half angle	φ	±60	±60	deg.
Dark current (V_R = 10 V)	I_R	100 (≤200)	100 (≤200)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.55	0.55	A/W
Quantum yield (λ = 850 nm)	η	0.80	0.80	Electrons / Photon
Open circuit voltage (E_v = 1000 lx, standard light A, T=2856 K)	V_o	390 (≥320)	–	mV
(E_e = 0.5 mW/cm^2; λ = 950 nm)	V_o	–	340 (≥280)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T=2856 K)	I_{SC}	24 (≥15)	–	µA
(E_e = 0.5 mW/cm^2; λ = 950 nm)	I_{SC}	–	7.5 (≥4)	µA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 1 Ω, V_R = 0 V, λ = 830 nm, I_P = 20 µA)	t_r, t_f	≤500	≤500	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	40	40	pF
(V_R = 10 V, f = 1 MHz, E_v = 0 lx)	C_{10}	10	10	pF
Temperature coefficient of V_o	TC	–2.6	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.18	0.18	%/K

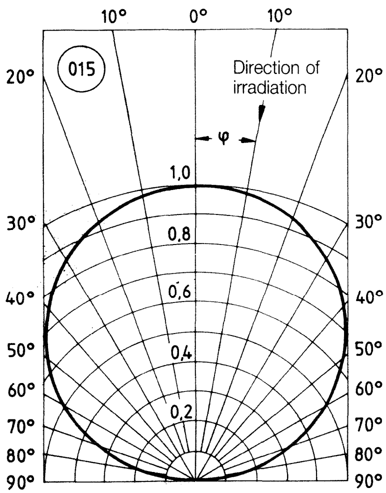
Relative spectral sensitivity versus wavelength
SFH 248



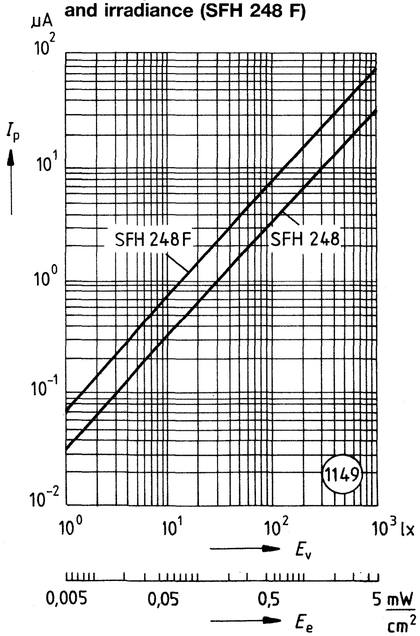
Relative spectral sensitivity versus wavelength
SFH 248 F



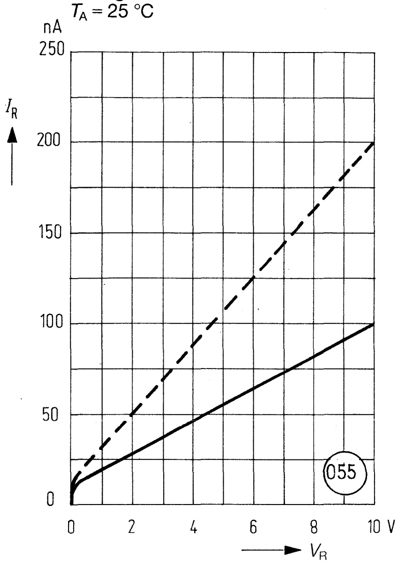
Directional characteristic
Relative spectral sensitivity versus half angle



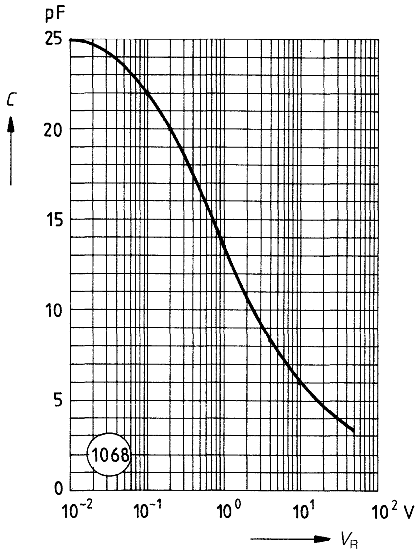
Photocurrent versus illuminance (SFH 248) and irradiance (SFH 248 F)



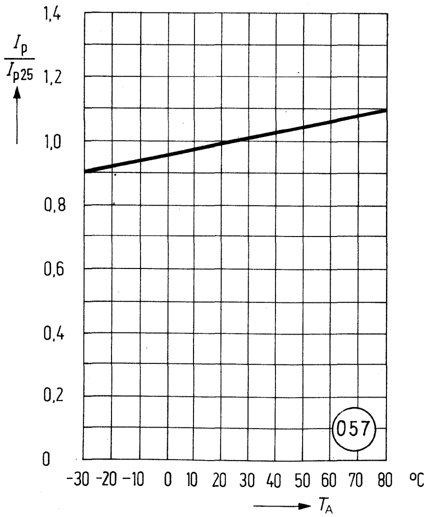
Dark current versus reverse voltage
$T_A = 25\ °C$



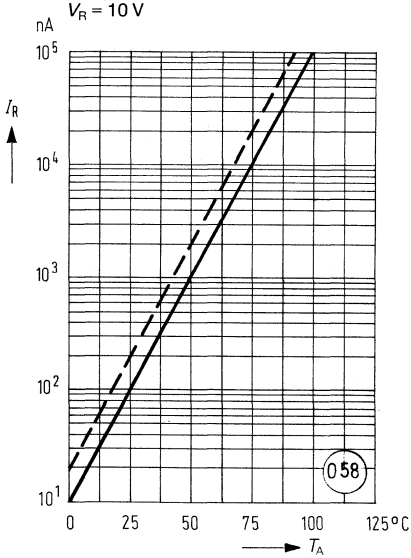
Diode capacitance versus reverse voltage



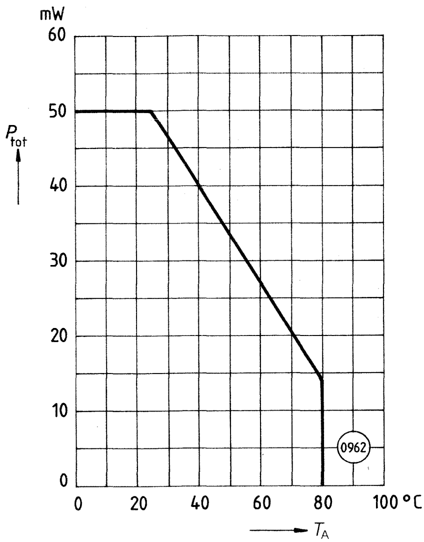
Photocurrent versus ambient temperature



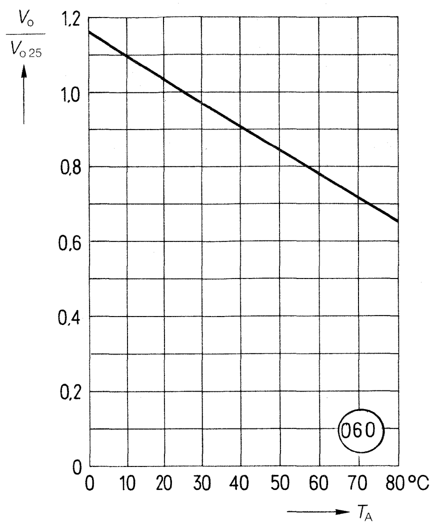
Dark current versus ambient temperature
$V_R = 10\ V$



Total power dissipation versus ambient temperature



Open-circuit voltage versus ambient temperature



Silicon PIN Photodiode
Silicon PIN Photodiode with Daylight Filter

SFH 2030
SFH 2030 F

Preliminary Data

SFH 2030 and SFH 2030 F are Silicon Photodiodes in PIN planar technology. The N-Si material used results in a positive front and negative back contact. These photodetectors can be operated as photodiodes with reverse voltage or as photovoltaic cells.

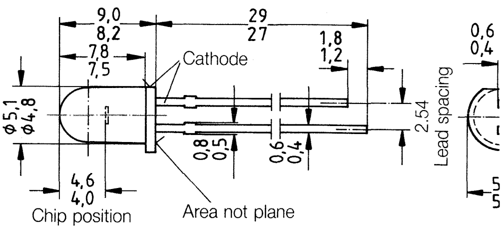
Package 5 mm LED package (T 1¾), transparent epoxy resin (black epoxy resin for SFH 2030 F), solder tabs, lead spacing 2.54 mm (1⁄10″).

Cathode marking Short solder tab

Application Industrial electronics, "measuring and controlling", light-reflecting switches for steady and varying intensity, fiber optic transmission systems.

Features

- High reliability
- No testable degradation
- High packing density
- Low noise
- High open-circuit voltage as photovoltaic cells
- High cutoff frequency
- Short switching time
- Low capacitance
- High spectral sensitivity
- Wide temperature range
- Suitable for use in the visible light and near infrared range
- Daylight filter
- Same package as of phototransistor SFH 303, SFH 303 F, IRED SFH 485



Approx. weight 0.4 g
Dimensions in mm

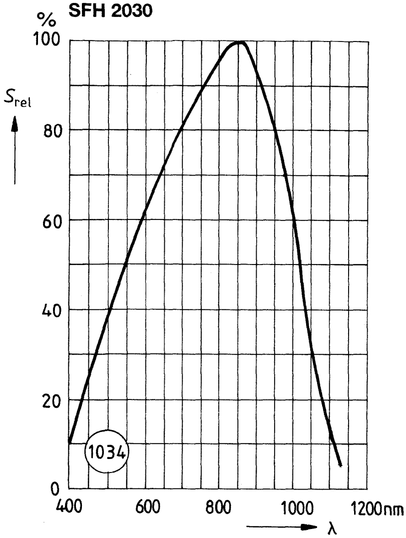
Type	Ordering code
SFH 2030	Q62702-P955
SFH 2030 F	Q62702-P956

Maximum ratings

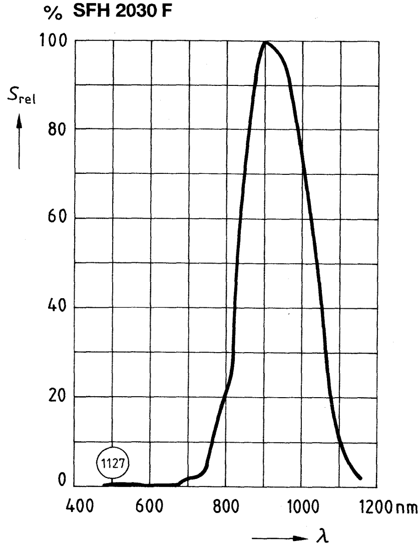
Operating and storage temperature range	T_{op}, T_{stg}	–40...+80	°C
Soldering temperature in a 2 mm distance from case bottom ($t \leq 3$ s)	T_{sold}	300	°C
Reverse voltage	V_R	30	V
Total power dissipation	P_{tot}	100	mW

Characteristics (T_A = 25 °C)		SFH 2030	SFH 2030 F	
Spectral sensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	80 (≥50)	–	nA/lx
Spectral sensitivity (V_R = 5 V; λ = 950 nm E_e = 0.5 mW/cm²)	S	–	25 (≥15)	μA
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	900	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	800...1100	nm
Radiant sensitive area	A	1	1	mm²
Dimension of radiant sensitive area	$L \times W$	0.985 × 0.985	0.985 × 0.985	mm
Distance chip surface to case surface	D	4.0...4.6	4.0...4.6	mm
Half angle	φ	±20	±20	deg.
Dark current (V_R = 20 V)	I_R	1 (≤5)	1 (≤5)	nA
Spectral sensitivity (λ = 850 nm)	S_λ	0.62	0.62	A/W
Quantum yield (λ = 850 nm)	η	0.89	0.89	$\frac{\text{Electrons}}{\text{Photon}}$
Open circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_o	420 (≥350)	–	mV
(E_e = 0.5 mW/cm²; λ = 950 nm)	V_o	–	370 (≥300)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K)	I_{SC}	80 (≥50)	–	μA
(E_e = 0.5 mW/cm²; λ = 950 nm)	I_{SC}	–	25 (≥15)	μA
Rise and fall time of photocurrent from 10% to 90%, and from 90% to 10% of final value (R_L = 50 Ω, V_R = 5 V, λ = 880 nm, I_P = 14 μA)	t_r, t_f	2 (≤4)	2 (≤4)	ns
Forward voltage (I_F = 100 mA, E_e = 0, T_A = 25 °C)	V_F	1.3	1.3	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	11	11	pF
Temperature coefficient of V_o	TC	–2.6	–2.6	mV/K
Temperature coefficient of I_{SC}	TC	0.2	0.2	%/K
Noise equivalent power (V_R = 20 V)	NEP	2.9×10^{-14}	2.9×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detection limit (V_R = 20 V)	D^*	3.5×10^{12}	3.5×10^{12}	$\frac{cm \cdot \sqrt{Hz}}{W}$

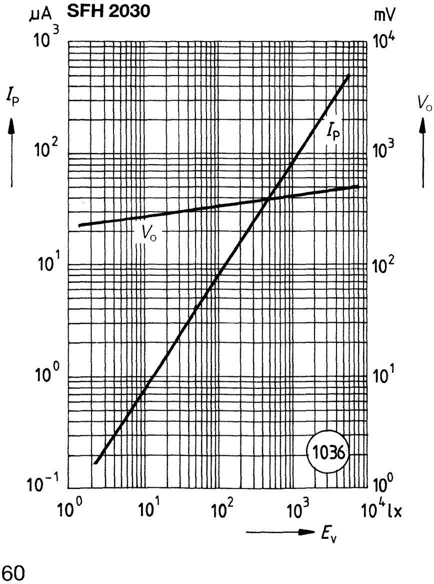
Relative spectral sensitivity versus wavelength
SFH 2030



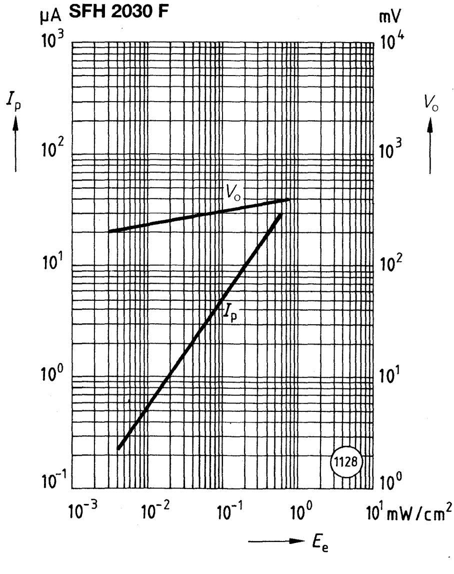
Relative spectral sensitivity versus wavelength
SFH 2030 F



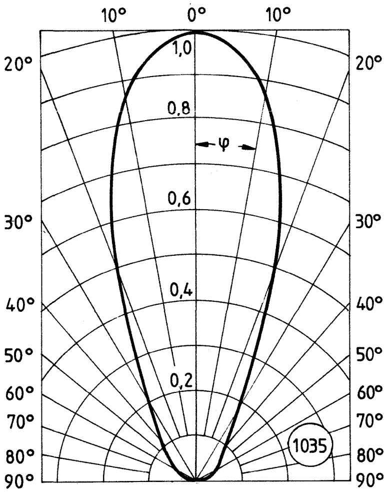
Photocurrent and open-circuit voltage versus illuminance
SFH 2030



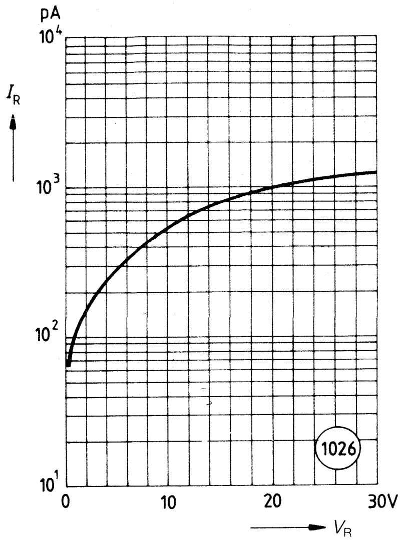
Photocurrent and open-circuit voltage versus irradiance
SFH 2030 F



Directional characteristic
Relative spectral sensitivity versus half angle



Dark current versus reverse voltage



Phototransistors

BP 103 is a Silicon NPN Phototransistor in epitaxial planar technology with base connection. The collector terminal is electrically connected to the case.

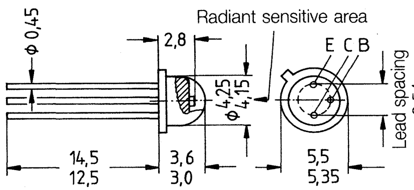
Package 18 A3 DIN 41870 (TO 18), base plate, transparent epoxy resin lens, solder tabs, lead spacing 2.54 mm (1/10″)

Collector indication Projection at case bottom

Application Computer-controlled flashes, light-reflecting switches for steady and varying intensity, “measuring and controlling”

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Available in groups
- Same package as of LD 242



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
BP 103 II	Q62702-P79-S1
BP 103 III	Q62702-P79-S2
BP 103 IV*	Q62702-P79-S3

Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–40...+80	°C
Dip soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Iron soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	50	V
Collector current	I_C	100	mA
Collector peak current ($\tau < 10$ µs)	I_{CM}	200	mA
Emitter base voltage	V_{EB}	7	V
Power dissipation (T_A = 25 °C)	P_{tot}	300	mW
Thermal resistance	R_{thJA}	500	K/W
	R_{thJC}	200	K/W

* Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

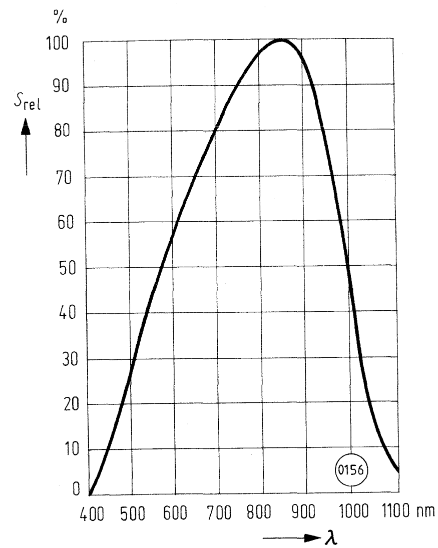
Characteristics (T_A = 25 °C)

Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	440...1100	nm
Radiant sensitive area	A	0.12	mm^2
Dimensions of chip area	$L \times W$	0.5 × 0.5	mm
Distance between chip surface and case surface	D	0.2...0.8	mm
Half angle	φ	±55	deg.
Photocurrent of collector-base photodiode (E_v = 1000 lx; V_{CB} = 5 V)	I_{PCB}	1.5	µA
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	9	pF
(V_{CB} = 0 V; f = 1 MHz; E = 0 lx)	C_{CB}	13	pF
(V_{EB} = 0 V; f = 1 MHz; E = 0 lx)	C_{EB}	21	pF
Collector-emitter leakage current (V_{CEO} = 35 V; E = 0 lx)	I_{CEO}	5 (≤100)	nA

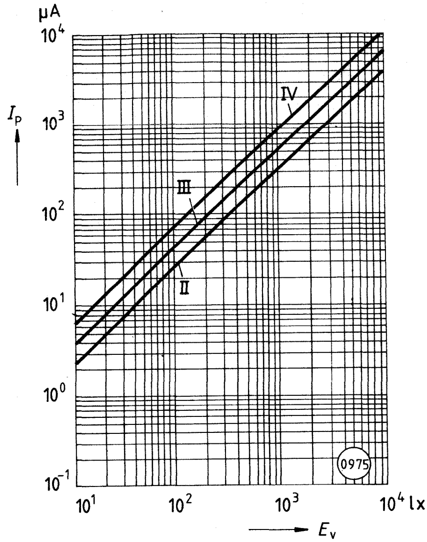
The phototransistors are grouped according to their spectral sensitivity and distinguished by roman figures

		II	III	IV	
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_{PCE}	250...500	400...800	≥630	µA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	I_{PCE}	63...125	100...200	160...320	µA
Rise and fall time (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	5	7	9	µs
Collector-emitter saturation voltage ($I_C = I_{PCE\ min} \cdot 0.3$; E = 1000 lx)	$V_{CE\ sat}$	130	140	150	mV
Current gain (E_v = 1000 lx; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	250	400	630	

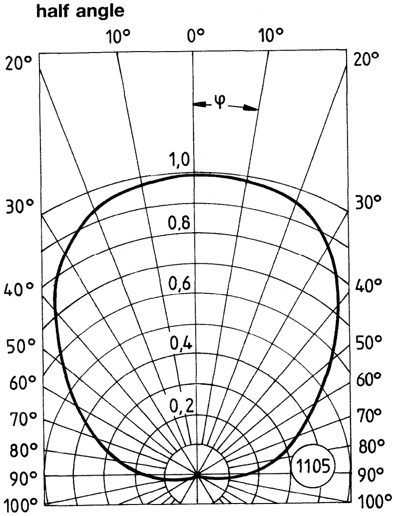
Relative spectral sensitivity versus wavelength



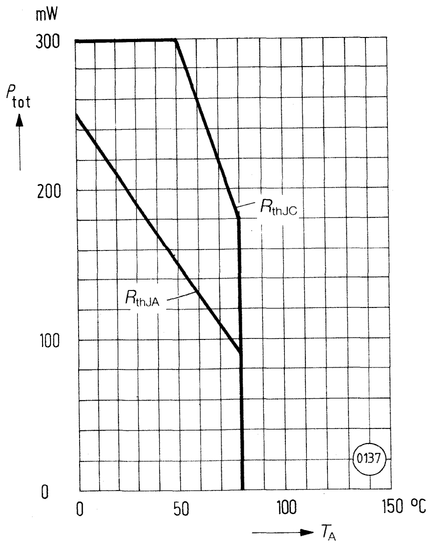
Photocurrent versus illuminance



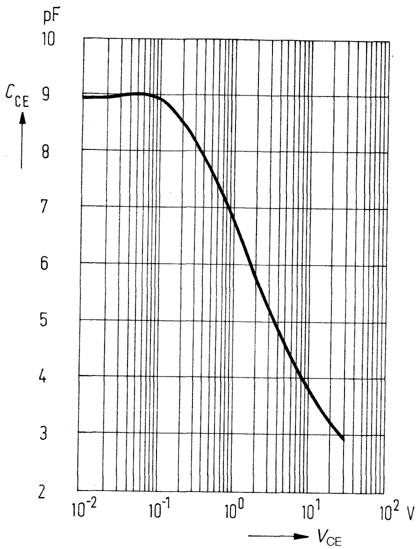
Directional characteristic
Relative spectral sensitivity versus half angle



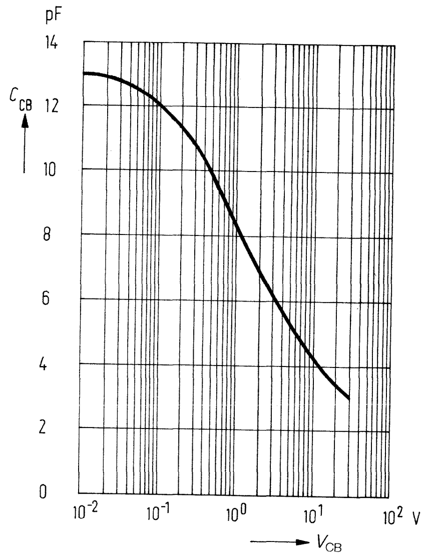
Total power dissipation versus ambient temperature



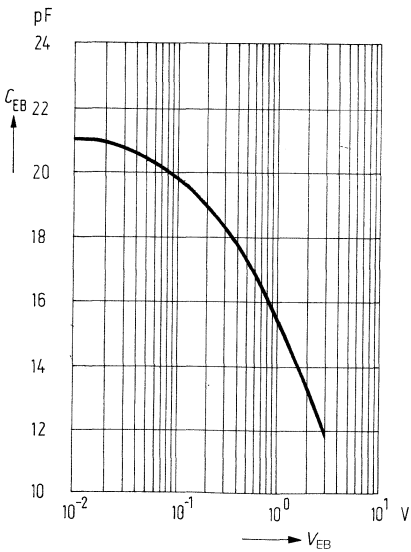
Collector-emitter capacitance versus collector-emitter voltage



Collector-base capacitance versus collector-base voltage



Emitter-base capacitance versus emitter-base voltage



BP 103 B is a Silicon NPN Phototransistor in epitaxial planar technology without base connection.

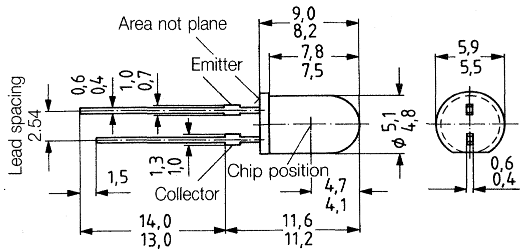
Package 5 mm LED package (T 1¾), transparent epoxy resin, solder tabs, lead spacing 2.54 mm (1/10″)

Collector indication Short solder tab

Application Computer-controlled flashes, light-reflecting switches for steady and varying intensity, industrial electronics, “measuring and controlling”

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Available in groups
- Same package as of LD 271



Approx. weight 0.2 g
Dimensions in mm

Type	Ordering code
BP 103 B II	Q62702-P85-S2
BP 103 B III	Q62702-P85-S3
BP 103 B IV*	Q62702-P85-S4

Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–55...+100	°C
Dip soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Iron soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	35	V
Collector current	I_C	50	mA
Collector peak current ($\tau < 10$ µs)	I_{CM}	100	mA
Emitter-collector voltage	V_{EC}	7	V
Power dissipation (T_A = 25 °C)	P_{tot}	200	mW
Thermal resistance	R_{thJA}	375	K/W

* Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

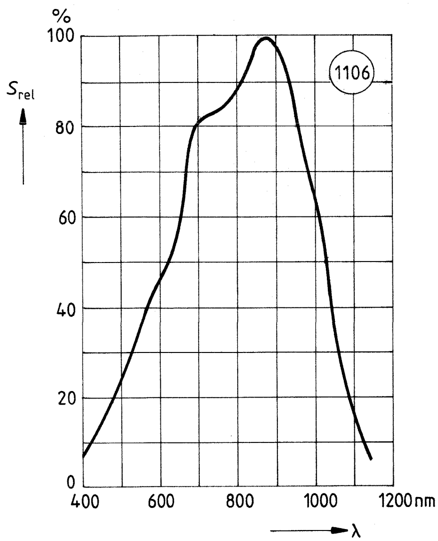
Characteristics (T_A = 25 °C)

Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	420...1100	nm
Radiant sensitive area	A	0.12	mm^2
Dimensions of chip area	$L \times W$	0.5 × 0.5	mm
Distance between chip surface and case surface	D	4.1...4.7	mm
Half angle	φ	±25	deg.
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	6.5	pF
Collector-emitter leakage current (V_{CEO} = 35 V; E = 0 lx)	I_{CEO}	5 (≤100)	nA

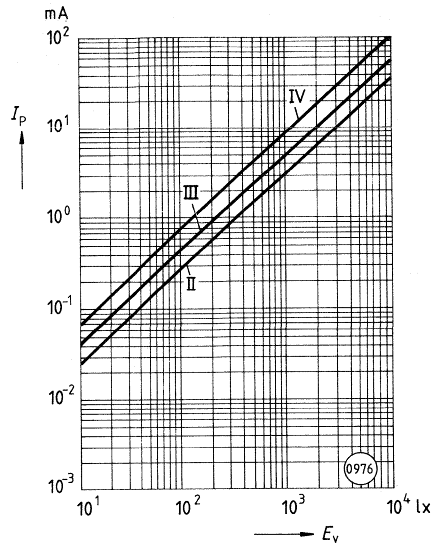
The phototransistors are grouped according to their spectral sensitivity and distinguished by roman figures

		II	III	IV	
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_{PCE}	2.5...5.0	4.0...8.0	≥6.3	mA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	I_{PCE}	0.63...1.25	1...2	≥1.6	mA
Rise and fall time (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	7.5	10	10	µs
Collector-emitter saturation voltage ($I_C = I_{PCE\ min} \cdot 0.3$; E = 1000 lx)	$V_{CE\ sat}$	130	140	150	mV
Current gain (E_v = 1000 lx; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	350	550	650	

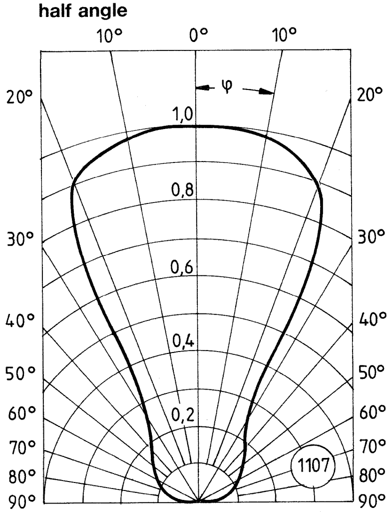
Relative spectral sensitivity versus wavelength



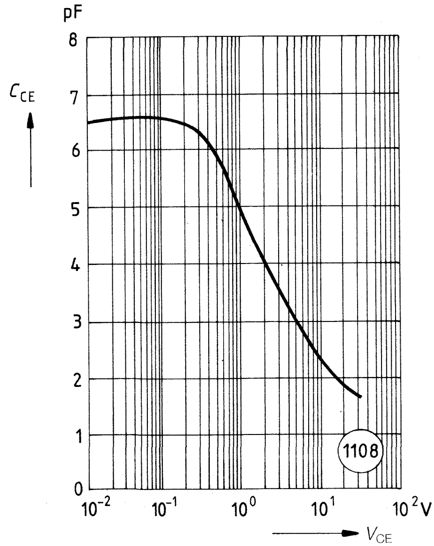
Photocurrent versus illuminance



Directional characteristic
Relative spectral sensitivity versus half angle



Collector-emitter capacitance versus collector-emitter voltage



BPX 38 is a Silicon NPN Phototransistor in epitaxial planar technology with base connection. The collector terminal is electrically connected to the case.

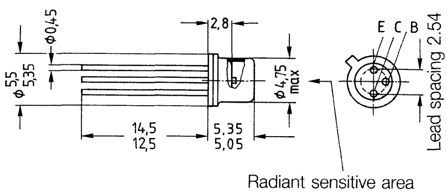
Package 18A3 DIN 41876 (TO 18), flat glass lens, hermetically sealed package, lead spacing 2.54 mm (1/10″)

Collector indication Projection at case bottom

Application Light-reflecting switches for steady and varying intensity, industrial electronics, "measuring and controlling", lens systems

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Available in groups
- Same package as of SFH 402



Approx. weight 1.0 g
Dimensions in mm

Type	Ordering code
BPX 38 II	Q62702-P15-S2
BPX 38 III	Q62702-P15-S3
BPX 38 IV*	Q62702-P15-S4

Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–55...+125	°C
Dip soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Iron soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	50	V
Collector current	I_C	50	mA
Collector peak current ($\tau < 10$ µs)	I_{CM}	200	mA
Emitter base voltage	V_{EB}	7	V
Power dissipation	P_{tot}	330	mW
Thermal resistance	R_{thJA}	≤450	K/W
	R_{thJC}	≤150	K/W

* Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

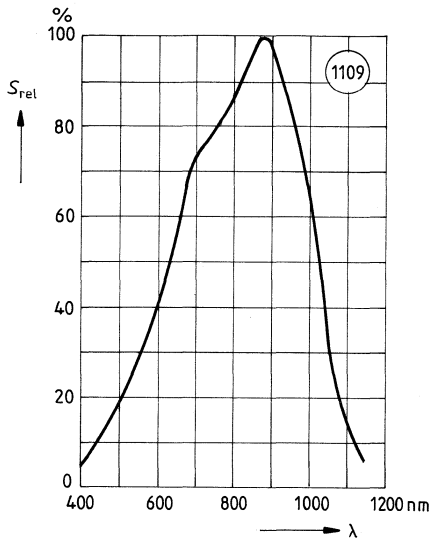
Characteristics (T_A = 25 °C)

Wavelength of max. sensitivity	$\lambda_{S\ max}$	870	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	450...1100	nm
Radiant sensitive area	A	0.675	mm^2
Dimensions of chip area	$L \times W$	1 × 1	mm
Distance between chip surface and case surface	D	2.25...2.55	mm
Half angle	φ	±40	deg.
Photocurrent of collector-base photodiode			
(E_v = 1000 lx; V_{CE} = 5 V)	I_{PCB}	6.2	µA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	I_{PCB}	1.2	µA
Capacitance			
(V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	23	pF
(V_{CB} = 0 V; f = 1 MHz; E = 0 lx)	C_{CB}	41	pF
(V_{EB} = 0 V; f = 1 MHz; E = 0 lx)	C_{EB}	47	pF

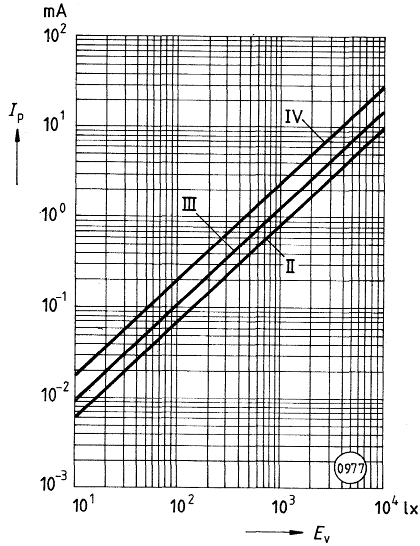
The phototransistors are grouped according to their spectral sensitivity and distinguished by roman figures

		II	III	IV	
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_{PCE}	0.63...1.25	1.0...2.0	≥1.6	mA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	I_{PCE}	0.16...0.32	0.25...0.5	≥0.4	mA
Rise and fall time (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	9	12	15	µs
Collector-emitter saturation voltage ($I_C = I_{PCE\ min} \cdot 0.3$; E = 1000 lx)	$V_{CE\ sat}$	175	195	215	mV
Current gain (E_v = 1000 lx; V_{CE} = 5 V; E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	150	240	350	
Collector-emitter leakage current (V_{CEO} = 25 V; E = 0 lx)	I_{CEO}	8 (≤200)	12 (≤500)	20 (≤500)	nA

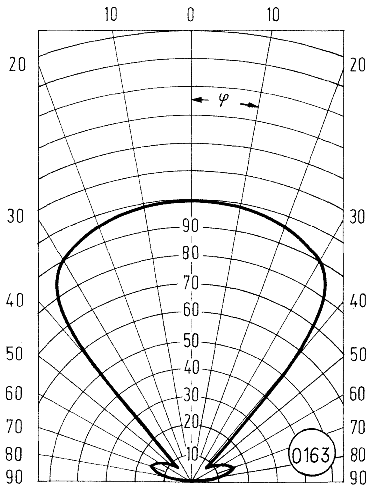
Relative spectral sensitivity versus wavelength



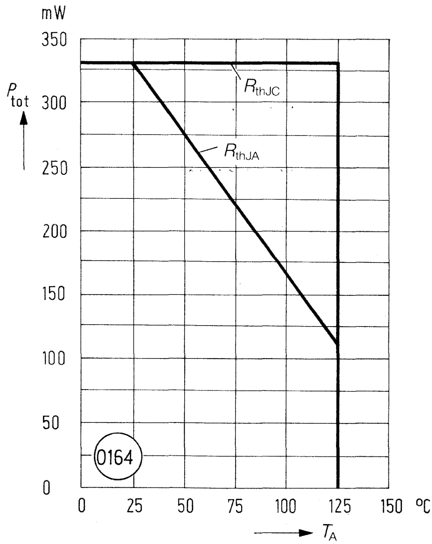
Photocurrent versus illuminance



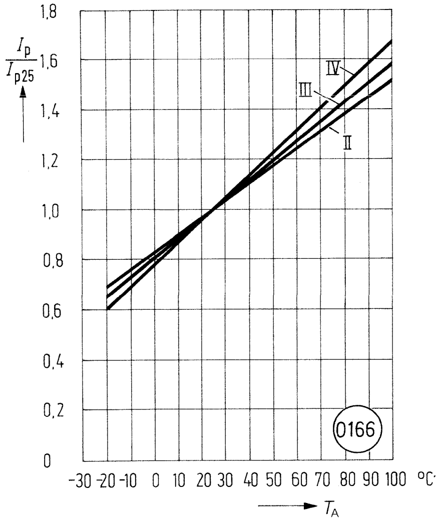
Directional characteristic
Relative spectral sensitivity versus half angle



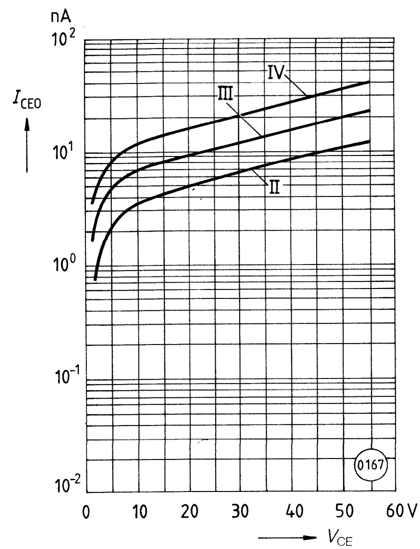
Total power dissipation versus ambient temperature



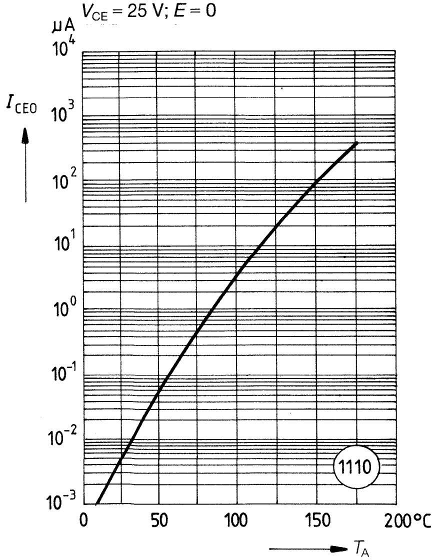
Photocurrent versus ambient temperature



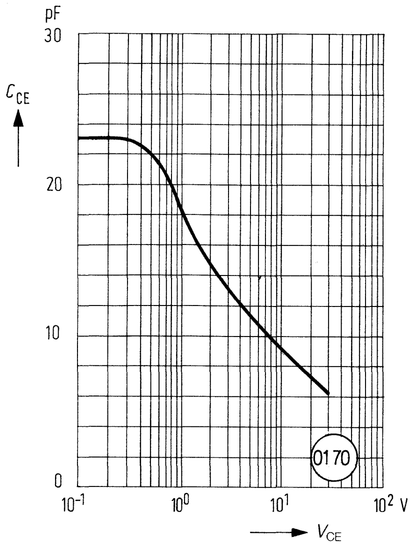
Collector-emitter leakage current versus collector-emitter voltage



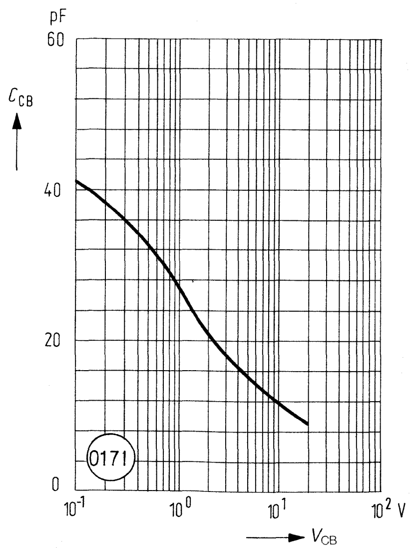
Collector-emitter leakage current versus ambient temperature
V_{CE} = 25 V; E = 0



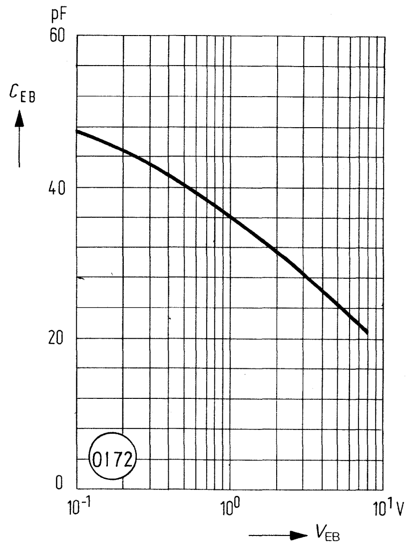
Collector-emitter capacitance versus collector-emitter voltage



Collector-base capacitance versus collector-base voltage



Emitter-base capacitance versus emitter-base voltage



Silicon NPN Phototransistor

BPX 43 is a Silicon NPN Phototransistor in epitaxial planar technology with base connection. The collector terminal is electrically connected to the case.

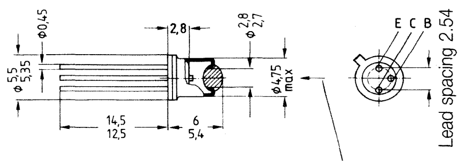
Package 18 A3 DIN 41876 (TO 18), glass lens, hermetically sealed package, solder tabs, lead spacing 2.54 mm (1/10″)

Collector indication Projection at case bottom

Application Light-reflecting switches for steady and varying intensity, industrial electronics, "measuring and controlling"

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Available in groups
- Same package as of SFH 401



Approx. weight 1.0 g
Dimensions in mm

Type	Ordering code
BPX 43 II	Q62702-P16-S2
BPX 43 III	Q62702-P16-S3
BPX 43 IV*	Q62702-P16-S4

Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–55...+125	°C
Dip soldering temperature (≥2 mm distance from case bottom; soldering time t ≤5 s)	T_{sold}	260	°C
Iron soldering temperature (≥2 mm distance from case bottom; soldering time t ≤3 s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	50	V
Collector current	I_C	50	mA
Collector peak current (τ <10 µs)	I_{CM}	200	mA
Emitter base voltage	V_{EB}	7	V
Power dissipation (T_A = 25 °C)	P_{tot}	330	mW
Thermal resistance	R_{thJA}	≤450	K/W
	R_{thJC}	≤150	K/W

* Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

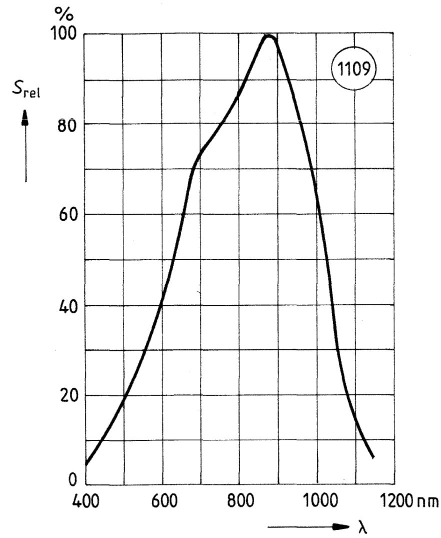
Characteristics (T_A = 25 °C)

Wavelength of max. sensitivity	$\lambda_{S\ max}$	870	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	450...1100	nm
Radiant sensitive area	A	0.675	mm^2
Dimensions of chip area	$L \times W$	1 × 1	mm
Distance between chip surface and case surface	D	2.6...3.2	mm
Half angle	φ	±15	deg.
Photocurrent of collector-base photodiode			
(E_v = 1000 lx; V_{CB} = 5 V)	I_{PCB}	30	µA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CB} = 5 V)	I_{PCB}	7.1	µA
Capacitance			
(V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	23	pF
(V_{CB} = 0 V; f = 1 MHz; E = 0 lx)	C_{CB}	41	pF
(V_{EB} = 0 V; f = 1 MHz; E = 0 lx)	C_{EB}	47	pF

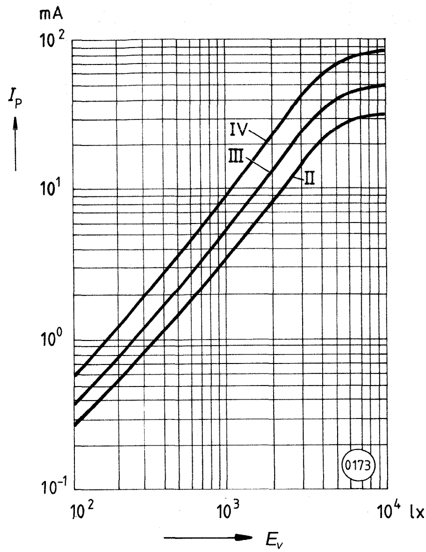
The phototransistors are grouped according to their spectral sensitivity and distinguished by roman figures

		II	III	IV	
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_P	2.5...5.0	4.0...8.0	≥6.3	mA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	I_P	0.63...1.25	1.0...2.0	≥1.6	mA
Rise and fall time (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	9	12	15	µs
Collector-emitter saturation voltage ($I_C = I_{PCE\ min} \cdot 0.3$; E = 1000 lx)	$V_{CE\ sat}$	190	230	280	mV
Current gain (E_v = 1000 lx; V_{CE} = 5 V; E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	125	200	300	
Collector-emitter leakage current (V_{CEO} = 25 V; E = 0 lx)	I_{CEO}	8 (≤200)	12 (≤500)	20 (≤500)	nA

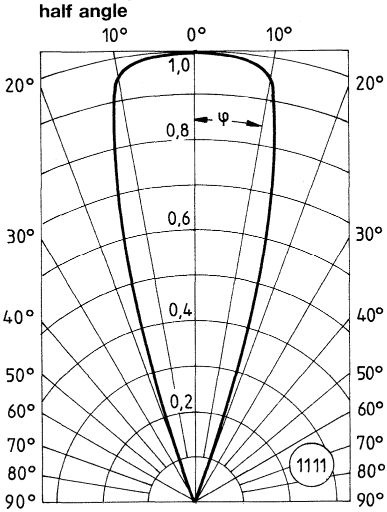
Relative spectral sensitivity versus wavelength



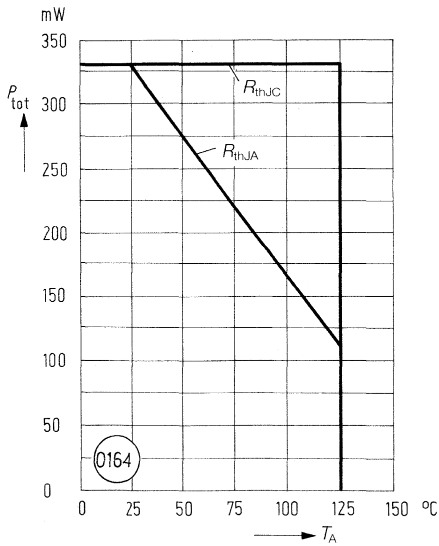
Photocurrent versus illuminance
(V_{CE} = 5 V)



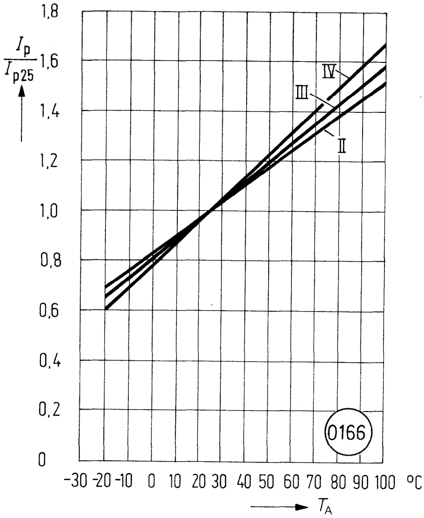
Directional characteristic
Relative spectral sensitivity versus half angle



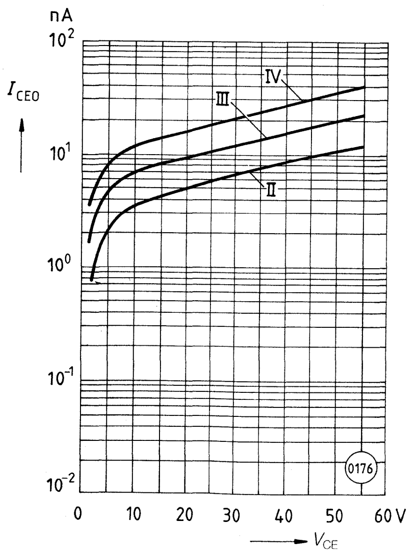
Total power dissipation versus ambient temperature



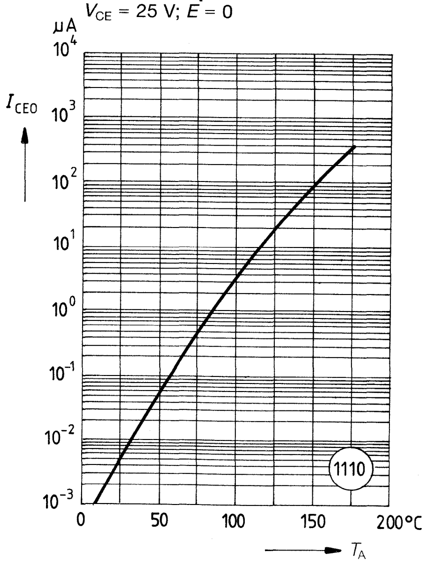
Photocurrent versus ambient temperature



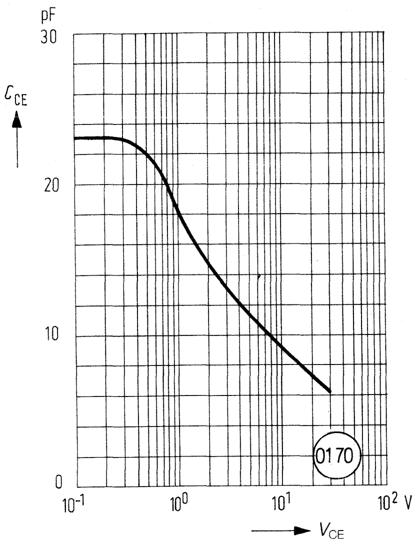
Collector-emitter current versus collector-emitter voltage



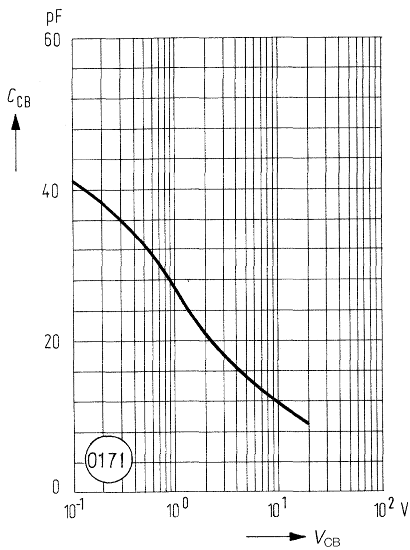
Collector-emitter current versus ambient temperature
V_{CE} = 25 V; E = 0



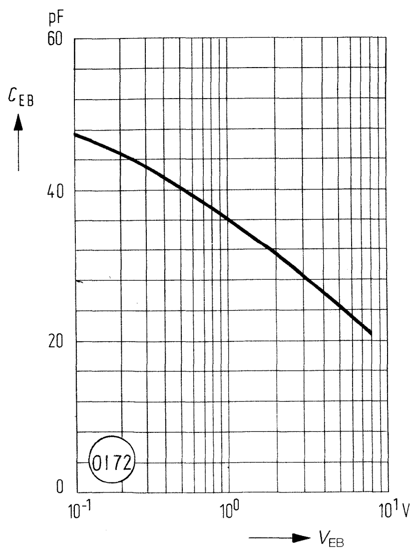
Collector-emitter capacitance versus collector-emitter voltage



Collector-base capacitance versus collector-base voltage



Emitter-base capacitance versus emitter-base voltage



BPX 81 is a Silicon NPN Phototransistor in epitaxial planar technology without base connection.

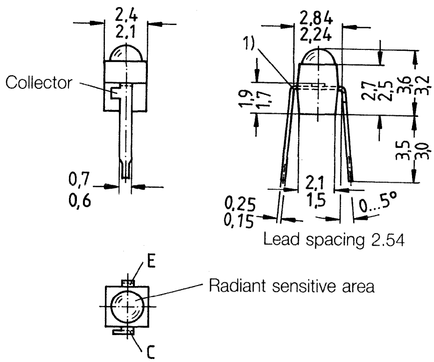
Package Lead frame, transparent epoxy resin lens, solder tabs, lead spacing 2.54 mm (1/10″)

Collector indication Projection at solder tab

Application Computer-controlled flashes, miniature light-reflecting switches for steady and varying intensity, industrial electronics, “measuring and controlling”

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Available in groups
- Same package as of LD 261



Approx. weight 0.03 g
Dimensions in mm

1) Detaching area of tools, flash not true to size

Type	Ordering code
BPX 81 II	Q62702-P43-S2
BPX 81 III	Q62702-P43-S3
BPX 81 IV*	Q62702-P43-S4

Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	−40...+80	°C
Dip soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 3$ s)	T_{sold}	230	°C
Iron soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 5$ s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	32	V
Collector current	I_C	50	mA
Collector peak current (τ <10 µs)	I_{CM}	200	mA
Power dissipation (T_A = 25 °C)	P_{tot}	100	mW
Thermal resistance	R_{thJA}	750	K/W
	R_{thJC}	650	K/W

* Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

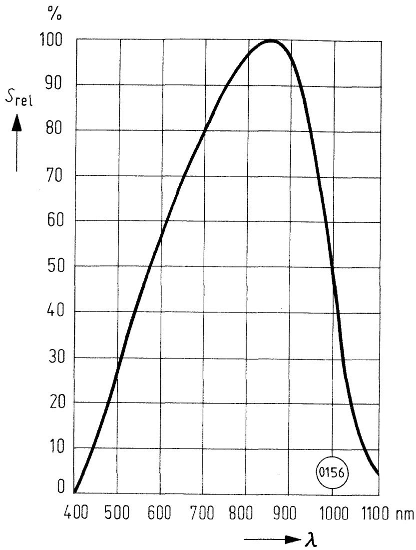
Characteristics (T_A = 25 °C)

Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	440...1070	nm
Radiant sensitive area	A	0.17	mm^2
Dimensions of chip area	$L \times W$	0.6 × 0.6	mm
Distance between chip surface and apex of lens	D	1.3...1.9	mm
Half angle	φ	±18	deg.
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	6	pF
Collector-emitter leakage current (V_{CEO} = 25 V; E = 0 lx)	I_{CEO}	25 (≤200)	nA

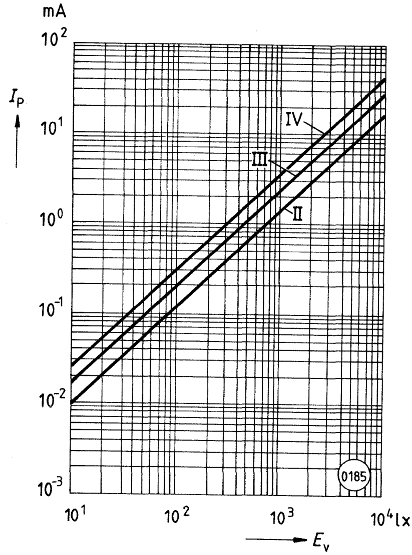
The phototransistors are grouped according to their spectral sensitivity and distinguished by roman figures

		II	III	IV	
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_P	1.0...2.0	1.6...3.2	≥2.5	mA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	I_P	0.25...0.50	0.40...0.80	≥0.63	mA
Rise and fall time (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	5.5	6	8	µs
Collector-emitter saturation voltage ($I_C = I_{PCE\ min} \cdot 0.3$; λ = 950 nm; E_e = 0.5 mW/cm²)	$V_{CE\ sat}$	150	150	150	mV
Current gain (E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	190	300	450	

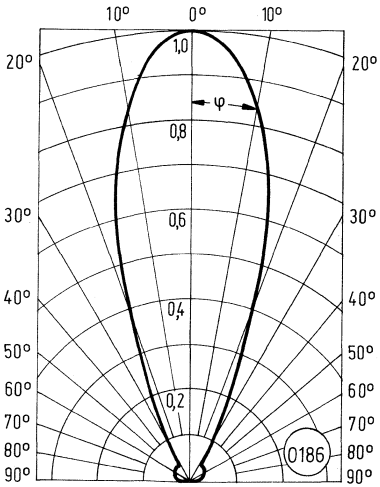
Relative spectral sensitivity versus wavelength



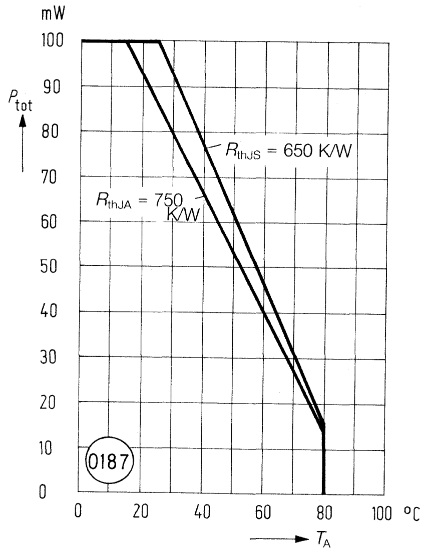
Photocurrent versus illuminance



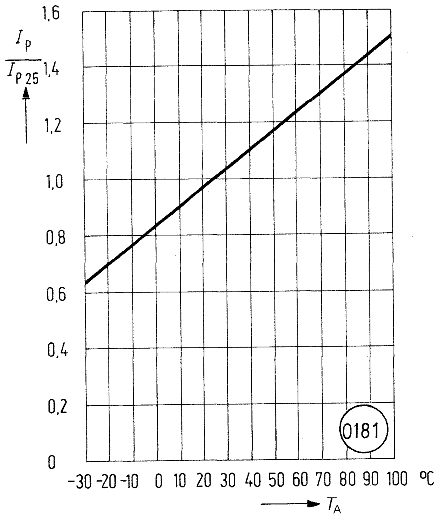
Directional characteristic
Relative spectral sensitivity versus half angle



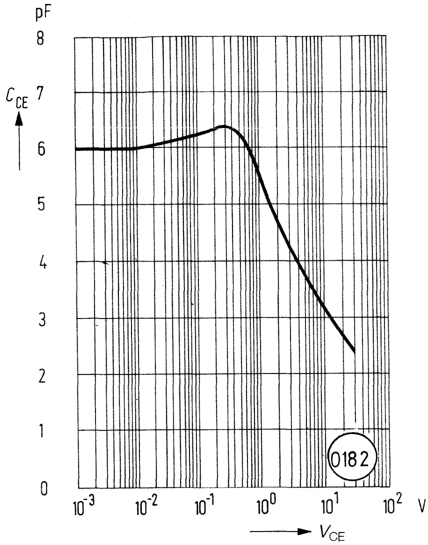
Total power dissipation versus ambient temperature



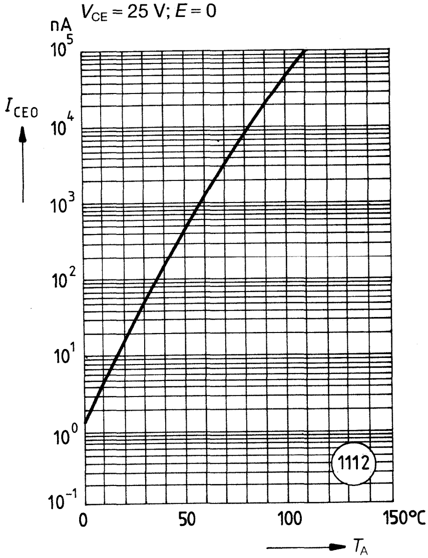
Photocurrent versus ambient temperature



Collector-emitter capacitance versus collector-emitter voltage



Collector-emitter leakage current versus ambient temperature
V_{CE} = 25 V; E = 0



Silicon NPN Phototransistor Arrays

BPX 80...89 are Silicon NPN Phototransistor arrays in epitaxial planar technology without base connection.

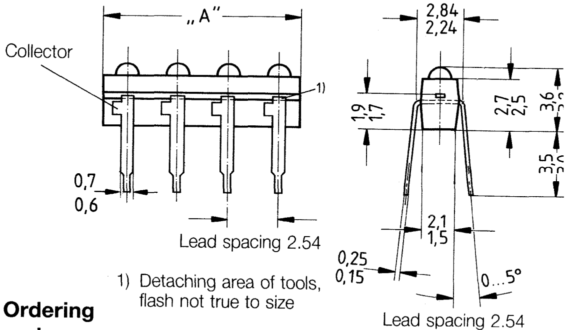
Package Lead frame, arrays, transparent epoxy resin lens, solder tabs, lead spacing 2.54 mm (1/10″)

Collector indication Projection at solder tab

Application Miniature light-reflecting switches for steady and varying intensity, punched tape reading, industrial electronics, "measuring and controlling"

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Available in groups
- Same package as of LD 260



1) Detaching area of tools, flash not true to size

Sample with 4 phototransistors (e.g. BPX 84)

Approx. weight 0.12 g
Dimensions in mm

Type	Number of transistors per array	Dimension "A" min.	Dimension "A" max.	Ordering code
BPX 82	2	4.5	4.9	Q62702-P21
BPX 83	3	7.0	7.4	Q62702-P25
BPX 84	4	9.6	10	Q62702-P30
BPX 85	5	12.1	12.5	Q62702-P31
BPX 86	6	14.6	15	Q62702-P22
BPX 87	7	17.2	17.6	Q62702-P32
BPX 88	8	19.7	20.1	Q62702-P33
BPX 89	9	22.3	22.7	Q62702-P26
BPX 80	10	24.8	25.2	Q62702-P28

Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–40...+80	°C
Dip soldering temperature (≥2 mm distance from the case bottom; soldering time t ≤3 s)	T_{sold}	230	°C
Iron soldering temperature (≥2 mm distance from the case bottom; soldering time t ≤5 s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	32	V
Collector current	I_C	50	mA
Collector peak current (τ <10 μs)	I_{CM}	200	mA
Power dissipation (T_A = 25 °C)	P_{tot}	100	mW
Thermal resistance	R_{thJA}	750	K/W
	R_{thJS}	650	K/W

Characteristics (T_A = 25 °C)

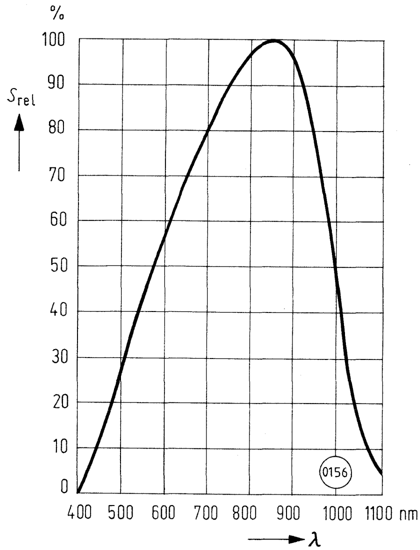
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	440...1070	nm
Radiant sensitive area	A	0.17	mm^2
Dimensions of chip area	$L \times W$	0.6 × 0.6	mm
Distance between chip surface and apex of lens	D	1.3...1.9	mm
Half angle	φ	±18	deg.
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	6	pF
Collector-emitter leakage current (V_{CEO} = 25 V; E = 0 lx)	I_{CEO}	25 (≤200)	nA

The phototransistors are grouped according to their spectral sensitivity and distinguished by letters (e.g. BPX 82 A)

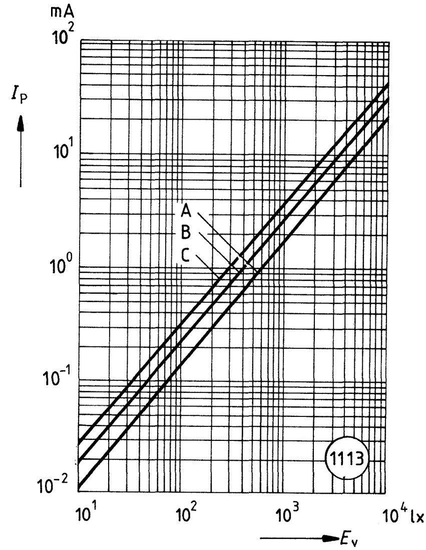
		A	B	C	
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_P	1.25...2.5	1.6...3.2	≥2	mA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	I_P	0.32...0.63	0.40...0.80	≥0.5	mA
Rise and fall time (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	5,5	6	8	µs
Collector-emitter saturation voltage ($I_C = I_{PCE\ min} \cdot 0.3$; λ = 950 nm; E_e = 0.5 mW/cm^3)	$V_{CE\ sat}$	150	150	150	mV
Current gain E_e = 0.5 mW/cm^2; (λ = 950 nm; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	190	300	450	

Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

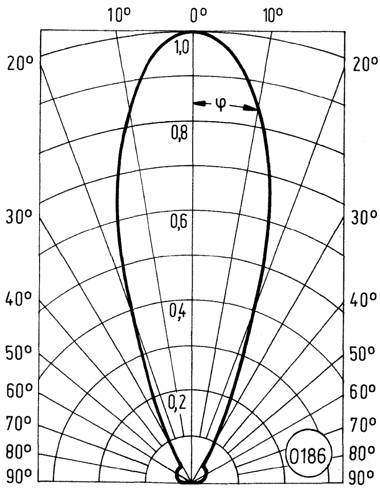
Relative spectral sensitivity versus wavelength



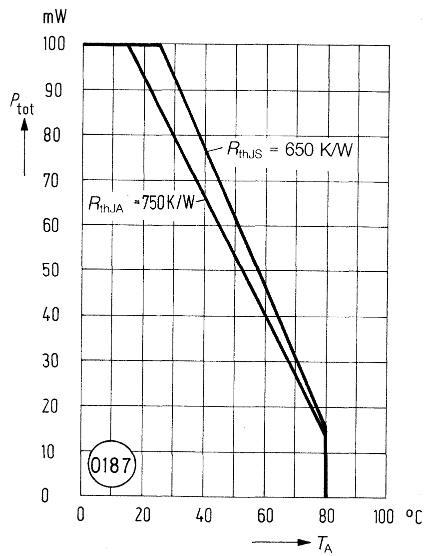
Photocurrent versus illuminance



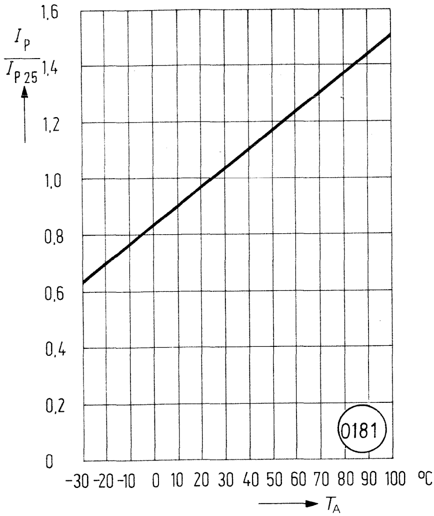
Directional characteristic
Relative spectral sensitivity versus half angle



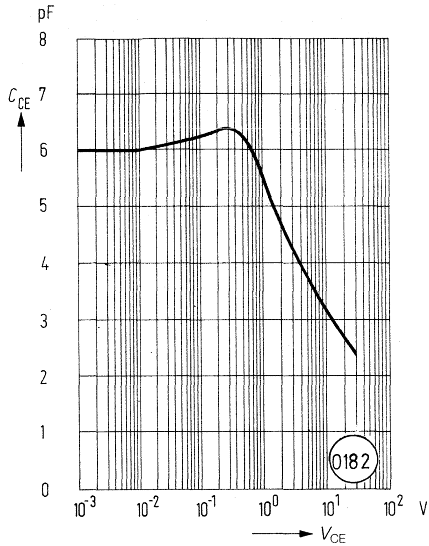
Total power dissipation versus ambient temperature



Photocurrent versus ambient temperature



Collector-emitter capacitance versus collector-emitter voltage



BPY 62 is a Silicon NPN Phototransistor in epitaxial planar technology with base connection. The collector terminal is electrically connected to the case.

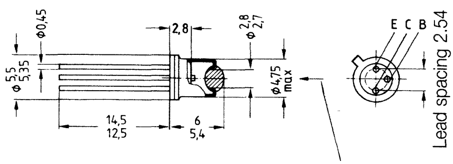
Package 18A3 DIN 41876 (TO 18), glass lens, hermetically sealed package, solder tabs, lead spacing 2.54 mm (1/10″)

Collector indication Projection at case bottom

Application Computer-controlled flashes, light-reflecting switches for steady and varying intensity, "measuring and controlling"

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Available in groups
- Same package as of SFH 401



Approx. weight 1.0 g
Dimensions in mm

Type	Ordering code
BPY 62 II	Q60215-Y1111
BPY 62 III	Q60215-Y1112
BPY 62 IV	Q60215-Y1113

Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–55...+125	°C
Dip soldering temperature (≥2 mm distance from the case bottom; soldering time t ≤5 s)	T_{sold}	260	°C
Iron soldering temperature (≥2 mm distance from the case bottom; soldering time t ≤3 s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	32	V
Collector current	I_C	50	mA
Collector peak current (τ <10 µs)	I_{CM}	200	mA
Emitter base voltage	V_{EB}	5	V
Power dissipation (T_A = 25 °C)	P_{tot}	300	mW
Thermal resistance	R_{thJA}	500	K/W
	R_{thJC}	200	K/W

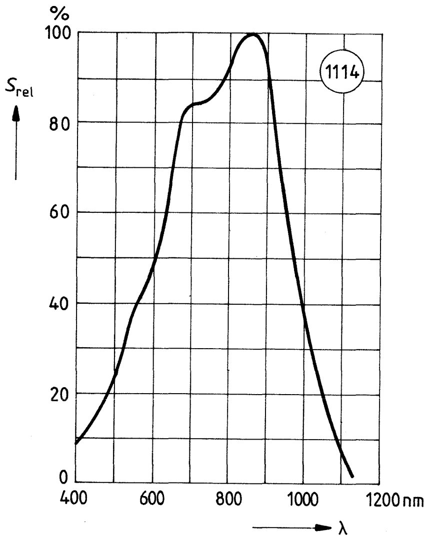
Characteristics (T_A = 25 °C)

Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1080	nm
Radiant sensitive area	A	0.12	mm^2
Dimensions of chip area	$L \times W$	0.5 × 0.5	mm
Distance between chip surface and case surface	D	2.6...3.2	mm
Half angle	φ	±8	deg.
Photocurrent of collector-base photodiode (E_v = 1000 lx; V_{CB} = 5 V)	I_{PCB}	17	µA
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	6	pF
(V_{CB} = 0 V; f = 1 MHz; E = 0 lx)	C_{CB}	10	pF
(V_{EB} = 0 V; f = 1 MHz; E = 0 lx)	C_{EB}	21	pF
Collector-emitter leakage current (V_{CEO} = 25 V; E = 0 lx)	I_{CEO}	5 (≤100)	nA

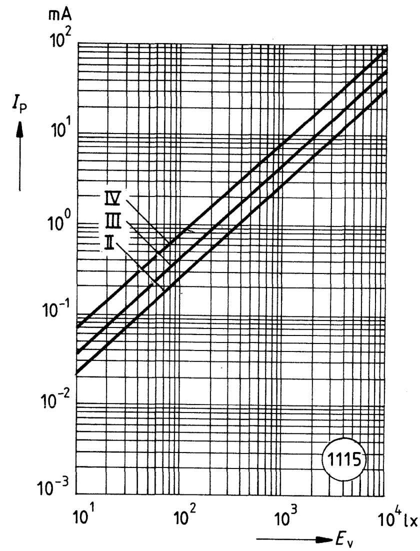
The phototransistors are grouped according to their spectral sensitivity and distinguished by roman figures

		II	III	IV	
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_P	2.0...4.0	3.2...6.3	≥5.0	mA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	I_P	0.5...1	0.8...1.6	≥1.25	mA
Rise and fall time (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	5	7	9	µs
Collector-emitter saturation voltage ($I_C = I_{PCE\ min} \cdot 0.3$; E = 1000 lx)	$V_{CE\ sat}$	140	140	140	mV
Current gain (E_v = 1000 lx; V_{CE} = 5 V; E_e = 0.5 mW/cm^2 λ = 950 nm; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	180	280	400	

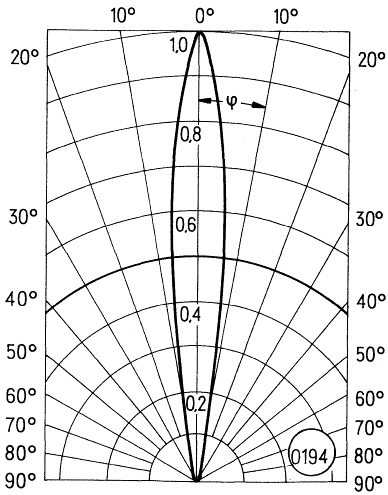
Relative spectral sensitivity versus wavelength



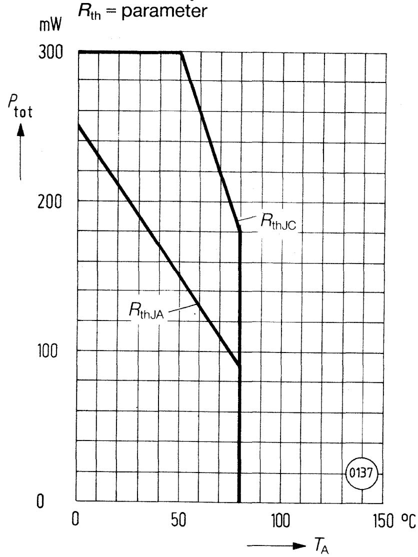
Photocurrent versus illuminance



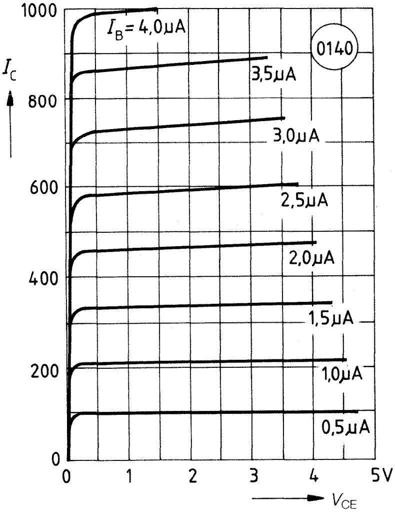
Directional characteristic
Relative spectral sensitivity versus half angle



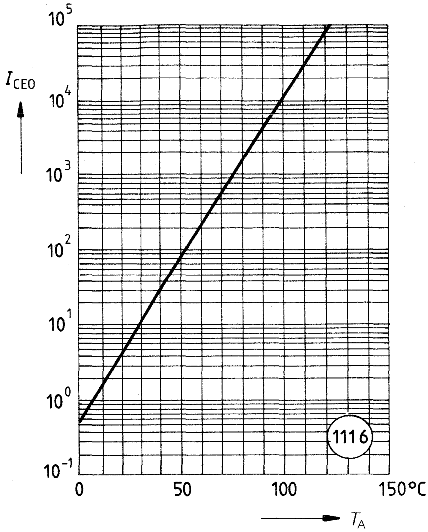
Total power dissipation versus ambient temperature
R_{th} = parameter



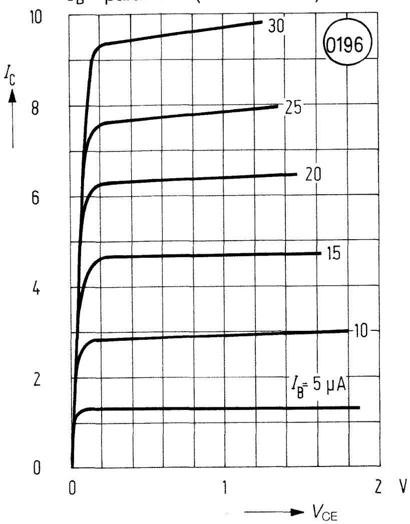
Output characteristics
Collector current versus
collector-emitter voltage
I_B = parameter



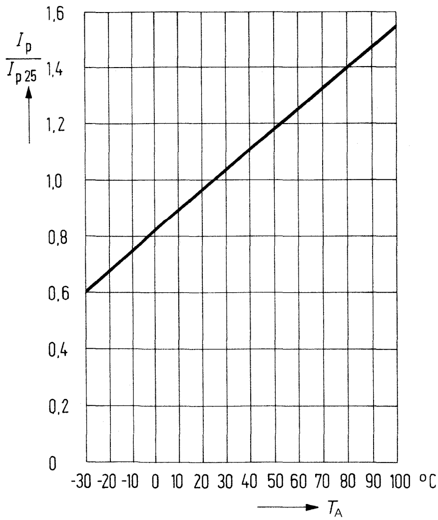
Collector-emitter leakage current
versus ambient temperature
V_{CE} = 25 V; E = 0



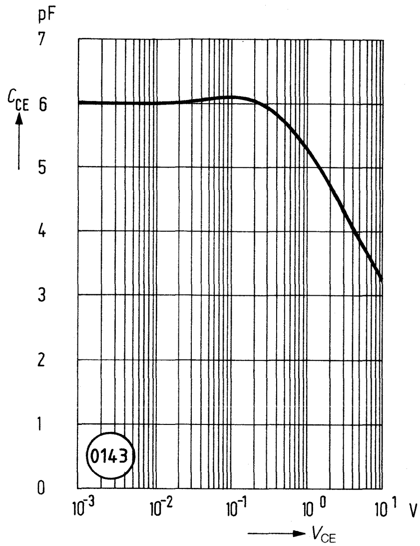
Output characteristics
Collector current versus
collector-emitter voltage
I_B = parameter (emitter circuit)



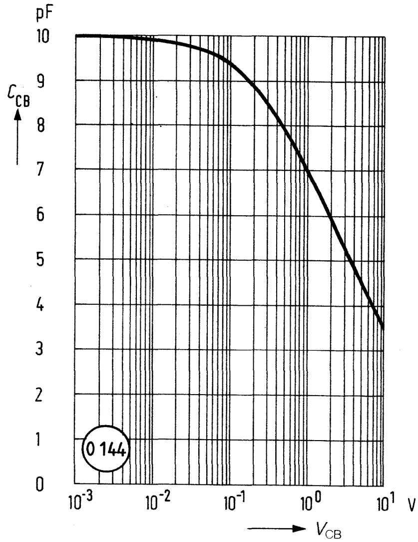
Photocurrent versus ambient
temperature



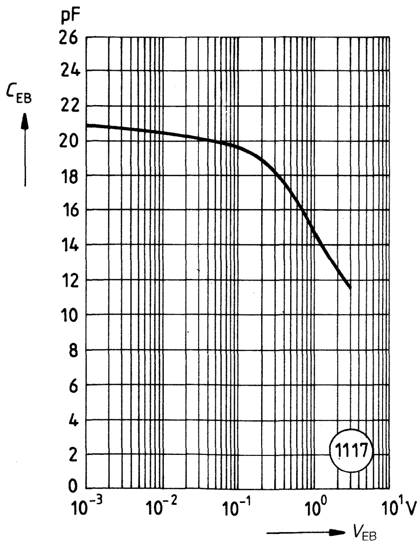
Collector-emitter capacitance versus collector-emitter voltage



Collector-base capacitance versus collector-base voltage



Emitter-base capacitance versus emitter-base voltage



Silicon NPN Phototransistor
Silicon NPN Phototransistor with Daylight Filter

SFH 303
SFH 303 F

Preliminary data

SFH 303 and SFH 303 F are Silicon NPN Phototransistors in epitaxial planar technology with base connection.

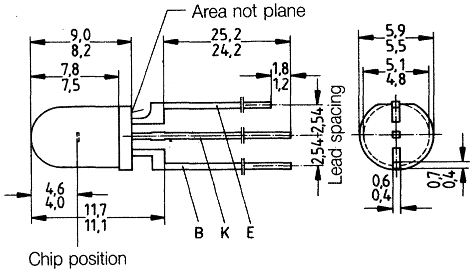
Package 5 mm LED package (T 1¾), transparent epoxy resin or black epoxy resin (SFH 303 F) solder tabs, lead spacing 2.54 mm (1⁄10″)

Emitter indication Solder tab with projection

Application Industrial electronics, “measuring and controlling”, light-reflecting switches for steady and varying intensity, fiber optic transmission systems

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Daylight filter (SFH 303 F)
- Same package as of photodiode SFH 2030, SFH 2030 F, IRED SFH 485



Approx. weight 0.2 g
Dimensions in mm

Type	Ordering code
SFH 303	Q62702-P957
SFH 303 F	Q62702-P958

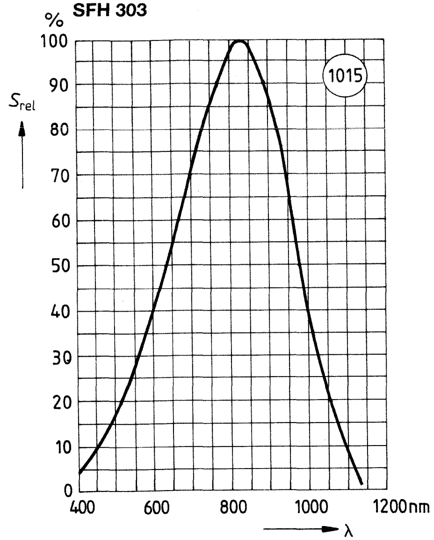
Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–55...+100	°C
Dip soldering temperature (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Iron soldering temperature (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	50	V
Collector current	I_C	50	mA
Collector peak current ($\tau < 10$ µs)	I_{CM}	100	mA
Emitter base voltage	V_{EB}	7	V
Power dissipation (T_A = 25 °C)	P_{tot}	200	mW
Thermal resistance	R_{thJA}	375	K/W

Characteristics (T_A = 25 °C)		SFH 303	SFH 303 F	
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	900	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	800...1100	nm
Radiant sensitive area	A	0.30	0.30	mm^2
Dimensions of radiant sensitive area	$L \times W$	0.75 × 0.75	0.75 × 0.75	mm
Distance between chip surface and case surface	D	4...4.6	4...4.6	mm
Half angle	φ	±20	±20	deg.
Photocurrent of collector-base photodiode (E_v = 1000 lx; V_{CB} = 5 V)	I_{PCB}	27	27	µA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CB} = 5 V)	I_{PCB}	5	5	µA
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	9	9	pF
(V_{CB} = 0 V; f = 1 MHz; E = 0 lx)	C_{CB}	19	19	pF
(V_{EB} = 0 V; f = 1 MHz; E = 0 lx)	C_{EB}	20	20	pF
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_P	13 (≥4) typ.	–	mA
(E_e = 0.5 mW/cm²; λ = 950 nm; V_{CE} = 5 V)	I_P	–	2 (≥0.8) typ.	mA
Rise and fall time (I_C = 2 mA; λ = 830 nm; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	15	15	µs
Collector-emitter saturation voltage (I_C = 2 mA; E = 1000 lx)	$V_{CE\ sat}$	140	–	mV
(I_C = 250 µA; λ = 950 nm; E_e = 0.5 mW/cm²)	$V_{CE\ sat}$	–	130	mV
Current gain (E_v = 1000 lx; V_{CE} = 5 V; E_e = 0.5 mW/cm²; λ = 880 nm; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	typ. 500	typ. 500	
Collector-emitter leakage current (V_{CEO} = 10 V; E = 0 lx)	I_{CEO}	2 (≤50)	2 (≤50)	nA

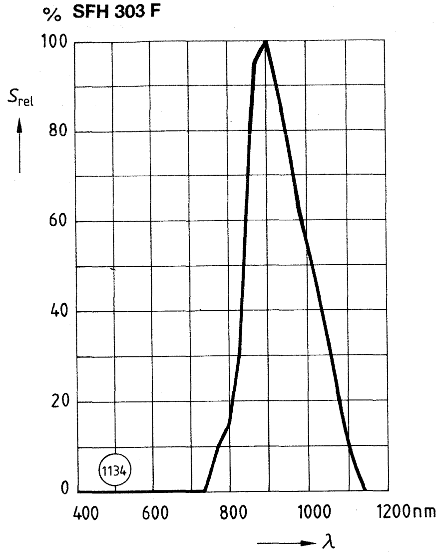
Relative spectral sensitivity versus wavelength

SFH 303



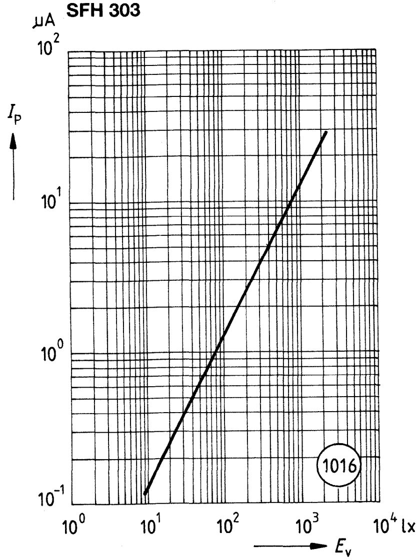
Relative spectral sensitivity versus wavelength

SFH 303 F



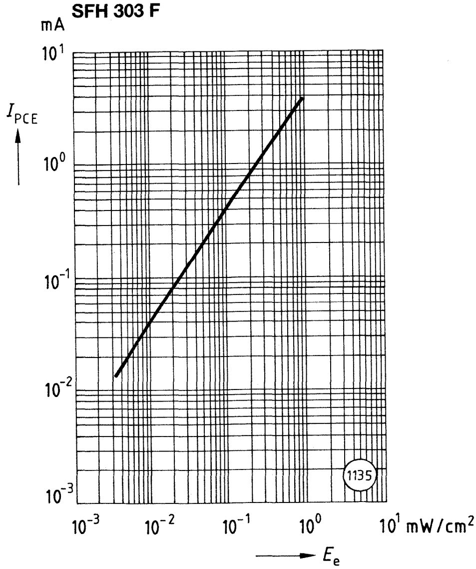
Photocurrent versus illuminance

SFH 303

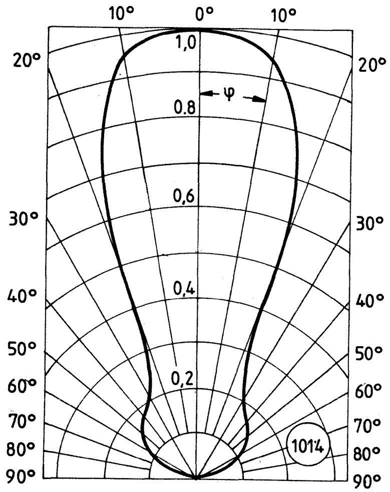


Photocurrent versus irradiance

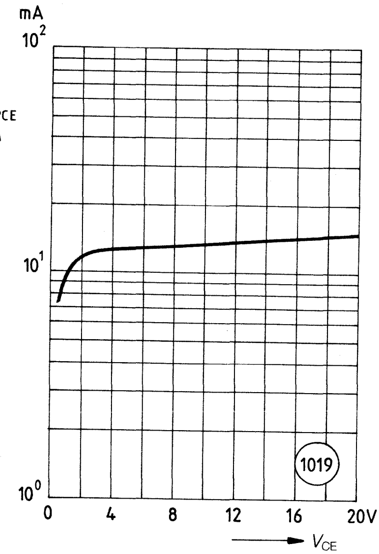
SFH 303 F



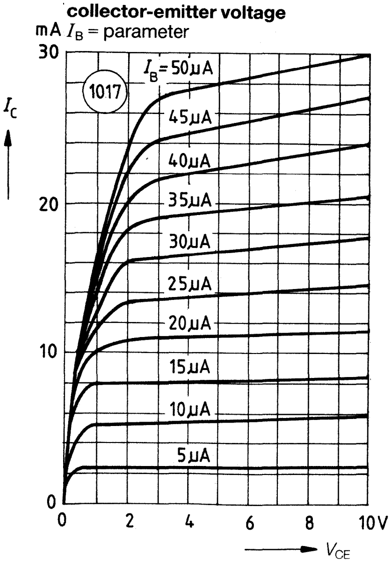
Directional characteristic
Relative spectral sensitivity versus half angle



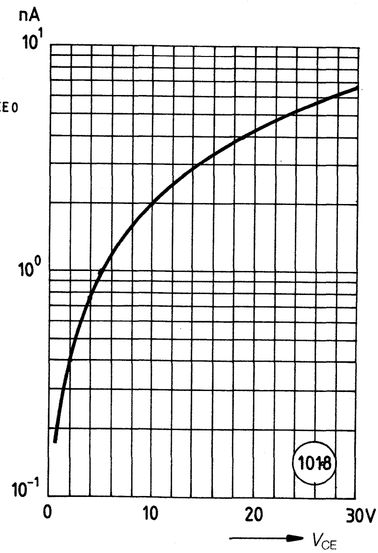
Photocurrent versus collector-emitter voltage



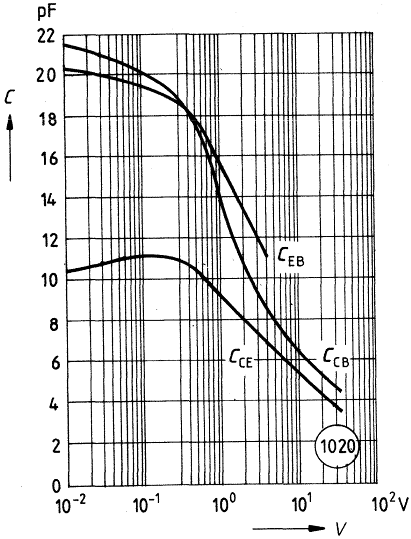
Output characteristics
Collector current versus collector-emitter voltage



Collector-emitter leakage current versus collector-emitter voltage



Capacitance versus voltage



Silicon NPN Phototransistor

SFH 305 is a Silicon NPN Phototransistor in epitaxial planar technology without base connection.

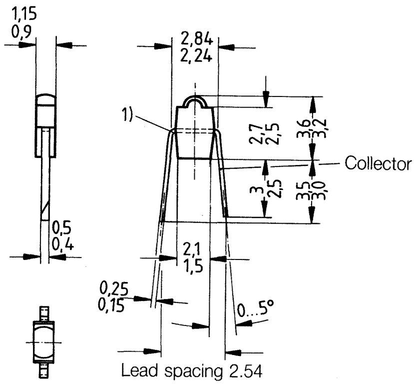
Package Miniature lead frame, transparent epoxy resin, solder tabs, lead spacing 2.54 mm (1/10″)

Collector indication Sloping solder tab

Application Miniature light-reflecting switches for steady and varying intensity, punched tape readers, industrial electronics, "measuring and controlling"

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Available in groups
- Same package as of SFH 405



1) Detaching area of tools, flash not true to size

Approx. weight 0.02 g
Dimensions in mm

Type	Ordering code
SFH 305 II	Q62702-P848
SFH 305 III	Q62702-P849

Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–40...+80	°C
Dip soldering temperature (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	230	°C
Iron soldering temperature (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	32	V
Collector current	I_C	50	mA
Collector peak current ($\tau < 10$ μs)	I_{CM}	200	mA
Power dissipation (T_A = 25 °C)	P_{tot}	75	mW
Thermal resistance	R_{thJA}	950	K/W
	R_{thJS}	850	K/W

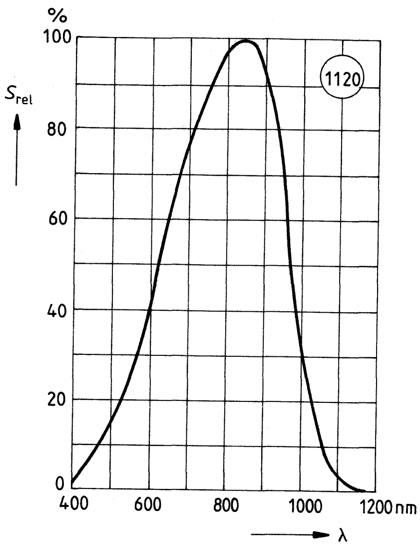
Characteristics (T_A = 25 °C)

Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	460...1060	nm
Radiant sensitive area	A	0.17	mm^2
Dimensions of chip area	$L \times W$	0.6 × 0.6	mm
Distance between chip surface and apex of lens	D	1.3...1.9	mm
Half angle	φ	±16	deg.
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	5.5	pF
Collector-emitter leakage current (V_{CEO} = 25 V; E = 0 lx)	I_{CEO}	3 (≤20)	nA

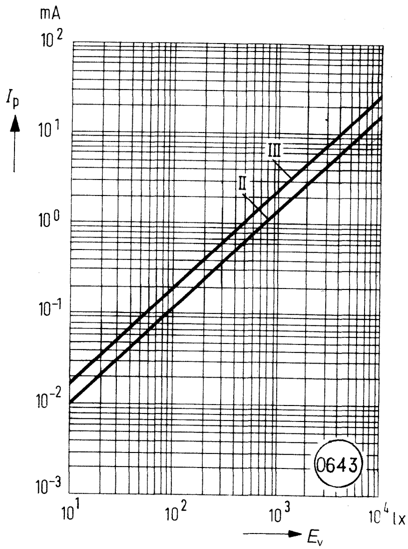
The phototransistors are grouped according to their spectral sensitivity and distinguished by roman figures

		II	III	
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_P	1...2	1.6...3.2	mA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	I_P	0.25...0.5	0.4...0.8	mA
Rise and fall time (I_C = 1 mA; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	5.5	6	µs
Collector-emitter saturation voltage ($I_C = I_{PCE\ min} \cdot 0.3$; λ = 950 nm; E_e = 0.5 mW/cm^2)	$V_{Ce\ sat}$	150	150	mV
Current gain (E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	190	300	

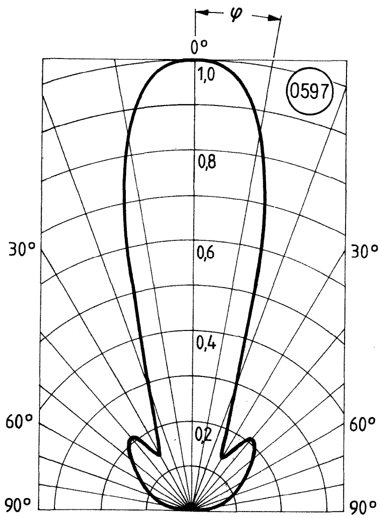
Relative spectral sensitivity versus wavelength



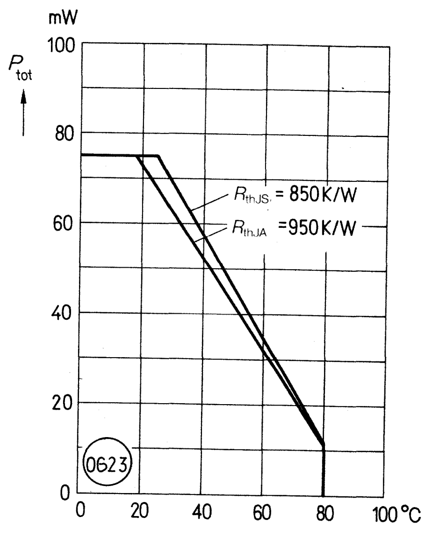
Photocurrent versus illuminance



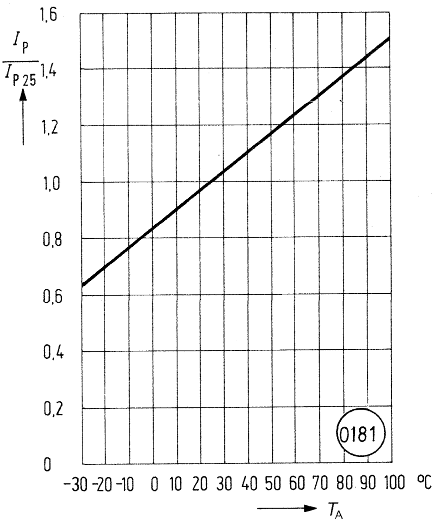
Directional characteristic
Relative spectral sensitivity versus half angle



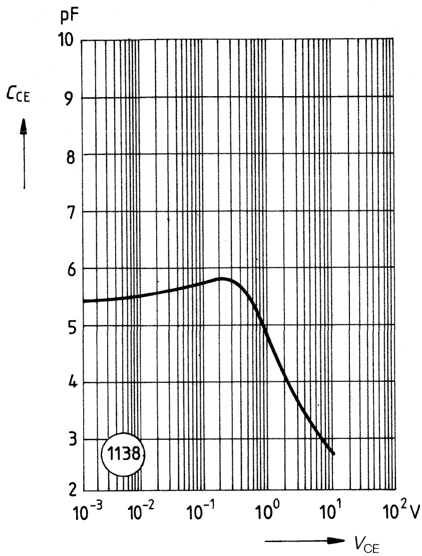
Total power dissipation versus ambient temperature



Photocurrent versus ambient temperature

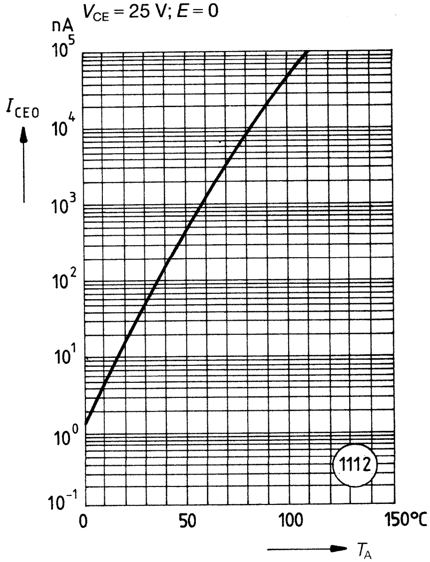


Collector-emitter capacitance versus collector-emitter voltage



Collector-emitter leakage current versus ambient temperature

V_{CE} = 25 V; E = 0



Silicon NPN Phototransistor
Silicon NPN Phototransistor with Daylight Filter

SFH 309
SFH 309 F

Preliminary data

SFH 309 and SFH 309 F are Silicon NPN Phototransistors in epitaxial planar technology without base connection.

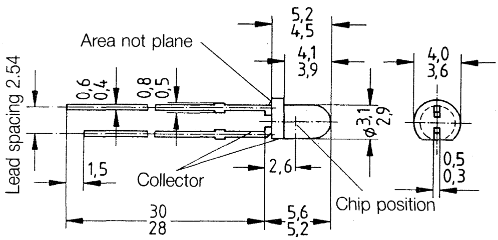
Package 3 mm LED package (T 1), transparent epoxy resin (SFH 309), black epoxy resin (SFH 309 F), solder tabs, lead spacing 2.54 mm (1/10")

Collector indication Collector lead 1.5 mm shorter

Application Light-reflecting switches for steady and varying intensity, industrial electronics, "measuring and controlling"

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Daylight filter (SFH 309 F)
- Same package as of IRED SFH 409, SFH 487



Approx. weight 0.3 g
Dimensions in mm

Type	Ordering code
SFH 309	Q62702-P859
SFH 309 F	Q62702-P941

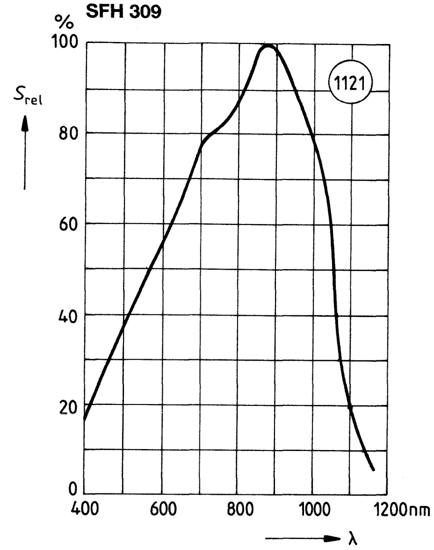
Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–55...+100	°C
Dip soldering temperature (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Iron soldering temperature (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	35	V
Collector current	I_C	15	mA
Collector peak current ($\tau < 10$ µs)	I_{CM}	75	mA
Power dissipation (T_A = 25 °C)	P_{tot}	165	mW
Thermal resistance	R_{thJA}	450	K/W

Characteristics (T_A = 25 °C)		SFH 309	SFH 309 F	
Wavelength of max. sensitivity	$\lambda_{S\ max}$	880	900	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	380...1125	800...1100	nm
Radiant sensitive area	A	0.045	0.045	mm^2
Dimensions of radiant sensitive area	∅	0.24	0.24	mm
Distance between chip surface and lead frame standoff	D	2.6	2.6	mm
Half angle	φ	±16	±16	deg.
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	5.3	5.3	pF
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_P	typ. 5 (≥1.6)	–	mA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	I_P	typ. 1.3 (≥0.4)	typ. 2 (≥0.5)	mA
Rise and fall time (I_C = 2 mA; λ = 830 nm V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	10	10	µs
Collector-emitter saturation voltage (I_C = 2 mA; I_B = 50 µA; E = 0 lx)	$V_{CE\ sat}$	200	–	mV
(I_C = 0.25 mA; λ = 950 nm; E_e = 0.5 mW/cm^2)	$V_{CE\ sat}$	–	130	mV
Collector-emitter leakage current (V_{CEO} = 10 V; E = 0 lx)	I_{CEO}	60 (≤200)	60 (≤200)	nA

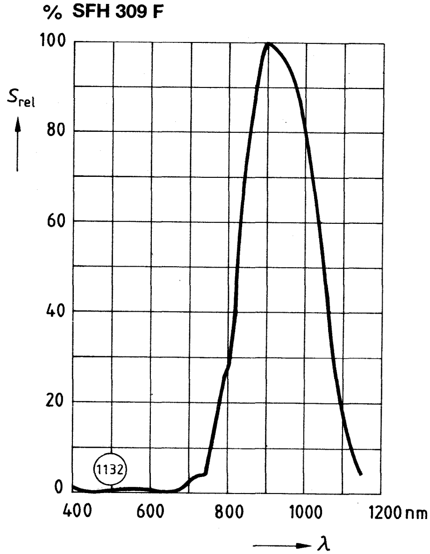
Relative spectral sensitivity versus wavelength

SFH 309



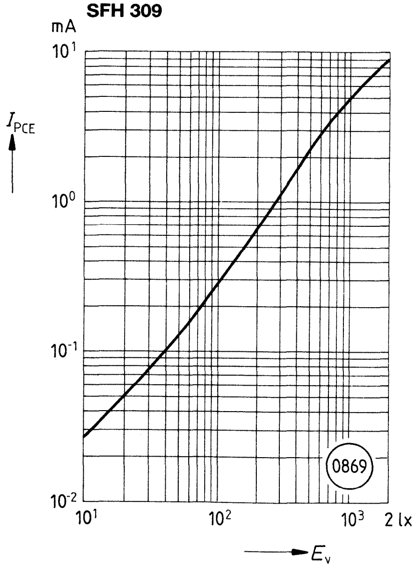
Relative spectral sensitivity versus wavelength

SFH 309 F



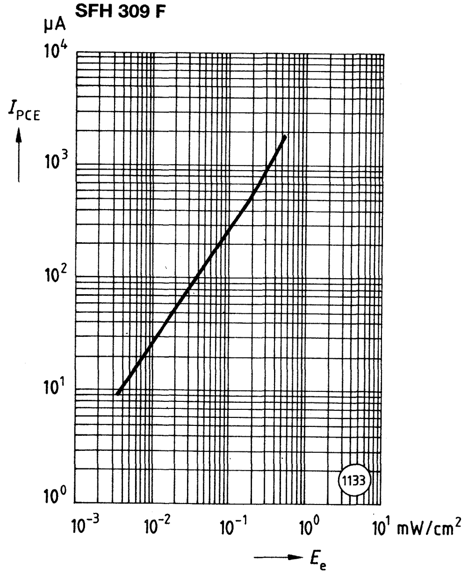
Photocurrent versus illuminance

SFH 309

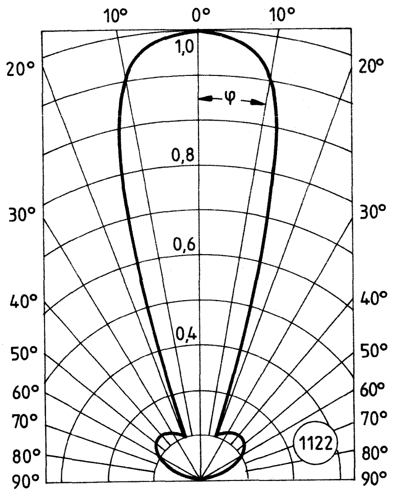


Photocurrent versus irradiance

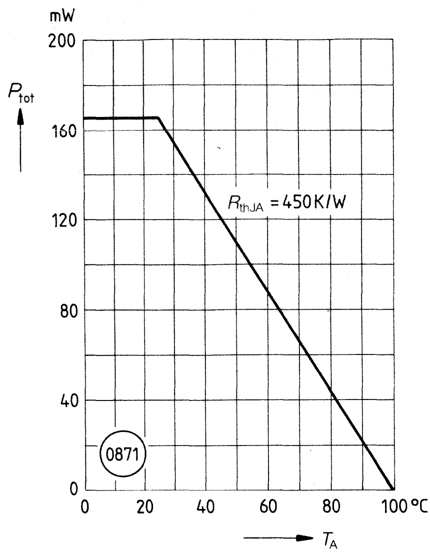
SFH 309 F



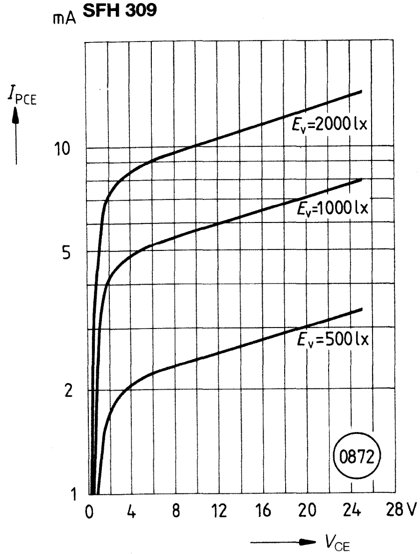
Directional characteristic
Relative spectral sensitivity versus half angle



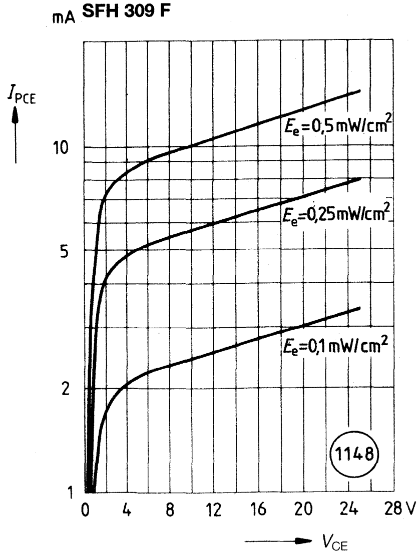
Total power dissipation versus ambient temperature



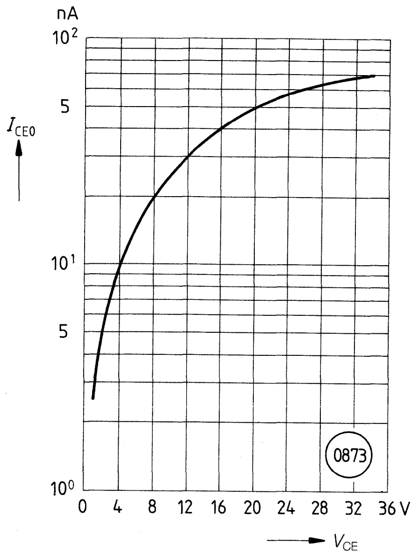
Photocurrent versus collector-emitter voltage
SFH 309



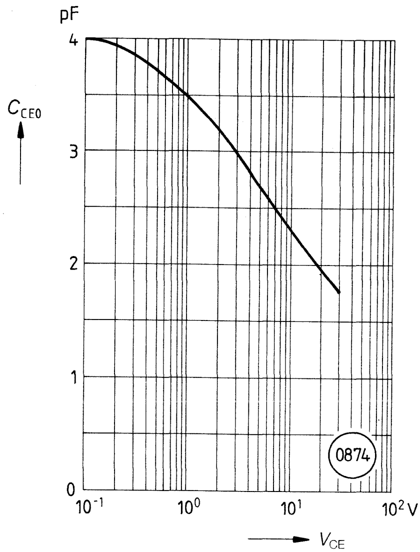
Photocurrent versus collector-emitter voltage
SFH 309 F



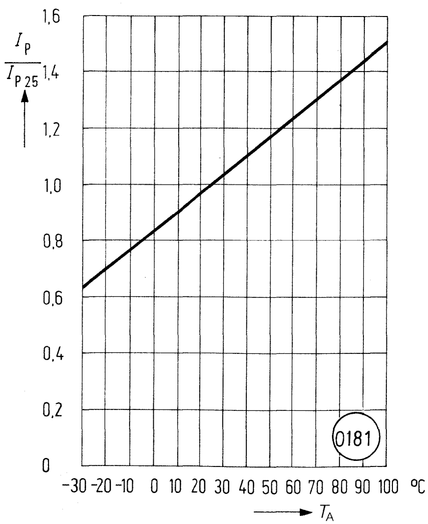
Collector-emitter leakage current versus collector-emitter voltage



Collector-emitter capacitance versus collector-emitter voltage



Photocurrent versus ambient temperature



Silicon NPN Phototransistor
Silicon NPN Phototransistor with Daylight Filter

SFH 317
SFH 317 F

Preliminary data

SFH 317 and SFH 317 F are Silicon NPN Phototransistors in epitaxial planar technology with base connection.

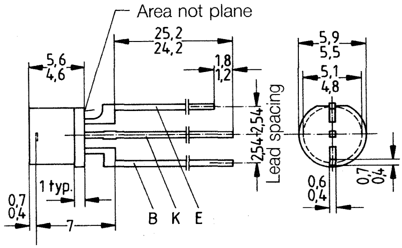
Package 5 mm LED package, plane surface, transparent epoxy resin (SFH 317) and black epoxy resin (SFH 317 F) solder tabs, lead spacing 2.54 mm (1/10″)

Emitter indication Solder tab with projection

Application Industrial electronics, “measuring and controlling”, light-reflecting switches for steady and varying intensity, fiber optic transmission systems

Features

- High reliability
- No testable degradation
- Short switching time
- High spectral sensitivity
- Good linearity
- Suitable for use in the visible light and near infrared range
- Daylight filter (SFH 317 F)
- Same package as of photodiode SFH 217 SFH 217 F, IRED SFH 485 P



Approx. weight 0.2 g
Dimensions in mm

Type	Ordering code
SFH 317	Q62702-P959
SFH 317 F	Q62702-P960

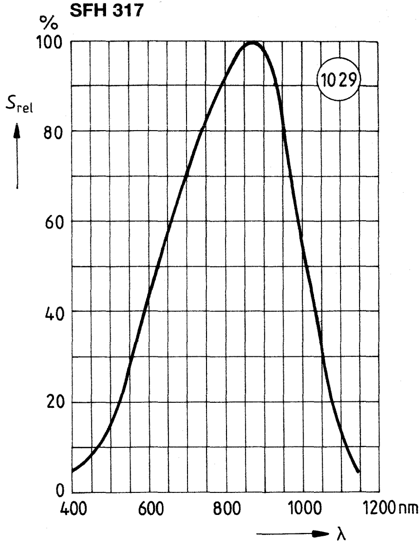
Maximum ratings

Operating and storage temperature	T_{op}, T_{stg}	–55...+100	°C
Dip soldering temperature (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Iron soldering temperature (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Collector-emitter voltage	V_{CE}	50	V
Collector current	I_C	50	mA
Collector peak current (τ <10 µs)	I_{CM}	100	mA
Emitter base voltage	V_{EB}	7	V
Power dissipation (T_A = 25 °C)	P_{tot}	200	mW
Thermal resistance	R_{thJA}	375	K/W

Characteristics (T_A = 25 °C)		SFH 317	SFH 317 F	
Wavelength of max. sensitivity	$\lambda_{S\ max}$	850	900	nm
Range of spectral sensitivity (S = 10% of S_{max})	λ	400...1100	800...1100	nm
Radiant sensitive area	A	0.3	0.3	mm^2
Dimensions of radiant sensitive area	$L \times W$	0.75 × 0.75	0.75 × 0.75	mm
Distance between chip surface and case surface	D	0.4...0.7	0.4...0.7	mm
Half angle	φ	±60	±60	deg.
Photocurrent of collector-base photodiode (E_v = 1000 lx; V_{CB} = 5 V)	I_{PCB}	2.6	2.6	µA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CB} = 5 V)	I_{PCB}	0.65	0.65	µA
Capacitance (V_{CE} = 0 V; f = 1 MHz; E = 0 lx)	C_{CE}	9	9	pF
(V_{CB} = 0 V; f = 1 MHz; E = 0 lx)	C_{CB}	19	19	pF
(V_{EB} = 0 V; f = 1 MHz; E = 0 lx)	C_{EB}	20	20	pF
Photocurrent (E_v = 1000 lx; V_{CE} = 5 V)	I_P	1.8 (≥0.5) typ.	–	mA
(E_e = 0.5 mW/cm^2; λ = 950 nm; V_{CE} = 5 V)	I_P	–	0.2 (≥0.1) typ.	mA
Rise and fall time (I_C = 2 mA; λ = 830 nm; V_{CE} = 5 V; R_L = 1 kΩ)	t_r, t_f	15	15	µs
Collector-emitter saturation voltage (I_C = 2 mA; E = 1000 lx)	$V_{CE\ sat}$	140	–	mV
(I_C = 30 µA; λ = 950 nm; E_e = 0.5 mW/cm^2)	$V_{CE\ sat}$	–	130	mV
Current gain (E_v = 1000 lx; V_{CE} = 5 V; E_e = 0.5 mW/cm^2; λ = 880 nm; V_{CE} = 5 V)	$\frac{I_{PCE}}{I_{PCB}}$	typ. 500	typ. 500	
Collector-emitter leakage current (V_{CEO} = 10 V; E = 0 lx)	I_{CEO}	2 (≤50)	2 (≤50)	nA

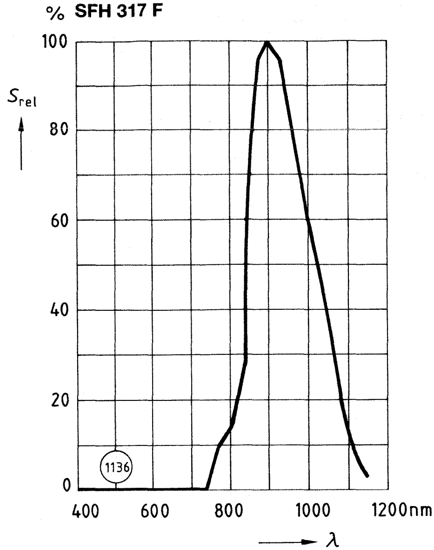
Relative spectral sensitivity versus wavelength

SFH 317



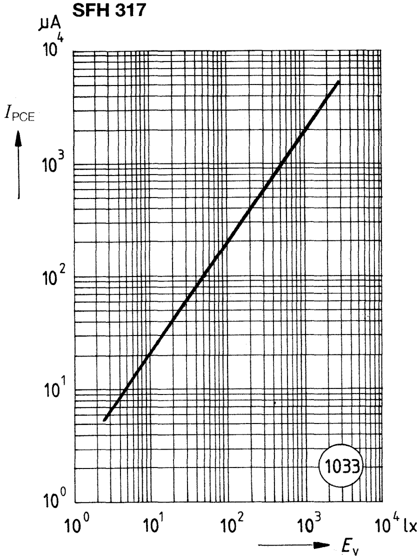
Relative spectral sensitivity versus wavelength

SFH 317 F



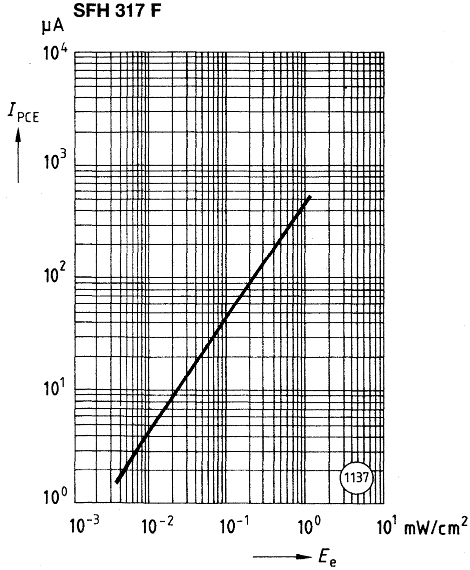
Photocurrent versus illuminance

SFH 317

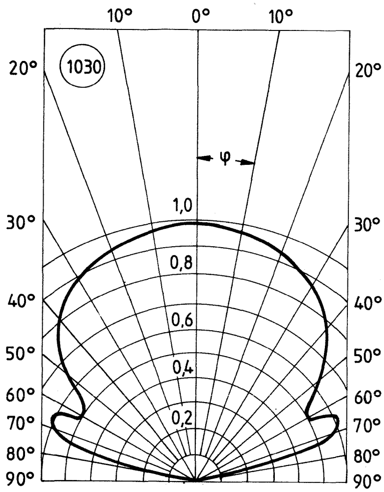


Photocurrent versus irradiance

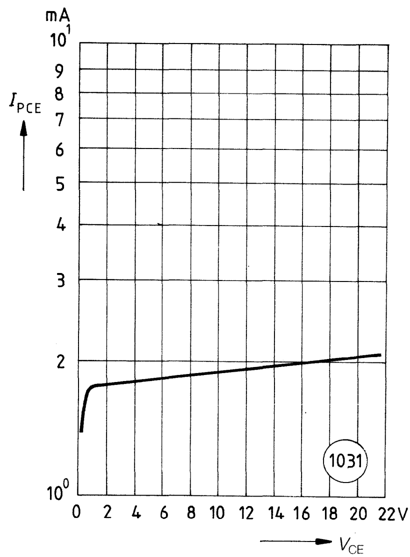
SFH 317 F



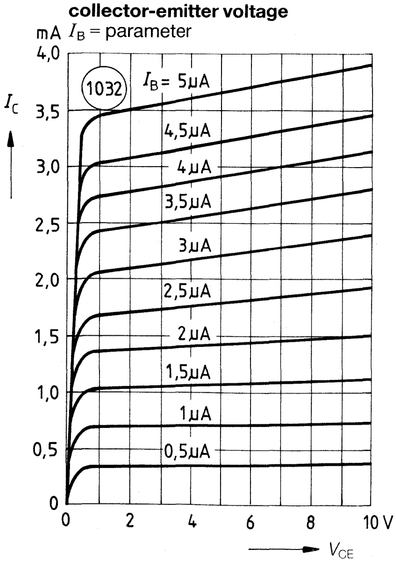
Directional characteristic
Relative spectral sensitivity versus half angle



Photocurrent versus collector-emitter voltage



Output characteristics
Collector current versus collector-emitter voltage
I_B = parameter



Capacitance versus voltage

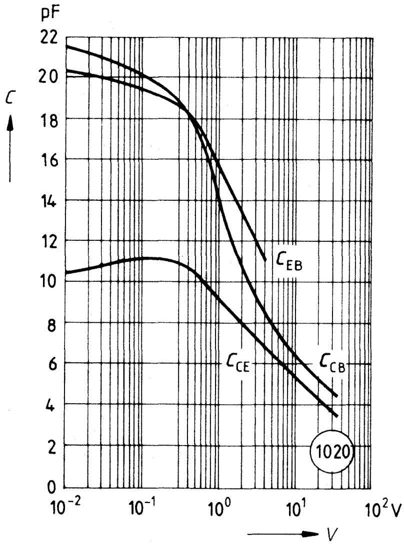


Photo ICs

Excerpt from the Data Book "Integrated Circuits for Industrial Applications"

Type	Ordering code	Package
TFA 1001 W	Q67000-A1357	Transparent miniature plastic package, 6 pins

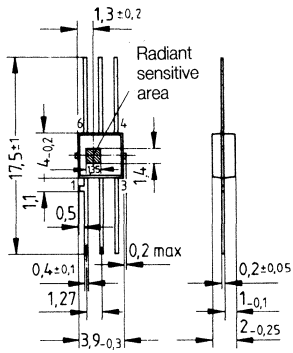
The bipolar IC TFA 1001 W contains a photodiode and an amplifier. At its output (open NPN collector), the TFA 1001 W supplies a current directly proportional to the illuminance. Another pin permits a linearized characteristic curve at low illuminances and can be used to inhibit the output.

Application

- Exposure meters
- Exposure control systems
- Electronic flashes
- Optical follow-up control
- Smoke detectors
- Linear optocouplers
- Color identification

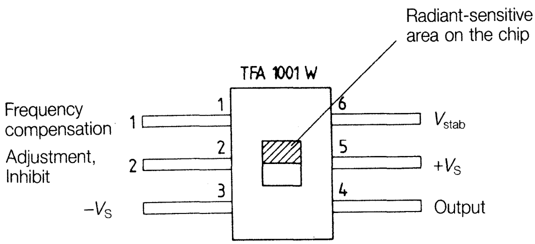
Features

- High sensitivity
- High output current linearity
- Good spectral sensitivity
- Low current consumption
- Wide modulation range
- Large operating voltage range



Approx. weight 0.1 g
Dimensions in mm

Pin configuration



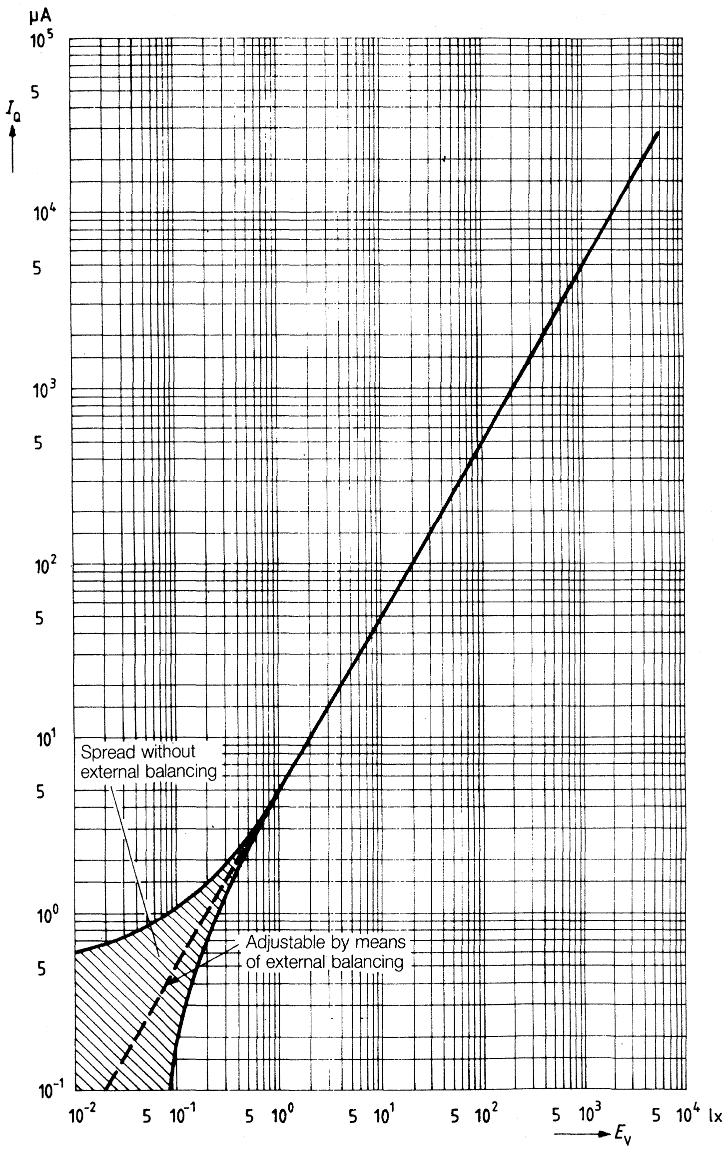
Maximum ratings

		Lower limit B	Upper limit A	
Supply voltage	V_S		15	V
Output current	I_Q		50	mA
Power dissipation	P_{tot}		200	mW
Junction temperature	T_j		100	°C
Storage temperature	T_{stg}	–40	85	°C
Thermal resistance (system-air)	$R_{th\ SA}$		250	K/W

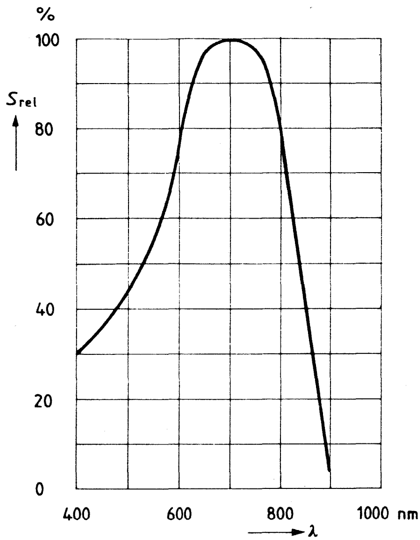
Characteristics at T_A = 25 °C, supply voltage applied to pin 5		Lower limit B	typ	Upper limit A	
Supply voltage	V_S	2.5		15	V
Current consumption at E_v = 0 lx	I_S			1	mA
Ambient temperature (during operation)	T_A	–10		70	°C
Illuminance	E_v	0		5000	lx
Sensitivity in range E_v = 1 lx to 1000 lx	S	2.5	5	7.5	µA/lx
Output current at E_v = 0.05 lx	I_Q		0.25		µA
E_v = 1 lx	I_Q	2.5	5	7.5	µA
E_v = 1000 lx	I_Q	2.5	5	7.5	mA
E_v = 5000 lx	I_Q		25		mA
Stabilized voltage at pin 6	V_{stab}	1.2	1.35	1.5	V
Supply voltage dependence of stabilized voltage V_{stab}	$\Delta V_{stab}/\Delta V_S$		2		mV/V
Temperature dependence of stabilized voltage V_{stab}	$\Delta V_{stab}/\Delta T$		–0.3		mV/°C

Important comment: The TFA 1001 W is subject to the product range "Integrated Circuits" and is quoted here only in extracts. Detailed characteristics and information on application are to be found in the Data Book "Integrated Circuits for Industrial Applications", edition 1985/86, order no. B1-B3182-X-X-7600. The data book also contains Processing Guidelines and information on quality for the TFA 1001 W.

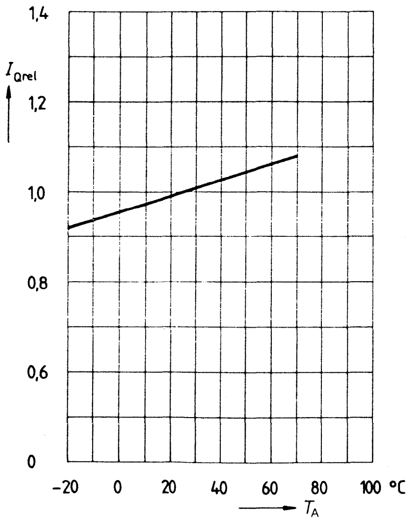
Photocurrent versus illuminance



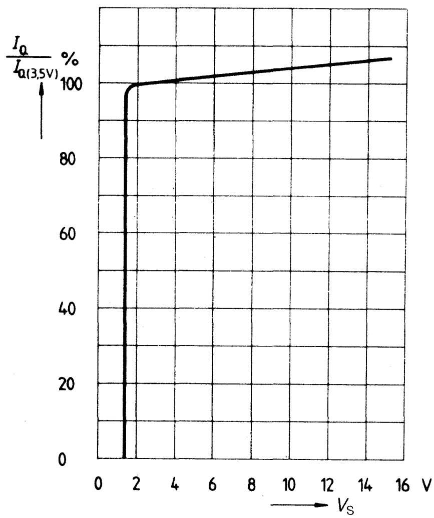
Relative spectral sensitivity versus wavelength



Relative output current versus ambient temperature
in range E_v = 1 lx to 1000 lx

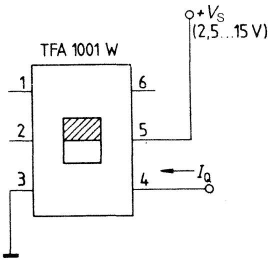


Output current versus supply voltage

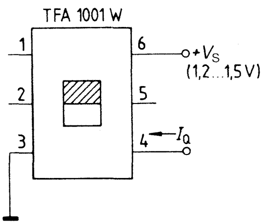


Possible applications of TFA 1001 W as light/current transducer

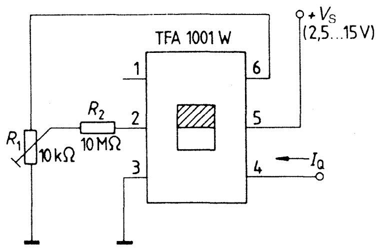
1) for operating voltage 2.5 to 15 V



2) for low operating voltage 1.2 to 1.5 V



3) for especially low illuminance down to 0.01 lx



In case of low illuminance (see characteristic: output current versus illuminance), the output current can be balanced by means of the adjustment control R_1. The lower range of the output characteristic can be linearized even more by setting a dark current of about 5 nA.

Custom-designed Optoelectronic Multichip Arrays

K
O
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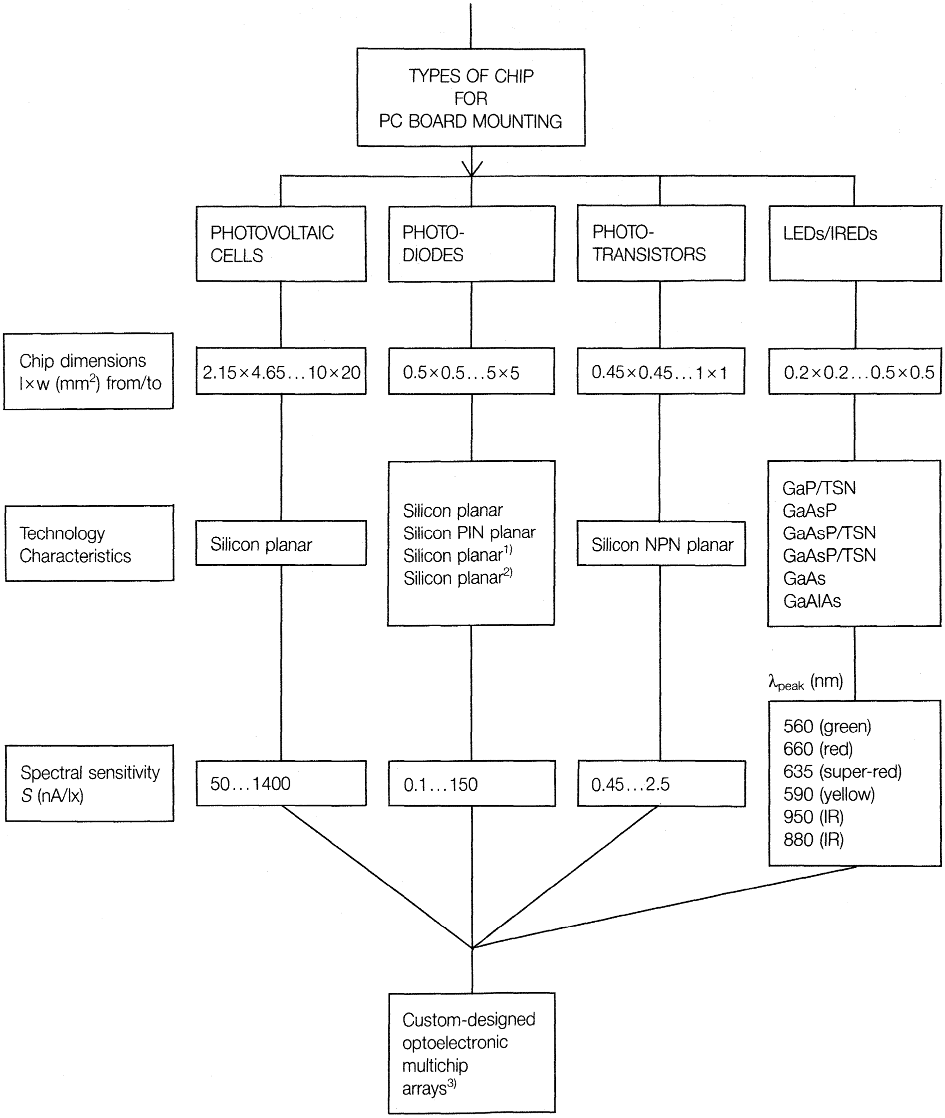
Custom-Designed Optoelectronic Multichip Arrays



1) Low reverse current
2) High blue sensitivity
3) Refer to brochure: "Custom-Designed Optoelectronic Multidetector Arrays"; B2-B2799-X-X-7600

6-Chip Silicon Photodiode Array with Low Dark Current

KOM 0622033 A

Preliminary data

KOM 0622033 A is a 6 chip photodiode array fabricated in planar technology with low reverse current. The N Si material used results in a positive front and negative back contact. These photodetectors are suitable for diode operation (with reverse voltage) as well as for element operation.

Package	PC board with solder lugs, cover frame with clear epoxy seal
Cathode marking	see dimensional drawing
Application	General-purpose PC board for shaft encoders; the individually led-out photodiodes permit external components to be connected (series – parallel – antiparallel)

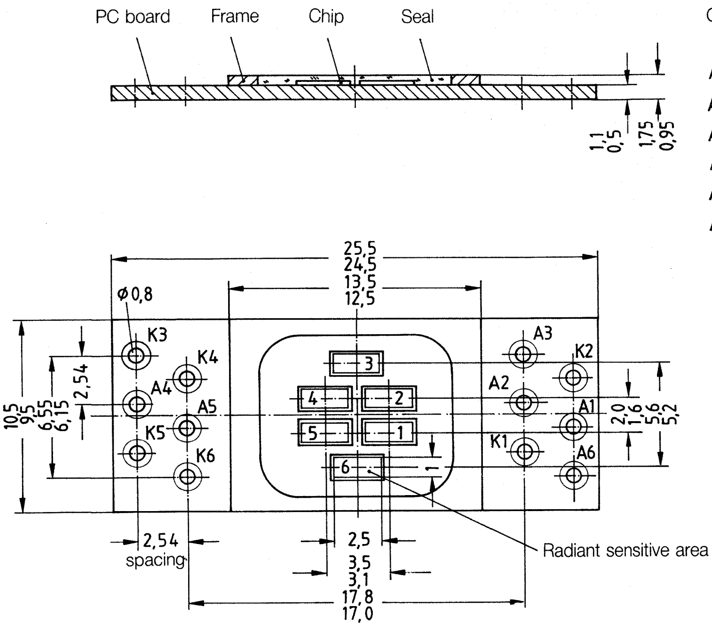
Type	Ordering code
KOM 0622033 A	Q62702-K2

Technical data (single segment)

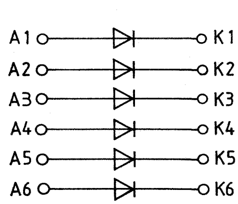
(T_A = 25 °C; E_v = 1000 lx; standard light A, T = 2856 K)

Wavelength of max. spectral sensitivity	λ_S	850	nm
Spectral sensitivity (S = 10% of S_{max})	λ	400...1050	nm
Radiant sensitive area (6 elements)	A	1 × 2.5	mm
Half angle	φ	±60	degrees
Dark current (V_R = 5 V)	I_R	1 (≤50)	nA
Max. deviation of the spectral sensitivity of the systems from the average value	Δ_S	±10	%
Open-circuit voltage	V_o	425 (≥300)	mV
Photocurrent (V_R = 5 V)	I_P	26.5 (≥15)	µA
Forward voltage (I_F = 10 mA)	V_F	0.7 (≤0.8)	V
Reverse voltage (I_R = 5 µA)	V_R	>20	V
Capacitance (V_R = 0 V) (chip)	C_0	150	pF

Outline drawing



Circuit diagram



Dimensions in mm

8-Chip Silicon Photodiode Array with Very Low Dark Current

Preliminary data

KOM 0622045 is an 8-chip photodiode linear array fabricated in planar technology with low reverse current. The N Si material used results in a positive front and negative back contact. These photodetectors are suitable for diode operation (with reverse voltage) as well as for element operation.

Package PC board with pin connectors; cover frame with clear epoxy seal, 2.54 mm (1/10″) lead spacing

Cathode marking see outline drawing

Application General-purpose PC board for scanning arrays

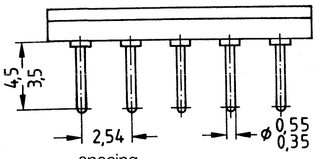
Type	Ordering code
KOM 0622045	Q62702-K3

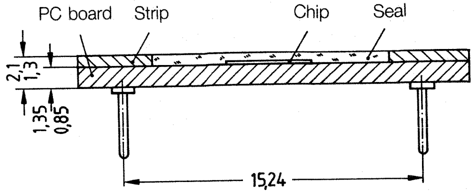
Technical data (single segment)

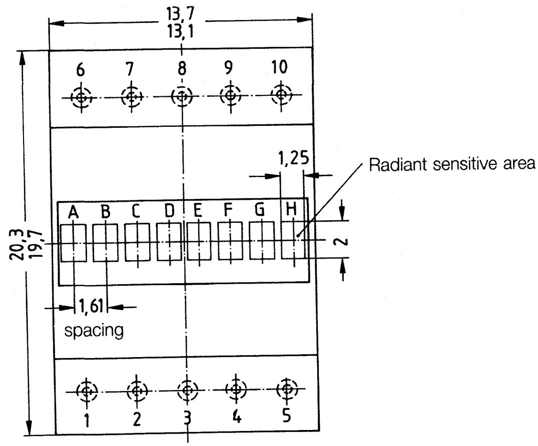
(T_A = 25 °C; E_v = 1000 lx; standard light A, T = 2856 K)

Wavelength of max. spectral sensitivity	λ_S	850	nm
Spectral sensitivity (S = 10% of S_{max})	λ	400...1050	nm
Radiant sensitive area (8 elements)	A	1.25 × 2	mm
Half angle	φ	±60	degrees
Dark current (V_R = 5 V)	I_R	5 (≤50)	pA
Max. deviation of the spectral sensitivity of the systems from the average value	Δ_S	±5	%
Open-circuit voltage	V_o	425 (≥300)	mV
Photocurrent (V_R = 5 V)	I_P	17 (≥12)	µA
Forward voltage (I_F = 10 mA)	V_F	0.7 (≤0.8)	V
Reverse voltage (I_R = 5 µA)	V_R	>20	V
Capacitance (V_R = 0 V) (chip)	C_0	235	pF

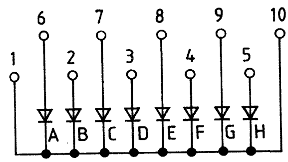
Outline drawing







Circuit diagram



Dimensions in mm

64-Element Silicon Circular Array with Very Low Dark Current

KOM 0622059

Preliminary data

KOM 0622059 is a 64-element circular array fabricated in planar technology with low reverse current. The N Si material used results in a positive front and negative back contact. These photodetectors are suitable for diode operation (with reverse voltage) as well as for element operation.

Package PIN-GRID array printed board with pin connectors[1]) 2.54 mm (1⁄10″) lead spacing, clear epoxy seal

Cathode marking Pin 65 (K), see outline drawing

Application Circular coordinate recognition or adjustment control. Angle increment detectors with a resolution of 5.625 degrees. Surface control of ring-shaped areas, e.g. bottle necks.

Type	Ordering code
KOM 0622059	Q62702-K4

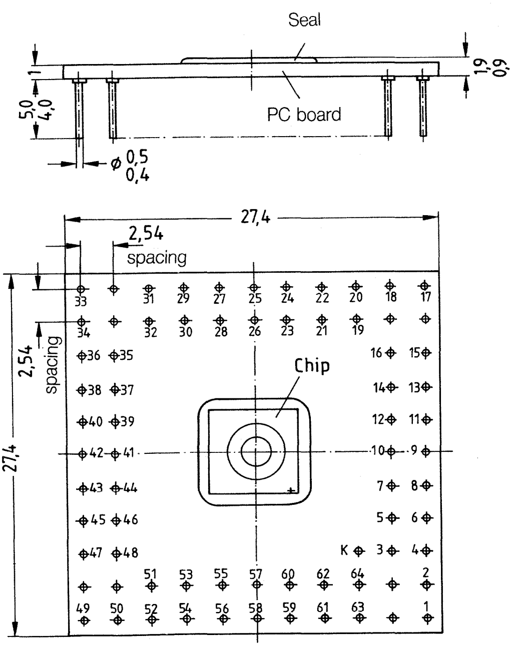
Technical data (single segment)

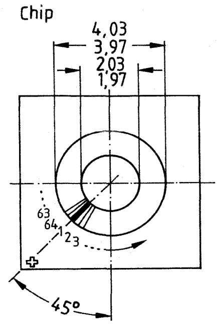
(T_A = 25 °C; E_v = 1000 lx; standard light A, T = 2856 K)

Wavelength of max. spectral sensitivity	λ_S	850	nm
Spectral sensitivity (S = 10% of S_{max})	λ	400...1050	nm
Radiant sensitive area (64 elements)	A	0.12 × 1	mm
Resolution (single segment)		5.625	degrees
Half angle	φ	±60	degrees
Dark current (V_R = 5 V)	I_R	15 (≤150)	pA
Max. deviation of the spectral sensitivity of the systems from average value	Δ_S	~5	%
Open-circuit voltage	V_0	425 (≥300)	mV
Photocurrent (V_R = 5 V)	I_P	2.5 (≥1.8)	µA
Forward voltage (I_F = 10 mA)	V_F	0.9 (≤1)	V
Reverse voltage (I_R = 5 µA)	V_R	18 (≥10)	V
Capacitance (V_R = 0 V)	C_0	23	pF
(V_R = 5 V)	C_5	14	pF

[1]) Socket: PIN GRID ARRAY SOCKET UX-1111-084-GH-Y-33

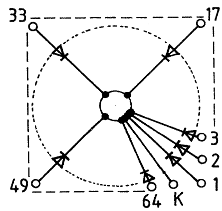
Outline drawing





Radiant sensitive area for each single segment 0.11 × 1 mm

Circuit diagram



Dimensions in mm

Infrared Emitters (IREDs)

GaAs Infrared Emitter

The GaAs infrared emitting diode LD 242, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible. The cathode is electrically connected to the case.

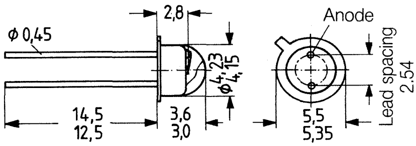
Package Base plate as per 18 A3 DIN 41876 (TO 18), transparent epoxy resin lens, solder tabs, lead spacing 2.54 mm (1/10″)

Anode identification Projection at case bottom

Application IR remote control and sound transmission, light-reflecting switches for steady and varying intensity

Features

- High reliability
- Long life
- Wide beam
- High pulse power
- Available in groups
- Same package as of BP 103



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
LD 242 II	Q62703-Q198
LD 242 III*)	Q62703-Q199

Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–40...+80	°C
Soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 3$ s)	T_{sold}	230	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current (T_C = 25 °C)	I_F	250	mA
Surge current ($\tau \leq 10$ µs, D = 0)	i_{FS}	3	A
Power dissipation (T_C = 25 °C)	P_{tot}	470	mW
Thermal resistance	R_{thJA}	450	K/W
	R_{thJC}	160	K/W

*) Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

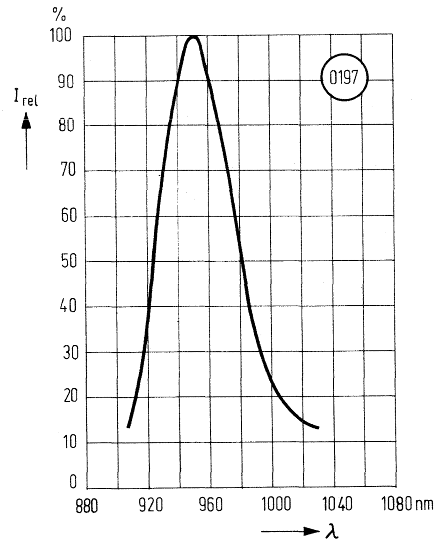
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 100 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 100 mA, t_p = 20 ms)	$\Delta\lambda$	55	nm
Half angle	φ	±40	deg.
Active chip area	A	0.25	mm^2
Dimensions of active chip area	$L \times W$	0.5 × 0.5	mm
Distance chip surface to case surface	D	0.3...0.7	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V)	C_o	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.3 (≤1.5)	V
(I_F = 1 A; t_p = 100 µs)	V_F	1.9 (≤2.5)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	0.3	nm/K

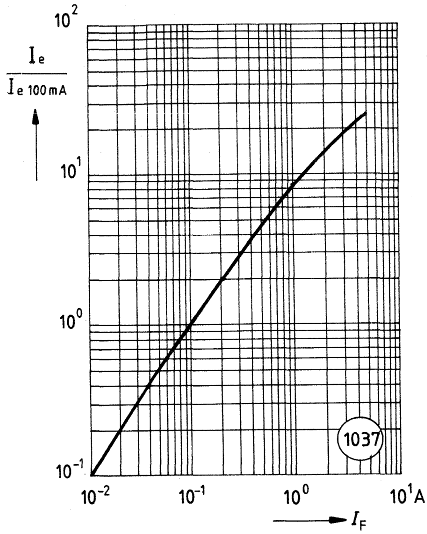
The diodes are grouped according to their radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees

		II	III	
Radiant intensity (I_F = 100 mA, t_p = 20 ms)	I_e	4...8	≥6.3	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	45	60	mW/sr
Radiant flux (total) (I_F = 100 mA, t_p = 20 ms)	Φ_e	13	16	mW

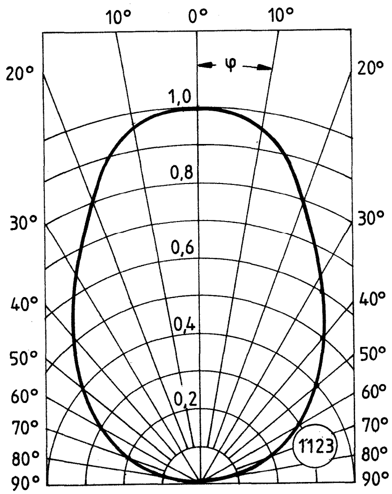
Relative spectral emission versus wavelength



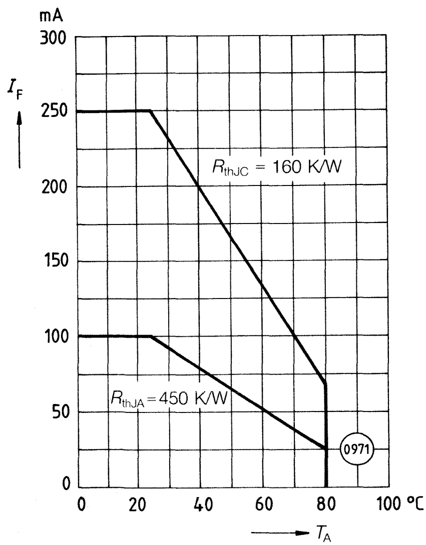
Radiant intensity versus forward current



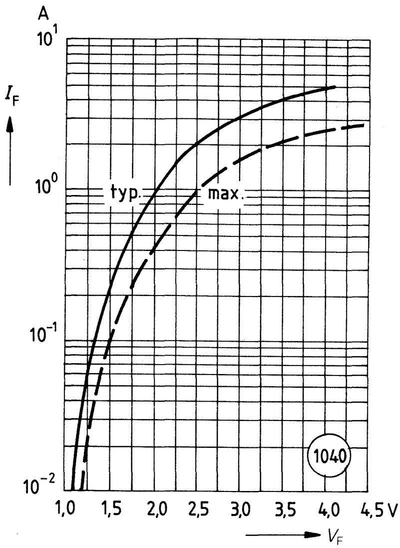
Radiation characteristic
Relative spectral emission versus half angle



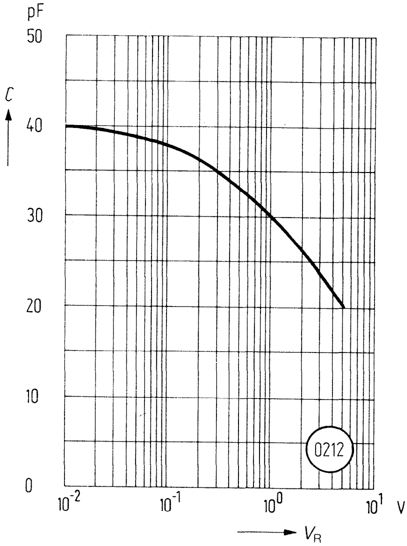
Forward current versus ambient temperature



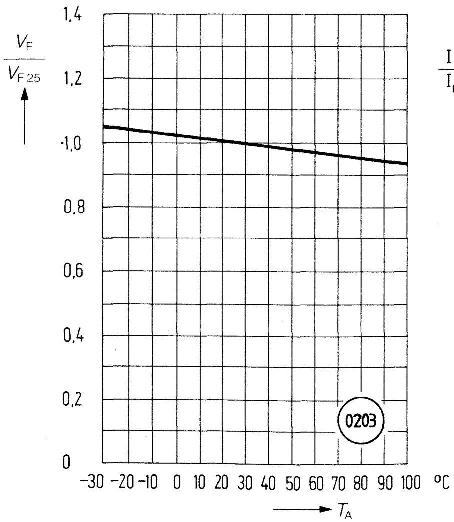
Forward current versus forward voltage



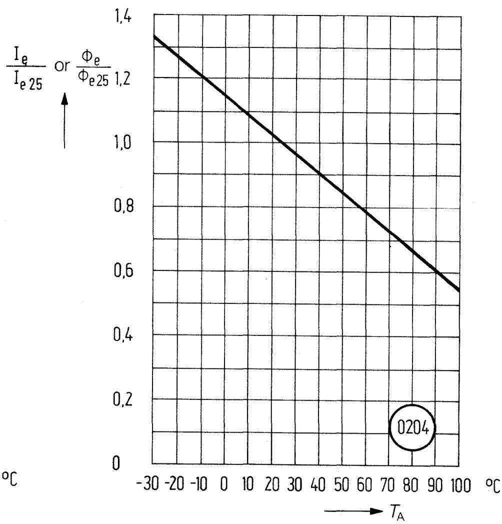
Capacitance versus reverse voltage



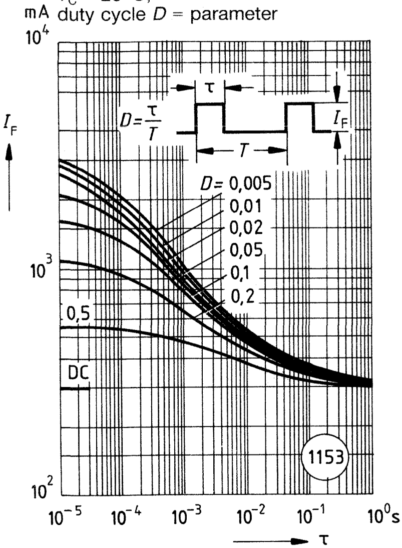
Forward voltage versus ambient temperature



Radiant intensity versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
T_C = 25 °C;
duty cycle D = parameter



The GaAs infrared emitting diode LD 261, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible.

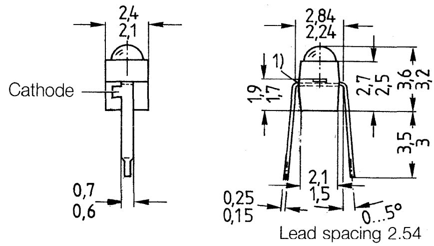
Package Lead frame, transparent epoxy resin lens, solder tabs, lead spacing 2.54 mm (1/10″)

Cathode identification Projection at solder tab

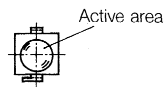
Application Miniature light-reflecting switches for steady and varying intensity, punched-tape readers, industrial electronics, “measuring and controlling”

Features

- High reliability
- Long life
- High radiant intensity
- Available in groups
- Same package as of BPX 81



Type	Ordering code
LD 261 IV	Q62703-Q66
LD 261 V	Q62703-Q67
LD 261 VI[1])	Q62703-Q236



1) Detaching area of tools, flash not true to size

Approx. weight 0.03 g
Dimensions in mm

Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–40...+80	°C
Soldering temperature (≥2 mm distance from case bottom; soldering time t ≤3 s)	T_{sold}	230	°C
Junction temperature	T_j	80	°C
Reverse voltage	V_R	5	V
Forward current	I_F	60	mA
Surge current (τ = 10 µs, D = 0)	i_{FS}	1.6	A
Power dissipation (T_A = 25 °C)	P_{tot}	85	mW
Thermal resistance	R_{thJA}	750	K/W
	R_{thJS}	650	K/W

[1]) Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

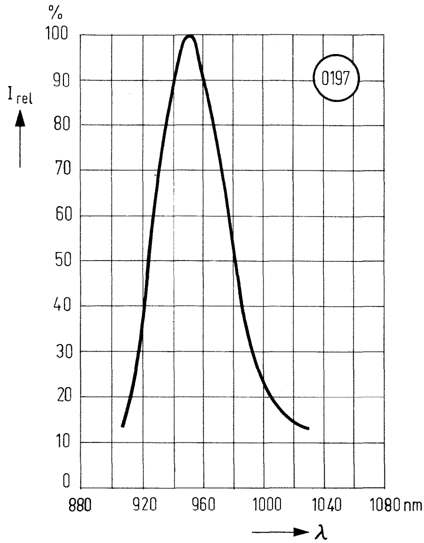
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 50 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 50 mA, t_p = 20 ms)	$\Delta \lambda$	55	nm
Half angle	φ	±30	deg.
Active chip area	A	0.25	mm^2
Dimensions of active chip area	$L \times W$	0.5 × 0.5	mm
Distance chip surface to apex of lens	D	1.3...1.9	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 50 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V)	C_o	40	pF
Forward voltage (I_F = 50 mA; t_p = 20 ms)	V_F	1.25 (≤1.4)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	0.3	nm/K

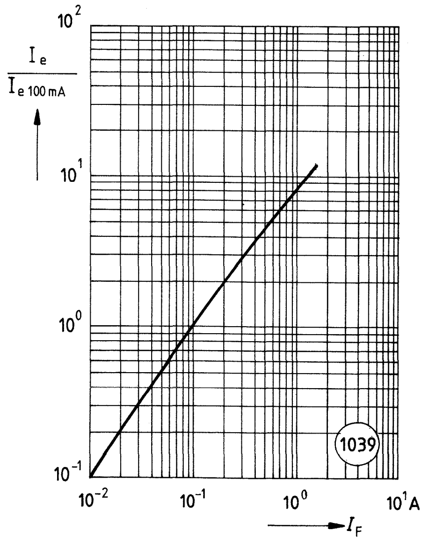
The diodes are grouped according to their radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees

		IV	V	VI	
Radiant intensity (I_F = 50 mA, t_p = 20 ms)	I_e	2...4	3.2...6.3	≥5	mW/sr
Radiant flux (total) (I_F = 50 mA, t_p = 20 ms)	Φ_e	5	6.5	8	mW

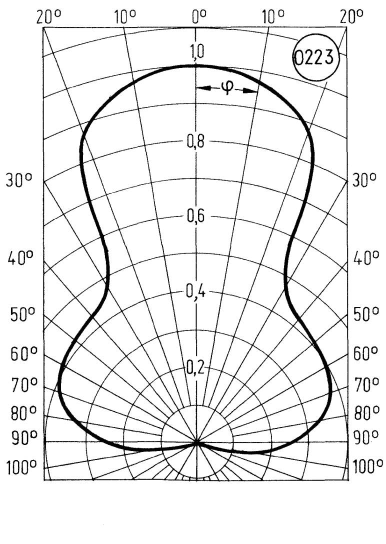
Relative spectral emission versus wavelength



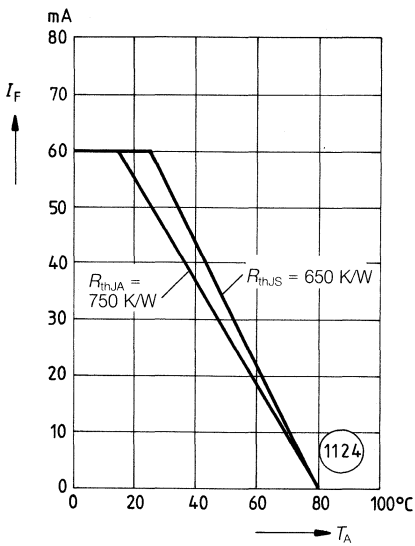
Radiant intensity versus forward current



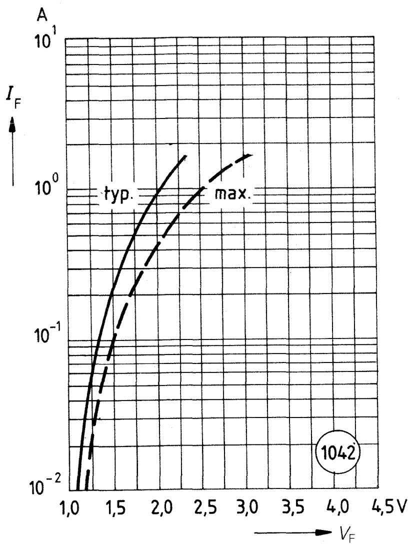
Radiation characteristic
Relative spectral emission versus half angle



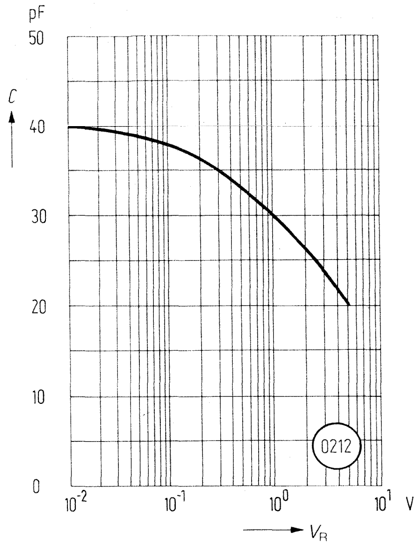
Forward current versus ambient temperature



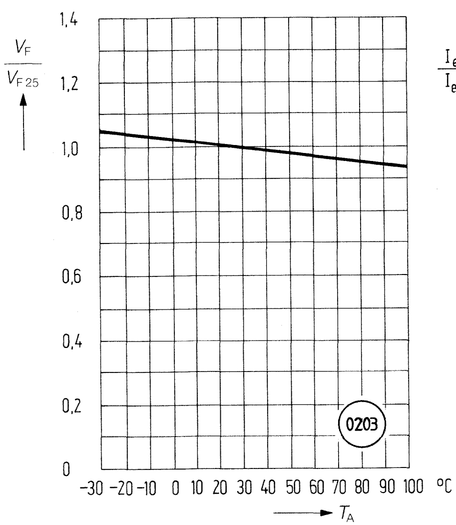
Forward current versus forward voltage



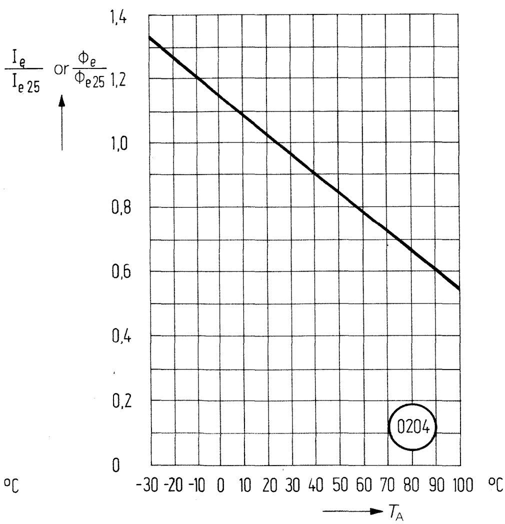
Capacitance versus reverse voltage



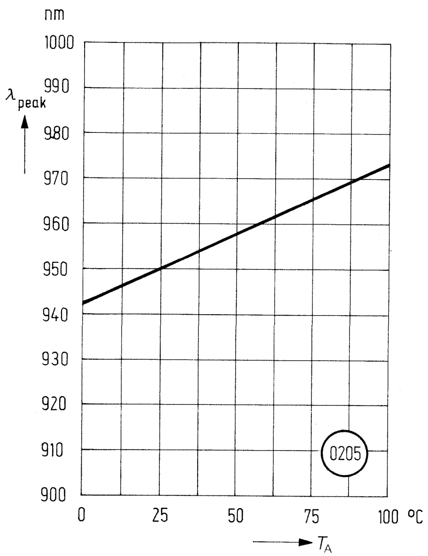
Forward voltage versus ambient temperature



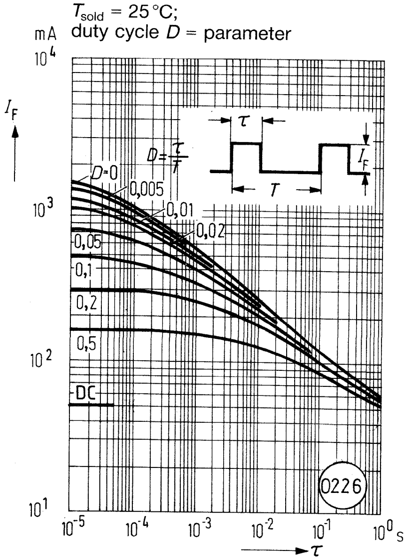
Radiant intensity versus ambient temperature



Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
T_{sold} = 25 °C;
duty cycle D = parameter



GaAs Infrared Emitter Arrays

These GaAs infrared emitter arrays, fabricated in a liquid phase epitaxy process, feature high efficiency and emit radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible.

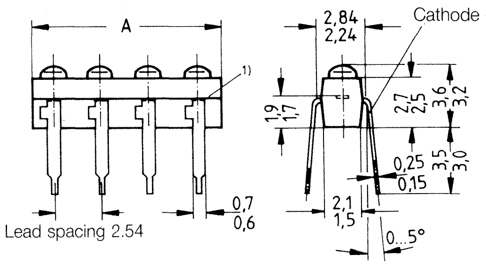
Package Arrays, lead frame, transparent epoxy resin lens, lead spacing 2.54 mm (1/10″)

Cathode identification Projection at solder tab

Application Miniature light-reflecting switches for steady and varying intensity, punched tape readers, industrial electronics, “measuring and controlling”

Features

- High reliability
- Long life
- High radiant intensity
- Available in groups
- Same package as of BPX 80



1) Detaching area of tools, flash not true to size
4-Diode-Array (LD 264)

Approx. weight 0.12 g
Dimensions in mm

Type	IRED per array	Dimension »A« min.	max.	Ordering code
LD 262	2	4.5	4.9	Q62703-Q70
LD 263	3	7	7.4	Q62703-Q71
LD 264	4	9.6	10	Q62703-Q72
LD 265	5	12.1	12.5	Q62703-Q73
LD 266	6	14.6	15	Q62703-Q74
LD 267	7	17.2	17.6	Q62703-Q75
LD 268	8	19.7	20.1	Q62703-Q76
LD 269	9	22.3	22.7	Q62703-Q77
LD 260	10	24.8	25.2	Q62703-Q78

Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	−40...+80	°C
Soldering temperature (≥2 mm distance from case bottom; soldering time $t \leq 3$ s)	T_{sold}	230	°C
Junction temperature	T_j	80	°C
Reverse voltage	V_R	5	V
Forward current	I_F	50	mA
Surge current (τ = 10 µs, D = 0)	i_{FS}	1.6	A
Power dissipation (T_A = 25 °C)	P_{tot}	85	mW
Thermal resistance	R_{thJA}	750	K/W
	R_{thJS}	650	K/W

Characteristics (T_A = 25 °C)

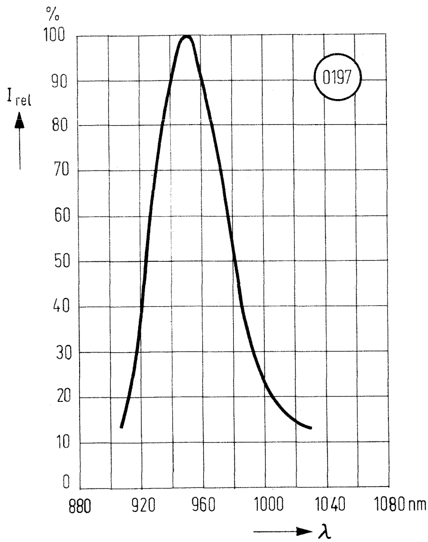
Wavelength at peak emission (I_F = 50 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 50 mA, t_p = 20 ms)	$\Delta\lambda$	55	nm
Half angle	φ	±30	deg.
Active chip area	A	0.25	mm^2
Dimensions of active chip area	$L \times W$	0.5 × 0.5	mm
Distance chip surface to apex of lens	D	1.3...1.9	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 50 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V)	C_o	40	pF
Forward voltage (I_F = 50 mA; t_p = 20 ms)	V_F	1.25 (≤1.4)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	–0.55	%/K
Temperature coefficient of V_F	TC_V	–1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	0.3	nm/K

The diodes are grouped according to their radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees

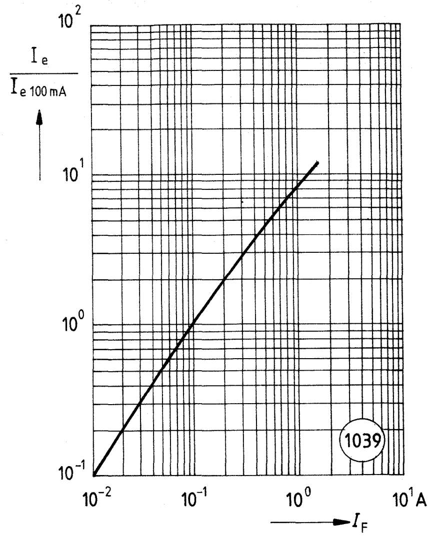
		A	B	C	
Radiant intensity (I_F = 50 mA, t_p = 20 ms)	I_e	2.5...5	3.15...6.3	4.8...8	mW/sr
Radiant flux (total) (I_F = 50 mA, t_p = 20 ms)	Φ_e	5	6.5	8	mW

Since production numbers vary in group A, B and C please make sure that the required type is available.

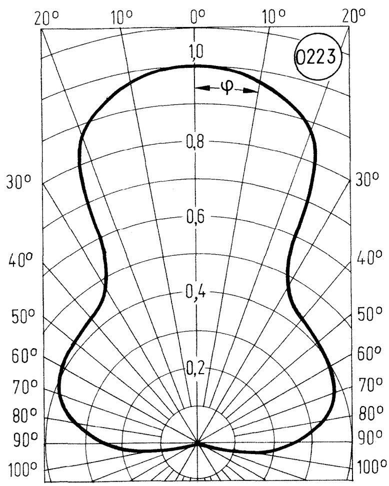
Relative spectral emission versus wavelength



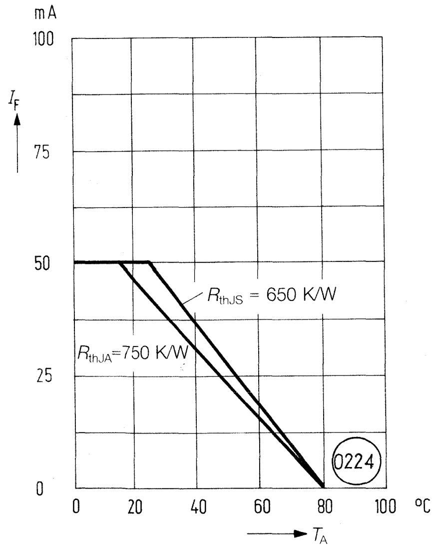
Radiant intensity versus forward current



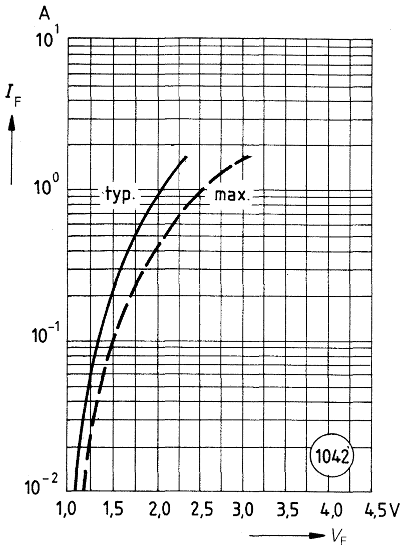
Radiation characteristic
Relative spectral emission versus half angle



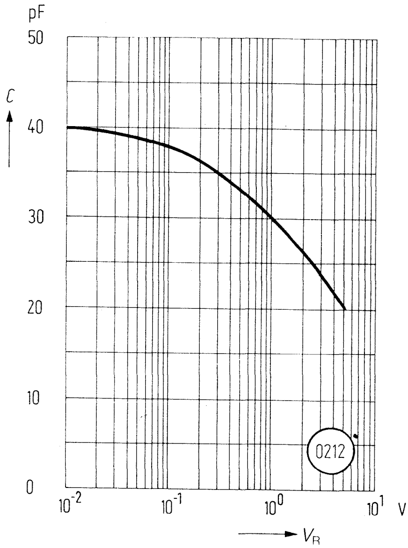
Forward current versus ambient temperature



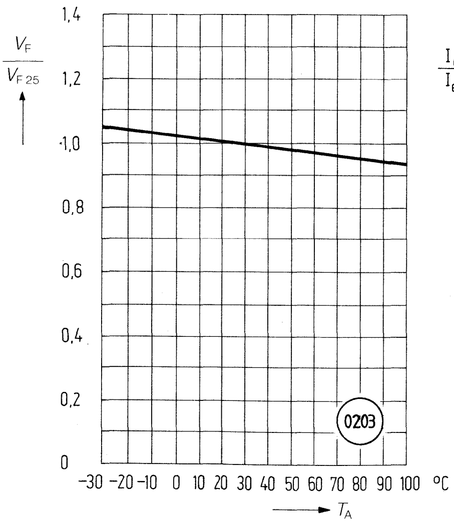
Forward current versus forward voltage



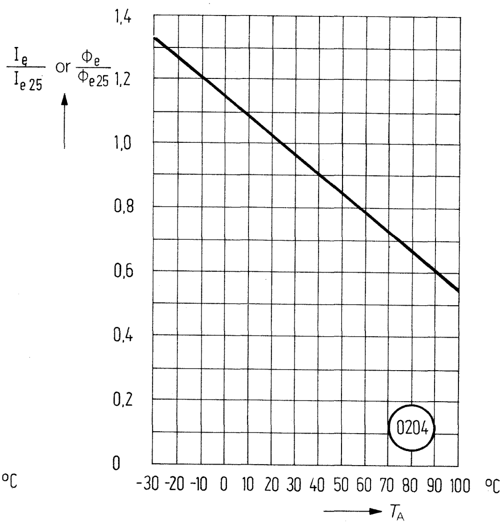
Capacitance versus reverse voltage



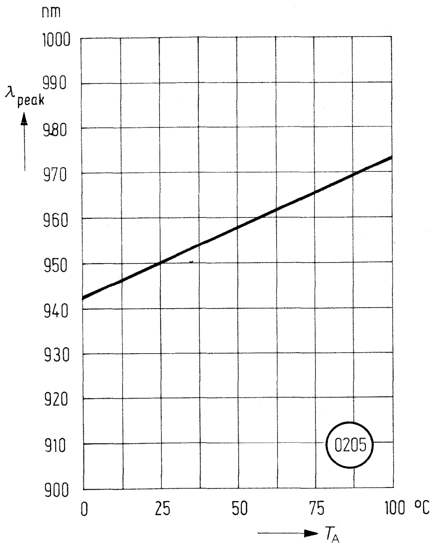
Forward voltage versus ambient temperature



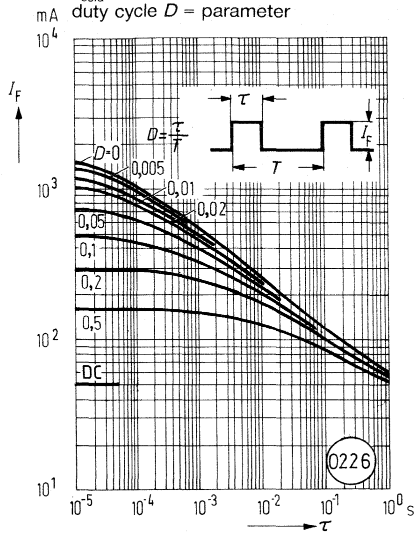
Radiant intensity versus ambient temperature



Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
T_{sold} = 25 °C;
duty cycle D = parameter



GaAs Infrared Emitter

LD 271
LD 271 H

The GaAs infrared emitting diode LD 271, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible.

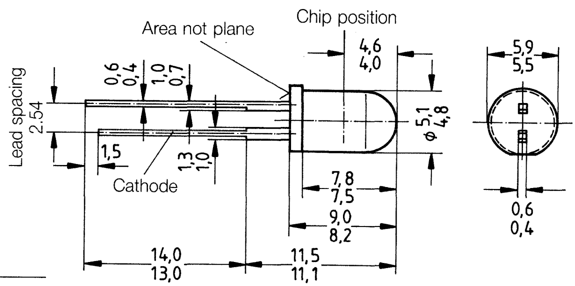
Package 5 mm LED package (T 1¾), grey-colored epoxy resin, solder tabs, lead spacing 2.54 mm (1/10″)

Cathode identification Solder tab with larger diameter

Application IR remote control of hifi and TV sets, video tape recorders, dimmers, remote controls of various equipment, light-reflecting switches for steady and varying intensity

Features

- High reliability
- Long life
- High radiant intensity
- High pulse power
- Same package as of BP 103 B



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
LD 271	Q62703-Q148
LD 271 H	Q62703-Q256

Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature (≥10 mm distance from case bottom; soldering time t ≤3 s)	T_{sold}	260	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current	I_F	130	mA
Surge current (τ ≤10 µs, D = 0)	i_{FS}	3.5	A
Power dissipation (T_A = 25 °C)	P_{tot}	210	mW
Thermal resistance	R_{thJA}	350	K/W

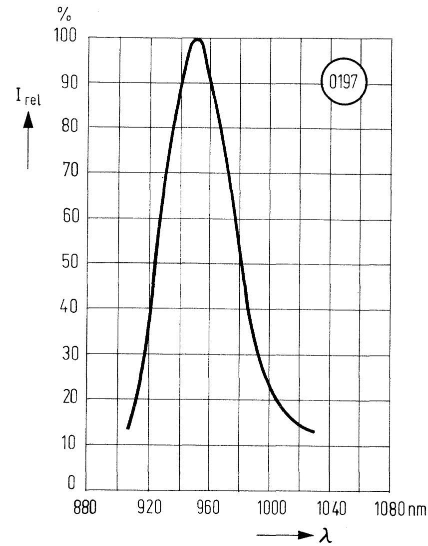
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 100 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 100 mA)	$\Delta\lambda$	55	nm
Half angle	φ	±25	deg.
Active chip area	A	0.25	mm^2
Dimensions of active chip area	$L \times W$	0.5 × 0.5	mm
Distance chip surface to case surface	D	4.0...4.6	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V)	C_o	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.30 (≤1.5)	V
(I_F = 1 A; t_p = 100 µs)	V_F	1.9 (≤2.5)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	+0.3	nm/K

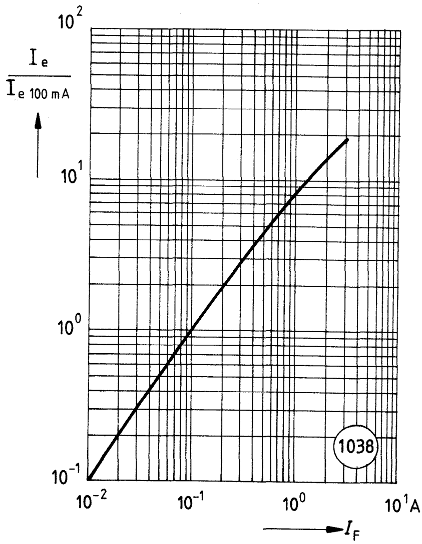
Radiant intensity I_e in axial direction
at a steradian Ω = 0.01 sr, or 6.5 degrees

		LD 271	LD 271 H	
Radiant intensity (I_F = 100 mA, t_p = 20 ms)	I_e	15 (≥10)	≥16	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	typ. 100	typ. 120	mW/sr
Radiant flux (total) (I_F = 100 mA, t_p = 20 ms)	Φ_e	typ. 12	typ. 16	mW

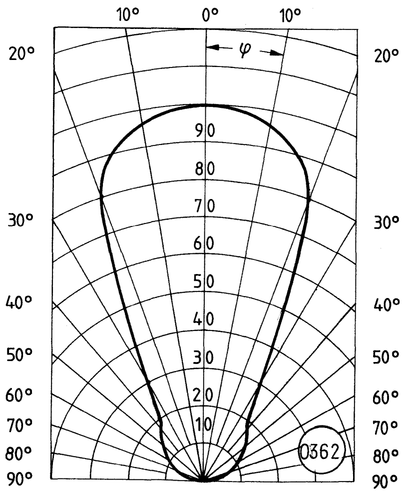
Relative spectral emission versus wavelength



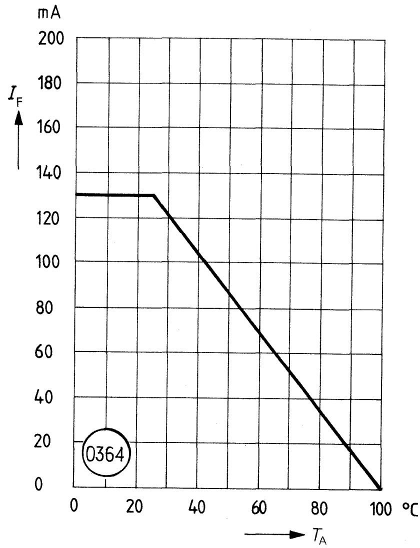
Radiant intensity versus forward current



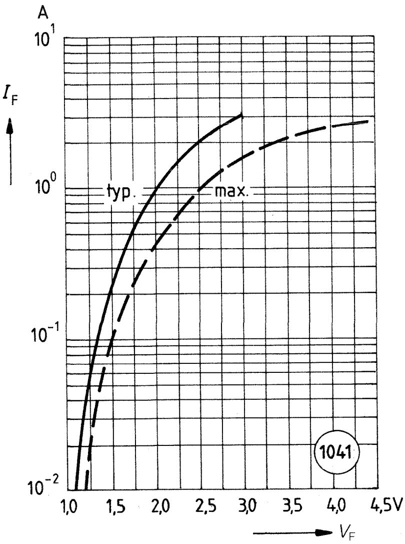
Radiation characteristic
Relative spectral emission versus half angle



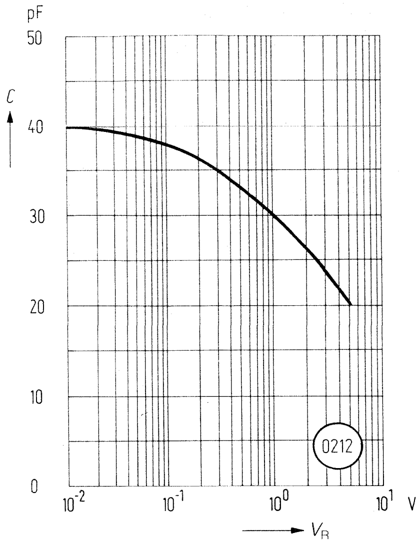
Forward current versus ambient temperature



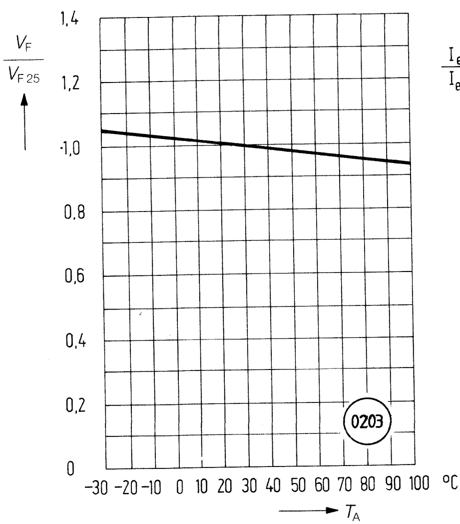
Forward current versus forward voltage



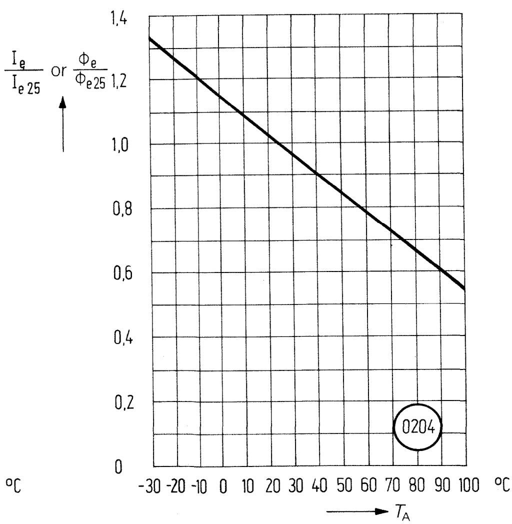
Capacitance versus reverse voltage



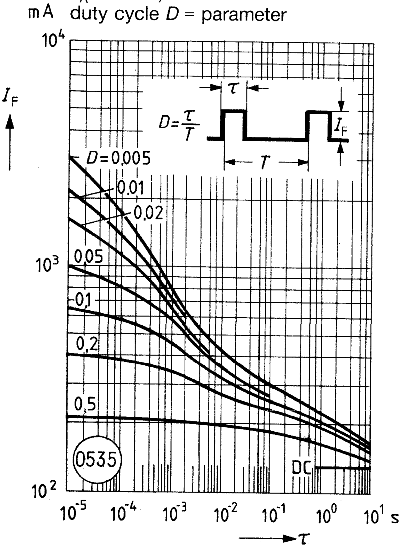
Forward voltage versus ambient temperature



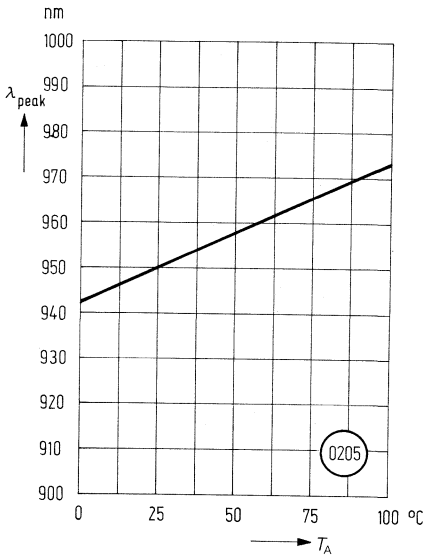
Radiant intensity versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
T_A = 25 °C;
duty cycle D = parameter



Wavelength at peak emission versus ambient temperature



GaAs Infrared Emitter

The GaAs infrared emitting diode LD 271, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible.

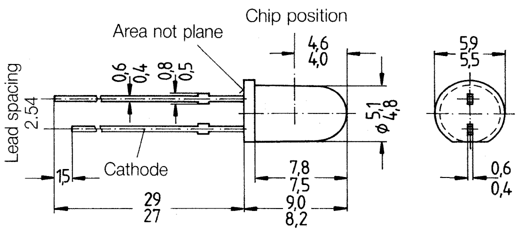
Package 5 mm LED package (T 1¾), grey-colored epoxy resin, solder tabs, lead spacing 2.54 mm (1⁄10″)

Cathode identification Short solder tab

Application IR-remote control for hifi and TV sets, video tape recorders, dimmers, remote control for various equipment, light-reflecting switches for steady and varying intensity

Features

- High reliability
- Long life
- High radiant intensity
- High pulse power
- Long leads
- Available in groups
- Same package as of BP 103 B



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
LD 271 L	Q62703-Q833
LD 271 LH	Q62703-Q838

Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature (≥10 mm distance from case bottom; soldering time $t \leq 3$ s)	T_{sold}	260	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current	I_F	130	mA
Surge current (τ = 10 µs, D = 0)	i_{FS}	3.5	A
Power dissipation (T_A = 25 °C)	P_{tot}	210	mW
Thermal resistance	R_{thJA}	350	K/W

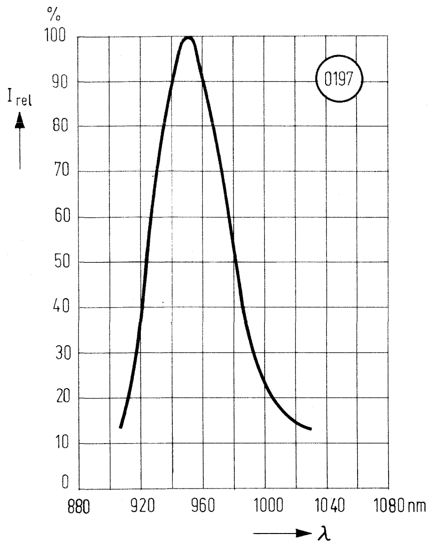
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 100 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 100 mA, t_p = 20 ms)	$\Delta \lambda$	55	nm
Half angle	φ	±25	deg.
Active chip area	A	0.25	mm^2
Dimensions of active chip area	$L \times W$	0.5 × 0.5	mm
Distance chip surface to case surface	D	4.0...4.6	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.30 (≤1.5)	V
(I_F = 1 A; t_p = 100 µs)	V_F	1.9 (≤2.5)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	–0.55	%/K
Temperature coefficient of V_F	TC_V	–1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	+0.3	nm/K

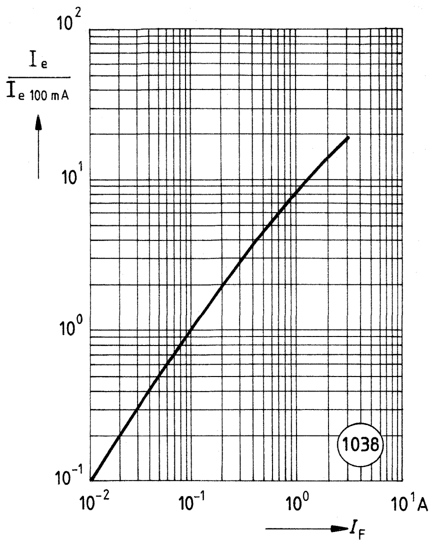
The diodes are grouped according to their radiant intensity I_e in axial direction
at a steradian Ω = 0.01 sr, or 6.5 degrees

		LD 271 L	LD 271 LH	
Radiant intensity				
(I_F = 100 mA)	I_e	15 (≥10)	≥16	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	typ. 100	typ. 120	mW/sr
Radiant flux (total) (I_F = 100 mA)	Φ_e	typ. 12	typ. 16	mW

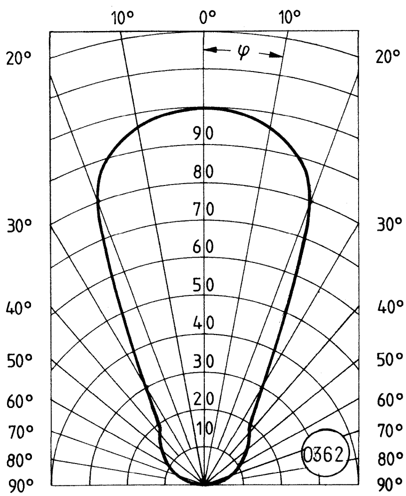
Relative spectral emission versus wavelength



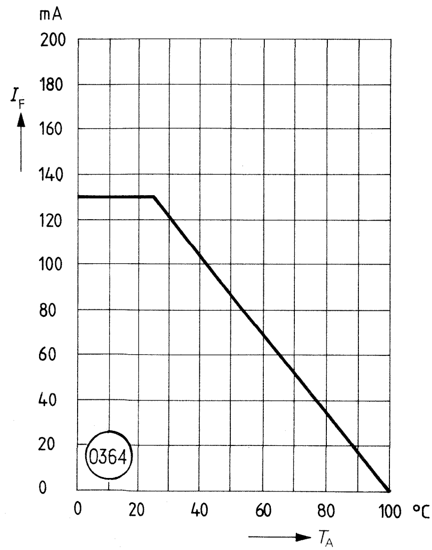
Radiant intensity versus forward current



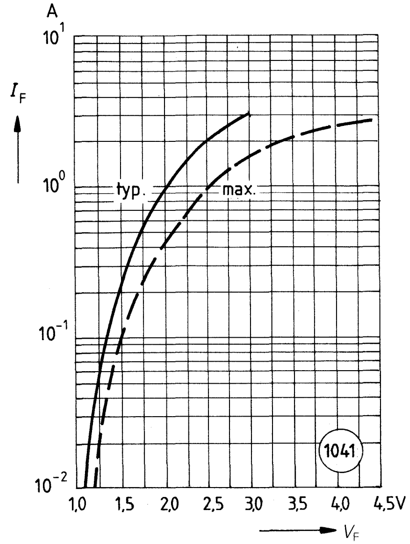
Radiation characteristic
Relative spectral emission versus half angle



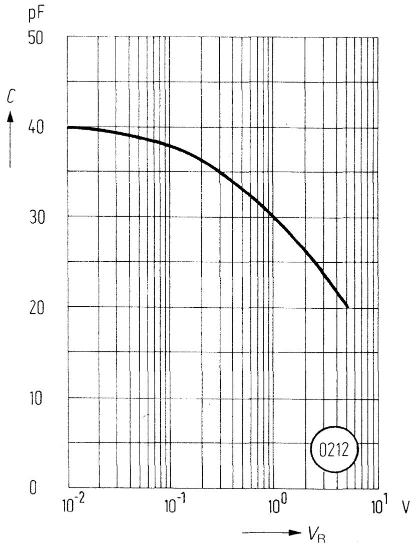
Forward current versus ambient temperature



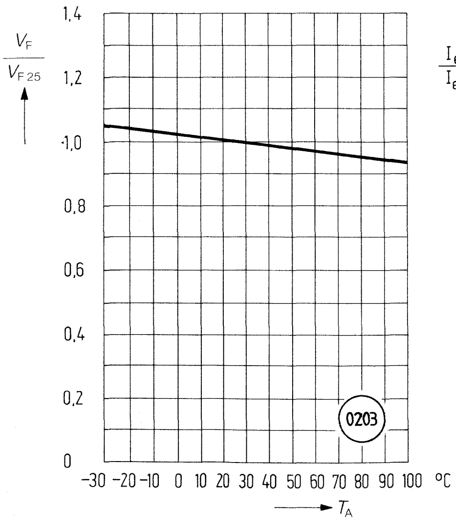
Forward current versus forward voltage



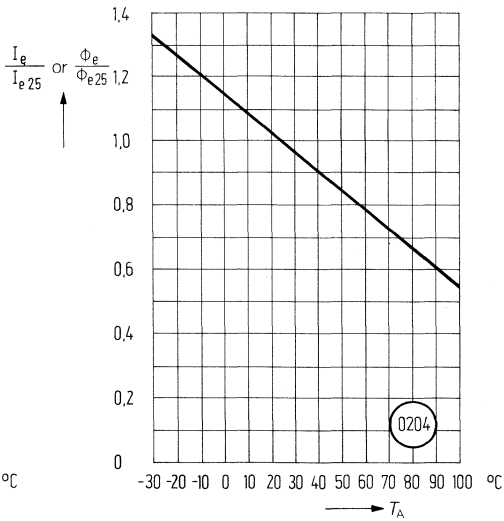
Capacitance versus reverse voltage



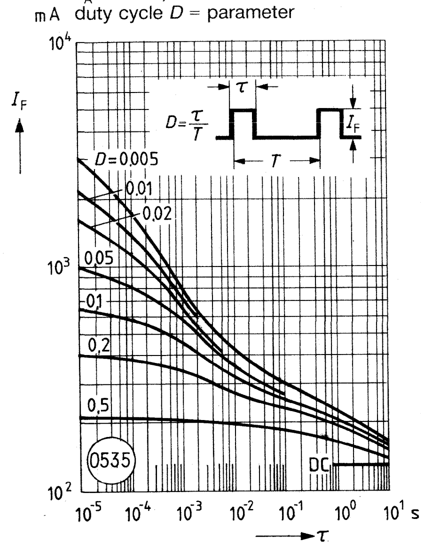
Forward voltage versus ambient temperature



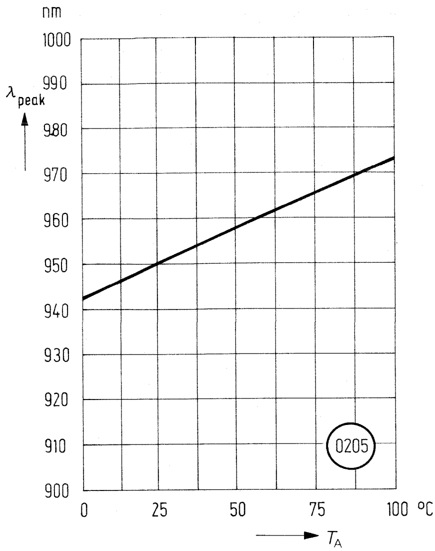
Radiant intensity versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
T_A = 25 °C;
duty cycle D = parameter



Wavelength at peak emission versus ambient temperature



Two-Chip GaAs Infrared Emitter

LD 273

The two-chip GaAs infrared emitting diode LD 273, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible.

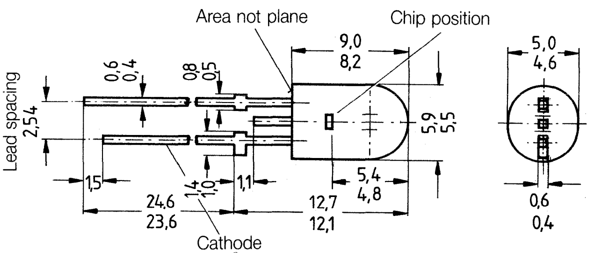
Package Similar to 5 mm LED package, grey-colored epoxy resin, solder tabs, lead spacing 2.54 mm (1/10″)

Cathode identification Short solder tab

Application IR-remote control for hifi and TV sets, video tape recorders, dimmers, remote control for various equipment, light-reflecting switches for steady and varying intensity

Features

- High reliability
- Long life
- High radiant intensity
- High radiant intensity (total)
- High pulse power
- Series connection of the 2 IR-chips



Approx. weight 0.4 g
Dimensions in mm

Type	Ordering code
LD 273	Q62703-Q694

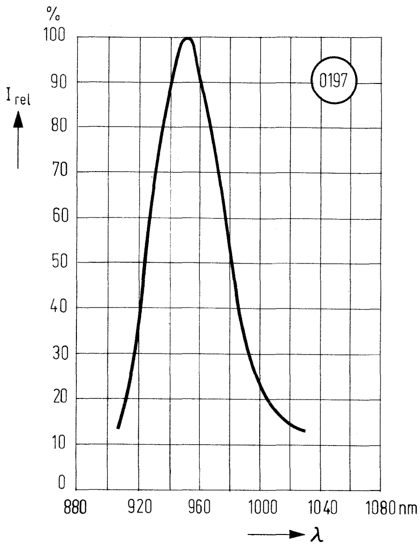
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature (≥10 mm distance from case bottom; soldering time t ≤3 s)	T_{sold}	260	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	10	V
Forward current	I_F	100	mA
Surge current (τ ≤10 µs; D = 0)	i_{FS}	3.2	A
Power dissipation (T_A = 25 °C)	P_{tot}	260	mW
Thermal resistance	R_{thJA}	280	K/W

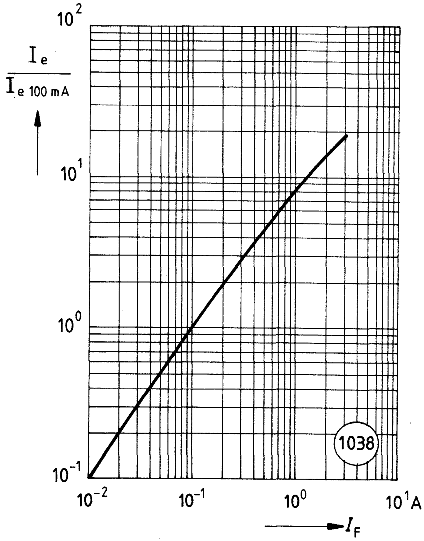
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 100 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 100 mA, t_p = 20 ms)	$\Delta\lambda$	55	nm
Half angle (pin terminal plane: horizontal)	φ_H	±25	deg.
Half angle (pin terminal plane: vertical)	φ_V	±15	deg.
Active chip areas (2 chips)	A	0.09	mm^2
Dimensions of active chip area/chip	$L \times W$	0.3 × 0.3	mm
Distance chip surface to case surface	D	4.8...5.4	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V)	C_o	10	pF
Forward voltage (I_F = 100 mA)	V_F	2.6 (≤3.0)	V
(I_F = 1 A; t_p = 100 µs)	V_F	3.8 (≤5.2)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	50 (≥10)	V
Reverse current (V_R = 10 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−3	mV/K
Temperature coefficient of λ_{peak}	TC_λ	+0.3	nm/K
Radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees (I_F = 100 mA, t_p = 20 ms)	I_e	≥25	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	220	mW/sr
Radiant flux (total) (I_F = 100 mA, t_p = 20 ms)	Φ_e	26	mW

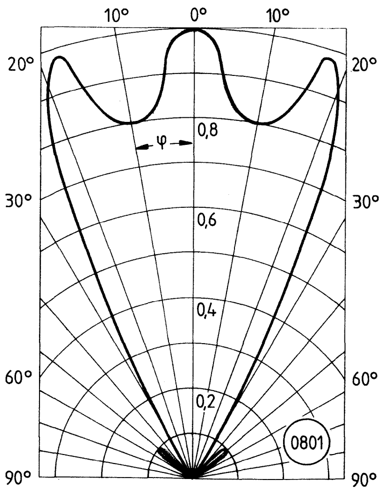
Relative spectral emission versus wavelength



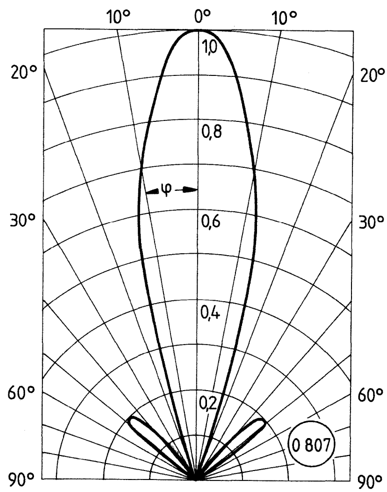
Radiant intensity versus forward current



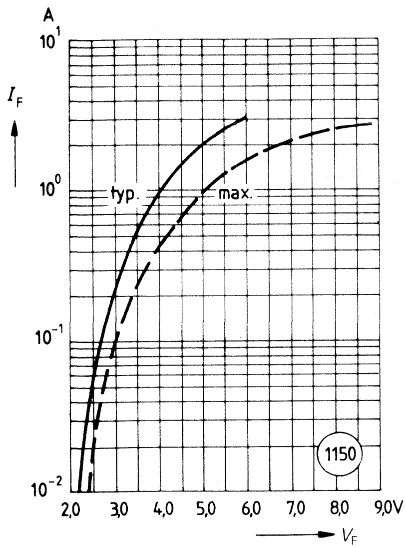
Radiation characteristic horizontally to pin terminal plane Relative spectral emission versus half angle



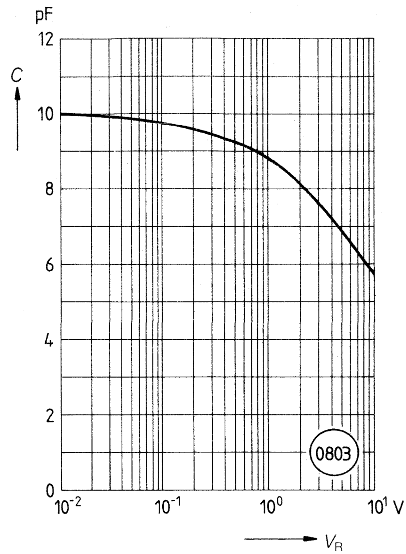
Radiation characteristic vertically to pin terminal plane Relative spectral emission versus half angle



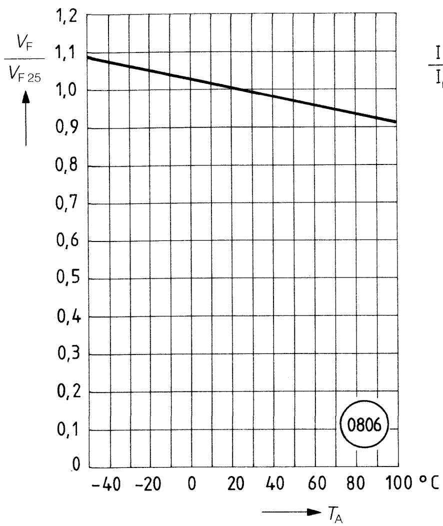
Forward current versus forward voltage



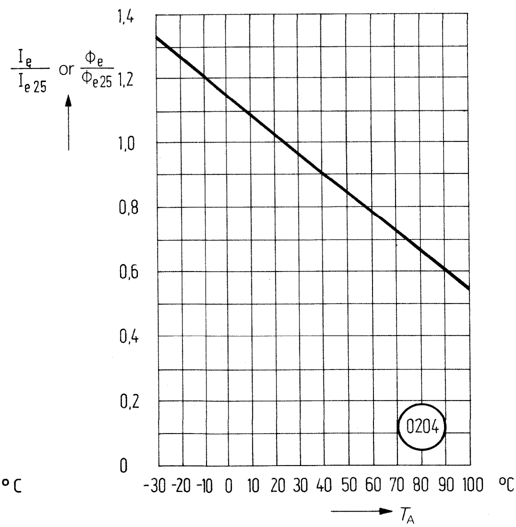
Capacitance versus reverse voltage



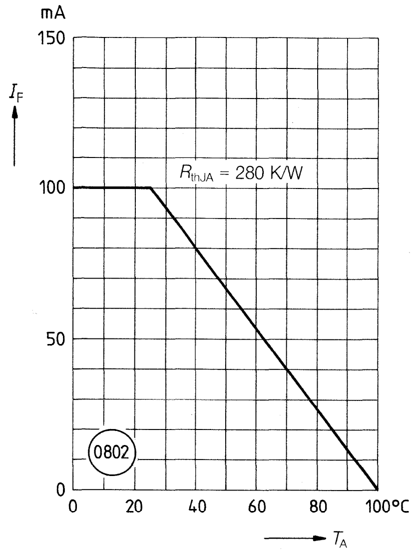
Forward voltage versus ambient temperature



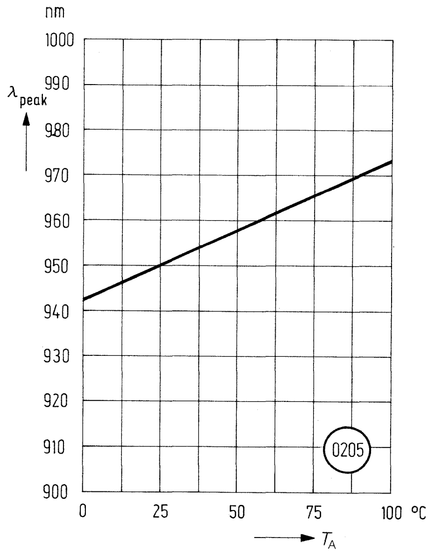
Radiant intensity versus ambient temperature



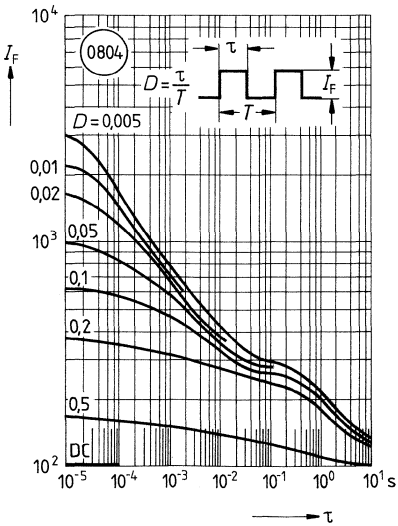
Forward current versus ambient temperature



Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
T_A = 25 °C;
duty cycle D = parameter



GaAs Infrared Emitter

LD 274

The GaAs infrared emitting diode LD 274, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible.

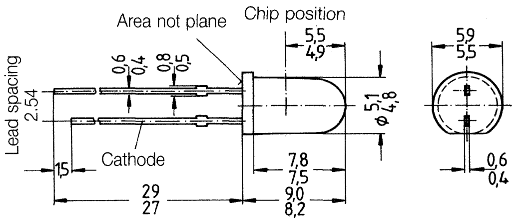
Package 5 mm LED package (T 1¾), grey-colored epoxy resin, solder tabs, lead spacing 2.54 mm (1⁄10″)

Cathode identification Short solder tab

Application IR-remote control for hifi and TV sets, video tape recorders, dimmers, remote control for various equipment, light-reflecting switches for steady and varying intensity

Features

- High reliability
- Long life
- Very high radiant intensity; narrow beam
- High pulse power



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
LD 274	Q62703-Q1031

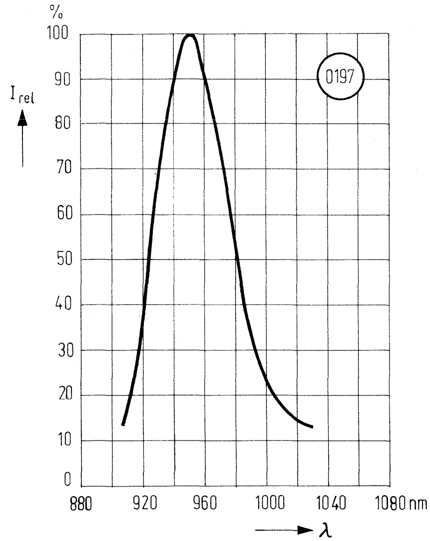
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current	I_F	100	mA
Surge current ($\tau \leq 10$ µs, $D = 0$)	i_{FS}	3	A
Power dissipation (T_A = 25 °C)	P_{tot}	165	mW
Thermal resistance	R_{thJA}	450	K/W

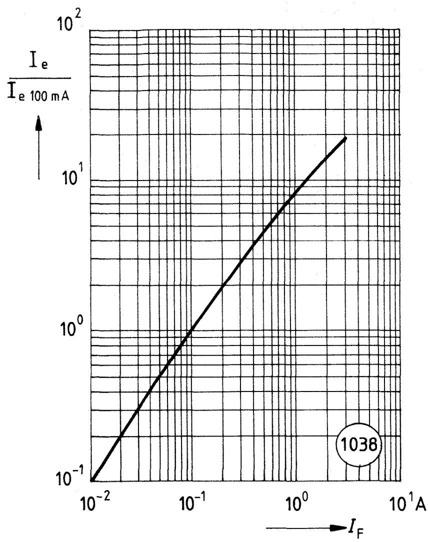
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 100 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 100 mA, t_p = 20 ms)	$\Delta \lambda$	55	nm
Half angle	φ	10	deg.
Active chip area	A	0.09	mm^2
Dimensions of active chip area	$L \times W$	0.3 × 0.3	mm
Distance chip surface to case surface	D	4.9...5.5	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V)	C_o	25	pF
Forward voltage (I_F = 100 mA)	V_F	1.30 (≤1.5)	V
(I_F = 1 A; t_p = 100 µs)	V_F	1.9 (≤2.5)	V
Breakdown voltage (I_R = 100 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	+0.3	nm/K
Radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees (I_F = 100 mA, t_p = 20 ms)	I_e	(≥30) typ. 60	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	typ. 400	mW/sr
Radiant flux (total) (I_F = 100 mA, t_p = 20 ms)	Φ_e	typ. 13	mW

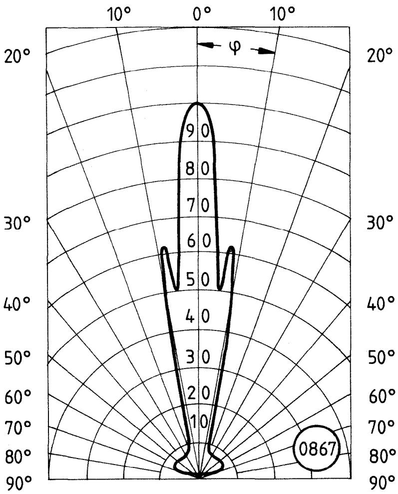
Relative spectral emission versus wavelength



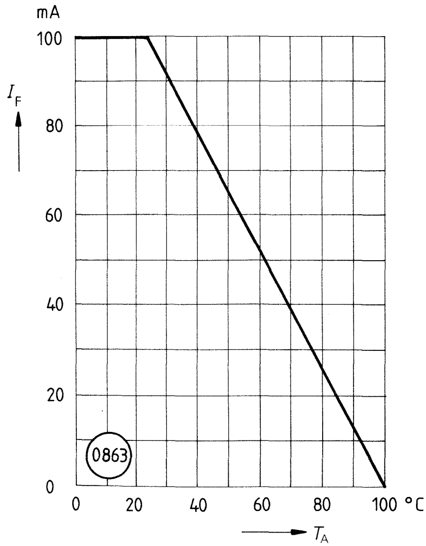
Radiant intensity versus forward current



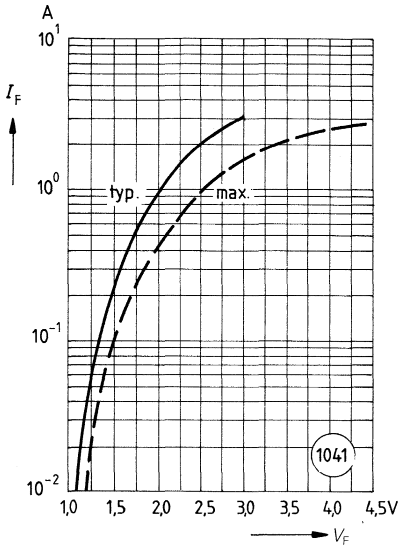
Radiation characteristic
Relative spectral emission versus half angle



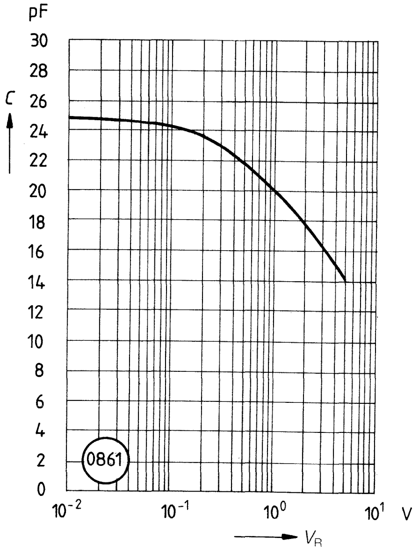
Forward current versus ambient temperature



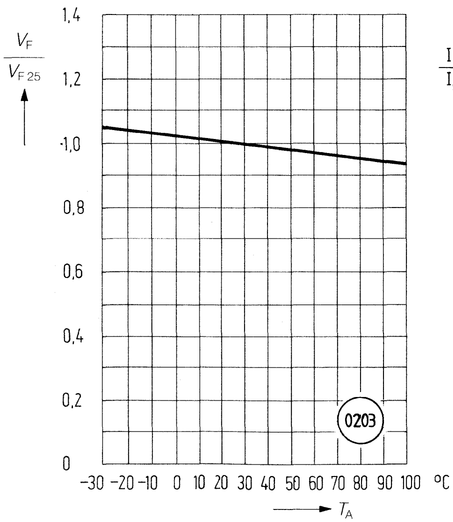
Forward current versus forward voltage



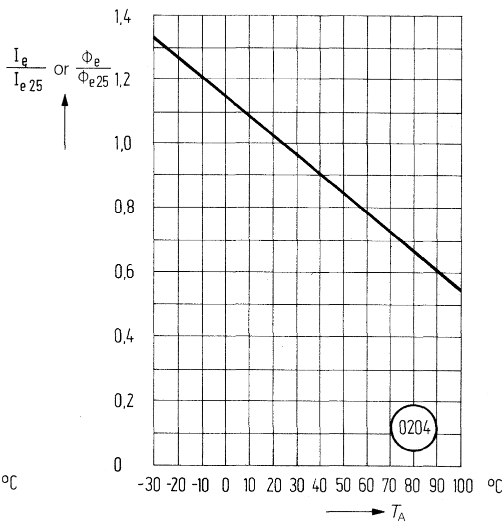
Capacitance versus reverse voltage



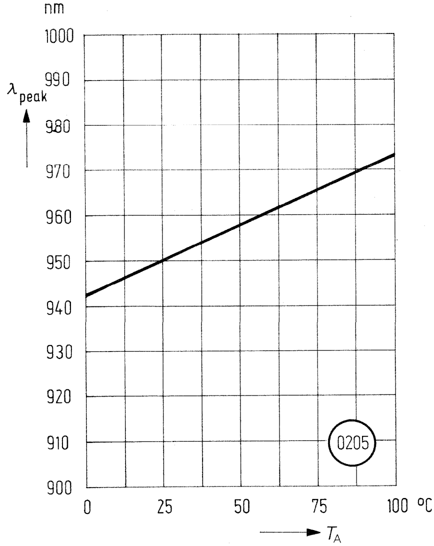
Forward voltage versus ambient temperature



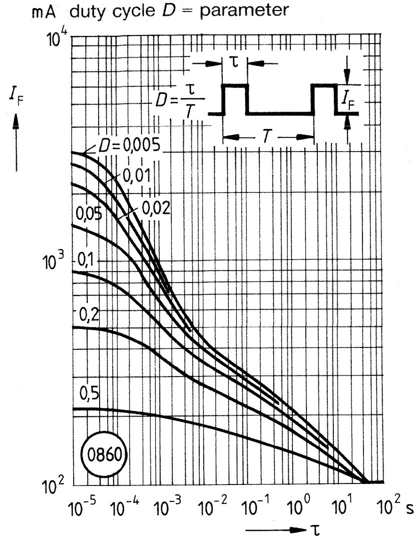
Radiant intensity versus ambient temperature



Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter



The GaAs infrared emitting diode SFH 400, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible. The cathode is electrically connected to the case.

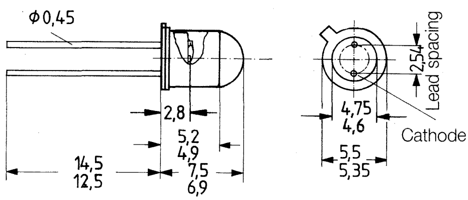
Package 18 A 3 DIN 41 876 (TO 18), glass lens, hermetically sealed package, solder tabs, lead spacing 2.54 mm (1/10″)

Anode identification Projection at case bottom

Application Light-reflecting switches for steady and varying intensity, IR-remote control, industrial electronics, "measuring and controlling"

Features

- High reliability
- Long life
- Very high radiant intensity; narrow beam
- High pulse power
- Available in groups
- Same package as of SFH 480, SFH 216



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 400 II	Q62702-P783
SFH 400 III*)	Q62702-P784

Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from case bottom; soldering time t ≤5 s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from case bottom; soldering time t ≤3 s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current (T_C = 25 °C)	I_F	300	mA
Surge current (τ ≤10 µs, D = 0)	i_{FS}	3	A
Power dissipation (T_C = 25 °C)	P_{tot}	470	mW
Thermal resistance	R_{thJA}	450	K/W
	R_{thJC}	160	K/W

*) Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

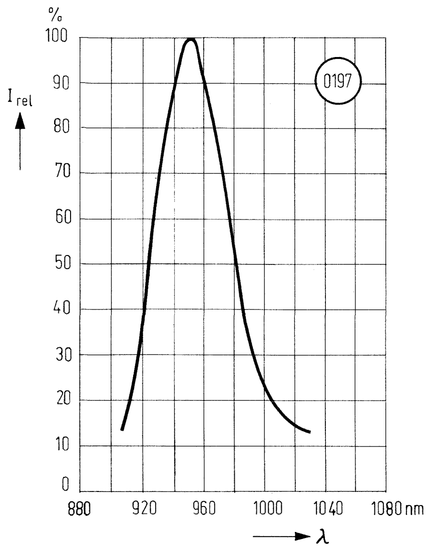
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 100 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 100 mA, t_p = 20 ms)	$\Delta \lambda$	55	nm
Half angle	φ	±6	deg.
Active chip area	A	0.25	mm^2
Dimensions of active chip area	$L \times W$	0.5 × 0.5	mm
Distance chip surface to case surface	D	4.0...4.8	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.30 (≤1.5)	V
(I_F = 1 A; t_p = 100 µs)	V_F	1.9 (≤2.5)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	0.3	nm/K

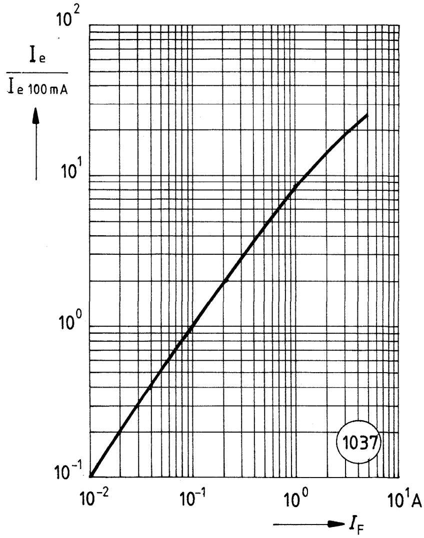
The diodes are grouped according to their radiant intensity I_e in axial direction
at a steradian Ω = 0.01 sr, or 6.5 degrees

		II	III	
Radiant intensity (I_F = 100 mA, t_p = 20 ms)	I_e	20...40	≥32	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	220	270	mW/sr
Radiant flux (total) (I_F = 100 mA, t_p = 20 ms)	Φ_e	5.5	7	mW

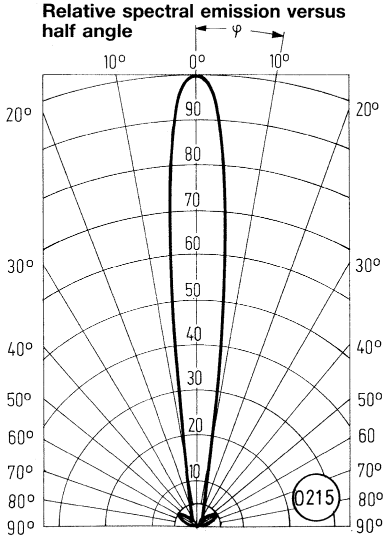
Relative spectral emission versus wavelength



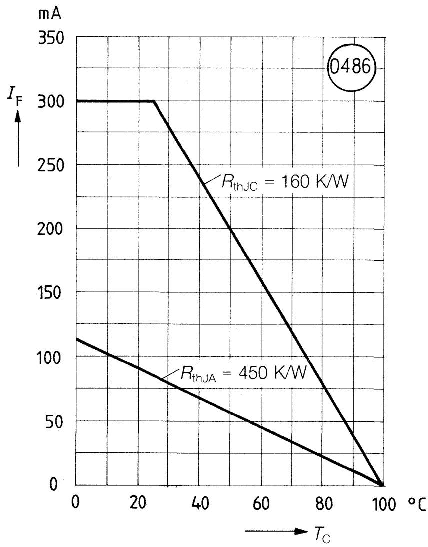
Radiant intensity versus forward current



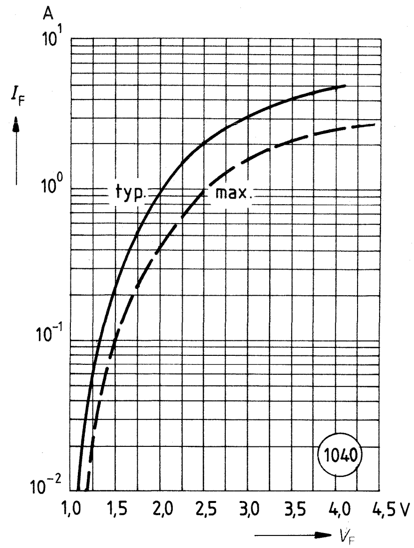
Radiation characteristic
Relative spectral emission versus half angle



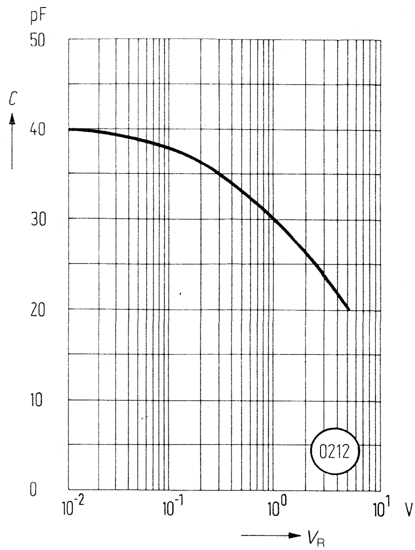
Forward current versus case temperature



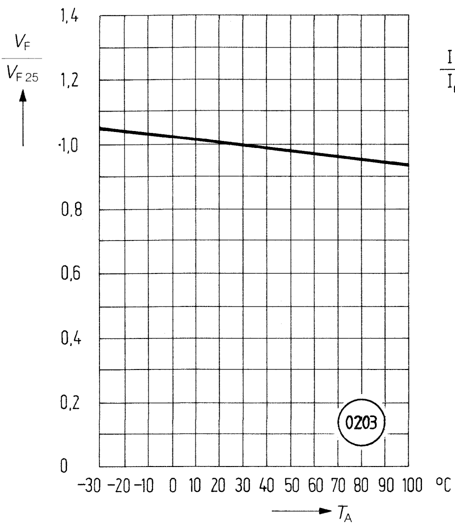
Forward current versus forward voltage



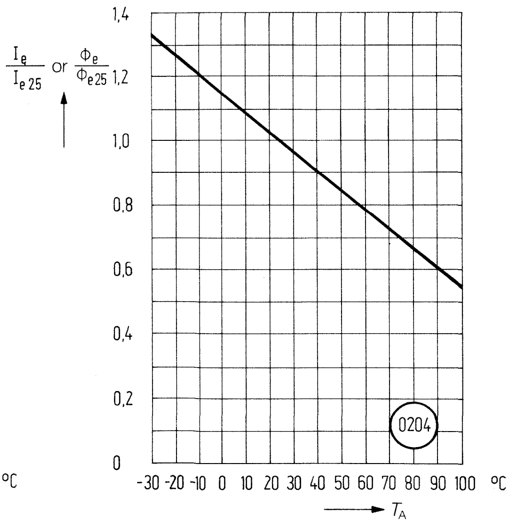
Capacitance versus reverse voltage



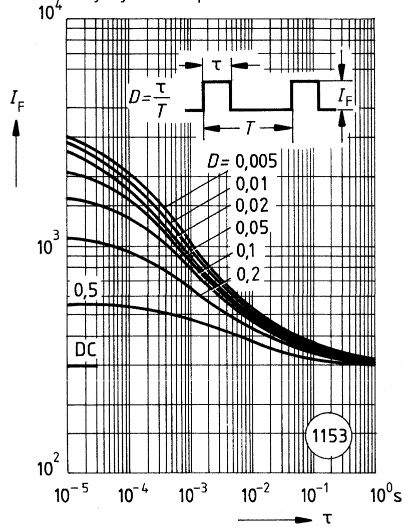
Forward voltage versus ambient temperature



Radiant intensity versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
T_C = 25 °C;
duty cycle D = parameter



The GaAs infrared emitting diode SFH 401, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible. The cathode is electrically connected to the case.

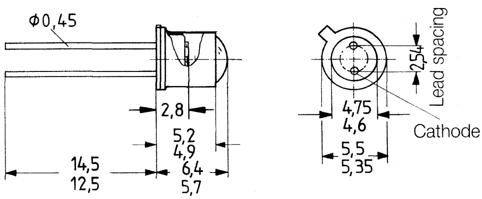
Package 18 A 3 DIN 41 876 (TO 18), glass lens, hermetically sealed package, solder tabs, lead spacing 2.54 mm (1/10")

Anode identification Projection at case bottom

Application Light-reflecting switches, for steady and varying intensity, IR-remote control for various equipment, industrial electronics, "measuring and controlling"

Features

- High reliability
- Long life
- High radiant intensity; narrow beam
- High pulse power
- Available in groups
- Same package as of SFH 481



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 401 II	Q62702-P786
SFH 401 III*)	Q62702-P787

Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from case bottom; soldering time t ≤5 s)	T_{sold}	260	°C
Soldering temperature at iron soldering ≥2 mm distance from the case bottom; soldering time t≤3 s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current (T_C = 25 °C)	I_F	300	mA
Surge current (τ ≤10 µs, D = 0)	i_{FS}	3	A
Power dissipation (T_C = 25 °C)	P_{tot}	470	mW
Thermal resistance	R_{thJA}	450	K/W
	R_{thJC}	160	K/W

*) Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

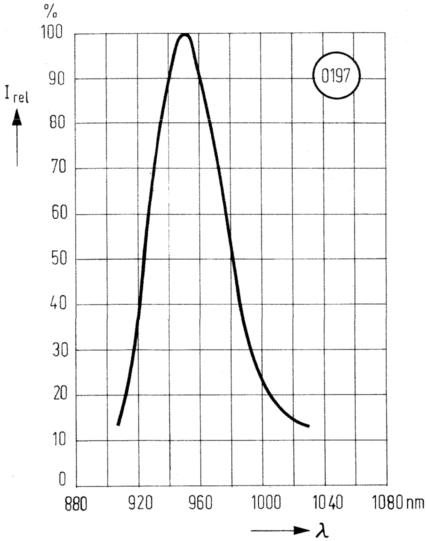
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 100 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 100 mA, t_p = 20 ms)	$\Delta\lambda$	55	nm
Half angle	φ	15	deg.
Active chip area	A	0.25	mm^2
Dimensions of active chip area	$L \times W$	0.5 × 0.5	mm
Distance chip surface to case surface	D	2.8...3.7	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.30 (≤1.5)	V
(I_F = 1 A; t_p = 100 µs)	V_F	1.9 (≤2.5)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	0.3	nm/K

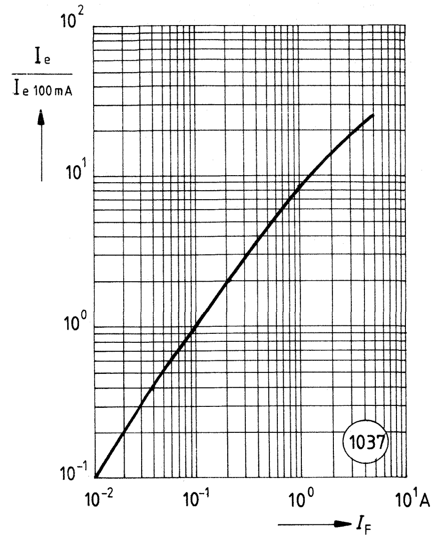
The diodes are grouped according to their radiant intensity I_e in axial direction
at a steradian Ω = 0.01 sr, or 6.5 degrees

		II	III	
Radiant intensity (I_F = 100 mA, t_p = 20 ms)	I_e	10...20	≥16	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	100	120	mW/sr
Radiant flux (total) (I_F = 100 mA, t_p = 20 ms)	Φ_e	5.5	7	mW

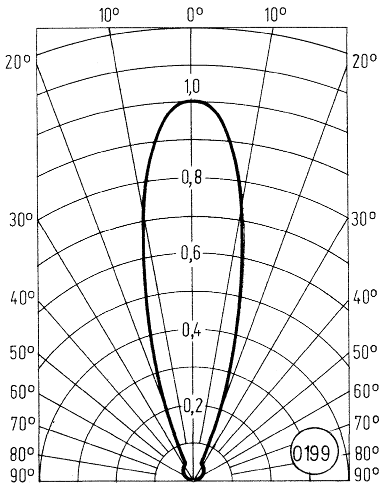
Relative spectral emission versus wavelength



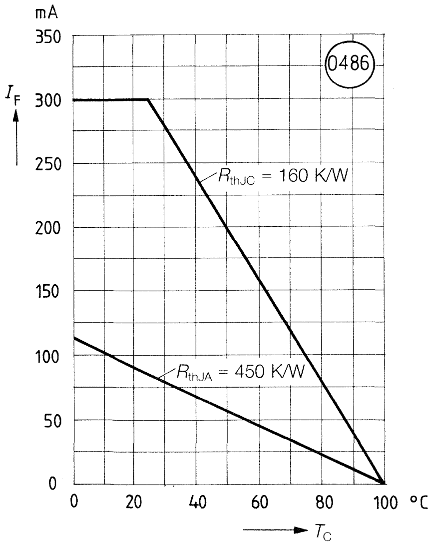
Radiant intensity versus forward current



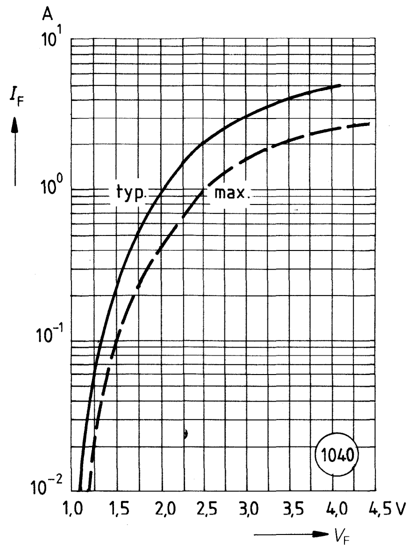
Radiation characteristic
Relative spectral emission versus half angle



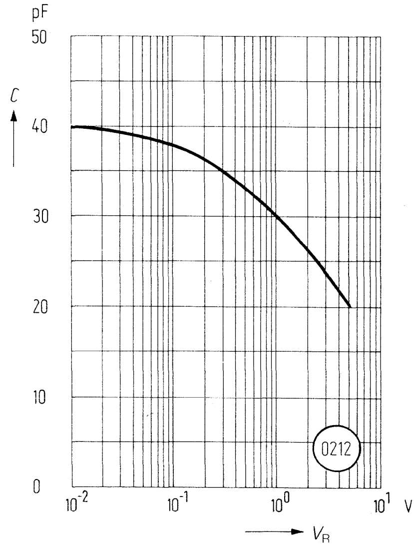
Forward current versus case temperature



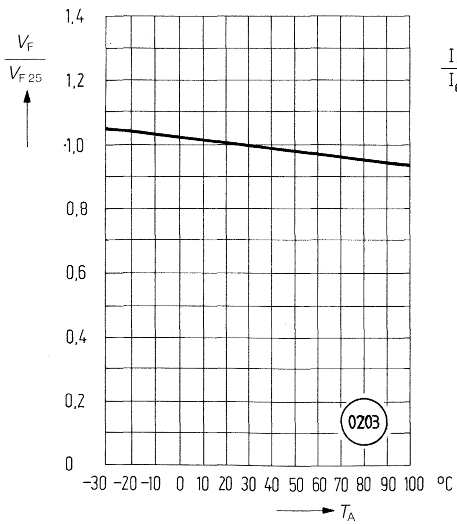
Forward current versus forward voltage



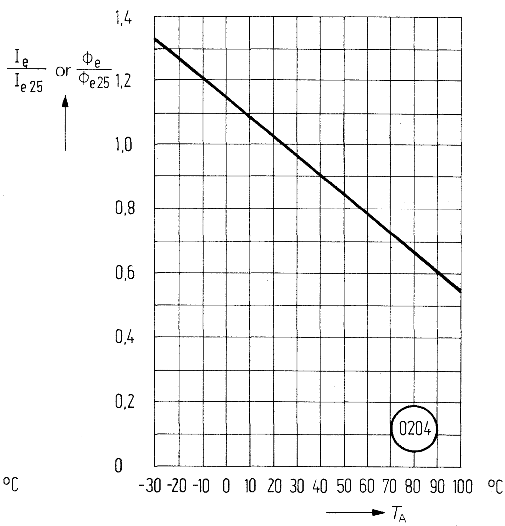
Capacitance versus reverse voltage



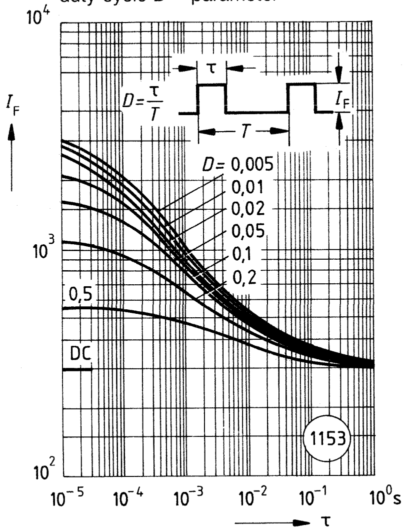
Forward voltage versus ambient temperature



Radiant intensity versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
T_C = 25 °C;
duty cycle D = parameter



GaAs Infrared Emitter **SFH 402**

The GaAs infrared emitting diode SFH 402, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible. The cathode is electrically connected to the case.

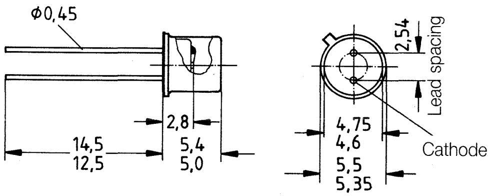
Package 18 A 3 DIN 41 876 (TO 18), glass lens, hermetically sealed package, solder tabs, lead spacing 2.54 mm (1/10″)

Anode identification Projection at case bottom

Application Light-reflecting switches for steady and varying intensity, IR remote controls, industrial electronics, "measuring and controlling"

Features

- High reliability
- Long life
- Wide beam
- High pulse power
- Available in groups
- Same package as of SFH 482, BPX 38, BPX 65, BPX 66



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 402 II	Q62702-P789
SFH 402 III*)	Q62702-P790

Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	−55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time t ≤5 s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time t ≤3 s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current (T_C = 25 °C	I_F	300	mA
Surge current (τ ≤10 µs, D = 0)	i_{FS}	3	A
Power dissipation (T_C = 25 °C)	P_{tot}	470	mW
Thermal resistance	R_{thJA}	450	K/W
	R_{thJC}	160	K/W

*) Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

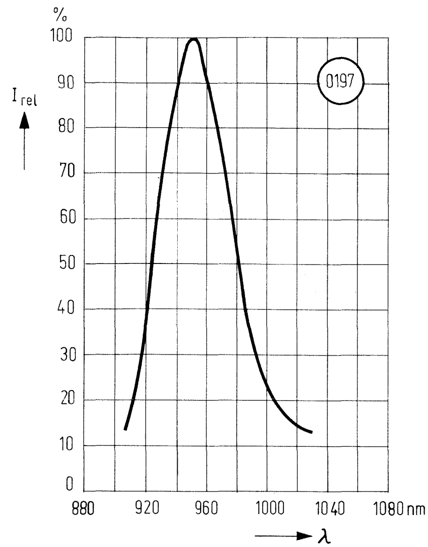
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 100 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 100 mA, t_p = 20 ms)	$\Delta\lambda$	55	nm
Half angle	φ	±40	deg.
Active chip area	A	0.25	mm^2
Dimensions of active chip area	$L \times W$	0.5 × 0.5	mm
Distance chip surface to case surface	D	2.1...2.7	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	40	pF
Forward voltage (I_F = 100 mA)	V_F	1.30 (≤1.5)	V
(I_F = 1 A; t_p = 100 µs)	V_F	1.9 (≤2.5)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	0.3	nm/K

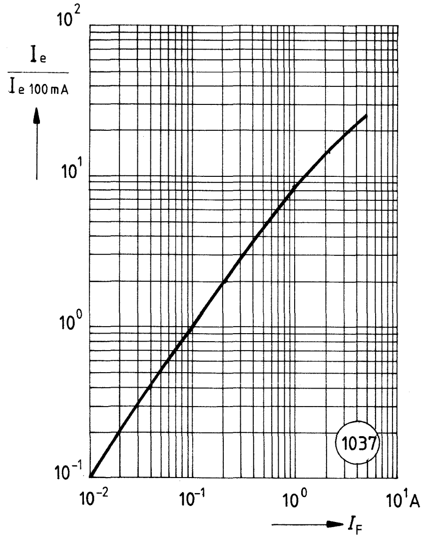
The diodes are grouped according to their radiant intensity I_e in axial direction
at a steradian Ω = 0.01 sr, or 6.5 degrees

		II	III	
Radiant intensity (I_F = 100 mA, t_p = 20 ms)	I_e	2.5...5	≥4	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	28	35	mW/sr
Radiant flux (total) (I_F = 100 mA, t_p = 20 ms)	Φ_e	5.5	7	mW

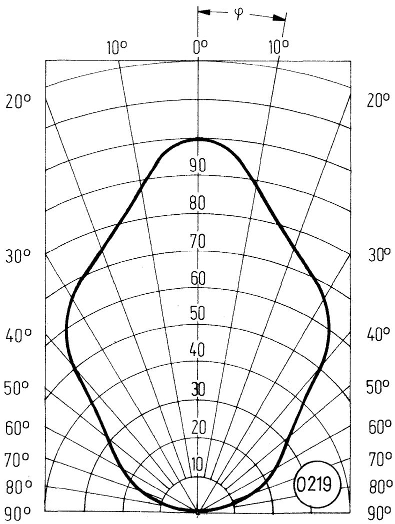
Relative spectral emission versus wavelength



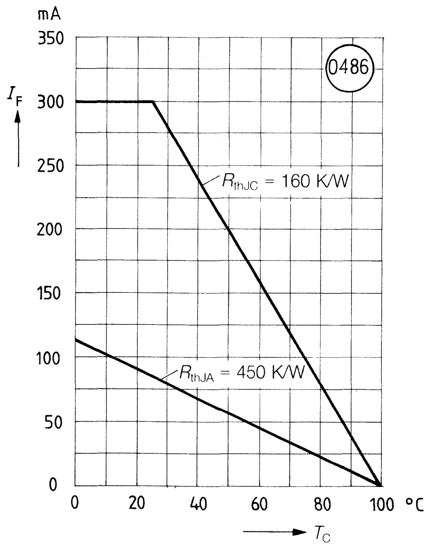
Radiant intensity versus forward current



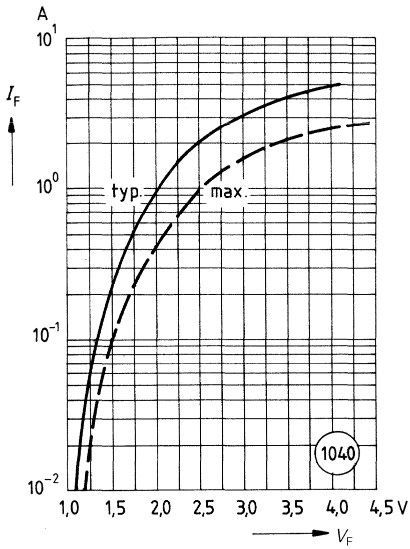
Radiation characteristic
Relative spectral emission versus half angle



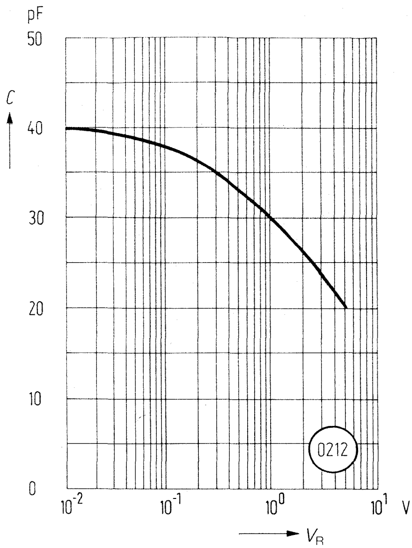
Forward current versus case temperature



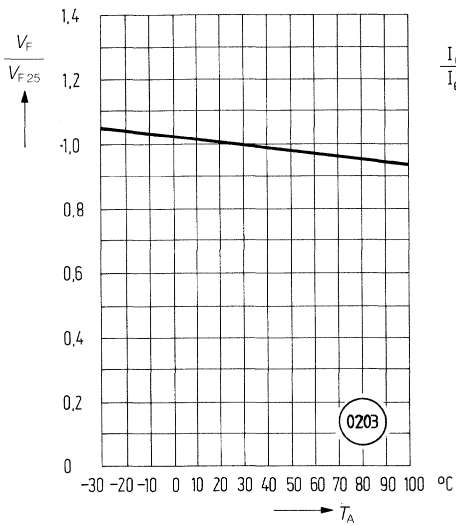
Forward current versus forward voltage



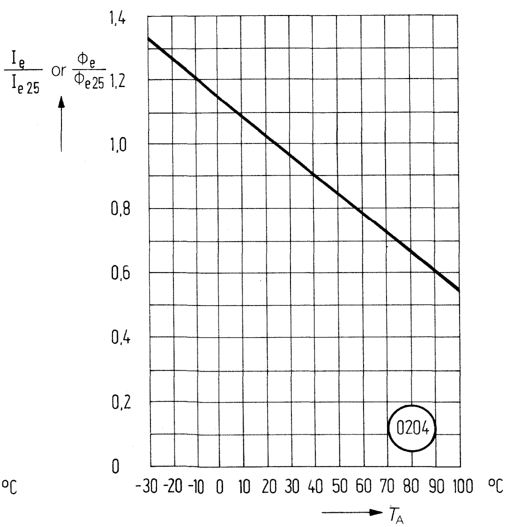
Capacitance versus reverse voltage



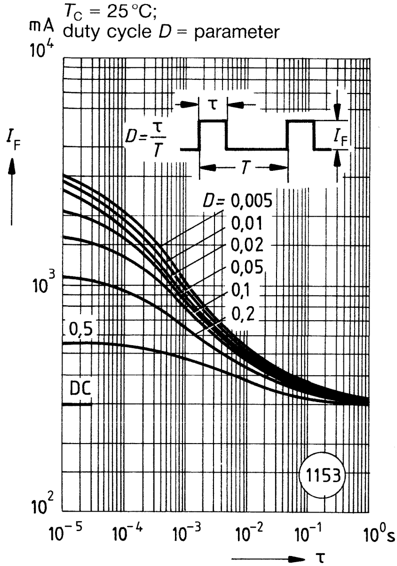
Forward voltage versus ambient temperature



Radiant intensity versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
T_C = 25 °C;
duty cycle D = parameter



The GaAs infrared emitting diode SFH 405, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible.

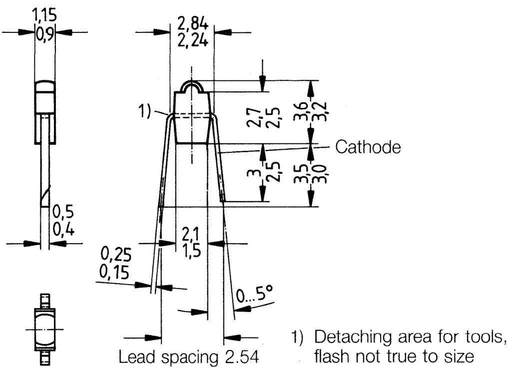
Package Miniature lead frame, transparent epoxy resin lens, solder tabs, lead spacing 2.54 mm (1/10″)

Cathode identification Sloping solder tab

Application Miniature light-reflecting switches for steady and varying intensity, punched card readers, industrial electronics, "measuring and controlling"

Features

- High reliability
- Long life
- High radiant intensity
- High pulse power
- Available in groups
- Same package as of SFH 305



Approx. weight 0.02 g
Dimensions in mm

Type	Ordering code
SFH 405 II	Q62702-P856
SFH 405 III*)	Q62702-P857

Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–40...+80	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	230	°C
Soldering temperature at iron soldering ≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Junction temperature	T_j	80	°C
Reverse voltage	V_R	5	V
Forward current	I_F	40	mA
Surge current (τ = 10 μs, D = 0)	i_{FS}	1.6	A
Power dissipation (T_A = 25 °C)	P_{tot}	65	mW
Thermal resistance	R_{thJA}	950	K/W
	R_{thJS}	850	K/W

*) Supplies out of this group cannot always be guaranteed due to unforeseeable spread of yield. In this case we will reserve us the right of delivering a substitute group.

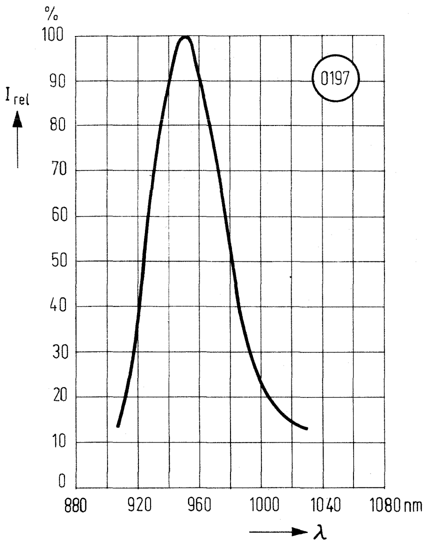
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 40 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 40 mA, t_p = 20 ms)	$\Delta \lambda$	55	nm
Half angle	φ	±16	deg.
Active chip area	A	0.25	mm^2
Dimensions of active chip area	$L \times W$	0.5 × 0.5	mm
Distance chip surface to apex of lens	D	1.3...1.9	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 40 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	40	pF
Forward voltage (I_F = 40 mA)	V_F	1.25 (≤1.4)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	0.3	nm/K

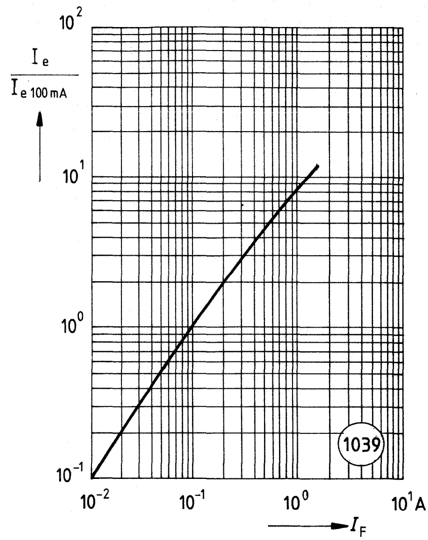
The diodes are grouped according to their radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees

		II	III	
Radiant intensity (I_F = 40 mA, t_p = 20 ms)	I_e	≤3.2	≥2.5	mW/sr
Radiant flux (total) (I_F = 40 mA, t_p = 20 ms)	Φ_e	2.5	4	mW

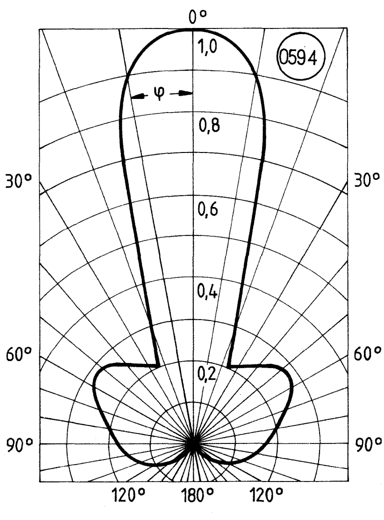
Relative spectral emission versus wavelength



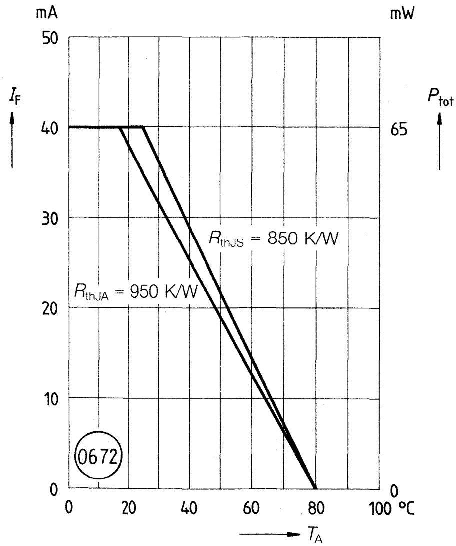
Radiant intensity versus forward current



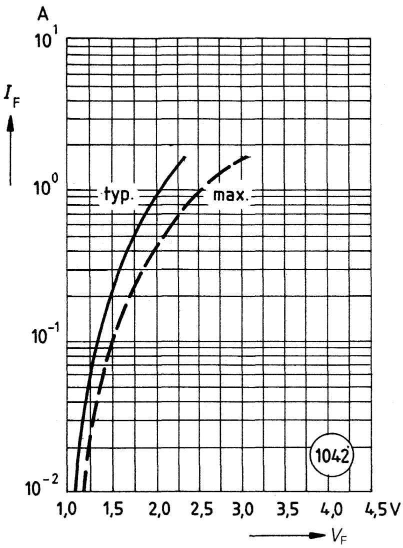
Directional characteristic
Relative spectral emission versus half angle



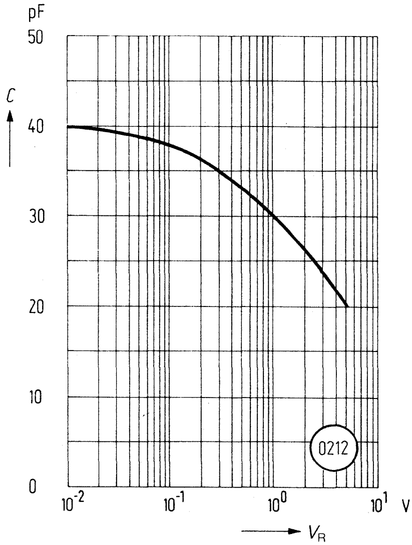
Forward current versus ambient temperature



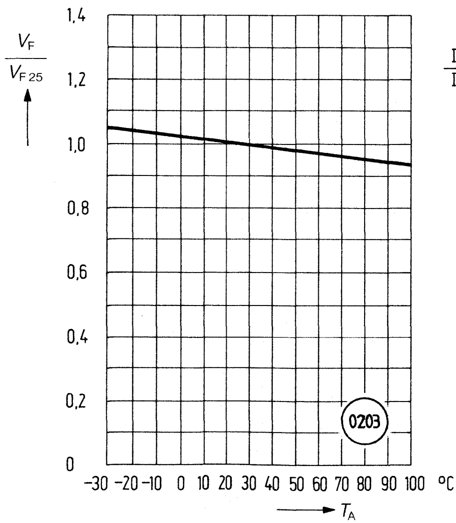
Forward current versus forward voltage



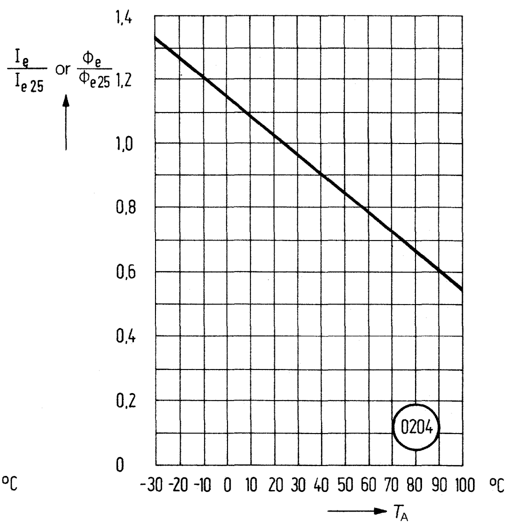
Capacitance versus reverse voltage



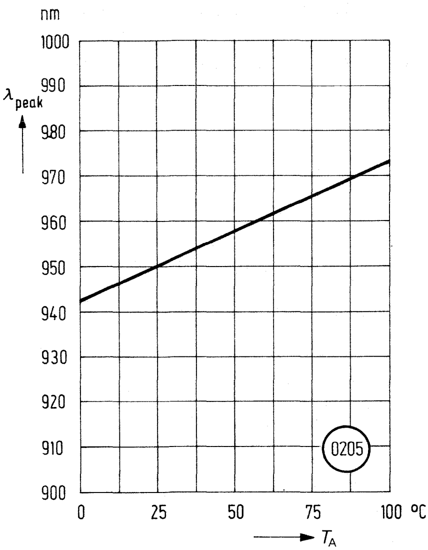
Forward voltage versus ambient temperature



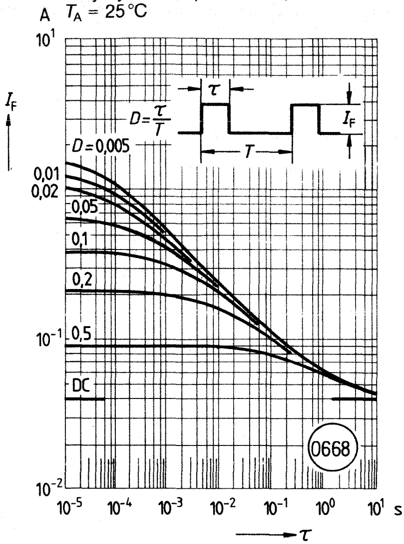
Radiant intensity versus ambient temperature



Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter; T_A = 25 °C



The GaAs infrared emitting diode SFH 409, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The radiation is activated by dc or pulse operation in forward direction; simultaneous modulation is possible.

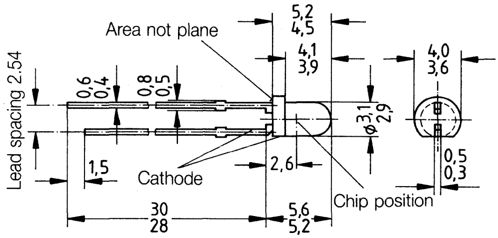
Package 3 mm LED package (T1), grey-colored transparent epoxy resin, solder tabs, lead spacing 2.54 mm (1⁄10″)

Cathode identification Short solder tab

Application Light-reflecting switches for steady and varying intensity, IR remote control

Features

- High reliability
- Long life
- High radiant intensity
- High pulse power
- Same package as of SFH 309



Approx. weight 0.3 g
Dimensions in mm

Type	Ordering code
SFH 409	Q62702-P860

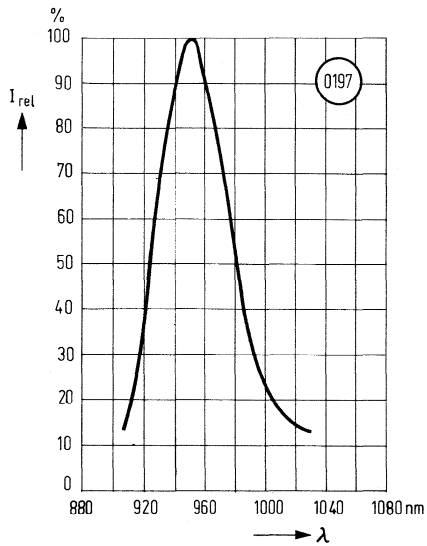
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	−55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current	I_F	100	mA
Surge current (τ = 10 µs, D = 0)	i_{FS}	3	A
Power dissipation (T_A = 25 °C)	P_{tot}	165	mW
Thermal resistance	R_{thJA}	450	K/W

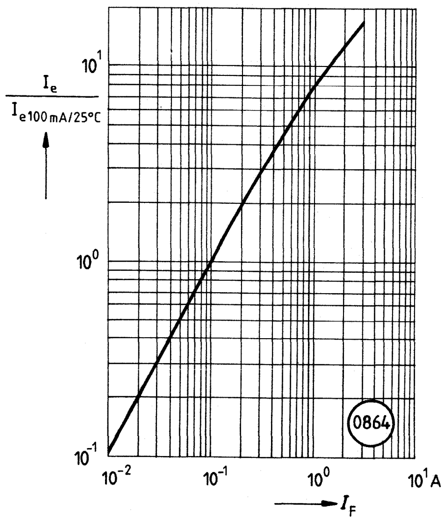
Characteristics (T_A = 25 °C)

Wavelength at peak emission (I_F = 100 mA, t_p = 20 ms)	λ_{peak}	950 ± 20	nm
Spectral bandwidth at 50% of I_{max} (I_F = 100 mA, t_p = 20 ms)	$\Delta \lambda$	55	nm
Half angle	φ	20	deg.
Active chip area	A	0.09	mm^2
Dimensions of active chip area	$L \times W$	0.3 × 0.3	mm
Distance chip surface to lead-frame stand-off	D	2.6	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	1	µs
Capacitance (V_R = 0 V)	C_o	25	pF
Forward voltage (I_F = 100 mA)	V_F	1.30 (≤1.5)	V
(I_F = 1 A; t_p = 100 µs)	V_F	1.9 (≤2.5)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.55	%/K
Temperature coefficient of V_F	TC_V	−1.5	mV/K
Temperature coefficient of λ_{peak}	TC_λ	+0.3	nm/K
Radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees (I_F = 100 mA, t_p = 20 ms)	I_e	(≥6) typ. 15	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	typ. 100	mW/sr
Radiant flux (total) (I_F = 100 mA, t_p = 20 ms)	Φ_e	typ. 14	mW

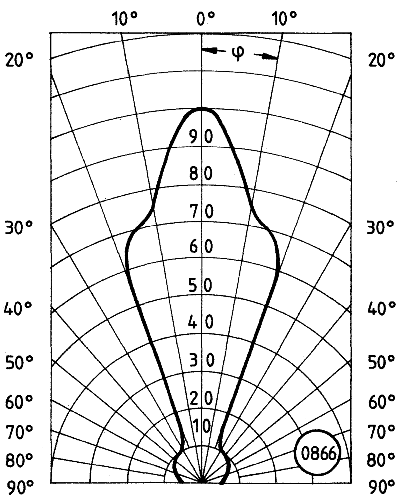
Relative spectral emission versus wavelength



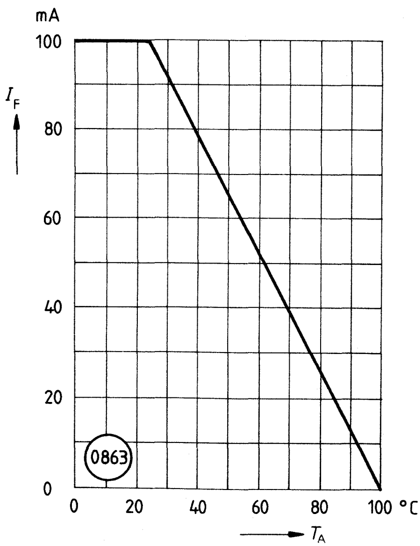
Radiant intensity versus forward current
(r = 5 µs, *t* = 5 ms)



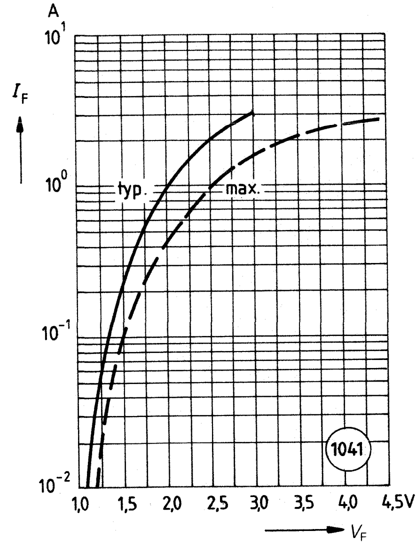
Radiation characteristic
Relative spectral emission versus half angle



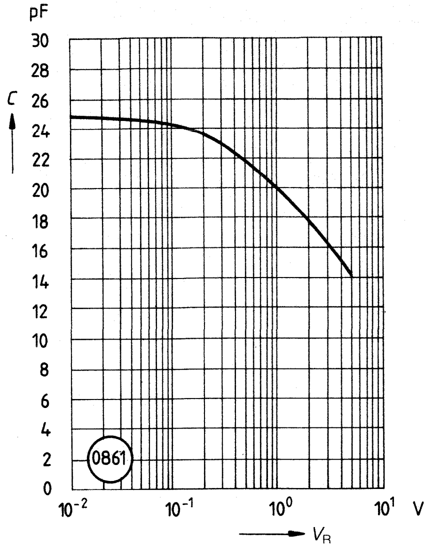
Forward current versus ambient temperature



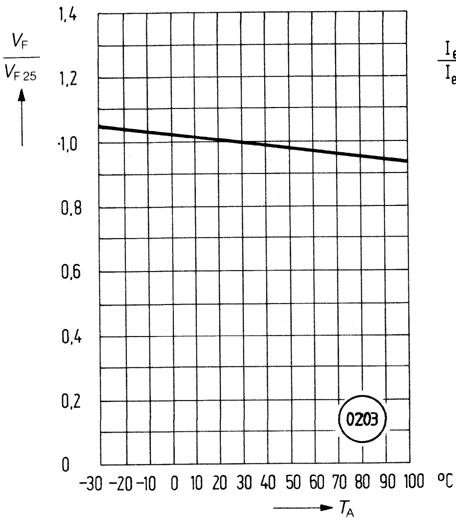
Forward current versus forward voltage



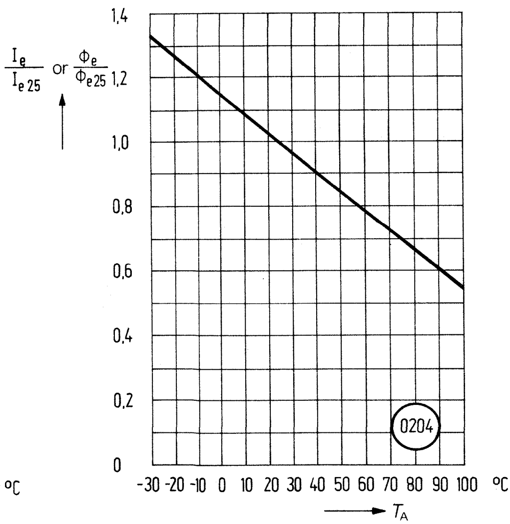
Capacitance versus reverse voltage



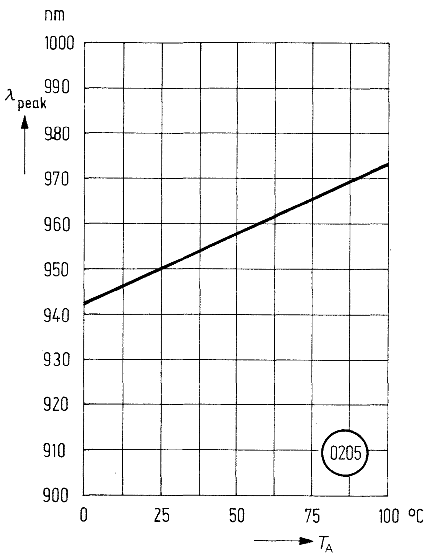
Forward voltage versus ambient temperature



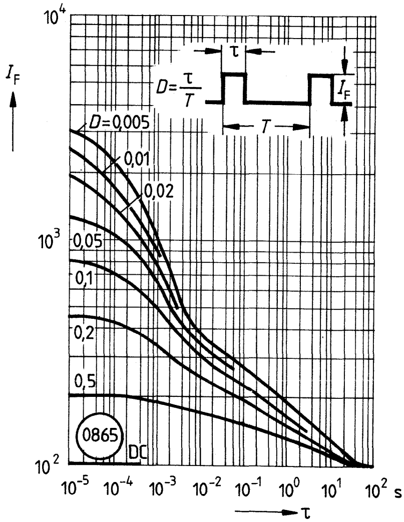
Radiant intensity versus ambient temperature



Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter;
T_A = 25 °C



GaAlAs Infrared Emitter (880 nm)

SFH 480

The GaAlAs infrared emitting diode SF 480, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The anode is electrically connected to the case.

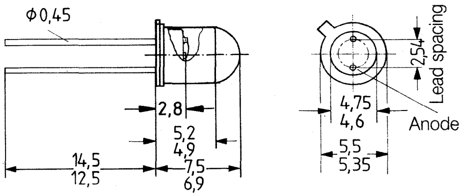
Package 18 A 2, DIN 41 876 (similar to TO 18)

Cathode identification Projection at case bottom

Application IR remote control for various equipment, light-reflecting switches for steady and varying intensity

Features

- High reliability
- Long life
- High radiant intensity; narrow beam
- High pulse power
- Excellent spectral match with silicon photodetectors
- Hermetically sealed metal case



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 480	Q62703-Q1087

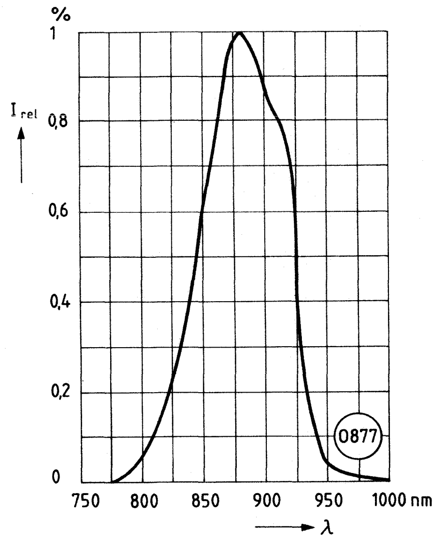
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time t ≤5 s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time t ≤3 s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current (T_C ≤25 °C)	I_F	200	mA
Surge current (τ ≤10 μs)	i_{FS}	2.5	A
Power dissipation (T_C ≤25 °C)	P_{tot}	470	mW
Thermal resistance:			
Junction/ambient air	R_{thJA}	450	K/W
Junction/case	R_{thJC}	160	K/W

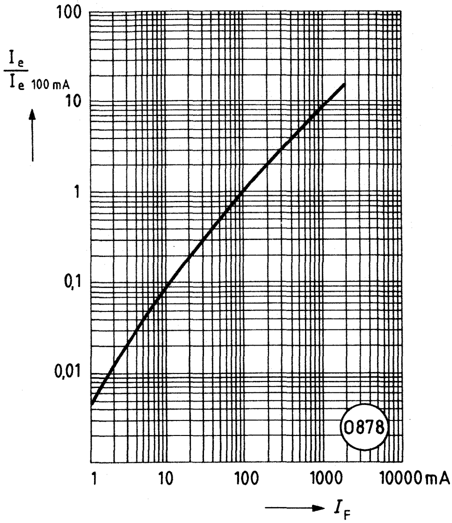
Characteristics (T_A = 25 °C)

Wavelength at peak emission			
(I_F = 10 mA)	λ_{peak}	880	nm
(I_F = 100 mA, t_p = 20 ms; D = 1:12)	λ_{peak}	883	nm
(I_F = 1 A; t_p = 100 µs; D = 1:100)	λ_{peak}	886	nm
Spectral bandwidth at 50% of I_{max}			
(I_F = 10 mA)	$\Delta \lambda$	80	nm
Half angle	φ	±6	deg.
Active chip area	A	0.16	mm^2
Dimensions of active chip area	$L \times W$	0.4 × 0.4	mm
Distance chip surface to case surface	D	4.0...4.8	mm
Switching times			
I_e from 10% to 90% and from 90% to 10%			
(I_F = 100 mA)	t_r, t_f	0.6; 0.5	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	25	pF
Forward voltage (I_F = 100 mA; t_p = 20 ms))	V_F	1.5 (≤1.8)	V
(I_F = 1 A; t_p = 100 µs)	V_F	3.0 (≤3.8)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	–0.5	%/K
Temperature coefficient of V_F	TC_V	–0.2	%/K
Temperature coefficient of λ_{peak}	TC_λ	0.25	nm/K
Radiant intensity I_e in axial direction			
at a steradian Ω = 0.01 sr, or 6.5 degrees			
(I_F = 100 mA, t_p = 20 ms)	I_e	50 (≥25)	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	450	mW/sr
Radiant flux (total)			
(I_F = 100 mA)	Φ_e	10	mW

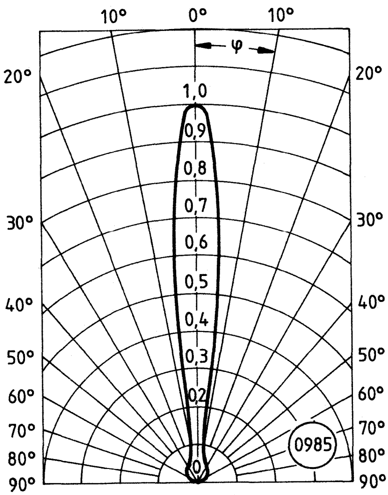
Relative spectral emission versus wavelength



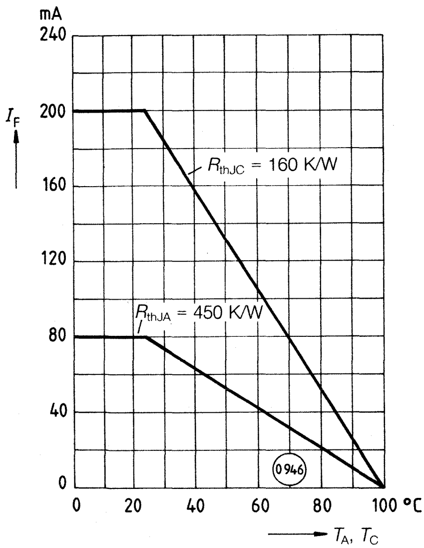
Radiant intensity versus forward current



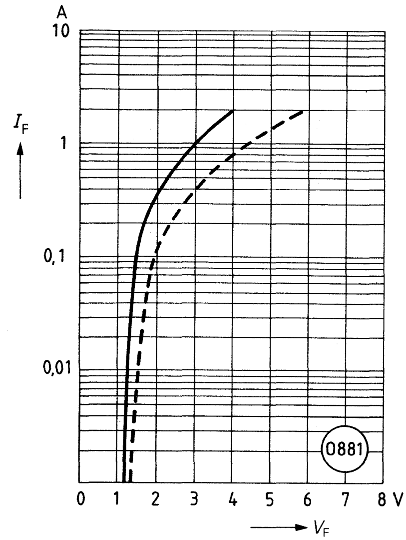
Radiation characteristic
Relative spectral emission versus half angle



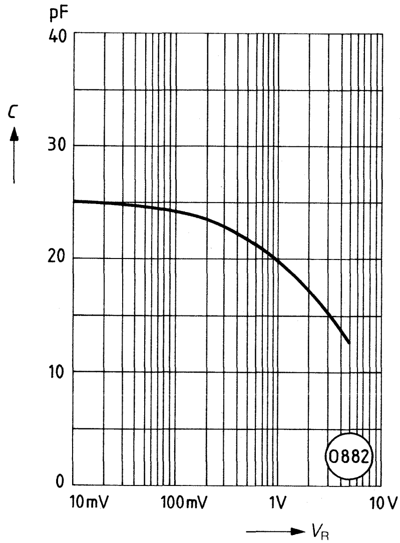
Forward current versus case and ambient temperature



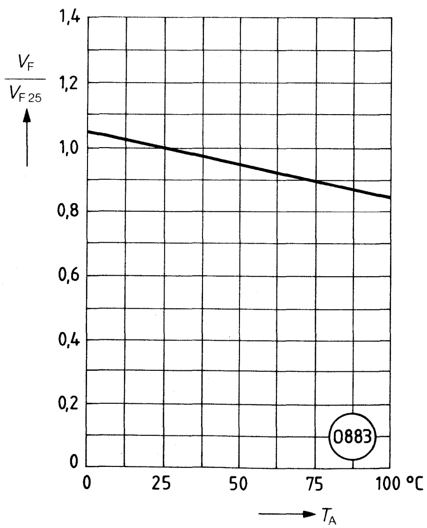
Forward current versus forward voltage



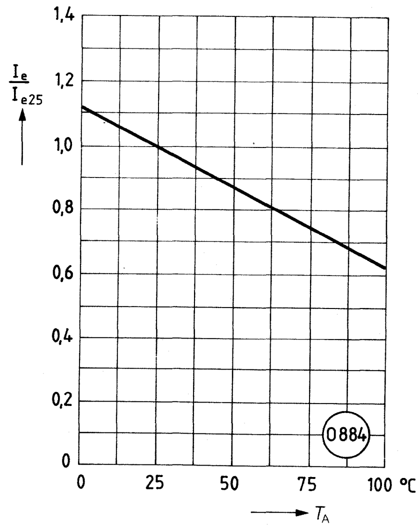
Capacitance versus reverse voltage



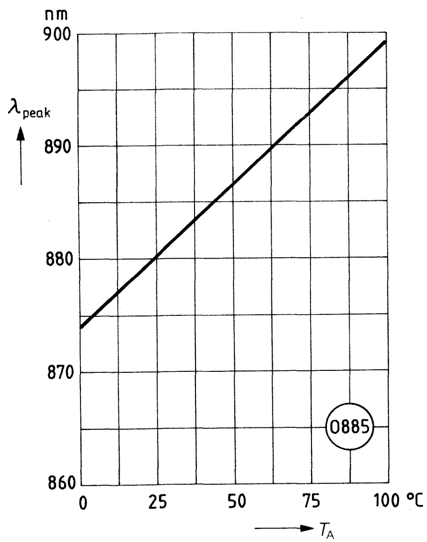
Forward voltage versus ambient temperature



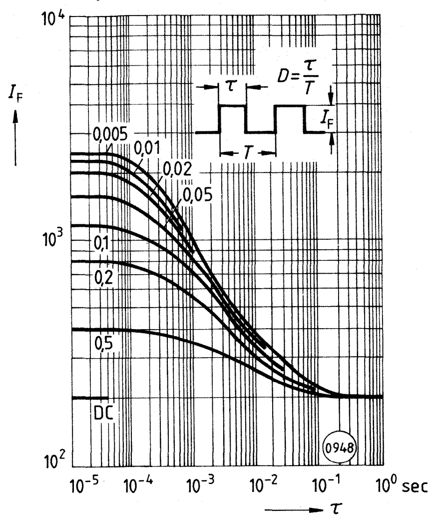
Radiant intensity versus ambient temperature



Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter



GaAlAs Infrared Emitter (880 nm) — SFH 481

The GaAlAs infrared emitting diode SFH 481, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The anode is electrically connected to the case.

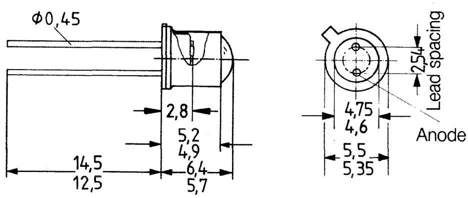
Package 18 A 2 DIN 41 876 (similar to TO 18)

Cathode identification Projection at case bottom

Application IR remote controls, light-reflecting switches for steady and varying intensity

Features

- High reliability
- Long life
- High radiant intensity; narrow beam
- High pulse power
- Excellent spectral match with silicon photodetectors
- Hermetically sealed metal case



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 481	Q62703-Q1088

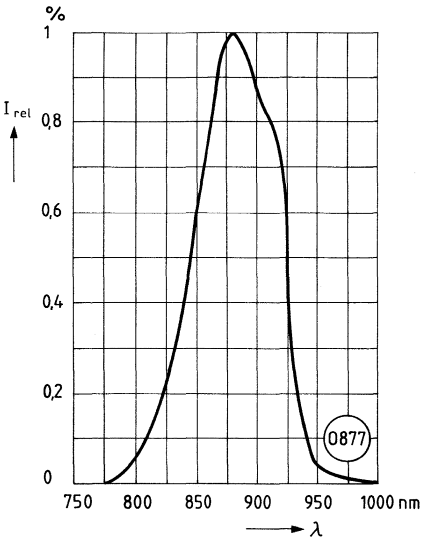
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time t ≤5 s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time t ≤3 s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current (T_C ≤25 °C)	I_F	200	mA
Surge current (τ ≤10 µs)	i_{FS}	2.5	A
Power dissipation (T_C ≤25 °C)	P_{tot}	470	mW
Thermal resistance:			
Junction/ambient air	R_{thJA}	450	K/W
Junction/case	R_{thJC}	160	K/W

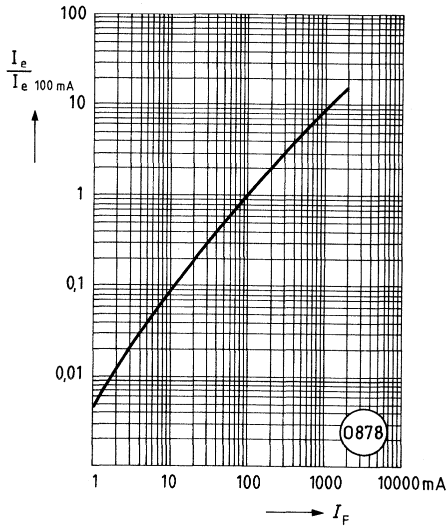
Characteristics (T_A = 25 °C)

Wavelength at peak emission			
(I_F = 10 mA)	λ_{peak}	880	nm
(I_F = 100 mA; t_p = 20 ms; D = 1:12)	λ_{peak}	883	nm
(I_F = 1 A; t_p = 100 µs; D = 1:100)	λ_{peak}	886	nm
Spectral bandwidth at 50% of I_{max} (I_F = 10 mA)	$\Delta\lambda$	80	nm
Half angle	φ	±15	deg.
Active chip area	A	0.16	mm^2
Dimensions of active chip area	$L \times W$	0.4 × 0.4	mm
Distance chip surface to case surface	D	2.8...3.7	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	0.6; 0.5	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	25	pF
Forward voltage (I_F = 100 mA; t_p = 20 ms)	V_F	1.5 (≤1.8)	V
(I_F = 1 A; t_p = 100 µs)	V_F	3.0 (≤3.8)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.5	%/K
Temperature coefficient of V_F	TC_V	−0.2	%/K
Temperature coefficient of λ_{peak}	TC_λ	0.25	nm/K
Radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees			
(I_F = 100 mA, t_p = 20 ms)	I_e	20 (≥10)	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	180	mW/sr
Radiant flux (total) (I_F = 100 mA)	Φ_e	10	mW

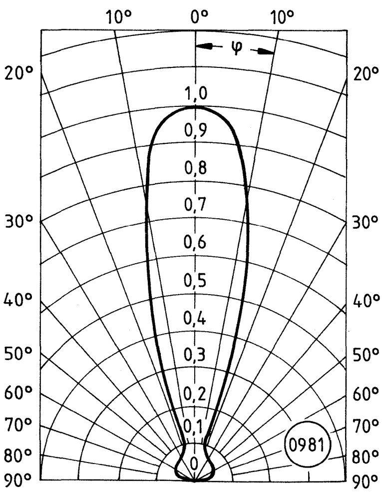
Relative spectral emission versus wavelength



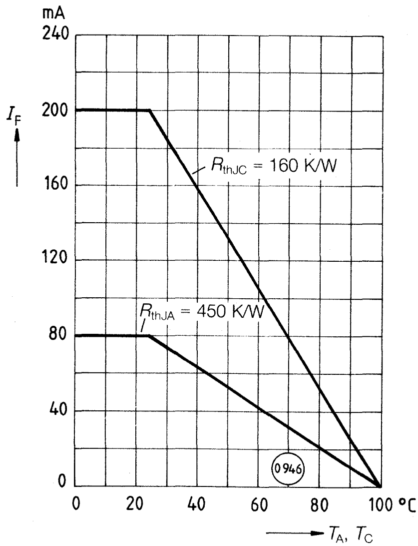
Radiant intensity versus forward current



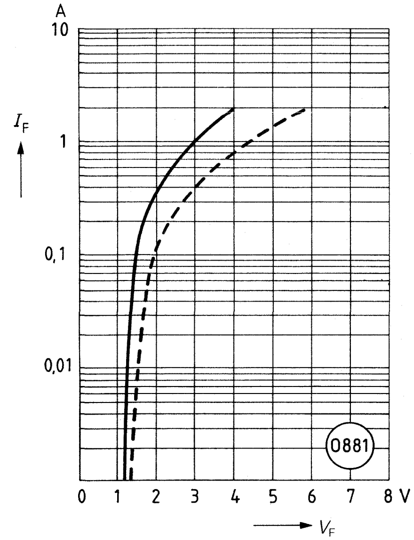
Radiation characteristic
Relative spectral emission versus half angle



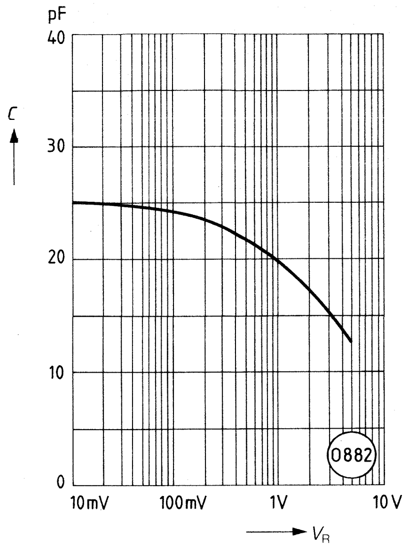
Forward current versus case and ambient temperature



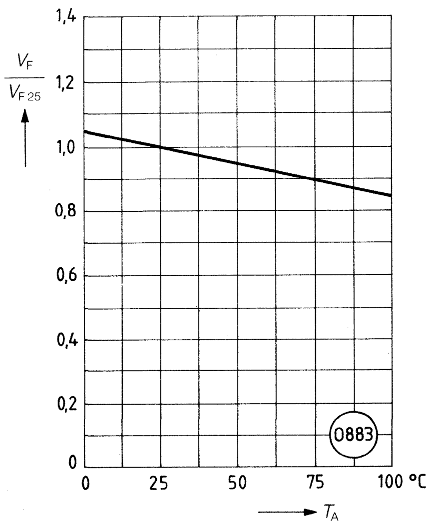
Forward current versus forward voltage



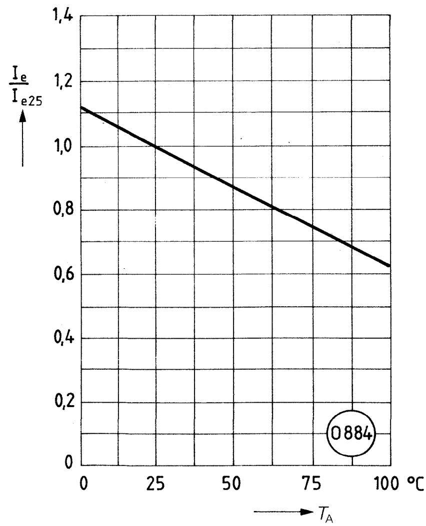
Capacitance versus reverse voltage



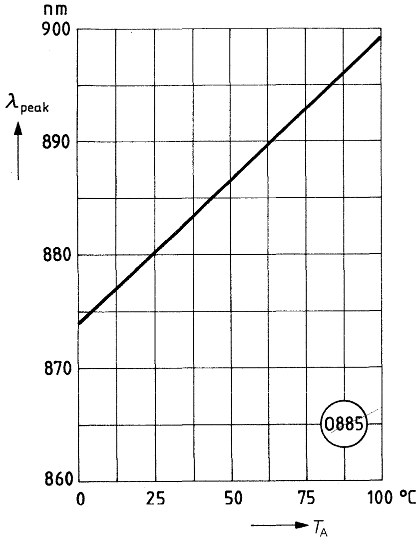
Forward voltage versus ambient temperature



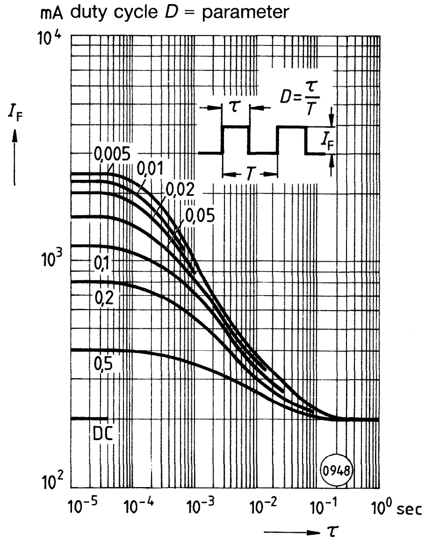
Radiant intensity versus ambient temperature



Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter



The GaAlAs infrared emitting diode SFH 482, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range. The anode is electrically connected to the case.

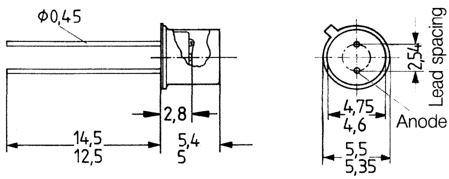
Package 18 A2, DIN 41876 (similar to TO 18)

Cathode identification Projection at case bottom

Application IR remote controls for various equipment, light-reflecting switches for steady and varying intensity

Features

- High reliability
- Long life
- Wide beam
- High pulse power
- Excellent spectral match with silicon photodetectors
- Hermetically sealed metal case



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 482	Q62703-Q1089

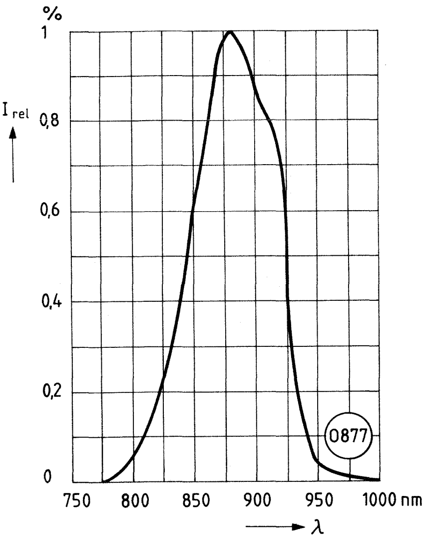
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current ($T_C \leq 25$ °C)	I_F	200	mA
Surge current ($\tau \leq 10$ µs)	i_{FS}	2.5	A
Power dissipation ($T_C \leq 25$ °C)	P_{tot}	470	mW
Thermal resistance:			
Junction/ambient air	R_{thJA}	450	K/W
Junction/case	R_{thJC}	160	K/W

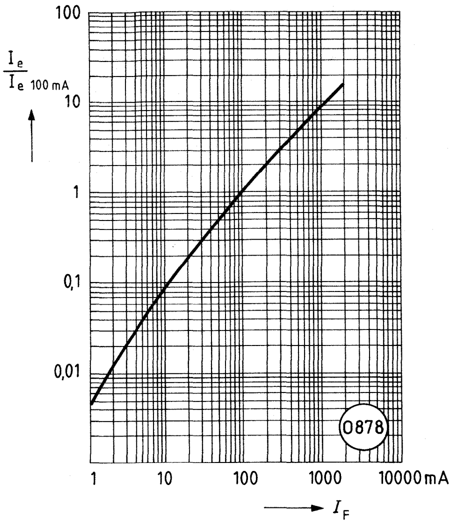
Characteristics (T_A = 25 °C)

Wavelength at peak emission			
(I_F = 10 mA)	λ_{peak}	880	nm
(I_F = 100 mA; t_p = 20 ms; D = 1:12)	λ_{peak}	883	nm
(I_F = 1 A; t_p = 100 µs; D = 1:100)	λ_{peak}	886	nm
Spectral bandwidth at 50% of I_{max}			
(I_F = 10 mA)	$\Delta \lambda$	80	nm
Half angle	φ	±30	deg.
Active chip area	A	0.16	mm^2
Dimensions of active chip area	$L \times W$	0.4 × 0.4	mm
Distance chip surface to case surface	D	2.1...2.7	mm
Switching times			
I_e from 10% to 90% and from 90% to 10%			
(I_F = 100 mA)	t_r, t_f	0.6; 0.5	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	25	pF
Forward voltage (I_F = 100 mA; t_p = 20 ms)	V_F	1.5 (≤1.8)	V
(I_F = 1 A; t_p = 100 µs)	V_F	3.0 (≤3.8)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.5	%/K
Temperature coefficient of V_F	TC_V	−0.2	%/K
Temperature coefficient of λ_{peak}	TC_λ	0.25	nm/K
Radiant intensity I_e in axial direction			
at a steradian Ω = 0.01 sr, or 6.5 degrees			
(I_F = 100 mA, t_p = 20 ms)	I_e	6 (≥3)	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	63	mW/sr
Radiant flux (total)			
(I_F = 100 mA)	Φ_e	10	mW

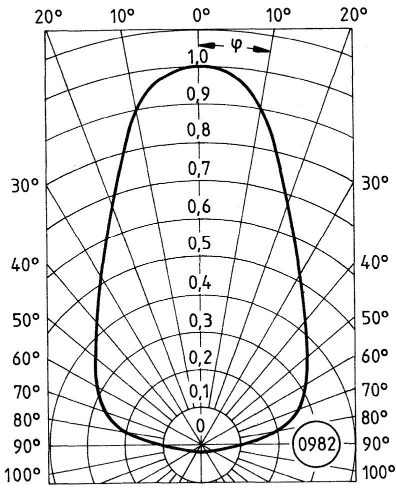
Relative spectral emission versus wavelength



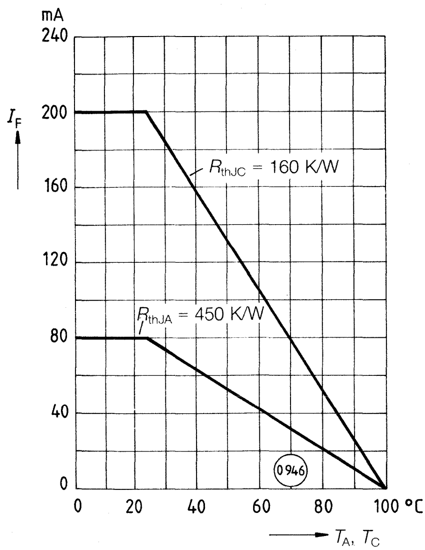
Radiant intensity versus forward current



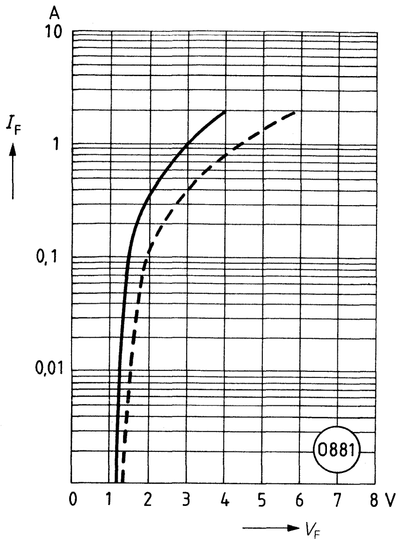
Radiation characteristic
Relative spectral emission versus half angle



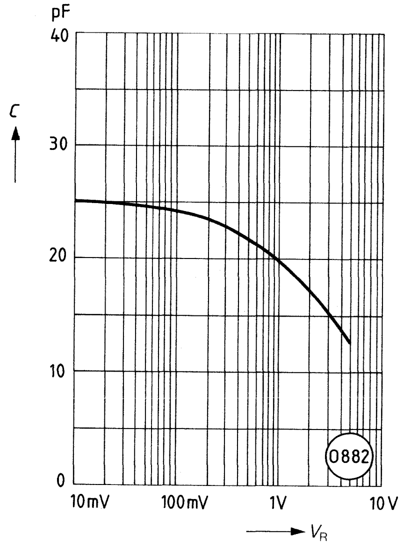
Forward current versus case and ambient temperature



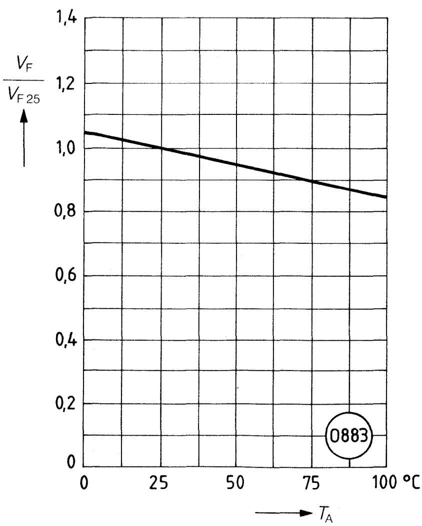
Forward current versus forward voltage



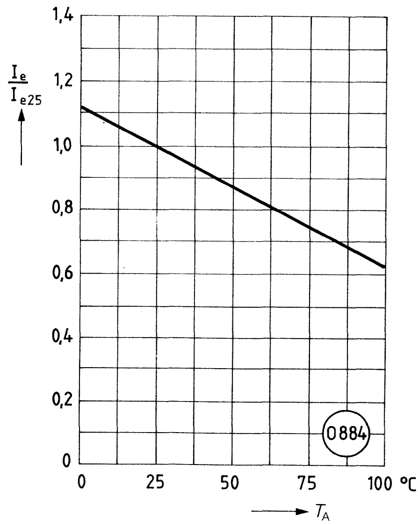
Capacitance versus reverse voltage



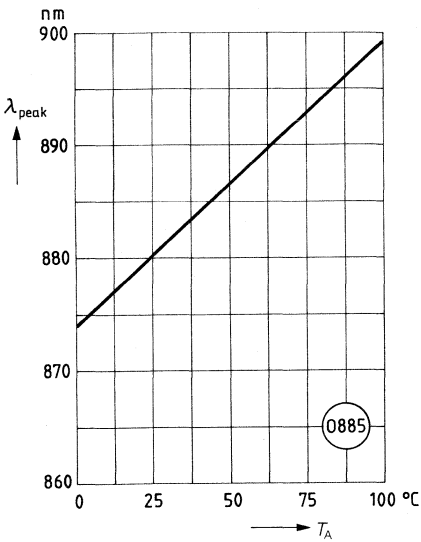
Forward voltage versus ambient temperature



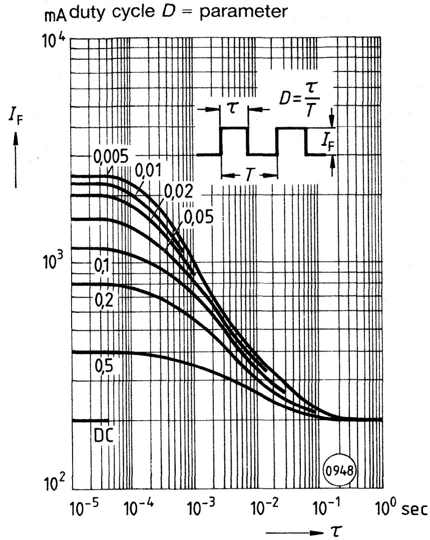
Radiant intensity versus ambient temperature



Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter



The GaAlAs infrared emitting diode SFH 484, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range.

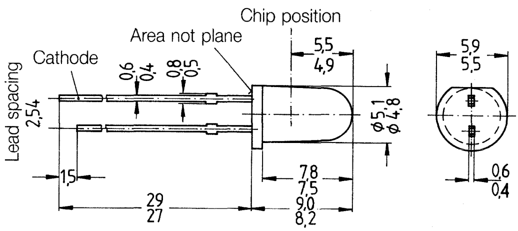
Package 5 mm LED package, (T 1¾), violet-colored transparent epoxy resin, solder tabs, lead spacing 2.54 mm (1⁄10″)

Anode identification Short solder tab

Application IR remote control for hifi and TV sets, video tape recorders, light-reflecting switches, dimmers, remote control for steady and varying intensity

Features

- High reliability
- Long life
- High radiant intensity, extremely narrow beam
- High pulse power
- Excellent spectral match with silicon photodetectors



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 484	Q62703-Q1092

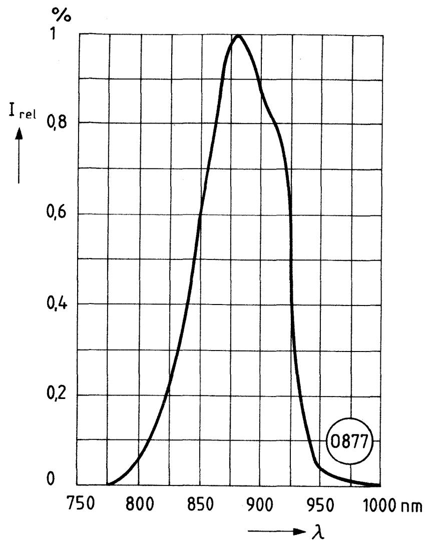
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time t ≤5 s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time t ≤3 s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current	I_F	100	mA
Surge current (τ ≤10 µs)	i_{FS}	2.5	A
Power dissipation (T_A ≤25 °C)	P_{tot}	200	mW
Thermal resistance (at 10 mm maximum clearance between PC board and bottom of plastic body)	R_{thJA}	375	K/W

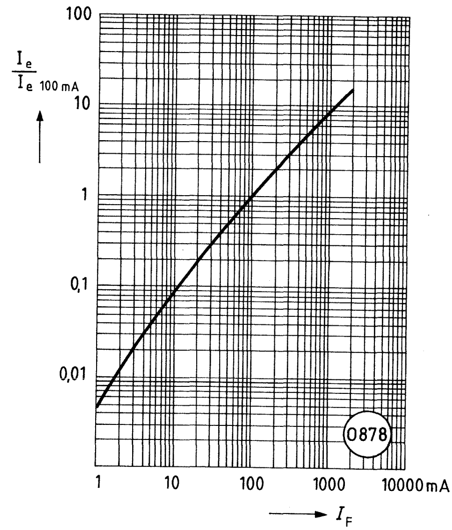
Characteristics (T_A = 25 °C)

Wavelength at peak emission			
(I_F = 10 mA)	λ_{peak}	880	nm
(I_F = 100 mA; t_p = 20 ms; D = 1:12)	λ_{peak}	883	nm
(I_F = 1 A; t_p = 100 µs; D = 1:100)	λ_{peak}	886	nm
Spectral bandwidth at 50% of I_{max} (I_F = 10 mA)	$\Delta\lambda$	80	nm
Half angle	φ	±8	deg.
Active chip area	A	0.16	mm^2
Dimensions of active chip area	$L \times W$	0.4 × 0.4	mm
Distance chip surface to case surface	D	4.9...5.5	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	0.6; 0.5	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	25	pF
Forward voltage (I_F = 100 mA; t_p = 20 ms)	V_F	1.5 (≤1.8)	V
(I_F = 1 A; t_p = 100 µs)	V_F	3.0 (≤3.8)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	–0.5	%/K
Temperature coefficient of V_F	TC_V	–0.2	%/K
Temperature coefficient of λ_{peak}	TC_λ	0.25	nm/K
Radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees			
(I_F = 100 mA, t_p = 20 ms)	I_e	100 (≥50)	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	900	mW/sr
Radiant flux (total) (I_F = 100 mA)	Φ_e	20	mW

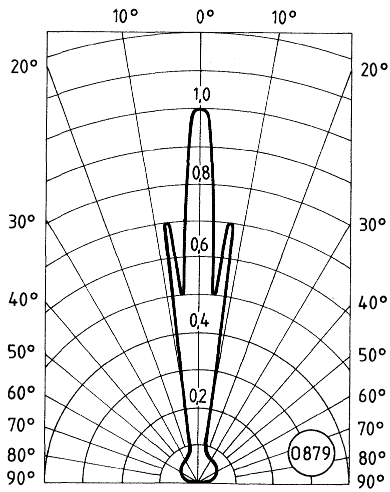
Relative spectral emission versus wavelength



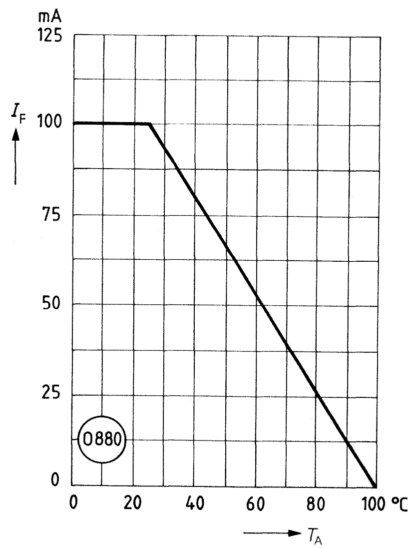
Radiant intensity versus forward current



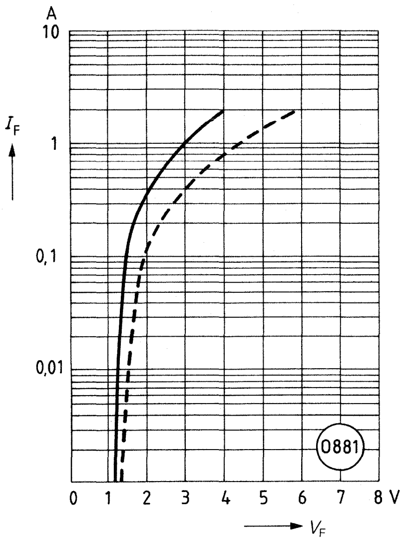
Radiation characteristic
Relative spectral emission versus half angle



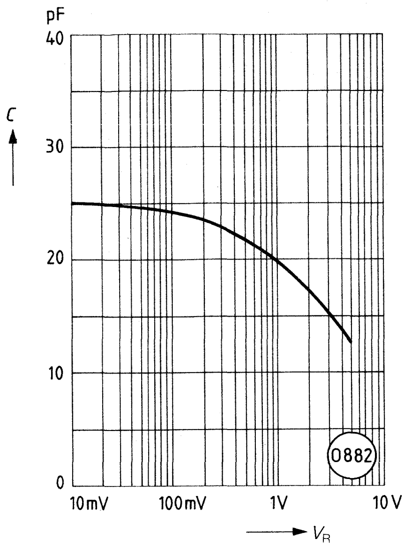
Forward current versus ambient temperature



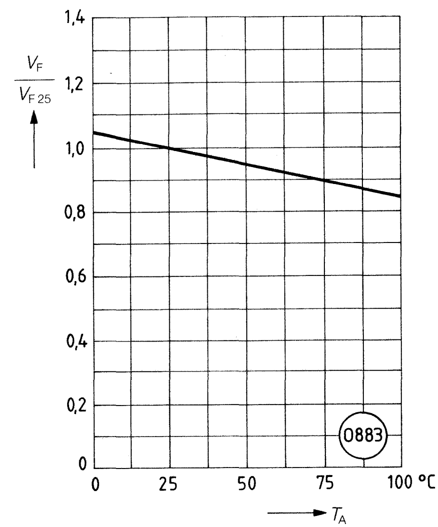
Forward current versus forward voltage



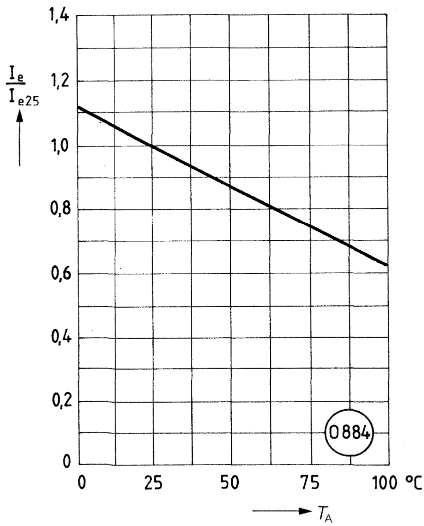
Capacitance versus reverse voltage



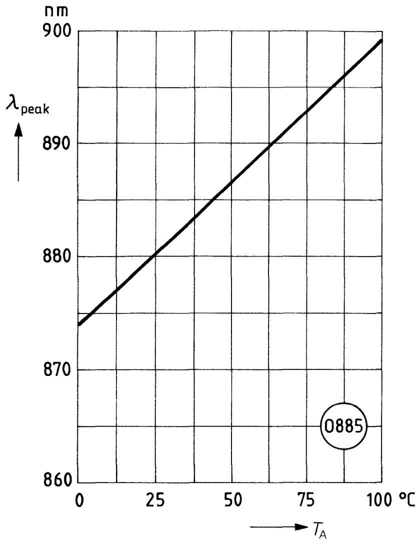
Forward voltage versus ambient temperature



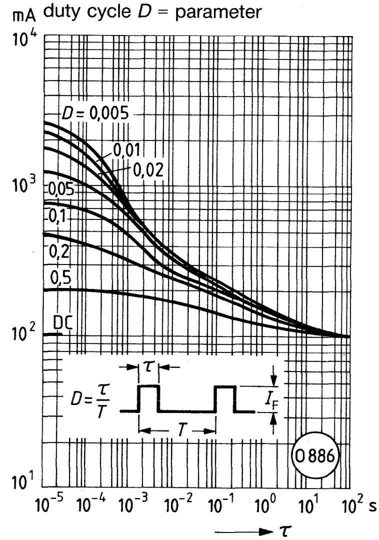
Radiant intensity versus ambient temperature



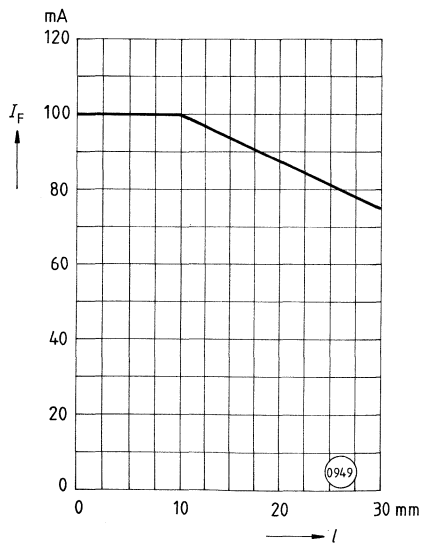
Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter



Forward current versus lead length



The GaAlAs infrared emitting diode SFH 485, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range.

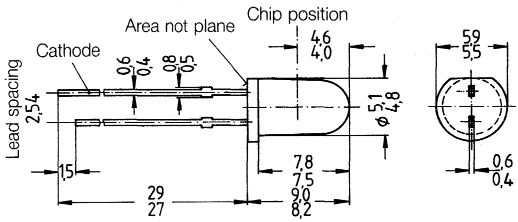
Package 5 mm LED package (T 1¾), violet-colored transparent epoxy resin, solder tabs, lead spacing 2.54 mm (1/10″)

Anode identification Short solder tab

Application IR remote control of hifi and TV sets, video tape recorders, dimmers, light-reflecting switches (max. 500 kHz)

Features

- High reliability
- Long life
- High radiant intensity
- High pulse power
- Excellent spectral match with silicon photodetectors



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 485	Q62703-Q1093

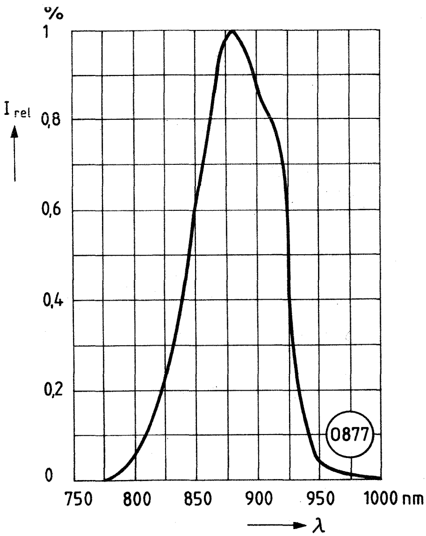
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current	I_F	100	mA
Surge current ($\tau \leq 10$ µs)	i_{FS}	2.5	A
Power dissipation ($T_A \leq 25$ °C)	P_{tot}	200	mW
Thermal resistance (at 10 mm maximum clearance between PC board and bottom of plastic body)	R_{thJA}	375	K/W

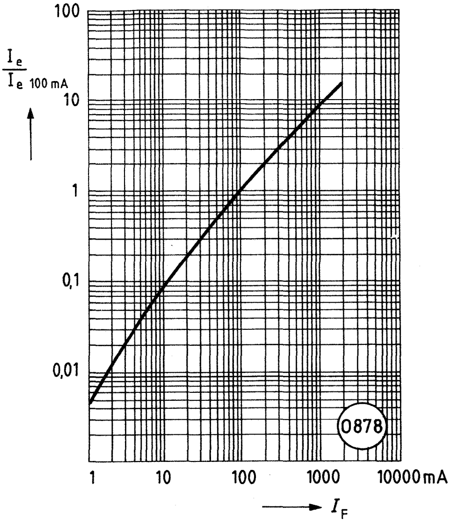
Characteristics (T_A = 25 °C)

Wavelength at peak emission			
(I_F = 10 mA)	λ_{peak}	880	nm
(I_F = 100 mA; t_p = 20 ms; D = 1:12)	λ_{peak}	883	nm
(I_F = 1 A; t_p = 100 µs; D = 1:100)	λ_{peak}	886	nm
Spectral bandwidth at 50% of I_{max} (I_F = 10 mA)	$\Delta\lambda$	80	nm
Half angle	φ	±20	deg.
Active chip area	A	0.16	mm^2
Dimensions of active chip area	$L \times W$	0.4 × 0.4	mm
Distance chip surface to case surface	D	4.0...4.6	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	0.6; 0.5	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	25	pF
Forward voltage (I_F = 100 mA; t_p = 20 ms)	V_F	1.5 (≤1.8)	V
(I_F = 1 A; t_p = 100 µs)	V_F	3.0 (≤3.8)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	−0.5	%/K
Temperature coefficient of V_F	TC_V	−0.2	%/K
Temperature coefficient of λ_{peak}	TC_λ	0.25	nm/K
Radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees			
(I_F = 100 mA, t_p = 20 ms)	I_e	40 (≥16)	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	360	mW/sr
Radiant flux (total) (I_F = 100 mA)	Φ_e	20	mW

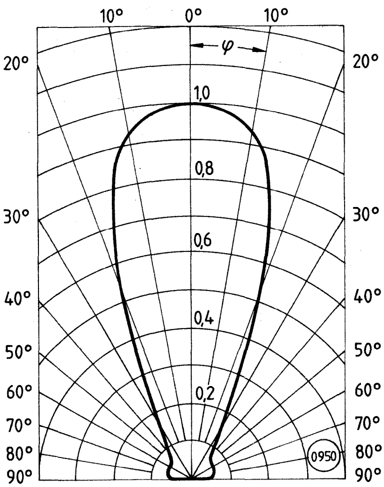
Relative spectral emission versus wavelength



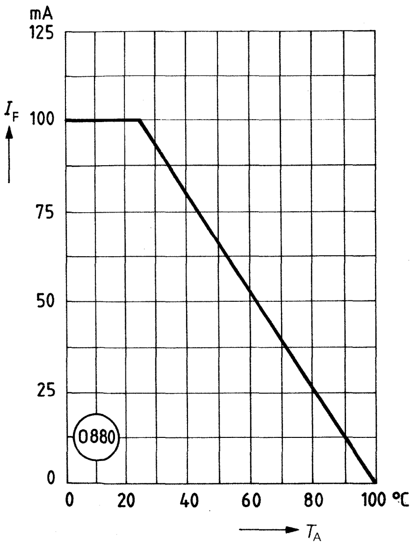
Radiant intensity versus forward current



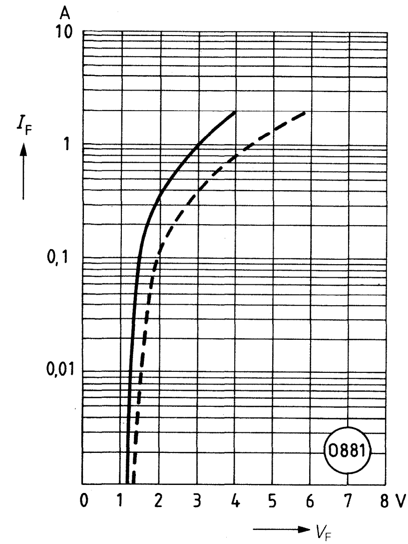
Radiation characteristic
Relative spectral emission versus half angle



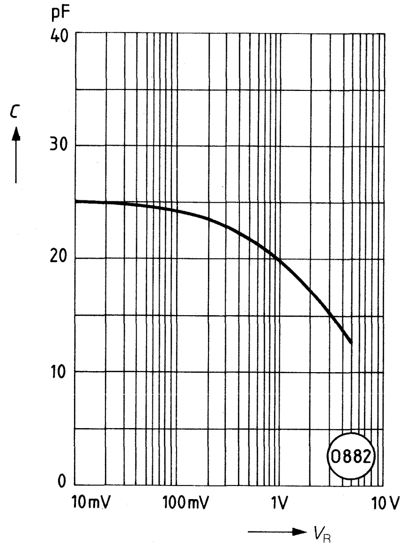
Forward current versus ambient temperature



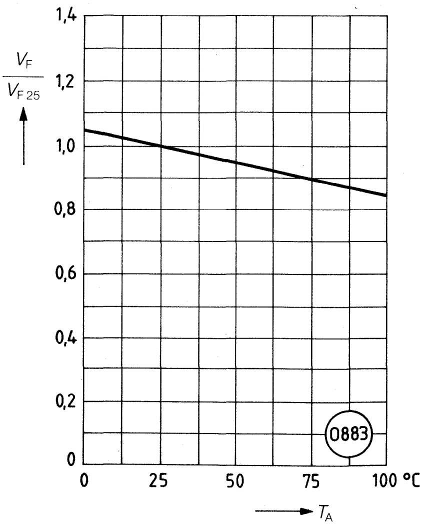
Forward current versus forward voltage



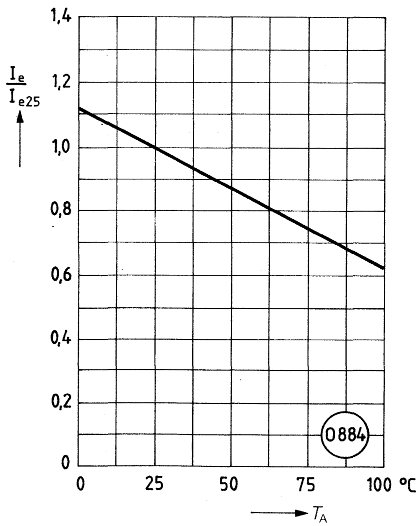
Capacitance versus reverse voltage



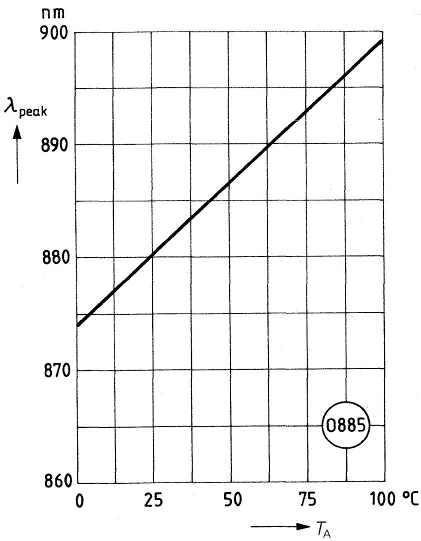
Forward voltage versus ambient temperature



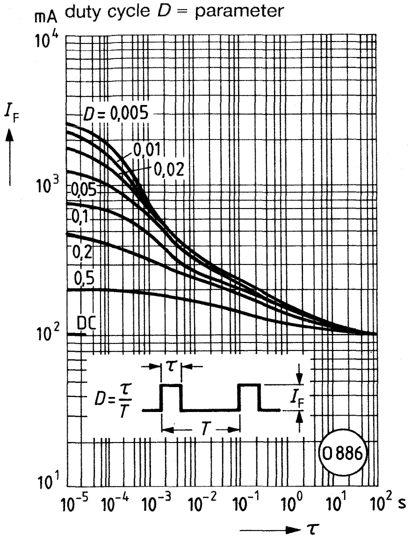
Radiant intensity versus ambient temperature



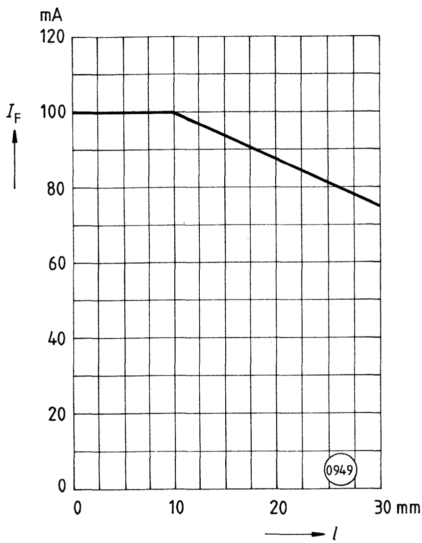
Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter



Forward current versus lead length



GaAlAs Infrared Emitter (880 nm) — SFH 485 P

The GaAlAs infrared emitting diode SFH 485 P, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range.

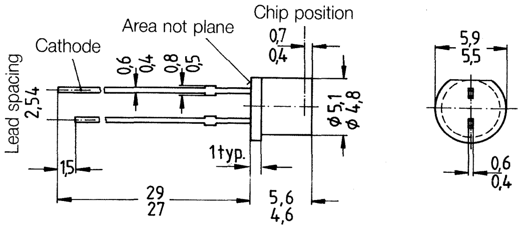
Package 5 mm LED package; violet-colored transparent epoxy resin, solder tabs, lead spacing 2.54 mm (1/10″)

Anode identification Short solder tab

Application Light-reflecting switches for steady and varying intensity (max. 500 kHz), fiber optic transmission system

Features

- High reliability
- Long life
- High efficiency
- Small tolerance: Chip surface/case surface
- High pulse power
- Excellent spectral match with silicon photodetectors
- Plane surface



Approx. weight 0.5 g
Dimensions in mm

Type	Ordering code
SFH 485 P	Q62703-Q516

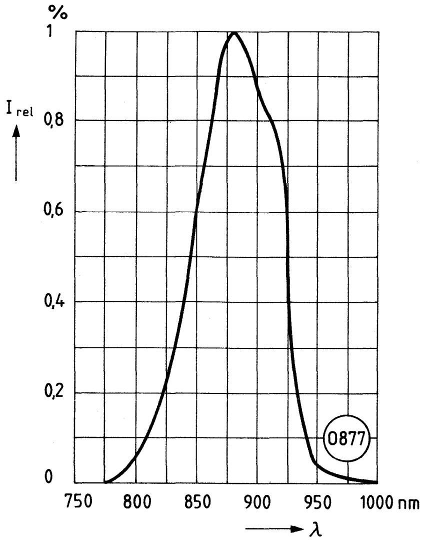
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current	I_F	100	mA
Surge current ($\tau \leq 10\ \mu s$)	i_{FS}	2.5	A
Power dissipation ($T_A \leq 25$ °C)	P_{tot}	200	mW
Thermal resistance (at 10 mm maximum clearance between PC board and bottom of plastic body)	R_{thJA}	375	K/W

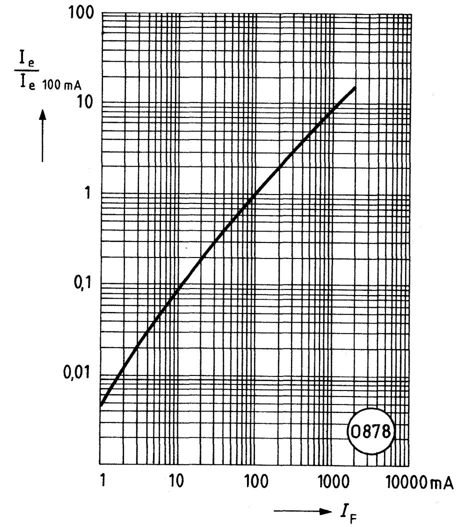
Characteristics (T_A = 25 °C)

Wavelength at peak emission			
(I_F = 10 mA)	λ_{peak}	880	nm
(I_F = 100 mA; t_p = 20 ms; D = 1:12)	λ_{peak}	883	nm
(I_F = 1 A; t_p = 100 µs; D = 1:100)	λ_{peak}	886	nm
Spectral bandwidth at 50% of I_{max} (I_F = 10 mA)	$\Delta\lambda$	80	nm
Half angle	φ	40	deg.
Active chip area	A	0.16	mm^2
Dimensions of active chip area	$L \times W$	0.4 × 0.4	mm
Distance chip surface to case surface	D	0.4...0.7	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	0.6; 0.5	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	25	pF
Forward voltage (I_F = 100 mA; t_p = 20 ms)	V_F	1.5 (≤1.8)	V
(I_F = 1 A; t_p = 100 µs)	V_F	3.0 (≤3.8)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	–0.5	%/K
Temperature coefficient of V_F	TC_V	–0.2	%/K
Temperature coefficient of λ_{peak}	TC_λ	0.25	nm/K
Radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees			
(I_F = 100 mA, t_p = 20 ms)	I_e	6 (≥3)	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	54	mW/sr
Radiant flux (total) (I_F = 100 mA)	Φ_e	20	mW

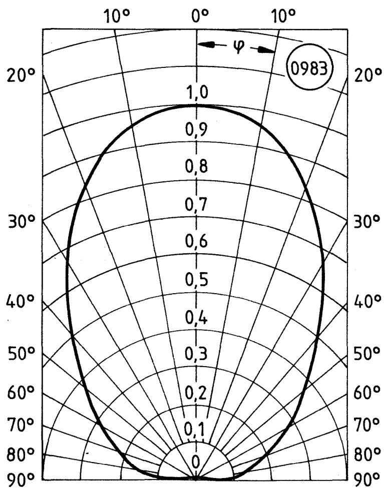
Relative spectral emission versus wavelength



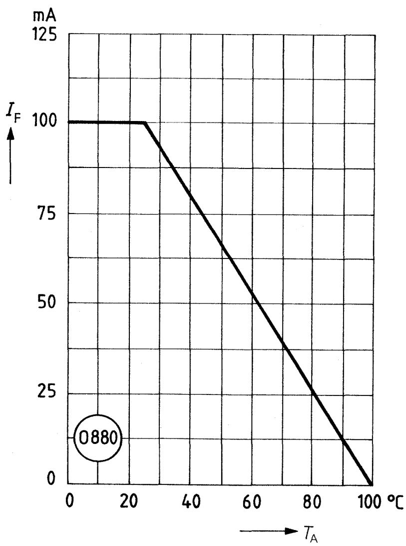
Radiant intensity versus forward current



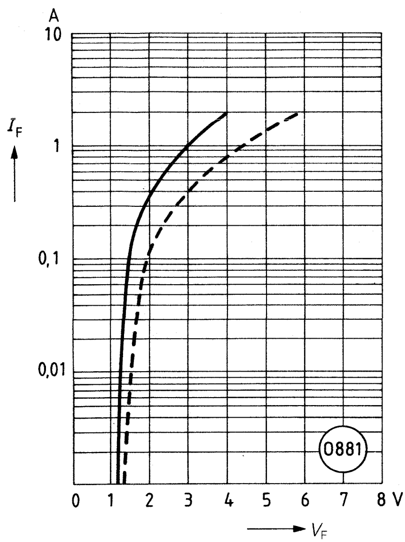
Radiation characteristic
Relative spectral emission versus half angle



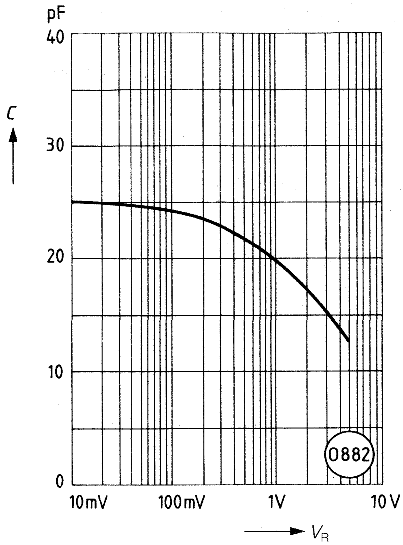
Forward current versus ambient temperature



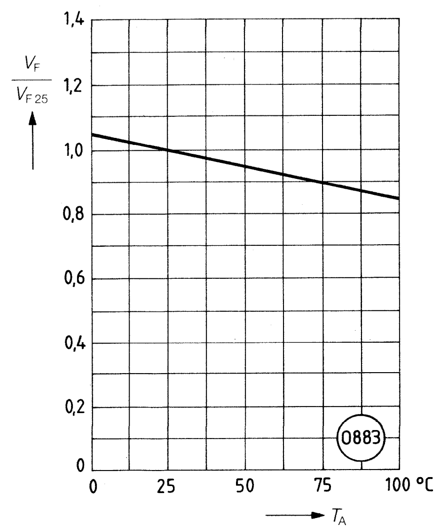
Forward current versus forward voltage



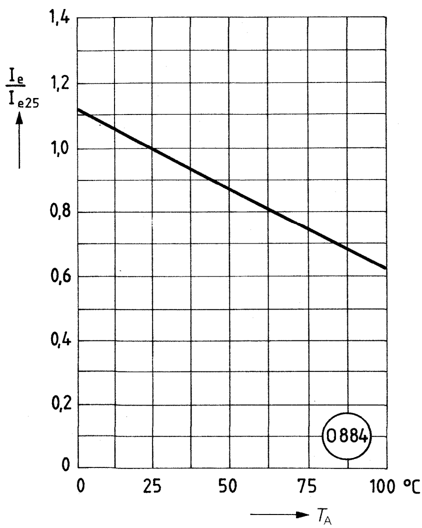
Capacitance versus reverse voltage



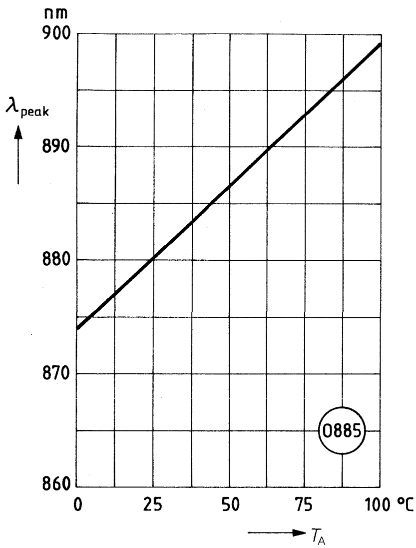
Forward voltage versus ambient temperature



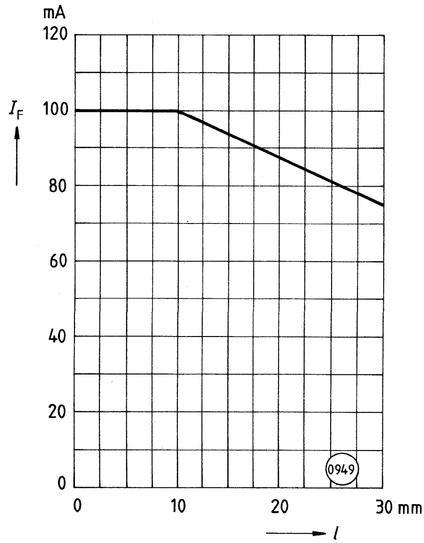
Radiant intensity versus ambient temperature



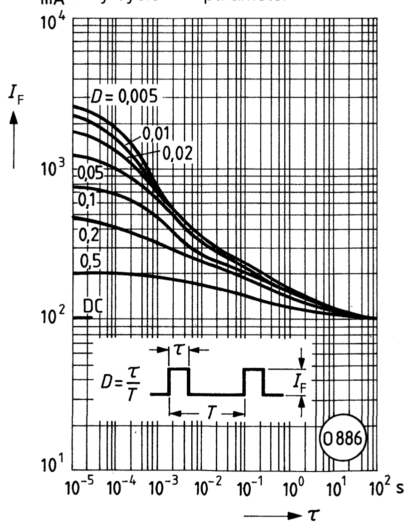
Wavelength at peak emission versus ambient temperature



Forward current versus lead length



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter



GaAlAs Infrared Emitter (880 nm) — SFH 487

The GaAlAs infrared emitting diode SFH 487, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range.

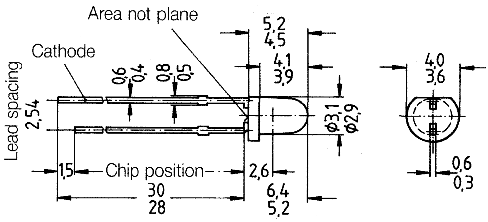
Package 3 mm LED package (T 1), violet-colored transparent epoxy resin, solder tabs, lead spacing 2.54 mm (1/10″)

Anode identification Short solder tab

Application IR remote control for hifi and TV sets, video tape recorders, dimmers, light-reflecting switches (max. 500 kHz)

Features

- High reliability
- Long life
- High radiant intensity
- High pulse power
- Excellent spectral match with silicon photodetectors



Approx. weight 0.3 g
Dimensions in mm

Type	Ordering code
SFH 487	Q62703-Q1095

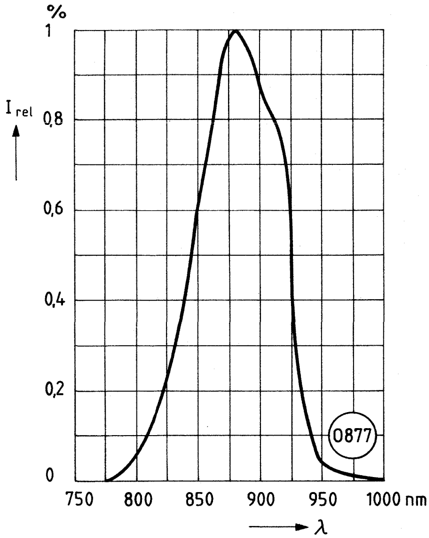
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current	I_F	100	mA
Surge current ($\tau \leq 10$ µs)	i_{FS}	2.5	A
Power dissipation ($T_A \leq 25$ °C)	P_{tot}	200	mW
Thermal resistance (at 10 mm maximum clearance between PC board and bottom of plastic body)	R_{thJA}	375	K/W

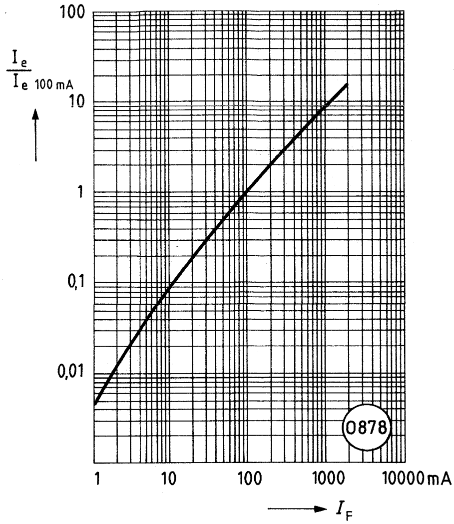
Characteristics (T_A = 25 °C)

Wavelength at peak emission			
(I_F = 10 mA)	λ_{peak}	880	nm
(I_F = 100 mA; t_p = 20 ms; D = 1:12)	λ_{peak}	883	nm
(I_F = 1 A; t_p = 100 µs; D = 1:100)	λ_{peak}	886	nm
Spectral bandwidth at 50% of I_{max}			
(I_F = 10 mA)	$\Delta \lambda$	80	nm
Half angle	φ	±20	deg.
Active chip area	A	0.16	mm^2
Dimensions of active chip area	$L \times W$	0.4 × 0.4	mm
Distance chip surface to lead-frame stand-off	D	2.6	mm
Switching times			
I_e from 10% to 90% and from 90% to 10%			
(I_F = 100 mA)	t_r, t_f	0.6; 0.5	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	25	pF
Forward voltage (I_F = 100 mA; t_p = 20 ms)	V_F	1.5 (≤1.8)	V
(I_F = 1 A; t_p = 100 µs)	V_F	3.0 (≤3.8)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	–0.5	%/K
Temperature coefficient of V_F	TC_V	–0.2	%/K
Temperature coefficient of λ_{peak}	TC_λ	0.25	nm/K
Radiant intensity I_e in axial direction			
at a steradian Ω = 0.01 sr, or 6.5 degrees			
(I_F = 100 mA, t_p = 20 ms)	I_e	30 (≥12.5)	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	270	mW/sr
Radiant flux (total)			
(I_F = 100 mA)	Φ_e	20	mW

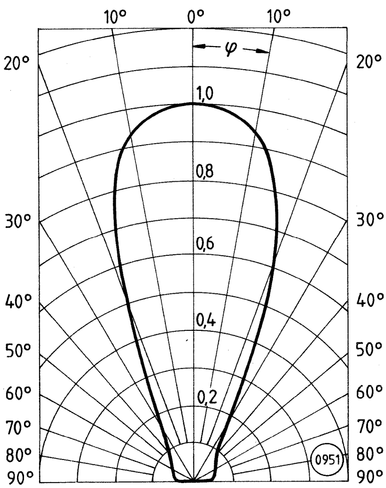
Relative spectral emission versus wavelength



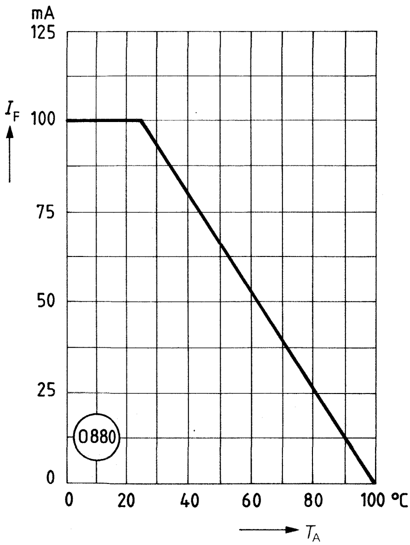
Radiant intensity versus forward current



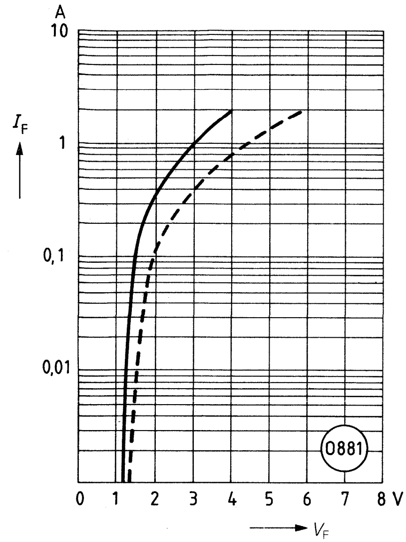
Radiation characteristic
Relative spectral emission versus half angle



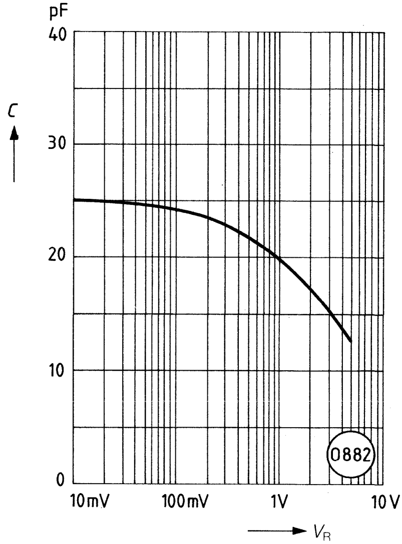
Forward current versus ambient temperature



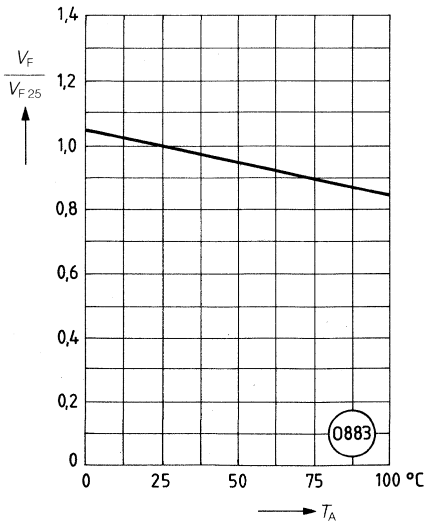
Forward current versus forward voltage



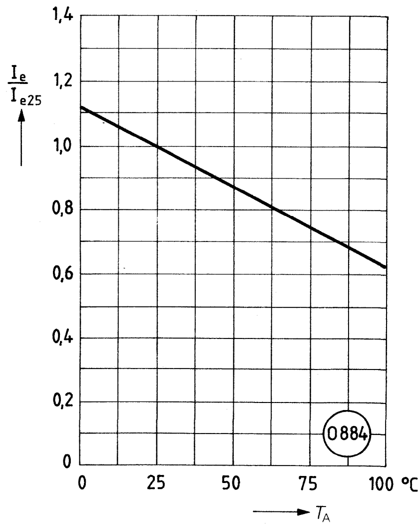
Capacitance versus reverse voltage



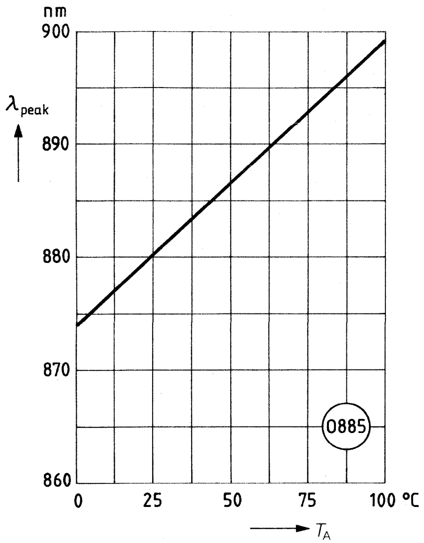
Forward voltage versus ambient temperature



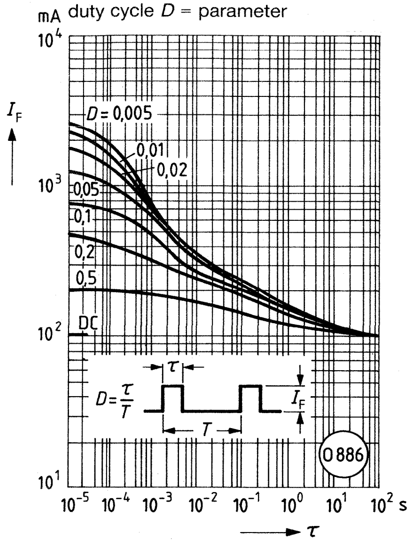
Radiant intensity versus ambient temperature



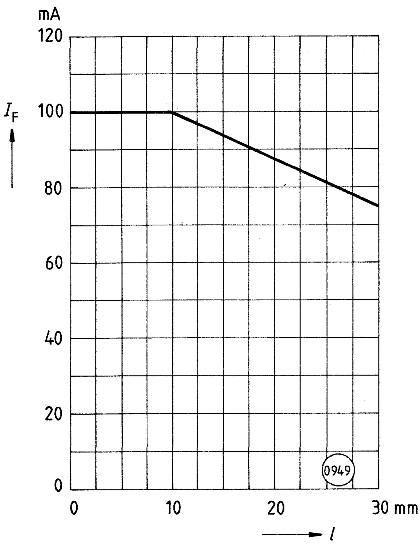
Wavelength at peak emission versus ambient temperature



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle *D* = parameter



Forward current versus lead length



The GaAlAs infrared emitting diode SFH 487 P, fabricated in a liquid phase epitaxy process, features high efficiency and emits radiation at a wavelength in the near infrared range.

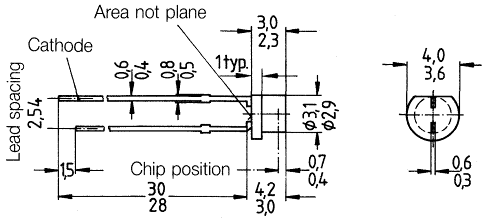
Package 3 mm LED package; violet-colored transparent epoxy resin, solder tabs, lead spacing 2.54 mm (1/10″)

Anode identification Short solder tab

Application Light-reflecting switches for steady and varying intensity (max. 500 kHz), fiber optic transmission system

Features

- High reliability
- Long life
- High efficiency
- Close tolerance: Chip surface/case surface
- High pulse power
- Excellent spectral match with silicon photodetectors
- Plane surface



Approx. weight 0.3 g
Dimensions in mm

Type	Ordering code
SFH 487 P	Q62703-Q517

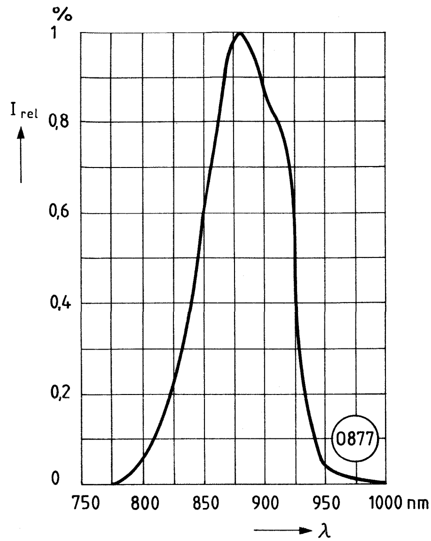
Maximum ratings

Storage and operating temperature	T_{stg}, T_{op}	–55...+100	°C
Soldering temperature at dip soldering (≥2 mm distance from the case bottom; soldering time $t \leq 5$ s)	T_{sold}	260	°C
Soldering temperature at iron soldering (≥2 mm distance from the case bottom; soldering time $t \leq 3$ s)	T_{sold}	300	°C
Junction temperature	T_j	100	°C
Reverse voltage	V_R	5	V
Forward current	I_F	100	mA
Surge current ($\tau \leq 10$ µs)	i_{FS}	2.5	A
Power dissipation ($T_A \leq 25$ °C)	P_{tot}	200	mW
Thermal resistance (at 10 mm maximum clearance between PC board and bottom of plastic body)	R_{thJA}	375	K/W

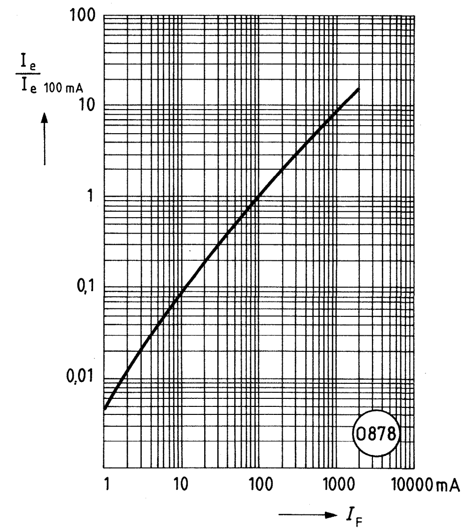
Characteristics (T_A = 25 °C)

Wavelength at peak emission			
(I_F = 10 mA)	λ_{peak}	880	nm
(I_F = 100 mA; t_p = 20 ms; D = 1:12)	λ_{peak}	883	nm
(I_F = 1 A; t_p = 100 µs; D = 1:100)	λ_{peak}	886	nm
Spectral bandwidth at 50% of I_{max} (I_F = 10 mA)	$\Delta\lambda$	80	nm
Half angle	φ	65	deg.
Active chip area	A	0.16	mm^2
Dimensions of active chip area	$L \times W$	0.4 × 0.4	mm
Distance chip surface to case surface	D	0.4...0.7	mm
Switching times I_e from 10% to 90% and from 90% to 10% (I_F = 100 mA)	t_r, t_f	0.6; 0.5	µs
Capacitance (V_R = 0 V; f = 1 MHz)	C_o	25	pF
Forward voltage (I_F = 100 mA; t_p = 20 ms)	V_F	1.5 (≤1.8)	V
(I_F = 1 A; t_p = 100 µs)	V_F	3.0 (≤3.8)	V
Breakdown voltage (I_R = 10 µA)	V_{BR}	30 (≥5.0)	V
Reverse current (V_R = 5 V)	I_R	0.01 (≤10)	µA
Temperature coefficient of I_e or Φ_e	TC_I	–0.5	%/K
Temperature coefficient of V_F	TC_V	–0.2	%/K
Temperature coefficient of λ_{peak}	TC_λ	0.25	nm/K
Radiant intensity I_e in axial direction at a steradian Ω = 0.01 sr, or 6.5 degrees			
(I_F = 100 mA, t_p = 20 ms)	I_e	4 (≥2)	mW/sr
(I_F = 1 A; t_p = 100 µs)	I_e	27	mW/sr
Radiant flux (total) (I_F = 100 mA)	Φ_e	20	mW

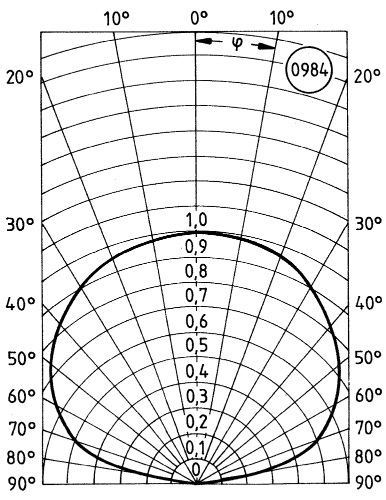
Relative spectral emission versus wavelength



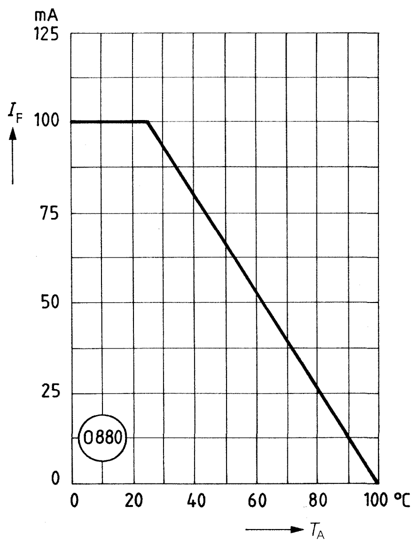
Radiant intensity versus forward current



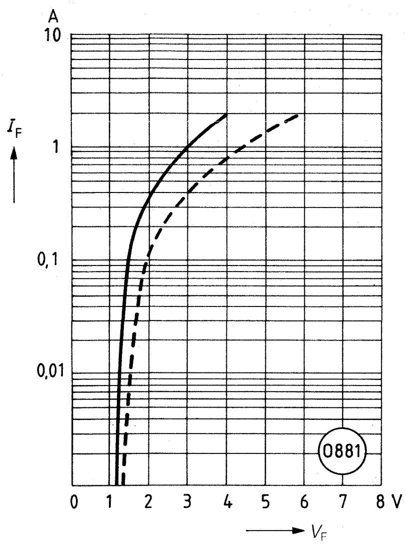
Radiation characteristic
Relative spectral emission versus half angle



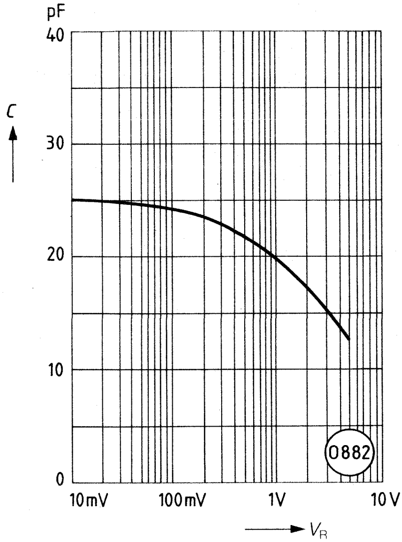
Forward current versus ambient temperature



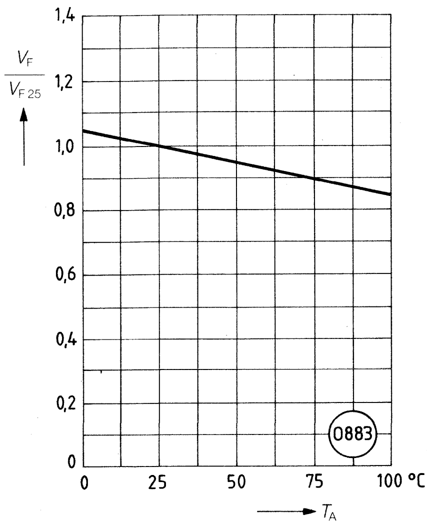
Forward current versus forward voltage



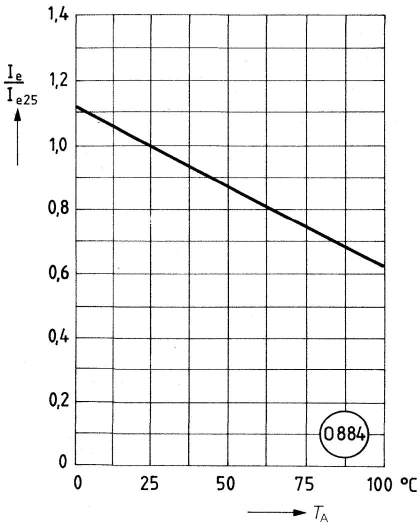
Capacitance versus reverse voltage



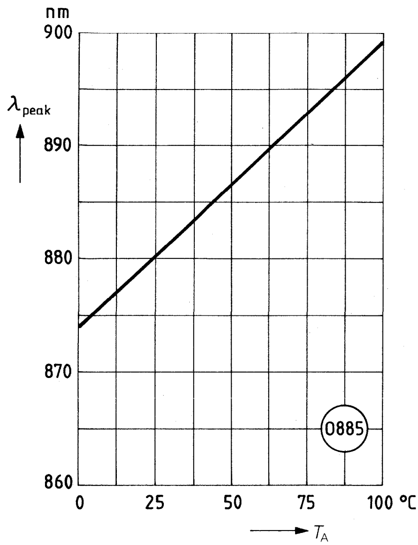
Forward voltage versus ambient temperature



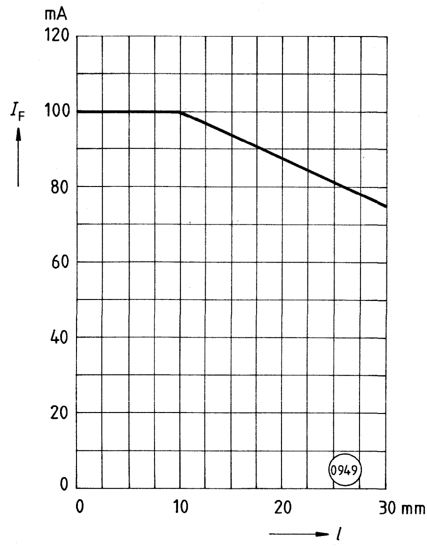
Radiant intensity versus ambient temperature



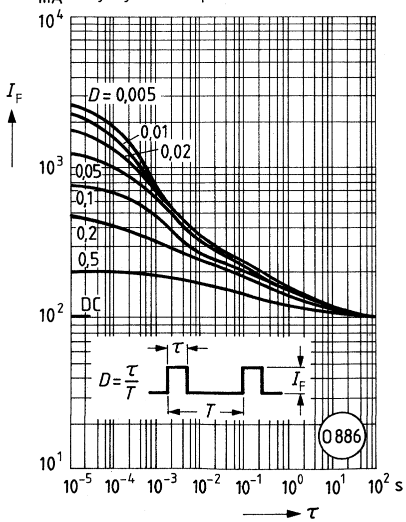
Wavelength at peak emission versus ambient temperature



Forward current versus lead length



Permissible pulse handling capability
Forward current versus cycle duration
duty cycle D = parameter



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Type	Ordering code	Page	Type	Ordering code	Page
BP 103 II	Q62702-P79-S1	265	BPY 48 P	Q60215-Y65	78
BP 103 III	Q62702-P79-S2	265	BPY 62 II	Q60215-Y1111	290
BP 103 IV	Q62702-P79-S3	265	BPY 62 III	Q60215-Y1112	290
BP 103 B II	Q62702-P85-S2	269	BPY 62 IV	Q60215-Y1113	290
BP 103 B III	Q62702-P85-S3	269	BPY 63 P	Q60215-Y63-S1	81
BP 103 B IV	Q62702-P85-S4	269	BPY 64 P	Q60215-Y67	85
BP 104	Q62702-P84	99	KOM 0622033 A	Q62702-K2	324
BP 104 BS	Q62702-P917	104	KOM 0622045	Q62702-K3	326
BPW 21	Q62702-P885	109	KOM 0622059	Q62702-K4	328
BPW 32	Q62702-P74	114	LD 242 II	Q62703-Q198	333
BPW 33	Q62702-P76	119	LD 242 III	Q62703-Q199	333
BPW 34	Q62702-P73	124	LD 260	Q62703-Q78	343
BPW 34 B	Q62702-P945	129	LD 261 IV	Q62703-Q66	338
BPW 34 F	Q62702-P929	134	LD 261 V	Q62703-Q67	338
BPX 38 II	Q62702-P15-S2	272	LD 261 VI	Q62703-Q236	338
BPX 38 III	Q62702-P15-S3	272	LD 262	Q62703-Q70	343
BPX 38 IV	Q62702-P15-S4	272	LD 263	Q62703-Q71	343
BPX 43 II	Q62702-P16-S2	277	LD 264	Q62703-Q72	343
BPX 43 III	Q62702-P16-S3	277	LD 265	Q62703-Q73	343
BPX 43 IV	Q62702-P16-S4	277	LD 266	Q62703-Q74	343
BPX 48	Q62702-P17-S1	139	LD 267	Q62703-Q75	343
BPX 60	Q62702-P54	144	LD 268	Q62703-Q76	343
BPX 61	Q62705-P25	149	LD 269	Q62703-Q77	343
BPX 63	Q62702-P55	154	LD 271	Q62703-Q148	348
BPX 65	Q62702-P27	159	LD 271 H	Q62703-Q256	348
BPX 66	Q62702-P80	164	LD 271 L	Q62703-Q833	353
BPX 79	Q62702-P51	67	LD 271 LH	Q62703-Q838	353
BPX 80	Q62702-P28	286	LD 273	Q62703-Q694	358
BPX 81 II	Q62702-P43-S2	282	LD 274	Q62703-Q1031	363
BPX 81 III	Q62702-P43-S3	282	SFH 100	Q62702-F595	193
BPX 81 IV	Q62702-P43-S4	282	SFH 200	Q62702-P86	198
BPX 82	Q62702-P21	286	SFH 204	Q62702-P89	202
BPX 83	Q62702-P25	286	SFH 205	Q62702-P102	207
BPX 84	Q62702-P30	286	SFH 205 Q 2	Q62702-P896	211
BPX 85	Q62702-P31	286	SFH 206	Q62702-P128	215
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BPX 87	Q62702-P32	286	SFH 212	Q62702-P145	224
BPX 88	Q62702-P33	286	SFH 216	Q62702-P936	229
BPX 89	Q62702-P26	286	SFH 217	Q62702-P946	234
BPX 90	Q62702-P47	169	SFH 217 F	Q62702-P947	234
BPX 90 K	Q62702-P928	174	SFH 219	Q62702-P948	239
BPX 91 B	Q62702-P48-S	179	SFH 221	Q62702-P950	243
BPX 92	Q62702-P49	183	SFH 230	Q62702-P951	248
BPY 11 P IV	Q60215-Y111-S4	71	SFH 230 F	Q62702-P952	248
BPY 11 P V	Q60215-Y111-S5	71	SFH 248	Q62702-P953	253
BPY 12	Q62702-P9	188	SFH 248 F	Q62702-P954	253
BPY 47 P	Q60215-Y66	75	SFH 303	Q62702-P957	295

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SFH 303 F	Q62702-P958	295	SFH 409	Q62702-P860	388
SFH 305 II	Q62702-P848	300	SFH 480	Q62703-Q1087	393
SFH 305 III	Q62702-P849	300	SFH 481	Q62703-Q1088	398
SFH 309	Q62702-P859	304	SFH 482	Q62703-Q1089	403
SFH 309 F	Q62702-P941	304	SFH 484	Q62703-Q1092	408
SFH 317	Q62702-P959	309	SFH 485	Q62703-Q1093	413
SFH 317 F	Q62702-P960	309	SFH 485 P	Q62703-Q516	418
SFH 400 II	Q62702-P783	368	SFH 487	Q62703-Q1095	423
SFH 400 III	Q62702-P784	368	SFH 487 P	Q62703-Q517	428
SFH 401 II	Q62702-P786	373	SFH 2030	Q62702-P955	258
SFH 401 III	Q62702-P787	373	SFH 2030 F	Q62702-P956	258
SFH 402 II	Q62702-P789	378	TFA 1001 W	Q67000-A1357	315
SFH 402 III	Q62702-P790	378	TP 60 P	Q62607-S60	88
SFH 405 II	Q62702-P856	383	TP 61 P	Q62607-S61	92
SFH 405 III	Q62702-P857	383			

Summary of Ordering Codes (Q numbers)

Ordering code	Type	Page	Ordering code	Type	Page
Q60215-Y63-S1	BPY 63 P	81	Q62702-P79-S3	BP 103 IV	265
Q60215-Y65	BPY 48 P	78	Q62702-P80	BPX 66	164
Q60215-Y66	BPY 47 P	75	Q62702-P84	BP 104	99
Q60215-Y67	BPY 64 P	85	Q62702-P85-S2	BP 103 B II	269
Q60215-Y111-S4	BPY 11 P IV	71	Q62702-P85-S3	BP 103 B III	269
Q60215-Y111-S5	BPY 11 P V	71	Q62702-P85-S4	BP 103 B IV	269
Q60215-Y1111	BPY 62 II	290	Q62702-P86	SFH 200	198
Q60215-Y1112	BPY 62 III	290	Q62702-P89	SFH 204	202
Q60215-Y1113	BPY 62 IV	290	Q62702-P102	SFH 205	207
Q62607-S60	TP 60 P	88	Q62702-P128	SFH 206	215
Q62607-S61	TP 61 P	92	Q62702-P129	SFH 206 K	219
Q62702-F595	SFH 100	193	Q62702-P145	SFH 212	224
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Q62702-P49	BPX 92	183	Q62702-P953	SFH 248	253
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Summary of Ordering Codes (Q numbers)

Ordering code	Type	Page	Ordering code	Type	Page
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Q62703-Q74	LD 266	343	Q62703-Q1031	LD 274	363
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Q62703-Q198	LD 242 II	333	Q62703-Q1095	SFH 487	423
Q62703-Q199	LD 242 III	333	Q62705-P25	BPX 61	149
Q62703-Q236	LD 261 VI	338	Q67000-A1357	TFA 1001W	315
Q62703-Q256	LD 271 H	348			

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