PHILIPS

Optoelectronic devices

S8b 1986

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Data handbook

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Electronic components and materials

Semiconductors

Book S8b 1986

Optoelectronic devices

OPTOELECTRONIC DEVICES

DATA HANDBOOK SYSTEM

Our Data Handbook System comprises more than 60 books with specifications on electronic components, subassemblies and materials. It is made up of four series of handbooks:

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

The contents of each series are listed on pages iv to viii.

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

When ratings or specifications differ from those published in the preceding edition they are indicated with arrows in the page margin. Where application information is given it is advisory and does not form part of the product specification.

Condensed data on the preferred products of Philips Electronic Components and Materials Division is given in our Preferred Type Range catalogue (issued annually).

Information on current Data Handbooks and on how to obtain a subscription for future issues is available from any of the Organizations listed on the back cover.
Product specialists are at your service and enquiries will be answered promptly.

ELECTRON TUBES (BLUE SERIES)

The blue series of data handbooks comprises:

T1	**Tubes for r.f. heating**
T2a	**Transmitting tubes for communications, glass types**
T2b	**Transmitting tubes for communications, ceramic types**
T3	**Klystrons**
T4	**Magnetrons for microwave heating**
T5	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
T6	**Geiger-Müller tubes**
T8	**Colour display systems** Colour TV picture tubes, colour data graphic display tube assemblies, deflection units
T9	**Photo and electron multipliers**
T10	**Plumbicon camera tubes and accessories**
T11	**Microwave semiconductors and components**
T12	**Vidicon and Newvicon camera tubes**
T13	**Image intensifiers and infrared detectors**
T15	**Dry reed switches**
T16	**Monochrome tubes and deflection units** Black and white TV picture tubes, monochrome data graphic display tubes, deflection units

SEMICONDUCTORS (RED SERIES)

The red series of data handbooks comprises:

S1 **Diodes**
Small-signal silicon diodes, voltage regulator diodes ($<$ 1,5 W), voltage reference diodes, tuner diodes, rectifier diodes

S2a **Power diodes**

S2b **Thyristors and triacs**

S3 **Small-signal transistors**

S4a **Low-frequency power transistors and hybrid modules**

S4b **High-voltage and switching power transistors**

S5 **Field-effect transistors**

S6 **R.F. power transistors and modules**

S7 **Surface mounted semiconductors**

S8a **Light-emitting diodes**

S8b **Devices for optoelectronics**
Optocouplers, photosensitive diodes and transistors, infrared light-emitting diodes and infrared sensitive devices, laser and fibre-optic components

S9 **Power MOS transistors**

S10 **Wideband transistors and wideband hybrid IC modules**

S11 **Microwave transistors**

S12 **Surface acoustic wave devices**

S13 **Semiconductor sensors**

***S14** **Liquid Crystal Displays**

*To be issued shortly.

INTEGRATED CIRCUITS (PURPLE SERIES)

The NEW SERIES of handbooks is now completed. With effect from the publication date of this handbook the "N" in the handbook code number will be deleted.
Handbooks to be replaced during 1986 are shown below.

The purple series of handbooks comprises:

IC01	**Radio, audio and associated systems** Bipolar, MOS	new issue 1986 IC01N 1985
IC02a/b	**Video and associated systems** Bipolar, MOS	new issue 1986 IC02Na/b 1985
IC03	**Integrated circuits for telephony** Bipolar, MOS	new issue 1986 IC03N 1985
IC04	**HE4000B logic family** CMOS	new issue 1986 IC4 1983
IC05N	**HE4000B logic family — uncased ICs** CMOS	published 1984
IC06N	**High-speed CMOS; PC74HC/HCT/HCU** Logic family	published 1986
IC08	**ECL 10K and 100K logic families**	New issue 1986 IC08N 1984
IC09N	**TTL logic series**	published 1986
IC10	**Memories** MOS, TTL, ECL	new issue 1986 IC7 1982
IC11N	**Linear LSI**	published 1985
Supplement to IC11N	**Linear LSI**	published 1986
IC12	**I^2C-bus compatible ICs**	not yet issued
IC13	**Semi-custom** Programmable Logic Devices (PLD)	new issue 1986 IC13N 1985
IC14N	**Microprocessors, microcontrollers and peripherals** Bipolar, MOS	published 1985
IC15	**FAST TTL logic series**	new issue 1986 IC15N 1985
IC16	**CMOS integrated circuits for clocks and watches**	first issue 1986
IC17	**Integrated Services Digital Networks (ISDN)**	not yet issued
IC18	**Microprocessors and peripherals**	new issue 1986*

* The Microprocessors were included in handbook IC14N 1985, so IC18 will replace that part of IC14N.

COMPONENTS AND MATERIALS (GREEN SERIES)

The green series of data handbooks comprises:

C2	**Television tuners, coaxial aerial input assemblies, surface acoustic wave filters**
C3	**Loudspeakers**
C4	**Ferroxcube potcores, square cores and cross cores**
C5	**Ferroxcube for power, audio/video and accelerators**
C6	**Synchronous motors and gearboxes**
C7	**Variable capacitors**
C8	**Variable mains transformers**
C9	**Piezoelectric quartz devices**
C11	**Varistors, thermistors and sensors**
C12	**Potentiometers, encoders and switches**
C13	**Fixed resistors**
C14	**Electrolytic and solid capacitors**
C15	**Ceramic capacitors**
C16	**Permanent magnet materials**
C17	**Stepping motors and associated electronics**
C18	**Direct current motors**
C19	**Piezoelectric ceramics**
C20	**Wire-wound components for TVs and monitors**
C22	**Film capacitors**

SELECTION GUIDE

OPTOCOUPLERS

Standard types, UL recognized and VDE approved

Transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,4 V		I_F = 10 mA I_C = 2 mA		I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX35U	SOT-90B	0,4	0,9	0,4	4,4	3	3	30	99
CNX39U	SOT-90B	0,6	1,0	0,4	4,4	5,5	4	30	99
CNX36U	SOT-90B	0,8	2,0	0,4	4,4	8	6	30	99
CNY57U	SOT-90B	0,2	0,8	0,4	4,4	3	3	30	233
CNY57AU	SOT-90B	0,4		0,4	4,4	5*	5*	30	233

* I_C = 4 mA.

High-voltage transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,4 V		I_F = 16 mA I_C = 2 mA		I_C = 4 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX38U	SOT-90B	0,7	2,1	0,4	4,4	5	5	80	131

Darlington transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 1 mA V_{CE} = 1 V		I_F = 5 mA I_C = 10 mA		I_F = 1 mA; V_{CC} = 5 V; R_L = 100 Ω; R_{BE} = 1 MΩ			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX48U	SOT-90B	5,0		1,0	4,4	5	30	30	159

Standard types

Transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,4 V		I_F = 10 mA I_C = 2 mA		I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX35	SOT-90B	0,4	0,9	0,4	4,4	3	3	30	83
CNX39	SOT-90B	0,6	1,0	0,4	4,4	5,5	4	30	83
CNX36	SOT-90B	0,8	2,0	0,4	4,4	8	6	30	83
CNY57	SOT-90B	0,2	0,8	0,4	4,4	3	3	30	219
CNY57A	SOT-90B	0,4		0,4	4,4	5	5	30	219

High-voltage transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,4 V		I_F = 16 mA I_C = 2 mA		I_C = 4 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX38	SOT-90B	0,7	2,1	0,4	4,4	5	5	80	115

Darlington transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 1 V V_{CE} = 1 V		I_F = 5 mA; I_C = 10 mA		I_F = 1 mA; V_{CC} = 5 V; R_L = 100 Ω; R_{BE} = 1 MΩ			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX48	SOT-90B	5,0		1,0	4,4	5	30	30	147

Other standard types, UL recognized or pending, VDE approved.

Transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 10 V		I_F = 50 mA I_C = 2 mA		I_C = 2 mA; V_{CC} = 10 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
4N25	SOT-90B	0,2		0,5	2,820	3	3	30	291
4N25A	SOT-90B	0,2		0,5	2,820	3	3	30	291
4N26	SOT-90B	0,2		0,5	2,820	3	3	30	291
4N27	SOT-90B	0,1		0,5	2,820	3	3	30	291
4N28	SOT-90B	0,1		0,5	2,820	3	3	30	291

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 10 V		I_F = 10 mA I_C = 0,5 mA		I_C = 2 mA; V_{CC} = 10 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
4N35	SOT-90B	1,0		0,3	4,4	7	5	30	x
4N36	SOT-90B	1,0		0,3	2,820	7	5	30	x
4N37	SOT-90B	1,0		0,3	2,820	7	5	30	x
H11A1	SOT-90B	0,5		0,4	2,820	3*	3*	30	259
H11A2	SOT-90B	0,2		0,4	2,820	3*	3*	30	259
H11A3	SOT-90B	0,2		0,4	2,820	3*	3*	30	259
H11A4	SOT-90B	0,1		0,4	2,820	3*	3*	30	259
H11A5	SOT-90B	0,3		0,4	2,820	3*	3*	30	x

* t_r/t_f.

x : Data sheet available on request, UL recognition pending.

Other standard types, UL recognized or pending, VDE approved.

Transistor output (cont.)

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA, V_{CE} = 10 V		I_F = 60 mA, I_C = 1,6 mA		I_C = 2 mA; V_{CC} = 10 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
MCT26	SOT-90B	0,06		0,5	4,4	3*	3*	30	271

* t_r/t_f.

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA, V_{CE} = 10 V		I_F = 16 mA, I_C = 2 mA		I_F = 20 mA; V_{CC} = 5 V; R_L = 2 kΩ; R_{BE} = 100 KΩ			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
MCT2	SOT-90B	0,2		0,4	4,4	5	10	30	265

High-voltage transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA, V_{CE} = 10 V		I_F = 20 mA, I_C = 4 mA		I_C = 2 mA; V_{CC} = 10 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
4N38	SOT-90B	0,1		1,0	2,820	5	5	80	x
4N38A	SOT-90B	0,1		1,0	2,820	5	5	80	x

x : Data sheet available on request, UL recognition pending.

Other standard types, UL recognized or pending, VDE approved.

High-voltage transistor output (cont.)

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 5 V		I_F = 10 mA I_C = 2,5 mA		I_C = 2 mA; V_{CC} = 10 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNY17-1	SOT-90B	0,4	0,8	0,3	4,4	5	5	70	x
CNY17-2	SOT-90B	0,63	1,25	0,3	4,4	5	5	70	x
CNY17-3	SOT-90B	1,0	2,0	0,3	4,4	5	5	70	x

Darlington transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 1 mA V_{CE} = 5 V		I_F = 1 mA I_C = 1 mA		I_C = 10 mA; V_{CC} = 10 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
H11B1	SOT-90B	5,0		1,0	2,820	125	100	25	x
H11B2	SOT-90B	2,0		1,0	2,820	125	100	25	x
H11B3	SOT-90B	1,0		1,0	2,820	125	100	25	x

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 5 V		I_F = 50 mA I_C = 50 mA		I_C = 10 mA; V_{CC} = 10 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
H11B255	SOT-90B	1,0		1,0	2,820	125	100	55	x

x : Data sheet available on request, UL recognition pending.

Other standard types, UL recognized or pending, VDE approved.

Darlington transistor output (cont.)

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 5 V		I_F = 50 mA; I_C = 50 mA		I_F = 10 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
MCA230	SOT-90B	1,0		1,0	4,4	5	100	30	x
MCA231	SOT-90B	2,0		1,2*	4,4	5	100	30	x
MCA255	SOT-90B	1,0		1,0	4,4	5	100	55	x

* I_F = 10 mA

Types for mains applications, UL recognized, VDE approved

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,4 V		I_F = 10 mA I_C = 4 mA		I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX62	SOT-174	0,4		0,4	5,3	3	3	50	171
CNX72	SOT-90B	0,4		0,4	5,3*	26	2,5**	30	183
CNX82	SOT-212	0,4		0,4	5,3	3	3	50	195
CNX83	SOT-212	0,4		0,4	5,3	3	3	50	207

* VDE approved for 4,4 kV.

** Max. values, R_{BE} = 56 kΩ.

Notes : CNX83, UL and VDE approval pending.
CNX82 and CNX83, pin distance 10,16 mm.
CNX62 and CNX82 have no base connection.

x : Data sheet available on request, UL recognition pending.

Types with input/output pin distance 15,24 mm

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,4 V		I_F = 10 mA I_C = 2 mA		I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX21	SOT-211	0,2		0,4*	10	3	2,5**	30	75
CNY62	SOT-91B	0,25		0,4	5,3	3	3	50	247
CNY63	SOT-91B	0,5		0,4▲	4,4	5	5	30	247

* Typ. value.
** t_r/t_f (V_{CC} = 20 V).
▲ I_C = 4 mA

Types for telephony applications, recognized by French CNET

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 2 mA V_{CE} = 5 V		I_F = 50 mA I_C = 10 mA		I_C = 16 mA; V_{CC} = 5 V; R_L = 1 kΩ			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
SL5500	SOT-90B	0,3		0,4	2,5	20	50	30	x

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 2 mA V_{CE} = 5 V		I_F = 10 mA; I_C = 0,5 mA		I_C = 16 mA; V_{CC} = 5 V; R_L = 1 kΩ			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
SL5501	SOT-90B	0,15		0,4	2,5	20	50	30	x

x : Data sheet available on request.

Types for telephony applications, recognized by CNET (cont.)

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 2 mA V_{CE} = 5 V		I_F = 20 mA I_C = 1 mA		I_C = 10 mA; V_{CC} = 10 V; R_L = 1 kΩ			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
SL5502R	SOT-211	0,20		0,3	2,5	25	25	32	x

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 2 mA V_{CE} = 5 V		I_F = 20 mA; I_C = 2 mA		I_C = 16 mA; V_{CC} = 5 V; R_L = 1 kΩ			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
SL5504	SOT-90B	0,15		0,4	2,5	50	100	80	x
SL5511	SOT-90B	0,25		0,4	2,5	20	50	30	x

New generation of optocouplers with GaAlAs emitter diode

Low current types, transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,4 V		I_F = 10 mA; I_C = 2 mA		I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNG35	SOT-90B	0,4	0,9	0,4	4,4	3	3	30	53
CNG36	SOT-90B	0,8	2,0 1,0* 0,6**	0,4	4,4	8	6	30	53

* Typ. value at I_F = 2 mA.
** Typ. value at I_F = 0,5 mA.

x : Data sheet available on request.

New generation of optocouplers with GaAlAs emitter diode (cont.)

Telephony applications, approved by British Telecom (output transistor)

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,5 V		I_F = 10 mA I_C = 1 mA		I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
PO40/44A	SOT-90B	0,6 0,25*	1,5	0,5	3,5	7	7	30	277

* Min. value at I_F = 1 mA; V_{CE} = 0,4 V.

Note : The PO40/44A can replace each individual type PO40A, PO41A, PO42A, PO43A and PO44A.

High-speed type, diode/transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CC} = 4,5 V		I_F = 10 mA I_C = 2 mA V_{CC} = 4,5 V		I_C = 2 mA; V_{CC} = 5V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNR36	SOT-97F	0,2		0,4	3,5	0,85	0,85	18	67
SL5505S	SOT-97F	0,2	4,0	0,4	3,5	0,85	0,85	22	x

x : Data sheet available on request.

Types in metal encapsulation

Transistor output

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,4 V				I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX44	SOT-104C	0,3			1,0	5	5	50	299
CNX46	SOT-104C	0,3			1,0	5	5	50	299
CNY50-1	SOT-104B	0,25			1,0	5	5	50	327
CNY50-2	SOT-104B	0,4			1,0	5	5	50	327

Transistor output, GaAlAs emitter diode

type	case	C.T.R.		V_{CEsat}	V_{IORM}	t_{on}/t_{off} (typ.)		$V_{(BR)CEO}$	page
		I_F = 10 mA V_{CE} = 0,4 V		I_F = 50 mA I_C = 2 mA		I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
		min.	max.	max. (V)	kV (a.c.) peak value	t_{on} (μs)	t_{off} (μs)	min. (V)	
CNX44A	SOT-104C	0,4			1,0	5	5	60	309
CNX91	SOT-18F	0,3		0,4	0,8	5*	5*	50	319
CNX92	SOT-18F	0,3		0,4	0,8	5*	5*	50	319

* t_r/t_f.

OTHER OPTOELECTRONIC DEVICES

Infrared GaAs and GaAlAs emitter diodes

type	case	λ_p typ. (nm)	I_F max. (mA)	I_{FRM} max. (mA)	V_R max. (V)	ϕ_e typ. (μW)	I_e (mW/sr)	at I_F (mA)	$\theta_{½}$ typ. (o)	t_r/t_f typ. (ns)	page
CQW89A	SOD-63D2	830	130	2500*	5	8000	> 9	100	40	30/30	405
CQW89A-1	SOD-63D2	830	130	2500*	5	8000	> 12	100	40	30/30	405
CQW89A-2	SOD-63D2	830	130	2500*	5	8000	> 15	100	40	30/30	405
CQY11B	TO-18	880	30	200 ▲	2	100	0,064	20	70	30/30	411
CQY11C	TO-18	880	30	200 ▲	2	50	1,25	20	7	30/30	415
CQY49B	TO-18	930	100	1000*	5		> 0,3	50	80	600/350	421
CQY49C	TO-18	930	100	1000*	5		> 3,0	50	15	600/350	421
CQY50	DO-31	930	100	500*	2	700	0,180	20	35	600/350	427
CQY52	DO-31	930	100	500*	2	1500	0,450	20	35	600/350	427
CQY53S	FO-81	690	50		3		1 ▲▲	10	90		433
CQY58A	SOD-53F	930	50	200*	5	1000	> 2	20	20	3000/3000	437
CQY58A-1	SOD-53F	930	50	200*	5	1000	> 1	20	20	3000/3000	437
CQY58A-2	SOD-53F	930	50	200*	5	1000	3	20	20	3000/3000	437
CQY89A	SOD-63B2	930	130	1000**	5	12 000	> 9	100	40		443
CQY89A-1	SOD-63B2	930	130	1000**	5	12 000	> 12	100	40		443
CQY89A-2	SOD-63B2	930	130	1000**	5	12 000	> 15	100	40		443

* tp = ⩽ 10 μs; δ = 0,01
** tp = 50 μs; δ = 0,05
▲ tp = 100 μs; δ = 0,1
▲▲ I_v = 1 mcd

Recommended combinations of emitters and receivers

emitter	receivers
CQY11B	BPX29
CQY11C	BPX25
CQY49B	BPX29, BPX72
CQY49C	BPX25, BPX72
CQY50/52A	BPX71-203/204, BPW71
CQY58A	BPW22A-1, BPW22A-2
CQY58A-1	BPW22A-1, BPW22A-2
CQY58A-2	BPW22A-1, BPW22A-2
CQW89A	BPW50
CQW89A-1	BPW50
CQW89A-2	BPW50
CQY89A	BPW50
CQY89A-1	BPW50
CQY89A-2	BPW50

Photodiodes

type	case	λ_p typ. (nm)	V_R max. (V)	I_L typ. (μA)	at V_R; (V)	E_e; (mW/cm^2)	T_c(K) λ(nm)	I_R max. (nA)	at V_R (V)	A (mm^2)	page
BPW50	SOD-67	930	32	45	5	1	930	30	10	5	347
BPX40	see note	800	18	8*		4,75	2856	500	15	2,1	367
BPX41		800	18	24*		4,75	2856	1000	15	6,3	373
BPX42		800	18	75*		4,75	2856	5000	10	24,8	379
BPX61	SOT-49/3	850	32	70	5	4,75	2856	30	10	6,75	385
BPX61P	SOT-49/3	850	70	70				1			

Note : Types BPX40 to BPX42 are unencapsulated. * BPX40,41 and 42 measured in photovoltaic mode, min values.

Phototransistors (NPN)

type	case	V_{CEO} max. (V)	I_C max. (mA)	I_L (mA)	at V_{CE} ; (V)	E_e ; (mW/cm²)	T_c(K) λ(nm)*	I_{CEO} max. (μA)	at V_{CE} (V)	page
BPW22A-1	SOD-53F	50	25	1,5 to 8	5	1	930*	0,1	30	341
BPW22A-2	SOD-53F	50	25	5 to 25	5	1	930*	0,1	30	341
BPX25	SOT-29/2	50	100	> 4	6	7,75	2856	0,1	24	361
BPX29	SOT-29/1	50	100	> 0,2	6	7,75	2856	0,1	24	361
BPX71	SOT-71A	50	20	0,5 to 15	5	20	2856	0,025	30	391
BPX71-204	SOT-71A	50	20	7 to 15	5	20	2856	0,025	30	391
BPX72	SOT-70A	50	25	0,5–3	5	4,75	2856	0,1	20	397
BPX72D	SOT-70A	50	25	0,85–3	5	4,75	2856	0,1	20	397
BPX72E	SOT-70A	50	25	1,4–3	5	4,75	2856	0,1	20	397
BPX72F	SOT-70A	50	25	2,4–5	5	4,75	2856	0,1	20	397

Photo-Darlington transistor

type	case	V_{CEO} max. (V)	I_C max. (mA)	I_L (mA)	at V_{CE} ; (V)	E_e ; (mW/cm²)	T_c(K) λ(nm)*	I_{CEO} max. (μA)	at V_{CE} (V)	page
BPW71	SOT-71A	30	100	> 15	5	1	930*	0,1	10	353

Lasers and fibre-optic components

Emitters

type	description	page
CQF24	GaAlAs high intensity LED. Hermetic TO-46 header with microlens. Radiant power coupled in fibre of 200 μm core diameter is 400 μW at 830 nm.	457
516CQF-B	GaAlAs multi-longitudinal mode diode laser coupled to a 50/125 μm graded index fibre; radiant output power 3 mW at 850 nm. Options also available for 820 and 870 nm.	487
502CQF	Buried heterostructure InGaAsP laser diode emitting at 1,3 μm and coupled to a 50/125 μm graded index fibre. Built in SOT-191 together with a fast responding monitor diode.	475
503CQF	Buried heterostructure InGaAsP laser diode coupled to a single mode fibre pigtail; radiant output power 1,5 mW at 1,3 μm.	479
CQL10A	AlGaAs double heterostructure laser with photo p-i-n diode optically coupled to the rear facet; radiant output power 5 mW at 820 nm.	463
504CQL	AlGaAs double heterostructure visible laser diode with photo p-i-n diode optically coupled to the rear facet; output power 5 mW at 780 nm.	483
CQL13A	Collimator pen consisting of lens system and laser device with output power 2 mW.	467
CQL16	Collimator pen consisting of lens system and laser device with output power 2 mW.	471

Receivers

BPF24	Si photo p-i-n diode in hermetic sealed TO-46 header with microlens. Responsivity 0,4 A/W.	453

Infrared sensors

type	case	number of elements	element dimensions mm	spectral response µm	responsivity typ. V/W	N.E.P. typ. W/Hz½	page
RPY97	SOT-49H	2	2 x 1	6,5 to 14	(10 µm, 10) 150	(10 µm, 10,1) $1{,}5 \times 10^{-9}$	507
RPY100	SOT-49H	1	2 x 1	6 to 15	(10 µm, 10) 150	(10 µm, 10,1) $2{,}5 \times 10^{-9}$	517
RPY101	SOT-49H	1	2 x 1,5	6 to 15	(10 µm, 10) 150	(10 µm, 10,1) $3{,}8 \times 10^{-9}$	527
RPY102	SOT-49H	1	2 x 2	6 to 15	(10 µm, 10) 75	(10 µm, 10,1) 5×10^{-9}	537
RPY103	SOT-49H	2	2 x 1	6 to 15	(10 µm, 10) 150	(10 µm, 10,1) $2{,}2 \times 10^{-9}$	547
RPY107	SOT-49H	1	2 x 1	1 to 15	(500 K, 10) 130	(500 K, 10,1) $3{,}0 \times 10^{-9}$	557
RPY109	SOT-49H	1	2 x 2	1 to 15	(500 K, 10) 65	(500 K, 10,1) 6×10^{-9}	567
P2105	SOT-49G	1	2 x 2	1 to 25	(500 K, 10) 90	(500 K, 10,1) $1{,}4 \times 10^{-9}$	577

Fresnel lens

A low cost Fresnel lens array for use with sensors, suitable for general purpose movement sensing applications. It is designed to provide high sensitivity, long range monitoring up to at least 12 m, with 90° volumetric coverage.

Lens specification		page
Focal length	30,5 mm	583
Nominal coverage	12 m x 90 °	
Number of monitored zones	A = 8 B = 4 C = 3	
Nominal average transmission	50 %	
Material	polyethylene	

TYPE NUMBER SURVEY

TYPE NUMBER SURVEY

In this alphanumeric list we present all optoelectronic devices mentioned in this handbook

GENERAL

GENERAL SAFETY RECOMMENDATIONS OPTOELECTRONIC DEVICES

1. GENERAL

When properly used and handled, optoelectronic devices do not constitute a risk to health or environment. Modern high technology materials have been used in the manufacture of these devices to ensure optimum performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the devices are heated to destruction and it is important that the following recommendations are observed.

Care should be taken to ensure that all personnel who may handle, use or dispose of these products are aware of the necessary precautions.

Individual product data sheets will indicate whether any specific hazards are likely to be present.

2. DISPOSAL

These devices should be disposed of in accordance with the relevant legislation; in the United Kingdom disposal should therefore be carried out in accordance with the Deposit of Poisonous Waste Act 1972 and the Control of Pollution Act 1974, or with the latest legislation.

3. FIRE

Optoelectronic devices themselves, when used within the specified limits, do not present a fire hazard.

Devices can contain arsenic, beryllium, lead, mercury, selenium, tellurium or similar hazardous materials or compounds, which, if exposed to high temperatures may emit toxic or noxious fumes.

Most packaging materials are flammable and care should be taken in the disposal of such materials, some of which will emit toxic fumes if burned.

4. HANDLING

Care must be exercised with those devices incorporating glass or plastic. If these devices are broken, precautions must be taken against the following hazards that may arise:

- Broken glass or ceramic. Protective clothing such as gloves should be worn.
- Contamination from toxic materials and vapours. In particular, skin contact and inhalation must be avoided.
- Access to live contacts which may be at high potential. Devices must be isolated from the mains supply prior to their removal.

5. BERYLLIUM COMPOUNDS

Beryllium oxide dust is toxic if inhaled or if particles enter a cut or an abrasion. At all times avoid handling beryllium oxide ceramics; if they are touched, the hands must be washed thoroughly with soap and water. Do nothing to beryllium oxide ceramics that may produce dust or fumes.

Care should be taken upon eventual disposal that they are not thrown out with general industrial waste. Users seeking disposal of devices incorporating beryllium oxide ceramics should first take advice from the manufacturer's service department.

This potential hazard is present at all times from receipt to disposal of devices.

6. OTHER COMPOUNDS

Other compounds, such as those containing arsenic, indium, lead, lithium, selenium, tantalum, tellurium etc., may be toxic by ingestion or inhalation.

The above information and recommendations are given in good faith and are in accordance with the best knowledge and opinion available at the date of the compilation of the data sheets.

RATING SYSTEMS

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

DEFINITIONS OF TERMS USED

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

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

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

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

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

Note
Limiting conditions may be either maxima or minima.

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

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

ABSOLUTE MAXIMUM RATING SYSTEM

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

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

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

DESIGN MAXIMUM RATING SYSTEM

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

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

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

DESIGN CENTRE RATING SYSTEM

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

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

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

LETTER SYMBOLS FOR TRANSISTORS AND SIGNAL DIODES

based on IEC Publication 148

LETTER SYMBOLS FOR CURRENTS, VOLTAGES AND POWERS

Basic letters

The basic letters to be used are:

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

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

Subscripts

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

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

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

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

b) instantaneous total values
Example i_B

c) average total values
Example $I_{B(AV)}$

d) peak total values
Example I_{BM}

e) root-mean-square total values
Example $I_{B(RMS)}$

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

a) instantaneous values
Example i_b

b) root-mean-square values
Example $I_{b(rms)}$

c) peak values
Example I_{bm}

d) average values
Example $I_{b(av)}$

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

Additional rules for subscripts

Subscripts for currents

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

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

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

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

Subscripts for voltages

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

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

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

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

Subscripts for supply voltages or supply currents

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

Examples: V_{CC}, I_{EE}

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

Example : V_{CCE}

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

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

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

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

Subscripts for multiple devices

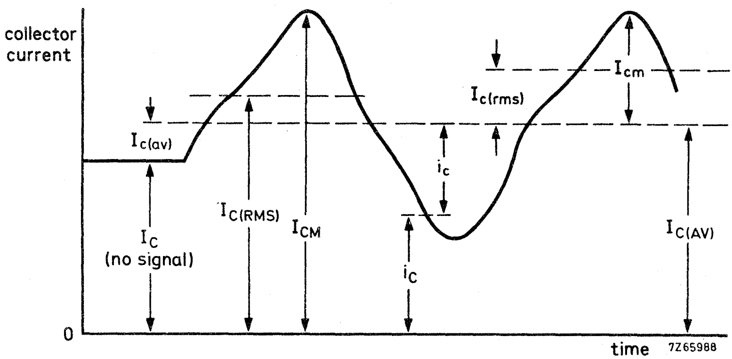
For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

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

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

Application of the rules

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



LETTER SYMBOLS FOR ELECTRICAL PARAMETERS

Definition

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

Basic letters

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

B, b = susceptance; imaginary part of an admittance

C = capacitance

G, g = conductance; real part of an admittance

H, h = hybrid parameter

L = inductance

R, r = resistance; real part of an impedance

X, x = reactance; imaginary part of an impedance

Y, y = admittance;

Z, z = impedance;

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

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

b) all inductances and capacitances.

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

Subscripts

General subscripts

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

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

Examples: Z_S, h_f, h_F

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

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

R_E = d.c. value of the external emitter resistance.

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

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

Examples: h_{fe} = small-signal value of the short-circuit forward current transfer ratio in common-emitter configuration

$Z_e = R_e + jX_e$ = small-signal value of the external impedance

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

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

Subscripts for four-pole matrix parameters

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

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

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

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

Distinction between real and imaginary parts

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

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

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

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

PRO ELECTRON TYPE DESIGNATION CODE FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete semiconductor devices – as opposed to integrated circuits –, multiples of such devices and semiconductor chips.

"Although not all type numbers accord with the Pro Electron system, the following explanation is given for the ones that do."

A basic type number consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

FIRST LETTER

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

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

SECOND LETTER

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

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

SERIAL NUMBER

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

VERSION LETTER

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

SUFFIX

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

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

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

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

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

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

* When these serial numbers are exhausted the serial number for consumer types may be extended to four figures, and that for industrial types to three figures.

DEFINITIONS FOR OPTOELECTRONIC DEVICES ACCORDING TO IEC 306

DEFINITIONS AND UNITS VALID FOR INFRARED RADIATION

Radiant flux, radiant power ϕ, P, (ϕ_e)

This is the power emitted, transferred or received as radiation, i.e. the radiant energy (dQ_e) emitted per second.

$$\phi_e = \frac{dQ_e}{dt} \qquad \text{unit: watt, W}$$

Radiant intensity I_e, I

For a source of given direction, the radiant intensity is the radiant power leaving the source, or an element of the source, in an element of solid angle (Ω) containing the given direction, divided by that element of solid angle.

$$I_e = \frac{d\phi_e}{d\Omega} \qquad \text{unit: watt per steradian, W/sr}$$

Irradiance E, (E_e)

At a point on a surface, the irradiance is the radiant power incident on an element of the surface containing the point divided by the area (A) of that element.

$$E = \frac{d\phi_e}{dA} \qquad \text{unit: watt per square metre, W/m}^2$$

DEFINITIONS AND UNITS VALID FOR VISIBLE LIGHT

This is radiation capable of stimulating the eye. Exceptions to this definition are made where necessary in the data sheets, e.g. dark and light currents of a phototransistor and light rise time of a near-infrared light emitting diode.

Luminous flux ϕ, (ϕ_v)

The luminous flux $d\phi$ of a source of luminous intensity I_v in an element of solid angle of $d\Omega$, is given by:

$$d\phi = I_v.d\Omega \qquad \text{unit: lumen, lm}$$

Lumen

This is the luminous flux radiating from a point source of uniform luminous intensity of 1 candela, contained within a solid angle of 1 steradian.

$$1 \text{ lm} = 1 \text{ cd.sr}$$

Luminous intensity I_v, (I)

For a source of given direction, the luminous intensity is the luminous flux leaving the source, or an element of the source, in an element of solid angle (Ω) containing the given direction, divided by that element of solid angle.

$$I_v = \frac{d\phi_v}{d\Omega} \qquad \text{unit: candela, cd}$$

Candela

This is the luminous intensity in a given direction, of a source emitting monochromatic radiation at a frequency of 540×10^{12} Hz*, the radiant intensity of which, in that direction, being 1/683 W/sr.

* Approximately 555 nm.

Illuminance E_v, (E)

At a point on a surface, the illuminance is the luminous flux incident on an element of the surface containing the point, divided by the area (A) of that element.

$$E_v = \frac{d\phi_v}{dA} \qquad \text{unit: lux, lx}$$

Lux lx

This is the illumination produced when 1 lumen of flux falls on a surface of area 1 square metre. It will be seen that an illumination of 1 lx is produced on a area of 1 square metre at a distance of 1 metre from a point source of 1 candela.

Distribution temperature T_d

This is the temperature of a black body at which the spectral radiation distribution of the radiator under consideration, in a given wavelength range, is proportional or approximately proportional to the spectral radiation distribution of the black body. If the wavelength range given includes visible radiation, then the distribution temperature corresponds to the colour temperature.

Colour temperature T_c

The colour temperature of a radiator is the temperature of a black body which has the same, or approximately the same, spectral radiation distribution in the visible range as the radiator under consideration.

DEFINITIONS OF ELECTRICAL QUANTITIES

Photocurrent I_{ph}

This is the change in output current from the photocathode due to incident radiation.

Dark current I_d

This is the current flowing in a photoelectric device in the absence of illumination.

Dark current equivalent radiation E_d

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

Quantum efficiency

This is the ratio of the number of emitted photoelectrons to the number of incident photons. Quantum efficiency (Q.E.) at a given wavelength of incident radiation may be calculated as follows:

$$\text{Q.E.} = \frac{\text{constant} \times S_k}{\lambda}$$

where S_k = spectral sensitivity (A/W) at wavelength λ
λ = wavelength of incident radiation (nm)

constant $= \frac{hc}{e} = 1{,}24 \times 10^3$ W.nm/A

h = Planck's constant ($6{,}6256 \times 10^{-34}$ js)
c = velocity of electromagnetic waves in vacuo = $2{,}997925 \times 10^8$ m/s
e = elementary charge = $1{,}60210 \times 10^{-19}$ coulomb or $4{,}80298 \times 10^{-19}$ e.s.u.

Saturation voltage V_{CEsat}

This is the lowest operating voltage which causes no change in photocurrent when this voltage is increased with constant radiation.

Saturation current I_{CEsat}

This is the output current of a photosensitive device which is not changed by an increase of either:

a. the irradiance under constant operating conditions, or,
b. the operating voltage under constant irradiance.

Thermal resistance

This is the ratio of temperature rise to power dissipation or

$$R_{th\,j\text{-}a} = \frac{T_j - T_{amb}}{P_{tot}}$$

The thermal resistance is also the reciprocal of the derating factor.

Pulsed operation

Under these conditions higher peak power dissipation is possible. In general, the shorter the pulse and lower the frequency, the lower is the temperature that the junction reaches.

By analogy with thermal resistance:

$$Z_{th\,j\text{-}a} = \frac{T_j - T_{amb}}{P_{tot}}$$

DEFINITIONS OF SENSITIVITY

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

Actinity of radiation Z

This is the ratio of the sensitivity to a given radiation to the sensitivity to a reference radiation.

Radiant sensitivity S_R

This may be expressed as either:

a. the ratio of the photocurrent of the device to the incident radiant power, expressed in amperes per watt (A/W), or,
b. the ratio of the photocurrent of the device to the incident irradiance, expressed in amperes per watt per square metre ($A/W/m^2$).

Absolute spectral sensitivity $s(\lambda)$

This is the radiant sensitivity for monochromatic radiation of a stated wavelength.

Relative spectral sensitivity $s(\lambda)_{rel}$

This is the ratio of the radiant sensitivity at a particular wavelength to the radiant sensitivity at a reference wavelength, usually the wavelength of maximum reponse.

Note

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

Luminous sensitivity S_L

This may be expressed as either:

a. the ratio of the photocurrent of the device to the incident luminous flux, expressed in amperes per lumen (A/lm), or,
b. the ratio of the photocurrent of the device to the incident illuminance, expressed in amperes per lux (A/lx).

Dynamic sensitivity S_D

Under stated operating conditions, this is the ratio of the variation of the photocurrent of the device to the initiating small variation in the incident radiant or luminous power.

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

Spectral sensitivity characteristics

This is the relationship, usually shown in graphical form, between the wavelength and the absolute or relative spectral sensitivity.

Absolute spectral sensitivity characteristics

This is the relationship, usually shown in graphical form, between the wavelength and the absolute spectral sensitivity.

Relative spectral sensitivity characteristics

This is the relationship between wavelength and the relative spectral sensitivity.

Quantum efficiency characteristic

This is the relationship, usually shown in graphical form, between the wavelength and the quantum efficiency.

DEFINITIONS OF TIME QUANTITIES

Rise time t_r

This is the time required for the photocurrent to rise from a stated low percentage to a stated higher percentage of the maximum value when a steady state of radiation is instantaneously applied. It is usual to consider the 10% and 90% levels (see Figs 1 and 2).

Fall time t_f

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

It is usual to consider the 90% and 10% levels (see Figs 1 and 2).

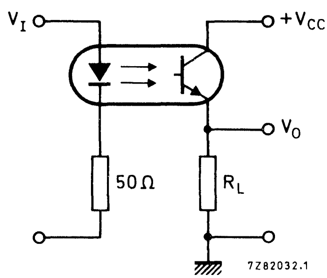


Fig. 1 Switching circuit.

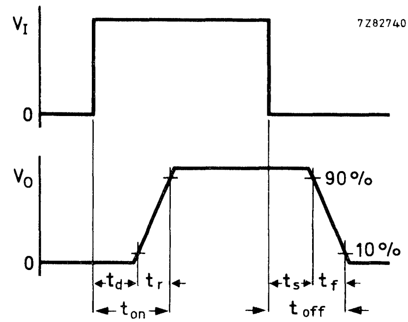


Fig. 2 Waveforms.

DEFINITIONS AND UNITS OF INFRARED SENSITIVE DEVICES

Emissivity

This is the ratio of the radiant exitance of a thermal radiator to that of a black body radiator at the same temperature.

Absolute refractive index n

This is the ratio of the velocity of light in vacuo to that in a particular medium. For most practical purposes the velocity of light in vacuo can be replaced by that in air.

Detectivity

This is the signal-to-noise ratio per unit radiant power. Thus it is the reciprocal of the N.E.P. Care must be exercised when considering detectivity as this term has also been used in the definitions of D*.

unit: 1/watts (1/W)

D*

This is an independent figure of merit which is defined as the r.m.s. signal-to-noise ratio in a 1 Hz bandwidth per unit r.m.s. incident radiant power per square root of detector area. Unless otherwise stated, it is assumed that the detector field of view is hemispherical (2 π steradian).

unit: $cm\sqrt{Hz}/W$

Wave number

This is the reciprocal of the wavelength in centimetres. $(\frac{1}{\lambda})$

N.E.P. (Noise Equivalent Power)

This is the r.m.s. value of the incident, chopped, radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $V/\sqrt{Hz}$.

unit: $W/\sqrt{Hz}$

Responsivity

This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped, radiant power.

unit: V/W

Noise equivalent irradiation

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

Radiance L_e

This is the radiant intensity (I_e) at a point on a surface and in a given direction, of an element of that surface, divided by the area of the orthogonal projection of the element on a plane perpendicular to the given direction.

unit: watt per steradian square metre, $W/sr.m^2$

Radiant exitance (radiant emittance) M_e

At a point on a surface, this is the radiant power leaving an element of that surface, divided by the area of the element.

$$M_e = \frac{d\phi_e}{dA}$$ unit: watt per square metre, W/m^2

Luminous exitance (luminous emittance) M_v

At a point on a surface, this is the luminous flux leaving an element of that surface, divided by the area of that element.

$$M_v = \frac{d\phi_v}{dA}$$ unit: lumen per square metre, lm/m^2

Luminance L_v

This is the luminous intensity (I_v) at a point on a surface and in a given direction, of an element of that surface divided by the area of the orthogonal projection of the element on a plane perpendicular to the given direction.

unit: candela per square metre, cd/m^2

Steradian sr (see Fig. 3)

This is the solid angle subtended at the centre of a sphere by an element of the surface area equal to the square of the radius of the sphere. There are, therefore, 4π steradians in a complete sphere.

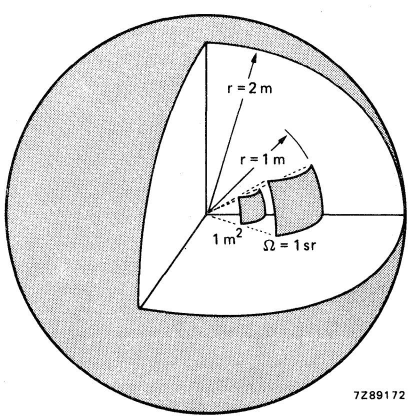


Fig. 3.

ADDITIONAL DEFINITIONS FOR OPTOCOUPLERS

Input current I_i

Current flowing in the input terminals corresponding, in most cases, to the forward current of the LED (I_F).

Output current I_o

Current flowing in the output terminals corresponding, in most cases, to the collector current of the transistor.

Transfer matrix

The output expressed as a function of the input is

$$V_o = AV_i + Bi_i$$
$$i_o = CV_i + Di_i$$

which can be expressed as the matrix

$$M = \begin{pmatrix} V_o \\ i_o \end{pmatrix} = \begin{pmatrix} A & B \\ C & D \end{pmatrix} \begin{pmatrix} v_i \\ i_i \end{pmatrix}$$

the general transfer matrix.

Transfer ratio τ

The transfer ratio is derived from

$$V_o/V_i = A$$
$$i_o/V_i = C$$
$$V_o \approx Bi_i$$
$$i_o \approx Di_i$$

and $\tau = i_i/i_e$ for a given V_o

The ratio is usually expressed as a factor.

Isolation voltage V_{IORM}

The maximum voltage that can be applied between the short-circuited input terminals and the short-circuited output terminals. The type of voltage must be specified, i.e. direct, alternating or repetitive peak.

Repetitive peak voltage rating indicates the resistance to transients. If exceeded, this can result in irreversible damage to the device.

Working voltage V_z

The maximum voltage that may be applied continuously between the input and the output of the device under normal operating conditions without altering its characteristics.

Collector cut-off current (dark) I_{CEW}

The collector cut-off (dark) current at a defined V_{CC} and a defined working voltage V_z applied between the short-circuited leads of the IR diode and the emitter of the transistor.

Input and output capacitance C_{io}

The capacitance between the input terminals and the output terminals.

Insulation resistance R_{io}

The resistance between the input terminals and the output terminals.

Common-mode rejection ratio CMRR

The ratio between a common-mode voltage and the output voltage expressed in dB. The coupling, mainly capacitive, reduces the value.

$$CMRR = 20 \log \frac{V_o}{V_{cm}}$$

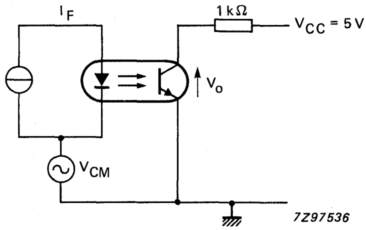


Fig. 1.

Linearity

Linearity depends on both the emitter and receiver characteristics. The characteristics of the transistor are shown in Fig. 2, those of the diode are shown in Fig. 3.

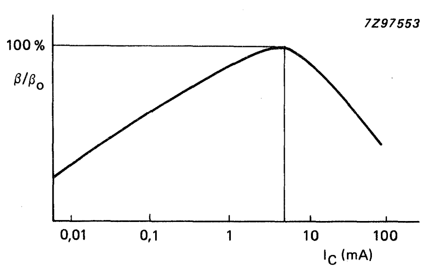


Fig. 2.

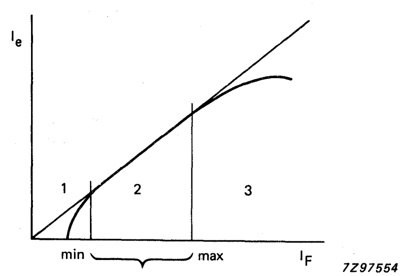


Fig. 3.

Zone 1 shows the non-linearity caused by the non-radiative current of the LED being greater than the radiative current. Non-linearity in zone 3 is caused by saturation.

DEFINITIONS OF TIME QUANTITIES

Switching times

Switching times are defined for a square input pulse, V_i.

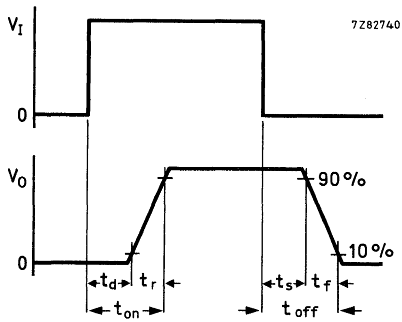


Fig. 4 Waveforms.

Delay time t_d

The time elapsing between the start of the pulse and the moment when the output signal reaches 10% of its maximum value.

Rise time t_r

The time elapsing between the moment when the output signal is 10% of its maximum value and the moment when it reaches 90% of this value.

Turn-on time t_{on}

The time elapsing between the start of the pulse and the moment when the corresponding output signal is 90% of its maximum value.

$$t_{on} = t_d + t_r$$

Storage time t_s

The time elapsing between the end of the input pulse and the moment when the corresponding output signal drops by 10% of its maximum value (or the time when it is still 90%).

Fall time t_f

The time èlapsing between the moment when the output signal is still 90% of its maximum value and the moment when it is no more than 10%.

Turn-off time t_{off}

The time elapsing between the end of the input pulse and the moment when the corresponding output signal falls to 10% of its maximum value.

$$t_{off} = t_s + t_f$$

Propagation delay times

High-Low propagation delay time t_{PHL}

for TTL: The time between the specified reference points on the input and output waveforms with the output changing from the defined HIGH level to the defined LOW level.

for CMOS: The time between the specified reference points, normally the 50% points on the input and output waveforms, with the output changing from the defined HIGH level to the defined LOW level.

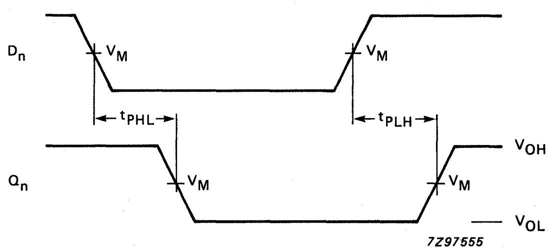


Fig. 5 TTL.

Low-High propagation delay time t_{PLH}

for TTL: The time between the specified reference points on the input and output waveforms with the output changing from the defined LOW level to the defined HIGH level.

for CMOS: The time between the specified reference points, normally the 50% points on the input and output waveforms, with the output changing from the defined LOW level to the defined HIGH level.

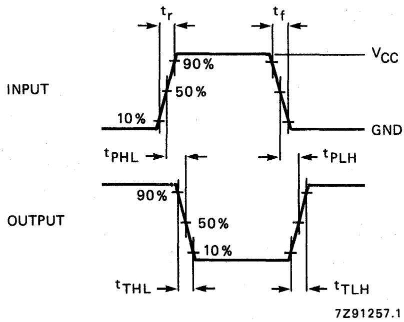


Fig. 6 CMOS.

PARAMETERS INFLUENCING THE CURRENT TRANSFER RATIO OF AN OPTOCOUPLER

Our optocouplers are frequently specified at V_{CE} = 0,4 V, I_F = 10 mA. Many other suppliers specify the transfer ratio at V_{CE} = 5 V or even 10 V when, in fact, the C.T.R. can be much higher. In comparing Philips optocouplers with alternative types a correction factor should be applied.

The current transfer ratio I_C/I_F (CTR) of an optocoupler depends mainly on the biasing conditions of the LED and phototransistor.

The curve of Fig. 1 shows a typical example of the I_C/I_F (CTR) at different I_F and V_{CE} values. The I_C/I_F (CTR) is normailized at 1 for I_F = 10 mA, V_{CE} = 0,4 V and for a high I_C/I_F (CTR).

If the base of the device is accessible, it is possible to limit the I_C/I_F (CTR) by wiring a resistance R_{BE} between the base and emitter. This resistance provides a threshold and thus limits the noise at the optocoupler output.

The curve of Fig. 2 shows three zones:

1. The phototransistor is OFF and only the current of the collector-base photodiode is available.
2. The phototransistor is just at the limit of conduction.
3. The phototransistor is ON and the collector current is no longer dependent on R_{BE}.

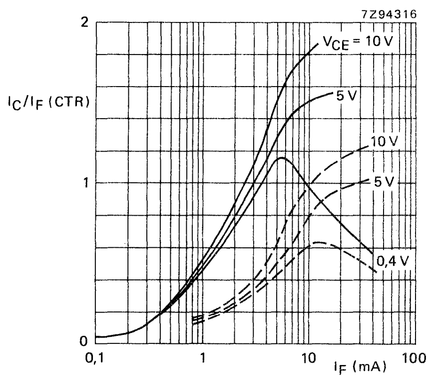


Fig. 1.

—— Piece with a high I_C/I_F (CTR)

– – – Piece with a low I_C/I_F (CTR)

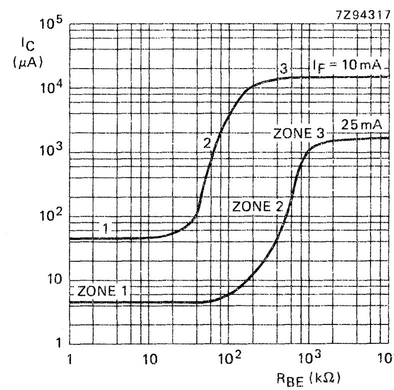


Fig. 2 V_{CC} = 5 V; T_{amb} = 25 °C; typical values.

OPTOCOUPLER SWITCHING TIMES

The curves published for each optocoupler type refer to the non-saturating mode. It is possible to choose the collector current and the load resistance R_L corresponding to the desired switching times.

In the saturation mode, the switching times depend on the forward current I_F, the load resistance R_L and an extra resistance R_{BE} which may be connected between the base and emitter of the photo-transistor. This greatly improves the speed of the circuit.

Fig. 1 shows the typical switching times as a function of R_L without R_{BE}.

Fig. 2 shows these times as a function of I_F without R_{BE} and with R_{BE} = 100 kΩ.

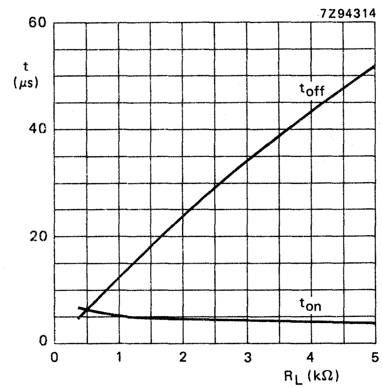


Fig. 1 V_{CC} = 5 V; I_F = 10 mA.

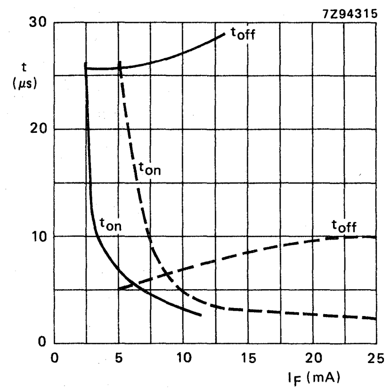


Fig. 2 V_{CC} = 5 V; R_L = 2,5 kΩ.

——— $R_{BE} = \infty$

– – – – R_{BE} = 100 kΩ

APPROVALS/RECOGNITIONS

See data sheets for file and certificate numbers

	UL	VDE 0883	VDE 0804	VDE 0860	others
CNG35					
CNG36					
CNR36					
CNX21					
CNX35					
CNX35U	x	x	x	x	
CNX36					
CNX36U	x	x	x	x	
CNX38					
CNX38U	x	x	x	x	
CNX39					
CNX39U	x	x	x	x	
CNX44					
CNX44A					
CNX46					
CNX48					
CNX48U	x	x	x	x	
CNX62	x	x	x	x	(see note 1)
CNX72	x	x	x	x	
CNX82	x	x	x	x	(see note 2)
CNX83	pending	pending	pending	pending	
CNX91					
CNX92					
CNY17-1	pending	x	x	x	
CNY17-2	pending	x	x	x	
CNY17-3	pending	x	x	x	
CNY50					
CNY57					
CNY57A					
CNY57AU	x	x	x	x	
CNY57U	x	x	x	x	
CNY62					
CNY63					
H11A1	x	x			
H11A2	x	x			
H11A3	x	x			
H11A4	x	x			
H11A5	pending	x			
H11B1	pending	x			
H11B2	pending	x			
H11B3	pending	x			

	UL	VDE 0883	VDE 0804	VDE 0860	others
H11B255	pending	x			
MCA230	pending	x			
MCA231	pending	x			
MCA255	pending	x			
MCT2	x	x	x	x	
MCT26	x	x	x	x	
PO40/44A					British Telecom (see note 3)
SL5500					French CNET
SL5501					French CNET
SL5502R					French CNET
SL5504					French CNET
SL5511					French CNET
SL5505S					French CNET
4N25	x	x			CNET approval pending
4N25A	x	x			
4N26	x	x			
4N27	x	x			
4N28	x	x			
4N35	pending	x	x	x	
4N36	pending	x			
4N37	pending	x			
4N38	pending	x			
4N38A	pending	x			

Note 1 Application approval based on video game G2700/. . . by Nordic countries. Approved by BSI for standard BS415–1979.

Note 2 Approvals for Nordic countries and BSI pending.

Note 3 This type PO40/44A can replace each individual type PO40A, PO41A, PO42A, PO43A and PO44A.

SECTION A1

Optocouplers in a plastic encapsulation

GaAlAs OPTOCOUPLERS

Optically coupled isolators consisting of an infrared emitting GaAlAs diode and a silicon n-p-n phototransistor with accessible base in a SOT-90B envelope, designed for low input current and long life operation.

The application of an IR emitting diode, based on a special GaAlAs (intrinsic) process results in a perfect linearity at low input currents and a very low degradation during the device's operating life.

QUICK REFERENCE DATA

Diode				
Forward current (d.c.)		I_F	max.	100 mA
Transistor				
Collector-emitter voltage (open base)		V_{CEO}	max.	30 V
Optocoupler				
Output/input d.c. current transfer ratio (C.T.R.)				
I_F = 10 mA; V_{CE} = 0,4 V	CNG35	I_C/I_F	min.	0,4
	CNG36	I_C/I_F	min.	0,8
I_F = 500 μA; V_{CE} = 0,4 V	CNG35	I_C/I_F	min.	0,1
	CNG36	I_C/I_F	min.	0,2
Leakage current under working voltage 2,5 kV d.c. value; V_{CC} = 10 V		I_{CEW}	max.	200 nA
Isolation voltage		V_{IORM}	min.	4,4 kV(d.c.) 3,12 kV(r.m.s.)

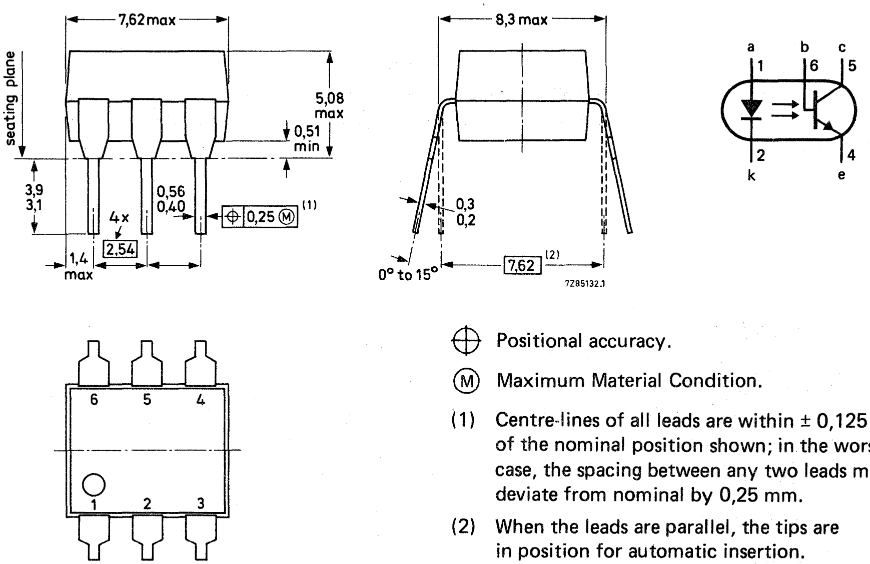
MECHANICAL DATA

SOT-90B (see Fig. 1).

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.



⌖ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	2,5 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	70 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Junction temperature	T_j	max.	125 °C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	max.	500 K/W
transistor	$R_{th\ j\text{-}a}$	max.	500 K/W
From junction to ambient, device mounted on a printed circuit board			
diode	$R_{th\ j\text{-}a}$	max.	400 K/W
transistor	$R_{th\ j\text{-}a}$	max.	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	$L_{(IO1)}$	min.	7,2 mm
External tracking path (creepage distance) input terminals to output terminals	$L_{(IO2)}$	min.	7,0 mm
Tracking resistance (KB-value)		KB-100/A	

DEVELOPMENT DATA

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,45 V
		max.	1,75 V
Reverse current V_R = 5 V	I_R	max.	10 μA

Transistor

Collector-emitter breakdown voltage open base; I_C = 1 mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage open emitter; I_C = 0,1 mA	$V_{(BR)CBO}$	min.	70 V
Emitter-collector breakdown voltage open base; I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V
Collector cut-off current (dark) V_{CE} = 10 V	I_{CEO}	typ.	2 nA
		max.	50 nA
V_{CE} = 10 V; T_{amb} = 70 °C	I_{CEO}	max.	10 μA
V_{CB} = 10V	I_{CBO}	max.	20 nA

Optocoupler

Collector current					
at T_{amb} = 0 °C to 70 °C					
V_F = 0,8 V; V_{CE} = 15 V		$I_{CE(L)}$	max.	15	μA
I_F = 2 mA; V_{CE} = 0,4 V		$I_{CE(L)}$	min.	250	μA
Collector-emitter saturation voltage					
I_F = 10 mA; I_C = 2 mA	CNG35	V_{CEsat}	typ.	0,15	V
			max.	0,4	V
I_F = 10 mA; I_C = 4 mA	CNG36	V_{CEsat}	typ.	0,19	V
			max.	0,4	V
Output capacitance					
V_{CB} = 10 V; f = 1 MHz		C_{bc}	typ.	4,5	pF
Collector current at					
working voltage V_W = 2,5 kV;					
(d.c. value) see notes 1 and 2					
V_{CC} = 10 V; T_j = 25 °C		I_{CEW}	max.	200	nA
V_{CC} = 10 V; T_j = 70 °C		I_{CEW}	max.	100	μA
Isolation voltage					
(see note 3)		V_{IORM}	min.	4,4	kV(d.c.)
				3,12	kV(r.m.s.)
Capacitance between input and output					
V = 0; f = 1 MHz		C_{io}	typ.	0,6	pF
Insulation resistance between input and output					
$\pm V_{IO}$ = 1 kV		r_{IO}	min.	10^{10}	Ω
			typ.	10^{12}	Ω
Switching times (see figures 3 and 4)					
I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	CNG35	t_{on}	typ.	3	μs
Turn-off time		t_{off}	typ.	3	μs
I_C = 2 mA; V_{CC} = 5 V, R_L = 1 kΩ					
Turn-on time	CNG35	t_{on}	typ.	12	μs
Turn-off time		t_{off}	typ.	12	μs
I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	CNG36	t_{on}	typ.	8	μs
Turn-off time		t_{off}	typ.	6	μs
I_C = 2 mA; V_{CC} = 5 V, R_L = 1 kΩ					
Turn-on time	CNG36	t_{on}	typ.	20	μs
Turn-off time		t_{off}	typ.	18	μs

			CNG35	CNG36
D.C. current transfer ratio (C.T.R.)		min.	0,4	0,8
I_F = 10 mA; V_{CE} = 0,4 V	I_C/I_F	typ.	0,7	1,0
		max.	1,6	
I_F = 2 mA; V_{CE} = 0,4 V	I_C/I_F	typ.	0,9	1,4
I_F = 0,5 mA; V_{CE} = 0,4 V	I_C/I_F	min.	0,1	0,2
		typ.	0,5	0,8

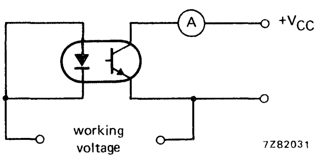


Fig. 2.

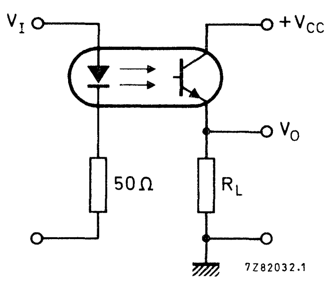


Fig. 3 Switching circuit.

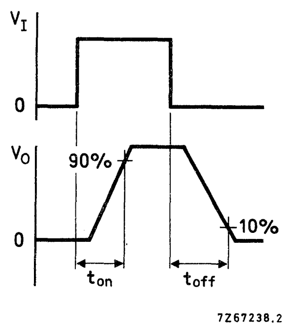


Fig. 4 Waveforms.

Notes.

1. This parameter is the maximum collector-emitter leakage current measured when a high voltage is applied between the emitter and the two shorted diode leads.
2. As quality assurance (on a sample basis), these parameters are covered by a 1000 hour reliability test.
3. Tested on sample basis. The input diode leads are shorted together and all the transistor leads shorted together, then a test voltage of 4,4 kV (d.c.) is applied for 1 min.

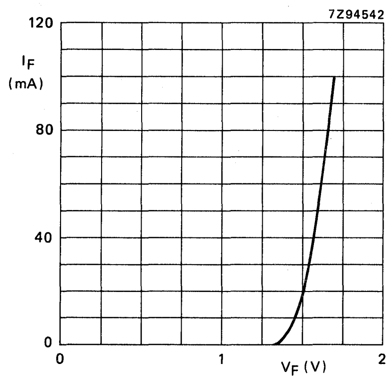


Fig. 5 T_{amb} = 25 °C; typical values.

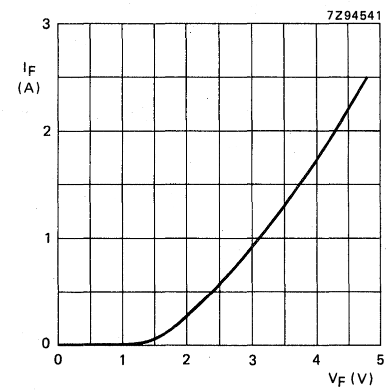


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms; typical values.

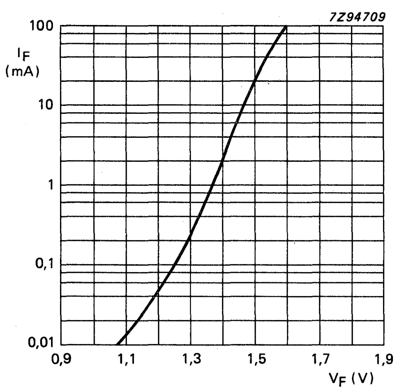


Fig. 7 T_{amb} = 25 °C; typical values.

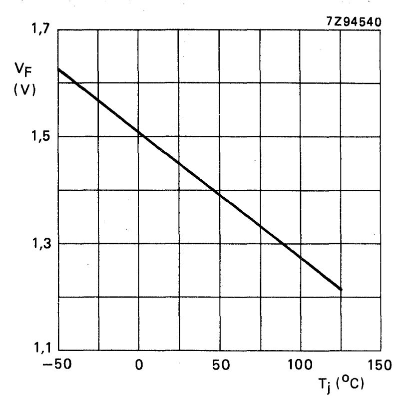


Fig. 8 I_F = 10 mA; typical values.

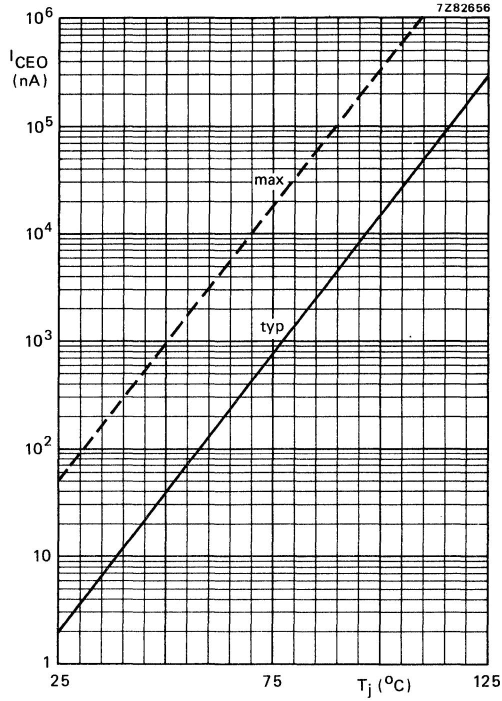


Fig. 9 $I_F = 0$; $V_{CE} = 10$ V.

DEVELOPMENT DATA

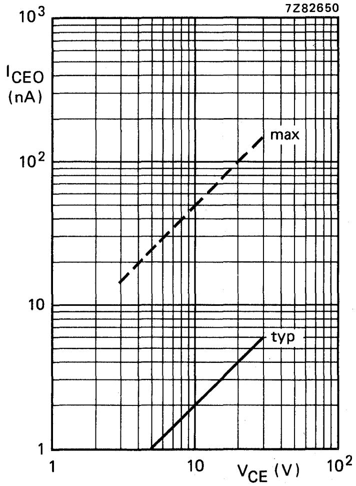


Fig. 10 $I_F = 0$; $T_j = 25$ °C.

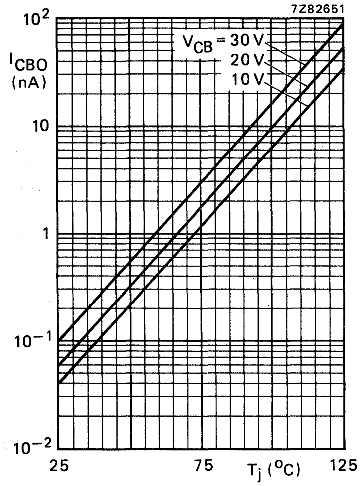


Fig. 11 Typical values.

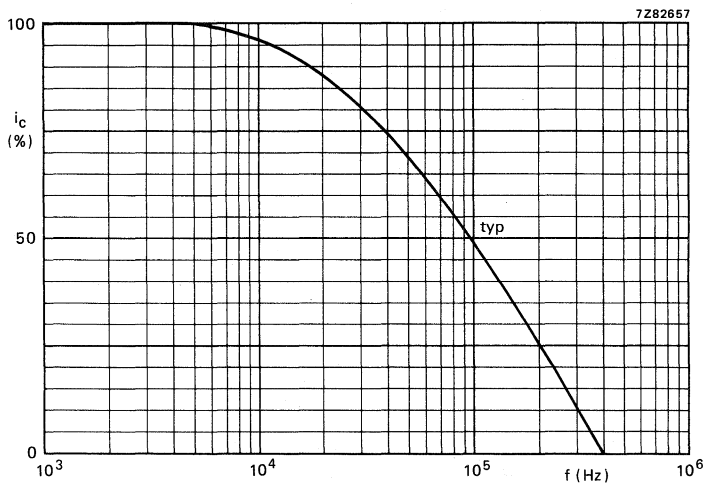


Fig. 12 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1$ kΩ; $T_{amb} = 25$ °C.

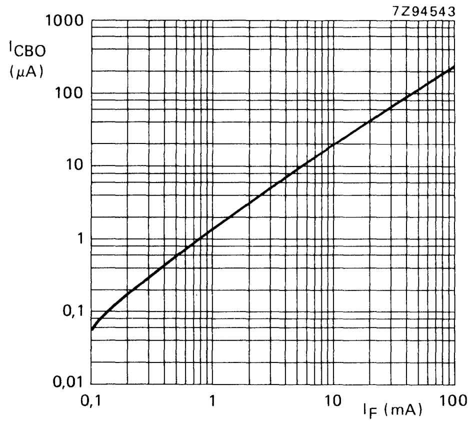


Fig. 13 V_{CB} = 5 V; T_{amb} = 25 °C; typical values.

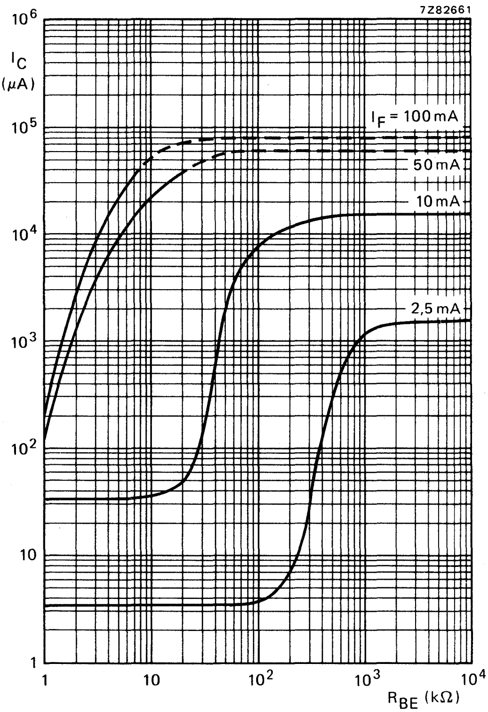


Fig. 14 $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

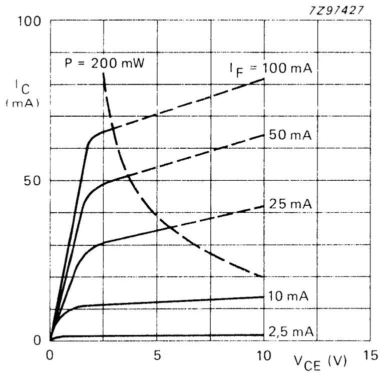


Fig. 15 T_{amb} = 25 °C, typical values; CNG35.

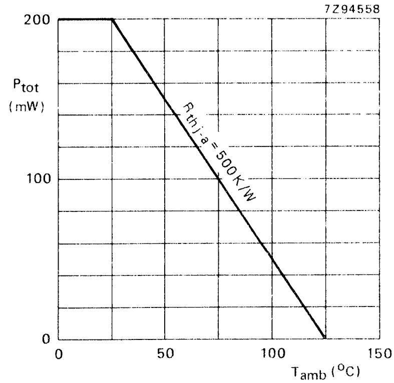


Fig. 16.

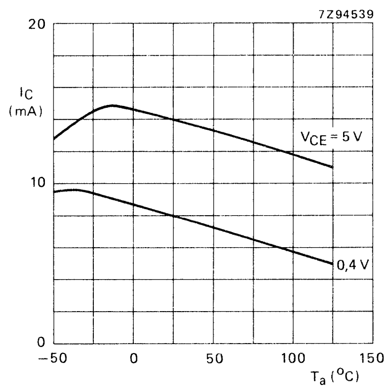


Fig. 17 I_F = 10 mA; typical values; CNG35.

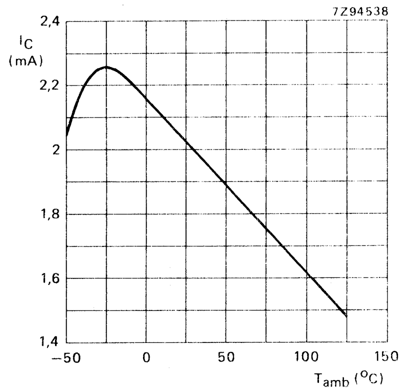


Fig. 18 I_F = 2 mA; V_{CE} = 0,4 V; typical values; CNG35.

DEVELOPMENT DATA

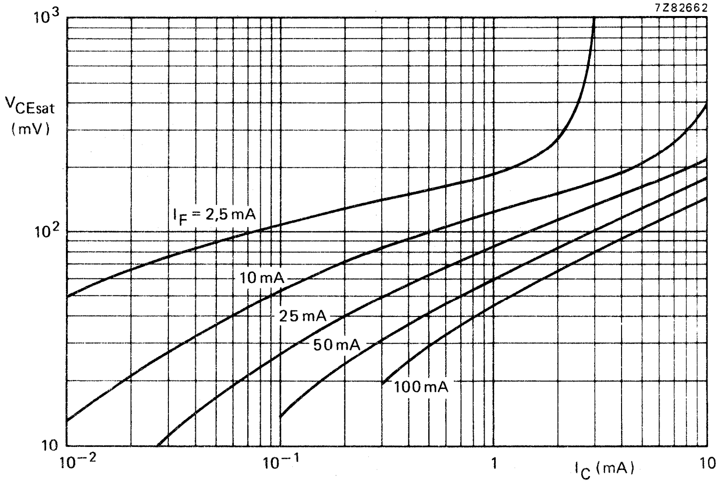


Fig. 19 $I_B = 0$; $T_{amb} = 25\ ^oC$; typical values.

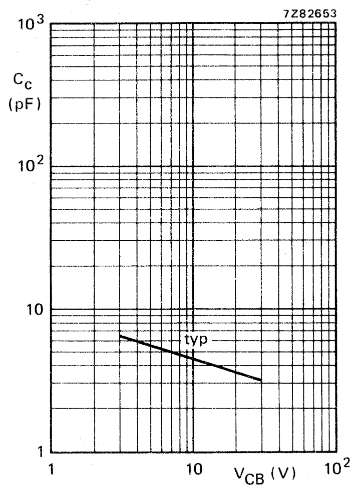


Fig. 20 f = 1 MHz; $T_{amb} = 25\ ^oC$.

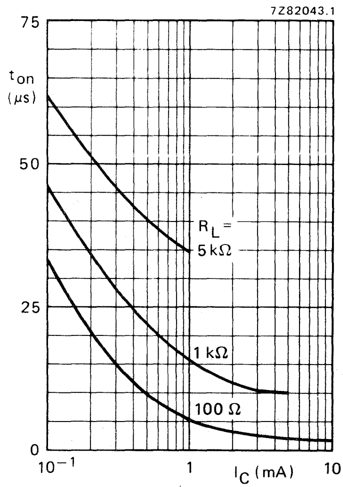


Fig. 21 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typi al values. (See also Fig. 23); CNG35.

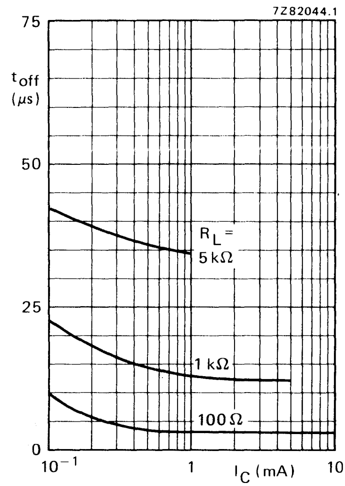


Fig. 22 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 23); CNG35.

DEVELOPMENT DATA

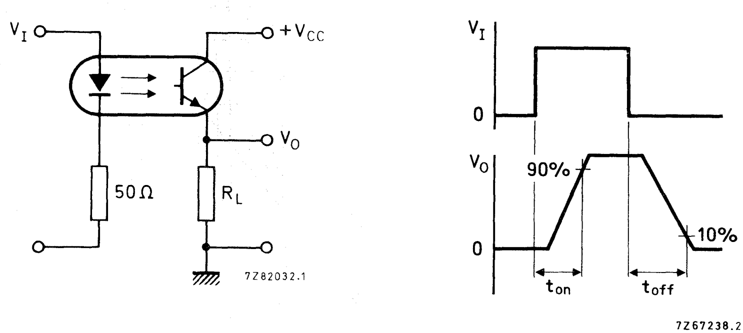


Fig. 23 Switching circuit and waveforms.

HIGH-SPEED OPTOCOUPLER

The CNR36 is a fast switching optocoupler consisting of a GaAlAs light emitting diode which is optically coupled to an integrated silicon photodetector in an 8-pin dual-in-line (DIL) envelope SOT-97F. It is suitable for use with TTL integrated circuits.

Features

- short propagation delay times
- low saturation voltage
- high isolation voltage of 2,5 kV (r.m.s.) and 3,5 kV (d.c.)
- working voltage of 2,5 kV (d.c.)
- high transient immunity

QUICK REFERENCE DATA

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 1 μs	I_{FM}	max.	1 A
Transistor			
Collector-emitter breakdown voltage			
I_C = 10 mA	$V_{(BR)CEO}$	min.	18 V
Optocoupler			
Output current			
I_F = 10 mA; V_{CC} = 4,5 V; V_o = 0,4 V	I_{OL}	min.	2 mA
		typ.	4 mA
Logic low output voltage			
I_F = 10 mA; V_{CC} = 4,5 V; I_o = 2 mA	V_{OL}	typ.	0,2 V
		max.	0,4 V
Propagation delay time	t_{PHL}	max.	0,8 μs
	t_{PLH}	max.	0,8 μs
Common mode transient immunity	±CM	min.	1 kV/μs
Isolation voltage	V_{IORM}	min.	3,5 kV(d.c.)
			2,5 kV(r.m.s.)

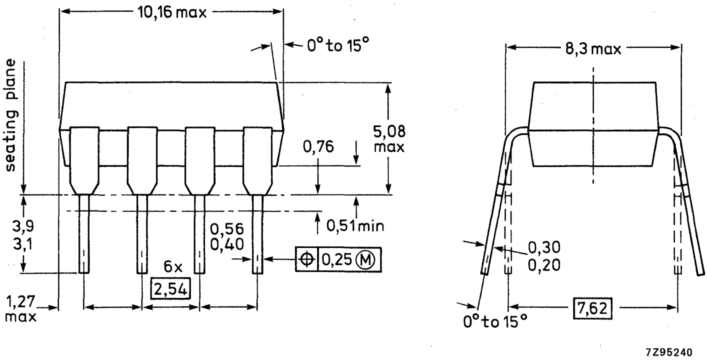
MECHANICAL DATA

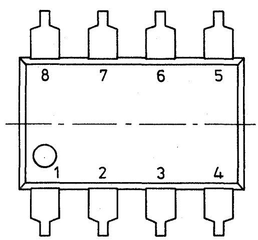
SOT-97F (see Fig. 1).

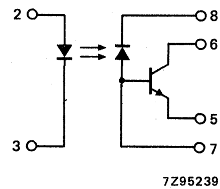
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-97F.







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from the nominal by 0,25 mm.

(2) When the leads are parallel, the tips remain in position for automatic insertion.

RATINGS

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

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 1 μs	I_{FM}	max.	1 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Transistor			
Emitter-base voltage	V_{EBO}	max.	5 V
Collector-emitter breakdown voltage			
I_C = 10 mA	$V_{(BR)CEO}$	min.	18 V
Emitter-base breakdown voltage	$V_{(BR)EBO}$	min.	5 V
Collector current (d.c.)	I_C	max.	10 mA
Total power dissipation up to T_{amb} = 85 °C	P_{tot}	max.	100 mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Operating junction temperature	T_j	max.	125 °C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	=	500 K/W
transistor	$R_{th\ j\text{-}a}$	=	500 K/W
From junction to ambient, with the device mounted on a printed circuit board			
diode	$R_{th\ j\text{-}a}$	=	400 K/W
transistor	$R_{th\ j\text{-}a}$	=	400 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ. max.	1,65 V 1,9 V
Reverse current V_R = 5 V	I_R	max.	10 μA

Transistor (diode: I_F = 0)

Collector-emitter breakdown voltage at I_C = 10 mA	$V_{(BR)CEO}$	min.	18 V
Collector-base breakdown voltage* at I_C = 100 μA	$V_{(BR)CBh}$	min.	30 V
Emitter-base breakdown voltage at I_E = 0,1 mA	$V_{(BR)EBO}$	min.	5 V
Logic high output current $I_F = 0$; $V_o = V_{CC}$ = 5,5 V	I_{OH}	typ. max.	5 nA 500 nA
Logic high output current $I_F = 0$; $V_o = V_{CC}$ = 15V	I_{OH}	max.	100 μA
Logic high supply current $I_F = 0$; $I_o = 0$; V_{CC} = 15V	I_{CCH}	max.	1 μA
Logic low supply current I_F = 10 mA; V_{CC} = 15 V	I_{CCL}	typ.	20 μA

Optocoupler

Output current I_F = 10 mA; V_{CC} = 4,5 V; V_o = 0,4 V	I_{OL}	min. typ.	2 mA 4 mA

* Cathode connected to collector

DEVELOPMENT DATA

Logic low output voltage I_F = 10 mA; V_{CC} = 4,5 V; I_O = 2 mA	V_{OL}	typ. max.	0,2 V 0,4 V
Isolation voltage (note 2)	V_{IORM}	min.	3,5 kV(d.c.) 2,5 kV(r.m.s.)
Capacitance between input and output f = 1 MHz	C_{io}	typ.	0,6 pF
Insulation resistance between input and output $\pm V_{IO}$ = 1 kV	r_{IO}	min. typ.	10^{10} Ω 10^{12} Ω
Switching times (see Figs 2 and 3) I_F = 10 mA; V_{CC} = 5 V; R_L = 2,5 kΩ			
Propagation delay time to logic low at output	t_{PHL}	typ. max.	0,5 µs 0,8 µs
Propagation delay time to logic high at output	t_{PLH}	typ. max.	0,4 µs 0,8 µs

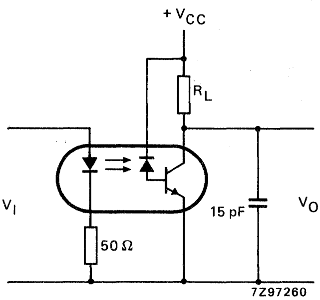


Fig. 2 Switching circuit.

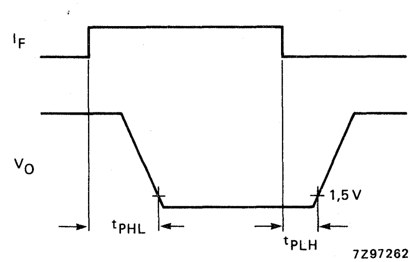


Fig. 3 Waveforms.

Switching times (see Figs 4 and 5)
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω

Turn-on time	t_{on}	typ.	0,85 µs
Turn-off time	t_{off}	typ.	0,85 µs

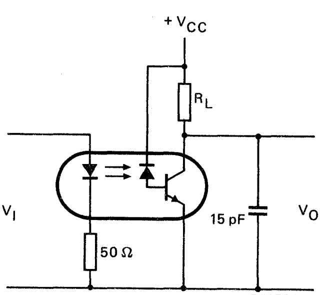


Fig. 4 Switching circuit.

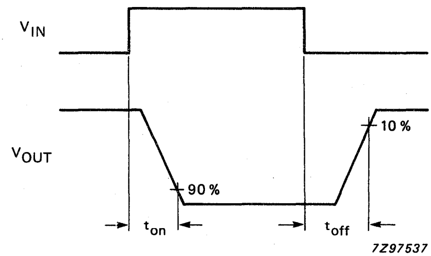


Fig. 5 Waveforms.

Transient immunity

V_{CC} = 5 V; V_{CM} = 10 V_{PP}; R_L = 2,5 kΩ

Common mode transient immunity at logic low I_F = 10 mA	C_{ML}	min.	−1 kV/μs
Common mode transient immunity at logic high I_F = 0	C_{MH}	min.	1 kV/μs
Logic high output current (note 1, see Fig. 6) V_{CC} = 5,5 V; working voltage (d.c.) = 2,5 kV; T_{amb} = 70C	I_{OHW}	max.	100 μA

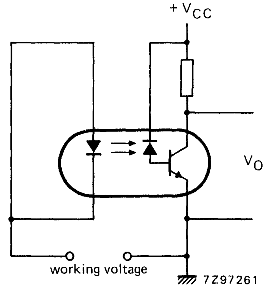


Fig. 6.

DEVELOPMENT DATA

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(I01)	min.	7,2 mm
External tracking path (creepage dist) input terminals to output terminals	L(I02)	min.	7,0 mm
Tracking resistance (KB-value)			

Notes

1. This parameter is the working collector-emitter leakage current measured when a high voltage is applied between the emitter and the short circuited diode leads.
2. Tested on a sample basis with a voltage of 3500 V (d.c.) or 2,5 kV (r.m.s.) for 1 minute between the shorted input (diode) leads and the shorted output (phototransistor) leads.

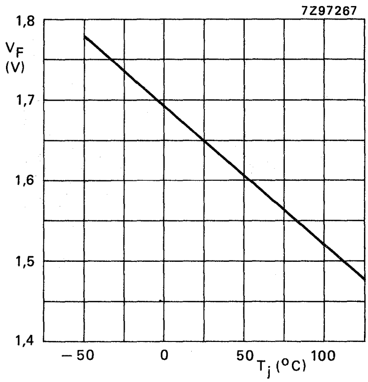


Fig. 7 I_F = 10 mA; typical values.

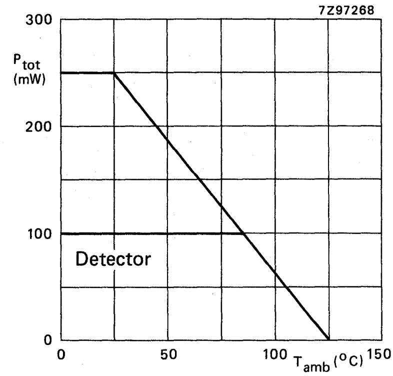


Fig. 8.

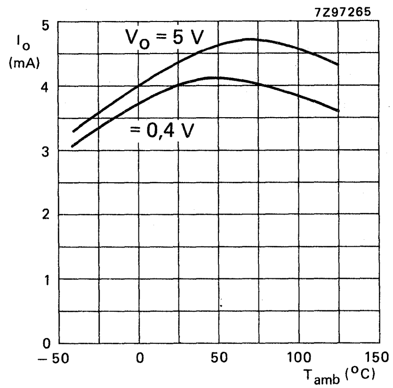


Fig. 9 V_{CC} = 5 V; I_F = 10 mA; typical values.

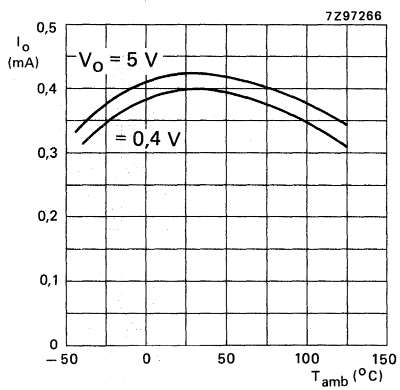


Fig. 10 V_{CC} = 5 V; I_F = 2 mA; typical values.

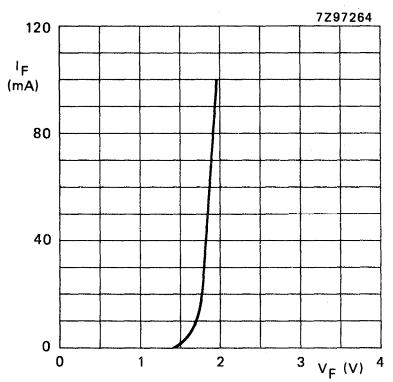


Fig. 11 T_{amb} = 25 °C; typical values.

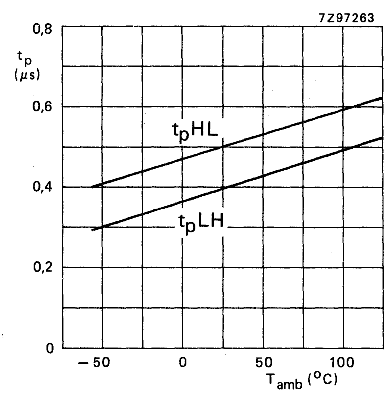


Fig. 12 I_F = 10 mA; V_{CC} = 5 V; R_L = 2,5 kΩ; typical values.

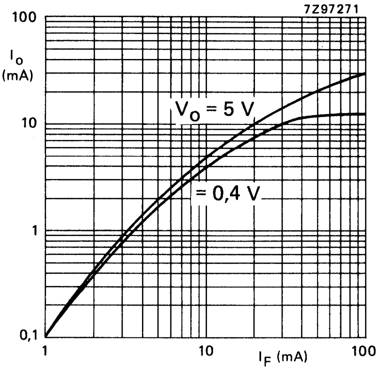


Fig. 13 V_{CC} = 5 V; typical values.

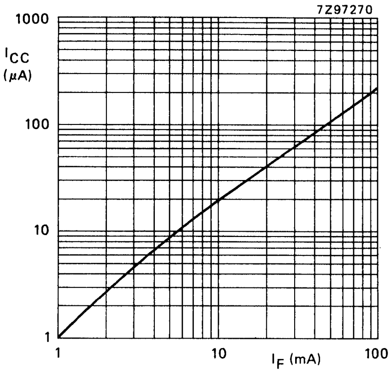


Fig. 14 V_{CC} = 15 V; I_o = 0; typical values.

DEVELOPMENT DATA

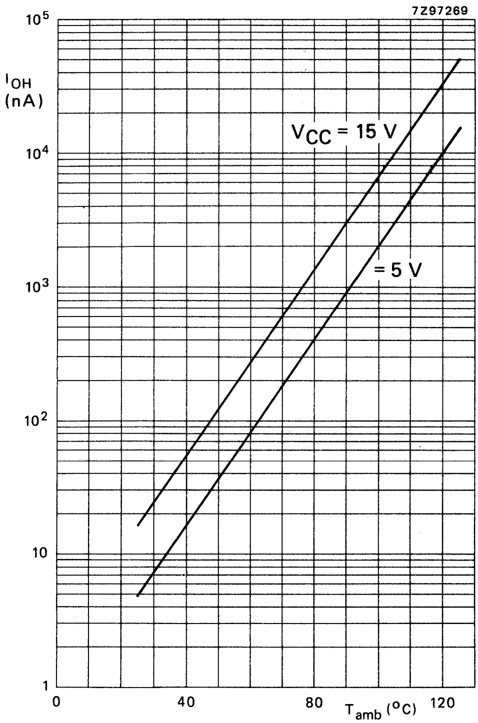


Fig. 15 Typical values.

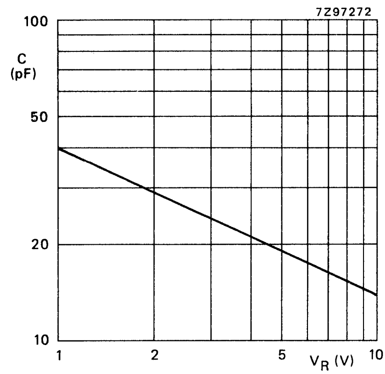


Fig. 16 T_{amb} = 25 °C; typical values.

Photodiode capacitance

HIGH-VOLTAGE OPTOCOUPLER

Optically coupled isolator consisting of an infrared emitting GaAs diode and a silicon n-p-n phototransistor. The base is not accessible.

Features of this product:
- very high isolation voltage of 10 kV (d.c.).
- working voltage of 10 kV (d.c.).
- high common mode rejection 85 dB

QUICK REFERENCE DATA

Diode				
Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	50	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 ^oC	P_{tot}	max.	100	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Total power dissipation up to T_{amb} = 25 ^oC	P_{tot}	max.	100	mW
Optocoupler				
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V; (I_B = 0)	I_C/I_F	>	0,2	
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 10 kV diode: I_F = 0 (see also Fig. 4)	I_{CEW}	<	200	nA
Isolation voltage (d.c.)	V_{IORM}	min.	10	kV

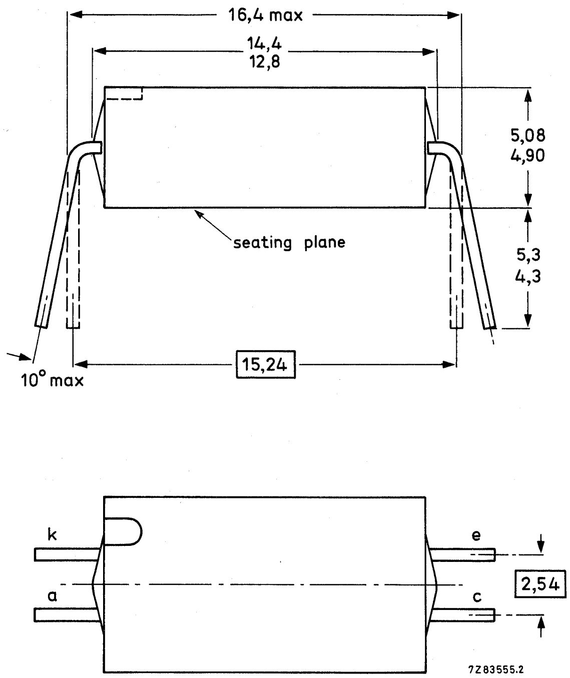
MECHANICAL DATA

SOT-211 (see Fig. 1)

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-211.



RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	50 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100 mW

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current			
d.c.	I_C	max.	25 mA
peak value	I_{CM}	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100 mW

Optocoupler

Storage temperature	T_{stg}	−55 to + 100	°C
Junction temperature	T_j	max. 100	°C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max. 260	°C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	max. 750	K/W
transistor	$R_{th\ j\text{-}a}$	max. 750	K/W
From junction to ambient, device mounted on a printed circuit board			
diode	$R_{th\ j\text{-}a}$	max. 400	K/W
transistor	$R_{th\ j\text{-}a}$	max. 400	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Diode

Forward voltage $I_F = 10$ mA	V_F	typ.	1,15	V
		<	1,3	V
Reverse current $V_R = 5$ V	I_R	<	100	μA
Diode capacitance at f = 1 MHz $V_R = 0$	C_d	typ.	40	pF

Transistor

Collector cut-off current (dark) $V_{CE} = 10$ V	I_{CEO}	typ.	2	nA
		<	50	nA
Collector-emitter breakdown voltage open base; $I_C = 1$ mA	$V_{(BR)CEO}$	min.	30	V
Emitter-collector breakdown voltage open base; $I_E = 0{,}1$ mA	$V_{(BR)ECO}$	min.	7	V

Optocoupler ($I_B = 0$)*

Output/input d.c. current transfer ratio (C.T.R.) $I_F = 10$ mA; $V_{CE} = 0{,}4$ V	I_C/I_F	min.	0,2	
		typ.	0,5	
Collector-emitter saturation voltage $I_F = 10$ mA; $I_C = 2$ mA	V_{CEsat}	typ.	0,15	V
Isolation voltage, d.c. value (see note 1)	V_{IORM}	min.	10	kV

Note see next page.

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

Capacitance between input and output			
$I_F = 0$; $V = 0$; $f = 1$ MHz	C_{io}	typ.	0,15 pF
Insulation resistance between input and output			
$\pm V_{IO} = 1$ kV	r_{IO}	>	10^{11} Ω
			12^{12} Ω
Common mode rejection (see Fig. 3)			
$I_C = 2$ mA; $f = 10$ kHz	CMRR	typ.	85 dB
Switching times (see Fig. 13)			
$I_{Con} = 2$ mA; $V_{CC} = 5$ V; $R_L = 100$ Ω			
Turn-on time	t_{on}	typ.	3 μs
Turn-off time	t_{off}	typ.	3 μs
$I_{Con} = 2$ mA; $V_{CC} = 5$ V; $R_L = 1$ kΩ			
Turn-on time	t_{on}	typ.	12 μs
Turn-off time	t_{off}	typ.	12,5 μs
Collector cut-off current (dark) see Fig. 2			
$V_{CC} = 10$ V; working voltage (d.c.) = 10 kV	I_{CEW}	<	200 nA*

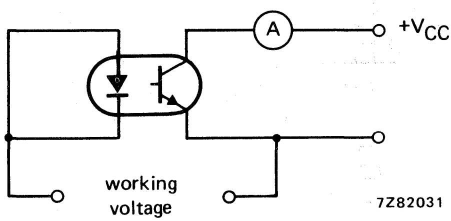


Fig. 2.

Notes

1. This parameter is tested with both input (diode) leads shorted together and both output (phototransistor) leads shorted together at 10 kV (d.c.) for 1 min. Tested on sample basis.
2. $$CMRR = \frac{V_o}{V_{CM}}.$$

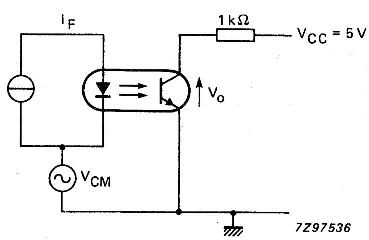


Fig. 3.

* As quality assurance (on a sample basis), these parameters are covered by a 1000 h reliability test.

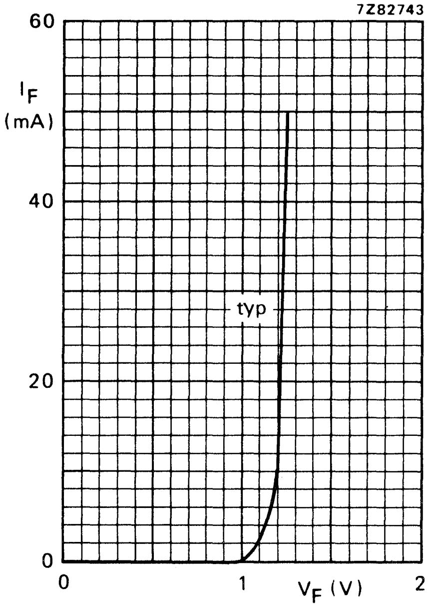


Fig. 4 T_j = 25 °C.

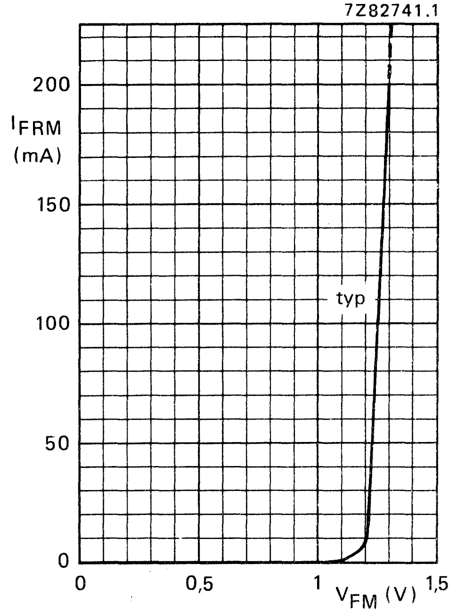


Fig. 5 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms.

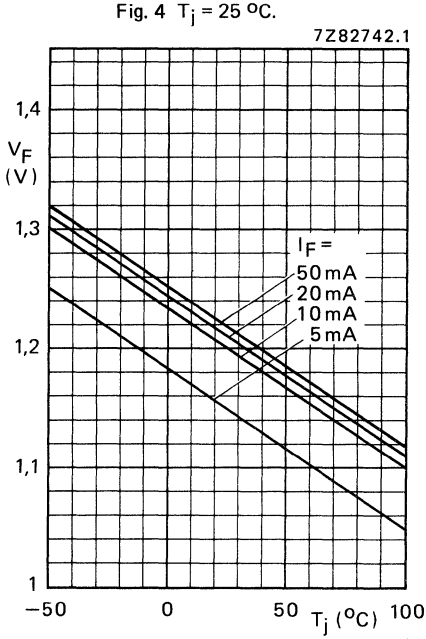


Fig. 6 Typical values.

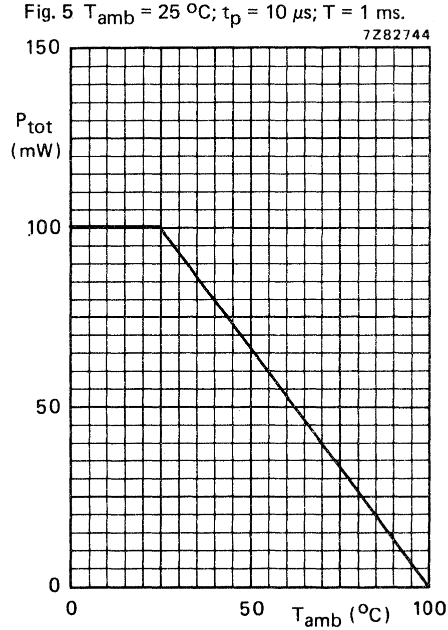


Fig. 7 Power derating curve for diode and transistor versus ambient temperature.

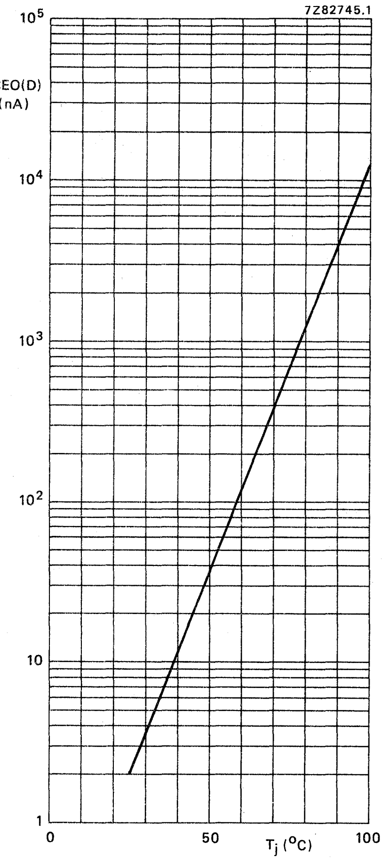


Fig. 8 Typical values.

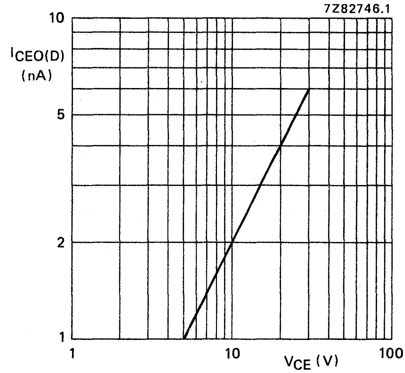


Fig. 9 Typical values.

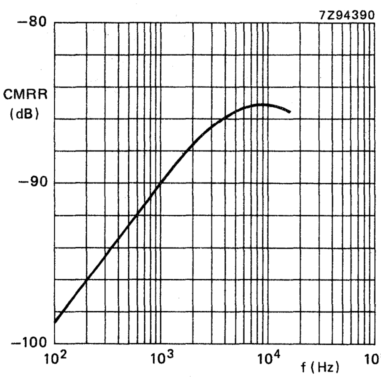


Fig. 10 Typical values.

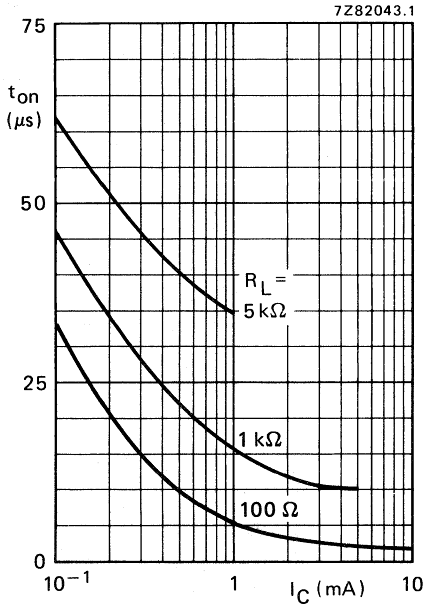


Fig. 11 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. See also Fig. 13.

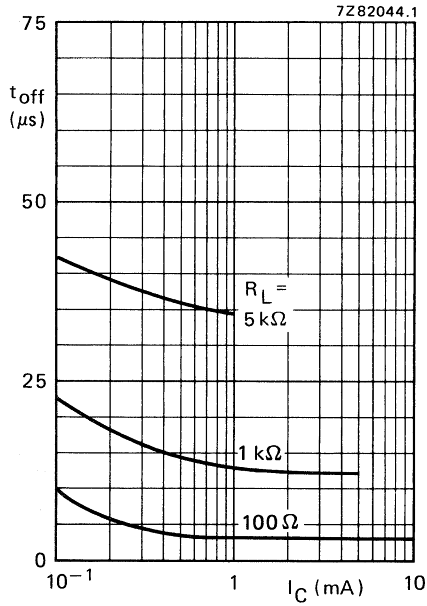


Fig. 12 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. See also Fig. 13.

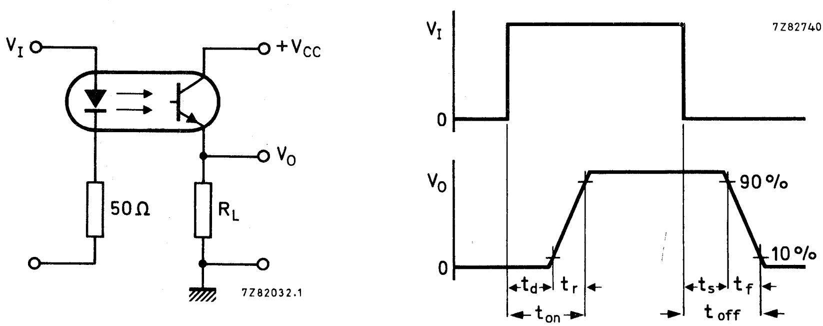


Fig. 13 Switching circuit and waveforms.

OPTOCOUPLERS

Optically coupled isolators consisting of an infrared emitting GaAs diode and a silicon n-p-n photo transistor with accessible base. Plastic envelopes. Suitable for TTL integrated circuits.

Features of these products:

- high output/input d.c. current transfer ratio;
- low saturation voltage;
- high isolation voltage of 3,12 kV (r.m.s.) and 4,4 kV (d.c.);
- working voltage 2,5 kV (d.c.).

QUICK REFERENCE DATA

Diode				
Continuous reverse voltage		V_R	max.	5 V
Forward current				
d.c.		I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01		I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	200 mW
Transistor				
Collector-emitter voltage (open base)		V_{CEO}	max.	30 V
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	200 mW
Optocoupler				
Output/input d.c. current transfer ratio (C.T.R.)	**CNX35**			0,4 to 0,9
I_F = 10 mA; V_{CE} = 0,4 V; (I_B = 0)	**CNX39**	I_C/I_F		0,6 to 1,0
	CNX36			0,8 to 2,0
Collector cut-off current (dark)				
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV				
diode: I_F = 0 (see also Fig. 2)		I_{CEW}	max.	200 nA
Isolation voltage (d.c.)		V_{IORM}	min.	4,4 kV

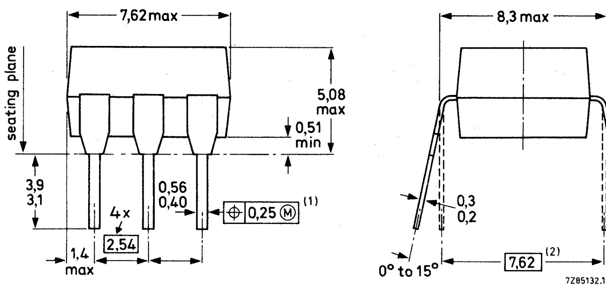
MECHANICAL DATA

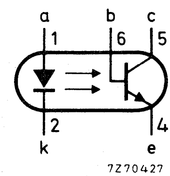
SOT-90B (see Fig. 1).

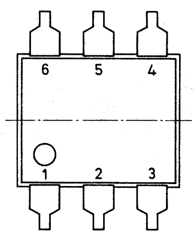
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode				
Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	70	V
Emitter-collector voltage (open base)	V_{ECO}	max.	7	V
Collector current (d.c.)	I_C	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Operating junction temperature	T_j	max.	125 °C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	=	500 K/W
transistor	$R_{th\ j\text{-}a}$	=	500 K/W
From junction to ambient, device mounted on a printed-circuit board			
diode	$R_{th\ j\text{-}a}$	=	400 K/W
transistor	$R_{th\ j\text{-}a}$	=	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2 mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)			KB-100/A

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,15 V
		max.	1,5 V
Reverse current V_R = 5 V	I_R	max.	10 μA

Transistor (I_F = 0)

Collector cut-off current (dark) V_{CE} = 10 V	I_{CEO}	typ.	2 nA
		max.	50 nA
V_{CE} = 10 V; T_{amb} = 70 °C	I_{CEO}	max.	10 μA
V_{CB} = 10 V	I_{CBO}	max.	20 nA
Collector-emitter breakdown voltage at I_C = 1 mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage at I_C = 0,1 mA	$V_{(BR)CBO}$	min.	70 V
Emitter-collector breakdown voltage at I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V

Optocoupler (I_B = 0)*

Output/input d.c. current transfer ratio (C.T.R.)

I_F = 10 mA; V_{CE} = 0,4 V	**CNX35**	I_C/I_F	0,4 to 0,9
	CNX39	I_C/I_F	0,6 to 1,0
	CNX36	I_C/I_F	0,8 to 2,0

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

Output/input d.c. current transfer ratio (C.T.R.)					
I_F = 10 mA; V_{CE} = 5 V		I_C/I_F	typ.	1,5	
Collector-emitter saturation voltage					
I_F = 10 mA; I_C = 2 mA	**CNX35** **CNX39**	V_{CEsat}	max. typ.	0,4 0,15	
I_F = 10 mA; I_C = 4 mA	**CNX36**	V_{CEsat}	max. typ.	0,4 0,19	
Isolation voltage **		V_{IORM}	min.	4,4 kV (d.c.) 3,12 kV (r.m.s.)	
Collector cut-off current (light) at T_{amb} = 0 °C to 70 °C					
V_F = 0,8 V; V_{CE} = 15 V		$I_{CE(L)}$	max.	15	μA
I_F = 2 mA; V_{CE} = 0,4 V		$I_{CE(L)}$	min.	150	μA
Collector capacitance at f = 1 MHz					
$I_E = I_e$ = 0; V_{CB} = 10 V		C_{bc}	typ.	4,5	pF
Capacitance between input and output					
I_F = 0; V = 0; f = 1 MHz		C_{io}	typ.	0,6	pF
Insulation resistance between input and output					
± V_{IO} = 1 kV		r_{IO}	min. typ.	10^{10} 10^{12}	Ω

Switching times (see Figs 2 and 3)

		CNX35	CNX39	CNX36	
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ. 3	5,5	8	μs
Turn-off time	t_{off}	typ. 3	4	6	μs
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 1 kΩ					
Turn-on time	t_{on}	typ. 12	14	20	μs
Turn-off time	t_{off}	typ. 12	12	18	μs

Collector cut-off current (dark) see Fig. 4				
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV	I_{CEW}	max.	200	nA*
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV; T_j = 70 °C	I_{CEW}	max.	100	μA*

* As quality assurance (on a sample basis), these parameters are covered by a 1000 h reliability test.

** Tested on a sample basis with a voltage of 4400 Vdc for 1 minute between the shorted input (diode) leads and the shorted output (phototransistor) leads.

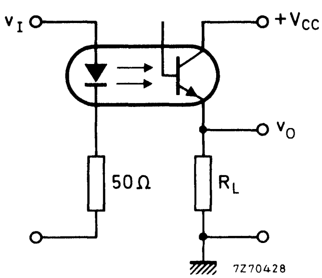


Fig. 2 Switching circuit.

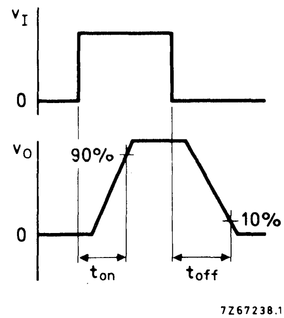


Fig. 3 Waveforms.

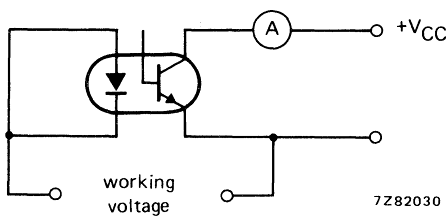


Fig. 4.

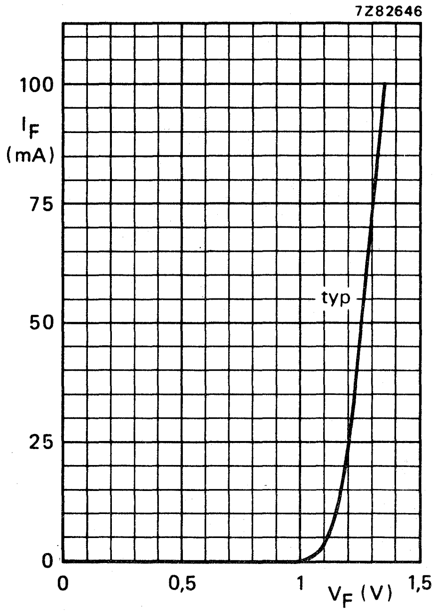


Fig. 5 T_{amb} = 25 °C.

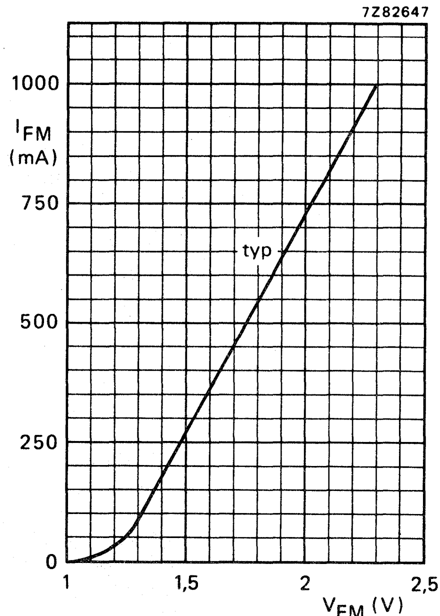


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms.

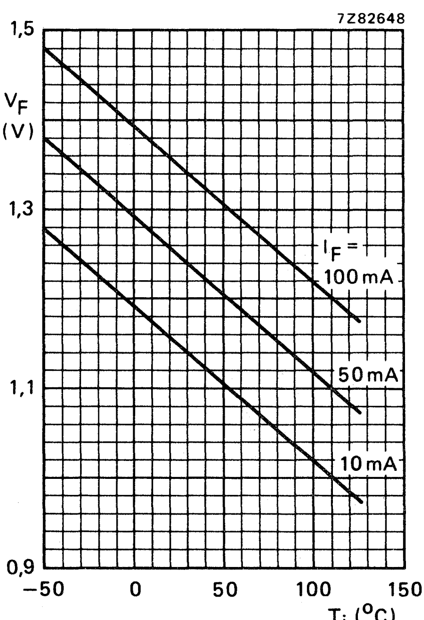


Fig. 7 Typical values.

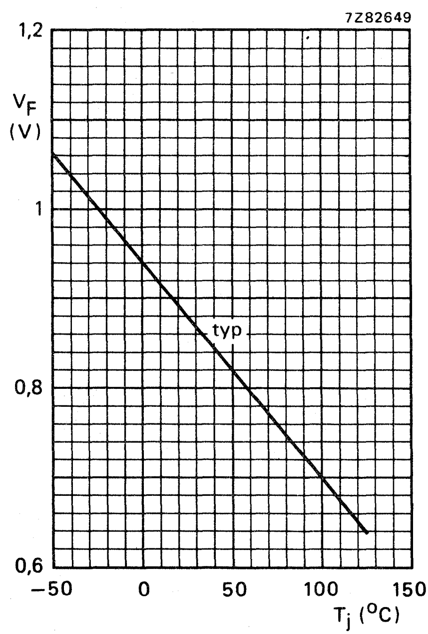


Fig. 8 I_F = 50 μA.

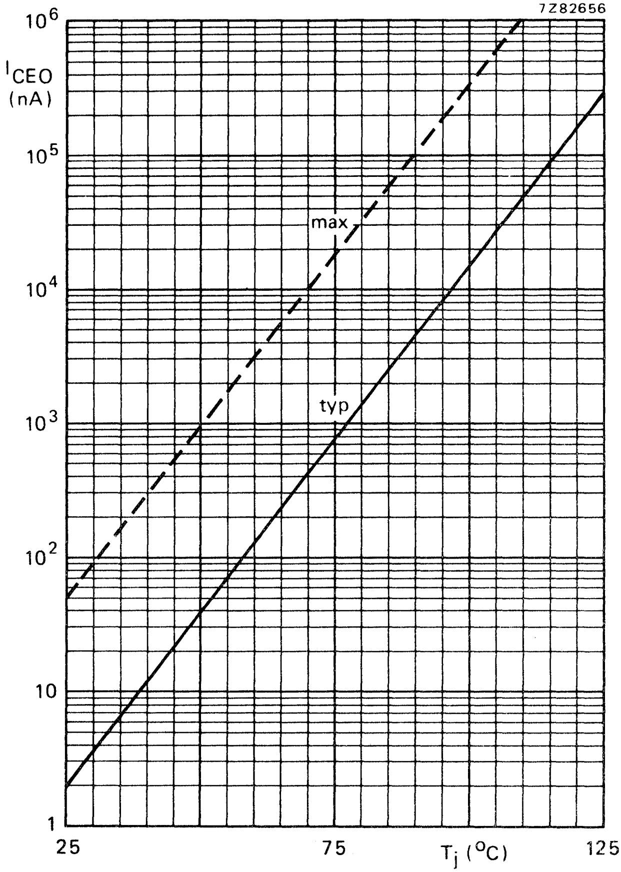


Fig. 9 $I_F = 0$; $V_{CE} = 10$ V.

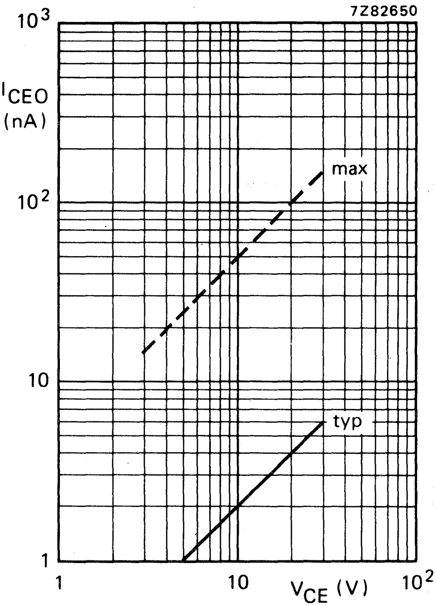


Fig. 10 $I_F = 0$; $T_j = 25\ ^oC$.

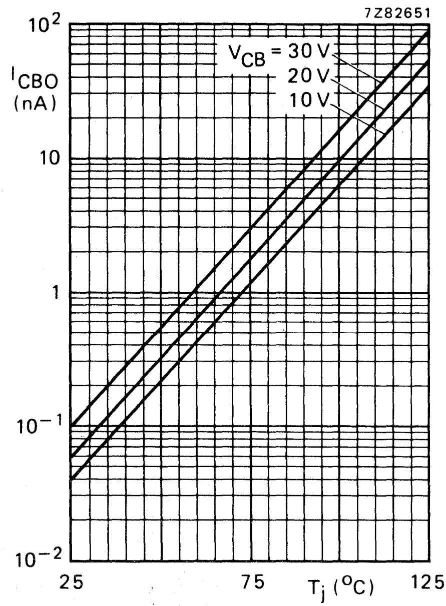


Fig. 11 Typical values.

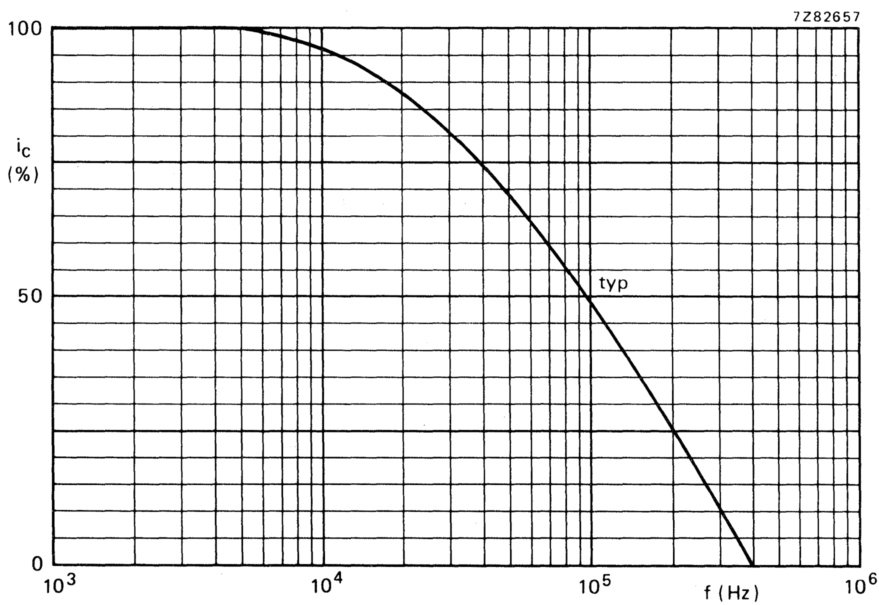


Fig. 12 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1\ k\Omega$; $T_{amb} = 25\ ^oC$.

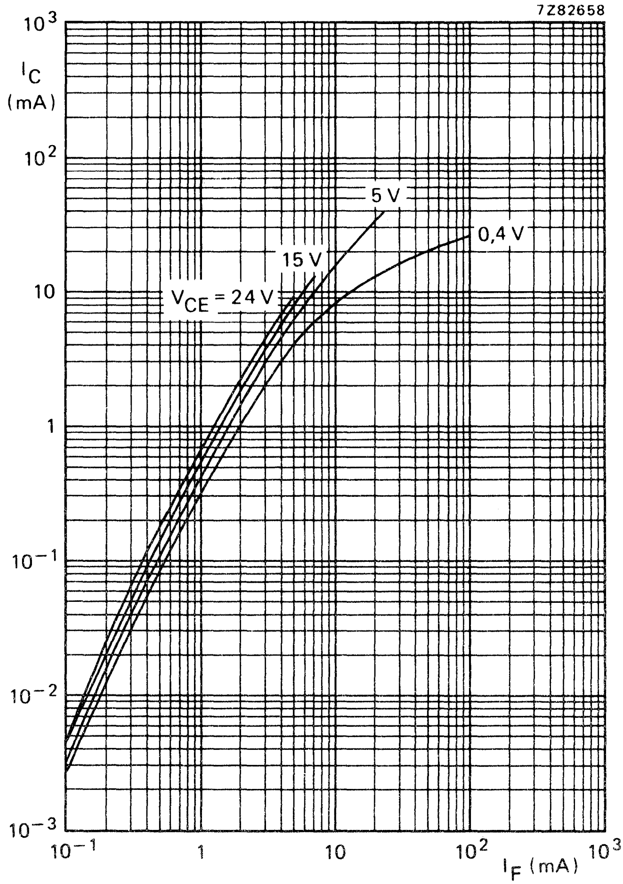


Fig. 13 T_{amb} = 25 °C, typical values.

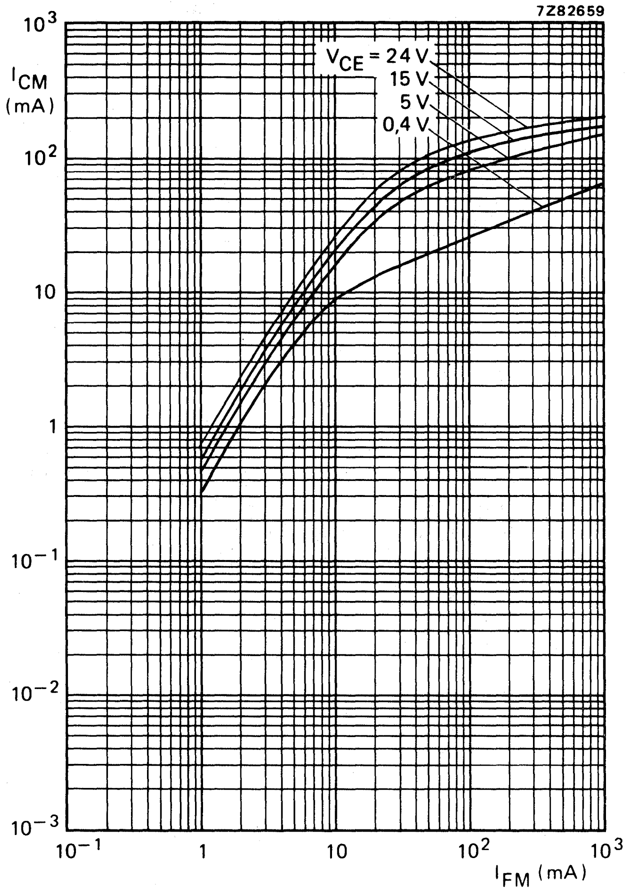


Fig. 14 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms; typical values.

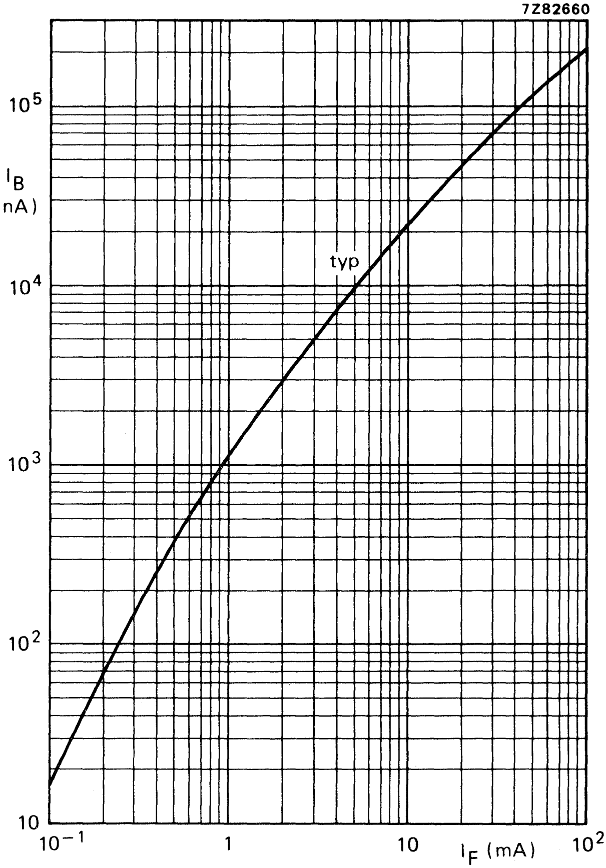


Fig. 15 V_{CB} = 5 V; T_{amb} = 25 °C.

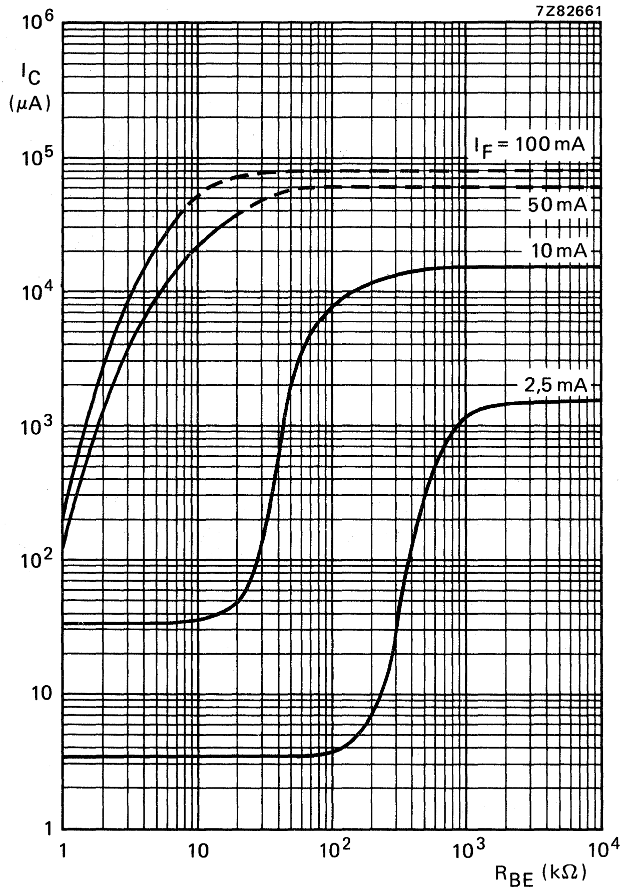


Fig. 16 $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

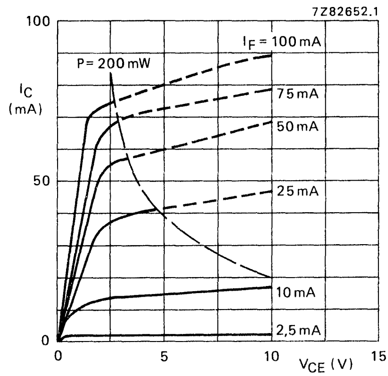


Fig. 17 T_{amb} = 25 °C; typical values.

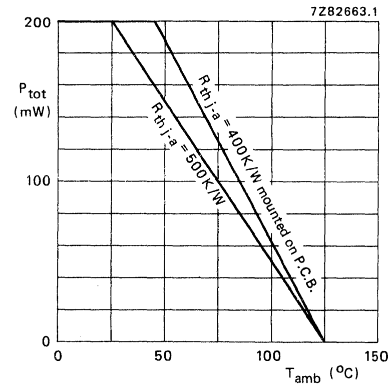


Fig. 18.

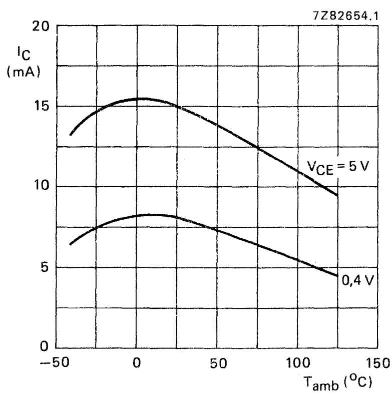


Fig. 19 I_F = 10 mA; typical values.

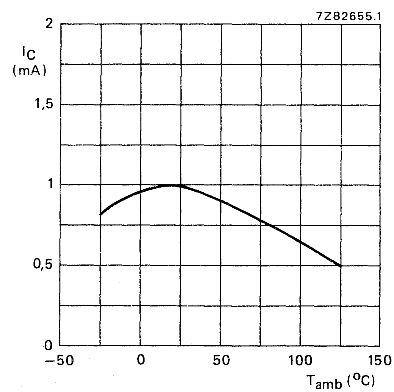


Fig. 20 I_F = 2 mA; V_{CE} = 0,4 V; typical values.

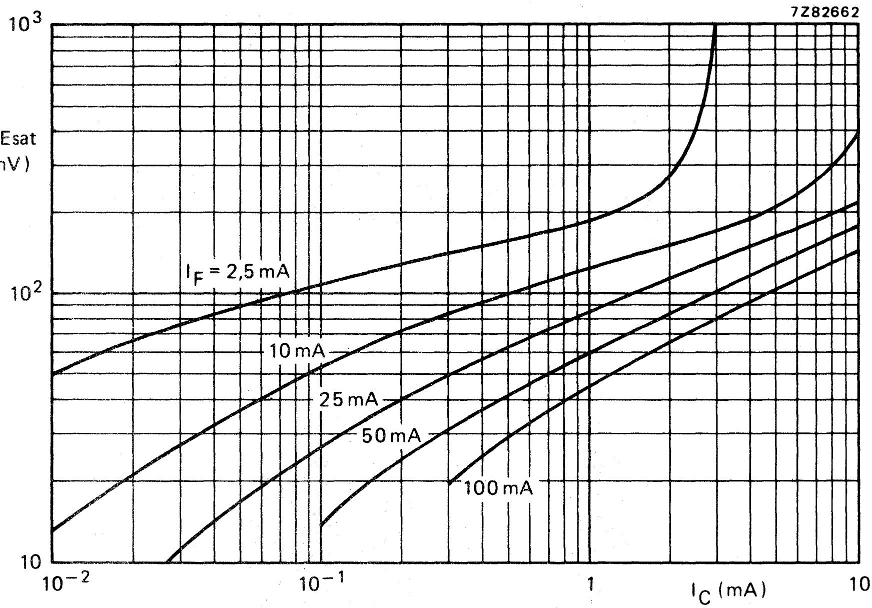


Fig. 21 $I_B = 0$; $T_{amb} = 25$ °C; typical values.

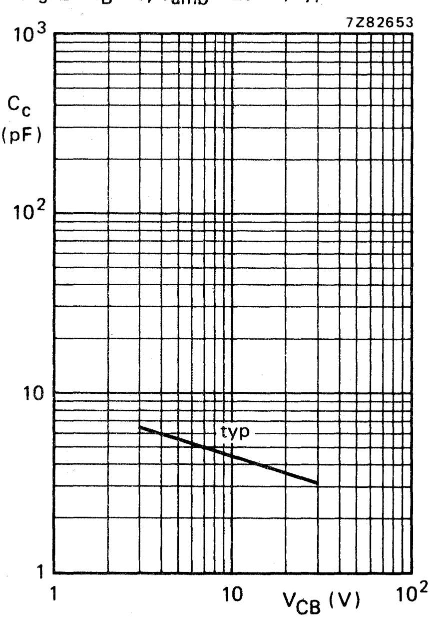


Fig. 22 f = 1 MHz; $T_{amb} = 25$ °C.

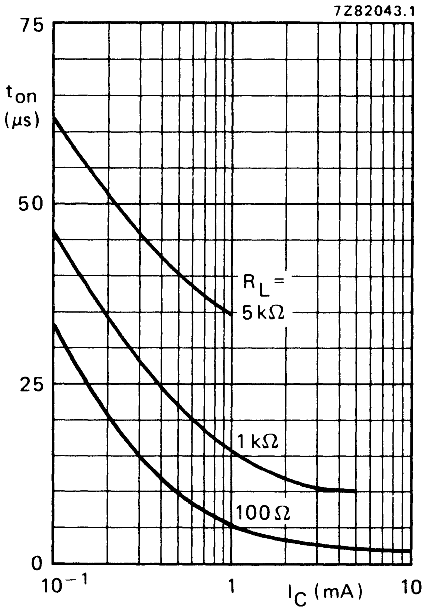


Fig. 23 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 25) CNX35.

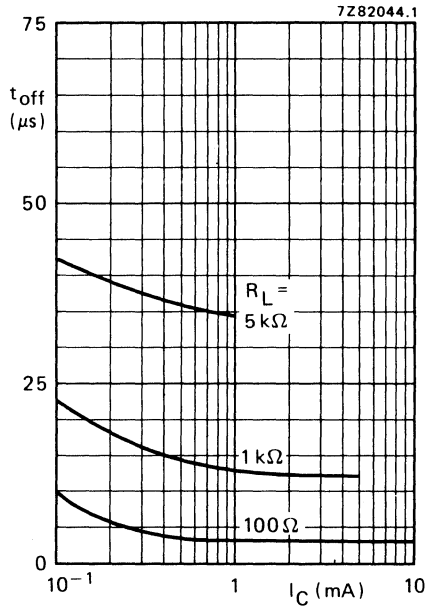


Fig. 24 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 25) CNX35.

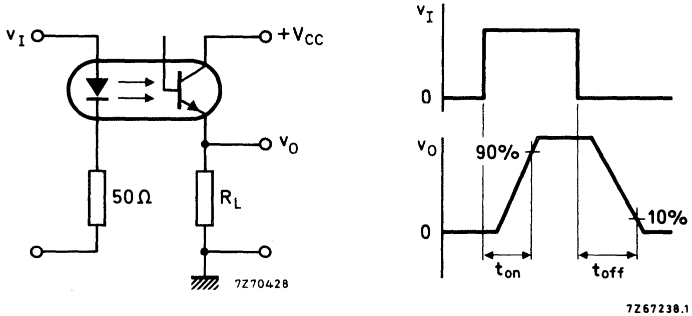


Fig. 25 Switching circuit and waveforms.

OPTOCOUPLERS

Optically coupled isolators consisting of an infrared emitting GaAs diode and a silicon n-p-n photo transistor with accessible base. Plastic envelopes. Suitable for TTL integrated circuits.

Features of these products:

- high output/input d.c. current transfer ratio;
- low saturation voltage;
- high isolation voltage of 3,12 kV (r.m.s.) and 4,4 kV (d.c.);
- working voltage 2,5 kV (d.c.)

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83
Complied for reinforced isolation at 250 VAC with:

DIN 57 804/VDE 0804/1.83 (isolation group C)
DIN IEC 65/VDE 0860/8.81

QUICK REFERENCE DATA

Diode				
Continuous reverse voltage		V_R	max.	5 V
Forward current				
d.c.		I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01		I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	200 mW
Transistor				
Collector-emitter voltage (open base)		V_{CEO}	max.	30 V
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	200 mW
Optocoupler				
Output/input d.c. current transfer ratio (C.T.R.)	**CNX35U**			0,4 to 0,9
I_F = 10 mA; V_{CE} = 0,4 V; (I_B = 0)	**CNX39U**	I_C/I_F		0,6 to 1,0
	CNX36U			0,8 to 2,0
Collector cut-off current (dark)				
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV				
diode: I_F = 0 (see also Fig. 2)		I_{CEW}	max.	200 nA
Isolation voltage (d.c.)		V_{IORM}	min.	4,4 kV

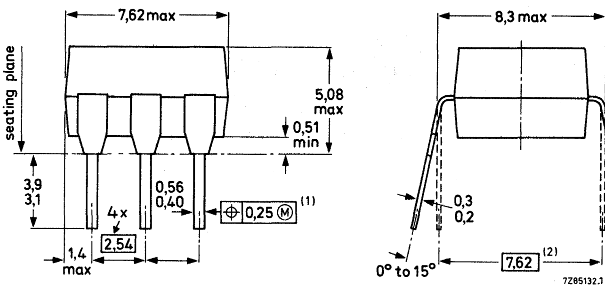
MECHANICAL DATA

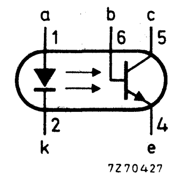
SOT-90B (see Fig. 1).

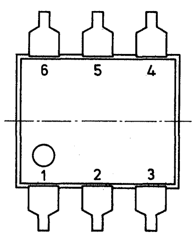
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode				
Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	70	V
Emitter-collector voltage (open base)	V_{ECO}	max.	7	V
Collector current (d.c.)	I_C	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Operating junction temperature	T_j	max.	125 °C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	=	500 K/W
transistor	$R_{th\ j\text{-}a}$	=	500 K/W
From junction to ambient, device mounted on a printed-circuit board			
diode	$R_{th\ j\text{-}a}$	=	400 K/W
transistor	$R_{th\ j\text{-}a}$	=	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2 mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)			KB-100/A

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,15 V
		max.	1,5 V
Reverse current V_R = 5 V	I_R	max.	10 μA

Transistor (I_F = 0)

Collector cut-off current (dark) V_{CE} = 10 V	I_{CEO}	typ.	2 nA
		max.	50 nA
V_{CE} = 10 V; T_{amb} = 70 °C	I_{CEO}	max.	10 μA
V_{CB} = 10 V	I_{CBO}	max.	20 nA
Collector-emitter breakdown voltage at I_C = 1 mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage at I_C = 0,1 mA	$V_{(BR)CBO}$	min.	70 V
Emitter-collector breakdown voltage at I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V

Optocoupler (I_B = 0)*

Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V	**CNX35U**	I_C/I_F	0,4 to 0,9
	CNX39U	I_C/I_F	0,6 to 1,0
	CNX36U	I_C/I_F	0,8 to 2,0

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

Output/input d.c. current transfer ratio (C.T.R.)				
I_F = 10 mA; V_{CE} = 5 V		I_C/I_F	typ.	1,5
Collector-emitter saturation voltage				
→ I_F = 10 mA; I_C = 2 mA	**CNX35U**	V_{CEsat}	max.	0,4
	CNX39U		typ.	0,15
I_F = 10 mA; I_C = 4 mA	**CNX36U**	V_{CEsat}	max.	0,4
			typ.	0,19
Isolation voltage, d.c. value**		V_{IORM}	min.	4,4 kV
Isolation voltage, r.m.s. value		V_{IORM}	min.	3,12 kV
Collector cut-off current (light) at T_{amb} = 0 °C to 70 °C				
V_F = 0,8 V; V_{CE} = 15 V		$I_{CE(L)}$	max.	15 μA
I_F = 2 mA; V_{CE} = 0,4 V		$I_{CE(L)}$	min.	150 μA
Collector capacitance at f = 1 MHz				
I_E = I_e = 0; V_{CB} = 10 V		C_{bc}	typ.	4,5 pF
Capacitance between input and output				
I_F = 0; V = 0; f = 1 MHz		C_{io}	typ.	0,6 pF
Insulation resistance between input and output				
± V_{IO} = 1 kV		r_{IO}	min.	10^{10} Ω
			typ.	10^{12} Ω

Switching times (see Figs 2 and 3)		CNX35U	CNX39U	CNX36U	
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ. 3	5,5	8	μs
Turn-off time	t_{off}	typ. 3	4	6	μs
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 1 kΩ					
Turn-on time	t_{on}	typ. 12	14	20	μs
Turn-off time	t_{off}	typ. 12	12	18	μs

Collector cut-off current (dark) see Fig. 4			
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV	I_{CEW}	max.	200 nA*
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV; T_j = 70 °C	I_{CEW}	max.	100 μA*

* As quality assurance (on a sample basis), these parameters are covered by a 1000 h reliability test.

** Every single product is tested by applying an isolation test voltage of 3750 Vac (rms) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

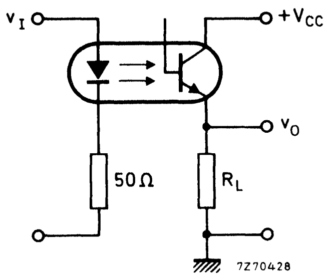


Fig. 2 Switching circuit.

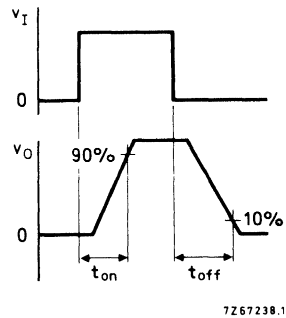


Fig. 3 Waveforms.

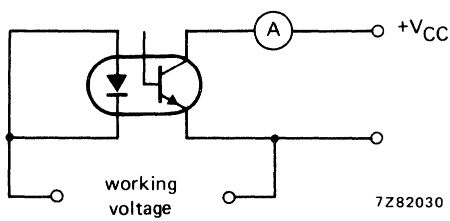


Fig. 4.

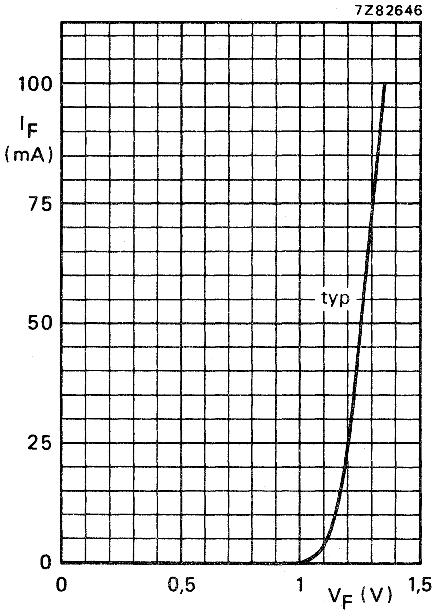


Fig. 5 T_{amb} = 25 °C.

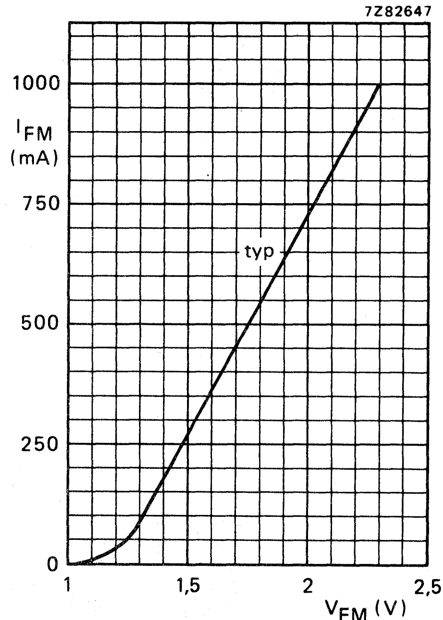


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms.

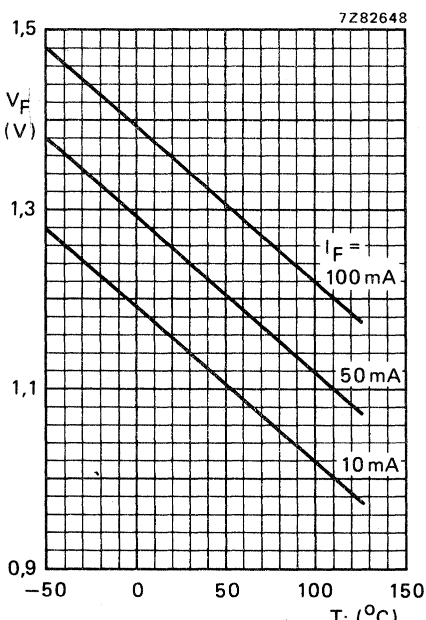


Fig. 7 Typical values.

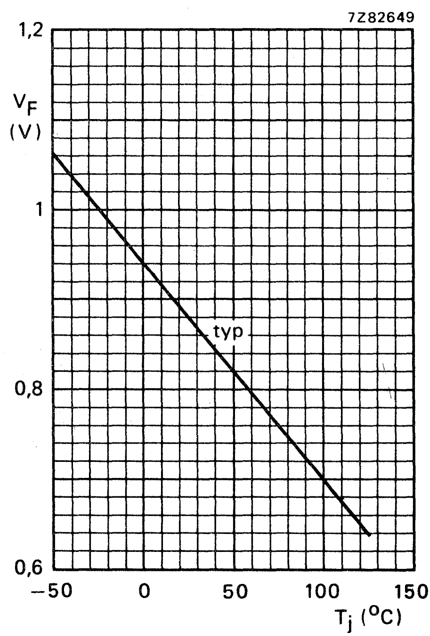


Fig. 8 I_F = 50 μA.

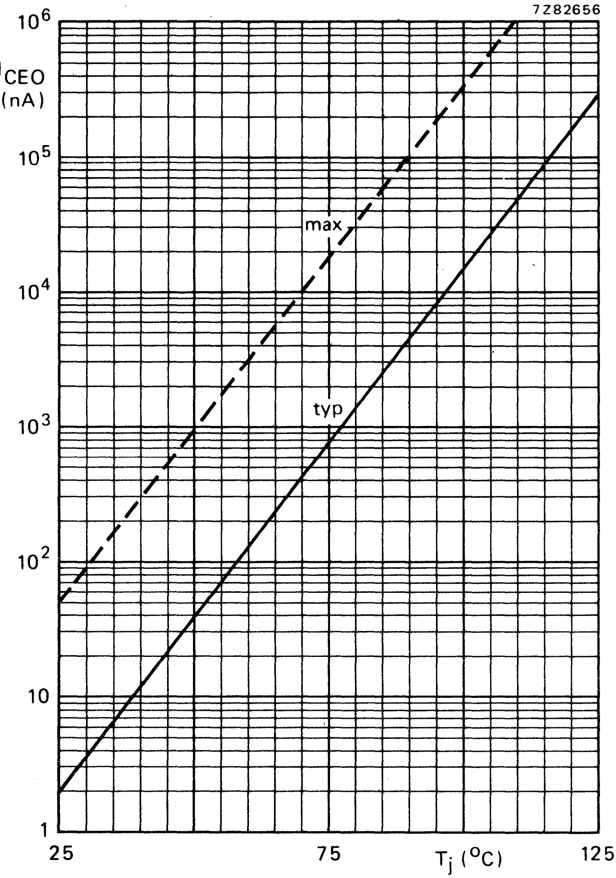


Fig. 9 $I_F = 0$; $V_{CE} = 10$ V.

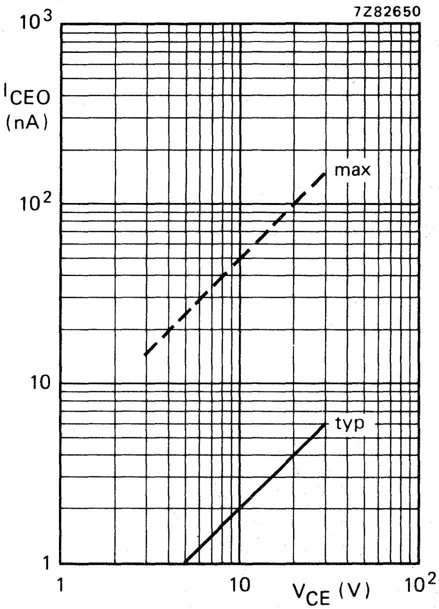


Fig. 10 $I_F = 0$; $T_j = 25\ ^oC$.

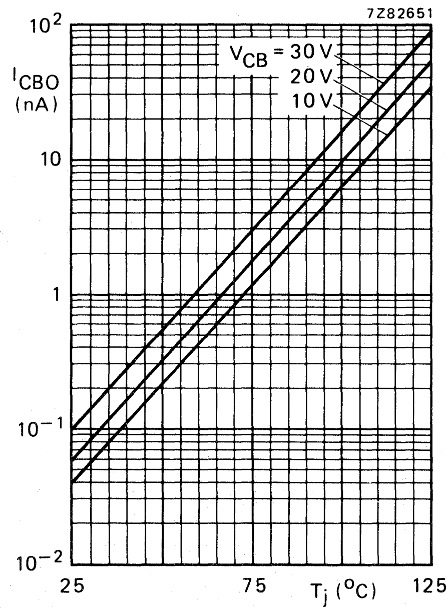


Fig. 11 Typical values.

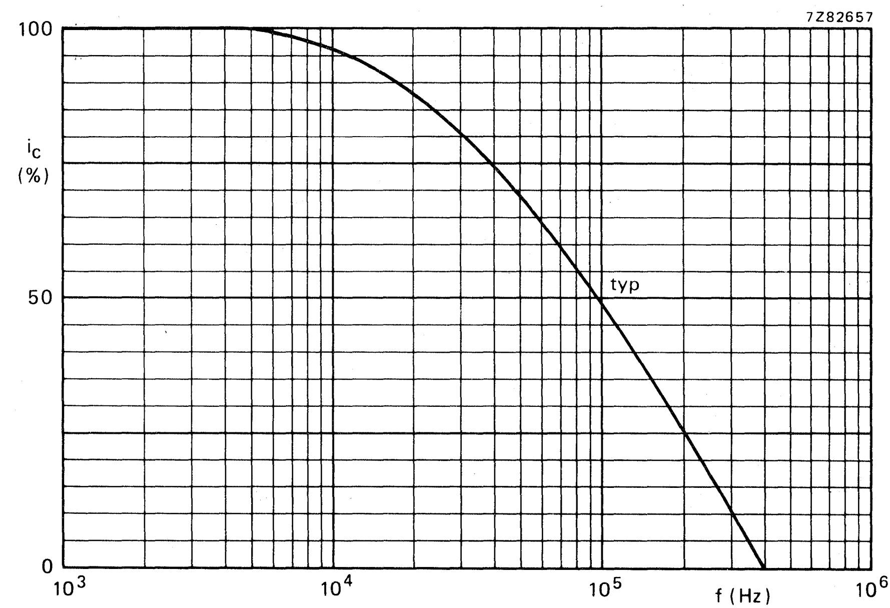


Fig. 12 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1\ k\Omega$; $T_{amb} = 25\ ^oC$.

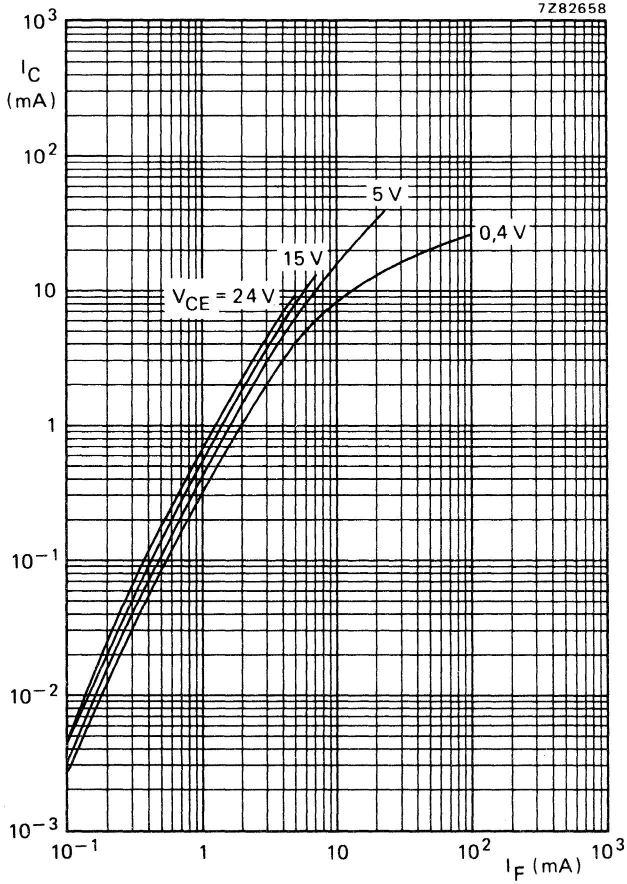


Fig. 13 T_{amb} = 25 °C, typical values.

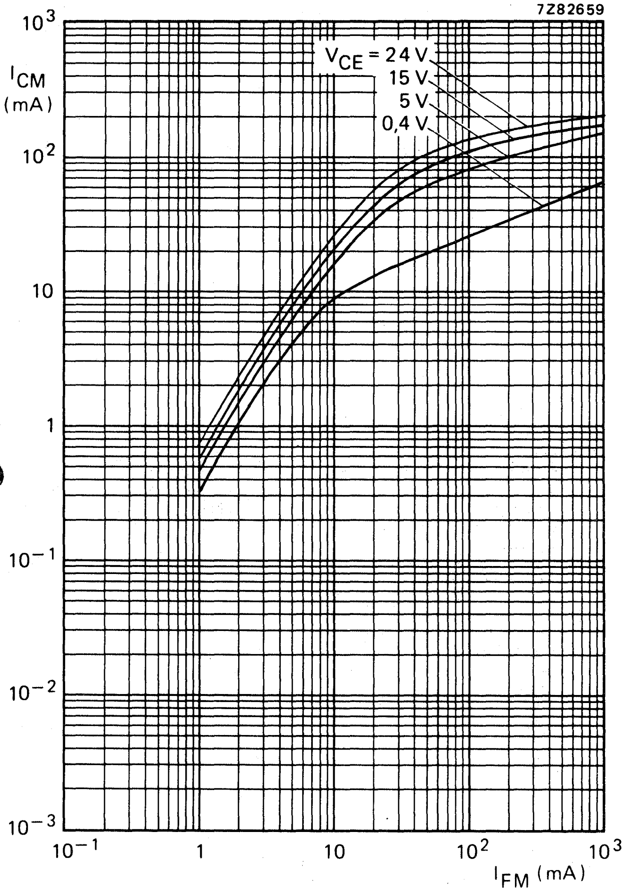


Fig. 14 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms; typical values.

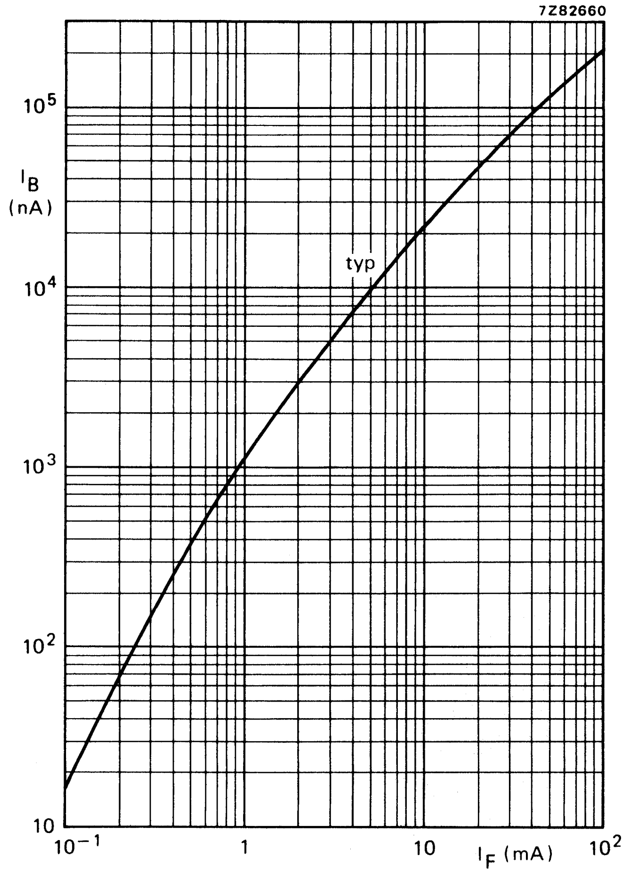


Fig. 15 V_{CB} = 5 V; T_{amb} = 25 °C.

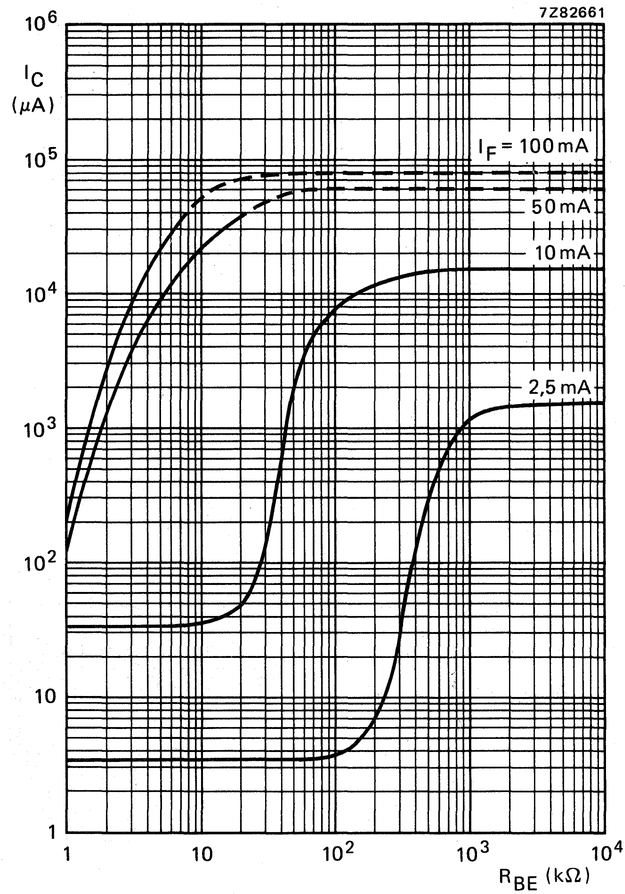


Fig. 16 $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

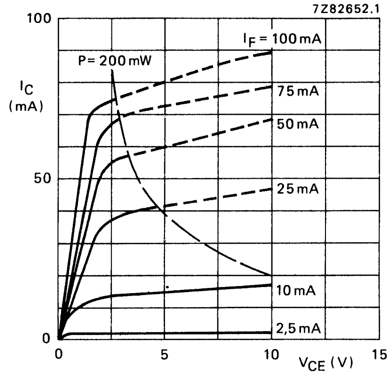


Fig. 17 T_{amb} = 25 °C; typical values.

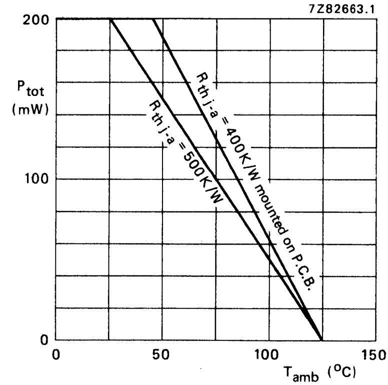


Fig. 18.

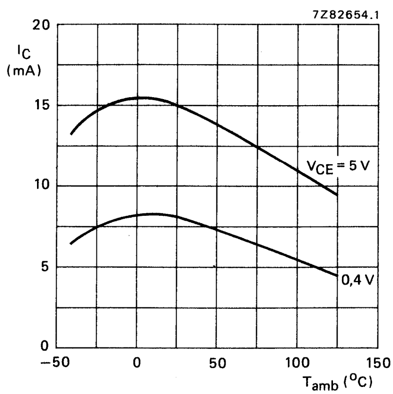


Fig. 19 I_F = 10 mA; typical values.

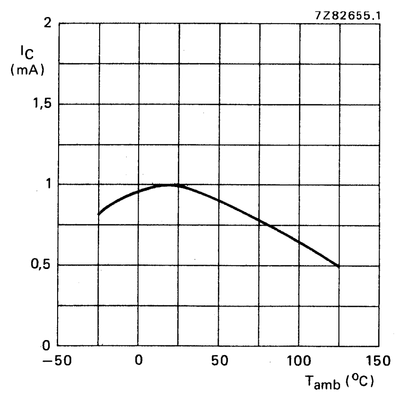


Fig. 20 I_F = 2 mA; V_{CE} = 0,4 V; typical values.

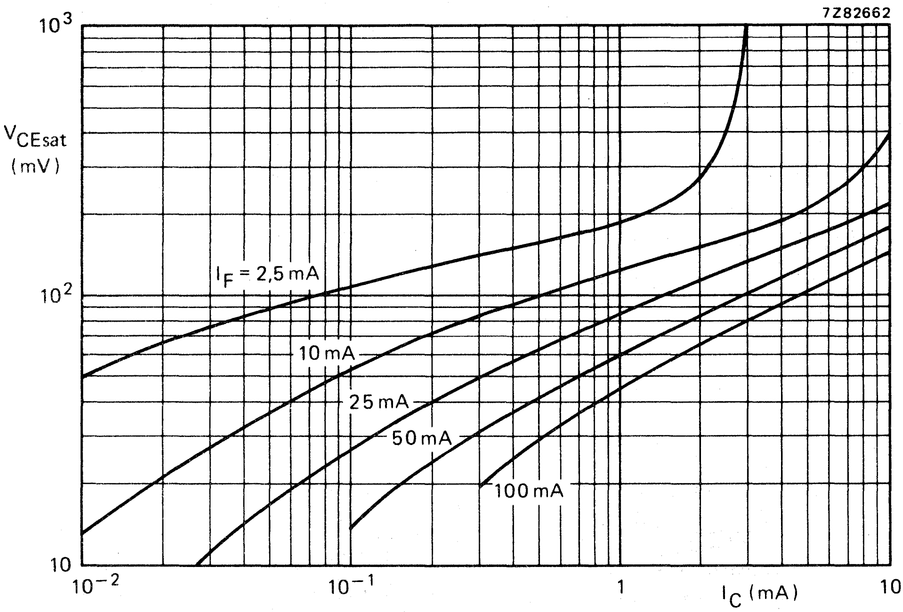


Fig. 21 $I_B = 0$; $T_{amb} = 25$ °C; typical values.

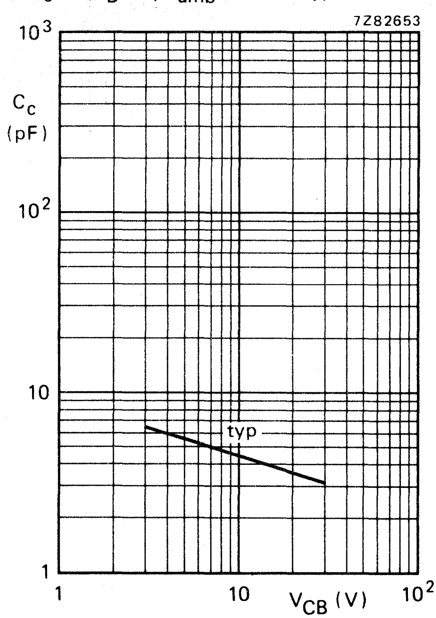


Fig. 22 f = 1 MHz; $T_{amb} = 25$ °C.

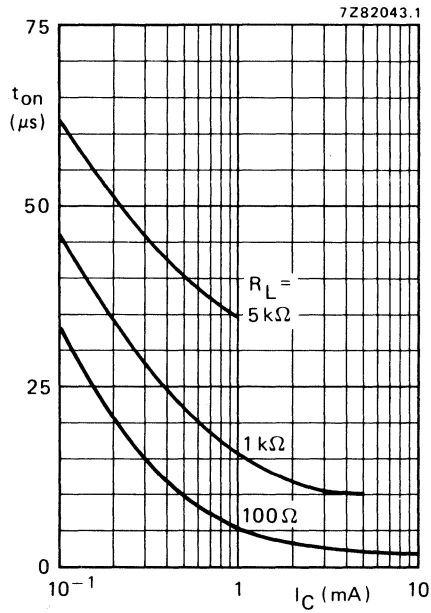


Fig. 23 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 25).

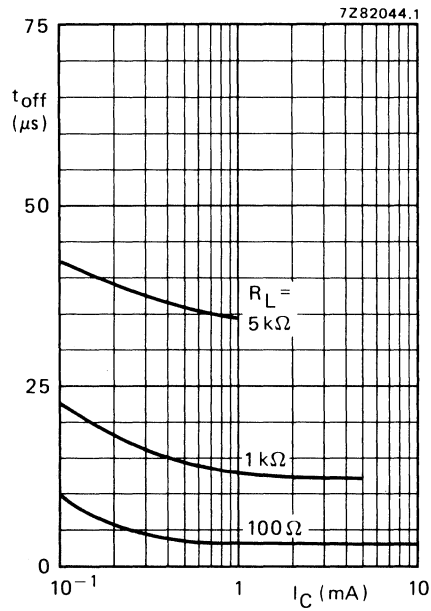


Fig. 24 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 25).

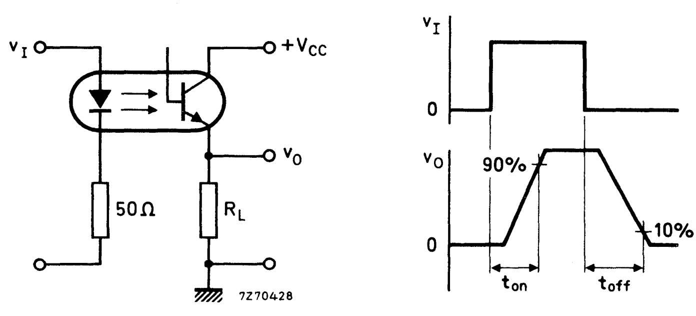


Fig. 25 Switching circuit and waveforms.

OPTOCOUPLER

Optically coupled isolator consisting of an infrared emitting GaAs diode and a silicon n-p-n photo-transistor with accessible base. Plastic envelope. Suitable for TTL integrated circuits.

Features of these products:

- high output/input d.c. current transfer ratio;
- low saturation voltage;
- high isolation voltage of 3,12 kV (r.m.s.) and 4,4 kV (d.c.);
- working voltage 2,5 kV (d.c.)

QUICK REFERENCE DATA

Diode				
Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 ^oC	P_{tot}	max.	200	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	80	V
Total power dissipation up to T_{amb} = 25 ^oC	P_{tot}	max.	200	mW
Optocoupler				
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 10 V; (I_B = 0)	I_C/I_F		0,7 to 2,1	
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV diode; I_F = 0 (see also Fig. 4)	I_{CEW}	max.	200	nA
Isolation voltage (d.c.)	V_{IORM}	min.	4,4	kV

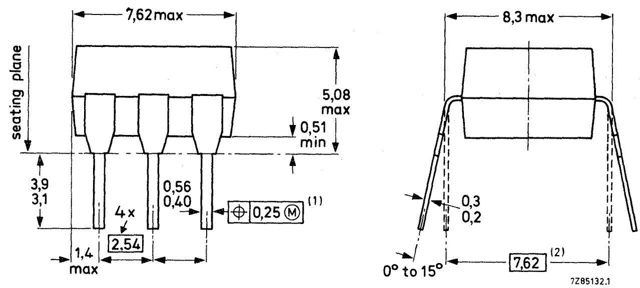
MECHANICAL DATA

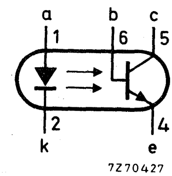
SOT-90B (see Fig. 1).

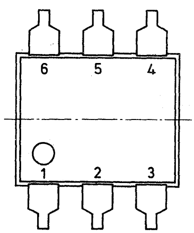
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Transistor			
Collector-base voltage (open emitter)	V_{CBO}	max.	120 V
Collector-emitter voltage (open base)	V_{CEO}	max.	80 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Operating junction temperature	T_j	max.	125 °C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	=	500 K/W
transistor	$R_{th\ j\text{-}a}$	=	500 K/W
From junction to ambient, device mounted on a printed-circuit board			
diode	$R_{th\ j\text{-}a}$	=	400 K/W
transistor	$R_{th\ j\text{-}a}$	=	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2 mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)			KB-100/A

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Diode

Forward voltage $I_F = 10$ mA	V_F	typ.	1,15 V
		<	1,5 V
Reverse current $V_R = 5$ V	I_R	<	10 μA

Transistor ($I_F = 0$)

Collector cut-off current (dark) $V_{CE} = 50$ V	I_{CEO}	typ.	2 nA
		<	50 nA
$V_{CE} = 50$ V; $T_{amb} = 70$ °C	I_{CEO}	<	10 μA
$V_{CB} = 10$ V; $T_{amb} = 25$ °C	I_{CBO}	<	20 nA
Collector-emitter breakdown voltage at $I_C = 1$ mA	$V_{(BR)CEO}$	min.	80 V
Collector-base breakdown voltage at $I_C = 0{,}1$ mA	$V_{(BR)CBO}$	min.	120 V
Emitter-collector breakdown voltage at $I_E = 0{,}1$ mA	$V_{(BR)ECO}$	min.	7 V

Optocoupler ($I_B = 0$)*

Output/input d.c. current transfer ratio (C.T.R.)			
$I_F = 10$ mA; $V_{CE} = 10$ V	I_C/I_F		0,7 to 2,1
$I_F = 16$ mA; $V_{CE} = 0,4$ V	I_C/I_F	>	0,5
Collector-emitter saturation voltage			
$I_F = 16$ mA; $I_C = 2$ mA	V_{CEsat}	typ.	0,2 V
		<	0,4 V
Isolation voltage **	V_{IORM}	min.	4,4 kV(d.c.)
			3,12 kV (r.m.s.)
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	4,5 pF
Capacitance between input and output			
$I_F = 0$; V = 0; f = 1 MHz	C_{io}	typ.	0,6 pF
Insulation resistance between input and output			
$\pm V_{IO} = 1$ kV	r_{IO}	>	10^{10} Ω
		typ.	10^{12} Ω
Switching times (see Figs 2 and 3)			
$I_{Con} = 4$ mA; $V_{CC} = 5$ V; $R_L = 100$ Ω			
Turn-on time	t_{on}	typ.	5 μs
Turn-off time	t_{off}	typ.	5 μs
$I_{Con} = 4$ mA; $V_{CC} = 5$ V; $R_L = 1$ kΩ			
Turn-on time	t_{on}	typ.	15 μs
Turn-off time	t_{off}	typ.	15 μs
Collector cut-off current			
$V_F = 0,8$ V; $-V_{CE} = 15$ V			
$T_{amb} = 0$ °C to +70 °C	I_{CE1}	max.	15 μA
Collector cut-off current			
at $I_F = 2$ mA; $-V_{CE} = 0,4$ V			
$T_{amb} = 0$ °C to +70 °C	I_{CE2}	min.	150 μA
Collector cut-off current (dark) see Fig. 4			
$V_{CC} = 10$ V; working voltage (d.c.) = 1,5 kV	I_{CEW}	<	200 nA▲
$V_{CC} = 10$ V; working voltage (d.c.) = 1,5 kV; $T_j = 70$ °C	I_{CEW}	<	100 μA▲

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

** Tested on a sample basis with a voltage of 4400 Vdc for 1 minute between the shorted input (diode) leads and the shorted output (phototransistor) leads.

▲ As quality assurance (on a sample basis), these parameters are covered by a 1000 h reliability test.

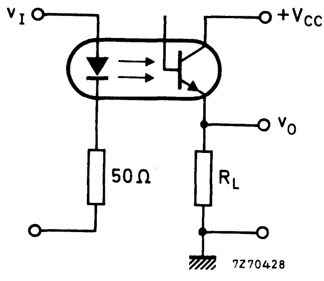


Fig. 2 Switching circuit.

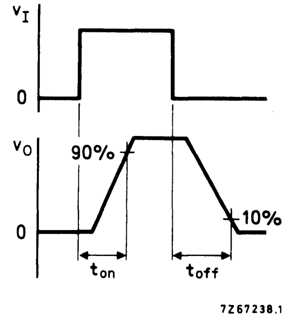


Fig. 3 Waveforms.

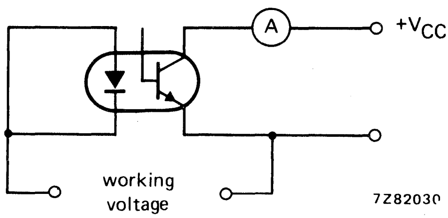


Fig. 4.

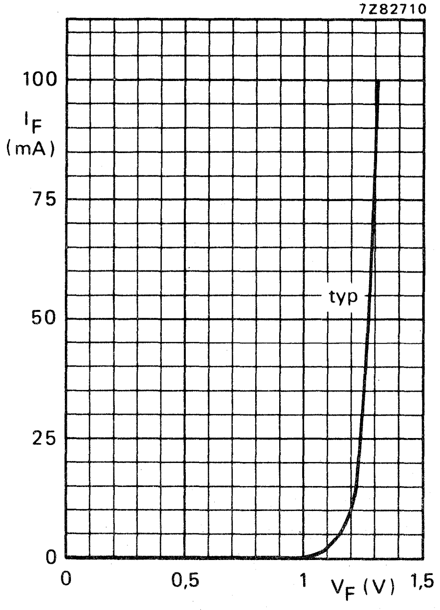


Fig. 5 T_{amb} = 25 °C.

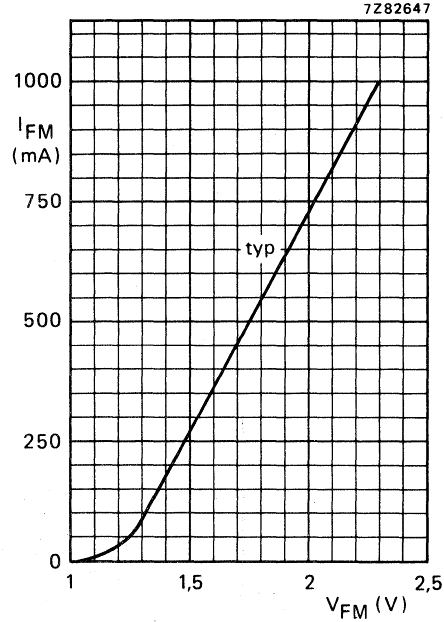


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms.

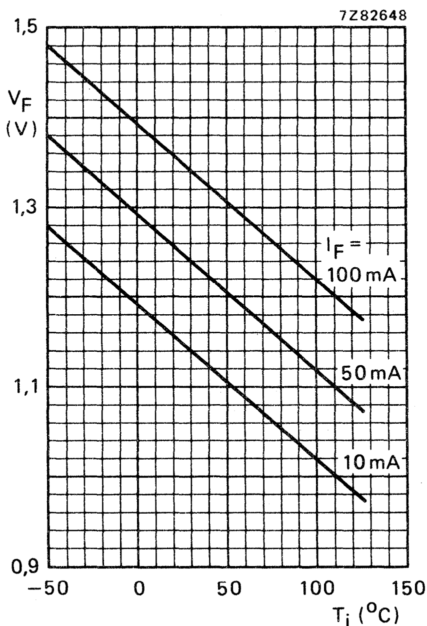


Fig. 7 Typical values.

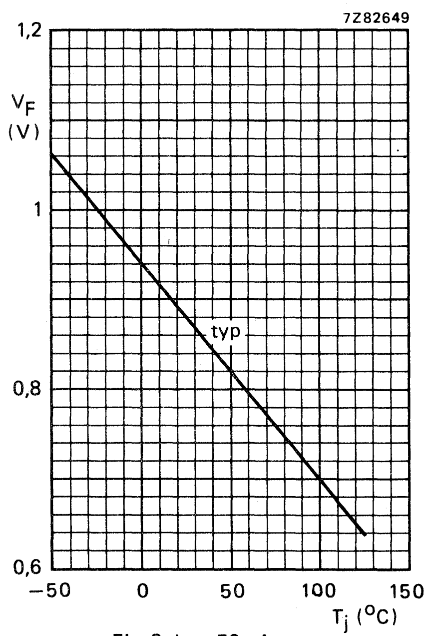


Fig. 8 I_F = 50 μA.

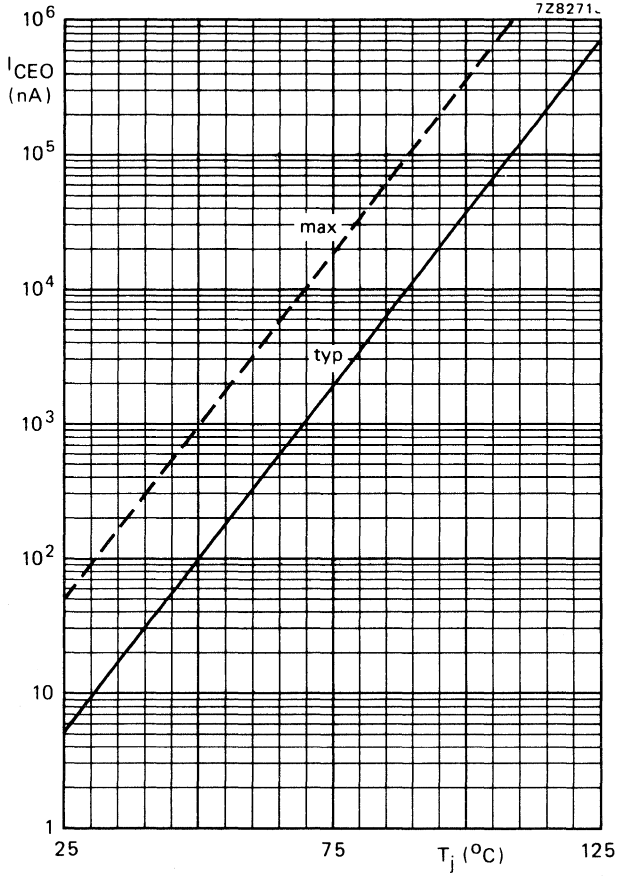


Fig. 9 $I_F = 0$; $V_{CE} = 10$ V.

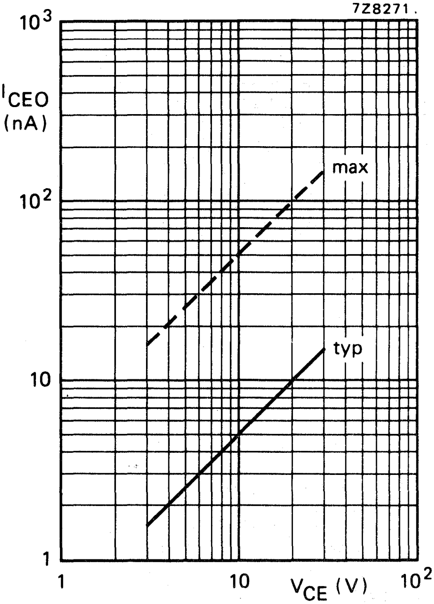


Fig. 10 $I_F = 0$; $T_j = 25$ °C.

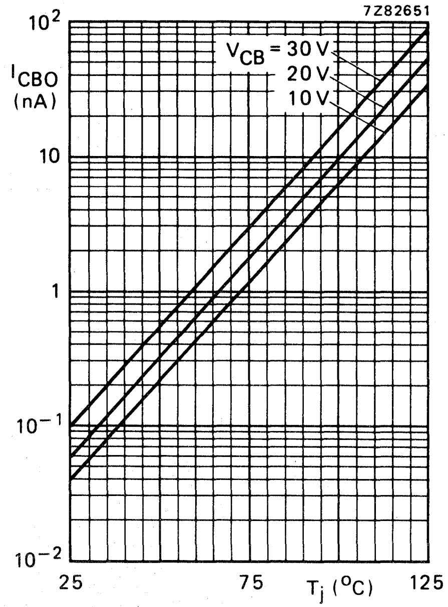


Fig. 11 Typical values.

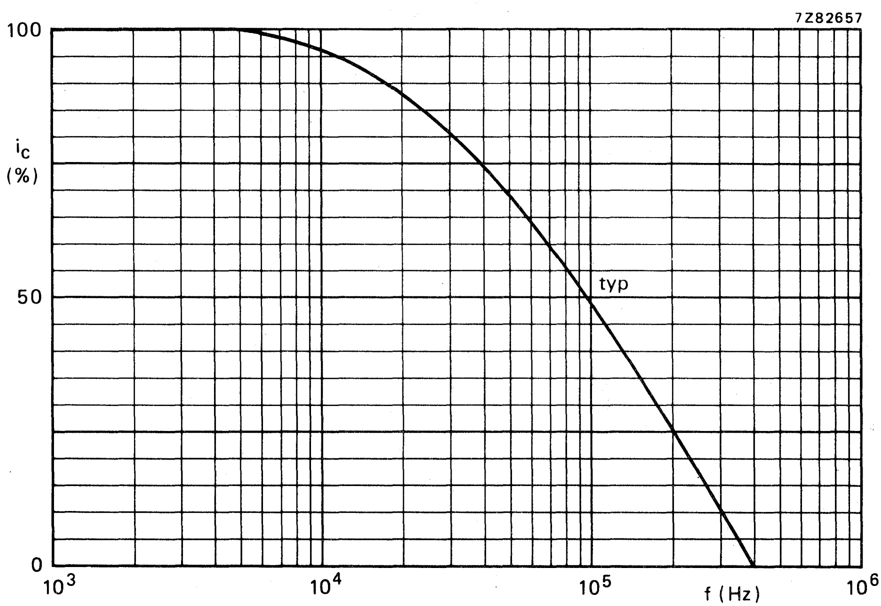


Fig. 12 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1$ kΩ; $T_{amb} = 25$ °C.

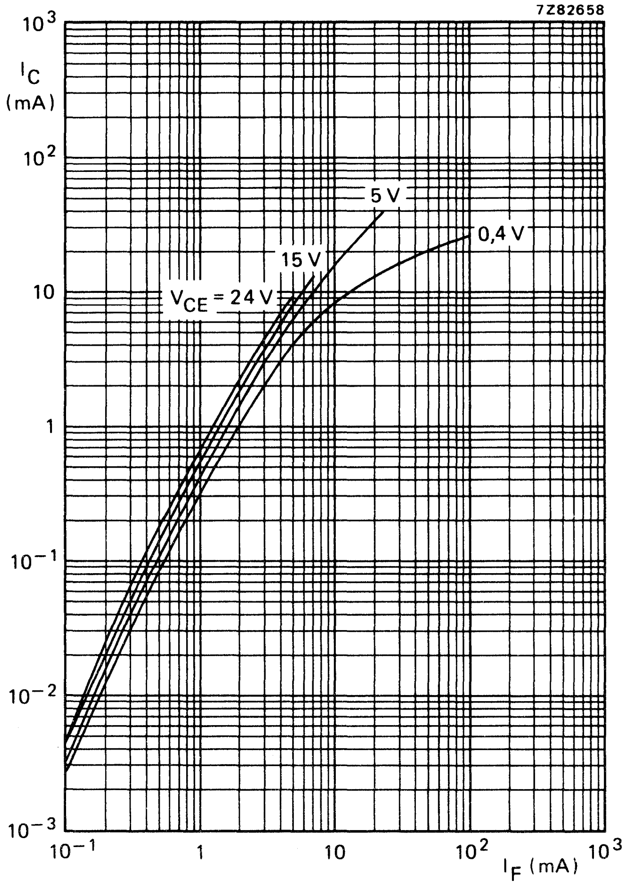


Fig. 13 T_{amb} = 25 °C, typical values.

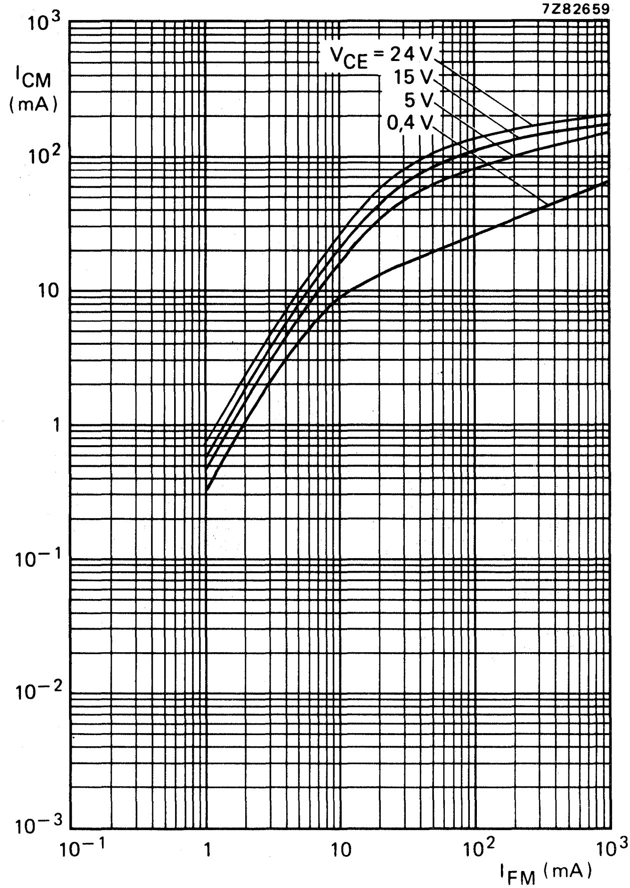


Fig. 14 T_{amb} = 25 °C; t_p = 20 μs; T = 2 ms; typical values.

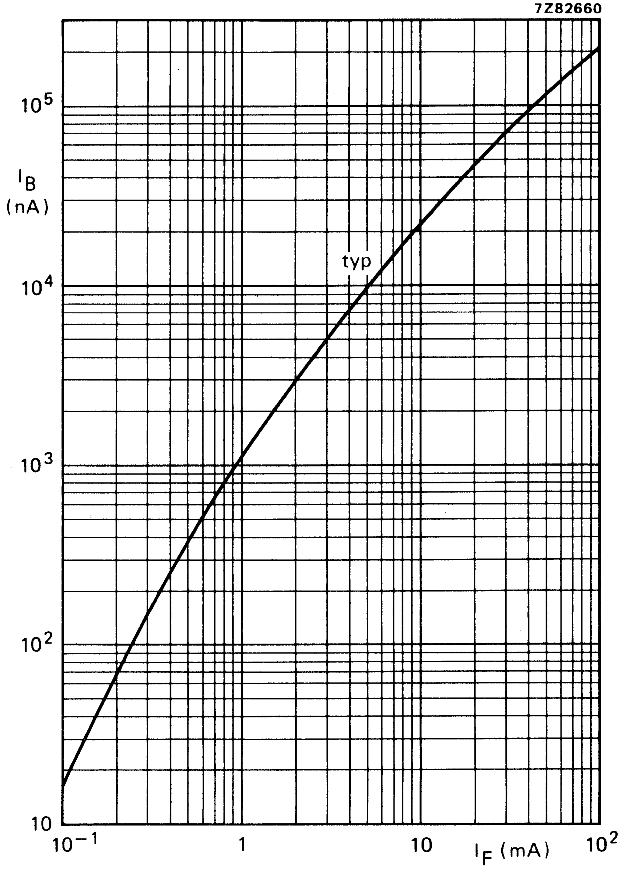


Fig. 15 V_{CB} = 5 V; T_{amb} = 25 °C.

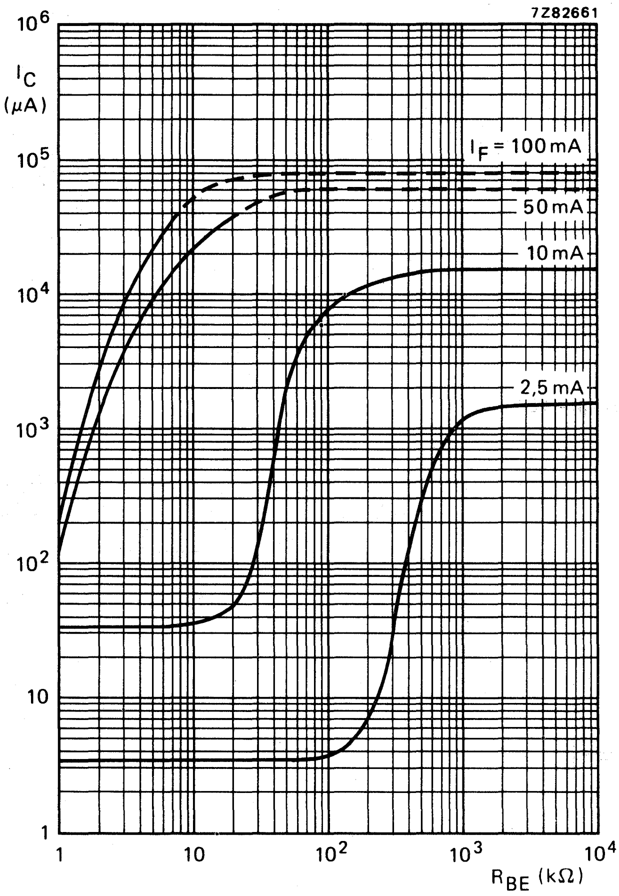


Fig. 16 $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

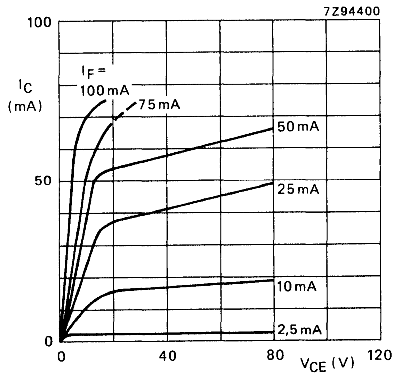


Fig. 17 T_{amb} = 25 °C; typical values.

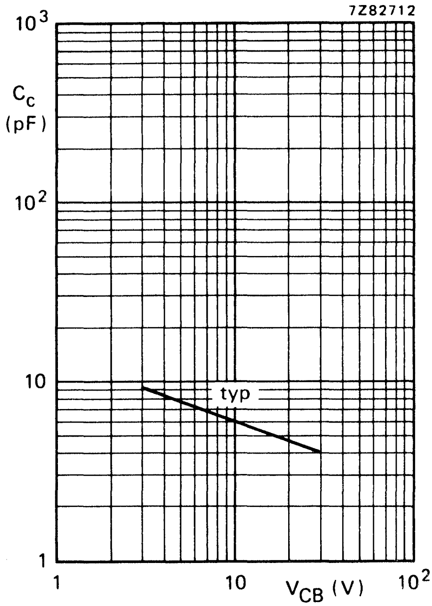


Fig. 18 f = 1 MHz; T_{amb} = 25 °C.

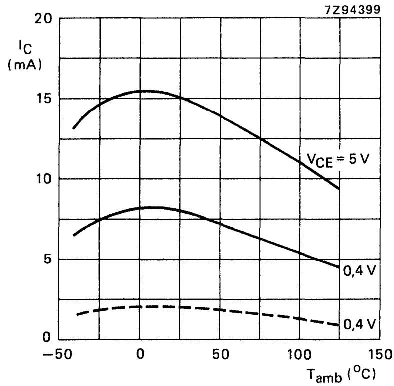


Fig. 19 I_F = 10 mA; typical values.

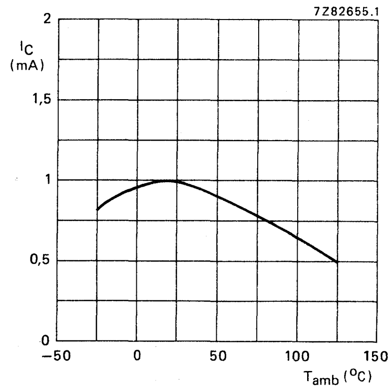


Fig. 20 I_F = 2 mA; typical values.

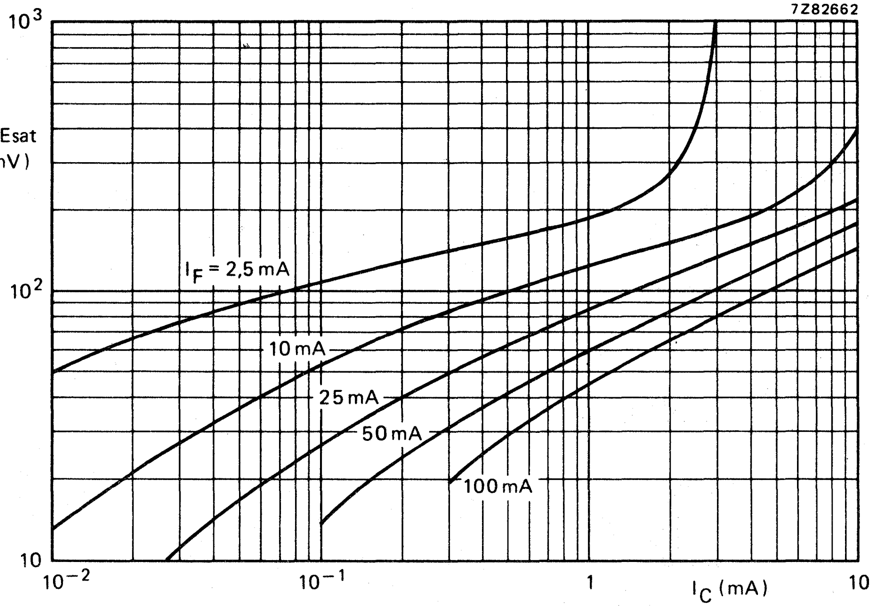


Fig. 21 $I_B = 0$; $T_{amb} = 25$ °C; typical values.

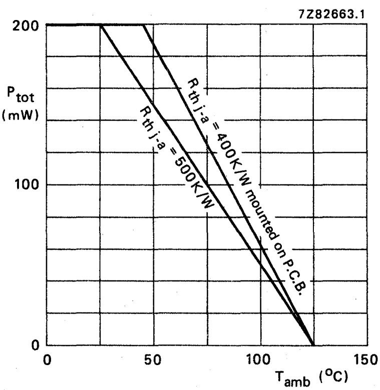


Fig. 22 Max. permissible power dissipation for total device versus ambient temperature.

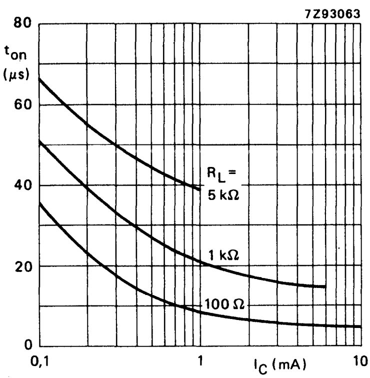


Fig. 23 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 25.)

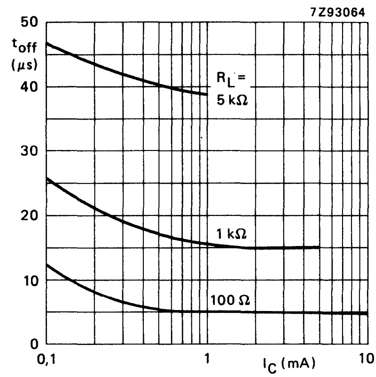


Fig. 24 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C, typical values. (See also Fig. 25.)

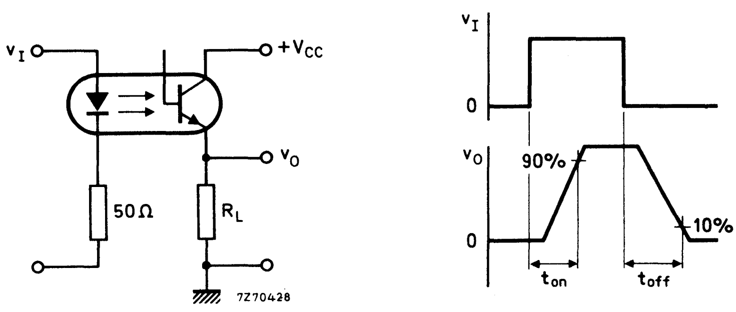


Fig. 25 Switching circuit and waveforms.

OPTOCOUPLER

Optically coupled isolator consisting of an infrared emitting GaAs diode and a high voltage silicon n-p-n phototransistor with assessible base. Plastic envelope. Suitable for TTL integrated circuits.

Features of this product:

- high output/input d.c. current transfer ratio;
- low saturation voltage;
- high isolation voltage of 3,12 kV (r.m.s.) and 4,4 kV (d.c.)
- working voltage 2,5 kV (d.c.)

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83
Complied for reinforced isolation at 250 VAC with:
DIN 57 804/VDE 0804/1.83 (isolation group C)
DIN IEC 65/VDE 0860/8.81

QUICK REFERENCE DATA

Diode				
Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	80	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Optocoupler				
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 10 V; (I_B = 0)	I_C/I_F		0,7 to 2,1	
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV diode; I_F = 0 (see also Fig. 4)	I_{CEW}	max.	200	nA
Isolation voltage (d.c.)	V_{IORM}	min.	4,4	kV

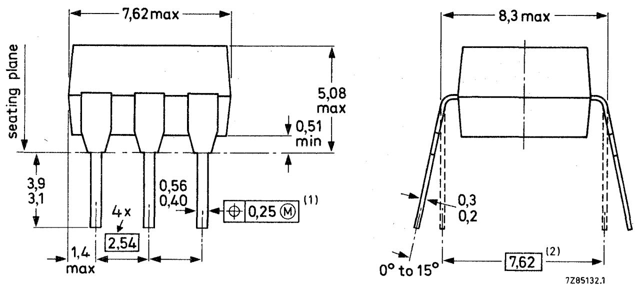
MECHANICAL DATA

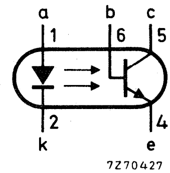
SOT-90B (see Fig. 1).

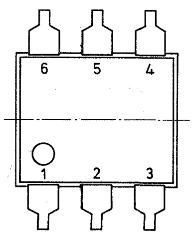
MECHANICAL DATA

Dimensions in mm

→ Fig. 1 SOT-90B.







⌖ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode			
→ Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Transistor			
Collector-base voltage (open emitter)	V_{CBO}	max.	120 V
Collector-emitter voltage (open base)	V_{CEO}	max.	80 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150	°C
Operating junction temperature	T_j	max.	125	°C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260	°C

THERMAL RESISTANCE

From junction to ambient in free air				
diode	$R_{th\ j\text{-}a}$	=	500	K/W
transistor	$R_{th\ j\text{-}a}$	=	500	K/W
From junction to ambient, device mounted on a printed-circuit board				
diode	$R_{th\ j\text{-}a}$	=	400	K/W
transistor	$R_{th\ j\text{-}a}$	=	400	K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2	mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0	mm
Tracking resistance (KB-value)			KB-100/A	

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,15	V
		<	1,5	V
Reverse current V_R = 5 V	I_R	<	10	μA

Transistor (I_F = 0)

Collector cut-off current (dark) V_{CE} = 50 V	I_{CEO}	typ.	2	nA
		<	50	nA
V_{CE} = 50V; T_{amb} = 70 °C	I_{CEO}	<	10	μA
V_{CB} = 10 V; T_{amb} = 25 °C	I_{CBO}	<	20	nA
Collector-emitter breakdown voltage at I_C = 1 mA	$V_{(BR)CEO}$	min.	80	V
Collector-base breakdown voltage at I_C = 0,1 mA	$V_{(BR)CBO}$	min.	120	V
Emitter-collector breakdown voltage at I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7	V

Optocoupler (I_B = 0)*

Output/input d.c. current transfer ratio (C.T.R.)			
I_F = 10 mA; V_{CE} = 10 V	I_C/I_F		0,7 to 2,1
I_F = 16 mA; V_{CE} = 0,4 V	I_C/I_F	>	0,5
Collector-emitter saturation voltage		typ.	0,2 V
I_F = 16 mA; I_C = 2 mA	V_{CEsat}	<	0,4 V
Isolation voltage**	V_{IORM}	min.	4,4 kV(d.c.) 3,12 kV(r.m.s.)
Collector capacitance at f = 1 MHz			
$I_E = I_e$ = 0; V_{CB} = 10 V	C_c	typ.	4,5 pF
Capacitance between input and output			
I_F = 0; V = 0; f = 1 MHz	C_{io}	typ.	0,6 pF
Insulation resistance between input and output		>	10^{11} Ω
± V_{IO} = 1 kV	r_{IO}	typ.	10^{12} Ω
Switching times (see Figs 2 and 3)			
I_{Con} = 4 mA; V_{CC} = 5 V; R_L = 100 Ω			
Turn-on time	t_{on}	typ.	5 μs
Turn-off time	t_{off}	typ.	5 μs
I_{Con} = 4 mA; V_{CC} = 5 V; R_L = 1 kΩ			
Turn-on time	t_{on}	typ.	15 μs
Turn-off time	t_{off}	typ.	15 μs
Collector cut-off current			
V_F = 0,8 V; $-V_{CE}$ = 15 V			
T_{amb} = 0 °C to + 70 °C	I_{CE1}	max.	15 μA
Collector cut-off current			
at I_F = 2 mA; $-V_{CE}$ = 0,4 V			
T_{amb} = 0 °C to + 70 °C	I_{CE2}	min.	150 μA
Collector cut-off current (dark) see Fig. 4			
V_{CC} = 10 V; working voltage (d.c.) = 1,5 kV	I_{CEW}	<	200 nA ▲
V_{CC} = 10 V; working voltage (d.c.) = 1,5 kV; T_j = 70 °C	I_{CEW}	<	100 μA ▲

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

** Every single product is tested by applying an isolation test voltage of 3750 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

▲ As quality assurance (on a sample basis), these parameters are covered by a 1000 h reliability test.

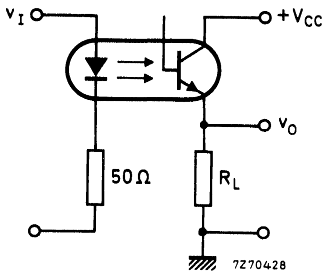


Fig. 2 Switching circuit.

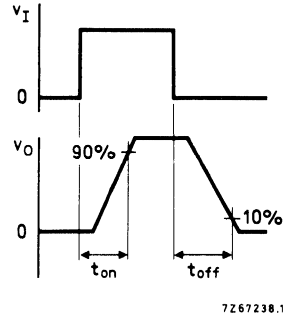


Fig. 3 Waveforms.

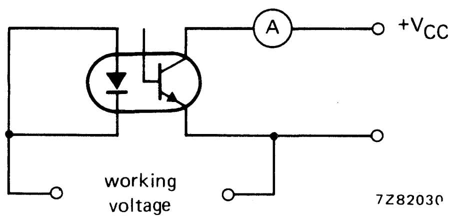


Fig. 4.

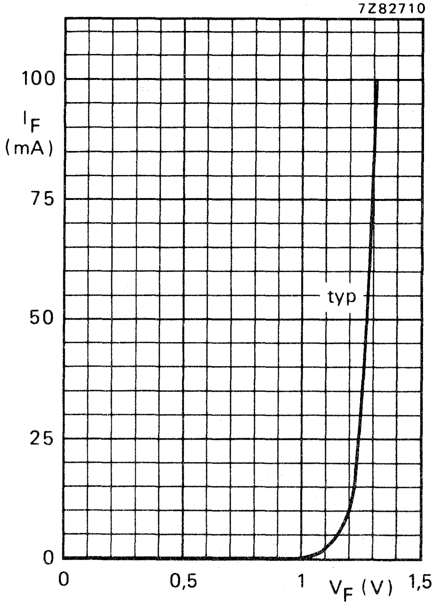


Fig. 5 T_{amb} = 25 °C.

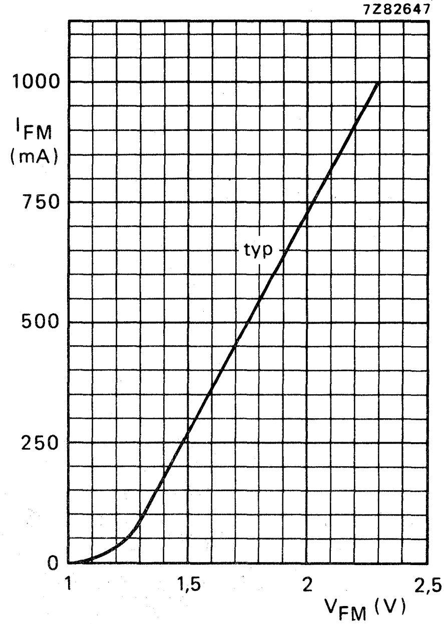


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms.

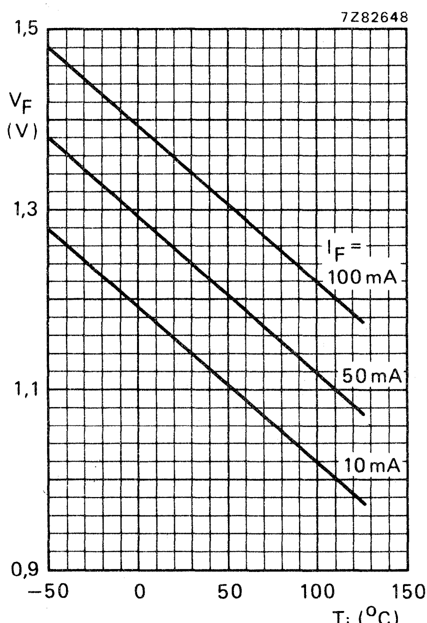


Fig. 7 Typical values.

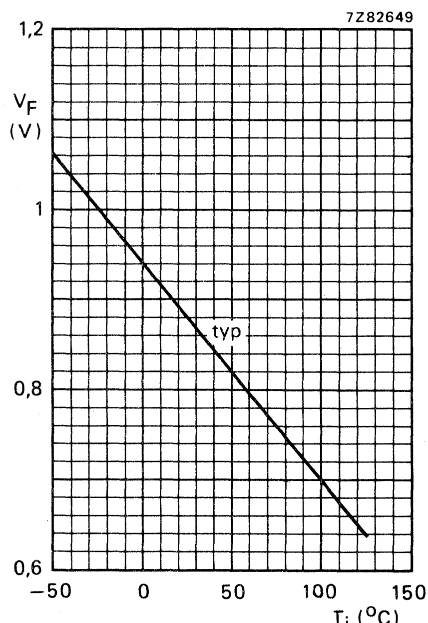


Fig. 8 I_F = 50 μA.

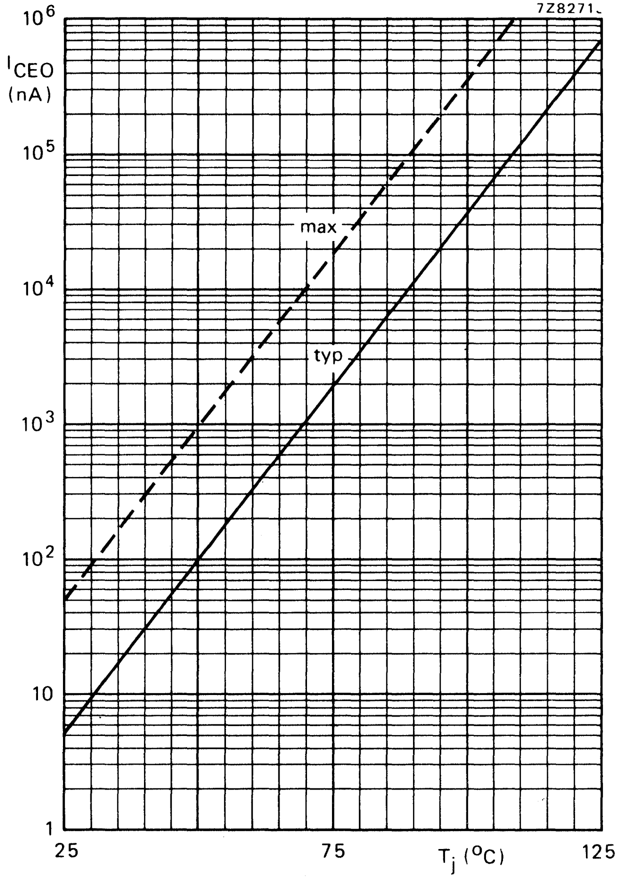


Fig. 9 $I_F = 0$; $V_{CE} = 10$ V.

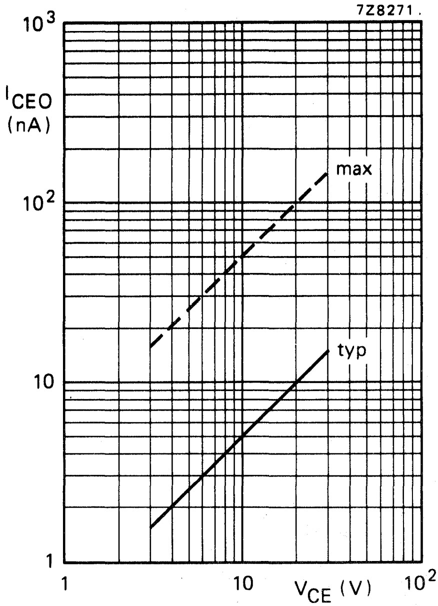


Fig. 10 $I_F = 0$; $T_j = 25$ °C.

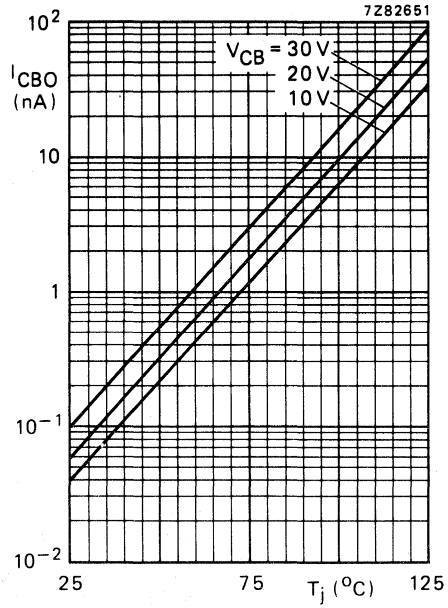


Fig. 11 Typical values.

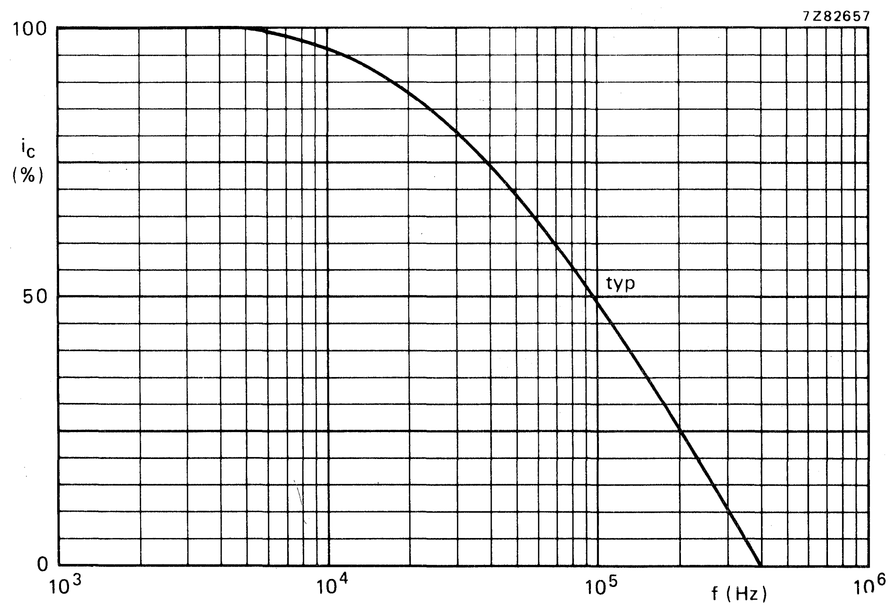


Fig. 12 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1$ kΩ; $T_{amb} = 25$ °C.

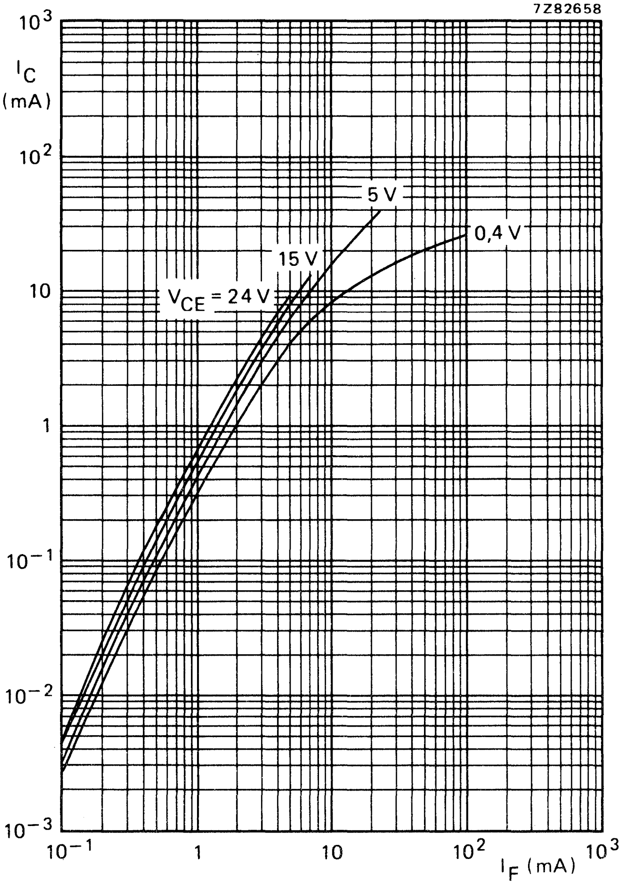


Fig. 13 T_{amb} = 25 °C, typical values.

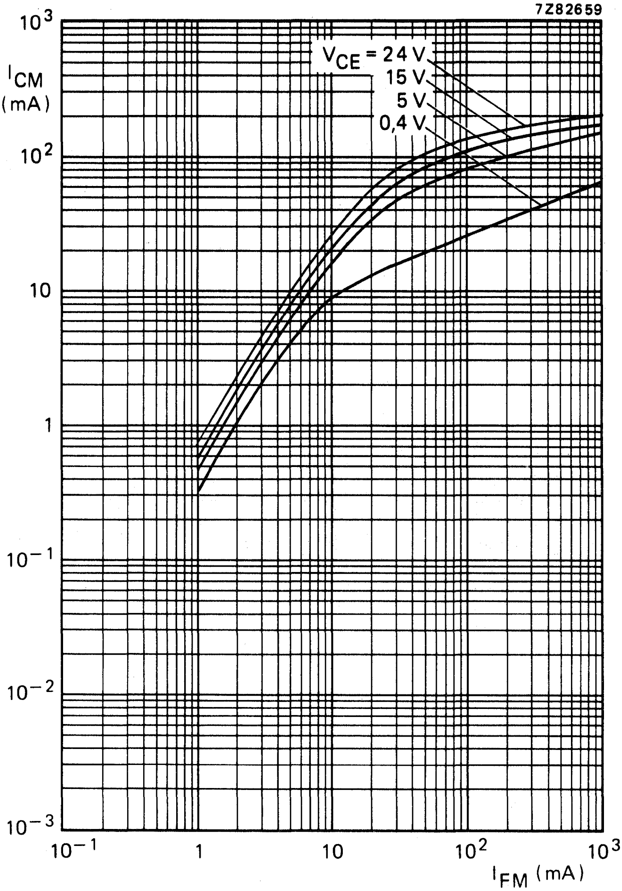


Fig. 14 T_{amb} = 25 °C; t_p = 20 μs; T = 2 ms; typical values.

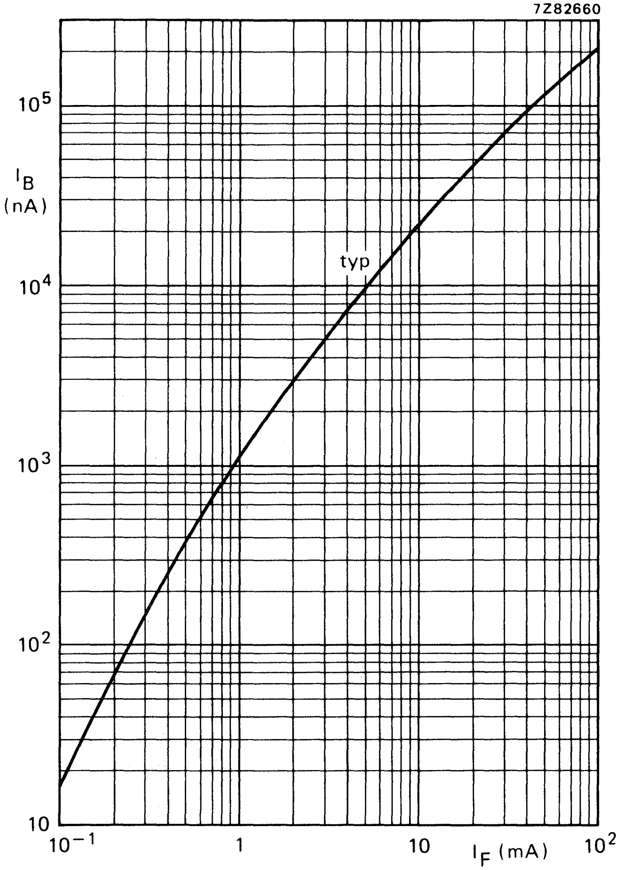


Fig. 15 V_{CB} = 5 V; T_{amb} = 25 °C.

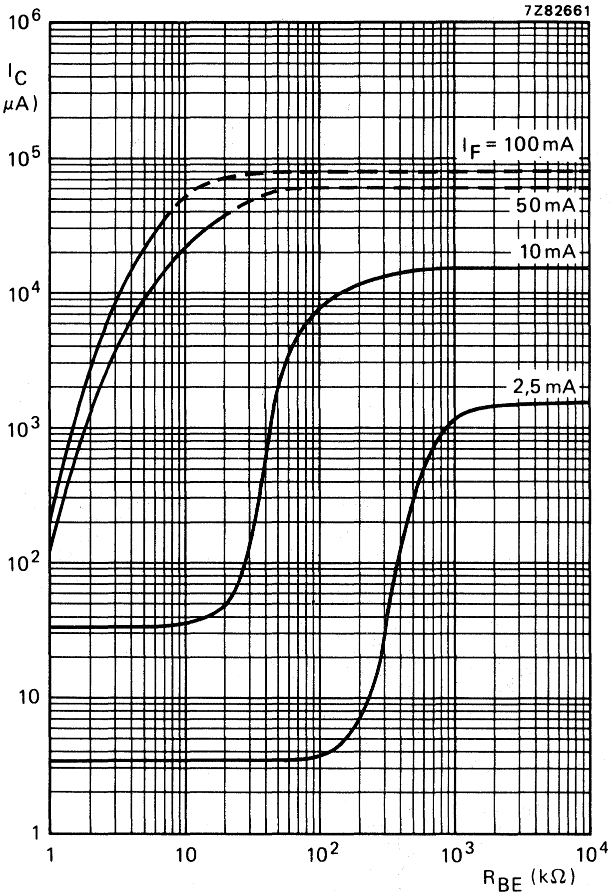


Fig. 16 $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

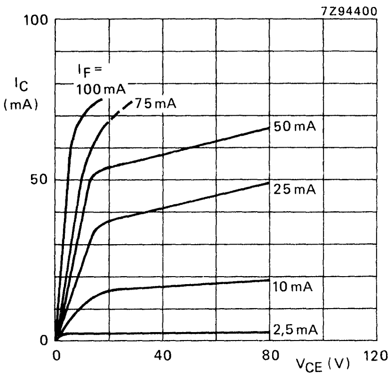


Fig. 17 T_{amb} = 25 °C; typical values.

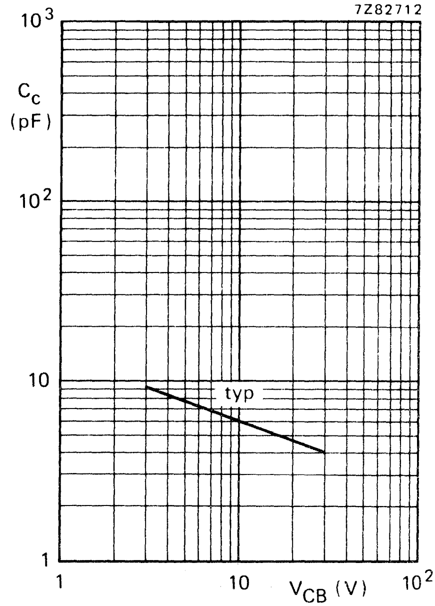


Fig. 18 f = 1 MHz; T_{amb} = 25 °C.

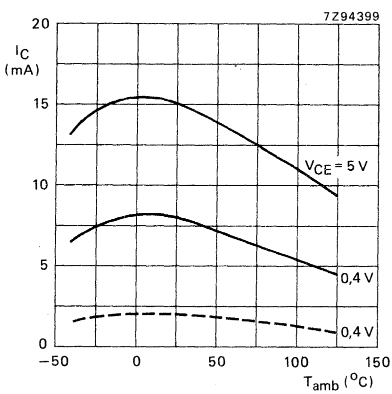


Fig. 19 I_F = 10 mA; typical values.

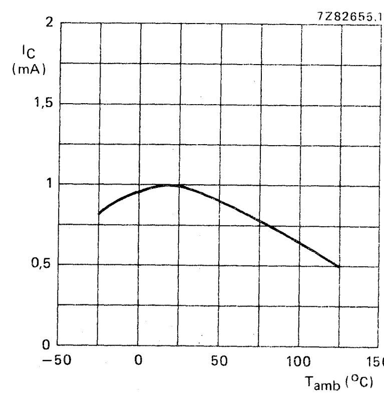


Fig. 20 I_F = 2 mA; typical values.

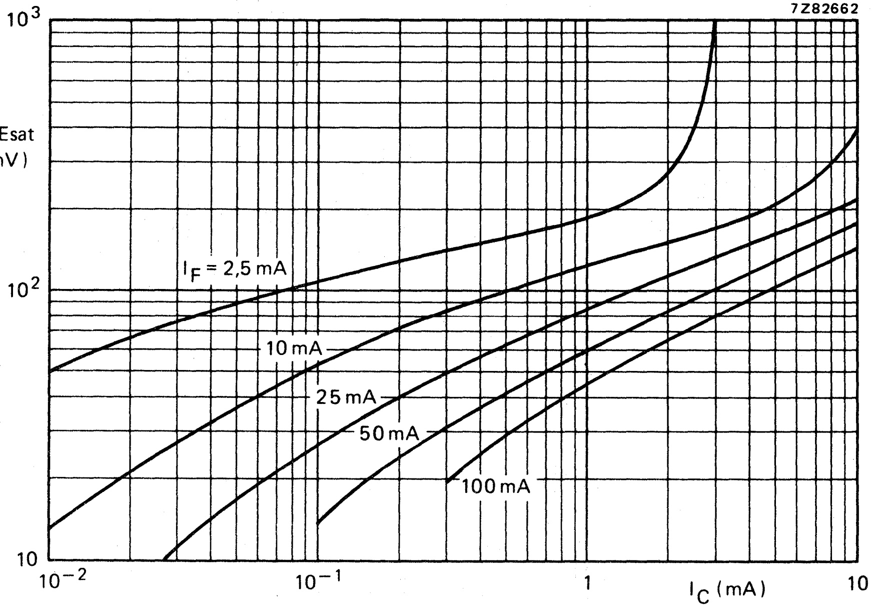


Fig. 21 $I_B = 0$; $T_{amb} = 25$ °C; typical values.

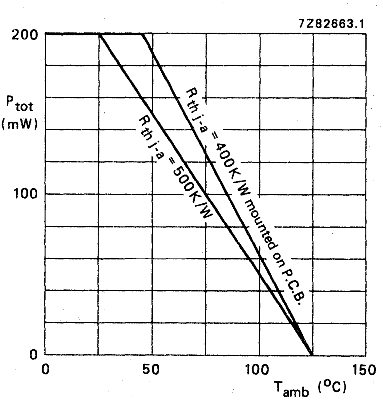


Fig. 22 Max. permissible power dissipation for total device versus ambient temperature.

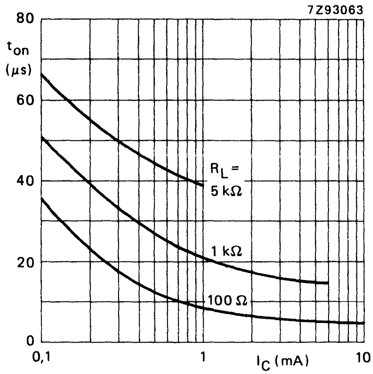


Fig. 23 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 25.)

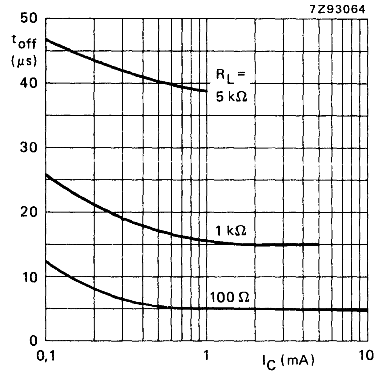


Fig. 24 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C, typical values. (See also Fig. 25.)

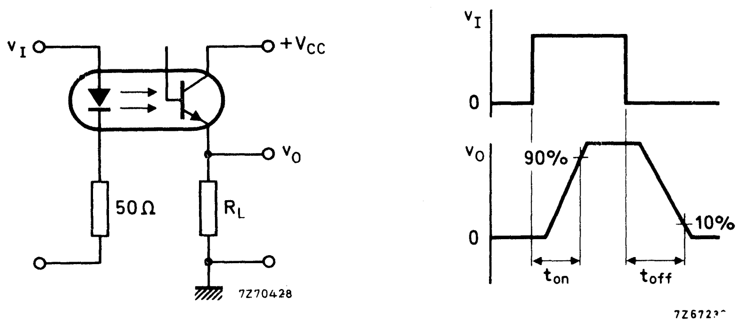


Fig. 25 Switching circuit and waveforms.

OPTOCOUPLER

Opto-isolator comprising an infrared emitting GaAs diode and a silicon n-p-n Darlington phototransistor with accessible base. Plastic 6-lead dual-in line (DIL) envelope.

Features:

- very high output/input d.c. current transfer ratio;
- high isolation voltage of 3,12 kV (r.m.s.) and 4,4 kV (d.c.);
- working voltage 2,5 kV (d.c.)

QUICK REFERENCE DATA

Diode				
Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Optocoupler				
Output/input d.c. current transfer ratio (C.T.R.) I_F = 1 mA; V_{CE} = 1 V; (I_B = 0)	I_C/I_F	min.	5	
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV diode: I_F = 0 (see also Fig. 2)	I_{CEW}	max.	1	μA
Isolation voltage (d.c.)	V_{IORM}	min.	4,4	kV

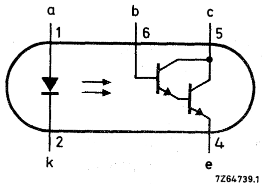
MECHANICAL DATA

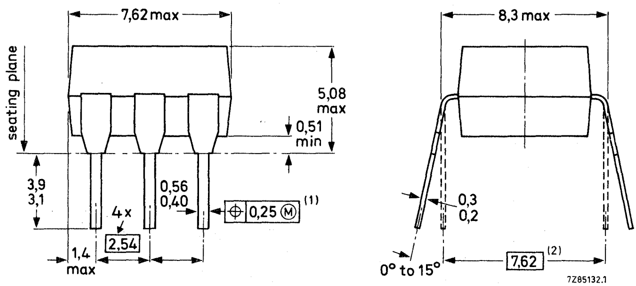
SOT-90B (see Fig. 1).

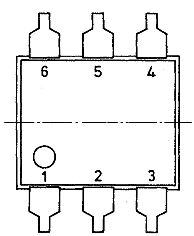
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







⊕ Positional accuracy.

Ⓜ Maximum material condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Junction temperature	T_j	max.	125 °C

Transistor

Collector-emitter breakdown voltage I_C = 1 mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage I_C = 0,1 mA	$V_{(BR)CBO}$	min.	30 V
Emitter-collector breakdown voltage I_E = 0,1 mA	$V_{(BR)ECO}$	min.	6 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Junction temperature	T_j	max.	125 °C

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Lead soldering temperature up to the seating plane; t_{sld} < 10 s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air diode and transistor	$R_{th\ j\text{-}a}$	=	500 K/W
From junction to ambient, device mounted on a printed-circuit board diode and transistor	$R_{th\ j\text{-}a}$	=	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2 mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)			KB-100/A

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,15 V
		max.	1,3 V
Reverse current V_R = 5 V	I_R	max.	10 μA

Transistor (I_F = 0)

Collector cut-off current (dark) V_{CE} = 10 V	I_{CEO}	typ.	20 nA
		max.	100 nA
V_{CB} = 10 V	I_{CEO}	max.	20 nA
Collector-emitter breakdown voltage at I_C = 1 mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage at I_C = 0,1 mA	$V_{(BR)CBO}$	min.	30 V

Emitter-collector breakdown voltage at I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V
Optocoupler (I_B = 0)*			
Output/input d.c. current transfer ratio (C.T.R.)			
I_F = 0,5 mA; V_{CE} = 1 V	I_C/I_F	min.	3,5
I_F = 1,0 mA; V_{CE} = 1 V	I_C/I_F	min.	5
I_F = 10 mA; V_{CE} = 1 V	I_C/I_F	min.	6
Collector cut-off current (dark) see Fig. 2			
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV	I_{CEW}	max.	1 μA**
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV; T_j = 70 °C	I_{CEW}	max.	1000 μA**
Collector-emitter saturation voltage			
I_F = 5 mA; I_C = 10 mA	V_{CEsat}	max.	1 V
Isolation voltage ▲	V_{IORM}	min.	4,4 kV (d.c.) 3,12 kV (r.m.s.)
Collector capacitance at f = 1 MHz			
$I_E = I_e$ = 0; V_{CB} = 10 V	C_{bc}	typ.	4,5 pF
Capacitance between input and output			
I_F = 0; V = 0; f = 1 MHz	C_{io}	typ.	0,6 pF
Insulation resistance between input and output			
± V_{IO} = 1 kV	r_{IO}	min.	10^{10} Ω
		typ.	10^{12} Ω
Switching times (see Figs 3 and 4)			
I_{Fon} = 10 mA; V_{CC} = 5 V; R_E = 100 Ω; R_{BE} = 1 MΩ	t_{on}	typ.	5 μs
	t_{off}	typ.	30 μs
I_{Fon} = 1 mA; V_{CC} = 5 V; R_E = 1 kΩ; R_{BE} = 10 MΩ	t_{on}	typ.	50 μs
	t_{off}	typ.	250 μs

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

** As quality assurance (on a sample basis), these parameters are covered by a 1000 h reliability test.

▲ Tested on a sample basis with a voltage of 4400 V (d.c.) for 1 minute between the shorted input (diode) leads and the shorted output (phototransistor) leads.

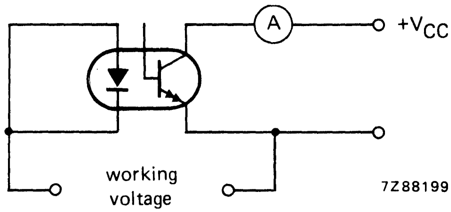


Fig. 2.

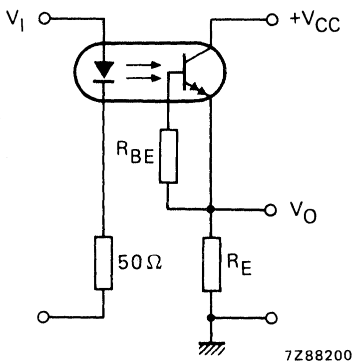


Fig. 3 Switching circuit.

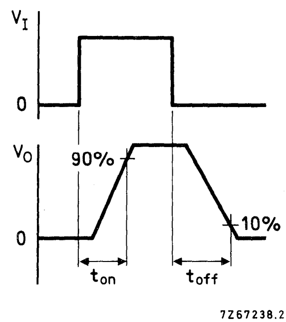


Fig. 4 Waveforms.

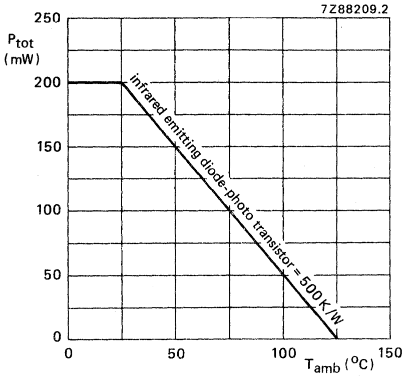


Fig. 5 Power derating curve for diode and transistor as a function of temperature.

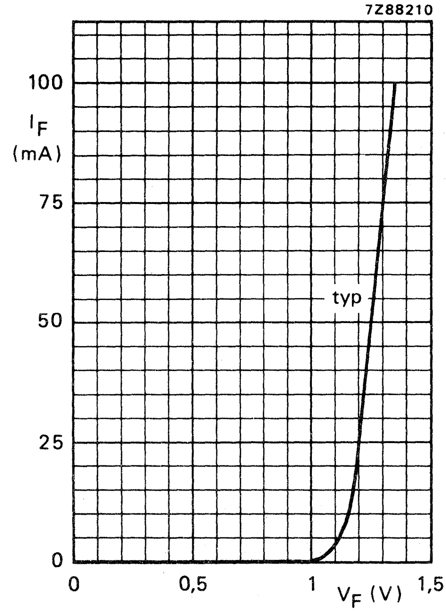


Fig. 6 T_{amb} = 25 °C.

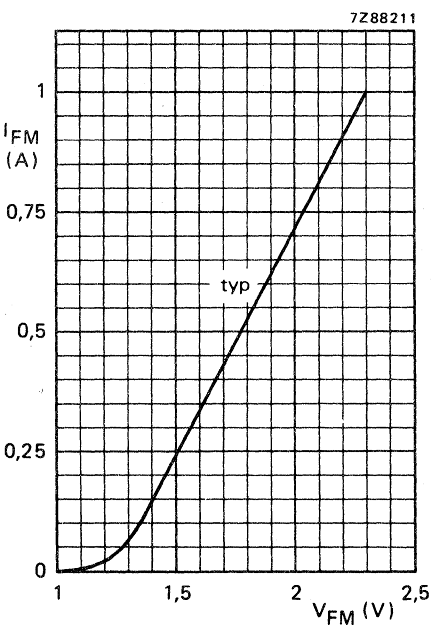


Fig. 7 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01.

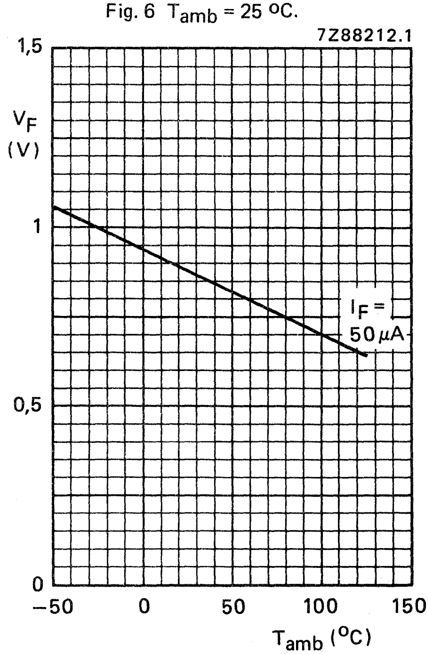


Fig. 8 Typical values.

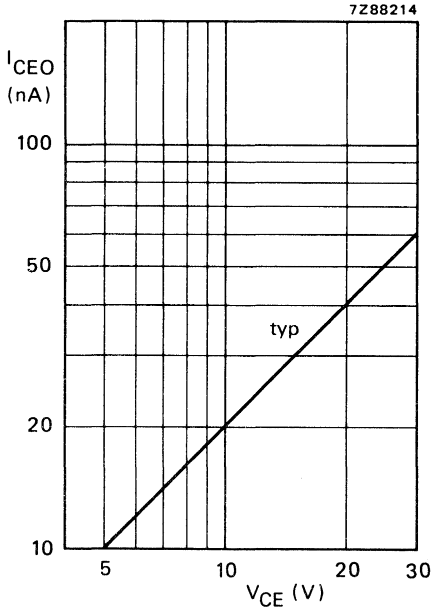


Fig. 9 $I_F = 0$; $T_j = 25\ ^oC$.

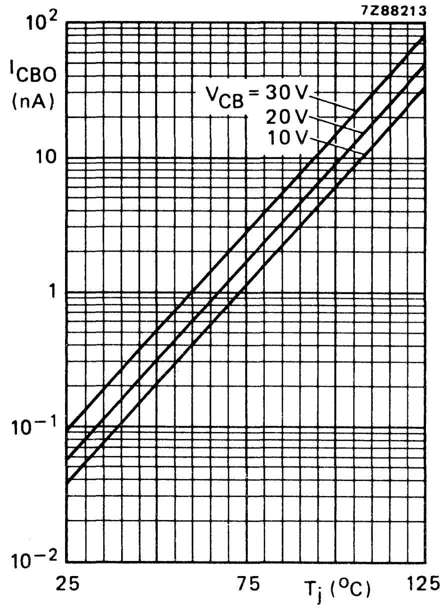


Fig. 10 Typical values.

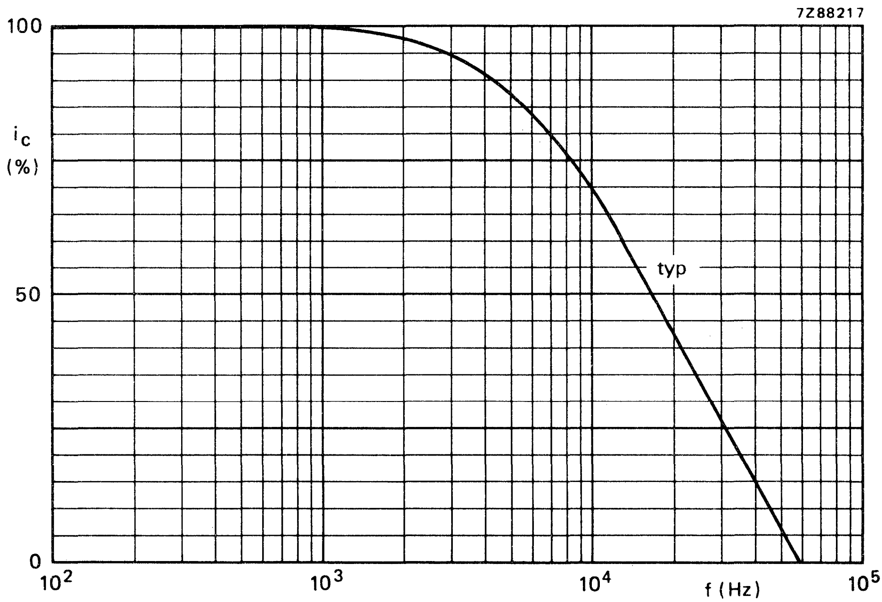


Fig. 11 $I_C = 10$ mA; $V_{CC} = 5$ V; $R_E = 100\ \Omega$; $R_{BE} = 1\ M\Omega$; see also Fig. 4.

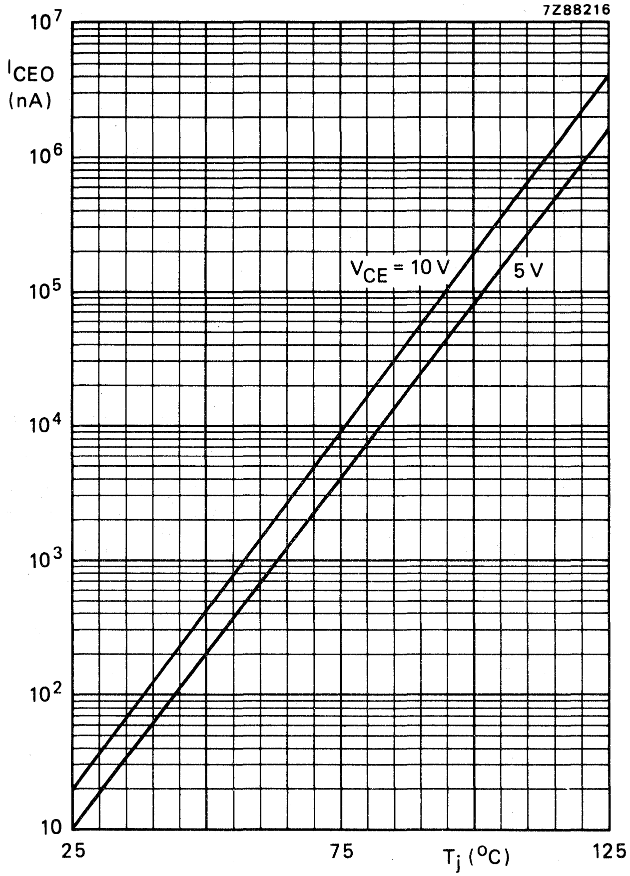


Fig. 12 $I_F = 0$; typical values.

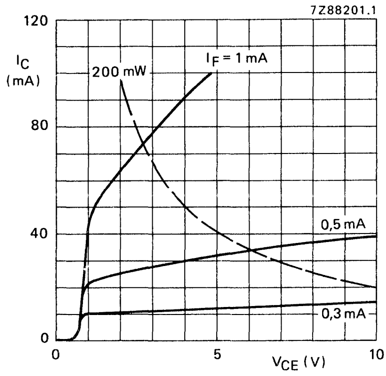


Fig. 13 Typical values; T_{amb} = 25 °C.

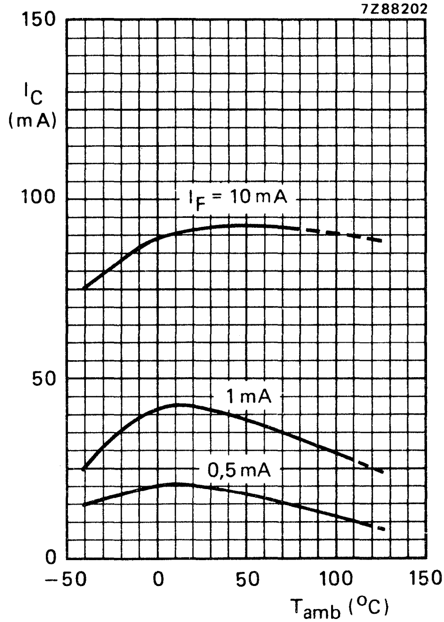


Fig. 14 Typical values; I_B = 0; V_{CE} = 1 V.

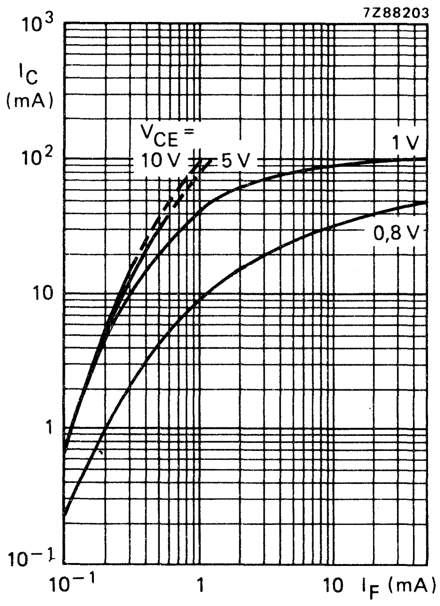


Fig. 15 Typical values; I_B = 0; T_{amb} = 25 °C.

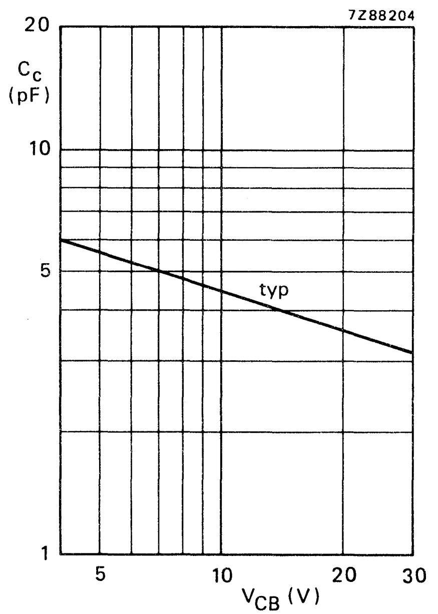


Fig. 16 I_E = I_e = 0; f = 1 MHz; T_{amb} = 25 °C.

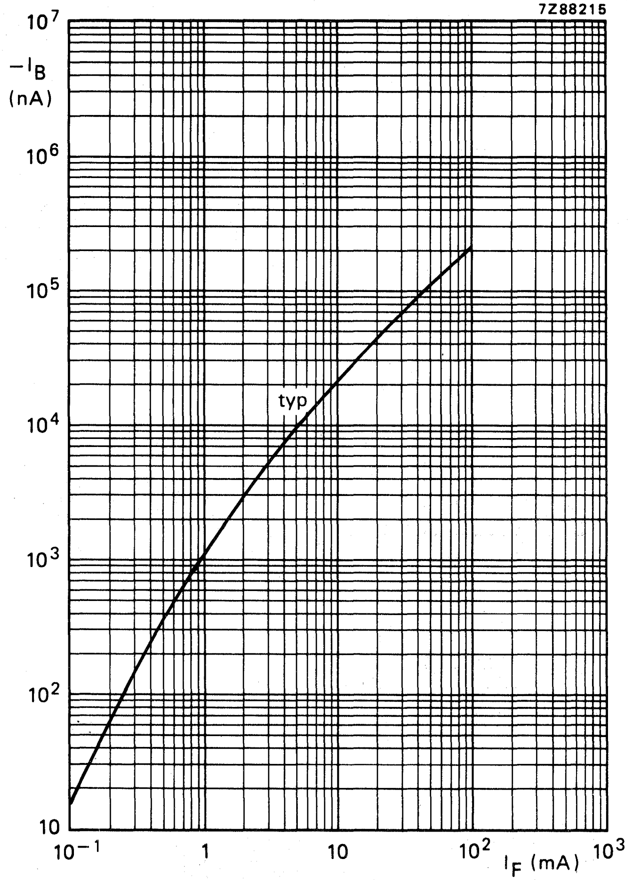


Fig. 17 $I_E = 0$; $V_{CB} = 5$ V; $T_{amb} = 25$ °C.

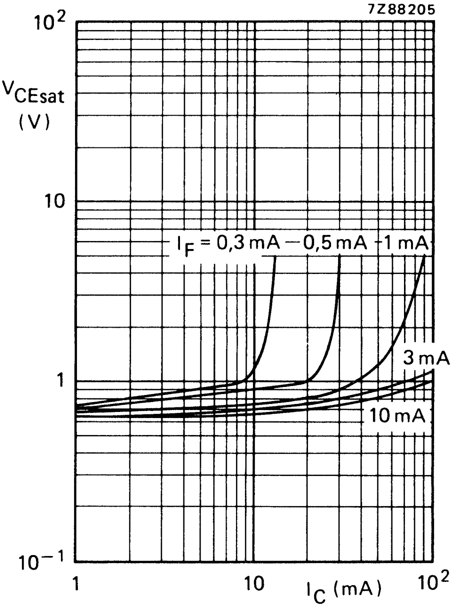


Fig. 18 Typical values; $I_B = 0$; $T_{amb} = 25\ ^oC$.

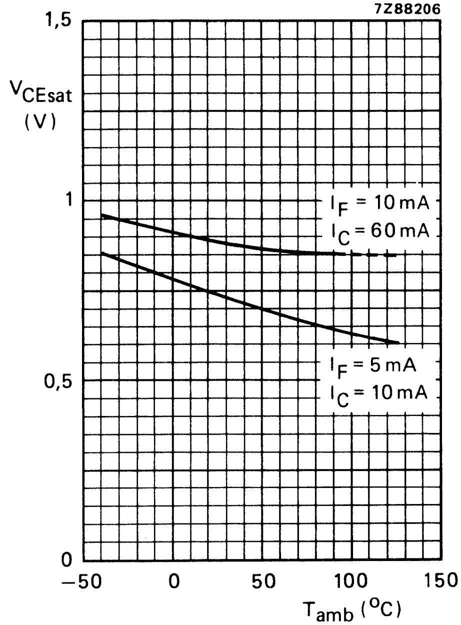


Fig. 19 Typical values; $I_B = 0$.

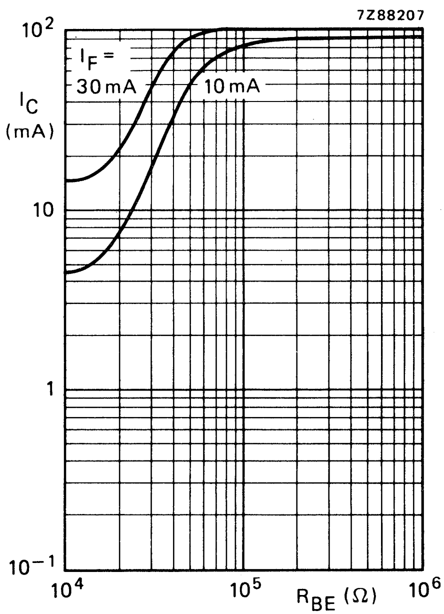


Fig. 20 Typ. values; $V_{CE} = 1$ V; $T_{amb} = 25\ ^oC$.

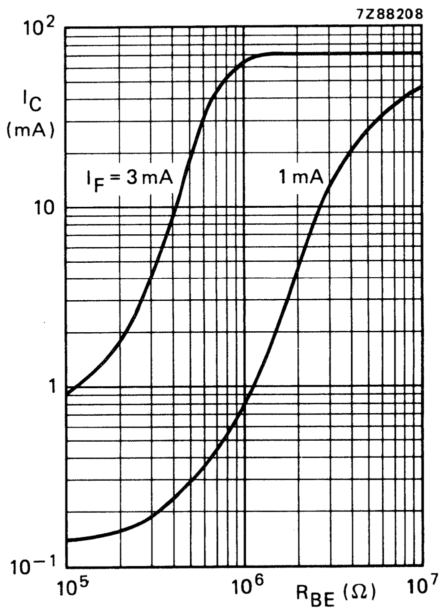


Fig. 21 Typ. values; $V_{CE} = 1$ V; $T_{amb} = 25\ ^oC$.

OPTOCOUPLER

Opto-isolator comprising an infrared emitting GaAs diode and a silicon n-p-n Darlington phototransistor with accessible base. Plastic 6-lead dual-in line (DIL) envelope.

Features:

- very high output/input d.c. current transfer ratio;
- high isolation voltage of 3,12 (r.m.s.) and 4,4 kV (d.c.)
- working voltage 2,5 kV (d.c.)

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83
Complied for reinforced isolation at 250 VAC with:
DIN 57 804/VDE 0804/1.83 (isolation group C)
DIN IEC 65/VDE 0860/8.81

QUICK REFERENCE DATA

Diode				
Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Optocoupler				
Output/input d.c. current transfer ratio (C.T.R.) I_F = 1 mA; V_{CE} = 1 V; (I_B = 0)	I_C/I_F	min.	5	
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 1,5 kV diode: I_F = 0 (see also Fig. 2)	I_{CEW}	max.	1	μA
Isolation voltage (d.c.)	V_{IORM}	min.	4,4	kV

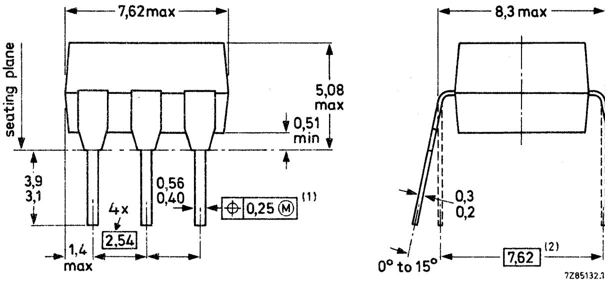
MECHANICAL DATA

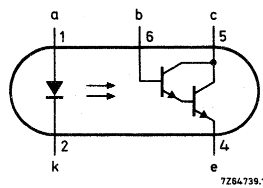
SOT-90B (see Fig. 1).

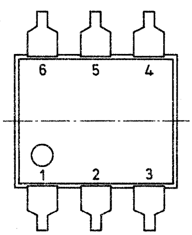
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







⊕ Positional accuracy.

(M) Maximum material condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 ^oC	P_{tot}	max.	200	mW
Junction temperature	T_j	max.	125	^oC

Transistor

Collector-emitter breakdown voltage $I_C = 1$ mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage $I_C = 0,1$ mA	$V_{(BR)CBO}$	min.	30 V
Emitter-collector breakdown voltage $I_E = 0,1$ mA	$V_{(BR)ECO}$	min.	6 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	200 mW
Junction temperature	T_j	max.	125 °C

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air diode and transistor	$R_{th\ j\text{-}a}$	=	500 K/W
From junction to ambient, device mounted on a printed-circuit board diode and transistor	$R_{th\ j\text{-}a}$	=	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2 mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)			KB-100/A

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Diode

Forward voltage $I_F = 10$ mA	V_F	typ. max.	1,15 V 1,3 V
Reverse current $V_R = 5$ V	I_R	max.	10 μA

Transistor ($I_F = 0$)

Collector cut-off current (dark) $V_{CE} = 10$ V	I_{CEO}	typ. max.	20 nA 100 nA
$V_{CB} = 10$ V	I_{CEO}	max.	20 nA
Collector-emitter breakdown voltage at $I_C = 1$ mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage at $I_C = 0,1$ mA	$V_{(BR)CBO}$	min.	30 V

Emitter-collector breakdown voltage at I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V
Optocoupler (I_B = 0)*			
Output/input d.c. current transfer ratio (C.T.R.)			
I_F = 0,5 mA; V_{CE} = 1 V	I_C/I_F	min.	3,5
I_F = 1,0 mA; V_{CE} = 1 V	I_C/I_F	min.	5
I_F = 10 mA; V_{CE} = 1 V	I_C/I_F	min,	6
Collector cut-off current (dark) see Fig. 2			
V_{CC} = 10 V; working voltage (d.c.) = 1,5 kV	I_{CEW}	max.	1 μA **
V_{CC} = 10 V; working voltage (d.c.) = 1,5 kV; T_j = 70 °C	I_{CEW}	max.	1000 μA **
Collector-emitter saturation voltage I_F = 5 mA; I_C = 10 mA	V_{CEsat}	max.	1 V
→ Isolation voltage▼	V_{IORM}	min.	4,4 kV(d.c.) 3,12 kV(r.m.s.)
Collector capacitance at f = 1 MHz I_E = I_e = 0; V_{CB} = 10 V	C_{bc}	typ.	4,5 pF
Capacitance between input and output I_F = 0; V = 0; f = 1 MHz	C_{io}	typ.	0,6 pF
Insulation resistance between input and output ± V_{IO} = 1 kV	r_{IO}	min. typ.	10^{10} Ω 10^{12} Ω
Switching times (see Figs 3 and 4)			
I_{Fon} = 10 mA; V_{CC} = 5 V; R_E = 100 Ω; R_{BE} = 1 MΩ	t_{on} t_{off}	typ. typ.	5 μs 30 μs
I_{Fon} = 1 mA; V_{CC} = 5 V; R_E = 1 kΩ; R_{BE} = 10 MΩ	t_{on} t_{off}	typ. typ.	50 μs 250 μs

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

** As quality assurance (on a sample basis), these parameters are covered by a 1000 h reliability test.

▲ Every single product is tested by applying an isolation test voltage of 3750 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

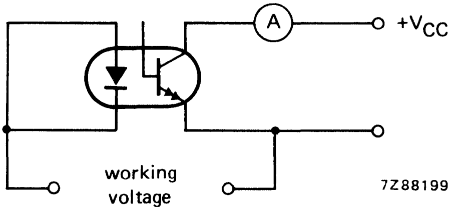


Fig. 2.

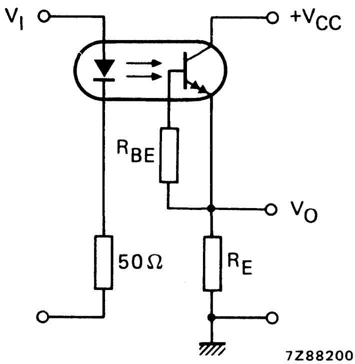


Fig. 3 Switching circuit.

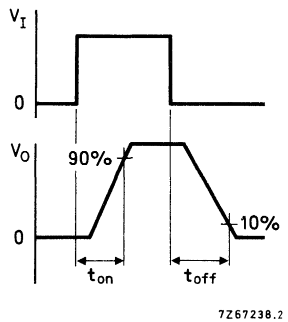


Fig. 4 Waveforms.

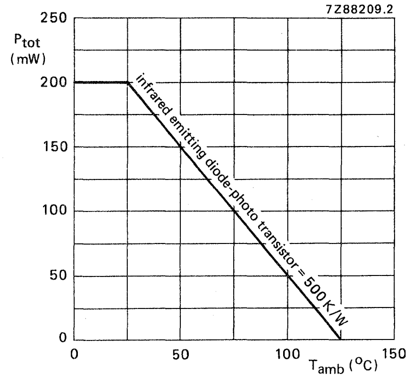


Fig. 5 Power derating curve for diode and transistor as a function of temperature.

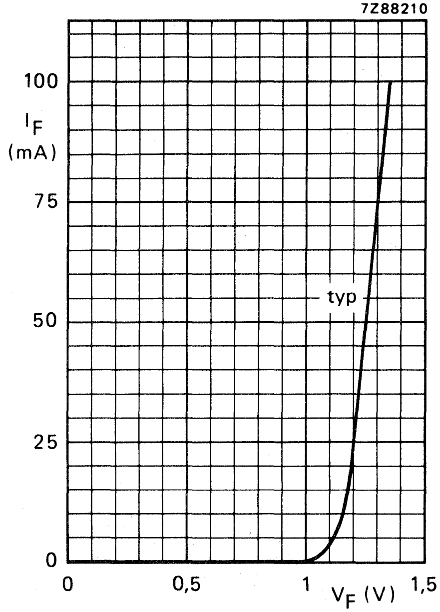


Fig. 6 T_{amb} = 25 °C.

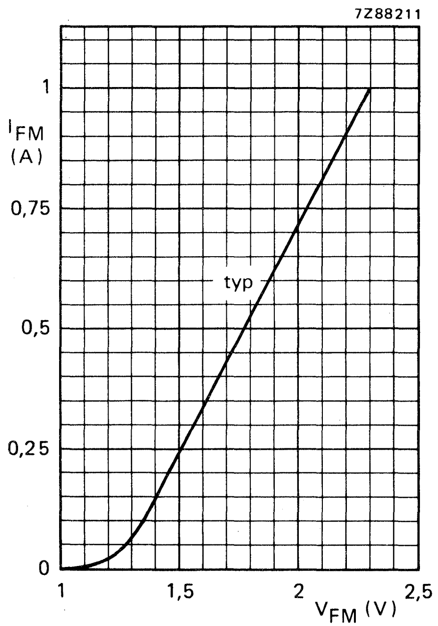


Fig. 7 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01.

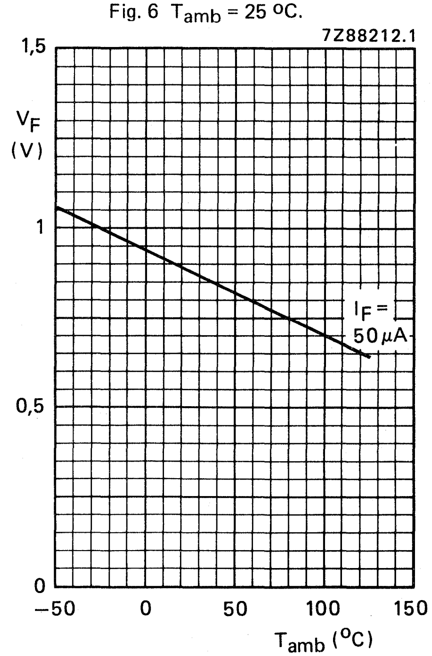


Fig. 8 Typical values.

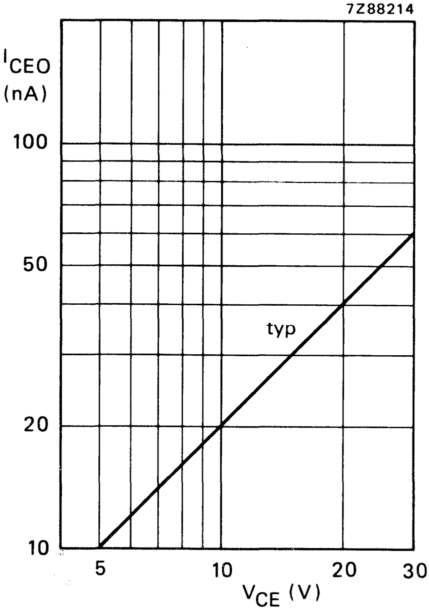


Fig. 9 $I_F = 0$; $T_j = 25\ ^oC$.

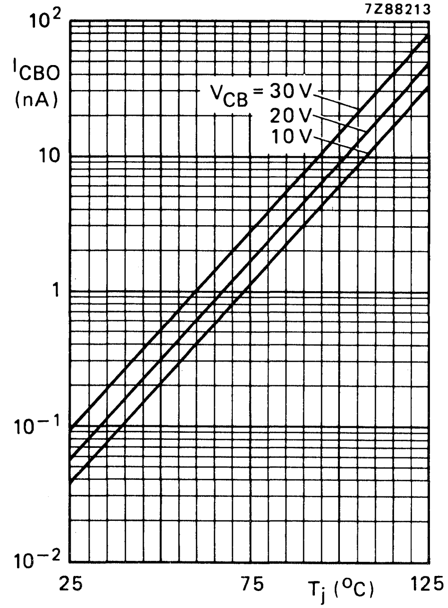


Fig. 10 Typical values.

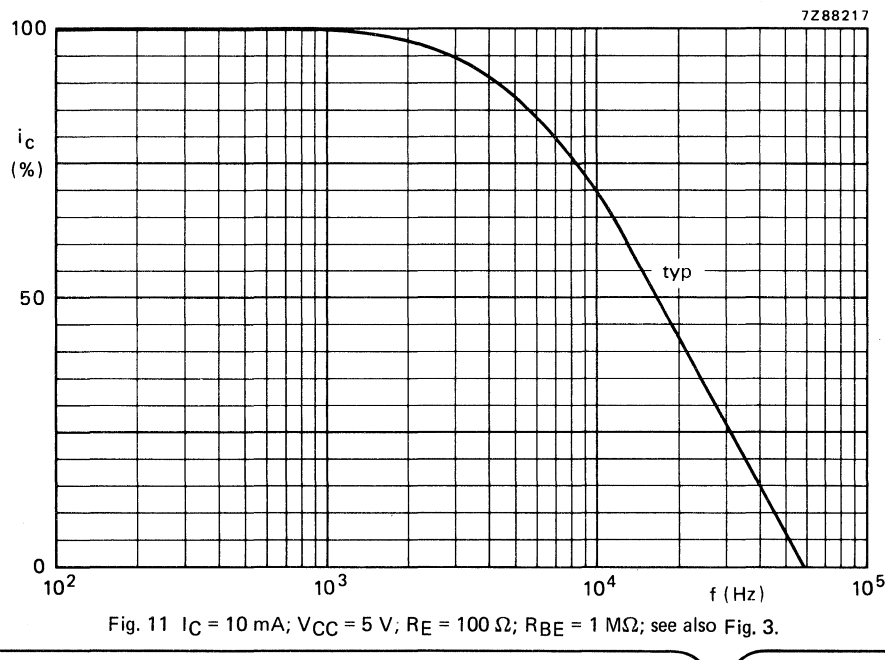


Fig. 11 $I_C = 10$ mA; $V_{CC} = 5$ V; $R_E = 100\ \Omega$; $R_{BE} = 1\ M\Omega$; see also Fig. 3.

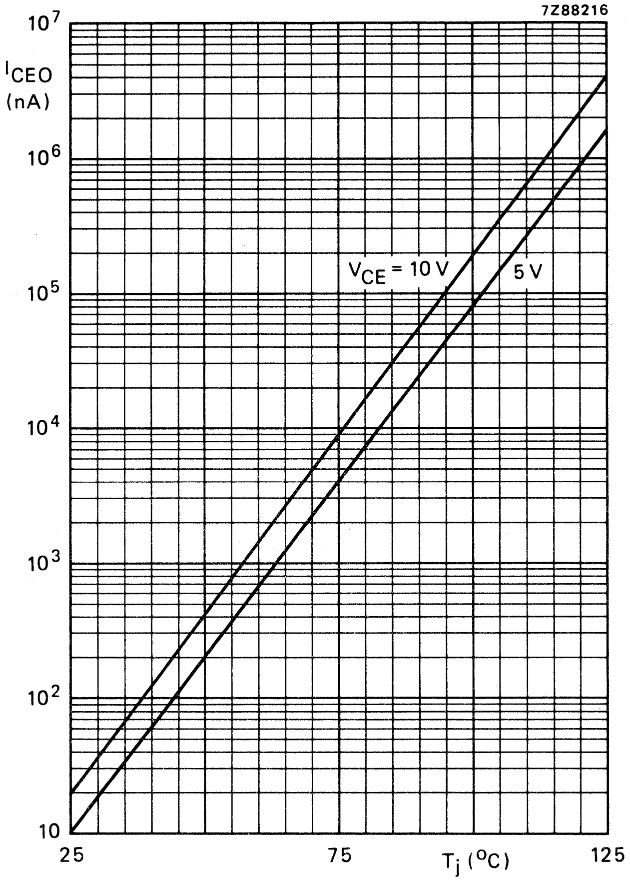


Fig. 12 $I_F = 0$; typical values.

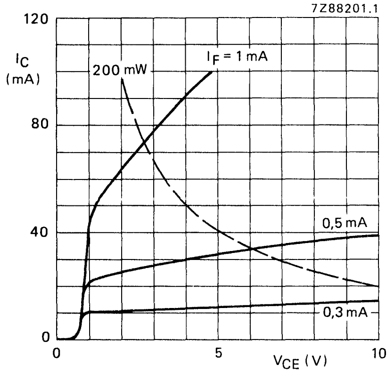


Fig. 13 Typical values; T_{amb} = 25 °C.

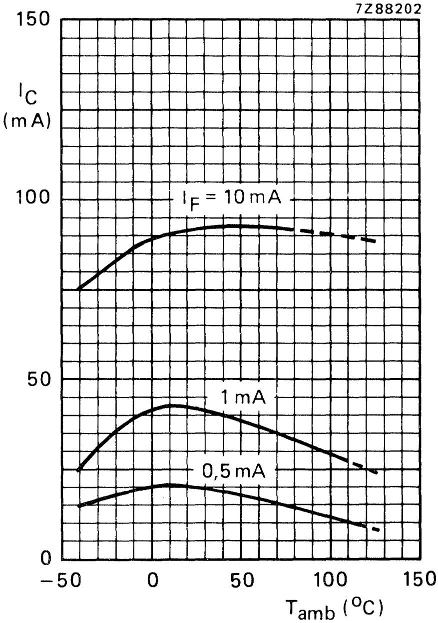


Fig. 14 Typical values; I_B = 0; V_{CE} = 1 V.

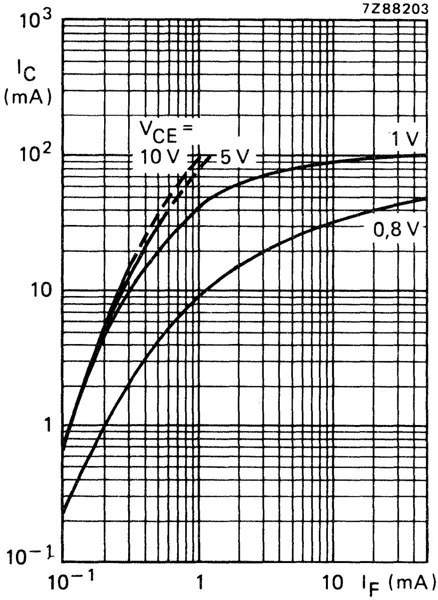


Fig. 15 Typical values; I_B = 0; T_{amb} = 25 °C.

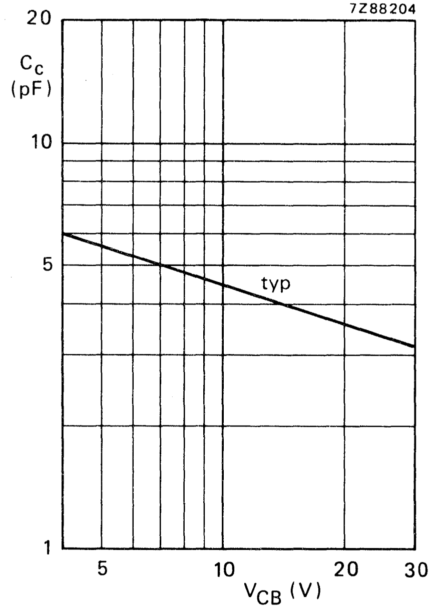


Fig. 16 I_E = I_e = 0; f = 1 MHz; T_{amb} = 25 °C.

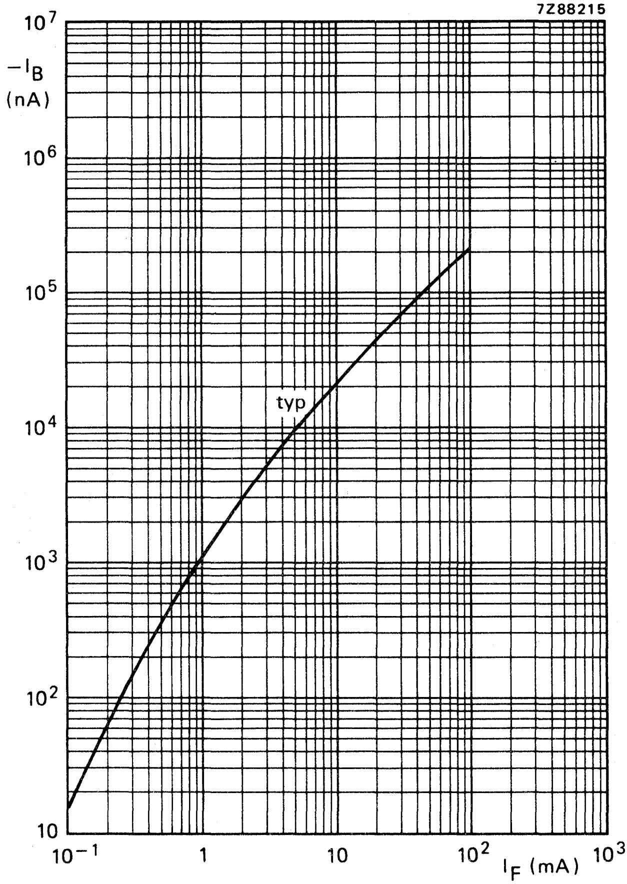


Fig. 17 $I_E = 0$; $V_{CB} = 5$ V; $T_{amb} = 25$ °C.

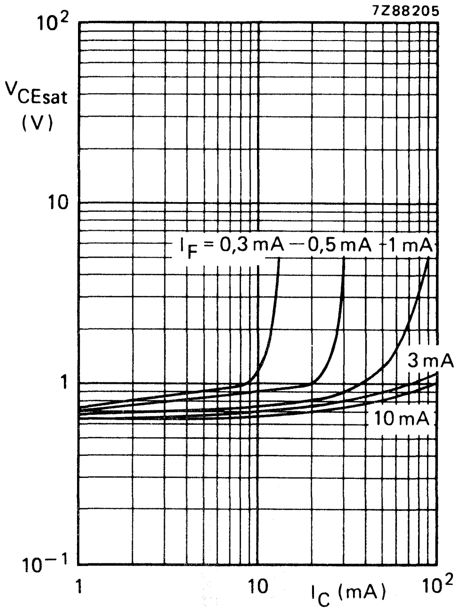


Fig. 18 Typical values; $I_B = 0$; $T_{amb} = 25\ ^oC$.

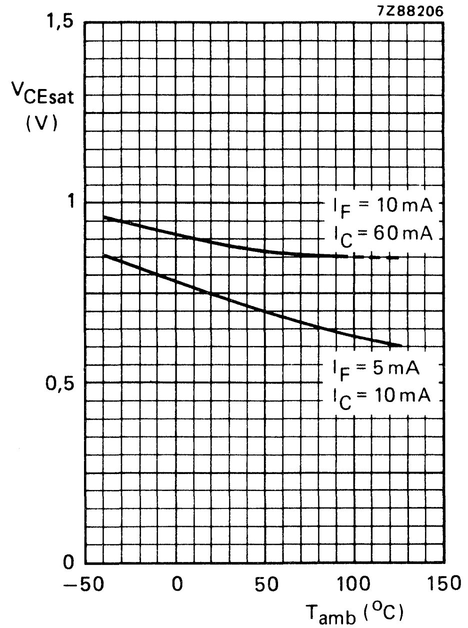


Fig. 19 Typical values; $I_B = 0$.

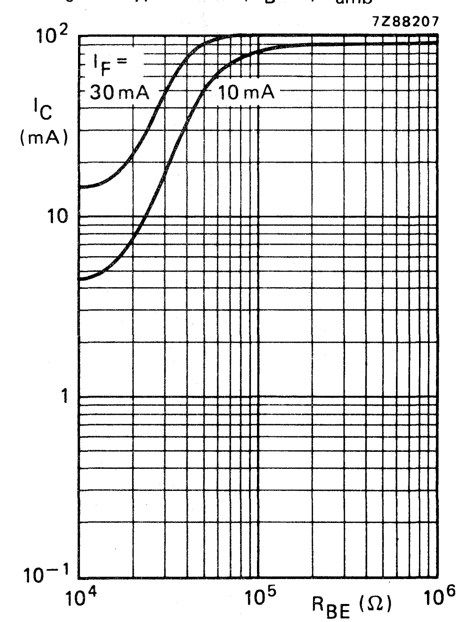


Fig. 20 Typ. values; $V_{CE} = 1$ V; $T_{amb} = 25\ ^oC$.

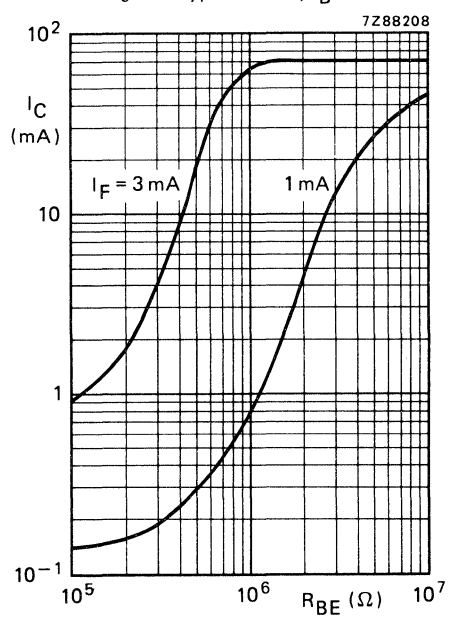


Fig. 21 Typ. values; $V_{CE} = 1$ V; $T_{amb} = 25\ ^oC$.

HIGH-VOLTAGE OPTOCOUPLER

The CNX62 is an optocoupler consisting of an infrared emitting GaAs diode and a silicon n-p-n phototransistor in a dual-in-line (DIL) plastic envelope. The base is not connected.

Features

- high current transfer ratio and a low saturation voltage suitable for use with TTL integrated circuits
- high degree of a.c. and d.c. insulation (3750 V r.m.s. and 5300 V d.c.)
- working voltage of 2,5 kV (d.c.)

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83
Complied for reinforced isolation at 250 VAC with:
DIN 57 804/VDE 0804/1.83 (isolation group C)
DIN IEC 65/VDE 0860/8.81

QUICK REFERENCE DATA

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Optocoupler			
Output/input d.c. current transfer ratio (C.T.R.)			
I_F = 10 mA; V_{CE} = 0,4 V	I_C/I_F	min.	0,4
Collector cut-off current (dark)			
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV			
I_F (diode) = 0 (see Fig. 4)	I_{CEW}	max.	200 nA
Collector-emitter saturation voltage			
I_F = 10 mA; I_C = 4 mA	V_{CEsat}	max.	0,4 V
Isolation voltage (d.c.)	V_{IORM}	min.	5,3 kV

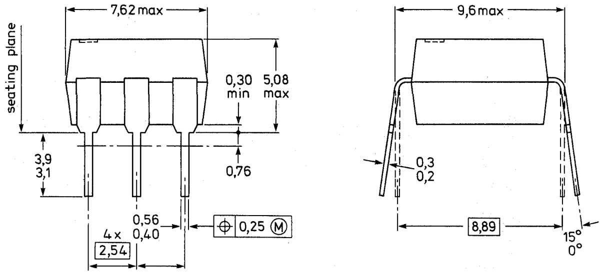
MECHANICAL DATA

SOT-174 (see Fig. 1).

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-174.



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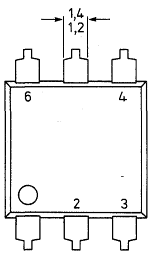
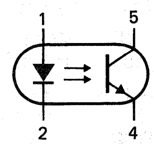




The base is not connected.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C (when mounted on a printed circuit board: T_{amb} = 45 °C)	P_{tot}	max.	200 mW

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Emitter-collector voltage	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C (when mounted on a printed circuit board: T_{amb} = 45 °C)	P_{tot}	max.	200 mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	125	°C
Soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260	°C

THERMAL RESISTANCE

From junction to ambient in free air				
diode	$R_{th\ j\text{-}a}$	max.	500	K/W
transistor	$R_{th\ j\text{-}a}$	max.	500	K/W
From junction to ambient when mounted on p.c.b.				
diode	$R_{th\ j\text{-}a}$	max.	400	K/W
transistor	$R_{th\ j\text{-}a}$	max.	400	K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	8,4	mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0	mm
Tracking resistance (KB-value)			KB-100/A	

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Diode

Forward voltage $I_F = 10$ mA	V_F	typ. max.	1,15 1,50	V V
Reverse current $V_R = 5$ V	I_R	max.	10	μA

Transistor

Collector-emitter breakdown voltage $I_C = 1$ mA	$V_{(BR)CEO}$	min.	50	V
Emitter-collector breakdown voltage $I_E = 0,1$ mA	$V_{(BR)ECO}$	min.	7	V
Collector cut-off current (dark); diode $I_F = 0$ $V_{CE} = 10$ V	I_{CEO}	typ. max.	2 50	nA nA
$V_{CE} = 10$ V; $T_{amb} = 70$ °C	I_{CEO}	max.	10	μA

Optocoupler

Output/input d.c. current transfer ratio (C.T.R.) $I_F = 10$ mA; $V_{CE} = 0,4$ V	I_C/I_F	min. typ.	0,4 0,8	
$I_F = 10$ mA; $V_{CE} = 5$ V	I_C/I_F	typ.	1,5	
Collector cut-off current (light) $T_{amb} \leq 70$ °C; $V_F = 0,8$ V; $V_{CE} = 15$ V	$I_{CE(L)}$	max.	15	μA
$T_{amb} \leq 70$ °C; $I_F = 2$ mA; $V_{CE} = 0,4$ V	$I_{CE(L)}$	min.	150	μA

Optocoupler (continued)

Collector-emitter saturation voltage I_F = 10 mA; I_C = 4 mA	V_{CEsat}	typ. max.	0,19 V 0,40 V
Collector cut-off current (dark) at working voltage (2,5 kV d.c.); V_{CC} = 10 V; T_J = 25 °C (see Fig. 4) V_{CC} = 10 V; T_J = 70 °C (see Fig. 4)	I_{CEW}	max. max.	200 nA* 100 μA*
Isolation voltage (see note 1)	V_{IORM}	min.	5,3 kV(d.c.) 3,75 kV(r.m.s.)
Capacitance between input and output V = 0; f = 1 MHz	C_{io}	typ.	0,6 pF
Insulation resistance between input and output V_{IO} = ± 1000 V	R_{IO}	min. typ.	10^{10} Ω 10^{12} Ω
Switching times (see Figs 2 and 3)			
Turn-on time I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω I_C = 2 mA; V_{CC} = 5 V; R_L = 1 kΩ	t_{on}	typ. typ.	3 μs 12 μs
Turn-off time I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω I_C = 2 mA; V_{CC} = 5 V; R_L = 1 kΩ	t_{off}	typ. typ.	3 μs 12 μs

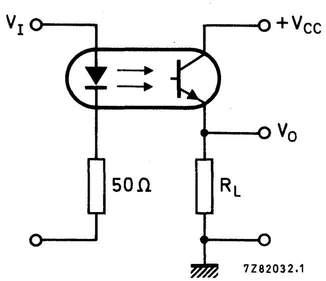


Fig. 2 Switching circuit.

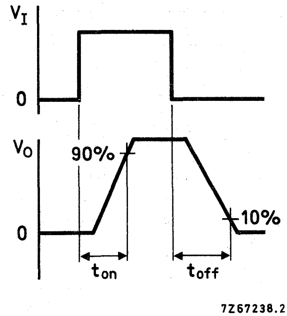


Fig. 3 Waveforms.

* The two parameters are tested on a sample basis for 1000 h.

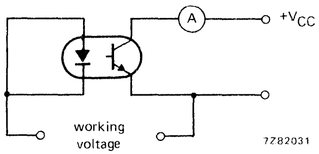


Fig. 4.

Note 1:

Every single product is tested by applying an isolation test voltage of 4500 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

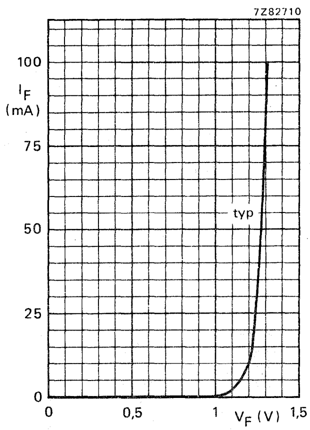


Fig. 5 T_{amb} = 25 °C.

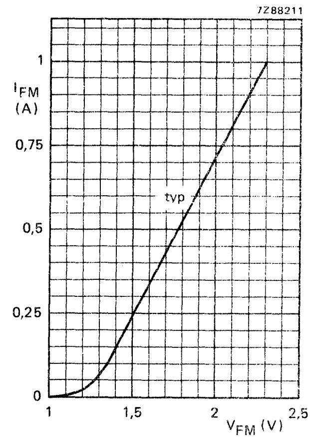


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01.

→

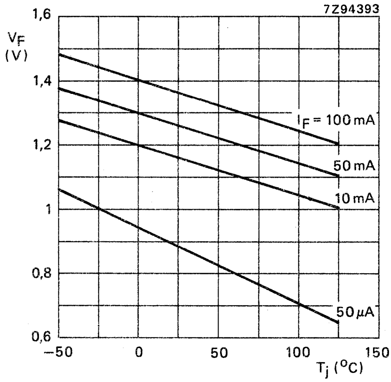


Fig. 7 Typical values.

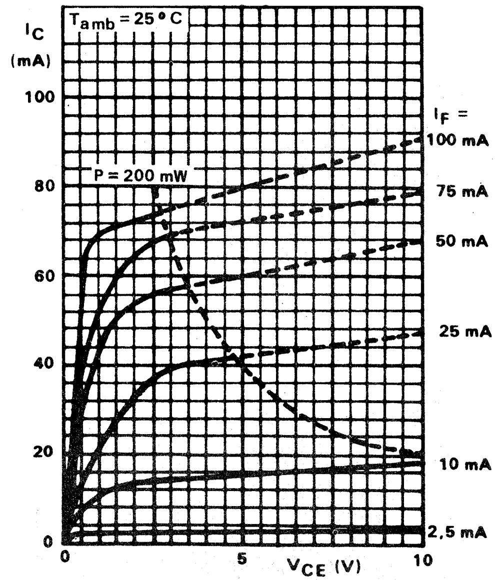


Fig. 8 Typical values.

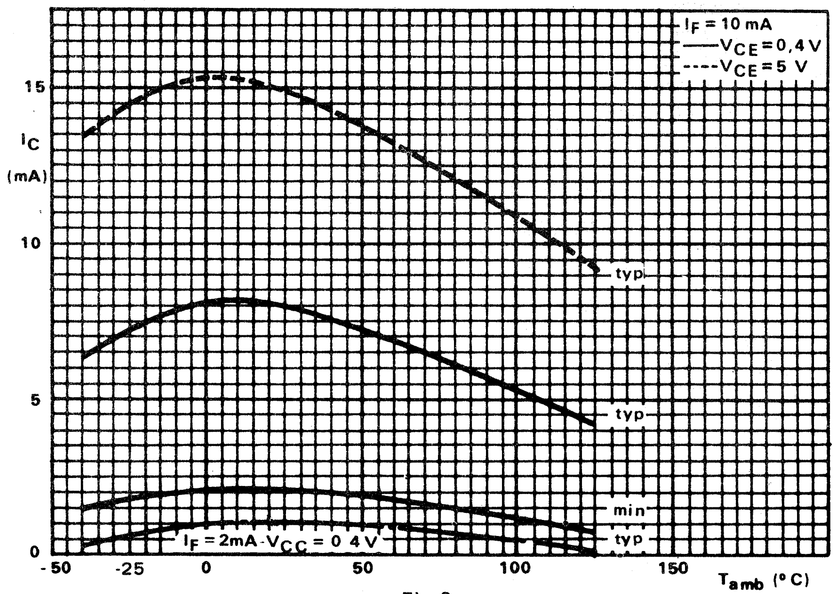


Fig. 9.

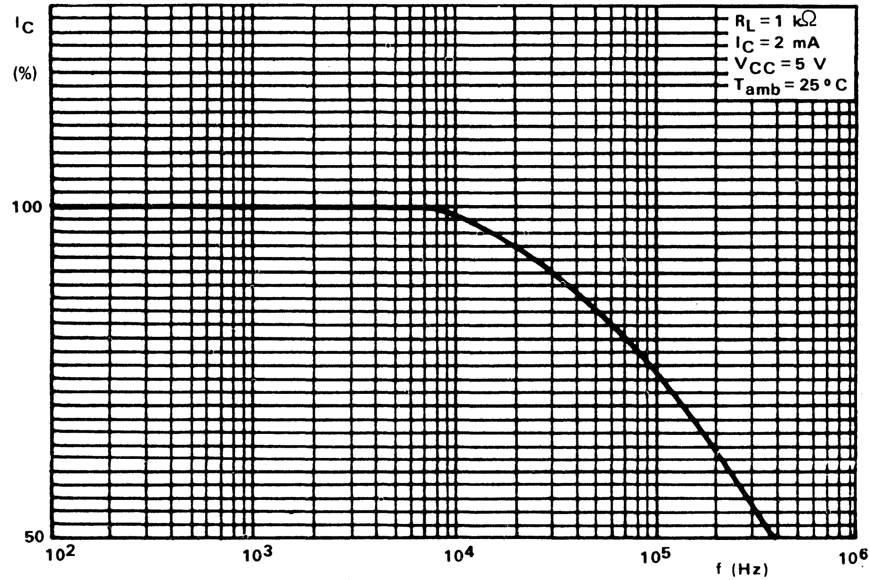


Fig. 10 Typical values.

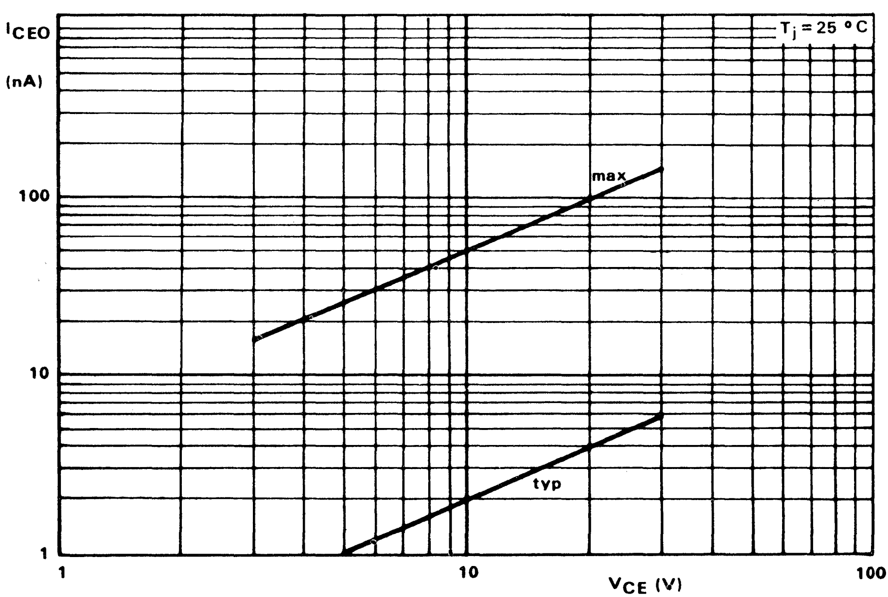


Fig. 11.

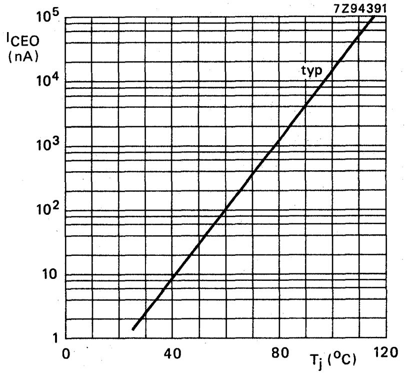


Fig. 12 V_{CE} = 10 V.

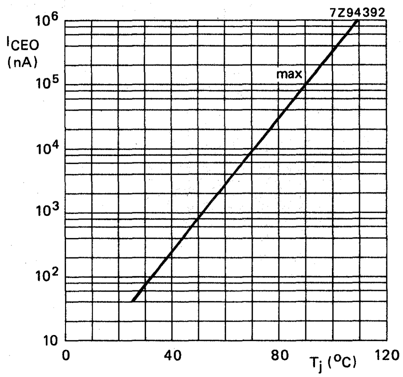


Fig. 13 V_{CE} = 10 V.

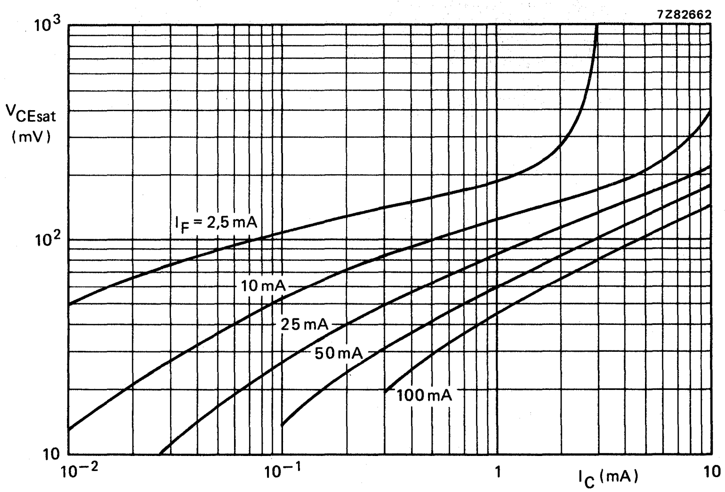


Fig. 14 T_{amb} = 25 °C; typical values.

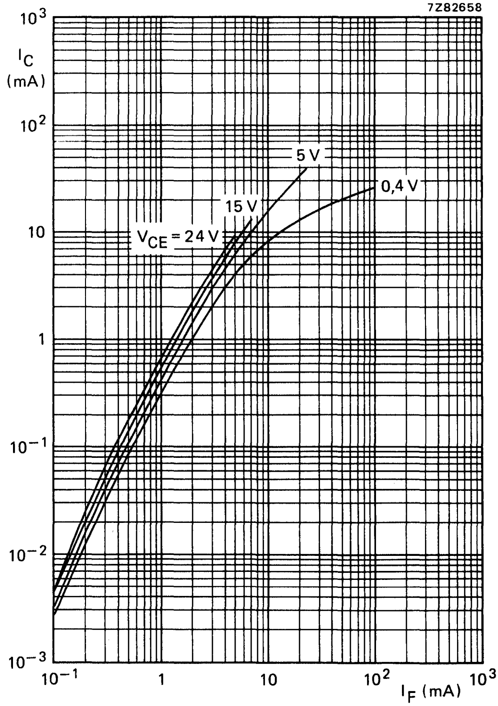


Fig. 15 T_{amb} = 25 °C; typical values.

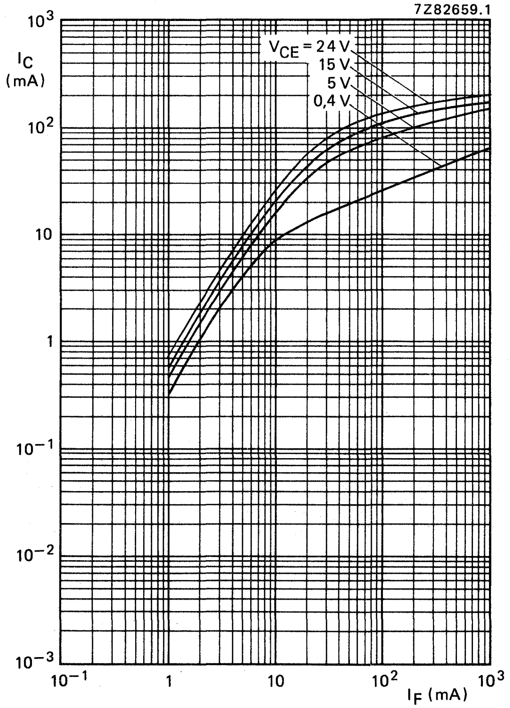


Fig. 16 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01; typical values.

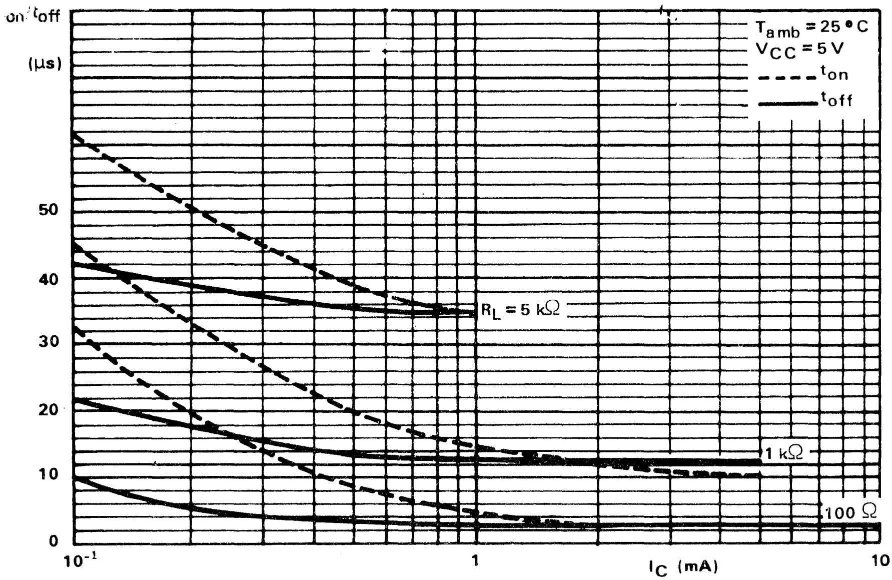


Fig. 17 Typical values.

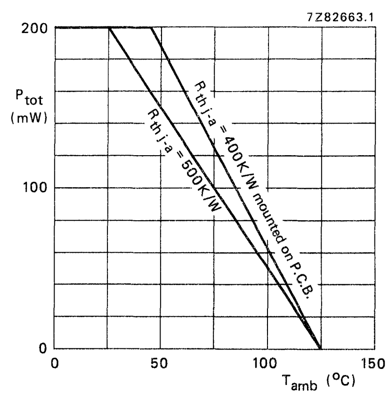


Fig. 18.

HIGH-VOLTAGE OPTOCOUPLER

The CNX72 is an optocoupler consisting of an infrared emitting GaAs diode and a silicon n-p-n phototransistor in a dual-in-line (DIL) plastic envelope.

Features

- high current transfer ratio and a low saturation voltage suitable for use with TTL integrated circuits
- high degree of insulation (5300 V d.c.)
- working voltage of 2,5 kV (d.c.)

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83
Complied for reinforced isolation at 250 VAC with:
DIN 57 804/VDE 0804/1.83 (isolation group C)
DIN IEC 65/VDE 0860/8.81

QUICK REFERENCE DATA

Diode				
Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 ^oC when mounted on a printed circuit board	P_{tot}	max.	200	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Total power dissipation up to T_{amb} = 25 ^oC when mounted on a printed circuit board	P_{tot}	max.	200	mW
Optocoupler				
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V	I_C/I_F	min.	0,4	
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV I_F (diode) = 0 (see Fig. 4)	I_{CEW}	max.	200	nA
Collector-emitter saturation voltage I_F = 10 mA; I_C = 4 mA	V_{CEsat}	max.	0,4	V
Isolation voltage (d.c.)*	V_{IORM}	min.	5,3	kV

MECHANICAL DATA

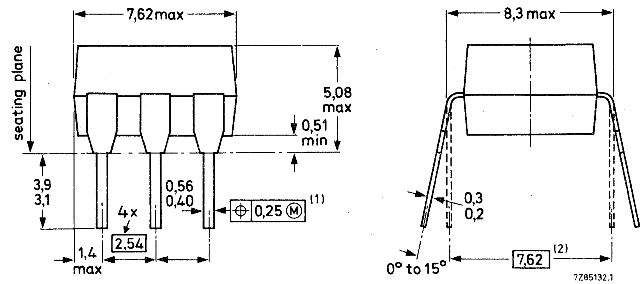
SOT-90B (see Fig. 1).

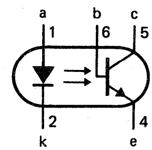
* VDE recognized: V_{IORM} 4,4 kV d.c.

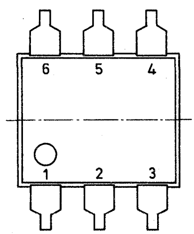
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C when mounted on a p.c.b.	P_{tot}	max.	200 mW
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Emitter-collector voltage	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C when mounted on a p.c.b.	P_{tot}	max.	200 mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Junction temperature	T_j	max.	125 °C
Soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	max.	500 K/W
transistor	$R_{th\ j\text{-}a}$	max.	500 K/W
From junction to ambient when mounted on p.c.b.			
diode	$R_{th\ j\text{-}a}$	max.	400 K/W
transistor	$R_{th\ j\text{-}a}$	max.	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2 mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)			KB-100/A

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Diode

Forward voltage $I_F = 10$ mA	V_F	typ.	1,15 V
		max.	1,50 V
Reverse current $V_R = 5$ V	I_R	max.	10 μA

Transistor

Collector-emitter breakdown voltage $I_C = 1$ mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage $I_C = 0,1$ mA	$V_{(BR)CBO}$	min.	70 V
Emitter-collector breakdown voltage $I_E = 0,1$ mA	$V_{(BR)ECO}$	min.	7 V
Collector cut-off current (dark); diode $I_F = 0$			
$V_{CE} = 10$ V	I_{CEO}	typ.	2 nA
		max.	50 nA
$V_{CE} = 10$ V; $T_{amb} = 70$ °C	I_{CEO}	max.	10 μA
$V_{CB} = 10$ V	I_{CBO}	max.	20 nA

Optocoupler

Output/input d.c. current transfer ratio (C.T.R.) $I_F = 10$ mA; $V_{CE} = 0,4$ V	I_C/I_F	min.	0,4
		max.	1,6
Collector-emitter saturation voltage $I_F = 10$ mA; $I_C = 4$ mA	V_{CEsat}	typ.	0,19 V
		max.	0,40 V

Optocoupler (continued)

Collector cut-off (light) at T_{amb} = 0 °C to 70 °C			
V_F = 0,8 V; V_{CE} = 15 V	$I_{CE(L)}$	max.	15 μA
I_F = 2 mA; V_{CE} = 0,4 V	$I_{CE(L)}$	min.	150 μA
Collector cut-off current (datk) at working voltage V_W = 2,5 kV (d.c. value);			
V_{CC} = 10 V; T_j = 25 °C (see Fig. 4)	I_{CEW}	max.	200 nA
V_{CC} = 10 V; T_j = 70 °C (see Fig. 4)		max.	100 μA
Isolation voltage* (see note 1)	V_{IORM}	min.	5,3 kV(d.c.) 3,75 kV(r.m.s.)
Capacitance between input and output V = 0; f = 1 MHz	C_{io}	typ.	0,6 pF
Output capacitance V_{CB} = 10 V; f = 1 MHz	C_{bc}	max.	4,5 pF
Insulation resistance between input and output V_{IO} = ± 1000 V	R_{IO}	min.	10^{10} Ω
		typ.	10^{12} Ω
Switching times (see Figs 2 and 3)			
Turn-on time I_C = 2 mA; V_{CC} = 5 V; R_L = 1 kΩ; R_{BE} = 56 kΩ	t_{on}	max.	26 μs
Turn-off time I_C = 2 mA; V_{CC} = 5 V; R_L = 1 kΩ; R_{BE} = 56 kΩ	t_{off}	max.	2,5 μs

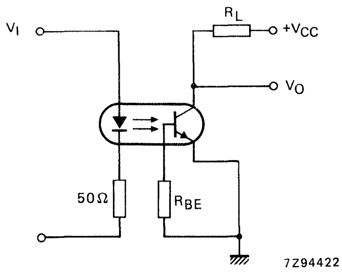


Fig. 2 Switching circuit.

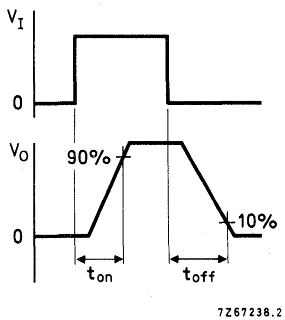


Fig. 3 Waveforms.

* VDE recognized : V_{IORM} 4,4 kV d.c.

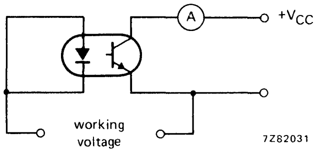


Fig. 4.

Note 1:

Every single product is tested by applying an isolation test voltage of 4500 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

DEVELOPMENT DATA

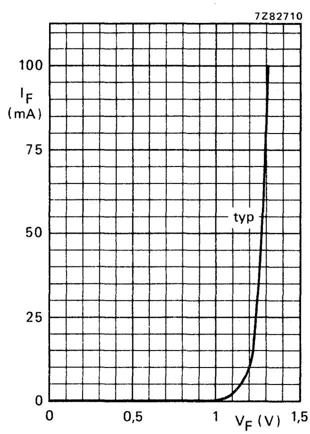


Fig. 5 T_{amb} = 25 °C.

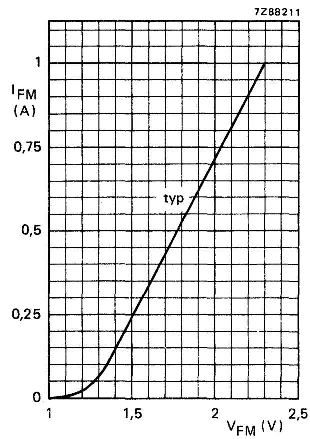


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs ; δ = 0,01.

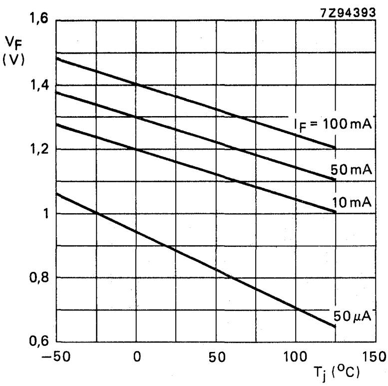


Fig. 7 Typical values.

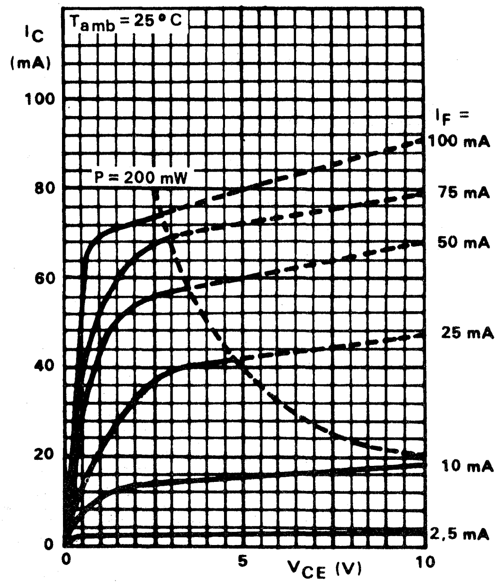


Fig. 8 Typical values.

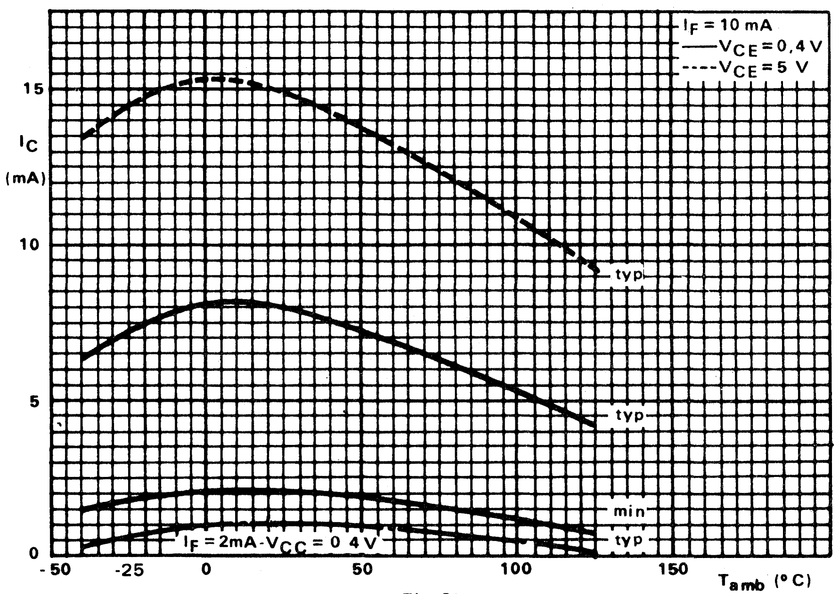


Fig. 9.

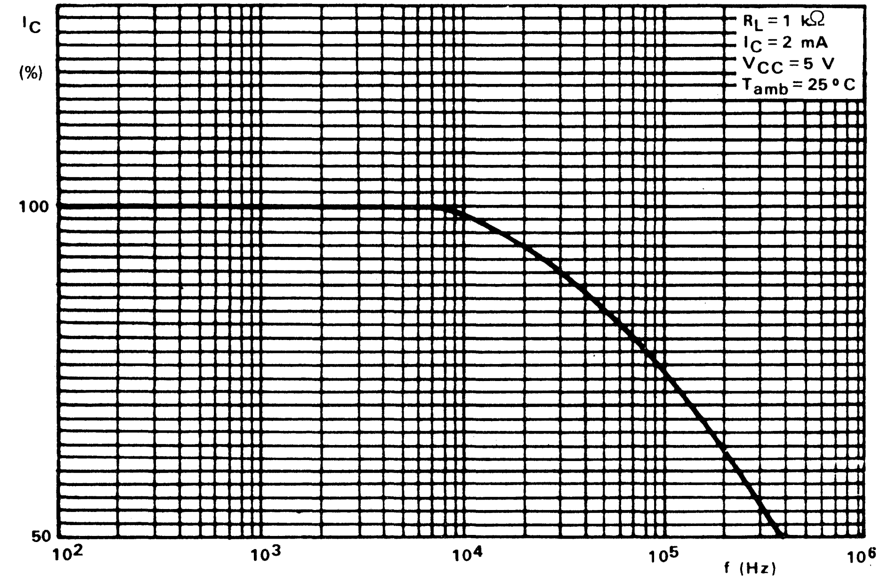


Fig. 10 Typical values.

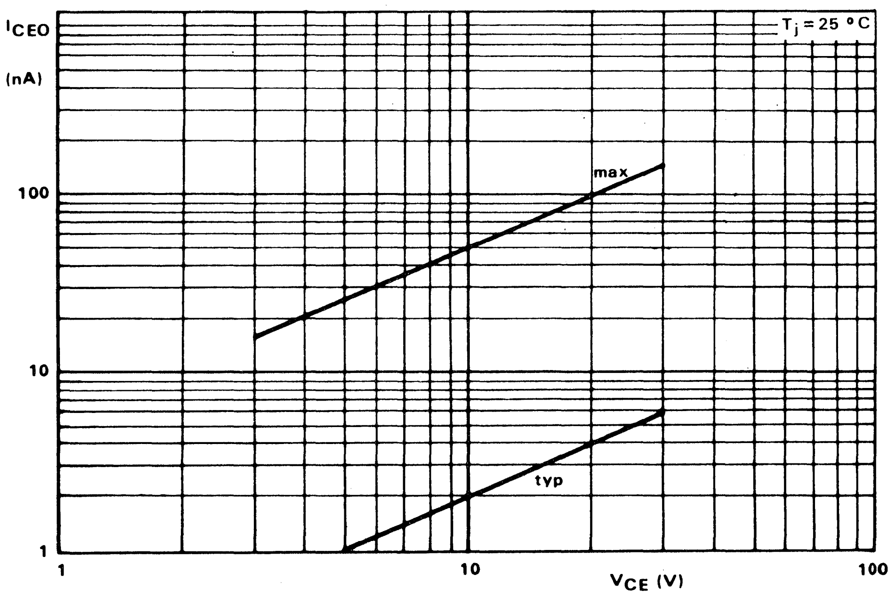


Fig. 11.

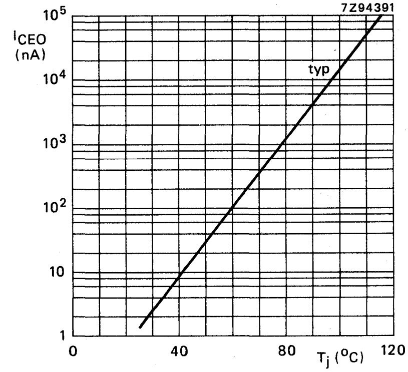


Fig. 12 V_{CE} = 10 V.

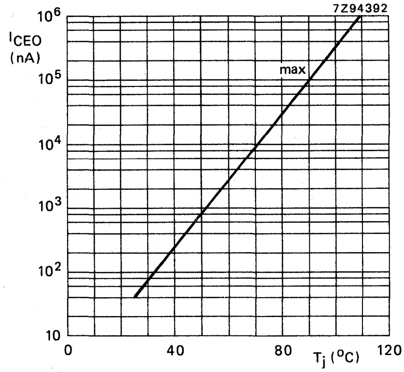


Fig. 13 V_{CE} = 10 V.

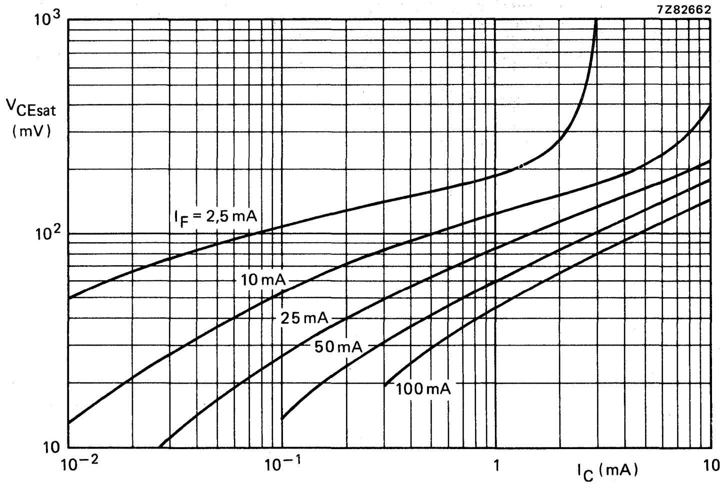


Fig. 14 T_{amb} = 25 °C; typical values.

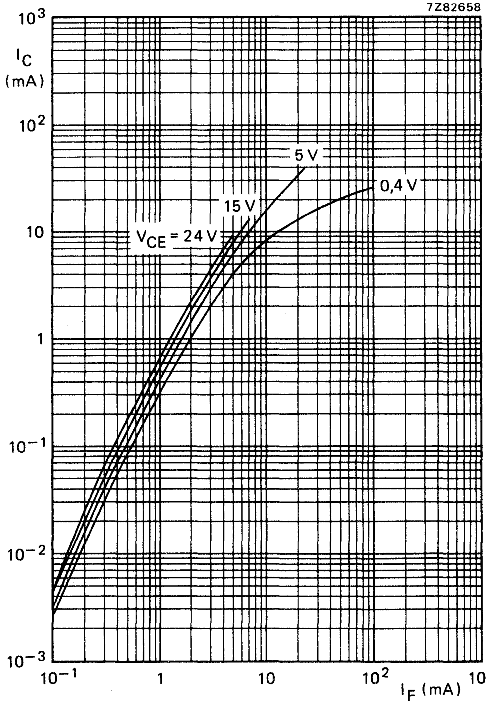


Fig. 15 T_{amb} = 25 °C; typical values.

DEVELOPMENT DATA

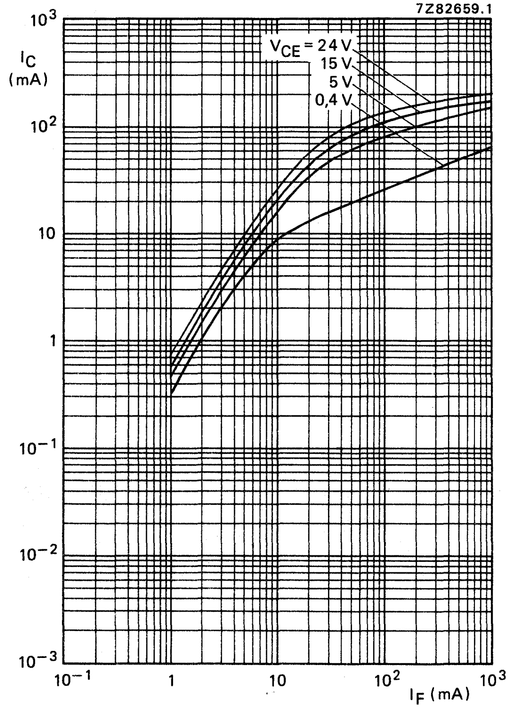


Fig. 16 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01; typical values.

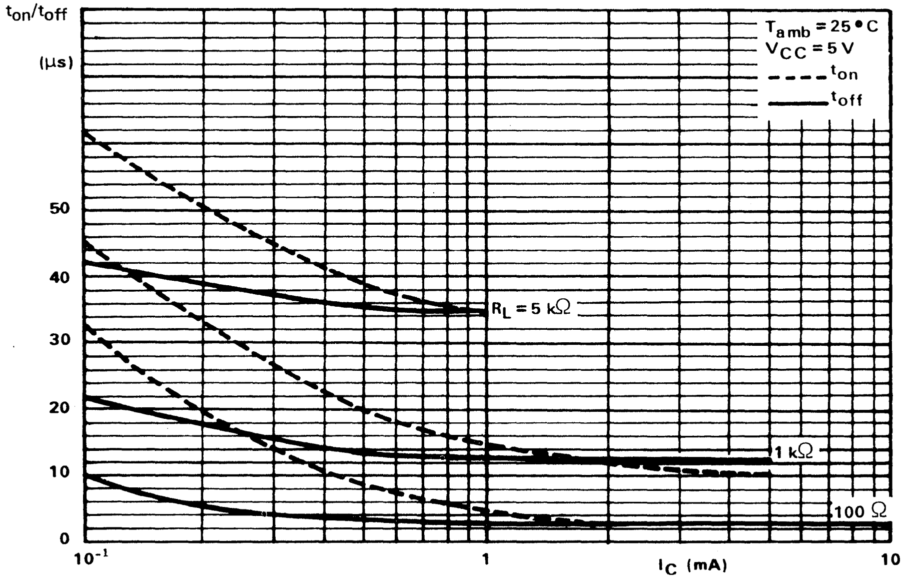


Fig. 17 Typical values.

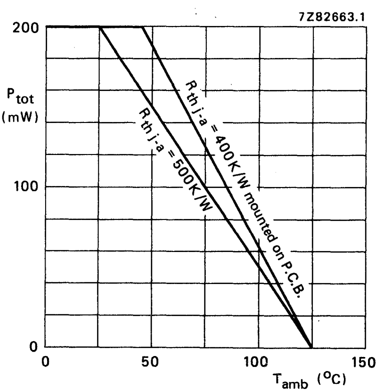


Fig. 18.

DEVELOPMENT DATA

HIGH-VOLTAGE OPTOCOUPLER

The CNX82 is an optocoupler consisting of an infrared emitting GaAs diode and a silicon n-p-n phototransistor in a dual-in-line (DIL) plastic envelope. The base is not connected.

Features

- high current transfer ratio and a low saturation voltage suitable for use with TTL integrated circuits
- high degree of a.c. and d.c insulation (3750 V r.m.s. and 5300 V d.c.)
- working voltage of 2,5 kV (d.c.)

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83
Complied for reinforced isolation at 250 VAC with:
DIN 57 804/VDE 0804/1.83 (isolation group C)
DIN IEC 65/VDE 0860/8.81

QUICK REFERENCE DATA

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C when mounted on a p.c.b.	P_{tot}	max.	200 mW
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Total power dissipation up to T_{amb} = 25 °C when mounted on a p.c.b.	P_{tot}	max.	200 mW
Optocoupler			
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V	I_C/I_F	min.	0,4
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV I_F (diode) = 0 (see Fig. 4)	I_{CEW}	max.	200 nA
Collector-emitter saturation voltage I_F = 10 mA; I_C = 4 mA	V_{CEsat}	max.	0,4 V
Isolation voltage (d.c.)	V_{IORM}	min.	5,3 kV

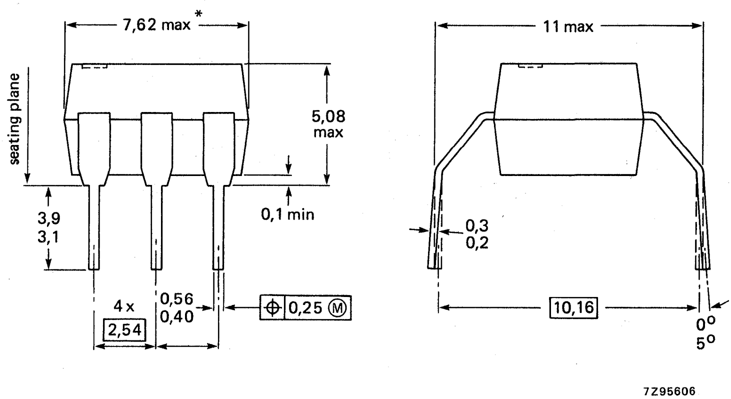
MECHANICAL DATA

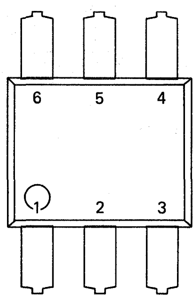
SOT-212 (see Fig. 1).

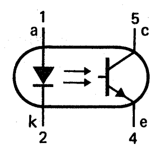
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-212.







The base is not connected.

* During 1986, the body length will be increased to max. 8,75 mm.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C when mounted on a p.c.b.	P_{tot}	max.	200 mW

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Emitter-collector voltage	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C when mounted on a p.c.b.	P_{tot}	max.	200 mW

DEVELOPMENT DATA

Optocoupler

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	125	°C
Soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260	°C

THERMAL RESISTANCE

From junction to ambient in free air				
diode	$R_{th\ j\text{-}a}$	max.	500	K/W
transistor	$R_{th\ j\text{-}a}$	max.	500	K/W
From junction to ambient when mounted on p.c.b.				
diode	$R_{th\ j\text{-}a}$	max.	400	K/W
transistor	$R_{th\ j\text{-}a}$	max.	400	K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	9,6	mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0	mm
Tracking resistance (KB-value)	V_{TR}		KB-100/A	

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Diode

Forward voltage $I_F = 10$ mA	V_F	typ.	1,15	V
		max.	1,50	V
Reverse current $V_R = 5$ V	I_R	max.	10	μA

Transistor

Collector-emitter breakdown voltage $I_C = 1$ mA	$V_{(BR)CEO}$	min.	50	V
Emitter-collector breakdown voltage $I_E = 0,1$ mA	$V_{(BR)ECO}$	min.	7	V
Collector cut-off current (dark); diode $I_F = 0$				
$V_{CE} = 10$ V	I_{CEO}	typ.	2	nA
		max.	50	nA
$V_{CE} = 10$ V; $T_{amb} = 70$ °C	I_{CEO}	max.	10	μA

Optocoupler

Output/input d.c. current transfer ratio (C.T.R.)				
$I_F = 10$ mA; $V_{CE} = 0,4$ V	I_C/I_F	min.	0,4	
		typ.	0,8	
$I_F = 10$ mA; $V_{CE} = 5$ V	I_C/I_F	typ.	1,5	
Collector cut-off current (light)				
$T_{amb} \leq 70$ °C; $V_F = 0,8$ V; $V_{CE} = 15$ V	$I_{CE(L)}$	max.	15	μA
$T_{amb} \leq 70$ °C; $I_F = 2$ mA; $V_{CE} = 0,4$ V	$I_{CE(L)}$	min.	150	μA

Optocoupler (continued)

Collector - emitter saturation voltage I_F = 10 mA; I_C = 4 mA	V_{CEsat}	typ. max.	0,19 V 0,40 V
Collector cut-off current (dark) at working voltage V_W = 2,5 kV (d.c. value); V_{CC} = 10 V; T_j = 25 °C (see Fig. 4) * V_{CC} = 10 V; T_j = 70 °C (see Fig. 4) *	I_{CEW}	max. max.	200 nA 100 μA
Isolation voltage (see note 1)	V_{IORM}	min.	5,3 kV(d.c.) 3,75 kV(r.m.s.)
Capacitance between input and output V = 0; f = 1 MHz	C_{io}	typ.	0,6 pF
Insulation resistance between input and output V_{IO} = ± 1000 V	R_{IO}	min. typ.	10^{10} Ω 10^{12} Ω
Switching times (see Figs 2 and 3)			
Turn-on time I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω I_C = 2 mA; V_{CC} = 5 V; R_L = 1 kΩ	t_{on}	typ. typ.	3 μs 12 μs
Turn-off time I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω I_C = 2 mA; V_{CC} = 5 V; R_L = 1 kΩ	t_{off}	typ. typ.	3 μs 12 μs

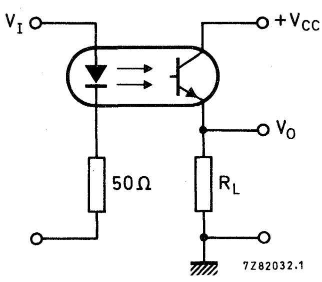


Fig. 2 Switching circuit.

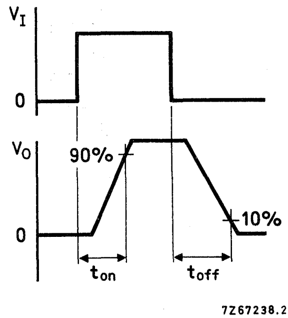


Fig. 3 Waveforms.

* The two parameters are tested on a sample basis for 1000 h.

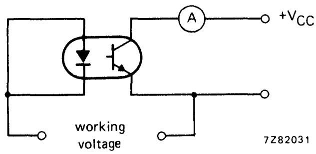


Fig. 4.

Note 1:

Every single product is tested by applying an isolation test voltage of 4500 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

DEVELOPMENT DATA

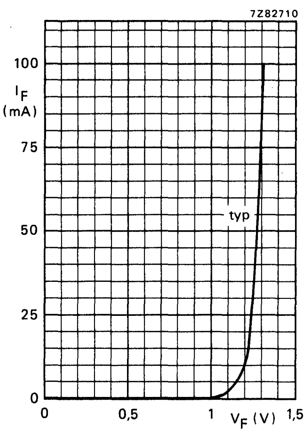


Fig. 5 T_{amb} = 25 °C.

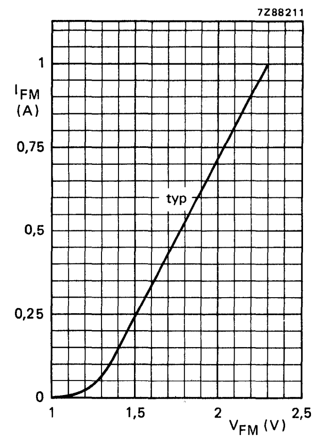


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01.

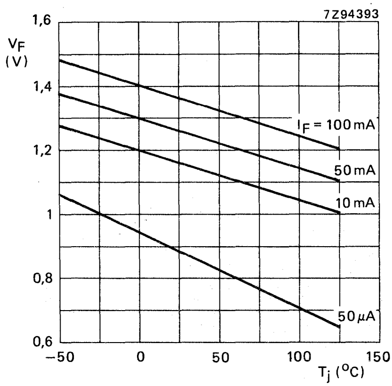


Fig. 7 Typical values.

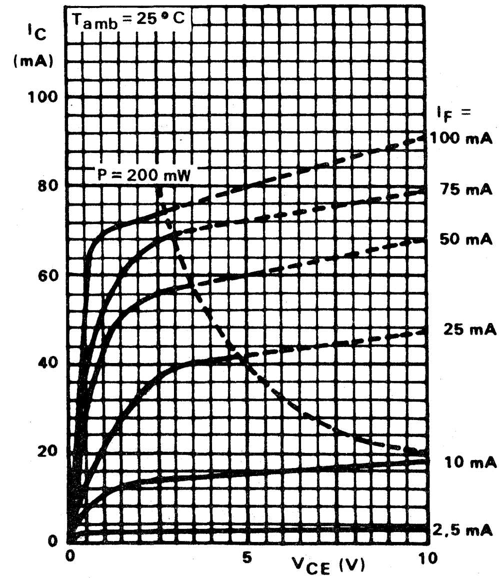


Fig. 8 Typical values.

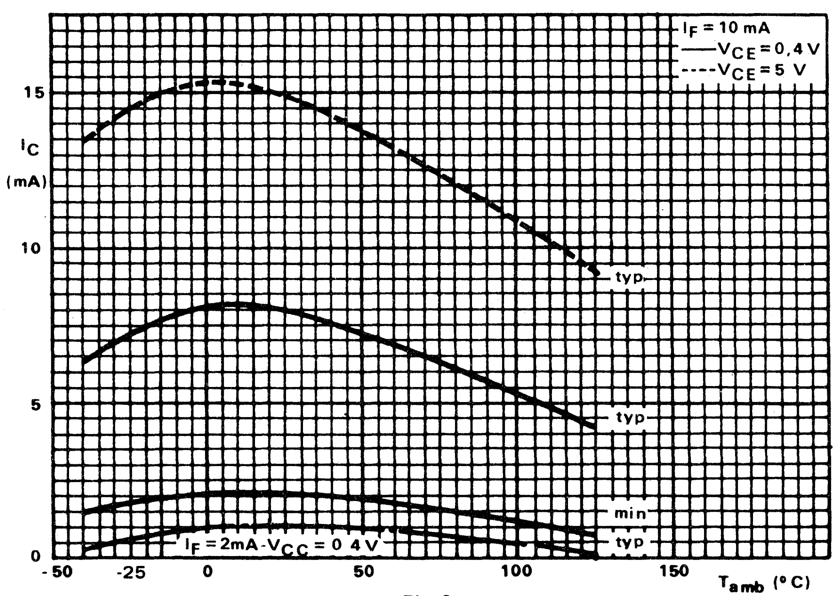


Fig. 9.

DEVELOPMENT DATA

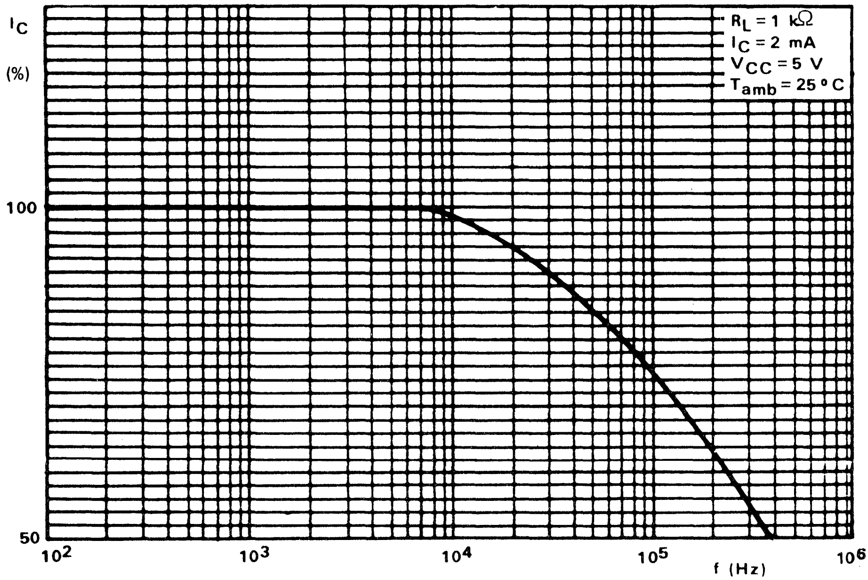


Fig. 10 Typical values.

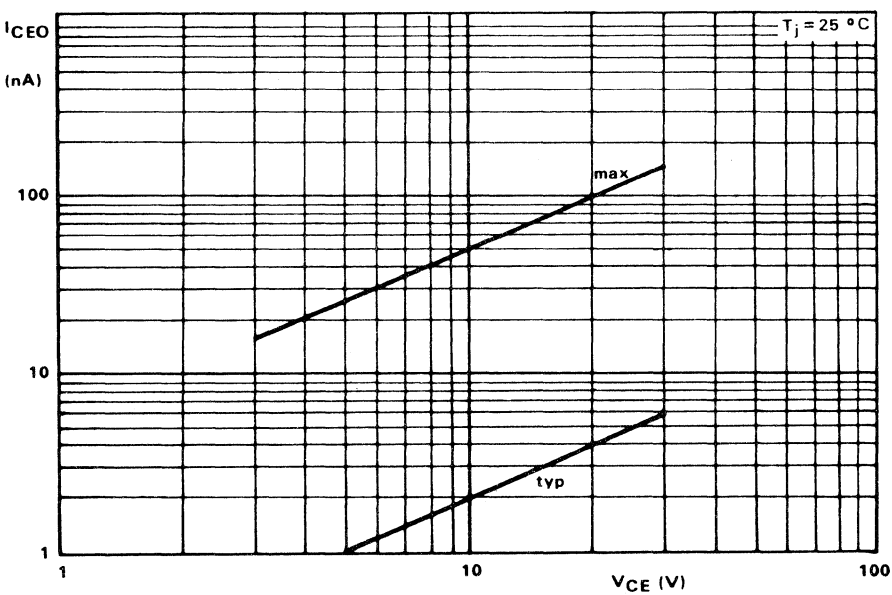


Fig. 11.

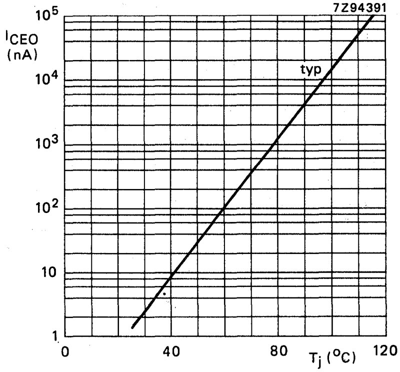


Fig. 12 $V_{CE} = 10$ V.

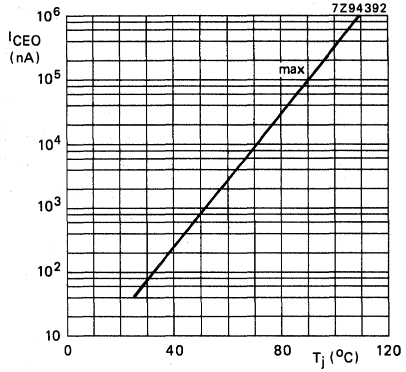


Fig. 13 $V_{CE} = 10$ V.

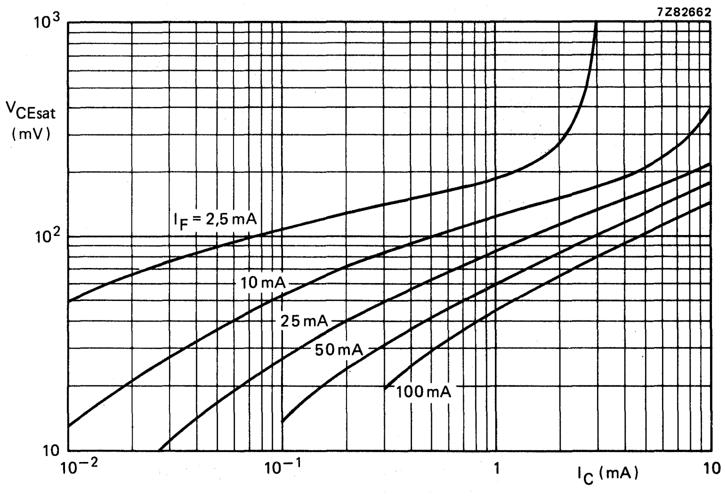


Fig. 14 $T_{amb} = 25$ °C; typical values.

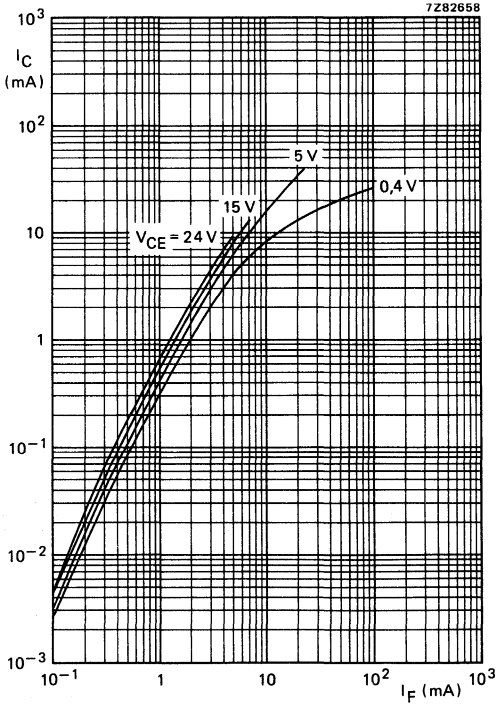


Fig. 15 T_{amb} = 25 °C; typical values.

DEVELOPMENT DATA

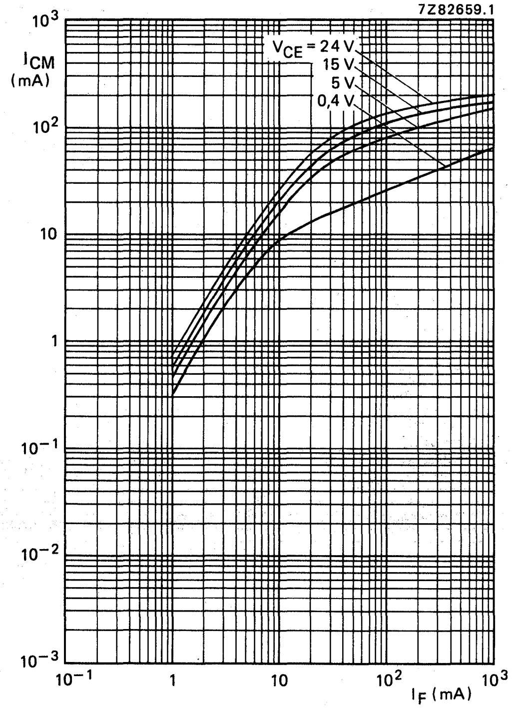


Fig. 16 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01; typical values.

Fig. 17 Typical values.

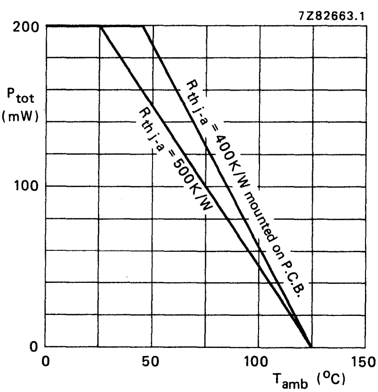


Fig. 18.

DEVELOPMENT DATA

HIGH-VOLTAGE OPTOCOUPLER

The CNX83 is an optocoupler consisting of an infrared emitting GaAs diode and a silicon n-p-n phototransistor in a dual-in-line (DIL) plastic envelope. The device is derived from the CNX82 but has the base connected.

Features

- high current transfer ratio and a low saturation voltage suitable for use with TTL integrated circuits
- high degree of a.c. and d.c. insulation (3750 V r.m.s. and 5300 V d.c.)
- working voltage of 2,5 kV (d.c.)

Requests for UL recognition and VDE approval are pending.

QUICK REFERENCE DATA

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 ^oC when mounted on a p.c.b.	P_{tot}	max.	200 mW
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Total power dissipation up to T_{amb} = 25 ^oC when mounted on a p.c.b.	P_{tot}	max.	200 mW
Optocoupler			
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 4 V	I_C/I_F	min.	0,4
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV I_F (diode) = 0 (see Fig. 4)	I_{CEW}	max.	200 nA
Collector-emitter saturation voltage I_F = 10 mA; I_C = 4 mA	V_{CEsat}	max.	0,4 V
Isolation voltage (d.c.)	V_{IORM}	min.	5,3 kV

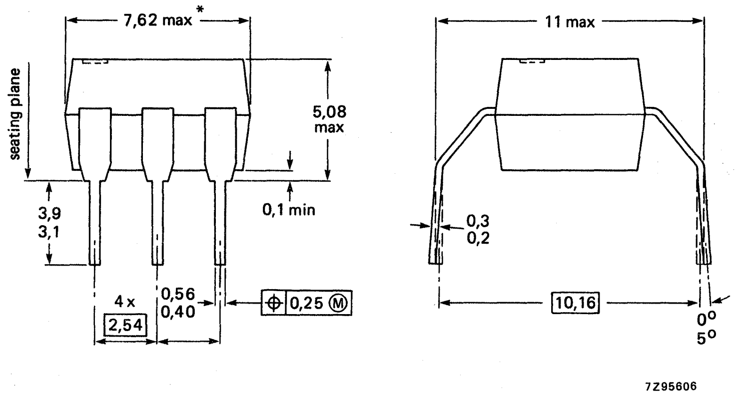
MECHANICAL DATA

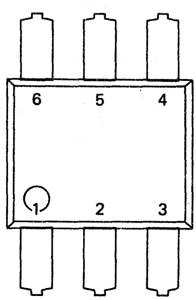
SOT-212 (see Fig. 1).

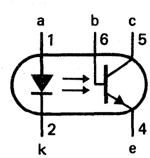
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-212.







* During 1986, the body length will be increased to max. 8,75 mm.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 ^oC when mounted on a p.c.b.	P_{tot}	max.	200 mW

Transistor

Collector-base voltage (open emitter)	V_{CBO}	max.	70 V
Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Emitter-collector voltage	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 ^oC when mounted on a p.c.b.	P_{tot}	max.	200 mW

DEVELOPMENT DATA

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Junction temperature	T_j	max.	125 °C
Soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	max.	500 K/W
transistor	$R_{th\ j\text{-}a}$	max.	500 K/W
From junction to ambient when mounted on p.c.b.			
diode	$R_{th\ j\text{-}a}$	max.	400 K/W
transistor	$R_{th\ j\text{-}a}$	max.	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	9,6 mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)			KB-100/A

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,15 V
		max.	1,50 V
Reverse current V_R = 5 V	I_R	max.	10 μA

Transistor

Collector-emitter breakdown voltage I_C = 1 mA	$V_{(BR)CEO}$	min.	50 V
Emitter-collector breakdown voltage I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V
Collector-base breakdown voltage at I_C = 0,1 mA	$V_{(BR)CBO}$	min.	70 V
Collector cut-off current (dark); diode I_F = 0			
V_{CE} = 10 V	I_{CEO}	typ.	2 nA
		max.	50 nA
V_{CE} = 10 V; T_{amb} = 70 °C	I_{CEO}	max.	10 μA
V_{CB} = 10 V; T_{amb} = 25 °C	I_{CBO}	max.	20 nA

Optocoupler

Output/input d.c. current transfer ratio (C.T.R.)			
I_F = 10 mA; V_{CE} = 0,4 V	I_C/I_F	min.	0,4
		typ.	0,8
I_F = 10 mA; V_{CE} = 5 V	I_C/I_F	typ.	1,5

Optocoupler (continued)

Collector cut-off current (light)			
$T_{amb} \leqslant 70\ ^oC$; $V_F = 0{,}8$ V; $V_{CE} = 15$ V	$I_{CE(L)}$	max.	15 μA
$T_{amb} \leqslant 70\ ^oC$; $I_F = 2$ mA; $V_{CE} = 0{,}4$ V	$I_{CE(L)}$	min.	150 μA
Collector-emitter saturation voltage			
$I_F = 10$ mA; $I_C = 4$ mA	V_{CEsat}	typ.	0,19 V
		max.	0,40 V
Collector cut-off current (dark) at working voltage $V_W = 2{,}5$ kV (d.c. value);			
$V_{CC} = 10$ V; $T_j = 25\ ^oC$ (see Fig. 4)	I_{CEW}	max.	200 nA *
$V_{CC} = 10$ V; $T_j = 70\ ^oC$ (see Fig. 4)	I_{CEW}	max.	100 μA *
Isolation voltage (see note 1)	V_{IORM}	max.	5,3 kV(d.c.)
			3,75 kV(r.m.s.)
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_{bc}	typ.	4,5 pF
Capacitance between input and output			
V = 0; f = 1 MHz	C_{io}	typ.	0,6 pF
Insulation resistance between input and output			
$V_{IO} = \pm 1000$ V	R_{IO}	min.	10^{10} Ω
		typ.	10^{12} Ω
Switching times (see Figs 2 and 3)			
Turn-on time			
$I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 100\ \Omega$	t_{on}	typ.	3 μs
$I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1\ k\Omega$	t_{on}	typ.	12 μs
Turn-off time			
$I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 100\ \Omega$	t_{off}	typ.	3 μs
$I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1\ k\Omega$	t_{off}	typ.	12 μs

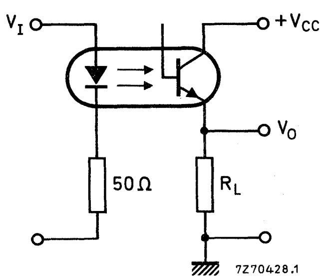


Fig. 2 Switching circuit.

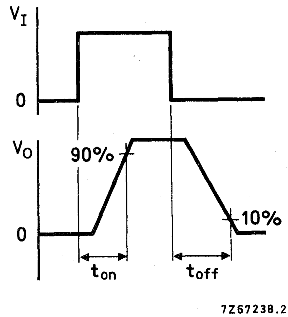


Fig. 3 Waveforms.

* The two parameters are tested on a sample basis for 1000 h.

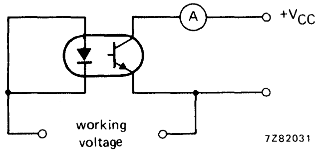


Fig. 4.

Note 1:

Every single product is tested by applying an isolation test voltage of 4500 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

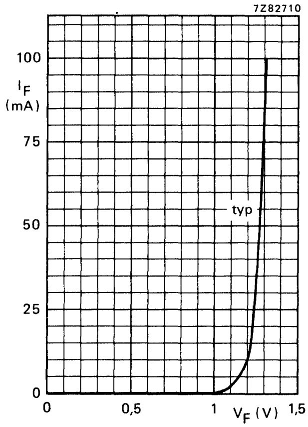


Fig. 5 T_{amb} = 25 °C.

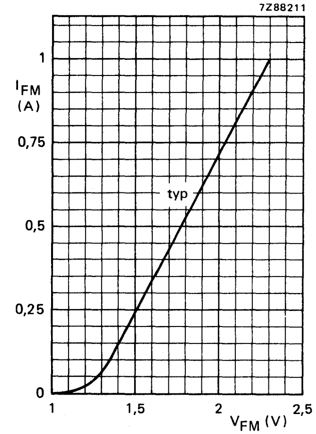


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01.

DEVELOPMENT DATA

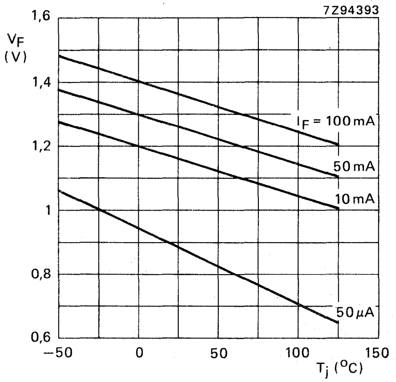


Fig. 7 Typical values.

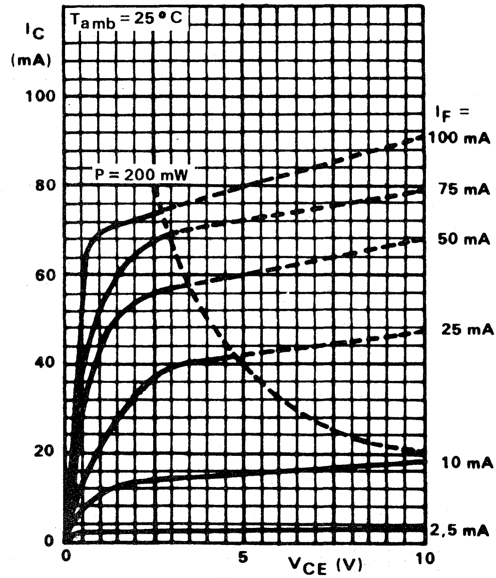


Fig. 8 Typical values.

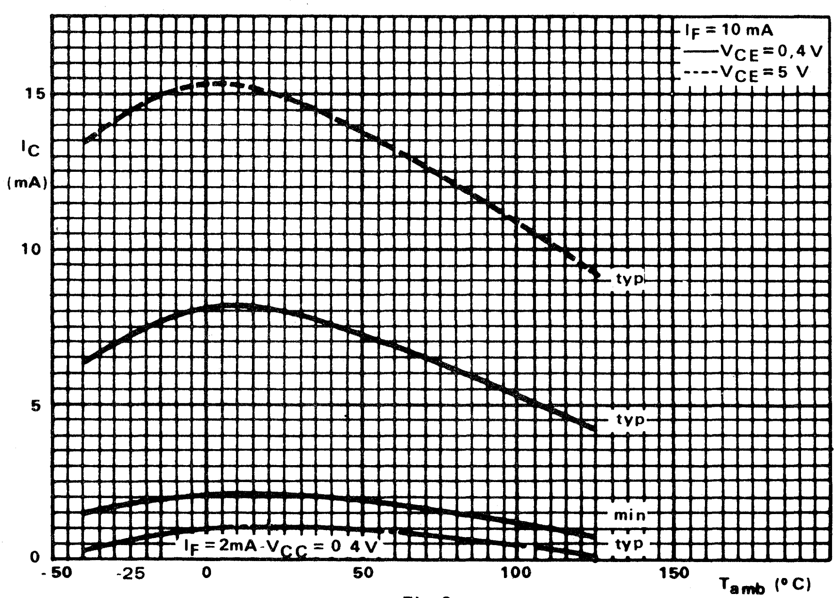


Fig. 9.

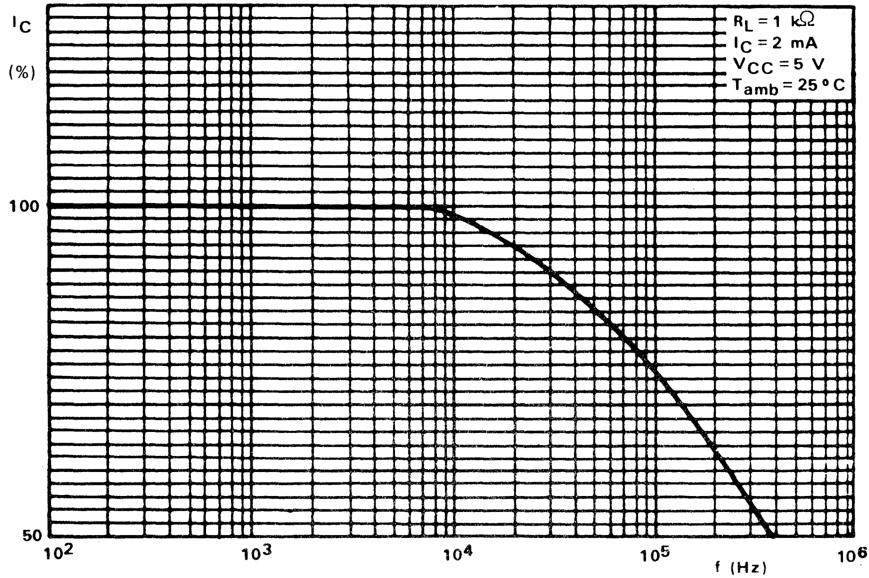


Fig. 10 Typical values.

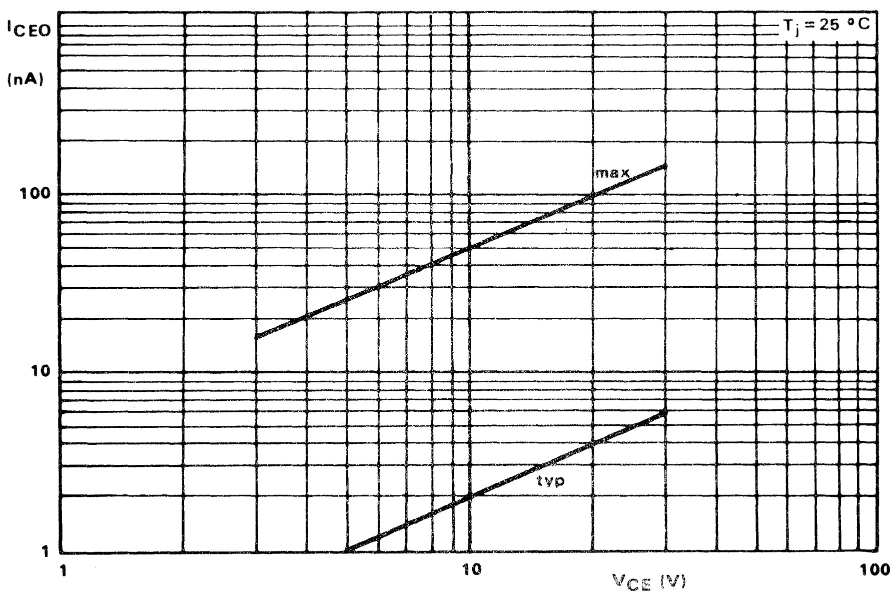


Fig. 11.

DEVELOPMENT DATA

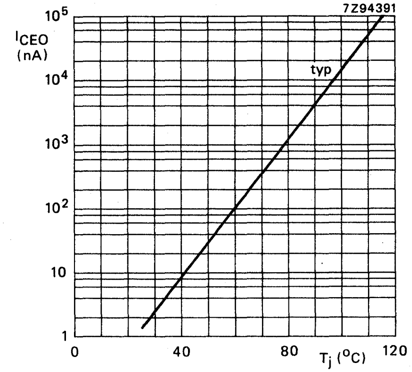


Fig. 12 V_{CE} = 10 V.

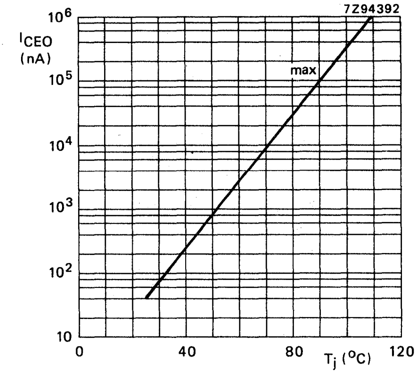


Fig. 13 V_{CE} = 10 V.

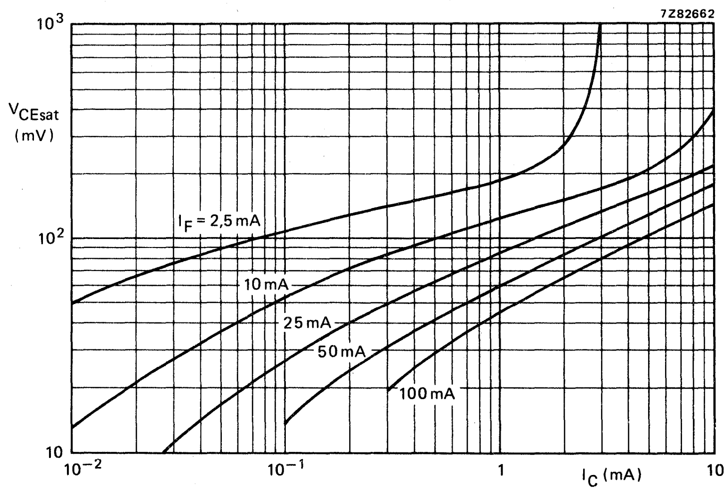


Fig. 14 T_{amb} = 25 °C; typical values.

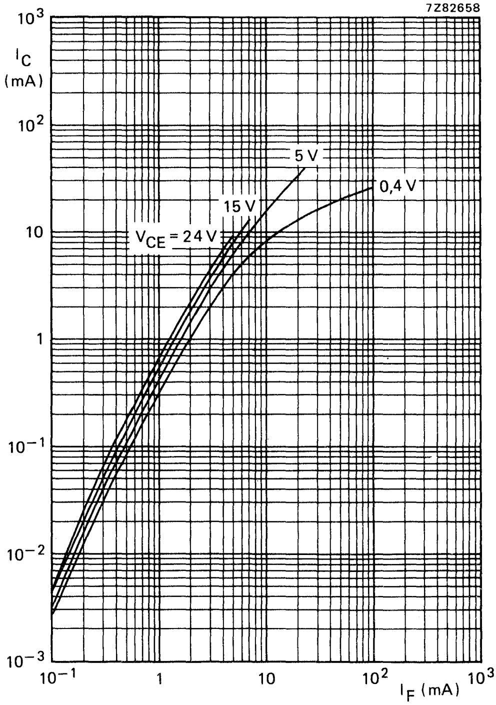


Fig. 15 T_{amb} = 25 °C; typical values.

DEVELOPMENT DATA

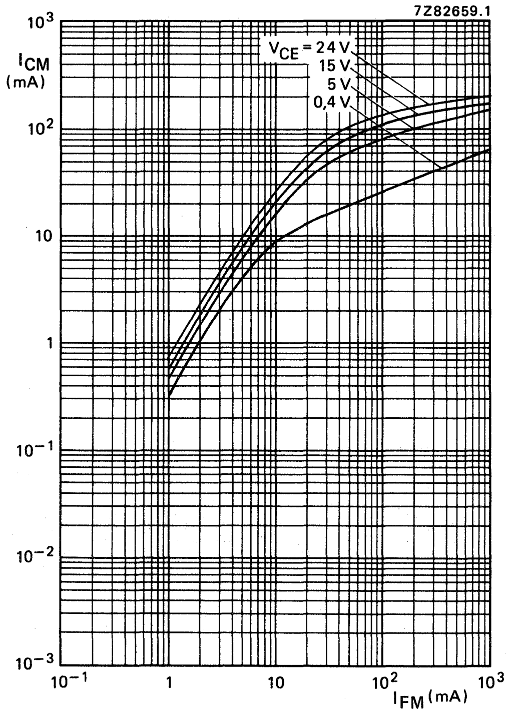


Fig. 16 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01; typical values.

DEVELOPMENT DATA

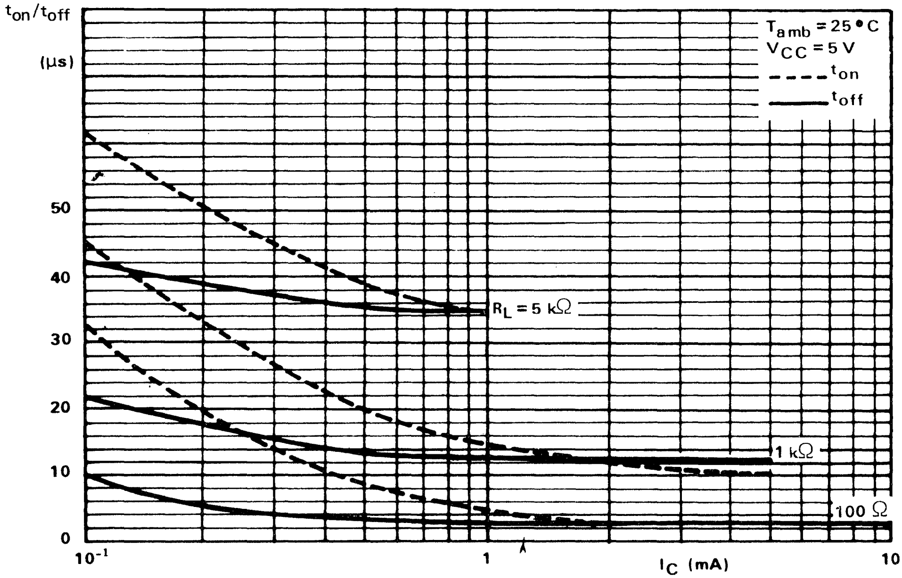


Fig. 17 Typical values.

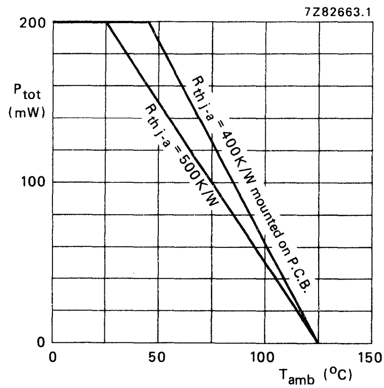


Fig. 18.

OPTOCOUPLERS

Optically coupled isolators consisting of an infrared emitting GaAs diode and a silicon n-p-n photo-transistor with accessible base. Plastic envelopes. Suitable for TTL integrated circuits.

Features of these products:

- high output/input d.c. current transfer ratio;
- low saturation voltage;
- high isolation voltage of 3,12 kV (r.m.s.) and 4,4 kV (d.c.);
- working voltage 2,5 kV (d.c.)

QUICK REFERENCE DATA

Diode				
Continuous reverse voltage		V_R	max.	5 V
Forward current				
d.c.		I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01		I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	200 mW
Transistor				
Collector-emitter voltage (open base)		V_{CEO}	max.	30 V
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	200 mW
Photocoupler				
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V; (I_B = 0)	**CNY57**	I_C/I_F	min.	0,2
	CNY57A	I_C/I_F	min.	0,4
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV diode: I_F = 0 (see also Fig. 2)		I_{CEW}	max.	200 nA
Isolation voltage (d.c.)		V_{IORM}	min.	4,4 kV

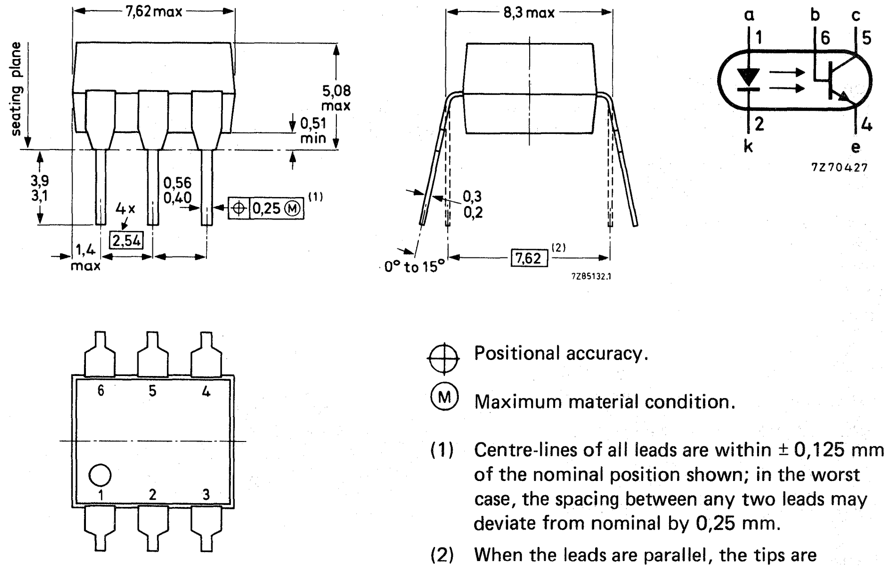
MECHANICAL DATA

SOT-90B (see Fig. 1).

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.



⊕ Positional accuracy.

Ⓜ Maximum material condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Operating junction temperature	T_j	max.	125	°C

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	70	V
Emitter-collector voltage (open base)	V_{ECO}	max.	7	V
Collector current (d.c.)	I_C	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Operating junction temperature	T_j	max.	125	°C

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	=	500 K/W
transistor	$R_{th\ j\text{-}a}$	=	500 K/W
From junction to ambient, device mounted on a printed-circuit board			
diode	$R_{th\ j\text{-}a}$	=	400 K/W
transistor	$R_{th\ j\text{-}a}$	=	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2 mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)			KB-100/A

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,15 V
		<	1,5 V
Reverse current V_R = 5 V	I_R	<	10 μA

Transistor (diode: I_F = 0)

Collector cut-off current (dark) V_{CE} = 10 V	I_{CEO}	typ.	2 nA
		<	50 nA
V_{CE} = 10 V; T_{amb} = 70 °C	I_{CEO}	<	10 μA
V_{CB} = 10 V	I_{CBO}	<	20 nA

Optocoupler (I_B = 0)*

Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V	CNY57	I_C/I_F		0,2 to 0,8
			typ.	0,5
	CNY57A	I_C/I_F	>	0,4
			typ.	1

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

Collector cut-off current (dark) see Fig. 2					
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV	I_{CEW}	<	200		nA
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV; T_j = 70 °C	I_{CEW}	<	100		μA

			CNY57	CNY57A	
Collector-emitter breakdown voltage I_C = 1 mA	$V_{(BR)CEO}$	min.	30	30	V
Collector-base breakdown voltage I_C = 0,1 mA	$V_{(BR)CBO}$	min.	70	70	V
Emitter-collector breakdown voltage I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7	7	V
Collector-emitter saturation voltage I_F = 10 mA; I_C = 2 mA	V_{CEsat}	typ.	0,15	–	
		<	0,4	–	V
I_F = 10 mA; I_C = 4 mA	V_{CEsat}	typ.	–	0,19	V
		<	–	0,4	V
Isolation voltage*	V_{IORM}	min.	4,4	4,4	kV (d.c.)
			3,12	3,12	kV (r.m.s.)
Capacitance between input and output I_F = 0; V = 0; f = 1 MHz	C_{io}	typ.	0,6	0,6	pF
Output capacitance at F = 1 MHz V_{CB} = 10 V	C_{bc}	typ.	4,5	4,5	pF
Insulation resistance between input and output ± V_{IO} = 1 kV	r_{IO}	>	10^{10}	10^{10}	Ω
		typ.	10^{12}	10^{12}	Ω
Switching times (see Figs 3 and 4) I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.	3	–	μs
Turn-off time	t_{off}	typ.	3	–	μs
I_{Con} = 4 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.	–	5	μs
Turn-off time	t_{off}	typ.	–	5	μs

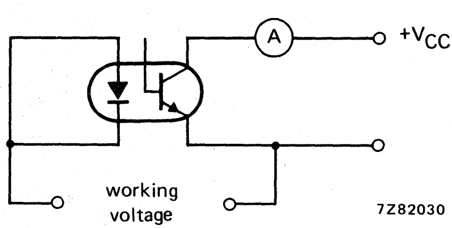


Fig. 2.

* Tested on a sample basis with a voltage of 4400 V (d.c.) for 1 minute between the shorted input (diode) leads and the shorted output (phototransistor) leads.

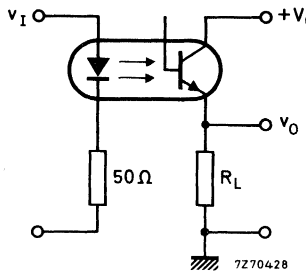


Fig. 3 Switching circuit.

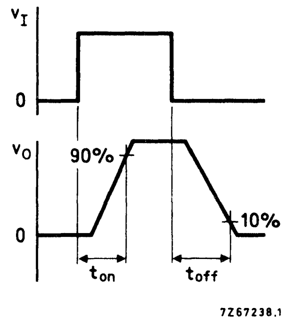


Fig. 4 Waveforms.

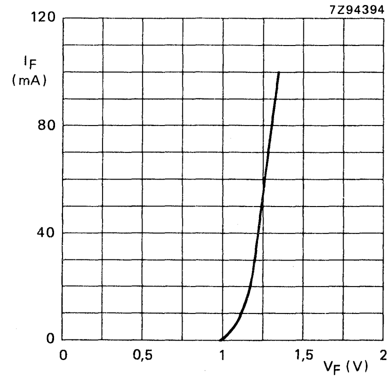


Fig. 5 T_{amb} = 25 °C; typical values.

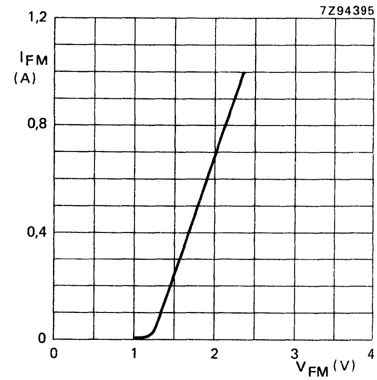


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01; typical values.

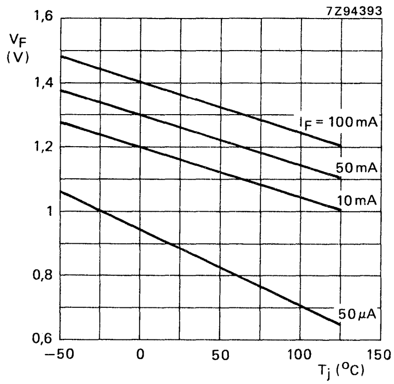


Fig. 7 Typical values.

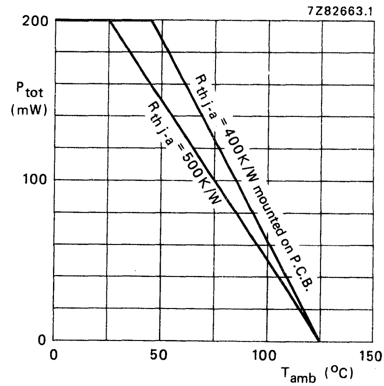


Fig. 8

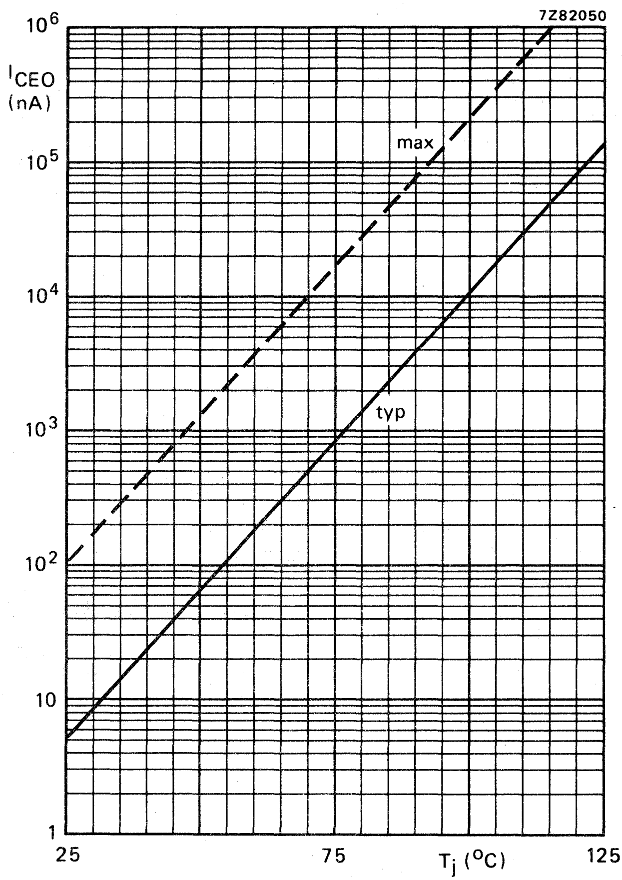


Fig. 9 $I_F = 0$; $V_{CE} = 10$ V.

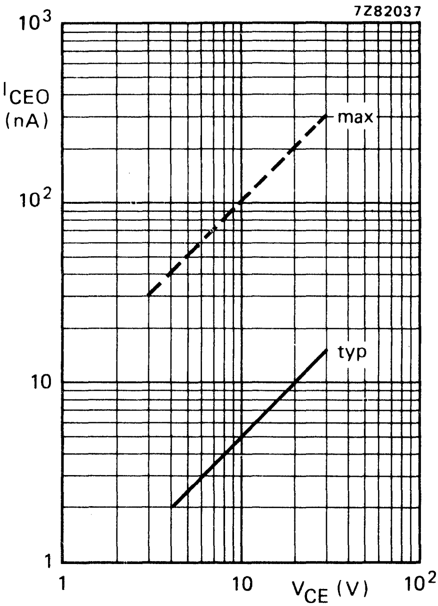


Fig. 10 $I_F = 0$; $T_j = 25\ ^oC$.

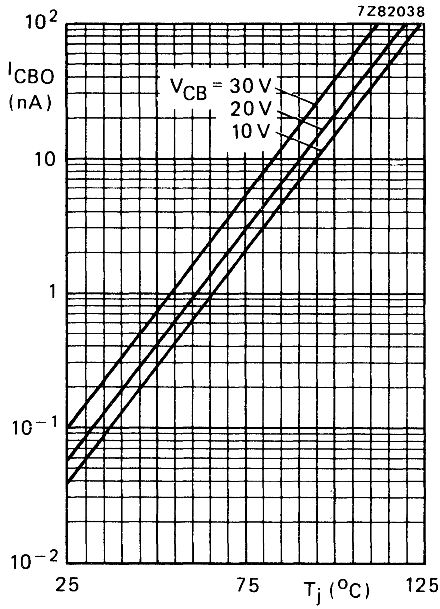


Fig. 11 $I_F = 0$; typical values.

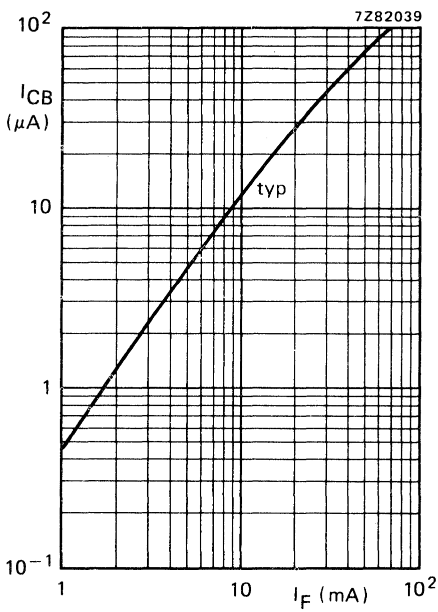


Fig. 12 $I_E = 0$; $V_{CB} = 5$ V; $T_{amb} = 25\ ^oC$.

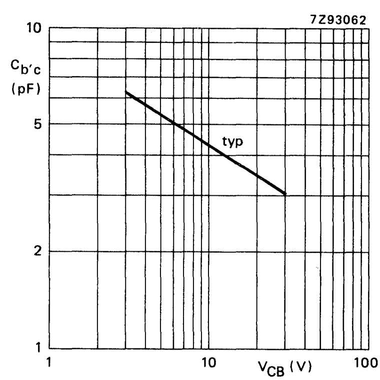


Fig. 13 f = 1 MHz.

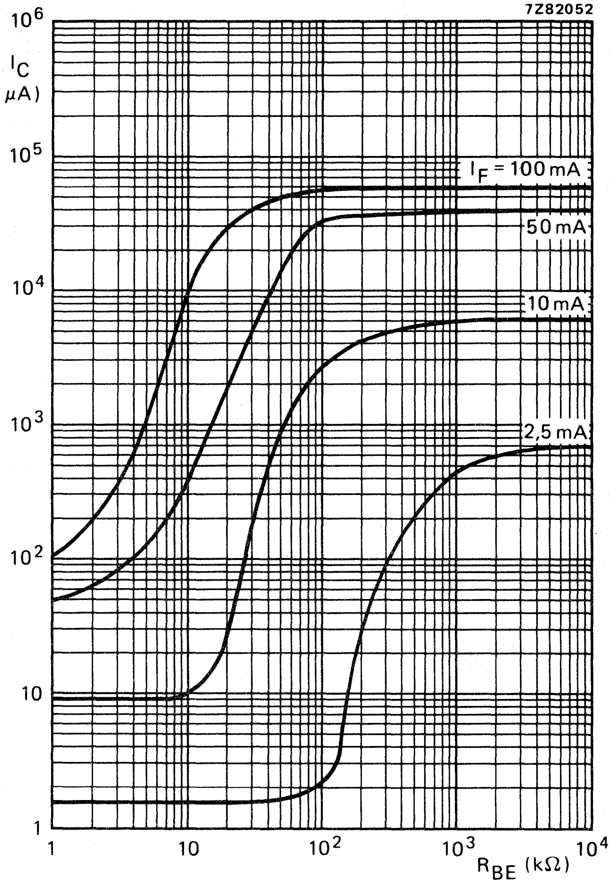


Fig. 14 **CNY57**; $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

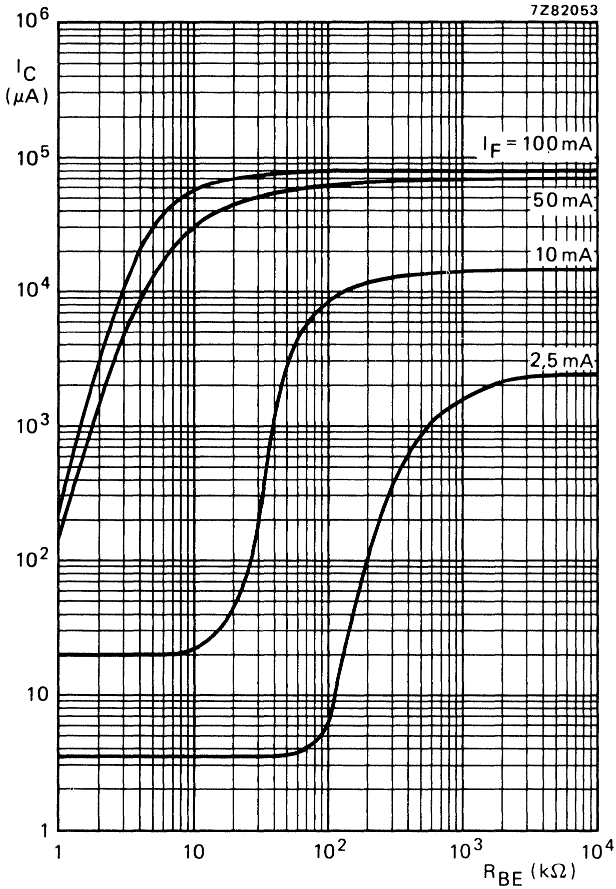


Fig. 15 **CNY57A**; $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

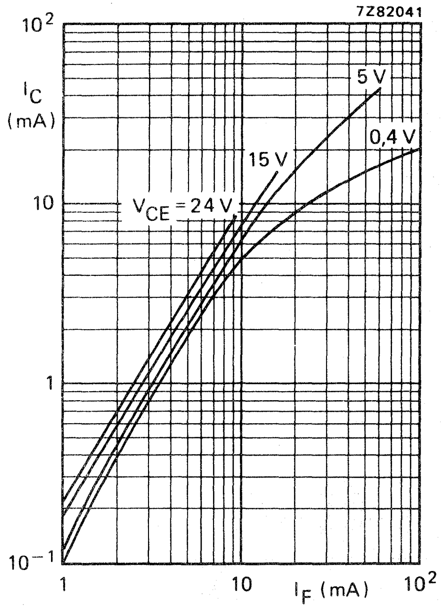


Fig. 16 **CNY57**; T_{amb} = 25 °C; typical values.

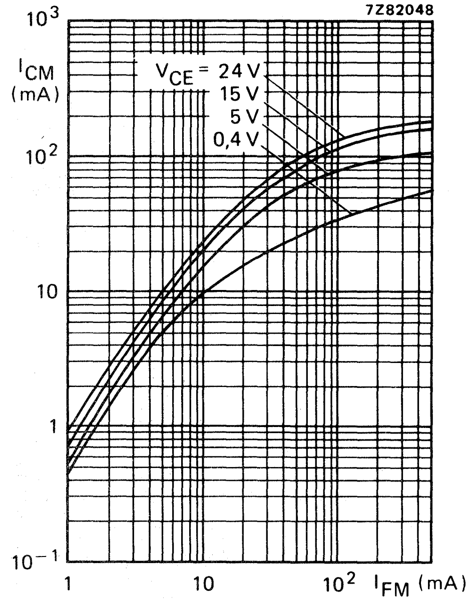


Fig. 17 **CNY57A**; T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms; typical values.

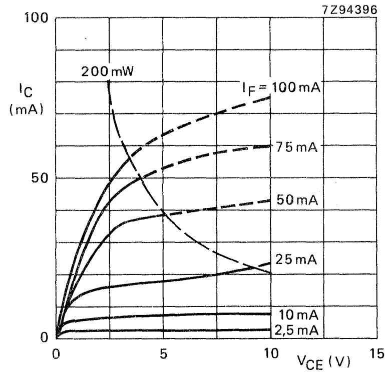


Fig. 18 **CNY57**; T_{amb} = 25 °C; typical values.

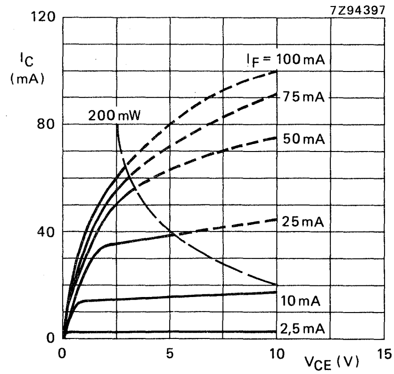


Fig. 19 **CNY57A; T_{amb} = 25 °C; typical values.**

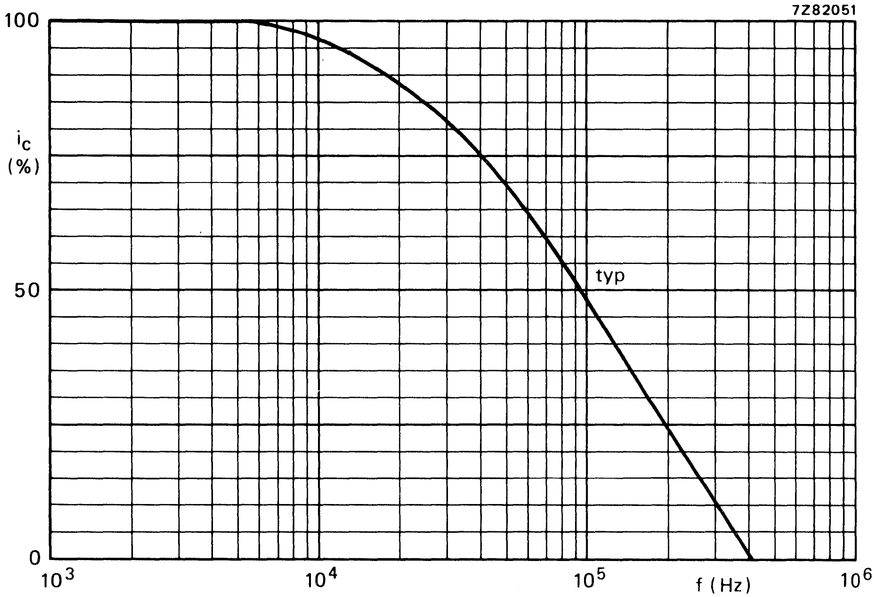


Fig. 20 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1$ kΩ; $T_{amb} = 25$ °C.

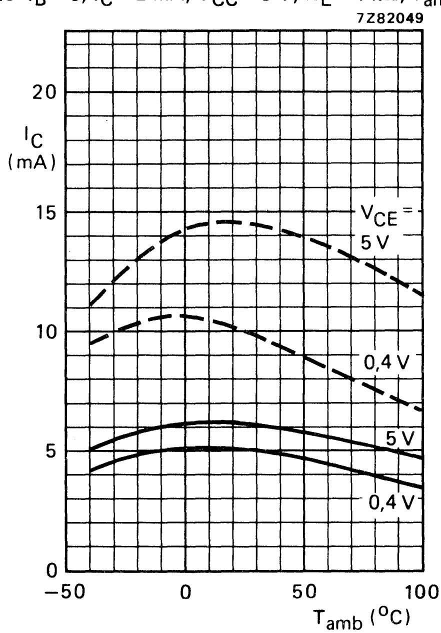


Fig. 21 —— **CNY57;** – – – **CNY57A;** $I_B = 0$; $I_F = 10$ mA; typical values.

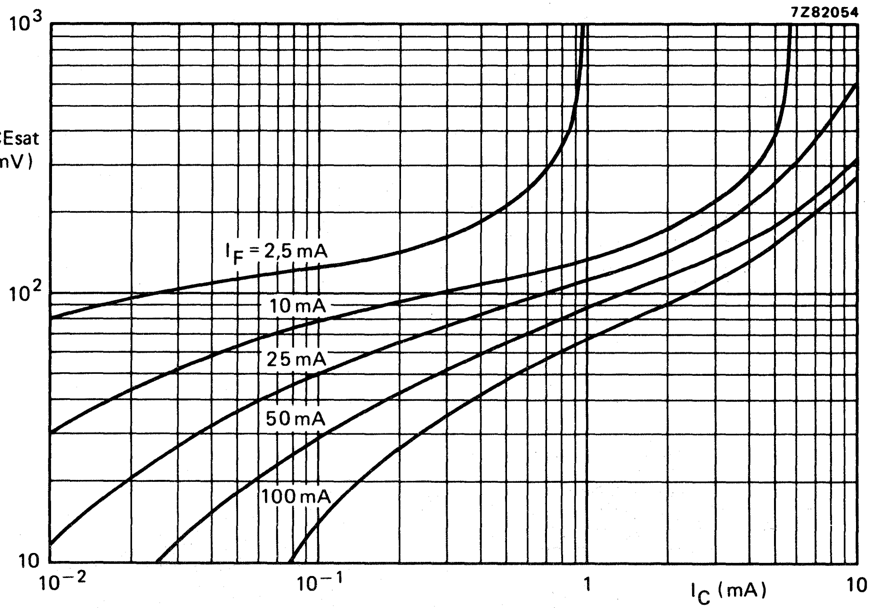


Fig. 22 **CNY57;** I_B = 0; T_{amb} = 25 °C; typical values.

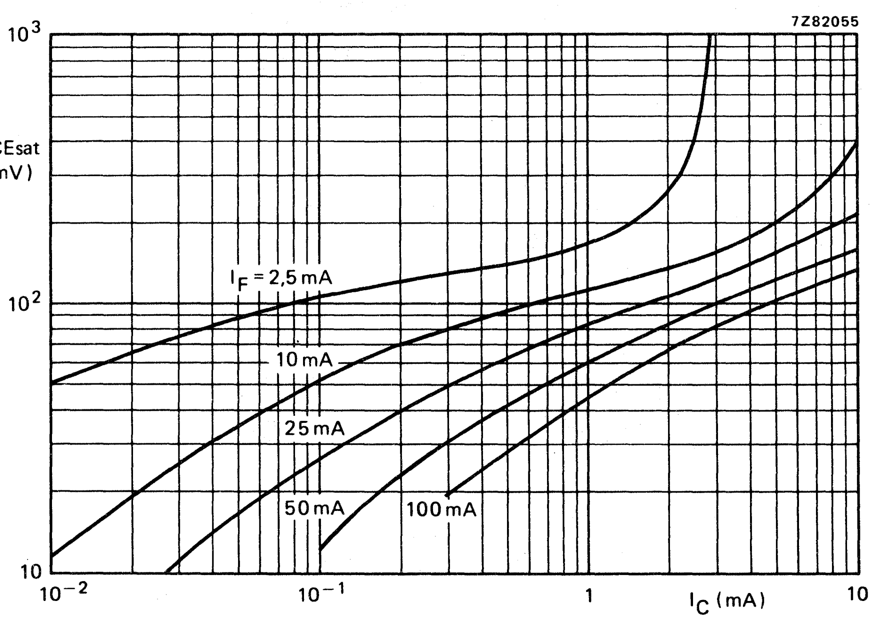


Fig. 23 **CNY57A;** I_B = 0; T_{amb} = 25 °C; typical values.

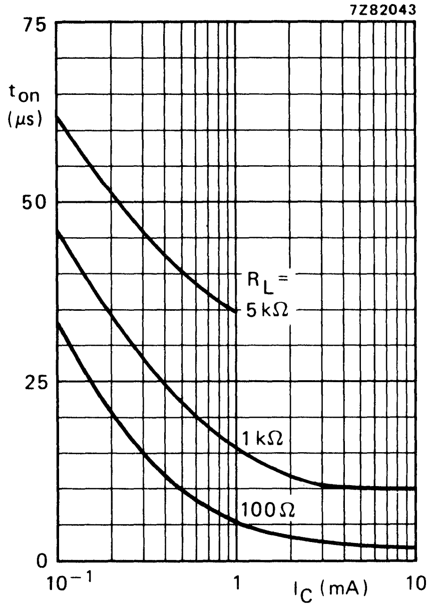


Fig. 24 **CNY57**; $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 26.)

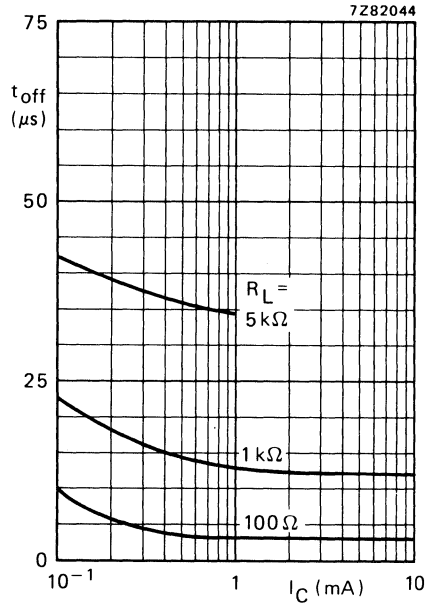


Fig. 25 **CNY57**; $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 26.)

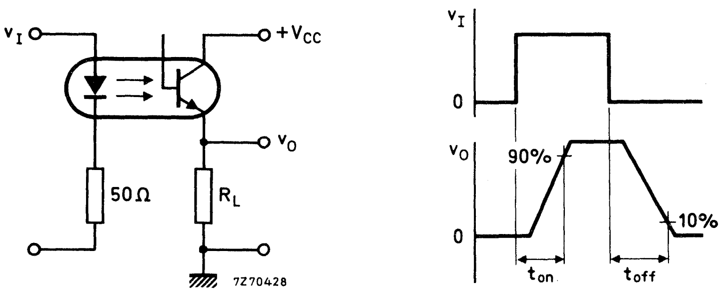


Fig. 26 Switching circuit and waveforms.

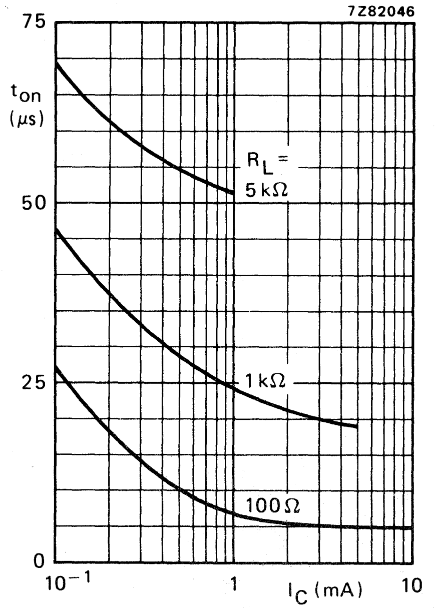


Fig. 27 **CNY57A**; $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 29.)

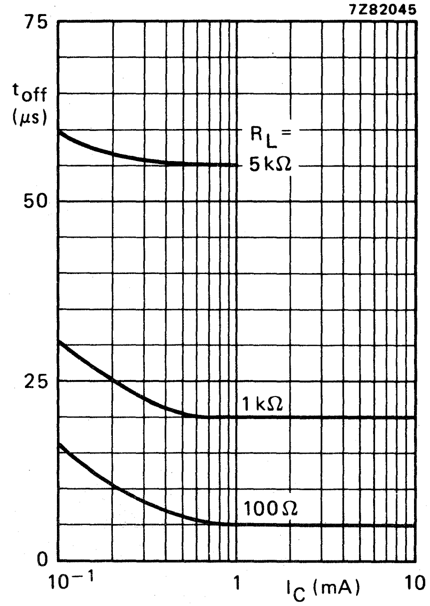


Fig. 28 **CNY57A**; $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 29.)

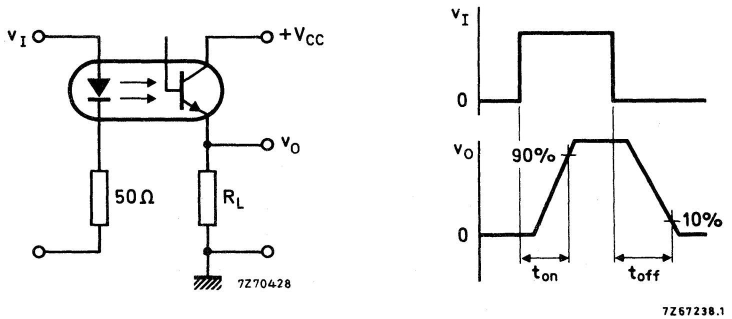


Fig. 29 Switching circuit and waveforms.

OPTOCOUPLERS

Optically coupled isolators consisting of an infrared emitting GaAs diode and a silicon n-p-n photo-transistor with accessible base. Plastic envelopes. Suitable for TTL integrated circuits.

Features of these produts:

- high output/input d.c. current transfer ratio;
- low saturation voltage;
- high isolation voltage of 3,12 kV (r.m.s.) and 4,4 kV (d.c.);
- working voltage 2,5 kV (d.c.).

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83
Complied for reinforced isolation at 250 VAC with:
DIN 57 804/VDE 0804/1.83 (isolation group C)
DIN IEC 65/VDE 0860/8.81

QUICK REFERENCE DATA

Diode					
Continuous reverse voltage		V_R	max.	5	V
Forward current					
d.c.		I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01		I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	200	mW
Transistor					
Collector-emitter voltage (open base)		V_{CEO}	max.	30	V
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	200	mW
Optocoupler					
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V; (I_B = 0)	**CNY57U**	I_C/I_F	min.	0,2	
	CNY57AU	I_C/I_F	min.	0,4	
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV diode: I_F = 0 (see also Fig. 2)		I_{CEW}	max.	200	nA
Isolation voltage (d.c.)		V_{IORM}	min.	4,4	kV

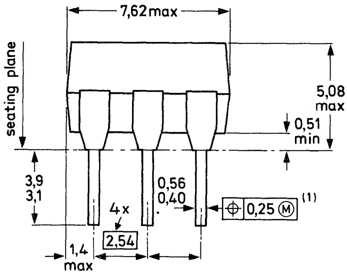
MECHANICAL DATA

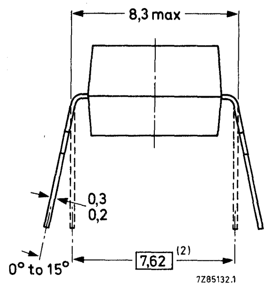
SOT-90B (see Fig. 1).

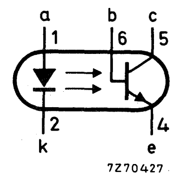
MECHANICAL DATA

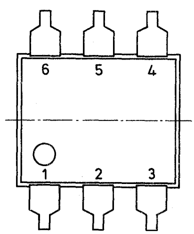
Dimensions in mm

Fig. 1 SOT-90B.









⊕ Positional accuracy.

Ⓜ Maximum material condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Operating junction temperature	T_j	max.	125	°C

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector-base voltage (open emitter)	V_{CBO}	max.	70	V
Emitter-collector voltage (open base)	V_{ECO}	max.	7	V
Collector current (d.c.)	I_C	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Operating junction temperature	T_j	max.	125	°C

Photocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	=	500 K/W
transistor	$R_{th\ j\text{-}a}$	=	500 K/W
From junction to ambient, device mounted on a printed-circuit board			
diode	$R_{th\ j\text{-}a}$	=	400 K/W
transistor	$R_{th\ j\text{-}a}$	=	400 K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2 mm
External tracking path (creepage dist) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)			KB-100/A

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,15 V
		<	1,5 V
Reverse current V_R = 5 V	I_R	<	10 μA

Transistor (diode: $I_F = 0$)

Collector cut-off current (dark) V_{CE} = 10 V	I_{CEO}	typ.	2 nA
		<	50 nA
V_{CE} = 10 V; T_{amb} = 70 °C	I_{CEO}	<	10 μA
V_{CB} = 10 V	I_{CBO}	<	20 nA

Photocoupler ($I_B = 0$)*

Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V	CNY57U	I_C/I_F		0,2 to 0,8
			typ.	0,5
	CNY57AU	I_C/I_F	>	0,4
			typ.	1

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

Collector cut-off current (dark) see Fig. 2					
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV	I_{CEW}	<	200		nA
V_{CC} = 10 V; working voltage (d.c.) = 2,5 kV; T_j = 70 °C	I_{CEW}	<	100		μA
			CNY57U	**CNY57AU**	
Collector-emitter breakdown voltage I_C = 1 mA	$V_{(BR)CEO}$	min.	30	30	V
Collector-base breakdown voltage I_C = 0,1 mA	$V_{(BR)CBO}$	min.	70	70	V
Emitter-collector breakdown voltage I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7	7	V
Collector-emitter saturation voltage I_F = 10 mA; I_C = 2 mA	V_{CEsat}	typ.	0,15	–	V
		<	0,4	–	V
I_F = 10 mA; I_C = 4 mA	V_{CEsat}	typ.	–	0,19	V
		<	–	0,4	V
Isolation voltage*	V_{IORM}	min.	4,4	4,4	kV(d.c.)
			3,12	3,12	kV(r.m.s.)
Capacitance between input and output I_F = 0; V = 0; f = 1 MHz	C_{io}	typ.	0,6	0,6	pF
Output capacitance at F = 1 MHz V_{CB} = 10 V	C_{bc}	typ.	4,5	4,5	pF
Insulation resistance between input and output ± V_{IO} = 1 kV	r_{IO}	>	10^{10}	10^{10}	Ω
		typ.	10^{12}	10^{12}	Ω
Switching times (see Figs 3 and 4)					
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.	3	–	μs
Turn-off time	t_{off}	typ.	3	–	μs
I_{Con} = 4 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.	–	5	μs
Turn-off time	t_{off}	typ.	–	5	μs

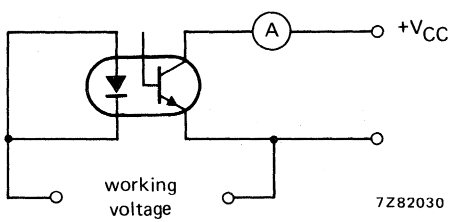


Fig. 2.

* Every single product is tested by applying an isolation test voltage of 3750 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

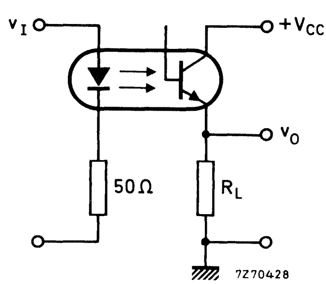


Fig. 3 Switching circuit.

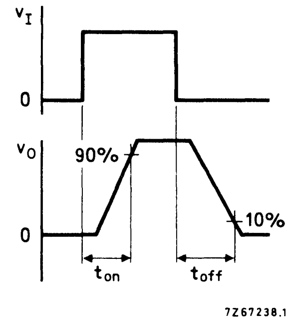


Fig. 4 Waveforms.

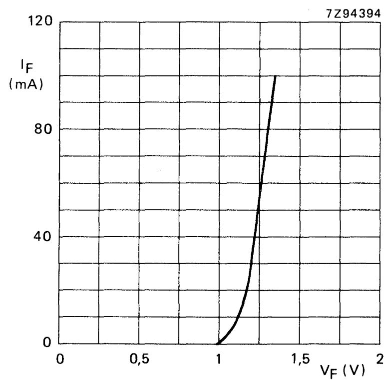


Fig. 5 T_{amb} = 25 °C; typical values.

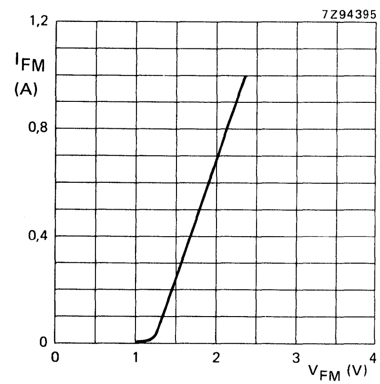


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01; typical values.

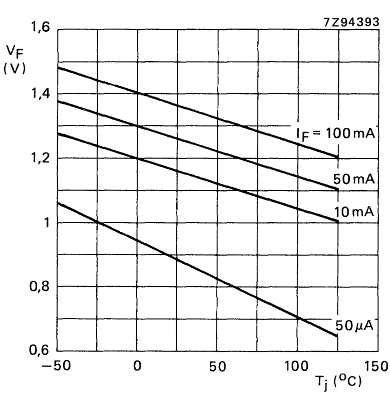


Fig. 7 Typical values.

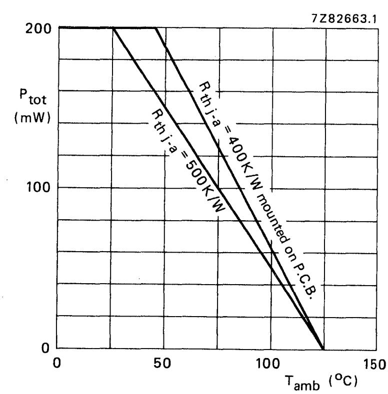


Fig. 8

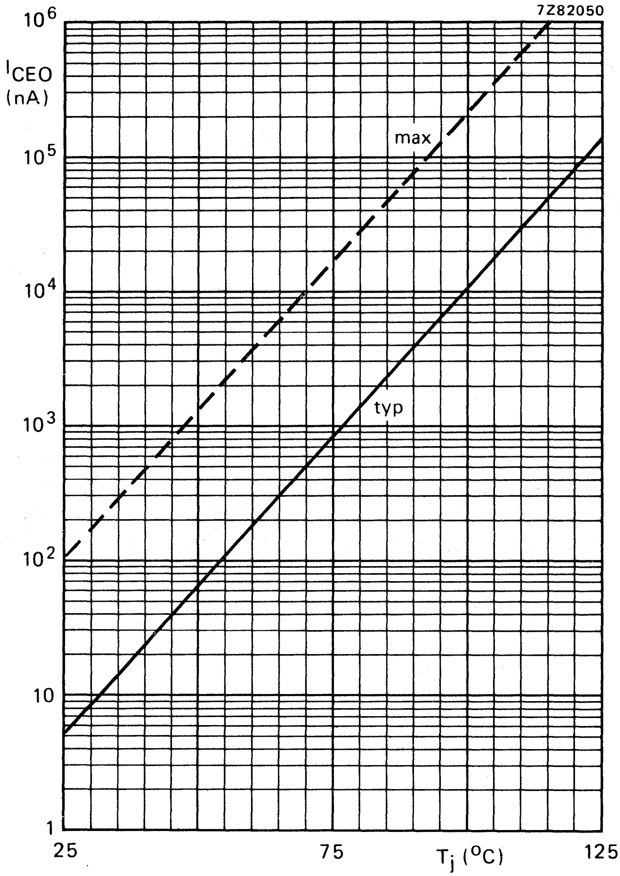


Fig. 9 $I_F = 0$; $V_{CE} = 10$ V.

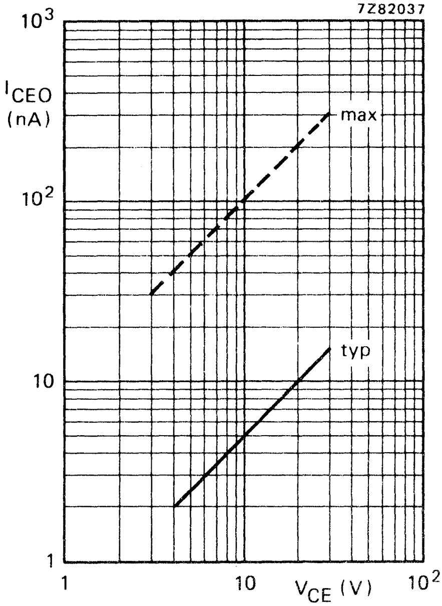


Fig. 10 $I_F = 0$; $T_j = 25\ ^oC$.

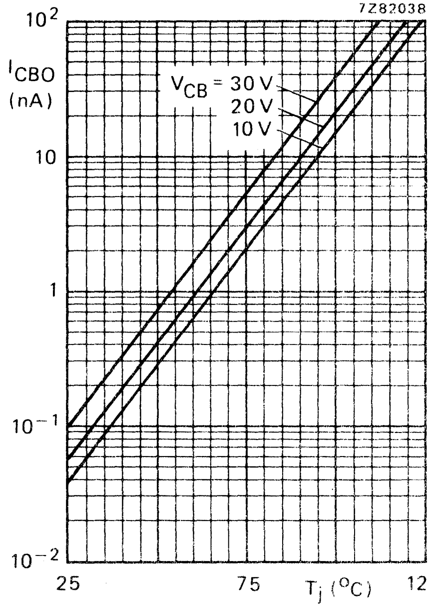


Fig. 11 $I_F = 0$; typical values.

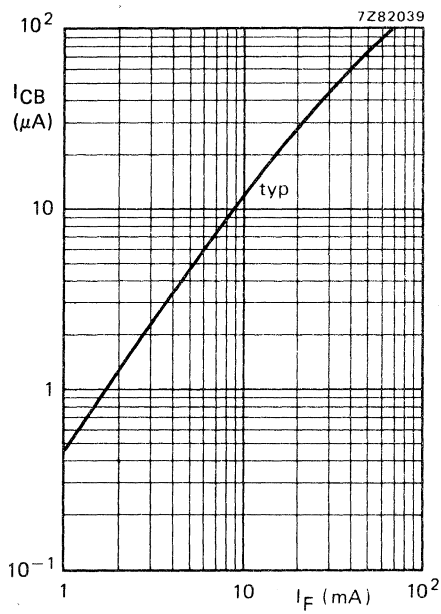


Fig. 12 $I_E = 0$; $V_{CB} = 5$ V; $T_{amb} = 25\ ^oC$.

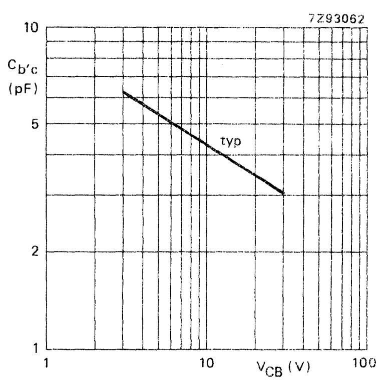


Fig. 13 f = 1 MHz.

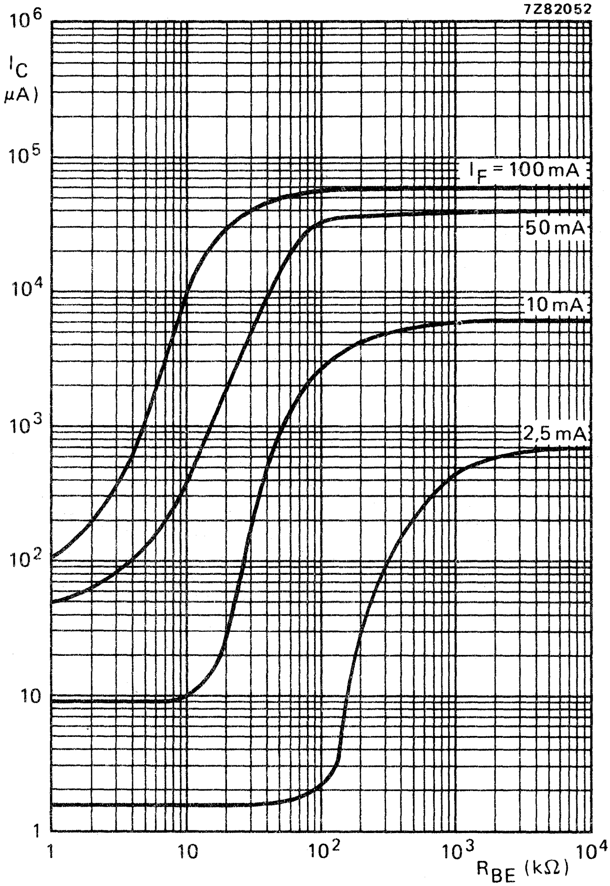


Fig. 14 **CNY57U**; $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

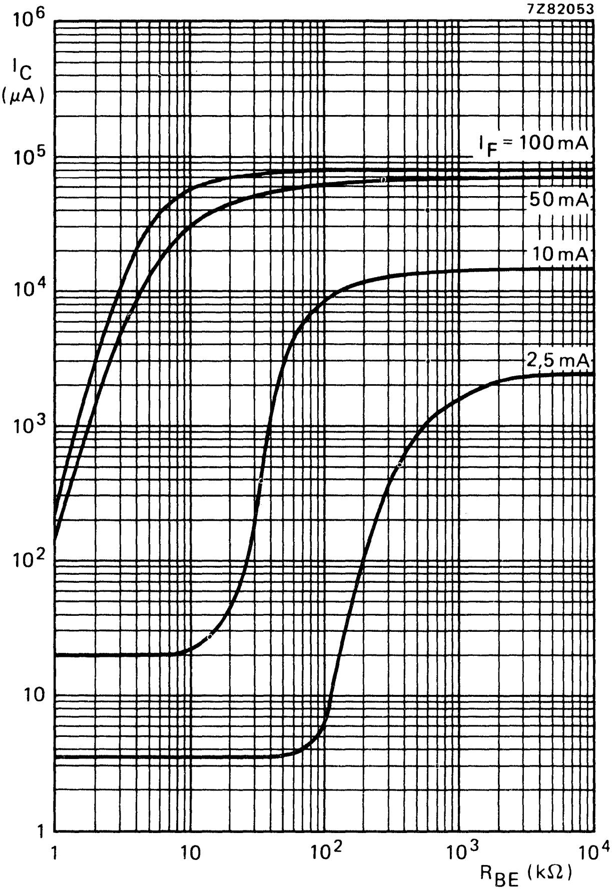


Fig. 15 **CNY57AU**; $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

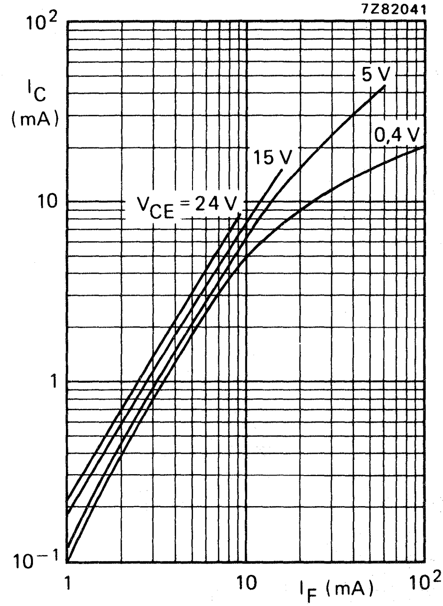


Fig. 16 **CNY57U**; T_{amb} = 25 °C; typical values.

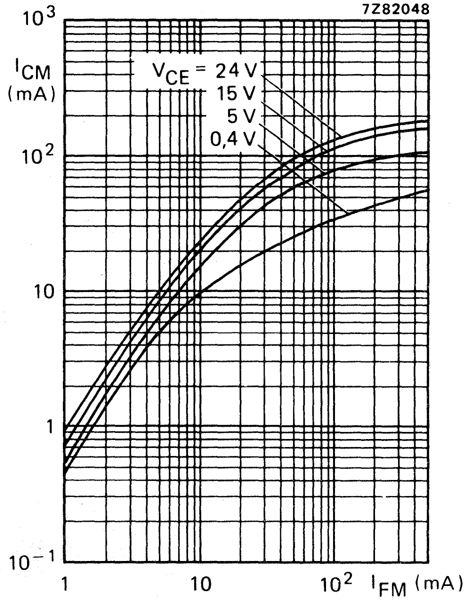


Fig. 17 **CNY57AU**; T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms; typical values.

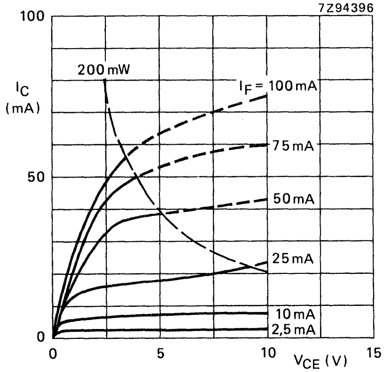


Fig. 18 **CNY57U**; T_{amb} = 25 °C; typical values.

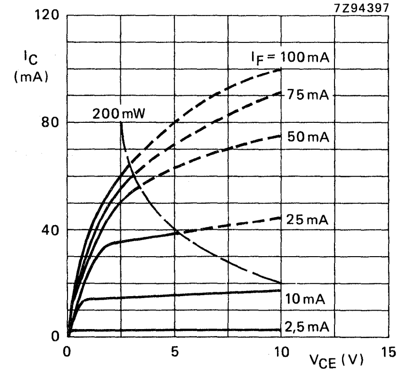


Fig. 19 **CNY57AU**; T_{amb} = 25 °C; typical values.

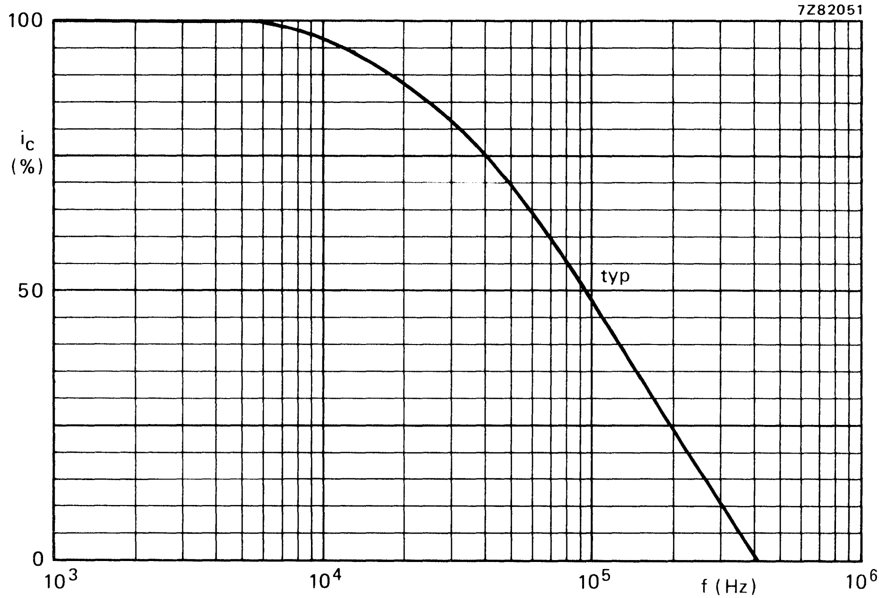


Fig. 20 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1$ kΩ; $T_{amb} = 25$ °C.

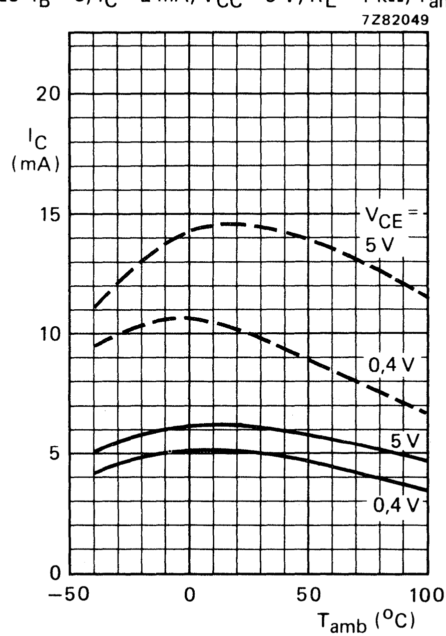


Fig. 21 ——— **CNY57U**; – – – **CNY57AU**; $I_B = 0$; $I_F = 10$ mA; typical values.

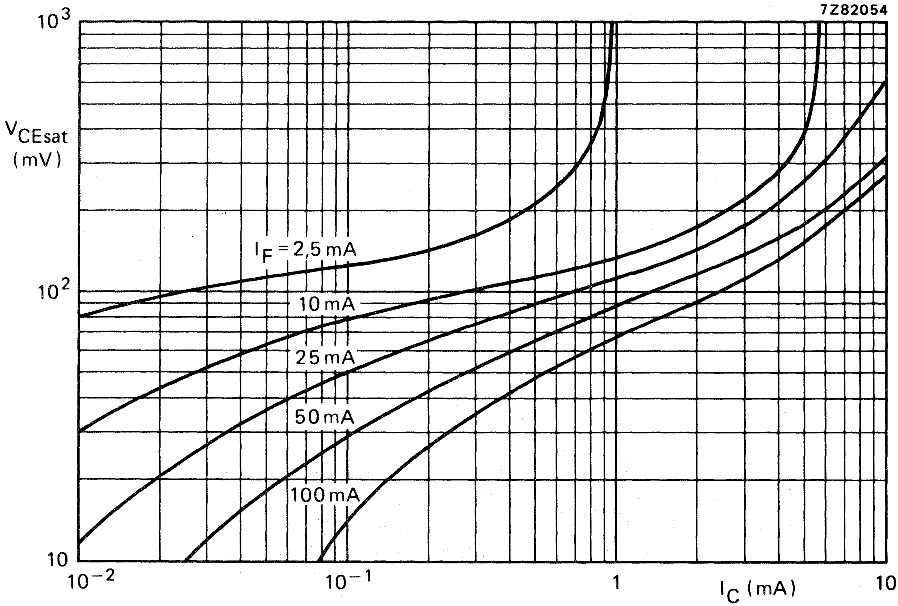


Fig. 22 **CNY57U**; $I_B = 0$; $T_{amb} = 25\ ^oC$; typical values.

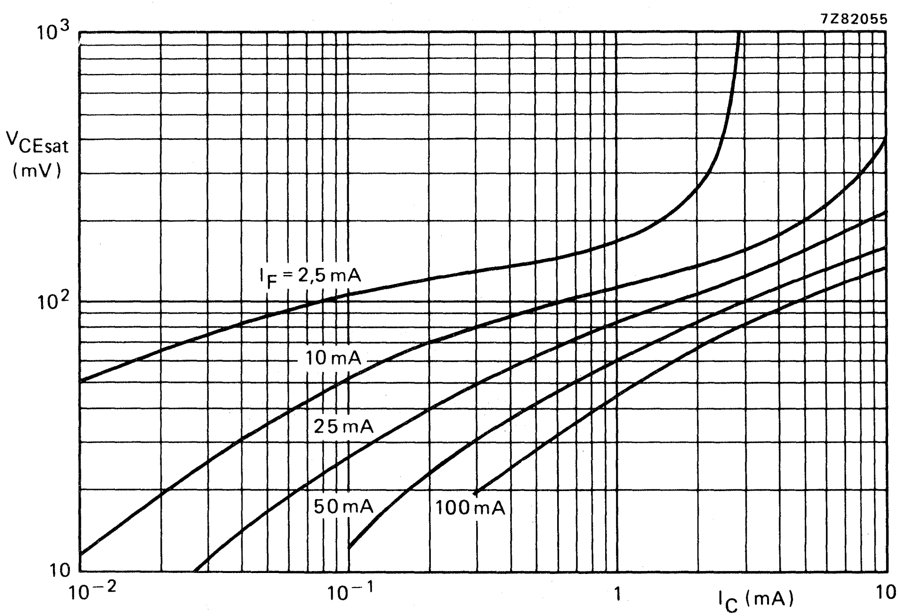


Fig. 23 **CNY57AU**; $I_B = 0$; $T_{amb} = 25\ ^oC$; typical values.

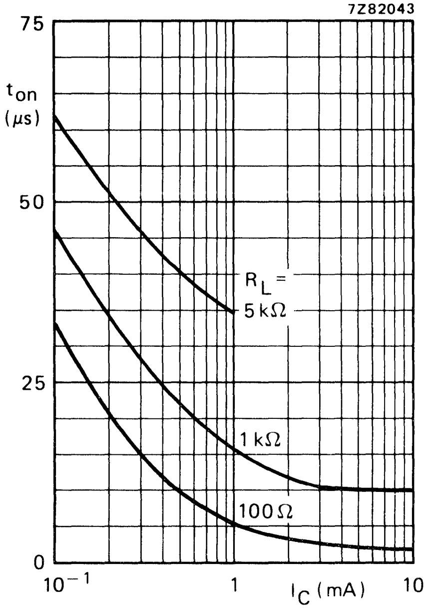


Fig. 24 **CNY57U**; I_B = 0; V_{CC} = 5 V; T_{amb} = 25 °C; typ. values. (See also Fig. 26.)

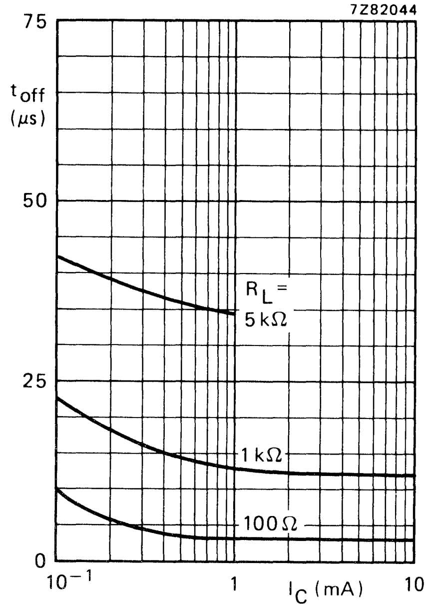
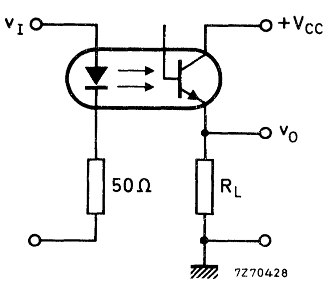


Fig. 25 **CNY57U**; I_B = 0; V_{CC} = 5 V; T_{amb} = 25 °C; typ. values. (See also Fig. 26.)



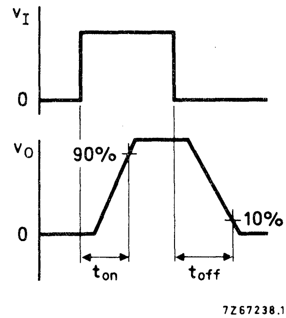


Fig. 26 Switching circuit and waveforms.

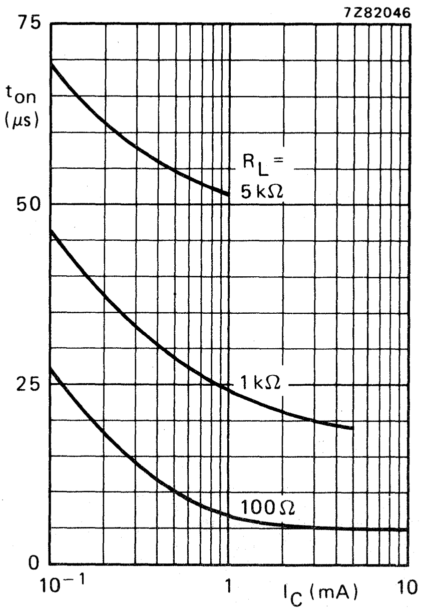


Fig. 27 **CNY57AU**; $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typ. values. (See also Fig. 29.)

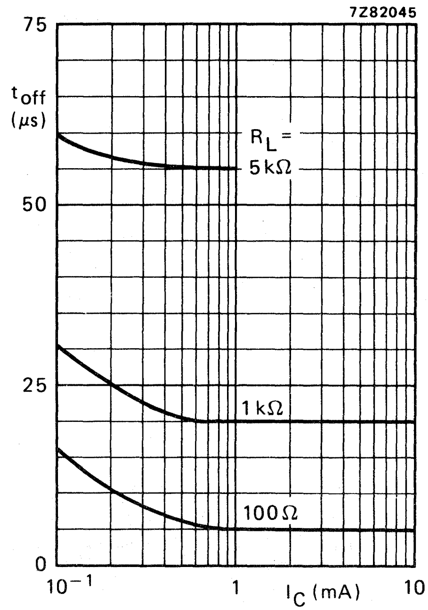
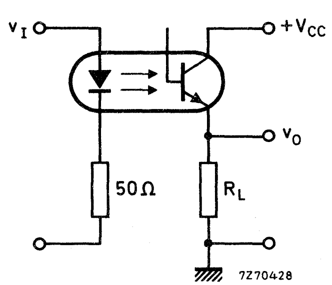


Fig. 28 **CNY57AU**; $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typ. values. (See also Fig. 29.)



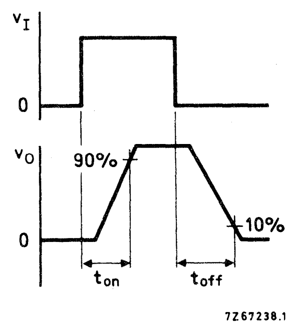


Fig. 29 Switching circuit and waveforms.

OPTOCOUPLERS

Optically coupled isolators consisting of an infrared emitting GaAs diode and a silicon n-p-n phototransistor without accessible base. Plastic envelopes. Suitable for TTL integrated circuits.

Features of these products:

- high output/input d.c. current transfer ratio;
- low saturation voltage;
- a high isolation voltage
  CNY62 3,75 kV (r.m.s.) and 5,3 kV (d.c.);
  CNY63 3 kV (r.m.s.) and 4,3 kV (d.c.);
- working voltage 1,5 kV.

QUICK REFERENCE DATA

			CNY62	CNY63	
Diode					
Continuous reverse voltage	V_R	max.	5	5	V
Forward current					
d.c.	I_F	max.	100	100	mA
(peak value); t_p = 10 μs; δ = 0,1	I_{FRM}	max.	1000	1000	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150	150	mW
Transistor					
Collector-emitter voltage (open base)	V_{CEO}	max.	50	30	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	200	mW
Optocoupler					
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V; (I_B = 0)	I_C/I_F	min.	0,25	0,50	
Collector cut-off current (dark) V_{CC} = 10 V; working voltage (d.c.) = 1,5 kV diode: I_F = 0 (see also Fig. 2)	I_{CEW}	max.	200	200	nA
Isolation voltage (d.c.)	V_{IORM}	min.	5,3	4,3	kV

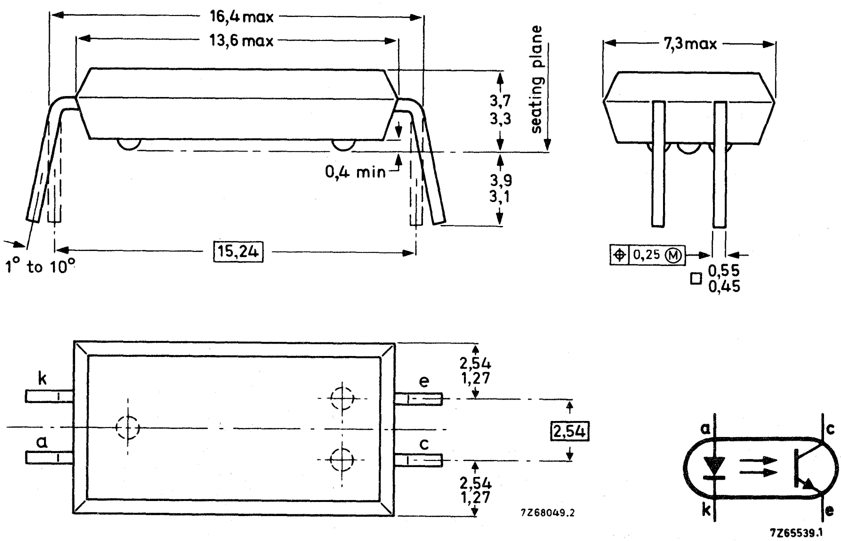
MECHANICAL DATA

SOT-91B (see Fig. 1).

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-91B.



⊕ Positional accuracy.

Ⓜ Maximum material condition.

RATINGS

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

Diode

Continuous reverse voltage		V_R	max.	5 V
Forward current				
d.c.		I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,1		I_{FRM}	max.	1000 mA
Total power dissipation up to T_{amb} = 25 ^oC		P_{tot}	max.	150 mW
Operating junction temperature		T_j	max.	125 ^oC

Transistor

Collector-emitter voltage (open base)	**CNY62**	V_{CEO}	max.	50 V
	CNY63	V_{CEO}	max.	30 V
Emitter-collector voltage (open base)		V_{ECO}	max.	7 V
Collector current (d.c.)		I_C	max.	100 mA

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Operating junction temperature	T_j	max.	125 °C

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Lead soldering temperature up to the seating plane; t_{sld} < 10 s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient in free air

diode	$R_{th\ j\text{-}a}$	=	650 K/W ←
transistor	$R_{th\ j\text{-}a}$	=	500 K/W

From junction to ambient, device mounted on a printed-circuit board

diode	$R_{th\ j\text{-}a}$	=	600 K/W ←
transistor	$R_{th\ j\text{-}a}$	=	400 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

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

Transistor (diode: I_F = 0)

Collector cut-off current (dark) V_{CE} = 10 V		I_{CEO}	typ.	5 nA
			<	100 nA
V_{CE} = 10 V; T_{amb} = 70 °C		I_{CEO}	<	10 μA
Collector-emitter breakdown voltage I_C = 1 mA	CNY62	$V_{(BR)\ CEO}$	min	50 V
	CNY63		min	30 V
Emitter-collector breakdown voltage I_E = 0,1 mA	CNY62	$V_{(BR)\ CEO}$	min	7V
	CNY63		min	7V

Optocoupler (I_B = 0)*

Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V	**CNY62**	I_C/I_F	>	0,25 ←
			typ.	0,50
	CNY63	I_C/I_F	>	0,5
			typ.	1,0
Collector cut-off current (dark) see Fig. 2 V_{CC} = 10 V; working voltage (d.c.) = 1,5 kV		I_{CEW}	<	200 nA
V_{CC} = 10 V; working voltage (d.c.) = 1,5 kV; T_j = 70 °C		I_{CEW}	<	100 μA

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

			CNY62	CNY63	
Collector-emitter saturation voltage					
I_F = 10 mA; I_C = 2 mA	V_{CEsat}	typ.	0,17	–	V
		<	0,40	–	V
I_F = 10 mA; I_C = 4 mA	V_{CEsat}	typ.	–	0,17	V
		<	–	0,40	V
Isolation voltage; t = 1 min	V_{IORM}	min.	5,3	4,3	kV(d.c.)
	V_{IORM}	min.	3,75	3	kV(r.m.s.)
Capacitance between input and output $I_F = 0$; V = 0; f = 1 MHz	C_{io}	typ.	0,6	0,6	pF
Insulation resistance between input and output $\pm V_{IO}$ = 1 kV	r_{IO}	>	10^{10}	10^{10}	Ω
		typ.	10^{12}	10^{12}	Ω
Switching times (see Fig. 19)					
I_{Con} = 2 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.	3	–	μs
Turn-off time	t_{off}	typ.	3	–	μs
I_{Con} = 4 mA; V_{CC} = 5 V; R_L = 100 Ω					
Turn-on time	t_{on}	typ.	–	5	μs
Turn-off time	t_{off}	typ.	–	5	μs

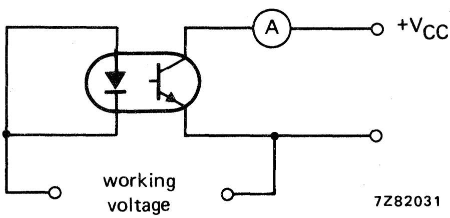


Fig. 2.

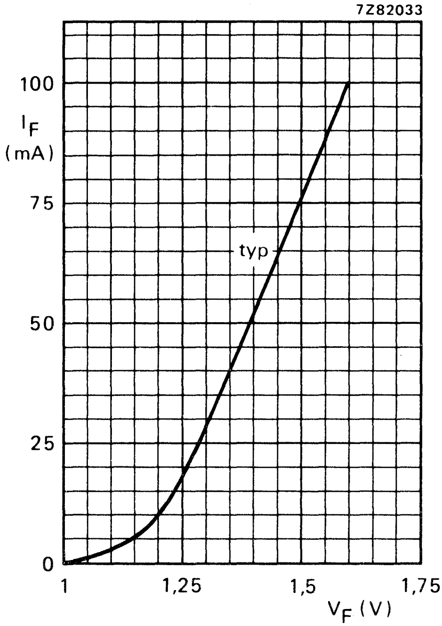


Fig. 3 T_{amb} = 25 °C.

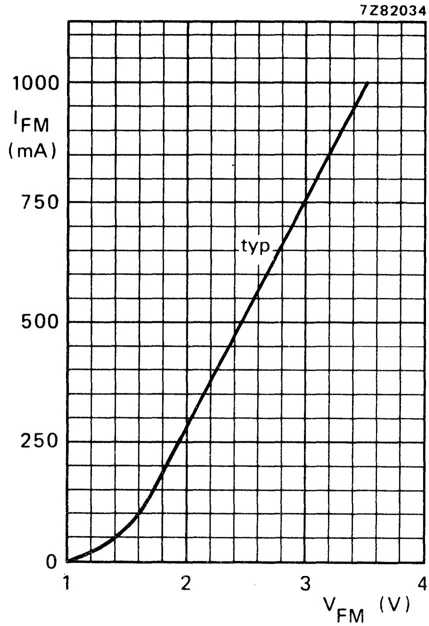


Fig. 4 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms.

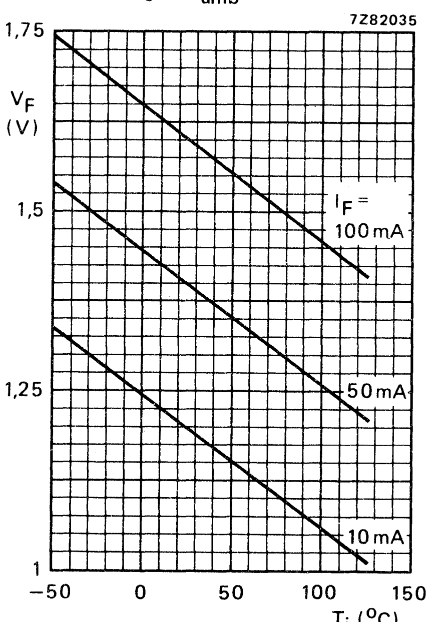


Fig. 5 Typical values.

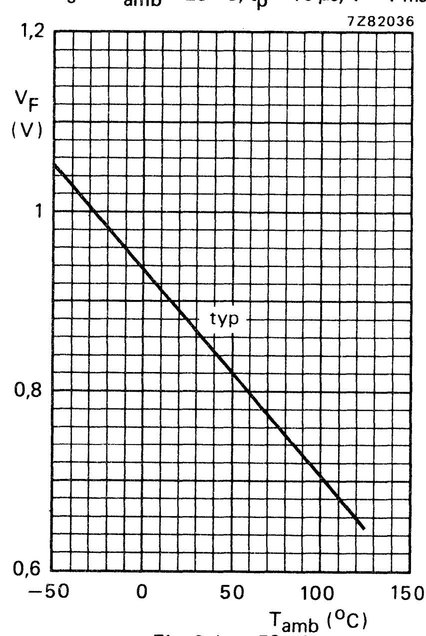


Fig. 6 I_F = 50 μA.

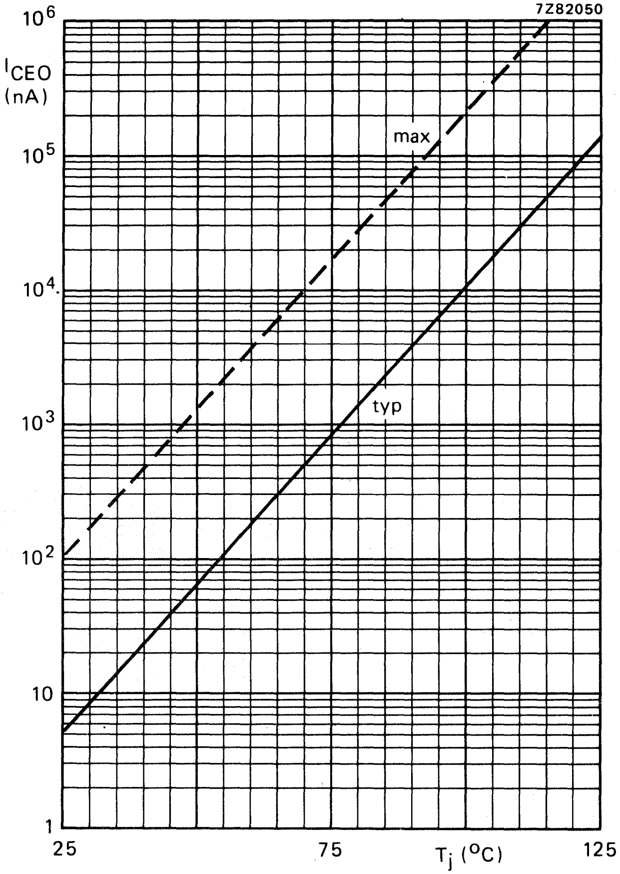


Fig. 7 $I_F = 0$; $V_{CE} = 10$ V.

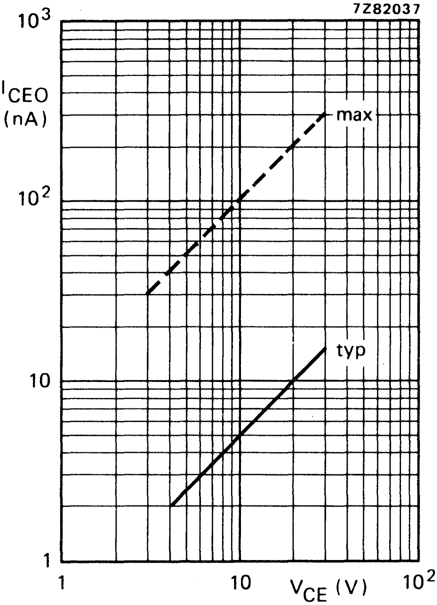


Fig. 8 $I_F = 0$; $T_j = 25\ ^oC$.

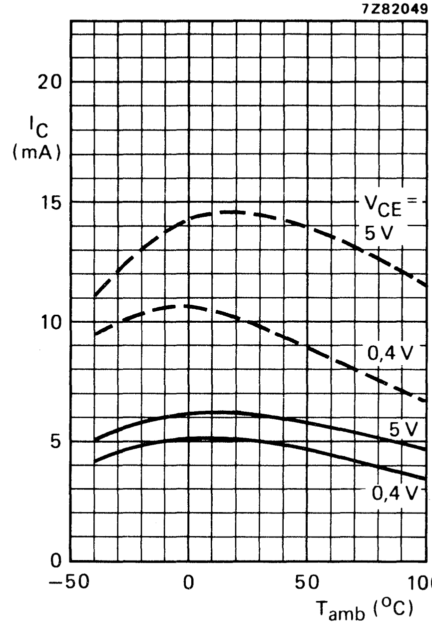


Fig. 9 $I_B = 0$; $I_F = 10$ mA;
—— **CNY62**; ––– **CNY63**; typical values.

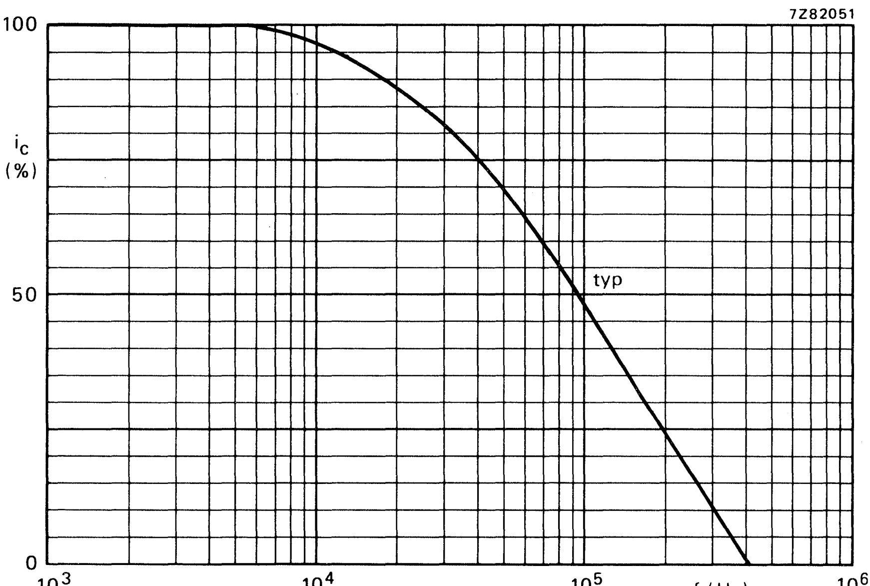


Fig. 10 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1\ k\Omega$; $T_{amb} = 25\ ^oC$.

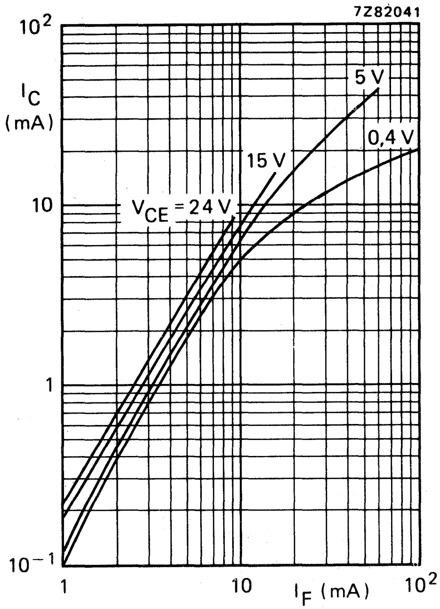


Fig. 11 **CNY62**; T_{amb} = 25 °C; typical values.

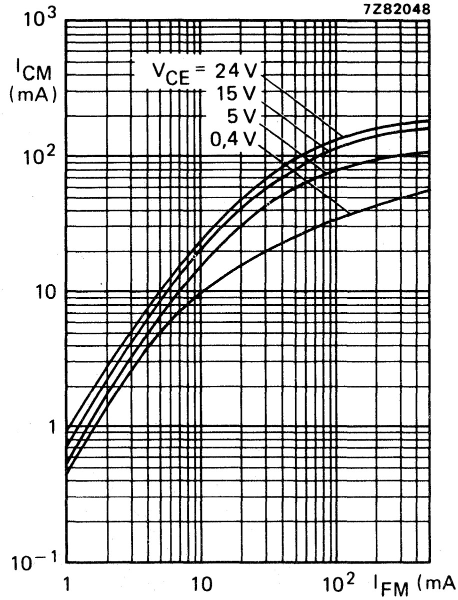


Fig. 12 **CNY63**; T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms; typical values.

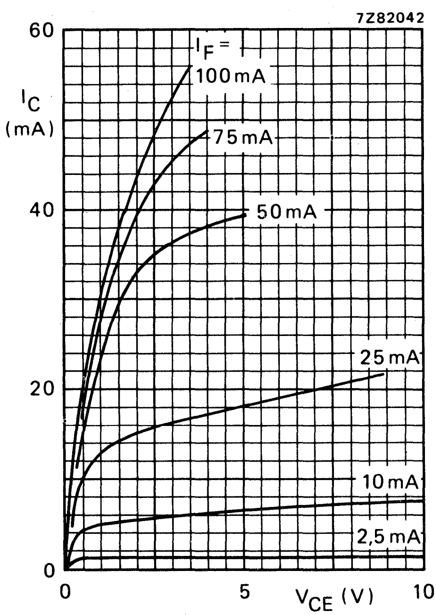


Fig. 13 **CNY62**; T_{amb} = 25 °C; typical values.

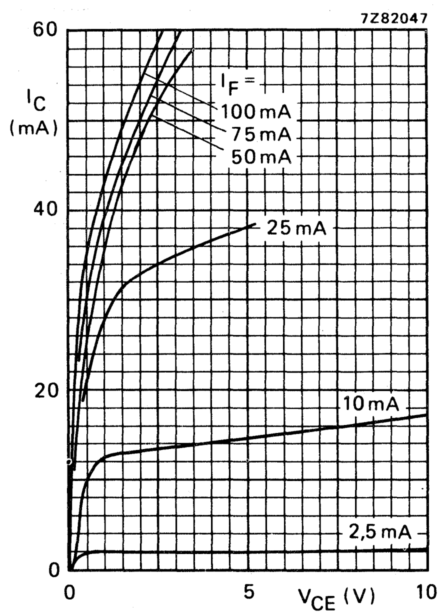


Fig. 14 **CNY63**; T_{amb} = 25 °C; typical values.

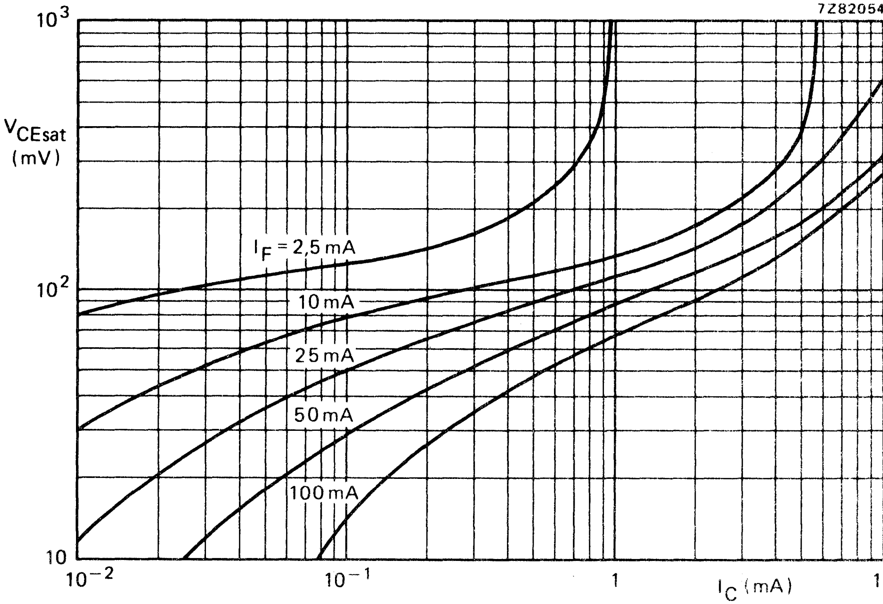


Fig. 15 **CNY62;** $I_B = 0$; $T_{amb} = 25\ ^oC$; typical values.

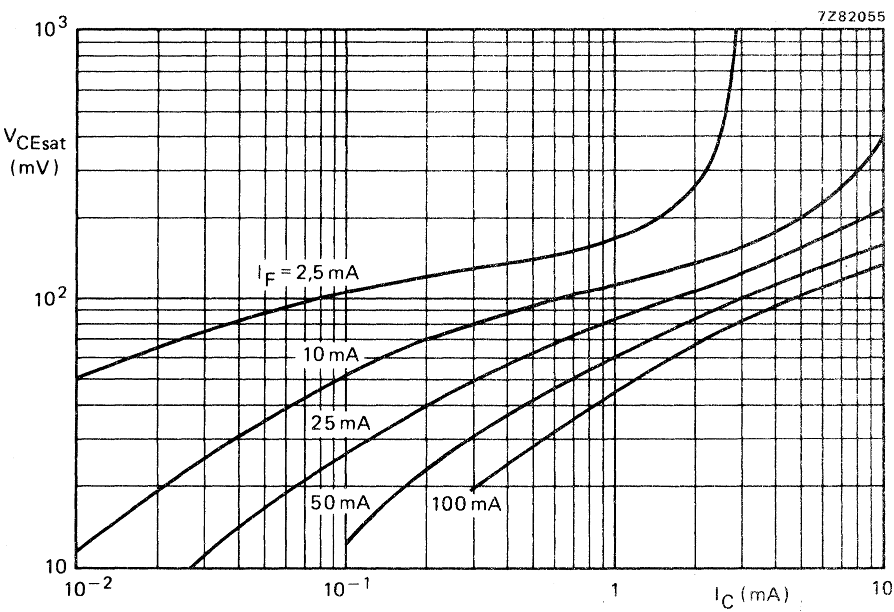


Fig. 16 **CNY63**; $I_B = 0$; $T_{amb} = 25\ ^oC$; typical values.

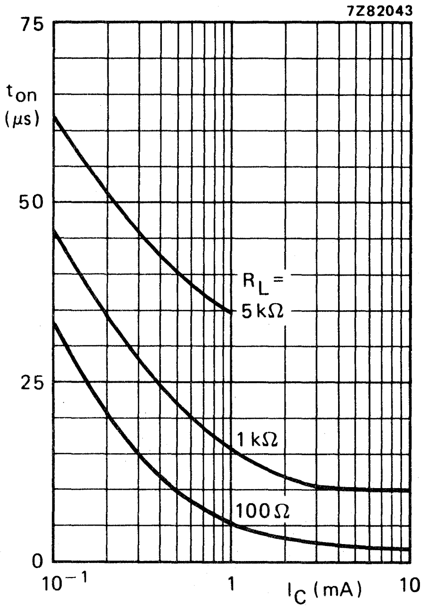


Fig. 17 **CNY62**; $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 19).

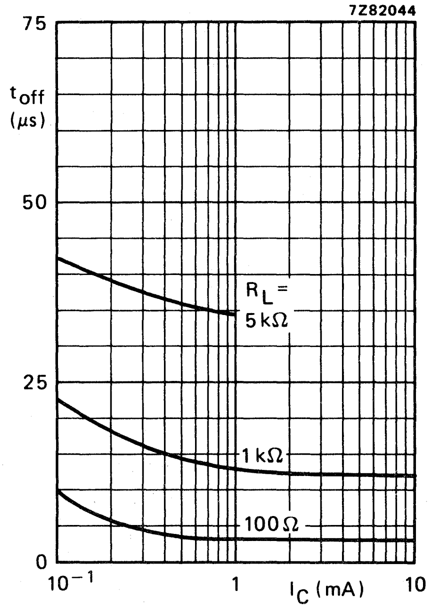


Fig. 18 **CNY62**; $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 19).

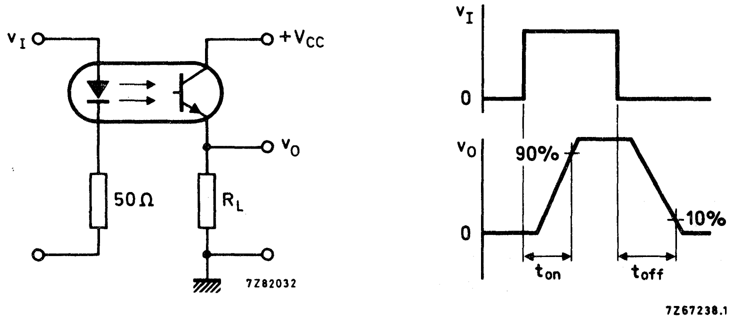


Fig. 19 Switching circuit and waveforms.

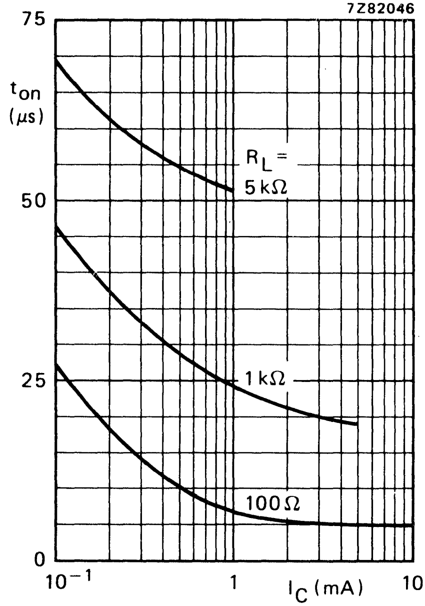


Fig. 20 **CNY63**; I_B = 0; V_{CC} = 5 V; T_{amb} = 25 °C; typical values. (See also Fig. 22).

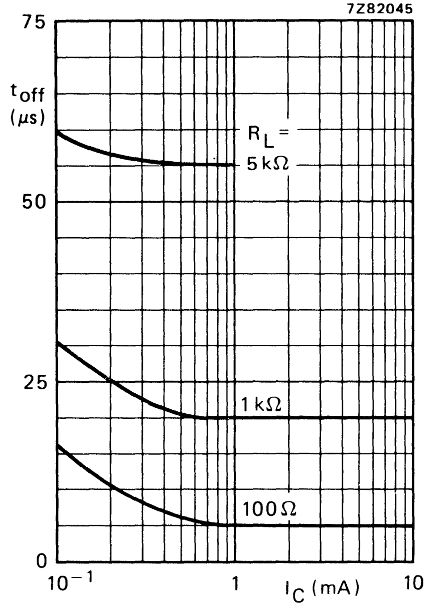


Fig. 21 **CNY63**; I_B = 0; V_{CC} = 5 V; T_{amb} = 25 °C; typical values. (See also Fig. 22).

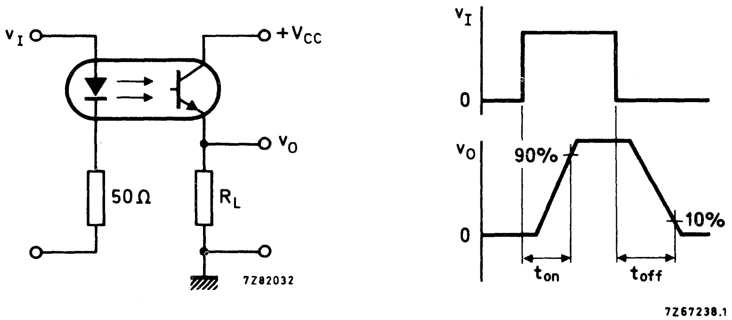


Fig. 22 Switching circuit and waveforms.

OPTOCOUPLERS

This product range is one of the industrial standards applied in the market. The current transfer ratio, isolation voltage and low saturation voltage comply to the specifications of the main part of the optocoupler market.

This range can be used with TTL circuits and is comprised of an infrared emitting GaAs diode and an N-P-N silicon phototransistor.

UL — Covered under UL component recognition FILE E90700 ←

VDE — Approved according to VDE 0883/6.83

QUICK REFERENCE DATA

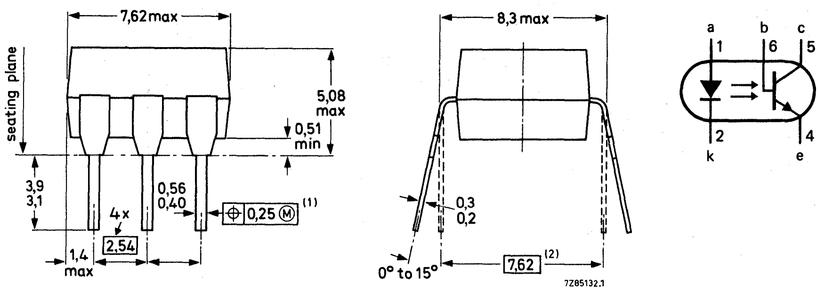
Collector-emitter voltage of phototransistor		V_{CEO}	max.	30 V
Forward current of infrared emitting diode (d.c.)		I_F	max.	60 mA
D.C. current transfer ratio at I_F = 10 mA; V_{CE} = 10 V	H11A1	I_C/I_F	min.	0,5
	H11A2	I_C/I_F	min.	0,2
	H11A3	I_C/I_F	min.	0,2
	H11A4	I_C/I_F	min.	0,1
Total power dissipation up to T_{amb} = 25 ^oC		P_{tot}	max.	250 mW
Isolation voltage (d.c.)		V_{IORM}	min.	2 kV (r.m.s.)

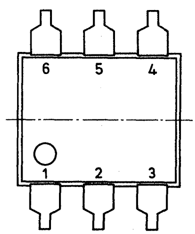
MECHANICAL DATA

SOT-90B (see Fig. 1).

MECHANICAL DATA Dimensions in mm

Fig. 1 SOT-90B.





⌖ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips remain in position for automatic insertion.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	60 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100 mW

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	70 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150 mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150	°C
Operating junction temperature	T_j		−55 to +100	°C
Operating temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260	°C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW

THERMAL RESISTANCE

From junction to ambient in free air

diode	$R_{th\ j\text{-}a}$	max.	500	K/W
transistor	$R_{th\ j\text{-}a}$	max.	500	K/W

LINEAR DERATING FACTORS

Above 25 °C

diode	1,33	mW/K
transistor	2	mW/K

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2	mm
External tracking path (creepage distance) input terminals to output terminals	L(IO2)	min.	7,0	mm
Tracking resistance (KB-value)		KB-100/A		

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,15	V
		max.	1,5	V
Reverse current V_R = 5 V	I_R	max.	10	μA
Capacitance at f = 1 MHz V = 0	C_d	typ.	50	pF

Transistor

Collector-emitter breakdown voltage I_C = 10 mA	$V_{(BR)CEO}$	min.	30	V
Collector-base breakdown voltage I_C = 0,1 mA	$V_{(BR)CBO}$	min.	70	V
Emitter-collector breakdown voltage I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7	V
Dark current V_{CE} = 10 V	I_{CEO}	typ.	2	nA
		max.	50	nA

Optocoupler

Output/input d.c. current transfer ratio				
I_F = 10 mA; V_{CE} = 10 V	H11A1	I_C/I_F	min.	0,5
	H11A2, H11A3	I_C/I_F	min.	0,2
	H11A4	I_C/I_F	min.	0,1
Collector-emitter saturation voltage I_F = 10 mA; I_C = 0,5 mA		V_{CEsat}	max.	0,4 V
			typ.	0,1 V
Output capacitance at f = 1 MHz V_{CE} = 10 V		C_{CE}	typ.	2 pF
Isolation voltage *		V_{IORM}	min.	2 kV (r.m.s.)
				2,82 kV (d.c.)
Capacitance between input and output V = 0; f = 1 MHz		C_{io}	max.	2 pF
Insulation resistance between input and output V_{IO} = 500 V		R_{IO}	min.	10^{11} Ω
Rise time I_C = 2 mA; V_{CC} = 10 V; R_L = 100 Ω		t_r	typ.	3 μs
Fall time I_C = 2 mA; V_{CC} = 10 V; R_L = 100 Ω		t_f	typ.	3 μs

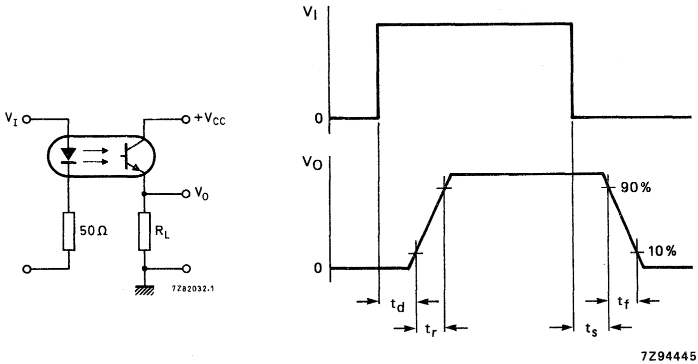


Fig. 2 Measuring circuit and waveforms.

* Every single product is tested by applying an isolation test voltage of 2500 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

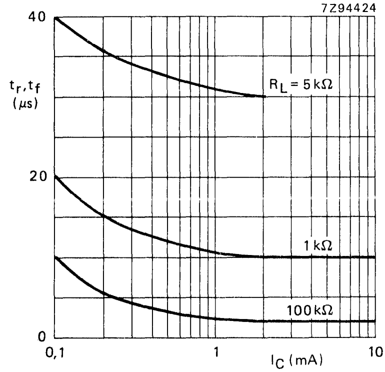


Fig. 3 V_{CC} = 10 V; T_{amb} = 25 °C; typical values.

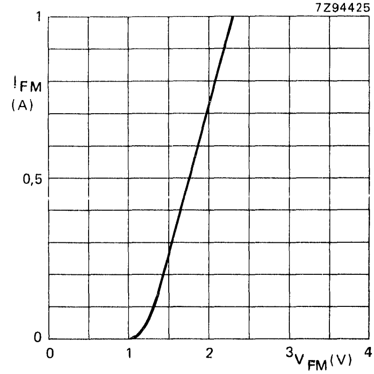


Fig. 4 T_{amb} = 25 °C; t_{on} = 20 μs; δ = 0,01; typical values.

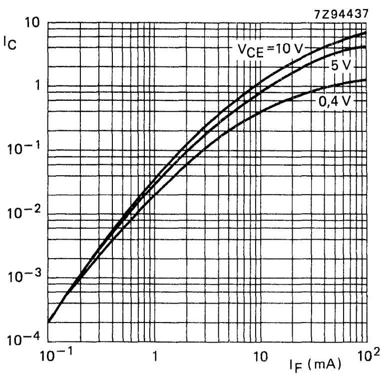


Fig. 5 Normalized to I_F = 10 mA; V_{CE} = 10 V; typical values.

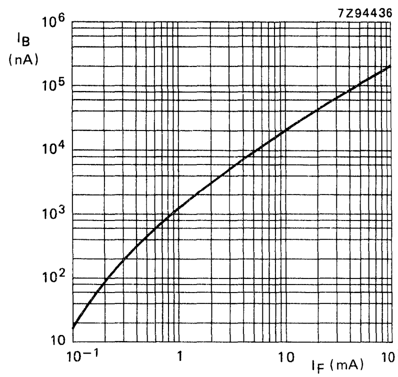


Fig. 6 V_{CB} = 10 V; T_{amb} = 25 °C; typical values.

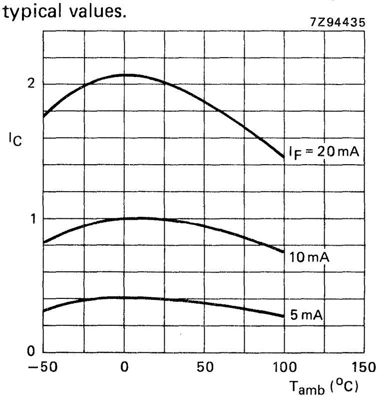


Fig. 7 Normalized at I_F = 10 mA; V_{CE} = 10V; typical values.

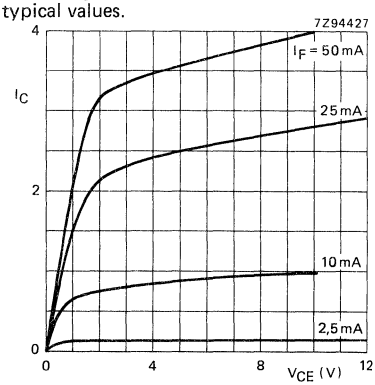


Fig. 8 Normalized at 10 mA; V_{CE} = 10 V; T_{amb} = 25°C. typical values.

OPTOCOUPLER

This product range is one of the industrial standards applied in the market. The current transfer ratio, isolation voltage and low saturation voltage comply to the specifications of the main part of the optocoupler market.

It can be used with TTL circuits and is comprised of an infrared emitting GaAs diode and an N-P-N silicon phototransistor.

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83
Complied for reinforced isolation at 250 VAC with:
DIN 57 804/VDE 0804/1.83 (isolation group C)
DIN IEC 65/VDE 0860/8.81

QUICK REFERENCE DATA

Collector-emitter voltage of phototransistor	V_{CEO}	max.	30 V
Forward current of infrared emitting diode (d.c.)	I_F	max.	60 mA
D.C. current transfer ratio at I_F = 10 mA; V_{CE} = 10 V	I_C/I_F	min.	0,2
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Isolation voltage d.c. value	V_{IORM}	min.	4,4 kV

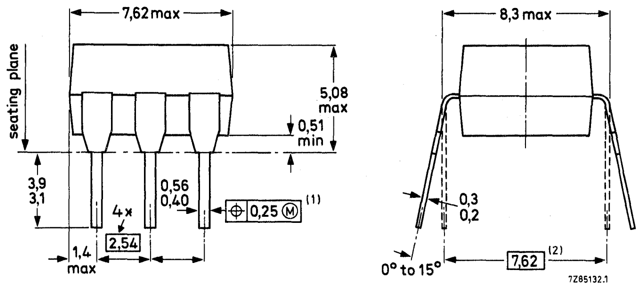
MECHANICAL DATA

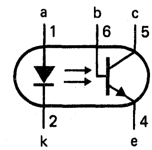
SOT-90B (see Fig. 1).

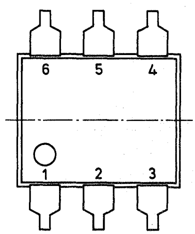
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips remain in position for automatic insertion.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	60 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	70 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW

Optocoupler

Storage temperature	T_{stg}		–55 to +150	°C
Operating junction temperature	T_j		–55 to +125	°C
Soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260	°C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW

THERMAL RESISTANCE

From junction to ambient in free air				
diode	$R_{th\ j\text{-}a}$	max.	500	K/W
transistor	$R_{th\ j\text{-}a}$	max.	500	K/W

LINEAR DERATING FACTORS

Above 25 °C		
diode	2,6	mW/K
transistor	2,6	mW/K
optocoupler	3,3	mW/K

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2	mm
External tracking path (creepage distance) input terminals to output terminals	L(IO2)	min.	7,0	mm
Tracking resistance (KB-value)		KB-100/A		

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

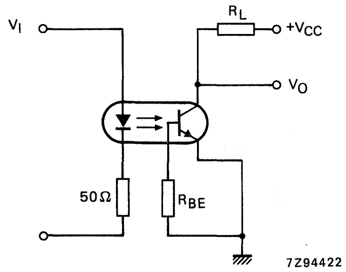
Forward voltage I_F = 20 mA	V_F	typ. max.	1,2 1,5	V V
Reverse current V_R = 5 V	I_R	max.	10	μA
Capacitance at f = 1 MHz V = 0;	C_d	typ.	50	pF

Transistor

Collector-emitter breakdown voltage I_C = 1 mA	$V_{(BR)CEO}$	min.	30	V
Collector-base breakdown voltage I_C = 0,01 mA	$V_{(BR)CBO}$	min.	70	V
Emitter-collector breakdown voltage I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7	V
Dark current V_{CE} = 10 V	I_{CEO}	typ. max.	2 50	nA nA
V_{CB} = 10 V	I_{CBO}	max.	20	nA
D.C. current gain I_C = 100 μA; V_{CE} = 5 V	h_{FE}	typ.	300	

Optocoupler

Output/input d.c. current transfer ratio I_F = 10 mA; V_{CE} = 10 V	I_C/I_F	typ. min.	0,6 0,2
Collector-emitter saturation voltage I_F = 16 mA; I_C = 2 mA	V_{CEsat}	max. typ.	0,4 V 0,15 V
Emitter-base capacitance V_{BE} = 0	C_{be}	typ.	8 pF
Collector-base capacitance at f = 1 MHz V_{CB} = 10 V	C_{bc}	typ.	4,5 pF
Collector-emitter capacitance V_{CE} = 0	C_{ce}	typ.	8 pF
Isolation voltage*	V_{IORM}	min.	4,4 kV(d.c.) 3,12 kV(r.m.s.)
Capacitance between input and output V = 0; f = 1 MHz	C_{io}	typ.	0,5 pF
Insulation resistance between input and output V_{IO} = ± 500 V	R_{IO}	min. typ.	10^{11} Ω 10^{12} Ω
Turn-on time (saturated) see Fig. 2 (TTL def.)			
I_F = 15 mA; V_{CC} = 5 V; R_L = 2 kΩ R_{BE} = ∞	t_{on}	typ.	5 μs
I_F = 20 mA; V_{CC} = 5 V; R_L = 2 kΩ R_{BE} = 100 kΩ	t_{on}	typ.	5 μs
Turn-off time (saturated) see Fig. 2 (TTL def.)			
I_F = 15 mA; V_{CC} = 5 V; R_L = 2 kΩ R_{BE} = ∞	t_{off}	typ.	30 μs
I_F = 20 mA; V_{CC} = 5 V; R_L = 2 kΩ R_{BE} = 100 kΩ	t_{off}	typ.	10 μs
Bandwidth I_C = 2 mA; V_{CE} = 10 V; R_L = 100 kΩ	B_W	typ.	300 kHz



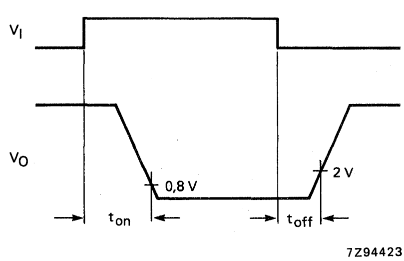


Fig. 2 Measuring circuit and waveforms.

* Every single product is tested by applying an isolation test voltage of 3750 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

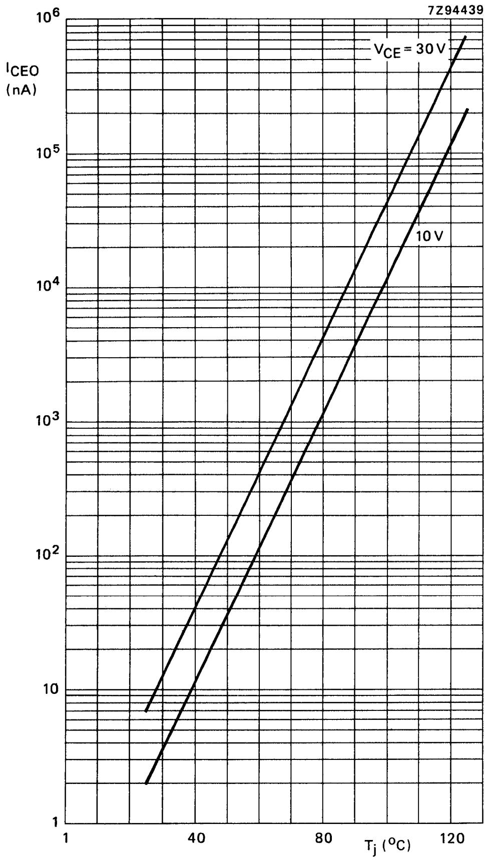


Fig. 3. Typical values.

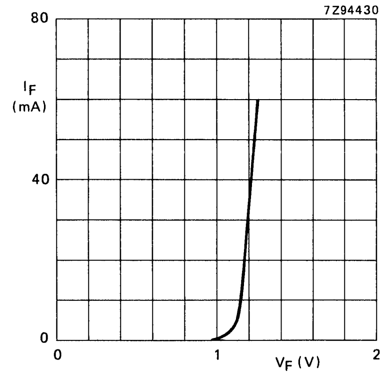


Fig. 4 T_{amb} = 25 °C; typical values.

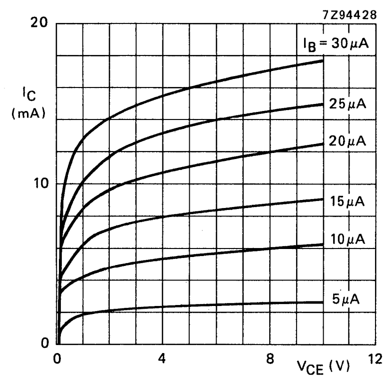


Fig. 5 T_{amb} = 25 °C; typical values.

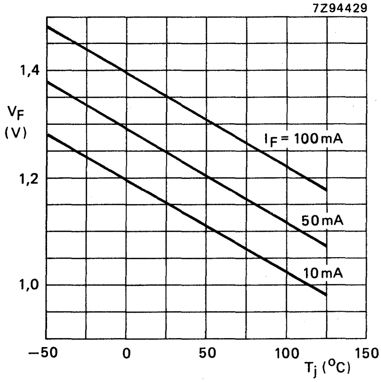


Fig. 6 Typical values.

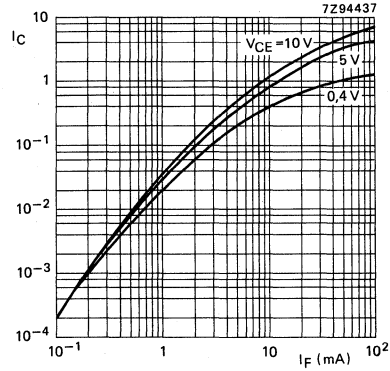


Fig. 7 Normalized to I_F = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C; typical values.

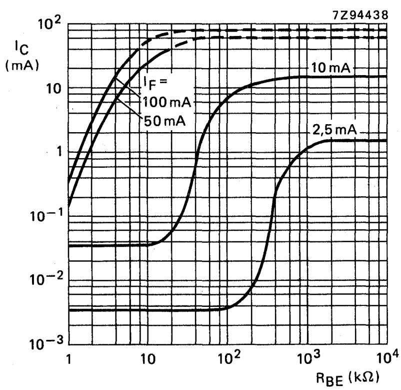


Fig. 8 V_{CE} = 5 V; T_{amb} = 25 °C; typical values.

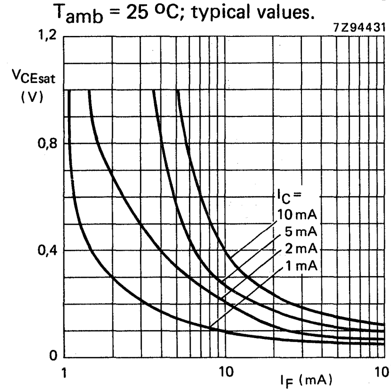


Fig. 9 T_{amb} = 25 °C; typical values.

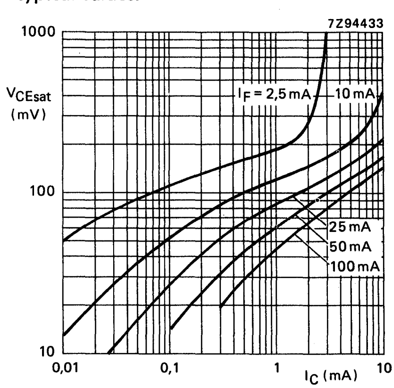


Fig. 10 T_{amb} = 25 °C; typical values.

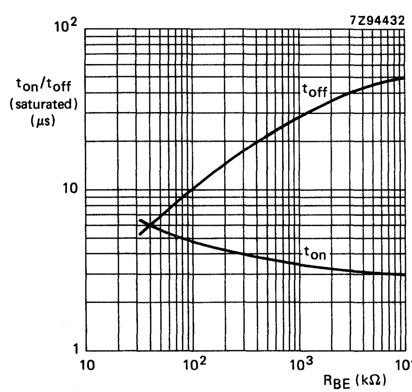


Fig. 11 I_F = 20 mA; R_L = 2 kΩ; T_{amb} = 25 °C; typical values.

OPTOCOUPLER

Optocoupler in a DIL plastic envelope. The MCT26 comprises an infrared GaAs diode and a N-P-N silicon phototransistor.

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83
Complied for reinforced isolation at 250 VAC with:
DIN 57 804/VDE 0804/1.83 (isolation group C)
DIN IEC 65/VDE 0860/8.81

QUICK REFERENCE DATA

Collector-emitter voltage of phototransistor	V_{CEO}	max.	30	V
Forward current of infrared emitting diode (d.c.)	I_F	max.	60	mA
D.C. current transfer ratio at I_F = 10 mA; V_{CE} = 10 V	I_C/I_F	min.	0,06	
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Isolation voltage d.c. value	V_{IORM}	min.	4,4	kV

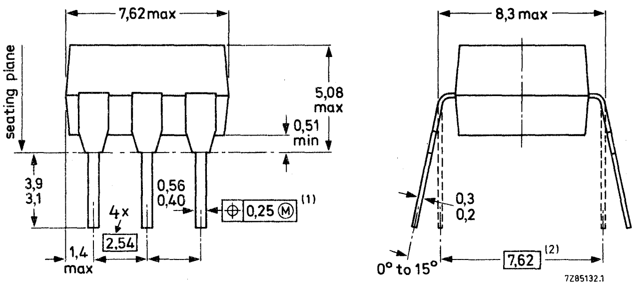
MECHANICAL DATA

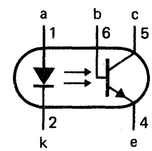
SOT-90B (see Fig. 1).

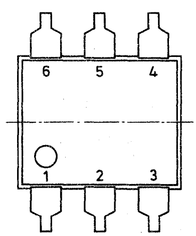
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips remain in position for automatic insertion.

RATINGS

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

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	60 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	30 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150 °C
Operating junction temperature	T_j		−55 to +125 °C
Soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW

THERMAL RESISTANCE

From junction to ambient in free air

diode	$R_{th\ j\text{-}a}$	max.	500 K/W
transistor	$R_{th\ j\text{-}a}$	max.	500 K/W

LINEAR DERATING FACTORS

Above 25 °C

diode	2,6 mW/K
transistor	2,6 mW/K
optocoupler	3,3 mW/K

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2 mm
External tracking path (creepage distance) input terminals to output terminals	L(IO2)	min.	7,0 mm
Tracking resistance (KB-value)		KB-100/A	

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 20 mA	V_F	typ.	1,2 V
		max.	1,5 V
Reverse current V_R = 5 V	I_R	max.	10 μA
Capacitance at f = 1 MHz V = 0	C_d	typ.	50 pF

Transistor

Collector-emitter breakdown voltage I_C = 1 mA	$V_{(BR)CEO}$	min.	30 V
Collector-base breakdown voltage I_C = 0,01 mA	$V_{(BR)CBO}$	min.	30 V
Emitter-collector breakdown voltage I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V
Dark current V_{CE} = 5 V	I_{CEO}	typ.	2 nA
		max.	100 nA
V_{CB} = 5 V	I_{CBO}	max.	100 nA
D.C. current gain I_C = 100 μA; V_{CE} = 5 V	h_{FE}	typ.	300

Optocoupler

Output/input d.c. current transfer ratio $I_F = 10$ mA; $V_{CE} = 10$ V	I_C/I_F	min.	0,06
Collector-emitter saturation voltage $I_F = 20$ mA; $I_C = 0,25$ mA	V_{CEsat}	max.	0,3 V
		typ.	0,1 V
$I_F = 60$ mA; $I_C = 1,6$ mA	V_{CEsat}	max.	0,5 V
		typ.	0,2 V
Collector-emitter capacitance $V_{CE} = 0$	C_{ce}	typ.	8 pF
Isolation voltage *	V_{IORM}	min.	4,4 kV(d.c.)
			3,12 kV(r.m.s.)
Capacitance between input and output V = 0; f = 1 MHz	C_{io}	typ.	0,5 pF
Insulation resistance between input and output $V_{IO} = 500$ V	R_{IO}	min.	10^{11} Ω
		typ.	10^{12} Ω
Rise time (see Fig. 2) $I_C = 2$ mA; $V_{CC} = 10$ V; $R_L = 100$ Ω	t_r	typ.	3 μs
Fall time (see Fig. 2) $I_C = 2$ mA; $V_{CC} = 10$ V; $R_L = 100$ Ω	t_f	typ.	3 μs
Bandwidth $I_C = 2$ mA; $V_{CE} = 10$ V; $R_L = 100$ Ω	B_W	typ.	300 kHz

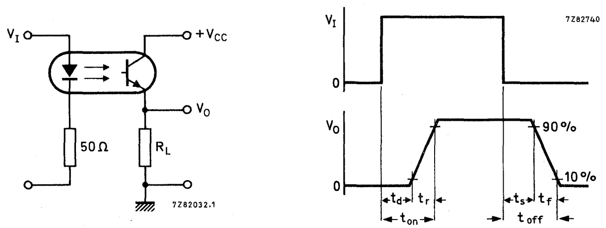


Fig. 2 Measuring circuit and waveforms.

* Every single product is tested by applying an isolation test voltage of 3750 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

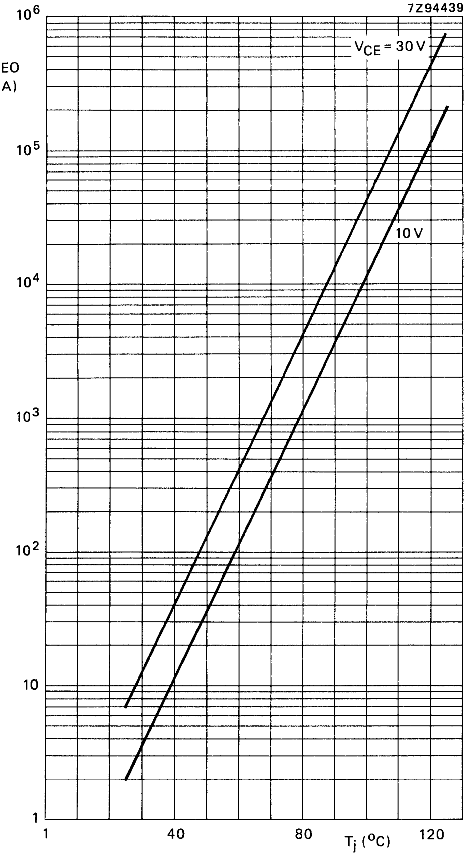


Fig. 3 Typical values.

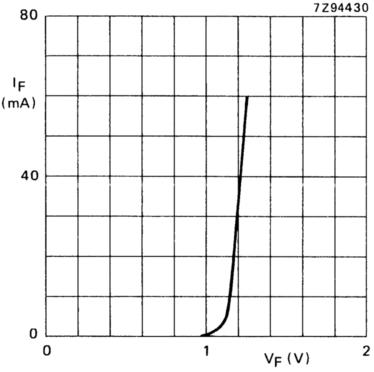


Fig. 4 T_{amb} = 25 °C; typical values.

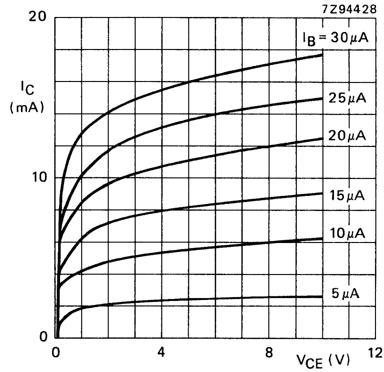


Fig. 5 T_{amb} = 25 °C; typical values.

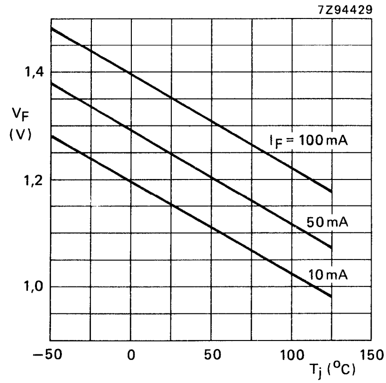


Fig. 6 Typical values.

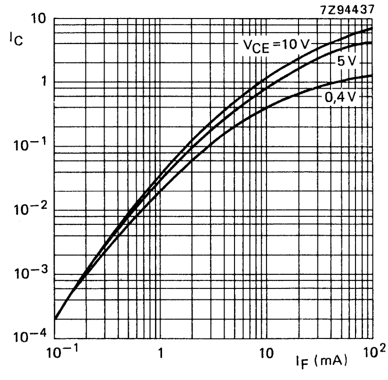


Fig. 7 Normalized to I_F = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C; typical values.

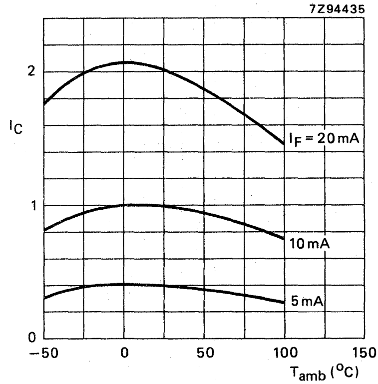


Fig. 8 Normalized to I_F = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C; typical values.

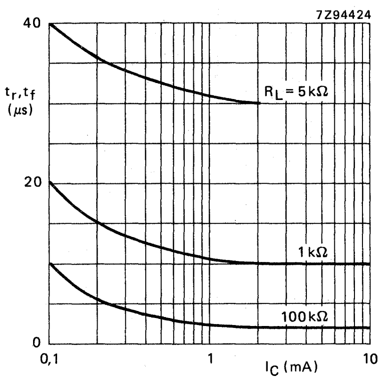


Fig. 9 T_{amb} = 25 °C; typical values.

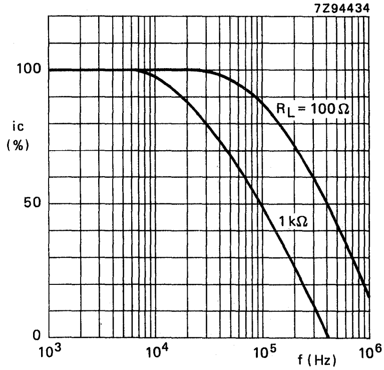


Fig. 10 I_C = 2 mA; V_{CC} = 10 V; T_{amb} = 25 °C; typical values.

OPTOCOUPLER

Optically coupled isolator consisting of an infrared emitting GaAlAs diode and a silicon n-p-n phototransistor with accessible base in a SOT-90B envelope. Designed for low input current and long life operation.

The application of an IR emitting device, based on a special GaAlAs (intrinsic) process, results in perfect linearity at low input currents and a very low degradation during the device's operating life.

The PO40/44A is selected according to British Telecom specifications for telephony and can serve for each individual spec PO40A, PO41A, PO42A, PO43A, PO44A and is BT approved.

QUICK REFERENCE DATA

Diode			
Forward current (d.c.)	I_F	max.	100 mA
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Optocoupler			
Output/input d.c. current transfer ratio (C.T.R.)			
I_F = 0,5 mA; V_{CE} = 5 V	I_C/I_F	min.	0,1
I_F = 1,0 mA; V_{CE} = 0,4 V	I_C/I_F	min.	0,25
I_F = 10 mA; V_{CE} = 0,5 V	I_C/I_F	min.	0,6
Leakage current under working voltage 1,5 kV d.c. value V_{CC} = 10 V	I_{CEW}	max.	200 nA
Isolation voltage d.c. value	V_{IORM}	min.	3,5 kV

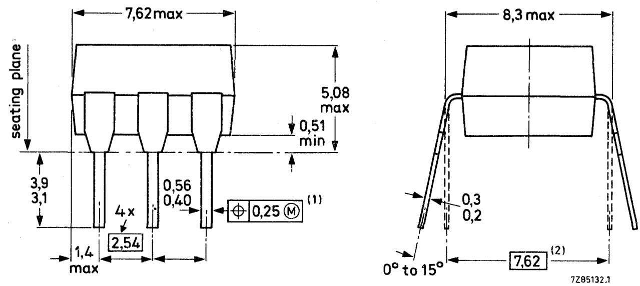
MECHANICAL DATA

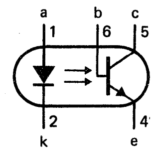
SOT-90B (see Fig. 1).

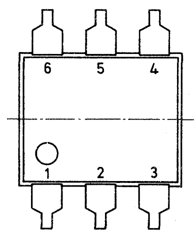
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips are in position for automatic insertion.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	2,5 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	30 V
Collector-base voltage (open emitter)	V_{CBO}	max.	70 V
Emitter-collector voltage (open base)	V_{ECO}	max.	5 V
Collector current	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW

Optocoupler

Storage temperature	T_{stg}		−55 to +150	°C
Operating ambient temperature	T_{amb}		−55 to +100	°C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW
Lead soldering temperature up to the seating plane; t_{sld} < 10 s	T_{sld}	max.	260	°C

THERMAL RESISTANCE

From junction to ambient in free air				
diode	$R_{th\ j\text{-}a}$	max.	500	K/W
transistor	$R_{th\ j\text{-}a}$	max.	500	K/W
From junction to ambient, device mounted on a printed circuit board				
diode	$R_{th\ j\text{-}a}$	max.	400	K/W
transistor	$R_{th\ j\text{-}a}$	max.	400	K/W

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	$L_{(IO1)}$	min.	7,2	mm
External tracking path (creepage distance) input terminals to output terminals	$L_{(IO2)}$	min.	7,0	mm
Tracking resistance (KB-value)		KB-100/A		

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage I_F = 10 mA	V_F	typ.	1,45	V
		max.	1,6	V *
I_F = 0,1 mA; T_{amb} = 70 °C	V_F	min.	0,45	V
Reverse current V_R = 5 V	I_R	max.	10	μA

Transistor

Collector-emitter breakdown voltage open base; I_C = 1 mA	$V_{(BR)CEO}$	min.	30	V
Collector-base breakdown voltage open emitter; I_C = 0,1 mA	$V_{(BR)CBO}$	min.	70	V
Emitter-collector breakdown voltage open base; I_E = 0,1 mA	$V_{(BR)ECO}$	min.	5	V
Collector cut-off current (dark) V_{CE} = 28 V	I_{CEO}	typ.	2	nA
		max.	200	nA

* Internal specification.

DEVELOPMENT DATA

Optocoupler

Output/input d.c. current transfer ratio (C.T.R.)			
I_F = 10 mA; V_{CE} = 0,5 V	I_C/I_F	min. max.	0,6 1,5
I_F = 1 mA; V_{CE} = 0,4 V	I_C/I_F	min.	0,25
I_F = 0,5 mA; V_{CE} = 5 V	I_C/I_F	min.	0,1
I_F = 3 mA; V_{CE} = 1 V	I_C/I_F	min.	0,3
I_F = 5 mA; V_{CE} = 5 V	I_C/I_F	min.	0,3
I_F = 10 mA; V_{CE} = 10 V	I_C/I_F	min.	0,25
I_F = 20 mA; V_{CE} = 0,5 V	I_C/I_F	min.	0,25
Collector current			
I_F = 0,1 mA; V_{CE} = 5 V	I_{CE}	max.	100 μA
DC current gain			
I_C = 0,4 mA; V_{CE} = 1 V	h_{FE}	min.	200
Collector-emitter saturation voltage			
I_F = 10 mA; I_C = 1 mA	V_{CEsat}	max.	0,5 V
Output capacitance			
V_{CB} = 10 V; f = 1 MHz	C_{bc}	typ.	4,5 pF
Collector cut-off current (dark) at working voltage V_W = 1,5 kV; (d.c. value) see notes 1 and 2			
V_{CC} = 10 V;	I_{CEW}	max.	200 nA
V_{CC} = 10 V; T_j = 70 °C	I_{CEW}	max.	100 μA
Isolation voltage (d.c. value) see note 3	V_{IORM}	min.	3,5 kV
Capacitance between input and output			
V = 0; f = 1 MHz	C_{io}	typ.	0,6 pF
Insulation resistance between input and output			
$\pm V_{IO}$ = 1 kV	R_{IO}	min. typ.	10^{10} Ω 10^{12} Ω
Switching times (see figures 3 and 4)			
I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
Turn-on time	t_{on}	max.	7 μs
Turn-off time	t_{off}	max.	7 μs

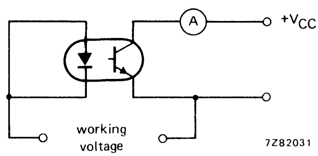


Fig. 2.

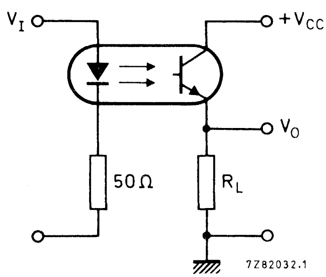


Fig. 3 Switching circuit.

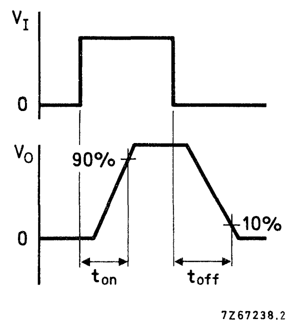


Fig. 4 Waveforms.

Notes.

1. This parameter is the maximum collector-emitter leakage current measured when a high voltage is applied between the emitter and the two shorted diode leads (see Fig. 2).
2. As quality assurance (on a sample basis), these parameters are covered by a 1000 hour reliability test.
3. Tested on sample basis. The input diode leads are shorted together an all the transistor leads shorted together, then a test voltage of 4,4 kV (d.c.) is applied for 1 min.

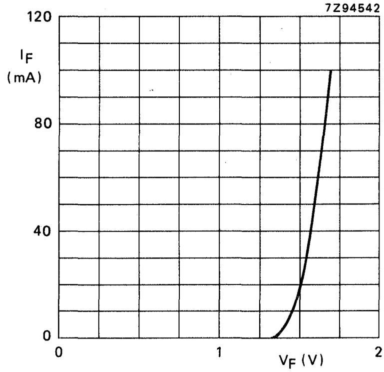


Fig. 5 T_{amb} = 25 °C; typical values.

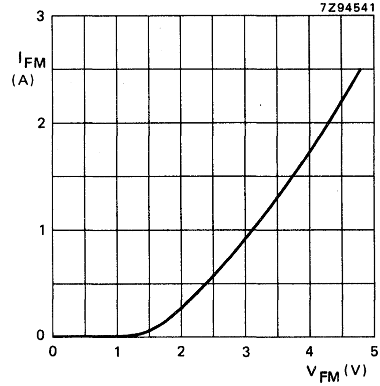


Fig. 6 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms; typical values.

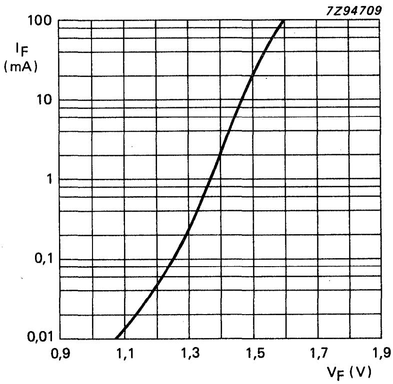


Fig. 7 T_{amb} = 25 °C; typical values.

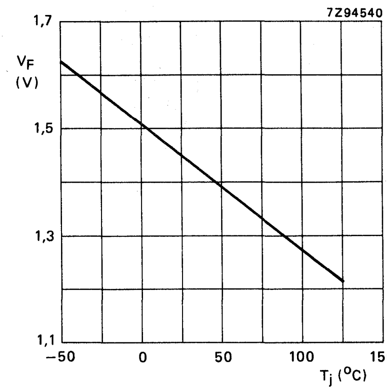


Fig. 8 I_F = 10 mA; typical values.

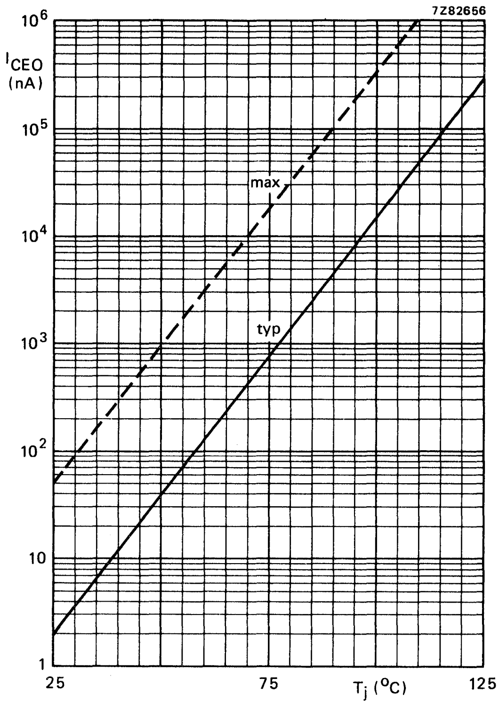


Fig. 9 $I_F = 0$; $V_{CE} = 10$ V; typical values.

DEVELOPMENT DATA

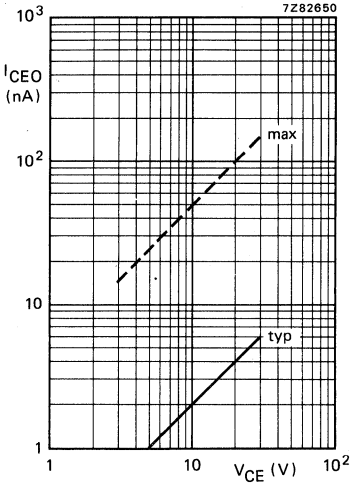


Fig. 10 $I_F = 0$; $T_j = 25\ ^oC$.

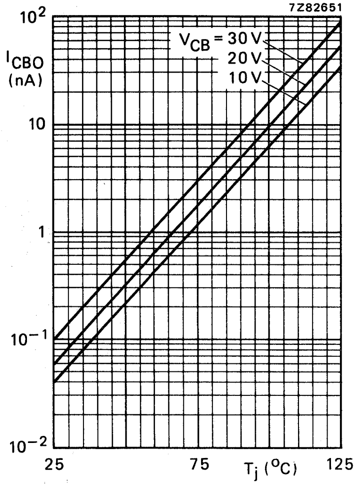


Fig. 11 Typical values.

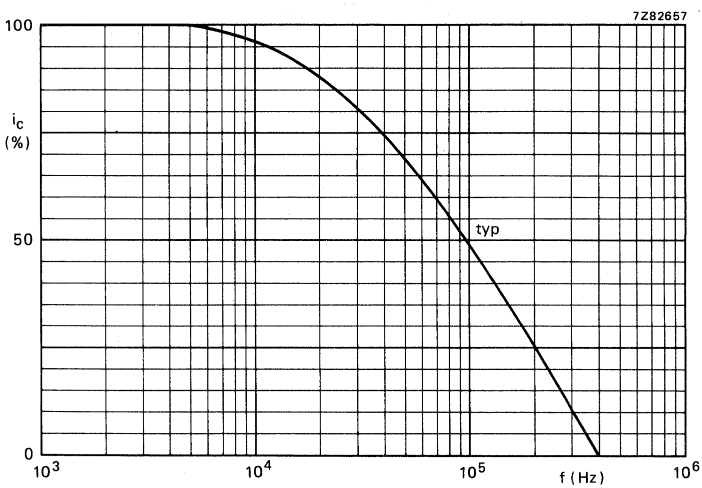


Fig. 12 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1\ k\Omega$; $T_{amb} = 25\ ^oC$.

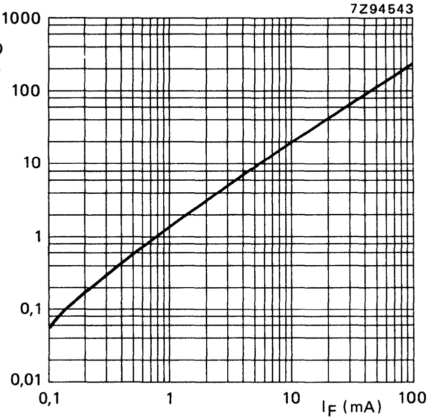


Fig. 13 V_{CB} = 5 V; T_{amb} = 25 ^oC; typical values.

DEVELOPMENT DATA

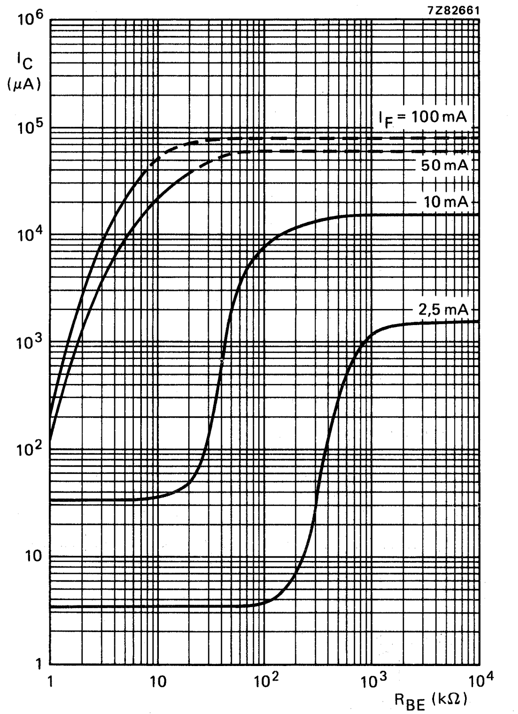


Fig. 14 $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

DEVELOPMENT DATA

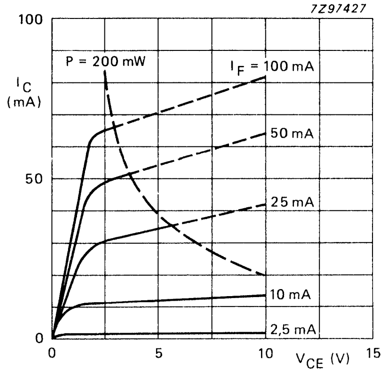


Fig. 15 T_{amb} = 25 °C; typical values.

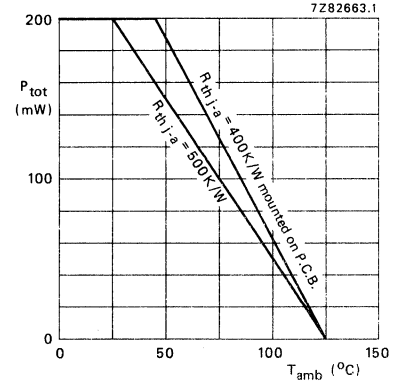


Fig. 16

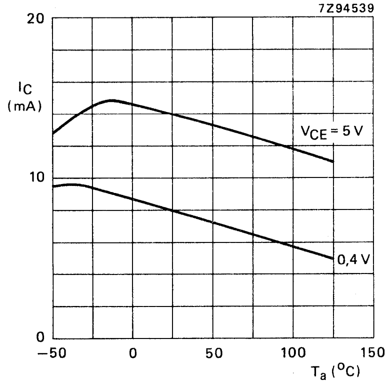


Fig. 17 I_F = 10 mA; typical values.

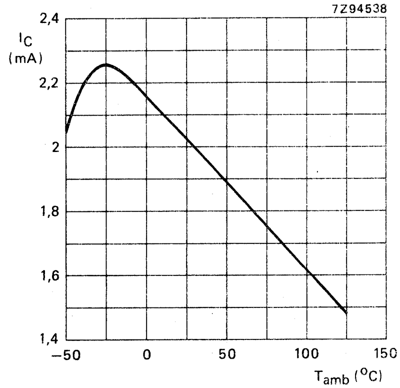


Fig. 18 I_F = 2 mA; V_{CE} = 0,4 V; typical values.

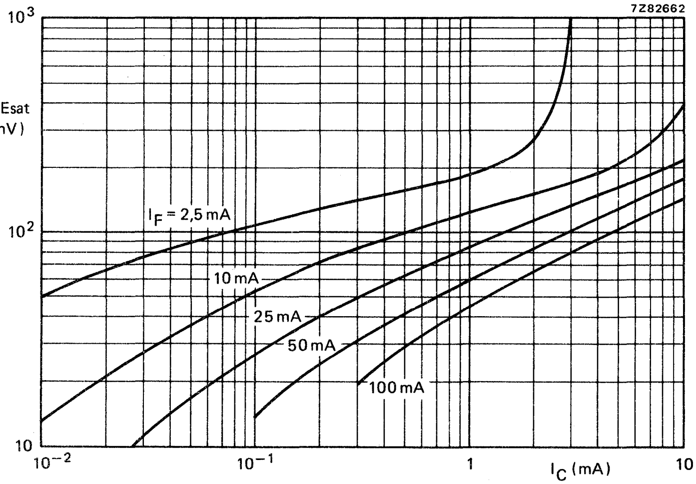


Fig. 19. $I_B = 0$; $T_{amb} = 25\ ^oC$; typical values.

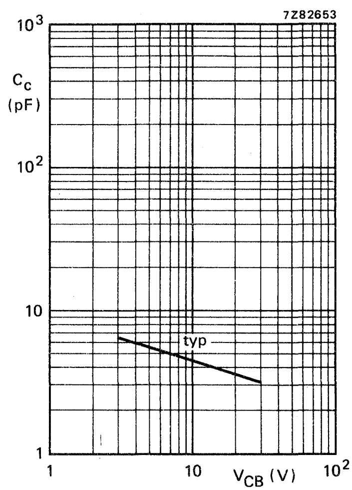


Fig.20. f = 1 MHz; $T_{amb} = 25\ ^oC$.

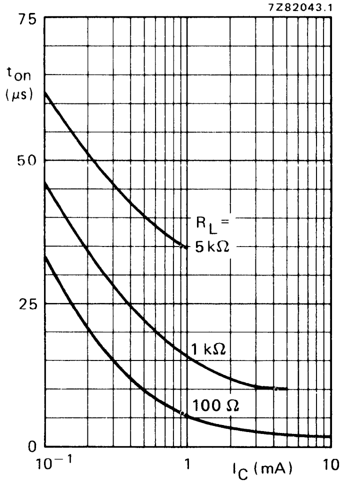


Fig. 21. $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 23).

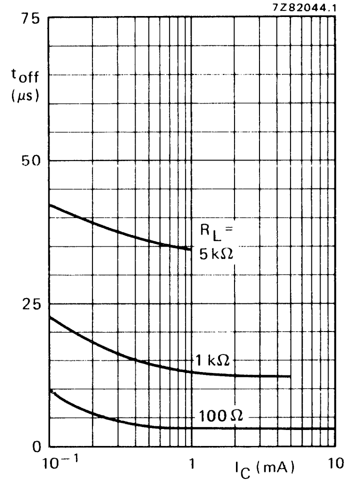
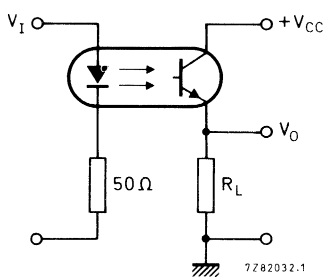


Fig. 22. $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See also Fig. 23).



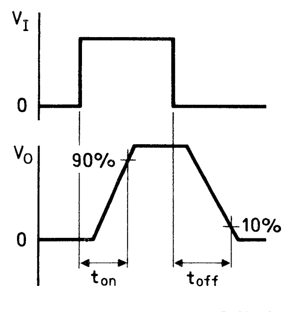


Fig. 23. Switching circuit and waveforms.

OPTOCOUPLERS

This product range is one of the industrial standards applied in the market. The current transfer ratio, isolation voltage and low saturation voltage comply to the specifications of the main part of the optocoupler market.

This range can be used with TTL circuits and is comprised of an infrared emitting GaAs diode and an N-P-N silicon phototransistor.

UL — Covered under UL component recognition FILE E90700

VDE — Approved according to VDE 0883/6.83

QUICK REFERENCE DATA

Collector-emitter voltage of phototransistor*		V_{CEO}	max.	30 V
Forward current of infrared emitting diode (d.c.)*		I_F	max.	80 mA
D.C. current transfer ratio at I_F = 10 mA; V_{CE} = 10 V*	4N25 to 4N26	I_C/I_F	min.	0,2
	4N27 4N28	I_C/I_F	min.	0,1
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	250 mW
Isolation voltage (see note 1)		V_{IORM}	min.	2,0 kV(r.m.s.)

MECHANICAL DATA

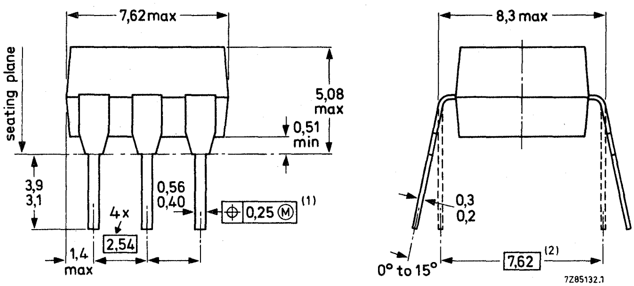
SOT-90B (see Fig. 1).

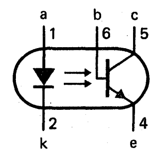
* Indicates JEDEC registered data.

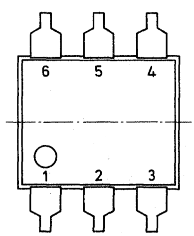
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-90B.







⊕ Positional accuracy.

Ⓜ Maximum Material Condition.

(1) Centre-lines of all leads are within ± 0,125 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by 0,25 mm.

(2) When the leads are parallel, the tips remain in position for automatic insertion.

RATINGS

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

Diode			
Continuous reverse voltage*	V_R	max.	5 V
Forward current*			
d.c.	I_F	max.	80 mA
peak value; t_{on} = 300 μs; δ = 0,02	I_{FRM}	max.	3 A
Total power dissipation			
→ up to T_{amb} = 25 °C *	P_{tot}	max.	150 mW
Transistor			
Collector-emitter voltage (open base)*	V_{CEO}	max.	30 V
Collector-base voltage (open emitter)*	V_{CBO}	max.	70 V
Emitter-collector voltage (open base)*	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation			
up to T_{amb} = 25 °C *	P_{tot}	max.	150 mW

* Indicates JEDEC registered data.

Optocoupler

Storage temperature*	T_{stg}		−55 to +150	°C
Operating junction temperature*	T_j		−55 to +100	°C
Soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260	°C
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250	mW ←

THERMAL RESISTANCE

From junction to ambient in free air diode	$R_{th\ j\text{-}a}$	max.	500	K/W
transistor	$R_{th\ j\text{-}a}$	max.	500	K/W

LINEAR DERATING FACTORS

Above 25 °C

diode*	2	mW/K
transistor*	2	mW/K
optocoupler*	3,3	mW/K

ISOLATION RELATED VALUES

External air gap (clearance) input terminals to output terminals	L(IO1)	min.	7,2	mm
External tracking path (creepage distance) input terminals to output terminals	L(IO2)	min.	7,0	mm
Tracking resistance (KB-value)		KB-100/A		

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage* I_F = 10 mA	V_F	typ.	1,15	V
		max.	1,5	V
Reverse current* V_R = 5 V	I_R	max.	100	μA
Capacitance at f = 1 MHz V = 0	C_d	typ.	50	pF

Transistor

Collector-emitter breakdown voltage* I_C = 1 mA	$V_{(BR)CEO}$	min.	30	V
Collector-base breakdown voltage* I_C = 0,1 mA	$V_{(BR)CBO}$	min.	70	V
Emitter-collector breakdown voltage* I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7	V

* Indicates JEDEC registered data.

Dark current *				
V_{CE} = 10 V	4N25 to 4N27	I_{CEO}	typ.	2 nA
			max.	50 nA
V_{CB} = 10 V	4N28	I_{CEO}	max.	100 nA
		I_{CBO}	max.	20 nA
Optocoupler				
Output/input d.c. current transfer ratio*				
I_F = 10 mA; V_{CE} = 10 V	4N25 to 4N26	I_C/I_F	min.	0,2
	4N27 4N28	I_C/I_F	min.	0,1
Collector-emitter saturation voltage*				
I_F = 50 mA; I_C = 2 mA		V_{CEsat}	max.	0,5 V
			typ.	0,1 V
Isolation voltage (see notes 1 and 2)		V_{IORM}	min.	2,0 kV(r.m.s.)
				2,8 kV(d.c.)
Capacitance between input and output				
V_{IO} = 0; f = 1 MHz		C_{io}	typ.	0,6 pF
Insulation resistance between input and output				
V_{IO} = 500 V		R_{IO}	typ.	10^{12} Ω
Bandwidth				
$-I_C$ = 2 mA; V_{CE} = 10 V				
R_L = 100 Ω		B_W	typ.	300 kHz
Switching times (unsaturated) see Fig. 2				
Rise time				
I_C = 2 mA; V_{CC} = 10 V; R_L = 100 Ω		t_r	typ.	3 μs
Fall time				
I_C = 2 mA; V_{CC} = 10 V; R_L = 100 Ω		t_f	typ.	3 μs
Switching times (saturated) see Fig. 3				
Turn-on time (TTL def.)				
I_F = 15 mA; V_{CC} = 5 V; R_L = 2 kΩ; R_{BE} = ∞		t_{on}	typ.	5 μs
I_F = 20 mA; V_{CC} = 5 V; R_L = 2 kΩ; R_{BE} = 100 kΩ		t_{on}	typ.	5 μs
Turn-off time (TTL def.)				
I_F = 15 mA; V_{CC} = 5 V; R_L = 2 kΩ; R_{BE} = ∞		t_{off}	typ.	30 μs
I_F = 20 mA; V_{CC} = 5 V; R_L = 2 kΩ; R_{BE} = 100 kΩ		t_{off}	typ.	10 μs

* Indicates JEDEC registered data.

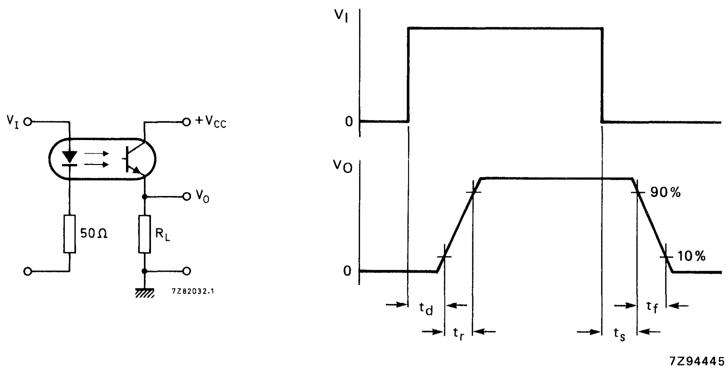


Fig. 2 Measuring circuit and waveforms.

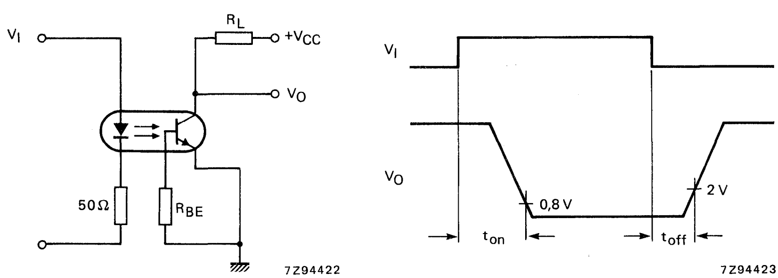


Fig. 3 Measuring circuit and waveforms.

Note 1:

Satisfies JEDEC registered isolation voltage ratings (min. V_{IO}):

4N25	2,5 kV (peak)
4N25-A	1,775 kV (r.m.s.)
4N26	1,5 kV (peak)
4N27	1,5 kV (peak)
4N28	0,5 kV (peak)

Note 2:

Every single product is tested by applying an isolation test voltage of 2500 V (r.m.s.) for 2 seconds between the shorted input (diode) leads and the shorted output (phototransistor) leads.

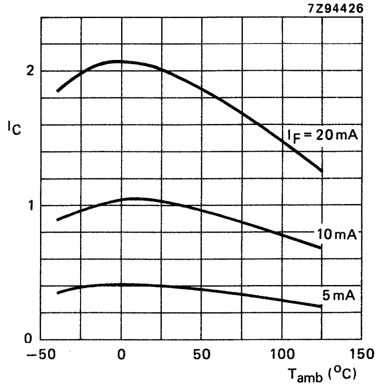


Fig. 4 Normalized at $I_F = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; typical values.

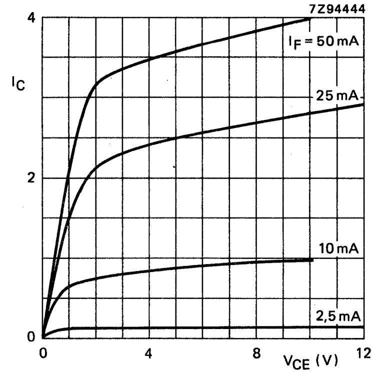


Fig. 5 Normalized at $I_C = 1$ mA; $I_F = 10$ mA; $V_{CE} = 10$ V; typical values.

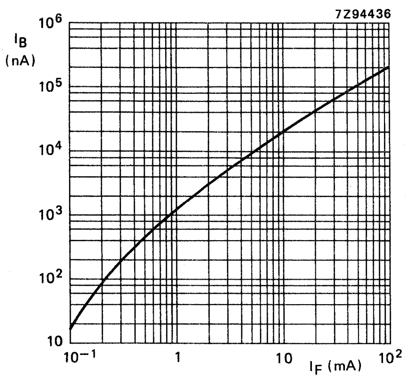


Fig. 6 $V_{CB} = 10$ V; $T_{amb} = 25$ °C; typical values.

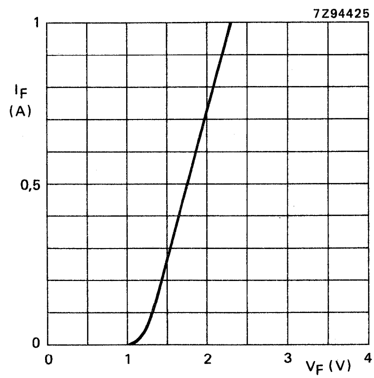


Fig. 7 $T_{amb} = 25$ °C; $t_{on} = 20$ μs; $\delta = 0{,}01$; typical values.

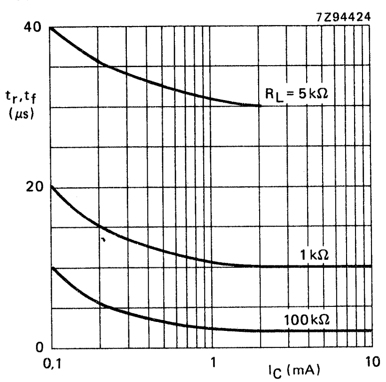


Fig. 8 Normalized at $I_F = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C; typical values.

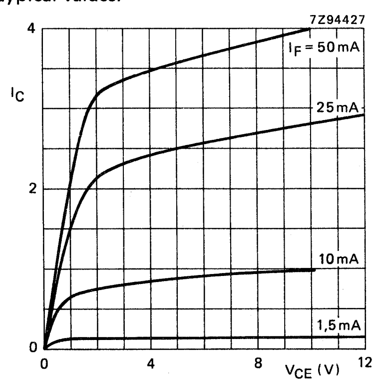


Fig. 9 $T_{amb} = 25$ °C; typical values.

SECTION B1

Special optocouplers (opto high-tech line)

OPTOCOUPLERS

Optocouplers in a hermetically sealed metal envelope. They have high reliability and can be used under severe conditions such as in military or industrial applications. The CNX44 and CNX46 differ only in the pinning connections and both types have an unconnected base.

An outstanding characteristic is the high common-mode rejection ratio.

QUICK REFERENCE DATA

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 75 °C mounted on a p.c.b.	P_{tot}	max.	150 mW
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Total power dissipation up to T_{amb} = 75 °C mounted on a p.c.b.	P_{tot}	max.	150 mW
Optocoupler			
Output/input d.c. current transfer ratio			
I_F = 10 mA; V_{CE} = 0,4 V	I_C/I_F	min.	0,3
Collector cut-off current (dark)			
V_{CE} = 15 V; working voltage (d.c.) = 1,0 kV	I_{CEW}	max.	200 nA
Isolation voltage (d.c.)	V_{IORM}	min.	1,0 kV
Common-mode rejection ratio			
I_C = 2 mA; f = 10 kHz	CMRR	typ.	85 dB

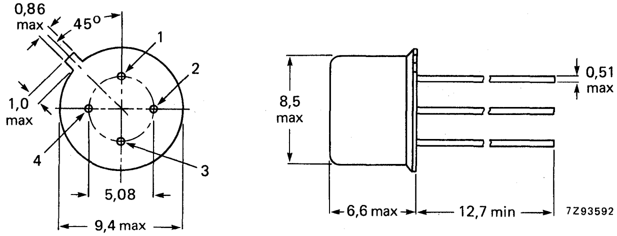
MECHANICAL DATA

SOT-104C (see Fig. 1).

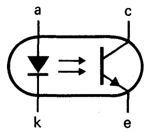
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-104C.

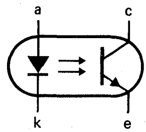


Lead reference



CNX44

a = pin 1
k = pin 2
e = pin 3
c = pin 4



CNX46

a = pin 3
k = pin 4
e = pin 1
c = pin 2

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
peak value; t_{on} = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	150 mW

Transistor

Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Emitter-collector voltage	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	150 mW

Optocoupler

Storage temperature	T_{stg}		−65 to +150 °C
Operating ambient temperature	T_{amb}		−55 to +125 °C
Total power dissipation of diode and transistor up to T_{amb} = 75 °C	P_{tot}	max.	300 mW

THERMAL RESISTANCE

From junction to ambient			
diode	$R_{th\ j\text{-}a}$	max.	330 K/W
transistor	$R_{th\ j\text{-}a}$	max.	330 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage			
I_F = 10 mA	V_F	typ. max.	1,15 V 1,30 V
I_F = 2 mA; T_{amb} = 0 to 70 °C	V_F	max.	1,20 V
Reverse current			
V_R = 5 V	I_R	typ. max.	1 μA 100 μA

Transistor

Collector-emitter breakdown voltage			
I_C = 1 mA	$V_{(BR)CEO}$	min.	50 V
Emitter-collector breakdown voltage			
I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V
Collector cut-off current (dark); diode I_F = 0			
V_{CE} = 20 V	I_{CEO}	typ. max.	5 nA 100 nA
V_{CE} = 20 V; T_{amb} = 70 °C	I_{CEO}	max.	10 μA
D.C. current gain			
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	typ.	600

Optocoupler

Output/input d.c. current transfer ratio (C.T.R.)			
I_F = 10 mA; V_{CE} = 0,4 V	I_C/I_F	min. typ.	0,3 0,6
I_F = 10 mA; V_{CE} = 5 V	I_C/I_F	typ.	1,0
Switching times (see Figs 4 and 5)			
I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω	t_{on} t_{off}	typ. typ.	5 μs 5 μs
Collector cut-off current (dark) at working voltage 1 kV (d.c. value);			
V_{CC} = 15 V; T_j = 25 °C (see Fig. 3) V_{CC} = 15 V; T_j = 70 °C (see Fig. 3)	I_{CEW}	max. max.	200 nA* 50 μA*
Isolation voltage (d.c. value) between shorted input and shorted output terminals	V_{IORM}	min.	1,0 kV
Capacitance between input and output			
V = 0; f = 1 MHz	C_{IO}	typ.	1 pF
Insulation resistance between input and output			
V_{IO} = 500 V	R_{IO}	min. typ.	10^{11} Ω 10^{12} Ω
Common-mode rejection ratio (see Fig. 2)			
I_C = 2 mA; f = 10 kHz	CMRR	typ.	85 dB

* As quality assurance (on a sample basis), these parameters are covered by a 1000 h reliability test.

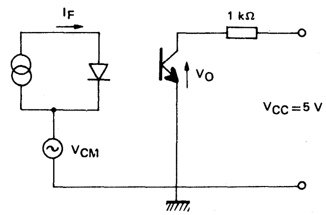


Fig. 2.

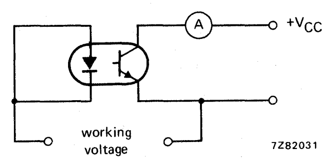


Fig. 3.

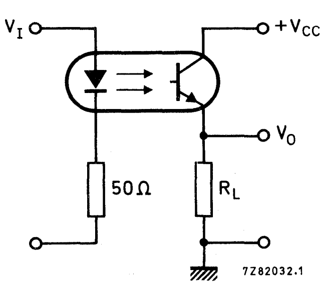


Fig. 4.

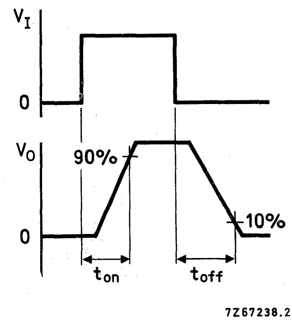


Fig. 5.

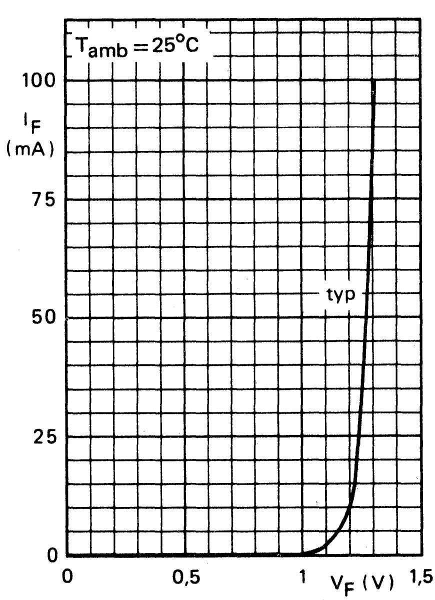


Fig. 6.

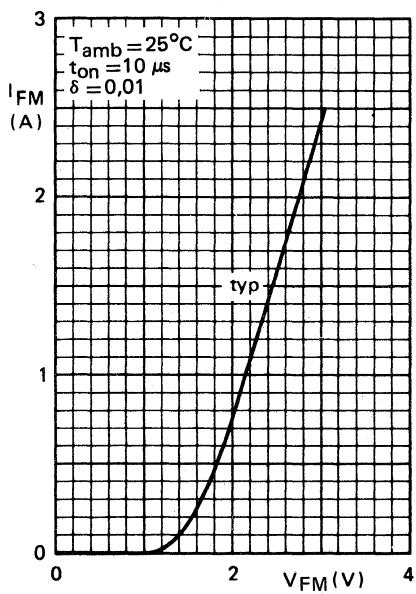


Fig. 7.

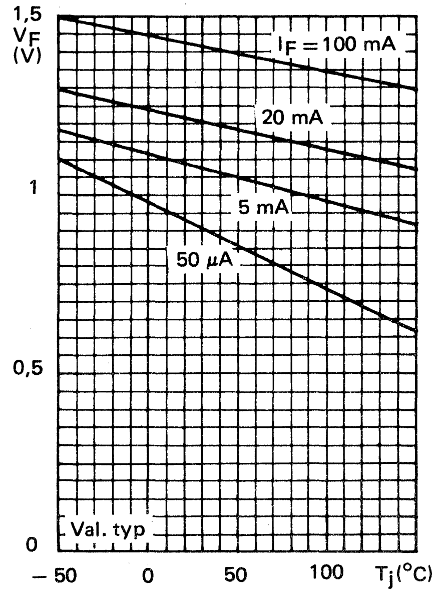


Fig. 8.

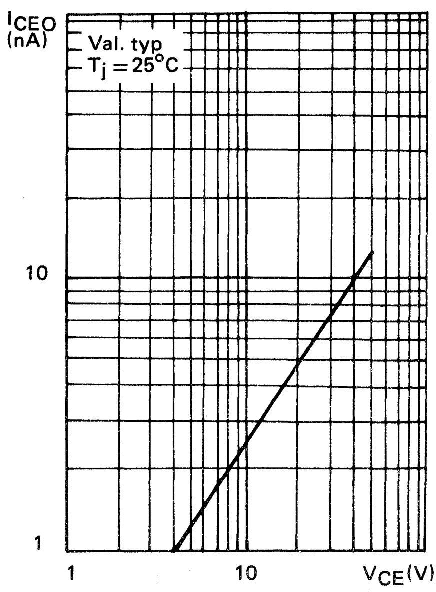


Fig. 9.

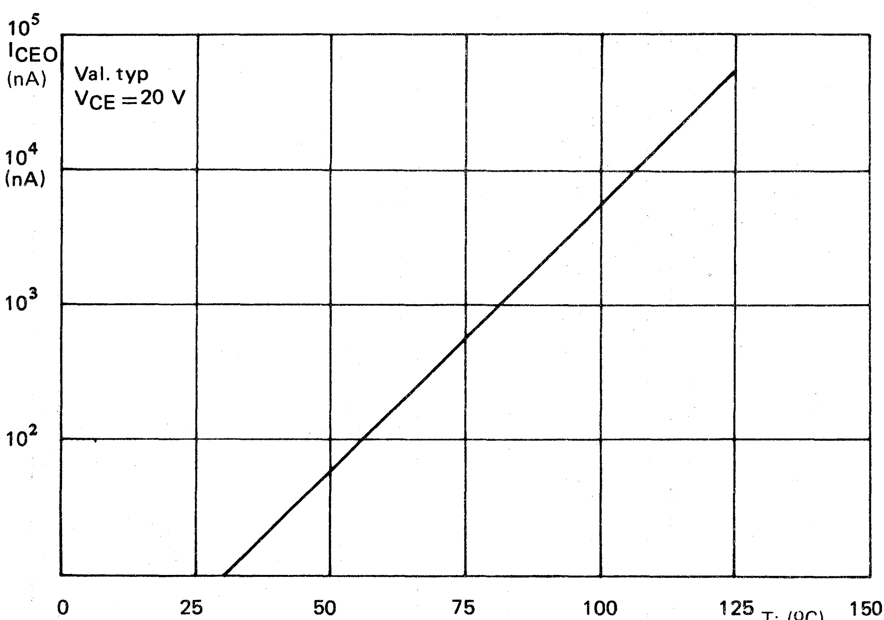


Fig. 10.

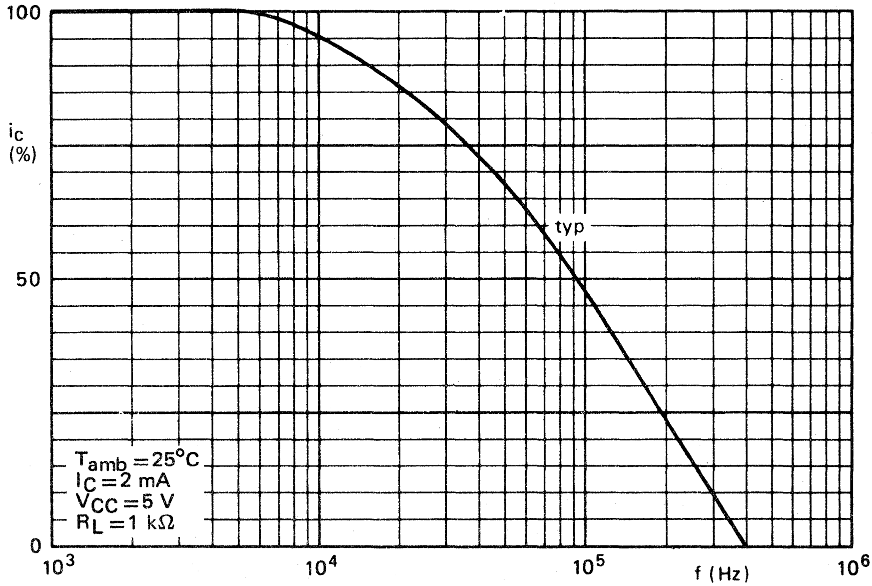


Fig. 11.

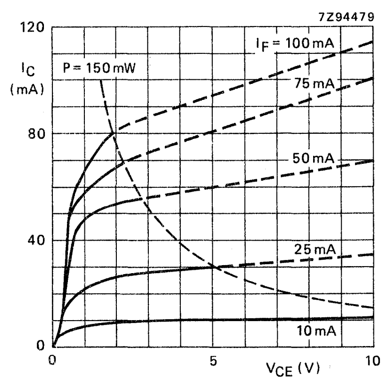


Fig. 12 T_{amb} = 25 °C; typical values.

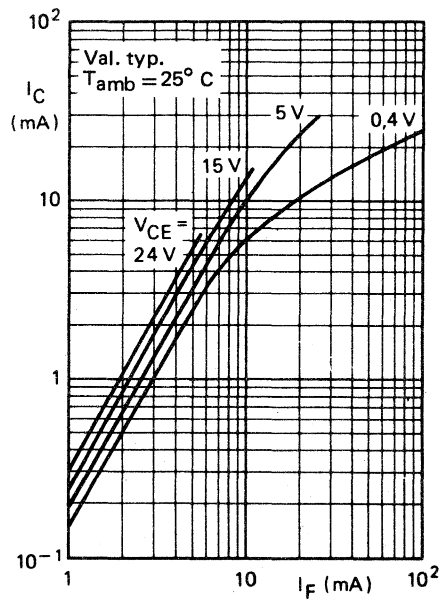


Fig. 13.

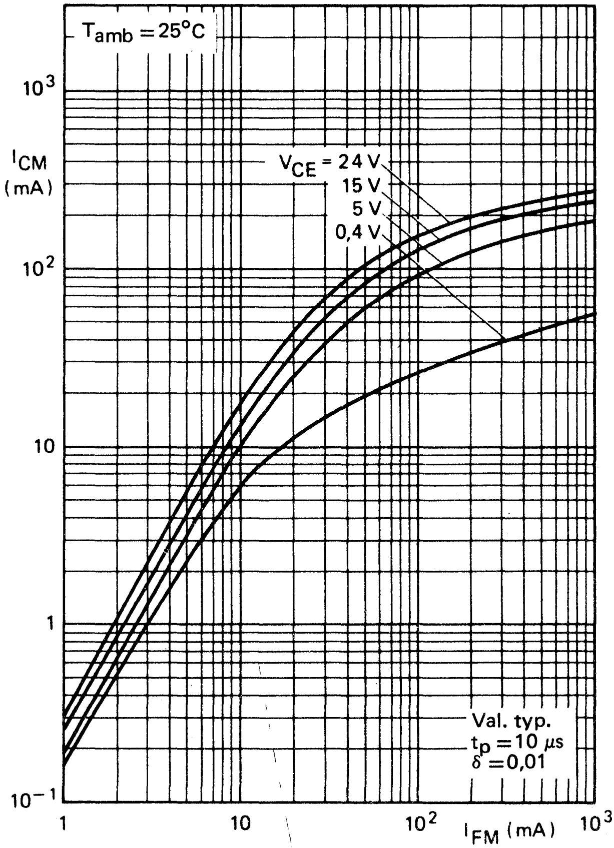

$T_{amb} = 25°C$
10^3
I_{CM} (mA)
10^2
10
1
10^{-1}
V_{CE} = 24 V
15 V
5 V
0,4 V
Val. typ.
$t_p = 10\ \mu s$
$\delta = 0,01$
1
10
10^2
I_{FM} (mA)
10^3

Fig. 14.

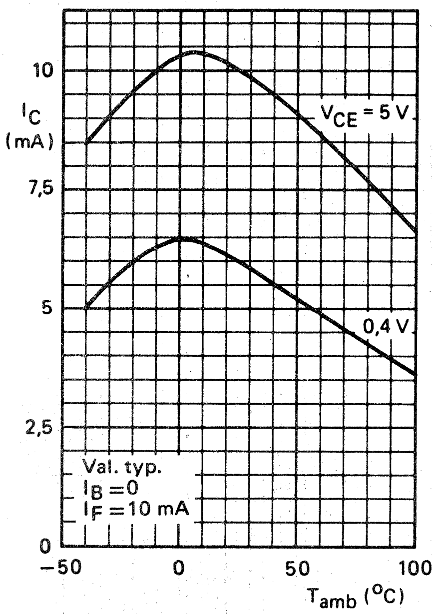


Fig. 15.

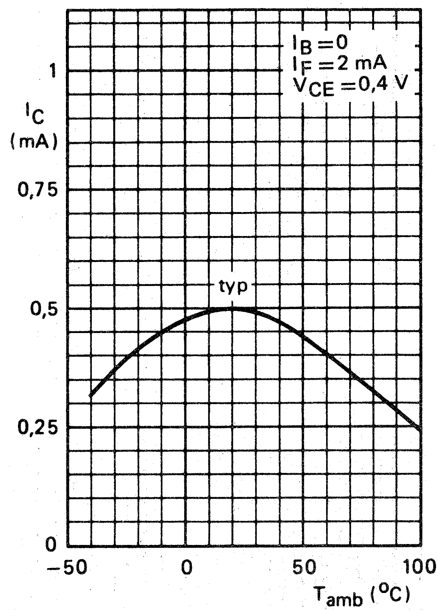


Fig. 16.

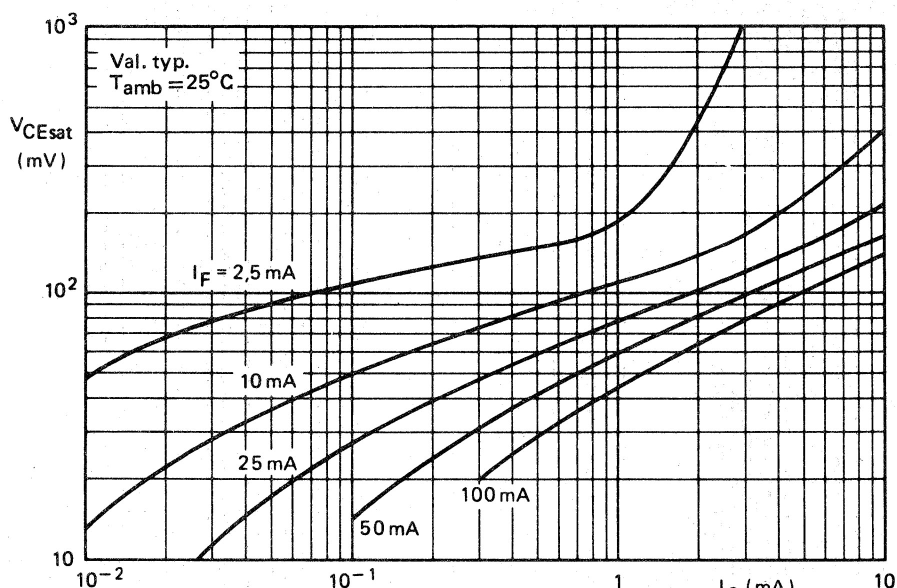


Fig. 17.

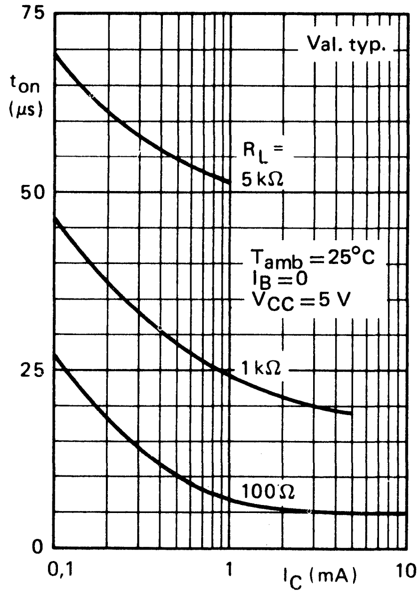


Fig. 18.

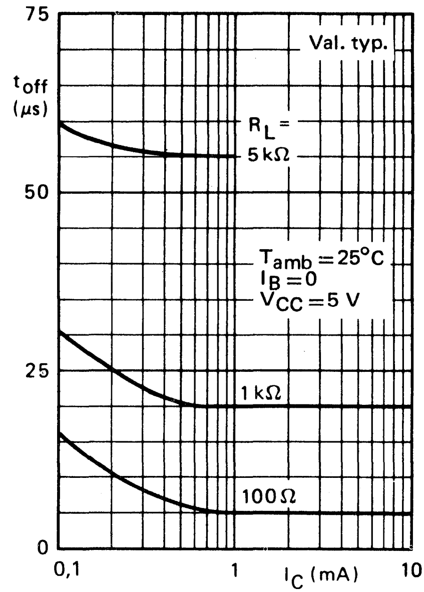


Fig. 19.

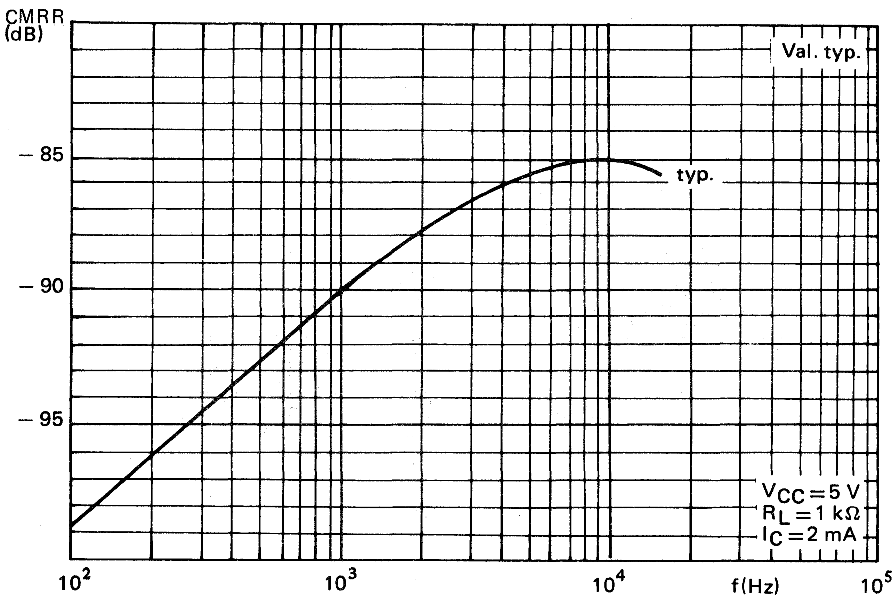


Fig. 20 T_{amb} = 25 °C.

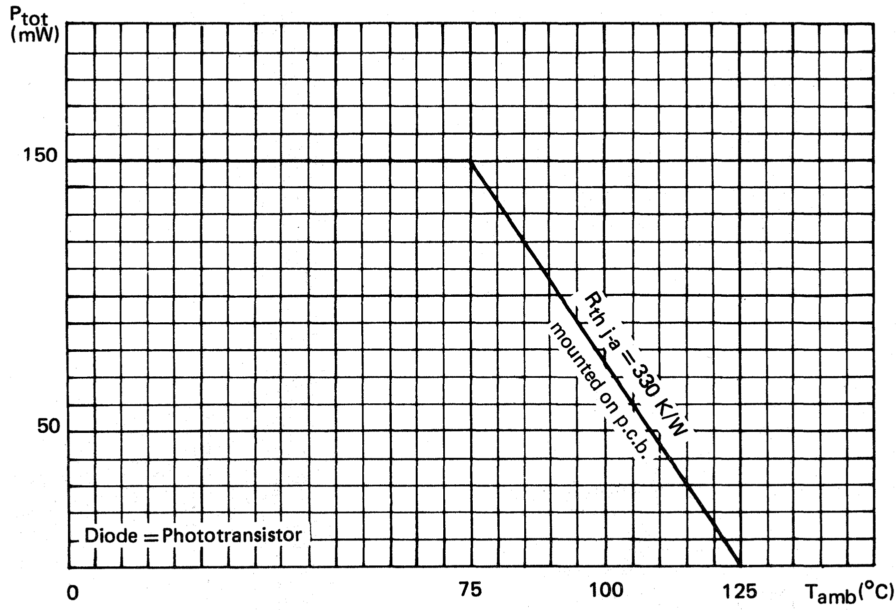

Ptot
(mW)
150
50
Diode = Phototransistor
Rth j-a = 330 K/W
mounted on p.c.b.
0
75
100
125
Tamb(°C)

Fig. 21.

OPTOCOUPLER

Optocoupler in a hermetically sealed metal envelope. It has high reliability and can be used under severe conditions such as military or industrial applications.

An outstanding characteristic is the high common-mode rejection ratio.

QUICK REFERENCE DATA

Diode			
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	60 V
Optocoupler			
Output/input d.c. current transfer ratio (C.T.R.)			
I_F = 10 mA; V_{CE} = 0,4 V	I_C/I_F	min.	0,3
Collector cut-off current (dark)			
V_{CE} = 15 V; working voltage (d.c.) = 1,0 kV	I_{CEW}	max.	200 nA
Isolation voltage			
d.c. value	V_{IORM}	min.	1,0 kV
Common mode rejection ratio			
I_C = 2 mA; f = 10 kHz	CMRR	typ.	85 dB

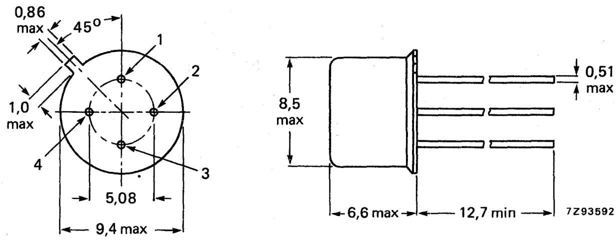
MECHANICAL DATA

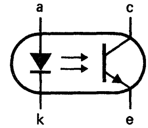
SOT-104C (see Fig. 1).

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-104C.





Pinning

pin 1 = anode
pin 2 = cathode
pin 3 = emitter
pin 4 = collector

RATINGS

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

Diode				
Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	150	mW
Transistor				
Collector-emitter voltage (open base)	V_{CEO}	max.	60	V
Emitter-collector voltage (open base)	V_{ECO}	max.	7	V
Collector current	I_C	max.	100	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	150	mW
Optocoupler				
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	300	mW
Storage temperature	T_{stg}		−65 to +150	°C
Operating ambient temperature	T_{amb}		−55 to +125	°C

THERMAL RESISTANCE

From junction to ambient in free air				
diode	$R_{th\ j\text{-}a}$	max.	330	K/W
transistor	$R_{th\ j\text{-}a}$	max.	330	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode			
Forward voltage I_F = 10 mA	V_F	typ. max.	1,15 V 1,3 V
Forward voltage I_F = 2 mA; T_{amb} = 0 °C to 70 °C	V_F	max.	1,2 V
Reverse current V_R = 5 V	I_R	typ. max.	1 μA 100 μA
Transistor			
Collector-emitter breakdown voltage open base; I_C = 1 mA	$V_{(BR)CEO}$	min.	60 V
Emitter-collector breakdown voltage open base; I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V
Collector cut-off current (dark) V_{CE} = 20 V	I_{CEO}	typ. max.	5 nA 100 nA
V_{CE} = 20 V; T_a = 70 °C	I_{CEO}	max.	10 μA
D.C. current gain I_C = 10 mA; V_{CE} = 5 V	h_{FE}	typ.	600
Optocoupler			
Output/input d.c. current transfer ratio (C.T.R.) I_F = 10 mA; V_{CE} = 0,4 V	I_C/I_F	min. typ.	0,4 0,8
I_F = 10 mA; V_{CE} = 5 V	I_C/I_F	typ.	1,0
Switching times I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω Turn-on time Turn-off time	 t_{on} t_{off}	 typ. typ.	 5 μs 5 μs
Isolation voltage, d.c. value between shorted input leads and shorted output leads	V_{IORM}	min.	1,0 kV
Collector cut-off current (dark) V_{CC} = 15 V; working voltage (d.c.) = 1 kV T_j = 25 °C T_j = 70 °C (see Fig. 3)	 I_{CEW} I_{CEW}	 max. max.	 200 nA* 50 μA*
Insulation resistance between input and output V_{IO} = 500 V	R_{IO}	min. typ.	10^{11} Ω 10^{12} Ω
Capacitance between input and output V = 0; f = 1 MHz	C_{IO}	typ.	1 pF

* As quality assurance (on a sample basis), these parameters are covered by a 1000 h reliability test.

Common mode rejection ratio I_C = 2 mA; f = 10 kHz (see Fig. 2)	CMRR	typ.	85 dB

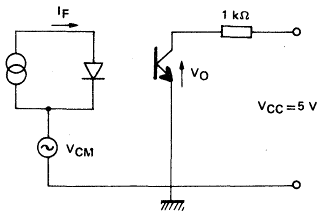


Fig. 2.

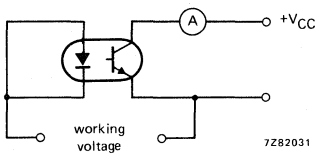


Fig. 3

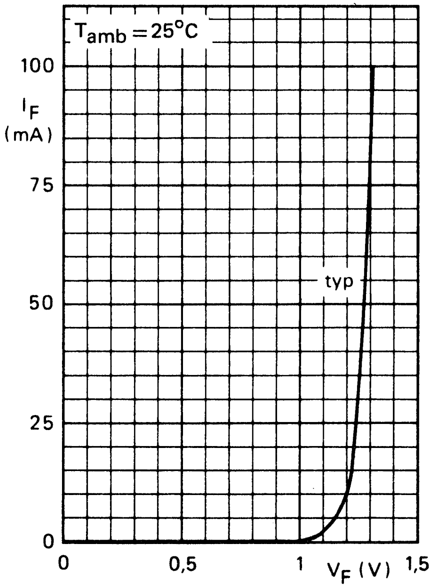


Fig. 4 Typical values.

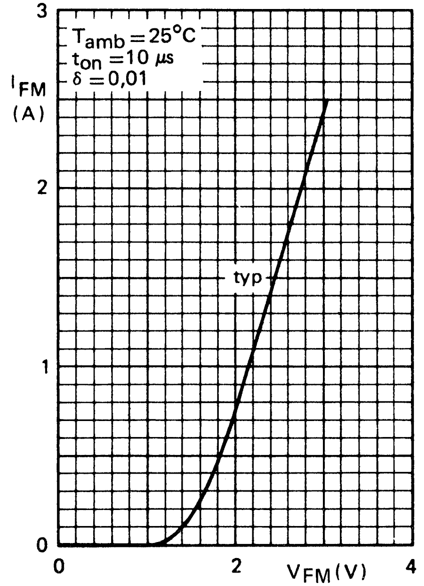


Fig. 5 Typical values.

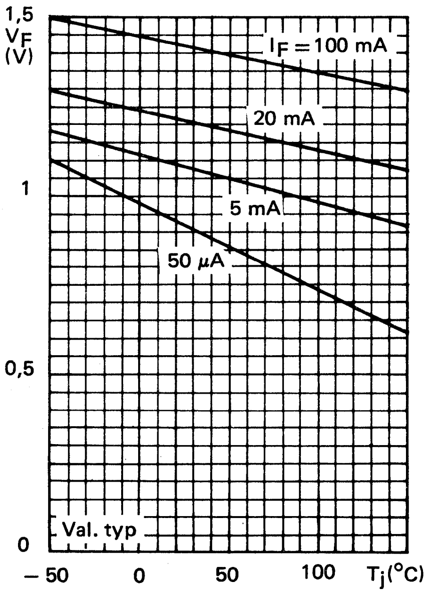


Fig. 6 Typical values.

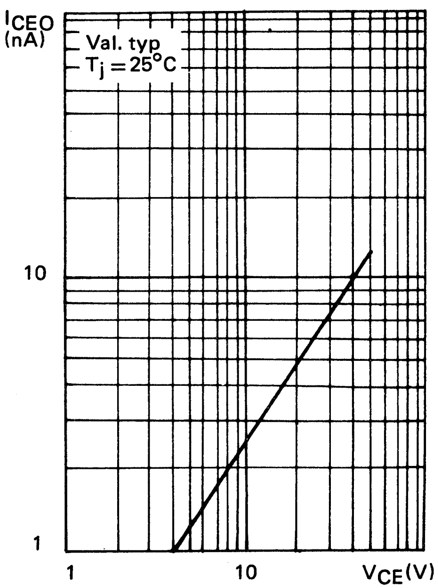


Fig. 7 Typical values.

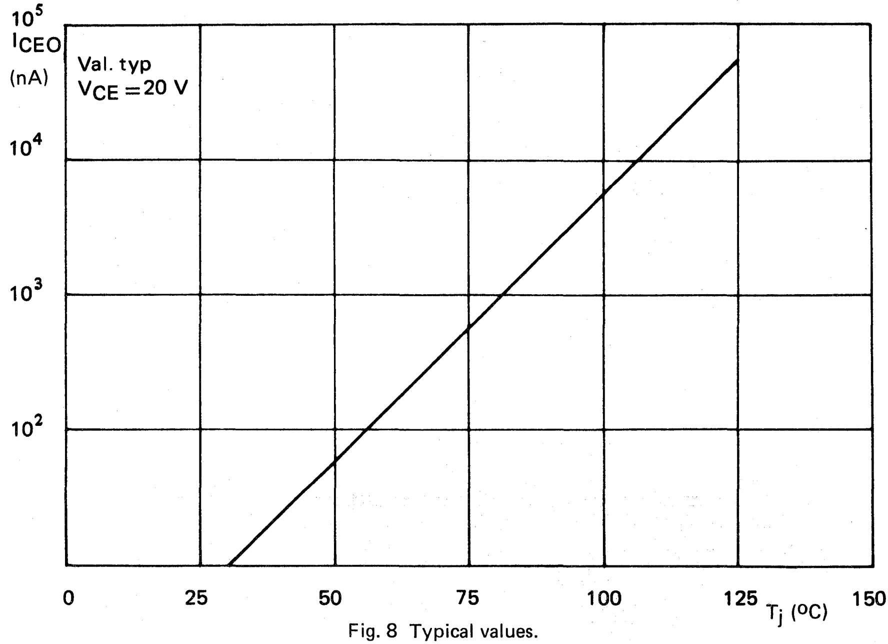


Fig. 8 Typical values.

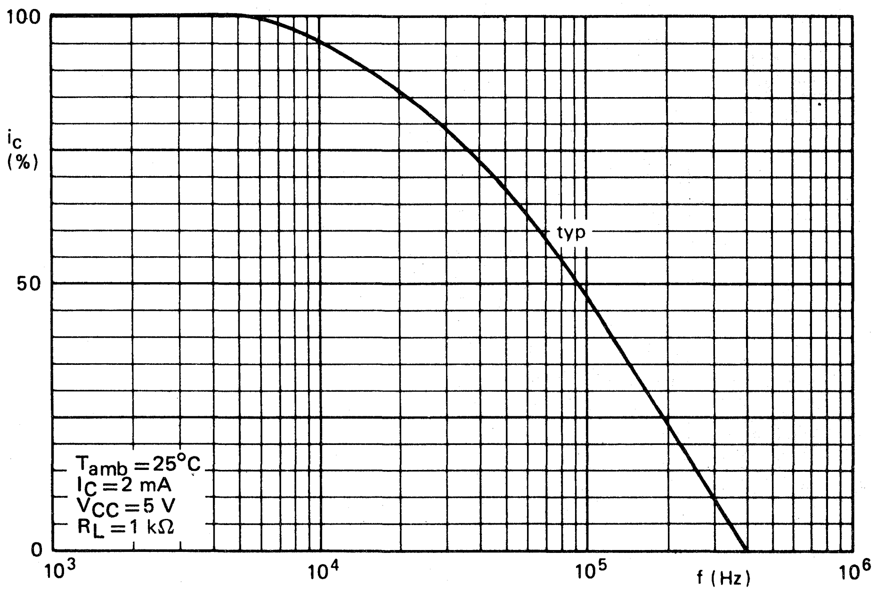


Fig. 9 Typical values.

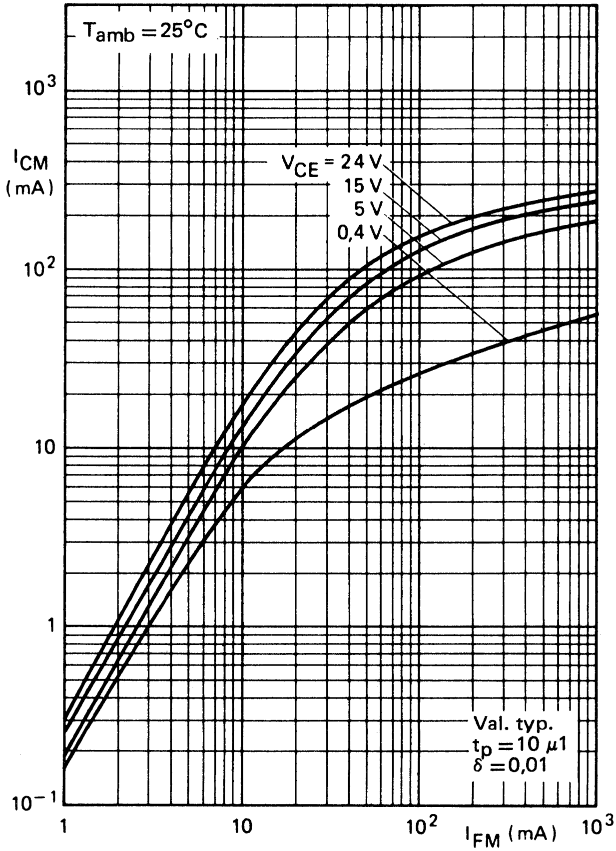


Fig. 10 Typical values.

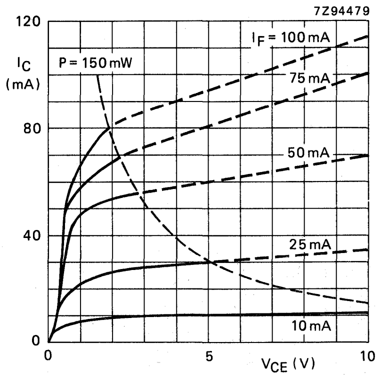


Fig. 11 T_{amb} = 25 °C; typical values.

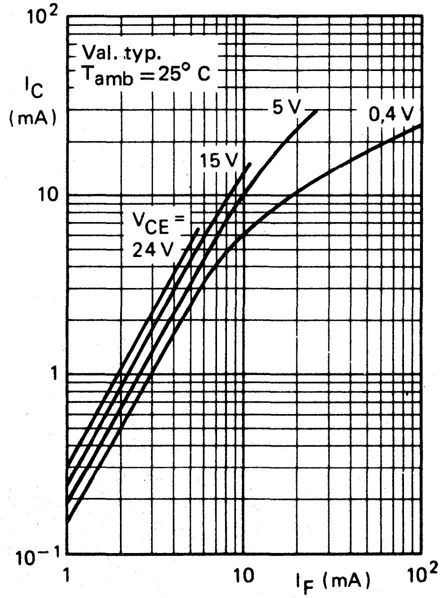


Fig. 12 Typical values.

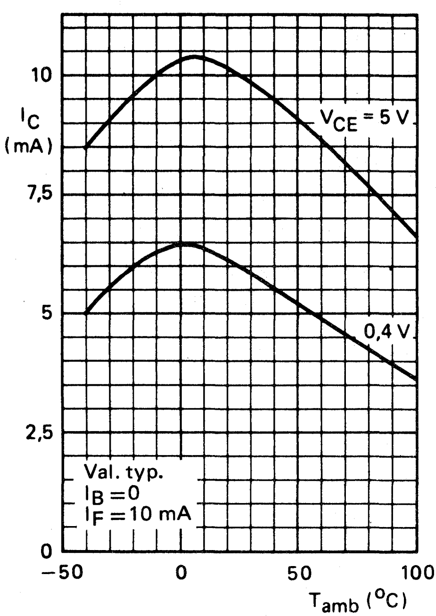


Fig. 13 Typical values.

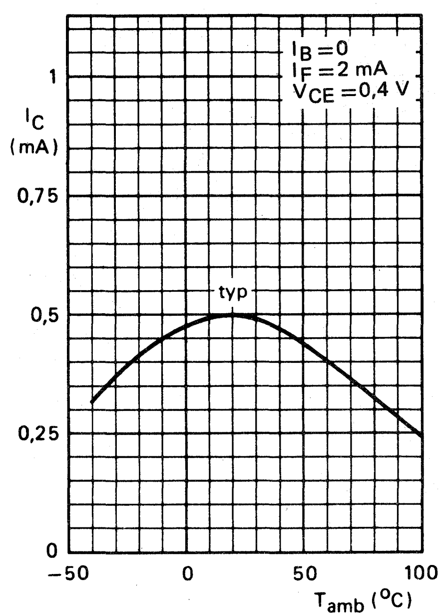


Fig. 14 Typical values.

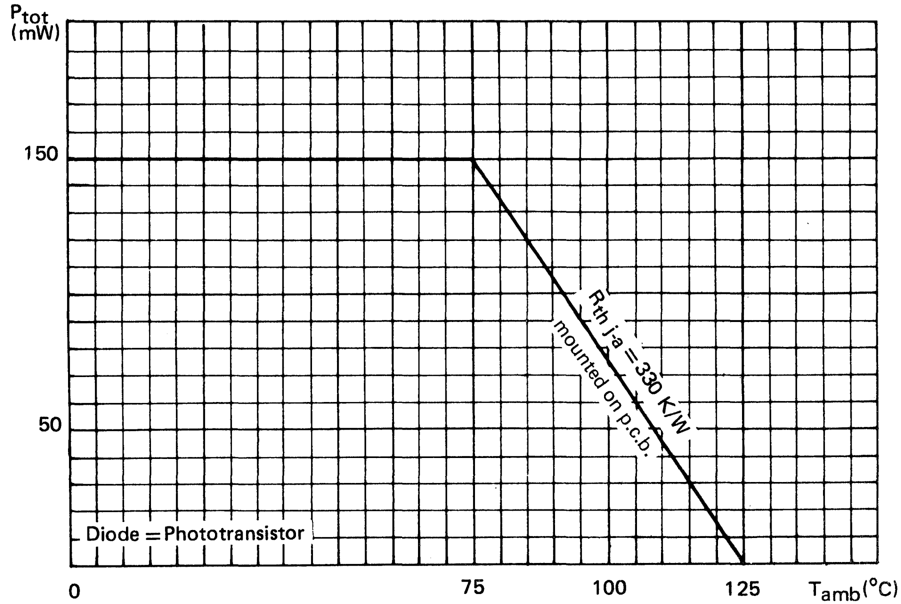


Fig. 15 Typical values.

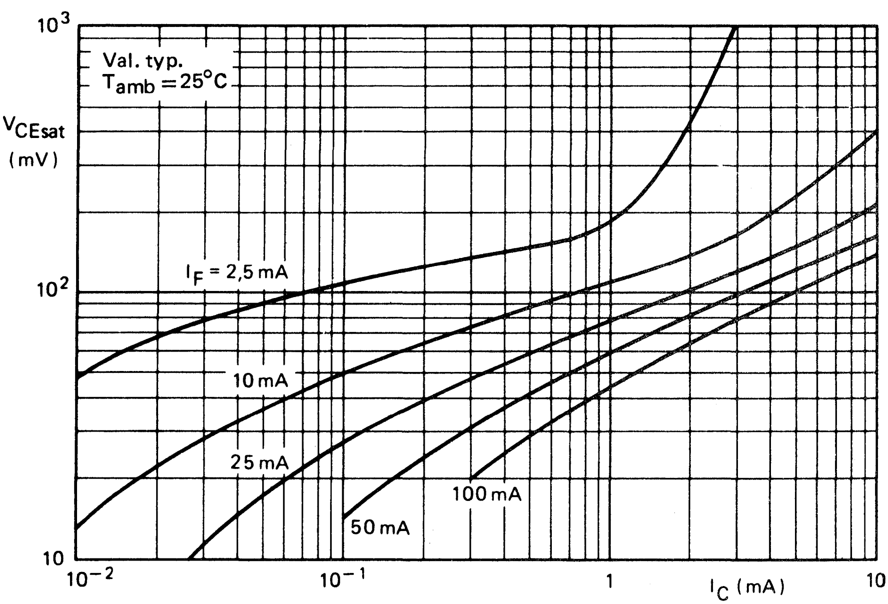


Fig. 16 Typical values.

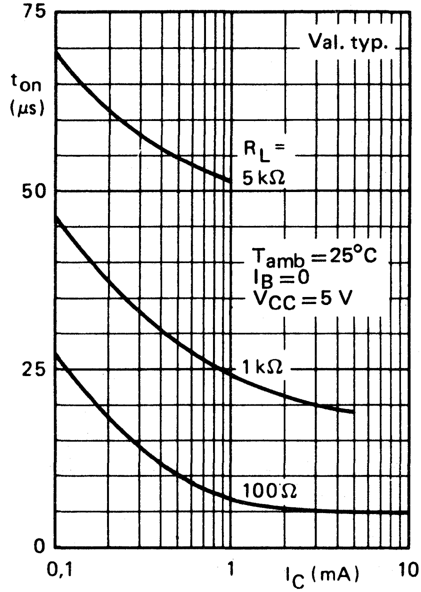


Fig. 17 Typical values.

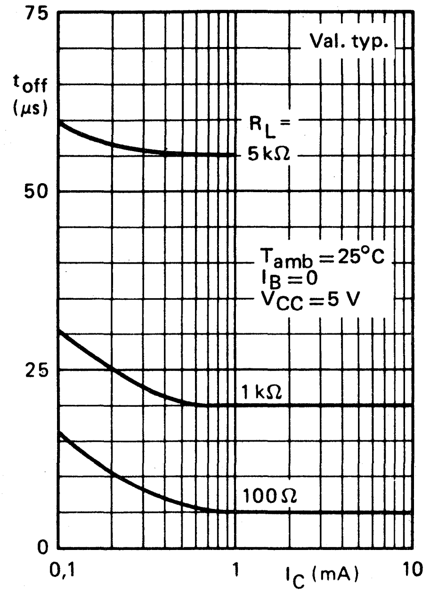


Fig. 18 Typical values.

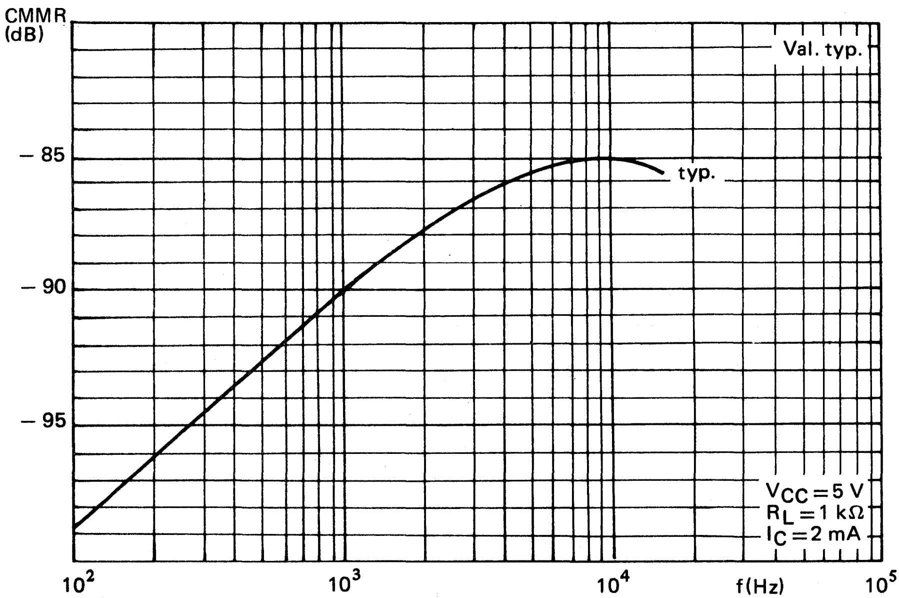


Fig. 19 T_{amb} = 25 °C; typical values.

OPTOCOUPLERS

Optically coupled isolators consisting of an infrared emitting GaAlAs diode and a silicon n-p-n phototransistor. Hermetically sealed in a SOT-18F envelope, the CNX91 and CNX92 are intended for professional applications.

The difference between the two types is the pinning of the phototransistor.

QUICK REFERENCE DATA

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	2,5 A
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Collector current	I_C	max.	100 mA
Optocoupler			
Leakage current under working voltage 500 V d.c. value V_{CE} = 15 V			
T_j = 25 °C	I_{CEW}	max.	200 nA
T_j = 70 °C	I_{CEW}	max.	100 μA
Isolation voltage d.c. value	V_{IORM}	min.	0,8 kV
Common mode rejection ratio I_C = 2 mA; f = 10 kHz	CMRR	min.	80 dB

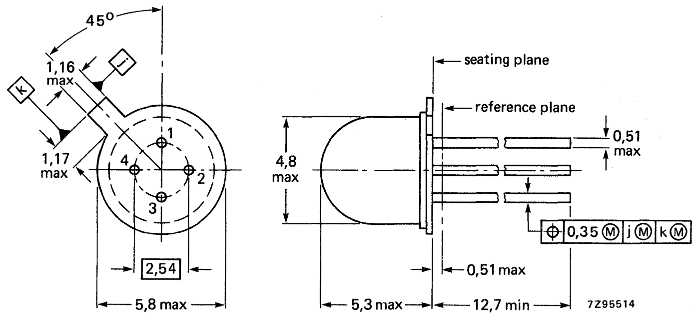
MECHANICAL DATA

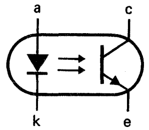
SOT-18F (see Fig. 1).

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-18F.





Pin reference

CNX91

pin 1 = anode
pin 2 = collector
pin 3 = emitter
pin 4 = cathode

CNX92

pin 1 = anode
pin 2 = emitter
pin 3 = collector
pin 4 = cathode

RATINGS

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

Diode			
Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	2,5 A
Transistor			
Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current	I_C	max.	100 mA
Optocoupler			
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	230 mW
Storage temperature	T_{stg}		−65 to +150 °C
Operating ambient temperature	T_{amb}		−55 to +125 °C
Soldering temperature 2 mm from the seating plane; < 10 s	T_{sld}		260 °C

THERMAL RESISTANCE

From junction to ambient in free air			
diode	$R_{th\ j\text{-}a}$	max.	600 K/W
transistor	$R_{th\ j\text{-}a}$	max.	500 K/W
From junction to case			
diode	$R_{th\ j\text{-}c}$	max.	300 K/W
transistor	$R_{th\ j\text{-}c}$	max.	200 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage			
I_F = 2 mA	V_F	max.	1,5 V
I_F = 10 mA	V_F	max.	1,65 V
I_F = 50 mA	V_F	max.	1,80 V
Reverse current			
V_R = 5 V	I_R	max.	100 μA
Diode capacitance	C_d	typ.	200 pF

Transistor

Collector-emitter breakdown voltage			
open base; I_C = 1 mA	$V_{(BR)CEO}$	min.	50 V
Emitter-collector breakdown voltage			
open base; I_E = 0,1 mA	$V_{(BR)ECO}$	min.	7 V
Collector cut-off current (dark)			
V_{CE} = 50 V	I_{CEO}	typ.	5 nA
		max.	50 nA
V_{CE} = 5 V	I_{CEO}	max.	10 nA

Optocoupler

Collector current			
I_F = 10 mA; V_{CE} = 0,4 V	I_C	min.	3 mA
		max.	20 mA
Saturation voltage			
I_F = 50 mA; I_C = 10 mA	V_{CEsat}	max.	0,4 V
Switching times			
I_C = 2 mA; V_{CC} = 5 V; R_L = 100 Ω			
Delay time	t_d	typ.	2 μs
		max.	4 μs
Rise time	t_r	typ.	4 μs
		max.	5 μs
Storage time	t_s	typ.	0,4 μs
		max.	0,5 μs
Fall time	t_f	typ.	4 μs
		max.	5 μs
Isolation voltage, d.c. value			
connected between shorted input leads and shorted output leads	V_{IORM}	min.	0,8 kV

Collector cut-off current (dark)			
V_{CE} = 15 V;			
working voltage (d.c.) = 500 V			
T_j = 25 °C	I_{CEW}	max.	200 nA
T_j = 70 °C	I_{CEW}	max.	100 μA
(see Fig. 3)			
Insulation resistance between input and output			
V_{IO} = 500 V	r_{IO}	min.	10^{12} Ω
Capacitance between input and output			
V = 0; f = 1 MHz	C_{io}	typ.	1 pF
		max.	2 pF
Common mode rejection ratio			
I_C = 2 mA; f = 10 kHz	CMRR	min.	80 dB
(see Fig. 2)		typ.	90 dB

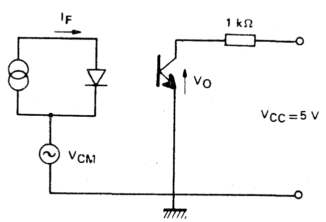


Fig. 2.

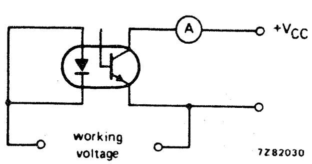


Fig. 3.

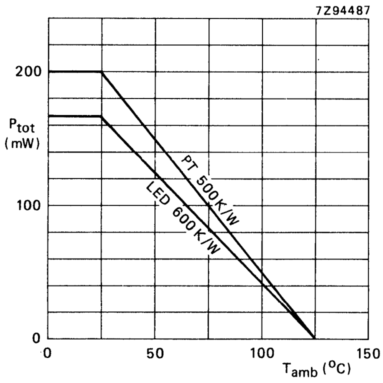


Fig. 4 Power derating curve.

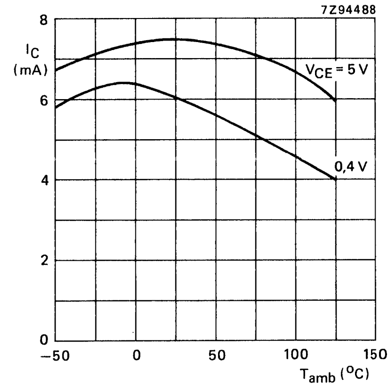


Fig. 5 I_F = 10 mA; typical values.

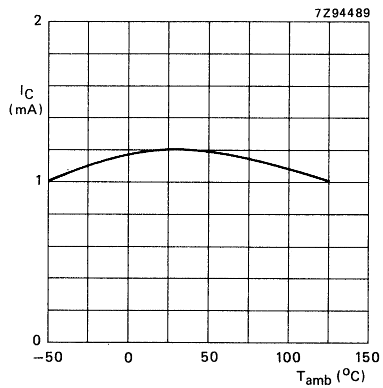


Fig. 6 I_F = 2 mA; V_{CE} = 5 V; typical values.

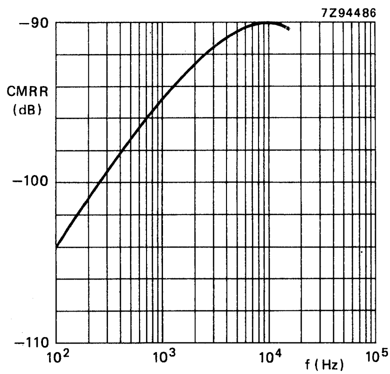


Fig. 7 I_C = 2 mA, V_{CC} = 5 V; R_L = 1 kΩ; typical values.

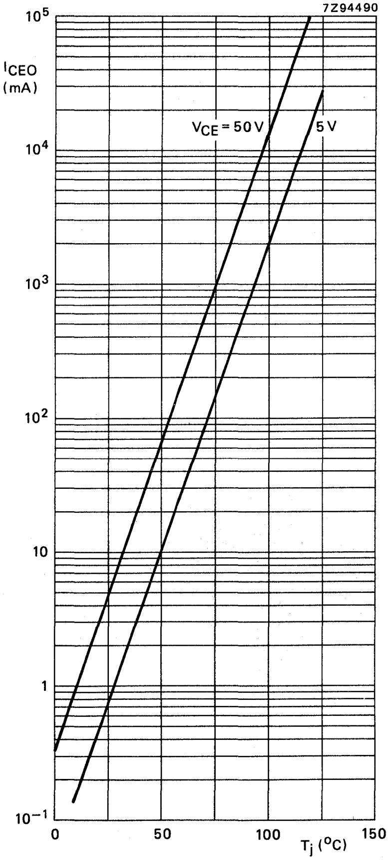


Fig. 8 T_{amb} = 25 °C; typical values.

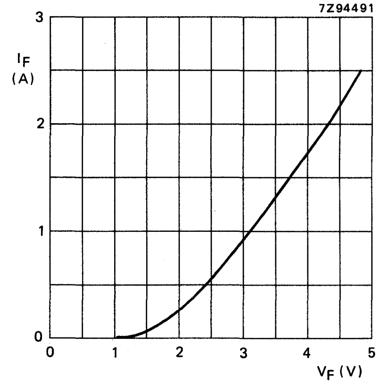


Fig. 9 T_{amb} = 25 °C; δ = 0,01; T_{on} = 10 μs; typical values.

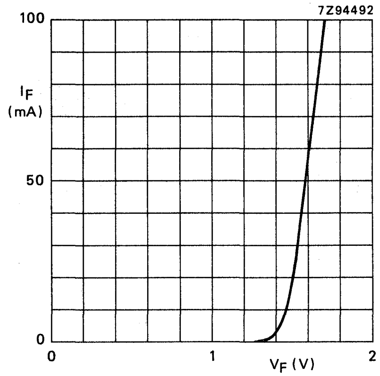


Fig. 10 T_{amb} = 25 °C; typical values.

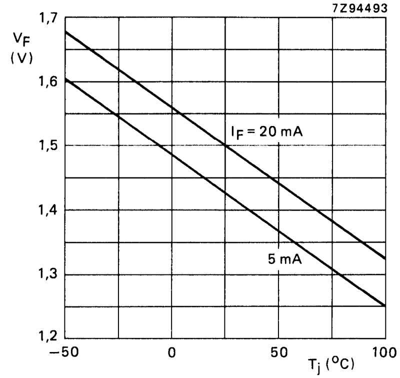


Fig. 11 Typical values.

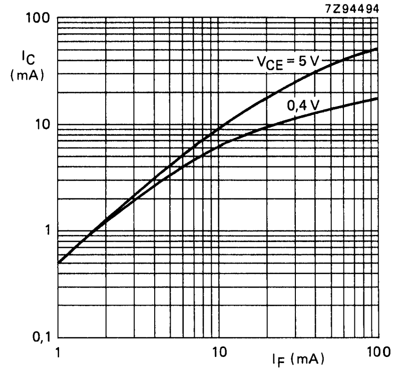


Fig. 12 T_{amb} = 25 °C; typical values.

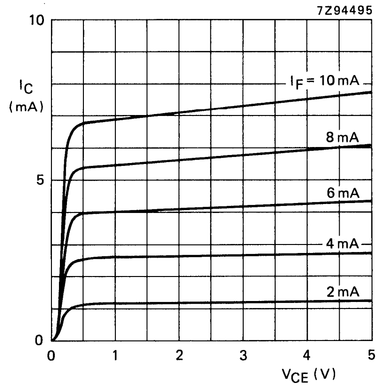


Fig. 13 Typical values.

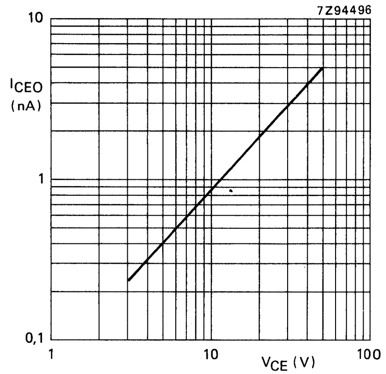


Fig. 14 T_j = 25 °C; typical values.

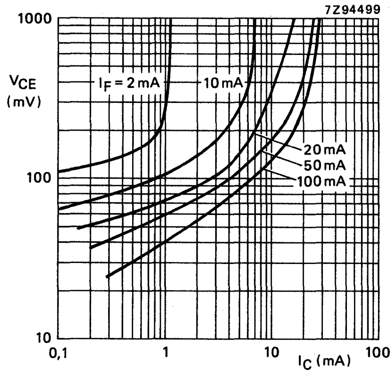


Fig. 15 T_{amb} = 25 °C; V_{CC} = 5 V; typical values.

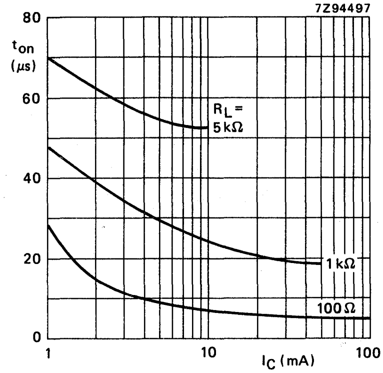


Fig. 16 V_{CC} = 5 V; typical values.

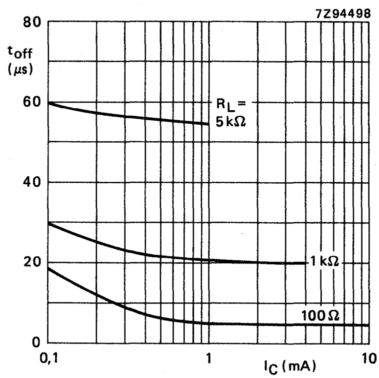


Fig. 17 T_{amb} = 25 °C; typical values.

OPTOCOUPLER

Optically coupled isolator consisting of an infrared emitting GaAs diode and a silicon n-p-n phototransistor with accessible base. Hermetically encapsulated in a metal envelope. The CNY50 is intended for professional applications.

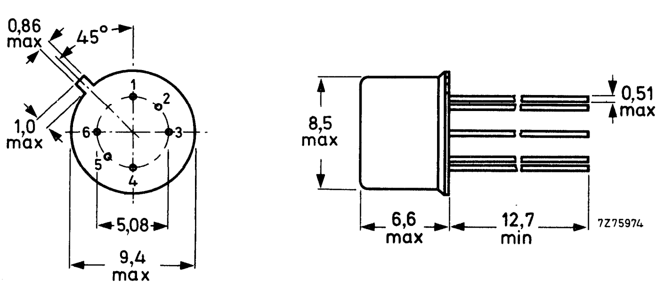
QUICK REFERENCE DATA

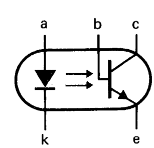
Diode					
Continuous reverse voltage		V_R	max.	5	V
Forward current					
d.c.		I_F	max.	100	mA
(peak value); t_p = 10 μs; δ = 0,01		I_{FRM}	max.	3	A
Total power dissipation up to T_{amb} = 75 ^oC		P_{tot}	max.	150	mW
Transistor					
Collector-emitter voltage (open base)		V_{CEO}	max.	50	V
Total power dissipation up to T_{amb} = 75 ^oC		P_{tot}	max.	150	mW
Optocoupler					
Output/input d.c. current transfer ratio (C.T.R.)					
I_F = 10 mA; V_{CE} = 0,4 V; (I_B = 0)	**CNY50-1**	I_C/I_F	min.	0,25	
			max.	1,0	
	CNY50-2	I_C/I_F	min.	0,4	
			max.	1,6	
Collector cut-off current (dark)					
V_{CC} = 15 V; working voltage (d.c.) = 1 kV		I_{CEW}	max.	200	nA
Isolation voltage(d.c.)		V_{IORM}	min.	1,5	kV

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-104B.





Lead reference

pin 1 = emitter
pin 2 = base
pin 3 = collector
pin 4 = anode
pin 5 = N.C.
pin 6 = cathode

Maximum lead diameter guaranteed only for 12,7 mm.

RATINGS

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

Diode

Continuous reverse voltage	V_R	max.	5 V
Forward current			
d.c.	I_F	max.	100 mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	3 A
Total power dissipation up to T_{amb} = 75 °C (see Fig. 2)	P_{tot}	max.	150 mW
Operating junction temperature	T_j	max.	125 °C

Transistor

Collector-base voltage (open emitter)	V_{CBO}	max.	70 V
Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	150 mW
Operating junction temperature	T_j	max.	125 °C

Optocoupler

Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}		−65 to + 150 °C
Operating ambient temperature	T_{amb}		−55 to + 125 °C

THERMAL RESISTANCE

From junction to ambient in free air

diode	$R_{th\ j\text{-}a}$	=	330 K/W
transistor	$R_{th\ j\text{-}a}$	=	330 K/W

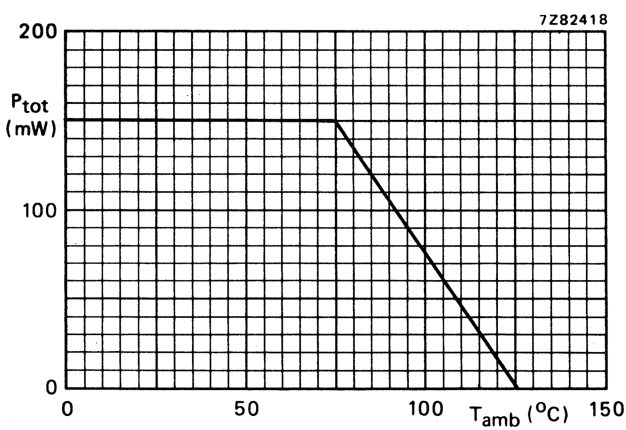


Fig. 2 Power/temperature derating curve for diode and transistor.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Diode

Forward voltage				
I_F = 2 mA; T_{amb} = 0 °C to 70 °C		V_F	<	1,2 V
I_F = 10 mA		V_F	typ.	1,15 V
			<	1,3 V
Reverse current				
V_R = 5 V		I_R	typ.	1 μA
			<	20 μA
Diode capacitance				
V_R = 0; f = 1 MHz		C_d	typ.	75 pF
Transistor (diode: I_F = 0)				
Collector-base breakdown voltage				
open emitter; I_C = 0,1 mA		$V_{(BR)CBO}$	>	70 V
Collector-emitter breakdown voltage				
open base; I_C = 1 mA		$V_{(BR)CEO}$	>	50 V
Emitter-collector breakdown voltage				
open base; I_E = 0,1 mA		$V_{(BR)ECO}$	>	7 V
Collector cut-off current (dark)				
I_E = 0; V_{CB} = 10 V		I_{CBO}	<	20 nA
I_B = 0; V_{CE} = 20 V		I_{CEO}	typ.	5 nA
			<	100 nA
I_B = 0; V_{CE} = 20 V; T_{amb} = 70 °C		I_{CEO}	<	10 μA
D.C. current gain				
I_C = 10 mA; V_{CE} = 5 V		h_{FE}	min.	200
			typ.	600
Optocoupler (I_B = 0)				
Output/input d.c. current transfer ratio (C.T.R.)			min.	0,25
I_F = 10 mA; V_{CE} = 0,4 V	**CNY50-1**	I_C/I_F	typ.	0,4
			max.	1,0
			min.	0,4
	CNY50-2	I_C/I_F	typ.	0,8
			max.	1,6
Collector cut-off current (dark) see Fig. 3				
V_{CC} = 15 V; working voltage (d.c.) = 1 kV				
T_j = 25 °C		I_{CEW}	<	200 nA
T_j = 70 °C		I_{CEW}	<	100 μA
Isolation voltage, d.c. value between shorted input and shorted output terminals		V_{IORM}	min.	1,5 kV
Capacitance between input and output				
I_F = 0; V = 0; f = 1 MHz		C_{io}	typ.	1 pF
			max.	2,5 pF

Insulation resistance between input and output $\pm V_{IO} = 500$ V	r_{IO}	>	10^{11}	Ω
		typ.	10^{12}	Ω
Switching times $I_F = 10$ mA; $V_{CC} = 5$ V; $R_L = 2$ kΩ	t_{on}	typ.	20	μs
	t_{off}	typ.	70	μs

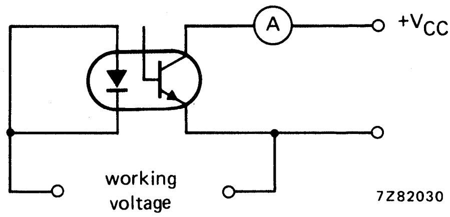


Fig. 3.

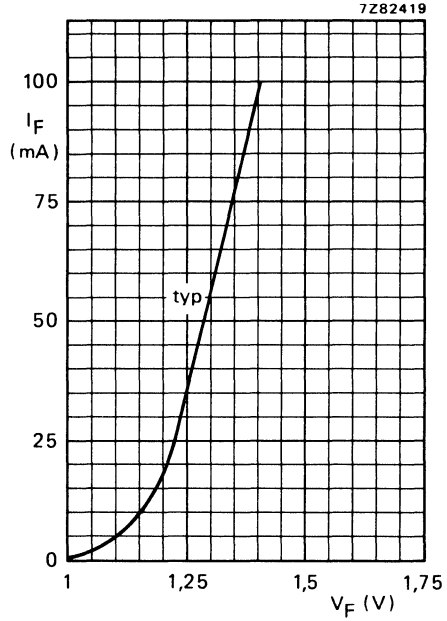


Fig. 4 T_{amb} = 25 ^oC.

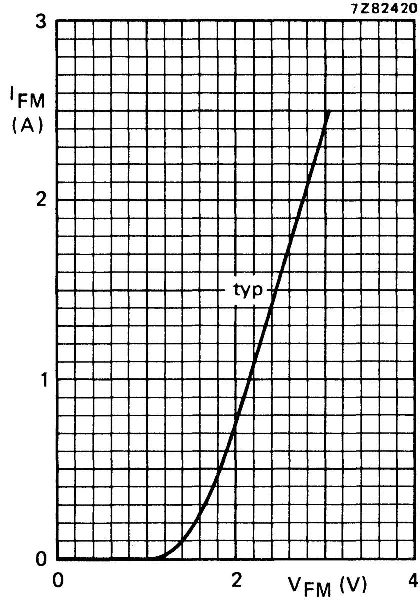


Fig. 5 T_{amb} = 25 ^oC; t_p = 10 μs; δ = 0,01.

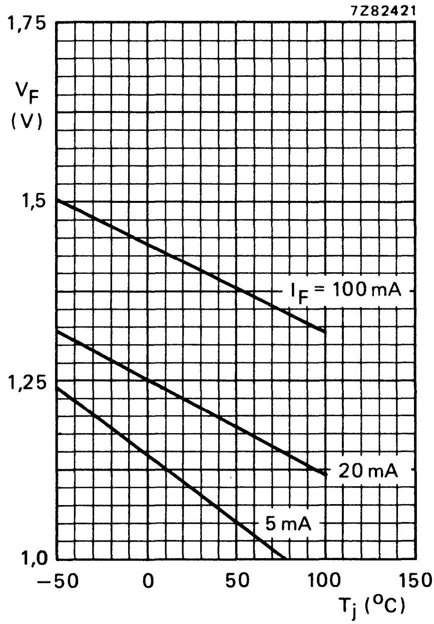


Fig. 6 Typical values.

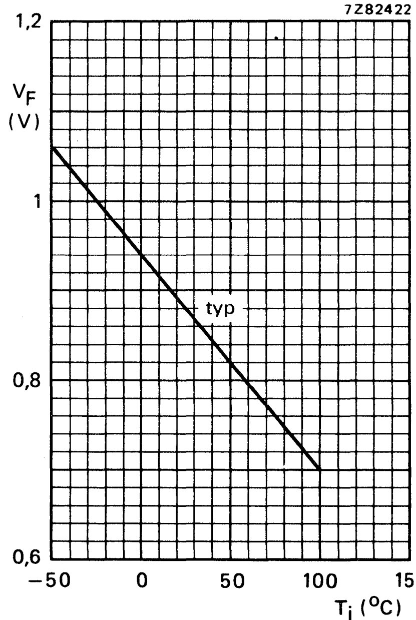


Fig. 7 I_F = 50 μA.

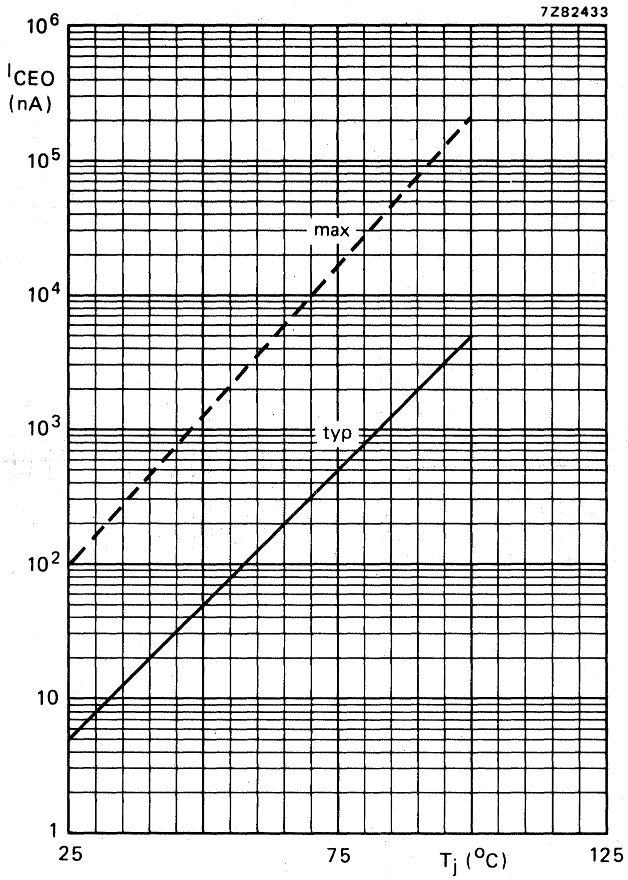


Fig. 8 $I_F = 0$; $V_{CE} = 20$ V.

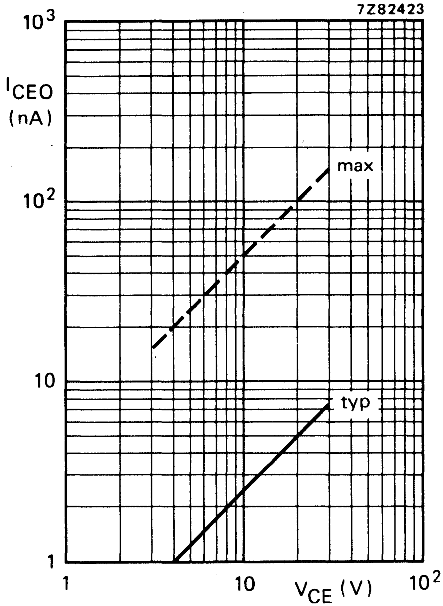


Fig. 9 $I_F = 0$; $T_j = 25\ ^oC$.

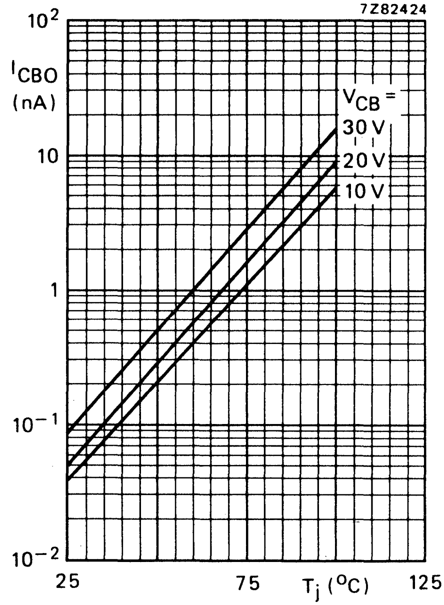


Fig. 10 $I_F = 0$; typical values.

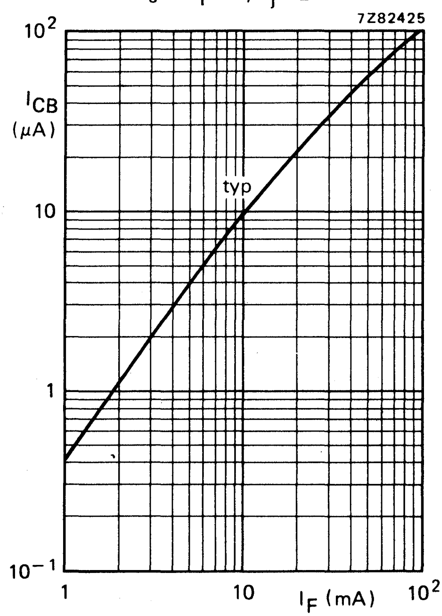


Fig. 11 $I_E = 0$; $V_{CB} = 5$ V; $T_{amb} = 25\ ^oC$.

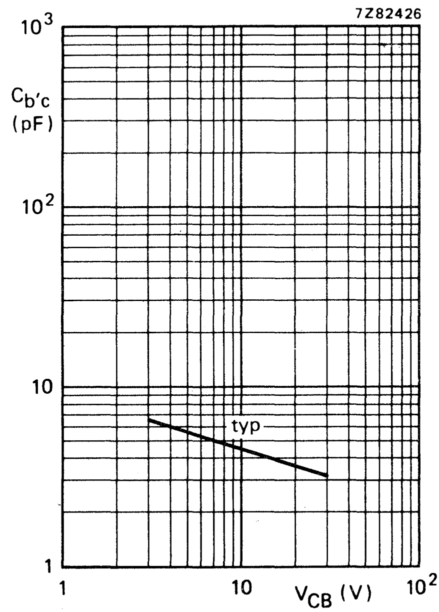


Fig. 12 f = 1 MHz; $T_{amb} = 25\ ^oC$.

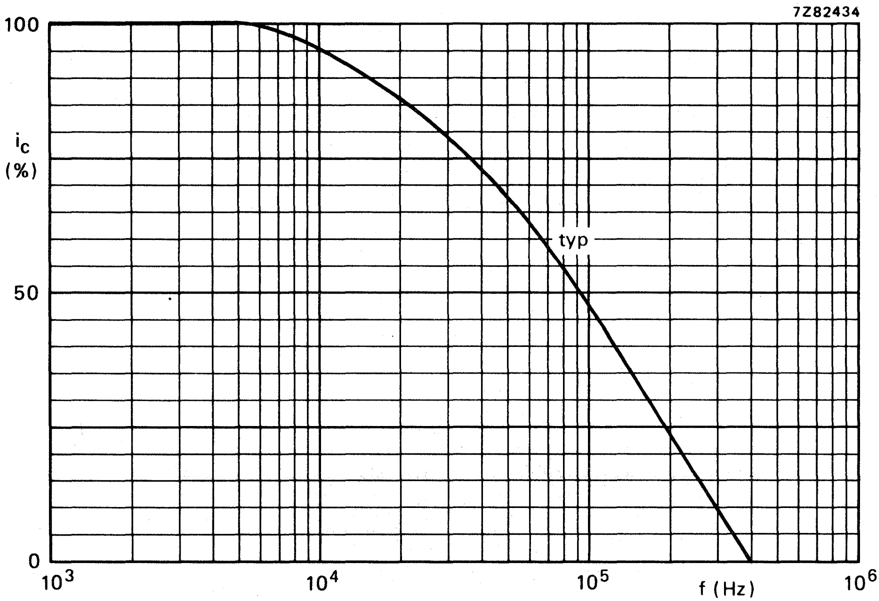


Fig. 13 $I_B = 0$; $I_C = 2$ mA; $V_{CC} = 5$ V; $R_L = 1$ kΩ; $T_{amb} = 25$ °C.

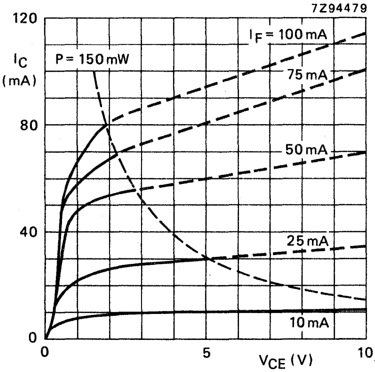


Fig. 14 $T_{amb} = 25$ °C; typical values.

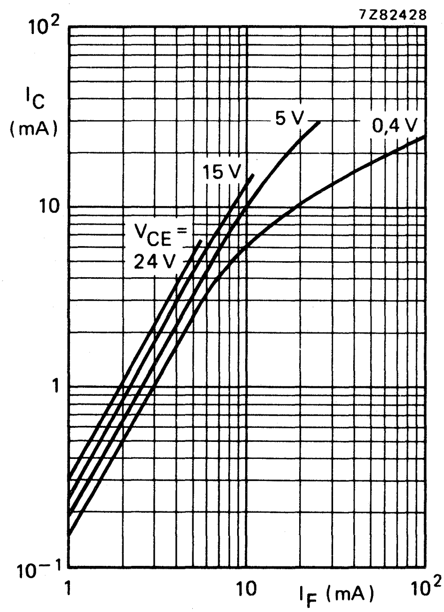


Fig. 15 $T_{amb} = 25$ °C; typical values.

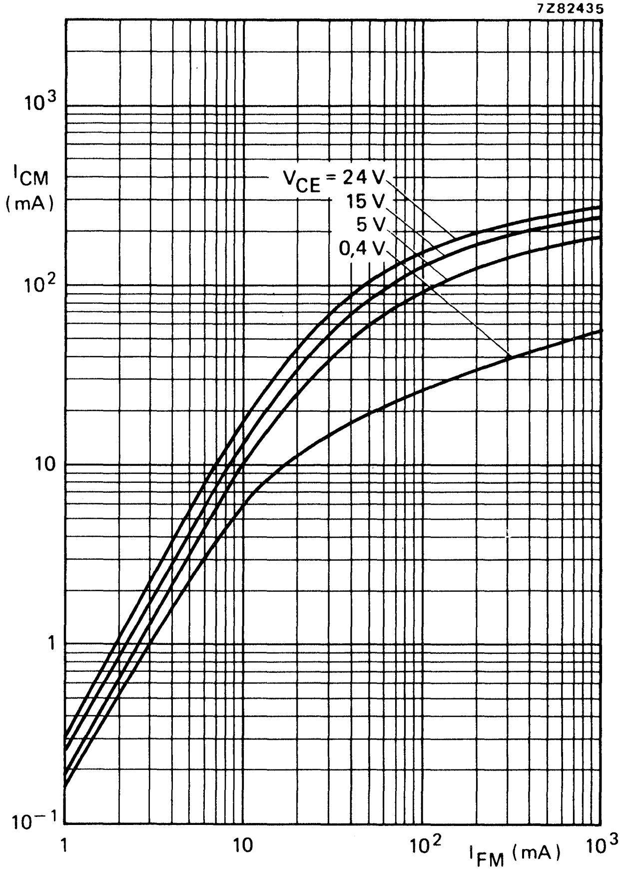


Fig. 16 T_{amb} = 25 °C; t_p = 10 μs; δ = 0,01; typical values.

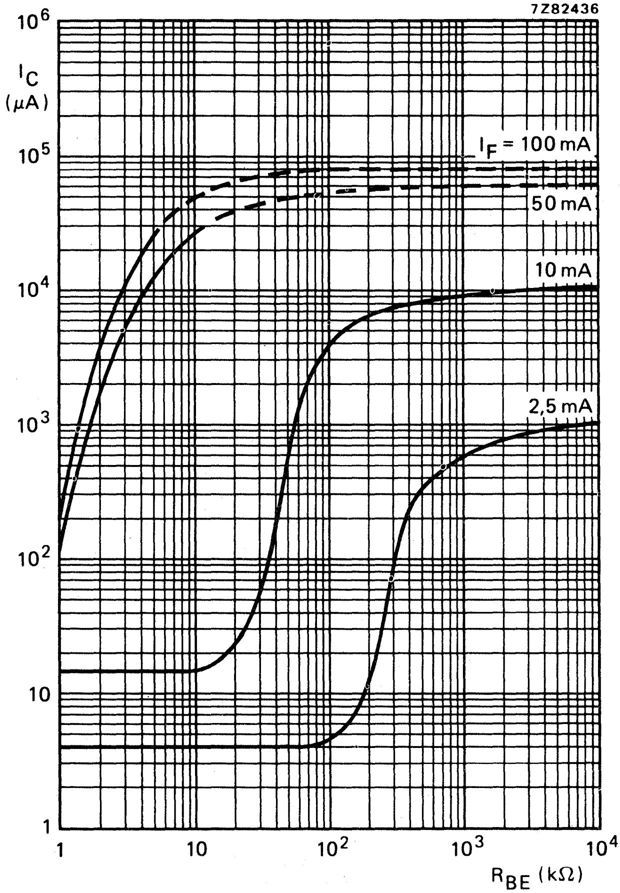


Fig. 17 $I_B = 0$; $V_{CE} = 5$ V; $T_{amb} = 25$ °C; typical values.

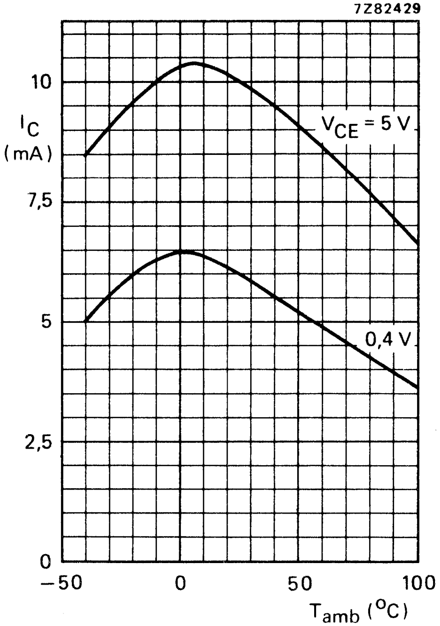


Fig. 18 $I_B = 0$; $I_F = 10$ mA; typical values.

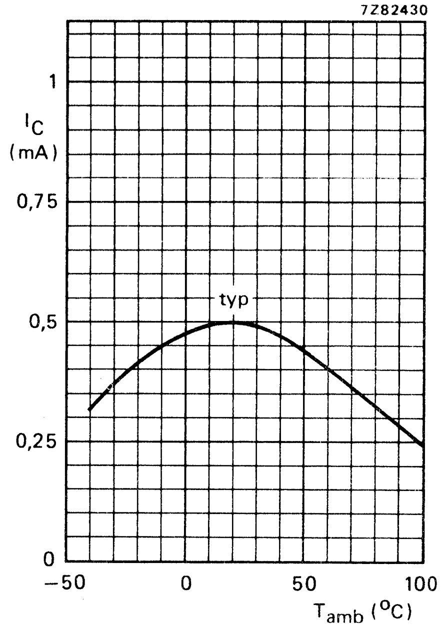


Fig. 19 $I_B = 0$; $I_F = 2$ mA; $V_{CE} = 0{,}4$ V.

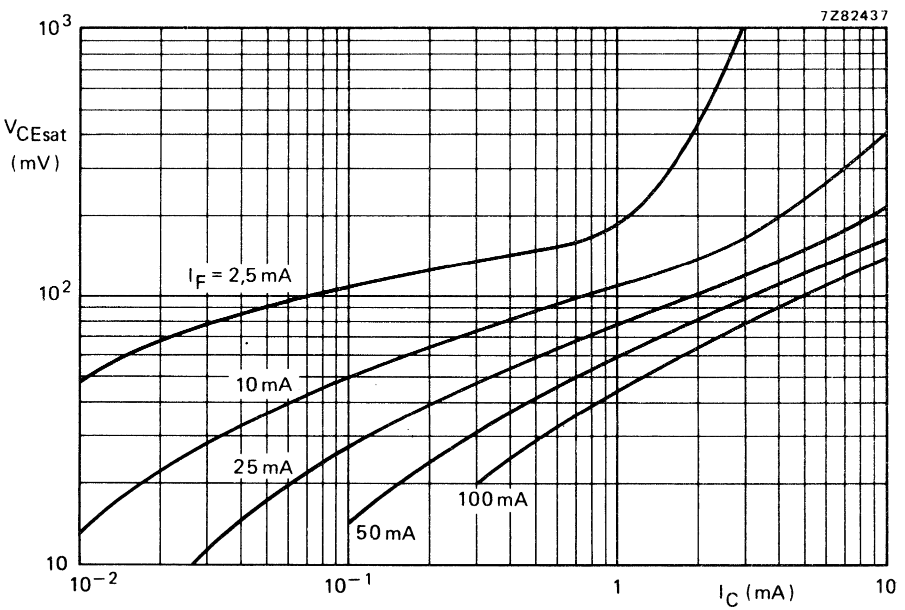


Fig. 20 $I_B = 0$; $T_{amb} = 25$ °C; typical values.

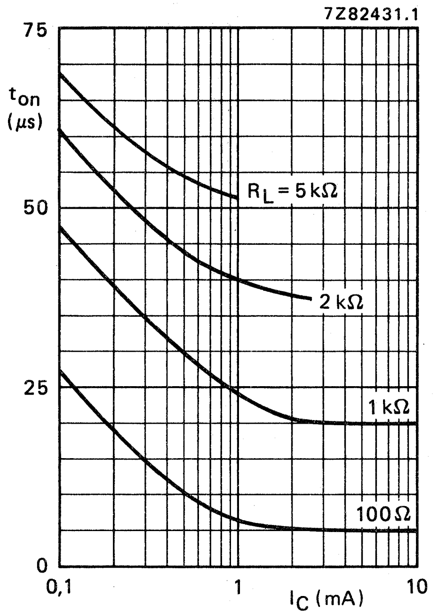


Fig. 21 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See Fig. 23).

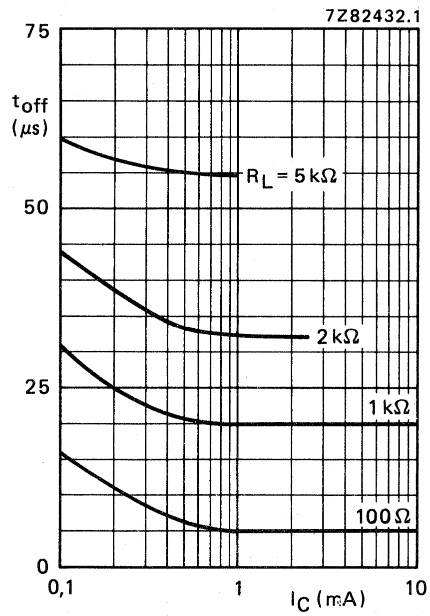


Fig. 22 $I_B = 0$; $V_{CC} = 5$ V; $T_{amb} = 25$ °C; typical values. (See Fig. 23).

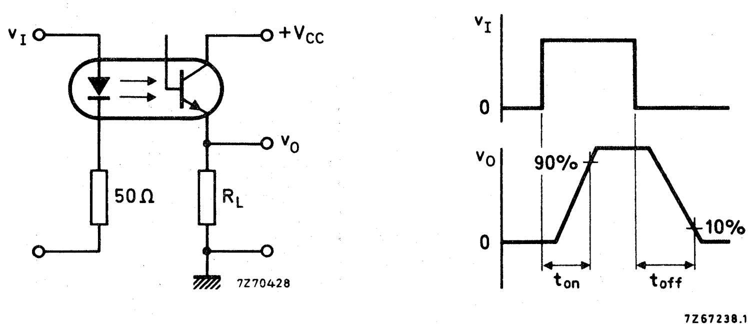


Fig. 23 Switching circuit and waveforms.

SECTION B2

Photosensitive semiconductors

SILICON PHOTOTRANSISTOR

N-P-N silicon phototransistor in epoxy resin encapsulation intended for optical coupling and encoding. The base is inaccessible. Combination with IR emitter diode CQY58A is recommended.

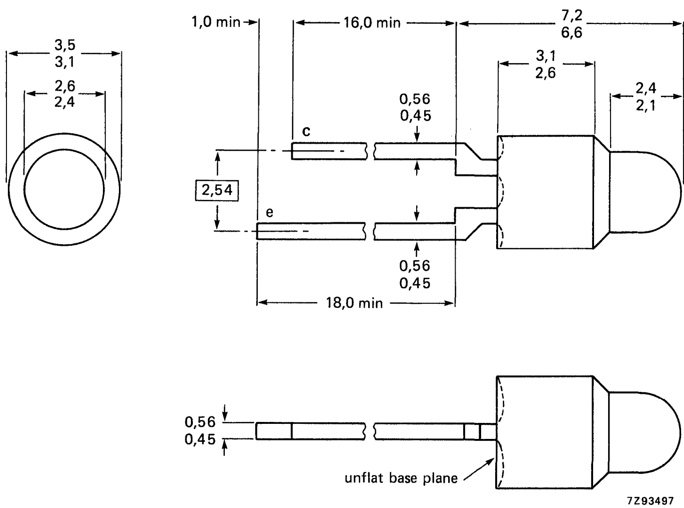
QUICK REFERENCE DATA

Collector-emitter voltage		V_{CEO}	max.	50 V
Collector current (d.c.)		I_C	max.	25 mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	100 mW
Collector dark current V_{CE} = 30 V; E = 0		$I_{CEO(D)}$	<	100 nA
Collector light current V_{CE} = 5 V; E_e = 1 mW/cm²; λ_p = 930 nm	**BPW22A-1**	$I_{CEO(L)}$	>	1,5 to 8 mA
	BPW22A-2	$I_{CEO(L)}$	>	5 to 25 mA
Wavelength at peak response		λ_p	typ.	800 nm

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-53F.



RATINGS

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

Collector-emitter voltage	V_{CEO}	max.	50 V
Emitter-collector voltage	V_{ECO}	max.	7 V
Collector current			
d.c.	I_C	max.	25 mA
peak value	I_{CM}	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100 mW
Storage temperature	T_{stg}	−55 to + 100 °C	
Junction temperature	T_j	max.	100 °C
Lead soldering temperature $>$1,5 mm from the seating plane; $t_{sld} < 7$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient, device mounted on printed-circuit board	$R_{th\ j\text{-}a}$	=	750 K/W

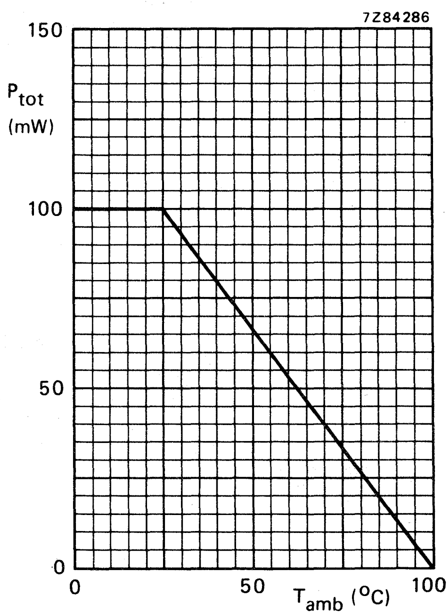


Fig. 2 Power derating curve versus ambient temperature.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector dark current				
V_{CE} = 30 V; E = 0		$I_{CEO(D)}$	<	100 nA
Collector light current				
V_{CE} = 5 V; E_e = 1 mW/cm²; λ_p = 930 nm	**BPW22A-1**	$I_{CEO(L)}$		1,5 to 8 mA
	BPW22A-2	$I_{CEO(L)}$		5 to 25 mA
Collector-emitter saturation voltage				
I_C = 1 mA; E_e = 1 mW/cm²; λ_p = 930 nm		V_{CEsat}	<	0,4 V
Wavelength at peak response		λ_p	typ.	800 nm
Bandwidth at half height		$\Delta\lambda$	typ.	400 nm
Half sensitivity angle		$\theta_{1/2}$	typ.	20°
Switching times (see Figs 3, 4, 9 and 10)				
I_{Con} = 2 mA; V_{CC} = 5 V; R_E = 100 Ω; T_{amb} = 25 °C				
turn-on time		t_{on}	typ.	3 μs
turn-off time		t_{off}	typ.	3 μs
I_{Con} = 2 mA; V_{CC} = 5 V; R_E = 1 kΩ; T_{amb} = 25 °C				
turn-on time		t_{on}	typ.	12,0 μs
turn-off time		t_{off}	typ.	12,0 μs

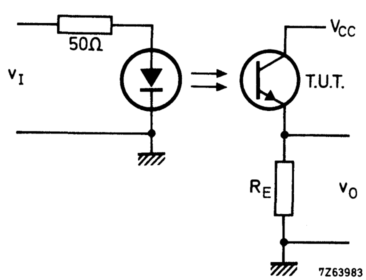


Fig. 3 Switching circuit with light emitting diode CQY58A. T.U.T. = BPW22A.

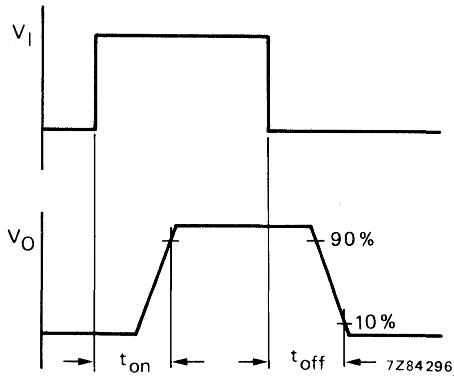


Fig. 4 Input and output switching waveforms.

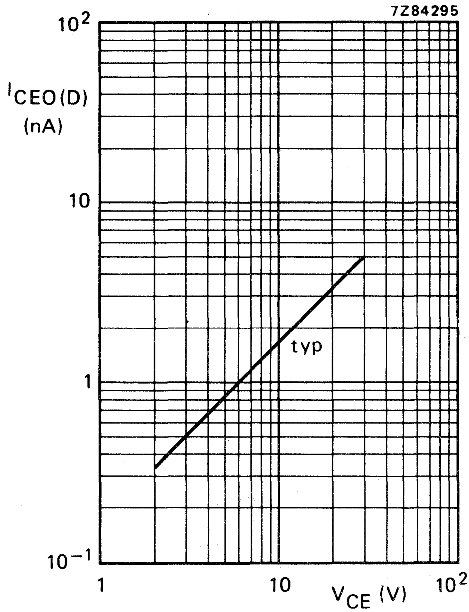


Fig. 5 E = 0; T_j = 25 °C.

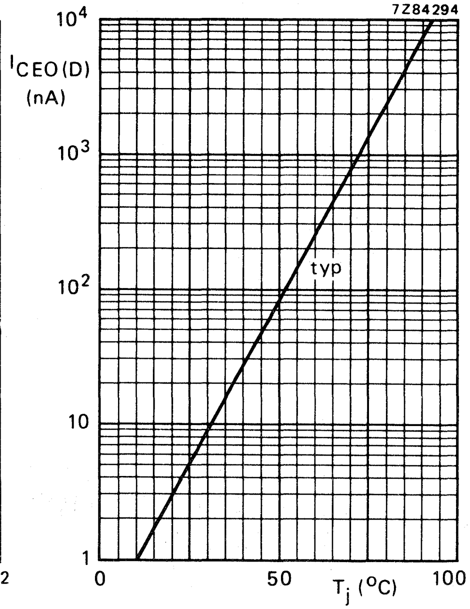


Fig. 6 E = 0; V_{CE} = 30 V.

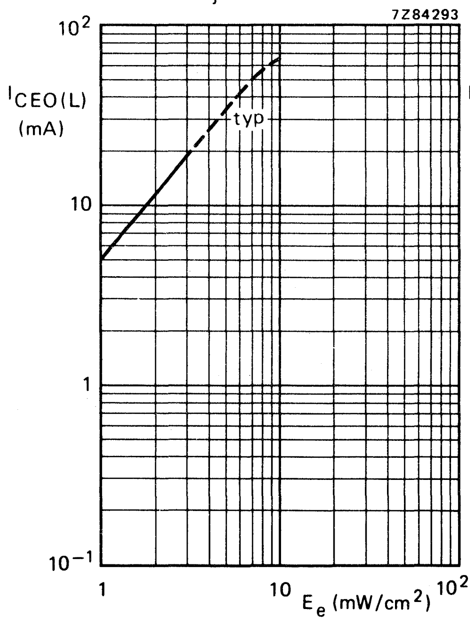


Fig. 7 GaAs source: λ_{pk} = 930 nm; V_{CE} = 5 V; T_j = 25 °C.

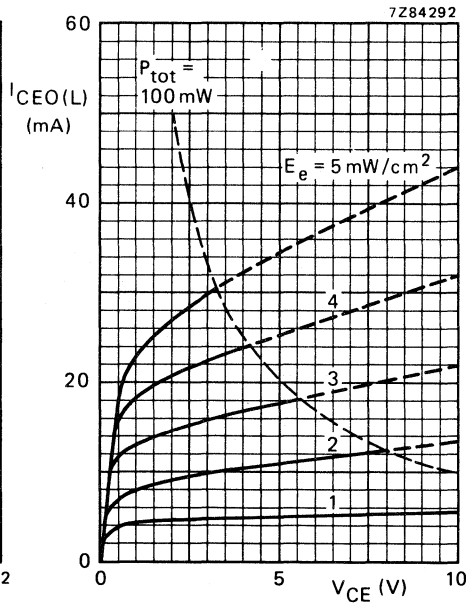


Fig. 8 λ_{pk} = 930 nm; T_j = 25 °C; typical values.

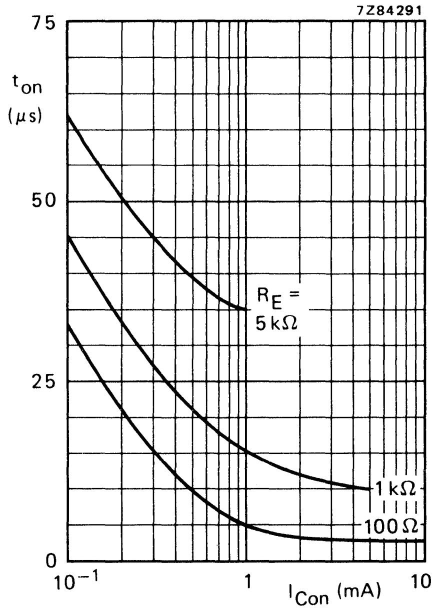


Fig. 9 V_{CC} = 5 V; T_{amb} = 25 °C; typical values; see also Figs 3 and 4.

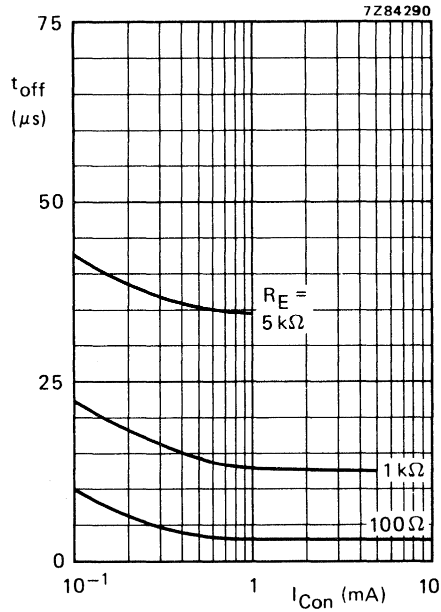


Fig. 10 V_{CC} = 5 V; T_{amb} = 25 °C; typical values; see also Figs 3 and 4.

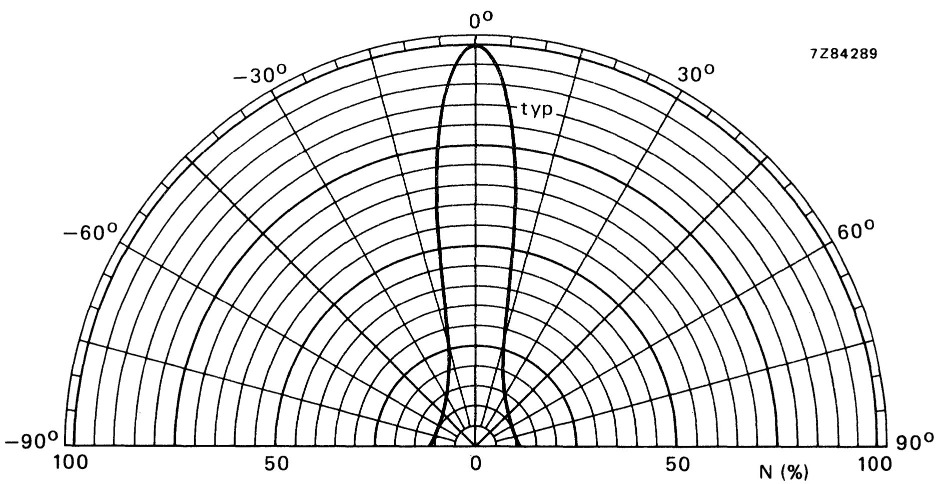


Fig. 11.

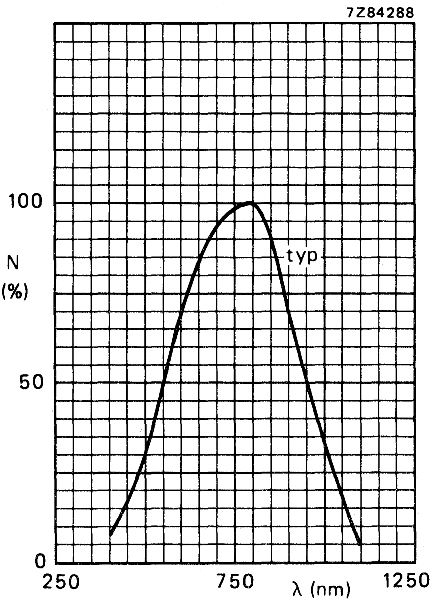


Fig. 12 Spectral response.

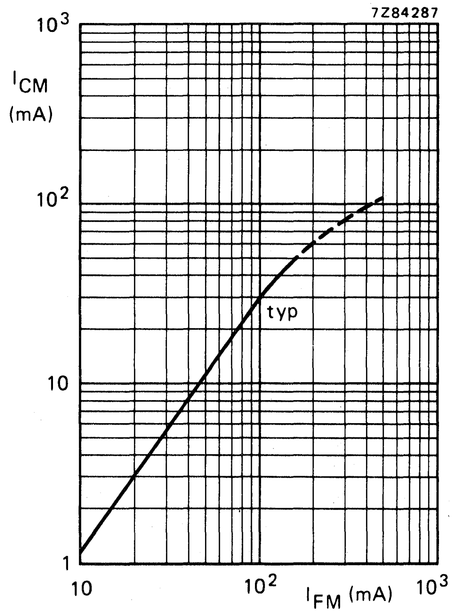


Fig. 13 V_{CE} = 5 V; t_p (I_{FM}) = 10 μs; T = 1 ms; d* = 10 mm; T_{amb} = 25 °C.

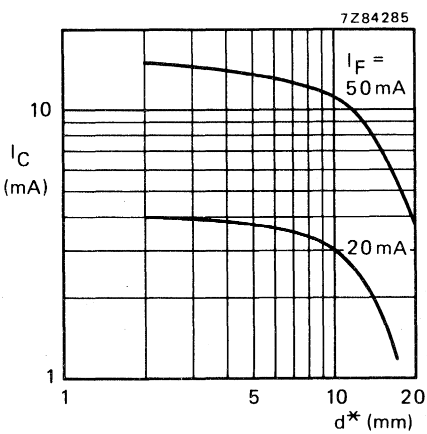


Fig. 14 V_{CE} = 5 V; T_{amb} = 25 °C; typical values.

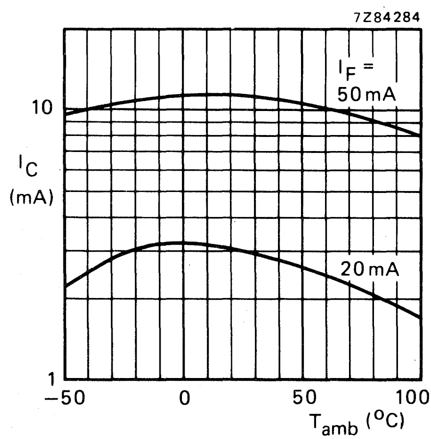


Fig. 15 V_{CE} = 5 V; d* = 10 mm; typical values.

* d = shortest free distance of mechanical on-axis when BPW22A is coupled with CQY58A.

HIGH-SPEED SILICON PHOTO P-I-N DIODE

The BPW50 is optimized for applications with remote control systems. Combination with IR emitter diode CQY89A-2 or CQW89A is recommended. If combined with high-speed IR emitting diode CQW89A, carrier frequencies of up to 1 MHz can be applied.

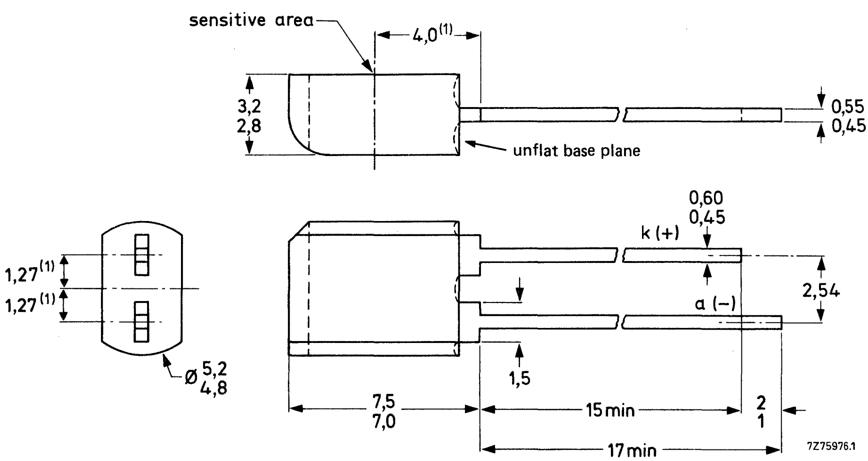
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	32	V
Total power dissipation up to T_{amb} = 47,5 °C	P_{tot}	max.	150	mW
Junction temperature	T_j	max.	100	°C
Dark reverse current V_R = 10 V; E_e = 0	$I_{R(D)}$	<	30	nA
Ligth reverse current V_R = 5 V; E_e = 1 mW/cm²; λ = 930 nm	$I_{R(L)}$	>	30	μA
Wavelength at peak response V_R = 5 V	λ_p	typ.	930	nm
Sensitive area	A	typ.	5	mm²

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-67.



(1) Reference for the positional tolerance of the sensitive area.

RATINGS

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

Continuous reverse voltage	V_R	max.	32 V
Total power dissipation up to T_{amb} = 47,5 °C	P_{tot}	max.	150 mW
Storage temperature	T_{stg}	−30 to + 100 °C	
Junction temperature	T_j	max.	100 °C
Lead soldering temperature up to the seating plane; $t_{sld} < 10$ s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

→ From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	350 K/W

CHARACTERISTICS

$T_j = 25$ °C

Dark reverse current $V_R = 10$ V; $E_e = 0$	$I_{R(D)}$	typ.	2 nA
		<	30 nA
Light reverse current $V_R = 5$ V; $E_e = 1$ mW/cm²; λ = 930 nm	$I_{R(L)}$	>	30 μA
		typ.	45 μA
Reverse voltage $I_R = 0{,}1$ mA; $E_e = 0$	V_R	>	32 V
Wavelength at peak response → $V_R = 5$ V	λ_p	typ.	930 nm
Diode capacitance $V_R = 3$ V	C_d	typ.	17 pF
		<	30 pF
$V_R = 0$	C_d	typ.	50 pF
Light switching times (see Figs 2 and 3) Rise time and fall time $V_{KK} = 10$ V; $R_A = 1$ kΩ	t_r, t_f	typ.	50 ns

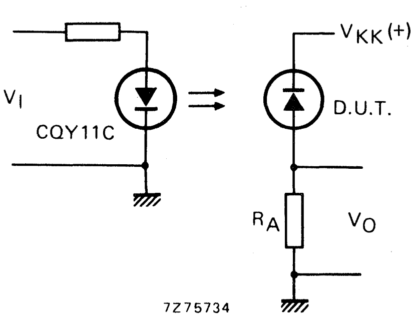


Fig. 2 Switching circuit.

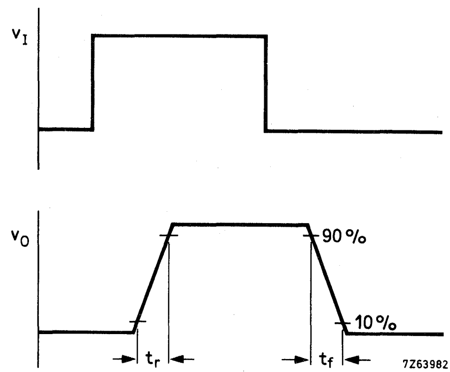


Fig. 3 Input and output switching waveforms.

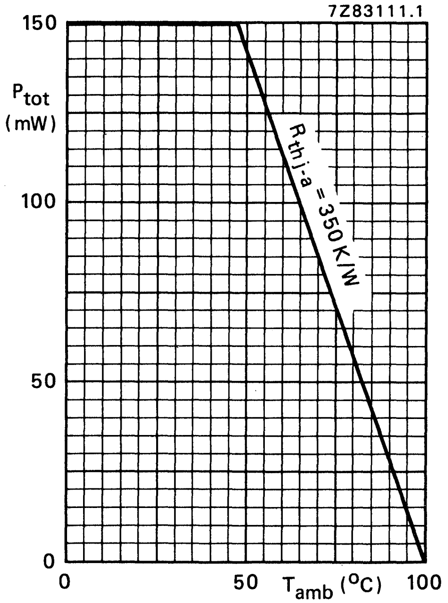


Fig. 4 Maximum permissible power dissipation as a function of temperature.

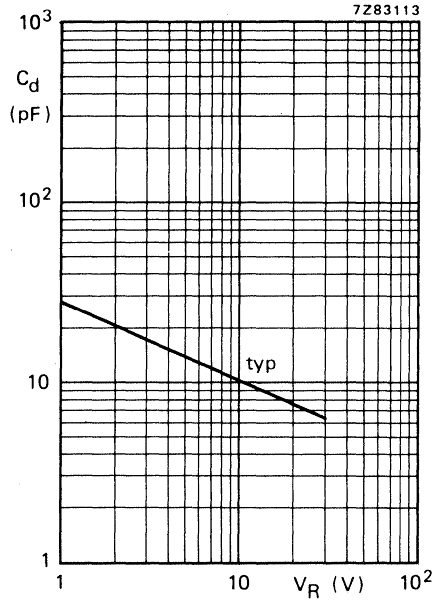


Fig. 5 T_{amb} = 25 °C.

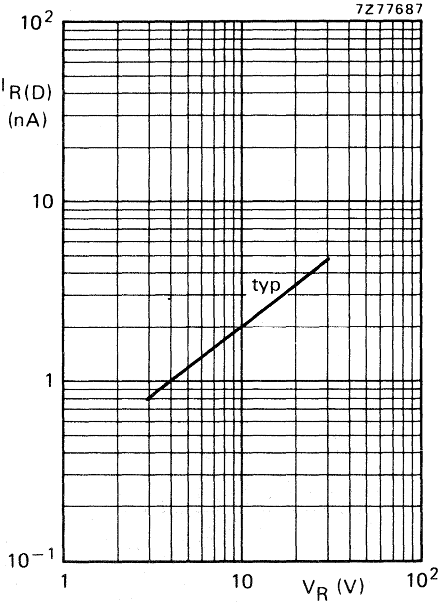


Fig. 6 E = 0; T_{amb} = 25 °C.

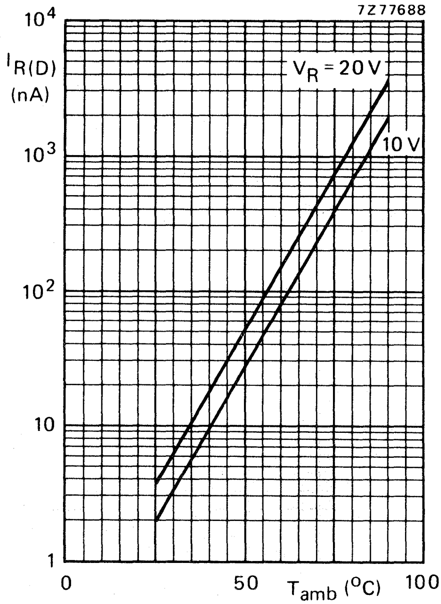


Fig. 7 E = 0; typical values.

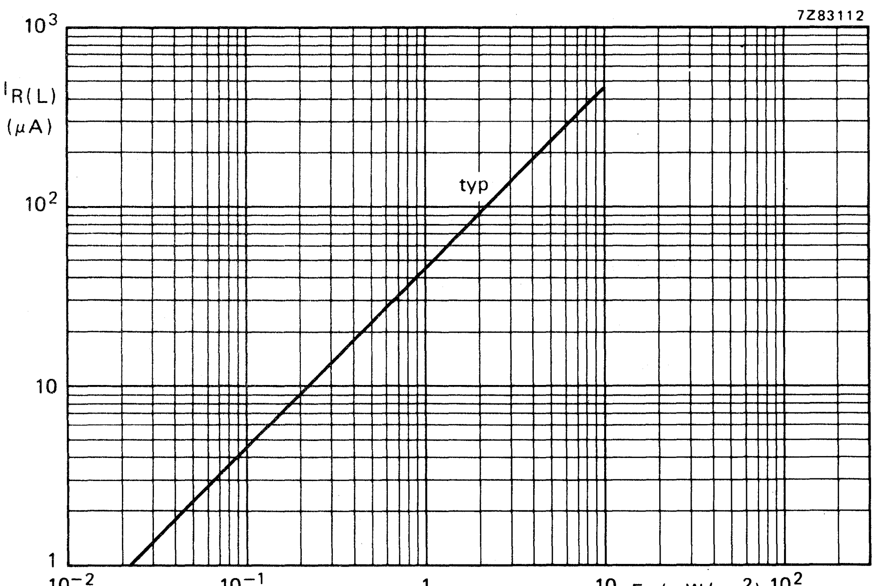


Fig. 8 V_R = 5 V; λ = 930 nm; T_{amb} = 25 °C.

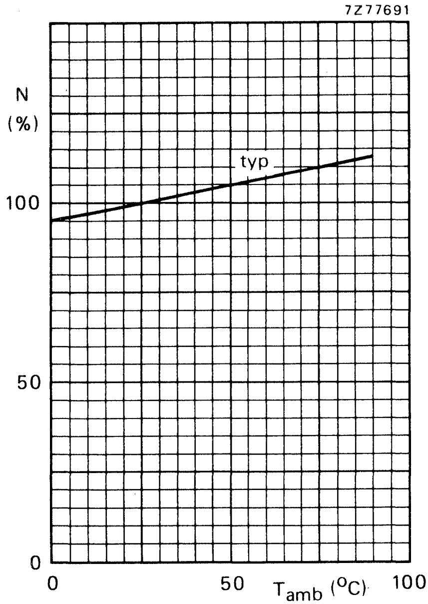


Fig. 9 $E_e = 1\ mW/cm^2$; $\lambda = 930$ nm.

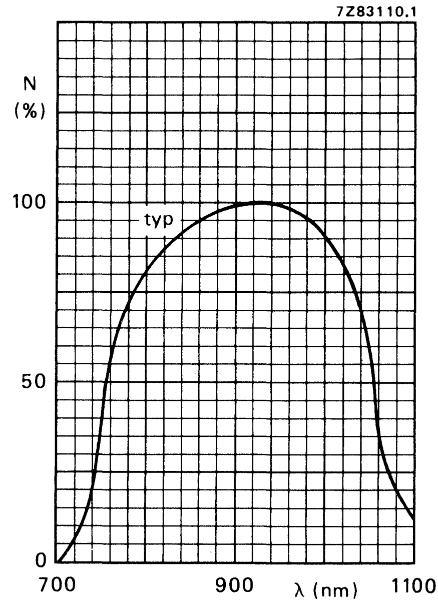


Fig. 10 $V_R = 5$ V; $T_{amb} = 25\ ^{o}C$.

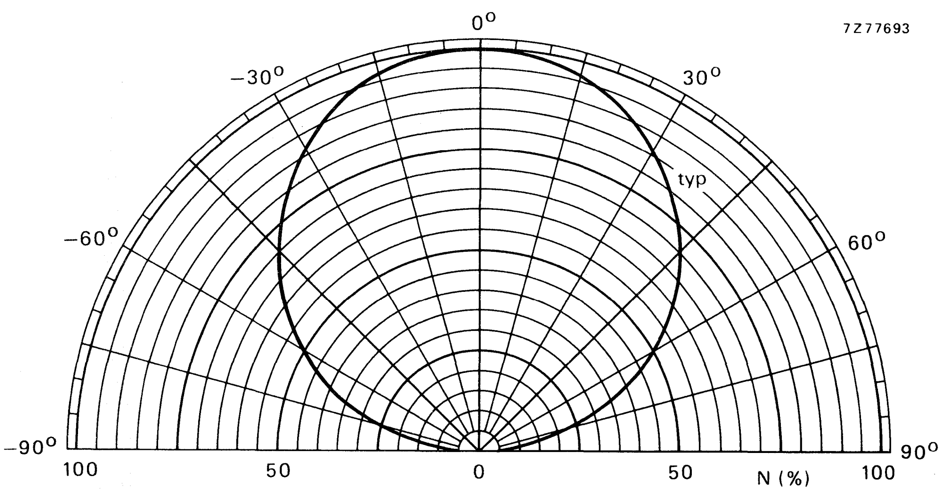


Fig. 11.

SILICON PHOTO-DARLINGTON TRANSISTOR

N-P-N subminiature photo-darlington transistor mounted in a SOT-71 envelope.
This envelope is designed for assembly onto printed circuit boards.

QUICK REFERENCE DATA

Collector-emitter voltage	V_{CEO}	max.	30 V
Collector current (peak value)	I_{CM}	max.	150 mA
Junction temperature	T_j	max.	150 °C
Collector dark current V_{CE} = 10 V; E = 0	I_{CEO}	max.	100 nA
Collector current V_{CE} = 5 V; E = 1 mW/cm^2 (see note 1)	I_C	min.	15 mA
Wavelength of maximum sensitivity E = 1 mW/cm^2	λ	typ.	800 nm

MECHANICAL DATA

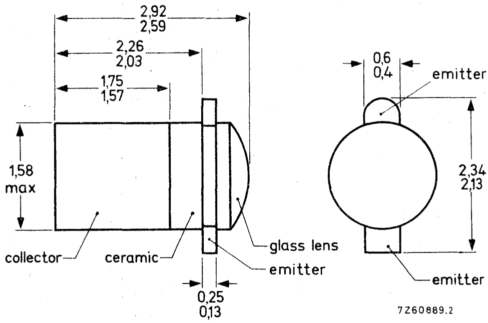
Dimensions in mm

SOT-71A (see Fig. 1).

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-71A.



RATINGS

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

Collector-emitter voltage	V_{CEO}	max.	30	V
Emitter-collector voltage	V_{ECO}	max.	7	V
Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value) t_p = 100 μs; δ = 0,1	I_{CM}	max.	150	mA
Total power dissipation up to T_{amb} = 55 °C when mounted on a printed circuit board	P_{tot}	max.	100	mW
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C
Lead soldering temperature; < 10 s	T_{sld}	max.	240	°C

THERMAL RESISTANCE

Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	max.	2000	K/W
Thermal resistance from junction to ambient when device is mounted on a P.C.B.	$R_{th\ j\text{-}a}$	max.	950	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise stated

Collector-emitter breakdown voltage I_C = 1 mA	$V_{(BR)CEO}$	min.	30	V
Emitter-collector breakdown voltage I_C = 0,1 mA	$V_{(BR)ECO}$	min.	7	V
Collector dark current V_{CE} = 10 V; E = 0	I_{CEO}	typ.	25	nA
		max.	100	nA
V_{CE} = 10 V; E = 0; T_j = 100 °C	I_{CEO}	typ.	200	µA
Collector current V_{CE} = 5 V; E = 1 mW/cm² (see note 1)	I_C	min.	15	mA
		typ.	37	mA
Collector-emitter saturation voltage I_C = 2 mA; E = 1 mW/cm² (see note 1)	V_{CEsat}	max.	1,1	V
Switching times (see Fig. 2 and 3) I_C = 5 mA; V_{CC} = 5 V; R_L = 100 Ω				
Delay time	t_d	typ.	25	µs
Rise time	t_r	typ.	60	µs
		max.	300	µs
Storage time	t_s	typ.	2,0	µs
Fall time	t_f	typ.	40	µs
		max.	200	µs
Wavelength of maximum sensitivity E = 1 mW/cm²	λ	typ.	800	nm
Bandwidth of half sensitivity E = 1 mW/cm²	Δλ	typ.	400	nm
Halve sensitivity angle	θ½	typ.	20	°
Sensitive area	A	typ.	1,7	mm²

Note 1: For this measurement, the source is a GaAs diode (930 nm).

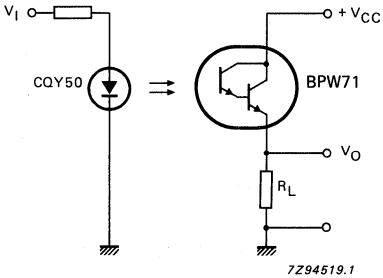


Fig. 2 Measuring circuit.

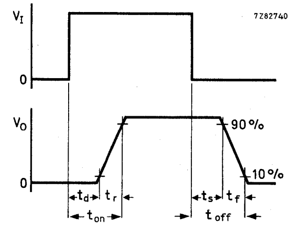


Fig. 3 Waveforms.

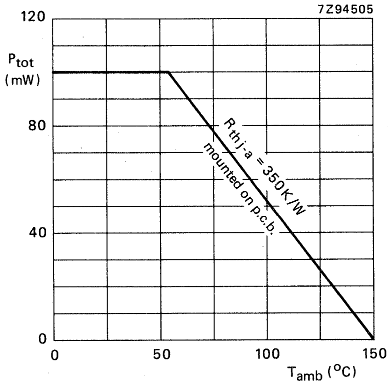


Fig. 4 Power derating curve.

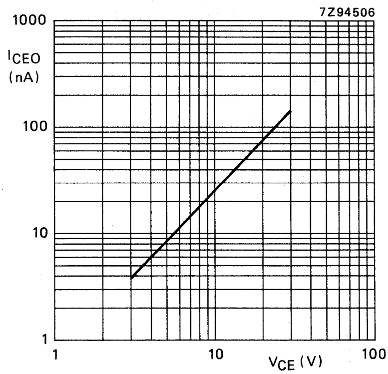


Fig. 5 T_j = 25 °C; typical values.

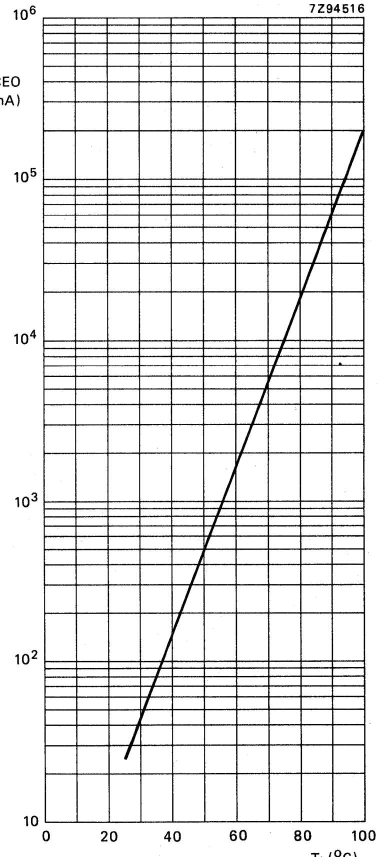


Fig. 6 V_{CE} = 10 V; typical values.

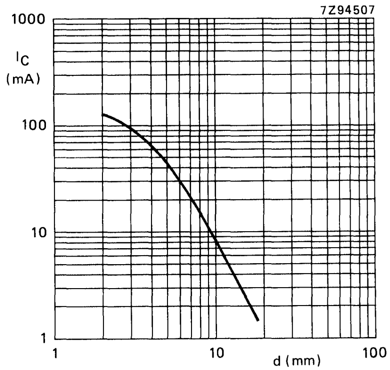


Fig. 7 V_{CE} = 5 V; I_F = 20 mA; T_{amb} = 25 °C; typical values.

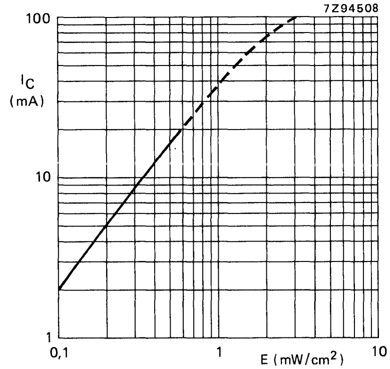


Fig. 8 V_{CE} = 5 V; source λ = 930 nm; typical values.

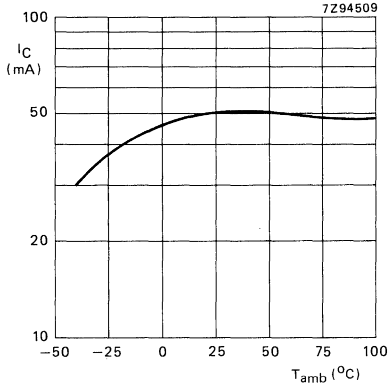


Fig. 9 V_{CE} = 5 V; I_F = 20 mA; typical values.

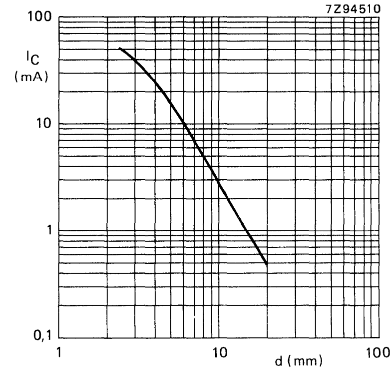
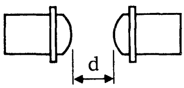


Fig. 10 V_{CE} = 5 V; I_F = 10 mA; T_{amb} = 25 °C; d = 5 mm; typical values.



(coupled with CQY50)

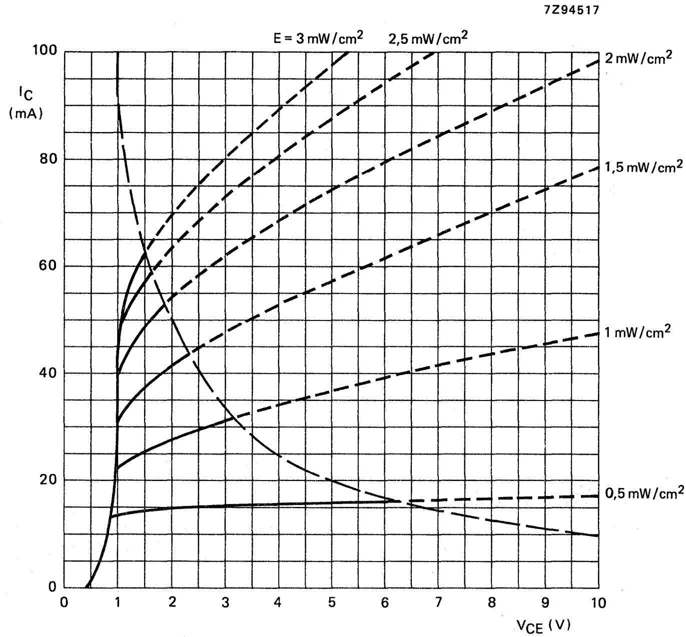


Fig. 11 T_{amb} = 25 °C; source λ = 930 nm; typical values.

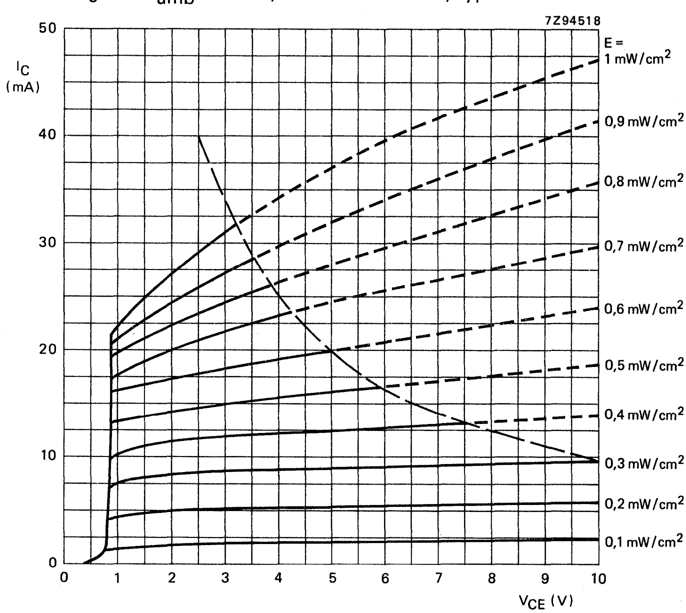


Fig. 12 T_{amb} = 25 °C; source λ = 930 nm; typical values.

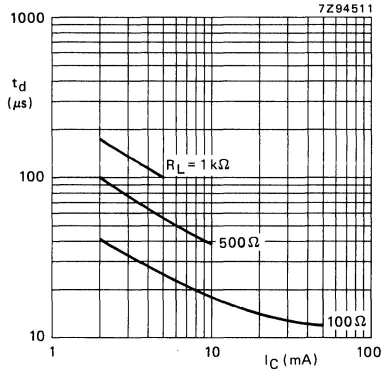


Fig. 13 T_{amb} = 25 °C; V_{CC} = 5 V; typical values.

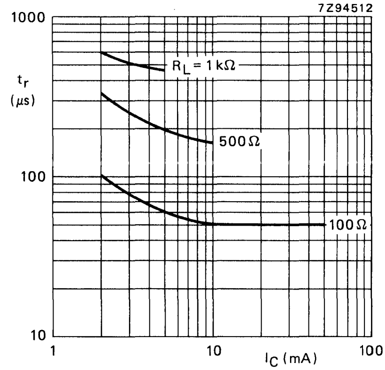


Fig. 14 T_{amb} = 25 °C; V_{CC} = 5 V; typical values.

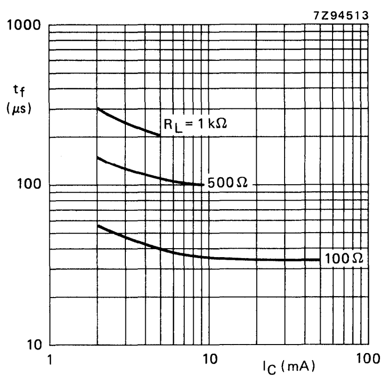


Fig. 15 T_{amb} = 25 °C; V_{CC} = 5 V; typical values.

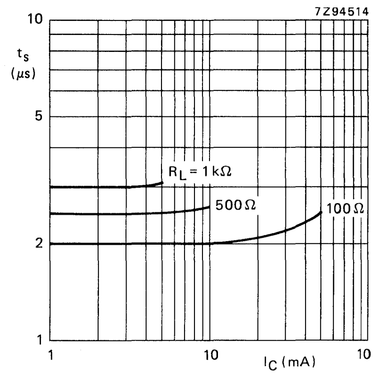


Fig. 16 T_{amb} = 25 °C; V_{CC} = 5 V; typical values.

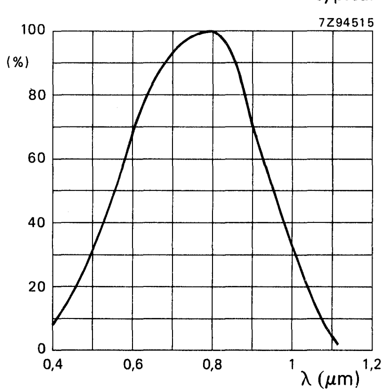


Fig. 17 Typical values.

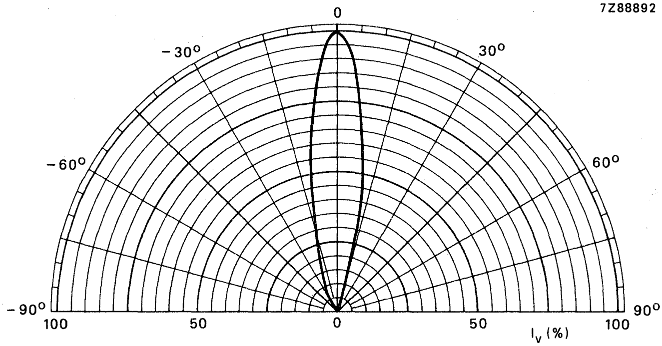


Fig. 18.

SILICON PLANAR EPITAXIAL PHOTOTRANSISTORS

General purpose n-p-n silicon phototransistors in a TO-18 envelope. The BPX25 has a lens, the BPX29 has a plane window. Combination with CQY11B and CQY11C or CQY49B and CQY49C is recommended.

QUICK REFERENCE DATA

Collector-emitter voltage		V_{CEO}	max.	50	V
Collector current (peak value)		I_{CM}	max.	200	mA
Junction temperature		T_j	max.	150	°C
Collector dark current					
V_{CE} = 24 V; E = 0		I_{CEO}	max.	100	nA
Collector light current					
V_{CE} = 6 V; E = 1000 lux	BPX25	I_C	min.	4	mA
	BPX29	I_C	min.	0,2	mA

MECHANICAL DATA

Dimensions in mm

See Fig. 1.

MECHANICAL DATA

Dimensions in mm

Fig. 1a SOT-29/2.

BPX25

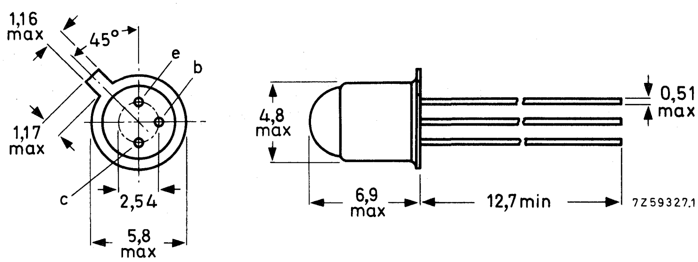
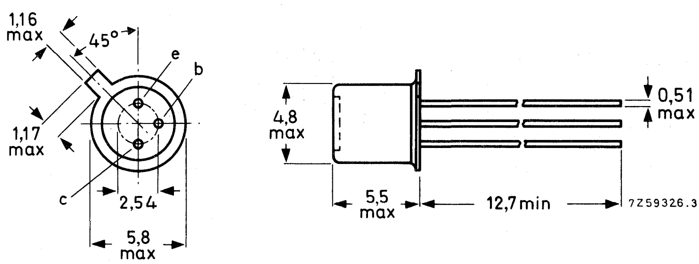


Fig. 1b SOT-29/1.

BPX29



RATINGS

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

Collector-base voltage	V_{CBO}	max.	50 V
Collector-emitter voltage	V_{CEO}	max.	50 V
Emitter-base voltage	V_{EBO}	max.	7 V
Collector current (d.c.)	I_C	max.	100 mA
Collector current (peak value) ; t_p = 50 μs; δ = 0,1	I_{CRM}	max.	200 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	max.	400 K/W
Thermal resistance from junction to case	$R_{th\ j\text{-}c}$	max.	150 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise stated

Collector dark current				
V_{CE} = 24 V; E = 0	I_{CEO}	typ.	10 nA	
		max.	100 nA	
V_{CE} = 24 V; E = 0; T_j = 100 °C	I_{CEO}	typ.	10 μA	
		max.	100 μA	
D.C. current gain				
I_C = 2 mA; V_{CE} = 6 V	h_{FE}	typ.	500	
Cut-off frequency				
Source : modulated GaAs : 0,4 mW/cm²				
Load : optimum (50 Ω); V_{CE} = 24 V	f_{CO}	typ.	200 kHz	

			BPX25	BPX29
Collector light current				
V_{CE} = 6 V				
E = 1000 lux (see note 1)	I_C	min.	4,0	0,2 mA
		typ.	10	0,6 mA
Switching times (see note 2)				
Delay time	t_d	typ.	1,0	2,5 μs
		max.	3,0	5,0 μs
Rise time	t_r	typ.	1,5	2,5 μs
		max.	3,0	5,0 μs
Storage time	t_s	typ.	0,2	0,2 μs
		max.	0,5	0,5 μs
Fall time	t_f	typ.	1,5	3,5 μs
		max.	4,0	8,0 μs
Half sensitivity angle	θ½	typ.	30	80 °
Wavelength at peak response	λ_p	typ.	800	800 nm
Bandwidth at half height	$\Delta\lambda$	typ.	400	400 nm

Note 1: Source : tungsten filament lamp with T_c = 2856 K

Note 2: Source : modulated GaAs: 0,4 mW/cm²
load : optimum (50 Ω); V_{CE} = 24 V

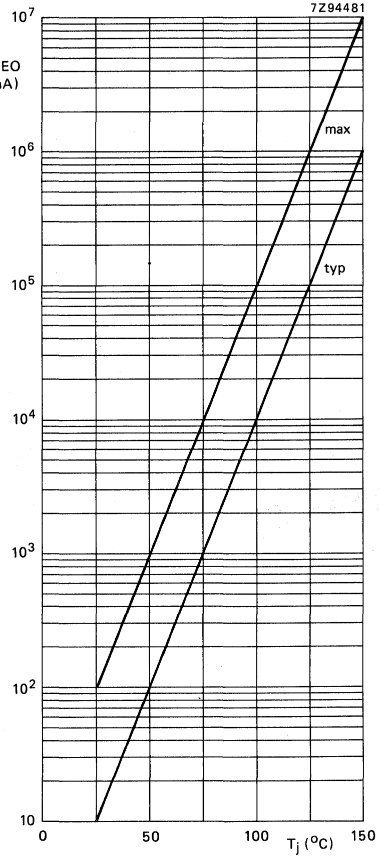


Fig. 2 Typical values; E = 0; V_{CE} = 24 V.

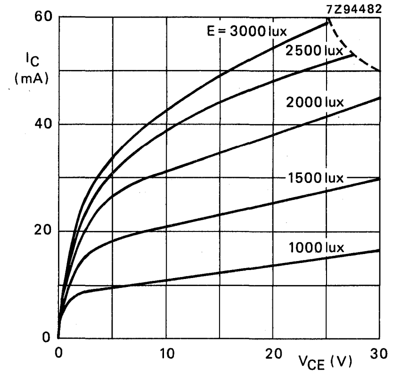


Fig. 3 BPX25; Typical values.

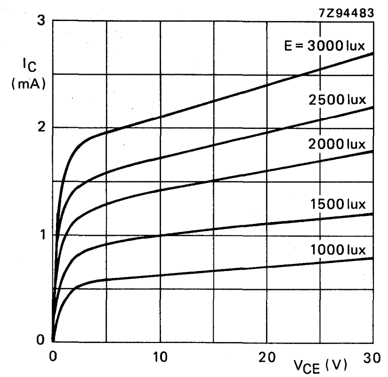


Fig. 4 BPX29; Typical values.

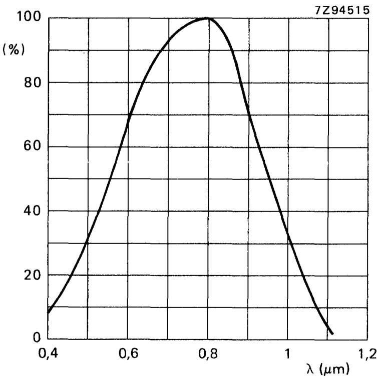


Fig. 5 Typical values.

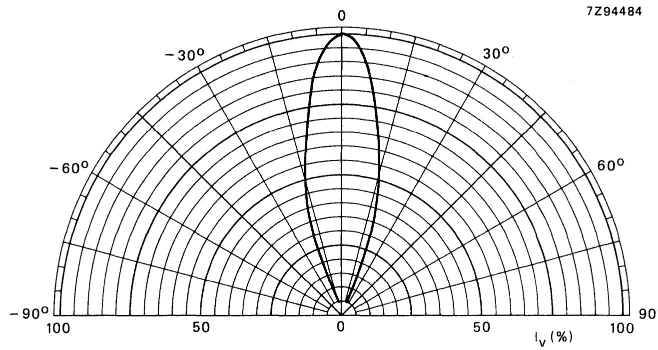


Fig. 6 BPX25; Typical values.

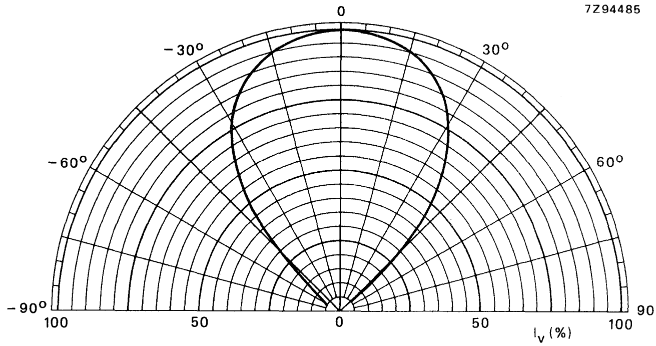


Fig. 7 BPX29; Typical values.

SILICON PLANAR PHOTODIODE

Unencapsulated photodiode for general purpose applications.

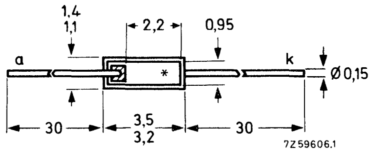
QUICK REFERENCE DATA

Reverse voltage	V_R	max.	18 V
Luminous current V_R = 15 V; E = 1000 lx	I_{Po}	typ.	14 μA
Dark reverse current at V_R = 15 V	I_R	<	0,5 μA
Wavelength at peak response	λ_p	typ.	800 nm

MECHANICAL DATA

Dimensions in mm

Fig. 1.



Slice thickness 0,27 mm

* Sensitive area = 2,2 x 0,95 mm.

RATINGS

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

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

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Dark reverse current			
V_R = 15 V	I_R	typ.	0,01 μA
		<	0,5 μA
V_R = 15 V; T_{amb} = 100 °C	I_R	typ.	0,6 μA
		<	4,0 μA
Photovoltaic mode			
E = 1000 lx; T_c = 2856 K (equivalent to 4,75 mW/cm²)			
Light reverse current; V = 0	I_1	>	8 μA
		typ.	13 μA
Forward voltage; I = 0	V_F	>	330 mV
		typ.	350 mV
Luminous current with external voltage*			
V_R = 15 V; E = 1000 lx; T_c = 2856 K (equivalent to 4,75 mW/cm²)	I_{Po}	>	8,5 μA
		typ.	14 μA
Wavelength at peak response	λ_p	typ.	800 nm
Diode capacitance; f = 500 kHz			
V_R = 15 V	C_d	typ.	90 pF
V_R = 0	C_d	typ.	300 pF
Cut-off frequency (modulated GaAs source)	f_{co}	typ.	500 kHz

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

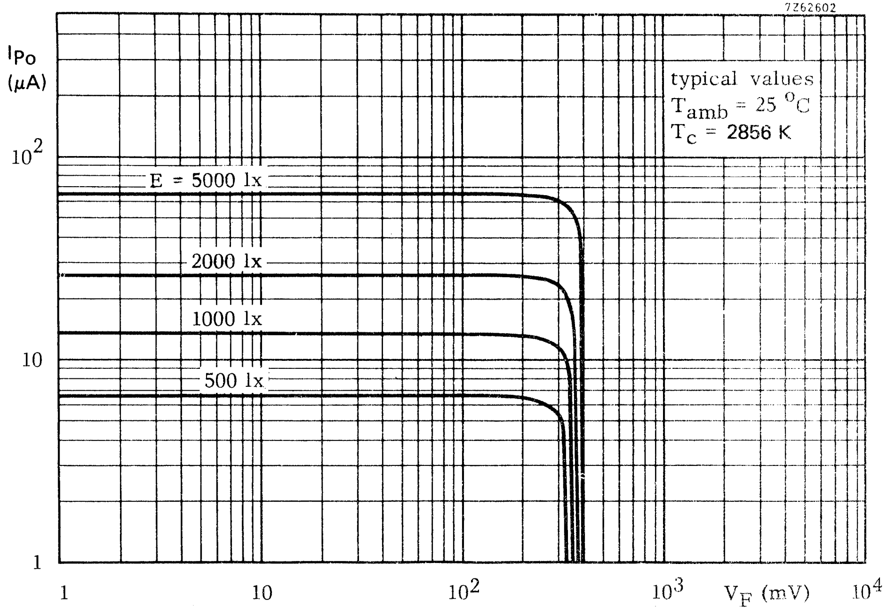

7Z62602
I_{Po}
(μA)
10^2
10
1
typical values
T_{amb} = 25 °C
T_c = 2856 K
E = 5000 lx
2000 lx
1000 lx
500 lx
1
10
10^2
10^3
V_F (mV)
10^4

Fig. 2.

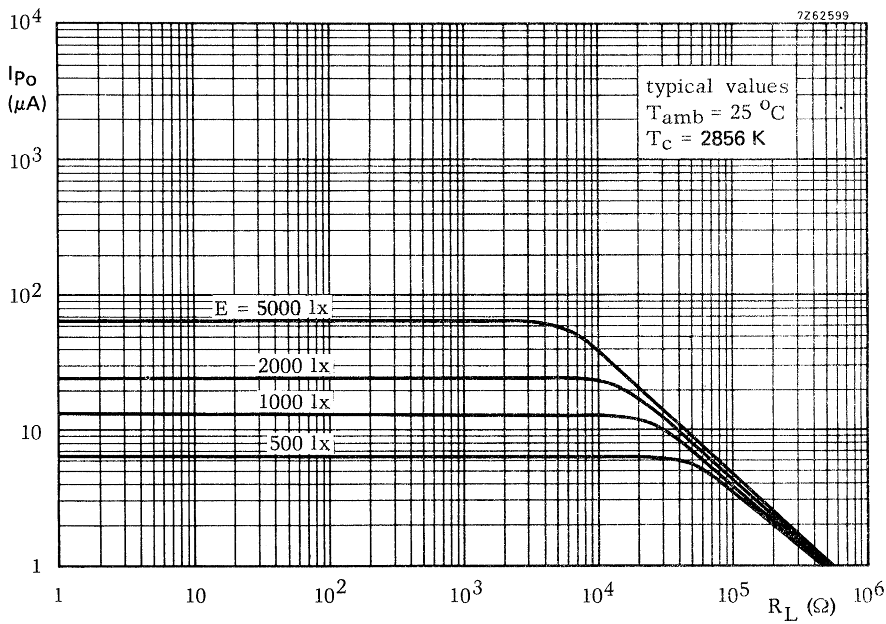

7Z62599
10^4
I_{Po}
(μA)
10^3
10^2
10
1
typical values
T_{amb} = 25 °C
T_c = 2856 K
E = 5000 lx
2000 lx
1000 lx
500 lx
1
10
10^2
10^3
10^4
10^5
R_L (Ω)
10^6

Fig. 3.

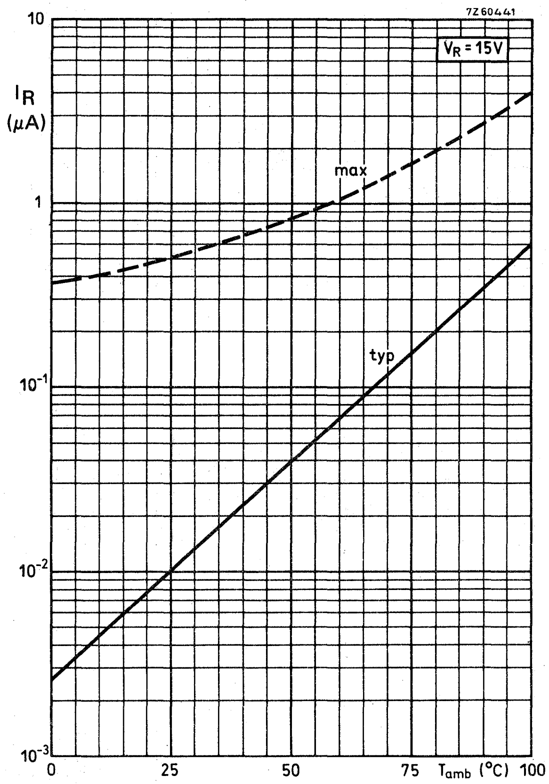


Fig. 4.

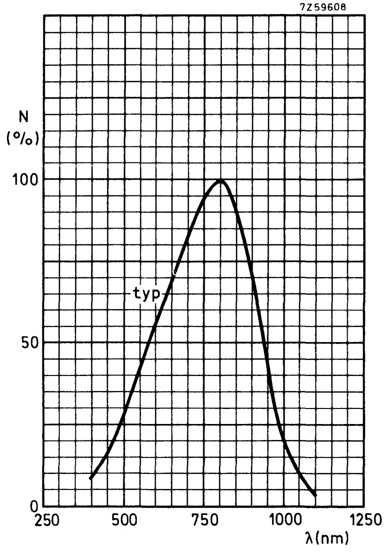

7Z59608
N
(%)
100
50
0
typ
250
500
750
1000
1250
λ(nm)

Fig. 5.

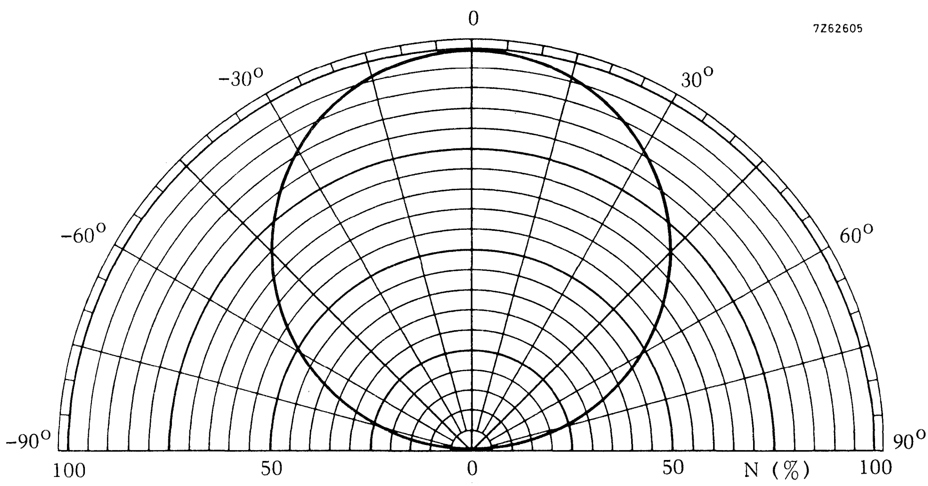

0
7Z62605
-30°
30°
-60°
60°
-90°
90°
100
50
0
50
N (%)
100

Fig. 6.

SILICON PLANAR PHOTODIODE

Unencapsulated photodiode for general purpose applications.

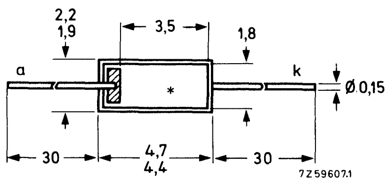
QUICK REFERENCE DATA

Reverse voltage	V_R	max.	18	V
Luminous current V_R = 15 V; E = 1000 lx	I_{Po}	typ.	40	μA
Dark reverse current at V_R = 15 V	I_R	<	1	μA
Wavelength at peak response	λ_p	typ.	800	nm

MECHANICAL DATA

Dimensions in mm

Fig. 1.



Slice thickness 0,27 mm

* Sensitive area = 3,5 x 1,8 mm.

RATINGS

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

Reverse voltage	V_R	max.	18 V
Forward current	I_F	max.	10 mA
Dark reverse current	I_R	max.	5 mA
Storage temperature	T_{stg}	−65 to +	125 °C
Junction temperature	T_j	max.	125 °C

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Dark reverse current			
V_R = 15 V	I_R	typ.	0,02 μA
		<	1,0 μA
V_R = 15 V; T_{amb} = 100 °C	I_R	typ.	1,2 μA
		<	8,0 μA
Photovoltaic mode			
E = 1000 lx; T_c = 2856 K (equivalent to 4,75 mW/cm²)			
Light reverse current; V = 0	I_1	>	24 μA
		typ.	38 μA
Forward voltage; I = 0	V_F	>	330 mV
		typ.	350 mV
Luminous current with external voltage*			
V_R = 15 V; E = 1000 lx; T_c = 2856 K (equivalent to 4,75 mW/cm²)	I_{Po}	>	25 μA
		typ.	40 μA
Wavelength at peak response	λ_p	typ.	800 nm
Diode capacitance; f = 500 kHz			
V_R = 15 V	C_d	typ.	250 pF
V_R = 0	C_d	typ.	800 pF
Cut-off frequency (modulated GaAs source)	f_{co}	typ.	500 kHz

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

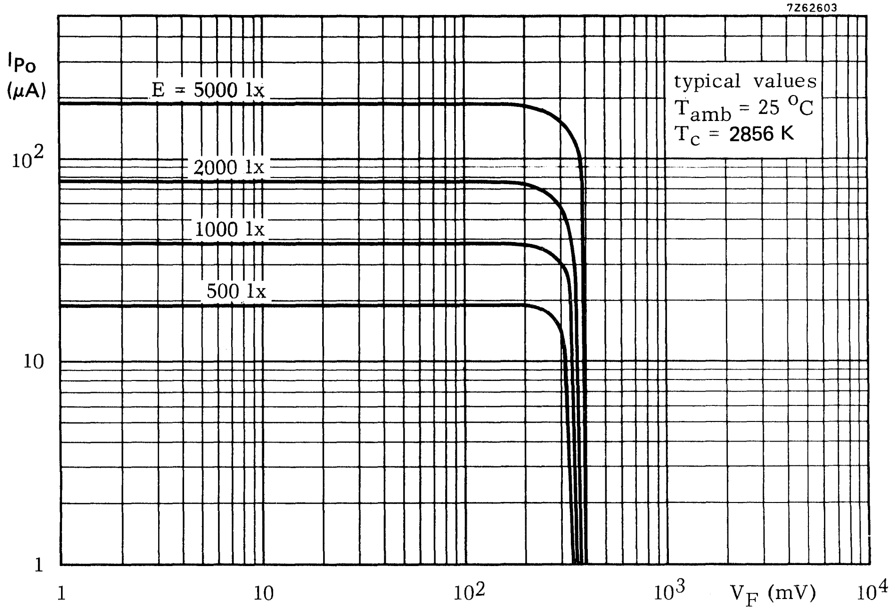

7Z62603
I_{Po}
(μA)
E = 5000 lx
2000 lx
1000 lx
500 lx
typical values
T_{amb} = 25 °C
T_c = 2856 K
10^2
10
1
1
10
10^2
10^3
V_F (mV)
10^4

Fig. 2.

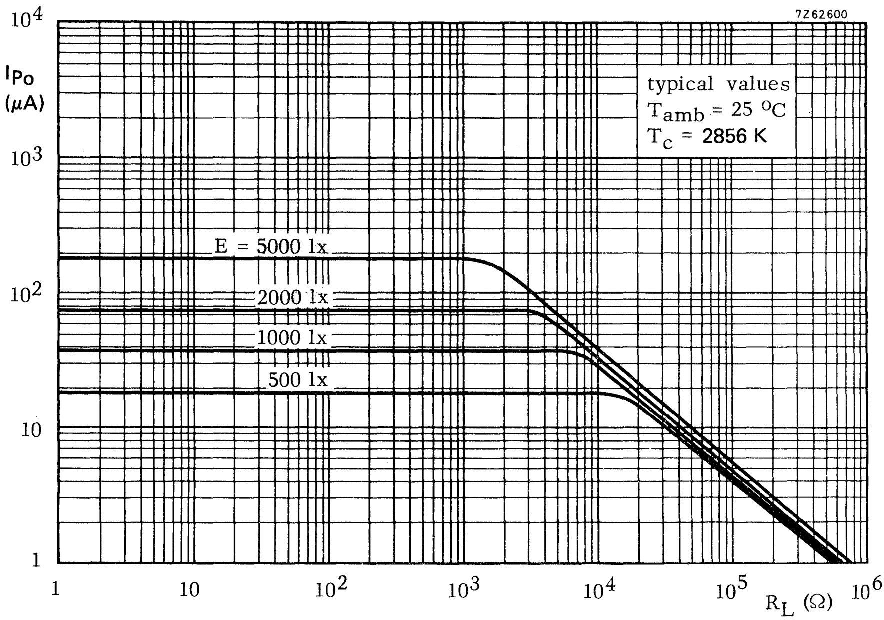

7Z62600
10^4
I_{Po}
(μA)
10^3
E = 5000 lx
2000 lx
1000 lx
500 lx
typical values
T_{amb} = 25 °C
T_c = 2856 K
10^2
10
1
1
10
10^2
10^3
10^4
10^5
R_L (Ω)
10^6

Fig. 3.

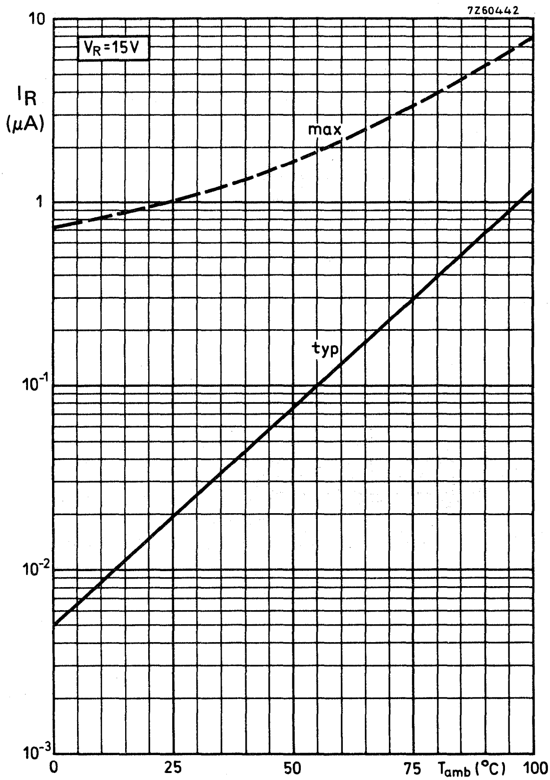


Fig. 4.

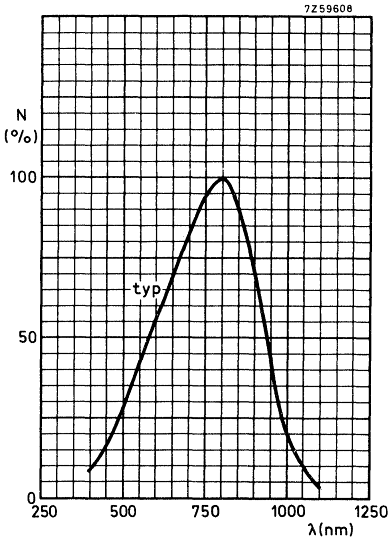

7Z59608
N
(%)
100
50
0
typ
250
500
750
1000
1250
λ(nm)

Fig. 5.

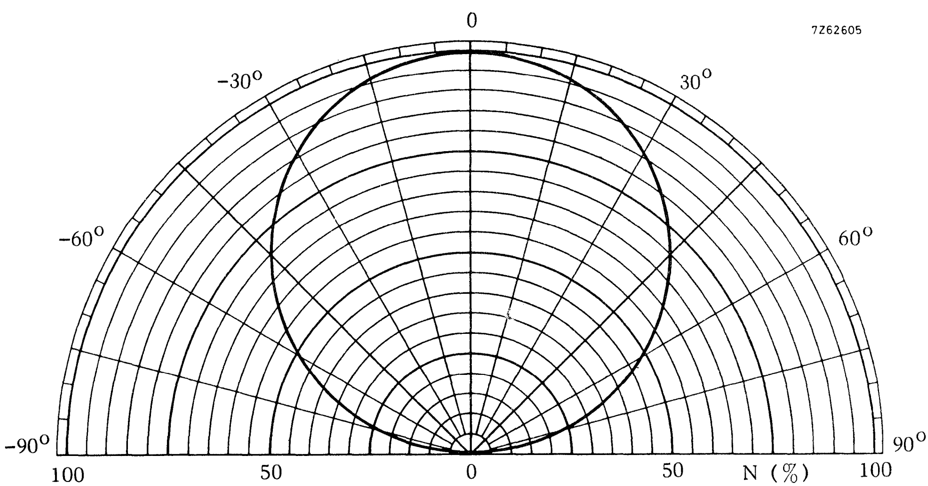

0
7Z62605
-30°
30°
-60°
60°
-90°
90°
100
50
0
50
N (%)
100

Fig. 6.

SILICON PLANAR PHOTODIODE

Unencapsulated photodiode for general purpose applications.

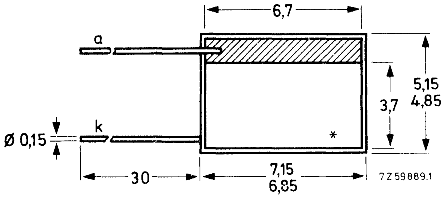
QUICK REFERENCE DATA

Reverse voltage	V_R	max.	12	V
Luminous current V_R = 10 V; E = 1000 lx	I_{Po}	typ.	110	μA
Dark reverse current at V_R = 10 V	I_R	<	5	μA
Wavelength at peak response	λ_p	typ.	800	nm

MECHANICAL DATA

Dimensions in mm

Fig. 1.



Slice thickness 0,27 mm

* Sensitive area 6,7 x 3,7 mm.

RATINGS

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

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

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Dark reverse current			
V_R = 10 V	I_R	typ.	0,1 μA
		<	5,0 μA
V_R = 10 V; T_{amb} = 100 °C	I_R	typ.	6,0 μA
		<	40 μA
Photovoltaic mode			
E = 1000 lx; T_c = 2856 K (equivalent to 4,75 mW/cm^2)			
Light reverse current; V = 0	I_1	>	75 μA
		typ.	140 μA
Forward voltage; I = 0	V_F	>	330 mV
		typ.	350 mV
Luminous current with external voltage*			
V_R = 10 V; E = 1000 lx; T_c = 2856 K (equivalent to 4,75 mW/cm^2)	I_{Po}	>	85 μA
		typ.	110 μA
Wavelength at peak response	λ_p	typ.	800 nm
Diode capacitance; f = 500 kHz			
V_R = 10 V	C_d	typ.	1000 pF
V_R = 0	C_d	typ.	3000 pF
Cut-off frequency (modulated GaAs source)	f_{co}	typ.	500 kHz

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

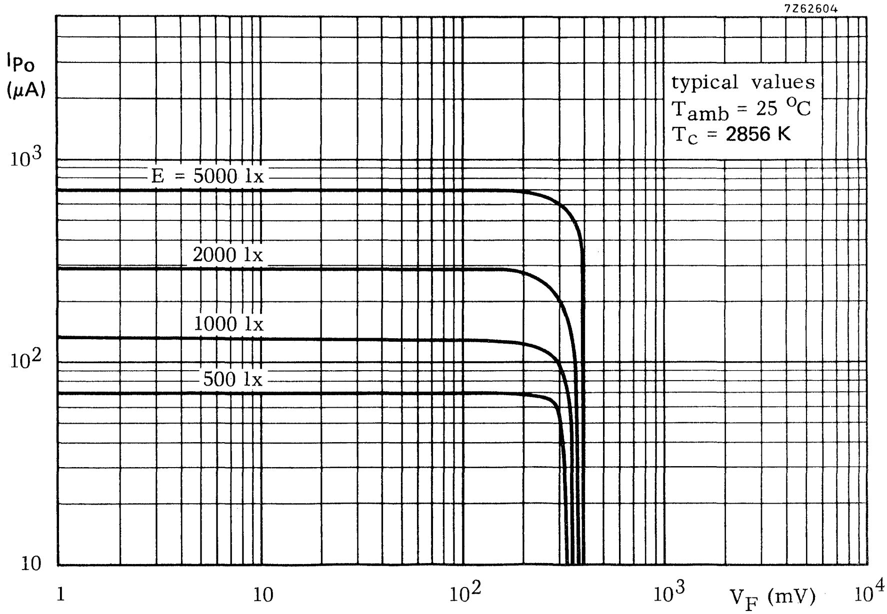

7Z62604
I_{Po} (μA)
10^3
10^2
10
typical values
T_{amb} = 25 °C
T_c = 2856 K
E = 5000 lx
2000 lx
1000 lx
500 lx
1
10
10^2
10^3
V_F (mV)
10^4

Fig. 2.

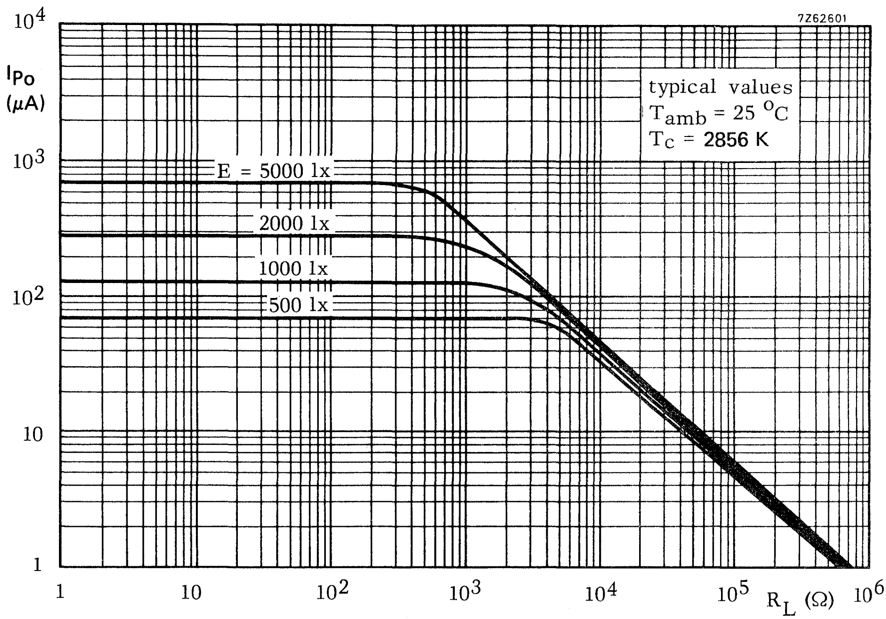

7Z62601
10^4
I_{Po} (μA)
10^3
10^2
10
1
typical values
T_{amb} = 25 °C
T_c = 2856 K
E = 5000 lx
2000 lx
1000 lx
500 lx
1
10
10^2
10^3
10^4
10^5
R_L (Ω)
10^6

Fig. 3.

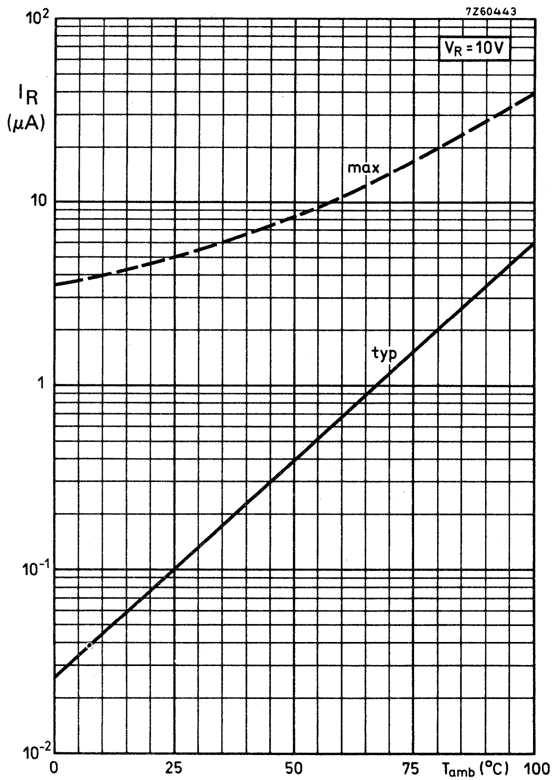


Fig. 4.

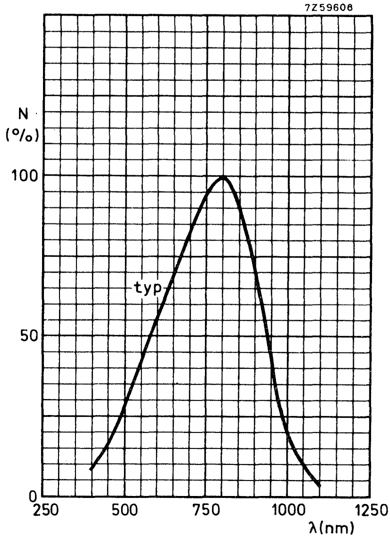

7Z59608
N
(%)
100
50
0
typ
250
500
750
1000
1250
λ(nm)

Fig. 5.

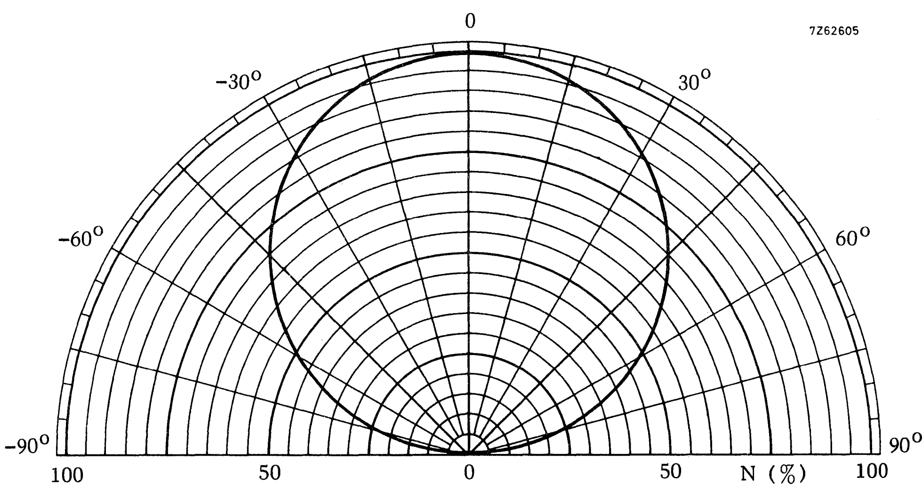

0
7Z62605
−30°
30°
−60°
60°
−90°
90°
100
50
0
50
N (%)
100

Fig. 6.

SILICON PLANAR PHOTODIODE

PIN silicon planar photodiode mounted in a SOT-49 envelope.

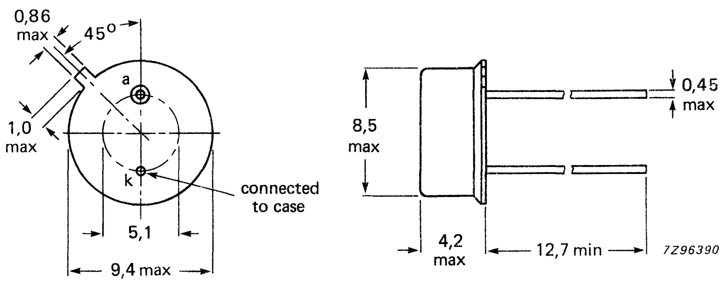
QUICK REFERENCE DATA

Reverse voltage	**BPX61** **BPX61P**	V_R	max. max.	32 V 70 V
Sensitivity $V_R = 5$ V; $E = 1$ mW/cm^2; $\lambda = 930$ nm		S_E	min.	35 μA
Sensitive area		A	typ.	6,75 mm^2
Total power dissipation up to $T_{amb} = 25\ ^oC$		P_{tot}	max.	325 mW

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-49/3.



RATINGS

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

Reverse voltage	BPX61	V_R	max.	32 V
	BPX61P		max.	70 V *
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	325 mW
Storage temperature		T_{stg}		−65 to +150 °C
Junction temperature		T_j	max.	125 °C
Operating temperature		T_{op}		−40 to +125 °C

THERMAL RESISTANCE

Thermal resistance from junction to ambient		$R_{th\ j\text{-}a}$	max.	220 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise stated

Reverse voltage I_R = 100 μA	BPX61	V_R	min.	32 V
	BPX61P		min.	70 V
Dark current V_R = 10 V	BPX61	I_R	typ.	2 nA
			max.	30 nA
	BPX61P	I_R	typ.	0,6 nA
			max.	1 nA
Photovoltaic voltage (see note 1) E = 100 lux		V_L	typ.	285 mV
E = 1000 lux		V_L	typ.	365 mV
Light current (see note 1) V_R = 5 V; E = 1000 lux		I_L	typ.	70 μA
Light current V_R = 5 V; E = 1 mW/cm²; λ = 930 nm		S_E	min.	35 μA
			typ.	45 μA
Wavelength at peak response V_R = 5 V		λ_p	typ.	850 nm
Capacitance V_R = 0 V		C_{J0}	typ.	70 pF
V_R = 3 V	BPX61	C_{J3}	typ.	20 pF
			max.	40 pF
V_R = 50 V	BPX61P	C_{J50}	typ.	6 pF
Sensitive area		A	typ.	6,75 mm²
Temperature coefficients		K_{VL}	typ.	−2,6 mV/°C
		K_{IL}	typ.	0,2 %/°C
Switching times (see Figs 2 and 3) V_R = 10 V; R_L = 1 kΩ; λ = 930 nm	PBX61, BPX61P	t_r	typ.	25 ns
		t_f	typ.	40 ns
V_R = 50 V; R_L = 1 kΩ; λ = 930 nm	BPX61P	t_r	typ.	15 ns
		t_f	typ.	20 ns

* At this voltage, the junction temperature must be lower than 70 °C.

Noise equivalent power $V_R = 10$ V	BPX61	N_{EP}	typ.	$4,2 \times 10^{-14}$	$\frac{W}{\sqrt{Hz}}$
	BPX61P	N_{EP}	typ.	3×10^{-14}	$\frac{W}{\sqrt{Hz}}$
Detectivity $V_R = 10$ V	BPX61	D*	typ.	$6,2 \times 10^{-12}$	$\frac{cm \sqrt{Hz}}{W}$
	BPX61P	D*	min.	$8,6 \times 10^{-12}$	$\frac{cm \sqrt{Hz}}{W}$

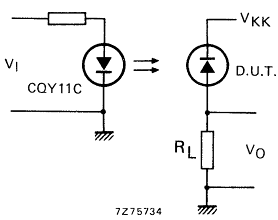


Fig. 2 Measuring circuit.

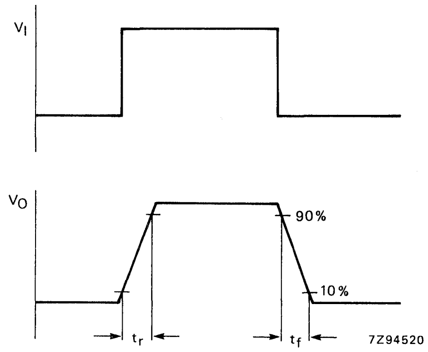


Fig. 3 Waveforms.

Note 1: Tungsten filament source with colour temperature 2856 °K.

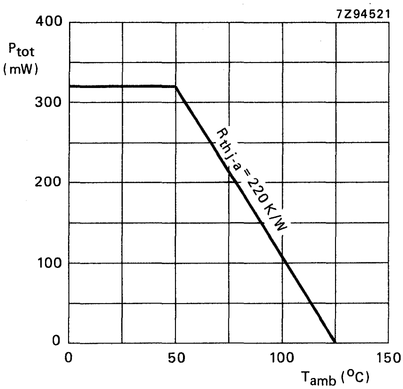


Fig. 4.

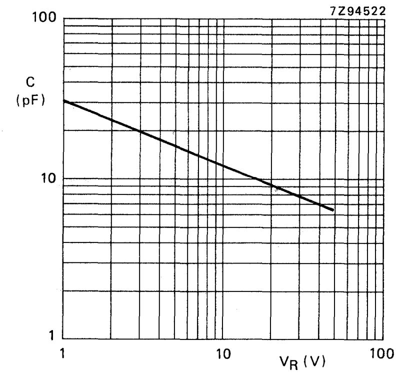


Fig. 5 f = 1 MHz; T_{amb} = 25 °C; typical values.

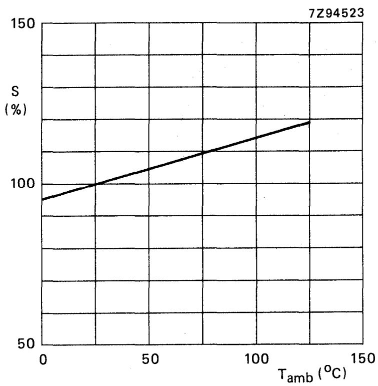


Fig. 6 V_R = 5 V; E = 1000 lux; typical values.

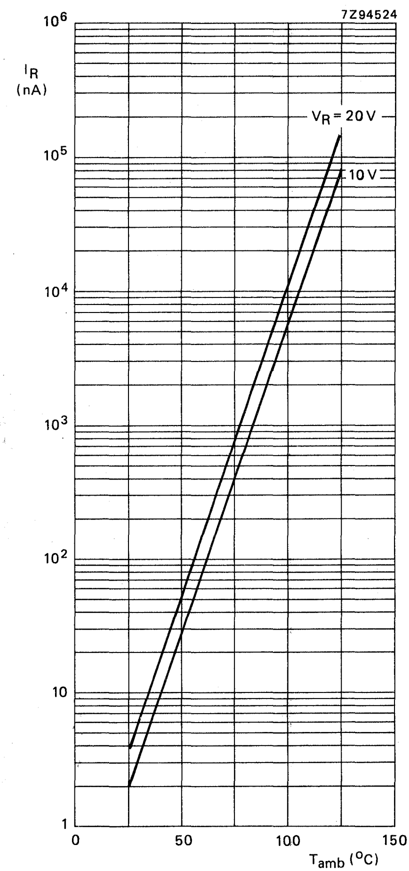


Fig. 7 E = 0; typical values BP X 61.

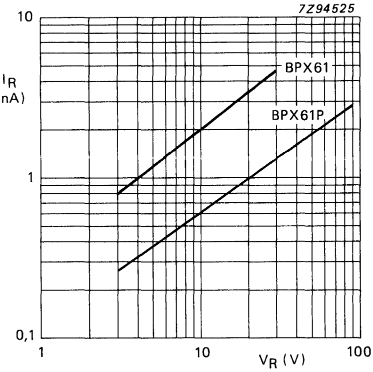


Fig. 8 T_{amb} = 25 °C; E = 0; typical values.

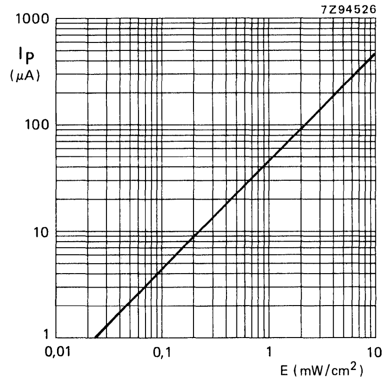


Fig. 9 V_R = 5 V; T_{amb} = 25 °C; λ = 930 nm; typical values.

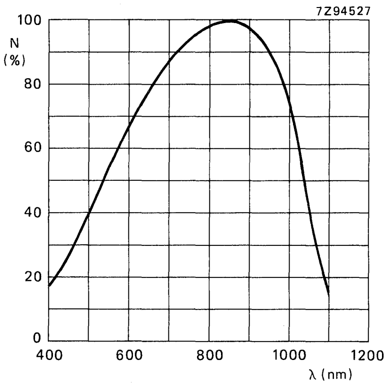


Fig. 10 Typical values.

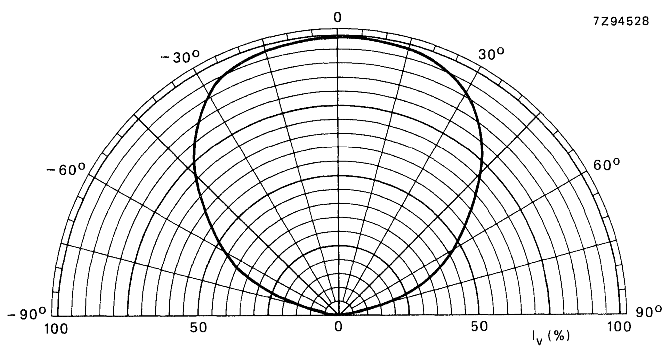


Fig. 11 V_R = 5 V; E = 1000 lux; T_{amb} = 25 °C; typical values.

PHOTOTRANSISTOR

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

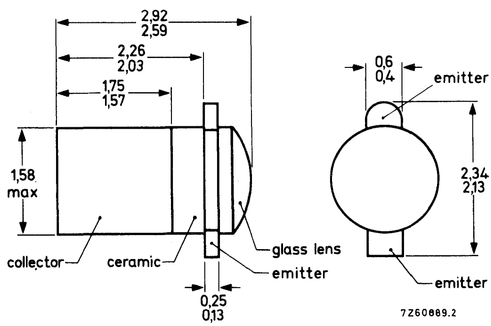
QUICK REFERENCE DATA

Collector-emitter voltage		V_{CEO}	max.	50 V
Collector current (d.c.)		I_C	max.	20 mA
Junction temperature		T_j	max.	150 °C
Collector dark (cut-off) current V_{CE} = 30 V		I_{CEO}	<	25 nA
Collector light (cut-off) current V_{CE} = 5 V; E_e = 20 mW/cm^2	**BPX71**	I_P		0,5 to 15 mA
	BPX71-204	I_P		7 to 15 mA
Wavelength at peak response		λ_p	typ.	800 nm
Half sensitivity angle		θ½	typ.	40°

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-71A (DO-31).



RATINGS

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

Collector-emitter voltage	V_{CEO}	max.	50	V
Emitter-collector voltage	V_{ECO}	max.	7	V
Collector current				
d.c.	I_C	max.	20	mA
(peak value); $t_p \leqslant 50\ \mu s$; $\delta \leqslant 0{,}1$	I_{CM}	max.	50	mA
Total power dissipation				
up to $T_{amb} = 50\ ^oC$	P_{tot}	max.	50	mW
up to $T_{mb} = 55\ ^oC$	P_{tot}	max.	100	mW
Storage temperature	T_{stg}	−65 to +150		^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	2000	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	950	K/W

CHARACTERISTICS

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

Collector dark (cut-off) current					
$V_{CE} = 30$ V		I_{CEO}	<	25	nA
$V_{CE} = 30$ V; $T_{amb} = 100\ ^oC$		I_{CEO}	<	100	μA
Collector light current					
$V_{CE} = 5$ V; tungsten filament lamp source with colour temperature 2856 K					
$E_e = 4{,}75$ mW/cm^2		I_P	typ.	1	mA
$E_e = 20$ mW/cm^2	**BPX71**	I_P		0,5 to 15	mA
	BPX71-204	I_P		7 to 15	mA
Collector-emitter breakdown voltage					
$E = 0$; $I_C = 0{,}5$ mA		$V_{(BR)CEO}$	>	50	V
Emitter-collector breakdown voltage					
$E = 0$; $I_C = 0{,}1$ mA		$V_{(BR)ECO}$	>	7	V
Collector-emitter light saturation voltage					
$I_C = 0{,}4$ mA; $E_e = 20$ mW/cm^2; $T_c = 2856$ K		V_{CEsat}	typ.	150	mV
			<	400	mV
Wavelength at peak response		λ_p	typ.	800	nm
Bandwidth at half height		$\Delta\lambda$	typ.	400	nm

Switching times

I_{Con} = 0,8 mA; V_{CC} = 35 V; R_L = 1 kΩ

Delay time	t_d	typ.	2,0 μs
		<	20 μs
Rise time	t_r	typ.	3,0 μs
		<	30 μs
Storage time	t_s	typ.	0,1 μs
		<	2,0 μs
Fall time	t_f	typ.	2,5 μs
		<	20 μs

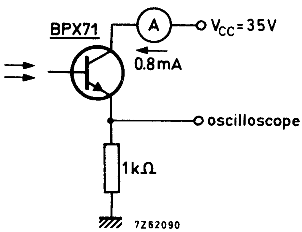


Fig. 2 Test circuit.

Light input pulse:

t_r = t_f = 20 ns

t_p = 20 μs

f = 500 Hz

λ = 800 nm

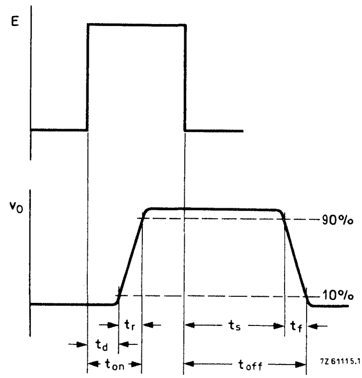


Fig. 3 Waveforms.

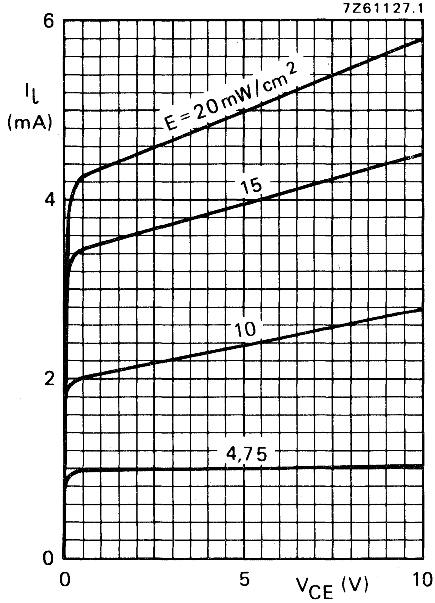


Fig. 4 Typical values; T_{amb} = 25 °C.

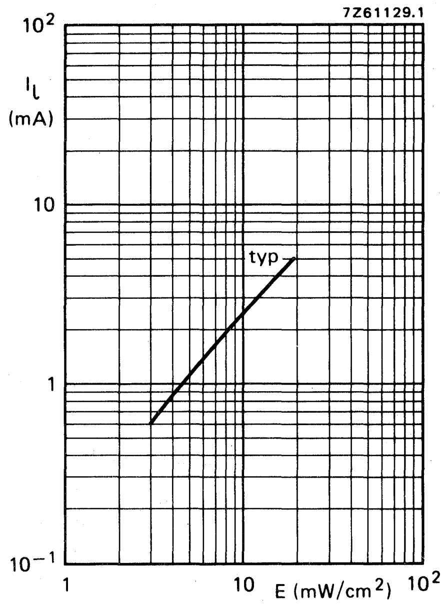


Fig. 5 V_{CE} = 5 V; T_{amb} = 25 °C.

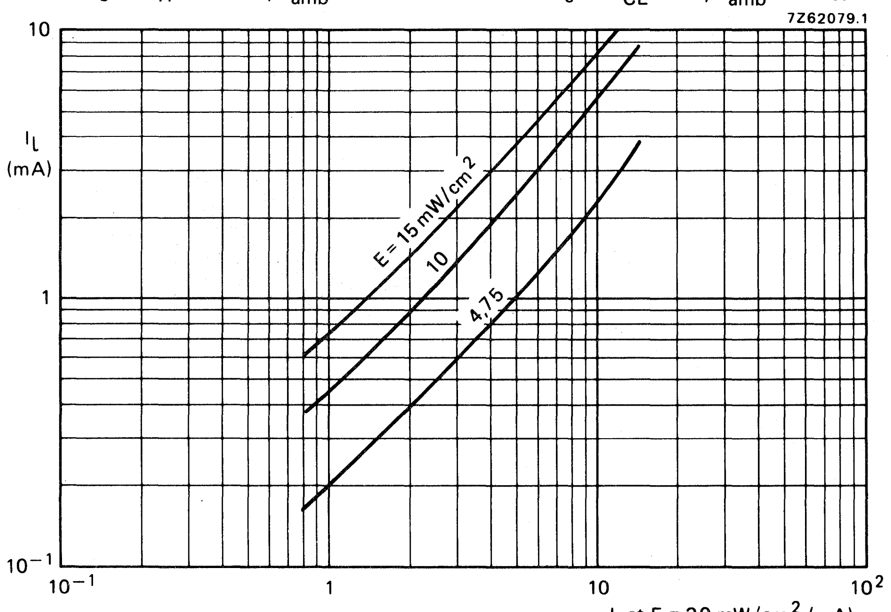


Fig. 6 V_{CE} = 5 V; T_{amb} = 25 °C; typical values.

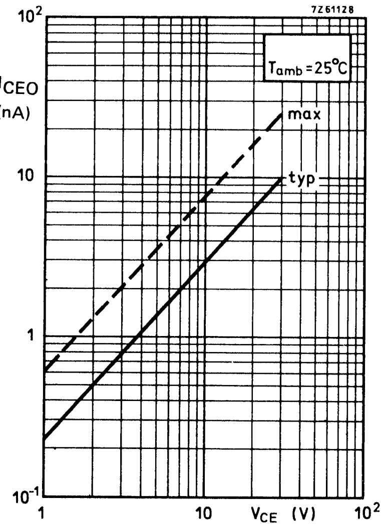


Fig. 7.

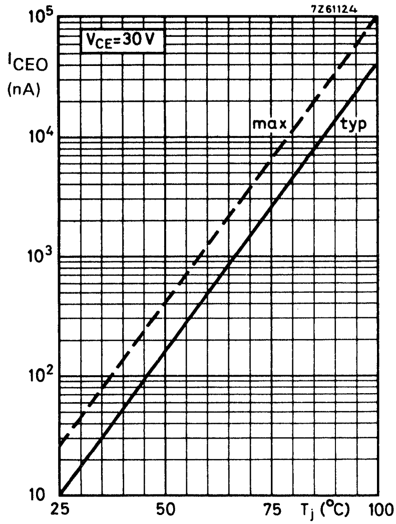


Fig. 8.

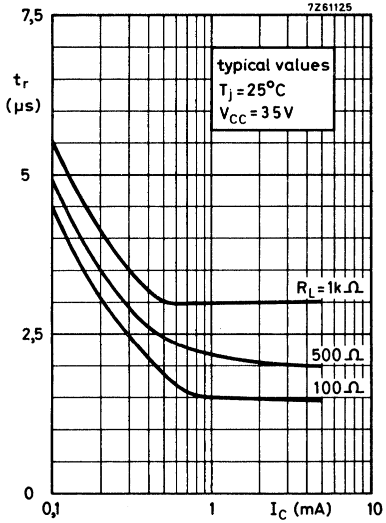


Fig. 9.

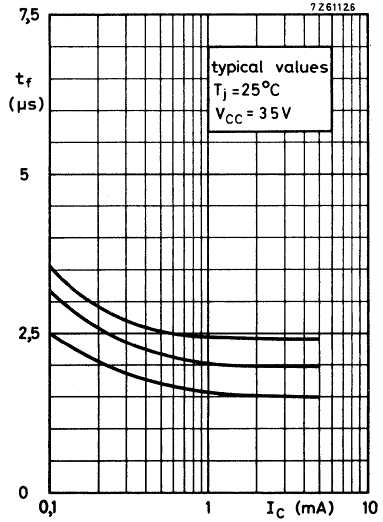


Fig. 10.

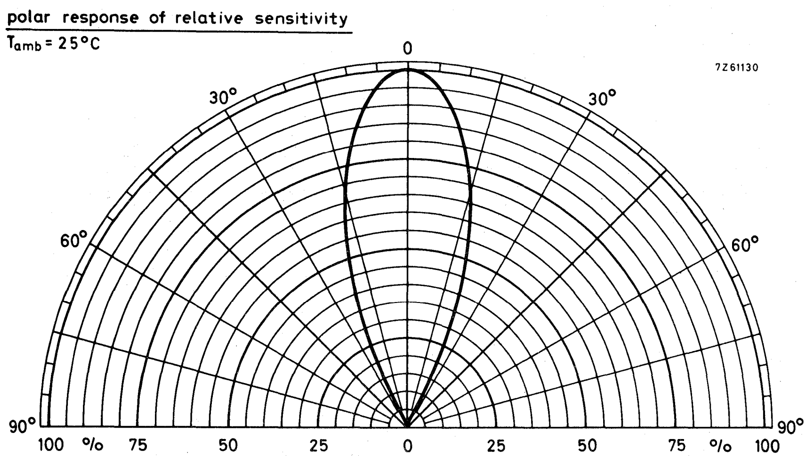


Fig. 11 Typical values.

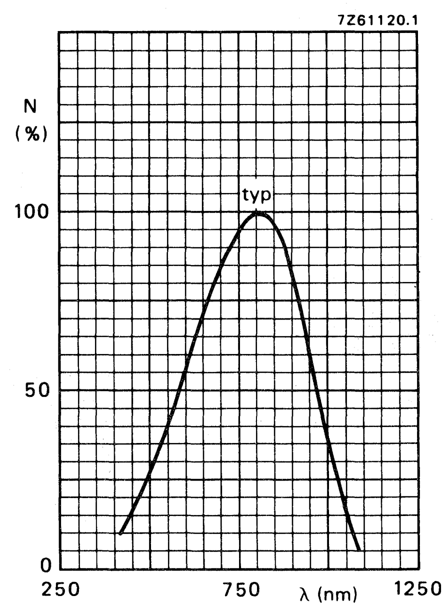


Fig. 12.

PHOTOTRANSISTOR

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

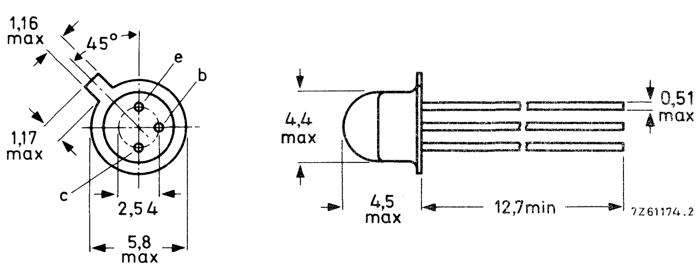
QUICK REFERENCE DATA

Collector-emitter voltage (open base)		V_{CEO}	max.	50 V
Collector current (d.c.)		I_C	max.	25 mA
Junction temperature		T_j	max.	125 °C
Collector dark (cut-off) current V_{CE} = 20 V		I_{CEO}	<	100 nA
Collector light (cut-off) current V_{CE} = 5 V; E_v = 1000 lx (E_e = 4,75 mW/cm^2)	**BPX72**	I_C		500 to 3000 μA
	BPX72D	I_C		850 to 2000 μA
	BPX72E	I_C		1400 to 3000 μA
	BPX72F	I_C		2400 to 5000 μA
Wavelength at peak response		λ_p	typ.	800 nm
Half sensitivity angle		$\theta½$	typ.	120°

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-70A.



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

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	50 V
Collector-emitter voltage (open base)	V_{CEO}	max.	50 V
Emitter-collector voltage (open base)	V_{ECO}	max.	7 V
Collector current			
d.c.	I_C	max.	25 mA
(peak value); $t_p \leqslant 50\ \mu s$; $\delta \leqslant 0,1$	I_{CM}	max.	50 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	180 mW
Storage temperature	T_{stg}	−40 to + 125 °C	
Junction temperature	T_j	max.	125 °C

THERMAL RESISTANCE

→ From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	550 K/W

CHARACTERISTICS

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

Collector dark (cut-off) current				
V_{CE} = 20 V		I_{CEO}	typ.	10 nA
			<	100 nA
V_{CE} = 20 V; T_j = 100 °C		I_{CEO}	typ.	10 μA
			<	100 μA
Collector light (cut-off) current				
V_{CE} = 5 V; tungsten filament lamp source with colour temperature 2856 K				
E_v = 1000 lx (E_e = 4,75 mW/cm²)	**BPX72**	I_C		500 to 3000 μA
	BPX72D	I_C		850 to 2000 μA
	BPX72E	I_C		1400 to 3000 μA
	BPX72F	I_C		2400 to 5000 μA
E_v = 2500 lx (E_e = 12 mW/cm²)		I_C	typ.	3000 μA
Collector-base breakdown voltage				
E = 0; I_C = 0,1 mA		$V_{(BR)CBO}$	>	50 V
Collector-emitter breakdown voltage				
E = 0; I_C = 1 mA		$V_{(BR)CEO}$	>	50 V
Emitter-collector breakdown voltage				
E = 0; I_C = 0,1 mA		$V_{(BR)ECO}$	>	7 V
Collector capacitance				
$I_E = I_e$ = 0; V_{CB} = 20 V		C_c	typ.	3,5 pF
Wavelength at peak response		λ_p	typ.	800 nm
Bandwidth at half height		$\Delta\lambda$	typ.	400 nm

Switching times

I_{Con} = 1 mA; V_{CC} = 5 V; R_L = 100 Ω

Delay time	t_d	typ.	3,0 μs
		<	6,0 μs
Rise time	t_r	typ.	6,0 μs
		<	20 μs
Storage time	t_s	typ.	1,5 μs
		<	3,0 μs
Fall time	t_f	typ.	4,0 μs
		<	20 μs

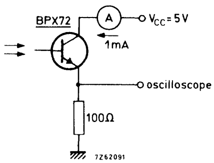


Fig. 2 Test circuit.

Light input pulse:

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

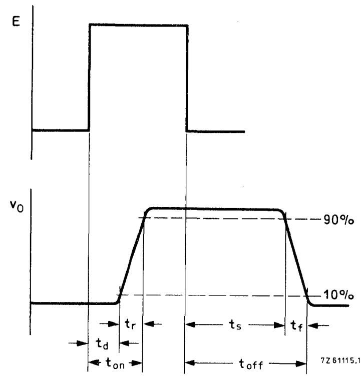


Fig. 3 Waveforms.

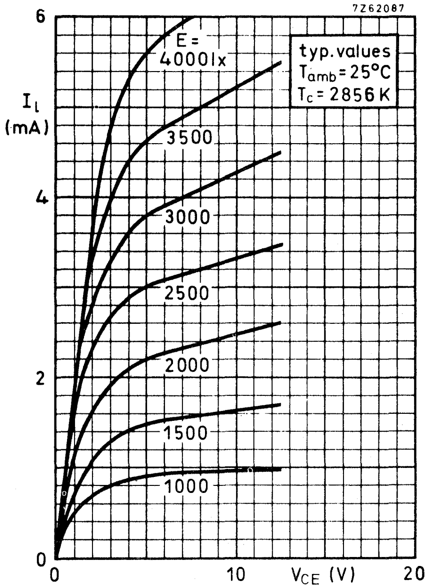


Fig. 4.

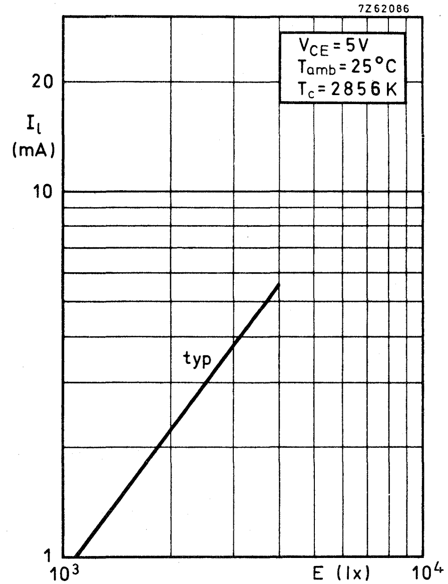


Fig. 5.

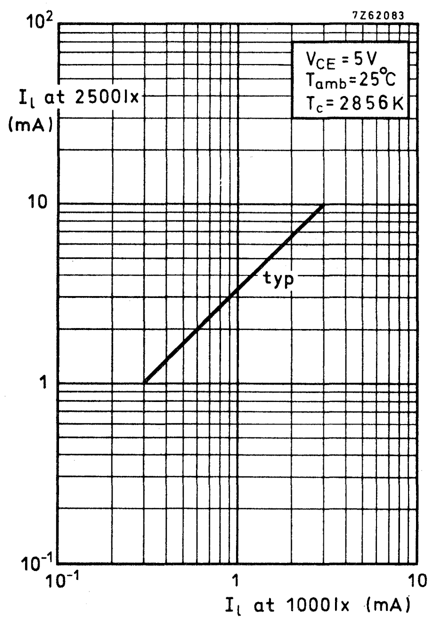


Fig. 6.

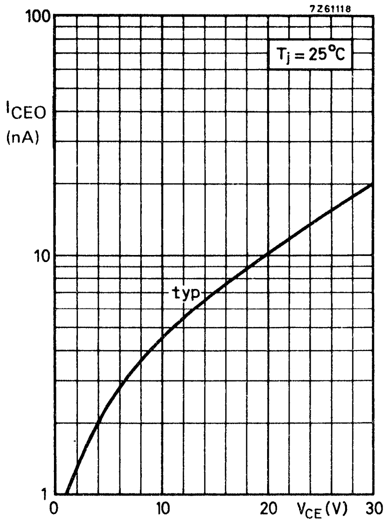


Fig. 7.

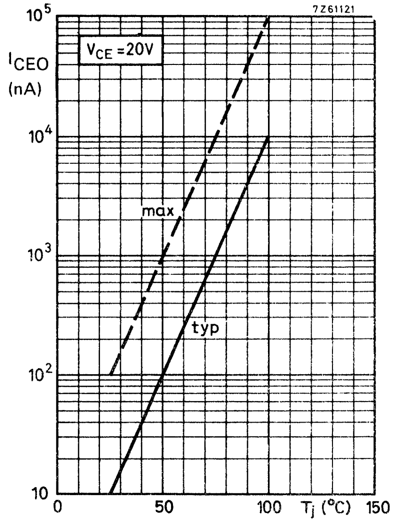


Fig. 8.

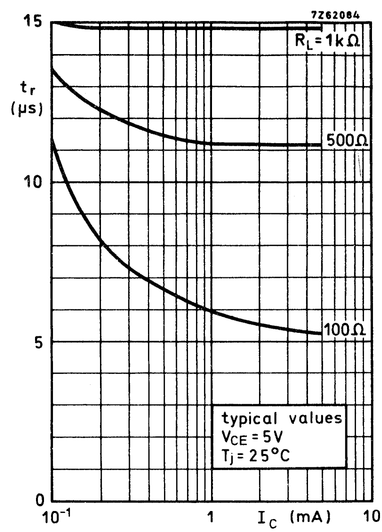


Fig. 9.

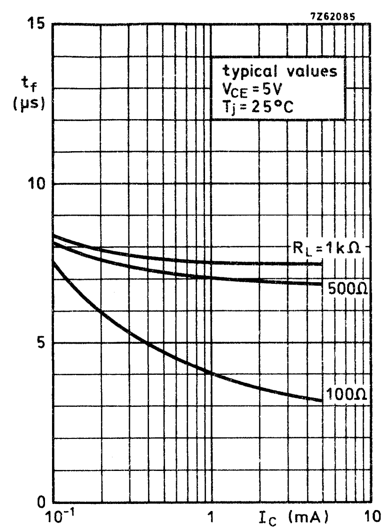


Fig. 10.

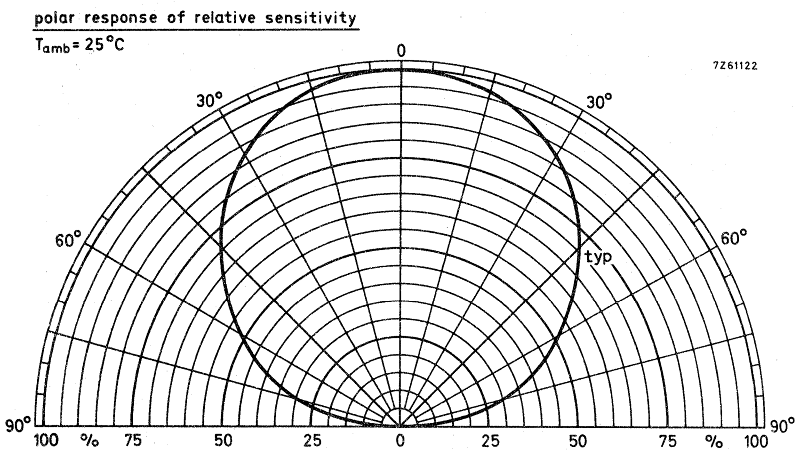


Fig. 11 Typical values.

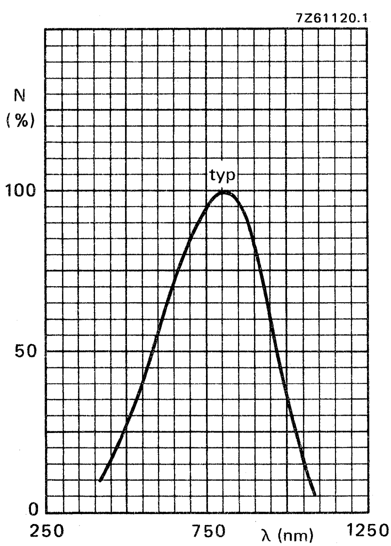


Fig. 12.

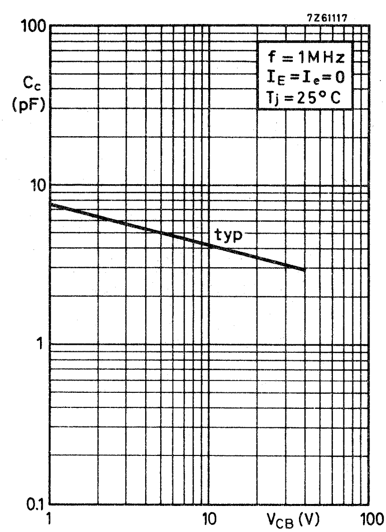


Fig. 13.

SECTION B3

Infrared light emitting diodes

HIGH-SPEED INFRARED EMITTING DIODE

Circular infrared emitting diode with diameter of 5 mm which emits infrared light at a typical peak wavelength of 830 nm (GaAlAs; infrared) when forward biased.

The CQW89A has a SOD-63 outline and is moulded in a light blue encapsulation with long leads.

The application of new GaAlAs (intrinsic) technology results in extremely short switching times and very low degradation during the devices operating life.

It is intended for remote control applications using carrier frequencies up to 1 MHz. Combination with the high-speed photo p-i-n diode BPW50 is recommended.

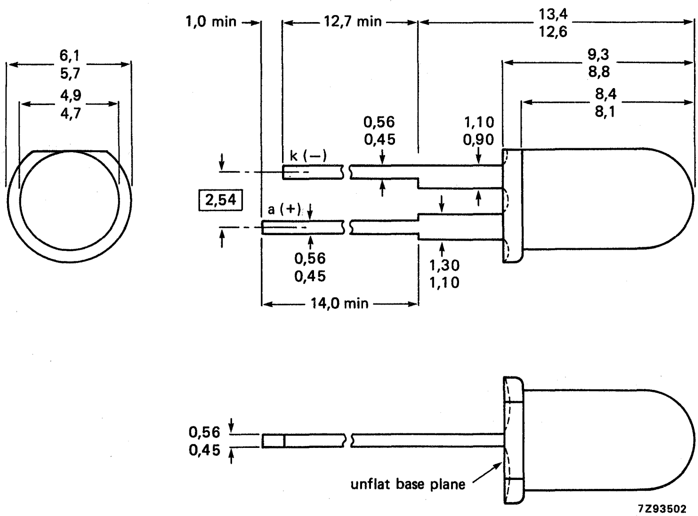
QUICK REFERENCE DATA

Continuous reverse voltage		V_R	max.	5	V
Forward current (d.c.)		I_F	max.	130	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	300	mW
Junction temperature		T_j	max.	100	°C
Radiant intensity (on axis)					
static (at d.c. condition)					
I_F = 100 mA	CQW89A	I_e	min.	9	mW/sr
	CQW89A-1	I_e	min.	12	mW/sr
	CQW89A-2	I_e	min.	15	mW/sr
dynamic (at pulse condition)					
I_{FM} = 100 mA; t_p = 0,5 μs; δ = 0,5		I_{eD}	typ.	0,8	I_e
Switching times (see Figs 2 and 3)					
I_F = 100 mA		t_r	typ.	30	ns
		t_f	typ.	30	ns
Wavelength at peak emission		λ_p	typ.	830	nm
Beamwidth at half-intensity directions		$\theta_{1/2}$	typ.	40	°

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-63D2.



RATINGS

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

Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	130	mA
peak value; t_p = 10 μs; δ = 0,01	I_{FM}	max.	2500	mA
peak value; t_p = 50 μs; δ = 0,01	I_{FM}	max.	1500	mA
Total power dissipation up to T_{amb} = 25 °C with heatsink	P_{tot}	max.	300	mW
Storage temperature	T_{stg}		−55 to +100	°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature t_{sld} < 10 s	T_{sld}	max.	260	°C

THERMAL RESISTANCE

From junction to ambient when the device is mounted on a printed circuit board	$R_{th\ j\text{-}a}$	max.	350	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage I_F = 1,5 A; t_{on} = 50 μs; δ = 0,01		V_F	typ.	3,7	V
Forward voltage I_F = 100 mA		V_F	typ.	1,7	V
			max.	2,2	V
Reverse current V_R = 5 V		I_R	max.	100	μA
Diode capacitance at f = 1 MHz V_R = 0		C_d	typ.	200	pF
Total radiant power I_F = 100 mA		ϕ_e	typ.	8	mW
Radiant intensity (on axis) static (at d.c. condition) I_F = 100 mA	CQW89A	I_e	min.	9	mW/sr
	CQW89A-1	I_e	min.	12	mW/sr
	CQW89A-2	I_e	min.	15	mW/sr
dynamic (at pulse condition)* I_{FM} = 100 mA; t_p = 0,5 μs; δ = 0,5		I_{eD}	typ.	0,8	I_e

* I_{eD} = Dynamic radiant intensity (average radiant intensity level during pulse time).

Radiant power temperature coefficient	$k_{\phi e}$	typ.	−0,6 %/K
Wavelength at peak emission I_F = 100 mA	λ_p	typ.	830 nm
Bandwidth at half-height I_F = 100 mA	$\Delta\lambda$	typ.	35 nm
Beamwidth at half-intensity direction I_F = 100 mA	$\theta_{1/2}$	min. typ.	28 ° 40 °
Switching times (see Figs 2 and 3) I_F = 100 mA	t_r t_f	typ. typ.	30 ns 30 ns

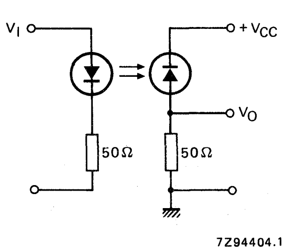


Fig. 2 Measuring circuit.

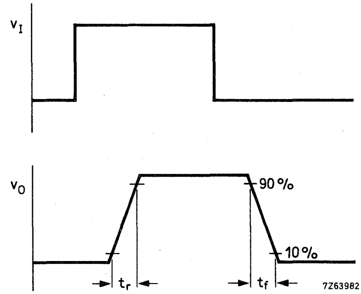


Fig. 3 Waveforms.

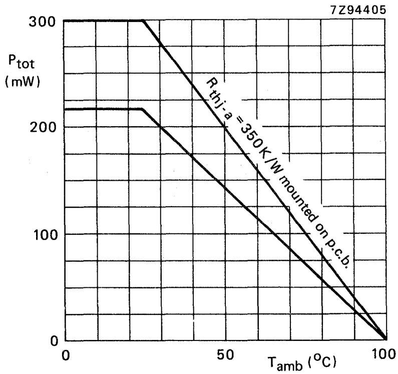


Fig. 4 Typical values.

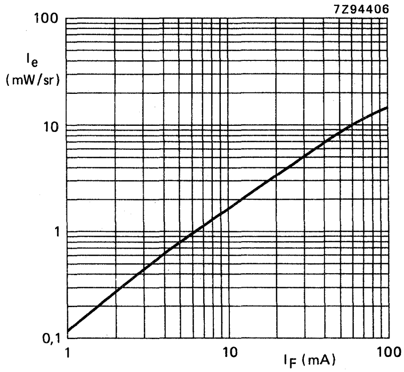


Fig. 5 t_{on} = 10 μs; δ = 0,01; T_{amb} = 25 °C; typical values.

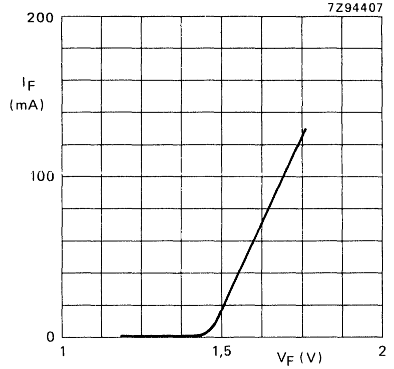


Fig. 6 T_{amb} = 25 °C; typical values.

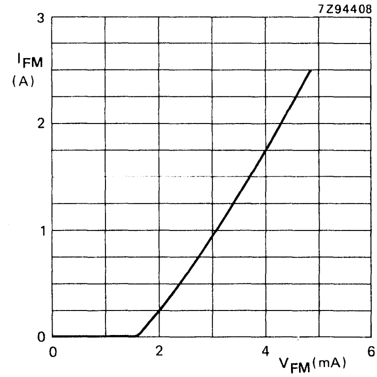


Fig. 7 t_{on} = 10 μs; T_{amb} = 25 °C; typical values.

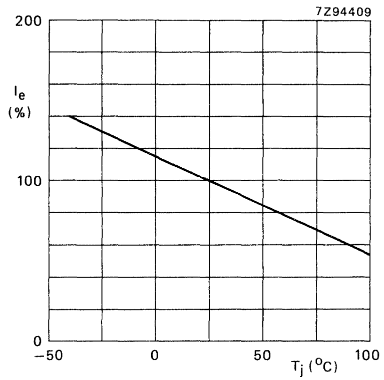


Fig. 8 I_F = 100 mA; typical values.

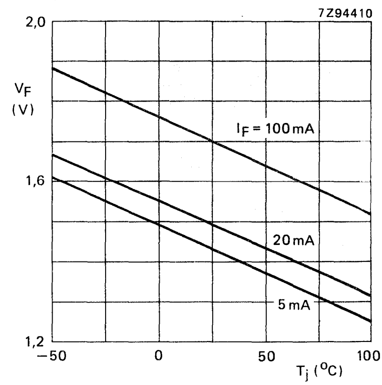


Fig. 9 Typical values.

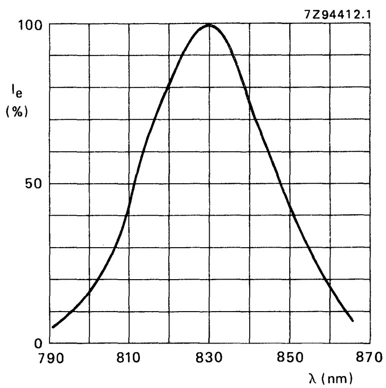


Fig. 10 Spectral response; typical values.

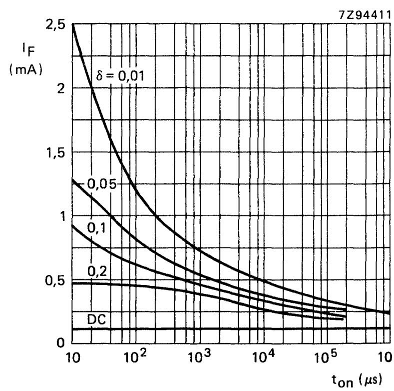


Fig. 11 Typical values.

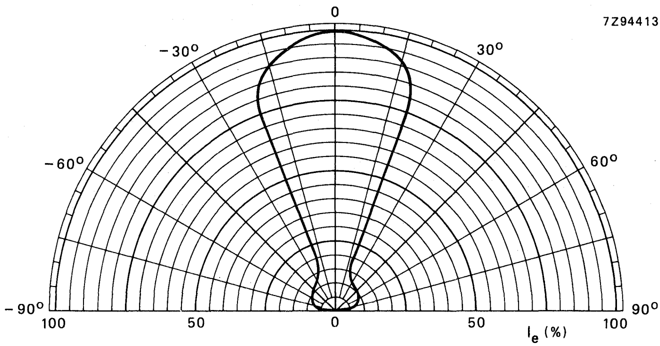


Fig. 12 Typical values.

GaAs LIGHT EMITTING DIODE

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

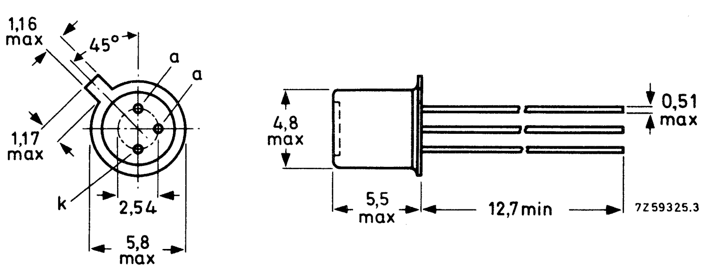
QUICK REFERENCE DATA

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

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18, except for window.



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

RATINGS

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

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

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Forward voltage at I_F = 30 mA	V_F	typ. <	1,3 V 1,6 V
I_{FM} = 0,2 A	V_F	typ.	1,5 V
Reverse current at V_R = 2 V	I_R	<	100 μA
Diode capacitance at f = 1 MHz; V_R = 0	C_d	typ.	65 pF
Radiant output power at I_F = 20 mA	ϕ_e	> typ.	60 μW 100 μW
I_F = 20 mA; T_j = 100 °C	ϕ_e	typ.	50 μW
I_F = 200 mA *	ϕ_e	typ.	1,16 mW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	typ.	64 μW/sr
Radiance at I_F = 20 mA	L_e	typ.	1,6 mW/mm²sr
I_F = 200 mA *	L_e	typ.	15 mW/mm²sr
Emissive area	A_e	typ.	0,04 mm²
Wavelength at peak emission	λ_p	typ.	880 nm
Bandwidth at half height	$\Delta\lambda$	typ.	40 nm
Switching times			
Rise time at I_{Fon} = 20 mA	t_r	typ. <	30 ns 100 ns
Fall time at I_{Fon} = 20 mA	t_f	typ. <	30 ns 100 ns

* t_p = 100 μs; δ = 0,1.

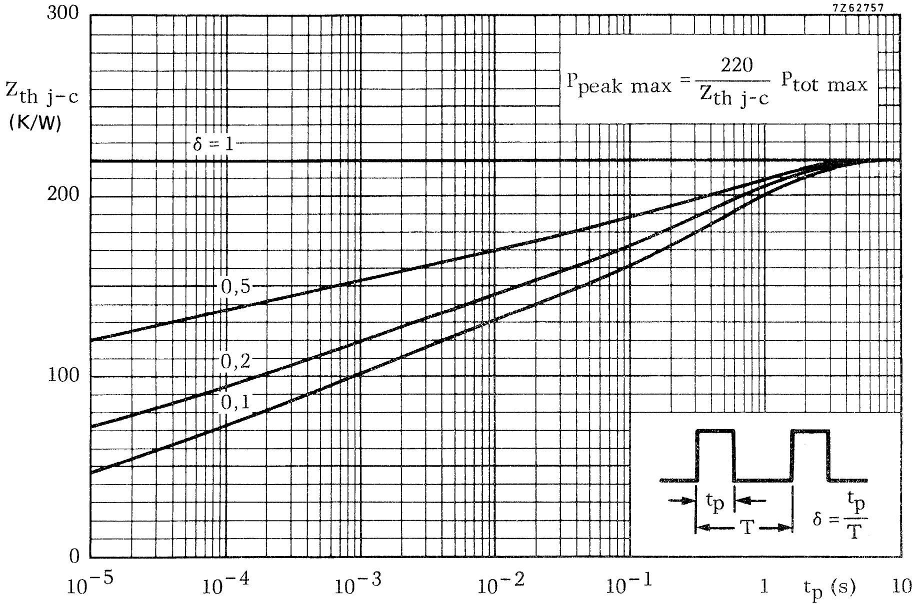


Fig. 2.

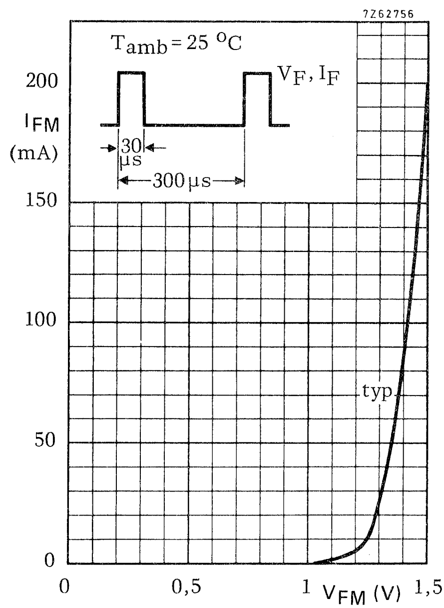


Fig. 3.

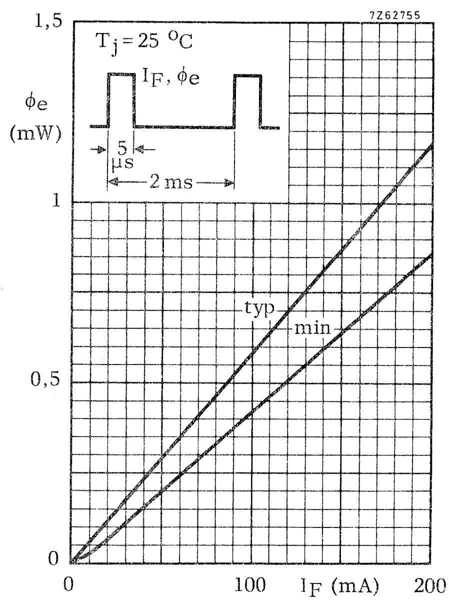


Fig. 4.

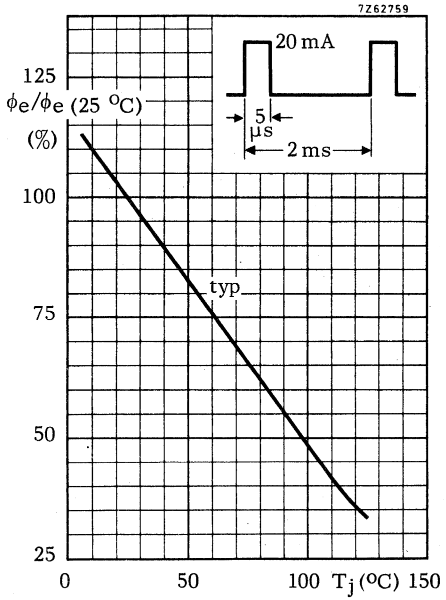


Fig. 5.

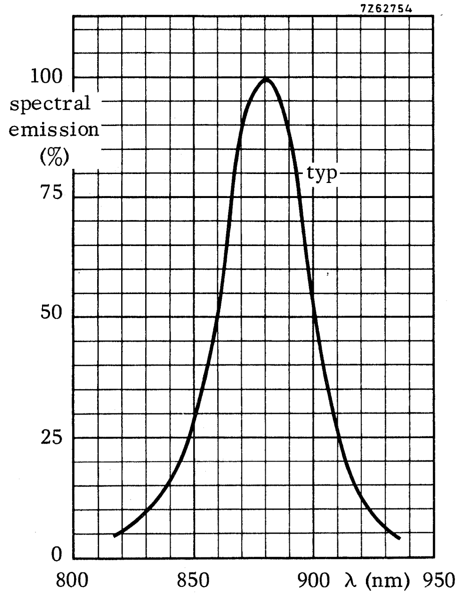


Fig. 6.

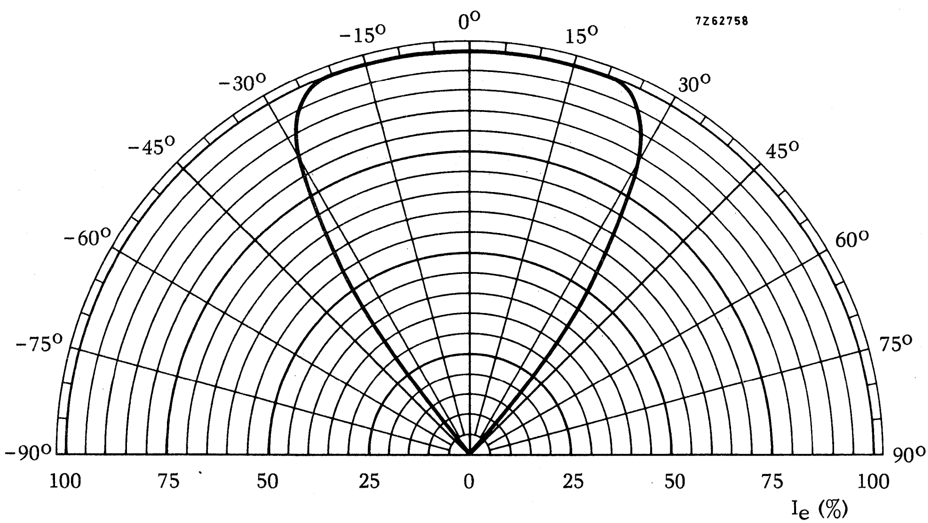


Fig. 7.

GaAs LIGHT EMITTING DIODE

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

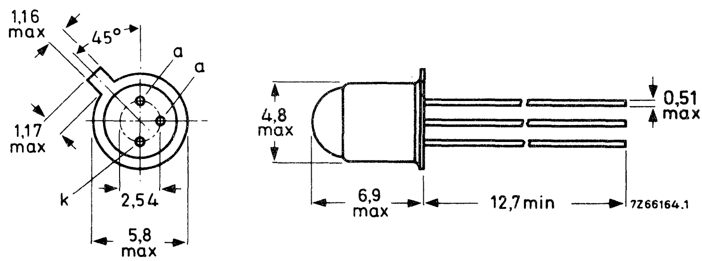
QUICK REFERENCE DATA

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

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18, except for lens.



RATINGS

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

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

THERMAL RESISTANCE

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

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Forward voltage at I_F = 30 mA	V_F	typ.	1,3	V
		<	1,6	V
I_{FM} = 200 mA	V_F	typ.	1,5	V
Reverse current at V_R = 2 V	I_R	<	100	μA
Diode capacitance at V_R = 0; f = 20 MHz	C_d	typ.	25	pF
Total radiant power at I_F = 20 mA	ϕ_e	typ.	50	μW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	typ.	1,25	mW/sr
Mean irradiance on a receiving area with D = 2 mm at a distance a = 10 mm and at I_F = 20 mA, measured as in Fig. 2	E_e	>	0,28	mW/cm^2
		typ.	0,50	mW/cm^2 *

* This corresponds typically with I_E = 0,4 mA in a phototransistor BPX25 and with 200 μA in a phototransistor BPX72.

CHARACTERISTICS (continued)

Decrease of radiant power with temperature	$\frac{\Delta\phi_e}{\Delta T_j}$	typ.	0,7 %/K
Cross-section of the radiant beam between 0 to 10 mm from the lens	A_{beam}	typ.	7 mm^2
Angle between optical and mechanical axis		typ.	6 ^{o}
Wavelength at peak emission	λ_p	typ.	880 nm
Bandwidth at half height	$\theta_{½}$	typ.	40 nm
Switching times			
Rise time at I_{Fon} = 20 mA	t_r	typ.	30 ns
		<	100 ns
Fall time at I_{Fon} = 20 mA	t_f	typ.	30 ns
		<	100 ns

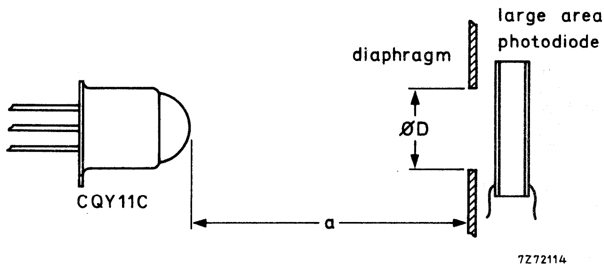


Fig. 2.

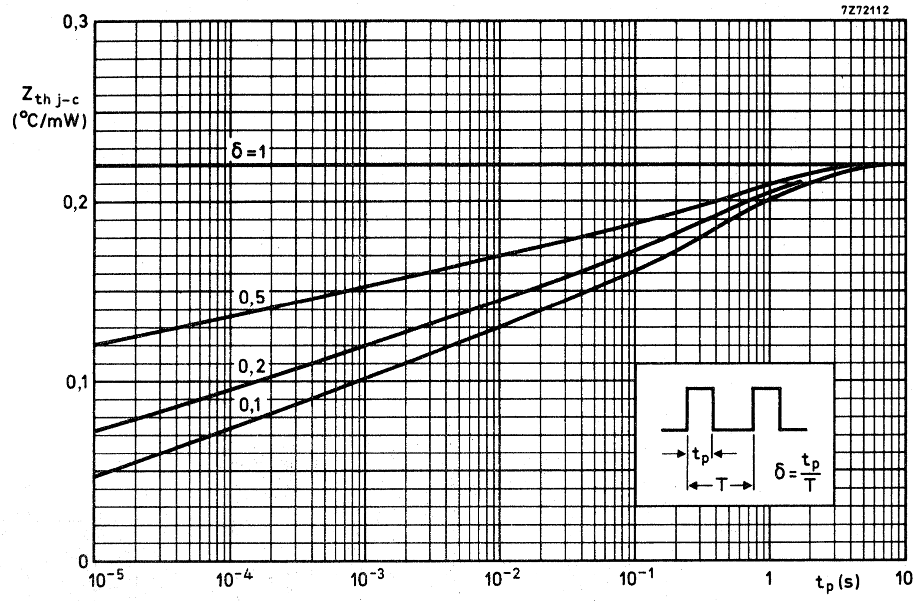


Fig. 3.

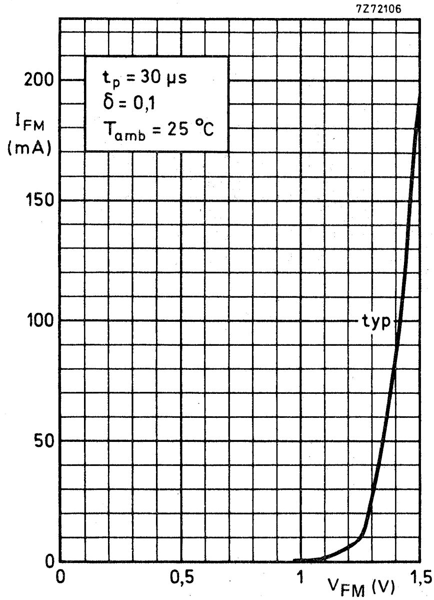


Fig. 4.

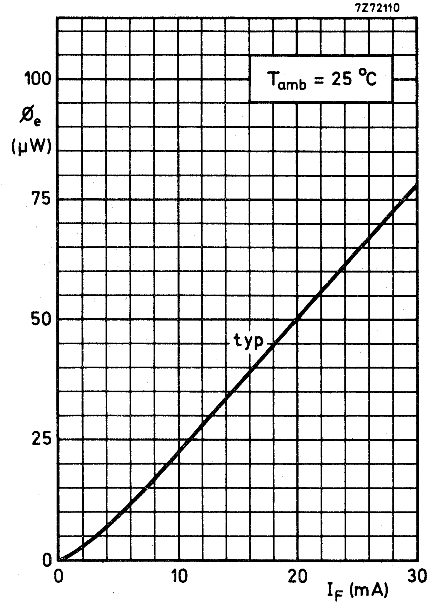


Fig. 5.

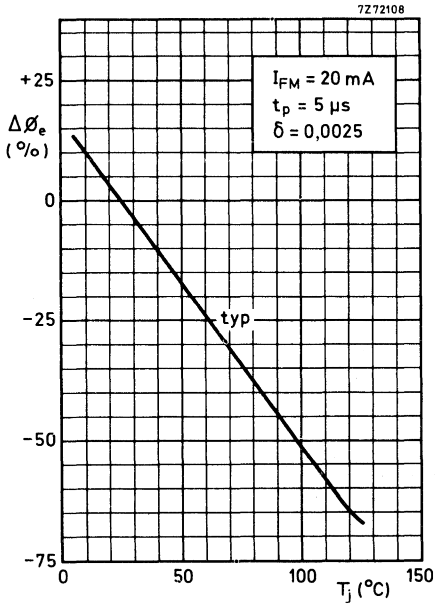


Fig. 6 .

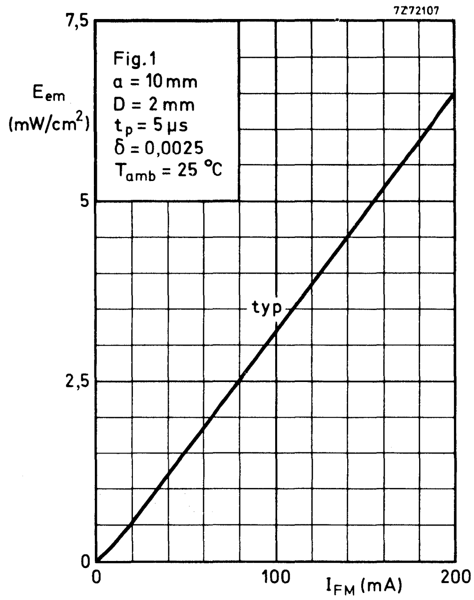


Fig. 7.

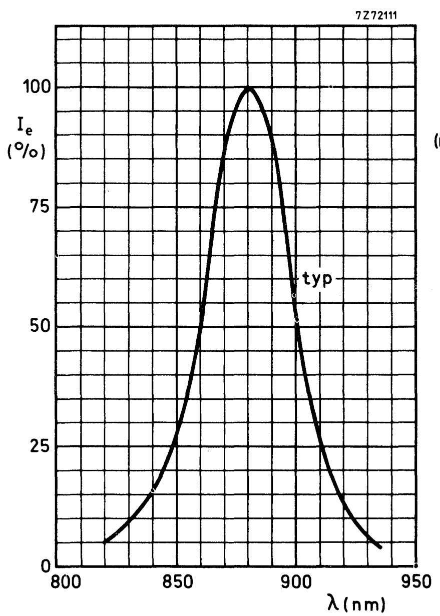


Fig. 8.

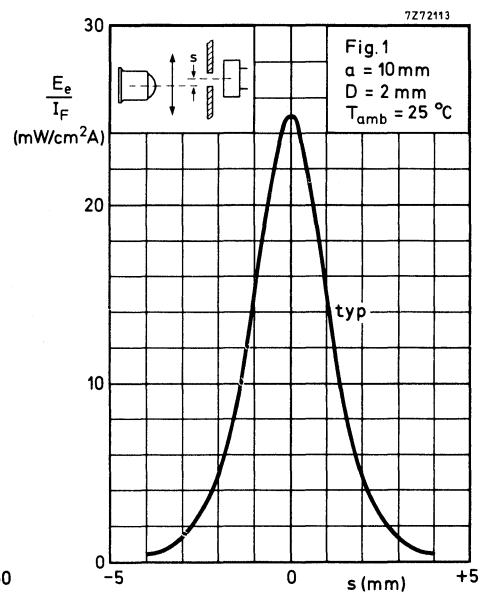


Fig. 9.

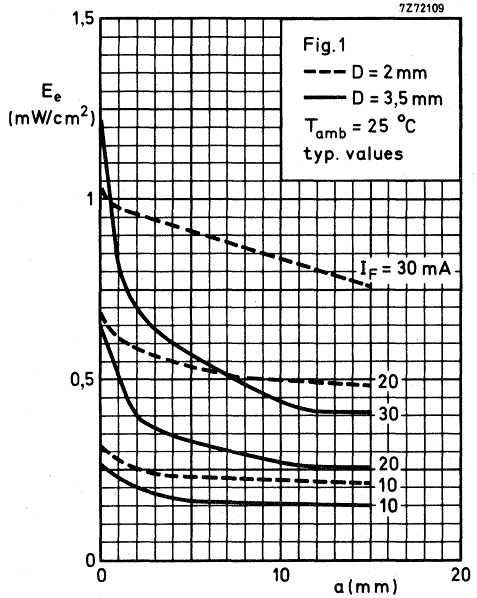

7Z72109
1,5
E_e
(mW/cm^2)
1
0,5
0
Fig.1
D = 2 mm
D = 3,5 mm
T_{amb} = 25 °C
typ. values
I_F = 30 mA
20
30
20
10
10
0
10
20
a (mm)

Fig. 10.

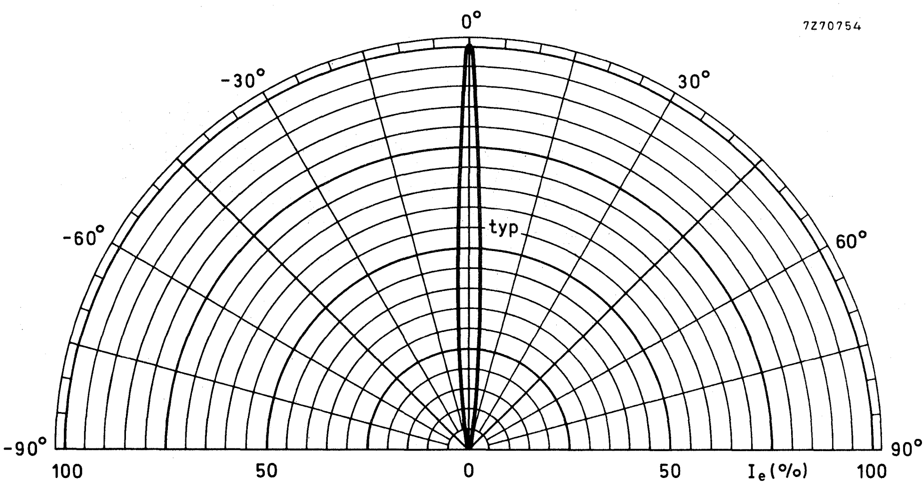

0°
7Z70754
-30°
30°
-60°
60°
typ
-90°
90°
100
50
0
50
I_e (%)
100

Fig. 11.

GaAs LIGHT EMITTING DIODES

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

QUICK REFERENCE DATA

Continuous reverse voltage		V_R	max.	5	V
Forward current (d.c.)		I_F	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	150	mW
Radiant intensity (on-axis) at I_F = 50 mA	CQY49B	I_e	max.	0,3	mW/sr
	CQY49C	I_e	max.	3	mW/sr
Wavelength at peak emission		λ_p	typ.	930	nm
Thermal resistance from junction to ambient		$R_{th\ j\text{-}a}$	=	0,665	K/mW

MECHANICAL DATA

Dimensions in mm

Fig. 1 CQY49B: TO-18 except for window.

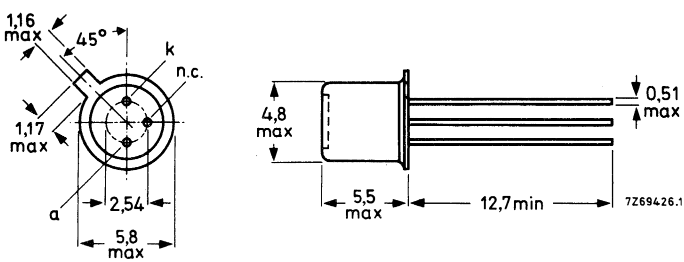
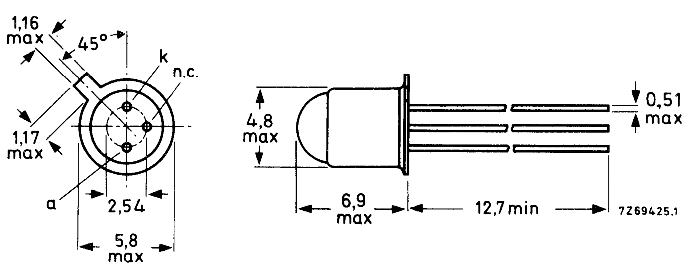


Fig. 1b CQY49C: TO-18 except for lens.



RATINGS

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

Continuous reverse voltage	V_R	max.	5	V
Forward current (d.c.)	I_F	max.	100	mA
Forward current (peak value) $t_p < 10\ \mu s$; $\delta < 0{,}01$	I_{FRM}	max.	1	A
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	150	mW
Storage temperature	T_{stg}		−55 to +100	^oC
Operating junction temperature	T_j	max.	125	^oC
Lead soldering temperature $> 1{,}5$ mm from the body; $t_{sld} < 10$ s	T_{sld}	max.	260	^oC

THERMAL RESISTANCE

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

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

			CQY49B	CQY49C	
Forward voltage at $I_F = 50$ mA	V_F	typ.	1,3		V
		max.	1,5		V
Reverse current at $V_R = 5$ V	I_R	max.	100		μA
Diode capacitance $V_R = 0$; f = 1 MHz	C_d	typ.	55		pF
Radiant intensity (on-axis) at $I_F = 50$ mA	I_e	min.	0,3	3	mW/sr
		typ.	0,5	5	mW/sr
Wavelength at peak emission	λ_p	typ.	930		nm
Bandwidth at half height	$\Delta\lambda$	typ.	50		nm
Beamwidth between half-intensity directions	$\theta_{½}$	typ.	80°	15°	
Switching times $I_{Fon} = 50$ mA; $t_p = 2\ \mu s$; f = 45 kHz					
Rise time	t_r	typ.	600		ns
Fall time	t_f	typ.	350		ns

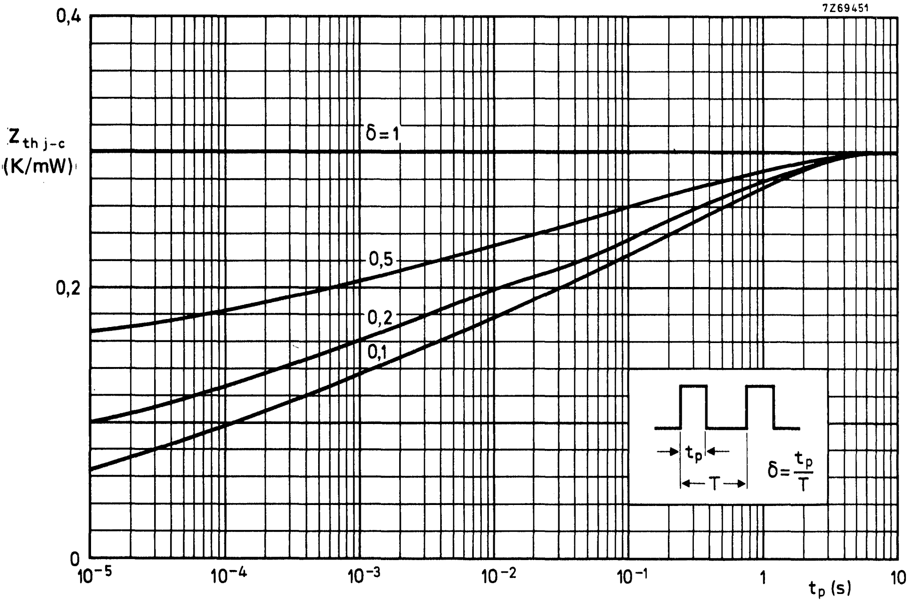


Fig. 2 Typical values.

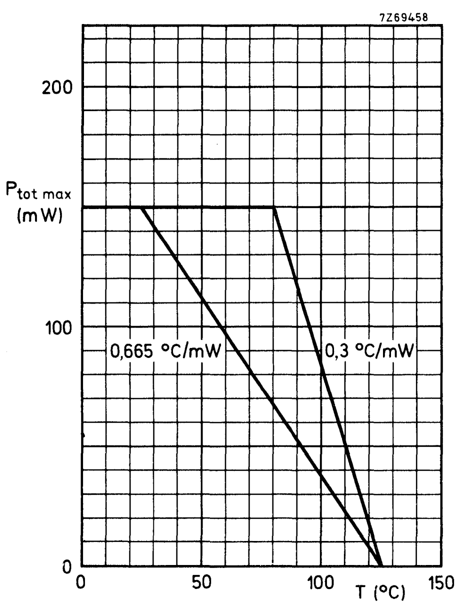


Fig. 3.

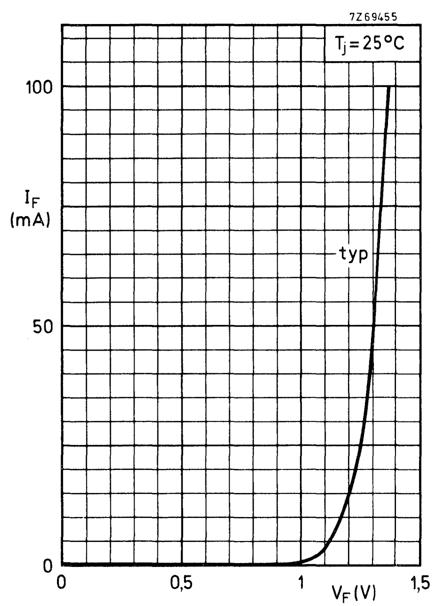


Fig. 4.

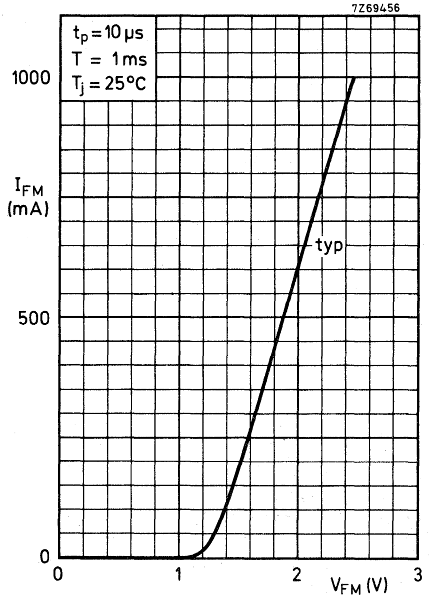


Fig. 5.

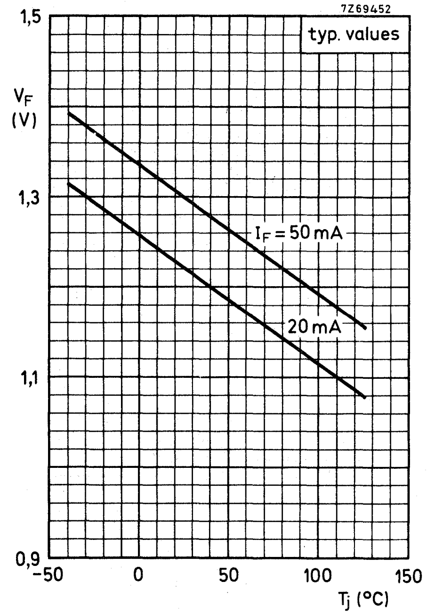


Fig. 6.

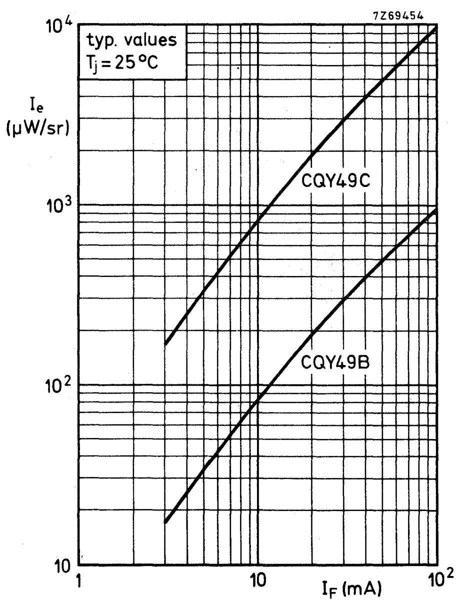


Fig. 7.

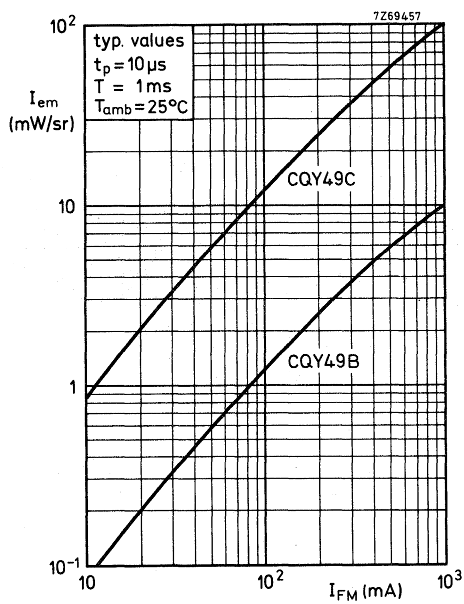


Fig. 8.

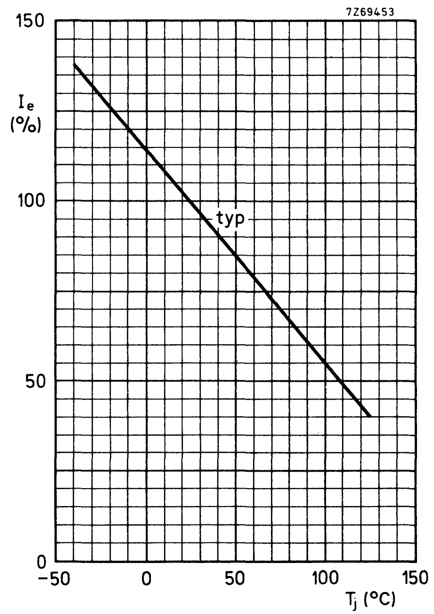


Fig. 9.

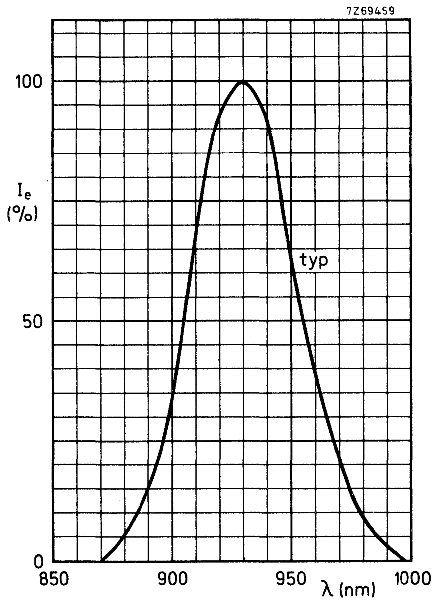


Fig. 10.

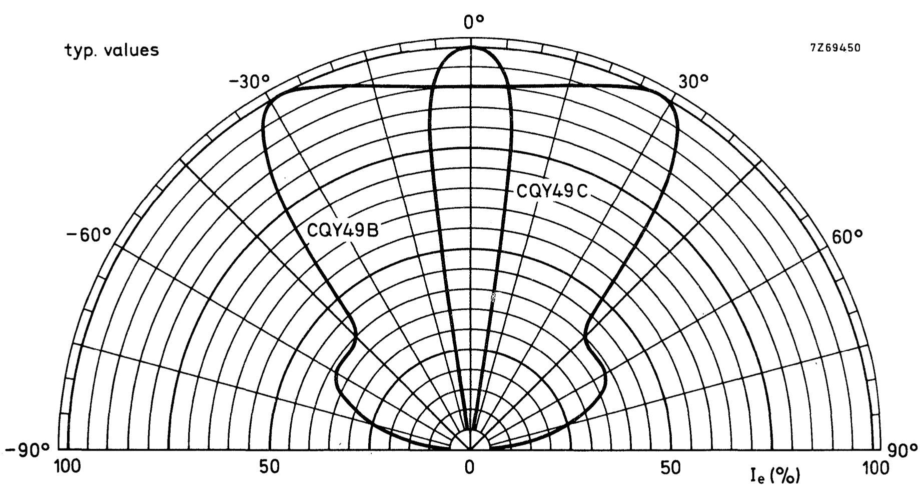


Fig. 11.

GaAs LIGHT EMITTING DIODE

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

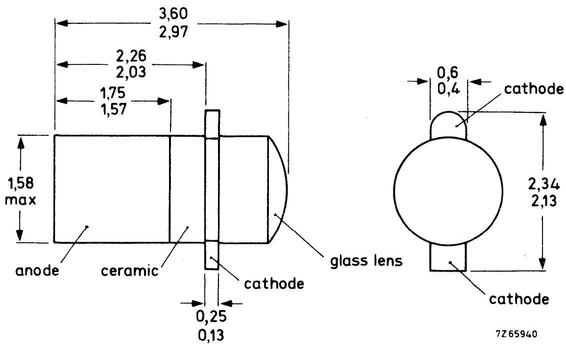
QUICK REFERENCE DATA

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

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-31, except for length.



RATINGS

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

Continuous reverse voltage	V_R	max.	2	V
Forward current (d.c.)	I_F	max.	100	mA
Forward current (peak value) $t_p = 10\ \mu s$; $\delta = 0,01$	I_{FRM}	max.	500	mA
Storage temperature	T_{stg}		−65 to +150	^oC
Operating junction temperature	T_j	max.	125	^oC
Total power dissipation up to $T_{amb} = 25\ ^oC$ device mounted on printed circuit board *	P_{tot}	max.	150	mW

THERMAL RESISTANCE

From junction to ambient, device mounted on printed circuit board *	$R_{th\ j\text{-}a}$	=	0,66	K/mW

CHARACTERISTICS

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

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

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

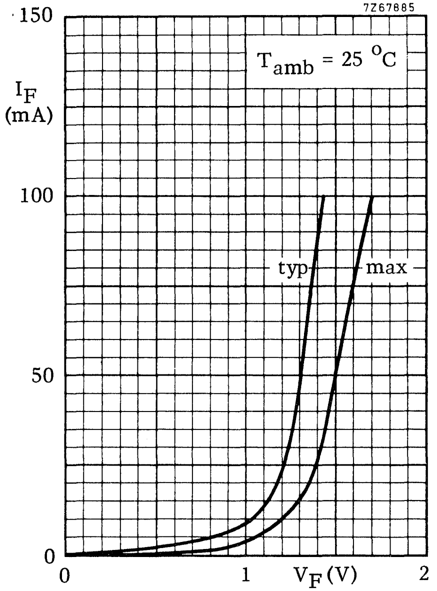


Fig. 2.

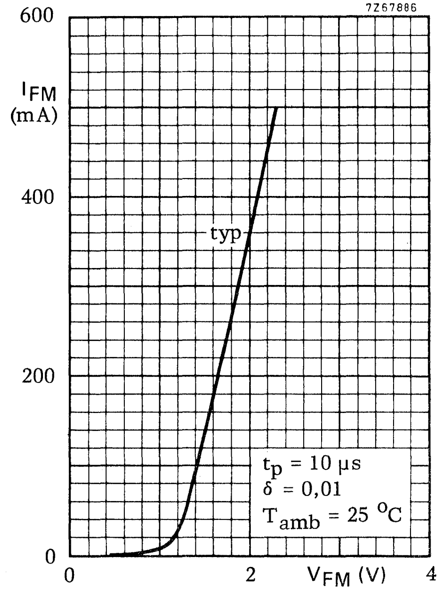


Fig. 3.

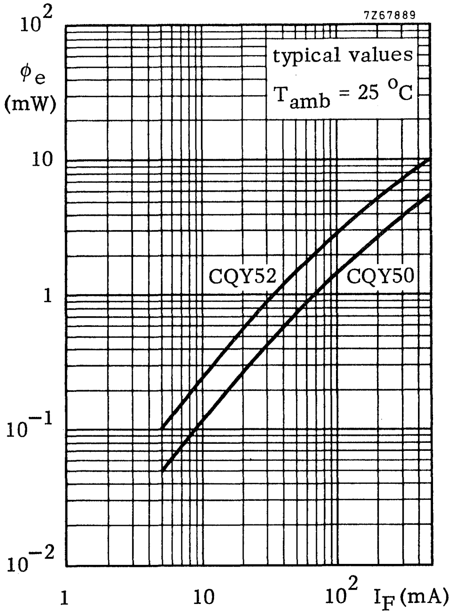


Fig. 4.

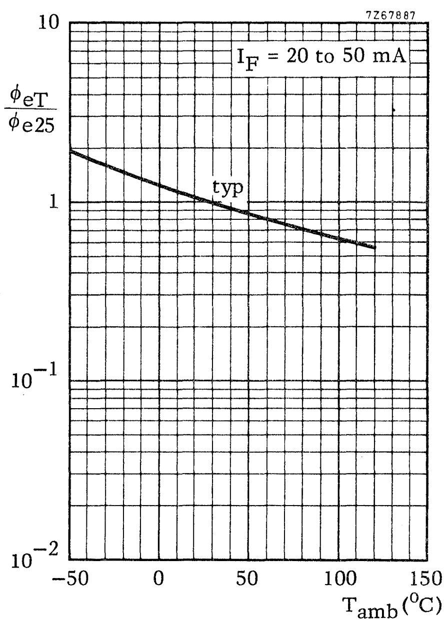


Fig. 5.

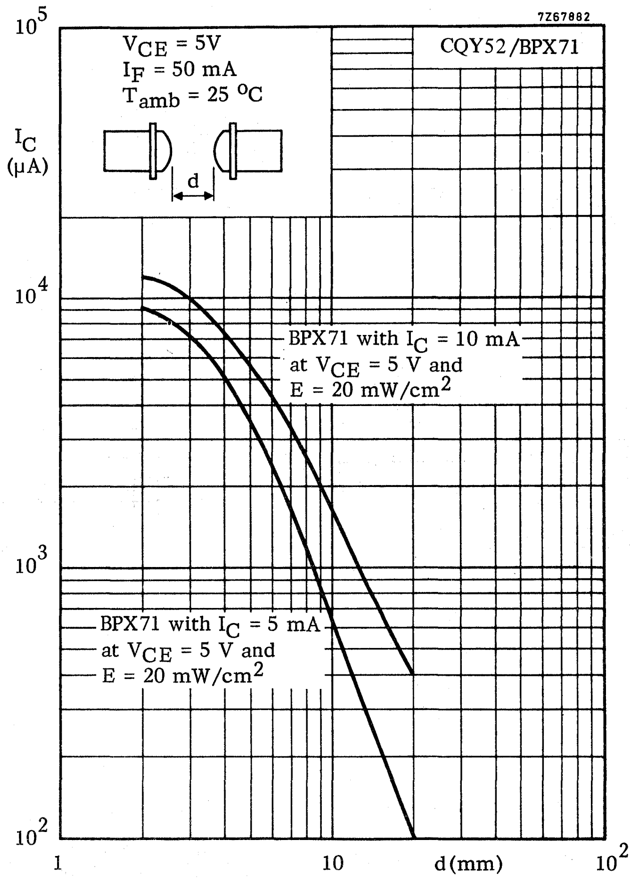


Fig. 6 Typical values.

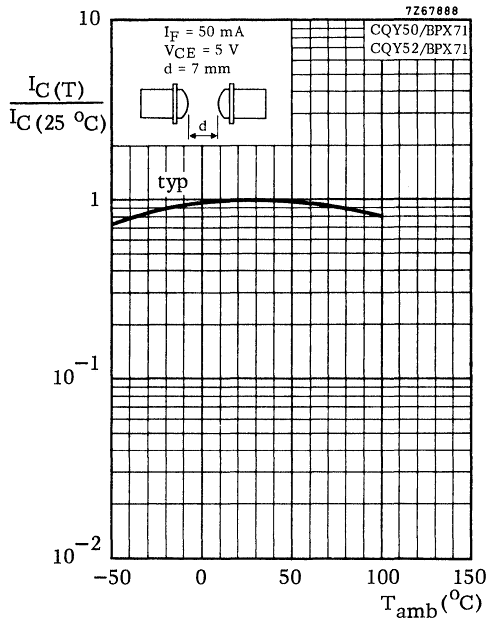


Fig. 7.

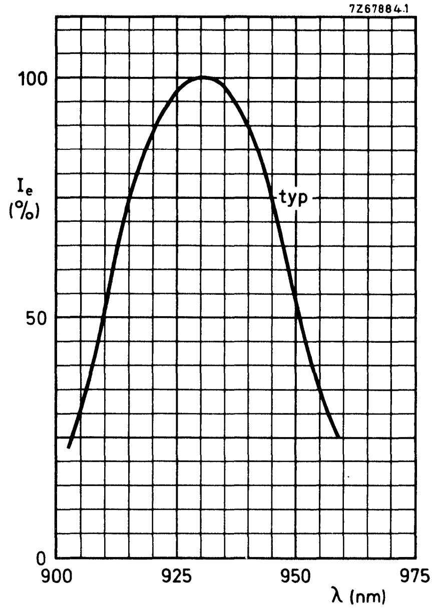


Fig. 8.

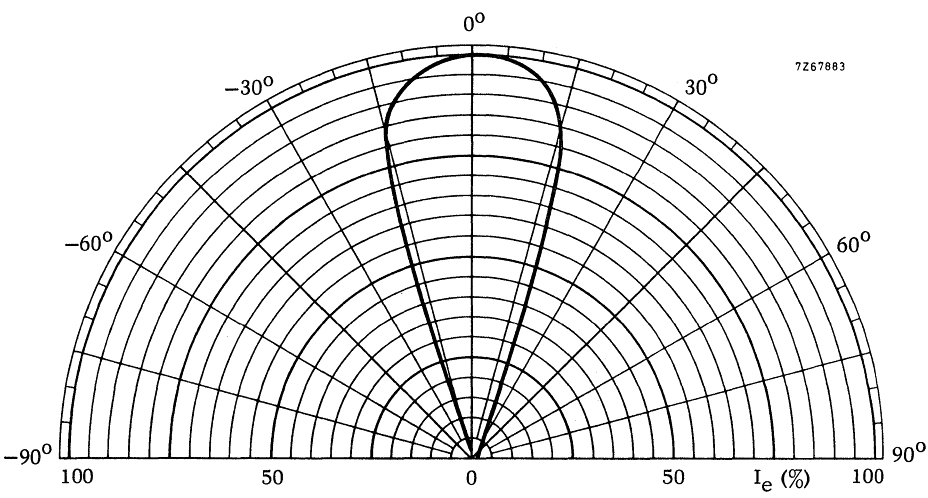


Fig. 9 Typical values.

LIGHT EMITTING DIODE

Circular light emitting diode with diameter of 6 mm which emits visible red light at a maximum peak wavelength of 690 nm (GaPAs; red) when forward biased.

The CQY53S has an FO-81 outline with a clear plastic lens.

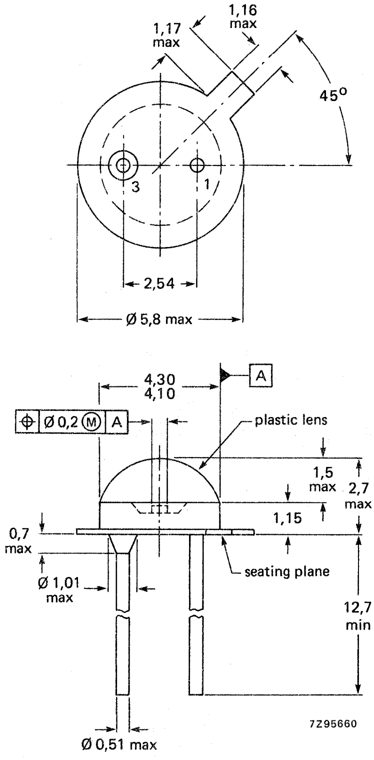
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	3	V
Forward current (d.c.)	I_F	max.	50	mA
Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	125	mW
Junction temperature	T_j	max.	85	°C
Luminous intensity I_F = 10 mA	I_v	min.	400	μcd
Wavelength at peak emission	λ_p	max.	690	nm
Beamwidth at half-intensity directions	$\theta_{1/2}$	min.	90	°

MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-81.



1 : anode
3 : cathode (connected to case)

RATINGS

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

Continuous reverse voltage	V_R	max.	3 V
Forward current (d.c.)	I_F	max.	50 mA
Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	125 mW
Storage temperature	T_{stg}		−40 to +100 °C
Junction temperature	T_j	max.	85 °C
Lead soldering temperature t_{sld} < 7 s	T_{sld}	max.	260 °C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	max.	320 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage I_F = 10 mA	V_F	min.	1,4 V
		typ.	1,8 V
Reverse current V_R = 3 V	I_R	max.	100 μA
Luminous intensity I_F = 10 mA	I_v	min.	400 μcd
		max.	1000 μcd
Wavelength at peak emission	λ_p	min.	630 nm
		max.	690 nm
Bandwidth at half height	$\Delta\lambda$	typ.	20 nm
		max.	40 nm
Beamwidth at half-intensity directions	$\theta_{½}$	min.	90 °

DEVELOPMENT DATA

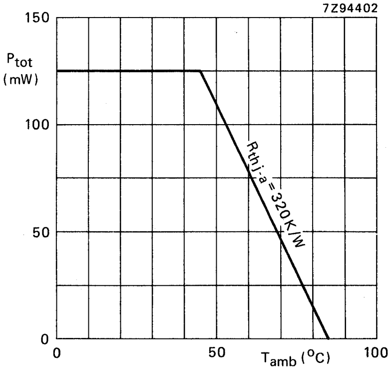


Fig. 2.

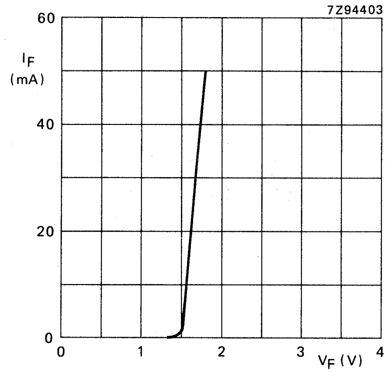


Fig. 3 Typical values.

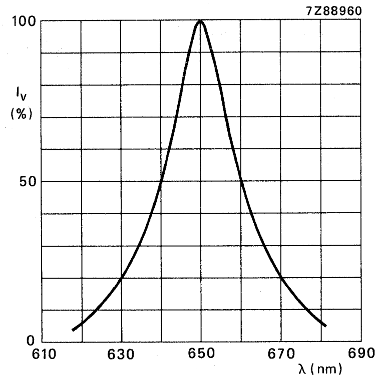


Fig. 4 Typical values.

INFRARED EMITTING DIODE

Diffused planar light emitting diode intended for optical coupling and encoding. It emits radiation in the near infrared when forward biased. Infrared translucent epoxy encapsulation (dark blue). Combination with phototransistor BPW22A is recommended.

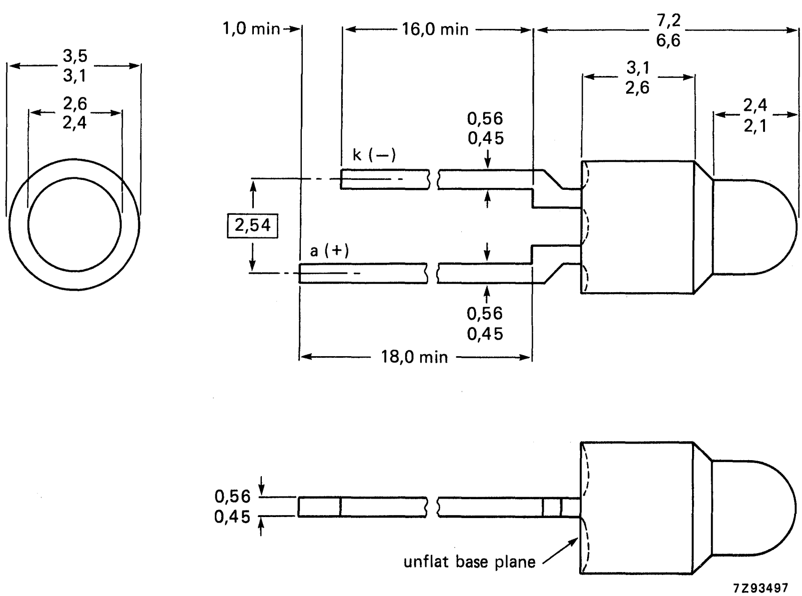
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	5	V
Forward current (d.c.)	I_F	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100	mW
Radiant intensity (on-axis) at I_F = 20 mA	I_e	typ.	2	mW/sr
Wavelength at peak emission	λ_p	typ.	930	nm
Beamwidth between half-intensity directions	$\theta_{1/2}$	typ.	20	°

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-53F.



RATINGS

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

Continuous reverse voltage	V_R	max.	5	V
Forward current				
d.c.	I_F	max.	50	mA
(peak value); t_p = 10 μs; δ = 0,01	I_{FRM}	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C (see Fig. 2)	P_{tot}	max.	100	mW
Storage temperature	T_{stg}	−55 to +	100	°C
Junction temperature	T_j	max.	100	°C
Lead soldering temperature				
→ > 1,5 mm from the seating plane; t_{sld} < 7 s	T_{sld}	max.	260	°C

THERMAL RESISTANCE

From junction to ambient, → device mounted on a printed-circuit board	$R_{th\,j\text{-}a}$	=	750	K/W

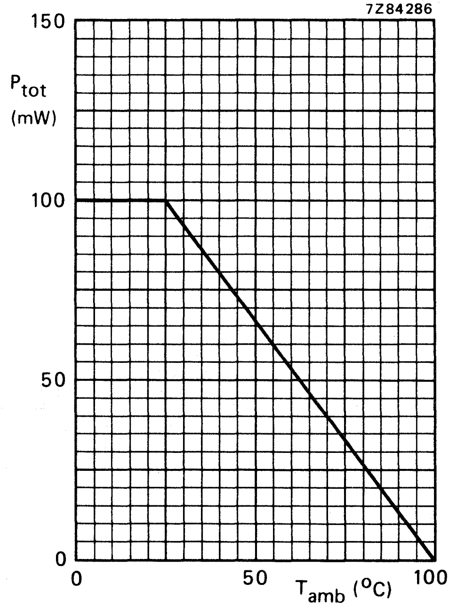


Fig. 2 Power derating curve versus ambient temperature.

CHARACTERISTICS

T_j = 25 °C

Forward voltage I_F = 20 mA		V_F	typ. max.	1,2 V 1,5 V
Reverse current V_R = 5 V		I_R	max.	100 μA
Diode capacitance V_R = 0; f = 1 MHz		C_d	typ.	40 pF
Total radiant power I_F = 20 mA	**CQY58A**	ϕ_e I_e	typ. min.	1 mW 2 mW/sr
Radiant intensity (on-axis) I_F = 20 mA	**CQY58A-1**	I_e	min. max.	1 mW/sr 5 mW/sr
	CQY58A-2	I_e	min.	3 mW/sr
Wavelength at peak emission		λ_p	typ.	930 nm
Bandwidth at half height		$\Delta\lambda$	typ.	50 nm
Beamwidth between half-intensity directions I_F = 20 mA		$\theta_{1/2}$	typ.	20 °
Switching times I_{Fon} = 20 mA				
Light rise time		t_r	typ.	3 μs
Light fall time		t_f	typ.	3 μs

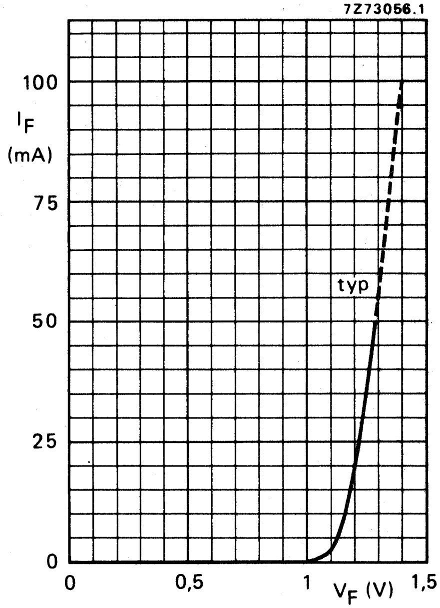


Fig. 3 T_{amb} = 25 °C.

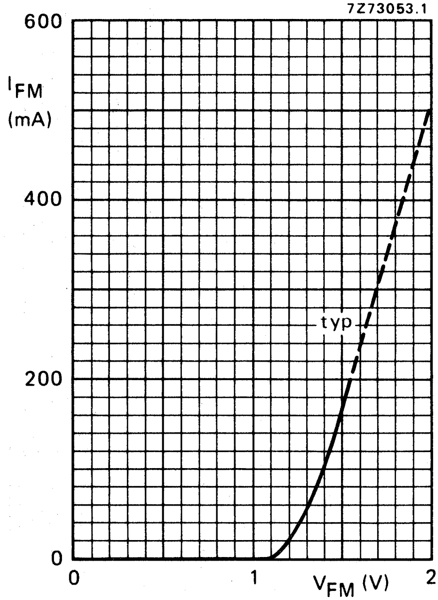


Fig. 4 t_p = 10 μs; T = 1 ms; T_{amb} = 25 °C.

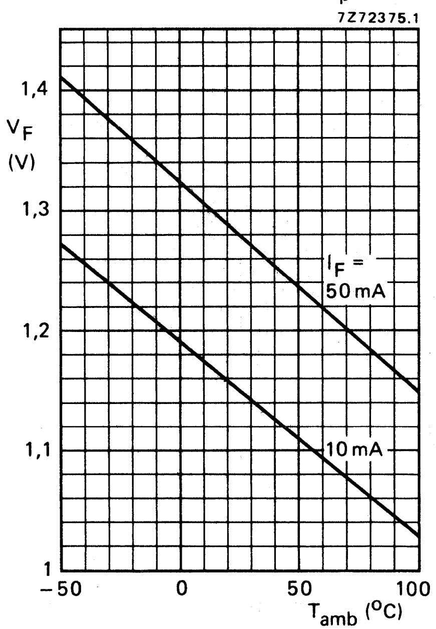


Fig. 5 Typical values.

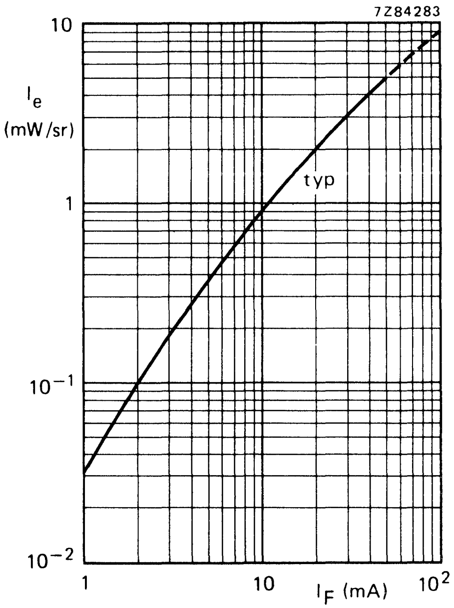


Fig. 6 T_{amb} = 25 °C.

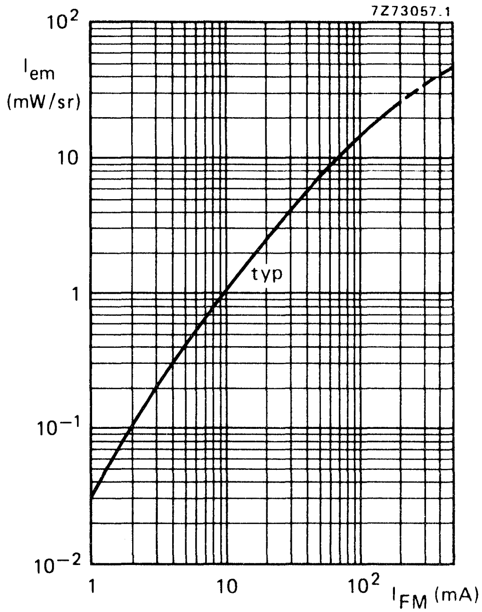


Fig. 7 t_p = 10 μs; T = 1 ms; T_{amb} = 25 °C.

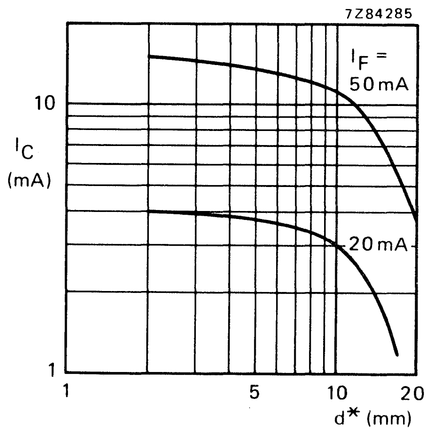


Fig. 8 V_{CE} = 5 V; T_{amb} = 25 °C; typical values.

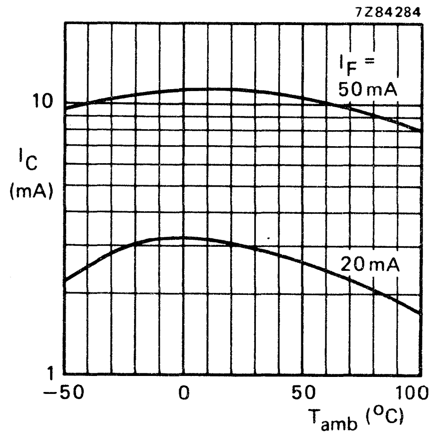


Fig. 9 V_{CE} = 5 V; d* = 10 mm; typical values.

* d = shortest free distance of mechanical on-axis when BPW22A is coupled with CQY58A.

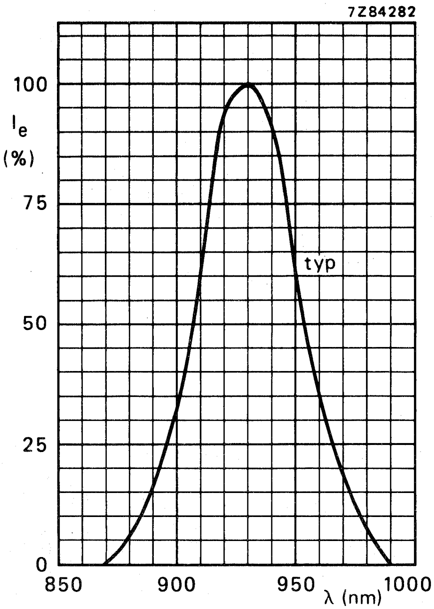


Fig. 10 Spectral response.

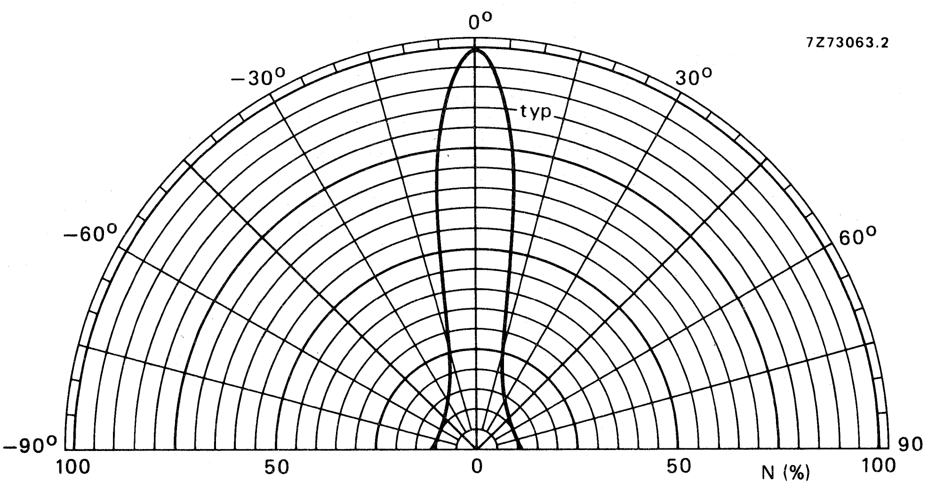


Fig. 11 Typical values.

GaAs LIGHT EMITTING DIODE

Epitaxial gallium arsenide light emitting diode intended for remote-control applications. It emits radiation in the near infrared when forward biased. Infrared translucent epoxy encapsulation (dark blue).

Combination with the photo p-i-n diode BPW50 is recommended.

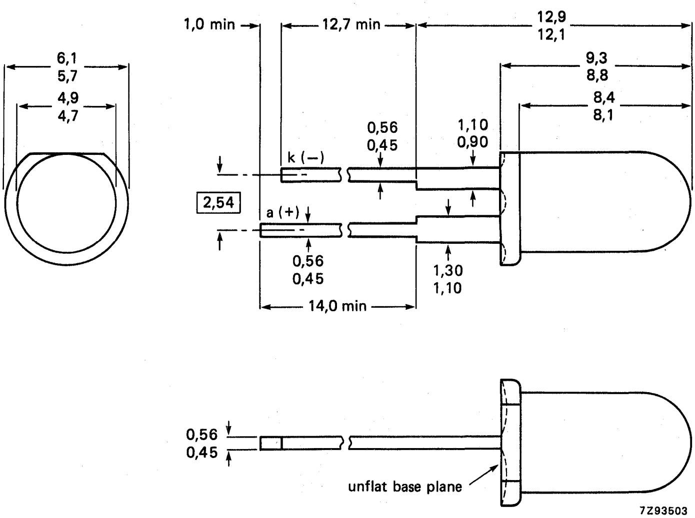
QUICK REFERENCE DATA

Continuous reverse voltage		V_R	max.	5	V
Forward current (d.c.)		I_F	max.	130	mA
Total power dissipation up to T_{amb} = 25 °C		P_{tot}	max.	215	mW
Junction temperature		T_j	max.	100	°C
Radiant intensity (on-axis)					
static (at d.c. condition)					
I_F = 100 mA	CQY89A	I_e	min.	9	mW/sr
	CQY89A-1	I_e	min.	12	mW/sr
	CQY89A-2	I_e	min.	15	mW/sr
dynamic (at pulse condition)					
I_{FM} = 100 mA; t_p = 0,5 μs; δ = 0,5		I_{eD}	typ.	0,3	I_e
Wavelength at peak emission		λ_p	typ.	930	nm

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-63B2.



RATINGS

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

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

THERMAL RESISTANCE

From junction to ambient mounted on a printed-circuit board	$R_{th\ j\text{-}a}$	=	350	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Forward voltage $I_F = 100$ mA		V_F	typ.	1,4	V
			<	1,6	V
$I_{FM} = 1500$ mA; $t_p = 20\ \mu s$; $\delta = 0{,}033$		V_{FM}	typ.	2,4	V
Reverse current $V_R = 5$ V		I_R	<	100	μA
Diode capacitance $V_R = 0$; f = 1 MHz		C_d	typ.	40	pF
Total radiant power $I_F = 100$ mA		ϕ_e	>	7	mW
			typ.	12	mW
Decrease of radiant power with temperature $I_F = 100$ mA		$\frac{\Delta\phi_e}{\Delta T_j}$	typ.	1	%/K
Radiant intensity (on-axis) static (at d.c. condition) $I_F = 100$ mA	CQY89A	I_e	min.	9	mW/sr
	CQY89A-1	I_e	min.	12	mW/sr
	CQY89A-2	I_e	min.	15	mW/sr
dynamic (at pulse condition)* $I_{FM} = 100$ mA; $t_p = 0{,}5\ \mu s$; $\delta = 0{,}5$		I_{eD}	typ.	0,3	I_e

* I_{eD} = Dynamic radiant intensity (average radiant intensity level during pulse time).

Wavelength at peak emission I_F = 100 mA	λ_p	typ.	930 nm
Bandwidth at half height I_F = 100 mA	$\Delta\lambda$	typ.	50 nm
Beamwidth between half-intensity directions I_F = 100 mA	$\theta_{½}$	typ.	40 °

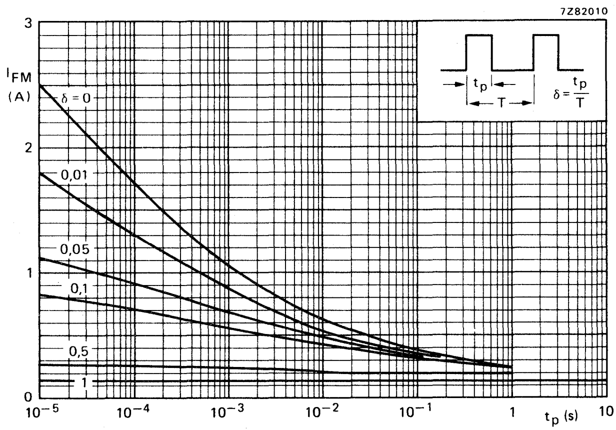


Fig. 2 T_{amb} = 25 °C; $T_{j\ peak}$ = 100 °C.

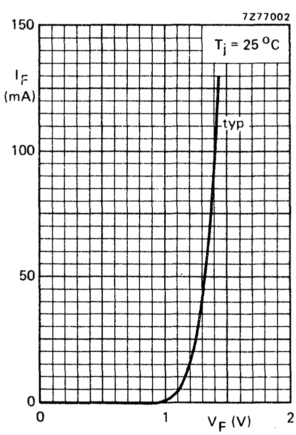


Fig. 3.

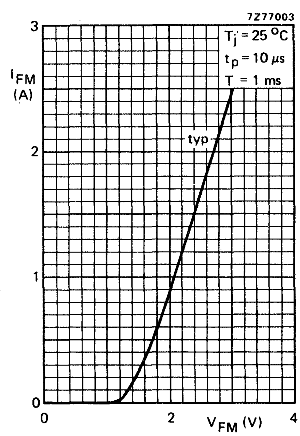


Fig. 4.

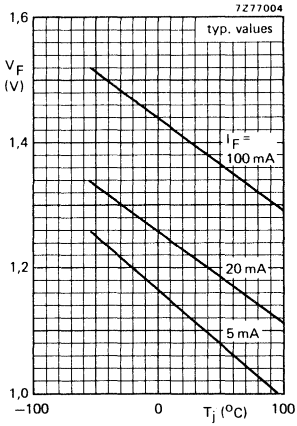


Fig. 5.

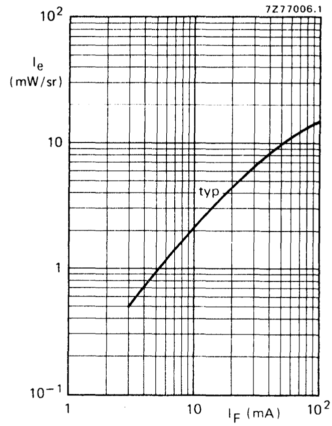


Fig. 6 T_j = 25 °C.

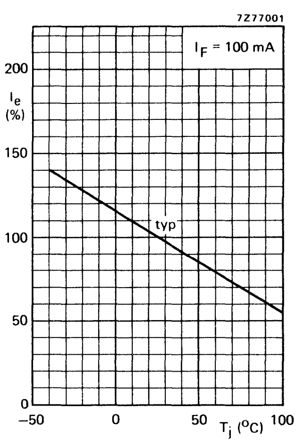


Fig. 7.

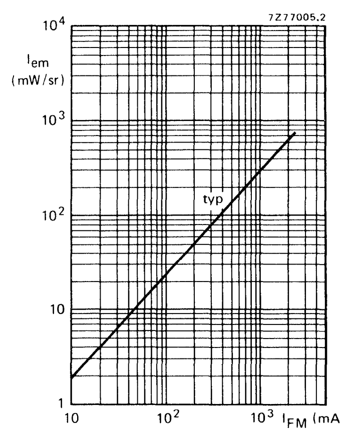


Fig. 8 T_{amb} = 25 °C; t_p = 10 μs; T = 1 ms.

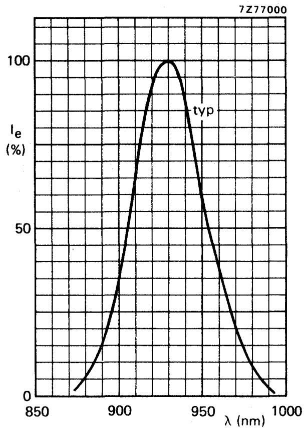

7Z77000
100
I_e
(%)
50
0
850
900
950
1000
λ (nm)
typ

Fig. 9.

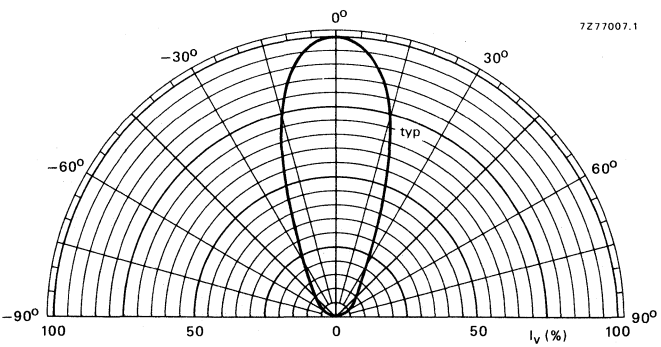

0°
7Z77007.1
−30°
30°
−60°
60°
−90°
90°
typ
100
50
0
50
I_v (%)
100

Fig. 10.

SECTION C1

Laser and fibre-optic components

SAFE OPERATION AND HANDLING OF LASER-DIODES

In the past, semiconductor laser-diodes have always been regarded as some of the more expensive semiconductor components. High cost restricted their use to professional and military applications, and even the use of laser-diodes in fibre-optic communications didn't lead to the expected price reduction. It has been the demand for laser diodes in compact disc players and Laservision systems that has stimulated large scale production with the result that these devices are readily available at low cost. Consequently, new applications, which were not previously economically worthwhile (such as bar code readers, distance and speed measurements etc.), are continually evolving and more companies than ever before are dealing with lasers for the first time. For all applications, the laser beam must be collimated and properly focused. It is therefore necessary to emphasise the dangers involved and the special requirements for handling lasers.

HANDLING RECOMMENDATIONS

Our laser-diodes are high quality devices. Handled correctly they are very reliable:

- Laser-diodes are extremely sensitive to electrostatic discharges. Always short-circuit the anode to the cathode when the diode is not in use. In addition, we recommend that persons handling the laser should be earthed, as well as their tools.
- Keep the laser-diode clean, both in use and in storage. This is particularly important for the light-emitting aperture.

OPERATING RECOMMENDATIONS

Once connected into the circuit, a laser diode can be damaged by:

- Transient current pulses and excessive currents. Electrically, the laser-diode is a reliable device and can tolerate substantial current surges, but optically, it is more easily damaged because of the extremely high flux passing through both facets, while in operation. To prevent gradual or instantaneous damage, the laser should be carefully controlled when it is switched on and off. You should also ensure that peak and mean power supply levels, radiant flux and forward current do not exceed the maximum ratings.
- High temperatures, which reduce device reliability and shorten lifetimes. We recommend using a heatsink and, as mentioned previously, carefully controlling the power supply. We also suggest you operate the laser-diode at the lowest temperature possible.

SAFETY RECOMMENDATIONS

The light from a semiconductor laser has a number of potential health risks associated with it. Because of material constraints, the light produced usually has a wavelength in the invisible infrared region that is of sufficient intensity to damage the retina. So take care to avoid looking directly at the light close to the source, especially with collimated beams, and avoid the optical axis at greater distances. You should also ensure there are no surfaces which can accidentally reflect the light. All laser-diode packages carry a warning label and the diodes fall within safety class 3B of the international standard code.

SILICON PHOTODIODE FOR FIBRE-OPTIC COMMUNICATIONS

Photo p-i-n diode in hermetic TO-46 encapsulation, designed for fibre-optic transmissions over short and medium distances, mainly for military and industrial applications.

It is optimized to be coupled with a 200 μm core diameter fibre and to be used in combination with the CQF24 emitter.

The crystal is electrically isolated from the case.

QUICK REFERENCE DATA

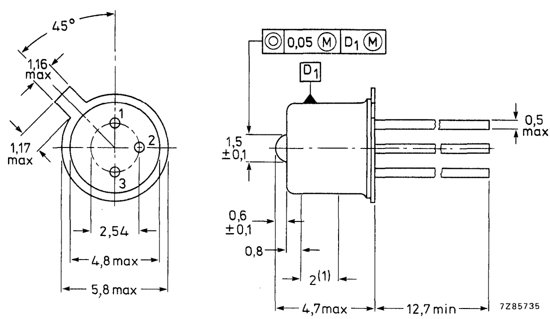
Continuous reverse voltage	V_R	max.	50 V
Dark reverse current at V_R = 15 V	$I_{R(D)}$	max.	0,8 nA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100 mW
Diode capacitance at V_R = 15 V	C_d	max.	2,5 pF
Spectral sensitivity at V_R = 15 V; λ = 850 nm	s_λ	min.	0,4 A/W

MECHANICAL DATA

Dimensions in mm

Fig. 1.

Pinning:
1 = anode
2 = cathode
3 = case



(1) Case diameter over this length is 4,7 (+ 0,05; −0,1) mm.

RATINGS

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

→ Continuous reverse voltage	V_R	max.	50	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	100	mW
Junction temperature	T_j	max.	150	°C
Operating temperature	T_{op}	−55 to + 125		°C
Storage temperature	T_{stg}	−65 to + 150		°C

THERMAL RESISTANCE

From junction to ambient when the device is mounted on a printed circuit	$R_{th\ j\text{-}a}$	typ.	400	K/W
		max.	500	K/W
From junction to case	$R_{th\ j\text{-}c}$	typ.	100	K/W
		max.	150	K/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Dark reverse current at V_R = 15 V	$I_{R(D)}$	max.	0,8	nA
Spectral sensitivity at V_R = 15 V; λ = 850 nm	s_λ	min.	0,4	A/W
		typ.	0,55	A/W
Wavelength at peak response	λ_p	typ.	850	nm
Diode capacitance at V_R = 10 V	C_d	typ.	1,5	pF
		max.	2,5	pF
Switching times at V_R = 10 V; R_L = 50 Ω (10%-90%)	t_r	max.	4	ns
	t_f	max.	4	ns

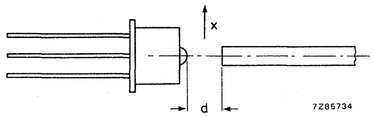


Fig. 2 Distance d and lateral displacement x.

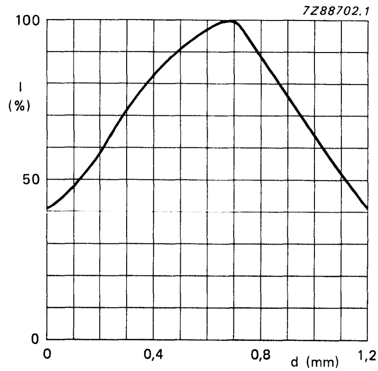


Fig. 3.

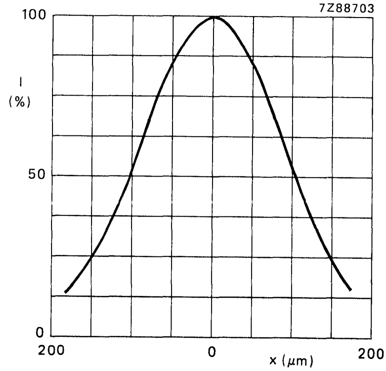


Fig. 4.

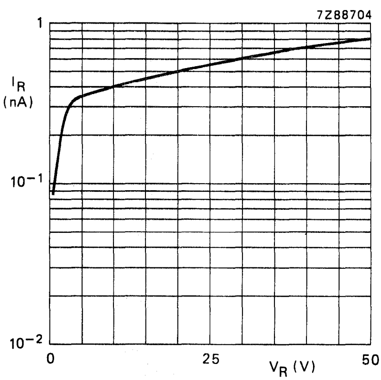


Fig. 5 T_{amb} = 25 °C.

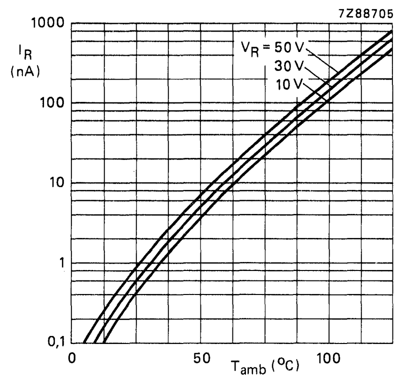


Fig. 6.

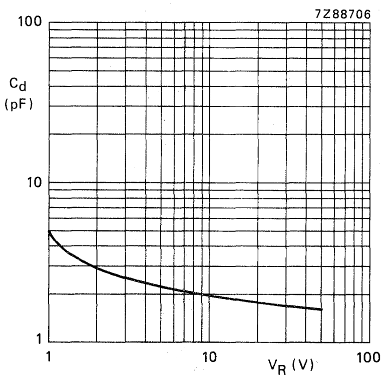


Fig. 7 f = 1 MHz; T_{amb} = 25 °C.

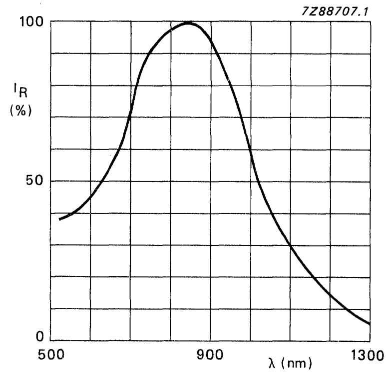


Fig. 8 V_R = 10 V; T_{amb} = 25 °C.

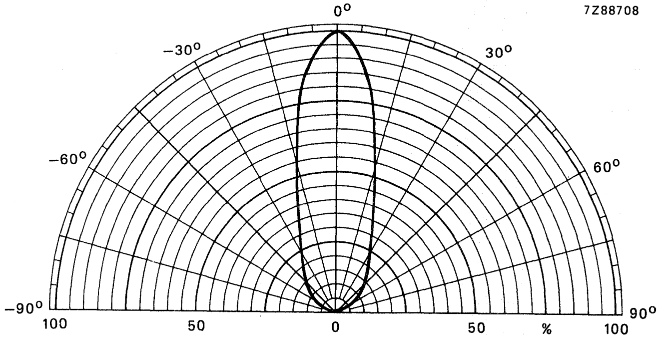


Fig. 9.

GaAlAs LIGHT EMITTING DIODE

Infrared light emitting diode in hermetic TO-46 encapsulation, designed for fibre-optic transmissions over short and medium distances, mainly for military and industrial applications.

It is optimized to be coupled with a 200 μm core diameter fibre and to be used in combination with the BPF24 receiver.

The crystal is electrically isolated from the case.

QUICK REFERENCE DATA

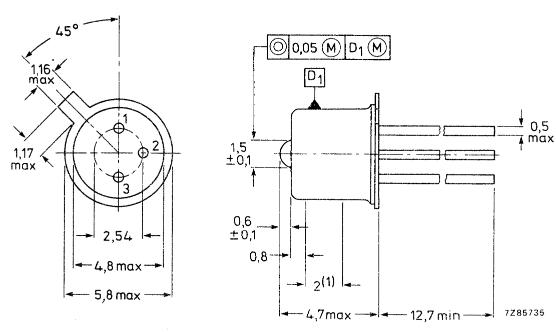
Continuous reverse voltage	V_R	max.	3 V
Forward current (d.c.)	I_F	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	250 mW
Optical power coupled into fibre (ϕ core = 200 μm and NA = 0,2) at I_F = 100 mA	ϕ_e	min.	200 μW
Switching times at I_F = 100 mA	t_r	typ.	10 ns
	t_f	typ.	10 ns
Wavelength at peak emission	λ_p	typ.	850 nm

MECHANICAL DATA

Dimensions in mm

Fig. 1.

Pinning:
1 = anode
2 = cathode
3 = case



(1) Case diameter over this length is 4,7 (+ 0,05; –0,1) mm.

RATINGS

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

Continuous reverse voltage	V_R	max.	3	V
Forward current	I_F	max.	100	mA
Forward current (peak) $t = 10\ \mu s$; $\delta = 0,1$	I_{FM}	max.	300	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$ device mounted on a printed circuit	P_{tot}	max.	250	mW
Junction temperature	T_j	max.	150	^oC
Operating temperature	T_{op}		−55 to +125	^oC
Storage temperature	T_{stg}		−65 to +150	^oC

THERMAL RESISTANCE

From junction to ambient when the device is mounted on a printed circuit	$R_{th\ j\text{-}a}$	typ.	400	K/W
		max.	500	K/W
From junction to case	$R_{th\ j\text{-}c}$	typ.	100	K/W
		max.	150	K/W

CHARACTERISTICS

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

Forward voltage at $I_F = 100$ mA	V_F	typ.	1,9	V
		max.	2,5	V
Reverse current at $V_R = 3$ V	I_R	max.	100	μA
Radiant power coupled into fibre at $I_F = 100$ mA; ϕ core = 200 μm, NA = 0,2 (see notes 1 and 2)	ϕ_e	min.	200	μW
		typ.	400	μW
Radiant intensity at $I_F = 100$ mA	I_e	min.	5	mW/sr
→ Wavelength at peak emission	λ_p	min.	820	nm
		typ.	850	nm
		max.	880	nm
Spectral width at half height	$\Delta\lambda$	typ.	40	nm
Switching times at $I_{Fon} = 100$ mA	t_r	typ.	10	ns
		max.	15	ns
	t_f	typ.	10	ns
		max.	15	ns

NOTES

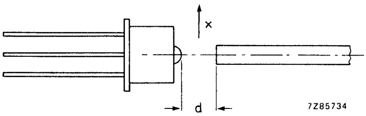


Fig. 2 Distance d and lateral displacement x.

1. For this measurement the device is shifted along its 3 axes, so that the maximum power is coupled into the fibre.

   If the device is adjusted in front of the geometrical axis of the same fibre with distance d = 0,7 mm, P_{min} = 100 μW.

2. For a different core diameter $\phi_x \leqslant 200\ \mu m$: $\dfrac{P_{inj(x)}}{P_{inj(200)}} = \left(\dfrac{\phi_x}{200}\right)^2$

   For a different numerical aperture $NA_x \leqslant 0{,}2$: $\dfrac{P_{inj(x)}}{P_{inj(0,2)}} = \left(\dfrac{NA_x}{0{,}2}\right)^2$

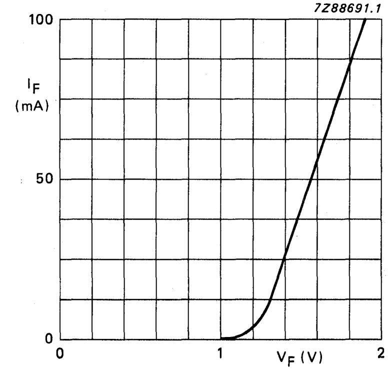


Fig. 3 T_{amb} = 25 °C.

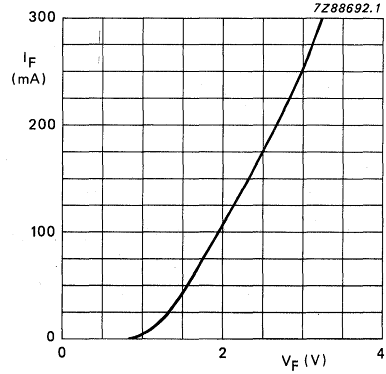


Fig. 4 T_{amb} = 25 °C; T_{on} = 10 μs; δ = 0,1.

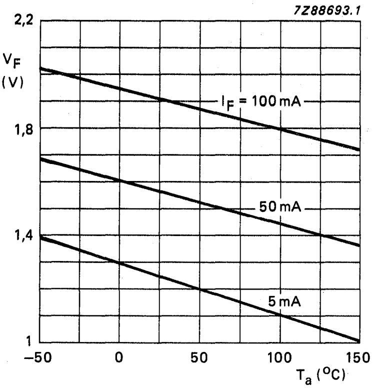


Fig. 5.

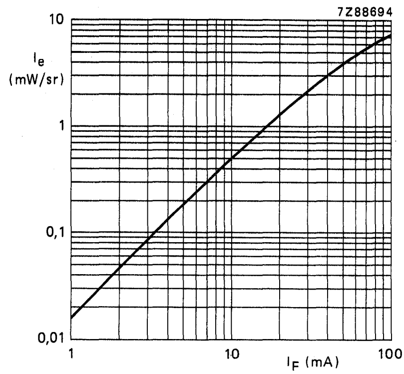


Fig. 6 T_{amb} = 25 °C.

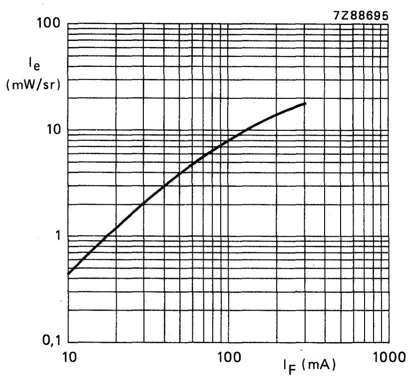


Fig. 7 T_{amb} = 25 °C; T_{on} = 10 μs; δ = 0,01.

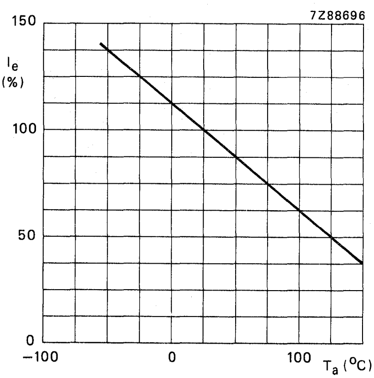


Fig. 8.

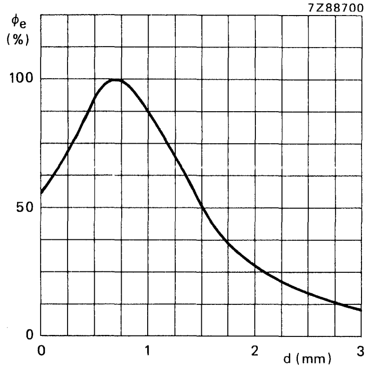


Fig. 9 See notes 1 and 2.

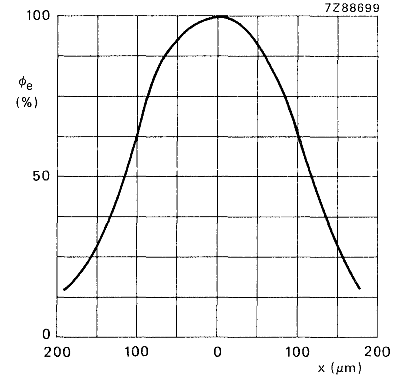


Fig. 10 Distance d = 700 μm.
See notes 1 and 2.

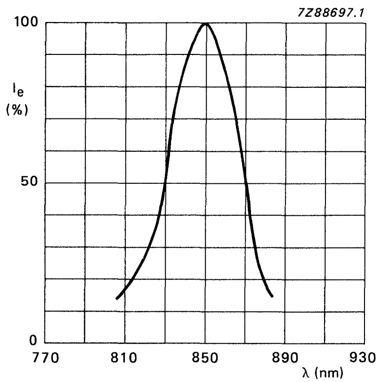


Fig. 11 I_F = 100 mA; T_{amb} = 25 ^oC.

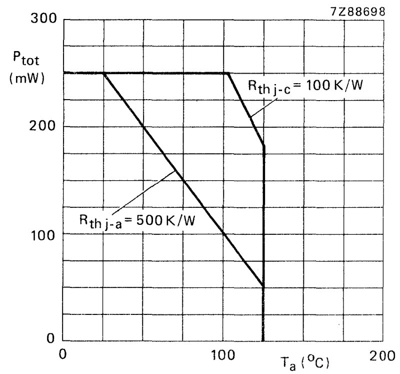


Fig. 12.

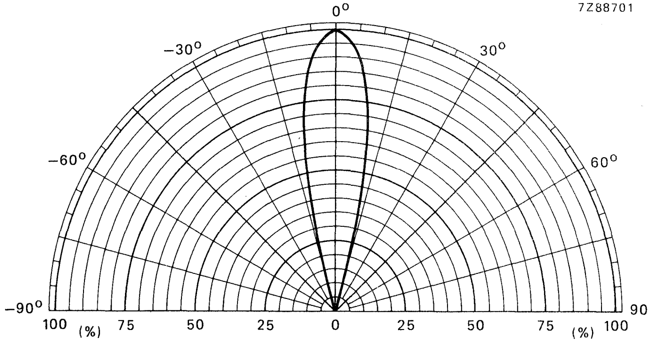


Fig. 13.

DOUBLE HETEROSTRUCTURE AlGaAs LASER

The CQL10A is designed for reading applications such as: video-audio disc applications, optical memories, security systems, etc.

This device is mounted in an hermetic SOT-148 encapsulation specifically designed for easy alignment in an optical read or write system. The copper heatsink is circular and precision engineered with a diameter accuracy of +0, −9 μm. Laser-stripe and mechanical axis coincide within 50 μm.

The CQL10A is standard equipped with a photo p-i-n diode, optically coupled to the rear emitting facet of the laser. This fast responding (less than 20 ns) photodiode can be used as a sensor to control the laser radiant output level. The ultra-flat top window (flat within two fringes) guarantees an unperturbed beam wavefront.

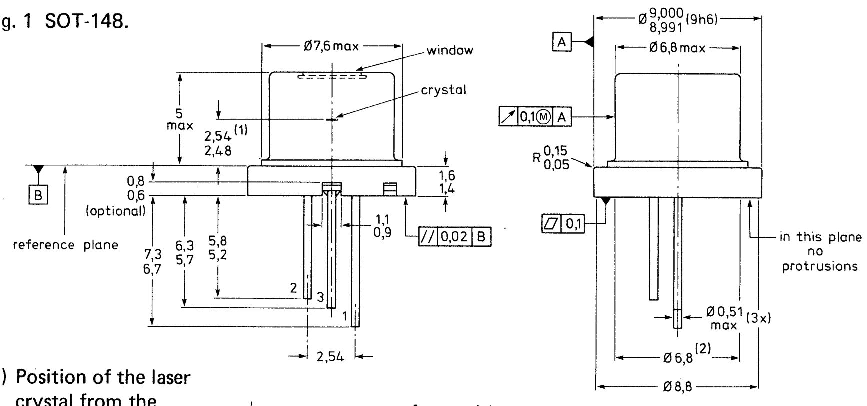
QUICK REFERENCE DATA

Threshold current at T_c = 30 °C	I_{th}	typ.	65	mA
C.W. radiant output power up to T_c = 60 °C	ϕ_e	typ.	5	mW
Wavelength at peak emission	λ_p	typ.	820	nm

MECHANICAL DATA

Dimensions in mm

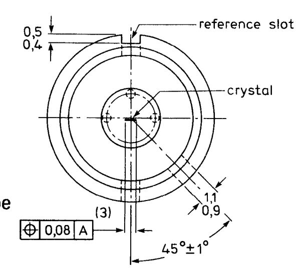
Fig. 1 SOT-148.

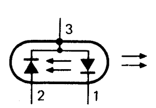


(1) Position of the laser crystal from the reference plane.

(2) Within the plane of ϕ 6,8 protrusions and irregularities are permitted.

(3) The positional accuracy of the laser stripe with respect to the flange diameter.





LASER

The double heterostructure stripe laser operates in single transverse, multiple longitudinal mode (TE_{00}) over the full power range. The structure is designed to operate C.W. 5 mW up to relatively high temperatures (60 °C case temperature) and a wavelength of 820 nm which makes reading standard Video Long Play records and compact discs (DAD) a possible application.

RATINGS

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

Radiant output power	ϕ_e	max.	10	mW
Reverse voltage	V_R	max.	1	V
Temperatures *(both laser and photodiode)*				
C.W. operation	T_c		−20 to +60	°C
storage	T_{stg}		−55 to +100	°C

CHARACTERISTICS

Threshold current				
at $T_c = 30$ °C	I_{th}	typ.	65	mA
at $T_c = 60$ °C	I_{th}	typ.	90	mA
Operating current				
$\phi_e = 5$ mW; $T_c = 30$ °C	I_{op}	typ.	85	mA
		max.	120	mA
$\phi_e = 5$ mW; $T_c = 60$ °C	I_{op}	typ.	120	mA
		max.	160	mA
Recommended operating radiant output power up to $T_c = 60$ °C	ϕ_e	typ.	5	mW
Forward voltage drop up to $T_c = 60$ °C; $\phi_e = 5$ mW	V_F	typ.	2,5	V
Wavelength at peak emission; $\phi_e = 5$ mW; $T_c = 30$ °C	λ_p	typ.	820	nm
Spectral width at half height; $\phi_e = 5$ mW	$\Delta\lambda$	typ.	4	nm
Far-field angle at half-intensity directions (FWHM)				
perpendicular to the junction plane	$\alpha_{50\%}(\perp)$	typ.	50	°
parallel to the junction plane	$\alpha_{50\%}(\parallel)$	typ.	35	°
Near-field width at half-intensity directions (FWHM)	$\delta_{50\%}$	typ.	6-7	μm
Astigmatism (distance between focal lines)	A_D	typ.	15	μm
Series resistance	R_S	typ.	5	Ω
Differential efficiency at $\phi_e = 2$ mW	ϵ	typ.	0,15	W/A
Spontaneous emission at I_{th}	ϕ_{spon}	typ.	0,5	mW
Turn-on/turn-off time (above threshold)	t_{on}/t_{off}	typ.	1	ns
Degradation rate; $T_c = 60$ °C; $\phi_e = 5$ mW	$\frac{1}{I_{op}} \cdot \frac{dI_{op}}{dT}$	typ.	5	%/Kh
Temperature coefficient of wavelength	$\frac{d\lambda_{pk}}{dT}$	typ.	0,25	nm/K
Temperature coefficient of I_{th}	$\frac{1}{I_{th}} \cdot \frac{dI_{th}}{dT}$	typ.	1	%/K
Thermal resistance from junction to case	$R_{th\,j\text{-}c}$	typ.	50	K/W

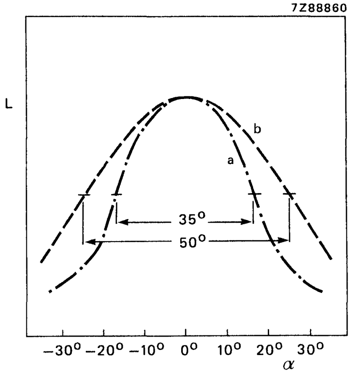


Fig. 2 Far-field pattern.
a. parallel to the junction plane.
b. perpendicular to the junction plane.

PHOTODIODE

RATINGS

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

Reverse voltage	V_R	max.	30 V

CHARACTERISTICS

Luminous sensitivity at V_R = 15 V	N	typ.	0,5 A/W
Dark reverse current at V_R = 15 V	$I_{R(D)}$	max.	10 nA
Capacitance at V_R = 0	C_d	max.	5 pF
Monitor diode current at V_R = 15 V	$I_{R(L)}$		150-400 µA/mW

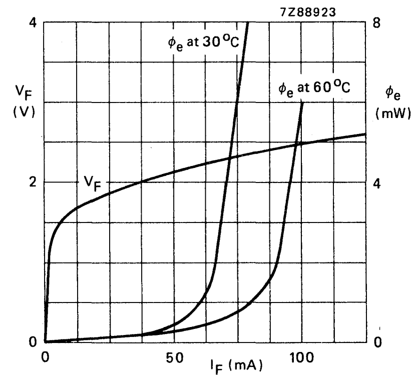


Fig. 3 Forward voltage drop (V_F) and radiant output power (ϕ_e) of laser diode as a function of forward current; typ. values.

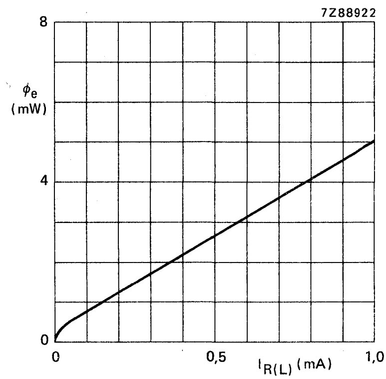
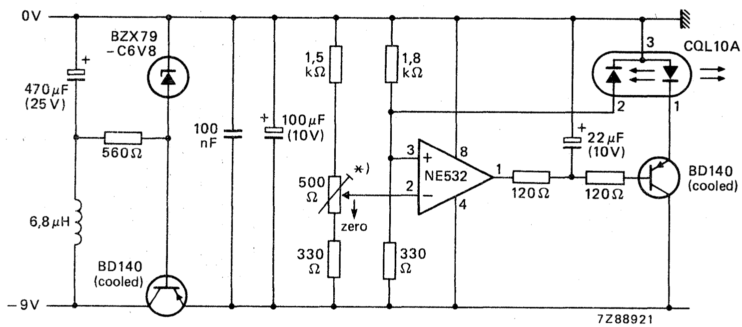


Fig. 4 Radiant output power (ϕ_e) as a function of monitor current of photodiode; V_R (photodiode) = 15 V; typ. values.



* Ten-turn. Zero position is at 0,58 revolution. Each revolution is equivalent to 500 μA monitor diode current. Adjust from zero position.

Fig. 5 Recommended control circuit for continuous operation.

OPERATING PRECAUTIONS

Semiconductor lasers in general are easily damaged by overdriving and electrical transients. Electrically, the laser diode is a very reliable device and can easily withstand current surges of several amperes. Optically, however, the laser diode is more susceptible to damage because of the extremely high optical flux density passing through both facets, while in operation. By overdriving or transients to the laser, even for pulses in the nanosecond region, the optical flux density can rise to unacceptable values (10 to 100 MW/cm^2), causing gradual or catastrophic degradation of the laser facets. Current transients should therefore be carefully avoided; they can substantially decrease the laser life time.

CAUTION

Aluminium gallium arsenide lasers emit radiation which is invisible to the human eye. When in use, do not look directly into the device. Direct viewing of laser light at close ranges, especially in conjunction with collimating lenses, may cause eye damage.

The device falls within safety class 3B of the international standard code.

COLLIMATOR PEN

The collimator pen CQL13A is used for reading applications such as: data retrieval, video-audio disc applications, optical memories, security systems etc.

The pen is mounted in a non-hermetic encapsulation, specifically designed for easy alignment in an optical read or write system, and consists of a lens system and a laser device. The lens system collimates the diverging laser light. The wavefront quality is diffraction limited. A cylindrical lens is used for correction of the astigmatism of the laser.
The housing is circular and precision manufactured with a diameter accuracy between + 0 and −11 μm.

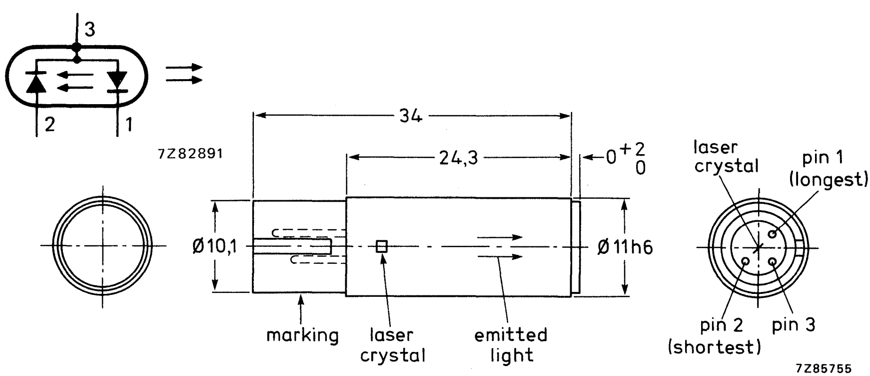
QUICK REFERENCE DATA

Output power ϕ_e		2	mW
Current at output power ϕ_e = 2 mW and temperature of 60 °C	<	175	mA
Wavelength at peak emission λ_p	typ.	820	nm
Wavefront form of bundle (non-convergent) divergence	<	0,3	mrad

MECHANICAL DATA

Dimensions in mm

Fig. 1.



Mass	max. 8 g
Concentricity	angle between the mechanical and optical axis ⩽ 10 mrad
Marking	type number CQL13A and serial number
Mounting	on a p.c. board by means of a specifically designed connector
Accessories	the pen is supplied with a connector
WARNING	THE LASER AND CONSEQUENTLY THE COLLIMATOR PEN HAS POSITIVE POLARITY ON THE CASE.

CHARACTERISTICS

Measuring conditions

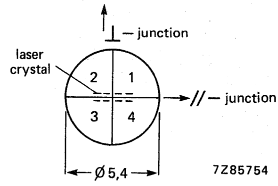
Climatological	relative humidity 5–90%, atmospheric pressure. Housing temperature of the pen 5–60 °C
Electrical	d.c. operation, optical feedback drive and protection against transients
Optical	only the radiation in a bundle with a diameter of 5,4 mm is relevant

Optical data

Output power	ϕ_e	max. 2 mW (see Fig. 4)
Spectral		
wavelength	λ	820 ± 10 nm
bandwidth	$\Delta\lambda$	< 4 nm (see note)
wavelength drift	$\Delta\lambda/\Delta T$	approx. 0,25 nm/K
Bundle properties		
dimension		ϕ 5,4 mm
wavefront form		plane, non-convergent divergence < 0,3 mrad
aberrations		variance of wavefront with respect to the Gaussian reference sphere is less than $\lambda^2/300$
polarization		plane
polarization ratio		typ. 35 : 1
Intensity distribution		
transversal mode		TE_{oo}-fundamental
longitudinal mode		see note
symmetry		variation of optical power in the four quadrants (see Fig. 2) typ. 20%
ripple		local value of the intensity < 15% of the smooth value
filling ratio I_{rim}/I_{max}		> 0,17

Note: the number of longitudinal modes is related to the spectral width.

Fig. 2.



Electrical data

Current	
at ϕ_e = 2 mW and T_h = 60 °C	⩽ 175 mA
Drive voltage V_d	⩽ 5 V
Resistance between collimator pen and connector at 10 mA, max. 20 mV_{pp} and 1 kHz	⩽ 12 mΩ

PHOTODIODE (see Fig. 5)

RATINGS

Reverse voltage	V_R	≤	30 V

CHARACTERISTICS

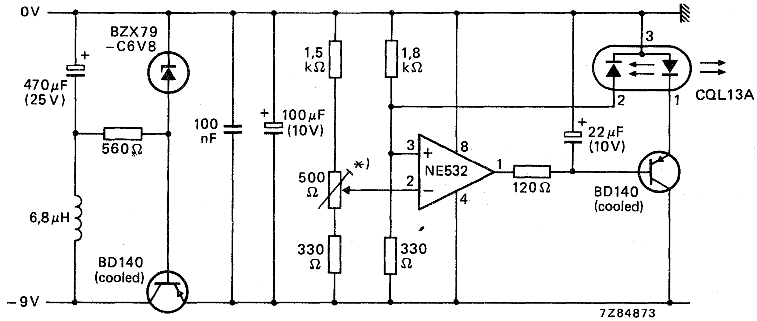
Monitor diode sensitivity (ratio of photodiode current to optical power emitted by collimator pen) at ϕ_e = 2 mW			0,1 A/W
Dark reverse current at V_R = 15 V	$I_{R(D)}$	<	10 nA
Capacitance at V_R = 0	C_d	<	5 pF

ENVIRONMENTAL TESTS

The device meets all specifications mentioned below 2 hours after each test. During these tests the collimator pen is not operating.

test	in accordance with	conditions
Rapid change of temperature	IEC 68-2-14, test Na	−25 °C to 25 °C to 70 °C to 25 °C; duration of each exposure 30 min and 10 cycles in total
Dry heat	IEC 68-2-2, test Bc	Temperature: 70 °C Duration: 7 days
Cold	IEC 68-2-1 test Aa	Temperature: −25 °C Duration: 7 days
Damp heat, steady state	IEC 68-2-3 test Ca	Temperature: 40 °C Relative humidity (R.H.): 90–95% Duration: 42 days
Damp heat, cyclic	IEC 68-2-30 test Db	Temperature/R.H. 45 °C/100% (12 h) to 25 °C/ 85% (12 h) Duration of one cycle: 24 hours Number of cycles: 42
Vibration	IEC 68-2-6 test Db	Frequency range: 10–55 Hz Amplitude: 0,75 mm Duration: 6 hours (2 h in each of directions)
Shock	IEC 68-2-27 test Ea	Pulse shape: half-sine Pulse duration: 11 ms Peak acceleration: 981 m/s² Number of shocks: 10 in each of 3 directions
Bump	IEC 68-2-29 test Eb	Pulse duration: 6 ms Peak acceleration: 390 m/s² Number of bumps: 1000 Axes of direction: 6

Cleaning test — The cylinder lens at the side of the long conjugate is cleaned 100x with a small piece of cotton wool, soaked in a 45–95% solution of ethyl-alcohol in water, attached to the end of a small stick.



* Ten-turn. Zero position is at 0,58 revolution. Each revolution is equivalent to 500 µA monitor diode current.

Fig. 3 Recommended control circuit.

OPERATING PRECAUTIONS

Semiconductor lasers in general are easily damaged by overdriving and transients. Electrically, the laser diode is a very reliable device and can easily withstand current surges of several amperes. Optically, however, the diode laser is more susceptible to damage because of the extremely high optical flux density passing through both facets, while in operation. By overdriving or transients to the laser, even for pulses in the nanosecond region, the optical flux density can rise to unacceptible values (10 to 100 MW/cm^2), causing gradual or catastrophic degradation of the laser facets.
Current transients should therefore be carefully avoided; they decrease the laser life time.

CAUTION

Aluminium gallium arsenide lasers emit radiation which is invisible to the human eye. When in use, do not look directly into the device. Direct viewing of laser light at close ranges, especially in conjunction with collimating lenses, may cause eye damage.

The device meets the requirements of safety class 3B of the international standard code.

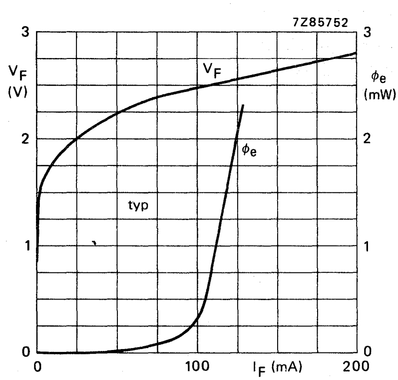


Fig. 4 T_h = 60 °C.

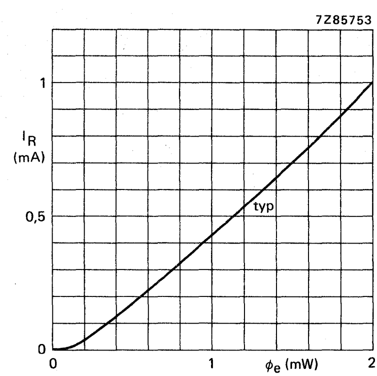


Fig. 5 V_R = 15 V.

COLLIMATOR PEN

The collimator pen CQL16 is used as a laser source in measuring equipment such as telemetry, leveller and security systems.

The pen is mounted in a non-hermetic encapsulation, specifically designed for easy alignment in an optical read or write system, and consists of a lens system and a laser device. The lens system collimates the diverging laser light. The wavefront quality is diffraction limited.
The housing is circular and precision manufactured with a diameter accuracy between + 0 and −11 μm.

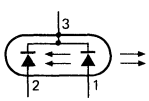
QUICK REFERENCE DATA

Output power	ϕ_e	max.	2	mW
Current at ϕ_e = 2 mW and T_h = 60 °C	I	max.	100	mA
Wavelength at peak emission	λ_p	typ.	780	nm
Wavefront form of bundle (non-convergent) divergence		max.	0,3	mrad

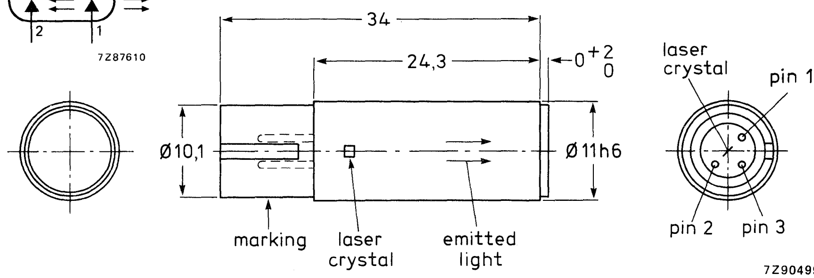
MECHANICAL DATA

Dimensions in mm

Fig. 1.



7Z87610



7Z90499

Mass	max. 8 g
Concentricity	angle between the mechanical and optical axis ⩽ 10 mrad
Marking	type number CQL16 and serial number
Mounting	on a p.c. board by means of a specifically designed connector
Accessories	the pen is supplied with a connector
WARNING	THE LASER, AND CONSEQUENTLY THE COLLIMATOR PEN, HAS NEGATIVE POLARITY ON THE CASE. The LASER is protected by an antistatic spring which shall NOT be removed before the pen is installed in the connector.

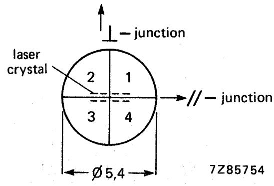
CHARACTERISTICS

Measuring conditions

Climatological	relative humidity 5-90%, atmospheric pressure. Housing temperature of the pen 5-60 °C
Electrical	d.c. operation, optical feedback drive and protection against transients
Optical	only the radiation in a stripe with dimensions 5,4 mm x 3 mm is relevant

Optical data

Output power	ϕ_e	max. 2 mW
Spectral		
wavelength	λ	780 ± 10 nm
bandwidth	$\Delta\lambda$	< 2 nm
wavelength drift	$\Delta\lambda/\Delta T$	approx. 0,25 nm/K
Bundle properties		
dimensions		stripe 5,4 mm x 3 mm, FWHM*
wavefront form		plane, non-convergent, divergence < 0,3 mrad
aberrations		variance of wavefront with respect to the Gaussian reference sphere is less than $\lambda^2/300$
polarization		plane
polarization ratio		typ. 60 : 1
Intensity distribution		
transversal mode		TE_{00}-fundamental
symmetry		spot width ⊥ to junction 5,4 mm spot width // to junction 3,0 mm, FWHM*



Electrical data

Current at ϕ_e = 2 mW and T_h = 60 °C	I	⩽	100 mA
Drive voltage	V_d	⩽	5 V
Resistance between collimator pen and connector at 10 mA, max. 20 mV_{pp} and 1 kHz		⩽	12 mΩ

* FWHM means full width half maximum.

PHOTODIODE

RATINGS

Reverse voltage	V_R	≤	30 V

CHARACTERISTICS

Monitor diode sensitivity (ratio of photodiode current to optical power emitted by collimator pen) at ϕ_e = 2 mW		typ.	0,6 A/W
Dark reverse current at V_R = 15 V	$I_{R(D)}$	<	10 nA
Capacitance at V_R = 0	C_c	<	5 pF

ENVIRONMENTAL TESTS

The device meets all specifications mentioned below 2 hours after each test. During these tests the collimator pen is not operating.

test	in accordance with	conditions
Rapid change of temperature	IEC 68-2-14, test Na	–25 °C to 25 °C to 70 °C to 25 °C; duration of each exposure 30 min and 10 cycles in total
Dry heat	IEC 68-2-2, test Bc	Temperature: 70 °C Duration: 7 days
Cold	IEC 68-2-1 test Aa	Temperature: –25 °C Duration: 7 days
Damp heat, steady state	IEC 68-2-3 test Ca	Temperature: 40 °C Relative humidity (R.H.): 90-95% Duration: 42 days
Damp heat, cyclic	IEC 68-2-30 test Db	Temp./R.H. 45 °C/100% (12 h) to 25 °C/ 85% (12 h) Duration of one cycle: 24 hours Number of cycles: 42
Vibration	IEC 68-2-6 test Db	Frequency range: 10-55 Hz Amplitude: 0,75 mm Duration: 6 hours (2 h in each of directions)
Shock	IEC 68-2-27 test Ea	Pulse shape: half-sine Pulse duration: 11 ms Peak acceleration: 981 m/s^2 Number of shocks: 10 in each of 3 directions
Bump	IEC 68-2-29 test Eb	Pulse duration: 6 ms Peak acceleration: 390 m/s^2 Number of bumps: 1000 Axes of direction: 6

Cleaning test — The cylinder lens at the side of the long conjugate is cleaned 100x with a small piece of cotton wool, soaked in a 45-95% solution of ethyl-alcohol in water, attached to the end of a small stick.

DEVELOPMENT DATA

OPERATING PRECAUTIONS

Semiconductor lasers in general are easily damaged by overdriving and transients. Electrically, the laser diode is a very reliable device and can easily withstand current surges of several amperes. Optically, however, the diode laser is more susceptible to damage because of the extremely high optical flux density passing through both facets, while in operation. By overdriving or transients to the laser, even for pulses in the nanosecond region, the optical flux density can rise to unacceptible values (10 to 100 MW/cm^2), causing gradual or catastrophic degradation of the laser facets.
Current transients should therefore be carefully avoided; they decrease the laser life time.

CAUTION

Aluminium gallium arsenide lasers emit radiation which is invisible to the human eye. When in use, do not look directly into the device. Direct viewing of laser light at close ranges, especially in conjunction with collimating lenses, may cause eye damage.

The device meets the requirements of safety class 3B of the international standard code.

BURIED HETEROJUNCTION InGaAsP LASER DIODE WITH FIBRE PIGTAIL

The 502CQF is an InGaAsP buried heterojunction semiconductor laser diode. The device is designed for high-speed long distance, optical communications and data transmissions.

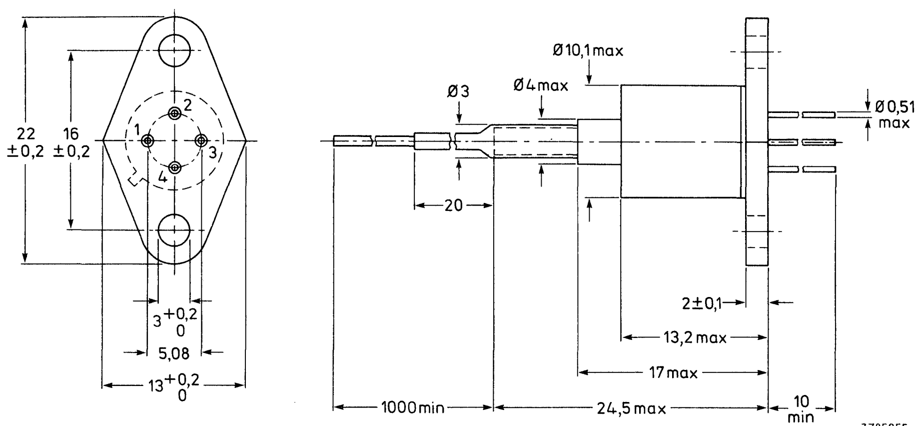
The diode laser, emitting in the 1300 nm transmission window of optical fibres, is mounted in a specifically designed hermetic SOT-184 encapsulation.

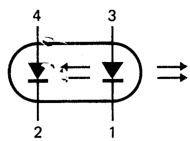
The 502CQF is standard equipped with a fast-responding photodiode optically coupled to the rear facet of the laser for monitoring the laser radiant output power. A graded index optical fibre pigtail with dimensions 50/125/950 μm is coupled to the front facet of the laser.

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-184.





LASER

The buried heterojunction InGaAsP laser is designed to operate at a radiant output level of up to 3 mW in the fibre, up to relatively high case temperatures (60 °C) and at an emission wavelength of 1300 nm.

All lasers have been subjected to a burn-in test at a radiant output level of 3 mW at a case temperature of 60 °C.

RATINGS

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

Radiant output power from fibre pigtail	ϕ_e	max.	3 mW

CHARACTERISTICS

Threshold current T_c = 30 °C	I_{th}	typ. max.	25 mA 40 mA
Radiant output power from fibre pigtail T_c = 60 °C	ϕ_e	max.	3 mW
Forward voltage drop ϕ_e = 2 mW	V_F	max.	1,5 V
Wavelength at peak emission	λp	typ.	1300 nm
Spectral width at half intensity at 10% intensity	$\Delta\lambda$	max. max.	1 nm 4 nm
Rise time, fall time laser biased near I_{th}	t_r, t_f	typ.	0,5 ns
Temperature coefficient of wavelength	$\frac{d\lambda p}{dT}$	typ.	0,5 nm/K
Temperature coefficient of threshold current	$\frac{1}{I_{th}} \cdot \frac{dI_{th}}{dT}$	typ.	2 %/K
Differential efficiency (stimulated emission)	ϵ	typ.	0,1 mW/mA
Extinction ratio ϕ_e = 3 mW		typ.	1:50

PHOTODIODE

Reverse voltage	V_R	max.	5 V
Dark reverse current V_R = 5 V	I_{RD}	typ.	10 μA
Monitor diode current	I_R		100 to 300 μA/mW

FIBRE PIGTAIL

Graded index silica rubber		min.	typ.	max.	
numerical aperture on axis	NA	0,20	0,21	0,22	
core diameter	ϕ_{core}	48	50	52	μm
cladding diameter	ϕ_{clad}	123	125	127	μm
primary coating thickness	ϕ_{pc}		20		μm
secondary coating diameter	ϕ_{sc}		950		μm

Options: other fibre for pigtail may be accommodated.

Options may be subject to surcharge.

TEMPERATURES (total assembly)

C.W. operation	T_{op}		0 to 60	°C
Storage	T_{stg}		−40 to +100	°C
Thermal resistance from junction to case	$R_{th\ j\text{-}c}$	typ.	45	K/W

DEVELOPMENT DATA

OPERATING PRECAUTIONS

Semiconductor lasers in general are easily damaged by overdriving and electrical transients. Electrically, the laser diode is a very reliable device and can easily withstand current surges of several amperes. Optically, however, the diode laser is more susceptible to damage because of the extremely high optical flux density passing through both facets, while in operation. By overdriving or transients to the laser, even for pulses in the nanosecond region, the optical flux density can rise to unacceptable values (10 to 100 MW/cm^2), causing gradual or catastrophic degradation of the laser facets.
Current transients should therefore be carefully avoided; they can substantially decrease the laser life time and may cause mortal damage. Before connecting the laser to the supply circuit, make sure that there are no transients which could make the laser output exceeding the maximum ratings for radiant flux or forward current. The connection and disconnection of the laser to or from a power supply must be made only after reducing the voltage to the minimum and setting the output control to the zero position.
Avoid poor electrical connection on the load side of the power supply circuit, as this may cause the laser voltage to rise if the power supply is operated in constant current mode.

WARNING

The laser diode is extremely sensitive to electrostatic discharges. The anode and the cathode shall therefore always be shorted when the diode is disconnected.

CAUTION

Indium gallium arsenide phosphide lasers emit radiation which is invisible to the human eye. When in use, do not look directly into the device. Direct viewing of laser light at close ranges, especially in conjunction with collimating lenses, may cause eye damage.

The device falls within safety class 3B of the international standard code.

Note: Each laser is accompanied by an individual test sheet, showing the P_{opt} - I_{op} characteristic and the monitor current for a given optical output power.

BURIED HETEROJUNCTION InGaAsP LASER DIODE WITH SINGLE MODE FIBRE PIGTAIL

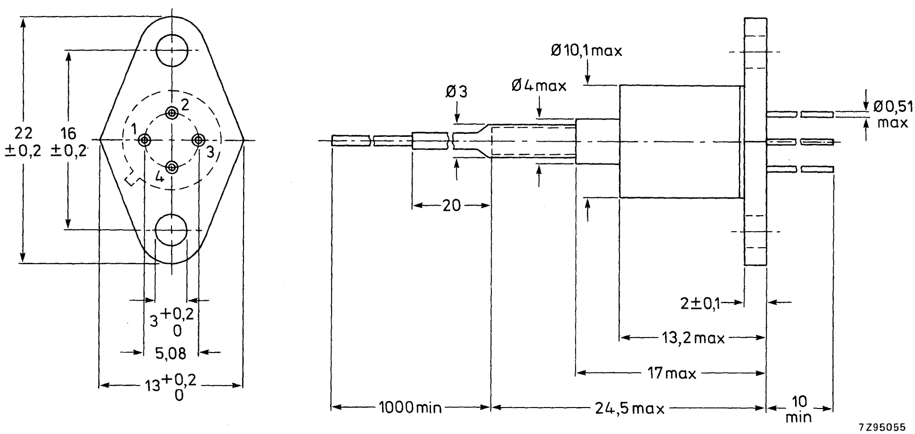
The 503CQF is an InGaAsP buried heterojunction semiconductor laser diode. The device is designed for high-speed long distance, optical communications and data transmissions.

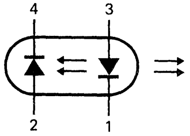
The diode laser, emitting in the 1300 nm transmission window of optical fibres, is mounted in a specifically designed hermetic encapsulation (modified TO-5). The 503CQF is standard equipped with a fast-responding photodiode optically coupled to the rear facet of the laser for monitoring the laser radiant output power. A single mode optical fibre pigtail with dimensions 8/125/950 μm is coupled to the front facet of the laser.

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-184.





LASER

The buried heterojunction InGaAsP laser is designed to operate at a radiant output level of up to 2 mW in the fibre, up to relatively high case temperatures (60 °C) and at an emission wavelength of 1300 nm.

All lasers have been subjected to a burn-in test at a radiant output level of 2 mW at a case temperature of 60 °C.

RATINGS

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

Radiant output power from fibre pigtail	ϕ_e	max.	2 mW

CHARACTERISTICS

Threshold current T_c = 30 °C	I_{th}	typ. max.	25 mA 40 mA
Radiant output power from fibre pigtail T_c = 60 °C	ϕ_e	max.	1,5 mW
Forward voltage drop ϕ_e = 2 mW	V_F	max.	1,5 V
Wavelength at peak emission	λ_p	typ.	1300 nm
Spectral width at half intensity at 10% intensity	$\Delta\lambda$	max. max.	1 nm 4 nm
Rise time, fall time laser biased near I_{th}	t_r, t_f	typ.	0,5 ns
Temperature coefficient of wavelength	$\frac{d\lambda_p}{dT}$	typ.	0,5 nm/K
Temperature coefficient of threshold current	$\frac{1}{I_{th}} \cdot \frac{dI_{th}}{dT}$	typ.	2 %/K
Differential efficiency (stimulated emission)		typ.	0,1 mW/mA
Extinction ratio ϕ_e = 1,5 mW	ϵ	typ.	1:50

PHOTODIODE

Reverse voltage	V_R	max.	5 V
Dark reverse current V_R = 5 V	I_{RD}	typ.	20 μA
Monitor diode current	I_R		100 to 300 μA/mW

FIBRE PIGTAIL

Single mode

		min.	typ.	max.	
mode field diameter	ϕ_{core}		8		μm
excentricity of core				1,5	μm
cladding diameter	ϕ_{clad}	123	125	127	μm
primary coating thickness	ϕ_{pc}		20		μm
secondary coating diameter	ϕ_{sc}		950		μm

Options: other fibre for pigtail may be accommodated.

Options may be subject to surcharge.

TEMPERATURES (total assembly)

C.W. operation	T_{op}		0 to 60	°C
Storage	T_{stg}		−40 to +100	°C
Thermal resistance from junction to case	$R_{th\ j\text{-}c}$	typ.	45	K/W

OPERATING PRECAUTIONS

Semiconductor lasers in general are easily damaged by overdriving and electrical transients. Electrically, the laser diode is a very reliable device and can easily withstand current surges of several amperes. Optically, however, the diode laser is more susceptible to damage because of the extremely high optical flux density passing through both facets, while in operation. By overdriving or transients to the laser, even for pulses in the nanosecond region, the optical flux density can rise to unacceptable values (10 to 100 MW/cm^2), causing gradual or catastrophic degradation of the laser facets.
Current transients should therefore be carefully avoided; they can substantially decrease the laser life time and may cause mortal damage. Before connecting the laser to the supply circuit, make sure that there are no transients which could make the laser output exceeding the maximum ratings for radiant flux or forward current. The connection and disconnection of the laser to or from a power supply must be made only after reducing the voltage to the minimum and setting the output control to the zero position.
Avoid poor electrical connection on the load side of the power supply circuit, as this may cause the laser voltage to rise if the power supply is operated in constant current mode.

WARNING

The laser diode is extremely sensitive to electrostatic discharges. The anode and the cathode shall therefore always be shorted when the diode is disconnected.

CAUTION

Indium gallium arsenide phosphide lasers emit radiation which is invisible to the human eye. When in use, do not look directly into the device. Direct viewing of laser light at close ranges, especially in conjunction with collimating lenses, may cause eye damage.

The device falls within safety class 3B of the international standard code.

Note : Each laser is accompanied by an individual test sheet, showing the P_{opt} - I_{op} characteristic and the monitor current for a given optical output power.

AlGaAs DOUBLE HETEROSTRUCTURE VISIBLE LASER-DIODE

The 504CQL is designed for reading applications such as: video-audio disc applications, optical memories, security systems, etc.

This device is mounted in an hermetic SOT-148 encapsulation specifically designed for easy alignment in an optical read system. The copper heatsink is circular and precision engineered with a diameter accuracy of +0, −9 μm. Laserstripe and mechanical axis coincide within 50 μm.

The 504CQL is standard equipped with a photo p-i-n diode, optically coupled to the rear emitting facet of the laser. This fast responding (less than 20 ns) photodiode can be used as a sensor to control the laser radiant output level. The ultra-flat top window (flat within two fringes) guarantees an unperturbed beam wavefront.

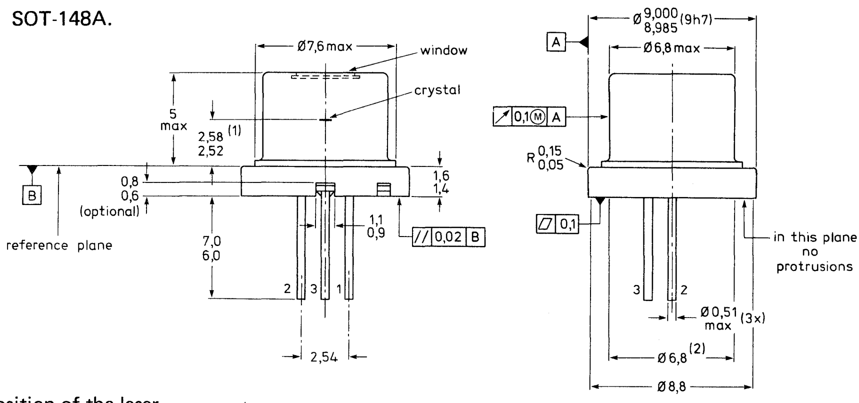
QUICK REFERENCE DATA

Threshold current at T_c = 30 °C	I_{th}	typ.	60 mA
C.W. radiant output power up to T_c = 60 °C	ϕ_e	typ.	5 mW
Wavelength at peak emission	λ_p	typ.	780 nm

MECHANICAL DATA

Dimensions in mm

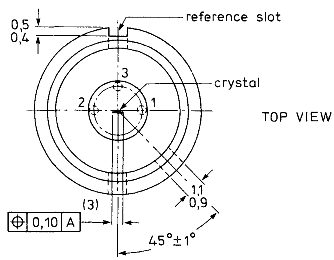
Fig. 1 SOT-148A.

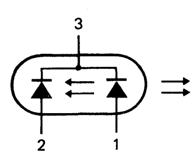


(1) Position of the laser crystal from the reference plane.

(2) Within the plane of ϕ 6,8 protrusions and irregularities are permitted.

(3) The positional accuracy of the laser strip with respect to the flange diameter.





LASER

The double heterostructure stripe laser is made by using internal current confinement. The structure is designed to operate C.W. 5 mW at a wavelength of 780 nm. The device is primarily intended for reading applications of Compact Discs (DAD) and Video Long Play records.

All lasers have been subjected to a burn-in test at rated radiant output level and at elevated case temperature.

→ RATINGS

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

Radiant output power	ϕ_e	max.	7	mW
Reverse voltage	V_R	max.	2	V
Temperatures *(both laser and photodiode)*				
c.w. operation	T_c		−10 to + 60	°C
storage	T_{stg}		−40 to + 85	°C

→ CHARACTERISTICS

Threshold current				
at T_c = 30 °C	I_{th}	typ.	60	mA
at T_c = 60 °C	I_{th}	typ.	80	mA
Operating current				
ϕ_e = 5 mW; T_c = 30 °C	I_{op}	typ.	80	mA
		max.	100	mA
Recommended operating radiant output power up to T_c = 60 °C	ϕ_e	typ.	5	mW
Forward voltage drop up to T_c = 60 °C				
ϕ_e = 5 mW	V_F	typ.	1,7	V
		max.	2,2	V
Wavelength at peak emission				
ϕ_e = 5 mW; T_c = 30 °C	λ_p		780 ± 15	nm
Spectral width at half height				
ϕ_e = 5 mW	$\Delta\lambda$	typ.	2	nm
Far-field angle at half-intensity directions (FWHM)*				
ϕ_e = 2 mW; T_c = 30 °C				
perpendicular to the junction plane	$\theta_{1/2}$ (⊥)	typ.	30	°
parallel to the junction plane	$\theta_{1/2}$ (‖)	typ.	12	°
Astigmatism (distance between focal lines)	A_D	typ.	11	µm
Series resistance	R_S	typ.	2	Ω
Differential efficiency at ϕ_e = 2 mW	ϵ	typ.	0,25	W/A
Spontaneous emission at I_{th}	ϕ_{spon}	typ.	0,1	mW
Turn-on/turn-off time (above threshold)	t_{on}/t_{off}	typ.	1	ns
Temperature coefficient of wavelength	$\frac{d\lambda_p}{dT}$	typ.	0,25	nm/K
Thermal resistance				
from junction to case	$R_{th\ j\text{-}c}$	typ.	50	K/W

* FWHM stands for full width half maximum.

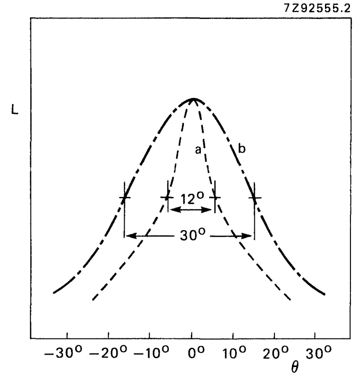


Fig. 2 Far-field pattern.
a. parallel to the junction plane.
b. perpendicular to the junction plane.

DEVELOPMENT DATA

PHOTODIODE

RATINGS

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

Reverse voltage	V_R	max. 30 V

CHARACTERISTICS

Luminous sensitivity at $V_R = 15$ V	N	typ. 0,3 A/W
Dark reverse current at $V_R = 15$ V	$I_{R(D)}$	max. 10 nA
Capacitance at $V_R = 0$	C_d	max. 5 pF
Monitor diode current response at $V_R = 7,5$ V	$I_{R(L)}$	0,25–0,75 A/W

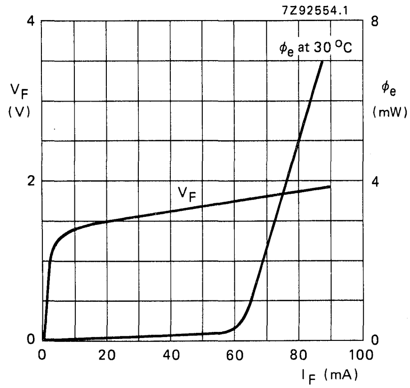


Fig. 3 Forward voltage drop (V_F) and radiant output power (ϕ_e) of laser diode as a function of forward current; typical values.

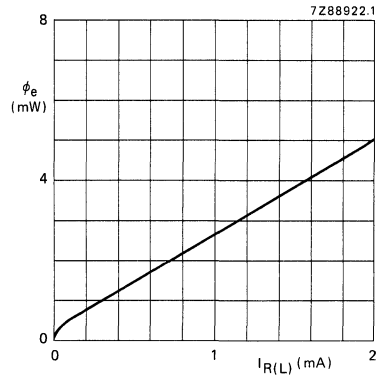


Fig. 4 Radiant output power (ϕ_e) as a function of monitor current of photodiode; V_R (photodiode) = 7,5 V; typical values.

OPERATING PRECAUTIONS

Semiconductor lasers in general are easily damaged by overdriving and electrical transients. Electrically, the laser diode is a very reliable device and can easily withstand current surges of several amperes. Optically, however, the diode laser is more susceptible to damage because of the extremely high optical flux density passing through both facets, while in operation. By overdriving or transients to the laser, even for pulses in the nanosecond region, the optical flux density can rise to unacceptible values (10 to 100 MW/cm^2), causing gradual or catastrophic degradation of the laser facets.

Current transients should therefore be carefully avoided; they can substantially decrease the laser life time and may cause mortal damage. Before connecting the laser to the supply circuit, make sure that there are no transients which could make the laser output exceeding the maximum ratings for radiant flux or forward current. The connection and disconnection of the laser to or from a power supply must be made only after reducing the voltage to the minimum and setting the output control potentiometer to the zero position.

Avoid poor electrical connection on the load side of the power supply circuit, as this may cause the laser voltage to rise if the power supply is operated in constant current mode.

CAUTION

Aluminium gallium arsenide lasers emit radiation which is invisible to the human eye. When in use, do not look directly into the device. Direct viewing of laser light at close ranges, especially in conjunction with collimating lenses, may cause eye damage.

The device falls within safety class 3B of the international standard code.

WARNING

The laser diode is extremely sensitive to electrostatic discharges. The anode and the cathode shall therefore always be shorted when the diode is disconnected.

DOUBLE HETEROSTRUCTURE AlGaAs DIODE LASER WITH FIBRE PIGTAIL

The 516CQF-B is an AlGaAs double heterostructure semiconductor laser designed for high speed (560 Mb/s), long distance, optical communications.

The diode laser, emitting in the first transmission window of silica optical fibres, is mounted in a specifically designed hermetic encapsulation.

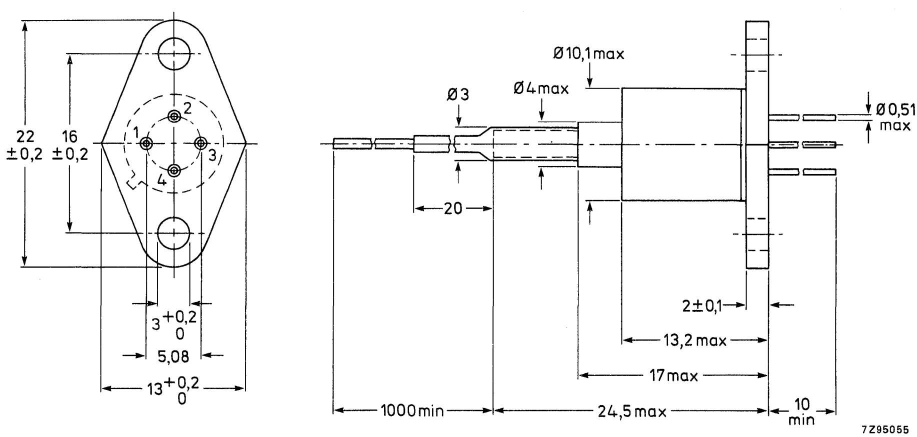
The 516CQF-B is standard equipped with a fast-responding photodiode optically coupled to the rear facet of the laser for monitoring the laser radiant output power. A silica graded index optical fibre pigtail is coupled to the front facet of the laser.

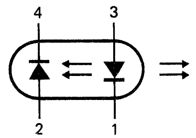
The monitor diode is electrically insulated from the case.

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-184.





LASER

The double heterostructure laser, made by means of the MOVPE process, with very narrow stripe operates in a stable single transverse mode (TE_{00}) over the full power range and in several longitudinal modes. This results in a rather short coherence length, which is advantageous in suppressing modal noise and optical feedback effects.

The structure is designed to operate at a radiant output level of up to 3 mW in the fibre, up to relatively high case temperatures (60 °C) and at an emission wavelength of 850 nm.

All lasers have been subjected to a burn-in test at radiant output level from the laser facet of 5 mW at a case temperature of 60 °C.

RATINGS

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

Radiant output power from fibre pigtail	ϕ_e	max.	5	mW
Reverse voltage	V_R	max.	1	V

CHARACTERISTICS

Threshold current				
$T_c = 30\ ^oC$	I_{th}	typ.	90	mA
$T_c = 60\ ^oC$	I_{th}	typ. max.	120 150	mA mA
Radiant output power from fibre pigtail				
$T_c = 60\ ^oC$	ϕ_e	typ.	3	mW
Forward voltage drop				
$\phi_e = 3$ mW	V_F	typ.	2,5	V
Wavelength at peak emission	λ_p	typ.	850	nm
Spectral width at half intensity	$\Delta\lambda$	typ.	3	nm
Rise time, fall time				
laser biased near I_{th}	t_r, t_f	typ.	0,5	ns
Spectrum at $\phi_e = 1$ mW (FWHM)		typ.	10	longitudinal modes
Extinction ratio at $\phi_e = 3$ mW			1 : 10	
Temperature coefficient of wavelength	$\frac{d\lambda p}{dT}$	typ.	0,25	nm/K
Temperature coefficient of I_{th}	$\frac{1}{I_{th}} \cdot \frac{dI_{th}}{dt}$	typ.	1	%/K
Differential efficiency				
(stimulated emission)	ϵ	typ.	0,1	mW/mA

PHOTODIODE

Reverse voltage	V_R	max.	30	V
Responsitivity				
$V_R = 15$ V	N	typ.	0,5	A/W
Dark reverse current				
$V_R = 15$ V	I_{RD}	max.	10	nA
Capacitance				
$V_R = 0$	C_d	max.	5	pF
Monitor diode current	I_F		100 to 300	μA/mW

FIBRE PIGTAIL

Graded index silica		min.	typ.	max.	
numerical aperture on axis	NA	0,20	0,21	0,22	
core diameter	ϕ_{core}	48	50	52	μm
cladding diameter	ϕ_{clad}	123	125	127	μm
primary coating thickness	ϕ_{pc}		20		μm
secundary coating diameter	ϕ_{sc}		950		μm

Options: other fibre for pigtail may be made available.
other wavelengths are available and are specified by adding a suffix to the type number accordingly:

suffix A = 820 nm
suffix B = 850 nm
suffix C = 870 nm

Options may be subject to surcharge.

TEMPERATURES (total assembly)

C.W. operation	T_{op}		0 to 60 °C
Storage	T_{stg}		−20 to +100 °C
Thermal resistance junction to case	$R_{th\ j\text{-}c}$	typ.	45 K/W

OPERATING PRECAUTIONS

Semiconductor lasers in general are easily damaged by overdriving and electrical transients. Electrically, the laser diode is a very reliable device and can easily withstand current surges of several amperes. Optically, however, the diode laser is more susceptible to damage because of the extremely high optical flux density passing through both facets, while in operation. By overdriving or transients to the laser, even for pulses in the nanosecond region, the optical flux density can rise to unacceptable values (10 to 100 MW/cm^2), causing gradual or catastrophic degradation of the laser facets.
Current transients should therefore be carefully avoided; they can substantially decrease the laser life time and may cause mortal damage. Before connecting the laser to the supply circuit, make sure that there are no transients which could make the laser output exceed the maximum ratings for radiant flux or forward current. The connection and disconnection of the laser to or from a power supply must be made only after reducing the voltage to the minimum and setting the output control to the zero position.
Avoid poor electrical connection on the load side of the power supply circuit, as this may cause the laser voltage to rise if the power supply is operated in constant current mode.

WARNING

The laser diode is extremely sensitive to electrostatic discharges. The anode and the cathode shall therefore always be short-circuited when the diode is disconnected.

CAUTION

Aluminum gallium arsenide lasers emit radiation which is invisible to the human eye. When in use, do not look directly into the device. Direct viewing of laser light at close ranges, especially in conjunction with collimating lenses, may cause eye damage.

The device falls within safety class 3B of the international standard code.

Note: Each laser is accompanied by an individual test sheet, showing the $\phi_e - I_{op}$ characteristic and the monitor current for a given optical output power.

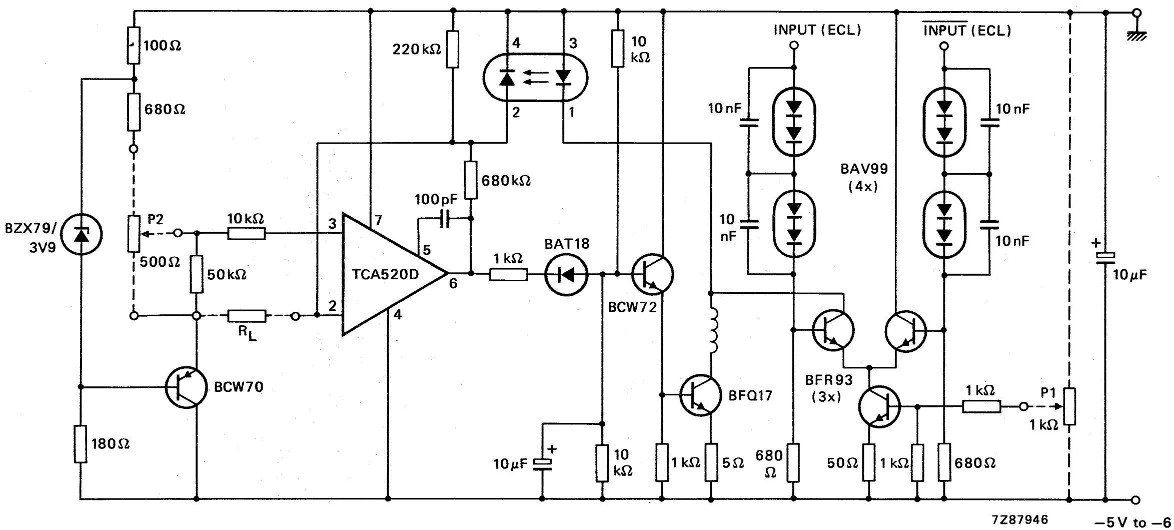


Fig. 2 Typical modulation circuit with ECL logic input and control of average optical power output. Data rate > 200 Mb/s.

P_1	sets the peak-peak modulation current.
P_2	sets the laser bias current.
R_L	determines maximum mean value of optical output power.
1-2-3-4	laser connections.

Note: if single ECL drive is applied, the other input shall be connected to the ECL threshold level (−1,35 V).

SECTION C2

Infrared sensors

PYROELECTRIC INFRARED DETECTORS

In line with our policy of continual improvement, some of our original ceramic pyroelectric detectors have been superseded by more advanced, lower-cost devices. The tables on the following pages give details of the original detectors and their replacements. Greater detail for the current types is available in our published data.

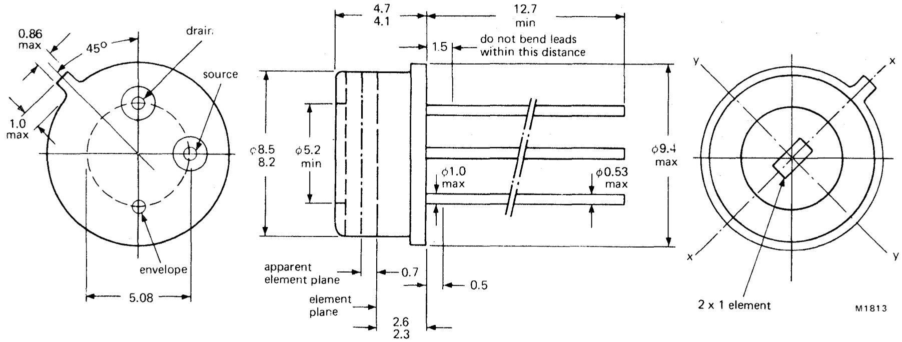
The replacement types are specified with a unity gain source follower circuit. The responsivity levels will therefore appear to be approximately x 5 lower than the types they replace, since the latter were specified with a gain of x 4.8 with the exception of the RPY96, which was specified with a unity gain source follower circuit.

RPY86

MECHANICAL DATA

SOT-49E (low profile TO-5)

Dimensions in mm

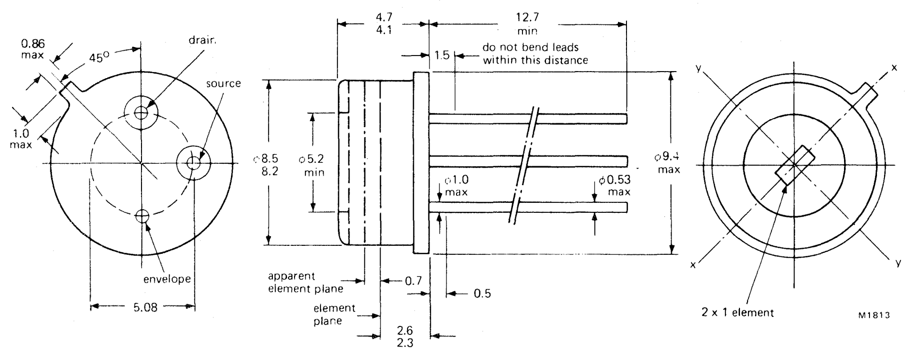


RPY87

MECHANICAL DATA

SOT-49E (low profile TO-5)

Dimensions in mm

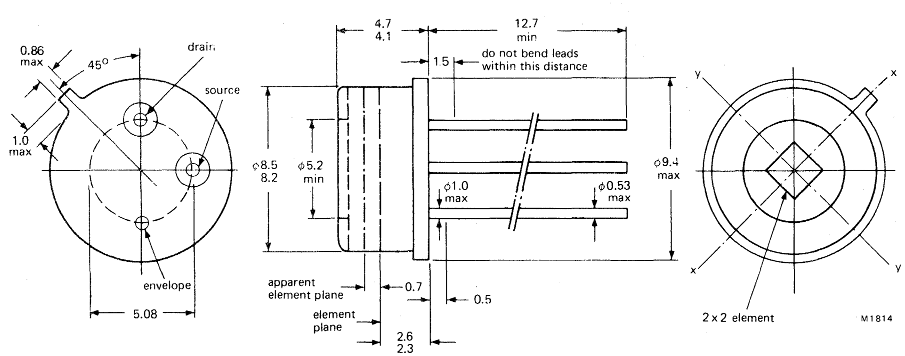


RPY88

MECHANICAL DATA

SOT-49E (low profile TO-5)

Dimensions in mm

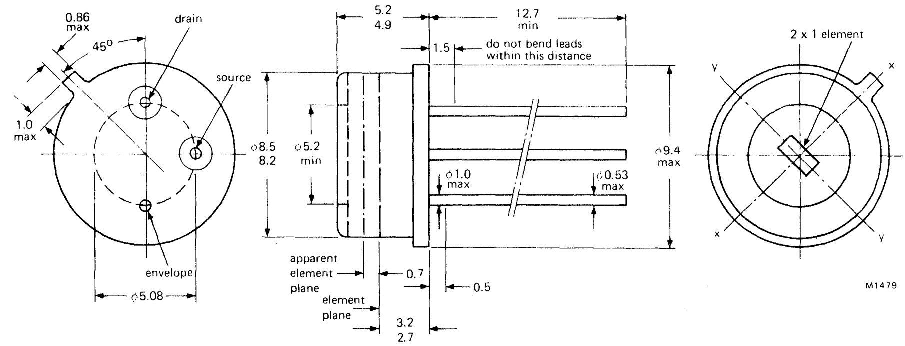


RPY100

MECHANICAL DATA

SOT-49H (TO-5 variant)

Dimensions in mm

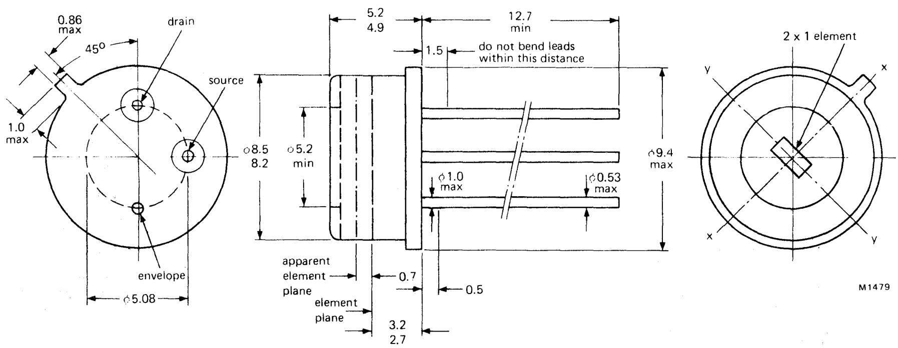


RPY107

MECHANICAL DATA

SOT-49H (TO-5 variant)

Dimensions in mm

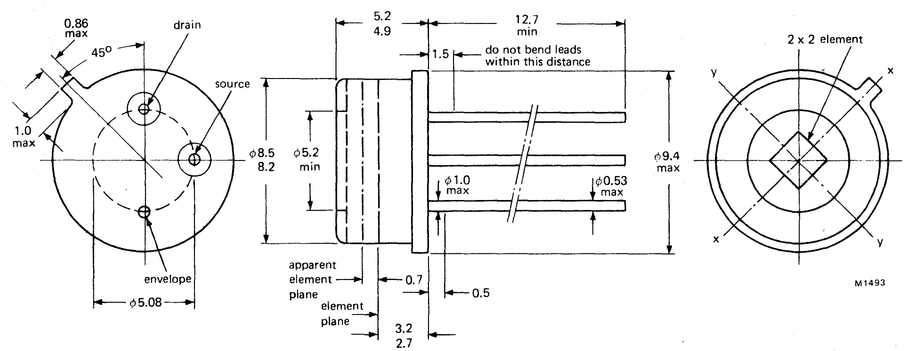


RPY102

MECHANICAL DATA

SOT-49H (TO-5 variant)

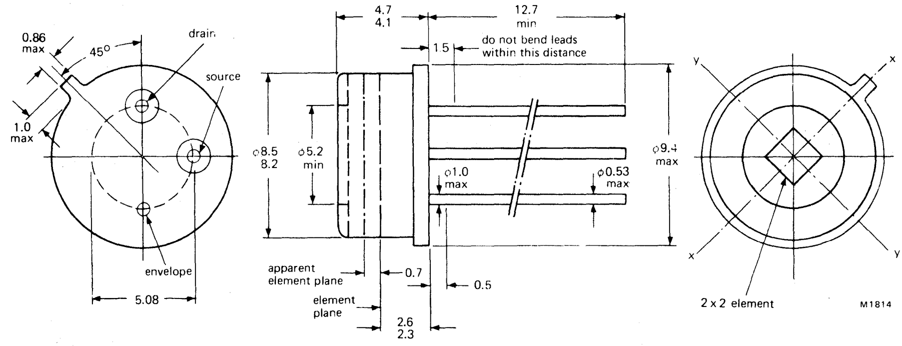
Dimensions in mm



RPY89

MECHANICAL DATA Dimensions in mm

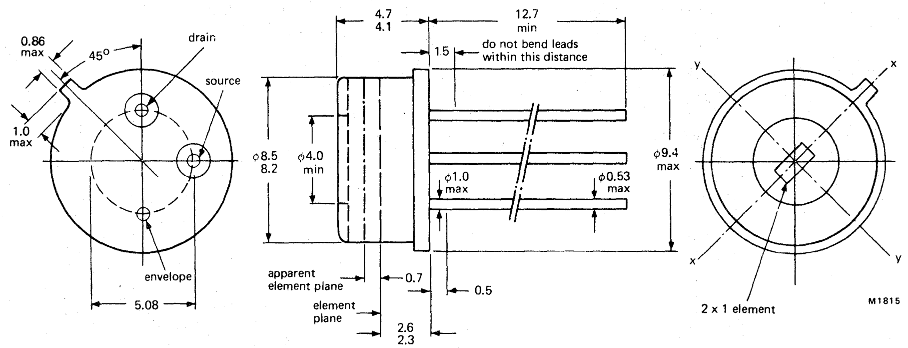
SOT-49E (low profile TO-5)



RPY96

MECHANICAL DATA Dimensions in mm

SOT-49F (low profile TO-5)

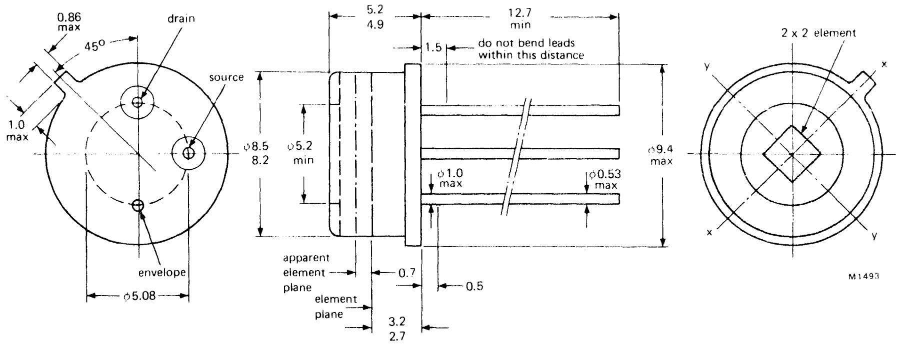


RPY109

MECHANICAL DATA

SOT-49H (TO-5 variant)

Dimensions in mm

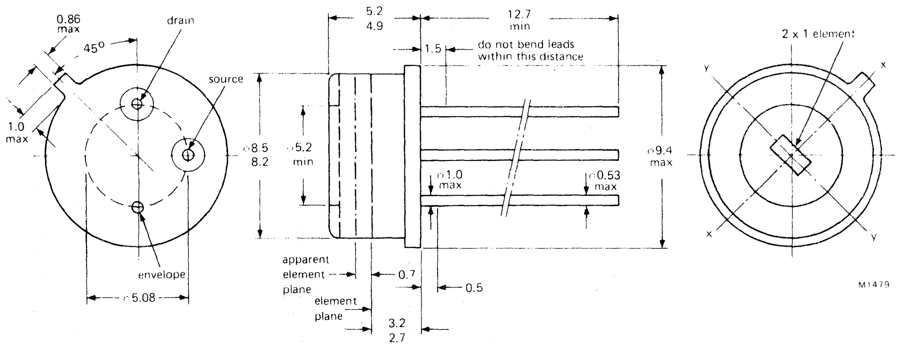


RPY100

MECHANICAL DATA

SOT-49H (TO-5 variant)

Dimensions in mm

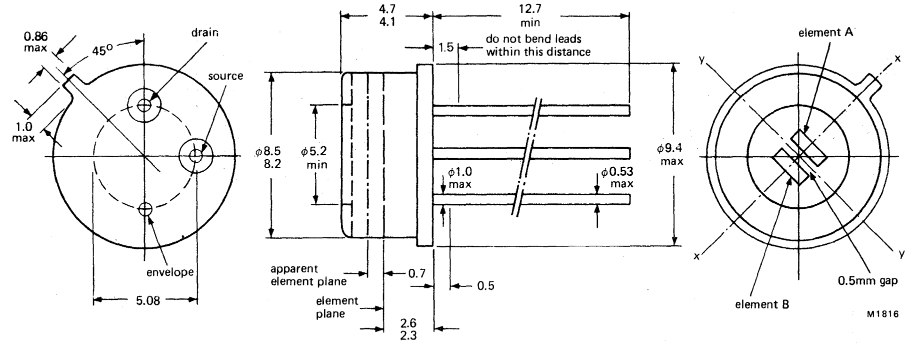


RPY93

MECHANICAL DATA

SOT-49E (low profile TO-5)

Dimensions in mm

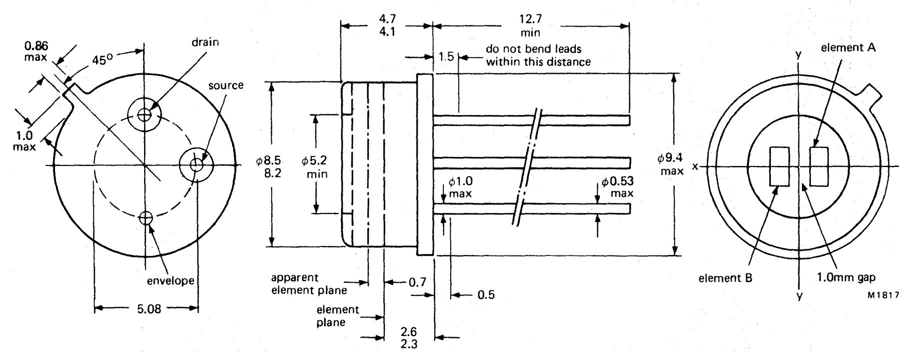


RPY94

MECHANICAL DATA

SOT-49E (low profile TO-5)

Dimensions in mm

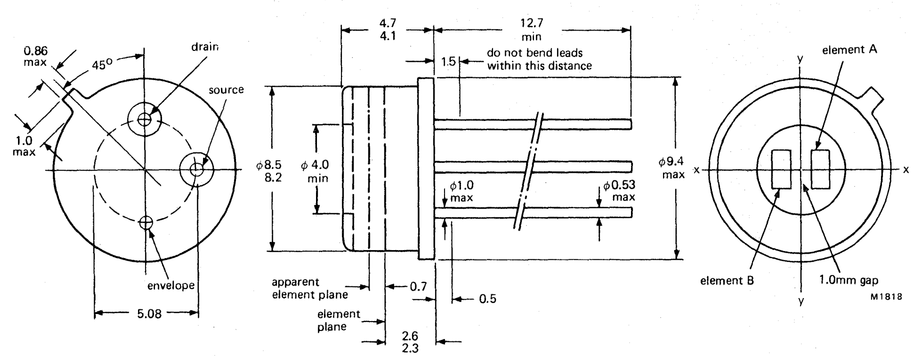


RPY95

MECHANICAL DATA

SOT-49F (low profile TO-5)

Dimensions in mm

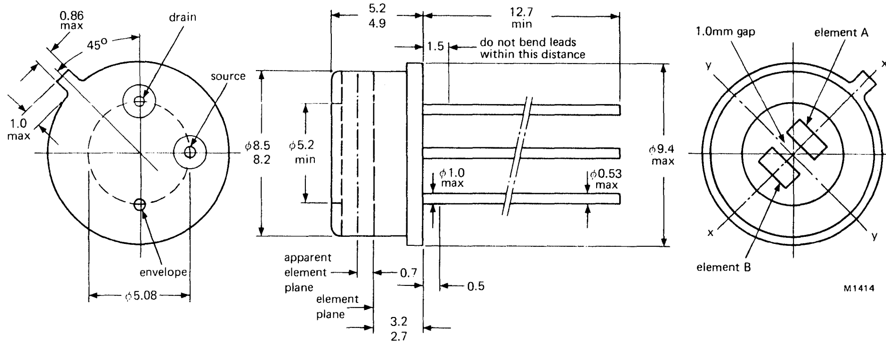


RPY103

MECHANICAL DATA

SOT-49H (TO-5 variant)

Dimensions in mm

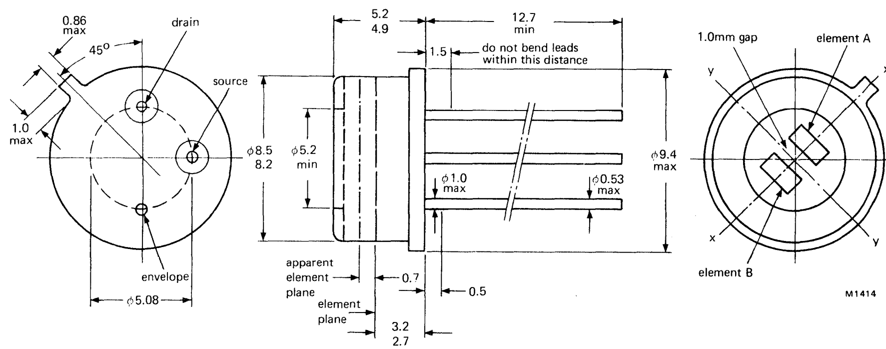


RPY97

MECHANICAL DATA

SOT-49H (TO-5 variant)

Dimensions in mm

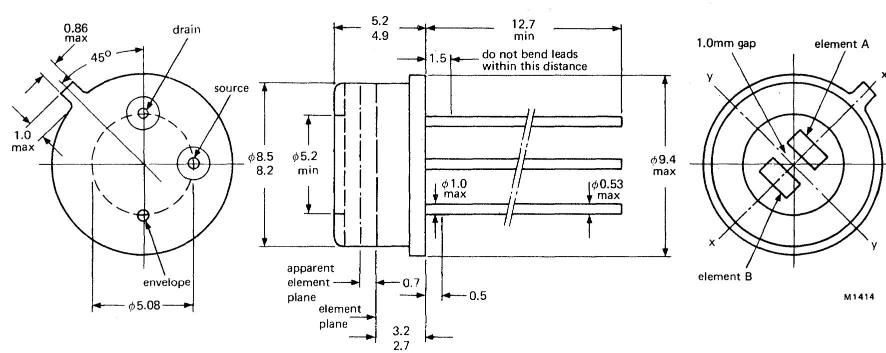


RPY97

MECHANICAL DATA

SOT-49H (TO-5 variant)

Dimensions in mm



OBSOLESCENT TYPES

RPY86

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to > 14	μm
Responsivity (10 μm, 10)	typ.	600	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1)	typ.	0.9×10^{-9}	$WHz^{-1/2}$
Element dimensions		2 x 1	mm
Field of View	typ.	110	degrees
Operating voltage		9	V
Optimum operating frequency range		0.1 to 1000	Hz

RPY87

QUICK REFERENCE DATA

Spectral Response		1.0 to > 15	μm
Responsivity (6 μm, 10)	typ.	500	VW^{-1}
Noise Equivalent Power (N.E.P.) (6 μm, 10, 1)	typ.	1.05×10^{-9}	$WHz^{-1/2}$
Element dimensions		2 x 1	mm
Field of View	typ.	110	degrees
Operating voltage		9	V
Optimum operating frequency range		0.1 to 1000	Hz

RPY88

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to > 14	μm
Responsivity (10 μm, 10)	typ.	300	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1)	typ.	1.65×10^{-9}	$WHz^{-1/2}$
Element dimensions		2 x 2	mm
Field of View	typ.	110	degrees
Operating voltage		9	V
Optimum operating frequency range		0.1 to 1000	Hz

RPY100

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10)	typ.	150	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1)	typ.	2.5×10^{-9}	$WHz^{-1/2}$
Peak signal (500 K, 1)	typ.	460	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	20	μV
Element dimensions	nom.	2 x 1	mm
Field of View in horizontal plane (x-x)	typ.	110	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

RPY107

QUICK REFERENCE DATA

Spectral Response		1.0 to >15	μm
Responsivity (500 K, 10)	typ.	130	VW^{-1}
Noise Equivalent Power (N.E.P.) (500 K, 10, 1)	typ.	3.0×10^{-9}	$WHz^{-1/2}$
Element dimensions		2 x 1	mm
Field of View	typ.	110	degrees
Operating voltage		3	V
Optimum operating frequency range		0.1 to 20	Hz

RPY102

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10)	typ.	75	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1)	typ.	5.0×10^{-9}	$WHz^{-1/2}$
Peak signal (500 K, 1)	typ.	460	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	15	μV
Element dimensions	nom.	2 x 2	mm
Field of view in horizontal plane (x-x)	typ.	110	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

OBSOLESCENT TYPES

RPY89

QUICK REFERENCE DATA

Spectral Response		1.0 to > 15	μm
Responsivity (6 μm, 10)	typ.	250	VW^{-1}
Noise Equivalent Power (N.E.P.) (6 μm, 10, 1)	typ.	2.0×10^{-9}	$WHz^{-1/2}$
Element dimensions		2 x 2	mm
Field of View	typ.	110	degrees
Operating voltage		9	V
Optimum operating frequency range		0.1 to 1000	Hz

RPY96

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to > 14	μm
Responsivity, (10 μm, 10)	typ.	130	VW^{-1}
Noise Equivalent Power (N.E.P.), (10 μm, 10, 1)	typ.	3.5×10^{-9}	$WHz^{-1/2}$
Element dimensions		2 x 1	mm
Field of view	typ.	105	degrees
Operating voltage		9	V
Optimum operating frequency range		0.1 to 1000	Hz

RPY109

QUICK REFERENCE DATA

Spectral response		1.0 to >15	μm
Responsivity (500 K, 10)	typ.	65	VW^{-1}
Noise Equivalent Power (N.E.P.) (500 K, 10, 1)	typ.	6.0×10^{-9}	$WHz^{-½}$
Peak signal (500 K, 1)	typ.	385	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	15	μV
Element dimensions	nom.	2 x 2	mm
Field of view in horizontal plane (x-x)	typ.	110	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

RPY100

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10)	typ.	150	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1)	typ.	2.5×10^{-9}	$WHz^{-½}$
Peak signal (500 K, 1)	typ.	460	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	20	μV
Element dimensions	nom.	2 x 1	mm
Field of View in horizontal plane (x-x)	typ.	110	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

OBSOLESCENT TYPES

RPY93

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to > 14	µm
Responsivity (10 µm, 10), each element	typ.	800	VW^{-1}
Noise Equivalent Power (N.E.P.), (10 µm, 10, 1), each element	typ.	1.4×10^{-9}	$WHz^{-1/2}$
Element dimensions, each element		2 x 0.75	mm
Element separation		0.5	mm
Field of View in horizontal plane (x-x)	typ.	120	degrees
Operating voltage		9	V
Optimum operating frequency range		0.1 to 1000	Hz

RPY94

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to > 14	µm
Responsivity (10 µm, 10), each element	typ.	650	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 µm, 10, 1), each element	typ.	1.5×10^{-9}	$WHz^{-1/2}$
Element dimensions, each element		2 x 1	mm
Element separation		1.0	mm
Field of View in horizontal plane (x-x)	typ.	130	degrees
Operating voltage		9	V
Optimum operating frequency range		0.1 to 1000	Hz

RPY95

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to > 14	µm
Responsivity (10 µm, 10), each element	typ.	450	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 µm, 10, 1), each element	typ.	2.1×10^{-9}	$WHz^{-1/2}$
Element dimensions, each element		2 x 1	mm
Element separation		1.0	mm
Field of View in horizontal plane (x-x)	typ.	110	degrees
Operating voltage		9	V
Optimum operating frequency range		0.1 to 1000	Hz

RPY103

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10), each element	typ.	150	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1), each element	typ.	2.2×10^{-9}	$WHz^{-1/2}$
Peak signal (500 K, 1)	typ.	460	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	15	μV
Element dimensions, each element	nom.	2 × 1	mm
Element separation	nom.	1	mm
Field of View in horizontal plane (x-x)	typ.	130	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

RPY97

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10), each element	typ.	150	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1), each element	typ.	2.5×10^{-9}	$WHz^{-1/2}$
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	22	μV
Element dimensions, each element	nom.	2.1 × 0.9	mm
Element separation	nom.	1.0	mm
Field of View in horizontal plane (x-x)	typ.	130	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

RPY97

QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10), each element	typ.	150	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1), each element	typ.	2.5×10^{-9}	$WHz^{-1/2}$
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	22	μV
Element dimensions, each element	nom.	2.1 × 0.9	mm
Element separation	nom.	1.0	mm
Field of View in horizontal plane (x-x)	typ.	130	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

DUAL ELEMENT PYROELECTRIC INFRARED DETECTOR

This is an infrared sensitive device specifically intended for battery operated passive infrared movement sensors such as intruder alarms and light switches. It has differentially connected dual elements which provide immunity from common mode signals such as those generated by variations in ambient temperature, background radiation and acoustic noise. The wide separation of the elements makes this detector compatible with most optical systems. The dual elements are combined with a single impedance converting amplifier, which is specially designed to function from low voltage supplies with low current consumption. The detector will give an output signal only when the radiation falling on the elements is unbalanced, as in a focused system. It is sealed in a low profile TO-5 can with a window optically coated to restrict the response to wavelengths greater than 6.5 μm.

QUICK REFERENCE DATA

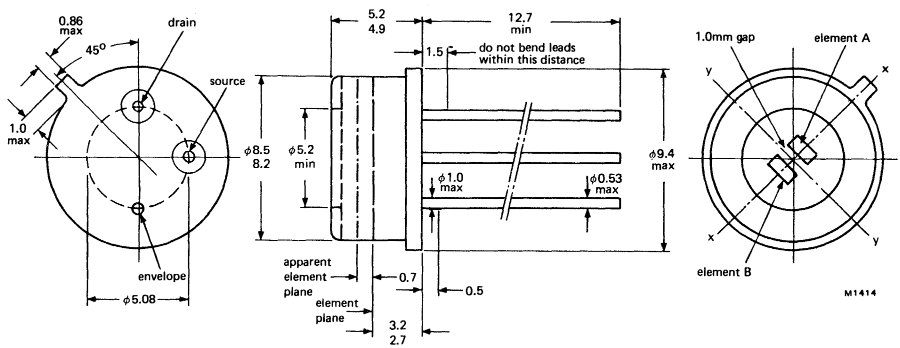
Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10), each element (see circuit 1)	typ.	150	VW^{-1}
Responsivity (10 μm, 10), each element (see circuit 2)	*typ.*	*720*	*VW^{-1}*
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1), each element	typ.	2.5×10^{-9}	$WHz^{-1/2}$
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	22	μV
Element dimensions, each element	nom.	2.1 × 0.9	mm
Element separation	nom.	1.0	mm
Field of View in horizontal plane (x-x)	typ.	130	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS— OPTOELECTRONIC DEVICES

MECHANICAL DATA

Dimensions in mm

SOT-49H (TO-5 variant)



PRODUCT SAFETY

Modern high technology materials have been used in the manufacture of this device to ensure high performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the device is heated to destruction. In the United Kindom disposal of large quantities should therefore be carried out in accordance with the Deposit of Poisonous Waste Act 1972 and the Control of Pollution Act 1974, or with the latest legislation.

SOLDERING

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

RATINGS

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

Supply voltage	max.	30	V
Temperature, operating range		−40 to +70	°C
Temperature, storage range		−55 to +85	°C
Lead soldering temperature, ⩾ 6 mm from header, t_{sld} ⩽ 3 s max.		+350	°C

OPERATING CONDITIONS

	min.	max.	
Voltage (operating note 5)	3	10	V
Frequency (operating note 5)	0.1	20	Hz

OPERATING NOTES

1. The case potential must not be allowed to become positive with respect to the other two terminals.
2. It is inadvisable to operate the detector at mains related frequencies.
3. To avoid the possibility of optical microphony, the detector must be firmly mounted.
4. An increase in temperature of element A will produce a positive going signal at the output. For element B, the corresponding output will be negative going.
5. The detector will operate outside the quoted range but may have a degraded performance.
6. Before testing, due to the high sensitivity of these detectors, care must be taken to ensure that the devices are allowed to become thermally stable.

CHARACTERISTICS (at T_{amb} = 22 °C ± 3 °C and with recommended circuit 1).

		min.	typ.	max.	
Spectral Response		6.5 ± 0.5	–	> 14	μm
Responsivity* (10 μm, 10)	note 1	95	150	–	VW^{-1}
Responsivity (10 μm, 10)	*note 5*	–	*720*	–	VW^{-1}
N.E.P. (10 μm, 10, 1)	note 1	–	2.5×10^{-9}	–	$WHz^{-1/2}$
Element matching*	note 2	–	–	± 20	%
Noise*, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	note 4	–	22	50	μV
Field of View (x-x plane, total angle)	note 3	–	130	–	degrees
Quiescent current		–	10	–	μA
Element dimensions			2.1 × 0.9 nominal		mm
Element separation			1.0 nominal		mm

*These parameters are 100% tested with statistical sample quality inspection.

FET Characteristics (at T_{amb} = 22 °C ± 3 °C)

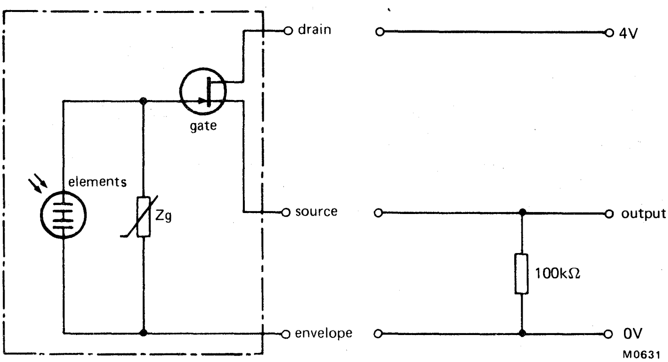
		min.	typ.	max.	
Gate-Source Cut-off Voltage I_D = 0.1 μA, V_{DS} = 6 V	$V_{(P)GS}$	−1.2	–	−0.5	V
Transfer Conductance V_{GS} = 0, V_{DS} = 6 V, f = 1.0 kHz	g_{fso}	1.3	–	–	mAV^{-1}

Notes

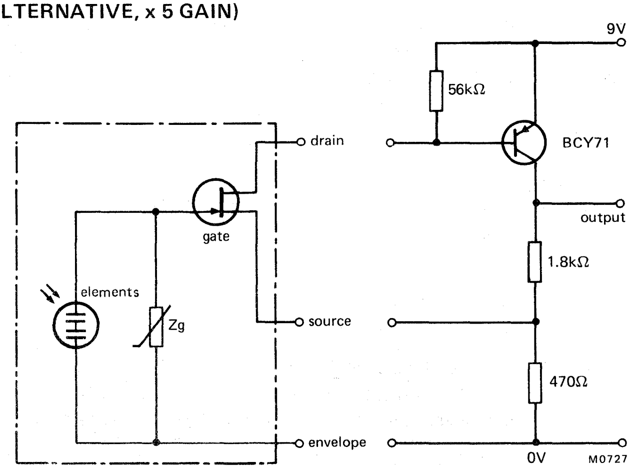
1. Each element. These characteristics apply throughout the spectral response range.
2. With both elements irradiated, the matching of the element signals is derived from:—

   $$\frac{\Delta S}{\frac{1}{2}(S_A + S_B)} \times 100$$, where S_A and S_B are the signals of the two elements and ΔS is the signal with both elements irradiated.
3. Field of view to 50% of the maximum signal level.
4. Using low noise filter with 3 dB bandwidth and roll off at 12 dB per octave. Detectors tested for 1 minute under stable electrical and thermal conditions; see operating note 6.
5. The RPY97 has been specifed in conjunction with a source follower circuit with a typical gain of 0.9. For comparison with the older type dual element detectors, the alternative circuit shown on page 4 should be used. This explains the difference in responsivity levels.

CIRCUIT 1 (RECOMMENDED)



CIRCUIT 2 (ALTERNATIVE, x 5 GAIN)



DEFINITIONS

1. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped radiant power. The published values of responsivity are qualified by figures in brackets, for example (10 μm, 10). The 10 μm denotes the wavelength of the infrared radiation generating the signal voltage, while the 10 indicates that the radiation is chopped at a frequency of 10 Hz.

2. Noise Equivalent Power (N.E.P.) $WHz^{-1/2}$
   This is the r.m.s. value of the incident, chopped radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $VHz^{-1/2}$. As with responsivity the relevant test conditions must be specified, for example (10 μm, 10, 1). The 10 μm is the wavelength of the incident radiation, 10 is the chopping frequency in Hz, and 1 is the bandwidth in Hz.

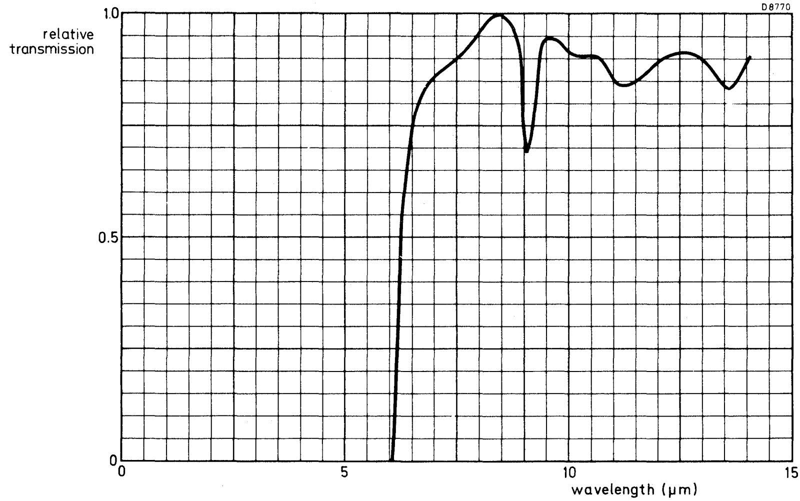
MECHANICAL AND ENVIRONMENTAL STANDARDS

As part of the Quality Assurance programme, the detectors are assessed at regular intervals against the requirements of the following IEC standards. The frequency of testing and the limits and conditions for the pre- and post-test measurements are based on those stipulated for the CECC 50 000 series of approved transistors.

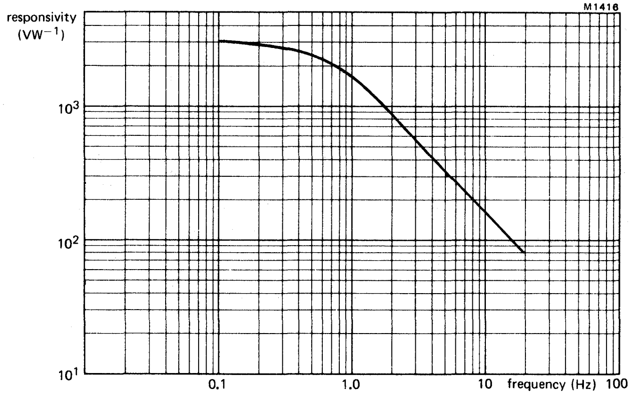
Test			Severity	Duration	Note
IEC 68-2-3	Ca	Damp Heat, steady state	+40 °C, 95% RH	168 hours	1
68-2-20	Ta	Solderability	+235 °C, 1.5 mm from header	5 seconds	1
68-2-21	Ub	Lead Fatigue	4 cycles	–	1
68-2-1	Aa	Low Temperature Storage	–55 °C	2000 hours	2
68-2-2	Ba	High Temperature Storage	+85 °C	2000 hours	2
68-2-14	Nb	Change of Temperature	–55 °C to +85 °C	10 cycles	2
68-2-6	Fc (B4)	Vibration, swept frequency	125 Hz to 2 kHz 196 ms^{-2}	2 h in each orientation	2
68-2-7	Ga	Acceleration, steady state	196000 ms^{-2}	60 seconds	2
68-2-27	Ea	Shock	14700 ms^{-2}	3 pulses 6 orientations	2
68-2-20	Tb	Resistance to Solder Heat	+350 °C, 6 mm from header	3 seconds	3

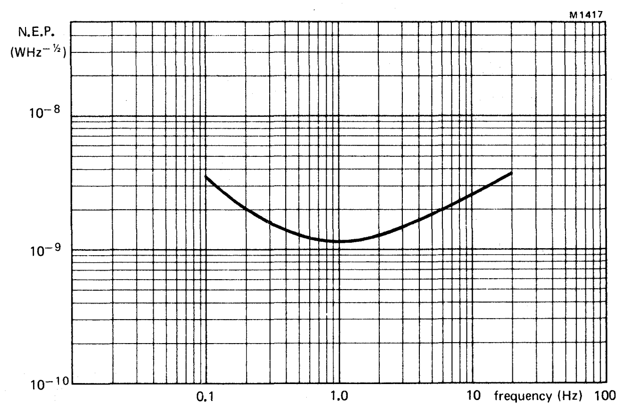
Notes

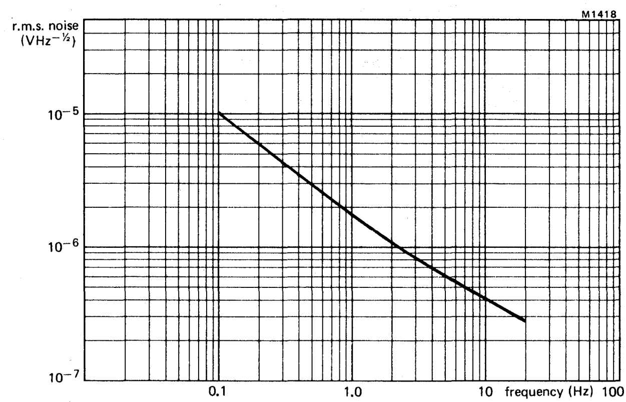
1. The detectors are checked on a production batch release principle at approximately weekly intervals. This is equivalent to Group B.
2. The detectors are checked at quarterly intervals. This is equivalent to Group C.
3. This is an annual check.



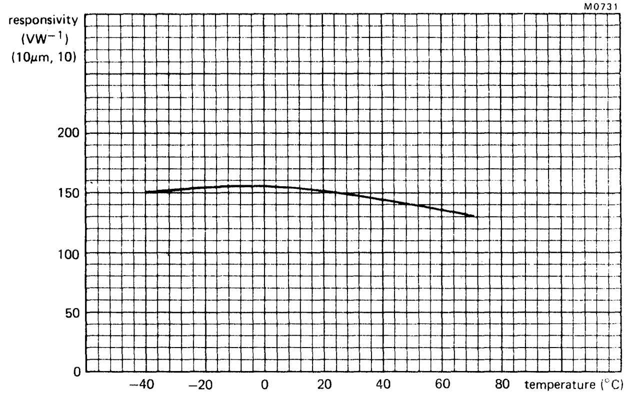
Typical normalized window transmission characteristic

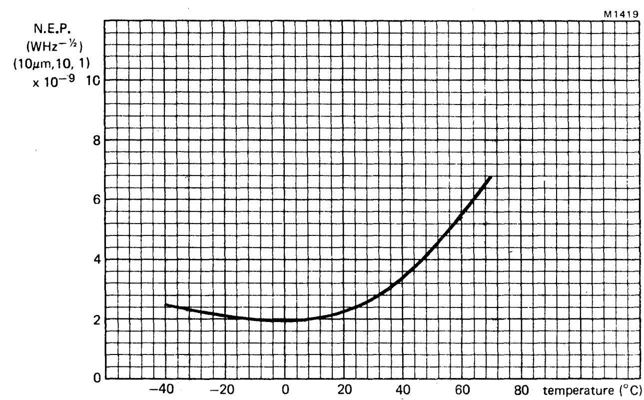


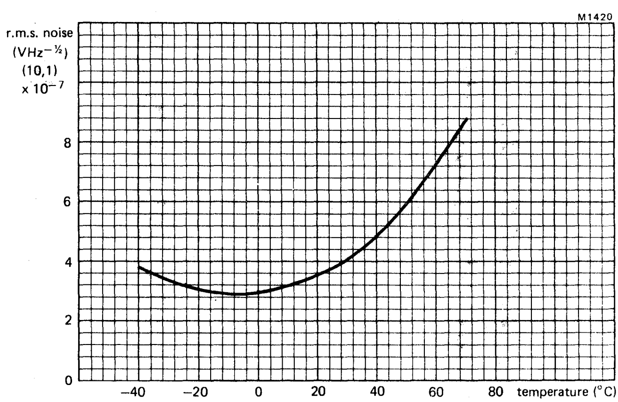




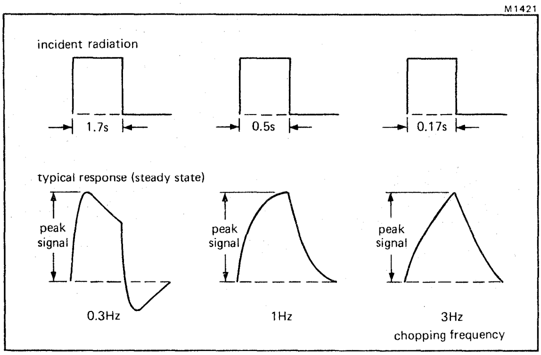
Typical Responsivity, N.E.P., and r.m.s. Noise as functions of Frequency, using recommended circuit 1 (one element screened).



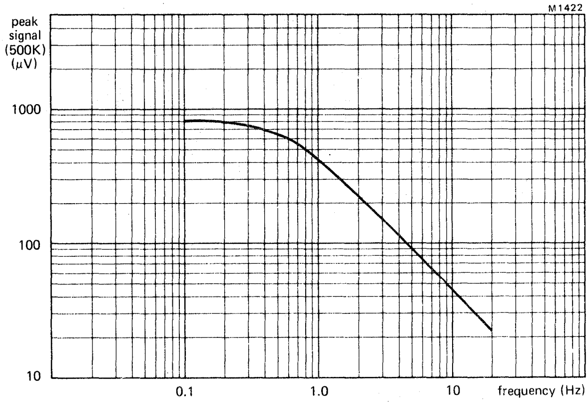




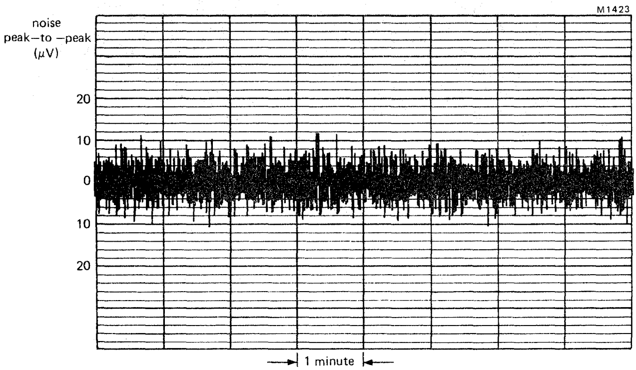
Typical Responsivity, N.E.P., and Noise as functions of Temperature, using recommended circuit 1 (one element screened).



Typical response (steady state) for a given chopping frequency

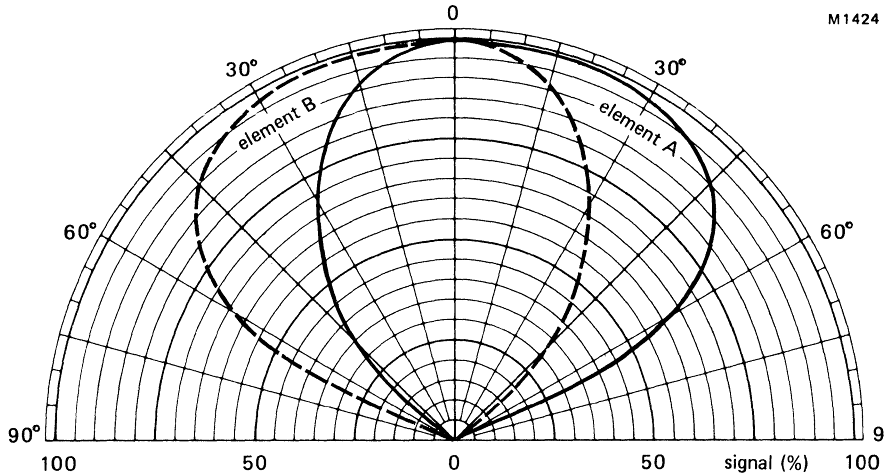


Typical Peak Signal as a function of Frequency
(energy level 25 μWcm^{-2} at the detector and one element screened)

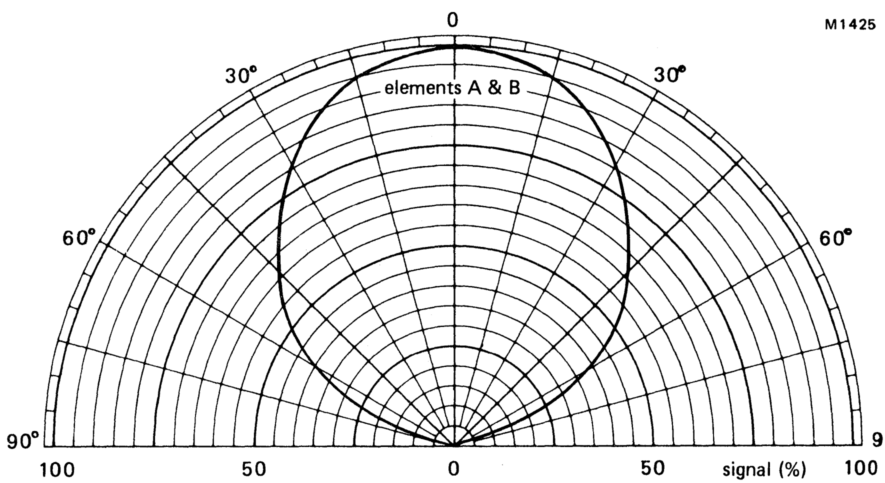


Typical peak-to-peak Noise as a function of Time
(filter bandwidth 0.5 Hz to 5 Hz)

POLAR DIAGRAMS



Typical Field of View in x-x plane (see Mechanical Data)



Typical Field of View in y-y plane (see Mechanical Data)

SINGLE ELEMENT PYROELECTRIC INFRARED DETECTOR

This is an infrared sensitive device intended for battery operated passive infrared movement sensors such as intruder alarms in which high grade optics e.g. multi-faceted mirrors or Fresnel lenses are used. The element is combined with a single impedance converting amplifier which is specially designed to function from low voltage supplies with low current consumption. The detector is sealed in a low profile TO-5 can with a window optically coated to restrict response to wavelengths greater than 6.5 μm.

QUICK REFERENCE DATA

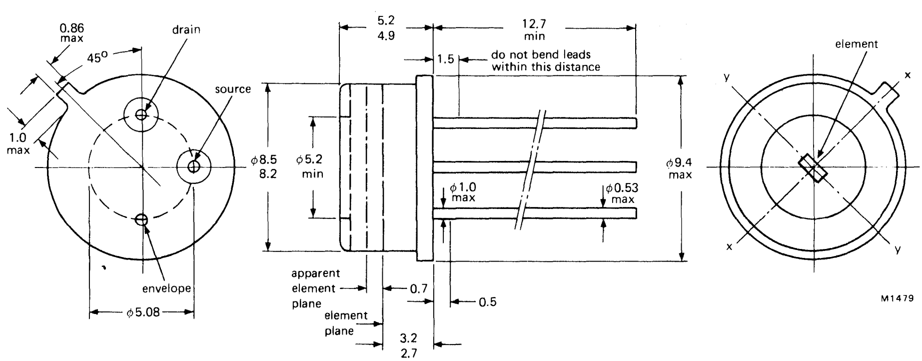
Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10)	typ.	150	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1)	typ.	2.5×10^{-9}	$WHz^{-1/2}$
Peak signal (500 K, 1)	typ.	460	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	20	μV
Element dimensions	nom.	2 x 1	mm
Field of View in horizontal plane (x-x)	typ.	110	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – OPTOELECTRONIC DEVICES

MECHANICAL DATA

Dimensions in mm

SOT-49H (TO-5 variant)



PRODUCT SAFETY

Modern high technology materials have been used in the manufacture of this device to ensure high performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the device is heated to destruction. In the United Kindom disposal of large quantities should therefore be carried out in accordance with the Deposit of Poisonous Waste Act 1972 and the Control of Pollution Act 1974, or with the latest legislation.

SOLDERING

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

RATINGS

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

Supply voltage	max.	30	V
Temperature, operating range		−40 to +70	°C
Temperature, storage range		−55 to +85	°C
Lead soldering temperature, ⩾ 6 mm from header, $t_{sld} \leqslant 3$ s max.		+350	°C

OPERATING CONDITIONS

	min.	max.	
Voltage (operating note 5)	3	10	V
Frequency (operating note 5)	0.1	20	Hz

OPERATING NOTES

1. The case potential must not be allowed to become positive with respect to the other two terminals.
2. It is inadvisable to operate the detector at mains related frequencies.
3. To avoid the possibility of optical microphony, the detector must be firmly mounted.
4. An increase in temperature of the element will produce a positive going signal at the output.
5. The detector will operate outside the quoted range but may have a degraded performance.
6. Before testing, due to the high sensitivity of these detectors, care must be taken to ensure that the devices are allowed to become thermally stable.

CHARACTERISTICS (at T_{amb} = 22 °C ± 3 °C and with recommended circuit)

		min.	typ.	max.	
Spectral Response		6.5 ± 0.5	—	>14	μm
Responsivity* (10 μm, 10)		95	150	—	VW^{-1}
N.E.P. (10 μm, 10, 1)		—	2.5×10^{-9}	—	$WHz^{-1/2}$
Peak signal (500 K, 1)	note 1	—	460	—	μV
Noise*, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	note 2	—	20	45	μV
Field of View (x-x plane, total angle)	note 3	90	110	—	degrees
(y-y plane, total angle)	note 3	90	110	—	degrees
Quiescent current		—	10	—	μA
Element dimensions			2 x 1 nominal		mm

*These parameters are 100% tested with statistical sample quality inspection.

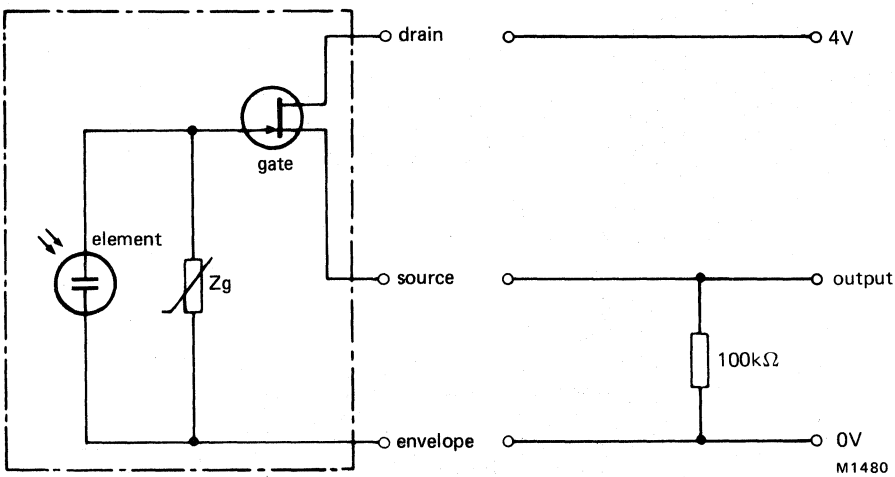
FET Characteristics (at T_{amb} = 22 °C ± 3 °C)

		min.	typ.	max.	
Gate-Source Cut-off Voltage I_D = 0.1 μA, V_{DS} = 6 V	$V_{P(GS)}$	−1.2	—	−0.5	V
Transfer Conductance V_{GS} = 0, V_{DS} = 6 V, f = 1 kHz	g_{fso}	1.3	—	—	mAV^{-1}

Notes

1. At an energy level of 25 μWcm^{-2} at the detector.
2. Using low noise filter with 3 dB bandwidth and roll off at 12 dB per octave. Detectors tested for 1 minute under stable electrical and thermal conditions; see operating note 6.
3. Field of view to 50% of the maximum signal level.

RECOMMENDED CIRCUIT



DEFINITIONS

1. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped radiant power. The published values of responsivity are qualified by figures in brackets, for example (10 μm, 10). The 10 μm denotes the wavelength of the infrared radiation generating the signal voltage, while the 10 indicates that the radiation is chopped at a frequency of 10 Hz.

2. Noise Equivalent Power (N.E.P.) $WHz^{-1/2}$
   This is the r.m.s. value of the incident, chopped radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $VHz^{-1/2}$. As with responsivity the relevant test conditions must be specified, for example (10 μm, 10, 1). The 10 μm is the wavelength of the incident radiation, 10 is the chopping frequency in Hz, and 1 is the bandwidth in Hz.

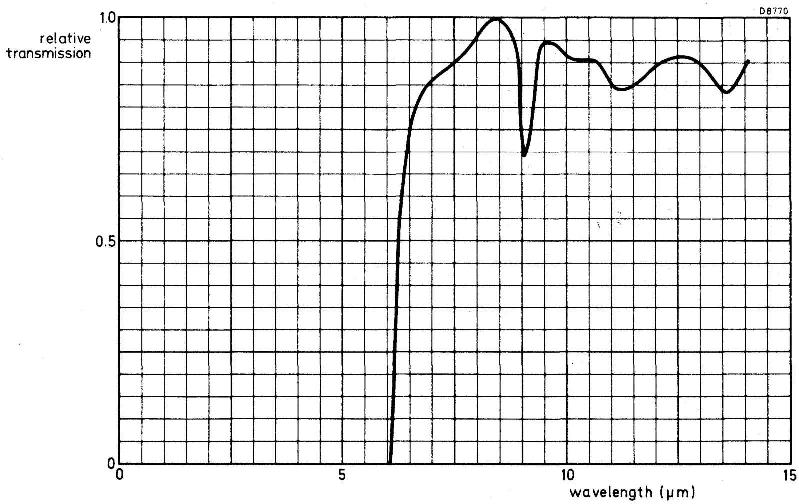
MECHANICAL AND ENVIRONMENTAL STANDARDS

As part of the Quality Assurance programme, the detectors are assessed at regular intervals against the requirements of the following IEC standards. The frequency of testing and the limits and conditions for the pre- and post-test measurements are based on those stipulated for the CECC 50 000 series of approved transistors.

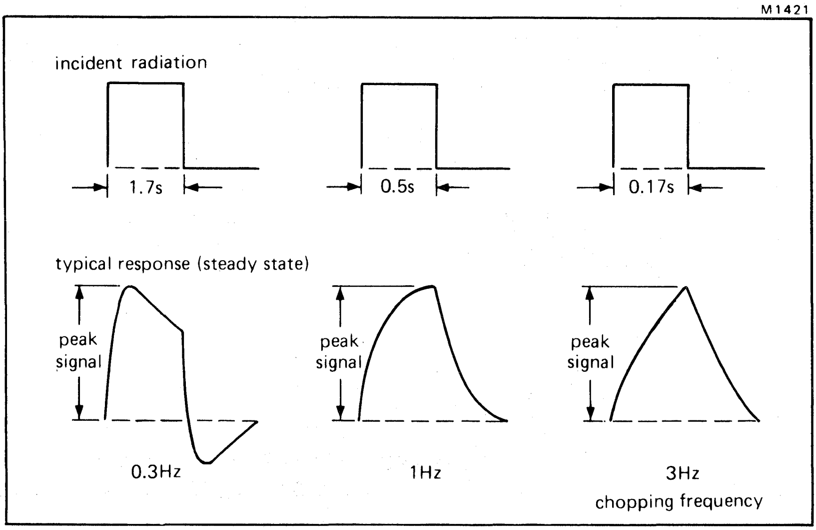
Test			Severity	Duration	Note
IEC 68-2-3	Ca	Damp Heat, steady state	+40 °C, 95% RH	168 hours	1
68-2-20	Ta	Solderability	+235 °C, 1.5 mm from header	5 seconds	1
68-2-21	Ub	Lead Fatigue	4 cycles	–	1
68-2-1	Aa	Low Temperature Storage	–55 °C	2000 hours	2
68-2-2	Ba	High Temperature Storage	+85 °C	2000 hours	2
68-2-14	Nb	Change of Temperature	–55 °C to +85 °C	10 cycles	2
68-2-6	Fc (B4)	Vibration, swept frequency	125 Hz to 2 kHz 196 ms^{-2}	2 h in each orientation	2
68-2-7	Ga	Acceleration, steady state	196000 ms^{-2}	60 seconds	2
68-2-27	Ea	Shock	14700 ms^{-2}	3 pulses 6 orientations	2
68-2-20	Tb	Resistance to Solder Heat	+350 °C, 6 mm from header	3 seconds	3

Notes

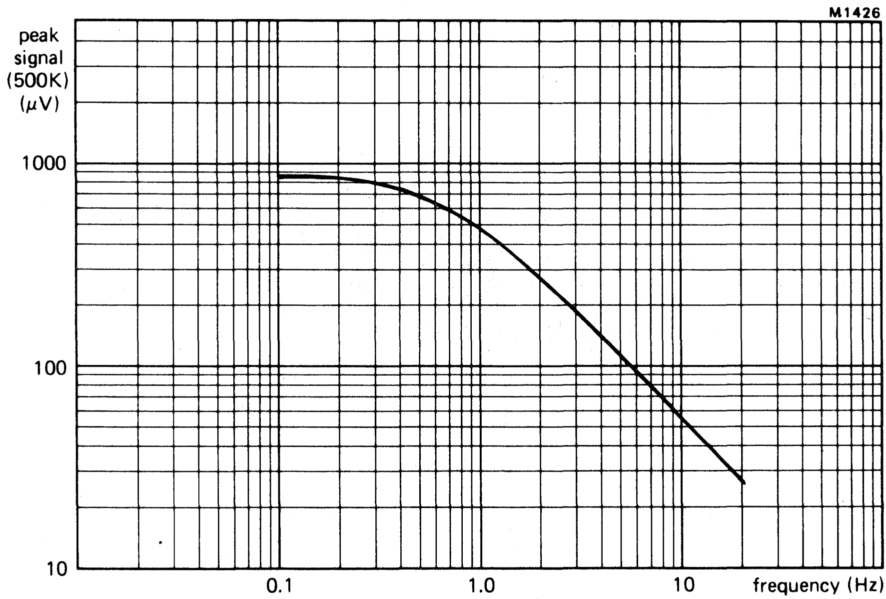
1. The detectors are checked on a production batch release principle at approximately weekly intervals. This is equivalent to Group B.
2. The detectors are checked at quarterly intervals. This is equivalent to Group C.
3. This is an annual check.



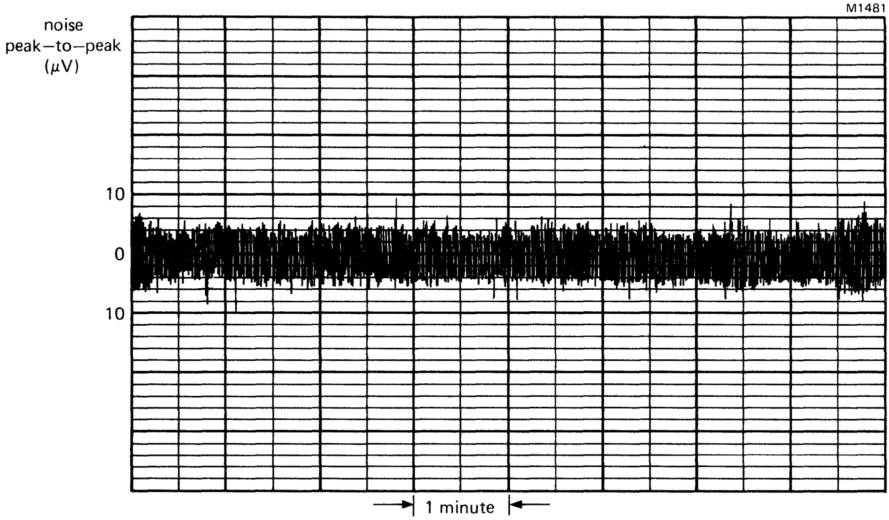
Typical normalized window transmission characteristic



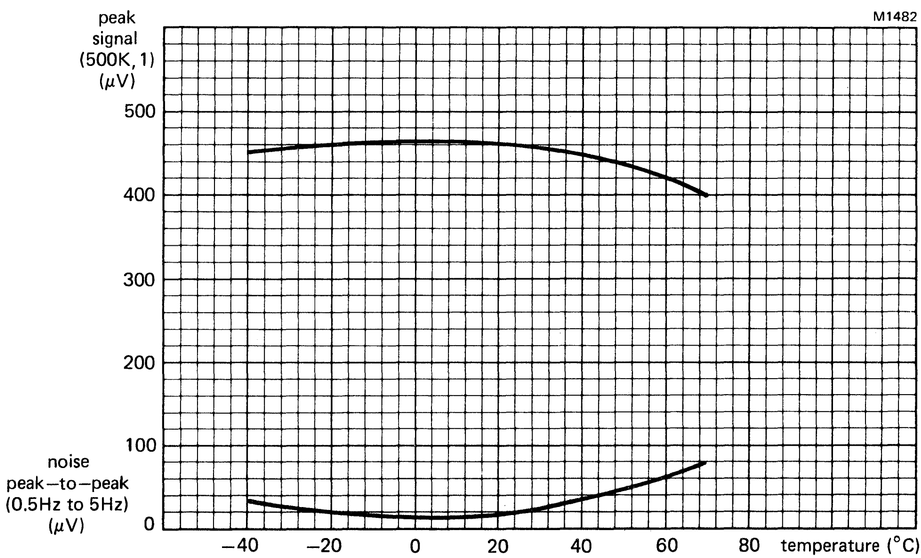
Typical response (steady state) for a given chopping frequency



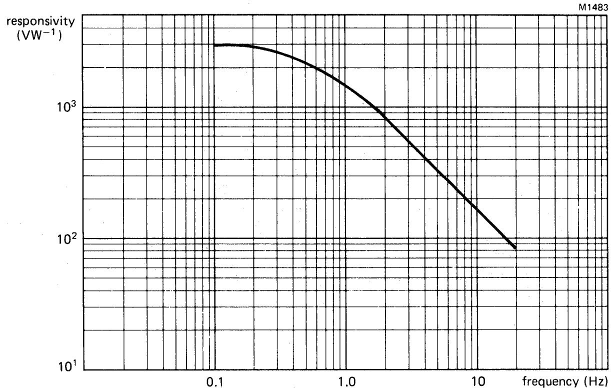
Typical peak Signal as a function of Frequency
(energy level 25 μWcm^{-2} at the detector)

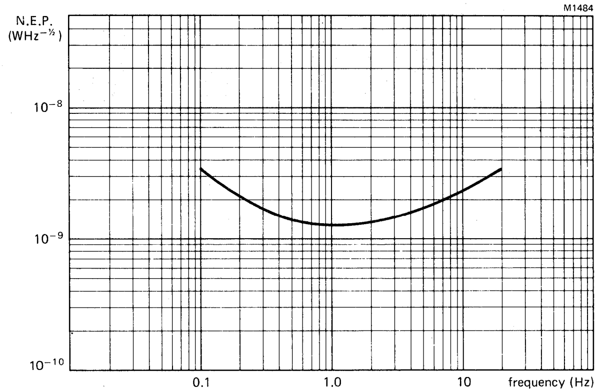


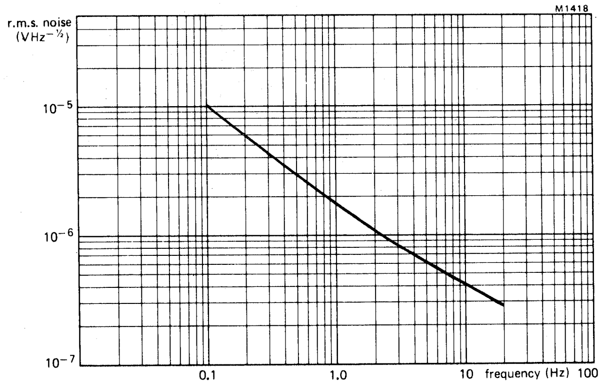
Typical peak-to-peak Noise as a function of Time
(filter bandwidth 0.5 Hz to 5 Hz)



Typical peak Signal and peak-to-peak Noise
as functions of Temperature
(peak Signal energy level, 25 μWcm^{-2} at the detector)

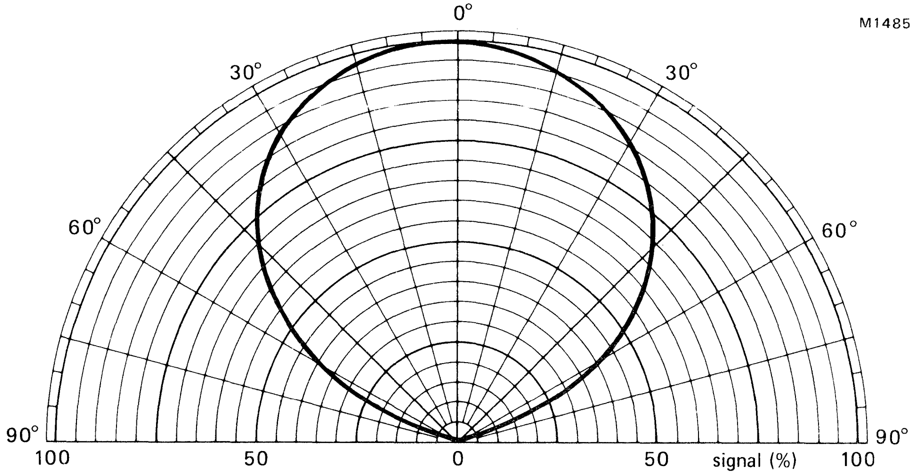




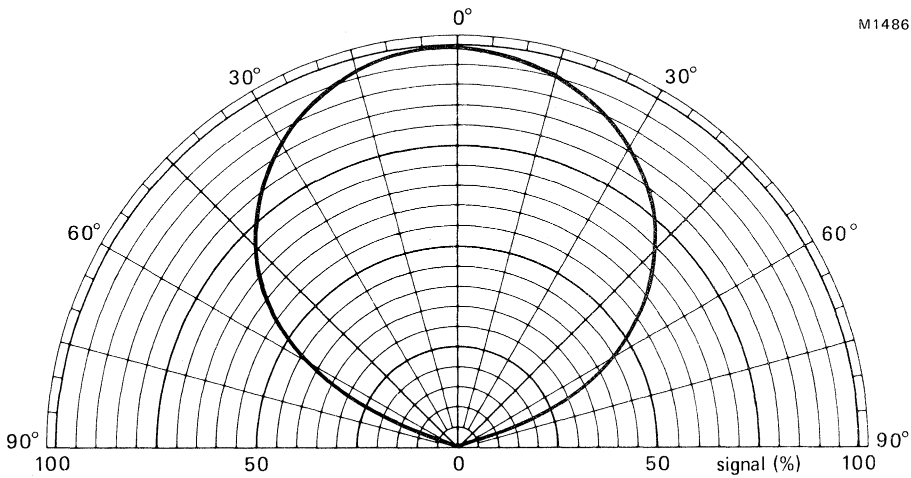


Typical Responsivity, N.E.P., and r.m.s. Noise as functions of Frequency, using recommended circuit.

POLAR DIAGRAMS



Typical Field of View in x-x plane (see Mechanical Data)



Typical Field of View in y-y plane (see Mechanical Data)

SINGLE ELEMENT PYROELECTRIC INFRARED DETECTOR

This is an infrared sensitive device intended for battery operated passive infrared movement sensors such as intruder alarms in which medium grade optics are used. The element is combined with a single impedance converting amplifier which is specially designed to function from low voltage supplies with low current consumption. The detector is sealed in a low profile TO-5 can with a window optically coated to restrict response to wavelengths greater than 6.5 μm.

QUICK REFERENCE DATA

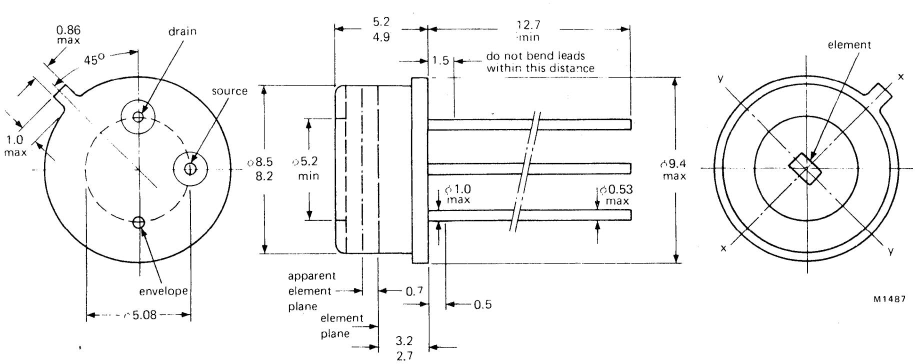
Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10)	typ.	150	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1)	typ.	3.8×10^{-9}	$WHz^{-1/2}$
Peak signal (500 K, 1)	typ.	460	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	18	μV
Element dimensions	nom.	2 x 1.5	mm
Field of View in horizontal plane (x-x)	typ.	110	degrees
Operating voltage	min.	3	
Optimum operating frequency range		0.1 to 20	Hz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – OPTOELECTRONIC DEVICES

MECHANICAL DATA

Dimensions in mm

SOT-49H (TO-5 variant)



PRODUCT SAFETY

Modern high technology materials have been used in the manufacture of this device to ensure high performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the device is heated to destruction. In the United Kindom disposal of large quantities should therefore be carried out in accordance with the Deposit of Poisonous Waste Act 1972 and the Control of Pollution Act 1974, or with the latest legislation.

SOLDERING

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

RATINGS

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

Supply voltage	max.	30	V
Temperature, operating range		–40 to +70	°C
Temperature, storage range		–55 to +85	°C
Lead soldering temperature, $\geqslant$ 6 mm from header, $t_{sld} \leqslant 3$ s max.		+350	°C

OPERATING CONDITIONS

	min.	max.	
Voltage (operating note 5)	3	10	V
Frequency (operating note 5)	0.1	20	Hz

OPERATING NOTES

1. The case potential must not be allowed to become positive with respect to the other two terminals.
2. It is inadvisable to operate the detector at mains related frequencies.
3. To avoid the possibility of optical microphony, the detector must be firmly mounted.
4. An increase in temperature of the element will produce a positive going signal at the output.
5. The detector will operate outside the quoted range but may have a degraded performance.
6. Before testing, due to the high sensitivity of these detectors, care must be taken to ensure that the devices are allowed to become thermally stable.

CHARACTERISTICS (at T_{amb} = 22 °C ± 3 °C and with recommended circuit)

		min.	typ.	max.	
Spectral Response		6.5 ± 0.5	—	>14	μm
Responsivity* (10 μm, 10)		65	100	—	VW^{-1}
N.E.P. (10 μm, 10, 1)		—	3.8 x 10^{-9}	—	WHz^{-1}
Peak signal (500 K, 1)	note 1	—	460	—	μV
Noise*, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	note 2	—	18	45	μV
Field of View (x-x plane, total angle)	note 3	90	110	—	degrees
(y-y plane, total angle)	note 3	90	110	—	degrees
Quiescent current		—	10	—	μA
Element dimensions			2 x 1.5 nominal		mm

*These parameters are 100% tested with statistical sample quality inspection.

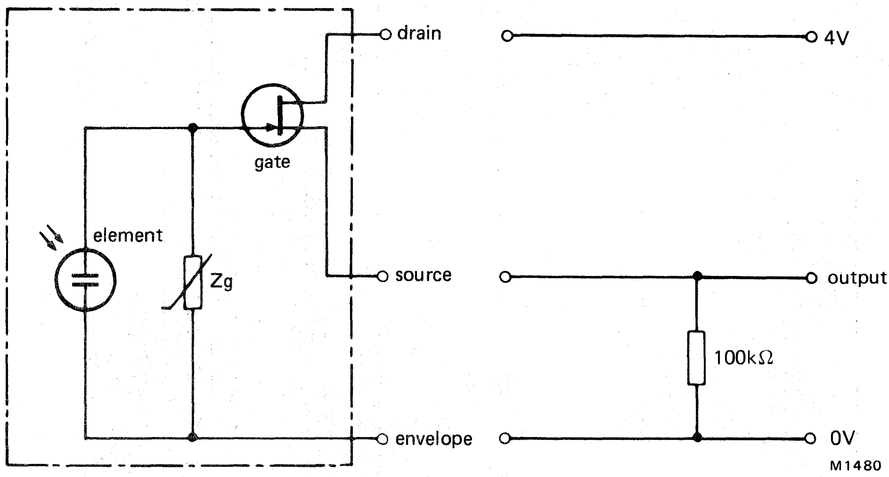
FET Characteristics (at T_{amb} = 22 °C ± 3 °C)

		min.	typ.	max.	
Gate-Source Cut-off Voltage I_D = 0.1 μA, V_{DS} = 6 V	$V_{P(GS)}$	−1.2	—	−0.5	V
Transfer Conductance V_{GS} = 0, V_{DS} = 6 V, f = 1 kHz	g_{fso}	1.3	—	—	mAV^{-1}

Notes

1. At an energy level of 25 μWcm^{-2} at the detector.
2. Using low noise filter with 3 dB bandwidth and roll off at 12 dB per octave. Detectors tested for 1 minute under stable electrical and thermal conditions; see operating note 6.
3. Field of view to 50% of the maximum signal level.

RECOMMENDED CIRCUIT



DEFINITIONS

1. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped radiant power. The published values of responsivity are qualified by figures in brackets, for example (10 μm, 10). The 10 μm denotes the wavelength of the infrared radiation generating the signal voltage, while the 10 indicates that the radiation is chopped at a frequency of 10 Hz.

2. Noise Equivalent Power (N.E.P.) $WHz^{-1/2}$
   This is the r.m.s. value of the incident, chopped radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $VHz^{-1/2}$. As with responsivity the relevant test conditions must be specified, for example (10 μm, 10, 1). The 10 μm is the wavelength of the incident radiation, 10 is the chopping frequency in Hz, and 1 is the bandwidth in Hz.

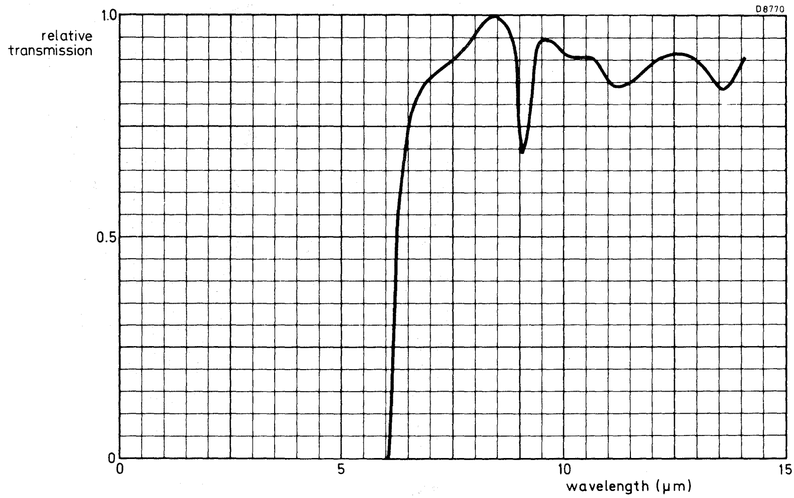
MECHANICAL AND ENVIRONMENTAL STANDARDS

As part of the Quality Assurance programme, the detectors are assessed at regular intervals against the requirements of the following IEC standards. The frequency of testing and the limits and conditions for the pre- and post-test measurements are based on those stipulated for the CECC 50 000 series of approved transistors.

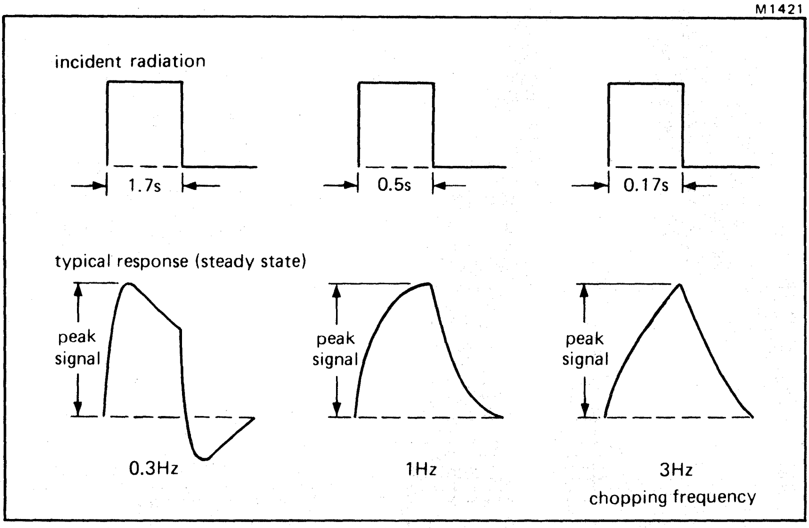
Test			Severity	Duration	Note
IEC 68-2-3	Ca	Damp Heat, steady state	+40 °C, 95% RH	168 hours	1
68-2-20	Ta	Solderability	+235 °C, 1.5 mm from header	5 seconds	1
68-2-21	Ub	Lead Fatigue	4 cycles	–	1
68-2-1	Aa	Low Temperature Storage	–55 °C	2000 hours	2
68-2-2	Ba	High Temperature Storage	+85 °C	2000 hours	2
68-2-14	Nb	Change of Temperature	–55 °C to +85 °C	10 cycles	2
68-2-6	Fc (B4)	Vibration, swept frequency	125 Hz to 2 kHz 196 ms^{-2}	2 h in each orientation	2
68-2-7	Ga	Acceleration, steady state	196000 ms^{-2}	60 seconds	2
68-2-27	Ea	Shock	14700 ms^{-2}	3 pulses 6 orientations	2
68-2-20	Tb	Resistance to Solder Heat	+350 °C, 6 mm from header	3 seconds	3

Notes

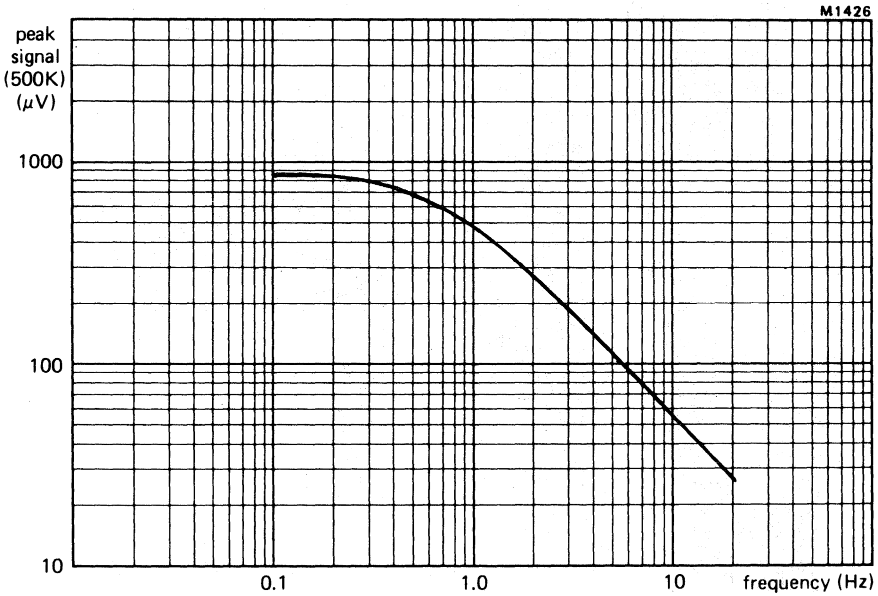
1. The detectors are checked on a production batch release principle at approximately weekly intervals. This is equivalent to Group B.
2. The detectors are checked at quarterly intervals. This is equivalent to Group C.
3. This is an annual check.



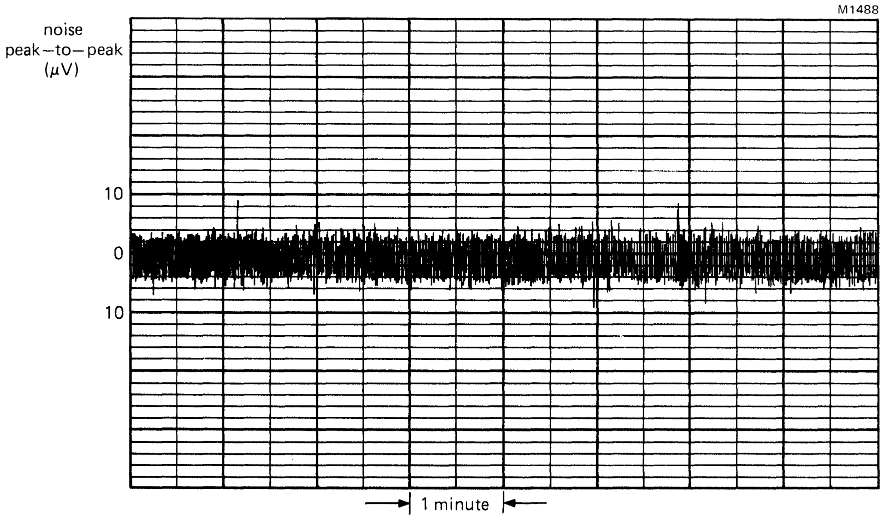
Typical normalized window transmission characteristic



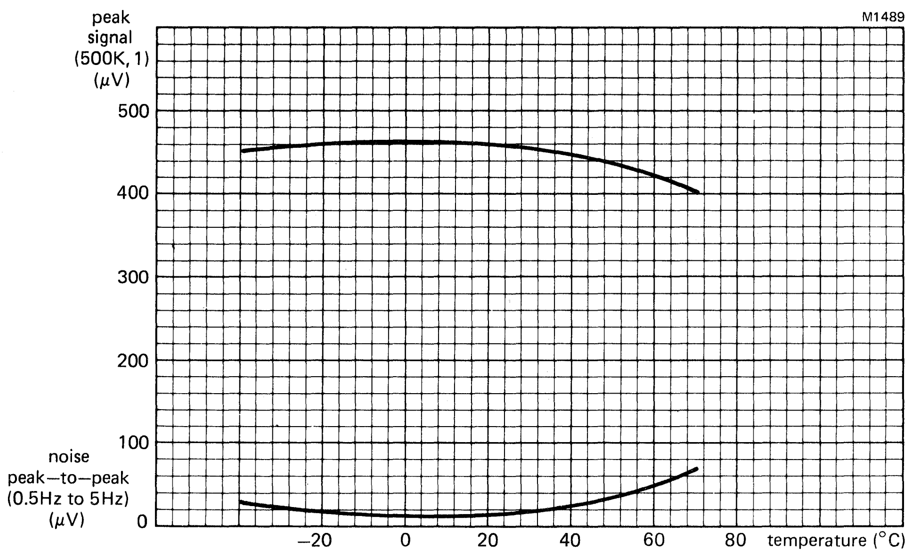
Typical response (steady state) for a given chopping frequency



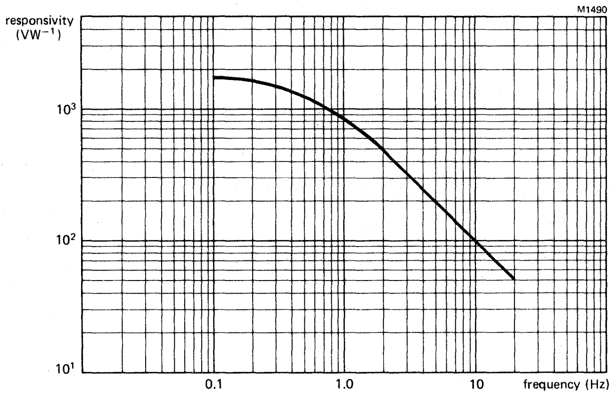
Typical peak Signal as a function of Frequency
(energy level 25 μWcm^{-2} at the detector)

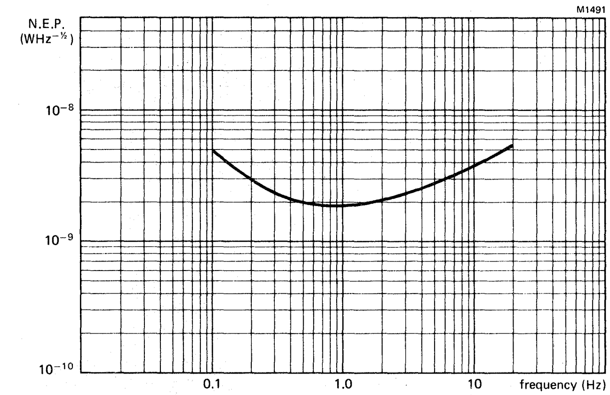


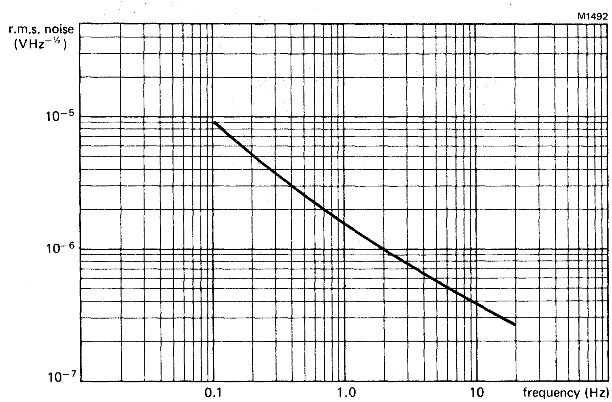
Typical peak-to-peak Noise as a function of Time
(filter bandwidth 0.5 Hz to 5 Hz)



Typical peak Signal and peak-to-peak Noise
as functions of Temperature
(peak Signal energy level, 25 μWcm^{-2} at the detector)

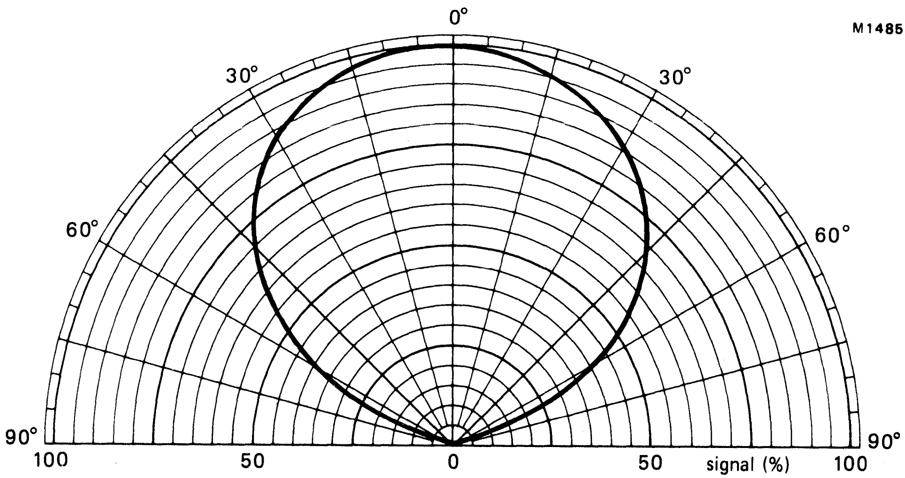




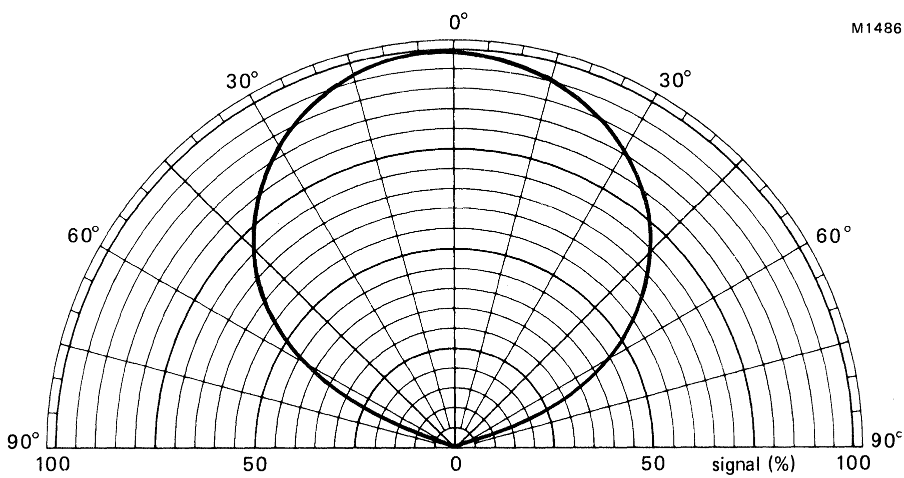


Typical Responsivity, N.E.P., and r.m.s. Noise as functions of Frequency, using recommended circuit.

POLAR DIAGRAMS



Typical Field of View in x-x plane (see Mechanical Data)



Typical Field of View in y-y plane (see Mechanical Data)

SINGLE ELEMENT PYROELECTRIC INFRARED DETECTOR

This is an infrared sensitive device intended for battery operated passive infrared movement sensors such as intruder alarms and light switches which use low grade or no optical focusing arrangements. The element is combined with a single impedance converting amplifier which is specially designed to function from low voltage supplies with low current consumption. The detector is sealed in a low profile TO-5 can with a window optically coated to restrict response to wavelengths greater than 6.5 μm.

QUICK REFERENCE DATA

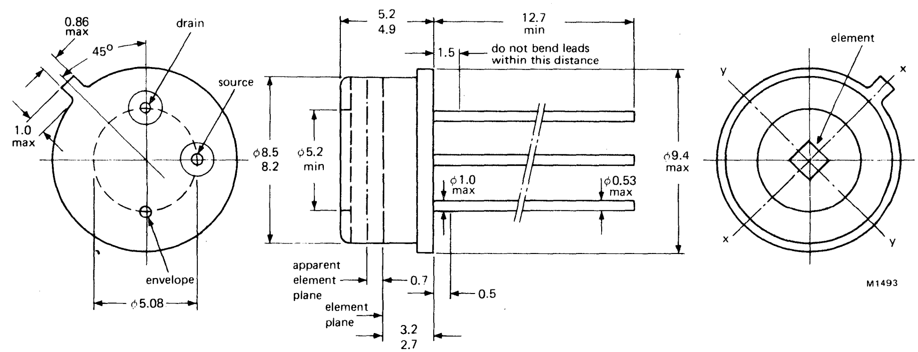
Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10)	typ.	75	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1)	typ.	5.0×10^{-9}	$WHz^{-1/2}$
Peak signal (500 K, 1)	typ.	460	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	15	μV
Element dimensions	nom.	2 x 2	mm
Field of view in horizontal plane (x-x)	typ.	110	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – OPTOELECTRONIC DEVICES

MECHANICAL DATA

Dimensions in mm

SOT-49H (TO-5 variant)



PRODUCT SAFETY

Modern high technology materials have been used in the manufacture of this device to ensure high performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the device is heated to destruction. In the United Kindom disposal of large quantities should therefore be carried out in accordance with the Deposit of Poisonous Waste Act 1972 and the Control of Pollution Act 1974, or with the latest legislation.

SOLDERING

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

RATINGS

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

Supply voltage	max.	30	V
Temperature, operating range		−40 to +70	°C
Temperature, storage range		−55 to +85	°C
Lead soldering temperature, ⩾ 6 mm from header, $t_{sld} \leqslant 3$ s max.		+350	°C

OPERATING CONDITIONS

	min.	max.	
Voltage (operating note 5)	3	10	V
Frequency (operating note 5)	0.1	20	Hz

OPERATING NOTES

1. The case potential must not be allowed to become positive with respect to the other two terminals.
2. It is inadvisable to operate the detector at mains related frequencies.
3. To avoid the possibility of optical microphony, the detector must be firmly mounted.
4. An increase in temperature of the element will produce a positive going signal at the output.
5. The detector will operate outside the quoted range but may have a degraded performance.
6. Before testing, due to the high sensitivity of these detectors, care must be taken to ensure that the devices are allowed to become thermally stable.

CHARACTERISTICS (at T_{amb} = 22 °C ± 3 °C and with recommended circuit)

		min.	typ.	max.	
Spectral Response		6.5 ± 0.5	—	>14	μm
Responsivity* (10 μm, 10)		50	75	—	VW^{-1}
N.E.P. (10 μm, 10, 1)		—	5.0×10^{-9}	—	WHz^{-1}
Peak signal (500 K, 1)	note 1	—	460	—	μV
Noise*, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	note 2	—	15	45	μV
Field of View (x-x plane, total angle)	note 3	90	110	—	degrees
(y-y plane, total angle)	note 3	90	110	—	degrees
Quiescent current		—	10	—	μA
Element dimensions			2 x 2 nominal		mm

*These parameters are 100% tested with statistical sample quality inspection.

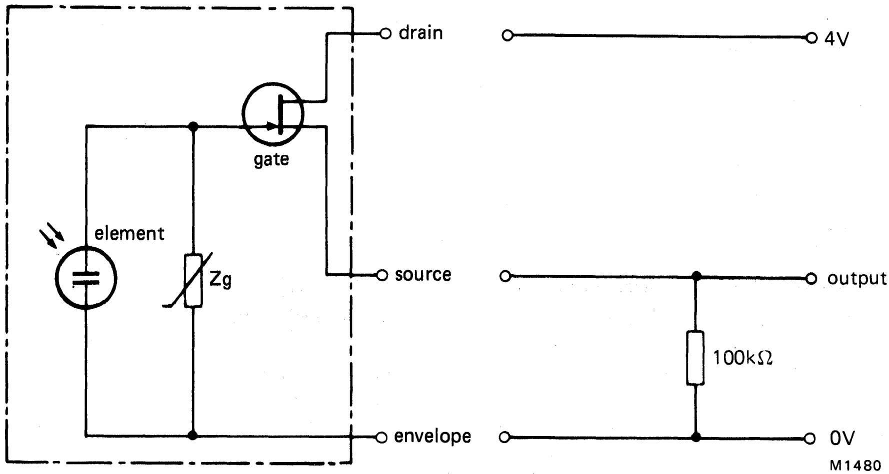
FET Characteristics (at T_{amb} = 22 °C ± 3 °C)

		min.	typ.	max.	
Gate-Source Cut-off Voltage I_D = 0.1 μA, V_{DS} = 6 V	$V_{P(GS)}$	−1.2	—	−0.5	V
Transfer Conductance V_{GS} = 0, V_{DS} = 6 V, f = 1 kHz	g_{fso}	1.3	—	—	mAV^{-1}

Notes

1. At an energy level of 25 μWcm^{-2} at the detector.
2. Using low noise filter with 3 dB bandwidth and roll off at 12 dB per octave. Detectors tested for 1 minute under stable electrical and thermal conditions; see operating note 6.
3. Field of view to 50% of the maximum signal level.

RECOMMENDED CIRCUIT



DEFINITIONS

1. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped radiant power. The published values of responsivity are qualified by figures in brackets, for example (10 μm, 10). The 10 μm denotes the wavelength of the infrared radiation generating the signal voltage, while the 10 indicates that the radiation is chopped at a frequency of 10 Hz.

2. Noise Equivalent Power (N.E.P.) $WHz^{-1/2}$
   This is the r.m.s. value of the incident, chopped radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $VHz^{-1/2}$. As with responsivity the relevant test conditions must be specified, for example (10 μm, 10, 1). The 10 μm is the wavelength of the incident radiation, 10 is the chopping frequency in Hz, and 1 is the bandwidth in Hz.

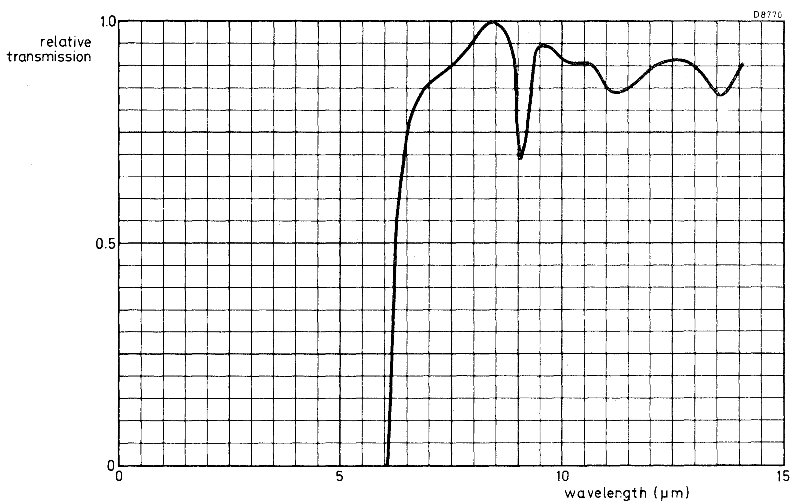
MECHANICAL AND ENVIRONMENTAL STANDARDS

As part of the Quality Assurance programme, the detectors are assessed at regular intervals against the requirements of the following IEC standards. The frequency of testing and the limits and conditions for the pre- and post-test measurements are based on those stipulated for the CECC 50 000 series of approved transistors.

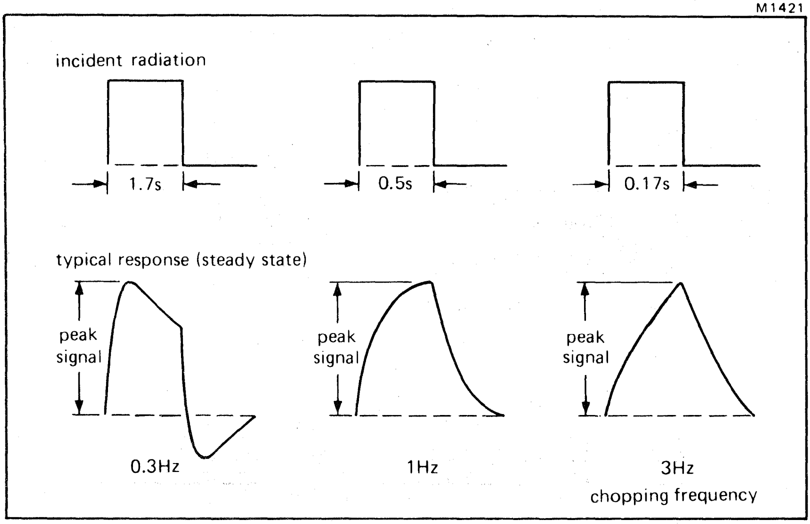
	Test		Severity	Duration	Note
IEC 68-2-3	Ca	Damp Heat, steady state	+40 °C, 95% RH	168 hours	1
68-2-20	Ta	Solderability	+235 °C, 1.5 mm from header	5 seconds	1
68-2-21	Ub	Lead Fatigue	4 cycles	–	1
68-2-1	Aa	Low Temperature Storage	–55 °C	2000 hours	2
68-2-2	Ba	High Temperature Storage	+85 °C	2000 hours	2
68-2-14	Nb	Change of Temperature	–55 °C to +85 °C	10 cycles	2
68-2-6	Fc (B4)	Vibration, swept frequency	125 Hz to 2 kHz 196 ms^{-2}	2 h in each orientation	2
68-2-7	Ga	Acceleration, steady state	196000 ms^{-2}	60 seconds	2
68-2-27	Ea	Shock	14700 ms^{-2}	3 pulses 6 orientations	2
68-2-20	Tb	Resistance to Solder Heat	+350 °C, 6 mm from header	3 seconds	3

Notes

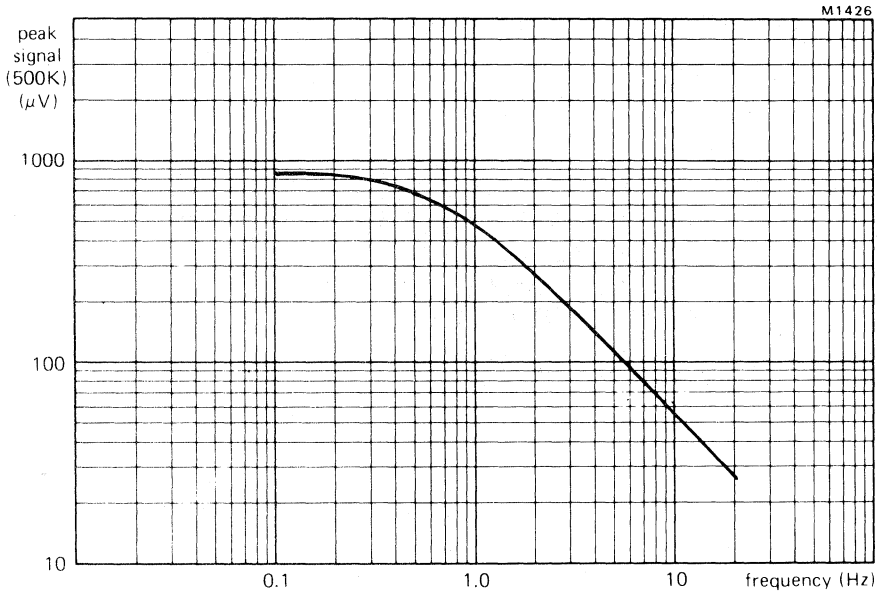
1. The detectors are checked on a production batch release principle at approximately weekly intervals. This is equivalent to Group B.
2. The detectors are checked at quarterly intervals. This is equivalent to Group C.
3. This is an annual check.



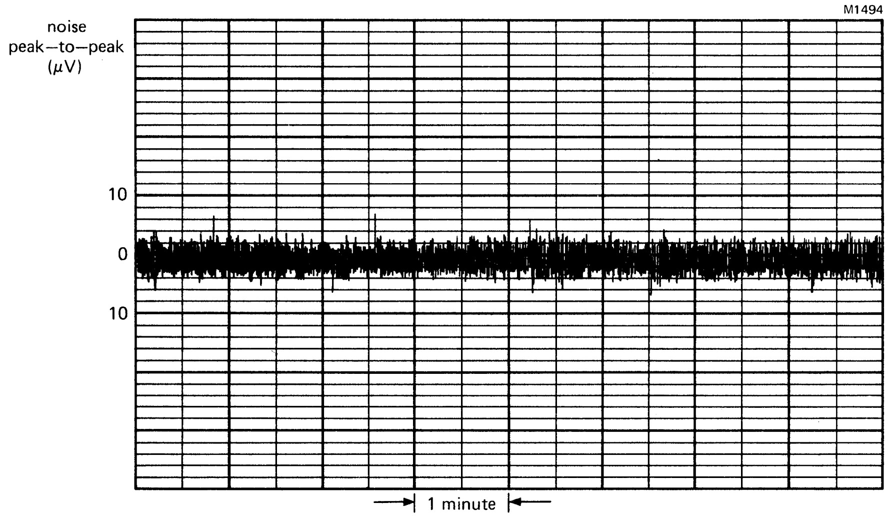
Typical normalized window transmission characteristic



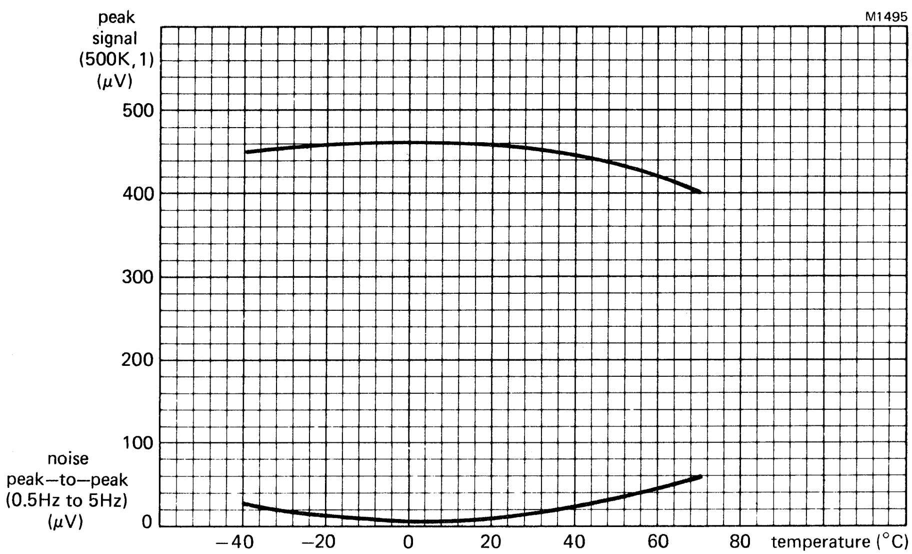
Typical response (steady state) for a given chopping frequency



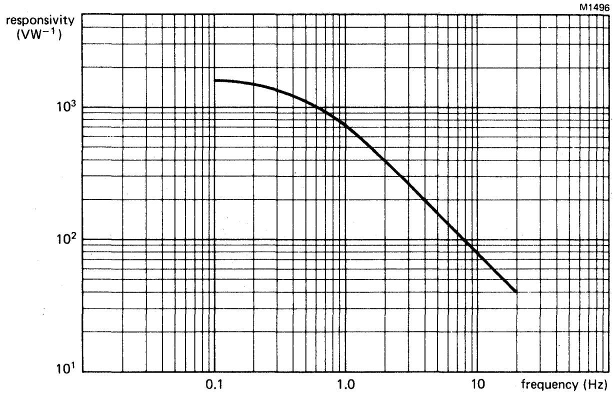
Typical peak Signal as a function of Frequency
(energy level 25 μWcm^{-2} at the detector)

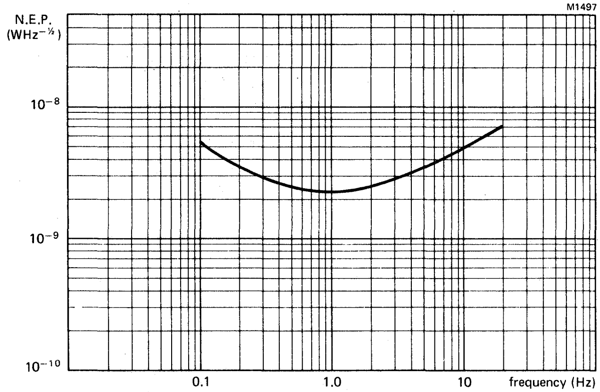


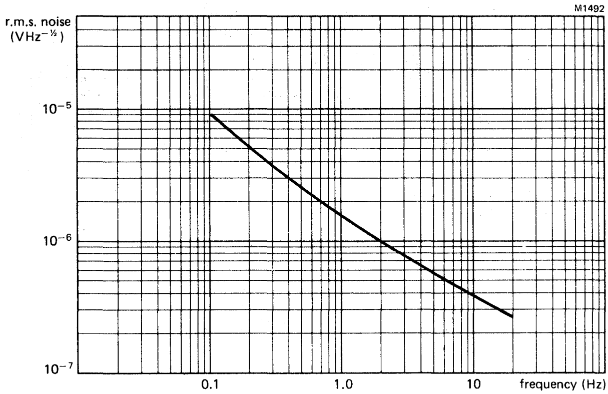
Typical peak-to-peak Noise as a function of Time
(filter bandwidth 0.5 Hz to 5 Hz)



Typical peak Signal and peak-to-peak Noise
as functions of Temperature
(peak Signal energy level, 25 μWcm^{-2} at the detector)

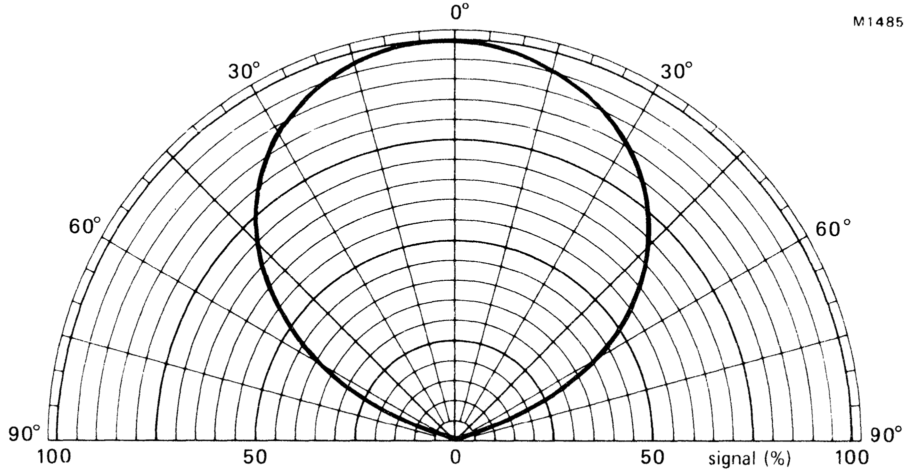




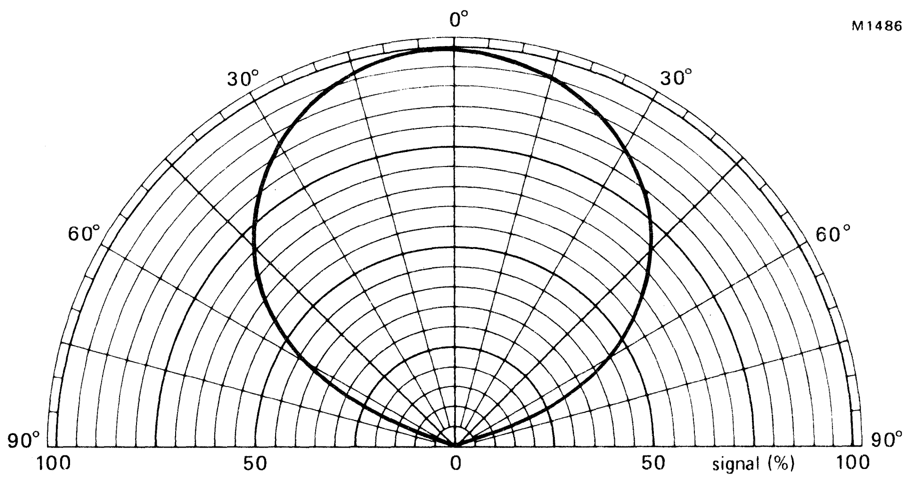


Typical Responsivity, N.E.P., and r.m.s. Noise as functions of Frequency, using recommended circuit.

POLAR DIAGRAMS



Typical Field of View in x-x plane (see Mechanical Data)



Typical Field of View in y-y plane (see Mechanical Data)

DUAL ELEMENT PYROELECTRIC INFRARED DETECTOR

This is an infrared sensitive device specifically intended for battery operated passive infrared movement sensors, such as intruder alarms. It has differentially connected dual elements specially designed to give improved noise and transient spike performance at elevated temperatures. The wide separation of the elements makes this detector compatible with most optical systems. The dual elements are combined with a single impedance converting amplifier which is designed to operate from low voltage supplies with low current consumption. The detector will give an output signal only when the radiation falling on the elements is unbalanced, as in a focused system. It is sealed in a low profile TO-5 can with a window optically coated to restrict the response to wavelengths greater than 6.5 μm.

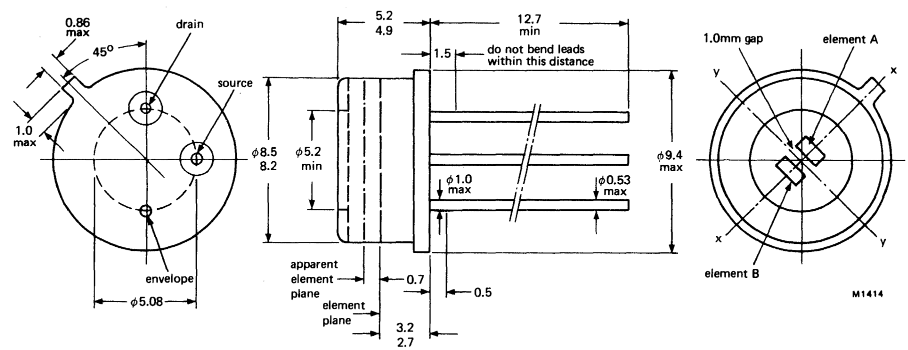
QUICK REFERENCE DATA

Spectral Response		6.5 ± 0.5 to >14	μm
Responsivity (10 μm, 10), each element	typ.	150	VW^{-1}
Noise Equivalent Power (N.E.P.) (10 μm, 10, 1), each element	typ.	2.2×10^{-9}	$WHz^{-1/2}$
Peak signal (500 K, 1)	typ.	460	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	15	μV
Element dimensions, each element	nom.	2 × 1	mm
Element separation	nom.	1	mm
Field of View in horizontal plane (x-x)	typ.	130	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – OPTOELECTRONIC DEVICES

MECHANICAL DATA

SOT-49H (TO-5 variant) Dimensions in mm



PRODUCT SAFETY

Modern high technology materials have been used in the manufacture of this device to ensure high performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the device is heated to destruction. In the United Kindom disposal of large quantities should therefore be carried out in accordance with the Deposit of Poisonous Waste Act 1972 and the Control of Pollution Act 1974, or with the latest legislation.

SOLDERING

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

RATINGS

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

Supply voltage	max.	30	V
Temperature, operating range		−20 to +50	°C
Temperature, storage range		−55 to +85	°C
Lead soldering temperature, ⩾ 6 mm from header, $t_{sld} \leqslant 3$ s max.		+350	°C

OPERATING CONDITIONS

	min.	max.	
Voltage (operating note 5)	3	10	V
Frequency (operating note 5)	0.1	20	Hz

OPERATING NOTES

1. The case potential must not be allowed to become positive with respect to the other two terminals.
2. It is inadvisable to operate the detector at mains related frequencies.
3. To avoid the possibility of optical microphony, the detector must be firmly mounted.
4. An increase in temperature of element A will produce a positive going signal at the output. For element B, the corresponding output will be negative going.
5. The detector will operate outside the quoted range but may have a degraded performance.
6. Before testing, due to the high sensitivity of these detectors, care must be taken to ensure that the devices are allowed to become thermally stable.

CHARACTERISTICS (at T_{amb} = 22 °C ± 3 °C and with recommended circuit)

		min.	typ.	max.	
Spectral Response		6.5 ± 0.5	–	> 14	μm
Responsivity* (10 μm, 10)	note 1	95	150	–	VW^{-1}
N.E.P. (10 μm, 10, 1)	note 1	–	2.2×10^{-9}	–	$WHz^{-1/2}$
Element matching* (10 μm, 10)	note 2	–	–	± 20	%
Peak signal (500 K, 1)	note 5	–	460	–	μV
Noise*, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	note 4	–	15	45	μV
Element matching (10 μm, 1)	note 2	–	–	± 20	%
Field of View (x-x plane, total angle)	note 3	100	130	–	degrees
(y-y plane, total angle)	note 3	85	–	–	degrees
Quiescent current		–	10	–	μA
Element dimensions			2 X 1 nominal		mm
Element separation			1 nominal		mm

*These parameters are 100% tested with statistical sample quality inspection.

FET Characteristics (at T_{amb} = 22 °C ± 3 °C)

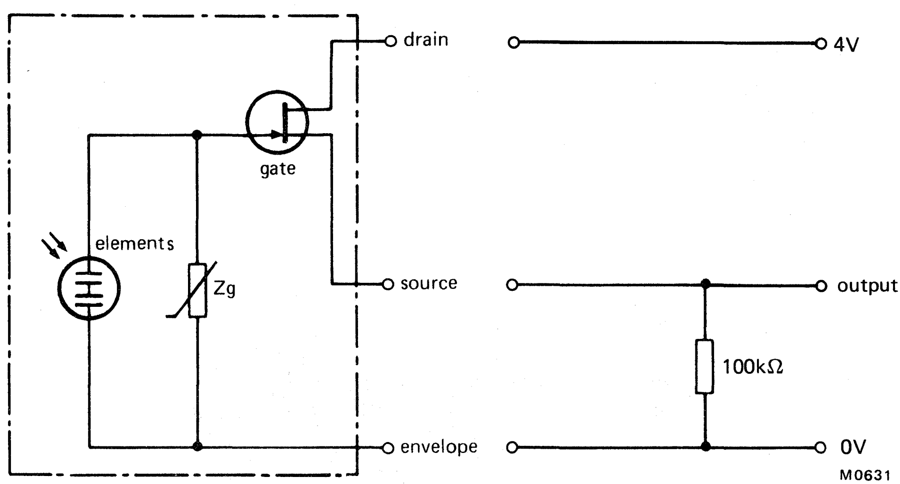
		min.	typ.	max.	
Gate-Source Cut-off Voltage I_D = 0.1 μA, V_{DS} = 6 V	$V_{P(GS)}$	−1.2	–	−0.5	V
Transfer Conductance V_{GS} = 0, V_{DS} = 6 V, f = 1 kHz	g_{fso}	1.3	–	–	mAV^{-1}

Notes

1. Each element. These characteristics apply throughout the spectral response range.
2. With both elements irradiated, the matching of the element signals is derived from:–

   $\frac{\Delta S}{\frac{1}{2}(S_A + S_B)} \times 100$, where S_A and S_B are the signals of the two elements and ΔS is the signal with both elements irradiated.
3. Field of view to 50% of the maximum signal level.
4. Using low noise filter with 3 dB bandwidth and roll off at 12 dB per octave. Detectors tested for 1 minute under stable electrical and thermal conditions; see operating note 6.
5. At an energy level of 25 μWcm^{-2} at the detector.

RECOMMENDED CIRCUIT



DEFINITIONS

1. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped radiant power. The published values of responsivity are qualified by figures in brackets, for example (10 μm, 10). The 10 μm denotes the wavelength of the infrared radiation generating the signal voltage, while the 10 indicates that the radiation is chopped at a frequency of 10 Hz.

2. Noise Equivalent Power (N.E.P.) $WHz^{-½}$
   This is the r.m.s. value of the incident, chopped radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $VHz^{-½}$. As with responsivity the relevant test conditions must be specified, for example (10 μm, 10, 1). The 10 μm is the wavelength of the incident radiation, 10 is the chopping frequency in Hz, and 1 is the bandwidth in Hz.

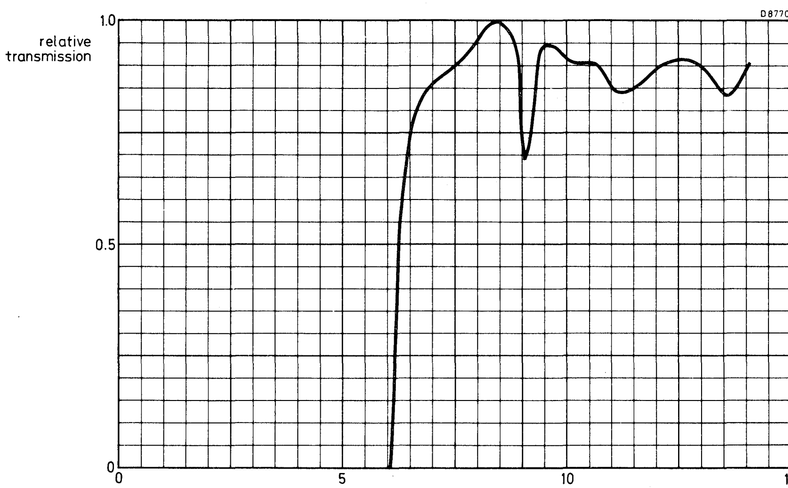
MECHANICAL AND ENVIRONMENTAL STANDARDS

As part of the Quality Assurance programme, the detectors are assessed at regular intervals against the requirements of the following IEC standards. The frequency of testing and the limits and conditions for the pre- and post-test measurements are based on those stipulated for the CECC 50 000 series of approved transistors.

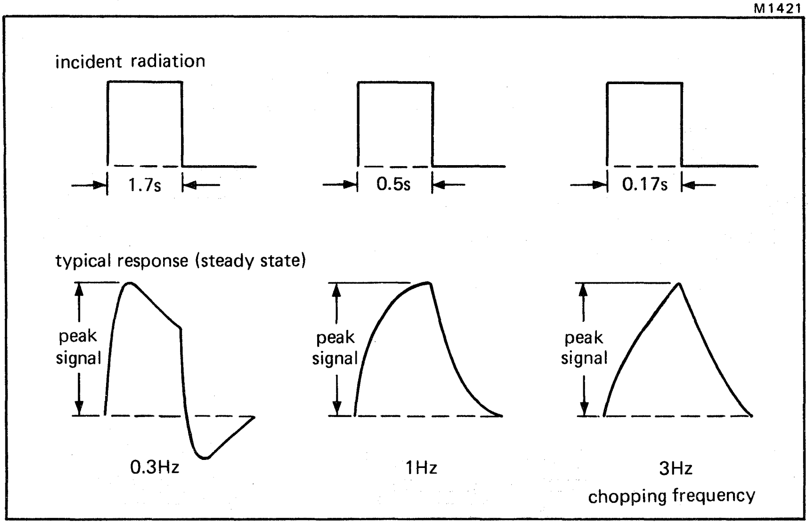
Test			Severity	Duration	Note
IEC 68-2-3	Ca	Damp Heat, steady state	+40 °C, 95% RH	168 hours	1
68-2-20	Ta	Solderability	+235 °C, 1.5 mm from header	5 seconds	1
68-2-21	Ub	Lead Fatigue	4 cycles	–	1
68-2-1	Aa	Low Temperature Storage	–55 °C	2000 hours	2
68-2-2	Ba	High Temperature Storage	+85 °C	2000 hours	2
68-2-14	Nb	Change of Temperature	–55 °C to +85 °C	10 cycles	2
68-2-6	Fc (B4)	Vibration, swept frequency	125 Hz to 2 kHz 196 ms^{-2}	2 h in each orientation	2
68-2-7	Ga	Acceleration, steady state	196000 ms^{-2}	60 seconds	2
68-2-27	Ea	Shock	14700 ms^{-2}	3 pulses 6 orientations	2
68-2-20	Tb	Resistance to Solder Heat	+350 °C, 6 mm from header	3 seconds	3

Notes

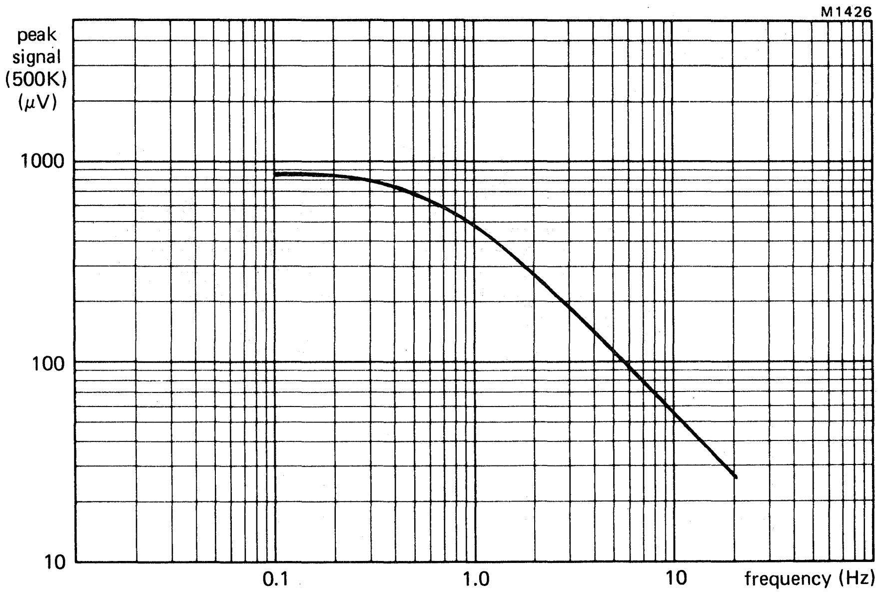
1. The detectors are checked on a production batch release principle at approximately weekly intervals. This is equivalent to Group B.
2. The detectors are checked at quarterly intervals. This is equivalent to Group C.
3. This is an annual check.



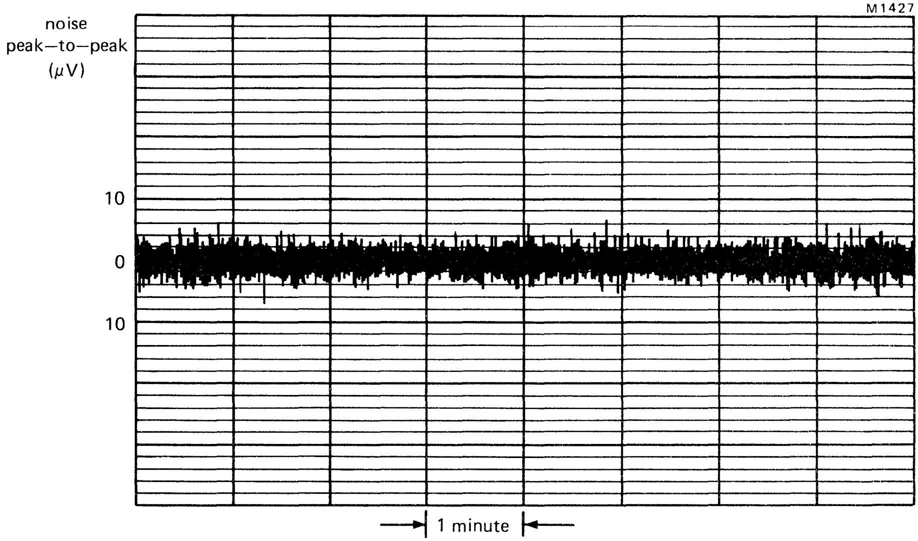
Typical normalized window transmission characteristic



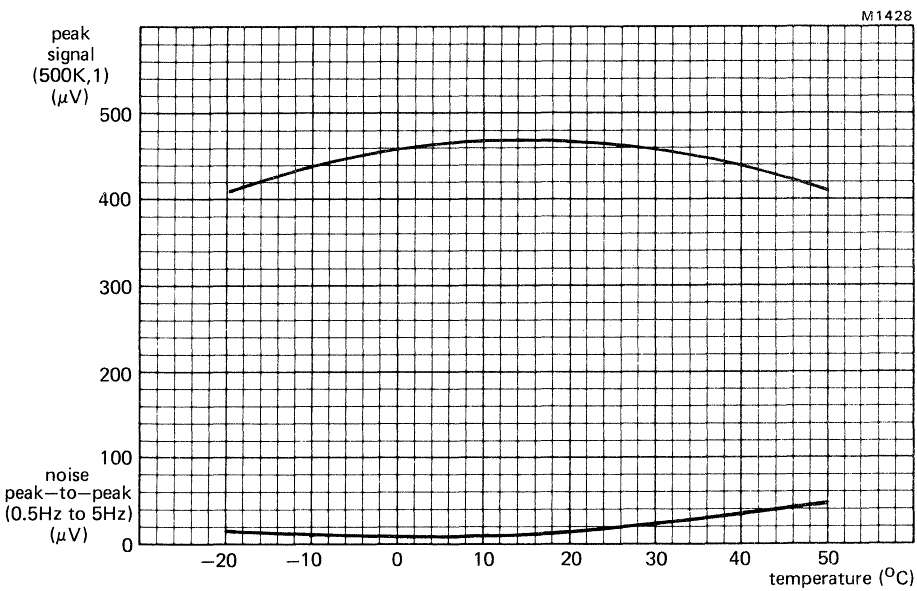
Typical response (steady state) for a given chopping frequency



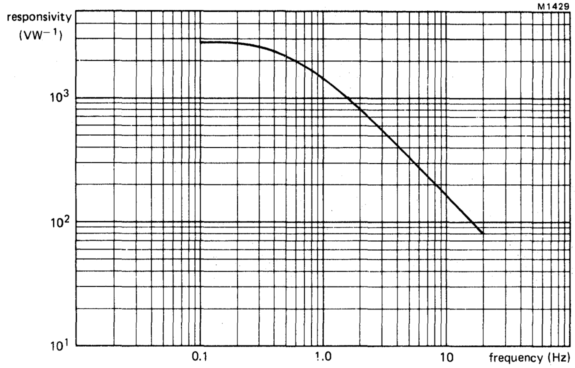
Typical Peak Signal as a function of Frequency
(energy level 25 μWcm^{-2} at the detector and one element screened)



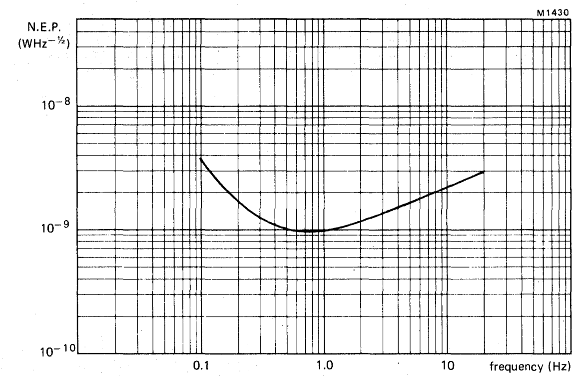
Typical peak-to-peak Noise as a function of Time
(filter bandwidth 0.5 Hz to 5 Hz)



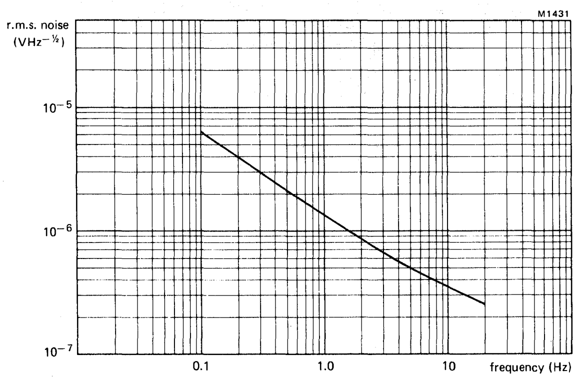
Typical peak Signal and peak-to-peak Noise as functions of Temperature
(peak Signal energy level 25 μWcm^{-2} at the detector, one element screened)



Typical Responsivity as a function of Frequency
(one element screened)

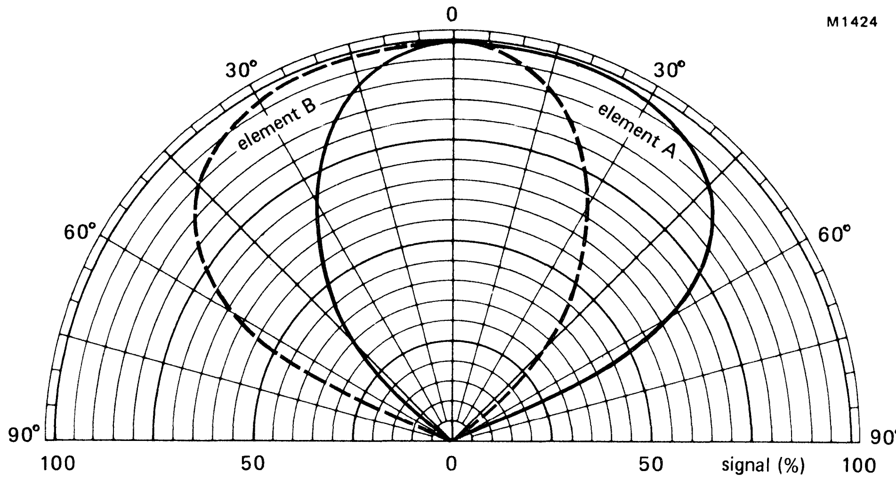


Typical N.E.P. as a function of Frequency
(one element screened)

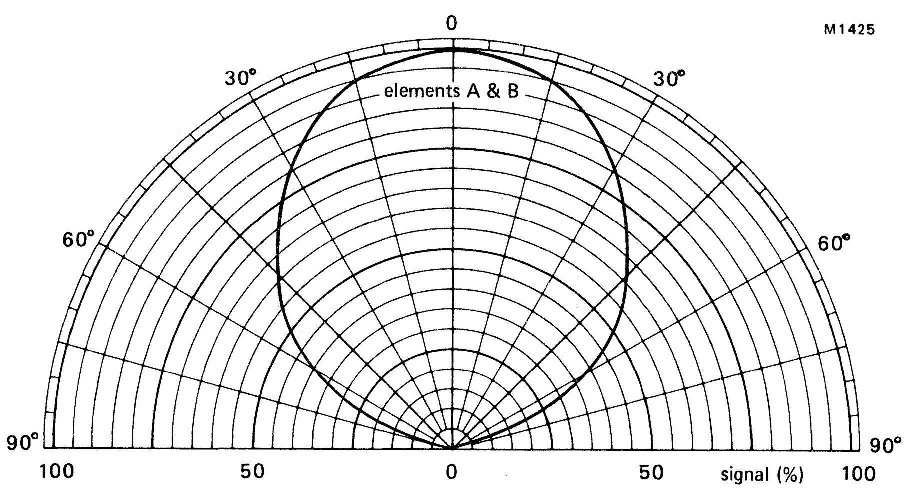


Typical r.m.s. Noise as a function of Frequency
(one element screened)

POLAR DIAGRAMS



Typical Field of View in x-x plane (see Mechanical Data)



Typical Field of View in y-y plane (see Mechanical Data)

SINGLE ELEMENT PYROELECTRIC INFRARED SENSOR

This is an infrared sensitive device incorporating a single impedance converting amplifier which is specially designed to function from low voltage supplies with low current consumption. The sensor is sealed in a low profile TO-5 can with an uncoated silicon window.

QUICK REFERENCE DATA

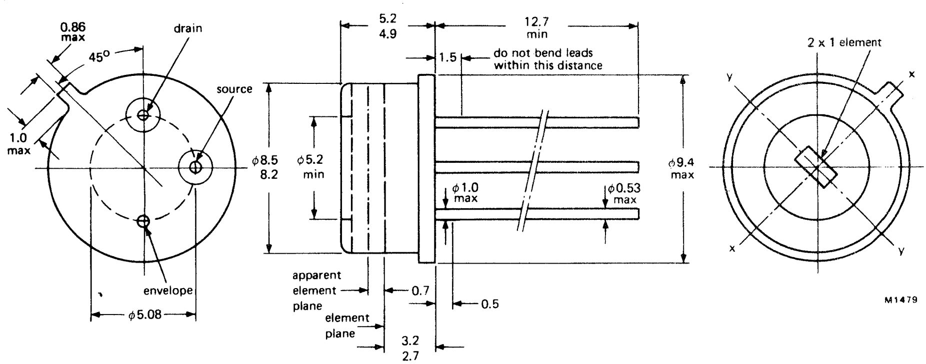
Spectral response		1.0 to >15	μm
Responsivity (500 K, 10)	typ.	130	VW^{-1}
Noise Equivalent Power (N.E.P.) (500 K, 10, 1)	typ.	3.0×10^{-9}	$WHz^{-\frac{1}{2}}$
Peak signal (500 K, 1) see characteristics, note 1	typ.	385	μV
Noise, peak-to-peak (bandwidth 0.4 Hz to 5 Hz)	typ.	20	μV
Element dimensions	nom.	2 x 1	mm
Field of view in horizontal plane (x-x)	typ.	110	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – OPTOELECTRONIC DEVICES

MECHANICAL DATA

Dimensions in mm

SOT-49H (TO-5 variant)



PRODUCT SAFETY

Modern high technology materials have been used in the manufacture of this device to ensure high performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the device is heated to destruction. Disposal of large quantities should therefore be carried out in accordance with the latest local legislation.

SOLDERING

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

RATINGS

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

Supply voltage	max.	30	V
Temperature, operating range		−40 to +70	°C
Temperature, storage range		−55 to +85	°C
Lead soldering temperature, ⩾ 6 mm from header, $t_{sld} \leqslant 3$ s		+350	°C

OPERATING CONDITIONS

	min.	max.	
Voltage (operating note 5)	3	10	V
Frequency (operating note 5)	0.1	20	Hz

OPERATING NOTES

1. The case potential must not be allowed to become positive with respect to the other two terminals.
2. It is inadvisable to operate the sensor at mains related frequencies.
3. To avoid the possibility of optical microphony, the sensor must be firmly mounted.
4. An increase in temperature of the element will produce a positive going signal at the output.
5. The sensor will operate outside the quoted range but may have a degraded performance.
6. Before testing, due to the high sensitivity of these sensors, care must be taken to ensure that the devices are allowed to become thermally stable.

CHARACTERISTICS (at T_{amb} = 22 °C ± 3 °C and with recommended circuit)

		min.	typ.	max.	
Spectral response		1.0	–	>15	μm
Responsivity* (500 K, 10)		90	130	–	VW^{-1}
N.E.P. (500 K, 10, 1)		–	3.0×10^{-9}	–	WHz^{-1}
Peak signal (500 K, 1)	note 1	–	385	–	μV
Noise*, peak-to-peak (bandwidth 0.4 Hz to 5 Hz)	note 2	–	20	45	μV
Field of view (x-x plane, total angle)	note 3	90	110	–	degrees
(y-y plane, total angle)	note 3	90	110	–	degrees
Quiescent current		–	10	–	μA
Element dimensions			2 x 1 nominal		mm

*These parameters are 100% tested with statistical sample quality inspection.

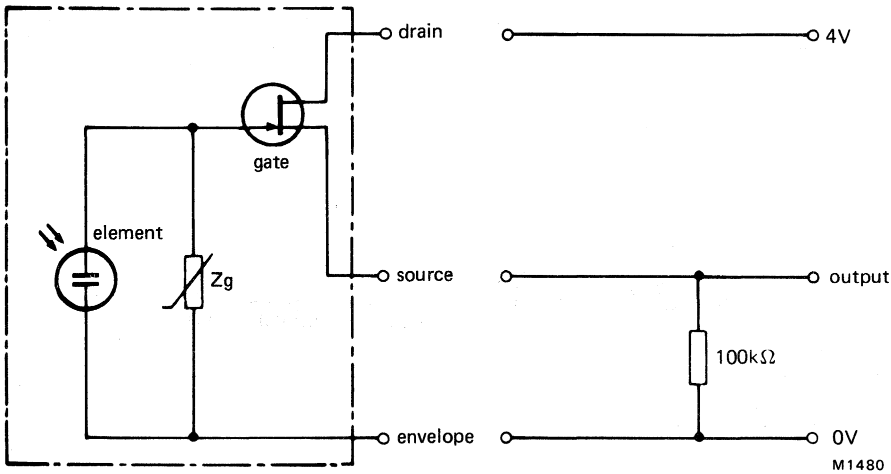
FET characteristics (at T_{amb} = 22 °C ± 3 °C)

		min.	typ.	max.	
Gate-source cut-off voltage I_D = 0.1 μA, V_{DS} = 6 V	$V_{P(GS)}$	–1.2	–	–0.5	V
Transfer conductance V_{GS} = 0, V_{DS} = 6 V, f = 1 kHz	g_{fso}	1.3	–	–	mAV^{-1}

Notes

1. At any energy level of 25 μWcm^{-2} at the sensor.
2. Using low noise filter with 3 dB bandwidth (0.4 to 5 Hz) and roll off at 12 dB per octave. Sensors tested for 1 minute under stable electrical and thermal conditions; see operating note 6.
3. Field of view to 50% of the maximum signal level.

RECOMMENDED CIRCUIT



DEFINITIONS

1. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped radiant power. The published values of responsivity are qualified by figures in brackets, for example (500 K, 10). The 500 K denotes the temperature of the black body source of the infrared radiation generating the signal voltage, while the 10 indicates that the radiation is chopped at a frequency of 10 Hz.
2. Noise Equivalent Power (N.E.P.) $WHz^{-1/2}$
   This is the r.m.s. value of the incident, chopped radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $VHz^{-1/2}$. As with responsivity the relevant test conditions must be specified, for example (500 K, 10, 1). The 500 K is the temperature of the black body source of the incident radiation, 10 is the chopping frequency in Hz, and 1 is the bandwidth in Hz.

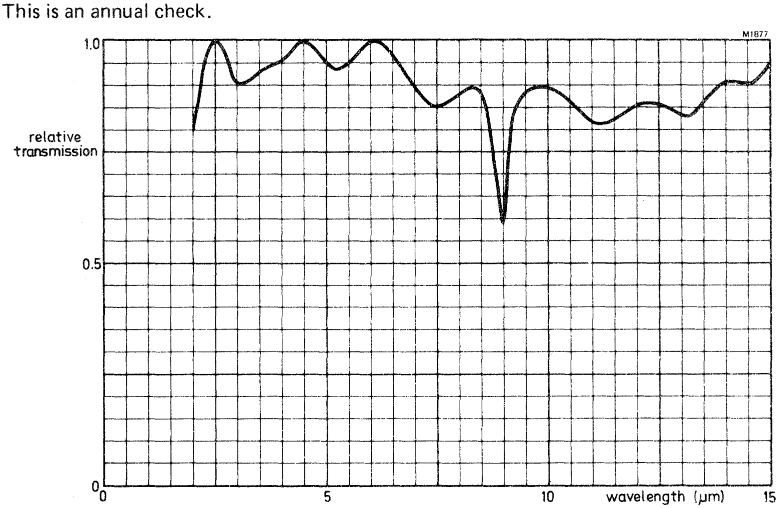
MECHANICAL AND ENVIRONMENTAL STANDARDS

As part of the Quality Assurance programme, the sensors will be assessed at regular intervals against the requirements of the following IEC standards. The frequency of testing and the limits and conditions for the pre- and post-test measurements are based on those stipulated for the CECC 50 000 series of approved transistors.

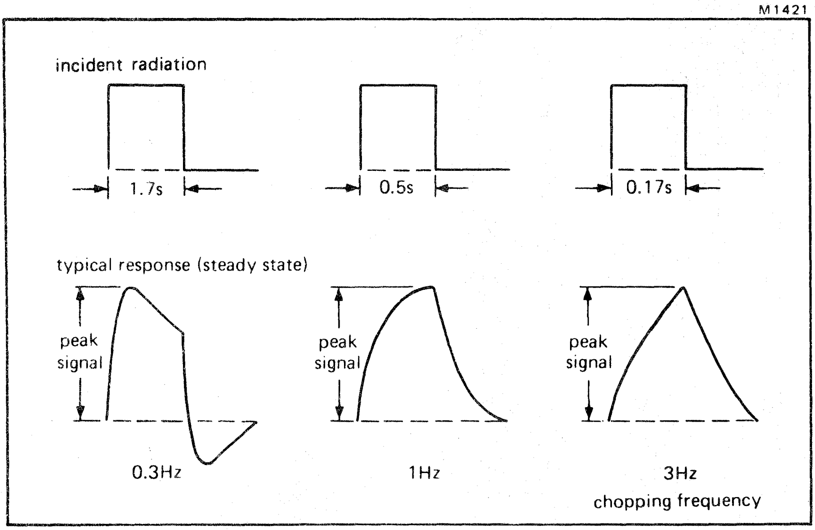
	Test			Severity	Duration	Note
IEC	68-2-3	Ca	Damp Heat, steady state	+40 °C, 95% RH	168 hours	1
	68-2-20	Ta	Solderability	+235 °C, 1.5 mm from header	5 seconds	1
	68-2-21	Ub	Lead Fatigue	4 cycles	–	1
	68-2-1	Aa	Low Temperature Storage	–55 °C	2000 hours	2
	68-2-2	Ba	High Temperature Storage	+85 °C	2000 hours	2
	68-2-14	Nb	Change of Temperature	–55 °C to +85 °C	10 cycles	2
	68-2-6	Fc (B4)	Vibration, swept frequency	125 Hz to 2 kHz 196 ms^{-2}	2 h in each orientation	2
	68-2-7	Ga	Acceleration, steady state	196000 ms^{-2}	60 seconds	2
	68-2-27	Ea	Shock	14700 ms^{-2}	3 pulses 6 orientations	2
	68-2-20	Tb	Resistance to Solder Heat	+350 °C, 6 mm from header	3 seconds	3

Notes

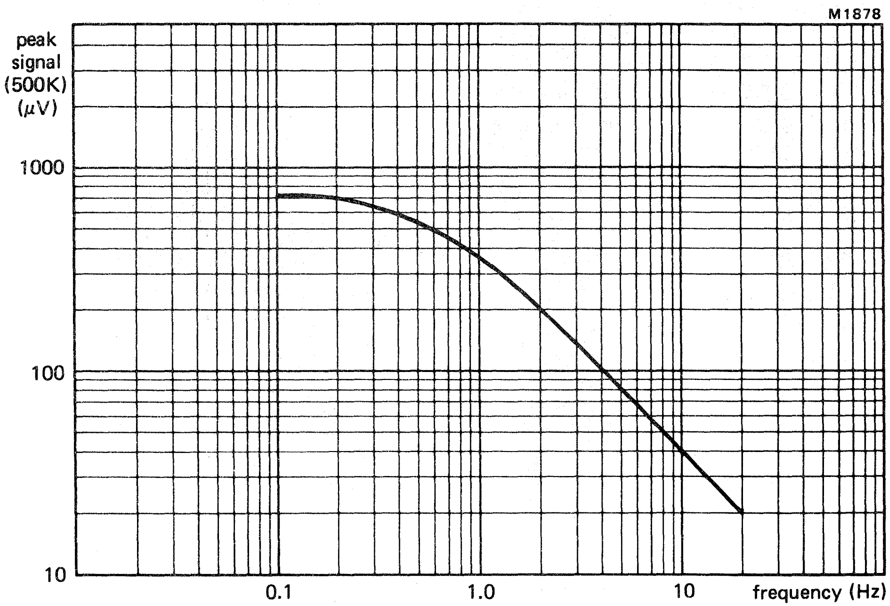
1. The sensors to be checked on a production batch release principle at approximately weekly intervals. This is equivalent to Group B.
2. The sensors to be checked at quarterly intervals. This is equivalent to Group C.
3. This is an annual check.



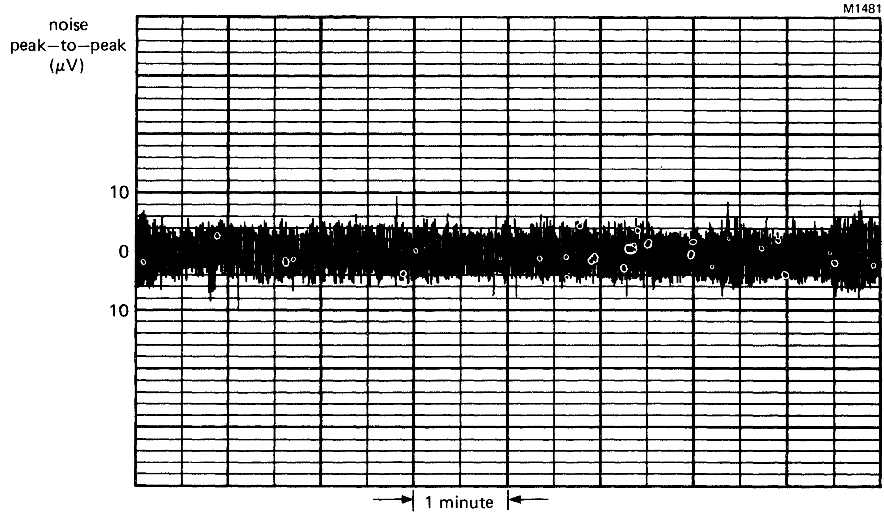
Typical normalized window transmission characteristic



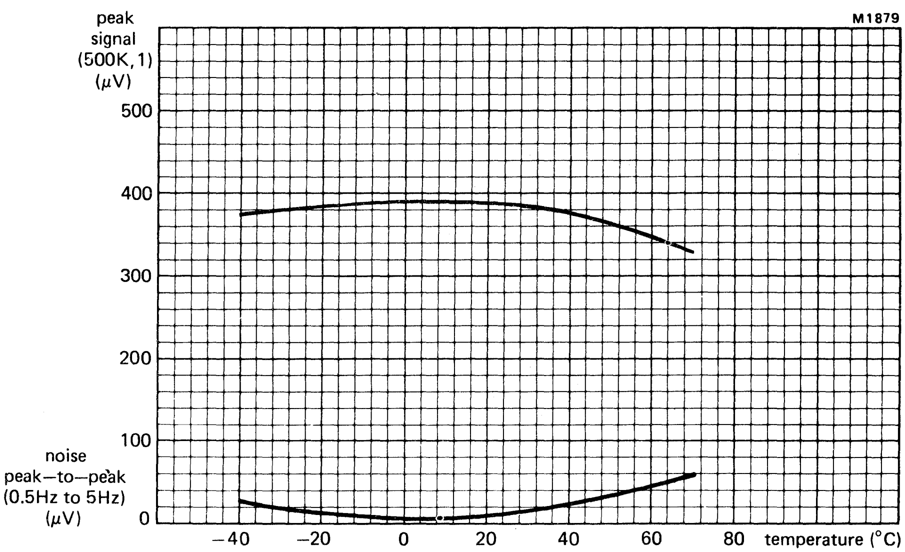
Typical response (steady state) for a given chopping frequency



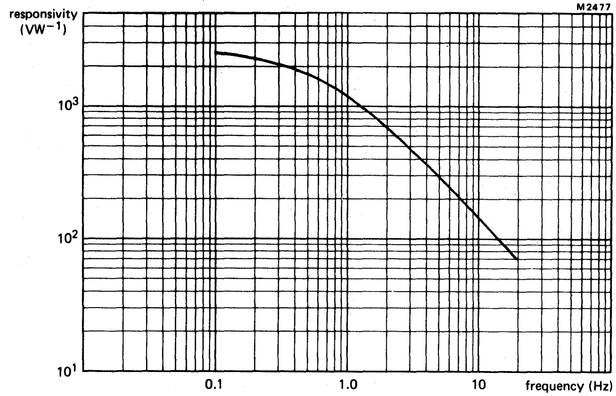
Typical peak signal as a function of frequency
(energy level 25 μWcm^{-2} at the sensor)

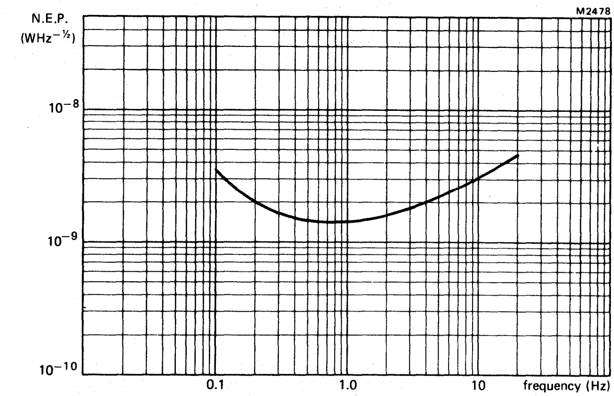


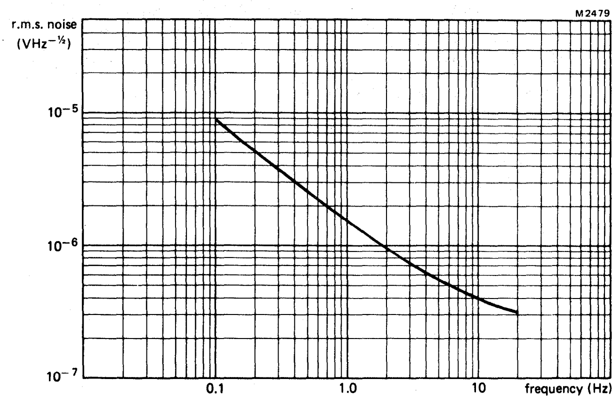
Typical peak-to-peak noise as a function of time
(filter bandwidth 0.5 Hz to 5 Hz)



Typical peak signal and peak-to-peak noise
as functions of temperature
(peak signal energy level, 25 μWcm^{-2} at the sensor)

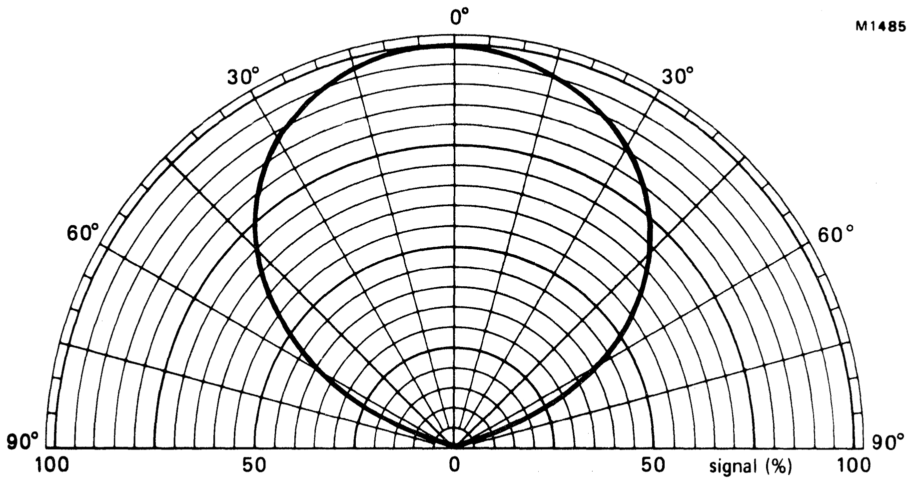




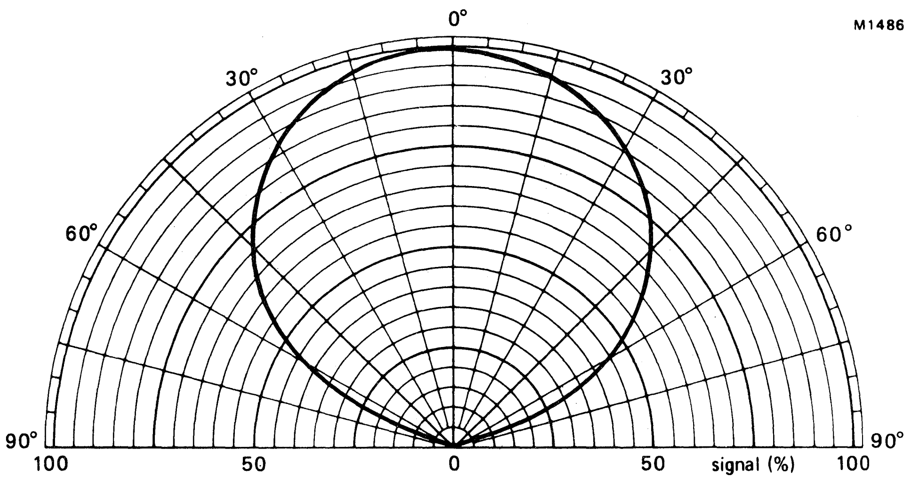


Typical responsivity, N.E.P., and r.m.s. noise as functions of frequency using recommended circuit.

POLAR DIAGRAMS



Typical field of view in x-x plane (see Mechanical data)



Typical field of view in y-y plane (see Mechanical Data)

SINGLE ELEMENT PYROELECTRIC INFRARED DETECTOR

This is an infrared sensitive device incorporating a single impedance converting amplifier which is specially designed to function from low voltage supplies with low current consumption. The detector is sealed in a low profile TO-5 can with an uncoated silicon window.

QUICK REFERENCE DATA

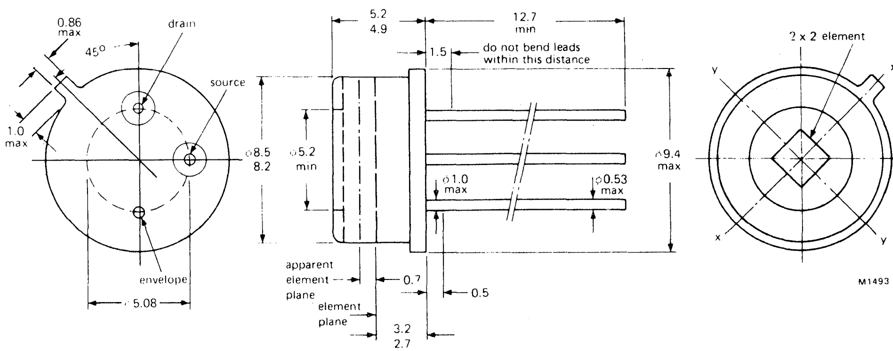
Spectral response		1.0 to >15	μm
Responsivity (500 K, 10)	typ.	65	VW^{-1}
Noise Equivalent Power (N.E.P.) (500 K, 10, 1)	typ.	6.0×10^{-9}	$WHz^{-1/2}$
Peak signal (500 K, 1) see characteristics, note 1	typ.	385	μV
Noise, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	typ.	15	μV
Element dimensions	nom.	2 x 2	mm
Field of view in horizontal plane (x-x)	typ.	110	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		0.1 to 20	Hz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – OPTOELECTRONIC DEVICES

MECHANICAL DATA

Dimensions in mm

SOT-49H (TO-5 variant)



PRODUCT SAFETY

Modern high technology materials have been used in the manufacture of this device to ensure high performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the device is heated to destruction. In the United Kindom disposal of large quantities should therefore be carried out in accordance with the Deposit of Poisonous Waste Act 1972 and the Control of Pollution Act 1974, or with the latest legislation.

SOLDERING

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

RATINGS

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

Supply voltage	max.	30	V
Temperature, operating range		−40 to +70	^oC
Temperature, storage range		−55 to +85	^oC
Lead soldering temperature, ⩾ 6 mm from header, t_{sld} ⩽ 3 s max.		+350	^oC

OPERATING CONDITIONS

	min.	max.	
Voltage (operating note 5)	3	10	V
Frequency (operating note 5)	0.1	20	Hz

OPERATING NOTES

1. The case potential must not be allowed to become positive with respect to the other two terminals.
2. It is inadvisable to operate the detector at mains related frequencies.
3. To avoid the possibility of optical microphony, the detector must be firmly mounted.
4. An increase in temperature of the element will produce a positive going signal at the output.
5. The detector will operate outside the quoted range but may have a degraded performance.
6. Before testing, due to the high sensitivity of these detectors, care must be taken to ensure that the devices are allowed to become thermally stable.

CHARACTERISTICS (at T_{amb} = 22 °C ± 3 °C and with recommended circuit)

		min.	typ.	max.	
Spectral Response		1.0	–	>15	μm
Responsivity* (500 K, 10)		45	65	–	VW^{-1}
N.E.P. (500 K, 10, 1)		–	6.0×10^{-9}	–	WHz^{-1}
Peak signal (500 K, 1)	note 1	–	385	–	μV
Noise*, peak-to-peak (bandwidth 0.5 Hz to 5 Hz)	note 2	–	15	45	μV
Field of View (x-x plane, total angle)	note 3	90	110	–	degrees
(y-y plane, total angle)	note 3	90	110	–	degrees
Quiescent current		–	10	–	μA
Element dimensions			2 x 2 nominal		mm

*These parameters are 100% tested with statistical sample quality inspection.

FET Characteristics (at T_{amb} = 22 °C ± 3 °C)

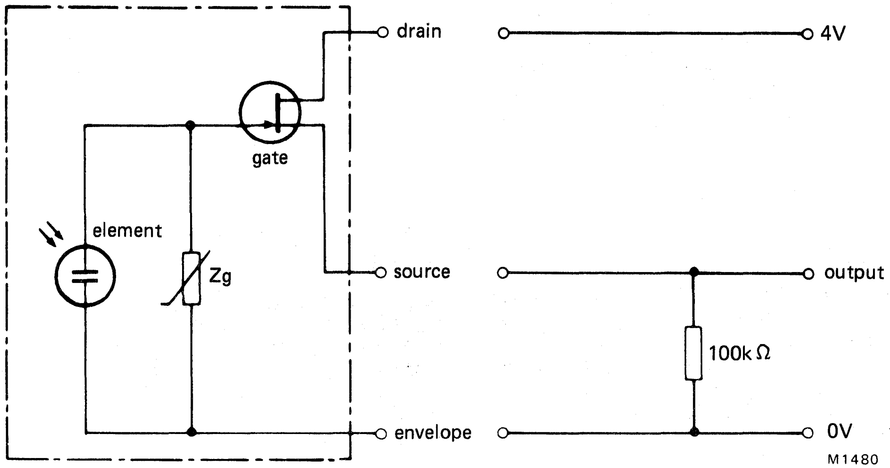
		min.	typ.	max.	
Gate-Source Cut-off Voltage I_D = 0.1 μA, V_{DS} = 6 V	$V_{P(GS)}$	−1.2	–	−0.5	V
Transfer Conductance V_{GS} = 0, V_{DS} = 6 V, f = 1 kHz	g_{fso}	1.3	–	–	mAV^{-1}

DEVELOPMENT DATA

Notes

1. At an energy level of 25 μWcm^{-2} at the detector.
2. Using low noise filter with 3 dB bandwidth and roll off at 12 dB per octave. Detectors tested for 1 minute under stable electrical and thermal conditions; see operating note 6.
3. Field of view to 50% of the maximum signal level.

RECOMMENDED CIRCUIT



DEFINITIONS

1. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped radiant power. The published values of responsivity are qualified by figures in brackets, for example (500 K, 10). The 500 K denotes the temperature of the black body source of the infrared radiation generating the signal voltage, while the 10 indicates that the radiation is chopped at a frequency of 10 Hz.
2. Noise Equivalent Power (N.E.P.) $WHz^{-\frac{1}{2}}$
   This is the r.m.s. value of the incident, chopped radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $VHz^{-\frac{1}{2}}$. As with responsivity the relevant test conditions must be specified, for example (500 K, 10, 1). The 500 K is the temperature of the black body source of the incident radiation, 10 is the chopping frequency in Hz, and 1 is the bandwidth in Hz.

MECHANICAL AND ENVIRONMENTAL STANDARDS

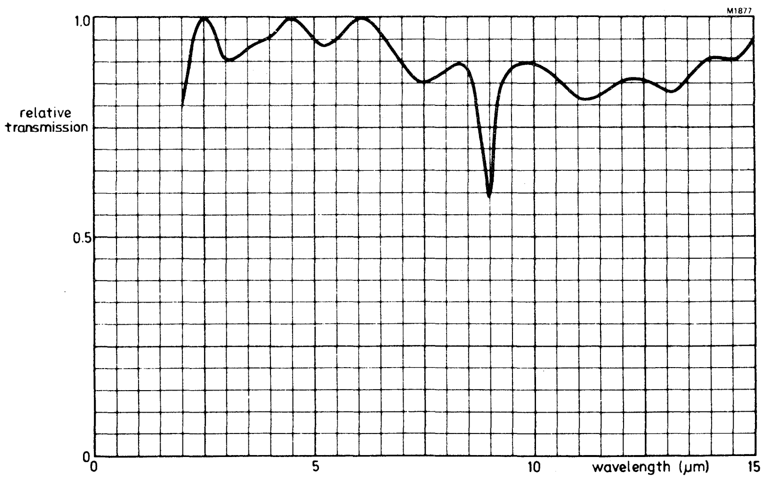
As part of the Quality Assurance programme, the detectors will be assessed at regular intervals against the requirements of the following IEC standards. The frequency of testing and the limits and conditions for the pre- and post-test measurements are based on those stipulated for the CECC 50 000 series of approved transistors.

Test			Severity	Duration	Note
IEC 68-2-3	Ca	Damp Heat, steady state	+40 °C, 95% RH	168 hours	1
68-2-20	Ta	Solderability	+235 °C, 1.5 mm from header	5 seconds	1
68-2-21	Ub	Lead Fatigue	4 cycles	–	1
68-2-1	Aa	Low Temperature Storage	–55 °C	2000 hours	2
68-2-2	Ba	High Temperature Storage	+85 °C	2000 hours	2
68-2-14	Nb	Change of Temperature	–55 °C to +85 °C	10 cycles	2
68-2-6	Fc (B4)	Vibration, swept frequency	125 Hz to 2 kHz 196 ms^{-2}	2 h in each orientation	2
68-2-7	Ga	Acceleration, steady state	196000 ms^{-2}	60 seconds	2
68-2-27	Ea	Shock	14700 ms^{-2}	3 pulses 6 orientations	2
68-2-20	Tb	Resistance to Solder Heat	+350 °C, 6 mm from header	3 seconds	3

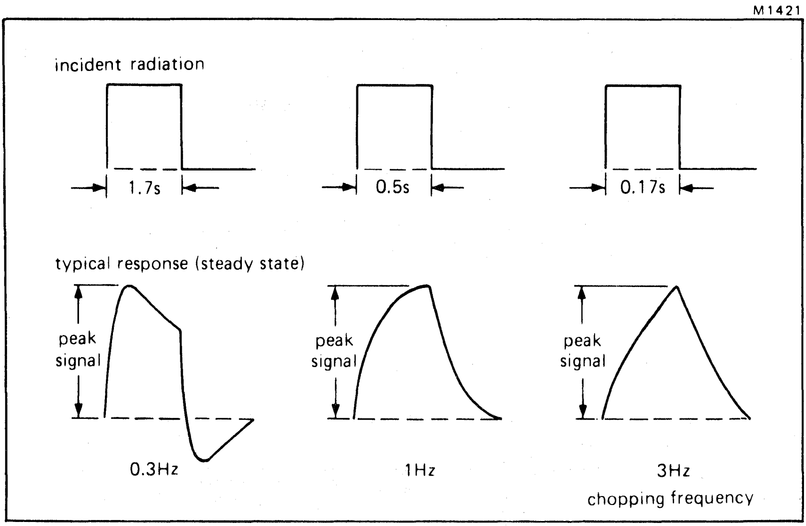
DEVELOPMENT DATA

Notes

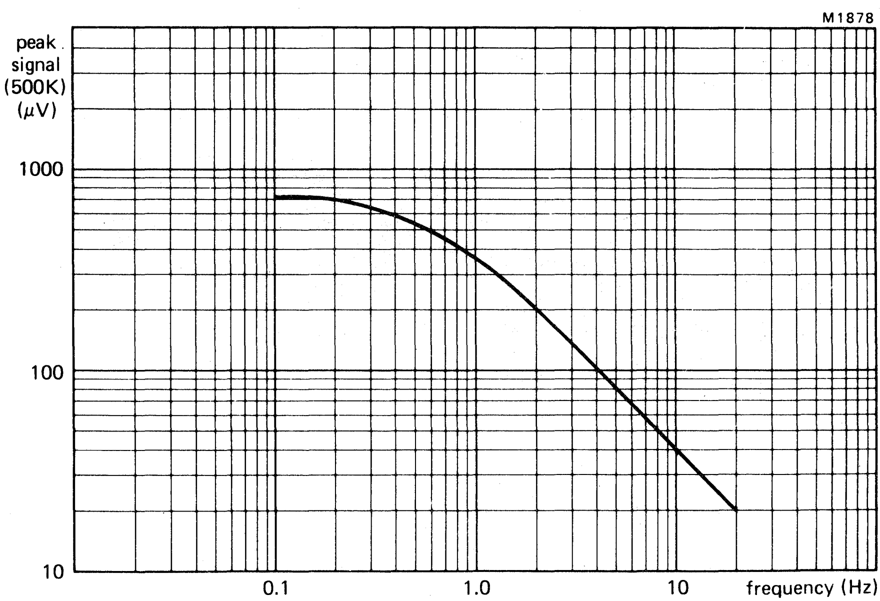
1. The detectors to be checked on a production batch release principle at approximately weekly intervals. This is equivalent to Group B.
2. The detectors to be checked at quarterly intervals. This is equivalent to Group C.
3. This is an annual check.



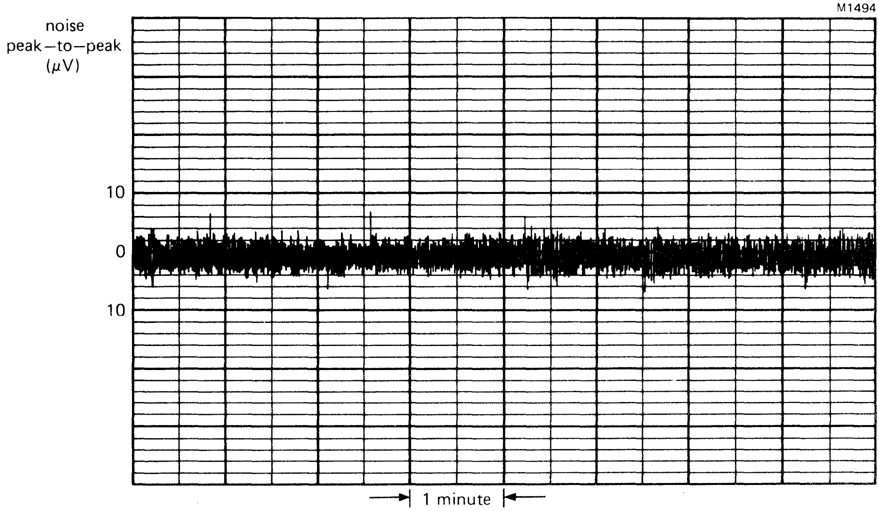
Typical normalized window transmission characteristic



Typical response (steady state) for a given chopping frequency

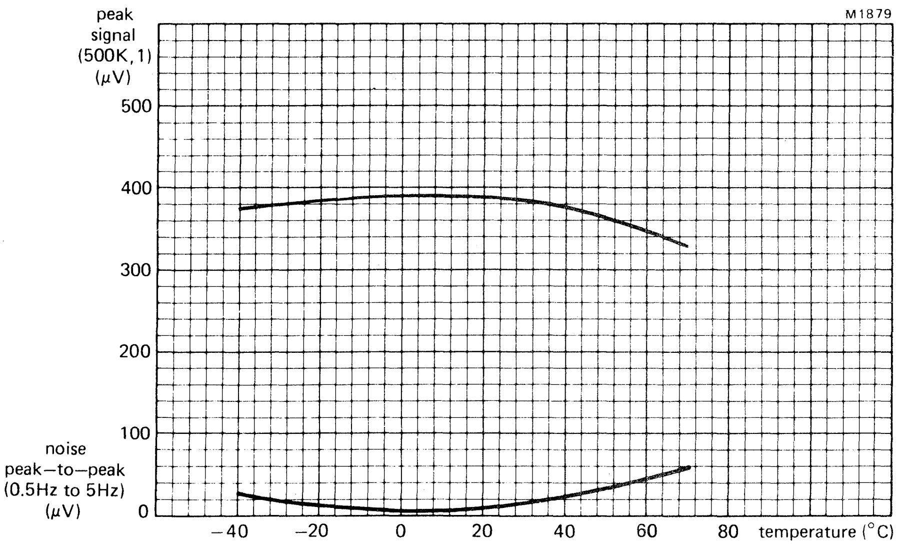


Typical peak Signal as a function of Frequency
(energy level 25 μWcm^{-2} at the detector)

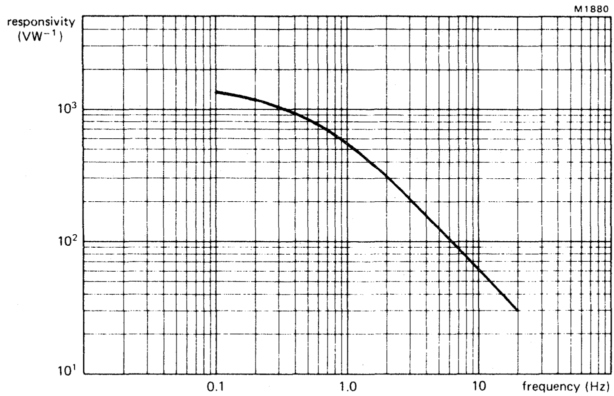


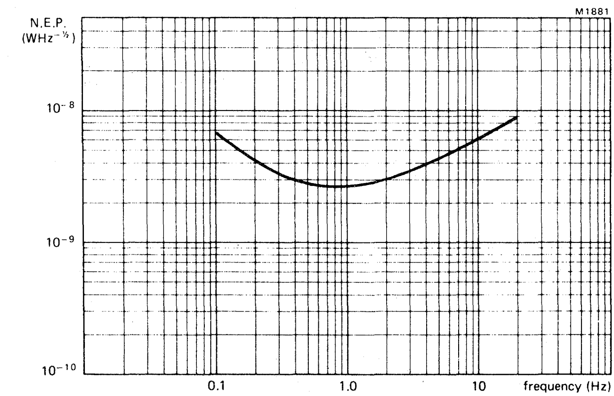
Typical peak-to-peak Noise as a function of Time
(filter bandwidth 0.5 Hz to 5 Hz)

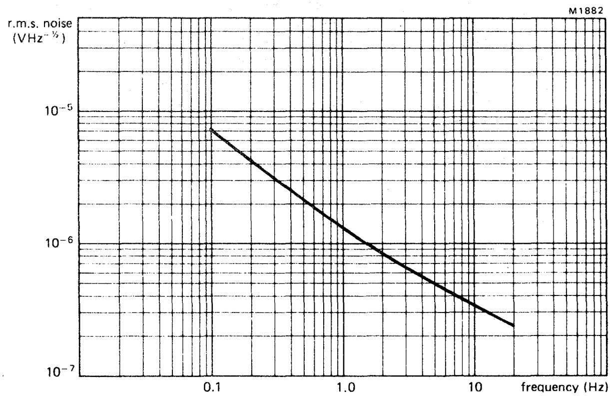
DEVELOPMENT DATA



Typical peak Signal and peak-to-peak Noise
as functions of Temperature
(peak Signal energy level, 25 μWcm^{-2} at the detector)

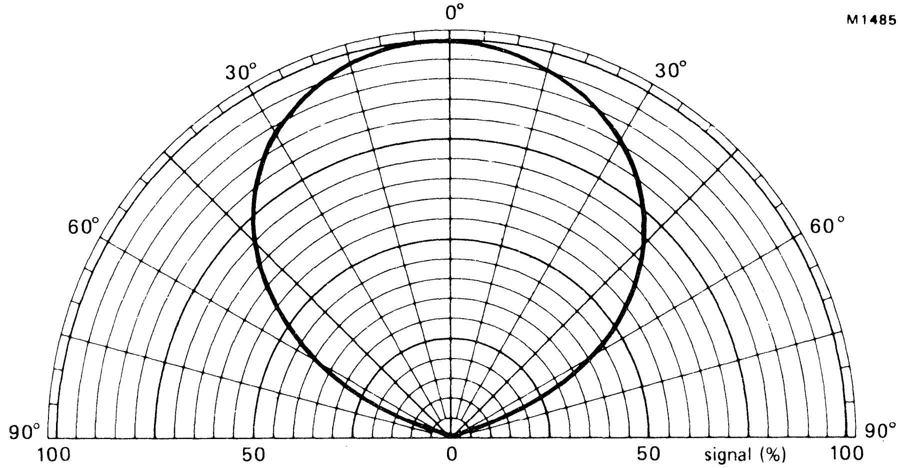




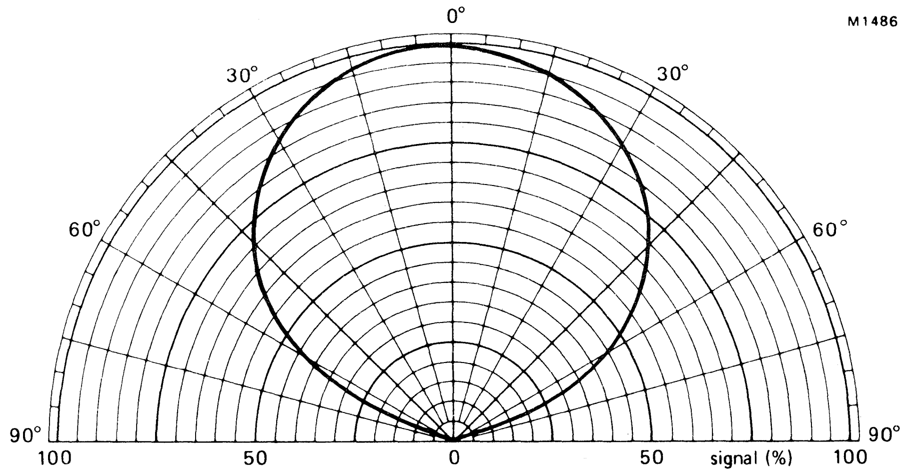


Typical Responsivity, N.E.P., and r.m.s. Noise as functions of Frequency, using recommended circuit.

POLAR DIAGRAMS



Typical Field of View in x-x plane (see Mechanical Data)



Typical Field of View in y-y plane (see Mechanical Data)

DEVELOPMENT DATA

SINGLE ELEMENT PYROELECTRIC INFRARED DETECTOR

This is an infrared sensitive device intended for gas analysis systems such as that used for analysing car exhausts. The element is combined with a single impedance converting amplifier which is specially designed to operate from low voltage supplies with low current consumption. The detector is sealed in a 3-lead TO-5 encapsulation modified to incorporate a potassium bromide (KBr) window.

QUICK REFERENCE DATA

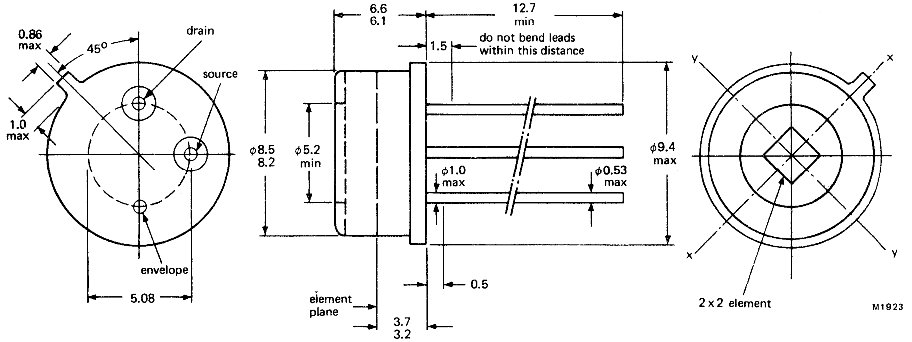
Spectral Response		1 to 25	μm
Responsivity (500 K, 10)	typ.	90	VW^{-1}
Noise Equivalent Power (N.E.P.) (500 K, 10, 1)	typ.	1.4×10^{-9}	$WHz^{-1/2}$
D* (500 K, 10, 1)	typ.	1.4×10^{8}	$cmHz^{1/2}W^{-1}$
Element dimensions	nom.	2 x 2	mm
Field of view in horizontal plane (x-x)	min.	60	degrees
Operating voltage	min.	3	V
Optimum operating frequency range		10 to 100	Hz

This data must be read in conjunction with GENERAL SAFETY RECOMMENDATIONS – OPTOELECTRONIC DEVICES

MECHANICAL DATA

Dimensions in mm

SOT-49G (TO-5 variant)



PRODUCT SAFETY

Modern high technology materials have been used in the manufacture of this device to ensure high performance. Some of these materials are toxic in certain circumstances. Mechanical or electrical damage is unlikely to give rise to any hazard, but toxic vapours may be generated if the device is heated to destruction. Disposal of large quantities should therefore be carried out in accordance with the latest local legislation.

SOLDERING

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

RATINGS

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

Supply voltage	max.	30	V
Temperature, operating range		−20 to +70	°C
Temperature, storage range		−20 to +70	°C
Lead soldering temperature, ⩾ 6 mm from header, t_{sld} ⩽ 3 s max.		+350	°C

OPERATING CONDITIONS

	min.	max.	
Voltage (operating note 5)	3	10	V
Frequency (operating note 5)	10	100	Hz

OPERATING NOTES

1. The case potential must not be allowed to become positive with respect to the other two terminals.
2. It is inadvisable to operate the detector at mains related frequencies.
3. To avoid the possibility of optical microphony, the detector must be firmly mounted.
4. An increase in temperature of the element will produce a positive going signal at the output.
5. The detector will operate outside the quoted range but may have a degraded performance.
6. Before testing, due to the high sensitivity of these detectors, care must be taken to ensure that the devices are allowed to become thermally stable.

CHARACTERISTICS (at T_{amb} = 22 °C ± 3 °C and with recommended circuit)

		min.	typ.	max.	
Spectral Response		1.0	–	25	μm
Responsivity (500 K, 10)		60	90	–	VW^{-1}
N.E.P. (500 K, 10, 1)		–	1.4×10^{-9}	3×10^{-9}	WHz^{-1}
D* (500 K, 10, 1)		–	1.4×10^{8}	–	$cmHz^{1/2}W^{-1}$
Field of View (x-x plane, total angle)	note 1	60	–	–	degrees
(y-y plane, total angle)	note 1	60	–	–	degrees
Quiescent current		–	10	–	μA
Element dimensions			2 x 2 nominal		mm

FET Characteristics (at T_{amb} = 22 °C ± 3 °C)

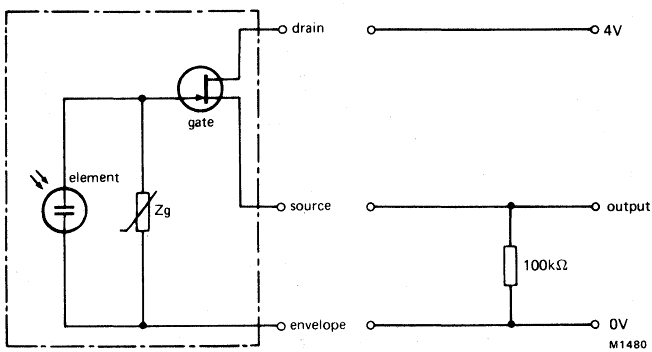
		min.	typ.	max.	
Gate-Source Cut-off Voltage I_D = 0.1 μA, V_{DS} = 6 V	$V_{P(GS)}$	–1.2	–	–0.5	V
Transfer Conductance V_{GS} = 0, V_{DS} = 6 V, f = 1 kHz	g_{fso}	1.3	–	–	mAV^{-1}

Notes

1. Field of view to 50% of the maximum signal level.

DEVELOPMENT DATA

RECOMMENDED CIRCUIT



DEFINITIONS

1. Responsivity VW^{-1}
   This is the ratio of the r.m.s. signal in volts to the r.m.s. value of the incident, chopped radiant power. The published values of responsivity are qualified by figures in brackets, for example (500 K, 10). The 500 K denotes the temperature of the black body source of the infrared radiation generating the signal voltage, while the 10 indicates that the radiation is chopped at a frequency of 10 Hz.
2. Noise Equivalent Power (N.E.P.) $WHz^{-1/2}$
   This is the r.m.s. value of the incident, chopped radiant power necessary to produce an r.m.s. signal to r.m.s. noise ratio of unity. The r.m.s. noise refers to the value calculated for unit square root bandwidth $VHz^{-1/2}$. As with responsivity the relevant test conditions must be specified, for example (500 K, 10, 1). The 500 K is the temperature of the black body source of the incident radiation, 10 is the chopping frequency in Hz, and 1 is the bandwidth in Hz.
3. D* $cmHz^{1/2}W^{-1}$
   This is a figure of merit for the material used in the detector and takes account of element size and signal to noise ratio. It is used to specify and compare detectors and in contrast to N.E.P., has a higher value for a better performance device.

   D* is defined by the expression: $$D^* = \frac{\frac{V_s}{V_n}\left[A\,(\Delta f)\right]^{1/2}}{W}$$

   where V_s = Signal voltage across detector terminals
   V_n = Noise voltage across detector terminals
   A = Detector area
   (Δf) = Bandwidth of measuring amplifier
   W = Radiated power incident on detector (r.m.s. value in watts)

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

   $$N.E.P. = \frac{(A)^{1/2}}{D^*}$$

MECHANICAL AND ENVIRONMENTAL STANDARDS

As part of the Quality Assurance programme, the detectors will be assessed at regular intervals against the requirements of the following IEC standards. The limits and conditions for the pre- and post-test measurements are based on those stipulated for the CECC 50 000 series of approved transistors.

Test			Severity	Duration
IEC 68-2-3	Ca	Damp Heat, steady state	+20 °C, 70% RH	96 hours
68-2-20	Ta	Solderability	+235 °C, 1.5 mm from header	5 seconds
68-2-21	Ub	Lead Fatigue	4 cycles	–
68-2-1	Aa	Low Temperature Storage	–20 °C	2000 hours
68-2-2	Ba	High Temperature Storage	+70 °C	2000 hours
68-2-14	Nb	Change of Temperature	–20 °C to +70 °C	10 cycles
68-2-6	Fc (B4)	Vibration, swept frequency	125 Hz to 2 kHz 196 ms^{-2}	2 h in each orientation
68-2-7	Ga	Acceleration, steady state	196000 ms^{-2}	60 seconds
68-2-27	Ea	Shock	14700 ms^{-2}	3 pulses 6 orientations
68-2-20	Tb	Resistance to Solder Heat	+350 °C, 6 mm from header	3 seconds

MOVEMENT SENSING USING A MULTI-ELEMENT FRESNEL LENS

1. INTRODUCTION

Our pyroelectric sensors are used extensively in passive infrared movement sensing applications where high sensitivity, reliability and low cost are basic requirements.

Although these sensors may be used directly to monitor scene thermal changes, it is generally advantageous to employ collecting optics to focus radiation on to the device. Thin, highly transmitting Fresnel lenses can collect infrared radiation very efficiently and provide optical gain over a defined field of view. This publication reviews the basic properties of Fresnel lenses in terms of geometric optics and describes the use of our Fresnel lens, which has been developed for general purpose movement sensing applications.

2. THE PROPERTIES OF FRESNEL LENSES

2.1 The Fresnel Lens

In applications such as movement sensing, it is often necessary to employ short focal length, large aperture lenses, to collect sufficient radiation from what may be a weak or distant source. Unfortunately, the unavoidable thickness of such lenses rules out standard lens materials because of absorption losses. On the other hand, materials which have very low absorption, over the 6 to 14 μm wavelength range, are generally too expensive for commercial use.

Fresnel lenses, however, offer a neat solution to such problems since they can be produced in extremely thin sheets and thus allow the use of materials which have relatively poor transmission (e.g. polyethylene). They are essentially equivalent to thick conventional lenses, but with most of the bulk material between the outer surfaces removed. Without elaborating further, the equivalence of both types of lenses can be shown by considering the laws of refraction. This shows that the ray bending or refracting power of a lens is a function of surface curvature (and material refractive index) rather than the path length within the body of the lens.

In modern Fresnel lens designs, the profile of each groove facet is determined by computer simulation to produce the sharpest possible image from a distant object.

Although it is possible to produce Fresnel lenses of very large area, the effects of total internal reflection dictate that it is not useful to have a lens diameter much greater than the focal length. Radiation reaching areas beyond this is merely reflected back into the lens.

2.2 Lens operation and formulae

This section reviews the properties of lenses in terms of geometrical optics. This idealized approach gives sufficiently accurate results for most practical situations.

2.2.1. Focusing and imaging formulae

A lens is a device having refracting power and can be used to collect parallel rays (radiation) and focus them at a single point. The greater the refracting power of a lens, the closer the focal point will be to the lens. Focal length is defined as the distance between the focal point and lens centre and is a basic measure of the radiation gathering ability of a lens.

The focal length of a thin, plano-convex lens is given by:

$$\frac{1}{f} = (n-1)\,\frac{1}{r}$$

Where n represents the lens refractive index (approx. 1.5 for polyethylene) and r is the lens radius of curvature at its centre.

Object and image positions are related by the standard formula.

$$\frac{1}{f} = \frac{1}{\ell'} - \frac{1}{\ell}$$

Where ℓ and ℓ' are object and image distances respectively. Details regarding sign convention for this formula can be found in Reference 1.

An implication of this formula is that all rays pass through the lens centre undeviated. This can be seen by considering rays from a small object h, placed on one side of the lens, as shown in Figure 1, where ℓ is greater than f.

For clarity only two extreme and one central ray are shown per object point. These are just particular rays in what is in fact a ray cone or bundle.

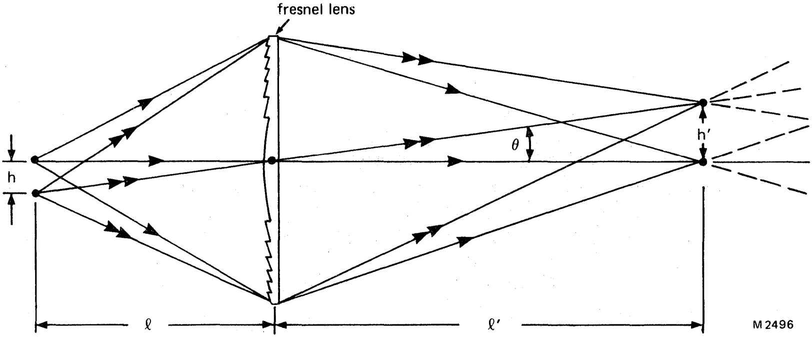


Figure 1 Image and object positions

A simple relationship exists between object and image size. By similar triangles, the magnification (M) is given directly as:

$$M = \frac{h'}{h} = \frac{\ell'}{\ell}$$

Where h and h' are object and image heights respectively.

Manipulation of the standard formula yields two further useful expressions for magnification:

$$M = 1 - \frac{\ell'}{f} \text{ and } M = \frac{1}{\frac{\ell}{f} + 1}$$

The effect of positioning an object about the focal point is shown in Figure 2.

When the object is precisely at the focal point P_1, the rays refracted by the lens emerge parallel to each other. Shifting the object away from the lens to P_2 causes the emergent rays to converge to a point P_2'. A shift towards the lens creates a divergent ray bundle.

Since the path of light rays is reversible, the points P_2 and P_2' are interchangeable. A radiating source (object) at P_2' will be imaged at P_2 the usual position for a sensing element. Moreover, radiation from a source positioned on the right hand side of the lens will be directed on to P_2 (the sensor), provided they are of the appropriate direction and within the

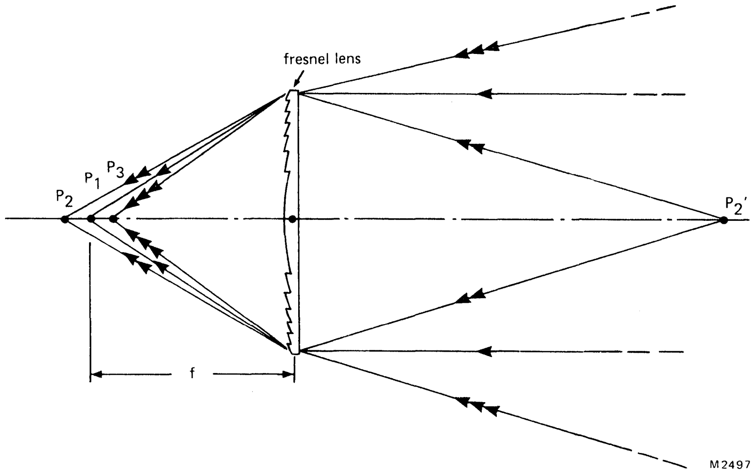


Figure 2 Effect of object shift

system 'field of view' (see section 2.2.2). In all cases, the line joining the centres of the lens and the sensor defines the direction (sensing) axis.

Returning to Figure 1, it can be seen that the ray cones overlap least at the image points. Thus the images of two adjacent sensor elements placed at P_2 (Figure 2), will be sharply defined and separated only near P_2'.

2.2.2 Field of view

An optical instrument such as a telescope may be used to view a limited area of a distant scene. This area limit, or object field of view, applies equally well to a lens and sensor system. A small object, placed near the focal point of a lens as in Figure 1, has an angular field of view (θ) given approximately as:

$$\theta = \frac{h}{f}$$

(NOTE: This angle is not to be confused with the sensor field of view).

2.2.3 Lens radiation collection

Although focal length determines the refracting power of a lens, the amount of radiation collected is also dependent on the effective collecting area.

A lens imaging a very distant source has a radiation gathering ability given by:

$$\text{Radiation collection} = \frac{K}{\text{f-number}^2}$$

Where f-number is the ratio of focal length over lens diameter and K is a constant.

An effective collecting area is implied in this expression. In general, it is simply the area within the rim of the lens; however, a lens inclined at an angle α to the direction axis has its effective area and collection reduced by a factor cos $(90-\alpha)$.

Collection is further reduced because of decreased transmission and image degradation (aberrations) of a tilted lens; the latter causes radiation to be redirected outside the defined image area.

3. MULTI-ELEMENT FRESNEL LENSES (ARRAYS)

Fresnel lens arrays are becoming increasingly favoured as radiation collecting devices for use with pyroelectric sensors.

The discrete field of view monitored by each element, coupled with a moving source, modulates the radiation incident on the sensor and thus causes pyroelectric signal generation. Significant signals occur whenever a thermal source passes from an unmonitored to monitored area, or vice versa.

By distributing many elements over the area of the array, extended coverage can be achieved.

Fresnel lens arrays have many advantages over equivalent reflecting optics arrays. Briefly these are:

- Less bulky and lighter
- Can be used without external windows
- Do not require specialized coating
- Cheaper to produce both in tooling and quantity unit costs

3.1 Our Fresnel lens array

We have developed a low cost Fresnel lens array for use with our sensors, suitable for general purpose movement sensing applications. It is designed to provide high sensitivity, long range monitoring up to a least 12 metres, with 90° volumetric coverage.

The lens specification is outlined in Table 1 and Figure 3.

Table 1 Lens Specification/Data

Focal length	30.5	mm
Nominal coverage	12 metres x 90	o
Number of monitored zones	A = 8 B = 4 C = 3	
Nominal average transmission	50	%
Material	polyethylene	

MECHANICAL DATA — Nominal dimensions in mm

For mounted lens

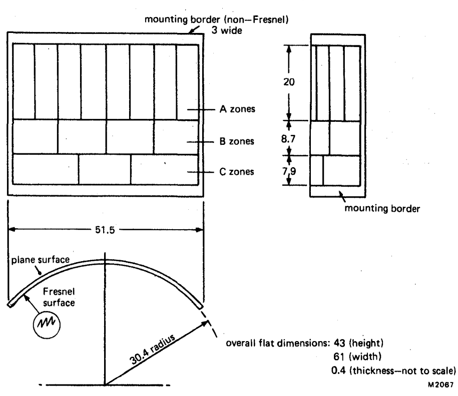
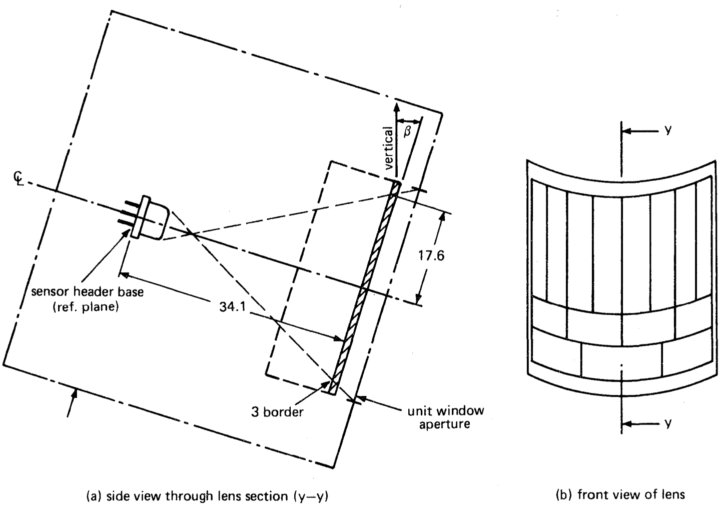


Figure 3 Lens mechanical data

The important features of the lens are:—

- A 15 element design which provides high signal sensitivity and movement discrimination.
- High quality optics match the imaging requirements of dual element sensors. Single element sensors may also be used, with reduced coverage (i.e. 50% fewer zones).
- Fresnel groove depth and thus transmission is constant over whole lens area.
- All elements are designed to give optimum radiation collection at the range limit — aspheric groove contours minimize image aberrations.
- Each element includes part of the central ring which maintains high collection efficiency — less loss due to inter-groove shadowing, scattering and diffraction.
- Can be used grooves-in or grooves-out, depending on requirements. In dusty environments grooves-in is recommended. If this is not the case, or if an external window is used, we recommend that the lens be used grooves-out, thus providing up to 20% more signal than with grooves-in.

3.1.1 Typical usage and performance



(a) side view through lens section (y—y)

(b) front view of lens

Figure 4 Typical mounting arrangement

A typical lens mounting arrangement is shown in Figures 4a and 4b, which represent the side and front views respectively. In Figure 4a the sensor plane and the lens section (y-y) are parallel and are inclined by an angle β to the vertical.

In this configuration all 'A' and 'B' elements are almost perpendicular to their respective direction axes (element to sensor centres), which ensures optimum collection along the zones. Objects positioned at the range limit are essentially in focus on the sensor. In addition, the system field of view is such that a human outline, at this range, just fills a 2 x 1 mm sensor area.

Nominal zonal coverage, corresponding to $\beta = 12^o$ and a fixing height of 2.1 metres, is depicted in Figures 5 and 6.

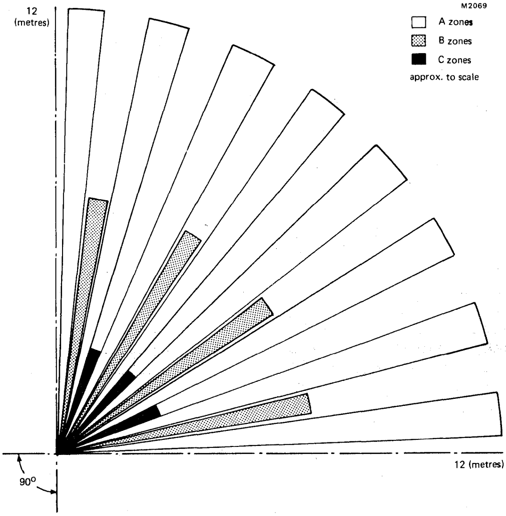


Figure 5 Nominal zonal coverage – plan view

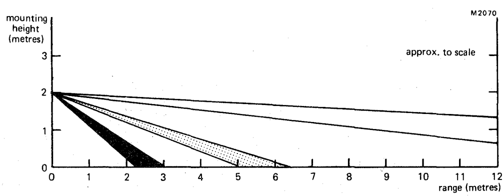


Figure 6 Nominal zonal coverage – side view

The minimum window aperture for the enclosure can be determined with reference to Figure 4a; namely by extending the dotted line from sensor to lens edges (vertically and horizontally) until they intersect the enclosure face.

A typical curve of sensor response against target range, for a single 'A' zone is shown in Figure 7. Because pyroelectric signal generation is proportional to radiant energy differences, this response curve will be strongly dependent on both background and target temperatures. The reduction of signal at short range results from minor cancellation effects. Such effects occur whenever both elements of a dual element sensor receive a proportion of energy from the same source.

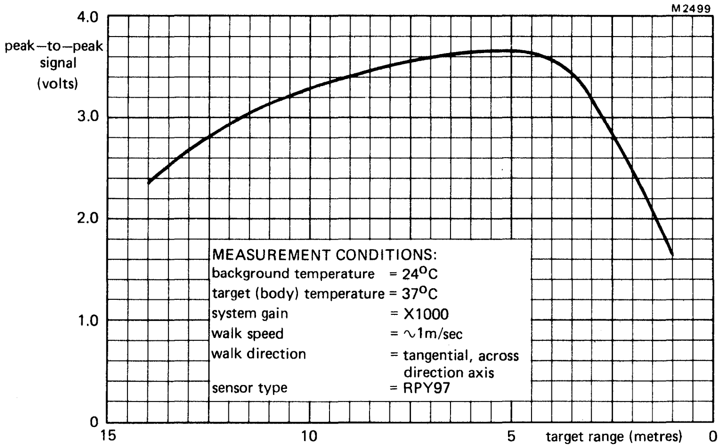


Figure 7 Typical signal level as a function of target range

3.1.2 Alternative mounting configurations

Although the mounting arrangement in Figure 4 will be suitable for most general applications, particular situations may dictate alternative configurations. Useful alternative mounting arrangements fall into two categories, **a)** where the unit is repositioned as a whole, and **b)** where the lens is repositioned relative to the sensor. Unit orientation and mounting height fall into the first category, whilst a different lens tilt angle, relative to a fixed sensor position, belongs to the latter category. The effect on system performance associated with any such changes needs careful consideration, particularly with regard to changes in zonal coverage and signal response.

The monitoring of a small room is one example where improved performance will be obtained by changes to the standard mounting arrangement. More effective coverage and increased signal levels will be achieved by inclining the zone-fan downwards or by shifting the whole zone-fan vertically downwards. The former can be achieved by a downward tilt of the unit whilst the latter simply requires a reduction in fixing height. In both cases, moving the lens and sensor as a unit does not affect the position of zones relative to one another.

The lens may be used equally well in other configurations where constraints such as unit shape restrictions dictate. In cases where it is necessary to change the position/orientation of the lens relative to the sensor, consideration must be given to associated changes in focusing as well as zonal coverage and signal response.

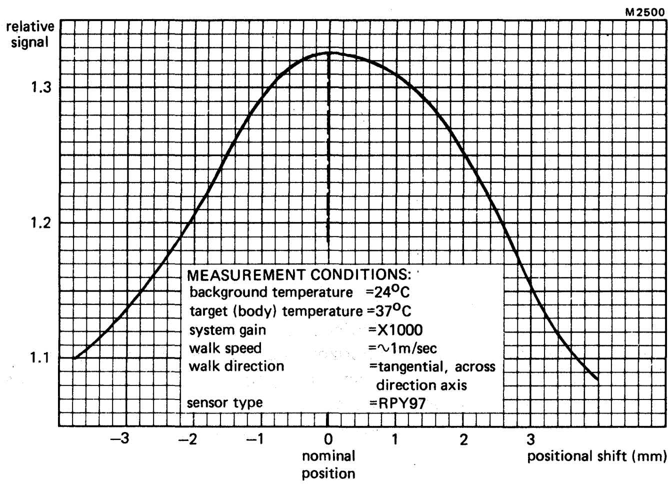


Figure 8 Typical relative signal as a function of sensor position

For guidance, a plot of signal sensitivity versus sensor position, for a single 'A' zone, is given in Figure 8, where the peak of the curve corresponds to the sensor in its nominal position. At this point, the image of the object at the design range is sharply defined so as to ensure minimum signal cancellation, after image motion across the elements.

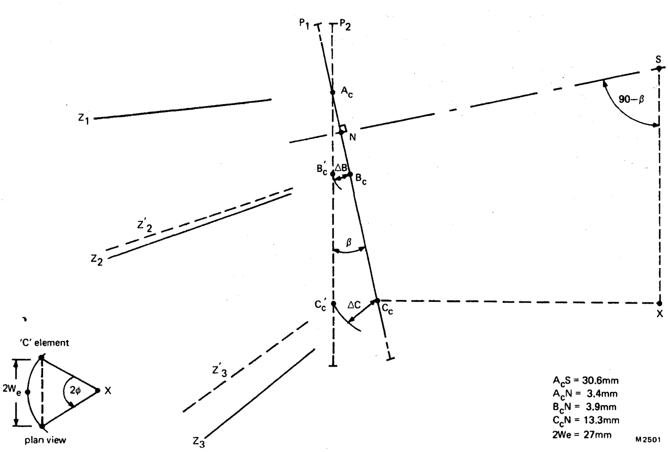


Figure 9 Zonal coverage as a function of lens tilt

The effect of lens tilt angle on zonal coverage is illustrated in Figure 9, where lens position P_1 corresponds to a 12^o tilt for nominal zonal coverage. Only the central vertical section of the lens is shown. A_c is an 'A' zone element centre, and is taken as being the section. B_c and C_c are the corresponding points for the B and C elements and S is the sensor position. S, A_c, B_c and C_c define the direction axes Z_1, Z_2 and Z_3 for position P_1. Note that the outer elements also define direction axes in space but have been omitted for clarity.

Another lens position of particular interest is that with the lens vertical (zero tilt) which corresponds to P_2 in the diagram. To maintain the nominal 'A' zone direction, the lens has been vertically rotated about A_c. This rotation also ensures that 'A' zone focusing is unaffected. Although direction axis Z_1 is common to position P_2 the new directions for the 'B' and 'C' zones become Z'_2 and Z'_3. Thus the zone-fan is compressed vertically, and the greatest shift occurs along the C element direction. Even so, the 'aiming' points of the 'B' and 'C' zone axes are shifted by only approx. 400 mm, along the floor. Such small shifts can be compensated for by repositioning the sensor along A_cS, at the penalty of 'A' zone defocusing.

For all tilt angles other than 0^o, the inclination of the extreme zones differs slightly from the central ones of any row. Over a lens tilt range of 0 to 14^o (fixed sensor position), however, the effect is of little practical significance. At 12^o tilt, for instance the extreme 'A' zone aims at a point approx. 500 mm above the central 'A' zone, at 12 metres range. Because of the shorter distances involved, the effect is also insignificant for the 'B' and 'C' zones.

The projected angle of any zone fan onto the horizontal plane is also affected by lens tilt. For tilt angles below 14^o the effect is small, and may be neglected for the 'A' and 'B' zones, given fixed S and rotation as in the diagram. For the 'C' zones, the sine of the projected zone fan semi-angle ϕ changes from:

$$\sin\phi \approx \frac{W_e}{C_cX} \approx \frac{W_e}{C'_cX - A_cC_c \sin\beta} \quad \text{to}$$

$$\sin\phi \approx \frac{W_e}{C'_cX} \quad \text{after rotation,}$$

where $C'_cX = A_cN \sin\beta + SN \cos\beta$ and W_e is the half-distance between the outer 'C' zone elements (see plan view inset). With the geometry of the lens given, simple trigonometry can be used to calculate the changes in fan angle. The total projected 'C' zone fan-angle is approximately 60^o for a 14^o tilt and changes to 52^o at zero tilt.

Although the element to sensor distance A_cS is taken to be fixed after rotation, lens geometry is such that the focusing distance of all 'A' zone elements, (to S) also remains essentially constant. This is not the case for the 'B' and 'C' element focusing distances, which are increased by ΔB and ΔC, respectively. For both these rows of elements, images which are sharply focused at S, now correspond to object points much closer to the lens. As a consequence of defocusing, increased cancellation effects reduce signal levels for the 'B' and 'C' zones at maximum range (see Figure 7); because of the proximity of object sources, the effect is less significant for the 'B' zones.

Because of the factors outlined in section 2.2.3, signal reduction also occurs as a direct result of lens inclination to the direction axis. For the 'A' zones, lens inclination to Z_1 is similar for both 0^o and 12^o tilt, so that radiation collection is unchanged. The 'B' and 'C' direction axes, however, are increasingly inclined to the lens after rotation to P_1. Typical signal reduction factors versus lens inclination angle α can be estimated from the curve in Figure 10. In this case, the additional signal reduction for the 'B' and 'C' zones after rotation, is approximately 50% and 60% respectively.

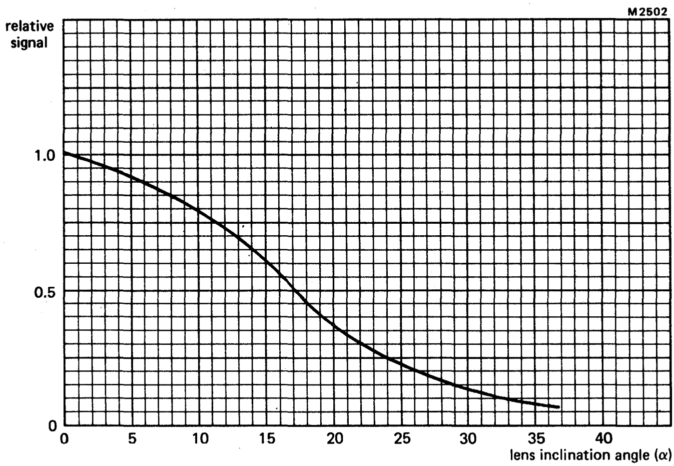


Figure 10 Typical relative signal as a function of lens inclination

Another factor which affects signal level is the sensor angle relative to a zone axis. This arises because sensor sensitivity is approximately dependent on the cosine of the angle between the sensor normal and the direction of incident radiation. In general, directing the sensor axis along SN provides a reasonable compromise. In this condition, the sensor response is within approx. 5% of maximum for both 'A' and 'B' zones, where maximum corresponds to radiation at normal incidence (0^o). The effective sensitivity of the sensor for the 'C' zone is within approx. 15% of maximum.

If desired, the optimum response may be achieved from one zone row by orientating the sensor vertically towards the effective centre of the central zone element; for the 'A' zones this corresponds approximately to a horizontal position of the sensor axis. Similarly, optimum response along the 'B' or 'C' zones can be achieved by directing the sensor axis at the centre of the appropriate element. Naturally, directing the sensor to favour a particular zone row reduces the signal response for the other rows.

In any particular configuration, account must be taken of any signal reduction factors e.g. lens inclination to a direction axis. Such factors will modify the signal sensitivity versus range curve. Because some of the effects associated with lens/sensor movement can independently affect signal cancellation, e.g. focusing and zonal coverage density, and because of the nature of real sources, the modification of overall response will only be approximated by the summation of all the separate reduction factors.

REFERENCE

1. Geometrical and physical optics, R.S. Longhurst (Longman).

ORDERING

The lens is available **only** in conjunction with one of **our** range of pyroelectric sensors and is obtainable by adding the suffix FL to **our** sensor part number.

INDEX OF TYPE NUMBERS

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

Mm = Microminiature semiconductors for hybrid circuits
SD = Small-signal diodes
Sm = Small-signal transistors
Sp = Special diodes
T = Tuner diodes
Vrg = Voltage regulator diodes

* = series
FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
P = Low-frequency power transistors
Sm = Small-signal transistors

P = Low-frequency power transistors

P = Low-frequency power transistors

type no.	book	section	type no.	book	section	type no.	book	section
BDX65C	S4a	P	BF256B	S5	FET	BF593	S4b	HVP
BDX66	S4a	P	BF256C	S5	FET	BF620	S7	Mm
BDX66A	S4a	P	BF324	S3	Sm	BF621	S7	Mm
BDX66B	S4a	P	BF370	S3	Sm	BF622	S7	Mm
BDX66C	S4a	P	BF410A	S5	FET	BF623	S7	Mm
BDX67	S4a	P	BF410B	S5	FET	BF660;R	S7	Mm
BDX67A	S4a	P	BF410C	S5	FET	BF689K	S10	WBT
BDX67B	S4a	P	BF410D	S5	FET	BF763	S10	WBT
BDX67C	S4a	P	BF419	S4b	HVP	BF767	S7	Mm
BDX68	S4a	P	BF420	S3	Sm	BF819	S4b	HVP
BDX68A	S4a	P	BF421	S3	Sm	BF820	S7	Mm
BDX68B	S4a	P	BF422	S3	Sm	BF821	S7	Mm
BDX68C	S4a	P	BF423	S3	Sm	BF822	S7	Mm
BDX69	S4a	P	BF450	S3	Sm	BF823	S7	Mm
BDX69A	S4a	P	BF451	S3	Sm	BF824	S7	Mm
BDX69B	S4a	P	BF457	S4b	HVP	BF840	S7	Mm
BDX69C	S4a	P	BF458	S4b	HVP	BF841	S7	Mm
BDX77	S4a	P	BF459	S4b	HVP	BF857	S4b	HVP
BDX78	S4a	P	BF469	S4b	HVP	BF858	S4b	HVP
BDX91	S4a	P	BF470	S4b	HVP	BF859	S4b	HVP
BDX92	S4a	P	BF471	S4b	HVP	BF869	S4b	HVP
BDX93	S4a	P	BF472	S4b	HVP	BF870	S4b	HVP
BDX94	S4a	P	BF483	S3	Sm	BF871	S4b	HVP
BDX95	S4a	P	BF485	S3	Sm	BF872	S4b	HVP
BDX96	S4a	P	BF487	S3	Sm	BF926	S3	Sm
BDY90	S4a	P	BF494	S3	Sm	BF936	S3	Sm
BDY90A	S4a	P	BF495	S3	Sm	BF939	S3	Sm
BDY91	S4a	P	BF496	S3	Sm	BF960	S5	FET
BDY92	S4a	P	BF510	S7/S5	Mm/FET	BF964	S5	FET
BF198	S3	Sm	BF511	S7/S5	Mm/FET	BF966	S5	FET
BF199	S3	Sm	BF512	S7/S5	Mm/FET	BF967	S3	Sm
BF240	S3	Sm	BF513	S7/S5	Mm/FET	BF970	S3	Sm
BF241	S3	Sm	BF536	S7	Mm	BF979	S3	Sm
BF245A	S5	FET	BF550;R	S7	Mm	BF980	S5	FET
BF245B	S5	FET	BF569	S7	Mm	BF981	S5	FET
BF245C	S5	FET	BF579	S7	Mm	BF982	S5	FET
BF247A	S5	FET	BF583	S4b	HVP	BF989	S7/S5	Mm/FET
BF247B	S5	FET	BF585	S4b	HVP	BF990	S7/S5	Mm/FET
BF247C	S5	FET	BF587	S4b	HVP	BF991	S7/S5	Mm/FET
BF256A	S5	FET	BF591	S4b	HVP	BF992	S7/S5	Mm/FET

FET = Field-effect transistors
HVP = High-voltage power transistors
Mm = Microminiature semiconductors for hybrid circuits
P = Low-frequency power transistors
Sm = Small-signal transistors
WBT = Wideband transistors

* = series
FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
RFP = R.F. power transistors and modules
RT = Tripler
Sm = Small-signal transistors
WBM= Wideband hybrid IC modules
WBT= Wideband transistors

* = series
RFP = R.F. power transistors and modules
ThM = Thyristor modules
WBM = Wideband hybrid IC modules

FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
PDT = Photodiodes or transistors
RFP = R.F. power transistors and modules
Sm = Small-signal transistors
Th = Thyristors

* = series
FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
PM = Power MOS transistors
Sm = Small-signal transistors
SP = Low-frequency switching power transistors
Th = Thyristors
Tri = Triacs

* = series
PM = Power MOS transistors
R = Rectified diodes

* = series
LED = Light-emitting diodes
M = Microwave transistors
Mm = Microminiature semiconductors for hybrid circuits
Ph = Photoconductive devices
PhC = Photocouplers
R = Rectifier diodes
TS = Transient suppressor diodes
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes

* = series
A = Accessories
I = Infrared devices
LED = Light-emitting diodes
M = Microwave transistors
PhC = Photocouplers
SEN = Sensors
WBM = Wideband hybrid IC modules

FET = Field-effect transistors
I = Infrared devices
M = Micriwave transistors
Mm = Microminiature semiconductors for hybrid circuits
P = Low-frequency power transistors
PhC = Photocouplers
R = Rectifier diodes
SEN = Sensors
Sm = Small-signal transistors
SP = Low-frequency switching power transistors
St = Rectifier stacks
WBM = Wideband hybrid IC modules

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PhC = Photocouplers
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Sm = Small-signal transistors
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Ph = Photoconductive devices
PhC = Photocouplers
RFP = R.F. power transistors and modules
Sm = Small-signal transistors

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