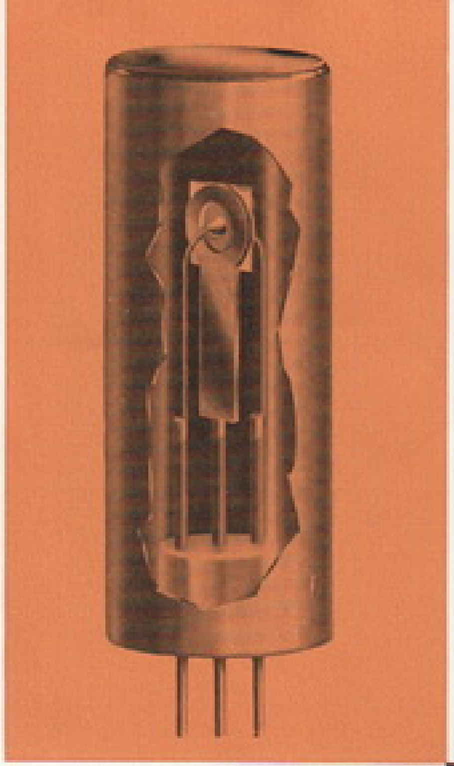
SECOND EDITION

PHILIPS

TRANSISTORS AND SEMI-CONDUCTOR DIODES

PHILIPS ELECTRON TUBE DIVISION



PHILIPS

TRANSISTORS

introduction

In the fast growing transistor field the designer as well as the manufacturer of electronic equipment will find it more and more difficult to have a complete and up-to-date picture of the various types that are currently available.

For this reason we are presenting in this folder our complete range of transistors with their main electrical characteristics. Also included are the dimensional drawings of the various executions.

The audio-frequency range has been supplemented by four subminiature types (OC 57, 58, 59 and 60) which offer the possibility of building hearing aids of very high quality,

RADIO-

Type	Maximum ratings						
	Collector-emitter voltage [1]		Peak collector current (mA)	Max. continuous junction temperature (°C)	Collector dissipation at 25 °C amb. P_C (mW)	Current gain h_{fe}	at I_E (mA)
	Peak (V)	D.C. (V)					
Converter, Mixer, Oscillator							
OC 44	15 [9]	15 [9]	10	75	83	100	1
OC 45	15 [9]	15 [9]	10	75	83	50	1
OC 170 [12]	20 [10]	20 [10]	10	75	83	100	1
OC 171 [12]	20 [10]	20 [10]	5	75	83	–	–

and at the same time are excellently suited for use in various other types of equipment, where small dimensions are of vital importance.

Our range of large-signal amplifiers has been extended with a class-A output type for car radios, the OC 26, which can be driven up to 4 W by a transistor driver.

A new type for all-transistor battery receivers has been added to our range, the OC 74. At a supply voltage of 9 V, a pair of these transistors (type number 2-OC 74) delivers an output of 1 W, whilst very low distortion is experienced.

In the radio-frequency range two alloy-diffused types (OC 170, 171) are now available. They are especially designed for applications in transistorised AM/FM receivers, which thus have become an appealing proposition to the setmaker.

For high-speed switching applications three n-p-n germanium types, the OC 139, 140 and 141, have been introduced. Optimum combination of the different functions of transistors in computers or calculating machines, which can only be reached with both p-n-p and n-p-n transistors, has become practicable by the introduction of these new types. Owing to their symmetrical structure, the main characteristics of n-p-n transistors are comparable for normal and inverted connections, which offers great improvements in switching performance and better possibilities of bidirectional use.

Finally, two new power switching types, the OC 35 and OC 36, have become available. These types have the advantage that a maximum voltage of 32 V and a maximum current of 6 A may be applied simultaneously; this means that the avalanche breakdown voltage at 6 A is higher than 32 V.

FREQUENCY TYPES

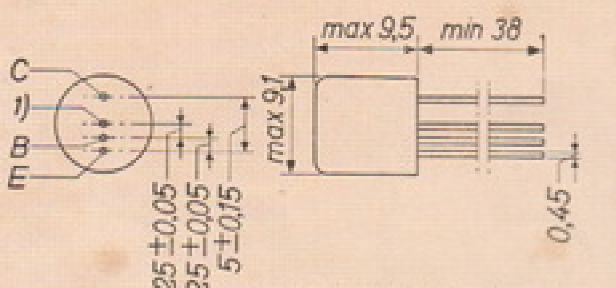
Characteristics at 25 °C					Dimensional drawing No.	Typical application
$-I_{CBO}$ (μA)	at $-V_{CB}$ (V)	$f_{\alpha b}$ (Mc/s)	at $-V_{CB}$ (V)	at I_E (mA)		
Applications (PNP, Ge-Types)						
0.5	2	15	6	1	2	mixer-oscillator in medium-wave receivers
0.5	2	6	6	1	2	IF amplifier in AM receivers

transfer admittance mA/V	input conductance mA/V	input capacitance pF	output conductance μA/V	output capacitance pF	at (V)	at (mA)	at (Mc/s)	
Y_{fe}	g_{ie}	C_{ie}	g_{oe}	C_{oe}	V_{CE}	I_E	f	
32	2.5	65	60	4.5	− 6	1	10.7	mixer-oscillator in short-wave receivers; IF amplifier in FM receivers
Y_{fb}	g_{ib}	C_{ib}	g_{ob}	C_{ob}	V_{CB}	I_E	f	(See dimensional drawing No. 3)
15	20	− 15	300	2.5	− 6	1	100	pre- and mixer-stage in FM receivers

AUDIO-

Type	Maximum ratings						
	Collector-emitter voltage [1]		Peak collector current (mA)	Max. continuous junction temperature (°C)	Collector dissipation at 25 °C amb. P_C (mW)	Current gain h_{fe}	at I_E (mA)
	Peak (V)	D.C. (V)					
Small-signal Amplifier Applications							
OC 57	7	3	10	55	10	35	0.25
OC 58	7	3	10	55	10	55	0.25
OC 59	7	3	10	55	10	80	0.25
OC 60	7	3	10	55	10	60	0.25
OC 70	30 [7]	30 [7]	50	75	125	30	0.5
OC 71	30 [7]	30 [7]	50	75	125	50	3
OC 75	30 [7]	30 [7]	50	75	125	90	3
Large-signal Amplifier Applications							
OC 26	32	16	3500	90	13000 [4]	33 [3]	1000
OC 30	32 [7]	16 [7]	1400	75	3600 [8]	35 [3]	100
OC 72 (2-OC 72)	32 [9]	32 [9]	250	75	165 [11]	70 [3]	10
OC 74 (2-OC 74)	20 [7]	20 [7]	300	75	550 [11]	65 [3]	300
OC 79	26	26	300	75	550 [11]	42 [3]	300

dimensional drawings



[1]) interlead shield and metal case

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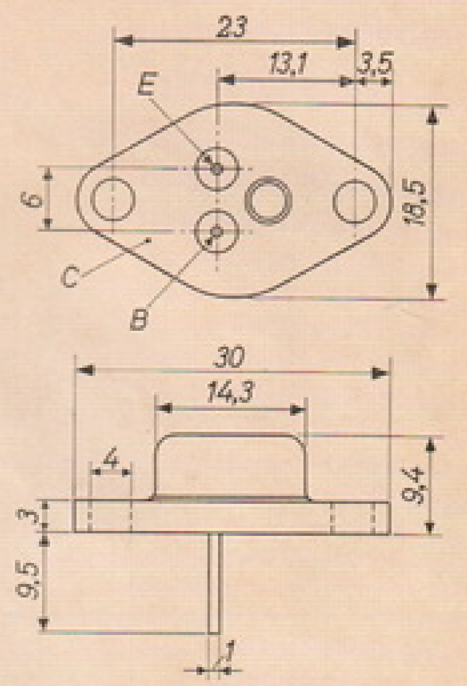

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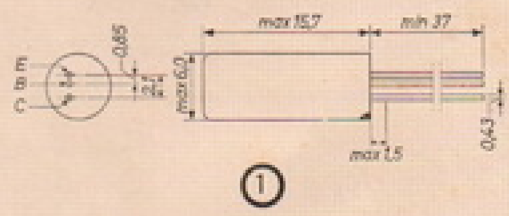

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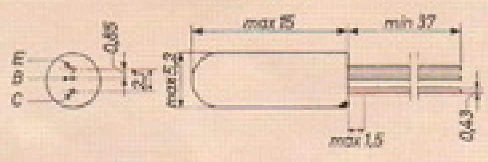

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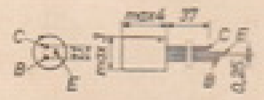

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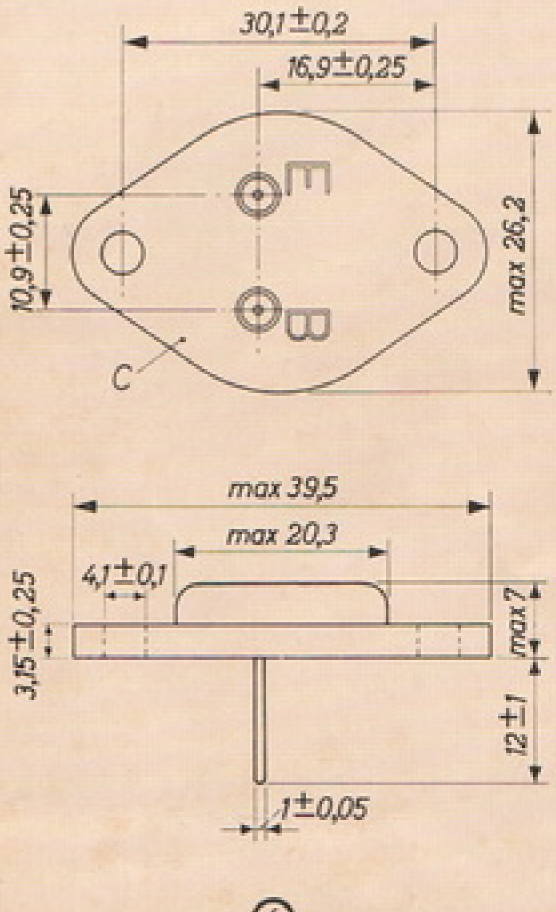
FREQUENCY TYPES

Characteristics at 25 °C					Dimensional drawing No.	Typical application
$-I_{CBO}$ (μA)	at $-V_{CB}$ (V)	$f_{\alpha b}$ (Mc/s)	at $-V_{CB}$ (V)	at I_E (mA)		
Class A (PNP, Ge-Types)						
1.5	2	1.4	0.5	0.25	4	pre-stages in hearing aids
1.5	2	1.6	0.5	0.25	4	pre-stages in hearing aids
1.5	2	2.2	0.5	0.25	4	pre-stages in hearing aids
1.5	2	1.6	0.5	0.25	4	output stages in hearing aids
5	4.5	0.45	2	0.5	2	general purpose
5	4.5	0.5	2	3	2	general purpose
5	4.5	0.75	2	3	2	general purpose high gain
Class A & B (PNP, Ge-Types)						
< 100	0.5	0.15	6	1000	6	medium gain power
12	14	0.3	7	100	5	medium gain power
4.5	10	0.9	6	10	1	medium power output and driver
10	9	1.5	6	50	1	large signal output and driver stages
10	12	1.2	6	50	1	medium power output



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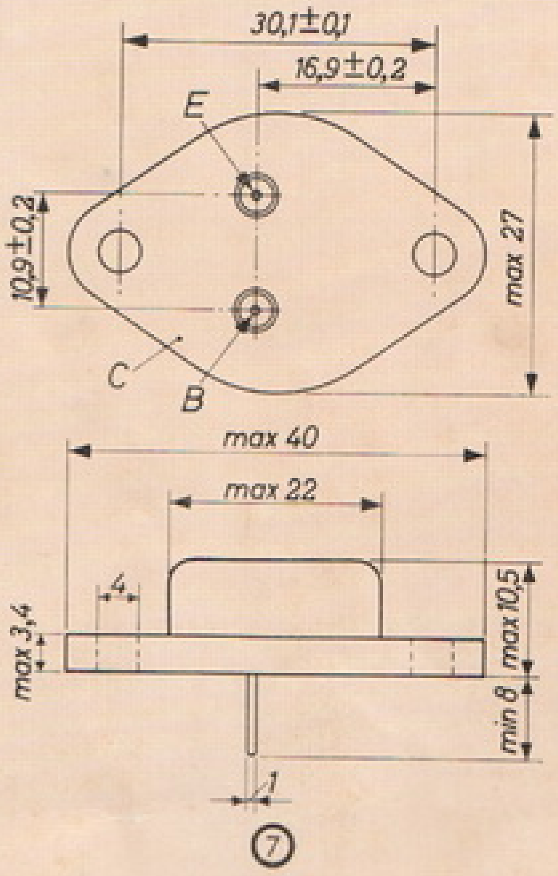

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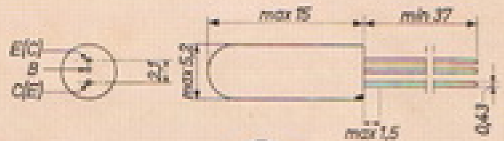

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Type	Maximum ratings: Collector-emitter voltage [1]) Peak (V)	D.C. (V)	Peak collector current (mA)	Max. continuous junction temperature (°C)	Collector dissipation at 25 °C amb. Pc (mW)	Current gain h_{fe}	at I_E (mA)
High-speed Switching Applica							
OC 22	32 [5])	24 [5])	1000	75	10000 [4])	150 [3])	1000
OC 23	40 [5])	24 [5])	1000	75	10000 [4])	150 [3])	1000
OC 24	32 [5])	24 [5])	1000	75	10000 [4])	150 [3])	1000
OC 46	20	20	125	75	83	< 80	15
OC 47	20	20	125	75	83	< 200	15
Low-speed Switching Applica							
OC 28	60/80 [6])	60/80 [6])	6000	90	13000 [4])	32 [3])	1000
OC 29	32/48/60 [14])	32/48/60 [14])	6000	90	13000 [4])	90 [3])	1000
OC 35	32/48/60 [14])	32/48/60 [14])	6000	90	13000 [4])	50 [3])	1000
OC 36	32/60/80 [15])	32/60/80 [15])	6000	90	13000 [4])	70 [3])	1000
OC 76	32 [9])	32 [9])	250	75	165 [11])	45 [3])	250
OC 77	60 [7])	60 [7])	250	75	165 [11])	52 [3])	250
OC 80	32	32	600	75	550 [11])	85 [3])	600
High-speed Switching Applica							
OC 139 [13])	20	20	250	75	100	45 [3])	15
OC 140 [13])	20	20	250	75	100	75 [3])	15
OC 141 [13])	20	20	250	75	100	150 [3])	15
Industrial Applications							
OC 200	25	25	50	150	250	20	1
OC 201	25	25	50	150	250	30	1

1) Thermal stability must be ensured
2) The voltages and currents of NPN types have the inverse polarity
3) Large-signal current gain h_{FE}
4) Total heat resistance K = 5 °C/W (junction to ambient)
5) Base-to-ground impedance < 100 Ω
6) Min. avalanche-voltage = 60 V at V_{BE} = 2 V and $-I_C$ = 6 A
Min. breakdown-voltage = 80 V at V_{BE} = 1 V and $-I_C \leqslant$ 3 mA
7) Base-to-ground impedance < 500 Ω
8) Total heat resistance K = 14 °C/W (junction to ambient)
9) Base-to-ground impedance < 1000 Ω

G AND COMPUTER TYPES

Characteristics at 25 °C					Dimensional drawing No.	Typical application
$-I_{CBO}$ (µA)	at $-V_{CB}$ (V)	$f_{\alpha b}$ (Mc/s)	at $-V_{CB}$ (V)	at I_E (mA)		
plications	**(PNP, Ge-Types)**					
30	10	2.5	2	400	7	digital computers, high quality audio amplifiers
30	10	2.5	2	400	7	pulse generator for ferrite store
30	10	2.5	2	400	7	medium frequency transmitter carrier telephony
< 3	5	> 3	5	3	2	medium current
< 3	5	> 5.5	5	3	2	medium current
plications	**(PNP, Ge-Types)**					
< 100	0.5	0.2	6	300	6	high voltage and high current applications, DC-converters
< 100	0.5	0.2	6	300	6	high current applications
< 100	0.5	0.2	6	300	6	high current applications DC-converters
< 100	0.5	0.2	6	300	6	high voltage and high current applications
4.5	10	0.9	6	10	1	pulse oscillators, DC-converters
4.5	10	0.9	6	10	1	pulse oscillators, DC-converters
10	12	2.0	6	50	1	pulse oscillators, DC-converters
plications	**(NPN [2]), Ge-Types)**					
0.8	5	> 3.5	5	3	8	computers
0.8	5	> 4.5	5	3	8	computers
0.8	5	> 9	5	3	8	computers
ons	**(PNP, Si-Types)**					
0.01	10	1	6	1	1	general purpose audio amplifier
0.01	10	4	6	1	1	general purpose audio amplifier

10) Collector-to-base

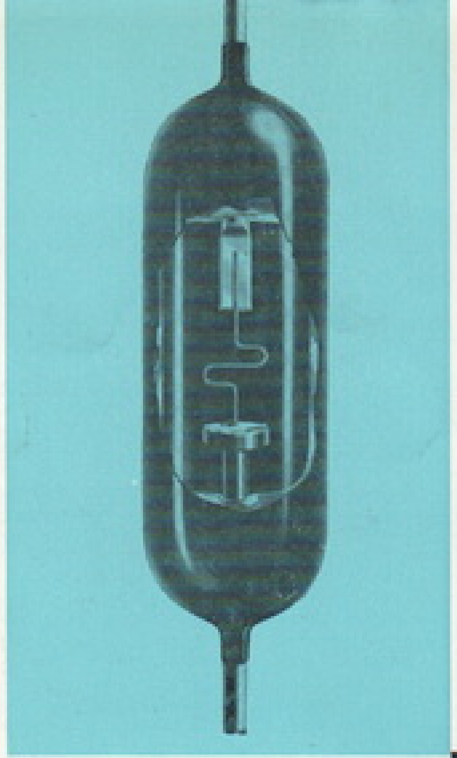
11) With cooling fin 56200 and heat sink of at least 12.5 cm²

12) Alloy-diffused Ge-PNP Transistor

13) Bi-directional Ge-NPN Transistor

14) $-V_{CE} > 32$ V at $-I_C = 6$ A and $V_{BE} = 2$ V
$-V_{CE} > 48$ V at $-I_C = 0.5$ A and $V_{BE} = 2$ V
$-V_{CE} > 60$ V at $-I_C \leqslant 3$ mA and $V_{BE} = 1$ V

15) $-V_{CE} > 32$ V at $-I_C = 6$ A and $V_{BE} = 2$ V
$-V_{CE} > 60$ V at $-I_C = 0.5$ A and $V_{BE} = 2$ V
$-V_{CE} > 80$ V at $-I_C \leqslant 3$ mA and $V_{BE} = 1$ V



PHILIPS

D I O D E S

The number of applications in which semiconductor diodes are used to advantage, has rapidly increased during the past years. In large measure this expansion is due to the electrical characteristics of these devices, a low forward resistance, high inverse resistance and very favourable characteristics at high frequencies, as well as to their specific properties, such as the absence of a heater, their small dimensions, their long life and rugged construction.

The range of semiconductor diodes, which have now firmly established themselves in electronics, is the outcome of lengthened experience in mass-producing these diodes. Extensive research, a detailed knowledge of the widely diverging requirements that semi-conductor diodes have to meet in practice, combined with life and field tests over a period of many years, have resulted in diodes whose particular advantages can be utilised to the full.

Semiconductor diodes can be split up into two main groups, *germanium* diodes and *silicon* diodes.

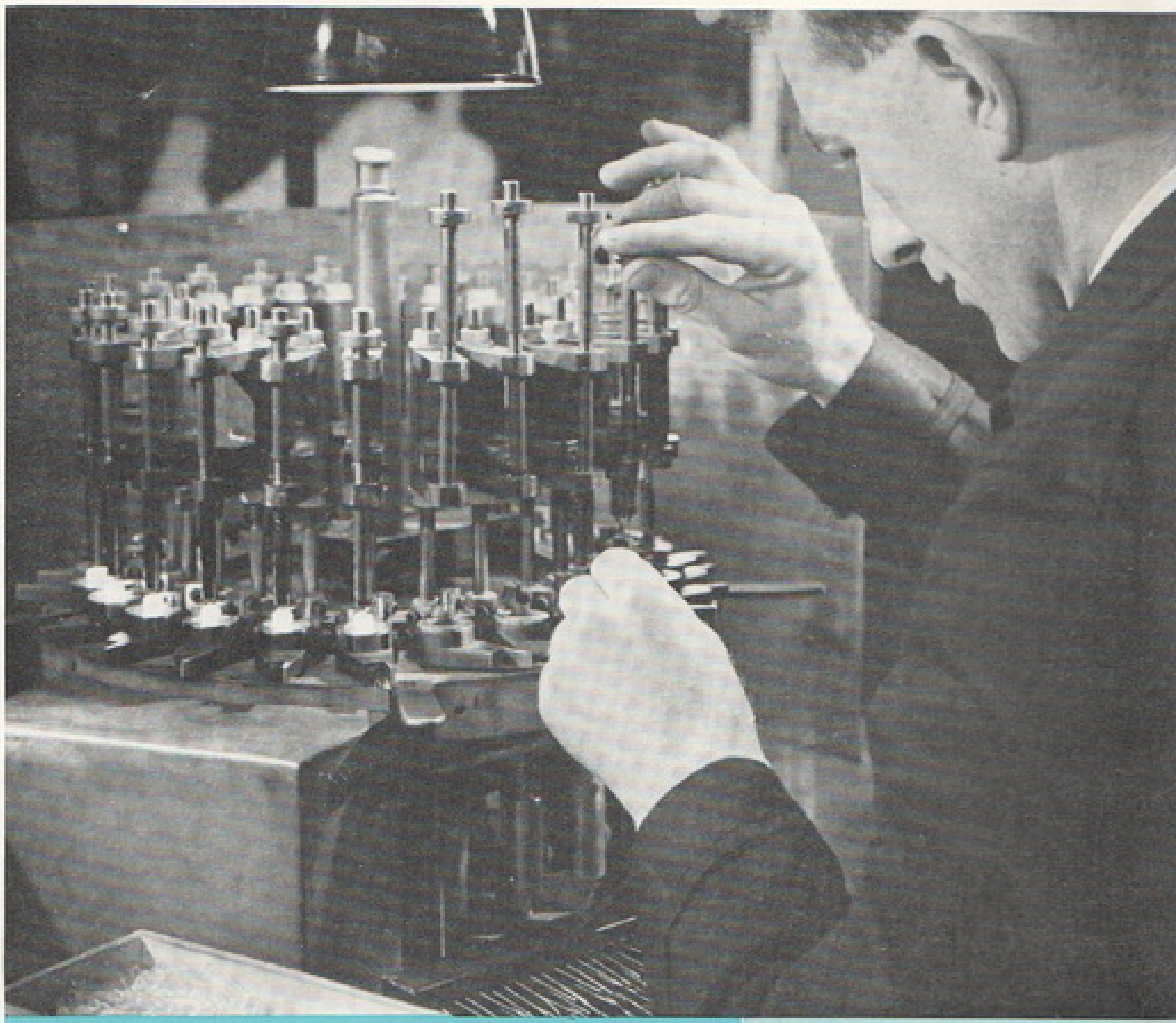
To discriminate between these two types, it should be recognised that the silicon diode, as compared with the germanium diode, has a much lower leakage current at the same temperature. Moreover, the silicon diode can cope with higher temperatures than germanium, so that it will be of great interest particularly in applications where high ambient temperatures occur.

The choice between silicon and germanium diodes for a given application, however, depends on many design factors which may differ greatly from case to case.

The range of diodes comprises four different executions:

1. double-ended all-glass envelope (70 and 80 series);
2. double-ended miniature all-glass envelope (90 series, OA 200, OA 202, OA 47);
3. single-ended all-glass envelope (OA 5, OA 7, OA 9);
4. metal case (OA 31, OA 210, OA 211, OA 214).

For a survey of the various types of diode we refer to the table in which the technical data and the specific applications of each type have been laid down.



Two of the various stages in the long and delicate manufacturing process of semiconductor devices: precision positioning instruments ensure products of great uniformity and high reliability.

DIODES	Type number	Absolute maximum ratings: Peak inverse voltage (V)	D.C. inverse voltage (V)	Average forward current (mA)	Peak forward current (mA)	Surge current 1 sec (mA)
Germanium	OA 5 [1]	100	100	115	350	500
	OA 7 [3]	25	15	50	50	400
	OA 9 [3]	25	25	35 [4]	500	800
	OA 47 [3]	25	15	50	50	300
	OA 90 [3]	30	20	8	45	200
	OA 91 [1]	115	90	50	150	500
	OA 95 [1]	115	90	50	150	500
	OA 70 [3]	22.5	15	50	150	400
	OA 73 [3]	30	20	50	150	400
	OA 79 [1]	45	30	35	100	200
	2-OA 79 [1]					
	OA 81 [1]	115	90	50	150	500
	OA 85 [1]	115	90	50	150	500
	OA 86 [1]	90	60	35	150	200
Silicon	OA 200	50	50	50	150	
	OA 202	150	150	30	100	

	Type number	Zener voltage nominal ($-V_Z$) (V)	Max. Zener current ($-I_D$) (mA)	Dynamic impedance R_Z at $I_Z = 5$ mA (Ω)	Reverse current at $V_D = 2$ V (mμA)
Silicon reference	OAZ 200	4.7	40	60	250
	OAZ 201	5.1	40	50	100
	OAZ 202	5.6	40	25	30
	OAZ 203	6.2	40	6	10
	OAZ 204	6.8	40	4	10
	OAZ 205	7.5	40	4	5
	OAZ 206	8.2	40	4	5
	OAZ 207	9.1	40	4	5

RECTIFIERS	Type number	Absolute maximum ratings: Peak inverse voltage (V)	Average forward current (A)	Peak forward current (A)
Germanium	OA 31	85	12	12
Silicon	OA 210	400	0.5 [4]	5
	OA 211 [5]	800	0.4 [4]	4
	OA 214 [5]	700	0.5 [4]	5

PHOTODIODE	Type number	Max. inverse voltage (V)	Max. inverse current (mA)	Sensitivity at $T_C = 2500$ °K N (μA/100 lux)
Germanium	OAP 12	30	3	> 5

[1]) Ratings at an ambient temperature of 25 °C.
[2]) Average values.
[3]) Absolute maximum ratings at an ambient temperature of 75 °C.

D SILICON DIODES

Electrical characteristics [1]			
Forward voltage at 0.1 mA (V)	Forward voltage at 10 mA (V)	Inverse current at specified voltage (μA) [2]	Description
0.1–0.25	0.25–0.55	8 at $-V_D$ = 100 V	Germanium gold-bonded 100 V diode in single-ended all-glass execution for general-purpose applications
0.18	0.42	1.9 at $-V_D$ = 25 V	Germanium gold-bonded diode in single-ended all-glass execution especially suitable for high forward current switching applications
0.16	0.32	3.3 at $-V_D$ = 25 V	Germanium gold-bonded diode in single-ended all-glass execution with high forward conductance, suitable for high forward current switching applications
0.17	0.40	30 at $-V_D$ = 25 V	Miniature double-ended execution of type OA 7
0.1–0.25	0.5–1.5	300 at $-V_D$ = 30 V	Miniature execution of the OA 70
0.1–0.25	0.65–1.9	75 at $-V_D$ = 100 V	Miniature execution of the OA 81
0.1–0.25	0.65–1.5	80 at $-V_D$ = 100 V	Miniature execution of the OA 85
0.1–0.25	0.55–2.0	150 at $-V_D$ = 22.5 V	Germanium point-contact diode in all-glass construction, designed for video detection
0.1–0.2	0.6–1.1	280 at $-V_D$ = 30 V	Germanium point-contact diode designed for use as video detector or ring modulator
0.15–0.3	0.8–2.2	90 at $-V_D$ = 45 V	OA 79: Germanium point-contact diode intended for use as AM detector 2-OA 79: Matched pair of OA 79 designed for use as ratio detector (damping resistance > 13.5 kΩ)
0.1–0.25	0.65–1.9	75 at $-V_D$ = 100 V	Germanium point-contact 100 V diode for general-purpose applications
0.1–0.25	0.65–1.5	75 at $-V_D$ = 100 V	Germanium point-contact diode for general-purpose applications (electrical characteristics are better than those of the OA 81)
0.14–0.25	0.82–1.47	130 at $-V_D$ = 90 V	Germanium point-contact computer-diode (especially suitable for switching applications)
0.53	0.80	0.05 at $-V_D$ = 50 V	Silicon-alloy 50 V diode in miniature envelope
0.53	0.80	0.05 at $-V_D$ = 150 V	Silicon-alloy 150 V diode in miniature envelope

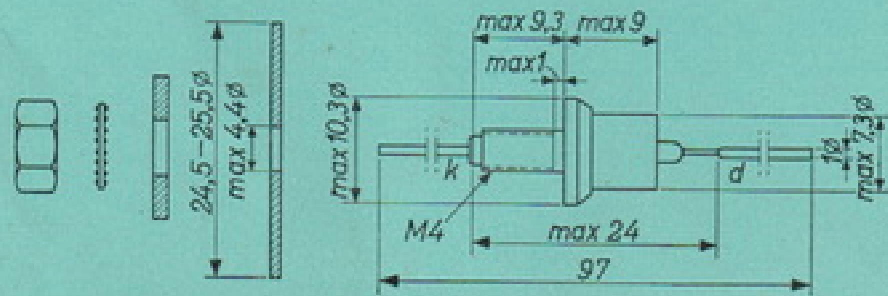
Typical change in Zener voltage with temperature I_z = ImA (mV/°C)	Forward voltage at I_D = 10 mA (V)	
−2	0.72	Silicon-alloy junction diodes in all-glass single-ended construction with external metal can intended for use as a low-current stabiliser or as a voltage reference
−1.8	0.72	
−1.5	0.72	
+1	0.72	
+3	0.72	
+4	0.72	
+5.5	0.72	
+6.5	0.72	

Maximum load capacitance (μF)	Minimum circuit resistance (Ω)	
1000		Germanium junction diode for use as power rectifier
200	4	Silicon-alloy 400 V diode, forward current 500 mA for use as mains rectifier
100	8	Silicon-alloy 800 V diode, forward current 400 mA for use as mains rectifier
100	7	Silicon-alloy 700 V diode, forward current 500 mA for use as mains rectifier

Dark current (T_{amb}=25°C; V=−10V) I_o (μA)	Wavelength for max. sensitivity λm (μ)	
< 15	1.55 (infra-red)	Germanium junction photodiode of the p-n alloy type in metal case, with a lens on top

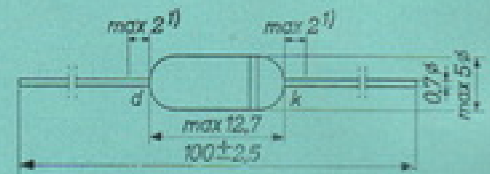
4) Sinusoidal input voltage and capacitive load.
5) A heat sink of min. 5 cm^2 is required.

dimensional drawings

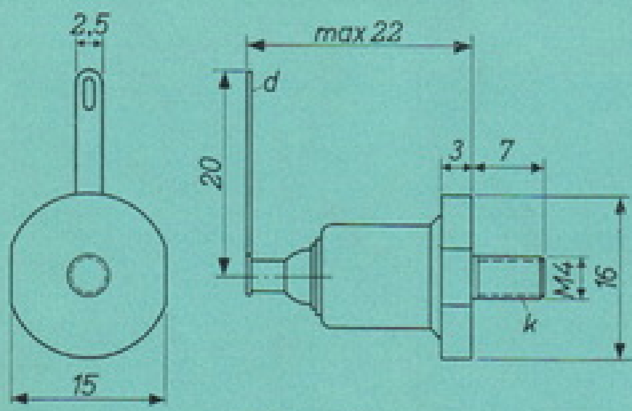


OA 210 series

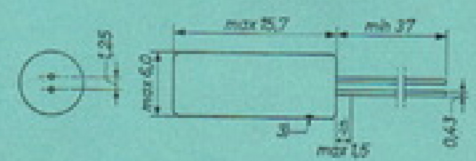
OA 90 series



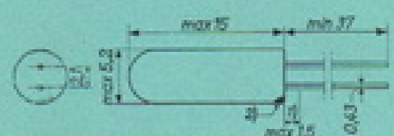
OA 70 .... OA 85



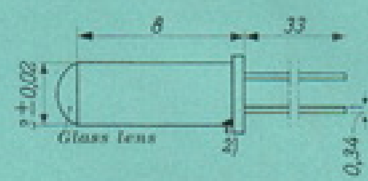
OA 31



OAZ 200-207



OA5, OA7, OA9



OAP 12 (twice actual size)

1) not tin-plated

2) 3) red dot indicates the cathode

Printed in Holland

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