PHILIPS INTERNATIONAL 56E D ■ 7110826 0042886 235 ■PHIN
T-33-29

SILICON DARLINGTON POWER TRANSISTORS

N-P-N epitaxial base transistors in monolithic Darlington circuit for audio output stages and general amplifier and switching applications; plastic SOT-82 envelope for clip mounting; can also be soldered or adhesive mounted into a hybrid circuit. P-N-P complements are BD332, BD334, BD336 and BD338.

QUICK REFERENCE DATA

			BD331	333	335	337	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	100	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	80	100	120	V
Collector-current (d.c.)	I_C	max.		6			A
Base current (d.c.)	I_B	max.		150			mA
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.		60			W
Junction temperature	T_j	max.		150			°C
D.C. current gain I_C = 3,0 A; V_{CE} = 3 V	h_{FE}	>		750			

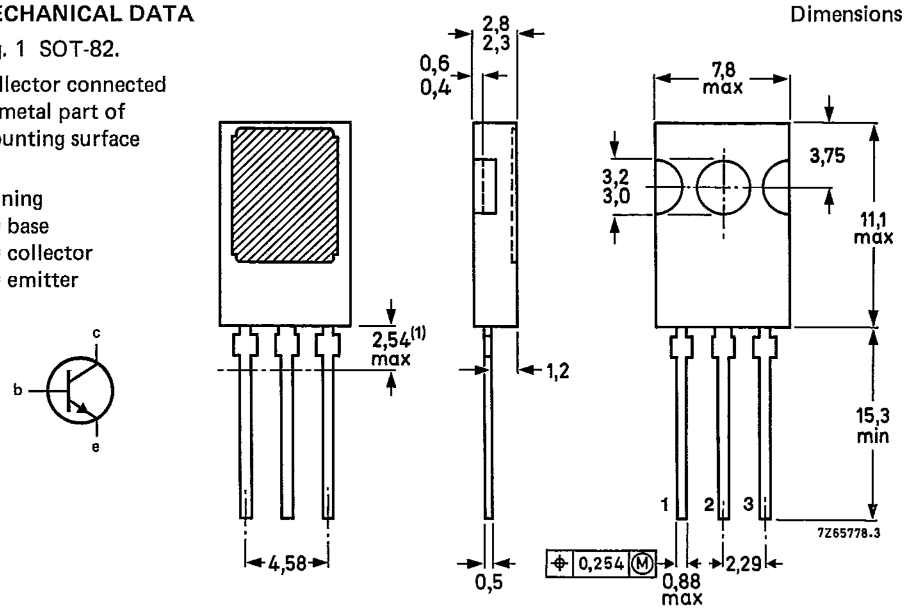
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-82.

Collector connected to metal part of mounting surface

Pinning
1 = base
2 = collector
3 = emitter



(1) Within this region the cross-section of the leads is uncontrolled.

See also chapters Mounting Instructions and Accessories.

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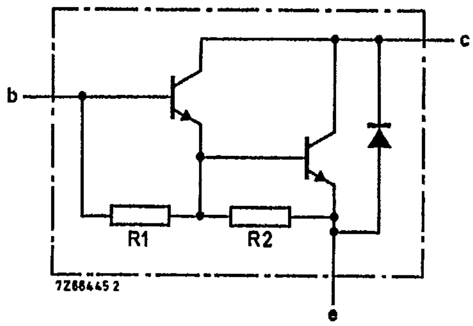


R_1 typ. 4 kΩ
R_2 typ. 100 Ω

Fig. 2 Circuit diagram.

RATINGS

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

			BD331	333	335	337	
Collector-base voltage (open emitter)	V_{CBO}	max.	60	80	100	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	80	100	120	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	5	V
Collector current (d.c.)	I_C	max.		6			A
Collector current (peak value) $t_p \leq 10$ ms; $\delta \leq 0{,}1$	I_{CM}	max.		10			A
Base current (d.c.)	I_B	max.		150			mA
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.		60			W
Storage temperature	T_{stg}			−65 to + 150			^oC
Junction temperature *	T_j	max.		150			^oC

THERMAL RESISTANCE *

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2,08	K/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	100	K/W

* Based on maximum average junction temperature in line with common industrial practice. The resulting higher junction temperature of the output transistor part is taken into account.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = V_{CBOmax}$	I_{CBO}	<	0,1	mA
$I_E = 0$; $V_{CB} = V_{CBOmax}$; $T_j = 150$ °C	I_{CBO}	<	1	mA
$I_B = 0$; $V_{CE} = ½ V_{CEOmax}$	I_{CEO}	<	0,2	mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	5	mA
D.C. current gain *				
$I_C = 0,5$ A; $V_{CE} = 3$ V	h_{FE}	typ.	1900	
$I_C = 3$ A; $V_{CE} = 3$ V	h_{FE}	>	750	
$I_C = 6$ A; $V_{CE} = 3$ V	h_{FE}	typ.	3000	
Base-emitter voltage **				
$I_C = 3$ A; $V_{CE} = 3$ V	V_{BE}	<	2,5	V
Collector-emitter saturation voltage				
$I_C = 3$ A; $I_B = 12$ mA	V_{CEsat}	<	2	V
Cut-off frequency				
$I_C = 3$ A; $V_{CE} = 3$ V	f_{hfe}	typ.	50	kHz
Turn-off breakdown energy with inductive load (see Fig. 12)				
$-I_{Boff} = 0$; $I_{Con} = 4,5$ A	$E_{(BR)}$	>	50	mJ
Diode forward voltage				
$I_F = 3$ A	V_F	typ.	1,8	V
D.C. current gain ratio of complementary matched pairs				
$I_C = 3$ A; $V_{CE} = 3$ V	h_{FE1}/h_{FE2}	<	2,5	
Small signal current gain				
$I_C = 3$ A; $V_{CE} = 3$ V; f = 1 MHz	h_{fe}	>	10	
Second-breakdown collector current				
$V_{CE} = 60$ V; $t_p = 25$ ms	$I_{(SB)}$	>	1	A
Switching times (between 10% and 90% levels)				
$I_{Con} = 3$ A; $I_{Bon} = -I_{Boff} = 12$ mA				
Turn-on time	t_{on}	typ.	1	μs
		<	2	μs
Turn-off time	t_{off}	typ.	5	μs
		<	10	μs

* Measured under pulse conditions: $t_p < 300$ μs, $\delta < 2\%$.
** V_{BE} decreases by about 3,8 mV/K with increasing temperature.

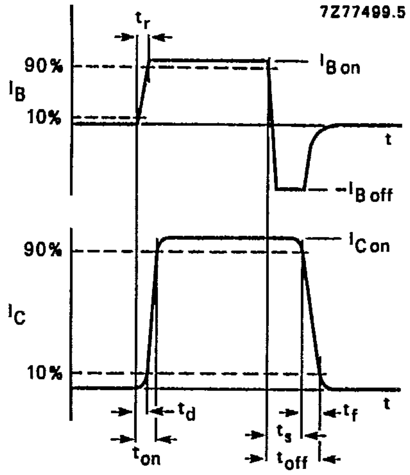
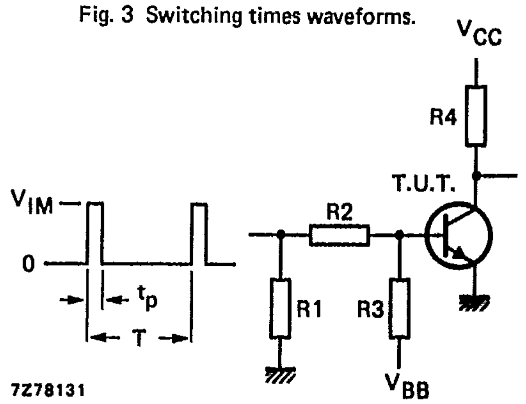
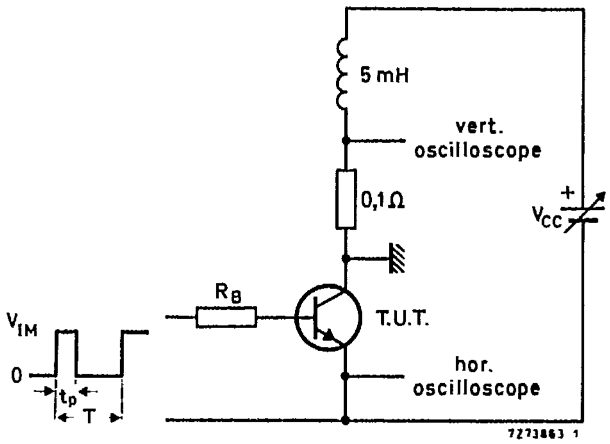


Fig. 3 Switching times waveforms.



V_{IM} = 10 V
V_{CC} = 10 V
$-V_{BB}$ = 4 V
R1 = 56 Ω
R2 = 410 Ω
R3 = 560 Ω
R4 = 3 Ω
$t_r = t_f$ = 15 ns
t_p = 10 μs
T = 500 μs

Fig. 4 Switching times test circuit.



V_{IM} = 12 V
R_B = 270 Ω
I_C = 4,5 A
δ = 1 %
t_p = 1 ms

Fig. 5 Test circuit for turn-off breakdown energy.

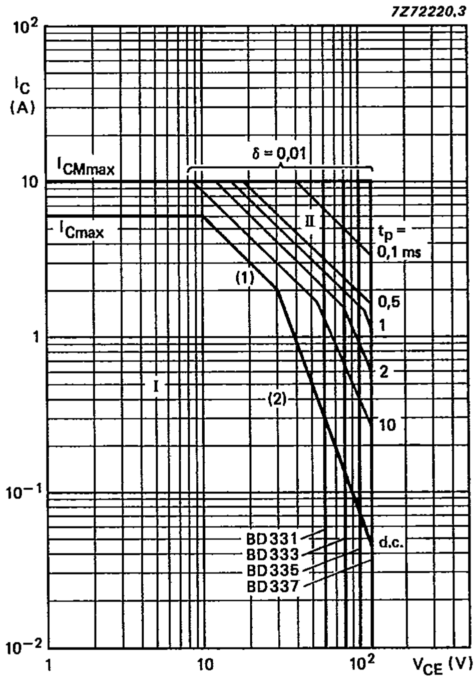


Fig. 6 Safe Operating Area, $T_{mb} \leqslant 25\ ^oC$.

I Region of permissible d.c. operation.
II Permissible extension for repetitive pulse operation.

(1) $P_{tot\ max}$ and $P_{peak\ max}$ lines.
(2) Second-breakdown limits.

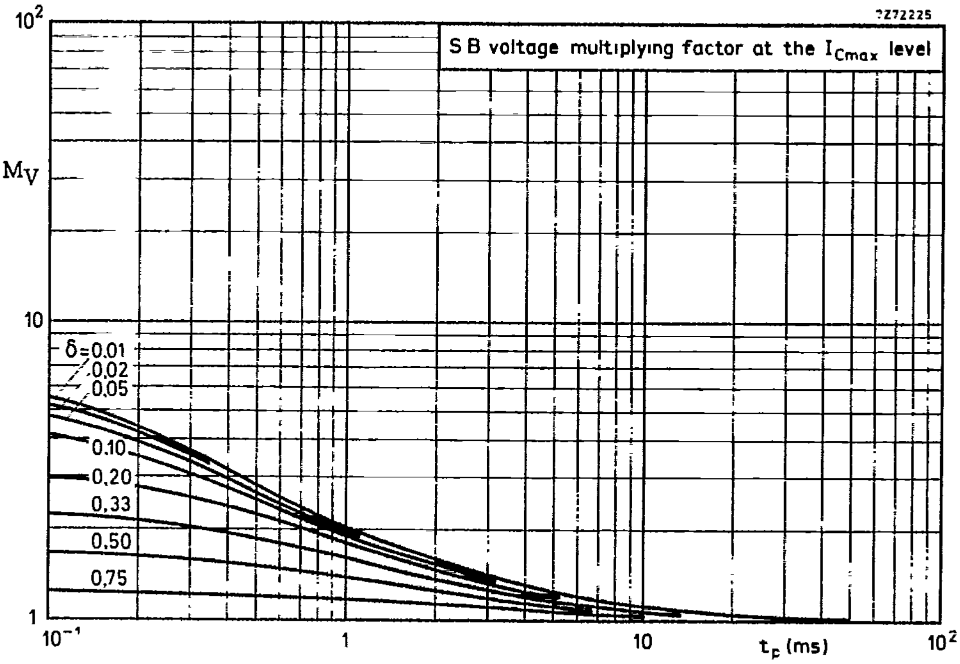


Fig. 7 Second breakdown voltage multiplying factor at I_{Cmax} level.

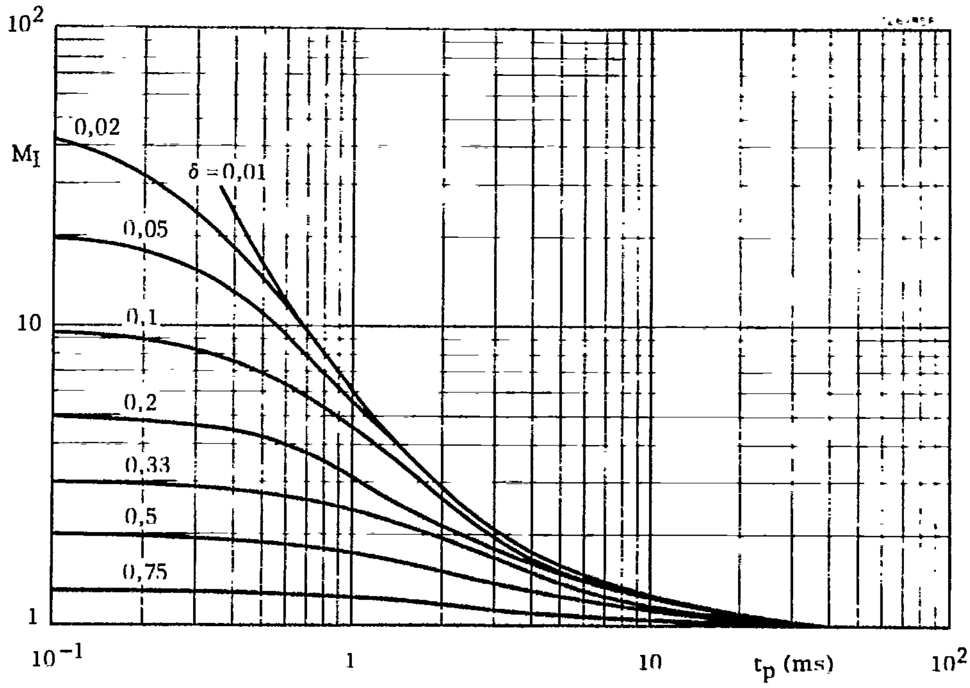


Fig. 8 Second breakdown current multiplying factor at V_{CEOmax} level.

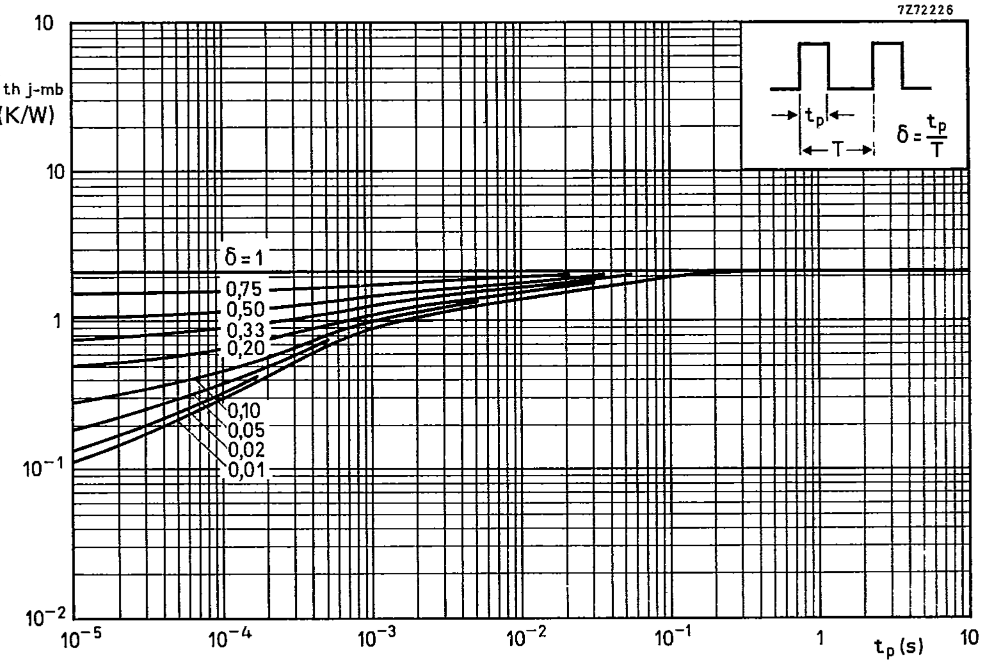


Fig. 9 Pulse power rating chart.

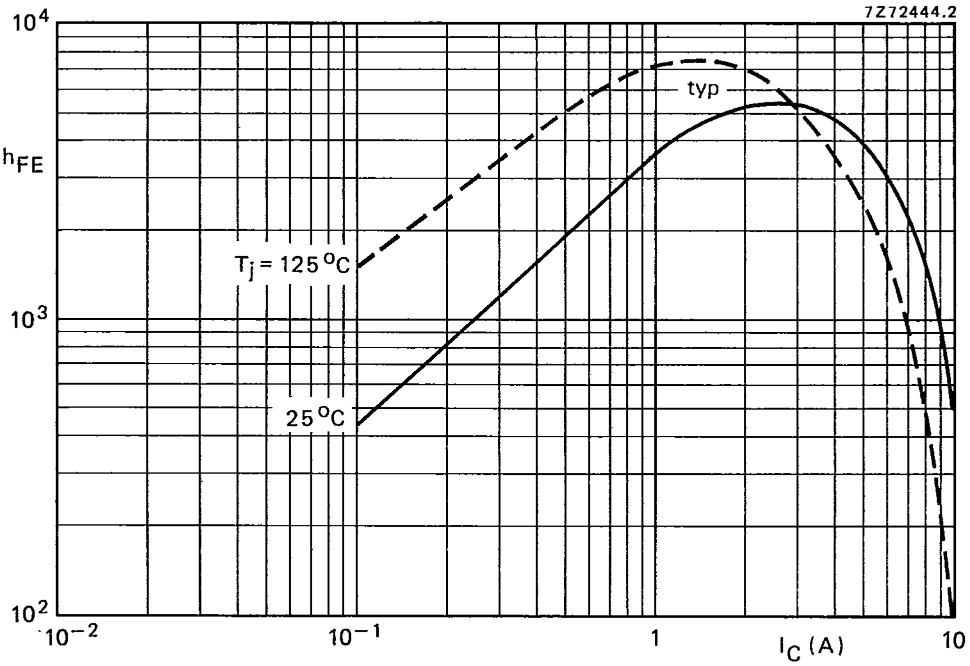


Fig. 10 D.C. current gain. V_{CE} = 3 V.

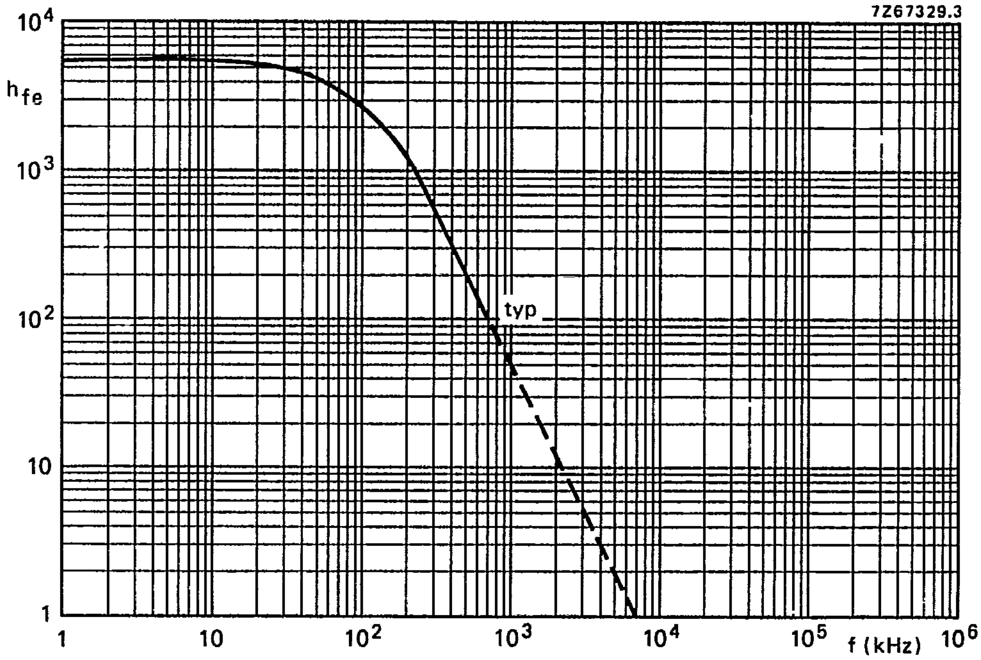


Fig. 11 Small signal current gain at I_C = 3 A; V_{CE} = 3 V.

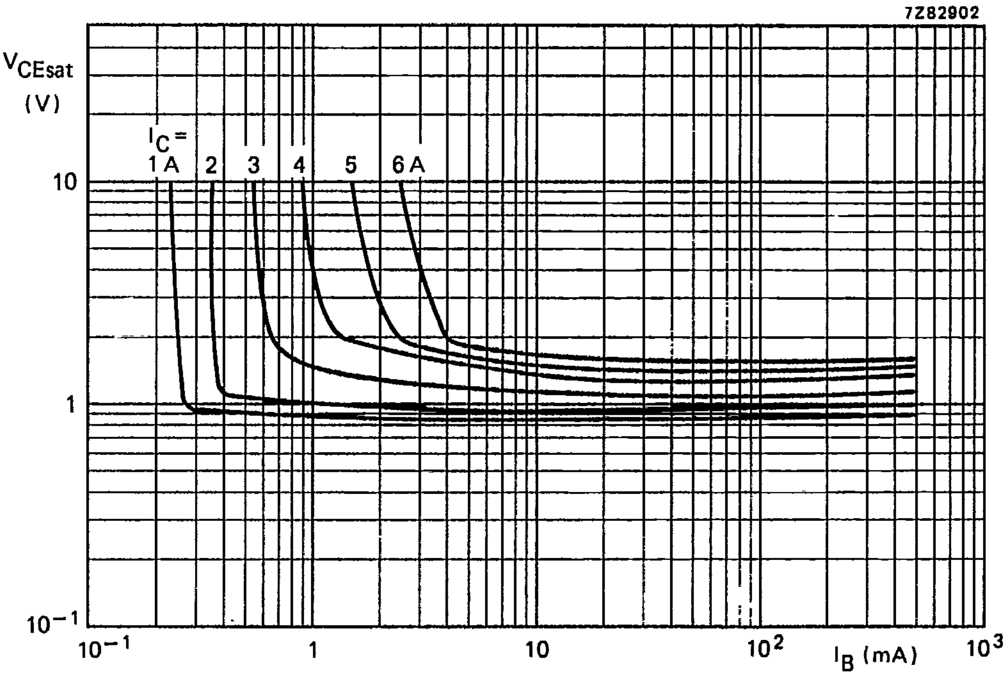


Fig. 12 Typical values collector-emitter saturation. T_j = 25 °C.

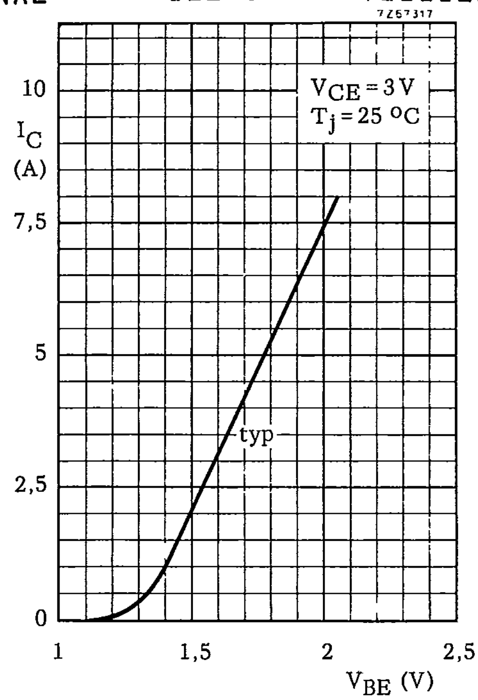


Fig. 13 Collector current.

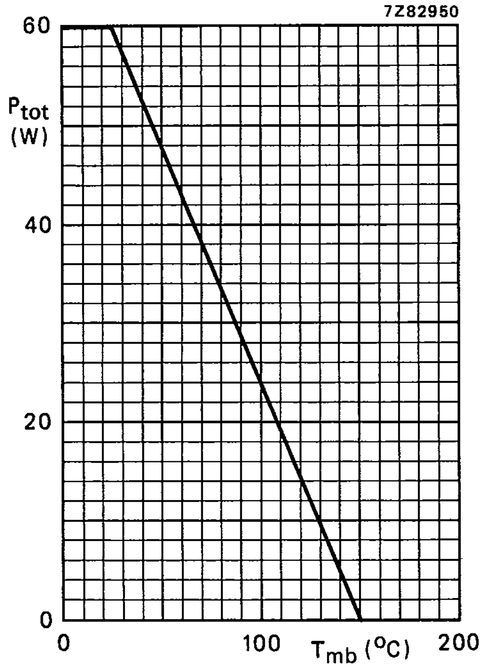


Fig. 14 Power derating curve.