

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 $T_{mb} = 25^\circ\text{C}$	P_{tot}	max.		60		W
Junction temperature	T_j	max.		150		$^\circ\text{C}$
D.C. current gain $I_C = 3,0\text{ A}; V_{CE} = 3\text{ V}$	h_{FE}	>		750		

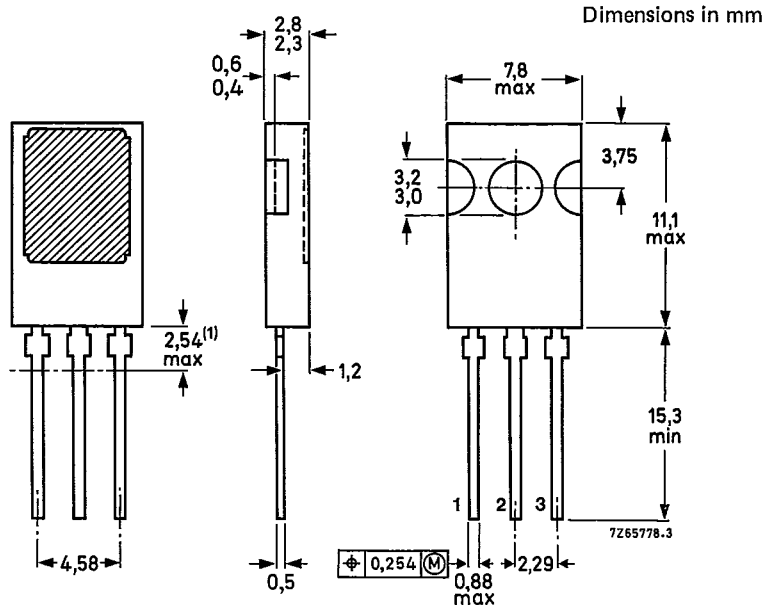
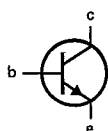
MECHANICAL DATA

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.

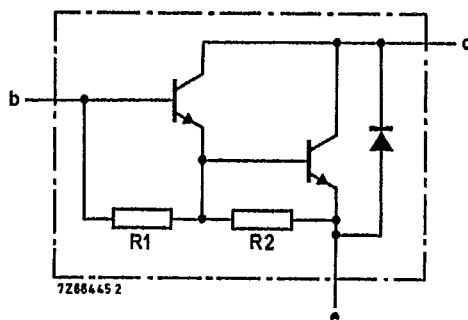
See also chapters Mounting Instructions and Accessories.

BD331; 333
BD335; 337

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R_1 typ. 4 k Ω
 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 $T_{mb} = 25$ °C	P_{tot}	max.	60			W
Storage temperature	T_{stg}		-65 to + 150			°C
Junction temperature *	T_j	max.	150			°C

THERMAL RESISTANCE *

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

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CHARACTERISTICS

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

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Collector cut-off current

 $I_E = 0; V_{CB} = V_{CB0max}$ $I_{CBO} < 0,1\text{ mA}$ $I_E = 0; V_{CB} = V_{CB0max}; T_j = 150\text{ }^{\circ}\text{C}$ $I_{CBO} < 1\text{ mA}$ $I_B = 0; V_{CE} = \frac{1}{2} V_{CE0max}$ $I_{CEO} < 0,2\text{ mA}$

Emitter cut-off current

 $I_C = 0; V_{EB} = 5\text{ V}$ $I_{EBO} < 5\text{ mA}$

D.C. current gain *

 $I_C = 0,5\text{ A}; V_{CE} = 3\text{ V}$ h_{FE} typ. 1900 $I_C = 3\text{ A}; V_{CE} = 3\text{ V}$ $h_{FE} > 750$ $I_C = 6\text{ A}; V_{CE} = 3\text{ V}$ h_{FE} typ. 3000

Base-emitter voltage **

 $I_C = 3\text{ A}; V_{CE} = 3\text{ V}$ $V_{BE} < 2,5\text{ V}$

Collector-emitter saturation voltage

 $I_C = 3\text{ A}; I_B = 12\text{ mA}$ $V_{CEsat} < 2\text{ V}$

Cut-off frequency

 $I_C = 3\text{ A}; V_{CE} = 3\text{ V}$ f_{hfe} typ. 50 kHz

Turn-off breakdown energy with inductive load (see Fig. 12)

 $-I_{Boff} = 0; I_{Con} = 4,5\text{ A}$ $E_{(BR)} > 50\text{ mJ}$

Diode forward voltage

 $I_F = 3\text{ A}$ V_F typ. 1,8 VD.C. current gain ratio of complementary
matched pairs $I_C = 3\text{ A}; V_{CE} = 3\text{ V}$ $h_{FE1}/h_{FE2} < 2,5$

Small signal current gain

 $I_C = 3\text{ A}; V_{CE} = 3\text{ V}; f = 1\text{ MHz}$ $h_{fe} > 10$

Second-breakdown collector current

 $V_{CE} = 60\text{ V}; t_p = 25\text{ ms}$ $I_{(SB)} > 1\text{ A}$

Switching times

(between 10% and 90% levels)

 $I_{Con} = 3\text{ A}; I_{Bon} = -I_{Boff} = 12\text{ mA}$

Turn-on time

 t_{on} typ. 1 μs
< 2 μs

Turn-off time

 t_{off} typ. 5 μs
< 10 μs * Measured under pulse conditions: $t_p < 300\text{ }\mu\text{s}$, $\delta < 2\%$.** V_{BE} decreases by about 3,8 mV/K with increasing temperature.

BD331; 333
BD335; 337

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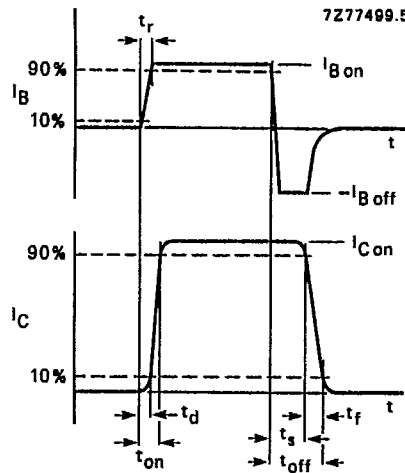
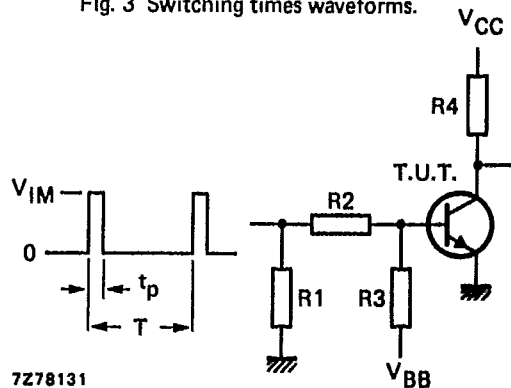
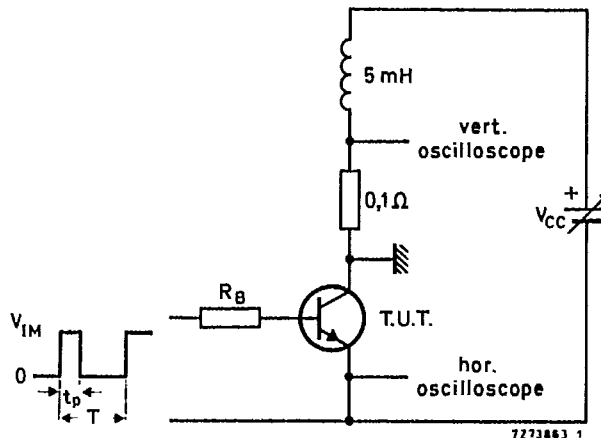


Fig. 3 Switching times waveforms.



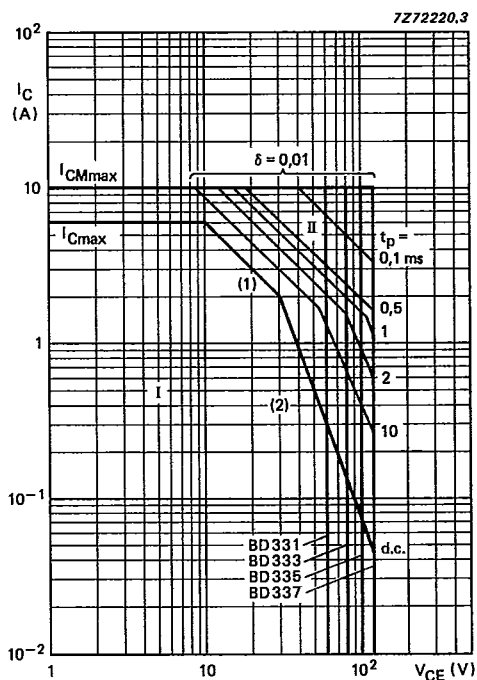
$V_{IM} = 10 \text{ V}$
 $V_{CC} = 10 \text{ V}$
 $-V_{BB} = 4 \text{ V}$
 $R_1 = 56 \Omega$
 $R_2 = 410 \Omega$
 $R_3 = 560 \Omega$
 $R_4 = 3 \Omega$
 $t_r = t_f = 15 \text{ ns}$
 $t_p = 10 \mu\text{s}$
 $T = 500 \mu\text{s}$

Fig. 4 Switching times test circuit.



$V_{IM} = 12 \text{ V}$
 $R_B = 270 \Omega$
 $I_C = 4.5 \text{ A}$
 $\delta = 1 \%$
 $t_p = 1 \text{ ms}$

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

Fig. 6 Safe Operating Area, $T_{mb} \leq 25^\circ\text{C}$.

- 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.

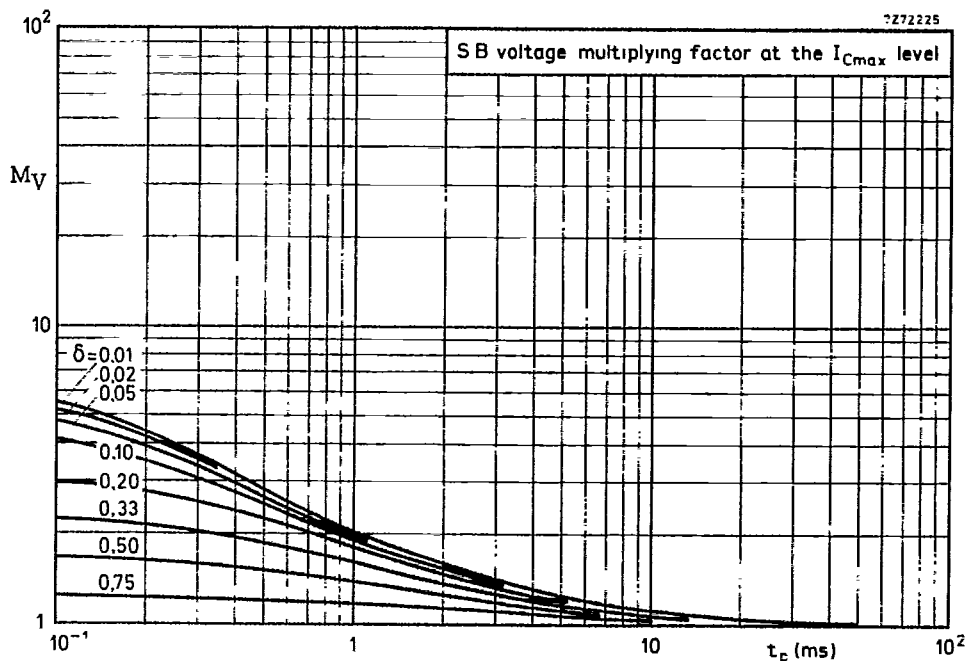


Fig. 7 Second breakdown voltage multiplying factor at I_{Cmax} level.

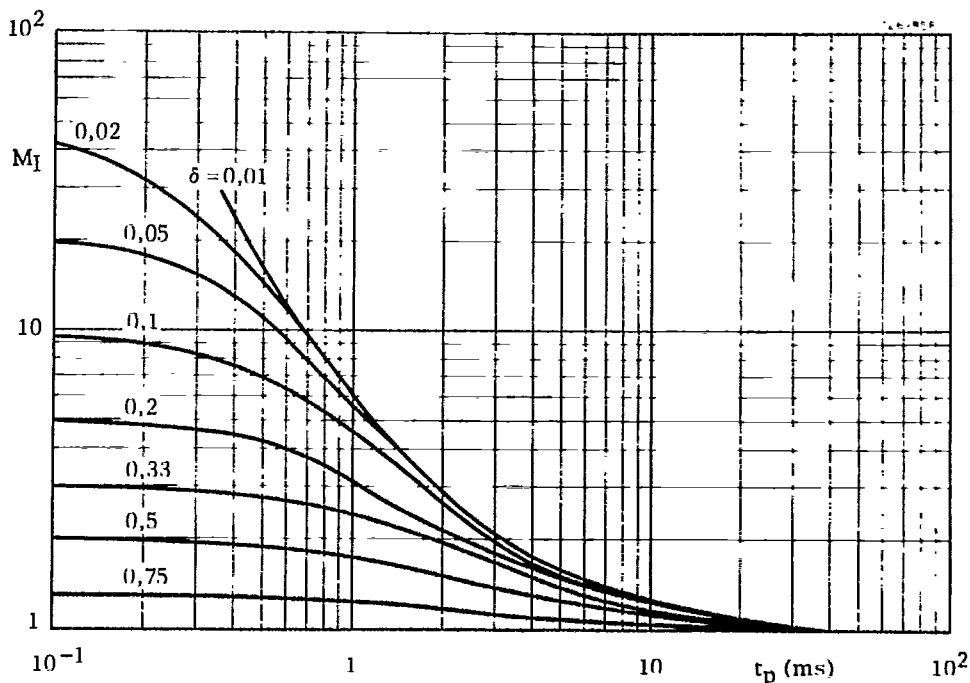


Fig. 8 Second breakdown current multiplying factor at V_{CEomax} level.

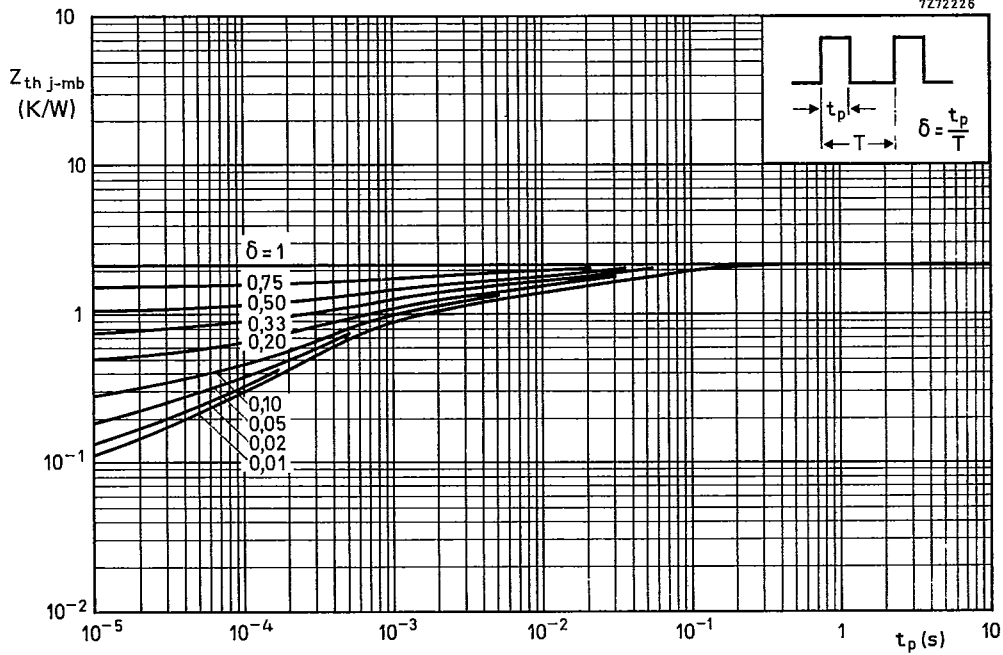


Fig. 9 Pulse power rating chart.

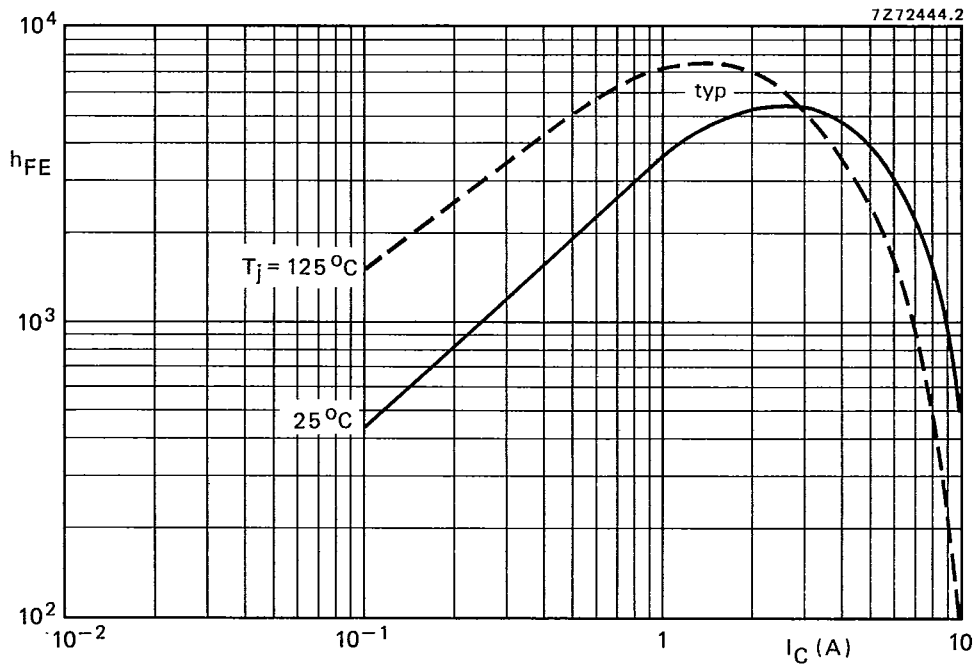


Fig. 10 D.C. current gain. $V_{CE} = 3\text{ V}$.

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BD335; 337

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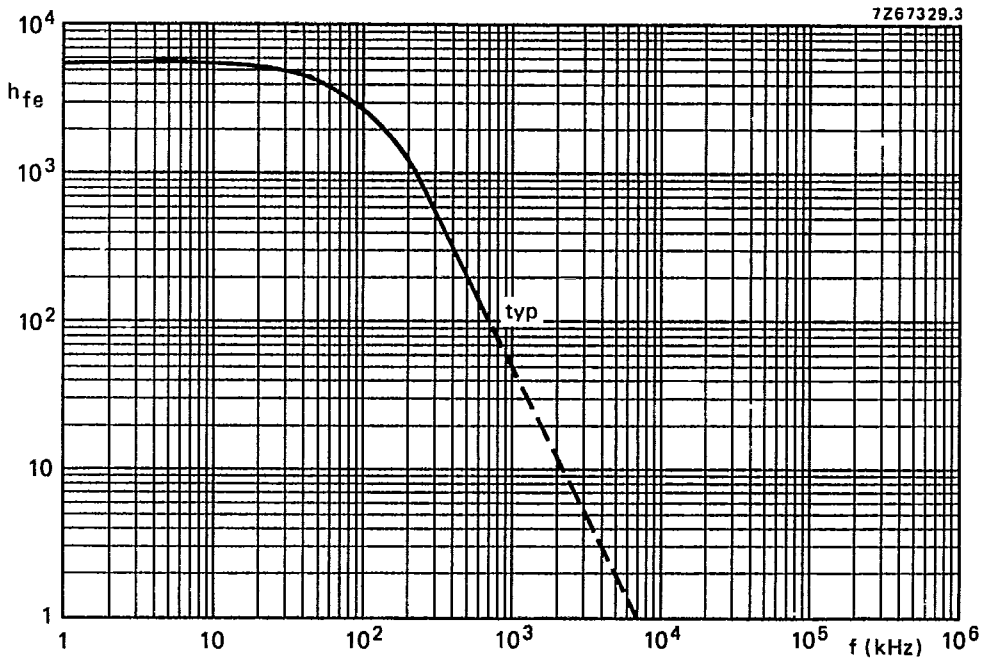


Fig. 11 Small signal current gain at $I_C = 3$ A; $V_{CE} = 3$ V.

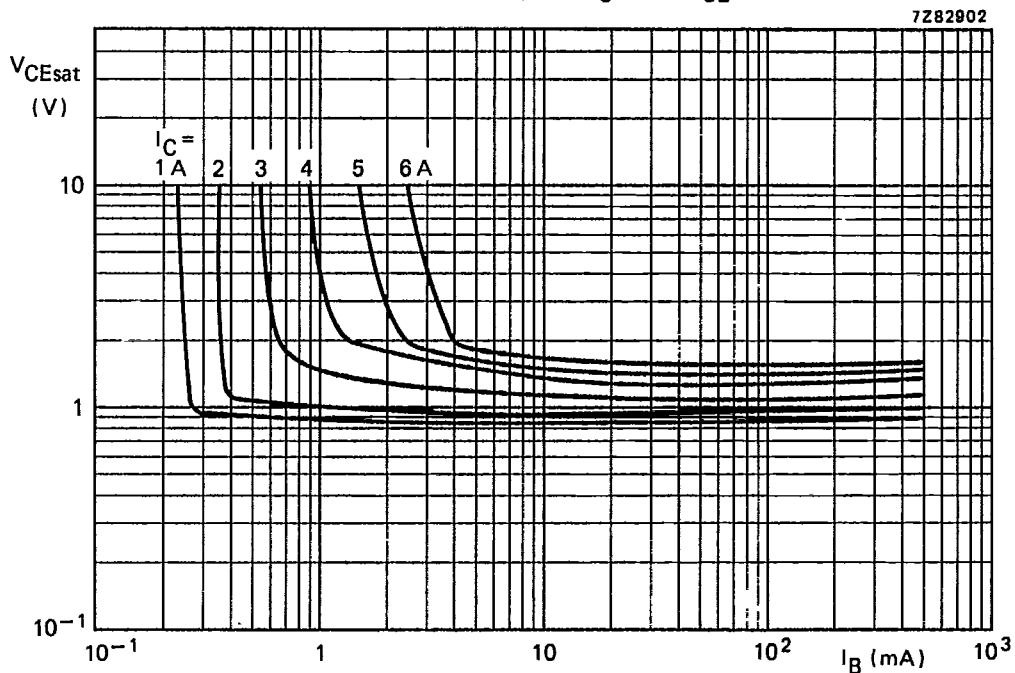


Fig. 12 Typical values collector-emitter saturation. $T_j = 25$ °C.

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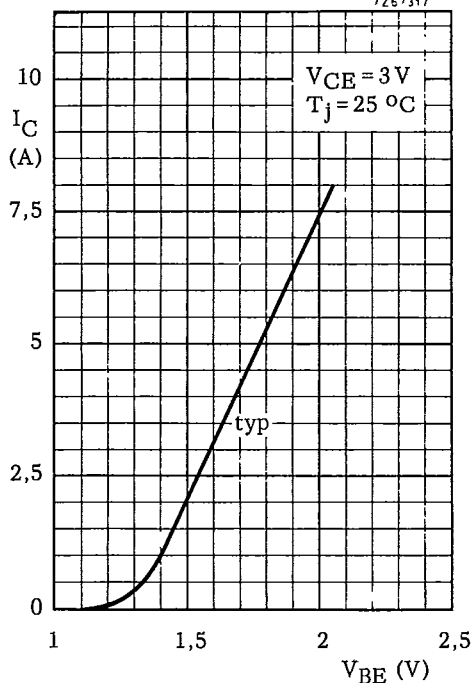


Fig. 13 Collector current.

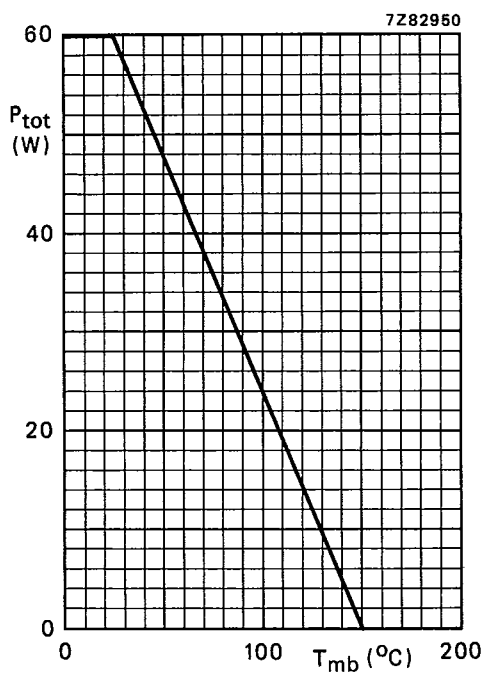


Fig. 14 Power derating curve.