

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 | | |

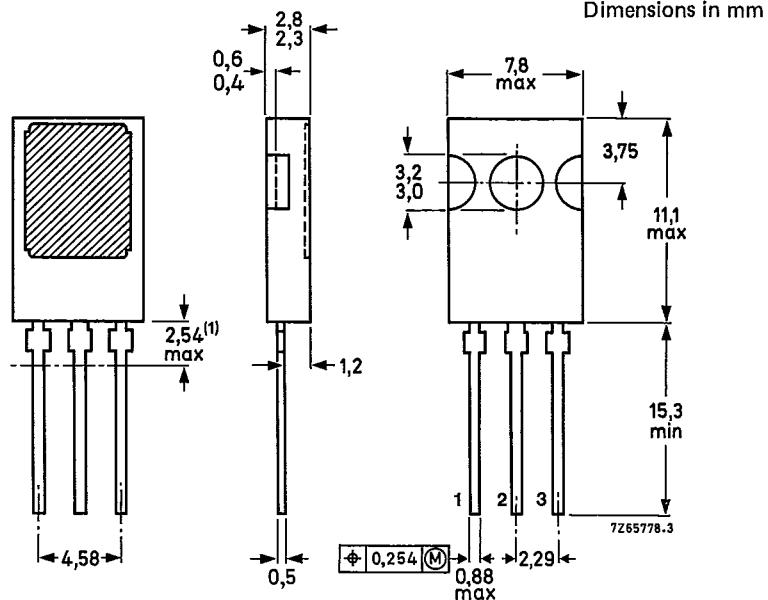
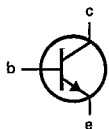
MECHANICAL DATA

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.

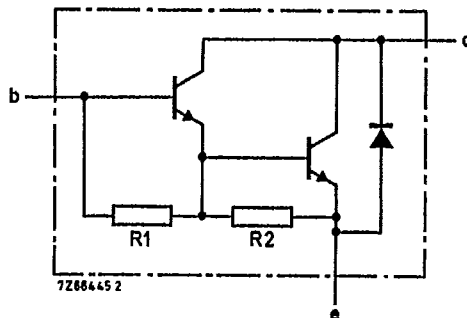
See also chapters Mounting Instructions and Accessories.

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.

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.

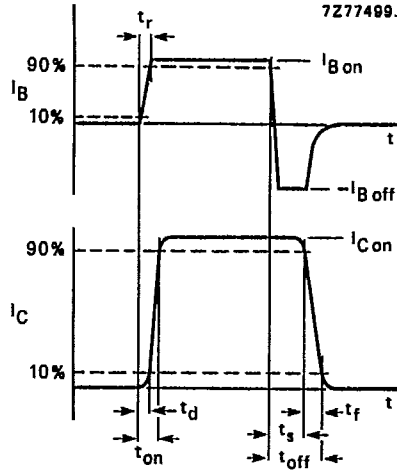
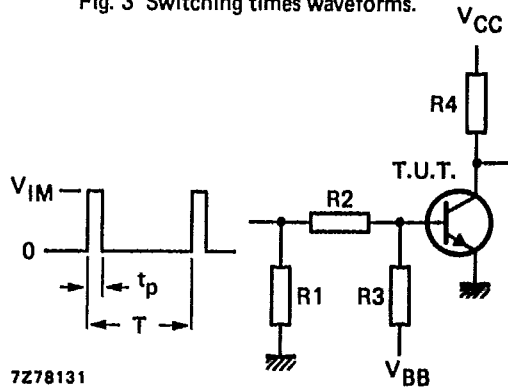
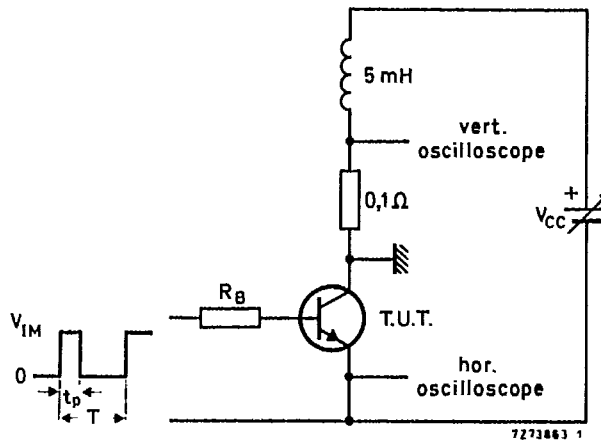


Fig. 3 Switching times waveforms.



- $V_{IM} = 10\text{ V}$
- $V_{CC} = 10\text{ V}$
- $-V_{BB} = 4\text{ V}$
- $R1 = 56\ \Omega$
- $R2 = 410\ \Omega$
- $R3 = 560\ \Omega$
- $R4 = 3\ \Omega$
- $t_r = t_f = 15\text{ ns}$
- $t_p = 10\ \mu\text{s}$
- $T = 500\ \mu\text{s}$

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.

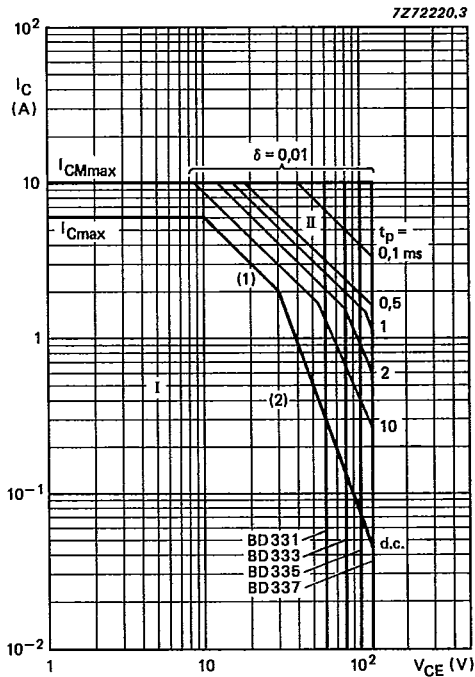


Fig. 6 Safe Operating Area, $T_{mb} \leq 25^\circ\text{C}$.

- 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.

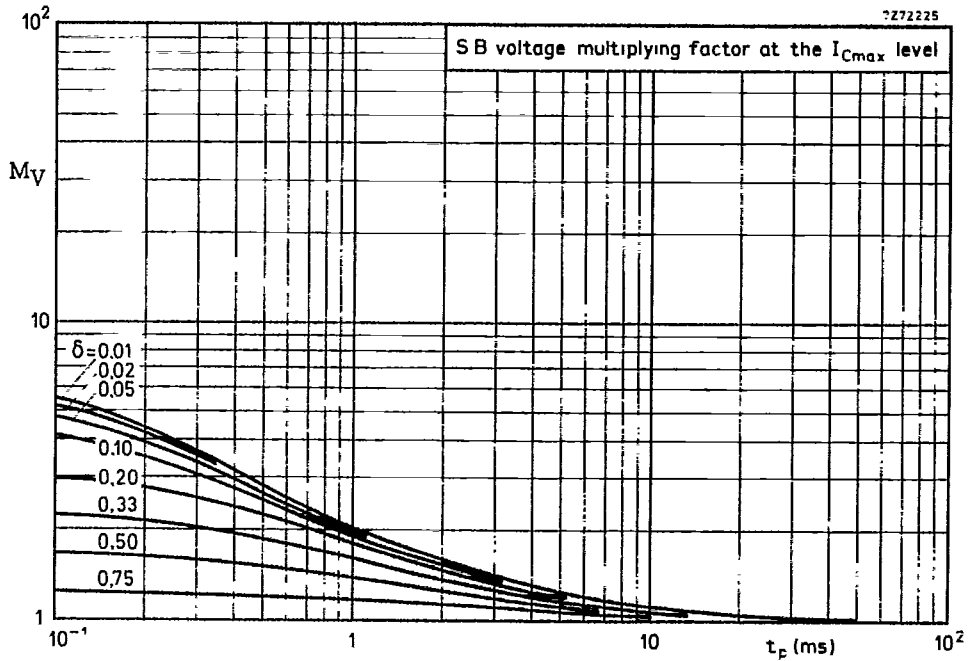


Fig. 7 Second breakdown voltage multiplying factor at I_{Cmax} level.

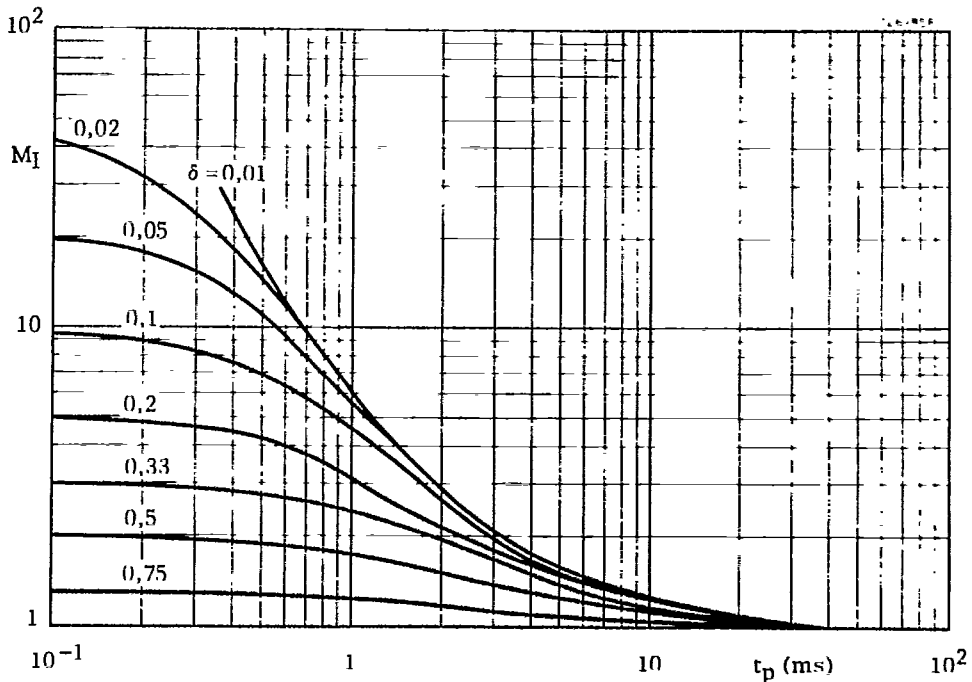


Fig. 8 Second breakdown current multiplying factor at V_{CEmax} level.

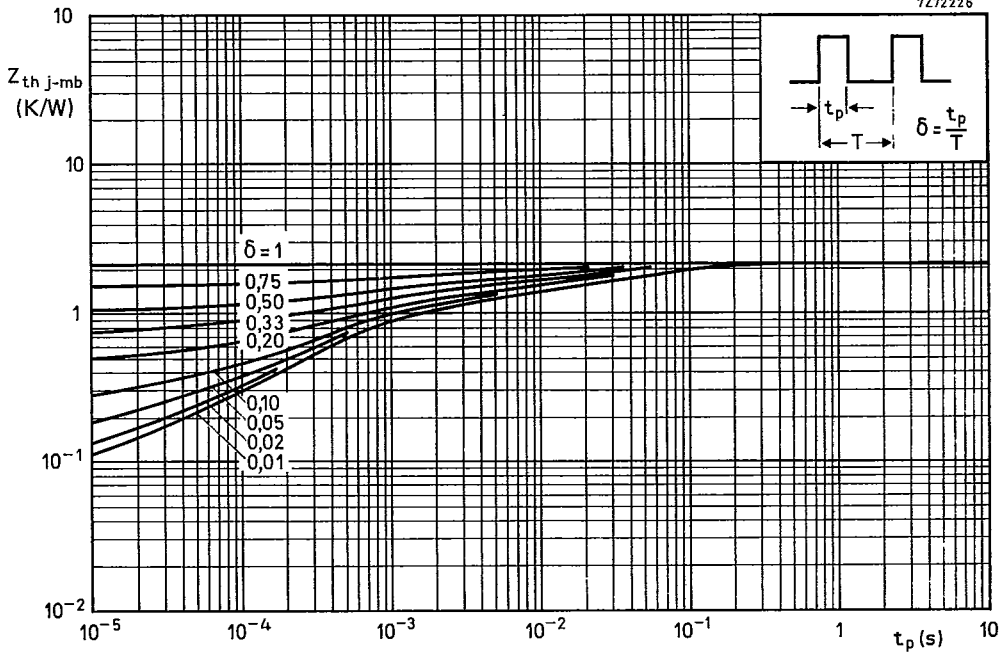


Fig. 9 Pulse power rating chart.

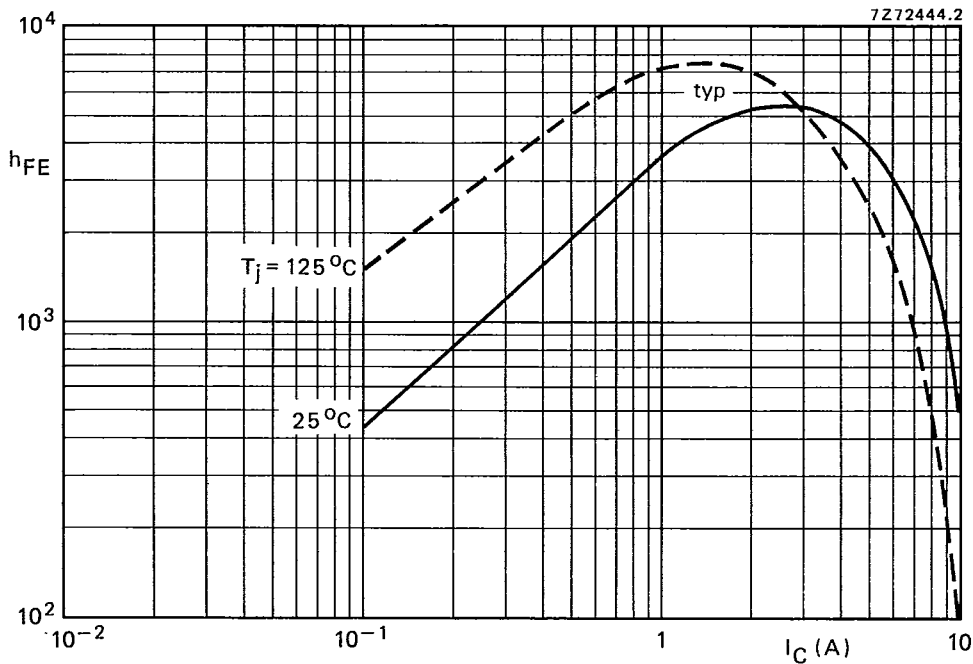


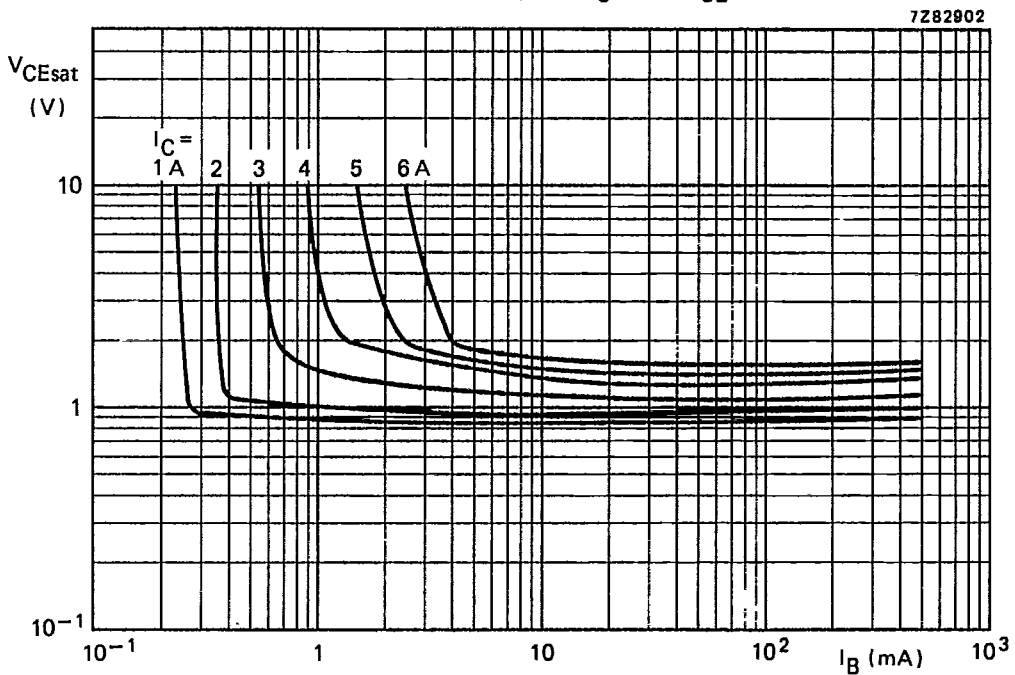
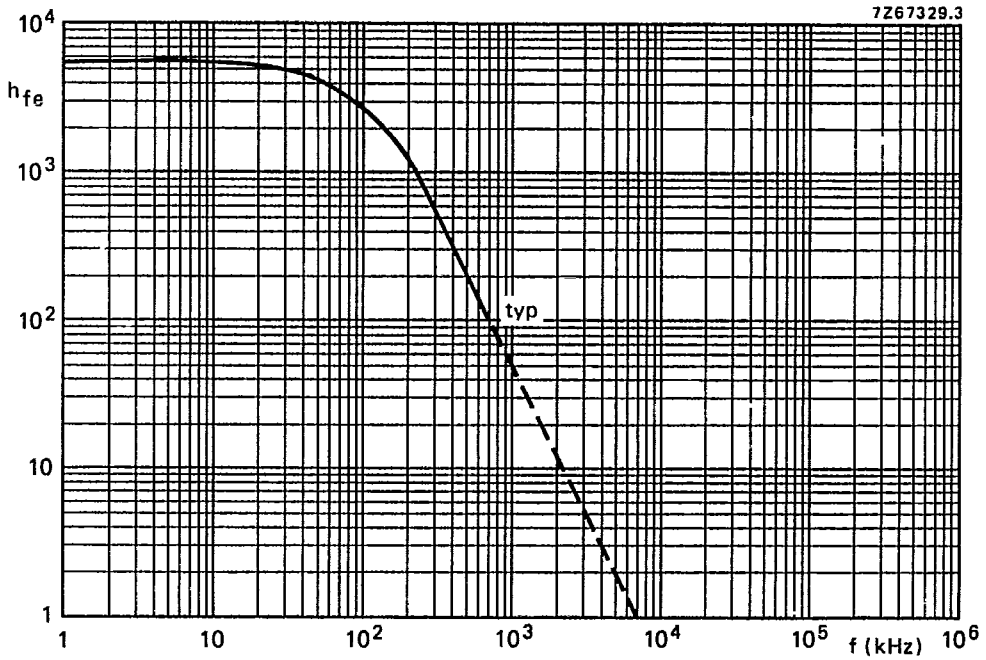
Fig. 10 D.C. current gain. $V_{CE} = 3 \text{ V}$.

BD331; 333
BD335; 337

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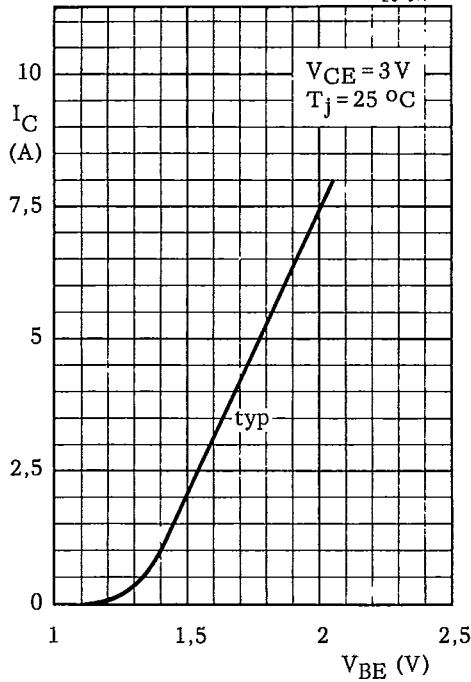


Fig. 13 Collector current.

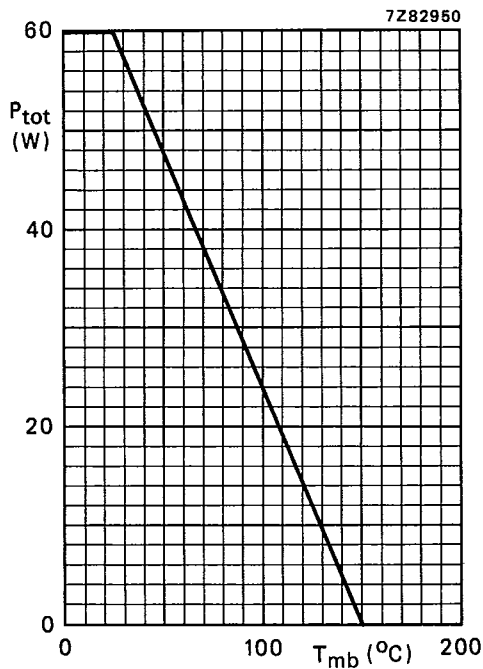


Fig. 14 Power derating curve.