

T-33-13

SILICON DIFFUSED POWER TRANSISTORS



High-voltage, high-speed, glass-passivated npn power transistors in a TO-3 envelope, intended for use in converters, inverters, switching regulators, motor control systems etc.

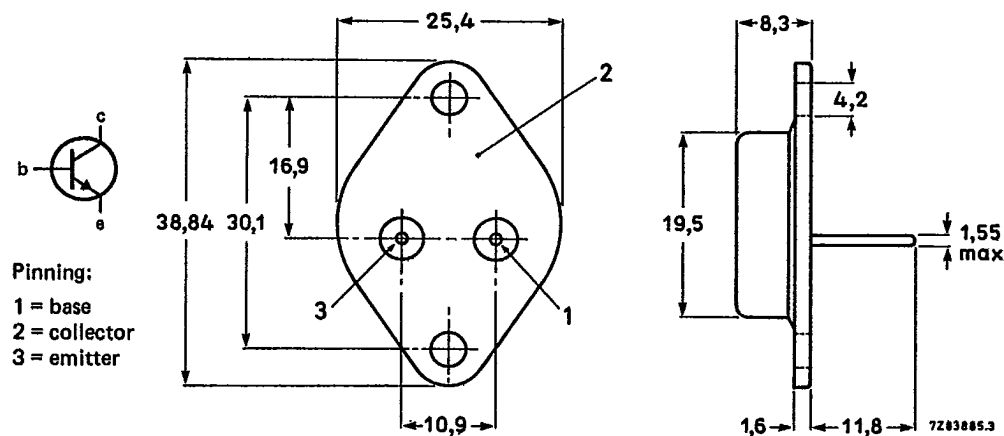
QUICK REFERENCE DATA

		BUS11	BUS11A
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM} max.	850	1000 V
Collector-emitter voltage (open base)	V_{CEO} max.	400	450 V
Collector-emitter saturation voltage	V_{CEsat} max.	1,5	V
Collector current (DC)	I_C max.	5	A
Collector current (peak value)	I_{CM} max.	10	A
Total power dissipation up to $T_{mb} = 25^\circ\text{C}$	P_{tot} max.	100	W
Fall time; resistive load	t_f max.	0,8	μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-3.



Collector connected to case.

Products approved to CECC 50 004-124 available on request.

BUS11
BUS11A

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RATINGS

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

		BUS11	BUS11A
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM} max.	850	1000 V
Collector-emitter voltage (open base)	V_{CEO} max.	400	450 V
Collector current (DC)	I_C max.	5	A
Collector current (peak value)	I_{CM} max.	10	A
Base current (DC)	I_B max.	2	A
Base current (peak value)	I_{BM} max.	4	A
Total power dissipation up to $T_{mb} = 25^\circ\text{C}$	P_{tot} max.	100	W
Storage temperature range	T_{stg}	-65 to +200	$^\circ\text{C}$
Junction temperature	T_j max.	200	$^\circ\text{C}$

THERMAL RESISTANCEFrom junction to mounting base $R_{th j-mb} = 1,75 \text{ K/W}$ **CHARACTERISTICS** $T_j = 25^\circ\text{C}$ unless otherwise specified

Collector cut-off current *

 $V_{CE} = V_{CESMmax}; V_{BE} = 0$ I_{CES} max. 1 mA $V_{CE} = V_{CESMmax}; V_{BE} = 0; T_j = 125^\circ\text{C}$ I_{CES} max. 2 mA

Emitter cut-off current

 $I_C = 0; V_{EB} = 9 \text{ V}$ I_{EBO} max. 10 mA

Saturation voltages

 $I_C = 3 \text{ A}; I_B = 0,6 \text{ A}$ V_{CEsat} max. 1,5 V $I_C = 2,5 \text{ A}; I_B = 0,5 \text{ A}$ V_{CEsat} max. 1,5 V $I_C = 3 \text{ A}; I_B = 0,6 \text{ A}$ V_{BEsat} max. 1,4 V $I_C = 2,5 \text{ A}; I_B = 0,5 \text{ A}$ V_{BEsat} max. 1,4 V

Collector-emitter sustaining voltage

 $I_C = 100 \text{ mA}; I_{Boff} = 0; L = 25 \text{ mH}$ $V_{CEO_{sust}min.}$ 400 450 V

* Measured with a half-sinewave voltage (curve tracer).

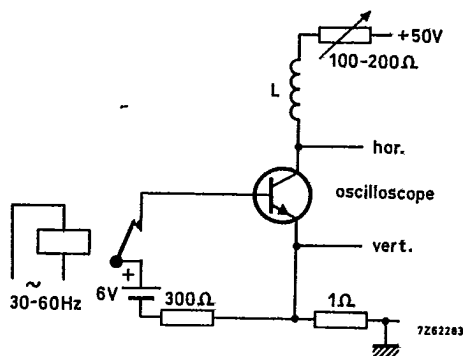


Fig. 2 Test circuit for $V_{CEOsust}$.

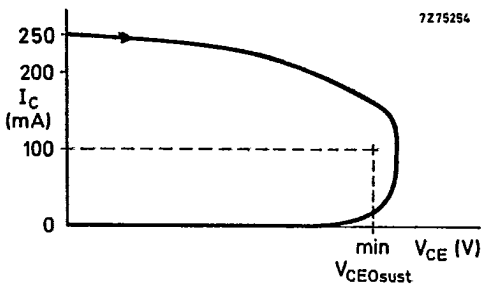


Fig. 3 Oscilloscope display for sustaining voltage.

Switching times resistive load (Figs 4 and 5)

$I_{Con} = 3 \text{ A}$; $I_{Bon} = I_{Boff} = 0,6 \text{ A}$
Turn-on time

Turn-off: Storage time
Fall time

$I_{Con} = 2,5 \text{ A}$; $I_{Bon} = -I_{Boff} = 0,5 \text{ A}$
Turn-on time

Turn-off: Storage time
Fall time

Switching times inductive load (Figs 6 and 7)

$I_{Con} = 3 \text{ A}$; $I_B = 0,6 \text{ A}$
Turn-off: Storage time

Fall time

$I_{Con} = 3 \text{ A}$; $I_B = 0,6 \text{ A}$; $T_j = 100 \text{ }^\circ\text{C}$
Turn-off: Storage time

Fall time

Switching times inductive load (Figs 6 and 7)

$I_{Con} = 2,5 \text{ A}$; $I_B = 0,5 \text{ A}$
Turn-off: Storage time

Fall time

$I_{Con} = 2,5 \text{ A}$; $I_B = 0,5 \text{ A}$; $T_j = 100 \text{ }^\circ\text{C}$
Turn-off: Storage time

Fall time

		BUS11		BUS11A	
t_{on}	max.	1	—	—	μs
t_s	max.	4	—	—	μs
t_f	max.	0,8	—	—	μs
t_{on}	max.	—	1	—	μs
t_s	max.	—	4	—	μs
t_f	max.	—	0,8	—	μs
t_s	typ.	1,1	—	—	μs
	max.	1,4	—	—	μs
t_f	typ.	80	—	—	ns
	max.	150	—	—	ns
t_s	typ.	1,2	—	—	μs
	max.	1,5	—	—	μs
t_f	typ.	140	—	—	ns
	max.	300	—	—	ns
t_s	typ.	—	1,1	—	μs
	max.	—	1,4	—	μs
t_f	typ.	—	80	—	ns
	max.	—	150	—	ns
t_s	typ.	—	1,2	—	μs
	max.	—	1,5	—	μs
t_f	typ.	—	140	—	ns
	max.	—	300	—	ns

BUS11
BUS11A

T-33-13

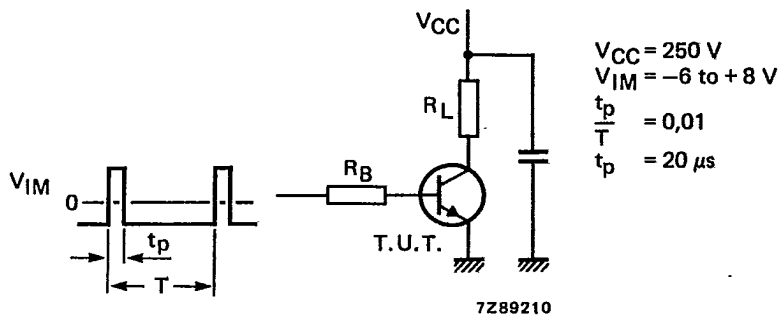


Fig. 4 Test circuit resistive load.

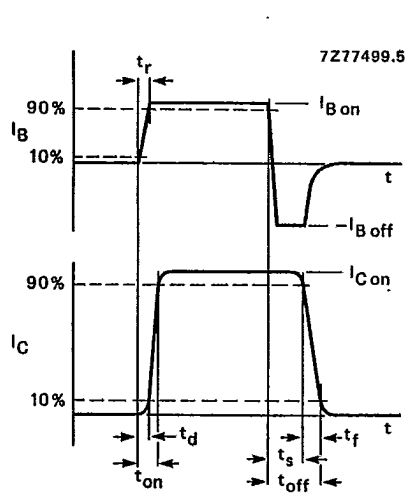


Fig. 5 Switching times waveforms with resistive load.

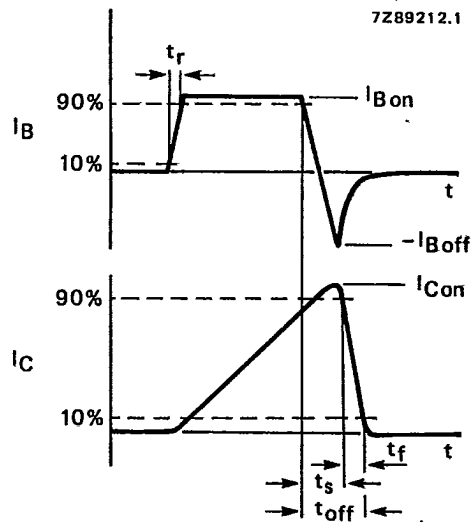


Fig. 6 Switching times waveforms with inductive load.

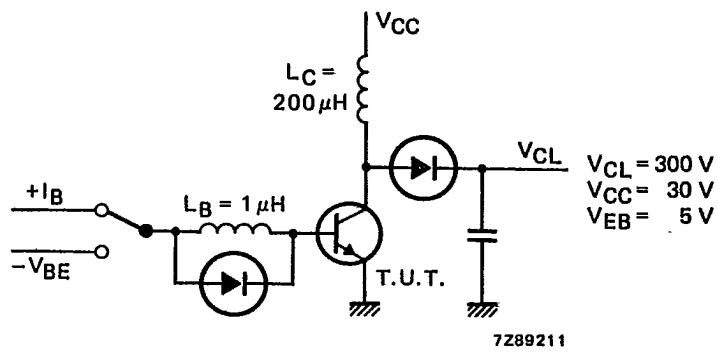
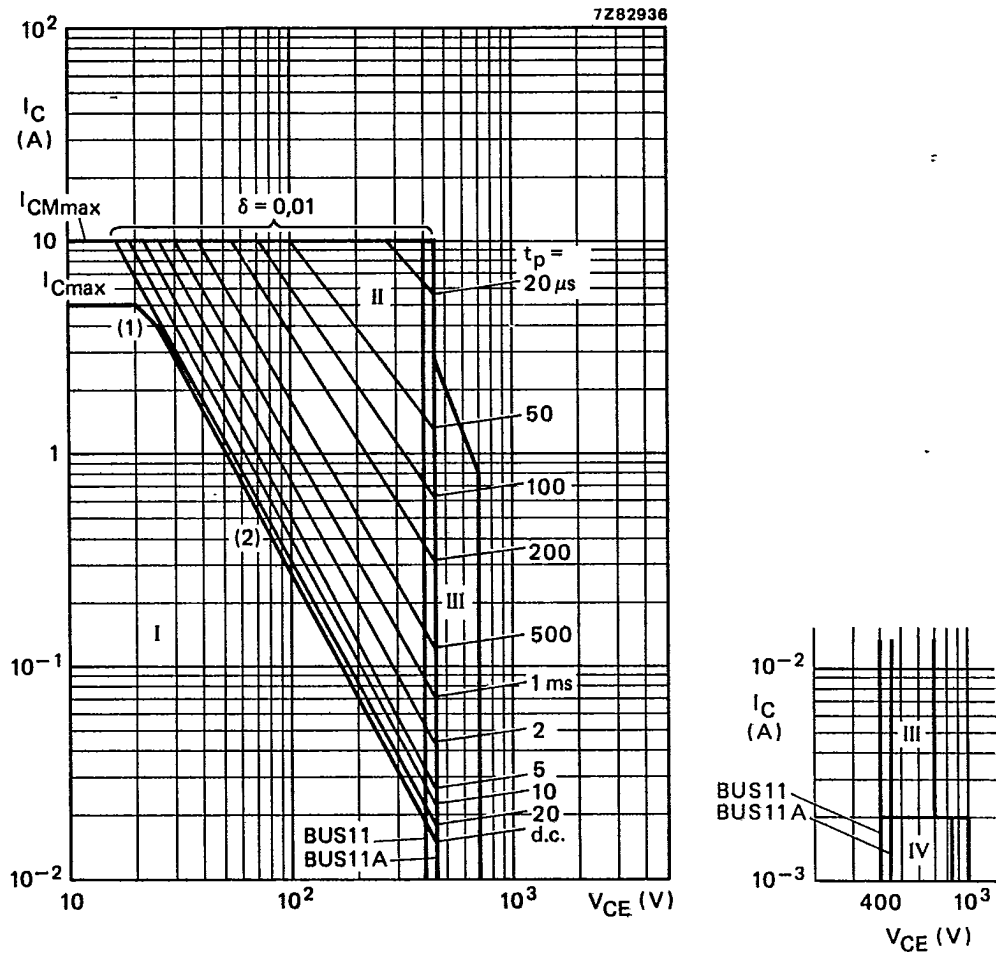


Fig. 7 Test circuit inductive load.



- (1) P_{tot} max and P_{tot} peak max. lines.
 (2) Second-breakdown limits.
- I Region of permissible DC operation
 II Permissible extension for repetitive pulse operation
 III Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leq 100 \Omega$ and $t_p \leq 0,6 \mu s$.
 IV Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 2 \text{ ms}$.

Fig. 8 Safe operating area at $T_{mb} \leq 25^\circ \text{C}$.

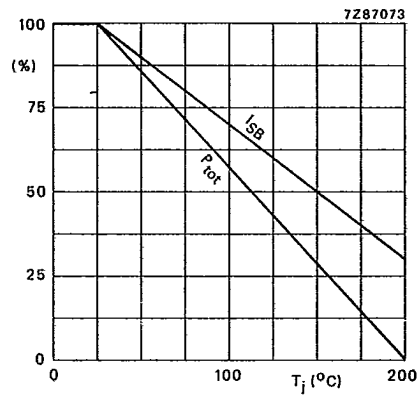


Fig. 9 Total power dissipation and second-breakdown current derating curve.

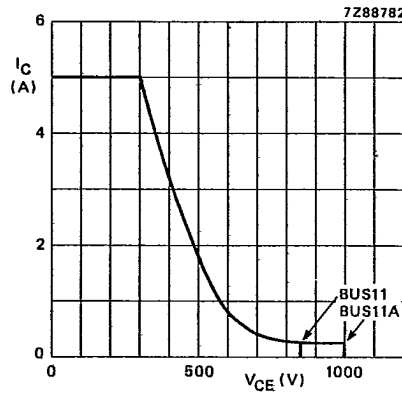


Fig. 10 Reverse bias SOAR.

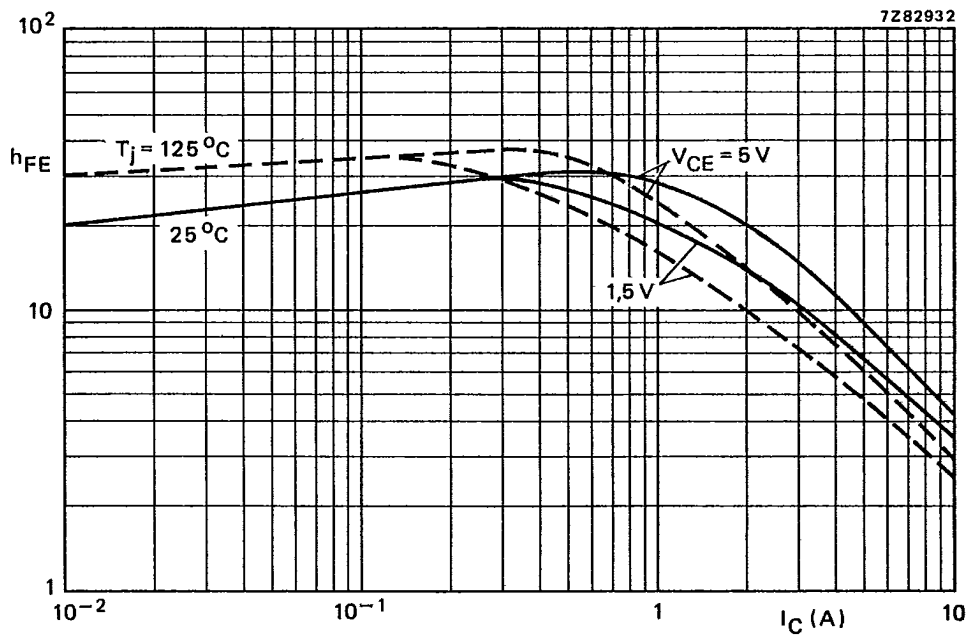


Fig. 11 DC current gain.

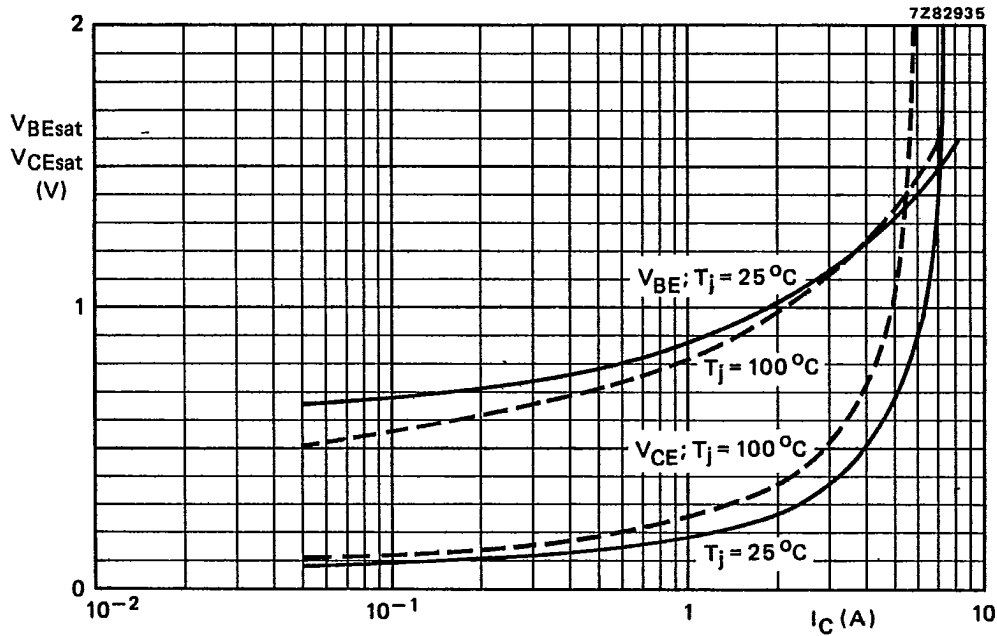


Fig. 12 Typical values base-emitter and collector-emitter voltage, $I_C/I_B = 5$.

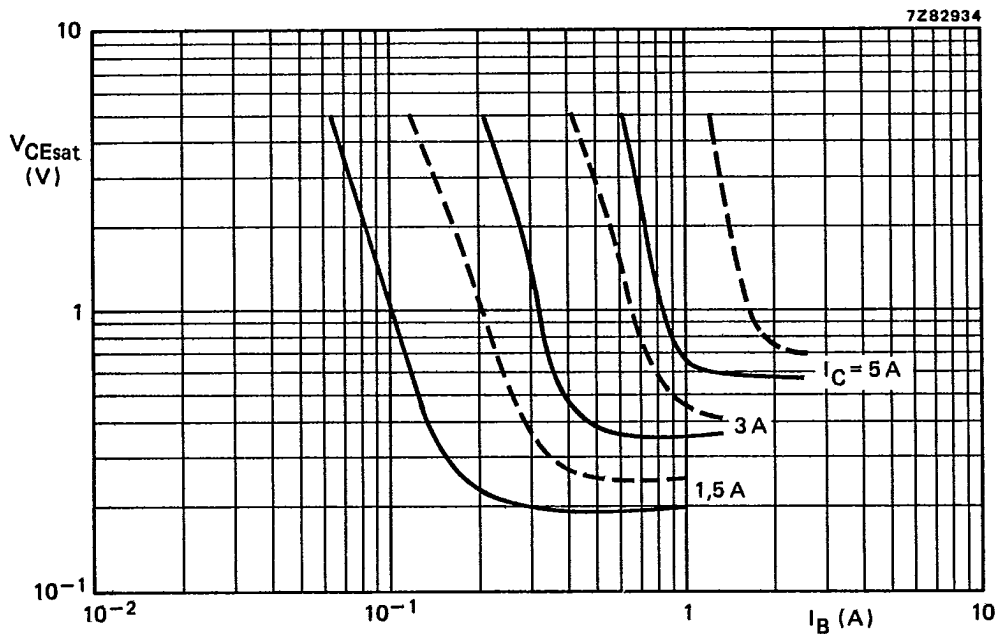
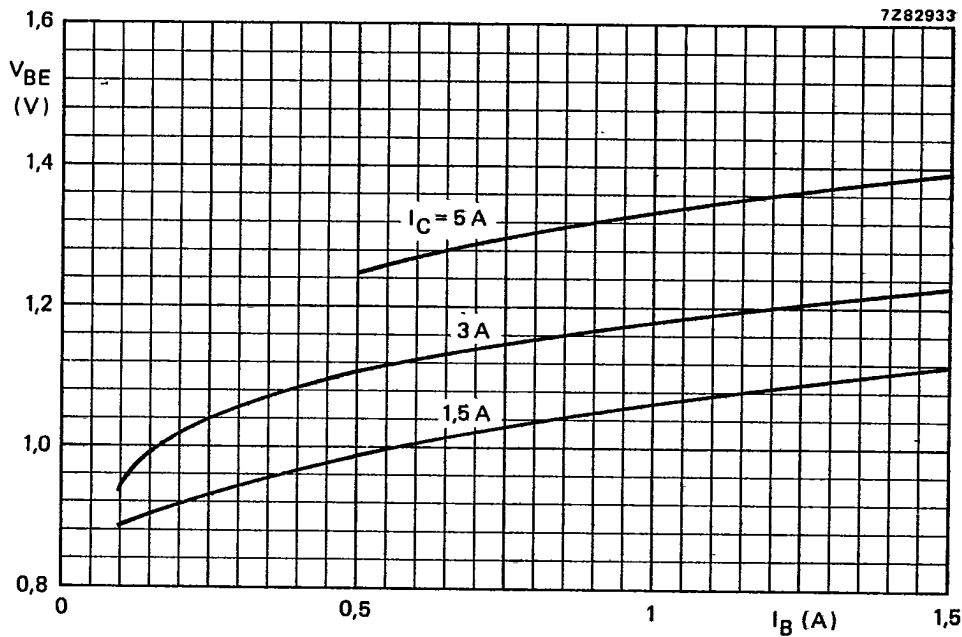


Fig. 13 Typ. (—) and max. (---) values collector-emitter saturation voltage at $T_j = 25^\circ\text{C}$.

Fig. 14 Typical values at $T_j = 25\text{ }^{\circ}\text{C}$.