

SILICON EPITAXIAL POWER TRANSISTORS

NPN silicon power transistors in a SOT186 envelope with an electrically insulated mounting base.

They are intended for use in audio amplifier output stages, general purpose amplifiers, and high-speed switching applications.

PNP complements are TIP32F, TIP32AF, TIP32BF, TIP32CF and TIP32DF.

QUICK REFERENCE DATA

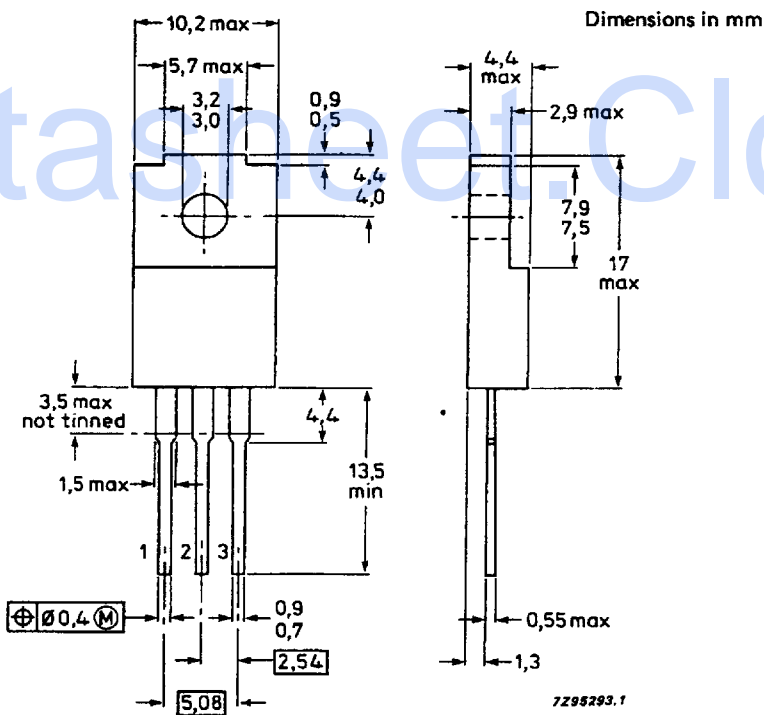
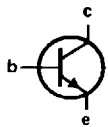
			TIP31F	31AF	31BF	31CF	31DF
Collector-base voltage (open emitter)	V_{CBO}	max.	80	100	120	140	160 V
Collector-emitter voltage (open base)	V_{CEO}	max.	40	60	80	100	120 V
Emitter-base voltage (open collector)	V_{EBO}	max.			5		V
DC collector current	I_C	max.			3		A
Peak collector current	I_{CM}	max.			5		A
DC current gain							
$I_C = 3$ A; $V_{CE} = 4$ V	h_{FE}	min.			10		
Small-signal current gain at $f = 1$ MHz							
$I_C = 0.5$ A; $V_{CE} = 10$ V	h_{fe}	min.			3		

MECHANICAL DATA

Fig.1 SOT186.

Pinning

- 1 = base
- 2 = collector
- 3 = emitter



RATINGS

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

			TIP31F	31AF	31BF	31CF	31DF
Collector-base voltage (open emitter)	V _{CBO}	max.	80	100	120	140	160 V
Collector-emitter voltage (open base)	V _{CEO}	max.	40	60	80	100	120 V
Emitter-base voltage (open collector)	V _{EBO}	max.			5		V
DC collector current	I _C	max.			3		A
Peak collector current	I _{CM}	max.			5		A
DC base current	I _B	max.			1		A
Total power dissipation up to T _h = 25 °C (note 1)	P _{tot}	max.			15		W
up to T _h = 25 °C (note 2)	P _{tot}	max.			22		W
Storage temperature range	T _{stg}				-65 to 150		°C
Junction temperature	T _j	max.			150		°C

THERMAL RESISTANCE

From junction to internal heatsink	R _{th j-mb}	=			3.12		K/W
From junction to external heatsink (note 1)	R _{th j-h}	=			8.12		K/W
From junction to external heatsink (note 2)	R _{th j-h}	=			5.62		K/W
From junction to ambient	R _{th j-a}	=			55		K/W

INSULATION

Voltage allowed between all terminals and external heatsink, peak value (note 3)	V _{insul}	max.			1000		V
Insulation capacitance between collector and external heatsink	C _{c-h}	typ.			12		pF

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
3. Heatsink temperature T_h = 25 °C; relative humidity R_H < 75%; atmospheric pressure P_{amb} = 1013 mbar.

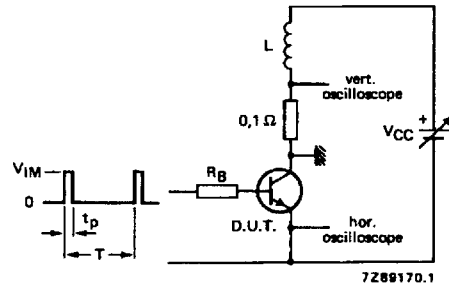
CHARACTERISTICS

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

			TIP31F	31AF	31BF	31CF	31DF
Collector cut-off current							
$I_B = 0; V_{CE} = 30\text{ V}$	I_{CEO}	max.	0.1	0.1	—	—	— mA
$I_B = 0; V_{CE} = 60\text{ V}$	I_{CEO}	max.	—	—	0.1	0.1	— mA
$I_B = 0; V_{CE} = 90\text{ V}$	I_{CEO}	max.	—	—	—	—	0.1 mA
$V_{BE} = 0; V_{CE} = V_{CB0max}$	I_{CES}	max.	0.2	0.2	0.2	0.2	0.2 mA
Emitter cut-off current							
$I_C = 0; V_{EB} = 5\text{ V}$	I_{EBO}	max.	0.2	0.2	0.2	0.2	0.2 mA
DC current gain (note 1)							
$I_C = 1\text{ A}; V_{CE} = 4\text{ V}$	h_{FE}	min.	25	25	25	25	25
$I_C = 3\text{ A}; V_{CE} = 4\text{ V}$	h_{FE}	min.	10	10	10	10	5
	h_{FE}	max.	50	50	50	50	—
Collector-emitter breakdown voltage (note 1)							
$I_B = 0; I_C = 30\text{ mA}$	$V_{(BR)CEO}$	min.	40	60	80	100	120 V
Collector-emitter saturation voltage (note 1)							
$I_C = 3\text{ A}; I_B = 375\text{ mA}$	V_{CEsat}	max.	1.2	1.2	1.2	1.2	— V
$I_C = 3\text{ A}; I_B = 750\text{ mA}$	V_{CEsat}	max.	—	—	—	—	2.5 V
Base-emitter voltages (notes 1 and 2)							
$I_C = 3\text{ A}; V_{CE} = 4\text{ V}$	V_{BE}	max.			1.8		V
Small-signal current gain							
$I_C = 0.5\text{ A}; V_{CE} = 10\text{ V}$							
at 1 kHz	h_{fe}	min.			20		
at 1 MHz	h_{fe}	min.			3		
Turn-off breakdown energy with inductive load (see Fig.3)							
$I_C = 1.8\text{ A}; L = 20\text{ mH}$	$E_{(BR)}$	min.			32		mJ
Switching times (see Fig.2)							
$I_C = 1\text{ A}; I_{B\text{ on}} = -I_{B\text{ off}} = 0.1\text{ A}$							
turn-on time	t_{on}	typ.			0.3		μs
turn-off time	t_{off}	typ.			1		μs

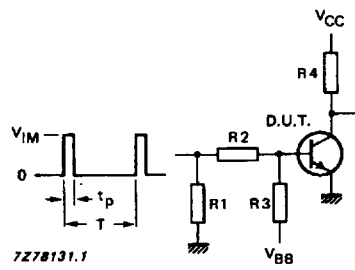
Notes

1. Measured under pulse conditions: $t_p = 300\ \mu\text{s}$; $\delta = 2\%$.
2. V_{BE} decreases by about 2.3 mV/K with increasing temperature.



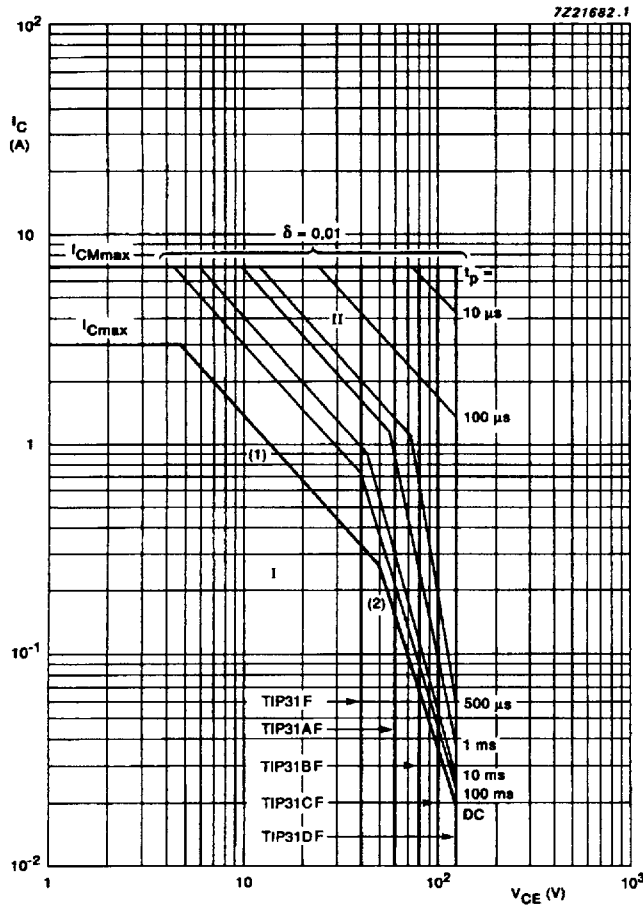
$V_{CC} = 20 \text{ V}$
 $V_{IM} = 30 \text{ V}$
 $-V_{BB} = 3 \text{ V}$
 $R_1 = 56 \Omega$
 $R_2 = 150 \Omega$
 $R_3 = 33 \Omega$
 $R_4 = 20 \Omega$
 $t_r = t_f = 15 \text{ ns}$
 $t_p = 20 \mu\text{s}$
 $T = 500 \mu\text{s}$

Fig.2 Switching times test circuit.



$V_{IM} = 12 \text{ V}$
 $R_B = 270 \Omega$
 $L = 20 \text{ mH}$
 $I_C = 1.8 \text{ A}$
 $t_p = 1 \text{ ms}$
 $\delta = 1 \%$

Fig.3 Test circuit for turn-off breakdown energy.



- I Region of permissible DC operation.
- II Permissible extension for repetitive pulse operation.
- (1) P_{tot} max and P_{peak} max lines.
- (2) Second-breakdown limits.

Mounted without heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.

Fig.4 Safe Operating Area, $T_{amb} = 25^\circ C$.

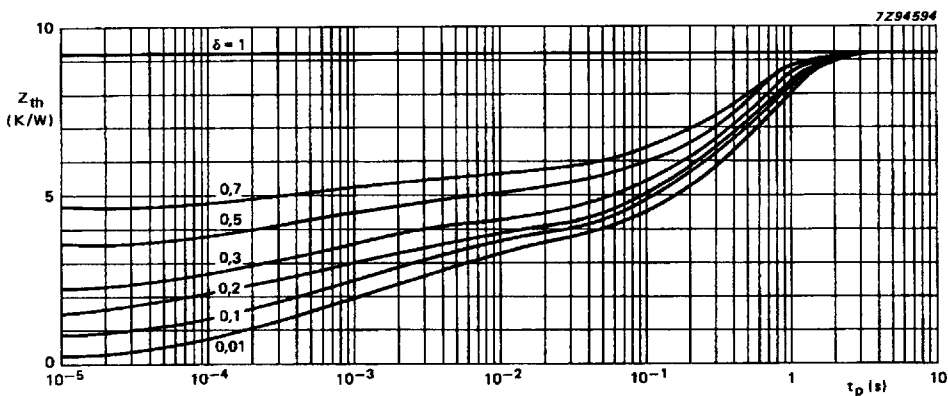


Fig.5 Pulse power rating chart; mounted without heatsink compound and 30 ± 5 newtons pressure on the envelope.

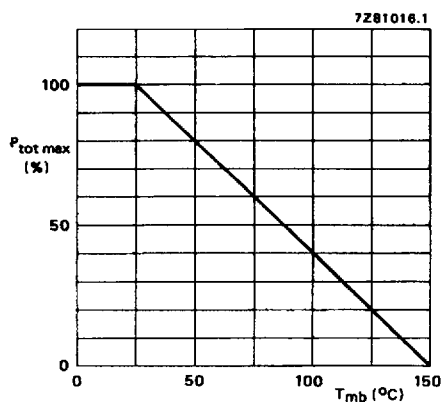


Fig.6 Total power dissipation.

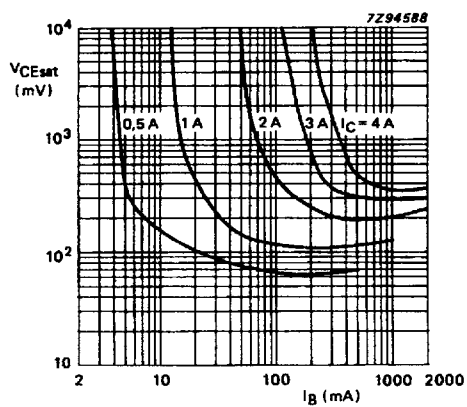


Fig.7 Typical collector-emitter saturation voltage; $T_j = 25\ ^\circ C$.

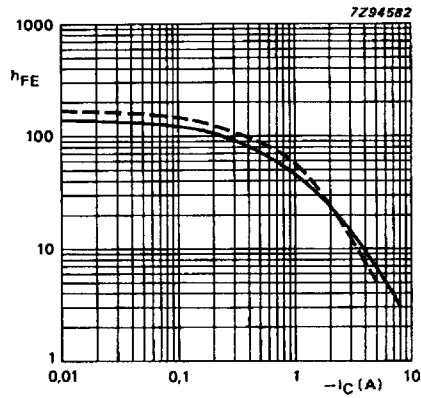


Fig.8 Typical DC current gain; $V_{CE} = 4$ V; $T_j = 25$ °C.