

## 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

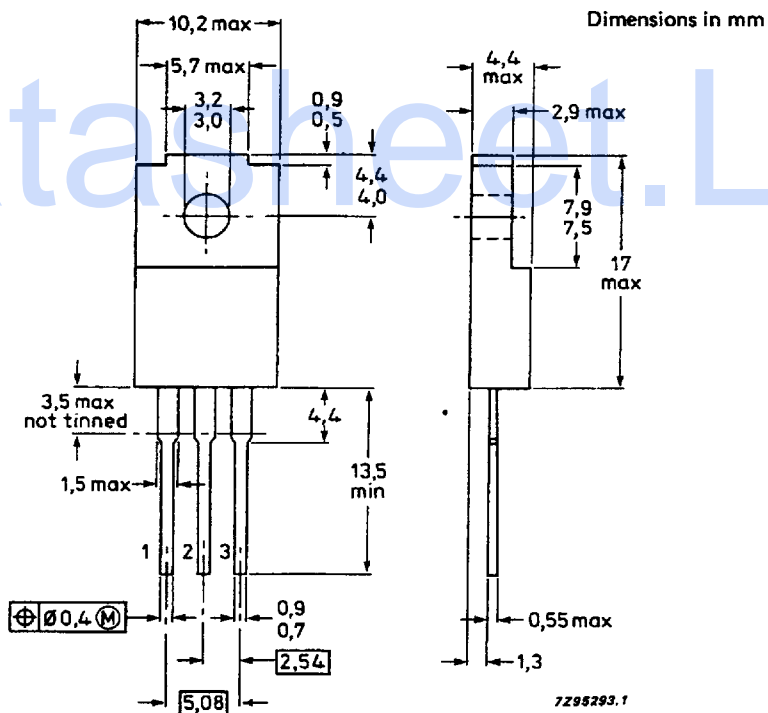
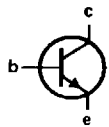
			TIP31F	31AF	31BF	31CF	31DF
Collector-base voltage (open emitter)	$V_{CBO}$	max.	80	100	120	140	160 V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	40	60	80	100	120 V
Emitter-base voltage (open collector)	$V_{EBO}$	max.			5		V
DC collector current	$I_C$	max.			3		A
Peak collector current	$I_{CM}$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

**THERMAL RESISTANCE**

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

**INSULATION**

Voltage allowed between all terminals and external heatsink, peak value (note 3)	V <sub>insul</sub>	max.			1000		V
Insulation capacitance between collector and external heatsink	C <sub>c-h</sub>	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<sub>h</sub> = 25 °C; relative humidity R<sub>H</sub> < 75%; atmospheric pressure P<sub>amb</sub> = 1013 mbar.

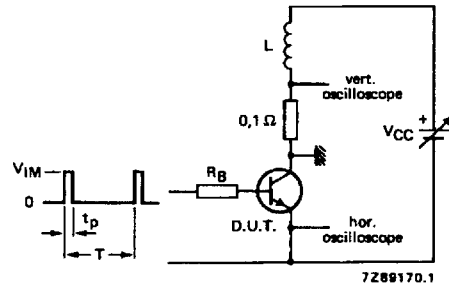
## CHARACTERISTICS

 $T_h = 25^\circ\text{C}$  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		$\mu\text{s}$
turn-off time	$t_{off}$	typ.			1		$\mu\text{s}$

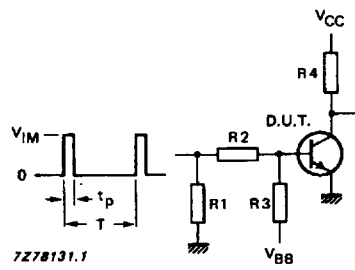
## Notes

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.



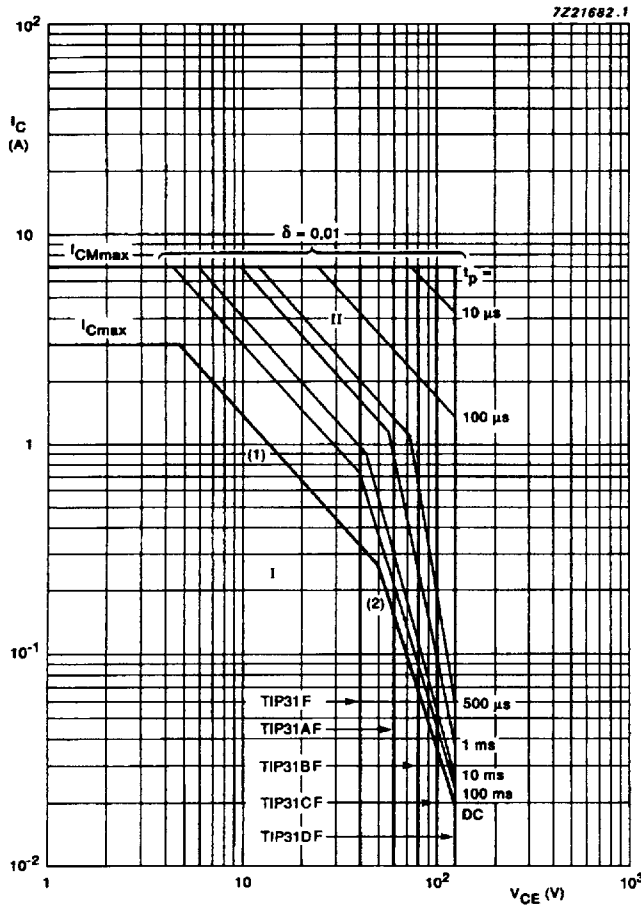
$V_{CC} = 20 \text{ V}$   
 $V_{IM} = 30 \text{ V}$   
 $-V_{BB} = 3 \text{ V}$   
 $R_1 = 56 \text{ } \Omega$   
 $R_2 = 150 \text{ } \Omega$   
 $R_3 = 33 \text{ } \Omega$   
 $R_4 = 20 \text{ } \Omega$   
 $t_r = t_f = 15 \text{ ns}$   
 $t_p = 20 \text{ } \mu\text{s}$   
 $T = 500 \text{ } \mu\text{s}$

Fig.2 Switching times test circuit.



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

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  $30 \pm 5$  newtons pressure on the centre of the envelope.

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

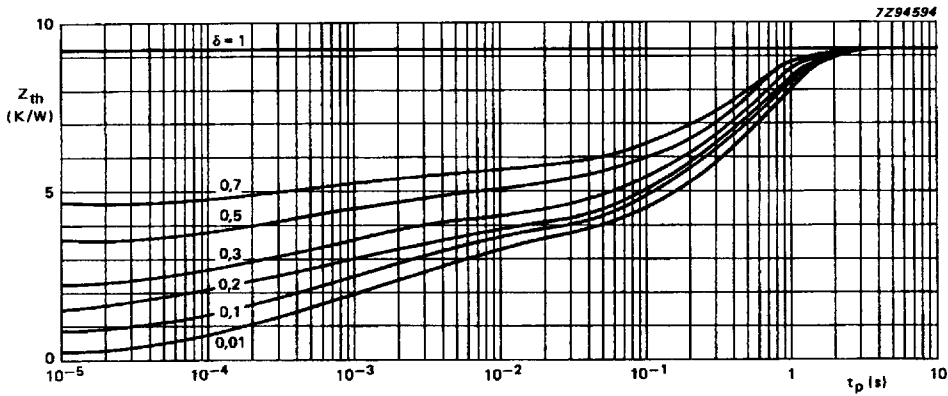


Fig.5 Pulse power rating chart; mounted without heatsink compound and  $30 \pm 5$  newtons pressure on the envelope.

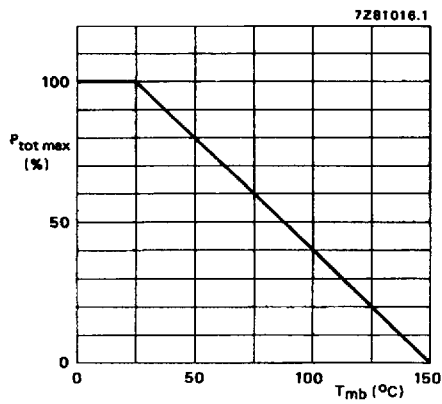


Fig.6 Total power dissipation.

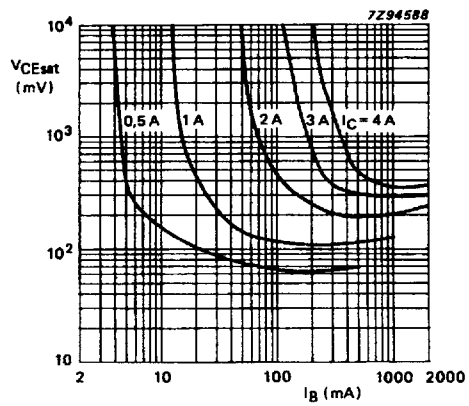


Fig.7 Typical collector-emitter saturation voltage;  $T_j = 25$  °C.

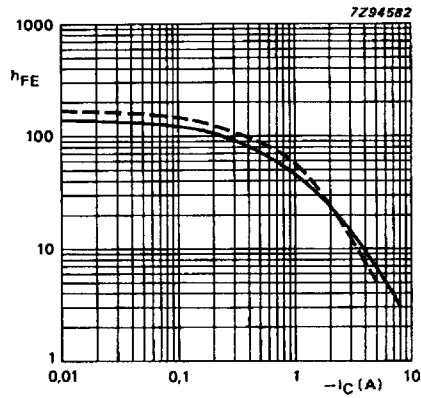


Fig.8 Typical DC current gain;  $V_{CE} = 4$  V;  $T_j = 25$  °C.