

## SILICON DARLINGTON POWER TRANSISTORS

P-N-P epitaxial base transistors in monolithic Darlington circuit for audio output stages and general purpose amplifier and switching applications. TO-220 plastic envelope. N-P-N complements are BDT65, BDT65A, BDT65B and BDT65C.

### QUICK REFERENCE DATA

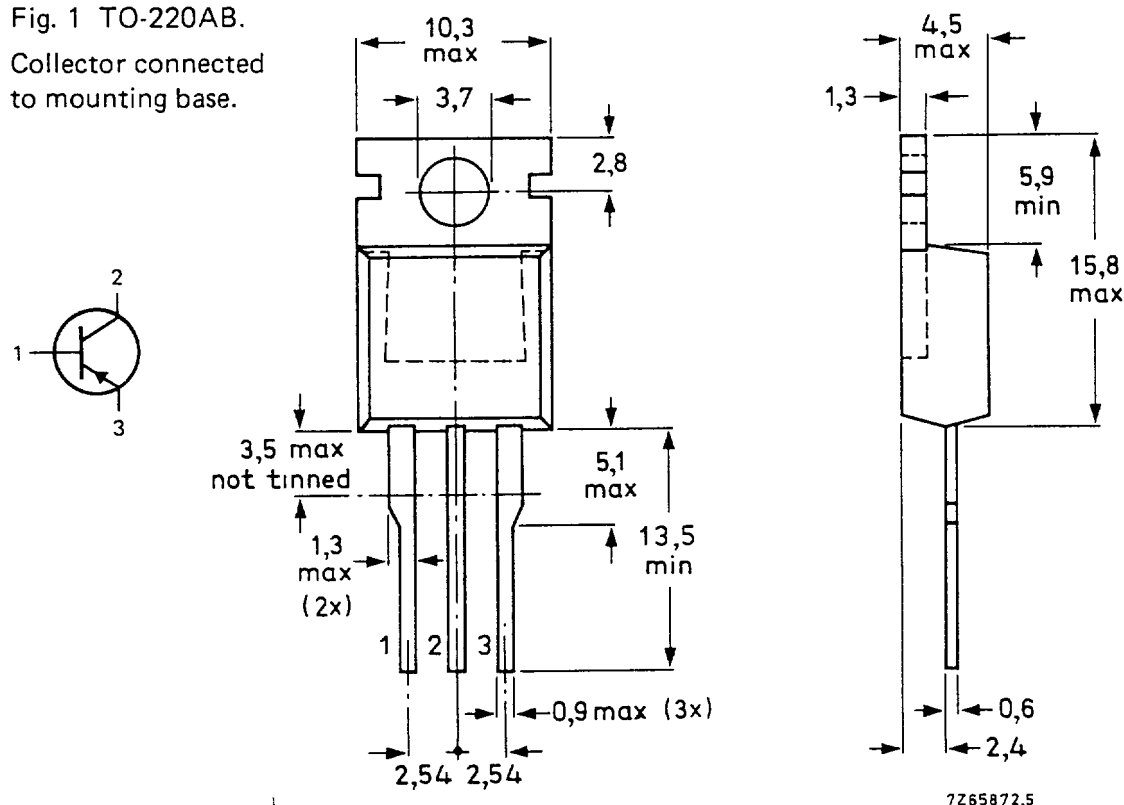
			BDT64	64A	64B	64C
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	60	80	100	120 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	80	100	120 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	5 V
Collector current (d.c.)	$-I_C$	max.	12			A
Total power dissipation up to $T_{mb} = 25\text{ }^\circ\text{C}$	$P_{tot}$	max.	125			W
Junction temperature	$T_j$	max.	150			$^\circ\text{C}$
D.C. current gain $-I_C = 5\text{ A}; -V_{CE} = 4\text{ V}$	$h_{FE}$	>	1000			

### MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-220AB.

Collector connected to mounting base.



See also chapters Mounting instructions and Accessories.

BDT64; 64A  
BDT64B; 64C

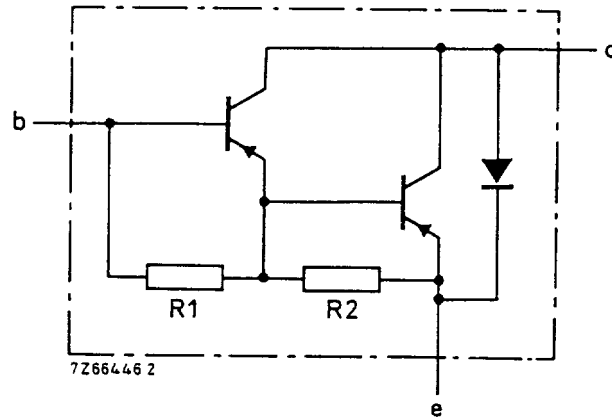


Fig. 2 Circuit diagram. R1 typ. 3 k $\Omega$ ; R2 typ. 45  $\Omega$ .

### RATINGS

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

			BDT64	64A	64B	64C	
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.	12				A
Collector current (peak value)	$-I_{CM}$	max.	20				A
Base current (d.c.)	$-I_B$	max.	500				mA
Total power dissipation up to $T_{mb} = 25\text{ }^\circ\text{C}$	$P_{tot}$	max.	125				W
Storage temperature	$T_{stg}$		-65 to +150				$^\circ\text{C}$
Junction temperature	$T_j$	max.	150				$^\circ\text{C}$

### THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	1				K/W
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## CHARACTERISTICS

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

Collector cut-off current

$$-V_{CB} = -V_{CB0\max}, I_E = 0$$

$$I_E = 0; -V_{CB} = -\frac{1}{2} V_{CB0\max}, T_j = 150\text{ }^\circ\text{C}$$

$$I_B = 0; -V_{CE} = -\frac{1}{2} V_{CE0\max}$$

$$-I_{CBO} < 0,4\text{ mA}$$

$$-I_{CBO} < 2\text{ mA}$$

$$-I_{CEO} < 0,2\text{ mA} \leftarrow$$

Emitter cut-off current

$$I_C = 0; -V_{EB} = 5\text{ V}$$

$$-I_{EBO} < 5\text{ mA}$$

D.C. current gain\*

$$-I_C = 1\text{ A}; -V_{CE} = 4\text{ V}$$

$$-I_C = 5\text{ A}; -V_{CE} = 4\text{ V}$$

$$-I_C = 12\text{ A}; -V_{CE} = 4\text{ V}$$

$$h_{FE} \text{ typ. } 1500$$

$$h_{FE} > 1000$$

$$h_{FE} \text{ typ. } 750$$

Base-emitter voltage

$$-I_C = 5\text{ A}; -V_{CE} = 4\text{ V}$$

$$-V_{BE} < 2,5\text{ V}$$

Collector-emitter saturation voltage\*

$$-I_C = 5\text{ A}; -I_B = 20\text{ mA}$$

$$-I_C = 10\text{ A}; -I_B = 100\text{ mA}$$

$$-V_{CEsat} < 2\text{ V}$$

$$-V_{CEsat} < 3\text{ V}$$

Diode, forward voltage

$$I_F = 5\text{ A}$$

$$I_F = 12\text{ A}$$

$$V_F < 2\text{ V}$$

$$V_F \text{ typ. } 2\text{ V}$$

Collector capacitance at  $f = 1\text{ MHz}$

$$-V_{CB} = 10\text{ V}; I_E = I_e = 0$$

$$C_C \text{ typ. } 200\text{ pF}$$

Second breakdown collector current

non-repetitive; without heatsink

$$-V_{CE} = 60\text{ V}; t_p = 0,1\text{ s}$$

$$-I_{SB} > 2\text{ A}$$

Switching times (see Figs 3 and 4)

$$-I_{Con} = 5\text{ A}; -I_{Bon} = I_{Boff} = 20\text{ mA}$$

$$-V_{CC} = 30\text{ V}$$

turn-on time

$$t_{on} \text{ typ. } 0,5\text{ }\mu\text{s}$$

$$t_{on} < 2\text{ }\mu\text{s}$$

turn-off time

$$t_{off} \text{ typ. } 2,5\text{ }\mu\text{s}$$

$$t_{off} < 5\text{ }\mu\text{s}$$

Small-signal current gain

$$-I_C = 5\text{ A}; -V_{CE} = 3\text{ V}; f = 1\text{ MHz}$$

$$h_{fe} > 10$$

\* Measured under pulse conditions:  $t_p < 300\text{ }\mu\text{s}$ ;  $\delta < 2\%$ .

CHARACTERISTICS (continued)

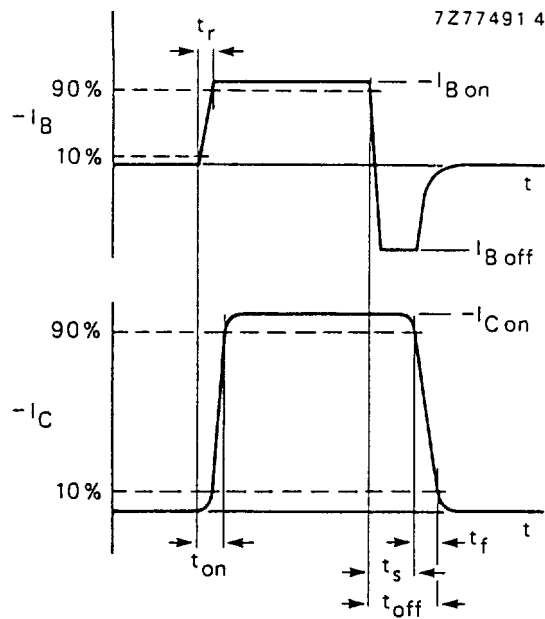


Fig. 3 Switching times waveforms.

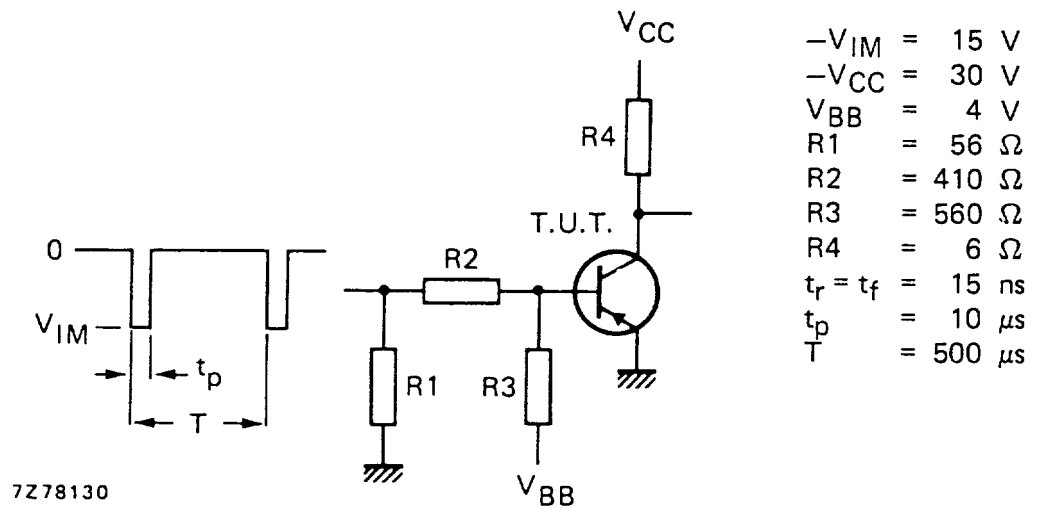


Fig. 4 Switching times test circuit.

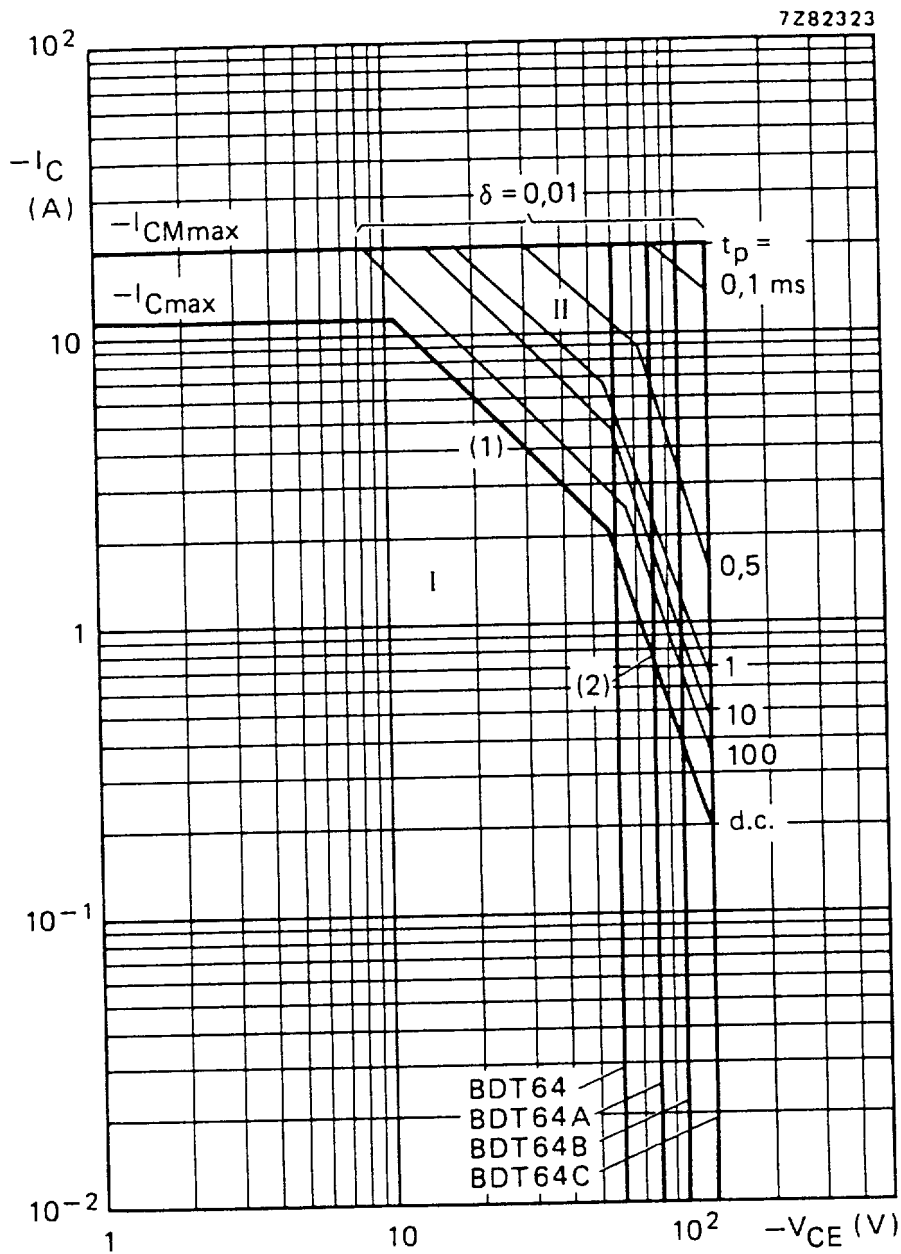


Fig. 5 Safe Operating Area;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ .

- 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.

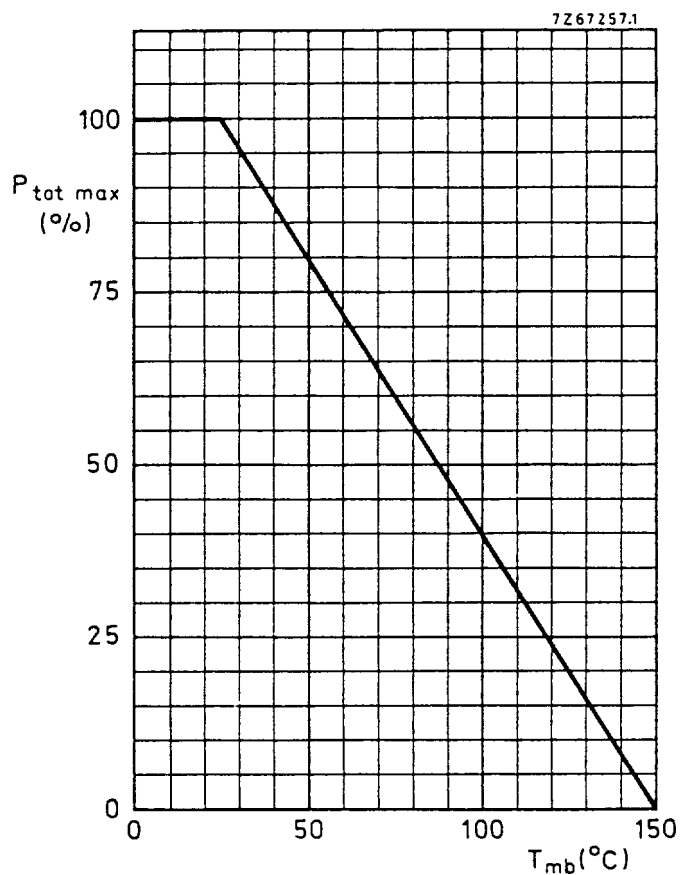


Fig. 6 Power derating curve.

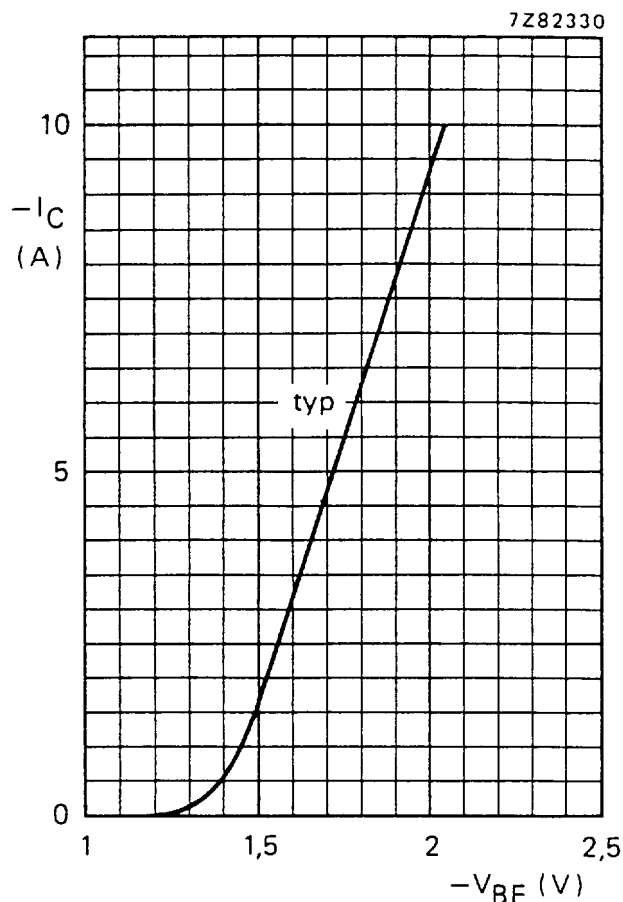


Fig. 7  $-V_{CE} = 3\ V$ ;  $T_{amb} = 25\ ^\circ C$ .

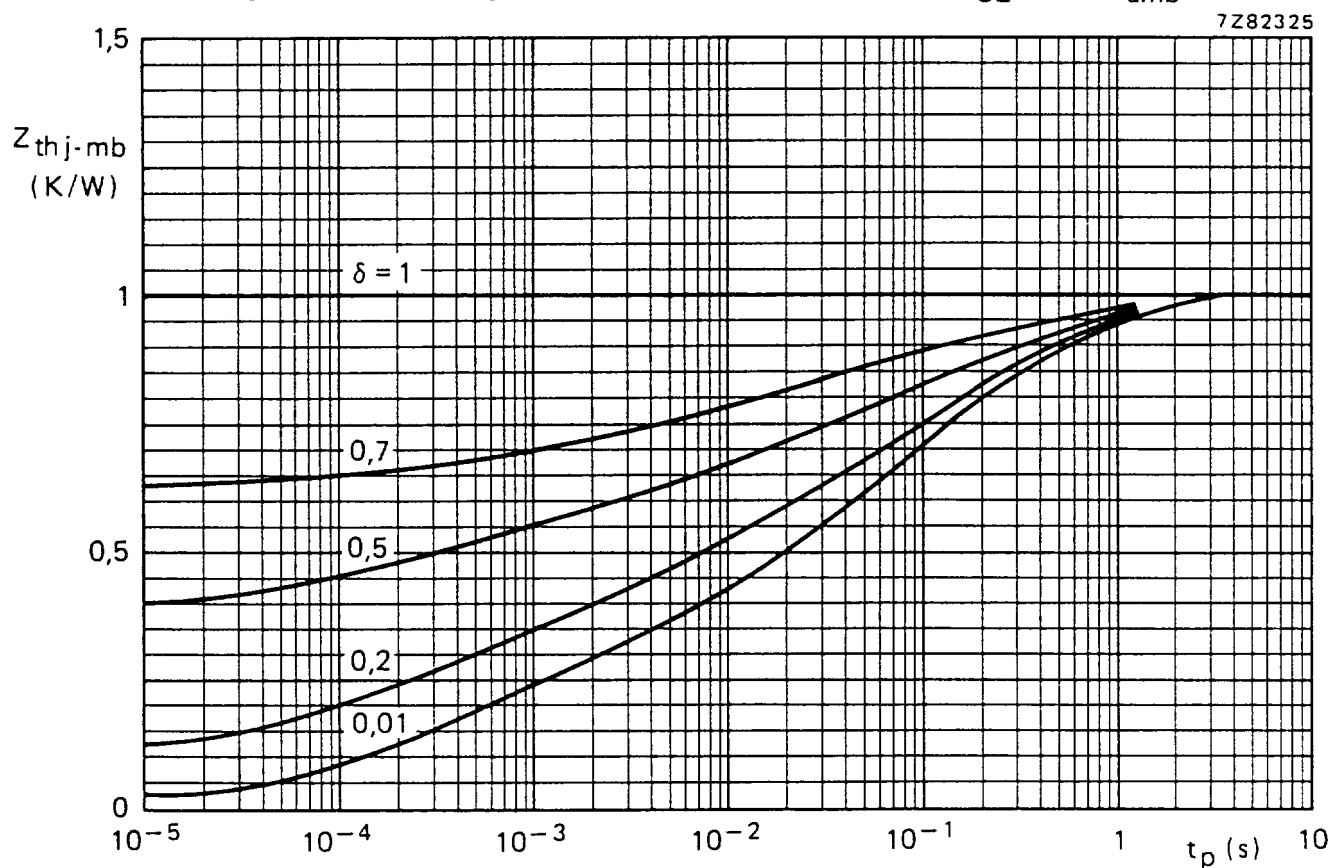


Fig. 8 Pulse power rating chart.

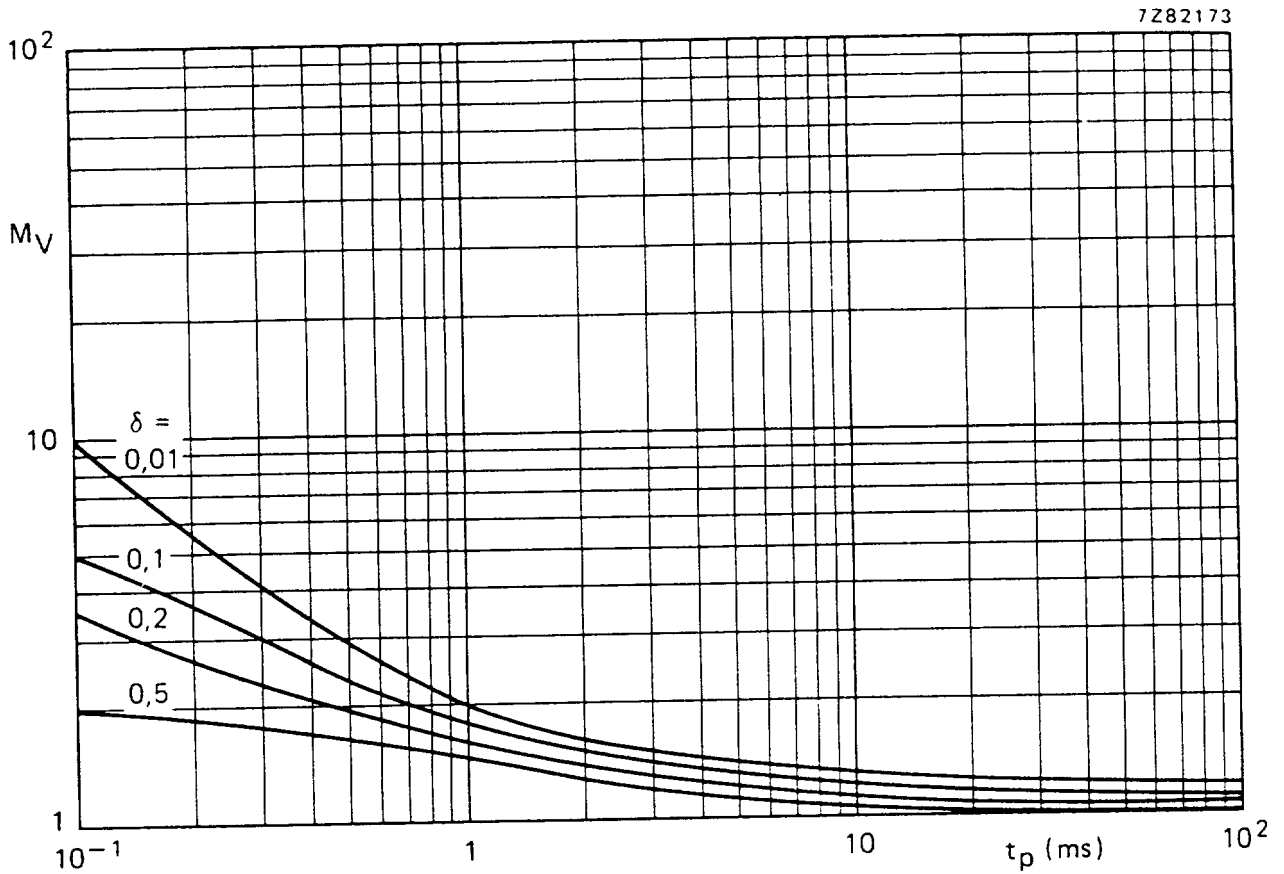


Fig. 9 S.B. voltage multiplying factor at the  $I_{Cmax}$  level.

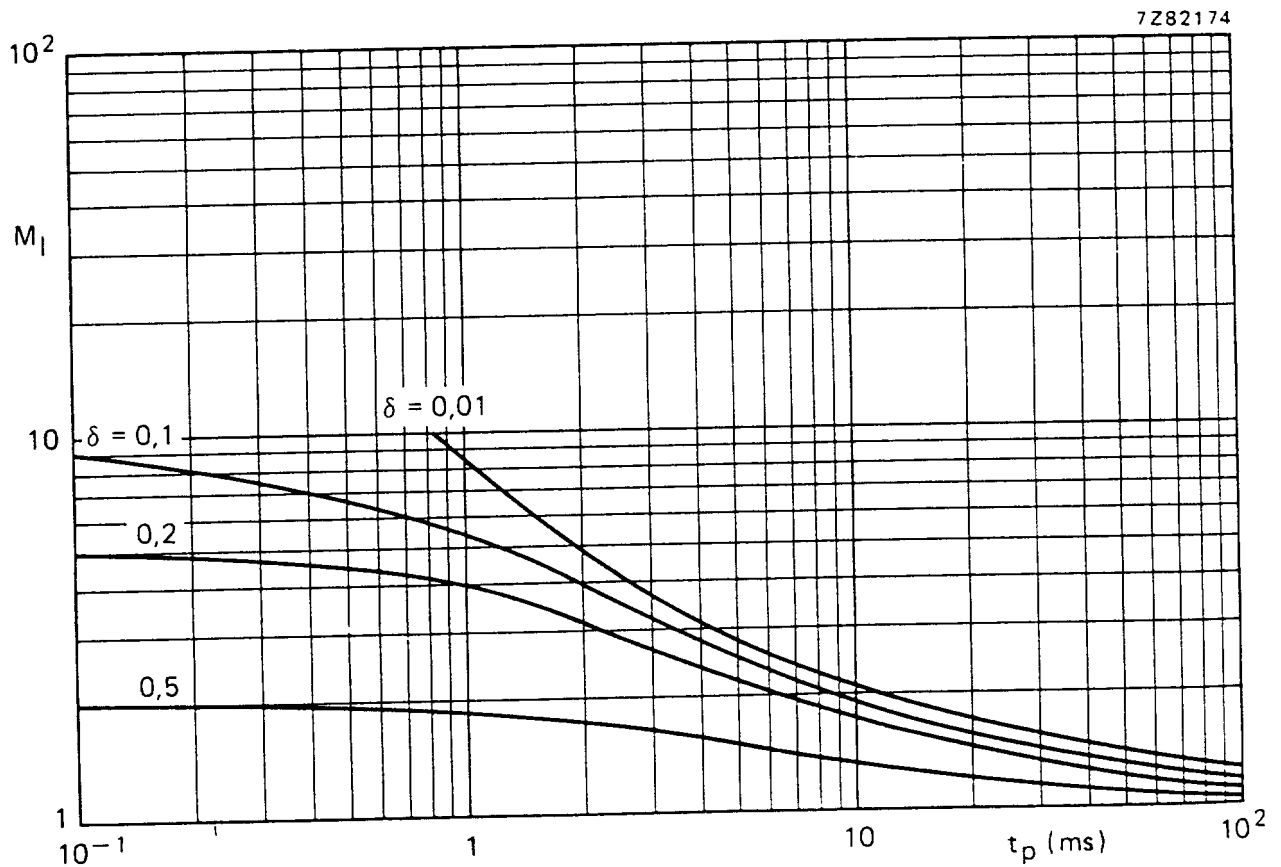


Fig. 10 S.B. current multiplying factor at the  $V_{CEOmax}$  level.

BDT64; 64A  
BDT64B; 64C

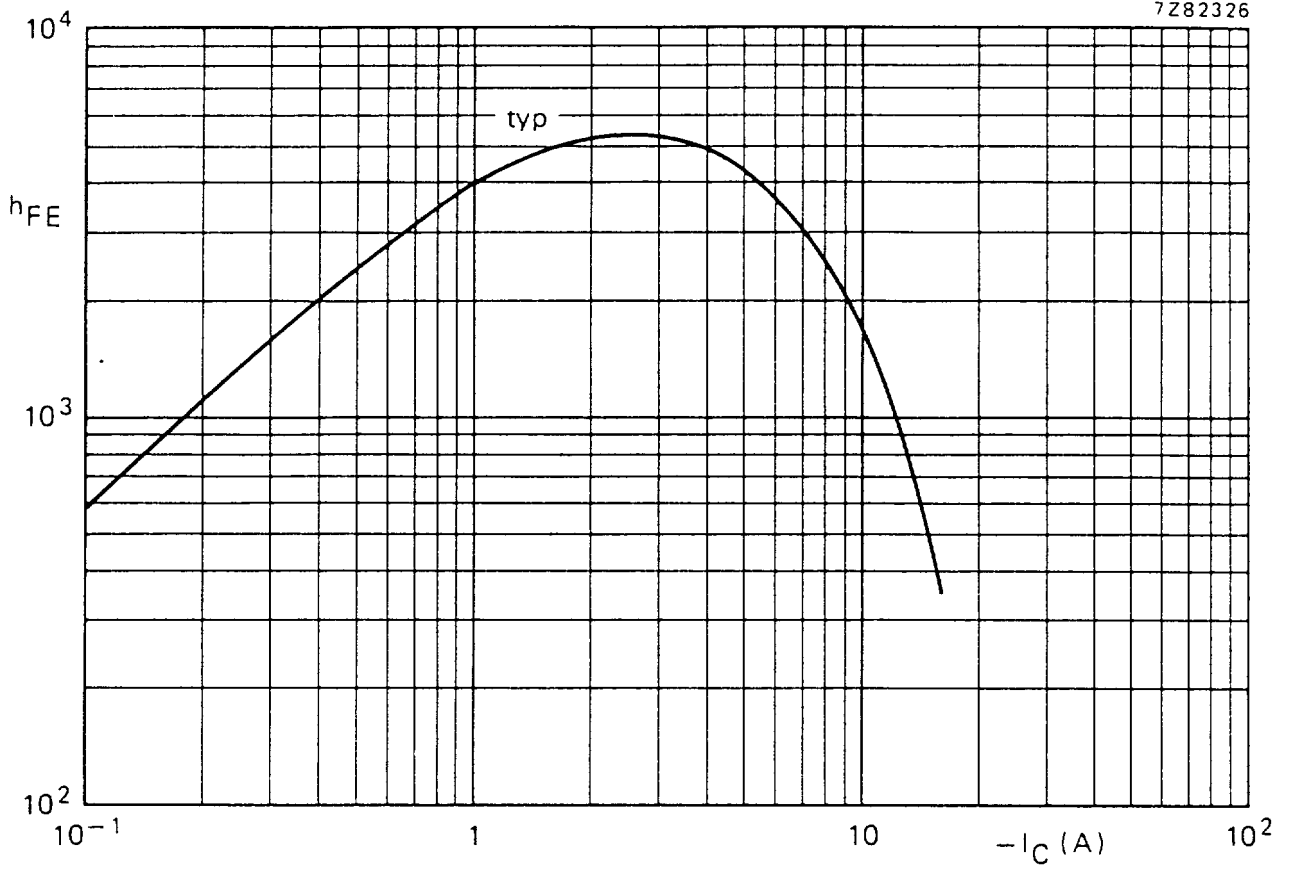


Fig. 11 D.C. current gain.  $-V_{CE} = 3$  V;  $T_j = 25$  °C.

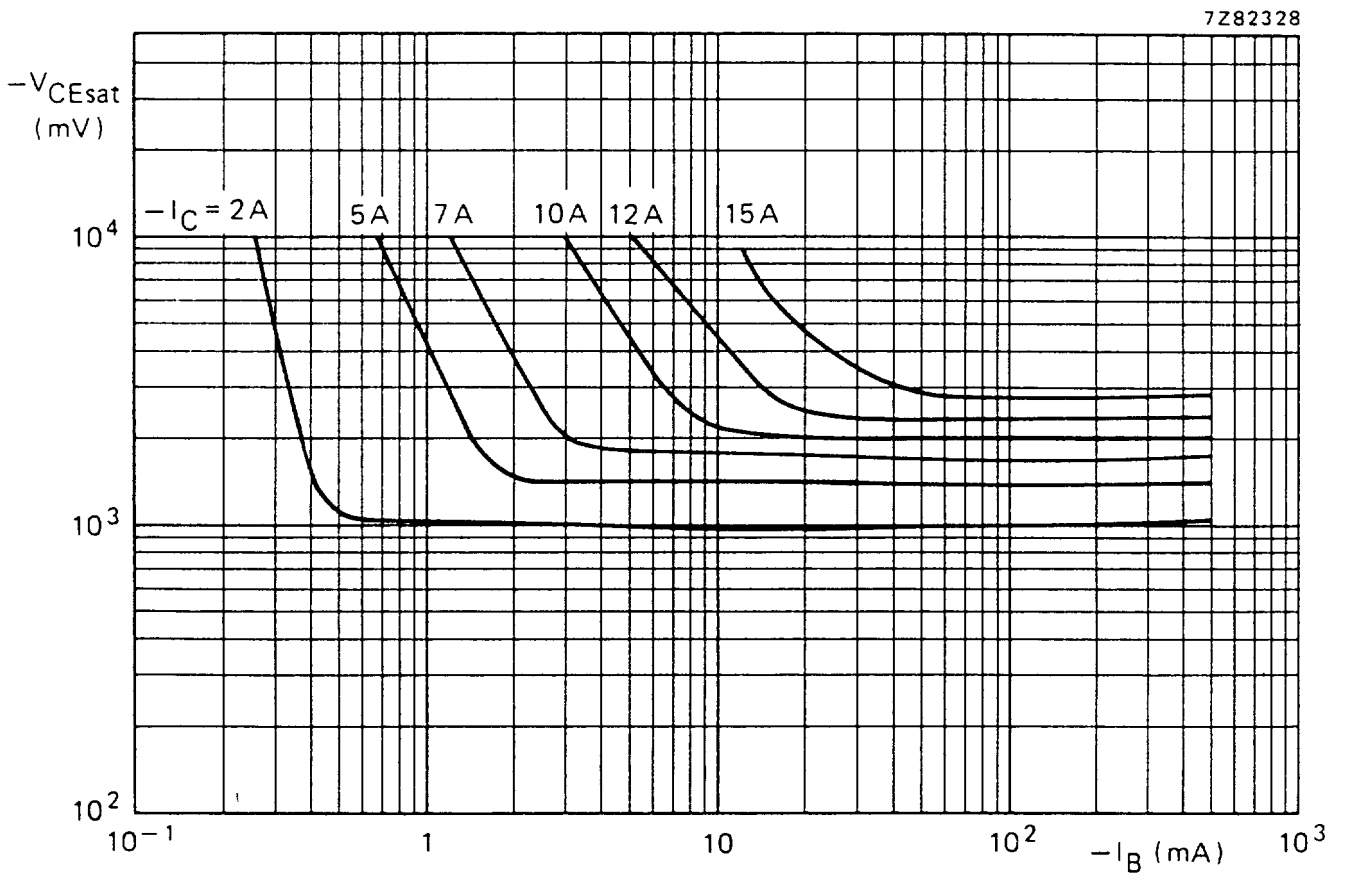


Fig. 12 Typical collector-emitter saturation voltages.



## SILICON DARLINGTON POWER TRANSISTORS

PNP Silicon Darlington power transistors in a SOT-186 envelope with an electrically insulated mounting base. The devices are designed for audio output stages and general amplifier and switching applications. NPN complements are BDT65F, BDT65AF, BDT65BF and BDT65CF.

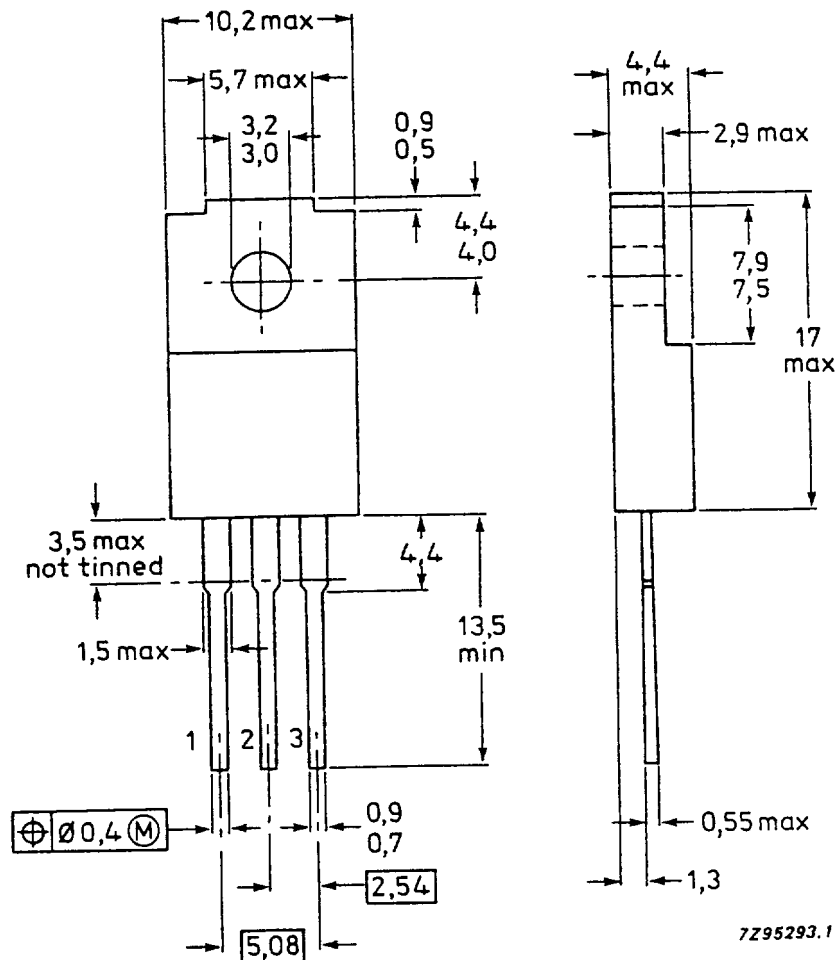
### QUICK REFERENCE DATA

			BDT64F	64AF	64BF	64CF
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 DC	$-I_C$	max.			12	A
Total power dissipation up to $T_h = 25^\circ\text{C}$	$P_{tot}$	max.			39	W
Junction temperature	$T_j$	max.			150	$^\circ\text{C}$
DC current gain $-I_C = 5\text{ A}; -V_{CE} = 4\text{ V}$	$h_{FE}$	min.			1000	

### MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-186.



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## RATINGS

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

			BDT64F	64AF	64BF	64CF
Collector-base voltage (open emitter)	$-V_{CB0}$	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.		5.0		V
Collector current DC	$-I_C$	max.		12		A
peak value	$-I_{CM}$	max.		20		A
Base current (DC)	$-I_B$	max.		500		mA
Total power dissipation up to $T_H = 25^\circ\text{C}$ (1)	$P_{tot}$	max.		22		W
up to $T_H = 25^\circ\text{C}$ (2)		max.		39		W
Storage temperature	$T_{stg}$			-65 to 150		$^\circ\text{C}$
Junction temperature	$T_j$	max.		150		$^\circ\text{C}$

## THERMAL RESISTANCE

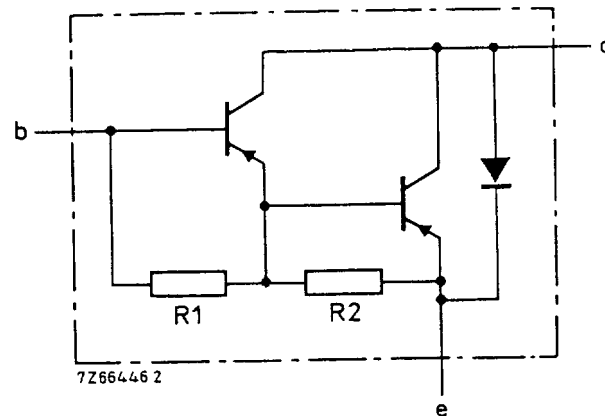
From junction to internal heatsink	$R_{th\ j-mb}$	=		0.9		K/W
From junction to external heatsink (1)	$R_{th\ j-h}$	=		5.7		K/W
From junction to external heatsink (2)	$R_{th\ j-h}$	=		3.2		K/W

## INSULATION

Voltage allowed between all terminals and external heatsink, peak value	$V_{insul}$	max.		1000		V
Insulation capacitance from collector to external heatsink	$C_{th}$	typ.		12		pF

(1) Mounted without heatsink compound and  $30 \pm 5$  newton pressure on centre of envelope.

(2) Mounted with heatsink compound and  $30 \pm 5$  newton pressure on centre of envelope.



R1 typ. 3 k $\Omega$   
R2 typ. 45  $\Omega$

Fig. 2 Circuit diagram.

**CHARACTERISTICS**

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

Collector cut-off current

$I_E = 0; -V_{CB} = -V_{CB0\text{max}}$	$-I_{CBO}$	max.	0.4	mA
$I_E = 0, T_j = 150\text{ }^\circ\text{C};$ $-V_{CB} = -1/2 V_{CB0\text{max}}$	$-I_{CBO}$	max.	2.0	mA
$I_B = 0;$ $-V_{CE} = -1/2 V_{CE0\text{max}}$	$-I_{CEO}$	max.	1.0	mA

Emitter cut-off current

$I_C = 0; -V_{EB} = 5\text{ V}$	$-I_{EBO}$	max.	5.0	mA
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DC current gain (3)

$-I_C = 1\text{ A}; -V_{CE} = 4\text{ V}$	$h_{FE}$	typ.	4000	
$-I_C = 5\text{ A}; -V_{CE} = 4\text{ V}$	$h_{FE}$	min.	1000	
$-I_C = 12\text{ A}; -V_{CE} = 4\text{ V}$	$h_{FE}$	typ.	800	

Base-emitter voltage (3)

$-I_C = 5\text{ A}; -V_{CE} = 4\text{ V}$	$-V_{BE}$	max.	2.5	V
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Collector-emitter saturation voltage (3)

$-I_C = 5\text{ A}; -I_B = 20\text{ mA}$	$-V_{CE\text{sat}}$	max.	2.0	V
$-I_C = 10\text{ A}; -I_B = 100\text{ mA}$	$-V_{CE\text{sat}}$	max.	3.0	V

Diode, forward voltage

$I_F = 5\text{ A}$	$V_F$	max.	2.0	V
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Collector capacitance at  $f = 1\text{ MHz}$

$-V_{CB} = 10\text{ V}; I_E = I_C = 0$	$C_c$	typ.	200	pF
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Second-breakdown collector current  
non-repetitive; without heatsink

$-V_{CE} = 60\text{ V}; t_p = 0.1\text{ s}$	$-I_{(SB)}$	min.	0.65	A
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Switching times

$-I_{Con} = 5\text{ A};$ $-I_{Bon} = I_{Boff} = 20\text{ mA}$ $-V_{CC} = 30\text{ V}$				
Turn-on time	$t_{on}$	typ.	0.5	$\mu\text{s}$
		max.	2.0	$\mu\text{s}$
		typ.	2.5	$\mu\text{s}$
Turn-off time	$t_{off}$	max.	5.0	$\mu\text{s}$

Small-signal current gain at  $f = 1\text{ MHz}$

$-I_C = 5\text{ A}; -V_{CE} = 3\text{ V}$	$h_{fe}$	min.	10	
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(3) Measured under pulse conditions;  $t_p < 300\text{ }\mu\text{s}; \delta < 2\%$ .

CHARACTERISTICS (continued)

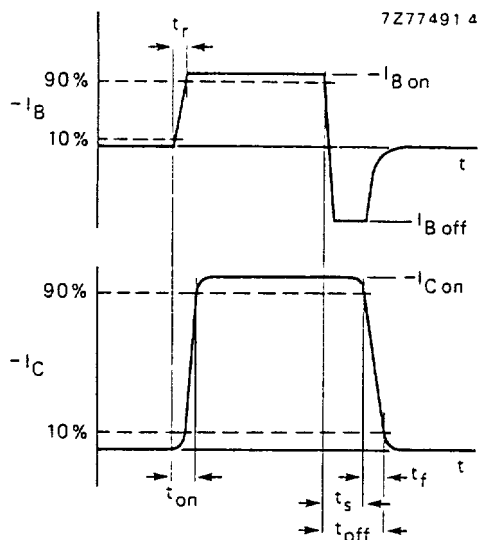


Fig. 3 Switching times waveforms.

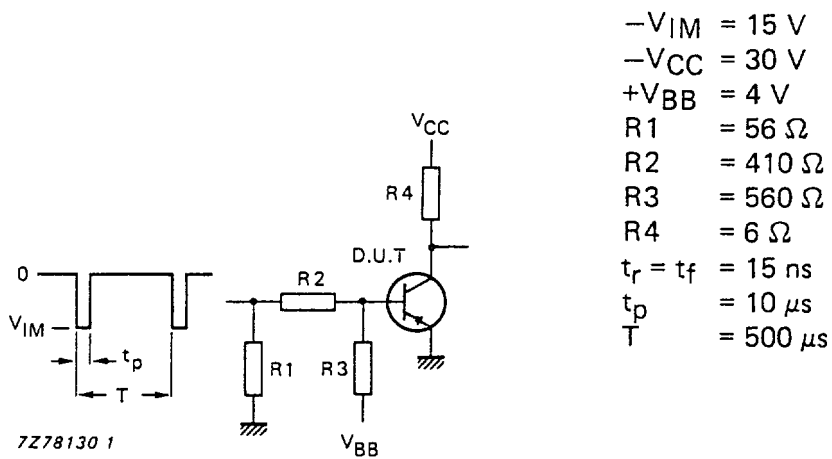


Fig. 4 Switching times test circuit.

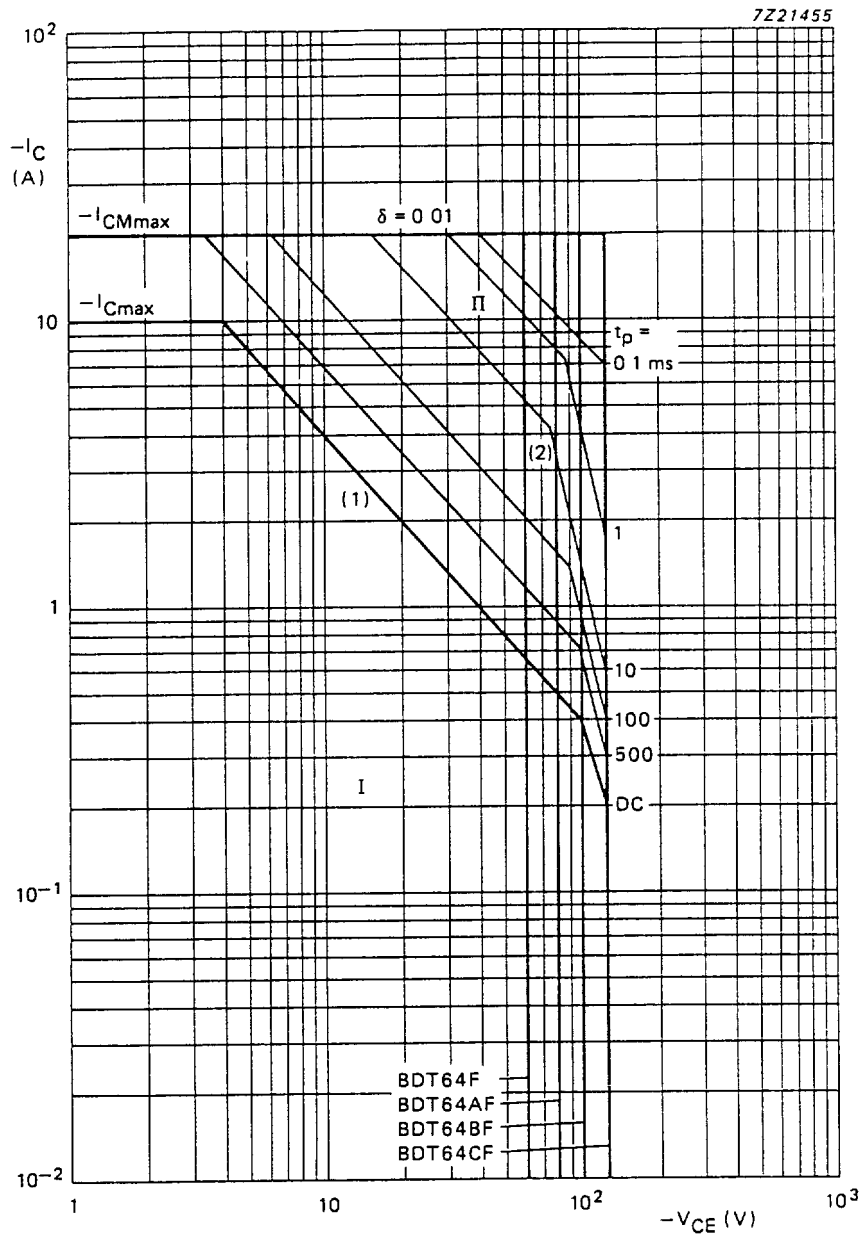


Fig. 5 Safe Operating Area;  $T_H = 25^\circ\text{C}$ .

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

BDT64F BDT64AF  
 BDT64BF BDT64CF

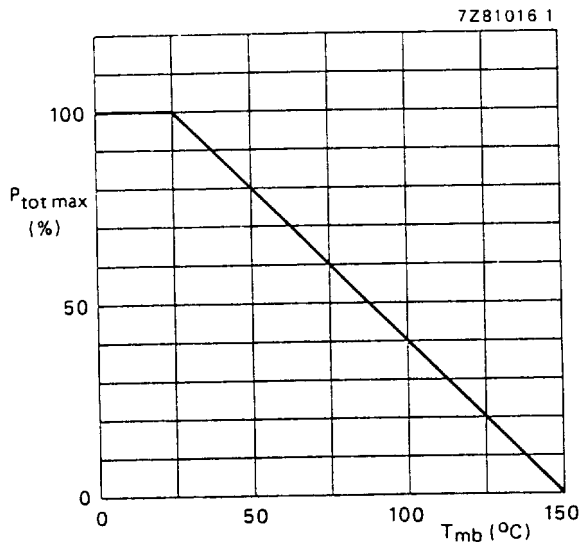


Fig. 6 Power derating curve.

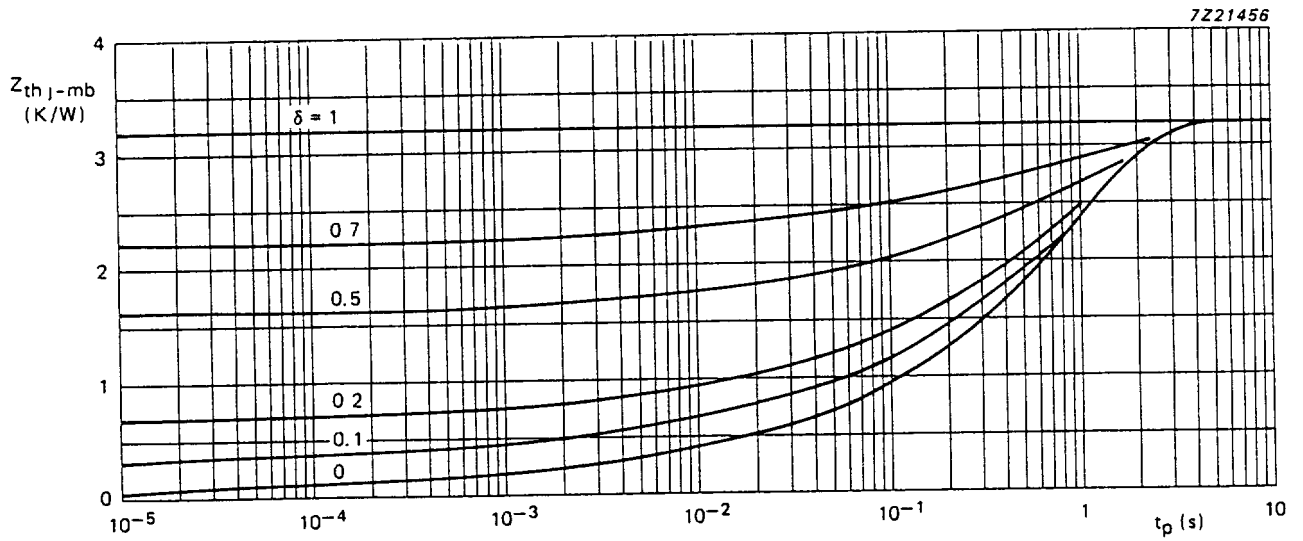


Fig. 7 Pulse power rating chart.

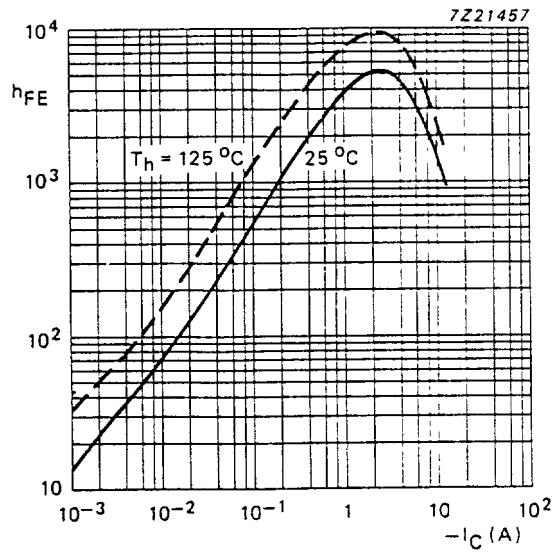


Fig. 8 Typical DC current gain as a function of collector current;  $-V_{CE} = 4\text{ V}$ ;  $T_j = 25\text{ }^\circ\text{C}$ .

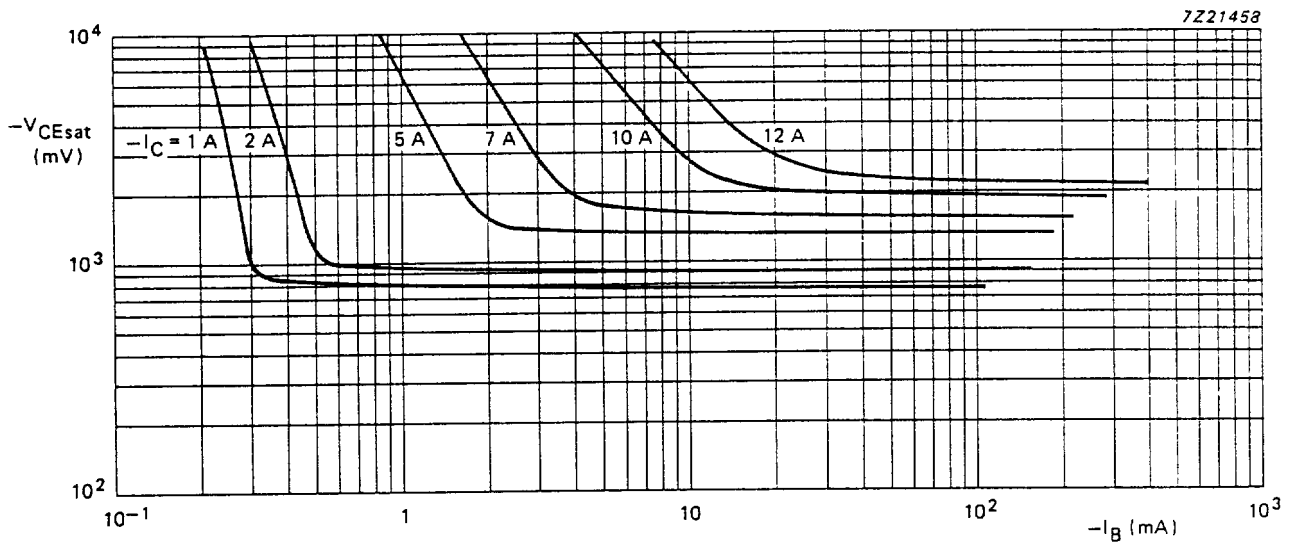


Fig. 9 Typical collector-emitter saturation voltages;  $T_h = 25\text{ }^\circ\text{C}$ .