PHILIPS INTERNATIONAL 56E D ■ 7110826 0042954 606 ■PHIN
T-33-31

SILICON DARLINGTON POWER TRANSISTORS

PNP silicon Darlington transistors in a SOT186 envelope with an electrically insulated mounting base.
NPN complements are BD643F, BD645F, BD647F, BD649F and BD651F.

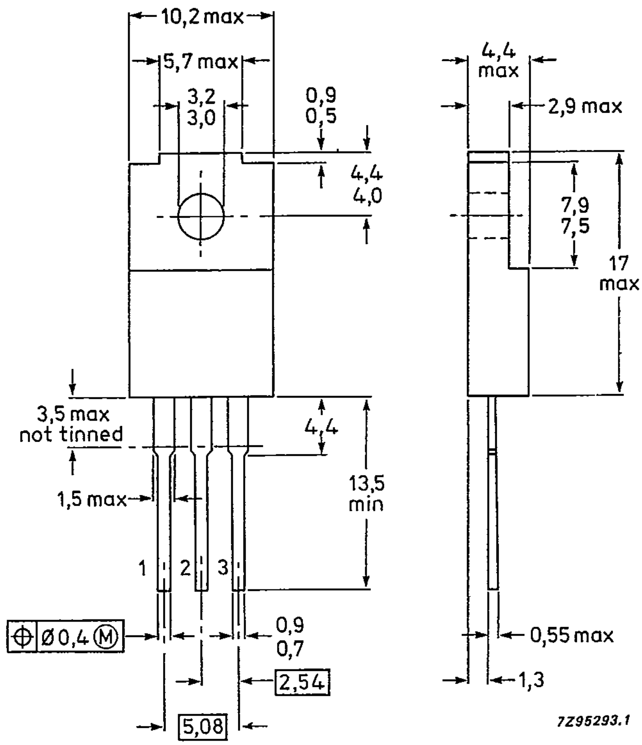
QUICK REFERENCE DATA

			BD644F	646F	648F	650F	652F	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	80	100	120	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	100	120	V
Collector current (DC)	$-I_C$	max.			8			A
Total power dissipation at $T_h \leq 25\ ^oC$	P_{tot}	max.			20			W
Junction temperature	T_j	max.			150			^oC

MECHANICAL DATA

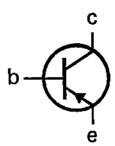
Dimensions in mm

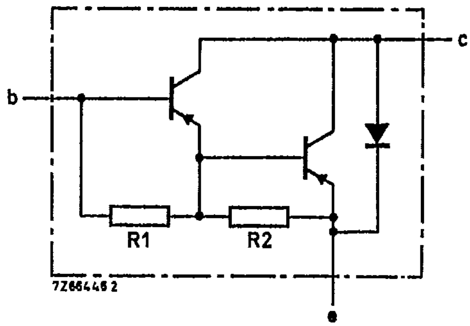
Fig.1 SOT186.



Pinning

1 = base
2 = collector
3 = emitter





R1 typ. 4 kΩ
R2 typ. 80 Ω

Fig. 2 Darlington circuit diagram.

RATINGS

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

			BD644F	646F	648F	650F	652F	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	80	100	120	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	100	120	V

Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (DC)	$-I_C$	max.	8	A
(peak value)	$-I_{CM}$	max.	12	A
Base current (DC)	$-I_B$	max.	150	mA
Total power dissipation at $T_h \leq 25\ ^oC$ (note 1)	P_{tot}	max.	20	W
at $T_h \leq 25\ ^oC$ (note 2)	P_{tot}	max.	32	W
Storage temperature range	T_{stg}		−65 to + 150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to internal heatsink	$R_{th\ j\text{-}mb}$	=	1.6	K/W
From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	=	6.3	K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	=	3.9	K/W

INSULATION

Voltage allowed between all terminals and external heatsink (peak value)	V_{insul}	max.	1000	V
Isolation capacitance from collector to external heatsink	C_{th}	max.	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.

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CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Emitter cut-off current				
V_{EB} = 5 V; I_C = 0	$-I_{EBO}$	max.	5	mA
Collector-emitter leakage current				
$-V_{CE}$ = $-1/2\ V_{CEO}$; I_B = 0	$-I_{CEO}$	max.	0.2	mA
Collector cut-off current				
$-V_{CB}$ = $-V_{CBO}$; I_E = 0	$-I_{CBO}$	max.	0.1	mA

			BD644F	646F	648F	650F	652F	
$-V_{CB}$ = 30 V; I_E = 0; T_j = 150 °C	$-I_{CBO}$	max.	1	–	–	–	–	mA
$-V_{CB}$ = 40 V; I_E = 0; T_j = 150 °C	$-I_{CBO}$	max.	–	1	–	–	–	mA
$-V_{CB}$ = 50 V; I_E = 0; T_j = 150 °C	$-I_{CBO}$	max.	–	–	1	–	–	mA
$-V_{CB}$ = 60 V; I_E = 0; T_j = 150 °C	$-I_{CBO}$	max.	–	–	–	1	–	mA
$-V_{CB}$ = 70 V; I_E = 0; T_j = 150 °C	$-I_{CBO}$	max.	–	–	–	–	1	mA
Collector-emitter leakage current								
$-V_{CE}$ = 25 V; I_B = 0	$-I_{CEO}$	max.	0.5	–	–	–	–	mA
$-V_{CE}$ = 30 V; I_B = 0	$-I_{CEO}$	max.	–	0.5	–	–	–	mA
$-V_{CE}$ = 40 V; I_B = 0	$-I_{CEO}$	max.	–	–	0.5	–	–	mA
$-V_{CE}$ = 50 V; I_B = 0	$-I_{CEO}$	max.	–	–	–	0.5	–	mA
$-V_{CE}$ = 60 V; I_B = 0	$-I_{CEO}$	max.	–	–	–	–	0.5	mA
Static forward current transfer ratio (note 1)								
$-I_C$ = 0.5 A; $-V_{CE}$ = 3 V	h_{FE}	typ.	2700	2700	2700	2700	2700	
$-I_C$ = 4 A; $-V_{CE}$ = 3 V	h_{FE}	min.	750	–	–	–	–	
$-I_C$ = 3 A; $-V_{CE}$ = 3 V	h_{FE}	min.	–	750	750	750	750	
$-I_C$ = 8 A; $-V_{CE}$ = 3 V	h_{FE}	typ.	2000	2000	2000	2000	2000	
Collector-emitter saturation voltage (note 1)								
$-I_C$ = 4 A; $-I_B$ = 16 mA	$-V_{CEsat}$	max.	2	–	–	–	–	V
$-I_C$ = 3 A; $-I_B$ = 12 mA	$-V_{CEsat}$	max.	–	2	2	2	2	V
$-I_C$ = 5 A; $-I_B$ = 50 mA	$-V_{CEsat}$	max.	2.5	2.5	2.5	2.5	2.5	V
Base-emitter saturation voltage (note 1)								
$-I_C$ = 5 A; $-I_B$ = 50 mA	$-V_{BEsat}$	max.	3	3	3	3	3	V
Base-emitter voltage (note 1)								
$-I_C$ = 4 A; $-V_{CE}$ = 3 V	$-V_{BE}$	max.	2.5	–	–	–	–	V
$-I_C$ = 3 A; $-V_{CE}$ = 3 V	$-V_{BE}$	max.	–	2.5	2.5	2.5	2.5	V
Common-emitter cut-off frequency								
$-I_C$ = 4 A; $-V_{CE}$ = 3 V	f_{hfe}	typ.	100	–	–	–	–	kHz
$-I_C$ = 3 A; $-V_{CE}$ = 3 V	f_{hfe}	typ.	–	100	100	100	100	kHz
Small signal current gain								
$-I_C$ = 4 A; $-V_{CE}$ = 3 V; f = 1 MHz	h_{fe}	typ.	150	–	–	–	–	
$-I_C$ = 3 A; $-V_{CE}$ = 3 V; f = 1 MHz	h_{fe}	typ.	–	150	150	150	150	

Forward bias second breakdown collector current				
$-V_{CE}$ = 50 V; t_p = 0.1 s	$-I_{(SB)}$	min.	0.55	A
Forward voltage				
I_F = 3 A	V_F	typ.	1.8	V

Note

1. To be measured under pulsed conditions, pulse time 300 μs; duty cycle 2%.

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CHARACTERISTICS (continued)

Switching times

$-I_C = 3$ A; $-I_{B\,on} = -I_{B\,off} = 12$ mA

Turn on time	t_{on}	max.	2	μs
		typ.	1	μs
Turn off time	t_{off}	max.	10	μs
		typ.	5	μs

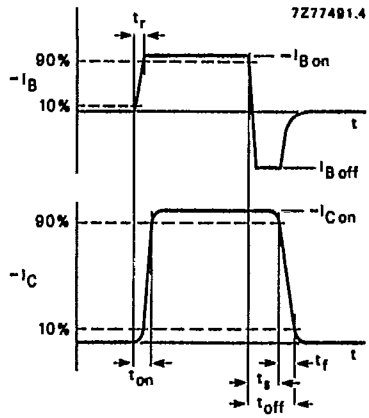
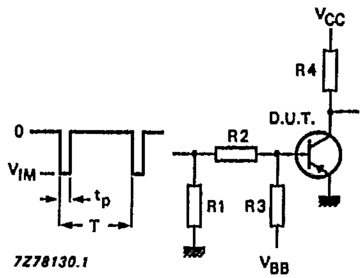
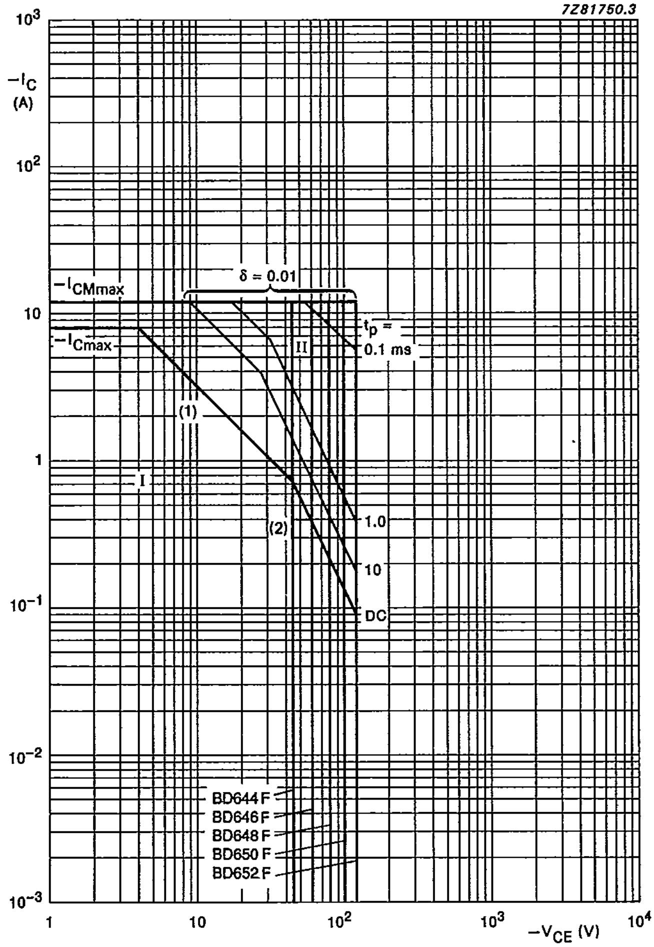


Fig. 3 Switching times waveforms.



$-V_{IM}$	=	10 V
$-V_{CC}$	=	10 V
$+V_{BB}$	=	4 V
R_1	=	56 Ω
R_2	=	410 Ω
R_3	=	560 Ω
R_4	=	3 Ω
$t_r = t_f$	=	15 ns
t_p	=	10 μs
T	=	500 μs

Fig. 4 Switching times test circuit.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

(1) $P_{tot\ max}$ and P_{peak} lines.
(2) Second-breakdown limits.

Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.

Fig.5 Safe Operating Area; T_{amb} = 25 °C.

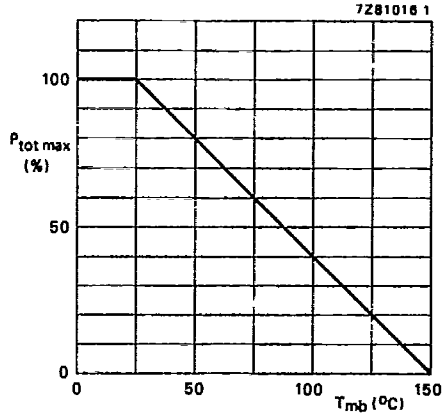


Fig. 6 Power derating curve.

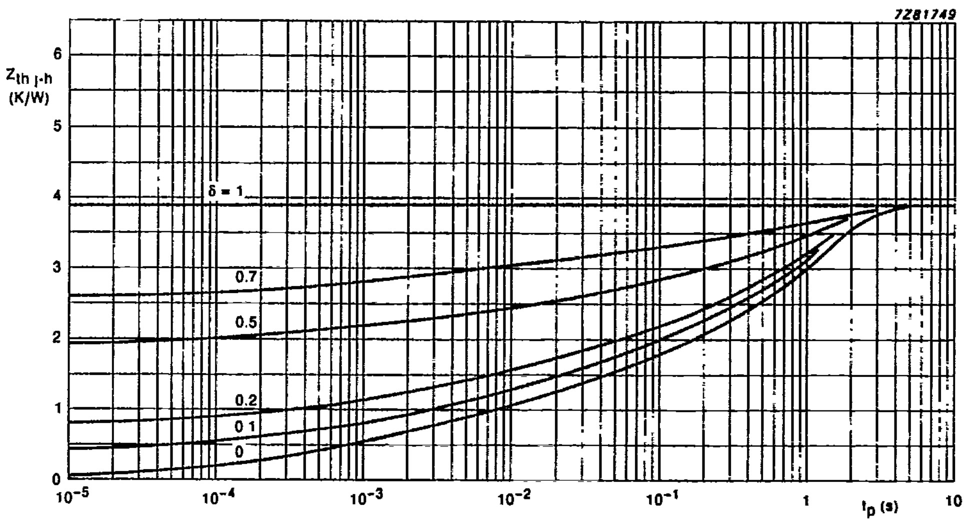


Fig. 7 Pulse power rating chart.

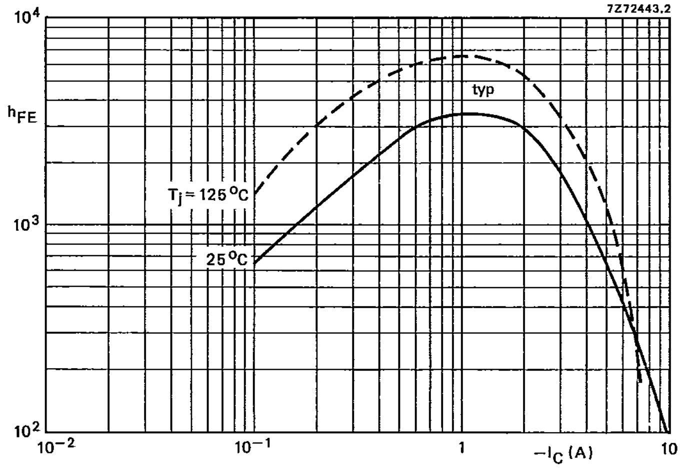


Fig. 8 Typical DC current gain curves, $-V_{CE} = 3$ V.

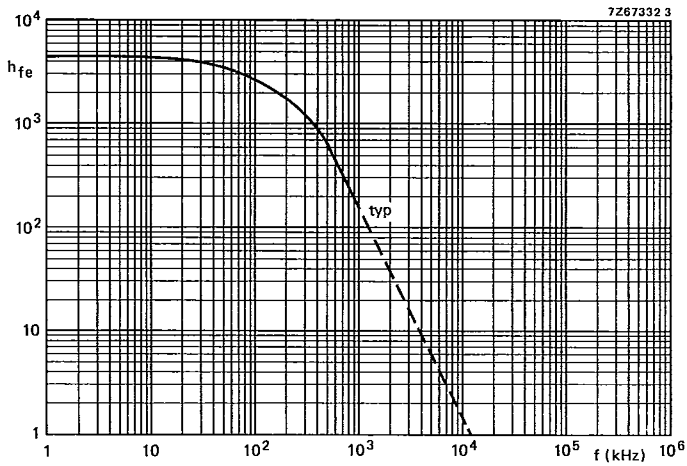


Fig. 9 Small signal current gain.

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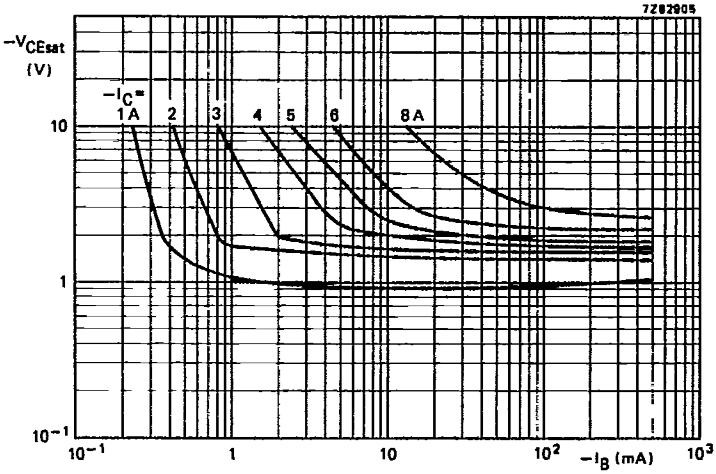

Fig. 10 Typical collector-emitter saturation voltage; T_j = 25 °C.