MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

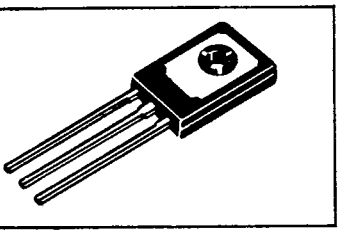
NPN
BD785, BD787
PNP
BD786, BD788

COMPLEMENTARY PLASTIC SILICON ANNULAR♦ POWER TRANSISTORS

. . . designed for low power audio amplifier and low current, high-speed switching applications.

- Low Collector-Emitter Sustaining Voltage — V_{CEO} (sus) 45 Vdc (Min) — BD785, BD786; 60 Vdc (Min) — BD787, BD788
- High Current-Gain — Bandwidth Product — f_T = 50 MHz (Min) @ I_C = 100 mAdc
- DC Current Gain Specified at 0.2, 1.0, 2.0 and 4.0 Adc
- Collector-Emitter Saturation Voltage Specified at 0.5, 1.0, 2.0 and 4.0 Adc

4 AMPERE
POWER TRANSISTORS
COMPLEMENTARY SILICON
45, 60VOLTS
15 WATTS



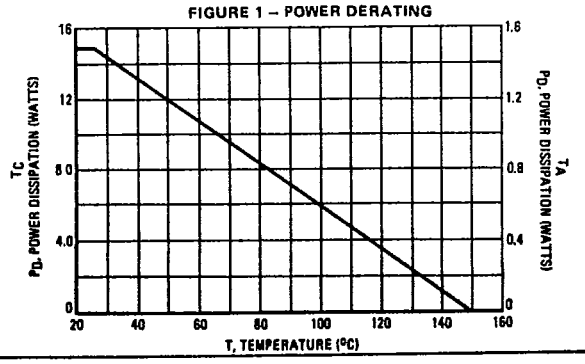
*MAXIMUM RATINGS

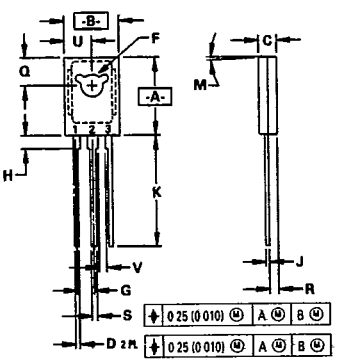
Rating	Symbol	BD785 BD786	BD787 BD788	Unit
Collector-Emitter Voltage	V_{CEO}	45	60	Vdc
Collector-Base Voltage	V_{CBO}	60	80	Vdc
Emitter-Base Voltage	V_{EBO}	6.0		Vdc
Collector Current — Continuous — Peak	I_C	4.0 8.0		Adc Adc
Base Current	I_B	1.0		Adc
Total Power Dissipation @ T_C = 25°C Derate Above 25°C	P_D	15 0.12		Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150		°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	8.34	°C/W

FIGURE 1 — POWER DERATING





NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	10.80	11.04	0.425	0.435
B	7.50	7.74	0.295	0.305
C	2.42	2.66	0.095	0.105
D	0.51	0.66	0.020	0.026
F	2.93	3.17	0.115	0.125
G	2.39 BSC		0.094 BSC	
H	1.27	2.41	0.050	0.095
J	0.39	0.63	0.015	0.025
K	14.61	16.63	0.575	0.655
M	3° TYP		3° TYP	
Q	3.76	4.01	0.148	0.158
R	1.15	1.39	0.045	0.055
S	0.64	0.88	0.025	0.035
U	3.69	3.93	0.145	0.155
V	1.02	—	0.040	—

STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. BASE

CASE 77-06
TO-225AA TYPE

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BD785, BD787 NPN
BD786, BD788 PNP

T-33-07
T-33-17

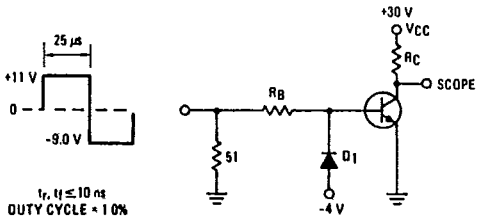
***ELECTRICAL CHARACTERISTICS** (T_C = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (1) (I_C = 10 mAdc, I_B = 0)	BD785, BD786	$V_{CEO(sus)}$	45	–	Vdc
	BD787, BD788		60	–	
Collector Cutoff Current (V_{CE} = 20 Vdc, I_B = 0)	BD785, BD786	I_{CEO}	–	100	μAdc
(V_{CE} = 30 Vdc, I_B = 0)	BD787, BD788		–	100	
Collector Cutoff Current (V_{CE} = 60 Vdc, $V_{BE(off)}$ = 1.5 Vdc)	BD785, BD786	I_{CEX}	–	1.0	μAdc
(V_{CE} = 80 Vdc, $V_{BE(off)}$ = 1.5 Vdc)	BD787, BD788		–	1.0	
(V_{CE} = 30 Vdc, $V_{BE(off)}$ = 1.5 Vdc, T_C = 125°C)	BD785, BD786		–	0.1	mAdc
(V_{CE} = 40 Vdc, $V_{BE(off)}$ = 1.5 Vdc, T_C = 125°C	BD787, BD788		–	0.1	
Emitter Cutoff Current (V_{EB} = 6.0 Vdc, I_C = 0)		I_{EBO}	–	1.0	μAdc
ON CHARACTERISTICS (1)					
DC Current Gain (I_C = 200 mAdc, V_{CE} = 3.0 Vdc)		h_{FE}	40	250	–
(I_C = 1.0 Adc, V_{CE} = 3.0 Vdc)			25	–	
(I_C = 2.0 Adc, V_{CE} = 3.0 Vdc)			20	–	
(I_C = 4.0 Adc, V_{CE} = 3.0 Vdc)			5.0	–	
Collector-Emitter Saturation Voltage (I_C = 500 mAdc, I_B = 50 mAdc)		$V_{CE(sat)}$	–	0.4	Vdc
(I_C = 1.0 Adc, I_B = 100 mAdc)			–	0.6	
(I_C = 2.0 Adc, I_B = 200 mAdc)			–	0.8	
(I_C = 4.0 Adc, I_B = 800 mAdc)			–	2.5	
Base-Emitter Saturation Voltage (I_C = 2.0 Adc, I_B = 200 mAdc)		$V_{BE(sat)}$	–	2.0	Vdc
Base-Emitter on Voltage (I_C = 2.0 Adc, V_{CE} = 3.0 Vdc)		$V_{BE(on)}$	–	1.8	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain – Bandwidth Product (I_C = 100 mAdc, V_{CE} = 10 Vdc, f = 10 MHz)		f_T	50	–	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_C = 0)	BD785, BD787	C_{ob}	–	50	pF
f = 0.1 MHz)	BD786, BD788		–	70	
Small-Signal Current Gain (I_C = 200 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)		h_{fe}	10	–	–

*Indicates JEDEC Registered Data.

(1) Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%

FIGURE 2 – SWITCHING TIME TEST CIRCUIT



t_r, $t_f \leq 10$ ns
DUTY CYCLE = 1.0%

R_B and R_C VARIED TO OBTAIN DESIRED CURRENT LEVELS

D_1 MUST BE FAST RECOVERY TYPE, eg:
MBD5300 USED ABOVE I_B ≈100 mA
MSD6100 USED BELOW I_B ≈100 mA

FOR PNP TEST CIRCUIT, REVERSE ALL POLARITIES

FIGURE 3 – TURN-ON TIME

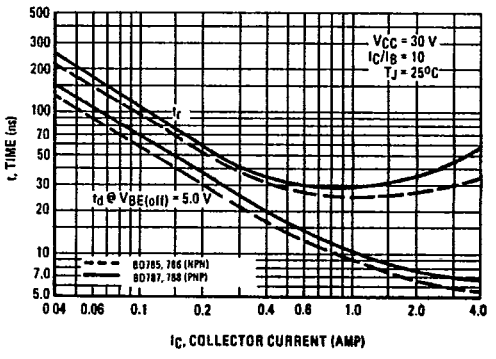


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FIGURE 4 – THERMAL RESPONSE

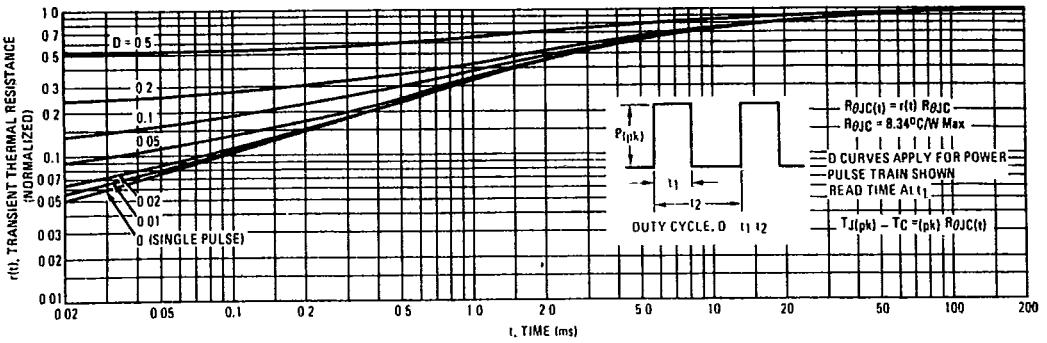
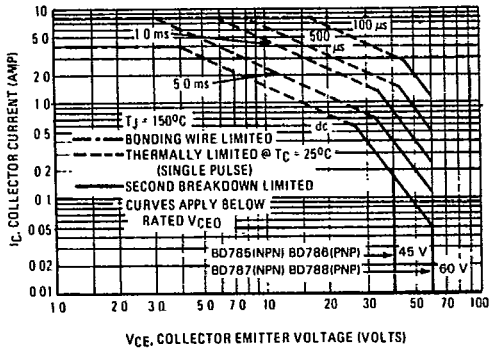


FIGURE 5 – ACTIVE-REGION SAFE OPERATING AREA



There are two limitations on the power handling ability of a transistor – average junction temperature and second breakdown. Safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on $T_{J(pk)}$ = 150°C; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 150^{\circ}C$. $T_{J(pk)}$ may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown. (See AN 415A)

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FIGURE 6 – TURN-OFF TIME

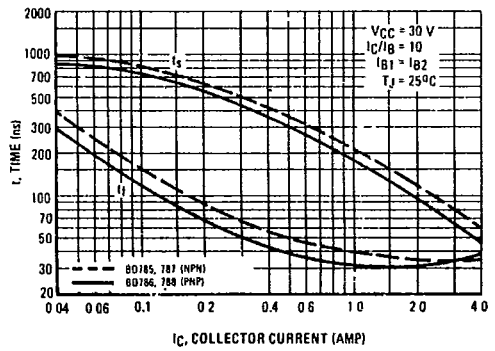

FIGURE 7 – CAPACITANCE

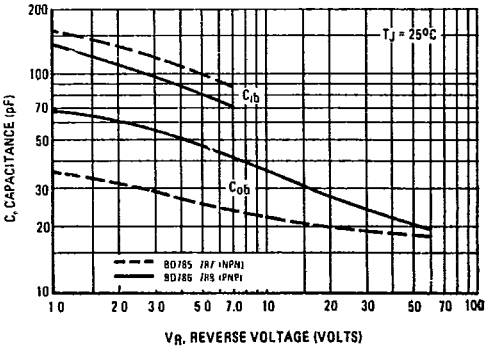

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FIGURE 8 – DC CURRENT GAIN

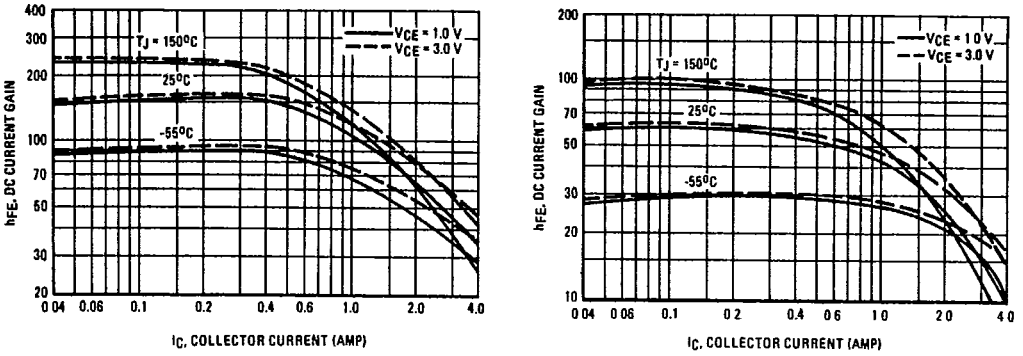

FIGURE 9 – "ON" VOLTAGES

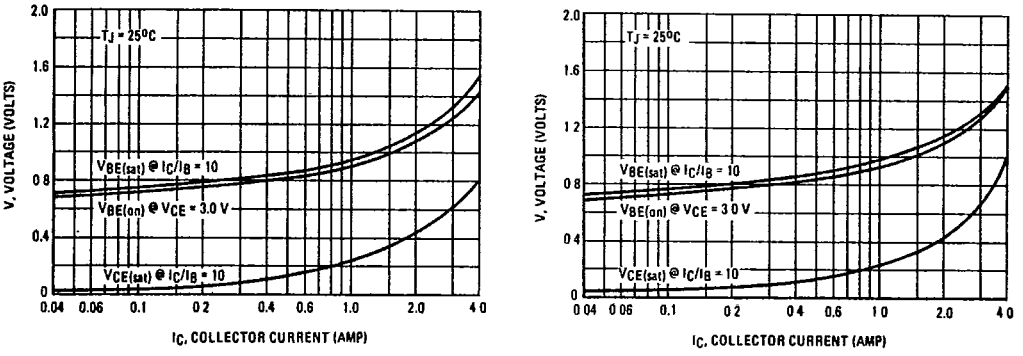

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FIGURE 10 – TEMPERATURE COEFFICIENTS