MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

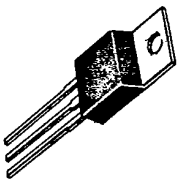
NPN	PNP
BD533	**BD534**
BD535	**BD536**
BD537	**BD538**

COMPLEMENTARY SILICON PLASTIC POWER TRANSISTORS

. . . designed for use in general purpose amplifier and switching applications.

- Collector-Emitter Saturation Voltage — V_{CE} = 0.8 Vdc (Max) @ I_C = 2.0 Adc
- Collector-Emitter Sustaining Voltage —
  $V_{CEO(sus)}$ = 45 Vdc (Min) BD533, BD534
  = 60 Vdc (Min) BD535, BD536
  = 80 Vdc (Min) BD537, BD538
- High Current Gain — Bandwidth Product f_T = 3.0 MHz (Min) @ I_C = 250 mAdc
- Compact TO-220 AB Package
- TO-66 Leadform Also Available ordered with "–66" suffix

4 AMPERE
POWER TRANSISTORS
COMPLEMENTARY SILICON
45, 60, 80 VOLTS
50 WATTS



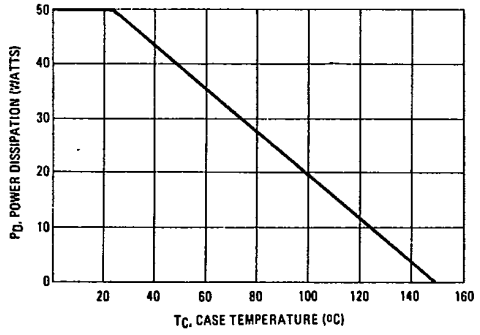
MAXIMUM RATINGS

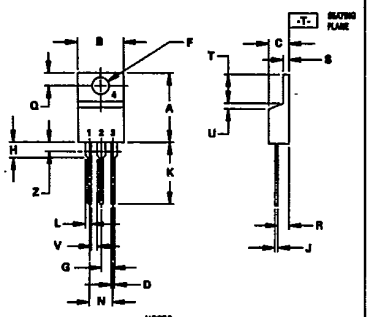
Rating	Symbol	BD533 BD534	BD535 BD536	BD537 BD538	Unit
Collector-Emitter Voltage	V_{CEO}	45	60	80	Vdc
Collector-Base Voltage	V_{CB}	45	60	80	Vdc
Emitter-Base Voltage	V_{EB}	5.0			Vdc
Collector Current - Continuous	I_C	4.0			Adc
Peak		8.0			
Base Current	I_B	1.0			Adc
Total Device Dissipation @ T_C = 25°C	P_D	50			Watts
Derate above 25°C		0.4			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	$R_{\theta JC}$	2.5	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	70	°C/W

FIGURE 1 — POWER DERATING





NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIM Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	14.48	15.75	0.570	0.620
B	9.66	10.28	0.380	0.405
C	4.07	4.82	0.160	0.190
D	0.64	0.86	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.42	2.66	0.095	0.105
H	2.80	2.93	0.110	0.155
J	0.46	0.71	0.018	0.028
K	12.70	14.27	0.500	0.562
L	1.15	1.39	0.045	0.055
N	4.83	5.33	0.190	0.210
Q	2.54	3.04	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.15	1.39	0.045	0.055
T	5.97	6.47	0.235	0.255
U	0.00	1.27	0.000	0.050
V	1.15	—	0.045	—
Z	—	2.04	—	0.080

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

CASE 221A-04
TO-220AB

3

BD533, BD535, BD537 NPN
BD534, BD536, BD538 PNP

T-33-11
T-33-21

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

Characteristic		Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage[1] (I_C = 0.1 Adc, I_B = 0)	BD533, BD534	$V_{CEO(sus)}$	45		Vdc
	BD535, BD536		60		
	BD537, BD538		80		
Collector Cutoff Current		I_{CBO}			mAdc
(V_{CB} = 45 Vdc, I_E = 0)	BD533, BD534			0.1	
(V_{CB} = 60 Vdc, I_E = 0)	BD535, BD536			0.1	
(V_{CB} = 80 Vdc, I_E = 0)	BD537, BD538			0.1	
Collector Cutoff Current		I_{CES}			μAdc
(V_{CE} = 45 Vdc, V_{EB} = 0)	BD533, BD534			100	
(V_{CE} = 60 Vdc, V_{EB} = 0)	BD535, BD536			100	
(V_{CE} = 80 Vdc, V_{EB} = 0)	BD537, BD538			100	
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)		I_{EBO}		1.0	mAdc
ON CHARACTERISTICS[1]					
DC Current Gain		h_{FE}			
(I_C = 10 mAdc, V_{CE} = 5 Vdc)	BD533, BD534		20		
	BD535, BD536		20		
	BD537, BD538		15		
(I_C = 500 mAdc, V_{CE} = 2 Vdc)			40		
(I_C = 2 Adc, V_{CE} = 2 Vdc)	BD533, BD534		25		
	BD535, BD536		25		
	BD537, BD538		15		
Collector-Emitter Saturation Voltage (I_C = 2.0 Adc, I_B = 0.2 Adc)		$V_{CE(sat)}$		0.8	Vdc
Base-Emitter On Voltage (I_C = 2.0 Adc, V_{CE} = 2.0 Vdc)		$V_{BE(on)}$		1.5	Vdc
DYNAMIC CHARACTERISTICS					
Current Gain — Bandwidth Product[2] (I_C = 250 mAdc, V_{CE} = 1 Vdc, f_{test} = 1 MHz)		f_T	3.0		MHz

[1] Pulse test = Pulse width ≤300 μs, Duty Cycle ≤2.0%.
[2] $f_T = |h_{fe}| \cdot f_{test}$

3

FIGURE 2 – SWITCHING TIME EQUIVALENT CIRCUIT

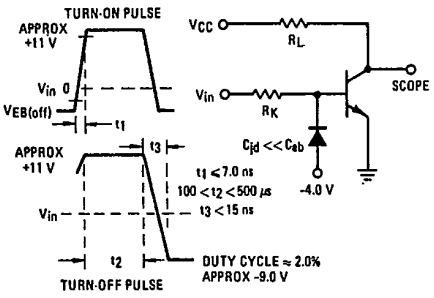
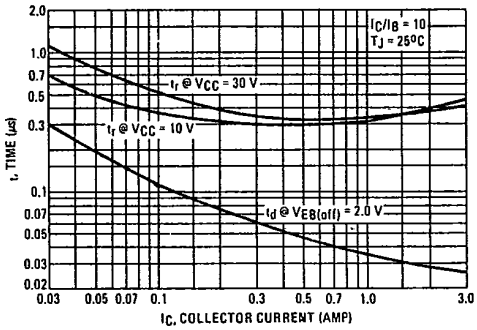


FIGURE 3 – TURN-ON TIME



BD533, BD535, BD537 NPN
BD534, BD536, BD538 PNP

T-33-11

T-33-21

FIGURE 4 – THERMAL RESPONSE

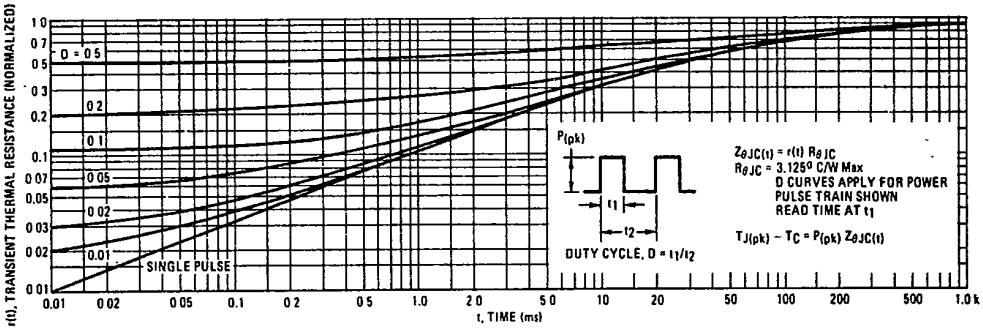
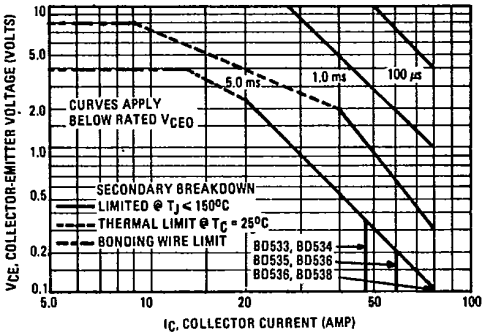


FIGURE 5 – ACTIVE REGION SAFE OPERATING AREA



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 $T_{J(pk)} \leq 150°C$. $T_{J(pk)}$ 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

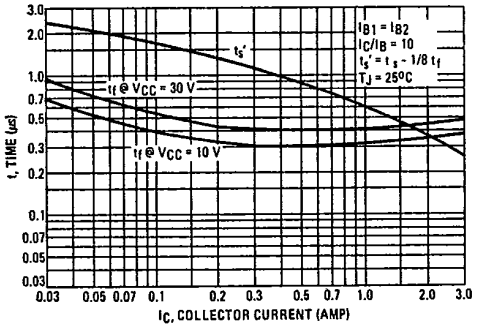
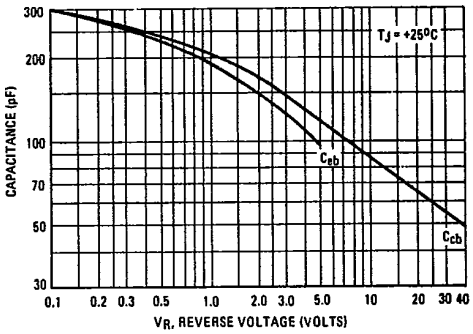


FIGURE 7 – CAPACITANCE



BD533, BD535, BD537 NPN
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T-33-11
T-33-21

FIGURE 8 – DC CURRENT GAIN

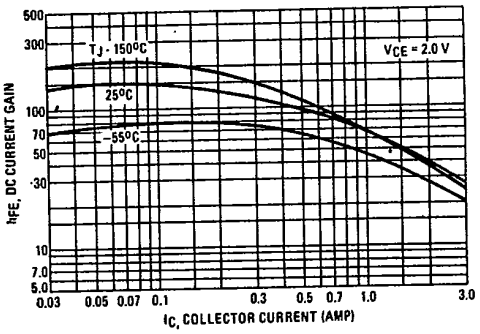

FIGURE 9 – COLLECTOR SATURATION REGION

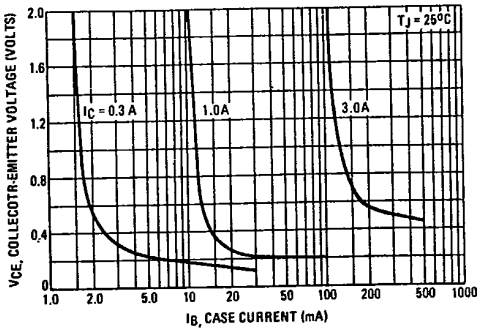

FIGURE 10 – "ON" VOLTAGES

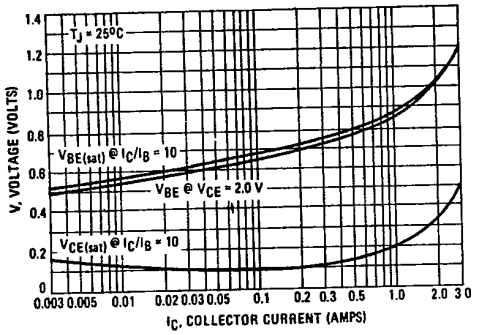

FIGURE 11 – TEMPERATURE COEFFICIENTS

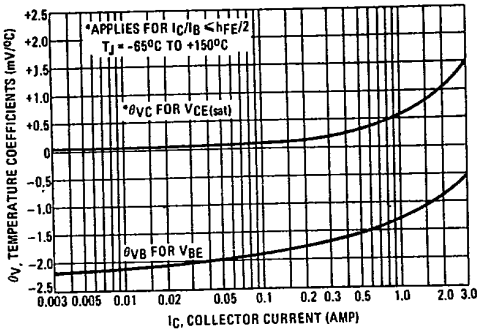

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FIGURE 12 – COLLECTOR CUT-OFF REGION

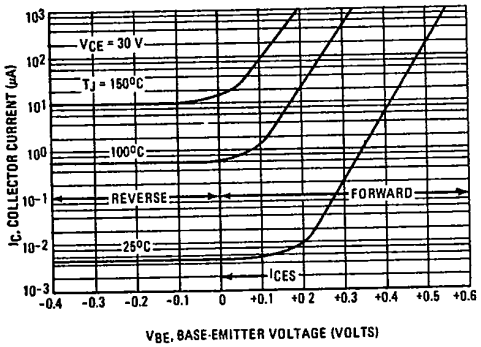

FIGURE 13 – EFFECTS OF BASE-EMITTER RESISTANCE