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*Consult Motorola if a direct replacement is necessary.

TABLE 5 — PLASTIC TO-220 (Continued)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s μs Max	Resistive Switching t_f μs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
2	45	BD239	BD240	15 min	1				3	30
	60	BD239A TIP110##	BD240A TIP115##	15 min 500 min	1 2	1.7 typ	1.3 typ	2	3 25#	30 50
	80	BD239B TIP111##	BD240B TIP116##	15 min 500 min	1 2	1.7 typ	1.3 typ	2	3 25#	30 50
	100	BD239C TIP112##	BD240C TIP117##	25 min 500 min	1 2	1.7 typ	1.3 typ	2	3 25#	30 50
	400	BUX84		30 min	0.1	3.5	1.4	1	4	50
	450	BUX85		30 min	0.1	3.5	1.4	1	4	50
	900	MJE1320		3 min	1	4 typ	0.8 typ	1		80
2.5	700	MJE8500		7.5 min	0.5	4	2	1		65
	750	MJE12007		1.1 min	2		1	2	4 typ	65
	800	MJE8501		7.5 min	0.5	4	2	1		65
3	40	TIP31	TIP32	25 min	1	0.6 typ	0.3 typ	1	3	40
	45	BD241	BD242	25 min	1				3	40
	60	BD241A TIP31A	BD242A TIP32A	25 min 25 min	1 1	0.6 typ	0.3 typ	1	3 3	40 40
	80	BD241B TIP31B	BD242B TIP32B	25 min 25 min	1 1	0.6 typ	0.3 typ	1	3 3	40 40
	100	BD241C TIP31C	BD242C TIP32C	25 min 25 min	1 1	0.6 typ	0.3 typ	1	3 3	40 40
	750	MJE16032		4 min	3	2	1.5	2		80
	850	MJE16034		4 min	3	2	1.5	2		80
4	45	2N6121	2N6124	25/100	1.5	0.4 typ	0.3 typ	1.5	2.5	40
	60	2N6122 BD535 MJE800T##	2N6125 MJE700T##	25/100 25 min 750 min	1.5 2 1.5	0.4 typ	0.3 typ	1.5	2.5 3 1#	40 50 40
	80	2N6123		20/80	1.5	0.4 typ	0.3 typ	1.5	2.5	40
	300	MJE13004		6/30	3	3	0.7	3	4	60
	400	MJE13005		6/30	3	3	0.7	3	4	60
5	60	TIP120##	TIP125##	1k min	3	1.5 typ	1.5 typ	3	4#	65
	80	TIP121##	TIP126##	1k min	3	1.5 typ	1.5 typ	3	4#	65
	100	TIP122##	TIP127##	1k min	3	1.5 typ	1.5 typ	4	4#	75
	250	2N6497		10/75	2.5	1.8	0.8	2.5	5	80
	300	2N6498		10/75	2.5	1.8	0.8	2.5	5	80
	400	MJE13070		8 min	3	1.5	0.5	3		80
	450	MJE16002 MJE16004		5 min 7 min	5 5	3 2.7	0.3 0.35	3 3		80 80
	700	MJE8502		7.5 min	1	4	2	2.5		80
	800	MJE8503		7.5 min	1	4	2	2.5		80
6	40	TIP41	TIP42	15/75	3	0.4 typ	0.15 typ	3	3	65
	45	BD243	BD244	15 min	3				3	65
	60	BD243A TIP41A	BD244A TIP42A	15 min 15/75	3 3	0.4 typ	0.15 typ	3	3 3	65 65
	80	BD243B TIP41B	BD244B TIP42B	15 min 15/75	3 3	0.4 typ	0.15 typ	3	3 3	65 65
	100	BD243C TIP41C	BD244C TIP42C	15 min 15/75	3 3	0.4 typ	0.15 typ	3	3 3	65 65
7	30	2N6288	2N6111	30/150	3	0.4 typ	0.15 typ	3	4	40

$|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

PNP
2N6107, 2N6109
2N6111
NPN
2N6288, 2N6292

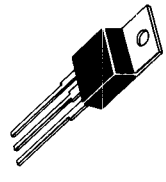
COMPLEMENTARY SILICON PLASTIC POWER TRANSISTORS

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

- DC Current Gain Specified to 7.0 Amperes
  h_{FE} = 30–150 @ I_C = 3.0 Adc – 2N6111, 2N6288
  = 2.3 (Min) @ I_C = 7.0 Adc – All Devices
- Collector-Emitter Sustaining Voltage –
  $V_{CEO(sus)}$ = 30 Vdc (Min) – 2N6111, 2N6288
  = 50 Vdc (Min) – 2N6109
  = 70 Vdc (Min) – 2N6107, 2N6292
- High Current Gain – Bandwidth Product
  f_T = 4.0 MHz (Min) @ I_C = 500 mAdc – 2N6288, 90, 92
  = 10 MHz (Min) @ I_C = 500 mAdc – 2N6107, 09, 11
- TO-220AB Compact Package
- TO-213AA Leadform Also Available

7 AMPERE POWER TRANSISTORS COMPLEMENTARY SILICON

30–50–70 VOLTS
40 WATTS



***MAXIMUM RATINGS**

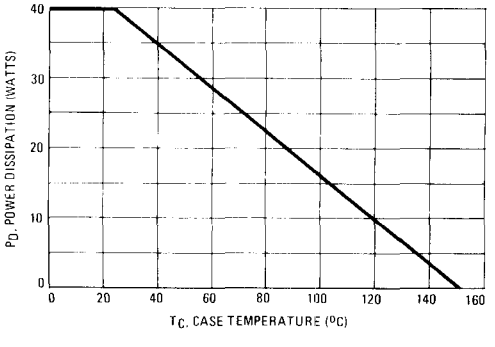
Rating	Symbol	2N6111 2N6288	2N6109	2N6107 2N6292	Unit
Collector-Emitter Voltage	V_{CEO}	30	50	70	Vdc
Collector-Base Voltage	V_{CB}	40	60	80	Vdc
Emitter-Base Voltage	V_{EB}	5.0			Vdc
Collector Current – Continuous Peak	I_C	7.0 10			Adc
Base Current	I_B	3.0			Adc
Total Power Dissipation @ T_C = 25°C Derate above 25°C	P_D	40 0.32			Watts W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150			°C

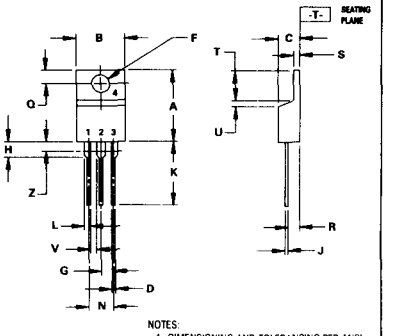
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.125	°C/W

*Indicates JEDEC Registered Data

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	0.88	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	3.93	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

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

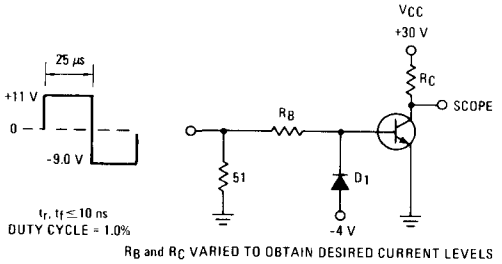
Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (1)		$V_{CEO(sus)}$			Vdc
(I_C = 100 mAdc, I_B = 0)	2N6111, 2N6288		30	–	
	2N6109		50	–	
	2N6107, 2N6292		70	–	
Collector Cutoff Current		I_{CEO}			mAdc
(V_{CE} = 20 Vdc, I_B = 0)	2N6111, 2N6288		–	1.0	
(V_{CE} = 40 Vdc, I_B = 0)	2N6109		–	1.0	
(V_{CE} = 60 Vdc, I_B = 0)	2N6107, 2N6292		–	1.0	
Collector Cutoff Current		I_{CEX}			μAdc
(V_{CE} = 40 Vdc, $V_{EB(off)}$ = 1.5 Vdc)	2N6111, 2N6288		–	100	
(V_{CE} = 60 Vdc, $V_{EB(off)}$ = 1.5 Vdc)	2N6109		–	100	
(V_{CE} = 80 Vdc, $V_{EB(off)}$ = 1.5 Vdc)	2N6107, 2N6292		–	100	
(V_{CE} = 30 Vdc, $V_{EB(off)}$ = 1.5 Vdc, T_C = 150°C)	2N6111, 2N6288		–	2.0	mAdc
(V_{CE} = 50 Vdc, $V_{EB(off)}$ = 1.5 Vdc, T_C = 150°C)	2N6109		–	2.0	
(V_{CE} = 70 Vdc, $V_{EB(off)}$ = 1.5 Vdc, T_C = 150°C)	2N6107, 2N6292		–	2.0	
Emitter Cutoff Current		I_{EBO}	–	1.0	mAdc
(V_{BE} = 5.0 Vdc, I_C = 0)					
ON CHARACTERISTICS (1)					
DC Current Gain		h_{FE}			–
(I_C = 2.0 Adc, V_{CE} = 4.0 Vdc)	2N6107, 2N6292		30	150	
(I_C = 2.5 Adc, V_{CE} = 4.0 Vdc)	2N6109		30	150	
(I_C = 3.0 Adc, V_{CE} = 4.0 Vdc)	2N6111, 2N6288		30	150	
(I_C = 7.0 Adc, V_{CE} = 4.0 Vdc)	All Devices		2.3	–	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	–	3.5	Vdc
(I_C = 7.0 Adc, I_B = 3.0 Adc)					
Base-Emitter On Voltage		$V_{BE(on)}$	–	3.0	Vdc
(I_C = 7.0 Adc, V_{CE} = 4.0 Vdc)					
DYNAMIC CHARACTERISTICS					
Current Gain – Bandwidth Product (2)		f_T			MHz
(I_C = 500 mAdc, V_{CE} = 4.0 Vdc, f_{test} = 1.0 MHz)					
	2N6288, 92		4.0	–	
	2N6107, 09, 11		10	–	
Output Capacitance		C_{ob}	–	250	pF
(V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)					
Small-Signal Current Gain		h_{fe}	20	–	–
(I_C = 0.5 Adc, V_{CE} = 4.0 Vdc, f = 50 kHz)					

*Indicates JEDEC Registered Data.

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

(2)$f_T = |h_{fe}| \bullet f_{test}$

FIGURE 2 – SWITCHING TIME TEST CIRCUIT



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

FIGURE 3 – TURN-ON TIME

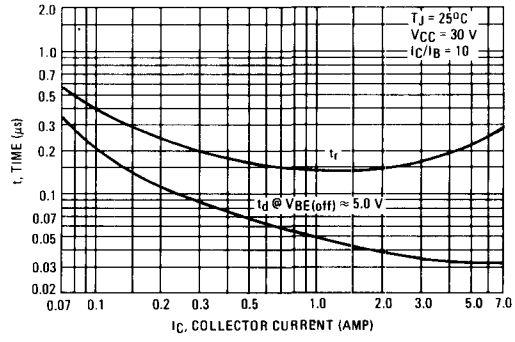


FIGURE 4 — THERMAL RESPONSE

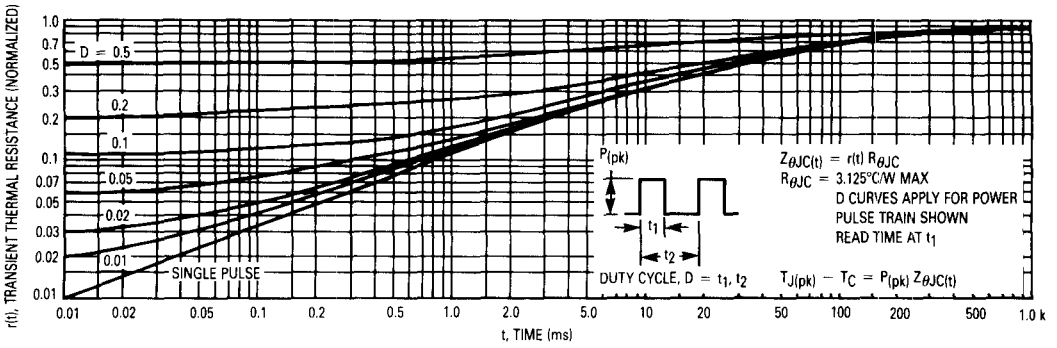
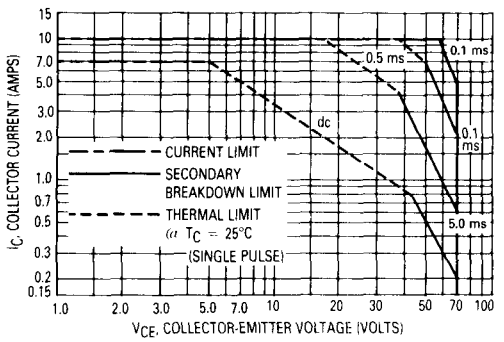


FIGURE 5 — ACTIVE-REGION SAFE OPERATING AREA



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.

FIGURE 6 — TURN-OFF TIME

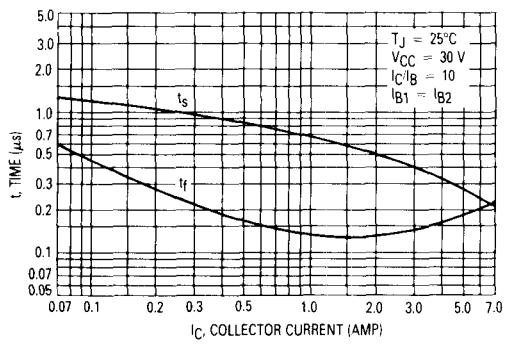
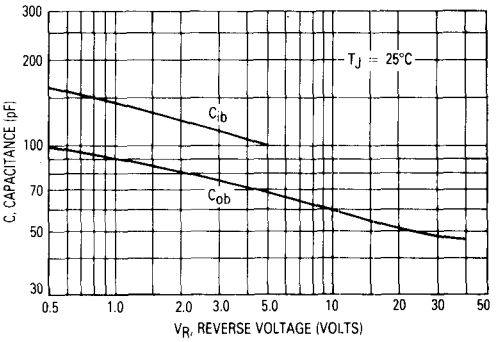


FIGURE 7 — CAPACITANCE



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