ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

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2N6284	2N6284		3-172
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2N6284JTX	2N6284JTX		3-172
2N6284JTXV	2N6284JTXV		3-172
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2N6287JAN	2N6287JAN		3-172
2N6287JTX	2N6287JTX		3-172
2N6287JTXV	2N6287JTXV		3-172
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2N6297	2N6297		3-177
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Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
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2N6328	2N6328		—
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2N6330		2N5884	3-127
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2N6378JAN	2N6378JAN		3-191
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2N6378JTXV	2N6378JTXV		3-191
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2N6384JTXV	2N6384JTXV		3-195
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2N6385JAN	2N6385JAN		3-195
2N6385JTX	2N6385JTX		3-195
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2N6407		MJE172	3-862
2N6408		MJE181	3-862
2N6409		MJE182	3-862

*Consult Motorola if a direct replacement is necessary.

TABLE 1 — METAL TO-204, TO-204AE (continued)

I_{C}Cont 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
25	60	2N5885	2N5883	20/100	10	1	0.8	10	4	200
	80	2N5886	2N5884 2N6436	20/100 30/120	10 10	1 1	0.8 0.25	10 10	4 40	200 200
	100	2N6338	2N6437	30/120	10	1	0.25	10	40	200
	120	2N6339	2N6438	30/120	10	1	0.25	10	40	200
	125	BUV10 BUV10N		10 min 10 min	20 20	1.2 1.55	0.25 0.45	20 15	8 10	150 175
	140	2N6340		30/120	10	1	0.25	10	40	200
	150	2N6341		30/120	10	1	0.25	10	40	200
	500	BUT14##		15 min	16	2.8	0.8	16		175
28	400	BUT13##		20 min	20	2.6	0.8	18		175
30	40	2N3771 2N5301	 2N4398	15/60 15/60	15 15	 2	 1	 10	2 2	150 200
	60	2N5302 MJ11012##	2N4399 MJ11011##	15/60 1k min	15 20	2	1	10	2 4#	200 200
	90	BUX39 MJ11014##	 MJ11013##	8 min 1k min	20 20	1	0.25	20	8 4#	120 200
	100	2N6328 MJ802	 MJ4502	6/30 25/100	30 7.5				3 2	200 200
	120	MJ11016##	MJ11015##	1k min	20				4#	200
	325	BUV23•		8 min	16	1.8	0.4	16	8	250
	400	BUS98• BUX98		8 min	20	2.3 3	0.4 0.8	20 20		250 250
	450	BUS98A• BUX98A MJ16020• MJ16022•		8 min 5 min 7 min	16 30 30	2.3 3 1.8 1.5	0.4 0.8 0.2 0.15	16 16 20 20		250 250 250 250
40	160	BUV21N•		10 min	40	1	0.2	40	8	250
	200	BUV21•		10 min	25	1.8	0.4	25	8	150
	250	BUS52• BUV22•		15 min 10 min	40 20	 1.1	 0.35	 20	 8	350 250
	350	MJ10022•##		50/600	120	2.5	0.9	20		250
	400	MJ10023•##		50/600	10	2.5	0.9	20		250
	700	BUT35•##		15 min	24	4	1.2	24		250
50	60	2N5685• MJ11028•##	2N5683• MJ11029•##	15/60 400 min	25 50	0.5 typ	0.3 typ	25	2	300 300
	80	2N5686•	2N5684• 2N6377•	15/60 30/120	25 20	0.5 typ 0.8	0.3 typ 0.25	25 20	2 30	300 250
	90	MJ11030•##	MJ11031•##	400 min	50					300
	100	2N6274•	2N6378•	30/120	20	0.8	0.25	20	30	250
	120	2N6275• MJ11032•##	2N6379• MJ11033•##	30/120 400 min	20 50	0.8	0.25	20	30	250 300
	125	BUV20•		10 min	50	1.2	0.25	50	8	250
	150	2N6277•		30/120	20	0.8	0.25	20	30	250

• Modified TO-3 60 mil pins, # $|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

☐ JAN, JTX, JTXV Available

TABLE 13 — POWER SWITCHING TRANSISTORS (continued)

I_C Cont 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	Case JEDEC/MOT
4	30	BD185		15 min	2				20	40	TO-225AA/77
	45	BD785	BD786	20 min	2				50	15	TO-225AA/77
	60	2N4877		20/100	4	1.5	0.5	4	30	10	TO-205AD/79
		BD189		15 min	2				20	40	TO-225AA/77
		BD787	BD788	20 min	2				50	15	TO-225AA/77
	80	BD789	BD790	10 min	2				40	15	TO-225AA/77
	100	BD791	BD792	10 min	2				40	15	TO-225AA/77
5	80	2N5337	2N6191	60/240	2	2	0.2	2	30	10	TO-205AD/79
	100	2N5339	2N6193	60/240	2	2	0.2	2	30	10	TO-205AD/79
7	60	2N6315	2N6317	20/100	2.5	1	0.8	2.5	4	90	TO-213AA/80
	80	2N5428		60/240	2	2	0.2	2	30	60	TO-213AA/80
		2N6316	2N6318	20/100	2.5	1	0.8	2.5	4	90	TO-213AA/80
	100	2N5430		60/240	2	2	0.2	2	30	60	TO-213AA/80
7.5	60	2N3447		40/120	5	2	0.35	5	10	115	TO-204/1
	80	2N3448		40/120	5	2	0.35	5	10	115	TO-204/1
8	120	MJE15028	MJE15029	20 min	4	0.4 typ	0.18 typ	5	30	50	TO-220/221A
	150	MJE15030	MJE15031	20 min	4	0.4 typ	0.18 typ	5	30	50	TO-220/221A
10	60	2N5877	2N5875	20/100	4	1	0.8	4	4	150	TO-204/1
	80	2N5878	2N5876	20/100	4	1	0.8	4	4	150	TO-204/1
15	60	2N5881	2N5879	20/100	6	1	0.8	6	4	160	TO-204/1
	80	2N5882	2N5880	20/100	6	1	0.8	6	4	160	TO-204/1
18	160	BUX41N		8 min	12	1.2	0.25	12	8	120	TO-204/1
20	75	2N5039		20/100	10	1.5	0.5	10	60	140	TO-204/1
	80	2N5303	2N5745	15/60	10	2	1	10	2	200	TO-204/1
	90	2N5038		20/100	12	1.5	0.5	12	60	140	TO-204/1
	125	BUX40		8 min	15	1	0.25	15	8	120	TO-204/1
	160	BUV11N		10 min	15	1.2	0.25	15	8	150	TO-204/1
25	60	2N5885	2N5883	20/100	10	1	0.8	10	4	200	TO-204/1
	80	2N5886	2N5884	20/100	10	1	0.8	10	4	200	TO-204/1
			2N6436	30/120	10	1	0.25	10	40	200	TO-204/1
	100	2N6338	2N6437	30/120	10	1	0.25	10	40	200	TO-204/1
	120	2N6339	2N6438	30/120	10	1	0.25	10	40	200	TO-204/1
	125	BUV10		10 min	20	1.2	0.25	20	8	150	TO-204/1
		BUV10N		10 min	20	1.55	0.45	15	10	175	TO-204/1
	140	2N6340		30/120	10	1	0.25	10	40	200	TO-204/1
	150	2N6341		30/120	10	1	0.25	10	40	200	TO-204/1
30	40	2N5301	2N4398	15/60	15	2	1	10	2	200	TO-204/1
	60	2N5302	2N4399	15/60	15	2	1	10	2	200	TO-204/1
	90	BUX39		8 min	20	1	0.25	20	8	120	TO-204/1

(continued)

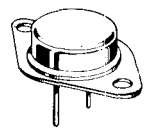
2N6338 thru 2N6341

HIGH-POWER NPN SILICON TRANSISTORS

. . . designed for use in industrial-military power amplifier and switching circuit applications.

- High Collector-Emitter Sustaining Voltage –
  $V_{CEO(sus)}$ = 100 Vdc (Min) – 2N6338
  = 120 Vdc (Min) – 2N6339
  = 140 Vdc (Min) – 2N6340
  = 150 Vdc (Min) – 2N6341
- High DC Current Gain –
  h_{FE} = 30-120 @ I_C = 10 Adc
  = 12 (Min) @ I_C = 25 Adc
- Low Collector-Emitter Saturation Voltage –
  $V_{CE(sat)}$ = 1.0 Vdc (Max) @ I_C = 10 Adc
- Fast Switching Times @ I_C = 10 Adc
  t_r = 0.3 μs (Max)
  t_s = 1.0 μs (Max)
  t_f = 0.25 μs (Max)
- Complement to 2N6436–38

25 AMPERE
POWER TRANSISTORS
NPN SILICON
100, 120, 140, 150 VOLTS
200 WATTS



*MAXIMUM RATINGS

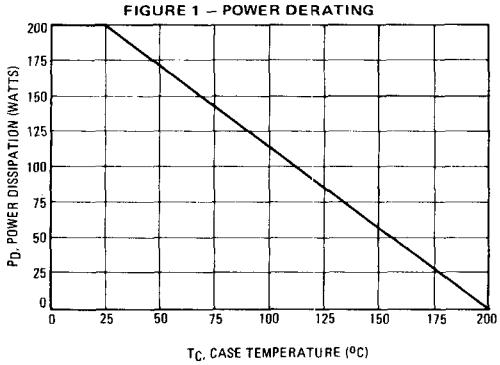
Rating	Symbol	2N6338	2N6339	2N6340	2N6341	Unit
Collector-Base Voltage	V_{CB}	120	140	160	180	Vdc
Collector-Emitter Voltage	V_{CEO}	100	120	140	150	Vdc
Emitter-Base Voltage	V_{EB}	6.0				Vdc
Collector Current – Continuous Peak	I_C	25 50				Adc
Base Current	I_B	10				Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	200 1.14				Watts W/°C
Operating and Storage Junction Temperature Range	T_J,T_{stg}	-65 to +200				°C

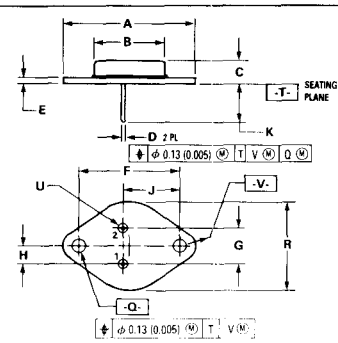
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	0.875	°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. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO-204AA OUTLINE SHALL APPLY.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	—	39.37	—	1.550
B	—	21.08	—	0.830
C	6.35	8.25	0.250	0.325
D	0.97	1.09	0.038	0.043
E	1.40	1.77	0.055	0.070
F	30.15 BSC		1.187 BSC	
G	10.92 BSC		0.430 BSC	
H	5.46 BSC		0.215 BSC	
J	16.89 BSC		0.665 BSC	
K	11.18	12.19	0.440	0.480
Q	3.84	4.19	0.151	0.165
R	—	26.67	—	1.050
U	4.83	5.33	0.190	0.210
V	3.84	4.19	0.151	0.165

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

CASE 1-06
TO-204AA
(TO-3)

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 = 50 mAdc, I_B = 0)	2N6338		100	–	
	2N6339		120	–	
	2N6340		140	–	
	2N6341		150	–	
Collector Cutoff Current		I_{CEO}			μAdc
(V_{CE} = 50 Vdc, I_B = 0)	2N6338		–	50	
(V_{CE} = 60 Vdc, I_B = 0)	2N6339		–	50	
(V_{CE} = 70 Vdc, I_B = 0)	2N6340		–	50	
(V_{CE} = 75 Vdc, I_B = 0)	2N6341		–	50	
Collector Cutoff Current		I_{CEX}			
(V_{CE} = Rated V_{CEO}, $V_{EB(off)}$ = 1.5 Vdc)			–	10	μAdc
(V_{CE} = Rated V_{CEO}, $V_{EB(off)}$ = 1.5 Vdc, T_C = 150°C)			–	1.0	mAdc
Collector Cutoff Current		I_{CBO}	–	10	μAdc
(V_{CB} = Rated V_{CB}, I_E = 0)					
Emitter Cutoff Current		I_{EBO}	–	100	μAdc
(V_{BE} = 6.0 Vdc, I_C = 0)					
ON CHARACTERISTICS (1)					
DC Current Gain		h_{FE}			–
(I_C = 0.5 Adc, V_{CE} = 2.0 Vdc)			50		
(I_C = 10 Adc, V_{CE} = 2.0 Vdc)			30	120	
(I_C = 25 Adc, V_{CE} = 2.0 Vdc)			12		
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$			Vdc
(I_C = 10 Adc, I_B = 1.0 Adc)			–	1.0	
(I_C = 25 Adc, I_B = 2.5 Adc)				1.8	
Base-Emitter Saturation Voltage		$V_{BE(sat)}$			Vdc
(I_C = 10 Adc, I_B = 1.0 Adc)			–	1.8	
(I_C = 25 Adc, I_B = 2.5 Adc)			–	2.5	
Base-Emitter On Voltage		$V_{BE(on)}$	–	1.8	Vdc
(I_C = 10 Adc, V_{CE} = 2.0 Vdc)					
DYNAMIC CHARACTERISTICS					
Current-Gain – Bandwidth Product (2)		f_T	40	–	MHz
(I_C = 1.0 Adc, V_{CE} = 10 Vdc, f_{test} = 10 MHz)					
Output Capacitance		C_{ob}		300	pF
(V_{CB} = 10 Vdc, I_E = 0, f = 0.1 MHz)					
SWITCHING CHARACTERISTICS					
Rise Time		t_r	–	0.3	μs
(V_{CC} ≈ 80 Vdc, I_C = 10 Adc, I_{B1} = 1.0 Adc, $V_{BE(off)}$ = 6.0 Vdc)					
Storage Time		t_s	–	1.0	μs
(V_{CC} ≈ 80 Vdc, I_C = 10 Adc, I_{B1} = I_{B2} = 1.0 Adc)					
Fall Time		t_f	–	0.25	μs
(V_{CC} ≈ 80 Vdc, I_C = 10 Adc, I_{B1} = I_{B2} = 1.0 Adc)					

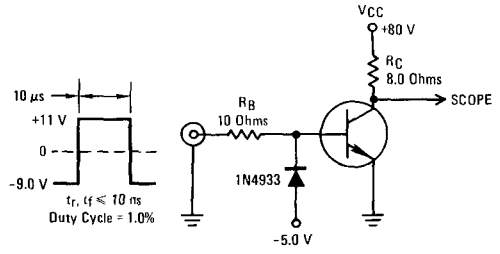
*Indicates JEDEC Registered Data.

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

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

3

FIGURE 2 – SWITCHING TIME TEST CIRCUIT



Note: For information on Figures 3 and 6, R_B and R_C were varied to obtain desired test conditions.

FIGURE 3 – TURN-ON TIME

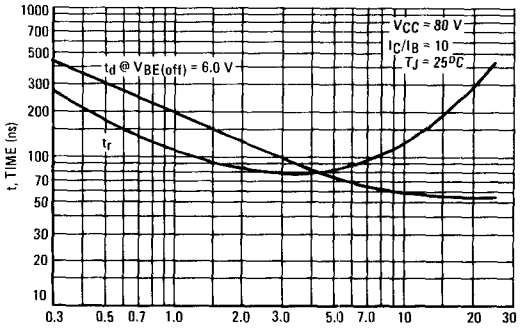


FIGURE 4 – THERMAL RESPONSE

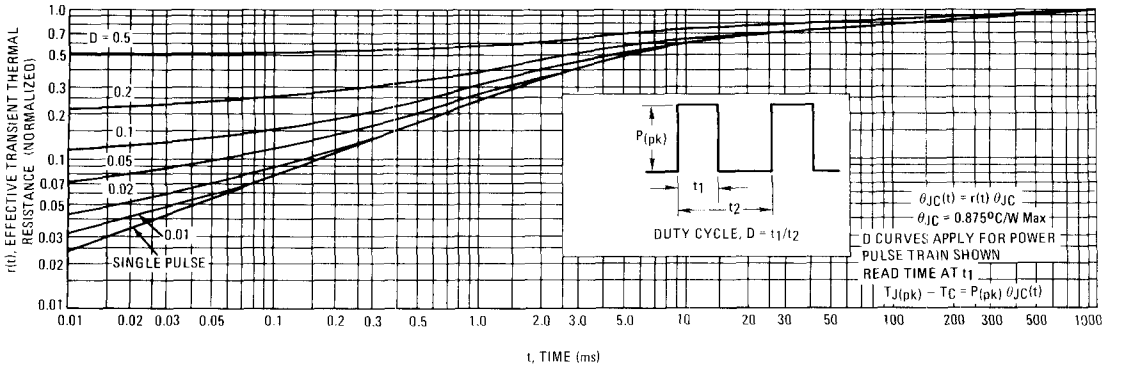
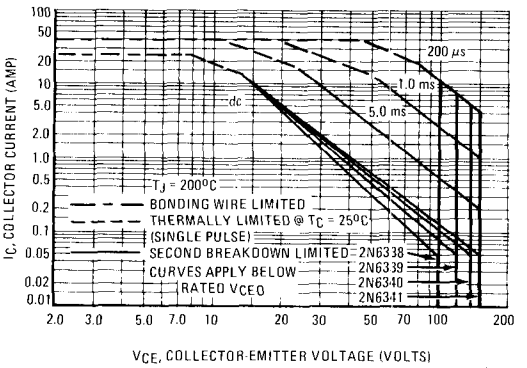


FIGURE 5 – ACTIVE REGION SAFE OPERATING AREA



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 $T_{J(pk)}$ = 200°C; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leqslant 200^{\circ}C$. $T_{J(pk)}$ 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.

FIGURE 6 – TURN-OFF TIME

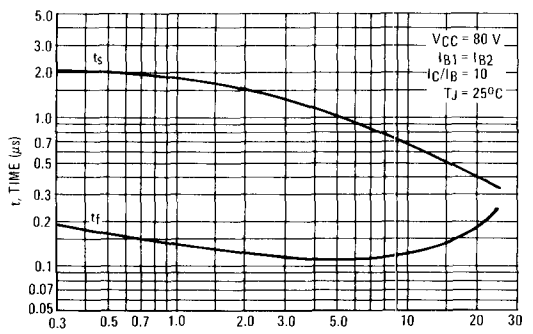


FIGURE 7 – CAPACITANCE