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2N5684	2N5684		3-112
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2N5684JTX	2N5684JTX		3-112
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Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
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*Consult Motorola if a direct replacement is necessary.

TABLE 1 — METAL TO-204, TO-204AE (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
15		MJ16012		7 min	15	0.9 typ	0.15 typ	10		175
		2N6836		10/30	10	3	0.35	10	10	175
	500	MJ16010A		5 min	15	3	0.4	10		175
	850*	MJ12022		5 min	15		0.1 typ	10		175
16	100		BD318	25 min	5				1	200
		2N5629	2N6029	25/100	8	1.2 typ	1.2 typ	8	1	200
	120	2N5630	2N6030	20/80	8	1.2 typ	1.2 typ	8	1	200
	140	2N3773	2N6609	15/60	8	1.1 typ	1.5 typ	8	4	150
		2N5631	2N6031	15/60	8	1.2 typ	1.2 typ	8	1	200
	200	MJ15022	MJ15023	15/60	8				5	250
	250	MJ15024	MJ15025	15/60	8				5	250
18	160	BUX41N		8 min	12	1.2	0.25	12	8	120
20	60	2N3772		15/60	10				2	150
		2N6282##	2N6285##	750/18k	10	2.5 typ	2.5 typ	10	4#	160
	75	2N5039		20/100	10	1.5	0.5	10	60	140
	80	2N5303	2N5745	15/60	10	2	1	10	2	200
		2N6283##	2N6286##	750/18k	10	2.5 typ	2.5 typ	10	4#	160
	90	2N5038		20/100	12	1.5	0.5	12	60	140
	100	2N6284##	2N6287##	750/18k	10	2.5 typ	2.5 typ	10	4#	160
	125	BUX40		8 min	15	1	0.25	15	8	120
	140	MJ15003	MJ15004	25/150	5				2	250
	160	BUV11N		10 min	15	1.2	0.25	15	8	150
	200	BUV11		10 min	12	1.8	0.4	12	8	150
		MJ13330		8/40	10	3.5	0.7	10	5 to 40	175
	250	BUV12		10 min	10	1.5	0.5	10	8	150
		MJ13331		8/40	10	3.5	0.7	10	5 to 40	175
	350	MJ10000##		40/400	10	3	1.8	10	10#	175
		MJ10004##		40/400	10	1.5	0.5	10	10#	175
	400	MJ10001##		40/400	10	3	1.8	10	10#	175
		MJ10005##		40/400	10	1.5	0.5	10	10#	175
		MJ13333		10/60	5	4	0.7	10		175
	450	MJ10008##		30/300	10	2	0.6	10	8#	175
		MJ16014		5 min	20	2.7	0.35	20		250
		MJ16016		7 min	20	2.2	0.25	20		250
		2N6837		10/30	15	2.5	0.25	15		250
	500	MJ10009##		30/300	10	2	0.6	10	8#	175
		MJ13335		10/60	5	4	0.7	10		175
	700	BUT15##		15 min	12	2.5	0.8	12		175
	750	MJ10024##		50/600	20	5	1.8	10		250
	850	MJ10025##		50/600	20	5	1.8	10		250

* $V_{(BR)CEX}$, # $|h_{fe}|$ @ 1 MHz, ## Darlington

(continued)

☐ JAN, JTX, JTXV Available

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

NPN	PNP
2N5629	2N6029
2N5630	2N6030
2N5631	2N6031

HIGH-VOLTAGE – HIGH POWER TRANSISTORS

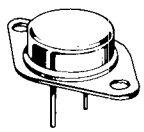
. . . designed for use in high power audio amplifier applications and high voltage switching regulator circuits.

- High Collector-Emitter Sustaining Voltage –
  $V_{CEO(sus)}$ = 100 Vdc – 2N5629, 2N6029
  = 120 Vdc – 2N5630, 2N6030
  = 140 Vdc – 2N5631, 2N6031
- High DC Current Gain – @ I_C = 8.0 Adc
  h_{FE} = 25 (Min) – 2N5629, 2N6029
  = 20 (Min) – 2N5630, 2N6030
  = 15 (Min) – 2N5631, 2N6031
- Low Collector-Emitter Saturation Voltage –
  $V_{CE(sat)}$ = 1.0 Vdc (Max) @ I_C = 10 Adc

16 AMPERE

POWER TRANSISTORS
COMPLEMENTARY SILICON

100-120-140 VOLTS
200 WATTS



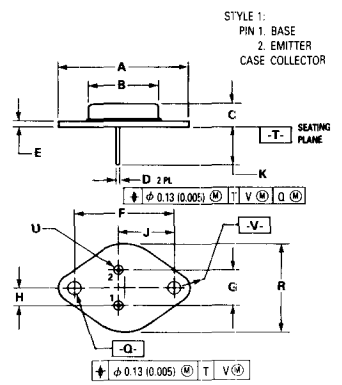
*MAXIMUM RATINGS

Rating	Symbol	2N5629 2N6029	2N5630 2N6030	2N5631 2N6031	Unit
Collector Emitter Voltage	V_{CEO}	100	120	140	Vdc
Collector-Base Voltage	V_{CB}	100	120	140	Vdc
Emitter-Base Voltage	V_{EB}	← 7.0 →			Vdc
Collector Current Continuous Peak	I_C	← 16 → ← 20 →			Adc
Base Current Continuous	I_B	← 5.0 →			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

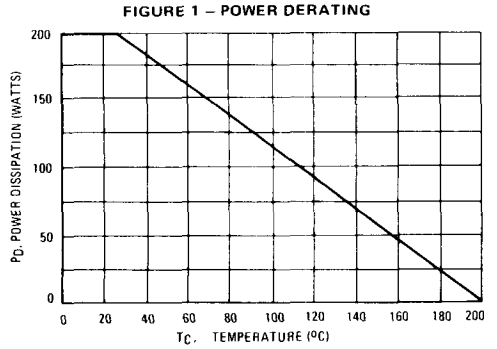


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO 204AA OUTLINE SHALL APPLY.

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

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

FIGURE 1 – POWER DERATING



Safe Area Curves are indicated by Figure 5. All Limits are applicable and must be observed.

3

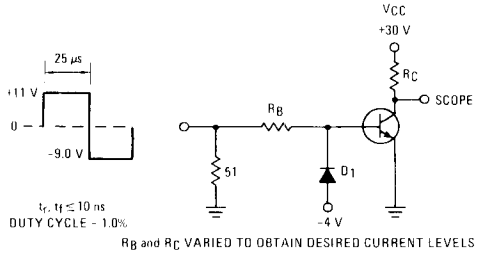
***ELECTRICAL CHARACTERISTICS** (T_C = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (1) (I_C = 200 mAdc, I_B = 0)	2N5629, 2N6029 2N5630, 2N6030 2N5631, 2N6031	$V_{CEO(sus)}$	 100 120 140	 — — —	Vdc
Collector-Emitter Cutoff Current (V_{CE} = 50 Vdc, I_B = 0) (V_{CE} = 60 Vdc, I_B = 0) (V_{CE} = 70 Vdc, I_B = 0)	2N5629, 2N6029 2N5630, 2N6030 2N5631, 2N6031	I_{CEO}	 — — —	 2.0 2.0 2.0	mAdc
Collector-Emitter Cutoff Current (V_{CE} = Rated V_{CB}, $V_{EB(off)}$ = 1.5 Vdc) (V_{CE} = Rated V_{CB}, $V_{EB(off)}$ = 1.5 Vdc, T_C = 150°C)		I_{CEX}	 — —	 2.0 7.0	mAdc
Collector-Base Cutoff Current (V_{CB} = Rated V_{CB}, I_E = 0)		I_{CBO}	—	2.0	mAdc
Emitter-Base Cutoff Current (V_{BE} = 7.0 Vdc, I_C = 0)		I_{EBO}	—	5.0	mAdc
ON CHARACTERISTICS (1)					
DC Current Gain (I_C = 8.0 Adc, V_{CE} = 2.0 Vdc) (I_C = 16 Adc, V_{CE} = 2.0 Vdc)	2N5629, 2N6029 2N5630, 2N6030 2N5631, 2N6031 All Types	h_{FE}	 25 20 15 4.0	 100 80 60 —	—
Collector-Emitter Saturation Voltage (I_C = 10 Adc, I_B = 1.0 Adc) (I_C = 16 Adc, I_B = 4.0 Adc)	All Types	$V_{CE(sat)}$	 — —	 1.0 2.0	Vdc
Base-Emitter Saturation Voltage (I_C = 10 Adc, I_B = 1.0 Adc)		$V_{BE(sat)}$	—	1.8	Vdc
Base-Emitter On Voltage (I_C = 8.0 Adc, V_{CE} = 2.0 Vdc)		$V_{BE(on)}$	—	1.5	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain—Bandwidth Product (2) (I_C = 1.0 Adc, V_{CE} = 20 Vdc, f_{test} = 0.5 MHz)		f_T	1.0	—	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 0.1 MHz)	2N5629, 30, 31 2N6029, 30, 31	C_{ob}	—	 500 1000	pF
Small-Signal Current Gain (I_C = 4.0 Adc, V_{CE} = 10 Vdc, f = 1.0 kHz)		h_{fe}	15	—	—

*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 TIMES 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

For PNP test circuit, reverse all polarities and D1.

FIGURE 3 – TURN-ON TIME

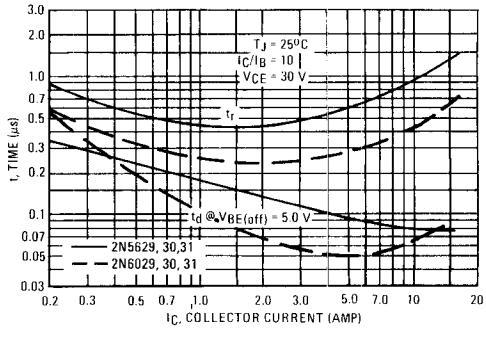


FIGURE 4 – THERMAL RESPONSE

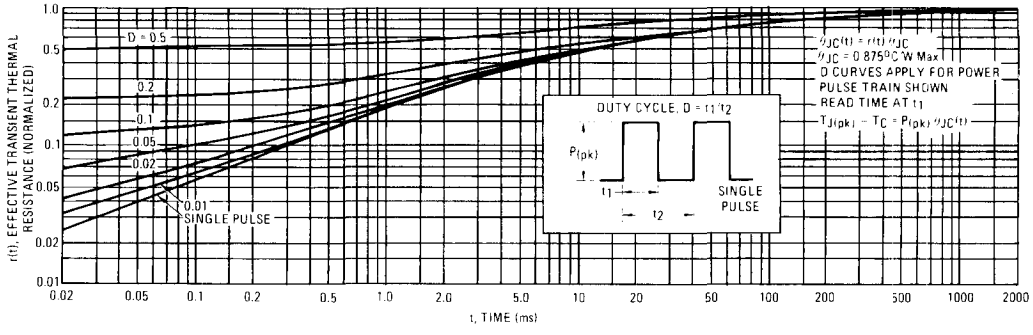
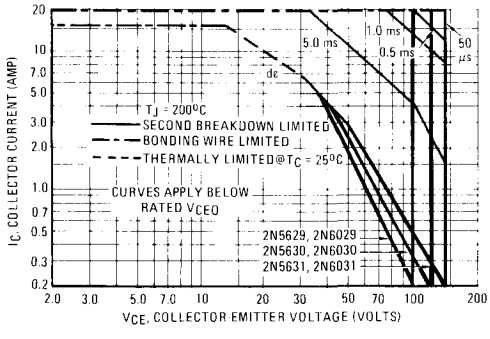


FIGURE 5 – ACTIVE-REGION SAFE OPERATING AREA



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.

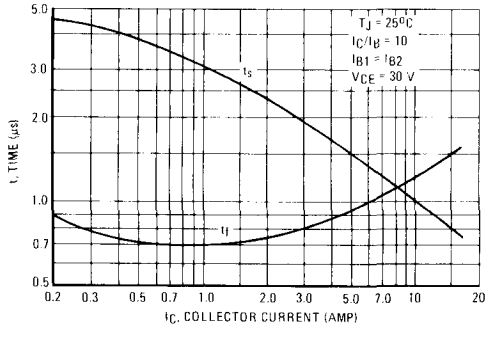
The data of Figure 5 is based on $T_{J(pk)} = 200^oC$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leqslant 200^oC$. $T_{J(pk)}$ may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

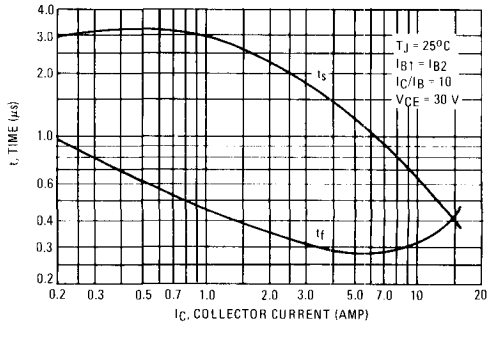
3

NPN
2N5629, 2N5630, 2N5631

PNP
2N6029, 2N6030, 2N6031

FIGURE 6 – TURN-OFF TIME

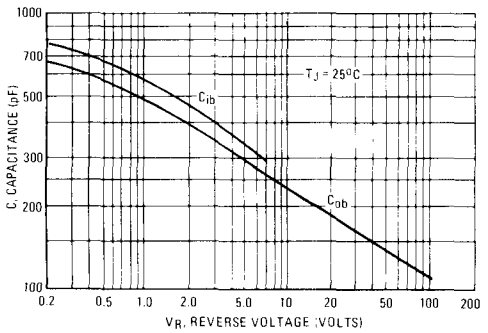




NPN
2N5629, 2N5630, 2N5631

PNP
2N6029, 2N6030, 2N6031

FIGURE 7 – CAPACITANCE



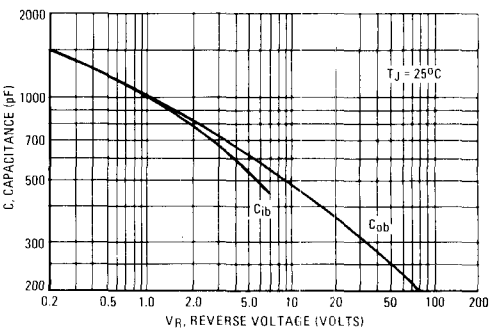
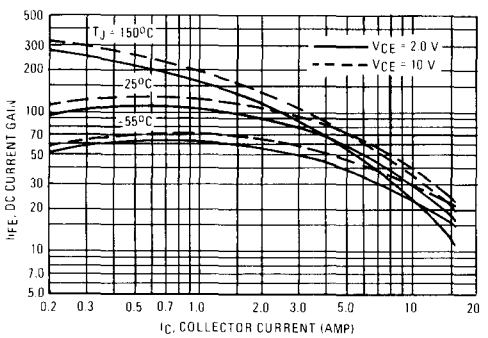


FIGURE 8 – DC CURRENT GAIN



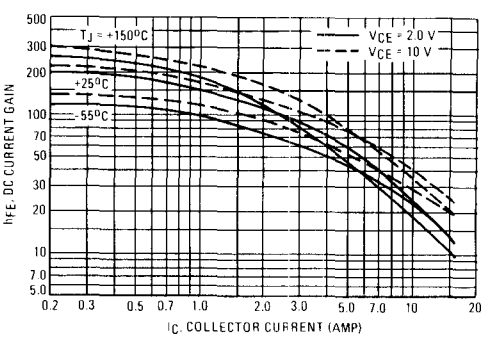
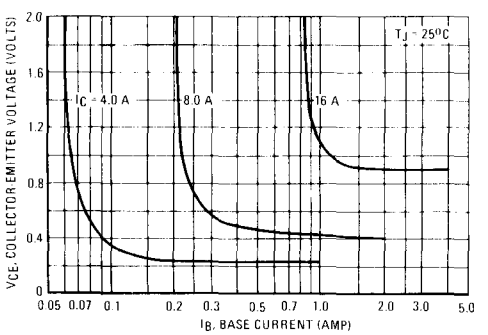
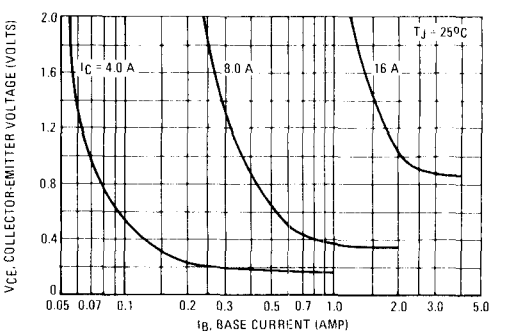


FIGURE 9 – COLLECTOR SATURATION REGION





3