ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

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*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
6	375	BU326		30 typ	0.6	3.5	1**	2.5	6	90
	400	BU326A		30 typ	0.6	3.5	1**	2.5	6	90
7.5	80	2N3448		40/120	5	2	0.35	5	10	115
8	60	MJ1000##	MJ900##	1k min	3					90
		2N6055##	2N6053##	750/18k	4	1.5 typ	1.5 typ	4	4#	100
	80	MJ1001##	MJ901##	1k min	3					90
		2N6056##	2N6054##	750/18k	4	1.5 typ	1.5 typ	4	4#	100
	250	2N6306		15/75	3	1.6	0.4	3	5	125
	300	2N6307		15/75	3	1.6	0.4	3	5	125
	350	2N6308		12/60	3	1.6	0.4	5	5	125
	400	2N6545		7/35	5	4	1	5	6	125
			MJ6503	15 min	2	2	0.5	4		125
		MJ13080		8 min	5	1.5	0.5	5		150
	450	MJ16006		5 min	8	2.5	0.25	5		150
		MJ16008		7 min	8	2.2	0.25	5		150
		2N6835		10/30	5	2.5	0.25	5	10	150
	500	MJ16006A		5 min	8	3	0.4	5		150
	850*	MJ12021		5 min	8		0.1 typ	5		150
	1400*	MJ10011##		20 min	4		1	4		80
	1500*	MJ12005		5 min	5		1	5		100
9	400	BUX47		7 min	6	2	0.4	6		150
	450	BUX47A		7 min	5	2	0.4	5		150
10	40	2N6383##	2N6648##	1k/20k	5				20#	100
	60		2N3789	15 min	3	0.3 typ	0.4 typ	5	4	150
		2N3715	2N3791	30 min	3	0.3 typ	0.4 typ	5	4	150
		2N5877	2N5875	20/100	4	1	0.8	4	4	150
		2N6384##		1k/20k	5				20#	100
		MJ3000##	MJ2500##	1k min	5					150
	80	2N3714	2N3790	15 min	3	0.3 typ	0.4 typ	5	4	150
		2N3716	2N3792	30 min	3	0.3 typ	0.4 typ	5	4	150
		2N5878	2N5876	20/100	4	1	0.8	4	4	150
		2N6385##		1k/20k	5				20#	100
		MJ3001##	MJ2501##	1k min	5					150
	140	2N5634		15/60	5	0.9 typ	0.9 typ	5	1	150
		2N3442		20/70	4					117

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

(continued)

JAN, JTX, JTXV Available

TABLE 12 — POWER DARLINGTONS (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	$\|h_{fe}\|$ @ 1 MHz Min	P_D (Case) Watts @ 25°C	Case JEDEC/MOT
8	80	MJ1001	MJ901	1k min	3					90	TO-204/1
		TIP101	TIP106	1k/20k	3	1.5 typ	1.5 typ	3	4	80	TO-220/221A
		2N6044	2N6041	1k/10k	4	1.5 typ	1.5 typ	3	4	75	TO-220/221A
		2N6301	2N6299	750k/18k	4	1.5 typ	1.5 typ	4	4	75	TO-213A/80
		2N6056	2N6054	750k/18k	4	1.5 typ	1.5 typ	4	4	100	TO-204A/1
		MJE6044	MJE6041	1k/20k	4	1.5 typ	1.5 typ	4	2	75	TO-225AB/90
	100	BDX53C	BDX54C	750 min	3				4	60	TO-220/221A
		BD901	BD902	750 min	3				1	70	TO-220/221A
		MJE6045		1k/20k	4	1.5 typ	1.5 typ	4	2	75	TO-225AB/90
		MJD122	MJD127	1k/12k	4	1.5 typ	2 typ	4	4	20	TO-252/369A-04
		MJF102	MJF107	3k min	3	1.5 typ	1.5 typ	3	4	35	—/221C-02
		TIP102	TIP107	1k/20k	3	1.5 typ	1.5 typ	3	4	80	TO-220/221A
		2N6045	2N6042	1k/10k	4	1.5 typ	1.5 typ	3	4	75	TO-220/221A
	120	BDX53D	BDX54D	750 min	3				4	60	TO-220/221A
	150	BU807•		100 min	5	0.55 typ	0.2 typ	5		60	TO-220/221A
	200	BU806•		100 min	5	0.55 typ	0.2 typ	5		60	TO-220/221A
	300	MJE5740		200/400	4	8 typ	2 typ	6		80	TO-220/221A
	350	MJE5741		200/400	4	8 typ	2 typ	6		80	TO-220/221A
	400	MJE5742		200/400	4	8 typ	2 typ	6		80	TO-220/221A
	500	BUT50P•		30 min	2	0.75 typ	0.1 typ	5		100	TO-218/340D
	1400*	MJ10011		20 min	4			1	4	80	TO-204/1
10	40	2N6383	2N6648	1k/20k	5				20	100	TO-204/1
		D44E1		1000 min	5	2 typ	0.5 typ	10		50	TO-220/221A
	45	BDX33	BDX34	750 min	4				3	70	TO-220/221A
	60	BDV65	BDV64	1k min	5					125	TO-218/340D
		BDX33A	BDX34A	750 min	4				3	70	TO-220/221A
		MJ3000	MJ2500	1k min	5					150	TO-204/1
		2N6387	2N6667	1k/20k	5				20	65	TO-220/221A
		2N6384		1k/20k	5				20	100	TO-204/1
		D44E2		1000 min	5	2 typ	0.5 typ	10		50	TO-220/221A
		TIP140	TIP145	500 min	10	2.5 typ	2.5 typ	5	4	125	TO-218/340
	80	2N6388	2N6668	1k/20k	5				20	65	TO-220/221A
		2N6385		1k/20k	5				20	100	TO-204/1
		BDV65A	BDV64A	1k min	5					125	TO-218/340D
		BDX33B	BDX34B	750 min	3				3	70	TO-220/221A
		D44E3		1000 min	5	2 typ	0.5 typ	10		50	TO-220/221A
		MJD44E3		1k min	5	2 typ	0.5 typ	10		20	TO-252/369A-04
		TIP141	TIP146	500 min	10	2.5 typ	2.5 typ	5	4	125	TO-218/340
	100	BDV65B	BDV64B	1k min	5					125	TO-218/340D
		BDX33C	BDX34C	750 min	3				3	70	TO-220/221A
		TIP142	TIP147	500 min	10	2.5 typ	2.5 typ	5	4	125	TO-218/340
	120	BDV65C	BDV64C	1k min	5					125	TO-218/340D
		BDX33D	BDX34D	750 min	3				3	70	TO-220/221A
	200	BU323P		150 min	6	15	15	6		125	TO-218/340D
	250	BU323AP		150 min	6	15	15	6		125	TO-218/340D
	350	BU323		150 min	6	7.5 typ	5.2 typ	6		175	TO-204/1
		MJ10002		30/300	5	2.5	1	5	10	150	TO-204/1
		MJ10006•		30/300	5	1.5	0.5	5	10	150	TO-204/1
	400	BU323A		150 min	6	7.5 typ	5.2 typ	6		175	TO-204/1
		MJH10012		100/2k	6	15	15	6		118	TO-218/340
		MJ10007•		30/300	5	1.5	0.5	5	10	150	TO-204/1

• Darlington with speed-up diode.

(continued)

NPN
2N6383, 2N6384
2N6385
PNP
2N6648

COMPLEMENTARY SILICON POWER DARLINGTON TRANSISTORS

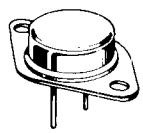
. . . monolithic complementary silicon Darlington transistors designed for low and medium frequency power applications such as power switching, audio amplifiers, hammer drivers, and shunt and series regulators.

- High Gain Darlington Performance
- True Complementary Specifications

15 AMPERE PEAK

COMPLEMENTARY SILICON POWER DARLINGTON TRANSISTORS

40–60–80 VOLTS
100 WATTS



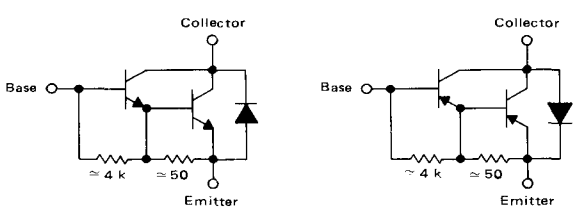
*MAXIMUM RATINGS

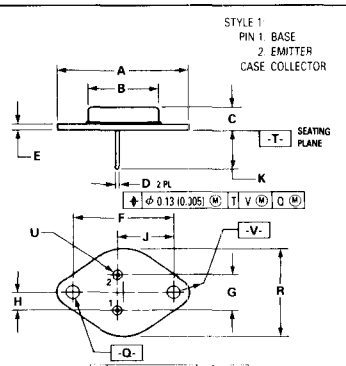
Rating	Symbol	2N6383 2N6648	2N6384	2N6385	Unit
Collector-Emitter Voltage	$V_{CEO(sus)}$	40	60	80	Vdc
Collector-Emitter Voltage	V_{CEX}	40	60	80	Vdc
Collector-Emitter Voltage	V_{CBO}	40	60	80	Vdc
Emitter Base Voltage	V_{EBO}	5.0			Vdc
Collector Current – Continuous	I_C	10			Adc
Peak (1)**	I_{CM}	15			
Base Current – Continuous	I_B	0.25			Adc
Total Power Dissipation @ T_C = 25°C (2)	P_D	100			Watts
Derate above 25°C		0.571			W/°C
Operating and Storage Junction Temperature Range (2)	T_J, T_{stg}	-65 to +200			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.75	°C/W
Maximum Lead Temperature for Soldering Purposes: 1/32" from Case for 5 Seconds	T_L	235	°C

*Indicates JEDEC Registered Data.
**Not JEDEC Registered.
(1) Pulse Width = 50 ms, Duty Cycle ≤ 10%.
(2) Exceeds JEDEC Registration for 2N6648.
JEDEC Registration gives P_D = 70 W, T_J = 150°C.





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)

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)	2N6383, 2N6648	$V_{CEO(sus)}$	40	--	Vdc
	2N6384		60	--	
	2N6385		80	--	
Collector Cutoff Current (V_{CE} = Rated Value)		I_{CEO}	--	1.0	mAdc
*Collector Cutoff Current (V_{CE} = Rated $V_{CEO(sus)}$ Value, $V_{BE(off)}$ = 1.5 Vdc)		I_{CEV}	--	0.3	mAdc
(V_{CE} = Rated $V_{CEO(sus)}$ Value, $V_{BE(off)}$ = 1.5 Vdc, T_C = 150°C)			--	3.0	
*Emitter Cutoff Current (V_{EB} = 5.0 Vdc, I_C = 0)		I_{EBO}	--	10	mAdc
Collector-Emitter Sustaining Voltage (1) (R_{BE} = 100 Ω, I_C = 200 mA)	2N6383, 2N6648	$V_{CER(sus)}$	40	--	Vdc
	2N6384		60	--	
	2N6385		80	--	
Collector-Emitter Sustaining Voltage (1) ($V_{BE(off)}$ = 1.5 V, I_C = 200 mA)	2N6383, 2N6648	$V_{CEV(sus)}$	40	--	Vdc
	2N6384		60	--	
	2N6385		80	--	
ON CHARACTERISTICS (1)					
*DC Current Gain (I_C = 5.0 Adc, V_{CE} = 3.0 Vdc)		h_{FE}	1000	20,000	--
(I_C = 10 Adc, V_{CE} = 3.0 Vdc)			100	--	
*Collector-Emitter Saturation Voltage (I_C = 5.0 Adc, I_B = 0.01 Adc)		$V_{CE(sat)}$	--	2.0	Vdc
(I_C = 10 Adc, I_B = 0.1 Adc)			--	3.0	
*Base-Emitter On Voltage (I_C = 5.0 Adc, V_{CE} = 3.0 Vdc)		$V_{BE(on)}$	--	2.8	Vdc
(I_C = 10 Adc, V_{CE} = 3.0 Vdc)			--	4.5	
Diode Forward Voltage (I_F = 10 Adc)		V_F	--	4.0	Vdc
***DYNAMIC CHARACTERISTICS**					
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f_{test} = 1.0 MHz)		C_{ob}	--	200	pF
*Magnitude of Common-Emitter Small-Signal Short-Circuit Current Transfer Ratio (I_C = 1.0 Adc, V_{CE} = 5.0 Vdc, f = 1.0 MHz)		$\|h_{fe}\|$	20	--	--
Common Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio (I_C = 1.0 Adc, V_{CE} = 5.0 Vdc, f = 1.0 kHz)		h_{fe}	1000	--	--
SECOND BREAKDOWN					
Second Breakdown Collector Current with Base-Forward Biased		$I_{S/B}$	See Figures 8 and 9		
Second Breakdown Energy with Base Reverse-Biased (L = 12 mH, R_{BE} = 100 Ω, $V_{BE(off)}$ = 1.5 Vdc, I_C = 4.5 Adc)		$E_{s/b}$	120	--	mJ

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2%.

* Indicates JEDEC Registered Data.

FIGURE 1 – DC CURRENT GAIN

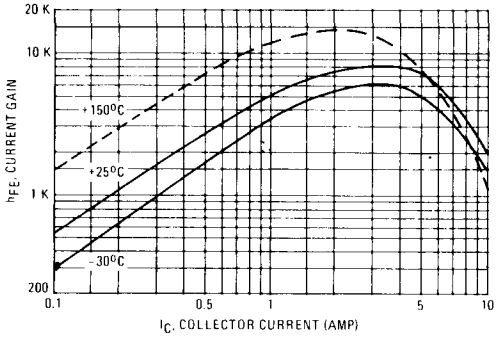


FIGURE 2 – COLLECTOR SATURATION REGION

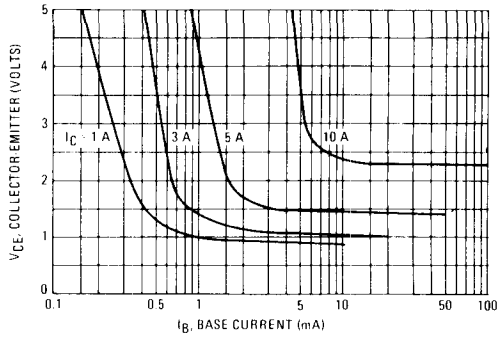


FIGURE 3 – COLLECTOR-EMITTER SATURATION VOLTAGE

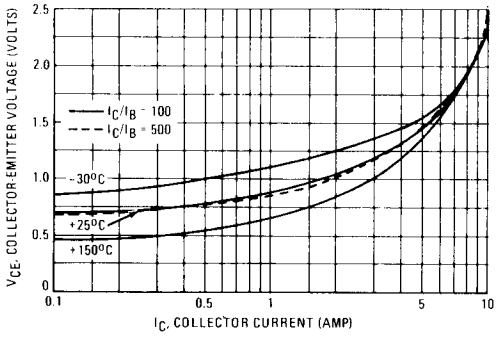


FIGURE 4 – BASE-EMITTER VOLTAGE

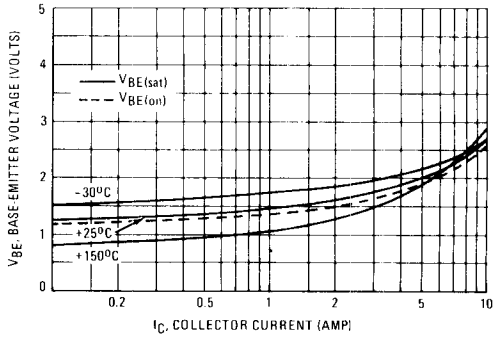


FIGURE 5 – SWITCHING TIME TEST CIRCUIT
(Shown for NPN)

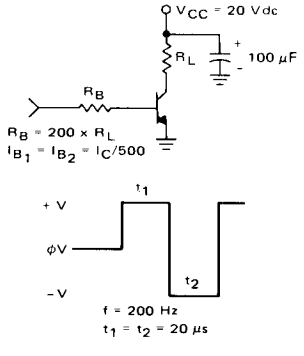
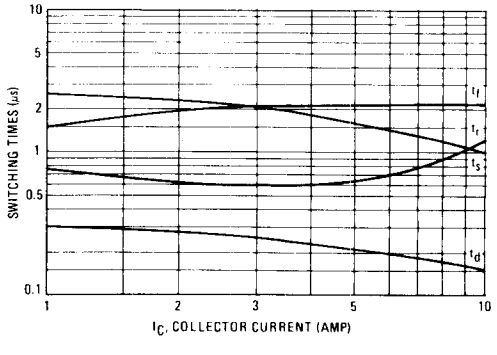
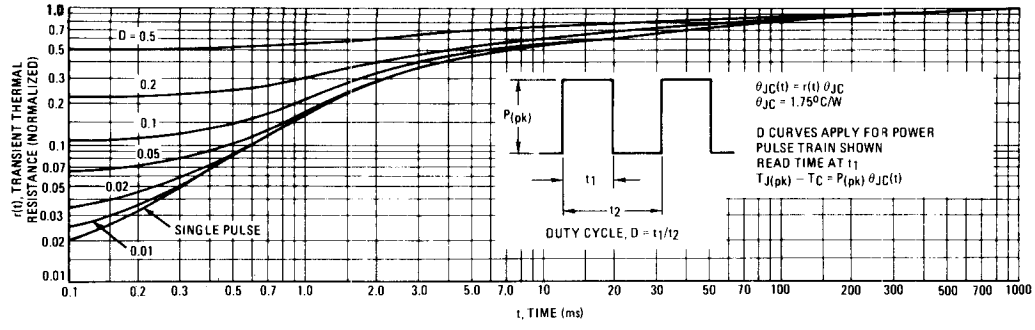


FIGURE 6 – SWITCHING TIMES



3

FIGURE 7 – THERMAL RESPONSE



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 8 is based on $T_C = 25^oC$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated for temperature.

$T_{J(pk)}$ may be calculated from the data in Figure 7. At high case temperatures, see Figure 9, thermal limitations will reduce the current that can be handled to values less than the limitations imposed by second breakdown. Second breakdown limitations do derate the same as thermal limitations. Allowable current at the voltages shown on Figure 8 may be found at any case temperature by derating linearly to 200°C.

FORWARD BIASED SAFE OPERATING AREA

FIGURE 8 – $T_C = 25^oC$

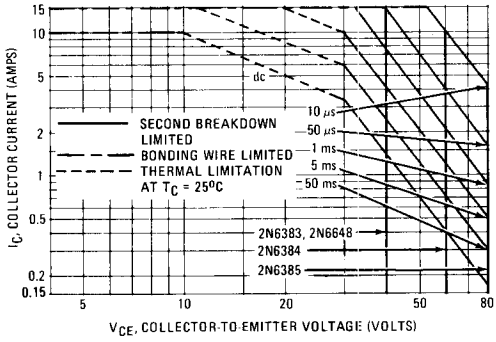


FIGURE 9 – $T_C = 100^oC$

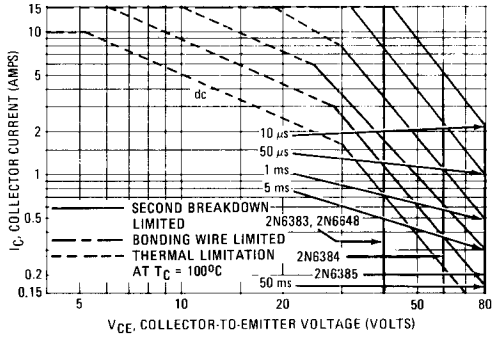


FIGURE 10 – CE DIODE CHARACTERISTICS