

## 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 <sub>C</sub> Cont Amps Max	V <sub>CE0(sus)</sub> Volts Min	Device Type		hFE Min/Max	@ I <sub>C</sub> Amp	Resistive Switching			f <sub>T</sub> MHz Min	P <sub>D</sub> (Case) Watts @ 25°C	
		NPN	PNP			t <sub>s</sub> μs Max	t <sub>f</sub> μs Max	@ I <sub>C</sub> Amp			
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	1.5 typ	1.5 typ	4	4#	90	
		2N6055##	2N6053##	750/18k	4					100	
	80	MJ1001##	MJ901##	1k min	3	1.5 typ	1.5 typ	4	4#	90	
		2N6056##	2N6054##	750/18k	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
					15 min	2	2	0.5	4		125
		MJ13080	MJ6503	8 min	5	1.5	0.5	5	150		
	450	MJ16006	MJ16008	2N6835	5 min	8	2.5	0.25	5	10	150
					7 min	8	2.2	0.25	5		150
					10/30	5	2.5	0.25	5		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	2N3715	2N3789	15 min	3	0.3 typ	0.4 typ	5	4	150	
				30 min	3	0.3 typ	0.4 typ	5	4	150	
				20/100	4	1	0.8	4	4	150	
				1k/20k	5				20#	100	
				1k min	5				150		
	80	2N3716	2N3790	15 min	3	0.3 typ	0.4 typ	5	4	150	
				30 min	3	0.3 typ	0.4 typ	5	4	150	
				20/100	4	1	0.8	4	4	150	
				1k/20k	5				20#	100	
1k min				5				150			
140	2N5634	2N3442	15/60	5	0.9 typ	0.9 typ	5	1	150		
			20/70	4				117			

\* V<sub>(BR)CEX</sub>, # |h<sub>FE</sub>| @ 1 MHz, ## Darlington

(continued)

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JAN, JTX, JTXV Available

**TABLE 14 — SWITCHMODE POWER TRANSISTORS (continued)**

V <sub>CEO(sus)</sub> Volts Min	I <sub>C</sub> Cont Amps Max	V <sub>CEV</sub> Volts Min	Device Type NPN unless otherwise noted	h <sub>FE</sub> Min/Max	@ I <sub>C</sub> Amp	Resistive Switching			f <sub>T</sub> MHz Min	P <sub>D</sub> (Case) Watts @ 25°C	Case JEDEC/MOT	
						t <sub>s</sub> μs Max	t <sub>f</sub> μs Max	@ I <sub>C</sub> Amp				
400	8	850	2N6545★	7/35	5	4	1	5	6	80 125 50	TO-204/1	
		800	MJE5742#	200/400	4	8 typ	2 typ	6			TO-220/221A	
		800	MJE16080	5 min	8	2	0.5	5			TO-220/221A	
		850	BUW12	6 min	6	4	0.8	5			TO-218/340	
		850	BUX84	30 min	0.1	3.5	1.4	1			4	TO-220/221A
		700	MJE13007★	6/30	5	3	0.7	5			4	TO-220/221A
		650	MJ13080★	8 min	5	1.5	0.5	5			TO-204/1	
		650	MJE16106	6/25	8	2 typ	0.1 typ	5			100	TO-220/221A
		650	MJH16106	6/25	8	2 typ	0.1 typ	5			125	TO-218/340
		450	MJ6503-PNP★	15 min	2	2	0.5	4			TO-204/1	
		450	MJE5852-PNP★	15 min	2	2	0.5	4			TO-220/221A	
		6	900	BU326A	30 typ	0.6	3.5	1**			2.5	6
	900		BU426A	30 typ	0.6	2 typ	0.5 typ	2.5	6 typ	113	TO-218/340D	
	5		850	2N6543★	7/35	3	4	0.8	3	6	125	TO-204/1
			850	BUW11	6 min	3	4	0.8	3			TO-218/340
			650	MJ13070★	8 min	3	1.5	0.5	3			TO-204/1
	4		700	MJE13005★	6/30	3	3	0.7	3	4	TO-220/221A	
		700	MJE13003★	5/25	1	4	0.7	1	5	TO-225AA/77R		
0.5	400	MJ4647-PNP	20 min	0.5	0.72*		0.05	40	TO-205AD/79			
375	6	800	BU326	30 typ	0.6	3.5	1**	2.5	6	90	TO-204/1	
		800	BU426	30 typ	0.6	2 typ	0.5 typ	2.5	6 typ	113	TO-218/340D	
350	40	450	MJ10022##★	50/600	10	2.5	0.9	20			TO-204/197	
		20	450	MJ10000#★	40/400	10	3	1.8	10	10**	TO-204/1	
	15	450	MJ10004##★	40/400	10	1.5	0.5	10	10**	TO-204/1		
		375	2N6251	6/50	10	3.5	1	10	2.5	TO-204/1		
	10	450	MJ10002#★	30/300	5	2.5	1	5	10**	TO-204/1		
		450	MJ10006##★	30/300	5	1.5	0.5	5	10**	TO-204/1		
		400	MJ13014★	8/20	5	2	0.5	5	TO-204/1			
	8	700	2N6308	12/60	3	1.6	0.4	5	5	TO-204/1		
700		MJE5741#	200/400	4	8 typ	2 typ	6	TO-220/221A				
400		MJE5851-PNP	15 min	2	2	0.5	4	TO-220/221A				
2	400	2N6213-PNP	10/100	1	2.5	0.6	1	4	TO-213AA/80			
325	30	400	BUV23	8 min	16	1.8	0.4	16	8	250	TO-204/197	
		15	400	BUX13	8 min	8	2.5	0.8	8	8	150	TO-204/1
	5	350	2N6235	25/125	1	3.5	0.5	1	20	TO-213AA/80		
300	15	650	2N6546★	6/30	10	4	0.7	10	6 to 24		TO-204/1	
		12	600	MJE13008★	6/30	8	3	0.7	8	4**	TO-220/221A	
	8	600	2N6307	15/75	3	1.6	0.4	3	5		TO-204/1	
		600	MJE13006★	6/30	5	3	0.7	5	4		TO-220/221A	
		600	MJE5740	200/400	4	8 typ	2 typ	6			TO-220/221A	
		350	MJE5850-PNP★	15 min	2	2	0.5	4			TO-220/221A	
	5	400	2N6498	10/75	2.5	1.8	0.8	2.5	5		TO-220/221A	
	4	600	MJE13004★	6/30	3	3	0.7	3	4		TO-220/221A	
	2	500	2N3585	25/100	1	4	3	1	10		TO-213AA/80	
		500	2N6422-PNP	25/100	1	4	3	1	10		TO-213AA/80	
350		2N6212-PNP	10/100	1	2.5	0.6	1	4		TO-213AA/80		
1.5	600	MJE13002★	5/25	1	4	0.7	1	5		TO-225AA/77R		

★ Designers Data Sheet characterization  
 # Darlington    ## Darlington with speed-up diode    \* t<sub>off</sub>    \*\* |h<sub>FE</sub>| @ 1 MHz

(continued)



**2N6306**  
**2N6307, 2N6308**

**HIGH VOLTAGE NPN SILICON POWER TRANSISTORS**

... designed for high voltage inverters, switching regulators and line-operated amplifier applications. Especially well suited for switching power supply applications in associated consumer products.

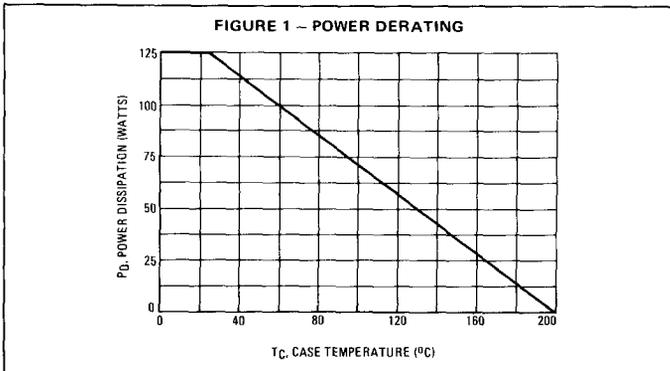
- High Collector-Base Voltage —  
 $V_{CB} = 500 \text{ Vdc} - 2N6306$   
 $= 600 \text{ Vdc} - 2N6307$   
 $= 700 \text{ Vdc} - 2N6308$
- Excellent DC Current Gain @  $I_C = 3.0 \text{ Adc}$   
 $h_{FE} = 15 - 75 - 2N6306, 2N6307$   
 $= 12 - 60 - 2N6308$
- Low Collector-Emitter Saturation Voltage @  $I_C = 3.0 \text{ Adc}$   
 $V_{CE(sat)} = 0.8 \text{ Vdc (Max)} - 2N6306$   
 $= 1.0 \text{ Vdc (Max)} - 2N6307$   
 $= 1.5 \text{ Vdc (Max)} - 2N6308$
- Current Gain Bandwidth Product —  
 $f_T = 5.0 \text{ MHz (Min)} @ I_C = 0.3 \text{ Adc}$

**\*MAXIMUM RATINGS**

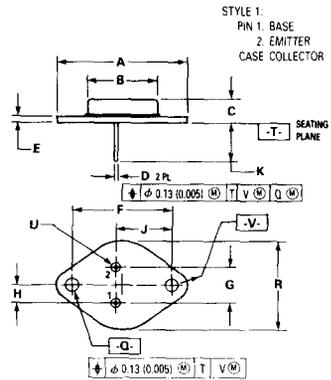
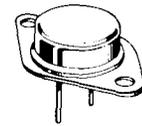
Rating	Symbol	2N6306	2N6307	2N6308	Unit
Collector-Base Voltage	$V_{CB}$	500	600	700	Vdc
Collector-Emitter Voltage	$V_{CEO}$	250	300	350	Vdc
Emitter-Base Voltage	$V_{EB}$	← 8.0 →			Vdc
Collector Current — Continuous Peak	$I_C$	← 8.0 → 16			A dc
Base Current	$I_B$	← 4.0 →			A dc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	← 125 → 0.714			Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	← -65 to +200 →			$^\circ\text{C}$

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$\theta_{JC}$	1.4	$^\circ\text{C/W}$

\*Indicates JEDEC Registered Data.



**8 AMPERE**  
**POWER TRANSISTORS**  
**NPN SILICON**  
**250-300-350 VOLTS**  
**125 WATTS**



- 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		INCHES	
	MIN	MAX	MIN	MAX
A	—	39.37	—	1.560
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	11.78	12.19	0.460	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)**

## 2N6306, 2N6307, 2N6308

### \*ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit	
<b>OFF CHARACTERISTICS</b>					
Collector-Emitter Sustaining Voltage (1) (I <sub>C</sub> = 100 mA <sub>dc</sub> , I <sub>B</sub> = 0)	2N6306 2N6307 2N6308	V <sub>CE0(sus)</sub>	250 300 350	— — —	V <sub>dc</sub>
Collector Cutoff Current (V <sub>CE</sub> = Rated V <sub>CE0</sub> , I <sub>B</sub> = 0)		I <sub>CEO</sub>	—	0.5	mA <sub>dc</sub>
Collector Cutoff Current (V <sub>CE</sub> = 500 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> ) (V <sub>CE</sub> = 600 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> ) (V <sub>CE</sub> = 700 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> ) (V <sub>CE</sub> = 450 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> , T <sub>C</sub> = 150°C) (V <sub>CE</sub> = 550 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> , T <sub>C</sub> = 150°C) (V <sub>CE</sub> = 650 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> , T <sub>C</sub> = 150°C)	2N6306 2N6307 2N6308 2N6306 2N6307 2N6308	I <sub>CEX</sub>	— — — — — —	0.5 0.5 0.5 2.5 2.5 2.5	mA <sub>dc</sub>
Emitter Cutoff Current (V <sub>BE</sub> = 8.0 V <sub>dc</sub> , I <sub>C</sub> = 0)		I <sub>EBO</sub>	—	1.0	mA <sub>dc</sub>
<b>ON CHARACTERISTICS</b>					
DC Current Gain (1) (I <sub>C</sub> = 3.0 A <sub>dc</sub> , V <sub>CE</sub> = 5.0 V <sub>dc</sub> ) (I <sub>C</sub> = 8.0 A <sub>dc</sub> , V <sub>CE</sub> = 5.0 V <sub>dc</sub> )	2N6306, 2N6307 2N6308 2N6306, 2N6307 2N6308	h <sub>FE</sub>	15 12 4.0 3.0	75 60 —	—
Collector-Emitter Saturation Voltage (1) (I <sub>C</sub> = 3.0 A <sub>dc</sub> , I <sub>B</sub> = 0.6 A <sub>dc</sub> ) (I <sub>C</sub> = 8.0 A <sub>dc</sub> , I <sub>B</sub> = 2.0 A <sub>dc</sub> ) (I <sub>C</sub> = 8.0 A <sub>dc</sub> , I <sub>B</sub> = 2.67 A <sub>dc</sub> )	2N6306 2N6307 2N6308 2N6306, 2N6307 2N6308	V <sub>CE(sat)</sub>	— — —	0.8 1.0 1.5 5.0 5.0	V <sub>dc</sub>
Base-Emitter Saturation Voltage (1) (I <sub>C</sub> = 8.0 A <sub>dc</sub> , I <sub>B</sub> = 2.0 A <sub>dc</sub> ) (I <sub>C</sub> = 8.0 A <sub>dc</sub> , I <sub>B</sub> = 2.67 A <sub>dc</sub> )	2N6306, 2N6307 2N6308	V <sub>BE(sat)</sub>	—	2.3 2.5	V <sub>dc</sub>
Base-Emitter On Voltage (1) (I <sub>C</sub> = 3.0 A <sub>dc</sub> , V <sub>CE</sub> = 5.0 V <sub>dc</sub> )	2N6306, 2N6307 2N6308	V <sub>BE(on)</sub>	—	1.3 1.5	V <sub>dc</sub>
Second Breakdown Energy (Figure 2) (I <sub>C(pk)</sub> = 3.0 A <sub>dc</sub> , L = 40 mH, R <sub>BE</sub> = 3 kΩ, V <sub>BE2</sub> = 1.5 V <sub>dc</sub> )		E <sub>s/ib</sub>	—	180	mJ
<b>DYNAMIC CHARACTERISTICS</b>					
Current Gain - Bandwidth Product (2) (I <sub>C</sub> = 0.3 A <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f <sub>test</sub> = 1.0 MHz)		f <sub>T</sub>	5.0	—	MHz
Output Capacitance (V <sub>CB</sub> = 10 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 0.1 MHz)		C <sub>ob</sub>	—	250	pF
<b>SWITCHING CHARACTERISTICS</b>					
Rise Time (V <sub>CC</sub> = 125 V <sub>dc</sub> , I <sub>C</sub> = 3.0 A <sub>dc</sub> , I <sub>B</sub> = 0.6 A <sub>dc</sub> )		t <sub>r</sub>	—	0.6	μs
Storage Time (3) (V <sub>CC</sub> = 125 V <sub>dc</sub> , I <sub>C</sub> = 3.0 A <sub>dc</sub> , I <sub>B1</sub> = 0.6 A <sub>dc</sub> , I <sub>B2</sub> = 1.5 A <sub>dc</sub> ) Pulse Width = 25 μs Pulse Width = 5.0 μs		t <sub>s</sub>	—	1.6 0.8	μs
Fall Time (V <sub>CC</sub> = 125 V <sub>dc</sub> , I <sub>C</sub> = 3.0 A <sub>dc</sub> , I <sub>B1</sub> = 0.6 A <sub>dc</sub> , I <sub>B2</sub> = 1.5 A <sub>dc</sub> )		t <sub>f</sub>	—	0.4	μs

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

(2) f<sub>T</sub> = |h<sub>fe</sub>| • f<sub>test</sub>

(3) "On" time is 25 μs. t<sub>s</sub> decreases with shorter pulse widths, being approximately 50% of the values shown at a 5.0 μs pulse width.

\*Indicates JEDEC Registered Data.

**FIGURE 2 – SECOND BREAKDOWN ENERGY TEST CIRCUIT AND WAVEFORMS**

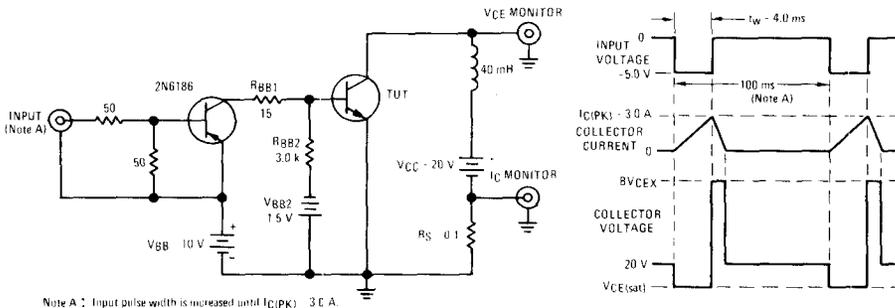


FIGURE 3 – THERMAL RESPONSE

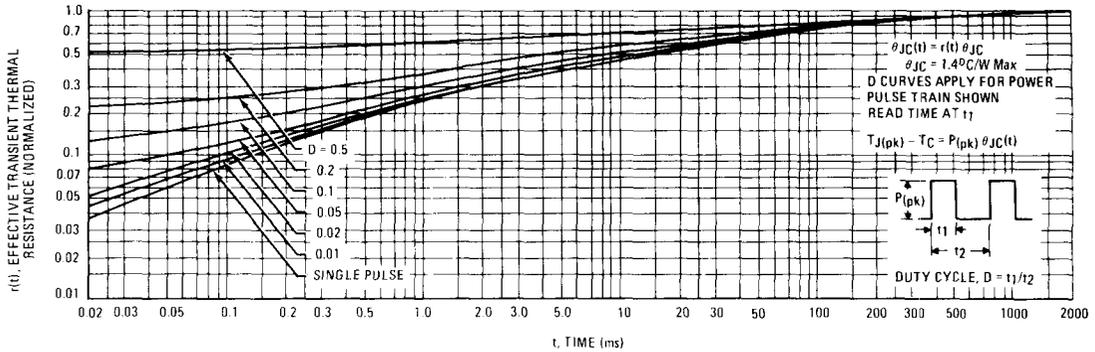
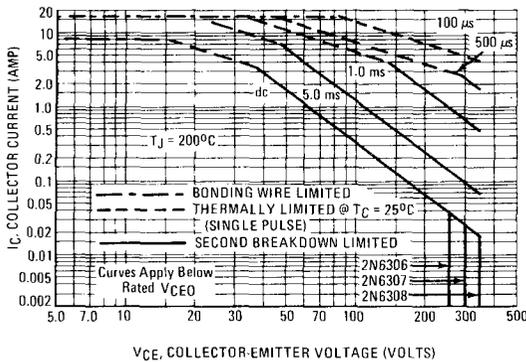


FIGURE 4 – ACTIVE-REGION SAFE OPERATING AREA



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 4 is based on  $T_{J(pk)} = 200^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} \leq 200^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 3. 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 5 – SWITCHING TIMES TEST CIRCUIT

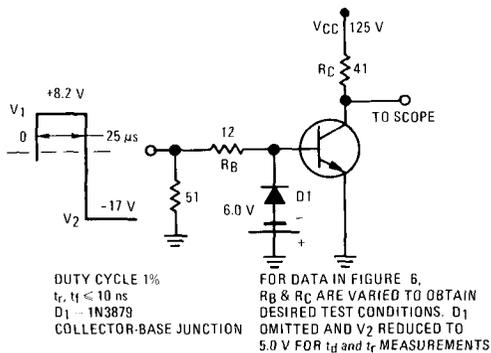
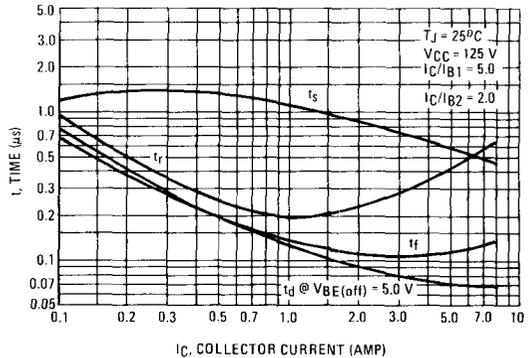


FIGURE 6 – TURN-ON AND TURN-OFF TIMES



# 2N6306, 2N6307, 2N6308

FIGURE 7 – DC CURRENT GAIN

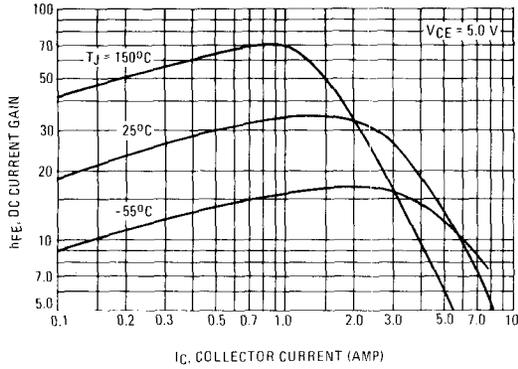


FIGURE 8 – COLLECTOR SATURATION REGION

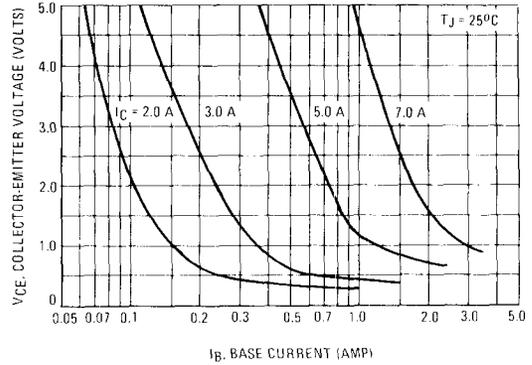


FIGURE 9 – "ON" VOLTAGES

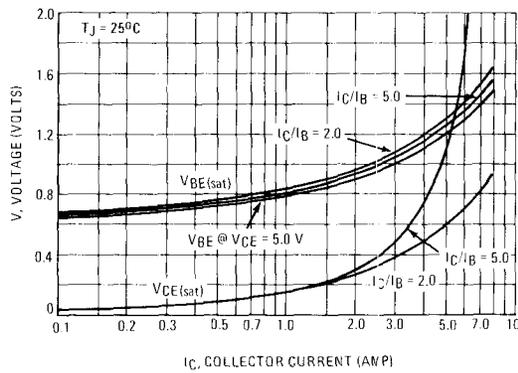


FIGURE 10 – TEMPERATURE COEFFICIENTS

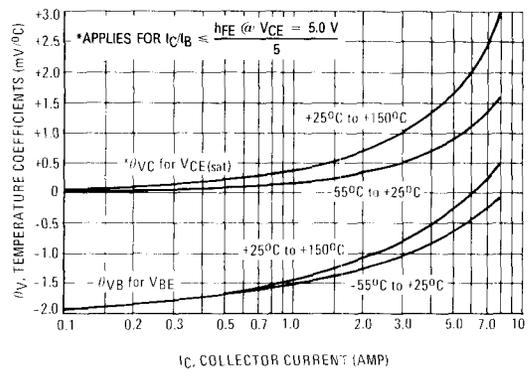


FIGURE 11 – COLLECTOR-CUTOFF REGION

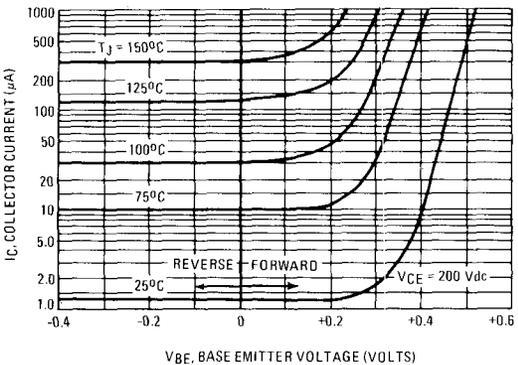
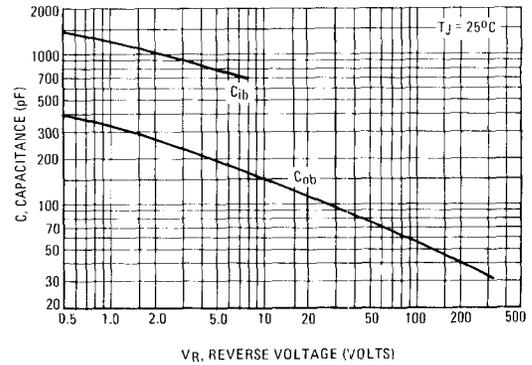


FIGURE 12 – CAPACITANCE



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