

ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number	Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
2N5664		2N3585	3-20	2N5882	2N5882		3-123
2N5665		2N3585	3-20	2N5883	2N5883		3-127
2N5671		2N6338	3-188	2N5884	2N5884		3-127
2N5672		2N6339	3-188	2N5885	2N5885		3-127
2N5678		2N6378	3-191	2N5886	2N5886		3-127
2N5683	2N5683		3-112	2N5929		2N6338	3-188
2N5683JAN	2N5683JAN		3-112	2N5930		2N6338	3-188
2N5683JTX	2N5683JTX		3-112	2N5931		2N6341	3-188
2N5683JTXV	2N5683JTXV		3-112	2N5932		2N6338	3-188
2N5684	2N5684		3-112	2N5933		2N6338	3-188
2N5684JAN	2N5684JAN		3-112	2N5935		2N6341	3-188
2N5684JTX	2N5684JTX		3-112	2N5936		2N6338	3-188
2N5684JTXV	2N5684JTXV		3-112	2N5937		2N6341	3-188
2N5685	2N5685		3-112	2N5954		2N6318	3-185
2N5685JAN	2N5685JAN		3-112	2N5955		2N6317	3-185
2N5685JTX	2N5685JTX		3-112	2N5956		2N6317	3-185
2N5685JTXV	2N5685JTXV		3-112	2N5970		2N5882	3-123
2N5686	2N5686		3-112	2N5971		2N5882	3-123
2N5686JAN	2N5686JAN		3-112	2N5972		MJ15003	3-713
2N5686JTX	2N5686JTX		3-112	2N5974		MJE2955	3-904
2N5686JTXV	2N5686JTXV		3-112	2N5975		MJE2955	3-904
2N5729		2N5337	3-97	2N5976		MJE2955	3-904
2N5730		2N5339	3-97	2N5977		MJE30E5	3-904
2N5733		2N6274	3-168	2N5978		MJE30E5	3-904
2N5734		2N6338	3-188	2N5979		MJE30E5	3-904
2N5737		2N5878	3-120	2N5980		MJE2955	3-904
2N5738		2N5880	3-123	2N5981		MJE2955	3-904
2N5739		2N5878	3-120	2N5982		2N5988	3-131
2N5740		2N5880	3-123	2N5983		MJE30E5	3-904
2N5741		2N5883	3-127	2N5984		MJE30E5	3-904
2N5742		2N6029	3-105	2N5985		2N5991	3-131
2N5743		2N5883	3-127	2N5986		2N6498	3-211
2N5744		MJ4502	3-536	2N5987		2N6490	3-207
2N5745	2N5745		3-68	2N5988		2N6491	3-207
2N5745JAN	2N5745JAN		3-68	2N5989	2N5989		3-131
2N5745JTX	2N5745JTX		3-68	2N5990	2N5991		3-131
2N5745JTXV	2N5745JTXV		3-68	2N5991	2N5991		3-131
2N5758	2N5758		3-116	2N6021		TIP32C	3-1073
2N5759		2N3055A	3-9	2N6022		TIP32C	3-1073
2N5760	2N5760		3-116	2N6023		2N6124	3-154
2N5804		2N6306	3-181	2N6024		2N6124	3-154
2N5805		2N6543	3-215	2N6025		2N6125	3-154
2N5838		2N6308	3-181	2N6026		2N6125	3-154
2N5839		2N6308	3-181	2N6029	2N6029		3-105
2N5840		2N6308	3-181	2N6030	2N6030		3-105
2N5867		2N3789	3-56	2N6031	2N6031		3-105
2N5868		2N3790	3-56	2N6032		2N6275	3-168
2N5869		2N3714	3-26	2N6033		2N6277	3-168
2N5870		2N3714	3-26	2N6034	2N6034		3-135
2N5871		2N3789	3-56	2N6035	2N6035		3-135
2N5872		2N3790	3-56	2N6036	2N6036		3-135
2N5873		2N3714	3-26	2N6037	2N6037		3-135
2N5874		2N3714	3-26	2N6038	2N6038		3-135
2N5875	2N5875		3-120	2N6039	2N6039		3-135
2N5876	2N5876		3-120	2N6040	2N6040		3-139
2N5877	2N5877		3-120	2N6041	2N6041		3-139
2N5878	2N5878		3-120	2N6042	2N6042		3-139
2N5879	2N5879		3-123	2N6043	2N6043		3-139
2N5880	2N5880		3-123	2N6044	2N6044		3-139
2N5881	2N5881		3-123	2N6045	2N6045		3-139

*Consult Motorola if a direct replacement is necessary.



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

I _C Cont Amps Max	V _{CE0(sus)} Volts Min	Device Type		h _{FE} Min/Max	@ I _C Amp	Resistive Switching			f _T MHz Min	P _D (Case) Watts @ 25°C
		NPN	PNP			t _s μs Max	t _f μs Max	@ I _C Amp		
25	60	2N5885	2N5883	20/100	10	1	0.8	10	4	200
	80	2N5886	2N5884	20/100	10	1	0.8	10	4	200
			2N6436	30/120	10	1	0.25	10	40	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	20	1.2	0.25	20	8	150
20					1.55	0.45	15	10	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	2N4398	15/60	15				2	150
		2N5301		15/60	15			10	2	200
	60	2N5302	2N4399	15/60	15	2	1	10	2	200
		MJ11012##	MJ11011##	1k min	20				4#	200
	90	BUX39	MJ11013##	8 min	20	1	0.25	20	8	120
		MJ11014##		1k min	20				4#	200
	100	2N6328	MJ4502	6/30	30				3	200
		MJ802		25/100	7.5				2	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	0.4	20		250	
				20	3	0.8	20		250	
450	BUS98A•	BUX98A	8 min	16	2.3	0.4	16		250	
				30	3	0.8	16		250	
				30	1.8	0.2	20		250	
				30	1.5	0.15	20		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	40					350
				10 min	20	1.1	0.35	20	8	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•	2N5683•	15/60	25	0.5 typ	0.3 typ	25	2	300
		MJ11028•##	MJ11029•##	400 min	50					300
	80	2N5686•	2N5684•	15/60	25	0.5 typ	0.3 typ	25	2	300
			2N6377•	30/120	20	0.8	0.25	20	30	250
	90	MJ11030•##	MJ11031•##	400 min	50					300
	100	2N6274•	2N6378•	30/120	20	0.8	0.25	20	30	250
	120	2N6275•	2N6379•	30/120	20	0.8	0.25	20	30	250
MJ11032•##			MJ11033•##	400 min	50					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

2

PNP
2N5683, 2N5684
NPN
2N5685, 2N5686

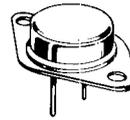
HIGH-CURRENT COMPLEMENTARY SILICON POWER TRANSISTORS

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

- High Current Capability – I_C Continuous = 50 Amperes.
- DC Current Gain –
 $h_{FE} = 15 - 60 @ I_C = 25 \text{ Adc}$
- Low Collector-Emitter Saturation Voltage –
 $V_{CE(sat)} = 1.0 \text{ Vdc (Max) @ } I_C = 25 \text{ Adc}$

50 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS

60–80 VOLTS
300 WATTS



***MAXIMUM RATINGS**

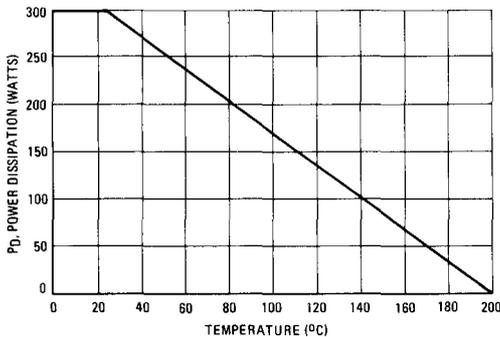
Rating	Symbol	2N5683 2N5685	2N5684 2N5686	Unit
Collector-Emitter Voltage	V_{CEO}	60	80	Vdc
Collector-Base Voltage	V_{CB}	60	80	Vdc
Emitter-Base Voltage	V_{EB}	5.0		Vdc
Collector Current – Continuous	I_C	50		A dc
Base Current	I_B	15		A dc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	300 1.715		Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200		$^\circ\text{C}$

***THERMAL CHARACTERISTICS**

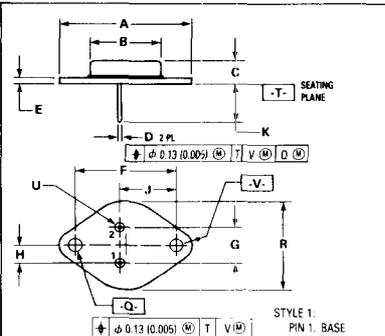
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	0.584	$^\circ\text{C/W}$

*Indicates JEDEC Registered Data.

FIGURE 1 – POWER DERATING



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



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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	—	39.37	—	1.550
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	5.48 BSC		0.215 BSC	
J	16.89 BSC		0.665 BSC	
K	11.18	12.19	0.440	0.480
Q	3.84	4.13	0.151	0.165
R	—		26.67	
U	4.83	5.33	0.190	0.210
V	3.84	4.13	0.151	0.165

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

2N5683, 2N5684 PNP, 2N5685, 2N5686 NPN

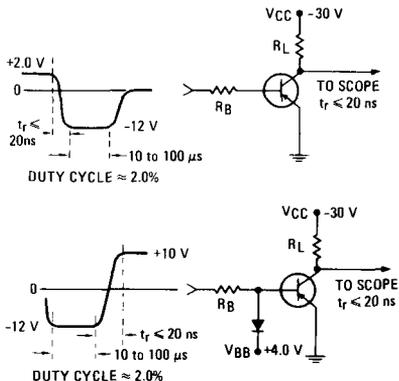
*ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage (Note 1) ($I_C = 0.2 \text{ Adc}$, $I_B = 0$)	$V_{CE0(sus)}$	60 80	— —	Vdc
Collector Cutoff Current ($V_{CE} = 30 \text{ Vdc}$, $I_B = 0$) ($V_{CE} = 40 \text{ Vdc}$, $I_B = 0$)	I_{CEO}	— —	1.0 1.0	mAdc
Collector Cutoff Current ($V_{CE} = 60 \text{ Vdc}$, $V_{EB(off)} = 1.5 \text{ Vdc}$) ($V_{CE} = 80 \text{ Vdc}$, $V_{EB(off)} = 1.5 \text{ Vdc}$) ($V_{CE} = 60 \text{ Vdc}$, $V_{EB(off)} = 1.5 \text{ Vdc}$, $T_C = 150^\circ\text{C}$) ($V_{CE} = 80 \text{ Vdc}$, $V_{EB(off)} = 1.5 \text{ Vdc}$, $T_C = 150^\circ\text{C}$)	I_{CEX}	— — — —	2.0 2.0 10 10	mAdc
Collector Cutoff Current ($V_{CB} = 60 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 80 \text{ Vdc}$, $I_E = 0$)	I_{CBO}	— —	2.0 2.0	mAdc
Emitter Cutoff Current ($V_{BE} = 5.0 \text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	5.0	mAdc
ON CHARACTERISTICS				
DC Current Gain (Note 1) ($I_C = 25 \text{ Adc}$, $V_{CE} = 2.0 \text{ Vdc}$) ($I_C = 50 \text{ Adc}$, $V_{CE} = 5.0 \text{ Vdc}$)	h_{FE}	15 5.0	60 —	—
Collector-Emitter Saturation Voltage (Note 1) ($I_C = 25 \text{ Adc}$, $I_B = 2.5 \text{ Adc}$) ($I_C = 50 \text{ Adc}$, $I_B = 10 \text{ Adc}$)	$V_{CE(sat)}$	— —	1.0 5.0	Vdc
Base-Emitter Saturation Voltage (Note 1) ($I_C = 25 \text{ Adc}$, $I_B = 2.5 \text{ Adc}$)	$V_{BE(sat)}$	—	2.0	Vdc
Base-Emitter On Voltage (Note 1) ($I_C = 25 \text{ Adc}$, $V_{CE} = 2.0 \text{ Vdc}$)	$V_{BE(on)}$	—	2.0	Vdc
DYNAMIC CHARACTERISTICS				
Current Gain-Bandwidth Product ($I_C = 5.0 \text{ Adc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ MHz}$)	f_T	2.0	—	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 0.1 \text{ MHz}$)	C_{ob}	— —	2000 1200	pF
Small-Signal Current Gain ($I_C = 10 \text{ Adc}$, $V_{CE} = 5.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h_{fe}	15	—	—

*Indicates JEDEC Registered Data

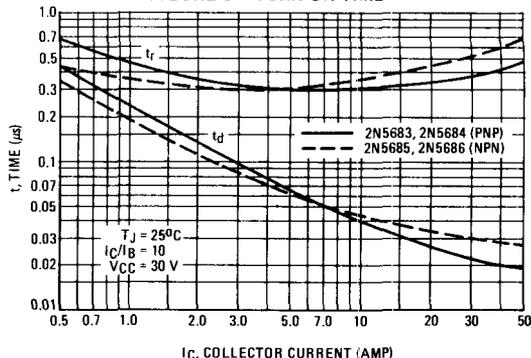
Note 1: Pulse Test: Pulse Width $\leq 300 \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

FIGURE 2 – SWITCHING TIME TEST CIRCUIT



FOR CURVES OF FIGURES 3 & 6, R_B & R_L ARE VARIED.
INPUT LEVELS ARE APPROXIMATELY AS SHOWN.
FOR NPN CIRCUITS, REVERSE ALL POLARITIES.

FIGURE 3 – TURN-ON TIME



2N5683, 2N5684 PNP, 2N5685, 2N5686 NPN

FIGURE 4 – THERMAL RESPONSE

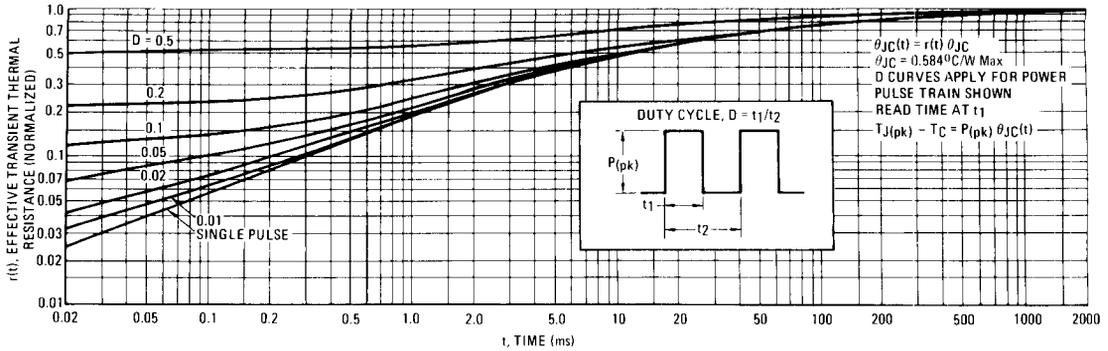
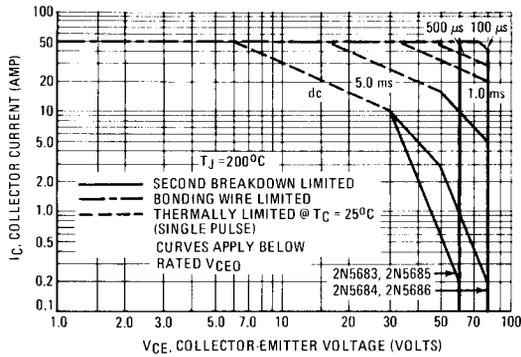


FIGURE 5 – ACTIVE-REGION SAFE OPERATING AREA



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 $T_{J(pk)} = 200^\circ\text{C}$; 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 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

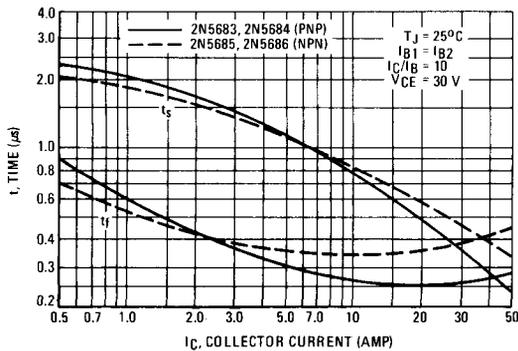
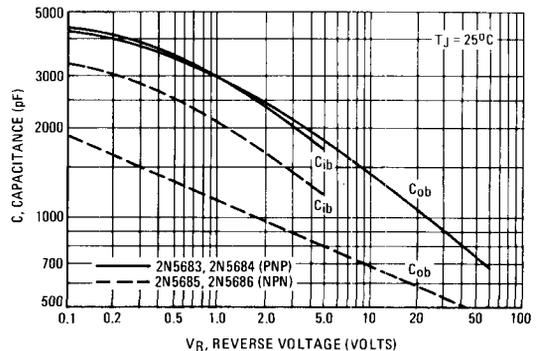


FIGURE 7 – CAPACITANCE



2N5683, 2N5684 PNP, 2N5685, 2N5686 NPN

PNP
2N5683, 2N5684

NPN
2N5685, 2N5686

FIGURE 8 - DC CURRENT GAIN

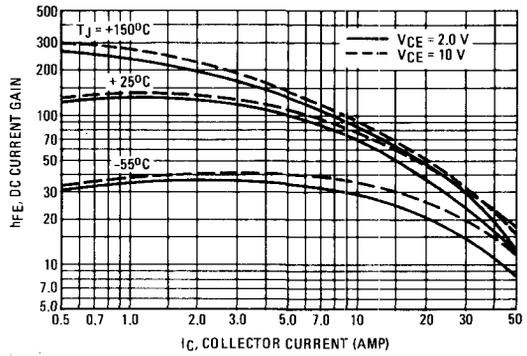
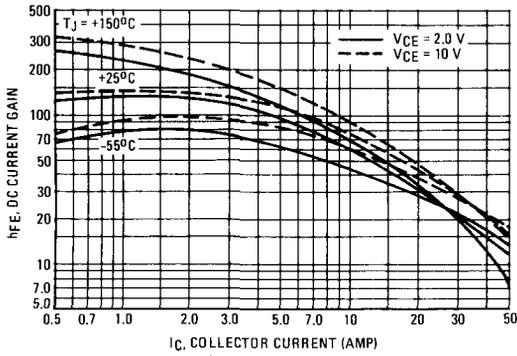


FIGURE 9 - COLLECTOR SATURATION REGION

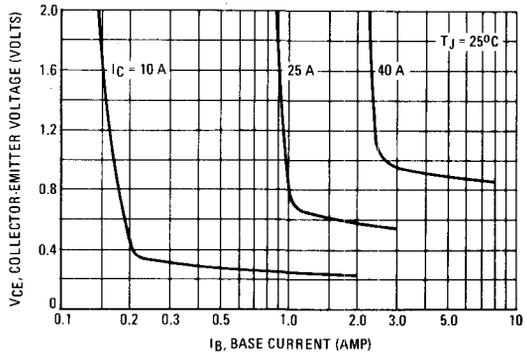
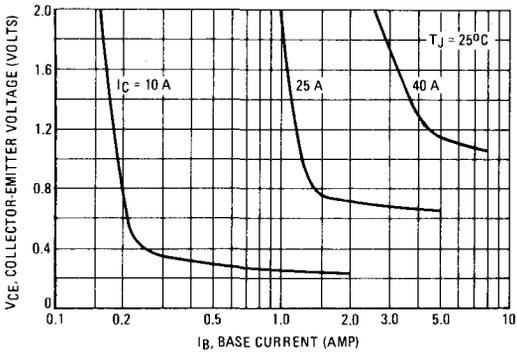
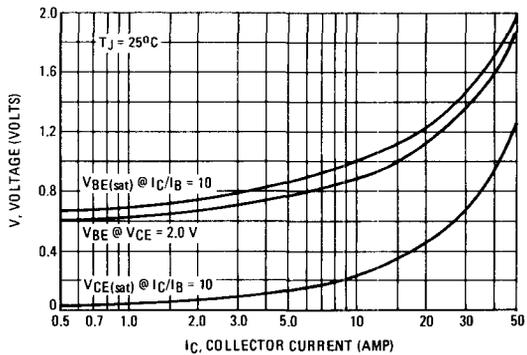
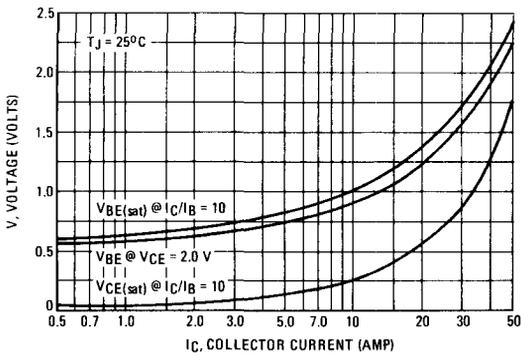


FIGURE 10 - "ON" VOLTAGES



3