

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
2N6050	2N6050		3-143	2N6188	2N6193		3-158
2N6051	2N6051		3-143	2N6189	2N6193		3-158
2N6051JAN	2N6051JAN		3-143	2N6190	2N6190		3-158
2N6051JTX	2N6051JTX		3-143	2N6191	2N6191		3-158
2N6051JTXV	2N6051JTXV		3-143	2N6192	2N6193		3-158
2N6052	2N6052		3-143	2N6193	2N6193		3-158
2N6052JAN	2N6052JAN		3-143	2N6193JAN	2N6193JAN		3-158
2N6052JTX	2N6052JTX		3-143	2N6193JTX	2N6193JTX		3-158
2N6052JTXV	2N6052JTXV		3-143	2N6193JTXV	2N6193JTXV		3-158
2N6053	2N6053		3-147	2N6211	2N6211		3-161
2N6054	2N6054		3-147	2N6212	2N6212		3-161
2N6055	2N6055		3-147	2N6213	2N6213		3-161
2N6056	2N6056		3-147	2N6226		MJ15016	3-9
2N6057	2N6057		3-143	2N6227		MJ15016	3-9
2N6058	2N6058		3-143	2N6228		MJ15016	3-9
2N6058JAN	2N6058JAN		3-143	2N6229		2N5880	3-123
2N6058JTX	2N6058JTX		3-143	2N6230		MJ15002	3-710
2N6058JTXV	2N6058JTXV		3-143	2N6231		MJ15002	3-710
2N6059	2N6059		3-143	2N6233		2N3584	3-20
2N6059JAN	2N6059JAN		3-143	2N6234		2N3585	3-20
2N6059JTX	2N6059JTX		3-143	2N6235		2N3585	3-20
2N6059JTXV	2N6059JTXV		3-143	2N6242		MJ13015	3-670
2N6077		2N3585	3-20	2N6243		MJ13335	3-700
2N6078		2N3585	3-20	2N6244		MJ13333	3-700
2N6079		2N3585	3-20	2N6245		MJ13335	3-700
2N6098		2N6487	3-207	2N6246		2N5879	3-123
2N6099		2N6487	3-207	2N6247		2N5880	3-123
2N6100		2N6487	3-207	2N6248		MJ15016	3-9
2N6101		2N6488	3-207	2N6249	2N6249		3-164
2N6102		2N6488	3-207	2N6250	2N6250		3-164
2N6103		2N6486	3-207	2N6251	2N6251		3-164
2N6106		2N6107	3-151	2N6253		2N5877	3-120
2N6107	2N6107		3-151	2N6254		2N5878	3-120
2N6108		2N6109	3-151	2N6257		2N5886	3-127
2N6109	2N6109		3-151	2N6258		2N5686	3-112
2N6110		2N6111	3-151	2N6259		2N5631	3-105
2N6111	2N6111		3-151	2N6260		2N3054A	3-2
2N6121	2N6121		3-154	2N6261		2N4233A	3-64
2N6122	2N6122		3-154	2N6262		2N5760	3-116
2N6123	2N6123		3-154	2N6263		2N3584	3-20
2N6124	2N6124		3-154	2N6264		2N3584	3-20
2N6125	2N6125		3-154	2N6270		2N6338	3-188
2N6126		TIP32C	3-1073	2N6271		2N6338	3-188
2N6127		2N6436	3-203	2N6272		2N6338	3-188
2N6128		2N6338	3-188	2N6273		2N6338	3-188
2N6129		TIP41	3-1083	2N6274	2N6274		3-168
2N6130		TIP41A	3-1083	2N6274JAN	2N6274JAN		3-168
2N6131		TIP41B	3-1083	2N6274JTX	2N6274JTX		3-168
2N6132		TIP42C	3-1083	2N6274JTXV	2N6274JTXV		3-168
2N6133		TIP42C	3-1083	2N6275	2N6275		3-168
2N6134		TIP42C	3-1083	2N6276		2N6275	3-168
2N6175		MPS-U10	3-1052	2N6277	2N6277		3-168
2N6176		MPS-U10	3-1052	2N6277JAN	2N6277JAN		3-168
2N6177		MJE340	3-876	2N6277JTX	2N6277JTX		3-168
2N6178		MPS-U06	3-1048	2N6277JTXV	2N6277JTXV		3-168
2N6179		MPS-U05	3-1048	2N6278		2N6274	3-168
2N6180		MPS-U56	3-1062	2N6279		2N6275	3-168
2N6181		MPS-U55	3-1062	2N6280		2N6275	3-168
2N6186	2N6190		3-158	2N6281		2N6277	3-168
2N6187	2N6191		3-158	2N6282	2N6282		3-172

*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		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		
10	250	MJ15011	MJ15012	20/100	2					200
	300	MJ3041##		250 min	2.5					175
	325	MJ413 MJ423 MJ431		20/80 30/90 15/35	0.5 1 2.5				2.5 2.5 2.5	125 125 125
	350	BU323## MJ3042## MJ13014 MJ10002## MJ10006##		150 min 250 min 8/20 3/300 30/300	6 2.5 5 5 5	7.5 typ 2 2.5 1.5	5.2 typ 0.5 1 0.5	6 5 5 5	10# 10#	175 175 150 150 150
	400	BU323A## MJ10007## MJ10012## MJ13015		150 min 30/300 100/2k 8/20	6 5 6 5	7.5 typ 1.5 15 2	5.2 typ 0.5 15 0.5	6 5 6 5	10#	175 150 175 150
	600	MJ10014##		10/250	10	2.5	0.8	10		175
	700	MJ8504		7.5 min	1.5	4	2	5		175
	800	MJ8505 MJ16018		7.5 min 4 min	1.5 5	4 4.5 typ	2 0.2 typ	5 5		175 150
	950*	MJ12010		4.2 min	5		1	5		100
12	60	2N6057##	2N6050##	750/18k	6	1.6 typ	1.5 typ	6	4#	150
	80	2N6058##	2N6051##	750/18k	6	1.6 typ	1.5 typ	6	4#	150
	100	2N6059##	2N6052##	750/18k	6	1.6 typ	1.5 typ	6	4#	150
15	60	2N3055 2N3055A 2N6576## 2N5881	MJ2955 MJ2955A 2N5879	20/70 20/70 2k/20k 20/100	4 4 4 6	0.7 typ 2 1	0.3 typ 7 0.8	4 10 6	2.5 0.8 10-200# 4	115 115 120 160
	80	2N5882	2N5880	20/100	6	1	0.8	6	4	160
	90	2N6577##		2k/20k	4	2	7	10	10-200#	120
	120	MJ15015 2N6578##	MJ15016	20/70 2k/20k	4 4	2	7	10	1 10-200#	180 120
	140	MJ15001	MJ15002	25/150	4				2	200
	150	MJ11018##	MJ11017##	100 min	15				3#	175
	200	BUX41 2N6249 MJ11020##	MJ11019##	8 min 10/50 100 min	8 10 15	1.5 3.5	0.4 1	8 10	8 2.5 3#	120 175 175
	250	MJ11022##	MJ11021##	100 min	15				3#	175
	275	2N6250		8/50	10	3.5	1	10	2.5	175
	300	2N6546		6/30	10	4	0.7	10	6 to 24	175
	325	BUX13		8 min	8	2.5	0.8	8	8	150
	400	BUX48 2N6547 MJ13090 MJ16110		8 min 6/30 8 min 6/20	10 10 10 15	2 4 2.5 0.8 typ	0.4 0.7 0.5 0.1 typ	10 10 10 10	6 to 24	175 175 175 175
	450	BUX48A MJ16010		8 min 5 min	8 15	2 1.2 typ	0.4 0.2 typ	10 10		175 175

* V_{BR}/CEX. # |h_{FE}| @ 1 MHz, ## Darlington

(continued)

 JAN, JTX, JTXV Available

TABLE 12 — POWER DARLINGTONS (continued)

I _C Cont Amps Max	V _{CE(sus)} Volts Min	Device Type		h _{FE} Min/Max	@ I _C Amp	Resistive Switching			h _{fe} @ 1 MHz Min	P _D (Case) Watts @ 25°C	Case JEDEC/MOT
		NPN	PNP			t _s μs Max	t _f μs Max	@ I _C Amp			
10	400	MJ10012		100/2k	6	15	15	6		175	TO-204/1
	600	MJ10014●		10/250	10	2.5	0.8	10		175	TO-204/1
12	60	2N6057	2N6050	750/18k	6	1.6 typ	1.5 typ	6	4	150	TO-204/1
	80	2N6058	2N6051	750/18k	6	1.6 typ	1.5 typ	6	4	150	TO-204/1
	100	2N6059	2N6052	750/18k	6	1.6 typ	1.5 typ	6		150	TO-204/1
	1000	BUT16●		5 min	8	3.3	1.5	8		150	TO-204/1
15	60	2N6576		2k/20k	4	2	7	10	10/200	120	TO-204/1
	90	2N6577		2k/20k	4	2	7	10	10/200	120	TO-204/1
	120	2N6578		2k/20k	4	2	7	10	10/200	120	TO-204/1
	150	MJ11018 MJH11018	MJ11017 MJH11017	100 min 100 min	15 15				3 3	175 150	TO-204/1 TO-218/340
	200	MJ11020 MJH11020	MJ11019 MJH11019	100 min 100 min	15 15				3 3	175 150	TO-204/1 TO-218/340
	250	MJ11022 MJH11022	MJ11021 MJH11021	100 min 100 min	15 15				3 3	175 150	TO-204/1 TO-218/340
	500	BUT51P		40 min	5	1.1	0.16	10		125	TO-218/340D
20	60	2N6282 MJH6282	2N6285 MJH6285	750/18k 750/18k	10 10	2.5 typ 2.5 typ	2.5 typ 2.5 typ	10 10	4 4	160 125	TO-204/1 TO-218/340
	80	2N6283 MJH6283	2N6286 MJH6286	750/18k 750/18k	10 10	2.5 typ 2.5 typ	2.5 typ 2.5 typ	10 10	4 4	160 125	TO-204/1 TO-218/340
	100	2N6284 MJH6284	2N6287 MJH6287	750/18k 750/18k	10 10	2.5 typ 2.5 typ	2.5 typ 2.5 typ	10 10	4 4	160 125	TO-204/1 TO-218/340
	350	MJ10000 MJ10004●		40/400 40/400	10 10	3 1.5	1.8 0.5	10 10	10 10	175 175	TO-204/1 TO-204/1
	400	MJ10001 MJ10005●		40/400 40/400	10 10	3 1.5	1.8 0.5	10 10	10 10	175 175	TO-204/1 TO-204/1
	450	MJ10008●		30/300	10	2	0.6	10	8	175	TO-204/1
	500	MJ10009●		30/300	10	2	0.6	10	8	175	TO-204/1
	700	BUT15●		15 min	12	2.5	0.8	12		175	TO-204/1
	750	MJ10024●		50/600	5	5	1.8	10		250	TO-204/1
	850	MJ10025●		50/600	5	5	1.8	10		250	TO-204/1
25	500	BUT14●		15 min	16	2.8	0.8	16		175	TO-204/1
28	400	BUT13●		20 min	20	2.6	0.8	18		175	TO-204/1
30	60	MJ11012	MJ11011	1k min	20				4	200	TO-204/1
	90	MJ11014	MJ11013	1k min	20				4	200	TO-204/1
	120	MJ11016	MJ11015	1k min	20				4	200	TO-204/1
40	350	MJ10022●		50/600	10	2.5	0.9	20		250	TO-204/197
	400	MJ10023●		50/600	10	2.5	0.9	20		250	TO-204/197
	700	BUT35●		15 min	24	4	1.2	24		250	TO-204/197
50	60	MJ11028	MJ11029	400 min	50					300	TO-204/197

● Darlington with speed-up diode.

(continued)

PNP
2N6050 thru 2N6052
NPN
2N6057 thru 2N6059

**DARLINGTON COMPLEMENTARY
SILICON POWER TRANSISTORS**

... designed for general-purpose amplifier and low frequency switching applications.

- High DC Current Gain —
 $h_{FE} = 3500$ (Typ) @ $I_C = 5.0$ Adc
- Collector-Emitter Sustaining Voltage — @ 100 mA
 $V_{CEO(sus)} = 60$ Vdc (Min) — 2N6050, 2N6057
80 Vdc (Min) — 2N6051, 2N6058
100 Vdc (Min) — 2N6052, 2N6059
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors

***MAXIMUM RATINGS**

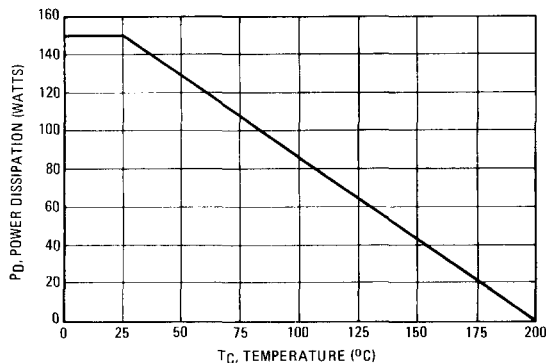
Rating	Symbol	2N6050 2N6057	2N6051 2N6058	2N6052 2N6059	Unit
Collector-Emitter Voltage	V_{CEO}	60	80	100	Vdc
Collector-Base Voltage	V_{CB}	60	80	100	Vdc
Emitter-Base Voltage	V_{EB}	5.0			Vdc
Collector Current — Continuous	I_C	12			Adc
Peak		20			
Base Current	I_B	0.2			Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$	P_D	150			Watts
Derate above 25°C		0.857			W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200 $^\circ\text{C}$			$^\circ\text{C}$

THERMAL CHARACTERISTICS

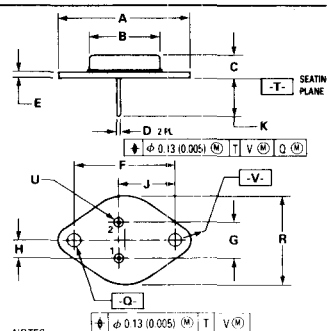
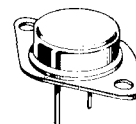
Characteristic	Symbol	Rating	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.17	$^\circ\text{C/W}$

*Indicates JEDEC Registered Data

FIGURE 1 — POWER DERATING



**DARLINGTON
12 AMPERE
COMPLEMENTARY SILICON
POWER TRANSISTORS
60-80-100 VOLTS
150 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	—	1.550
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)**

2N6050 thru 2N6052 PNP/2N6057 thru 2N6059 NPN

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

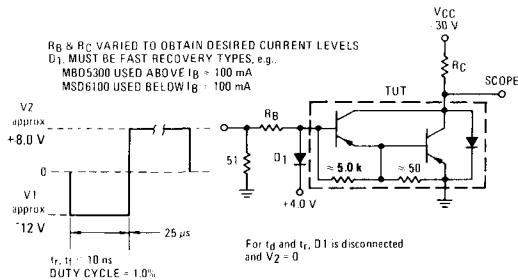
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage ⁽¹⁾ ($I_C = 100 \text{ mAdc}$, $I_B = 0$)	$V_{CEO(sus)}$	60 80 100	— — —	Vdc
Collector Cutoff Current ($V_{CE} = 30 \text{ Vdc}$, $I_B = 0$) ($V_{CE} = 40 \text{ Vdc}$, $I_B = 0$) ($V_{CE} = 50 \text{ Vdc}$, $I_B = 0$)	I_{CEO}	— — —	1.0 1.0 1.0	mAdc
Collector Cutoff Current ($V_{CE} = \text{Rated } V_{CEO}$, $V_{BE(off)} = 1.5 \text{ Vdc}$) ($V_{CE} = \text{Rated } V_{CEO}$, $V_{BE(off)} = 1.5 \text{ Vdc}$, $T_C = 150^\circ\text{C}$)	I_{CEX}	—	0.5 5.0	mAdc
Emitter Cutoff Current ($V_{BE} = 5.0 \text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	2.0	mAdc
ON CHARACTERISTICS ⁽¹⁾				
DC Current Gain ($I_C = 6.0 \text{ Adc}$, $V_{CE} = 3.0 \text{ Vdc}$) ($I_C = 12 \text{ Adc}$, $V_{CE} = 3.0 \text{ Vdc}$)	h_{FE}	750 100	18,000 —	—
Collector-Emitter Saturation Voltage ($I_C = 6.0 \text{ Adc}$, $I_B = 24 \text{ mAdc}$) ($I_C = 12 \text{ Adc}$, $I_B = 120 \text{ mAdc}$)	$V_{CE(sat)}$	— —	2.0 3.0	Vdc
Base-Emitter Saturation Voltage ($I_C = 12 \text{ Adc}$, $I_B = 120 \text{ mAdc}$)	$V_{BE(sat)}$	—	4.0	Vdc
Base-Emitter On Voltage ($I_C = 6.0 \text{ Adc}$, $V_{CE} = 3.0 \text{ Vdc}$)	$V_{BE(on)}$	—	2.8	Vdc
DYNAMIC CHARACTERISTICS				
Magnitude of Common Emitter Small-Signal Short Circuit Forward Current Transfer Ratio ($I_C = 5.0 \text{ Adc}$, $V_{CE} = 3.0 \text{ Vdc}$, $f = 1.0 \text{ MHz}$)	$ h_{fe} $	4.0	—	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 0.1 \text{ MHz}$)	C_{ob}	— —	500 300	pF
Small-Signal Current Gain ($I_C = 5.0 \text{ Adc}$, $V_{CE} = 3.0 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	h_{fe}	300	—	—

*Indicates JEDEC Registered Data

(1) Pulse test: Pulse Width = 300 μs , Duty Cycle = 2.0%.

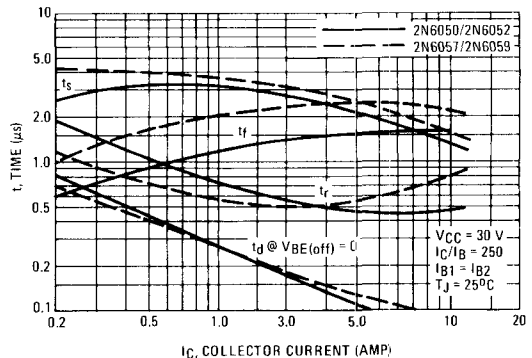
3

FIGURE 2 — SWITCHING TIMES TEST CIRCUIT



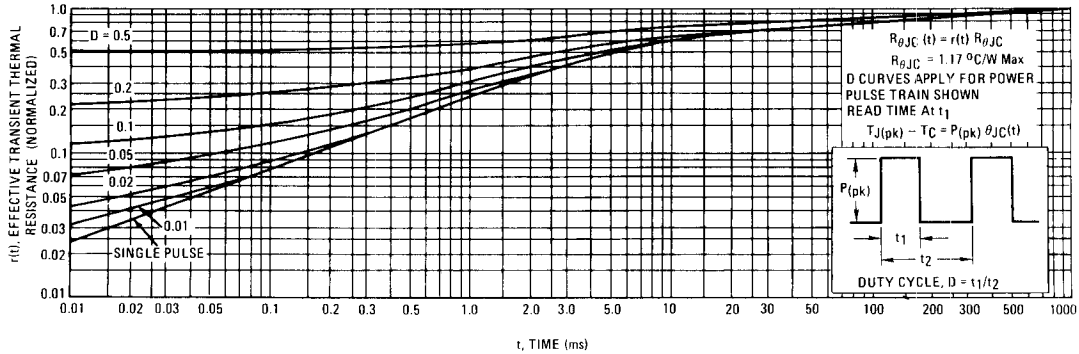
For NPN test circuit reverse diode and voltage polarities.

FIGURE 3 — SWITCHING TIMES



2N6050 thru 2N6052 PNP/2N6057 thru 2N6059 NPN

FIGURE 4 – THERMAL RESPONSE



ACTIVE-REGION SAFE OPERATING AREA

FIGURE 5 – 2N6050, 2N6057

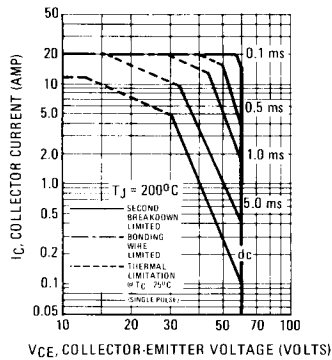


FIGURE 6 – 2N6051, 2N6058

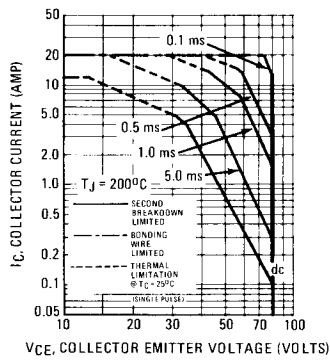
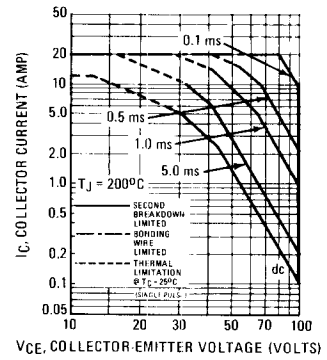


FIGURE 7 – 2N6052, 2N6059



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 Figures 5, 6 and 7 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 8 – SMALL-SIGNAL CURRENT GAIN

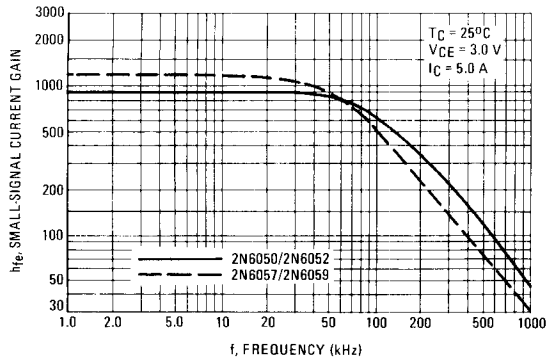
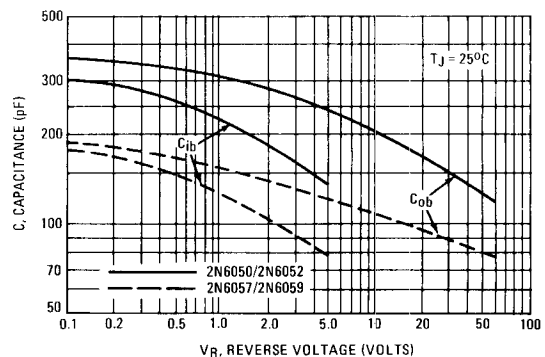


FIGURE 9 – CAPACITANCE



2N6050 thru 2N6052 PNP/2N6057 thru 2N6059 NPN

PNP
2N6050, 2N6051, 2N6052

NPN
2N6057, 2N6058, 2N6059

FIGURE 10 – DC CURRENT GAIN

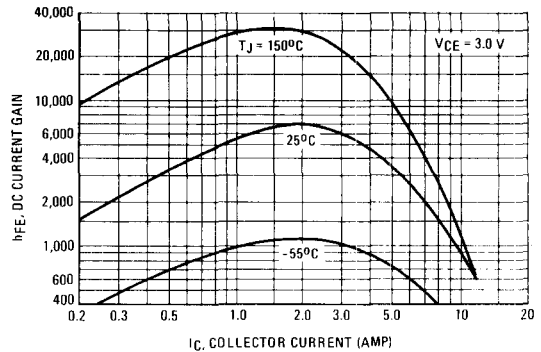
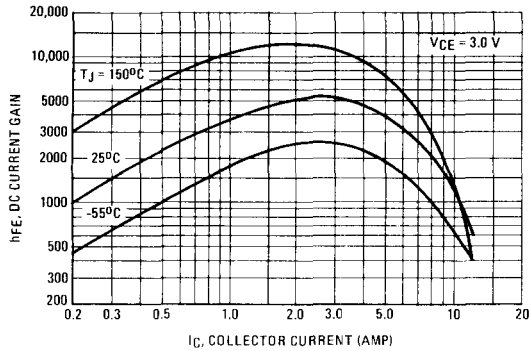


FIGURE 11 – COLLECTOR SATURATION REGION

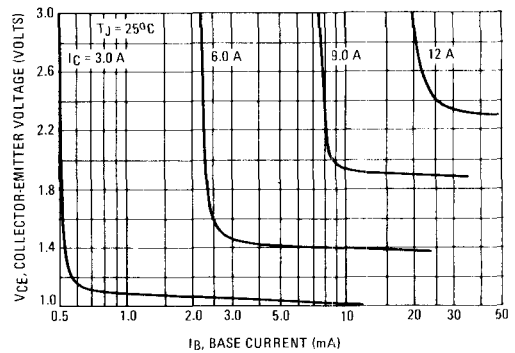
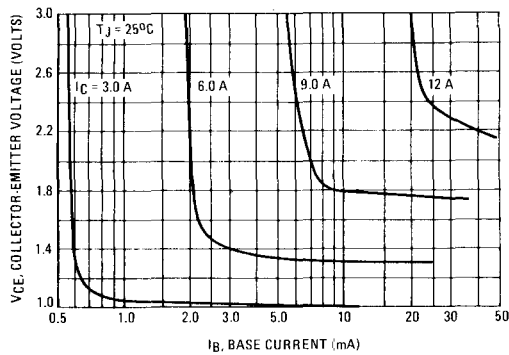


FIGURE 12 – "ON" VOLTAGES

