

ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

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*Consult Motorola if a direct replacement is necessary.

TABLE 4 — PLASTIC TO-218 (continued)

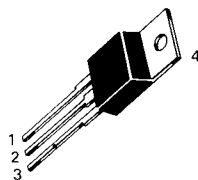
I _C Cont Amps Max	V _{CEO(sus)} Volts Min	Device Type		h _{FE} Min/Max	@ I _C Amp	Resistive Switching			f _T MHz Min	P _D (Case) Watts @ 25°C
		NPN	PNP			t _s μs Max	t _f μs Max	@ I _C Amp		
15	400	BUV48†		8 min	10	2	0.4	10		150
		MJH13090		8 min	10	2.5	0.5	10		125
		MJH16110		6/20	10	0.8 typ	0.1 typ	10		135
	450	BUV48A†		8 min	8	2	0.4	10		150
		MJH16010		5 min	15	1.2	0.2	10		150
		MJH16012		7 min	15	0.9	0.15	10		150
	500	BUT51P##†		40 min	5	1.1	0.16	10		125
		MJH16010A		5 min	15	3	0.4	10		150
	1600	MJE1600		15 min	8	1.2 typ	0.1 typ	10		150
16	100	MJE4340	MJE4350	15 min	8	1.2 typ	1.2 typ	8	1	125
	120	MJE4341	MJE4351	15 min	8	1.2 typ	1.2 typ	8	1	125
	140	MJE4342	MJE4352	15 min	8	1.2 typ	1.2 typ	8	1	125
	160	MJE4343	MJE4353	15 min	8	1.2 typ	1.2 typ	8	1	125
20	60	MJH6282##	MJH6285##	750/18k	10				4#	125
	80	MJH6283##	MJH6286##	750/18k	10				4#	125
	100	MJH6284##	MJH6287##	750/18k	10				4#	125
25	40	TIP35	TIP36	10/75	15	0.6 typ	0.3 typ	10	3	125
	45	BD249†	BD250†	10 min	15				3	125
	60	BD249A†	BD250A†	10 min	15				3	125
		TIP35A	TIP36A	10/75	15	0.6 typ	0.3 typ	10	3	125
	80	BD249B†	BD250B†	10 min	15				3	125
		TIP35B	TIP36B	10/75	15	0.6 typ	0.3 typ	10	3	125
	100	BD249C†	BD250C†	10 min	15				3	125
		TIP35C	TIP36C	10/75	15	0.6 typ	0.3 typ	10	3	125

I_{hfe} at 1 MHz, ## Darlington

† These devices supplied in Case 340D-01. Consult Motorola for details.

TABLE 5 — PLASTIC TO-220

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR


CASE 221A-04 (TO-220AB)

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		
0.5	350	MJE2360T		15 min	0.1				10 typ	30
		MJE2361T		40 min	0.1				10 typ	30
1	40	TIP29	TIP30	15/75	1	0.6 typ	0.3 typ	1	3	30
	60	TIP29A	TIP30A	15/75	1	0.6 typ	0.3 typ	1	3	30
	80	TIP29B	TIP30B	15/75	1	0.6 typ	0.3 typ	1	3	30
	100	TIP29C	TIP30C	15/75	1	0.6 typ	0.3 typ	1	3	30
	250	TIP47		30/150	0.3	2 typ	0.18 typ	0.3	10	40
	300	TIP48		30/150	0.3	2 typ	0.18 typ	0.3	10	40
	350	TIP49		30/150	0.3	2 typ	0.18 typ	0.3	10	40
	400	TIP50		30/150	0.3	2 typ	0.18 typ	0.3	10	40

(continued)

MOTOROLA SEMICONDUCTOR TECHNICAL DATA

NPN
TIP29
TIP29A
TIP29B
TIP29C

PNP
TIP30
TIP30A
TIP30B
TIP30C

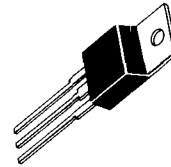
COMPLEMENTARY SILICON PLASTIC POWER TRANSISTORS

... designed for use in general purpose amplifier and switching applications. Compact TO-220 AB package. TO-66 leadform also available.

1 AMPERE

POWER TRANSISTORS
COMPLEMENTARY SILICON

40-60-80-100 VOLTS
30 WATTS



MAXIMUM RATINGS

Rating	Symbol	TIP29 TIP30	TIP29A TIP30A	TIP29B TIP30B	TIP29C TIP30C	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	80	100	Vdc
Collector-Base Voltage	V_{CB}	40	60	80	100	Vdc
Emitter-Base Voltage	V_{EB}	5.0				Vdc
Collector Current - Continuous	I_C	1.0				Adc
Peak		3.0				Adc
Base Current	I_B	0.4				Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	P_D	30				Watts
Derate above 25°C		0.24				W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$	P_D	2.0				Watts
Derate above 25°C		0.016				W/ $^\circ\text{C}$
Unclamped Inductive Load Energy (See Note 3)	E	32				mJ
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150				$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	4.167	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C/W}$

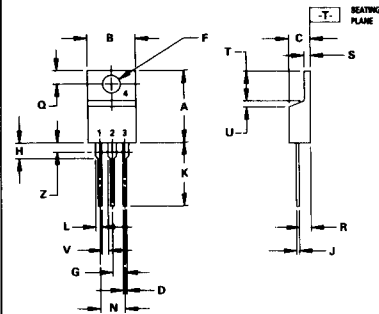
ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage (1) ($I_C = 30 \text{ mA}$, $I_B = 0$)	$V_{CE(sus)}$	40 60 80 100	— — — —	Vdc
Collector Cutoff Current ($V_{CE} = 30 \text{ Vdc}$, $I_B = 0$)	I_{CEO}	—	0.3	mA
($V_{CE} = 60 \text{ Vdc}$, $I_B = 0$)		—	0.3	mA
Collector Cutoff Current ($V_{CE} = 40 \text{ Vdc}$, $V_{EB} = 0$)	I_{CES}	—	200	μA
($V_{CE} = 60 \text{ Vdc}$, $V_{EB} = 0$)		—	200	μA
($V_{CE} = 80 \text{ Vdc}$, $V_{EB} = 0$)		—	200	μA
($V_{CE} = 100 \text{ Vdc}$, $V_{EB} = 0$)		—	200	μA
Emitter Cutoff Current ($V_{BE} = 5.0 \text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	1.0	mA
ON CHARACTERISTICS (1)				
DC Current Gain ($I_C = 0.2 \text{ A}$, $V_{CE} = 4.0 \text{ Vdc}$)	h_{FE}	40	—	—
($I_C = 1.0 \text{ A}$, $V_{CE} = 4.0 \text{ Vdc}$)		15	75	—
Collector-Emitter Saturation Voltage ($I_C = 1.0 \text{ A}$, $I_B = 125 \text{ mA}$)	$V_{CE(sat)}$	—	0.7	Vdc
Base-Emitter On Voltage ($I_C = 1.0 \text{ A}$, $V_{CE} = 4.0 \text{ Vdc}$)	$V_{BE(on)}$	—	1.3	Vdc
DYNAMIC CHARACTERISTICS				
Current Gain - Bandwidth Product (2) ($I_C = 200 \text{ mA}$, $V_{CE} = 10 \text{ Vdc}$, $f_{test} = 1 \text{ MHz}$)	f_T	3.0	—	MHz
Small-Signal Current Gain ($I_C = 0.2 \text{ A}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1 \text{ kHz}$)	h_{fe}	20	—	—

(1) Pulse Test: Pulse Width $< 300 \mu\text{s}$, Duty Cycle $< 2.0\%$.

(2) $f_T = h_{fe} \cdot f_{test}$

(3) This rating based on testing with $L_C = 20 \text{ mH}$, $R_{BE} = 100 \Omega$, $V_{CC} = 10 \text{ V}$, $I_C = 1.8 \text{ A}$, P.R.F. = 10 Hz.



NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- DIM Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	14.49	15.75	0.570	0.620
B	9.90	10.28	0.390	0.405
C	4.97	4.82	0.190	0.190
D	0.64	0.88	0.025	0.035
F	3.61	3.73	0.142	0.147
G	2.42	2.66	0.095	0.105
H	2.80	3.32	0.110	0.155
J	0.46	0.71	0.018	0.028
K	12.70	14.27	0.500	0.562
L	1.15	1.39	0.045	0.055
N	4.83	5.33	0.190	0.210
Q	2.54	3.06	0.100	0.120
R	2.04	2.79	0.080	0.110
S	1.15	1.39	0.045	0.055
T	5.97	6.47	0.235	0.255
U	0.00	1.27	0.000	0.050
V	1.15	—	0.045	—
Z	—	2.04	—	0.080

STYLE 1:

- PIN 1: BASE
- COLLECTOR
- EMITTER
- COLLECTOR

CASE 221A-04
TO-220AB

TIP29, TIP29A, TIP29B, TIP29C, NPN, TIP30, TIP30A, TIP30B, TIP30C, PNP

FIGURE 1 — DC CURRENT GAIN

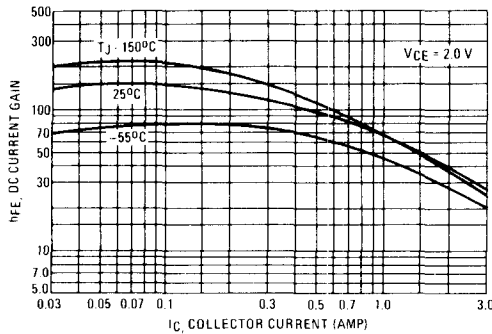


FIGURE 2 — TURN-OFF TIME

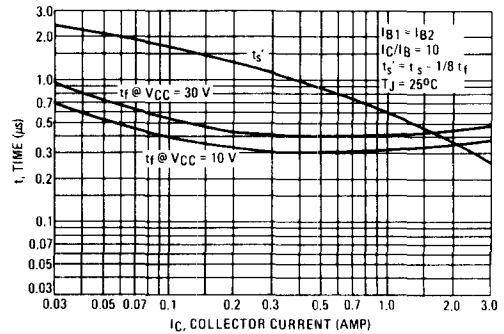


FIGURE 3 — SWITCHING TIME EQUIVALENT CIRCUIT

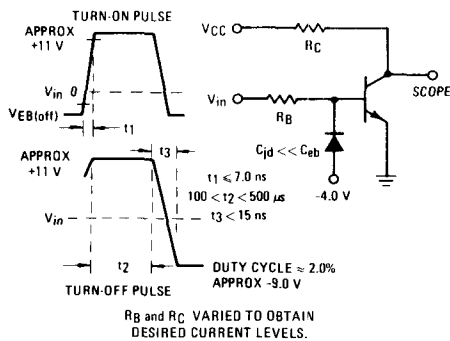


FIGURE 4 — TURN-ON TIME

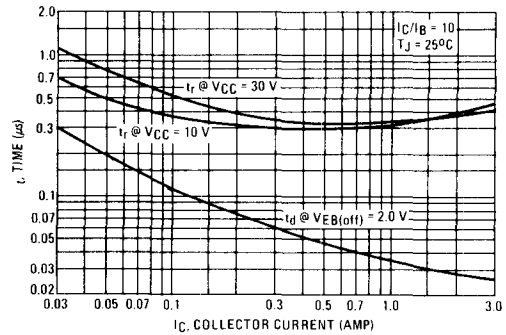
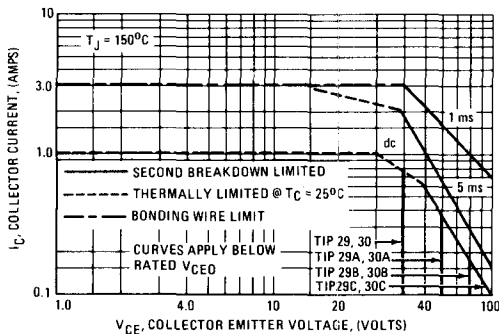


FIGURE 5 — ACTIVE REGION SAFE OPERATING AREA



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} operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on $T_{J(pk)} = 150^\circ\text{C}$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} < 150^\circ\text{C}$. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.