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*Consult Motorola if a direct replacement is necessary.

TABLE 5 — PLASTIC TO-220 (Continued)

I _C Cont Amps Max	V _{CEO(sus)} Volts Min	Device Type		hFE 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		
2	45	BD239	BD240	15 min	1				3	30
	60	BD239A TIP110##	BD240A TIP115##	15 min 500 min	1 2	1.7 typ	1.3 typ	2	3 25#	30 50
	80	BD239B TIP111##	BD240B TIP116##	15 min 500 min	1 2	1.7 typ	1.3 typ	2	3 25#	30 50
	100	BD239C TIP112##	BD240C TIP117##	25 min 500 min	1 2	1.7 typ	1.3 typ	2	3 25#	30 50
	400	BUX84		30 min	0.1	3.5	1.4	1	4	50
	450	BUX85		30 min	0.1	3.5	1.4	1	4	50
	900	MJE1320		3 min	1	4 typ	0.8 typ	1		80
2.5	700	MJE8500		7.5 min	0.5	4	2	1		65
	750	MJE12007		1.1 min	2		1	2	4 typ	65
	800	MJE8501		7.5 min	0.5	4	2	1		65
3	40	TIP31	TIP32	25 min	1	0.6 typ	0.3 typ	1	3	40
	45	BD241	BD242	25 min	1				3	40
	60	BD241A TIP31A	BD242A TIP32A	25 min 25 min	1 1	0.6 typ	0.3 typ	1	3 3	40 40
	80	BD241B TIP31B	BD242B TIP32B	25 min 25 min	1 1	0.6 typ	0.3 typ	1	3 3	40 40
	100	BD241C TIP31C	BD242C TIP32C	25 min 25 min	1 1	0.6 typ	0.3 typ	1	3 3	40 40
	750	MJE16032		4 min	3	2	1.5	2		80
	850	MJE16034		4 min	3	2	1.5	2		80
4	45	2N6121	2N6124	25/100	1.5	0.4 typ	0.3 typ	1.5	2.5	40
	60	2N6122 BD535 MJE800T##	2N6125 MJE700T##	25/100 25 min 750 min	1.5 2 1.5	0.4 typ	0.3 typ	1.5	2.5 3 1#	40 50 40
	80	2N6123		20/80	1.5	0.4 typ	0.3 typ	1.5	2.5	40
	300	MJE13004		6/30	3	3	0.7	3	4	60
	400	MJE13005		6/30	3	3	0.7	3	4	60
5	60	TIP120##	TIP125##	1k min	3	1.5 typ	1.5 typ	3	4#	65
	80	TIP121##	TIP126##	1k min	3	1.5 typ	1.5 typ	3	4#	65
	100	TIP122##	TIP127##	1k min	3	1.5 typ	1.5 typ	4	4#	75
	250	2N6497		10/75	2.5	1.8	0.8	2.5	5	80
	300	2N6498		10/75	2.5	1.8	0.8	2.5	5	80
	400	MJE13070		8 min	3	1.5	0.5	3		80
	450	MJE16002 MJE16004		5 min 7 min	5 5	3 2.7	0.3 0.35	3 3		80 80
	700	MJE8502		7.5 min	1	4	2	2.5		80
	800	MJE8503		7.5 min	1	4	2	2.5		80
6	40	TIP41	TIP42	15/75	3	0.4 typ	0.15 typ	3	3	65
	45	BD243	BD244	15 min	3				3	65
	60	BD243A TIP41A	BD244A TIP42A	15 min 15/75	3 3	0.4 typ	0.15 typ	3	3 3	65 65
	80	BD243B TIP41B	BD244B TIP42B	15 min 15/75	3 3	0.4 typ	0.15 typ	3	3 3	65 65
	100	BD243C TIP41C	BD244C TIP42C	15 min 15/75	3 3	0.4 typ	0.15 typ	3	3 3	65 65
7	30	2N6288	2N6111	30/150	3	0.4 typ	0.15 typ	3	4	40

[h_{FE}] @ 1 MHz, ## Darlington

(continued)

MOTOROLA SEMICONDUCTOR TECHNICAL DATA

NPN
**TIP41
TIP41A
TIP41B
TIP41C**

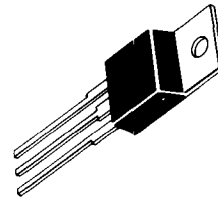
PNP
**TIP42
TIP42A
TIP42B
TIP42C**

COMPLEMENTARY SILICON PLASTIC POWER TRANSISTORS

... designed for use in general purpose amplifier and switching applications.

- Collector-Emitter Saturation Voltage —
 $V_{CE(sat)} = 1.5 \text{ Vdc (Max) @ } I_C = 6.0 \text{ Adc}$
- Collector-Emitter Sustaining Voltage —
 $V_{CE(sus)} = 40 \text{ Vdc (Min) — TIP41, TIP42}$
 $= 60 \text{ Vdc (Min) — TIP41A, TIP42A}$
 $= 80 \text{ Vdc (Min) — TIP41B, TIP42B}$
 $= 100 \text{ Vdc (Min) — TIP41C, TIP42C}$
- High Current Gain — Bandwidth Product
 $f_T = 3.0 \text{ MHz (Min) @ } I_C = 500 \text{ mAdc}$
- Compact TO-220/AB Package
- TO-66 Leadform Also Available

**6 AMPERE
POWER TRANSISTORS
COMPLEMENTARY SILICON**
**40-60-80-100 VOLTS
65 WATTS**



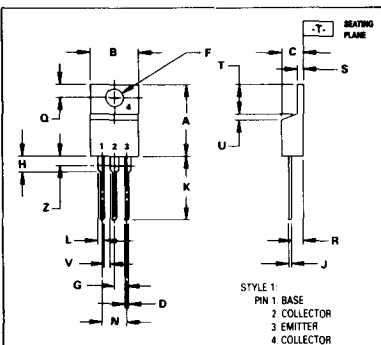
*MAXIMUM RATINGS

Rating	Symbol	TIP41 TIP42	TIP41A TIP42A	TIP41B TIP42B	TIP41C TIP42C	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	6				Adc
Collector Current - Peak		10				Adc
Base Current	I_B	2.0				Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$	P_D	65				Watts
Derate above 25°C		0.52				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 (1)	E	62.5				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	$R_{\theta JC}$	1.92	$^\circ\text{C/W}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C/W}$

(1) $I_C = 2.5 \text{ A}$, $L = 20 \text{ mH}$, P.R.F. = 10 Hz, $V_{CC} = 10 \text{ V}$, $R_{BE} = 100 \Omega$.



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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	14.48	15.75	0.570	0.620
B	9.66	10.28	0.380	0.406
C	4.07	4.82	0.160	0.190
D	0.64	0.80	0.025	0.032
F	3.61	3.73	0.142	0.147
G	2.42	2.66	0.095	0.105
H	2.80	3.93	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
M	4.82	5.33	0.190	0.210
Q	2.54	3.04	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	0.60	1.27	0.000	0.050
V	1.15	—	0.045	—
Z	—	2.04	—	0.080

**CASE 221A-04
TO-220AB**

TIP41, TIP41A, TIP41B, TIP41C, NPN, TIP42, TIP42A, TIP42B, TIP42C, PNP

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (1) ($I_C = 30\text{ mA}$, $I_B = 0$)	TIP41, TIP42 TIP41A, TIP42A TIP41B, TIP42B TIP41C, TIP42C	$V_{CE(sus)}$	40 60 80 100	— — — —	Vdc
Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 60\text{ Vdc}$, $I_B = 0$)	TIP41, TIP41A, TIP42, TIP42A TIP41B, TIP41C, TIP42B, TIP42C	I_{CEO}	— —	0.7 0.7	mAdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 60\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 80\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 100\text{ Vdc}$, $V_{EB} = 0$)	TIP41, TIP42 TIP41A, TIP42A TIP41B, TIP42B TIP41C, TIP42C	I_{CES}	— — — —	400 400 400 400	μAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)		I_{EBO}	—	1.0	mAdc
ON CHARACTERISTICS (1)					
DC Current Gain ($I_C = 0.3\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)		h_{FE}	30 15	— 75	—
Collector-Emitter Saturation Voltage ($I_C = 6.0\text{ Adc}$, $I_B = 600\text{ mAdc}$)		$V_{CE(sat)}$	—	1.5	Vdc
Base-Emitter On Voltage ($I_C = 6.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)		$V_{BE(on)}$	—	2.0	Vdc
DYNAMIC CHARACTERISTICS					
Current Gain — Bandwidth Product (2) ($I_C = 500\text{ mAdc}$, $V_{CE} = 10\text{ Vdc}$, $f_{test} = 1\text{ MHz}$)		f_T	3.0	—	MHz
Small-Signal Current Gain ($I_C = 0.5\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1\text{ kHz}$)		$ h_{fe} $	20	—	—

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

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

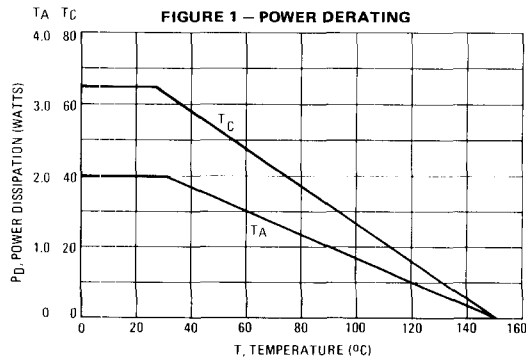


FIGURE 2 — SWITCHING TIME TEST CIRCUIT

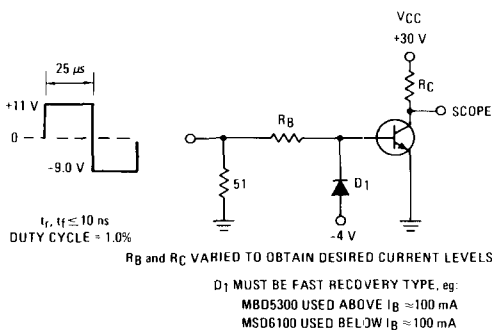
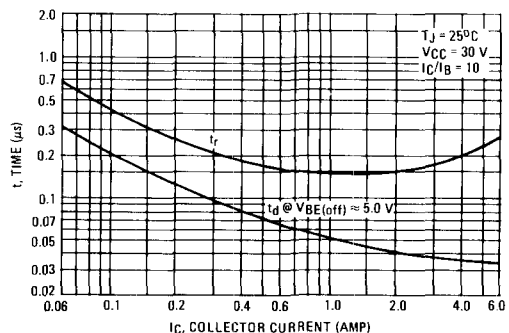


FIGURE 3 — TURN-ON TIME



TIP41, TIP41A, TIP41B, TIP41C, NPN, TIP42, TIP42A, TIP42B, TIP42C, PNP

FIGURE 4 – THERMAL RESPONSE

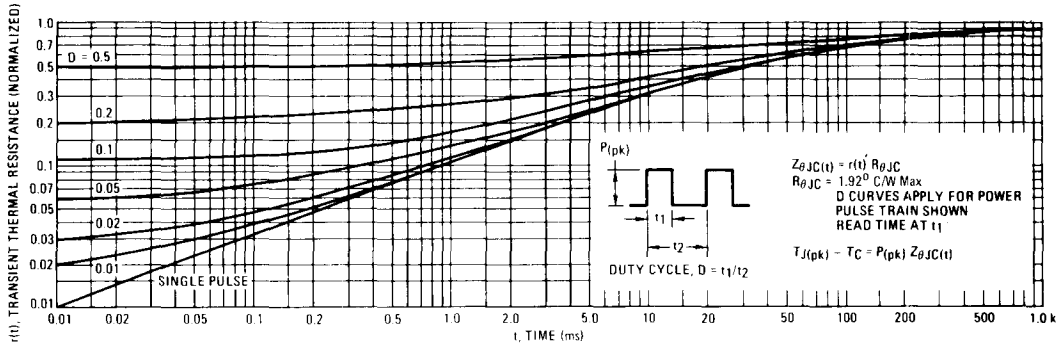
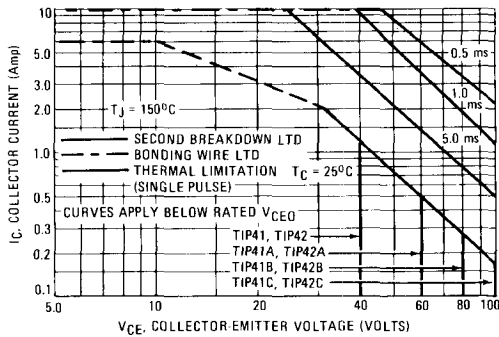


FIGURE 5 – ACTIVE-REGION SAFE OPERATING AREA



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 $T_J(p_k) = 150^\circ\text{C}$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_J(p_k) \leq 150^\circ\text{C}$. $T_J(p_k)$ 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

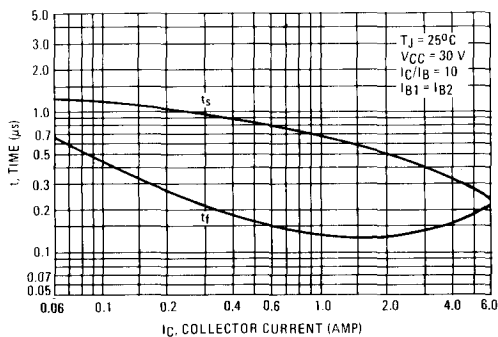
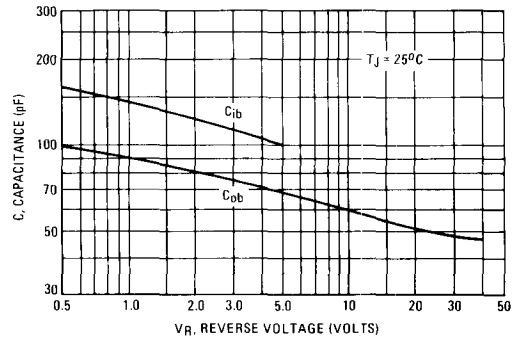


FIGURE 7 – CAPACITANCE



TIP41, TIP41A, TIP41B, TIP41C, NPN, TIP42, TIP42A, TIP42B, TIP42C, PNP

FIGURE 8 – DC CURRENT GAIN

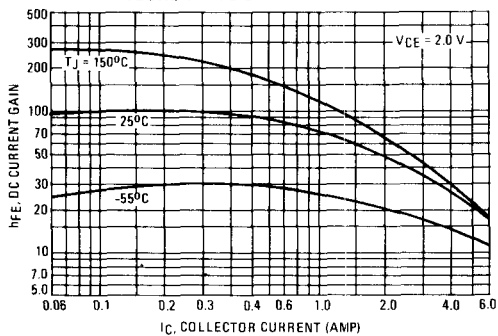


FIGURE 9 – COLLECTOR SATURATION REGION

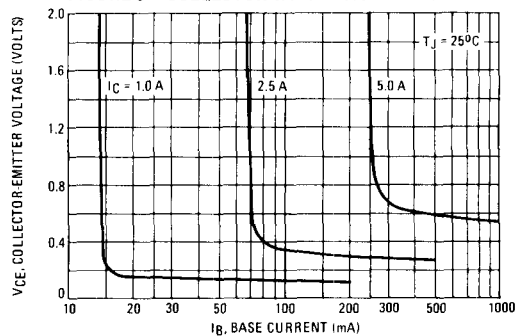


FIGURE 10 – "ON" VOLTAGES

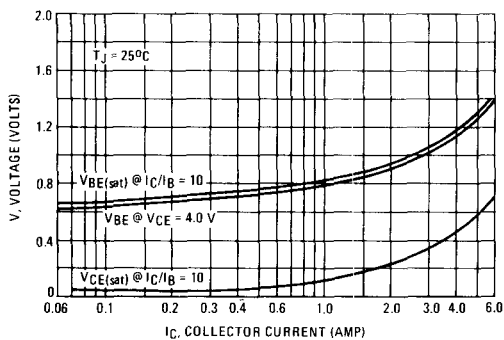


FIGURE 11 – TEMPERATURE COEFFICIENTS

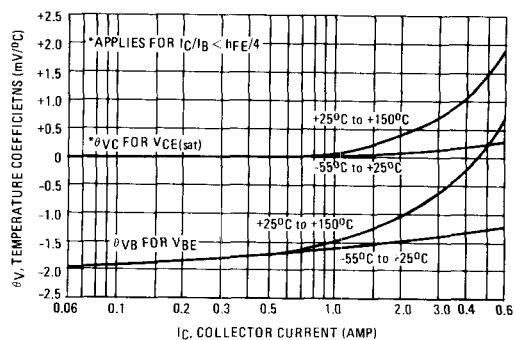


FIGURE 12 – COLLECTOR CUT-OFF REGION

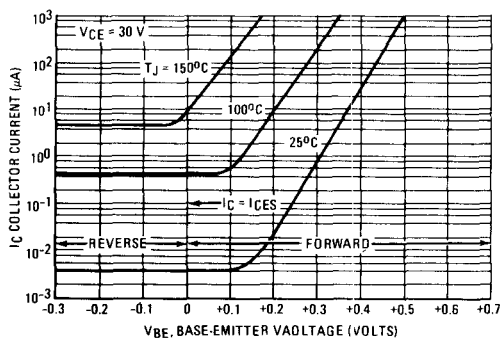


FIGURE 13 – EFFECTS OF BASE-EMITTER RESISTANCE

