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Complementary Silicon Plastic Power Transistors

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

- Collector–Emitter Saturation Voltage —
 $V_{CE(sat)} = 1.2 \text{ Vdc (Max) @ } I_C = 3.0 \text{ Adc}$
- Collector–Emitter Sustaining Voltage —
 $V_{CEO(sus)} = 60 \text{ Vdc (Min) — TIP31A, TIP32A}$
 $= 80 \text{ Vdc (Min) — TIP31B, TIP32B}$
 $= 100 \text{ Vdc (Min) — TIP31C, TIP32C}$
- High Current Gain — Bandwidth Product
 $f_T = 3.0 \text{ MHz (Min) @ } I_C = 500 \text{ mAdc}$
- Compact TO–220 AB Package

*MAXIMUM RATINGS

Rating	Symbol	TIP31A TIP32A	TIP31B TIP32B	TIP31C TIP32C	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 Peak	I_C	3.0 5.0			Adc
Base Current	I_B	1.0			Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	40 0.32			Watts W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	2.0 0.016			Watts W/ $^\circ\text{C}$
Unclamped Inductive Load Energy (1)	E	32			mJ
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to +150			$^\circ\text{C}$

THERMAL CHARACTERISTICS

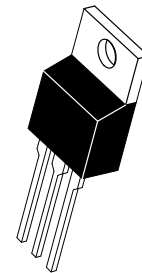
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C/W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	3.125	$^\circ\text{C/W}$

(1) $I_C = 1.8 \text{ A}$, $L = 20 \text{ mH}$, P.R.F. = 10 Hz, $V_{CC} = 10 \text{ V}$, $R_{BE} = 100 \Omega$.

NPN
TIP31A
TIP31B*
TIP31C*
PNP
TIP32A
TIP32B*
TIP32C*

*Motorola Preferred Device

3 AMPERE
POWER TRANSISTORS
COMPLEMENTARY
SILICON
60–80–100 VOLTS
40 WATTS



CASE 221A–06
TO–220AB

Preferred devices are Motorola recommended choices for future use and best overall value.

REV 1

TIP31A TIP31B TIP31C TIP32A TIP32B TIP32C

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (1) ($I_C = 30\text{ mA}$, $I_B = 0$)	$V_{CE(sus)}$	60 80 100	—	Vdc
Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 60\text{ Vdc}$, $I_B = 0$)	I_{CEO}	— — —	0.3 0.3 0.3	mAdc
Collector Cutoff Current ($V_{CE} = 60\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 80\text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 100\text{ Vdc}$, $V_{EB} = 0$)	I_{CES}	— — —	200 200 200	μAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	1.0	mAdc

ON CHARACTERISTICS (1)

DC Current Gain ($I_C = 1.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$) ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	h_{FE}	25 10	— 50	—
Collector–Emitter Saturation Voltage ($I_C = 3.0\text{ Adc}$, $I_B = 375\text{ mAdc}$)	$V_{CE(sat)}$	—	1.2	Vdc
Base–Emitter On Voltage ($I_C = 3.0\text{ Adc}$, $V_{CE} = 4.0\text{ Vdc}$)	$V_{BE(on)}$	—	1.8	Vdc

DYNAMIC CHARACTERISTICS

Current–Gain — Bandwidth Product ($I_C = 500\text{ mAdc}$, $V_{CE} = 10\text{ Vdc}$, $f_{test} = 1.0\text{ MHz}$)	f_T	3.0	—	MHz
Small–Signal Current Gain ($I_C = 0.5\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)	h_{fe}	20	—	—

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

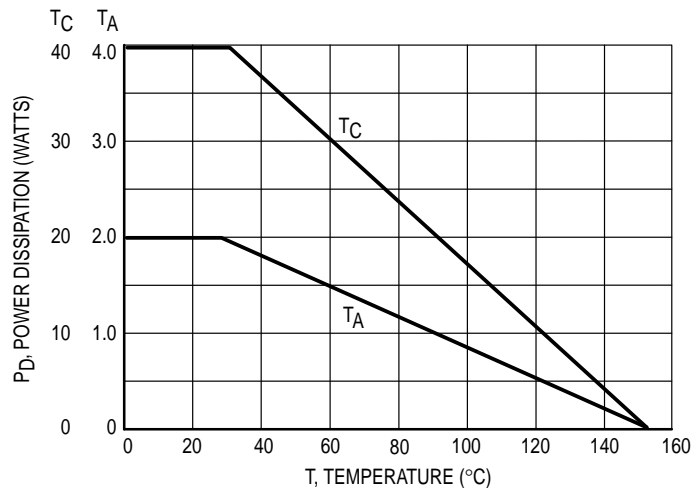


Figure 1. Power Derating

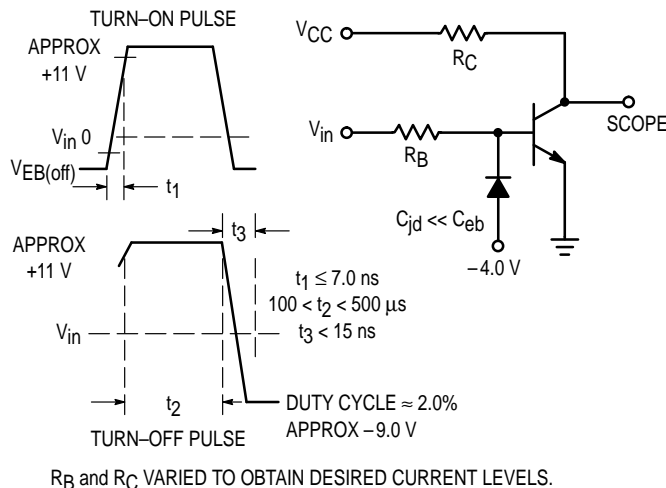


Figure 2. Switching Time Equivalent Circuit

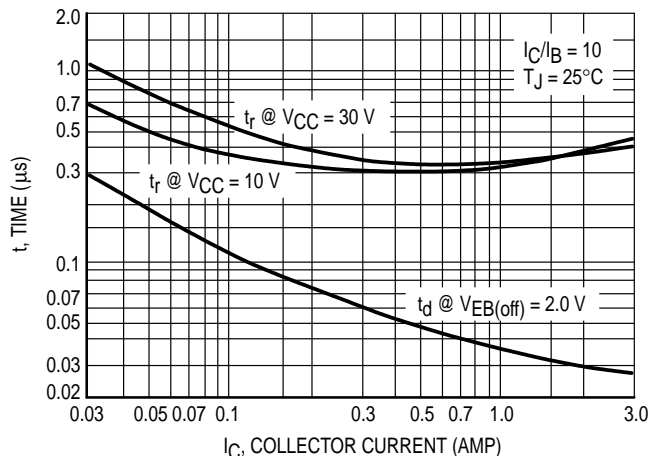


Figure 3. Turn–On Time

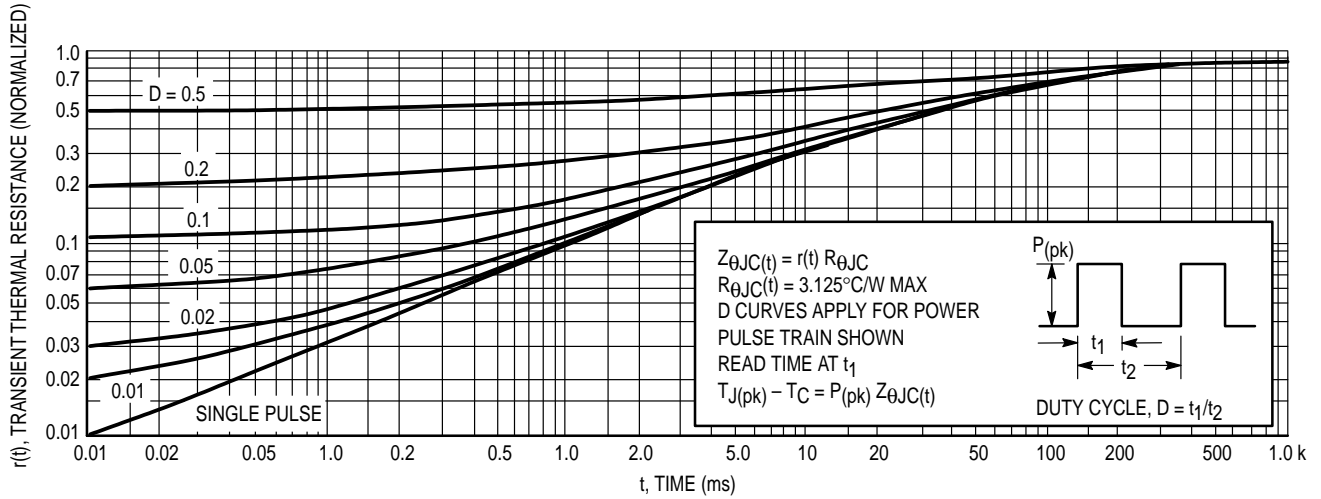


Figure 4. Thermal Response

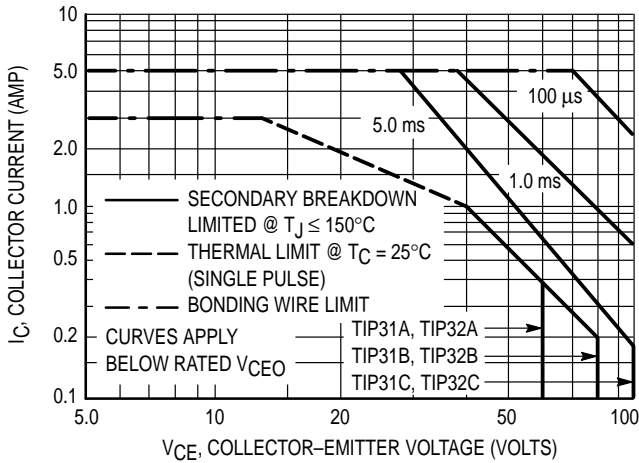


Figure 5. Active Region Safe Operating Area

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

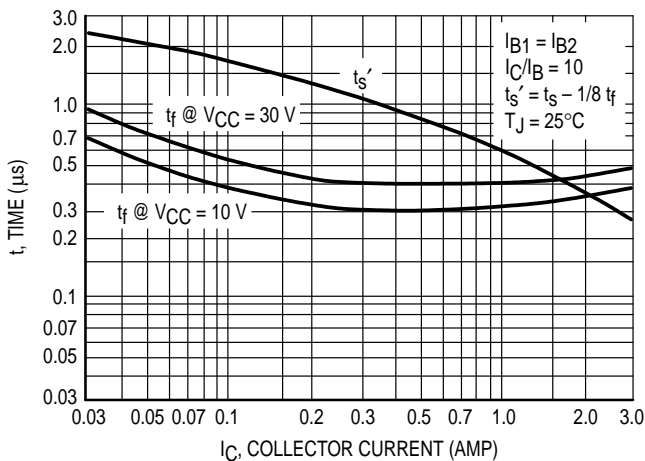


Figure 6. Turn-Off Time

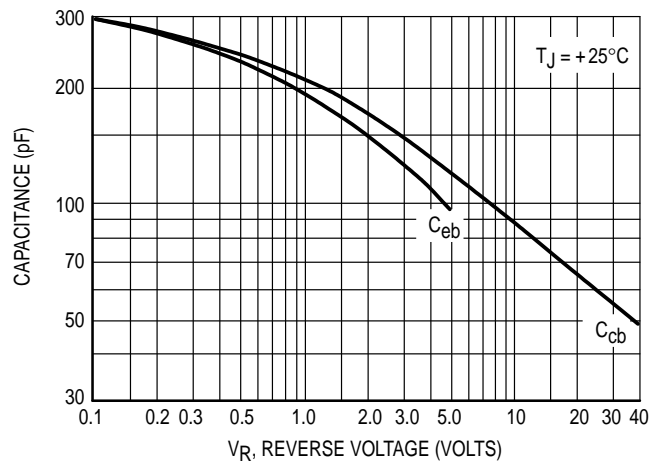


Figure 7. Capacitance

TIP31A TIP31B TIP31C TIP32A TIP32B TIP32C

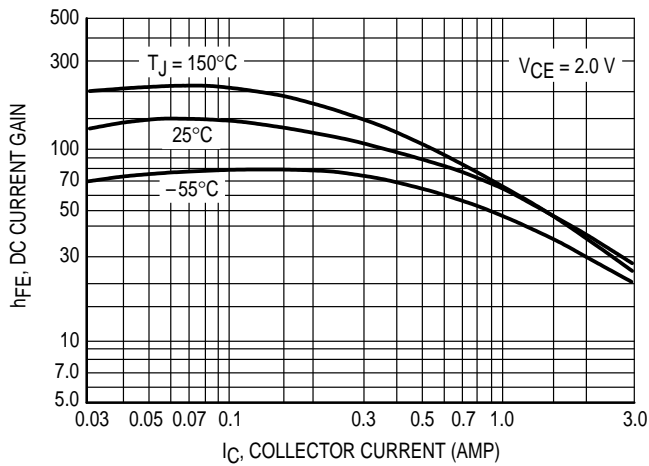


Figure 8. DC Current Gain

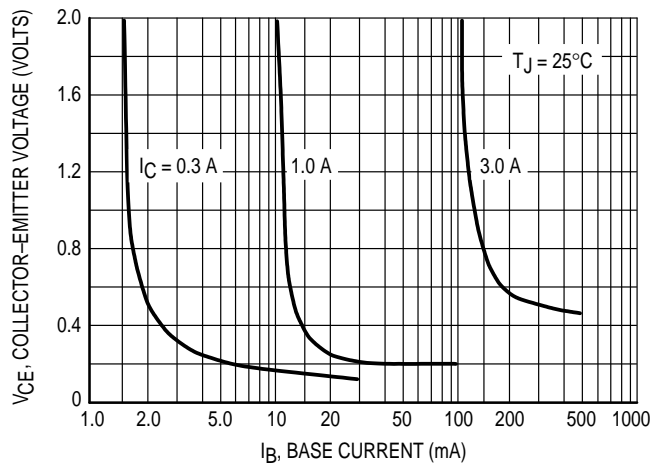


Figure 9. Collector Saturation Region

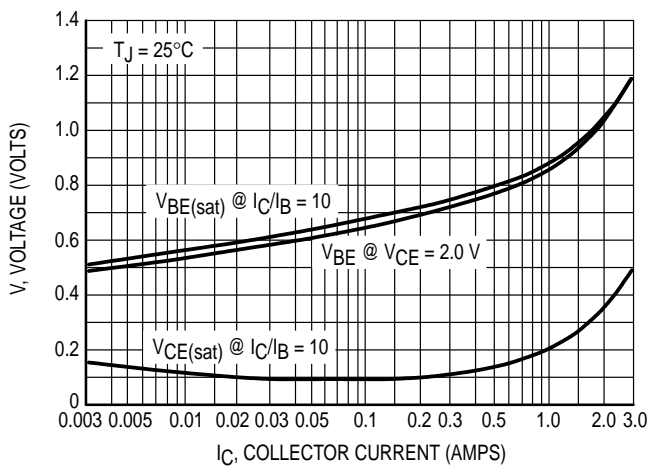


Figure 10. "On" Voltages

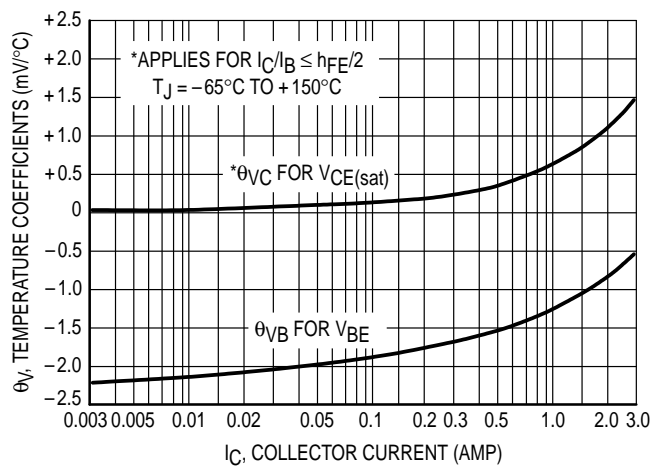


Figure 11. Temperature Coefficients

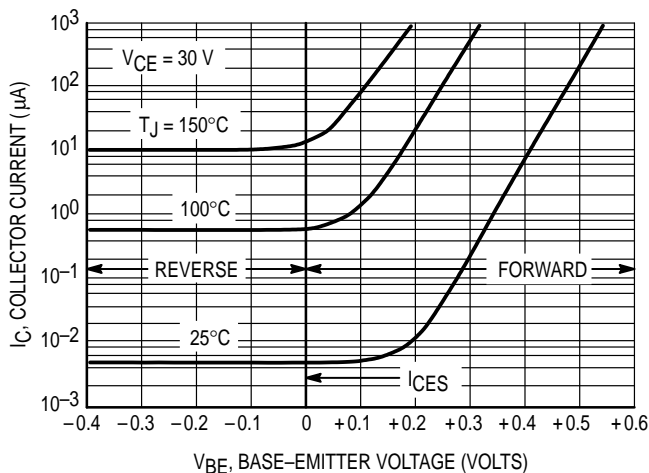


Figure 12. Collector Cut-Off Region

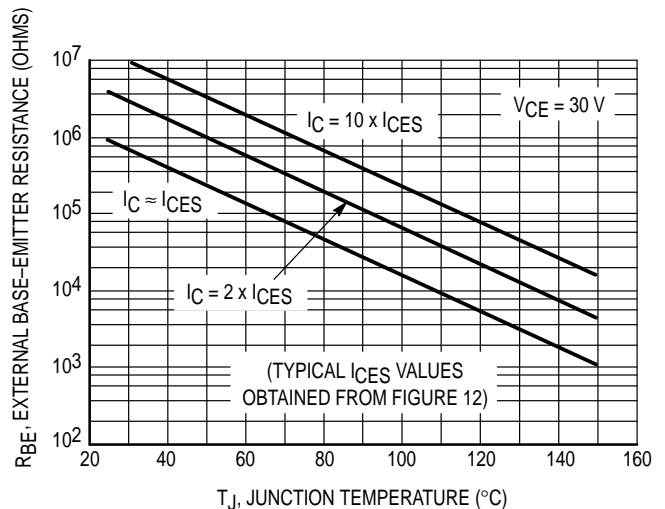
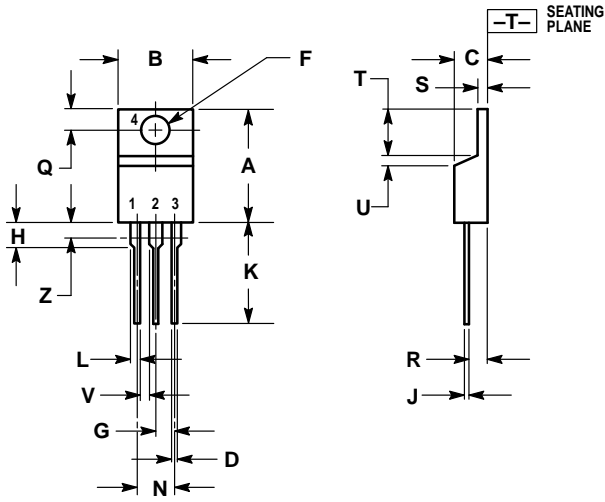


Figure 13. Effects of Base-Emitter Resistance

PACKAGE DIMENSIONS




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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	—	1.15	—
Z	—	0.080	—	2.04

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

CASE 221A-06
 TO-220AB
 ISSUE Y

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