

High Voltage NPN Silicon Power Transistors

... designed for line operated audio output amplifier, Switchmode power supply drivers and other switching applications.

- 250 V to 400 V (Min) — $V_{CEO(sus)}$
- 1 A Rated Collector Current
- Popular TO-220 Plastic Package

MAXIMUM RATINGS

Rating	Symbol	TIP47	TIP48	TIP49	TIP50	Unit
Collector-Emitter Voltage	V_{CEO}	250	300	350	400	Vdc
Collector-Base Voltage	V_{CB}	350	400	450	500	Vdc
Emitter-Base Voltage	V_{EB}	5.0				Vdc
Collector Current — Continuous Peak	I_C	1.0 2.0				A dc
Base Current	I_B	0.6				A dc
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 Inducting Load Energy (See Figure 8)	E	20				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	$R_{\theta JC}$	3.125	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C}/\text{W}$

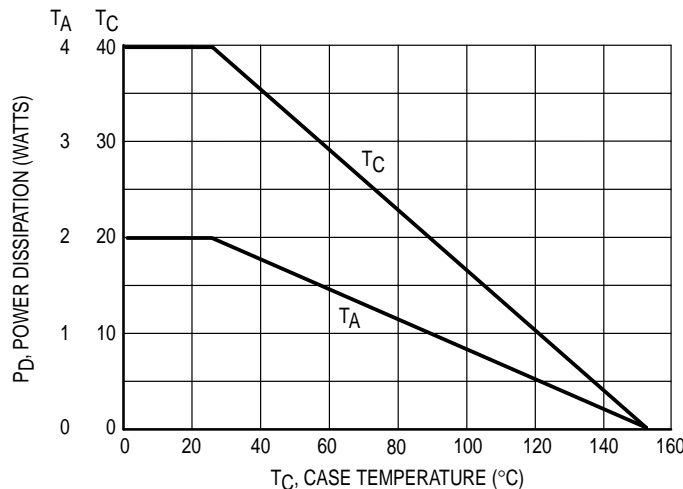


Figure 1. Power Derating

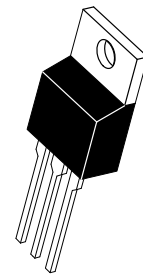
Preferred devices are Motorola recommended choices for future use and best overall value.

REV 1

TIP47*
TIP49*
TIP48*
TIP50*

*Motorola Preferred Device

**1.0 AMPERE
POWER TRANSISTORS
NPN SILICON
250-300-350-400 VOLTS
40 WATTS**



**CASE 221A-06
TO-220AB**

TIP47 TIP49 TIP48 TIP50

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

Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
Collector–Emitter Sustaining Voltage (1) ($I_C = 30\text{ mA dc}$, $I_B = 0$)	TIP47 TIP48 TIP49 TIP50	$V_{CE(sus)}$	250 300 350 400	— — — —	Vdc
Collector Cutoff Current ($V_{CE} = 150\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 200\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 250\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 300\text{ Vdc}$, $I_B = 0$)	TIP47 TIP48 TIP49 TIP50	I_{CEO}	— — — —	1.0 1.0 1.0 1.0	mAdc
Collector Cutoff Current ($V_{CE} = 350\text{ Vdc}$, $V_{BE} = 0$) ($V_{CE} = 400\text{ Vdc}$, $V_{BE} = 0$) ($V_{CE} = 450\text{ Vdc}$, $V_{BE} = 0$) ($V_{CE} = 500\text{ Vdc}$, $V_{BE} = 0$)	TIP47 TIP48 TIP49 TIP50	I_{CES}	— — — —	1.0 1.0 1.0 1.0	mAdc
Emitter Cutoff Current ($V_{BE} = 5.0\text{ Vdc}$, $I_C = 0$)		I_{EBO}	—	1.0	mAdc

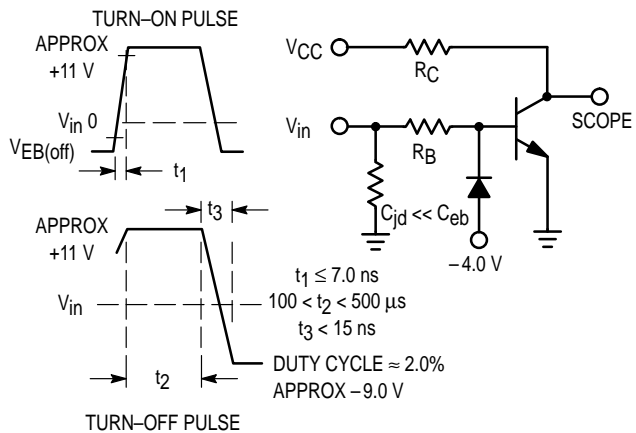
ON CHARACTERISTICS (1)

DC Current Gain ($I_C = 0.3\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$) ($I_C = 1.0\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$)	h_{FE}	30 10	150 —	—
Collector–Emitter Saturation Voltage ($I_C = 1.0\text{ Adc}$, $I_B = 0.2\text{ Adc}$)	$V_{CE(sat)}$	—	1.0	Vdc
Base–Emitter On Voltage ($I_C = 1.0\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$)	$V_{BE(on)}$	—	1.5	Vdc

DYNAMIC CHARACTERISTICS

Current–Gain — Bandwidth Product ($I_C = 0.1\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 2.0\text{ MHz}$)	f_T	10	—	MHz
Small–Signal Current Gain ($I_C = 0.2\text{ Adc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)	h_{fe}	25	—	—

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



R_B and R_C VARIED TO OBTAIN DESIRED CURRENT LEVELS.

Figure 2. Switching Time Equivalent Circuit

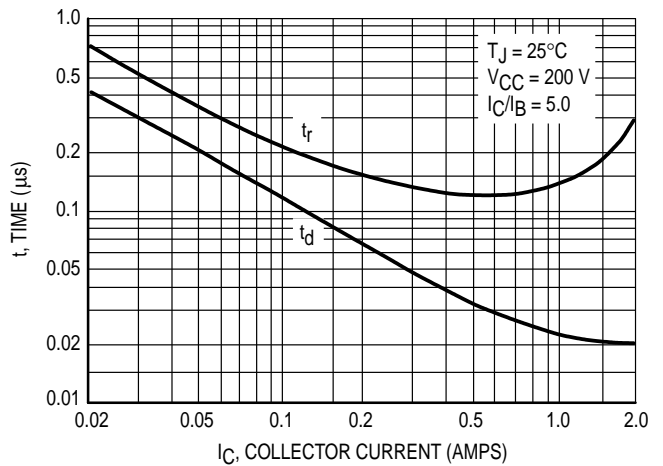


Figure 3. Turn–On Time

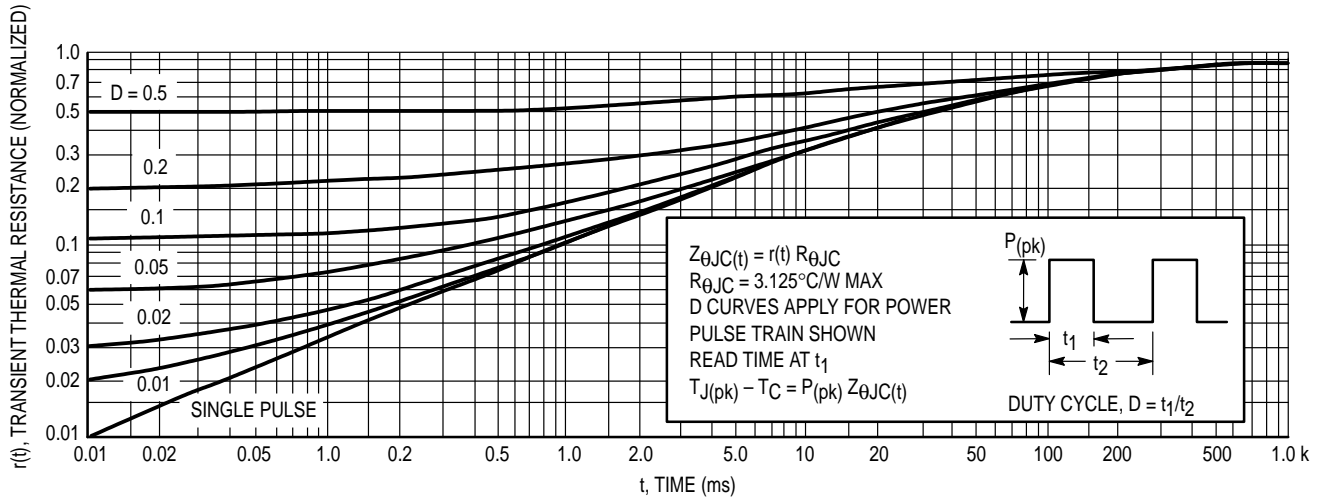


Figure 4. Thermal Response

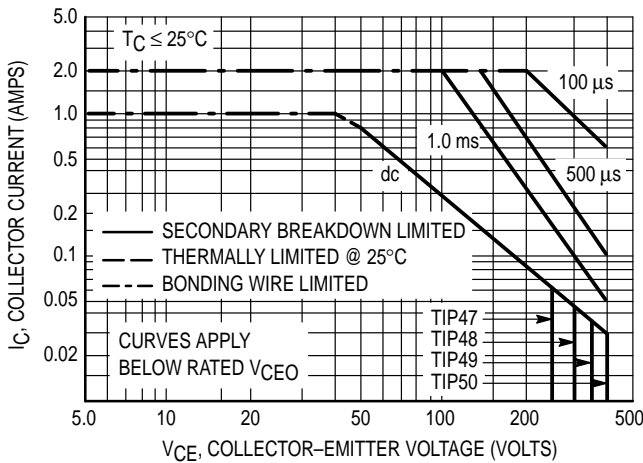


Figure 5. Active Region Safe Operating Area

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.

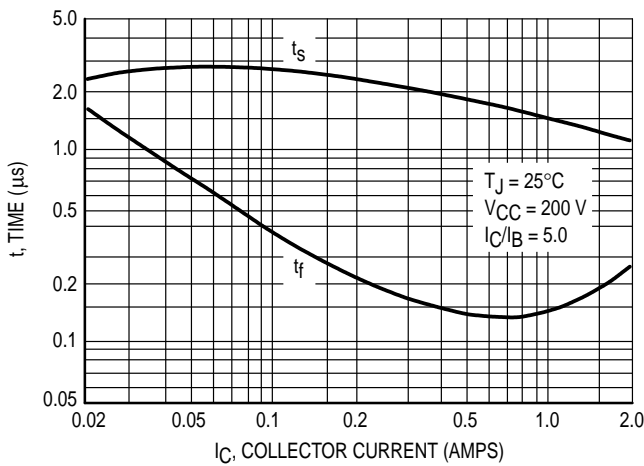


Figure 6. Turn-Off Time

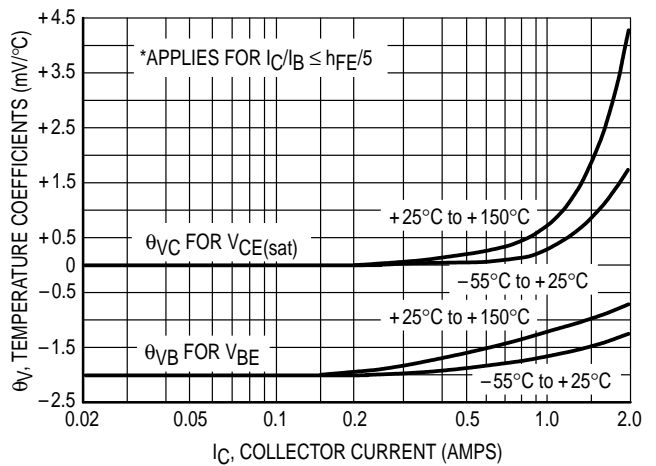
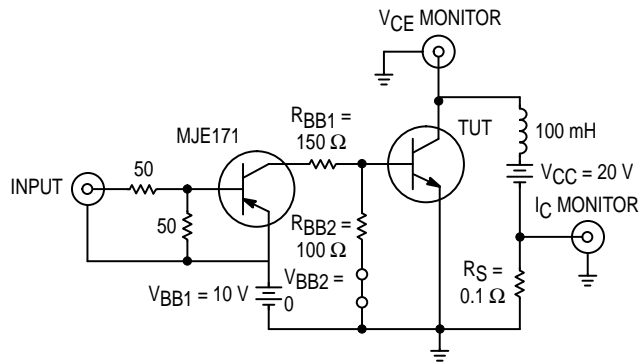


Figure 7. Temperature Coefficients



Note A: Input pulse width is increased until $I_{CM} = 0.63$ A.

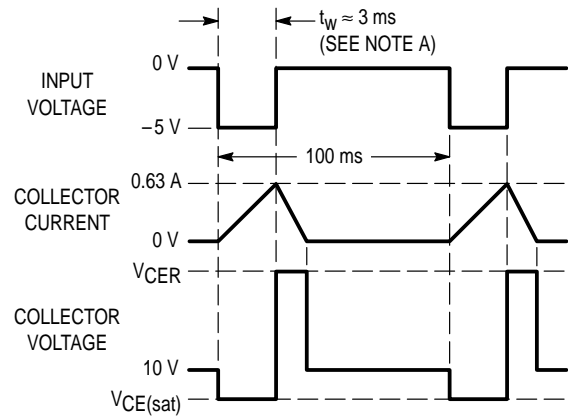


Figure 8. Inductive Load Switching

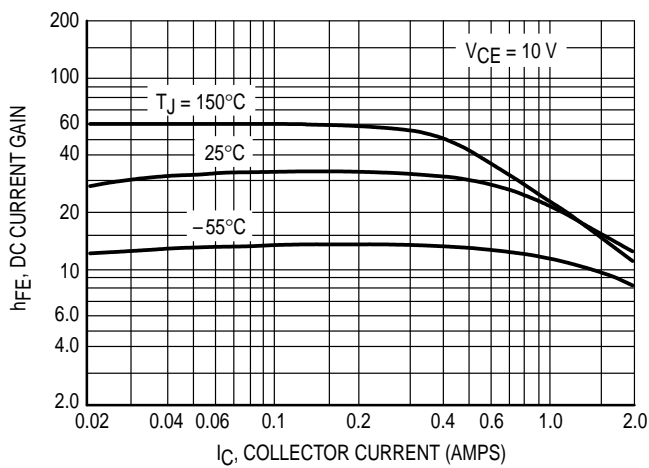


Figure 9. DC Current Gain

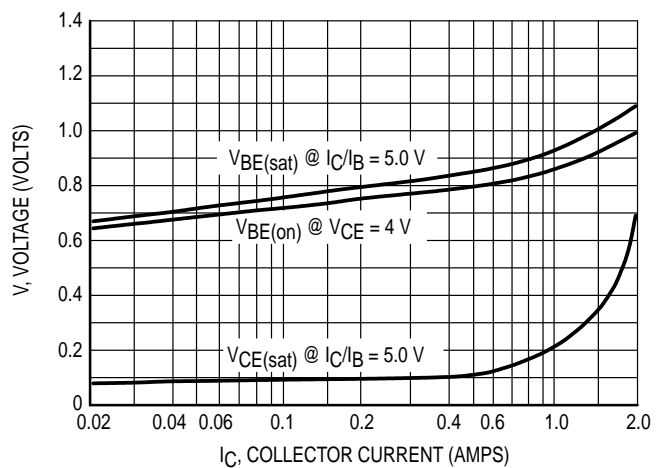
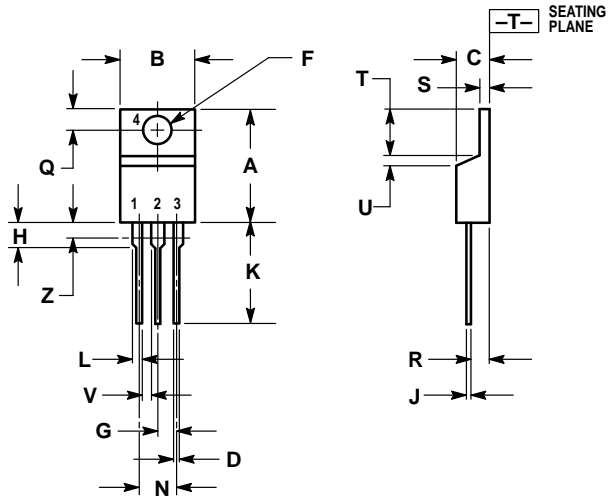


Figure 10. "On" Voltages

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
 - COLLECTOR
 - EMITTER
 - COLLECTOR

CASE 221A-06
TO-220AB
ISSUE Y

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