

# 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	TIP50	Unit
Collector–Emitter Voltage	$V_{CEO}$	250	300	400	Vdc
Collector–Base Voltage	$V_{CB}$	350	400	500	Vdc
Emitter–Base Voltage	$V_{EB}$	5.0			Vdc
Collector Current — Continuous	$I_C$	1.0			Adc
Peak		2.0			
Base Current	$I_B$	0.6			Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	40			Watts
		0.32			W/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	2.0			Watts
		0.016			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	$^\circ\text{C}/\text{W}$

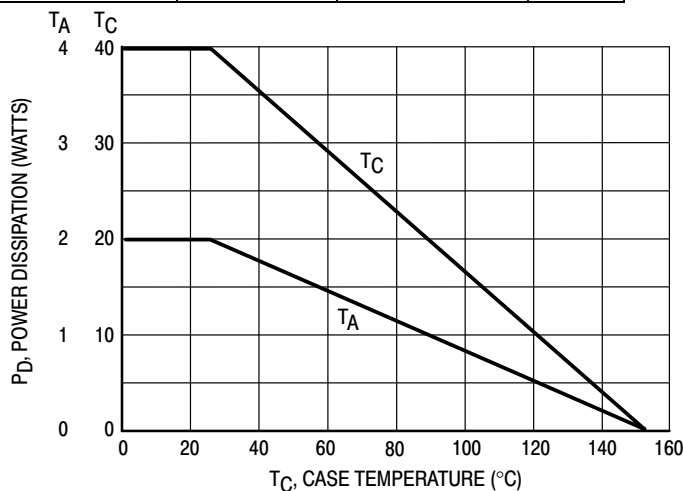


Figure 1. Power Derating

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

**TIP47\***  
**TIP48\***  
**TIP50\***

\*ON Semiconductor Preferred Device

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

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

**CASE 221A-09  
 TO-220AB**

# TIP47 TIP48 TIP50

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

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

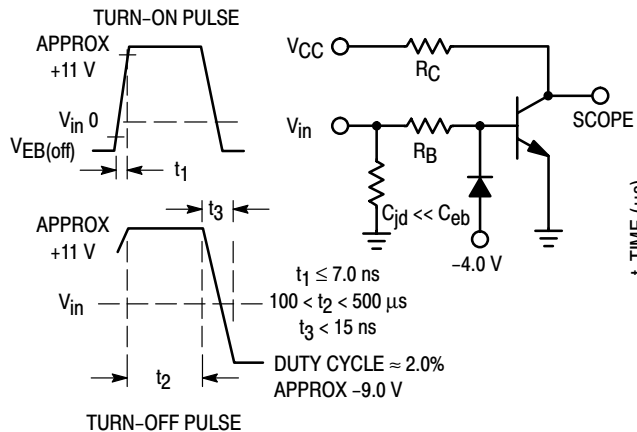
## ON CHARACTERISTICS (1)

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

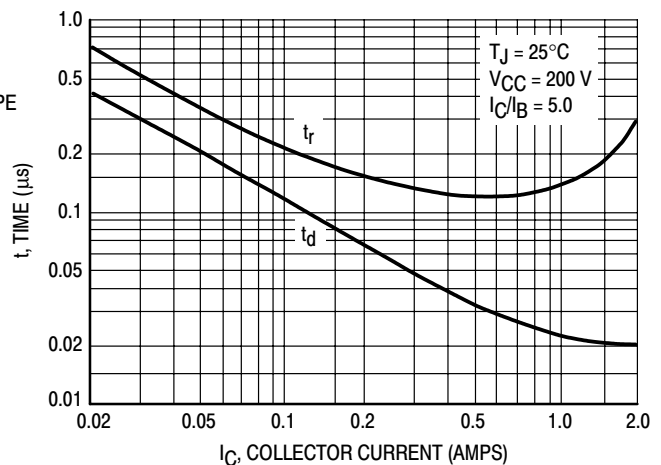
Current–Gain — Bandwidth Product ( $I_C = 0.1\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 2.0\text{ MHz}$ )	$f_T$	10	—	MHz
Small–Signal Current Gain ( $I_C = 0.2\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	25	—	—

(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**

# TIP47 TIP48 TIP50

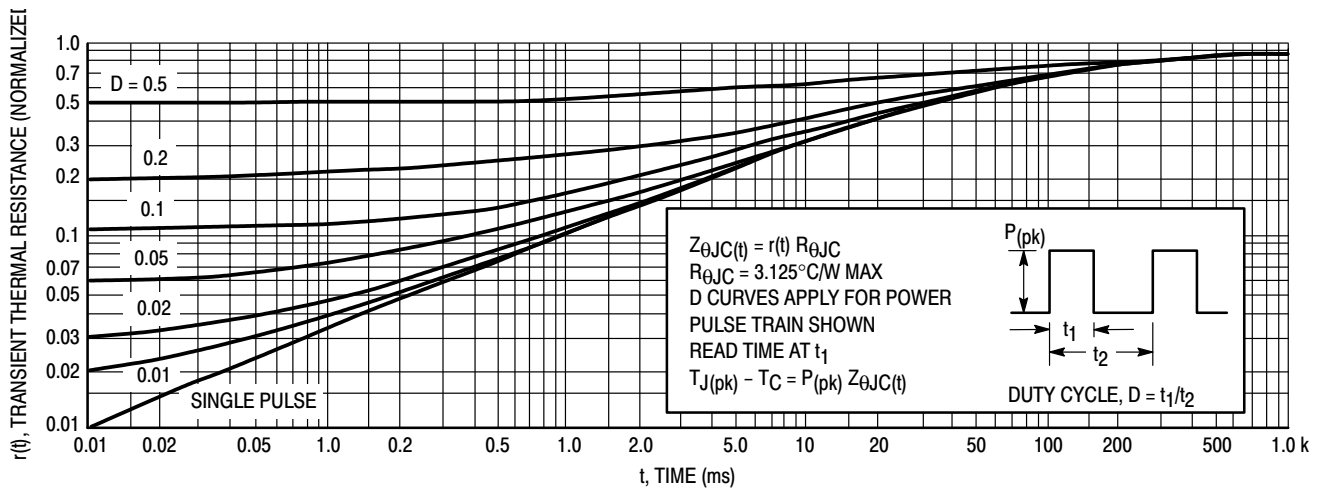


Figure 4. Thermal Response

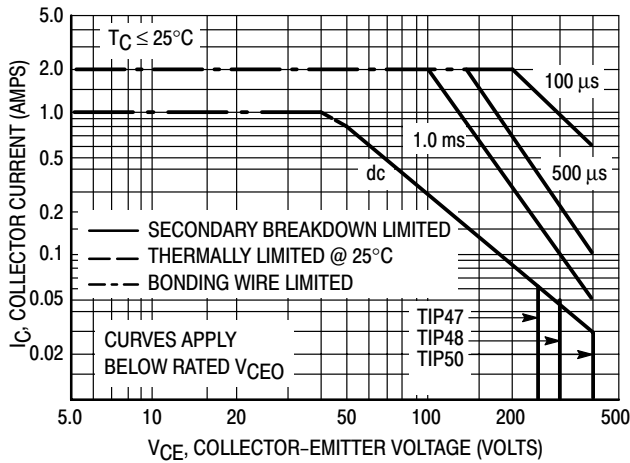


Figure 5. Active Region Safe Operating Area

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.

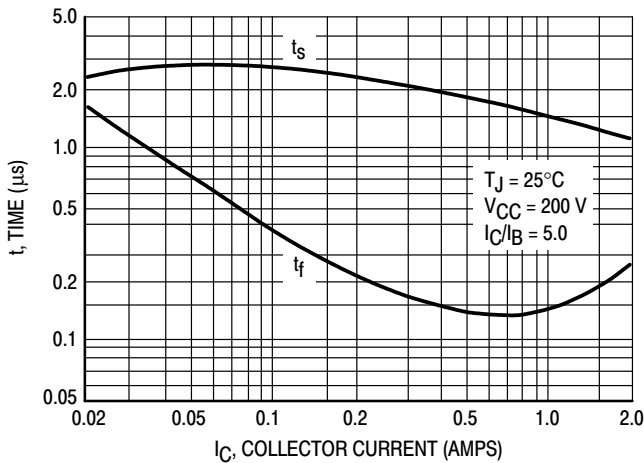


Figure 6. Turn-Off Time

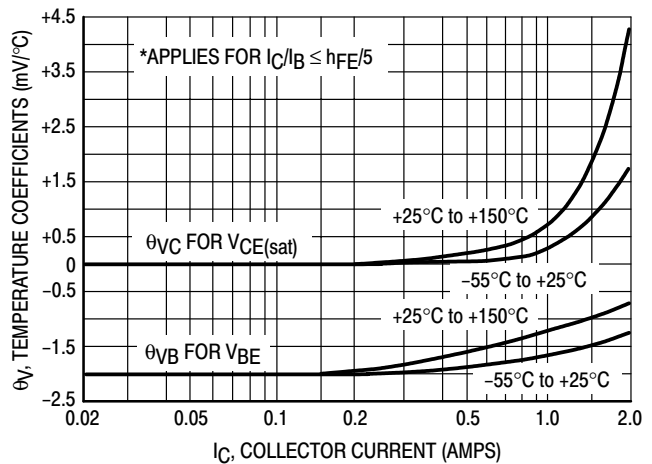
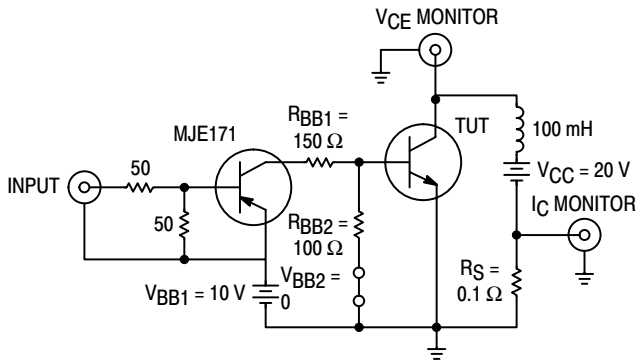


Figure 7. Temperature Coefficients

TIP47 TIP48 TIP50



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

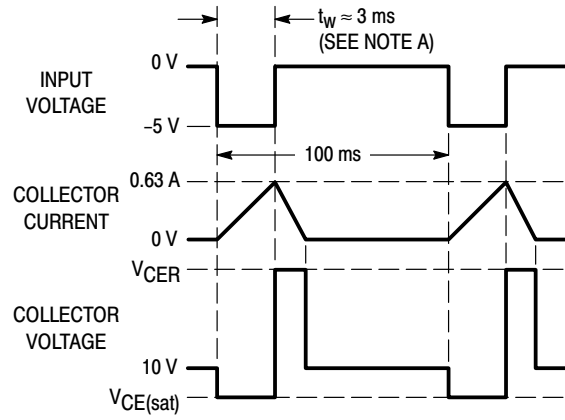


Figure 8. Inductive Load Switching

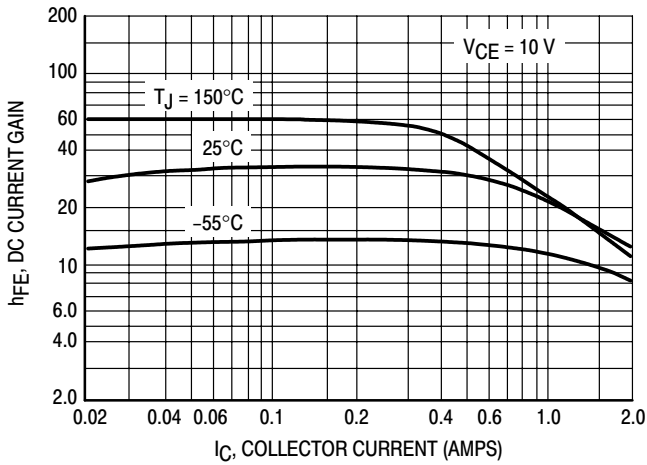


Figure 9. DC Current Gain

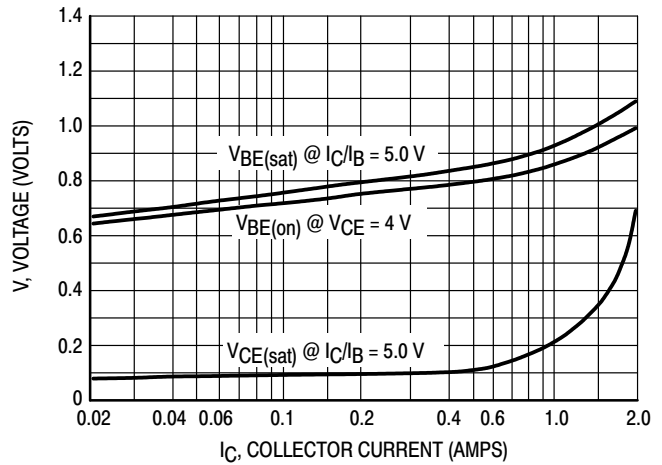
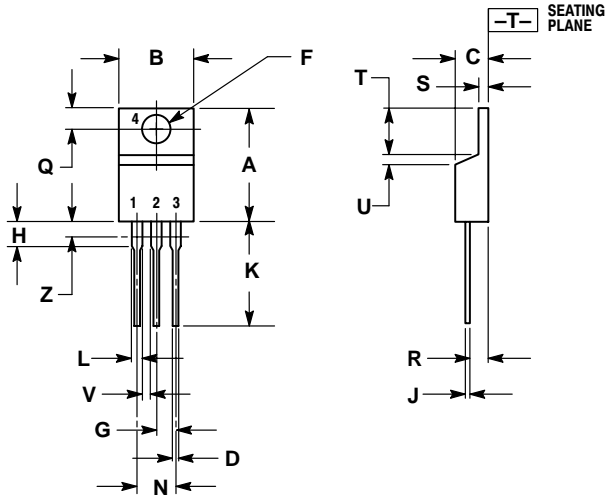


Figure 10. "On" Voltages

# TIP47 TIP48 TIP50

## PACKAGE DIMENSIONS

### TO-220AB CASE 221A-09 ISSUE AA



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


- 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

## Notes

## Notes

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