

# TIP47, TIP48, TIP50

Preferred Device

## High Voltage NPN Silicon Power Transistors

This series is designed for line operated audio output amplifier, SWITCHMODE™ power supply drivers and other switching applications.

### Features

- 250 V to 400 V (Min) –  $V_{CEO(sus)}$
- 1 A Rated Collector Current
- Popular TO–220 Plastic Package
- Pb–Free Packages are Available\*

### 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	$I_C$	1.0			Adc
– Continuous		2.0			
– Peak					
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			W
		0.32			W/ $^\circ\text{C}$
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	2.0			W
		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			$^\circ\text{C}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

### THERMAL CHARACTERISTICS

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

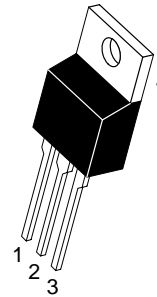
\*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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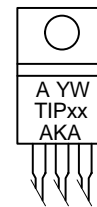
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**1.0 AMPERE  
POWER TRANSISTORS  
NPN SILICON  
250–300–350–400 VOLTS  
40 WATTS**



TO–220AB  
CASE 221A  
STYLE 1

### MARKING DIAGRAM



A = Assembly Location  
Y = Year  
W = Work Week  
TIP = Device Code  
xx = 47, 48, or 50  
AKA = Location Code

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

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

# 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 (Note 1) ( $I_C = 30\text{ mA}$ , $I_B = 0$ )	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
<b>ON CHARACTERISTICS (Note 1)</b>					
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
<b>DYNAMIC CHARACTERISTICS</b>					
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  $\leq 2.0\%$ .

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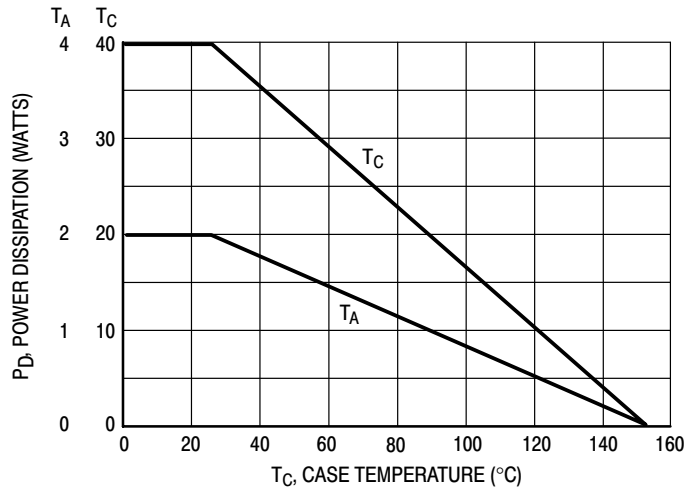
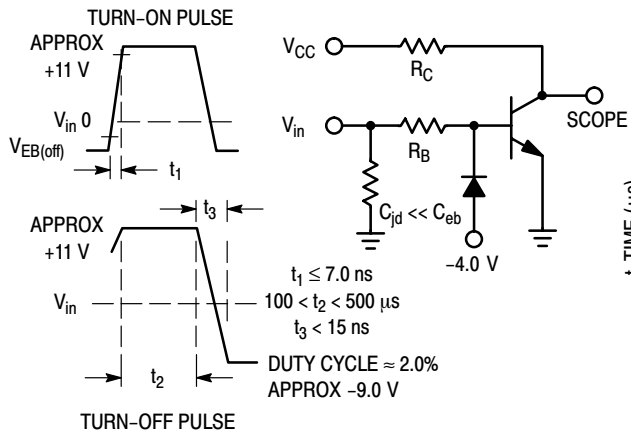


Figure 1. Power Derating



R<sub>B</sub> and R<sub>C</sub> VARIED TO OBTAIN DESIRED CURRENT LEVELS.

Figure 2. Switching Time Equivalent Circuit

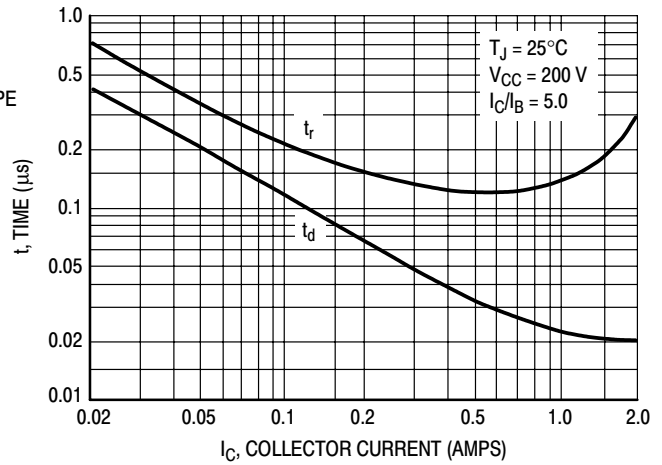


Figure 3. Turn-On Time

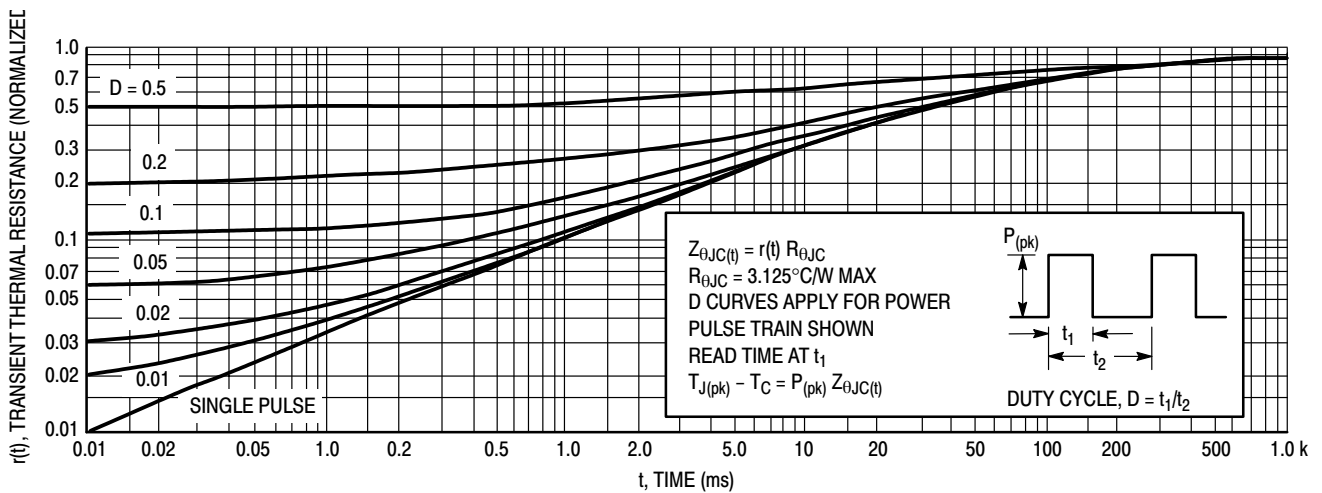


Figure 4. Thermal Response

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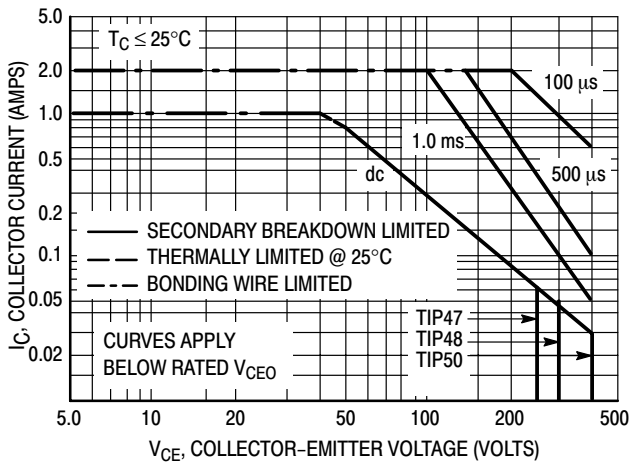


Figure 5. Active Region Safe Operating Area

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.

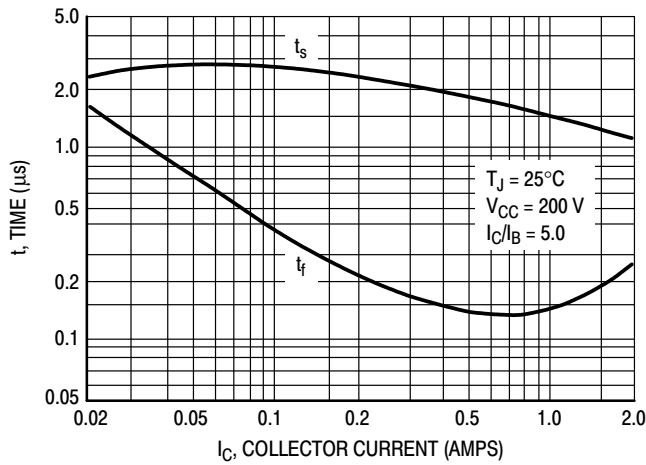


Figure 6. Turn-Off Time

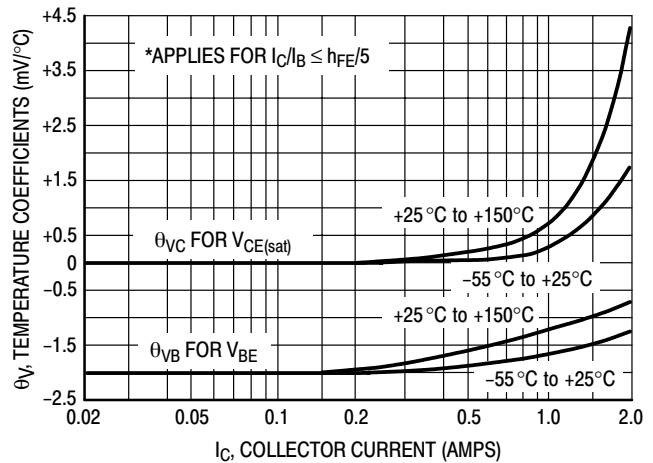
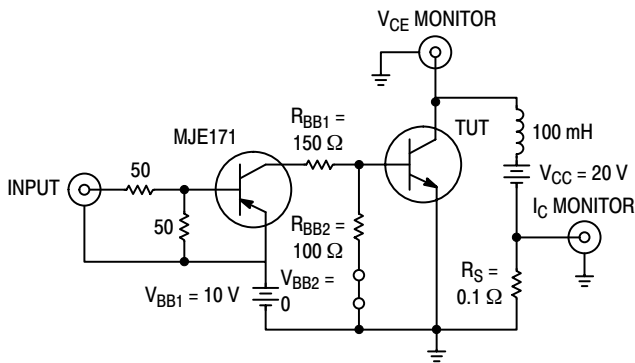


Figure 7. Temperature Coefficients



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

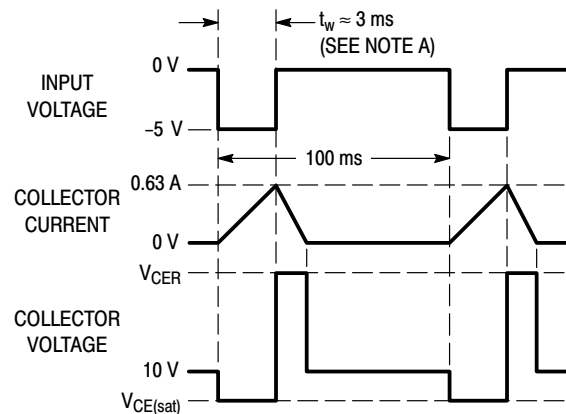
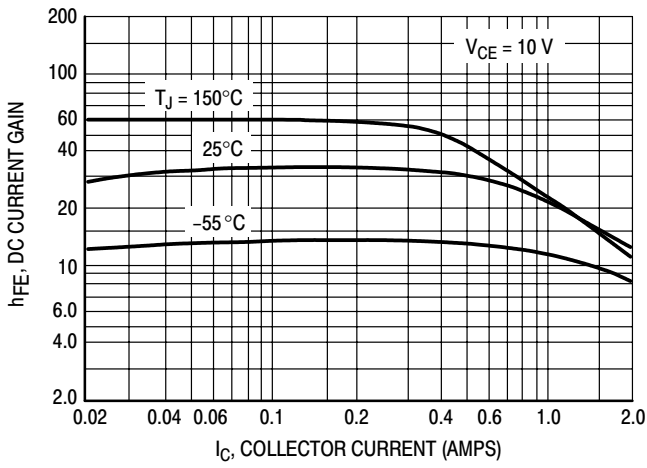
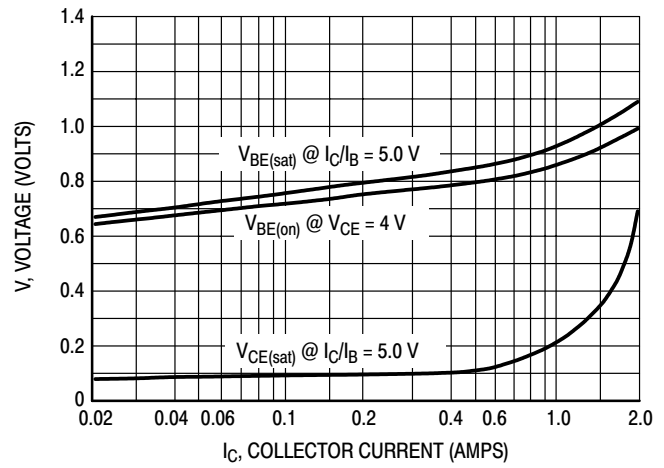


Figure 8. Inductive Load Switching

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**Figure 9. DC Current Gain**



**Figure 10. "On" Voltages**

### ORDERING INFORMATION

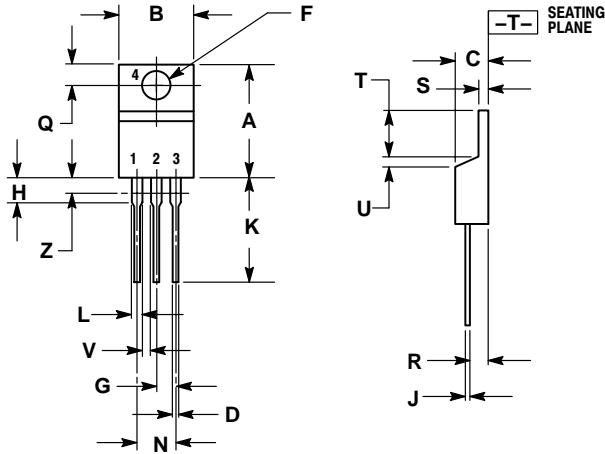
Device	Package	Shipping <sup>†</sup>
TIP47	TO-220	50 Units / Rail
TIP47G	TO-220 (Pb-Free)	50 Units / Rail
TIP48	TO-220	50 Units / Rail
TIP48G	TO-220 (Pb-Free)	50 Units / Rail
TIP50	TO-220	50 Units / Rail
TIP50G	TO-220 (Pb-Free)	50 Units / Rail

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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## PACKAGE DIMENSIONS

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




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

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