

# High Voltage NPN Silicon Power Transistors

## TIP47G, TIP48G, TIP50G

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

### Features

- Popular TO-220 Plastic Package
- Complementary to the MJE5730 and MJE5731 Series
- These Devices are Pb-Free and are RoHS Compliant\*

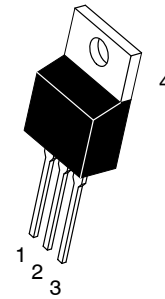
### MAXIMUM RATINGS

| Symbol         | Rating                                                                                   | TIP47        | TIP48 | TIP50 | Unit                     |
|----------------|------------------------------------------------------------------------------------------|--------------|-------|-------|--------------------------|
| $V_{CEO}$      | Collector – Emitter Voltage                                                              | 250          | 300   | 400   | Vdc                      |
| $V_{CB}$       | Collector – Base Voltage                                                                 | 350          | 400   | 500   | Vdc                      |
| $V_{EB}$       | Emitter – Base Voltage                                                                   | 5.0          |       |       | Vdc                      |
| $I_C$          | Collector Current – Continuous                                                           | 1.0          |       |       | Adc                      |
| $I_{CM}$       | Collector Current – Peak                                                                 | 2.0          |       |       | Adc                      |
| $I_B$          | Base Current                                                                             | 0.6          |       |       | Adc                      |
| $P_D$          | Total Power Dissipation<br>@ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | 40<br>0.32   |       |       | W<br>W/ $^\circ\text{C}$ |
| $P_D$          | Total Power Dissipation<br>@ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | 2.0<br>0.016 |       |       | W<br>W/ $^\circ\text{C}$ |
| E              | Unclamped Inducting Load<br>Energy (See Figure 8)                                        | 20           |       |       | mJ                       |
| $T_J, T_{stg}$ | Operating and Storage<br>Junction Temperature Range                                      | -65 to +150  |       |       | $^\circ\text{C}$         |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

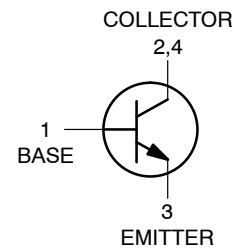
### THERMAL CHARACTERISTICS

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

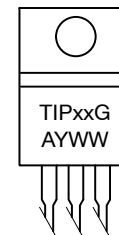


TO-220AB  
CASE 221A  
STYLE 1

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



### MARKING DIAGRAM



TIPxx = Device Code  
 xx = 47, 48, or 50  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

\*For additional information on our Pb-Free strategy and soldering details, please download the [onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D](#).

# TIP47G, TIP48G, TIP50G

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

| Symbol | Characteristic | Min | Max | Unit |
|--------|----------------|-----|-----|------|
|--------|----------------|-----|-----|------|

### OFF CHARACTERISTICS

|                |                                                                                                                                                                          |                         |                   |                   |      |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-------------------|-------------------|------|
| $V_{CEO(sus)}$ | Collector–Emitter Sustaining Voltage (Note 1)<br>( $I_C = 30\text{ mAdc}$ , $I_B = 0$ )                                                                                  | TIP47<br>TIP48<br>TIP50 | 250<br>300<br>400 | –<br>–<br>–       | Vdc  |
| $I_{CEO}$      | Collector Cutoff Current<br>( $V_{CE} = 150\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 200\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 300\text{ Vdc}$ , $I_B = 0$ )          | TIP47<br>TIP48<br>TIP50 | –<br>–<br>–       | 1.0<br>1.0<br>1.0 | mAdc |
| $I_{CES}$      | Collector Cutoff Current<br>( $V_{CE} = 350\text{ Vdc}$ , $V_{BE} = 0$ )<br>( $V_{CE} = 400\text{ Vdc}$ , $V_{BE} = 0$ )<br>( $V_{CE} = 500\text{ Vdc}$ , $V_{BE} = 0$ ) | TIP47<br>TIP48<br>TIP50 | –<br>–<br>–       | 1.0<br>1.0<br>1.0 | mAdc |
| $I_{EBO}$      | Emitter Cutoff Current<br>( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )                                                                                                      |                         | –                 | 1.0               | mAdc |

### ON CHARACTERISTICS (Note 1)

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

### DYNAMIC CHARACTERISTICS

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

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

# TIP47G, TIP48G, TIP50G

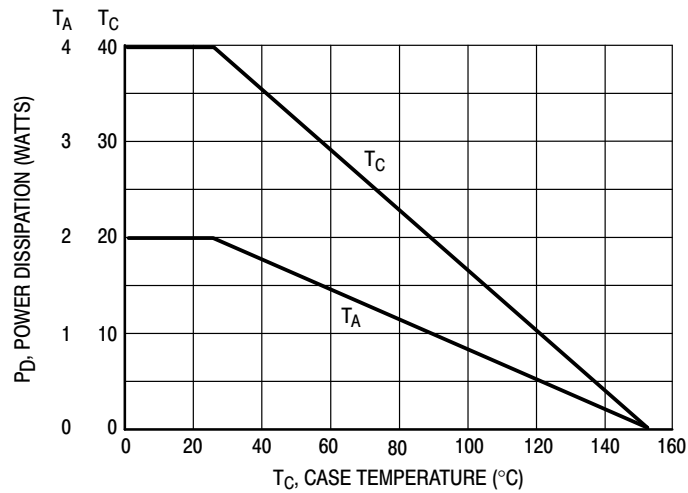
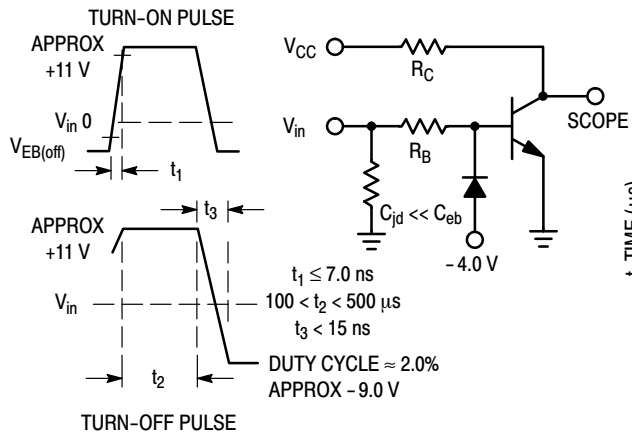


Figure 1. Power Derating



$R_B$  and  $R_C$  VARIED TO OBTAIN DESIRED CURRENT LEVELS.

Figure 2. Switching Time Equivalent Circuit

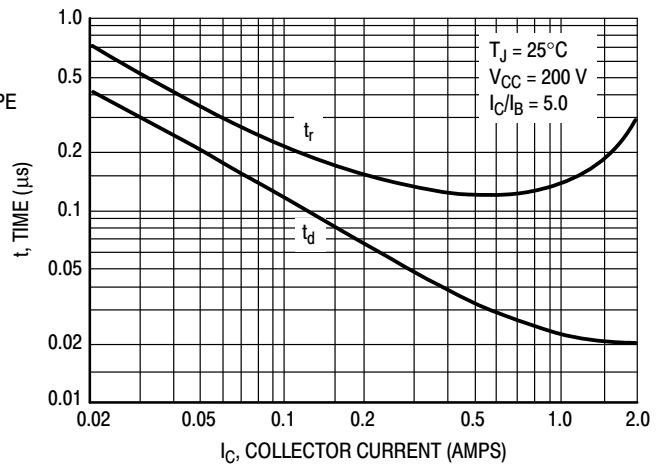


Figure 3. Turn-On Time

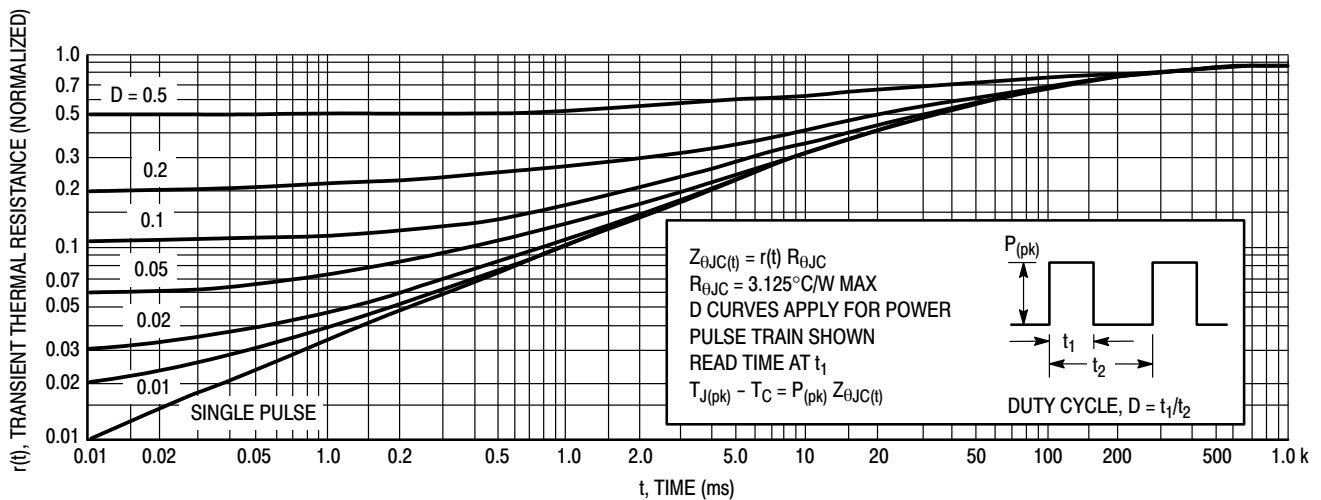


Figure 4. Thermal Response

## TIP47G, TIP48G, TIP50G

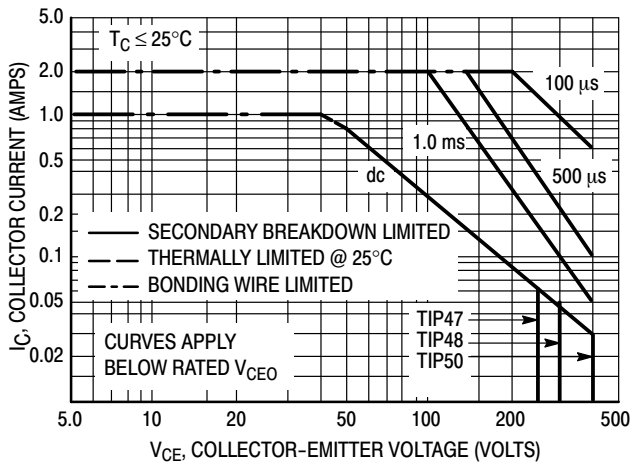


Figure 5. Active Region Safe Operating Area

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.

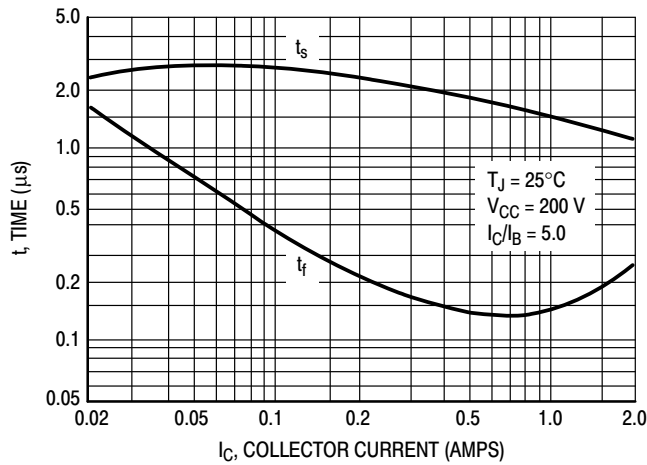


Figure 6. Turn-Off Time

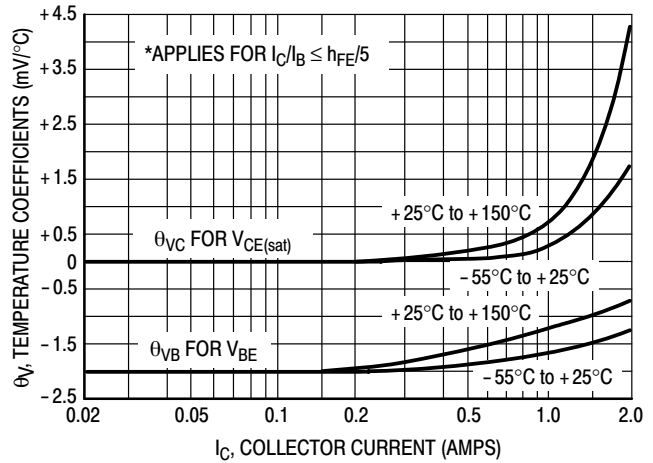
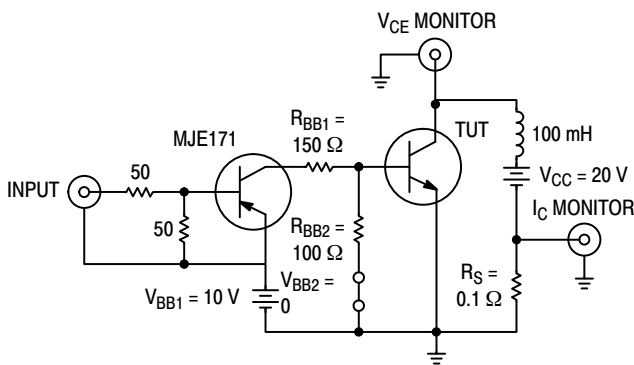


Figure 7. Temperature Coefficients



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

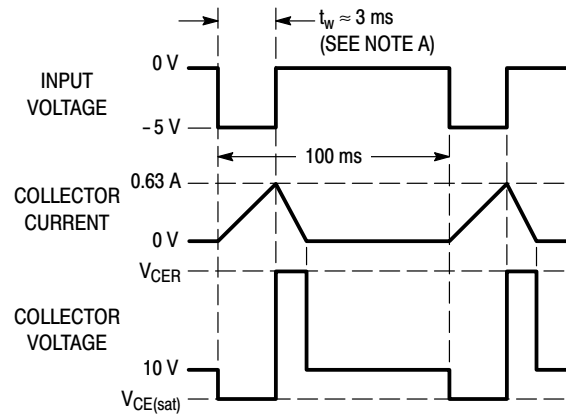
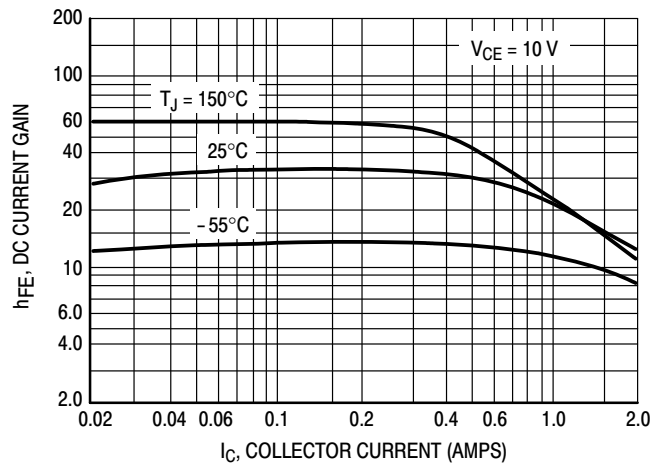
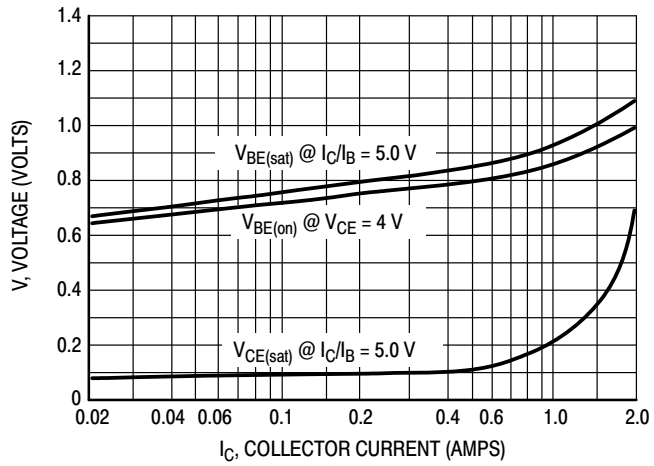


Figure 8. Inductive Load Switching

## TIP47G, TIP48G, TIP50G



**Figure 9. DC Current Gain**



**Figure 10. "On" Voltages**

### ORDERING INFORMATION

| Device | Package             | Shipping        |
|--------|---------------------|-----------------|
| TIP47G | TO-220<br>(Pb-Free) | 50 Units / Rail |
| TIP48G | TO-220<br>(Pb-Free) | 50 Units / Rail |
| TIP49G | TO-220<br>(Pb-Free) | 50 Units / Rail |
| TIP50G | TO-220<br>(Pb-Free) | 50 Units / Rail |


**TO-220-3 10.10x15.12x4.45, 2.54P**

CASE 221A

ISSUE AL

DATE 05 FEB 2025



| MILLIMETERS |          |       |       |
|-------------|----------|-------|-------|
| DIM         | MIN      | NOM   | MAX   |
| A           | 4.07     | 4.45  | 4.83  |
| A1          | 1.15     | 1.28  | 1.41  |
| A2          | 2.04     | 2.42  | 2.79  |
| b           | 1.15     | 1.34  | 1.52  |
| b1          | 0.64     | 0.80  | 0.96  |
| c           | 0.36     | 0.49  | 0.61  |
| D           | 9.66     | 10.10 | 10.53 |
| D1          | 8.43     | 8.63  | 8.83  |
| E           | 14.48    | 15.12 | 15.75 |
| E1          | 12.58    | 12.78 | 12.98 |
| E2          | 1.27 REF |       |       |

| MILLIMETERS |       |       |       |
|-------------|-------|-------|-------|
| DIM         | MIN   | NOM   | MAX   |
| e           | 2.42  | 2.54  | 2.66  |
| e1          | 4.83  | 5.08  | 5.33  |
| H1          | 5.97  | 6.22  | 6.47  |
| L           | 12.70 | 13.49 | 14.27 |
| L1          | 2.80  | 3.45  | 4.10  |
| Q           | 2.54  | 2.79  | 3.04  |
| øP          | 3.60  | 3.85  | 4.09  |
| Z           | ---   | ---   | 3.48  |

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

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

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

STYLE 3:  
PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE

STYLE 4:  
PIN 1. MAIN TERMINAL 1  
2. MAIN TERMINAL 2  
3. GATE  
4. MAIN TERMINAL 2

STYLE 5:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN

STYLE 6:  
PIN 1. ANODE  
2. CATHODE  
3. ANODE  
4. CATHODE

STYLE 7:  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE  
4. ANODE

STYLE 8:  
PIN 1. CATHODE  
2. ANODE  
3. EXTERNAL TRIP/DELAY  
4. ANODE

STYLE 9:  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR

STYLE 10:  
PIN 1. GATE  
2. SOURCE  
3. DRAIN  
4. SOURCE

STYLE 11:  
PIN 1. DRAIN  
2. SOURCE  
3. GATE  
4. SOURCE

STYLE 12:  
PIN 1. MAIN TERMINAL 1  
2. MAIN TERMINAL 2  
3. GATE  
4. NOT CONNECTED

**DOCUMENT NUMBER:** 98ASB42148B

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**DESCRIPTION:** TO-220-3 10.10x15.12x4.45, 2.54P

**PAGE 1 OF 1**

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