

TIP47G, TIP48G, TIP50G

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
- These Devices are Pb–Free and are RoHS Compliant*

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 | | | | Adc |
| – Continuous | | 1.0 | | | |
| – Peak | | 2.0 | | | |
| Base Current | I_B | 0.6 | | | Adc |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 40 | | | W |
| | | 0.32 | | | $W/^\circ\text{C}$ |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°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 | | | $^\circ\text{C}$ |

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 | $^\circ\text{C}/\text{W}$ |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

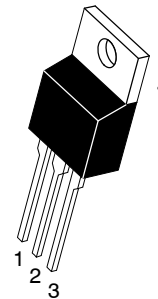
*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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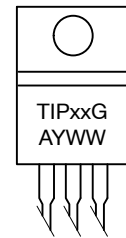
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**1.0 AMPERE
POWER TRANSISTORS
NPN SILICON
250 – 300 – 400 VOLTS
40 WATTS**



TO–220AB
CASE 221A
STYLE 1

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 in the package dimensions section on page 2 of this data sheet.

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

| Characteristic | Symbol | Min | Max | Unit |
|--|-------------------------|---------------|-------------------|---------------------------|
| OFF CHARACTERISTICS | | | | |
| Collector–Emitter Sustaining Voltage (Note 1) ($I_C = 30\text{ mAdc}$, $I_B = 0$) | TIP47 TIP48 TIP50 | $V_{CE(sus)}$ | 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 (Note 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 $\leq 2.0\%$.

ORDERING INFORMATION

| Device | Package | Shipping |
|--------|---------------------|-----------------|
| 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 |
| TIP49 | TO–220 | 50 Units / Rail |
| TIP49G | TO–220 (Pb–Free) | 50 Units / Rail |
| TIP50 | TO–220 | 50 Units / Rail |
| TIP50G | TO–220 (Pb–Free) | 50 Units / Rail |

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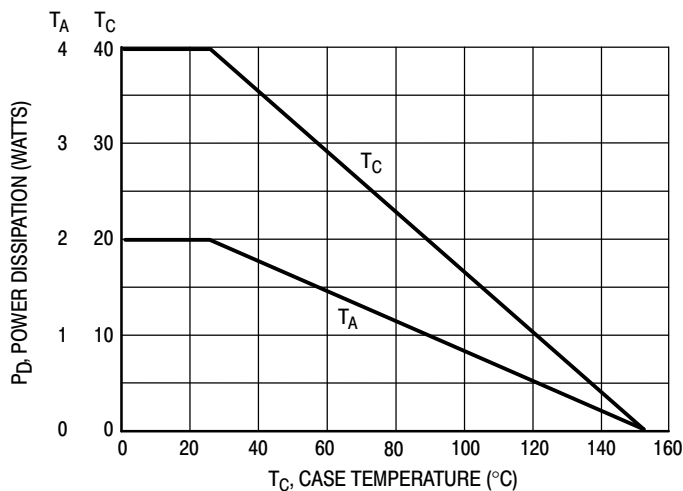
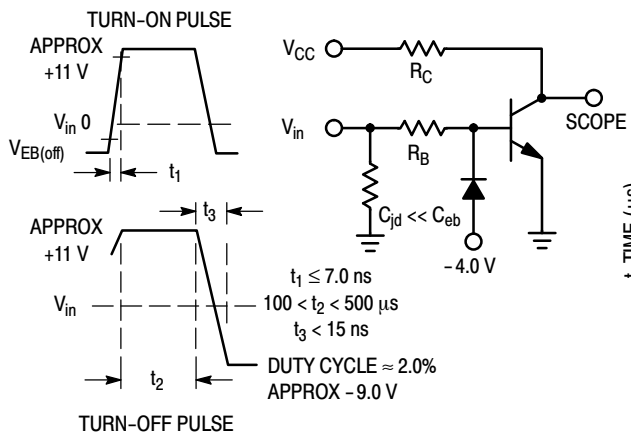


Figure 1. Power Derating



R_B and R_C VARIED TO OBTAIN DESIRED CURRENT LEVELS.

Figure 2. Switching Time Equivalent Circuit

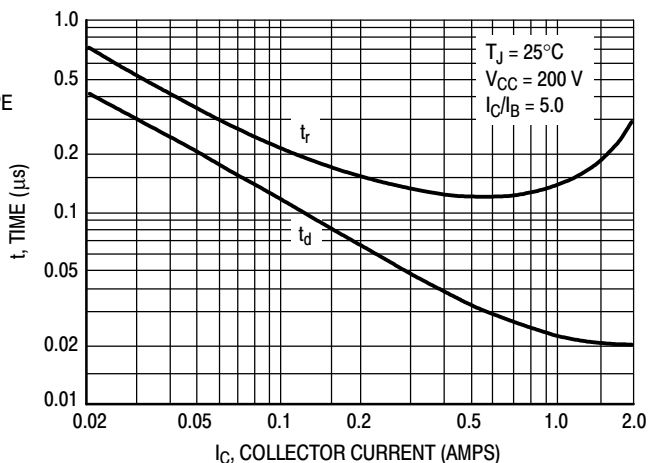


Figure 3. Turn-On Time

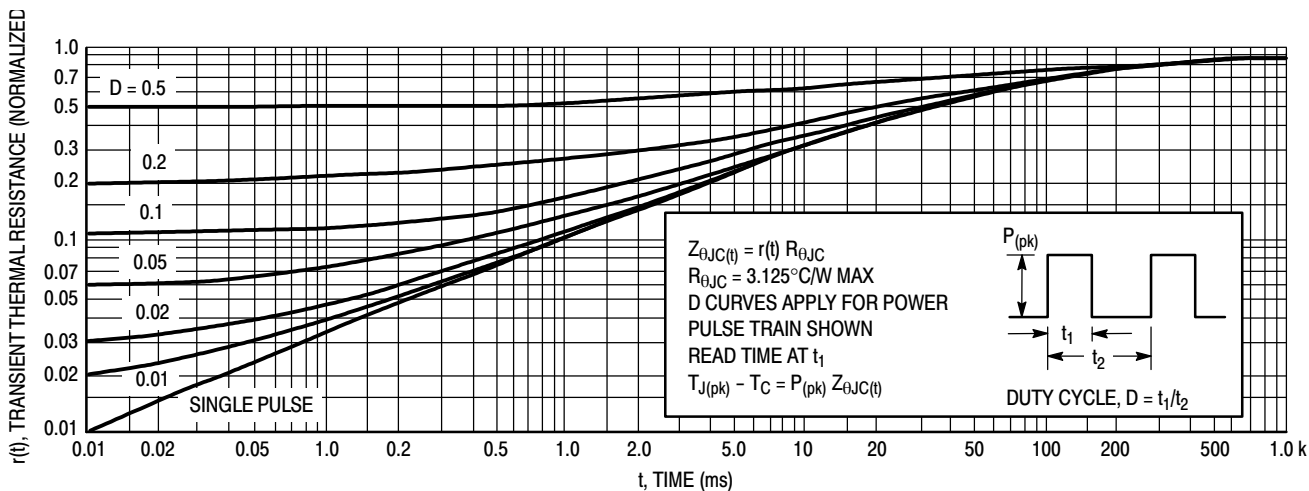


Figure 4. Thermal Response

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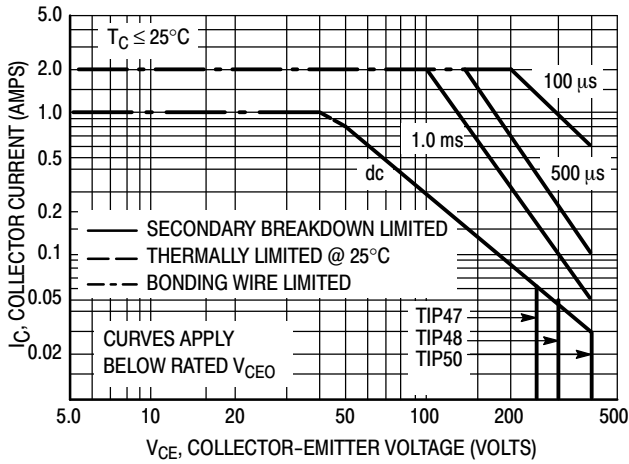


Figure 5. Active Region Safe Operating Area

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.

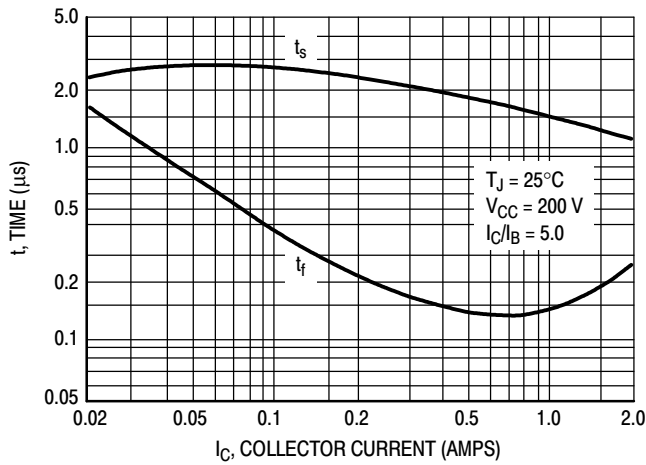


Figure 6. Turn-Off Time

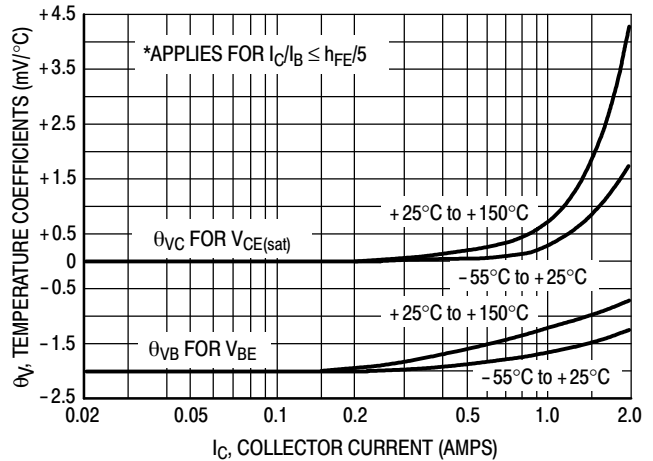
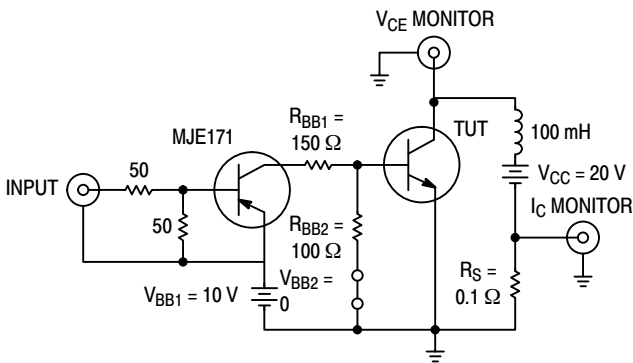


Figure 7. Temperature Coefficients



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

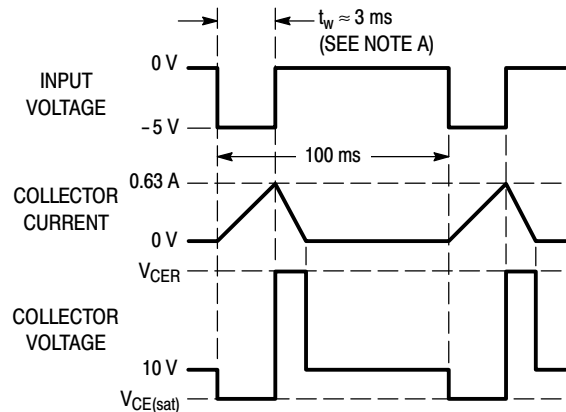


Figure 8. Inductive Load Switching

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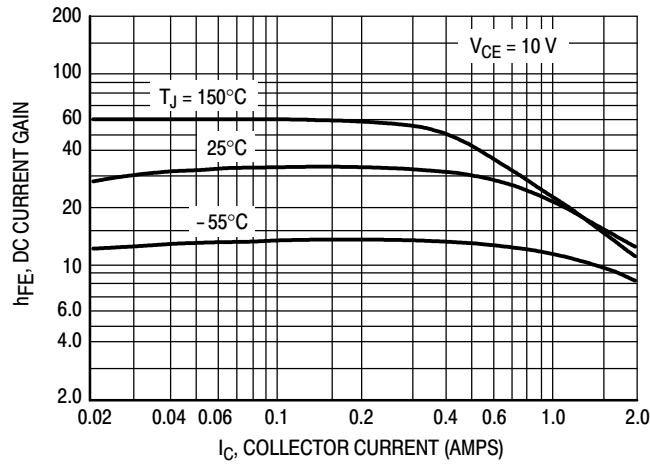


Figure 9. DC Current Gain

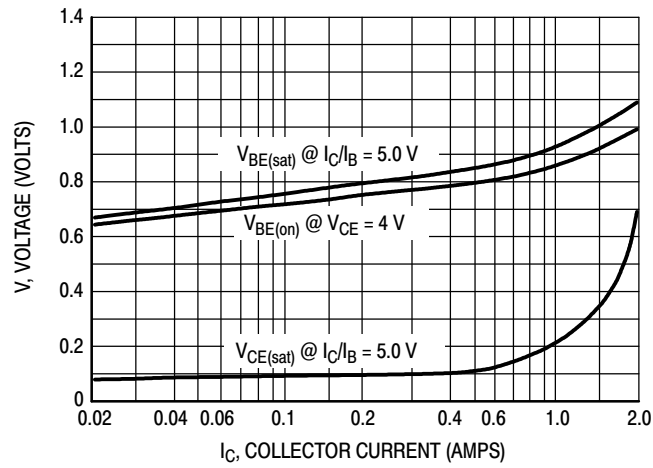
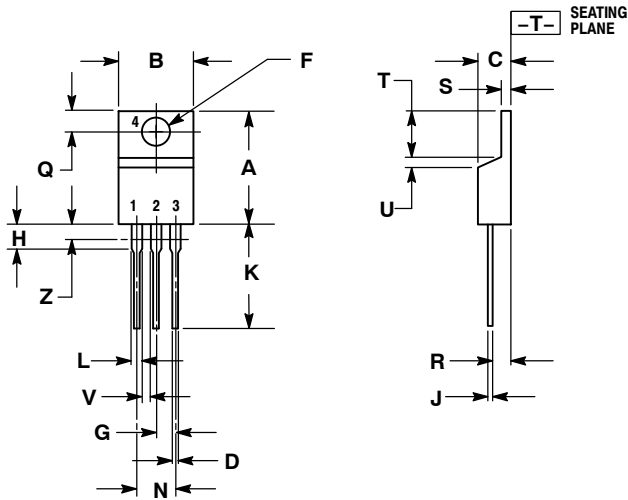


Figure 10. "On" Voltages

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PACKAGE DIMENSIONS

TO-220AB
CASE 221A-09
ISSUE AF



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 | 0.161 | 3.61 | 4.09 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.155 | 2.80 | 3.93 |
| J | 0.014 | 0.025 | 0.36 | 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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