

TIP35A, TIP35B, TIP35C (NPN); TIP36A, TIP36B, TIP36C (PNP)

TIP35B, TIP35C, TIP36B, and TIP36C are Preferred Devices

Complementary Silicon High-Power Transistors

Designed for general-purpose power amplifier and switching applications.

Features

- 25 A Collector Current
- Low Leakage Current –
 $I_{CEO} = 1.0 \text{ mA @ } 30 \text{ and } 60 \text{ V}$
- Excellent DC Gain –
 $h_{FE} = 40 \text{ Typ @ } 15 \text{ A}$
- High Current Gain Bandwidth Product –
 $|h_{fe}| = 3.0 \text{ min @ } I_C = 1.0 \text{ A, } f = 1.0 \text{ MHz}$
- Pb-Free Packages are Available*

MAXIMUM RATINGS

| Rating | Symbol | TIP35A TIP36A | TIP35B TIP36B | TIP35C TIP36C | Unit |
|--|----------------|------------------|------------------|------------------|--------------------------|
| Collector – Emitter Voltage | V_{CEO} | 60 | 80 | 100 | Vdc |
| Collector – Base Voltage | V_{CB} | 60 | 80 | 100 | Vdc |
| Emitter – Base Voltage | V_{EB} | 5.0 | | | Vdc |
| Collector Current – Continuous – Peak (Note 1) | I_C | 25 40 | | | Adc |
| Base Current – Continuous | I_B | 5.0 | | | Adc |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 125 | | | W W/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range | T_J, T_{stg} | –65 to +150 | | | $^\circ\text{C}$ |
| Unclamped Inductive Load | E_{SB} | 90 | | | mJ |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|--|-----------------|------|--------------------|
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 1.0 | $^\circ\text{C/W}$ |
| Junction-to-Free-Air Thermal Resistance | $R_{\theta JA}$ | 35.7 | $^\circ\text{C/W}$ |

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.

1. Pulse Test: Pulse Width = 10 ms, Duty Cycle $\leq 10\%$.

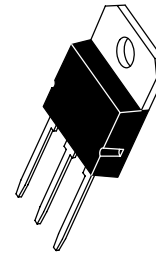
*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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25 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS 60–100 VOLTS, 125 WATTS



SOT-93 (TO-218)
CASE 340D
STYLE 1

MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
TIP3xx = Device Code
xx = 5A, 5B, 5C
6A, 6B, 6C
G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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

TIP35A, TIP35B, TIP35C (NPN); TIP36A, TIP36B, TIP36C (PNP)

ORDERING INFORMATION

| Device | Package | Shipping |
|---------|------------------------------|-----------------|
| TIP35A | SOT-93 (TO-218) | 30 Units / Rail |
| TIP35AG | SOT-93 (TO-218) (Pb-Free) | 30 Units / Rail |
| TIP35B | SOT-93 (TO-218) | 30 Units / Rail |
| TIP35BG | SOT-93 (TO-218) (Pb-Free) | 30 Units / Rail |
| TIP35C | SOT-93 (TO-218) | 30 Units / Rail |
| TIP35CG | SOT-93 (TO-218) (Pb-Free) | 30 Units / Rail |
| TIP36A | SOT-93 (TO-218) | 30 Units / Rail |
| TIP36AG | SOT-93 (TO-218) (Pb-Free) | 30 Units / Rail |
| TIP36B | SOT-93 (TO-218) | 30 Units / Rail |
| TIP36BG | SOT-93 (TO-218) (Pb-Free) | 30 Units / Rail |
| TIP36C | SOT-93 (TO-218) | 30 Units / Rail |
| TIP36CG | SOT-93 (TO-218) (Pb-Free) | 30 Units / Rail |

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

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

OFF CHARACTERISTICS

| | | | | | |
|--|--|-----------------------|-----------------|-------------|-----|
| Collector-Emitter Sustaining Voltage (Note 2) (I _C = 30 mA, I _B = 0) | TIP35A, TIP36A TIP35B, TIP36B TIP35C, TIP36C | V _{CEO(sus)} | 60 80 100 | - - - | Vdc |
| Collector-Emitter Cutoff Current (V _{CE} = 30 V, I _B = 0) (V _{CE} = 60 V, I _B = 0) | TIP35A, TIP36A TIP35B, TIP35C, TIP36B, TIP36C | I _{CEO} | - - | 1.0 1.0 | mA |
| Collector-Emitter Cutoff Current (V _{CE} = Rated V _{CEO} , V _{EB} = 0) | | I _{CES} | - | 0.7 | mA |
| Emitter-Base Cutoff Current (V _{EB} = 5.0 V, I _C = 0) | | I _{EBO} | - | 1.0 | mA |

ON CHARACTERISTICS (Note 2)

| | | | | | |
|--|--|----------------------|----------|------------|-----|
| DC Current Gain (I _C = 1.5 A, V _{CE} = 4.0 V) (I _C = 15 A, V _{CE} = 4.0 V) | | h _{FE} | 25 15 | - 75 | - |
| Collector-Emitter Saturation Voltage (I _C = 15 A, I _B = 1.5 A) (I _C = 25 A, I _B = 5.0 A) | | V _{CE(sat)} | - - | 1.8 4.0 | Vdc |
| Base-Emitter On Voltage (I _C = 15 A, V _{CE} = 4.0 V) (I _C = 25 A, V _{CE} = 4.0 V) | | V _{BE(on)} | - - | 2.0 4.0 | Vdc |

DYNAMIC CHARACTERISTICS

| | | | | | |
|---|--|-----------------|-----|---|-----|
| Small-Signal Current Gain (I _C = 1.0 A, V _{CE} = 10 V, f = 1.0 kHz) | | h _{fe} | 25 | - | - |
| Current-Gain — Bandwidth Product (I _C = 1.0 A, V _{CE} = 10 V, f = 1.0 MHz) | | f _T | 3.0 | - | MHz |

2. Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.

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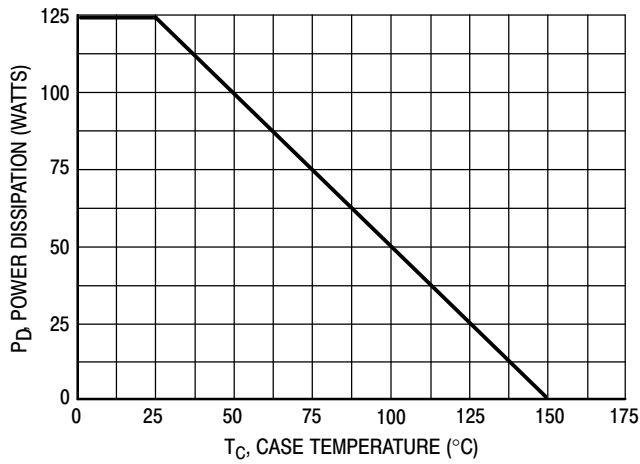
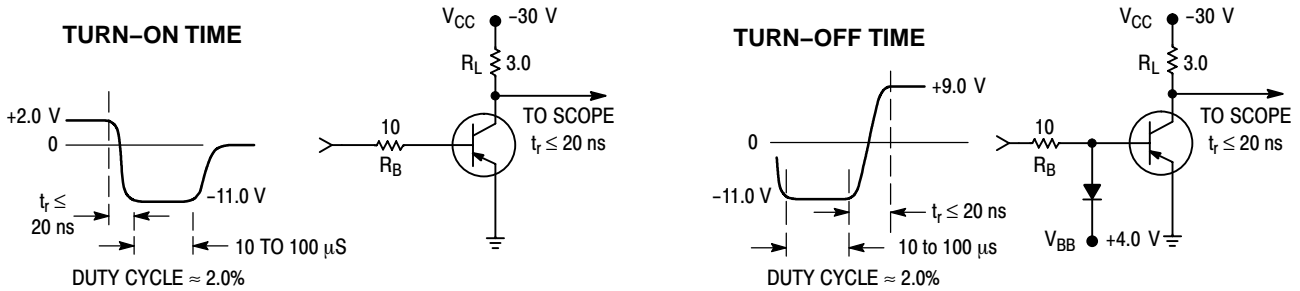


Figure 1. Power Derating



FOR CURVES OF FIGURES 3 & 4, R_B & R_L ARE VARIED.
 INPUT LEVELS ARE APPROXIMATELY AS SHOWN.
 FOR NPN, REVERSE ALL POLARITIES.

Figure 2. Switching Time Equivalent Test Circuits

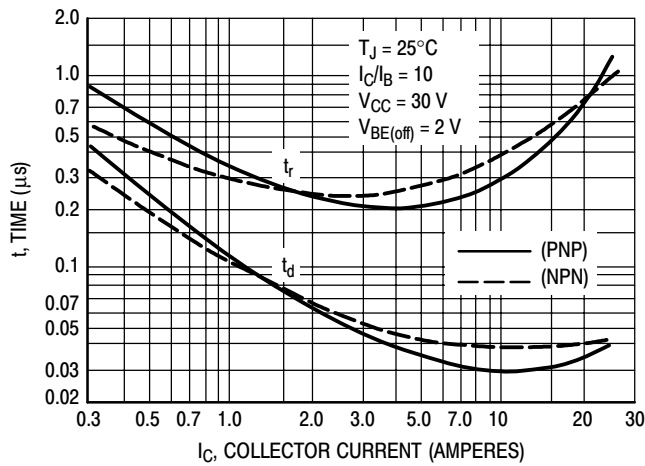


Figure 3. Turn-On Time

TIP35A, TIP35B, TIP35C (NPN); TIP36A, TIP36B, TIP36C (PNP)

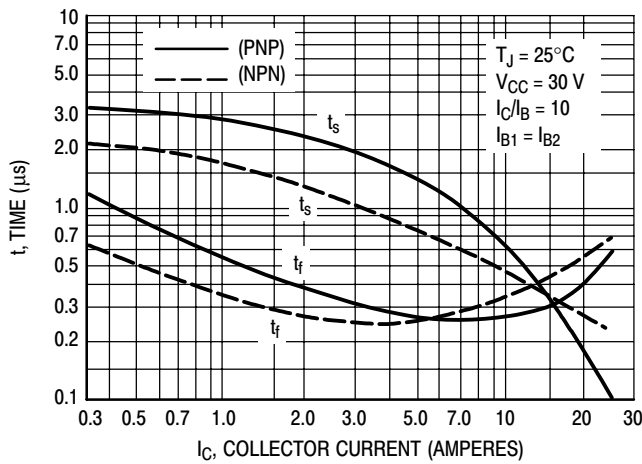


Figure 4. Turn-Off Time

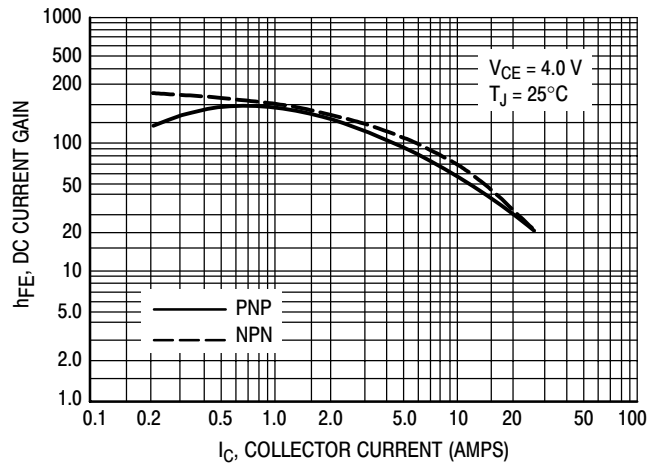


Figure 5. DC Current Gain

FORWARD BIAS

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 6 is based on $T_C = 25^\circ\text{C}$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when $T_C \geq 25^\circ\text{C}$. Second breakdown limitations do not derate the same as thermal limitations.

REVERSE BIAS

For inductive loads, high voltage and high current must be sustained simultaneously during turn-off, in most cases, with the base to emitter junction reverse biased. Under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc. The safe level for these devices is specified as Reverse Bias Safe Operating Area and represents the voltage-current conditions during reverse biased turn-off. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. Figure 7 gives RBSOA characteristics.

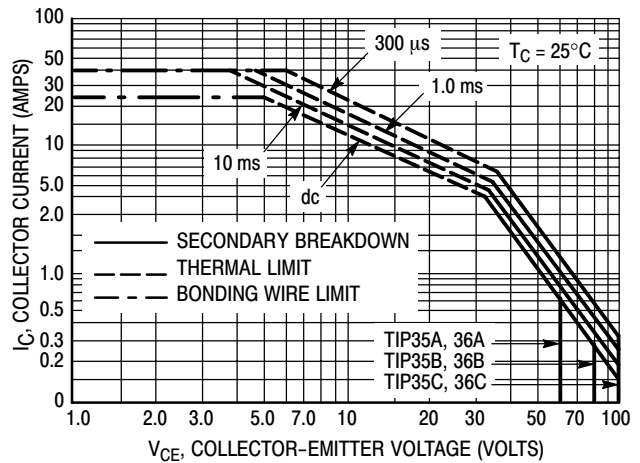


Figure 6. Maximum Rated Forward Bias Safe Operating Area

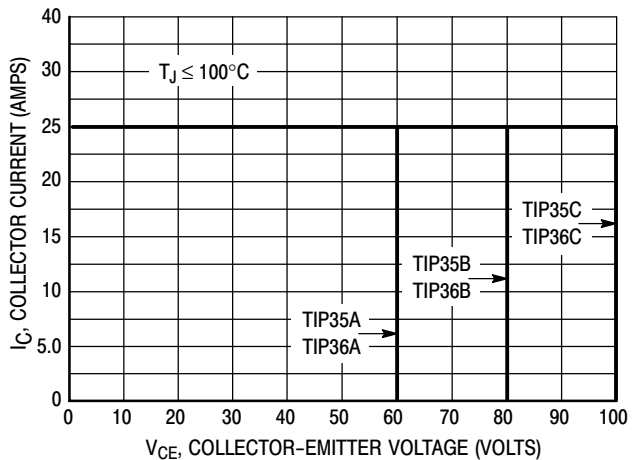
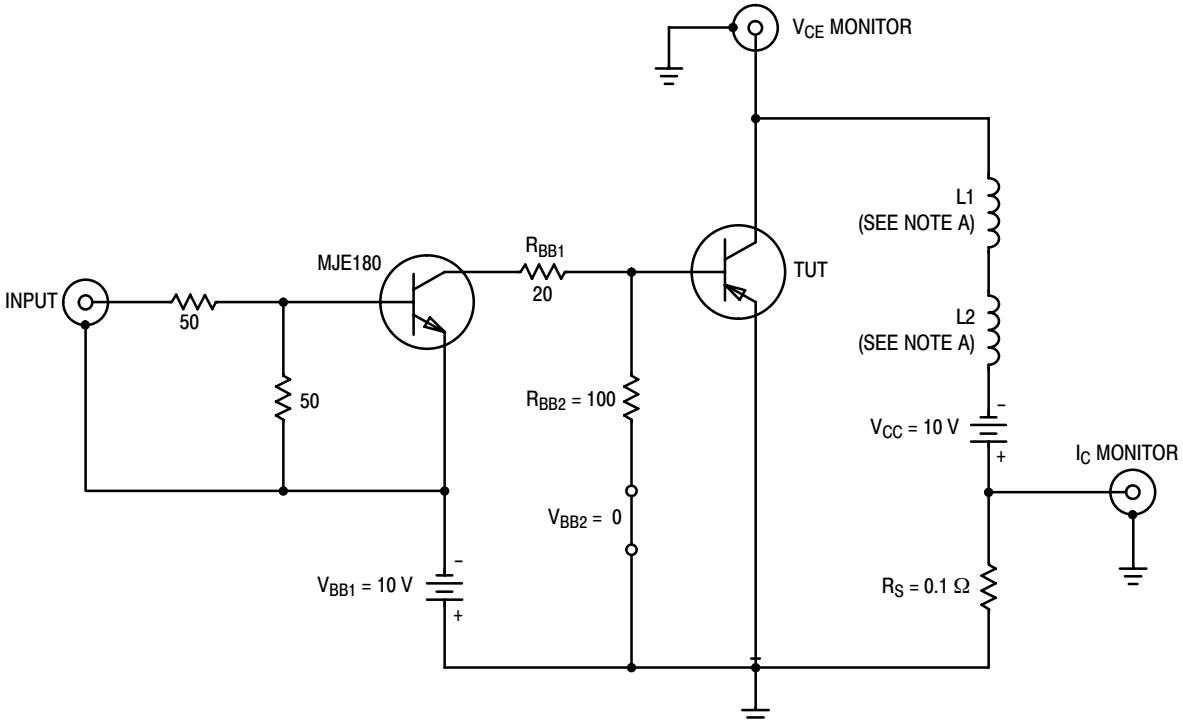


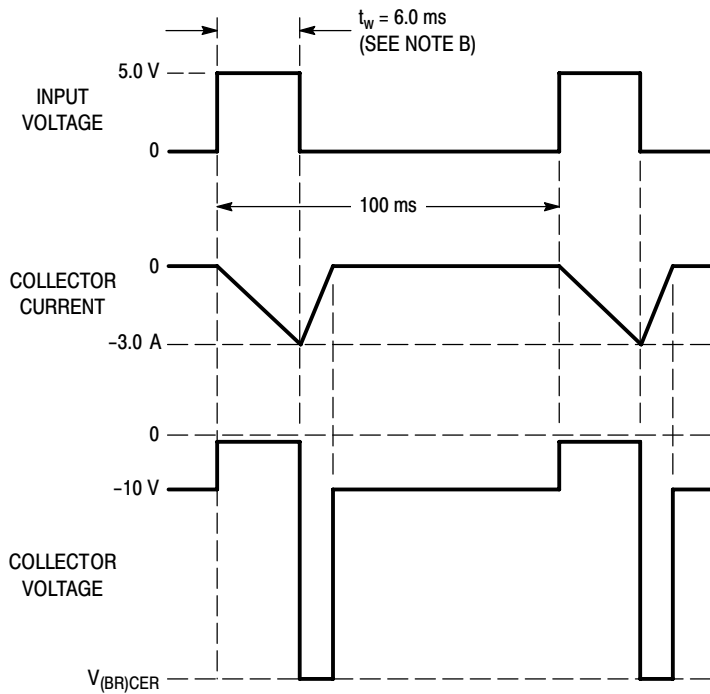
Figure 7. Maximum Rated Forward Bias Safe Operating Area

TIP35A, TIP35B, TIP35C (NPN); TIP36A, TIP36B, TIP36C (PNP)

TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS



NOTES:

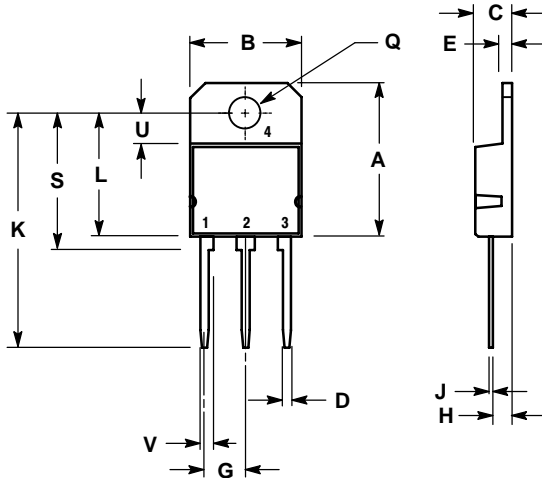
- A. L1 and L2 are 10 mH, 0.11 Ω , Chicago Standard Transformer Corporation C-2688, or equivalent.
- B. Input pulse width is increased until $I_{CM} = -3.0$ A.
- C. For NPN, reverse all polarities.

Figure 8. Inductive Load Switching

TIP35A, TIP35B, TIP35C (NPN); TIP36A, TIP36B, TIP36C (PNP)

PACKAGE DIMENSIONS

SOT-93 (TO-218)
CASE 340D-02
ISSUE E



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | --- | 20.35 | --- | 0.801 |
| B | 14.70 | 15.20 | 0.579 | 0.598 |
| C | 4.70 | 4.90 | 0.185 | 0.193 |
| D | 1.10 | 1.30 | 0.043 | 0.051 |
| E | 1.17 | 1.37 | 0.046 | 0.054 |
| G | 5.40 | 5.55 | 0.213 | 0.219 |
| H | 2.00 | 3.00 | 0.079 | 0.118 |
| J | 0.50 | 0.78 | 0.020 | 0.031 |
| K | 31.00 REF | | 1.220 REF | |
| L | --- | 16.20 | --- | 0.638 |
| Q | 4.00 | 4.10 | 0.158 | 0.161 |
| S | 17.80 | 18.20 | 0.701 | 0.717 |
| U | 4.00 REF | | 0.157 REF | |
| V | 1.75 REF | | 0.069 | |

STYLE 1:

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

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