

# Complementary Silicon High-Power Transistors

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

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 –  
 $|h_{fe}| = 3.0 \text{ min @ } I_C = 1.0 \text{ A, } f = 1.0 \text{ MHz}$
- These are Pb-Free Devices\*

### MAXIMUM RATINGS

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

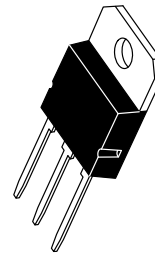
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL CHARACTERISTICS

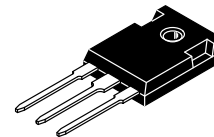
| Symbol          | Characteristic                             | Max  | Unit               |
|-----------------|--------------------------------------------|------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance,<br>Junction-to-Case    | 1.0  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Junction-To-Free-Air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

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 onsemi Soldering and Mounting Techniques Reference Manual, [SOLDDRRM/D](#).



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



TO-247  
CASE 340L  
STYLE 3

**NOTE:** Effective June 2012 this device will be available only in the TO-247 package. Reference FPCN# 16827.

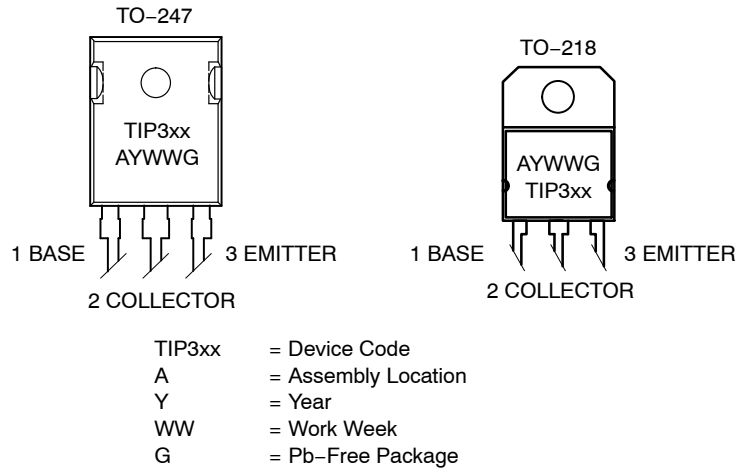
## 25 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS 60–100 VOLTS, 125 WATTS

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

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

## MARKING DIAGRAMS



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

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

### OFF CHARACTERISTICS

|               |                                                                                                                      |                                                    |                 |             |     |
|---------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|-----------------|-------------|-----|
| $V_{CE(sus)}$ | Collector-Emitter Sustaining Voltage (Note 2)<br>( $I_C = 30\text{ mA}$ , $I_B = 0$ )                                | TIP35A, TIP36A<br>TIP35B, TIP36B<br>TIP35C, TIP36C | 60<br>80<br>100 | –<br>–<br>– | Vdc |
| $I_{CEO}$     | Collector-Emitter Cutoff Current<br>( $V_{CE} = 30\text{ V}$ , $I_B = 0$ )<br>( $V_{CE} = 60\text{ V}$ , $I_B = 0$ ) | TIP35A, TIP36A<br>TIP35B, TIP35C, TIP36B, TIP36C   | –<br>–          | 1.0<br>1.0  | mA  |
| $I_{CES}$     | Collector-Emitter Cutoff Current<br>( $V_{CE} = \text{Rated } V_{CEO}$ , $V_{EB} = 0$ )                              |                                                    | –               | 0.7         | mA  |
| $I_{EBO}$     | Emitter-Base Cutoff Current<br>( $V_{EB} = 5.0\text{ V}$ , $I_C = 0$ )                                               |                                                    | –               | 1.0         | mA  |

### ON CHARACTERISTICS (Note 2)

|               |                                                                                                                                          |          |            |     |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------|----------|------------|-----|
| $h_{FE}$      | DC Current Gain<br>( $I_C = 1.5\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )<br>( $I_C = 15\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )               | 25<br>15 | –<br>75    | –   |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage<br>( $I_C = 15\text{ A}$ , $I_B = 1.5\text{ A}$ )<br>( $I_C = 25\text{ A}$ , $I_B = 5.0\text{ A}$ ) | –<br>–   | 1.8<br>4.0 | Vdc |
| $V_{BE(on)}$  | Base-Emitter On Voltage<br>( $I_C = 15\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )<br>( $I_C = 25\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )        | –<br>–   | 2.0<br>4.0 | Vdc |

### DYNAMIC CHARACTERISTICS

|          |                                                                                                              |     |   |     |
|----------|--------------------------------------------------------------------------------------------------------------|-----|---|-----|
| $h_{fe}$ | Small-Signal Current Gain<br>( $I_C = 1.0\text{ A}$ , $V_{CE} = 10\text{ V}$ , $f = 1.0\text{ kHz}$ )        | 25  | – | –   |
| $f_T$    | Current-Gain — Bandwidth Product<br>( $I_C = 1.0\text{ A}$ , $V_{CE} = 10\text{ V}$ , $f = 1.0\text{ MHz}$ ) | 3.0 | – | MHz |

2. Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

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

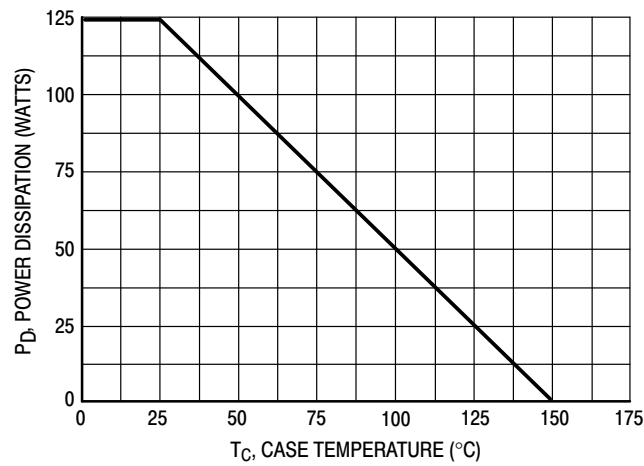
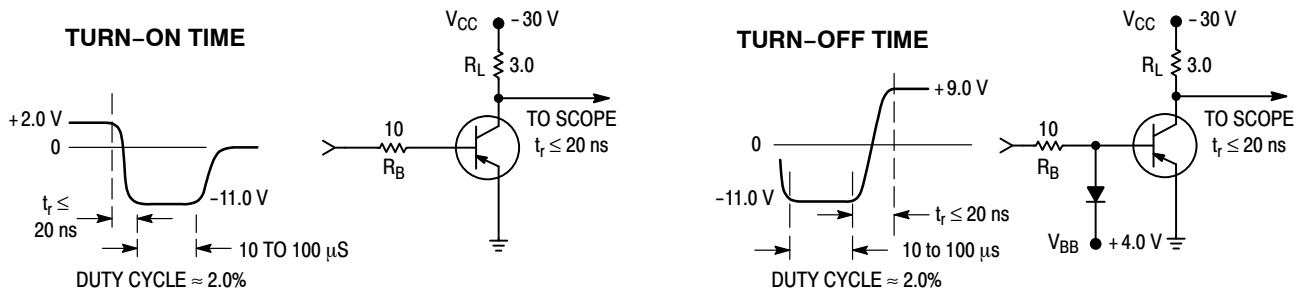


Figure 1. Power Derating



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

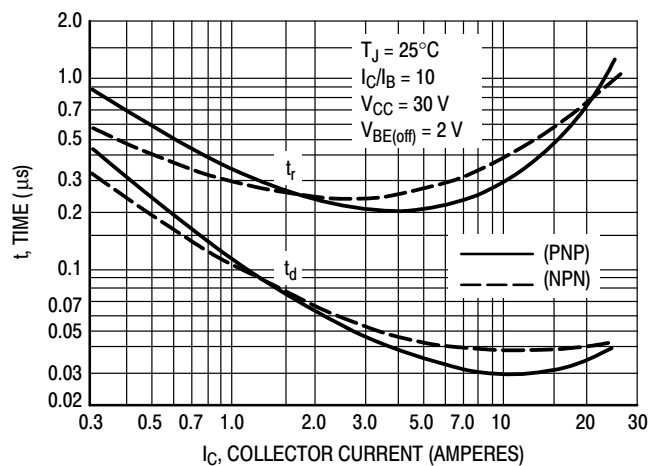


Figure 3. Turn-On Time

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

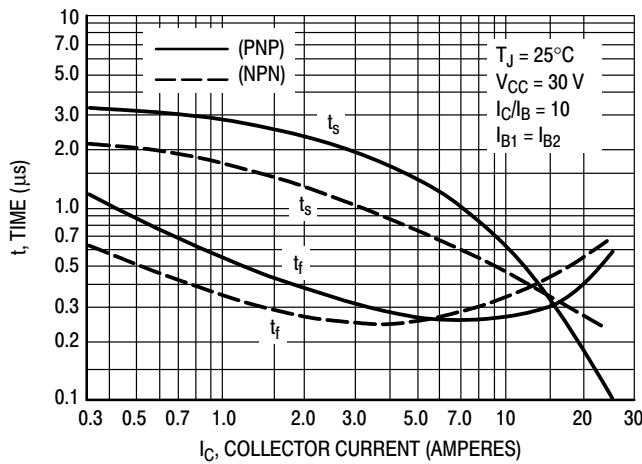


Figure 4. Turn-Off Time

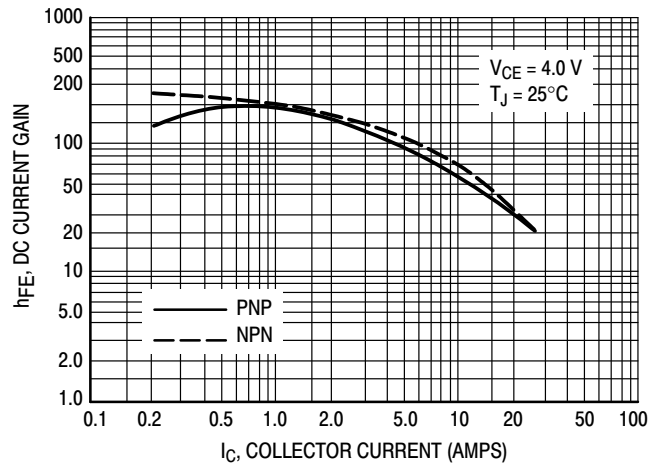


Figure 5. DC Current Gain

### 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.

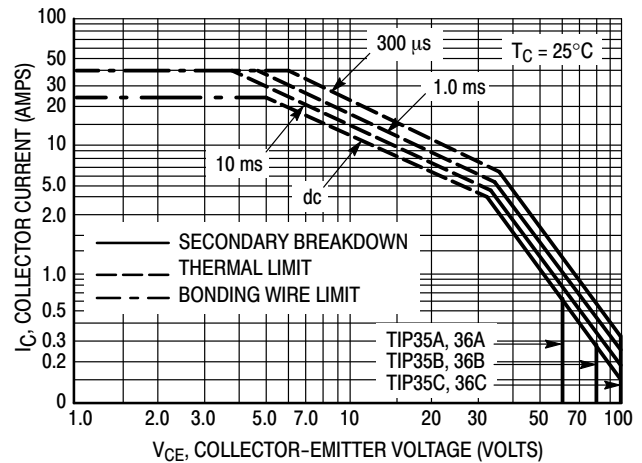


Figure 6. Maximum Rated Forward Bias Safe Operating Area

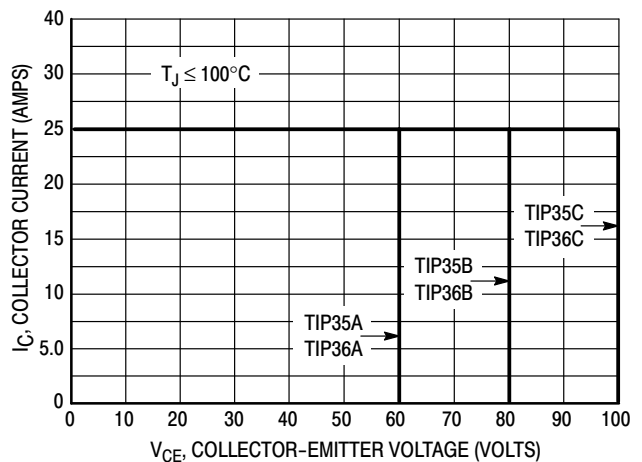
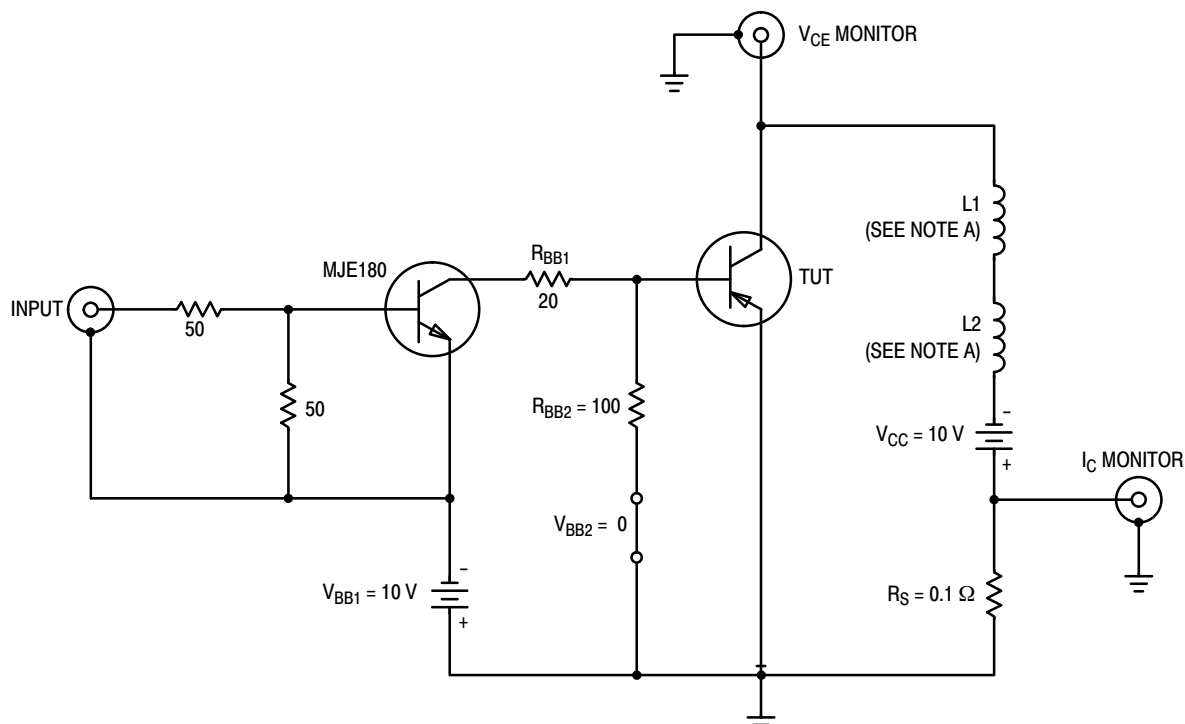


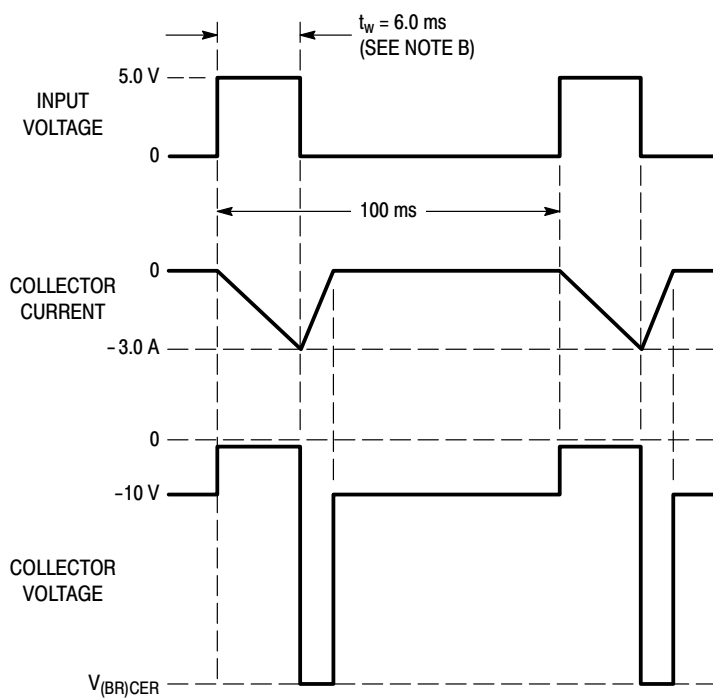
Figure 7. Maximum Rated Forward Bias Safe Operating Area

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

## TEST CIRCUIT



## VOLTAGE AND CURRENT WAVEFORMS



### NOTES:

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

**Figure 8. Inductive Load Switching**

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

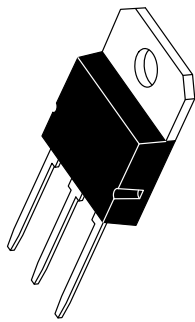
### ORDERING INFORMATION

| Device  | Package                      | Shipping        |
|---------|------------------------------|-----------------|
| TIP35AG | SOT-93 (TO-218)<br>(Pb-Free) | 30 Units / Rail |
| TIP35BG | SOT-93 (TO-218)<br>(Pb-Free) | 30 Units / Rail |
| TIP35CG | SOT-93 (TO-218)<br>(Pb-Free) | 30 Units / Rail |
| TIP36AG | SOT-93 (TO-218)<br>(Pb-Free) | 30 Units / Rail |
| TIP36BG | SOT-93 (TO-218)<br>(Pb-Free) | 30 Units / Rail |
| TIP36CG | SOT-93 (TO-218)<br>(Pb-Free) | 30 Units / Rail |
| TIP35AG | TO-247<br>(Pb-Free)          | 30 Units / Rail |
| TIP35BG | TO-247<br>(Pb-Free)          | 30 Units / Rail |
| TIP35CG | TO-247<br>(Pb-Free)          | 30 Units / Rail |
| TIP36AG | TO-247<br>(Pb-Free)          | 30 Units / Rail |
| TIP36BG | TO-247<br>(Pb-Free)          | 30 Units / Rail |
| TIP36CG | TO-247<br>(Pb-Free)          | 30 Units / Rail |

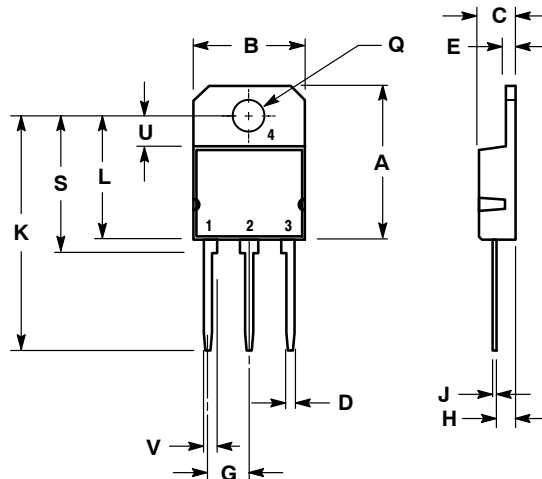


SOT-93 (TO-218)  
CASE 340D-02  
ISSUE E

DATE 03 JAN 2002



SCALE 1:1



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

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

- 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     |       |

GENERIC  
MARKING DIAGRAM\*

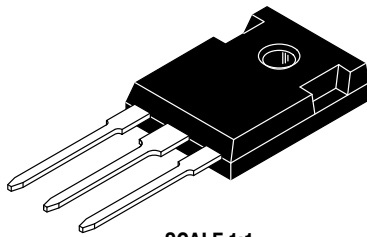


A = Assembly Location  
Y = Year  
WW = Work Week  
XXXXX = Device Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

|                  |                 |                                                                                                                                                                                     |
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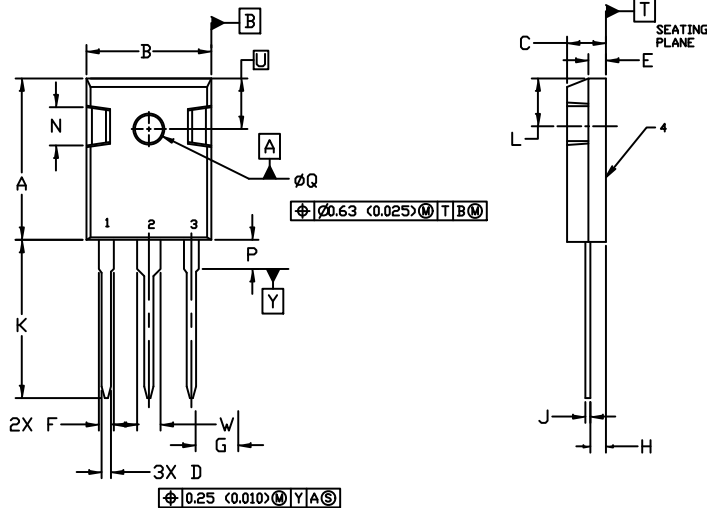
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TO-247  
CASE 340L  
ISSUE G

DATE 06 OCT 2021

SCALE 1:1

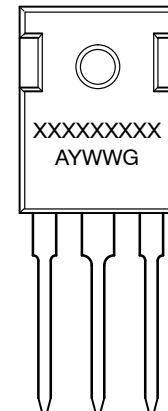


NOTES:

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

|     | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
| DIM | MIN.        | MAX.  | MIN.      | MAX.  |
| A   | 20.32       | 21.08 | 0.800     | 0.830 |
| B   | 15.75       | 16.26 | 0.620     | 0.640 |
| C   | 4.70        | 5.30  | 0.185     | 0.209 |
| D   | 1.00        | 1.40  | 0.040     | 0.055 |
| E   | 1.90        | 2.60  | 0.075     | 0.102 |
| F   | 1.65        | 2.13  | 0.065     | 0.084 |
| G   | 5.45 BSC    |       | 0.215 BSC |       |
| H   | 1.50        | 2.49  | 0.059     | 0.098 |
| J   | 0.40        | 0.80  | 0.016     | 0.031 |
| K   | 19.81       | 20.83 | 0.780     | 0.820 |
| L   | 5.40        | 6.20  | 0.212     | 0.244 |
| N   | 4.32        | 5.49  | 0.170     | 0.216 |
| P   | ----        | 4.50  | ----      | 0.177 |
| Q   | 3.55        | 3.65  | 0.140     | 0.144 |
| U   | 6.15 BSC    |       | 0.242 BSC |       |
| W   | 2.87        | 3.12  | 0.113     | 0.123 |

GENERIC  
MARKING DIAGRAM\*



- STYLE 1:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE  
4. DRAIN
- STYLE 2:  
PIN 1. ANODE  
2. CATHODE (S)  
3. ANODE 2  
4. CATHODE (S)
- STYLE 3:  
PIN 1. BASE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR
- STYLE 4:  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER  
4. COLLECTOR
- STYLE 5:  
PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE
- STYLE 6:  
PIN 1. MAIN TERMINAL 1  
2. MAIN TERMINAL 2  
3. GATE  
4. MAIN TERMINAL 2

XXXXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

|                  |             |                                                                                                                                                                                  |
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