

# MJH6284 (NPN), MJH6287 (PNP)

## Darlington Complementary Silicon Power Transistors

These devices are designed for general-purpose amplifier and low-speed switching motor control applications.

### Features

- Similar to the Popular NPN 2N6284 and the PNP 2N6287
- Rugged RBSOA Characteristics
- Monolithic Construction with Built-in Collector-Emitter Diode
- These are Pb-Free Devices\*

### MAXIMUM RATINGS

| Rating                                                                                 | Symbol         | Max         | Unit                     |
|----------------------------------------------------------------------------------------|----------------|-------------|--------------------------|
| Collector-Emitter Voltage                                                              | $V_{CEO}$      | 100         | Vdc                      |
| Collector-Base Voltage                                                                 | $V_{CB}$       | 100         | Vdc                      |
| Emitter-Base Voltage                                                                   | $V_{EB}$       | 5.0         | Vdc                      |
| Collector Current – Continuous<br>– Peak                                               | $I_C$          | 20<br>40    | Adc                      |
| Base Current                                                                           | $I_B$          | 0.5         | Adc                      |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 160<br>1.28 | W<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                    | $T_J, T_{stg}$ | -65 to +150 | $^\circ\text{C}$         |

### THERMAL CHARACTERISTICS

| Characteristic                       | Symbol          | Max  | Unit               |
|--------------------------------------|-----------------|------|--------------------|
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 0.78 | $^\circ\text{C/W}$ |

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.

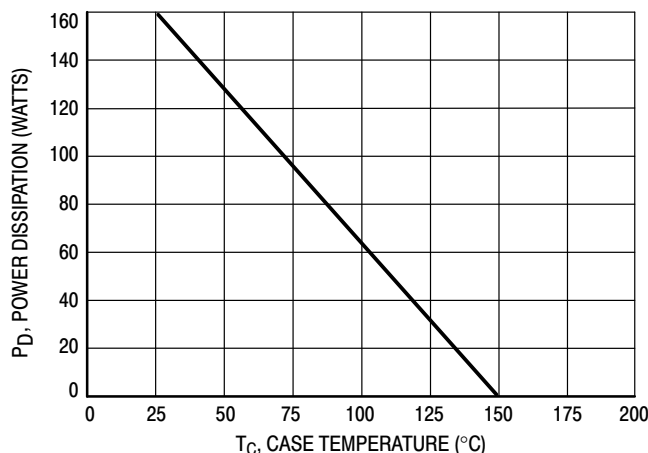


Figure 1. Power Derating

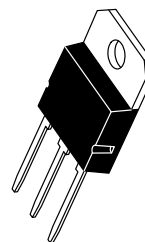
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



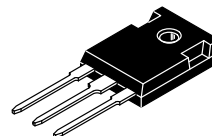
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## DARLINGTON 20 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS 100 VOLTS, 160 WATTS



SOT-93  
(TO-218)  
CASE 340D



TO-247  
CASE 340L  
STYLE 3

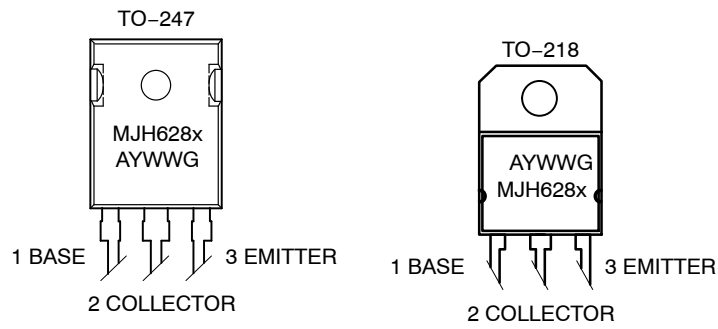
**NOTE:** Effective June 2012 this device will be available only in the TO-247 package. Reference FPCN# 16827.

### ORDERING INFORMATION

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

# MJH6284 (NPN), MJH6287 (PNP)

## MARKING DIAGRAMS



MJH628x = Device Code  
x = 4 or 7  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

## ORDERING INFORMATION

| Device Order Number | Package Type        | Shipping        |
|---------------------|---------------------|-----------------|
| MJH6284G            | TO-218<br>(Pb-Free) | 30 Units / Rail |
| MJH6287G            | TO-218<br>(Pb-Free) | 30 Units / Rail |
| MJH6284G            | TO-247<br>(Pb-Free) | 30 Units / Rail |
| MJH6287G            | TO-247<br>(Pb-Free) | 30 Units / Rail |

## MJH6284 (NPN), MJH6287 (PNP)

### ELECTRICAL CHARACTERISTICS (T<sub>G</sub> = 25°C unless otherwise noted)

| Characteristic                                                                                                                                                                                         | Symbol         | Min    | Max        | Unit |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|------------|------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                             |                |        |            |      |
| Collector–Emitter Sustaining Voltage ( $I_C = 0.1 \text{ Adc}$ , $I_B = 0$ )                                                                                                                           | $V_{CEO(sus)}$ | 100    | –          | Vdc  |
| Collector Cutoff Current ( $V_{CE} = 50 \text{ Vdc}$ , $I_B = 0$ )                                                                                                                                     | $I_{CEO}$      | –      | 1.0        | mAdc |
| Collector Cutoff Current<br>( $V_{CE} = \text{Rated } V_{CB}$ , $V_{BE(off)} = 1.5 \text{ Vdc}$ )<br>( $V_{CE} = \text{Rated } V_{CB}$ , $V_{BE(off)} = 1.5 \text{ Vdc}$ , $T_C = 150^\circ\text{C}$ ) | $I_{CEX}$      | –<br>– | 0.5<br>5.0 | mAdc |
| Emitter Cutoff Current ( $V_{BE} = 5.0 \text{ Vdc}$ , $I_C = 0$ )                                                                                                                                      | $I_{EBO}$      | –      | 2.0        | mAdc |

### ON CHARACTERISTICS (Note 1)

|                                                                                                                                                       |               |            |             |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------|-------------|-----|
| DC Current Gain<br>( $I_C = 10 \text{ Adc}$ , $V_{CE} = 3.0 \text{ Vdc}$ )<br>( $I_C = 20 \text{ Adc}$ , $V_{CE} = 3.0 \text{ Vdc}$ )                 | $h_{FE}$      | 750<br>100 | 18,000<br>– | –   |
| Collector–Emitter Saturation Voltage<br>( $I_C = 10 \text{ Adc}$ , $I_B = 40 \text{ mAdc}$ )<br>( $I_C = 20 \text{ Adc}$ , $I_B = 200 \text{ mAdc}$ ) | $V_{CE(sat)}$ | –<br>–     | 2.0<br>3.0  | Vdc |
| Base–Emitter On Voltage ( $I_C = 10 \text{ Adc}$ , $V_{CE} = 3.0 \text{ Vdc}$ )                                                                       | $V_{BE(on)}$  | –          | 2.8         | Vdc |
| Base–Emitter Saturation Voltage ( $I_C = 20 \text{ Adc}$ , $I_B = 200 \text{ mAdc}$ )                                                                 | $V_{BE(sat)}$ | –          | 4.0         | Vdc |

## DYNAMIC CHARACTERISTICS

|                                                                                                                 |          |        |            |     |
|-----------------------------------------------------------------------------------------------------------------|----------|--------|------------|-----|
| Current–Gain Bandwidth Product ( $I_C = 10\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )     | $f_T$    | 4.0    | –          | MHz |
| Output Capacitance<br>( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )<br><br>MJD6284<br>MJD6287 | $C_{ob}$ | –<br>– | 400<br>600 | pF  |
| Small–Signal Current Gain ( $I_C = 10\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )          | $h_{fe}$ | 300    | –          | –   |

## SWITCHING CHARACTERISTICS

| Resistive Load |                                                                                                               | Symbol | Typical |     | Unit          |
|----------------|---------------------------------------------------------------------------------------------------------------|--------|---------|-----|---------------|
|                |                                                                                                               |        | NPN     | PNP |               |
| Delay Time     | $V_{CC} = 30 \text{ Vdc}$ , $I_C = 10 \text{ Adc}$<br>$I_{B1} = I_{B2} = 100 \text{ mA}$<br>Duty Cycle = 1.0% | $t_d$  | 0.1     | 0.1 | $\mu\text{s}$ |
| Rise Time      |                                                                                                               | $t_r$  | 0.3     | 0.3 |               |
| Storage Time   |                                                                                                               | $t_s$  | 1.0     | 1.0 |               |
| Fall Time      |                                                                                                               | $t_f$  | 3.5     | 2.0 |               |

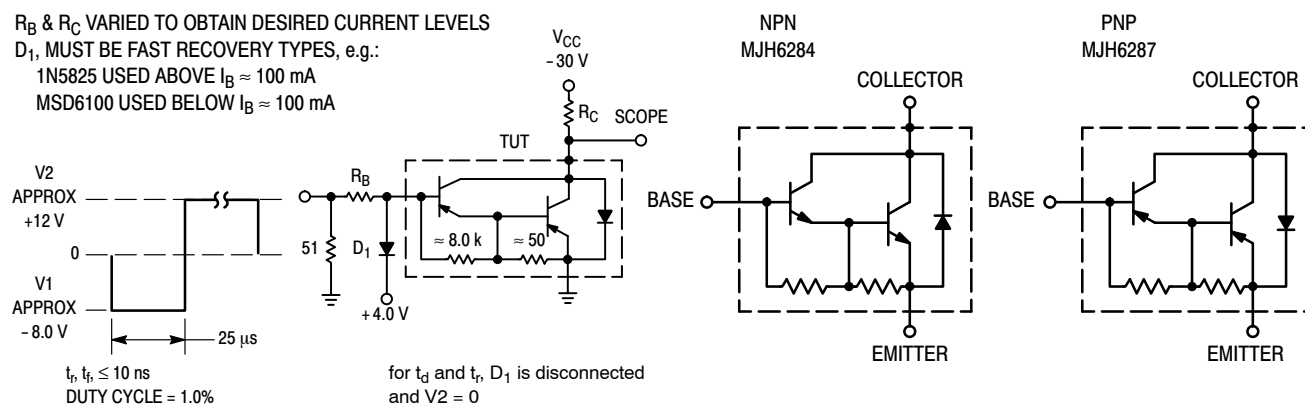
1. Pulse test: Pulse Width = 300  $\mu$ s, Duty Cycle = 2.0%.

### R<sub>B</sub> & R<sub>C</sub> VARIED TO OBTAIN DESIRED CURRENT LEVELS

D<sub>1</sub>, MUST BE FAST RECOVERY TYPES, e.g.:

1N5825 USED ABOVE  $I_B \approx 100$  mA

MSD6100 USED BELOW  $I_B \approx 100$  mA



For NPN test circuit reverse diode and voltage polarities.

**Figure 2. Switching Times Test Circuit**

### Figure 3. Darlington Schematic

## MJH6284 (NPN), MJH6287 (PNP)

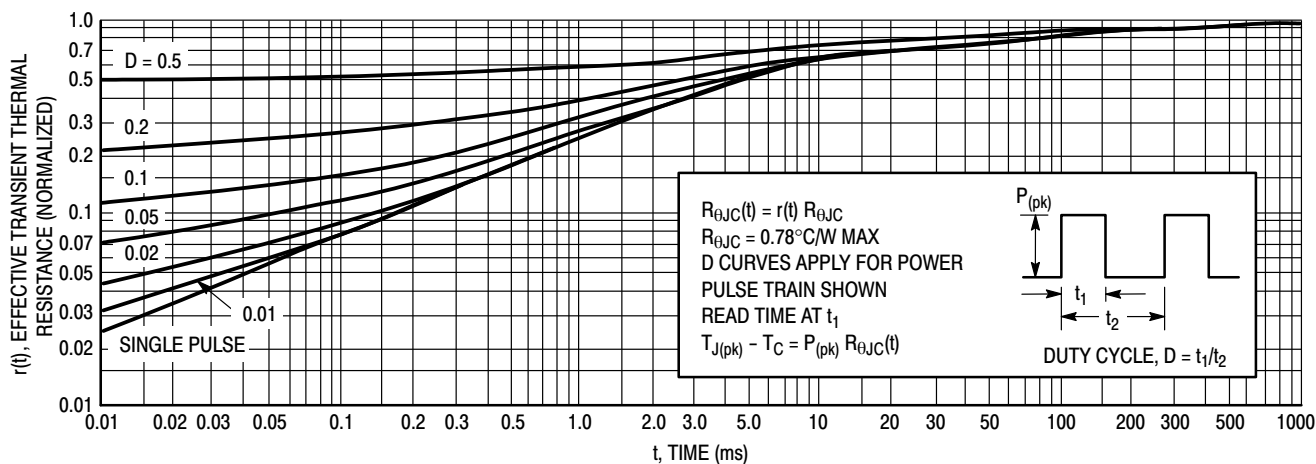


Figure 4. Thermal Response

## FBSOA, FORWARD BIAS SAFE OPERATING AREA

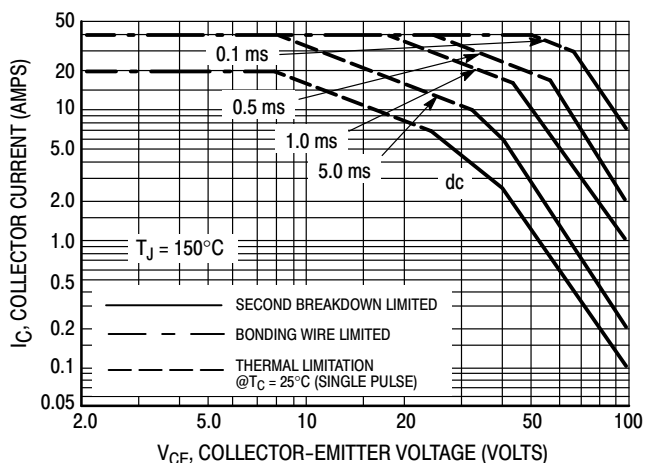


Figure 5. MJH6284, MJH6287

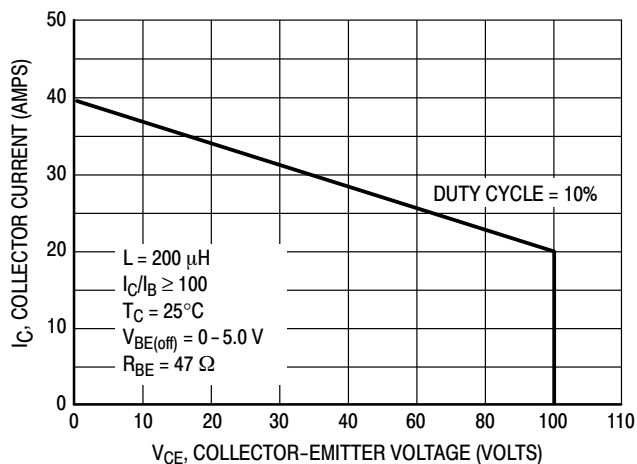


Figure 6. Maximum RBSOA, Reverse Bias Safe Operating Area

## 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 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.

# MJH6284 (NPN), MJH6287 (PNP)

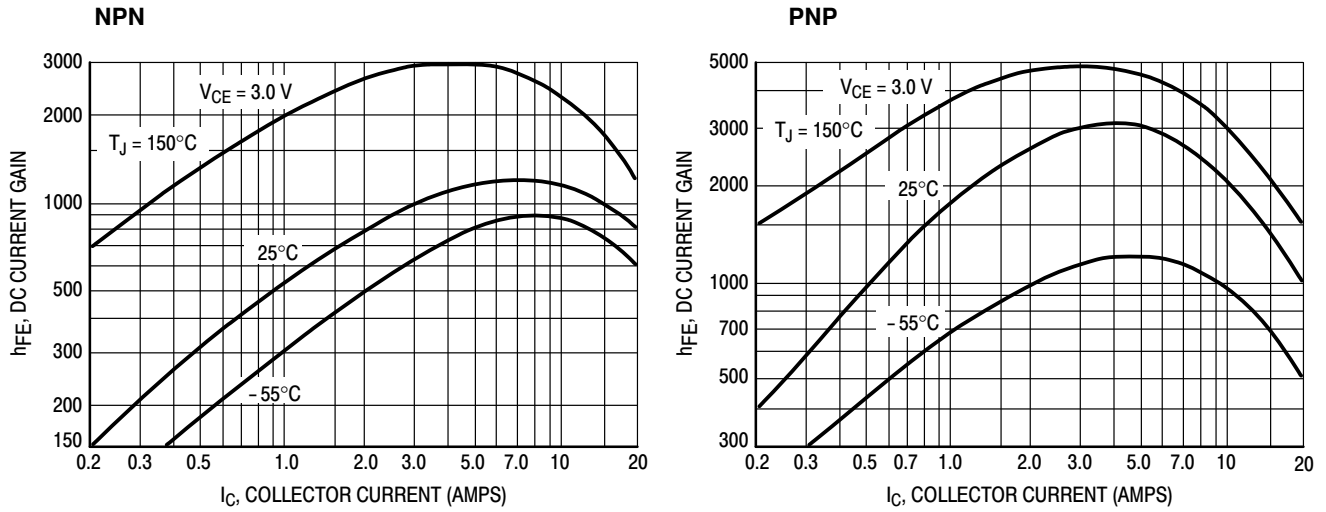


Figure 7. DC Current Gain

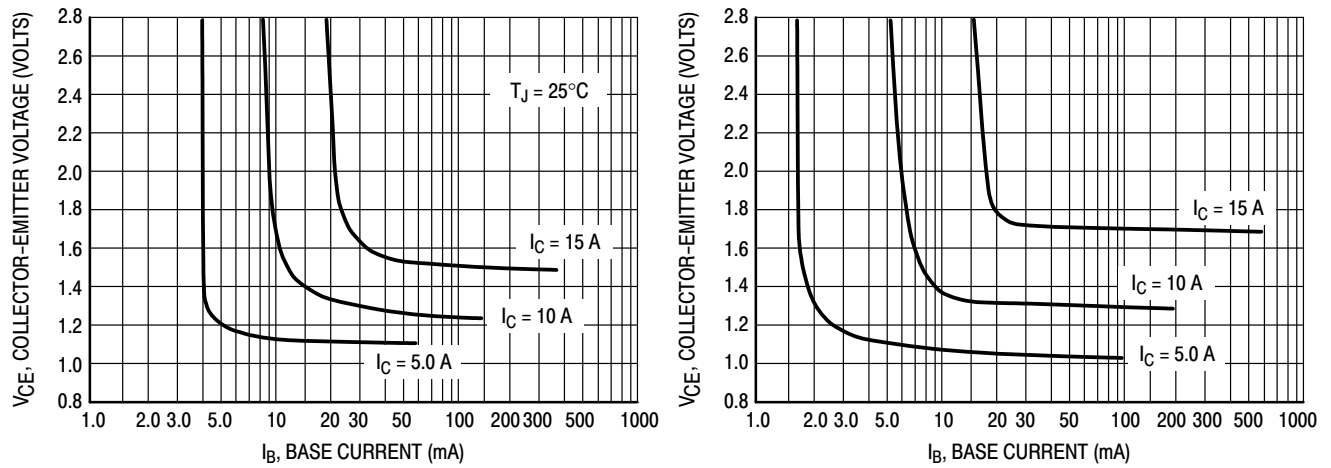


Figure 8. Collector Saturation Region

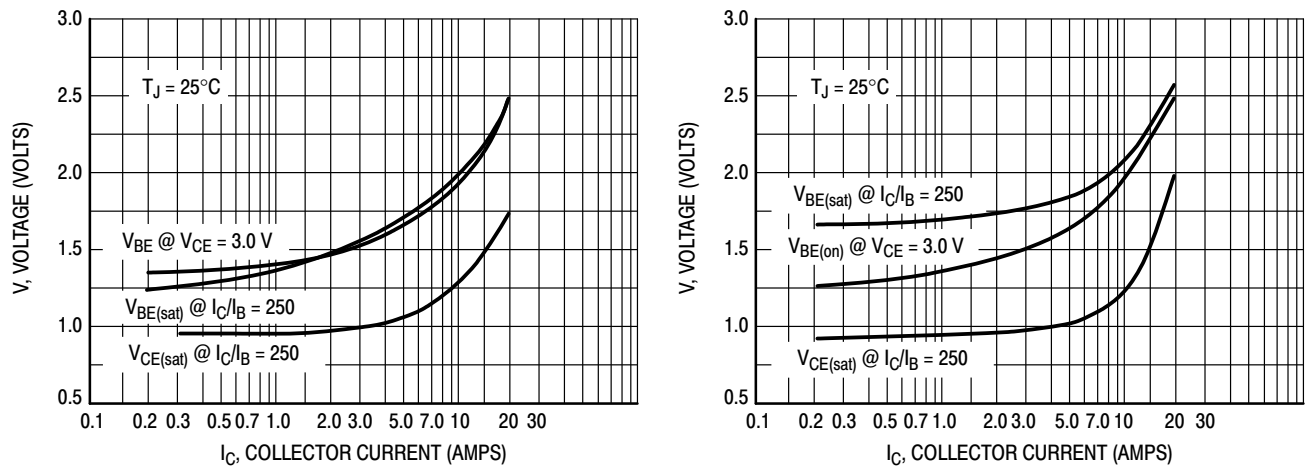


Figure 9. "On" Voltages

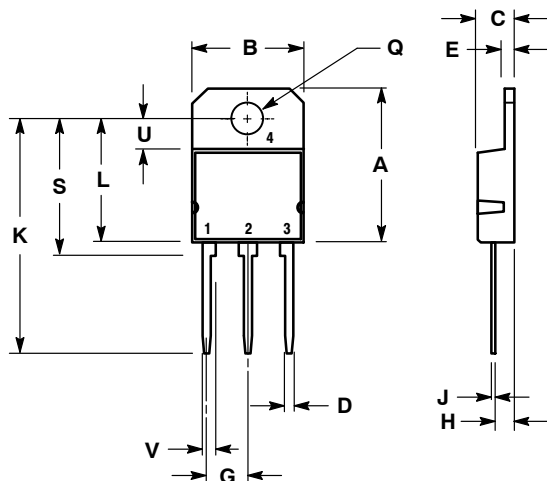
# MJH6284 (NPN), MJH6287 (PNP)

## 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     |       |

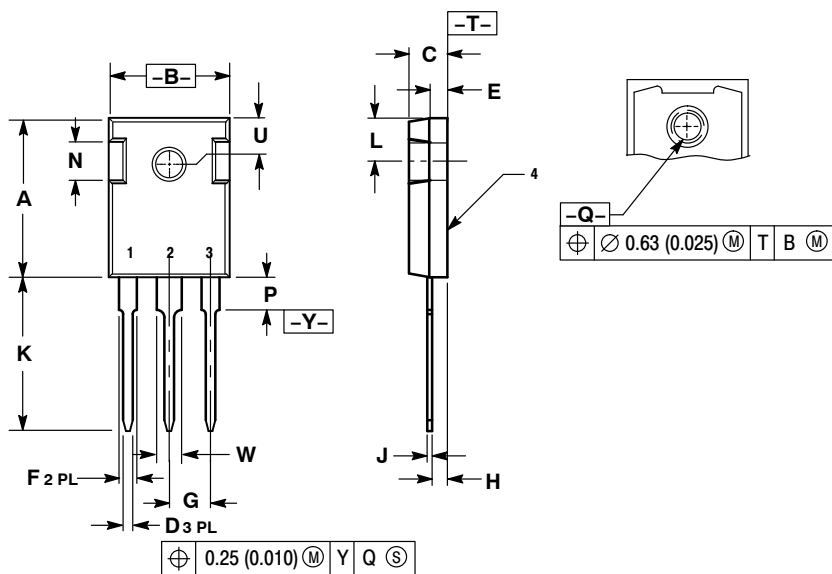
#### STYLE 1:

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

### TO-247

CASE 340L-02

ISSUE F



#### NOTES:

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

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | 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 |

#### STYLE 3:

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

## MJH6284 (NPN), MJH6287 (PNP)

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