

# NPN Silicon Planar Epitaxial Transistor

## PZT2222A

This NPN Silicon Epitaxial transistor is designed for use in linear and switching applications. The device is housed in the SOT-223 package which is designed for medium power surface mount applications.

### Features

- PNP Complement is PZT2907AT1
- The SOT-223 Package Can be Soldered Using Wave or Reflow
- SOT-223 Package Ensures Level Mounting, Resulting in Improved Thermal Conduction, and Allows Visual Inspection of Soldered Joints
- The Formed Leads Absorb Thermal Stress During Soldering, Eliminating the Possibility of Damage to the Die
- Available in 12 mm Tape and Reel
- S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant\*

### MAXIMUM RATINGS

| Rating                                                          | Symbol    | Value        | Unit             |
|-----------------------------------------------------------------|-----------|--------------|------------------|
| Collector-Emitter Voltage                                       | $V_{CEO}$ | 40           | Vdc              |
| Collector-Base Voltage                                          | $V_{CBO}$ | 75           | Vdc              |
| Emitter-Base Voltage (Open Collector)                           | $V_{EBO}$ | 6.0          | Vdc              |
| Collector Current                                               | $I_C$     | 600          | mAdc             |
| Total Power Dissipation up to $T_A = 25^\circ\text{C}$ (Note 1) | $P_D$     | 1.5          | W                |
| Storage Temperature Range                                       | $T_{stg}$ | - 65 to +150 | $^\circ\text{C}$ |
| Junction Temperature Range                                      | $T_J$     | - 55 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.

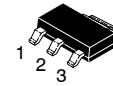
1. Device mounted on an epoxy printed circuit board 1.575 inches x 1.575 inches x 0.059 inches; mounting pad for the collector lead min. 0.93 inches<sup>2</sup>.

### THERMAL CHARACTERISTICS

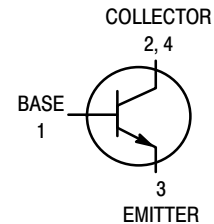
| Rating                                                                | Symbol          | Value     | Unit                      |
|-----------------------------------------------------------------------|-----------------|-----------|---------------------------|
| Thermal Resistance, Junction-to-Ambient                               | $R_{\theta JA}$ | 83.3      | $^\circ\text{C}/\text{W}$ |
| Lead Temperature for Soldering, 0.0625" from case Time in Solder Bath | $T_L$           | 260<br>10 | $^\circ\text{C}$<br>Sec   |

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

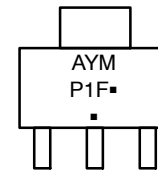
## SOT-223 PACKAGE NPN SILICON TRANSISTOR SURFACE MOUNT



SOT-223 (TO-261)  
CASE 318E-04  
STYLE 1



### MARKING DIAGRAM



- A = Assembly Location  
Y = Year  
M = Month Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device       | Package           | Shipping <sup>†</sup> |
|--------------|-------------------|-----------------------|
| PZT2222AT1G  | SOT-223 (Pb-Free) | 1,000 Tape & Reel     |
| SPZT2222AT1G | SOT-223 (Pb-Free) | 1,000 Tape & Reel     |
| PZT2222AT3G  | SOT-223 (Pb-Free) | 4,000 Tape & Reel     |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# PZT2222A

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

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

### OFF CHARACTERISTICS

|                                                                                                                                                           |                      |        |          |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------|----------|--------------|
| Collector-Emitter Breakdown Voltage (I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 0)                                                                        | V <sub>(BR)CEO</sub> | 40     | –        | Vdc          |
| Collector-Base Breakdown Voltage (I <sub>C</sub> = 10 μAdc, I <sub>E</sub> = 0)                                                                           | V <sub>(BR)CBO</sub> | 75     | –        | Vdc          |
| Emitter-Base Breakdown Voltage (I <sub>E</sub> = 10 μAdc, I <sub>C</sub> = 0)                                                                             | V <sub>(BR)EBO</sub> | 6.0    | –        | Vdc          |
| Base-Emitter Cutoff Current (V <sub>CE</sub> = 60 Vdc, V <sub>BE</sub> = – 3.0 Vdc)                                                                       | I <sub>BEX</sub>     | –      | 20       | nAdc         |
| Collector-Emitter Cutoff Current (V <sub>CE</sub> = 60 Vdc, V <sub>BE</sub> = – 3.0 Vdc)                                                                  | I <sub>CEX</sub>     | –      | 10       | nAdc         |
| Emitter-Base Cutoff Current (V <sub>EB</sub> = 3.0 Vdc, I <sub>C</sub> = 0)                                                                               | I <sub>EBO</sub>     | –      | 100      | nAdc         |
| Collector-Base Cutoff Current<br>(V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0)<br>(V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0, T <sub>A</sub> = 125°C) | I <sub>CBO</sub>     | –<br>– | 10<br>10 | nAdc<br>μAdc |

### ON CHARACTERISTICS

|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                      |                                         |                                              |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------------------|----------------------------------------------|-------|
| DC Current Gain<br>(I <sub>C</sub> = 0.1 mAdc, V <sub>CE</sub> = 10 Vdc)<br>(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc)<br>(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, T <sub>A</sub> = – 55°C)<br>(I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 10 Vdc)<br>(I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 1.0 Vdc)<br>(I <sub>C</sub> = 500 mAdc, V <sub>CE</sub> = 10 Vdc) | h <sub>FE</sub>      | 35<br>50<br>70<br>35<br>100<br>50<br>40 | –<br>–<br>–<br>–<br>300<br>–<br>–            | –     |
| Collector-Emitter Saturation Voltages<br>(I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc)<br>(I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)                                                                                                                                                                                                                                                                                                | V <sub>CE(sat)</sub> | –<br>–                                  | 0.3<br>1.0                                   | Vdc   |
| Base-Emitter Saturation Voltages<br>(I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc)<br>(I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)                                                                                                                                                                                                                                                                                                     | V <sub>BE(sat)</sub> | 0.6<br>–                                | 1.2<br>2.0                                   | Vdc   |
| Input Impedance<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)                                                                                                                                                                                                                                                                                             | h <sub>ie</sub>      | 2.0<br>0.25                             | 8.0<br>1.25                                  | kΩ    |
| Voltage Feedback Ratio<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)                                                                                                                                                                                                                                                                                      | h <sub>re</sub>      | –<br>–                                  | 8.0x10 <sup>–4</sup><br>4.0x10 <sup>–4</sup> | –     |
| Small-Signal Current Gain<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)                                                                                                                                                                                                                                                                                   | h <sub>fe</sub>      | 50<br>75                                | 300<br>375                                   | –     |
| Output Admittance<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)<br>(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)                                                                                                                                                                                                                                                                                           | h <sub>oe</sub>      | 5.0<br>25                               | 35<br>200                                    | μmhos |
| Noise Figure (V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 100 μAdc, f = 1.0 kHz)                                                                                                                                                                                                                                                                                                                                                                        | F                    | –                                       | 4.0                                          | dB    |

### DYNAMIC CHARACTERISTICS

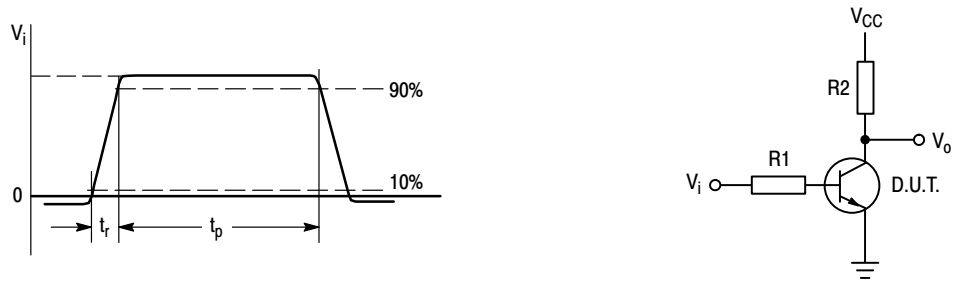
|                                                                                                       |                |     |     |     |
|-------------------------------------------------------------------------------------------------------|----------------|-----|-----|-----|
| Current-Gain – Bandwidth Product<br>(I <sub>C</sub> = 20 mAdc, V <sub>CE</sub> = 20 Vdc, f = 100 MHz) | f <sub>T</sub> | 300 | –   | MHz |
| Output Capacitance (V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)                        | C <sub>c</sub> | –   | 8.0 | pF  |
| Input Capacitance (V <sub>EB</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)                        | C <sub>e</sub> | –   | 25  | pF  |

### SWITCHING TIMES (T<sub>A</sub> = 25°C)

|              |                                                                                                                                    |                |   |     |    |
|--------------|------------------------------------------------------------------------------------------------------------------------------------|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> = 30 Vdc, I <sub>C</sub> = 150 mAdc,<br>I <sub>B(on)</sub> = 15 mAdc, V <sub>EB(off)</sub> = 0.5 Vdc)<br>Figure 1 | t <sub>d</sub> | – | 10  | ns |
| Rise Time    |                                                                                                                                    | t <sub>r</sub> | – | 25  |    |
| Storage Time | (V <sub>CC</sub> = 30 Vdc, I <sub>C</sub> = 150 mAdc,<br>I <sub>B(on)</sub> = I <sub>B(off)</sub> = 15 mAdc)<br>Figure 2           | t <sub>s</sub> | – | 225 | ns |
| Fall Time    |                                                                                                                                    | t <sub>f</sub> | – | 60  |    |

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.

# PZT2222A



**Figure 1. Input Waveform and Test Circuit for Determining Delay Time and Rise Time**

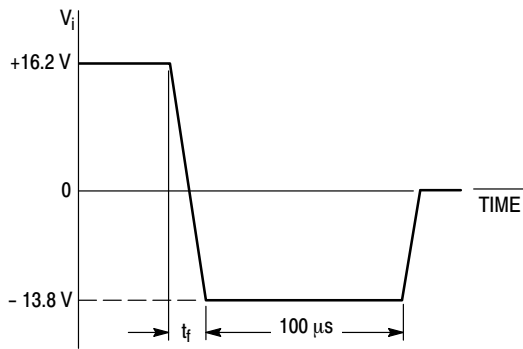
$V_i = -0.5 \text{ V to } +9.9 \text{ V}$ ,  $V_{CC} = +30 \text{ V}$ ,  $R_1 = 619 \Omega$ ,  $R_2 = 200 \Omega$ .

**PULSE GENERATOR:**

**PULSE DURATION**  $t_p$  3 200 ns  
**RISE TIME**  $t_r$  3 2 ns  
**DUTY FACTOR**  $\delta = 0.02$

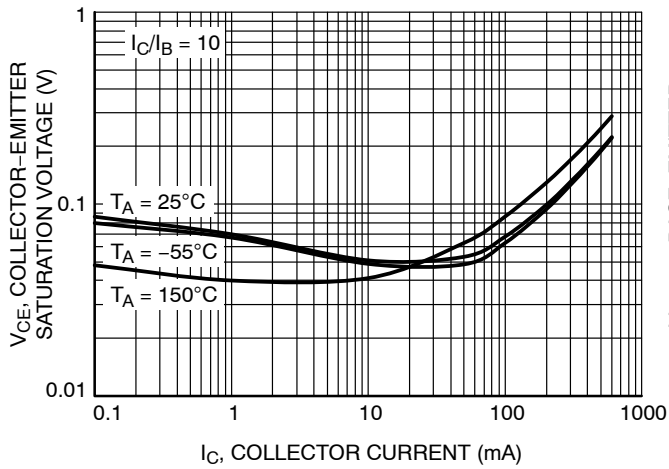
**OSCILLOSCOPE:**

**INPUT IMPEDANCE**  $Z_i > 100 \text{ k}\Omega$   
**INPUT CAPACITANCE**  $C_i < 12 \text{ pF}$   
**RISE TIME**  $t_r < 5 \text{ ns}$

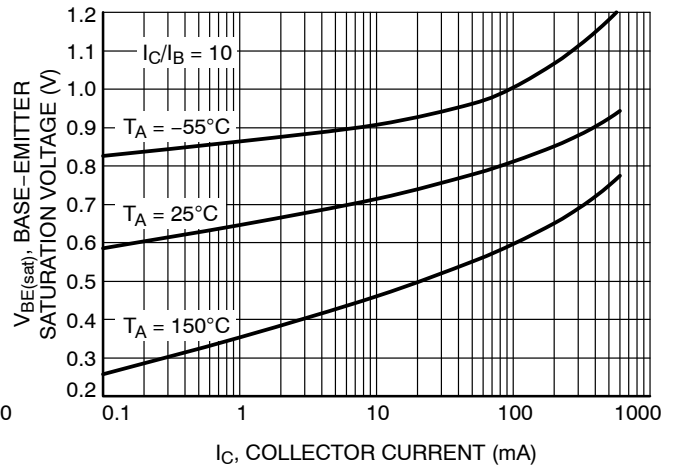


**Figure 2. Input Waveform and Test Circuit for Determining Storage Time and Fall Time**

## TYPICAL CHARACTERISTICS



**Figure 3. Collector Emitter Saturation Voltage vs. Collector Current**



**Figure 4. Base Emitter Saturation Voltage vs. Collector Current**

TYPICAL CHARACTERISTICS

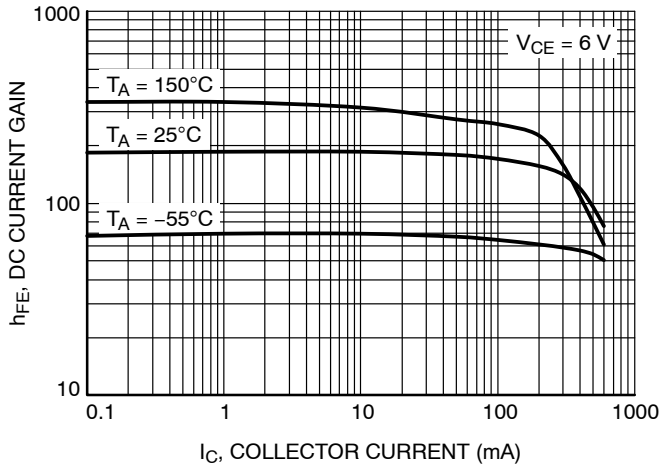


Figure 5. DC Current Gain vs. Collector Current

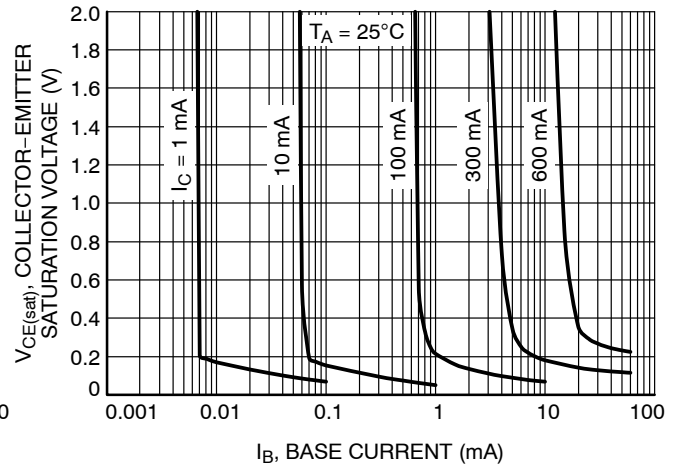


Figure 6. Saturation Region

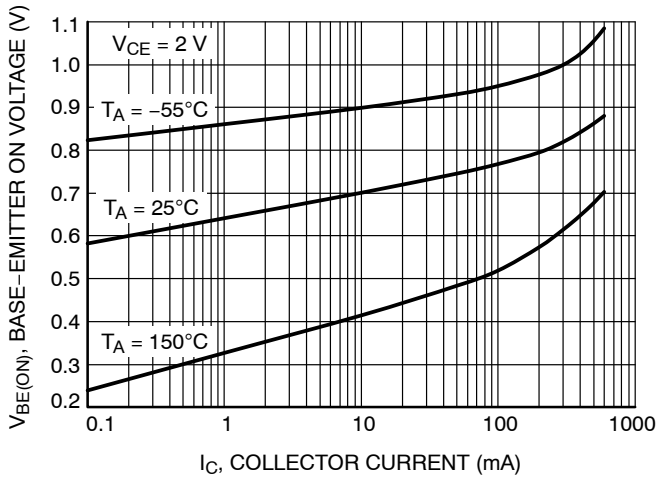


Figure 7. Base-Emitter Turn-On Voltage vs. Collector Current

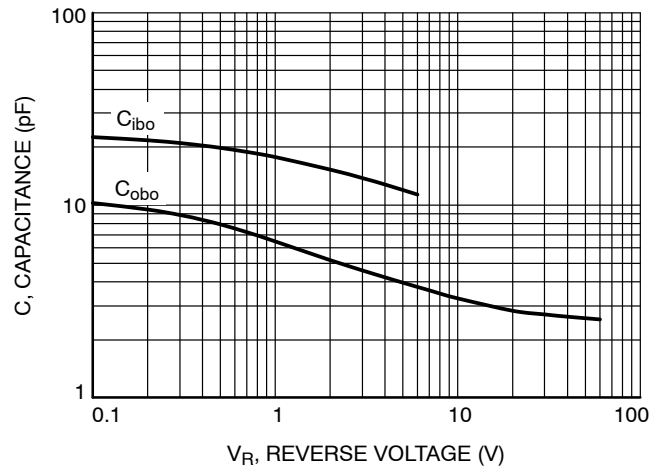


Figure 8. Capacitance

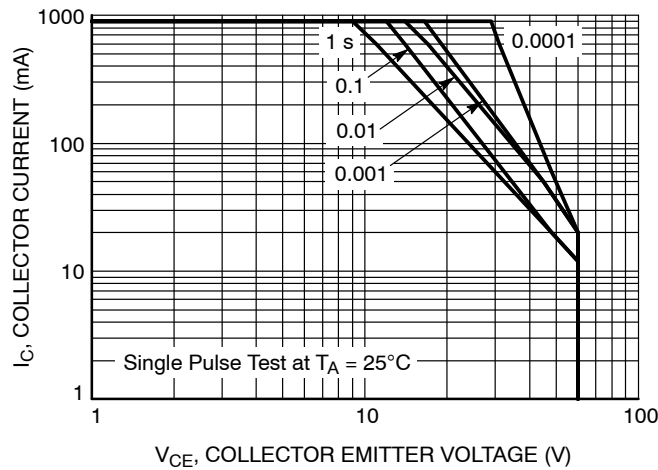


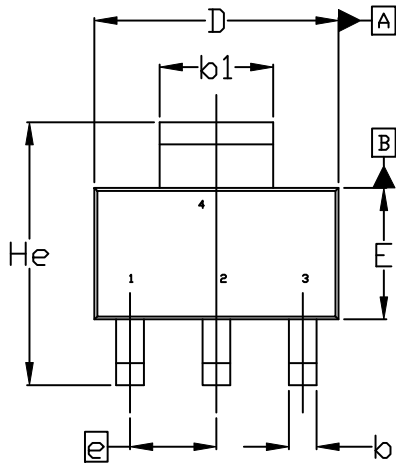
Figure 9. Safe Operating Area



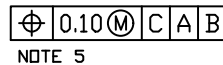
SCALE 1:1

**SOT-223 (TO-261)**  
CASE 318E-04  
ISSUE R

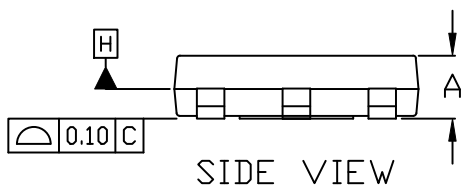
DATE 02 OCT 2018



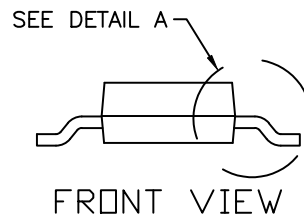
TOP VIEW



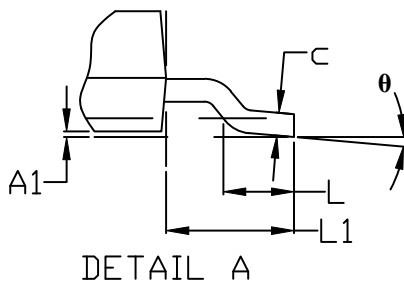
NOTE 5



SIDE VIEW



FRONT VIEW

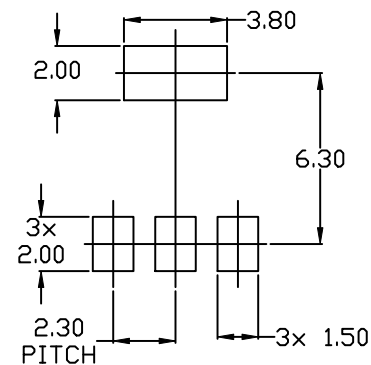


DETAIL A

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D & E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.200MM PER SIDE.
4. DATUMS A AND B ARE DETERMINED AT DATUM H.
5. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
6. POSITIONAL TOLERANCE APPLIES TO DIMENSIONS b AND b1.

| MILLIMETERS |          |      |      |
|-------------|----------|------|------|
| DIM         | MIN.     | NOM. | MAX. |
| A           | 1.50     | 1.63 | 1.75 |
| A1          | 0.02     | 0.06 | 0.10 |
| b           | 0.60     | 0.75 | 0.89 |
| b1          | 2.90     | 3.06 | 3.20 |
| c           | 0.24     | 0.29 | 0.35 |
| D           | 6.30     | 6.50 | 6.70 |
| E           | 3.30     | 3.50 | 3.70 |
| e           | 2.30 BSC |      |      |
| L           | 0.20     | ---  | ---  |
| L1          | 1.50     | 1.75 | 2.00 |
| He          | 6.70     | 7.00 | 7.30 |
| θ           | 0°       | ---  | 10°  |


RECOMMENDED MOUNTING  
FOOTPRINT

|                         |                         |                                                                                                                                                                                     |
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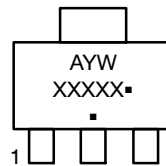
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**SOT-223 (TO-261)**  
**CASE 318E-04**  
**ISSUE R**

DATE 02 OCT 2018

|                                                                              |                                                                             |                                                                               |                                                                       |                                                                       |
|------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|
| <b>STYLE 1:</b><br>PIN 1. BASE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR | <b>STYLE 2:</b><br>PIN 1. ANODE<br>2. CATHODE<br>3. NC<br>4. CATHODE        | <b>STYLE 3:</b><br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE<br>4. DRAIN           | <b>STYLE 4:</b><br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE<br>4. DRAIN   | <b>STYLE 5:</b><br>PIN 1. DRAIN<br>2. GATE<br>3. SOURCE<br>4. GATE    |
| <b>STYLE 6:</b><br>PIN 1. RETURN<br>2. INPUT<br>3. OUTPUT<br>4. INPUT        | <b>STYLE 7:</b><br>PIN 1. ANODE 1<br>2. CATHODE<br>3. ANODE 2<br>4. CATHODE | <b>STYLE 8:</b><br>CANCELLED                                                  | <b>STYLE 9:</b><br>PIN 1. INPUT<br>2. GROUND<br>3. LOGIC<br>4. GROUND | <b>STYLE 10:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE<br>4. ANODE |
| <b>STYLE 11:</b><br>PIN 1. MT 1<br>2. MT 2<br>3. GATE<br>4. MT 2             | <b>STYLE 12:</b><br>PIN 1. INPUT<br>2. OUTPUT<br>3. NC<br>4. OUTPUT         | <b>STYLE 13:</b><br>PIN 1. GATE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR |                                                                       |                                                                       |

**GENERIC  
MARKING DIAGRAM\***



A = Assembly Location  
 Y = Year  
 W = Work Week  
 XXXXX = Specific Device Code  
 ■ = Pb-Free Package

(Note: Microdot may be in either location)  
 \*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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