

## PNP SILICON SWITCHING TRANSISTOR

Qualified per MIL-PRF-19500/512

### DEVICES

**2N4029**

**2N4033**

**2N4033UA**

**2N4033UB**

### LEVELS

**JAN**

**JANTX**

**JANTXV**

**JANS**

### ABSOLUTE MAXIMUM RATINGS ( $T_C = +25^\circ\text{C}$ unless otherwise noted)

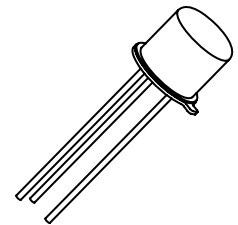
| Parameters / Test Conditions                        | Symbol          | Value   | Unit              |                    |
|---|-----------------|---|-------------------|--------------------|
| Collector-Emitter Voltage                           | $V_{CEO}$       | 80  | Vdc               |                    |
| Collector-Base Voltage                              | $V_{CBO}$       | 80  | Vdc               |                    |
| Emitter-Base Voltage                                | $V_{EBO}$       | 5.0   | Vdc               |                    |
| Collector Current                                   | $I_C$           | 1.0   | A <sub>dc</sub>   |                    |
| Total Power Dissipation @ $T_A = +25^\circ\text{C}$ | $P_T$           | 2N4029 <sup>1</sup><br>2N4033 <sup>2</sup><br>2N4033UA, UB <sup>3</sup> | 0.5<br>0.8<br>0.5 | W                  |
| Operating & Storage Junction Temperature Range      | $T_j, T_{stg}$  | -65 to +200   | $^\circ\text{C}$  |                    |
| Thermal Resistance, Junction-to-Case                | $R_{\theta JC}$ | 2N4029<br>2N4033  | 80<br>40          | $^\circ\text{C/W}$ |

#### Note:

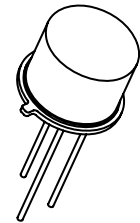
- Derate linearly 2.86mW/ $^\circ\text{C}$  for  $T_A > +25^\circ\text{C}$
- Derate linearly 4.56mW/ $^\circ\text{C}$  for  $T_A > +25^\circ\text{C}$
- For UB package and use  $R_{\theta JC}$  or see thermal curves in /512

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

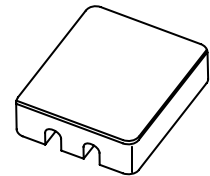
| Parameters / Test Conditions   | Symbol    | Min. | Max.           | Unit  |
|--|-----------|------|----------------|---|
| <b>OFF CHARACTERISTICS</b>   |           |      |                |   |
| Collector-Base Cutoff Current<br>$V_{CB} = 80\text{Vdc}$<br>$V_{CB} = 60\text{Vdc}$<br>$V_{CB} = 60\text{Vdc}, T_A = +150^\circ\text{C}$ | $I_{CBO}$ |      | 10<br>10<br>25 | $\mu\text{A}_{dc}$<br>$\eta\text{A}_{dc}$<br>$\mu\text{A}_{dc}$ |
| Emitter-Base Cutoff Current<br>$V_{EB} = 5.0\text{Vdc}$<br>$V_{EB} = 3.0\text{Vdc}$  | $I_{EBO}$ |      | 10<br>25       | $\mu\text{A}_{dc}$<br>$\eta\text{A}_{dc}$                       |
| Collector-Emitter Cutoff Current<br>$V_{BE} = 2.0\text{Vdc}, V_{CE} = 60\text{Vdc}$  | $I_{CEX}$ |      | 25             | $\eta\text{A}_{dc}$   |



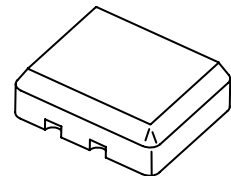
TO-18 (TO-206AA)  
2N4029



TO-39 (TO-205AD)  
2N4033



UA Package



UB Package

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

| Parameters / Test Conditions   | Symbol        | Min.                        | Max.                | Unit |
|--|---------------|-----------------------------|---------------------|------|
| <b>ON CHARACTERISTICS <sup>(3)</sup></b>   |               |                             |                     |      |
| Forward-Current Transfer Ratio<br>$I_C = 100\mu\text{A dc}$ , $V_{CE} = 5.0\text{V dc}$<br>$I_C = 100\text{mA dc}$ , $V_{CE} = 5.0\text{V dc}$<br>$I_C = 500\text{mA dc}$ , $V_{CE} = 5.0\text{V dc}$<br>$I_C = 1.0\text{A dc}$ , $V_{CE} = 5.0\text{V dc}$<br>$I_C = 500\text{mA dc}$ , $V_{CE} = 5.0\text{V dc}$ , $T_A = -55^\circ\text{C}$ | $h_{FE}$      | 50<br>100<br>70<br>25<br>30 | 300                 |      |
| Collector-Emitter Saturation Voltage<br>$I_C = 150\text{mA dc}$ , $I_B = 15\text{mA dc}$<br>$I_C = 500\text{mA dc}$ , $I_B = 50\text{mA dc}$<br>$I_C = 1.0\text{A dc}$ , $I_B = 100\text{mA dc}$   | $V_{CE(sat)}$ |                             | 0.15<br>0.50<br>1.0 | Vdc  |
| Base-Emitter Voltage<br>$I_C = 150\text{mA dc}$ , $I_B = 15\text{mA dc}$<br>$I_C = 500\text{mA dc}$ , $I_B = 50\text{mA dc}$   | $V_{BE(sat)}$ |                             | 0.9<br>1.2          | Vdc  |

## DYNAMIC CHARACTERISTICS

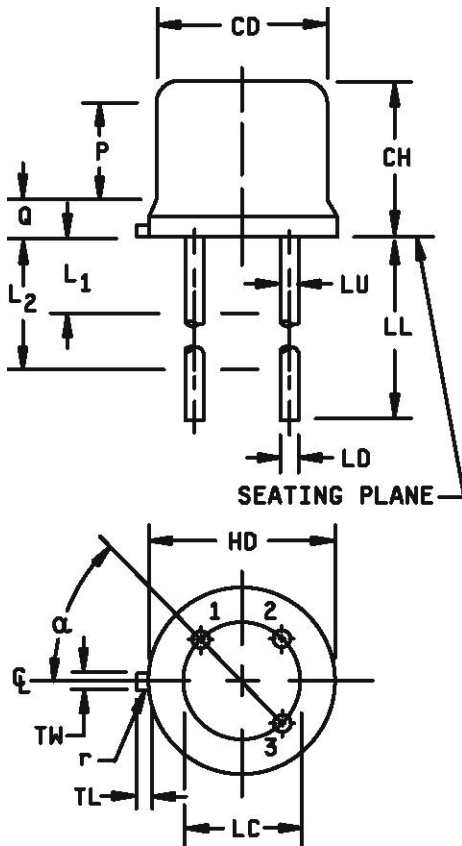
| Parameters / Test Conditions   | Symbol     | Min. | Max. | Unit |
|--|------------|------|------|------|
| Magnitude of Common Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio<br>$I_C = 50\text{mA dc}$ , $V_{CE} = 10\text{V dc}$ , $f = 100\text{MHz}$ | $ h_{fe} $ | 1.5  | 6.0  |      |
| Output Capacitance<br>$V_{CB} = 10\text{V dc}$ , $I_E = 0$ , $100\text{kHz} \leq f \leq 1.0\text{MHz}$   | $C_{obo}$  |      | 20   | pF   |
| Input Capacitance<br>$V_{EB} = 0.5\text{V dc}$ , $I_C = 0$ , $100\text{kHz} \leq f \leq 1.0\text{MHz}$   | $C_{ibo}$  |      | 80   | pF   |

## SWITCHING CHARACTERISTICS

| Parameters / Test Conditions  | Symbol | Min. | Max. | Unit |
|---|--------|------|------|------|
| On-Time<br>$V_{CC} = 31.9\text{V dc}$ ; $I_C = 500\text{mA dc}$ ; $I_{B1} = 50\text{mA dc}$   | $t_d$  |      | 15   | ns   |
| Rise Time<br>$V_{CC} = 31.9\text{V dc}$ ; $I_C = 500\text{mA dc}$ ; $I_{B1} = 50\text{mA dc}$ | $t_r$  |      | 25   | ns   |
| Storage Time<br>$V_{CC} = 31.9\text{V}$ , $I_C = 500\text{mA dc}$ , $I_{B1} = 50\text{mA dc}$ | $t_s$  |      | 175  | ns   |
| Fall Time<br>$V_{CC} = 31.9\text{V}$ , $I_C = 500\text{mA dc}$ , $I_{B1} = 50\text{mA dc}$    | $t_f$  |      | 35   | ns   |

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

## PACKAGE DIMENSIONS

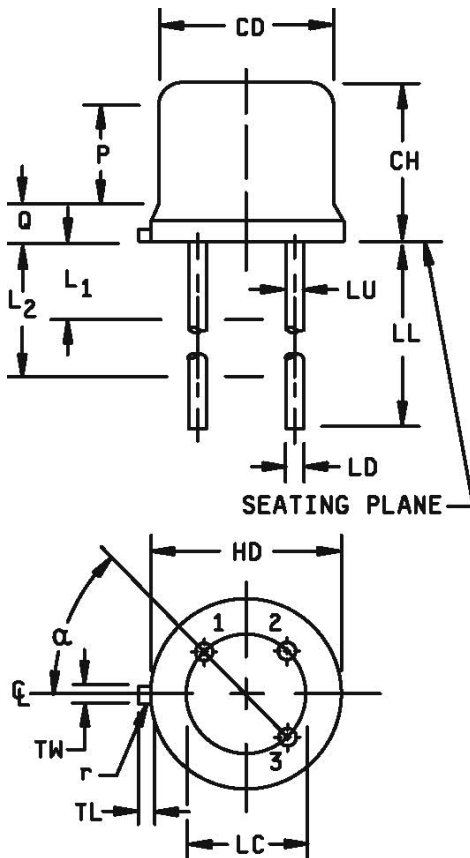


| Symbol         | Dimensions |      |             |       | Notes    |
|----------------|------------|------|-------------|-------|----------|
|                | Inches     |      | Millimeters |       |          |
|                | Min        | Max  | Min         | Max   |          |
| CD             | .178       | .195 | 4.52        | 4.95  |          |
| CH             | .170       | .210 | 4.32        | 5.34  |          |
| HD             | .209       | .230 | 5.31        | 5.84  |          |
| LC             | .100 TP    |      | 2.54 TP     |       | 6        |
| LD             | .016       | .021 | 0.41        | 0.53  | 7, 8     |
| LL             | .500       | .750 | 12.70       | 19.05 | 7, 8, 12 |
| LU             | .016       | .019 | 0.41        | 0.48  | 7, 8     |
| L <sub>1</sub> |            | .050 |             | 1.27  | 7, 8     |
| L <sub>2</sub> | .250       |      | 6.35        |       | 7, 8     |
| Q              |            | .040 |             | 1.02  | 5        |
| TL             | .028       | .048 | 0.71        | 1.22  | 3, 4     |
| TW             | .036       | .046 | 0.91        | 1.17  | 3        |
| r              |            | .010 |             | 0.25  | 10       |
| P              | .100       |      | 2.54        |       |          |
| α              | 45° TP     |      |             |       | 6        |

### NOTES:

- 1 Dimension are in inches.
- 2 Millimeters equivalents are given for general information only.
- 3 Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
- 4 Dimension TL measured from maximum HD.
- 5 Body contour optional within zone defined by HD, CD, and Q.
- 6 Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods.
- 7 Dimension LU applies between L<sub>1</sub> and L<sub>2</sub>. Dimension LD applies between L<sub>2</sub> and minimum. Diameter is uncontrolled in L<sub>1</sub> and beyond LL minimum.
- 8 All three leads.
- 9 The collector shall be internally connected to the case.
- 10 Dimension r (radius) applies to both inside corners of tab.
- 11 In accordance with ASME Y14.5M, diameters are equivalent to φx symbology.
- 12 For "L" suffix devices, dimension LL is 1.50 (38.10mm) minimum, 1.75 (44.45mm) maximum.

**FIGURE 1. Physical dimensions for 2N4029 (TO-18).**

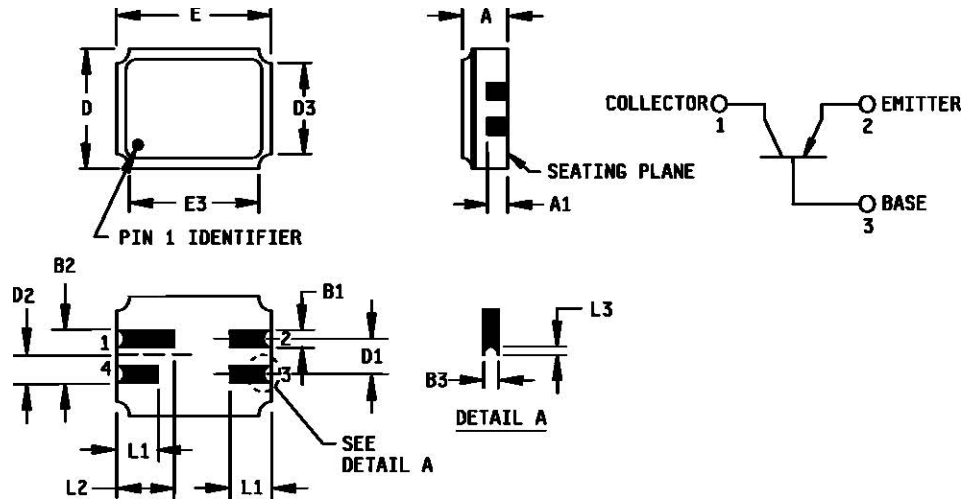


| Symbol         | Dimensions |      |             |       | Notes    |
|----------------|------------|------|-------------|-------|----------|
|                | Inches     |      | Millimeters |       |          |
|                | Min        | Max  | Min         | Max   |          |
| CD             | .305       | .335 | 7.75        | 8.51  |          |
| CH             | .240       | .260 | 6.10        | 6.60  |          |
| HD             | .335       | .370 | 8.51        | 9.40  |          |
| LC             | .200 TP    |      | 5.08 TP     |       | 6        |
| LD             | .016       | .021 | 0.41        | 0.53  | 7, 8     |
| LL             | .500       | .750 | 12.70       | 19.05 | 7, 8, 12 |
| LU             | .016       | .019 | 0.41        | 0.48  | 7, 8     |
| L <sub>1</sub> |            | .050 |             | 1.27  | 7, 8     |
| L <sub>2</sub> | .250       |      | 6.35        |       | 7, 8     |
| Q              |            | .050 |             | 1.27  | 5        |
| TL             | .029       | .045 | 0.74        | 1.14  | 3, 4     |
| TW             | .028       | .034 | 0.71        | 0.86  | 3        |
| r              |            | .010 |             | 0.25  | 10       |
| P              | .100       |      | 2.54        |       |          |
| α              | 45° TP     |      |             |       | 6        |

**NOTES:**

- 1 Dimension are in inches.
- 2 Millimeters equivalents are given for general information only.
- 3 Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
- 4 Dimension TL measured from maximum HD.
- 5 Body contour optional within zone defined by HD, CD, and Q.
- 6 Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods.
- 7 Dimension LU applies between L<sub>1</sub> and L<sub>2</sub>. Dimension LD applies between L<sub>2</sub> and minimum. Diameter is uncontrolled in L<sub>1</sub> and beyond LL minimum.
- 8 All three leads.
- 9 The collector shall be internally connected to the case.
- 10 Dimension r (radius) applies to both inside corners of tab.
- 11 In accordance with ASME Y14.5M, diameters are equivalent to φx symbology.
- 12 For "L" suffix devices, dimension LL is 1.50 (38.10mm) minimum, 1.75 (44.45mm) maximum.

**FIGURE 2. Physical dimensions for 2N4033 (TO-39).**

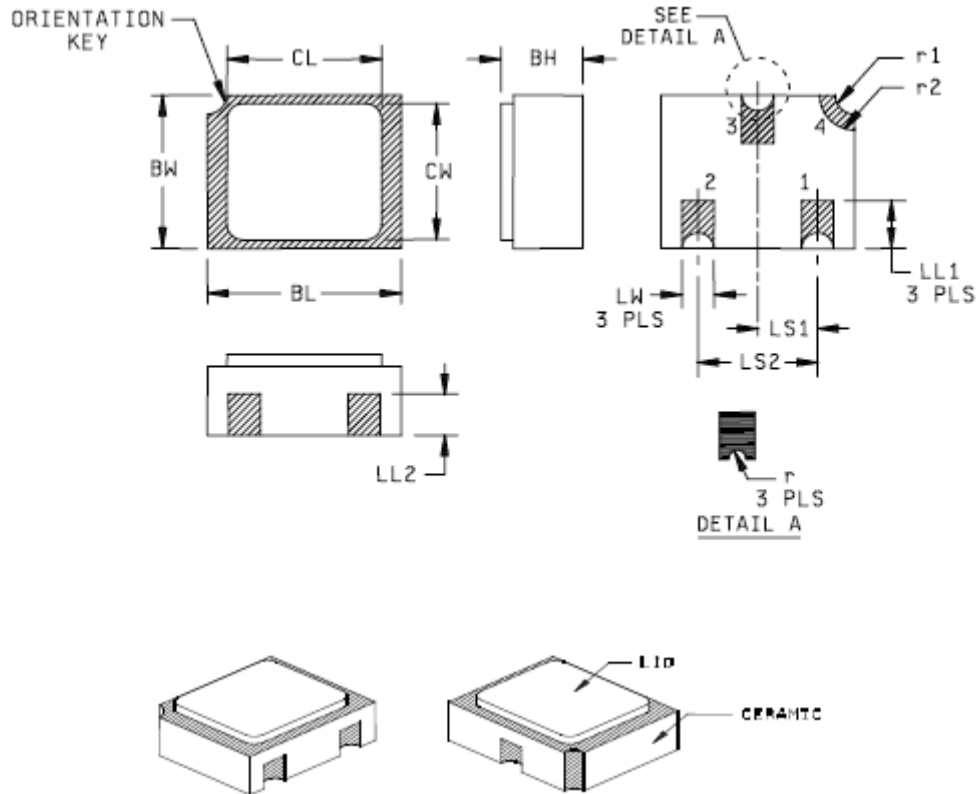


| Ltr.           | Dimensions |      |             |      | Note | Ltr.           | Dimensions |      |             |      | Note |
|----------------|------------|------|-------------|------|------|----------------|------------|------|-------------|------|------|
|                | Inches     |      | Millimeters |      |      |                | Inches     |      | Millimeters |      |      |
|                | Min        | Max  | Min         | Max  |      |                | Min        | Max  | Min         | Max  |      |
| A              | .061       | .075 | 1.55        | 1.91 | 3    | D <sub>2</sub> | .0375 BSC  |      | 0.952 BSC   |      |      |
| A <sub>1</sub> | .029       | .041 | 0.74        | 1.04 |      | D <sub>3</sub> |            | .155 |             | 3.94 |      |
| B <sub>1</sub> | .022       | .028 | 0.56        | 0.71 |      | E              | .215       | .225 | 5.46        | 5.72 |      |
| B <sub>2</sub> | .075 REF   |      | 1.91 REF    |      |      | E <sub>3</sub> |            | .225 |             | 5.72 |      |
| B <sub>3</sub> | .006       | .022 | 0.15        | 0.56 | 5    | L <sub>1</sub> | .032       | .048 | 0.81        | 1.22 |      |
| D              | .145       | .155 | 3.68        | 3.93 |      | L <sub>2</sub> | .072       | .088 | 1.83        | 2.24 |      |
| D <sub>1</sub> | .045       | .055 | 1.14        | 1.39 |      | L <sub>3</sub> | .003       | .007 | 0.08        | 0.18 | 5    |

**NOTES:**

- 1 Dimensions are in inches.
- 2 Millimeters equivalents are given for general information only.
- 3 Dimension "A" controls the overall package thickness. When a window lid is used, dimension "A" must increase by a minimum of .010 inch (0.254 mm) and a maximum of .040 inch (1.020 mm).
- 4 The corner shape (square, notch, radius, etc) may vary at the manufacturer's option, from that shown on the drawing.
- 5 Dimensions "B3" minimum and "L3" minimum and the appropriately castellation length define an unobstructed three-dimensional space traversing all of the ceramic layers in which a castellation was designed. (Castellations are required on bottom two layers, optional on top ceramic layer.) Dimension "B3" maximum and "L3" maximum define the maximum width and depth of the castellation at any point on its surface. Measurement of these dimensions may be made prior to solder dipping.
- 6 In accordance with ASME Y14.5M, diameters are equivalent to  $\phi$ x symbology.

**FIGURE 3. Physical dimensions, surface mount (UA version).**



| Symbol | Dimensions |      |             |      | Note |
|--------|------------|------|-------------|------|------|
|        | Inches     |      | Millimeters |      |      |
|        | Min        | Max  | Min         | Max  |      |
| BH     | .046       | .056 | 1.17        | 1.42 |      |
| BL     | .115       | .128 | 2.92        | 3.25 |      |
| BW     | .085       | .108 | 2.16        | 2.74 |      |
| CL     |            | .128 |             | 3.25 |      |
| CW     |            | .108 |             | 2.74 |      |
| LL1    | .022       | .038 | 0.56        | 0.96 |      |
| LL2    | .017       | .035 | 0.43        | 0.89 |      |

| Symbol | Dimensions |      |             |      | Note |
|--------|------------|------|-------------|------|------|
|        | Inches     |      | Millimeters |      |      |
|        | Min        | Max  | Min         | Max  |      |
| LS1    | .036       | .040 | 0.91        | 1.02 |      |
| LS2    | .071       | .079 | 1.81        | 2.01 |      |
| LW     | .016       | .024 | 0.41        | 0.61 |      |
| r      |            | .008 |             | .203 |      |
| r1     |            | .012 |             | .305 |      |
| r2     |            | .022 |             | .559 |      |

**NOTES:**

- 1 Dimensions are in inches.
- 2 Millimeters are given for general information only.
- 3 Hatched areas on package denote metalized areas.
- 4 Pad 1 = Base, Pad 2 = Emitter, Pad 3 = Collector, Pad 4 = Shielding connected to the lid.
- 5 In accordance with ASME Y14.5M, diameters are equivalent to  $\phi x$  symbology.

**FIGURE 4. Physical dimensions, surface mount (UB version).**