

## NPN SILICON TRANSISTOR

Qualified per MIL-PRF-19500/727

### DEVICES

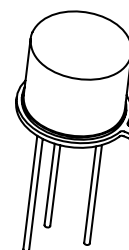
|               |               |                |                |
|---------------|---------------|----------------|----------------|
| <b>2N5010</b> | <b>2N5013</b> | <b>2N5010S</b> | <b>2N5013S</b> |
| <b>2N5011</b> | <b>2N5014</b> | <b>2N5011S</b> | <b>2N5014S</b> |
| <b>2N5012</b> | <b>2N5015</b> | <b>2N5012S</b> | <b>2N5015S</b> |

### LEVELS

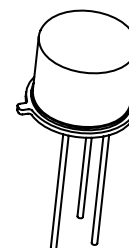
**JAN**  
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### ABSOLUTE MAXIMUM RATINGS ( $T_C = +25^\circ\text{C}$ unless otherwise noted)

| Parameters / Test Conditions                   | Symbol                         | Value                                | Unit               |
|------------------------------------------------|--------------------------------|--------------------------------------|--------------------|
| Collector-Emitter Voltage                      | $V_{\text{CER}}$               | 2N5010                               | 500                |
|                                                |                                | 2N5011                               | 600                |
|                                                |                                | 2N5012                               | 700                |
|                                                |                                | 2N5013                               | 800                |
|                                                |                                | 2N5014                               | 900                |
|                                                |                                | 2N5015                               | 1000               |
| Collector-Base Voltage                         | $V_{\text{CBO}}$               | 2N5010                               | 500                |
|                                                |                                | 2N5011                               | 600                |
|                                                |                                | 2N5012                               | 700                |
|                                                |                                | 2N5013                               | 800                |
|                                                |                                | 2N5014                               | 900                |
|                                                |                                | 2N5015                               | 1000               |
| Emitter-Base Voltage                           | $V_{\text{EBO}}$               | 5                                    | Vdc                |
| Collector Current                              | $I_{\text{C}}$                 | 200                                  | mAdc               |
| Base Current                                   | $I_{\text{B}}$                 | 20                                   | mAdc               |
| Total Power Dissipation                        | $P_{\text{t}}$                 | @ $T_{\text{A}} = +25^\circ\text{C}$ | 1.0                |
|                                                |                                | @ $T_{\text{C}} = +25^\circ\text{C}$ | 7.0                |
| Thermal Resistance, Junction to Case 1/        | $R_{\theta\text{JC}}$          | 20                                   | $^\circ\text{C/W}$ |
| Operating & Storage Junction Temperature Range | $T_{\text{j}}, T_{\text{stg}}$ | -65 to +200                          | $^\circ\text{C}$   |



**TO-5**  
**2N5010 thru 2N5015**



**TO-39**  
**2N5010S thru 2N5015S**

### Note:

1/ See 19500/727 for Thermal Derating Curves.

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

| Parameters / Test Conditions                                                                                                                                                                                                              | Symbol        | Min.                                    | Max.                             | Unit                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------------------------------|----------------------------------|----------------------------------------------|
| Collector to Base Cutoff Current<br>$V_{CB} = 400\text{V}$ 2N5010<br>$V_{CB} = 500\text{V}$ 2N5011<br>$V_{CB} = 580\text{V}$ 2N5012<br>$V_{CB} = 650\text{V}$ 2N5013<br>$V_{CB} = 700\text{V}$ 2N5014<br>$V_{CB} = 760\text{V}$ 2N5015    | $I_{CBO1}$    |                                         | 10<br>10<br>10<br>10<br>10<br>10 | nAdc<br>nAdc<br>nAdc<br>nAdc<br>nAdc<br>nAdc |
| @ $T_A = +150^\circ\text{C}$<br>$V_{CB} = 400\text{V}$ 2N5010<br>$V_{CB} = 500\text{V}$ 2N5011<br>$V_{CB} = 588\text{V}$ 2N5012<br>$V_{CB} = 650\text{V}$ 2N5013<br>$V_{CB} = 700\text{V}$ 2N5014<br>$V_{CB} = 760\text{V}$ 2N5015        | $I_{CBO2}$    |                                         | 10<br>10<br>10<br>10<br>10<br>10 | uAdc<br>uAdc<br>uAdc<br>uAdc<br>uAdc<br>uAdc |
| Emitter to Base Cutoff Current<br>$V_{EB} = 4\text{V}$                                                                                                                                                                                    | $I_{EBO}$     |                                         | 20                               | uAdc                                         |
| Collector to Base Breakdown Voltage<br>$I_C = 0.1\text{mAdc}$ 2N5010<br>$I_C = 0.1\text{mAdc}$ 2N5011<br>$I_C = 0.1\text{mAdc}$ 2N5012<br>$I_C = 0.2\text{mAdc}$ 2N5013<br>$I_C = 0.2\text{mAdc}$ 2N5014<br>$I_C = 0.2\text{mAdc}$ 2N5015 | $V_{(BR)CBO}$ | 500<br>600<br>700<br>800<br>900<br>1000 |                                  | Vdc<br>Vdc<br>Vdc<br>Vdc<br>Vdc<br>Vdc       |
| Emitter to Base Breakdown Voltage<br>$I_C = 0\text{mA}$<br>$I_E = 0.05\text{mA}$                                                                                                                                                          | $V_{(BR)EBO}$ | 5                                       |                                  | Vdc                                          |
| Collector to Emitter Breakdown Voltage<br>$R_{BE} = 1\text{K}\Omega$ 2N5010<br>$I_C = 0.2\text{mA}$ , Pulsed 2N5011<br>2N5012<br>2N5013<br>2N5014<br>2N5015                                                                               | $V_{(BR)CER}$ | 500<br>600<br>700<br>800<br>900<br>1000 |                                  | Vdc<br>Vdc<br>Vdc<br>Vdc<br>Vdc<br>Vdc       |
| Forward-Current Transfer Ratio<br>$I_C = 25\text{mA}$ 2N5010, 2N5011, 2N5012<br>$I_C = 20\text{mA}$ 2N5013, 2N5014, 2N5015<br>$V_{CE} = 10\text{V}$                                                                                       | $h_{FE1}$     | 30<br>30                                | 180<br>180                       |                                              |
| $V_{CE} = 10\text{V}$<br>$I_C = 5\text{mA}$                                                                                                                                                                                               | $h_{FE2}$     | 10                                      |                                  |                                              |
| $V_{CE} = 10\text{V}$<br>$I_C = 20\text{mA}$ @ $T_A = -55^\circ\text{C}$                                                                                                                                                                  | $h_{FE3}$     | 10                                      |                                  |                                              |

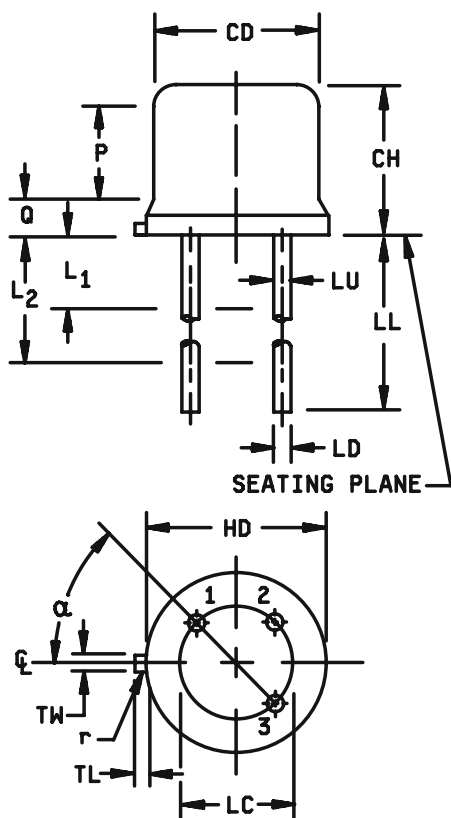
## ELECTRICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ , unless otherwise noted) (Cont.)

| Parameters / Test Conditions                                                                                                                                                                                                                            | Symbol        | Min. | Max.                                   | Unit                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|----------------------------------------|----------------------------------------|
| Base-Emitter Saturation Voltage<br>$I_C = 25\text{mA}$ 2N5010, 2N5011, 2N5012<br>$I_C = 20\text{mA}$ 2N5013, 2N5014, 2N5015<br>$I_B = 5\text{mA}$ , Pulsed                                                                                              | $V_{BE(SAT)}$ |      | 1.0<br>1.0                             | Vdc<br>Vdc                             |
| Collector-Emitter Saturation Voltage<br>$I_C = 25\text{mA}$ 2N5010<br>$I_C = 25\text{mA}$ 2N5011<br>$I_C = 25\text{mA}$ 2N5012<br>$I_C = 20\text{mA}$ 2N5013<br>$I_C = 20\text{mA}$ 2N5014<br>$I_C = 20\text{mA}$ 2N5015<br>$I_B = 5\text{mA}$ , Pulsed | $V_{CE(SAT)}$ |      | 1.4<br>1.5<br>1.6<br>1.6<br>1.6<br>1.8 | Vdc<br>Vdc<br>Vdc<br>Vdc<br>Vdc<br>Vdc |

## DYNAMIC CHARACTERISTICS

| Parameters / Test Conditions                                                                                                                                                                                                                                     | Symbol     | Min.       | Max. | Unit |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|------|------|
| Magnitude of small signal short-circuit forward current transfer ratio<br>$V_{CE} = 10\text{Vdc}$ , $I_C = 25\text{mA}$ , $f = 10\text{MHz}$ 2N5010, 2N5011, 2N5012<br>$V_{CE} = 10\text{Vdc}$ , $I_C = 20\text{mA}$ , $f = 10\text{MHz}$ 2N5013, 2N5014, 2N5015 | $ h_{fe} $ | 1.0<br>1.0 |      |      |
| Open circuit output capacitance<br>$V_{CB} = 10\text{V}$ , $I_E = 0$ , $f = 2\text{MHz}$                                                                                                                                                                         | $C_{obo}$  |            | 30   | pF   |

## PACKAGE DIMENSIONS



|                      | Dimensions  |      |             |      |       |
|----------------------|-------------|------|-------------|------|-------|
| Symbol               | Inches      |      | Millimeters |      | Notes |
|                      | Min         | Max  | Min         | Max  |       |
| CD                   | .305        | .335 | 7.75        | 8.51 | 6     |
| CH                   | .240        | .260 | 6.10        | 6.60 |       |
| HD                   | .335        | .370 | 8.51        | 9.40 |       |
| LC                   | .200 TP     |      | 5.08 TP     |      | 7     |
| LD                   | .016        | .019 | 0.41        | 0.48 | 8,9   |
| LL                   | See note 14 |      |             |      |       |
| LU                   | .016        | .019 | 0.41        | 0.48 | 8,9   |
| L <sub>1</sub>       |             | .050 |             | 1.27 | 8,9   |
| L <sub>2</sub>       | .250        |      | 6.35        |      | 8,9   |
| P                    | .100        |      | 2.54        |      | 7     |
| Q                    |             | .030 |             | 0.76 | 5     |
| TL                   | .029        | .045 | 0.74        | 1.14 | 3,4   |
| TW                   | .028        | .034 | 0.71        | 0.86 | 3     |
| r                    |             | .010 |             | 0.25 | 10    |
| α                    | 45° TP      |      | 45° TP      |      | 7     |
| 1, 2, 10, 12, 13, 14 |             |      |             |      |       |

### NOTE:

- Dimensions are in inches.
- Millimeters are given for general information only.
- Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
- Dimension TL measured from maximum HD.
- Body contour optional within zone defined by HD, CD, and Q.
- CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
- Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by gauging procedure.
- Dimension LU applies between L1 and L2. Dimension LD applies between L2 and LL minimum. Diameter is uncontrolled in and beyond LL minimum.
- All three leads.
- The collector shall be internally connected to the case.
- Dimension r (radius) applies to both inside corners of tab.
- In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.
- Lead 1 = emitter, lead 2 = base, lead 3 = collector.
- For non-S-suffix devices (TO-5), dimension LL = 1.5 inches (38.10 mm) min. and 1.75 inches (44.45 mm) max. For S-suffix types (TO-39), dimension LL = .5 inch (12.70 mm) min. and .750 inch (19.05 mm) max.