



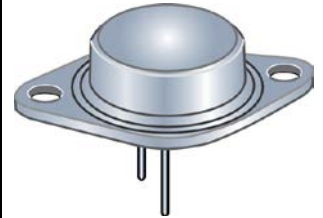
## PNP Darlington Power Silicon Transistor

Qualified per MIL-PRF-19500/527

Qualified Levels:  
JAN, JANTX, and  
JANTXV

### DESCRIPTION

This high speed PNP transistor is rated at -10 amps and is military qualified up to the JANTXV level. This TO-204AA isolated package features a 180 degree lead orientation.



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**TO-204AA (TO-3)  
Package**

### FEATURES

- JEDEC registered 2N6648 through 2N6650
- JAN, JANTX, and JANTXV qualifications are available per MIL-PRF-19500/527
- RoHS compliant versions available (commercial grade only)

### APPLICATIONS / BENEFITS

- Military and other high reliability applications
- High frequency response
- TO-204AA case with isolated terminals

### MAXIMUM RATINGS @ $T_A = +25^\circ\text{C}$ unless otherwise noted

| Parameters/Test Conditions          | Symbol              | Value             | Unit               |
|-------------------------------------|---------------------|-------------------|--------------------|
| Junction and Storage Temperature    | $T_J$ and $T_{STG}$ | -65 to +175       | $^\circ\text{C}$   |
| Thermal Resistance Junction-to-Case | $R_{\theta JC}$     | 1.76              | $^\circ\text{C/W}$ |
| Collector-Emitter Voltage           | $V_{CEO}$           | -40<br>-60<br>-80 | V                  |
| Collector-Base Voltage              | $V_{CBO}$           | -40<br>-60<br>-80 | V                  |
| Emitter-Base Voltage                | $V_{EBO}$           | -5                | V                  |
| Total Power Dissipation             | $P_T$               | 5.0<br>85         | W                  |
| Base Current                        | $I_B$               | -0.25             | A                  |
| Collector Current                   | $I_C$               | -10               | A                  |

- Notes:**
1. Derate linearly 33.3 mW/ $^\circ\text{C}$  above  $T_A > +25^\circ\text{C}$ .
  2. Derate linearly 567 mW/ $^\circ\text{C}$  above  $T_C > +25^\circ\text{C}$ .

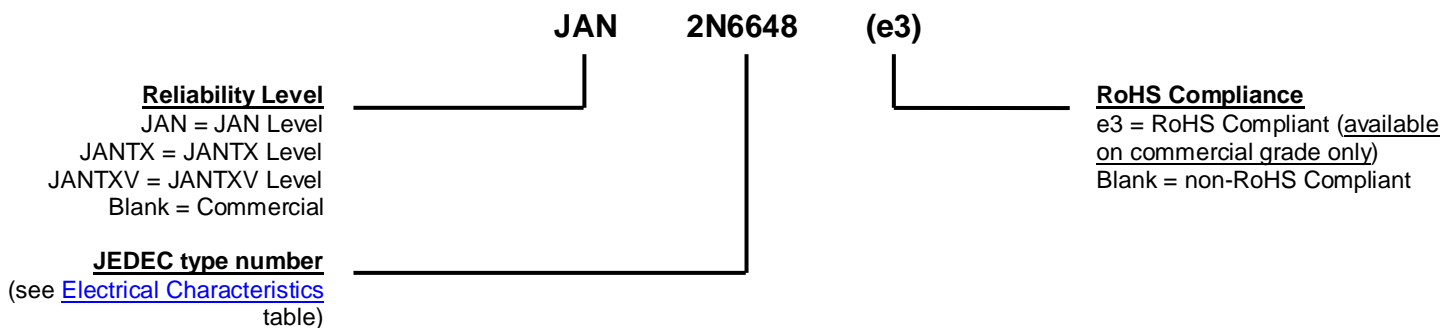
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**MECHANICAL and PACKAGING**

- CASE: Industry standard TO-204AA (TO-3), hermetically sealed, 0.040 inch diameter pins
- FINISH: Solder dipped tin-lead over nickel plated alloy 52 or RoHS compliant matte-tin plating. Solderable per MIL-STD-750 method 2026.
- POLARITY: PNP (see [schematic](#))
- MOUNTING HARDWARE: Consult factory for optional insulator and sheet metal screws
- WEIGHT: Approximately 15 grams
- See [package dimensions](#) on last page.

**PART NOMENCLATURE**

**SYMBOLS & DEFINITIONS**

| Symbol    | Definition  |
|-----------|---|
| $I_B$     | Base current: The value of the dc current into the base terminal.   |
| $I_C$     | Collector current: The value of the dc current into the collector terminal.   |
| $I_E$     | Emitter current: The value of the dc current into the emitter terminal.   |
| $T_C$     | Case temperature: The temperature measured at a specified location on the case of a device.   |
| $V_{CB}$  | Collector-base voltage: The dc voltage between the collector and the base.  |
| $V_{CBO}$ | Collector-base voltage, base open: The voltage between the collector and base terminals when the emitter terminal is open-circuited.        |
| $V_{CC}$  | Collector-supply voltage: The supply voltage applied to a circuit connected to the collector.   |
| $V_{CEO}$ | Collector-emitter voltage, base open: The voltage between the collector and the emitter terminals when the base terminal is open-circuited. |
| $V_{CE}$  | Collector-emitter voltage: The dc voltage between the collector and the emitter.  |
| $V_{EB}$  | Emitter-base voltage: The dc voltage between the emitter and the base.  |
| $V_{EBO}$ | Emitter-base voltage, collector open: The voltage between the emitter and base terminals with the collector terminal open-circuited.        |

**ELECTRICAL CHARACTERISTICS @  $T_A = +25^\circ\text{C}$  unless otherwise noted**

| Characteristics | Symbol | Min. | Max. | Unit |
|-----------------|--------|------|------|------|
|-----------------|--------|------|------|------|

**OFF CHARACTERISTICS**

|  |                            |               |                   |                     |
|--|----------------------------|---------------|-------------------|---------------------|
| Collector-Emitter Breakdown Voltage<br>$I_C = -200\text{ mA}$  | 2N6648<br>2N6649<br>2N6650 | $V_{(BR)CEO}$ | -40<br>-60<br>-80 | V                   |
| Collector-Emitter Breakdown Voltage<br>$I_C = -200\text{ mA}, R_{BB} = 100\ \Omega$  | 2N6648<br>2N6649<br>2N6650 | $V_{(BR)CER}$ | -40<br>-60<br>-80 | V                   |
| Collector-Emitter Cutoff Current<br>$V_{CE} = -40\text{ V}$<br>$V_{CE} = -60\text{ V}$<br>$V_{CE} = -80\text{ V}$  | 2N6648<br>2N6649<br>2N6650 | $I_{CEO}$     |                   | -1.0<br>mA          |
| Collector-Emitter Cutoff Current<br>$V_{CE} = -40\text{ V}, V_{BE} = 1.5\text{ V}$<br>$V_{CE} = -60\text{ V}, V_{BE} = 1.5\text{ V}$<br>$V_{CE} = -80\text{ V}, V_{BE} = 1.5\text{ V}$ | 2N6648<br>2N6649<br>2N6650 | $I_{CEX}$     |                   | 10<br>$\mu\text{A}$ |
| Emitter-Base Cutoff Current<br>$V_{EB} = 5.0\text{ V}$   |                            | $I_{EBO}$     |                   | -10<br>mA           |
| Collector-Emitter Cutoff Current<br>$V_{CE} = -40\text{ V}$<br>$V_{CE} = -60\text{ V}$<br>$V_{CE} = -80\text{ V}$  | 2N6648<br>2N6649<br>2N6650 | $I_{CBO}$     |                   | -1.0<br>mA          |

**ON CHARACTERISTICS**

|  |  |               |                            |                   |
|--|--|---------------|----------------------------|-------------------|
| Forward-Current Transfer Ratio<br>$I_C = -1.0\text{ A}, V_{CE} = -3.0\text{ V}$<br>$I_C = -5\text{ A}, V_{CE} = -3.0\text{ V}$<br>$I_C = -10\text{ A}, V_{CE} = -3.0\text{ V}$<br>$I_C = -5\text{ A}, V_{CE} = -3.0\text{ V}, T_A = -65^\circ\text{C}$ |  | $h_{FE}$      | 300<br>1,000<br>100<br>200 | 20,000            |
| Collector-Emitter Saturation Voltage<br>$I_C = -5.0\text{ A}, I_B = -10\text{ mA}$<br>$I_C = -10\text{ A}, I_B = -0.1\text{ mA}$   |  | $V_{CE(sat)}$ |                            | -2.0<br>-3.0<br>V |
| Base-Emitter Voltage Non-saturated<br>$V_{CE} = -3.0\text{ V}, I_C = -5.0\text{ A}$<br>$V_{CE} = -3.0\text{ V}, I_C = -10\text{ A}$  |  | $V_{BE(on)}$  |                            | -2.8<br>-4.5<br>V |

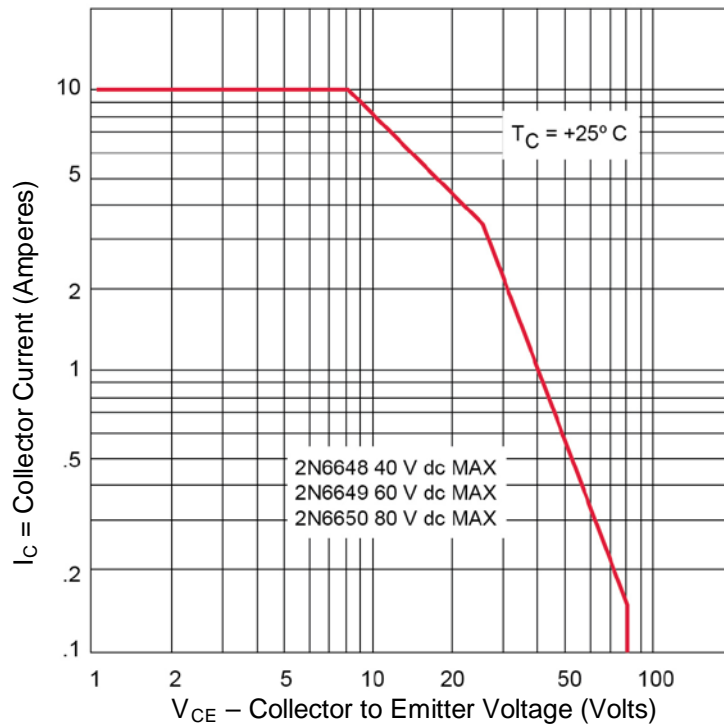
**DYNAMIC CHARACTERISTICS**

|  |  |            |    |           |
|--|--|------------|----|-----------|
| Magnitude of Common Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio<br>$I_C = -1.0\text{ A}, V_{CE} = -5.0\text{ V}, f = 1.0\text{ MHz}$ |  | $ h_{fe} $ | 30 | 400       |
| Output Capacitance<br>$V_{CB} = -10\text{ V}, I_E = 0, 100\text{ kHz} \leq f \leq 1\text{ MHz}$  |  | $C_{obo}$  |    | 300<br>pF |

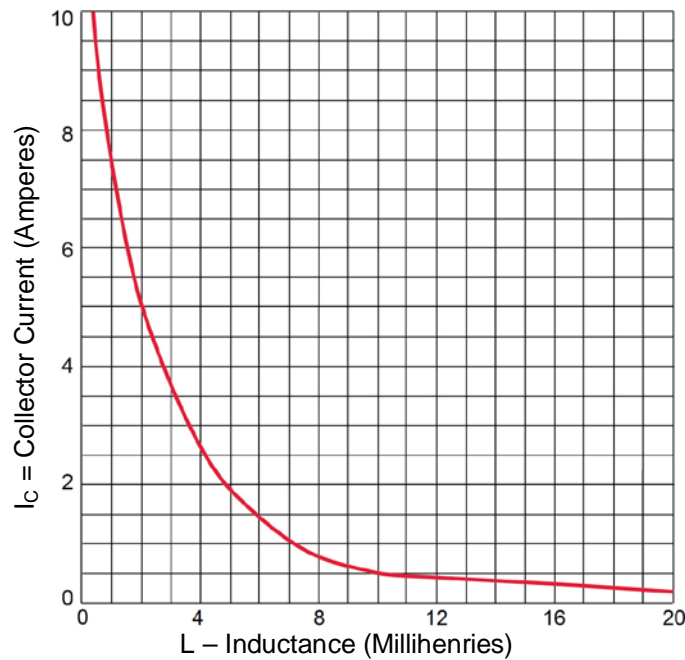
**ELECTRICAL CHARACTERISTICS @  $T_C = 25^\circ\text{C}$  unless otherwise noted. (continued)**
**SWITCHING CHARACTERISTICS**

|  |           |  |     |               |
|--|-----------|--|-----|---------------|
| Turn-On Time<br>$V_{CC} = -30\text{ V}, I_C = -5.0\text{ A}; I_B = -20\text{ mA}$              | $t_{on}$  |  | 2.5 | $\mu\text{s}$ |
| Turn-Off Time<br>$V_{CC} = -30\text{ V}, I_C = -5.0\text{ A}; I_{B1} = I_{B2} = -20\text{ mA}$ | $t_{off}$ |  | 10  | $\mu\text{s}$ |

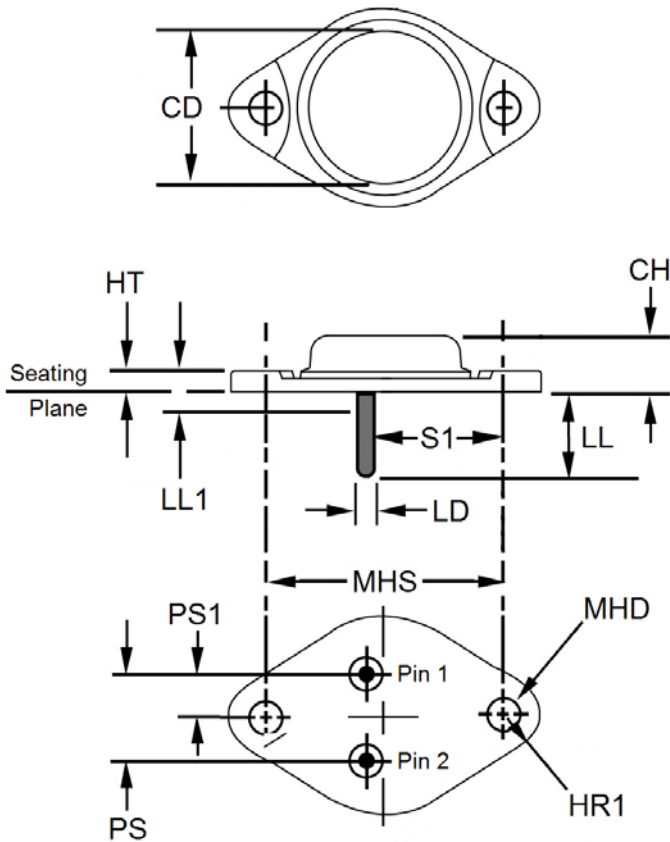
**SAFE OPERATING AREA (See [Figures 1 and 2](#) and [MIL-STD-750, Test Method 3053](#))**
**DC Tests**
 $T_C = +25^\circ\text{C}, t = 1\text{ second}, 1\text{ Cycle}$ 
**Test 1**
 $V_{CE} = -8.5\text{ V}, I_C = -10\text{ A}$ 
**Test 2**
 $V_{CE} = -25\text{ V}, I_C = -3.4\text{ A}$ 
**Test 3**
 $V_{CE} = -40\text{ V}, I_C = -0.9\text{ A (2N6648)}$ 
 $V_{CE} = -60\text{ V}, I_C = -0.3\text{ A (2N6649)}$ 
 $V_{CE} = -80\text{ V}, I_C = -0.14\text{ A (2N6650)}$

**SAFE OPERATING AREA**


**FIGURE 1**  
Maximum Safe Operating Graph (continuous dc)



**FIGURE 2**  
Safe Operating Area for Switching Between Saturation and Cutoff (unclamped inductive load)

**PACKAGE DIMENSIONS**


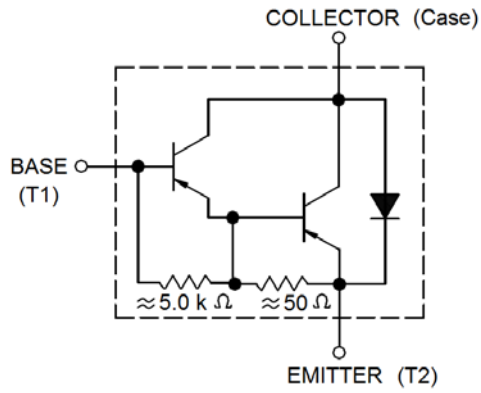
| Ltr | Dimensions |       |             |       | Notes |
|-----|------------|-------|-------------|-------|-------|
|     | Inches     |       | Millimeters |       |       |
|     | Min        | Max   | Min         | Max   |       |
| CD  | -          | 0.875 | -           | 22.23 |       |
| CH  | 0.250      | 0.450 | 6.35        | 11.43 |       |
| HR  | 0.495      | 0.525 | 12.57       | 13.34 |       |
| HR1 | 0.131      | 0.188 | 3.33        | 4.78  |       |
| HT  | 0.050      | 0.135 | 1.52        | 3.43  |       |
| LD  | 0.038      | 0.043 | 0.97        | 1.09  |       |
| LL  | 0.312      | 0.500 | 7.92        | 12.70 |       |
| LL1 | -          | 0.050 | -           | 1.27  |       |
| MHD | 0.151      | 0.161 | 3.84        | 4.09  |       |
| MHS | 1.177      | 1.197 | 29.90       | 30.40 |       |
| PS  | 0.420      | 0.440 | 10.67       | 11.18 | 3     |
| PS1 | 0.205      | 0.225 | 5.21        | 5.72  | 3     |
| S1  | 0.655      | 0.675 | 16.64       | 17.15 |       |

**NOTES:**

1. Dimensions are in inches.
2. Millimeters are given for information only.
3. These dimensions should be measured at points 0.050 inch (1.27 mm) and 0.055 inch (1.40 mm) below seating plane. When gauge is not used measurement will be made at the seating plane.
4. The seating plane of the header shall be flat within 0.001 inch (0.03 mm) concave to 0.004 inch (0.10 mm) convex inside a 0.930 inch (23.62 mm) diameter circle on the center of the header and flat within 0.001 inch (0.03 mm) concave to 0.006 inch (0.15 mm) convex overall.
5. Mounting holes shall be deburred on the seating plane side.
6. Collector is electrically connected to the case.
7. In accordance with AMSE Y14.5M, diameters are equivalent to  $\Phi$ x symbology.

See schematic on next page

**SCHEMATIC**



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