

## PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PLASTIC, PNP,  
SILICON, SWITCHING, TYPE 2N2907AUE1  
JAN, JANTX, JANJ

This specification is approved for use by all Departments  
and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers the performance requirements for plastic PNP, silicon, switching transistors. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1, SOT-23 (similar to TO-236).

1.3 Maximum ratings.

| Types      | $P_T$<br>$T_A = +25^\circ\text{C}$<br>(1) (2) | $I_C$            | $V_{CBO}$      | $V_{CEO}$      | $V_{EBO}$     | $T_{OP}$ and $T_{STG}$   | $R_{\theta JA}$                   |
|------------|---|------------------|----------------|----------------|---------------|--------------------------|-----------------------------------|
| 2N2907AUE1 | <u>mW</u><br>500                              | <u>mA</u><br>600 | <u>V</u><br>60 | <u>V</u><br>60 | <u>V</u><br>5 | <u>°C</u><br>-55 to +150 | <u>°C/W</u><br>417 (1)<br>556 (2) |

- (1) If the printed wiring board is made of alumina substrate; alumina = 0.4 x 0.3 x 0.024 in., 99.5 percent alumina: Derate linearly 2.4 mW/°C for  $T_A > +25^\circ\text{C}$  (see layout for  $R_{\theta JA}$  test).
- (2) If the printed wiring board is made of FR5 substrate; FR5 = 1.0 (25.4 mm) x 0.75 (19.05 mm) x 0.062 (1.57 mm) in.: Derate linearly 1.8 mW/°C for  $T_A > +25^\circ\text{C}$ .

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC/VAC, Post Office Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Primary electrical characteristics at  $T_A = +25^\circ\text{C}$ .

|     |  | $h_{FE}$ at $V_{CE} = 10\text{ V dc}$    |   |  |  |                                       |  |  |
|-----|--|--|---|--|--|---------------------------------------|--|--|
|     |  | $h_{FE8}$<br>$I_C = 1.0\ \mu\text{A dc}$ | $h_{FE9}$<br>$I_C = 10\ \mu\text{A dc}$ | $h_{FE1}$<br>$I_C = 0.1\ \text{mA dc}$ | $h_{FE2}$<br>$I_C = 1.0\ \text{mA dc}$ | $h_{FE3}$<br>$I_C = 10\ \text{mA dc}$ | $h_{FE4}$ (1)<br>$I_C = 150\ \text{mA dc}$ | $h_{FE5}$ (1)<br>$I_C = 500\ \text{mA dc}$ |
| Min |  | 35                                       | 40                                      | 75                                     | 100                                    | 100                                   | 100  | 50   |
| Max |  |  |   |  | 450                                    |                                       | 300  |  |

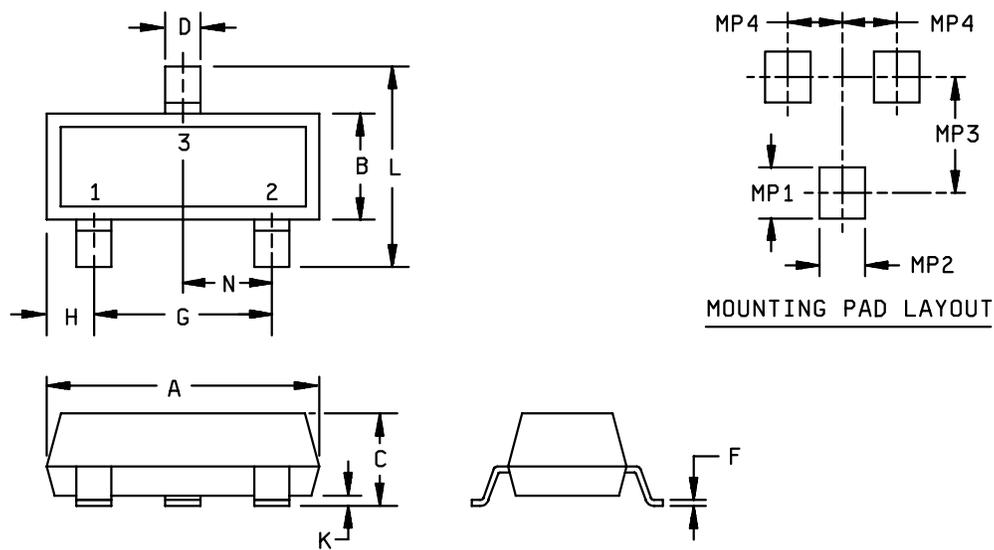
| Types      | Limit      | $ h_{fe} $<br>$f = 100\ \text{MHz}$<br>$V_{CE} = 20\ \text{V dc}$<br>$I_C = 20\ \text{mA dc}$ | $C_{obo}$<br>$100\ \text{kHz} \leq f \leq 1\ \text{MHz}$<br>$V_{CB} = 10\ \text{V dc}$<br>$I_E = 0$ | Switching (saturated) |                  |
|------------|------------|---|---|-----------------------|------------------|
|            |            |   |   | $t_{on}$              | $t_{off}$        |
| 2N2907AUE1 | Min<br>Max | 2.0   | <u>pF</u><br>8  | <u>ns</u><br>45       | <u>ns</u><br>300 |

| Types      | Limit      | $V_{CE(sat)1}$ (1)<br>$I_C = 150\ \text{mA dc}$<br>$I_B = 15\ \text{mA dc}$ | $V_{CE(sat)2}$ (1)<br>$I_C = 500\ \text{mA dc}$<br>$I_B = 50\ \text{mA dc}$ | $V_{BE(sat)1}$ (1)<br>$I_C = 150\ \text{mA dc}$<br>$I_B = 15\ \text{mA dc}$ | $V_{BE(sat)2}$ (1)<br>$I_C = 500\ \text{mA dc}$<br>$I_B = 50\ \text{mA dc}$ |
|------------|------------|---|---|---|---|
| 2N2907AUE1 | Min<br>Max | <u>V dc</u><br>0.4  | <u>V dc</u><br>1.6  | <u>V dc</u><br>1.3  | <u>V dc</u><br>2.6  |

(1) Pulsed see 4.5.1.

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.



NOTES:

1. All dimensions are in inches.
2. Millimeters are given for general information only.
3. Terminal numbers are shown for reference.  
1 = Base, 2 = Emitter, 3 = Collector

| Symbol | Dimensions |      |             |       |
|--------|------------|------|-------------|-------|
|        | Inches     |      | Millimeters |       |
|        | Min        | Max  | Min         | Max   |
| A      | .110       | .123 | 2.8         | 3.1   |
| B      | .051       | .057 | 1.32        | 1.43  |
| C      | .037       | .046 | 0.95        | 1.15  |
| D      | .015       | .017 | 0.39        | 0.41  |
| F      | .005       | .007 | 0.125       | 0.175 |
| G      | .074       | .076 | 1.88        | 1.92  |
| H      | .018       | .024 | 0.46        | 0.59  |
| K      | 0          | .004 | 0           | 0.1   |
| L      | .094       | .103 | 2.4         | 2.6   |
| N      | .037       | .038 | 0.94        | 0.96  |
| MP1    | .035       | .036 | 0.89        | 0.91  |
| MP2    | .031       | .032 | 0.79        | 0.81  |
| MP3    | .078       | .080 | 1.99        | 2.01  |
| MP4    | .037       | .038 | 0.94        | 0.96  |

FIGURE 1. Physical dimensions (SOT-23, similar to TO-236).

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement there to, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

JEDEC Standard 20 - Moisture Reflow Sensitivity Classification for Surface Mount Devices.  
JESD22A -112 - ESD Testing.  
JESD22-A101 - Steady State Temperature Humidity Bias Life Test.  
JESD22-A102 - Autoclave.  
JESD22-A103 - High temperature storage life.  
JESD22-A113 - Preconditioning.

(Applications for copies should be addressed to the Electronics Industries Alliance, 2500 Wilson Boulevard, Arlington, VA 22201-3834.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents may also be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows.

FIT - Failure in time.

UE1 - Unleaded encapsulated plastic over epoxy wire bonded frame (non-hermetic).

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500, and figure 1 herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.5 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.6 Electrical test requirements. The electrical test requirements shall be group A as specified herein.

3.7 Marking. Marking shall be in accordance with MIL-PRF-19500, except as specified herein. The part marking shall consist of an abbreviated date code (Y, M), JAN brand (J), manufacturer code (m), and part number code (B) due to space limitations (see figure 2).

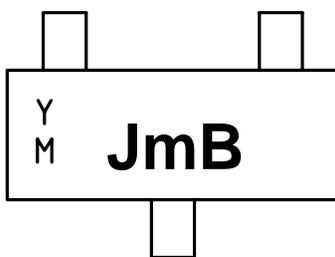


FIGURE 2. Part marking orientation.

3.7.1 Date code. The date code shall be as follows:

- a. 1st character: Designator of the manufacturing year, where Y will be "M" through "Z" to indicate the year. The sequence starts back at "A" after the year 2011. This sequence will repeat every 24 years. Letters "I" and "O" will not be used.

|      |      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
| M    | N    | P    | R    | S    | T    | U    | V    | W    | X    | Y    | Z    | A    |

- b. 2nd character: Designator of the manufacturing month, where M will be "1" through "D" to indicate the month.

|     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
| 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | O   | N   | D   |

3.7.2 JAN brand. The "J" denotes the JAN brand. Refer to the certificate of conformance or unit packaging for quality assurance level.

3.7.3 Manufacturers code. The "m" (which will progress: A, B, C, etc...) denotes the manufacturer. The letter "A" is assigned to manufacturer CAGE code 14936. Contact the preparing activity for new letter assignments.

3.7.4 Part code. The 'B' is the part number code on a TO-236AB (SOT-23) for a 2N2907AUE1.

3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

#### 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3)
- c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.2.1 JANJ qualification. For JANJ qualification, 4.4.2.1 herein shall be performed as required by the qualifying activity.

4.2.2 JANJ devices. For JANJ level, 3.3.1 through 3.3.1.3 of MIL-PRF-19500 shall apply, except as modified herein. Supplier imposed requirements as well as alternate screens, procedures, and/or controls shall be documented in the QM plan and must be submitted to the qualifying activity for approval. When alternate screens, procedures, and/or controls are used, in lieu of the JANJ screens herein equivalency shall be proven and documented in the QM plan. Radiation characterization may be submitted in the QM plan at the option of the manufacturer, however, 3.3.1.1 of MIL-PRF-19500 is not required. Die lot control and rework for JANJ shall be in accordance with the JANS requirements of 3.13 and D3.13.2.1 of MIL-PRF-19500. Lot formation and conformance inspection requirements for JANJ shall be those used for JANTXV devices as a minimum.

4.3 Screening ( JANJ, JANTX). For appendix D qualified suppliers, screening shall be in accordance with table IV of MIL-PRF-19500 and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable. For appendix C qualified suppliers (QML), and for JANJ, refer to QM plan for screening requirements. The level of screening for screens 3a, 10, and 12 will be determined based on the reliability FIT level (see 4.3.1).

| Screen (see table IV of MIL-PRF-19500) | Measurement   |   |   |
|--|---|---|---|
|  | JANS Level<br>(for reference only)  | JANJ Level  | JANTX Level   |
| 1a                                     | Required  | Required  | Not required  |
| 1b                                     | Required  | Required  | Not required  |
| 2                                      | Not required  | Not required  | Not required  |
| 3a                                     | Required  | Required  | Required  |
| 3b                                     | Not applicable  | Not applicable  | Not applicable  |
| (1) 3c                                 | Thermal impedance (see 4.3.3)   | Thermal impedance (see 4.3.3)   | Thermal impedance (see 4.3.3)   |
| 4                                      | Not applicable  | Not applicable  | Not applicable  |
| 5                                      | Not applicable  | Not applicable  | Not applicable  |
| 6                                      | Not applicable  | Not applicable  | Not applicable  |
| 7a                                     | Not applicable  | Not applicable  | Not applicable  |
| 7b                                     | Not applicable  | Not applicable  | Not applicable  |
| 8                                      | Required  | Wafer level traceability  | Not required  |
| /9                                     | $I_{CBO2}, h_{FE4}$   | $I_{CBO2}, h_{FE4}$   | Not applicable  |
| 10                                     | Method 1039, condition A, of MIL-STD-750, 24 hrs minimum  | Method 1039, condition A, of MIL-STD-750, 24 hrs minimum  | Method 1039, condition A, of MIL-STD-750, 48 hrs minimum  |
| 11                                     | $I_{CBO2}, h_{FE2}, \Delta I_{CBO2} = 100$ percent of initial value or +5 nA dc, whichever is greater; $\Delta h_{FE4} = \pm 15$ percent            | $I_{CBO2}, h_{FE2}, \Delta I_{CBO2} = 100$ percent of initial value or +5 nA dc, whichever is greater; $\Delta h_{FE4} = \pm 15$ percent            | $I_{CBO2}, h_{FE4}$   |
| 12                                     | Required<br>240 hours minimum<br>See 4.3.2  | Required<br>240 hours minimum<br>See 4.3.2  | Required<br>80 hours minimum<br>See 4.3.2   |
| 13a                                    | Subgroup 2 of table I herein; $\Delta I_{CBO2} = 100$ percent of initial value or +5 nA dc, whichever is greater; $\Delta h_{FE2} = \pm 15$ percent | Subgroup 2 of table I herein; $\Delta I_{CBO2} = 100$ percent of initial value or +5 nA dc, whichever is greater; $\Delta h_{FE2} = \pm 15$ percent | Subgroup 2 of table I herein; $\Delta I_{CBO2} = 100$ percent of initial value or +5 nA dc, whichever is greater; $\Delta h_{FE2} = \pm 15$ percent |
| 13b                                    | Group A, subgroup 3   | 1) 100 percent in-line electricals at 85°C<br>2) Group A, subgroup 3, high temp, 100 percent<br>3) Group A, subgroup 3, low temp, n = 116, c = 0    | Not required  |
| 14a                                    | Not applicable  | Not applicable  | Not applicable  |
| 14b                                    | Not applicable  | Not applicable  | Not applicable  |
| 15                                     | Required  | Required  | Not required  |
| 16                                     | Required  | Required  | Not required  |

(1) Thermal impedance shall be performed any time after screen 3.

4.3.1 QML JANTX, JANJ screening requirements. The level of screening will be determined by demonstration of reliability performance. The reliability models and methods will be in accordance with the models below. The table below will be used to determine the level of screening for the individual screens based on the reliability performance. NOTE: Each screen test will be determined individually by the reliability performance demonstrated. As an example there can be a demonstrated performance of temperature cycle to a level below  $< 6 \times 10^{-9}$  which would result in a screen of the group B temperature cycle test at a  $n = 116$ ,  $c = 0$ , but the HTRB may only demonstrate a reliability level of  $\leq 10$ ,  $> 1$ , which would require a screen of group B,  $n = 500$ ,  $c = 0$ . Confidence level will be 60 percent.

| Screen Test      | Reliability Model (1) (2) (3)   | Constants for Model                  | Unit of measure | Level   | Screen level                              |
|------------------|---|--------------------------------------|-----------------|---|---|
| Temp cycle<br>3a | Coffin Manson   | M = 4<br><T use = 55°C               | Failure / cycle | $> 6 \times 10^{-8}$                              | 4.3, screening 100 percent ( JANJ, JANTX) |
|                  |   |                                      |                 | $\leq 6 \times 10^{-8}$ ,<br>$> 6 \times 10^{-9}$ | Group B, n = 500 c = 0                    |
|                  |   |                                      |                 | $< 6 \times 10^{-9}$                              | Group B, n = 116 c = 0                    |
| HTRB<br>10       | Arrhenious  | Ea = .7<br>T <sub>J</sub> use = 55°C | FIT             | $> 10$  | 4.3, screening 100 percent ( JANJ, JANTX) |
|                  |   |                                      |                 | $\leq 10, > 1$                                    | Group B, n = 500 c = 0                    |
|                  |   |                                      |                 | $< 1$   | Group B, n = 116 c = 0                    |
| OP Life<br>12    | Arrhenious  | Ea = .7<br>T <sub>J</sub> use = 55°C | FIT             | $> 10$  | 4.3, screening 100 percent ( JANJ, JANTX) |
|                  |   |                                      |                 | $\leq 10, > 1$                                    | Group B, n = 500 c = 0                    |
|                  |   |                                      |                 | $< 1$   | Group B, n = 116 c = 0                    |
| 13b              | Group A, subgroup 3 will be in accordance with 4.3, screening table for JANJ. |                                      |                 |   |   |

- (1) Thermo-mechanical Effects (Coffin-Manson):

$$A_f = \left( \frac{\Delta T_t}{\Delta T_u} \right)^m$$

$A_f$  = acceleration factor  
 $\Delta T_t$  = thermal cycle temperature change in the test environment  
 $\Delta T_u$  = thermal cycle temperature change in the use environment  
 $m$  = constant, typical value for a given failure mechanism or derived from empirical data

- (2) Thermal Effects (Arrhenius):

$$A_f = \exp \left[ \frac{E_a}{k} \cdot \left( \frac{1}{T_u} - \frac{1}{T_t} \right) \right]$$

$T_u$  = use environment junction temperature (in °K)  
 $T_t$  = test environment junction temperature (in °K)  
 $A_f$  = acceleration factor  
 $k$  = Boltzman's Constant ( $8.6171 \times 10^{-5}$  eV)  
 $E_a$  = activation energy, typical value for a given failure mechanism or derived from empirical data

- (3) Failure Rate Estimating Methodology:

$$\lambda = \frac{\chi^2(\alpha, d.f.)}{2 \cdot A_f \cdot t} \cdot 10^9$$

$\lambda$  = failure rate (Failures-In-Time)  
 $\chi^2$  = chi-square function  
 $\alpha$  = (100 - confidence level) / 100  
 $d.f.$  = (2n + 2) degrees of freedom  
 $n$  = number of failures  
 $A_f$  = acceleration factor  
 $t$  = (sample size x total test time) device-hours

4.3.2 Power burn-in conditions. Power burn-in conditions are as follows:  $T_A$  = room ambient as defined in the general requirements of 4.5 of MIL-STD-750; 2N2907A:  $V_{CB} = 10 - 30$  V dc, power shall be applied to achieve a  $T_J$  of +135°C minimum and a minimum power dissipation of 75 percent of rated  $P_T$  as defined in 1.3.

4.3.3 Thermal behavior measurements, (delta  $V_{be}$ ) 100 percent screening in accordance with method 3131 of MIL-STD-750.

- a.  $I_M$  measurement current ----- 5 mA.
- b.  $I_H$  forward heating current ----- 200 mA minimum.
- c.  $t_H$  heating time----- 20 - 30 ms.
- d.  $t_{md}$  measurement delay time ----- 5 ms maximum.
- e.  $V_{CE}$  collector-emitter voltage during heating ----- 10 V dc.

The delta  $V_{be}$  limits are fixed to 100 mV minimum and 200 mV maximum.

4.4 Conformance inspection. For appendix D qualified suppliers, conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. For appendix C qualified suppliers (QML), and for JANJ, refer to QM plan for "On-Going Reliability Monitor Requirements".

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and table I herein. Separate samples may be used for each subgroup.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified in 4.4.2.1 for JAN, JANTX, and JANJ and as follows. Electrical measurements (end-points) for JAN, JANTX and JANJ shall be as specified below. Delta requirements shall be as specified below and shall be the steps of table III herein. Separate samples may be used for each step, however, preconditioning shall be performed on each sample.

| <u>Step</u> | <u>Method</u>           | <u>Condition</u>  |
|-------------|-------------------------|---|
| 0           |                         | Preconditioning:<br>a.-Dipping of devices in a perfluoropolyter liquid: 10 sec. +150°C 2 times.<br>b.-Rinse of devices in deionized water.<br>c.-Dry of the devices at T <sub>A</sub> .<br>d.-Thermal cycle: condition. G, 100cycles. |
|             | 1051                    |   |
| 1           | 2026                    | Solderability: n = 15 c = 0.  |
| 2           | 1051                    | Temp. cycle: Condition G, 25 cycles, n = 15, c = 0.   |
| 3           | JESD22-A102             | Autoclave: Condition C, 96 hours, n = 15, c = 0.  |
| 4           | 2031                    | Soldering heat: T = +260°C, 10 sec., n = 20, c = 0.   |
| 5           |                         | PCB simulation  |
| 6           | 1039                    | Steady-state operation life: Condition B, T <sub>J</sub> = +135°C minimum, 240 hrs, 20 V, 13.6mA, T <sub>A</sub> = +45°C, n = 45, c = 0.  |
| 7           | 1039                    | HTRB: Condition A, +150°C minimum, 168 hours, 48V, n = 45, c = 0.   |
|             | Electrical measurements | Group A, subgroup 2.  |
|             | Delta shift             | See table III.  |

4.4.2.1 Group B sample selection. In the event of a group B failure, the manufacturer may pull a new sample at double size from either the failed assembly lot or from another assembly lot from the same wafer lot. If the new "assembly lot" option is exercised, the failed assembly lot shall be scrapped. Samples selected for group B inspection for JAN and JANTX shall be selected randomly from a minimum of three wafers (or from each wafer in the lot). JANJ samples will be from each wafer. When the QML screening option is used, (see 4.3.1) the tests used will replace the tests in group B, but the remainder of group B will be performed.

4.4.3 Group C inspection, JAN, JANTX, and JANJ. Group C inspection (JAN, JANTX, and JANJ) shall be as specified in 4.4.3.1 and shall include tests which are performed periodically. Group C test on each structurally identical device grouping shall be performed on devices from each three months production (once per quarter) of devices (based on inspection lot identification codes) for each assembly location and die attach method. When there is a JANJ lot available the JANJ lot will be selected for the sample. Electrical measurements (end-points) shall be as specified below and in accordance with group A, subgroup 2 herein. Delta requirements shall be as specified below and shall be the steps of table III herein. The sample size for each of these steps is: 45 devices,  $c = 0$ . Separate samples may be used for each step, however, preconditioning shall be performed on all samples. For rules on resubmission for failed steps, see MIL-PRF-19500 rules on resubmission of failed subgroups.

4.4.3.1 Group C inspection, (JAN, JANTX, JANJ).

| <u>Step</u> | <u>Method</u>           | <u>Condition</u>   |
|-------------|-------------------------|--|
| 0           |                         | Preconditioning:<br>a.-Dipping of devices in a perfluoropolyter liquid: 10 sec. +150°C 2 times.<br>b.-Rinse of devices in deionized water.<br>c.-Dry of the devices at $T_A$ .<br>d.-Thermal cycle: condition G, 100 cycles. |
|             | 1051                    |  |
| 1           | JESD22-A103             | Low temp storage (substitute low temperature condition): -50°C, 1,000 hours.   |
| 2           | 1051                    | Temp. cycle: condition G, 1,000 cycles.  |
| 3           | JESD22-A102             | Autoclave: condition C, 96 hours.  |
| 4           | JESD22-A101             | Moisture resistance (85/85 biased): 50V.   |
| 5           |                         | PCB simulation.  |
| 6           | 1039                    | Steady state operation life: Condition B, $T_J = +150^\circ\text{C}$ minimum, 1,000 hrs, 32V, 10 mA, $T_A = +45^\circ\text{C}$ .   |
| 7           | 1039                    | HTRB: Condition A, +150°C, 1000 hours, 48V.  |
|             | Electrical measurements | Group A subgroup 2.  |
|             | Delta shift             | See table III.   |

4.4.3.2 Group C sample selection. Samples for steps in group C shall be in accordance with MIL-PRF-19500.

4.4.4 Group E Inspection. Group E inspection shall be performed for qualification or re-qualification only. The tests specified in table II herein must be performed to maintain qualification. Subgroup 7 and 8 are for characterization of the devices and have no pass or fail criteria. These subgroups are intended for user information only. Separate samples may be used for each subgroup, however, preconditioning shall be performed on all samples.

4.5 Method of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Input capacitance. This test shall be conducted in accordance with method 3240 of MIL-STD-750, except the output capacitor shall be omitted.

TABLE I. Group A inspection .

| Inspection <u>1/</u>                    | MIL-STD-750 |   | Symbol                | Limit |     | Unit  |
|---|-------------|---|-----------------------|-------|-----|-------|
|   | Method      | Conditions  |                       | Min   | Max |       |
| <u>Subgroup 1</u> <u>2/</u>             |             |   |                       |       |     |       |
| Resistance to solvents <u>3/</u>        | 1022        | n = 15, c = 0   |                       |       |     |       |
| <u>Subgroup 2</u>                       |             |   |                       |       |     |       |
| Collector to base cutoff current        | 3036        | V <sub>CB</sub> = 60 V dc   | I <sub>CBO1</sub>     |       | 10  | μA dc |
| Emitter to base cutoff current          | 3061        | V <sub>EB</sub> = 5 V dc  | I <sub>EBO1</sub>     |       | 10  | μA dc |
| Breakdown voltage, collector to emitter | 3011        | Bias condition D; I <sub>C</sub> = 10 mA dc; pulsed (see 4.5.1)                             | V <sub>(BR)CEO</sub>  | 60    |     | V dc  |
| Collector to emitter cutoff current     | 3041        | Bias condition D; V <sub>CE</sub> = 50 V dc   | I <sub>CES</sub>      |       | 50  | nA dc |
| Collector to base cutoff current        | 3036        | Bias condition D; V <sub>CB</sub> = 50 V dc   | I <sub>CBO2</sub>     |       | 10  | nA dc |
| Emitter to base cutoff current          | 3061        | Bias condition D; V <sub>EB</sub> = 4 V dc  | I <sub>EBO2</sub>     |       | 50  | nA dc |
| Forward-current transfer ratio          | 3076        | V <sub>CE</sub> = 10 V dc; I <sub>C</sub> = 0.1 mA dc                                       | h <sub>FE1</sub>      | 75    |     |       |
| Forward-current transfer ratio          | 3076        | V <sub>CE</sub> = 10 V dc; I <sub>C</sub> = 1.0 mA dc                                       | h <sub>FE2</sub>      | 100   | 450 |       |
| Forward-current transfer ratio          | 3076        | V <sub>CE</sub> = 10 V dc; I <sub>C</sub> = 10 mA dc  | h <sub>FE3</sub>      | 100   |     |       |
| Forward-current transfer ratio          | 3076        | V <sub>CE</sub> = 10 V dc; I <sub>C</sub> = 150 mA dc; pulsed(see 4.5.1)                    | h <sub>FE4</sub>      | 100   | 300 |       |
| Forward-current transfer ratio          | 3076        | V <sub>CE</sub> = 10 V dc; I <sub>C</sub> = 500 mA dc; pulsed see 4.5.1                     | h <sub>FE5</sub>      | 50    |     |       |
| Collector-emitter saturation voltage    | 3071        | I <sub>C</sub> = 150 mA dc; I <sub>B</sub> = 15 mA dc pulsed (see 4.5.1)                    | V <sub>CE(sat)1</sub> |       | 0.4 | V dc  |
| Collector-emitter saturation voltage    | 3071        | I <sub>C</sub> = 500 mA dc; I <sub>B</sub> = 50 mA dc; pulsed (see 4.5.1)                   | V <sub>CE(sat)2</sub> |       | 1.6 | V dc  |
| Base-emitter saturation voltage         | 3066        | Test condition A; I <sub>C</sub> = 150 mA dc; I <sub>B</sub> = 15 mA dc; pulsed (see 4.5.1) | V <sub>BE(sat)1</sub> | 0.6   | 1.3 | V dc  |
| Base-emitter saturation voltage         | 3066        | Test condition A; I <sub>C</sub> = 500 mA dc; I <sub>B</sub> = 50 mA dc; pulsed (see 4.5.1) | V <sub>BE(sat)2</sub> |       | 2.6 | V dc  |

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

| Inspection <u>1/</u>   | MIL-STD-750 |  | Symbol     | Limit |     | Unit             |
|--|-------------|--|------------|-------|-----|------------------|
|  | Method      | Conditions   |            | Min   | Max |                  |
| <u>Subgroup 3</u>  |             |  |            |       |     |                  |
| High temperature operation   |             | $T_A = +150^\circ\text{C}$   |            |       |     |                  |
| Collector to base cutoff current                                       | 3036        | Bias condition D; $V_{CB} = 50\text{ V dc}$                                      | $I_{CBO3}$ |       | 10  | $\mu\text{A dc}$ |
| Low temperature operation  |             | $T_A = -55^\circ\text{C}$  |            |       |     |                  |
| Forward-current transfer ratio   | 3076        | $V_{CE} = 10\text{ V dc}; I_C = 10\text{ mA dc}$                                 | $h_{FE6}$  | 50    |     |                  |
| <u>Subgroup 4</u>  |             |  |            |       |     |                  |
| Small-signal short-circuit forward current transfer ratio              | 3206        | $V_{CE} = 10\text{ V dc}; I_C = 1\text{ mA dc}; f = 1\text{ kHz}$                | $h_{fe}$   | 100   |     |                  |
| Magnitude of small-signal short-circuit forward current transfer ratio | 3306        | $V_{CE} = 20\text{ V dc}; I_C = 20\text{ mA dc}; f = 100\text{ MHz}$             | $ h_{fe} $ | 2.0   |     |                  |
| Input capacitance (output open-circuited)                              | 3240        | $V_{EB} = 2\text{ V dc}; I_C = 0;$<br>$100\text{ kHz} \leq f \leq 1\text{ MHz}$  | $C_{ibo}$  |       | 30  | pF               |
| Open circuit output capacitance  | 3236        | $V_{CB} = 10\text{ V dc}; I_E = 0;$<br>$100\text{ kHz} \leq f \leq 1\text{ MHz}$ | $C_{obo}$  |       | 8   | pF               |
| Saturated turn-on time   |             | (See figure 3)   | $t_{on}$   |       | 45  | ns               |
| Saturated turn-off time  |             | (See figure 4)   | $t_{off}$  |       | 300 | ns               |
| <u>Subgroups 5, 6 and 7</u>  |             |  |            |       |     |                  |
| Not required   |             |  |            |       |     |                  |

1/ For sampling plan see MIL-PRF-19500.

2/ For resubmission of failed subgroup A1, double the sample size of the failed test or sequence of tests. A failure in group A, subgroup 1 shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.

3/ Not required for laser marked parts.

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TABLE II. Group E inspection (all quality levels) - for qualification only.

| Inspection                       | MIL-STD-750 (unless otherwise noted) |   | Qualification |
|----------------------------------|--------------------------------------|---|---------------|
|                                  | Method                               | Conditions  |               |
| <u>Preconditioning</u>           | JESD22-A113 <u>1/</u>                | Level 1   | All           |
| <u>Subgroup 1</u>                |                                      |   |               |
| Temperature cycling (air to air) | 1051                                 | Test condition G, 1000 cycles   | n = 77, c = 0 |
| Electrical measurements          |                                      | See group A, subgroup 2.  |               |
| <u>Subgroup 2 2/</u>             |                                      |   | n = 77, c = 0 |
| Steady state operation life      | 1039                                 | 1000 hours, condition B.  |               |
| Electrical measurements          |                                      | See group A, subgroup 2.  |               |
| <u>Subgroup 2a 2/</u>            |                                      |   | n = 77, c = 0 |
| HTRB                             | 1039                                 | 1000 hours, condition A.  |               |
| Electrical measurements          |                                      | See group A, subgroup 2.  |               |
| <u>Subgroup 2b 2/</u>            |                                      |   | n = 77, c = 0 |
| Intermittent life                | 1037                                 | Intermittent operation life: $V_{CB} = 10$ V dc ,<br>15,000 cycles, $\Delta T_J \geq +100^\circ\text{C}$ ; forced air<br>cooling allowed on cooling cycle only. |               |
| Electrical measurements          |                                      | See group A, subgroup 2.  |               |
| <u>Subgroup 3</u>                |                                      |   |               |
| Not applicable                   |                                      |   |               |
| <u>Subgroup 4</u>                |                                      |   | n = 77, c = 0 |
| Moisture resistance              | JESD22-A101 <u>1/</u>                | 1000 hours  |               |
| Electrical measurements          |                                      | See group A, subgroup 2.  |               |
| <u>Subgroup 4a</u>               |                                      |   | n = 77, c = 0 |
| Autoclave                        | JESD22-A102 <u>1/</u>                | 96 hours  |               |
| Electrical measurements          |                                      | See group A, subgroup 2.  |               |
| <u>Subgroup 5</u>                |                                      |   |               |
| Thermal resistance               | 3131                                 | See figures 5 and 6.  | n = 10, c = 0 |

See footnotes at end of table.

TABLE II. Group E inspection (all quality levels) - for qualification only - Continued.

| Inspection   | MIL-STD-750 (unless otherwise noted) |  | Qualification           |
|--|--------------------------------------|--|-------------------------|
|  | Method                               | Conditions                               |                         |
| <u>Subgroup 6</u><br>ESD   | JESD22A-112<br>MM & HBM <u>1/</u>    |  | n = 30, c = 0<br>2 lots |
| <u>Subgroup 7</u><br>Moisture reflow sensitivity classification<br>for surface mount devices |                                      |  | J-STD-20 <u>1/</u>      |
| <u>Subgroup 8</u><br>Parametric characterization   |                                      | Group A, subgroup 2; -50°C, 25°C, +100°C | n = 25 for 3<br>lots    |

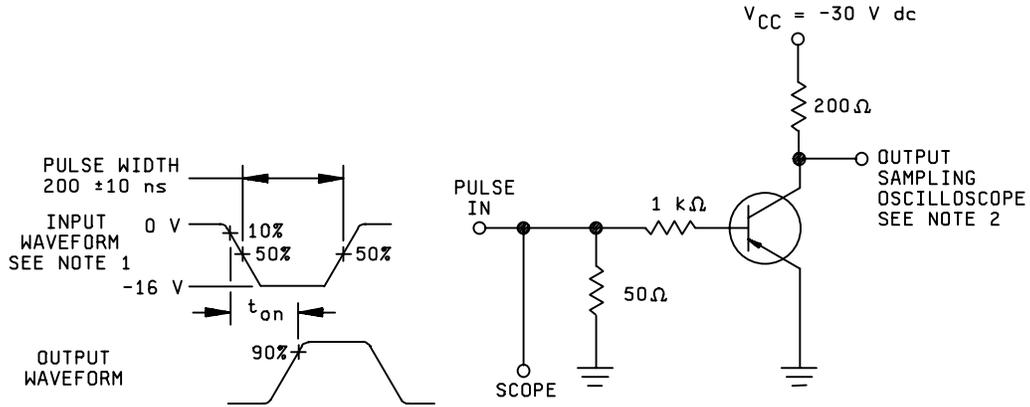
1/ Non-government standard document, see 2.3.

2/ Subgroups 2, 2a, and 2b do not need to be performed sequentially.

TABLE III. Groups B and C delta measurements.

| Step | Inspection                     | MIL-STD-750 |   | Symbol                         | Limit   |
|------|--------------------------------|-------------|---|--------------------------------|---|
|      |                                | Method      | Conditions  |                                |   |
| 1    | Collector-base cutoff current  | 3036        | Bias condition D, $V_{CB} = 50$ V dc                    | $\Delta I_{CB02}$<br><u>1/</u> | Pre test distribution to average $+3\sigma$ & $-3\sigma$ .<br>Post test distribution to average $+4\sigma$ & $-4\sigma$ of the pre test results.  |
| 2    | Forward current transfer ratio | 3076        | $V_{CE} = 10$ V dc; $I_C = 150$ mA dc; pulsed see 4.5.1 | $\Delta h_{FE4}$<br><u>1/</u>  | Pre test distribution to average $+3\sigma$ & $-3\sigma$ .<br>Post test distribution to average $+4\sigma$ & $-4\sigma$ of the pre test results (not to exceed 25% change from initial reading) |

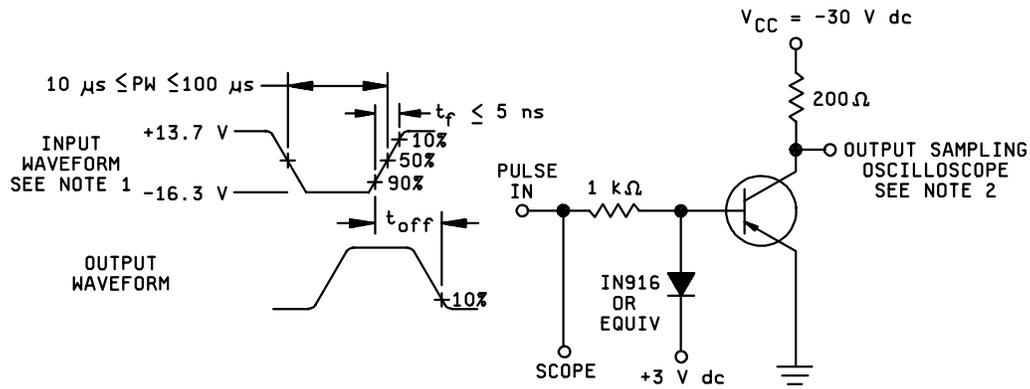
1/ Devices which exceed the group A limits for this test shall not be accepted.



NOTES:

1. The rise time ( $t_r$ ) of the applied pulse shall be  $\leq 2.0$  ns, duty cycle  $\leq 2$  percent and the generator source impedance shall be 50 ohms.
2. Sampling oscilloscope:  $Z_{in} \geq 100$  K ohms,  $C_{in} \leq 12$  pF, rise time  $\leq 5$  ns.

FIGURE 3. Saturated turn-on switching time test circuit.



NOTES:

1. The rise time ( $t_r$ ) of the applied pulse shall be  $\leq 2.0$  ns, duty cycle  $\leq 2$  percent and the generator source impedance shall be 50 ohms.
2. Sampling oscilloscope:  $Z_{in} \geq 100$  K ohms,  $C_{in} \leq 12$  pF, rise time  $\leq 5$  ns.

FIGURE 4. Saturated turn-off switching time test circuit.

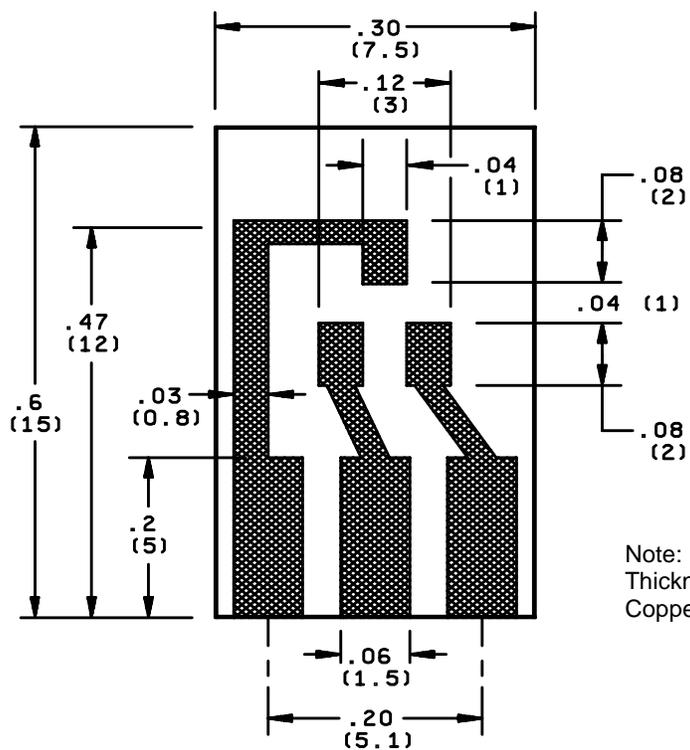


FIGURE 5. Layout for  $R_{\theta JA}$  test.

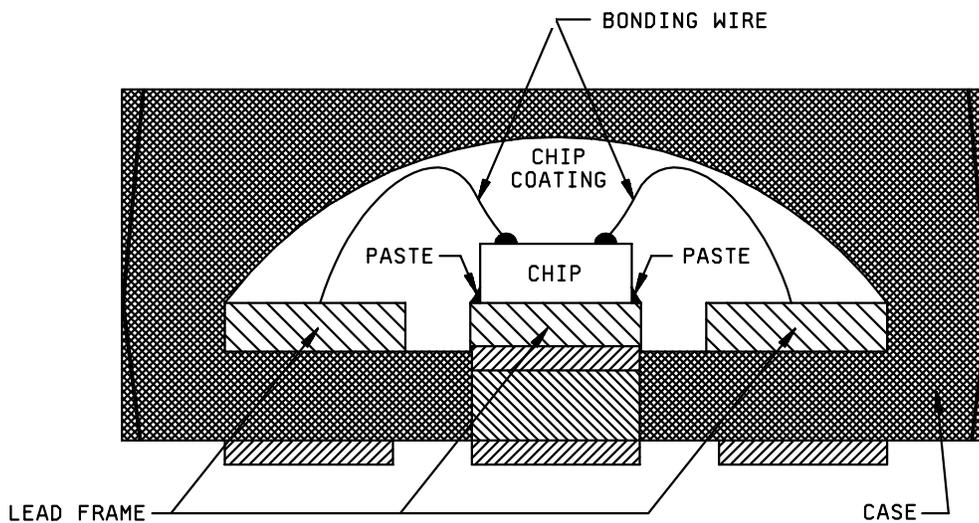


FIGURE 6. Sample construction.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).
- c. Packaging requirements (see 5.1).
- d. Lead finish (see 3.4.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers' List (QML) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000.

Custodians:  
Army - CR  
Navy - NW  
Air Force - 11  
NASA - NA  
DLA - CC

Preparing activity:  
DLA - CC  
(Project 5961-2341)

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