The documentation and process conversion measures necessary to comply with this revision shall be completed by 23 May 2002.

INCH-POUND

MIL-PRF-19500/398F
23 January 2002
SUPERSEDING
MIL-PRF-19500/398E
11 September 2000

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-FREQUENCY
TYPES 2N3866, 2N3866A, 2N3866UB, 2N3866AUB, JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

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 NPN silicon, VHF-UHF amplifier transistor. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500. Two levels of product assurance are provided for die.

* 1.2 Physical dimensions. See figure 1 (TO-39), figure 2 (surface mount, UB), and figure 3 (die).

* 1.3 Maximum ratings.

| Types | $P_T$ $T_C$ = (3), | $P_T$ (1) $T_A$ = (2) | $V_{CBO}$ | $V_{CEO}$ | $V_{EBO}$ | $I_C$ | $T_J$ and $T_{STG}$ | $R_{\theta JC}$ | $R_{\theta JA}$ |
|---|---|---|---|---|---|---|---|---|---|
| | W | W | V dc | V dc | V dc | A dc | °C | °C/W | °C/W |
| 2N3866, 2N3866A | 2.9 | 1.0 | 60 | 30 | 3.5 | 0.4 | -65 to +200 | 60 | |
| 2N3866UB, 2N3866AUB | | 0.5 | 60 | 30 | 3.5 | 0.4 | -65 to +200 | | 325 |

(1) Derate linearly 5.71 mW/°C (2N3866, 2N3866A) and 2.86 mW/°C (2N3866UB, 2N3866AUB) above $T_A \geq +25°C$.
(2) $T_A$ = Room ambient as defined in the general requirements of MIL-PRF-19500.
(3) $P_T$ = 2.9 W at $T_C$ = +25°C, derate at 16.6 mW/°C above $T_C$ > +25°C.

* 1.4 Primary electrical characteristics.

| | $h_{FE}$ (1) $V_{CE}$ = 5.0 V dc $I_C$ = 50 mA dc | | $\lvert h_{fe} \rvert$ $V_{CE}$ = 15 V dc $I_C$ = 50 mA dc f = 200 MHz | | $V_{CE(SAT)}$ $I_C$ = 100 mA dc $I_B$ = 10 mA dc | $C_{obo}$ $V_{CB}$ = 28 V dc $I_E$ = 0 100 kHz ≤ f ≤ 1 MHz | $P_{out1}$ $V_{CC}$ = 28 V dc $P_{in}$ = 0.15 W f = 400 MHz | $P_{out2}$ $V_{CC}$ = 28 V dc Pin = 0.075 W f = 400 MHz |
|---|---|---|---|---|---|---|---|---|
| | 2N3866 2N3866UB | 2N3866A 2N3866AUB | 2N3866 2N3866UB | 2N3866A 2N3866AUB | V dc | pF | W | W |
| Min | 15 | 25 | 2.5 | 4.0 | | | 1.0 | 0.5 |
| Max | 200 | 200 | 8.0 | 7.5 | 1.0 | 3.5 | 2.0 | |

(1) Pulsed (see 4.5.1)

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, P. O. 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.

AMSC N/A FSC 5961

2. 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.

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 thereto, 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 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. The abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows:

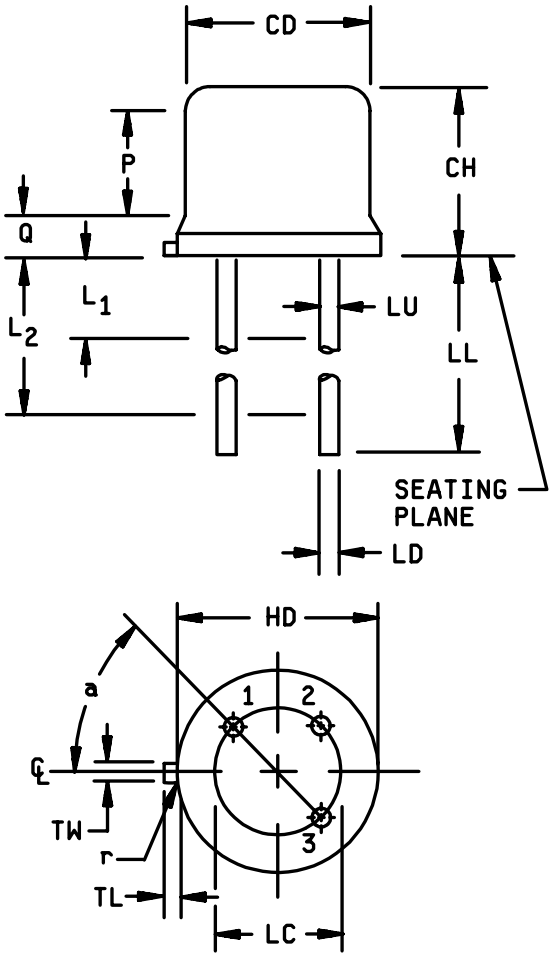
$\eta$: (eta) Collector efficiency = $\frac{\text{rf power out}}{\text{dc power in}} \times 100$

Pin: Input power

Pout: Output power

* 3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (similar to T0-39), figure 2 (UB), and figure 3 (die) 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).

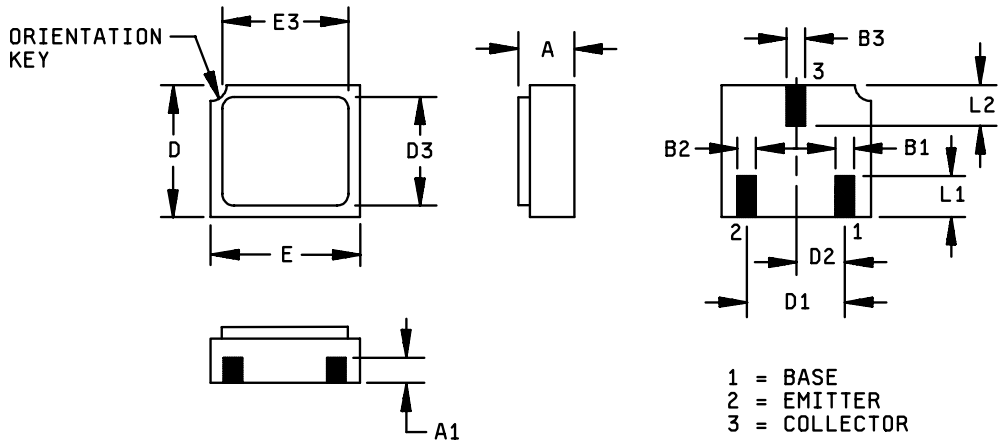



NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of 0.011 inch (0.28 mm).
4. TL measured from HD maximum.
5. Outline in this zone is not controlled.
6. CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
7. 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.
8. LU applies between $L_1$ and $L_2$. LD applies between $L_2$ and LL minimum. Diameter is uncontrolled in $L_1$ and beyond LL minimum.
9. All three leads.
10. The collector shall be electrically and mechanically connected to the case.
11. r (radius) applies to both inside corners of tab.

FIGURE 1. Physical dimensions.

| Symbol | Dimensions | | | | Notes |
|---|---|---|---|---|---|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| CH | .240 | .260 | 6.10 | 6.60 | |
| LC | 0 .200 TP | | 5.08 TP | | 7 |
| LD | .016 | .021 | 0.41 | 0.53 | 8, 9 |
| LU | .016 | .019 | 0.41 | 0.48 | 8, 9 |
| HD | .335 | .370 | 8.51 | 9.40 | |
| CD | .305 | .335 | 7.75 | 8.51 | 6 |
| TW | .028 | .034 | 0.71 | 0.86 | 3 |
| TL | .029 | .045 | 0.74 | 1.14 | 4 |
| LL | .500 | .750 | 12.70 | 19.05 | 8, 9 |
| $L_1$ | | .050 | | 1.27 | 8, 9 |
| $L_2$ | .250 | | 6.35 | | 8, 9 |
| P | .100 | | 2.54 | | 6 |
| Q | | | | | 5 |
| r | | .010 | | 0.25 | 11, 3 |
| $\alpha$ | 45° TP | | 45° TP | | 7 |

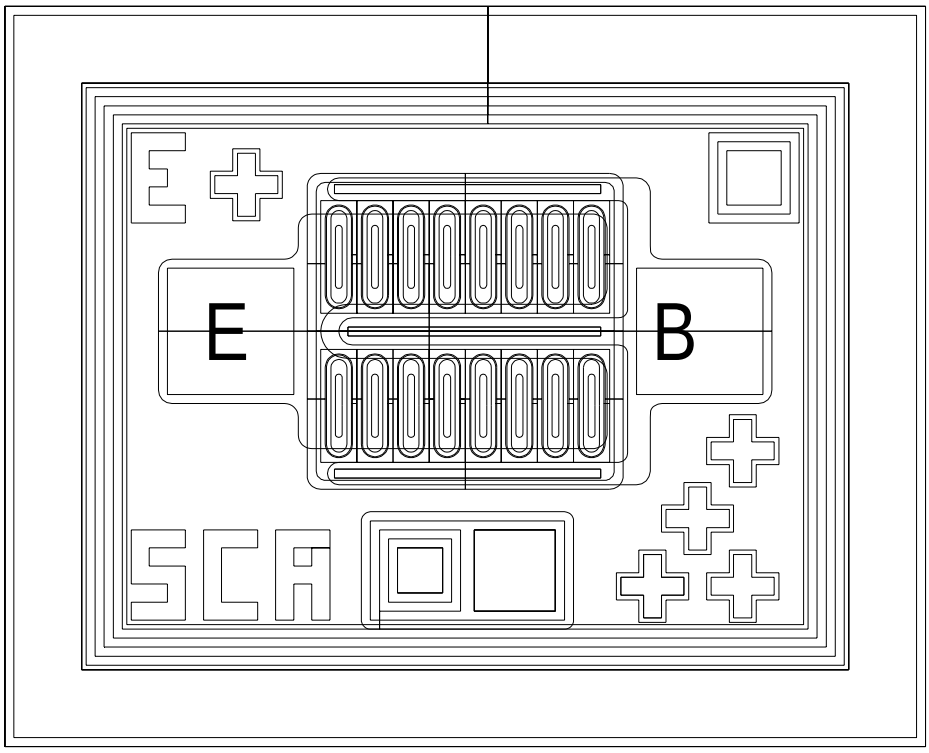
FIGURE 1. Physical dimensions - Continued.




| Symbol | Dimensions | | | | Note |
|---|---|---|---|---|---|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| A | .046 | .056 | 0.97 | 1.42 | |
| A1 | .017 | .035 | 0.43 | 0.89 | |
| B1 | .016 | .024 | 0.41 | 0.61 | |
| B2 | .016 | .024 | 0.41 | 0.61 | |
| B3 | .016 | .024 | 0.41 | 0.61 | |
| D | .085 | .108 | 2.41 | 2.74 | |
| D1 | .071 | .079 | 1.81 | 2.01 | |
| D2 | .035 | .039 | 0.89 | 0.99 | |
| D3 | .085 | .108 | 2.41 | 2.74 | |
| E | .115 | .128 | 2.82 | 3.25 | |
| E3 | | .128 | | 3.25 | |
| L1 | .022 | .038 | 0.56 | 0.96 | |
| L2 | .022 | .038 | 0.56 | 0.96 | |

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

* FIGURE 2. Physical dimensions, surface mount (UB version).




| | |
|---|---|
| Die size: | 0.016 x 0.020 inches |
| Die thickness: | 0.008 ± 0.0016 inches |
| Base pad: | 0.0028 x 0.0028 inches |
| Emitter pad: | 0.0028 x 0.0028 inches |
| Back metal: | Gold, 6500 ± 1950 Ang |
| Top metal: | Aluminum, 17500 ± 2500 Ang |
| Back side: | Collector |
| Glassivation: | $SiO_2$, 7500 ± 1500 Ang |

* FIGURE 3. JANHC and JANKC (A-version) die dimensions.

3.4.2 Transistor construction. These devices shall be constructed in a manner and using materials which enable the transistors to meet the applicable requirements of MIL-PRF-19500 and this document.

* 3.4.3 Marking. Devices shall be marked in accordance with MIL-PRF-19500, except for the UB suffix package. Marking on the UB package shall consist of an abbreviated part number, the date code, and the manufacturer's symbol or logo. The prefixes JAN, JANTX, JANTXV, and JANS can be abbreviated as J, JX, JV, and JS respectively. The "2N" prefix and the "AUB" suffix can also be omitted.

3.5 Electrical performance characteristics. Unless otherwise specified, 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 the subgroups specified in 4.4.2 and 4.4.3 herein.

* 3.7 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.

* 4.3 Screening (JANS, JANTXV, and JANTX levels only). 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.

| Screen (see table IV of MIL-PRF-19500) | Measurement | |
|---|---|---|
| | JANS level | JANTX and JANTXV levels |
| 3 | Thermal impedance, method 3131 of MIL-STD-750 | Thermal impedance, method 3131 of MIL-STD-750 |
| 9 | $I_{CEO}$ and $h_{FE1}$ | Not applicable |
| 11 | $I_{CEO}$ and $h_{FE1}$;<br>$\Delta I_{CEO}$ = 100 percent of initial value or 2 μA dc, whichever is greater.<br>$\Delta h_{FE1}$ = ±20 percent of initial value. | $I_{CEO}$ and $h_{FE1}$ |
| 12 | See 4.3.1 | See 4.3.1 |
| 13 | $\Delta I_{CEO}$ = 100 percent of initial value or 2 μA dc, whichever is greater;<br>$\Delta h_{FE1}$ = ± 20 percent of initial value; subgroups 2 and 3 of table I herein. | $\Delta I_{CEO}$ = 100 percent of initial value or 2 μA dc, whichever is greater;<br>$\Delta h_{FE1}$ = ± 20 percent of initial value; subgroup 2 of table I herein. |

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

* 4.3.2 Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500, "Discrete Semiconductor Die/Chip Lot Acceptance". Burn-in duration for the JANKC level follows JANS requirements; the JANHC follows JANTX requirements.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in VIa (JANS) of 4.4.2.1. See 4.4.2.2 herein for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) requirements shall be in accordance with group A, subgroup 2 herein. Delta requirements apply to the subgroups specified in 4.4.2.1 and 4.4.2.2, and shall be those specified in 4.5.5.

* 4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

| Subgroup | Method | Conditions |
|---|---|---|
| B4 | 1037 | $V_{CB}$ = 10 V dc; 2,000 cycles. |
| B5 | 1027 | $V_{CB}$ = 10 V dc; $P_D \geq 100$ percent of maximum rated $P_T$ (see 1.3). (NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.)<br><br>Option 1: 96 hours minimum sample size in accordance with table VIa of MIL-PRF-19500, adjust $T_A$ or $P_D$ to achieve $T_J$ = +275°C minimum.<br><br>Option 2: 216 hours minimum, sample size = 45, c = 0; adjusted $T_A$ or $P_D$ to achieve a $T_J$ = +225°C minimum. |

4.4.2.2 Group B inspection, table VIb (JAN, JANTX and JANTXV). Separate samples may be used for each step. 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.

| Step | Method | Conditions |
|---|---|---|
| 1 | 1027 | Steady-state life: Test condition B, 340 hours, $V_{CB}$ = 10 to 30 V dc; power shall be applied to achieve $T_J$ = +150°C minimum and a power dissipation of $P_D \geq 75$ percent of max rated $P_T$ as defined in 1.3. n = 45 devices, c = 0. For small lots, n = 12 devices, c = 0. |
| 2 | 1027 | The steady-state life test of step 1 shall be extended to 1,000 hours for each die design. Samples shall be selected from a wafer lot every twelve months of wafer production. Group B, step 2 shall not be required more than once for any single wafer lot. n = 45, c = 0. |
| 3 | 1032 | High-temperature life (non-operating), t = 340 hours; $T_A$ = +200°C. n = 22, c = 0. |

4.4.2.3 Group B sample selection. Samples selected from group B inspection shall meet all of the following requirements.

a. For JAN, JANTX and JANTXV samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. For JANS samples shall be selected from each inspection lot. See MIL-PRF-19500.

b. Must be chosen from an inspection lot that has been submitted to and passed group A, subgroup 2 conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (subgroups B4 and B5 for JANS, and group B for JAN, JANTX and JANTXV) may be pulled prior to the application of final lead finish.

* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table VII of MIL-PRF-19500, and in 4.4.3.1 (JANS).and 4.4.3.2 (JAN, JANTX, and JANTXV) herein for group C testing. Electrical measurements (end-points) requirements shall be in accordance with group A, subgroup 2 herein. Delta requirements apply to the subgroups C6 and C8, and shall be those specified in 4.5.5.

* 4.4.3.1 Group C inspection, table VII (JANS) of MIL-PRF-19500.

| Subgroup | Method | Conditions |
|---|---|---|
| C2 | 2036 | Test condition E (not applicable to UB suffix devices). |
| C5 | 3131 | See 4.5.2; n = 22, c =0. |
| C6 | 1026 | Test condition B, 1,000 hours, $V_{CB}$ = 10 V dc; power shall be applied to achieve $T_J$ = +150°C minimum and a power dissipation of $P_D \geq 75$ percent of max rated $P_T$ as defined in 1.3. n = 45 devices, c = 0. For small lots, n = 12 devices, c = 0. |

* 4.4.3.2 Group C inspection, table VII (JAN, JANTX and JANTXV) of MIL-PRF-19500.

| Subgroup | Method | Conditions |
|---|---|---|
| C2 | 2036 | Test condition E (not applicable to UB suffix devices). |
| C6 | | Not applicable. |
| C8 | 3005 | Pre-pulse condition $V_{CE}$ = 0, $I_C$ = 0; pulse condition $I_C$ = 400 mA dc, $t_P$ = 60 s, 1 cycle; $t_r \leq 6s$, $t_f \leq 6s$. Sample size, n = 22, c = 0 (see 4.5.4). |

4.4.3.3 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any inspection lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes group A tests for conformance inspection. Testing of a subgroup using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup.

* 4.4.4 Group E inspection. Group E inspection shall be performed in accordance with table II herein for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification that did not request the performance of table II tests, the tests specified in table II herein must be performed to maintain qualification.

4.5 Methods 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 MIL-STD-750.

4.5.2 Thermal resistance. Thermal resistance measurements shall be conducted in accordance with test method 3131 of MIL-STD-750. The following details shall apply:

a. Collector current magnitude during power application shall be 79 mA dc minimum.

b. Collector to emitter voltage magnitude shall be 20 V dc minimum.

c. Reference temperature measuring point shall be the case.

d. Reference point temperature shall be $+25°C \leq T_R \leq +75°C$ and recorded before the test is started.

e. Mounting arrangement shall be with heat sink to case.

f. Maximum limit of $R_{\theta JC}$ shall be 60°C/W.

* 4.5.3 Power-output and collector-efficiency measurements. The device shall be tested in the circuit of figure 4 using the procedure outlined on figure 5. The specified conditions shall be applied and the variable capacitors adjusted to obtain maximum power output. When the maximum power output is obtained, the collector current shall be measured and recorded. The collector efficiency shall be computed as follows:

$$\eta \text{ in percent} = \frac{P_O \text{ (watts)} \times 100}{28 \times I_C \text{ (amperes)}}$$

* 4.5.4 Burnout by pulsing. The devices shall be tested in the circuit of figure 6. The voltage source shall be increased from zero until the specified current is reached. The current shall be maintained for the specified time.

4.5.5 Delta requirements. Delta requirements shall be as specified below:

| Step | Inspection | MIL-STD-750 | | Symbol | Limit | | Unit |
|---|---|---|---|---|---|---|---|
| | | Method | Conditions | | Min | Max | |
| 1. | Collector to emitter cutoff current | 3036 | Bias condition D; $V_{CE}$ = 28 V dc | $\Delta I_{CEO}$ (1) | ± 100 percent of initial value or 2 μA dc, whichever is grearer. | | |
| 2. | Forward current transfer ratio | 3076 | $V_{CE}$ = 5 V dc, $I_C$ = 50 mA dc (pulsed see 4.5.1) | $\Delta h_{FE1}$ (1) | ± 25 percent from initial reading. | | |
| 3. | Collector to emitter voltage (saturated) | 3071 | $I_C$ = 100 mA dc, $I_B$ = 10 mA dc, (pulsed see 4.5.1) | $\Delta V_{CE(sat)1}$ (1) (2) | ± 50 mV dc change from previous measured value. | | |

(1) Devices which exceed group A limits shall be consider failures.
(2) JANS only.

*TABLE I. Group A inspection.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 1 2/ | | | | | | |
| Visual and mechanical examination 3/ | 2071 | n = 45 devices, c = 0 | | | | |
| Solderability 3/ 4/ | 2026 | n = 15 leads, c = 0 | | | | |
| Resistance to solvents 3/ 4/ 5/ | 1022 | n = 15 devices, c = 0 | | | | |
| Temp cycling 3/ 4/ | 1051 | Test condition C, 25 cycles. n = 22 devices, c = 0 | | | | |
| Hermetic seal 4/ | 1071 | n = 22 devices, c = 0 | | | | |
| Fine leak<br>Gross leak | | | | | | |
| Electrical measurements 4/ | | Group A, subgroup 2 | | | | |
| Bond strength 3/ 4/ | 2037 | Precondition $T_A$ = +250°C at t = 24 hrs or $T_A$ = +300°C at t = 2 hrs, n = 11 wires, c = 0 | | | | |
| Subgroup 2 | | | | | | |
| Collector-emitter breakdown voltage | 3011 | Bias condition D; $I_C$ = 5 mA dc; pulsed (see 4.5.1) | $V_{(BR)CEO}$ | 30 | | V dc |
| Collector-base breakdown voltage | 3001 | Bias condition D; $I_C$ = 100 µA dc; pulsed (see 4.5.1) | $V_{(BR)CBO}$ | 60 | | V dc |
| Emitter-base breakdown voltage | 3026 | Bias condition D; $I_E$ = 100 µA dc; pulsed (see 4.5.1) | $V_{(BR)EBO}$ | 3.5 | | V dc |
| Collector-emitter cutoff current | 3041 | Bias condition D; $V_{CE}$ = 28 V dc | $I_{CEO}$ | | 20 | µA dc |
| Collector-emitter cutoff current | 3041 | Bias condition C; $V_{CE}$ = 55 V dc | $I_{CES1}$ | | 100 | µA dc |
| Forward-current transfer ratio | 3076 | $V_{CE}$ = 5.0 V dc; $I_C$ = 50 mA dc; pulsed (see 4.5.1) | $h_{FE1}$ | | | |
| 2N3866, 2N3866UB | | | | 15 | 200 | |
| 2N3866A, 2N3866AUB | | | | 25 | 200 | |

See footnote at end of table.

*TABLE I. Group A inspection - Continued.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroup 2 continued | | | | | | |
| Forward-current transfer ratio<br>2N3866, 2N3866UB<br>2N3866A, 2N3866AUB | 3076 | $V_{CE}$ = 5.0 V dc; $I_C$ = 360 mA dc; pulsed (see 4.5.1) | $h_{FE2}$ | <br>5.0<br>8.0 | | |
| Collector-emitter saturated voltage | 3071 | $I_C$ = 100 mA dc; $I_B$ = 10 mA dc; pulsed (see 4.5.1) | $V_{CE(sat)}$ | | 1.0 | V dc |
| Subgroup 3 | | | | | | |
| High temperature operation | | $T_A$ = +150°C | | | | |
| Collector to emitter Cutoff current | 3041 | Bias condition C; $V_{CE}$ = 55 V dc | $I_{CES2}$ | | 2.0 | mA dc |
| Low temperature operation | | $T_A$ = -55°C | | | | |
| Forward-current transfer ratio<br>2N3866, 2N3866UB<br>2N3866A, 2N3866AUB | 3076 | $V_{CE}$ = 5.0 V dc; $I_C$ = 50 mA dc; pulsed (see 4.5.1) | $h_{FE3}$ | <br>7<br>12 | | |
| Subgroup 4 | | | | | | |
| Magnitude of small-signal short-circuit current transfer ratio<br>2N3866, 2N3866UB<br>2N3866A, 2N3866AUB | 3306 | $V_{CE}$ = 15 V dc; $I_C$ = 50 mA dc; f = 200 MHz | $\lvert h_{fe} \rvert$ | <br>2.5<br>4.0 | <br>8.0<br>7.5 | |
| Open circuit output capacitance | 3236 | $V_{CB}$ = 28 V dc; $I_E$ = 0 | $C_{obo}$ | | 3.5 | pF |
| Power output | | $V_{CC}$ = 28 V dc; $P_{in}$ = 0.15 W; f = 400 MHz (see figure 4 and 4.5.3) | $P_{1out}$ | 1.0 | 2.0 | W |
| Power output | | $V_{CC}$ = 28 V dc; $P_{in}$ = 0.075 W; f = 400 MHz (see figure 4 and 4.5.3) | $P_{2out}$ | 0.5 | | W |
| Collector-efficiency | | $V_{CC}$ = 28 V dc; $P_{in}$ = 0.15 W; f = 400 MHz (see 4.5.3) | $\eta_1$ | 45 | | % |
| Collector-efficiency | | $V_{CC}$ = 28 V dc; $P_{in}$ = 0.075 W; f = 400 MHz (see 4.5.3) | $\eta_2$ | 40 | | % |

See footnote at end of table.

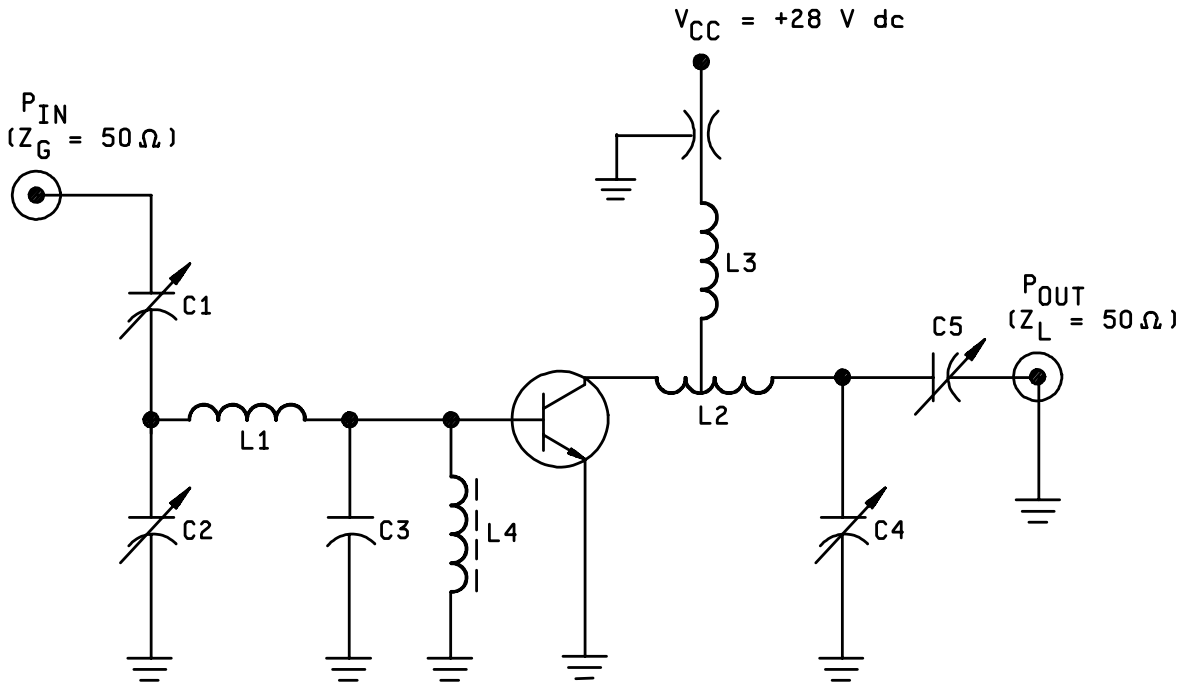
* TABLE I. Group A inspection - Continued.

| Inspection 1/ | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|
| | Method | Conditions | | Min | Max | |
| Subgroups 5 and 6<br><br>Not applicable<br><br>Subgroup 7<br><br>Collector-emitter breakdown voltage (clamped inductive) | 3011 | $V_{BE}$ = -1.5 V dc; $I_C$ = 40 mA dc (see figure 7) | $V_{(BR)CEX}$ | 55 | | V dc |

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/ Separate samples may be used.
4/ Not required for JANS devices.
5/ Not required for laser marked devices.

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

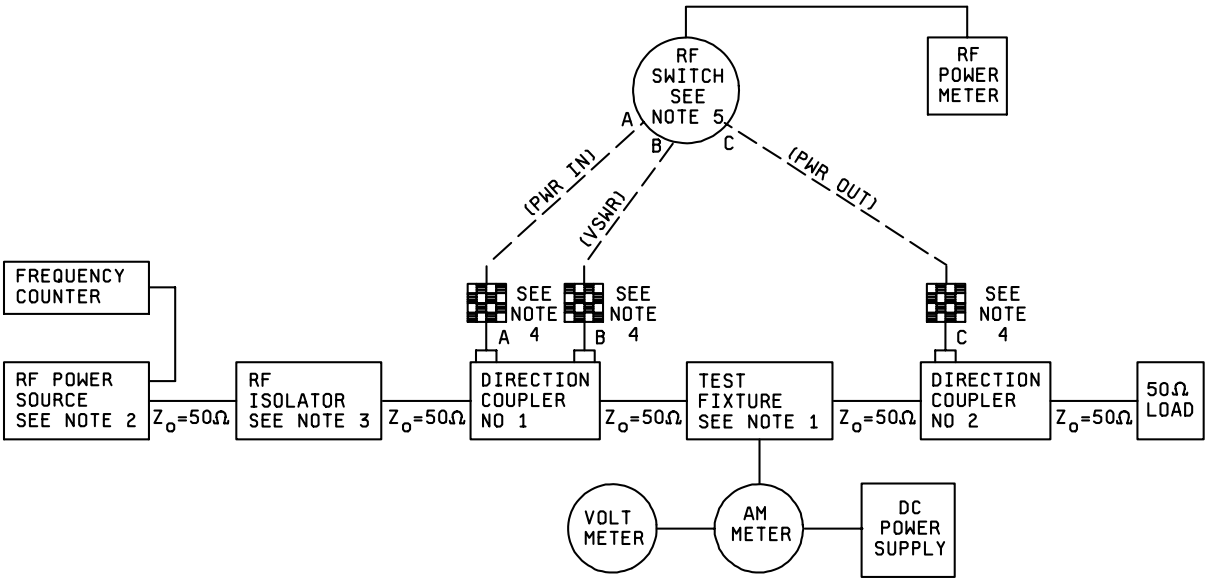
| Inspection | MIL-STD-750 | | Qualification |
|---|---|---|---|
| | Method | Conditions | |
| Subgroup 1 | | | 45 devices<br>c = 0 |
| Temperature cycling (air to air) | 1051 | Test condition C, 500 cycles | |
| Hermetic seal | 1071 | | |
| Fine leak<br>Gross leak | | | |
| Electrical measurements | | See group A, subgroup 2 and 4.5.5 herein. | |
| Subgroup 2 | | | 45 devices<br>c = 0 |
| Intermittent life | 1037 | $V_{CB}$ = 10 V dc, 6000 cycles | |
| Electrical measurements | | See group A, subgroup 2 and 4.5.5 herein. | |
| Subgroup 3 | | | |
| Not applicable | | | |
| Subgroup 4 | | | 22 devices<br>c = 0 |
| Thermal resistance | 3131 | $R_{\theta JC}$ | |
| Subgroups 5, 6, and 7 | | | |
| Not applicable | | | |
| Subgroup 8 | | | 45 devices<br>c = 0 |
| Reverse stability | 1033 | Condition A for devices ≥ 400 V, condition B for devices < 400 V. | |




$C_1$, $C_2$, $C_5$ = 3 - 35 pF.
$C_3$ = 24 pF (see note).
$C_4$ = 0.4 - 7 pF.
$L_1$ = Straight piece number 16 bare tin wire, 0.625 inch long.
$L_2$ = 3 turns number 16 wire, 0.250 inch ID, 0.312 inch long.
$L_3$ = 1 turns number 18 wire, 0.250 inch ID, 0.022 inch long.
$L_4$ = Ferrite RF choke, Z = 450 Ω.

NOTE: For optimum performance, $C_3$ should be mounted as close as possible to base lead.

* FIGURE 4. Power - output test circuit (400 MHz).



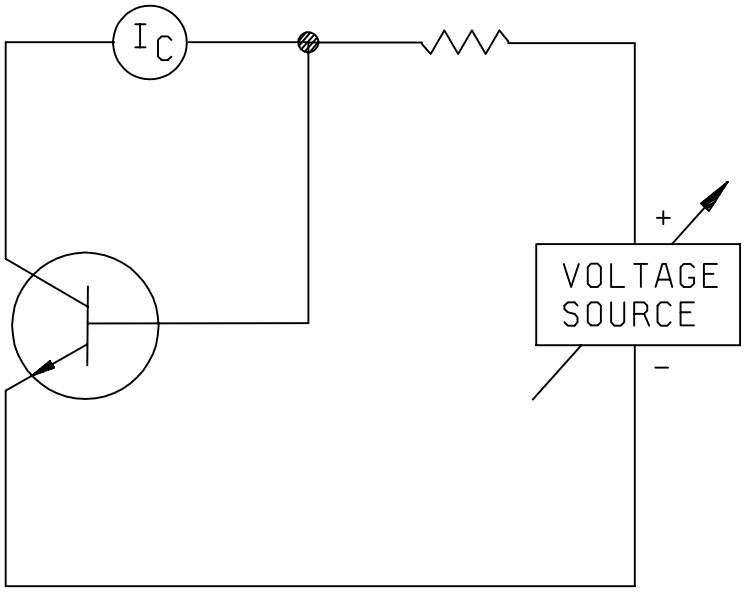

NOTES:

1. Test fixture is the circuit as described on figure 4.
2. RF power source may be any unit capable of generating desired power level at desired frequency with a harmonic and spurious content at least 20 dB below operating frequency level.
3. The RF isolator may be any device (pad, circulator, ect.) capable of establishing at least 20 dB of isolation (RL > 20 dB) between RF source and test fixture.
4. Variable attenuators (or fixed if calibrated): Attenuator on directional coupler number 2 shall be calculated against known working standard either by means of calibration chart or suitable adjustment if variable. Attenuator at position "A" of directional coupler number 1 shall be calibrated or adjusted so that actual power at test fixture is known. Attenuator at position "B" shall be adjusted to establish sensitivity needed to measure VSWR.
5. RF switch may be eliminated if additional power meters are used.

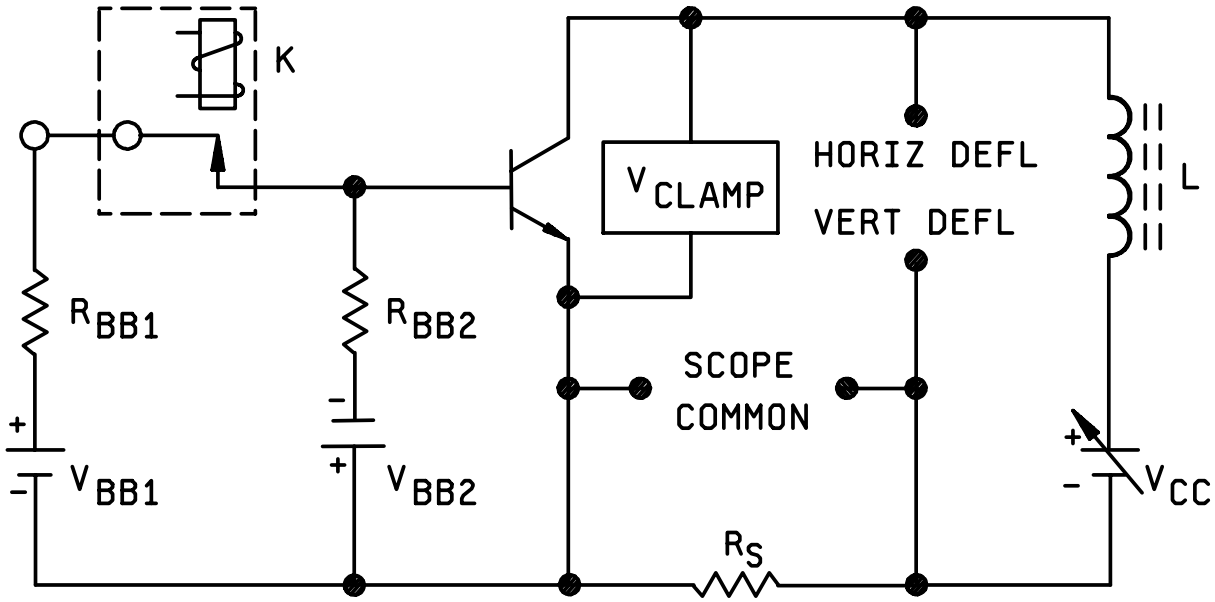
PROCEDURE:

a. Remove "test fixture" and install jumper between directional coupler number 1 and directional coupler number 2.
b. Set the RF switch to power output position "C".
c. Adjust frequency and power of RF source, as required by specification, and monitor frequency counter and RF power meter respectively (see note 4).
d. Set the RF switch to position "A" and adjust variable attenuator to obtain identical reading as power out in position "C" (see note 4).
e. Reconnect "test fixture" in test setup and insert device.
f. Adjust power supply to 28 V dc.
g. Adjust circuit output tuning for maximum power gain and circuit input tuning for maximum VSWR. (Switch between power in; VSWR, and power out while tuning and repeat as many times as necessary to obtain minimum VSWR and maximum power out. Check power in level before taking final reading. Minimum VSWR is defined as minimum reading obtained on power meter with switch in position "B" and maintaining power in.)

* FIGURE 5. RF power output ($P_{OUT}$) test procedure.




* FIGURE 6. Burnout by pulsing test circuit.




$R_{BB1}$ = 150 Ω.
$V_{BB1}$ = 20 V dc.
K = s.p.s.t relay, 6 V ac coil (Clare Mercury Relay, model number HGP-1400, or equivalent).
$R_{BB2}$ = 33 Ω.
$V_{BB2}$ = 1.5 V dc.
$R_S$ = 1 Ω ± 1 percent, .5 watt (noninductive).
$V_{CC}$ = The voltage should be adjusted to approximately 17 volts.
L = 25 mH, 100 mA, 83 Ω resistive (Miller number 957, or equivalent).
Vclamp = 55 V (min).
$V_{(BR)CEX}$ clamped at 10 percent over rating.

* FIGURE 7. $V_{BR(CEX)}$ (clamped inductive) test circuit.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. 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 Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' 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).

e. Type designation and product assurance level.

f. For die acquisition, the JANHC or JANKC letter version shall be specified (see figure 3).

g. Surface mount designation if applicable.

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.

* 6.4 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N3866) will be identified on the QML.

| Die ordering information (1) | | |
|---|---|---|
| PIN | Manufacturer | |
| | 34156 | |
| 2N3866<br>2N3866A | JANHCA2N3866<br>JANHCA2N3866A | |

(1) For JANKC level, replace JANHC with JANKC.

* 6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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

Review activities:
Army - AR, MI, SM
Navy - AS, MC
Air Force - 19, 99

Preparing activity:
DLA - CC

(Project 5961-2574)

**STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL**

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

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| **I RECOMMEND A CHANGE:** | 1. DOCUMENT NUMBER<br>MIL-PRF-19500/398F | 2. DOCUMENT DATE<br>23 January 2002 |
|---|---|---|

3. **DOCUMENT TITLE**
SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-FREQUENCY TYPES 2N3866, 2N3866A, 2N3866UB, 2N3866AUB JAN, JANTX, JANTXV, JANS, JANHC, AND JANKC

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

| a. NAME (Last, First, Middle initial) | b. ORGANIZATION | |
|---|---|---|
| c. ADDRESS (Include Zip Code) | d. TELEPHONE (Include Area Code)<br>COMMERCIAL<br>DSN<br>FAX<br>EMAIL | 7. DATE SUBMITTED |

8. PREPARING ACTIVITY

| a. Point of Contact<br>Alan Barone | b. TELEPHONE<br>Commercial: 614-692-0510 DSN: 850-0510 FAX: 614-692-6939 EMAIL: alan_barone@dscc.dla.mil |
|---|---|
| c. ADDRESS<br>Defense Supply Center, Columbus<br>ATTN: DSCC-VAC<br>P.O. Box 3990<br>Columbus, OH 43216-5000 | IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:<br>Defense Standardization Program Office (DLSC-LM)<br>8725 John J. Kingman, Suite 2533, Fort Belvoir, VA 22060-6221<br>Telephone (703) 767-6888 DSN 427-6888 |