

The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 September 2007.

INCH-POUND

MIL-PRF-19500/413E
27 June 2007
SUPERSEDING
MIL-PRF-19500/413D
21 March 2006

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-POWER,
TYPES 2N3771 AND 2N3772, JAN, JANTX, AND JANTXV

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

The requirements for acquiring the product described herein shall consist of this specification sheet and MIL-PRF-19500.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN silicon, high-power transistors for use in high-speed power-switching applications. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (TO-3).

1.3 Maximum ratings. Unless otherwise specified, $T_A = +25^\circ\text{C}$.

| Type | P_T | | $R_{\theta JC}$ | $R_{\theta JA}$ | V_{CBO} | V_{CEO} | V_{EBO} | I_B | I_C | T_{STG} and T_J |
|--------|-------------------------------|-------------------------------|--------------------------------------|--------------------------------------|-------------|-------------|-------------|-------------|-------------|------------------------------------|
| | $T_A = +25^\circ\text{C}$ (1) | $T_C = +25^\circ\text{C}$ (2) | | | | | | | | |
| | <u>W</u> | <u>W</u> | <u>$^\circ\text{C/W}$</u> | <u>$^\circ\text{C/W}$</u> | <u>V dc</u> | <u>V dc</u> | <u>V dc</u> | <u>V dc</u> | <u>A dc</u> | <u>$^\circ\text{C}$</u> |
| 2N3771 | 6 | 150 | 1.17 | 29.2 | 50 | 40 | 7 | 7.5 | 30 | -65 to +200 |
| 2N3772 | 6 | 150 | 1.17 | 29.2 | 100 | 60 | 7 | 5.0 | 20 | -65 to +200 |

(1) Derate linearly 34.2 mW/ $^\circ\text{C}$ for $T_A > +25^\circ\text{C}$.

(2) Derate linearly 857 mW/ $^\circ\text{C}$ for $T_C > +25^\circ\text{C}$.

1.4 Primary electrical characteristics.

| Type | h_{FE2} at $V_{CE} = 4$ V dc | | | | $V_{CE(SAT)1}$ (1) | |
|--------|--------------------------------|------------|-----------------|------------|-------------------------------------|-------------------------------------|
| | $I_C = 15$ A dc | | $I_C = 10$ A dc | | $I_C = 15$ A dc $I_B = 1.5$ A dc | $I_C = 10$ A dc $I_B = 1.0$ A dc |
| | <u>Min</u> | <u>Max</u> | <u>Min</u> | <u>Max</u> | <u>V dc</u> | <u>V dc</u> |
| 2N3771 | 15 | 60 | | | 1.5 Max | |
| 2N3772 | | | 15 | 60 | | 1.2 Max |

(1) Pulsed (see 4.5.1).

Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dsc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil/>.

1.4 Primary electrical characteristics - continued.

| Limits | $ h_{fe} $ | C_{obo} | Switching (see figure 2) | | | |
|--------|--|--|-----------------------------|---------------|-----------------------------|---------------|
| | $V_{CE} = 4 \text{ V dc}$ $I_C = 1 \text{ A dc}$ $f = 100 \text{ kHz}$ | $V_{CB} = 10 \text{ V dc}$ $I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$ | t_{on}, t_{off} 2N3771 | | t_{on}, t_{off} 2N3772 | |
| Min | 6 | | μs | μs | μs | μs |
| Max | 30 | 1,200 pF | 10 | 12 | 8 | 10 |

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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 of documents cited in sections 3, 4, or 5 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 cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

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

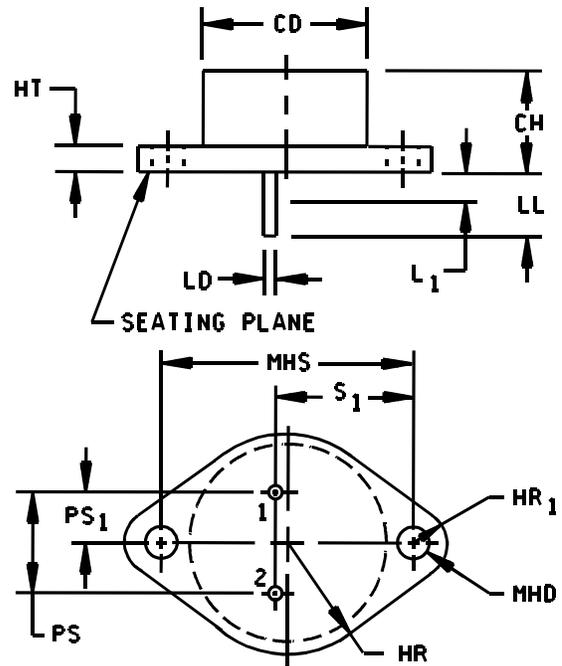
DEPARTMENT OF DEFENSE STANDARDS

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

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or <http://assist.daps.dla.mil/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, 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.

| Ltr | Dimension | | | | Notes |
|-----------------|-----------|-------|-------------|-------|-------|
| | Inches | | Millimeters | | |
| | Min | Max | Min | Max | |
| CH | .270 | .380 | 6.86 | 9.65 | |
| CD | | .875 | | 22.22 | |
| HR | .495 | .525 | 12.57 | 13.33 | |
| HR ₁ | .131 | .188 | 3.33 | 4.78 | |
| HT | .060 | .135 | 1.52 | 3.43 | |
| LD | .038 | .053 | 0.97 | 1.35 | 7 |
| LL | .312 | .500 | 7.92 | 12.70 | 7 |
| L ₁ | | .050 | | 1.27 | 7 |
| MHD | .151 | .165 | 3.84 | 4.19 | |
| MHS | 1.177 | 1.197 | 29.90 | 30.40 | |
| PS | .420 | .440 | 10.67 | 11.18 | 4 |
| PS ₁ | .205 | .225 | 5.21 | 5.72 | 4 |
| S ₁ | .655 | .675 | 16.64 | 17.15 | |



NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Terminal 1 is base; terminal 2 is emitter; case is collector.
4. These dimensions should be measured at points .050 - .055 inch (1.27 mm - 1.40 mm) below seating plane. When gauge is not used, measurement will be made at seating plane.
5. The seating place of the header shall be flat within .004 inch (0.102 mm) inside a .930 inch (23.62 mm) diameter circle on the center of the header and flat within .004 inch (0.03 mm) concave to .006 inch (0.15 mm) convex overall.
6. Collector shall be electrically connected to the case.
7. LD applies between L₁ and LL. Lead diameter shall not exceed twice LD within L₁.
8. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions, TO-3.

3. REQUIREMENTS

3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

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 manufacturers list 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.

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

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 Marking. Marking shall be in accordance with MIL-PRF-19500. At the option of the manufacturer, the country of origin marking may be omitted from the body of the transistor.

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

3.7 Electrical test requirements. The electrical test requirements shall be as specified in table I.

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 and tables I and II).

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

4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not request the performance of table III tests, the tests specified in table III herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

* 4.3 Screening. Screening shall be in accordance with table E-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 E-IV of MIL-PRF-19500) | Measurement |
|--|---|
| | JANTX and JANTXV levels |
| (1) 3c | Thermal impedance (see 4.3.2) |
| 9 | I_{CEX1} . |
| 11 | I_{CEX1} and h_{FE2} ; ΔI_{CEX1} = 100 percent of initial value or 200 μ A dc, whichever is greater. |
| 12 | Burn-in (see 4.3.1). |
| 13 | Subgroup 2 of table I herein. ΔI_{CEX1} = 100 percent of initial value or 500 μ A dc, whichever is greater; Δh_{FE2} = ± 25 percent of initial reading. |

- (1) Shall be performed anytime after temperature cycling, screen 3a; and does not need to be repeated in screening requirements.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: $T_A \leq +35^\circ\text{C}$; $V_{CB} = 25 \text{ V dc} \pm 5 \text{ V dc}$; $T_J = +187.5^\circ\text{C} \pm 12.5^\circ\text{C}$. NOTE: No heat sink or forced air cooling on the devices shall be permitted.

4.3.2 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3161 of MIL-STD-750 using the guidelines in that method for determining I_M , I_H , t_H , t_{SW} , (and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μ s max. See table III, group E, subgroup 4 herein.

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 table E-V of MIL-PRF-19500 and table I herein. End-point electrical measurements shall be in accordance with table I, subgroup 2 herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VIB (JAN, JANTX, and JANTXV) of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta requirement shall be in accordance with table II herein.

* 4.4.2.1 Group B inspection, table E-VIB (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| B3 | 1037 | For solder die attach: Intermittent operation life; 2,000 cycles; $V_{CB} \geq 10$ V dc; $T_A \leq +35^\circ\text{C}$ |
| B3 | 1027 | For eutectic die attach: $T_A \leq +35^\circ\text{C}$, $V_{CB} \geq 10$ V dc; adjust P_T to achieve $T_J = +175^\circ\text{C}$ minimum. |
| B3 | 2037 | Bond strength; test condition A or C as applicable. All internal leads for each device shall be pulled separately. |

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta requirements shall be in accordance with table II herein.

| <u>Subgroup</u> | <u>Method</u> | <u>Condition</u> |
|-----------------|---------------|--|
| C2 | 2036 | Test condition A, weight = 10 lbs., t = 15 s. |
| C5 | 3131 | See 4.3.2, $R_{\theta JC} = 1.17^\circ\text{C/W}$. |
| C6 | 1037 | For solder die attach: Intermittent operation life; 6,000 cycles; $V_{CB} \geq 10$ V dc; $T_A \leq +35^\circ\text{C}$ |
| C6 | 1027 | For eutectic die attach: $T_A \leq +35^\circ\text{C}$, $V_{CB} \geq 10$ V dc; adjust P_T to achieve $T_J = +175^\circ\text{C}$ minimum. |

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table E-IX of MIL-PRF-19500 and as specified herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein. Delta requirements shall be in accordance with table II herein.

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.

MIL-PRF-19500/413E

* TABLE I. Group A inspection.

| Inspection <u>1/</u> | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|-------------|--|-----------------|----------|------------|--------------------------------------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 1</u> | | | | | | |
| Visual and mechanical examination | 2071 | | | | | |
| <u>Subgroup 2</u> | | | | | | |
| Thermal impedance <u>2/</u> | 3131 | See 4.3.2 | $Z_{\theta JX}$ | | | $^{\circ}\text{C/W}$ |
| Breakdown voltage, collector to base 2N3771 2N3772 | 3011 | Bias condition D, pulsed (see 4.5.1), $I_C = 200 \text{ mA dc}$ | $V_{(BR)CEO}$ | 40 60 | | V dc V dc |
| Breakdown voltage collector to emitter 2N3771 2N3772 | 3011 | Bias condition B, $I_C = 200 \text{ mA dc}$, $R_{BE} = 100\Omega$, pulsed (see 4.5.1) | $V_{(BR)CER}$ | 45 70 | | V dc V dc |
| Breakdown voltage, collector to emitter 2N3771 2N3772 | 3011 | Bias condition A, $I_C = 200 \text{ mA dc}$, $V_{BE} = -1.5 \text{ V dc}$, pulsed (see 4.5.1) | $V_{(BR)CEX}$ | 50 90 | | V dc V dc |
| Collector-emitter cutoff current 2N3771 2N3772 | 3041 | Bias condition D $V_{CE} = 30 \text{ V dc}$ $V_{CE} = 50 \text{ V dc}$ | I_{CEO} | | 5 5 | mA dc mA dc |
| Emitter to base cutoff current | 3061 | Bias condition D, $V_{BE} = 7.0 \text{ V dc}$ | I_{EBO} | | 2.0 | mA dc |
| Collector-emitter cutoff current 2N3771 2N3772 | 3041 | Bias condition A, $V_{BE} = 1.5 \text{ V dc}$ $V_{CE} = 50 \text{ V dc}$ $V_{CE} = 100 \text{ V dc}$ | I_{CEX1} | | 500 500 | $\mu\text{A dc}$ $\mu\text{A dc}$ |
| Base emitter voltage (nonsaturated) 2N3771 2N3772 | 3066 | Test condition B, $V_{CE} = 4 \text{ V dc}$, pulsed (see 4.5.1), $I_C = 15 \text{ A dc}$ $I_C = 10 \text{ A dc}$ | V_{BE} | | 2.3 2.0 | V dc V dc |
| Collector to emitter voltage (saturated) 2N3771 2N3772 | 3071 | Pulsed (see 4.5.1) $I_C = 15 \text{ A dc}$, $I_B = 1.5 \text{ A dc}$ $I_C = 10 \text{ A dc}$, $I_B = 1.0 \text{ A dc}$ | $V_{CE(sat)1}$ | | 1.5 1.2 | V dc V dc |

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

| Inspection <u>1/</u> | MIL-STD-750 | | Symbol | Limits | | Unit |
|--|-------------|--|----------------|----------|------------|--------------------------------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 2</u> - Continued | | | | | | |
| Collector to emitter voltage (saturated) 2N3771 2N3772 | 3071 | Pulsed (see 4.5.1) $I_C = 30$ A dc, $I_B = 6$ A dc $I_C = 20$ A dc, $I_B = 4$ A dc | $V_{CE(sat)2}$ | | 4 4 | V dc V dc |
| Forward-current transfer ratio | 3076 | Pulsed (see 4.5.1), $V_{CE} = 4$ V dc, $I_C = 1.0$ A dc | h_{FE1} | 40 | | |
| Forward current transfer ratio 2N3771 2N3772 | 3076 | Pulsed (see 4.5.1), $V_{CE} = 4$ V dc $I_C = 15$ A dc $I_C = 10$ A dc | h_{FE2} | 15 15 | 60 60 | |
| <u>Subgroup 3</u> | | | | | | |
| High temperature operation: | | $T_A = +150^\circ\text{C}$ | | | | |
| Collector to emitter cutoff current 2N3771 2N3772 | 3041 | Bias condition A, $V_{BE} = -1.5$ V dc $V_{CE} = 50$ V dc $V_{CE} = 100$ V dc | I_{CEX2} | | 1.5 1.5 | mA dc mA dc |
| Low temperature operation: | | $T_A = -55^\circ\text{C}$ | | | | |
| Forward-current transfer ratio 2N3771 2N3772 | 3076 | Pulsed (see 4.5.1), $V_{CE} = 4$ V dc $I_C = 15$ A dc $I_C = 10$ A dc | h_{FE3} | 10 10 | | |
| <u>Subgroup 4</u> | | | | | | |
| Pulse response | 3251 | Test condition A except test circuit and pulse requirements in accordance with figure 2 herein | | | | |
| Turn on time 2N3771 2N3772 | | $V_{CC} = 30$ V dc $I_C = 15$ A dc, $I_{B1} = 1.5$ A dc $I_C = 10$ A dc, $I_{B1} = 1$ A dc | t_{on} | | 10 8 | μs μs |
| Turn off time 2N3771 2N3772 | | $V_{CC} = 30$ V dc $I_C = 15$ A dc, $I_{B1} = 1.5$ A dc $I_{B2} = -1.5$ A dc $I_C = 10$ A dc, $I_{B1} = 1$ A dc $I_{B2} = -1$ A dc | t_{off} | | 12 10 | μs μs |

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

| Inspection <u>1/</u> | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|-------------|---|------------|--------|-------|------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 4</u> - Continued | | | | | | |
| Magnitude of common emitter small-signal short-circuit forward-current transfer ratio | 3306 | $V_{CE} = 4 \text{ V dc}$, $I_C = 1.0 \text{ A dc}$ $f = 100 \text{ kHz}$ | $ h_{fe} $ | 6 | 30 | |
| Small-signal short-circuit forward-current transfer ratio | 3206 | $V_{CE} = 10 \text{ V dc}$, $I_C = 1.0 \text{ A dc}$ $f = 1 \text{ kHz}$ | h_{fe} | 40 | | |
| Output capacitance (open circuit) | 3236 | $V_{CB} = 10 \text{ V dc}$, $I_E = 0$, $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$ | C_{obo} | | 1,200 | pF |
| <u>Subgroup 5</u> | | | | | | |
| Safe operating area (dc operation) | 3051 | $T_C = +25^\circ\text{C}$, $t = 1 \text{ s}$, 1 cycle, see figure 3 | | | | |
| Test 1 (2N3771 only) | | $I_C = 30 \text{ A dc}$ $V_{CE} = 5 \text{ V dc}$ | | | | |
| Test 2 (2N3771 only) | | $I_C = 3.75 \text{ A dc}$ $V_{CE} = 40 \text{ V dc}$ | | | | |
| Test 3 (2N3772 only) | | $I_C = 20 \text{ A dc}$ $V_{CE} = 7.5 \text{ V dc}$ | | | | |
| Test 4 (2N3772 only) | | $I_C = 2.5 \text{ A dc}$ $V_{CE} = 60 \text{ V dc}$ | | | | |
| Safe operating area (clamped inductive) | 3053 | Load condition B, $T_C = +25^\circ\text{C}$, duty cycle ≤ 10 percent, (vary pulse width to achieve I_C), $R_s = 0.1\Omega$, (see figure 4) | | | | |
| Test 1 (2N3771 only) | | $R_{BB1} = 2\Omega$, $V_{BB1} \leq 14 \text{ V dc}$, $R_{BB2} = 100\Omega$, $V_{BB2} \leq 1.5 \text{ V dc}$, $I_C = 30 \text{ A dc}$, $V_{CC} = 20 \pm 5 \text{ V dc}$, $R_L \leq .67\Omega$, $L = 5 \text{ mH}$, 0.01 (Signal Transformer Co. CH-30 or equivalent), CR = 1N1186A, clamp voltage = 50 +0, -5 V dc, (device fails if clamp voltage not reached) | | | | |

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

| Inspection <u>1/</u> | MIL-STD-750 | | Symbol | Limits | | Unit |
|--|-------------|---|--------|--------|-----|------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 5</u> - Continued | | | | | | |
| Test 2 (2N3772 only) | | $R_{BB1} = 2\Omega$, $V_{BB1} \leq 10$ V dc, $R_{BB2} = 100\Omega$, $V_{BB2} = 1.5$ V dc, $I_C = 20$ A dc, $V_{CC} = 40 \pm 5$ V dc, $R_L \leq 2\Omega$, $L = 5$ mH, 0.01Ω (Signal Transformer Co. CH-30 or equivalent), CR = 1N1186A, clamp voltage = $90 +0, -5$ V dc, (device fails if clamp voltage not reached) | | | | |
| Electrical measurements | | See table I, subgroup 2 | | | | |
| <u>Subgroup 6</u> | | | | | | |
| Safe operating area (unclamped inductive) | 3053 | Load condition C (unclamped inductive load) see figure 5 herein; $T_C = +25^\circ\text{C}$; duty cycle $\leq 10\%$; $R_S = 0.1\Omega$; $R_{BB2} = 100\Omega$; $V_{CC} \leq 15$ V dc. | | | | |
| Test 1 (2N3771 only) | | $V_{BB2} = 1.5$ V dc; $R_{BB1} = 1\Omega$, $V_{BB1} \leq 12$ V dc, $I_C = 30$ A dc, $L = 1$ mH, 0.005Ω (Signal transformer Co. CH-100 or equivalent), $t_p \approx 5$ ms. | | | | |
| Test 2 (2N3772 only) | | $V_{BB2} = 1.5$ V dc, $R_{BB1} = 2\Omega$, $V_{BB1} \leq 12$ V dc, $I_C = 20$ A dc, $L = 2$ mH, 0.01Ω (Signal Transformer Co. CH-50 or equivalent), $t_p \approx 5$ ms. | | | | |
| * Test 3 (both types) | | $V_{BB2} = 0$ V, $R_{BB1} \leq 30\Omega$, $V_{BB1} \leq 10$ V dc, $I_C = 5.5$ A dc, $L = 40$ mH, 0.3Ω (Signal Transformer Co. CH-8 or equivalent), $t_p \approx 20$ ms. | | | | |

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

| Inspection <u>1/</u> | MIL-STD-750 | | Symbol | Limits | | Unit |
|---|-------------|--|--------|--------|-----|------|
| | Method | Conditions | | Min | Max | |
| <u>Subgroup 6</u> - Continued | | | | | | |
| Safe operating area (clamped inductive) (destructive) | 3053 | Load condition B, $T_C = +25^\circ\text{C}$, duty cycle $\leq 10\%$, $R_S = 0.1\Omega$, (see figure 4). | | | | |
| Test 1 (2N3771 only) | | $R_{BB1} = 2\Omega$, $V_{BB1} \leq 14\text{ V dc}$, $R_{BB2} = 100\Omega$, $V_{BB2} = 1.5\text{ V dc}$, $I_C = 30\text{ A dc}$, $V_{CC} = 50 +0, -5$ V dc , $R_L = 1.67\Omega$, $L = 5\text{ mH}$, 0.01Ω (Signal Transformer Co. CH-30 or equivalent), CR = 1N1186A, Clamp voltage = $50 +0, -5\text{ V dc}$. | | | | |
| Test 2 (2N3772 only) | | $R_{BB1} = 2\Omega$, $V_{BB1} \leq 10\text{ V dc}$, $R_{BB2} = 100\Omega$, $V_{BB2} = 1.5\text{ V dc}$ $I_C = 20\text{ A dc}$, $V_{CC} = 90 +0, -5$ V dc , $R_L = 4.5\Omega$, $L = 5\text{ mH}$, 0.01Ω (Signal Transformer Co. CH-30 or equivalent), CR = 1N1186A, Clamp voltage = $90 +0, -5\text{ V dc}$. | | | | |
| Electrical measurements | | See table I, subgroup 2 | | | | |

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

2/ This test required for the following end-point measurements only:
Group B, subgroups 2 and 3 (JAN, JANTX, and JANTXV).
Group C, subgroup 2 and 6.
Group E, subgroup 1.

TABLE II. Groups B, C, and E delta measurements. 1/ 2/ 3/

| Step | Inspection | MIL-STD-750 | | Symbol | Limit | | Unit |
|------|---|-------------|--|----------------------------|-------|-----|--|
| | | Method | Conditions | | Min | Max | |
| 1. | Forward-current transfer ratio 2N3771 2N3772 | 3076 | $V_{CE} = 4\text{ V dc}$, pulsed (see 4.5.1) $I_C = 15\text{ A dc}$ $I_C = 10\text{ A dc}$ | Δh_{FE2} <u>4/</u> | | | $\pm 25\%$ change from previously measured value |

1/ The delta measurements for table E-IX of MIL-PRF-19500 are subgroups 1 and 2.

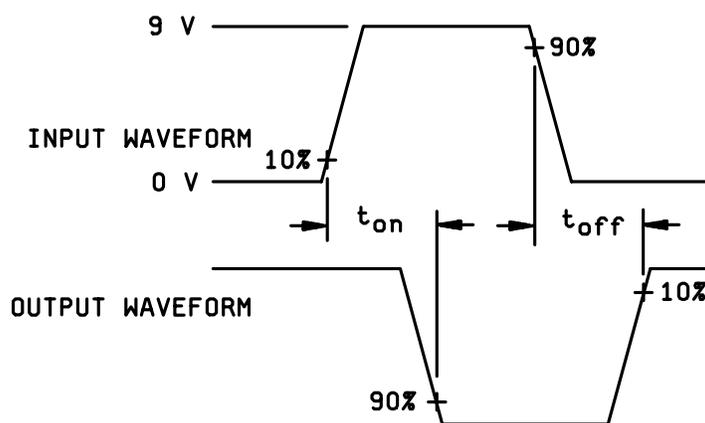
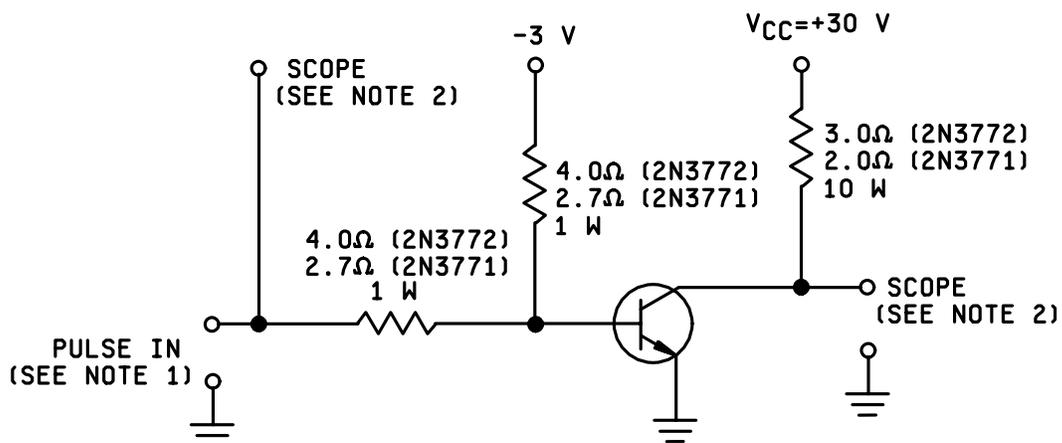
2/ The delta measurements for table E-VIB, (JAN, JANTX and JANTXV) of MIL-PRF-19500 are subgroups 3 and 6.

3/ The delta measurements for table E-VII of MIL-PRF-19500 are subgroups 2 and 6.

4/ Devices which exceed the group A limits for this test shall not be acceptable.

TABLE III. Group E inspection (all quality levels) for qualification or re-qualification only.

| Inspection | MIL-STD-750 | | Sample plan |
|--------------------------|-------------|--|---------------------|
| | Method | Conditions | |
| <u>Subgroup 1</u> | | | 45 devices c = 0 |
| Temperature cycling | 1051 | 1,000 cycles | |
| Hermetic seal | 1071 | Test conditions G or H | |
| Fine leak | | Test conditions C or D | |
| Gross leak | | | |
| Electrical measurements | | Table I, subgroup 2 and table II herein. | |
| <u>Subgroup 2</u> | | | 45 devices c = 0 |
| Blocking life | 1048 | 1,000 hours minimum, $T_A = +150^\circ\text{C}$, $V_{CB} = 80$ percent of rated. | |
| Electrical measurements | | Table I, subgroup 2 and table II herein. | |
| <u>Subgroup 4</u> | | | Sample size N/A |
| Thermal impedance curves | | See MIL-PRF-19500. | |
| <u>Subgroup 6</u> | | | 3 devices |
| ESD | 1020 | Testing is not required for class 3 listing. Testing is required for a nonsensitive listing to prove capability. | |
| <u>Subgroup 8</u> | | | 22 devices c = 0 |
| Reverse stability | 1033 | Condition B | |



NOTES:

1. The rise time (t_r) and fall time (t_f) of the applied pulse shall be each ≤ 20 nanoseconds, duty cycle ≤ 2 percent, generator source impedance shall be 50Ω , pulse width = $20\ \mu\text{s}$.
2. Output sampling oscilloscope: $Z_{in} \geq 100\ \text{k}\Omega$, $C_{in} \leq 50\ \text{pF}$, rise time ≤ 2.0 nanoseconds.

FIGURE 2. Pulse response test circuit.

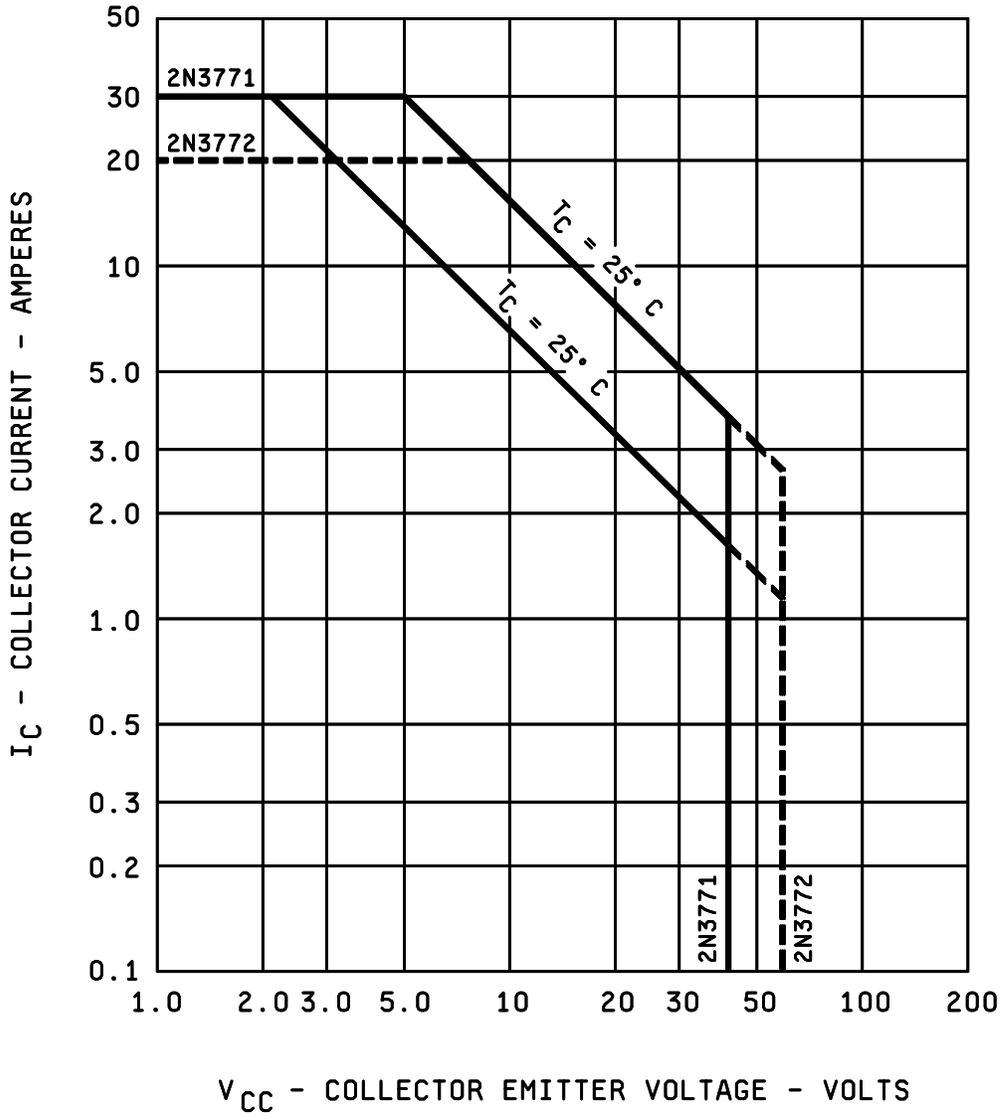


FIGURE 3. Maximum safe operating area graph (continuous dc).

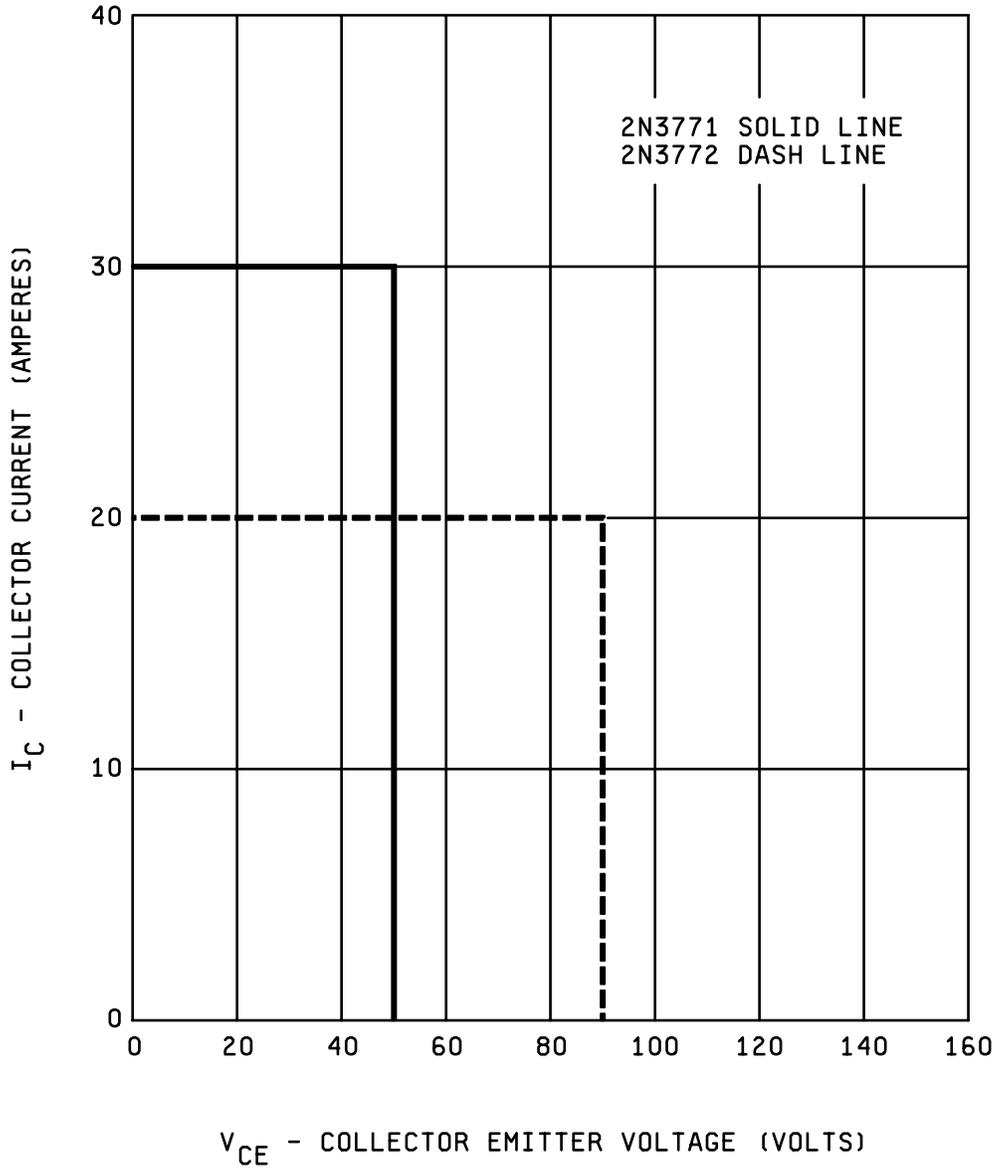


FIGURE 4. Safe operating area for switching between saturation and cutoff (clamped inductive load).

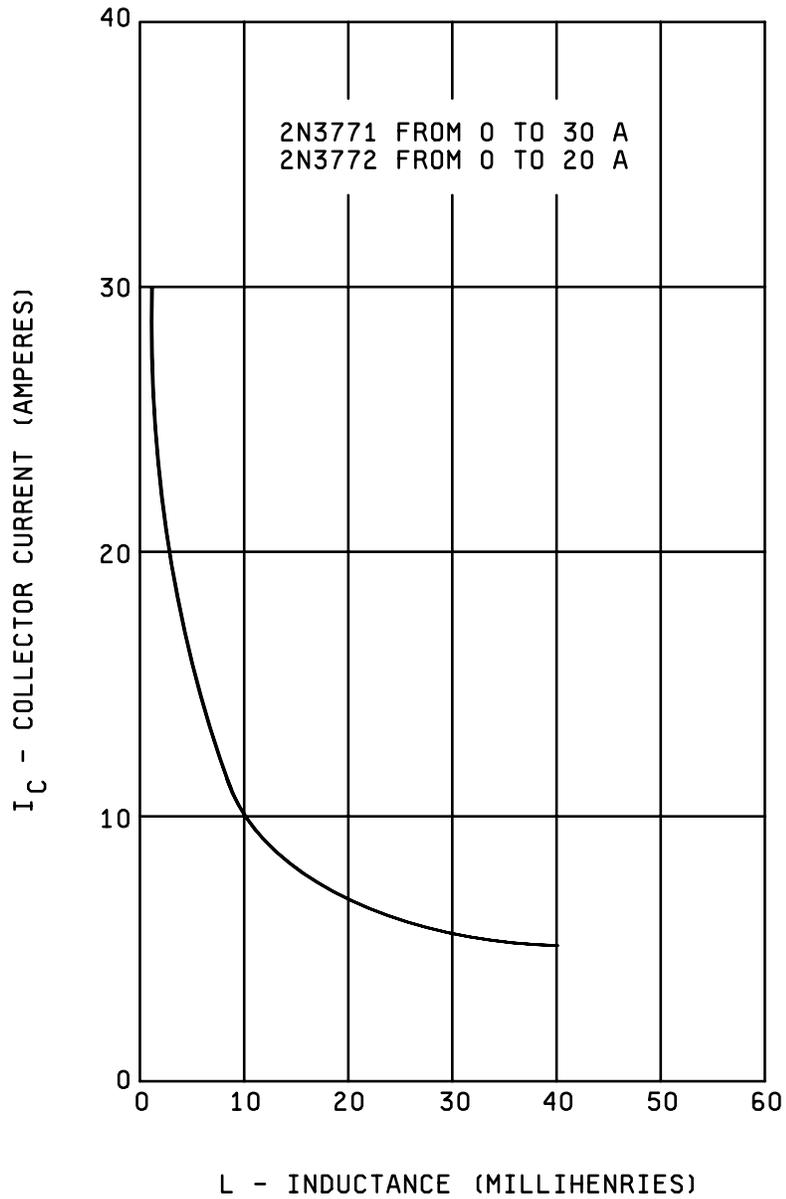


FIGURE 5. Safe operating area switching between saturation and cutoff (unclamped inductive load).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. 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. The notes specified in MIL-PRF-19500 are applicable to this specification.)

* 6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Packaging requirements (see 5.1).
- c. Lead finish (see 3.4.1).
- d. Product assurance level and type designator.

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 19500) 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 43218-3990 or e-mail vqe.chief@dla.mil.

6.4 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.

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NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://assist.daps.dla.mil/>.