

The documentation and process conversion measures necessary to comply with this revision shall be completed by 10 September 1997

INCH-POUND

MIL-PRF-19500/486E  
 10 June 1997  
 SUPERSEDING  
 MIL-S-19500/486D  
 27 June 1995

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, COUPLER, OPTOELECTRIC, SOLID STATE;  
 TYPES 4N22, 4N22A, 4N23, 4N23A, 4N24, 4N24A, 4N22U, 4N22AU,  
 4N23U, 4N23AU, 4N24U, 4N24AU; JAN, JANTX, JANTXV, AND JANS

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 solid state optically coupled isolators in which a gallium arsenide or gallium aluminum arsenide diode light source is optically coupled to a silicon NPN phototransistor. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figures 1 and 2.

1.3 Maximum ratings. Unless otherwise specified, maximum ratings apply to all case outlines and  $T_A = +25^\circ\text{C}$ .

1.3.1 Infrared-emitting diode maximum ratings.

|             |              |               |
|-------------|--------------|---------------|
| VR          | IF <u>1/</u> | IP <u>2/</u>  |
| <u>V dc</u> | <u>mA dc</u> | <u>A (pk)</u> |
| 2           | 40           | 1             |

1/ Derate linearly to  $+125^\circ\text{C}$  at  $0.67 \text{ mA}/^\circ\text{C}$  above  $+65^\circ\text{C}$ .

2/  $1.0 \mu\text{s}$  pulse width, 300 pps.

1.3.2 Phototransistor maximum ratings.

|             |             |             |              |              |
|-------------|-------------|-------------|--------------|--------------|
| VCEO        | VCBO        | VEBO        | PT <u>1/</u> | IC           |
| <u>V dc</u> | <u>V dc</u> | <u>V dc</u> | <u>mW</u>    | <u>mA dc</u> |
| 35          | 35          | 4           | 300          | 50           |

1/ Derate linearly to  $+125^\circ\text{C}$  at  $3 \text{ mA}/^\circ\text{C}$  above  $+25^\circ\text{C}$ .

1.3.1 Total device ratings.

|                                     |                 |
|-------------------------------------|-----------------|
| T <sub>J</sub> and T <sub>STG</sub> | V <sub>IO</sub> |
| <u>°C</u>                           | <u>V dc</u>     |
| -65 to +125                         | 1,000 max       |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, 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. Unless otherwise specified, electrical characteristics apply to all case outlines and TA = +25°C.

1.4.1 LED (input) characteristics.

|        |                   |                     |
|--------|-------------------|---------------------|
| Limits | IR<br>VR = 2 V dc | VF<br>IF = 10 mA dc |
|        | <u>A dc</u>       | <u>V dc</u>         |
| Min    |                   | 0.8                 |
| Max    | 100               | 1.3                 |

1.4.2 Phototransistor (output) characteristics.

|        |                          |                          |                            |                            |                                       |               |               |
|--------|--------------------------|--------------------------|----------------------------|----------------------------|---------------------------------------|---------------|---------------|
| Limits | IC(OFF)<br>VCE = 20 V dc | V(BR)CEO<br>IC = 1 mA dc | V(BR)CBO<br>IC = 100 µA dc | V(BR)CBO<br>IE = 100 µA dc | hFE<br>VCE = 20 V dc<br>IC = 10 mA dc |               |               |
|        | <u>nA</u>                | <u>V dc</u>              | <u>V dc</u>                | <u>V dc</u>                | 4N22<br>4N22A                         | 4N23<br>4N23A | 4N24<br>4N24A |
| Min    |                          | 35                       | 35                         | 4                          | 200                                   | 300           | 400           |
| Max    | 100                      |                          |                            |                            |                                       |               |               |

1.4.2 Coupled (transfer) characteristics.

|        |                                   |  |  |           |           |           |           |           |
|--------|-----------------------------------|--|--|-----------|-----------|-----------|-----------|-----------|
| Limits | RIO<br>at 1,000 V dc<br>see 4.5.4 | CIO<br>V = 0<br>f = 1 MHz<br>see 4.5.4 | Phototransistor mode switching ( see figure 3)<br>IC = 100 µA dc |           |           |           |           |           |
|        |                                   |  | 4N22   | 4N22A     | 4N23      | 4N23A     | 4N24      | 4N24A     |
|        | <u>ohms</u>                       | <u>pF</u>                              | tr   | tf        | tr        | tf        | tr        | tf        |
|        |                                   |  | <u>µs</u>  | <u>µs</u> | <u>µs</u> | <u>µs</u> | <u>µs</u> | <u>µs</u> |
| Min    | 1011                              | 5                                      | 15   | 15        | 15        | 15        | 20        | 20        |
| Max    |                                   |  |  |           |           |           |           |           |

|        |                        |               |               |                                       |               |               |                                      |               |               |
|--------|------------------------|---------------|---------------|---------------------------------------|---------------|---------------|--------------------------------------|---------------|---------------|
| Limits | VCE(SAT)<br>IF = 20 mA |               |               | IC(ON)2<br>IF = 10 mA<br>VCE = 5 V dc |               |               | IC(ON)1<br>IF = 2 mA<br>VCE = 5 V dc |               |               |
|        | IC = 2.5 mA            | IC = 5 mA     | C = 10 mA     |                                       |               |               |                                      |               |               |
|        | 4N22<br>4N22A          | 4N23<br>4N23A | 4N24<br>4N24A | 4N22<br>4N22A                         | 4N23<br>4N23A | 4N24<br>4N24A | 4N22<br>4N22A                        | 4N23<br>4N23A | 4N24<br>4N24A |
|        | <u>V dc</u>            | <u>V dc</u>   | <u>V dc</u>   | <u>mA dc</u>                          | <u>mA dc</u>  | <u>mA dc</u>  | <u>mA dc</u>                         | <u>mA dc</u>  | <u>mA dc</u>  |
| Min    | 0.3                    | 0.3           | 0.3           | 2.5                                   | 6.0           | 10.0          | 0.15                                 | 0.2           | 0.4           |
| Max    |                        |               |               |                                       |               |               |                                      |               |               |

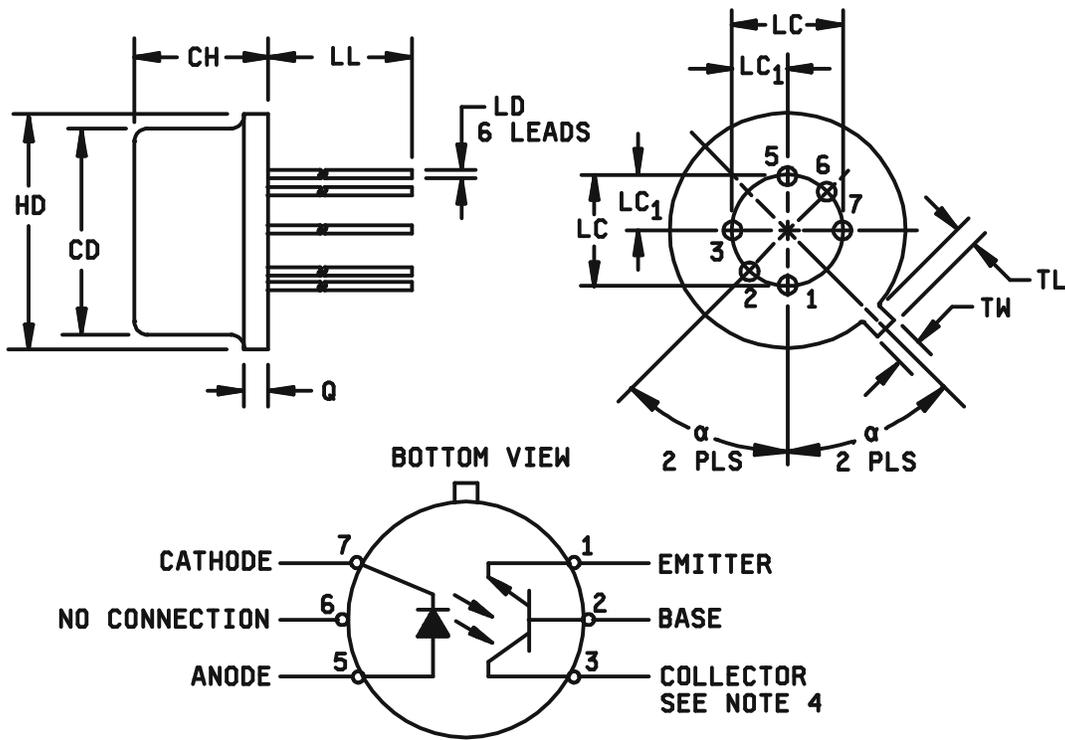


FIGURE 1. Physical dimensions and configuration.

| Ltr             | Dimensions |      |             |       | Notes |
|-----------------|------------|------|-------------|-------|-------|
|                 | Inches     |      | Millimeters |       |       |
|                 | Min        | Max  | Min         | Max   |       |
| HD              | .335       | .370 | 8.51        | 9.40  | 5     |
| CD              | .305       | .335 | 7.75        | 8.51  | 5     |
| LD              | .016       | 0.19 | 0.41        | 0.48  | 5     |
| $\alpha$        | 45° T.P.   |      | 45° T.P.    |       | 3     |
| Q               | - - -      | .040 | - - -       | 1.02  |       |
| CH              | .155       | .185 | 3.94        | 4.70  |       |
| LC              | .200 T.P.  |      | 5.08 T.P.   |       | 3     |
| LC <sub>1</sub> | .100 T.P.  |      | 2.54 T.P.   |       | 3     |
| TW              | .028       | .034 | 0.71        | 0.86  |       |
| TL              | .029       | .045 | 0.74        | 1.14  |       |
| LL              | .500       | .600 | 12.70       | 15.24 |       |

## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. T.P. designates true position. Leads having maximum diameter .019 inches (0.48 mm) measured in gauging plane .054 + .001, -.000 inch (1.37 +0.03, -0.00 mm) below the seating plane of the device shall be within .007 inch (0.18 mm) of their true position relative to a maximum width tab.
4. 4N22A, 4N23A, and 4N24A have collector isolated from the case.
5. In accordance with ANSI Y14.5M, diameters are equivalent to  $\varnothing$ x symbology.

FIGURE 1. Physical dimensions and configurations - Continued.

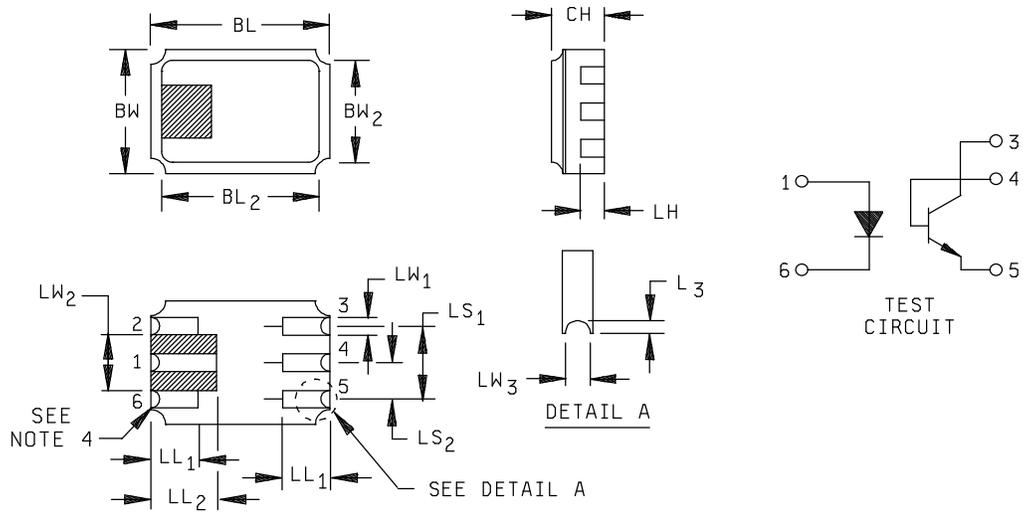


FIGURE 2. Physical dimensions and configuration, surface mount devices.

| Ltr             | Dimensions |      |            |      | Notes |
|-----------------|------------|------|------------|------|-------|
|                 | Inches     |      | Millimeter |      |       |
|                 | Min        | Max  | Min        | Max  |       |
| CH              | .058       | .080 | 1.47       | 2.03 |       |
| LH              | .026       | .034 | 0.66       | 0.86 |       |
| LW <sub>1</sub> | .022       | .028 | 0.56       | 0.71 |       |
| LW <sub>2</sub> | .072 REF   |      | 1.83 REF   |      |       |
| LW <sub>3</sub> | .006       | .022 | 0.15       | 0.56 |       |
| BW              | .165       | .175 | 4.19       | 4.44 |       |
| LS <sub>1</sub> | .095       | .105 | 2.41       | 2.67 |       |
| LS <sub>2</sub> | .045       | .055 | 1.14       | 1.39 |       |
| BW <sub>2</sub> | ---        | .175 | ---        | 4.44 |       |
| BL              | .240       | .250 | 6.10       | 6.35 |       |
| BL <sub>2</sub> | ---        | .250 | ---        | 6.35 |       |
| LL <sub>1</sub> | .060       | .070 | 1.52       | 1.78 |       |
| LL <sub>2</sub> | .082       | .098 | 2.08       | 2.49 |       |
| L <sub>3</sub>  | .003       | .007 | 0.08       | 0.18 |       |
| N               | 6          |      |            |      | 3     |
| ND              | 3          |      |            |      | 3     |
| NE              | 0          |      |            |      | 3     |

## NOTES:

- Dimensions are in inches.
- Metric equivalents are given for general information only.
- Symbol "N" is the maximum number of terminals. Symbols "ND" and "NE" are number of terminals along the length "BW" and "BL" respectively.
- Pin number designation:  

|            |                |              |
|------------|----------------|--------------|
| 1 - Anode. | 3 - Collector. | 5 - Emitter. |
| 2 - N/C.   | 4 - Base.      | 6 - Cathode. |

FIGURE 2. Physical dimensions and configurations, surface mounted devices - Continued.

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.

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

MILITARY

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available 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 (except for related associated specifications or specification sheets), 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 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500 and as specified herein.

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

IC(ON) ----- On-state collector current.

IC(OFF)----- Off-state collector current.

TT ----- Temperature, terminal pad.

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions for the purpose of interchangeability shall be as specified on figures 1 and 2 herein. With the approval of the qualifying activity, this device is authorized to contain organic material for JANS quality devices.

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

3.3.2 For eutectic alloyed die of less than  $1.5 \times 10^{-5}$  square inches (0.10 mm<sup>2</sup>) of surface area. Die shear process control shall be in accordance with the requirements for small area die in MIL-STD-883, method 2019.

3.3.3 JANTX and JANTXV only. Die shear process control on epoxy mounted die is not required.

3.4 Marking. Marking shall be as specified in MIL-PRF-19500.

3.4.1 Marking for surface mount devices. Marking shall be in accordance with MIL-PRF-19500.

3.5 Moisture content. The internal moisture content of the device package shall not exceed 10,000 PPM at +100°C.

3.6 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500, and figures 2 and 3.

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

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of inspection. 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.

4.3 Screening (JANTX, JANTXV, and JANS levels). Screening shall be in accordance with appendix E, 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 appendix E, table IV of MIL-PRF-19500) | Measurement   |   |
|--|---|---|
|  | JANS level  | JANTX and JANTXV levels   |
| 3  | See 4.3.1   | See 4.3.1   |
| 9 <u>1/</u>  | IC(OFF), hFE  | C(OFF), 100 percent read and record.  |
| 10   | See 4.3.2   | See 4.3.2   |
| 11 <u>2/</u>                                       | IR, IC(OFF)1, hFE and IC(ON)2;<br>ΔIC(OFF)1 = 100 percent of initial value or 25 nA dc, whichever is greater.<br>ΔhFE = ± 20 percent of initial reading.  | IR, IC(OFF)1, hFE and IC(ON)2;<br>ΔIC(OFF)1 = 100 percent of initial value or 25 nA dc, whichever is greater.   |
| 12   | See 4.3.3   | See 4.3.3   |
| 13   | Subgroup 2 of table I herein;<br>ΔIC(OFF)1 = 100 percent of initial value or 25 nA dc, whichever is greater.<br>ΔhFE = ± 20 percent of initial reading.<br>IC(ON) = ± 25 percent of initial reading;<br>ΔIR = 100 percent of initial value or 25 μA dc, whichever is greater. | Subgroup 2 of table I herein;<br>ΔIC(OFF)1 = 100 percent of initial value or 25 nA dc, whichever is greater. ΔhFE = ± 20 percent of initial reading. IC(ON) = ± 25 percent of initial reading; ΔIR = 100 percent of initial value or 25 μA dc, whichever is greater |

1/ Screen 9 may be omitted if IC(OFF)1 in screen 11 is determined using the maximum limit of IC(OFF)1 ≤ 25 nA (see screen 11).

2/ If screen 9 was omitted, IC(OFF)1 maximum limit is 25 nA and ΔIC(OFF)1 is not required.

4.3.1 Thermal shock (temperature cycling). All devices shall be subjected to thermal shock (temperature cycling) in accordance with MIL-STD-750, method 1051, test condition B, except T(min) = -55°C; 10 cycles, time at temperature extremes = 15 minutes minimum.

4.3.1.1 Monitored thermal shock (temperature cycling) (JANS only). One cycle on monitored cycling shall be performed on 100 percent of the devices. This test shall be performed any time after the completion of the thermal shock test specified or it may be the last of the 10 thermal cycles. All junctions shall be monitored for electrical continuity. Any discontinuity shall be cause for rejection of the device(s) under test. If 10 percent or more of the number of devices subjected to monitored temperature cycling fail, the entire lot shall be rejected as JANS types.

4.3.2 High temperature reverse bias (HTRB). All devices shall be subjected to high temperature reverse bias in accordance with MIL-STD-750, method 1039, test condition A, TA = +125°C, IF = 0, VCB = 28 V dc for 48 hours minimum.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: Burn-in circuit (see figure 4); VCC = 20 V dc, VCE = 10 V dc ± 5 V dc, IF = 40 mA dc, PT = 275 ± 25 mW. For surface mount devices, TA = room ambient as defined in the general requirements of 4.5 of MIL-STD-750; TT = +100°C to +125°C for surface mounted devices. No heat sink or forced air cooling on the devices shall be permitted.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table V of 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 appendix E, table VIb (JAN and JANTX) of MIL-PRF-19500 and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table II herein.

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

| Subgroup | Method | Conditions   |
|----------|--------|--|
| B3       | 1051   | Test condition B.  |
| B4       | 1037   | IF = 20 mA dc; VCE = 10 V dc; $t_{on} = t_{off} = 3$ minutes minimum for 2,000 cycles. PT = $275 \pm 25$ mW at $T_A =$ room ambient as defined in the general requirements of MIL-STD-750. No heat sink or forced air cooling shall be permitted on the devices. |

4.4.2.1 Group B inspection, appendix E, table VIb (JANTX and JANTXV) of MIL-PRF-19500.

| Subgroup | Method | Conditions  |
|----------|--------|---|
| B2       | 1051   | Test condition B.   |
| B3       | 1027   | IF = 20 mA dc; VCE = 10 V dc. PT = $275 \pm 25$ mW at $T_A =$ room ambient as defined in the general requirements of MIL-STD-750. No heat sink or forced air cooling shall be permitted on the devices. |

4.4.3 Group C inspection (all quality levels). Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VII of MIL-PRF-19500. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table II herein.

4.4.3.1 Group C inspection, appendix E, table VII of MIL-PRF-19500.

| Subgroup | Method | Conditions   |
|----------|--------|--|
| C2       | 2036   | Test condition E. Not applicable to surface mount devices.   |
| C3       | 2006   | Nonoperating, 30,000 G, X <sub>1</sub> , Y <sub>1</sub> , and Y <sub>2</sub> orientations.   |
| C6       | 1027   | IF = 20 mA dc; VCE = 10 V dc. PT = $275 \pm 25$ mW at $T_A =$ room ambient as defined in the general requirements of MIL-STD-750. No heat sink or forced air cooling shall be permitted on the devices. T = 1,000 hours. |

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 LED tests. These tests shall be performed with the output transistor terminals open.

4.5.3 Output transistor tests. These tests shall be performed with the input LED terminals open.

4.5.4 Isolation and coupling capacitance tests. The tests shall be performed between both input terminals 5 and 7 shorted together and the output terminals 1, 2, and 3 shorted together (see figure 1).

4.5.5 Monitored thermal shock (temperature cycling). One cycle of monitored temperature cycling shall be performed. All junctions shall be monitored for electrical continuity. Any discontinuity shall be cause for rejection of the device under test.

4.6 Internal visual (PRECAP) inspection (JANTXV level only). Internal visual inspection shall be performed in accordance with MIL-STD-750, methods 2072 and 2073 and as specified herein. Method 2072 shall be used for inspecting transistor die and completed assembly. Method 2073 shall be used for inspecting light emitting diode.

4.6.1 Gallium arsenide or gallium aluminum arsenide light emitting diode die inspection. The die shall be inspected under 100X (minimum).

TABLE I. Group A inspection.

| Inspection 1/  | MIL-STD-750 |  | Symbol        | Limits |                    | Unit   |
|--|-------------|--|---------------|--------|--------------------|--|
|  | Method      | Conditions   |               | Min    | Max                |  |
| <u>Subgroup 1</u><br>Visual and mechanical examination   | 2071        |  |               |        |                    |  |
| <u>Subgroup 2</u><br>(LED characteristics)   |             |  |               |        |                    |  |
| Reverse current  | 4016        | $V_R = 2 \text{ V dc}$ (see 4.5.2)   | $I_R$         |        | 100                | $\mu\text{A dc}$                                   |
| Forward voltage  | 4011        | $I_F = 10 \text{ mA dc}$ (see 4.5.2)   | $V_{F1}$      | 0.8    | 1.3                | $\text{V dc}$                                      |
| (Transistor characteristics)   |             |  |               |        |                    |  |
| Collector to emitter breakdown voltage   | 3011        | $I_C = 1.0 \text{ mA dc}$ ; $I_B = 0$ , (see 4.5.3)                                      | $V_{(BR)CEO}$ | 35     |                    | $\text{V dc}$                                      |
| Collector to base breakdown voltage  | 3001        | $I_C = 100 \text{ }\mu\text{A dc}$ ; $I_F = 0$ ,<br>$I_E = 0$ (see 4.5.3)                | $V_{(BR)CBO}$ | 35     |                    | $\text{V dc}$                                      |
| Emitter to base breakdown voltage  | 3026        | $I_E = 100 \text{ }\mu\text{A dc}$ ; $I_C = 0$ , $I_F = 0$<br>(see 4.5.3)                | $V_{(BR)EBO}$ | 4      |                    | $\text{V dc}$                                      |
| Off-state collector current<br>(phototransistor mode)  | 3041        | Bias condition D; $V_{CE} = 20 \text{ V dc}$ ;<br>$I_B = 0$ , $I_F = 0$ (see 4.5.3)      | $I_{C(OFF)1}$ |        | 100                | $\text{nA dc}$                                     |
| Forward-current transfer ratio <u>2/</u><br><br>4N22, 4N22A<br>4N23, 4N23A<br>4N24, 4N24A                      | 3076        | $V_{CE} = 5.0 \text{ V dc}$ ; $I_C = 10 \text{ mA dc}$ ;<br>$I_F = 0$ pulsed (see 4.5.3) | $h_{FE}$      |        | 200<br>300<br>400  |  |
| (Coupler characteristics)  |             |  |               |        |                    |  |
| On-state collector current <u>2/</u><br>(phtotransistor mode)<br><br>4N22, 4N22A<br>4N23, 4N23A<br>4N24, 4N24A | 3041        | $V_{CE} = 5 \text{ V dc}$ ; $I_F = 2 \text{ mA dc}$                                      | $I_{C(ON)1}$  |        | 0.15<br>0.2<br>0.4 | $\text{mA dc}$<br>$\text{mA dc}$<br>$\text{mA dc}$ |

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<br><br>On-state collector current <u>2</u> /<br>(phototransistor mode)<br><br>4N22, 4N22A<br>4N23, 4N23A<br>4N24, 4N24A<br><br>Collector to emitter saturated voltage<br><br>4N22, 4N22A<br>4N23, 4N23A<br>4N24, 4N24A   | 3041        | VCE = 5 V dc; IF = 10 mA dc  | IC(ON)2  | 2.5<br>6.0<br>10.0 |     | mA dc<br>mA dc<br>mA dc |
|  | 2071        | IF = 20 mA dc; Pulsed (see 4.5.1)<br><br>IC = 2.5 mA dc<br>IC = 5 mA dc<br>IC = 10 mA dc | VCE(sat) |                    | 0.3 | V dc                    |
| <u>Subgroup 3</u><br><br>High temperature operation:<br><br>(Transistor characteristics)<br><br>Off-state collector current<br>(phototransistor mode)<br><br>(Coupler characteristics)<br><br>On-state collector current <u>2</u> /<br>(phototransistor mode)<br><br>4N22, 4N22A<br>4N23, 4N23A<br>4N24, 4N24A<br><br>(LED characteristics)<br><br>Forward voltage<br><br>Low temperature operation: |             | TA = +100°C  |          |                    |     |                         |
|  | 3041        | Bias condition D; VCE = 20 V dc;<br>IB = 0, IF = 0 (see 4.5.3)                           | IC(OFF)2 |                    | 100 | μA dc                   |
|  | 3041        | VCE = 5 V dc; IF = 10 mA dc  | IC(ON)3  | 1.0<br>2.5<br>4.0  |     | mA dc<br>mA dc<br>mA dc |
|  | 4011        | IF = 10 mA dc (see 4.5.2)<br><br>TA = -55°C  | VF2      | 1.0                | 1.2 | 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 4</u>                                |             |   |                 |        |     |          |
| Input to output capacitance                      |             | $ V_{IN} - V_{Out}  = 0$ (see 4.5.4)<br>$f = 1$ MHz                                   | C <sub>IO</sub> |        | 5   | pF       |
| Input to output internal resistance              |             | $ V_{IN} - V_{Out}  = 1$ kV dc (see 4.5.4)  | R <sub>IO</sub> | 1011   |     | $\Omega$ |
| Rise time <u>2/</u><br>(phototransistor mode)    |             | VCC = 10 V dc; I <sub>F</sub> = 10 mA dc;<br>R <sub>L</sub> = 100 ohms (see figure 3) | t <sub>r</sub>  |        |     |          |
| 4N22, 4N22A                                      |             |   |                 |        | 15  | $\mu$ s  |
| 4N23, 4N23A                                      |             |   |                 |        | 15  | $\mu$ s  |
| 4N24, 4N24A                                      |             |   |                 |        | 20  | $\mu$ s  |
| Fall time <u>2/</u><br>(phototransistor mode)    |             | VCC = 10 V dc; I <sub>F</sub> = 10 mA dc;<br>R <sub>L</sub> = 100 ohms (see figure 3) | t <sub>f</sub>  |        |     |          |
| 4N22, 4N22A                                      |             |   |                 |        | 15  | $\mu$ s  |
| 4N23, 4N23A                                      |             |   |                 |        | 15  | $\mu$ s  |
| 4N24, 4N24A                                      |             |   |                 |        | 20  | $\mu$ s  |
| <u>Subgroups 5 and 6</u>                         |             |   |                 |        |     |          |
| Not applicable                                   |             |   |                 |        |     |          |
| <u>Subgroup 7</u>                                |             |   |                 |        |     |          |
| Monitored thermal shock<br>(temperature cycling) |             | See 4.5.5   |                 |        |     |          |

1/ For sampling plan, see MIL-PRF-19500.2/ Unless otherwise specified, tests and conditions apply to all case outlines.

TABLE II. Groups B and C electrical measurements.

| Step | Inspection   | MIL-STD-750 |  | Symbol                        | Limits  |     | Unit                    |
|------|--|-------------|--|-------------------------------|---|-----|-------------------------|
|      |  | Method      | Conditions   |                               | Min   | Max |                         |
| 1.   | Off-state collector current  | 3041        | VCE = 20 V dc,<br>IF = 0, condition D<br>(see 4.5.3)                 | IC(OFF)1                      |   | 100 | nA dc                   |
| 2.   | On-state collector current <u>4/</u><br><br>4N22, 4N22A<br>4N23, 4N23A<br>4N24, 4N24A    |             | VCE = 5 V dc,<br>IF = 10 mA dc                                       | IC(ON)2                       | 2.5<br>6.0<br>10.0  |     | mA dc<br>mA dc<br>mA dc |
| 3.   | Collector to emitter saturation voltage<br><br>4N22, 4N22A<br>4N23, 4N23A<br>4N24, 4N24A |             | IF = 20 mA dc<br><br>IC = 2.5 mA dc<br>IC = 5 mA dc<br>IC = 10 mA dc | VCE(SAT)                      |   | 0.3 | V dc                    |
| 4.   | Off-state collector current  | 3041        | VCE = 20 V dc,<br>IF = 0, condition D<br>(see 4.5.3)                 | $\Delta$ IC(OFF)1             | $\pm$ 100 percent of initial value<br>or 25 nA dc; whichever is<br>greater. |     |                         |
| 5.   | On-state collector current <u>4/</u>   |             | VCE = 5 V dc,<br>IF = 10 mA dc                                       | $\Delta$ IC(ON)2<br><u>5/</u> | $\pm$ 25 percent change from<br>initial reading.                            |     |                         |

1/ The electrical measurements for appendix E, table VIa (JANS) of MIL-PRF-19500 are as follows:

- a. Subgroup 3, see table II herein, steps 1, 2, and 3.
- b. Subgroup 4, see table II herein, steps 1, 2, and 3.
- c. Subgroup 5, see table II herein, steps 1, 2, 4, and 5.

2/ The electrical measurements for appendix E, table VIb (JANTX and JANTXV) of MIL-PRF-19500 are as follows:

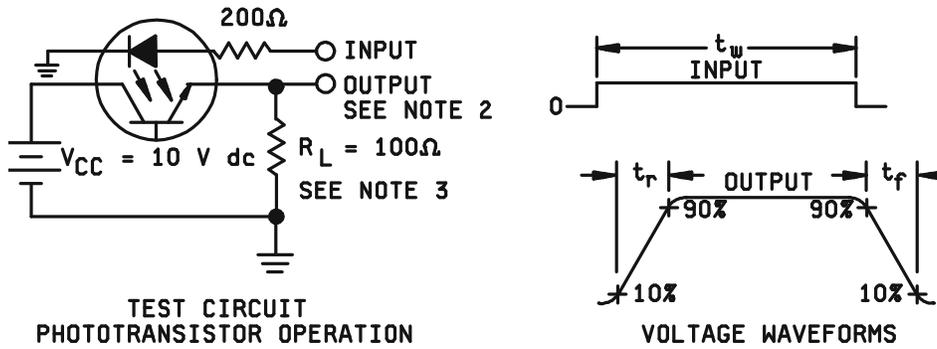
- a. Subgroup 2, see table II herein, steps 1, 2, and 3.
- b. Subgroup 3, see table II herein, steps 1, 2, 4, and 5.
- c. Subgroup 6, see table II herein, steps 4 and 5.

3/ The electrical measurements for appendix E, table VII of MIL-PRF-19500 are as follows:

- a. Subgroup 2, see table II herein, steps 1, 2, and 3 (JANS); and steps 1 and 2 (JANTX and JANTXV).
- b. Subgroup 3, see table II herein, steps 2 and 3.
- c. Subgroup 6, see table II herein, steps 4 and 5.

4/ Unless otherwise specified, tests and conditions apply to all case outlines.

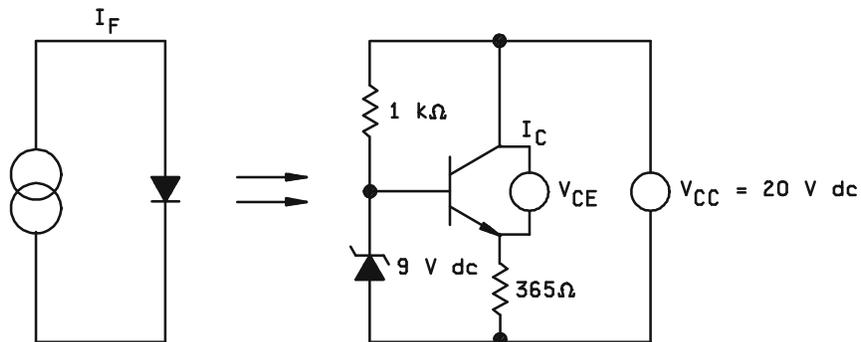
5/ Devices which exceed the group A limits for this test shall not be acceptable for shipment.



**NOTES:**

1. The input waveform is supplied by a generator with the following characteristics:  
 $Z_{OUT} = 50 \Omega$ ,  $t_r \leq 15 \text{ ns}$ , duty cycle = 1 percent,  $t_w = 100 \mu\text{s}$
2. The output waveform is monitored on an oscilloscope with the following characteristics:  $t_r \leq 1 \text{ ns}$ ,  $R_{IN} = 1 \text{ M}\Omega$ ,  $C_{IN} = 20 \text{ pF}$ .
3. Adjust amplitude of input for:  $I_F = 10 \text{ mA dc}$ .

FIGURE 3. Switching times.



**NOTES:**

1.  $I_F = 20 \text{ mA dc}$  for operation life tests.
2.  $I_F = 40 \text{ mA dc}$  for burn-in of TX and TXV.

FIGURE 4. Operation life test burn-in circuit.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or purchase order (see 6.2) When actual packaging of material 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.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129.

## 6. NOTES

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

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

6.2 Acquisition requirements. See MIL- PRF-19500.

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 Products List QPL No.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 purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, DSCC-VQE, Columbus, OH 43216.

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:  
Air Force - 17  
NASA - NA

Preparing activity:  
DLA - CC

Review activities:  
Air Force - 19, 85, 99

(Project 5980- 0016)

**STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL**

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**I RECOMMEND A CHANGE:**

**1. DOCUMENT NUMBER**

MIL-PRF-19500/486E

**2. DOCUMENT DATE (YYMMDD)**

970610

**3. DOCUMENT TITLE**

SEMICONDUCTOR DEVICE, COUPLER, OPTOELECTRIC. SOLID STATE; TYPES 4N22, 4N22A, 4N23, 4N23A, 4N24, 4N24A, 4N22U, 4N22AU, 4N23U, 4N23AU, 4N24U, 4N24AU; JAN, JANTX, JANTXV, AND JANS

**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)

7. DATE SUBMITTED (YYMMDD)

- (1) Commercial
- (2) AUTOVON (If applicable)

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