MILITARY SPECIFICATION

# SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, GERMANIUM, LOW-POWER TYPE 2N396A

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

## 1. SCOPE

1.1 Scope. This specification covers the detail requirements for a low-power, PNP, germanium, transistor.

1.2 Physical dimensions. See figure 1 (TO-5).

1.3 Maximum ratings.

| $P_T$ 1/ $T_A = 25°C$ | $I_C$ | $V_{CBO}$ | $V_{EBO}$ | $V_{CEO}$ | $T_{stg}$ |
|---|---|---|---|---|---|
| mW | mAdc | Vdc | Vdc | Vdc | °C |
| 200 | -200 | -30 | -20 | -20 | -65 to +100 |

1/ Derate 3.33 mW/°C for $T_A > 25°C$.

1.4 Primary electrical characteristics.

| | $h_{FE}$ $V_{CE} = -1.0$ Vdc $I_C = -10$ mAdc | $f_{hfb}$ $V_{CB} = -5.0$ Vdc $I_E = 1.0$ mAdc | $V_{CE}(sat)$ $I_C = -50$ mAdc $I_B = -3.3$ mAdc | $C_{obo}$ $V_{CB} = -5.0$ Vdc $I_E = 1.0$ mAdc 100 kHz $\leq f \leq$ 1 MHz |
|---|---|---|---|---|
| | | MHz | Vdc | pf |
| Min | 30 | 5 | --- | --- |
| Max | 150 | --- | -0.2 | 20 |

## 2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATION

MILITARY

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

STANDARDS

MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. Requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500.

3.3 Design, construction, and physical dimensions. Transistor shall be of the design, construction, and physical dimensions shown on figure 1.

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, and III.

3.5 Marking. The following marking specified in MIL-S-19500 may be omitted from the body of the transistor at the option of the manufacturer:

(a) Country of origin.
(b) Manufacturer's identification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.

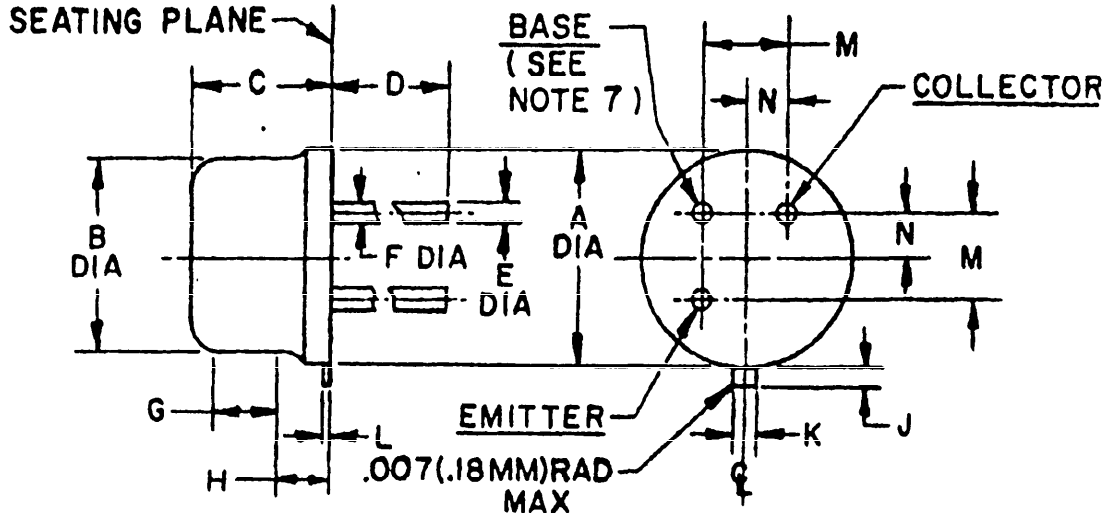
4.3 Quality conformance inspection. Quality conformance inspection shall consist of groups A, B, and C inspections.

4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.

4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.

4.3.3 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.

4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III.

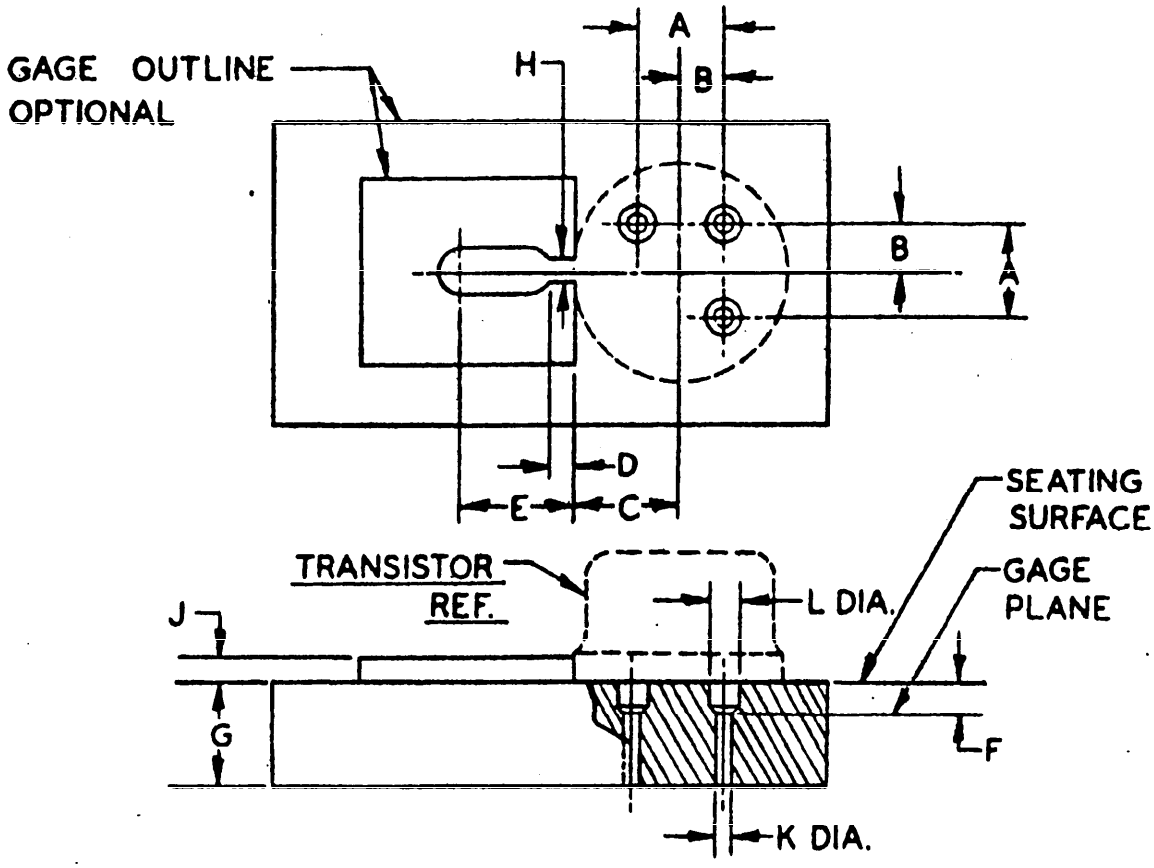



| DIMENSIONS | | | | | NOTES |
|---|---|---|---|---|---|
| LTR | INCHES | | MILLIMETERS | | |
| | MIN | MAX | MIN | MAX | |
| A | .335 | .370 | 8.51 | 9.40 | |
| B | .305 | .335 | 7.75 | 8.51 | |
| C | .240 | .260 | 6.10 | 6.60 | |
| D | 1.500 | 1.750 | 38.10 | 44.45 | 9 |
| E | .016 | .021 | .41 | .53 | 2,9 |
| F | .016 | .019 | .41 | .48 | 3,9 |
| G | .100 | --- | 2.54 | --- | 4 |
| H | --- | --- | --- | --- | 5 |
| J | .029 | .045 | .74 | 1.14 | 8 |
| K | .028 | .034 | .71 | .86 | |
| L | .009 | .125 | .23 | 3.18 | |
| M | .1414 Nom | | 3.59 Nom | | 6 |
| N | .0707 Nom | | 1.80 Nom | | 6 |

NOTES:

1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. Measured in the zone beyond .250 (6.35 mm) from the seating plane.
3. Measured in the zone .050 (1.27 mm) and .250 (6.35 mm) from the seating plane.
4. Variations on Dim B in this zone shall not exceed .010 (.25 mm).
5. Outline in this zone is not controlled.
6. When measured in a gaging plane .054+.001,-.000 (1.37+.03,-.00 mm) below the seating plane of the transistor max dia leads shall be within .007 (.18 mm) of their true location relative to a maximum width tab. Smaller dia leads shall fall within the outline of the max dia lead tolerance. Figure 2 preferred measured method.
7. The base shall be internally connected to the case.
8. Measured from the maximum diameter of the actual device.
9. All 3 leads.

FIGURE 1. Physical dimensions of transistor type 2N396A (TO-5).




NOTES:

1. The following gaging procedure shall be used: The use of a pin straightener prior to insertion in the gage is permissible. The device being measured shall be inserted until its seating plane is .125±.010 (3.18 mm ±.25 mm) from the seating surface of the gage. A spacer may be used to obtain the .125 (3.18 mm) distance from the gage seat prior to force application. A force of 8 oz ±.5 oz shall then be applied parallel and symmetrical to the device's cylindrical axis. When examined visually after the force application (the force need not be removed) the seating plane of the device shall be seated against the gage.
2. The location of the tab locator, within the limits of dim C, will be determined by the tab and flange dimension of the device being checked.
3. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.

| DIMENSIONS | | | | |
|---|---|---|---|---|
| LTR | INCHES | | MILLIMETERS | |
| | MIN | MAX | MIN | MAX |
| A | .1409 | .1419 | 3.58 | 3.60 |
| B | .0702 | .0712 | 1.78 | 1.81 |
| C | .182 | .199 | 4.62 | 5.05 |
| D | .009 | .011 | .23 | .28 |
| E | .125 Nom | | 3.18 Nom | |
| F | .054 | .055 | 1.37 | 1.40 |
| G | .372 | .378 | 9.45 | 9.60 |
| H | .0350 | .0355 | .89 | .90 |
| J | .150 Nom | | 3.81 Nom | |
| K | .0325 | .0335 | .83 | .85 |
| L | .0595 | .0605 | 1.51 | 1.54 |

FIGURE 2. Gage for lead and tab location for transistor type 2N396A.

TABLE I. Group A inspection

| Examination or test | MIL-STD-750 | | LTPD | Symbol | Limits | | |
|---|---|---|---|---|---|---|---|
| | Method | Details | | | Min | Max | Unit |
| Subgroup 1 | | | 10 | | | | |
| Visual and mechanical examination | 2071 | | | --- | --- | --- | --- |
| Subgroup 2 | | | 5 | | | | |
| Emitter to base cutoff current | 3061 | Bias cond. D; $V_{EB}$ = -10 Vdc | | $I_{EBO}$ | --- | -6.0 | µAdc |
| Collector to base cutoff current | 3036 | Bias cond. D; $V_{CB}$ = -20 Vdc | | $I_{CBO}$ | --- | -6.0 | µAdc |
| Collector to base cutoff current | 3036 | Bias cond. D; $V_{CB}$ = -30 Vdc | | $I_{CBO}$ | --- | -100 | µAdc |
| Collector to emitter cutoff current | 3041 | Bias cond. B; $V_{EB}$ = 2 Vdc; $R_B$ = 10 K ohms | | $I_{CEX}$ | --- | -6.0 | µAdc |
| Breakdown voltage, collector to emitter | 3011 | Bias cond. D; $I_C$ = -1.0 mAdc | | $BV_{CEO}$ | -20 | --- | Vdc |
| Forward-current transfer ratio | 3076 | $V_{CE}$ = -1.0 Vdc; $I_C$ = -10 mAdc | | $h_{FE}$ | 30 | 150 | --- |
| Forward-current transfer ratio | 3076 | $V_{CE}$ = -0.35 Vdc; $I_C$ = -200 mAdc | | $h_{FE}$ | 15 | --- | --- |
| Subgroup 3 | | | 5 | | | | |
| Small-signal short-circuit forward-current transfer-ratio cutoff frequency | 3301 | $V_{CB}$ = -5.0 Vdc; $I_E$ = 1.0 mAdc | | $f_{hfb}$ | 5 | --- | MHz |
| Collector to emitter voltage (saturated) | 3071 | $I_C$ = -50 mAdc; $I_B$ = -3.3 mAdc | | $V_{CE}(sat)$ | --- | -0.2 | Vdc |
| Open circuit output capacitance | 3236 | $V_{CB}$ = -5.0 Vdc; $I_E$ = 1.0 mAdc; 100 kHz $\leq f \leq$ 1 MHz | | $C_{obo}$ | --- | 20 | pf |
| Turn-off time | --- | (See figure 3) | | $t_s + t_{f_2}$ | --- | 0.2 | µsec |
| Subgroup 4 | | | 5 | | | | |
| High-temperature operation: | | $T_A$ = +71 ±3° C | | | | | |
| Collector to base cutoff current | 3036 | Bias cond. D; $V_{CB}$ = -20 Vdc | | $I_{CBO}$ | --- | -120 | µAdc |
| Low-temperature operation: | | $T_A$ = -55 ±3° C | | | | | |
| Forward-current transfer ratio | 3076 | $V_{CE}$ = -1.0 Vdc; $I_C$ = -10 mAdc | | $h_{FE}$ | 20 | --- | --- |

TABLE II. Group B inspection

| Examination or test | MIL-STD-750 | | LTPD | Symbol | Limits | | |
|---|---|---|---|---|---|---|---|
| | Method | Details | | | Min | Max | Unit |
| Subgroup 1 | | | 20 | | | | |
| Physical dimensions | 2066 | (See figure 1) | | --- | --- | --- | --- |
| Subgroup 2 | | | 15 | | | | |
| Solderability | 2026 | Omit aging | | --- | --- | --- | --- |
| Thermal shock (temperature cycling) | 1051 | Test cond. B; except T(high) = +100° C | | --- | --- | --- | --- |
| Thermal shock (glass strain) | 1056 | Test cond. A | | --- | --- | --- | --- |
| Seal (leak-rate) | --- | MIL-STD-202, method 112, test cond. C, procedure III; test cond. B for gross leaks | | --- | --- | $5x10^{-7}$ | atm cc/sec |
| Moisture resistance | 1021 | | | --- | --- | --- | --- |
| End points: | | | | | | | |
| Collector to base cutoff current | 3036 | Bias cond. D; $V_{CB}$ = -20 Vdc | | $I_{CBO}$ | --- | -6.0 | µAdc |
| Forward-current transfer r tio | 3076 | $V_{CE}$ = -1.0 Vdc; $I_C$ = -10 mAdc | | $h_{FE}$ | 30 | 150 | --- |
| Subgroup 3 | | | 15 | | | | |
| Shock | 2016 | Nonoperating; 1,500 G; 0.5 m sec; 5 blows in each orientation: $X_1$, $Y_1$, $Y_2$ and $Z_1$ | | --- | --- | --- | --- |
| Vibration fatigue | 2046 | Nonoperating | | --- | --- | --- | --- |
| Vibration, variable frequency | 2056 | | | --- | --- | --- | --- |
| Constant acceleration | 2006 | 10,000 G; in each orientation: $X_1$, $Y_1$, $Y_2$, and $Z_1$ | | --- | --- | --- | --- |
| End points: (Same as subgroup 2) | | | | | | | |
| Subgroup 4 | | | 20 | | | | |
| Terminal strength (lead fatigue) | 2036 | Test cond. E | | --- | --- | --- | --- |
| Subgroup 5 | | | 20 | | | | |
| Salt atmosphere (corrosion) | 1041 | | | --- | --- | --- | --- |
| End points: (Same as subgroup 2) | | | | | | | |

TABLE II. Group B inspection - Continued

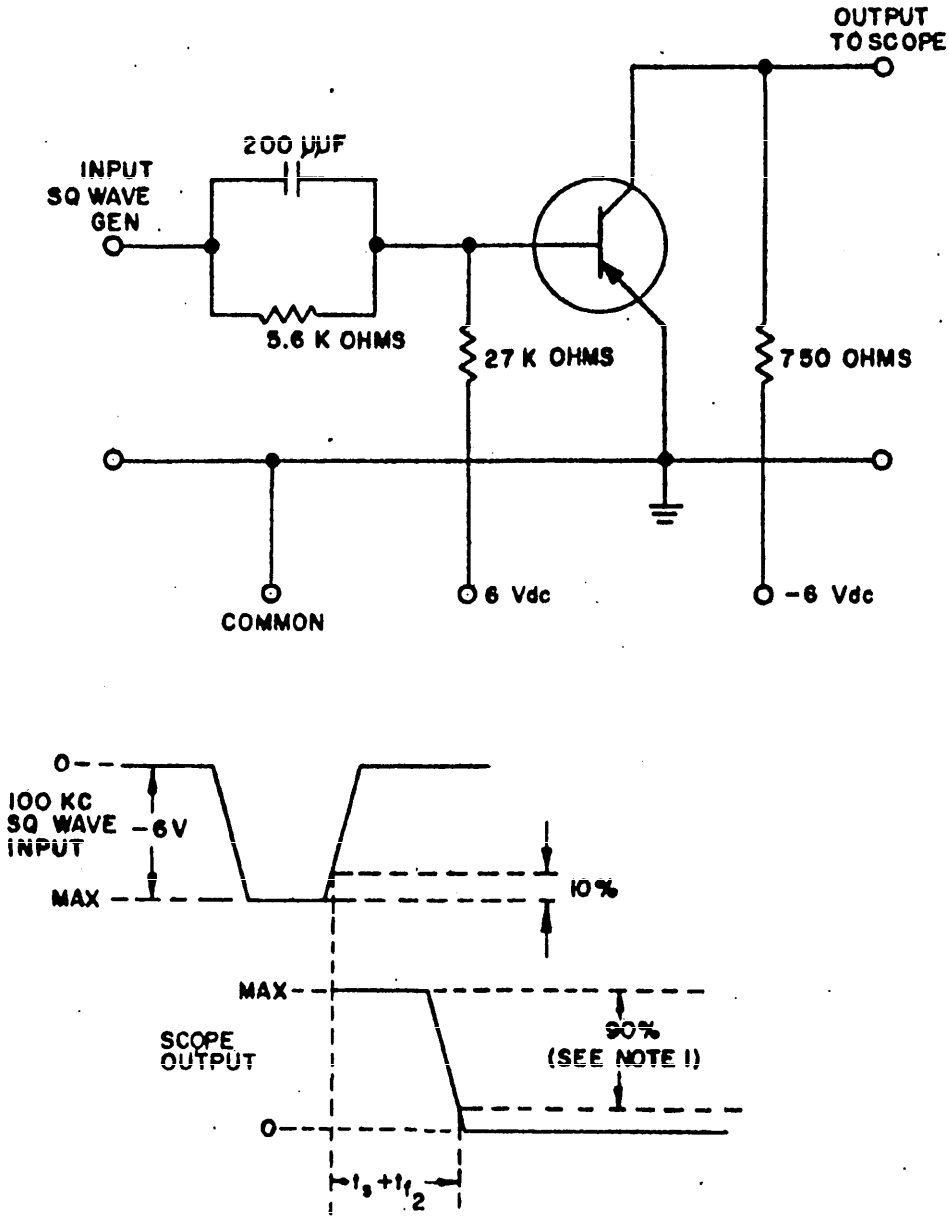
| Examination or test | MIL-STD-750 | | LTPD | Symbol | Limits | | |
|---|---|---|---|---|---|---|---|
| | Method | Details | | | Min | Max | Unit |
| Subgroup 6 | | | λ = 5 | | | | |
| High-temperature life (nonoperating) | 1031 | $T_{stg}$ = +100° C | | --- | --- | --- | --- |
| End points: | | | | | | | |
| Collector to base cutoff current | 3036 | Bias cond. D; $V_{CB}$ = -20 Vdc | | $I_{CBO}$ | --- | -8.0 | μAdc |
| Forward-current transfer ratio | 3076 | $V_{CE}$ = -1.0 Vdc; $I_C$ = -10 mAdc | | $h_{FE}$ | 25 | --- | --- |
| Subgroup 7 | | | λ = 5 | | | | |
| Intermittent operation life | 1036 | $T_A$ = 25° C; $P_T$ = 200 mW; $V_{CB}$ = -20 Vdc; Cycle: On, 50 ± 2 minutes Off, 10 ± 2 minutes | | --- | --- | --- | --- |
| End points: (Same as subgroup 6) | | | | | | | |

TABLE III. Group C inspection

| Examination or test | MIL-STD-750 | | LTPD | Symbol | Limits | | |
|---|---|---|---|---|---|---|---|
| | Method | Details | | | Min | Max | Unit |
| Subgroup 1 | | | 15 | | | | |
| Barometric pressure, reduced (altitude operation) | 1001 | Normal mounting; pressure = 8 mm Hg for 60 sec min | | --- | --- | --- | --- |
| Measurement during test: | | | | | | | |
| Collector to base cutoff current | 3036 | Bias cond. D; $V_{CB}$ = -30 Vdc | | $I_{CBO}$ | --- | -100 | μAdc |

5. PREPARATION FOR DELIVERY

5.1 See MIL-S-19500, section 5.




NOTES:

1. Any unit that turns on above the 90-percent point, once it starts to turn off, fails the test.

2. An equivalent circuit may be used.

FIGURE 3. Typical circuit for turn-off time test.

6. NOTES

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

6.2 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

6.3 Substitution criteria. The device covered herein is interchangeable with the device covered by the superseded MIL-S-19500/64C.

Custodians:
Army - EL
Navy - SH
Air Force - 11

Review activities:
Army - EL, MU, MI
Navy - SH
Air Force - 11, 17, 85

User activities:
Army - SM
Navy - CG, MC, AS, OS
Air Force - 14, 19

Preparing activity:
Navy - SH

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Code "C"