

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, GERMANIUM, LOW-POWER TYPE 2N331

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 an audio-frequency, PNP, germanium transistor.

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

1.3 Maximum ratings.*

P_C ^{1/} $T_A = 25^\circ C$	V_{CBO}	V_{EBO}	V_{CEO}	I_C	T_{stg}
mW	Vdc	Vdc	Vdc	mAdc	$^\circ C$
200	-30	-12	-16	200	-65 to +100

^{1/} Derate linearly at 2.67 mW/ $^\circ C$ for $T_A > 25^\circ C$.

1.4 Primary electrical characteristics.

Limits	h_{fb} $V_{CB} = -6 V_{dc}$ $I_E = 1 mA_{dc}$	h_{fe} $V_{CE} = -6 V_{dc}$ $I_C = 1.0 mA_{dc}$	h_{fb} $V_{CB} = -6 V_{dc}$ $I_E = 1.0 mA_{dc}$	C_{obo} $V_{CB} = -6 V_{dc}$ $I_E = 1 mA_{dc}$	NF $V_{CB} = -6 V_{dc}$ $I_E = 1.0 mA_{dc}$
	MHz		ohms	pf	db
Min	0.4	30	---	---	---
Max	---	70	50	50	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.

* Wherever used herein, the frequency measurement unit "Hertz" (Hz) is equivalent to and replaces "cycles per second" (cps).

FSC 5961

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. - Transistors 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 and II.

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

TABLE I. Group A inspection

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1</u>			10				
Visual and mechanical examination	2071			---	---	---	---
<u>Subgroup 2</u>			5				
Collector-to-base cutoff current	3036	Bias cond. D; $V_{CB} = -30 \text{ Vdc}$		I_{CBO}	---	-10	μAdc
Emitter-to-base cutoff current	3061	Bias cond. D; $V_{EB} = -12 \text{ Vdc}$		I_{EBO}	---	-10	μAdc
Small-signal short-circuit forward-current transfer ratio	3206	$V_{CE} = -6 \text{ Vdc}$; $I_C = 1.0 \text{ mAdc}$		h_{fe}	30	70	---
<u>Subgroup 3</u>			5				
Small-signal short-circuit input impedance	3201	$V_{CB} = -6 \text{ Vdc}$; $I_E = 1.0 \text{ mAdc}$		h_{ib}	---	50	ohms
Small-signal short-circuit output admittance	3231	$V_{CB} = -6 \text{ Vdc}$; $I_E = 1.0 \text{ mAdc}$		h_{ob}	---	1	umhos
Open-circuit output capacitance	3236	$V_{CB} = -6 \text{ Vdc}$; $I_E = 1.0 \text{ mAdc}$; $100\text{kHz} \leq f \leq 1 \text{ MHz}$		C_{obo}	---	50	pf

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 3</u> - Continued							
Noise figure	3246	$V_{CB} = -6 \text{ Vdc}$; $I_E = 1.0 \text{ mAdc}$; $f = 1 \text{ kHz}$; $R_G = 1,000 \text{ ohms}$; $R_L = 20,000 \text{ ohms}$	5	NF	---	20	db
<u>Subgroup 4</u>							
Small-signal short-circuit forward-current transfer-ratio cutoff frequency	3301	$V_{CB} = -6 \text{ Vdc}$; $I_E = 1.0 \text{ mAdc}$		f_{hfb}	0.4	---	MHz
High-temperature operation:	---	$T_A = +85^\circ \text{ C}$		---	---	---	---
Collector-to-base cutoff current	3036	Bias cond. D; $V_{CB} = -30 \text{ Vdc}$		I_{CBO}	---	-400	μA dc
Low-temperature operation:	---	$T_A = -65^\circ \text{ C}$		---	---	---	---
Small-signal short-circuit forward-current transfer ratio	3206	$V_{CE} = -6 \text{ Vdc}$; $I_C = 1.0 \text{ mAdc}$		h_{fe}	21	---	---

TABLE II. Group B inspection

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1</u>			10				
Physical dimensions	2066	(See figure 1.)		---	---	---	---
<u>Subgroup 2</u>			15				
Solderability	2026	Omit aging		---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. B except in step 3, $T = 100^\circ \text{ C}$		---	---	---	---
Thermal shock (glass strain)	1056	Test cond. A		---	---	---	---
Seal (leak-rate)	---	Method 112 of MIL-STD-202, test cond. C procedure III; test cond. B for gross leaks		---	---	5×10^{-7}	atm cc/sec
Moldure resistance	1021			---	---	---	---
End points:							
Collector-to-base cutoff current	3036	Bias cond. D; $V_{CB} = -30 \text{ Vdc}$		I_{CBO}	---	-10	μA dc
Small-signal short-circuit forward-current transfer ratio	3206	$V_{CE} = -6 \text{ Vdc}$; $I_C = 1.0 \text{ mAdc}$		h_{fe}	31	70	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 3</u>			15				
Shock	2016	Nonoperating; 1, 500 G, 0.5 msec, 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	20, 000 G; in each orientation: X ₁ , Y ₁ , Y ₂ , and Z ₁		---	---	---	---
End points: (Same as for subgroup 2.)							
<u>Subgroup 4</u>			15				
Terminal strength (lead fatigue)	2036	Test cond. E		---	---	---	---
<u>Subgroup 5</u>			15				
Salt atmosphere (corrosion)	1041			---	---	---	---
End points: (Same as for subgroup 2.)							
<u>Subgroup 6</u>			$\lambda = 10$				
High-temperature life (nonoperating)	1031	T _{stg} = +100° C		---	---	---	---
End points:							
Collector-to-base cutoff current	3036	Bias cond. D V _{CB} = -30 Vdc		I _{CBO}	---	-12	μ Adc
Small-signal short-circuit forward-current transfer ratio	3206	V _{CE} = -6 Vdc I _C = 1.0 mAdc		h _{fe}	25	85	---
<u>Subgroup 7</u>			$\lambda = 10$				
Steady-state-operation life	1026	T _A = +25° ±3° C; P _C = 200 mW; V _{CB} = -25 Vdc		---	---	---	---
End points: (Same as for subgroup 6.)							

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 and II.

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

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

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

4.6 Methods of examination and test. The methods of examination and test shall be as specified in tables I and II.

5. PREPARATION FOR DELIVERY

5.1 See MIL-S-19500, section 5.

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.

Custodians:

Army - EL
Navy - SH
Air Force - 11

Preparing activity:

Navy - SH

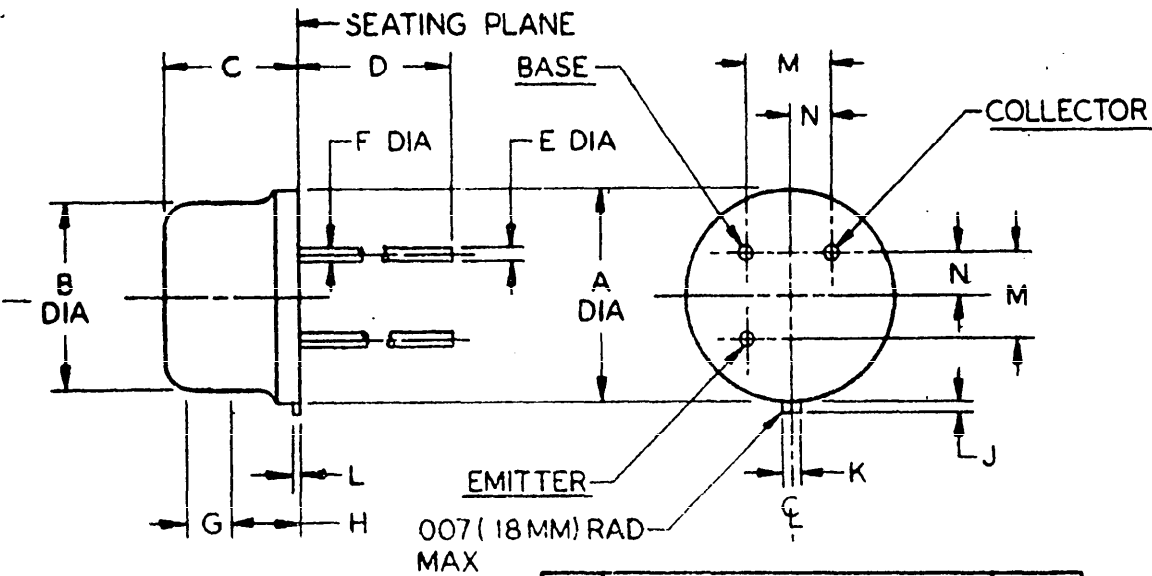
(Project 5961-0008-02)

Review activities:

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

User activities:

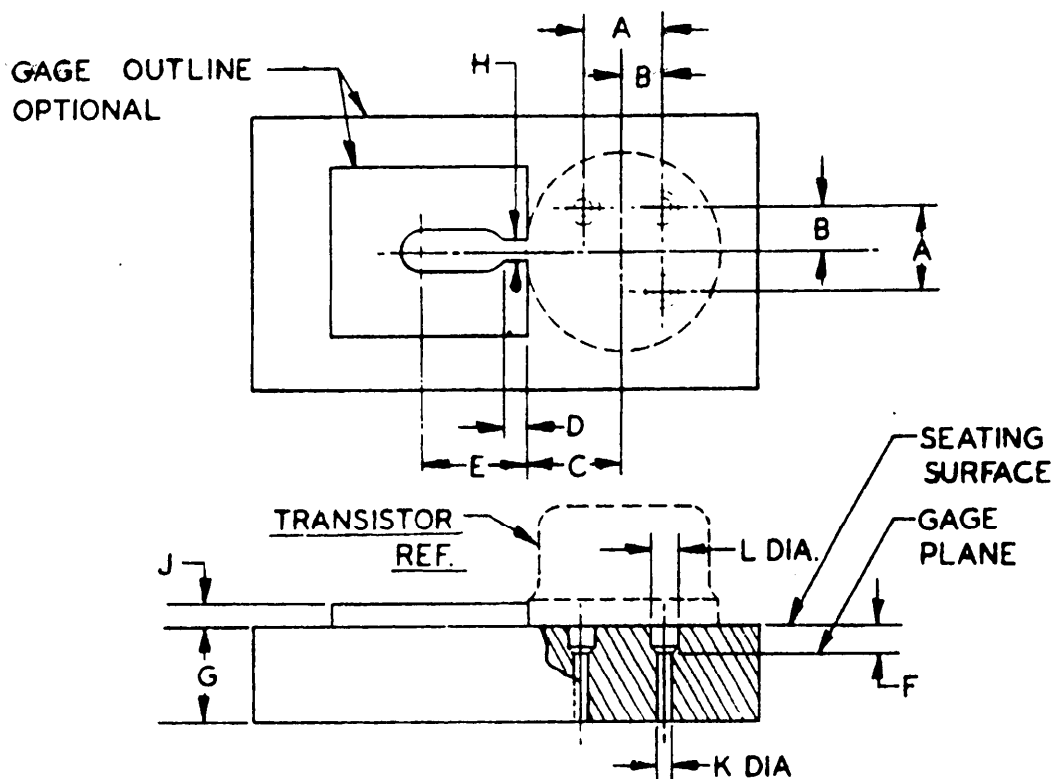
Army - SM
Navy - CG, MC, AS, OS
Air Force - 14, 19



Ltr	Dimensions in inches with metric equivalents (mm) in parentheses (see note 1)		Notes
	Minimum	Maximum	
A	.335 (8.51)	.370 (9.40)	
B	.305 (7.75)	.335 (8.51)	
C	.240 (6.10)	.260 (6.60)	
D	1.500 (38.10)	1.750 (44.45)	9
E	.016 (.41)	.021 (.53)	2,9
F	.016 (.41)	.019 (.48)	3,9
G	.100 (2.54)		4
H			5
J	.029 (.74)	.045 (1.14)	8
K	.028 (.71)	.034 (.86)	
L	.009 (.23)	.125 (3.18)	
M	.1414 (3.59) nom		6
N	.0707 (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. All leads electrically isolated from case.
 8. Measured from the maximum diameter of the actual device.
 9. All 3 leads.

FIGURE 1. Physical dimensions of transistor type 2N331 (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 $.125 \pm .010$ (3.18 $\pm$.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 $\pm$.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.

Ltr	Dimensions in inches with metric equivalents (mm) in parentheses (see note 3)	
	Minimum	Maximum
A	.1409 (3.58)	.1419 (3.60)
B	.0702 (1.78)	.0712 (1.81)
C	.182 (4.62)	.199 (5.05)
D	.009 (.23)	.011 (.28)
E	.125 (3.18) nom	
F	.054 (1.37)	.055 (1.40)
G	.372 (9.45)	.378 (9.60)
H	.0350 (.89)	.0355 (.90)
J	.150 (3.81) nom	
K	.0325 (.83)	.0335 (.85)
L	.0595 (1.51)	.0605 (1.54)

FIGURE 2. Gage for lead and tab location for transistor type 2N331.