

MIL-S-19500/110C

11 April 1972

SUPERSEDING

MIL-S-19500/110B

8 November 1965

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, LOW-POWER TYPES 2N328A AND 2N329A

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 PNP, silicon, low-power transistor.

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

1.3 Maximum ratings.

PT 1/	VCBO	VEBO	VCEO	Tstg and Top
mW	Vdc	Vdc	Vdc	°C
400	-50	-30	-40 (2N328A) -35 (2N329A)	-65 to +200

1/ Derate linearly 2.28 mW/°C for $T_A > 25^\circ\text{C}$.

1.4 Primary electrical characteristics.

Limits	h _{FE}		V _{CE(sat)}		V _{BE(sat)}		f _{hfb}	
			I _C = -10 mA _{dc} I _B = -2 mA _{dc}	I _C = -15 mA _{dc} I _B = -2 mA _{dc}	I _C = -3 mA _{dc} I _B = -1 mA _{dc}	V _{CB} = -5 V _{dc} I _E = 3 mA _{dc}		
	I _C = -0.3 V _{dc} I _C = -3 mA _{dc}							
	2N328A	2N329A	2N328A	2N329A	2N328A	2N329A	2N328A	2N329A
			<u>V_{dc}</u>	<u>V_{dc}</u>	<u>V_{dc}</u>	<u>V_{dc}</u>	<u>kHz</u>	<u>kHz</u>
Min	18	36	---	---	---	---	200	250
Max	44	88	-0.3	-0.4	-1	-1	---	---

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 specification, 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.

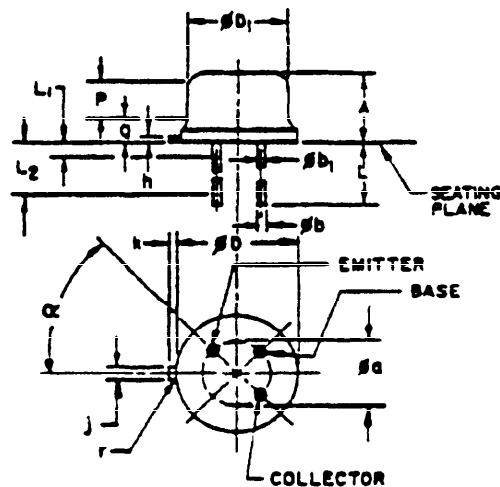
* 3.3.1 Lead material and finish. Lead material shall be Kovar or alloy 52. Lead finish shall be gold-plated. (Leads may be tin-coated if specified in the contract or order, and this requirement shall not be construed as adversely affecting the qualified-product status of the device, or applicable JAN marking (see 6.2)).

* 3.3.1.1 Selectivity of lead material. Where choice of lead material (see 3.3.1 above) is desired, it shall be specified in the contract or order (see 6.2).

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.

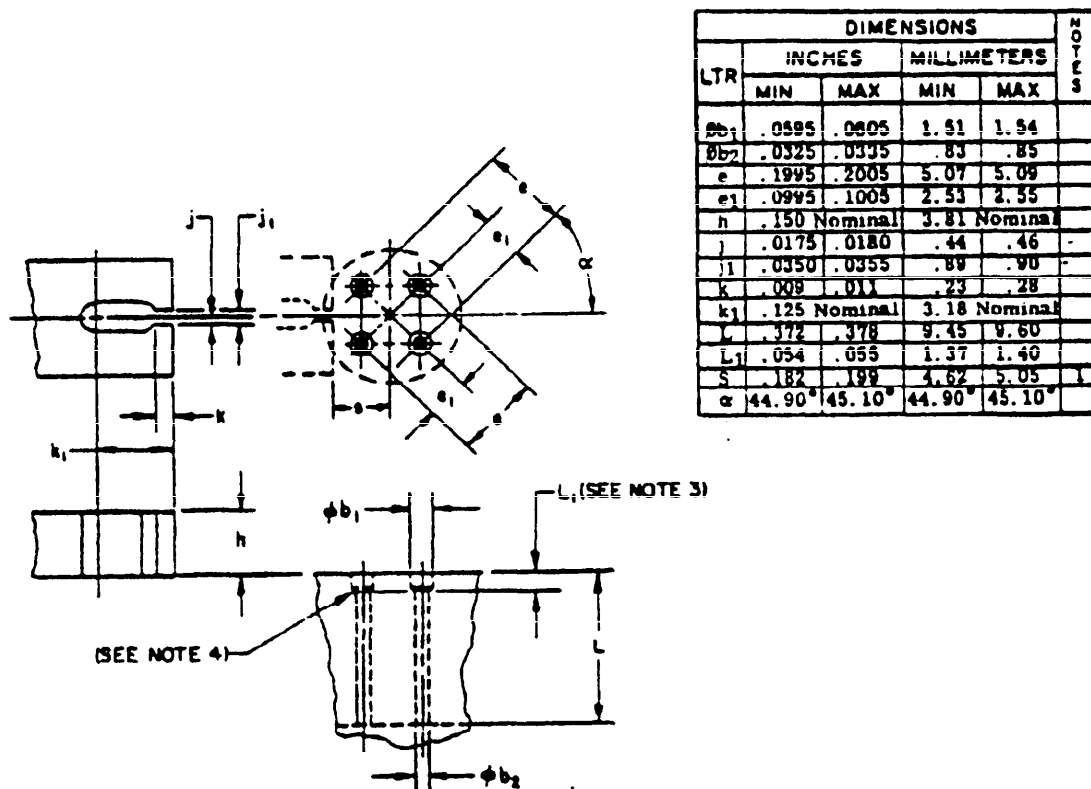


DIMENSIONS					NOTES
LTR	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.240	.260	6.10	6.60	
Ba	.200 TP		5.08 TP		6
Bb	.016	.021	.41	.53	7, 8
Bb1	.016	.019	.41	.48	7, 8
BD	.335	.370	8.51	9.40	
BD1	.305	.335	7.75	8.51	
h	.009	.041	.23	1.04	
j	.028	.034	.71	.86	2
k	.028	.045	.74	1.14	3
L	1.500	1.750	38.10	44.45	7, 8
L1	---	.050	---	1.27	7, 8
L2	.250	---	6.35	---	7, 8
P	.100	---	2.54	---	5
Q	---	.050	---	1.27	4
r	---	.010	---	.25	10
α	45° TP		45° TP		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. Beyond r(radius) maximum, j shall be held for a minimum length of .011(.28 mm).
3. k measured from maximum BD.
4. Outline in this zone is not controlled.
5. BD1 shall not vary more than .010(.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gage plane .054 + .001-.000(1.37+.03-.00 mm) below seating plane shall be within .007(.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by the gage and gaging procedure shown in figure 2.
7. Bb1 applies between L1 and L2. Bb applies between L2 and L minimum. Diameter is uncontrolled in L1 and beyond L minimum.
8. All three leads.
9. All leads electrically insulated from the case.
10. r(radius) applies to both inside corners of tab.

• FIGURE 1. Physical dimensions of transistor types 2N328A and 2N329A (TO-5).



NOTES:

1. The location of the tab locator within the limits indicated will be determined by the tab and flange dimensions of the device being checked.
2. The following gaging procedure shall be used:

The device being measured shall be inserted until its seating plane is .125(3.18 mm) $\pm$.010(.25 mm) from the seating surface of the gage. A force of 8 $\pm$.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.

The use of a pin straightener prior to insertion in the gage is permissible.

3. Gaging plane.
4. Drill angle.

FIGURE 2. Gage for lead and tab location for transistor types 2N328A and 2N329A.

TABLE I. Group A inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 1</u>							
Visual and mechanical examination	2071		10	---	---	---	---
<u>Subgroup 2</u>							
Collector to base cutoff current	3036	Bias cond. D; V _{CB} = -50 Vdc	5	I _{CBO}	---	-0.1	μAdc
Collector to emitter voltage (saturated)	3071	I _B = -2 mAdc		V _{CE(sat)}			
2N328A		I _C = -10 mAdc			---	-0.3	Vdc
2N329A		I _C = -15 mAdc			---	-0.4	Vdc
Forward-current transfer ratio	3076	V _{CE} = -0.5 Vdc; I _C = -3 mAdc		h _{FE}			
2N328A					18	44	---
2N329A					36	88	---
<u>Subgroup 3</u>							
Emitter to base cutoff current	3061	Bias cond. D; V _{EB} = -30 Vdc	5	I _{EBO}	---	-0.05	μAdc
Collector to base cutoff current	3036	Bias cond. D; V _{CB} = -30 Vdc		I _{CBO}	---	-0.03	μAdc
Breakdown voltage, collector to emitter	3011	Bias cond. D; I _C = -50 μAdc		BV _{CEO}			
2N328A					-40	---	Vdc
2N329A					-35	---	Vdc
Small-signal short-circuit forward-current transfer-ratio cutoff frequency	3301	V _{CB} = -5 Vdc I _E = 3 mAdc		f _{hfb}			
2N328A					200	---	kHz
2N329A					250	---	kHz
<u>Subgroup 4</u>							
Base emitter voltage (saturated)	3066	Test cond. A; I _C = -3 mAdc; I _B = -1 mAdc	5	V _{BE(sat)}	---	-1.0	Vdc
Base emitter voltage (saturated)	3066	Test cond. A; I _C = -10 mAdc; I _B = -2 mAdc		V _{BE(sat)}	---	-1.5	Vdc
Forward-current transfer ratio	3076	V _{CE} = -1.5 Vdc; I _B = -1 mAdc		h _{FE}			
2N328A					9	36	---
2N329A					15	72	---
Open circuit output capacitance	3236	V _{CB} = -6 Vdc; I _E = 0; 100 kHz ≤ f ≤ 1 MHz		C _{obo}	---	110	pF

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
• <u>Subgroup 5</u>			10				
High-temperature operation:		$T_A = +125^\circ\text{C}$					
Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -30\text{ Vdc}$		I_{CBO}	---	-10	μAde
Low-temperature operation:		$T_A = -65^\circ\text{C}$					
Forward-current transfer ratio	3076	$V_{CE} = -0.5\text{ Vdc};$ $I_C = -3\text{ mAde}$		h_{FE}			
2N328A					9	---	---
2N329A					18	---	---

TABLE II. Group B inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 1</u>			20				
Physical dimensions	2066	See figure 1		---	---	---	---
• <u>Subgroup 2</u>			15				
Solderability	2026			---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. C		---	---	---	---
Thermal shock (glass strain)	1056	Test condition A		---	---	---	---
Hermetic seal	1071	Test cond. G or H for fine leaks; test cond. A, C, D, or F for gross leaks		---	---	1×10^{-7}	atm cc/s
Moisture resistance	1031	Omit initial conditioning		---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -30\text{ Vdc}$		I_{CBO}	---	-0.03	μAde
Forward-current transfer ratio	3076	$V_{CE} = -0.5\text{ Vdc};$ $I_C = -3\text{ mAde}$		h_{FE}			
2N328A					18	44	---
2N329A					36	88	---
• <u>Subgroup 3</u>			15				
Shock	2016	Nonoperating; 1,500 G. for 0.5 ms, 5 blows in each orientation: X_1 , Y_1 , Y_2 , and Z_1		---	---	---	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 3 - Continued</u>							
Vibration, variable frequency	2056	Nonoperating	20	---	---	---	---
Constant acceleration	2006	20,000 G; in each orientation: X ₁ , Y ₁ , Y ₂ , and Z ₁		---	---	---	---
End points: (Same as subgroup 2)							
<u>Subgroup 4</u>							
Terminal strength (lead fatigue)	2036	Test condition E	20	---	---	---	---
End points:							
Hermetic seal	1071	Test cond. G or H for fine leaks; test cond. A, C, D, or F for gross leaks	20	---	---	1x10 ⁻⁷	atm cc/s
<u>Subgroup 5</u>							
Salt atmosphere (corrosion)	1041		10	---	---	---	---
<u>Subgroup 6</u>							
High-temperature life (nonoperating)	1032	Tstg = +200°C (see 4.3.4)	10	---	---	---	---
End points:							
Collector to base cutoff	3036	Bias condition D; V _{CB} = -30 Vdc		I _{CBO}	---	-.06	μAdc
Forward-current transfer ratio	3076	V _{CE} = -0.5 Vdc; I _C = -3 mAdc	10	h _{FE}			
2N328A					14	52	---
2N329A					28	104	---
<u>Subgroup 7</u>							
Steady-state operation life	1027	P _T = 400 mW; V _{CB} = -20 Vdc (see 4.3.4)	10	---	---	---	---
End points: (Same as subgroup 6)							

TABLE III. Group C inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 1</u>			20				
Thermal resistance	3151			θ_{J-A}	---	0.44	°C/mW

TABLE III. Group C inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
* <u>Subgroup 2</u> Resistance to solvents	---	MIL-STD-202, Method 215 (see 4.4.1)	10	---	---	---	---
* <u>Subgroup 3</u> High-temperature life (nonoperating) End points: (Same as subgroup 6 of group B)	1031	T _{stg} = +200°C (see 4.3.4)	$\lambda = 10$	---	---	---	---
* <u>Subgroup 4</u> Steady-state operation life End points: (Same as subgroup 6 of group B)	1026	P _T = 400 mW; V _{CB} = -20 Vdc; (see 4.3.4)	$\lambda = 10$	---	---	---	---

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 group 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 tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.

- * 4.3.4 Group B and group C life-test samples. Samples that have been subjected to group B, 340-hour life-test, may be continued on test to 1,000 hours in order to satisfy group C life-test requirements. These samples shall be predesignated, and shall remain subjected to the group C 1,000-hour acceptance evaluation after they have passed the group B, 340-hour acceptance criteria. The cumulative total of failures found during 340-hour test and during the subsequent interval up to 1,000 hours shall be computed for 1,000-hour acceptance criteria, see 4.3.3.

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

- 4.4.1 Resistance to solvents. Transistors shall be subjected to tests in accordance with method 215 of MIL-STD-202. The following details shall apply:

- (a) All areas of the transistor body where marking has been applied shall be brushed.
- (b) After subjection to the tests, there shall be no evidence of mechanical damage to the device and markings shall have remained legible.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery. Preparation for delivery shall be in accordance with MIL-S-19500.

6. NOTES

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

- 6.2 Ordering data.

- (a) Lead finish if other than gold-plated (see 3.3.1).
- (b) Selectivity of lead material (see 3.3.1.1).

- 6.3 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modification, corrections, deletions) 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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