

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER
 TYPES 2N1047A, 2N1048A, 2N1049A AND 2N1050A

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 NPN, power, silicon transistors.

1.2 Physical dimensions. See figure 1 (TO-57).

1.3 Maximum ratings.

P _T 1/ T _C = 25° C	P _T 2/ T _A = 25° C	VEBO	V _{CEO}		I _C	T _{stg} and T _{op}
			2N1047A 2N1049A	2N1048A 2N1050A		
<u>W</u>	<u>W</u>	<u>Vdc</u>	<u>Vdc</u>	<u>Vdc</u>	<u>mAdc</u>	<u>° C</u>
40	1	10	80	120	500	-65 to +200

1/ Derate linearly 228 mW/° C for T_C > 25° C.

2/ Derate linearly 5.7 mW/° C for T_A > 25° C.

1.4 Primary electrical characteristics.

	h _{FE}		h _{fe}	V _{CE(sat)}
	2N1047A 2N1048A V _{CE} = 10 Vdc I _C = 50 mAdc and I _C = 500 mAdc	2N1049A 2N1050A V _{CE} = 10 Vdc I _C = 50 mAdc and I _C = 500 mAdc		
			V _{CE} = 30 Vdc I _C = 30 mAdc f = 1 MHz	I _C = 500 mAdc I _B = 100 mAdc
Min	12	30	4	<u>Vdc</u> ---
Max	36	90	40	7.5

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.

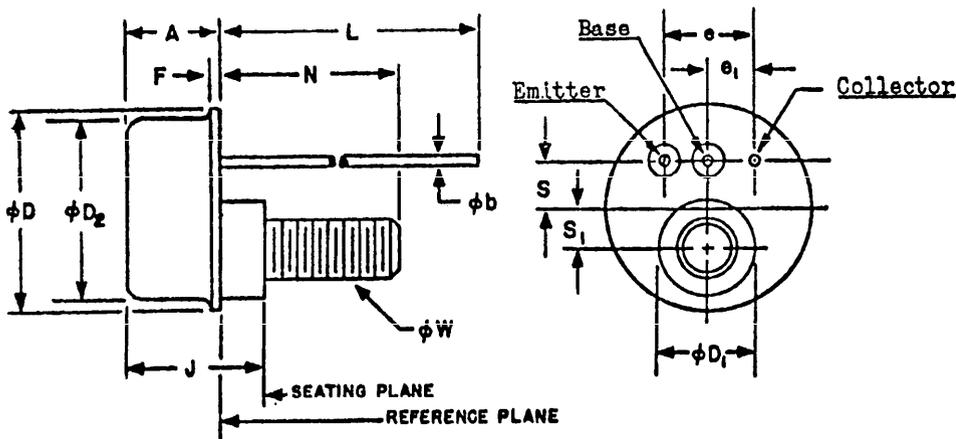
(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

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. 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, II, and III.
- 3.5 Marking. Devices shall be marked in accordance with MIL-S-19500.

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 six months during production.
 - 4.3.4 Group B and group C life-test samples. Samples that have been subjected to group B, 340-hours 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.
 - 4.3.5 Lot representative (group B and C inspections). At the option of the manufacturer, the highest voltage type represented in the lot may be used for group B and C inspections as representative of a lot containing the several types.



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	.195	.215	4.95	5.46	
ϕb	.016	.019	.407	.482	2, 5
ϕD	.440	.460	11.18	11.68	
ϕD_1	.220	.230	5.59	5.64	
ϕD_2	.400	.420	10.16	10.67	
e	.200 T. P.		5.08 T. P.		5
e1	.100 T. P.		2.54 T. P.		5
F	---	.030	---	.762	
J	.278	.318	7.06	8.08	
L	1.485	1.525	37.72	38.74	2
N	.380	.410	9.66	10.41	
S	.100 T. P.		2.54 T. P.		5
S1	.078 T. P.		1.98 T. P.		5
ϕW	.1141	.1177	2.898	2.990	3, 4

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. (Three leads). The specified lead diameter applies to the zone between .050 (1.27 mm) and .250 (6.35 mm) from the reference plane. Between .250 (6.35 mm) and end of lead, a maximum of .021 (.533 mm) is held. Outside of the zones the lead diameter is not controlled.
3. 6-32 UNC-2A maximum pitch diameter of plated threads shall be basic pitch diameter .1177 (2.99 mm).
4. Complete threads shall extend to within three threads of the seating plane and shall remain within tolerances to within two threads of tip of stud.
5. Maximum .019 (.482 mm) diameter leads and maximum .230 (5.84 mm) stud shoulder to be within .007 (.178 mm) radius of true location relative to the .460 (11.68 mm) diameter flange at a gaging plane .054 + .001 - .000 (1.37 + .025 - .000 mm), from the reference plane.
6. The collector shall be electrically connected to the case.

FIGURE 1. Physical dimensions of transistor types 2N1047A, 2N1048A, 2N1049A, and 2N1050A (TO-57).

TABLE I. Group A inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 1</u>			10				
Visual and mechanical examination	2071			---	---	---	---
<u>Subgroup 2</u>			5				
Breakdown voltage, collector to emitter	3011	Bias condition D $I_C = 30 \text{ mAdc}$ pulsed (see 4.4.1)		BV_{CEO} BV_{CEO}	80 120	---	Vdc Vdc
Breakdown voltage, collector to emitter	3011	Bias condition D $I_C = 60 \text{ mAdc}$ pulsed (see 4.4.1)		BV_{CEO} BV_{CEO}	60 100	---	Vdc Vdc
Emitter to base cutoff current	3061	Bias condition D $V_{EB} = 10 \text{ Vdc}$		I_{EBO}	---	250	μAdc
Collector to base cutoff current	3036	Bias condition D $V_{CB} = 30 \text{ Vdc}$		I_{CBO}	---	15	μAdc
Collector to base cutoff current	3036	Bias condition D $V_{CB} = 80 \text{ Vdc}$ $V_{CB} = 120 \text{ Vdc}$		I_{CBO}	---	250	μAdc
Collector to emitter cutoff current	3041	Bias condition A $V_{BE} = -1.5 \text{ Vdc}$ $V_{CE} = 80 \text{ Vdc}$ $V_{CE} = 120 \text{ Vdc}$		I_{CEX}	---	250	μAdc
<u>Subgroup 3</u>			5				
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ Vdc}$ $I_C = 500 \text{ mAdc}$ pulsed (see 4.4.1)		h_{FE} h_{FE}	12 30	36 90	---
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ Vdc}$ $I_C = 50 \text{ mAdc}$ pulsed (see 4.4.1)		h_{FE} h_{FE}	12 30	36 90	---
Collector to emitter voltage (saturated)	3071	$I_C = 500 \text{ mAdc}$ $I_B = 100 \text{ mAdc}$ pulsed (see 4.4.1)		$V_{CE(sat)}$	---	7.5	Vdc
Base emitter voltage (unsaturated)	3066	Test condition B $V_{CE} = 10 \text{ Vdc}$ $I_C = 500 \text{ mAdc}$ pulsed (see 4.4.1)		V_{BE}	---	6	Vdc
Magnitude of small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 30 \text{ Vdc}$ $I_C = 30 \text{ mAdc}$ $f = 1 \text{ MHz}$		$ h_{fe} $	4	40	---

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 4</u>			10				
High-temperature operation: Collector to base cutoff current	3036	$T_A = +150^\circ\text{C}$ Bias condition D $V_{CB} = 30\text{ Vdc}$		I_{CBO}	---	350	μAdc
Collector to emitter cutoff current	3041	Bias condition B $V_{CE} = 30\text{ Vdc}$ $R_{BE} = 1.5\text{ kilohms}$		I_{CER}	---	350	μAdc
Low-temperature operation: Forward-current transfer ratio	3076	$T_A = -65^\circ\text{C}$ $V_{CE} = 10\text{ Vdc}$ $I_C = 500\text{ mAdc}$ pulsed (see 4.4.1)					
2N1047A, 2N1048A 2N1049A, 2N1050A				h_{FE} h_{FE}	8 20	---	---

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 condition C, 10 cycles		---	---	---	---
Thermal shock (glass strain)	1056	Test condition B		---	---	---	---
Hermetic seal	1071	Test condition G or H for fine leaks; test condition A, C, D or F for gross leaks		---	---	5×10^{-7}	atm cc/s
Moisture resistance	1021			---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias condition D $V_{CB} = 30\text{ Vdc}$		I_{CBO}	---	15	μAdc
Forward-current transfer ratio	3076	$V_{CE} = 10\text{ Vdc}$ $I_C = 500\text{ mAdc}$ pulsed (see 4.4.1)					
2N1047A, 2N1048A 2N1049A, 2N1050A				h_{FE} h_{FE}	12 30	36 90	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 3</u>			15				
Shock	2016	Nonoperating; 500 G; 1 ms; 5 blows in each orientation: X ₁ , Y ₁ , Y ₂ , and Z ₁		---	---	---	---
Vibration, variable frequency	2056			---	---	---	---
Constant acceleration	2006	5000 G; in each orientation X ₁ , Y ₁ , Y ₂ and Z ₁		---	---	---	---
End points: (Same as subgroup 2)							
<u>Subgroup 4</u>			20				
Terminal strength (lead fatigue)	2036	Test condition E (for the three flexible leads only)		---	---	---	---
End points:							
Hermetic seal	1071	Test condition G or H for fine leaks; test condition A, C, D or F for gross leaks		---	---	5x10 ⁻⁷	atm cc/s
<u>Subgroup 5</u>			20				
Salt atmosphere (corrosion)	1041			---	---	---	---
<u>Subgroup 6</u>			7				
High-temperature life (nonoperating)	1032	T _{stg} = +200° C (see 4.3.4)		---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias condition D V _{CB} = 30 Vdc		ICBO	---	30	μAdc
Forward-current transfer ratio	3076	V _{CE} = 10 Vdc I _C = 500 mAdc pulsed (see 4.4.1)					
2N1047A, 2N1048A 2N1049A, 2N1050A				h _{FE} h _{FE}	9.6 24	43 108	--- ---
<u>Subgroup 7</u>			7				
Steady-state operation life	1027	+25° C < T _C ≤ +100° C V _{CE} = 40 Vdc P _T = 23W + $\frac{100^\circ \text{C} - T_C}{4.39^\circ \text{C/W}}$ (see 4.3.4)		---	---	---	---
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>			10				
Resistance to solvents	---	MIL-STD-202, Method 215 (see 4.4.2)		---	---	---	---
<u>Subgroup 2</u>			$\lambda = 10$				
High-temperature life (nonoperating)	1031	$T_{stg} = +200^{\circ} \text{C}$ (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							
<u>Subgroup 3</u>			$\lambda = 10$				
Steady-state operation life	1026	$+25^{\circ} \text{C} < T_C \leq +100^{\circ} \text{C}$ $V_{CE} = 40 V_{dc}$ $P_T = 23W + \left(\frac{100^{\circ} \text{C} - T_C}{4.39^{\circ} \text{C/W}} \right)$ (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							

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 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.4.2 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 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. THE EXTENT OF CHANGES (DELETIONS, ADDITIONS, ETC.) PRECLUDE THE ANNOTATION OF THE INDIVIDUAL CHANGES FROM THE PREVIOUS ISSUE OF THIS DOCUMENT.

MIL-S-19500/176B

Custodians:

Army - EL
Navy - EC
Air Force - 17

Review activities:

Army - MU, MI
Air Force - 11, 80
DSA - ES

User activities:

Army - SM
Navy - AS, CG, MC, SH
Air Force - 13, 15, 19

Preparing activity:
Navy - EC

Agent:
DSA - ES

(Project 5961-0260)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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