MIL-S-19500/40B
26 February 1968
SUPERSEDING
MIL-S-19500/40A
27 December 1960
(See 6.3)

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, GERMANIUM, POWER

TYPE 2N326

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, germanium, power transistor.

1.2 Physical dimensions. See figure 1 (TO-3).

1.3 Maximum ratings.

P_T 1/	V_{CBO}	V_{EBO}	V_{CES}	I_C	T_{stg}	T_J
W	Vdc	Vdc	Vdc	Adc	°C	°C
7	35	15	35	2	-65 to +85	+85

1/ Derate linearly .117 W/°C for $T_C > 25°$ C

* 1.4 Primary electrical characteristics.

Limits	h_{FE} V_{CE} = 1 Vdc I_C = 1 Adc	h_{FE} V_{CE} = 1 Vdc I_C = 0.5 Adc	V_{CE} (sat) I_C = 500 mAdc I_B = 50 mAdc	f_{hfb} V_{CB} = 10 Vdc I_C = 100 mAdc
	---	---	Vdc	MHz
Min	15	30	---	0.15
Max	60	60	0.60	4

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 this specification to the extent 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, and as follows:

V_{CES} . . . Collector to emitter voltage, with base short-circuited to emitter.

3.3 Design, construction, and physical dimensions. The transistor shall be of the design, construction, and physical dimensions specified in 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.

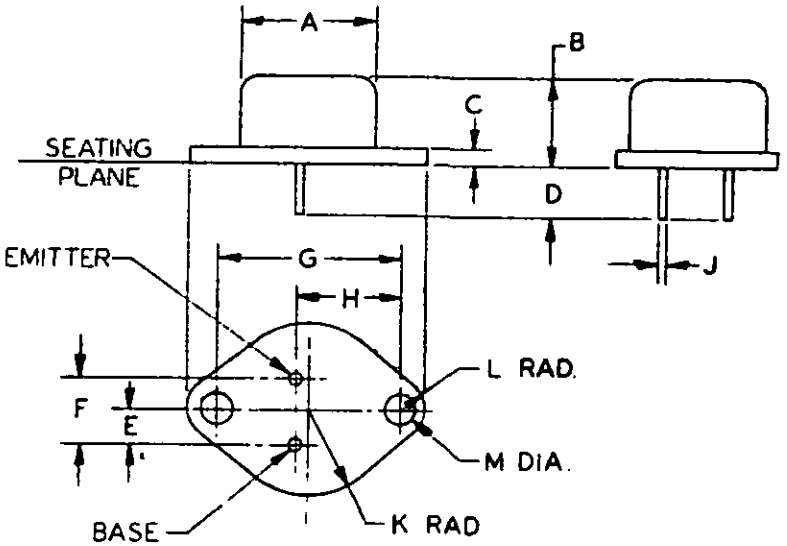
4. QUALITY ASSURANCE PROVISIONS

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 group A, B, and C inspections. When specified in the contract or order, one copy of the quality conformance inspection data, pertinent to the device inspection lot, shall be supplied with each shipment by the device manufacturer. (See 6.2.)

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



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	---	.875	---	22.23	
B	.250	.450	6.35	11.43	
C	---	.135	---	3.43	
D	.312	---	7.92	---	3
E	.205	.225	5.21	5.72	
F	.420	.440	10.67	11.18	
G	1.177	1.197	29.90	30.40	
H	.655	.675	16.64	17.15	2
J	.038	.043	.97	1.09	3
K	---	.525	---	13.34	
L	---	.188	---	4.78	
M	.151	.161	3.84	4.09	

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. This dimension should be measured at points .050 (1.27 mm) to .055 (1.40 mm) below seating plane. When gage is not used measurement will be made at seating plane.
3. Two leads.
4. Collector shall be electrically connected to the case.

FIGURE 1. Physical dimensions of transistor type 2N326 (TO-3).

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.

* 4.3.4 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 for 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.

* 4.3.5 Group C testing. The contractor shall, throughout the course of a contract or order, permit the Government representative to scrutinize all test data and findings covering manufacturer's test program on group C characteristics and parameters for the product concerned. Upon determination by the Government inspector (in advance of group C, 6-month, test results) that group C parameters are not being adequately met, the Government inspector may require lot-by-lot inspection, normally for a minimum of 3-consecutive lots, to be performed for required group C tests.

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

* 4.4.1 Time limit for end-point test measurements. End-point tests for qualification and quality conformance inspection shall be completed within 96 hours after completion of the last test in the subgroup.

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				
Breakdown voltage, collector to base	3001	Bias cond. D; I_C = 500 μAdc		BV_{CBO}	35	---	Vdc
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = 2 Vdc		I_{CBO}	---	300	μAdc
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = 35 Vdc		I_{CBO}	---	500	μAdc
Emitter to base cutoff current	3061	Bias cond. D; V_{EB} = 15 Vdc		I_{EBO}	---	500	μAdc
Collector to emitter cutoff current	3041	Bias cond. C; V_{CES} = 35 Vdc		I_{CES}	---	3	mAdc

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
* Subgroup 3			5				
Forward-current transfer ratio	3076	V_{CE} = 1 Vdc; I_C = 1 Adc		h_{FE}	15	60	---
Forward-current transfer ratio	3076	V_{CE} = 1 Vdc; I_C = 0.5 Adc		h_{FE}	30	60	---
Small-signal short-circuit forward-current transfer ratio cutoff frequency	3301	V_{CB} = 10 Vdc; I_C = 100 mAdc		f_{hfb}	0.15	4	MHz
Collector to emitter voltage (saturated)	3071	I_C = 500 mAdc; I_B = 50 mAdc		V_{CE} (sat)	---	0.60	Vdc
Base emitter voltage (nonsaturated)	3066	Test cond. B; V_{CE} = 1 Vdc; I_C = 0.5 Adc		V_{BE}	0.5	1	Vdc
Base emitter voltage (nonsaturated)	3066	Test cond. B; V_{CE} = 1 Vdc; I_C = 1 Adc		V_{BE}	0.75	1.80	Vdc

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			---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. A, except step 1 shall be at -65° C		---	---	---	---
Thermal shock (glass strain)	1056	Test cond. B		---	---	---	---
Terminal strength (tension)	2036	Test cond. A; weight = 10 lbs; time = 15 sec		---	---	---	---
Terminal strength (terminal torque)	2036	Test cond. D1; torque = 5 in-oz; time = 15 sec		---	---	---	---
Seal (leak-rate)	---	MIL-STD-202, method 112, test cond. C, procedure III; test cond. A or B for gross leaks		---	---	1×10^{-7}	atm cc/sec
Moisture resistance	1021	Omit initial conditioning		---	---	---	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
Subgroup 2 - Continued							
End points: (See 4.4.1.)							
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = 35 Vdc		I_{CBO}	---	500	μAdc
Collector to emitter cutoff current	3041	Bias cond. C; V_{CES} = 35 Vdc		I_{CES}	---	3.0	mAdc
Forward-current transfer ratio	3076	V_{CE} = 1 Vdc; I_C = 1 Adc		h_{FE}	15	60	---
* Subgroup 3			15				
Shock	2016	Nonoperating; 500 G, approx. 1.0 msec, 5 blows in each orientation: X_1, Y_1, Y_2, and Z_1		---	---	---	---
Vibration fatigue	2046	Nonoperating; 10 G		---	---	---	---
Vibration, variable frequency	2056	10 G		---	---	---	---
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				
Salt atmosphere (corrosion)	1041			---	---	---	---
End points:							
(Same as subgroup 2)							
* Subgroup 5			7				
High-temperature life (nonoperating)	1031	T_{stg} = +85° C; time = 340 hours (see 4.3.4)		---	---	---	---
End points: (See 4.4.1)							
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = 35 Vdc		I_{CBO}	---	1	mAdc
Collector to emitter cutoff current	3041	Bias cond. C; V_{CES} = 35 Vdc		I_{CES}	---	6	mAdc
Forward-current transfer ratio	3076	V_{CE} = 1 Vdc; I_C = 1 Adc		h_{FE}	10	60	---

TABLE II. Group B inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
* Subgroup 6			7				
Steady-state operation life	1026	T_A = +25° C; P_T = 1.4 W; time = 340 hours; (see 4.3.4)		---	---	---	---
End points:							
(Same as subgroup 5)							

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 = 6 mm Hg, time = 60 sec		---	---	---	---
Measurement during test:							
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = 35 Vdc		I_{CBO}	---	500	μAdc
Thermal resistance	3151			θ_{J-C}	---	8.6	°C/W
* Subgroup 2			λ = 10				
High-temperature life (nonoperating)	1031	T_{stg} = +85° C (see 4.3.4)		---	---	---	---
End points: (See 4.4.1.)							
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = 35 Vdc		I_{CBO}	---	1	mAdc
Collector to emitter cutoff current	3041	Bias cond. C; V_{CES} = 35 Vdc		I_{CES}	---	6	mAdc
Forward-current transfer ratio	3076	V_{CE} = 1 Vdc; I_C = 1 Adc		h_{FE}	10	60	---
* Subgroup 3			λ = 10				
Steady-state operation life	1026	T_A = +25° C; P_T = 1.4 W (see 4.3.4)		---	---	---	---
End points:							
(Same as subgroup 2)							

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 Ordering data. Procurement document should specify:

Inspection data (see 4.3).

6.3 Deletion of type 2N325. Type 2N325 has been deleted from this specification. This type is no longer manufactured. Information regarding a replacement type may be obtained from: Commanding General, U. S. Electronics Command, ATTN: AMSEL-PP-ED, Ft. Monmouth, N. J., 07703.

6.4 Interchangeability criteria. The device covered herein is interchangeable with the device covered by the superseded MIL-S-19500/40A.

6.5 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, 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.

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

Review activities:
Army - EL, MI
Navy - EC, SH
Air Force - 11, 17, 85
DSA - ES

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

Preparing activity:
Army - EL

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