MIL-S-19500/67A(EL)
10 October 1966
SUPERSEDING
MIL-T-19500/67(SigC)
22 January 1959

MILITARY SPECIFICATION

TRANSISTOR, PNP, GERMANIUM, 50-WATT
TYPE 2N1011

1. SCOPE

1.1 Scope.- This specification covers the detail requirements for germanium, PNP, power transistors for use in compatible equipment circuits. (See 3.4 and 6.2 herein.)

1.2 Outline and dimensions.- See Figure 1 herein.

1.3 Maximum ratings.-

P_C 1/	V_{CBO}	V_{CEO}	V_{CES}	V_{EBO}	I_E	T_{stg}	Barom. Press.
W	Vdc	Vdc	Vdc	Vdc	Adc	°C	Alt. (ft)
50	-80	-40	-80	-40	5	-65to+100	85,000

1/ At T_C = +25°C. For T_C > +25°C, derate at 0.67 W/°C.

1.4 Particular electrical characteristics.-

	f_{hfe} at: f=1 KHz V_{CE}= -2 Vdc I_C = -3 Adc	h_{FE} at: V_{CE}= -2Vdc I_C = -1Adc	h_{FE} at: V_{CE}= -2Vdc I_C = -3Adc	V_{BE}(sat) at: I_C=3Adc I_B=300mAdc	V_{CE}(sat) at: I_C=-3Adc I_B=300mAdc	I_{CBO} at: V_{CB}=-80Vdc
	KHz	---	---	Vdc	Vdc	mAdc
Min	5	---	30	---	---	---
Max	---	150	75	1.3	1.5	10

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 specified herein:

SPECIFICATIONS

MILITARY

MIL-S-19500	Semiconductor Devices, General Specification For

STANDARDS

MILITARY

MIL-STD-202	Test Methods For Electronic and Electrical Component Par
MIL-STD-750	Test Methods For Semiconductor Devices

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activit or as directed by the contracting officer. Both the title and number or symbol should be stipu ed when requesting copies.)

3. REQUIREMENTS

3.1 General.- Requirements for the transistors shall be in accordance with Specification MIL-S-19500, and as otherwise specified herein.

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

3.3 Design and construction.- The transistors shall be of the design, construction, and physical dimensions specified in Figure 1 herein.

3.3.1 Terminal arrangement.- The terminal arrangement on the transistor shall be as indicated in Figure 1 herein.

3.3.2 Operating position.- The transistors shall be capable of proper operation in any position.

3.4 Performance characteristics.- The transistor performance characteristics shall be as specified in Tables I, II, and III herein.

3.5 Marking.- Except as otherwise specified herein, marking shall be in accordance with Specification MIL-S-19500. If any specification-requirements waiver has been granted, the product-identification marking shall consist of the 'classification' type designation only. (See 4.3.5 herein.)

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- Except as otherwise specified herein, the responsibility for inspection, general procedures for acceptance, classification of inspection, and inspection conditions and methods of test shall be in accordance with Specification MIL-S-19500, Quality Assurance Provisions.

4.1.1 Procedure for lots held more than 1 year.- The requirements in Specification MIL-S-19500, paragraph 4.2, applicable to "lots held more than 6 months" shall apply, herewith, only to lots held more than 1 year.

4.2 Qualification and Quality Conformance inspection.- Qualification and Quality Conformance inspection shall be in accordance with Specification MIL-S-19500, Quality Assurance Provisions, and as otherwise specified herein (see 4.2.2 herein). Groups A, B, and C inspection shall consist of the examinations and tests specified in Tables I, II and III, respectively, herein. Quality Conformance inspection shall include inspection of Preparation for Delivery (see 5.1 herein).

4.2.1 Specified LTPD for subgroups.- The LTPD specified for a subgroup in Table I, II, and III herein shall apply for all of the tests, combined, in the subgroup.

4.2.2 Group B-Group C life test samples.- Samples that have been subjected to Group B, 250-hour life test may be continued on test for 1000 hours in order to satisfy Group C life test requirements. These samples shall be predesignated, and shall remain subjected to the Group C 1000-hour evaluation after they have passed the Group B, 250-hour acceptance criteria. The cumulative total of failures found during 250-hour test and during the subsequent interval up to 1000-hours shall be computed for 1000-hour acceptance criteria. (See 4.2.3 herein.)

4.2.3 Group C testing.- Unless otherwise specified, Group C tests shall be performed on the initial lot and thereafter on a lot every 6 months. (See Table III herein.) 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(s) 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 consective lots) to be performed for required Group C tests.

4.2.3 Disposition of sample units.- Sample units that have been subjected to Group B, Subgroup 2, and 4 tests shall not be delivered on the contract or order. Sample units that have been subjected to and have passed Group B, Subgroups 1, 3, 5, 6, and 7 tests, and all Group C tests, these tests to be considered non-destructive, may be delivered on the contract or order provided that, after Group B and C inspection is terminated, those sample units are subjected to and pass Group A inspection. Defective units from any sample group that may have passed group inspection shall not be delivered on the contract or order until the defect(s) has been remedied to the satisfaction of the Government.

4.3 Particular examination and test requirements.-

4.3.1 Interval for End-Point test measurements.- All applicable End-Point Test measurements shall be performed, after sample units have been subjected to required physical-mechanical or environmental test(s), in accordance with the following time-delay limitations:

(a) For Qualification inspection: within 24 hours.

(b) For Quality Conformance Inspection: within 96 hours.

4.3.2 Shock.- The shock testing apparatus shall be capable of providing shock pulses of the specified peak acceleration, waveform, and pulse duration to the body of the device. The acceleration pulse, as determined from the unfiltered output of a transducer with a natural frequency greater than 10,000 cycles per second, shall be a half-sine waveform with an allowable distortion not greater then ± 20 percent of the specified peak acceleration. The pulse duration shall be measured between the points at 10 percent of the peak acceleration during rise, and at 10 percent of the peak acceleration during decay. Absolute tolerance of the pulse duration shall be ± 30 percent of the specified duration.

4.3.3 Maximum Current test.- The specified current shall flow through the emitter lead of the transistor for the specified time, under the following additional conditions, and then the transistor shall meet the specified end-point tests:

(a) Base lead shall be connected electrically to the collector lead, throughout the test.

(b) A series resistor or other suitable means shall be employed to insure that the maximum current specified is not exceeded.

4.3.4 Mechanical Damage Resulting from Tests.- Except for intentionally deforming, mutilating, or dismembering mechanical-stress tests to which samples are subjected, there shall be no evidence of mechanical damage to any sample unit as a result of any of the Group A, B, and C tests.

4.3.5 Marking legibility.- Marking shall be legible before and after all tests.

Table I. Group A inspection.

Test Method per MIL-STD-750	Examination or test	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 1		15				
2071	Visual and mechanical examination	---		---	---	---	---
	Subgroup 2		10				
3036	Collector-to-base cutoff current	Bias Cond. D V_{CB}= -2 Vdc		I_{CBO}	---	-200	uAdc
3036	Collector-to-base cutoff current	Bias Cond. D V_{CB}= -80 Vdc		I_{CBO}	---	-10	mAdc
3061	Emitter-to-base cutoff current	Bias Cond. D V_{EB}= -40 Vdc		I_{EBO}	---	-3	mAdc
3076	Static forward-current transfer ratio	V_{CE}= -2 Vdc I_C = -1 Adc		h_{FE}	---	150	---
3076	Static forward-current transfer ratio	V_{CE}= -2 Vdc I_C = -3 Adc		h_{FE}	30	75	---
	Subgroup 3		10				
3011	Collector-emitter breakdown voltage	Bias Cond. D I_C= -300 mAdc		BV_{CEO}	-40	---	Vdc
3011	Collector-emitter breakdown voltage	Bias Cond. C I_C= -300 mAdc		BV_{CES}	-80	---	Vdc
3066	Base-emitter saturation voltage	Test Cond. A I_C= 3 Adc I_B = 300 mAdc		V_{BE}(sat)	---	1.3	Vdc

Table I. Group A inspection-(Cont'd).

Test Method per MIL-STD-750	Examination or test	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 3-(cont'd)						
3071	Collector-emitter saturation voltage	I_C= -3 Adc I_B= -300 mAdc		$V_{CE}(sat)$	---	1.5	Vdc
3301	Small-signal short-curcuit forward-current transfer-ratio cutoff frequency	V_{CE}= -2 Vdc I_C= -3 Adc f = 1 kHz		f_{hfe}	5	---	kHz

Table II. Group B inspection.

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 1		20				
2066	Physical dimensions	---		---	---	---	---
	Subgroup 2		15				
2026	Solderability	Omit aging		---	---	---	---
1051	Temperature cycling	Test Cond. B except T(high)= +100°C min		---	---	---	---
1056	Thermal shock (glass strain)	Test Cond. B		---	---	---	---
2036	Terminal strength (tension)	Test Cond. A Weight= 21 lbs. t= 15 sec		---	---	---	---
2/	Seal (leak rate)	Test Cond. C, procedure III; Test Cond. A for gross leaks		---	---	10^{-7}	atm cc/sec
1021	Moisture resistance	No initial conditioning		---	---	---	---
	End-point tests:						
3036	Collector-to-base cutoff current	Bias Cond. D V_{CB}= -80 Vdc		I_{CBO}	---	-10	mAdc
3076	Static forward-current transfer ratio	V_{CE}= -2 Vdc I_C = -3 Adc		h_{FE}	30	75	---

Table II. Group B inspection.-(Cont'd).

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 3		15				
2016	Shock	3/ Non-operating G = 500 5 blows of 1.0 msec ea. in orientations X1, Y1, Y2, Z1 (total = 20 blows)		---	---	---	---
2046	Vibration fatigue	Non-operating		---	---	---	---
2056	Vibration, variable frequency	---		---	---	---	---
2006	Constant acceleration (centrifuge)	G = 10,000 Orientations X1, Y1, Y2, Z1		---	---	---	---
	End-point tests: Same as listed under Subgroup 2 above						
	Subgroup 4		15				
1041	Salt atmosphere (corrosion)	---		---	---	---	---
	End-point tests: Same as listed under Subgroup 2 above						

Table II. Group B Inspection-(Cont'd).

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 5 4/		10				
5/	High-temperature operation:	T_A = +85°C, min					
3036	Collector-base cutoff current	Bias Cond. D V_{CB} = -80 Vdc		I_{CBO}	---	-20	mAdc
5/	Low-temperature operation:	T_A = -55°C					
3076	Static forward-current transfer ratio	V_{CE} = -2 Vdc I_C = -3 Adc		h_{FE}	15	---	---
	Subgroup 6		15				
1031	High-temperature life (non-operating)	T_{stg} = +100°C t= 250 hrs 6/					
	End-point tests:						
3036	Collector-base cutoff current	Bias Cond. D V_{CB} = =80 Vdc		I_{CBO}	---	-15	mAdc
3061	Emitter-base cutoff current	Bias Cond. D V_{EB} = -40 Vdc		I_{EBO}	---	-6	mAdc
3076	Static forward-current transfer ratio	V_{CE} = -2 Vdc I_C = -3 Adc		h_{FE}	23	90	---

Table II. Group B inspection-(Cont'd).

Test Method per MIL-STD-750	Examination or test 1/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 7		15				
1026	Steady state operation life	T_C= +85°C P_C= 10W V_{CB}= -20 Vdc t= 250 hrs 6/		---	---	---	---
	End-point tests: Same as listed under Subgroup 6 above						

1/ See 4.3.1 herein.

2/ Per Method 112 in Standard MIL-STD-202.

3/ See 4.3.2 herein.

4/ For this Subgroup, the sample units subjected to the High-Temperature Operation test shall be permitted to return to and be stabilized at room ambient temperature prior to their subjection to the Low-Temperature Operation test.

5/ Measurement(s) shall be made after thermal equilibrium has been reached at the temperature specified.

6/ See 4.2.2 herein.

Table III. Group C inspection. 1/

Test Method per MIL-STD-750	Examination or test 2/	Conditions	LTPD	Symbol	Limits Min	Limits Max	U
	Subgroup 1		20				
1001	Barometric pressure, reduced (altitude operation):	Pressure = 15.0 mmHg Normal mounting t = 1 minute, minimum		---	---	---	-
3036	*Measurement during test:* Collector-to-base cutoff current	Bias Cond. D V_{CB}= -80 Vdc		I_{CBO}	---	-10	m
3151	Thermal resistance (junction-to-case)	---		Θ_{J-C}	---	1.5	°(
3/	Maximum current	I_E= 5 Adc T_C= +71°C, max t= 1 hr.		---	---	---	-
	End-point tests:						
3036	Collector-to-base cutoff current	Bias Cond. D V_{CB}= -80 Vdc		I_{CBO}	---	-10	m
3076	Static forward-current transfer ratio	V_{CE}= -2 Vdc I_C = -3 Adc		h_{FE}	30	75	-
	Subgroup 2		λ=15				
1031	High-temperature life (non-operating)	T_{stg}= +100°C t = 1000 hrs 4/		---	---	---	-

Table III. Group C inspection. 1/ -(Cont'd).

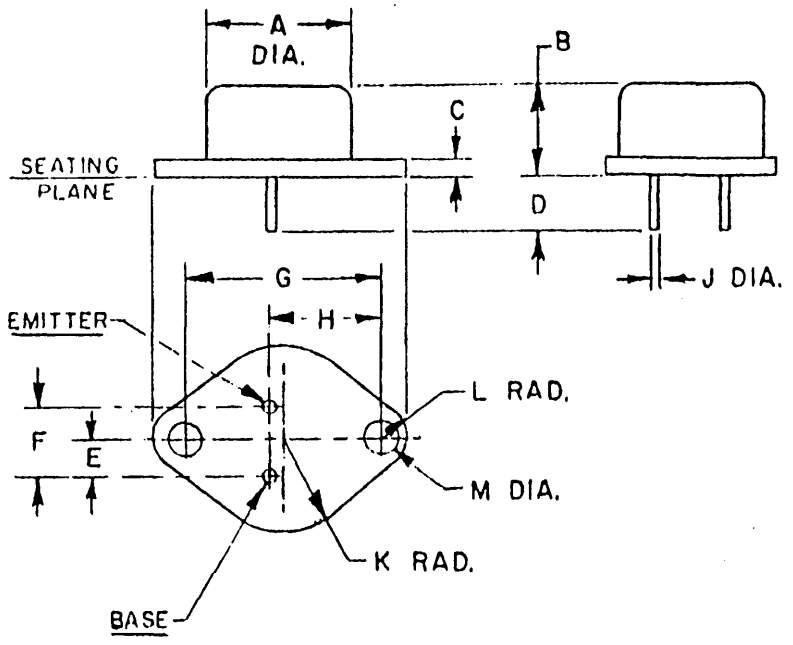
Test Method per MIL-STD-750	Examination or test 2/	Conditions	LTPD	Symbol	Limits Min	Limits Max	Unit
	Subgroup 2 -(Cont'd)						
	End-point tests:						
3036	Collector-base cutoff current	Bias Cond. D V_{CB} = -80 Vdc		I_{CBO}	---	-15	mAdc
3061	Emitter-base cutoff current	Bias Cond. D V_{EB} = -40 Vdc		I_{EBO}	---	-6	mAdc
3076	Static forward-current transfer ratio	V_{CE} = -2 Vdc I_C = -3 Adc		h_{FE}	23	90	---
	Subgroup 3		λ=15				
1026	Steady-state operation life	T_C = +85°C P_C = 10 W V_{CB} = -20 Vdc t = 1000 hrs 4/		---	---	---	---
	End-point tests: Same as listed under Subgroup 2 above						

1/ Periodicity: See 4.2.3 herein

2/ See 4.3.1 herein.

3/ See 4.3.3 herein.

4/ See 4.2.2 herein.



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.

DIMENSIONS					NOTE
LTR	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	---	.875	---	22.23	
B	.250	.450	6.35	11.43	4
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	

Figure 1. Outline and dimensions.

5. PREPARATION FOR DELIVERY

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

6. NOTES

6.1 Notes.- The notes included in Specification MIL-S-19500, with the following exceptions, are applicable to this specification.

6.2 Application guidance.- The transistors conforming to requirements of this document issue are directly replaceable (having superior performance characteristics) for the transistors covered under previous issue(s) of this document; conversely, no interchangeability is assignable to (use of) transistors covered by previous issue(s) of this document as ready replacements for transistors conforming to the requirements of this document issue.

6.3 Qualification.- With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in Qualified Products List (QPL)-19500, whether or not such products have actually been so listed by that date. Information pertaining to qualification of products covered by this specification should be requested from the Commanding General, U. S. Army Electronics Command, Fort Monmouth, New Jersey 07703, Attention: AMSEL-PP-EM-2.

6.4 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.

Custodian:
Army-EL

Preparing activity:
Army-EL

Project No. 5961-A078