

MIL-S-19500/76C(NAVY)
 20 September 1967
 SUPERSEDING
 MIL-S-19500/76B(NAVY)
 15 June 1965
 (See 6.2)

MILITARY SPECIFICATION
 TRANSISTOR, PNP, GERMANIUM, POWER
 TYPES 2N1412 AND 2N1412A

1. SCOPE

1.1 Description - This specification covers the detail requirements for a germanium, PNP power transistor and is in accordance with MIL-S-19500, except as otherwise specified herein.

1.2 Physical dimensions - (See figure 1)

1.3 Maximum ratings -

P_C 1/	V_{CB}	V_{EB}	V_{CEO}		$V_{CEX(sus)}$	V_{CES}	T_J	T_{stg}
			2N1412	2N1412A	2N1412A			
$\frac{W}{70}$	Vdc -100	Vdc -60	Vdc -65	Vdc -70	Vdc -85	Vdc -80	100°C	°C -65 to +100

1/ For collector power ratings at mounting-base temperatures above +25°C and up to +100°C, derate at 0.93 W/°C.

1.4 Primary electrical characteristics -

	h_{FE}		f_{hfe}	$V_{CE(sat)}$
	$V_{CE} = -2$ Vdc $I_C = -5$ Adc	$V_{CE} = -2$ Vdc $I_C = -10$ Adc	$V_{CE} = -6$ Vdc $I_C = -5$ Adc	$I_C = -12$ Adc $I_B = -2$ Adc
Minimum	25	---	5	---
Maximum	50	22	---	0.6

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.

MIL-S-19500/76C(NAVY)

SPECIFICATIONS

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 - The transistors shall be in accordance with MIL-S-19500 and as specified herein.

3.2 Abbreviations and symbols - The abbreviations and symbols used herein are defined in MIL-S-19500 and as follows:

T_{MB} - Mounting base temperature

3.3 Design, construction and physical dimensions - The 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 4.3, 4.4 and 4.5.

3.5 Marking - The following marking specified in MIL-S-19500 may be omitted from the device:

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

4. QUALITY ASSURANCE PROVISIONS

4.1 Qualification tests - Qualification tests shall be conducted at a laboratory satisfactory to the Naval Ship Engineering Center. Qualification tests shall consist of the tests specified in 4.3, 4.4 and 4.5. (Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.1).

- 4.2 Quality conformance inspection - Quality conformance inspection shall consist of the examinations and tests specified in 4.3, 4.4 and 4.5.
- 4.3 Group A inspection - Group A inspection shall consist of the examinations and tests shown in table I.
- 4.4 Group B inspection - Group B inspection shall consist of the examinations and tests shown in table II.
- 4.4.1 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 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 acceptance evaluation after they have passed Group B, 340-hour acceptance criteria. The cumulative total of failures found during the 340-hour test and during the subsequent interval up to 1000 hours shall be computed for the 1000-hour acceptance criteria (see 4.5).
- 4.5 Group C inspection - Group C inspection shall consist of the examinations and tests shown in table III. This inspection shall be performed on the initial lot, and thereafter on a lot every 6 months or every fifth lot, whichever occurs first.
- 4.6 Inspection conditions - Unless otherwise specified herein, all inspections shall be made at a T_{MB} of $+25^{\circ} \pm 3^{\circ}C$ (measured on the mounting stud).
- 5. PREPARATION FOR DELIVERY
- 5.1 See MIL-S-19500.

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				
Emitter to base cutoff current	3061 Cond. D	$V_{EB} = -2V_{dc}$		I_{EBO}	--	-200	μA_{dc}
Emitter to base cutoff current	3061 Cond. D	$V_{EB} = -60V_{dc}$		I_{EBO}	--	-6	mA_{dc}
Collector to base cutoff current	3036 Cond. D	$V_{CB} = -2V_{dc}$		I_{CBO}	--	-200	μA_{dc}
Collector to base cutoff current	3036 Cond. D	$V_{CB} = -100V_{dc}$		I_{CBO}	--	-6	mA_{dc}
Forward-current transfer ratio	3076	$V_{CE} = -2V_{dc}$ $I_C = -5A_{dc}$		h_{FE}	25	50	--
Forward-current transfer ratio 2N1412A(only)	3076	$V_{CE} = -2V$ $I_C = -10A_{dc}$		h_{FE}	--	22	--
Forward-current transfer ratio	3076	$I_C = -15A_{dc}$ $V_{CE} = -2V$		h_{FE}	8	--	--
Nonsaturated voltage	3066 Cond. B	$V_{CE} = -2V_{dc}$ $I_C = -5A_{dc}$		V_{EB}	--	0.8	Vdc
Nonsaturated voltage 2N1412A (only)	3066 Cond. B	$V_{CE} = -2V_{dc}$ $I_C = -10A_{dc}$		V_{EB}	--	1.3	Vdc
Floating potential	3020	$V_{CB} = -100V_{dc}$ Voltmeter input resistance 10 meg min		V_{EBF}	--	0.5	Vdc
Saturation voltage	3071	$I_C = -12A_{dc}$ $I_B = -2 A_{dc}$		V_{CE} (sat)	--	0.6	Vdc
Breakdown voltage, collector to emitter 2N1412 (only)	3011 Cond. D	$I_C = -1A_{dc}$ $I_B = 0$ 500 usec minimum $I_B = 0$		BV_{CEO}	-65	--	Volts

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

Examination or Test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min.	Max.	
2N1412A (only)		$I_C = -1\text{A dc}$ pulsed: $t_p = 500\text{ usec}$ minimum $I_B = 0$		BV_{CEO}	-70	--	Vdc
2N1412A (only)	See fig. 3	$I_C = -2\text{A dc}$ $V_{EB} = -15\text{Vdc}$ $R_{EB} = 15\text{ ohms}$ $L = 10\text{mhy}$		V_{CEX} (sus)	-85	--	Vdc
Breakdown voltage, collector to emitter	3011 Cond. C	$I_C = -300\text{ mA dc}$ $V_{BE} = 0$		BV_{CES}	-80	--	Vdc
<u>Subgroup 3</u>			10				
Small-signal short-circuit forward-current transfer ratio cutoff frequency	3301	$V_{CE} = -6\text{Vdc}$ $I_C = -5\text{A dc}$ $f(\text{ref}) = 1\text{KHz}$		f_{hfe}	5	--	KHz
High-temperature operation <u>1/</u>		$T_{MB} = +71^\circ$					
Emitter-base cutoff current	3061 Cond. D	$V_{EB} = -30\text{Vdc}$		I_{EBO}	--	-6.0	mA dc
Collector-base cutoff current	3036 Cond. D	$V_{CB} = -30\text{Vdc}$		I_{CBO}	--	-6.0	mA dc

1/ Test measurement shall be made after thermal equilibrium has been reached at the temperature specified herein.

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	Figure 1					
<u>Subgroup 2</u>			15				
Solderability	2026	Omit Aging					
Thermal shock (temperature cycling)	1051 Cond. B	Except step 3, $T_{(high)} = +100^{\circ} + 3^{\circ}C$ $-0^{\circ}C$					
Thermal shock (glass strain)	1056 Cond. A						
Seal	Mil-Std-202 Method 112 Cond. C, Procedure III	Test Cond. A or B for gross leaks				1 x 10^{-7}	atm. cc/sec.
Moisture resistance	1021						
<u>Subgroup 3</u>			15				
Shock	2016	Nonoperating 500 G min. 5 blows in each orientation, X_1 , Z_1 , Y_1 , Y_2 , pulse duration = 1.0 msec					
Vibration fatigue	2046	Nonoperating					
Vibration, variable frequency	2056	10 G					
Constant acceleration	2006	2000 G					
<u>Subgroup 4</u>			15				
Terminal strength, tension	2036 Cond. A	Weight = 10 lbs. $\pm$ 1 oz. Application time = 10 sec to ea. terminal					

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

Examination or Test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min.	Max.	
Torque (terminal)	2036 Cond. D1	Torque = 24 in-oz to be applied to flat of ea. terminal for t = 30 sec. each	20				
Torque (stud)	2036 Cond. D2	Torque = 12 in lb for t = 30 sec.					
<u>Subgroup 5</u>							
Salt atmosphere (corrosion)	1041						
<u>Endpoints for subgroups 2, 3 & 5</u>			7				
Emitter to base cut-off current	3061 Cond. D	VEB = -60Vdc					
Collector to base cutoff current	3036 Cond. D	V _{CB} = -100Vdc					
<u>Subgroup 6</u>							
High-temperature life (nonoperating)	1031	T _{stg} = +100°C t = 340 hrs. (see 4.4.1)	10				
<u>Subgroup 7</u>							
Steady state operation life	1026	T _{MB} = +75°C P _C = 20W V _{CE} = 40Vdc t = 340 hrs. (see 4.4.1)					
<u>Endpoints for subgroups 6 and 7</u>							
Emitter to base cut-off current	3061 Cond. D	VEB = -60Vdc		IEBO	--	-10	mAd

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

Examination or Test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min.	Max.	
Collector to base cutoff current	3036 Cond. D	V _{CB} = -100Vdc		I _{CBO}	--	-10	mA/dc
Forward-current transfer ratio	3076	V _{CE} = -2Vdc I _C = -5A dc		h _{FE}	20	55	

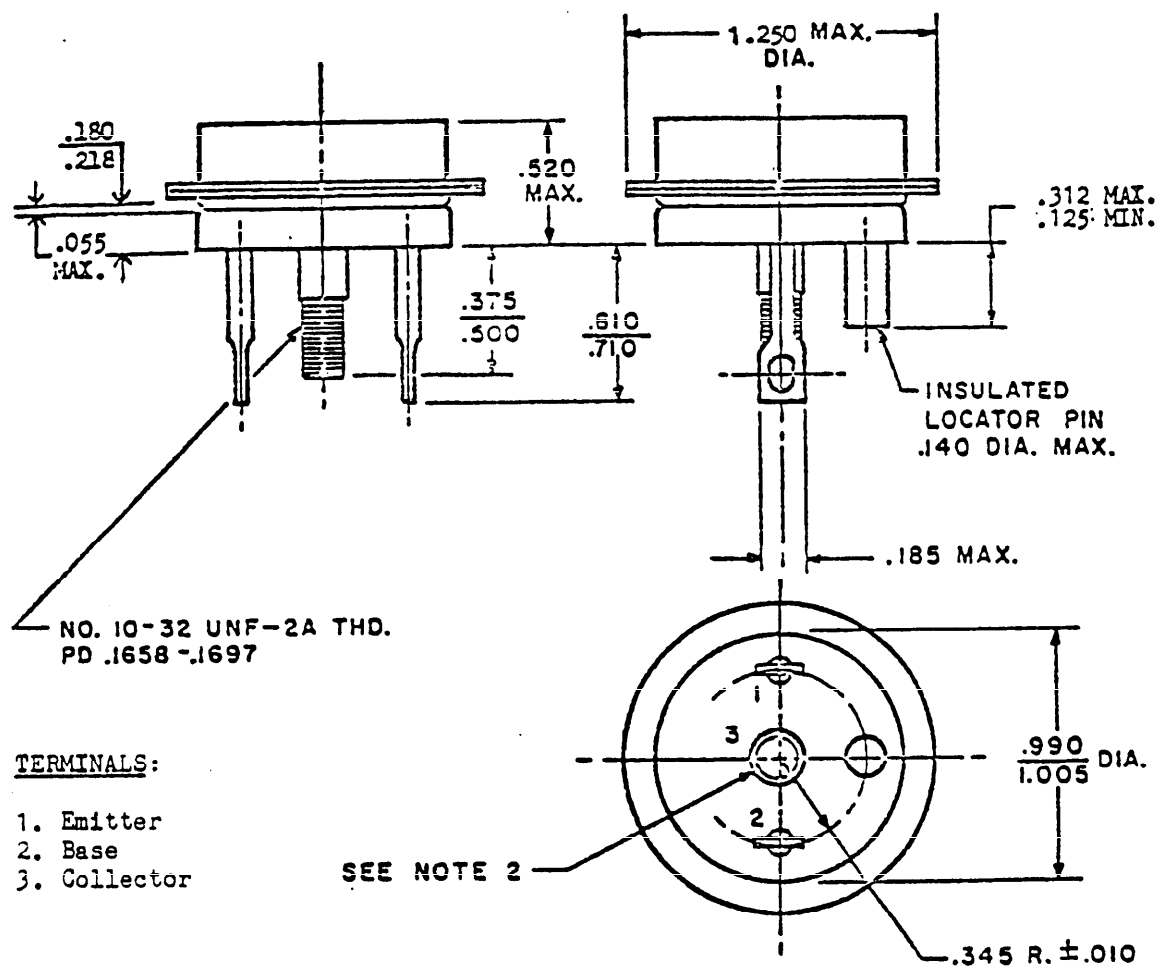
Table III - Group C Inspection

Examination or Test	Conditions		LTPD	Symbol	Limits		Unit
	Mil-Std-750 Method	Specific Conditions			Min.	Max.	
<u>Subgroup 1</u>			20				
Thermal resistance	3151			θ_{J-C}	--	1.0	°C/W
Barometric pressure, reduced (altitude operation)	1001	Pressure = 15 ± 2 mmHg t = 60 sec, min., Normal mounting					
(Monitor collector to base cutoff current)	3036 Cond. D	V _{CB} = -100Vdc		I _{CBO}	--	-6	mA/dc
Forward current transfer ratio	3076	V _{CE} = -2Vdc I _C = -5A dc Temp = -55°C		h _{FE}	15		
<u>Subgroup 2</u>			$\lambda = 10$				
High-temperature life (nonoperating)	1031	T _{stg} = +100°C					
<u>Subgroup 3</u>			$\lambda = 15$				
Steady state operation life	1026	T _{MB} = +75°C P _C = 20W V _{CE} = 40Vdc					

Table III - Group C Inspection (cont'd.).

Examination or Test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min.	Max.	
<u>Endpoints for sub-</u> <u>groups 2 and 3</u>							
Emitter to base cut-off current	3061 Cond. D	$V_{EB} = -60Vdc$		I_{EBO}	--	-10	mAdc
Collector to base cutoff current	3036 Cond. D	$V_{CB} = -100Vdc$		I_{CBO}	--	-10	mAdc
Forward-current transfer ratio	3076	$V_{CE} = -2Vdc$ $I_C = -5Adc$		h_{FE}	20	55	

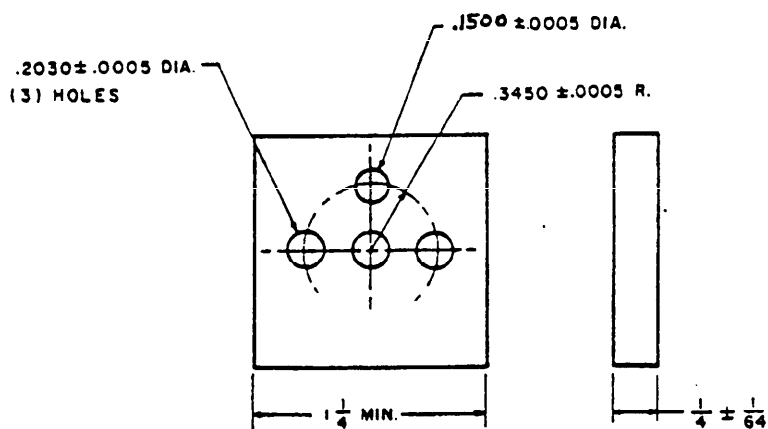
MIL-S-19500/76C(NAVY)



NOTES:

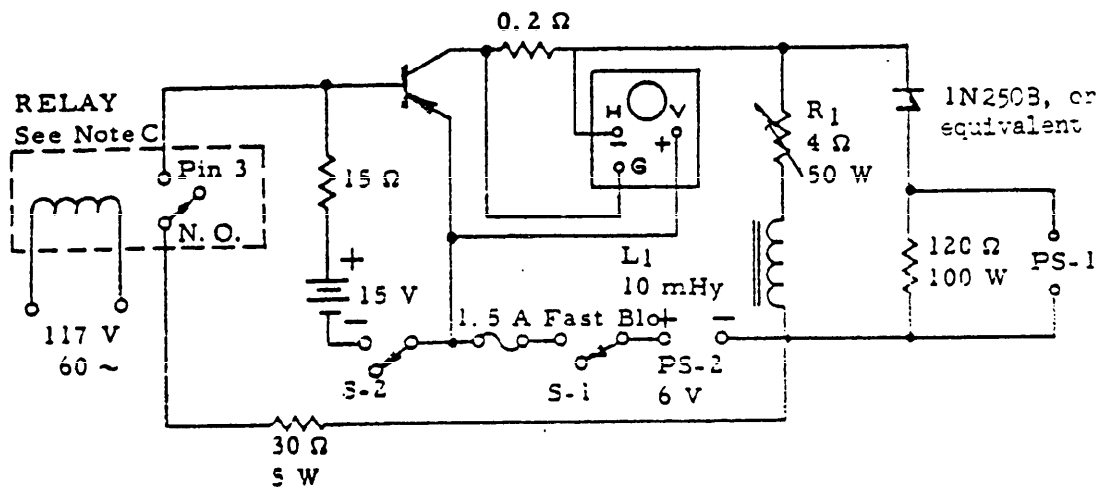
1. All dimensions in inches.
2. The collector shall be internally connected to the mounting base.
3. The gage shown on figure 2 is acceptable for use in checking base and terminals on a go, no-go basis.

Figure 1 - Physical dimensions of transistor, types 2N1412 and 2N1412A.



NOTE: ALL DIMENSIONS ARE IN INCHES

Figure 2 - Alinement gage for transistor, types 2N1412 and 2N1412A.



NOTES:

- a. The inductance of L_1 is 10 millihenries. L_1 consists of 201 turns of #16 heavy Formvar wound on a powdered iron core. The core is Arnold Engineering part number C 54228-2, or equivalent.
- b. Switch S_1 is used to eliminate arcs caused by removing the transistor from the test fixture.
- c. Mercury wetted relay - Clare HGP-2036, or equivalent, with 12K series resistor. Duty cycle = 50 ± 5 percent.

Procedure shall be as follows:

1. With all power supplies at zero insert the test transistor.
2. Zero the spot intensification of the oscilloscope in the lower left corner of the grid.
3. Engage the 117 volts to the relay.
4. Turn on PS-2 and the 15 volt reverse bias supplies. (S-1 and S-2)
5. Adjust R_1 to obtain $I_C = 2$ Amperes (observed on scope).

Figure 3 - $V_{CEX(sus)}$ test.

6. Observe the scope as the output of PS-1 is increased to the specified V_{CE} sustaining or until the displayed V_{CE} stops increasing, whichever occurs first. Do not increase V_{CE} beyond this point. The transistor has met the sustaining voltage criteria if the displayed V_{CE} reaches the specified voltage. A reject occurs when the displayed V_{CE} will not meet the specified $V_{CE}(\text{sus})$ voltage with increasing PS-1 voltage or when a device breaks down due to the lack of sustaining capability.
7. The test is completed. Return PS-1 to zero volts, open S-1 and remove the transistor.
8. Subsequent tests are performed by inserting the test device, closing S-1 and repeating Item 6. Maintain voltage and current test conditions by intermittent checks of Items 2 and 5.

Figure 3 - $V_{CEX}(\text{sus})$ test (cont'd).

6. NOTES

- 6.1 The activity responsible for the qualified products list is the Naval Ship Engineering Center, Department of the Navy, Washington, D. C. 20360, and information pertaining to qualification of products may be obtained from that activity. Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6". (Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pa. 19120.)
- 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.

Review activity:
Navy - SH

Preparing activity:
Navy - SH
(Project 5961-N120)

User activities:
Navy - AS, OS, MC, CG