

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, GERMANIUM, LOW-POWER
 TYPE 2N240

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 low-power, high-speed switching, PNP, germanium transistor.

1.2 Physical dimensions. See figure 1.

1.3 Maximum ratings.

$P_T \frac{1}{T_A = 25^\circ C}$	I_C	V_{CBO}	V_{EBO}	V_{CEO}	T_{stg}	T_J
<u>mW</u>	<u>mAdc</u>	<u>Vdc</u>	<u>Vdc</u>	<u>Vdc</u>	<u>°C</u>	<u>°C</u>
25	-15	-6.0	-6.0	-6.0	-65 to +85	+85

$\frac{1}{}$ Derate linearly 0.416 mW/°C for $T_A > 25^\circ C$.

1.4 Primary electrical characteristics.

Limits	h_{FE} $V_{CE} = -3.0 \text{ Vdc}$ $I_C = -0.5 \text{ mAdc}$	h_{fe} $V_{CE} = -3.0 \text{ Vdc}$ $I_C = -0.5 \text{ mAdc}$ $f = 5 \text{ MHz}$	$V_{CE(sat)}$ $I_C = -8.0 \text{ mAdc}$ $I_B = -2.5 \text{ mAdc}$	C_{obo} $V_{CB} = -3.0 \text{ Vdc}$ $I_E = 0$
Min	16	5	---	---
Max	100	---	-0.1	6.0

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, and as follows:

K'_s - - - - - Hole-storage constant
 $r_b'C_c$ - - - - - Collector-base time constant

3.3 Design, construction, and physical dimensions. Transistor shall be of the design, construction, and physical dimensions shown on figure 1.

3.3.1 Terminal-lead length. Terminal-lead length(s) other than that specified on figure 1 may be furnished under contract or order (see 6.2) where the devices covered herein are required directly for particular equipment-circuit installation or for automatic-assembly-technique programs. Where other lead lengths are required and provided, it shall not be construed as adversely affecting the Qualified-product status of the device, or applicable JAN marking.

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.

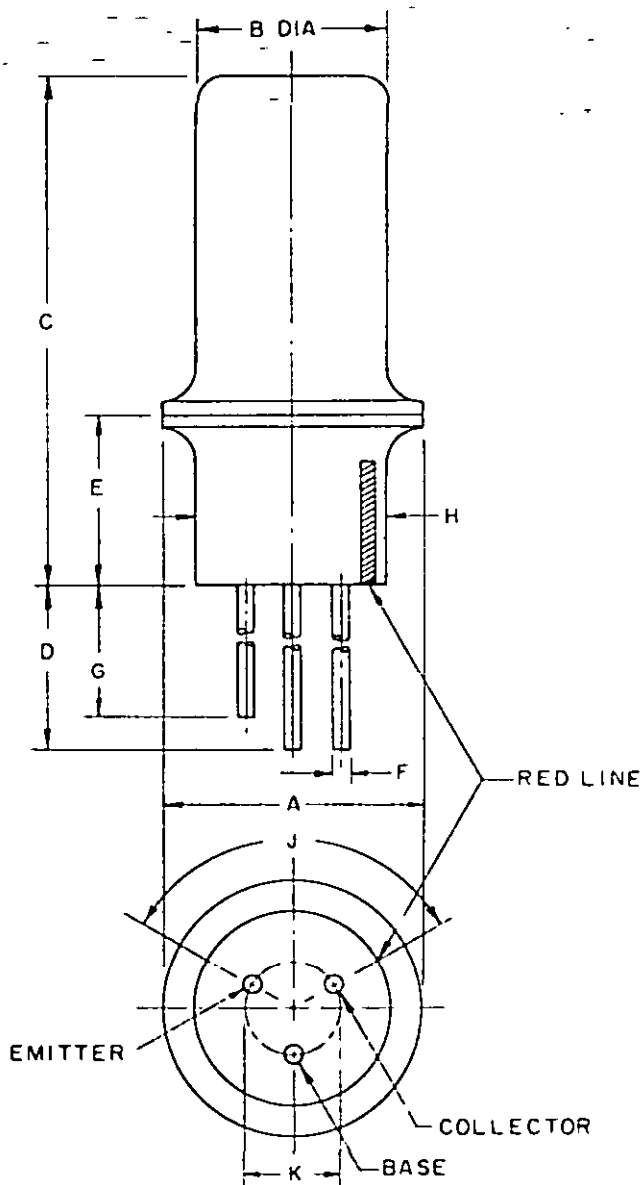
4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of groups 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 (see 6.2).

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



DIMENSIONS					NOTES
LTR	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.195	.230	4.95	5.84	
B	.155	.180	3.94	4.57	
C	.375	.475	9.53	12.07	
D	1.500	1.750	38.10	44.45	
E		.160		4.06	2
F	.016	.019	.41	.48	3,4
G	1.450	1.638	36.83	41.61	
H	.155	.180	3.94	4.57	
J	120° Nom				
K	.070 Nom		1.78 Nom		

- 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. Flange position not controlled within this range.
 - 3. All leads electrically isolated from case.
 - 4. All three leads.

FIGURE 1. Physical dimensions of transistor type 2N240.

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).

4.4 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.

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>			7				
Breakdown voltage, collector to base	3001	Bias cond. D; $I_C = -100 \mu\text{Adc}$		BV_{CBO}	-6	---	Vdc
Breakdown voltage, collector to emitter	3011	Bias cond. D; $I_C = -1.0 \text{ mAdc}$		BV_{CEO}	-6	---	Vdc
Breakdown voltage, emitter to base	3026	Bias cond. D; $I_E = -100 \mu\text{Adc}$		BV_{EBO}	-6	---	Vdc
Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -6.0 \text{ Vdc}$		I_{CBO}	---	-10	μAdc
Emitter to base cutoff current	3061	Bias cond. D; $V_{EB} = -6.0 \text{ Vdc}$		I_{EBO}	---	-10	μAdc
<u>Subgroup 3</u>			7				
Forward-current transfer ratio	3076	$V_{CE} = -3.0 \text{ Vdc}$; $I_C = -0.5 \text{ mAdc}$; pulsed (see 4.4.1)		h_{FE}	16	100	---
Collector to emitter voltage (saturated)	3071	$I_C = -2.0 \text{ mAdc}$; $I_B = -0.3 \text{ mAdc}$		$V_{CE}(\text{sat})$	---	-0.07	Vdc
Collector to emitter voltage (saturated)	3071	$I_C = -8.0 \text{ mAdc}$; $I_B = -2.5 \text{ mAdc}$		$V_{CE}(\text{sat})$	---	-0.1	Vdc
Base emitter voltage (saturated)	3066	Test cond. A; $I_C = -2.0 \text{ mAdc}$; $I_B = -0.3 \text{ mAdc}$		$V_{BE}(\text{sat})$	---	-0.5	Vdc
Base emitter voltage (saturated)	3066	Test cond. A; $I_C = -8.0 \text{ mAdc}$; $I_B = -2.5 \text{ mAdc}$		$V_{BE}(\text{sat})$	---	-1.0	Vdc

TABLE I. Group A Inspection - Continued

MIL-S-19500 25B

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 4</u>			10				
Small-signal short-circuit forward-current transfer ratio	3306	VCE = -3.0 Vdc; IC = -0.5 mA dc; f = 5 MHz		hfe	5	---	---
Open circuit output capacitance	3236	VCE = -3.0 Vdc; IE = 0		Cobo	---	6.0	pf
<u>Subgroup 5</u>			15				
Reach through voltage	---	VEB = -1 Vdc		VRT	-6	---	Vdc
Hole-storage factor	---	IB = -1 mA dc (see figure 2)		K's	---	120	nsec
Collector-base time constant	---	VCE = -3.0 Vdc; IE = -0.5 mA dc; f = 4 MHz (see figure 3)		τ ₀ C _c	---	1500	psec
<u>Subgroup 8</u>			15				
High-temperature operation:		TA = -55° C					
Collector to base cutoff current	3036	Bias cond. D; VCE = -3.0 Vdc		ICBO	---	-15	μA dc
Low-temperature operation:		TA = -55° C					
Forward-current transfer ratio	3076	VCE = -3.0 Vdc; IC = -0.5 mA dc; pulsed (see 4.4.1)		hFE	8	---	---

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. B except step 3 + 85° C		---	---	---	---
Thermal shock (glass strain)	1056	Test cond. A		---	---	---	---
Seal (leak-rate)	---	MIL-STD-202, method 112, test cond. C, procedure III; test cond. B for gross leaks		---	---	1x10 ⁻⁷	atm cc/sec
Moisture resistance	1021			---	---	---	---

TABLE B. Group B Inspection -Continued

Examination or test:	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 2 - Continued</u>							
End points:							
Collector to base cutoff current	3036	Bias cond. D: $V_{CB} = -6.0 \text{ Vdc}$		I_{CBO}	---	-10	μAdc
Collector to emitter voltage (saturated)	3071	$I_C = -8.0 \text{ mAdc}$; $I_B = -2.5 \text{ mAdc}$		$V_{CE(sat)}$	---	-0.1	Vdc
Forward-current transfer ratio	3076	$V_{CE} = -3.0 \text{ Vdc}$; $I_C = -0.5 \text{ mAdc}$; pulsed (see 4.4.1)		h_{FE}	16	100	---
<u>Subgroup 3</u>							
Shock	2016	Nonoperating: 500 G; 1.0 msec, 5 blows in each orientation: X_1 , Y_1 , Y_2 , and Z_1	15	---	---	---	---
Vibration fatigue	2046	Nonoperating: 10 G		---	---	---	---
Vibration, variable frequency	2056	10 G		---	---	---	---
Constant acceleration	2006	10,000 G; in each orienta- tion: 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 cond. E	15	---	---	---	---
<u>Subgroup 5</u>							
Salt atmosphere (corrosion)	1041		15	---	---	---	---
End points: (Same as subgroup 2)							
<u>Subgroup 6</u>							
High-temperature life (nonoperating)	1031	$T_{stg} = +85^\circ \text{C}$; $t = 340 \text{ hours}$ (see 4.3.4)	5	---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias cond. D: $V_{CB} = -6.0 \text{ Vdc}$		I_{CBO}	---	-20	μAdc
Collector to emitter voltage (saturated)	3071	$I_C = -8.0 \text{ mAdc}$; $I_B = -2.5 \text{ mAdc}$		$V_{CE(sat)}$	---	-0.1	Vdc
Forward-current transfer ratio	3076	$V_{CE} = -3.0 \text{ Vdc}$; $I_C = -0.5 \text{ mAdc}$; pulsed (see 4.4.1)		h_{FE}	12	---	---

TABLE II. Group B Inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 7</u> Steady-state operation life End points: (Same as subgroup 6)	1026	$T_A = 25^\circ\text{C}$; $P_T = 25\text{ mW}$; $V_{CB} = -2.5\text{ Vdc}$; $t = 340\text{ hours}$ (see 4.3.4)	7	---	---	---	---

TABLE III. Group C Inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 1</u> High-temperature life (nonoperating) End points: Collector to base cutoff current Collector to emitter voltage (saturated) Forward-current transfer ratio	1031	$T_{stg} = -85^\circ\text{C}$ (see 4.3.4)	$\lambda = 7$	---	---	---	---
	3036	Bias cond. D; $V_{CB} = -6.0\text{ Vdc}$		I_{CBO}	---	-20	μAde
	3071	$I_C = -8.0\text{ mAde}$; $I_B = -2.5\text{ mAde}$		$V_{CE(sat)}$	---	0.1	Vdc
	3076	$V_{CE} = -3.0\text{ Vdc}$; $I_C = -0.5\text{ mAde}$; pulsed (see 4.4.1)		h_{FE}	12	---	---
<u>Subgroup 2</u> Steady-state operation life End points: (Same as subgroup 1)	1026	$T_A = 25^\circ\text{C}$; $P_T = 25\text{ mW}$; $V_{CB} = -2.5\text{ Vdc}$ (see 4.3.4)	$\lambda = 10$	---	---	---	---

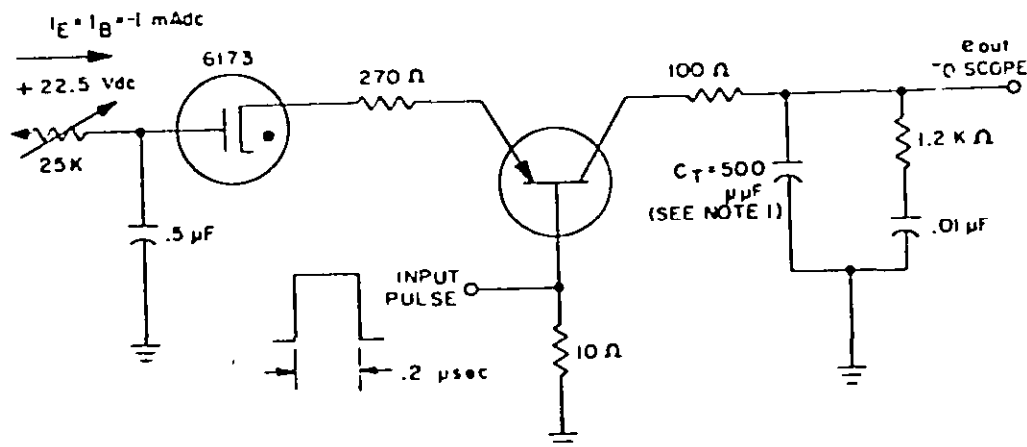
5. PREPARATION FOR DELIVERY

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.

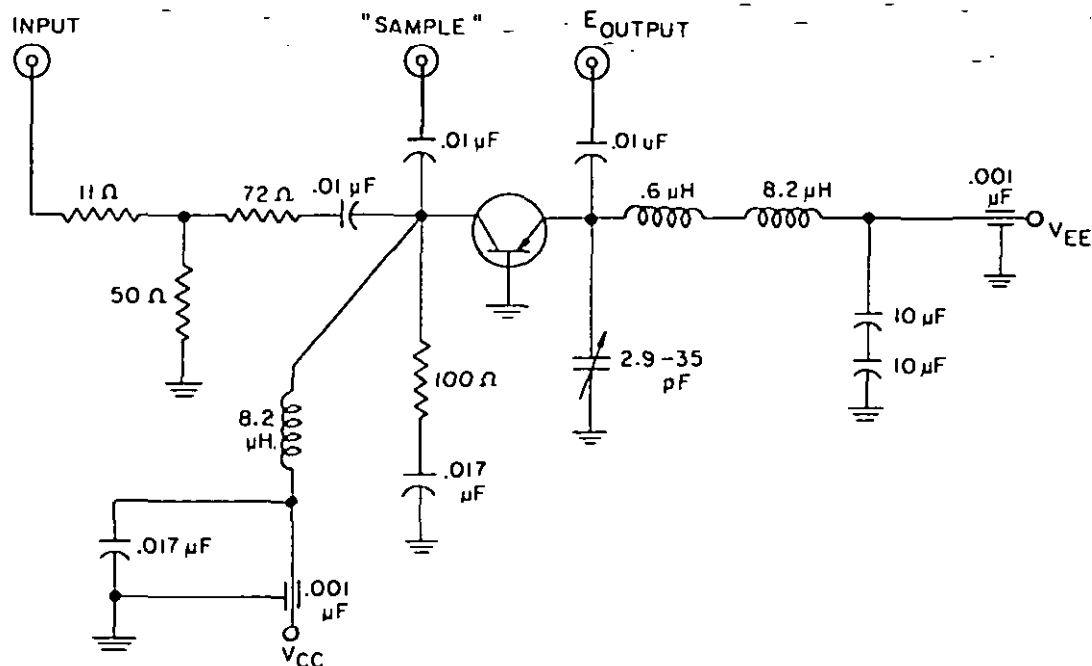
- (a) Terminal-lead length if other than specified in figure 1 (see 3.3.1).
(b) Inspection data (see 4.3).



NOTES.

1. C_T includes probe or scope capacitance. This value should be measured with the differentiating network disconnected.
2. $K's = \frac{C_T e_{out}}{I_E} = \frac{500 e_{out} \text{ uucoulombs}}{I \text{ mAdc}}$ (these units are the equivalent of musecl).
3. An equivalent circuit may be used.

FIGURE 2. Typical circuit for K's test.



PROCEDURAL NOTES:

1. Connect 4 MHz source to Input jack.
2. Connect *RFVM to Sample jack*.
3. Adjust 4 MHz level so that 1.6 V is read on RFVM.
4. Connect RFVM to Output jack; peak the emitter tuning capacitor on fixture.
5. Return RFVM to Sample jack.
6. Insert transistor into socket, apply bias, and set 4 MHz level for a 1.59 V reading on RFVM.
7. Connect RFVM to Output jack, $r_b C_c$ is read with 1 mV = 10 psec, 3 mV = 30 psec, etc, (the 1.59 Vin should be checked regularly during successive test measurements).

*RFVM = Boonton type 91CA or equiv; (high impedance); unterminated probe, Boonton type 91-6C adapter or equiv, to be used.

****Adapter BNC UG-491A/U, or equiv, to be used for connections to Input, Sample, and Output jacks.**

FIGURE 3. $r_b' C_c$ test circuit.

6.3 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.

Custodians:

Army - EL
Navy - EC
Air Force - 11

Preparing activity:

Navy - EC

(Project 5961-0008-16)

Review activities:

Army - EL, MI
Navy - SH
Air Force - 11, 17, 85
DSA - ES

User activities:

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