

MIL-S-19500/166C(NAVY)
22 June 1964
SUPERSEDING
MIL-S-19500/166B(NAVY)
20 September 1962
(See 6.2)

MILITARY SPECIFICATION
SEMICONDUCTOR DEVICE, TRANSISTOR,
TYPE 2N599

1. SCOPE

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

1.2 Mechanical dimensions and outline.- To-9 (see figure 1).

1.3 Absolute maximum ratings.-

VCB Vdc	VCES Vdc	VEB Vdc	Pt mW	T Storage °C.
-30	-20	-20	250	-65 to + 100

1.4 Primary electrical characteristics.-

	ICBO VCB = -30 Vdc	IEBO VEB = 20 Vdc	h_{fe} VCE = -5 Vdc, IE = 3 mAdc F = 4 mc	h_{FE} IC = -200 mAdc VCE = -1 Vdc	VCE IB = -0.33 mAdc IC = -10 mAdc
Min.	---	---	2.5	75	---
Max.	-25 μ Adc	-50 μ Adc	---	300	-0.2 Vdc.

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:

SPECIFICATION

MILITARY

MIL-S-19491 - Semiconductor Devices, Preparation for Delivery of.
MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARDS

MILITARY

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

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3.2 Design, construction and physical dimensions.- Transistors shall be of the design, construction and physical dimensions shown on figure 1.

3.3 Performance characteristics.- Performance characteristics shall be as specified in 4.2.2 and 4.2.3.

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

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

3.4.1 The device shall be marked with the "USN" prefix in lieu of the "JAN" prefix.

4. QUALITY ASSURANCE PROVISIONS

4.1 Qualification tests.- Qualification tests shall be conducted at a laboratory satisfactory to the Bureau of Ships. Qualification tests shall consist of the tests specified in 4.2.2 and 4.2.3. (Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification" (see 6.1).

4.2 Quality conformance inspection.- Quality conformance inspection shall consist of the examinations and tests specified in 4.2.2 and 4.2.3.

4.2.1 Group A inspection.- Group A inspection shall consist of the examinations and tests shown in table I.

4.2.2 Group B inspection.- Group B inspection shall consist of the examinations and tests shown in table II.

4.2.2.1 Destructive tests.- Tests listed in subgroups 2, 3, 4 and 6 are considered destructive.

4.2.2.2 Salt atmosphere.- The device shall be examined for destructive corrosion and illegible marking. Devices subjected to this test may be selected from the devices subjected to subgroups 1 through 5 of group B inspection.

4.2.2.3 Shock.- The shock waveform shall approximate one half-cycle of a sinewave with a rise time of $0.5 \begin{smallmatrix} +0.1 \\ -0 \end{smallmatrix}$ msec and a decay time of $0.5 \begin{smallmatrix} +0.1 \\ -0 \end{smallmatrix}$ msec. The acceleration of any secondary impacts shall not exceed 20 percent of each primary impact. The amplitude of any response waveform distortion shall not exceed 10 percent of the peak acceleration.

4.2.2.4 Subgroups 1, 2, 3, 4, 5 and 6 of group B inspection.- The initial lot shall be tested and the inspection period thereafter shall be 30 days or every fourth lot, whichever occurs first. The sample shall consist of the units selected from each lot shipped during the elapsed period, and each lot shall be represented equally in the sample.

4.2.2.5 Nonconformance.- If a sample fails subgroups 1, 2, 3, 4, 5 or 6 of Group B inspection, samples shall then be subjected to all tests in the subgroup in which failure occurred, on a lot by lot basis until three successive lots pass; then periodic inspection shall be resumed.

4.2.3 Quality conformance inspection information.- When specified in the contract or order, one copy of the quality conformance inspection information pertinent to the transistor inspection lot shall be furnished by the transistor supplier and shall accompany each transistor shipment from the inspection lot to the equipment manufacturer.

4.3 Inspection of preparation for delivery.- Sample items and packs shall be selected and inspected in accordance with MIL-S-19491 to verify conformance with requirements in section 5 of this specification.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery.- See MIL-S-19500.

6. NOTES

6.1 The activity responsible for the qualified products list is the Bureau of Ships, 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". (Copies of "Provisions Governing Qualification" may be obtained upon application to Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia 20, Pa.)

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.

Preparing activity:
Navy - Ships
(Project 5960-N468(NAVY))

Table I - Group A inspection.

Examination or test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 method	Specific conditions			Min.	Max.	
<u>Subgroup 1</u>			5				
Visual and mechanical examination	2071						
<u>Subgroup 2</u>			5				
Collector to base cutoff current	3036 Condition D	$V_{CB} = -30 \text{ Vdc}$		I_{CBO}	---	-25	$\mu\text{A dc}$
Forward-current transfer ratio	3076	$V_{CE} = -1 \text{ Vdc}$ $I_C = -200 \text{ mA dc}$		h_{FE}	75	300	---
Small-signal short circuit forward- current transfer ratio	3206	$V_{CE} = -5 \text{ Vdc}$ $I_E = 3 \text{ mA dc}$ $f = 4 \text{ mc}$		h_{fe}	2.5	---	---
<u>Subgroup 3</u>			5				
Collector to base cutoff current	3036 Condition D	$V_{CB} = -1.5 \text{ Vdc}$		I_{CBO}	---	-5	$\mu\text{A dc}$
Emitter to base cutoff current	3061 Condition D	$V_{EB} = -20 \text{ Vdc}$		I_{EBO}	---	-50	$\mu\text{A dc}$
Collector saturation voltage	3071	$I_C = -10 \text{ mA dc}$ $I_B = -0.33 \text{ mA dc}$		$V_{CE(sat)}$	---	2	Vdc
Base saturated voltage	3066 Condition A	$I_C = -10 \text{ mA dc}$ $I_B = -0.33 \text{ mA dc}$		$V_{BE(sat)}$	-0.15	-0.34	Vdc
Forward-current transfer ratio	3076	$V_{CE} = -1 \text{ Vdc}$ $I_C = -100 \text{ mA dc}$		h_{FE}	100	---	---
Collector to base cutoff current	3036 Condition D	$V_{CB} = -15 \text{ Vdc}$		I_{CBO}	---	-8	$\mu\text{A dc}$
<u>Subgroup 4</u>			5				
Collector to emitter cutoff current	3041 Condition C	$V_{CE} = -20 \text{ Vdc}$		I_{CES}	---	-250	$\mu\text{A dc}$
Output capacitance	3236	$V_{CB} = -10 \text{ Vdc}$ $f = 4 \text{ mc}$		C_{ob}	---	20	μuf
Collector saturation voltage	3071	$I_C = -200 \text{ mA dc}$ $I_B = -6.6 \text{ mA dc}$		$V_{CE(Sat)}$	---	-0.4	Vdc
Base saturated voltage	3066 Condition A	$I_C = -200 \text{ mA dc}$ $I_B = -6.6 \text{ mA dc}$		$V_{BE(Sat)}$	-0.3	-0.65	Vdc

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

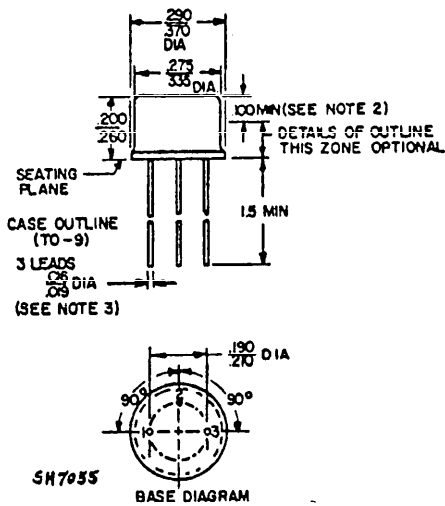
Examination or test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 method	Specific conditions			Min.	Max.	
<u>Subgroup 5</u>			5				
Rise time		(See figure 2)		t_r	----	175	µsec
Storage time		(See figure 3)		t_s	---	1000	µsec
Fall time		(See figure 3)		t_f	---	185	µsec
<u>Subgroup 6</u>			10				
High temperature operation:		$T_A = +55^\circ\text{C. min.}$					
Collector to base cutoff current	3036 Condition D	$V_{CB} = -15\text{ Vdc}$		I_{CBO}	---	-50	µAdc
Low temperature operation:		$T_A = -55^\circ\text{C. max.}$					
Forward-current transfer-ratio	3076	$V_{CE} = -1\text{ Vdc}$ $I_C = -200\text{ mAdc.}$		h_{FE}	60	---	---

Table II - Group B inspection.

Examination or test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 method	Specific conditions			Min.	Max.	
<u>Subgroup 1</u>			10				
Physical dimensions	2066						
<u>Subgroup 2</u>			10				
Solderability	2026						
Thermal shock (tem- perature cycling)	1051 Condition B	$T_{HIGH} = +95^\circ \pm 5^\circ\text{C.}$					
Thermal shock (glass strain)	1056 Condition A	$T_{HIGH} = +85^\circ\text{C. min.}$					
Moisture resistance	1021						
<u>Subgroup 3</u>			10				
Shock (see 4.2.2.3)	2016	Nonoperating 500G min., 5 blows each orientation: Y_1 , Y_2 , X_1 , and Z_1					
Vibration fatigue	2046	Nonoperating					

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

Examination or test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 method	Specific conditions			Min.	Max.	
<u>Subgroup 3 (Cont'd)</u>							
Vibration, variable frequency	2056						
Constant acceleration	2008	10,000G each orientation: Y ₁ , Y ₂ , X and Z					
<u>Subgroup 4</u>			10'				
Terminal strength	2036 Condition E						
<u>Subgroup 5</u>			10				
Barometric pressure, reduced:	1001	15 mm Hg.					
Collector to base cutoff current	3036 Condition D	V _{CB} = -30 Vdc		I _{CBO}	---	-50	uAdc
Thermal resistance	3151			θ_{J-C}	---	0.3	°C/mW
<u>Subgroup 6</u>			10				
Salt atmosphere, corrosion	1041						
<u>Subgroup 7</u>			$\lambda = 5$				
High-temperature life (nonoperating)	1031	T _A = +95°C min.					
<u>Subgroup 8</u>			$\lambda = 5$				
Steady state operation life	1026	V _{CB} = 5 Vdc P _C = 250 mW					
End points: for subgroups 2, 3, 6, 7, and 8							
Collector to base cutoff current	3036 Condition D	V _{CB} = -30 Vdc		I _{CBO}	---	35	uAdc
Forward-current transfer ratio	3076	V _{CE} = -1 Vdc I _C = -200 mAdc		h _{FE}	50	---	---



NOTES:

- 1. All dimensions in inches.
- 2. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.010.
- 3. The specified lead diameter applies in the zone between 0.050 and 0.250 from the seating-plane. Between 0.250 and 1.5, a maximum of 0.021 diameter is held. Outside of these zones, the lead diameter is not controlled.
- 4. Collector electrically connected to the case.
- 5. Lead arrangement:
 - Lead 1 Emitter
 - Lead 2 Base
 - Lead 3 Collector

Figure 1 - Outline dimensions of transistor type 2N599.

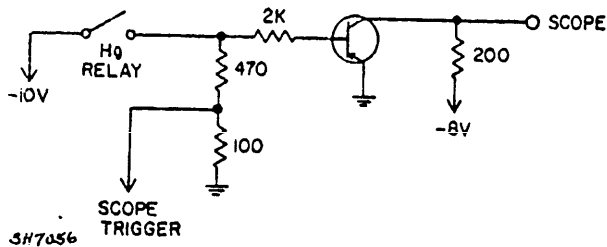


Figure 2 - Rise time circuit.

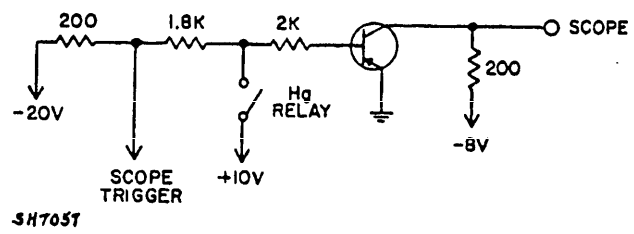


Figure 3 - Storage and fall time circuit.