MIL-S-19500/273A(NAVY)
21 March 1966
SUPERSEDING
MIL-S-19500/273(NAVY)
18 November 1963
(See 6.2)

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR TYPE

TYPE 2N744

1. SCOPE

1.1 Description. - This specification covers the detail requirements for an NPN, silicon, high-speed switching transistor and is in accordance with MIL-S-19500, except as otherwise specified herein.

1.2 Mechanical dimensions and outline. - See figure 1 (TO-18)

1.3 Absolute maximum ratings. -

P_T (mW)		T_{stg}	T_J	V_{EB} Vdc	V_{CB} Vdc	V_{CEO} Vdc	I_C mAdc
TC = 25°C 1/	T_A = 25° C 2/						
1000	300	-65° to +200°C	+175°C	5	20	15	200

1/Derate linearly 6.67 mW/°C for T_C 25°C.

2/Derate Linearly 2.0 mW/°C for T_A 25°C.

1.4 Primary electrical characteristics. -

	h_{FE}			V_{CE} (sat) at T_A = 170° ± 5°C Vdc		h_{fe} db
	V_{CE} = 0.25 Vdc I_C = 1.0 mAdc	V_{CE} = 0.35 Vdc I_C = 10 mAdc	V_{CE} = 1.0 Vdc I_C = 100 mAdc	I_C = 10 mAdc IB = 1.0 mAdc	I_C = 100 mAdc I_B = 10 mAdc	V_{CE} = 10 Vdc I_C = 10 mAdc f = 100 Mc
Min.	20	40	20	---	---	9
Max.	--	120	--	0.35	1.0	--

	V_{BE} Vdc		C_{obo} pf	rS ns	$t_s + t_f$ ns		$t_d + t_r$ ns	
	I_C = 10 mAdc I_B = 1.0 mAdc	I_C = 100 mAdc I_B = 10 mAdc	V_{CB} = 5 Vdc f = 1 Mc	I_C = 10 mAdc	I_C = 10 mAdc	I_C = 100 mAdc	I_C = 10 mAdc	I_C = 100 mAdc
Min.	0.65	---	---	--	--	--	--	--
Max.	0.85	1.5	5.0	18	24	45	16	12

FSC 5960

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.

STANDARD

MILITARY
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with 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.

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

I_{BC} . . . Forward-biased, base-collector current (d. c.), emitter open.

3.3 Design, construction and physical dimensions. - 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 4.2.1, 4.2.2 and 4.2.3.

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 Bureau of Ships. Qualification tests shall consist of the tests specified in 4.2.1, 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 4.2.1, 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 5 are considered destructive.

4.2.3 Group C inspection. - Group C inspection shall consist of the examinations and tests shown in table III. This inspection shall be conducted on the initial lot, and thereafter every 90 days (when in production) or every fifth lot, whichever occurs first.

5. PREPARATION FOR DELIVERY

5.1 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, 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.

Preparing activity:
Navy - SH
(Project 5960-N627(NAVY)

Table I - Group A inspection.

Examination or Test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 Method	Specific			Min.	Max.	
Subgroup 1 Visual and mechanical examination	2071		10	---	---	---	---
Subgroup 2 Collector-emitter cutoff current	3041	Condition C V_{CE} = 20 Vdc	5	I_{CES}	---	1.0	μAdc
Collector to base cutoff current	3036	Condition D V_{CB} = 20 Vdc		I_{CBO}	---	0.5	μAdc
Emitter to base cutoff current	3061	Condition D V_{EB} = 5 Vdc		I_{EBO}	---	10	μAdc
Collector to emitter breakdown voltage	3011	Condition D (Pulsed) I_C = 10 mAdc		BV_{CEO}	15	---	Vdc
Forward-current transfer ratio	3076	V_{CE} = 0.25 Vdc I_C = 1.0 mAdc		h_{FE}	20	---	---
Forward-current transfer ratio	3076	V_{CE} = 0.35 Vdc I_C = 10 mAdc		h_{FE}	40	120	---
Forward-current transfer ratio	3076	(Pulsed) V_{CE} = 1.0 Vdc I_C = 100 mAdc		h_{FE}	20	---	---
Base-emitter voltage	3066	Condition A I_C = 10 mAdc I_B = 0.5 mAdc		V_{BE}	0.65	0.85	Vdc
Base-emitter voltage	3066	Condition A (Pulsed) I_C = 100 mAdc I_B = 10 mAdc		V_{BE}	---	1.5	Vdc
Subgroup 3 Small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 10 Vdc I_C = 10 mAdc f = 100 Mc	10	h_{fe}	9	---	db
Open-circuit output capacitance	3236	V_{CB} = 5 Vdc f = 1Mc		C_{obo}	---	5	pf
Collector to emitter cutoff current	3041	Condition C V_{CE} = 20 Vdc T_A = 170° ± 5°C		I_{CES}	---	100	μAdc

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

Examination or Test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 Method	Specific			Min.	Max.	
Subgroup 3 (cont'd.)							
Collector to emitter cutoff current	3041	Condition A V_{CE} = 10 Vdc V_{BE} = 0.35 Vdc T_A = 100° ± 3°C		I_{CEX}	---	30	μAdc
Collector to emitter voltage (saturated)	3071	I_C = 10 mAdc I_B = 1.0 mAdc T_A = 170° ± 5°C		V_{CE} (sat)	---	0.35	Vdc
Collector to emitter voltage (saturated)	3071	(Pulsed) I_C = 100 mAdc I_B = 10 mAdc T_A = 170° ± 5°C		V_{CE} (sat)	---	1.0	Vdc
Forward-current transfer ratio	3076	V_{CE} = 0.35 Vdc I_C = 10 mAdc T_A = -55° ± 5°C		h_{FE}	20	---	---
Base-emitter voltage	3066	Condition A I_C = 10 mAdc I_B = 1.0 mAdc T_A = -55° ± 5°C		V_{BE}	---	1.1	Vdc
Base-emitter voltage	3066	Condition A (Pulsed) I_C = 100 mAdc I_B = 10 mAdc T_A = -55° ± 5°C		V_{BE}	---	1.6	Vdc
Subgroup 4							
Pulse response	3251	Condition B I_C = 10 mAdc V_{CC} = 2.7 Vdc R_C = 250 Ω R_B = 1.65 K Ω V_2 = 1.5 Vdc V_1 = +6.0 Vdc	10	$t_d + t_r$ $t_s + t_f$	--- ---	16 24	ns ns

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

Examination or Test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 Method	Specific			Min.	Max.	
Subgroup 4 (cont'd.)							
Pulse response		I_C = 100 mAdc V_{CC} = 6 Vdc R_C = 50 Ω R_B = 165 Ω V_2 = 2.35 Vdc V_1 = 7.75 Vdc		$t_d + t_r$ $t_s + t_f$	--- ---	12 45	ns ns
Storage-time constant	3251	Condition B I_C = 10 mAdc V_{CC} = 10.35 Vdc R_C = 1.0 K Ω R_B = 500 Ω V_2 = 4.0 Vdc V_1 = 6.0 Vdc		τ_S	---	18	ns

Table II - Group B inspection.

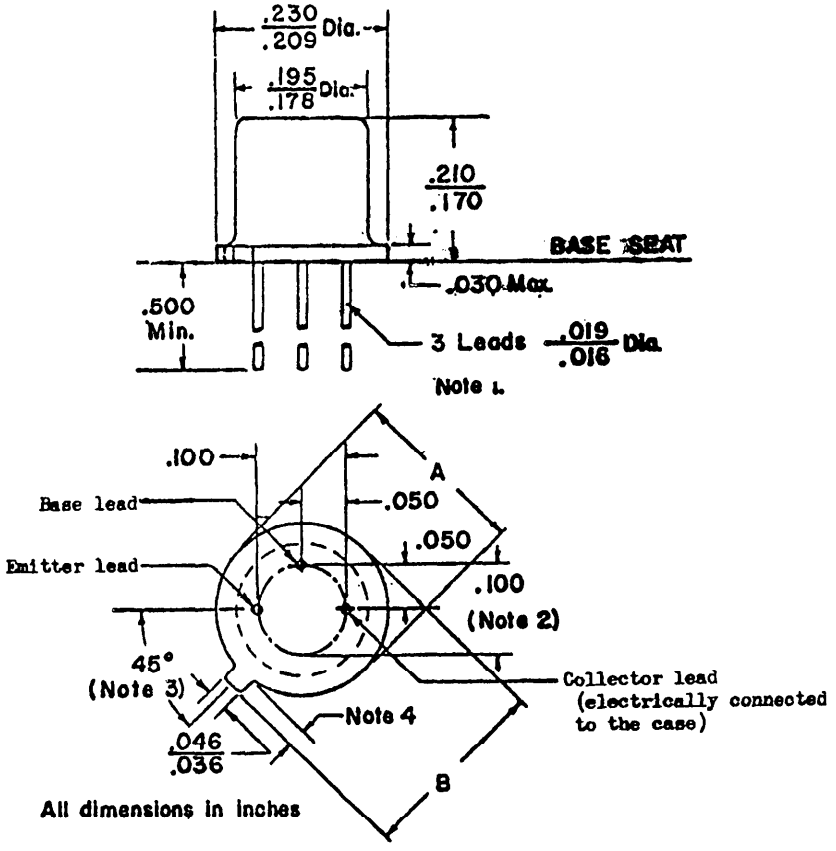
Examination or Test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 Method	Specific			Min.	Max.	
Subgroup 1							
Physical dimensions	2066	Figure 1	20				
Subgroup 2							
Solderability	2026		10				
Temperature cycling	1051	Condition C					
Thermal shock	1056	Condition A					
Moisture resistance	1021						
Subgroup 3							
Shock	2016	Nonoperating 1500 G, 0.5 msec 5 blows each orientation: X_1, Y_1, Y_2, Z_1	10				
Vibration fatigue	2046	Nonoperating					
Vibration, variable frequency	2056						
Constant acceleration	2006	20,000 G each orientation: X_1, Y_1, Y_2, Z_1					

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

Examination or Test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 Method	Specific			Min.	Max.	
Subgroup 4 Terminal strength, lead fatigue	2036	Condition E	20				
Subgroup 5 Salt atmosphere (corrosion)	1041		20				
End points for subgroups 2, 3 and 5: Collector to emitter cutoff current	3041	Condition C V_{CE} = 20 Vdc	20	I_{CES}	---	1.0	μ Adc
Forward-current transfer ratio	3076	V_{CE} = 0.35 Vdc I_C = 10 mAdc		h_{FE}	40	120	---
Subgroup 6 High temperature life (non-operating)	1031	T_A = +200°C	λ = 5				
Subgroup 7 Steady state operation life	1026	P_T = 300 mW V_{CB} = 10 Vdc	λ = 5				
End points for subgroups 6 and 7: Collector to emitter cutoff current	3041	Condition C V_{CE} = 20 Vdc		I_{CES}	---	2.0	μ Adc
Collector to emitter breakdown voltage	3011	Condition D (Pulsed) I_C = 10 mAdc		BV_{CEO}	15	---	Vdc
Change in static forward-current transfer ratio	3076	V_{CE} = 0.35 Vdc I_C = 10 mAdc		Δh_{FE}	---	±25	% of initial recorded value
Base-emitter voltage	3066	Condition A I_C = 10 mAdc I_B = 1.0 mAdc		V_{BE}	---	1.0	Vdc

Table III - Group C inspection

Examination or Test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 Method	Specific			Min.	Max.	
Subgroup 1 Burnout by pulsing	3005	Pre-pulse conditions: $I_{BC} = 0$ $I_E = 0$ $T_C = 25° \pm 3°C$ pulse conditions: $I_{BC} = 200$ mAdc $I_E = 0$ $T_C = 25° \pm 3°C$ $t_p = 30 \pm 5$ sec for 1 cycle	10				
End point: Forward-current transfer ratio	3076	$V_{CE} = 0.35$ Vdc $I_C = 10$ mAdc		h_{FE}	40	120	



Notes:

1. The specified lead diameter applies to the zone between 0.050 and 0.250 from the base seat. Between 0.250 and end of lead a maximum of 0.021 is held. Outside of these zones the lead diameter is not controlled.
2. Maximum diameter leads of a gaging plane 0.054 $^{+0.001}_{-0.000}$ below base seat to be within 0.007 of their true location relative to maximum width tab and to the maximum 0.230 diameter measured with a suitable gage. When gage is not used, measurement will be made at base seat.
3. Index tab for visual orientation only.
4. Tab length shall be 0.028 minimum, 0.048 maximum, and will be determined by subtracting diameter A from Dimension B.

Figure 1 - Mechanical dimensions and outline for transistor type 2N744.

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