

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 mA _{dc}
$T_C = 25^\circ C$ ^{1/}	$T_A = 25^\circ C$ ^{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 $T_A = 170^\circ \pm 5^\circ C$ Vdc		h_{fe} db
	$V_{CE} = 0.25$ Vdc $I_C = 1.0$ mA _{dc}	$V_{CE} = 0.35$ Vdc $I_C = 10$ mA _{dc}	$V_{CE} = 1.0$ Vdc $I_C = 100$ mA _{dc}	$I_C = 10$ mA _{dc} $I_B = 1.0$ mA _{dc}	$I_C = 100$ mA _{dc} $I_B = 10$ mA _{dc}	$V_{CE} = 10$ Vdc $I_C = 10$ mA _{dc} $f = 100$ Mc
Min.	20	40	20	---	---	9
Max.	--	120	--	0.35	1.0	--

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

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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:

IBC . . . 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.	
<u>Subgroup 1</u> Visual and mechanical examination	2071		10	---	---	---	---
<u>Subgroup 2</u> Collector-emitter cutoff current	3041	Condition C $V_{CE} = 20 \text{ Vdc}$	5	I_{CES}	---	1.0	μAdc
Collector to base cutoff current	3036	Condition D $V_{CB} = 20 \text{ Vdc}$		I_{CBO}	---	0.5	μAdc
Emitter to base cutoff current	3061	Condition D $V_{EB} = 5 \text{ Vdc}$		I_{EBO}	---	10	μAdc
Collector to emitter breakdown voltage	3011	Condition D (Pulsed) $I_C = 10 \text{ mAdc}$		BV_{CEO}	15	---	Vdc
Forward-current transfer ratio	3076	$V_{CE} = 0.25 \text{ Vdc}$ $I_C = 1.0 \text{ mAdc}$		h_{FE}	20	---	---
Forward-current transfer ratio	3076	$V_{CE} = 0.35 \text{ Vdc}$ $I_C = 10 \text{ mAdc}$		h_{FE}	40	120	---
Forward-current transfer ratio	3076	(Pulsed) $V_{CE} = 1.0 \text{ Vdc}$ $I_C = 100 \text{ mAdc}$		h_{FE}	20	---	---
Base-emitter voltage	3066	Condition A $I_C = 10 \text{ mAdc}$ $I_B = 0.5 \text{ mAdc}$		V_{BE}	0.65	0.85	Vdc
Base-emitter voltage	3066	Condition A (Pulsed) $I_C = 100 \text{ mAdc}$ $I_B = 10 \text{ mAdc}$		V_{BE}	---	1.5	Vdc
<u>Subgroup 3</u> Small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ Vdc}$ $I_C = 10 \text{ mAdc}$ $f = 100 \text{ Mc}$	10	h_{fe}	9	---	db
Open-circuit output capacitance	3236	$V_{CB} = 5 \text{ Vdc}$ $f = 1 \text{ Mc}$		C_{obo}	---	5	pf
Collector to emitter cutoff current	3041	Condition C $V_{CE} = 20 \text{ Vdc}$ $T_A = 170^\circ \pm 5^\circ\text{C}$		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.	
<u>Subgroup 3 (cont'd.)</u>							
Collector to emitter cutoff current	3041	Condition A $V_{CE} = 10 \text{ Vdc}$ $V_{BE} = 0.35 \text{ Vdc}$ $T_A = 100^\circ \pm 3^\circ\text{C}$		I_{CEX}	---	30	μAdc
Collector to emitter voltage (saturated)	3071	$I_C = 10 \text{ mAdc}$ $I_B = 1.0 \text{ mAdc}$ $T_A = 170^\circ \pm 5^\circ\text{C}$		$V_{CE}(\text{sat})$	---	0.35	Vdc
Collector to emitter voltage (saturated)	3071	(Pulsed) $I_C = 100 \text{ mAdc}$ $I_B = 10 \text{ mAdc}$ $T_A = 170^\circ \pm 5^\circ\text{C}$		$V_{CE}(\text{sat})$	---	1.0	Vdc
Forward-current transfer ratio	3076	$V_{CE} = 0.35 \text{ Vdc}$ $I_C = 10 \text{ mAdc}$ $T_A = -55^\circ \pm 5^\circ\text{C}$		h_{FE}	20	---	---
Base-emitter voltage	3066	Condition A $I_C = 10 \text{ mAdc}$ $I_B = 1.0 \text{ mAdc}$ $T_A = -55^\circ \pm 5^\circ\text{C}$		V_{BE}	---	1.1	Vdc
Base-emitter voltage	3066	Condition A (Pulsed) $I_C = 100 \text{ mAdc}$ $I_B = 10 \text{ mAdc}$ $T_A = -55^\circ \pm 5^\circ\text{C}$		V_{BE}	---	1.6	Vdc
<u>Subgroup 4</u>							
Pulse response	3251	Condition B $I_C = 10 \text{ mAdc}$ $V_{CC} = 2.7 \text{ Vdc}$ $R_C = 250 \Omega$ $R_B = 1.65 \text{ K } \Omega$ $V_2 = 1.5 \text{ Vdc}$ $V_1 = +6.0 \text{ Vdc}$	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.	
<u>Subgroup 4 (cont'd.)</u> Pulse response		$I_C = 100 \text{ mAdc}$ $V_{CC} = 6 \text{ Vdc}$ $R_C = 50 \Omega$ $R_B = 165 \Omega$ $V_2 = 2.35 \text{ Vdc}$ $V_1 = 7.75 \text{ Vdc}$		$t_d + t_r$ $t_s + t_f$	---	12 45	ns ns
Storage-time constant	3251	Condition B $I_C = 10 \text{ mAdc}$ $V_{CC} = 10.35 \text{ Vdc}$ $R_C = 1.0 \text{ K } \Omega$ $R_B = 500 \Omega$ $V_2 = 4.0 \text{ Vdc}$ $V_1 = 6.0 \text{ Vdc}$		TS	---	18	ns

Table II - Group B inspection.

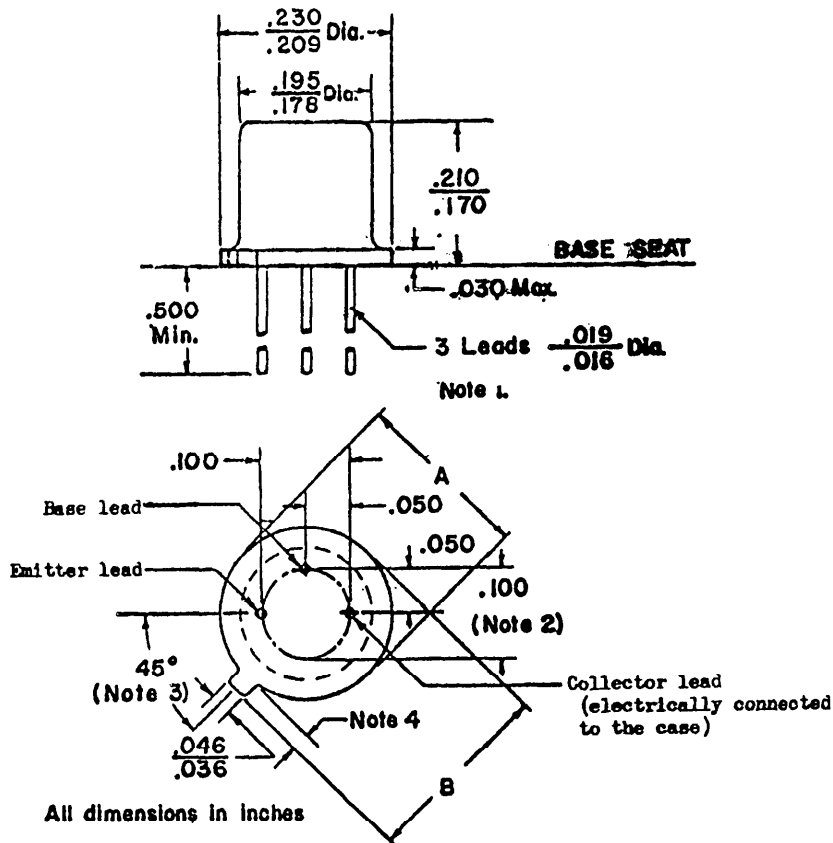
Examination or Test	Conditions		LTPD	Symbol	Limits		Unit
	MIL-STD-750 Method	Specific			Min.	Max.	
<u>Subgroup 1</u> Physical dimensions	2066	Figure 1	20				
<u>Subgroup 2</u> Solderability	2026		10				
Temperature cycling	1051	Condition C					
Thermal shock	1056	Condition A					
Moisture resistance	1021						
<u>Subgroup 3</u> Shock	2016	Nonoperat- ing 1500 G, 0.5 msec 5 blows each orientation: $X_1, Y_1, Y_2,$ Z_1	10				
Vibration fatigue	2046	Nonoperat- ing					
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.	
<u>Subgroup 4</u> Terminal strength, lead fatigue	2036	Condition E	20				
<u>Subgroup 5</u> Salt atmosphere (corrosion)	1041		20				
End points for subgroups 2, 3 and 5: Collector to emitter cutoff current	3041	Condition C $V_{CE} = 20 \text{ Vdc}$	20	I_{CES}	---	1.0	$\mu \text{ A dc}$
Forward-current transfer ratio	3076	$V_{CE} = 0.35 \text{ Vdc}$ $I_C = 10 \text{ mAdc}$		h_{FE}	40	120	---
<u>Subgroup 6</u> High temperature life (non-operating)	1031	$T_A = +200^\circ \text{C}$	$\lambda = 5$				
<u>Subgroup 7</u> Steady state operation life	1026	$P_T = 300 \text{ mW}$ $V_{CB} = 10 \text{ Vdc}$	$\lambda = 5$				
End points for subgroups 6 and 7: Collector to emitter cutoff current	3041	Condition C $V_{CE} = 20 \text{ Vdc}$		I_{CES}	---	2.0	$\mu \text{ A dc}$
Collector to emitter breakdown voltage	3011	Condition D (Pulsed) $I_C = 10 \text{ mAdc}$		BV_{CEO}	15	---	Vdc
Change in static forward-current transfer ratio	3076	$V_{CE} = 0.35 \text{ Vdc}$ $I_C = 10 \text{ mAdc}$		Δh_{FE}	---	± 25	% of initial recorded value
Base-emitter voltage	3066	Condition A $I_C = 10 \text{ mAdc}$ $I_B = 1.0 \text{ mAdc}$		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: $I_{BC} = 0$ $I_E = 0$ $T_C = 25^\circ \pm 3^\circ C$ pulse conditions: $I_{BC} = 200 \text{ mAdc}$ $I_E = 0$ $T_C = 25^\circ \pm 3^\circ C$ $t_p = 30 \pm 5 \text{ sec}$ for 1 cycle	10				
End point: Forward-current transfer ratio	3076	$V_{CE} = 0.35 \text{ Vdc}$ $I_C = 10 \text{ mAdc}$		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 $0.054 \begin{smallmatrix} +0.001 \\ -0.000 \end{smallmatrix}$ 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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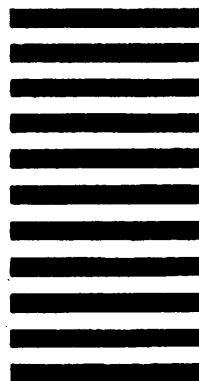
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