MIL-S-19500/31C
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SUPERSEDING
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MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, LOW-POWER TYPE 2N341

This specification is approved 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 NPN, silicon, low-power transistor.

1.2 Physical dimensions. See figure 1 (TO-11).

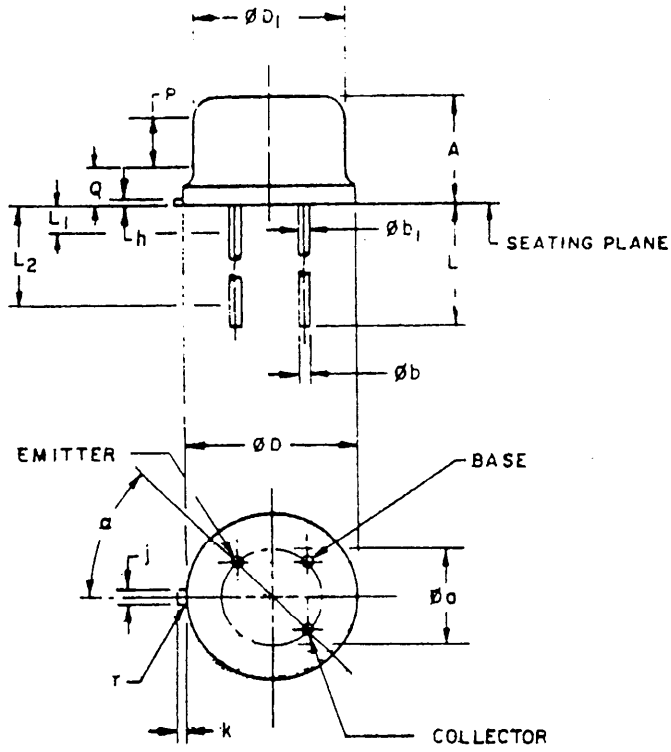
1.3 Maximum ratings.

P_T 1/ T_A = 25°C	P_T 2/ T_C = 25°C	V_{CBO}	V_{CEO}	V_{EBO}	I_C	T_{stg}
mW	mW	Vdc	Vdc	Vdc	mAdc	°C
750	1000	125	100	1	60	-65 to +150

1/ Derate linearly 6 mW/°C for T_A > 25°C.
2/ Derate linearly 8 mW/°C for T_C > 25°C.

1.4 Primary electrical characteristics.

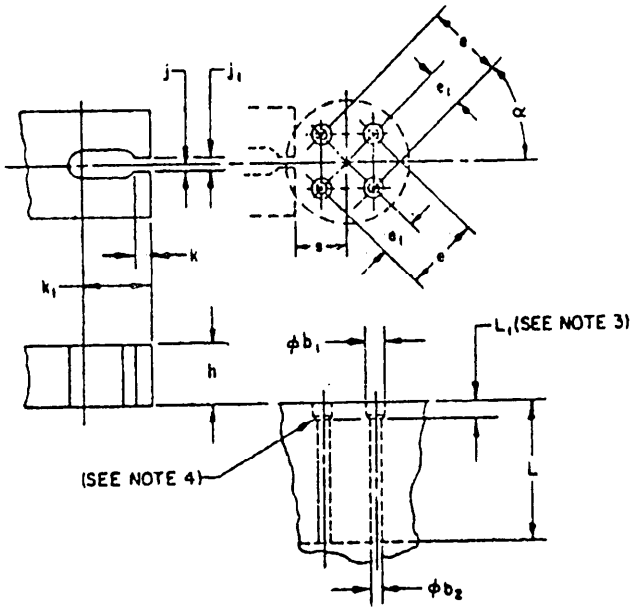
	h_{fe} I_E = -5 mAdc V_{CB} = 10 Vdc	h_{ib}	h_{ob}	h_{rb}	V_{CE}(sat) I_C = 20 mAdc I_B = 3.0 mAdc
		ohms	μmho	x10^{-6}	Vdc
Min	15	---	---	---	---
Max	60	30	2.0	300	6.0



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.360	.390	9.14	9.91	
Øa	.200 TP		5.080 TP		6
Øb	.016	.021	.41	.53	7, 8
Øb1	.016	.019	.41	.48	7, 8
ØD	.335	.370	8.51	9.40	
ØD1	.305	.335	7.75	8.51	
h	.009	.041	.23	1.04	
j	.028	.034	.71	.86	2
k	.029	.045	.74	1.14	3
L	1.500	1.750	38.10	44.45	7, 8
L1	---	.050	---	1.27	7, 8
L2	.250	---	6.35	---	7, 8
P	.200	---	5.08	---	5
Q	---	---	---	---	4
r	---	.010	---	.25	10
α	45° TP		45° TP		6

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. Beyond r(radius) maximum, j shall be held for a minimum length of .011(.28 mm).
3. k measured from maximum ØD.
4. Outline in this zone is not controlled.
5. ØD1 shall not vary more than .010(.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gage plane .054 + .001 - .000(1.37 + .03 - .00 mm) below seating plane shall be within .007(.18 mm) radius of True Position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by the gage and gaging procedure shown in figure 2.
7. Øb1 applies between L1 and L2. Øb applies between L2 and L minimum. Diameter is uncontrolled in L1 and beyond L minimum.
8. All three leads.
9. All leads electrically insulated from the case.
10. r(radius) applies to both inside corners of tab.

FIGURE 1. Physical dimensions of transistor type 2N341 (TO-11).



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
øb1	.0595	.0605	1.51	1.54	
øb2	.0325	.0335	.83	.85	
e	.1995	.2005	5.07	5.09	
e1	.0995	.1005	2.53	2.55	
h	.150 Nominal		3.81 Nominal		
j	.0175	.0180	.44	.46	
j1	.0350	.0355	.89	.90	
k	.009	.011	.23	.28	
k1	.125 Nominal		3.18 Nominal		
L	.372	.378	9.45	9.60	
L1	.054	.055	1.37	1.40	
S	.182	.199	4.62	5.05	1
α	44.90°	45.10°	44.90°	45.10°	

NOTES:
1. The location of the tab locator within the limits indicated will be determined by the tab and flange dimensions of the device being checked.
2. Gaging procedure. The device being measured shall be inserted until its seating plane is .125 ± .010 (3.18 ± .25 mm) from the seating surface of the gage. A force of 8 ± .5 oz. shall then be applied parallel and symmetrical to the device's cylindrical axis. When examined visually after the force application (the force need not be removed) the seating plane of the device shall be seated against the gage. The use of a pin straightener prior to insertion in the gage is permissible.
3. Gaging plane.
4. Drill Angle.

* FIGURE 2. Gage for lead and tab location for transistor type 2N341.

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.

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

* 3.3.1 Lead material and finish. Lead material shall be Kovar or Alloy 52. Lead finish shall be gold-plated. (Leads may be tin-coated if specified in the contract or order, and this requirement shall not be construed as adversely affecting the qualified-product status of the device, or applicable JAN marking, see 6.2.)

* 3.3.1.1 Selectivity of lead material. Where choice of lead material (see 3.3.1 above) is desired, it shall be specified in the contract or order (see 6.2).

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.

TABLE I. Group A inspection.

Examination or test	MIL-STD-750 Method	MIL-STD-750 Details	LTPD	Symbol	Limits Min	Limits Max	Unit
Subgroup 1			10				
Visual and mechanical examination	2071			---	---	---	---
Subgroup 2			5				
Breakdown voltage, collector to base	3001	Bias condition D; I_C = 50 μAdc		BV_{CBO}	125	---	Vdc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 1 mAdc		BV_{CEO}	100	---	Vdc
Breakdown voltage, emitter to base	3026	Bias condition D; I_E = 100 μAdc		BV_{EBO}	1	---	Vdc
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 30 Vdc		I_{CBO}	---	1	μAdc
Collector to emitter voltage (saturated)	3071	I_C = 20 mAdc; I_B = 3 mAdc		$V_{CE}(sat)$	---	6	Vdc
Base emitter voltage (saturated)	3066	Test condition A; I_C = 20 mAdc; I_B = 3 mAdc		$V_{BE}(sat)$	---	1	Vdc
Subgroup 3			5				
Small-signal short-circuit input impedance	3201	V_{CB} = 10 Vdc; I_E = -5 mAdc		h_{ib}	---	30	ohms
Small-signal short-circuit forward-current transfer ratio	3206	V_{CB} = 10 Vdc; I_E = -5 mAdc		h_{fe}	15	60	---
*Magnitude of small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 10 Vdc; I_E = -5 mAdc f = 1 MHz		$\lvert h_{fe} \rvert$	5	30	---
Small-signal open-circuit reverse-voltage transfer ratio	3211	V_{CB} = 10 Vdc; I_E = -5 mAdc		h_{rb}	---	300	$x10^{-6}$
Small-signal open-circuit output admittance	3216	V_{CB} = 10 Vdc; I_E = -5 mAdc		h_{ob}	---	2	μmho
*Open circuit output capacitance	3236	V_{CB} = 10 Vdc; I_E = 0 100 kHz $\leq$ f $\leq$ 1 MHz		C_{obo}	---	30	pF
Small-signal power gain	3256	V_{CE} = 67.5 Vdc; I_C = 10 mAdc (see 4.4.2)		G_{pe}	30	---	dB
Subgroup 4			10				
Low-temperature operation:		T_A = -55°C					
Small-signal short-circuit forward-current transfer ratio	3206	V_{CB} = 10 Vdc; I_E = -5 mAdc		h_{fe}	7.5	---	---

TABLE I. Group A inspection. - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 4 - Continued							
High-temperature operation:		T_A = +150°C					
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = 30 Vdc		I_{CBO}	---	100	µAdc

TABLE II. Group B inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 1			20				
Physical dimensions	2066	See figure 1.		---	---	---	---
* Subgroup 2			15				
Solderability	2026			---	---	---	---
Thermal shock (temperature cycling)	1051	Test condition F		---	---	---	---
Thermal shock (glass strain)	1056	Test condition A		---	---	---	---
Hermetic seal	1071	Test condition G or H for fine leaks; test condition A, C, D or F for gross leaks		---	---	$1x10^{-7}$	atm cc/s
Moisture resistance	1021			---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 30 Vdc		I_{CBO}	---	1	µAdc
Small-signal short-circuit forward-current transfer ratio	3206	V_{CB} = 10 Vdc; I_E = -5 mAdc		h_{fe}	15	60	---
Breakdown voltage, collector to base	3001	Bias condition D; I_C = 50 µAdc		BV_{CBO}	125	---	Vdc
* Subgroup 3			15				
Shock	2016	Nonoperating; 1500 G .5 ms; 5 blows in each orientation: X_1, Y_1, Y_2 and Z_1		---	---	---	---
Vibration, variable frequency	2056	Nonoperating		---	---	---	---
Constant acceleration	2006	20,000 G; in each orientation: X_1, Y_1, Y_2 and Z_1		---	---	---	---
End points: (Same as subgroup 2)							

TABLE II. Group B inspection. - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
* Subgroup 4			20				
Terminal strength (lead fatigue)	2036	Test condition E		---	---	---	---
End points:							
Hermetic seal	1071	Test condition G or H for fine leaks; test condition A, C, D or F for gross leaks		---	---	$1x10^{-7}$	atm cc/s
* Subgroup 5			20				
Salt atmosphere (corrosion)	1041			---	---	---	---
* Subgroup 6			7				
High-temperature life (nonoperating)	1032	T_{stg} = +150°C (see 4.3.4)		---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 30 Vdc		I_{CBO}	---	2	µAdc
Small-signal short-circuit forward-current transfer ratio	3206	V_{CB} = 10 Vdc; I_E = -5 mAdc		h_{fe}	12	---	---
Breakdown voltage, collector to base	3001	Bias condition D; I_C = 50 µAdc		BV_{CBO}	125	---	Vdc
Subgroup 7			7				
*Steady-state operation life (LTPD)	1027	P_T = 200 mW; V_{CB} = 30 Vdc; T_C = +125°C (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6)							

TABLE III. Group C inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 1			10				
*Barometric pressure, (reduced) (altitude operation)	1001	Normal mounting; pressure = 8 mmHg; for 60 sec min		---	---	---	---
Measurement during test:							
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 125 Vdc		I_{CBO}	---	50	µAdc

TABLE III. Group C inspection. - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 2			10				
Burnout by pulsing	3005	Prepulse test conditions: T_A = +25°C, I_{BC} = 0, I_E = 0 Pulse conditions: T_A = +25°C, I_{BC} = 60 mAdc, I_E = 0, t_p = 30 ±5 sec, 1 cycle		---	---	---	---
End points:							
Small-signal short-circuit forward-current transfer ratio	3206	V_{CB} = 10 Vdc; I_E = -5 mAdc		h_{fe}	15	60	---
* Subgroup 3			10				
Resistance to solvents	---	MIL-STD-202, Method 215 (see 4.4.1)		---	---	---	---
* Subgroup 4			λ=10				
Hign-temperature life (nonoperating)	1031	T_{stg} = +150°C (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							
* Subgroup 5			λ=10				
Steady-state-operation life	1026	P_T = 200 mW; V_{CB} = 30 Vdc; T_C = +125°C (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							

4.3 Quality conformance inspection. Quality conformance inspection shall consist of group A, B, and C inspections.

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.

* 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.

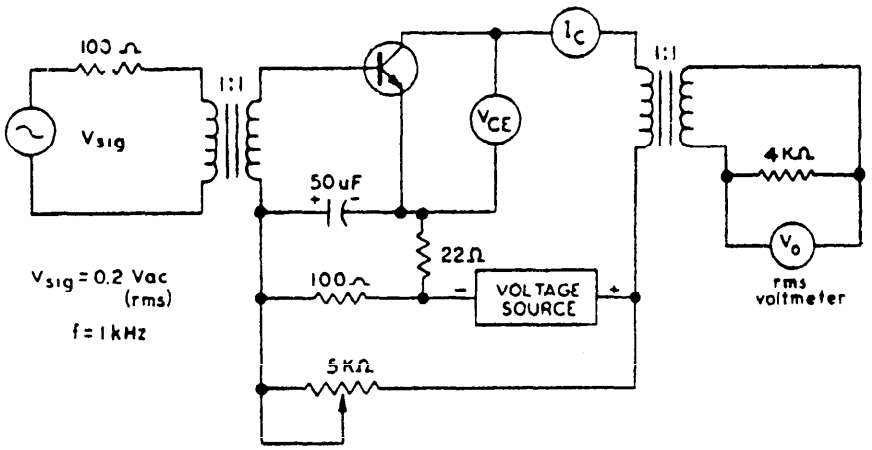
4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III, and as follows:

* 4.4.1 Resistance to solvents. Transistors shall be subjected to tests in accordance with method 215 of MIL-STD-202. The following details shall apply:

(a) All areas of the transistor body where marking has been applied shall be brushed.
(b) After subjection to the tests, there shall be no evidence of mechanical damage to the device and markings shall have remained legible.

4.4.2 Small-signal power gain. The transistor shall be operated in the circuit shown, and under the conditions specified, on figure 3. The power gain shall then be computed as follows:

$$G_{pe} = 10 \log_{10} \left[2.5(Vo)^2 \right]$$



* FIGURE 3. Small-signal power gain test circuit.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery shall be in accordance with MIL-S-19500.

6. NOTES

6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

* 6.2 Ordering data.

(a) Lead finish if other than gold-plated (see 3.3.1).
(b) Selectivity of lead material (see 3.3.1.1).

6.3 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modification, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - EL
Navy - EC
Air Force - 17

Review activities:
Army - MU, MI
Air Force - 11, 80
DSA - ES

User activities:
Army - SM
Navy - AS, CG, MC, OS, SH
Air Force - 13, 15, 19

Preparing activity:
Navy - EC

Agent:
DSA - ES

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