MIL-S-19500/80E
17 April 1972
SUPERSEDING
MIL-S-19500/80D
1 July 1965
(See 6.3)

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, LOW-POWER

TYPE 3N35

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 silicon, NPN, high-frequency, low-power tetrode transistor.

1.2 Physical dimensions. See figure 1 (TO-12).

1.3 Maximum ratings:

P_T 1/ T_A = 25°C	V_{CE}	V_{CB_1} or V_{CB_2}	V_{EB_1} or V_{EB_2}	I_E	I_{B1} or I_{B2}	T_{stg}
mW	Vdc	Vdc	Vdc	mAdc	mAdc	°C
125	30	30	1	20	5	-65 to +200

1/ Derate 0.714 mW/°C for $T_A > 25°C$.

1.4 Primary electrical characteristics at f = 70 MHz.

Limits	C_{iep}	C_{oep}	$\|h_{fe}\|$	NF	G_{pe}	r_{iep}	r_{oep}
	pF	pF		dB	dB	ohms	k ohms
Min	10	---	1.0	---	15	60	4
Max	50	3.0	2.5	14	---	240	15

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:

C_{iep} ..... Equivalent short-circuit common-emitter parallel input capacitance.

$$\text{i.e. } C_{iep} = \frac{-IM_{hie}}{2\pi f\left[(RE_{hie})2 + (IM_{hie})2\right]}$$

C_{oep} .... Equivalent short-circuit common-emitter parallel output capacitance.

i.e. $C_{oep} = IM_{yoe}/2\pi f$

IM_{hie}.... Imaginary part of the small-signal short-circuit common-emitter input impedance.

IM_{yoe} ... Imaginary part of the small-signal short-circuit common-emitter output admittance.

R_{B1B2}... Static base resistance (between base one and base two).

RE_{yoe} ... Real part of the small-signal short-circuit common-emitter output admittance.

r_{iep} ..... Equivalent short-circuit common-emitter parallel input resistance.

$$\text{i.e. } r_{iep} = RE_{hie} + \frac{(IM_{hie})\,2}{RE_{hie}}$$

r_{oep} ..... Equivalent short-circuit common-emitter parallel output resistance.

i.e. $r_{oep} = 1/RE_{yoe}$

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) is desired, it shall be specified in the contract or order (see 6.2).

3.3.2 Terminal-lead length. Terminal-lead length(s) other than that specified in figure 1 may be furnished when so stipulated in the 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.

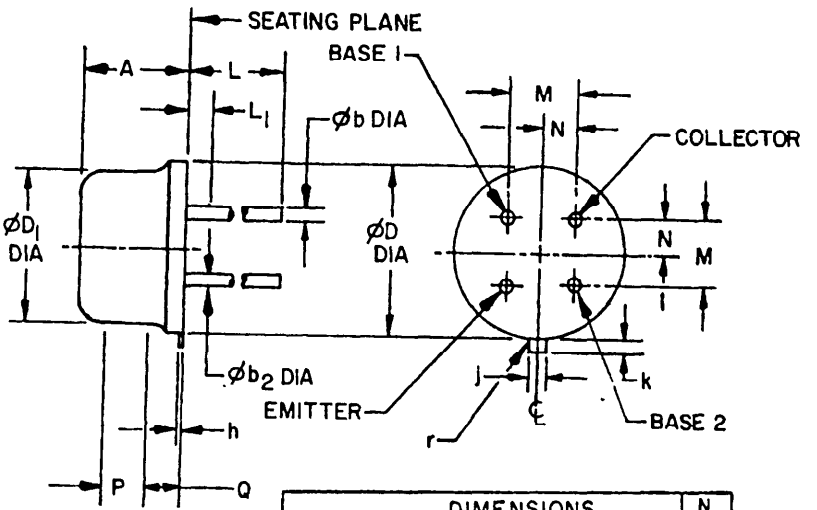
3.5 Marking. The following marking specified in MIL-S-19500 may be omitted from the body of the transistor at the option of the manufacturer:

(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.

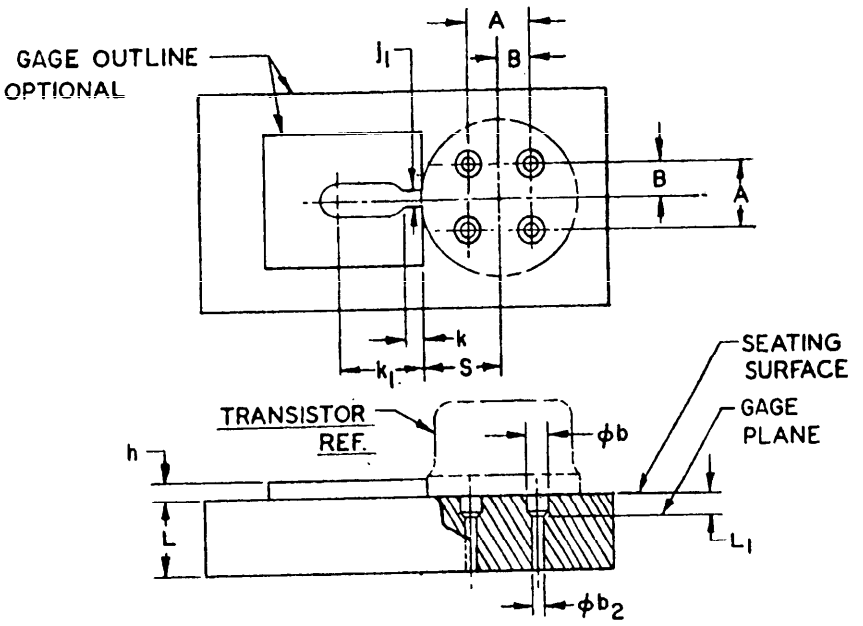
4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
øD	.335	.370	8.51	9.40	
$øD_1$	.305	.335	7.75	8.51	
A	.240	.260	6.10	6.60	
L	.500	.562	12.70	14.27	9
L_1	---	.050	---	1.27	10
øb	.016	.021	.41	.53	2, 9
$øb_2$	.016	.019	.41	.48	3, 9
P	.100	---	2.54	---	4
Q	---	.050	---	1.27	5
k	.029	.045	.74	1.14	8
j	.028	.034	.71	.86	11
h	.009	.041	.23	1.04	
M	.1414 Nom		3.59 Nom		6
N	.0707 Nom		1.80 Nom		6
r	---	.010	---	.254	

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. Measured in the zone beyond .250(6.35 mm) from the seating plane.
3. Measured in the zone .050(1.27 mm) and .250(6.35 mm) from the seating plane.
4. Variations on dimension $øD_1$ in this zone shall not exceed .010(.25 mm).
5. Outline in this zone is not controlled.
6. When measured in a gaging plane .054 + .001, -.000(1.37 + .03, -.00 mm) below the seating plane of the transistor maximum diameter leads shall be within .007(.18 mm) of their true location relative to a maximum width tab. Smaller diameter leads shall fall within the outline of the maximum diameter lead tolerance. Figure 2 preferred measured method.
7. All leads electrically insulated from the case.
8. Measured from the maximum diameter of the actual device.
9. All 4 leads. (See 3.3.1).
10. Diameter of leads in this zone is not controlled.
11. Beyond r max., j shall be held constant for a minimum length of .011(.28 mm).

FIGURE 1. Physical dimensions of transistor type 3N35 (TO-12).



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.1409	.1419	3.58	3.60	
B	.0702	.0712	1.78	1.81	
S	.182	.199	4.62	5.05	
k	.009	.011	.23	.28	
k_1	.125 Nom		3.18 Nom		
L	.372	.378	9.45	9.60	
L_1	.054	.055	1.37	1.40	
j_1	.0350	.0355	.89	.90	
h	.150 Nom		3.81 Nom		
ϕb	.0595	.0605	1.51	1.54	
$ϕb_2$	.0325	.0335	.83	.85	

NOTES:
1. The following gaging procedure shall be used: The use of a pin straightener prior to insertion in the gage is permissible. 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 spacer may be used to obtain the .125(3.18 mm) distance from the gage seat prior to force application. A force of 8 oz ±.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.
2. The location of the tab locator, within the limits of dimension S, will be determined by the tab and flange dimension of the device being checked.
3. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.

FIGURE 2. Gage for lead and tab location for transistor type 3N35.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 1			10				
Visual and mechanical examination	2071			---	---	---	---
Subgroup 2			5				
Collector to base cutoff current	3036	Bias cond. D; V_{CB_1} = 20 Vdc; I_{B_2} = 0		I_{CB_1O}	---	0.2	μAdc
Breakdown voltage, collector to base	3001	Bias cond. D; I_C = 50 μAdc; I_{B_2} = 0		BV_{CB_1O}	30	---	Vdc
Breakdown voltage, collector to emitter	3011	Bias cond. D; I_C = 1 mAdc; I_{B_1} = I_{B_2} = 0		BV_{CEO}	30	---	Vdc
Small-signal short-circuit forward-current transfer ratio	3206	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc		h_{fe}	10	40	---
Collector to emitter voltage (saturated)	3071	I_C = 5 mAdc; I_{B_1} = 1 mAdc; I_{B_2} = 0		$V_{CE}(sat)$	---	1.5	Vdc
Breakdown voltage, emitter to base	3026	Bias cond. D; I_E = 50 μAdc; I_C = 0; I_{B_2} = 0		BV_{EB_1O}	1.0	---	Vdc
Subgroup 3			20				
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc; f = 70 MHz		$\lvert h_{fe} \rvert$	1	2.5	---
Equivalent short-circuit common-emitter parallel output resistance	---	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc; f = 70 MHz		r_{oep}	4	15	k ohms
Equivalent short-circuit common-emitter parallel input resistance	3266	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc; f = 70 MHz		r_{iep}	60	240	ohms
Equivalent short-circuit common-emitter parallel input capacitance	3266	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc; f = 70 MHz		C_{iep}	10	50	pF
Small-signal power gain	3256	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc; f = 70 MHz (see 4.4.2)		G_{pe}	15	---	dB
Subgroup 4			20				
Equivalent short-circuit common-emitter parallel output capacitance	---	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc; f = 70 MHz		C_{oep}	---	3	pF

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 4 - Continued							
Noise figure	3246	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc; f = 70 MHz; R_g = 50 ohms		NF	---	14	dB
Base to base resistance	---	I_{B_1} = 0.1 mAdc; I_{B_2} = -0.1 mAdc; I_C = 0		$R_{B_1B_2}$	---	15	k ohms
Subgroup 5			20				
High-temperature operation:		T_A = 150°C		---	---	---	---
Collector to base cutoff current	3036	Bias cond. D; V_{CB_1} = 20 Vdc; I_{B_2} = 0		I_{CB_1O}	---	40	μAdc
Low-temperature operation:		T_A = -55°C		---	---	---	---
Small-signal short-circuit forward-current transfer ratio	3206	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc		h_{fe}	5	---	---

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 cond. C; 10 cycles; time at temperature extremes = 15 minutes minimum		---	---	---	---
Thermal shock (glass strain)	1056	Test condition A		---	---	---	---
Hermetic seal	1071	Test cond. G or H for fine leaks; test cond. A, C, D, or F for gross leaks		---	---	1×10^{-7}	atm cc/sec
Moisture resistance	1021			---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias cond. D; V_{CB_1} = 20 Vdc; I_{B_2} = 0		I_{CB_1O}	---	0.4	μAdc
Small-signal short-circuit forward-current transfer ratio	3206	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc		h_{fe}	10	40	---

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 3			15				
Shock	2016	Nonoperating; 1,500 G, 0.5 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)							
Subgroup 4			15				
Terminal strength (lead fatigue)	2036	Test cond. E		---	---	---	---
End points:							
Hermetic seal	1071	Test cond. G or H for fine leaks; test cond. A, C, D, or F for gross leaks		---	---	1×10^{-7}	atm cc/sec
Subgroup 5			15				
Salt atmosphere (corrosion)	1041			---	---	---	---
Subgroup 6			7				
High-temperature life (nonoperating)	1032	T_{stg} = 200°C (see 4.3.4)		---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias cond. D; V_{CB_1} = 20 Vdc; I_{B_2} = 0		I_{CB_1O}	---	1	μAdc
Small-signal short-circuit forward-current transfer ratio	3206	V_{CE} = 20 Vdc; I_E = -1.3 mAdc; I_{B_2} = -100 μAdc		h_{fe}	8	48	---
Subgroup 7			7				
Steady-state operation life	1027	T_A = +25°C; V_{CB_1} = 20 Vdc; I_{B_2} = 0; P_T = 125 mW (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				
Resistance to solvents	---	Method 215 of MIL-STD-202 (see 4.4.1)		---	---	---	---
Subgroup 2			λ = 10				
High-temperature life (nonoperating)	1031	T_{stg} = +200°C (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							
Subgroup 3			λ = 10				
Steady-state operation life	1026	T_A = +25°C; V_{CB_1} = 20 Vdc; I_{B_2} = 0; P_T = 125 mW (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							

4.3 Quality conformance inspection. Quality conformance inspection shall consist of groups 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-hour 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 Power gain. The power gain at 70 MHz and the conditions specified may be determined by computation utilizing the previously measured 70 MHz parameters and the following formula:

$$G_{pe} \text{ in dB} = 10 \log \left[\frac{|h_{fe}|^2 (r_{oep}) \left[(10^3) + 1.93 \ (10^{-4}) \ (C_{iep})^2 (r_{iep})^2 \right]}{4 \ (r_{iep})} \right]$$

where: r_{oep} is in kilohms; r_{iep} is in ohms; C_{iep} is in picofarads. If desired, an equivalent circuit may be used for power gain measurement.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery. 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).
(c) Terminal-lead length if other than specified in figure 1 (see 3.3.2).

6.3 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

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

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

User activities:
Army - SM
Navy - CG, MC, SH, AS

Preparing activity:
Army - EL

Agent:
DSA - ES

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