

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, GERMANIUM, HIGH-FREQUENCY

TYPE 2N128

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 PNP, germanium, high-frequency transistor.

1.2 Physical dimensions. See figure 1.

1.3 Maximum ratings.

P_T ^{1/} $T_A = 25^\circ C$	V_{CB0}	V_{EB0}	T_A
mW	Vdc	Vdc	° C
25	-10	-10	-65 to +85

^{1/} Derate linearly .417 mW/°C for $T_A > 25^\circ C$.

1.4 Primary electrical characteristics.

Limits	C_{obo} $V_{CB} = -3V_{dc}$ $I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	f_{max} $V_{CB} = -3V_{dc}$ $I_E = 0.5 \text{ mAdc}$ (see figure 2)	h_{fe} $V_{CE} = -3V_{dc}$ $I_C = -0.5 \text{ mAdc}$ $f = 5 \text{ MHz}$	$r_b' C_c$ $V_{CB} = -3 V_{dc}$ $I_E = 0.5 \text{ mAdc}$ $f = 4 \text{ MHz}$ (see figure 3)	NF $V_{CB} = -3 V_{dc}$ $I_C = -0.5 \text{ mAdc}$ $R_g = 500 \text{ ohms}$
	pf	MHz		psec	db
Min	1.5	45	5.5
Max	5	1000	-20

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-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:

$\tau_b \cdot C_c$ Collector-base time constant.

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 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.

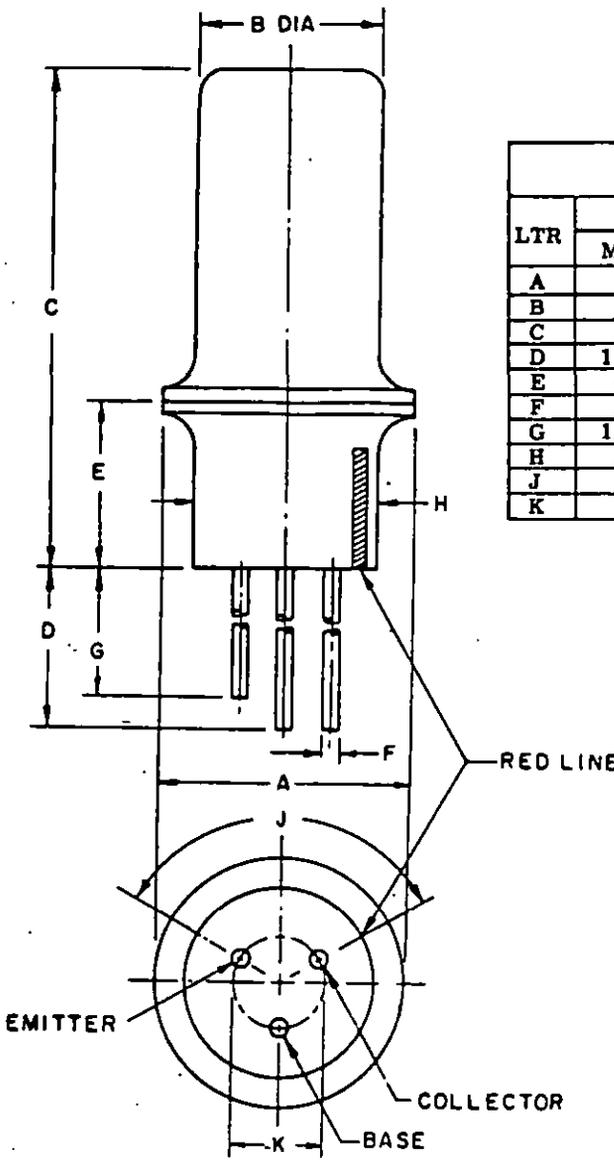
4.3 Quality conformance inspection. Quality conformance inspection shall consist of group A, B, and C inspections.

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-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 pre-designated, 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.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.195	.225	4.95	5.72	
B	.161	.179	4.09	4.55	
C	.425	.475	10.80	12.07	
D	1.500	1.688	38.10	42.82	
E	---	.160	---	4.06	2
F	.015	.018	.38	.46	3, 4
G	1.450	1.637	36.83	41.58	
H	.161	.179	4.09	4.55	
J	120° Nom				
K	.070	Nom	1.79 Nom		

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. Flange position not controlled within this range.
3. All leads electrically isolated from case.
4. All three leads.

FIGURE 1. Physical dimensions of transistor type 2N128.

TABLE I. Group A inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<i>Subgroup 1</i>			10				
Visual and mechanical examination	2071			--	--	--	--
<i>Subgroup 2</i>			7				
Breakdown voltage, collector to base	3001	Bias cond. D; $I_C = -15 \mu\text{A dc}$		BVCBO	-10	--	Vdc
Breakdown voltage, collector to base	3001	Bias cond. D; $I_C = -3 \mu\text{A dc}$		BVCBO	-3	--	Vdc
Breakdown voltage, emitter to base	3026	Bias cond. D; $I_E = -15 \mu\text{A dc}$		BVEBO	-10	--	Vdc
Breakdown voltage, emitter to base	3026	Bias cond. D; $I_E = -3 \mu\text{A dc}$		BVEBO	-3	--	Vdc
Collector to base cutoff current	3036	Bias cond. D; $V_{CB} = -3 \text{ Vdc}$		ICBO	--	4	$\mu\text{A dc}$
<i>Subgroup 3</i>			10				
Maximum frequency of oscillation	3311	$V_{CB} = -3 \text{ Vdc}$; $I_E = 0.5 \text{ mA dc}$; (see figure 2)		f_{max}	45	--	MHz
Collector-base time constant	--	$V_{CB} = -3 \text{ Vdc}$; $I_E = 0.5 \text{ mA dc}$; $f = 4 \text{ MHz}$ (see figure 3)		$r_b \cdot C_c$	--	1000	psec
Small-signal short-circuit forward-current transfer ratio	3206	$V_{CE} = -3 \text{ Vdc}$; $I_C = -0.5 \text{ mA dc}$		h_{fe}	19	65.7	--
Small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = -3 \text{ Vdc}$; $I_C = -0.5 \text{ mA dc}$; $f = 5 \text{ MHz}$		h_{fe}	5.5	--	--

TABLE I. Group A inspection - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<i>Subgroup 4</i>							
Small-signal open-circuit output admittance	3216	V _{CB} = -3 Vdc; I _E = 0.5 mA _{dc}	10	h _{ob}	--	4	μmho
Small-signal short-circuit input impedance	3201	V _{CB} = -3 Vdc; I _E = 0.5 mA _{dc}		h _{ib}	50	90	ohms
Open circuit output capacitance	3236	V _{CB} = -3 Vdc; I _E = 0; 100 kHz ≤ f ≤ 1 MHz		C _{ob}	1.5	5	pf
Noise figure	--	V _{CB} = -3 Vdc; I _C = -0.5 mA _{dc} ; R _g = 500 ohms		NF	--	20	db
<i>Subgroup 5</i>							
High-temperature operation:		T _A = +55°C	15				
Collector to base cutoff current	3036	Bias cond. D; V _{CB} = -3 Vdc		I _{CBO}	--	-15	μA _{dc}

TABLE II. Group B inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<i>Subgroup 1</i>							
Physical dimensions	2066	(See figure 1)	20	--	--	--	--
<i>Subgroup 2</i>							
Solderability	2026		15	--	--	--	--
Thermal shock (temperature cycling)	1051	Test cond. A, except Step 1, -65° +3, -0°C		--	--	--	--
Thermal shock (glass strain)	1056	Test cond. A		--	--	--	--

TABLE II. Group B inspection - Continued

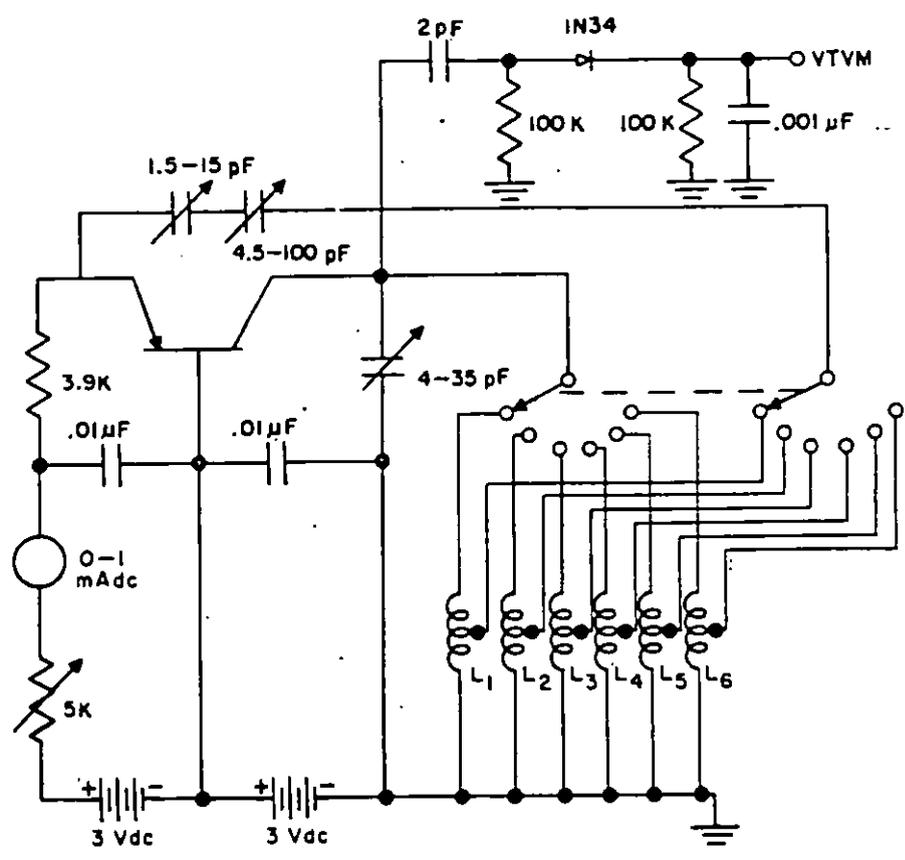
Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<i>Subgroup 2-Cont</i>							
Seal (leak-rate)	1071	Test cond. G or H for fine leak tests; test cond. A, C, D or F for gross leaks		--	--	1x10 ⁻⁷	atm cc/sec
Moisture resistance	1021			--	--	--	--
End points:							
Collector to base cutoff current	3036	Bias cond. D; VCB = -3 Vdc		ICBO	--	4	μ A dc
Small-signal short-circuit forward-current transfer ratio	3306	VCE = -3 Vdc; IC = -0.5 mA dc; f = 5 MHz		hfe	5.5	--	--
<i>Subgroup 3</i>							
Shock	2016	Nonoperating; 500 G, 1.0 msec, 5 blows in each orientation: X1, Y1, Y2 and Z1	15	--	--	--	--
Vibration, variable frequency	2056	10 G		--	--	--	--
Constant acceleration	2006	10,000 G; in each orientation: X1, Y1, Y2 and Z1		--	--	--	--
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	
<i>Subgroup 4</i>			15				
Terminal strength (lead fatigue)	2036	Test cond. E		--	--	--	--
End points:							
Seal (leak-rate)	1071	Test cond. G or H for fine leak tests; test cond. A, C, D or F for gross leaks		--	--	1x10 ⁻⁷	atm cc/sec
<i>Subgroup 5</i>			15				
Salt atmosphere (corrosion)	1041			--	--	--	--
End points:							
(Same as subgroup 2)							
<i>Subgroup 6</i>			7				
High-temperature life (nonoperating)	1032	T _{stg} = +85°C; time = 340 hours (see 4.3.4)		--	--	--	--
End points:							
Collector to base cutoff current	3036	Bias cond. D: V _{CB} = -3 Vdc		ICBO	--	-8	μA _{dc}
Small-signal short-circuit forward-current transfer ratio	3306	V _{CE} = -3 Vdc; I _C = -0.5 mA _{dc} ; f = 5 MHz		h _{fe}	4.5	--	--
<i>Subgroup 7</i>			7				
Steady-state operation life	1027	P _T = 25 mW; V _{CB} = -10 Vdc; time = 340 hours (see 4.3.4)		--	--	--	--
End points:							
(Same as subgroup 6)							

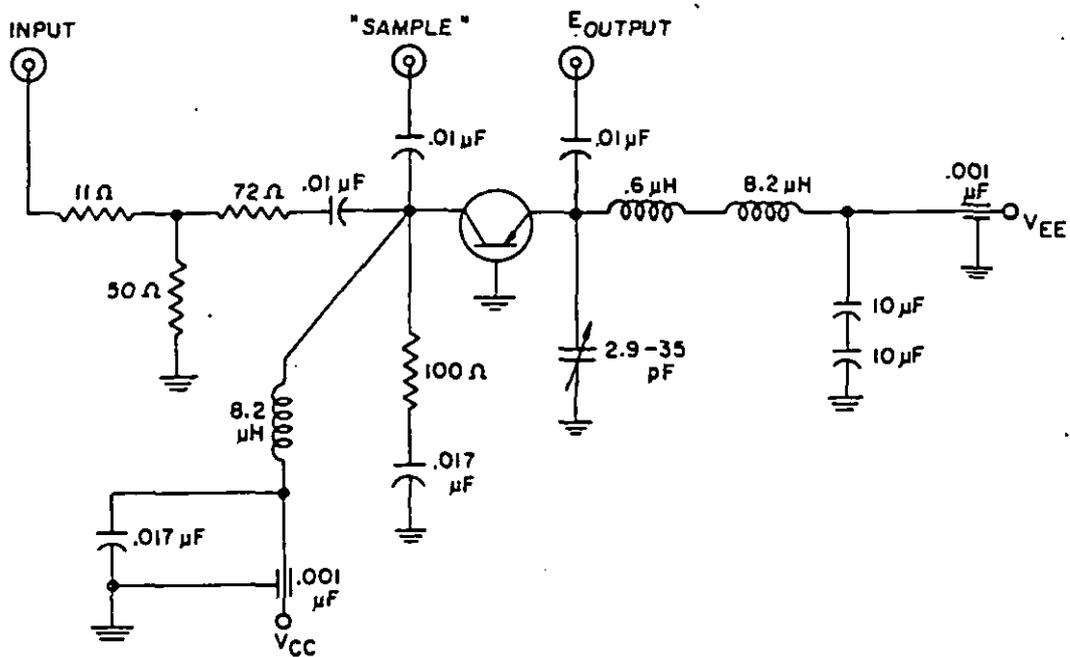
TABLE III. Group C inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<p><i>Subgroup 1</i></p> <p>High-temperature life (nonoperating)</p> <p>End points: (Same as subgroup 6 of group B)</p>	1031	T _{stg} = +85°C (see 4.3.4)	λ=10	---	---	---	---
<p><i>Subgroup 2</i></p> <p>Steady-state operation life</p> <p>End points: (Same as subgroup 6 of group B)</p>	1026	P _T = 25 mW; V _{CB} = -10 Vdc (see 4.3.4)	λ=10	---	---	---	---



COIL	INDUCTANCE, μ h	Q
L ₁	5.3	210
L ₂	2.7	195
L ₃	1.3	220
L ₄	0.63	300
L ₅	0.32	250
L ₆	0.15	170

FIGURE 2. f_{max} test circuit.



PROCEDURAL NOTES:

1. Connect 4 MHz source to input jack.
2. Connect *RFVM to Sample jack**.
3. Adjust 4 MHz level so that 1.8 V is read on RFVM.
4. Connect RFVM to Output jack; peak the emitter tuning capacitor on fixture.
5. Return RFVM to Sample jack.
6. Insert transistor into socket, apply bias, and set 4 MHz level for a 1.59 V reading on RFVM.
7. Connect RFVM to Output jack, $r_b'C_c$ is read with 1 mV = 10 psec, 3 mV = 30 psec, etc, (the 1.59 V_{in} should be checked regularly during successive test measurements).

*RFVM = Boonton type 91CA or equiv; (high impedance); unterminated probe, Boonton type 91-8C adapter or equiv, to be used.

**Adapter BNC UG-491A/U or equiv, to be used for connections to Input, Sample, and Output jacks.

FIGURE 3. $r_b'C_c$ test circuit.

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

5. PREPARATION FOR DELIVERY

5.1 See MIL-S-19500, section 5.

6. NOTES:

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

Custodians:

Army - EL
Navy - EC
Air Force - 11

Review activities:

Army - MU, MI
Navy -
Air Force - 17, 85
DSA - ES

User activities:

Army - SM
Navy - CG, MC, OS, AS, SH
Air Force - 13, 15, 19, 70, 80

Preparing activity:

Navy - EC

Agent:

DSA - ES

(Project 5961-0163)