

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, GERMANIUM, SWITCHING TYPE 2N3449

1. SCOPE

1.1 This specification covers the detailed requirements for a low-level, high-speed-switching germanium transistor designated 2N3449.

1.2 Physical dimensions: See figure 1.

1.3 Maximum ratings

P_C $T_A = 25^\circ\text{C}$ 1/	T_{stg}	BV_{CEO}	BV_{CES}	V_{CB}	V_{EB}	I_C
mW	$^\circ\text{C}$	Vdc	Vdc	Vdc	Vdc	mA dc
150	-65 to +100	-6	-15	-15	-1.5	-100

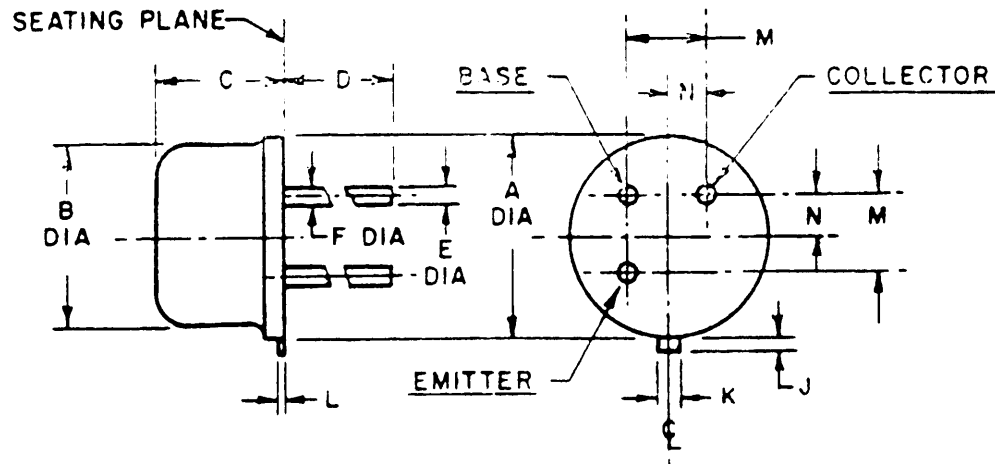
1/ Derate linearly at 2.0 mW/ $^\circ\text{C}$ for $T_A > 25^\circ\text{C}$

1.4 Primary electrical characteristics at $T_A = 25^\circ\text{C}$

h_{FE}		$V_{CE}(\text{sat})$	V_{BE}	C_{obo}	h_{re}
$V_{CB} = -0.25V_{dc}$ $I_C = -1.0\text{mA dc}$		$I_C = -1.0\text{mA dc}$ $I_B = -1.0\text{mA dc}$	$I_C = -1.0\text{mA dc}$ $I_B = -1.0\text{mA dc}$	$V_{CB} = -6V_{dc}$ $I_E = 0$ $f = 1\text{MC}$	$V_{CB} = -5V_{dc}$ $I_C = -5\text{mA dc}$ $f = 100\text{MC}$
Min	20	Vdc	Vdc	pF	3.0
Max	---	---	-0.3	---	---
		-0.20	-0.5	5.0	

1.5 Pulse response characteristics

	t_d	t_r	t_s	t_f
	In circuit of figure 2		In circuit of figure 3	
	nsec	nsec	nsec	nsec
Min	---	---	25	---
Max	18	30	60	65

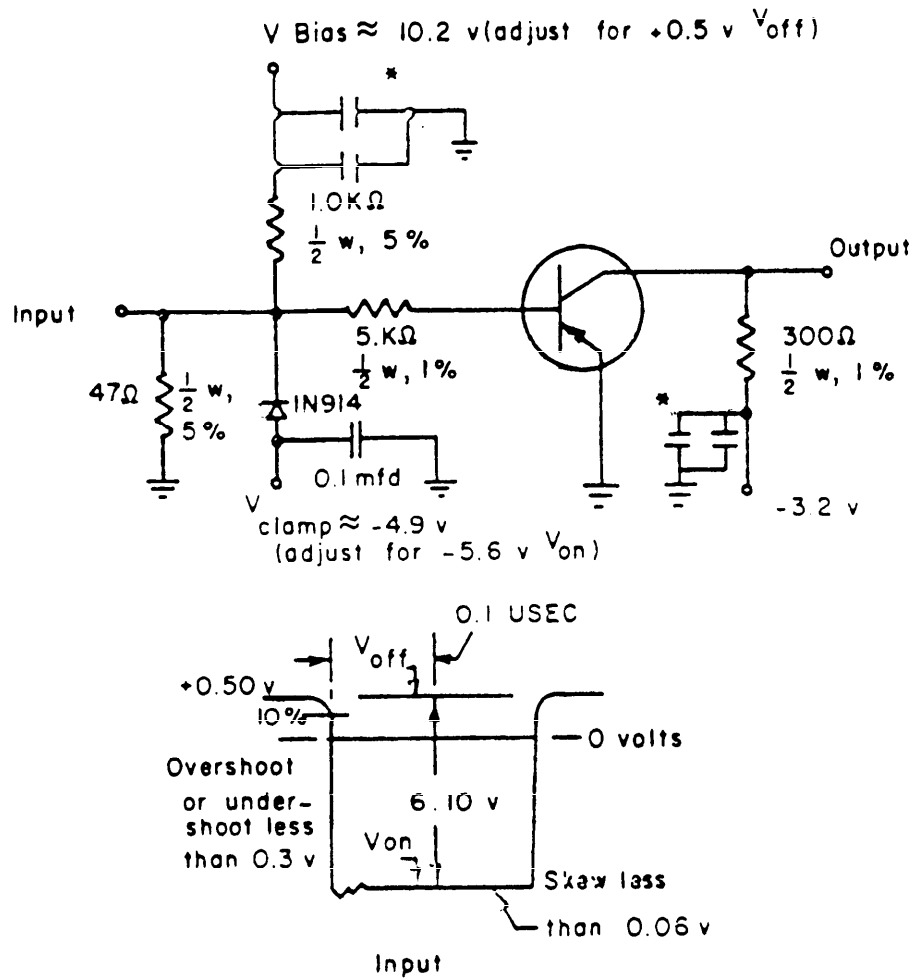


DIMENSIONS					NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	0.209	0.230	5.31	5.84	7 2,7 3,7 6
B	0.178	0.195	4.52	4.95	
C	0.170	0.210	4.32	5.33	
D	0.500	--	12.70	--	
E	--	0.021	--	0.53	
F	0.016	0.019	0.41	0.48	
J	0.028	0.048	0.71	1.22	
K	0.036	0.046	0.91	1.17	
L	--	0.020	--	0.51	
M	0.0707	Nom	1.80	Nom	4
N	0.0354	Nom	0.90	Nom	4

NOTES:

1. Metric equivalents in table and parentheses are shown for general information only and are based upon 1 inch = 25.4 mm.
2. Measured in the zone beyond 0.250 (6.35) from the seating plane.
3. Measured in the zone 0.050 (1.27) and 0.250 (6.35) from the seating plane.
4. When measured in a gaging plane 0.054 ± 0.001 (1.37 ± 0.03) below the seating plane of the transistor, max dia leads shall be within 0.007 (0.18) of their true location relative to a maximum width tab. Smaller dia leads shall fall within the outline of the max dia lead tolerance.
5. The collector shall be internally connected to the case.
6. Measured from the maximum diameter of the actual device.
7. All 3 leads.

Figure 1. Physical Dimensions of Transistor Type JAN 2N3449

Nominal Conditions

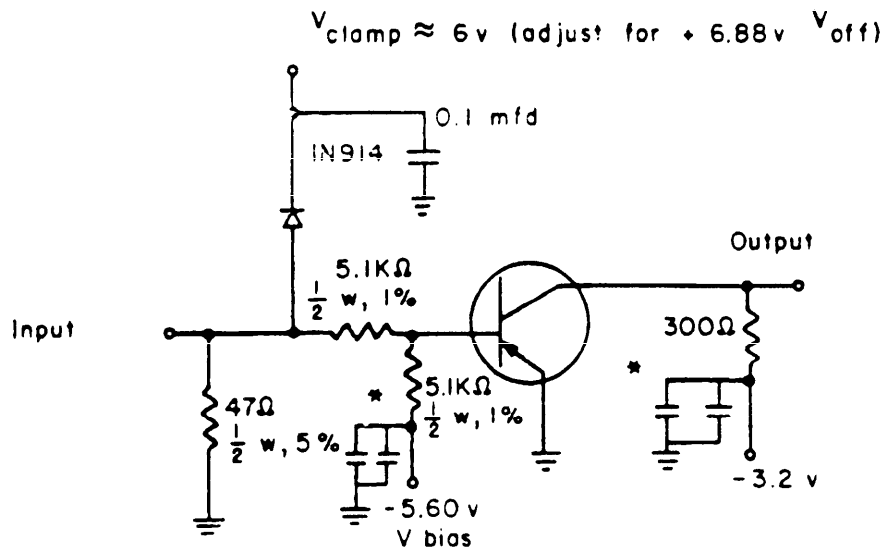
$$I_{CS} = -10 \text{ ma}$$

$$I_{B(1)} = -1.0 \text{ ma}$$

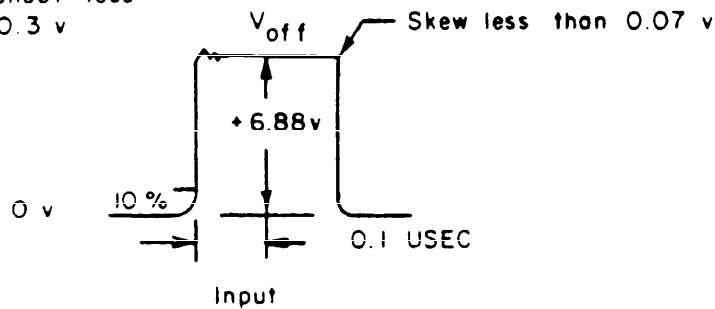
$$V_{BE(off)} = +0.5 \text{ v}$$

*50 mfd, 25 v
electrolytic capacitor
and a 0.1 mfd disc
type capacitor.

Figure 2. Pulse Response Schematic - Delay Time, Rise Time



Overshoot or
undershoot less
than 0.3 v



Nominal Conditions

$I_{\text{CS}} = -10 \text{ ma}$
 $I_{\text{B}(1)} = 1.0 \text{ ma}$
 $I_{\text{B}(2)} = +0.4 \text{ ma}$

* 50 mfd, 25 v
electrolytic capacitor
and a 0.1 mfd disc
type capacitor.

Figure 3. Pulse Response Schematic - Storage Time, Fall Time

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.

SPECIFICATION

Military

MIL-S-19500 Semiconductor Devices, General Specification for

STANDARD

MIL-STD-202 Test Methods for Electronic and Electrical Component Parts

(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 and symbols used herein are defined in MIL-S-19500.

3.3 Design and construction. The 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:

- 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 examinations and tests specified in tables I, II, and III.

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.

4.4 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 Test measurement. Test measurement shall be made after thermal equilibrium has been reached at the temperature specified.

TABLE I. GROUP A INSPECTION

EXAMINATION OR TEST	MIL-STD-750		LTPD	SYMBOL	LIMITS		UNIT
	METHOD	DETAILS			MIN	MAX	
<u>Subgroup 1</u>			10				
Visual and mechanical examination	2071						
<u>Subgroup 2</u>			5				
Collector-to-emitter cutoff current	3041 Bias cond A	$V_{CE} = -6V_{dc}$ $V_{EB} = +0.1V_{dc}$		I_{CEX}	---	-20	μA_{dc}
Base current	3030 except measure I_B	$V_{CE} = -6V_{dc}$ $V_{EB} = +0.1V_{dc}$		I_B	---	+20	μA_{dc}
Collector-to-base cutoff current	3036 Bias cond D	$V_{CB} = -5V_{dc}$ $I_E = 0$		I_{CBO}	---	-3.0	μA_{dc}
Breakdown voltage collector-to-base	3001 Bias cond D	$I_C = -100\mu A_{dc}$ $I_E = 0$		BV_{CBO}	-15	---	Vdc
Breakdown voltage collector-to-emitter	3011 Bias cond C	$I_C = -100\mu A_{dc}$ $V_{EE} = 0$		BV_{CES}	-15	---	Vdc
Breakdown voltage collector-to-emitter	3011 Bias cond D	$I_C = -5mA_{dc}$ $I_B = 0$		BV_{CEO}	-6.0	---	Vdc
Breakdown voltage emitter-to-base	3026 Bias cond D	$I_E = -100\mu A_{dc}$ $I_C = 0$		BV_{EBO}	-1.5	---	Vdc
<u>Subgroup 3</u>			5				
Forward-current transfer ratio	3076	$V_{CE} = -0.25V_{dc}$ $I_C = -10mA_{dc}$		h_{FE}	20	---	---
Collector-to-emitter voltage (saturated)	3071	$I_C = -2.0mA_{dc}$ $I_B = -0.1mA_{dc}$		$V_{CE(sat)}$	---	-0.20	Vdc
Collector-to-emitter voltage (saturated)	3071	$I_C = -10mA_{dc}$ $I_B = -1.0mA_{dc}$		$V_{CE(sat)}$	---	-0.20	Vdc
Collector-to-emitter voltage (saturated)	3071	$I_C = -20mA_{dc}$ $I_B = -1.0mA_{dc}$		$V_{CE(sat)}$	---	-0.25	Vdc
Base-emitter voltage (saturated)	3066 Cond A	$I_C = -10mA_{dc}$ $I_B = -0.5mA_{dc}$		V_{BE}	-0.30	-0.40	Vdc
Base-emitter voltage (saturated)	3066 Cond A	$I_C = -10mA_{dc}$ $I_B = -1.0mA_{dc}$		V_{BE}	-0.30	-0.50	Vdc
Base-emitter voltage (saturated)	3066 Cond A	$I_C = -20mA_{dc}$ $I_B = -1.0mA_{dc}$		V_{BE}	-0.35	-0.50	Vdc
<u>Subgroup 4</u>			10				
Open-circuit output capacitance	3236	$V_{CB} = -6.0V_{dc}$ $I_E = 0$ $f = 1mc$		C_{obo}	---	5.0	pf
Small-signal, short-circuit forward-current transfer ratio	3306	$V_{CE} = -5.0V_{dc}$ $I_C = -5.0mA_{dc}$ $f = 100mc$		h_{fe}	3.0	---	---

TABLE I. GROUP A INSPECTION (CONT)

EXAMINATION OR TEST	MIL-STD-750		LTPD	SYMBOL	LIMITS		UNIT
	METHOD	DETAILS			MIN	MAX	
<u>Subgroup 4 (cont)</u>							
Pulse response:	3851 Cond B	$V_{CC} = -5V_{dc}$	10				
Delay time		$R_C = 280\Omega$		t_d	---	25	nsec
Rise time		$R_B = 2.00 K\Omega$		t_r	---	30	nsec
Storage time		$V_1 = -2.30V_{dc}$		t_s	---	55	nsec
Fall time		$V_2 = +1.50V_{dc}$ 1/		t_f	---	65	nsec
<u>Subgroup 5</u>							
Pulse response:	---	See figure 2 1/	10				
Delay time				t_d	---	18	nsec
Rise time				t_r	---	30	nsec
Pulse response:	---	See figure 3 1/					
Storage time				t_s	25	60	nsec
Fall time			t_f	---	65	nsec	

1/ Input requirements: $t_r \leq 1 \text{ nsec}$, $t_f \leq 1 \text{ nsec}$, pulse width $\geq 200 \text{ nsec}$.

Oscilloscope requirements: $t_r \leq 3.5 \text{ nsec}$, $R_{in} \geq 100 K\Omega$, $C_{in} \geq 3 \text{ pf}$.

TABLE II. GROUP B INSPECTION

EXAMINATION OR TEST	MIL-STD-750		LTPD	SYMBOL	LIMITS		UNIT
	METHOD	DETAILS			MIN	MAX	
<u>Subgroup 1</u>			20				
Physical dimensions	2066	See figure 1					
<u>Subgroup 2</u>			20				
Solderability	2026						
Thermal shock (temperature cycling)	1051 Cond A	$T(\text{high}) = 100 \pm 3^\circ$					
Thermal shock (glass strain)	1056 Cond A						
Moisture resistance	1021						
End points:							
Collector-to-emitter voltage (saturated)	3071	$I_C = -20\text{mA dc}$ $I_B = -1.0\text{mA dc}$		$V_{CE}(\text{sat})$	---	0.25	Vdc
Collector-to-base cutoff current	3036 Bias Cond C	$V_{CB} = -5\text{ Vdc}$ $I_E = 0$		I_{CBO}	---	-3.0	$\mu\text{A dc}$
<u>Subgroup 3</u>			20				
Shock	2016	Nonoperating 500g, 1 msec, 5 shocks each orientation: X_1, Y_1, Y_2, Z_1					
Vibration fatigue	2046	Nonoperating 10g					
Vibration, variable frequency	2056	Nonoperating 10g					
Constant acceleration	2006	20,000g each orientation: X_1, Y_1, Y_2, Z_1					
End points: (Same as for subgroup 2)							
<u>Subgroup 4</u>			20				
Terminal strength (lead fatigue)	2036 Cond E						
Seal (leak mode)	Test method 112 of MIL-STD-202 Test cond C, procedure III; Test cond B for gross leaks					5×10^{-7}	$\frac{\text{atm}}{\text{cc/sec}}$
<u>Subgroup 5</u>			20				
Salt atmosphere (corrosion)	1041	---					
End points: (Same as for subgroup 2)							

TABLE II. GROUP B INSPECTION (CONT)

EXAMINATION OR TEST	MIL-STD-750		LTPD	SYMBOL	LIMITS		UNIT
	METHOD	DETAILS			MIN	MAX	
<u>Subgroup 6</u>			$\lambda = 15$				
High temperature life (nonoperating)	1031	$T_A = 100 \pm 3^\circ\text{C}$					
End points:							
Collector-to-emitter voltage (saturated)	3071	$I_C = -20 \text{ mAdc}$ $I_B = -1.0 \text{ mAdc}$		$V_{CE(sat)}$	---	-0.30	Vdc
Collector-to-base cutoff current	3036 Bias cond D	$V_{CB} = -5 \text{ Vdc}$ $I_E = 0$		I_{CBO}	---	-6.0	μAdc
<u>Subgroup 7</u>			$\lambda = 15$				
Steady-state operation life	1026	$T_A = 25 \pm 3^\circ\text{C}$ $P_C = 150 \text{ mW}$ $V_{CB} = -5 \text{ Vdc}$					
End points: (Same as for subgroup 6)							

TABLE III. GROUP C INSPECTION

EXAMINATION OR TEST	MIL-STD-750		LTPD	SYMBOL	LIMITS		UNIT
	METHOD	DETAILS			MIN	MAX	
<u>Subgroup 1</u>			20				
Barometric pressure, reduced (altitude operation)	1001	Pressure = 8 mmHg					
Measurement during test collector-to-base cutoff current	3036 Cond D	V _{CB} = 15 Vdc I _B = 0 For 60 sec min.		I _{CBO}	---	100	uAdc

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery and the quality assurance provisions for preparation for delivery shall conform to MIL-S-19500.

6. NOTES

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

Custodian:
Air Force - 11

Preparing activity:
Air Force - 11

Review activities:
Air Force - 17, 85

FOLD

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SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION

ORGANIZATION (of submitter)

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER A

☐

DIRECT GOVERNMENT CONTRACT

☐

SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES

☐ NO

IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity)

DATE