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°C 1/	T_{stg}	BV_{CBO}	BV_{CES}	V_{CB}	V_{EB}	I_C
mW	°C	Vdc	Vdc	Vdc	Vdc	mAdc
150	-65 to +100	-6	-15	-15	-1.5	-100

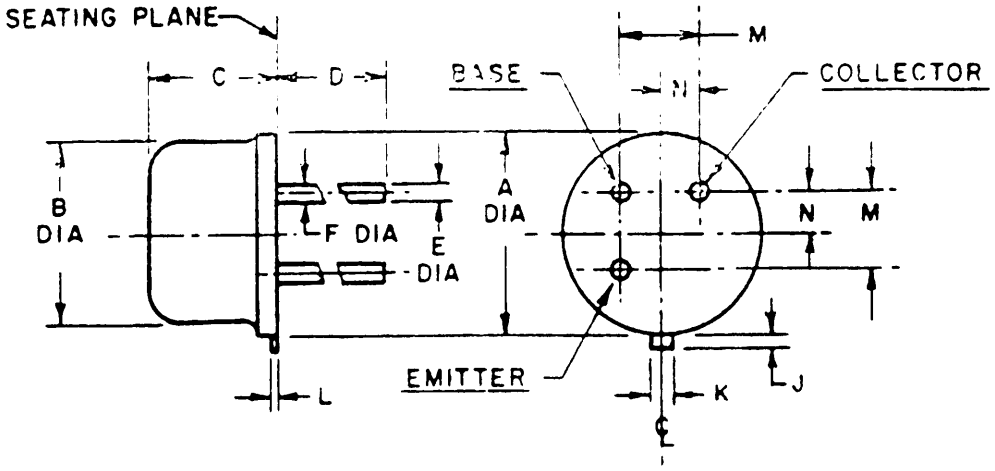
1/ Derate linearly at 2.0 mW/°C for $T_A > 25°C$

1.4 Primary electrical characteristics at T_A = 25°C

h_{FE}		$V_{CE(sat)}$	V_{BE}	C_{obo}	h_{fe}
V_{CE} = -0.25Vdc I_C = -10mAdc		I_C = -10mAdc I_B = -1.0mAdc	I_C = -10mAdc I_B = -1.0mAdc	V_{CB} = -6Vdc I_E = 0 f = 1MC	V_{CE} = -5Vdc I_C = -5mAdc f = 100MC
		Vdc	Vdc	pf	
Min	20	---	-0.3	---	3.0
Max	---	-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

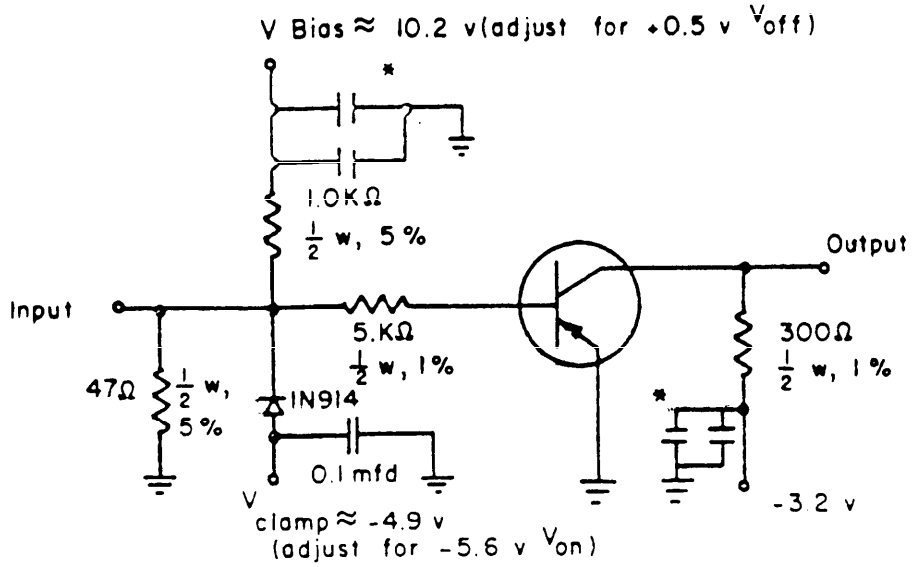


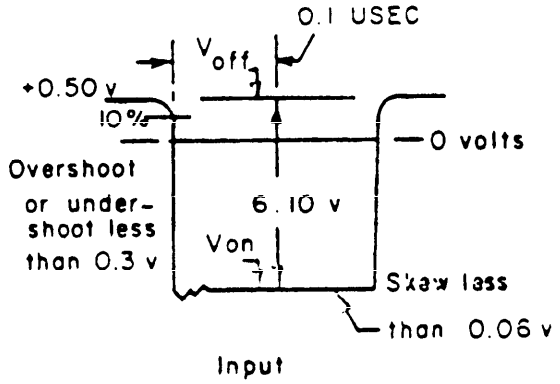
DIMENSIONS					NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	0.209	0.230	5.31	5.84	
B	0.178	0.195	4.52	4.95	
C	0.170	0.210	4.32	5.33	
D	0.500	--	12.70	--	7
E	--	0.021	--	0.53	2,7
F	0.016	0.019	0.41	0.48	3,7
J	0.028	0.048	0.71	1.22	6
K	0.036	0.046	0.91	1.17	
L	--	0.020	--	0.51	
M	0.0707 Nom		1.80 Nom		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 $^{+0.001}_{-0.000}$ (1.37 $^{+0.03}_{-0.00}$) 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



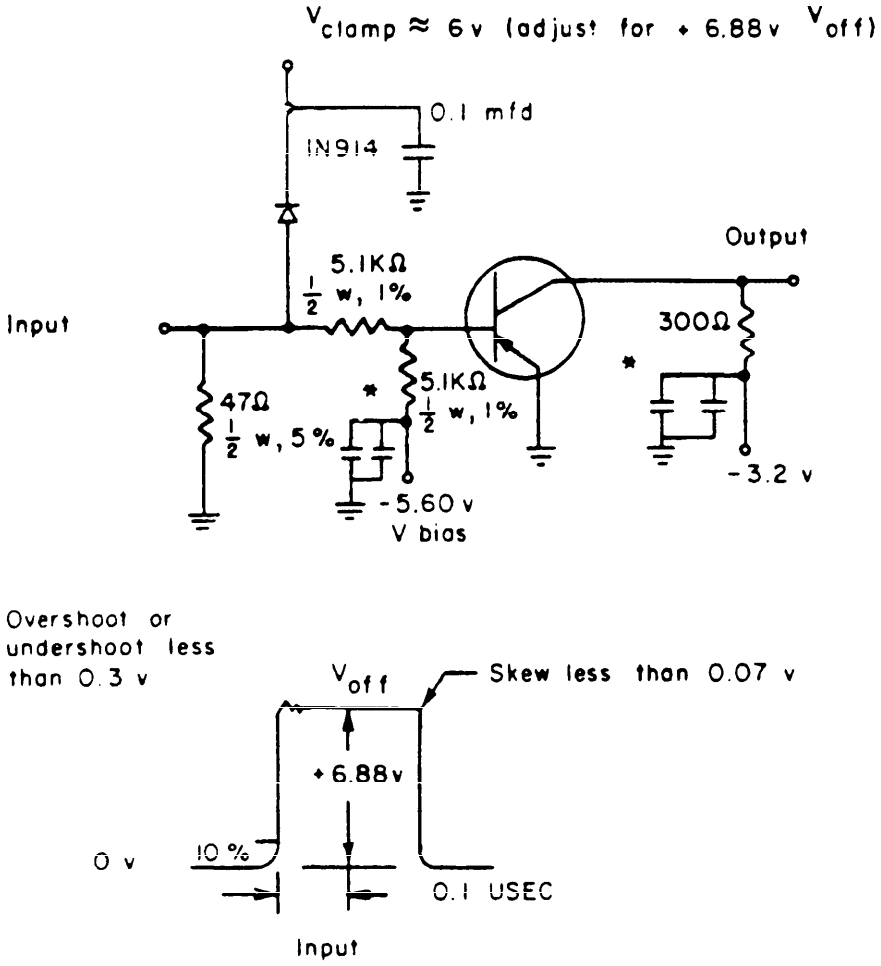


Nominal Conditions

I_{CS} = -10 ma
$I_{B(1)}$ = -1.0 ma
$V_{BE(off)}$ = +0.5 v

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

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



Nominal Conditions

I_{CS} = -10 ma
$I_{B(1)}$ = 1.0 ma
$I_{B(2)}$ = +0.4 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	
Subgroup 1			10				
Visual and mechanical examination	2071						
Subgroup 2			5				
Collector-to-emitter cutoff current	3041 Bias cond A	V_{CB} = -6Vdc V_{EB} = +0.1Vdc		I_{CEX}	---	-20	uAdc
Base current	3030 except measure I_B	V_{CB} = -6Vdc V_{EB} = +0.1Vdc		I_B	---	+20	uAdc
Collector-to-base cutoff current	3036 Bias cond D	V_{CB} = -5Vdc I_E = 0		I_{CBO}	---	-3.0	uAdc
Breakdown voltage collector-to-base	3001 Bias cond D	I_C = -100uAdc I_E = 0		BV_{CBO}	-15	---	Vdc
Breakdown voltage collector-to-emitter	3011 Bias cond C	I_C = -100uAdc V_{EB} = 0		BV_{CES}	-15	---	Vdc
Breakdown voltage collector-to-emitter	3011 Bias cond D	I_C = -5mAdc I_B = 0		BV_{CEO}	-6.0	---	Vdc
Breakdown voltage emitter-to-base	3026 Bias cond D	I_E = -100uAdc I_C = 0		BV_{EBO}	-1.5	---	Vdc
Subgroup 3			5				
Forward-current transfer ratio	3076	V_{CE} = -0.25Vdc I_C = -10mAdc		h_{FE}	20	---	---
Collector-to-emitter voltage (saturated)	3071	I_C = -2.0mAdc I_B = -0.1mAdc		$V_{CE}(sat)$	---	-0.20	Vdc
Collector-to-emitter voltage (saturated)	3071	I_C = -10mAdc I_B = -1.0mAdc		$V_{CE}(sat)$	---	-0.20	Vdc
Collector-to-emitter voltage (saturated)	3071	I_C = -20mAdc I_B = -1.0mAdc		$V_{CE}(sat)$	---	-0.25	Vdc
Base-emitter voltage (saturated)	3066 Cond A	I_C = -10mAdc I_B = -0.5mAdc		V_{BE}	-0.30	-0.40	Vdc
Base-emitter voltage (saturated	3066 Cond A	I_C = -10mAdc I_B = -1.0mAdc		V_{BE}	-0.30	-0.50	Vdc
Base-emitter voltage (saturated)	3066 Cond A	I_C = -20mAdc I_B = -1.0mAdc		V_{BE}	-0.35	-0.50	Vdc
Subgroup 4			10				
Open-circuit output capacitance	3236	V_{CB} = -6.0Vdc I_E = 0 f = 1mc		C_{obo}	---	5.0	pf
Small-signal, short-circuit forward-current transfer ratio	3306	V_{CE} = -5.0Vdc I_C = -5.0mAdc f = 100mc		h_{fe}	3.0	---	---

TABLE I. GROUP A INSPECTION (CONT)

EXAMINATION OR TEST	MIL-STD-750 METHOD	MIL-STD-750 DETAILS	LTPD	SYMBOL	LIMITS MIN	LIMITS MAX	UNIT
Subgroup 4 (cont)							
Pulse response:	3251 Cond B	V_{CC} = -3Vdc					
Delay time		R_C = 280Ω		t_d	---	25	nsec
Rise time		R_B = 2.00 KΩ		t_r	---	30	nsec
Storage time		V_1 = -2.30Vdc		t_s	---	55	nsec
Fall time		V_2 = +1.50Vdc 1/		t_f	---	65	nsec
Subgroup 5			10				
Pulse response:	---	See figure 2 1/					
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: $t_r \leq 1$ nsec, $t_f \leq 1$ nsec, pulse width ≥ 200 nsec.
Oscilloscope requirements: $t_r \leq 3.5$ nsec, Rin ≥ 100 KΩ, Cin ≥ 3 pf.

TABLE II. GROUP B INSPECTION

EXAMINATION OR TEST	MIL-STD-750 METHOD	MIL-STD-750 DETAILS	LTPD	SYMBOL	LIMITS MIN	LIMITS MAX	UNIT
Subgroup 1			20				
Physical dimensions	2066	See figure 1					
Subgroup 2			20				
Solderability	2026						
Thermal shock (temperature cycling)	1051 Cond A	T(high) = 100 ±3°					
Thermal shock (glass strain)	1056 Cond A						
Moisture resistance	1021						
End points:							
Collector-to-emitter voltage (saturated)	3071	I_C = -20mAdc I_B = -1.0mAdc		V_{CE}(sat)	---	0.35	Vdc
Collector-to-base cutoff current	3036 Bias Cond C	V_{CB} = -5 Vdc I_E = 0		I_{CBO}	---	-3.0	uAdc
Subgroup 3			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)							
Subgroup 4			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}	atm cc/sec
Subgroup 5			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	
Subgroup 6			λ =15				
High temperature life (nonoperating)	1031	T_A = 100 ±3°C					
End points:							
Collector-to-emitter voltage (saturated)	3071	I_C = -20 mAdc I_B = -1.0 mAdc		V_{CE}(sat)	---	-0.30	Vdc
Collector-to-base cutoff current	3036 Bias cond D	V_{CB} = -5 Vdc I_E = 0		I_{CBO}	---	-6.0	uAdc
Subgroup 7			λ =15				
Steady-state operation life	1026	T_A = 25 +3°C P_C = 150 mW V_{CB}= -5Vdc					
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	
Subgroup 1			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

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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

DD FORM 1 APR 63 1426 REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE C-8279