

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, GERMANIUM, TYPE 2N1854

1. SCOPE

1.1 Scope. This specification covers the detail requirements for a germanium, PNP switching transistor and is in accordance with MIL-S-19500, except as otherwise specified herein.

1.2 Physical dimensions. See figure 1 (TO-5).

1.3 Maximum ratings.

P_T ^{1/}	P_{EB} ^{2/}	V_{CB}	V_{EB}	V_{CE} ($R_B \approx 1K$)	I_C	T_{stg}
<u>mW</u>	<u>mW</u>	<u>Vdc</u>	<u>Vdc</u>	<u>Vdc</u>	<u>mAdc</u>	<u>°C</u>
150	25	-18	-2	-17	-100	-65 to +85

1/ Derate linearly 3.75 mW/°C for $T_A > 25^\circ C$.

2/ Derate linearly .5 mW/°C for $T_A > 25^\circ C$.

This rating refers to operation of the emitter base diode in the break-down region.

1.4 Primary electrical characteristics.

	h_{FE}	h_{FE}	$V_{CE(sat)}$	I_{CBO}	t_s	f_T
Limits	$V_{CE} = -.75 V$ $I_C = -100 mA$	$V_{CE} \approx -1.0 V$ $I_C = -50 mA$	$I_C = -20 mA$ $I_B = .5 mA$	$V_{CB} = -15 V$ $I_E = 0$ $T_A = 65^\circ C$	$I_C = -20 mA$ $I_B = -1.5 mA$	$I_C = -10 mA$ $V_{CE} = -1 Vdc$
	<u>25</u>	<u>---</u>	<u>Vdc</u>	<u>μAdc</u>	<u>ns</u>	<u>MHz</u>
Min	25	---	---	---	---	40
Max	---	400	-.30	-40	60	---

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:

V_{CERL} - Collector latch voltage. The collector to emitter voltage to which the transistor recovers when turned off.

f_{B5} - Frequency for gain = 5. The frequency at which the small signal common emitter current gain equals five.

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 and II.

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 designating symbol

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 and II.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of groups A and B.

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.

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

4.4.1 Disposition of sample units. Sample units which have been subjected to and passed subgroups 1, 6, 7, and 8, may be shipped on the contract or order, provided that after the test, the units can pass the group A inspection.

4.4.2 Case seal test. The transistors shall be subjected to a hydraulic pressure of 70 psig in a solution of water and 2 percent detergent for a minimum of 16 hours. The transistors shall then be washed and dried. The end point measurements shall be made within 8 hours of the pressure test.

TABLE I. Group A inspection

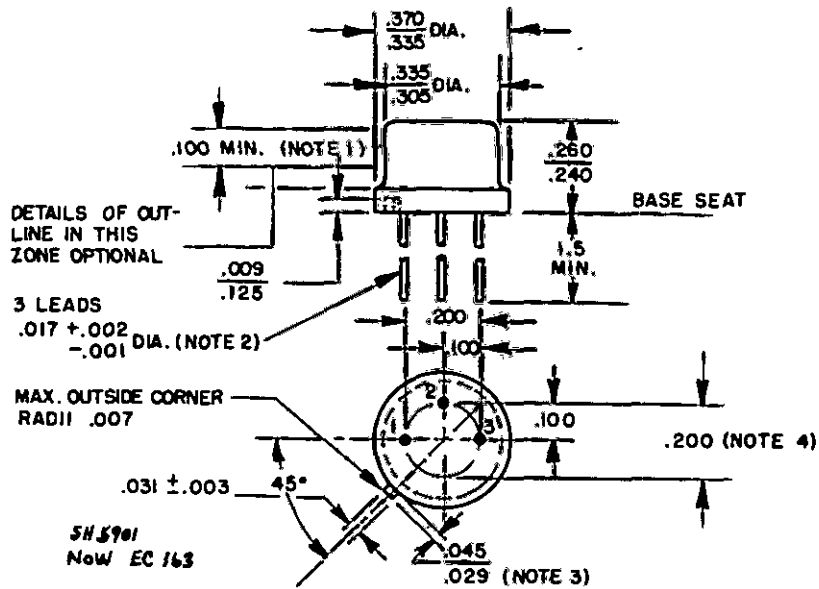
Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1</u>			10				
Visual and mechanical examination	2071			---	---	---	---
<u>Subgroup 2</u>			10				
Breakdown voltage collector to base	3001	Bias cond. D $I_C = -25 \mu\text{A}_{dc}$		BV_{CBO}	-18	---	Vdc
Collector reach-through voltage		$I_C = -25 \mu\text{A}_{dc}$ $V_{BE} = 0.2 \text{ Vdc}$		V_{RT}	-18	---	Vdc
Collector latch voltage		$R_L = 0.178 \text{ K } \Omega$ $R_{BE} = 1 \text{ K } \Omega$ (See figure 3)		V_{CERL}	-17	---	Vdc
Breakdown voltage emitter to base	3026	Bias cond. D $I_E = -100 \mu\text{A}_{dc}$		BV_{EBO}	-2	---	Vdc
Collector to emitter voltage (saturated)	3071	$I_C = -20 \text{ mA}_{dc}$ $I_B = -0.66 \text{ mA}_{dc}$		$V_{CE(sat)}$	---	-0.25	Vdc
		$I_C = -20 \text{ mA}_{dc}$ $I_B = -0.50 \text{ mA}_{dc}$		$V_{CE(sat)}$	---	-0.30	Vdc
		$I_C = -80 \text{ mA}_{dc}$ $I_B = -2.7 \text{ mA}_{dc}$		$V_{CE(sat)}$	---	-0.7	Vdc
Collector to base cutoff current	3036	Bias cond. D $V_{CB} = -15 \text{ Vdc}$		I_{CBO}	---	-40	μA_{dc}
Forward current transfer ratio	3076	$I_C = -50 \text{ mA}_{dc}$ $V_{CE} = -1.0 \text{ Vdc}$		h_{FE}	---	400	
		$I_C = -100 \text{ mA}_{dc}$ $V_{CE} = -0.75 \text{ Vdc}$		h_{FE}	25	---	
Storage time		$I_C = -20 \text{ mA}_{dc}$ $I_B = -1.5 \text{ mA}_{dc}$		t_s	--	60	nsec
		$I_C = -80 \text{ mA}_{dc}$ $I_B = -4.5 \text{ mA}_{dc}$ (See figure 2)		t_s	---	80	nsec
Frequency for gain ≈ 5		$I_C = -10 \text{ mA}_{dc}$ $V_{CE} = -1 \text{ Vdc}$		f_{B5}	8	---	MHz

TABLE II. Group B inspection

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1</u>			20				
Physical dimensions	2066	(See figure 4)		---	---	---	---
<u>Subgroup 2</u>			20				
Solderability	2026			---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. B $T_{max} = +85^{\circ} \text{C}$		---	---	---	---
Thermal shock (glass strain)	1056	Test cond. A $T_A = 0^{\circ} \text{C}$ to $+82^{\circ} \text{C}$		---	---	---	---
Moisture resistance	1021			---	---	---	---
End points:							
Collector to base cutoff current	3036	$T_A = 65^{\circ} \text{C}$ Bias cond. D; $V_{CB} = -15 \text{ Vdc}$		I_{CBO}	---	-56	μAdc
Reach through voltage		$I_C = -35 \mu\text{Adc}$ $V_{BE} = 0.20 \text{ Vdc}$		V_{RT}	-17	---	Vdc
Collector to emitter voltage (saturated)	3071	$I_C = -20 \text{ mAdc}$ $I_B = -0.57 \text{ mAdc}$		$V_{CE}^{(sat)}$	---	-0.30	Vdc
<u>Subgroup 3</u>			20				
Shock	2016	Nonoperating; 500 G, approx. 1 msec. 5 blows in each orientation: X_1 , Y_1 , Y_2 , and Z_1 .		---	---	---	---
Vibration fatigue	2046	Nonoperating; 10 G		---	---	---	---
Vibration, variable frequency	2056	Nonoperating		---	---	---	---
Constant acceleration	2006	10,000 G; in each orientation: X_1 , Y_1 , Y_2 , and Z_1 .		---	---	---	---
End points:							
(Same as subgroup 2)							
<u>Subgroup 4</u>			20				
Terminal strength (lead fatigue)	2036	Test cond. E		---	---	---	---
<u>Subgroup 5</u>			20				
Salt atmosphere (corrosion)	1041			---	---	---	---

TABLE II. Group B inspection (Continued)

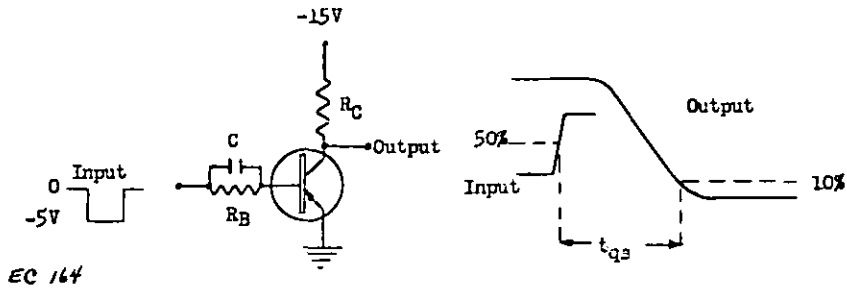
Examination or test	MIL-STD-750		LTPD	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 6</u>			20				
Case seal		(See 4.4.2)					
End points:							
Collector to base cutoff current	3036	$T_A = 65^\circ \text{C}$ Bias cond. D $V_{CB} = -15 \text{ Vdc}$		I_{CBO}	---	-56	μAdc
<u>Subgroup 7</u>			$\lambda = 10$				
High-temperature life (non-operating)	1031	$T_{stg} = +85^\circ \text{C}$		---	---	---	---
End points:							
Collector to base cutoff current	3036	$T_A = +65^\circ \text{C}$ Bias cond. D $V_{CB} = -15 \text{ Vdc}$		I_{CBO}	---	-56	μAdc
Reach through voltage		$I_C = -35 \mu\text{Adc}$ $V_{BE} = +0.20 \text{ Vdc}$		V_{RT}	-17	---	Vdc
Collector to emitter voltage (saturated)	3071	$I_C = -20 \text{ mAdc}$ $I_B = -0.57 \text{ mAdc}$		$V_{CE}(\text{sat})$	---	-0.30	Vdc
		$I_C = -80 \text{ mAdc}$ $I_B = -3.0 \text{ mAdc}$ $T_A = +55^\circ \text{C}$		$V_{CE}(\text{sat})$	---	-0.70	Vdc
Forward current transfer ratio	3076	$I_C = -100 \text{ mAdc}$ $V_{CE} = -0.75 \text{ Vdc}$		h_{FE}	20	---	---
<u>Subgroup 8</u>			$\lambda = 10$				
Steady state operation life	1026	$T_A = +71^\circ \text{C}$ (See figure 4 for specific conditions)		---	---	---	---
End points:							
(Same as subgroup 7)							



NOTES:

1. This zone is controlled for automatic handling. The variation in actual diameter within the zone shall not exceed 0.010.
2. The specified lead diameter applies in the zone between 0.050 and 0.250 from the base seat. Between 0.250 and 1.5 a maximum of 0.021 diameter is held. Outside of these zones the lead diameter is not controlled.
3. Measured from the maximum diameter of the actual device.
4. Maximum diameter lead measured at a gaging plane of 0.054 ± 0.001 below the base seat shall be within 0.007 inch of their true location relative to the maximum width tab.
5. All dimensions are in inches.
6. All leads isolated from the case.

Figure 1. Dimensions of transistor 2N1854.

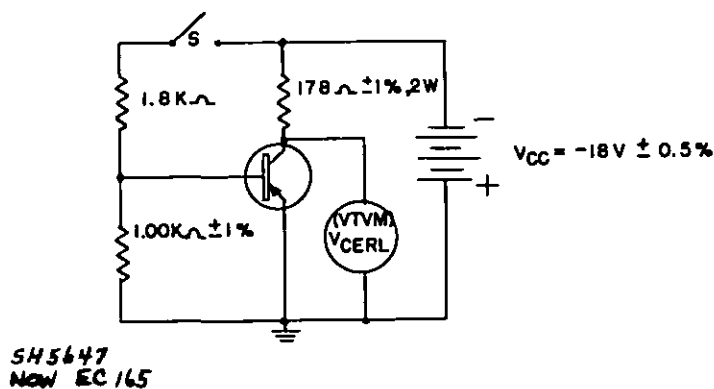


The charge storage time test will be performed in the circuit shown above. A -5 volt 100kHz square wave is fed into the input terminals and the output is observed on the oscilloscope. t_{qs} is defined as shown in the right hand figure.

Conditions

I_C	I_B	R_B	C	R_C
-20ma	-1.5ma	3.3K	104pf	750Ω
-80ma	-4.5ma	1.1K	440pf	189Ω

Figure 2. Charge storage time test circuit.



THE V_{CERL} TEST IS PERFORMED IN THE CIRCUIT ABOVE. A TRANSISTOR IS INSERTED WITH SWITCH S OPEN. THE SWITCH IS CLOSED AND THEN OPENED. UNITS ARE REJECTED IF V_{CERL} IS MORE POSITIVE THAN -17 VOLTS AFTER THE SWITCH IS OPENED.

Figure 3. V_{CERL} test circuit.

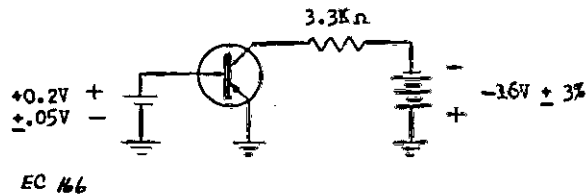


Figure 4. Operating life test circuit.

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.

Review activity:
Navy - SH

Preparing activity:
Navy-EC
Project No. 5961-N204

User activities:
Navy - AS, OS, MC, CG