

MILITARY SPECIFICATION
TRANSISTOR, NPN, SILICON
TYPES 2N389 AND 2N424

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 high power, silicon, NPN, transistors, and is in accordance with Specification MIL-S-19500 except as otherwise specified herein.

1.2 Physical dimensions. See figure 1 (TO-53)

1.3 Absolute-maximum ratings:

P_T 1/	V_{CE}		V_{CB}		V_{EB}	T_{stg}
$T_C = 25^\circ C$	2N389	2N424	2N389	2N424		
(W)	(Vdc)	(Vdc)	(Vdc)	(Vdc)	(Vdc)	(°C)
85	60	80	60	80	10	-65 to +200

1/ Derate 0.486 W/°C above $T_C = 25^\circ C$.

1.4 Primary electrical characteristics.

	h_{FE}	h_{FE}	$V_{CE(sat)}$	
	$I_C = 1 \text{ Adc}$ $V_{CE} = 15V_{dc}$	$I_C = 1 \text{ Adc}$ $V_{CE} = 15 V_{dc}$ $T_A = -55^\circ C$	2N389	2N424
Min	15	8	(Vdc)	(Vdc)
Max	60	---	5	10

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

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 Specification MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in Specification MIL-S-19500.

3.3 Design and construction. 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 as follows:

3.4.1 Salt atmosphere (corrosion). The transistor shall be examined for evidence of corrosion and legibility of marking before the specified measurements are made (see 4.4.1).

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 the examinations and tests specified in tables I and II.

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

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

4.4.1 Salt atmosphere. The marking shall be legible after the test. There shall be no evidence (when examined with no magnification) of flaking or pitting of the finish or corrosion that will interfere with the mechanical or electrical application of the device.

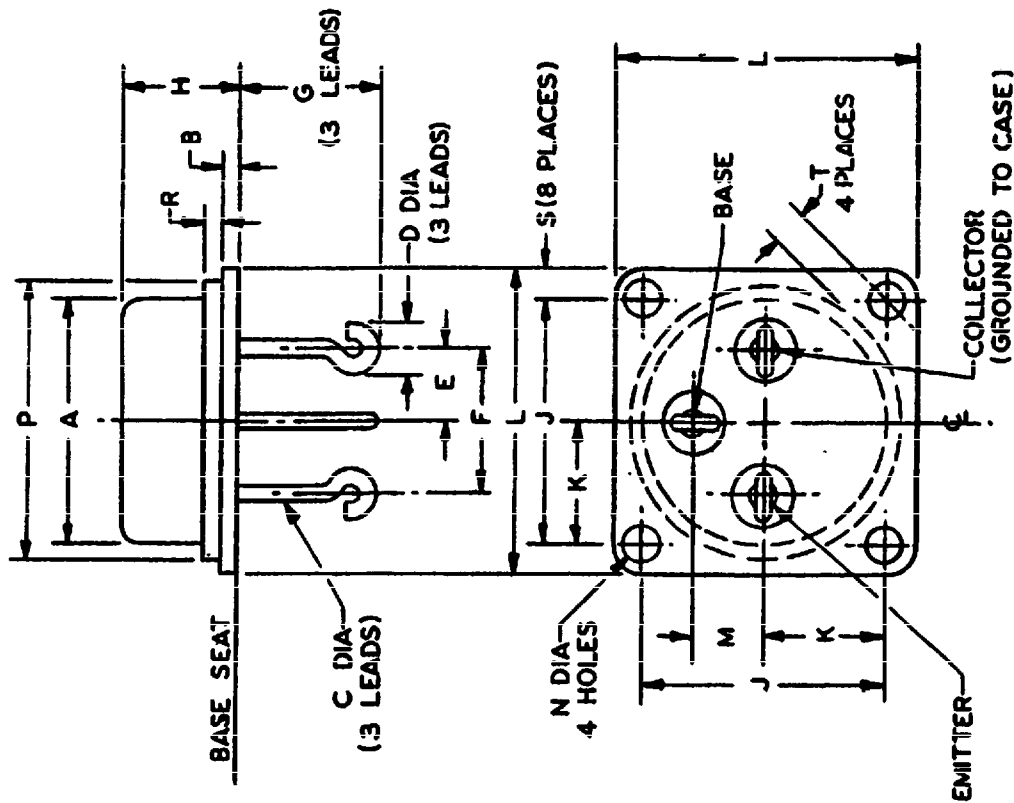
4.4.2 Pulse testing. Pulse measurements shall be used in accordance with Section 4 of MIL-STD-750.

4.4.3 Inspection conditions. All measurements are to be made at $T_A = 25^\circ\text{C}$ unless otherwise specified.

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

5. PREPARATION FOR DELIVERY

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



LTR	DIMENSIONS			
	INCHES		MILLIMETERS	
	MIN.	NOM.	MAX.	MIN. MAX.
A	.670	.675	.680	17.02 17.27
B	.040	.050	.055	1.02 1.40
C	.035	.040	.045	.89 1.14
D	.130	.140	.150	3.56 Nom
E	.190	.200	.210	4.83 5.33
F	.385	.400	.415	9.78 10.54
G	.370	.390	.420	9.47 10.49
H	.305	.325	.345	7.75 8.76
J	.670	.680	.690	17.02 17.53
K	.330	.340	.350	8.38 8.89
L	.850	.860	.870	21.59 22.10
M	.190	.200	.210	4.83 5.33
N	.096	.101	.106	2.44 2.69
P	.765	.775	.785	19.43 19.94
R	.030	.048	.065	.76 1.65
S	.075	.090	.105	1.91 2.67
T	.075	--	--	1.91 --

NOTES:

1. Metric equivalents are for information only and are based upon 1 inch = 25.4 mm.
2. Lead spacing measured at base seat.

Figure 1. Outline and dimensions for transistor types 2N389 and 2N424.

Table I. Group A Inspection.

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1</u>			10				
Visual and mechanical examination	2071			---	---	---	---
<u>Subgroup 2</u>			5				
Breakdown voltage collector to emitter	3011	Bias cond. B $I_C = 10 \text{ mA dc}$ $R_{BE} = 33 \text{ ohms}$		BV_{CER} BV_{GER}	60 80	---	Vdc Vdc
Collector to emitter voltage (saturated)	3071	$I_C = 1.0 \text{ A dc}$ $I_B = 200 \text{ mA dc}$ pulsed, see 4.4.2		$V_{CE(sat)}$ $V_{CE(sat)}$	---	5.0 10.0	Vdc Vdc
Breakdown voltage, emitter to base	3026	Bias cond. D $I_E = 10 \text{ mA dc}$		BV_{EBO}	10	---	Vdc
Forward-current transfer ratio	3076	$I_C = 1 \text{ A dc}$ $V_{CE} = 15 \text{ V dc}$ pulsed, see 4.4.2		h_{FE}	15	60	---
Forward-current transfer ratio	3076	$I_C = 100 \text{ mA dc}$ $V_{CE} = 15 \text{ V dc}$ pulsed, see 4.4.2		h_{FE}	8	---	---
Base to emitter voltage (nonsaturated)	3066	Test cond. B $V_{CE} = 15 \text{ V dc}$ pulsed, see 4.4.2		V_{BE} V_{BE}	---	8.0 8.0	Vdc Vdc
<u>Subgroup 3</u>			10				
High temperature operation:		$T_G = 100^\circ\text{C}$, see 4.4.4					
Collector to emitter cutoff current	3041	Bias cond. B $V_{CE} = 60 \text{ V dc}$ $R_{BE} = 33 \text{ ohms}$		I_{CER}	---	10	mA dc
Low temperature operation:		$T_A = -55^\circ\text{C max.}$ see 4.4.4					
Forward-current transfer ratio	3076	$V_{CE} = 15 \text{ V dc}$ $I_C = 1 \text{ A dc}$ pulsed, see 4.4.2		h_{FE}	8	---	---

Table II. Group B Inspection.

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 1</u>			20				
Physical dimensions	2066			---	(See figure 1)		
<u>Subgroup 2</u>			20				
Solderability	2026	Immersion depth = 0.200 ± 0.025 inches dwell time = 10 ± 1 sec.		---	---	---	---
Temperature cycling	1051	Test cond. C		---	---	---	---
Thermal shock (glass strain)	1056	Test cond B		---	---	---	---
Terminal strength (tension)	2036	Test cond. A weight = 10 lbs ± 10 oz. time = 15 ± 3 sec.		---	---	---	---
Terminal strength (torque)	2036	Test cond. D1 torque = 6 oz-in. time = 5 ± 1 sec.		---	---	---	---
Seal test (leak rate)	---	Method 112 MIL-STD-202 Test cond. C, Procedure III, Test cond. A for gross leaks		---	---	5x10 ⁻⁷	atm cc/sec
Moisture resistance	1021	omit initial conditioning		---	---	---	---
<u>End points:</u>							
Breakdown voltage, collector to emitter	3011	Bias cond B. I _C = 10 mA dc R _{BE} = 33 ohms					
2N389				BV _{CER}	60	---	V _{dc}
2N424				BV _{CER}	80	---	V _{dc}
Forward-current transfer ratio	3076	I _C = 1 A dc V _{CE} = 15 V _{dc} pulsed, see 4.4.2		h _{FE}	15	60	---
<u>Subgroup 3</u>			10				
Shock	2016	Nonoperating; 500 G, approx. 1 msec; 5 blows each in orientation X ₁ , Y ₁ , Y ₂ , and Z ₁		---	---	---	---
Vibration fatigue	2046	Nonoperating		---	---	---	---
Vibration, variable frequency	2056	Nonoperating		---	---	---	---
Constant acceleration	2006	5000 G in each orientation X ₁ ; Y ₁ ; Y ₂ ; and Z ₁		---	---	---	---
<u>End points:</u>							
(Same as subgroup 2)							

Table II. Group B inspection. - Continued

Examination or test	MIL-STD-750		L T P D	Symbol	Limits		
	Method	Details			Min	Max	Unit
<u>Subgroup 4</u>			10				
Salt atmosphere (corrosion)	1041	(See 3.4.1)		---	---	---	---
<u>End points:</u> (Same as subgroup 2)							
<u>Subgroup 5</u>			$\lambda = 10$				
High-temperature life (nonoperating)	1031	$T_{stg} = 200^{\circ}\text{C}$		---	---	---	---
<u>End points:</u> Breakdown voltage, collector to emitter	3011	Bias cond B. $I_C = 20 \text{ mA dc}$ $R_{BE} = 33 \text{ ohms}$					
2N399				BV_{CER}	60	---	Vdc
2N424				BV_{CER}	80	---	Vdc
Forward-current transfer ratio	3076	$I_C = 1 \text{ A dc}$ $V_{CE} = 15 \text{ V dc}$ pulsed, see 4.4.2		h_{FE}	12	75	---
<u>Subgroup 6</u>			$\lambda = 20$				
Steady state operation life	1026	$T_C = 100^{+5}_{-0}^{\circ}\text{C}$ $P_T = 48 \text{ W}$ $V_{CE} = 40 \text{ V dc}$		---	---	---	---
<u>End points:</u> (Same as subgroup 5)							

6. NOTES

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

Custodians:

Army - EL
Navy - SH
Air Force - 11

Preparing activity:

Navy - SH
(Project 5960-1924)

Review activities:

Army - EL, MU
Navy - SH
Air Force - 11, 17, 85

User activities:

Army - MI, SM
Navy - CG, MC, WP
Air Force - None