The documentation and process conversion measures necessary to comply with this revision shall be completed by 8 June 2001

INCH POUND

MIL-PRF-19500/317J
9 March 2001
SUPERSEDING
MIL-PRF-19500/317H
8 September 2000

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, SWITCHING,
TYPES 2N2369A, 2N3227, 2N4449, 2N2369AU, 2N3227U, 2N4449U,
2N2369AUA, 2N3227UA, 2N4449UA, 2N2369AUB, 2N3227UB, and 2N4449UB
JAN JANTX, JANTXV, JANS, JANHC AND JANKC

This specification is approved for use by all Departments
and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN, silicon, high speed switching transistors (including dual devices). Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500, and two levels of product assurance are provided for each unencapsulated device type.

1.2 Physical dimensions. Figure 1 (TO-18) for 2N2369A and 2N3227, figure 2 (TO-46) for 2N4449, figure 3 for UB version, figure 4 for UA version, figure 5 for U version (dual devices), and figure 6 and 7 (JANC).

1.3 Maximum ratings.

Types	P_T T_A = +25°C	V_{CBO}	V_{EBO}	V_{CEO}	V_{CES}	$R_{\theta JA}$	T_{OP} & T_{STG}
	W	V dc	V dc	V dc	V dc	°C/W	°C
2N2369A	0.36 (1)	40	4.5	15	40	325	-65
2N3227	0.36 (1)	40	6.0	20	40	325	to
2N4449	0.36 (1)	40	4.5	15	40	325	+200
All UA	0.5 (2)					210	
All UB	0.4 (3)					325	
All U	0.5 (4)					291	

(1) Derate linearly 2.06 mW/°C above T_A = +25°C.
(2) Derate linearly 4.76 mW/°C above T_C = +95°C.
(3) Derate linearly 3.08 mW/°C above T_C = +70°C.
(4) Derate linearly 3.44 mW/°C above T_A = +54.5°C.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, Post Office Box 3990, Columbus, OH 43213-1999, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5961

1.4 Primary electrical characteristics.

Type	h_{FE2} (1) V_{CE} = 0.4 V dc I_C = 30 mA dc		h_{FE4} (1) V_{CE} = 1.0 V dc I_C = 100 mA dc		$\lvert h_{FE} \rvert$ V_{CE} = 10 V dc I_C = 10 mA dc f = 100 MHz		$V_{CE(sat)1}$ I_C = 10 mA dc I_B = 1 mA dc	t_{on} I_C = 10 mA dc I_{B1} = 3 mA dc I_{B2} = -1.5 mA dc	t_{off} I_C = 10 mA dc I_{B1} = 3 mA dc I_{B2} = -1.5 mA dc	t_s
	Min	Max	Min	Max	Min	Max	V dc	ns	ns	ns
2N2369A	30	120	20	120	5.0	10	0.20	12	18	13
2N3227	40	250	30	150	5.0	10	0.20	12	25	18
2N4449	30	120	20	120	5.0	10	0.20	12	18	13

(1) Pulsed (see 4.5.1).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Performance Specification Semiconductor Devices, General Specification for.

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

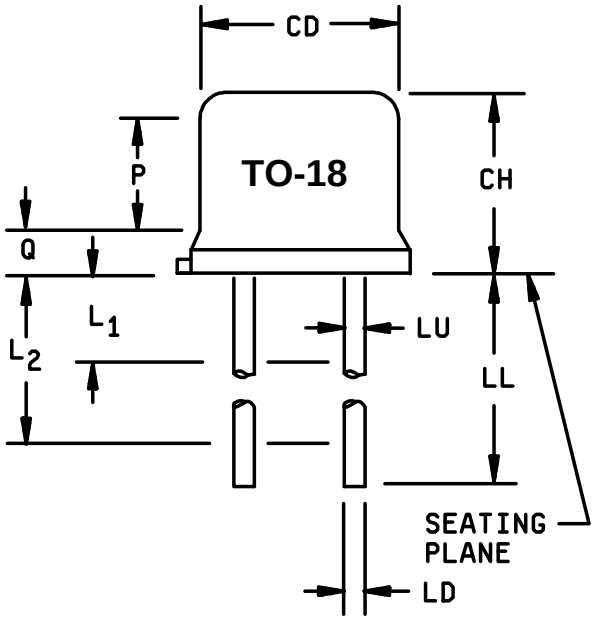
2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

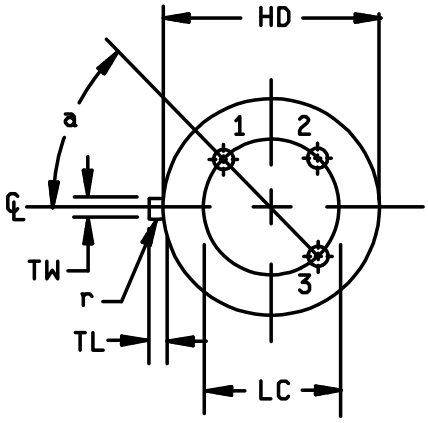
3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.170	.210	4.32	5.33	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		6
LD	.016	.021	0.41	0.53	7,8
LL	.500	.750	12.70	19.05	7,8,13
LU	.016	.019	0.41	0.48	7,8
L1	---	.050	---	1.27	7,8
L2	.250	---	6.35	---	7,8
Q	---	.030	---	0.76	5
TL	.028	.048	0.71	1.22	3,4
TW	.036	.046	0.91	1.17	3
r	---	.010	---	0.25	10
α	45° TP		45° TP		6

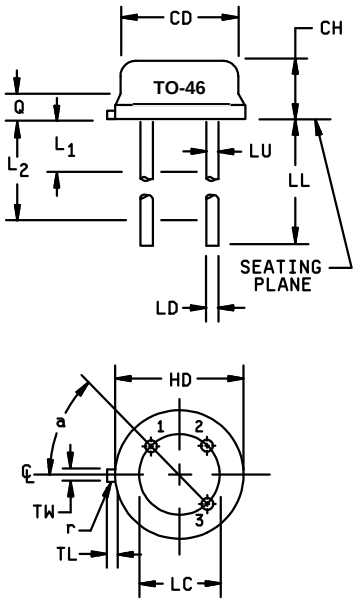




NOTES:
1. Dimension are in inches.
2. Metric equivalents are given for general information only.
3. Beyond r (radius) maximum, TH shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by the gauge and gauging procedure shown in figure 2.
7. Dimension LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
8. All three leads.
9. The collector shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.
12. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

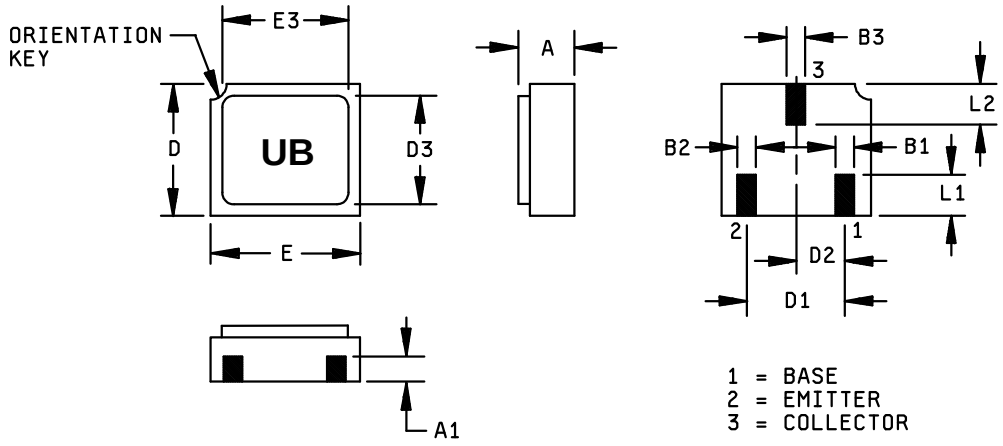
FIGURE 1. Physical dimensions TO-18 2N2369A and 2N3227.

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.065	.085	1.65	2.16	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		5
LD	.016	.021	0.41	0.53	
LL	.500	1.750	12.70	44.45	6
LU	.016	.019	0.41	0.48	6
L1	---	.050	---	1.27	6
L2	.250	---	6.35	---	6
Q	---	.040	---	1.02	3
TL	.028	.048	0.71	1.22	8
TW	.036	.046	0.91	1.17	4
r	---	.010	---	0.25	9
α	45° TP		45° TP		5



NOTES:
1. Dimensions are in inches. Lead 1 is emitter, lead 2 is base, and lead 3 is collector.
2. Metric equivalents are given for general information only.
3. Symbol TL is measured from HD maximum.
4. Details of outline in this zone are optional.
5. Leads at gauge plane .054 inch (1.37 mm) +.001 inch (0.03 mm) -.000 inch (0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of TP relative to tab. Device may be measured by direct methods or by gauge.
6. Symbol LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum.
7. Lead number three is electrically connected to case.
8. Beyond r maximum, TW shall be held for a minimum length of .011 inch (0.28 mm).
9. Symbol r applied to both inside corners of tab.
10. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.

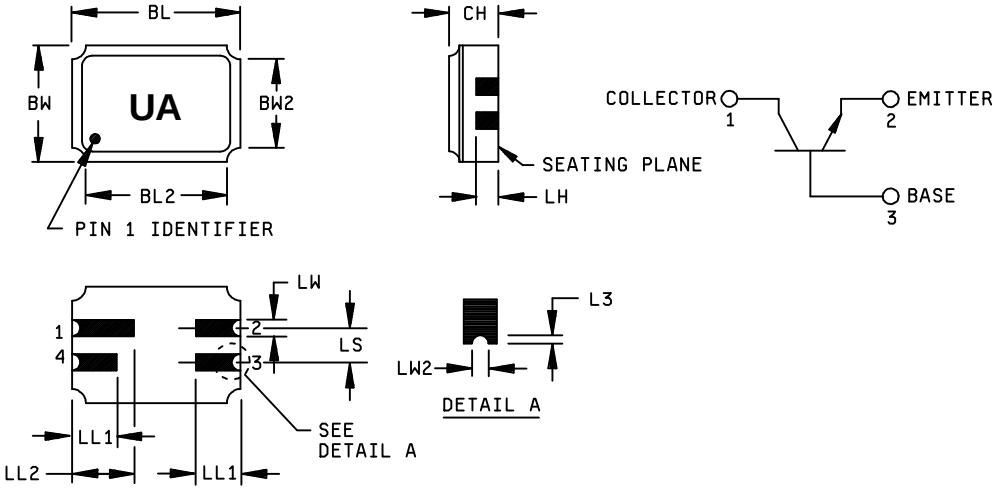
FIGURE 2. Physical dimensions – TO-46 2N4449.



Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.046	.056	0.97	1.42
A1	.017	.035	0.43	0.89
B1	.016	.024	0.41	0.61
B2	.016	.024	0.41	0.61
B3	.016	.024	0.41	0.61
D	.085	.108	2.41	2.74
D1	.071	.079	1.81	2.01
D2	.035	.039	0.89	0.99
D3	.085	.108	2.41	2.74
E	.115	.128	2.82	3.25
E3	---	.128	---	3.25
L1	.022	.038	0.56	0.96
L2	.022	.038	0.56	0.96

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

FIGURE 3. Physical dimensions - surface mount (UB version).

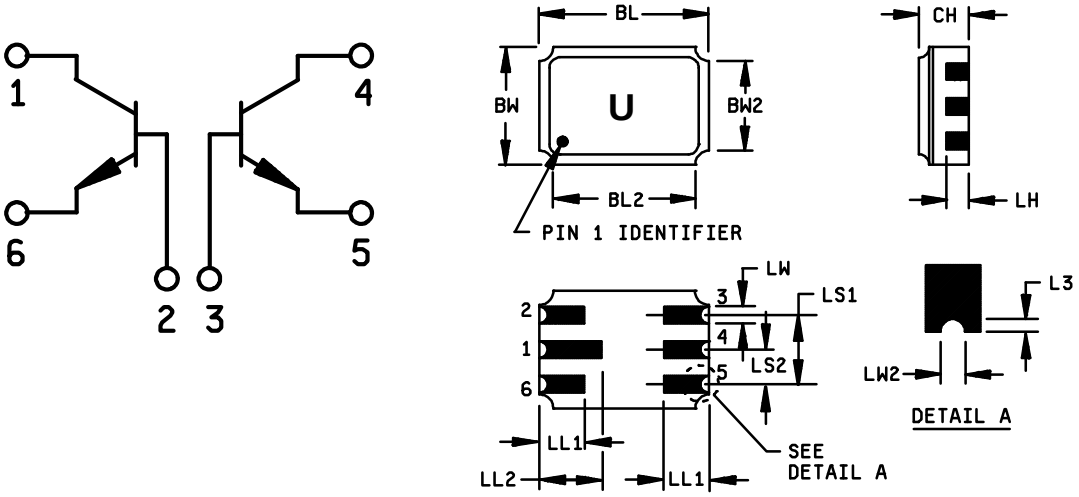


Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.215	.225	5.46	5.71
BL_2		.225		5.71
BW	.145	.155	3.68	3.93
BW_2		.155		3.93
CH	.061	.075	1.55	1.90
L_3	.003	.007	0.08	0.18
LH	.029	.042	0.74	1.04
LL_1	.032	.048	0.81	1.22
LL_2	.072	.088	1.83	2.23
LS	.045	.055	1.14	1.39
LW	.022	.028	0.56	0.71
LW_2	.006	.022	0.15	0.56

Pin no.	1	2	3	4
Transistor	Collector	Emiiter	Base	N/C

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. The coplanarity deviation of all terminal contact points, as defined by the device seating plane, shall not exceed .006 inch (0.15mm) for solder dipped leadless chip carriers.

FIGURE 4. Physical dimensions – surface mount (UA versions).

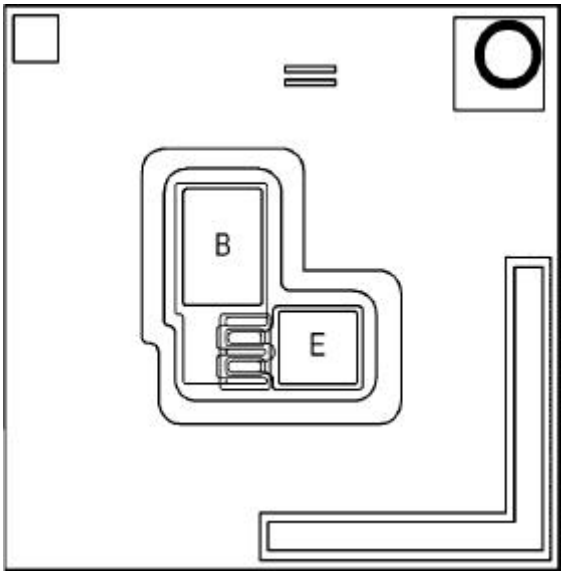


Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.240	.250	6.10	6.35
BL_2		.250		6.35
BW	.165	.175	4.19	4.44
BW_2		.175		4.44
CH	.066	.080	1.68	2.03
L_3	.003	.007	0.08	0.18
LH	.026	.034	0.66	0.86
LL_1	.060	.070	1.52	1.78
LL_2	.082	.098	2.08	2.49
LS_1	.095	.105	2.41	2.67
LS_2	.045	.055	1.14	1.39
LW	.022	.028	0.56	0.71
LW_2	.006	.022	0.15	0.56

Pin No.	1	2	3	4	5	6
Transistor	Collector no. 1	Base no. 1	Base no. 2	Collector no. 2	Emitter no. 2	Emitter no. 1

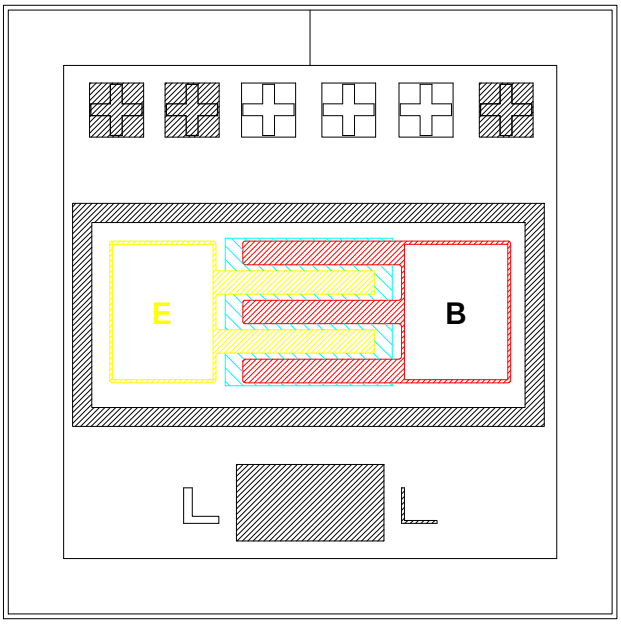
NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. The coplanarity deviation of all terminal contact points, as defined by the device seating plane, shall not exceed .006 inch (0.15 mm) for solder dipped leadless chip carriers.

FIGURE 5. Physical dimensions - surface mounted dual devices (U version).



1. Chip size: 20 x 20 mils ± 2 mils.
2. Chip thickness: 10 ± 1.5 mils nominal.
3. Top metal: Aluminum 10,000Å minimum, 12,000Å nominal.
4. Back metal: a. Al/Ti/Ni/Ag 12kÅ/3kÅ/7kÅ/7kÅ min.,15kÅ/5kÅ/10kÅ/10kÅ nominal.
   b. Gold 2,500Å minimum, 3,000Å nominal.
   c. Eutectic Mount – No Gold.
5. Backside: Collector.
6. Bonding pad: B = 4 x 4.5 mils, E = 4.5 x 5 mils.

FIGURE 6. JANHC and JANKC A-version die dimensions - 2N2369A.



Die size:	0.016 inch x 0.016 inch (0.4064 mm x 0.4064 mm).
Die thickness:	0.008 inch ± 0.0016 inch (0.2032 mm ±0.4064 mm).
Base pad:	0.0036 inch x 0.0028 inch (0.09144 mm x 0.07112 mm).
Emitter pad:	0.0036 inch x 0.0028 inch.
Back metal:	Gold, 6500 ± 1950 Ang.
Top metal:	Aluminum, 17500 ± 2500 Ang.
Back side:	Collector.
Glassivation:	SiO_2, 7500 ± 1500 Ang.

FIGURE 7. JANHC and JANKC B-version die dimensions - 2N2369A, 2N3227.

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500, and herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.5 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4 and table I herein. When a particular device is specified, the limit applies to all package types (e.g., 2N2369A, 2N2369AU, 2N2369AUA, and 2N2369AUB).

3.6 Electrical test requirements. The electrical test requirements shall be the subgroups specified in paragraphs table I herein. When a particular device is specified, the limit applies to all package types (e.g., 2N2369A, 2N2369AU, 2N2369AUA, and 2N2369AUB).

3.7 Marking. Marking shall be in accordance with MIL-PRF-19500, except for the UB suffix package. Marking on the UB package shall consist of an abbreviated part number, the date code, and the manufacturers symbol or logo. The prefixes JAN, JANTX, JANTXV and JANS can be abbreviated as J, JX, JV and JS respectively. The "2N" prefix and the "AUB" suffix may also be omitted.

3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3)

c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.3 Screening (JANS, JANTX, and JANTXV levels only). Screening shall be in accordance with table VI of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
3c	Thermal impedance (see 4.3.3)	Thermal impedance (see 4.3.3)
9	I_{CES} and h_{FE3}	Not applicable
11	I_{CES}; h_{FE3}; ΔI_{CES} = 100 percent of initial value or 25 nA dc, whichever is greater. Δh_{FE3} = ±15 percent of initial value.	I_{CES}, h_{FE3}
12	See 4.3.1 240 hours minimum	See 4.3.1 80 hours minimum
13	Subgroups 2 and 3 of table I herein; ΔI_{CES} = 100 percent of initial value or 25 nA dc, whichever is greater; Δh_{FE3} = ±15 percent of initial value.	Subgroup 2 of table I herein; ΔI_{CES} = 100 percent of initial value or 25 nA dc, whichever is greater; Δh_{FE3} = ±15 percent of initial value.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: V_{CE} = 5 - 15 Vdc, Pd= 360 mW, T_A = room ambient as defined in 4.5 of MIL-STD-750.

4.3.2. Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500, "Discrete Semiconductor Die/Chip Lot Acceptance". Burn-in duration for the JANKC level follows JANS requirements; the JANHC follows JANTX requirements

4.3.3 Thermal impedance ($Z_{\theta JX}$ measurements). The $Z_{\theta JX}$ measurements shall be performed in accordance with method 3131 of MIL-STD-750.

a. I_M measurement current ----------5 mA.

b. I_H forward heating current ----------50 mA (min).

c. t_H heating time ----------25 - 30 ms.

d. t_{md} measurement delay time ----------60 µs max.

e. V_{CE} collector-emitter voltage ----------10 V dc minimum.

The maximum limit for $Z_{\theta JX}$ under these test conditions is $Z_{\theta JX}$ (max) = 75°C/W, except the maximum limit for U package is $Z_{\theta JX}$ (max) = 175°C/W per side.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. If alternate screening is being performed in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of group A1 and A2 inspection only (table VIb, group B, subgroup 1 is not required to be performed again if group B has already been satisfied in accordance with 4.4.2).

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500, and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table VIa (JANS) of MIL-PRF-19500 and 4.4.2.1. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and 4.5.3 herein. See 4.4.2.2 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) for JAN, JANTX, and JANTXV shall be after each step in 4.4.2.2 and shall be in accordance with group A, subgroup 2 herein. Delta measurements shall be in accordance with 4.5.3 herein.

4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

Subgroup	Method	Condition
B4	1037	V_{CB} = 12 V dc
B5	1027	V_{CB} = 12 V dc. $P_D \geq$ 100 percent of maximum rated P_T (see 1.3). Option 1: 96 hrs min, sample size in accordance with table Via of MIL-PRF-19500, adjust T_A to achieve T_j = +275°C minimum. Option 2: 216 hrs min., sample size = 45, c = 0; adjust T_A to achieve T_j = +225°C minimum. (NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.)

4.4.2.2 Group B inspection, (JAN, JANTX, and JANTXV) Separate samples may be used for each step. In the event of a group B failure, the manufacturer may pull a new sample at double the sample size from either the failed assembly lot or from another assembly lot from the same wafer lot. If the new "assembly lot" option is exercised, the failed assembly lot shall be scrapped.

Step	Method	Condition
1	1039	Steady-state life: Test condition B, 340 hours, V_{CB} = 5 - 15 V dc. n = 45, c = 0. Maximum rated power (see 1.3) shall be applied to the device and ambient temperature shall be adjusted to achieve $T_J \geq$ 150°C.
2	1039	The steady state life test of step 1 shall be extended to 1,000 hours for each die design. Samples shall be selected from a wafer lot every twelve months of wafer production. Group B step 2 shall not be required more than once for any single wafer lot. n = 45, c = 0.
3	1032	High-temperature life (non-operating), T_A = +200°C. n = 22, c = 0.

4.4.2.3 Group B sample selection. Samples selected from group B inspection shall meet all of the following requirements:

a. For JAN, JANTX, and JANTXV samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. For JANS, samples shall be selected from each inspection lot. See MIL-PRF-19500.

b. Must be chosen from an inspection lot that has been submitted to and passed group A, subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (subgroups B4 and B5 for JANS, and group B for JAN, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table VII of MIL-PRF-19500, and in 4.4.3.1 (JANS).and 4.4.3.2 (JAN, JANTX, and JANTXV) herein for group C testing. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and 4.5.3 herein.

4.4.3.1 Group C inspection, table VII (JANS) of MIL-PRF-19500.

Step	Method	Condition
C2	2036	Test condition E; not applicable for U, UA and UB devices.
C6	1026	1,000 hours at V_{CB} = 5 - 15 V dc. n = 45, c= 0. Maximum rated power (see 1.3) shall be applied to the device and ambient temperature shall be adjusted to achieve $T_J \geq$ 150°C.

4.4.3.2 Group C inspection, table VII (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

Step	Method	Condition
C2	2036	Test condition E.
C6	Not applicable.	

4.4.3.3 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any inspection lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes group A tests for conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for C6 life test may be pulled prior to the application of final lead finish Testing of a subgroup using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Input capacitance. This test shall be conducted in accordance with method 3240 of MIL-STD-750, except the output capacitor shall be omitted.

4.5.3 Delta requirements. Delta requirements shall be as specified below:

Test	Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limit
		Method	Conditions		
1.	Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 10 mA dc; pulsed (see 4.5.1)	Δh_{FE3}	±25 percent change from initial value.
2.	Collector - emitter and resistance	3071	I_C = 10 mA dc; I_B = 1.0 mA dc	$\Delta V_{CE(sat)}$	±50 mV change from previous measured value.
3.	Collector - emitter cutoff current	3041	Bias condition C; V_{CE} = 20 V dc;	ΔI_{CES1}	100 percent of initial value or 25 nA dc, whichever is greater.

1/ The electrical measurements for table VIa (JANS) of MIL-PRF-19500 are as follows: Subgroups B4 and B5: tests 1, 2 and 3.
2/ The electrical measurements (JAN, JANTX and JANTXV) of 4.4.2.2 herein are as follows: Steps 1, 2 and 3: tests 1 and 3.
3/ The electrical measurements for table VII and 4.4.3.1 of MIL-PRF-19500 are as follows: Subgroup 6, see 4.5.3 herein, steps 2 and 3 (for JANS).

TABLE I. Group A inspection

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical 3/ examination	2071	n = 45 devices, c = 0				
Solderability 3/ 4/	2026	n = 15 leads, c = 0				
Resistance to solvents 3/ 4/ 5/	1022	n = 15 devices, c = 0				
Temp cycling 3/ 4/	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Heremetic seal 4/	1071	n = 22 devices, c = 0				
Fine leak						
Gross leak						
Electrical measurements 4/		Group A, subgroup 2				
Bond strength 3/ 4/	2037	Precondition T_A = +250°C at t = 24 hrs or T_A = 300°C at t = 2 hrs n = 11 wires, c = 0				
Subgroup 2						
Breakdown voltage, collector to base	3036	V_{CB} = 40 V dc	I_{CBO1}		10	µA dc
Breakdown voltage, emitter to base	3026		I_{EBO1}		10	µA dc
2N2369A, 2N4449		V_{EB} = 4.5 V dc				
2N3227		V_{EB} = 6.0 V dc				
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 10 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N2369A, 2N4449				15		V dc
2N3227				20		V dc
Collector to emitter cutoff current	3041	Bias condition C; V_{CE} = 20 V dc	I_{CES}		0.4	µA dc
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 32 V dc	I_{CBO2}		0.2	µA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4 V dc	I_{EBO2}		0.25	µA dc
Forward-current transfer ratio	3076	V_{CE} = 0.35 V dc; I_C = 10 mA dc pulsed (see 4.5.1)	h_{FE1}			
2N2369A, 2N4449,				40	120	
2N3227				70	250	
Forward-current transfer ratio	3076	V_{CE} = 0.4 V dc; I_C = 30 mA dc pulsed (see 4.5.1)	h_{FE2}			
2N2369A, 2N4449				30	120	
2N3227				40	250	
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 10 mA dc pulsed (see 4.5.1)	h_{FE3}			
2N2369A, 2N4449				40	120	
2N3227				75	300	

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

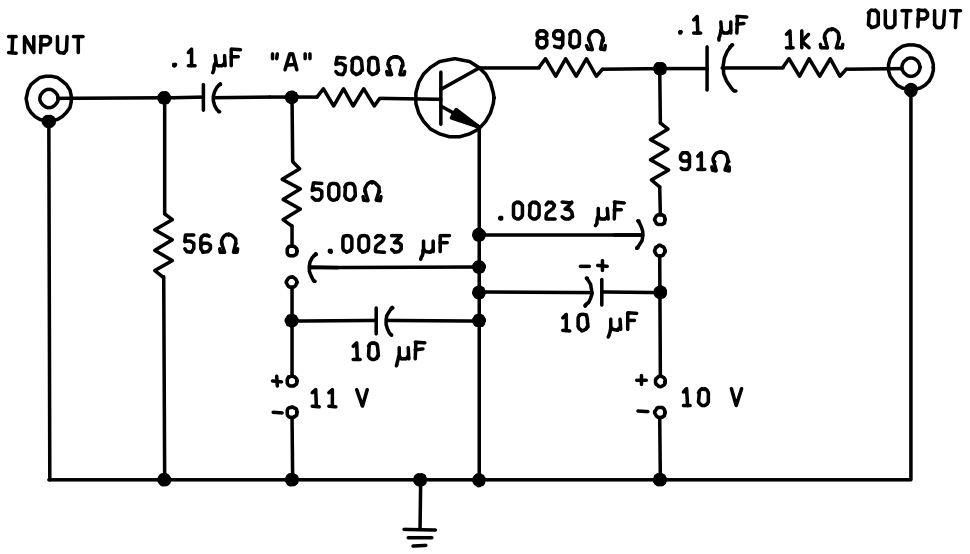
Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - Continued						
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 100 mA dc; pulsed(see 4.5.1)	h_{FE4}			
2N2369A, 2N4449				20	120	
2N3227				30	150	
Collector-emitter saturation voltage	3071	I_C = 10 mA dc; I_B = 1.0 mA dc pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.20	V dc
Collector-emitter saturation voltage	3071	I_C = 30 mA dc; I_B = 3.0 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		0.25	V dc
Collector-emitter saturation voltage	3071	I_C = 100 mA dc; I_B = 10 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)3}$		0.45	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 10 mA dc; I_B = 1.0 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)1}$	0.70	0.85	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 30 mA dc; I_B = 3.0 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)2}$		0.90	
Base-emitter saturation voltage	3066	Test condition A; I_C = 100 mA dc; I_B = 10 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)3}$	0.80	1.20	V dc
Subgroup 3						
High temperature operation		T_A = +150°C				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 20 V dc	I_{CBO2}		30	µA dc
High temperature operation		T_A = +125°C				
Collector to base cutoff current	3041	Bias condition A; V_{CE} = 10 V dc; V_{BE} = 0.25 V dc	I_{CEX2}		30	µA dc
Collector - emitter voltage saturated	3071	I_C = 10 mA dc I_B = 1.0 mA dc	$V_{CE(sat)4}$		0.3	V dc
Base - emitter saturated voltage	3066	Test condition A; I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{BE(sat)4}$			
2N2369A, 2N4449				0.59		V dc
2N3227				0.50		V dc
Low temperature operation		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 10 mA dc pulsed (see 4.5.1)	h_{FE5}			
2N2369A, 2N4449				20		
2N3227				40		
Base - emitter saturated voltage	3066	Test condition A; I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{BE(sat)5}$		1.02	V dc

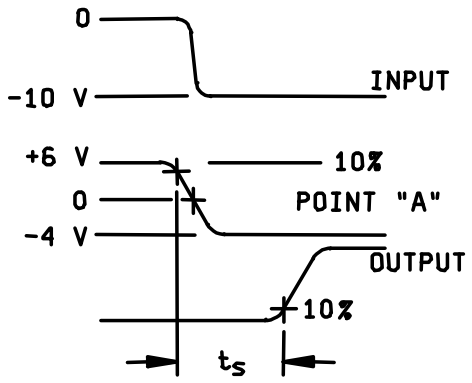
See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 4						
Small-signal short-circuit forward current transfer ratio	3306	V_{CE} = 10 V dc; I_C = 10 mA dc; f = 100 MHz	$\lvert h_{fe} \rvert$	5.0	10	
Open circuit output capacitance	3236	V_{CB} = 5 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{obo}		4.0	pF
Input capacitance (output open-circuited)	3240	V_{EB} = 0.5 V dc; I_C = 0; 100 kHz ≤ f ≤ 1 MHz	C_{ibo}			
2N2369A, 2N4449					5.0	pF
2N3227					4.0	pF
Charge storage time		I_C = 10 mA dc; I_{B1} = 10 mA dc; I_{B2} = 10 mA dc; (see figure 8)	t_S			
2N2369A, 2N4449					13	ns
2N3227					18	ns
Turn-on time		I_C = 10 mA dc; I_{B1} = 3.0 mA dc; I_{B2} = 1.5 mA dc; (see figure 9)	t_{on}		12	ns
Turn-off time		I_C = 10 mA dc; I_{B1} = 3.0 mA dc; I_{B2} = 1.5 mA dc; (see figure 9)	t_{off}			
2N2369A, 2N4449					18	ns
2N3227					25	ns

1/ For sampling (unless otherwise specified) plan see MIL-PRF-19500.
2/ For resubmission of failed subgroup A1, double the sample size of the failed test or sequence of tests. A failure in group A, subgroup 1 shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.
3/ Separate samples may be used.
4/ Not required for JANS devices.
5/ Not required for laser marked devices.

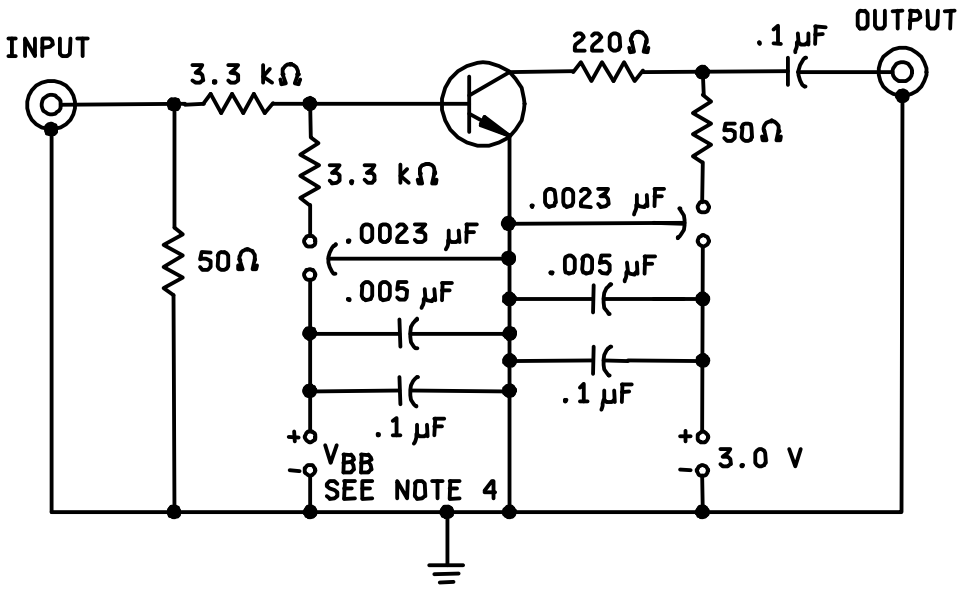


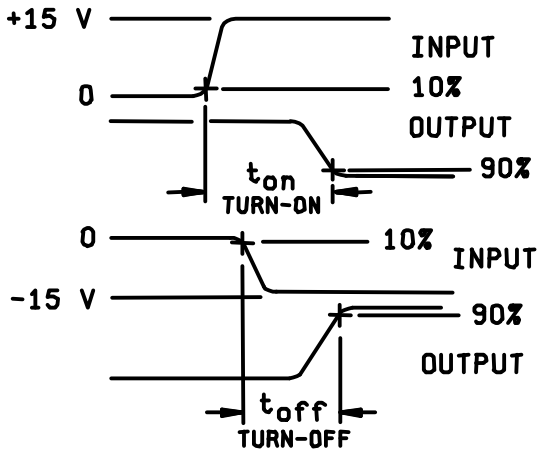


VOLTAGE WAVEFORMS

NOTES:
1. All capacitance in µF.
2. The input waveforms for each circuit are supplied by a pulse generator with the following characteristics: Z_{OUT} = 50Ω, $t_r \leq 1$ ns, PW ≥ 300 ns, duty cycle ≤ 2 percent.
3. Output waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq .1$ ns, Z_{IN} = 50Ω.

FIGURE 8. Charge storage time test circuit.





VOLTAGE WAVEFORMS

NOTES:
1. All capacitance in µF.
2. The input waveforms for each circuit are supplied by a pulse generator with the following characteristics: Z_{OUT} = 50Ω, $t_r \leq 1$ ns, PW ≥ 300 ns, duty cycle ≤ 2 percent.
3. Input and output waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq .1$ ns, Z_{IN} = 50Ω.
4. V_{BB} = -3.0 V for t_{on}, +12.0 V for t_{off}.

FIGURE 9. Turn-on and turn-off time test circuit.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements should be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. The acquisition requirements are as specified in MIL-PRF-19500.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturer's List QML-19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, DSCC-VQE, Columbus, OH 43216.

6.4 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N2369A) will be identified on the QPL.

Die ordering information		
PIN	Manufacturer	
	43611	34156
2N2369A	JANHCA2N2369, JANKCA2N2369	JANHCB2N2369A, JANKCB2N2369A
2N3227	JANHCA2N3227, JANKCA2N3227	JANHCB2N3227, JANKCB2N3227
2N4449	JANHCA2N4449, JANKCA2N4449	

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Army - CR
Navy - EC
Air Force - 11
NASA – NA
DLA - CC

Review activities:
Army - AR, MI, SM
Navy - AS, CG, MC
Air Force - 13, 19, 99

Preparing activity:
DLA - CC

(Project 5961-2430)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/317J	2. DOCUMENT DATE 9 March 2001

3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, SWITCHING, TYPES 2N2369A, 2N3227, 2N4449, 2N2369AU, 2N3227U, 2N4449U, 2N2369AUA, 2N3227UA, 2N4449UA, 2N2369AUB, 2N3227UB, and 2N4449UB JAN JANTX, JANTXV, JANS, JANHC AND JANKC

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (PLEASE PRINT)	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. NAME Alan Barone	b. TELEPHONE Commercial: 614-692-0510 DSN: 850-0510 FAX: 614-692-6939 EMAIL: alan.barone@dscc.dla.mil
c. ADDRESS *(Include Zip Code)* Defense Supply Center Columbus ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533 Fort Belvoir, Virginia 22060-6221 Telephone (703)767-6888 DSN 427-6888