

The documentation and process conversion measures necessary to comply with this revision shall be completed by 27 March 1994

INCH-POUND

MIL-S-19500/552A(USAF)
27 December 1993
SUPERSEDING
MIL-S-19500/552(USAF)
26 October 1981

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, TRANSIENT VOLTAGE SUPPRESSOR TYPES 1N6469 THROUGH 1N6476 JAN, JANTX, AND JANTXV

This specification is approved for use by the Rome Laboratory, Department of the Air Force, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for 1,500-watt peak pulse power silicon, transient voltage suppressor diodes. Three levels of product assurance are provided for each device type as specified in MIL-S-19500.

1.2 Physical dimensions. See figure 1.

1.3 Maximum ratings. Maximum ratings are as shown in columns 5 through 8 of table III herein and as follows:

$P_R = 3 \text{ W}$ (derate at 20 mW/°C above $T_A = +25^\circ\text{C}$) (see figure 2).

$P_{PP} = 1,500 \text{ W}$ (see figure 3) at $t_p = 1 \text{ ms}$.

$I_{FSH} = 130 \text{ A(pk)}$ at $+50^\circ\text{C}$. $t_p = 8.33 \text{ ns}$ ($T_A = +25^\circ\text{C}$).

$-55^\circ\text{C} \leq T_{op} \leq +175^\circ\text{C}$; $-55^\circ\text{C} \leq T_{STG} \leq +175^\circ\text{C}$ (ambient).

1.4 Primary electrical characteristics. Primary electrical characteristics are as shown in columns 2 and 4 of table III herein.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Electronics Supply Center, ATTN: DESC-ECT, 1507 Wilmington Pike, Dayton, OH 45444-5270, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

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FSC 5961

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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 (DOISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARD

MILITARY

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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 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 Associated detail specification. The individual item requirements shall be in accordance with MIL-S-19500 and as specified herein.

3.2 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions shall be as specified in MIL-S-19500.

P_{pp} Reverse peak pulse power.

V_{CF} Forward clamping voltage.

3.3 Design, construction, and physical dimensions. Design, construction, and physical dimensions shall be as specified in MIL-S-19500 and on figure 1 herein.

3.3.1 Construction. These devices shall be constructed utilizing metallurgically bonded-noncavity double-plug construction between both sides of the silicon die and terminal pins.

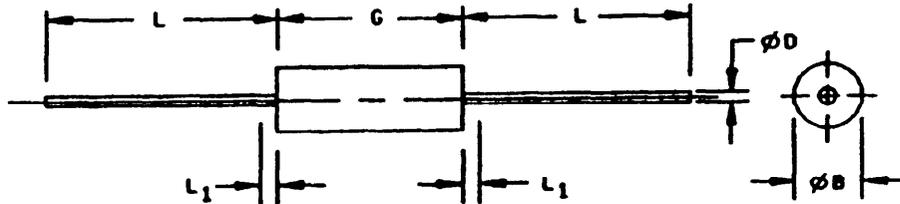
3.3.2 Lead finish. Lead finish shall be solderable in accordance with MIL-S-19500 and MIL-STD-750. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4 Marking. Marking shall be in accordance with MIL-S-19500.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein. Lot accumulation shall be six months in lieu of six weeks.

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-S-19500.



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
phi B	.150	.185	3.30	4.70	
phi D	.037	.042	0.94	1.07	3
G	.160	.375	4.06	9.53	3
L	.900	1.300	22.86	33.02	
L1	---	.050	---	1.27	4

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Package contour optional within phi D and length G. Heat slugs, if any, shall be included within this cylinder but shall not be subject to minimum limit of phi D.
4. Within this zone lead, diameter may vary to allow for lead finishes and irregularities other than heat slugs.

FIGURE 1. Physical dimensions.

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4.3 Screening (JANTXV and JANTX levels only). Screening shall be in accordance with table II of MIL-S-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 II of MIL-S-19500)	Measurement
	JANTX and JANTXV levels
9	Not applicable
11	I_R and $V_{(BR)}$
12	See 4.3.1
13	$\Delta I_R \leq 100$ percent of initial reading or column 5 of table III, whichever is greater; $\Delta V_{(BR)} \leq \pm 2$ percent of initial reading, or column 2 of table III, whichever is greater.

4.3.1 Power burn-in and steady-state operation life test conditions. This test shall be conducted with the devices subjected to test conditions in the following order of events and conditions:

- a. Read and record I_D and $V_{(BR)}$ at $T_A = +25^\circ\text{C}$.
- b. Pulse in accordance with 4.5.1a 20 times (screening and group B operation life test) and 100 times (group C) at $T_A = +25^\circ\text{C}$.
- c. Read I_D at $T_A = +25^\circ\text{C}$, remove defective devices, and record the number of failures.
- d. Apply the working peak reverse voltage ($V_{(RUN)}$) (column 4 of table III) at an ambient temperature of $T_A = +125^\circ\text{C}$, as follows. End point measurements shall be performed within 24 hours.
 - (1) 96 hours minimum (JANTX and JANTXV) for the screening test.
 - (2) 340 hours (JAN, JANTX, and JANTXV) for group B steady-state operation life test.
 - (3) 1,000 hours for group C steady-state operation life test.
- e. Read and record I_D and $V_{(BR)}$ at $T_A = +25^\circ\text{C}$. Devices with $\Delta I_D > 50$ percent (100 percent for steady-state operation life) of initial value or 20 percent of column 5, table III, whichever is greater, or $\Delta V_{(BR)} > 2$ percent (± 5 percent for steady-state operation life) of initial value shall be considered defective. For steady-state operation life I_D limit (maximum) shall be two times the group A limit. Remove defective devices and record the number of failures.

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-S-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-19500, and table I herein. (End-point electrical measurements shall be in accordance with the applicable steps of table II herein.)

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4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IVb (JAN, JANTXV, and JANTX) of MIL-S-19500, and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table II herein.

4.4.2.1 Group B inspection, table IVb of MIL-S-19500.

Subgroup	Method	Conditions
B3	1026	See 4.3.1.
B5	3101 or 4081	$R_{eJL} \leq 50^\circ\text{C}/\mu, +25^\circ\text{C} \leq T_L \leq +35^\circ\text{C}$ and recorded before the test is started.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table V of MIL-S-19500 and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table II herein.

4.4.3.1 Group C inspection, table V of MIL-S-19500.

Subgroup	Method	Conditions
C2	2036	Test condition A; weight = 5 pounds; t = 15 seconds \pm 3 seconds.
C6	1026	$T_A = +125^\circ\text{C}$ (see 4.3.1).
C7	4071	$=V_{(BR)}$ in accordance with MIL-STD-750, method 4071, $I_{(BR)}$ = column 3 of table III, $T_1 = +25^\circ\text{C} \pm 3^\circ\text{C}$; $T_2 = +125^\circ\text{C}$; maximum limits = column 8 of table III; units = %/°C; 22 devices, c = 0.
C8	---	Maximum peak pulse current; conditions, see 4.5.1b (20 μs pulse only) 10 pulses; 22 devices, c = 0.

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

4.5.1 Maximum peak pulse current (I_{pp}). The peak currents specified in column 7 of table III shall be applied in the reverse direction while simultaneously maintaining a reverse bias voltage of not less than the applicable voltage specified in column 4 of table III. The peak current shall be applied with a current versus time waveform as follows:

- Pulse current shall reach 100 percent of I_{pp} at $t \leq 10 \mu\text{s}$ and decay to 50 percent at $t \geq 1 \text{ ms}$ for $t_p = 1 \text{ ms}$ (see figure 4).
- Pulse current shall reach 100 percent of I_{pp} at $t \leq 8 \mu\text{s}$ and decay to 50 percent at $t \geq 20 \mu\text{s}$ for $t_p = 20 \mu\text{s}$ (see figure 5).

4.5.2 Clamping voltage $V_{C(max)}$. The peak pulse clamping voltage shall be measured across the diode in a 1 ms time interval. The response detector shall demonstrate equipment accuracy of ± 3 percent. The peak clamping voltage, as specified in column 6 of table III herein, shall be applicable to the 1 ms pulse of 4.5.1a only.

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TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits 2/		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Breakdown voltage	4021	$t_p \leq 300$ ms, duty cycle ≤ 2 percent; $I_{(BR)} =$ column 3 of table III	$V_{(BR1)}$	column 2 of table III		V dc
Reverse current	4016	DC method; $V_R = V_{RWM}$ (column 4 of table III)	I_D		column 2 of table III	μ A dc
<u>Subgroup 3</u>						
Minimum breakdown voltage	4021	$t_p \leq 300$ ms, duty cycle ≤ 2 percent; $I_{(BR)} =$ column 3 of table III; $T_A = -55^\circ$ C	$V_{(BR2)}$	column 9 of table III		V dc
<u>Subgroup 4</u>						
Clamping voltage maximum (see 4.5.2)		$t_p = 1.0$ ms (see 4.5.1a) $I_{pp} =$ column 7 of table III	V_C		column 6 of table III	V (pk)
Forward voltage	4011	$I_F = 4$ A dc	V_F	1.5		V (pk)
Forward voltage	4011	$I_{FM} = 100$ A (pk), $t_p = 300$ μ s, duty cycle = 4 pulses per minute maximum	V_{FM}	4.8		V (pk)
<u>Subgroup 5</u>						
Not applicable						
<u>Subgroup 6</u>						
Surge current	4066	One pulse, half sine wave 8.3 ms; $I_F = 0$, $V_{RWM} = 0$, $T_A = +25^\circ$ C, $I_{FSM} = 130$ A (pk)	I_{FSM}			
Electrical measurements		Table II, steps 1 and 2				
<u>Subgroup 7</u>						
Forward clamping voltage (see 4.5.2)		$t_p = 1.0$ ms (see 4.5.1) at I_{pp} except use forward direction current without prior bias voltage	V_{CF}		column 10 of table III	V (pk)

1/ For sampling plan, see MIL-S-19500.

2/ Column references are to table III herein.

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TABLE II. Group A, B, and C electrical end-point measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Reverse current (standby)	4016	DC method, $V_R = V_{RVM}$ (column 4 of table III)	I_{D1}		column 5 of table III	μA dc
2.	Breakdown voltage	4021	$t_p \leq 300$ ms, duty cycle ≤ 2 percent; $I_{(BR)} =$ column 3 of table III	$V_{(BR)}$	column 2 of table III		V dc
3.	Reverse current (standby)	4016	DC method; $V_R = V_{RVM}$ column 4 of table III	ΔI_{D1} 1/		100 percent of initial reading or 20 percent of column 5 of table III, whichever is greater.	
4.	Breakdown voltage	4021	$t_p \leq 300$ ms, duty cycle ≤ 2 percent; $I_{BR} =$ column 3 of table III	$\Delta V_{(BR)}$ 1/		± 5 percent of initial value.	

1/ The electrical measurements for table IVb (JANTX and JANTXV) of MIL-S-19500 are as follows:

- a. Subgroup 2, see table II herein, steps 1 and 2.
- b. Subgroup 3, see table II herein, steps 1, 2, 3, and 4 (see 4.3.1e).
- c. Subgroup 6, see table II herein, steps 1, 2, 3, and 4.

2/ The electrical measurements for table V of MIL-S-19500 are as follows:

- a. Subgroup 2, see table II herein, steps 1 and 2.
- b. Subgroup 6, see table II herein, steps 1, 2, 3, and 4 (see 4.3.1e).
- c. Subgroup 8, see table II herein, steps 1 and 2.

TABLE III. Electrical characteristics.

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7		Col 8	Col 9	Col 10
	$V_{(BR)}$ at $I_{(BR)}$ minimum V dc	$I_{(BR)}$ $t_p = 300 \text{ ns}$ duty cycle ≤ 2 percent mA dc	V_{RWM} V (PK)	I_D at V_{RWM} $\mu\text{A dc}$	V_C at I_{pp} for $t_D = 1 \text{ ms}$ V (PK)	I_p $t_p = 20 \mu\text{s}$ $t_r = 8 \mu\text{s}$ A (PK)		$-V_{(BR)}$ at $-I_{(BR)}$ X / °C	$V_{(BR)}$ minimum at $I_{(BR)}$ $T_A = -55^\circ\text{C}$ V dc	V_{CF} at $t_p = 1 \text{ ms}$ A (PK) = per col 7 inverse polarity V (PK)
1N6469	5.6	50	5	5,000	9.0	945	167	-.03, +.045	5.4	-3.5
1N6470	6.5	50	6	5,000	11.0	775	137	-.060	6.2	-3.2
1N6471	13.6	10	12	1,000	22.6	374	66	-.085	12.7	-3.8
1N6472	16.4	10	15	1,000	26.5	322	57	-.085	15.3	-3.8
1N6473	27.0	5	24	100	41.4	206	36.5	-.096	24.9	-3.6
1N6474	33.0	1	30.5	5	47.5	190	32	-.098	30.2	-3.6
1N6475	43.7	1	40.3	5	63.5	136	24	-.101	40.0	-3.5
1N6476	54.0	1	51.6	5	78.5	106	19	-.103	48.5	-3.4

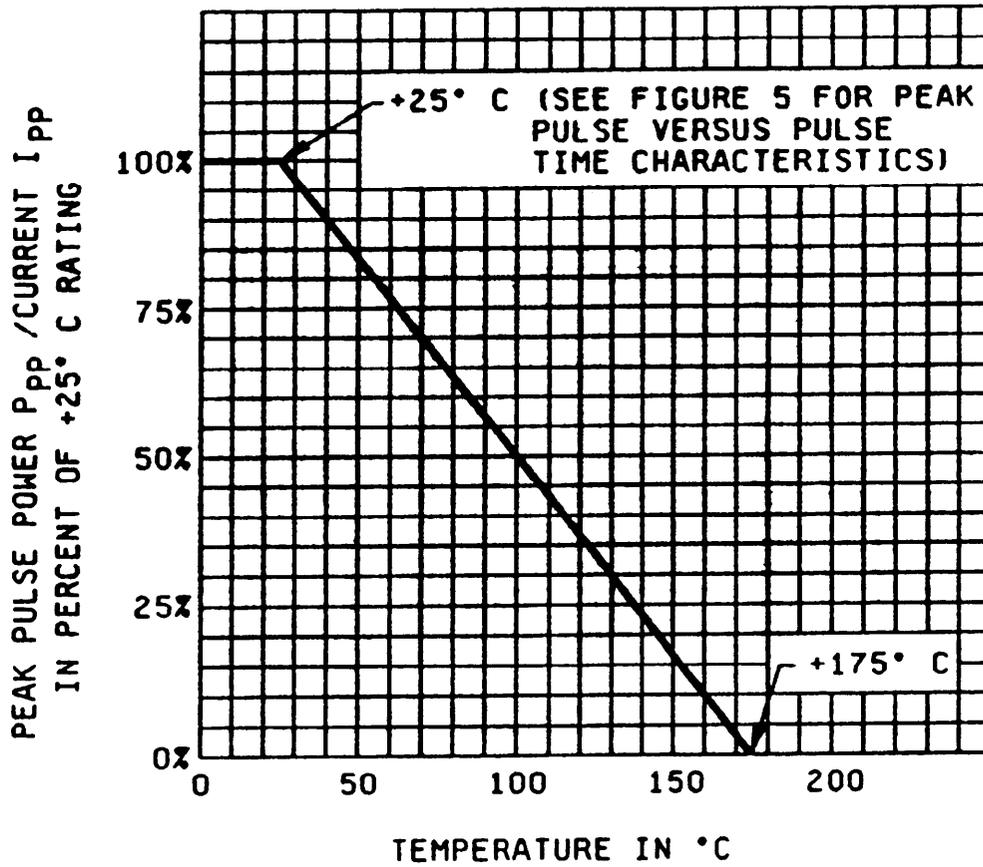
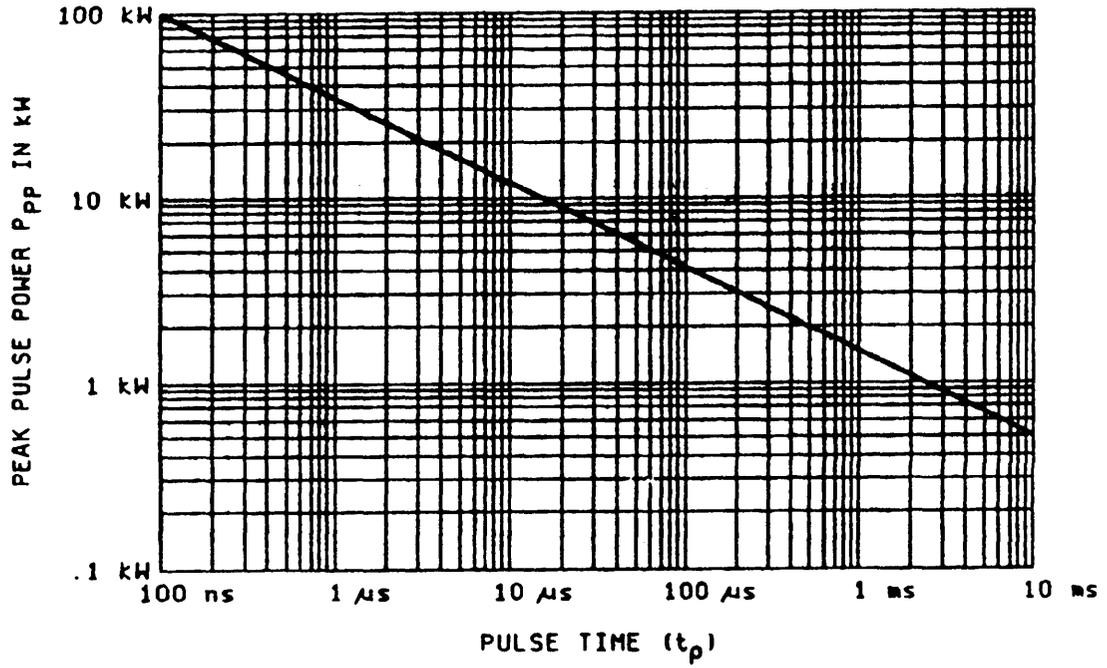


FIGURE 2. Derating curve.



NOTE: Power shall be determined from actual clamping voltage at peak pulse current and pulse time duration (see 4.5.2).

FIGURE 3. Peak pulse power versus pulse time.

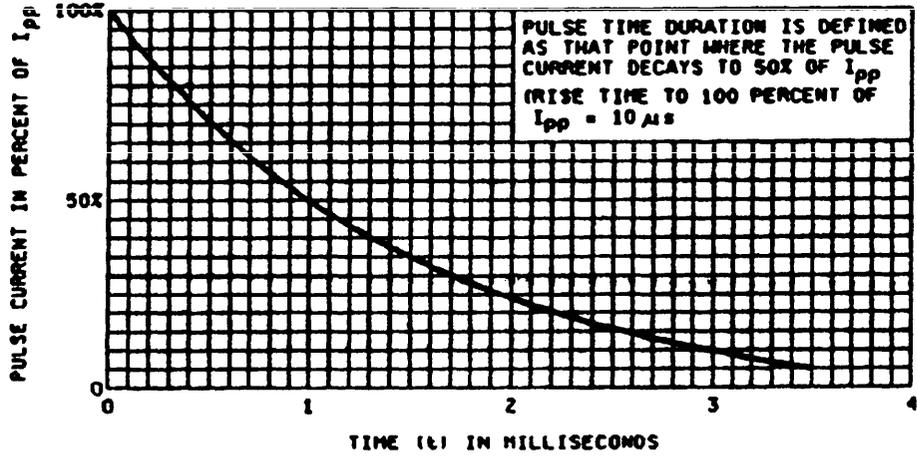


FIGURE 4. Current impulse waveform.

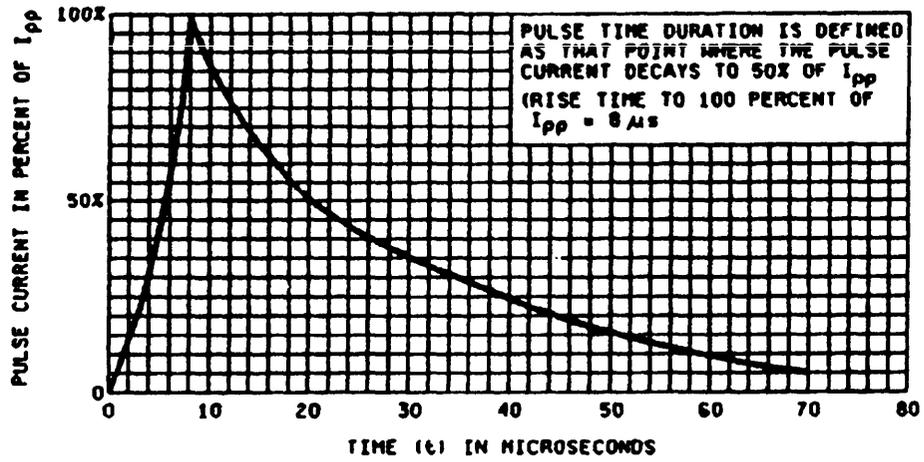


FIGURE 5. Current impulse waveform.

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5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-19500.

6. NOTES

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

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

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Issue of DODISS to be cited in the solicitation.
- b. Lead finish as applicable (see 3.3.1).
- c. Product assurance level and type designation.

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

CONCLUDING MATERIAL

Custodian:
Air Force - 17

Review activities:
Air Force - 19, 85, 99

User activity:
Air Force - 13

Preparing activity:
Air Force - 17

Agent:
DLA - ES

(Project 5961-F092)