

The documentation and process conversion measures necessary to comply with this revision shall be completed by 15 January 1999

INCH POUND

MIL-PRF-19500/552B
15 October 1998
SUPERSEDING
MIL-S-19500/552A(USAF)
27 December 1993

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, TRANSIENT VOLTAGE SUPPRESSOR TYPES 1N6469 THROUGH 1N6476, 1N6469US THROUGH 1N6476US JAN, JANTX, AND JANTXV

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 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-PRF-19500.

1.2 Physical dimensions. See figures 1 (similar to DO - 7) and 2 (surface mount).

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 $20 \text{ mW}/^\circ\text{C}$ above $T_A = +25^\circ\text{C}$ (see figure 3)h.
(derate at $100 \text{ mW}/^\circ\text{C}$ above $T_{EC} = +145^\circ\text{C}$ for surface mount devices) (see figure 3).

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

$I_{FSM} = 130 \text{ A(pk)}$. $T_p = 8.33 \text{ ms}$ ($T_A = +25^\circ\text{C}$).

$-55^\circ\text{C} \leq T_{op} \leq +175^\circ\text{C}$; $-55^\circ\text{C} \leq T_{STG} \leq +175^\circ\text{C}$ (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 Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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.

2.1.2 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 - Semiconductor Devices, General Specification for.

STANDARD

MILITARY

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

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

3.3. Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), 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. Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2. Associated detail specification. The individual item performance requirements shall be in accordance with MIL-PRF-19500, and as specified herein.

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

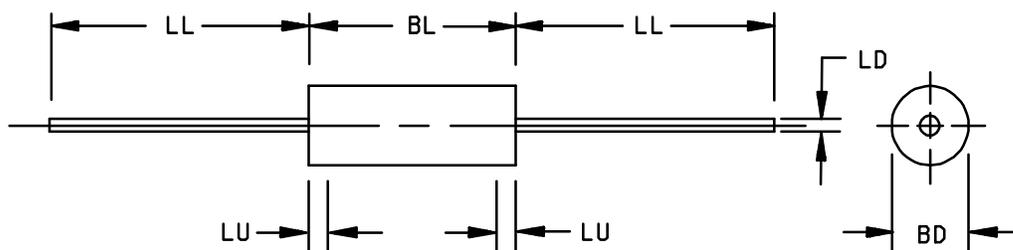
V_{CF}Forward clamping voltage.

3.4. Design, construction, and physical dimensions. Design, construction, and physical dimensions for the purpose of interchangeability shall be as specified on figures 1 and 2 herein.

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.

3.2. Lead finish. Unless otherwise specified, lead finish shall be solderable in accordance with MIL-PRF-19500 and MIL-STD-750 and herein.

3.5. Marking. Devices shall be marked in accordance with MIL-PRF-19500.

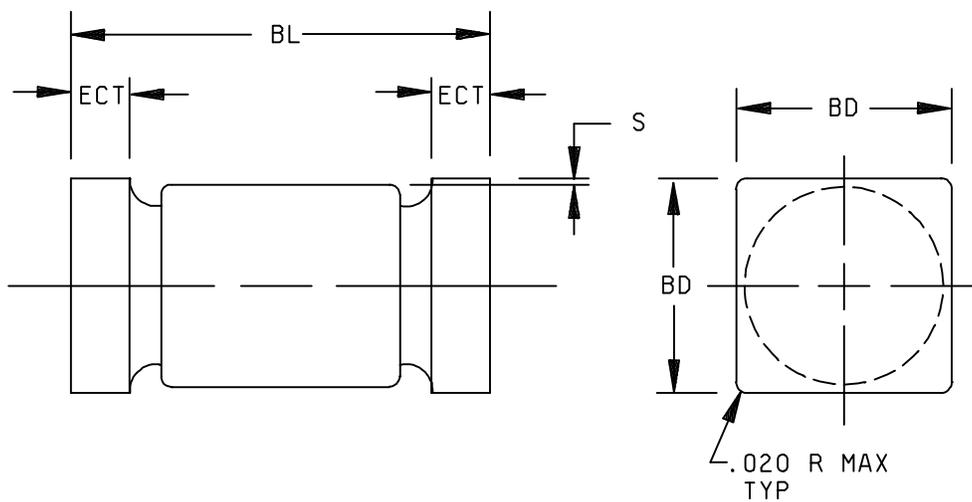


Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BD	.150	.185	3.81	4.70	3
LD	.037	.042	0.94	1.07	
BL	.150	.375	3.81	9.53	3
LL	.900	1.300	22.86	33.02	
LU		.050		1.27	4

NOTES:

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

FIGURE 1. Physical dimensions.



Dimensions				
Ltr	1N6469US through 1N6476US			
	D-5DC			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.205	.245	5.21	6.22
ECT	.019	.028	0.48	0.71
S	.003		0.08	
BD	.183	.202	4.65	5.13

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are for general information only.
3. Minimum clearance of glass body to mounting surface on all orientations.

FIGURE 2. Physical dimensions 1N6469US through 1N6476US.

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of inspection. 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).

4.1.1 Lot accumulation. Lot accumulation shall be six months in lieu of six weeks.

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

4.3 Screening (JANTXV and JANTX levels only). Screening shall be in accordance with appendix E, table IV 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 appendix E, table IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
9	Not applicable
11	I_D and $V_{(BR)}$
12	See 4.3.1
13	$\Delta I_D \leq 50$ percent of initial reading or 20 percent of column 5 of table III, whichever is greater; $\Delta V_{(BR)} \leq \pm 2$ percent of initial reading.

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_{RWM}) (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 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

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

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VIb (JAN, JANTXV, and JANTX) of MIL-PRF-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, appendix E, table VIb of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B3	1026	See 4.3.1.
B5	3101 or 4081	$R_{\theta JL} \leq 50^{\circ}\text{C/W}$ at $L = 0.375$ inch (9.53 mm), non-surface mount devices. $R_{\theta JEC} \leq 20^{\circ}\text{C/W}$ at $L = 0$ inches, surface mount devices. $T_A = +125^{\circ}\text{C}$.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VII of MIL-PRF-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, appendix E, table VII of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
C2	2036	Test condition A; weight = 5 pounds; $t = 15$ seconds ± 3 seconds.
C6	1026	$T_A = +125^{\circ}\text{C}$ (see 4.3.1).
C7	4071	$\infty V_{(BR)}$ 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 = $\%/^{\circ}\text{C}$; 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 $t \geq 1$ ms for $t_p \geq 1$ ms (see figure 5).
- 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 $t_p \geq 20$ ms (see figure 6).

4.5.2 Clamping voltage V_C . 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.

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits <u>2/</u>		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 5 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; $T_A = -55^\circ\text{C}$	$V_{(BR2)}$	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; $I_F = 0$, $V_{RWM} = 0$, $T_A = +25^\circ\text{C}$, $I_{FSM} = 130$ 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 4.5.1a) 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-PRF-19500.2/ Column references are to table III herein.

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	4016	DC method, $V_R = V_{RWM}$ (column 4 of table III)	I_D		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	$V_{(BR1)}$	Column 2 of table III		V dc
3.	Reverse current	4016	DC method; $V_R = V_{RWM}$ column 4 of table III	ΔI_D		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	$\Delta V_{(BR1)}$		± 5 percent of initial value.	

1/ The electrical measurements for appendix E, table VIb (JANTX and JANTXV) of MIL-PRF-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 appendix E, table VII of MIL-PRF-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	
	$V_{(BR1)}$ at $I_{(BR)}$ min. V dc	$I_{(BR)}$ t_p = 300 ms duty cycle ≤ 2 percent mA dc	V_{RWM} V(pk)	I_D at V_{RWM} μA dc	V_C at I_{PP} for $t_p = 1$ ms V (pk)	I_{PP} $t_p = 20$ ms $t_r = 8$ ms A (PK)		$t_p = 1$ ms $t_r = 10 \mu s$ A (PK)	$\infty V_{(BR)}$ at $I_{(BR)}$ %/°C	$V_{(BR2)}$ minimum at $I_{(BR)}$ $T_A = -55^\circ C$ V dc	V_{CF} at I_{PP} for $t_p = 1$ ms Inverse polarity Max 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	

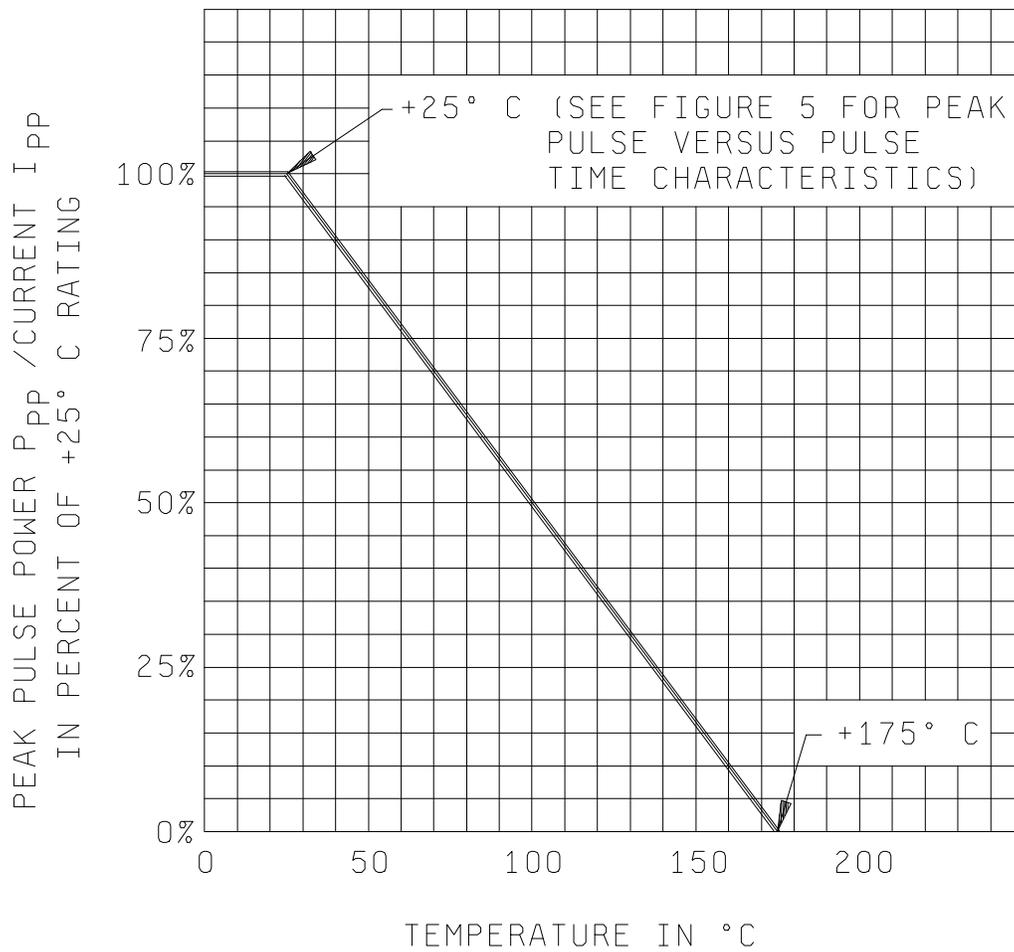
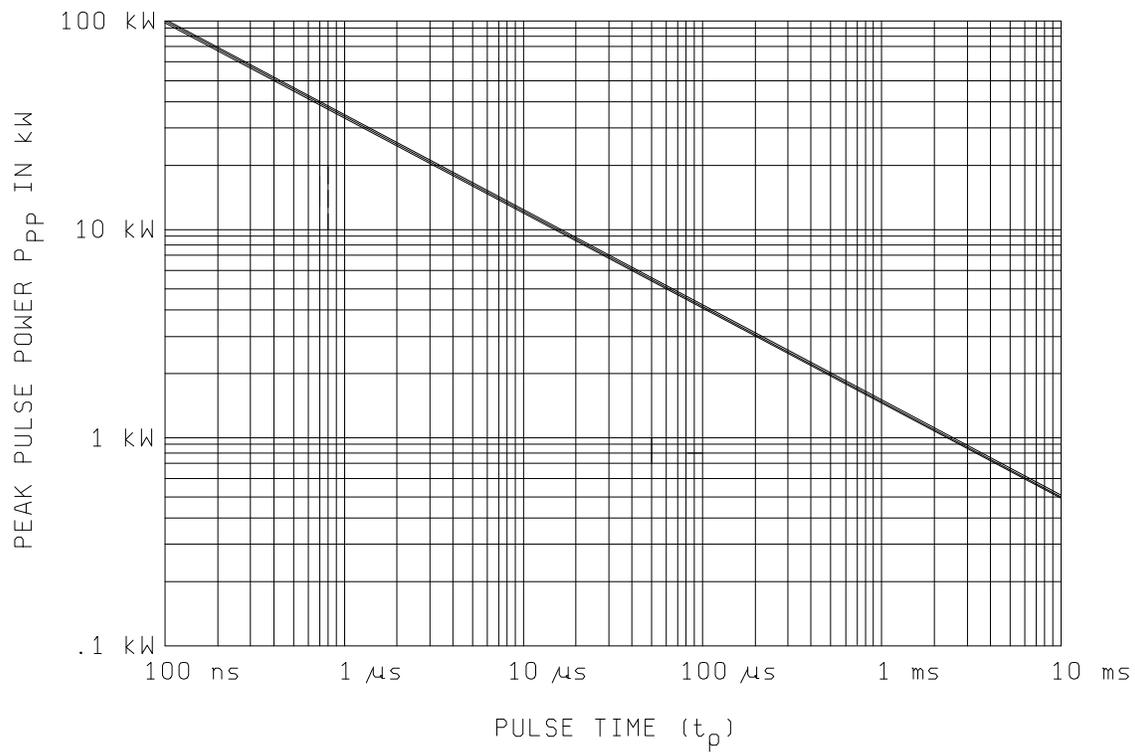


FIGURE 3. Derating curve.



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

FIGURE 4. Peak pulse power versus pulse time.

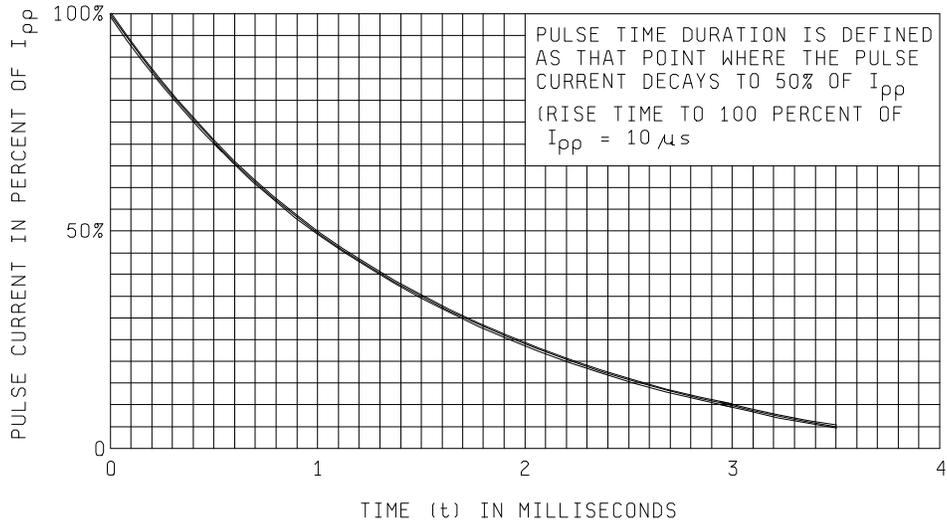


FIGURE 5. Current impulse waveform.

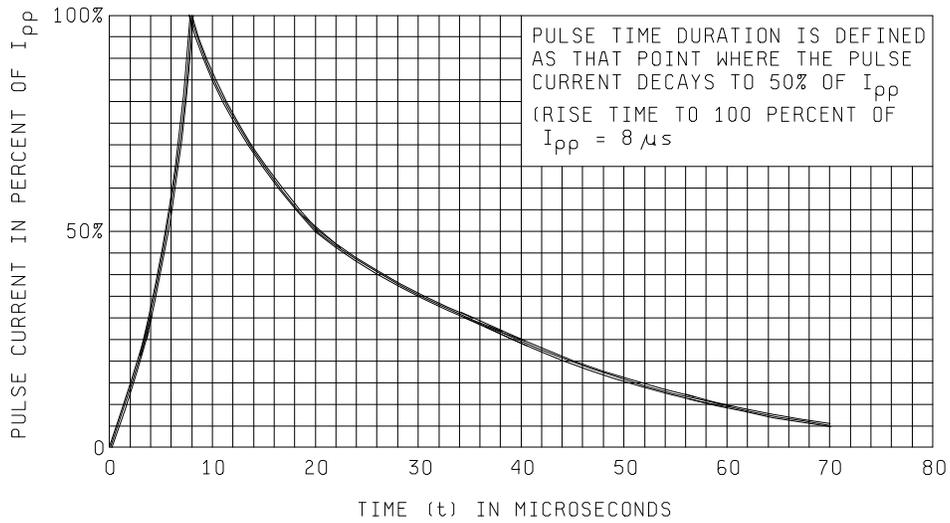


FIGURE 6. Current impulse waveform.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. When actual packaging of material 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.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-PRF-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-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. See 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 Products List QPL 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 purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from: Defense Supply Center Columbus, ATTN: DSCC-VQE, 3990 East Broad Street, Columbus, OH 43216-5000.

6.4 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.

Custodian:
Army - CR
Navy - EC
Air Force - 17

Preparing activity:
DLA - CC

(Project 5961-1830)

Review activities:
Air Force - 13, 19, 85, 99

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I RECOMMEND A CHANGE:
1. DOCUMENT NUMBER
 MIL-PRF-19500/552B

2. DOCUMENT DATE (YYMMDD)
 981015

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

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 (Last, First, Middle initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

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7. DATE SUBMITTED
 (YYMMDD)
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