

INCH-POUND

This documentation process conversion measures necessary to comply with this revision shall be completed by 6 October 1999

MIL-PRF-19500/434C
6 August 1999
SUPERSEDING
MIL-S-19500/434B
17 November 1992

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, TRANSIENT VOLTAGE SUPPRESSOR
TYPES 1N5610 THROUGH 1N5613
JAN, JANTX, JANTXV, AND JANS

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 1500 watt, peak, pulse power, silicon, transient, voltage suppressor diodes. Four levels of product assurance are provided for each device as specified in MIL-PRF-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:

$P_{PP} = 1500 \text{ W}$ (see figure 3) at $t_p = 1.0 \text{ ms}$.

$P_{M(AV)} = 3.0 \text{ W}$ (derate at $20 \text{ mW}/^\circ\text{C}$ above $T_A = +25^\circ\text{C}$) (see 6.4).

$I_{FSM} = 150 \text{ A (pk)}$ at $t_p = 8.33 \text{ ms}$ ($T_A = +25^\circ\text{C}$).

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

1.4 Primary electrical characteristics at $T_A = +25^\circ\text{C}$. Primary electrical characteristics are 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-VAC, 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 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

MILITARY

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Automated Printing Service, 700 Robbins Avenue, Building 4D (DPM-DODSSP), 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 (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 6.6).

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

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

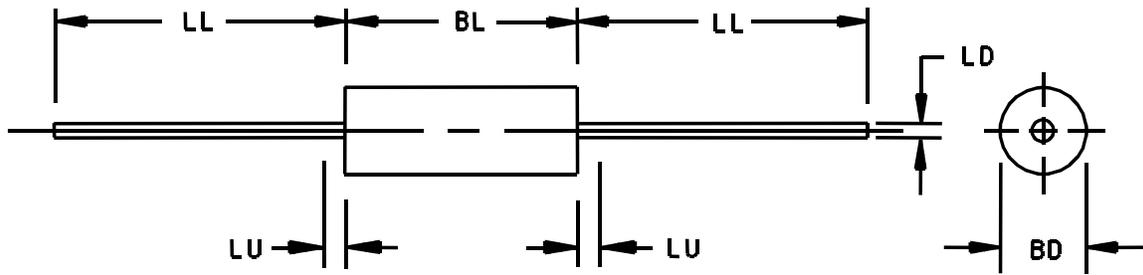
- V_C Clamping voltage. The maximum peak voltage appearing across the device when subjected to the peak pulse current I_{PP} .
- I_{PP} Peak pulse current at a specified condition.
- $I_{(BR)}$ Reverse breakdown current at a specified condition.
- P_{PP} Repetitive peak pulse power.
- $\alpha V_{(BR)}$ Temperature coefficient of $V_{(BR)}$.

3.4 Interface requirements and physical dimensions. The Interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and figure 1 herein.

3.4.1 Metallurgical bond construction. See MIL-PRF-19500.

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

3.5 Marking. Devices shall be marked as specified in MIL-PRF-19500. At the option of the manufacturer, marking of the country of origin may be omitted from the body of the transistor, but shall be retained on the container.



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BD	.150	.185	3.30	4.70	3
LD	.037	.042	0.94	1.07	
BL	.160	.375	4.06	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.
5. In accordance with ANSI Y14.5M, diameters are equivalent to ϕ x symbology.

FIGURE 1. Physical dimensions, type 1N5610 through 1N5613.

3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4 and table I.

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in Table I.

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.

4.3 Screening (JANS, JANTX, AND JANTXV levels only). Screening shall be in accordance with 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 table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
3	T _(high) = +175°C	T _(high) = +175°C
9	Not applicable	Not applicable
10	Not applicable	Not applicable
11	Not applicable	Not applicable
12	See 4.5.1	See 4.5.1
13	Interim electrical, delta, and group A, subgroup 2 and 3 electrical parameters not applicable for this screen (performed in screen 12). Subgroups 3 of table I herein.	Interim electrical, delta, and group A, subgroup 2 and 3 electrical parameters not applicable for this screen (performed in screen 12).

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 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 table VIa (JANS) and table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500. 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 VIa (JANS) of MIL-PRF-19500. Subgroup 7: Condition for accelerated steady-state operation life are as follows: See 4.5.2, T_A = +100°C (min); 1 ms pulse only (see 4.5.3.b).

4.4.2.2 Group B inspection, table VIb (JAN, JANTX, and JANTXV of MIL-PRF-19500). Subgroup 3: Condition for steady-state operation life are as follows: See 4.5.1, 1 ms pulse only (see 4.5.3.b).

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

- a. Subgroup 2: Condition for terminal strength are as follows: Lead tension: Test condition A; weight = 5 pounds; $t = 15 \pm 3$ s.
Lead fatigue: Test condition E; weight = 8 ounces.
- b. Subgroup 6: Condition for steady-state operation life are as follows: See 4.5.1, 1 ms pulse only (see 4.5.3.b).
- c. Subgroup 7: Condition for temperature coefficient of breakdown voltage are as follows: $I_{(BR)} =$ column 3 of table III, $T_1 = +25^\circ\text{C} \pm 3^\circ\text{C}$, $T_2 = T_1 + 100^\circ\text{C}$, sample size $n = 22$, $c = 0$.
- d. Subgroup 8: Condition for maximum peak pulse current are as follow: See 4.5.3a (20 μs pulse only) 10 pulses, sample size $n = 22$, $c = 0$.

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

4.5.1 Power burn-in (HTRB) and steady-state operation life test conditions. The test conditions and order of events shall be as follows:

- a. Read and record I_D and $V_{(BR)}$ at $T_A = +25^\circ\text{C}$. (This test is optional for JANTX and JANTXV devices during 100 percent screening).
- b. Pulse in accordance with 4.5.3b, 20 times (screening and group B) 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. If step a is omitted during 100 percent screening, $V_{(BR)}$ shall be read and recorded at this step.
- d. Apply the working peak reverse voltage (V_{WM}) (column 4 of table III) at $T_A = +125^\circ\text{C}$ as follows:
 1. 96 hours (JANTX and JANTXV) and 240 hours (JANS) 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 the initial reading or 1 μA dc, whichever is greater, or $\Delta V_{(BR)} > \pm 2$ percent (± 5 percent for steady-state operation life) initial value shall be considered defective. Remove defective devices and record the number of failures.

4.5.1.1 Group C steady-state operation life test (alternate procedure). When the group B 340 hour life test is continued on test to 1,000 hours to satisfy the group C life test requirements, the test shall be performed as given in 4.5.1 with the following exceptions:

- a. 4.5.1 step b shall be moved and performed following step e.
- b. 4.5.1 step e shall be repeated after step b is performed.

4.5.2 Accelerated steady-state operation life (JANS). This test shall be conducted with the devices subjected to the breakdown current specified in column 10 of table III for a total duration of 96 hours. At the beginning and end (with devices cooled to $T_A = +25^\circ\text{C}$) of the test, the devices shall be subjected to pulse conditions at the rate of one pulse per minute (max) for 10 pulses in accordance with 4.5.3 as specified.

4.5.3 Maximum peak pulse current (I_{pp}). The peak pulse 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 VS time waveform as follows (1 pulse per minute maximum):

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

NOTE: Tolerance on time (t) shall be -0, +10 percent.

4.5.4 Clamping voltage. 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.

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>						
Standby current	4016	DC method, $V_R = V_{WM}$ (column 4 of table III)	I_D		Column 5	$\mu\text{A dc}$
Breakdown voltage	4022	$t_p \leq 300$ ms, duty cycle ≤ 2 percent, $I_{(BR)} =$ column 3 of table III	$V_{(BR)}$	Column 2		V dc
<u>Subgroup 3</u>						
Minimum breakdown voltage	4022	$t_p \leq 300$ ms, duty cycle ≤ 2 percent, $I_{(BR)} =$ column 3 of table III, $T_A = -55^\circ\text{C}$	$V_{(BR)}$	Column 9		V dc
<u>Subgroup 4</u>						
Clamping voltage maximum (pulsed) (see 4.5.4)		$t_p = 1.0$ ms (see 4.5.3.b), $I_{PP} =$ column 7 of table III	V_C		Column 6	V (pk)
Forward voltage	4011	$I_{FM} = 100$ A (pk), $t_p = 8.3$ ms duty (max), cycle = 4 pulses per minute (max)	V_{FM}		4.8	V (pk)
<u>Subgroup 5</u>						
Not applicable						
<u>Subgroup 6</u>						
Forward surge current	4066	$I_{FSM} = 150$ A (pk), one pulse, half sinewave (8.3 ms), $I_F = 0$, $V_{RWM} = 0$, $T_A = +25^\circ\text{C}$				
End-point electrical measurements		See table II, steps 1 and 2				

NOTES:

1/ For sampling plan, see MIL-PRF-19500.2/ Column references are to table III.

TABLE II. Groups B and C electrical measurements. 1/ 2/ 3/ 4/ 5/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Standby current	4016	DC method, $V_R = V_{WM}$ column 4 of table III	I_D	Column 2	Column 5	$\mu\text{A dc}$
2.	Breakdown voltage	4022	$t_p \leq 300$ ms, duty cycle ≤ 2 percent, $I_{(BR)} =$ column 3 of table III	$V_{(BR)}$		V dc	
3.	Forward voltage	4011	$I_{FM} = 100$ A (pk), $t_p = 8.3$ ms (max), duty cycle = 4 pulses per minute (max)	V_{FM}		4.8	V (pk)
4.	Standby current	4016	DC method; $V_R = V_{WM}$ (column 4 of table III)	ΔI_D		100 percent of initial reading or 20 percent of column 5 of table III, whichever is greater.	
5.	Breakdown voltage	4022	$t_p \leq 300$ ms, duty cycle ≤ 2 percent, $I_{(BR)} =$ column 3 of table III	$\Delta V_{(BR)}$		± 5 percent of initial value	
6.	Clamping voltage		$t_p = 1.0$ ms (see 4.5.3b); $I_{PP} =$ column 7 of table III	V_C		Column 6	V (pk)

NOTES:

- 1/ Devices which exceed the group A limits for this test shall not be accepted.
- 2/ The electrical measurements for table VIa (JANS) of MIL-PRF-19500 are as follows:
 - a. Subgroup 3, see table II herein, steps 1, 2, 3, and 6.
 - b. Subgroup 7, see table II herein, steps 1, 2, 3, 4, and 5.
- 3/ The electrical measurements for 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 6 see table II herein, steps 1, 2, 4, and 5.
- 4/ The electrical measurements for table V of MIL-PRF-19500 are as follows:
 - a. Subgroup 2 and 3, see table II herein, steps 1, 2, and 3 for JANS and steps 1 and 2 for JANTX and JANTXV.
 - b. Subgroup 8, see table II herein, steps 1 and 2 for all levels.
- 5/ Column references are to table III.

TABLE III. Characteristics and ratings.

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7		Col 8	Col 9	Col 10
Type	Breakdown voltage $V_{(BR)}$ at $I_{(BR)}$ Min	Test current $I_{(BR)}$ $t_p \leq 300$ ms cycle ≤ 2 percent	Working peak reverse voltage V_{WM}	Maximum reverse current I_R at V_{WM}	Maximum clamping voltage V_C at I_{PP} for $t_p = 1$ ms	Maximum peak pulse current (I_{PP})		Maximum temperature coefficient of $V_{(BR)}$ $\alpha V_{(BR)}$	Minimum breakdown voltage at $I_{(BR)}$ $T_A = -55^\circ\text{C}$	Breakdown current $I_{(BR)}$ maximum dc current $T_A = +25^\circ\text{C}$
						$t_p = 20 \mu\text{s}$ $t_r = 8 \mu\text{s}$	$t_p = 1$ ms $t_r = 10 \mu\text{s}$			
	V dc	mA dc	V (pk)	μA dc	V (pk)	A (pk)	A (pk)	$\alpha/^\circ\text{C}$	V dc	mA dc
1N5610	33.0	1	30.5	5	47.6	193	32.0	.093	30.2	75.0
1N5611	43.7	1	40.3	5	63.5	136	24.0	.094	40.0	53.0
1N5612	54.0	1	49.0	5	78.5	116	19.0	.096	48.5	43.0
1N5613	191.0	1	175.0	5	265.0	33	5.7	.100	172.0	12.5

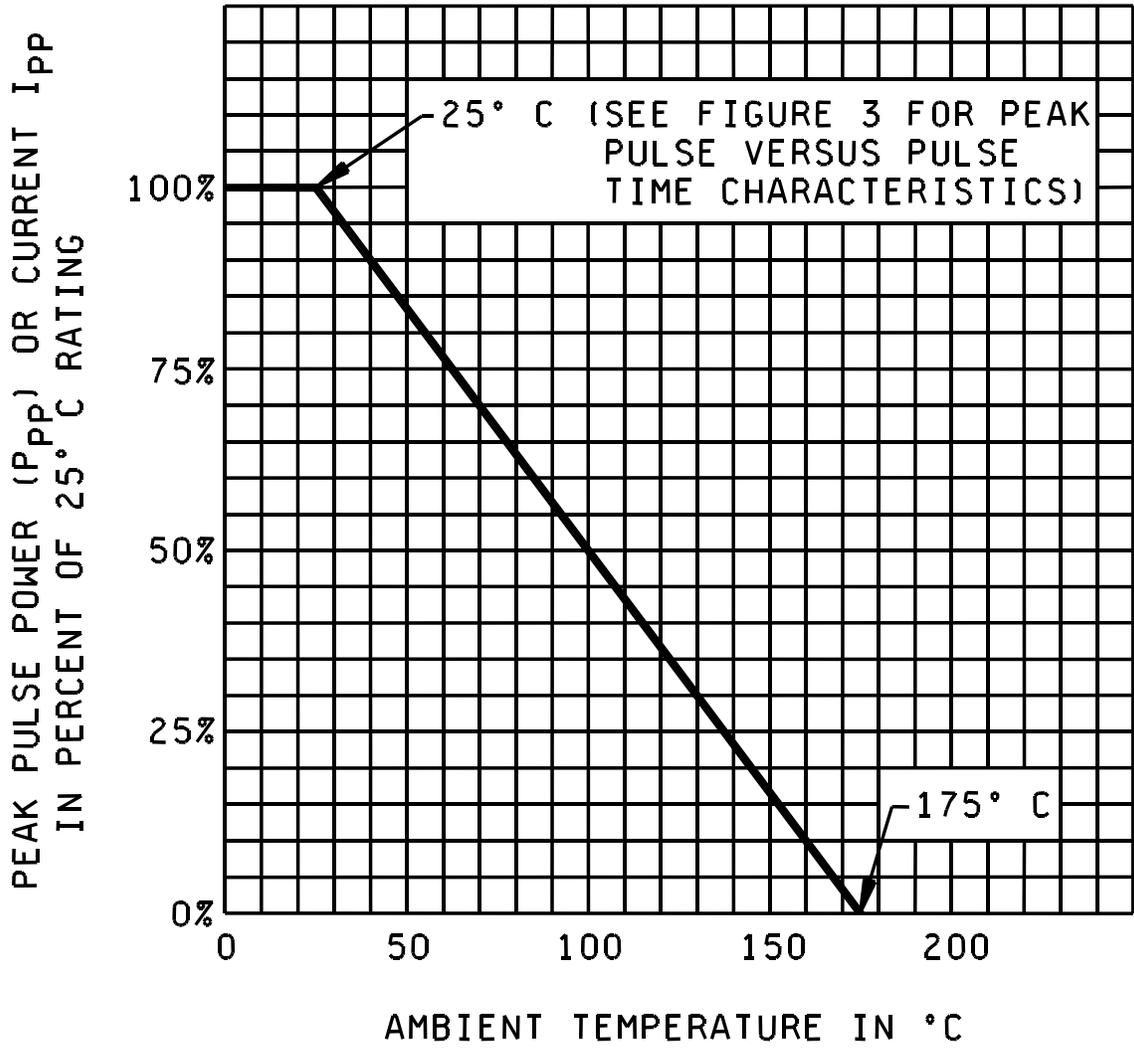


FIGURE 2. Derating curve.

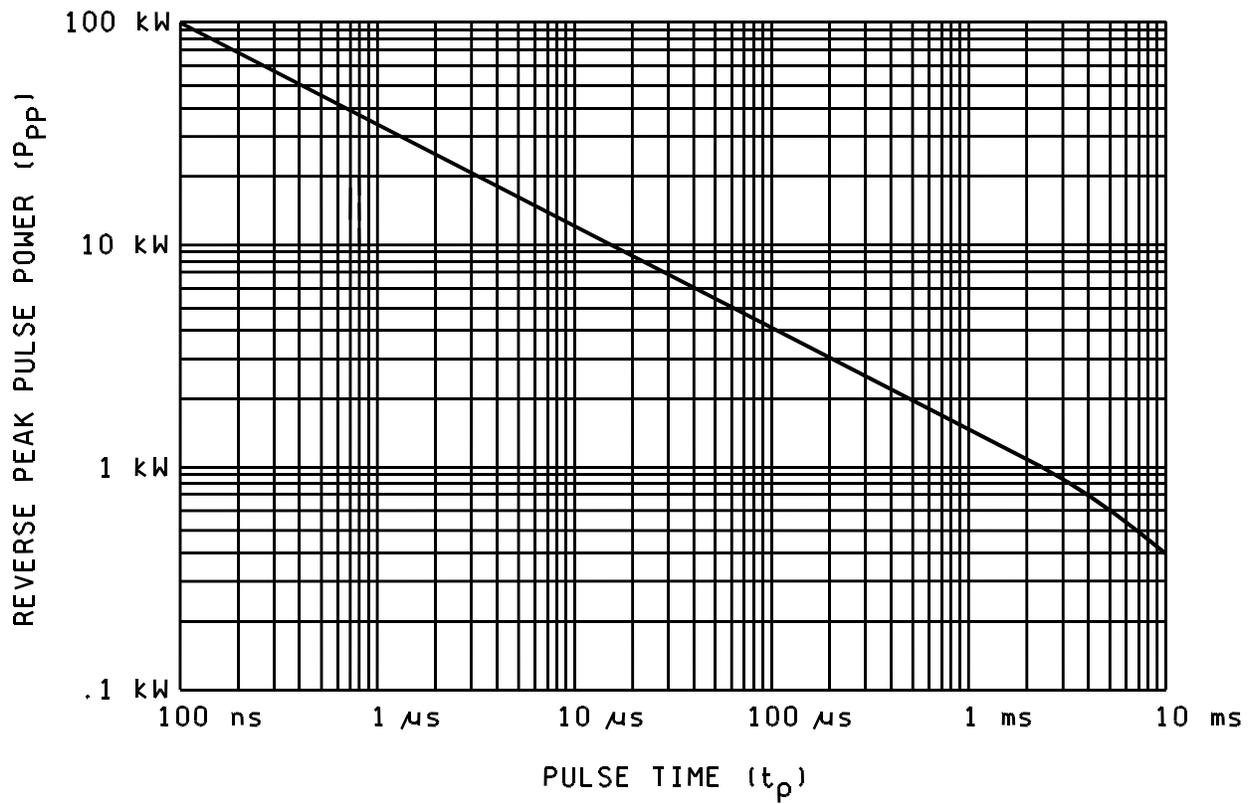
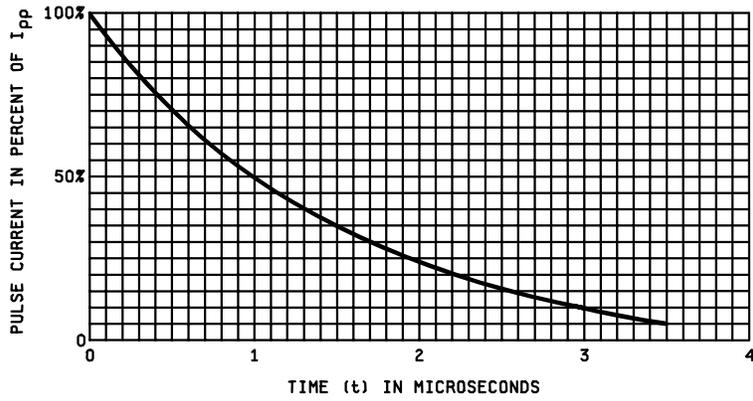
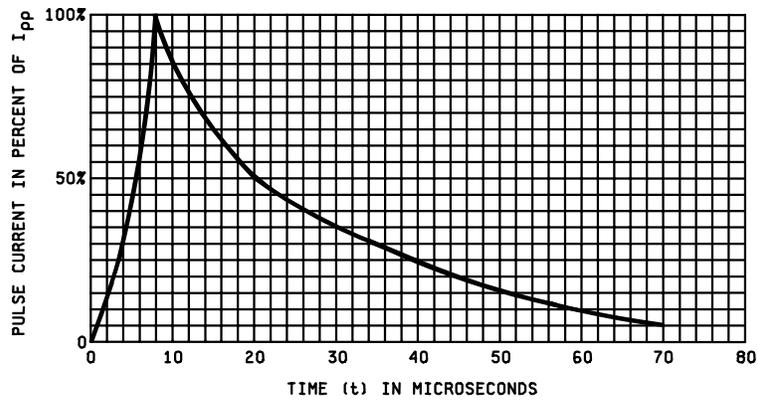


FIGURE 3. Peak pulse power versus pulse time.



NOTE: Pulse time duration is defined as that point where the pulse current decays to 50 percent of I_{PP}. (Rise time to 100 percent of I_{PP} = 10 μs).

FIGURE 4. Current impulse waveform.



NOTE: Pulse time duration is defined as that point where the pulse current decays to 50 percent of I_{PP}. (Rise time to 100 percent of I_{PP} = 8 μs).

FIGURE 5. Current impulse waveform.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). 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.

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. Acquisition documents should specify the following:

- a. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.2.1).
- b. Lead finish as specified (see 3.4.2).
- c. Type designation and product assurance level.
- d. Packing requirements (see 5.1)

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.

6.4 Steady-state power rating. This rating is not relevant for most applications.

6.5 Substitution information. For type numbers 1N5555 through 1N5558, formerly covered under this military specification are now covered under MIL-PRF-19500/500.

6.6 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 Manufacture 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 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.

CONCLUDING MATERIAL

Custodians:

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

Preparing activity:

DLA - CC

(Project 5961-2160)

Review activities:

Army - AR, MI, SM
Navy - AS, CG, MC
Air Force - 19, 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL		
<u>INSTRUCTIONS</u>		
<p>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.</p> <p>2. The submitter of this form must complete blocks 4, 5, 6, and 7.</p> <p>3. The preparing activity must provide a reply within 30 days from receipt of the form.</p> <p>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.</p>		
I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/434C	2. DOCUMENT DATE (YYMMDD)
3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, DIODE, SILICON, Transient Voltage Suppressor, TYPES 1N5610 THROUGH 1N5613, JAN, JANTX, JANTXV, JANS		
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)	d. TELEPHONE (Include Area Code) (1) Commercial (2) DSN (If applicable) (3) E-Mail	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY		
a. NAME Alan Barone	b. TELEPHONE (Include Area Code) (1) Commercial 614-692-0510 (2) DSN 850-0510 (3) E-Mail alan_barone@dsccl.dla.mil	
c. ADDRESS (Include Zip Code) Defense Supply Center Columbus ATTN: DSCC-VAC 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	