

The documentation and process conversion measures necessary to comply with this document shall be 15 October

INCH-POUND

MIL-PRF-19500/434E
w/AMENDMENT 2
1 September 2013
SUPERSEDING
w/AMENDMENT 1
MIL-PRF-19500/434E
24 March 2012

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.

The requirements for acquiring the product described herein shall consist of this specification sheet and [MIL-PRF-19500](#).

1. SCOPE

1.1 Scope. This specification covers the performance requirements for 1,500 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](#) (axial).

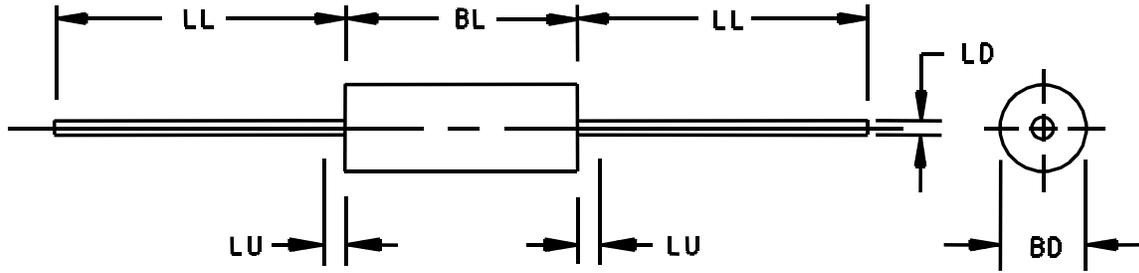
1.3 Maximum ratings. Maximum ratings are as shown in columns 5 through 8 of the characteristics and ratings table herein, and as follows:

- a. $P_{M(AV)} = 3.0 \text{ W}$ (derate at $20 \text{ mW/}^\circ\text{C}$ above $T_A = +25^\circ\text{C}$) (see [figure 2](#)).
- b. $P_{PP} = 1,500 \text{ W}$ (see [figure 3](#)) at $t_p = 1.0 \text{ ms}$.
- c. $I_{FSM} = 150 \text{ A}$ (pk) at $t_p = 8.33 \text{ ms}$ ($T_A = +25^\circ\text{C}$).
- d. $-55^\circ\text{C} \leq T_J \leq +175^\circ\text{C}$ (ambient), $-55^\circ\text{C} \leq T_{STG} \leq +175^\circ\text{C}$ (ambient).

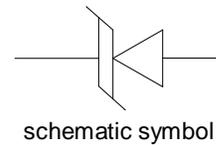
1.4 Primary electrical characteristics at $T_A = +25^\circ\text{C}$. Primary electrical characteristics are shown in columns 2 and 4 of the characteristics and ratings table herein.

Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil/>.

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Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BD	.150	.185	3.81	4.70	3
BL	.160	.375	4.06	9.53	3
LD	.037	.042	0.94	1.07	
LL	.900	1.300	22.86	33.02	
LU		.050		1.27	4



NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Package contour optional within BD and length BL.
4. Within this zone lead diameter may vary to allow for lead finishes and irregularities other than heat slugs.
5. In accordance with ASME Y14.5M, diameters are equivalent to Φ x symbology.

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

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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 of documents cited in sections 3, 4, or 5 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 cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATION

[MIL-PRF-19500](#) - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

[MIL-STD-750](#) - Test Methods for Semiconductor Devices.

* (Copies of these documents are available online at <http://quicksearch.dla.mil/> or <https://assist.dla.mil/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, 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 individual item requirements shall be as specified in [MIL-PRF-19500](#) and as modified herein.

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 manufacturers list (QML) before contract award (see [4.2](#) and [6.3](#)).

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

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

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in [MIL-PRF-19500](#), and on [figure 1](#) (axial leads).

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](#)).

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

3.6 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I.

3.7 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, tables II, III, and IV).

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

4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification sheet that did not require the performance of table IV tests, the tests specified in table IV herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

4.3 Screening (JANS, JANTX, and JANTXV levels only). Screening shall be in accordance with table E-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 E-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 table I, subgroup 2 and 3 electrical parameters not applicable for this screen (performed in screen 12).	Interim electrical, delta, and table I, 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 E-VIA (JANS) and table E-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.

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4.4.2.1 Group B inspection, table E-VIA (JANS) of MIL-PRF-19500. Subgroup 5: Condition for accelerated steady-state operation life are as follows: See 4.5.2, $T_A = +100^\circ\text{C}$ (min); 1 ms pulse only (see 4.5.3.b).

4.4.2.2 Group B inspection, table E-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 E-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 E-VII of MIL-PRF-19500.

- a. Subgroup 2: The conditions for terminal strength are as follows: Lead tension: Test condition A; weight = 12 pounds; $t = 15 \pm 3$ s.

Lead fatigue: Test condition E; weight = 8 ounces.
- b. Subgroup 6: The condition for steady-state operation life is as follows: See 4.5.1, 1 ms pulse only (see 4.5.3.b).
- c. Subgroup 8: The conditions 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: The conditions for maximum peak pulse current are as follows: See 4.5.3.a (20 μs pulse only) ten pulses, sample size $n = 22$, $c = 0$.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table E-IX of MIL-PRF-19500 and as specified in table IV herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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. Pulse in accordance with 4.5.3.b, 20 times (screening and group B) and 100 times (group C) at $T_A = +25^\circ\text{C}$.
- b. Read I_D and $V_{(BR)}$ at $T_A = +25^\circ\text{C}$, remove defective devices and record the number of failures.
- c. Apply the working peak reverse voltage (V_{WM}) (column 4 of table III) at $T_A = +125^\circ\text{C}$ as follows:
 - (1) For 96 hours (JANTX and JANTXV) and 240 hours (JANS) for the screening test.
 - (2) For 340 hours (JANTX, and JANTXV) for group B steady-state operation life test.
 - (3) For 1,000 hours for group C steady-state operation life test.
- d. 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.

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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 herein with the following exceptions:

- a. See 4.5.1 herein, step b shall be moved and performed following step e.
- b. See 4.5.1 herein, 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 clamping voltage (V_C) shall be as specified in 4.5.4. 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 4](#)).
- 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 5](#)).

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.

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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)	ID		Column 5	μA dc
Breakdown voltage	4022	$t_p \leq 300$ ms, duty cycle ≤ 2 percent, $I(\text{BR}) =$ 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, $I(\text{BR}) =$ 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	VC		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)	VFM		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				

1/ For sampling plan, see [MIL-PRF-19500](#).

2/ Column references are to [table III](#).

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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 5	μA dc
2.	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
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 4.5.3.b); $I_{PP} =$ column 7 of table III	V_C		Column 6	V (pk)

1/ Devices which exceed the group A limits for this test shall not be accepted.

2/ The electrical measurements for table E-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 E-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 E-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.

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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 at $I(BR)_{min}$ $V(BR)$	Test current $t_p \leq 300$ ms cycle ≤ 2 percent $I(BR)$	Working peak reverse voltage V_{WM}	Maximum reverse current at V_{WM} I_R	Maximum clamping voltage at I_{PP} for $t_p = 1$ ms V_C	Maximum peak pulse current (I_{PP})		Maximum temperature coefficient of $V(BR)$ $\alpha_V(BR)$	Minimum breakdown voltage of $I(BR)$ $T_A = -55^\circ C$	Breakdown current maximum dc current $T_A = +25^\circ C$ $I(BR)$
						$t_p = 20 \mu s$ $t_r = 8 \mu s$	$t_p = 1$ ms $t_r = 10 \mu s$			
	Vdc	mAdc	V(pk)	μ Adc	V(pk)	A(pk)	A(pk)	$\alpha/^\circ C$	Vdc	mAdc
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

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TABLE IV. Group E inspection.

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
<u>Subgroup 1</u>	1051	500 cycles, condition C, -55°C to +175°C. See table III . Steps 1, 2, 3, 4, and 5. 1,000 hours. See 4.5.1. See table III , Steps 1, 2, 3, 4, and 5. Not applicable Not applicable See 4.5.2 . Ipp shall be characterized by the supplier and this data shall be available to the government. Test shall be performed on each low and high voltage device for each structurally identical grouping. Test to failure. See table III , steps 1, 2, 3, 4, and 5.	45 devices c = 0
Temperature cycling			
Electrical measurements			
<u>Subgroup 2</u>			
Life test			
Electrical measurements			
<u>Subgroup 4</u>			
Not applicable			
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>	2031	3 devices, c = 0	
Peak pulse current			
Electrical measurements			
<u>Subgroup 7</u>			
Soldering heat			

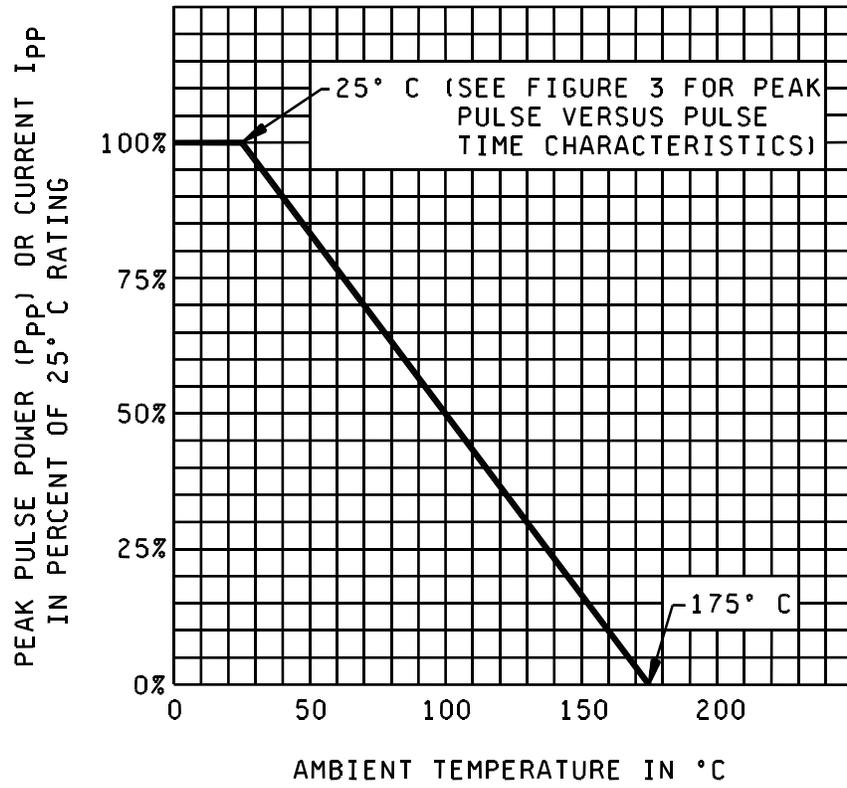


FIGURE 2. Derating curve.

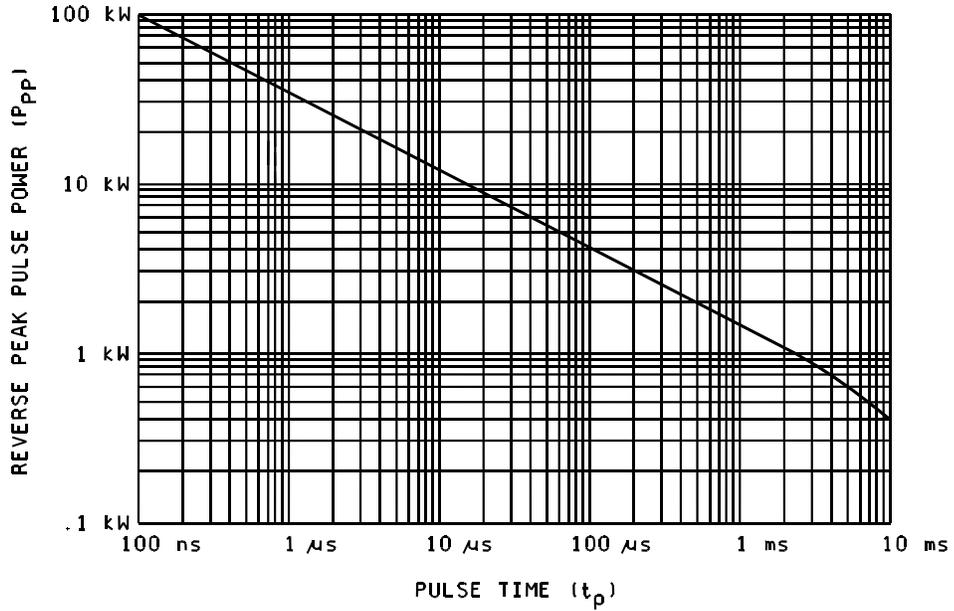
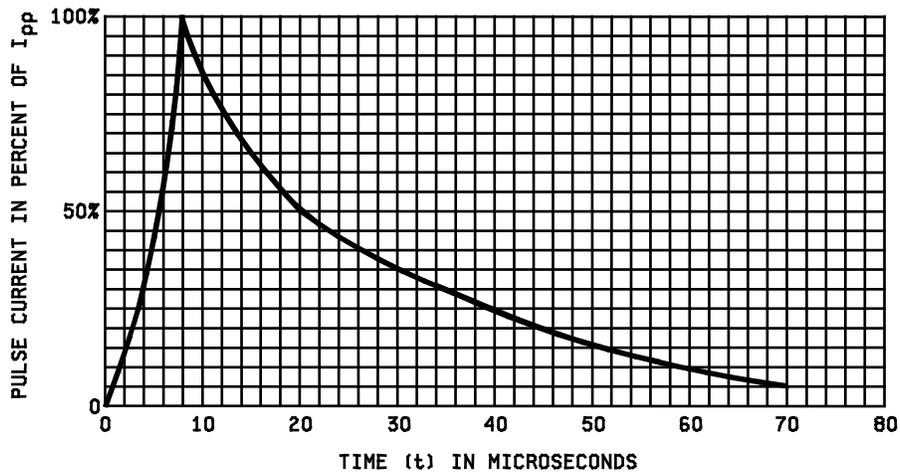
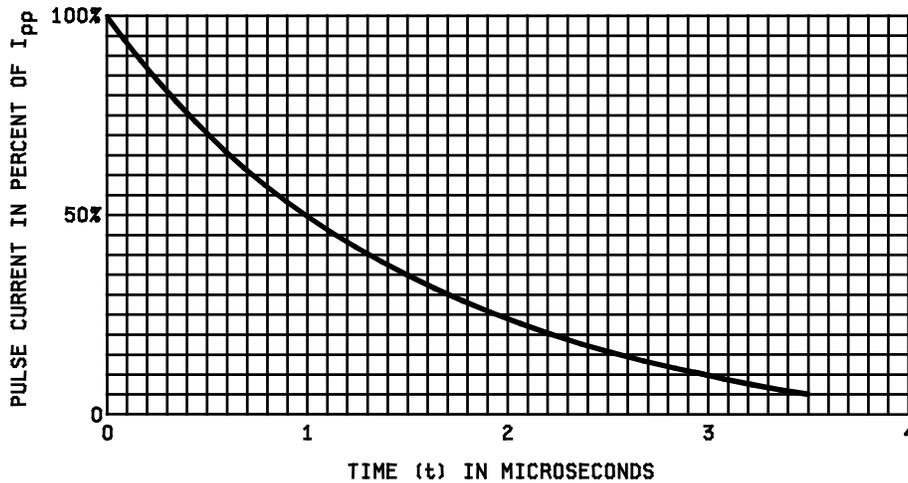


FIGURE 3. Peak pulse power versus pulse time.



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} = 8 μ s).

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} = 10 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 packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's 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. The notes specified in MIL-PRF-19500 are applicable to this specification.)

6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Packaging requirements (see 5.1).
- c. Lead finish (see 3.4.1).
- d. Product assurance level and type designator.

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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 Manufacturers 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 DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

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

6.5 Substitution information. Type numbers 1N5555 through 1N5558, formerly covered under this specification are now covered under [MIL-PRF-19500/500](#).

6.6 Amendment notations. The margins of this specification are marked with asterisks to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy - EC
Air Force - 85
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2013-070)

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

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