

The documentation and process conversion measures necessary to comply with this revision shall be completed by 12 December 1999

INCH-POUND

MIL-PRF-19500/551C
12 September 1999
SUPERSEDING
MIL-S-19500/551B
29 December 1994

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, TRANSIENT VOLTAGE SUPPRESSOR
TYPES 1N6461 THROUGH 1N6468 AND 1N6461US THROUGH 1N6468US
JAN, JANTX, JANTXV, 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 500-watt peak pulse, power, silicon, transient voltage suppressor diodes. Three levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500, and two levels of product assurance for each unencapsulated die type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figures 1, 2, 3, 4, and 5.

1.3 Maximum ratings. Maximum ratings are as shown in columns 4, 6, and 7 of table II herein and as follows:

$P_R = 2.5 \text{ W}$ ($T_A =$ room ambient as defined in the general requirements of 4.5 of MIL-STD-750)
derate at 16.7 mW/°C for leaded devices and 10 mW/°C for surface mount devices (see figure 6).

$P_{PR} = 500 \text{ W}$ (see figure 7) at $t_p = 1 \text{ ms}$.

$I_{FSM} = 80 \text{ A(pk)}$ at $t_p = 8.33 \text{ ms}$ ($T_A = +25^\circ\text{C}$).

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

1.4 Primary electrical characteristics. Primary electrical characteristic columns 2 and 4 of table II 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 - 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, 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 (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 Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500, and as specified herein.

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

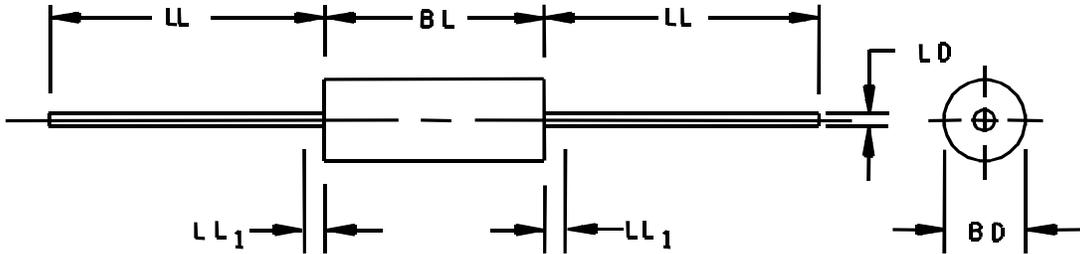
3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500 and as follows.

I_p	Maximum peak pulse current at a specified condition.
$I_{(BR)}$	Reverse breakdown current at a specified condition.
T_{EC}	Endcap temperature.

3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figures 1, 2, 3, 4, and 5 herein. The surface mount devices (US) shall be structurally identical to the "non US" version except for lead attachment.

3.4.1 Construction. These devices shall be constructed utilizing metallurgically bonded noncavity double plug construction between both sides of the silicon die and the terminal pins. Opaque glass is not permitted.

3.4.2 Lead finish. Lead finish shall be solderable as defined in 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).

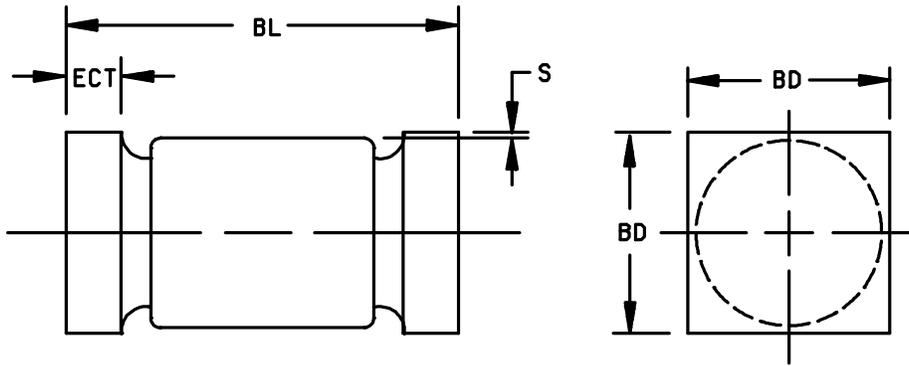


Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BD	0.115	0.145	2.92	3.68	3, 4
LD	0.037	0.042	0.94	1.07	4
BL	0.150	0.300	3.81	7.62	4
LL	0.900	1.300	22.86	33.02	
LL ₁		0.050		1.27	4

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimension BD shall be measured at the largest diameter.
4. Dimension BL includes dimension LL₁ region in which the diameter may vary from BD maximum to LD minimum.

FIGURE 1. Physical dimensions.

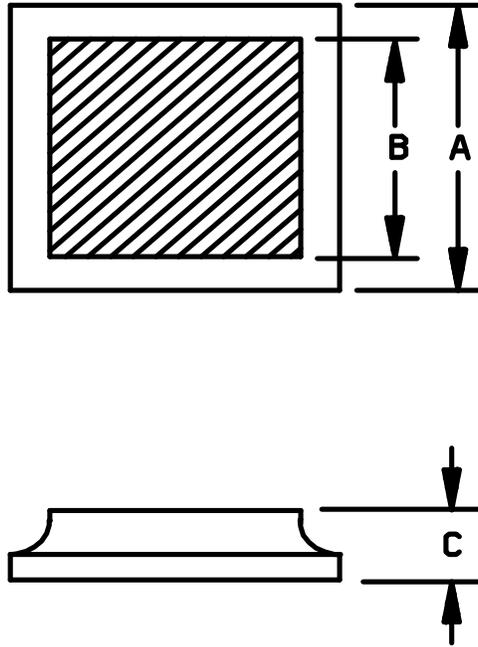


Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	0.200	0.225	5.08	5.72
ECT	0.019	0.028	0.48	0.71
S	0.003		0.08	
BD	0.137	0.148	3.48	3.76

NOTES:

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

FIGURE 2. Physical dimensions surface mount devices "US".



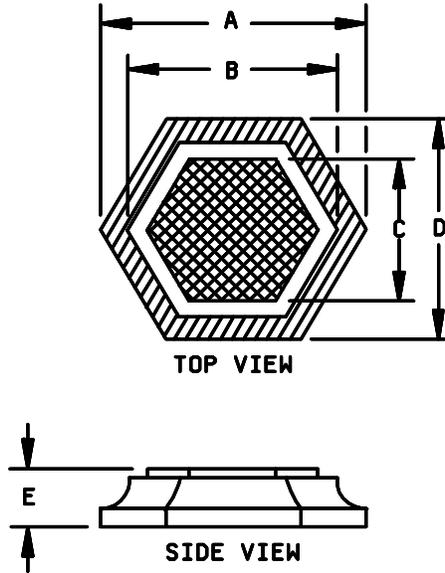
A version

Type	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	0.059 sq	0.065 sq	1.50 sq	1.65 sq
B	0.056 sq	0.060 sq	1.42 sq	1.52 sq
C	0.006	0.012	0.15	0.3

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metallization: Top (cathode) - Aluminum.
Bottom (anode) - Gold.

FIGURE 3. Physical dimensions JANHCA and JANKCA (die).



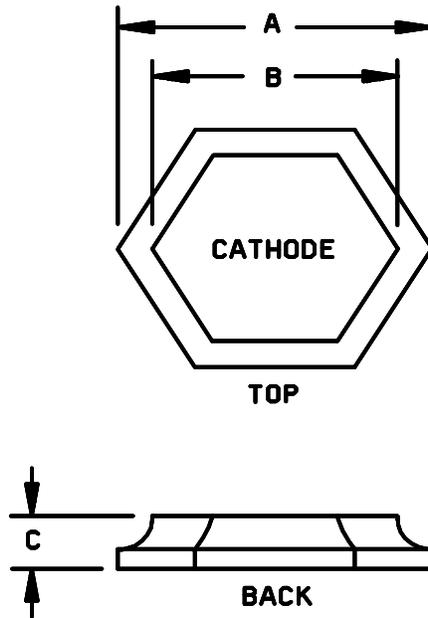
B version

Type	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	0.085	0.089	2.18	2.26
B	0.076	0.080	1.93	2.03
C	0.0066	0.070	1.68	1.78
D	0.074	0.078	1.88	1.98
E	0.010	0.015	0.25	0.38

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metallization: Top (cathode) - Aluminum.
Bottom (anode) - Ti/Ni/AU.

FIGURE 4. Physical dimensions JANHCB and JANKCB (die).



C version

Type	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	0.085	0.091	2.16	2.31
B	0.072	0.085	1.83	2.16
C	0.007	0.012	0.18	0.30

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Metallization: Top (cathode) - Aluminum.
Bottom (anode) - Gold.

FIGURE 5. Physical dimensions JANHCC and JANKCC (die).

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

3.5.1 Marking of surface mount (US) devices. Marking of surface mount devices shall be in accordance with MIL-PRF-19500.

3.5.2 Marking of JANHC and JANKC die. Marking for JANHC and JANKC die, shall be in accordance with MIL-PRF-19500.

3.5.3 Polarity. The polarity of all device types shall be indicated with a contrasting color band to denote the cathode end. Alternatively, for surface mount (US) devices, a minimum of three contrasting color dots spaced around the periphery on the cathode end may be used.

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

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

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).

4.1.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-PRF-19500, and as specified herein. Lot accumulation period shall be 3 months in lieu of 6 weeks.

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

4.2.1 JANHC and JANKC die qualification. JANHC and JANKC die qualification shall be in accordance with MIL-PRF-19500.

4.3 Screening (JANTX, and JANTXV levels only). Screening shall be in accordance with MIL-PRF-19500 (table IV), 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
	JANTX and JANTXV levels
9	Not applicable
11	Not applicable
12	See 4.3.2
13	Not applicable

4.3.1 Screening JANHC and JANKC. Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500.

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

- a. Pulse in accordance with 4.5.1b 20 times (screening and group B operation life test) and 100 times (group C) at T_A = room ambient as defined in the general requirements of MIL-STD-750.
- b. Read and record I_D at T_A = room ambient as defined in the general requirements of MIL-STD-750. Remove defective devices, and record the number of failures.
- c. Apply the working peak reverse voltage (V_{RWM}) (column 4 of table II) at an ambient temperature of +125°C as follows:
 - (1) 96 hours (JANTX and JANTXV) for the screening test.
 - (2) 340 hours (JANTX and JANTXV) for group B, steady-state operation life test.
 - (3) 1,000 hours for group C, steady-state operation life test.
- d. Read and record I_D and $V_{(BR)}$ at T_A = room ambient as defined in the general requirements of MIL-STD-750. Devices with $\Delta I_D > 50$ percent (100 percent for steady-state operation life) of initial value, or 20 percent of column 5 of table II, whichever is greater, or $\Delta V_{(BR)} = \pm 2$ percent (± 5 percent for steady-state operation life) of initial value shall be considered defective. 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 MIL-PRF-19500 and table I herein. End-point electrical measurements shall be in accordance with table I, subgroup 2 herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and paragraphs 4.4.2.1 herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.4.2.1 Group B inspection, table VIb of MIL-PRF-19500.

Subgroup	Method	Conditions
B3	1026	$T_A = +125^\circ\text{C}$, (see 4.3.2).
B5	3101 or 4081	$R_{\theta JL} \leq 60^\circ\text{C/W}$ at $L = 0.375$ inches (9.53 mm), non surface mount devices; $R_{\theta(JEC)} \leq 20^\circ\text{C/W}$ at $L = 0$ inches for surface mount devices.

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 and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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

Subgroup	Method	Conditions
C2	2036	Test condition A; weight = 5 pounds; t = 15 seconds \pm 3 seconds, (not applicable to surface mount devices).
C2	2036	Test condition E (not applicable to surface mount devices).
C6	1026	$T_A = +125^\circ\text{C}$, (see 4.3.2). leaded samples from the same lot may be used in lieu of surface mount devices.
C7	4071	$I_{(BR)} =$ column 3 of table II, $\alpha V_{(BR)}$, $T_1 = +25^\circ\text{C} \pm 3^\circ\text{C}$; $T_2 = +125^\circ\text{C} \pm 3^\circ\text{C}$; maximum limits = column 8 of table II. Sample size: 22 devices, c = 0.
C8		See 4.5.2a, 10 pulses, sample size: 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 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Maximum peak pulse current (I_{PP}). The peak currents specified in column 7 of table II 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 II. The peak current shall be applied with a current versus time waveform as follows:

- Pulse current shall reach 100 percent of I_{PP} at $t \leq 8 \mu\text{s}$ and decay to 50 percent at $t \geq 20 \mu\text{s}$ for $t_p = 20 \mu\text{s}$ (see figure 8).
- 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 9).

NOTE: Tolerance on pulse time shall be ± 10 percent.

4.5.3 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.

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; $V_R = V_{RWM}$ (column 4 of table II)	I_D		Column 5 of table II	μA dc
Breakdown voltage	4022	$t_p \leq 300$ ms, duty cycle ≤ 2 percent; $I_{(BR)} =$ column 3 of table II	$V_{(BR)1}$	Column 2 of table II		V dc
Forward voltage	4011	$I_F = 1$ A dc	V_F		1.5	V (pk)
<u>Subgroup 3</u>						
Low temperature operation		$T_A = -55^\circ C$				
Breakdown voltage	4022	$t_p \leq 300$ ms, duty cycle ≤ 2 percent; $I_{(BR)} =$ column 3 of table II.	$V_{(BR)2}$	Column 9 of table II		V dc
<u>Subgroup 4</u>						
Clamping voltage (see 4.5.3)		$t_p = 1.0$ ms (see 4.5.1) $I_{PP} =$ column 7 of table II	V_C		Column 6 of table II	V (pk)
<u>Subgroup 5</u>						
Not applicable						
<u>Subgroup 6</u>						
Forward surge current	4066	One pulse, half sine wave 8.3 ms; $I_F = 0$, $V_{RWM} = 0$, $T_A = +25^\circ C$.	I_{FSM}		80	A (pk)
Electrical measurements		See table I, subgroup 2				
<u>Subgroup 7</u>						
Clamping voltage inverse polarity maximum (see 4.5.3)		$t_p = 1.0$ ms (see 4.5.2) except use forward direction current without prior bias voltage	$-V_C$		Column 11 of table II	V (pk)

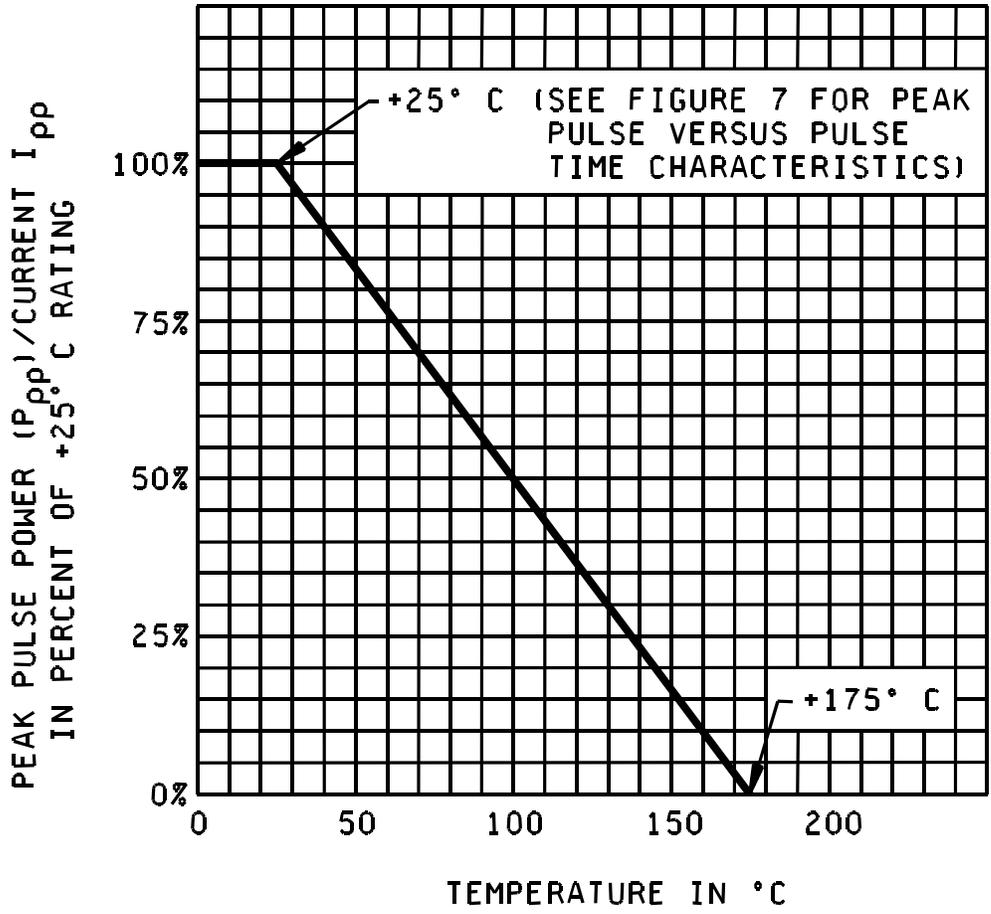
1/ For sampling plan, see MIL-PRF-19500.

2/ Column references are to table II herein.

TABLE II. Electrical characteristics. 1/

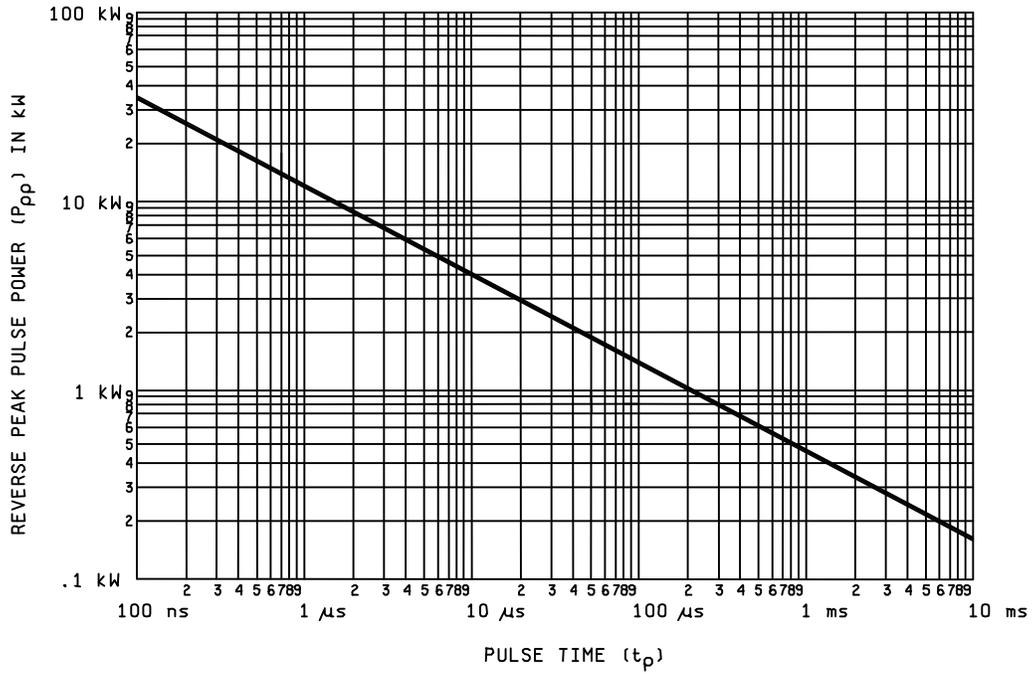
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7		Col 8	Col 9	Col 10	Col 11
	$V_{(BR)1}$ at $I_{(BR)}$	$I_{(BR)}$	V_{RWM}	I_D at V_{RWM}	V_C at I_{PP} for $t_p = 1$ ms	I_{PP}		$\alpha V_{(BR)}$	$V_{(BR)2}$ minimum at I_{BR} T_A = - 55°C	(I_{RM}) maximum dc current T_A = + 25°C	- V_C at $t_p = 1$ ms $A(pk)$ = in accordance with column 7 inverse polarity
	V dc	mA dc	V (pk)	μ A dc	V (pk)	t_p = 20 μ s t_r = 8 μ s	t_p = 1 ms t_r = 10 μ s				
1N6461	5.6	25	5	3,000	9.0	315	56	-0.03, +0.045	5.4	367	-3.5
1N6462	6.5	20	6	2,500	11.0	258	46	+0.060	6.2	304	-3.2
1N6463	13.6	5	12	500	22.6	125	22	+0.085	13.0	139	-3.8
1N6464	16.4	5	15	500	26.5	107	19	+0.085	15.6	63	-3.8
1N6465	27.0	2	24	50	41.4	69	12	+0.096	25.1	39	-3.6
1N6466	33.0	1	30.5	3	47.5	63	11	+0.098	30.2	34	-3.6
1N6467	43.7	1	40.3	2	63.5	45	8	+0.101	40.0	46	-3.5
1N6468	54.0	1	51.6	2	78.5	35	6	+0.103	48.5	20	-3.4

1/ These limits apply to the US device types also.



NOTE: Not applicable for JANHC or JANKC die.

FIGURE 6. Derating curve.



NOTE: Not applicable for JANHC or JANKC die.

FIGURE 7. Peak pulse power versus pulse time.

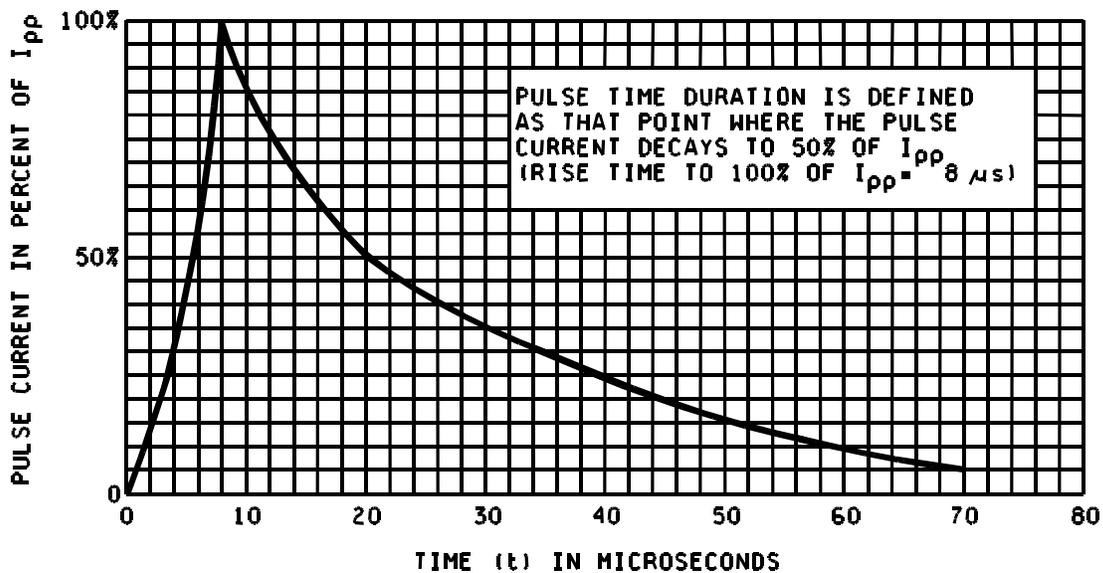


FIGURE 8. Current impulse waveform.

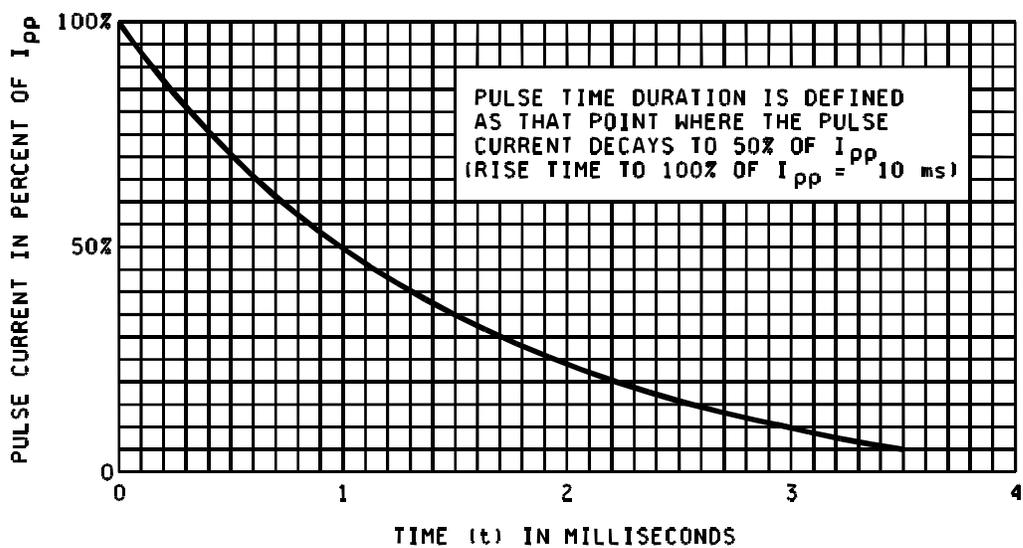


FIGURE 9. Current impulse waveform.

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 must specify the following:

- a. Issue of DODISS to be cited in the solicitation (see 2.2.1).
- b. The lead finish as specified (see 3.4.2).
- c. Type designation and quality assurance level.
- d. Packaging requirements (see 5.1).
- e. For die acquisition, the JANHC or JANKC letter version shall be specified (see figures 3, 4 and 5).

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 No.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 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example, JANHCA1N6461) will be identified on the QML.

JANC ordering information			
	Manufacturer		
PIN	12969	14099	66891
1N6461 through 1N6468	JANHCA1N6461 Through JANHCA1N6468	JANHCB1N6461 through JANHCB1N6468	JANHCC1N6461 through JANHCC1N6468

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 extensiveness of the changes.

Custodians:

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

Preparing activity:

DLA - CC
(Project 5961-2081)

Review activities:

Air Force - 13, 19

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.
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-19500/551C	2. DOCUMENT DATE 990912

3. **DOCUMENT TITLE**
SEMICONDUCTOR DEVICE, DIODE, SILICON, TRANSIENT VOLTAGE SUPPRESSOR TYPES 1N6461 THROUGH 1N6468 AND 1N6461US THROUGH 1N6468US JAN, JANTX, JANTXV, 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 (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan_barone@dsccl.dla.mil
c. ADDRESS Defense Supply Center Columbus, ATTN: DSCC-VAC, 3990 East Broad Street, 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, Suite 2533, Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888