

The documentation and process conversion measures necessary to comply with this document shall be completed by 28 February 2015.

INCH-POUND

MIL-PRF-19500/424C  
28 November 2014  
SUPERSEDING  
MIL-PRF-19500/424B  
18 October 2006

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, FAST RECOVERY, POWER RECTIFIER,  
1N5186, 1N5187, 1N5188, AND 1N5190,  
JAN, JANTX, AND JANTXV

Inactive for new design after the date of this document.  
For new design, use MIL-PRF-19500/411 (see 6.4).

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 silicon, fast recovery rectifier diodes. Three levels of product assurance are provided for each device type as specified in [MIL-PRF-19500](#).

1.2 Physical dimensions. See figure 1 (similar to DO-41).

1.3 Maximum ratings.

Types	V <sub>R</sub>	V <sub>RWM</sub>	I <sub>O</sub> T <sub>A</sub> = 25°C (1)	I <sub>O</sub> T <sub>A</sub> = 150°C	I <sub>FSM</sub> t <sub>p</sub> = 8.3 ms T <sub>A</sub> = 150°C	t <sub>rr</sub>	T <sub>STG</sub> and T <sub>J</sub>	R <sub>θJL</sub> at L = .375
	V dc	V (pk)	A dc	mA dc	A (pk)	ns	°C	°C/W
1N5186	100	100	3	700	80	150	-65 to +175	20
1N5187	200	200	3	700	80	200	-65 to +175	20
1N5188	400	400	3	700	80	250	-65 to +175	20
1N5190	600	600	3	700	80	400	-65 to +175	20

See notes on next page.

\* 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](mailto: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>.

1.3 Maximum ratings (continued).

- (1) Derate linearly at .018 A/°C from  $T_A = 25^\circ\text{C}$  to  $T_A = 150^\circ\text{C}$ ; derate linearly at .028 A/°C from  $T_A = 150^\circ\text{C}$  to  $T_A = 175^\circ\text{C}$ .

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 of 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 cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

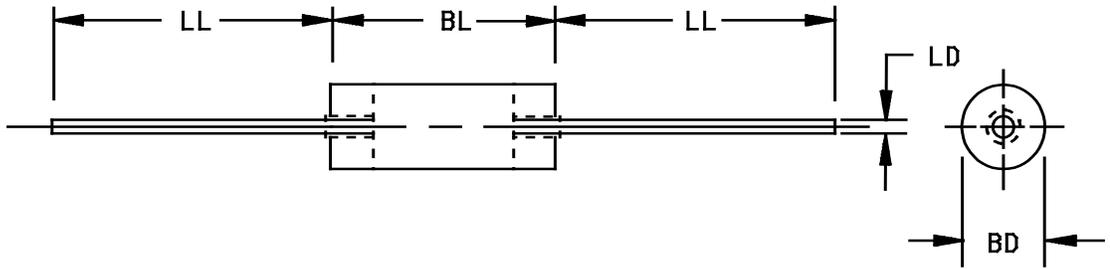
[MIL-PRF-19500](#) - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

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

\* (Copies of these documents are available online at <http://quicksearch.dla.mil>.)

\* 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.



Symbol	Dimension				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BD	.115	.155	2.92	3.94	3
LD	.038	.042	0.97	1.07	
BL	.150	.300	3.81	7.62	4
LL	1.00	1.50	25.40	38.10	

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Dimension BD shall be measured at the largest diameter. The BL dimension shall include the entire body including slugs.
4. Dimension BL shall include the sections of the lead over which the diameter is uncontrolled. This uncontrolled area is defined as the zone between the edge of the diode body and extending .050 inch (1.27 mm) onto the leads.
5. In accordance with ASME Y14.5M, diameters are equivalent to  $\phi$ x symbology.

FIGURE 1. Physical dimensions.

### 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 manufacturer's 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](#).

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in [MIL-PRF-19500](#) and on figure 1 (DO-41) herein.

3.4.2 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 contract or order (see 6.2).

\* 3.4.3 Diode construction. These devices shall be metallurgically bonded-thermally-matched-noncavity-double plug construction, utilizing a category I bond, in accordance with [MIL-PRF-19500](#).

3.5 Marking. Marking shall be in accordance with [MIL-PRF-19500](#).

3.5.1 Polarity. The polarity of all types shall be indicated with a contrasting color band to denote the cathode end.

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

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

\* 3.8 Workmanship. Semiconductor devices Diode, Silicon, Fast Recovery, Power Rectifier 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).

\* 4.1.1 Sampling and inspection. Sampling and inspection shall be in accordance with [MIL-PRF-19500](#) and as specified herein.

\* 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 request the performance of table II tests, the tests specified in table II 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 (JANTX and JANTXV levels only). Screening shall be in accordance with appendix E, 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 appendix E, table E-IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
(1) 3c	Thermal impedance (see 4.3.2)
7	Optional
9	Not applicable
11	$I_{R1}$ and $V_{F1}$
12	Method 1038, condition B (see 4.3.1)
(2) 13	Subgroup 2 of table I herein; $\Delta I_{R1} \leq 100$ percent of initial value or 250 nA dc, whichever is greater; $\Delta V_{F1} \leq \pm 0.1$ V dc. Scope display evaluation (see 4.5.1).
(3) 14	Required

- (1) Thermal impedance shall be performed any time after sealing provided temperature cycling is performed in accordance with screen 3 of MIL-PRF-19500, prior to this thermal test.
- (2)  $Z_{\theta JX}$  is not required in screen 13, if already previously performed.
- (3) For clear glass diodes, the hermetic seal (gross leak) may be performed at any time after temperature cycling.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows (see 4.5.3.1):  $I_{O(min)}$  = Rated  $I_O$  (see 1.3 herein).  $T_A = 55^\circ\text{C}$  maximum. Test conditions in accordance with method 1038 of MIL-STD-750, condition B. Adjust  $I_O$  or  $T_A$  to achieve the required  $T_J$ .  $T_J = 135^\circ\text{C}$  minimum. With approval of the qualifying activity and preparing activity, alternate burn-in criteria (hours, bias conditions,  $T_J$ , mounting conditions, etc.) may be used for JANTX and JANTXV quality levels. A justification demonstrating equivalence is required. In addition, the manufacturing site's burn-in data and performance history will be essential criteria for burn-in modification approval.

4.3.2 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3101 or 4081 as applicable of MIL-STD-750 using the guidelines in that method for determining  $I_M$ ,  $I_H$ ,  $t_H$ , (and  $V_C$  where appropriate).  $t_{MD}$  shall be 70  $\mu\text{s}$  maximum.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table E-V MIL-PRF-19500, and table I 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 appendix E, table E-VI (JAN, JANTX, and JANTXV) of [MIL-PRF-19500](#). Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein; except,  $Z_{\theta JX}$  need not to be performed. See subgroup conditions for delta limits when applicable.

\* 4.4.2.1 Group B inspection, appendix E, table E-VIb (JAN, JANTX and JANTXV of [MIL-PRF-19500](#).

	<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
*	B2	4066	Condition A, Required on each subplot; $I_{FSM} = 80$ A(pk); 10 surges of 8.3 ms each at 1 minute intervals, superimposed on $I_O = 3$ A dc; $V_R = \text{rated } V_{RWM}$ (see 1.3). $T_A = 25^\circ\text{C}$ .
	B3	1027	$I_O = 3$ A dc; $T_A = \text{room ambient}$ as defined in the general requirements of MIL-STD-750, (see 4.5); $f = 50\text{-}60$ Hz; $V_R = \text{rated } V_{RWM}$ (see 1.3 and 4.5.3).  Delta limits: $\Delta I_{R1} \leq 100$ percent of initial value or 250 nA dc, whichever is greater.
	B5		Not applicable.
	B6	1032	$T_A = +175^\circ\text{C}$ , $t = 340$ hours.

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 E-VII of [MIL-PRF-19500](#). Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein; except,  $Z_{\theta JX}$  need not to be performed. See subgroup conditions for delta limits when applicable.

	<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
	C2	2036	Tension: Test condition A; weight = 4 pounds; $t = 30$ seconds.  Lead fatigue: Test condition E.
	C6	1026	$I_O = 3$ A dc minimum; $T_A = \text{room ambient}$ as defined in the general requirements of <a href="#">MIL-STD-750</a> , (see 4.5); $f = 50\text{-}60$ Hz; $V_R = \text{rated } V_{RWM}$ (see 1.3 and 4.5.3).  Delta limits: $\Delta V_F \leq \pm 0.1$ V dc; $\Delta I_{R1} \leq 100$ percent of initial value or 250 nA dc, whichever is greater.

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

4.5.1 Scope-display evaluation. The reverse breakdown characteristics shall be viewed on an oscilloscope with display calibration factors of 5 to 20  $\mu\text{A}$  per division and 50 to 100 V per division. Reverse current over the knee shall be at 50  $\mu\text{A}$ . Each device shall exhibit a sharp knee characteristic and any discontinuity or dynamic instability of the trace shall be cause for rejection. See method 4023 of [MIL-STD-750](#).

4.5.2 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of [MIL-STD-750](#).

4.5.3 Burn-in and steady-state operation life tests. These tests shall be conducted with a half-sine waveform of the specified peak voltage impressed across the diode in the reverse direction followed by a half-sine waveform of the specified average rectified current. The forward conduction angle of the rectified current shall be neither greater than 180 degrees, nor less than 150 degrees.

\* 4.5.3.1 Free air power burn-in and life tests. The use of a current limiting or ballast resistor is permitted provided that each DUT still sees the full  $I_O$  (minimum) and that the minimum applied voltage, where applicable, is maintained through out the burn-in period. Use method 3100 of [MIL-STD-750](#) to measure  $T_J$ .

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TABLE I. Group A inspection.

Inspection <u>1</u> /	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance	3101	See 4.3.2	Z <sub>θJX</sub>			°C/W
Forward voltage	4011	I <sub>F</sub> = 9 A dc (pulsed); 2 percent maximum duty cycle	V <sub>F1</sub>	0.9	1.5	V (pk)
Reverse current	4016	DC method; V <sub>R</sub> = rated V <sub>RWM</sub> (see 1.3)	I <sub>R1</sub>		2.0	μA dc
Breakdown voltage	4021	I <sub>R</sub> = 100 μA dc	V(BR)1			
1N5186				120	---	V dc
1N5187				240	---	V dc
1N5188				480	---	V dc
1N5190				660	---	V dc
<u>Subgroup 3</u>						
High temperature operation:		T <sub>A</sub> = +100°C				
Reverse current	4016	DC method; V <sub>R</sub> = rated V <sub>RWM</sub> (see 1.3)	I <sub>R2</sub>		100	μA dc
Low temperature operation:		T <sub>A</sub> = -55°C				
Forward-voltage	4011	I <sub>F</sub> = 9 A (pk) (pulsed)	V <sub>F2</sub>	0.9	1.5	V (pk)
Reverse current	4016	DC method; V <sub>R</sub> = rated (see 1.3)	I <sub>R3</sub>		2	μA dc

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u>						
Reverse recovery time	4031	Condition B1	$t_{rr}$			
1N5186					150	ns
1N5187					200	ns
1N5188					250	ns
1N5190					400	ns
Capacitance	4001	$V_R = 0 \text{ V dc};$ $f = 1 \text{ Mhz}$	$C_1$			
1N5186					300	pF
1N5187					300	pF
1N5188					230	pF
1N5190					180	pF
Capacitance	4001	$V_R = 4 \text{ V dc};$ $f = 1 \text{ Mhz}$	$C_2$			
1N5186					200	pF
1N5187					170	pF
1N5188					120	pF
1N5190					90	pF
<u>Subgroups 5, 6, and 7</u>						
Not applicable						

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

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\* TABLE II. Group E inspection (all quality levels) for qualification only.

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
<u>Subgroup 1</u>			
Temperature cycling	1051	500 cycles; condition C	45 devices c = 0
Electrical measurement		See table I, group A, subgroup 2	
<u>Subgroup 2</u>			45 devices c = 0
Steady-state dc blocking life	1038	1,000 hours, condition A	
Electrical measurement		See table I, group A, subgroup 2	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance curves		See MIL-PRF-19500.	
<u>Subgroup 5</u>			10 devices c = 0
Barometric pressure 1N5188 and 1N5190 only	1001	Pressure = 8.0 mm V <sub>R</sub> = rated (see 1.3)	

## 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 3.4.2).

\* d. The complete Part or Identifying Number (PIN), see title and section 1.

\* 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](mailto: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 Substitution information. Devices covered under this specification are inactive for new design as of the date of this specification. For new design, in lieu of MIL-PRF-19500/424 (1N5186, 1N5187, 1N5188, and 1N5190), the preferred devices are MIL-PRF-19500/411 (1N5416, 1N5417, 1N5418, and 1N5420 respectively).

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\* 6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. 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 previous issue.

Custodians:

Army - CR  
Navy - EC  
Air Force - 85  
DLA - CC

Preparing activity:  
DLA -CC

(Project 5961-2014-117)

Review activities:

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

\* NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.