

The documentation and process conversion measures necessary to comply with this revision shall be completed by 29 August 1995

INCH-POUND

MIL-S-19500/424A
29 May 1995
SUPERSEDING
MIL-S-19500/424
23 June 1969

MILITARY SPECIFICATION

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-S-19500/411 (see 6.5).

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 detail requirements for silicon, fast recovery rectifier diodes. Three levels of product assurance are provided for each device type as specified in MIL-S-19500.

1.2 Physical dimensions. See figure 1 (Similar to D0-41).

1.3 Maximum ratings.

Types	V_R	V_{RWM}	I_O 1/ $T_A = 25^\circ C$	I_O $T_A = 150^\circ C$	I_{FSM} $t_p = 8.3 \text{ ms}$ $T_A = 150^\circ C$	t_{rr}	T_{STG} and T_J	$R_{\theta JL}$ at $L = .375$
	V dc	V (pk)	A dc	mA dc	A (pk)	ns	$^\circ C$	$^\circ C/W$
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

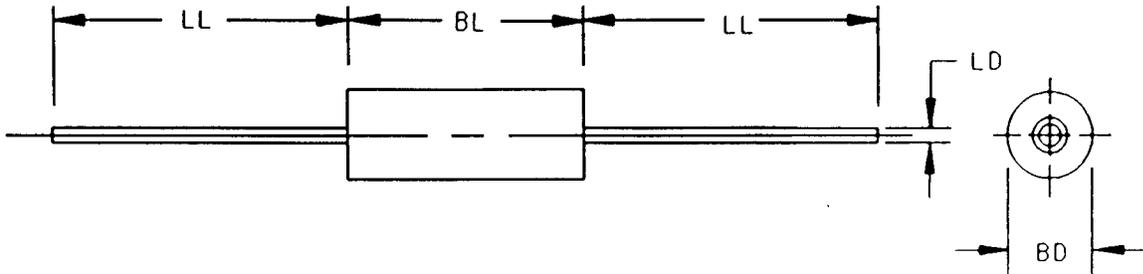
1/ Derate linearly at .018 A/ $^\circ C$ from $T_A = 25^\circ C$ to $T_A = 150^\circ C$; Derate linearly at .028 A/ $^\circ C$ from $T_A = 150^\circ C$ to $T_A = 175^\circ C$.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Electronics Supply Center, ATTN: DESC-ELDT, 1507 Wilmington Pike, Dayton, OH 45444-5765, by using the addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5961

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.



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

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimension ϕB shall be measured at the largest diameter.
4. The G dimension shall include all uncontrolled areas of the device leads.

FIGURE 1. Physical dimensions.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARDS

MILITARY

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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Defense Printing Service Detachment Office, Bldg. 4D (Customer Service), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following documents 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. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Y14.5M - Dimensioning and Tolerancing. (Dod adopted)

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018-3308.)

2.3 Order of precedence. 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 Associated detail specification. The individual item requirements shall be in accordance with MIL-S-19500 and as specified herein.

3.2 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-S-19500.

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-S-19500 and figure 1 herein.

3.3.1 Lead finish. Lead finish shall be in accordance with MIL-STD-750, MIL-S-19500, and herein.

3.4 Marking. Marking shall be in accordance with MIL-S-19500.

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

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

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

4.2.1 Group E inspection. Group E inspection shall be conducted in accordance with MIL-S-19500 and table II herein.

4.3 Screening (JANTX AND JANTXV levels only). Screening shall be in accordance with table II of MIL-S-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 II of MIL-S-19500)	Measurement
	JANTX and JANTXV levels
3C <u>1/</u>	Thermal impedance (see 4.4.1)
9	Not applicable
11	I_{R1} and V_{F1}
12	Method 1038, condition B (see 4.3.1)
13 <u>2/</u>	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).

1/ Thermal impedance shall be performed any time after sealing provided temperature cycling is performed in accordance with MIL-S-19500, screen 3 prior to this thermal test.

2/ $Z_{\theta JX}$ is not required in screen 13, if already previously performed.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows (see 4.5.3):

Type	V_R	I_O	f
1N5186	100 V dc	3 A dc	50-60 Hz
1N5187	200 V dc	3 A dc	50-60 Hz
1N5188	400 V dc	3 A dc	50-60 Hz
1N5190	600 V dc	3 A dc	50-60 Hz

NOTE: T_A = room ambient as defined in the general requirements of MIL-STD-750, (see 4.5).

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-S-19500.

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4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-19500, and table I herein. The following test conditions shall be used for $Z_{\theta JX}$: $Z_{\theta JX} = 1.5^{\circ}\text{C/W}$ max.

I_H	5 A minimum.
t_H	10 ms.
I_M	1 mA to 10 mA.
t_{MD}	100 μs maximum.

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

Subgroup	Method	Condition
2	4066	Required on each subplot; $I_{FSM} = 80 \text{ A(pk)}$; 10 surges of 8.3 ms each at 1 minute intervals, superimposed on $I_0 = 3 \text{ A dc}$; $V_R = \text{rated } V_{RWM}$ (see 1.3). $T_A = 25^{\circ}\text{C}$.
3	1027	$I_0 = 3 \text{ A dc}$; $T_A = \text{room ambient}$ as defined in the general requirements of MIL-STD-750, (see 4.5); $f = 50\text{-}60 \text{ Hz}$; $V_R = \text{rated } V_{RWM}$ (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.
5	----	Not applicable.
6	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 table V of MIL-S-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.

Subgroup	Method	Condition
2	2036	Tension: Test condition A; weight = 4 pounds; $t = 30$ seconds. Lead fatigue: Test condition E.
6	1026	$I_0 = 3 \text{ A dc}$; $T_A = \text{room ambient}$ as defined in the general requirements of MIL-STD-750, (see 4.5); $f = 50\text{-}60 \text{ Hz}$; $V_R = \text{rated } V_{RWM}$ (see 1.3 and 4.5.3). Delta limits: $\Delta V_F \leq \pm 0.1 \text{ V dc}$; $\Delta I_{R1} \leq 100$ 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 μA per division and 50 to 100 V per division. Reverse current over the knee shall be at 50 μA . Each device shall exhibit a sharp knee characteristic and any discontinuity or dynamic instability of the trace shall be cause for rejection. See MIL-STD-750C, method 4023.

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.

4.5.4 Thermal impedance ($Z_{\theta JX}$ measurements). The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750, method 3101.

4.5.4.1 Thermal impedance ($Z_{\theta JX}$ measurements) for initial qualification or requalification. The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750, method 3101 (read and record date $Z_{\theta JX}$). $Z_{\theta JX}$ shall be supplied on one lot (500 devices minimum). Twenty-two of these samples shall be serialized and provided to the qualifying activity for correlation prior to shipment of parts. Measurements conditions shall be in accordance with 4.4.1.

4.5.5 Thermal resistance. Thermal resistance measurement shall be performed in accordance with MIL-STD-750, method 3101 or 4081. Read and record data in accordance with group E herein and shall be included in the qualification report. Forced moving air or draft shall not be permitted across the devices during test. The maximum limit for $R_{\theta JL}$ under these test condition shall be $R_{\theta JL(max)} = 20^{\circ}\text{C/W}$ for $L = .375$. The following conditions shall apply:

- I_H 3 A.
- t_H 25 seconds minimum.
- I_M 1 mA to 10 mA.
- t_{MD} 100 μs maximum.

LS = Lead spacing = 3/8 inch as defined on figure 3 below:

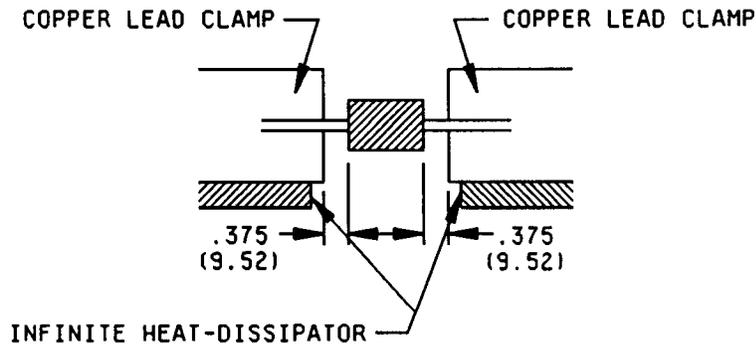


FIGURE 3. Mounting arrangement.

TABLE I. Group A inspection.

Inspection 1/	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 4.4.1	$Z_{\theta JX}$		1.5	$^{\circ}\text{C/W}$
Forward voltage	4011	$I_F = 9 \text{ A dc (pulsed)}$; 2% maximum duty cycle	V_{F1}	0.9	1.5	V (pk)
Reverse current	4016	DC method; $V_R = \text{rated } V_{RWM}$ (see 1.3)	I_{R1}	---	2.0	$\mu\text{A dc}$
Breakdown voltage	4021	$I_R = 100 \mu\text{A dc}$	$V_{(BR)1}$			
1N5186				120	---	V dc
1N5187				240	---	V dc
1N5188				480	---	V dc
1N5190				660	---	V dc
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +100^{\circ}\text{C}$				
Reverse current	4016	DC method; $V_R = \text{rated } V_{RWM}$ (see 1.3)	I_{R2}		100	$\mu\text{A dc}$
Low temperature operation:		$T_A = -55^{\circ}\text{C}$				
Forward-voltage	4011	$I_F = 9 \text{ A (pk)(pulsed)}$	V_{F2}	0.9	1.5	V(pk)
Reverse current	4016	DC method; $V_R = \text{rated (see 1.3)}$	I_{R3}		2	$\mu\text{A dc}$

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	$V_R = 0$ V dc; $f = 1$ Mhz	C_1			
1N5186				---	300	pF
1N5187				---	300	pF
1N5188				---	230	pF
1N5190				---	180	pF
Capacitance	4001	$V_R = 4$ V dc; $f = 1$ 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-S-19500.

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

Inspection	MIL-STD-750		Sampling plan <u>1/</u>
	Method	Conditions	
<u>Subgroup 1</u>			5
Temperature cycling	1051	500 cycles; condition C	
Electrical measurement		See table I, group A, subgroup 2	
<u>Subgroup 2</u>			5
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>			10 devices c = 0
Thermal resistance	3101 or 4081	See 4.5.5	
<u>Subgroup 5</u>			10 devices c = 0
Barometric pressure 1N5188 & 1N5190 only	1001	Pressure = 8.0 mm V _R = rated (see 1.3)	

1/ For sampling plans not specified, see MIL-S-19500.

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5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-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-S-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.
- b. Lead finish as specified (see 3.3.1).
- c. Product assurance level and type designation.

6.3 Replacement data.

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-S-19500/424 (1N5186, 1N5187, 1N5188, and 1N5190), the preferred devices are MIL-S-19500/411 (1N5416, 1N5417, 1N5418, and 1N5420 respectively).

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.

CONCLUDING MATERIAL

Custodians:

Army - ER
Navy - EC
Air Force - 17

Preparing activity:

DLA - ES

(Project 5961-1608)

Review activities:

Army - AR, MI
Navy - AS, CG, MC
Air Force - 19, 85

