

The documentation and process conversion measures necessary to comply with this document shall be completed by 27 January 2025.

INCH-POUND

MIL-PRF-19500/359L
w/AMENDMENT 1
27 August 2024
SUPERSEDING
MIL-PRF-19500/359L
19 April 2019

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER,
FAST RECOVERY, TYPES 1N4942, 1N4944, 1N4946, 1N4947, AND 1N4948,
QUALITY LEVELS JAN, JANTX, AND JANTXV

Inactive for new design after 27 February 1992.
See 6.6 for supersession data.

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 a silicon, fast recovery semiconductor power rectifier diode for use in equipment circuits. Three levels of product assurance (JAN, JANTX, and JANTXV) are provided for each device as specified in [MIL-PRF-19500](#).

1.2 Physical dimensions. The device package outline is a leaded axial package in accordance with [figure 1](#) for all device types.

1.3 Maximum ratings. Unless otherwise specified, $T_A = +25^\circ\text{C}$.

Device type	V_{RWM}	I_O $T_A = +55^\circ\text{C}$ (1) (2) (3)	I_O $T_A = +100^\circ\text{C}$ (2) (3)	I_{FSM} at $t_p = 8.3 \text{ ms}$ $I_O = .750 \text{ A dc}$ $T_A = +55^\circ\text{C}$	$R_{\theta JL}$ $L = .375 \text{ inch}$ (9.52 mm) (4)	t_{rr1} at $I_F = 0.5 \text{ A}$, $I_R = 1.0 \text{ A}$ $I_{REC} = 0.25 \text{ A}$	$R_{\theta JX}$ (2)	T_{STG} and T_J
	<u>V</u>	<u>A dc</u>	<u>A dc</u>	<u>A pk</u>	<u>°C /W</u>	<u>ns</u>	<u>°C/W</u>	<u>°C</u>
1N4942	200	1.0	.750	15	38	150	115	-65°C
1N4944	400	1.0	.750	15	38	150	115	to
1N4946	600	1.0	.750	15	38	250	115	+175°
1N4947	800	1.0	.750	15	38	250	115	C
1N4948	1,000	1.0	.750	15	38	500	115	

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@dlamail. 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>.

AMSC N/A

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1.3 Maximum ratings – Continued.

- (1) Derate linearly from 1.0 A at $T_A = +55^\circ\text{C}$ to 0.75 A at $+100^\circ\text{C}$. Derate linearly from 0.75 A to 0 A between $+100^\circ\text{C}$ and $+175^\circ\text{C}$.
- (2) For the 1 amp rating at 55°C ambient or 0.75 amp rating at 100°C ambient, these I_O ratings are for thermal (PC boards or other) mounting methods where thermal resistance from mounting point to ambient is still sufficiently controlled where $T_{J(\text{MAX})}$ in 1.3 is not exceeded. This equates to $R_{\theta JX} \leq 115^\circ\text{C/W}$ as shown. Also see application notes in 6.7.
- (3) Barometric pressure reduced, 1N4944, 1N4946: 8 mm Hg (100,000 ft); 1N4947, 14948: 33 mm Hg (70,000 ft).
- (4) Thermal resistance for junction-to-lead. See figure 2 for thermal impedance curve.

1.4 Primary electrical characteristics. Not applicable to this specification sheet.

1.5 Part or Identifying Number (PIN). The PIN is in accordance with MIL-PRF-19500, and as specified herein. See 6.4 for PIN construction example and 6.5 for a list of available PINs, and 6.6 for supersession information.

1.5.1 JAN certification mark and quality level. The quality level designators for encapsulated devices that are applicable for this specification sheet from the lowest to the highest level are as follows: "JAN", "JANTX" and "JANTXV".

1.5.2 Device type. The designation system for the devices covered by this specification sheet is as follows.

1.5.2.1 First number and first letter symbols. The devices of this specification sheet use the first number and letter symbols "1N".

1.5.2.2 Second number symbols. The second number symbols for the devices covered by this specification sheet are as follows: "4942", "4944", "4946", "4947" and "4948".

1.5.3 Lead finish. The lead finishes applicable to this specification sheet are listed on QPDSIS-19500.

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.

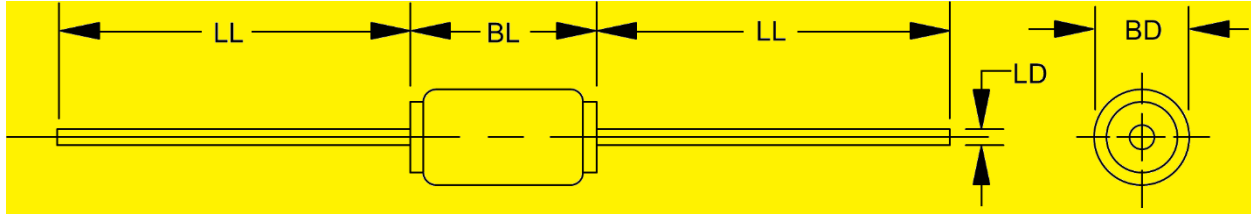
DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-750 – Test Methods For Semiconductor Devices.

(Copies of these documents are available online at <https://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.

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Dimensions					
SYM	Inch	Inch	mm	mm	Notes
	Min	Max	Min	Max	
BD	.065	.150	1.65	3.81	2
BL	.140	.250	3.56	6.35	3
LD	.027	.033	0.69	0.84	
LL	1.00	1.50	25.4	38.1	

NOTES:

1. Dimensions are in inches. Millimeter equivalents are given for general information only.
2. Dimension BD shall be measured at the largest diameter.
3. Dimension BL shall include the entire body including slugs and 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 onto the leads .050 inch (1.27 mm).

FIGURE 1. Physical dimensions axial package.

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](#) and as follows.

T _{CVF}	Temperature coefficient of forward voltage.
P _{RM}	Peak reverse power.

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in [MIL-PRF-19500](#), and on [figure 1](#). All devices shall be metallurgically bonded-thermally matched-noncavity-double plug construction as defined in [MIL-PRF-19500](#).

3.4.1 Diode construction. These devices shall be constructed utilizing non-cavity, double plug construction with high temperature metallurgical bonding between both sides of the silicon die and terminal pins. Metallurgical bond shall be in accordance with the requirements of category I appendix A, [MIL-PRF-19500](#). Point contact construction shall not be acceptable. Silver button Dumet design shall not be acceptable.

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

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 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](#) and [tables I, II, and III](#)).

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

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4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and 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 (quality levels JANTX and JANTXV). 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	Measurements for quality levels JANTX and JANTXV
(1) 3c	Thermal impedance (see 4.3.1).
9	Not applicable.
11	I_{R1} and V_{FM1} .
12	See 4.3.2 and 4.5.3.
(2) 13	Subgroup 2 of table I herein: $\Delta I_{R1} \leq \pm 100$ percent of initial reading or ± 50 nA dc whichever is greater. $\Delta V_{FM1} \leq +0.1$ V dc, -0.2 V dc. Scope display evaluation (see 4.5.4).

- (1) Thermal impedance shall be performed any time after sealing provided temperature cycling is performed in accordance with MIL-PRF-19500, screen 3 prior to this thermal test.
- (2) Thermal impedance is not required in screen 13, if already previously performed.

4.3.1 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3101 of MIL-STD-750 as applicable, using the guidelines in that method for determining I_M , I_H , t_H , t_{MD} , and K factor where appropriate. The thermal impedance limit used in screen 3c and table I, subgroup 2 shall be set statistically by the supplier.

4.3.2 Power burn-in conditions. Power burn-in conditions shall be in accordance with condition B of method 1038 of MIL-STD-750. The details of 4.5.3 and those that follows shall apply: $I_{O(min)} = 1$ A dc. $T_A = +55^\circ\text{C}$ maximum. 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) 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.

4.4 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 table E-V of MIL-PRF-19500 and table I herein. $Z_{\theta JX}$ endpoint shall be derived by the supplier and approved by the qualifying activity. This $Z_{\theta JX}$ end-point shall be documented in the qualification report.

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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 table E-VIB (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and herein. Delta electrical measurements shall be in accordance with table III herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B2	4066	I_{FSM} = rated (see 1.3); ten surges of 8.3 ms each at 1 minute intervals; superimposed on I_O = .750 A dc, V_{RWM} = rated (see 1.3). T_A = 55°C
B3	1027	I_O = 1.0 A dc minimum; Adjust I_O to achieve required T_J of 150°C minimum; f = 50 to 60 Hz; T_A = +55°C maximum; V_R = rated V_{RWM} (see 1.3 and 4.5.3); t = 340 hours. For irradiated devices, include t_{rr1} as an end-point measurement.

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 and herein. Delta electrical measurements shall be in accordance with table III herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	1056	Test condition A.
C2	2036	Tension: Test condition A, weight = 10 pounds (4.54 kg); t = 15 seconds.
C2	1021	Omit initial conditioning.
C5	4081	$R_{\theta JL}$ = 38°C/W; L = .375 inch (9.52 mm); I_M = 10 mA, see (4.5.6), I_H = 2 A, t_H = thermal equilibrium.
C6	1026	T_A = +55°C maximum; f = 50 to 60 Hz; I_O = 1.0 A minimum; Adjust I_O to achieve required T_J of 150°C minimum; V_R = rated V_{RWM} (see 1.3, 4.5.3). For irradiated devices, include t_{rr1} as an end-point measurement.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500 and as specified in table II herein. Delta electrical measurements shall be in accordance with table III herein.

4.5 Methods of inspection. Methods of inspection shall be 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 Inspection conditions. Unless otherwise specified, all inspections shall be conducted at an ambient temperature T_A of +25°C ±3°C.

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4.5.3 Burn-in and 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 Junction temperature measurements. Use method 3100 of MIL-STD-750 to measure T_J . The use of a current limiting or ballast resistor is permitted provided that each DUT still sees the required T_J and full rated I_O and that the minimum required voltage V_{RWM} is maintained throughout the burn-in period.

4.5.3.2 Mounting conditions. At the option of the manufacturer, any clips or heat sink mounting configurations may be utilized provided that I_O is increased such that the junction temperature of each diode is maintained at +135°C minimum for screening and +150°C minimum for life test and that the minimum required voltage V_{RWM} is maintained throughout the burn-in period.

4.5.4 Scope display evaluation. Scope display evaluation shall be sharp and stable in accordance with condition B of method 4023 of MIL-STD-750. Scope display may be performed on ATE (automatic test equipment) for screening only with the approval of the qualifying activity. Scope display in group A shall be performed on a curve tracer. The reverse current (I_{BR}) over the knee shall be 500 μA peak.

4.5.5 Peak reverse power test. Peak reverse power, $P_{RM} > 318$ W for square wave in accordance with method 4065 of MIL-STD-750 ($P_{RM} > 500$ W for half sine-wave). Test shall be performed on each subplot; sampling plan $n = 10$, $c = 0$.

4.5.6 Thermal resistance. Thermal resistance measurement shall be performed in accordance with method 4081 of MIL-STD-750 using the guidelines in that method for determining I_M , I_H , and t_H . Measurement delay time $t_{MD} = 70$ μs maximum. See table E-IX of MIL-PRF-19500, subgroup 4, and the thermal resistance versus pad area (for each pad) with 1, 2, and 3 oz copper for 1N4942 through 1N4948 figure herein. Forced moving air or draft shall not be permitted across the devices during test.

4.5.7 Peak reverse power characterization. The testing to characterize P_{RM} shall be conducted in accordance with method 4065 of MIL-STD-750. The following details shall apply:

- a. During the test, the voltage (V_{BR}) shall be monitored to verify it has not collapsed.
- b. Any collapse in V_{BR} during or after the test, or rise in leakage current (I_R) after the test that exceeds I_{R1} in table I, shall be considered a failure to that level of applied P_{RM} .
- c. Progressively higher levels of P_{RM} shall be applied until failure occurs on all devices within the chosen sample size to characterize each subplot.

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TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit	Limit	Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical	2071					
<u>Subgroup 2</u>						
Forward voltage	4011	Condition B, $I_{FM1} = 1.0$ A dc, pulsed (see 4.5.1)	V_{FM1}	0.6	1.3	V dc
Reverse current leakage	4016	Condition A or B; $V_R =$ rated V_{RWM} , (see 1.3), pulsed (see 4.5.1)	I_{R1}		1.0	μ A
Breakdown voltage	4021	$I_R = 50$ μ A, pulsed (see 4.5.1)	$V_{(BR)1}$			
1N4942				220		V dc
1N4944				440		V dc
1N4946				660		V dc
1N4947				880		V dc
1N4948				1,100		V dc
Thermal impedance	3101	See 4.3.1	$Z_{\theta JX}$			$^{\circ}$ C/W
<u>Subgroup 3</u>						
High temperature operation		$T_A = +150^{\circ}$ C				
Reverse current leakage	4016	Condition A or B; $V_R =$ rated V_{RWM} (see 1.3), pulsed (see 4.5.1)	I_{R2}		200	μ A
Low temperature operation		$T_A = -55^{\circ}$ C				
Forward voltage	4011	Condition B, $I_{FM} = 1$ A dc, pulsed (see 4.5.1)	V_{FM2}	0.6	1.5	V dc
Reverse current	4016	Condition A or B; $V_R =$ rated V_{RWM} (see 1.3)	I_{R3}		1.0	μ A dc

See footnote at end of table.

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TABLE I. Group A inspection – Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit	Limit	Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u>						
Forward recovery voltage	4026	$I_F = 0.25 \text{ A}$; $t_p = 20 \text{ ns}$, (minimum); $t_r = 8 \text{ ns}$	$V_{(PEAK)}$		5.0	V
Capacitance	4001	$V_R = 12 \text{ V dc}$, $f = 0.1 \text{ to } 1 \text{ MHz}$	C_J			
1N4942					45	pF
1N4944					35	pF
1N4946					25	pF
1N4947					20	pF
1N4948					15	pF
Reverse recovery time	4031	Condition B1	T_{rr1}			
1N4942					150	ns
1N4944					150	ns
1N4946					250	ns
1N4947					250	ns
1N4948					500	ns
Scope display evaluation	4023	Condition B, sharp and stable, see 4.5.4, $n = 116$, $c = 0$				
<u>Subgroup 5</u>						
Not applicable						
<u>Subgroup 6</u>						
Forward surge current	4066	Condition A; $I_{FSM} = \text{ten surges}$ of 15 A, 8.3 ms each at 1 minute intervals; superimposed on $I_O = .750 \text{ A dc}$; $V_{RWM} = \text{rated}$ (see 1.3 herein). $T_A = 55^\circ\text{C}$				
Electrical measurements		See table I, subgroup 2 except $Z_{\theta JX}$				
<u>Subgroup 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 1A</u>			45 devices, c = 0
Temperature cycling (air to air) 1/	1051	20 cycles, except high temperature shall be 150°C and low temperature shall be -195°C	
Hermetic seal 2/	1071		
Electrical measurement		See table I , group A, subgroup 2 and table III , steps 1 and 2. For irradiated devices, include t_{rr1} as an end-point measurement	
<u>Subgroup 1B</u>			45 devices, c = 0
Temperature cycling (air to air)	1051	500 cycles, condition C. -65°C to +175°C	
Hermetic seal 2/	1071		
Electrical measurement		See table I , group A, subgroup 2 and table III , steps 1 and 2. For irradiated devices, include t_{rr1} as an end-point measurement	
<u>Subgroup 2</u>			45 devices, c = 0
Steady-state blocking life	1048	Test condition A, $t = 1,000$ hours, $T_A = +150^\circ\text{C}$, $V_R = 0.8$ of rated V_{RWM} (see 1.3)	
Electrical measurement		See table I , group A, subgroup 2 and table III , steps 1 and 2. For irradiated devices, include t_{rr1} as an end-point measurement	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance		See MIL-PRF-19500	
<u>Subgroup 5</u>			22 devices, c = 0
Barometric pressure (reduced)	1001	1N4944, 1N4946 = 8 mm Hg (100,000 ft); 1N4947, 1N4948 = 33 mm Hg (70,000 ft); voltage during test = V_{RWM} maximum; leakage (I_R) during test shall be 5 μA	

See footnotes at end of table.

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

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
<u>Subgroup 6</u> Not applicable			
<u>Subgroup 7</u> Peak reverse power	4065	P_{RM} shall be characterized by the supplier and this data shall be available to the Government	n = 45
Electrical measurement		See 4.5.7	
<u>Subgroup 10</u>			22 devices, c = 0
Forward surge	4066	Condition A, I_{FSM} = rated (see 1.3); ten surges of 8.3 ms each at 1 minute intervals superimposed on I_O = .750 A dc; V_{RWM} = rated (see 1.3); T_A = + 55°C	
Electrical measurement		See table I, subgroup 2	

1/ Test method 1056 of MIL-STD-750, condition D, using liquid nitrogen may be used in lieu of test method 1051.

2/ Non-transparent glass encased double plug, non-cavity axial leaded diodes may use test method 2068 of MIL-STD-750.

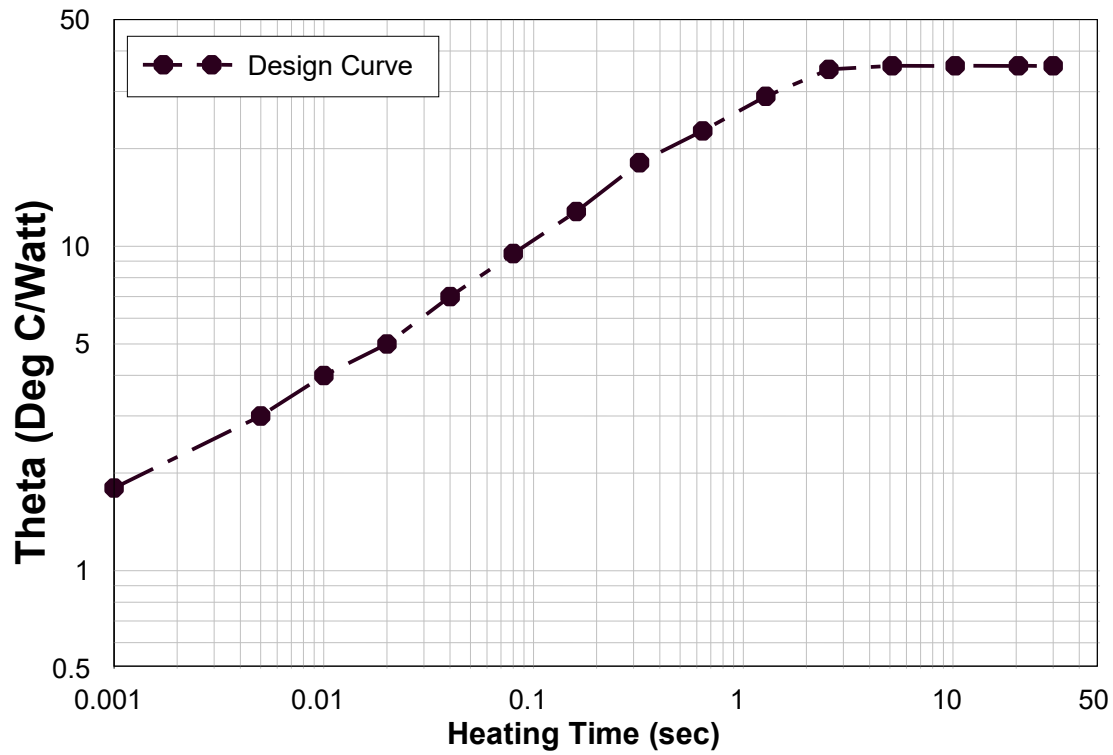
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TABLE III. Groups B, C, and E delta electrical measurements. 1/ 2/ 3/ 4/

Step	Inspection	MIL-STD-750		Symbol	Limit	Limit	Unit
		Method	Conditions		Min	Max	
1.	Forward voltage	4011	Condition B, $I_{FM1} = 1.0$ A dc, pulsed (see 4.5.1)	ΔV_F	-0.2	+0.1	V dc
2.	Reverse current leakage	4016	Condition A or B, $V_R =$ rated V_{RWM} , (see 1.3), pulsed (see 4.5.1)	ΔI_R	$\leq \pm 100$ percent of initial value or ± 50 nA, whichever is greater.		

- 1/ Devices which exceed the table I limits for this test shall not be accepted.
- 2/ The delta electrical measurements taken during group B inspection for quality levels JAN, JANTX, and JANTXV (table E-VIB of MIL-PRF-19500) shall be as follows: In addition to the measurements specified for subgroup 3, the measurements of steps 1 and 2 of this table shall also be taken.
- 3/ The delta electrical measurements taken during group C inspections for all quality levels (table E-VII of MIL-PRF-19500) shall be as follows:
 - a. In addition to the measurements specified for subgroup 2, the measurements of steps 1 and 2 of this table shall also be taken.
 - b. In addition to the measurements specified for subgroup 6, the measurements of steps 1 and 2 of this table shall also be taken.
- 4/ The delta electrical measurements taken during group E inspections for all quality levels (table E-IX of MIL-PRF-19500) shall be as follows:
 - a. In addition to the measurements specified for subgroup 1, the measurements of steps 1 and 2 of this table shall also be taken.
 - b. In addition to the measurements specified for subgroup 2, the measurements of steps 1 and 2 of this table shall also be taken.

Maximum Thermal Impedance



NOTES:

1. Maximum $R_{\theta JL} = 38^{\circ}\text{C/W}$.
2. $Z_{\theta JX} = 4^{\circ}\text{C/W}$ at 10 ms.

FIGURE 2. Thermal impedance curve ($R_{\theta JL}$) for axial leaded package.

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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 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.)

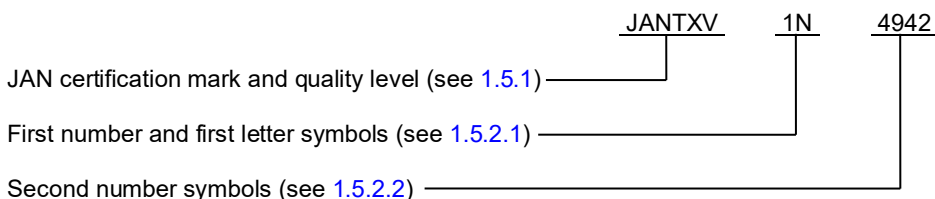
6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

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 PIN, see 1.5 and 6.4.

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://qpldocs.dla.mil>.

6.4 PIN construction example. The PINs are constructed using the following form.



6.5 List of PINs.

Quality level JAN	JAN1N4942	JAN1N4944	JAN1N4946	JAN1N4947	JAN1N4948
Quality level JANTX	JANTX1N4942	JANTX1N4944	JANTX1N4946	JANTX1N4947	JANTX1N4948
Quality level JANTXV	JANTXV1N4942	JANTXV1N4944	JANTXV1N4946	JANTXV1N4947	JANTXV1N4948

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6.6 Supersession information.

6.6.1 Superseded types. The device types of this specification were superseded through a previous revision and are covered on [MIL-PRF-19500/429](#). The preferred devices for new design and the corresponding superseded types are as follows:

Superseding types listed on MIL-PRF-19500/429	Superseded PIN that were specified within MIL-S-19500/359B, dated 27 February 1992
1N5615	1N4942
1N5617	1N4944
1N5619	1N4946
1N5621	1N4947
1N5623	1N4948

6.6.2 Substitution information. Devices covered by this specification are substitutable for the manufacturer's and user's PIN. This information in no way implies that manufacturers' PINs are suitable as substitutes for the military PINs.

6.7 Applications data.

6.7.1 Half-sine-wave application with 1N4942 through 1N4948. For a PCB mounting example with FR4 material where the full 1 amp I_o rating (half-sine-wave) is used at a T_J of 175°C and ambient temperature of 55°C, the following steps guide the user in what the PCB pad size will need to be with 1 oz, 2 oz, and 3 oz copper for 1N4942 to 1N4948. For axial-leaded, the lead length for mounting will be .187 inch (4.76 mm) or less from body to entry point on PCB surface.

- Use the P_o versus I_o curve on [figure 3](#) to look up 1 amp (X-axis) and follow up to the $T_J = 175^\circ\text{C}$ curve (lower) for 1.04 watts.
- Calculate maximum thermal resistance needed $(175^\circ\text{C} - 55^\circ\text{C}) / 1.04 \text{ W} = 115^\circ\text{C/W}$.
- Look up thermal resistance of 115°C/W on Y-axis using a thermal resistance verses pad area plot on one of the three curves on [figure 4](#) for different weights of copper cladding and then intersect curve horizontally to get answer. These curves assume still air, horizontal position.
- In this example, the answers are: 1 oz PCB = .042 in² (27.1 mm²), 2 oz PCB = .025 in² (16.13 mm²), 3 oz PCB = .014 in² (9.03 mm²) for each pad.
- Add a conservative guard-band to the pad size (larger) to keep T_J below 175°C.

6.7.2 Square-wave application with 1N4942 through 1N4948. For a PCB mounting example with FR4 material to support a 0.5 amp I_o square wave switching at a 0.50 duty factor (50 percent duty cycle) at $T_J = 125^\circ\text{C}$ and ambient temperature of 55°C , the following steps guide the user in what the PCB pad size will need to be with 1 oz, 2 oz, and 3 oz copper.

- a. Find size of copper pads on standard FR4 PCB to support operation at 0.5 amp I_o square wave switching at a 0.50 duty factor (50 percent duty cycle) at $T_J = 125^\circ\text{C}$ with $T_A = 55^\circ\text{C}$.
- b. Calculate peak $I_F = 0.5 \text{ A} / 0.50 \text{ duty factor} = 1 \text{ amp}$.
- c. Use the V_F versus I_F curve on [figure 5](#) to look up $I_F = 1 \text{ A}$ (Y-axis) and follow across to the $T_J = 125^\circ\text{C}$ curve (middle) for $V_F = 0.96 \text{ V}$.
- d. Calculate power = $I_F * V_F * \text{duty factor} = 1 \times 0.96 \times 0.50 = 0.48 \text{ W}$.
- e. Calculate maximum thermal resistance needed $(125^\circ\text{C} - 55^\circ\text{C}) / 0.48 \text{ W} = 146^\circ\text{C/W}$.
- f. Look up thermal resistance of 146°C/W on the Y-axis using a thermal resistance versus pad area plot on one of the three curves on [figure 4](#) for different weights of copper cladding and then intersect curve horizontally to get answer. Curves assume still air, horizontal position.
- g. In this example, the answers are: 1oz PCB = $.02 \text{ in}^2$ (12.9 mm^2), 2oz PCB = $.012 \text{ in}^2$ (7.74 mm^2), 3oz PCB = $.008 \text{ in}^2$ (5.16 mm^2) for each pad.
- h. A conservative pad guard-band is optional since T_J is only 125°C . NOTE: Multilayer PCB's, forced air cooling, will improve performance. Closed confinement of the PCB will do the opposite. Use sound thermal management.

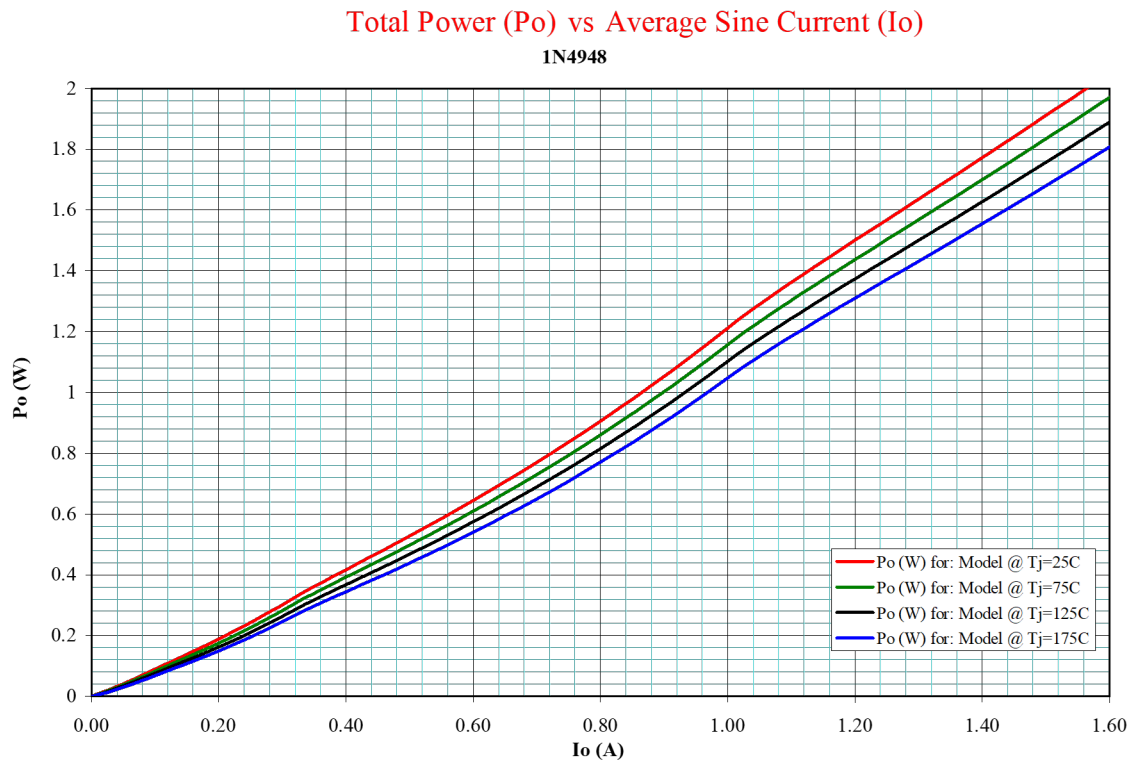


FIGURE 3. Rectifier power P_o versus I_o (average forward current) for all device types.

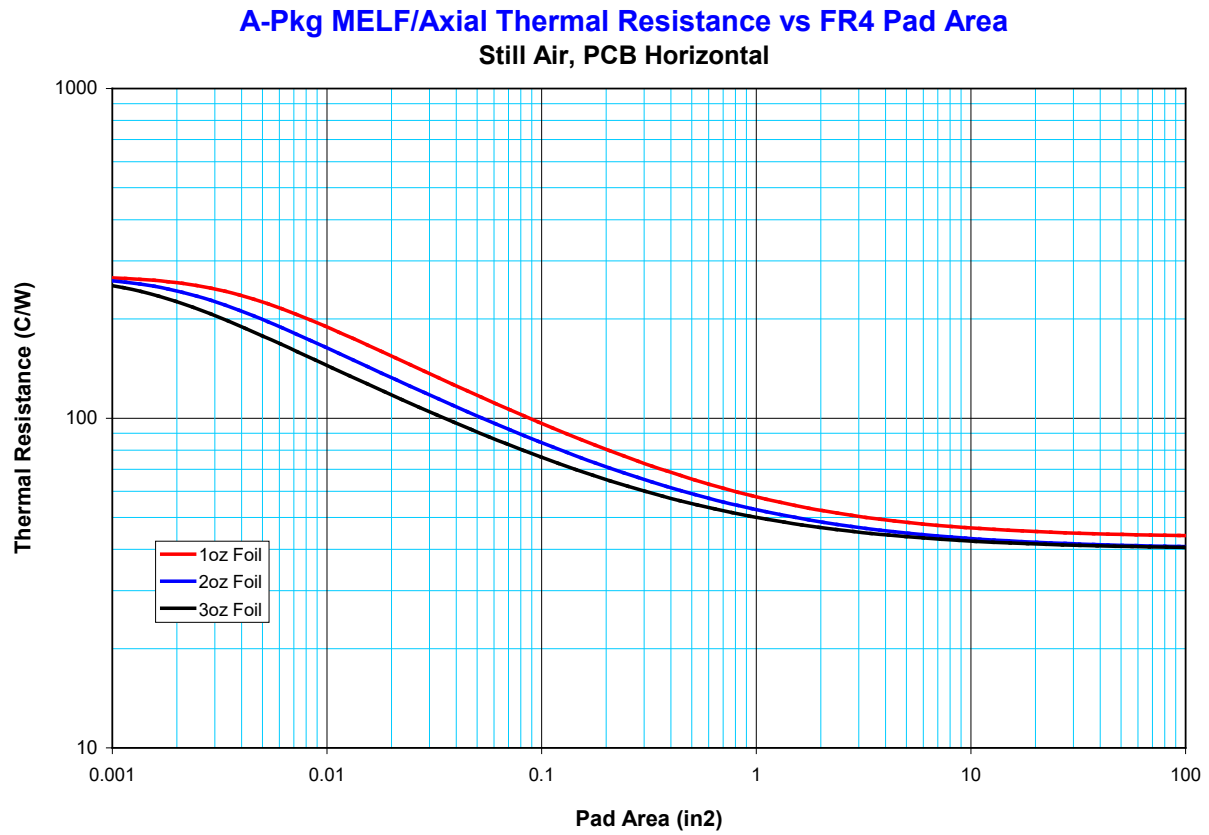


FIGURE 4. Thermal resistance versus pad area (for each pad) with 1, 2, and 3 oz copper for all device types.

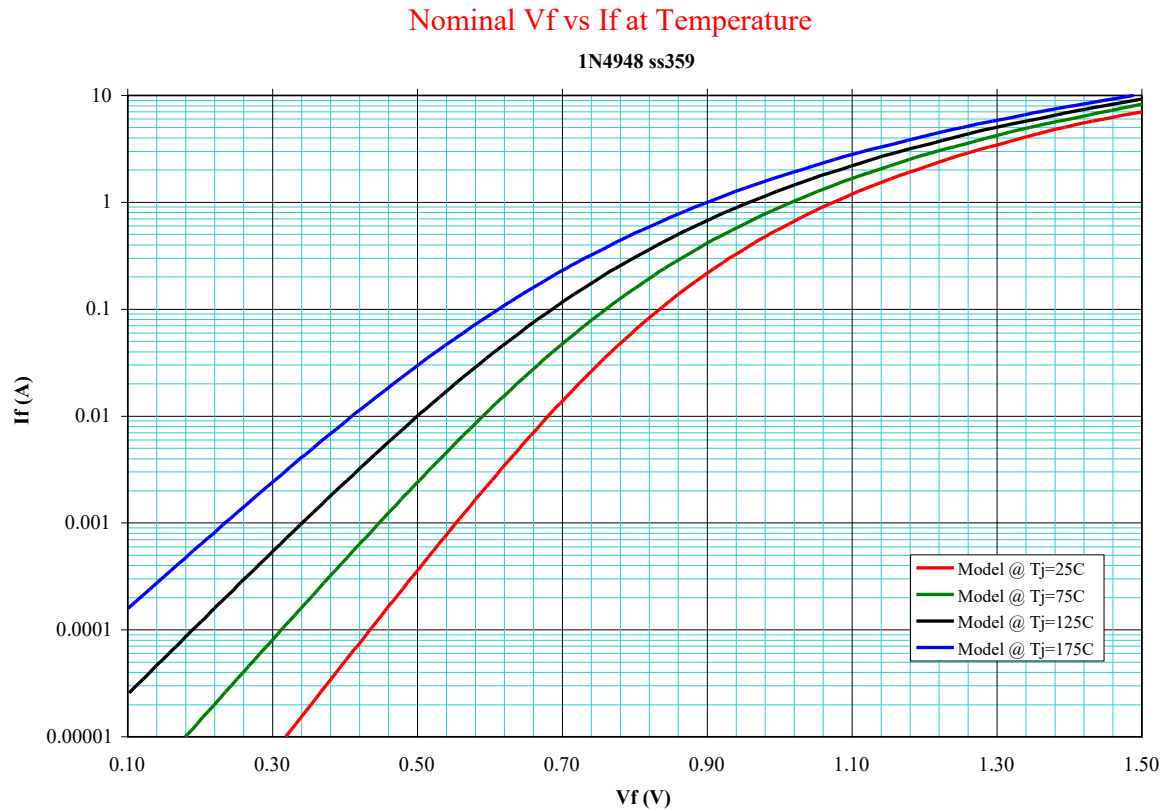


FIGURE 5. Forward voltage versus forward current for all device types.

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6.8 Request for new types and configurations. Requests for new device types or configurations for inclusions in this specification sheet should be submitted to: DLA Land and Maritime, ATTN: VAC, Post Office Box 3990, Columbus, OH 43218-3990 or by electronic mail at Semiconductor@dla.mil.

6.9 Amendment notations. The margins of this specification are marked with vertical lines 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 previous issue.

Custodians:

Army – CR
Navy – SH
Air Force – 85
NASA – NA
DLA – CC

Preparing activity:
DLA – CC

(Project 5961–2024–061)

Review activities:

Army – AR, MI, SM
Navy – AS, MC
Air Force – 19, 70, 71, 170

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>.