The documentation and process conversion measures necessary to comply with this revision shall be completed by 8 July 2008.

INCH-POUND

MIL-PRF-19500/411M
8 April 2008
SUPERSEDING
MIL-PRF-19500/411L
7 April 2004

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER, FAST RECOVERY,
1N5415 THROUGH 1N5420, 1N5415US THROUGH 1N5420US,
JAN, JANTX, JANTXV, JANS, JANTXVM, JANTXVD, JANTXVR,
JANTXVH, JANSM, JANSD, JANSR, AND JANSH

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 rectifier diodes. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500. Provision for radiation hardness assurance (RHA) to four radiation test levels is provided for JANTXV and JANS product assurance levels. RHA level designators "M", "D", "R", and "H" are appended to the device prefix to identify devices which have passed RHA requirements.

1.2 Physical dimensions. See figure 1 (axial lead) and figure 2 (surface mount).

* 1.3 Maximum ratings. Unless otherwise specified, T_A = 25°C.

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11
Types	V_{BR}	V_{RWM}	I_O (1) T_A = 55°C (2) (3)	I_O T_A = 100°C (3)	I_{FSM} I_O = 2 A dc T_A = 55°C t_p = 8.3 ms	t_{rr}	T_{STG} and T_J	$R_{\theta JL}$ at L = .375 in. (9.53 mm)	$R_{\theta JEC}$ at L = 0 for US versions	$R_{\theta JX}$ (3)
	V dc	V (pk)	A dc	A dc	A (pk)	ns	°C	°C/W	°C/W	°C/W
1N5415, US	50	50	3	2	80	150	-65	22	6.5	43
1N5416, US	100	100	3	2	80	150		22	6.5	43
1N5417, US	200	200	3	2	80	150	to	22	6.5	43
1N5418, US	400	400	3	2	80	150		22	6.5	43
1N5419, US	500	500	3	2	80	250		22	6.5	43
1N5420, US	600	600	3	2	80	400	+175	22	6.5	43

See notes on next page.

* Comments, suggestions, or questions on this document should be addressed to Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Semiconductor@dscc.dla.mil . Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil

AMSC N/A FSC 5961

* 1.3 Maximum ratings – Continued.

(1) Derate linearly at 22 mA/°C for 55°C ≤ T_A ≤ 100°C.
(2) Derate linearly at 26.7 mA/°C for 100°C ≤ T_A ≤ 175°C.
(3) For the 3A rating at 55°C ambient and the 2A rating at 100°C ambient, these I_O ratings are for a thermally mounting methods (PC boards or other) where the lead or end-cap temperatures cannot be maintained and where thermal resistance from mounting point to ambient is still sufficiently controlled where $T_{J(MAX)}$ in 1.3 is not exceeded. This equates to $R_{\theta JX}$ ≤ 43ºC/W in col. 11 of 1.3. Also see application notes in 6.4.

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 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://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil. or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, 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, 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

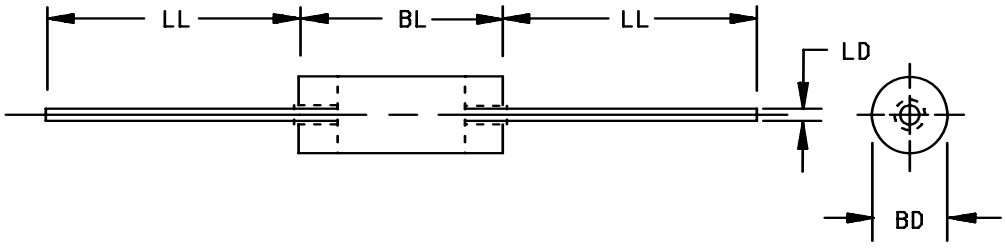
3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

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 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:

EC ..... End-cap.

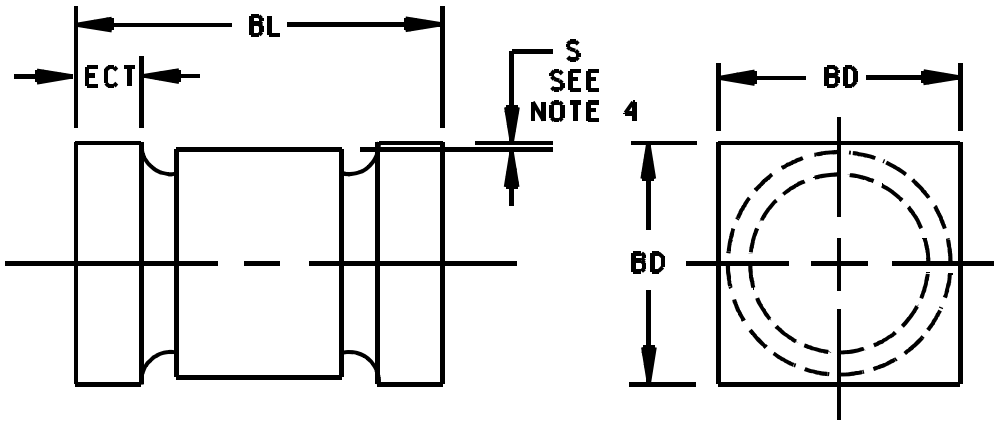
3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (DO-41) and figure 2 (surface mount) herein.



Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BD	.110	.180	2.79	4.57	3
LD	.036	.042	0.91	1.07	4
BL	.130	.260	3.30	6.60	4
LL	.90	1.30	22.9	33.0	

NOTES:
1. Dimensions are in inches.
2. Millimeter equivalents are given for general information only.
3. Dimension BD shall be measured at the largest diameter.
4. The BL dimension 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 .050 inch (1.27 mm) onto the leads.
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 1. Physical dimensions (axial lead).



Symbol	Dimension			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.200	.225	5.080	5.72
ECT	.019	.028	0.48	0.71
S	.003		0.08	
BD	.137	.148	3.48	3.76

NOTES:
1. Dimensions are in inches.
2. Millimeter equivalents are given for general information only.
3. Dimensions are pre-solder dip.
4. Minimum clearance of glass body to mounting surface on all orientations.
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 2. Physical dimensions of surface mount family.

3.4.1 Lead finish. Unless otherwise specified, lead or end-cap finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. When solder alloy is used for finish the maximum lead temperature is limited to 175°C maximum. Where a choice of finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4.2 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 in MIL-PRF-19500.

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

3.5.1 Marking of US version. For US version only, all marking may be omitted from the device except for the cathode marking. All marking which is omitted from the body of the device shall appear on the label of the initial container.

3.5.2 Polarity. The polarity shall be indicated with a contrasting color band to denote the cathode end. Alternately for surface mount (US) devices, a minimum of three evenly spaced contrasting color dots around the periphery of the cathode end may be used. No color coding will be permitted.

3.5.3 Radiation hardness assurance (RHA). Radiation hardness assurance requirements, part number designators, and test levels shall be as defined in MIL-PRF-19500.

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.

3.7.1 Post-irradiation performance characteristics. The electrical performance characteristics of the RHA devices are as specified in 4.4.4 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).

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

4.2.1 Qualification for radiation hardness assurance. Qualification inspection for radiation hardness assured JANS and JANTXV devices shall consist of group D examinations and tests specified in table II herein.

* 4.2.2 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 III tests, the tests specified in table III 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, JANTXV and JANTX levels only). Screening shall be in accordance with appendix E, table E-IV of MIL-PRF-19500 and as specified herein. Specified electrical measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screening (see appendix E, table E-IV of MIL-PRF-19500)	JANS level	JANTXV and JANTX level
2	Optional	Not required
(1) 3c	Thermal impedance (see 4.3.1)	Thermal impedance (see 4.3.1)
9	I_{R1} and V_{F1}	Not required
10	Method 1038 of MIL-STD-750, condition A	Method 1038 of MIL-STD-750, condition A
11	I_{R1} and V_{F1}; $\Delta I_{R1} \leq$ 100 percent of initial reading or 250 nA dc, whichever is greater; $\Delta V_{F1} \leq \pm 0.1$ V dc	I_{R1} and V_{F2}
12	Required, see 4.3.2	Required, see 4.3.2
(2) 13	Subgroups 2 and 3 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 4.5.2)	Subgroup 2 of table I herein; $\Delta I_{R1} \leq$ 100 percent of initial value or 250 nA dc, whichever is greater; $\Delta V_{F2} \leq \pm 0.1$ V dc, scope display evaluation (see 4.5.2)
15	Required	Not required
16	Required	Not required

(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) $Z_{\theta JX}$ 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 using the guidelines in that method for determining I_M, I_H, t_H shall be 10 ms, t_{MD} shall be 70 µs maximum. The thermal impedance limit shall comply with the thermal impedance graphs herein (less than or equal to the curve value at the same t_H time) and shall be less than the process determined statistical maximum limit as outlined in method 3101. See table III, subgroup 4 herein.

* 4.3.2 Power burn-in conditions. Power burn-in conditions are as follows: I_O = 3A minimum; T_A = 55°C maximum. Test conditions in accordance with method 1038 of MIL-STD-750, condition B. Use method 3100 of MIL-STD-750 to measure T_J. Adjust I_O or T_A to achieve the required T_J. T_J = 135°C minimum. With approval of the qualifying 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 sites 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 MIL-PRF-19500, and table I herein. The $Z_{\theta JX}$ end-point 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.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in appendix E, table E-VIa (JANS) and table E-VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500. Electrical measurements (end-points) and delta limits shall be in accordance with table IV herein.

* 4.4.2.1 Group B inspection, appendix E, table E-VIa (JANS) of MIL-PRF-19500. For B5, if a failure occurs, resubmission shall be at the test conditions of the original sample.

Subgroup	Method	Condition
B3	4066	I_{FSM} = rated I_{FSM} (see col. 6 of 1.3); ten surges of 8.3 ms each at 1 minute intervals, superimposed on I_O = 2 A dc, V_{RWM} = rated V_{RWM} (see col. 3 of 1.3).
B4	1037	Adjust I_O to achieve the required T_J, apply (see col. 5 of 1.3), V_R = rated V_{RWM} (see col. 3 of 1.3 and 4.5.3); 2,000 cycles.
B5	1027	I_O = 3 A minimum (see col. 4 of 1.3); apply V_R = rated V_{RWM} (see col. 3 of 1.3 and 4.5.3) adjust I_O or T_A to achieve T_J = 175°C minimum; f = 50 - 60 Hz; n = 45 c = 0. t = 1,000 hours; T_A = 55°C max. For irradiated devices, include t_{rr} as an end-point measurement.
B8	4065	Peak reverse power. $P_{RM} \geq 636$ W for square wave in accordance with test method 4065 of MIL-STD-750 ($P_{RM} \geq 1{,}000$ W for half-sine wave). Test shall be performed on each sublot; sampling plan n = 10, c = 0, electrical end-points, see table I, subgroup 2 herein.

* 4.4.2.2 Group B inspection, appendix E, table E-VIb (JAN, JANTX and JANTXV of MIL-PRF-19500).

Subgroup	Method	Condition
B3	1027	I_O = 3A minimum (see col. 4 of 1.3) minimum; adjust I_O or T_A to achieve the required T_J, apply V_R = rated V_{RWM} (see col. 3 of 1.3), f = 50 - 60 Hz (see 4.5.3.1). T_A = 55°C (max). For irradiated devices, include t_{rr} 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 appendix E, table E-VII of MIL-PRF-19500. Electrical measurements (end-points) and delta limits shall be in accordance with table IV herein.

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

Subgroup	Method	Condition
C2	2036	Tension: Test condition A; weight = 12 pounds; t = 15 seconds. Lead fatigue: Test condition E; weight 2 pounds. NOTE: Lead fatigue is not applicable for US devices (see figure 3 herein). Suitable fixtures may be used to pull the end-caps in a manner which does not aid construction. References to axial lead may be interpreted as end-cap with fixtures used for mounting.
C5	4081	See 4.3.1 $R_{\theta JL}$ (maximum) ≤ 22°C/W (see 4.3.1); L = .375 inch (9.53 mm). For surface mount devices (US version), $R_{\theta JEC}$ = 6.5°C/W maximum.
C6	1026	I_O = 3 A minimum; and adjust I_O or T_A to achieve the required T_J; apply V_R = rated V_{RWM} (see col. 3 of 1.3), f = 50 - 60 Hz (see 4.5.3.1), T_A = 55°C (max). For irradiated devices, include t_{rr} as an end-point measurement.

4.4.4 Group D inspection. Radiation hardness assured JANS and JANTXV devices shall include the group D tests specified in table II herein. These tests shall be performed as required in accordance with MIL-PRF-19500 and method 1019 of MIL-STD-750 for total ionizing dose or method 1017 for neutron fluence as applicable.

* 4.4.5 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 herein. Electrical measurements (endpoints) shall be in accordance with table I, subgroup 2 herein. See table IV for delta limits when applicable.

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 Scope display evaluation. Scope display evaluation shall be stable in accordance with 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 scope. The reverse current (I_{BR}) over the knee shall be 500 μA peak.

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 Free air burn-in and life tests. The use of a current limiting or ballast resistor is permitted provided that each DUT still sees the required T_J and I_O, and that the minimum required voltage, where applicable, is maintained through-out the burn-in period. Use method 3100 of MIL-STD-750 to measure T_J. T_J = 135°C minimum for screening and 150°C minimum for life tests. T_A = 55°C maximum.

* 4.5.4 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 max. See MIL-PRF-19500, table E-IX, subgroup 4, and figures 4 and 5 herein. Forced moving air or draft shall not be permitted across the devices during test.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Thermal impedance	3101	See 4.3.1	$Z_{\theta JX}$			°C/W
Forward voltage	4011	I_F = 1.5 A dc	V_{F1}	0.5	1.2	V
Forward voltage	4011	I_F = 9 A dc (pulsed see 4.5.1); t_p = 300 µs; 2 percent maximum duty cycle	V_{F2}	0.6	1.5	
Reverse current	4016	DC method, V_R = rated (see col. 2 of 1.3).	I_{R1}		1.0	µA
Breakdown voltage	4021	I_R = 50 µA dc	$V_{(BR)1}$			
1N5415, 1N5415US				55		V
1N5416, 1N5416US				110		V
1N5417, 1N5417US				220		V
1N5418, 1N5418US				440		V
1N5419, 1N5419US				550		V
1N5420, 1N5420US				660		V
Subgroup 3						
High temperature operation:		T_A = + 100°C				
Reverse current	4016	DC method, V_R = rated (see col. 2 of 1.3).	I_{R2}		20	µA
Low temperature operation:		T_A = -55°C				
Forward voltage	4011	I_F = 0.5 A	V_{F3}	0.5	1.4	V
Breakdown voltage	4021	I_R = 50 µA	$V_{(BR)2}$			
1N5415, 1N5415US				50		V
1N5416, 1N5416US				100		V
1N5417, 1N5417US				200		V
1N5418, 1N5418US				400		V
1N5419, 1N5419US				500		V
1N5420, 1N5420US				600		V

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 4						
Reverse recovery time	4031	Condition B1	t_{rr}			
1N5415, 1N5415US					150	ns
1N5416, 1N5416US					150	ns
1N5417, 1N5417US					150	ns
1N5418, 1N5418US					150	ns
1N5419, 1N5419US					250	ns
1N5420, 1N5420US					400	ns
Capacitance	4001	V_R = 4 V dc; 100 Khz ≤ f ≤ 1 Mhz	C			
1N5415, 1N5415US					550	pF
1N5416, 1N5416US					430	pF
1N5417, 1N5417US					250	pF
1N5418, 1N5418US					165	pF
1N5419, 1N5419US					140	pF
1N5420, 1N5420US					120	pF
Scope display evaluation	4023	See 4.5.2, n = 116, c = 0				
Subgroup 5						
Not applicable						
Subgroup 6						
Forward surge	4066	I_{FSM} = rated (see col. 6 of 1.3); ten surges of 8.3 ms each at 1 minute intervals, superimposed on I_O = 2 A dc, V_{RWM} = rated V_{RWM} (see col. 3 of 1.3).				
Electrical measurement		See table IV, steps 1, 2, 3, and 4.				
Subgroup 7						
Not applicable						

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

TABLE II. Group D inspection and end-point limits for radiation hardness assured JANS and JANTXV devices only.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 1						
Neutron irradiation	1017					
Electrical measurements		I_F = 9 A dc, (pulsed see 4.5.1)				
Forward voltage	4011	t_p = 300 μs; 2 percent maximum duty cycle	V_F			
M, D, R, H						
1N5415, 1N5415US				0.6	1.6	V
1N5416, 1N5416US				0.6	1.6	V
1N5417, 1N5417US				0.6	1.7	V
1N5418, 1N5418US				0.6	1.7	V
1N5419, 1N5419US				0.6	1.8	V
1N5420, 1N5420US				0.6	1.8	V
Reverse current, M, D, R, H	4016	DC method	I_R			
1N5415, 1N5415US		V_R = 50 V			1.0	μA
1N5416, 1N5416US		V_R = 100 V			1.0	μA
1N5417, 1N5417US		V_R = 200 V			1.0	μA
1N5418, 1N5418US		V_R = 400 V			1.0	μA
1N5419, 1N5419US		V_R = 500 V			1.0	μA
1N5420, 1N5420US		V_R = 600 V			1.0	μA
Subgroup 2						
Total dose irradiation	1019					
Electrical measurements		I_F = 9 A dc (pulsed see 4.5.1)	V_F			

See footnote at end of table.

TABLE II. Group D inspection and end-point limits for radiation hardness assured JANS and JANTXV devices only. - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Condition		Min	Max	
Subgroup 2 - Continued						
Forward voltage M, D, R. H	4011	t_p = 300 μs; 2 percent maximum duty cycle				
1N5415, 1N5415US				0.6	1.6	V
1N5416, 1N5416US				0.6	1.6	V
1N5417, 1N5417US				0.6	1.7	V
1N5418, 1N5418US				0.6	1.7	V
1N5419, 1N5419US				0.6	1.8	V
1N5420, 1N5420US				0.6	1.8	V
Reverse current M, D, R, H	4016	DC method	I_R			
1N5415, 1N5415US		V_R = 50 V dc			1.0	μA
1N5416, 1N5416US		V_R = 100 V dc			1.0	μA
1N5417, 1N5417US		V_R = 200 V dc			1.0	μA
1N5418, 1N5418US		V_R = 400 V dc			1.0	μA
1N5419, 1N5419US		V_R = 500 V dc			1.0	μA
1N5420, 1N5420US		V_R = 600 V dc			1.0	μA

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

* TABLE III. Group E inspection (all quality levels) for qualification and requalification only.

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
Subgroup 1A			45 devices c = 0
Temperature cycling (air to air)	1051 1/	20 cycles, low temperature shall be -195°C and high temperature shall be +150°C.	
Hermetic seal 2/	1071		
Electrical measurements		See table IV, herein.	
Subgroup 1B			
Temperature cycling (air to air)	1051	500 cycles, condition C, -65°C to +175°C.	
Hermetic seal 2/	1071		
Electrical measurements		See table IV, herein.	
Subgroup 2			
Steady-state dc blocking life	1048	1,000 hours, condition A; $V_R = V_{RWM}$ (see col. 3 of 1.3).	
Electrical measurements		See table IV, steps 1, 2, 3, and 4. For irradiated devices, include t_{rr} as an end-point measurement.	
Subgroup 4			
Thermal impedance curves		See MIL-PRF-19500.	
Subgroup 5			22 devices c = 0
Barometric pressure, reduced (altitude operation)	1001	Pressure 8.0 mm.	
Subgroup 6			3 devices c = 0
ESD	1020	Testing is not required for class 3 listing. Testing is required for a nonsensitive listing to prove capability.	

See footnotes at end of table.

* TABLE III. Group E inspection (all quality levels) for qualification and requalification only - Continued.

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
Subgroup 8 3/			
Peak reverse power	4065	Peak reverse power (P_{RM}) shall be characterized by the supplier and this data shall be available to the Government. Test shall be performed on each sublot.	45 devices
Electrical measurements		During the P_{RM} test, the voltage (V_{BR}) shall be monitored to verify it has not collapsed. Any collapse in V_{BR} during or after the P_{RM} test, or rise in leakage current (I_R) after the test that exceeds I_{R1} in group A, shall be considered a failure to that level of applied P_{RM}. Progressively higher levels of P_{RM} shall be applied until failure occurs on all devices within the chosen sample size.	
Subgroup 9			45 devices
Resistance to glass cracking	1057	Step stress to destruction by increasing cycles or up to a maximum of 25 cycles.	
Subgroup 10			22 devices c = 0
Forward surge	4066	Condition A, I_{FSM} = 80 A(pk); ten surges of 8.3 ms each at 1 minute intervals, superimposed on I_O = 2 A dc; V_{RWM} = rated V_{RWM} (see col. 3 of 1.3). T_A = +55°C.	
Electrical measurement		See table IV, herein.	

1/ Test method 1056 condition D, using liquid nitrogen may be used in lieu of TM 1051.
2/ Opaque glass double plug non cavity axial lead diodes may use TM 2068 in lieu of TM 1071.
3/ The sample size for this step stress requirement shall be determined by the supplier. A statistically significant sample size is required.

* TABLE IV. Delta measurements. 1/ 2/ 3/ 4/ 5/

Step	Inspection	MIL-STD-750		Symbol	Limit		Unit
		Method	Conditions		Min	Max	
1.	Reverse current	4016	DC method V_R = rated (see col. 2 of 1.3)	ΔI_R	100 percent of initial value or 250 nA dc, whichever is greater.		

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

2/ The electrical measurements for group B inspection in appendix E, table E-VIa (JANS) of MIL-PRF-19500 are as follows:

a. Subgroup 4, see table IV herein, step 1.
b. Subgroup 5, see table IV herein, step 1.

3/ The electrical measurements for group B inspection in appendix E, table E-VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 are as follows:

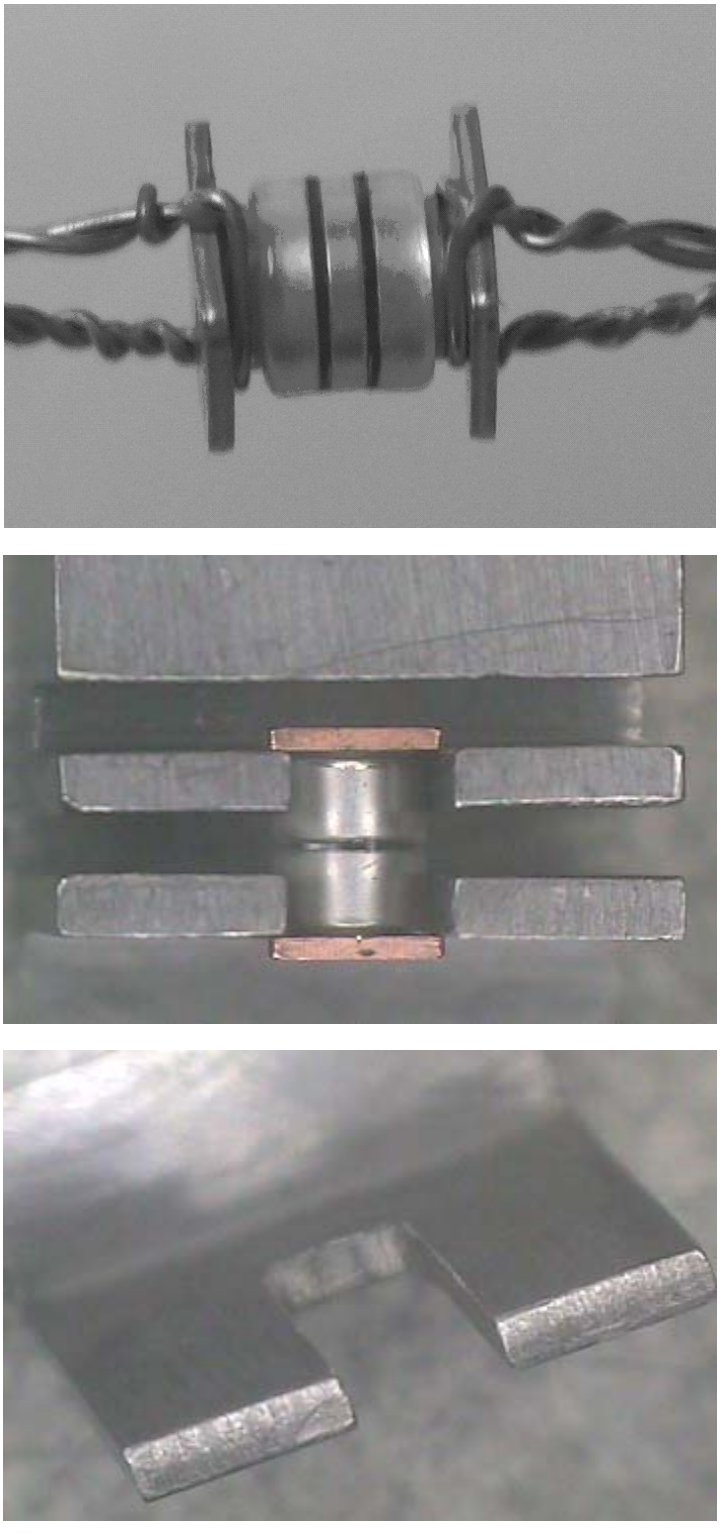
a. Subgroup 3, see table IV herein, step 1.
b. Subgroup 6, see table IV herein, step 1.

4/ The electrical measurements for group C inspection in appendix E, table E-VII (all quality levels) of MIL-PRF-19500 are as follows:

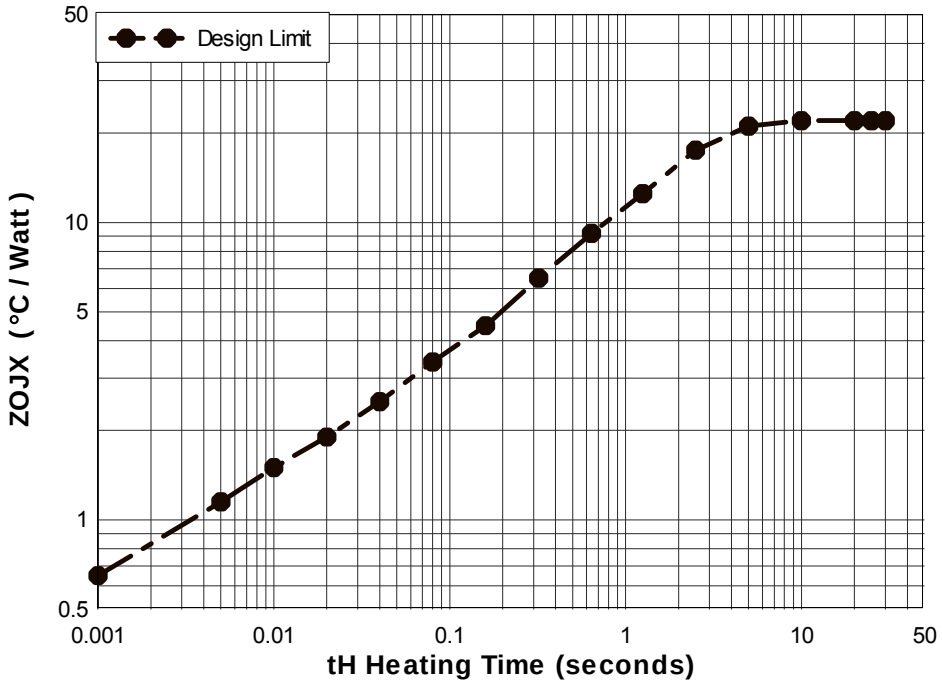
a. Subgroup 2, see table IV herein, step 1.
b. Subgroup 6, see table IV herein, step 1.

5/ The electrical measurements for group E inspection in appendix E, table E-IX of MIL-PRF-19500 are as follows:

a. Subgroup 1, see table IV herein, step 1.
b. Subgroup 2, see table IV herein, step 1.



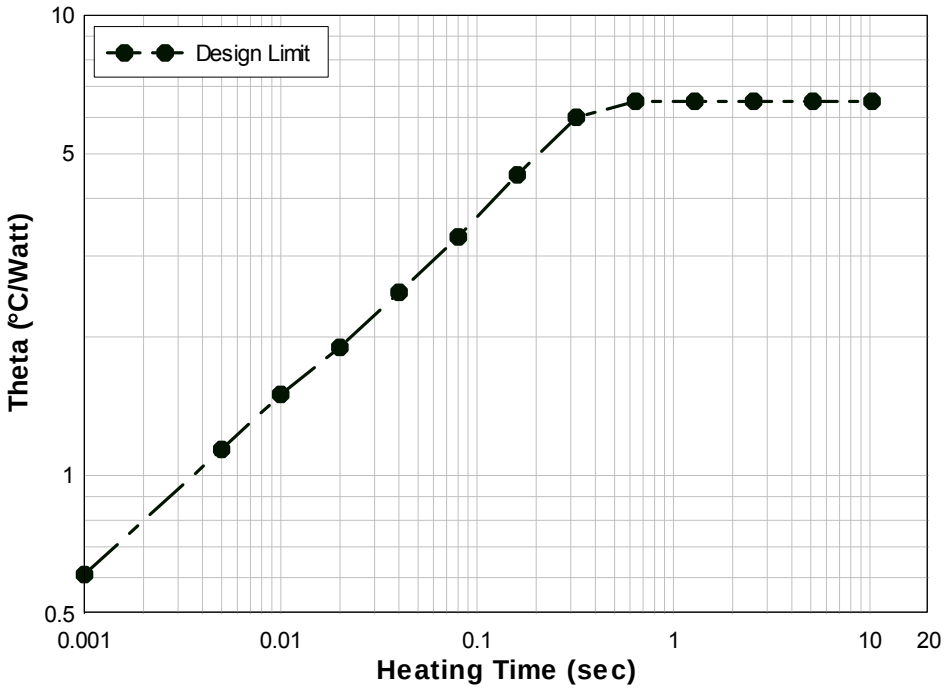
* FIGURE 3. US terminal strength mounting.



$Z_{\theta JX}$ = 1.5°C/W at 10 ms

$R_{\theta JL}$ = 22°C/W

FIGURE 4. Axial leaded thermal- impedance curve, maximum.



$Z_{\theta JX}$ = 1.5°C/W at 10 ms

$R_{\theta JEC}$ = 6.5°C/W

FIGURE 5. Surface mount thermal-impedance curve, maximum.

* 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.

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 Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil.

6.4 Application data.

6.4.1 PCB mounting with FR4 material for full 3 amp I_O. For a PCB mounting example with FR4 material where the full 3 amp I_O rating (half-sine-wave) is used at a T_J of 175ºC and ambient temperature of 55ºC, 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 axial-leaded, the lead length for mounting will be .187 inch (4.76 mm) or less from body to entry point on PCB surface.

a. Use the I_O versus Po curve on figure 6 to look up 3 amps (X-axis) and follow up to the T_J =175ºC curve (lower) for 2.81 watts.

b. Calculate maximum thermal resistance needed (175ºC - 55ºC) / 2.81 W = 43ºC/W.

c. Look up thermal resistance of 43ºC/W on Y-axis using a thermal resistance versus pad area plot on one of the three curves on figure 7 for different weights of copper cladding and then intersect curve horizontally to get answer. These curves assume still air, horizontal position.

d. In this example, the answer is: 1 oz PCB = 1.00 in^2 (25.4 mm^2), 2 oz PCB = .50 in^2 (12.7 mm^2), 3 oz PCB = .32 in^2 (8.128 mm^2) for each pad.

e. Add a conservative guard-band to the pad size (larger) to keep T_J below 175ºC.

* 6.4.2 PCB mounting with FR4 material for 1 amp I_O. For a PCB mounting example with FR4 material to support a 1 amp I_O square wave switching at a 0.50 duty factor (50 percent duty cycle) at T_J = 125ºC and ambient temperature of 55ºC, 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 1 amp I_O square wave switching at a 0.50 duty factor (50 percent duty cycle) at T_J = 100ºC with T_A = 55ºC.

b. Calculate peak I_F = 1A / 0.50 duty factor = 2 amps.

c. Use the V_F versus I_F curve on figure 8 to look up I_F = 2 A (Y-axis) and follow across to the T_J = 125ºC curve (middle) for V_F = 0.775 V.

d. Calculate power = I_F x V_F x duty factor = 2 x 0.775 x 0.50 = 0.775 W.

e. Calculate maximum thermal resistance needed (100ºC - 55ºC) / 0.775 W = 90ºC/W.

f. Look up thermal resistance of 90ºC/W on the Y-axis using a thermal resistance versus pad area plot on one of the three curves on figure 7 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 answer is: 1oz PCB = .092 in^2 (2.337 mm^2), 2oz PCB = .055 in^2 (1.397 mm^2), 3oz PCB = .036 in^2 (0.914 mm^2) for each pad.

h. A conservative pad guard-band is optional since T_J is only 100ºC. NOTE: Multilayer PCBs, forced air cooling will improve performance. Closed confinement of the PCB will do the opposite. Use sound thermal management.

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 last previous issue.

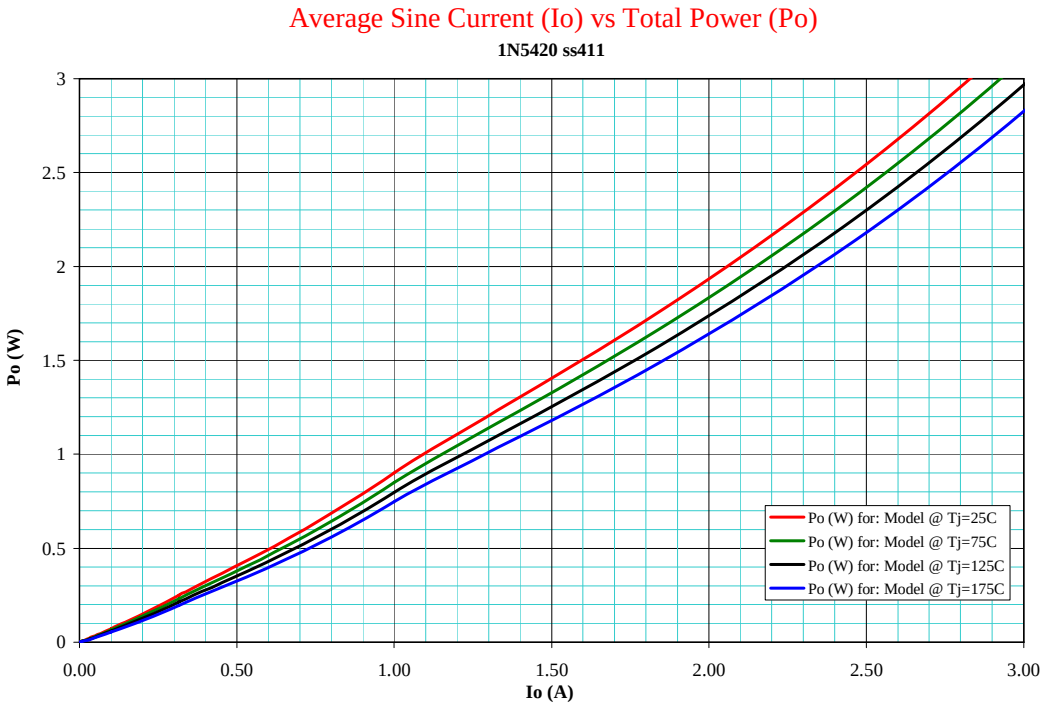


FIGURE 6. Rectifier power versus I_o (average forward current).

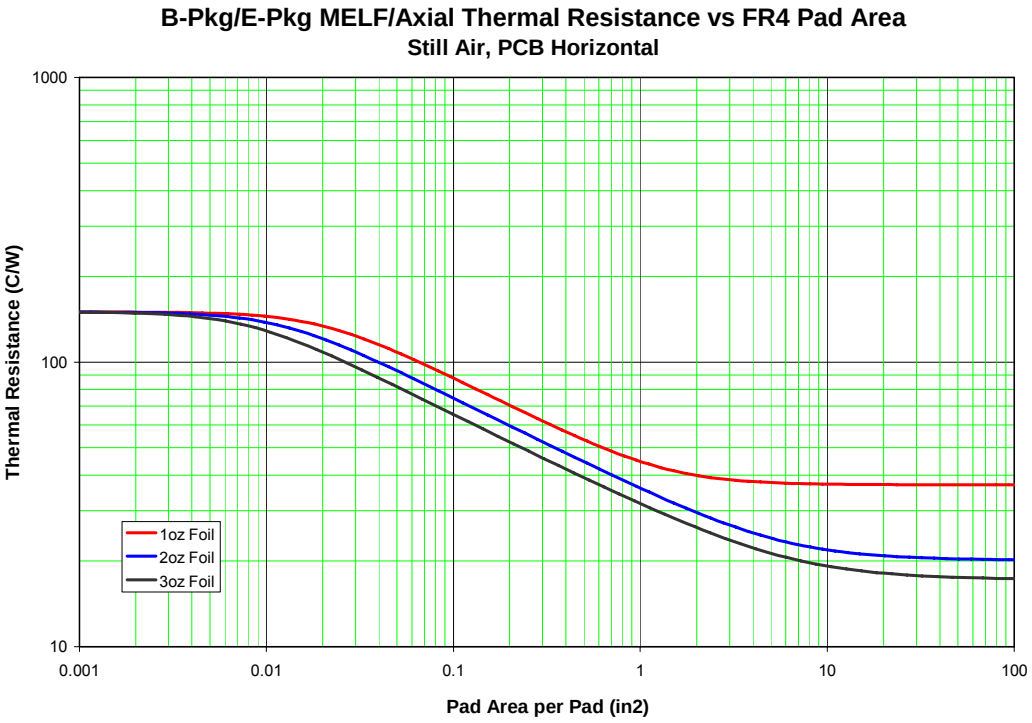


FIGURE 7. Thermal resistance versus pad area (for each pad) with 1 oz, 2 oz, and 3 oz copper.

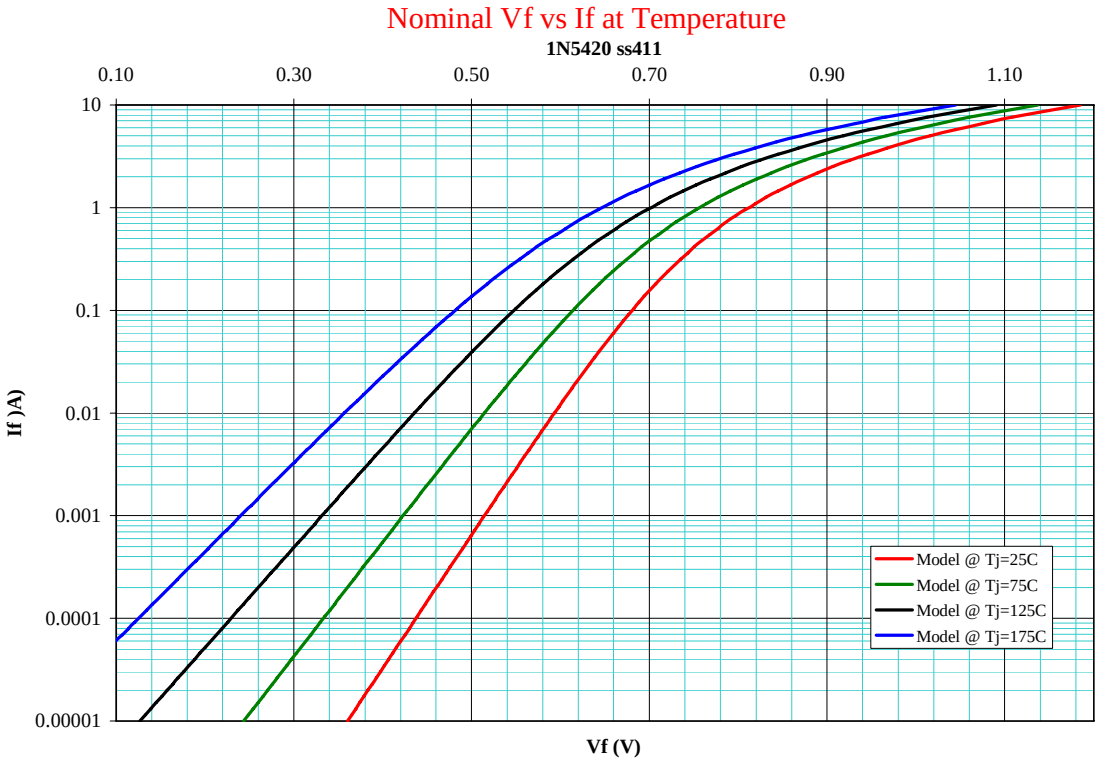


FIGURE 8. Forward voltage versus forward current for 1N5420.

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

Review activities:
Army - AR, AV, MI, SM
Navy - AS, MC
Air Force - 19, 71, 99

Preparing activity:
DLA - CC

(Project 5961-2007-057)

* 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 http://assist.daps.dla.mil.