The documentation and process conversion measures necessary to comply with this revision shall be completed by 20 October 2012.

INCH-POUND

MIL-PRF-19500/211D
20 July 2012
SUPERSEDING
MIL-PRF-19500/211C
10 December 2009

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER, TYPES 1N3164, 1N3168, 1N3170, 1N3172, 1N3174, 1N3175, 1N3176, 1N3177, AND R, TYPES JAN, JANTX, AND JANTXV

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 detail requirements for silicon power rectifier. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Normal and reverse types (reverse types, suffix R). Reverse and normal types are identical except: The normal types have the cathode connected to the stud and the reverse types have the anode connected to the stud. Designated values are applicable to both types.

1.3 Physical dimensions. See figure 1 (DO-205AB -formerly DO-9).

1.4 Ratings and characteristics.

Type	V_{RSM}	V_{RWM}	I_O $T_C = 150°C$ (1)	I_O $T_C = 120°C$ (1)	I_{FSM} 1/120 s	Barometric pressure (reduced)	T_J and T_{STG}
	V (pk)	V (pk)	A dc	A dc	A (pk)	mm Hg	°C
1N3164, R	240	200	200	300	6,250		-65 to +200
1N3168, R	480	400	200	300	6,250	8	-65 to +200
1N3170, R	720	600	200	300	6,250	8	-65 to +200
1N3172, R	960	800	200	300	6,250	15	-65 to +200
1N3174, R	1,200	1,000	200	300	6,250	15	-65 to +200
1N3175, R	1,440	1,200	200	300	6,250	33	-65 to +200
1N3176, R	1,680	1,400	200	300	6,250	33	-65 to +200
1N3177, R	1,920	1,600	200	300	6,250	54	-65 to +200

(1) Derate linearity at: 4.0 A dc/°C for $+150°C < T_C < +200°C$; 3.33 A dc/°C for $+120°C < T_C < +150°C$.

1.5 Thermal resistance characteristic: $R_{\theta JC} = 0.20°C/W$.

* 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. 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 FSC 5961

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 https://assist.dla.mil/quicksearch/ or https://assist.dla.mil. or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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.

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-205AA) herein.

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

3.4.2 Processing exemptions. Suppliers to this specification are exempt from the following restrictions stated in MIL-PRF-19500 regarding offshore wafer processing:

a. Beveling operation.

b. Isotropic etching of die surface.

c. Die attach operation which promotes any diffusion of metal alloy into silicon die.

3.5 Marking. Devices shall be marked as specified in MIL-PRF-19500.

* 3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.4, 1.5, and table I herein.

3.7 Electrical test requirements. The electrical test requirements shall be as specified in table I.

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:

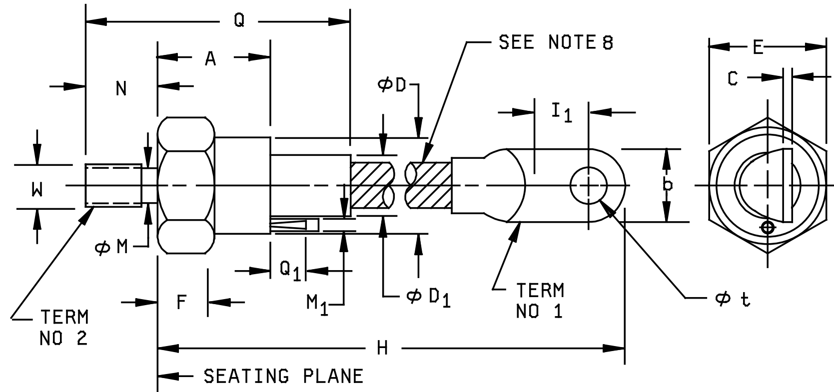
a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

c. Conformance inspection (see 4.4 and tables I and II).

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

4.2.1 Group E qualification. Group E qualification shall be performed herein for qualification or re-qualification only. In case qualification was awarded to a prior revision of the associated specification 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 to this revision to maintain qualification.



NOTES:
1. Dimensions are in inches. Millimeters are given for general information only.
2. Complete threads to extend to within 2.5 threads of seating plane.
3. .750-16 UNF-2A. Maximum pitch diameter of plated threads shall be basic pitch diameter, .7094 inch (18.019 mm) ref. (Screw Thread Standards for Federal Services) FED-STD-H28.
4. Angular orientation of terminal and tabulation with respect to hex base is undefined. Square or radius on end of terminal is undefined.
5. A chamfer (or undercut) on one, or both, ends of hexagonal portions is optional.
6. Tabulation optional.
7. Minimum flat.
8. Flexible leads.

Letter	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A		1.520		38.10	4
B	.530	.755	13.46	19.18	
C	.063	.172	1.60	4.37	
ϕD		1.100		27.94	
ϕD_1		.600		15.24	
E	1.218	1.252	30.94	31.75	
F	.250	.562	6.35	14.27	5
H	5.125	6.750	130.18	171.45	
I_1	.375		9.53		7
ϕM	.660	.745	16.76	18.92	2
M_1		.125		3.18	6
N	.793	.828	20.14	21.03	
Q		2.300		57.15	
Q_1		.375		9.53	6
ϕt	.265	.350	6.73	3.89	
W					3

FIGURE 1. Physical dimensions for semiconductor devices.

4.3 Screening (JANTX and JANTXV levels only). Screening shall be in accordance with 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.

Screening (see table E-IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
1	Method 2073 of MIL-STD-750 may be used in lieu of method 2074 for compression bonded devices only.
3c	Thermal impedance (see 4.3.1).
4	2,500 G; performed prior to installation of external lead.
10	Not applicable.
11	I_{RM1} and V_{FM} of subgroup 2 of table I herein.
12	Method 1038 of MIL-STD-750, condition A; V_{RM} = V_{RWM} rated (see 1.4), T_C = 150°C; f = 60 Hz.
13	Subgroup 2 of table I herein: ΔI_{RM1} = ±0.5 mA (pk) or 100 percent of initial value, whichever is greater. ΔV_{FM} = ±0.1 V (pk).

4.3.1 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 4081 of MIL-STD-750 using the guidelines in that method for determining I_M, I_H, t_H, t_{SW}, (and V_H where appropriate). Measurement delay time (t_{MD}) = 70 µs max. See table III, group E, subgroup 4 herein.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table E-V of MIL-PRF-19500, table I herein, and as specified herein. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table II herein.

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. Electrical measurements (end-points) and delta requirements shall be in accordance with applicable steps of table II herein.

4.4.2.1 Group B inspection, table E-VIB (JAN, JANTX, and JANTXV of MIL-PRF-19500).

Subgroup	Method	Condition
B3	1048 or	Blocking life. T_C = 185°C, -10, +0; V_{RWM} = V_{RM} (see 1.4); I_O = 0, half sine wave, f = 60 Hz.
B3	1037	See 4.5.1, ΔT_J = +85°C minimum; $I_O \geq$ 75 A, 2,000 cycles.
B5	4081	$R_{\theta JC}$ = 0.20°C/W.
B6	1032	T_A = +200°C.

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. Electrical measurements (end-points) and delta limits shall be in accordance with table II herein.

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

Subgroup	Method	Condition
C2	1051	-55°C to +175°C, 25 cycles.
C2	2036	Tension (lead): Test condition A; weight = 100 pounds; t = 15 ±3 seconds. Bending stress (lead): Test condition F; 10 pounds; t = 15 ±3 seconds. Torque (stud): Test condition D2; torque = 325 inch-pounds; t = 15 ±3 seconds.
C2	1071	Gross leak. Test condition C, step 2 or test condition D.
C5	1001	(For qualification only); t = 60 s, see 1.4 for test conditions (not applicable for 1N3164).
C6	1037 or	See 4.5.1, ΔT_J = +85°C minimum; $I_O \geq$ 75 A, 6,000 cycles.
C6	1048	Blocking life. T_C = +185°C, -10, +0; $V_{RWM} = V_{RM}$ (see 1.4); I_O = 0, half sine wave, f = 60 Hz.

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 table III herein. Electrical measurements (end-points) shall be in accordance with table II herein.

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

4.5.1 Power cycling. One complete test shall be as follows: First, heat the case to the maximum temperature specified by passing the specified amount of forward current through the diode under test. Then, remove the applied current and allow the case temperature to cool to the minimum case temperature specified. No time limit is applicable to any one cycle; however, the cycling shall be continuous until the required number of cycles have been completed. Sample size = 12, c = 0.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Thermal impedance 2/	3131	See 4.3.1	$Z_{\theta JC}$			°C/W
Forward voltage	4011	Pulse method: I_{FM} = 940 A (pk); pulse width = 8.5 ms max; duty cycle = 2 percent max	V_{FM1}		1.55	V (pk)
Reverse current	4016	AC method:	I_{RM1}			
1N3164, R		V_{RM} = 200 V (pk)			10	mA (pk)
1N3168, R		V_{RM} = 400 V (pk)			10	mA (pk)
1N3170, R		V_{RM} = 600 V (pk)			10	mA (pk)
1N3172, R		V_{RM} = 800 V (pk)			10	mA (pk)
1N3174, R		V_{RM} = 1,000 V (pk)			10	mA (pk)
1N3175, R		V_{RM} = 1,200 V (pk)			10	mA (pk)
1N3176, R		V_{RM} = 1,400 V (pk)			10	mA (pk)
1N3177, R		V_{RM} = 1,600 V (pk)			10	mA (pk)
Reverse current at peak reverse voltage	4016	AC method:	I_{RM2}			
1N3164, R		V_{RM} = 240 V (pk)			50	mA (pk)
1N3168, R		V_{RM} = 480 V (pk)			50	mA (pk)
1N3170, R		V_{RM} = 720 V (pk)			50	mA (pk)
1N3172, R		V_{RM} = 960 V (pk)			50	mA (pk)
1N3174, R		V_{RM} = 1,200 V (pk)			50	mA (pk)
1N3175, R		V_{RM} = 1,440 V (pk)			50	mA (pk)
1N3176, R		V_{RM} = 1,680 V (pk)			50	mA (pk)
1N3177, R		V_{RM} = 1,920 V (pk)			50	mA (pk)

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 3						
High temperature operation:		T_C = +175°C				
Reverse current	4016	AC method:	I_{RM3}			
1N3164, R		V_{RM} = 200 V (pk)			30	mA (pk)
1N3168, R		V_{RM} = 400 V (pk)			30	mA (pk)
1N3170, R		V_{RM} = 600 V (pk)			30	mA (pk)
1N3172, R		V_{RM} = 800 V (pk)			30	mA (pk)
1N3174, R		V_{RM} = 1,000 V (pk)			30	mA (pk)
1N3175, R		V_{RM} = 1,200 V (pk)			30	mA (pk)
1N3176, R		V_{RM} = 1,400 V (pk)			30	mA (pk)
1N3177, R		V_{RM} = 1,600 V (pk)			30	mA (pk)
Low temperature operation:		T_C = -65°C				
Reverse current	4016	AC method:	I_{RM4}			
1N3164, R		V_{RM} = 200 V (pk)			50	mA (pk)
1N3168, R		V_{RM} = 400 V (pk)			50	mA (pk)
1N3170, R		V_{RM} = 600 V (pk)			50	mA (pk)
1N3172, R		V_{RM} = 800 V (pk)			50	mA (pk)
1N3174, R		V_{RM} = 1,000 V (pk)			50	mA (pk)
1N3175, R		V_{RM} = 1,200 V (pk)			50	mA (pk)
1N3176, R		V_{RM} = 1,400 V (pk)			50	mA (pk)
1N3177, R		V_{RM} = 1,600 V (pk)			50	mA (pk)
Subgroups 4 and 5						
Not applicable						
Subgroup 6						
* Surge current	4066	T_C = +150°C; I_{FMS} = 5,000 A (pk), I_O = 200 A dc; ten 1/120 s surges; 1 surge/minute V_{RM} = V_{RWM} (see 1.4)				
Electrical measurements		See table II, steps 1 and 2				
Subgroup 7						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.
2/ This test required for the following end-point measurements only:
Group B, subgroups 2 and 3 (JAN, JANTX, and JANTXV).
Group C, subgroup 2 and 6.
Group E, subgroup 1.

TABLE II. Groups A, B, C, and E electrical measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward voltage	4011	Pulse method: I_{FM} = 940 A (pk); pulse width = 8.3 ms maximum; duty cycle = 2 percent maximum	V_{FM}		1.55	V (pk)
2.	Reverse current	4016	AC method:	I_{RM1}			
	1N3164, R		V_{RM} = 200 V (pk)			10	mA (pk)
	1N3168, R		V_{RM} = 400 V (pk)			10	mA (pk)
	1N3170, R		V_{RM} = 600 V (pk)			10	mA (pk)
	1N3172, R		V_{RM} = 800 V (pk)			10	mA (pk)
	1N3174, R		V_{RM} = 1,000 V (pk)			10	mA (pk)
	1N3175, R		V_{RM} = 1,200 V (pk)			10	mA (pk)
	1N3176, R		V_{RM} = 1,400 V (pk)			10	mA (pk)
	1N3177, R		V_{RM} = 1,600 V (pk)			10	mA (pk)
3.	Forward voltage (change)	4011	I_{FM} = 940 A (pk)	ΔV_{FM}		+0.1	V (pk)

1/ The electrical measurements for table E-VIB (JAN, JANTX, and JANTXV) of MIL-PRF-19500 are as follows:
- a. Subgroup 2, see table II herein, steps 1 and 2.
- b. Subgroup 3, see table II herein, steps 1, 2, and 3.
- c. Subgroup 6, see table II herein, steps 1 and 2.

2/ The electrical measurements for table E-VII (all quality levels) of MIL-PRF-19500 are as follows:
- a. Subgroup 2, see table II herein, steps 1 and 2.
- b. Subgroup 5, see table II herein, step 2 during test.
- c. Subgroup 6, see table II herein, steps 1, 2, and 3.

3/ The electrical measurements for table E-IX of MIL-PRF-19500 are as follows:
- a. Subgroup 1, see table II herein, steps 1, 2, and 3.
- b. Subgroup 2, see table II herein, steps 1, 2, and 3.

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

Inspection	MIL-STD-750		Sampling plan
	Method	Conditions	
* Subgroup 1			45 devices c = 0
Thermal shock	1056	100 cycles, 0°C to 100°C.	
* Hermetic seal	1071		
Electrical measurement		See table II herein.	
* Subgroup 2			45 devices c = 0
Steady-state reverse bias	1038	Test condition A, 1,000 hours.	
Electrical measurement		See table II herein.	
Subgroup 4			Sample size = N/A
Thermal impedance curves		See MIL-PRF-19500.	
Subgroup 5			3 devices c = 0
Barometric pressure	1001	V_{RWM} = rated V_{RWM} (see 1.4), pressure = rated pressure (see 1.4), t = 1 minute, (not applicable to 1N3164 and 1N3164R).	

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 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://assist.dla.mil.

6.4 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.

Custodians:
Army - CR
Navy - EC
Air Force - 85
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2012-073)

Review activities:
Army - AR, AV, MI, SM
Navy - AS, MC, OS
Air Force - 19, 70, 99

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