

The documentation and process conversion measures necessary to comply with this revision shall be completed by 15 March 2009.

INCH-POUND

MIL-PRF-19500/446E  
 15 December 2008  
 SUPERSEDING  
 MIL-PRF-19500/446D  
 13 September 2007

PERFORMANCE SPECIFICATION SHEET

\* SEMICONDUCTOR DEVICE, SILICON, HIGH-POWER, SINGLE PHASE, FULL WAVE BRIDGE RECTIFIER, TYPES SPA25, SPB25, SPC25, AND SPD25, 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 performance requirements for silicon, single phase, full wave rectifiers. Two levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1.

1.3 Maximum ratings.

Type number	$V_{RWM}$	Bridge (1) $I_{O1}$ at $T_C = +55^\circ C$	Bridge (2) $I_{O2}$ at $T_C = +100^\circ C$	$I_F(\text{surge})$ $I_O = 25 \text{ A dc}$ $T_C = +55^\circ C$ $t_p = 8.3 \text{ ms}$	Barometric pressure reduced	$t_{rr}$ $I_F = 0.5 \text{ A}$ $I_R = 1.0 \text{ A}$ $I_{rec} = 0.25 \text{ A}$
	<u>V (pk)</u>	<u>A dc</u>	<u>A dc</u>	<u>A (pk)</u>	<u>mm Hg</u>	<u><math>\mu s</math></u>
SPA25	100	25	15	150	8	2.5
SPB25	200	25	15	150	8	2.5
SPC25	400	25	15	150	8	2.5
SPD25	600	25	15	150	8	2.5

(1) Derate from 25 A dc at +55°C to 15 A dc at +100°C (222 mA dc/°C).

(2) Derate from 15 A dc at +100°C to 0 A dc at +150°C (300 mA dc/°C). Operating temperature: -65°C to +150°C. Storage ambient temperature: -65°C to +150°C.

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@dsc.dla.mil](mailto:semiconductor@dsc.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>.

## 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. 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.

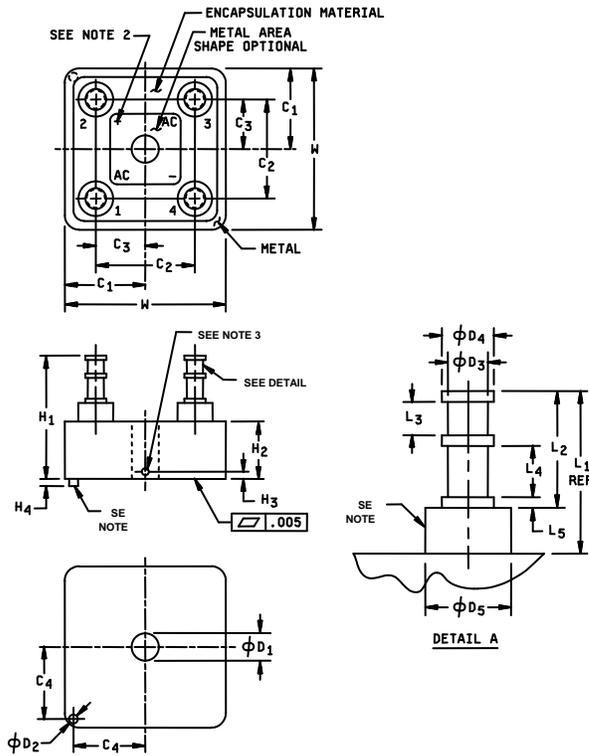
3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

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 herein.

3.4.1 Internal construction. The rectifier bridge shall consist of a metal and plastic encased assembly of discrete diodes. Each discrete diode shall be a glass-to-metal, ceramic-to-metal, or fused metal oxide-to-metal hermetically sealed package. No multiple diodes for each leg construction shall be permitted. The silicon die in each discrete diode shall be metallurgically bonded directly to the terminal pins. The completed assembly of diodes and other internal structures shall be encapsulated in a plastic material which polymerizes to a rigid condition by virtue of a chemical cross-linking mechanism. The rectifier bridge shall be free of voids either visible or as evidenced by failure to pass the environment test specified herein. Only those discrete diodes which have met these requirements shall be used in the rectifier bridge. Discrete diodes shall be manufactured and tested by the rectifier bridge manufacturer.

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



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
C <sub>1</sub>	.552	.572	14.02	14.53
C <sub>2</sub>	.624	.760	15.85	19.30
C <sub>3</sub>	.312	.380	7.92	9.65
C <sub>4</sub>	.495	.512	12.57	13.00
ΦD <sub>1</sub>	.189	.195	4.80	4.95
ΦD <sub>2</sub>	.057	.067	1.45	1.70
ΦD <sub>3</sub>	.108	.118	2.74	3.00
ΦD <sub>4</sub>	.141	.151	3.58	3.84
ΦD <sub>5</sub>	.225	.260	5.72	6.60
H <sub>1</sub>	.690	1.060	17.53	26.92
H <sub>2</sub>	.300	.500	7.62	12.70
H <sub>3</sub>	.040	.060	1.02	1.52
H <sub>4</sub>	.042	.062	1.07	1.57
L <sub>1</sub>	.370	.560	9.40	14.22
L <sub>2</sub>	.307	.365	7.80	9.27
L <sub>3</sub>	.089	.099	2.26	2.52
L <sub>4</sub>	.132	.163	3.35	4.14
L <sub>5</sub>	.026	.036	0.66	0.91
W	1.104	1.144	28.04	29.06

NOTES:

1. Dimensions are in inches. Millimeters are given for general information only.
2. Polarity shall be marked on the terminal side of the device. Terminal numbers are for reference and do not have to be marked on the bridge.
3. Point at which T<sub>C</sub> is read shall be in metal part of case as shown on drawing.
4. The locating pin shall be adjacent to the positive (+) terminal.
5. Insulating sleeve shall be alumina (AL<sub>2</sub>O<sub>3</sub>) composite material or equivalent.
6. The areas defined by the dimensions "L<sub>3</sub>" and "L<sub>4</sub>" are both acceptable for wire wrap and soldering.
7. In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.

FIGURE 1. Physical dimensions.

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500. Manufacturer's identification and date code shall be marked on the devices. Initial container package marking shall be in accordance with MIL-PRF-19500.

3.6 Polarity. Polarity shall be as marked on figure 1.

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

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I, group A herein.

3.9 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.

\* 4.3 Screening (JANTX and JANTXV). 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. The JANTXV requirements apply to the internal discrete diodes only, not to the assembly.

4.3.1 Discrete diode screening. One hundred percent of the internal discrete diodes shall be subjected to the following.

Screen (see table E-IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
(1) 3c	Thermal impedance (see 4.5.3)
9	Not applicable
11	$I_{R1}$ and $V_{F1}$
12	See 4.3.1.1
(2) 13	Subgroup 2 of table I herein. $\Delta V_{F1} = \pm 0.1$ V dc; $\Delta I_{R1} = 100$ percent of initial value or $\pm 250$ nA dc, whichever is greater

- (1) Shall be performed anytime after screen 3a.
- (2) Except thermal impedance, if already performed.

4.3.1.1 Power burn-in conditions. Power burn-in conditions are as follows: Method 1038 of MIL-STD-750, test condition B,  $T_A =$  room ambient as defined in the general requirements of 4.5 of MIL-STD-750 or 4.5 herein,  $V_{RWM} =$  rated  $V_{RWM}$  (see 1.3),  $I_O = 3$  A dc,  $f = 50 - 60$  Hz.

\* 4.3.2 Assembly screening. One hundred percent of the completed assemblies shall be subjected to the following.

Screen (see table E-IV of MIL-PRF-19500)	Measurement
Temperature cycling	Method 1051 of MIL-STD-750, condition F.
End points (1)	Subgroup 2 of table I herein.
Dielectric withstanding voltage	See 4.5.1

(1) Except thermal impedance.

4.4 Conformance inspection. Conformance inspection shall be performed on the finished rectifier assemblies 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.

\* 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 (JANTX and JANTXV) of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 (except thermal impedance) herein.

\* 4.4.2.1 Group B inspection, table E-VIB of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B1	2026	Immerse to insulating sleeve.
B2	1051	Condition F, 25 cycles.
B2	1071	Not applicable.
B3	1027	$I_O = 0$ A dc; $T_A = +150^\circ\text{C}$ ; $V_{RWM} = 80$ percent rated $V_{RWM}$ (see 1.3), $f = 60$ Hz, $n = 10$ , $c = 0$ .
B5		Operational thermal cycling, (see 4.5.4).
B5	3105	Junction temperature test (see 4.5.2).
B6		Not applicable.

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 as follows. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 (except thermal impedance) herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
C2	1056	Not applicable.
C2	2036	Test condition A, 6 pounds, t = 30 seconds.
C2	2036	Test condition D1, t = 10 seconds, 5 inch-pounds.
C2	1071	Not applicable.
C5	1001	Pressure = 8 mm Hg; $I_R = 2.0 \mu\text{A}$ dc maximum, $V_R =$ rated $V_{RWM}$ (see 1.3), (applied between all terminals to the case), t = 60 seconds.
C5	4066	$V_{RWM} = 0$ V, bridge $I_O = 25$ A dc (entire bridge biased); $T_C = 55^\circ\text{C} + 10^\circ\text{C}, - 0^\circ\text{C}$ ; $I_{FSM} = 150$ A (pk) (each device for each bridge leg); $t_p = 8.3$ ms; ten surges for each leg at maximum 1 minute intervals; n = 22, c = 0. Alternate condition: Each leg may be biased separately to $I_O = 12.5$ A dc. All other conditions are the same as above.
C6	1026	$I_O = 0$ A dc; $T_A = 150^\circ\text{C}$ ; $V_{RWM} = 80$ percent rated $V_{RWM}$ (see 1.3), f = 60 Hz.

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

4.5.1 Dielectric withstanding voltage. This test shall be performed with the metal case of the assembly connected to ground and all terminals connected to the high potential side of a dc power supply or a scope display test set. The voltage applied between the terminals and the case, shall be 2,800 volts dc. Any discontinuity or dynamic instability of the trace, or a breakdown current in excess of 10  $\mu\text{A}$  dc, shall be cause rejection.

4.5.2 Junction temperature test. This test shall be performed in accordance with method 3105 of MIL-STD-750. The maximum junction temperature for any diode in the bridge at the below specified conditions shall be 175°C maximum. The test conditions shall be as follows:

- a.  $T_C = 55^\circ\text{C}$                       or             $T_C = 100^\circ\text{C}$ .
- b.  $I_O = 25$  A dc,                               $I_O = 15$  A dc.
- c.  $I_{ref} = 10$  mA dc,                               $I_{ref} = 10$  mA dc.

4.5.3 Thermal impedence.  $\Delta V_F$  measurement shall be performed in accordance with method 3101 of MIL-STD-750. The following parameters shall apply: (1) Measurement current ( $I_M$ ): 10 mA; (2) Heating current ( $I_H$ ): 10 A minimum; (3) Heating time ( $t_H$ ): 10 ms; (4) Measurement time delay ( $t_{MD}$ ): 70  $\mu\text{s}$  maximum. The maximum limit for  $Z_{\theta JX}$  under these test conditions is 1.5  $^\circ\text{C}/\text{W}$ .

4.5.4 Operational thermal cycling. This test shall be performed by connecting a single phase 50 - 60 Hz sine wave input to the ac terminals of the bridge. The resistive load or input voltage shall be made variable in order to maintain a rated bridge output current of 25 A dc. Bridge case temperature shall be maintained at 55°C except during the cooling cycle when case temperature shall be permitted to drop 20°C maximum. Life-test duration shall be 2,000 cycles with a heating time of 8 minutes, +10, -0 minutes and a cooling time  $\geq 2$  minutes.

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance/leg	3101	See 4.5.3	$Z_{\theta JX}$		1.5	$^{\circ}\text{C}/\text{W}$
Forward voltage/leg	4011	$I_F = 39 \text{ A dc (pk)}$ , $t_p = 8.3 \text{ ms}$ ; duty cycle $\leq 2$ percent	$V_{F1}$	0.9	1.40	V (pk)
Reverse current/leg	4016	DC method; $V_R = \text{rated } V_{RWM}$ (see 1.3)	$I_{R1}$		2.0	$\mu\text{A dc}$
Breakdown voltage/leg	4021	$I_R = 50 \mu\text{A dc}$	$V_{(BR)1}$			
SPA25				110		V dc
SPB25				220		V dc
SPC25				440		V dc
SPD25				660		V dc
<u>Subgroup 3</u>						
High temperature operation:		$T_C = 100^{\circ}\text{C}$				
Reverse current/leg	4016	DC method; $V_R = \text{rated } V_{RWM}$ (see 1.3)	$I_{R2}$		150	$\mu\text{A dc}$
Low temperature operation:		$T_A = -55^{\circ}\text{C}$				
Reverse current/leg	4016	DC method; $V_R = \text{rated } V_{RWM}$ (see 1.3)	$I_{R3}$		50	$\mu\text{A dc}$
<u>Subgroup 4</u>						
Reverse recovery time/leg	4061	Condition B; $I_F = 0.5 \text{ A}$ , $I_R = 1.0 \text{ A}$ , $I_{\text{rec}} = 0.25 \text{ A}$	$t_{rr}$		2.5	$\mu\text{s}$
<u>Subgroups 5 and 6</u>						
Not applicable						

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

## 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. Terminal material and finish (see 3.4.2).
- d. Product assurance level and type designator.
- e. Destructive physical analysis when requested.

\* 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](mailto:vqe.chief@dla.mil). An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <http://assist.daps.dla.mil>.

\* 6.4 Interchangeability. JAN devices previously manufactured to MIL-PRF-19500/446 were constructed with JANTX level devices and are the same product assurance level as the JAN and JANTX devices in this revision. JAN and JANTX devices are identical for all requirements of this specification except for the device marking, and are directly interchangeable. The JANTX device is the preferred PIN for new design and acquisition. JAN devices are no longer procurable under this specification. Existing stock of JAN level devices may be used until exhausted.

6.5 Changes from previous issue. The margins of this specification are marked with an asterisk 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

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Review activities:

Army - MI  
Air Force - 19, 71, 99

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