

The documentation and process conversion measures necessary to comply with this document shall be completed by 25 Month 2019.

INCH-POUND

MIL-PRF-19500/649C  
 14 February 2019  
 SUPERSEDING  
 MIL-PRF-19500/649B  
 19 July 2013

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON,  
 POWER RECTIFIER, SCHOTTKY  
 TYPE 1N6781, JAN, JANTX, JANTXV, AND JANS

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, Schottky power rectifier diodes. Four levels of product assurance are provided for each device type as specified in [MIL-PRF-19500](#).

\* 1.2 Package outlines and die topography. The device package for the encapsulated device type are as follows: (2 pin, isolated - TO-257) in accordance with figure 1.

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

Type	$V_{RRM} = V_{RWM}$	$I_o$ $T_J = T_c = 100^\circ\text{C}$	$I_{FSM}$ $T_c = +100^\circ\text{C}$ $t_p = 8.3 \text{ ms}$	$R_{\theta JC}$	$R_{\theta JA}$	$T_{STG}$ and $T_{OP}$
1N6781	V (pk) dc 60	A dc 15	A (pk) 120	$^\circ\text{C}/\text{W}$ 2.5	$^\circ\text{C}/\text{W}$ 45	$^\circ\text{C}$ -65 to +150

(1) Derate at  $300\text{mA}/^\circ\text{C}$  above  $T_c = +100^\circ\text{C}$ .

1.4 Primary electrical characteristics. Unless otherwise specified,  $T_c = +25^\circ\text{C}$ .

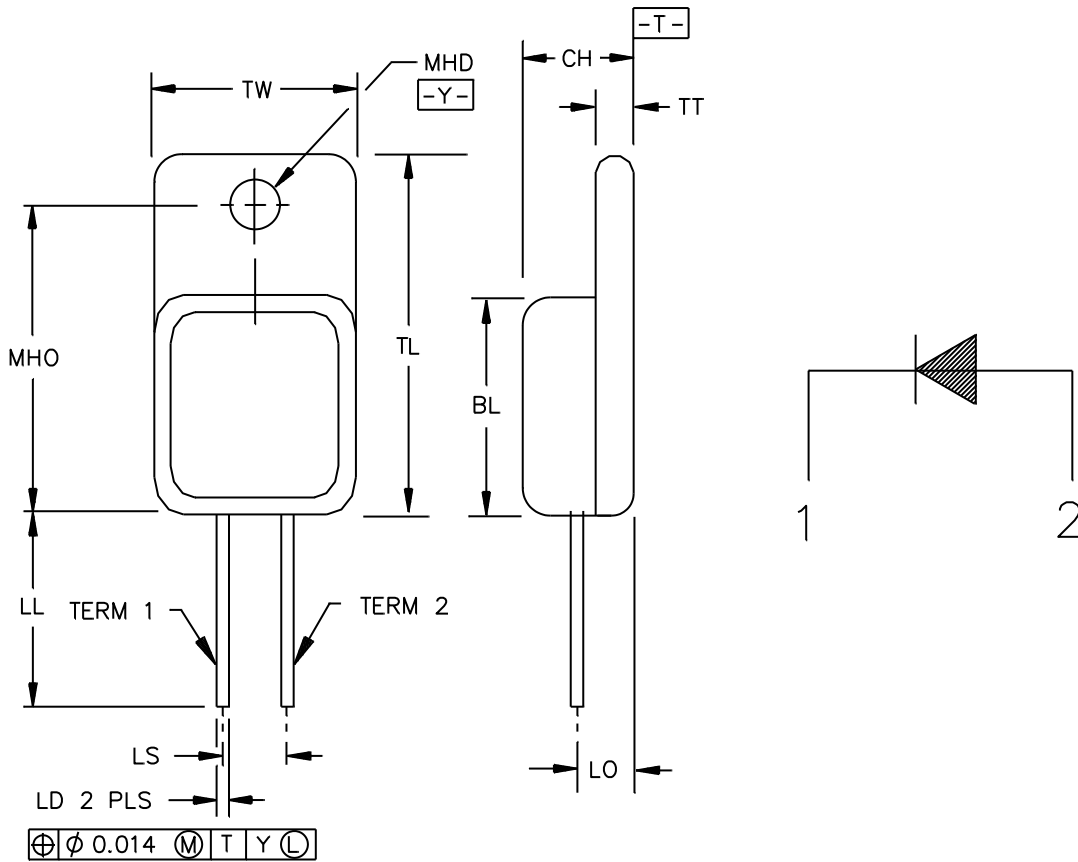
Type	$V_{F1}$ $I_F = 5 \text{ A dc}$	$V_{FS}$ $I_F = 15 \text{ A dc}$	$I_{R1}$ $V_R = 0.8 V_{RWM}$ (see 1.3)	$I_{R1}$ $V_R = 0.8 V_{RWM}$ $T_c = +125^\circ\text{C}$ (see 1.3)	$C_J$ $V_R = 5 \text{ V}$ $f = 1 \text{ MHz}$
1N6781	V dc 60	V dc 15	mA dc 120	mA dc 2.5	pF 45

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](mailto: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>.



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- \* 1.5 Part or Identifying Number (PIN). The PIN is in accordance with [MIL-PRF-19500](#), and as specified herein. See 6.5 for PIN construction example and 6.6 for a list of available PINs.
- \* 1.5.1 JAN certification mark and quality level for encapsulated devices. 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", "JANTXV" and "JANS".
- \* 1.5.2 Device type. The designation system for the device types of semiconductors covered by this specification sheet are as follows.
  - \* 1.5.2.1 First number and first letter symbols. The semiconductors 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 semiconductors covered by this specification sheet are as follows: "6781".
- \* 1.5.3 Suffix symbols. Suffix symbols are not applicable for this specification sheet.
- \* 1.5.4 Lead finish. The lead finishes applicable to this specification sheet are listed on [QPDSIS-19500](#).



Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BL	.410	.430	10.4	10.9	
CH	.249	.260	6.32	6.60	
LD	.035	.045	0.89	1.14	
LL	.500	.750	12.70	19.95	
LO	.150 typical		3.81		
LS	.200 bsc		5.08		
MHD	.140	.150	3.55	3.80	
MHO	.527	.537	13.4	13.6	
TL	.645	.665	16.4	16.9	
TT	.040	.050	1.02	1.27	
TW	.410	.420	10.4	10.7	

NOTES:

1. Dimensions are in inches. Millimeters are given for general information only.
2. Terminal 1 is the cathode and terminal 2 is the anode.
3. All terminals are isolated from case.
4. In accordance with ASME Y14.5M, diameters are equivalent to  $\phi$ x symbology.

FIGURE 1. Physical dimensions (TO-257AA, 2 pin, isolated).

## 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.

[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.

## 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-19500](#)) before contract award (see [4.2](#) and [6.3](#)).

3.3 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein shall be as specified in [MIL-PRF-19500](#).

3.4 Interface and physical dimensions. The interface requirements and physical dimensions shall be as specified in [MIL-PRF-19500](#) and on [figure 1](#) (a modified two pin version of TO-257AA) herein.

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

3.4.2 Lead formation. When lead formation is performed, as a minimum, the vendor shall perform 100 percent hermetic seal in accordance with screen 14 of E-IV of [MIL-PRF-19500](#) and 100 percent DC testing in accordance with [table I](#), subgroup 2 herein.

3.4.3 Lead isolation. Methods used for electrical isolation of the terminal feedthroughs shall employ materials that contain a minimum of 90 percent Al<sub>2</sub>O<sub>3</sub>(ceramic). Examples of such construction techniques are metallized ceramic eyelets or ceramic walled packages.

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3.4.4 Polarity. The identification of terminals of the device package shall be as shown on [figure 1](#). Terminal 1 shall be connected to the cathode and terminal 2 shall be connected to the anode.

3.5 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in [1.3](#), [1.4](#), and [table I](#) herein.

3.6 Electrical test requirements. The electrical test requirements shall be as specified in [table I](#) herein.

3.7 Marking. Marking shall be in accordance with [MIL-PRF-19500](#).

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](#), and as specified 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 JANS, JANTX and JANTXV 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.

Screen	Measurement	
	JANS level	JANTX and JANTXV levels
3c (1)	Thermal impedance (see <a href="#">4.3.2</a> )	Thermal impedance (see <a href="#">4.3.2</a> )
9 and 10	Not applicable	Not applicable
11	$I_{R1}$ and $V_{F2}$	$I_{R1}$ and $V_{F2}$
12	See <a href="#">4.3.1</a> , $t = 240$ hours	See <a href="#">4.3.1</a> , $t = 48$ hours
13	See subgroups 2 and 3 of <a href="#">table I</a> herein; $I_{R1}$ and $V_{F2}$ ; $\Delta I_{R1} \leq 100$ percent of initial value or $\pm 75 \mu A$ dc, whichever is greater; $\Delta V_{F2} \leq \pm 50$ mV.	See subgroups 2 of <a href="#">table I</a> herein; $I_{R1}$ and $V_{F2}$ ; $\Delta I_{R1} \leq 100$ percent of initial value or $\pm 75 \mu A$ dc, whichever is greater; $\Delta V_{F2} \leq \pm 50$ mV.

(1) Thermal impedance shall be performed any time after temperature cycling (screen 3a). Quality levels JANTX and JANTXV do not need to be repeated in screening requirements.

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4.3.1 Power burn-in conditions. The power burn-in conditions shall be as follows:

Test method 1038 of [MIL-STD-750](#), test condition A;  $T_C = +125^\circ\text{C}$  minimum;  $V_R = 48\text{ V dc}$ .

\* 4.3.2 Thermal impedance ( $Z_{\theta JX}$ ) measurements for screening. The thermal impedance measurements shall be performed in accordance with test method 3101 of [MIL-STD-750](#) using the guidelines in that test method for determining  $I_H$ ,  $I_M$ ,  $t_H$ ,  $t_{SW}$ ,  $t_{MD}$  ( $V_C$  and  $V_H$  where appropriate). The thermal impedance limit used in screen 3c and [table I](#), subgroup 2 herein shall be set statistically by the supplier. See [table II](#), subgroup 4 (group E) herein.

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. 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 test methods and conditions specified for subgroup testing in table E-VIA (JANS) and table E-VIB (JANTX and JANTXV) of [MIL-PRF-19500](#) and as follows. Delta requirements shall be in accordance with the applicable steps and footnotes of 4.6 herein.

4.4.2.1 Quality level JANS (table E-VIA of [MIL-PRF-19500](#)).

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B4	1037	$I_F$ or $I_O = 2\text{A}$ (minimum); $\Delta T_J = +85^\circ\text{C}$ , minimum.
B5	1038	Test condition A, $T_J = T_C = +150^\circ\text{C}$ , $V_R = 48\text{V dc}$ .
B6	3101	Limit for thermal resistance is $R_{\theta JC} = 2.5^\circ\text{C/W}$ .

4.4.2.2 Quality levels JANTX and JANTXV (table E-VIB of [MIL-PRF-19500](#)).

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1037	$I_F$ or $I_O = 2\text{A}$ (minimum); $\Delta T_J = +85^\circ\text{C}$ , minimum.

\* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table E-VII of [MIL-PRF-19500](#) and as follows herein. Delta requirements shall be in accordance with the applicable step and footnotes of 4.6 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition A, weight = 5 pounds $\pm 10$ ounce (2.25Kg $\pm 0.28$ Kg), $t = 15\text{ s} \pm 3\text{ s}$ .
C2	2006	X1, Y1, Z1, and Z2 axis.
C5	3101	See 4.5.2.
C6	1037	$I_F$ or $I_O = 2\text{A}$ (minimum); $\Delta T_J = +85^\circ\text{C}$ , minimum.
C6	1038	JANS only; test condition A, 1000 hours, $T_J = T_C = +150^\circ\text{C}$ , $V_R = 48\text{V dc}$ .

\* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in appendix E, table E-IX of MIL-PRF-19500 and as specified in table II herein. Delta requirements shall be in accordance with the applicable steps and footnotes of 4.6 herein.

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

4.5.1 Pulse response measurements. The conditions for the pulse response measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Thermal resistance ( $R_{\theta JC}$ ). Thermal resistance measurements shall be performed in accordance with test method 3101 of MIL-STD-750. The maximum limits for  $R_{\theta JC(max)}$  shall be 2.5°C/W for devices in the 2 pin case style. The following parameter measurements shall apply:

- a.  $I_H$  forward heating current ----- 9.9 A
- b.  $I_M$  measure current ----- 15 mA
- c.  $t_H$  heating time ----- Steady state (see MIL-STD-750, method 3101)
- d.  $t_{MD}$  measurement delay time ----- 35 ms
- e.  $V_H$  heating voltage ----- 1 V

4.5.3 Thermal impedance ( $Z_{\theta JX}$ ).

4.5.3.1 Measurements for initial qualification or requalification. The thermal impedance measurements shall be performed in accordance with test method 3101 of MIL-STD-750. Read and record data for thermal impedance derived conditions limits and thermal response curve shall be supplied to the qualifying activity on the qualification lot prior to qualification approval.

4.5.3.2 Measurements for group A. The thermal impedance measurements shall be performed in accordance with test method 3101 of MIL-STD-750. The following test conditions shall be used for thermal impedance, group A inspection:

- a.  $I_H$  forward heating current ----- 9.9 A
- b.  $I_M$  measure current ----- 15 mA
- c.  $t_H$  heating time ----- 200 ms
- d.  $t_{MD}$  measurement delay time ----- 35 ms
- e.  $V_H$  heating voltage ----- 1 V

The maximum limit for thermal impedance under these conditions are  $Z_{\theta JX(max)} = 2.4^\circ\text{C/W}$ .

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\* 4.6 Electrical and delta measurements. The values for the electrical and delta measurements for groups A, B, C, and E shall be as specified below. (1) (2) (3)

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1	Forward voltage	4011	Condition B, $I_F = 10$ A dc pulsed	$V_{F2}$		0.81	V dc
2	Reverse leakage current	4016	$V_R = 48$ V dc pulsed DC method	$I_{R1}$		0.30	mA dc
3	Forward voltage	4011	Condition B, $I_F = 10$ A dc pulsed	$\Delta V_{F2}$		±50 mV dc from initial reading	
4	Reverse leakage current	4016	$V_R = 48$ V dc pulsed DC method	$\Delta I_{R1}$		100 percent of initial value or ±75 µA dc whichever is greater	
5	Thermal impedance	3101	See 4.5.3	$Z_{\theta JX}$		2.40	°C/W

- (1) The electrical measurements for group B, quality level JANS shall be as follows:
  - a. In addition to the measurements specified for subgroup 3 of table E-VIA of MIL-PRF-19500, the measurements of steps 1 and 2 shall also be taken.
  - b. In addition to the measurements specified for subgroup 4 of table E-VIA of MIL-PRF-19500, the measurements of steps 1, 2, 3, 4, and 5 also be taken.
  - c. In addition to the measurements specified for subgroup 5 of table E-VIA of MIL-PRF-19500, the measurements of steps 1, 2, 3, and 4 also be taken.
- (2) The electrical measurements for group B, quality level JANTX and JANTXV shall be as follows:
  - a. In addition to the measurements specified for subgroup 2 of table E-VIB of MIL-PRF-19500, the measurements of steps 1 and 2 shall also be taken.
  - b. In addition to the measurements specified for subgroup 3 of table E-VIB of MIL-PRF-19500, the measurements of steps 1, 2, and 5 also be taken.
  - c. In addition to the measurements specified for subgroup 5 of table E-VIB of MIL-PRF-19500, the measurements of steps 1 and 2 also be taken.
- (3) The electrical measurements for group C, all quality levels, shall be as follows:
  - a. In addition to the measurements specified for subgroups 2 and 3 of table E-VII of MIL-PRF-19500, the measurements of step 1 shall also be taken.
  - b. In addition to the measurements specified for subgroup 6 of table E-VII of MIL-PRF-19500, the measurements of step 1 shall also be taken.
- (4) The electrical measurements for group E, all quality levels, shall be as follows: In addition to the measurements specified for subgroups 1 and 2 of table E-IX of MIL-PRF-19500 the measurements of steps 1 and 2 shall also be taken.
- (5) Devices which exceed the table I (group A) limits for this test shall not be accepted.



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TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Max	Min	
<u>Subgroup 1</u> Visual and mechanical examination	2071					
<u>Subgroup 2</u> Thermal impedance <u>2/</u>	3101	See 4.5.3.2	$Z_{\theta JX}$		2.40	°C/W
Forward voltage	4011	Condition B, Pulsed test <u>3/</u> $I_F = 5$ A dc $I_F = 10$ A dc $I_F = 15$ A dc	$V_{F1}$ $V_{F2}$ $V_{F3}$		0.70 0.81 0.88	V dc V dc V dc
Reverse leakage current	4016	DC method; pulsed test <u>3/</u> $V_R = 48$ V (pk)	$I_{R1}$		0.30	mA dc
<u>Subgroup 3</u> High temperature operation:		$T_C = +125^\circ\text{C}$				
Reverse leakage current	4016	DC method pulsed <u>3/</u> $V_R = 48$ V (pk)	$I_{R2}$		300	mA dc
Low temperature operation:		$T_C = -55^\circ\text{C}$				
Forward voltage	4011	Condition B, Pulsed test <u>3/</u> $I_F = 15$ A dc	$V_{F4}$		0.98	V dc
<u>Subgroup 4</u> Junction capacitance	4001	$V_R = 5$ V dc, $f = 1.0$ MHz	$C_J$		900	pF
<u>Subgroup 5 and 7</u> Not applicable						
<u>Subgroup 6</u> Surge current	4066	Condition A1; $T_A = +25^\circ\text{C}$ , $I_{FSM} = 120$ A(pk), $V_{RM} = 60$ V(pk), $I_O = 0$ A(pk), 6 surges of 8.3 ms each at 1 minute intervals				
Electrical measurements		See 4.6, steps 1 and 2				

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

\*2/ For end-point measurements, this test is required for the following subgroups:

Group B, subgroups 3, 4 and 5 (JANS).

Group B, subgroups 2 and 3 (JAN, JANTX, JANTXV).

Group C, subgroups 2 and 6.

Group E, subgroup 1.

3/ Pulse response test (see 4.5.1): Pulse width = 300 ms, duty cycle  $\leq$  2 percent.

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TABLE II. Group E inspection (all quality levels) – for qualification and re-qualification only.

Inspection	MIL-STD-750		Qualification sample plan
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling (air to air)	1051		
Hermetic seal Fine leak Gross leak	1071		
Electrical measurements		See 4.6 herein, steps 1 and 2.	
<u>Subgroup 2</u>			45 devices c = 0
Burn-in (for diodes, rectifiers, and zeners) (DC HTRB)	1038	Test condition A, t = 1,000 hours.	
Blocking life	1048	T <sub>C</sub> = +125°C; V <sub>R</sub> = 48 Vdc; t = 1,000 hours.	
Electrical measurements		See 4.6 herein, steps 1 and 2.	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			
Thermal impedance curves	3101	See 4.5.2 and MIL-PRF-19500.	
<u>Subgroup 5</u>			
Not applicable			

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. The complete Part or Identifying Number (PIN), see 1.5 and 6.6.

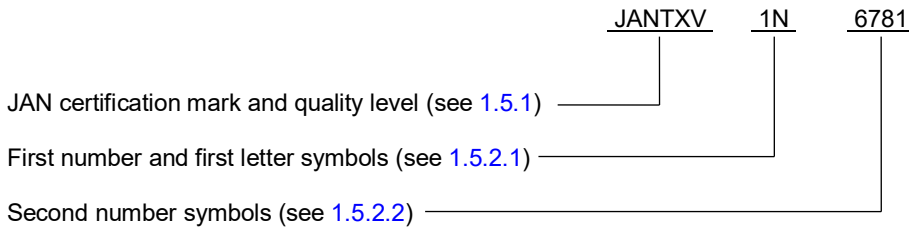
6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List ([QML-19500](#)) whether or not such products have actually been so listed by that date. The 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](mailto: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 Cross reference list. Parts covered by this specification may be used to replace the following commercial Part of Identifying Numbers (PIN):

Preferred types	Commercial types
JAN1N6781, JANTX1N6781, JANTXV1N6781, JANS1N6781	1N6781

\* 6.5 PIN construction example.

\* 6.5.1 Encapsulated devices The PINs for encapsulated devices are constructed using the following form.



\* 6.6 List of PINs. The following is a list of possible PINs available on this specification sheet.

PINs for types 1N6781.			
JAN1N6781	JANTX1N6781	JANTXV1N6781	JANS1N6781

6.7 Changes from previous issue. The margins of this specification are marked with vertical lines 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  
 DLA - CC

Preparing activity:  
 DLA - CC  
 (Project 5961-2018-094)

Review activities:  
 Air Force - 19, 99

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>.