

The documentation and process conversion measures necessary to comply with this document shall be completed by 29 January 2011.

INCH-POUND

MIL-PRF-19500/177H  
 29 October 2010  
 SUPERSEDING  
 MIL-PRF-19500/177G  
 6 April 2009

PERFORMANCE SPECIFICATION SHEET

\* SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON LOW-POWER TYPES 2N1131, 2N1131L, 2N1132, 2N1132L, 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 performance requirements for PNP silicon low-power transistors. Two levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1, 2N1131 and 2N1132 (TO-39), 2N1131L and 2N1132L (TO-5).

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

$P_T$ (1) $T_C = +25^\circ\text{C}$	$P_T$ (2) $T_A = +25^\circ\text{C}$	$V_{CBO}$	$V_{CEO}$	$V_{EBO}$	$I_C$	$T_{OP}$ and $T_J$
<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>mA dc</u>	<u>°C</u>
2.0	0.6	50	40	5.0	600	-65 to +200

(1) Derate linearly 11.4 mW/°C for  $T_C \geq +25^\circ\text{C}$ .

(2) Derate linearly 3.4 mW/°C for  $T_A \geq +25^\circ\text{C}$ .

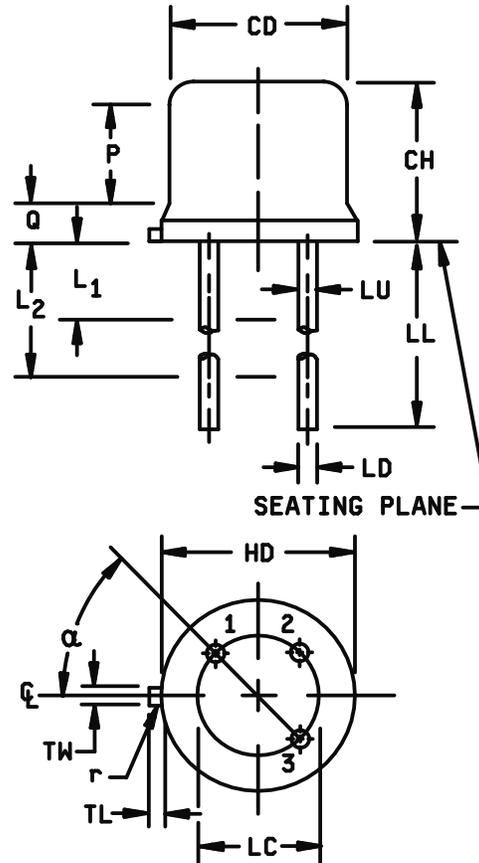
1.4 Primary electrical characteristics. Unless otherwise specified,  $T_A = +25^\circ\text{C}$ .

Types	$h_{FE1}$ (1)		$h_{fe1}$		$V_{BE(SAT)}$ (1)		$V_{CE(SAT)}$ (1)		$C_{obo}$		$ h_{re} $	
	$V_{CE} = 10 \text{ V dc}$ $I_C = 150 \text{ mA dc}$		$V_{CE} = 5.0 \text{ V dc}$ $I_C = 1.0 \text{ mA dc}$ $f = 1 \text{ kHz}$		$I_C = 150 \text{ mA dc}$ $I_B = 15 \text{ mA dc}$		$I_C = 150 \text{ mA dc}$ $I_B = 15 \text{ mA dc}$		$f = 1 \text{ MHz}$ $V_{CB} = 10 \text{ V dc}$ $I_E = 0$		$f = 20 \text{ MHz}$ $I_C = 50 \text{ mA dc}$ $V_{CE} = 10 \text{ V dc}$	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2N1131, L	20	45	15	50		1.5		1.3		45	2.5	20
2N1132, L	30	90	30	90		1.5		1.3		45	3.0	20

(1) Pulsed (see 4.5.1).

\* 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@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 <https://assist.daps.dla.mil>.

Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	6
CH	.240	.260	6.12	6.60	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		7
LD	.016	.019	0.41	0.48	8,9
LL	See note 14				
LU	.016	.019	0.41	0.48	8,9
L <sub>1</sub>		.050		1.27	8,9
L <sub>2</sub>	.250		6.35		8,9
P	.100		2.54		7
Q		.030		0.76	5
TL	.029	.045	0.74	1.14	3,4
TW	.028	.034	0.71	0.86	3
r		.010		0.25	10
$\alpha$	45° TP		45° TP		7
	1, 2, 10, 12, 13, 14				



## NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
7. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by gauging procedure.
8. Dimension LU applies between L<sub>1</sub> and L<sub>2</sub>. Dimension LD applies between L<sub>2</sub> and LL minimum. Diameter is uncontrolled in and beyond LL minimum.
9. All three leads.
10. The collector shall be internally connected to the case.
11. Dimension r (radius) applies to both inside corners of tab.
12. In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi$ x symbology.
13. Lead 1 = emitter, lead 2 = base, lead 3 = collector.
- \* 14. For L-suffix or non-S-suffix devices (TO-5), dimension LL = 1.5 inches (38.10 mm) min. and 1.75 inches (44.45 mm) max. For non-L suffix types (TO-39), dimension LL = .5 inch (12.70 mm) min. and .750 inch (19.05 mm) max.

\* FIGURE 1. Physical dimensions 2N1131 and 2N1132 ( TO-39), 2N1131L and 2N1132L (TO-5).

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.daps.dla.mil/quicksearch> or <https://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 manufacturers list 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.

R<sub>BE</sub>.....External resistance base to emitter.

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figure 1.

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

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

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

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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).

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 (JANTX level 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 (see table E-IV of MIL-PRF-19500)	Measurements
	JANTX and JANTXV levels only
(1) 3c	Thermal impedance method 3131 of MIL-STD-750 (see 4.3.2)
9	Not applicable
11	$I_{CBO1}$ and $h_{FE2}$
12	See 4.3.1
13	$\Delta I_{CBO1}$ = 100 percent of initial value or 1 $\mu$ A dc whichever is greater; $\Delta h_{FE2}$ = $\pm 20$ percent of initial value; subgroup 2 of table I herein

(1) Shall be performed anytime after temperature cycling, screen 3a; and does not need to be repeated in screening requirements.

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4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:  $V_{CB} = 10 - 30$  V dc. Power shall be applied to achieve  $T_J = +135^\circ\text{C}$  minimum using a minimum  $P_D = 75$  percent of  $P_T$  maximum rated as defined in 1.3. With approval of the qualifying activity and preparing activity, alternate burn-in criteria (hours, bias conditions,  $T_J$ , and mounting conditions) may be used for JANTX quality level. A justification demonstrating equivalence is required. In addition, the manufacturing site's burn-in data and performance history will be essential criteria for burn-in modification approval. Use method 3100 of MIL-STD-750 to measure  $T_J$ .

4.3.2 Thermal impedance. The thermal impedance measurements shall be performed in accordance with method 3131 of MIL-STD-750 using the guidelines in that method for determining  $I_M$ ,  $I_H$ ,  $t_H$ , and  $t_{SW}$  ( $V_C$  and  $V_H$  where appropriate). Measurement delay time ( $t_{MD}$ ) = 70  $\mu\text{s}$  max. See table II, group E, subgroup 4 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 MIL-PRF-19500 and table I herein.

\* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in table E-VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1027	$T_A =$ room ambient as defined in the general requirements of MIL-STD-750, $V_{CB} = 30$ V dc; adjust $P_T$ to achieve $T_J = 150^\circ\text{C}$ min.
B3	2037	Test condition D.
B6	1032	$T_{STG(max)} = +175^\circ\text{C}$

\* 4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the test and conditions specified for subgroup testing in table E-VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) requirements shall be in accordance with table I, subgroup 2 herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E
* C5	3131	$R_{\theta JX}$ only, as applicable (see 1.3) and in accordance with thermal impedance curves.
C6	1026	$T_A =$ room ambient as defined in the general requirements of MIL-STD-750, $V_{CB} = 30$ V dc; adjust $P_T$ to achieve $T_J = 150^\circ\text{C}$ min.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-IX of MIL-PRF-19500 and as specified in table II herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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.

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\* TABLE I. Group A inspection.

* Inspection 1/  <u>Subgroup 1</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Thermal Impedance	3131	See 4.3.2.	Z <sub>θJX</sub>			°C/W
Collector - emitter breakdown voltage	3011	Bias condition D; I <sub>C</sub> = 10 mA dc; pulsed (see 4.5.1)	V <sub>(BR)CEO</sub>	40		V dc
Collector - base breakdown voltage	3001	Bias condition D; I <sub>C</sub> = 10 μA dc	V <sub>(BR)CBO</sub>	50		V dc
Collector - base cutoff current	3036	Bias condition D; V <sub>CB</sub> = 50 V dc	I <sub>CBO1</sub>		10	μA dc
Collector - emitter cutoff current	3041	Bias condition B; V <sub>CE</sub> = 50 V dc; pulsed (see 4.5.1); R <sub>BE</sub> ≤ 10 ohms	I <sub>CER</sub>		10	mA dc
Collector – base cutoff current	3036	Bias condition D; V <sub>CB</sub> = 30 V dc	I <sub>CBO2</sub>		1.0	μA dc
Emitter - base cutoff current	3061	Bias condition D; V <sub>EB</sub> = 5.0 V dc	I <sub>EBO</sub>		100	μA dc
Forward-current transfer ratio	3076	V <sub>CE</sub> = 10 V dc; I <sub>C</sub> = 150 mA dc; pulsed (see 4.5.1)	h <sub>FE1</sub>			
2N1131, L 2N1132, L				20 30	45 90	
Forward-current transfer ratio	3076	V <sub>CE</sub> = 10 V dc; I <sub>C</sub> = 5.0 mA dc; pulsed (see 4.5.1)	h <sub>FE2</sub>			
2N1131, L 2N1132, L				15 25		
Collector - emitter saturated voltage	3071	I <sub>C</sub> = 150 mA dc; I <sub>B</sub> = 15 mA dc; pulsed (see 4.5.1)	V <sub>CE(SAT)</sub>		1.3	V dc
Base – emitter saturated voltage	3066	Test condition A; I <sub>C</sub> = 150 mA dc; I <sub>B</sub> = 15 mA dc; pulsed (see 4.5.1)	V <sub>BE(SAT)</sub>		1.5	V dc
<u>Subgroup 3</u>						
High-temperature operation:		T <sub>A</sub> = +150°C				
Collector - base cutoff current	3036	Bias condition D; V <sub>CE</sub> = 30 V dc	I <sub>CBO3</sub>		100	μA dc
Low-temperature operation:		T <sub>A</sub> = -55°C				
Forward-current transfer ratio	3076	V <sub>CE</sub> = 10 V dc; I <sub>C</sub> = 150 mA dc; pulsed (see 4.5.1)	h <sub>FE3</sub>			
2N1131, L 2N1132, L				10 15		

See footnote at end of table.

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\* TABLE I. Group A inspection – Continued.

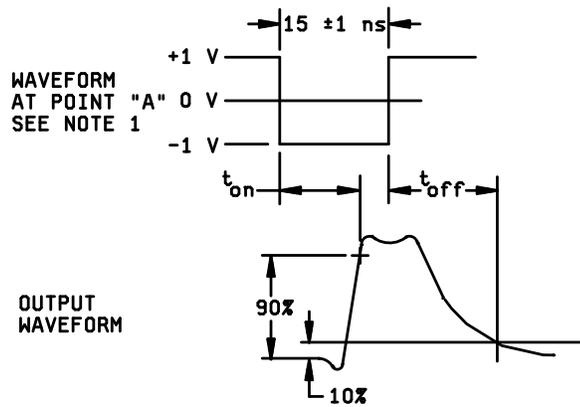
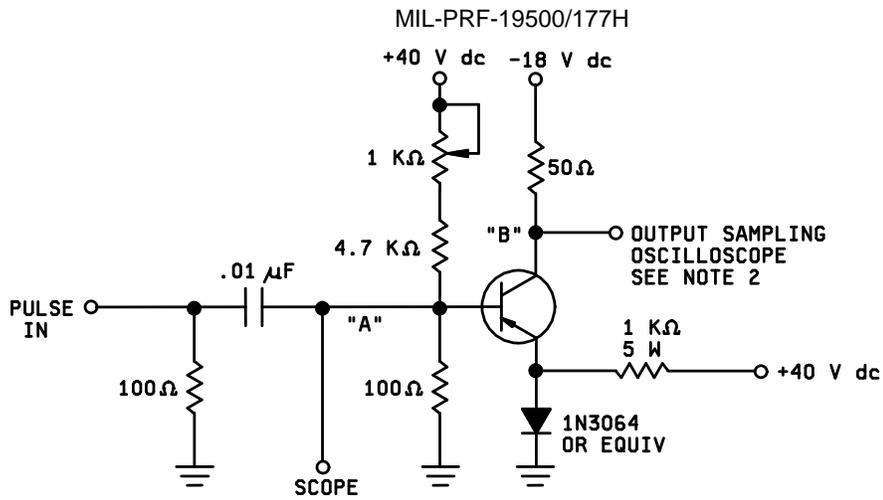
Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u>						
Small-signal short circuit forward-current transfer ratio 2N1131, L 2N1132, L	3206	$V_{CE} = 5.0 \text{ V dc}; I_C = 1.0 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{fe1}$	15 30	50 90	
Small-signal short circuit forward-current transfer ratio 2N1131, L 2N1132, L	3206	$V_{CE} = 10 \text{ V dc}; I_C = 5.0 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{fe2}$	20 30		
Small-signal open-circuit output admittance	3216	$V_{CE} = 5.0 \text{ V dc}; I_C = 1.0 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{ob1}$		1.0	$\mu\text{mho}$
Small-signal open-circuit output admittance	3216	$V_{CE} = 10 \text{ V dc}; I_C = 5.0 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{ob2}$		5.0	$\mu\text{mho}$
Small-signal short-circuit input impedance	3201	$V_{CE} = 5.0 \text{ V dc}; I_C = 1.0 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{ib1}$	25	35	$\Omega$
Small-signal short-circuit input impedance	3201	$V_{CE} = 10 \text{ V dc}; I_C = 5.0 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{ib2}$		10	$\Omega$
Small-signal open-circuit reverse-voltage transfer ratio	3211	$V_{CE} = 5.0 \text{ V dc}; I_C = 1.0 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{rb1}$		$8 \times 10^{-4}$	
Small-signal open-circuit reverse-voltage transfer ratio	3211	$V_{CE} = 10 \text{ V dc}; I_C = 5.0 \text{ mA dc}; f = 1 \text{ kHz}$	$h_{rb2}$		$8 \times 10^{-4}$	
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio  2N1131, L 2N1132, L	3306	$V_{CE} = 10 \text{ V dc}; I_C = 50 \text{ mA dc}; f = 20 \text{ MHz}$	$ h_{fe} $	2.5 3.0	20 20	
Open circuit output capacitance	3236	$V_{CB} = 10 \text{ V dc}; I_E = 0; 100 \text{ kHz} \leq f \leq 1.0 \text{ MHz}$	$C_{obo}$		45	pF
Input capacitance (output open-circuited)	3240	$V_{EB} = 0.5 \text{ V dc}; I_C = 0; 100 \text{ kHz} \leq f \leq 1.0 \text{ MHz}$	$C_{ibo}$		80	pF
Pulse response		Ssee figure 2	$t_{on} + t_{off}$		50	ns
<u>Subgroups 5, 6 and 7</u>						
Not applicable						

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

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

Inspection	MIL-STD-750		Qualification
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles.	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2 herein.	
<u>Subgroup 2</u>			45 devices c = 0
Intermittent life	1037	Intermittent operation life: $V_{CB} = 10$ V dc, 6,000 cycles. Adjust device current, or power, to achieve a minimum $\Delta T_J$ of +100°C.	
Electrical measurements		See table I, subgroup 2 herein.	
<u>Subgroup 4</u>			
Thermal impedance curves		See table E-IX of MIL-PRF-19500, group E, subgroup 4.	
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>			
Electrostatic discharge (ESD)	1020		
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition B for devices < 400 V.	



NOTES:

1. The rise time ( $t_r$ ) of the applied pulse shall be  $\leq 2.0$  ns, duty cycle  $\leq 2$  percent, and the generator source shall be  $50 \Omega$ .
2. Sampling oscilloscope:  $Z_{in} \geq 100 \text{ k}\Omega$ ,  $C_{in} \leq 12 \text{ pF}$ , rise time  $\leq .5$  ns.

FIGURE 2. Nonsaturated switching time test circuit.

## 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](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://assist.daps.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  
DLA - CC

Preparing activity:

DLA - CC  
  
(Project 5961-2010-052)

Review activities:

Army - AR, AV, MI, SM  
Navy - AS  
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.daps.dla.mil>.