The documentation and process conversion measures necessary to comply with this revision shall be completed by 15 May 2002.

INCH-POUND

MIL-PRF-19500/255N
15 February 2002
SUPERSEDING
MIL-PRF-19500/255M
20 March 2001

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, SWITCHING, TYPES 2N2221A, 2N2221AL, 2N2222A, 2N2222AL, 2N2221AUA 2N2222AUA, 2N2221AUB, AND 2N2222AUB, JAN, JANJ, JANTX, JANTXV, JANTXVD, JANTXVH, JANTXVM, JANTXVR, JANS, JANSD, JANSH, JANSM, JANSR, JANHC, JANHCM, JANHCD, JANHCR, JANHCH, JANKC, JANKCM, JANKCD, JANKCR, AND JANKCH

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN, silicon, switching transistors. Five levels of product assurance are provided for each encapsulated device type as specified in MIL-PRF-19500, and two levels of product assurance are provided for each unencapsulated device type. Provisions for radiation hardness assurance (RHA) to four radiation levels is provided for JANTXV JANS, JANHC, and JANKC 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 (similar to T0-18), figures 2 and 3 (surface mount case outlines UA and UB), and figures 4, 5, and 6 (JANHC and JANKC).

1.3 Maximum ratings.

Types	P_T $T_A = +25°C$	I_C	V_{CBO}	V_{CEO}	V_{EBO}	T_{OP} and T_{STG}	$R_{\theta JA}$
	W	mA dc	V dc	V dc	V dc	°C	°C/W
2N2221A, L,	(1) 0.5	800	75	50	6	-65 to +200	325
2N2222A, L	(1) 0.5	800	75	50	6	-65 to +200	325
2N2221AUA,	(2) 0.65	800	75	50	6	-65 to +200	210
2N2222AUA	(2) 0.65	800	75	50	6	-65 to +200	210
2N2221AUB,	(1) 0.50	800	75	50	6	-65 to +200	325
2N2222AUB	(1) 0.50	800	75	50	6	-65 to +200	325

(1) Derate linearly 3.08 mW/°C above T_A = +37.5°C.
(2) Derate linearly 4.76 mW/°C above T_A = +63.5°C.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center Columbus, ATTN: DSCC-VAC, P.O. Box 3990 Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5961
DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1.4 Primary electrical characteristics at T_A = +25°C.

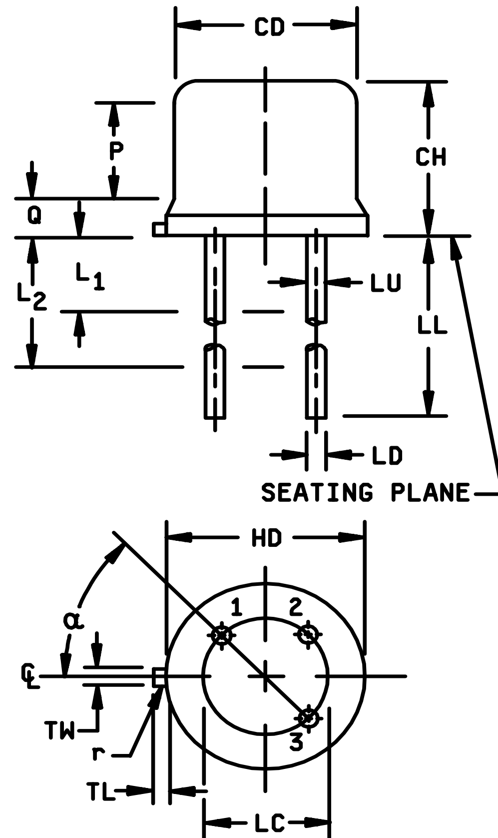
	h_{FE} at V_{CE} = 10 V dc									
	h_{FE1} I_C = 0. 1 mA dc		h_{FE2} I_C = 1.0 mA dc		h_{FE3} I_C = 10 mA dc		h_{FE4} (1) I_C = 150 mA dc		h_{FE5} (1) I_C = 500 mA dc	
	L, UA, UB 2N2221A	L, UA, UB 2N2222A	L, UA, UB 2N2221A	L, UA, UB 2N2222A	L, UA, UB 2N2221A	L, UA, UB 2N2222A	L, UA, UB 2N2221A	L, UA, UB 2N2222A	L, UA, UB 2N2221A	L, UA, UB 2N2222A
Min	30	50	35	75	40	100	40	100	20	30
Max			150	325			120	300		

Types	Limit	$/h_{fe}/$ f = 100 MHz V_{CE} = 20 V dc I_C = 20 mA dc	C_{obo} 100 kHz ≤ f ≤ 1 MHz V_{CB} = 10 V dc I_E = 0	Switching (saturated) t_{on} See figure 7	Switching (saturated) t_{off} See figure 8
			pF	ns	ns
2N2221A, 2N2222A L, UA, UB	Min	2.5	8		
	Max			35	300

Types	Limit	$V_{CE(sat)1}$ (1) I_C = 150 mA dc I_B = 15 mA dc	$V_{CE(sat)2}$ (1) I_C = 500 mA dc I_B = 50 mA dc	$V_{BE(sat)1}$ (1) I_C = 150 mA dc I_B = 15 mA dc	$V_{BE(sat)2}$ (1) I_C = 500 mA dc I_B = 50 mA dc
		V dc	V dc	V dc	V dc
2N2221A, 2N2222A L, UA, UB	Min			0.6	
	Max	0.3	1.0	1.2	2.0

(1) Pulsed see 4.5.1.

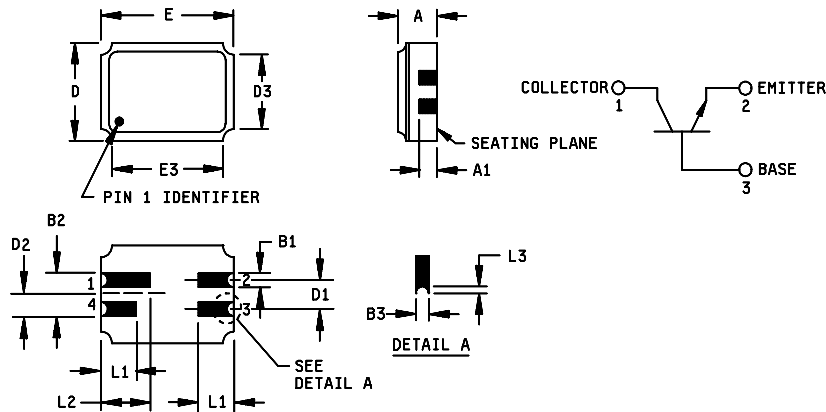
Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.170	.210	4.32	5.33	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		6
LD	.016	.021	0.41	0.53	7,8
LL	.500	.750	12.70	19.05	7,8,13
LU	.016	.019	0.41	0.48	7,8
L1		.050		1.27	7,8
L2	.250		6.35		7,8
P	.100		2.54		
Q		.030		0.76	5
TL	.028	.048	0.71	1.22	3,4
TW	.036	.046	0.91	1.17	3
r		.010		0.25	10
α	45° TP		45° TP		6
1, 2, 9, 11, 12, 13					



NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Beyond r (radius) maximum, TL shall be held for a minimum length of .011 inch (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. 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 the gauge and gauging procedure shown in figure 2.
7. Dimension LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
8. All three leads.
9. The collector shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.
12. Lead 1 = emitter, lead 2 = base, lead 3 = collector.
13. For L suffix devices, dimension LL = 1.5 inches (38.10 mm) min. and 1.75 inches (44.45 mm) max.

* FIGURE 1. Physical dimensions (similar to TO-18).

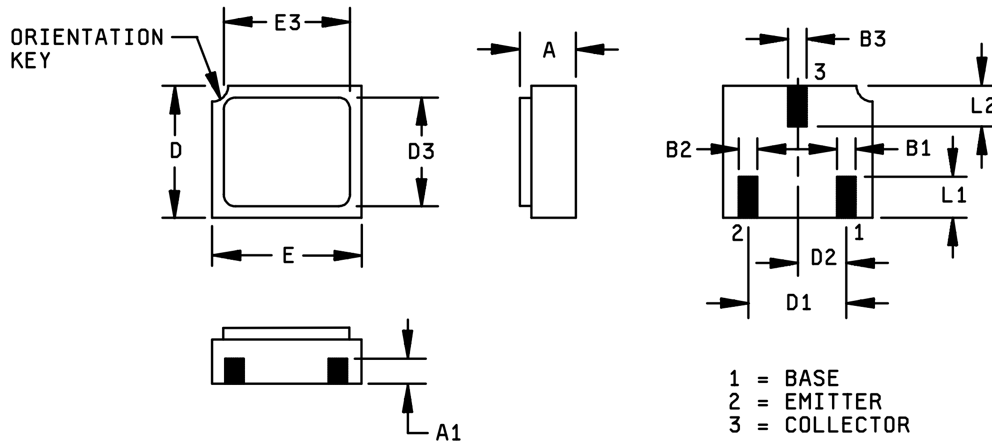


Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.061	.075	1.55	1.90	3
A1	.029	.041	0.74	1.04	
B1	.022	.028	0.56	0.71	
B2	.075 REF		1.91 REF		
B3	.006	.022	0.15	0.56	5
D	.145	.155	3.68	3.93	
D1	.045	.055	1.14	1.39	
D2	.0375 BSC		.952 BSC		
D3		.155		3.93	
E	.215	.225	5.46	5.71	
E3		.225		5.71	
L1	.032	.048	0.81	1.22	
L2	.072	.088	1.83	2.23	
L3	.003	.007	0.08	0.18	5

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimension "A" controls the overall package thickness. When a window lid is used, dimension "A" must increase by a minimum of .010 inch (0.254 mm) and a maximum of .040 inch (1.020 mm).
4. The corner shape (square, notch, radius, etc.) may vary at the manufacturer's option, from that shown on the drawing.
5. Dimensions "B3" minimum and "L3" minimum and the appropriately castellation length define an unobstructed three-dimensional space traversing all of the ceramic layers in which a castellation was designed. (Castellations are required on bottom two layers, optional on top ceramic layer.) Dimension "B3" maximum and "L3" maximum define the maximum width and depth of the castellation at any point on its surface. Measurement of these dimensions may be made prior to solder dipping.

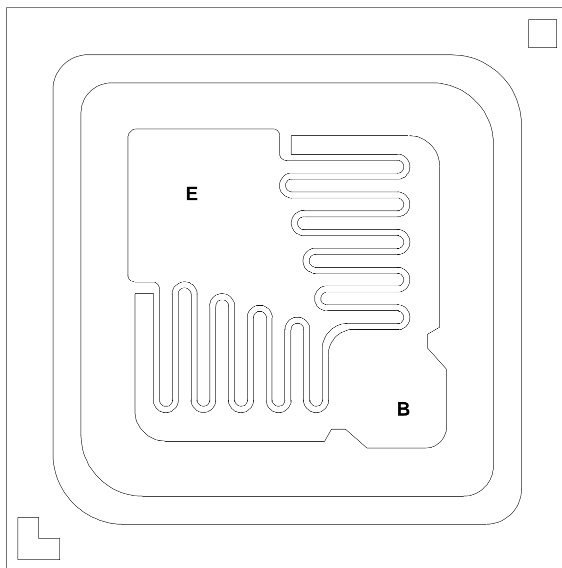
FIGURE 2. Physical dimensions, surface mount (UA version).



Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.046	.056	0.97	1.42	
A1	.017	.035	0.43	0.89	
B1	.016	.024	0.41	0.61	
B2	.016	.024	0.41	0.61	
B3	.016	.024	0.41	0.61	
D	.085	.108	2.41	2.74	
D1	.071	.079	1.81	2.01	
D2	.035	.039	0.89	0.99	
D3	.085	.108	2.41	2.74	
E	.115	.128	2.82	3.25	
E3		.128		3.25	
L1	.022	.038	0.56	0.96	
L2	.022	.038	0.56	0.96	

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

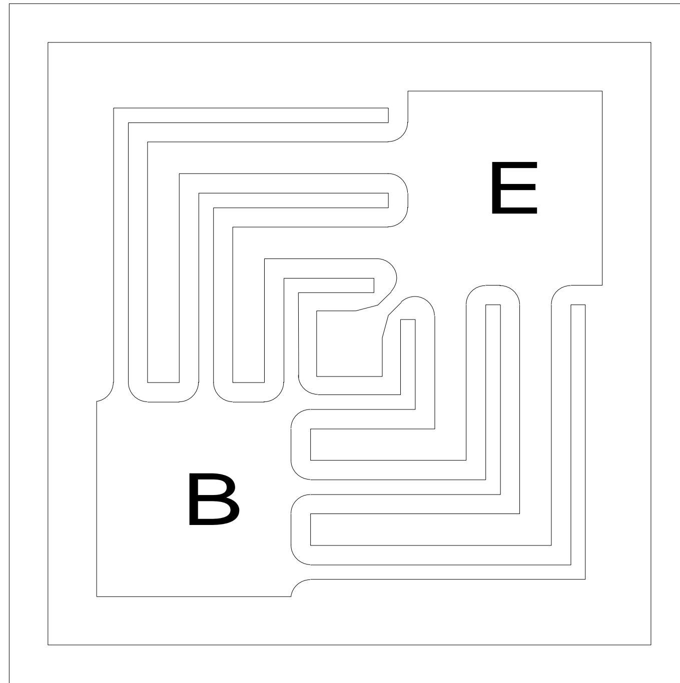
FIGURE 3. Physical dimensions, surface mount (UB version).



Physical characteristics:
B-version

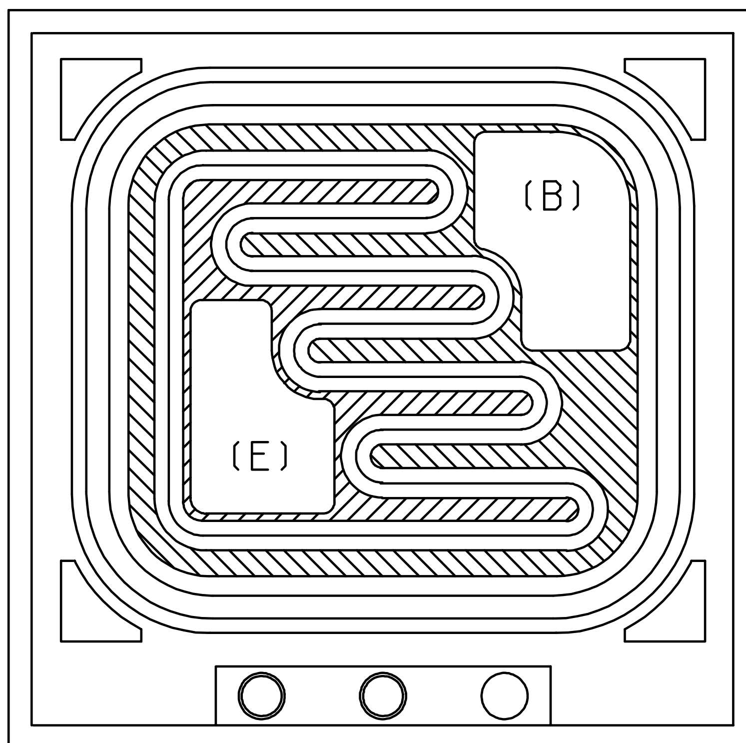
Chip size:	0.023 x 0.023 mils ± 0.002 mils.
Chip thickness:	0.010 ± 0.0015 mils.
Top metal:	Aluminum 15,000Å minimum, 18,000Å nominal.
Back metal:	A. Al/Ti/Ni/Ag 15kÅ/5kÅ/10kÅ/10kÅ.
	B. Gold 2,500Å minimum, 3,000Å nominal.
	C. Eutectic die mount - no metal.
Glassivation:	Si_3N_4 2,000 Å minimum, 8,000 Å nominal.
Backside:	Collector.
Bonding pad:	B = 0.0042 x 0.0042 mils, E = 0.0042 x 0.0042 mils.

FIGURE 4. JANHC and JANKC (B-version) die dimensions.



Die size:	.020 x .020 inch (0.508 mm x 0.508 mm).
Die thickness:	.008 ±.0016 inch (0.2032 mm ±0.04064 mm).
Base bonding pad:	.004 x .004 inch (0.1016 mm x 0.1016 mm).
Emitter bonding pad:	.004 x .004 inch.
Back metal:	Gold, 6,500 ±1950 Å.
Top metal:	Aluminum, 27,000 ±3,000 Å.
Back side:	Collector.
Glassivation:	SiO_2, 7,500 ±1,500 Å.

FIGURE 5. JANHC and JANKC (C-version) die dimensions.



Die size.	.0198 x .0198 inch ±.0005 inch (0.50292 x 0.50292 mm ±0.0127 mm).
Die thickness	.010 ±.001 inch (0.254 ±0.0254 mm) nominal.
Top metal	Aluminum, 21,000Å nominal.
Back metal	Gold 2,000Å nominal.
Backside	Collector.
Bonding pad	B = .0041 x .0059 inch (0.10414 x 0.14986 mm), E = .0038 x .0057 inch (0.09652 x 0.14478 mm).
Glassivation	Silicon oxide.

FIGURE 6. JANHC and JANKC (D-version for 2N2222A, and 2N2221A) die dimensions.

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 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation Production Services (DAPS), 700 Robbins Avenue, Building 4D (DPM-DODSSP), 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 requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

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.

UA, UB, - - - - - - - Surface mount case outlines (see figures 2 and 3).

* 3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500, and on figures 1, 2, 3, 4, 5, and 6 herein.

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 Radiation hardness assurance (RHA). Radiation hardness assurance requirements, PIN 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 paragraph 1.3, 1.4, and table I.

3.7 Electrical test requirements. The electrical test requirements shall be as specified in table I, subgroup 2.

3.8 Marking. Marking shall be in accordance with MIL-PRF-19500, except for the UB suffix package. Marking on the UB package shall consist of an abbreviated part number, the date code, and the manufacturers symbol or logo. The prefixes JAN, JANTX, JANTXV, JANJ, and JANS can be abbreviated as J, JX, JV, JJ, and JS respectively. The "2N" prefix and the "AUB" suffix can also be omitted.

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 4.4.5 herein.

4.2.1 JANJ devices. For JANJ level, 3.3.1 through 3.3.1.3 of MIL-PRF-19500 shall apply, except as modified herein. Supplier imposed requirements as well as alternate screens, procedures, and/or controls shall be documented in the QM plan and must be submitted to the qualifying activity for approval. When alternate screens procedures, and/or controls are used in lieu of the JANJ screens herein equivalency shall be proven and documented in the QM plan. Radiation characterization may be submitted in the QM plan at the option of the manufacturer, however, 3.3.1.1 of MIL-PRF-19500 is not required. Die lot controls and rework requirements shall be in accordance with 3.13 of MIL-PRF-19500 and D.3.13.2.1 for JANS level. Lot formation and conformance inspection requirements for JANJ shall be those used for JANTXV devices as a minimum

4.2.2 JANJ qualification. For JANJ qualification, 4.4.2.1 herein shall be performed as required by the qualifying activity. A JANS certified supplier may supply JANJ product utilizing the JANJ screening flow in 4.3 herein.

4.2.3 JANHC and JANKC qualification. JANHC and JANKC qualification inspection shall be in accordance with MIL-PRF-19500.

* 4.2.4 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 associated specification that did not request the performance of table III tests, the tests specified in table III herein must be performed by the first inspection lot of this revision to maintain qualification.

* 4.3 Screening (JANS, JANJ, JANTX, and JANTXV levels only). Screening shall be in accordance with table IV 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 IV of MIL-PRF-19500)	Measurement		
	JANS level	JANJ level	JANTX and JANTXV levels
2	Optional	Optional	Optional
3a 3b 3c	Required Not applicable Thermal impedance, method 3131 of MIL-STD-750	Required Not applicable Thermal impedance, method 3131 of MIL-STD-750	Required Not applicable Thermal impedance, method 3131 of MIL-STD-750
4	Required	Optional	Optional
5	Required	Required	Not applicable
7a and 7b	Required	Required	Required
8	Required	Not required	Not required
9	I_{CBO2}, h_{FE4}	I_{CBO2}, h_{FE4}	Not applicable
10	48 hours minimum	48 hours minimum	48 hours minimum
11	I_{CBO2}; h_{FE4}; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater. Δh_{FE4} = ±15 percent	I_{CBO2}; h_{FE4}; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater. Δh_{FE4} = ±15 percent	I_{CBO2}; h_{FE4}
12	See 4.3.2 240 hours minimum	See 4.3.2 240 hours minimum	See 4.3.2 80 hours minimum
13	Subgroups 2 and 3 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE4} = ±15 percent	Subgroups 2 and 3 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE4} = ±15 percent	Subgroup 2 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE4} = ±15 percent
14a and 14b	Optional	Optional	Optional
15	Required	Required	Not required
16	Required	Required	Not required

4.3.1 Screening (JANHC and JANKC). Screening of JANHC and JANKC die shall be in accordance with MIL-PRF-19500 "Discrete Semiconductor Die/Chip Lot Acceptance". Burn-in duration for the JANKC level follows JANS requirements; the JANHC follows JANTX requirements.

4.3.2 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°C minimum using a minimum P_D = 75 percent of P_T maximum rated as defined in 1.3.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. If alternate screening is being performed in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of group A1 and A2 inspection only (table VIb, group B, subgroup 1 is not required to be performed again if group B has already been satisfied in accordance with 4.4.2).

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 VIa (JANS) of MIL-PRF-19500 and 4.4.2.1. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and 4.5.3 herein: delta requirements only apply to subgroups B4, and B5. See 4.4.2.2 for JAN, JANJ, JANTX, and JANTXV group B testing. Electrical measurements (end-points) and delta requirements for JAN, JANJ, JANTX, and JANTXV shall be after each step in 4.4.2.2 and shall be in accordance with group A, subgroup 2 and 4.5.3 herein.

* 4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

Subgroup	Method	Condition
B4	1037	V_{CB} = 10 V dc.
B5	1027	V_{CB} = 10 V dc; $P_D \geq$ 100 percent of maximum rated P_T (see 1.3). (NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.) Option 1: 96 hours minimum sample size in accordance with MIL-PRF-19500, table VIa, adjust T_A or P_D to achieve T_J = +275°C minimum. Option 2: 216 hours minimum, sample size = 45, c = 0; adjusted T_A or P_D to achieve a T_J = +225°C minimum.

4.4.2.2 Group B inspection, (JAN, JANJ, JANTX, and JANTXV). Separate samples may be used for each step. In the event of a group B failure, the manufacturer may pull a new sample at double size from either the failed assembly lot or from another assembly lot from the same wafer lot. If the new “assembly lot” option is exercised, the failed assembly lot shall be scrapped.

Step	Method	Condition
1	1039	Steady-state life: Test condition B, 340 hours minimum, V_{CB} = 10 - 30 V dc, power shall be applied to achieve T_J = +150°C minimum using a minimum of P_D = 75 percent of maximum rated P_T as defined in 1.3. n = 45 devices, c = 0.
2	1039	The steady-state life test of step 1 shall be extended to 1,000 hrs for each die design. Samples shall be selected from a wafer lot every twelve months of wafer production. Group B step 2 shall not be required more than once for any single wafer lot. n = 45, c = 0.
3	1032	High-temperature life (non-operating), t = 340 hours, T_A = +200°C. n = 22, c = 0.

4.4.2.3 Group B sample selection. Samples selected from group B inspection shall meet all of the following requirements:

a. For JAN, JANJ, JANTX, and JANTXV samples shall be selected randomly from a minimum of three wafers (or from each wafer in the lot) from each wafer lot. For JANS, samples shall be selected from each inspection lot. See MIL-PRF-19500.

b. Must be chosen from an inspection lot that has been submitted to and passed group A, subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (subgroups B4 and B5 for JANS, and group B for JAN, JANJ, JANTX, and JANTXV) may be pulled prior to the application of final lead finish.

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 VII of MIL-PRF-19500, and in 4.4.3.1 (JANS) and 4.4.3.2 (JAN, JANJ, JANTX, and JANTXV) herein for group C testing. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and 4.5.3 herein; delta requirements only apply to subgroup C6.

4.4.3.1 Group C inspection, table VII (JANS) of MIL-PRF-19500.

Subgroup	Method	Condition
C2	2036	Test condition E; (method 2036 not applicable for UA and UB devices).
C6	1026	1,000 hours at V_{CB} = 10 V dc; power shall be applied to achieve T_J = +150°C minimum and a minimum of P_D = 75 percent of maximum rated P_T as defined in 1.3.

4.4.3.2 Group C inspection, table VII (JAN, JANJ, JANTX, and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Condition
C2	2036	Test condition E; not applicable for UA and UB devices.
C5	3131	$R_{\theta JA}$ (see 1.3).
C6		Not applicable.

4.4.3.3 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any inspection lot containing the intended package type and lead finish procured to the same specification which is submitted to and passes group A tests for conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for C6 life test may be pulled prior to the application of final lead finish. Testing of a subgroup using a single device type enclosed in the intended package type shall be considered as complying with the requirements for that subgroup.

4.4.4 Group D inspection. Conformance inspection for hardness assured JANS and JANTXV types 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 of MIL-STD-750 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 IX of MIL-PRF-19500 and as specified in table III herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein; except, $Z_{\theta JX}$ need not be performed. Delta measurements shall be in accordance with the applicable steps of 4.5.3.

4.5 Method 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 Input capacitance. This test shall be conducted in accordance with method 3240 of MIL-STD-750, except the output capacitor shall be omitted.

4.5.3 Delta requirements. Delta requirements shall be as specified below:

Step	Inspection	MIL-STD-750		Symbol	Limit	Unit
		Method	Conditions			
1	Collector-base cutoff current	3036	Bias condition D, V_{CB} = 60 V dc	ΔI_{CB02} (1)	100 percent of initial value or 8 nA dc, whichever is greater.	
2	Forward current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc; pulsed see 4.5.1	Δh_{FE4} (1)	±25 percent change from initial reading.	

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

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical 3/ examination 3/	2071	n = 45 devices, c = 0				
Solderability 3/ 4/	2026	n = 15 leads, c = 0				
Resistance to solvents 3/ 4/ 5/	1022	n = 15 devices, c = 0				
Temp cycling 3/ 4/	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic seal 4/ Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements 4/		Group A, subgroup 2				
Bond strength 3/ 4/	2037	Precondition T_A = +250°C at t = 24 hrs or T_A = +300°C at t = 2 hrs n = 11 wires, c = 0				
Decap internal visual (design verification) 4/	2075	n = 4 devices, c = 0				
Subgroup 2						
Collector to base cutoff current	3036	V_{CB} = 75 V dc	I_{CBO1}		10	µA dc
Emitter to base cutoff current	3061	V_{EB} = 6 V dc	I_{EBO1}		10	µA dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 10 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	50		V dc
Collector to emitter cutoff current	3041	Bias condition C; V_{CE} = 50 V dc	I_{CES}		50	nA dc
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 60 V dc	I_{CBO2}		10	nA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4 V dc	I_{EBO2}		10	nA dc
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 0.1 mA dc	h_{FE1}			
2N2221A, L, UA, UB				30		
2N2222A, L, UA, UB				50		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 1.0 mA dc	h_{FE2}			
2N2221A, L, UA, UB				35	150	
2N2222A, L, UA, UB				75	325	
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc	h_{FE3}			
2N2221A, L, UA, UB				40		
2N2222A, L, UA, UB				100		

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - Continued						
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc; pulsed (see 4.5.1)	h_{FE4}			
2N2221A, L, UA, UB				40	120	
2N2222A, L, UA, UB				100	300	
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 500 mA dc; pulsed (see 4.5.1)	h_{FE5}			
2N2221A, L, UA, UB				20		
2N2222A, L, UA, UB				30		
Collector-emitter saturation voltage	3071	I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.3	V dc
Collector-emitter saturation voltage	3071	I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		1.0	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)1}$	0.6	1.2	V dc
Base-emitter saturation voltage	3066	Test condition A; I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{BE(sat)2}$		2.0	V dc
Subgroup 3						
High temperature operation		T_A = +150°C				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 60 V dc	I_{CBO3}		10	µA dc
Low temperature operation		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc	h_{FE6}			
2N2221A, L, UA, UB				15		
2N2222A, L, UA, UB				35		
Subgroup 4						
Small-signal short-circuit forward current transfer ratio	3206	V_{CE} = 10 V dc; I_C = 1 mA dc; f = 1 kHz	h_{fe}			
2N2221A, L, UA, UB				30		
2N2222A, L, UA, UB				50		
Magnitude of small-signal short- circuit forward current transfer ratio	3306	V_{CE} = 20 V dc; I_C = 20 mA dc; f = 100 MHz	$/h_{fe}/$	2.5		
Open circuit output capacitance	3236	V_{CB} = 10 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{obo}		8	pF

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 4 - Continued						
Input capacitance (output open- circuited)	3240	V_{EB} = 0.5 V dc; I_C = 0; 100 kHz ≤ f ≤ 1 MHz	C_{ibo}		25	pF
Saturated turn-on time		(See figure 7)	t_{on}		35	ns
Saturated turn-off time		(See figure 8)	t_{off}		300	ns
Subgroups 5 and 6						
Not required						

1/ For sampling plan see MIL-PRF-19500.
2/ For resubmission of failed subgroup A1, double the sample size of the failed test or sequence of tests. A failure in group A, subgroup 1 shall not require retest of the entire subgroup. Only the failed test shall be rerun upon submission.
3/ Separate samples may be used.
4/ Not required for JANS devices.
5/ Not required for laser marked devices.

TABLE II. Group D inspection.

Inspection 1/ 2/	MIL-STD-750 Method	Conditions	Symbol	Limit Min	Max	Unit
Subgroup 1						
Neutron irradiation	1017					
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 60 V dc	I_{CBO1}		20	nA dc
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 0.1 mA dc	h_{FE1}			
M2N2221A, D2N2222A, R2N2222A, H2N2222A				35 34 10		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 1.0 mA dc	h_{FE2}			
M2N2221A, D2N2222A, R2N2222A, H2N2222A				49 49 21	325	
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc	h_{FE3}			
M2N2221A, D2N2222A, R2N2222A, H2N2222A				89 89 49		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc	h_{FE4}			
M2N2221A, D2N2222A, R2N2222A, H2N2222A				90 90 45	300	
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 500 mA dc	h_{FE5}	27		
Collector-emitter saturation voltage	3071	I_C = 150 mA dc; I_B = 15 mA dc;	$V_{CE(sat)1}$		33	V dc
Collector-emitter saturation voltage	3071	I_C = 500 mA dc; I_B = 50 mA dc;	$V_{CE(sat)2}$		1.1	V dc
Subgroup 2						
Total dose irradiation	1019					
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 60 V dc	I_{CBO1}		20	nA dc
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 0.1 mA dc	h_{FE1}			
M2N2221A, D2N2222A, R2N2222A, H2N2222A				45 34 10		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 1.0 mA dc	h_{FE2}			
M2N2221A, D2N2222A, R2N2222A, H2N2222A				67 60 21	325	

See footnotes at end of table.

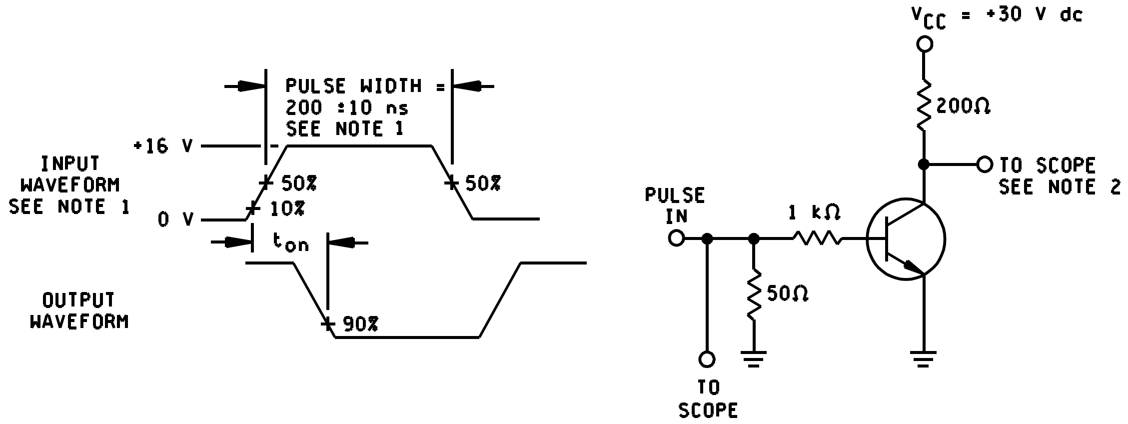
TABLE II. Group D inspection - Continued.

Inspection 1/ 2/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - Continued						
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc	h_{FE3}			
M2N2221A, D2N2222A, R2N2222A, H2N2222A				90 90 50		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc	h_{FE4}			
M2N2221A, D2N2222A, R2N2222A, H2N2222A				90 90 45		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 500 mA dc;	h_{FE5}	27		
Collector-emitter saturation voltage	3071	I_C = 150 mA dc; I_B = 15 mA dc;	$V_{CE(sat)1}$		.33	V dc
Collector-emitter saturation voltage	3071	I_C = 500 mA dc; I_B = 50 mA dc;	$V_{CE(sat)2}$		1.1	V dc

1/ Tests to be performed on all devices.
2/ For sampling plan, see MIL-PRF-19500.

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

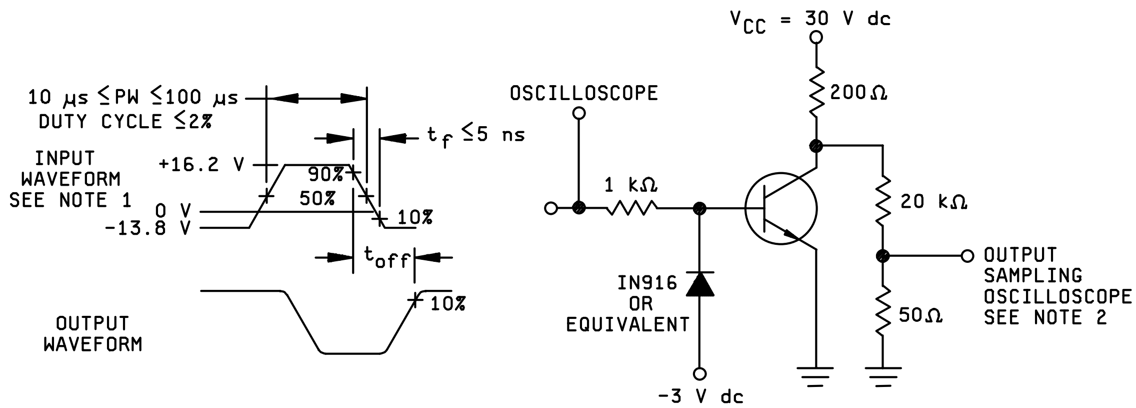
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See group A, subgroup 2 and 4.5.3 herein.	
Subgroup 2			45 devices c = 0
Intermittent life	1037	Intermittent operation life: V_{CB} = 10 V dc, 6000 cycles	
Electrical measurements		See group A, subgroup 2 and 4.5.3 herein.	
Subgroups 3, 4, 5, 6, and 7			
Not applicable			
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition A for devices ≥ 400 V, condition B for devices < 400 V.	



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 2.0 ns, duty cycle ≤ 2 percent, and the generator source impedance shall be 50 Ω.
2. Sampling oscilloscope: Z_{IN} ≥ 100 kΩ, C_{IN} ≤ 12 pF, rise time ≤ 5 ns.

* FIGURE 7. Saturated turn-on switching time test circuit.



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 2.0 ns, duty cycle ≤ 2 percent, and the generator source impedance shall be 50 Ω.
2. Sampling oscilloscope: Z_{IN} ≥ 100 kΩ, C_{IN} ≤ 12 pF, rise time ≤ 5 ns.

* FIGURE 8. Saturated turn-off 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 actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' 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.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).

c. Packaging requirements (see 5.1).

d. Lead formation and finish may be specified (see 3.4.1).

e. Type designation and product assurance level.

* f. For die acquisition, the JANHC or JANKC letter version shall be specified (see figures 4 through 6) as well as the RHA designer, if applicable. The JANHCA/JANKCA die version is obsolete as of the date of this revision. Other letter versions should be used.

g. Surface mount designation if applicable.

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) 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 43216-5000.

6.4 Supersession information. Devices covered by this specification supersede the manufacturers' and users' Part or Identifying Number (PIN). The term PIN is equivalent to the term part number which was previously used in this specification. This information in no way implies that manufacturers' PIN's are suitable as a substitute for the military PIN.

* 6.5 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCB2N2221A) will be identified on the QML. The JANHCA/JANKCA die version is obsolete as of the date of this revision.

Die ordering information (1)			
PIN	Manufacturer		
	43611	34156	12969
2N2221A 2N2222A	JANHCB2N2221A JANHCB2N2222A	JANHCC2N2221A JANHCC2N2222A	JANHCD2N2221A JANHCD2N2222A

(1) For JANKC level, replace JANHC with JANKC.

* 6.6 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 - 11
NASA - NA
DLA - CC

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

Preparing activity:
DLA - CC

(Project 5961-2564)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/255N	2. DOCUMENT DATE 15 February 2002

3. **DOCUMENT TITLE** SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, SWITCHING, TYPES 2N2221A, 2N2221AL, 2N2222A, 2N2222AL, 2N2221AUA 2N2222AUA, 2N2221AUB, AND 2N2222AUB, JAN, JANJ, JANTX, JANTXV, JANTXVD, JANTXVH, JANTXVM, JANTXVR, JANS, JANSD, JANSH, JANSM, JANSR, JANHC, JANHCM, JANHCD, JANHCR, JANHCH, JANKC, JANKCM, JANKCD, JANKCR, AND JANKCH

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial 614-692-0510 DSN 850-0510 FAX 614-692-6939 EMAIL alan.barone@dscc.dla.mil
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533 Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888