

The documentation and process conversion measures necessary to comply with this document shall be completed by 31 April 2011.

INCH-POUND

MIL-PRF-19500/453F
 31 January 2011
 SUPERSEDING
 MIL-PRF-19500/453E
 24 April 2006

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-FREQUENCY
 TYPE 2N5109 AND 2N5109UB, JAN, JANTX, JANTXV, JANS, JANHC, JANKC
 JANSM, JANSJ, JANSK, JANSL, JANSR, JANSF, JANSJ, AND JANSK

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 NPN silicon, VHF-UHF amplifier transistors. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500. Two levels of product assurance are provided for die. Provisions for radiation hardness assurance (RHA) to eight radiation levels is provided for JANS and JANKC product assurance levels. RHA level designators "M", "D", "P", "L", "R", "F", "G", and "H" are appended to the device prefix to identify devices, which have passed RHA requirements.

1.2 Physical dimensions. See figure 1 herein (similar to TO-39), figure 2 (2N5109UB) and figure 3 (JANHC2N5109, JANKC2N5109).

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

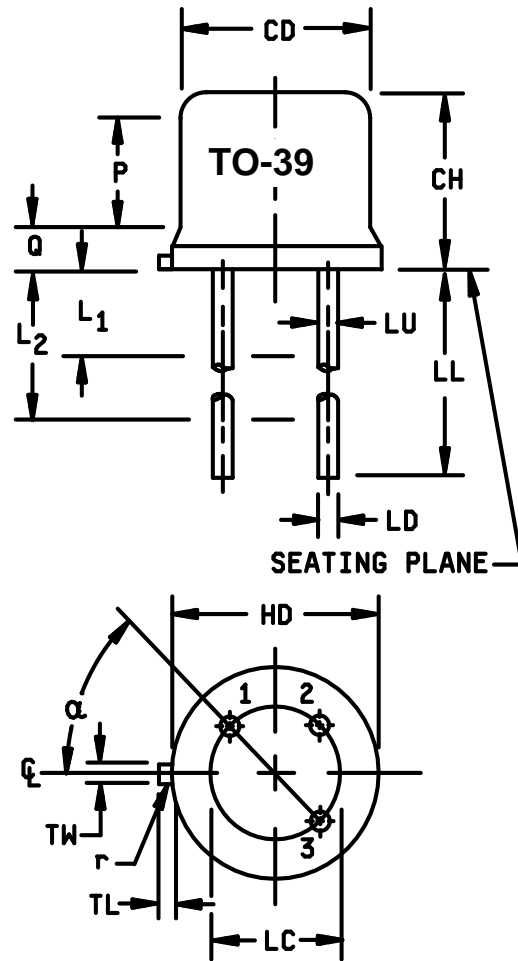
P_T (1) $T_A = +25^\circ\text{C}$	P_T (2) $T_C = +25^\circ\text{C}$	V_{CBO}	V_{CEO}	I_C	V_{EBO}	T_{STG} and T_J	$R_{\theta JA}$	$R_{\theta JC}$
<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>V dc</u>	<u>°C</u>	<u>°C/W</u>	<u>°C/W</u>
1	2.9	40	20	0.4	3.0	-65 to +200	175	60

(1) Derate at 5.71 mW/°C above $T_A > +25^\circ\text{C}$.

(2) Derate at 16.6 mW/°C above $T_C > +25^\circ\text{C}$.

* 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. 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				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
CH	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	
LC	.190	.210	4.83	5.33	
LD	.016	.021	0.41	0.53	4
LL	.500	.750	12.70	19.05	4
LU	.016	.019	0.41	0.48	4
L ₁		.050		1.27	4
L ₂	.250		6.35		4
Q		.050		1.27	6
TL	.029	.045	0.74	1.14	5
TW	.028	.034	0.71	0.86	
r		.010		0.25	
α	45° TP		45° TP		
P	.100		2.54		3

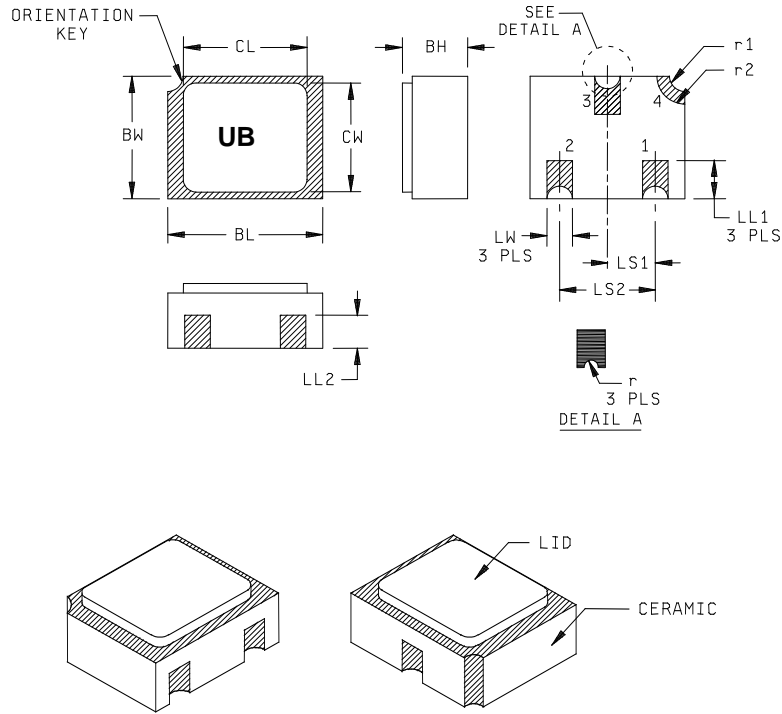


NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed .010 inch (0.0254 mm).
4. (Three leads) LU applies between L₁ and L₂. LD applies between L₂ and .5 inch (12.70 mm) from seating plane. Diameter is uncontrolled in L₁ and beyond .5 inch (12.70 mm) from seating plane.
5. Measured from maximum diameter of the actual device.
6. Details of outline in this zone optional.
7. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions of transistor type 2N5109 (similar to TO-39).

MIL-PRF-19500/453F



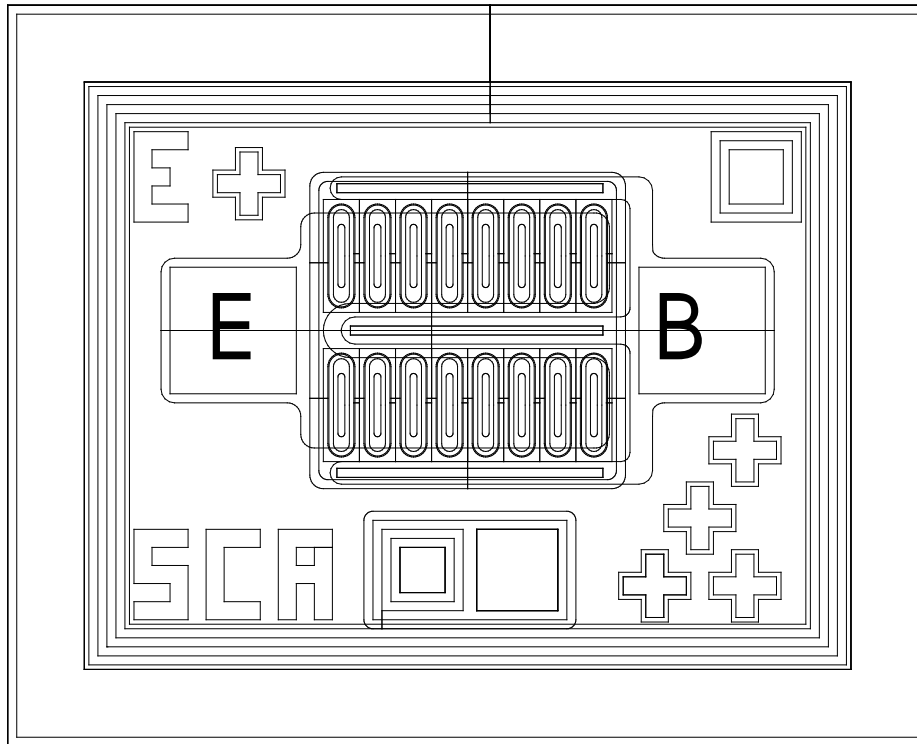
Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
BH	.046	.056	1.17	1.42	
BL	.115	.128	2.92	3.25	
BW	.085	.108	2.16	2.74	
CL		.128		3.25	
CW		.108		2.74	
LL1	.022	.038	0.56	0.96	
LL2	.017	.035	0.43	0.89	

Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
LS ₁	.036	.040	0.91	1.02	
LS ₂	.071	.079	1.81	2.01	
LW	.016	.024	0.41	0.61	
r		.008		.203	
r1		.012		.305	
r2		.022		.559	

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Hatched areas on package denote metallized areas.
4. Lid material: Kovar.
5. Pad 1 = Base, Pad 2 = Emitter, Pad 3 = Collector, Pad 4 = Shielding connected to the lid.
- * 6. In accordance with ASME Y14.5M, diameters are equivalent to ϕ x symbology.

* FIGURE 2. Physical dimensions, surface mount (2N5109UB).



Die size: .016 x .020 inches (0.4064 x 0.508 mm).
Die thickness: .008 ±.0016 inches (0.2032 ±0.04064 mm).
Base pad: .0028 x .0028 inches (0.07112 x 0.07112 mm).
Emitter pad: .0028 x .0028 inches (0.07112 x 0.07112 mm).
Back metal: Gold, 6500 ±1950 Ang
Top metal: Aluminum, 17500 ±2500 Ang
Back side: Collector
Glassivation: SiO₂, 7500 ±1500 Ang

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Unless otherwise specified tolerance is .00100 inch (0.0254 mm).

FIGURE 3. JANHC and JANKC (A-version) die dimensions.

MIL-PRF-19500/453F

1.4 Primary electrical characteristics (common to all types).

Limits	h_{FE}	$V_{CE(SAT)}$	C_{obo}	h_{FE}	Power gain
	$V_{CE} = 15 \text{ V dc}$ $I_C = 50 \text{ mA dc}$	$I_C = 100 \text{ mA dc}$ $I_B = 10 \text{ mA dc}$	$I_E = 0$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$ $V_{CB} = 28 \text{ V dc}$	$V_{CE} = 15 \text{ V dc}$ $I_C = 50 \text{ mA dc}$ $f = 200 \text{ MHz}$	$I_C = 50 \text{ mA dc}$ $f = 200 \text{ MHz}$ $P_{in} = -10 \text{ dB}$ $V_{CE} = 15 \text{ V dc}$
Min	40	V dc	pF	6.0	dB
Max	150	0.5	3.5	11.0	11.0

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 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.

cm..... Cross modulation
G..... Voltage gain.
NF..... Noise figure

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500, and figure 1 (similar to TO-39), figure 2 (2N5109UB) and figure 3 (JANH2N5109 and JANKC2N5109) 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 1.3, 1.4, and table I.

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

* 3.8 Marking. Marking shall be in accordance with MIL-PRF-19500. The radiation hardened designator M, D, P, L, R, F, G, or H shall immediately precede (or replace) the device "2N" identifier (depending upon degree of abbreviation required).

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 and table I, II, and III).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.2.1 JANH2C and JANKC qualification. JANHC and JANKC qualification inspection shall be in accordance with MIL-PRF-19500.

4.2.2 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 III tests, the tests specified in table III herein that were not performed in the prior revision shall be performed on the first inspection lot of this revision to maintain qualification.

MIL-PRF-19500/453F

4.3 Screening (JANS, JANTX and JANTXV levels only). Screening shall be in accordance with table E-IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table E-IV of MIL-PRF-19500)	Measurement	
	JANS levels	JANTX and JANTXV levels
(1) 3c	Thermal impedance (see 4.3.2)	Thermal impedance (see 4.3.2)
9	I_{CEO1} and h_{FE1}	Not applicable
10	48 hours minimum	48 hours minimum
11	I_{CEO1} and h_{FE1} ; ΔI_{CEO1} = 100 percent of initial value or 2 μ A dc, whichever is greater. Δh_{FE1} = \pm 20 percent.	I_{CEO1} and h_{FE1}
12	See 4.3.1	See 4.3.1
13	Subgroups 2 and 3 of table I herein; ΔI_{CEO1} = 100 percent of initial value or 2 μ A dc, whichever is greater. Δh_{FE1} = 20 percent change from initial reading.	Subgroup 2 of table I herein; ΔI_{CEO1} = 100 percent of initial value or 2 μ A dc, whichever is greater. Δh_{FE1} = 20 percent change from initial reading.

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

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: V_{CB} = 10 - 30 V dc; T_A = room ambient as defined in the general requirements of 4.5 of MIL-STD-750. Power shall be applied to the device to achieve a junction temperature, T_J = +135°C minimum and a minimum P_D = 75 percent of P_T maximum rated as defined in 1.3 herein. 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 JAN, JANTX, and JANTXV. 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.

* 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 , t_{SW} , (and V_H where appropriate). Measurement delay time (t_{MD}) = 70 μ s max. See table III, group E, subgroup 4 herein.

4.3.3 Screening (JANHNC 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.

4.4 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 E.5.3.1d of 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).

MIL-PRF-19500/453F

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-VIa (JANS) and 4.4.2.1 herein. See 4.4.2.2 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B4	1037	$V_{CB} = 10 - 30$ V dc, adjust power or current to achieve a $\Delta T_J = +100^\circ\text{C}$.
B5	1027	$V_{CB} = 10$ V dc; $T_A = +125^\circ\text{C} \pm 25^\circ\text{C}$ for 96 hours with P_T adjusted according to the chosen T_A to give $T_J = +275^\circ\text{C}$ minimum. Optionally, the test may be performed for a minimum of 216 hours with P_T adjusted to achieve a $T_J = +225^\circ\text{C}$; sample size = 45, $c = 0$. In this case, the ambient temperature shall be adjusted such that a minimum 75 percent of maximum rated P_T (see 1.3) is applied to the device under test. (NOTE: If a failure occurs, resubmission shall be at the test conditions of the original sample.)

4.4.2.2 Group B inspection, table E-VIb (JAN, 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.

<u>Step</u>	<u>Method</u>	<u>Conditions</u>
1	1026	Steady-state life: 340 hours, $V_{CB} = 10 - 30$ V dc; power shall be applied to achieve $T_J = +150^\circ\text{C}$ minimum and a power dissipation of $P_D \geq 75$ percent of max rated P_T as defined in 1.3 herein shall be used. $n = 45$ devices, $c = 0$. For small lots, $n = 12$ devices, $c = 0$. The sample size may be increased and the test time decreased so long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.
2	1048	Blocking life, $T_A = +150^\circ\text{C}$, $V_{CB} = 80$ percent of rated voltage, 48 hours minimum. $n = 45$ devices, $c = 0$.
3	1032	High-temperature life (non-operating), $t = 340$ hours, $T_A = +200^\circ\text{C}$. $n = 22$, $c = 0$.

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

- a. For JAN, 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. Shall 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, JANTX and JANTXV) may be pulled prior to the application of final lead finish.

MIL-PRF-19500/453F

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 in 4.4.3.1 (JANS) and 4.4.3.2 (JAN, JANTX and JANTXV) herein for group C testing. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E, (not applicable to 2N5109UB).
C5	3131	See 4.3.2, $R_{\theta JC} = 60^{\circ}\text{C/W}$.
C6	1026	1,000 hours at $V_{CB} = 10\text{ V dc}$; power shall be applied to achieve $T_J = +150^{\circ}\text{C}$ minimum and a power dissipation of $P_D \geq 75$ percent of max rated P_T as defined in 1.3 herein shall be applied. $n = 45$ devices, $c = 0$. For small lots, $n = 12$ devices, $c = 0$. The sample size may be increased and the test time decreased so long as the devices are stressed for a total of 45,000 device hours minimum, and the actual time of test is at least 340 hours.

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

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition E (not applicable to 2N5109UB).
C5	3131	See 4.3.2, $R_{\theta JC} = 60^{\circ}\text{C/W}$.
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 JANKC 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 (see 6.2.e herein), except group D, subgroup 2 may be performed separate from other subgroups. Group D inspection may also be performed ahead of the screening lot using die selected in accordance with MIL-PRF-19500 and related documents. Alternate package options may also be substituted for the testing provided there is no adverse effect to the fluence profile.

* 4.4.5 Group E inspection. Group E inspection shall be performed in accordance with table III herein for qualification or re-qualification only. In case qualification was awarded to a prior revision of the specification that did not request the performance of table III tests, the tests specified in table III herein must be performed to maintain qualification.

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.

MIL-PRF-19500/453F

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u> <u>2/</u>						
Visual and mechanical <u>3/</u> examination	2071	n = 45 devices, c = 0				
Solderability <u>3/ 4/</u>	2026	n = 15 leads, c = 0				
Resistance to <u>3/ 4/ 5/</u> solvent	1022	n = 15 devices, c = 0				
Temp cycling <u>3/ 4/</u>	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Hermetic seal <u>4/</u> Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements <u>4/</u>		Table I, subgroup 2				
Bond strength <u>3/ 4/</u>	2037	Precondition $T_A = +250^\circ\text{C}$ at t = 24 hrs or $T_A = +300^\circ\text{C}$ at t = 2 hrs, n = 11 wires, c = 0				
<u>Subgroup 2</u>						
Thermal impedance <u>6/</u>	3131	See 4.3.2	$Z_{\theta JX}$			$^\circ\text{C/W}$
Breakdown voltage, collector to base	3001	Bias condition D; $I_C = 100 \mu\text{A}$ dc	$V_{(BR)CBO}$	40		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 5 \text{ mA}$ dc	$V_{(BR)CEO}$	20		V dc
Breakdown voltage, emitter to base	3026	Bias condition D; $I_C = 100 \mu\text{A}$ dc	$V_{(BR)EBO}$	3.0		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 5 \text{ mA}$ dc; $R_2 = 10 \Omega$	$V_{(BR)CER}$	40		V dc
Collector to emitter cutoff current	3041	Bias condition D; $V_{CE} = 15 \text{ V}$ dc	I_{CE01}		20	μA dc
Forward-current transfer ratio	3076	$V_{CE} = 15 \text{ V}$ dc; $I_C = 50 \text{ mA}$ dc; pulsed (see 4.5.1)	h_{FE1}	40	150	
Collector to emitter saturated voltage	3071	$I_C = 100 \text{ mA}$ dc; $I_B = 10 \text{ mA}$ dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.5	V dc
<u>Subgroup 3</u>						
High temperature operation:		$T_C = +175^\circ\text{C}$				
Collector to emitter cutoff current	3041	Bias condition D; $V_{CE} = 15 \text{ V}$ dc	I_{CE02}		5.0	mA dc

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/ 	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 3</u> - Continued						
Low temperature operation		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 5\text{ V dc}; I_C = 50\text{ mA dc};$ pulsed (see 4.5.1)	h_{FE2}	15		
<u>Subgroup 4</u>						
Open circuit output capacitance	3236	$V_{CB} = 28\text{ V dc}; I_E = 0; 100\text{ kHz} \leq f \leq 1\text{ MHz}$	C_{obo}		3.5	pF
Magnitude of common-emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 15\text{ V dc}; f = 200\text{ MHz}$	$ h_{fe} $			
		$I_C = 25\text{ mA dc};$ $I_C = 50\text{ mA dc};$ $I_C = 100\text{ mA dc}$		5.0 6.0 5.0	10 11.0 10.5	
Power gain (narrow band) current		$V_{CC} = 15\text{ V dc}; I_C = 50\text{ mA dc};$ $f = 200\text{ MHz}; \text{pin} = -10\text{ dB};$ (see figure 4)	G_{PE}	11		dB
Cross modulation		$V_{CC} = 15\text{ V dc}; I_C = 50\text{ mA dc};$ 54 dB output; (see figure 4)	cm		-57	dB
Noise figure		$V_{CC} = 15\text{ V dc}; I_C = 10\text{ mA dc};$ $f = 200\text{ MHz}; \text{pin} = -10\text{ dB};$ (see figure 4)	NF		3.5	dB
Voltage gain (wideband)		$V_{CC} = 15\text{ V dc}; I_C = 50\text{ mA dc};$ $f = 50\text{ to }216\text{ MHz}; \text{pin} = -10\text{ dB}$ (see figure 5)	G	11		dB
<u>Subgroups 5, 6, and 7</u>						
Not applicable						

1/ For sampling plan, unless otherwise specified 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 table I, 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.

6/ This test required for the following end-point measurements only:

Group B, step 1 of 4.4.2.2 herein (JAN, JANTX, and JANTXV).

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

Group C, subgroup 2 and 6.

Group E, subgroup 1 and 2.

MIL-PRF-19500/453F

* TABLE II. Group D inspection and end-point limits.

Inspection <u>1/</u> <u>2/</u> <u>3/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u> <u>4/</u>						
Neutron irradiation	1017	Neutron exposure $V_{CES} = 0$ V				
Breakdown voltage, collector to base	3001	Bias condition D; $I_C = 100$ μ A dc	$V_{(BR)CBO}$	40		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 5$ mA dc	$V_{(BR)CEO}$	20		V dc
Breakdown voltage, emitter to base	3026	Bias condition D; $I_C = 100$ μ A dc	$V_{(BR)EBO}$	3.0		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 5$ mA dc; $R_2 = 10$ Ω	$V_{(BR)CER}$	40		V dc
Collector to emitter cutoff current	3041	Bias condition D; $V_{CE} = 15$ V dc	I_{CEO1}		40	μ A dc
Forward-current transfer ratio	3076	$V_{CE} = 15$ V dc, $I_C = 50$ mA dc; pulsed (see 4.5.1)	$[h_{FE1}]$	<u>5/</u> [20]	150	
Collector to emitter saturated voltage	3071	$I_C = 100$ mA dc; $I_B = 10$ mA dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.58	V dc
<u>Subgroup 2</u>						
Steady-state total dose irradiation	1019	Gamma exposure $V_{CES} = 16$ V				
Breakdown voltage, collector to base	3001	Bias condition D; $I_C = 100$ μ A dc	$V_{(BR)CBO}$	40		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 5$ mA dc	$V_{(BR)CEO}$	20		V dc
Breakdown voltage, emitter to base	3026	Bias condition D; $I_C = 100$ μ A dc	$V_{(BR)EBO}$	3.0		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 5$ mA dc; $R_2 = 10$ Ω	$V_{(BR)CER}$	40		V dc
Collector to emitter cutoff current	3041	Bias condition D; $V_{CE} = 15$ V dc	I_{CEO1}		40	μ A dc
Forward-current transfer ratio	3076	$V_{CE} = 15$ V dc, $I_C = 50$ mA dc; pulsed (see 4.5.1)	$[h_{FE1}]$	<u>5/</u> [20]	150	
Collector to emitter saturated voltage	3071	$I_C = 100$ mA dc; $I_B = 10$ mA dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		0.58	V dc

1/ Tests to be performed on all devices receiving radiation exposure.

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

3/ Electrical characteristics apply to all device types unless otherwise noted.

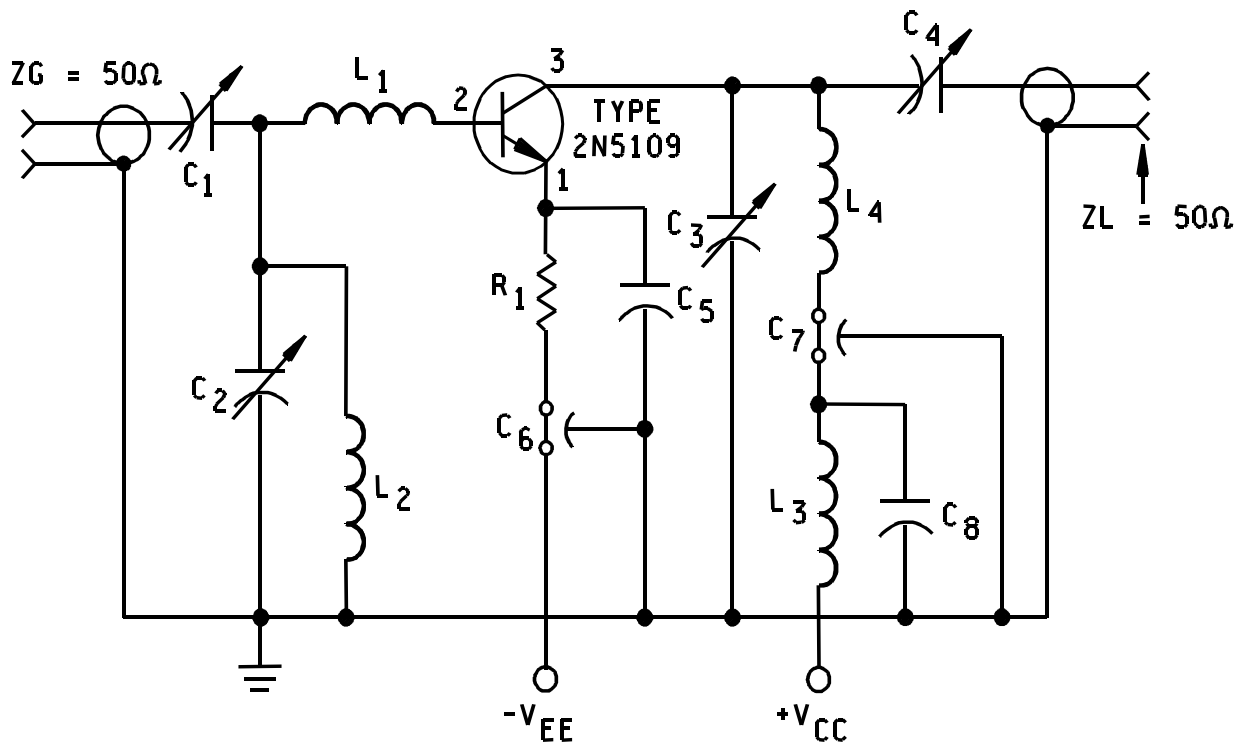
4/ See 6.2.e herein.

5/ See method 1019 of MIL-STD-750, for how to determine $[h_{FE}]$ by first calculating the delta ($1/h_{FE}$) from the pre and post-radiation h_{FE} . Notice that $[h_{FE}]$ is not the same as h_{FE} and cannot be measured directly. The $[h_{FE}]$ value can never exceed the pre-radiation minimum h_{FE} that it is based upon.

MIL-PRF-19500/453F

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

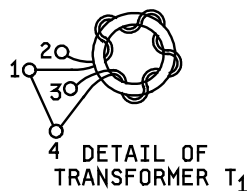
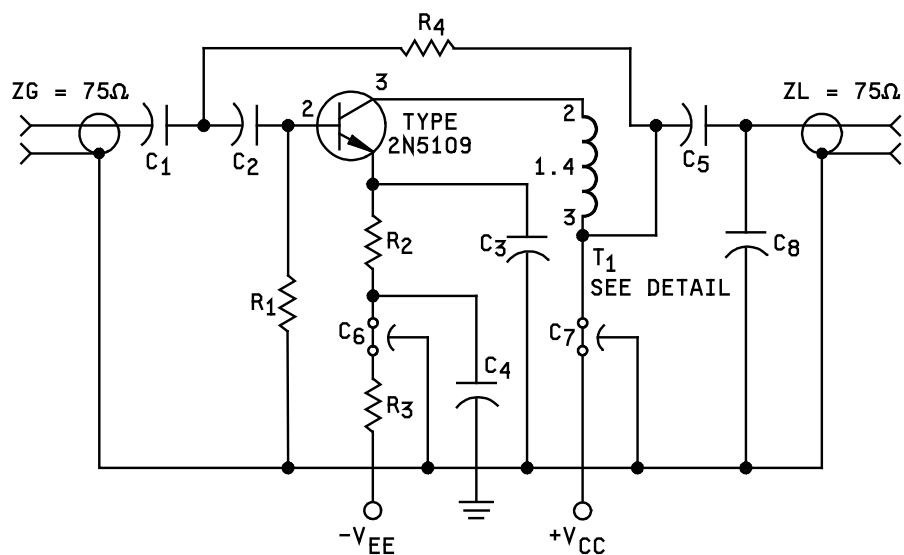
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
<u>Subgroup 1</u>			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles.	
Hermetic seal Fine leak Gross leak	1071		
Electrical measurements		See table I, subgroup 2.	
<u>Subgroup 2</u>			45 devices c = 0
Intermittent life	1037	V _{CB} = 10 V dc, 6000 cycles, adjust power or current to achieve a ΔTJ = +100°C.	
Electrical measurements		See table I, subgroup 2.	
<u>Subgroup 4</u>			Sample size N/A
Thermal impedance curves		See Mil-PRF-19500.	
<u>Subgroup 5</u>			
Not applicable			
<u>Subgroup 6</u>			3 devices
ESD	1020	Testing not required for class 3 listing. Testing is required for nonsensitive listing to prove capability.	
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition B.	



C₁, C₂, C₃: 1.0 to 30 pF.
 C₄: 1.0 to 20 pF.
 C₅: 10,000 pF.
 C₆, C₇: 1,000 pF.
 C₈: .01 μF.

L₁: 4.5 turns, number 22 wire, .187 inch I. D.
 L₄: 3.5 turns, number 22 wire, .187 inch I. D.
 L₂, L₃: 0.82 μH RFC.
 R₁: 240 Ω, 2 watts.

FIGURE 4. RF amplifier for power gain and noise figure tests.



C₁, C₂, C₃, C₅: 0.002 μF.
 C₄: 0.03 μF.
 C₆, C₇: 1500 pF
 C₈: 18 pF.
 R₁: 4.7 kΩ, 0.25 W.
 R₂: 6.8 Ω, 0.5 W.

R₃ : 330 Ω, 1W.
 R₄ : 200 Ω, 0.25 W.
 T₁ : 4 turns number 30 wire.

Bifilar wound on "Indiana General".
 Core number CF-102-Q1, or equivalent.

FIGURE 5. RF amplifier for voltage gain test.

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.

* e. For acquisition of RHA designed devices, table II, subgroup 1 testing of group D is optional. If subgroup 1 testing is desired, it should be specified in the contract.

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML 19500) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DLA Land and Maritime, ATTN: VQE, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqe.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.daps.dla.mil>.

6.4 Suppliers of JANHC and JANKC die. The qualified JANHC and JANKC suppliers with the applicable letter version (example JANHCA2N5109) will be identified on the QML.

Die ordering information	
PIN	Manufacturer
	34156
2N5109	JANHCA2N5109 JANKCA2N5109

6.5 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
Air Force - 85
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-2010-085)

Review activity:
Army - MI
Air Force - 19, 71, 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>.