

The documentation and process conversion measures necessary to comply with this document shall be completed by 28 February 2017.

INCH-POUND

MIL-PRF-19500/453H
30 November 2016
SUPERSEDING
MIL-PRF-19500/453G
5 September 2015

PERFORMANCE SPECIFICATION SHEET

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TRANSISTOR, NPN, SILICON, HIGH-FREQUENCY, AMPLIFIER
TYPE 2N5109 QUALITY LEVELS JAN, JANTX, JANTXV, JANS, JANHC, JANKC

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 (JAN, JANTX, JANTXV and JANS) are provided for each encapsulated device type as specified in [MIL-PRF-19500](#) and two levels of product assurance (JANHC and JANKC) are provided for each unencapsulated device type. Provisions for radiation hardness assurance (RHA) to two radiation levels ("R" and "F") are provided for JANTXV product assurance level. Provisions for (RHA) to eight radiation levels is provided for JANS, JANHC 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 Package outlines. The device packages for the encapsulated device types are as follows: (2N5109) (TO-39) in accordance with [figure 1](#) (2N5109UB) (UB) in accordance with [figure 2](#). The dimensions and topography for JANHC and JANKC unencapsulated die is as follows: The A version die in accordance with and [figure 3](#).

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 $T_C > +25^\circ\text{C}$.

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1.4 Primary electrical characteristics (common to all types).

Limits	hFE	V _{CE(SAT)}	C _{obo}	hFE	Power gain
		V _{CE} = 15 V dc I _C = 50 mA dc	I _C = 100mA dc I _B = 10 mA dc	I _E = 0 100 kHz ≤ f ≤ 1 MHz V _{CB} = 28 V dc	V _{CE} = 15 V dc I _C = 50 mA dc f = 200 MHz
Min	40	V dc	pF	6.0	dB
Max	150	0.5	3.5	11.0	11.0

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 designators.

1.5.1.1 Quality level designators 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".

1.5.1.2 Quality level designators for unencapsulated devices (die). The quality level designators for unencapsulated devices (die) that are applicable for this specification sheet from the lowest to the highest level are as follows: "JANHC" and "JANKC".

1.5.2 Radiation hardness assurance (RHA) designator. The RHA levels that are applicable for this specification sheet from lowest to highest for JANS quality levels are as follows: "M", "D", "P", "L", "R", "F", "G", and "H". For the RHA levels for TXV quality levels are as follows: "R" and "F".

1.5.3 Device type. The designation system for the device types covered by this specification sheet are as follows.

1.5.3.1 First number and first letter symbols. The semiconductors of this specification sheet use the first number and letter symbols "2N".

1.5.3.2 Second number symbols. The second number symbols for the semiconductors covered by this specification sheet are as follows: "5109".

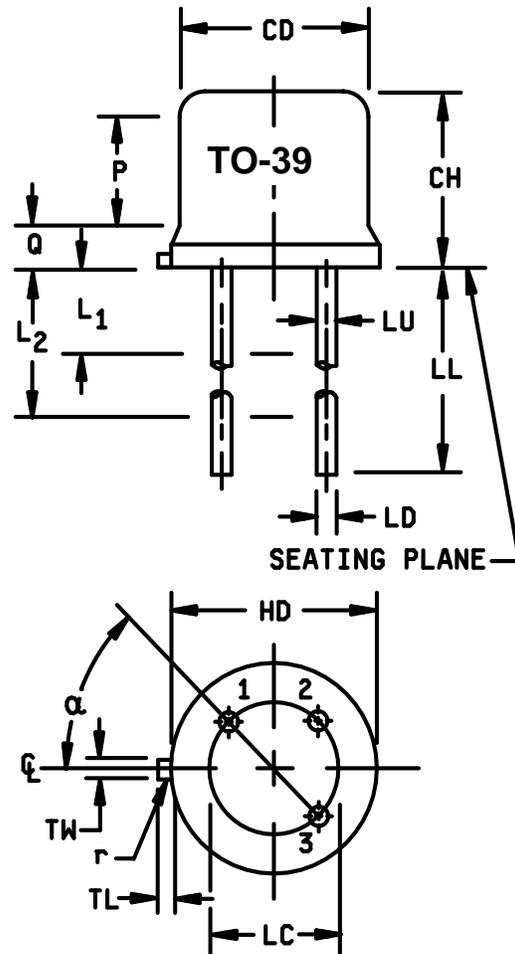
1.5.4 Suffix symbols. The following suffix letters are incorporated in the PIN for this specification sheet.

	A blank first suffix symbol indicates encapsulated devices. Applicable for the 2N5109 (see figure 1 , TO-39).
UB	Indicates a surface mount 2N5109UB, (see figure 2)

1.5.5 Lead finish. The lead finishes applicable to this specification sheet are listed on [QML-19500](#).

1.5.6 Die identifiers for unencapsulated devices (manufacturers and critical interface identifiers). The manufacturer die identifiers that are applicable for this specification sheet is "A".

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

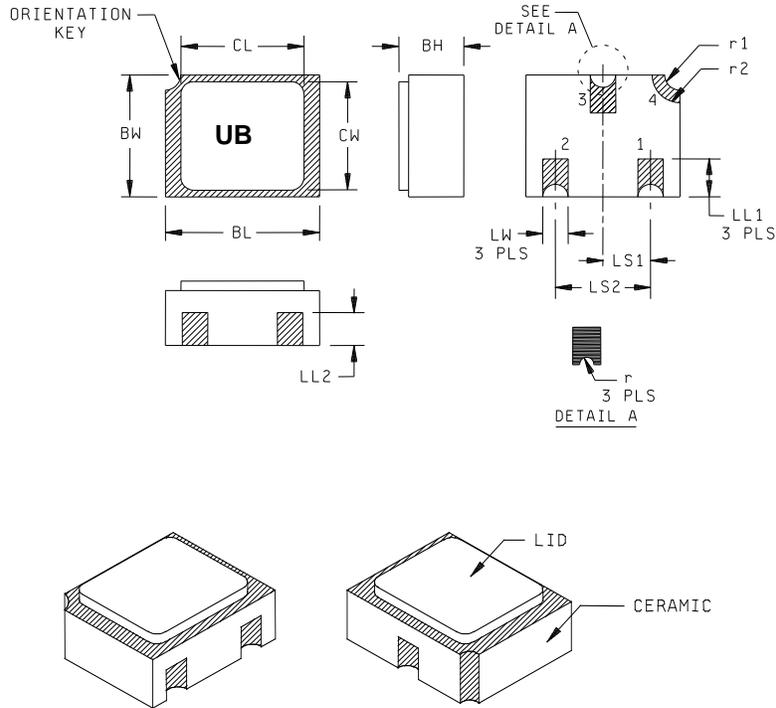


NOTES:

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).

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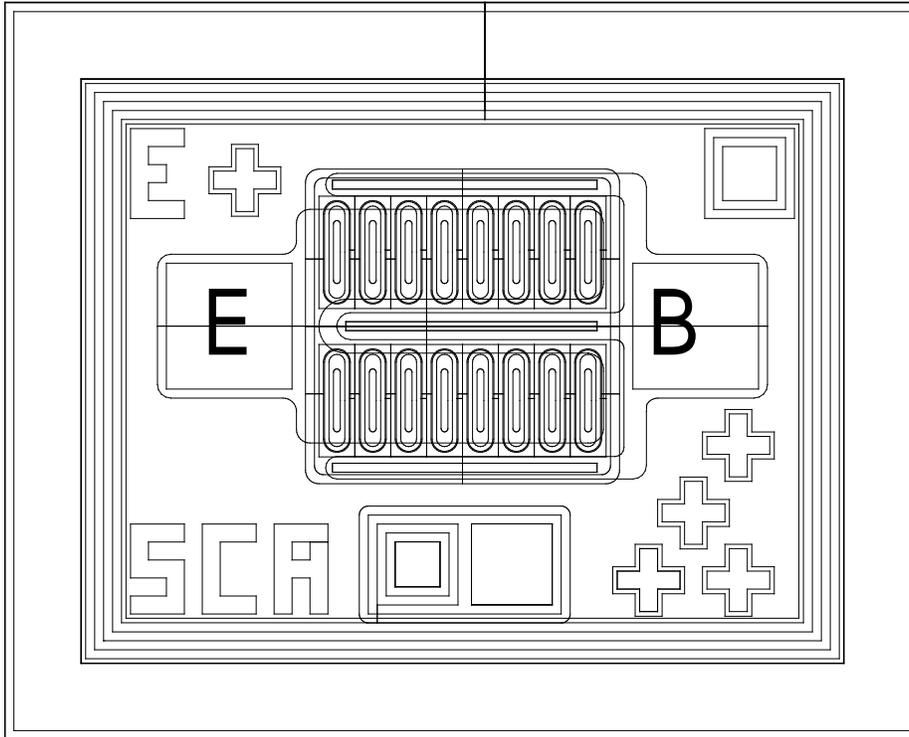
Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
BH	.046	.056	1.17	1.42	
BL	.115	.128	2.92	3.25	
BW	.085	.108	2.16	2.74	
CL		.128		3.25	
CW		.108		2.74	
LL1	.022	.038	0.56	0.96	
LL2	.017	.035	0.43	0.89	

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:	SiO ₂ , 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.

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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

[MIL-PRF-19500](#) - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

[MIL-STD-750](#) - Test Methods for Semiconductor Devices.

(Copies of these documents are available online at <http://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) 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](#), [table II](#), and [table III](#)).

4.2 Qualification inspection. Qualification inspection shall be in accordance with [MIL-PRF-19500](#) and as specified herein.

4.2.1 JANHC 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.

* 4.2.2.1 Group E thermal response. With extremely small junction devices such as this one, a true thermal impedance cannot be measured, only calculated. While "thermal response" has been substituted for "thermal impedance" herein, the terms, units and procedure as essentially unchanged. Each supplier shall submit a thermal response ($Z_{\theta JX}$) histogram of the entire qualification lot. The histogram data shall be taken prior to the removal of devices that are atypical for thermal response. Thermal response curves (from $Z_{\theta JX}$ test pulse time to $R_{\theta JX}$ minimum steady-state time) of the best device in the qual lot and the worst device in the qual lot (that meets the supplier proposed screening limit), or from the thermal grouping, shall be submitted. The optimal test conditions and proposed initial thermal response screening limit shall be provided in the qualification report. Data indicating how the optimal test conditions were derived for $Z_{\theta JX}$ shall also be submitted. The proposed maximum thermal response $Z_{\theta JX}$ screening limit shall be submitted. The qualifying activity may approve a different $Z_{\theta JX}$ limit not to exceed the specification's thermal curve for conformance inspection end-point measurements as applicable. Equivalent data, procedures, or statistical process control plans may be used for part, or all, of the above requirements. The approved thermal response conditions and limit for $Z_{\theta JX}$ shall be used by the supplier in screening and [table I](#), subgroup 2. The approved thermal resistance conditions for $R_{\theta JX}$ shall be used by the supplier for conformance inspection. For product families with similar thermal characteristics based on the same physical and thermal die, package, and construction combination (thermal grouping), the supplier may use the same thermal response curves.

* 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	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; JANTX and JANTXV levels do 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 minimum P_D = 100 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 JANHNC 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 JANHNC 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).

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.

* 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	$V_{CB} = 10 - 30 \text{ V dc}$, adjust power or current to achieve a $\Delta T_J = +100^\circ\text{C}$.
* B5	1027	$V_{CB} = 10 - 30 \text{ V dc}$; $P_D = 100$ 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 table E-VIa of MIL-PRF-19500, adjust T_A to achieve $T_J = +275^\circ\text{C}$ minimum. Option 2: 216 hours minimum, sample size = 45, $c = 0$, adjusted T_A to achieve a $T_J = +225^\circ\text{C}$ minimum.

* 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: 1,000 hours, $V_{CB} = 10 - 30 \text{ V dc}$; power shall be applied and ambient adjusted to achieve $T_J = +150^\circ\text{C}$ using a minimum power dissipation of $P_D \geq 100$ percent of max rated P_T as defined in 1.3 herein. $n = 45$ 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.

* 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.

* 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	$R_{\theta JC} = 60^{\circ}\text{C/W}$.
* C6	1026	1,000 hours at $V_{CB} = 10 - 30 \text{ V dc}$; power shall be applied and ambient temperature shall be adjusted to achieve $T_J = +150^{\circ}\text{C}$ minimum and a power dissipation of $P_D \geq 100$ percent of max rated P_T as defined in 1.3 herein shall be applied. $n = 45$ 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	$R_{\theta JC} = 60^{\circ}\text{C/W}$.
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. 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](#).

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TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1 2/</u>						
Visual and mechanical 3/ examination	2071	n = 45 devices, c = 0				
Solderability 3/ 4/	2026	n = 15 leads, c = 0				
Resistance to 3/ 4/ 5/ solvent	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/		Table I, 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				
<u>Subgroup 2</u>						
Thermal impedance 6/	3131	See 4.3.2	Z _{θJX}			°C/W
Breakdown voltage, collector to base	3001	Bias condition D; I _C = 100 μA 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 μA 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 _{CE01}		20	μA dc
Forward-current transfer ratio	3076	V _{CE} = 15 V dc; I _C = 50 mA dc; pulsed (see 4.5.1)	h _{FE1}	40	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}		0.5	V dc
<u>Subgroup 3</u>						
High temperature operation:		T _C = +175°C				
Collector to emitter cutoff current	3041	Bias condition D; V _{CE} = 15 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.

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.

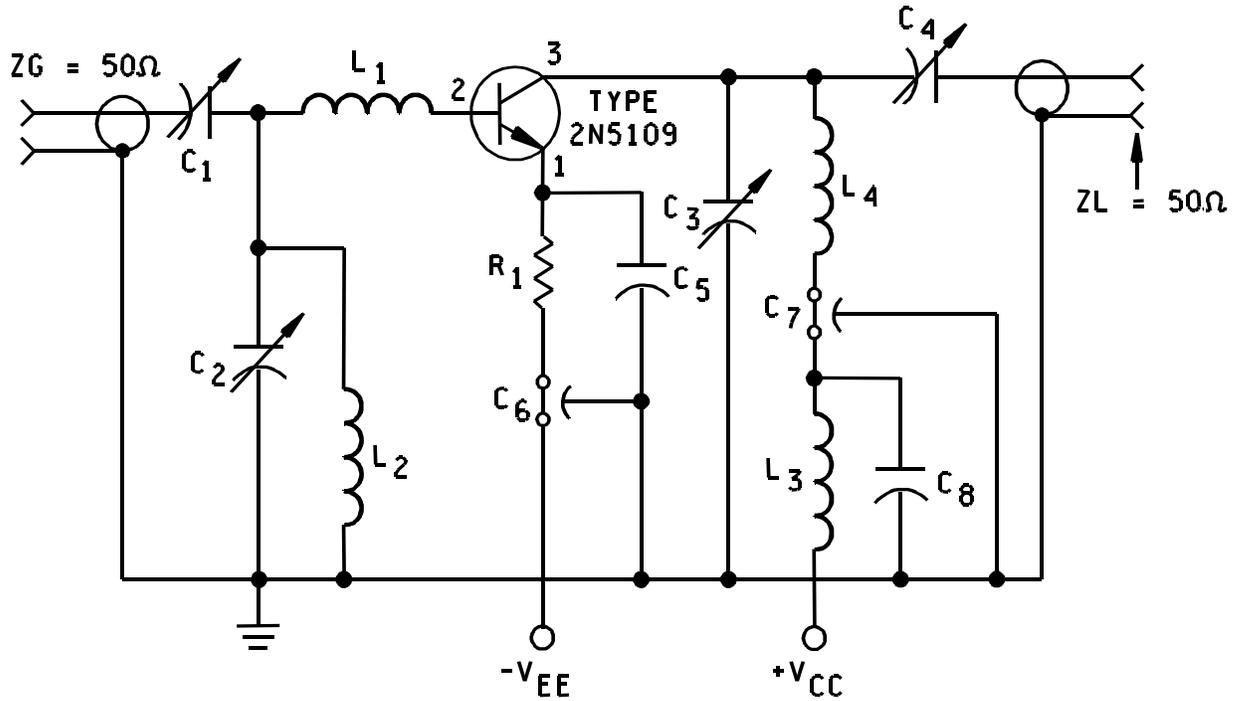
4/ See 6.2.e herein.

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.

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 $\Delta T_J = +100^\circ\text{C}$.	
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>			11 devices
ESD	1020	Testing is required for nonsensitive listing to prove capability.	
<u>Subgroup 8</u>			45 devices c = 0
Reverse stability	1033	Condition B.	

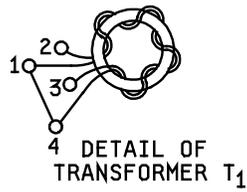
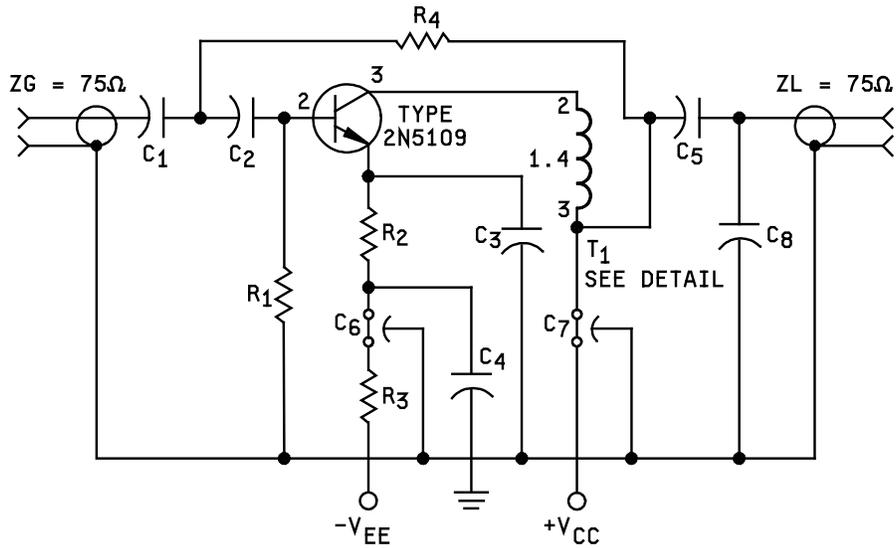
*



C_1, C_2, C_3 : 1.0 to 30 pF.
 C_4 : 1.0 to 20 pF.
 C_5 : 10,000 pF.
 C_6, C_7 : 1,000 pF.
 C_8 : .01 μ F.

L_1 : 4.5 turns, number 22 wire, .187 inch I. D.
 L_4 : 3.5 turns, number 22 wire, .187 inch I. D.
 L_2, L_3 : 0.82 μ H RFC.
 R_1 : 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. The complete Part or Identifying Number (PIN), see 1.5 and 6.5.
- 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.

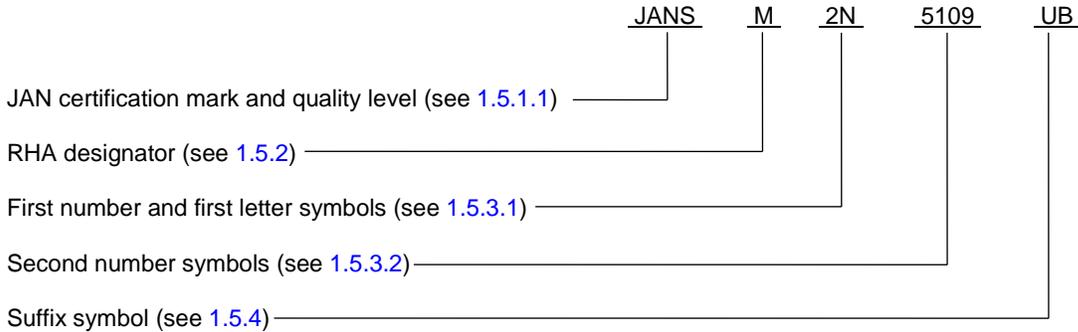
6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List (QML 19500) whether or not such products have actually been so listed by that date. The attention 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.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.

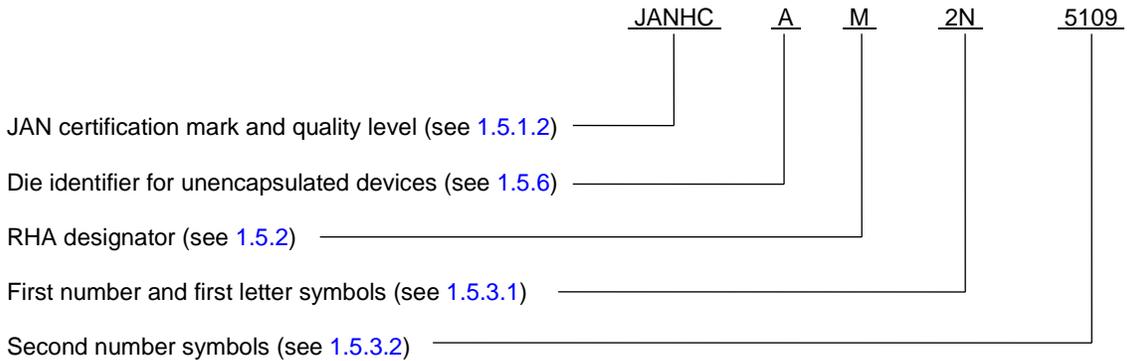
Die ordering information	
PIN	Manufacturer
	34156
2N5109	JANHCA2N5109 JANKCA2N5109

6.5 PIN construction example.

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



6.5.2 Unencapsulated devices. The PINs for un-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 type 2N5109. 1/	
JAN2N5109	JAN2N5109UB
JANTX2N5109	JANTX2N5109UB
JANTXV2N5109	JANTXV2N5109UB
JANTXVR2N5109	JANTXVR2N5109UB
JANTXVF2N5109	JANTXVF2N5109UB
JANS#2N5109	JANS#2N5109UB
JANHCA#2N5109	JANKCA#2N5109

(1) The number sign (#) represent one of eight RHA designators available (M, D, P, L, R, F, G, or H). The PIN is also available without a RHA designator.

6.7 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 previous issue.

Custodians:

Army - CR
Air Force - 85
DLA - CC

Preparing activity:

DLA - CC

(Project 5961-2016-102)

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.dla.mil>.