The documentation and process conversion measures necessary to comply with this document shall be completed by 18 September 2011.

INCH-POUND

MIL-PRF-19500/398K
18 June 2011
SUPERSEDING
MIL-PRF-19500/398J
26 January 2010

PERFORMANCE SPECIFICATION SHEET

* SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-FREQUENCY, TYPES 2N3866, 2N3866A, 2N3866UB, 2N3866AUB, JAN, JANTX, JANTXV, JANS, JANHC, JANKC, JANSM, JANSD, JANSP, JANSL, JANSR, JANSF, JANSG, JANSH, JANHCM, JANHCD, JANHCP, JANHCL, JANHCR, JANHCF, JANHCG, JANHCH, JANKCM, JANKCD, JANKCP, JANKCL, JANKCR, JANKCF, JANKCG, AND JANKCH

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 transistor. 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. Radiation hardness assurance (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 (TO-39), figure 2 (surface mount, UB), and figure 3 (die).

1.3 Maximum ratings. Unless otherwise specified, T_A = +25°C.

Types	P_T (1) T_A = (2)	P_T T_C = (3)	V_{CBO}	V_{CEO}	V_{EBO}	I_C	T_J and T_{STG}	$R_{\theta JC}$	$R_{\theta JA}$
	W	W	V dc	V dc	V dc	A dc	°C	°C/W	°C/W
2N3866, 2N3866A	1.0	2.9	60	30	3.5	0.4	-65 to +200	60	175
2N3866UB, 2N3866AUB	0.5		60	30	3.5	0.4	-65 to +200		325

(1) Derate linearly 5.71 mW/°C (2N3866, 2N3866A) and 3.08 mW/°C (2N3866UB, 2N3866AUB) above $T_A \geq$ +25°C.
(2) T_A = room ambient as defined in the general requirements of MIL-PRF-19500.
(3) P_T = 2.9 W at T_C = +25°C, derate at 16.6 mW/°C above T_C > +25°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 or emailed to Semiconductor@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil .

1.4 Primary electrical characteristics.

	h_{FE} (1) V_{CE} = 5.0 V dc I_C = 50 mA dc		$\lvert h_{fe} \rvert$ V_{CE} = 15 V dc I_C = 50 mA dc f = 200 MHz		$V_{CE(SAT)}$ I_C = 100 mA dc I_B = 10 mA dc	C_{obo} V_{CB} = 28 V dc I_E = 0 100 kHz ≤ f ≤ 1 MHz	P_{out1} V_{CC} = 28 V dc P_{in} = 0.15 W f = 400 MHz	P_{out2} V_{CC} = 28 V dc Pin = 0.075 W f = 400 MHz
	2N3866 2N3866UB	2N3866A 2N3866AUB	2N3866 2N3866UB	2N3866A 2N3866AUB	V dc	pF	W	W
Min	15	25	2.5	4.0			1.0	0.5
Max	200	200	8.0	7.5	1.0	3.5	2.0	

(1) Pulsed (see 4.5.1).

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.

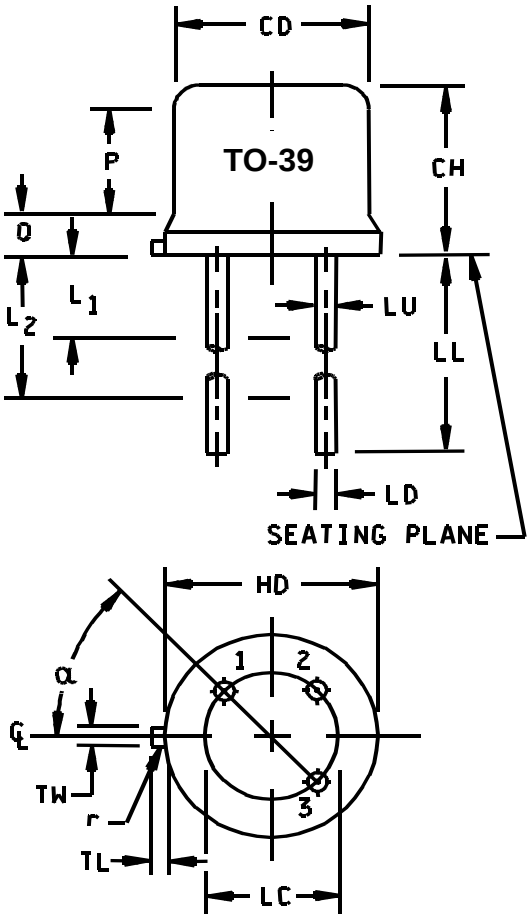
DEPARTMENT OF DEFENSE STANDARDS

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.

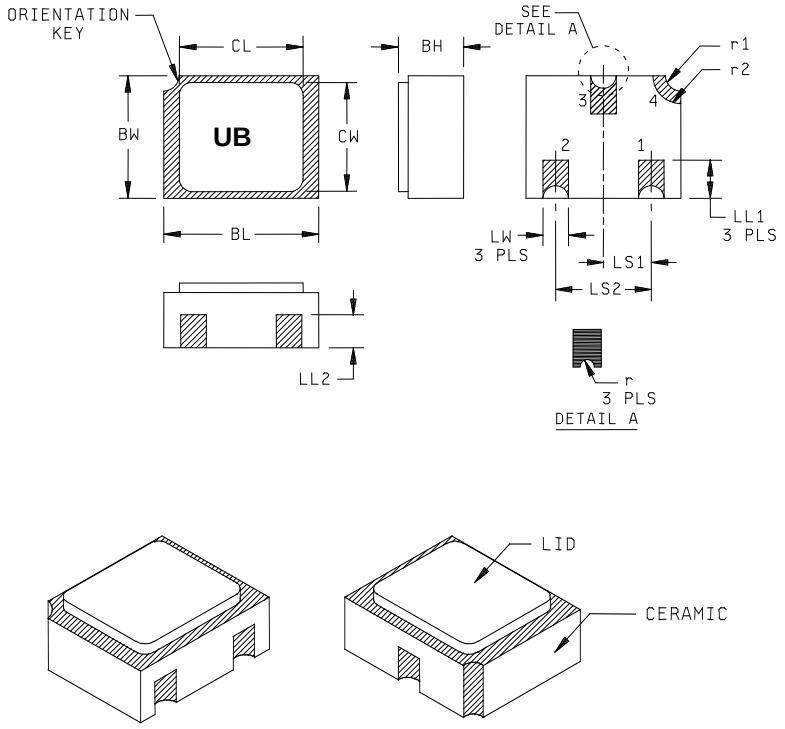
Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	6
CH	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		7
LD	.016	.021	0.41	0.53	8,9
LL	.500	.750	12.70	19.05	8, 9
LU	.016	.019	0.41	0.48	8,9
L_1		.050		1.27	8,9
L_2	.250		6.35		8,9
P	.100		2.54		7
Q		.030		0.76	5
TL	.029	.045	0.74	1.14	3,4
TW	.028	.034	0.71	0.86	3
r		.010		0.25	10
α	45° TP		45° TP		7



NOTES:

1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Beyond r (radius) maximum, TW shall be held for a minimum length of .011 (0.28 mm).
4. Dimension TL measured from maximum HD.
5. Body contour optional within zone defined by HD, CD, and Q.
6. CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
7. Leads at gauge plane .054 +.001 -.000 inch (1.37 +0.03 -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by gauging procedure.
8. Dimension LU applies between L_1 and L_2. Dimension LD applies between L_2 and LL minimum. Diameter is uncontrolled in and beyond LL minimum.
9. All three leads.
10. The collector shall be internally connected to the case.
11. Dimension r (radius) applies to both inside corners of tab.
12. In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.
13. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

FIGURE 1. Physical dimensions (TO-5, TO-39).

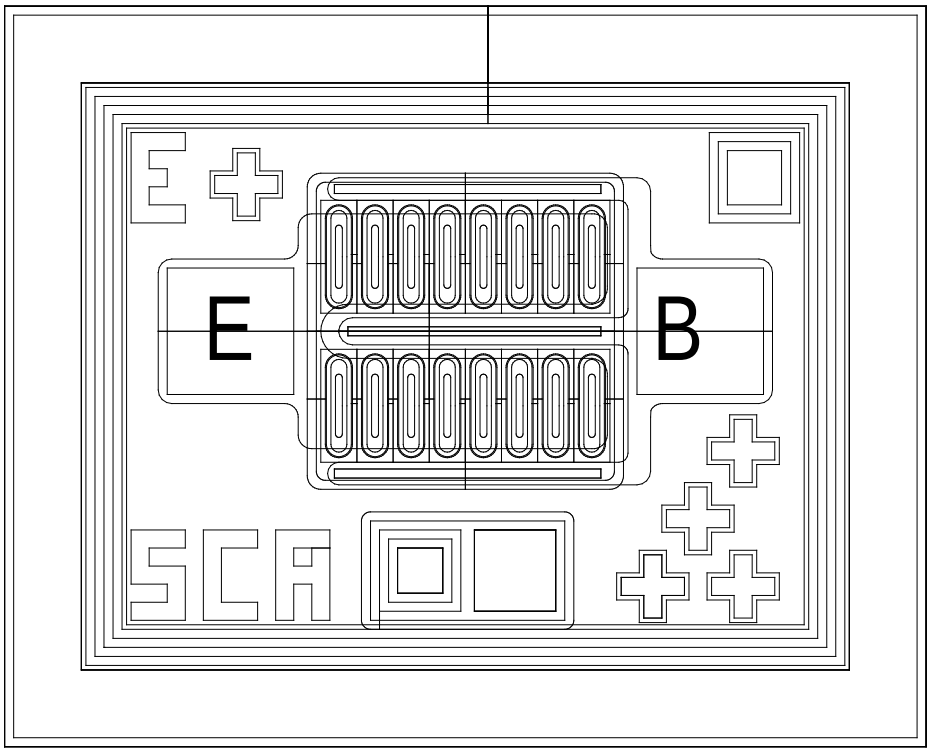


Ltr.	Dimensions				Note	Ltr.	Dimensions				Note
	Inches		Millimeters				Inches		Millimeters		
	Min	Max	Min	Max			Min	Max	Min	Max	
BH	.046	.056	1.17	1.42		LS1	.035	.040	0.89	1.02	
BL	.115	.128	2.92	3.25		LS2	.071	.079	1.80	2.01	
BW	.085	.108	2.16	2.74		LW	.016	.024	0.41	0.61	
CL		.128		3.25		r		.008		0.20	
CW		.108		2.74		r1		.012		0.31	
LL1	.022	.038	0.56	0.97		r2		.022		0.56	
LL2	.017	.035	0.43	0.89							

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 Φx symbology.

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



Die size:	.016 x .020 inch (0.41 x 0.51 mm).
Die thickness:	.008 ±.0016 inch (0.20 ±0.041 mm).
Base pad:	.0028 x .0028 inch (0.07 x 0.07 mm).
Emitter pad:	.0028 x .0028 inch (0.07 x 0.07 mm).
Back metal:	Gold, 6,500 ±1,950 Å.
Top metal:	Aluminum, 17,500 ±2,500 Å.
Back side:	Collector.
Glassivation:	SiO_2, 7,500 ±1,500 Å.

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

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:

η: ..... (eta) Collector efficiency = $\frac{\text{rf power out}}{\text{dc power in}} \times 100$

Pin: Input power
Pout: Output power

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and figures 1 (TO-39), figure 2 (UB), and figure 3 (JANHC, JANKC).

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).

* 3.4.2 Marking. Devices shall be marked 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 manufacturer's symbol or logo. The prefixes JAN, JANTX, JANTXV, and JANS can be abbreviated as J, JX, JV, and JS respectively. The "2N" prefix and the "AUB" suffix can also be omitted. 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).

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

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I herein.

3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

* 4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3).

* c. Conformance inspection (see 4.4 and tables I and II).

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

4.2.1 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 procedures are 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 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, JANTXV, and JANTX 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 level	JANTX and JANTXV levels
* (1) 3c	Thermal response, method 3131 of MIL-STD-750 (see 4.3.3).	Thermal response, method 3131 of MIL-STD-750 (see 4.3.3).
9	I_{CEO} and h_{FE1}	Not applicable.
11	I_{CEO} and h_{FE1}; ΔI_{CEO} = 100 percent of initial value or 2 μA dc, whichever is greater; Δh_{FE1} = ±20 percent of initial value.	I_{CEO} and h_{FE1}
12	See 4.3.1.	See 4.3.1.
13	Subgroups 2 and 3 of table I herein. ΔI_{CEO} = 100 percent of initial value or 2 μA dc, whichever is greater; Δh_{FE1} = ±20 percent of initial value.	Subgroup 2 of table I herein. ΔI_{CEO} = 100 percent of initial value or 2 μA dc, whichever is greater; Δh_{FE1} = ±20 percent of initial value.

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

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows: T_A = room ambient as defined in the general requirements of MIL-STD-750; V_{CB} = 10 to 30 V dc. Power shall be applied to achieve a junction temperature T_J = +135°C minimum and power dissipation of $P_T \geq 75$ percent of max rated P_T 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 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 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.

4.3.3 Thermal response, (ΔV_{BE} measurements). The ΔV_{BE} measurements shall be performed in accordance with method 3131 of MIL-STD-750 using the guidelines in that method for determining V_H, V_{CE}, I_M, I_H, t_H, and t_{MD}. The ΔV_{BE} limit used in screen 3c of 4.3 herein and table I, subgroup 2 shall be set statistically by the supplier over several die lots and submitted to the qualifying activity for approval.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-19500 and table I herein.

* 4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the tests and conditions specified for subgroup testing in E-VIa (JANS) of MIL-PRF-19500 and 4.4.2.1. Electrical measurements (end-points) shall be in accordance with table I, subgroups 2 and 3, as applicable. See 4.4.2.2 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) for JAN, JANTX, and JANTXV shall be after each step in 4.4.2.2 and 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.

Subgroup	Method	Conditions
B4	1037	V_{CB} = 10 V dc; 2,000 cycles, adjust power or current to achieve a ΔT_J = +100°C.
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 table E-VIa of MIL-PRF-19500, 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, 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.

Step	Method	Conditions
1	1026	Steady-state life: 1,000 hours, V_{CB} = 10 to 30 V dc; power shall be applied to achieve T_J = +150°C minimum and a power dissipation of $P_D \geq 75$ percent of max rated P_T as defined in 1.3. n = 45 devices, c = 0. The sample size may be increased and the test time decreased as 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°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°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 table I, 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. Electrical measurements (end-points) requirements 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.

Subgroup	Method	Conditions
C2	2036	Test condition E (not applicable to UB suffix devices).
C5	3131	See 4.5.2; n = 22, c =0.
C6	1026	1,000 hours, V_{CB} = 10 V dc; power shall be applied to achieve T_J = +150°C minimum and a power dissipation of $P_D \geq 75$ percent of max rated P_T as defined in 1.3. n = 45 devices, c = 0. The sample size may be increased and the test time decreased as 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.

Subgroup	Method	Conditions
C2	2036	Test condition E (not applicable to UB suffix devices).
C6		Not applicable.
C8	3005	Pre-pulse condition V_{CE} = 0, I_C = 0; pulse condition I_C = 400 mA dc, t_P = 60 s, 1 cycle; $t_r \leq 6s$, $t_f \leq 6s$. Sample size, n = 22, c = 0 (see 4.5.4).

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. 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, JANJ, 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 (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 conducted in accordance with the conditions specified for subgroup testing in table E-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.

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 MIL-STD-750.

4.5.2 Thermal resistance. Thermal resistance measurements shall be conducted in accordance with test method 3131 of MIL-STD-750. The following details shall apply:

a. Collector current magnitude during power application shall be 79 mA dc minimum.

b. Collector to emitter voltage magnitude shall be 20 V dc minimum.

c. Reference temperature measuring point shall be the case.

d. Reference point temperature shall be $+25°C \leq T_R \leq +75°C$ and recorded before the test is started.

e. Mounting arrangement shall be with heat sink to case.

f. Maximum limit of $R_{\theta JC}$ shall be 60°C/W for 2N3866, 2N3866A; $R_{\theta JA}$ shall be 325°C/W for 2N3866UB and 2N3866AUB.

4.5.3 Power output and collector efficiency measurements. The device shall be tested in the circuit of figure 4 using the procedure outlined on figure 5. The specified conditions shall be applied and the variable capacitors adjusted to obtain maximum power output. When the maximum power output is obtained, the collector current shall be measured and recorded. The collector efficiency shall be computed as follows:

$$\eta \text{ in percent} = \frac{P_O \text{ (watts)} \times 100}{28 \times I_C \text{ (amperes)}}$$

4.5.4 Burn-out by pulsing. The devices shall be tested in the circuit of figure 6. The voltage source shall be increased from zero until the specified current is reached. The current shall be maintained for the specified time.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical examination 3/	2071	n = 45 devices, c = 0 (JAN and JANTX) n = 116 devices, c = 0 (JANTXV) n = 15 devices, c = 0 (JANS)				
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/	1071	n = 22 devices, c = 0				
Fine leak Gross leak						
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				
Subgroup 2						
Thermal response 6/	3151	See 4.3.3	ΔV_{BE}			mV
Collector-emitter breakdown voltage	3011	Bias condition D; I_C = 5 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	30		V dc
Collector-base breakdown voltage	3001	Bias condition D; I_C = 100 µA dc; pulsed (see 4.5.1)	$V_{(BR)CBO}$	60		V dc
Emitter-base breakdown voltage	3026	Bias condition D; I_E = 100 µA dc; pulsed (see 4.5.1)	$V_{(BR)EBO}$	3.5		V dc
Collector-emitter cutoff current	3041	Bias condition D; V_{CE} = 28 V dc	I_{CEO}		20	µA dc
Collector-emitter cutoff current	3041	Bias condition C; V_{CE} = 55 V dc	I_{CES1}		100	µA 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	
Subgroup 2 - Continued						
Forward-current transfer ratio 2N3866, 2N3866UB 2N3866A, 2N3866AUB	3076	V_{CE} = 5.0 V dc; I_C = 50 mA dc; pulsed (see 4.5.1)	h_{FE1}	 15 25	 200 200	
Forward-current transfer ratio 2N3866, 2N3866UB 2N3866A, 2N3866AUB	3076	V_{CE} = 5.0 V dc; I_C = 360 mA dc; pulsed (see 4.5.1)	h_{FE2}	 5.0 8.0		
Collector-emitter saturated voltage	3071	I_C = 100 mA dc; I_B = 10 mA dc; pulsed (see 4.5.1)	$V_{CE(sat)}$		1.0	V dc
Subgroup 3						
High temperature operation		T_A = +150°C				
Collector to emitter cutoff current	3041	Bias condition C; V_{CE} = 55 V dc	I_{CES2}		2.0	mA dc
Low temperature operation		T_A = -55°C				
Forward-current transfer ratio 2N3866, 2N3866UB 2N3866A, 2N3866AUB	3076	V_{CE} = 5.0 V dc; I_C = 50 mA dc; pulsed (see 4.5.1)	h_{FE3}	 7 12		
Subgroup 4						
Magnitude of small-signal short-circuit current transfer ratio 2N3866, 2N3866UB 2N3866A, 2N3866AUB	3306	V_{CE} = 15 V dc; I_C = 50 mA dc; f = 200 MHz	$\lvert h_{fe} \rvert$	 2.5 4.0	 8.0 7.5	
Open circuit output capacitance	3236	V_{CB} = 28 V dc; I_E = 0, 100 kHz ≤ f ≤ 1 MHz	C_{obo}		3.5	pF
Power output		V_{CC} = 28 V dc; P_{in} = 0.15 W; f = 400 MHz (see figure 4 and 4.5.3)	P_{1out}	1.0	2.0	W
Power output		V_{CC} = 28 V dc; P_{in} = 0.075 W; f = 400 MHz (see figure 4 and 4.5.3)	P_{2out}	0.5		W

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Collector-efficiency		V_{CC} = 28 V dc; P_{in} = 0.15 W; f = 400 MHz (see 4.5.3)	$\eta 1$	45		%
Collector-efficiency		V_{CC} = 28 V dc; P_{in} = 0.075 W; f = 400 MHz (see 4.5.3)	$\eta 2$	40		%
Subgroups 5 and 6						
Not applicable						
Subgroup 7						
Collector-emitter breakdown voltage (clamped inductive)	3011	V_{BE} = -1.5 V dc; I_C = 40 mA dc (see figure 7)	$V_{(BR)CEX}$	55		V dc

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 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, subgroups 3, 4, and 5 (JANS).
Group B, steps 2 and 3 (JAN, JANTX, and JANTXV).
Group C, subgroups 2 and 6.
Group E, subgroups 1 and 2.

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

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1 4/						
Neutron irradiation	1017	Neutron exposure V_{CES} = 0 V				
Collector-base breakdown voltage	3011	Bias condition D; I_C = 5 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	30		V dc
Collector-emitter breakdown voltage	3001	Bias condition D; I_C = 100 µA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	60		V dc
Emitter-base breakdown voltage	3026	Bias condition D; I_E = 100 µA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	3.5		V dc
Collector-emitter cutoff current	3041	Bias condition D; V_{CB} = 28 V dc	I_{CEO}		40	µA dc
Collector-emitter cutoff current	3041	Bias condition C; V_{CE} = 55 V dc	I_{CES1}		200	µA dc
Forward-current transfer ratio 2N3866, 2N3866UB 2N3866A, 2N3866AUB	3076	V_{CE} = 5 V dc, I_C = 50 mA dc; pulsed (see 4.5.1)	h_{FE1} 5/	 [7.5] [12.5]	 200 200	
Forward-current transfer ratio 2N3866, 2N3866UB 2N3866A, 2N3866AUB	3076	V_{CE} = 5 V dc, I_C = 360 mA dc; pulsed (see 4.5.1)	h_{FE2} 5/	 [2.5] [4.0]		
Collector-emitter saturated voltage	3071	I_C = 100 mA dc, I_B = 10 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)}$		1.15	V dc

See footnotes at end of table.

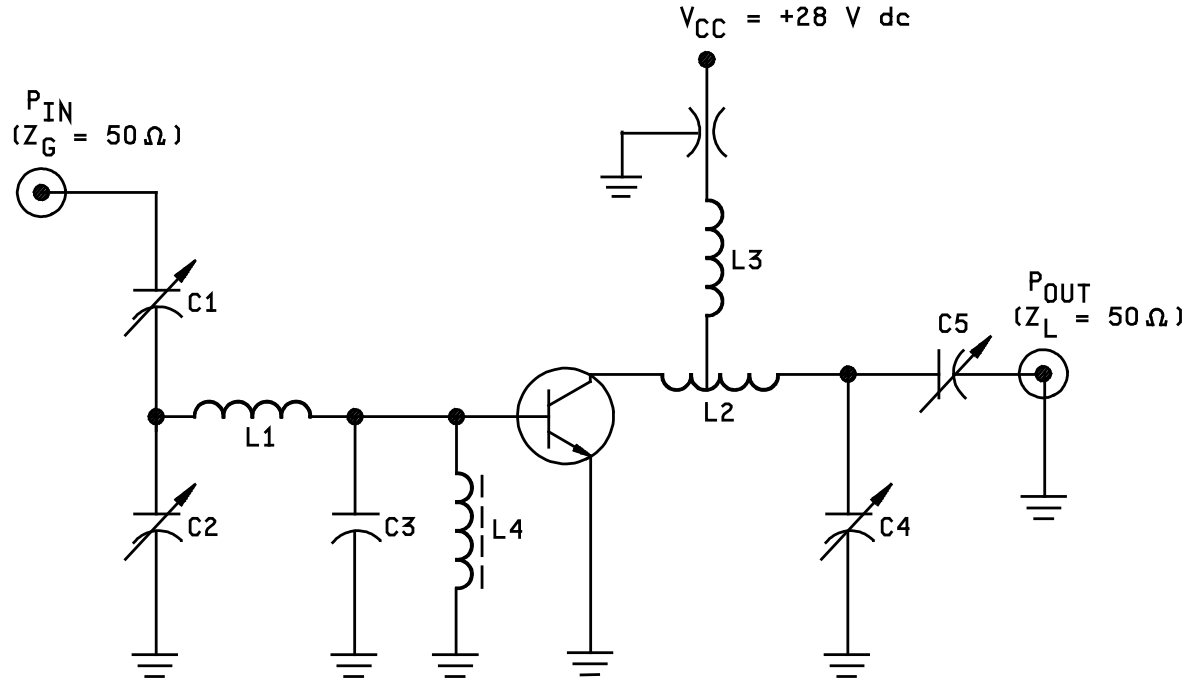
* TABLE II. Group D inspection and end-point limits - Continued.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 2						
Steady-state total dose irradiation	1019	Gamma exposure V_{ECS} = 24 V				
Collector-base breakdown voltage	3011	Bias condition D; I_C = 5 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	30		V dc
Collector-emitter breakdown voltage	3001	Bias condition D; I_C = 100 µA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	60		V dc
Emitter-base breakdown voltage	3026	Bias condition D; I_E = 100 µA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	3.5		V dc
Collector-emitter cutoff current	3041	Bias condition D; V_{CB} = 28 V dc	I_{CEO}		40	µA dc
Collector-emitter cutoff current	3041	Bias condition C; V_{CE} = 55 V dc	I_{CES1}		200	µA dc
Forward-current transfer ratio 2N3866, 2N3866UB 2N3866A, 2N3866AUB	3076	V_{CE} = 5 V dc, I_C = 50 mA dc; Pulsed (see 4.5.1)	h_{FE1} 5/	 [7.5] [12.5]	 200 200	
Forward-current transfer ratio 2N3866, 2N3866UB 2N3866A, 2N3866AUB	3076	V_{CE} = 5 V dc, I_C = 360 mA dc Pulsed (see 4.5.1)	h_{FE2} 5/	 [2.5] [4.0]		
Collector-emitter saturated voltage	3071	I_C = 100 mA dc, I_B = 10 mA dc, pulsed (see 4.5.1)	$V_{CE(sat)}$		1.15	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 the corresponding AL, UA, UB, and UBC suffix versions 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 the [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.

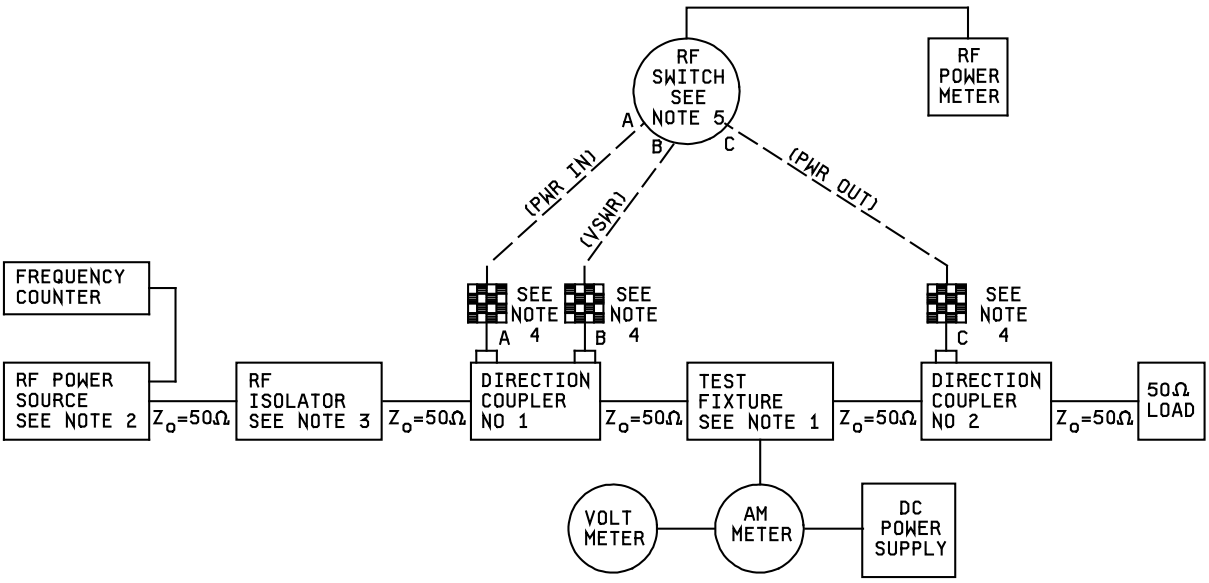
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles.	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2 herein.	
Subgroup 2			45 devices c = 0
Intermittent life	1037	V_{CB} = 10 V dc, 6,000 cycles, adjust power or current to achieve a ΔT_J = +100°C.	
Electrical measurements		See table I, subgroup 2 herein.	
Subgroup 4			Sample size N/A
Thermal response curves		See 4.2.2.1.	
Subgroup 5			
Not applicable			
Subgroup 6			11 devices c = 0
ESD	1020		
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition B	



C_1, C_2, C_5 = 3 - 35 pF.
C_3 = 24 pF (see note).
C_4 = 0.4 - 7 pF.
L_1 = Straight piece number 16 bare tin wire, .625 inch (15.87 mm) long.
L_2 = 3 turns number 16 wire, .250 inch (6.35 mm) ID, .312 inch (7.92 mm) long.
L_3 = 1 turns number 18 wire, .250 inch (6.35 mm) ID, .022 inch (0.56 mm) long.
L_4 = Ferrite RF choke, Z = 450 Ω.

NOTE: For optimum performance, C_3 should be mounted as close as possible to base lead.

FIGURE 4. Power output test circuit (400 MHz).



NOTES:

1. Test fixture is the circuit as described on figure 4.
2. RF power source may be any unit capable of generating desired power level at desired frequency with a harmonic and spurious content at least 20 dB below operating frequency level.
3. The RF isolator may be any device (pad, circulator, ect.) capable of establishing at least 20 dB of isolation (RL > 20 dB) between RF source and test fixture.
4. Variable attenuators (or fixed if calibrated): Attenuator on directional coupler number 2 shall be calculated against known working standard either by means of calibration chart or suitable adjustment if variable. Attenuator at position "A" of directional coupler number 1 shall be calibrated or adjusted so that actual power at test fixture is known. Attenuator at position "B" shall be adjusted to establish sensitivity needed to measure VSWR.
5. RF switch may be eliminated if additional power meters are used.

PROCEDURE:

a. Remove "test fixture" and install jumper between directional coupler number 1 and directional coupler number 2.
b. Set the RF switch to power output position "C".
c. Adjust frequency and power of RF source, as required by specification, and monitor frequency counter and RF power meter respectively (see note 4).
d. Set the RF switch to position "A" and adjust variable attenuator to obtain identical reading as power out in position "C" (see note 4).
e. Reconnect "test fixture" in test setup and insert device.
f. Adjust power supply to 28 V dc.
g. Adjust circuit output tuning for maximum power gain and circuit input tuning for maximum VSWR. (Switch between power in; VSWR, and power out while tuning and repeat as many times as necessary to obtain minimum VSWR and maximum power out. Check power in level before taking final reading. Minimum VSWR is defined as minimum reading obtained on power meter with switch in position "B" and maintaining power in.)

FIGURE 5. RF power output (P_{OUT}) test procedure.

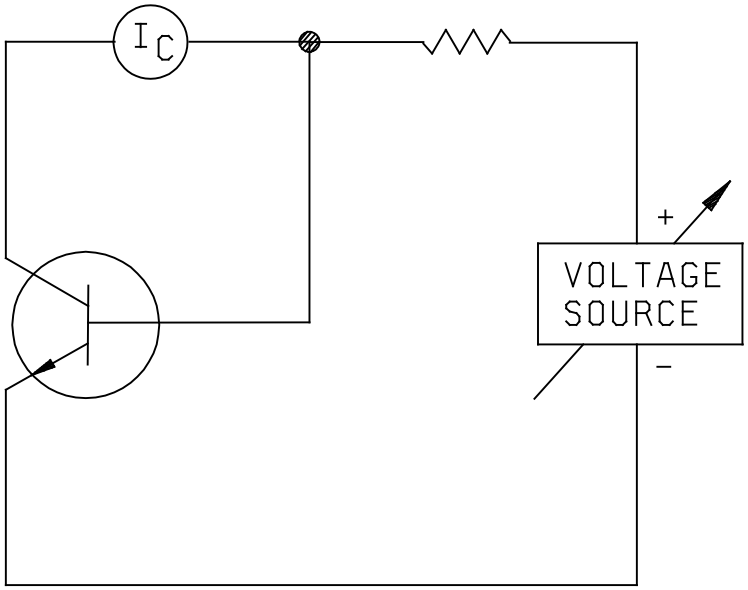
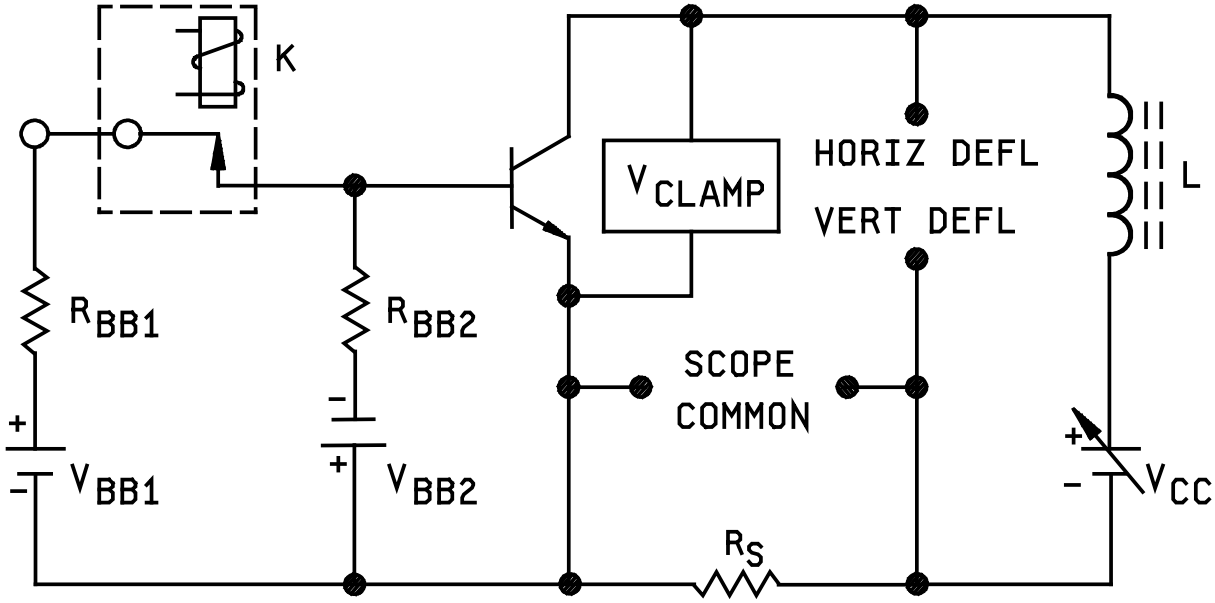


FIGURE 6. Burn-out by pulsing test circuit.



R_{BB1} = 150 Ω.
V_{BB1} = 20 V dc.
K = s.p.s.t relay, 6 V ac coil (Clare Mercury Relay, model number HGP-1400, or equivalent).
R_{BB2} = 33 Ω.
V_{BB2} = 1.5 V dc.
R_S = 1 Ω ±1 percent, .5 watt (non-inductive).
V_{CC} = The voltage should be adjusted to approximately 17 volts.
L = 25 mH, 100 mA, 83 Ω resistive (Miller number 957, or equivalent).
Vclamp = 55 V (min).
$V_{(BR)CEX}$ clamped at 10 percent over rating.

FIGURE 7. $V_{BR(CEX)}$ (clamped inductive) test circuit.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory. The notes specified in MIL-PRF-19500 are applicable to this specification.)

6.1 Intended use. Semiconductors conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

* 6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. Packaging requirements (see 5.1).

c. Lead finish (see 3.4.1).

d. Product assurance level and type designator.

* 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 JANHCA2N3866) will be identified on the QML.

Die ordering information (1)	
PIN	Manufacturer
	34156
2N3866 2N3866A	JANHCA2N3866 JANHCA2N3866A

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

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
Navy - EC
Air Force - 85
NASA - NA
DLA - CC

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

Preparing activity:
DLA - CC

(Project 5961-2010-083)

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.