The documentation and process conversion measures necessary to comply with this document shall be completed by 11 September 2012.

INCH-POUND
MIL-PRF-19500/573C
11 June 2012
SUPERSEDING
MIL-PRF-19500/573B
25 September 2011

PERFORMANCE SPECIFICATION SHEET

* SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, SWITCHING
TYPES 2N4209, JAN, JANTX, JANTXV, JANTXVM, JANTXVD, JANTXVP, JANTXVL, JANTXVR, JANTXVF, JANTXVG, JANTXVH, JANS, JANSM, JANSD, JANSP, JANSL, JANSR, JANSF, JANSG, JANSH, JANHC, JANHCM, JANHCD, JANHCP, JANHCL, JANHCR, JANHCF, JANHCG, JANHCH, JANKC, 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 PNP silicon high-speed logic switching 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 each unencapsulated device type. 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-18) and figure 2 (JANHC and JANKC die).

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

P_T (1) T_A = +25°C	P_T (2) T_C = +25°C	V_{CBO}	V_{CEO}	V_{EBO}	I_C	T_{OP} and T_{STG}	$R_{\theta JC}$ 1/ 2/
mW	mW	V dc	V dc	V dc	mA dc	°C	°C/W
360	700	15	15	4.5	50	-65 to +200	250

(1) Derate linearly 2.05 mW/°C above T_A > 25°C.
(2) Derate linearly 4.0 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 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. Unless otherwise specified, T_A = +25°C.

Limits	h_{FE2} 2/ V_{CE} = 0.3 V dc I_C = 10 mA dc	h_{FE3} 2/ V_{CE} = 1.0 V dc I_C = 10 mA dc	$\lvert h_{fe} \rvert$ f = 100 MHz V_{CE} = 10 V dc I_C = 10 mA dc
MIN	50	55	8.5
MAX	120	125	

Limits	$V_{BE(SAT)2}$ I_C = 10 mA dc I_B = 1.0 mA dc 2/	$V_{CE(SAT)2}$ I_C = 10 mA dc I_B = 1.0 mA dc 2/	C_{obo} V_{CB} = 5 V dc I_E = 0 100 kHz ≤ f ≤ 1 MHz	t_{on} I_C = 10 mA dc I_B = 1.0 mA dc See figure 3	t_{off} I_C = 10 mA dc I_B = 1.0 mA dc See figure 3 2
	V dc	V dc	pF	ns	ns
Min	0.70				
Max	0.95	0.18	3.0	15	20

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.

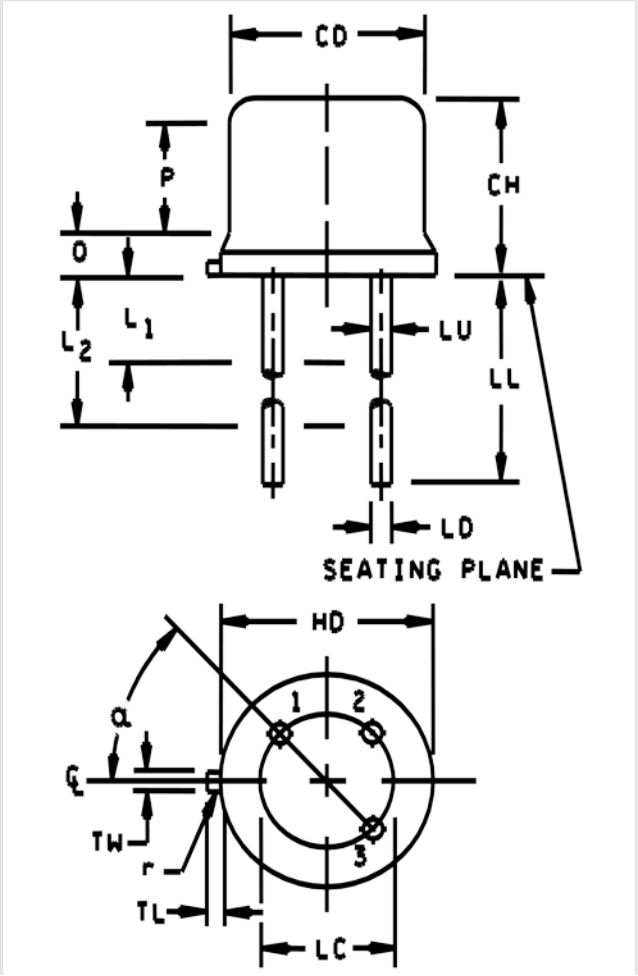
DEPARTMENT OF DEFENSE STANDARDS

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.)

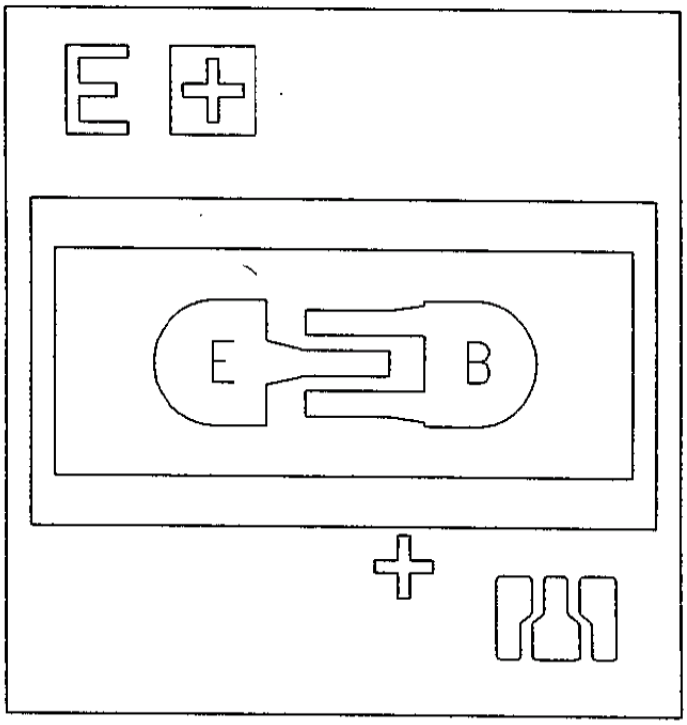
* 2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.170	.210	4.32	5.33	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		6
LD	.016	.021	0.41	0.53	7,8
LL	.500	.750	12.70	19.05	7,8,13
LU	.016	.019	0.41	0.48	7,8
L_1		.050		1.27	7,8
L_2	.250		6.35		7,8
P	.100		2.54		
Q		.030		0.76	5
TL	.028	.048	0.71	1.22	3,4
TW	.036	.046	0.91	1.17	3
r		.010		0.25	10
α	45° TP		45° TP		6



NOTES:
1. Dimension 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. 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.
7. Dimension LU applies between L_1 and L_2. Dimension LD applies between L_2 and minimum. Diameter is uncontrolled in L_1 and beyond LL minimum.
8. All three leads.
9. The collector shall be internally connected to the case.
10. Dimension r (radius) applies to both inside corners of tab.
11. In accordance with ANSI Y14.5M, diameters are equivalent to Nx symbology.
12. Lead 1 is the emitter; lead 2 is the base; lead 3 is the collector.

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



NOTES:
1. Die Size: .016inch x .016 inch (0.410 mm x 410 mm)
2. Die Thickness: .008 inch ± .0005 inch (0.203 mm ± 0.0127 mm)
3. Base bonding pad: .0021 inch x .0021 inch (0.0533 mm x 0.0533 mm)
4. Emitter bonding pad: .0021 inch x .0021 inch (0.0533 mm x 0.0533 mm)
5. Back metal: 6,500 Å ± 1,500 Å
6. Top metal: Aluminum, 17,500 Å ± 2,500 Å
7. Back side: Collector
8. Glassivation: SiO_2, 7,500 Å ± 1,500 Å

* FIGURE 2. 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 manufacturers list before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

* 3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (TO-18) and figure 2 (A version) 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 characteristic are as specified in 1.3, 1.4 and table I herein.

3.7 Electrical test requirements. The electrical test requirements shall be as specified in 4.4.2 and 4.4.3 herein.

* 3.8 Marking. Devices shall be marked in accordance with MIL-PRF-19500. The prefixes JAN, JANTX, JANTXV, and JANS can be abbreviated as J, JX, JV, and JS respectively. The "2N" prefix 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).

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

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 level	JANTX and JANTXV levels
(1) 3c	Thermal impedance, method 3131 of MIL-STD-750 (see 4.3.2)	Thermal impedance, method 3131 of MIL-STD-750 (see 4.3.2)
9	h_{FE3}, I_{CES1}	Not applicable
11	I_{CES1}; h_{FE3}; ΔI_{CES1} = 100 percent of initial value or 5 nA dc, whichever is greater, Δh_{FE3} = ±15 percent change from initial value	I_{CES1} and h_{FE3}
12	See 4.3.1	See 4.3.1
13	Subgroups 2 and 3 of table I herein; ΔI_{CES1} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE3} = ±15 percent change from initial value	Subgroup 2 of table I herein; ΔI_{CES1} = 100 percent of initial value or 5 nA dc, whichever is greater; Δh_{FE3} = ± 15 percent change from initial value

(1) Shall be performed anytime after temperature cycling, screen 3a; TX and TXV 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 4.5 of MIL-STD-750; V_{CB} = 12 V dc; P_T = 360 mW. NOTE: No heat sink or forced air cooling on the devices shall be permitted.

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

* 4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. If alternate screening is being performed in accordance with MIL-PRF-19500, a sample of screened devices shall be submitted to and pass the requirements of group A1 and A2 inspection only (table E-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 table E-V of MIL-PRF-19500 and table I herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table E-VIa (JANS) and table E-VIb (JANTX and JANTXV) of MIL-PRF-19500. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table III 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; P_T = 360 mW at T_A = room ambient as defined in the general requirements of MIL-STD-750. $t_{on} = t_{off}$ = 1 minute minimum for 2,000 cycles. No heat sink or forced-air cooling on devices shall be permitted.
B5	1027	V_{CB} = 10 V dc; for 96 hours, T_A = +125°C for 96 hours, P_T = 360 mW at T_A = +100°C or adjusted as required according to the chosen T_A to give an average T_J = +275°C.
B6	3131	See 4.5.3.

* 4.4.2.2 Group B inspection, table E-VIb (JANTX and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Conditions
B3	1027	V_{CB} = 12 V dc; P_T = 360 mW at T_A = room ambient as defined in the general requirements of MIL-STD-750. No heat sink or forced-air cooling on the devices shall be permitted.
B5	3131	See 4.5.3.

* 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 conditions specified for subgroup testing in table E-VIII of MIL-PRF-19500. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table III herein.

* 4.4.3.1 Group C inspection, table E-VIII of MIL-PRF-19500.

Subgroup	Method	Conditions
C2	2036	Test condition E.
C6	1026	V_{CB} = 12 V dc, P_T = 360 mW at T_A = room ambient as defined in the general requirements of MIL-STD-750. No heat sink or forced-air cooling on device shall be permitted.

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

Subgroup	Method	Condition
C2	2036	Test condition E
C6	1026	Not applicable.

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

* 4.4.4 Group D inspection. Conformance inspection for hardness assured JANS and JANTXV types shall include the group D tests specified in table II herein. These tests shall be performed as required in accordance with MIL-PRF-19500 and method 1019 of MIL-STD-750 for total ionizing dose, or method 1017 of MIL-STD-750 for neutron fluence, as applicable (see 6.2 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 or to the total dose response from molecular hydrogen in the package. Any alternate package should be tested for molecular hydrogen using Method 1018 (internal gas analysis). If hydrogen is detected total dose testing must be performed in the alternate package.

* 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 IV herein. Electrical measurements (end-points) and delta requirements shall be in accordance with table III herein as specified in the footnotes for table III.

4.5 Method of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Input capacitance. Use method 3240, MIL-STD-750, except the output capacitor shall be omitted.

4.5.3 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 2.5 mA dc.

b. Collector to emitter voltage magnitude shall be 10 V dc.

c. Reference point temperature shall be $+25°C \leq T_R \leq +35°C$. The chosen reference temperature shall be recorded before the test is started.

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

e. Maximum $R_{\theta JC}$ limit shall be 250°C/W.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical examination	2071					
Subgroup 2						
Thermal impedance 3/	3131	See 4.3.2	$Z_{\theta JX}$			°C/W
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 15 V dc	I_{CBO1}		10	µA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4.5 V dc	I_{EBO}		10	µA dc
Breakdown voltage collector -emitter	3011	Bias condition D; I_C = 3 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	15		V dc
Breakdown voltage collector -emitter	3041	Bias condition C; I_C = 100 mA dc	$V_{(BR)CES}$	15		V dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 3.5 V dc	I_{EBO2}		10	nA dc
Collector-emitter cutoff current	3041	V_{CE} = 10 V dc	I_{CES1}		10	nA dc
Forward-current transfer ratio	3076	V_{CE} = 0.5 V dc; I_C = 1.0 mA dc	h_{FE1}	35		
Forward-current transfer ratio	3076	V_{CE} = 0.3 V dc; I_C = 10 mA dc	h_{FE2}	50	120	
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 10 mA dc	h_{FE3}	55	125	
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 50 mA dc	h_{FE4}	40		
Collector-emitter voltage Saturated	3071	I_C = 1.0 mA dc; I_B = 0.1 mA dc	$V_{CE(SAT)1}$		0.15	V dc
Collector-emitter voltage Saturated	3071	I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{CE(SAT)2}$		0.18	V dc
Collector-emitter voltage Saturated	3071	I_C = 50 mA dc; I_B = 5.0 mA dc, pulsed (see 4.5.1)	$V_{CE(SAT)3}$		0.6	V dc
Base-emitter voltage saturated	3066	I_C = 1.0 mA dc; I_B = 0.1 mA dc	$V_{BE(SAT)1}$		0.8	V dc
Base-emitter voltage saturated	3066	I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{BE(SAT)2}$	0.70	0.95	V dc
Base-emitter voltage saturated	3066	I_C = 50 mA dc; I_B = 5.0 mA dc; pulsed (see 4.5.1)	$V_{BE(SAT)3}$		1.5	V dc

See footnotes at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 3						
High-temperature operation:		T_A = +125°C				
Collector-emitter cutoff current	3041	Bias condition D; V_{CE} = 10 V dc	I_{CES2}		5.0	µA dc
Low-temperature operation:		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 10 mA dc	h_{FE5}	25		
Subgroup 4						
Open circuit output capacitance	3236	V_{CB} = 5.0 V dc; I_E = 0 100 kHz ≤ f ≤ 1 MHz	C_{obo}		3.0	pF
Input capacitance (output open-circuited)	3240	V_{CB} = 5.0 V dc; I_E = 0 100 kHz ≤ f ≤ 1 MHz	C_{ibo}		3.5	pF
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 10 V dc; I_C = 10 mA dc; f = 100 MHz	$\lvert h_{fe} \rvert$	8.5		
* Turn-on delay time		See figure 3	t_d		10	ns
* Rise time		See figure 3	t_r		15	ns
* Storage time		See figure 3	t_{s1}		20	ns
* Storage time		See figure 3	t_{s2}		20	ns
* Turn-on time		See figures 4 and 5	t_{on}		15	ns
* Turn-off time		See figures 4 and 5	t_{off}		20	ns
Subgroup 5						
Not applicable						

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

2/ For resubmission of failed test in subgroup 1 of table I, 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/ This test required for the following end-point measurements only:

* Group B, subgroups 2 and 3 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.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 4/						
Neutron irradiation	1017	Neutron exposure V_{CES} = 0 V				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 15 V dc	I_{CBO1}		20	µA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4.5 V dc	I_{EBO}		20	µA dc
Breakdown voltage collector-emitter	3011	Bias condition D; I_C = 3 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	15		V dc
Breakdown voltage collector-emitter	3041	Bias condition C; I_C = 100 mA dc	$V_{(BR)CES}$	15		V dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 3.5 V dc	I_{EBO2}		20	nA dc
Collector-emitter cutoff current	3041	V_{CE} = 10 V dc	I_{CES1}		20	nA dc
Forward-current transfer ratio	3076	V_{CE} = 0.5 V dc; I_C = 1.0 mA dc	h_{FE1}	[17.5] 5/		
Forward-current transfer ratio	3076	V_{CE} = 0.3 V dc; I_C = 10 mA dc	h_{FE2}	[25] 5/	120	
Forward-current transfer ratio	3076	I_C = 50 mA dc; I_B = 5.0 mA dc, pulsed (see 4.5.1)	h_{FE3}	[27.5] 5/	125	
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 50 mA dc	h_{FE4}	[20] 5/		
Collector-emitter voltage saturated	3071	I_C = 1.0 mA dc; I_B = 0.1 mA dc	$V_{CE(SAT)1}$		0.173	V dc
Collector-emitter voltage saturated	3071	I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{CE(SAT)2}$		0.207	V dc
Collector-emitter voltage saturated	3071	I_C = 50 mA dc; I_B = 5.0 mA dc, pulsed (see 4.5.1)	$V_{CE(SAT)3}$		0.69	V dc

See footnotes at end of table.

* TABLE II. Group D inspection. - Continued.

Inspection 1/ 2/ 3/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 - Continued						
Base-emitter voltage saturated	3066	I_C = 1.0 mA dc; I_B = 0.1 mA dc	$V_{BE(SAT)1}$		0.92	V dc
Base-emitter voltage saturated	3066	I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{BE(SAT)2}$	0.7	1.09	V dc
Base-emitter voltage saturated	3066	I_C = 50 mA dc; I_B = 5.0 mA dc; pulsed (see 4.5.1)	$V_{BE(SAT)3}$		1.73	V dc
Subgroup 2						
Steady-state dose irradiation	1019	Gamma exposure V_{CES} = 15 V				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 15 V dc	I_{CBO1}		20	µA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 4.5 V dc	I_{EBO}		20	µA dc
Breakdown voltage collector-emitter	3011	Bias condition D; I_C = 3 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	15		V dc
Breakdown voltage collector-emitter	3041	Bias condition C; I_C = 100 mA dc	$V_{(BR)CES}$	15		V dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 3.5 V dc	I_{EBO2}		20	nA dc
Collector-emitter cutoff current	3041	V_{CE} = 10 V dc	I_{CES1}		20	nA dc
Forward-current transfer ratio	3076	V_{CE} = 0.5 V dc; I_C = 1.0 mA dc	[h_{FE1}]	[17.5] 5/		
Forward-current transfer ratio	3076	V_{CE} = 0.3 V dc; I_C = 10 mA dc	[h_{FE2}]	[25] 5/	120	
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 10 mA dc	[h_{FE3}]	[27.5] 5/	125	
Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 50 mA dc	[h_{FE4}]	[20] 5/		
Collector-emitter voltage saturated	3071	I_C = 1.0 mA dc; I_B = 0.1 mA dc	$V_{CE(SAT)1}$		0.173	V dc
Collector-emitter voltage saturated	3071	I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{CE(SAT)2}$		0.207	V dc
Collector-emitter voltage saturated	3071	I_C = 50 mA dc; I_B = 5.0 mA dc, pulsed (see 4.5.1)	$V_{CE(SAT)3}$		0.69	V dc

See footnotes at end of table.

* TABLE II. Group D inspection. - Continued.

Inspection 1/ 2/ 3/	MIL-STD-750	Symbol	Limit	Unit		
	Method	Conditions		Min	Max	
Subgroup 2 - Continued						
Base-emitter voltage saturated	3066	I_C = 1.0 mA dc; I_B = 0.1 mA dc	$V_{BE(SAT)1}$		0.92	V dc
Base-emitter voltage saturated	3066	I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{BE(SAT)2}$	0.7	1.09	V dc
Base-emitter voltage saturated	3066	I_C = 50 mA dc; I_B = 5.0 mA dc; pulsed (see 4.5.1)	$V_{BE(SAT)3}$		1.73	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. Groups B and C electrical measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector-emitter cutoff current	3041	Bias condition D; V_{CB} = 10 V dc	I_{CES1}		10	nA dc
2.	Collector-emitter cutoff current	3041	Bias condition D; V_{CB} = 10 V dc	I_{CES2}		20	nA dc
3.	Collector-emitter voltage (saturated)	3071	I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{CE(Sat)2}$		0.18	V dc
4.	Base-emitter voltage (saturated)	3066	I_C = 10 mA dc; I_B = 1.0 mA dc	$V_{BE(Sat)2}$	0.70	0.95	V dc
5.	Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 10 mA dc	h_{FE3}	50	125	
6.	Forward-current transfer ratio	3076	V_{CE} = 1.0 V dc; I_C = 10 mA dc	Δh_{FE3}	±25 percent change from initial value.		
7.	Collector-emitter cutoff current	3041		ΔI_{CES1}	100 percent of initial value or 5 nA dc, whichever is greater.		
8.	Base-emitter voltage (saturated)	3066	I_C = 10 mA dc; I_B = 1.0 mA dc	$\Delta V_{BE(Sat)2}$	±50 mV dc change from initial value.		

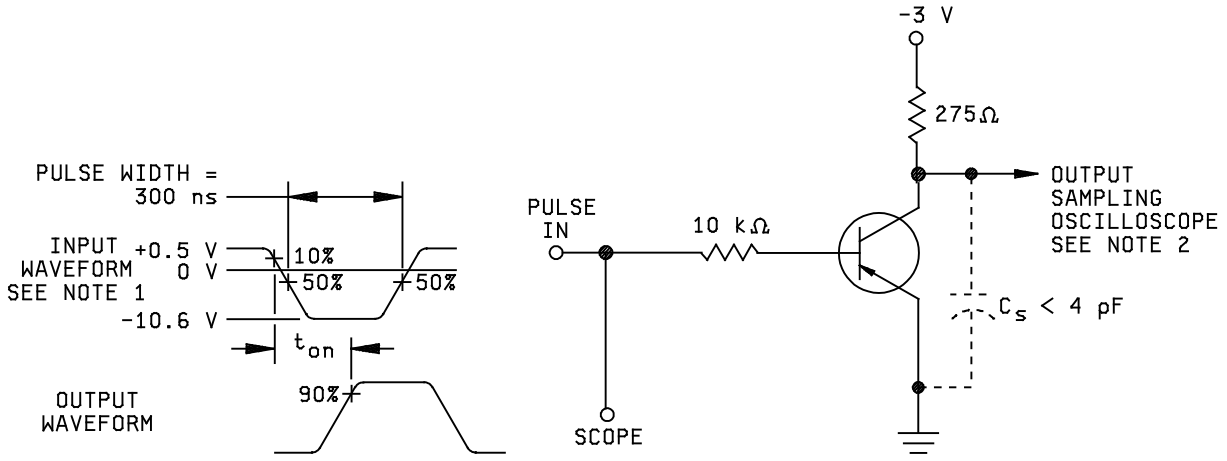
1/ The electrical measurements for table E-VIa (JANS) of MIL-PRF-19500 are as follows:
   a. Subgroup 3, see table III herein, steps 1, 3, 4, and 5.
   b. Subgroup 4, see table III herein, steps 2, 3, 4, 5, 6, 7, and 8.
   c. Subgroup 5, see table III herein, steps 2, 3, 4, 5, 6, and 7.

2/ The electrical measurements for table E-VIb (JANTX and JANTXV) of MIL-PRF-19500 are as follows:
   a. Subgroup 2, see table III herein, steps 1, 4, and 5.
   b. Subgroups 3 and 6, see table III herein, steps 2, 5, and 6.

3/ The electrical measurements for table E-VII of MIL-PRF-19500 are as follows:
   a. Subgroups 2 and 3, table III herein, steps 1, 3, and 4.
   b. Subgroup 6, see table III herein, steps 1, 3, 4, 5, and 6 (for JANS) and 2, 3, and 5 (for JAN, JANTX, and JANTXV).

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

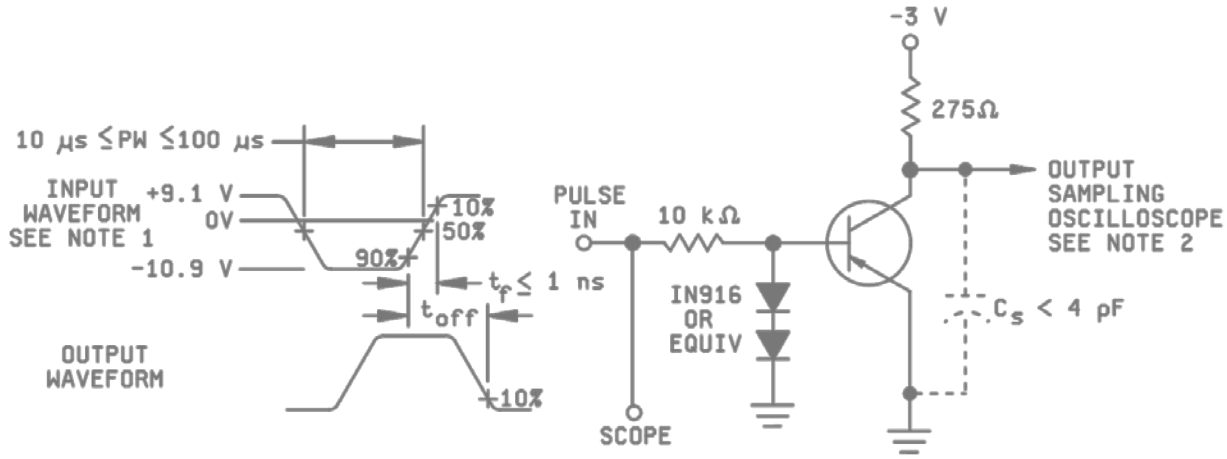
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2 and 4.5.3 herein	
Subgroup 2			
Intermittent life	1037	Intermittent operation life: V_{CB} = 10 V dc, 6,000 cycles. Adjust device current, or power, to achieve a minimum ΔT_J of +100°C	45 devices c = 0
Electrical measurements		See table I, subgroup 2 and 4.5.3 herein	
Subgroup 4			
Thermal impedance curves		See table E-IX, MIL-PRF-19500, group E, subgroup 4.	Sample size N/A
Subgroup 5			
Not applicable			
Subgroup 6			11 devices c = 0
Electrostatic discharge (ESD)	1020		
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition B	



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 1.0 ns, duty cycle ≤ 2 percent, and the generator source Z shall be 50Ω.
2. Sampling oscilloscope: Z_{IN} ≥ 100 kΩ; rise time(t_r) ≤ .1 ns.

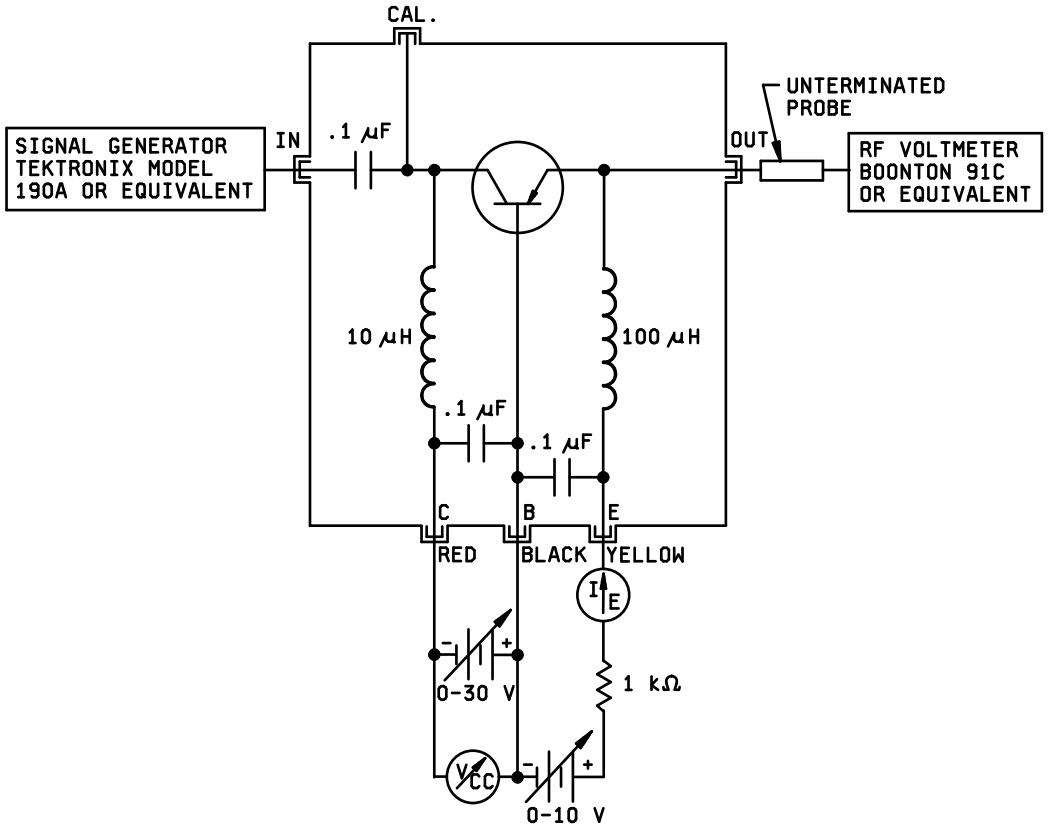
* FIGURE 3. Delay and rise time, test circuit.



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 1.0 ns, duty cycle ≤ 2 percent, and the generator source Z shall be 50Ω.
2. Sampling oscilloscope: Z_{IN} ≥ 100 kΩ; rise time (t_r) ≤ .1 ns.

* FIGURE4. Storage and fall time, test circuit.



Procedure:

1. Set signal generator to 31.8 MHz and connect to "IN" connector on test jig.
2. Connect low voltage dc power supplies as shown. A 1 K ohm resistor should be placed in series with the emitter power supply to prevent damage to transistors being tested.
3. Set collector supply for V_{CE} = -20 V dc, and emitter supply for I_C = -10 mA.
4. Connect RF voltmeter with unterminated probe adapter to "CAL" connector on test jig. Adjust signal generator until RF voltage is 1 volt (NOTE: Decade switching of voltmeter should be accurate from 1 mV to 3 volts. If not, input voltage may be set using voltage dividers, utilizing lower scales of the RF voltmeter. If this is done, the voltage dividers should be left in place when the voltmeter is removed, as they constitute a load on the input of the circuit.)
5. Remove RF voltmeter from "CAL" connector and connect to "OUT" connector. Meter will now read $r_b'C_c$ as follows:

Meter range full scale

3 mV
10 mV
30 mV
.1 volt

* FIGURE 5. Collector-base time constant test circuit (an equivalent circuit may be used).

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 JANHCA2N4209) will be identified on the QML.

Die ordering information (1)	
PIN	Manufacturer
	34156
2N4209	JANHCA2N4209

(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

Preparing activity:
DLA - CC

(Project 5961-2012-017)

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

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