

The documentation and process conversion measures necessary to comply with this revision shall be completed by 30 March 1994

INCH-POUND

MIL-S-19500/396D
30 December 1993
SUPERSEDING
MIL-S-19500/396C
6 February 1984

MILITARY SPECIFICATION
SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, SWITCHING
TYPES 2N3762, 2N3762L, 2N3763, 2N3763L, 2N3764, AND 2N3765
JANTX, JANTXV, AND JANS

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

1. SCOPE

1.1 Scope. This specification covers the detail requirements for PNP silicon switching transistors. Three levels of product assurance is provided for each device type as specified in MIL-S-19500.

1.2 Physical dimensions. See 3.3 (similar to TO-5, TO-39, and TO-46).

1.3 Maximum ratings.

Types	P _T T _A = +25°C	V _{CB0}	V _{CE0}	V _{EB0}	I _c	T _{0P} and T _{STG}	R _{θJC}
	W	V dc	V dc	V dc	A dc	°C	°C/W
2N3762	1.0 1/	40	40	5	1.5	-55 to +200	60
2N3762L	1.0 1/	40	40	5	1.5	-55 to +200	60
2N3763	1.0 1/	60	60	5	1.5	-55 to +200	60
2N3763L	1.0 1/	60	60	5	1.5	-55 to +200	60
2N3764	0.5 2/	40	40	5	1.5	-55 to +200	88
2N3765	0.5 2/	60	60	5	1.5	-55 to +200	88

1/ Derate linearly at 5.71 mW/°C above T_A = +25°C.

2/ Derate linearly at 2.86 mW/°C above T_A = +25°C.

1.4 Primary electrical characteristics T_A = +25°C. (Applies to all devices unless otherwise indicated.)

Limits	h _{FE1} V _{CE} = 1.0 V dc I _c = 10 mA dc	h _{FE3} V _{CE} = 1.0 V dc I _c = 500 mA dc	h _{FE5} 1/ V _{CE} = 5.0 V dc I _c = 1.5 A dc
			2N3762 2N3763 2N3762L 2N3763L 2N3764 2N3765
Min	35	40	30 20
Max		140	

1/ Pulsed (see 4.5.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: NASA/Parts Project Office (NPP0), NASA Goddard Space Flight Center, Code 310.A, Greenbelt, MD 20771 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5961

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

Limits	$ h_{FE} $ $f = 100 \text{ MHz}$ $V_{CE} = 10 \text{ V dc}$ $I_C = 50 \text{ mA dc}$		$V_{CE(SAT)}$ $I_C = 500 \text{ mA dc}$ $I_B = 50 \text{ mA dc}$ 1/	C_{obo} $V_{CE} = 10 \text{ V dc}$ $I_E = 0$ 100 kHz $\leq f \leq 1 \text{ MHz}$	Pulse response			
	2N3762 2N3763 2N3764 2N3765				See fig.1	See fig. 2		
			V_{dc}	ρF	t_d	t_r	t_s	t_f
Min	1.8	1.5			ns	ns	ns	ns
Max	6.0	6.0	0.5	15	8	35	80	35

1/ Pulsed (see 4.5.1).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

MILITARY

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

STANDARD

MILITARY

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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Associated detail specification. The individual item requirements shall be in accordance with MIL-S-19500, and as specified herein.

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

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-S-19500, appendix F, figure 8, T-1C (for 2N3762 and 2N3763, similar to T0-39) and T-1A (for 2N3762L and 2N3763L, similar to T0-5) and figure 9, T-2B (for 2N3764 and 2N3765, similar to T0-46).

3.3.1 Lead finish. Lead finish shall be solderable in accordance with MIL-S-19500.

3.4 Marking. Marking shall be in accordance with MIL-S-19500.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-S-19500.

4.3 Screening (JANTX, JANTXV, and JANS levels). Screening shall be in accordance with MIL-S-19500 (table II), 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 II of MIL-S-19500)	Measurements	
	JANS level	JANTX and JANTXV Levels
9	I_{CBO} and h_{FE3}	Not applicable
11	I_{CBO} ; h_{FE3} ; $\Delta I_{CBO} = 100\%$ of initial value or 10 nA dc whichever is greater; $\Delta h_{FE3} = \pm 15\%$	I_{CBO} and h_{FE3}
12	See 4.3.1	See 4.3.1
13	Subgroups 2 and 3 of table I herein; $\Delta I_{CBO} = 100\%$ of initial value or 10 nA dc, whichever is greater; $\Delta h_{FE3} = \pm 15\%$	Subgroup 2 of table I herein; $\Delta I_{CBO} = 100\%$ of initial value or 10 nA dc, whichever is greater; $\Delta h_{FE3} = \pm 15\%$

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, 4.5 (all product assurance levels);

JANS level:

2N3762	-	$V_{CB} = 10$ V dc	$P_T = 1.0$ W
2N3763	-	$V_{CB} = 10$ V dc	$P_T = 1.0$ W
2N3764	-	$V_{CB} = 10$ V dc	$P_T = 0.5$ W
2N3765	-	$V_{CB} = 10$ V dc	$P_T = 0.5$ W

JANTX and JANTXV levels:

2N3762	-	$V_{CB} = 30$ V dc	$P_T = 1.0$ W
2N3763	-	$V_{CB} = 40$ V dc	$P_T = 1.0$ W
2N3764	-	$V_{CB} = 30$ V dc	$P_T = 0.5$ W
2N3765	-	$V_{CB} = 40$ V dc	$P_T = 0.5$ W

NOTE: No heat sink or forced air cooling on the devices shall be permitted. Power burn-in conditions for "L" suffix devices are identical to their corresponding non-L suffix devices.

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-S-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-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 IVa (JANS) and table IVb (JANTX and JANTXV) of MIL-S-19500, and as follows. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps and footnotes of table II herein.

4.4.2.1 Group B inspection, table IVa (JANS) of MIL-S-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	2037	Test condition A.
B4	1037	$V_{CB} = 10$ V dc, $P_T = 1.0$ W (for 2N3762, 2N3762L, 2N3763, and 2N3763L), $P_T = .5$ W (for 2N3764 and 2N3765) at $T_A = +30^\circ\text{C} \pm 5^\circ\text{C}$; $t_{on} = t_{off} = 3$ minutes minimum for 2,000 cycles. No heat sink or forced-air cooling on devices shall be permitted.
B5	1027	$V_{CB} = 10$ V dc, $P_T = 1.0$ W (for 2N3762, 2N3762L, 2N3763, and 2N3763L), $P_T = 0.5$ W (for 2N3764 and 2N3765) at $T_A = +125^\circ\text{C} \pm 25^\circ\text{C}$ for 96 hours or $T_A = +100^\circ\text{C}$ for 96 hours with P_T adjusted as required by the chosen T_A to give an average lot. $T_J = +275^\circ\text{C}$. Marking legibility requirements shall not apply.
B6	3131	See 4.5.2.

4.4.2.2 Group B inspection, table IVb (JANTX and JANTXV) of MIL-S-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1027	2N3762, 2N3762L - $V_{CB} = 30$ V dc; $P_T = 1.0$ W at $T_A = +30^\circ\text{C} \pm 5^\circ\text{C}$ 2N3763, 2N3763L - $V_{CB} = 40$ V dc; $P_T = 1.0$ W at $T_A = +30^\circ\text{C} \pm 5^\circ\text{C}$ 2N3764 - $V_{CB} = 30$ V dc; $P_T = 0.5$ W at $T_A = +30^\circ\text{C} \pm 5^\circ\text{C}$ 2N3765 - $V_{CB} = 40$ V dc; $P_T = 0.5$ W at $T_A = +30^\circ\text{C} \pm 5^\circ\text{C}$ No heat sink or forced-air cooling on the devices shall be permitted.
B5	3131	See 4.5.2.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table V of MIL-S-19500 and as follows. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps of table II herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Test condition A.
C6	1027	2N3762 - $V_{CB} = 30$ V dc; $P_T = 1.0$ W at $T_A = +30^\circ\text{C} \pm 5^\circ\text{C}$ 2N3763 - $V_{CB} = 40$ V dc; $P_T = 1.0$ W at $T_A = +30^\circ\text{C} \pm 5^\circ\text{C}$ 2N3764 - $V_{CB} = 30$ V dc; $P_T = 0.5$ W at $T_A = +30^\circ\text{C} \pm 5^\circ\text{C}$ 2N3765 - $V_{CB} = 40$ V dc; $P_T = 0.5$ W at $T_A = +30^\circ\text{C} \pm 5^\circ\text{C}$ No heat sink or forced-air cooling on device shall be permitted.

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

- a. Collector current magnitude during power application shall be 100 mA dc (2N3762, 2N3762L, 2N3763, and 2N3763L) and 60 mA dc (2N3764 and 2N3765).
- b. Collector to base voltage magnitude shall be 10 V dc.
- c. Reference temperature measuring point shall be the case.
- d. Reference point temperature shall be $+25^{\circ}\text{C} \leq T_R \leq +35^{\circ}\text{C}$ and the chosen T_R 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 (2N3762, 2N3762L, 2N3763, and 2N3763L) and 88°C/W (2N3764 and 2N3765).

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-19500.

6. NOTES.

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Issue of DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.1).
- b. Lead finish as specified (see 3.3.1).
- c. Type designation and product assurance level.

6.3 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical examination	2071					
<u>Subgroup 2</u>						
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 10 \text{ mA dc}$; Pulsed (see 4.5.1)	$V_{(BR)CEO}$	40 60		V dc V dc
2N3762, 2N3764 2N3763, 2N3765						
Breakdown voltage collector to base	3001	Bias condition D; $I_C = 10 \mu\text{A dc}$	$V_{(BR)CBO}$	40 60		V dc V dc
2N3762, 2N3764 2N3763, 2N3765						
Breakdown voltage emitter to base	3026	Bias condition D; $I_E = 10 \mu\text{A dc}$	$V_{(BR)EBO}$	5		V dc
Collector to base cutoff current	3036	Bias condition D; $V_{CB} = 20 \text{ V dc}$; $V_{CB} = 30 \text{ V dc}$	I_{CBO}		100	nA dc
2N3762, 2N3764 2N3763, 2N3765						
Collector to emitter cutoff current	3041	Bias condition A; $V_{EB} = 2.0 \text{ V dc}$; $V_{CE} = 20 \text{ V dc}$; $V_{CE} = 30 \text{ V dc}$	I_{CEX1}		100	nA dc
2N3762, 2N3764 2N3763, 2N3765						
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 2.0 \text{ V dc}$	I_{EBO}		200	nA dc
Forward - current transfer ratio	3076	$V_{CE} = 1.0 \text{ V dc}$; $I_C = 10 \text{ mA dc}$	h_{FE1}	35		
Forward - current transfer ratio	3076	$V_{CE} = 1.0 \text{ V dc}$; $I_C = 150 \text{ mA dc}$; Pulsed (see 4.5.1)	h_{FE2}	40		
Forward - current transfer ratio	3076	$V_{CE} = 1.0 \text{ V dc}$; $I_C = 500 \text{ mA dc}$; Pulsed (see 4.5.1)	h_{FE3}	40	140	

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 2</u> - Continued.						
Forward - current transfer ratio 2N3762, 2N3764 2N3763, 2N3765	3076	$V_{CE} = 1.5$ V dc; $I_C = 1.0$ A dc; Pulsed (see 4.5.1)	h_{FE4}	30 20	120 80	
Forward - current transfer ratio 2N3762, 2N3764 2N3763, 2N3765	3076	$V_{CE} = 5.0$ V dc; $I_C = 1.5$ A dc; Pulsed (see 4.5.1)	h_{FE5}	30 20		
Collector to emitter voltage (saturated)	3071	$I_C = 10$ mA dc; $I_B = 1$ mA dc; Pulsed (see 4.5.1)	$V_{CE(SAT)1}$		0.10	V dc
Collector to emitter voltage (saturated)	3071	$I_C = 150$ mA dc; $I_B = 15$ mA dc; Pulsed (see 4.5.1)	$V_{CE(SAT)2}$		0.22	V dc
Collector to emitter voltage (saturated)	3071	$I_C = 500$ mA dc; $I_B = 50$ mA dc; Pulsed (see 4.5.1)	$V_{CE(SAT)3}$		0.50	V dc
Collector to emitter voltage (saturated)	3071	$I_C = 1.0$ A dc; $I_B = 100$ mA dc; Pulsed (see 4.5.1)	$V_{CE(SAT)4}$		0.90	V dc
Base to emitter voltage (saturated)	3066	Test condition A; $I_C = 10$ mA dc; $I_B = 1$ mA dc	$V_{BE(SAT)1}$		0.80	V dc
Base to emitter voltage (saturated)	3066	Test condition A; $I_C = 150$ mA dc; $I_B = 15$ mA dc; Pulsed (see 4.5.1)	$V_{BE(SAT)2}$		1.0	V dc
Base to emitter voltage (saturated)	3066	Test condition A; $I_C = 500$ mA dc; $I_B = 50$ mA dc; Pulsed (see 4.5.1)	$V_{BE(SAT)3}$		1.2	V dc
Base to emitter voltage (saturated)	3066	Test condition A; $I_C = 1.0$ A dc; $I_B = 100$ mA dc; Pulsed (see 4.5.1)	$V_{BE(SAT)4}$.90	1.40	V dc

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection ^{1/}	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 3</u>						
High - temperature operation		$T_A = +150^\circ\text{C}$				
Collector to emitter cutoff current 2N3762, 2N3764 2N3763, 2N3765		Bias condition A; $V_{EB} = 2\text{ V dc};$ $V_{CE} = 20\text{ V dc};$ $V_{CE} = 30\text{ V dc}$	I_{CEX2}		150	$\mu\text{A dc}$
Low - temperature operation		$T_A = -55^\circ\text{C}$				
Forward - current transfer ratio	3076	$V_{CE} = 1.0\text{ V dc};$ $I_C = 500\text{ mA dc};$ Pulsed (see 4.5.1)	h_{FE6}	20		
<u>Subgroup 4</u>						
Magnitude of common emitter, small - signal short - circuit forward - current transfer ratio 2N3762, 2N3764 2N3763, 2N3765	3306	$V_{CE} = 10\text{ V dc};$ $I_C = 50\text{ mA dc};$ $f = 100\text{ MHz}$	$ h_{fe} $	1.8 1.5	6.0 6.0	
Open circuit output capacitance	3236	$V_{CB} = 10\text{ V dc};$ $I_E = 0;$ $100\text{ kHz} \leq f \leq \text{MHz}$	C_{obo}		15	pF
Input capacitance (output open - circuited)	3240	$V_{EB} = .5\text{ V dc};$ $I_C = 0;$ $100\text{ kHz} \leq f \leq \text{MHz}$	C_{ibo}		80	pF
Pulse response						
Pulse delay time	3251	See figure 1	t_d		8	ns
Pulse rise time	3251	See figure 1	t_r		35	ns
Pulse storage time	3251	See figure 2	t_s		80	ns
Pulse fall time	3251	See figure 2	t_f		35	ns

^{1/} For sampling plan, see MIL-S-19500. Electrical characteristics for "L" suffix devices are identical to their corresponding non-L suffix devices.

TABLE II. Groups B and C electrical measurements. 1/ 2/ 3/

Step	Inspection	MIL-STD-750		Symbol	Limit		Unit
		Method	Conditions		Min	Max	
1.	Collector to base cutoff current 2N3762, 2N3764 2N3763, 2N3765	3036	Bias condition D; $V_{CB} = 20$ V dc; $V_{CB} = 30$ V dc	I_{CBO}		100 100	nA dc nA dc
2.	Collector to base cutoff current 2N3762, 2N3764 2N3763, 2N3765	3036	Bias condition D; $V_{CB} = 20$ V dc; $V_{CB} = 30$ V dc	I_{CBO}		200 200	nA dc nA dc
3.	Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = 2$ V dc	I_{EBO}		200	nA dc
4.	Collector to emitter voltage (saturated)	3071	$I_C = 500$ mA dc; $I_B = 50$ mA dc; pulsed (see 4.5.1)	$V_{CE(SAT)3}$		0.5	V dc
5.	Base to emitter voltage (saturated)	3066	Test condition A; $I_C = 500$ mA dc; $I_B = 50$ mA dc; pulsed (see 4.5.1)	$V_{BE(SAT)3}$		1.2	V dc
6.	Forward - current transfer ratio	3076	$V_{CE} = 1.0$ V dc; $I_C = 500$ mA dc; pulsed (see 4.5.1)	h_{FE3}	40	140	
7.	Collector to base cutoff current 2N3762 & L, 2N3764 2N3763 & L, 2N3765	3036	Bias condition D; $V_{CB} = 20$ V dc; $V_{CB} = 30$ V dc	ΔI_{CBO}	±100% of initial value or 10 nA dc, whichever is greater		
8.	Forward - current transfer ratio	3076	$V_{CE} = 1.0$ V dc; $I_C = 500$ mA dc	Δh_{FE3}	± 20% change from initial reading		
9.	Collector to emitter voltage (saturated)	3071	$I_C = 500$ mA dc; $I_B = 50$ mA dc; pulsed (see 4.5.1)	$\Delta V_{CE(SAT)3}$	±50 mV dc change from previous measured value		

1/ The electrical measurements for table IVa (JANS) of MIL-S-19500 are as follows:

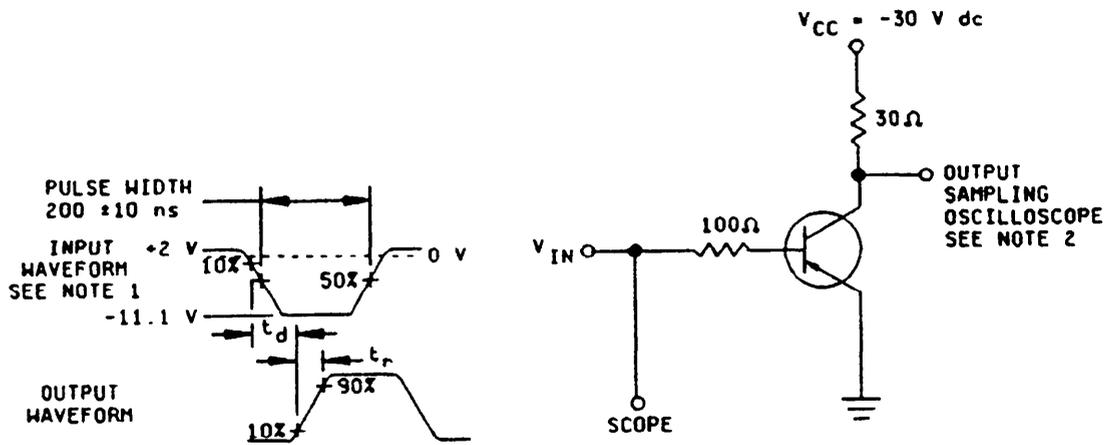
- a. Subgroup 3, see table II herein, steps 1, 3, 4, 5, and 6.
- b. Subgroups 4 and 5, see table II herein, steps 7, 8, and 9.

2/ The electrical measurements for table IVb (JANTX and JANTXV) of MIL-S-19500 are as follows:

- a. Subgroup 2, see table II herein, steps 1 and 5.
- b. Subgroups 3 and 6, see table II herein, steps 2 and 8.

3/ The electrical measurements for table V of MIL-S-19500 are as follows:

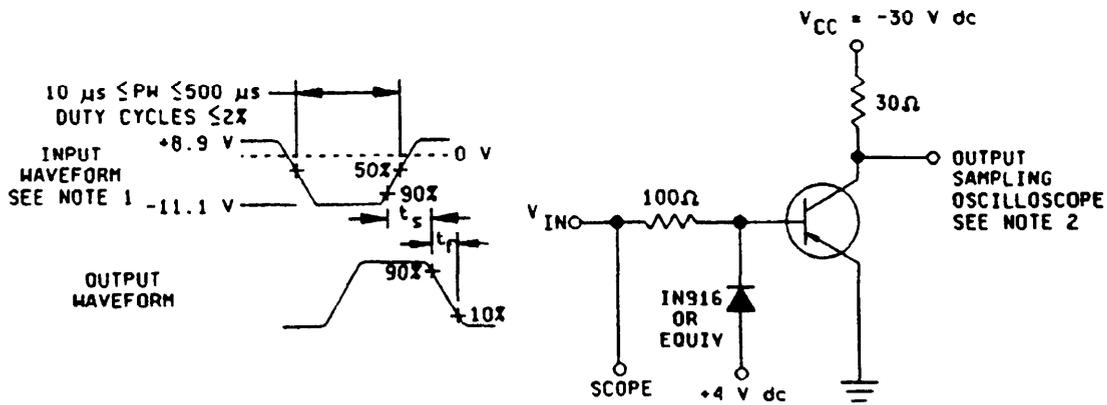
- a. Subgroups 2 and 3, see table II herein, steps 1, 3, 4, 5, and 6 (JANS); and steps 1 and 6 (JANTX and JANTXV).
- b. Subgroup 6, see table II herein, steps 2, 3, 4, 5, 6, 7, and 8 (JANS); and steps 2 and 8 (JANTX and JANTXV).



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 2 ns, duty cycle $\leq 2\%$, and the generator source impedance shall be 50Ω .
2. Sampling oscilloscope: $Z_{in} \geq 100$ k Ω , $C_{in} \leq 12$ pF, rise time $\leq .1$ ns.
3. $I_{B1} = -100$ mA dc.

FIGURE 1. Pulse response test circuit for t_d and t_f .



NOTES:

1. The rise time (t_r) of the applied pulse shall be ≤ 2 ns, duty cycle $\leq 2\%$, and the generator source impedance shall be 50Ω .
2. Sampling oscilloscope: $Z_{in} \geq 100$ k Ω , $C_{in} \leq 12$ pF, rise time $\leq .1$ ns.
3. $I_{B1} = +I_{B2} = -100$ mA dc.

FIGURE 2. Pulse response test circuit for t_s and t_f .

CONCLUDING MATERIAL

Custodians:

Army - ER
Navy - EC
Air Force - 17
NASA - NA

Review activities:

Army - MI
Navy - AS, CG, MC
Air Force - 15, 19, 85, 99
DLA - ES

Preparing activity:
NASA - NA

Agent:
DLA - ES

(Project 5961-1462)

