The documentation and process conversion measures necessary to comply with this revision shall be completed by 5 July 2002.

INCH-POUND

MIL-PRF-19500/392F
5 April 2002
SUPERSEDING
MIL-PRF-19500/392E
6 June 2001

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, SWITCHING
TYPE 2N3485A, 2N3486A, JAN, JANTX AND JANTXV

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 performance requirements for PNP silicon switching transistors. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (T0-46).

1.3 Maximum ratings.

P_T		V_{CBO}	V_{CEO}	V_{EBO}	I_C	T_{op} and T_{ST}	$R_{\theta JC}$	$R_{\theta JA}$
T_A =+25°C (1)	T_C = +25°C (2)							
W	W	V dc	V dc	V dc	mA dc	°C	°C /W	°C /mW
0.5	2.0	60	60	5	600	-65 TO +200	87	0.325

(1) Derate linearly at 3.08 mW/°C above T_A = +37.5°C.
(2) Derate linearly at 11.43 mW/°C above T_C = +25°C.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, 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

1.4 Primary electrical characteristics.

	h_{FE2} V_{CE} = 10 V dc I_C = 1.0 mA dc		h_{FE4} V_{CE} = 10 V dc I_C = 150 mA dc (1)		$\|h_{fe}\|$ V_{CE} = 20 V dc I_C = 50 mA dc f = 100 MHz	C_{obo} 100 kHz ≤ f ≤ 1 Mhz V_{CB} = 10 V dc I_E = 0	Switching			
							t_{on}	t_{off}		t_{on} + t_{off} (nonsaturated)
	2N3485A	2N3486A	2N3485A	2N3486A		pF	ns	2N3485A	2N3486A	ns
Min	40	100	40	100	2.0					
Max			120	300	10	8	45	175	200	18

(1) Pulsed (see 4.5.1).

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 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 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

DEPARTMENT OF DEFENSE

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

STANDARD

DEPARTMENT OF DEFENSE

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

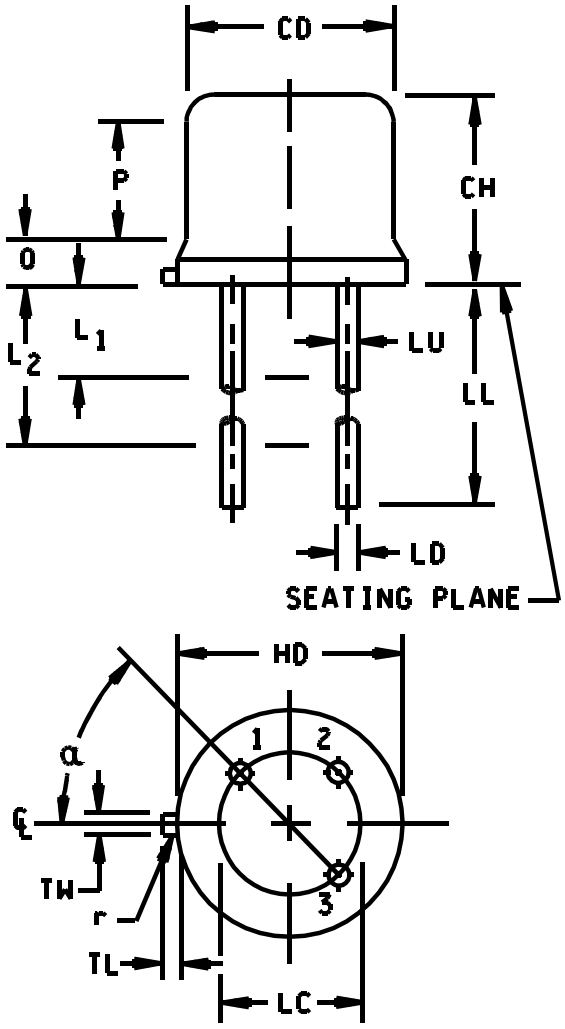


FIGURE 1. Physical dimensions - TO-46.

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.178	.195	4.52	4.95	
CH	.065	.085	1.65	2.16	
HD	.209	.230	5.31	5.84	
LC	.100 TP		2.54 TP		6
LD		.021		.53	7
LL	.500	.750	12.70	19.05	7
LU	.016	.019	.41	.48	7
L1		.050		1.27	7
L2	.250		6.35		7
Q		.040		1.02	7
r		.010		.25	10
TL	.028	.048	.71	1.22	3
TW	.036	.046	.91	1.17	
α	45° TP		45° TP		6

NOTES:
1. Dimension are in inches.
2. Metric equivalents are given for general information only.
3. Beyond r (radius) maximum, TL 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 .008 inch (0.041 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 LL 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 Φx symbology.
12. Lead 1 = emitter, lead 2 = base, lead 3 = collector.

FIGURE 1. Physical dimensions - TO-46 – Continued.

2.3 Order of precedence. 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 requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

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.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500, and figure 1 (T0-46) herein.

3.5 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).

3.6 Electrical performance characteristics. Unless otherwise specified herein, 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 paragraphs 4.4.2 and 4.4.3 herein.

3.8 Marking. Marking shall be in accordance with MIL-PRF-19500. At the option of the manufacturer, marking may be omitted from the body, but shall be retained on the initial container.

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).

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

* 4.4.1 Group E qualification. Group E qualification shall be performed herein for qualification or requalification only. In case qualification was awarded to a prior revision of the associated specification that did not request the performance of group E tests, the tests specified in group E herein shall be performed by the first inspection lot to this revision to maintain qualification.

* 4.3 Screening. Screening shall be in accordance with table 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 IV of MIL-PRF-19500)	Measurements
	JANTX & JANTXV levels
3c	Thermal impedance, method 3131 of MIL-STD-750.
9	Not applicable.
10	24 hours minimum.
11	I_{CBO2}, h_{FE4}
12	See 4.3.1, t = 80 hours minimum
13	Subgroup 2 of table I herein; ΔI_{CBO2} = 100 percent of initial value or 5 nA dc whichever is greater. Δh_{FE4} = ± 15 percent.

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, section 4.5: V_{CB} = 10 - 30 V dc; power shall be applied to achieve T_J = 135°C minimum and a minimum power dissipation of P_D = 75 percent of the maximum rated P_T as defined in 1.3.
NOTE: No heat sink or forced air cooling on the devices shall be permitted.

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 table V of MIL-PRF-19500 and table I herein.

4.4.2 Group B inspection. See 4.4.2.1 for JAN, JANTX, and JANTXV group B testing. Electrical measurements (end-points) and delta requirements for JAN, JANTX, and JANTXV shall be after each step in 4.4.2.1 and shall be in accordance with group A, subgroup 2 and 4.5.2 herein.

4.4.2.1 Group B inspection, (JAN, JANTX, and JANTXV. 1/

Step	Method	Condition
1	1039	Steady-state life: Test condition B, 340 hours, V_{CB} = 10 - 30 V dc, power shall be applied to achieve T_J = 150°C minimum and a minimum power dissipation P_D = 75 percent of maximum rated P_T as defined in 1.3 herein. n = 45, c = 0.
2	1039	The steady-state life test of step 1 shall be extended to 1,000 hours for each die design. Samples shall be selected from a wafer lot every twelve months of wafer production. Group B, step 2 shall not be required more than once for any single wafer lot. n = 45, c = 0.
3	1032	High- temperature life (non-operating), T_A = +200°C, t = 340 hours, n = 22, c = 0.

4.4.2.2 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.

b. Must 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 (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 in 4.4.3.1 (JAN, JANTX, and JANTXV) herein for group C testing. Electrical measurements (end-points) and delta requirements shall be in accordance with group A, subgroup 2 and 4.5.2 herein.

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

	Subgroup	Method	Condition
	C2	2036	Test condition E.
*	C5	3131	$R_{\theta JC}$ = 87°C/W.
	C6		Not applicable.

4.4.3.2 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.

_____

1/ 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.

* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table IX of MIL-PRF-19500 and as specified herein. Electrical measurements (end-points) and delta measurements shall be in accordance with the applicable steps of 4.5.2 and table I subgroup 2 herein.

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 Delta requirements. Delta requirements shall be as specified below:

Step	Inspection	MIL-STD-750		Symbol	Limit
		Method	Conditions		
1	Collector-base cutoff current	3036	Bias condition D, V_{CB} = 50 V dc	ΔI_{CB02} (1)	100 percent of initial value or ± 5 nA dc, whichever is greater.
2	Forward current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc; pulsed see 4.5.1	Δh_{FE4} (1)	±25 percent change from initial reading.

(1) Devices which exceed the group A limits for this test shall not be accepted.

TABLE I. Group A inspection.

*

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical inspection 3/	2071	n = 45 devices, c = 0				
Solderability 3/	2026	n = 15 leads, c = 0				
Resistance to solvents 3/ 4/	1022	n = 15 devices, c = 0				
Temp cycling 3/	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Heremetic seal Fine leak Gross leak	1071	n = 22 devices, c = 0				
Electrical measurements		Group A, subgroup 2				
Bond strength 3/	2037	Precondition T_A = + 250°C at t = 24 hours or T_A = + 300°C at t = 2 hours n = 11 wires, c = 0				
Decap internal visual (design verification)	2075	n = 4, c = 0				
Subgroup 2						
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 60 V dc	I_{CBO1}		10	µA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 5 V dc	I_{EBO1}		10	µA dc
Breakdown voltage, collector to emitter	3011	Bias condition. D; I_C = 10 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$	60		V dc
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 50 V dc	I_{CBO2}		10	nA 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 2 - Continued.						
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 3.5 V dc	I_{EBO2}		50	nA dc
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 0.1 mA dc	h_{FE1}			
2N3485A 2N3486A				40 75		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 1.0 mA dc	h_{FE2}			
2N3485A 2N3486A				40 100		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc	h_{FE3}			
2N3485A 2N3486A				40 100		
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 150 mA dc pulsed (see 4.5.1)	h_{FE4}			
2N3485A 2N3486A				40 100	120 300	
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 500 mA dc pulsed (see 4.5.1)	h_{FE5}			
2N3485A 2N3486A				40 50		
Saturation voltage and resistance	3071	I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$V_{CE(SAT)1}$		0.4	V dc
Saturation voltage and resistance	3071	I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{CE(SAT)2}$		1.6	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 2 - Continued.						
Base-emitter voltage (saturated)	3066	Test condition A; I_C = 150 mA dc; I_B = 15 mA dc; pulsed (see 4.5.1)	$V_{BE(SAT)1}$		1.3	V dc
Base-emitter voltage (saturated)	3066	Test condition A; I_C = 500 mA dc; I_B = 50 mA dc; pulsed (see 4.5.1)	$V_{BE(SAT)2}$		2.6	V dc
Subgroup 3						
High - temperature operation		T_A = +150°C				
Collector - base cutoff current		Bias condition D; V_{CB} = 50 V dc	I_{CBO3}		10	µAdc
Low - temperature operation		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 1.0 mA dc	h_{FE6}			
2N3485A 2N3486A				20 40		
Subgroup 4						
Small signal short circuit forward current transfer ratio	3206	V_{CE} = 10 V dc; I_C = 1 mA dc; f = 1 kHz	h_{fe}			
2N3485A 2N3486A				40 100		
Magnitude of small signal short-circuit forward-current transfer ratio	3306	V_{CE} = 20 V dc; I_C = 50 mA dc; f = 100 MHz	$\|h_{fe}\|$	2.0	10	
Open circuit output capacitance	3236	V_{CB} = 10 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{obo}		8	pF

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

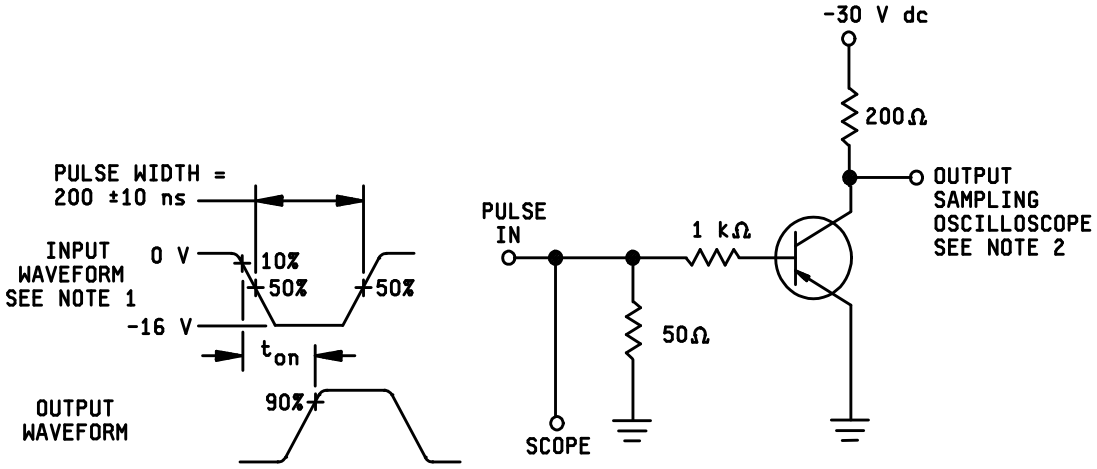
Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
Subgroup 4 - Continued.						
Input capacitance (output open-circuited)	3240	V_{EB} = 2.0 V dc; I_C = 0; 100 kHz ≤ f ≤ 1 MHz	C_{ibo}		30	pF
Turn-on time		(See figure 2)	t_{on}		45	ns
Turn-off time		(See figure 3)	t_{off}			ns
2N3485A 2N3486A					175 200	
Pulse response (nonsaturated)		(See figure 4)	$t_{on} + t_{off}$		18	ns
Subgroup 5, 6 and 7						
Not applicable						

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 group A, 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. Subgroups 1 and 7 may be performed simultaneously.
4/ Not required for laser marked devices.

TABLE II. Group E inspection (all quality levels) – for qualification only.

*

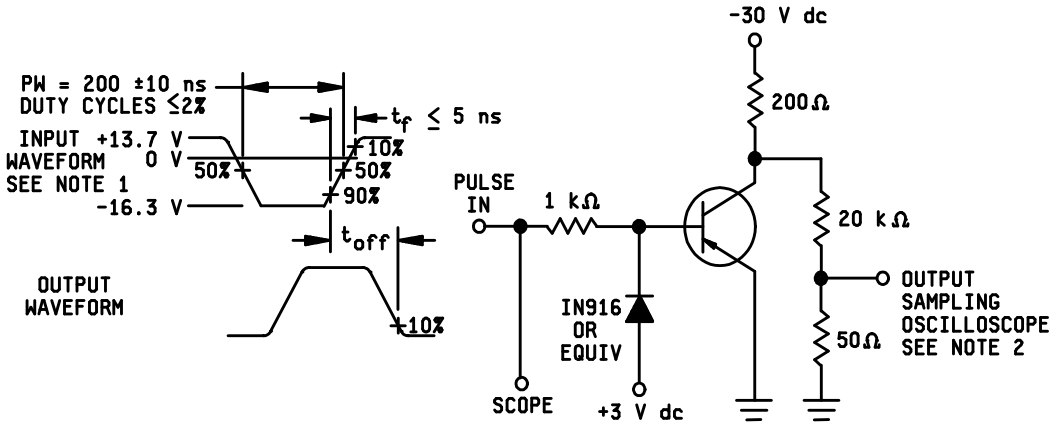
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling (air to air)	1051	Test condition C, 500 cycles	
Hermetic seal			
Fine leak Gross leak	1071		
Electrical measurements		See group A, subgroup 2 and 4.5.2 herein.	
Subgroup 2			45 devices c = 0
Intermittent life	1037	V_{CB} = 10 V dc, 6,000 cycles.	
Electrical measurements		See group A, subgroup 2 and 4.5.2 herein.	
Subgroups 3. 4, 5, 6 and 7			
Not applicable			
Subgroup 8			45 devices c = 0
Reverse stability	1033	Condition A for devices ≥ 400 V Condition B for devices < 400 V	



NOTES:

1. The rise time (t_r) and fall time (t_f) of the applied pulse shall be ≤ 2.0 ns; duty cycle ≤ 2 percent; generator source impedance shall be 50 ohms.
2. Output sampling oscilloscope: Z_{in} ≥ 100 kΩ; C_{in} ≤ RPF; rise time ≤ 0.2 ns.

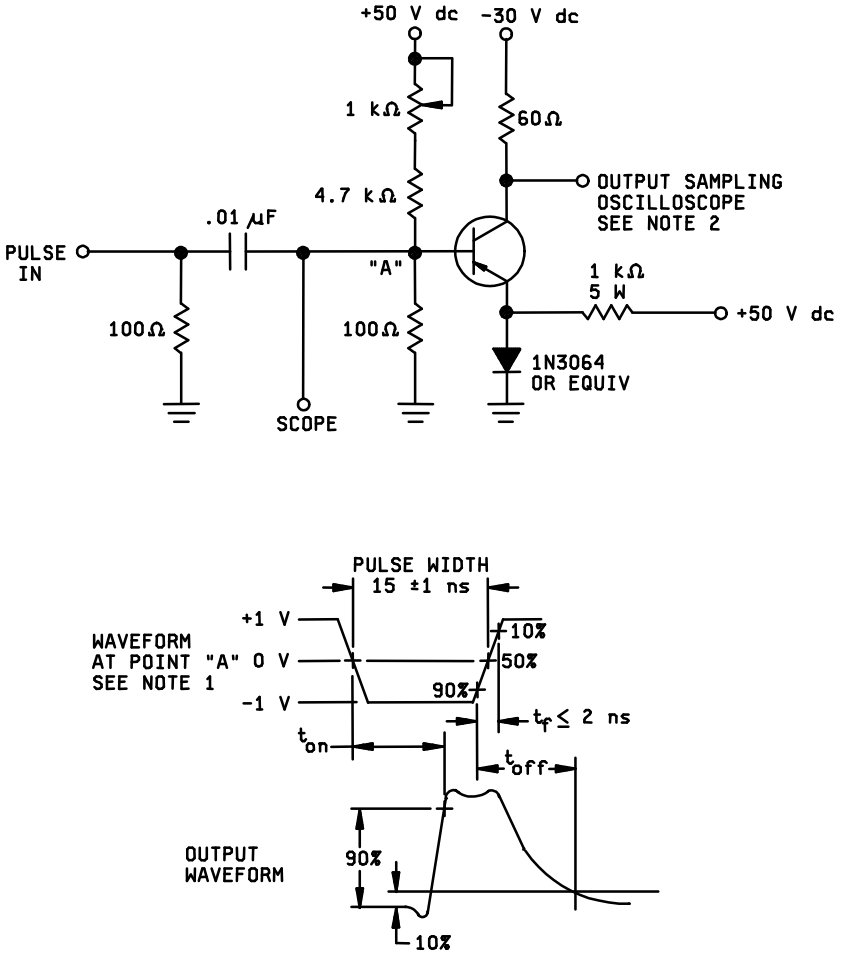
FIGURE 2. Saturated turn-on switching time test circuit.



NOTES:

1. The rise time (t_r) and fall time (t_f) of the applied pulse shall be ≤ 2.0 ns; duty cycle ≤ 2 percent; generator source impedance shall be 50 ohms.
2. Output sampling oscilloscope: Z_{in} ≥ 100 kΩ; C_{in} ≤ RPF; rise time ≤ 0.2 ns.

FIGURE 3. Saturated turn-off switching time test circuit.



NOTES:

1. The rise time (t_r) and fall time (t_f) of the applied pulse shall be ≤ 2.0 ns; duty cycle ≤ 2 percent; generator source impedance shall be 50 ohms.
2. Output sampling oscilloscope: $Z_{in} \geq 100$ kΩ; $C_{in} \leq$ RPF; rise time ≤ 0.2 ns.

FIGURE 4. Nonsaturated turn-on switching time 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 actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. Issue of DoDISS to be cited in the solicitation and, if required, the specified issue of individual documents referenced (see 2.2.1).

c. Lead finish (see 3.4.1).

d. Type designation and quality assurance level.

e. Packaging requirements (see 5.1).

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) 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 Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.4 Changes from previous issue. The margins of this revision are marked with an asterisk 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 - 11
DLA - CC

Review activities:
Army - AV, MI, SM
Navy - AS, MC
Air Force - 19, 71, 99

Preparing activity:
DLA - CC

(Project 5961-2561)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/392F	2. DOCUMENT DATE 5 April 2002

1. DOCUMENT TITLE
SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, SWITCHING TYPE 2N3485A, 2N3486A, JAN, JANTX AND JANTXV

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) COMMERCIAL DSN FAX EMAIL	7. DATE SUBMITTED

8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial DSN FAX EMAIL 614-692-0510 850-0510 614-692-6939 alan.barone@dscc.dla.mil
c. ADDRESS Defense Supply Center Columbus, ATTN: DSCC-VAC P.O. Box 3990 Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman, Suite 2533 Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888