The documentation and process conversion measures necessary to comply with this revision shall be completed by 12 November 1999.

INCH-POUND

MIL-PRF-19500/518C(USAF)
12 August 1999
SUPERSEDING
MIL-S-19500/518B(USAF)
21 November 1994

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER
TYPE 2N3766, 2N3767 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 NPN silicon, power 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 (similar to T0-66).

1.3 Maximum ratings.

Type	P_T T_C = +25°C 1/	V_{CBO}	V_{CEO}	V_{EBO}	I_B	I_C	T_{OP} and T_{stg}	$R_{\theta JC}$
	W	V dc	V dc	V dc	A dc	A dc	°C	°C/W
2N3766	25	80	60	6	2	4	-65 to +200	7
2N3767	25	100	80	6	2	4	-65 to +200	7

1/ Between T_C = +25°C and T_C = +200°C, linear derating factor (average) = 143 m/W°C.

1.4 Primary electrical characteristics.

Type	h_{FE2} 1/		h_{FE3} 1/		C_{obo}		$\lvert h_{fe} \rvert$		$V_{BE(sat)}$	
	V_{CE} = 10 V dc I_C = 1 A dc		V_{CE} = 5 V dc I_C = 500 mA dc		V_{CB} = 10 V dc I_E = 0 0.1 MHz ≤ f ≤ 1 MHz		V_{CE} = 10 V dc I_C = 500 mA dc f = 10 MHz		I_C = 1 A dc I_B = 0.1 A dc	
	Min	Max	Min	Max	Min PF	Max pF	Min	Max	Min V dc	Max V dc
2N3766	20		40	160		50	1	8		1.5
2N3767	20		40	160		50	1	8		1.5

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: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAC, 3990 East Broad Street, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Primary electrical characteristics. Continued.

Type	$V_{CE(sat)1}$		$V_{CE(sat)2}$		Switching			
	I_C = 1 A dc I_B = 0.1 A dc		I_C = 500 mA dc I_B = 50 mA dc		t_{on}		t_{off}	
					(see table I and figure 2 herein)			
	Min	Max	Min	Max	Min µs	Max µs	Min µs	Max µs
2N3766		2.5		1.0		0.25		2.5
2N3767		2.5		1.0		0.25		2.5

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

MILITARY

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Defense Automated Printing Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), 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 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified manufacturer's list before contract award (see 4.2 and 6.3).

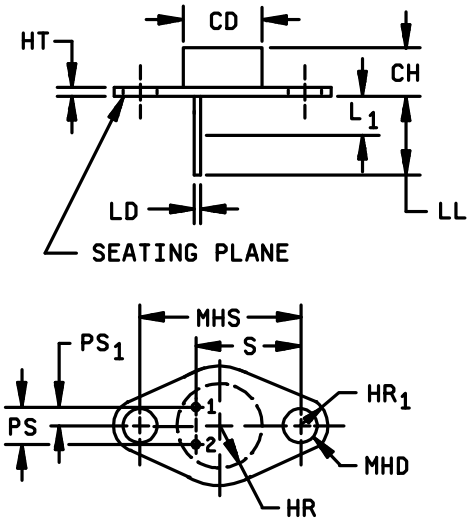
3.2 Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500 and as specified herein.

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

3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 herein.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-STD-750, MIL-PRF-19500, and herein. Where a choice of lead finish or formation is desired, it shall be specified in the acquisition requirements (see 6.2).

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		0.620		15.76	
CH	0.250	0.340	6.35	8.64	
HR		0.350		8.89	4
HT	0.050	0.075	1.27	1.91	
HR_1	0.115	0.145	2.92	3.68	4
LD	0.028	0.034	0.71	0.86	4, 6
LL	0.360	0.500	9.14	12.70	
L_1		0.050		1.27	6
MHD	0.142	0.152	3.61	3.86	4
MHS	0.958	0.962	24.33	24.43	
PS	0.190	0.210	4.83	5.33	3
PS_1	0.093	0.107	2.36	2.72	3
S	0.570	0.590	14.48	14.99	



NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. These dimensions should be measured at points 0.050 inch (1.27 mm) +0.005 inch (0.13 mm) -0.000 inch (0.00 mm) below seating plane. When gauge is not used, measurement will be made at the seating plane.
4. Two places.
5. The seating plane of the header shall be flat within 0.001 inch (0.03 mm) concave to 0.004 inch (0.10 mm) convex inside a 0.930 inch (23.62 mm) diameter circle on the center of the header and flat within 0.001 inch (0.03 mm) concave to 0.006 inch (0.15 mm) convex overall.
6. Lead diameter shall not exceed twice LD within L_1.
7. Lead number 1 is the emitter, lead 2 is the base, case is the collector.
8. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions (similar to TO-66).

3.5 Marking. Marking shall be in accordance with 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 requirements shall be the subgroups specified in table I herein.

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.

4.3 Screening (JANTX and JANTXV levels only). 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)	Measurement
	JANTX and JANTXV levels
11	I_{CEX1} and h_{FE2};
12	See 4.3.1.
13	Subgroup 2 of table I herein. ΔI_{CEX1} = 100 percent of initial value or 1 μA dc, whichever is greater; Δh_{FE2} = 25 percent of initial value.

1/ Hermetic seal test shall be performed in either screen 7 or screen 14.

4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:

T_J = +187.5°C ±12.5°C; V_{CB} ≥ 10 V dc; T_A ≤ +35°C.

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. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified. 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. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

Step	Method	Condition
1	1039	Steady-state life: Test condition B, 340 hours, $V_{CB} \geq 10$ V dc, $T_J = 175°C$ min. No heat sink or forced-air cooling on the devices shall be permitted. n = 45 devices, 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, however, Group B shall not be required more than once for any single wafer lot. n = 45, c = 0.
3	1032	High-temperature life (non-operating), $T_A = +200°C$. n = 22, c = 0

4.4.2.1 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. See MIL-PRF-19500.

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 for subgroup testing in table VII of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, subgroup 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.
C6		Not applicable

4.4.3.2 Group C sample selection. Samples for subgroups in group C shall be chosen at random from any 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.

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

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

4.5.2 Coil selection for safe operating area (SOA) tests. In selecting coils for use in clamped and unclamped inductive SOA tests, prime consideration should be given to the commercially available coil. However, due to the extreme critical nature of the coil in these circuits and wide tolerance of some commercially available coils (+100 percent, -50 percent), it shall be the semiconductor manufacturer's responsibility to prove upon request compliance or equivalency of any coil used (commercial or in-plant designed) to be within (+20 percent, -10 percent) of the specified inductance at the rated current and dc resistance.

4.5.3 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 applications shall be 0.4 A dc.

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

c. Reference temperature measuring point shall be the case.

d. Reference point temperature shall be $+25°C \leq T_R \leq +35°C$ and recorded before the test is started.

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

f. Maximum limit shall be $R_{\theta JC} = 7°C/W$.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1 2/						
Visual and mechanical 3/ examination	2071	n = 45 devices, c = 0				
Solderability 3/	2026	n = 15 leads, c = 0				
Resistance to 3/ 4/ solvent	1022	n = 15 devices, c = 0				
Temp cycling 3/	1051	Test condition C, 25 cycles. n = 22 devices, c = 0				
Heremetic seal	1071	n = 22 devices, c = 0				
Fine leak						
Gross leak						
Electrical measurements		Group A, subgroup 2				
Bond strength 3/	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						
Collector to emitter breakdown voltage	3011	Bias condition D; I_C = 100 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N3766				60		V dc
2N3767				80		V dc
Collector to emitter cutoff current	3041	Bias condition D;	I_{CEO}		500	µA dc
2N3766		V_{CE} = 60 V dc				
2N3767		V_{CE} = 80 V dc				
Emitter-base cutoff current	3061	Bias condition D; V_{EB} = 6 V dc	I_{EBO}		500	µA dc
Collector to emitter cutoff current	3041	Bias condition A; V_{BE} = 1.5 V dc;	I_{CEX1}			
2N3766		V_{CE} = 80 V dc			10	µA dc
2N3767		V_{CE} = 100 V dc			10	µA dc
Collector to base cutoff current	3036	Bias condition D;	I_{CBO}			
2N3766		V_{CB} = 80 V dc			10	µA dc
2N3767		V_{CB} = 100 V dc			10	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						
Base to emitter non-saturated voltage	3066	Test condition B; V_{CE} = 10 V dc; I_C = 1.0 A dc; pulsed (see 4.5.1)	V_{BE}		1.5	V dc
Collector to emitter saturated voltage	3071	I_C = 1.0 A dc; I_B = 0.1 A dc; pulsed (see 4.5.1)	$V_{CE(sat)1}$		2.5	V dc
Collector to emitter saturated voltage	3071	I_C = 0.5 A dc; I_B = 0.05 A dc; pulsed (see 4.5.1)	$V_{CE(sat)2}$		1.0	V dc
Forward-current transfer ratio	3076	V_{CE} = 5 V dc; I_C = 50 mA dc; pulsed (see 4.5.1)	h_{FE1}	30		
Forward-current transfer ratio	3076	V_{CE} = 5 V dc; I_C = 500 mA dc; pulsed (see 4.5.1)	h_{FE3}	40	160	
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 1 A dc; pulsed (see 4.5.1)	h_{FE3}	20		
Subgroup 3						
High-temperature operation:		T_A = +150°C				
Collector to emitter cutoff current	3041	Bias condition A; V_{BE} = 1.5 V dc	I_{CEX2}			
2N3766		V_{CE} = 50 V dc			1.0	mA dc
2N3767		V_{CE} = 70 V dc			1.0	mA dc
Low-temperature operation:		T_A = -55°C				
Forward-current transfer ratio	3086	V_{CE} = 5.0 V dc; I_C = 0.5 A dc; pulsed (see 4.5.1)	h_{FE4}	13		

See footnotes at end of table.

1ABLE I. Group A inspection - Continued.

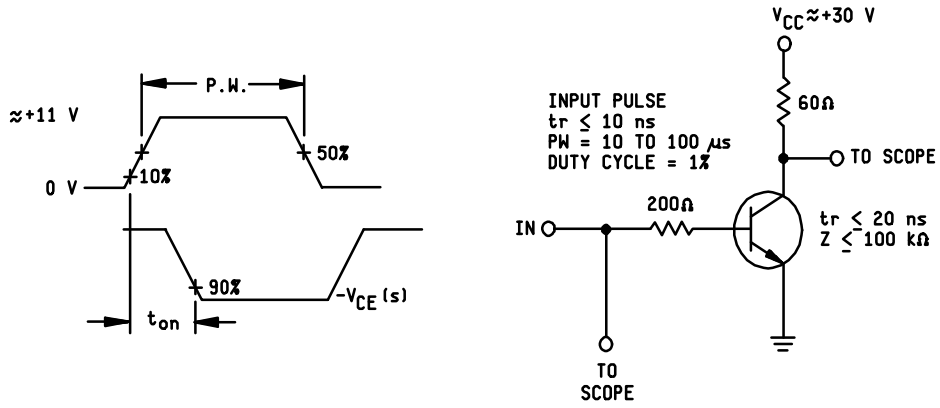
Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 4						
Pulse response:	3251	Test condition A, except test circuit and pulse requirements in accordance with figure 2 herein.				
Turn-on time		V_{CC} = 30 V dc; I_C = 0.5 A dc; I_{B1} = 0.05 A dc	t_{on}		0.25	µs
Turn-off time		V_{CC} = 30 V dc; I_C = 0.5 A dc; I_{B1} = I_{B2} = .05 A dc	t_{off}		2.5	µs
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 10 V dc; I_C = 500 mA dc; f = 10 MHz	$\lvert h_{fe} \rvert$	1	8	
Open capacitance (open circuit)	3236	V_{CE} = 10 V dc; I_E = 0; 0.1 MHz ≤ f ≤ 1.0 MHz	C_{obo}		50	pF
Subgroup 5						
Safe operating area (continuous dc)	3051	T_C = +25°C; power application t = 1 s; 1 cycle; (see figure 3)				
Test 1		V_{CE} = 6.25 V dc; I_C = 4 A dc				
Test 2		V_{CE} = 20 V dc; I_C = 1.25 A dc				
Test 3						
2N3766		V_{CE} = 50 V dc; I_C = 150 mA dc				
2N3767		V_{CE} = 65 V dc; I_C = 150 mA dc				

See footnotes at end of table.

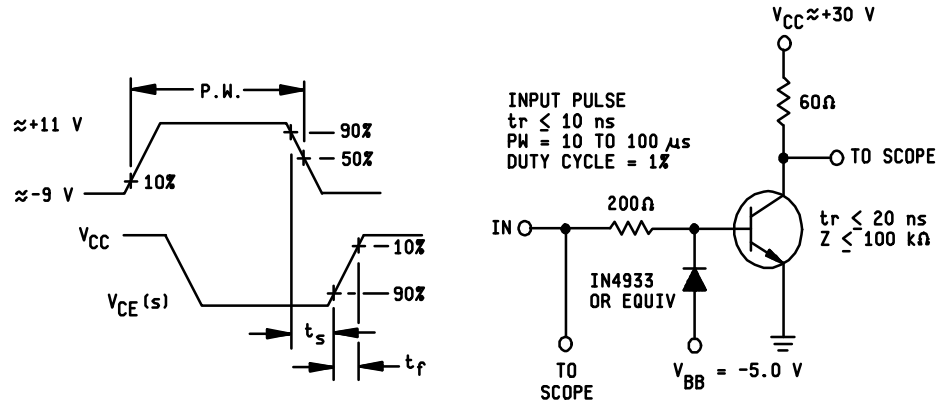
1ABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 5- Continued						
Safe operating area (clamped switching)	3053	Load condition B; T_A = +25°C; V_{CC} = 20 V dc, $t_p \approx$ 1.5 ms, R_{BB1} = 5 Ω; (Vary to obtain I_C); duty cycle ≤ 5 percent; $I_C \approx$ 4 A dc; R_{BB2} = 100 Ω; V_{BB2} = 1.5 V dc; $V_{BB1} \approx$ 10 V dc; L = 5 mH, at 4A, R of inductor = .5 Ω, and R_{LOAD} = R of inductor. 5/				
2N3766		Clamp voltage = 60 V dc				
2N3767		Clamp voltage = 80 V dc				
		Device fails if clamp voltage is not reached.				
End point electrical measurements		See table I, subgroup 2 herein, I_{CEX1} and h_{FE2} electrical tests				
Subgroups 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.
3/ Separate samples may be used.
4/. Not required for laser marked devices.
5/ L = 5 mH (2 each Essex Stancor C-2688 in parallel 1A, 0.5 ohm, or equivalent (see 4.5.2).



TURN-ON (t_{on}) TIME TEST CIRCUIT



TURN-OFF (t_{off}) TIME TEST CIRCUIT

FIGURE 2. Switching time test circuit.

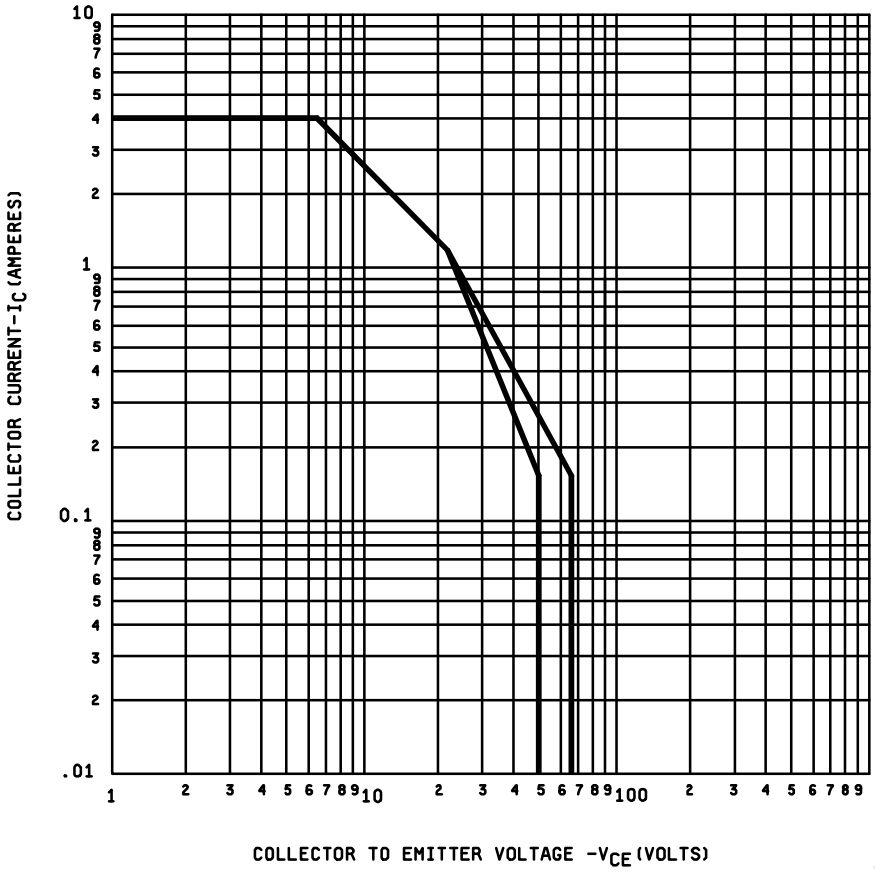


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FIGURE 3. Maximum safe operating area graph (continuous dc) for types 2N3766 and 2N3767.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. When actual packaging of material 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

(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-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Issue of DODISS to be cited in the solicitation (see 2.2.1).

b. The lead finish as specified (see 3.4.1).

c. Type designation and quality assurance level.

d. 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 Manufacturer's List QML No.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 purchase 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, 3990 East Broad Street, Columbus, OH 43216-5000.

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Air Force - 11
DLA - CC

Review activities:
Air Force - 19, 99

Preparing activity:
DLA - CC

(Project 5961-F153)

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-19500/518C	2. DOCUMENT DATE 990812

3. **DOCUMENT TITLE**
SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, POWER TYPES 2N3766, 2N3767 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, 3990 East Broad Street, 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