

The documentation and process conversion measures necessary to comply with this revision shall be completed by 25 September 1999.

INCH-POUND

MIL-PRF-19500/225F
25 June 1999
SUPERSEDING
MIL-S-19500/225E
15 April 1994

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON,
TYPES 2N1711, 2N1711S, 2N1890, 2N1890S,
JAN AND JANTX

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, low-power transistors. Two levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See 3.3 (similar to TO-5).

1.3 Maximum ratings.

Type 1/	P_T 2/ $T_C = +25^\circ\text{C}$	P_T 3/ $T_A = +25^\circ\text{C}$	V_{CBO}	V_{EBO}	I_C	V_{CER} $R_{BE} = 10\ \Omega$	T_J and T_{STG}
	<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>mA dc</u>	<u>V dc</u>	<u>°C</u>
2N1711	3.0	0.8	75	7	500	50	-65 to +200
2N1890	3.0	0.8	100	7	500	80	-65 to +200

1/ Also applies to the corresponding "S" suffix device.

2/ Derate linearly at 17.2 mW/°C for $T_C > +25^\circ\text{C}$.

3/ Derate linearly at 4.57 mW/°C for $T_A > +25^\circ\text{C}$.

1.4 Primary electrical characteristics.

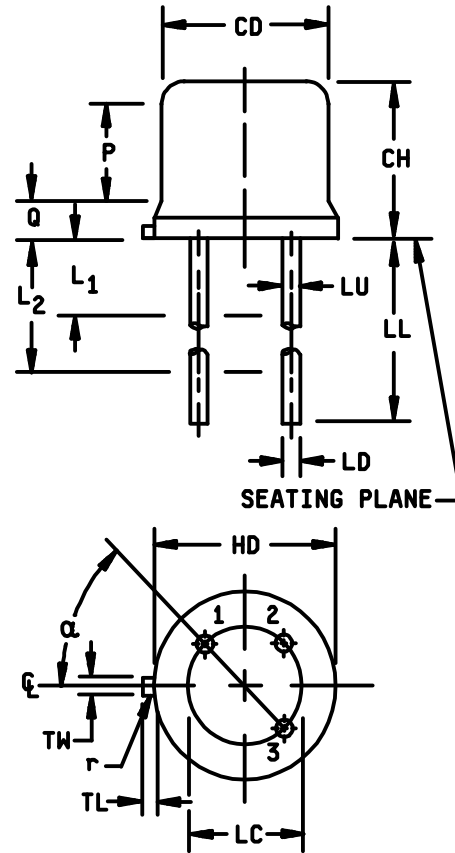
Limits	h_{FE1} 1/	h_{FE2} 1/	$ h_{fe} $	$V_{CE(SAT)}$	
	$V_{CE} = 10\ \text{V dc}$ $I_C = 10\ \mu\text{A dc}$	$V_{CE} = 10\ \text{V dc}$ $I_C = 150\ \text{mA dc}$	$f = 20\ \text{MHz}$ $V_{CE} = 10\ \text{V dc}$ $I_C = 50\ \text{mA dc}$	2N1711 2/ $I_C = 150\ \text{mA dc}$ $I_B = 50\ \text{mA dc}$	2N1890 2/ $I_C = 50\ \text{mA dc}$ $I_B = 5.0\ \text{mA dc}$
				<u>V dc</u>	<u>V dc</u>
Min	20	100	3.5	0.2	0.2
Max		300	12	1.5	1.2

1/ Pulsed (see 4.5.1).

2/ Also applies to the corresponding "S" suffix device.

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-VAT, 3990 East Broad St., Columbus, OH 43216-5000, by using the addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

Symbol	Dimensions				Note
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.335	7.75	8.51	
CH	.240	.260	6.10	6.60	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.021	0.41	0.53	7,8
LL	see notes 7, 8, 13				
LU	.016	.019	0.41	0.48	7,8
L1	---	.050	---	1.27	7,8
L2	.250	---	6.35	---	7,8
Q	---	.050	---	1.27	5
TL	.029	.045	0.74	1.14	3,4
TW	.028	.034	0.71	0.86	3
r	---	.010	---	0.25	10
α	45° TP		45° TP		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 .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by the gauge and gauging procedure shown in figure 2.
7. Dimension LU applies between L₁ and L₂. Dimension LD applies between L₂ and LL minimum. Diameter is uncontrolled in L₁ 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 ϕ x symbology.
12. Lead 1 = emitter, lead 2 = base, lead 3 = collector (case).
13. For 2N1711S and 2N1890S, dimension LL = .5 inches (12.70 mm) min. and .75 inches (19.05 mm) max.
For 2N1711 and 2N1890, dimension LL = 1.5 inches (38.10 mm) min. and 1.75 inches (44.45 mm) max.

FIGURE 1. Physical dimensions (similar to TO-5).

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 Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, 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 Associated specification. The individual item requirements shall be in accordance with MIL-PRF-19500 and as specified herein.

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

3.3 Interface requirements and physical dimensions. The Interface requirements and physical dimensions shall be as specified in MIL-PRF-19500, MIL-HDBK-6100, and herein.

3.3.1 Lead finish. Lead finish shall be solderable in accordance with MIL-STD-750 and MIL-PRF-19500.

3.4 Marking. Marking shall be in accordance with MIL-PRF-19500. At the option of the manufacturer, the country of origin may be omitted from the body of the transistor.

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

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

3.7 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.4).

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).

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

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

4.3 Screening (JANTX level). 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 level only
1/	Thermal impedance (see 4.3.2)
9	Not applicable
11	h_{FE2} ; I_{CBO1}
12	See 4.3.1
13	ΔI_{CBO1} = 100 percent of initial value or 5 nA dc; whichever is greater; Δh_{FE2} = ± 15 percent of initial value;

1/ Thermal impedance shall be performed anytime after sealing provided temperature cycling is performed in accordance with MIL-PRF-19500, screen 3 prior to this thermal test.

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 (see 4.5).

P_T = 800 mW;

2N1711, 2N1711S: V_{CB} = 24 V dc.

2N1890, 2N1890S: V_{CB} = 48 V dc.

NOTE: No heat sink or forced air cooling of the devices shall be permitted.

4.3.2 Thermal impedance $Z_{\theta JX}$ measurements (for qualification only). The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750, method 3131.

- a). I_M measurement current.....10 mA.
- b). I_H forward heating current.....50 mA minimum.
- c). t_H heating time.....10 ms.
- d). t_{MD} measurement delay time100 μ s minimum.
- e). V_{CE} collector - emitter voltage.....10 V dc.

The maximum limit for $Z_{\theta JX}$ under these test conditions is $Z_{\theta JX}(\text{max}) = 58^\circ\text{C/W}$.

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. The test conditions for $Z_{\theta JX}$ shall be those used in 4.3.2.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JANTX) of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein.

Subgroup	Method	Condition
B3	1027	T_A = room ambient as defined in the general requirements of MIL-STD-750 (see 4.5); $T_J = 150^\circ\text{C min}$; $V_{CB} = 24$ V dc for 2N1711 and 2N1711S; $V_{CB} = 48$ V dc for 2N1890 and 2N1890S.

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, and as follows. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein.

Subgroup	Method	Condition
C2	2036	Lead fatigue: Test condition E.
C6	1026	T_A = room ambient as defined in the general requirements of MIL-STD-750 (see 4.5). $T_J = 150^\circ\text{C min}$; $V_{CB} = 24$ V dc for 2N1711 and 2N1711S; $V_{CB} = 48$ V dc for 2N1890 and 2N1890S.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein.

Subgroup	Method	Condition
E1	1051	Condition C, 500 cycles; 22 devices, $c = 0$.
E1	1071	
E2	1038	80 to 85 percent of rated V_{CBO} , $T_A = 150^\circ\text{C}$, $t = 1,000$ hours
E3	----	Not applicable.
E4	3131	See 4.5.2, 22 devices, $c = 0$.
E5	----	Not applicable.

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

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

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance 2/	3131	See 4.4.1	$Z_{\theta JX}$		58	°C/W
Breakdown voltage collector to base	3001	Bias condition D, $I_C = 100 \mu A$ dc	$V_{(BR)CBO}$			
2N1711, 2N1711S				75		V dc
2N1890, 2N1890S				100		V dc
Breakdown voltage emitter to base	3026	Bias condition D, $I_E = 100 \mu A$ dc	$V_{(BR)EBO}$	7		V dc
Breakdown voltage collector to emitter	3011	Bias condition D, $I_C = 30$ mA dc, pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N1711, 2N1711S				30		V dc
2N1890, 2N1890S				60		V dc
Breakdown voltage collector to emitter	3011	Bias condition D, $I_C = 100$ mA dc, pulsed (see 4.5.1), $R_{BE} = 10 \Omega$	$V_{(BR)CER}$			
2N1711, 2N1711S				50		V dc
2N1890, 2N1890S				80		V dc
Collector to base cutoff current	3036	Bias condition D	I_{CBO1}			
2N1711, 2N1711S		$V_{CB} = 60$ V dc			10	nA dc
2N1890, 2N1890S		$V_{CB} = 80$ V dc			10	nA dc
Emitter to base cutoff current	3061	Bias condition D, $V_{EB} = 5$ V dc	I_{EBO}		5.0	nA dc
Collector to emitter saturated voltage	3071	$I_C = 150$ mA dc, $I_B = 15$ mA dc, pulsed (see 4.5.1)	$V_{CE(sat)1}$			
2N1711, 2N1711S					1.5	V dc
2N1890, 2N1890S					5.0	V dc
Collector to emitter saturated voltage	3071	$I_C = 50$ mA dc, $I_B = 5$ mA dc, pulsed (see 4.5.1)	$V_{CE(sat)2}$			
2N1890, 2N1890S					1.2	V dc
Base emitter saturated voltage	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

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

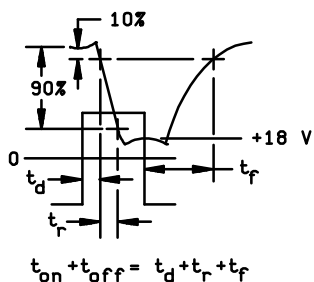
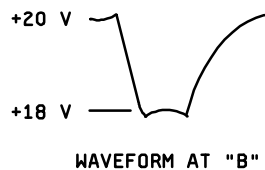
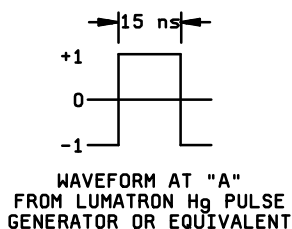
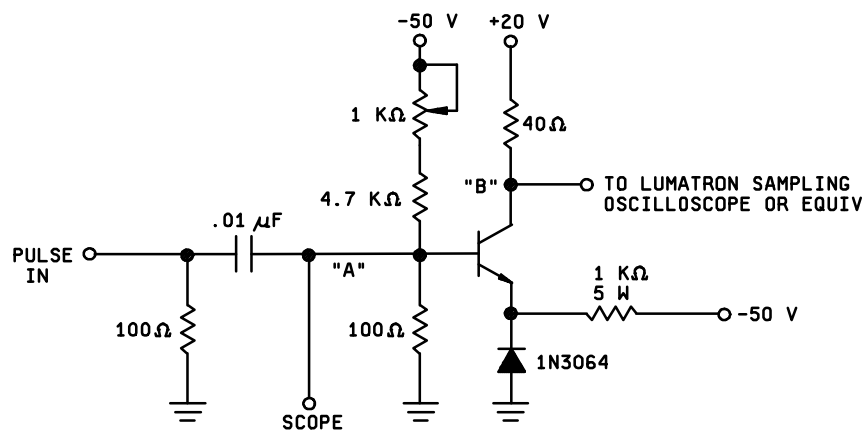
Inspection 1/ <u>Subgroup 2</u> - Continued	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Base emitter saturated voltage	3066	Test condition A, $I_C = 50 \text{ mA dc}$, $I_B = 5 \text{ mA dc}$, pulsed (see 4.5.1)	$V_{BE(sat)2}$			
2N1890, 2N1890S					0.9	V dc
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ V dc}$, $I_C = 10 \mu\text{A dc}$, pulsed (see 4.5.1)	h_{FE1}	20		
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ V dc}$, $I_C = 150 \text{ mA dc}$, pulsed (see 4.5.1)	h_{FE2}	100	300	
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ V dc}$, $I_C = 500 \text{ mA dc}$, pulsed (see 4.5.1)	h_{FE3}			
2N1711, 2N1711S				50		
<u>Subgroup 3</u>						
High temperature operation:		$T_A = +150^\circ\text{C}$				
Collector to base cutoff current	3036	Bias condition D	I_{CBO2}			
2N1711, 2N1711S		$V_{CB} = 60 \text{ V dc}$			10	$\mu\text{A dc}$
2N1890, 2N1890S		$V_{CB} = 80 \text{ V dc}$			15	$\mu\text{A dc}$
Low temperature operation:		$T_A = -55^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 10 \text{ V dc}$, $I_C = 10 \text{ mA dc}$, pulsed (see 4.5.1)	h_{FE1}	35		
<u>Subgroup 4</u>						
Small-signal short- circuit forward- current transfer ratio	3206	$V_{CE} = 5 \text{ V dc}$, $I_C = 1 \text{ mA dc}$	h_{fe}	80	200	
		$V_{CE} = 10 \text{ V dc}$, $I_C = 5 \text{ mA dc}$	h_{fe}	90	270	
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10 \text{ V dc}$, $I_C = 50 \text{ mA dc}$, $f = 20 \text{ MHz}$	$ h_{fe} $	3.5	12	

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u> - Continued						
Small-signal short-circuit input impedance	3201	$V_{CB} = 10 \text{ V dc}, I_C = 5 \text{ mA dc}$	h_{ib}	4	8	Ω
Small-signal short-circuit output admittance	3216	$V_{CB} = 10 \text{ V dc}, I_C = 5 \text{ mA dc}$	h_{ob}			
2N1711, 2N1711S 2N1890, 2N1890S				0.0 0.0	1.0 0.3	μmhos μmhos
Small-signal open-circuit reverse-voltage transfer ratio	3211	$V_{CB} = 10 \text{ V dc}, I_C = 5 \text{ mA dc}$	h_{rb}			
2N1711, 2N1711S 2N1890, 2N1890S					5×10^{-4} 1.5×10^{-4}	μmhos μmhos
Open circuit output capacitance	3236	$V_{CB} = 10 \text{ V dc}, I_E = 0,$ $100 \text{ kHz} \leq f \leq 1 \text{ MHz}$	C_{obo}			
2N1711, 2N1711S 2N1890, 2N1890S				8 5	25 15	pF pF
Pulse response	3251	Test condition A, except test circuit and pulse requirements See figure 2 herein.	$t_{on} + t_{off}$		30	ns
<u>Subgroups 5, 6, and 7</u>						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.2/ Need not be performed in screen 13.



NOTES:

1. The rise time (T_r) of the applied pulse shall be $2.0 \leq ns$, duty cycle ≤ 2 percent, and the generator source impedance shall be 50Ω .
2. Sampling oscilloscope: $Z_{in} \geq 100 k\Omega$, $C_{in} \leq 12 pF$, rise time $\leq 2 ns$.

FIGURE 2. Pulse response (turn-on plus turn-off) measurement circuit and waveforms.

4.5.2 Thermal resistance (qualification only). 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 30 mA dc (2N1711 and 2N1711S), and 50 mA dc (2N1890 and 2N1890S).
- b. Collector to emitter voltage magnitude ≥ 20 V dc.
- c. Reference temperature measuring point shall be the case.
- d. Reference point temperature shall be $25^{\circ}\text{C} \leq T_R \leq 75^{\circ}\text{C}$ and recorded before the test is started.
- e. Mounting arrangement shall be with heat sink to case.
- f. t_{md} measurement delay time = 100 μs
- g. I_M measurement current = 10 mA
- h. Maximum limit shall be $R_{\theta JC} = 58^{\circ}\text{C/W}$.

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 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 Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129.

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 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 2.2.1).
- b. Lead finish (see 3.3.1).
- c. Type designation and product assurance level.
- d. Packaging requirements (see 5.1).

6.3 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.

6.4 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 purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, DSCC-VQE, Columbus, OH 43216.

CONCLUDING MATERIAL

Custodians:
Navy - EC
Army - CR
Air Force - 11
NASA - NA
DLA - CC

Preparing activity:
DLA - CC

(Project 5961-1921)

Review activities:
Army - AR, AV, MI, SM
Navy - AS, CG, MC
Air Force - 13, 19

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL			
<u>INSTRUCTIONS</u>			
<p>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.</p> <p>2. The submitter of this form must complete blocks 4, 5, 6, and 7.</p> <p>3. The preparing activity must provide a reply within 30 days from receipt of the form.</p> <p>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.</p>			
I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/225F	2. DOCUMENT DATE 99/06/21	
3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, TYPES 2N1711, 2N1711S, 2N1890, 2N1890S, JAN AND JANTX			
4. NATURE OF CHANGE <i>(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)</i>			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME (Last, First, Middle initial)	b. ORGANIZATION		
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code)	7. DATE SUBMITTED	
	Commercial DSN FAX EMAIL		
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@dscclia.mil		
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAT 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 Road, Suite 2533 Fort Belvoir, Virginia 22060-6221 Telephone (703) 767-6888 DSN 427-6888		