The documentation and process conversion measures necessary to comply with this revision shall be completed by 5 May 1995

INCH-POUND

MIL-S-19500/274C(ER)
5 January 1995

SUPERSEDING
MIL-S-19500/274B(EL)
4 April 1969

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, NPN, SILICON, TRANSISTORS
TYPES 2N910, 2N910S, 2N911, 2N911S, 2N912, AND 2N912S, JAN AND JANTX

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

1. SCOPE

1.1 Scope. This specification covers the detail requirements for NPN, silicon, transistors for small-signal, general purpose amplifier applications. Two levels of product assurance are provided for each device type as specified in MIL-S-19500.

1.2 Physical dimensions. See figure 1 and 3.3 herein.

1.3 Maximum ratings. 1/

P_T 1/ T_A = +25°C	P_T T_C = +25°C 2/	$V(BR)_{CBO}$	$V(BR)_{EBO}$ 3/	$V(BR)_{CEO}$ 3/	T_{OP} and T_{STG}
mW	mW	V dc	V dc	V dc	°C
500	1800	100	7	60	-65 to +200

1/ Derate linearly 2.86 mW/°C above T_A = +25°C.
2/ Derate linearly 10.3 mW/°C above T_C = +25°C.
3/ Pulsed (see 4.5.1).

1.4 Primary electrical characteristics. Characteristics apply to each transistor in the array.

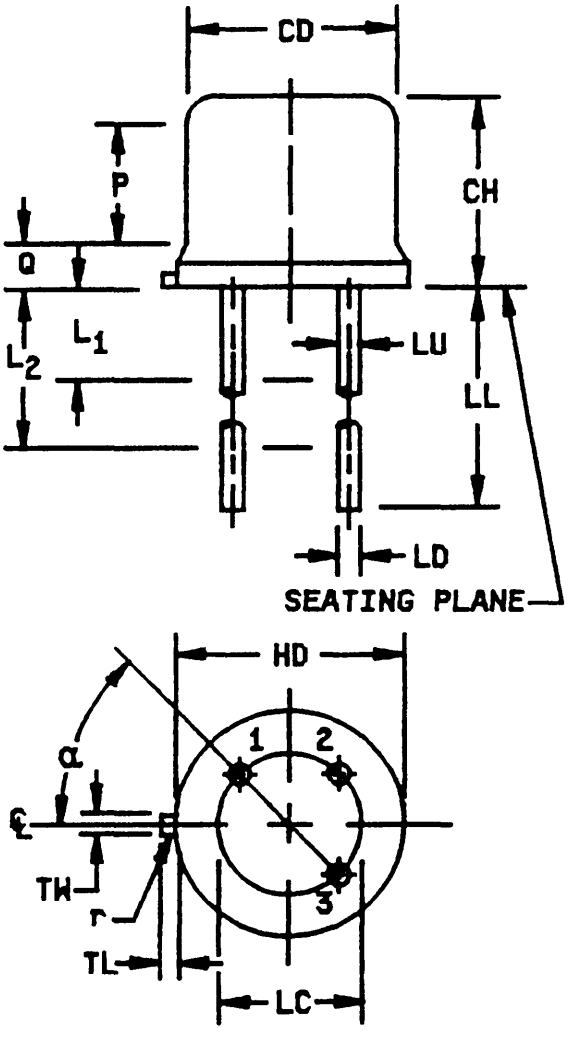
TYPE 1/	h_{FE} at V_{CE} = 10 V dc				h_{fe} at V_{CE} = 5 V dc				$\lvert h_{fe} \rvert$ V_{CE} = 10 V dc I_C = 50 mA dc f = 20 MHz	
	h_{FE1} I_C = 0.1 mA dc		h_{FE2} I_C = 10 mA dc		h_{fe1} I_C = 1 mA dc		h_{fe2} I_C = 5 mA dc			
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2N910	35		75	300	76	200	80	200	3.0	10.0
2N911	20		35	140	36	90	40	100	2.5	9.0
2N912	10		15	60	18	40	20	50	2.0	8.0

See footnote on page 3.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Research Laboratory, Electronics and Power Sources Directorate, ATTN: AMSRL-EP-RD, Ft. Monmouth, NJ 07703-5601 by using the Standardization Document Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5961

Symbol	Inches		Millimeters		Note
	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		
LD	.016	.021	0.41	0.53	4
LL	See notes 8 and 9				
LU	.016	.019	0.41	0.48	4
L_1		.050		1.27	
L_2	.250		6.35		
TL	.028	.048	0.71	1.22	5
TW	.036	.046	.91	1.17	
P	.100		2.54		3,6
Q		.040		1.02	
r		.007		.018	
α	45° TP		45° TP		



NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed .010 inch (0.254 mm).
4. (Three leads) LU applies between L_1 and L_2. LD applies between L_2 and .5 inch (12.70 mm) from seating plane. Diameter is uncontrolled in L_1 and beyond .5 inch (12.70 mm) from seating plane.
5. Measured from maximum diameter of the actual device.
6. Details of outline in this zone optional.
7. The collector shall be electrically connected to the case.
8. For transistor types 2N910, 2N911, and 2N912, LL is .5 inch (12.7 mm) minimum and .75 inch (19.05 mm) maximum.
9. For transistor types 2N910S and 2N911S, LL is 1.5 inches (38.7 mm) minimum and 1.75 inches (44.45 mm) maximum.
10. In accordance with ANSI Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Physical dimensions of transistor type 2N5109.

1.4 Primary electrical characteristics - Continued.

TYPE 1/	NF		h_{ib2}		h_{ob}		$V_{BE(sat)}$		$V_{CE(sat)}$		C_{obo}	
	f = 1 kHz 1/ V_{CE} = 10 V dc I_C = 0.3 mA dc		V_{CE} = 5 V dc I_C = 1 mA dc		V_{CE} = 5 V dc I_C = 1 mA dc		I_C = 10 mA dc I_B = 1 mA dc		I_C = 50 mA I_B = 1 mA dc		f ≥ .1 ≤ 1 MHz V_{CB} = 10 V dc I_E = 0 mA dc	
	Min dB	Max dB	Min Ω	Max Ω	Min umhos	Max umhos	Min V dc	Max V dc	Min V dc	Max V dc	Min pF	Max pF
2N910		12	20	30		.4	.6	.8		.4		15
2N911		15	20	30		.4	.6	.8		.4		15
2N912		18	20	30		.4	.6	.8		.4		15

1/ Test circuit conditions: R_g = 510Ω, power bandwidth = 200 Hz. Characteristics apply to "S" suffix also.

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 Defense Printing Service Detachment Office, Building 4D (Customer Service), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 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 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 and on figure 1 herein.

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 level only). Screening shall be in accordance with table II of MIL-S-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 II of MIL-S-19500)	Measurement JANTX level only
1/	Thermal impedance (see 4.3.2)
9	Not applicable
11	h_{FE3}; I_{CBO1}
12	See 4.3.1
13	ΔI_{CBO}: 100 percent of initial value or 1.5 nA dc; whichever is greater; Δh_{FE3}: ±25 percent of initial value.

1/ Thermal impedance shall be performed anytime after sealing provided temperature cycling is performed in accordance with MIL-S-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 MIL-STD-750; V_{CB} = 60 V dc; P_T = 500 mW.

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

4.3.2 Thermal impedance $Z_{\theta JC}$ measurements for screening. The $Z_{\theta JC}$ measurements shall be performed in accordance with MIL-STD-750, method 3131. The maximum limit and conditions for $Z_{\theta JC}$ in screening (table II of MIL-S-19500) shall be derived by each vendor by means of process control of actual measurements which characterizes the die attach process. When three lot date codes have exhibited control, the data from these three lots will be used to establish a fixed screening limit (not to exceed the group A limit). Once a fixed limit has been established, monitor all future sealing lots using a sample from each lot.

4.3.2.1 Thermal impedance ($Z_{\theta JC}$ measurements) for initial qualification or requalification. The $Z_{\theta JC}$ measurements shall be performed in accordance with MIL-STD-750, method 3131 (read and record value $Z_{\theta JC}$) derived conditions, limits, and thermal response curve shall be supplied to the qualifying activity on the qualification lot prior to qualification approval.

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-S-19500 and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-19500 and table I herein. The following test conditions shall be used for $Z_{\theta JC}$ in group A, subgroup 2 inspection.

a. I_H measuring current . . . . . 10 mA.

b. I_H forward heating current . . . . . 1 A.

c. t_H heating time . . . . . 10 ms.

d. t_{MD} measurement delay time . . . . . 100 µs maximum.

The maximum limit for $Z_{\theta JC}$ in group A, subgroup 2 is $Z_{\theta JC}$ (maximum) = 97.4°C/W.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IVb (JANTX) of MIL-S-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. V_{CB} = 60 V dc; P_T = 500 mW dc.

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) 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 (see 4.5) of MIL-STD-750; V_{CB} = 60 V dc, P_T = 500 mW.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-S-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	1026	
E3		Not Applicable.
E4	3131	See 4.3.2.1, 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	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Breakdown voltage, collector to base	3001	Bias condition C; I_C = 10 µA dc	$V_{(BR)CBO}$	100		V dc
Breakdown voltage, collector to emitter	3011	Bias condition D; I_C = 30 mA dc, Pulsed (see 4.5.1)	$V_{(BR)CEO}$	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 ohms	$V_{(BR)CEO}$	80		V dc
Breakdown voltage, emitter to base	3026	Bias condition D; I_E = 100 µA dc	$V_{(BR)EBO}$	7		V dc
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 75 V dc	I_{CBO}		15	nA dc
Emitter to base cutoff current	3061	Bias condition D; V_{EB} = 5 V dc	I_{EBO}		15	nA dc
Base to emitter voltage (saturated)	3066	Test condition A; I_C = 50 mA dc, I_B = 5 mA dc, Pulsed (see 4.5.1)	$V_{BE(sat)}$		.9	V dc
Base to emitter voltage (saturated)	3066	Test condition A; I_C = 10 mA dc, I_B = 1 mA dc, Pulsed (see 4.5.1)	$V_{BE(sat)}$	.6	.8	V dc
Collector to emitter voltage (saturated)	3071	I_C = 50 mA dc; I_B = 5 mA dc, Pulsed (see 4.5.1)	$V_{CE(sat)}$		1	V dc
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc	h_{FE2}			
2N910, 2N910S				75	300	
2N911, 2N911S				35	140	
2N912, 2N912S				15	60	

See footnote 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						
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 0.1 mA dc	h_{FE1}			
2N910, 2N910S				35		
2N911, 2N911S				20		
2N912, 2N912S				10		
Subgroup 3						
High temperature operation:		T_A = +150°C				
Collector to base cutoff current	3036	Bias condition D; V_{CB} = 75 V dc	I_{CBO}		15	µA dc
Low temperature operation:		T_A = +125°C				
Forward-current transfer ratio	3076	V_{CE} = 10 V dc; I_C = 10 mA dc	h_{FE3}			
2N910, 2N910S				30		
2N911, 2N911S				15		
2N912, 2N912S				10		
Subgroup 4						
Small-signal short-circuit forward-current transfer ratio	3206	V_{CE} = 5 V dc; I_C = 5 mA dc, f = 1 kHz	h_{fe2}			
2N910, 2N910S				80	200	
2N911, 2N911S				40	100	
2N912, 2N912S				20	50	
Small-signal short-circuit forward-current transfer ratio	3206	V_{CE} = 5 V dc; I_C = 1 mA dc, f = 1 kHz	h_{fe2}			
2N910, 2N910S				76	200	
2N911, 2N911S				36	90	
2N912, 2N912S				18	40	
Magnitude of common emitter small-signal short-circuit forward-current transfer ratio	3306	V_{CE} = 10 V dc; I_C = 50 mA dc, f = 20 MHz	$\|h_{fe}\|$	3	10	
2N910, 2N910S				3	10	
2N911, 2N911S				2.5	9	
2N912, 2N912S				2	8	

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 4 - Continued						
Common emitter small-signal short-circuit input impedance	3201	V_{CE} = 5 V dc; I_C = 5 mA dc, f = 1 kHz	h_{ie}			
2N910, 2N910S					1600	Ω
2N911, 2N911S					1000	Ω
2N912, 2N912S					500	Ω
Small-signal open-circuit output admittance (common emitter)	3216	V_{CE} = 5 V dc; I_C = 5 mA dc, f = 1 kHz	h_{oe}			
2N910, 2N910S					100	µohms
2N911, 2N911S					50	µohms
2N912, 2N912S					25	µohms
Small-signal short-circuit input impedance (common base)	3201	V_{CE} = 5 V dc; I_C = 5 mA dc, f = 1 kHz	h_{ib1}	4	8	Ω
Small-signal short-circuit input impedance (common base)	3201	V_{CE} = 5 V dc; I_C = 1 mA dc, f = 1 kHz	h_{ib2}	20	30	Ω
Small-signal short-circuit output impedance (common base)	3216	V_{CE} = 5 V dc; I_C = 5 mA dc, f = 1 kHz	h_{ob}		.6	µohms
Small-signal open-circuit reverse-voltage transfer ratio (common base)	3211	V_{CE} = 5 V dc; I_C = 5 mA dc, f = 1 kHz	h_{rb1}			
2N910, 2N910S					3.00×10^{-4}	
2N911, 2N911S					1.75×10^{-4}	
2N912, 2N912S					1.50×10^{-4}	
Small-signal open-circuit reverse-voltage transfer ratio (common base)	3211	V_{CE} = 5 V dc; I_C = 1 mA dc, f = 1 kHz	h_{rb2}			
2N910, 2N910S					2.50×10^{-4}	
2N911, 2N911S					1.25×10^{-4}	
2N912, 2N912S					1.00×10^{-4}	

See footnote at end of table.

TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 4 - Continued						
Open circuit output capacitance (common base)	3236	V_{CB} = 10 V dc; I_E = 0, 100 kHz ≤ f ≤ 1 MHz	C_{obo}		15.0	pF
Input capacitance output short-circuit	3240	V_{EB} = 0.5 V dc; I_C = 0, 100 kHz ≤ f ≤ 1 MHz	C_{ibs}		85	pF
Noise figure	3246	V_{CE} = 10 V dc; I_C = 0.3 mA dc, R_L = 510Ω, f = 1 kHz, Power bandwidth 200 Hz		.6	.8	V dc
2N910, 2N910S					12	dB
2N911, 2N911S					15	dB
2N912, 2N912S					18	dB

1/ For sampling plan, see MIL-S-19500.

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.

b. Lead finish (see 3.3.1).

c. Type designation and product assurance level.

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 extensiveness of the changes.

CONCLUDING MATERIAL

Custodian:
Army - ER

Preparing activity:
Army - ER

(Project 5961-1489)

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-S-19500/274C(ER)	2. DOCUMENT DATE (YYMMDD) 950105

3. DOCUMENT TITLE
SEMICONDUCTOR DEVICE, NPN, SILICON, TRANSISTORS, TYPES 2N910, 2N910S, 2N911, 2N911S, 2N912S, AND 2N912, JAN AND JANTX

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) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME DIRECTOR, US ARMY RESEARCH LABORATORY	b. TELEPHONE (Include Area Code) (1) Commercial 908-544-3450 (2) AUTOVON 995-3450
c. ADDRESS (Include Zip Code) POWER SOURCES DIRECTORATE ATTN: AMSRL-EP-RD FORT MONMOUTH, NJ 07703-5601	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340