

The documentation and process conversion measures necessary to comply with this revision shall be completed by 30 October 1999.

INCH-POUND

MIL-PRF-19500/522A  
30 July 1999  
SUPERSEDING  
MIL-S-19500/522(EL)  
21 August 1976

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-FREQUENCY  
TYPES 2N6603 AND 2N6604  
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, microwave transistors. Three levels of product assurance are provided for the device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1.

1.3 Maximum ratings.

	P <sub>T</sub>				V <sub>CB0</sub>	V <sub>CEO</sub>	V <sub>EBO</sub>	I <sub>C</sub>	T <sub>J</sub>	T <sub>STG</sub>
	1/ T <sub>A</sub> = +25°C	2/ T <sub>C</sub> = +125°C	3/ T <sub>A</sub> = +25°C	4/ T <sub>C</sub> = +125°C						
	mW	mW	mW	mW	V dc	V dc	V dc	mA dc	°C	°C
2N6603	300	400			25	15	3.0	30	200	-65 to +200
2N6604			350	500	25	15	3.0	30	200	-65 to +200

1/ Derate at 1.71 mW/°C above T<sub>A</sub> > +25°C.

2/ Derate at 5.33 mW/°C above T<sub>C</sub> > +125°C.

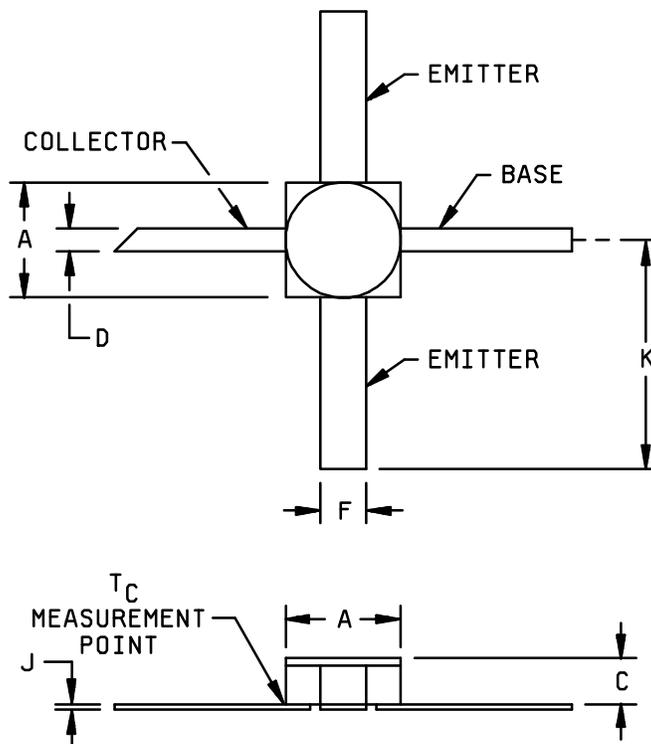
3/ Derate at 2.00 mW/°C above T<sub>A</sub> > +25°C.

4/ Derate at 6.66 mW/°C above T<sub>C</sub> > +125°C.

1.4 Primary electrical characteristics (common to all types).

Type	h <sub>FE</sub>				C <sub>cb</sub>		NF		G <sub>pe</sub>				
	V <sub>CE</sub> = 10 V dc I <sub>C</sub> = 15 mA dc		V <sub>CE</sub> = 10 V dc I <sub>C</sub> = 30 mA dc		V <sub>CB</sub> = 10 V dc I <sub>E</sub> = 0 mA dc 0.1 MHz ≤ f ≤ 1 MHz		V <sub>CE</sub> = 10 V dc I <sub>C</sub> = 5 mA dc f = 1 GHz		V <sub>CE</sub> = 10 V dc I <sub>C</sub> = 15 mA dc f = 1 GHz		V <sub>CE</sub> = 10 V dc I <sub>C</sub> = 30 mA dc f = 1 GHz		
	Min	Max	Min	Max	pF		dB		dB		dB		
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
2N6603	30	200			.25	.75	1.0	2.5	15	21			
2N6604			30	200	.30	.80	1.5	3.0			15	21	

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 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.



Ltr	Dimensions			
	Inches		Millimeters	
	Min.	Max	Min	Max
A	0.090	0.105	2.29	2.67
C	0.032	0.050	0.89	1.40
D	0.016	0.024	0.41	0.61
F	0.035	0.043	0.89	1.09
J	0.003	0.006	0.08	0.15
K	0.175	0.230	4.45	5.84

NOTE: The top of the device body is hermetically sealed by a metallic cap which is electrically connected to the emitter.

FIGURE 1. Physical dimensions

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 (NPM-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 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 are defined in MIL-PRF-19500.

$G_{NF}$  ----- Power gain with device tuned for optimum noise figure.

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

3.3.1 Lead finish. Lead finish shall be solderable as defined in MIL-PRF-19500, MIL-STD-750, and herein.

3.4 Marking. Devices shall be marked in accordance with MIL-PRF-19500. At the option of the manufacturer, the marking of 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).

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

4.3 Screening (JANTX and JANTXV levels only). Screening shall be in accordance with MIL-PRF-19500 (table IV), 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
10	48 hours minimum
11	$I_{CBO}$ and $h_{FE}$
12	See 4.3.1
13	Subgroup 2 of table I; $\Delta h_{FE} = \pm 15$ percent of initial value.

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

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

- $T_A$  = Room ambient as defined in the general requirements of MIL-STD-750, section 4.5;
- 2N6603:  $V_{CB} \geq 15$  V dc;  $P_T = 300$  mW.
- 2N6604:  $V_{CB} \geq 15$  V dc;  $P_T = 350$  mW.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein. Group A inspection shall be performed on each subplot.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-PRF-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 VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and paragraph 4.4.2.1 herein. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein.

4.4.2.1 Group B inspection, table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Condition
B3	1027	$V_{CB} \geq 15$ V dc; adjust $P_T$ to achieve $T_J = +150^\circ\text{C}$ min, $T_A \leq 35^\circ\text{C}$ . No heat sink or forced-air cooling on the devices shall be permitted.
B6	1032	$T_A = +200^\circ\text{C}$ .

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	Test cond. A, weight = 5 lbs, t = 15 seconds each terminal.
C6	1026	$V_{CB} \geq 15$ V dc; adjust $P_T$ to achieve $T_J = +150^\circ\text{C}$ min, $T_A \leq 35^\circ\text{C}$ . No heat sink or forced-air cooling on the devices 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 Power Gain, Noise Figure and GNF: The device shall be tested in the circuits of figures 2 or 3. The specified conditions shall be applied and the slide screw tuners adjusted to obtain maximum power output for the  $G_{pe}$  test and minimum noise figure for NF and GNF tests.

TABLE I. Group A inspection.

Inspection 1/ Method	MIL-STD-750		Symbol	Limits		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; $I_C = 1 \text{ mA dc}$ ; pulsed (see 4.5.1)	$V_{(BR)CEO}$	15		V dc
Breakdown voltage, collector to base	3001	Bias condition D; $I_C = 100 \mu\text{A dc}$ ;	$V_{(BR)CBO}$	25		V dc
Breakdown voltage, emitter to base	3026	Bias condition D; $I_C = 100 \mu\text{A dc}$ ;	$V_{(BR)EBO}$	3		V dc
Collector to base cutoff current	3036	Bias condition D; $I_C = 100 \mu\text{A dc}$ ;	$I_{CBO}$		50	nA dc
Forward-current transfer ratio 2N6603 2N6604	3076	$V_{CE} = 10 \text{ V dc}$ $I_C = 15 \text{ mA dc}$ $I_C = 30 \text{ mA dc}$ $T_A = +150^\circ\text{C}$	$h_{FE}$	30	200	
<u>Subgroup 3</u>						
High-temperature operation:						
Collector to base cutoff current	3036	Bias condition D; $I_C = 100 \mu\text{A dc}$ ;	$I_{CBO}$		5.0	$\mu\text{A dc}$
Low-temperature operation:						
Forward-current transfer ratio 2N6603 2N6604	3076	$V_{CE} = 10 \text{ V dc}$ $I_C = 15 \text{ mA dc}$ $I_C = 30 \text{ mA dc}$	$h_{FE}$	15		
<u>Subgroup 4</u>						
Power gain 2N6603 2N6604	----	$V_{CE} = 10 \text{ V dc}$ ; $f = 1 \text{ GHz}$ (see 4.5.2 and figure 2) $I_C = 15 \text{ mA dc}$ $I_C = 30 \text{ mA dc}$	$G_{pe}$	15	21	dB
Collector to base capacitance 2N6603 2N6604	3236	$V_{CB} = 10 \text{ V dc}$ ; $I_E = 0$ .1 MHz $\leq f \leq 1 \text{ MHz}$	$C_{cb}$	.25 .30	.75 .80	pF pF

See footnotes at end of table.

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4 - continued</u>						
Noise figure	----	$V_{CE} = 10 \text{ V dc}; I_C = 5 \text{ mA dc};$ $f = 1 \text{ GHz}$ (see 4.5.2 and figure 3)	NF			
2N6603				1.0	2.5	dB
2N6604				1.5	3.0	dB
<u>Subgroups 5 and 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Input reflection coefficient	----	$V_{CE} = 10 \text{ V dc}; f = 1 \text{ GHz};$ $Z_O = 50 \Omega;$				
2N6603		$I_C = 15 \text{ mA dc}$	/S11/ LOS11	.5 +165	.8 -165	-- °C
2N6604		$I_C = 30 \text{ mA dc}$	/S11/ LOS11	.45 +155	.75 -175	-- °C
Output reflection coefficient	----	$V_{CE} = 10 \text{ V dc}; f = 1 \text{ GHz};$ $Z_O = 50 \Omega;$				
2N6603		$I_C = 15 \text{ mA dc}$	/S22/ LOS22	.25 -70	.5 -30	-- °C
2N6604		$I_C = 30 \text{ mA dc}$	/S22/ LOS22	.2 -70	.4 -30	-- °C
Forward transfer coefficient	----	$V_{CE} = 10 \text{ V dc}; f = 1 \text{ GHz};$ $Z_O = 50 \Omega;$				
2N6603		$I_C = 15 \text{ mA dc}$	/S21/ <sup>2</sup>	12	--	dB
2N6604		$I_C = 30 \text{ mA dc}$	/S21/ <sup>2</sup>	12	--	dB
Reverse transfer coefficient	----	$V_{CE} = 10 \text{ V dc}; f = 1 \text{ GHz};$ $Z_O = 50 \Omega;$				
2N6603		$I_C = 15 \text{ mA dc}$	/S12/ <sup>2</sup>	--	-22.5	dB
2N6604		$I_C = 30 \text{ mA dc}$	/S12/ <sup>2</sup>	--	-22.5	dB
Power gain at optimum noise figure	----	$V_{CE} = 10 \text{ V dc}; I_C = 5 \text{ mA dc};$ $f = 2 \text{ GHz}$ (see 4.5.2 and figures 2 and 3)	G <sub>NF</sub>	6	--	dB

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

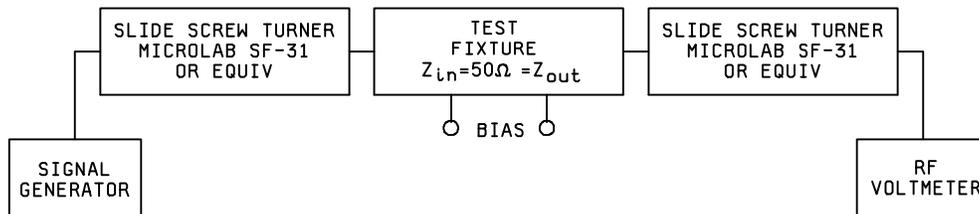


FIGURE 2. Block diagram of Power Gain test circuit at 1 GHz.

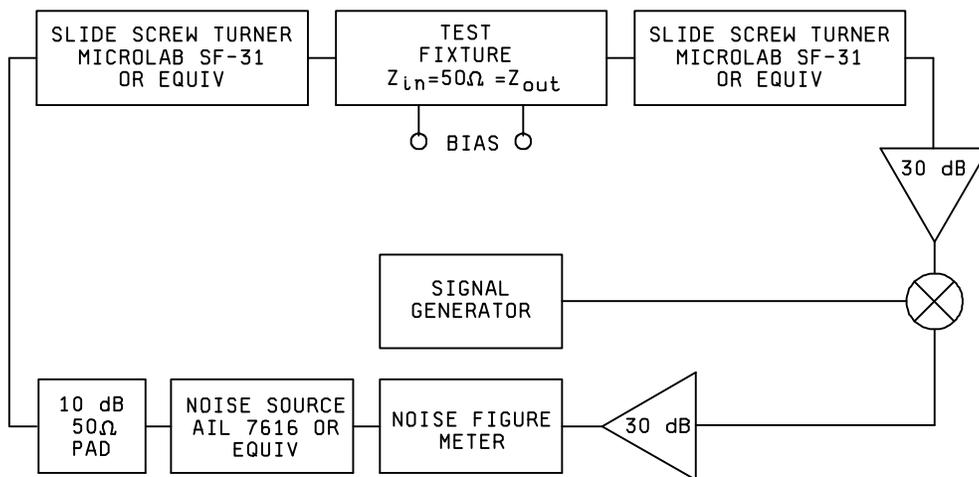


FIGURE 3. Block diagram of Noise Figure test circuit at 1 GHz.

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.

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.
- b. Lead finish as specified (see 3.3.1).
- c. Product assurance level and type designation.

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.

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:  
Army - CR  
DLA - CC

Preparing activity:  
DLA - CC  
(Project 5961-A160)

<b>STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL</b>		
<b><u>INSTRUCTIONS</u></b>		
<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>		
<b>I RECOMMEND A CHANGE:</b>	<b>1. DOCUMENT NUMBER</b> MIL-PRF-19500/522A	<b>2. DOCUMENT DATE</b> 99/07/30
<b>3. DOCUMENT TITLE</b> SEMICONDUCTOR DEVICE, FIELD-EFFECT TRANSISTOR, N-CHANNEL SILICON, JAN, JANTX, AND JANTXV		
<b>4. NATURE OF CHANGE</b> <i>(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)</i>		
<b>5. REASON FOR RECOMMENDATION</b>		
<b>6. SUBMITTER</b>		
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
<b>8. PREPARING ACTIVITY</b>		
a. Point of Contact Alan Barone	b. TELEPHONE Commercial      DSN      FAX      EMAIL 614-692-0510    850-0510    614-692-6939    alan_barone@dsc.c.dla.mil	
c. ADDRESS Defense Supply Center Columbus ATTN: DSCC-VAT Columbus, OH 43216-5000	<b>IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:</b> 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	