

The documentation and process conversion measures necessary to comply with this revision shall be completed by 2 June 93.

INCH-POUND

MIL-S-19500/383A
2 March 1993
SUPERSEDING
MIL-S-19500/383
14 January 1969

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, VOLTAGE-VARIABLE CAPACITOR
TYPES 1N5139A THROUGH 1N5148A
NON-TX, TX, AND TXV

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 detail requirements for a silicon, voltage-variable-capacitor diode for use in tuning and harmonic generator applications. The prefix "TX" is used on devices submitted to and passing the special process-conditioning, testing, and screening specified in 4.5 through 4.5.7.3. The prefix "TXV" is used on devices submitted to and passing the internal visual inspection specified in 4.6.

1.2 Physical dimensions. See figure 1 (D0-7)

1.3 Maximum ratings. (See table V).

Limit	P_T 1/	V_{RM} (wkg)	V_{BR} $I_R = 10 \mu A$ dc	C $V_R = 4$ V dc $f = 1$ MHz	Capacitance ratio	Q $f = 50$ MHz $V_R = 4$ V dc
	mW	V (pk)	V dc	pf		
Minimum	----	----	65	(See table IV)	(See table IV)	(See table IV)
Maximum	400	60	----	(See table IV)	----	----

1/ Derate linearly 2.67 mW/°C above 25°C.

OPERATING AMBIENT TEMPERATURE: -65°C TO +175°C.

STORAGE TEMPERATURE: -65°C TO +200°C.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Electronics Supply Center, ATTN: DESC-ECT, 1507 Wilmington Pike, Dayton, OH 45444-5270 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

FSC 5961

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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-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

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. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500 and as follows:

Q Quality factor (ratio of reactance to effective resistance)

TC_C Temperature coefficient of capacitance.

3.3 Design, construction, and physical dimensions. The diode shall be of the design, construction, and physical dimensions as specified in MIL-S-19500 and as shown on figure 1 herein.

3.3.1 Lead finish. Lead finish shall be solderable in accordance with MIL-STD-750 and MIL-S-19500, and herein. Lead finish may be specified in the contract (see 6.2), without affecting the qualified product status of the device or applicable JAN marking.

3.4 Process-conditioning, testing, and screening for "TX" types. Process-conditioning, testing, and screening for the "TX" types shall be as specified in 4.5.

3.4.1 Internal visual (PRECAP) inspection and process-conditioning, testing, and screening of "TXV" types. The "TXV" device type shall, in addition to all performance requirements, be internally visually inspected and process-conditioned, tested, and screened in accordance with 4.6.

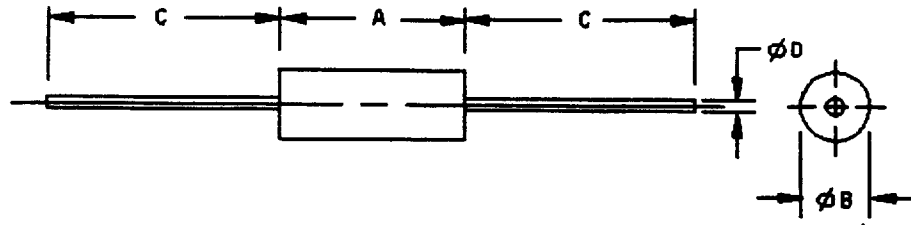
3.5 Marking. Device marking shall be in accordance with MIL-S-19500. At the manufacturer's option, the following markings may be omitted:

- a. Manufacturer's identification.
- b. Country of origin.

3.5.1 Type designation. It is permissible to have the type designation on more than one line; however, if this is done, the break in the type number shall be as follows:

J1N - - - - - XXXX or JTX1N - - - - - XXXX

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Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A	.230	.300	5.84	7.62	
B	.085	.107	2.16	2.72	3
C	1.00	1.500	25.40	38.10	
D	.018	.022	0.46	0.56	1,2

NOTES:

1. The specified lead diameter applies in the zone between .050 (1.27 mm) and 1.000 (25.40 mm) from the diode body. Outside of this zone the lead diameter is not controlled.
2. Both leads shall be within the specified dimensions.
3. The minimum body diameter shall be maintained over .15 (.38 mm) inch of body length.
4. Metric equivalents are given for general information only.

FIGURE 1. Semiconductor device, diode, types 1N5139A and 1N5148A (non-TX, TX, and TXV).

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3.5.2 TX marking. Devices in accordance with the TX requirements shall be marked with a TX preceding the applicable type designation.

3.5.3 Polarity. The polarity shall be indicated with a contrasting color band to denote the cathode end.

3.5.4 TXV marking. Devices in accordance with TXV requirements shall be marked in TXV immediately following the JAN prefix.

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 consist of the examinations and test specified in tables I, II, and III. Qualification for a particular group of capacitance units in the group. The manufacturer has the option of testing the lowest- and highest-nominal-capacitance units in the group. The manufacturer has the option of submitting samples individually to subgroups 5 and 6 of group B and subgroup 3 of group C inspection or of submitting to the tightened combination of these tests, using a sample size under the LTPD = 5 column and a test duration of 1,000 hours. The number of specimens to be inspected in the group, determination of defectives, and the number of defectives shall be as specified in the qualification inspection procedure of MIL-S-19500 with the exception that the inspection routine for structurally similar devices does not apply. Ten samples of all other types shall be subjected to subgroup 2 of group A inspection and subgroup 2 of group C inspection.

4.2.1 Qualification testing. The non-TX types shall be used for qualification testing. At the manufacturer's request to the qualifying activity, qualification will be extended to include the TX and TXV types of the device.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests specified in group A, B, and C. (Provisions of MIL-S-19500 early acceptance procedure do not apply to this specification.) Group A inspection and subgroup 2 of group C inspection shall be performed on a subplot basis. Group B inspection and subgroup 1 of group C inspection shall be performed on a lot basis in accordance with MIL-S-19500. A lot shall be considered as a collection of types in the series 1N5139A through 1N5148A.

4.3.1 Inspection lot. Inspection lot shall be defined in MIL-S-19500 except that the lot accumulation period requirements shall be 6 months in lieu of 6 weeks.

4.3.2 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-19500, and table I herein.

4.3.3 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table II herein.

4.3.4 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table III herein. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.

4.4 Methods of inspection. Methods of inspection shall be as specified in tables I, II, and III, the referenced methods of MIL-STD-750, and the figures herein. Section 4 of MIL-STD-750 is applicable.

4.4.1 Terminal strength and salt atmosphere. Electrical rejects or structurally similar devices may be used for subgroup 4 of group B inspection and subgroup 1 of group C inspection.

4.4.2 Temperature coefficient of capacitance test. Throughout the temperature range specified, the capacitance shall not change by more than the amount specified relative to the capacitance value measured at $T_A = 25^\circ\text{C}$. (Refer to test method 4071 in MIL-STD-750 for guidance in the performance of this test.)

4.5 Process-conditioning, testing, and screening of "TX" types. The procedure for process-conditioning, testing, and screening the "TX" types shall be in accordance with 4.5.1 through 4.5.7.3 and figure 2. The process-conditioning shall be conducted on 100 percent of the lot, prior to submission of the lot to the tests specified in tables I, II, and III. (At the option of the manufacturer, the non "TX" types may be subjected to process-conditioning and testing.)

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits <u>2/</u>		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Breakdown voltage	4021	$I_R = 10 \mu\text{A dc}$	B_V	65		V dc
Reverse current	4016	$V_R = 55 \text{ V dc; dc method}$	I_R		20	nA dc
Reverse current	4016	$V_R = 55 \text{ V dc; dc method}$ $T_A = 150^\circ\text{C}$	I_R		20	$\mu\text{A dc}$
Capacitance	4001	$V_R = 4 \text{ V dc; } f = 1 \text{ MHz}$	C	Column 3	Column 4	pf
Capacitance ratio operation	4001	From $V_R = 4 \text{ V dc}$ to $V_R = 60 \text{ V dc;}$ $f = 1 \text{ MHz}$		Column 5		
Quality factor	4036	$V_R = 4 \text{ V dc; } f = 50 \text{ MHz}$ table V	Q	Column 6		

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

2/ Column references are to table IV herein.

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TABLE II. Group B inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits <u>2/</u>		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Physical dimensions	2066	See figure 1				
<u>Subgroup 2</u>						
Solderability	2026					
Thermal shock (temperature cycling)	1051	Test condition C; T (high) = 175°C				
Thermal shock (glass strain)	1056	Test condition A				
Terminal strength (tension)	2036	Test condition A; 4 pounds; t = 15				
Moisture resistance	1021					
End points:						
Breakdown voltage	4021	$I_R = 10 \mu\text{A dc}$	BV	65		V dc
Reverse current	4016	$V_R = 55 \text{ V dc}$; dc method	I_R		20	nA dc
Capacitance	4001	$V_R = 4 \text{ V dc}$; $f = 1 \text{ MHz}$	C	Column 3	Column 4	pf
<u>Subgroup 3</u>						
Shock (nonoperating)	2016	1500 G; 0.5 ms; 5 blows in each orientation: X_1 , Y_1 , and Y_2				
Vibration, variable frequency	2056					
Constant acceleration (nonoperating)	2006	20,000 G; in orientations X_1 , Y_1 , and Y_2				
End points: (same as subgroup 2)						
<u>Subgroup 4</u>						
Terminal strength (lead fatigue) (see 4.4.1)	2036	Test condition E				

See footnotes at end of table.

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TABLE II. Group B inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits <u>2/</u>		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 5</u> High-temperature life (nonoperating) End points: (same as subgroup 2)	1032	$T_A = 200^\circ\text{C}; t = 500 \text{ hours}$				
<u>Subgroup 6</u> Steady-state operation life (see 4.3.4.1) End points: (same as subgroup 2)	1027	$V_R = 60 \text{ V dc}; T_A = 150^\circ\text{C};$ $t = 500 \text{ hours}$				

1/ For sampling plan, see MIL-S-19500.2/ Column references are to table IV.TABLE III. Group C inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits <u>2/</u>		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u> Salt atmosphere (see 4.4.1)	1041	$T_A = -40^\circ\text{C to } +85^\circ\text{C};$ $V_R = 4 \text{ V dc}$	TC_C		0.03	%/ $^\circ\text{C}$
<u>Subgroup 2</u> Temperature coefficient of capacitance (see 4.4.2)						
<u>Subgroup 3</u> Steady-state operation life (see 4.3.4.1) End points:	1026	$V_R = 60 \text{ V dc}; T_A = 150^\circ\text{C}$				
Breakdown voltage	4021	$I_R = 10 \mu\text{A dc}$	BV	65		V dc
Reverse current	4016	$V_R = 55 \text{ V dc}; \text{dc method}$	I_R		20	nA dc
Capacitance	4001	$V_R = 4 \text{ V dc}; f = 1 \text{ MHz}$	C	Column 3	Column 4	pf

1/ For sampling plan, see MIL-S-19500.2/ Column references are to table IV.

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TABLE IV. Test ratings for diodes, types (TX, TXV, and Non-TX) 1N5139A through 1N5148.

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
Type (See 1.1)	Capacitance $V_R = 4 \text{ V dc}$			Capacitance ratio From $V_R = 4 \text{ V dc}$ to $V_R = 60 \text{ V dc}$	Q $V_R = 4 \text{ V dc}$ $f = 50 \text{ MHz}$
	Nom	Min	Max	Min	Max
	pf	pf	pf		
1N5139A	6.8	6.46	7.14	2.7	350
1N5140A	10.0	9.50	10.50	2.8	300
1N5141A	12.0	11.40	12.60	2.8	300
1N5142A	15.0	14.30	15.70	2.8	250
1N5143A	18.0	17.10	18.90	2.8	250
1N5144A	22.0	20.90	23.10	3.2	200
1N5145A	27.0	25.70	28.30	3.2	200
1N5146A	33.0	31.40	34.60	3.2	200
1N5147A	39.0	37.10	40.90	3.2	200
1N5148A	47.0	44.70	49.30	3.2	200

4.5.1 Quality assurance (lot verification). Quality assurance shall keep lot records, monitor for compliance to the prescribed procedures, and observe that satisfactory manufacturing conditions and records on lots are maintained for these devices. The records shall be available for review by the customer at all times. The quality assurance monitoring shall include, but not limited to: process-conditioning, testing, and screening. (The conditioning and screening tests performed as standard production tests need not be repeated when these are acceptable to the Government beforehand as being equal to or more severe than specified herein and the relative process-conditioning sequence is maintained.)

4.5.2 High-temperature storage. All devices shall be stored for at least 48 hours at a minimum temperature (T_A) of 200°C .

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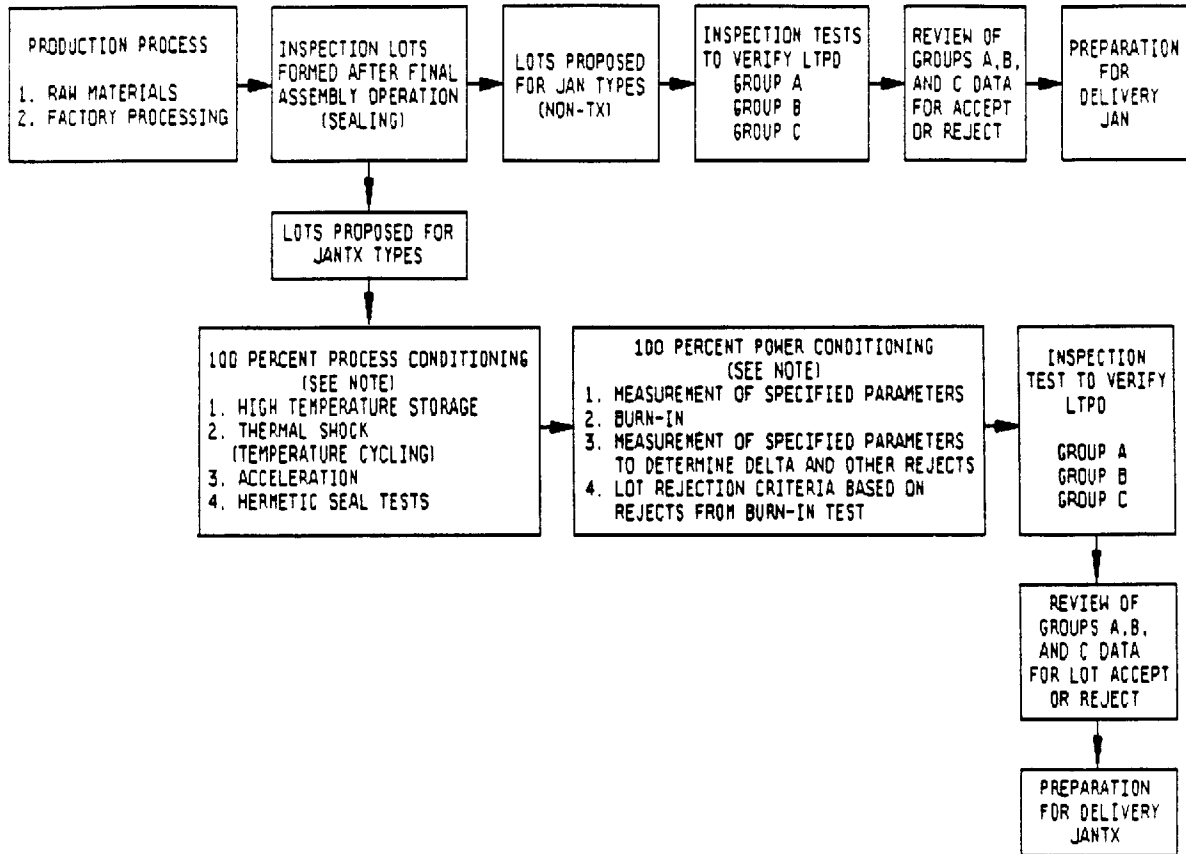


FIGURE 2. Order of procedure diagram for JAN (non-TX) and JANTX types.

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4.5.3 Thermal shock (temperature cycling). All devices shall be subjected to thermal shock (temperature cycling) and shall be performed in accordance with MIL-STD-750, method 1051, test condition C, except that 10 cycles shall be continuously performed and the time at the temperature extremes shall be 15 minutes.

4.5.4 Acceleration. All devices shall be subjected to acceleration test in accordance with MIL-STD-750, method 2006, with the following exceptions: The test shall be performed one time in the Y_1 orientation only, at a peak level of 20,000 G, minimum. The 1-minute hold-time requirement shall not apply.

4.5.5 Hermetic seal (fine leak) test. All devices shall be fine-leak tested in accordance with MIL-STD-750, method 1071, test condition G or H.

4.5.6 Hermetic seal (gross-leak) test. All devices shall be tested for gross-leaks in accordance with MIL-STD-750, method 1071, test condition D or E.

4.5.7 Preburn-in tests. The parameter I_R of table V shall be measured and the data recorded for all devices in the lot. All devices shall be handled or identified such that the delta end points can be determined after the burn-in test. All devices which fail to meet these requirements initially will be removed from the inspection lot and the quantity removed noted on the lot history.

TABLE V. Burn-in test measurements.

Inspection	MIL-STD-750		Symbol	Limits		Unit
	Method	Details		Min	Max	
Reverse current	4016	$V_R = 55$ V dc; dc method	I_R		20	nA dc

4.5.7.1 Burn-in test. All devices shall be operated for 96 hours minimum under the following conditions:

$$T_A = 175^\circ\text{C}$$

$$V_R = 60$$
 V dc

4.5.7.2 Post burn-in tests. The parameter I_R of table V shall be retested after burn-in and the data recorded for all devices in the lot. The parameter measured shall not have changed during the burn-in test from the initial value by more than the specified amount as follows:

$$\Delta I_R = 100\% \text{ or } 5 \text{ nanoamperes, whichever is greater.}$$

4.5.7.3 Burn-in test failure (screening). All devices that exceed delta (Δ) limit of 4.5.7.2 or the limit of table V after burn-in, shall be removed from the inspection lot and the quantity removed shall be noted on the lot history. Where the quantity removed after burn-in exceeds 10 percent of the total inspection lot on burn-in test, the entire lot shall be unacceptable as "TX" types.

4.6 Internal visual (PRECAP) inspection and process-conditioning, testing, and screening of TXV types. The internal visual inspection shall be performed in accordance with test methods 2073 and 2074 of MIL-STD-750 prior to encapsulation on a 100 percent basis and process-conditioning, testing, and screening shall be as specified in 4.5. The manufacturer shall permit the authorized government representative to witness concurrent with time of manufacturer's performance of these tests, the process-conditioning, testing, and screening of the devices. Those conditioning and screening tests normally performed by a manufacturer as standard production tests need not be repeated when these are predesignated and acceptable to the Government as being equal to or more severe than the test specified herein.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-S-19500.

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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. Product assurance level and type designator.

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

Custodians:

Navy - EC
Air Force - 17

Review Activities:

Navy - SH
Air Force - 85, 99
DLA - ES

User activities:

Navy - AS, CG, MC

Preparing activity:

Navy - EC

Agent:

DLA - ES

(Project 5961-N072)