

The documentation and process conversion measures necessary to comply with this revision shall be completed by 19 April 1992

TINCH-POUND

MIL-S-19500/228F  
19 April 1991  
SUPERSEDING  
MIL-S-19500/228E  
16 May 1969

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, RECTIFIER,  
TYPES 1N3611, 1N3611UR, 1N3612, 1N3612UR, 1N3613, 1N3613UR,  
1N3614, 1N3614UR, 1N3957, 1N3957UR, 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 detail requirements for 1.0 ampere silicon rectifier diodes. One level of product assurance is provided for each device type as specified in MIL-S-19500.

1.2 Physical dimensions. See figures 1 and 2.

1.3 Maximum ratings.

Types	$V_R$	$V_{RWM}$	$I_O$ 1/ $T_A = 100^\circ\text{C}$ 2/	$I_O$ 1/ $T_A = 150^\circ\text{C}$ 2/	$I_{FSM}$ $I_O = 300\text{ mA dc}$ $T_A = 150^\circ\text{C}$ $t_p = 8\text{ ms}$
	V dc	V (pk)	A dc	mA dc	A (pk)
1N3611, 1N3611UR	240	200	1.0	300	20
1N3612, 1N3612UR	480	400	1.0	300	20
1N3613, 1N3613UR	720	600	1.0	300	20
1N3614, 1N3614UR	920	800	1.0	300	30
1N3457, 1N3457UR	1150	1000	1.0	300	20

Types	Barometric pressure (reduced)	$T_{STG}$	$T_J$	$R_{\theta JA}$
	mmHg	$^\circ\text{C}$	$^\circ\text{C}$	$^\circ\text{C/W}$
1N3611, 1N3611UR	8	-65 to +200	-65 to +175	2.41
1N3612, 1N3612UR	8	-65 to +200	-65 to +175	2.41
1N3613, 1N3613UR	8	-65 to +200	-65 to +175	2.41
1N3614, 1N3614UR	54	-65 to +200	-65 to +175	2.41
1N3457, 1N3457UR	87	-65 to +200	-65 to +175	2.41

1/  $I_O$  rating is independent of heat sinking, special mounting, or forced air across the body or leads of the device.

2/ Derate linearly at 13.3 mA/ $^\circ\text{C}$  between  $T_A = 100^\circ\text{C}$  and  $T_A = 175^\circ\text{C}$ .

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Electronics Supply Center, DESC-ECT, 1507 Wilmington Pike, Dayton, OH 45444-5280 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

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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-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 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 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 shall be as specified in MIL-S-19500, and as follows:

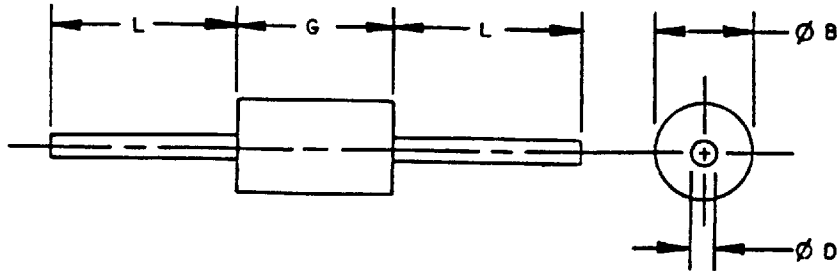
UR - - - - - Unleaded or surface mounted (round end-capped diodes).

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-S-19500, and figures 1 and 2 herein. No lead (Pb) shall be used in the construction of the die bonds.

3.3.1 Lead material and finish. Lead material shall be solderable as defined in MIL-S-19500, MIL-STD-750, and herein. Where a choice of lead material or finish is desired, it shall be specified in the acquisition document (see 6.2).

3.3.2 Diode construction. These devices shall be constructed utilizing non-cavity double plug construction with high temperature metallurgical bonding between both sides of the silicon die and terminal pins.

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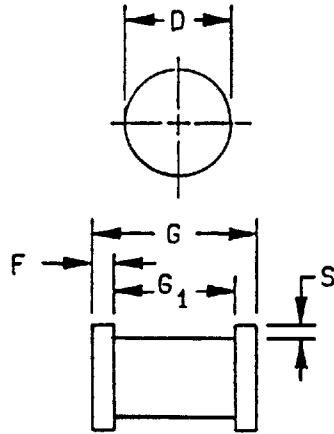
Dimensions					
Ltr	Inches		Millimeters		Notes
	Min	Max	Min	Max	
ØB	.060	.110	1.52	2.79	3
ØD	.025	.034	0.64	0.86	4
G	.140	.205	3.56	5.21	4
L	.600	1.500	15.24	38.10	

## NOTES:

1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Dimension ØB shall be measured at the largest diameter.
4. The G dimension shall include all uncontrolled areas of the device leads.

FIGURE 1. Physical dimensions.

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Dimensions				
Ltr	Inches		Millimeters	
	Min	Max	Min	Max
D	.091	.103	2.31	2.62
F	.019	.028	0.48	0.71
G	.168	.200	4.27	5.08
G <sub>1</sub>	.100 Ref		2.54 Ref	
S	.003 Min		0.08 Min	

FIGURE 2. Physical dimensions for types 1N3611UR, 1N3612UR, 1N3613UR, 1N3614UR, 1N3957UR (DO-213AA).

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3.4 Marking. Devices shall be marked as specified in MIL-S-19500. At the option of the manufacturer, the following marking may be omitted from the body of the device:

- a. Manufacturer's identification.
- b. Country of origin.
- c. Lot identification code.
- d. "1N" of the type designation.

3.4.1 Marking of "UR" version devices. For "UR" version devices, all marking (except polarity) may be omitted from the body, but shall be retained on the initial container.

3.4.2 Polarity. Polarity shall be as specified in 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, and table IV herein.

4.3 Screening (JANTX level only). Screening shall be in accordance with MIL-S-19500 (table II), 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
1/	Thermal response (see 4.3.1)
9	Not applicable
11	$I_R$ and $V_F$
12	See 4.3.2
13	Subgroup 2 of table I herein. $\Delta V_{F1} = \pm 0.1$ V (pk) $\Delta I_{R2} = 25$ percent of initial value or $\pm 50$ nA dc, whichever is greater.

1/ Thermal response shall be performed anytime after screen 3 and before screen 11.

4.3.1 Thermal response ( $\Delta V_F$  measurements). The  $\Delta V_F$  measurements shall be performed in accordance with MIL-STD-750, method 3101. The  $\Delta V_F$  conditions and maximum  $\Delta V_F$  limit shall be derived by each vendor. The chosen  $\Delta V_F$  measurement and conditions for each device in the qualification lot shall be submitted in the qualification report and thermal response curve shall be plotted. The chosen  $\Delta V_F$  value shall be considered final after the manufacturer has had the opportunity to test five consecutive lots.

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4.3.2 Power burn-in conditions. Power burn-in conditions are as follows (see 4.5.1):

Types	V <sub>RWM</sub>	I <sub>O</sub>	T <sub>A</sub>	Hours
1N3611, 1N3611UR	200 V dc	1 A dc	25°C ±3°C	96
1N3612, 1N3612UR	400 V dc	1 A dc	25°C ±3°C	96
1N3613, 1N3613UR	600 V dc	1 A dc	25°C ±3°C	96
1N3614, 1N3614UR	800 V dc	1 A dc	25°C ±3°C	96
1N3957, 1N3957UR	1000 V dc	1 A dc	25°C ±3°C	96

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-S-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with MIL-S-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 IVb (JAN, JANTX, and JANTXV) of MIL-S-19500, and table II herein. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps of table V herein.

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 table III herein. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps of table V herein.

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

4.5.1 Burn-in and steady-state operation life tests. These tests shall be conducted with a half-sine waveform of the specified peak voltage impressed across the diode in the reverse direction followed by a half-sine waveform of the specified average rectified current. The forward conduction angle of the rectified current shall be neither greater than 180 degrees, nor less than 150 degrees.

4.5.2 Mounting.

4.5.2.1 Mounting conditions. The diodes shall be suspended by the leads with at least 6 inches of no. 22 or smaller wire between each lead and the power source. The connecting wires may be soldered to the leads, or MS27491-20 contacts may be used. Other clips may be used provided they have equal or less mass than the MS27491-20 contact. No forced air shall be permitted and the diodes shall be shielded from drafts.

4.5.2.2 Alternate mounting conditions. At the option of the manufacturer, other chip or heat sink mounting configurations may be utilized provided that I<sub>O</sub> is adjusted such that the junction temperature of each diode is maintained at least 120°C above the specified ambient temperature of 25°C.

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TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Forward voltage	4011	$I_F = 1 \text{ A dc (pulsed)}$ $t_p = 300 \text{ } \mu\text{s}; \text{ PRR} = 60 \text{ Hz}$	V <sub>F1</sub>	0.6	1.1	V (pk)
Reverse current	4016	DC method; $V_R = \text{rated}$ (see 1.3)	I <sub>R1</sub>		1.0	$\mu\text{A dc}$
Reverse current	4016	AC method; $V_R = \text{rated}$ (see 1.3); $f = 60 \text{ Hz}$	I <sub>R2</sub>		100	$\mu\text{A dc}$
<u>Subgroup 3</u>						
High temperature operation:		$T_A = 150^\circ\text{C}$				
Reverse current	4016	DC method; $V_R = \text{rated}$ (see 1.3)	I <sub>R3</sub>		300	$\mu\text{A dc}$
Low temperature operation:		$T_A = -65^\circ\text{C}$				
Forward voltage	4011	$I_F = 1.0 \text{ A (pulsed)}$	V <sub>F2</sub>	0.6	1.5	V dc

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

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TABLE II. Group B inspection for JANTX devices.

Inspection <u>1/</u>	MIL-STD-750	
	Method	Conditions
<u>Subgroup 1</u>		
Solderability	2026	
Resistance to solvents	1022	
<u>Subgroup 2</u>		
Thermal shock (temperature cycling)	1051	Test condition C
Hermetic seal	1071	
Gross leak		
Electrical measurements		See table V, steps 1 and 2
<u>Subgroup 3</u>		
Steady-state operation life	1026	$I_0 = 300 \text{ mA dc}$ ; $T_A = 150^\circ\text{C} \pm 5^\circ\text{C}$ ; $f = 60 \text{ Hz}$ ; $V_{RWM} = (\text{see } 1.3)$
Electrical measurements		See table V, steps 1, 2, 3, 4, and 5
<u>Subgroup 4</u>		
Not applicable		

See footnote at end of table.



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TABLE II. Group B inspection for JANTX devices - Continued.

Inspection <u>1/</u>	MIL-STD-750	
	Method	Conditions
<u>Subgroup 5</u>		
Thermal resistance	4081	$T_1 = 25^\circ\text{C}$ ; $R_{\theta JA} =$ (see 1.3)
<u>Subgroup 6</u>		
High-temperature life (nonoperating)	1032	$T_A = 200^\circ\text{C}$
Electrical measurements		See table V, steps 1 and 2
<u>Subgroup 7</u>		
Surge current	4066	IFSM = 20 A (pk); 10 surges of 8.3 ms each at 1 minute intervals, superimposed on $I_0 = 300 \mu\text{A}$ dc; $V_{RMS} =$ rated (see 1.3); $T_A = 150^\circ\text{C}$
End-point electrical measurements		See table V, steps 1, 2, and 5

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

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TABLE III. Group C inspection (all quality levels).

Inspection <u>1/</u>	MIL-STD-750	
	Method	Conditions
<u>Subgroup 1</u>		
Physical dimensions	2066	See figure 1
<u>Subgroup 2</u>		
Thermal shock (temperature cycling)	1051	Test condition A
Terminal strength (tension)	2036	Test condition A; weight = 4 pounds; t = 15 s; not applicable to "UR" devices
Terminal strength (lead fatigue)	2036	Test condition E; not applicable to "UR" devices
hermetic seal	1071	
Gross leak		
Moisture resistance	1021	Omit initial conditions
Electrical measurements		See table V, steps 1 and 2
<u>Subgroup 3</u>		
Shock	2016	Nonoperating; 1,500 G; 5 blows of 0.5 ms each in orientations: X <sub>1</sub> , Y <sub>1</sub> , and Y <sub>2</sub> (total 15 blows)
Vibration, variable frequency	2056	Nonoperating
Electrical measurements		See table V, steps 1 and 2

See footnote at end of table.

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TABLE III. Group C inspection (all quality levels) - Continued.

Inspection <u>1/</u>	MIL-STD-750	
	Method	Conditions
<u>Subgroup 4</u>		
Salt atmosphere (corrosion)	1041	
<u>Subgroup 5</u>		
Barometric pressure	1001	Pressure = (see 1.3); t = 1 minute (minimum)
Measurement during test		See table V, step 2
<u>Subgroup 6</u>		
Steady-state operation life	1026	$I_0 = 300 \text{ mA dc}$ ; $T_A = 25^\circ\text{C} \pm 3^\circ\text{C}$ ; $f = 60 \text{ Hz}$ $V_{RMS} = (\text{see } 1.3)$
Electrical measurements		See table V, steps 1, 2, and 5

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

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TABLE IV. Group E inspection (all quality levels) for qualification only.

Inspection	MIL-STD-750		Qualification conformance inspection
	Method	Conditions	
<u>Subgroup 1</u>			22 devices, c = 1
Thermal shock (temperature cycling)	1061	500 cycles	
Electrical measurements		See table V, steps 1, 2, 3, and 4	
<u>Subgroup 2</u>			22 devices, c = 1
Steady-state dc blocking life	1038 or 1049	Condition A; 1,000 hours	
Electrical measurements		See table V, steps 1, 2, 3, 4, and 5	
<u>Subgroup 3</u>			3 devices, c = 0
Destructive physical analysis	2101	Photos of cross sections shall be submitted in the qualification report. Vendors shall retain duplicate photos.	
<u>Subgroups 4 and 5</u>			
Not applicable			
<u>Subgroup 6</u>			
Not applicable			

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TABLE V. Groups A, B, C, and E electrical measurements.

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward voltage	4011	Pulse width = 8.3 ms maximum; duty cycle = 2 percent maximum; $I_F = 1.0$ A dc	$V_{F1}$	0.6	1.1	V dc
2.	Reverse current	4016	DC method; $V_R =$ rated (see 1.3)	$I_{R1}$		1.0	$\mu$ A dc
3.	Forward voltage	4011	Pulse width = 8.3 ms maximum; duty cycle = 2 percent maximum; $I_F = 1.0$ A dc	$\Delta V_{F1}$ <u>1/</u>		$\pm 1.1$ V dc maximum	
4.	Reverse current	4016	DC method; $V_R =$ rated (see 1.3)	$\Delta I_{R1}$ <u>1/</u>		$\pm 25$ percent of initial value or $\pm 50$ nA dc (whichever is greater) change from initial group A reading	
5.	Thermal response	3101	See 4.3.1	$\Delta V_F$			mV

1/ Devices that exceed group A limits for this test shall be rejected.