DIODES, SILICON, POWER RECTIFIER,

FAST RECOVERY,

BASED ON TYPES 1N3890, 1N3891 AND 1N3893

ESCC Detail Specification No. 5103/010

ISSUE 1

October 2002

Document Custodian: European Space Agency - see https://escies.org

LEGAL DISCLAIMER AND COPYRIGHT

european space agency
agence spatiale européenne

Pages 1 to 18

DIODES, SILICON, POWER RECTIFIER,

FAST RECOVERY,

BASED ON TYPES 1N3890, 1N3891 AND 1N3893

ESA/SCC Detail Specification No. 5103/010

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 4	October 1983	-	-
Revision 'A'	July 1993		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This issue supersedes Issue 3 and incorporates all modifications agreed on the basis Policy DCR 21022 and the following DCR's:-		
		Table 1(b)	: Note 'f' changed to read 50/60Hz	22176
		Figure 1	: X axis reworded	23120
		Figure 3	: Polarity unit numbers changed	23120
		Para. 2	: Alinea (c) deleted	23120
		Para. 4.4.1	: Steel-nickel case included	22176
		Table 2	: "Other Parameters" changed to "a.c. Parameters" as per format	23120
		Figure 4	: Note (*) sign placed before 'L' value	23120
			: Penultimate line: ir changed to i_r	23120
		Table 4	: Note 2 added	22176
			: Test 1: I_V changed to I_F	23120
			: Test 2: VR changed to V_R = PIV	23120
			: Test 3: deleted	23120
		Table 5	: Test 2: editorial change	23120
			: Test 2: f = 50Hz changed to f = 50/60Hz	22176
		Table 6	: Editorial changes	23120
'A'	July '93	P1. Cover Page		None
		P2. DCN		None
		P9. Para. 4.2.2	: PIND deviation amended	21043
		Para. 4.2.3	: Radiographic Inspection deviation deleted	21049
		This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.		

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES (Applicable to specific Manufacturers only)
None.

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Diodes, Silicon, Power Rectifier, Fast Recovery, based on Types 1N3890, 1N3891 and 1N3893.

It shall be read in conjunction with ESA/SCC Generic Specification No. 5000, the requirements of which are supplemented herein.

1.2 COMPONENT TYPE VARIANTS

Variants of the basic diodes specified herein, which are also covered by this specification, are listed in Table 1(a).

1.3 MAXIMUM RATINGS

The maximum ratings, which shall not be exceeded at any time during use or storage, applicable to the diodes specified herein, are scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

The derating information applicable to the diodes specified herein is shown in Figure 1.

1.5 PHYSICAL DIMENSIONS

The physical dimensions of the diodes specified herein are shown in Figure 2.

1.6 FUNCTIONAL DIAGRAM

The functional diagram, showing lead identification, of the diodes specified herein, is shown in Figure 3.

2. APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:-

(a) ESA/SCC Generic Specification No. 5000 for Discrete Semiconductors.

(b) MIL-STD-750, Test Methods and Procedures for Semiconductor Devices.

TABLE 1(a) - TYPE VARIANTS

Type No.		JEDEC No.		Peak Inverse Voltage (V)
Standard	Reverse	Standard	Reverse	
02	12	1N3890	1N3890R	100
03	13	1N3891	1N3891R	200
05	15	1N3893	1N3893R	400

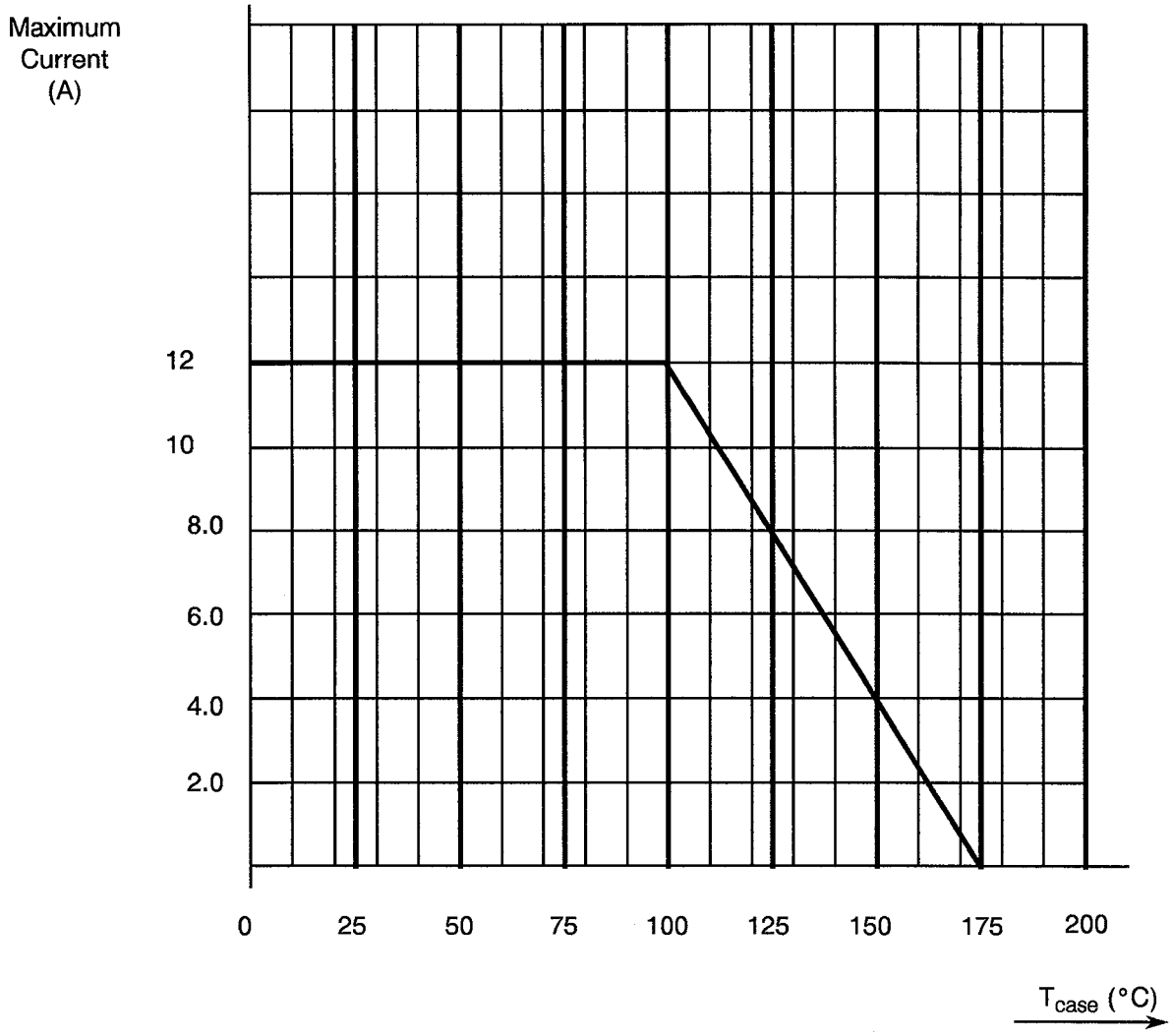
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTIC	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Operating Junction	T_j	−65 to +150	°C	Tcase = +100°C
2	Storage Temperature Range	T_{stg}	−65 to +175	°C	
3	Soldering Temperature	T_{sol}	+260	°C	Time: ≤10s
4	Average Rectified Current	I_O	12	A	
5	Peak Forward Current	I_{FSM}	150	A	See Note

NOTES

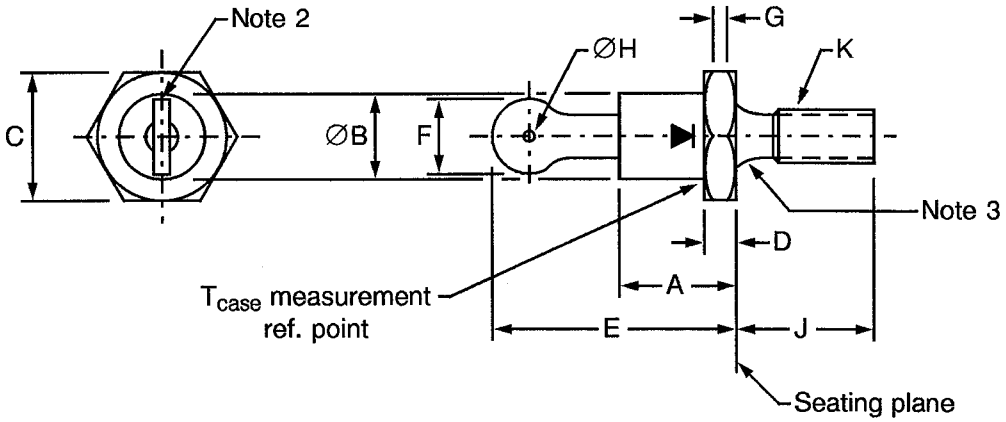
1. 50% Duty Cycle; 50/60 Hz; T_{case} = +100°C; one pulse.

FIGURE 1 - PARAMETER DERATING INFORMATION



Maximum Current versus Case Temperature

FIGURE 2 - PHYSICAL DIMENSIONS

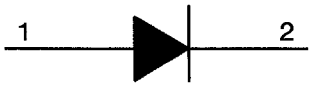


SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	-	0.405	-	10.29	
B	-	0.424	-	10.77	
C	0.424	0.437	10.77	11.10	
D	0.075	0.175	1.90	4.44	
E	-	0.800	-	20.32	
F	-	0.250	-	6.35	8
G	0.060	-	1.52	-	
H	0.060	-	1.52	-	
J	0.422	0.453	10.72	11.51	
K	-	-	-	-	4, 5, 6, 7

NOTES

1. Metric equivalents (to the nearest 0.01mm) are given for general information only and are based upon 1 inch = 25.4mm.
2. Angular orientation of this terminal is undefined.
3. Diameter of unthreaded portion 0.189 inch (4.80mm) maximum 0.163 inch (4.14mm) minimum.
4. The A.S.A. thread reference is 10-32 UNF-2A.
5. Maximum pitch diameter of plated threads shall be basic pitch diameter 0.169inch (4.29mm) and in accordance with Handbook H28.
6. Unit shall not be damaged by torque of 15 inch/lb applied to 10-32 UNF-2B nut assembled on thread.
7. Complete threads shall extend to within 2-1/2 threads of seating plane.
8. Terminal-end shape is unrestricted.

FIGURE 3 - FUNCTIONAL DIAGRAM



1. Anode
2. Cathode

- Standard polarity unit numbers 02, 03 and 05 have cathode connected to the stud.
- Reverse polarity unit numbers 12, 13 and 15 have anode connected to the stud.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESA/SCC Basic Specification No. 21300 shall apply.

4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the diodes specified herein are stated in this specification and ESA/SCC Generic Specification No. 5000 for Discrete Semiconductors. Deviations from the Generic Specification applicable to this specification only, are listed in Para. 4.2.

Deviations from the applicable Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESA/SCC requirements and do not affect the components' reliability, are listed in the appendices attached to this specification.

4.2 DEVIATIONS FROM GENERIC SPECIFICATION

4.2.1 Deviations from Special In-process Controls

None.

4.2.2 Deviations from Final Production Tests (Chart II)

(a) Para. 9.2.1, Bond Strength Test: Not applicable.

(b) Para. 9.2.2, Die-shear Test: Not applicable.

(c) Para. 9.7, Particle Impact Noise Detection (PIND) Test: Not applicable.

(d) Para. 9.5, Thermal Shock Test: To be performed in accordance with MIL-STD-202, Test Method 107, Test Condition 'B'.

4.2.3 Deviations from Burn-in and Electrical Measurements (Chart III)

(a) H.T.R.B. Test: Shall not be performed.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Bond Strength and Die-shear Tests: Shall not be performed.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the diodes specified herein shall be checked. They shall conform to those shown in Figure 2.

4.3.2 Weight

The maximum weight of the diodes specified herein shall be 7.0 grammes.

4.3.3 Terminal Strength

The requirements for terminal strength testing are specified in Section 9 of ESA/SCC Generic Specification No. 5000. The test conditions shall be as follows:-

Test Condition : 'A' (Tension).
Applied Force : 9.0 kg.
Duration : 15 seconds.

4.4 MATERIALS AND FINISHES

The materials and finishes shall be as specified herein. Where a definite material is not specified, a material which will enable the diodes specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material does not guarantee acceptance of the finished product.

4.4.1 Case

Steel-nickel or nickel case, hermetically sealed; all metal surfaces are gold-plated.

4.4.2 Lead Material and Finish

Not applicable.

4.5 MARKING

4.5.1 General

The marking of all components delivered to this specification shall be in accordance with the requirements of ESA/SCC Basic Specification No. 21700. Each component shall be marked in respect of:-

(a) Lead Identification.

(b) The SCC Component Number.

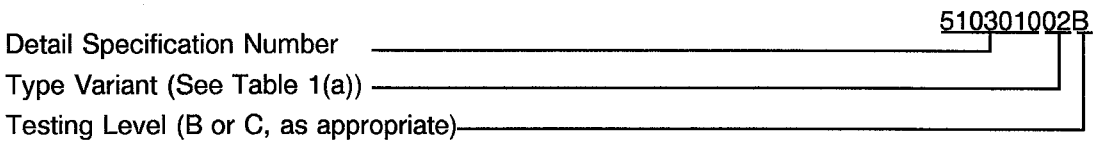
(c) Traceability Information.

4.5.2 Lead Identification

Lead identification shall be as shown in Figures 2 and 3.

4.5.3 The SCC Component Number

Each component shall bear the SCC Component Number which shall be constituted and marked as follows:



4.5.4 Traceability Information

Each component shall be marked in respect of traceability information in accordance with the requirements of ESA/SCC Basic Specification No. 21700.

4.5.5 Marking of Small Components

When it is considered that the component is too small to accommodate the marking as specified above, as much as space permits shall be marked. The order of precedence shall be as follows:-

(a) Lead Identification.

(b) The SCC Component Number.

(c) Traceability Information.

The marking information in full shall accompany each component in its primary package.

4.6 ELECTRICAL MEASUREMENTS

4.6.1 Electrical Measurements at Room Temperature

The parameters to be measured at room temperature are scheduled in Table 2. The measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

4.6.2 Electrical Measurements at High and Low Temperatures

The parameters to be measured at high and low temperatures are scheduled in Table 3.

4.6.3 Circuits for Electrical Measurements

Circuits for use in performing the electrical measurements listed in Tables 2 and 3 are shown in Figure 4 of this specification

4.7 BURN-IN TESTS

4.7.1 Parameter Drift Values

The parameter drift values applicable to burn-in are specified in Table 4 of this specification. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3$ °C. The parameter drift values (Δ) applicable to the parameters scheduled, shall not be exceeded. In addition to these drift value requirements, the appropriate limit value specified for a given parameter in Table 2 shall not be exceeded.

4.7.2 Conditions for Burn-in

The requirements for burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 5000. The conditions for burn-in shall be as shown in Table 5.

4.7.3 Electrical Circuits for Burn-in

Circuits for use in performing the burn-in tests are shown in Figure 5 of this specification.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - d.c. PARAMETERS

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
1	Forward Voltage	V_F	4011	I_F = 12A	-	1.4	V
2	Reverse Current	I_R	4016	V_R = PIV (1)	-	15	µA

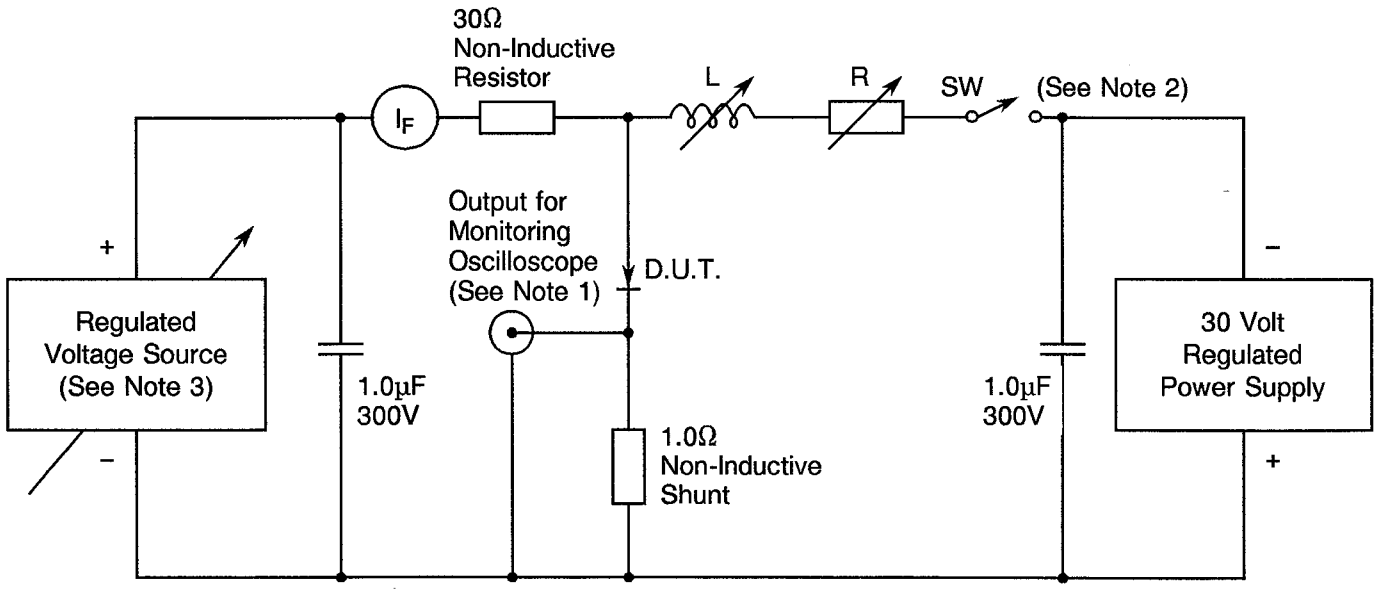
NOTES
1. See Table 1(a).

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - a.c. PARAMETERS

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
3	Reverse Recovery Time	t_{rr}	4031 and Figure 4 of this Detail Specification	I_F = 1.0A di/dt = 25A/µs V_R = 30V $I_{R(rec)}$ = 2.0A (peak)	-	200	ns

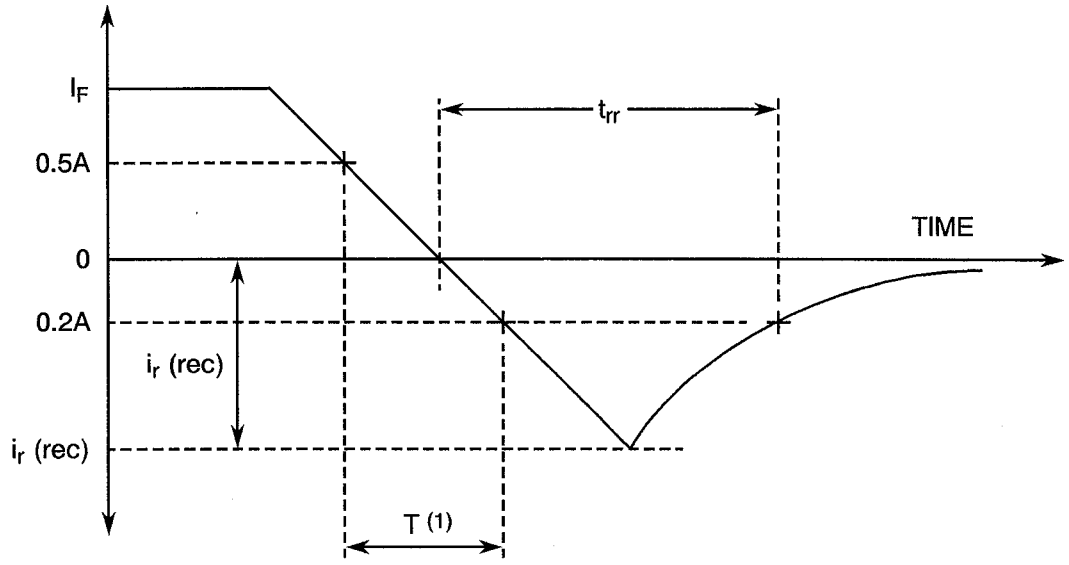
FIGURE 4 - TEST CIRCUIT

REVERSE RECOVERY CIRCUIT



NOTES
1. Monitoring oscilloscope requirements: $t_r \leq 14$ns, $R_{in} \geq 9$M, $C_{in} \leq 12$pF, L_{in} (series) ≤ 0.5µH.
2. SW Characteristics:-
   Mercury-wetted make-before-break relay switched at a 60Hz rate. The relay should conduct for approximately 640µs and be open for approximately 7.7ms.
3. Voltage source characteristics: Output impedance $\leq 0.5\Omega$ from 0 to 2 kHZ.

FIGURE 4 - TEST CIRCUIT (CONT'D)



NOTES

1. Adjust L and R to achieve T = 0.028 second (L ≃ 1.2μH).

   then $\frac{di}{dt} = \frac{0.7}{0.028} = -25A/\mu s.$

- Care shall be exercised to minimise stray inductances in the test circuit and to ensure that the total resistance of the reverse current loop can be adjusted sufficiently low that more than 2 amperes will flow if not blocked by the diode being tested.
  Switch SW shall be activated and the regulated voltage source adjusted to achieve the specified forward current when SW is open. Inductance L and resistor R shall be adjusted to achieve the following characteristics of waveform.

- The di/dt shall be specified value between the forward 0.5 ampere point and reverse 0.2 ampere point.

- The I_R (rec) shall be the maximum value obtainable except that, if it exceeds 2 amperes, it shall be reduced to equal 2 amperes.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	Reverse Current at High Temperature	I_R	4016	V_R = PIV (1) T_{case} = +100°C	-	1.0	mA
2	Reverse Current at Low Temperature	I_R	4016	V_R = PIV (1) T_{case} = -65°C	-	15	µA

NOTES
1. See Table 1(a).

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITION	CHANGE LIMITS (Δ)	UNIT
1	Forward Voltage	V_F	4011	I_F = 12A	±10 or (2) 100	% mV
2	Reverse Current	I_R	4016	V_R = PIV (1)	±100 or (2) 5.0	% µA

NOTES
1. See Table 1(a).
1. Whichever is the greater referred to the initial value.

TABLE 5 - CONDITIONS FOR BURN-IN

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Case Temperature	T_{case}	+ 150	°C
2	Reverse Voltage (2)	$V_{(1/2\ sine)}$	V_{peak} = PIV (1) f = 50/60 Hz	V
3	Average Rectified Forward Current	I_O	0	A

NOTES

1. See Table 1(a).
2. This test shall be conducted with a 1/2 sine waveform of the specified peak voltage impressed across the diode in the reverse direction, followed by a 1/120 second period of I_o equal to zero.

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN

Not applicable.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESA/SCC GENERIC SPECIFICATION NO. 5000

4.8.1 Electrical Measurements on Completion of Environmental Tests

The parameters to be measured on completion of environmental tests are scheduled in Table 2. The measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

4.8.2 Electrical Measurements at Intermediate Points and on Completion of Endurance Tests

The parameters to be measured at intermediate points and on completion of endurance testing are scheduled in Table 6.

4.8.3 Conditions for Operating Life Tests (Part of Endurance Testing)

The requirements for operating life testing are specified in Section 9 of ESA/SCC Generic Specification No. 5000. The conditions for operating life testing shall be the same as specified in Table 5 for the burn-in test.

4.8.4 Electrical Circuits for Operating Life Tests

The circuit to be used for performance of the operating life tests shall be the same as shown in Figure 5 for burn-in.

4.8.5 Conditions for High Temperature Storage Test (Part of Endurance Testing)

The requirements for the high temperature storage test are specified in ESA/SCC Generic Specification No. 5000. The temperature to be applied shall be the maximum storage temperatrue specified in Table 1(b) of this specification.

TABLE 6 - ELECTRICAL MEASUREMENTS AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
1	Forward Voltage	V_F	4011	I_F = 12A	-	1.6	V
2	Reverse Current	I_R	4016	V_R = PIV (1)	-	30	µA
3	Reverse Recovery Time	t_{rr}	4031	I_F = 1.0A V_R = 30V di/dt = -25A/µs I_R(rec) = 2.0A (peak)	-	200	ns

NOTES
1. See Table 1(a).