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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**

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| | | | |
| | | | |

**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: i_r changed to i_f | 23120 |
| | | Table 4 | : Note 2 added | 22176 |
| | | | : Test 1: I_V changed to I_F | 23120 |
| | | | : Test 2: V_R changed to $V_R = PIV$ | 23120 |
| | | | : Test 3: deleted | 23120 |
| | | Table 5 | : Test 2: editorial change | 23120 |
| | | | : Test 2: $f = 50\text{Hz}$ changed to $f = 50/60\text{Hz}$ | 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. | | |

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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

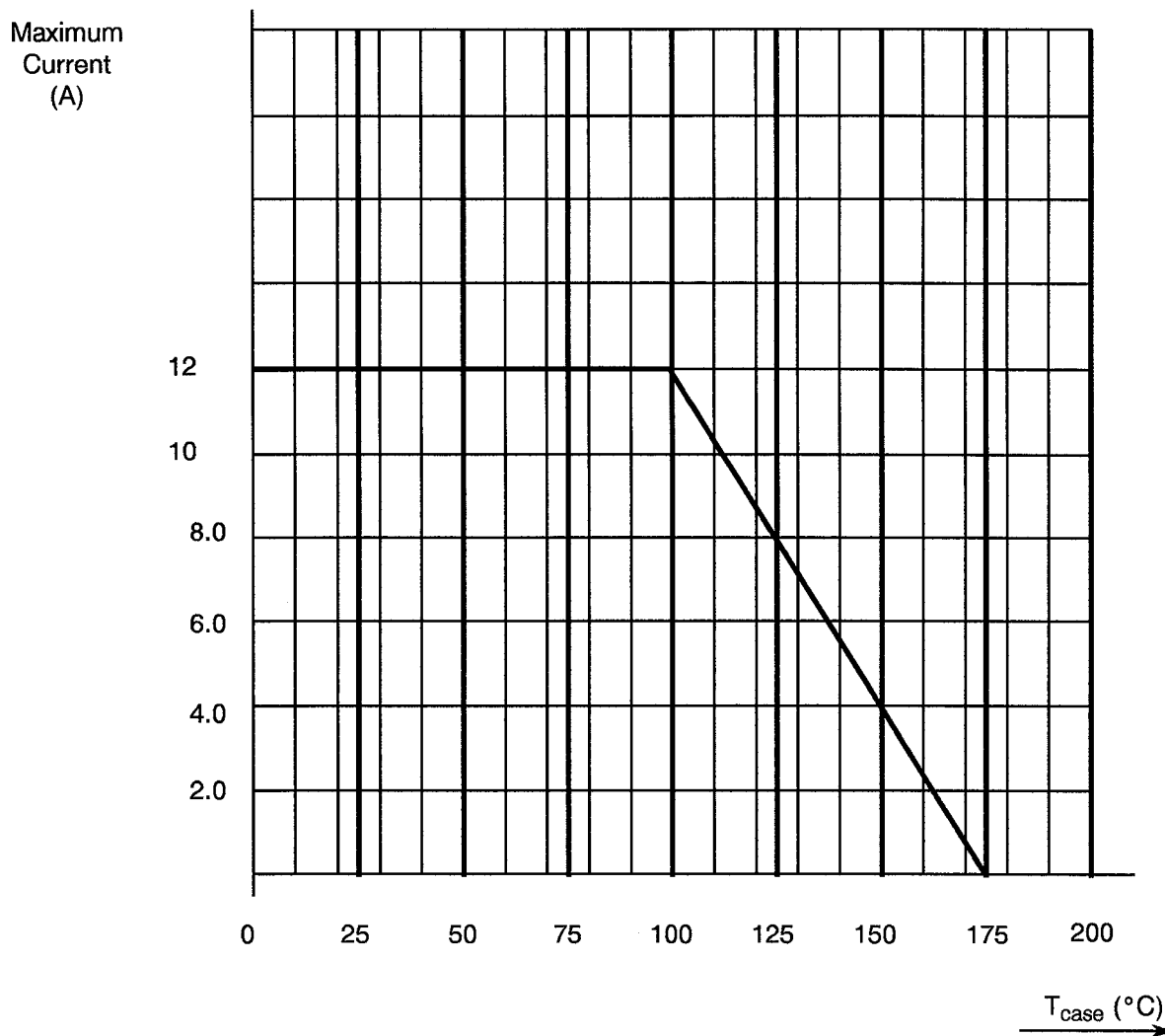
| No. | CHARACTERISTIC | SYMBOL | MAXIMUM RATING | UNIT | REMARKS |
|-----|---------------------------|-----------|----------------|------|----------------------------|
| 1 | Operating Junction | T_j | -65 to +150 | °C | $T_{case} = +100^{\circ}C$ |
| 2 | Storage Temperature Range | T_{stg} | -65 to +175 | °C | |
| 3 | Soldering Temperature | T_{sol} | +260 | °C | Time: $\leq 10s$ |
| 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; $T_{case} = +100^{\circ}C$; one pulse.



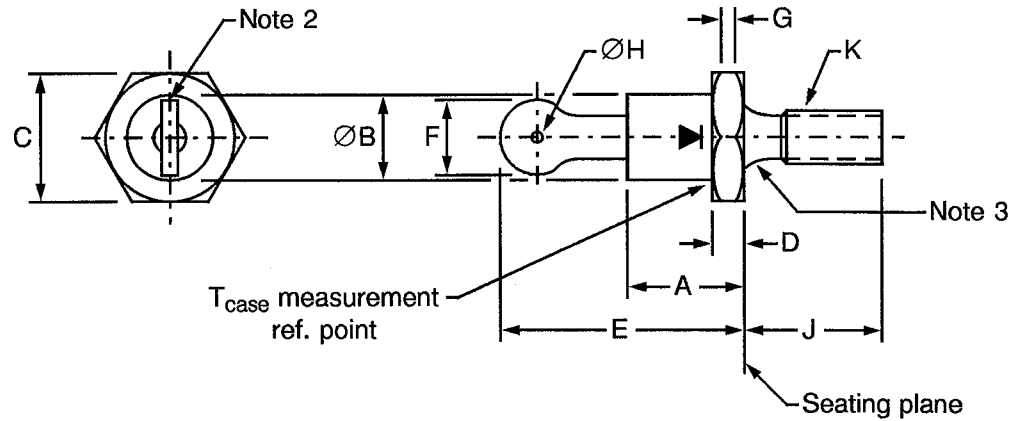
FIGURE 1 - PARAMETER DERATING INFORMATION



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:-

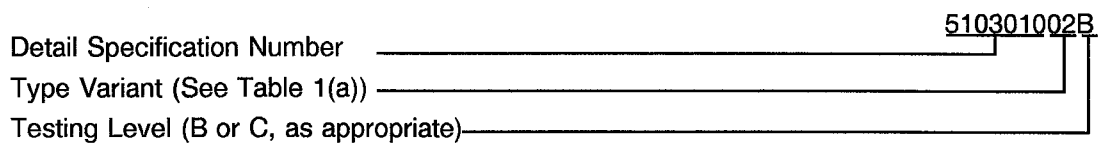
- (a) Lead Identification.
- (b) The SCC Component Number.
- (c) Traceability Information.

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

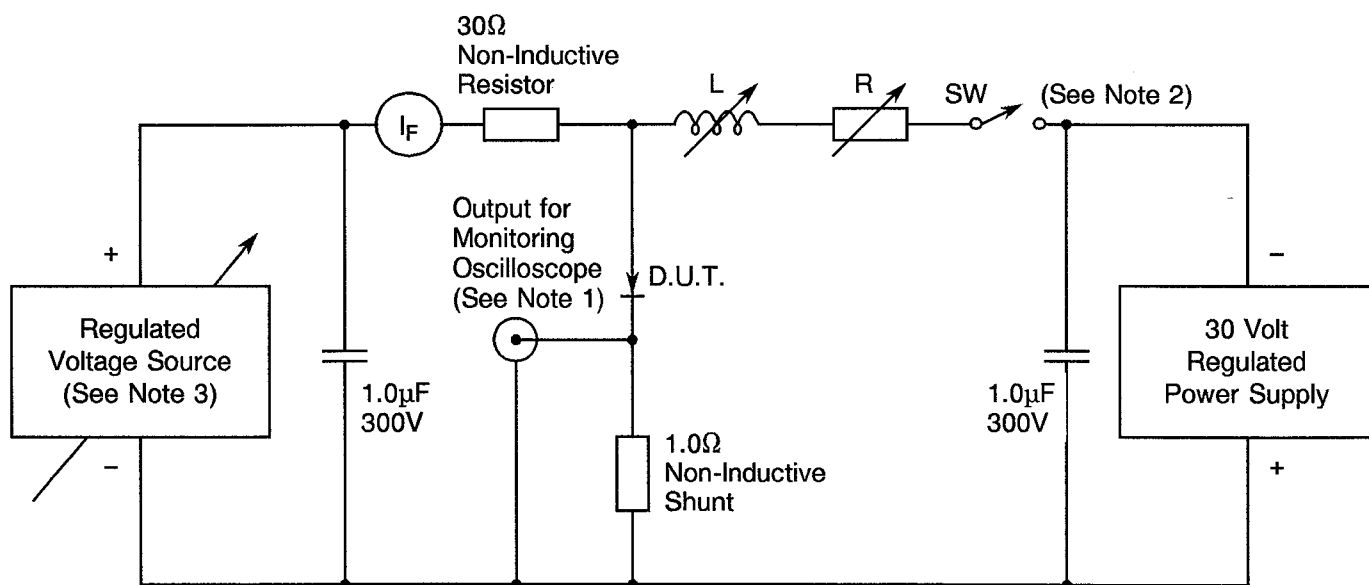
1. See Table 1(a).

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 | $I_F = 1.0A$ $di/dt = 25A/\mu s$ $V_R = 30V$ $I_{R(rec)} = 2.0A (peak)$ | - | 200 | ns |

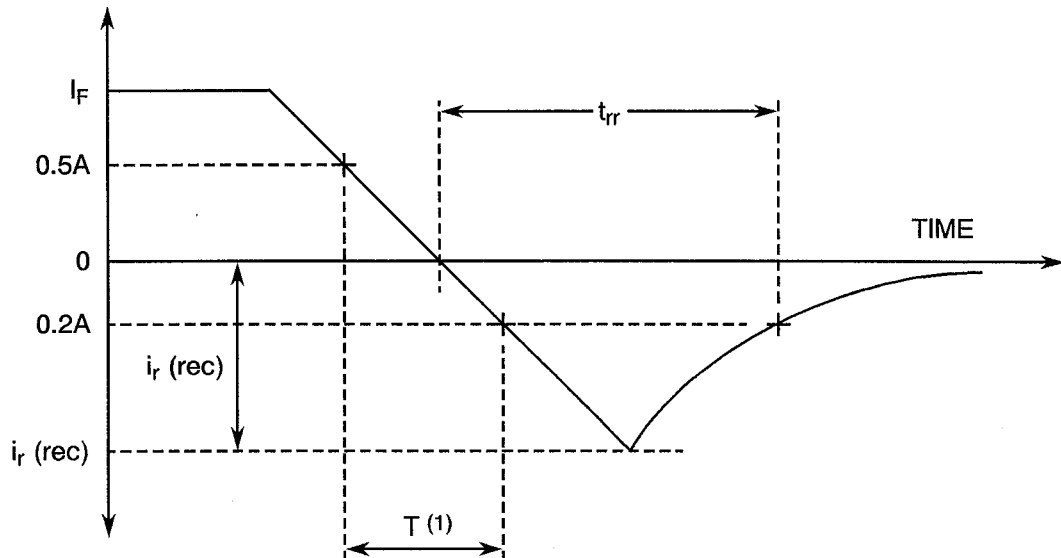
FIGURE 4 - TEST CIRCUIT

REVERSE RECOVERY CIRCUIT



NOTES

- Monitoring oscilloscope requirements: $t_r \leq 14ns$, $R_{in} \geq 9M$, $C_{in} \leq 12pF$, $L_{in} (series) \leq 0.5\mu H$.
- SW Characteristics:-
Mercury-wetted make-before-break relay switched at a 60Hz rate. The relay should conduct for approximately $640\mu s$ and be open for approximately 7.7ms.
- 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 ($L \approx 1.2\mu\text{H}$).

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

- 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 | $V_R = PIV (1)$ $T_{case} = +100^\circ C$ | - | 1.0 | mA |
| 2 | Reverse Current at Low Temperature | I_R | 4016 | $V_R = PIV (1)$ $T_{case} = -65^\circ C$ | - | 15 | μA |

NOTES

- 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

- See Table 1(a).
- 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) | $V_{(1/2 \text{ sine})}$ | $V_{\text{peak}} = \text{PIV (1)}$ $f = 50/60 \text{ Hz}$ | V |
| 3 | Average Rectified Forward Current | I_0 | 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_0 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 temperature 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 | $I_F = 1.0A$ $V_R = 30V$ $di/dt = -25A/\mu s$ $I_R(\text{rec}) = 2.0A$ (peak) | - | 200 | ns |

NOTES

1. See Table 1(a).