# DIODES, SWITCHING,

# BASED ON TYPE 1N4150-1

# ESCC Detail Specification No. 5101/024

**ISSUE 1**

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# BASED ON TYPE 1N4150-1

# ESA/SCC Detail Specification No. 5101/024

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 1 and incorporates all modifications defined in Revision 'A' to Issue 1 and the changes agreed in the following DCRs:- | | |
| | | Cover page | | None |
| | | DCN | | None |
| | | Table 1(b) | : No. 1, Characteristics, Symbol and Unit amended | 221442 |
| | | | : No. 2, New No. 2 added and all subsequent items renumbered | 221442 |
| | | | : New No. 3, In Remarks, "Note 1" deleted and "At $T_{amb}$ = +25°C" added | 221442 |
| | | | : New Nos. 5 and 6, Maximum Ratings amended | 221442 |
| | | | : No. 7, Remarks deleted and "Note 2" added | 221442 |
| | | | : New No. 9 added | 221442 |
| | | | : Note 1 amended | 221442 |
| | | | : New Note 2 added | 221442 |
| | | Figure 1 | : Chart and Undertitle amended | 221442 |
| | | Para. 4.2.2 | : New Deviation "(d)" added and all subsequent items renumbered | 221442 |
| | | | : New Deviation "(g)" added | 221442 |
| | | Para. 4.5.1 | : Existing text deleted and new text added | 221442 |
| | | Para. 4.5.2 | : Title and text amended | 221442 |
| | | Para. 4.5.5 | : Deleted in toto | 221442 |
| | | Table 2 D.C. | : New Nos. 3 and 4 added and Nos. 3 to 5 renumbered as "5" to "7" respectively | 221442 |
| | | | : New No. 5, Characteristics and Symbol amended | 221442 |
| | | | : New No. 6, "D.C. Method" added to Conditions | 221442 |
| | | | : New No. 7, Test Condition amended to "−10μA" and "(1)" deleted | 221442 |
| | | | : Old No. 6, Renumbered as "12" and moved to Table 2 A.C. | 221442 |
| | | Table 2 A.C. | : New No. 8, "(Note 1)" added to Test Conditions | 221442 |
| | | | : New No. 9, Characteristics, Symbol, Test Method and Conditions amended | 221442 |
| | | | : Old No. 9 deleted | 221442 |
| | | | : New Notes 10 and 11 added | 221442 |
| | | | : No. 12 added from Table 2 D.C. No. 6, with Symbol, Conditions, Limits and Unit amended | 221442 |
| | | | : New Notes 2 and 3 added | 221442 |
| | | Table 3 | : No. 4 renumbered to "6" and "D.C. Method" added to Test Conditions | 221442 |
| | | Table 4 | : No. 3, Renumbered to "5" and Characteristics, Symbol and Change Limits amended | 221442 |
| | | | : No. 4 renumbered as "6" | 221442 |
| | | Table 5(b) | : No. 1, New No. 1 added | 221442 |
| | | | , Existing No. 1 renumbered as "2" and complete entry amended | 221442 |
| | | | : Old No. 2, Renumbered as "3" and Characteristics and Conditions amended | 221442 |
| | | Table 6 | : First No. 3 renumbered as "5", Characteristics and Symbol amended and Δ Limits added | 221442 |
| | | | : First No. 4, Renumbered as "6" and Δ Limits added | 221442 |
| | | | : Second Nos. 3 and 4 deleted | 221442 |
| | | Appendix 'A' | : Appendix added | 221442 |
| 'A' | Apr. '99 | P1. Cover page | | None |
| | | P2. DCN | | None |
| | | P7. Figure 1 | : Slope Value added | 23909 |

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**TABLES**



**FIGURES**



**APPENDICES** (Applicable to specific Manufacturers only)

## 1. GENERAL

### 1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Diodes, Switching, based on Type 1N4150-1. 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 type diodes specified herein, which are also covered by this specification, are given 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 as scheduled in Table 1(b).

### 1.4 PARAMETER DERATING INFORMATION

The parameter 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.

### 1.7 HIGH TEMPERATURE TEST PRECAUTIONS

For tin-lead plated or solder-dipped lead finish, all tests to be performed at a temperature that exceeds +125°C shall be carried out in 100% inert atmosphere.

### 1.8 HANDLING PRECAUTIONS

These components are susceptible to damage by electrostatic discharge. Therefore, suitable precautions shall be employed for protection during all phases of manufacture, testing, shipment and any handling.

These components are categorised as Class 3 with a Minimum Critical Path Failure Voltage of 6500V.

## 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.

(c) MIL-STD-202, Test Methods for Electronic and Electrical Component Parts.

## 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.

## TABLE 1(a) - TYPE VARIANTS

| VARIANT | BASED ON TYPE | LEAD MATERIAL AND FINISH |
|---|---|---|
| 01 | 1N4150-1 | C3 or C4 |
| 02 | 1N4150-1 | L3 or L4 |

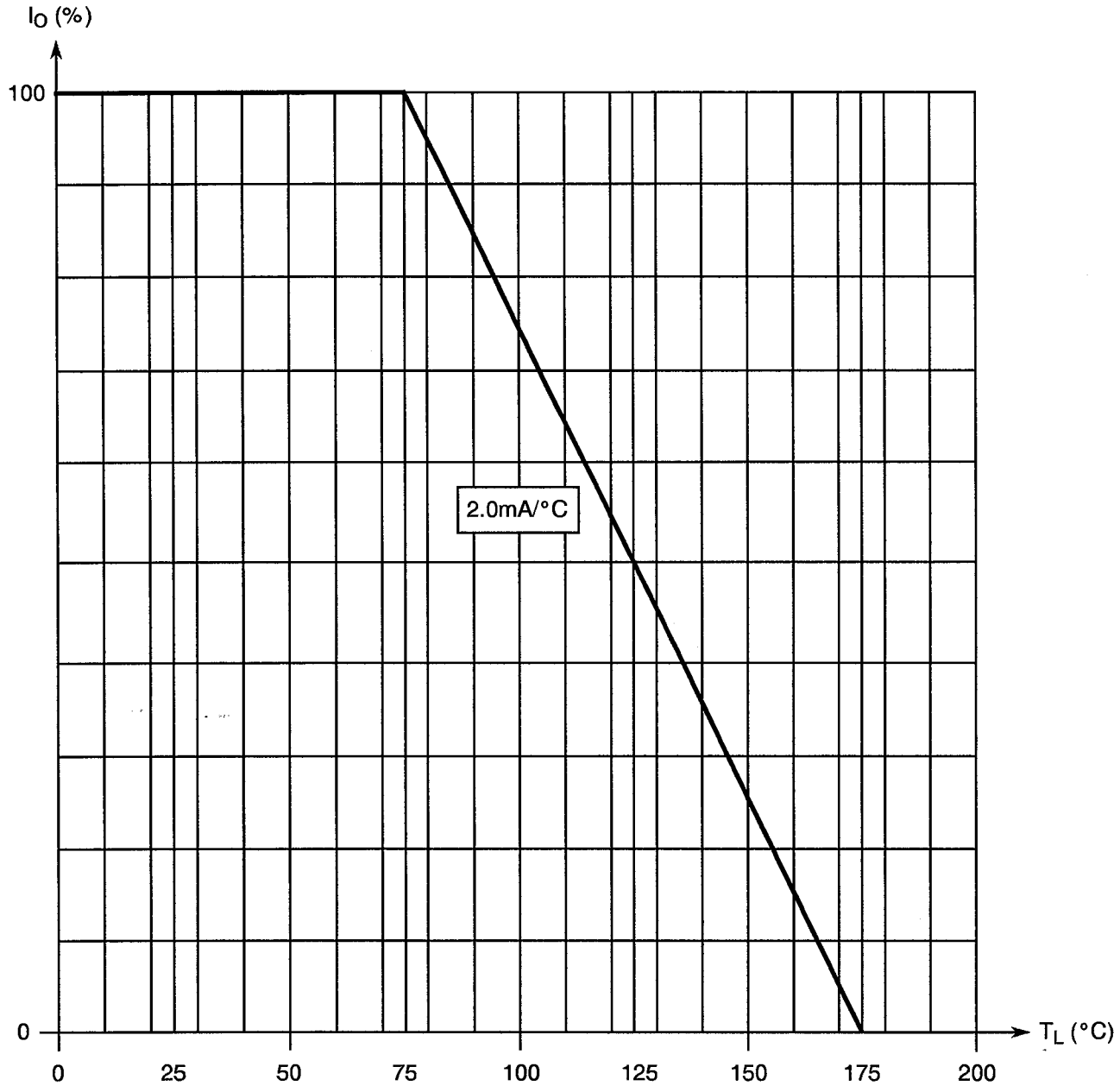
## TABLE 1(b) - MAXIMUM RATINGS

| No. | CHARACTERISTICS | SYMBOL | MAXIMUM RATING | UNIT | REMARKS |
|---|---|---|---|---|---|
| 1 | Working Peak Reverse Voltage | $V_{RWM}$ | 50 | V(pk) | |
| 2 | Average Output Rectified Current | $I_O$ | 200 | mA | Note 1 |
| 3 | Total Power Dissipation | $P_{tot}$ | 500 | mW | At $T_{amb}$ = +25°C |
| 4 | Forward Surge Current | $I_{FSM}$ | 0.5 | A | $t_p$ = 1.0s |
| | | | 4.0 | A | $t_p$ = 1.0µs |
| 5 | Operating Temperature Range | $T_{op}$ | −65 to +175 | °C | $T_{amb}$ |
| 6 | Storage Temperature Range | $T_{stg}$ | −65 to +175 | °C | |
| 7 | Soldering Temperature | $T_{sol}$ | +260 | °C | Note 2 |
| 8 | Breakdown Voltage | $V_{(BR)}$ | 75 | V | |
| 9 | Thermal Resistance (Junction to Lead) | $R_{TH(J-L)}$ | 250 | °C/W | |

**NOTES**

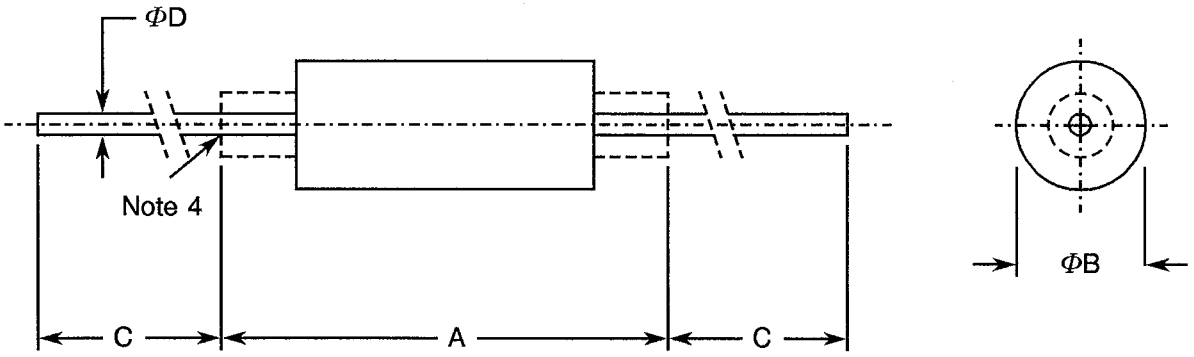
1. At $T_L \leq +75°C$ at 9.53mm from the body. For derating at $T_L > +75°C$, see Figure 1.
2. Duration 10 seconds maximum at a distance of not less than 1.5mm from the device body and the same lead shall not be resoldered until 3 minutes have elapsed.

## FIGURE 1 - PARAMETER DERATING INFORMATION




Average Output Rectified Current versus Temperature

## FIGURE 2 - PHYSICAL DIMENSIONS



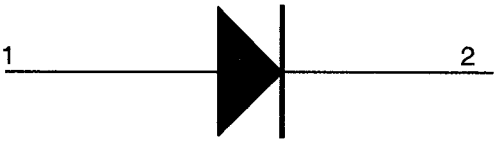

| SYMBOL | MILLIMETRES | | NOTES |
|---|---|---|---|
| | MIN. | MAX. | |
| A | 3.56 | 4.57 | 4 |
| B | 1.42 | 1.91 | 2, 3 |
| C | 25.40 | 38.10 | 1 |
| D | 0.46 | 0.56 | 5 |

**NOTES**

1. Both leads shall be within the specified limits (see 4.3.1).
2. The maximum diameter of dimension B shall apply for dimension A.
3. The minimum diameter of dimension B shall apply over at least 1.91mm of dimension A.
4. Ferrule is optional for dimension A.
5. The specified lead diameter applies in the zone between 1.27mm and 25.4mm from the diode body to the end of the lead. Outside of this zone the lead diameter shall not exceed diameter B.

## FIGURE 3 - FUNCTIONAL DIAGRAM

1 Anode
2 Cathode




**NOTES**

1. The cathode end shall be marked with a coloured ring.

## 4. REQUIREMENTS

### 4.1 GENERAL

The complete requirements for procurement of the diodes specified herein shall be as 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. 9.5.1, Thermal Shock Test: Shall be performed in accordance with Test Method 107, Condition 'B' of MIL-STD-202.

(d) At any time following Para. 9.5.1, Thermal Shock Test, Thermal Impedance measurements shall be performed in accordance with MIL-STD-750, Test Method 3101 as specified in Table 2, No. 12.

(e) Para. 9.6, Constant Acceleration: Not applicable.

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

(g) Immediately following Para. 9.9.3, Electrical Measurements at Room Temperature, a Surge Current test shall be performed on a sample basis, LTPD = 7 or lower, in accordance with MIL-STD-750, Test Method 4066 using the following conditions:

- $I_{FSM} = 2.0A(pk)$

10 surges at a rate of 1 per minute maximum and of duration 1/100 or 1/120 seconds.

Before and after Surge Current application, the sample devices shall be electronically tested in accordance with Table 6 of this specification.

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

(a) Para. 9.8.1, Seal Test, Fine Leak: Not applicable.

(b) Para. 9.8.2, Seal Test, Gross Leak: Shall be performed in accordance with Test Method 1071, Condition 'E' of MIL-STD-750.

(c) Para. 9.12, Radiographic Inspection: Not applicable.

#### 4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Para. 9.2.3, Bond Strength Test: Not applicable.

(b) Para. 9.2.4, Die Shear Test: Not applicable.

(c) Para. 9.8.1, Seal Test, Fine Leak: Not applicable.

(d) Para. 9.8.2, Seal Test, Gross Leak: Shall be performed in accordance with Test Method 1071, Condition 'E' of MIL-STD-750.

(e) Para. 9.15, Constant Acceleration: Not applicable.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

(a) Para. 9.8.1, Seal Test, Fine Leak: Not applicable.

(b) Para. 9.8.2, Seal Test, Gross Leak: Shall be performed in accordance with Test Method 1071, Condition 'E' of MIL-STD-750.

(c) Para. 9.15, Constant Acceleration: Not applicable.

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 0.2 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'.

Applied Force : 5.0 Newtons.

Duration : 10 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

Glass, hermetically sealed.

4.4.2 Lead Material and Finish

The lead material shall be either Type 'C' or Type 'L' with Type '3 or 4' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500. (See Table 1(a) for Type Variants).

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 and the following paragraphs. When the component is too small to accommodate all of the marking specified, as much as space permits shall be marked and the marking information, in full, shall accompany the component in its primary package.

The information to be marked and the order of precedence, shall be as follows:-

(a) Polarity.

(b) The SCC Component Number.

(c) Traceability Information.

4.5.2 Polarity

Polarity shall be as shown in Figure 3.

4.5.3 The SCC Component Number

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

510102401B

Detail Specification Number

Type Variant (see Table 1(a))

Testing Level (B or C, as applicable)

4.5.4 Traceability Information

Each component shall be marked in respect of traceability information as defined in ESA/SCC Basic Specification No. 21700.

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. Unless otherwise stated, 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 electrical measurements listed in Tables 2 and 3 are shown in Figure 4.

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, measurements shall be performed at $T_{amb} = +22 \pm 3$ °C. The parameter drift values ($\Delta$) applicable to the scheduled parameters shall not be exceeded. In addition to these drift value requirements for a given parameter, the appropriate limit value specified in Table 2 shall not be exceeded.

4.7.2 Conditions for H.T.R.B. and Power Burn-in

The requirements for H.T.R.B. and Power Burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 5000. The conditions for H.T.R.B. and Power Burn-in shall be as specified in Tables 5(a) and 5(b) of this specification.

4.7.3 Electrical Circuits for H.T.R.B. and Power Burn-in

Circuits for use in performing the H.T.R.B. and Power Burn-in tests are shown in Figures 5(a) and 5(b) of this specification.

## TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - D.C. PARAMETERS

| No. | CHARACTERISTICS | SYMBOL | MIL-STD-750 TEST METHOD | TEST CONDITIONS | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 1 | D.C. Forward Voltage 1 | $V_{F1}$ | 4011 | $I_F = 1.0mA$ | 0.54 | 0.62 | V |
| 2 | D.C. Forward Voltage 2 | $V_{F2}$ | 4011 | $I_F = 10mA$ | 0.66 | 0.74 | V |
| 3 | D.C. Forward Voltage 3 | $V_{F3}$ | 4011 | $I_F = 50mA$ (1) | 0.76 | 0.86 | V |
| 4 | D.C. Forward Voltage 4 | $V_{F4}$ | 4011 | $I_F = 100mA$ (1) | 0.82 | 0.92 | V |
| 5 | D.C. Forward Voltage 5 | $V_{F5}$ | 4011 | $I_F = 200mA$ (1) | 0.87 | 1.0 | V |
| 6 | D.C. Reverse Current | $I_R$ | 4016 | D.C. Method $V_R = -50V$ | - | 100 | nA |
| 7 | D.C. Breakdown Voltage | $V_{(BR)}$ | 4021 | $I_R = -10\mu A$ | 75 | - | V |

**NOTES**
1. Pulsed operation, $t_p = 300\mu s$; $\delta > 2\%$.

## TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - A.C. PARAMETERS

| No. | CHARACTERISTICS | SYMBOL | MIL-STD-750 TEST METHOD | TEST CONDITIONS | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 8 | Capacitance | C | 4001 | $V_R = 0V$<br>$f = 1.0MHz$<br>(Note 1) | - | 2.5 | pF |
| 9 | Reverse Recovery Time | $t_{rr}$ | 4031, Condition 'A' | $I_F = I_R = 10$ to $100mA$<br>$R_L = 100\Omega$<br>$C \geq 1.0nF$<br>$I_{rr} = 1/10 I_F$<br>$R = \geq 1.0\Omega$<br>(Note 1) | - | 4.0 | ns |
| 10 | Forward Recovery Time | $t_{fr}$ | 4026 | $I_F = 200mA$<br>(Notes 1 and 2) | - | 10 | ns |
| 11 | Forward Recovery Voltage | $V_{fr}$ | 4026 | $I_F = 200mA$<br>(Notes 1 and 2) | - | 5.0 | V(pk) |
| 12 | Thermal Impedance | $Z_{TH(J-C)}$ | 3101 | $I_H = 300$ to $500$ mA<br>$t_H = 10ms$<br>$I_M = 1.0$ to $10$ mA<br>$t_{MD} = 70\mu s$ max.<br>(Note 3) | - | 70 | °C/W |

**NOTES**
1. Measurements shall be performed on a sample basis LTPD = 7 or less.
2. Forward Recovery Time ($t_{fr}$) shall be measured as the interval between zero time and the point where the pulse has decreased to 110% of the steady-state value of $V_F$ when $I_F = 200mA$. The maximum rise time of the response detector shall be 1.0ns. The maximum Forward Recovery Voltage ($V_{fr}$) shall be measured during the forward recovery interval.
3. During Chart II only.

## TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

| No. | CHARACTERISTICS | SYMBOL | MIL-STD-750 TEST METHOD | TEST CONDITIONS | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 6 | D.C. Reverse Current | $I_R$ | 4016 | D.C. Method<br>$V_R = -50V$<br>$T_{amb} = +150°C$ | - | 100 | µA |

## FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

Not applicable.

## TABLE 4 - PARAMETER DRIFT VALUES

| No. | CHARACTERISTICS | SYMBOL | SPEC. AND/OR TEST METHOD | TEST CONDITIONS | CHANGE LIMITS (Δ) | UNIT |
|---|---|---|---|---|---|---|
| 5 | D.C. Forward Voltage 5 | $V_{F5}$ | As per Table 2 | As per Table 2 | ±25 | mV |
| 6 | D.C. Reverse Current | $I_R$ | As per Table 2 | As per Table 2 | ±40<br>or (1)<br>±100 | nA<br><br>% |

**NOTES**

1. Whichever is greater.

## TABLE 5(a) - CONDITIONS FOR HIGH TEMPERATURE REVERSE BIAS BURN-IN

| No. | CHARACTERISTICS | SYMBOL | CONDITION | UNIT |
|---|---|---|---|---|
| 1 | Ambient Temperature | $T_{amb}$ | +150 | °C |
| 2 | D.C. Reverse Voltage | $V_R$ | −50 (Note 1) | V |
| 3 | Duration | t | 72 | hrs |

**NOTES**

1. At the end of the H.T.R.B. Burn-in, $T_{amb}$ shall be decreased to room temperature and the reverse-bias shall remain applied until $T_{amb}$ is less than +35°C.

## TABLE 5(b) - CONDITIONS FOR POWER BURN-IN AND OPERATING LIFE TESTS

| No. | CHARACTERISTICS | SYMBOL | CONDITION | UNIT |
|---|---|---|---|---|
| 1 | Ambient Temperature | $T_{amb}$ | MIL-STD-750 | °C |
| 2 | Working Peak Reverse Voltage | $V_{RWM}$ | 50 | V(pk) |
| 3 | Average Output Rectified Current | $I_O$ | 200<br>f = 50 to 60 Hz | mA |

## FIGURE 5(a) - ELECTRICAL CIRCUIT FOR HIGH TEMPERATURE REVERSE BIAS BURN-IN

Not applicable.

## FIGURE 5(b) - ELECTRICAL CIRCUIT FOR POWER BURN-IN AND OPERATING LIFE TESTS

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. Unless otherwise stated, 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 tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

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(b) 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(b) 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 | SPEC. AND/OR TEST METHOD | TEST CONDITIONS | CHANGE LIMITS (Δ) | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Min. | Max. | |
| 5 | D.C. Forward Voltage 5 | $V_{F5}$ | As per Table 2 | As per Table 2 | ±25mV | - | 1.0 | V |
| 6 | D.C. Reverse Current | $I_R$ | As per Table 2 | As per Table 2 | ±40nA or (1) ±100% | - | 100 | nA |

**NOTES**

1. Whichever is greater, referred to initial value.

**APPENDIX 'A'**



AGREED DEVIATIONS FOR MICROSEMI (IRL)

| ITEMS AFFECTED | DESCRIPTION OF DEVIATIONS |
|---|---|
| Table 2, No. 12 of this specification | The maximum limit for $Z_{TH(J-C)}$ in screening shall be derived by means of Lot Norm testing on each die lot being processed and shall not exceed 30°C/W. |