# DIODES, SILICON, RECTIFIER, 400mW

# BASED ON TYPES 1N645 THROUGH 1N649

# ESCC Detail Specification No. 5103/001

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Pages 1 to 17

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space components
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## DOCUMENTATION CHANGE NOTICE

| Rev. Letter | Rev. Date | Reference | CHANGE Item | Approved DCR No. |
|---|---|---|---|---|
| | | This issue supersedes Issue 2 and incorporates all modifications agreed on the basis of Policy DCR's 21019, 21022 and 21025; and the following DCR's:- | | |
| | | Cover page | | None |
| | | DCN | | None |
| | | Contents | : Paras. 4.2.3, 4.2.4 and 4.2.5 moved to page 10 | None |
| | | Table 1(a) | : $I_R$ column at 25°C deleted and columns numbered | 23150 |
| | | Paras. 4.2.3, 4.2.4 and 4.2.5 moved to page 10 | | None |
| | | Table 2 | : Note 2 added | 23150 |
| | | Table 3 | : Note changed | 23150 |
| | | Table 4 | : ±40nA added to $I_R$ delta | 22239 |
| | | Table 4 | : Format changed | 23150 |
| | | Table 6 | : Tests re-numbered and format changed | 23150 |
| 'A' | April '85 | P1. Cover page | | None |
| | | P2. DCN | : Added change to page 10 as follows: | 23206 |
| | | | "Para. 4.2.3 - HTRB requirement corrected | 23206" |
| 'B' | July '93 | P1. Cover Page | | None |
| | | P2. DCN | | None |
| | | P6. Table 1(a) | : "Lead Material and/or Finish" column added | 21025 |
| | | P9. Para. 4.2.2 | : PIND deviation amended | 21043 |
| | | P10. Para. 4.2.3 | : H.T.R.B. deviation deleted | 23499 |
| | | | : 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

# 1. GENERAL

## 1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for a Diode, Silicon Rectifier, 400mW based on Types 1N645 through 1N649.

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.

## TABLE 1(a) - TYPE VARIANTS

| (1) Variant | (2) Equivalent JEDEC Type | (3) Reverse Voltage & Rev. Continuous $V_R = V_R$ WM (V) | (4) Breakdown Voltage $V_{(BR)}$ (V) | (5) Reverse Current $T_{amb}$ = +100°C $I_R$ (µA) | (6) Lead Material and Finish |
|---|---|---|---|---|---|
| 01 | 1N645 | 225 | 275 | 15 | C3 or C4 |
| 02 | 1N646 | 300 | 360 | 15 | C3 or C4 |
| 03 | 1N647 | 400 | 480 | 20 | C3 or C4 |
| 04 | 1N648 | 500 | 600 | 20 | C3 or C4 |
| 05 | 1N649 | 600 | 720 | 25 | C3 or C4 |

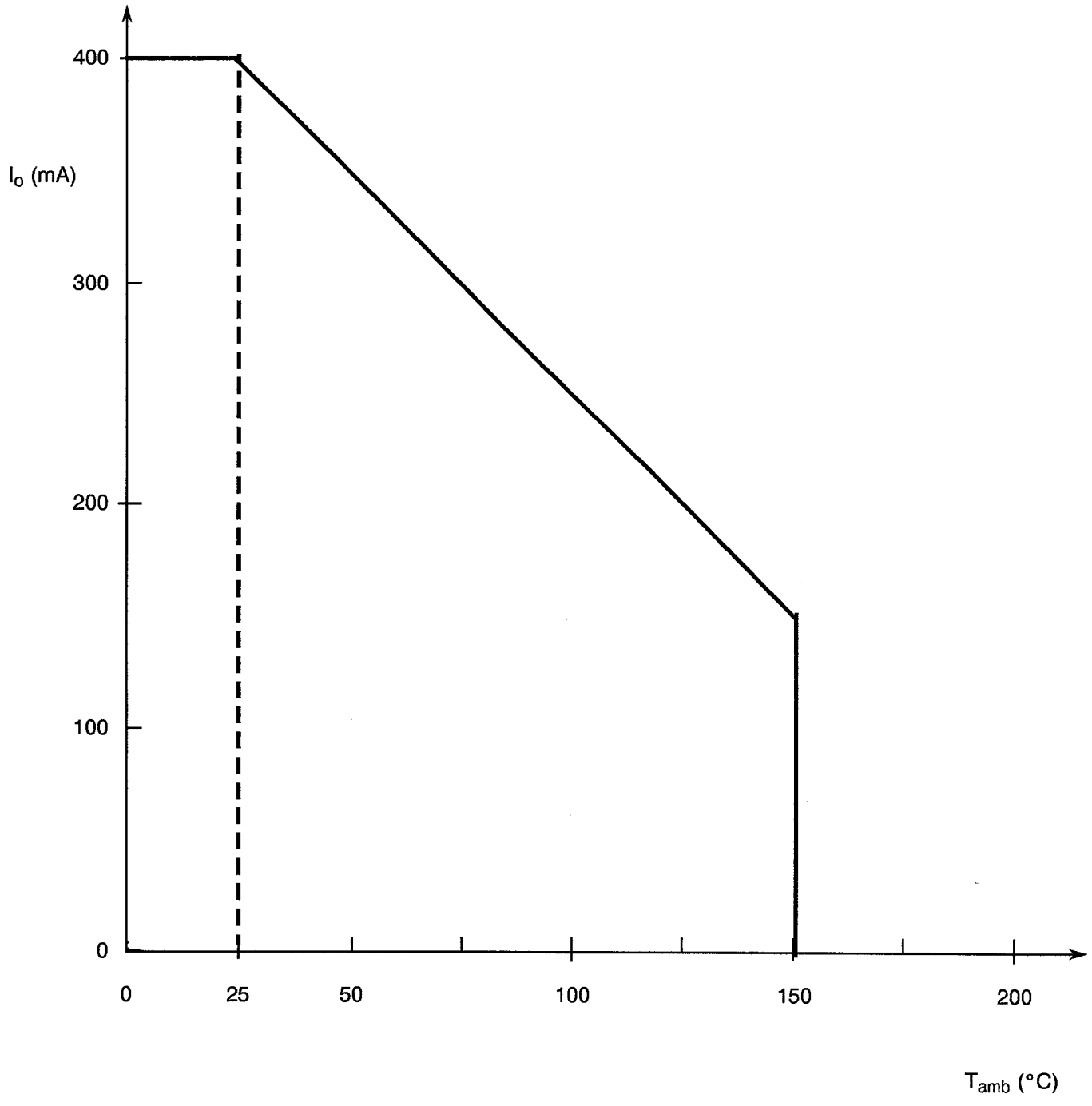
## TABLE 1(b) - MAXIMUM RATINGS

| No. | CHARACTERISTIC | SYMBOL | MAXIMUM RATING | UNIT | REMARKS |
|---|---|---|---|---|---|
| 1 | Operating Junction Temperature Range | $T_j$ | −65 to +150 | °C | |
| 2 | Storage Temperature Range | $T_{stg}$ | −65 to +150 | °C | |
| 3 | Soldering Temperature | $T_{sol}$ | +260 | °C | Time: ≤ 10 seconds; Distance from case: ≥ 1.5mm |
| 4 | Peak Surge Forward Current | $I_{FSM}$ | 3.0 | A | $T_{amb}$ = +25°C; t = 10ms |
| 5 | Reverse Voltage | $V_R$ | See Note 1 | V | |
| 6 | Mean Forward Current | $I_O$ | 0.4 | A | See Note 2 |

**NOTES**

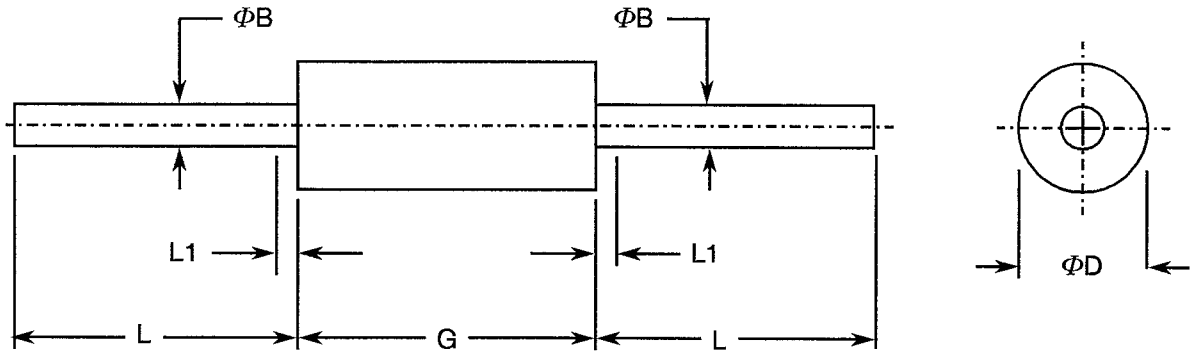
1. See Column 3 of Table 1(a).
2. At $T_{amb} \leq +25°C$. For derating with temperature see Figure 1.

**FIGURE 1 - PARAMETER DERATING INFORMATION**




Permissible average forward current versus ambient temperature.

## FIGURE 2 - PHYSICAL DIMENSIONS



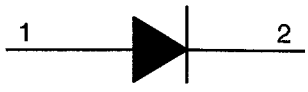

Millimetre dimensions are derived from original inch dimensions.

| SYMBOL | INCHES | | MILLIMETRES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| ΦB | 0.018 | 0.022 | 0.458 | 0.558 | - |
| ΦD | 0.085 | 0.107 | 2.16 | 2.71 | 1 |
| G | 0.230 | 0.300 | 5.85 | 7.62 | 1 |
| L | 1.000 | - | 25.40 | - | - |
| L1 | - | 0.050 | - | 1.27 | 2 |

**NOTES**

1. Package contour optional within cylinder of diameter ΦD and length G. Slugs, if any, shall be included within this cylinder but shall not be subject to the minimum limit of ΦD.
2. Lead diameter not controlled in this zone to allow for flash, lead finish build-up, and minor irregularities other than slugs.

## FIGURE 3 - FUNCTIONAL DIAGRAM




1. Anode
2. Cathode

**NOTES**

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

## 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.

## 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) Bond Strength Test: Shall not be performed.

(b) Die Shear Test: Shall not be performed.

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

(d) Thermal Shock Test: Shall be performed according to Test Method 107, Condition 'B', of MIL-STD-202.

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

None.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Bond Strength Test: Shall not be performed.

(b) Die-shear Test: 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 0.25 grammes.

4.3.4 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 : 18 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 Type 'C' with either Type '3 or 4' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500.

## 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.

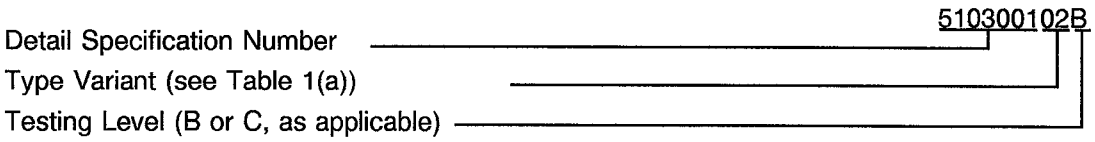
(c) Traceability Information.

### 4.5.2 Lead Identification

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

### 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 of this specification 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, the measurements shall be performed at $T_{amb} = +22 \pm 3$ °C. The parameter drift values ($\Delta$) 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 specified in Table 5 of this specification.

### 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.

### 4.7.4 Conditions and Electrical Circuits for High Temperature Reverse Bias.

The requirements for the High Temperature Reverse Bias test are specified in Section 7 of ESA/SCC Generic Specification No. 5000. The conditions shall be as specified in Table 5, the electrical circuits to be used are shown in Figure 5 of this specification.

## TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

| No. | CHARACTERISTICS | SYMBOL | MIL-STD-750 TEST METHOD | TEST CONDITION | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 1 | Reverse Current | $I_R$ | 4016 | $V_R$ = (1) | - | 0.2 | µA |
| 2 | Forward voltage | $V_F$ | 4011 | $I_F = I_O$ = 0.4A | - | 1.0 | V |

**NOTES**
1. See Column 3 of Table 1(a).
2. See Column 5 of Table 1(a).

## FIGURE 4 - TEST CIRCUIT

Not applicable.

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

| No. | CHARACTERISTICS | SYMBOL | MIL-STD-750 TEST METHOD | TEST CONDITION | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 1 | Reverse Current at $T_{amb}$ = +100°C | $I_R$ | 4016 | $V_R$ = (1) | - | (2) | µA |

**NOTES**
1. See Page 13.

## TABLE 4 - PARAMETER DRIFT VALUES

| No. | CHARACTERISTICS | SYMBOL | SPEC. AND/OR TEST METHOD | TEST CONDITION | CHANGE LIMITS (Δ) | UNIT |
|---|---|---|---|---|---|---|
| 1 | Reverse Current | $I_R$ | As per Table 2 | As per Table 2 | ±100<br>or (1)<br>±40 | %<br><br>nA |
| 2 | Forward Voltage | $V_F$ | As per Table 2 | As per Table 2 | ±10 | % |

**NOTES**
1. Whichever is greater.

## TABLE 5 - CONDITIONS FOR BURN-IN AND HIGH TEMPERATURE REVERSE BIAS

BURN-IN

| No. | CHARACTERISTIC | SYMBOL | CONDITION | UNIT |
|---|---|---|---|---|
| 1 | Ambient Temperature | $T_{amb}$ | +25 | °C |
| 2 | Forward Current | $I_F$ | $I_F = I_O = 0.4A$ | A |

HIGH TEMPERATURE REVERSE BIAS

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

**NOTES**

1. See Column 3 of Table 1(a)
   After HTRB, all diodes shall be cooled to room ambient temperature (+22 ± 5°C) before removal of the impressed voltage.

## FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN AND HTRB

BURN-IN

Not applicable.

HIGH TEMPERATURE REVERSE BIAS

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 test 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 | SPEC. AND/OR TEST METHOD | TEST CONDITION | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 1 | Reverse Current | $I_R$ | As per Table 2 | As per Table 2 | - | 0.2 | µA |
| 2 | Forward Voltage | $V_F$ | As per Table 2 | As per Table 2 | - | 1.0 | V |