



**DIODES, SiC, SCHOTTKY, BLOCKING
HIGH TEMPERATURE**

BASED ON TYPE SIC-HT-SBD01

ESCC Detail Specification No. 5106/022

Issue 1	July 2017
---------	-----------



LEGAL DISCLAIMER AND COPYRIGHT

European Space Agency, Copyright © 2017. All rights reserved.

The European Space Agency disclaims any liability or responsibility, to any person or entity, with respect to any loss or damage caused, or alleged to be caused, directly or indirectly by the use and application of this ESCC publication.

This publication, without the prior permission of the European Space Agency and provided that it is not used for a commercial purpose, may be:

- copied in whole, in any medium, without alteration or modification.
- copied in part, in any medium, provided that the ESCC document identification, comprising the ESCC symbol, document number and document issue, is removed.



DOCUMENTATION CHANGE NOTICE

(Refer to <https://escies.org> for ESCC DCR content)

DCR No.	CHANGE DESCRIPTION

TABLE OF CONTENTS

1	GENERAL	5
1.1	SCOPE	5
1.2	APPLICABLE DOCUMENTS	5
1.3	TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS	5
1.4	THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS	5
1.4.1	The ESCC Component Number	5
1.4.2	Component Type Variants	5
1.5	MAXIMUM RATINGS	6
1.6	HANDLING PRECAUTIONS	6
1.7	PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION	7
1.7.1	TO-257 Package – 3 Terminals	7
1.8	FUNCTIONAL DIAGRAM	8
1.9	MATERIALS AND FINISHES	8
2	REQUIREMENTS	8
2.1	GENERAL	8
2.1.1	Deviations from the Generic Specification	8
2.1.1.1	Deviations from Production Control – Chart F2	8
2.1.1.2	Deviations from Screening Tests - Chart F3	9
2.1.1.3	Deviations from Qualification and Periodic Testing - Chart F4	10
2.2	MARKING	10
2.3	CASE ISOLATION	10
2.4	TERMINAL STRENGTH	10
2.5	ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES	11
2.5.1	Room Temperature Electrical Measurements	11
2.5.2	High and Low Temperatures Electrical Measurements	11
2.5.3	Notes to Room, High and Low Temperatures Electrical Measurements	11
2.6	PARAMETER DRIFT VALUES	12
2.7	INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS	13
2.8	HIGH TEMPERATURE REVERSE BIAS BURN-IN CONDITIONS	13
2.9	POWER BURN-IN CONDITIONS	13
2.10	OPERATING LIFE CONDITIONS	13
2.11	TOTAL DOSE RADIATION TESTING	14
2.11.1	Bias Conditions and Total Dose Level for Total Dose Radiation Testing	14
2.11.2	Electrical Measurements for Total Dose Radiation Testing	14
APPENDIX A		15

1 GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics and test and inspection data for the component type variants and/or the range of components specified below. It supplements the requirements of, and shall be read in conjunction with, the ESCC Generic Specification listed under Applicable Documents.

1.2 APPLICABLE DOCUMENTS

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

- (a) ESCC Generic Specification No. [5000](#)
- (b) [MIL-STD-750](#), Test Methods and Procedures for Semiconductor Devices
- (c) [MIL-STD-883](#), Test Method Standard Microelectronics
- (d) JEDS531, JEDEC Standard: Thermal Resistance Test Method for Signal and Regulator Diodes (Forward Voltage, Switching Method).

1.3 TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. [21300](#) shall apply.

1.4 THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS

1.4.1 The ESCC Component Number

The ESCC Component Number shall be constituted as follows:

Example: 510602201

- Detail Specification Reference: 5106022
- Component Type Variant Number: 01 (as required)
- Total Dose Radiation Level Letter: R (as required)

1.4.2 Component Type Variants

The component type variants applicable to this specification are as follows:

Variant Number	Based on Type	Case (Note 1)	Terminal Material and Finish (Note 2)	Weight max (g)	Total Dose Radiation Level Letter (Note 3)
01	SIC-HT-SBD01	TO-257	H14	5	R [100krad(Si)]

NOTES:

1. See Para. 1.7.
2. The lead material and finish shall be in accordance with the requirements of ESCC Basic Specification No. [23500](#).
3. Total dose radiation level letters are defined in ESCC Basic Specification No. [22900](#). If an alternative radiation test level is specified in the Purchase Order the letter shall be changed accordingly.

1.5 MAXIMUM RATINGS

The maximum ratings shall not be exceeded at any time during use or storage.

Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

Characteristics	Symbols	Maximum Ratings	Units	Remarks
Forward Current (Continuous)	I_F	2.5	A	Over T_{op}
Reverse Voltage (Continuous)	V_R	250	V	Over T_{op}
Forward Surge Current	I_{FSM}	25	A	Single pulse: 10ms, half-sine
Repetitive Forward Surge Current	I_{RFSM}	15	A	1kHz, 2% duty cycle, squarewave
Operating Temperature Range	T_{op}	-170 to +270	°C	T_{case}
Storage Temperature Range	T_{stg}	-170 to +270	°C	
Junction Temperature	T_j	+285	°C	
Soldering Temperature	T_{sol}	+260	°C	Note 1
Thermal Resistance, Junction-to-Case	$R_{th(j-c)}$	3	°C/W	Over T_{op} Note 2

NOTES:

1. Duration 10 seconds maximum and the same terminal shall not be resoldered until 30 minutes have elapsed.
2. Case mounted on infinite heat sink.

1.6 HANDLING PRECAUTIONS

The TO-257 package contain Beryllium Oxide (BeO) and therefore must not be ground, machined, sandblasted or subjected to any mechanical operation which will produce dust. The case must not be subjected to any chemical process (e.g. etching) which will produce fumes.

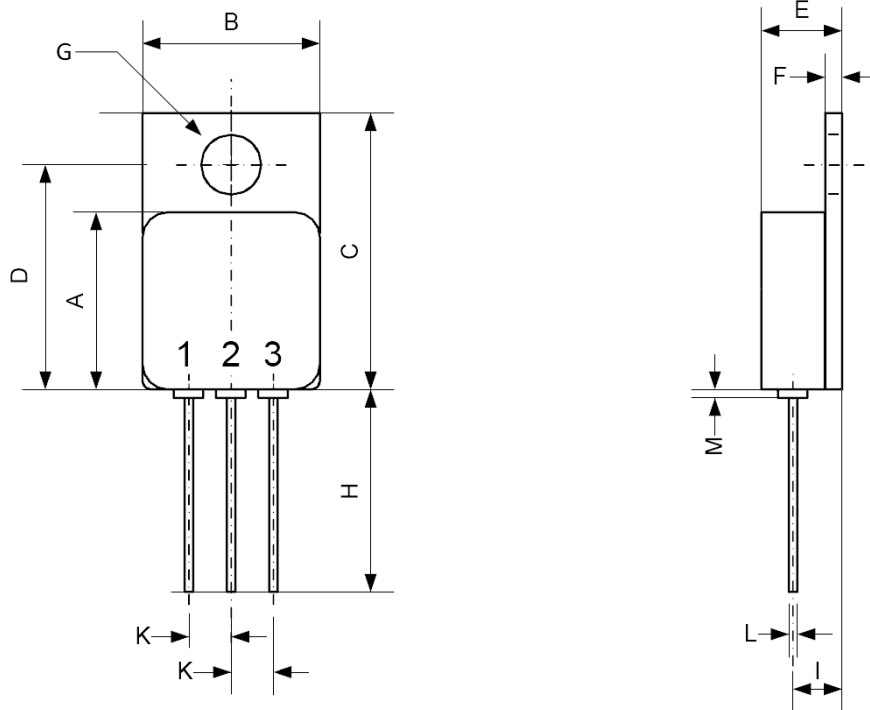
These devices shall not be handled by the terminals.

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

These components are categorised as Class 3 per ESCC Basic Specification No. [23800](#) with a Minimum Critical Path Failure Voltage of 8kV.

1.7 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION

1.7.1 TO-257 Package – 3 Terminals



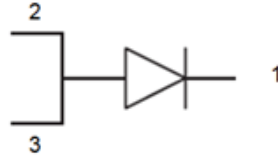
Symbols	Dimensions (mm)	
	Min	Max
A	10.4	10.8
B	10.4	10.8
C	16.2	16.8
D	13.1	13.9
E	4.8	5.4
F	0.9	1.1
G	3.5	3.7
H	14	19
I	2.7	3.2
K	2.54 BSC	2.54 BSC
L	0.6	1
M	-	1.3

NOTES:

- The terminal identification is specified by the component's geometry. The terminal identification shall be: terminal 1 = Cathod, terminal 2 = Anode, terminal 3 = Anode.

1.8 FUNCTIONAL DIAGRAM

Terminal 1: Cathode
Terminal 2: Anode
Terminal 3: Anode



NOTES:

1. The case is not connected to any terminal.

1.9 MATERIALS AND FINISHES

Materials and finishes shall be as follows:

- (a) Case
The case shall be hermetically sealed and have a ceramic/metal body.
- (b) Terminals
As specified in Component Type Variants.

2 REQUIREMENTS

2.1 GENERAL

The complete requirements for procurement of the components specified herein are as stated in this specification and the ESCC Generic Specification. Permitted deviations from the Generic Specification, applicable to this specification only, are listed below.

Permitted deviations from the Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESCC requirement and do not affect the component's reliability, are listed in the appendices attached to this specification.

2.1.1 Deviations from the Generic Specification

2.1.1.1 *Deviations from Production Control – Chart F2*

- (a) Wafer Lot Acceptance: Room Temperature Electrical Measurements (Wafer Lot Screening): shall be performed go-no-go (either as an on-wafer measurement or after dice separation). Acceptable dice are those which show no evidence of a double barrier or anomalous V/I curve when tested at $I_F \leq 100\mu\text{A}$ and which have $I_R < 1.1\mu\text{A}$ at $V_R = 250\text{V}$.

(b) Special In-Process Controls:

The following additional tests and inspections shall be performed:

- i. CSAM inspection in accordance with MIL-STD-883, Test Method 2030 shall be performed immediately after die attach (prior to wire bonding). The inspection shall be performed on a minimum sample of 1 component for every 30 components die attached. The die attach shall appear uniform with no evidence of voids exceeding 10% of the bonding area in total and 3% of the bonding area for any individual void. No failures are allowed. The test is considered destructive; tested parts shall be clearly identified and removed from the lot.
- ii. The following electrical measurements shall be performed on all components after assembly and prior to encapsulation. Components that fail these measurements shall be clearly identified and removed from the lot.

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Reverse Current	I_R	4016	$V_R = 250V$, DC method	-	1.1	μA
Forward Voltage	V_F	4011	$I_F = 3A$, Pulse method (pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$)	-	1.5	V

- iii. Internal Gas Analysis in accordance with MIL-STD-750, Test Method 1018 shall be performed after encapsulation. The test shall be performed on a minimum sample of 6 components from the production lot with at least 1 sample from each encapsulation batch (if applicable). Prior to the test, Serialisation, High Temperature Stabilisation Bake and Temperature Cycling (only 10 cycles minimum) shall be performed as specified in Chart F3 in the ESCC Generic Specification. The details of all measurable gases shall be recorded against serial number. No failures are allowed. The test is considered destructive; tested parts shall be clearly identified and removed from the lot.
- iv. Thermal Resistance shall be measured go-no-go after encapsulation, as specified in Para. 2.5.1. The test shall be performed on a minimum sample of 50 components from the production lot with at least 10 samples from each encapsulation batch (if applicable). No failures are allowed. The test is considered destructive; tested parts shall be clearly identified and removed from the lot.

2.1.1.2 Deviations from Screening Tests - Chart F3

- (a) Serialisation: shall be performed after encapsulation during Chart F2 (prior to Internal Gas Analysis).
- (b) Temperature Cycling: the following test conditions shall apply:
 - Maximum transfer time: 5 minutes
 - Maximum ramp time: 30 minutes
 - Number of cycles: 50 total:
 - cycles 1 to 40: $-165^{\circ}C$ to $+270^{\circ}C$;
 - cycles 41 to 50: $-170^{\circ}C$ to $+270^{\circ}C$
- (c) Particle Impact Noise Detection may be performed at any point after Temperature Cycling, prior to Seal.
- (d) Measurements of Parameter Drift Values at high temperature after Power Burn-in need not be repeated in High and Low Temperatures Electrical Measurements.

2.1.1.3 *Deviations from Qualification and Periodic Testing - Chart F4*

- (a) Temperature Cycling: the following test conditions shall apply:
- Maximum transfer time: 5 minutes
 - Maximum ramp time: 30 minutes
- (b) Operating Life: An additional data point at 1500 ±48 hours shall apply.

2.2 MARKING

The marking shall be in accordance with the requirements of ESCC Basic Specification No. [21700](#) and as follows.

The information to be marked on the component shall be:

- (a) The ESCC Qualified Component symbol (for ESCC qualified components only).
(b) The ESCC Component Number.
(c) Traceability information.
(d) Warning sign for Beryllium Oxide.

2.3 CASE ISOLATION

Case Isolation shall be performed as specified in the ESCC Generic Specification and as follows:

- Test Conditions:
 - Test voltage: 500Vdc
 - Duration of application of test voltage: 10s
 - Points of application of test voltage: between case metal tab and all terminals connected together
 - Maximum leakage current: 100nA

2.4 TERMINAL STRENGTH

The test conditions for Terminal Strength, tested as specified in the ESCC Generic Specification, shall be as follows:

- Test condition: A, tension, with an applied force of 40N for a duration of 10s.

2.5 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

Electrical measurements shall be performed at room, high and low temperatures. Consolidated notes are given after the tables.

2.5.1 Room Temperature Electrical Measurements

The measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions	Limits		Units
				Min	Max	
Reverse Current	I_R	4016	$V_R = 250\text{V}$, DC method	-	10	μA
Forward Voltage	V_{F1}	4011	$I_F = 0.5\text{A}$, Note 1	-	1.3	V
	V_{F2}	4011	$I_F = 1.5\text{A}$, Note 1	-	1.5	V
	V_{F3}	4011	$I_F = 2.5\text{A}$, Note 1	-	1.6	V
Capacitance	C	4001	$V_R = 2\text{V}$, $f = 1\text{kHz}$	-	1	nF
Thermal Resistance	$R_{th(j-c)}$	-	JEDS531 Note 2	(Calculate ΔV_F , see Note 2)		$^{\circ}\text{C/W}$

2.5.2 High and Low Temperatures Electrical Measurements

Characteristics	Symbols	MIL-STD-750 Test Method	Test Conditions (Note 3)	Limits		Units
				Min	Max	
Reverse Current	I_R	4016	$T_{amb} = +270 (+0 -5)^{\circ}\text{C}$ and $-165 (+5 -0)^{\circ}\text{C}$ $V_R = 250\text{V}$, DC method	-	150	μA
Forward Voltage	V_{F1}	4011	$T_{amb} = +270 (+0 -5)^{\circ}\text{C}$ $I_F = 0.5\text{A}$, Note 1	-	0.9	V
			$T_{amb} = -165 (+5 -0)^{\circ}\text{C}$ $I_F = 0.5\text{A}$, Note 1	-	1.9	V
	V_{F2}	4011	$T_{amb} = +270 (+0 -5)^{\circ}\text{C}$ $I_F = 1.5\text{A}$, Note 1	-	1.2	V
			$T_{amb} = -165 (+5 -0)^{\circ}\text{C}$ $I_F = 1.5\text{A}$, Note 1	-	2.1	V
	V_{F3}	4011	$T_{amb} = +270 (+0 -5)^{\circ}\text{C}$ $I_F = 2.5\text{A}$, Note 1	-	1.5	V
			$T_{amb} = -165 (+5 -0)^{\circ}\text{C}$ $I_F = 2.5\text{A}$, Note 1	-	2.2	V

2.5.3 Notes to Room, High and Low Temperatures Electrical Measurements

1. Pulsed measurement: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.
2. Performed only during Chart F2 on a sample basis (go-no-go)(see Para. 2.1.1.1(b)iv). The limits for ΔV_F shall be defined by the Manufacturer on every lot in accordance with JEDS531 and shall guarantee $R_{th(j-c)} \leq 2^{\circ}\text{C/W}$.
3. 100% read and record measurements shall be performed.

2.6 PARAMETER DRIFT VALUES

Unless otherwise specified, the measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

The test methods and test conditions shall be as per the corresponding test defined in Para. 2.5.1, Room Temperature Electrical Measurements.

The drift values (Δ) shall not be exceeded for each characteristic specified. The corresponding absolute limit values for each characteristic shall not be exceeded.

Characteristics	Symbols	Limits			Units
		Drift Value Δ	Absolute		
			Min	Max	
Reverse Current	I_R	± 1 or (1) $\pm 100\%$	-	10	μA
Reverse Current at $T_{amb} = +270 (+0 -5)^{\circ}\text{C}$	I_R	± 10 or (1) $\pm 100\%$	-	150	μA
Forward Voltage	V_{F1}	$\pm 5\%$	-	1.3	V
	V_{F2}	$\pm 5\%$	-	1.5	V
	V_{F3}	$\pm 5\%$	-	1.6	V
Forward Voltage at $T_{amb} = +270 (+0 -5)^{\circ}\text{C}$	V_{F3}	$\pm 10\%$	-	1.5	V

NOTES:

1. Whichever is the greater.

2.7 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

Unless otherwise specified, the measurements shall be performed at $T_{amb} = +22 \pm 3^{\circ}\text{C}$.

The test methods and test conditions shall be as per the corresponding test defined in Para. 2.5.1.

The limit values for each characteristic shall not be exceeded.

Characteristics	Symbols	Limits		Units
		Min	Max	
Reverse Current	I_R	-	10	μA
Reverse Current at $T_{amb} = +270 (+0 -5)^{\circ}\text{C}$ Note 1	I_R	-	150	μA
Forward Voltage	V_{F1}	-	1.3	V
	V_{F2}	-	1.5	V
	V_{F3}	-	1.6	V
Forward Voltage at $T_{amb} = +270 (+0 -5)^{\circ}\text{C}$ Note 1	V_{F3}	-	1.5	V

NOTES:

1. Not required to be performed during the Mechanical Shock/Vibration/Constant Acceleration/Seal Subgroup in Chart F4.

2.8 HIGH TEMPERATURE REVERSE BIAS BURN-IN CONDITIONS

Characteristics	Symbols	Test Conditions	Units
Case Temperature	T_{case}	+270 (+0 -5)	$^{\circ}\text{C}$
Reverse Voltage	V_R	250	V
Duration	t	96 minimum	Hours

NOTES:

1. Voltage may be switched off during cool down.

2.9 POWER BURN-IN CONDITIONS

Characteristics	Symbols	Test Conditions	Units
Case Temperature	T_{case}	+270 (+0 -5) (Note 1)	$^{\circ}\text{C}$
Forward Current	I_F	2.5	A
Duration	t	168 minimum	Hours

NOTES:

1. During testing the case temperature shall be monitored to ensure the specified temperature limits are not exceeded.

2.10 OPERATING LIFE CONDITIONS

The following conditions shall apply:

- For period 0 to 1500 hours: As specified for Power Burn-in (see Para. 2.9)
- For period 1500 to 2000 hours: As specified for HTRB Burn-in (see Para. 2.8)

2.11 TOTAL DOSE RADIATION TESTING

2.11.1 Bias Conditions and Total Dose Level for Total Dose Radiation Testing

The following bias condition shall be used during irradiation testing:

- 5 samples: unbiased (all terminals short-circuited together)
- 5 samples: reverse biased, $V_R = 250V$

The total dose level applied shall be as specified in the component type variant information herein or in the Purchase Order.

2.11.2 Electrical Measurements for Total Dose Radiation Testing

Prior to irradiation testing the devices shall have successfully met Room Temperature Electrical Measurements specified in Para. 2.5.1 herein.

Unless otherwise stated the measurements shall be performed at $T_{amb} = +22 \pm 3^\circ C$.

Unless otherwise specified the test methods and test conditions shall be as per the corresponding test defined in Para. 2.5.1.

The parameters to be measured during irradiation testing and on completion of irradiation testing are shown below:

Characteristics	Symbols	Limits		Units	
		Drift Value Δ	Absolute		
			Min		Max
Reverse Current	I_R	± 1 or (1) $\pm 100\%$	-	10	μA
Reverse Current at $T_{amb} = +270 (+0 -5)^\circ C$	I_R	± 10 or (1) $\pm 100\%$	-	150	μA
Forward Voltage	V_{F1}	$\pm 5\%$	-	1.3	V
	V_{F2}	$\pm 5\%$	-	1.5	V
	V_{F3}	$\pm 5\%$	-	1.6	V
Forward Voltage at $T_{amb} = +270 (+0 -5)^\circ C$	V_{F3}	$\pm 10\%$	-	1.5	V

NOTES:

1. Whichever is the greater.

APPENDIX A**ADDITIONAL DATA – ALTER TECHNOLOGY (E)**

(a) Derating for Space Application

These components are sensitive to Single Event Effects if operated in a space environment unless the following derating is applied:

Characteristics	Symbols	Maximum Ratings	Units	Remarks
Reverse Voltage	V_R	200	V	Over T_{op}