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Pages 1 to 20

**TRANSISTORS, LOW POWER, NPN,
BASED ON TYPE BSX39
ESA/SCC Detail Specification No. 5201/015**

SCC

**space components
coordination group**

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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.	
'A'	Feb. '92	This issue incorporates all modifications agreed on the basis of Policy DCR's 21019, 21021, 21022 and 21025.			
		P1.	Cover Page	None	
		P2.	DCN	None	
		P5.	Para. 1.2	: Paragraph amended	21021
			Para. 2	: "ESA/SCC Basic Spec. No. 23500" added	21025
		P10.	Para. 4.2.2	: Bond Strength and Die Shear Test deviations deleted	23499
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P17.	Table 3	: Note deleted	21047		
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		P6.	Table 1(a)	: First two column headings amended : Variants 02 and 03 added	221226 221226
		P11.	Para. 4.4.2	: Paragraph rewritten	221226
		This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.			

**SCC**

ESA/SCC Detail Specification

No. 5201/015

PAGE 3

ISSUE 1

TABLE OF CONTENTS

	<u>Page</u>
1. <u>GENERAL</u>	5
1.1 Scope	5
1.2 Component Type Variants	5
1.3 Maximum Ratings	5
1.4 Parameter Derating Information	5
1.5 Physical Dimensions	5
1.6 Functional Diagram	5
2. <u>APPLICABLE DOCUMENTS</u>	5
3. <u>TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS</u>	10
4. <u>REQUIREMENTS</u>	10
4.1 General	10
4.2 Deviations from Generic Specification	10
4.2.1 Deviations from Special In-process Controls	10
4.2.2 Deviations from Final Production Tests (Chart II)	10
4.2.3 Deviations from Burn-in Tests and Electrical Measurements (Chart III)	10
4.2.4 Deviations from Qualification Tests (Chart IV)	11
4.2.5 Deviations from Lot Acceptance Tests (Chart V)	11
4.3 Mechanical Requirements	11
4.3.1 Dimension Check	11
4.3.2 Weight	11
4.3.3 Terminal Strength	11
4.4 Materials and Finishes	11
4.4.1 Case	11
4.4.2 Lead Material and Finish	11
4.5 Marking	12
4.5.1 General	12
4.5.2 Lead Identification	12
4.5.3 The SCC Component Number	12
4.5.4 Traceability Information	12
4.5.5 Marking of Small Components	12



	<u>Page</u>
4.6 Electrical Measurements	13
4.6.1 Electrical Measurements at Room Temperature	13
4.6.2 Electrical Measurements at High and Low Temperatures	13
4.6.3 Circuits for Electrical Measurements	13
4.7 Burn-in Tests	13
4.7.1 Parameter Drift Values	13
4.7.2 Conditions for Burn-in	13
4.7.3 Electrical Circuits for Burn-in	13
4.8 Environmental and Endurance Tests	19
4.8.1 Electrical Measurements on Completion of Environmental Tests	19
4.8.2 Electrical Measurements at Intermediate Points and on Completion of Endurance Tests	19
4.8.3 Conditions for Operating Life Tests (Part of Endurance Testing)	19
4.8.4 Electrical Circuits for Operating Life Tests	19
4.8.5 Conditions for High Temperature Storage Test (Part of Endurance Testing)	19

TABLES

1(a) Type Variants	6
1(b) Maximum Ratings	6
2 Electrical Measurements at Room Temperature	14
3 Electrical Measurements at High and Low Temperatures	17
4 Parameter Drift Values	17
5 Conditions for Burn-in	18
6 Electrical Measurements at Intermediate Points and on Completion of Endurance Testing	20

FIGURES

1 Parameter Derating Information	7
2 Physical Dimensions	8
3 Functional Diagram	9
4 Test Circuit	16
5 Electrical Circuit for Burn-in	N/A

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 Transistors, Low Power, NPN, based on Type BSX39.

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

See 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 transistors specified herein, are scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

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

1.5 PHYSICAL DIMENSIONS

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

1.6 FUNCTIONAL DIAGRAM

The functional diagram, showing lead identification of the transistors 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.
- (c) ESA/SCC Basic Specification No. 23500, Requirements for Lead Materials and Finishes for Components for Space Application.

**TABLE 1(a) - TYPE VARIANTS**

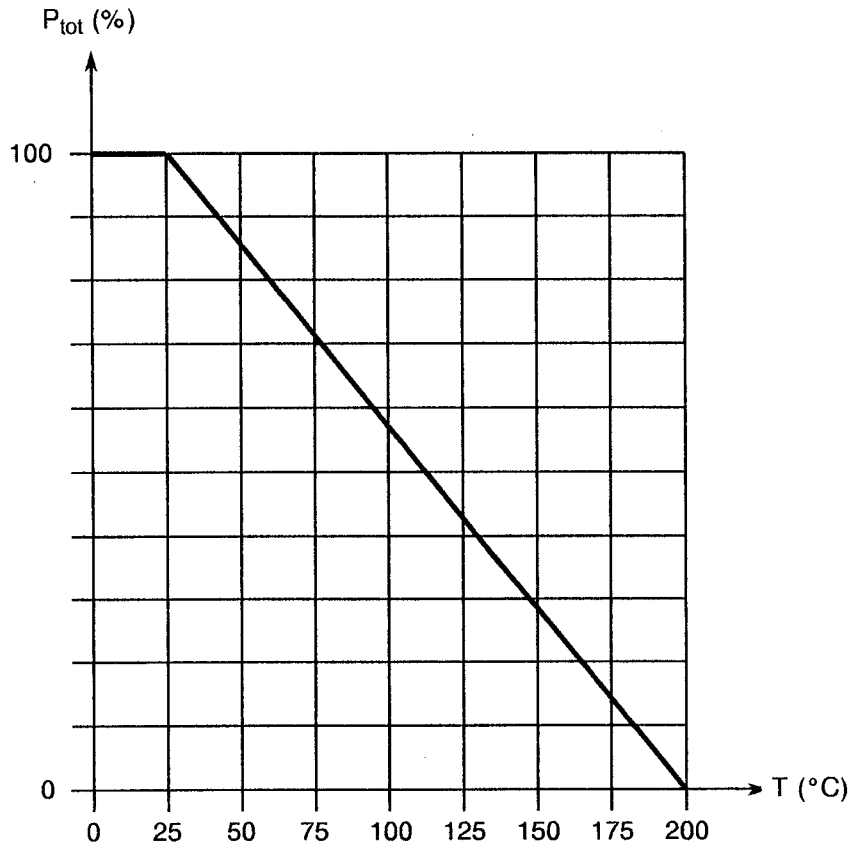
VARIANT	BASED ON TYPE	CASE	FIGURE	LEAD MATERIAL AND FINISH
01	BSX39	TO18	2	D2
02	BSX39	TO18	2	D3 or D4
03	BSX39	TO18	2	D7

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	45	V	Over entire Operating Temperature Range
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	20	V	Over entire Operating Temperature Range
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	5.0	V	Over entire Operating Temperature Range
4	Collector Current	I_C	500	mA	
5	Power Dissipation	P_{tot}	360	mW	$T_{amb} \leq +25^{\circ}C$
			1.2	W	$T_{case} \leq +25^{\circ}C$
6	Operating Temperature Range	T_{op}	- 55 to + 200	$^{\circ}C$	T_{amb}
7	Storage Temperature Range	T_{stg}	- 55 to + 200	$^{\circ}C$	
8	Soldering Temperature	T_{sol}	+ 260	$^{\circ}C$	Time: 60 sec.



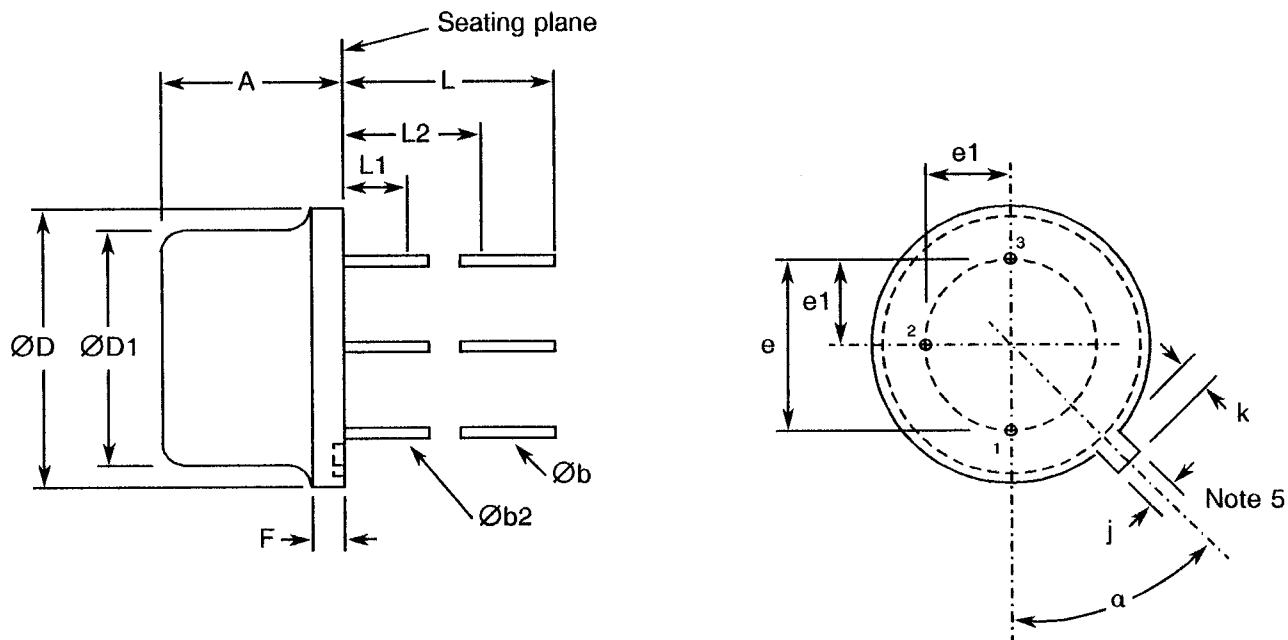
FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature (T_{amb})



FIGURE 2 - PHYSICAL DIMENSIONS



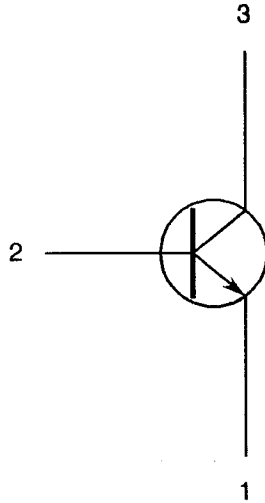
SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.170	0.210	4.32	5.33	
Øb	0.016	0.021	0.406	0.533	1
Øb2	0.016	0.019	0.406	0.483	1
ØD	0.209	0.230	5.31	5.84	
ØD1	0.178	0.195	4.52	4.95	
e	0.100 T.P.		2.54 T.P.		2, 4
e1	0.050 T.P.		1.27 T.P.		2, 4
F	-	0.030	-	0.762	
j	0.036	0.046	0.914	1.17	4
k	0.028	0.048	0.711	1.22	3
L	0.500	-	12.70	-	1
L1	-	0.050	-	1.27	1
L2	0.250	-	6.35	-	1
α	45° T.P.		45° T.P.		5

NOTES

- (3 leads) Øb2 applies between L1 and L2. Øb applies between L2 and 0.5 inch (12.70mm) from seating plane. Diameter is uncontrolled in L1 and beyond 0.5 inch (12.70mm) from seating plane.
- Leads having maximum diameter 0.019 inch (0.483mm), measured in gauging plane 0.054 inch (1.37mm) + 0.001 inch (0.25mm) - 0.000 inch (0.000mm) below the seating plane of the device shall be within 0.007 inch (0.178mm) of their true positions relative to a maximum width tab.
- Measured from maximum diameter of the actual device.
- The device may be measured by direct methods or by the gauge and gauging procedure described in gauge drawing GS-2.
- Tab centreline.



FIGURE 3 - FUNCTIONAL DIAGRAM





CONNECTIONS

1. Emitter.
2. Base.
3. Collector.

NOTES

1. The collector is internally connected to the case.

 	<p style="text-align: center;">ESA/SCC Detail Specification No. 5201/015</p>	<p style="text-align: center;">Rev. 'A'</p>	<p>PAGE 10 ISSUE 1</p>
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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 transistors 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)

None.

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

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



4.2.4 Deviations from Qualification Tests (Chart IV)

None.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

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

4.3.2 Weight

The maximum weight of the transistors specified herein shall be 0.4 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: E, Lead fatigue.
Applied Force: 2.5 ± 0.1 Newtons.
Duration: -.

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 transistors 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

Metal case, hermetically sealed, similar to JEDEC TO-18.

4.4.2 Lead Material and Finish

The lead material shall be Type 'D' with either Type '2', Type '3 or 4' or Type '7' 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. Each component shall be marked in respect of:-

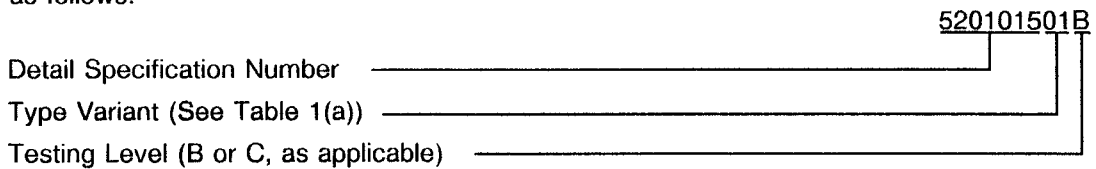
- (a) Lead Identification.
- (b) The SCC Component Number.
- (c) Traceability Information.

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. Unless otherwise specified, 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, 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 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.

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

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	$I_C = 100\mu A$ $I_E = 0A$	45	-	V
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	$I_C = 10mA$ $I_B = 0A$ (Note 1)	20	-	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	$I_E = 100\mu A$ $I_C = 0A$	5.0	-	V
4	Collector-Emitter Cut-off Current	I_{CES}	3041	$V_{CE} = 20V$	-	100	nA
5	Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	3071	$I_C = 300mA$ $I_B = 30mA$ (Note 1)	-	0.5	V
6	Base-Emitter Saturation Voltage	$V_{BE(SAT)}$	3071	$I_C = 300mA$ $I_B = 30mA$ (Note 1)	-	1.7	V
7	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$V_{CE} = 0.4V$ $I_C = 30mA$ (Note 1)	40	120	-
		h_{FE2}		$V_{CE} = 0.5V$ $I_C = 100mA$ (Note 1)	25	-	
		h_{FE3}		$V_{CE} = 1.0V$ $I_C = 300mA$ (Note 1)	15	-	

NOTES1. Pulse Measurement: Pulse length $\leq 300\mu s$, Duty Cycle $\leq 2\%$.

**SCC**ESA/SCC Detail Specification
No. 5201/015

PAGE 15

ISSUE 1

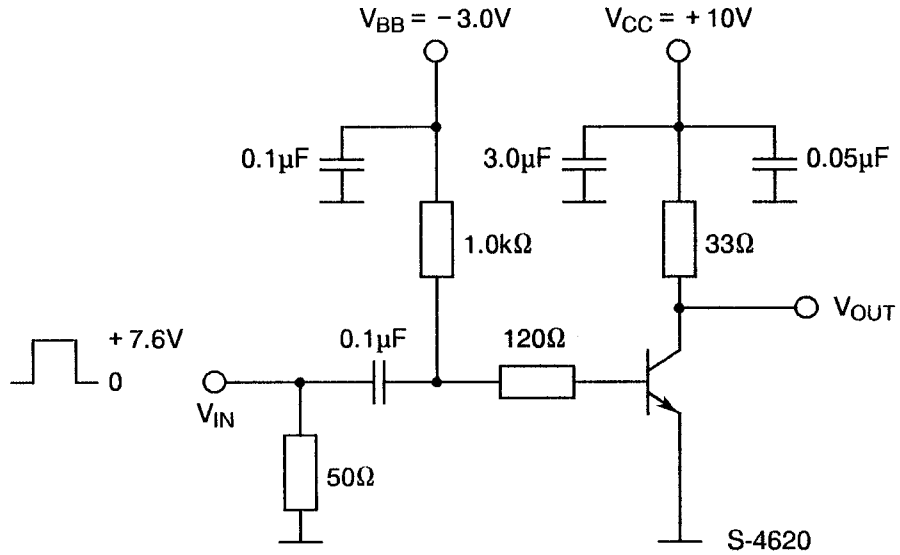
TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - a.c. PARAMETERS

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	Small Signal Current Gain	h_{fe}	3306	$V_{CE} = 10V$ $I_C = 30mA$ $f = 100MHz$	3.5	-	-
2	Output Capacitance	C_{obo}	3236	$V_{CB} = 5.0V$ $I_E = 0A$ $f = 1.0MHz$	-	5.0	pF
3	Turn-on Time	t_{on}	3251.1 Cond. B	See Figure 4 $I_C = 300mA$ $V_{CC} = 10V$ $I_{B1} = - I_{B2} = 30mA$	-	15	ns
4	Turn-off Time	t_{off}	3251.1 Cond. B	See Figure 4 $I_C = 300mA$ $V_{CC} = 10V$ $I_{B1} = - I_{B2} = 30mA$	-	25	ns



FIGURE 4 - TEST CIRCUIT

(For information only)



PULSE GENERATOR
 $t_r, t_f < 1.0\text{ns}$
 $PW \geq 240\text{ns}$
 $Z_{IN} = 50\Omega$

TO OSCILLOSCOPE
 $t_r < 1.0\text{ns}$
 $Z_{IN} = 100\text{k}\Omega$



		ESA/SCC Detail Specification No. 5201/015	Rev. 'A'	PAGE 17
				ISSUE 1

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	Collector-Emitter Cut-off Current	I_{CES}	3041	$T_{amb} = +125^{\circ}C$ $V_C = 20V$	-	30	μA
2	D.C. Forward Current Transfer Ratio	h_{FE}	3076	$T_{amb} = -55^{\circ}C$ $V_{CE} = 0.4V$ $I_C = 30mA$	12	-	

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	CHANGE LIMIT	UNIT
1	Collector-Emitter Cut-off Current	I_{CES}	3041	$V_{CE} = 20V$	± 100 or (2) 25	% nA
2	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$V_{CE} = 0.4V$ (1) $I_C = 30mA$	± 15	%
3	Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	3071	$I_C = 300mA$ (1) $I_B = 30mA$	± 15 or (2) 25	% mV

NOTES


1. Pulse Measurement: Pulse length $\leq 300\mu s$, Duty Cycle $\leq 1\%$.
2. Whichever is greater, related to initial value.

TABLE 5 - CONDITIONS FOR BURN-IN

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+ 25	°C
2	Power Dissipation	P_{tot}	0.36	W
3	Collector-Base Voltage	V_{CB}	10	V

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN

Not applicable.

	<p style="text-align: center;">ESA/SCC Detail Specification No. 5201/015</p>		<p>PAGE 19 ISSUE 1</p>
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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 tests 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 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 Section 9 of 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 CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$I_C = 30\text{mA}$ $V_{CE} = 0.4\text{V}$ (1)	40	120	-
2	Collector-Emitter	$V_{CE(SAT)}$	3071	$I_C = 300\text{mA}$ $I_B = 30\text{mA}$ (1)	-	0.5	V
3	Collector-Emitter Cut-off Current	I_{CES}	3041	$V_{CE} = 20\text{V}$	-	100	nA

NOTES

1. Pulse Measurement: Pulse length $\leq 300\mu\text{s}$, Duty Cycle $\leq 1\%$.