



TRANSISTORS, SWITCHING POWER, NPN

BASED ON TYPE 2N5542

ESCC Detail Specification No. 5203/035

ISSUE 1

October 2002



	ESCC Detail Specification		PAGE ii ISSUE 1
--	---------------------------	--	--------------------

LEGAL DISCLAIMER AND COPYRIGHT

European Space Agency, Copyright © 2002. 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.



europaean space agency
agence spatiale européenne

Pages 1 to 18

TRANSISTORS, SWITCHING POWER, NPN,

BASED ON TYPE 2N5542

ESA/SCC Detail Specification No. 5203/035



**space components
coordination group**

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 1	September 1982	-	-
Revision 'A'	February 1992	<i>Pommes</i>	<i>J. Lab</i>

	<p style="text-align: center;">ESA/SCC Detail Specification No. 5203/035</p>	<p style="text-align: center;">Rev. 'A'</p>	<p>PAGE 2 ISSUE 1</p>
---	--	---	---------------------------

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 21022 for adaptation to new ESA/SCC Generic Specification No. 5000 Issue 4 April 1982 requirements.		
		P1. Cover page	None	
		P2. DCN	None	
		P6. Table 1(a)	21025	
		P9. Para. 2	21025	
		Para. 4.2.2	23499	
		Para. 4.2.3	21043	
		Para. 4.2.4	23499	
		P10. Para. 4.4.2	21025	
		P15. Table 3	21047	
		This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.		

 	<p style="text-align: center;">ESA/SCC Detail Specification No. 5203/035</p>		<p>PAGE 3 ISSUE 1</p>
---	--	--	---------------------------

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>	9
3.	<u>TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS</u>	9
4.	<u>REQUIREMENTS</u>	9
4.1	General	9
4.2	Deviations from Generic Specification	9
4.2.1	Deviations from Special In-process Controls	9
4.2.2	Deviations from Final Production Tests (Chart II)	9
4.2.3	Deviations from Burn-in and Electrical Measurements (Chart III)	9
4.2.4	Deviations from Qualification Tests (Chart IV)	9
4.2.5	Deviations from Lot Acceptance Tests (Chart V)	9
4.3	Mechanical Requirements	10
4.3.1	Dimension Check	10
4.3.2	Weight	10
4.3.3	Terminal Strength	10
4.4	Materials and Finishes	10
4.4.1	Case	10
4.4.2	Lead Material and Finish	10
4.5	Marking	11
4.5.1	General	11
4.5.2	Lead Identification	11
4.5.3	The SCC Component Number	11
4.5.4	Traceability Information	11
4.5.5	Marking of Small Components	11



	<u>Page</u>	
4.6	Electrical Measurements	12
4.6.1	Electrical Measurements at Room Temperature	12
4.6.2	Electrical Measurements at High and Low Temperatures	12
4.6.3	Circuits for Electrical Measurements	12
4.7	Burn-in Tests	12
4.7.1	Parameter Drift Values	12
4.7.2	Conditions for Burn-in	12
4.7.3	Electrical Circuits for Burn-in	12
4.8	Environmental and Endurance Tests	17
4.8.1	Electrical Measurements on Completion of Environmental Tests	17
4.8.2	Electrical Measurements at Intermediate Points and on Completion of Endurance Tests	17
4.8.3	Conditions for Operating Life Tests (Part of Endurance Testing)	17
4.8.4	Electrical Circuits for Operating Life Tests	17
4.8.5	Conditions for High Temperature Storage Test (Part of Endurance Testing)	17

TABLES

1(a)	Type Variants	6
1(b)	Maximum Ratings	6
2	Electrical Measurements at Room Temperature - d.c. Parameters	13
	Electrical Measurements at Room Temperature - a.c. Parameters	14
3	Electrical Measurements at High and Low Temperatures	15
4	Parameter Drift Values	15
5	Conditions for Burn-in	16
6	Electrical Measurements at Intermediate Points and on Completion of Endurance Testing	18

FIGURES

1	Parameter Derating Information	7
2	Physical Dimensions	8
3	Functional Diagram	8
4	Test Circuit	14
5	Electrical Circuit for Burn-in	16

APPENDICES (Applicable to specific Manufacturers only)

None.

 ESA/SCC	ESA/SCC Detail Specification No. 5203/035		PAGE 5 ISSUE 1
--	--	--	-------------------

1. **GENERAL**

1.1 **SCOPE**

This specification details the ratings, physical and electrical characteristics, test and inspection data for a Transistor, Switching Power, NPN, based on Type 2N5542.

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.

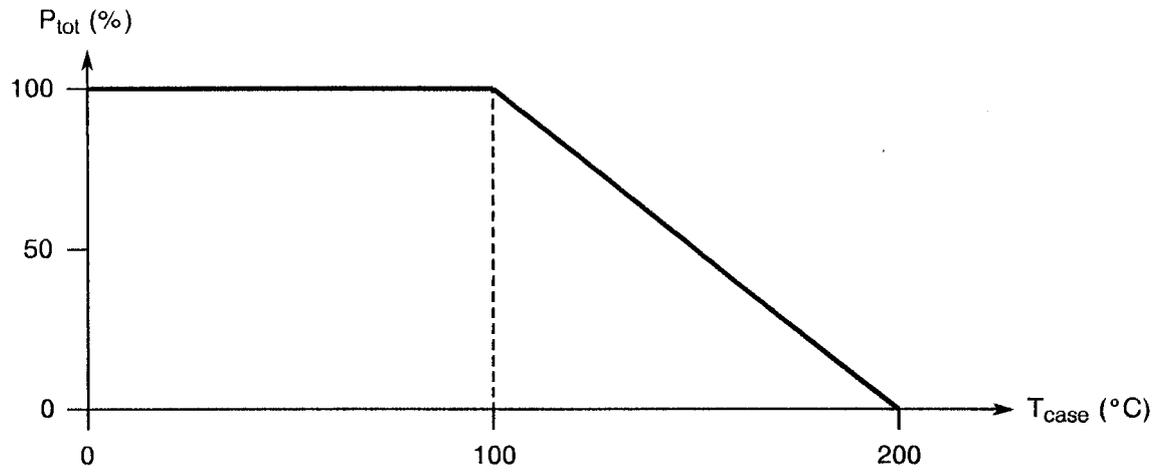
**TABLE 1(a) - TYPE VARIANTS**

VARIANT	BASED ON TYPE	LEAD MATERIAL AND FINISH
01	2N5542	D2

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	175	V	
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	130	V	
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	8.0	V	
4	Collector Current	I_C	10	A	
5	Base Current (Continuous)	I_B	2.0	A	
6	Power Dissipation	P_{tot}	50	W	$T_{case} = +100^{\circ}C$
7	Operating Temperature Range	T_{op}	- 65 to + 200	$^{\circ}C$	T_{amb}
8	Storage Temperature Range	T_{stg}	- 65 to + 200	$^{\circ}C$	
9	Soldering Temperature	T_{sol}	+ 235	$^{\circ}C$	Time: $\leq 10s$ Distance from case $\geq 1.5mm$

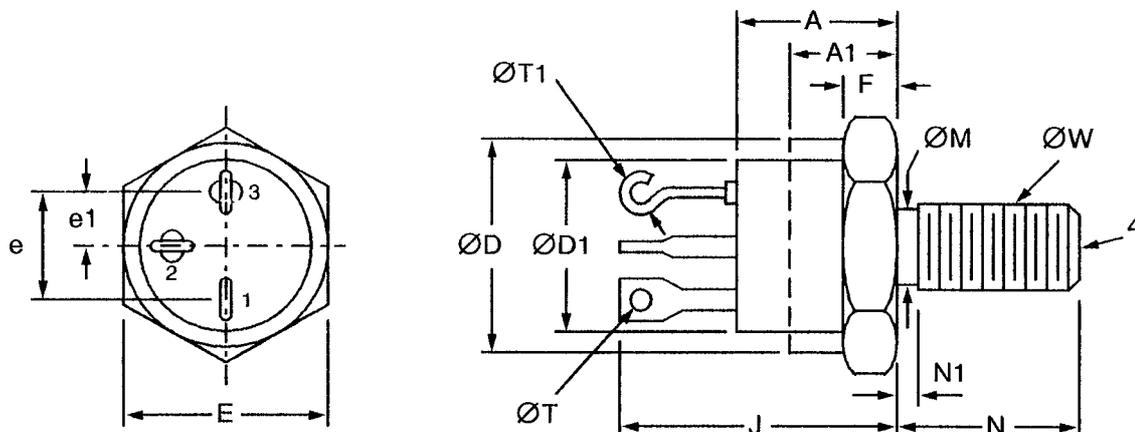
FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature



FIGURE 2 - PHYSICAL DIMENSIONS

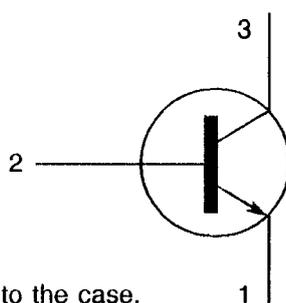


SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.325	0.460	8.26	11.68	
A1	-	0.270	-	6.86	2
ØD	0.610	0.687	15.49	17.45	2
ØD1	0.570	0.610	14.48	15.49	
E	0.667	0.687	16.94	17.45	
e	0.340	0.415	8.64	10.54	5
e1	0.170	0.213	4.32	5.41	5
F	0.090	0.150	2.29	3.81	1
J	0.640	0.875	16.26	22.23	
ØM	0.220	0.249	5.59	6.32	
N	0.422	0.455	10.72	11.56	
N1	-	0.090	-	2.29	
ØT	0.047	0.072	1.19	1.83	
ØT1	0.046	0.077	1.17	1.96	4
ØW	0.2225	0.2268	5.651	5.761	3

NOTES

1. Dimension does not include sealing flanges.
2. Package contour optional within dimensions specified.
3. Pitch diameter - thread 1/4-28 UNF-2A or ISO Ref. M6. A clearance hole of 0.276 inch (7.01mm) minimum diameter ensures interchangeability.
4. This terminal can be flattened and pierced or hook type.
5. Position of leads in relation to the hexagon is not controlled.

FIGURE 3 - FUNCTIONAL DIAGRAM



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

NOTES

1. The collector is internally connected to the case.

**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 Semiconductor Components.
- (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.

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 are stated in this specification and ESA/SCC Generic Specification No. 5000. 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**

- (a) Polyimide passivation will be applied and cured prior to encapsulation.

4.2.2 Deviations from Final Production Tests (Chart II)

None.

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

None.

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 18 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: 'D2' (Stud Torque).
Applied Force: Torque 1.7Nm (15 in./lbs).
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 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-61.

4.4.2 Lead Material and Finish

The lead material shall be Type 'D' with Type '2' 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:-

520303501B

Detail Specification Number _____

Type Variant _____

Testing Level (B or C, as applicable) _____

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, 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	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
1	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	$I_C = 100mA$ $I_B = 0A$ Note 1	130	-	V
2	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3026	$I_C = 10\mu A$	175	-	V
3	Collector-Base Cut-off Current	I_{CBO}	3041	$V_{CB} = 100V$	-	0.5	μA
4	Emitter-Base Cut-off Current	I_{EBO}	3061D	$V_{EB} = 8.0V$ $I_C = 0A$	-	10	μA
5	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$I_C = 1.0A$ $V_{CE} = 5.0V$ Note 1	30	-	-
		h_{FE2}		$I_C = 5.0A$ $V_{CE} = 5.0V$ Note 1	30	90	
		h_{FE3}		$I_C = 7.5A$ $V_{CE} = 5.0V$ Note 1	20	-	
6	Collector Saturation Voltage	V_{CEsat1}	3071	$I_C = 1.0A$ $I_B = 0.1A$ Note 1	-	0.15	V
7	Collector Saturation Voltage	V_{CEsat2}	3071	$I_C = 5.0A$ $I_B = 0.5A$ Note 1	-	0.5	V
8	Base Saturation Voltage	V_{BEsat1}	3066	$I_C = 5.0A$ $I_B = 0.5A$ Note 1	-	1.2	V
9	Base Saturation Voltage	V_{BEsat2}	3066	$I_C = 10A$ $I_B = 1.0A$ Note 1	-	2.5	V

NOTES

1. Pulsed measurement: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2.0\%$.



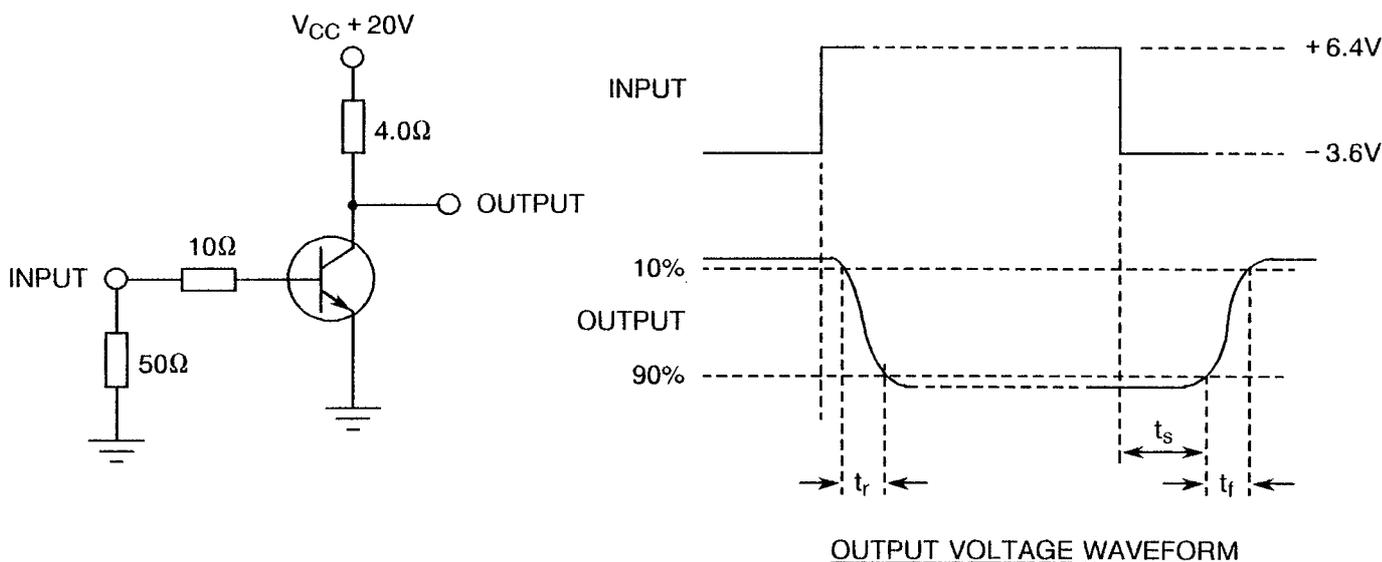
TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - a.c. PARAMETERS

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST FIG.	TEST CONDITIONS (NOTE 1)	LIMITS		UNIT
						MIN	MAX	
1	A.C. Forward Current Transfer Ratio	h_{fe}	3206	-	$I_C = 1.0A$ $V_{CE} = 10V$ $f = 10MHz$	2.0	-	-
2	Turn-on Time	t_r	-	4	$V_{CC} = 20V$ $I_C = 5.0A$ $I_B = 0.5A$	-	0.5	μs
3	Storage Time	t_s	-	4	$V_{CC} = 20V$ $I_C = 5.0A$ $I_B = 0.5A$	-	1.5	μs
4	Turn-off Time	t_f	-	4	$V_{CC} = 20V$ $I_C = 5.0A$ $I_B = 0.5A$	-	0.5	μs

NOTES

1. Shall be performed on a sample basis, LTPD7.

FIGURE 4 - TEST CIRCUIT



NOTES

1. Test conditions: $I_C = 5.0A$, $I_{B1} = -I_{B2} = 0.5A$, $P_W = 10sec$, Duty Cycle = 2.0%.
2. Voltages indicated on the input waveform are approximate and for reference only. The specific base currents are measured using a current probe.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
1	Collector-Base Cut-off Current	I_{CBO}	3041	$T_{case} = +150^{\circ}C$ $V_{CB} = 100V$	-	100	μA
2	D.C. Forward Current Transfer Ratio	h_{FE2}	3076	$T_{case} = -55^{\circ}C$ $I_C = 5.0A$ $V_{CE} = 5.0V$ Note 1	15	-	-
3	Collector Saturation Voltage	V_{CEsat2}	3071	$T_{case} = -55^{\circ}C$ $I_C = 5.0A$ $I_B = 0.5A$	-	0.75	V

NOTES

1. Pulsed measurement: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2.0\%$.

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
1	Emitter-Base Cut-off Current	I_{EBO}	3061D	$V_{EB} = 8.0V$ $I_C = 0A$	1.0 or (1) ± 100	μA %
2	Collector-Base Cut-off Current	I_{CBO}	3041	$V_{CB} = 100V$	50 or (1) ± 100	nA %
3	D.C. Forward Current Transfer Ratio	h_{FE2}	3076A	$V_{CE} = 5.0V$ $I_C = 5.0A$ Note 2	+25 - 20	%
4	Collector Saturation Voltage	V_{CEsat2}	3071	$I_C = 5.0A$ $I_B = 0.5A$ Note 2	± 50	mV

NOTES

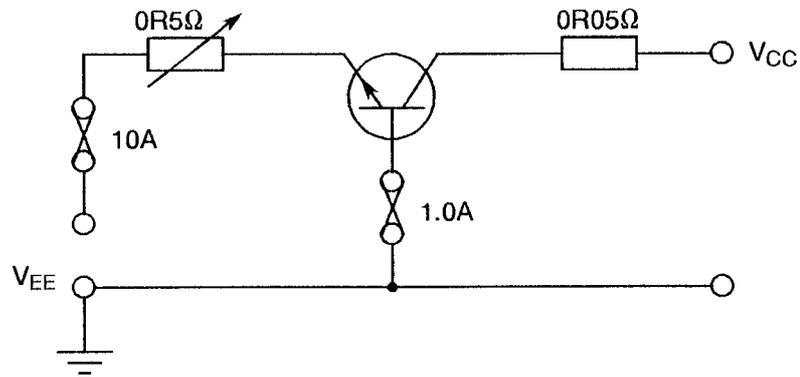
1. Whichever is greater, referred to the initial value.
2. Pulsed measurement: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2.0\%$.



TABLE 5 - CONDITIONS FOR BURN-IN

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Case Temperature	T_{case}	+ 100	°C
2	Emitter Current	I_E	≥ 2.5	A
3	Power Dissipation	P_{tot}	50	W

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN



 	<p style="text-align: center;">ESA/SCC Detail Specification No. 5203/035</p>		<p>PAGE 17 ISSUE 1</p>
---	--	--	----------------------------

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 of this specification.

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 performing the operating life tests shall be the same as that 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	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	D.C. Forward Current Transfer Ratio	h_{FE}	3076	$I_C = 5.0A$ $V_{CE} = 5.0V$ Note 1	24	112	-
2	Collector-Emitter Saturation Voltage	V_{CEsat}	3071	$I_C = 5.0A$ $I_B = 0.5A$ Note 1	-	0.75	V
3	Collector-Base Cut-off Current	I_{CBO}	3041	$V_{CB} = 100V$	-	0.75	μA

NOTES

1. Pulsed measurement: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2.0\%$.