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Pages 1 to 18

**TRANSISTORS, HIGH POWER, NPN,**

**BASED ON TYPE SDT 79823**

**ESA/SCC Detail Specification No. 5203/036**



**space components  
coordination group**

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		SCCG Chairman	ESA Director General or his Deputy
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**DOCUMENTATION CHANGE NOTICE**

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
'A'	Feb. '92	<p>This Issue incorporates all modifications agreed on the basis of Policy DCR 21016 for adaptation to new qualification requirements and Policy DCR 21019, "Appendices to Detail Specifications".</p> <p>P1. Cover page</p> <p>P2. DCN</p> <p>P5. Para. 2 : MIL-STD-1276 deleted, "ESA/SCC Basic Spec. No. 23500" added</p> <p>P6. Table 1(a) : "Lead Material and/or Finish" column added</p> <p>P9. Para. 4.2.2 : Bond Strength and Die Shear Test deviations deleted</p> <p style="padding-left: 40px;">: PIND deviation deleted</p> <p style="padding-left: 40px;">: H.T.R.B. deviation deleted</p> <p style="padding-left: 40px;">: Bond Strength and Die Shear Test deviations deleted</p> <p>P10. Para. 4.4.2 : Paragraph amended</p> <p>P15. Table 3 : Sampling Note deleted</p>	<p>None</p> <p>None</p> <p>21025</p> <p>21025</p> <p>23499</p> <p>21043</p> <p>23499</p> <p>23499</p> <p>21025</p> <p>21047</p>	
		<p>This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.</p>		



## TABLE OF CONTENTS

	<u>Page</u>
<b>1. <u>GENERAL</u></b>	<b>5</b>
1.1 Scope	5
1.2 Component Type Variants	5
1.3 Maximum Ratings	5
1.4 Parameter Derating Information and Safe Operating Area	5
1.5 Physical Dimensions	5
1.6 Functional Diagram	5
<b>2. <u>APPLICABLE DOCUMENTS</u></b>	<b>5</b>
<b>3. <u>TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS</u></b>	<b>9</b>
<b>4. <u>REQUIREMENTS</u></b>	<b>9</b>
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	10
4.5.1 General	10
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	11
4.6.1	Electrical Measurements at Room Temperature	11
4.6.2	Electrical Measurements at High and Low Temperatures	11
4.6.3	Circuits for Electrical Measurements	11
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
4.7.4	Conditions and Electrical Circuits for High Temperature Reverse Bias	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 and High Temperature Reverse Bias	16
6	Electrical Measurements at Intermediate Points and on Completion of Endurance Testing	18

#### FIGURES

1	Parameter Derating Information and Safe Operating Area	7
2	Physical Dimensions	8
3	Functional Diagram	8
4	Test Circuits	N/A
5	Electrical Circuits for Burn-in and H.T.R.B.	16

#### 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 a Transistor, High Power, NPN, based on Type SDT 79823.

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 AND SAFE OPERATING AREA**

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 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.
- (d) MIL-STD-105, Sampling Procedures and Tables for Inspection by Attributes.

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

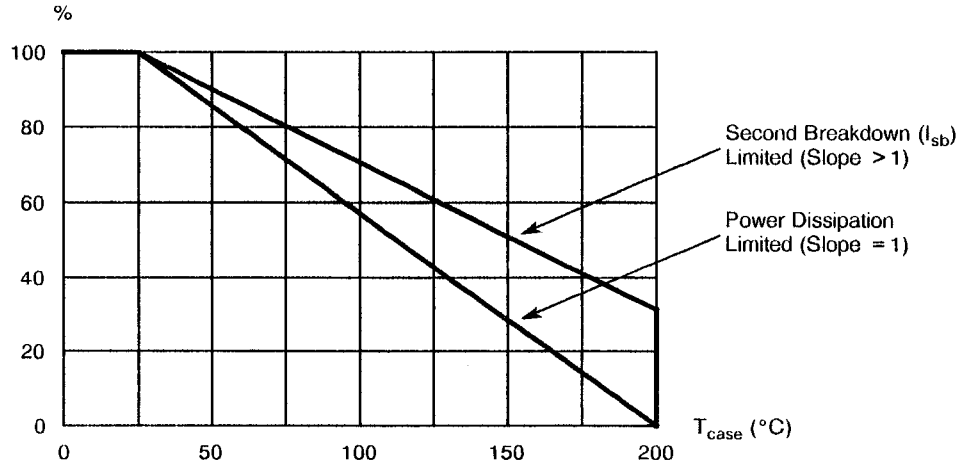
VARIANT	BASED ON TYPE	CASE	FIGURE	LEAD MATERIAL AND FINISH
01	SDT 79823	TO-228 AB	2	H2

**TABLE 1(b) - MAXIMUM RATINGS**

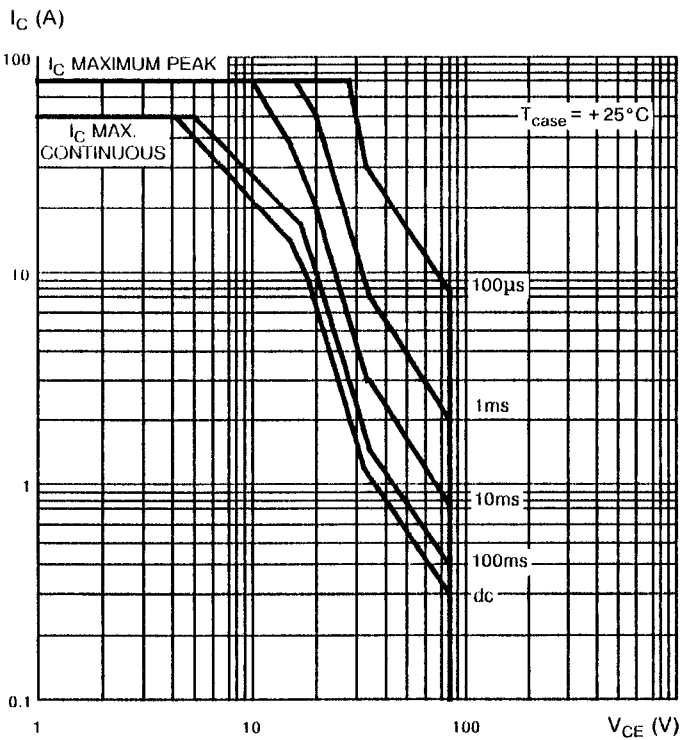
No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Voltage	$V_{CBO}$	100	V	
2	Collector-Emitter Voltage	$V_{CEO}$	80	V	
3	Emitter-Base Voltage	$V_{EBO}$	8.0	V	
4	Collector Current	$I_{C(PK)}$	50	A	Peak value
5	Base Current	$I_B$	5.0	A	
6	Power Dissipation (see Figure 1)	$P_{tot}$	100	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	$T_{sol}$	+ 265	$^{\circ}C$	Time: $\leq 10s$ Distance from case $\geq 1.5mm$



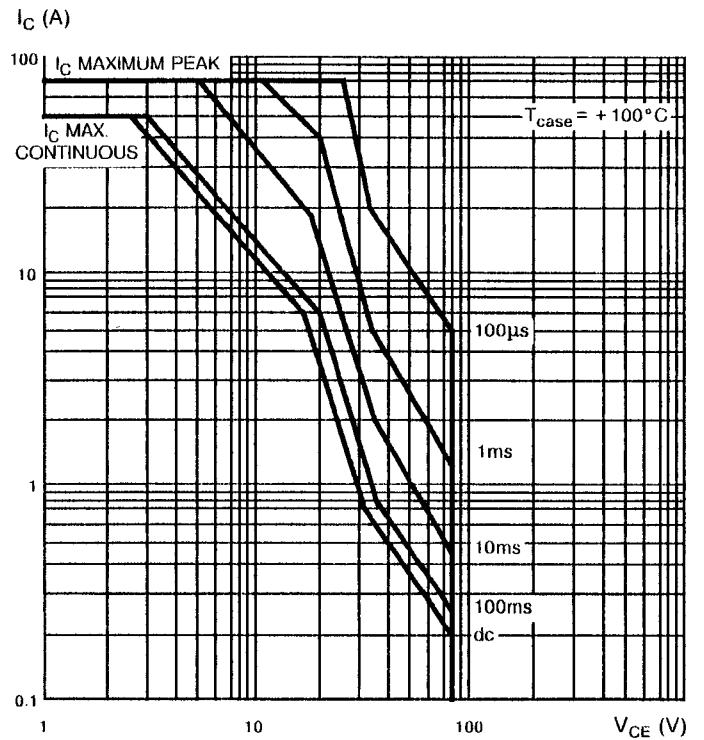
**FIGURE 1 - PARAMETER DERATING INFORMATION AND SAFE OPERATING AREA**



Derating Curve for Forward-Biased Safe Area Plots



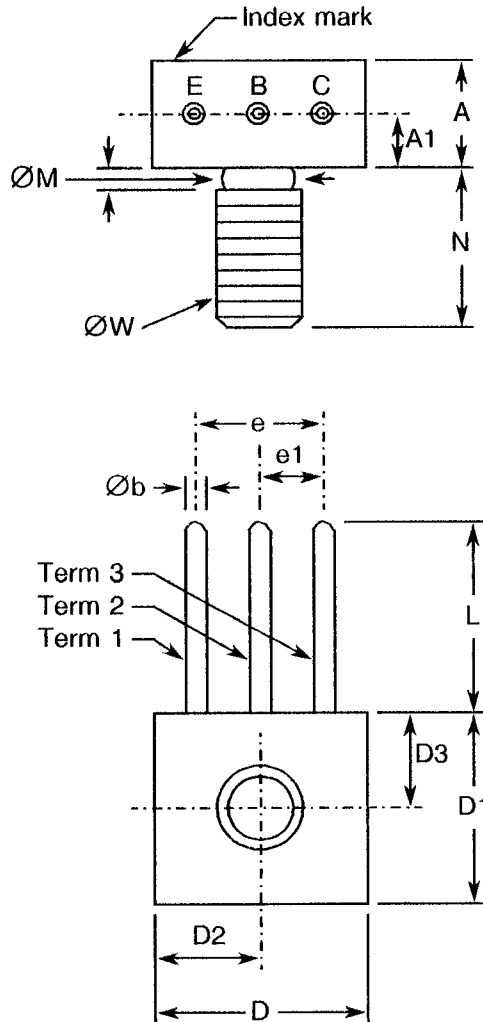
Forward-Biased Safe Area



Forward-Biased Safe Area



**FIGURE 2 - PHYSICAL DIMENSIONS**

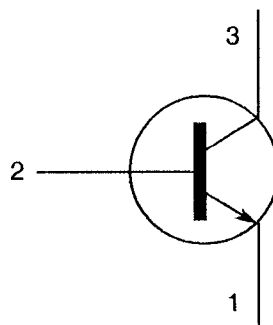


SYMBOL	INCHES		MILLIMETRES	
	MIN.	MAX.	MIN.	MAX.
A	0.320	0.370	8.13	9.39
A1	0.200	0.230	5.08	5.84
Øb	0.035	0.045	0.89	1.14
D	0.625	0.675	15.88	17.14
D1	0.575	0.625	14.61	15.87
D2	0.313	0.338	7.95	8.58
D3	0.288	0.312	7.32	7.92
e	0.365	0.385	9.28	9.77
e1	0.182	0.192	4.63	4.87
L	0.475	0.525	12.07	13.33
ØM	0.223	0.249	5.67	6.32
N	0.395	0.445	10.04	11.30
N1	-	0.089	-	2.26
ØW	¼-28 UNF-2A		¼-28 UNF-2A	

**NOTES**

- 1. Term 1 - Emitter.
- Term 2 - Base.
- Term 3 - Collector.

**FIGURE 3 - FUNCTIONAL DIAGRAM**



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

**NOTES**

- 1. Package isolated from connections 1, 2 and 3.



**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. In addition, the following abbreviations are used:-

$R_{TH(J-C)}$  = Thermal Resistance Junction to Case.  
 $R_{INS}$  = Isolation Resistance.  
 $I_{S/B}$  = Forward Bias Secondary Breakdown Current.

**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**

None.

**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 20 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' (Tension).  
Applied Force: 66.75 Newtons (15 lb.f).  
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, gold-plated as per MIL-C-45204, Type II, Grade 'C' or 'D' (optional), Class 0, 200-hour tensile load test waived.

#### 4.4.2 Lead Material and Finish

The lead material shall be Type 'H' 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:-

520303601B

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 ( $\Delta$ ) 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 - d.c. PARAMETERS**

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
1	Collector-Emitter Voltage	$V_{CEr}$	3030	$I_C = 10mA, R_{BE} = 1.0k\Omega$	100	-	V
2	Collector-Emitter Voltage	$V_{CEO}$	3030	$I_C = 100mA, I_B = 0A$ Note 1	80	-	V
3	Emitter-Base Breakdown Voltage	$BV_{EBO}$	3026	$I_E = 10\mu A$	8.0	-	V
4	Collector Cut-off Current	$I_{CBO}$	3036	$V_{CB} = 60V, I_E = 0A$	-	500	nA
5	Collector Cut-off Current	$I_{CER}$	3041	$V_{CE} = 50V, R_{BE} = 1.0k\Omega$	-	2.0	$\mu A$
6	Collector Cut-off Current	$I_{CEX}$	3041	$V_{CE} = 80V, V_{EB} = 0.5V$	-	10	$\mu A$
7	Emitter Cut-off Current	$I_{EBO}$	3061	$V_{EB} = 6.0V, I_C = 0A$	-	1.0	$\mu A$
8	Base-Emitter Saturation Voltage	$V_{BEsat1}$	3066	$I_C = 1.0A, I_B = 50mA$	-	0.9	V
9		$V_{BEsat2}$		$I_C = 10A, I_B = 500mA$ Note 1	-	1.3	
10	Collector-Emitter Saturation Voltage	$V_{CEsat1}$	3071	$I_C = 1.0A, I_B = 50mA$	-	0.08	V
11		$V_{CEsat2}$		$I_C = 10A, I_B = 500mA$	-	0.5	
12		$V_{CEsat3}$		$I_C = 25A, I_B = 2.5A$ Note 1	-	1.0	
13	Static Forward Current Transfer Ratio (Common Emitter)	$h_{FE1}$	3076	$V_{CE} = 0.5V, I_C = 1.0A$	55	165	-
14		$h_{FE2}$		$V_{CE} = 0.5V, I_C = 5.0A$	40	150	
15		$h_{FE3}$		$V_{CE} = 1.0V, I_C = 10A$	30	120	
16		$h_{FE4}$		$V_{CE} = 5.0V, I_C = 5.0A$ Note 1	30	-	
17	Thermal Resistance Junction to Case	$R_{TH(J-C)}$	3151	$V_{CE} = 15V, I_C = 4.0A$ $p_w = 1.0s$ Note 2	-	1.0	$^{\circ}C/W$
18	Isolation Resistance	$R_{INS}$	1016	$V_{CB} = V_{CE} = V_{BE} = 0V$ 500V applied Notes 2 and 3	200	-	M $\Omega$
19	Forward Bias Secondary Breakdown Current	$I_{S/B}$	-	$V_{CE} = 50V, t = 10ms$ 5 pulses Note 2	2.0	-	A

**NOTES:** See Page 14.



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

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS (NOTE 2)	LIMITS		UNIT
					MIN	MAX	
20	Dynamic Forward Current Transfer Ratio	$h_{fe}$	3206	$V_{CE} = 10V$ $I_C = 1.0A$ $f = 10MHz$	2.0	-	-
21	Output Capacitance	$C_{obo}$	3236	$V_{CB} = 10V$ $f = 1.0MHz$	-	700	pF
22	Delay Time	$t_d$	-	$V_{CC} = 20V$ $R_L = 200\Omega$ $I_C = 10A$ $I_{B1} = 0A$ $I_{B2} = 500mA$	-	150	ns
23	Rise Time	$t_r$	-	$V_{CC} = 20V$ $R_L = 200\Omega$ $I_C = 10A$ $I_{B1} = -I_{B2} = 500mA$	-	500	ns
24	Storage Time	$t_s$	-	$V_{CC} = 20V$ $R_L = 200\Omega$ $I_C = 10A$ $I_{B1} = -I_{B2} = 500mA$	-	1500	ns
25	Fall Time	$t_f$	-	$V_{CC} = 20V$ $R_L = 200\Omega$ $I_C = 10A$ $I_{B1} = -I_{B2} = 500mA$	-	300	ns

**NOTES**

1. Pulsed measurement,  $t_p = 300\mu s$ , Duty Cycle  $\leq 2.0\%$ .
2. If more than 32 units have to be measured, the measurements shall be made on a sample basis in accordance with Para. 7.4.2 of ESA/SCC Generic Specification No. 5000, LTPD 7.
3. Isolation resistance is measured between emitter, base and collector terminals, connected together, and case.

**FIGURE 4 - TEST CIRCUITS**

Not applicable.



**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 Cut-off Current	$I_{CER}$	3041	$V_{CE} = 50V, R_{BE} = 1.0k\Omega$ $T_{amb} = +100^{\circ}C$	-	50	$\mu A$
2	Base-Emitter Saturation Voltage	$V_{BEsat2}$	3066	$I_C = 10A, I_B = 500mA$ $T_{amb} = -55^{\circ}C, \text{Note 1}$	-	1.5	V
3	Collector-Emitter Saturation Voltage	$V_{CEsat1}$	3071	$I_C = 1.0A, I_B = 50mA$ $T_{amb} = +100^{\circ}C, \text{Note 1}$	-	0.12	V
4		$V_{CEsat1}$		$I_C = 1.0A, I_B = 50mA$ $T_{amb} = -55^{\circ}C, \text{Note 1}$	-	0.07	
5		$V_{CEsat2}$		$I_C = 10A, I_B = 500mA$ $T_{amb} = +100^{\circ}C, \text{Note 1}$	-	0.6	
6		$V_{CEsat2}$		$I_C = 10A, I_B = 500mA$ $T_{amb} = -55^{\circ}C, \text{Note 1}$	-	0.4	
7	Static Forward Transfer Ratio (Common Emitter)	$h_{FE1}$	3076	$V_{CE} = 0.5V, I_C = 1.0A$ $T_{amb} = -55^{\circ}C, \text{Note 1}$	40	-	-
8		$h_{FE2}$		$V_{CE} = 0.5V, I_C = 5.0A$ $T_{amb} = -55^{\circ}C, \text{Note 1}$	20	-	
9		$h_{FE3}$		$V_{CE} = 1.0V, I_C = 10A$ $T_{amb} = -55^{\circ}C, \text{Note 1}$	15	-	

**NOTES**

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

**TABLE 4 - PARAMETER DRIFT VALUES**

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	CHANGE LIMITS ( $\Delta$ )	UNIT
1	Collector Cut-off Current	$I_{CBO}$	3036	$V_{CB} = 60V$	$\pm 50$ or $+50, -100$	nA %
2	Collector-Emitter Saturation Voltage 2	$V_{CE(SAT)2}$	3071	$I_C = 10A$ $I_B = 500mA$	$\pm 50$	mV
3	Base-Emitter Saturation Voltage 2	$V_{BE(SAT)2}$	3066	$I_C = 10A$ $I_B = 500mA$	$\pm 130$	mV
4	Static Forward Current Transfer Ratio 4	$h_{FE4}$	3076	$V_{CE} = 5.0V$ $I_C = 5.0A$	$\pm 15$	%



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

CONDITIONS FOR HIGH TEMPERATURE REVERSE BIAS

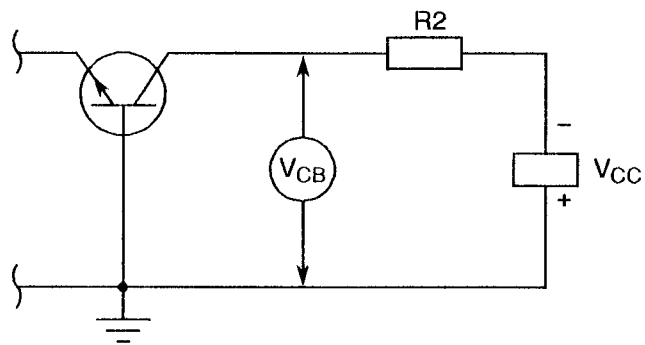
No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Case Temperature	$T_{case}$	+ 150	°C
2	Collector-Base Voltage	$V_{CB}$	80	V
3	Duration	t	96	Hrs

CONDITIONS FOR BURN-IN

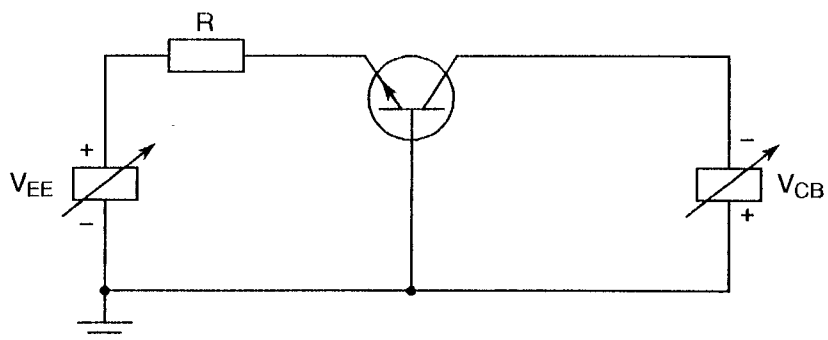
No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Case Temperature	$T_{case}$	+ 100	°C
2	Collector-Emitter Voltage	$V_{CE}$	10	V
3	Power Dissipation	$P_{tot}$	100	W

**FIGURE 5 - ELECTRICAL CIRCUITS FOR BURN-IN AND HIGH TEMPERATURE REVERSE BIAS**

ELECTRICAL CIRCUIT FOR HIGH TEMPERATURE REVERSE BIAS



ELECTRICAL CIRCUIT FOR BURN-IN







- 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.

**SCC**ESA/SCC Detail Specification  
No. 5203/036

PAGE 18

ISSUE 1

**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	Collector Cut-off Current	$I_{CBO}$	3041	$V_{CB} = 60V$	-	500	nA
2	Static Forward Current Transfer Ratio 4	$h_{FE4}$	3076	$V_{CE} = 5.0V$ $I_C = 5.0A$ Note 1	30	-	-
3	Collector Saturation Voltage 2	$V_{CEsat2}$	3071	$I_C = 10A$ $I_B = 0.5A$ Note 1	-	0.5	V
4	Base-Emitter Saturation Voltage 2	$V_{BEsat2}$	3066	$I_C = 10A$ $I_B = 0.5A$ Note 1	-	1.3	V

**NOTES**

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