TRANSISTORS, HIGH POWER, NPN

BASED ON TYPE SDT 79823

ESCC Detail Specification No. 5203/036

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space components
coordination group

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Issue 1	March 1982	-	-
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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE Reference	CHANGE Item	Approved DCR No.
		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".		
'A'	Feb. '92	P1. Cover page		None
		P2. DCN		None
		P5. Para. 2	: MIL-STD-1276 deleted, "ESA/SCC Basic Spec. No. 23500" added	21025
		P6. Table 1(a)	: "Lead Material and/or Finish" column added	21025
		P9. Para. 4.2.2	: Bond Strength and Die Shear Test deviations deleted	23499
			: PIND deviation deleted	21043
		Para. 4.2.3	: H.T.R.B. deviation deleted	23499
		Para. 4.2.4	: Bond Strength and Die Shear Test deviations deleted	23499
		P10. Para. 4.4.2	: Paragraph amended	21025
		P15. Table 3	: Sampling Note deleted	21047
		This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.		

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TABLES

FIGURES

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.

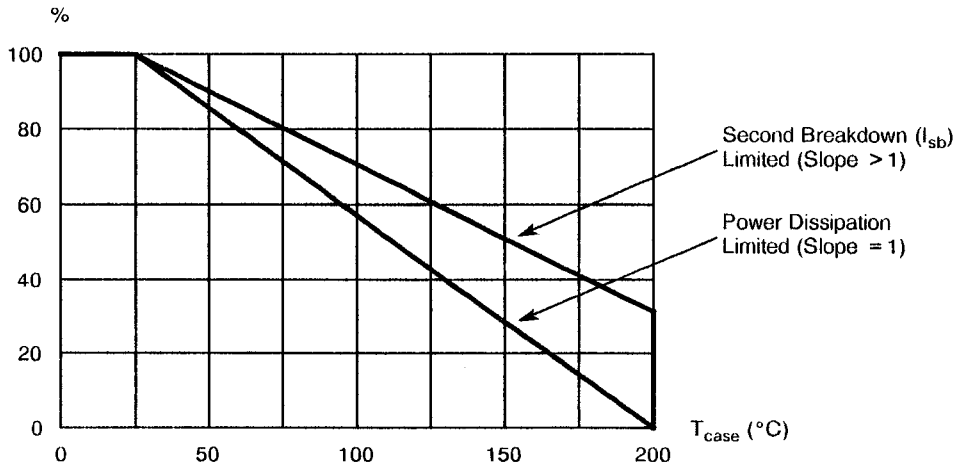
TABLE 1(a) - TYPE VARIANTS

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

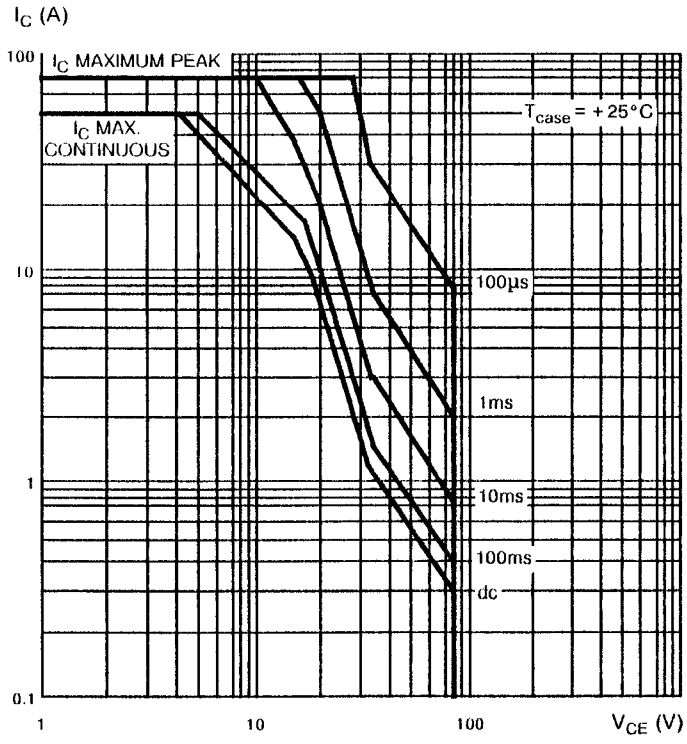
TABLE 1(b) - MAXIMUM RATINGS

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°C
7	Operating Temperature Range	T_{op}	−65 to +200	°C	T_{amb}
8	Storage Temperature Range	T_{stg}	−65 to +200	°C	
9	Soldering Temperature	T_{sol}	+265	°C	Time: ≤10s Distance from case ≥1.5mm

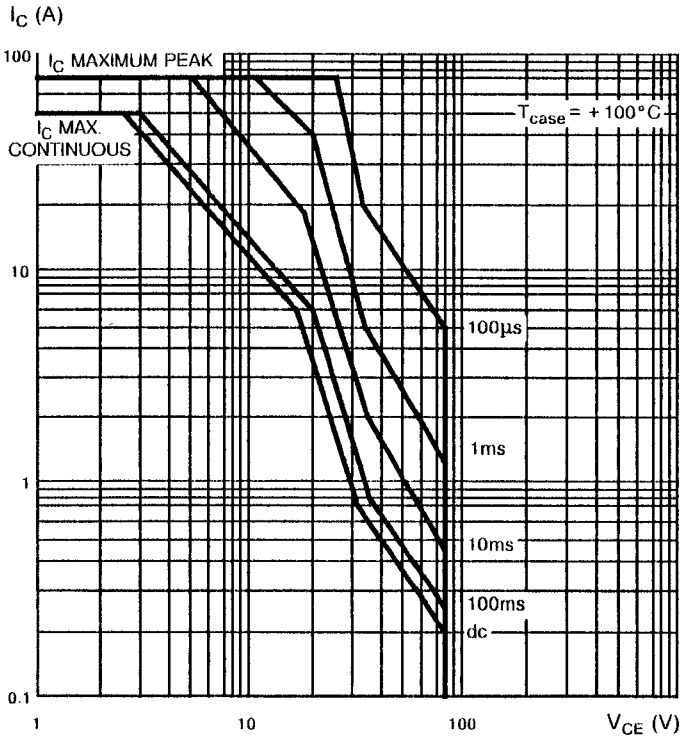
FIGURE 1 - PARAMETER DERATING INFORMATION AND SAFE OPERATING AREA



Derating Curve for Forward-Biased Safe Area Plots

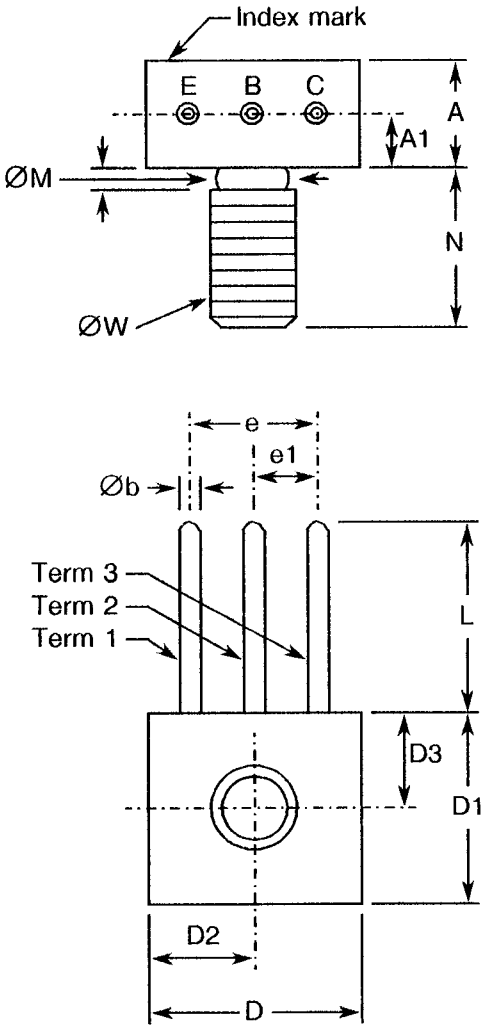


Forward-Biased Safe Area



Forward-Biased Safe Area

FIGURE 2 - PHYSICAL DIMENSIONS

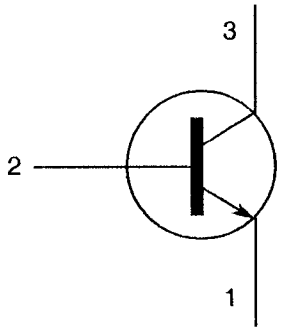


SYMBOL	INCHES		MILLIMETRES	
	MIN.	MAX.	MIN.	MAX.
A	0.320	0.370	8.13	9.39
A1	0.200	0.230	5.08	5.84
Øb	0.035	0.045	0.89	1.14
D	0.625	0.675	15.88	17.14
D1	0.575	0.625	14.61	15.87
D2	0.313	0.338	7.95	8.58
D3	0.288	0.312	7.32	7.92
e	0.365	0.385	9.28	9.77
e1	0.182	0.192	4.63	4.87
L	0.475	0.525	12.07	13.33
ØM	0.223	0.249	5.67	6.32
N	0.395	0.445	10.04	11.30
N1	-	0.089	-	2.26
ØW	$\frac{1}{4}$-28 UNF-2A		$\frac{1}{4}$-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.

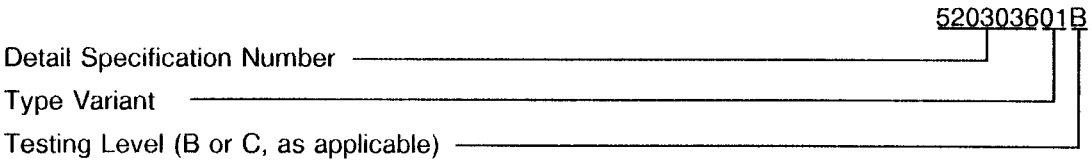
(c) Traceability Information.

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:-



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.

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} = 1.0kΩ	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 = 10μA	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} = 1.0kΩ	-	2.0	μA
6	Collector Cut-off Current	I_{CEX}	3041	V_{CE} = 80V, V_{EB} = 0.5V	-	10	μA
7	Emitter Cut-off Current	I_{EBO}	3061	V_{EB} = 6.0V, I_C = 0A	-	1.0	μA
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 pw = 1.0s Note 2	-	1.0	°C/W
18	Isolation Resistance	R_{INS}	1016	V_{CB} = V_{CE} = V_{BE} = 0V 500V applied Notes 2 and 3	200	-	MΩ
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} = 1.0kΩ T_{amb} = +100°C	-	50	µA
2	Base-Emitter Saturation Voltage	V_{BEsat2}	3066	I_C = 10A, I_B = 500mA T_{amb} = −55°C, Note 1	-	1.5	V
3	Collector-Emitter Saturation Voltage	V_{CEsat1}	3071	I_C = 1.0A, I_B = 50mA T_{amb} = +100°C, Note 1	-	0.12	V
4		V_{CEsat1}		I_C = 1.0A, I_B = 50mA T_{amb} = −55°C, Note 1	-	0.07	
5		V_{CEsat2}		I_C = 10A, I_B = 500mA T_{amb} = +100°C, Note 1	-	0.6	
6		V_{CEsat2}		I_C = 10A, I_B = 500mA T_{amb} = −55°C, 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°C, Note 1	40	-	-
8		h_{FE2}		V_{CE} = 0.5V, I_C = 5.0A T_{amb} = −55°C, Note 1	20	-	
9		h_{FE3}		V_{CE} = 1.0V, I_C = 10A T_{amb} = −55°C, Note 1	15	-	

NOTES

1. Pulse measurement: Pulse Length ≤ 300µs, Duty Cycle ≤ 2.0%.

TABLE 4 - PARAMETER DRIFT VALUES

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

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

CONDITIONS FOR HIGH TEMPERATURE REVERSE BIAS

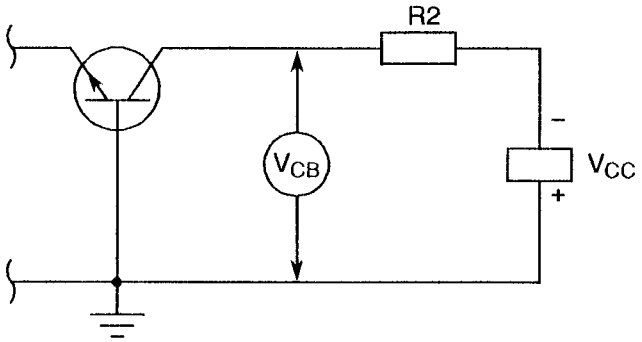
No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Case Temperature	T_{case}	+ 150	°C
2	Collector-Base Voltage	V_{CB}	80	V
3	Duration	t	96	Hrs

CONDITIONS FOR BURN-IN

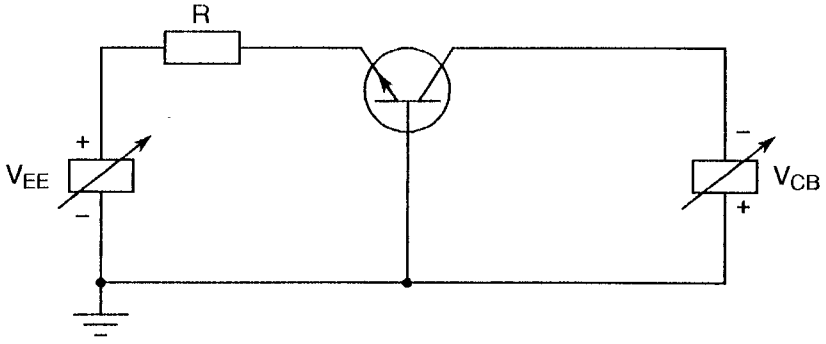
No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Case Temperature	T_{case}	+ 100	°C
2	Collector-Emitter Voltage	V_{CE}	10	V
3	Power Dissipation	P_{tot}	100	W

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.

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$300µs, Duty Cycle $\leq$2.0%.