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Pages 1 to 19

TRANSISTORS, HIGH POWER, NPN



BASED ON TYPE 2N6033

ESA/SCC Detail Specification No. 5203/026



**space components
coordination group**

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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 2 and incorporates all modifications agreed on the basis of Policy DCR's 21022 and 21025 and the following DCR's:- Table 1(b) : Note 1 added to P _{tot} and Table reformatted Para. 4.4.2 : Lead Material amended Table 2 : Reformatted Table 2 a.c. : Reformatted Figure 4 : t _{on} and t _{off} redefined Tables 3 and 4 : Reformatted Table 6 : Reformatted		23172 22299 23172 23172 23124 23172 23172
'A'	Feb. '92	P1. Cover page P2. DCN P5. Para. 1.2 : Paragraph amended P6. Table 1(a) : "Lead Material and/or Finish" column added P9. Para. 2 : "ESA/SCC Basic Spec. No. 23500" added Para. 4.2.2 : Bond Strength and Die Shear Test deviations deleted : PIND deviation deleted Para. 4.2.3 : Radiographic Inspection deviation deleted Para. 4.2.4 : Bond Strength and Die Shear Test deviations deleted P16. Table 3 : Note 2 deleted	None None 21021 21025 21025 23499 21043 21049 23499 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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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 2N6033.

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	2N6033	See Para. 4.4.2

TABLE 1(b) - MAXIMUM RATINGS

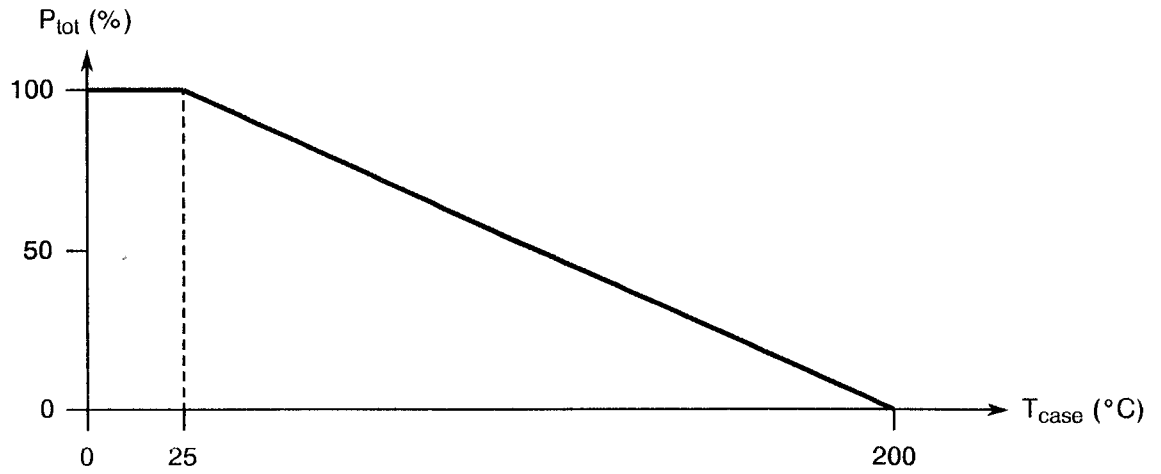
No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	150	V	
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	120	V	
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	7.0	V	
4	Collector Current	I_C	40	A	
5	Base Current	I_B	10	A	
6	Thermal Resistance	$R_{TH(J-C)}$	1.25	°C/W	
7	Power Dissipation	P_{tot}	140	W	Note 1
8	Operating Temperature Range	T_{op}	- 65 to + 200	°C	T_{amb}
9	Storage Temperature Range	T_{stg}	- 65 to + 200	°C	
10	Soldering Temperature	T_{sol}	+ 265	°C	Time: ≤ 10s Distance from case ≥ 1.5mm

NOTES

- At $T_{case} \leq +25^\circ\text{C}$ and $V_{CE} \leq 24\text{V}$. For derating at $T_{case} > +25^\circ\text{C}$, see Figure 1.



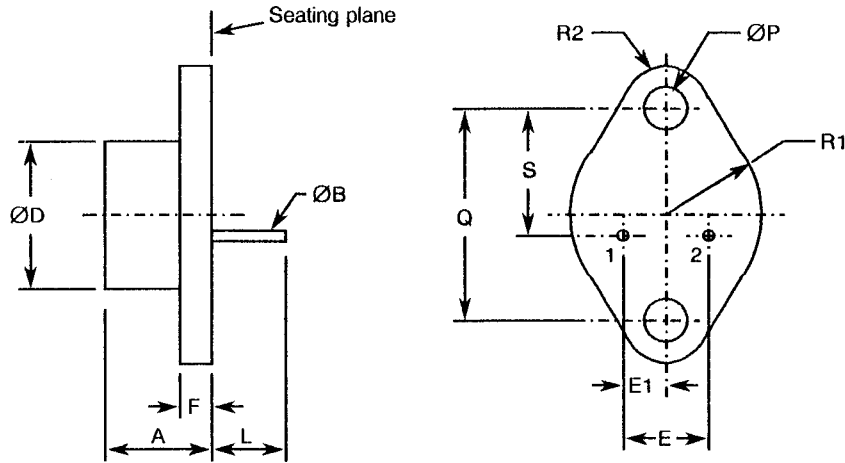
FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature



FIGURE 2 - PHYSICAL DIMENSIONS

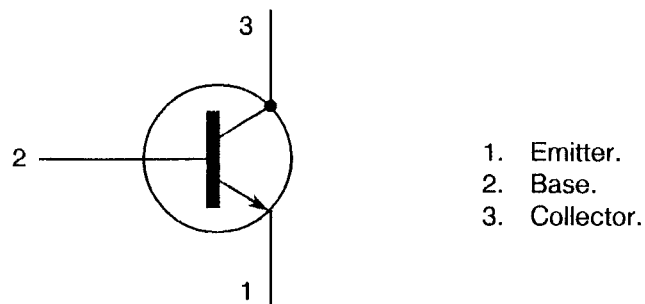


SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.35	11.43	
ØB	0.059	0.061	1.50	1.55	2
ØD	-	0.875	-	22.22	
E	0.420	0.440	10.67	11.18	
E1	0.205	0.225	5.21	5.72	
F	0.050	0.135	1.27	3.43	
L	0.312	-	7.92	-	2
ØP	0.151	0.161	3.84	4.09	
Q	1.177	1.197	29.90	30.40	
R1	0.495	0.525	12.57	13.34	
R2	0.131	0.188	3.33	4.78	
S	0.655	0.675	16.64	17.14	1

NOTES

1. These dimensions should be measured at points 0.050 (1.27mm) to 0.055 (1.40mm) below seating plane. When gauge is not used, measurement will be made at seating plane.
2. 2 leads.
3. Collector shall be electrically connected to the case.
4. Metric equivalents are given for general information only and are based on 1.00 inch = 25.4mm.

FIGURE 3 - FUNCTIONAL DIAGRAM



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**

None.

4.2.2 Deviations from Final Production Tests (Chart II)

None.

4.2.3 Deviations from Burn-in 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.

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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 22 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: 20 Newtons.
 Duration: 10 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-3 (Modified ØB pins).
 Bottom: copper nickel; Top: nickel.

4.4.2 Lead Material and Finish

The lead material shall be clad copper core in accordance with the following:-

(a) Composition - 1/3 of Total Diameter Copper core with 2/3 of Total Diameter Alloy 52 Cladding.

(b) Physical Properties:-

- (i) Tensile Strength = 520 N/mm² Elongation Sup. or equal to 25%.
- (ii) Resistivity = less than 0.60Ω mm²/m at +20°C.
- (iii) Thermal Expansion = 10.1 to 10.3 μm/m°C (for +10 to +450°C).
 = 10.3 to 10.5 μm/m°C (for +10 to +550°C).

The lead finish shall be Type '2' in accordance with the requirements of ESA/SCC Basic Specification No. 23500 except the gold plating thickness shall be 0.3μm thickness.



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:-

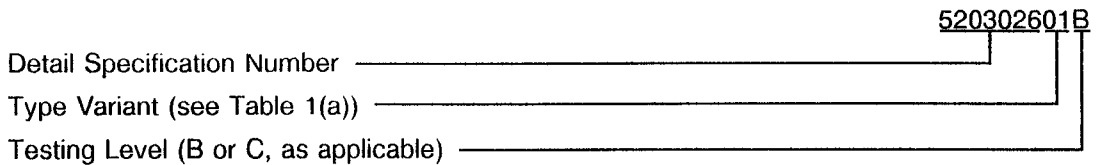
- (a) Lead Identification.
- (b) The SCC Component Number.
- (c) Traceability Information.

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.

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	$I_C = 200mA$ $I_B = 0A$ Note 1	120	-	V
2	Base-Emitter Breakdown Voltage	$V_{(BR)BEO}$	3026	$I_E = 10mA$ $I_C = 0A$	7.0	-	V
3	Collector-Emitter Cut-off Current	I_{CEX1}	3041	$V_{CE} = 135V$ $V_{BE} = -1.5V$	-	10	mA
4	Collector-Emitter Cut-off Current	I_{CEO}	3041	$V_{CE} = 80V$ $I_B = 0A$	-	10	mA
5	Emitter-Base Cut-off Current	I_{EBO}	3061	$V_{EB} = 7.0V$ $I_C = 0A$	-	10	mA
6	DC Forward Current Transfer Ratio	h_{FE}	3076	$I_C = 40A$ $V_{CE} = 2.0V$ Note 1	10	50	-
7	Collector Saturation Voltage	V_{CESat}	3071	$I_C = 40A$ $I_B = 4.0A$ Notes 1 and 2	-	1.0	V
8	Base Saturation Voltage	V_{BESat}	3066	$I_C = 40A$ $I_B = 4.0A$ Notes 1 and 2	-	2.0	V

NOTES

1. Pulsed measurement: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2.0\%$.
2. Saturation voltage measured 6.0mm from header.

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

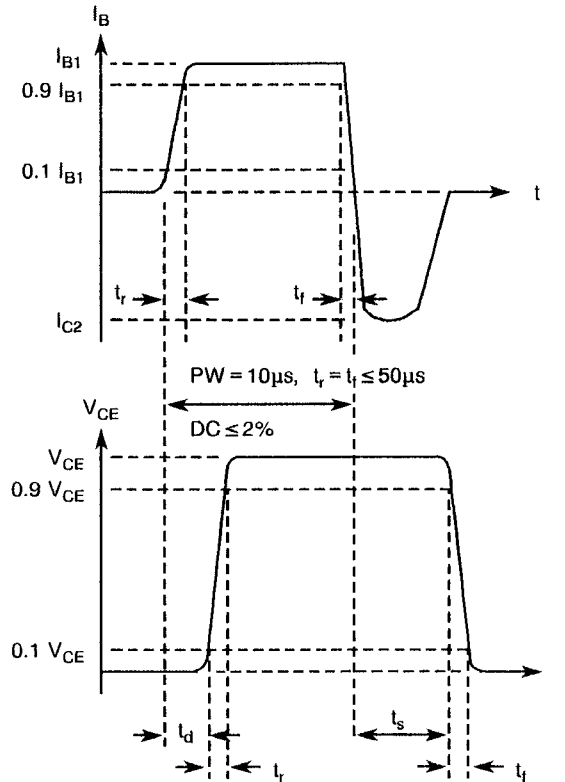
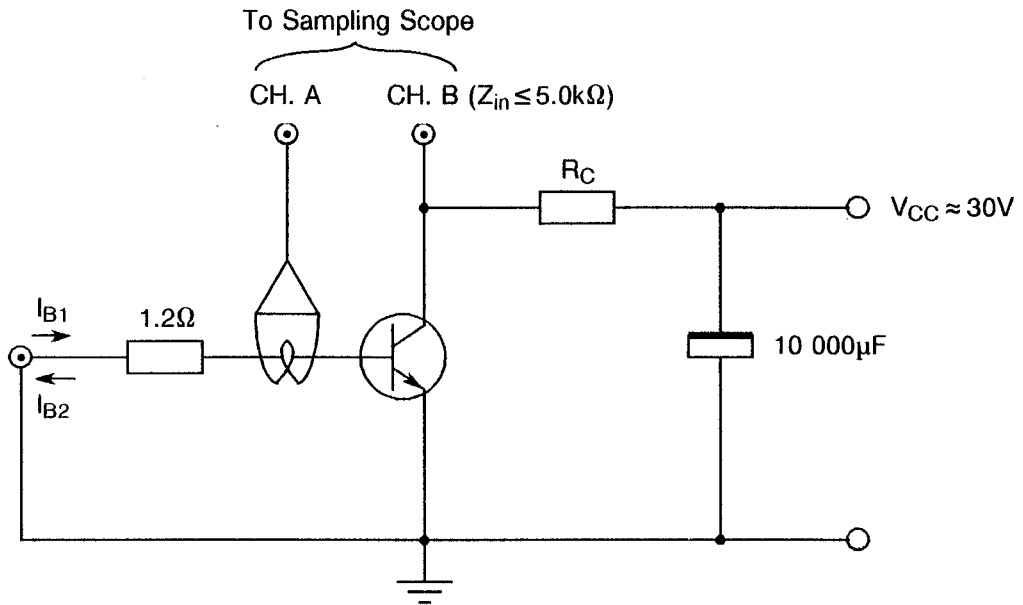
No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST FIG.	TEST CONDITIONS (NOTE 1)	LIMITS		UNIT
						MIN	MAX	
9	A.C. Forward Current Transfer Ratio	h_{fe}	3206	-	$I_C = 2.0A$ $V_{CE} = 10V$ $f = 5.0MHz$	10	40	-
10	Output Capacitance	C_{obo}	3236	-	$V_{CB} = 10V$ $I_E = 0A$ $f = 1.0MHz$	-	800	pF
11	Turn-on Time	t_r	-	4	$I_C = 40A$ $I_{B1} = 4.0A$ $I_{B2} = -4.0A$ $V_{CC} = 30V$	-	1.0	μs
12	Storage Time	t_s	-	4	$I_C = 40A$ $I_{B1} = 4.0A$ $I_{B2} = -4.0A$ $V_{CC} = 30V$	-	1.5	μs
13	Turn-off Time	t_f	-	4	$I_C = 40A$ $I_{B1} = 4.0A$ $I_{B2} = -4.0A$ $V_{CC} = 30V$	-	0.5	μs

NOTES

1. Test to be performed on a sample basis, LTPD7.



FIGURE 4 - TEST CIRCUITS



NOTES

1. $R_C = 0.75\Omega$ at $I_C = 40A$.
 $R_C = 0.60\Omega$ at $I_C = 50A$.
2. I_{B1} and I_{B2} are measured with Tektronix probe P6042.
3. $t_{on} = t_d + t_r$, $t_{off} = t_s + t_f$.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
6	D.C. Forward Current Transfer Ratio	h_{FE}	3076	$T_{amb} = -55^{\circ}C$ $I_C = 40A$ $V_{CE} = 2.0V$ Note 1	5.0	-	-
14	Collector-Emitter Cut-off Current 2	I_{CEX2}	3041	$T_{amb} = +150^{\circ}C$ $V_{CE} = 100V$ $V_{BE} = -1.5V$	-	10	mA

NOTES

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

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
4	Collector-Emitter Cut-off Current	I_{CEO}	As per Table 2	As per Table 2	± 1.0 or (1) ± 100	mA %
5	Emitter-Base Cut-off Current	I_{EBO}	As per Table 2	As per Table 2	± 1.0 or (1) ± 100	mA %
7	Collector Saturation Voltage	V_{CESat}	As per Table 2	As per Table 2	± 100	mV
8	Base-Emitter Saturation Voltage	V_{BESat}	As per Table 2	As per Table 2	± 100	mV

NOTES

1. Whichever is greater, referred to the initial value.





TABLE 5 - CONDITIONS FOR BURN-IN

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Case Temperature	T_{case}	+ 100	°C
2	Collector-Current	I_C	6.0	A
3	Power Dissipation	P_{tot}	80	W

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN

Not applicable.

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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 $T_{amb} = +22 \pm 3 \text{ }^\circ\text{C}$.

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 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 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	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
3	Collector-Emitter Cut-off Current 1	I_{CE1}	As per Table 2	As per Table 2	-	10	mA
6	D.C. Forward Current Transfer Ratio	h_{FE}	As per Table 2	As per Table 2	10	50	-
7	Collector-Emitter Saturation Voltage	V_{CESat}	As per Table 2	As per Table 2	-	1.0	V