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Pages 1 to 22

TRANSISTORS, POWER, NPN

BASED ON TYPE 2N3599

ESA/SCC Detail Specification No. 5208/006

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	CHANGE Reference	CHANGE Item	Approved DCR No.
'A'	Feb. '92	This Issue incorporates all modifications agreed on the basis of Policy DCR 21016 for adaptation to new qualification requirements.		
		P1.	Cover page	None
		P2.	DCN	None
		P4. Table of Contents	: "Appendices" title added	21019
		P5. Para. 1.2	: Paragraph amended	21021
		P6. Table 1(a)	: "Lead Material and/or Finish" column amended	21025
		P11. Para. 2	: MIL-STD-1276 deleted, "ESA/SCC Basic Spec. No. 23500" added	21025
		Para. 4.1	: Additional text added	21019
		Para. 4.2.2	: PIND deviation deleted	21043
		P13. Para. 4.4.2	: Paragraph amended	21025
		P18. Table 3(a), (b)	: Reference to Note 2 deleted, Note 1 put under this table	21047
		This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.		
'B'	Aug. '96	P1.	Cover page	None
		P2.	DCN	None
		P5. Para. 1.7	: Text amended	21083

TABLE OF CONTENTS

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for a Transistor, Power, NPN, based on Type 2N3599.

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.

1.7 HIGH TEMPERATURE TEST PRECAUTIONS

For tin-lead plated or solder-dipped lead finish, all tests to be performed at a temperature that exceeds +125°C shall be carried out in a 100% inert atmosphere.

1.8 BERYLLIUM OXIDE WARNING

THESE COMPONENTS CONTAIN BERYLLIUM OXIDE, THE DUST OF WHICH IS HIGHLY TOXIC. DISPOSAL BY WAY OF PUBLIC WASTE SYSTEMS IS STRICTLY FORBIDDEN.

TABLE 1(a) - TYPE VARIANTS

VARIANT	CASE	FIGURE	LEAD MATERIAL AND FINISH
01	TO61	2	D2
02	TO61	2	D3 or D4

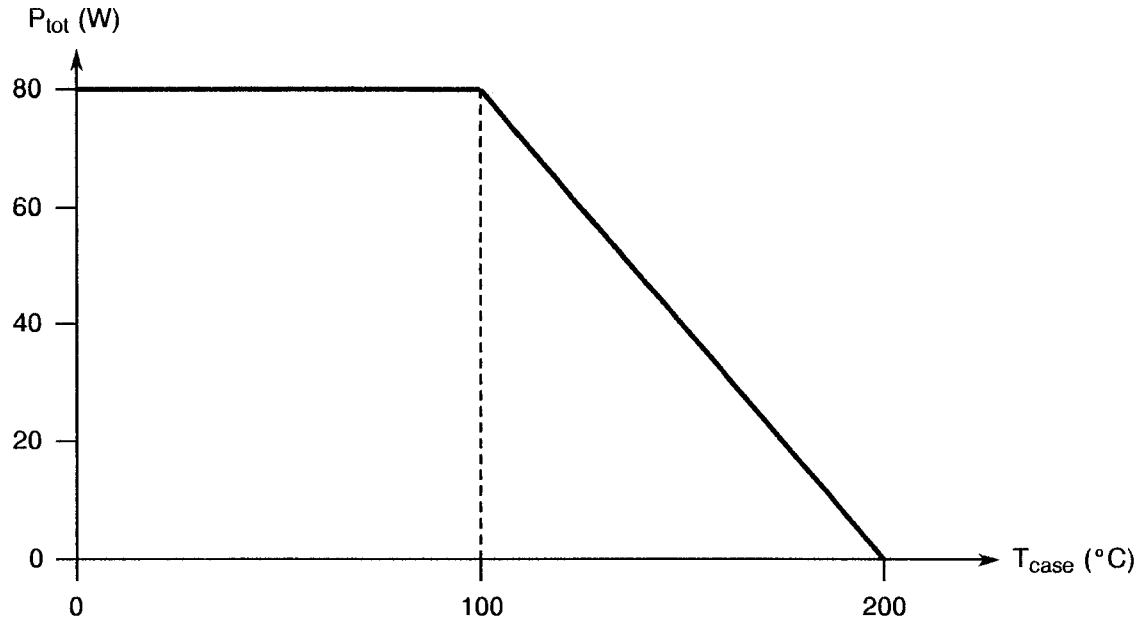
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Voltage	V_{CB}	100	Vdc	
2	Collector-Emitter Voltage	V_{CE}	80	Vdc	
3	Emitter-Base Voltage	V_{EB}	8.0	Vdc	
4	Collector Current (Continuous)	I_C	20	Adc	
5	Power Dissipation (Continuous)	P_{tot}	80	W	V_{CE} = 40Vdc Note 1
6	Operating Temperature Range	T_{op}	− 65 to + 200	°C	T_{case}
7	Storage Temperature Range	T_{stg}	− 65 to + 200	°C	
8	Soldering Temperature	T_{sol}	+ 260	°C	Note 2

NOTES

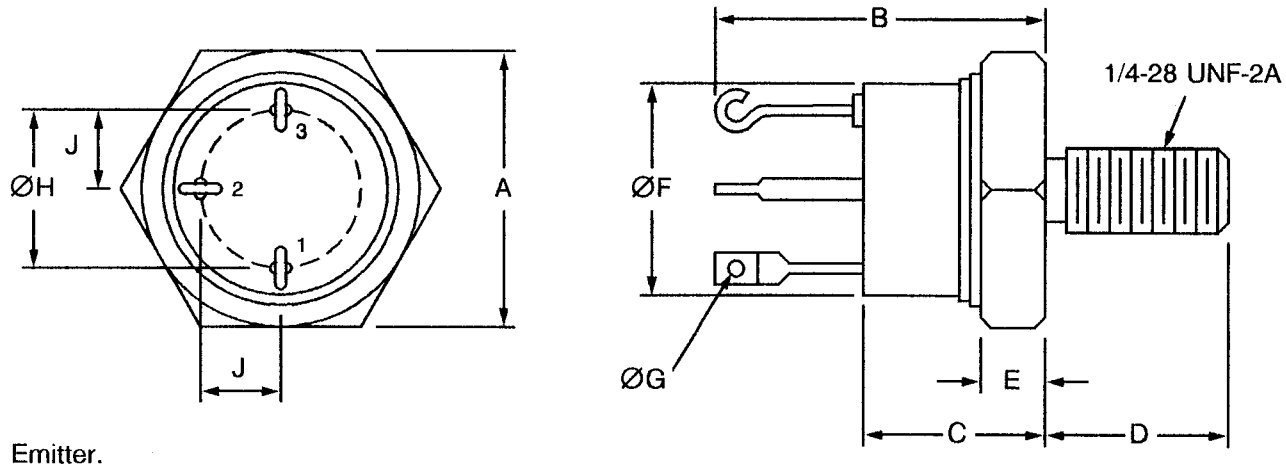
1. For derating at $T_{case} > +100°C$, see Figure 1.
2. Duration 10 seconds maximum at a distance of not less than 1.5mm from the device body and the same lead shall not be resoldered until 3 minutes have elapsed.

FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature

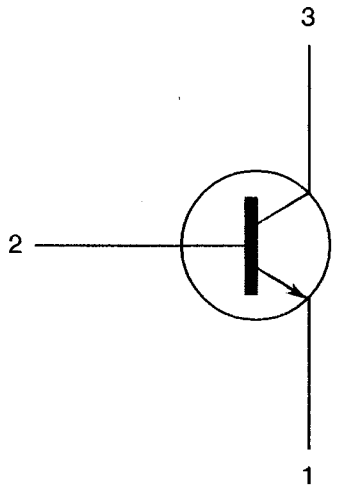
FIGURE 2 - PHYSICAL DIMENSIONS



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

SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.677	0.687	17.20	17.45	
B	0.720	0.790	18.29	20.07	
C	0.385	0.440	9.78	11.18	
D	0.425	0.455	10.80	11.56	
E	-	0.090	-	2.29	
ØF	0.590	0.610	14.99	15.50	
ØG	0.054	0.068	1.37	1.73	
ØH	0.385	0.415	9.78	10.54	
J	0.170	0.213	4.25	5.41	
K	0.105	0.125	2.67	3.18	

FIGURE 3 - FUNCTIONAL DIAGRAM



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

NOTES

1. The collector is electrically isolated from 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.

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

(e) MIL-STD-883, Test Methods and Procedures for Microelectronics.

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)

(a) Add the following test, after Para. 9.2.1, "Bond Strength Test": Die Shear Test in accordance with MIL-STD-883 Method 2019, to be performed on 3 devices with no failures permitted.

(b) Para. 9.6, "Constant Acceleration": Change Acceleration Level to 10000g.

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

(a) Para. 7.1.1(a), High Temperature Reverse Bias test: Not applicable.

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:-

Terminal:

Test Condition: 'A' (Tension).
Applied Force: 10 lb.f.
Duration: 15 seconds.

Stud:

Test Condition: 'D2' (Stud Torque).
Applied Torque: 20 lb.f.in.
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

The case shall be hermetically sealed and have a metal body with hard glass seals and the lid shall be welded, brazed or preform soldered.

4.4.2 Lead Material and Finish

The lead material shall be Type 'D' with either Type '2' or Type '3 or 4' 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) The SCC Component Number.

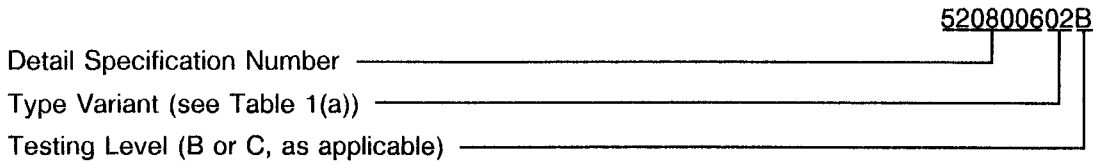
(b) Traceability Information.

4.5.2 Lead Identification

Leads shall be positioned as shown in Figure 2. No lead identification shall be marked on the part.

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, 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. The measurements shall be performed at $T_{amb} = -55(+5-0)$ and $+150(+0-5)$ °C respectively.

4.6.3 Circuits for Electrical Measurements

Circuits for use in performing the electrical measurements listed in Tables 2 and 3 are shown, where applicable, in MIL-STD-750 and 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

Not applicable.

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-Base Breakdown Voltage	BV_{CBO}	3001 Bias Cond. D	I_C = 100µAdc I_E = 0Adc	100	-	V
2	Collector-Emitter Breakdown Voltage	BV_{CES}	3011 Bias Cond. C	I_C = 1.0mAdc V_{BE} = 0Adc	100	-	V
3	Emitter-Base Breakdown Voltage	BV_{EBO}	3026 Bias Cond. D	I_E = 1.0mAdc I_C = 0Adc	8.0	-	V
4	Collector Cut-off Current	I_{CES}	3041 Bias Cond. C	V_{CE} = 60Vdc V_{BE} = 0Vdc	-	100	nA
5	Emitter Cut-off Current	I_{EBO}	3061 Bias Cond. D	V_{BE} = 5.0Vdc I_C = 0Adc	-	100	nA
6	Collector Saturation Voltage	$V_{CE(SAT)}$	3071	I_C = 10Adc I_B = 1.0Adc Note 1	-	0.5	V
7	Base Saturation Voltage	$V_{BE(SAT)}$	3066	I_C = 10Adc I_B = 1.0Adc Note 1	-	1.5	V
8	D.C. Forward Current Transfer Ratio 1	h_{FE1}	3076	V_{CE} = 5.0Vdc I_C = 100mAdc Note 1	90	-	-
9	D.C. Forward Current Transfer Ratio 2	h_{FE2}	3076	V_{CE} = 5.0Vdc I_C = 5.0Adc Note 1	80	240	-
10	D.C. Forward Current Transfer Ratio 3	h_{FE3}	3076	V_{CE} = 5.0Vdc I_C = 10Adc Note 1	60	-	-

NOTES: See Page 17.

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

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST FIG.	TEST CONDITIONS (NOTE 2)	LIMITS		UNIT
						MIN	MAX	
11	High Frequency Forward Current Gain	h_{fe}	3206	-	V_{CE} = 10Vdc I_C = 2.0Adc f = 10MHz	3.0	-	-
12	Output Capacitance	C_{obo}	3236	-	V_{CB} = 10Vdc I_E = 0Adc f = 0.1MHz	-	700	pF
13	Input Capacitance	C_{ibo}	3240	-	V_{EB} = 0.5Vdc	-	3000	pF
14	Turn On Time	t_{on}	-	4(a)	I_C = 10Adc $I_{B1} = I_{B2}$ = 1.0Adc	-	0.5	µs
15	Turn Off Time	t_{off}	-	4(b)	I_C = 10Adc $I_{B1} = I_{B2}$ = 1.0Adc	-	2.1	µs

NOTES

1. Pulsed measurement: Pulse Width ≤ 300µs, Duty Cycle ≤ 2.0%.
2. If more than 20 units have to be measured, the measurements shall be made on a sample basis in accordance with Level II, Table IIa, with an AQL = 1.0% of MIL-STD-105.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

TABLE 3(a) - T_{amb} = +150(+0−5) °C

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
4	Collector Cut-off Current	I_{CES}	3036 Bias Cond. D	T_{amb} = +150°C V_{CE} = 60Vdc V_{BE} = 0Vdc	-	1.0	mA

TABLE 3(b) - T_{amb} = −55(+5−0) °C

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
9	D.C. Forward Current Transfer Ratio 2	h_{FE2}	3076	T_{amb} = −55°C I_C = 5.0Adc V_{CE} = 5.0Vdc Note 1	40	120	-

NOTES

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

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

FIGURE 4(a) - TURN-ON TIME

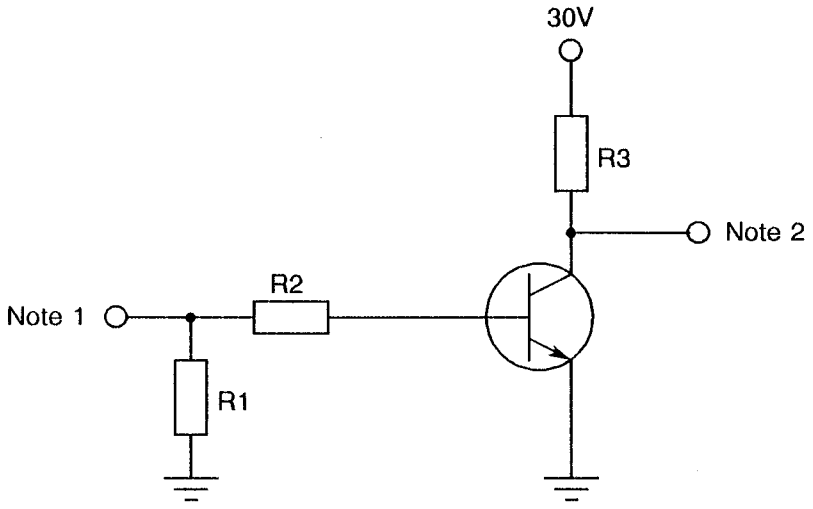
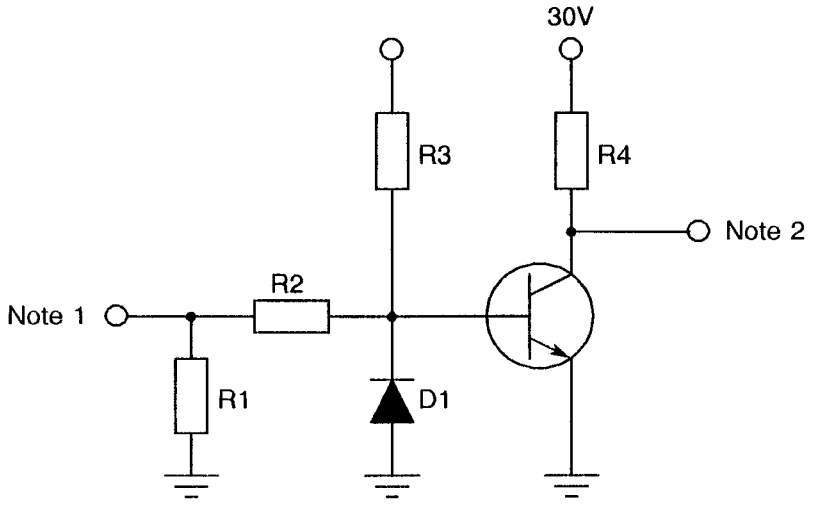


FIGURE 4(b) - TURN-OFF TIME



NOTES

1. Pulse rate 150pps, rise time ≤ 10ns.
2. Oscilloscope: rise time ≤ 5.0ns, input impedance 10MΩ.

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
5	Emitter Cut-off Current	I_{EBO}	As per Table 2	As per Table 2	±20	nA %
6	Collector Saturation Voltage	$V_{CE(SAT)}$	As per Table 2	As per Table 2	±50	mV
9	D.C. Forward Current Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	±25	%

TABLE 5 - CONDITIONS FOR BURN-IN AND OPERATING LIFE TESTS

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Case Temperature	T_{case}	+100(+0−5)	°C
2	Collector-Base Voltage	V_{CB}	20	V
3	Power Dissipation	P_{tot}	80	W
4	Test Method 1039 of MIL-STD-750	-	B	-

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 during Endurance Tests

The parameters to be measured at intermediate points during endurance tests are scheduled in Table 6 of this specification.

4.8.3 Electrical Measurements on Completion of Endurance Tests

The parameters to be measured on completion of endurance testing are scheduled in Table 6 of this specification. The measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

4.8.4 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.

4.8.5 Electrical Circuits for Operating Life Tests

Not applicable.

4.8.6 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 conditions for high temperature storage shall be $T_{amb} = +200(+0-5)$ °C.

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.	
5	Emitter Cut-off Current	I_{EBO}	As per Table 2	As per Table 2	-	100	nA
6	Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	As per Table 2	As per Table 2	-	0.5	V
9	D.C. Forward Current Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	80	240	-