TRANSISTORS, LOW POWER, NPN,

BASED ON TYPE 2N2857

ESCC Detail Specification No. 5201/014

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space components
coordination group

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		SCCG Chairman	ESA Director General or his Deputy
Issue 3	November 1986	-	-
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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 defined in the following DCR's:-		
		Table of Contents	: Para's 4.7.2 and 4.7.3, "Power" added to Title	23258
			: Table 2, Titles expanded	23258
			: Table 5, "Power" added to Title	23258
			: Figure 5, "Power" added to Title	23258
		Table 1(a)	: Case corrected to TO72	22460
		Table 1(b)	: Nos. 1, 2 and 3, "Breakdown" deleted from Characteristics	22460
			: No. 4, "(Continuous)" added to Characteristics	22460
		Figure 2	: Table rewritten with metric measurements as prime	23258
		Para. 4.2.2(c)	: PIND Test and Condition added	22460
			: Para. 4.2.2 to 4.2.4, ESA/SCC 5000 paragraph references added	22460
		Para. 4.3.3	: Applied Force added	22460
		Para. 4.4.1	: Paragraph rewritten	22460
		Para. 4.5.3	: Component Number corrected	23258
		Para. 4.7.1	: Paragraph amended	23258
		Paras 4.7.2 & 4.7.3	: "Power" added to Title and text	23258
		Table 2	: Nos. 1, 2 and 3, Symbols amended	22460
			: No. 4, Characteristic amended	22460

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		Table 2a.c.	: Nos. 11 and 12, under Conditions, "f = 1MHz" added	22384
			: Note 1 amended	22460
		Table 3	: No. 4, Characteristics amended	22460
			: Note 4 amended	22460
		Table 4	: No. 4, Characteristics amended	22460
		Table 5	: "Power" added to Title	23258
		Figure 5	: "Power" added to Title	23258
		Table 6	: No. 6 corrected to No. 5	22460
		Appendix 'A'	: DCR Column deleted	23187
'A'	Feb. '92	P1. Cover Page		None
		P2A. DCN		None
		P5. Para. 1.2	: Paragraph amended	21021
		Para. 2	: "ESA/SCC Basic Spec. No. 23500" added	21025
		P10. Para. 4.2.2	: Bond Strength and Die Shear Test deviations deleted	23499
			: PIND deviation deleted	21043
		Para. 4.2.3	: Radiographic Inspection deviation deleted	21049
		Para. 4.2.4	: Bond Strength and Die Shear Test deviations deleted	23499
		P16. Table 3	: Note deleted	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
		P2A. DCN		None
		P11. Para. 4.3.3	: Applied force deleted	221332

TABLE OF CONTENTS

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Transistors, Low Power NPN, based on Type 2N2857.

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 CHARACTERISTICS

The physical characteristics 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 Semiconductors.

(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.

TABLE 1(a) - TYPE VARIANTS

VARIANT	CASE	FIGURE	LEAD MATERIAL AND FINISH
01	TO-72	2	D2

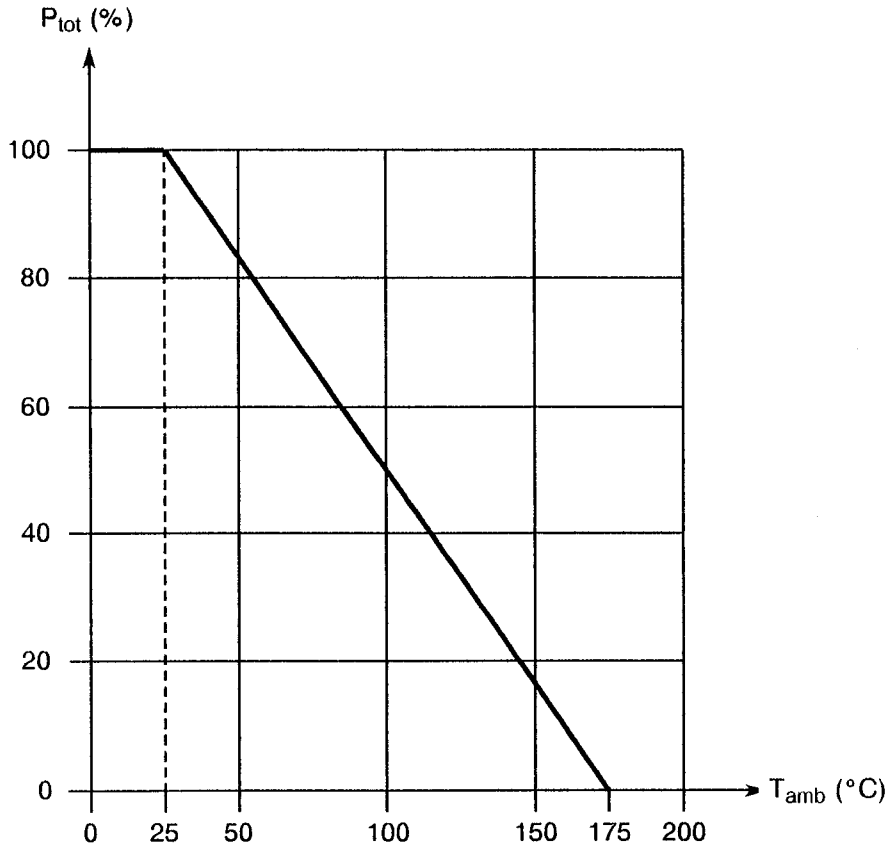
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Voltage	V_{CBO}	30	V	
2	Collector-Emitter Voltage	V_{CEO}	15	V	
3	Emitter-Base Voltage	V_{EBO}	2.5	V	
4	Collector Current (Continuous)	I_C	40	mA	
5	Power Dissipation	P_{tot}	200	mW	Note 1
6	Operating Temperature Range	T_{op}	−55 to +175	°C	T_{amb}
7	Storage Temperature Range	T_{stg}	−65 to +200	°C	
8	Soldering Temperature	T_{sol}	+235	°C	Time: ≤10 sec. Distance to case ≥1.5mm

NOTES

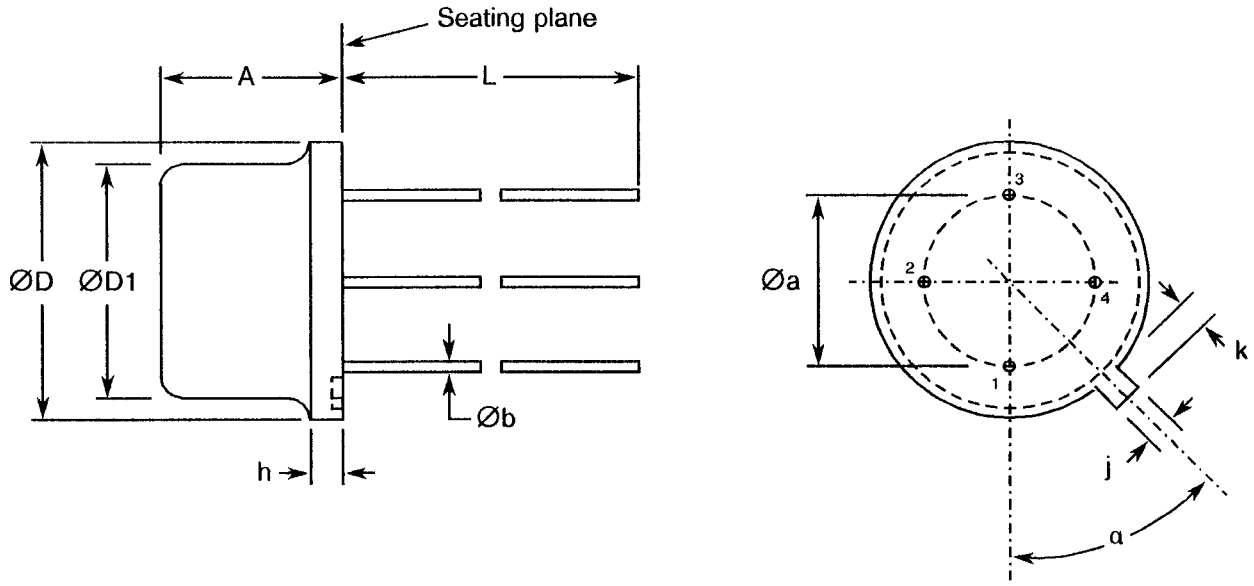
1. At T_{amb} = +25°C. For derating at T_{amb} > +25°C, see Figure 1.

FIGURE 1 - PARAMETER DERATING INFORMATION



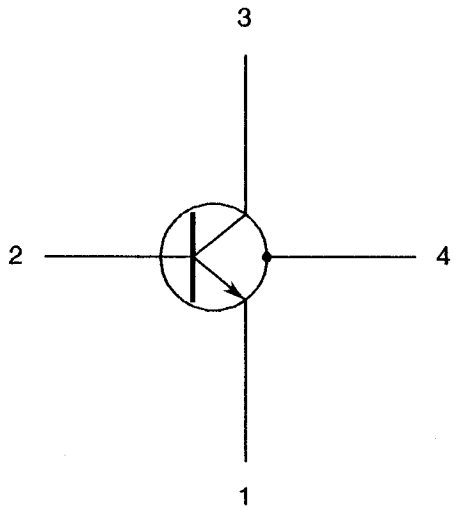
Power Dissipation versus Temperature (T_{amb})

FIGURE 2 - PHYSICAL DIMENSIONS



SYMBOL	MILLIMETRES		INCHES		NOTES
	MIN.	MAX	MIN.	MAX.	
A	4.30	5.30	0.170	0.210	
Øa	2.40	2.60	0.094	0.102	
Øb	0.40	0.48	0.016	0.019	
ØD	5.30	5.80	0.209	0.230	
ØD1	4.50	4.90	0.178	0.195	
h	-	0.70	-	0.030	
j	0.90	1.20	0.036	0.048	
k	0.70	1.20	0.028	0.048	
L	12.70	-	0.500	-	
α	45° T.P.		45° T.P.		

FIGURE 3 - FUNCTIONAL DIAGRAM



CONNECTIONS

1. Emitter.
2. Base.
3. Collector.
4. Shield Lead - electrically connected to case.

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 shall be as stated in this specification and ESA/SCC Generic Specification No. 5000 for Discrete Semiconductors. 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)

Para. 9.22, 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.

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 0.4 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: 'E', Lead Fatigue.

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, preform soldered or glass frit sealed.

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.

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.

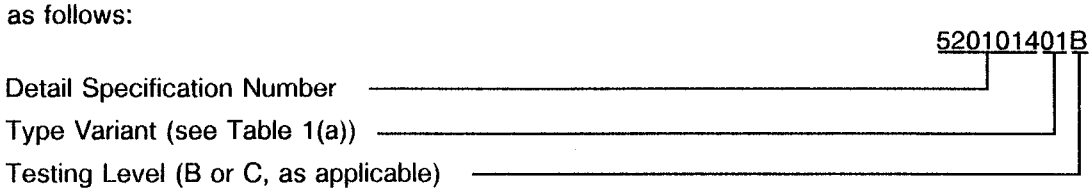
(c) Traceability Information.

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. Unless otherwise specified, 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 are shown 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 Power Burn-in

The requirements for power burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 5000. The conditions for power burn-in shall be as specified in Table 5 of this specification.

4.7.3 Electrical Circuits for Power Burn-in

Not applicable.

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

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	$I_C = 1.0\mu A$	30	-	V
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	$I_C = 3.0mA$	15	-	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	$I_E = 10\mu A$	2.5	-	V
4	Collector-Base Cut-off Current	I_{CBO}	3036	$V_{CB} = 15V$	-	10	nA
5	D.C. Forward Current Transfer Ratio	h_{FE}	3076	$V_{CE} = 1.0V$ $I_C = 3.0mA$	30	150	-
6	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	3071	$I_C = 10mA$ $I_B = 1.0mA$	-	0.4	V
7	Base-Emitter Saturation Voltage	$V_{BE(sat)}$	3066	$I_C = 10mA$ $I_B = 1.0mA$	-	1.0	V

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - a.c. PARAMETERS (NOTE 1)

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
8	Noise Figure	NF	3246	V_{CE} = 10V I_C = 1.5mA f = 450MHz R_C = 50Ω	-	5.0	dB
9	Small Signal Power Gain	G_{pe}	This Spec. Figure 4	V_{CE} = 6.0V I_C = 1.5mA f = 450MHz	12.5	21	dB
10	A.C. Forward Current Transfer Ratio	h_{fe}	3306	V_{CE} = 6.0V I_C = 5.0mA f = 100MHz Note 2	10	-	-
11	Input Capacitance	C_{ibo}	3240	V_{EB} = 0.5V I_E = 0 f = 1.0MHz Note 2	-	2.0	pF
12	Output Capacitance	C_{obo}	3236	V_{CB} = 10V I_E = 0 f = 1.0MHz	-	1.7	pF

NOTES

1. Measurements performed on a sample basis, LTPD7 or less.
2. Case lead grounded.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

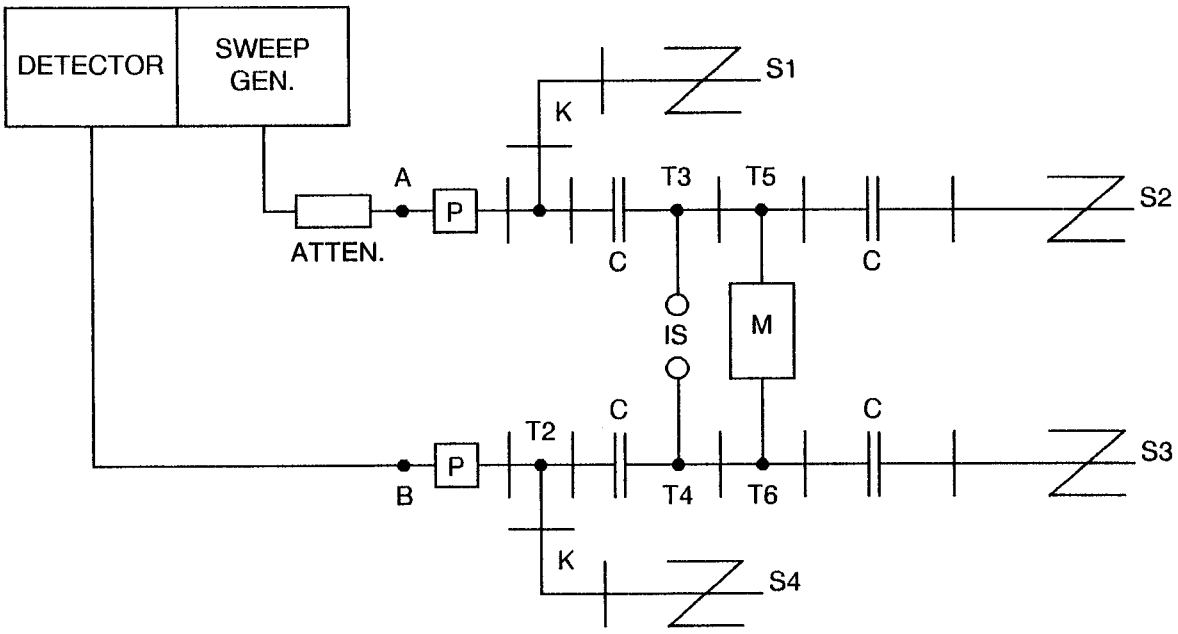
No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
4	Collector-Base Cut-off Current	I_{CBO}	3036	T_{amb} = +150(+0−5)°C V_{CB} = 15V	-	1.0	µA
5	D.C. Forward Current Transfer Ratio	h_{FE}	3076	T_{amb} = −55(+5−0)°C I_C = 3.0mA V_{CE} = 1.0V	10	-	

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMIT (Δ)	UNIT
4	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	±3.0	nA
5	D.C. Forward Current Transfer Ratio	h_{FE}	As per Table 2	As per Table 2	±25	%

FIGURE 4 - SMALL SIGNAL POWER GAIN MEASUREMENT

Coaxial line circuit for measuring small signal power gain at 800MHz.



C	=	Coupling capacitor	'P'	=	3dB pad
K	=	Coaxial knee	IS	=	Bias insertion unit
S	=	Coaxial stub	'M'	=	Transistor mounting
T	=	Coaxial 'T'			

Each transistor shall be tuned for maximum power gain. The measuring circuit shall be decoupled from the transistor supply. To prevent damage to the transistor, the supply voltage shall be switched off before the transistor is inserted into the measuring jig.

Calibration Procedure

Input and output of the sweep generator are short-circuited by connecting 'A' and 'B' with the attenuator in position 10dB. The calibration voltage is adjusted to a calibration line of the sweep generator. Subsequently, 'A' and 'B' are connected to the measuring circuit and the total attenuation is adjusted to 10dB.

Transition Losses

After calibration of the sweep generator, a transistor is tuned for maximum power output in the circuit. Next, the transistor is replaced by a standard short and the input stub tuned to minimum attenuation.

The loss in output impedance transition $= \frac{\text{total loss}}{2}$

The same procedure shall be repeated for input impedance transition.

The measurement values shall be corrected according to the losses in impedance.

Gain Measurement

After tuning for maximum output (gain), the power gain of the transistor equals:-

measured gain + losses T_1 and T_2.

TABLE 5 - CONDITIONS FOR POWER BURN-IN

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+25	°C
2	Power Dissipation	P_{tot}	200	mW
3	Collector-Base Voltage	V_{CB}	12	V

FIGURE 5 - ELECTRICAL CIRCUIT FOR POWER BURN-IN

Not applicable.

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 tests are scheduled in Table 6.

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 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 Section 9 of 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.	
4	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	-	10	nA
5	D.C. Forward Current Transfer Ratio	h_{FE}	As per Table 2	As per Table 2	30	150	-

APPENDIX 'A'

AGREED DEVIATIONS FOR SGS (ITALY)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Table 2 (a.c. parameters)	Forward transmission coefficient S_{21e} may be measured instead of the small signal power gain.

No.	CHARACTERISTICS	SYMBOL	TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
9	Forward Transmission Coefficient	S_{21e}	Figure 6	I_C = 14mA V_{CE} = 10V f = 800MHz	6.0	-	dB

FIGURE 6 - TEST CIRCUIT FOR MEASUREMENT OF FORWARD TRANSMISSION COEFFICIENT