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Pages 1 to 19

TRANSISTORS, HIGH POWER, PNP,

BASED ON TYPE 2N5005

ESA/SCC Detail Specification No. 5204/005

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 4	February 1988	-	-
Revision 'A'	February 1992		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 3 and incorporates all modifications defined in Revision 'A' to Issue 3 and the following DCR's:-		
		Table of Contents	: Para. 4.6, "Requirements" deleted from Title	23259
			: Para's 4.7.2, 4.7.3 and 4.7.4, Titles amended	23259
			: Table 2, Titles expanded	23259
			: Table 5, Title amended	23259
			: Figure 5, Title amended	23259
			: Appendix 'A', entry deleted and "None" substituted	22512
		Para. 1.2	: Paragraph expanded	23259
		Table 1(a)	: Variant -02 and Package added	22319
			: Table standardised	22461
		Table 1(b)	: Nos. 1, 2 and 3, "breakdown" deleted from Characteristics	23259
			: No. 4, "(Continuous)" added to Characteristics	22461
			: No. 8, Symbol amended and remarks expanded	22461
		Figure 2	: Old Figure deleted, new Figures 2(a) and 2(b) added and Notes amended	22319/ 22461
			: Table rewritten with Metric measurements as prime, in Notes Column, 4 deleted and 5 amended to read "4"	23259/ 22461
		Figure 3	: Figure moved to Page 9, Figure and 2nd Note amended and all subsequent pages renumbered	22319/ 22461

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		Para. 4.2.2 to 4.2.3	: ESA/SCC 5000 Reference Para. Nos. added to individual Tests	23259
		Para. 4.2.2(c)	: Test Condition added	22461
		Para. 4.2.4	: Chart IV added to Title and Bond Strength and Die Shear Tests added	22461
		Para. 4.4.1	: Paragraph rewritten	23259
		Para. 4.5.3	: Part Number corrected and Type Variant rewritten	23259
		Para. 4.6	: "Requirements" deleted from Title	23259
		Para. 4.6.3	: Text deleted and "Not applicable" substituted	23259
		Paras 4.7.2, 4.7.3, 4.7.4	: Paragraphs rearranged and rewritten	23259
		Table 2	: Spec. and Test method Column heading and Column entries standardised	23259
			: Nos. 2, 6, 7 and 8, under Test Conditions (*) deleted and "See Note" added	23259
			: Nos. 7 and 8, Characteristics corrected	23259
		Table 2 a.c.	: Number 2, Symbol corrected to C_{obo}	23259
			: Numbers corrected to run sequentially with Table 2 d.c.	23259
			: Note completed	23259
		Table 3	: "See Note" added to Title	22461
			: Tests renumbered and Columns, Symbols and Characteristics aligned to Table 2	22461
			: Note deleted and new Note added	22461
		Table 4	: Tests characterised as per Table 2 and Note deleted	23259

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		Table 5	: Main Title amended	23259
			: In High Temperature Reverse Bias Table, "Duration" numbered as 4	23259
			: Burn-in subheading amended	23259
		Figure 5	: Main Title amended	23259
			: Burn-in subheading amended	23259
		Para. 4.8.3 & 4.8.4	: "power" added before burn-in in text	22461
		Para. 4.8.5	: Last sentence amended to read ".... Table 1(b)"	23259
		Table 6	: Table characterised as per Table 2 and Note deleted	23259
		Appendix 'A'	: Deleted	22512
'A'	Feb. '92	P1. Cover Page		None
		P2B. 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	: H.T.R.B. deviation deleted	23499
			: 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.		

TABLE OF CONTENTS

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for a Transistor, High Power, PNP, based on Type 2N2005.

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.

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.

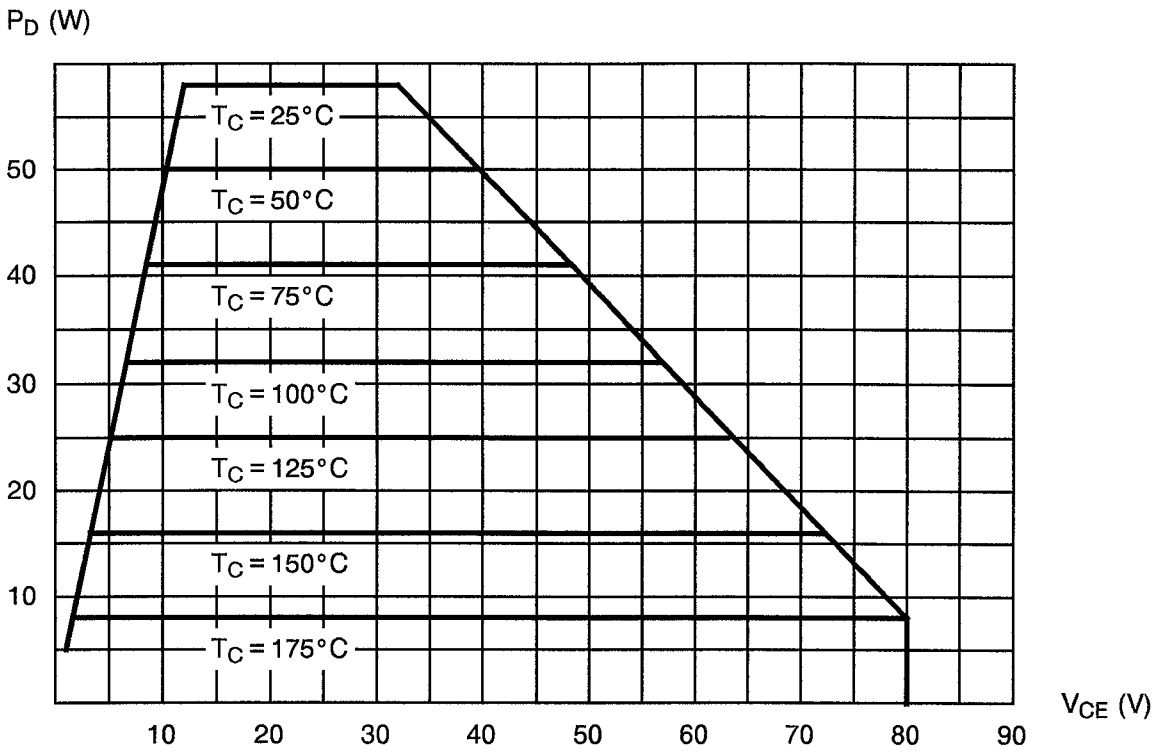
TABLE 1(a) - TYPE VARIANTS

VARIANT	CASE	PACKAGE	FIGURE	LEAD MATERIAL AND FINISH
01	2N5005	3 Lead	2(a)	D2
02	2N5005	4 Lead	2(b)	D2

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}	−5.5	V	
4	Collector Current (Continuous)	I_C	−5.0	A	
6	Power Dissipation	P_{tot}	50	W	$T_C \leq 50°C$
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}	+235	°C	Time: ≤10 sec. Distance from case: ≥1.5mm

FIGURE 1 - PARAMETER DERATING INFORMATION



Rated Power Dissipation versus Temperature and Collector Emitter Voltage

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a)

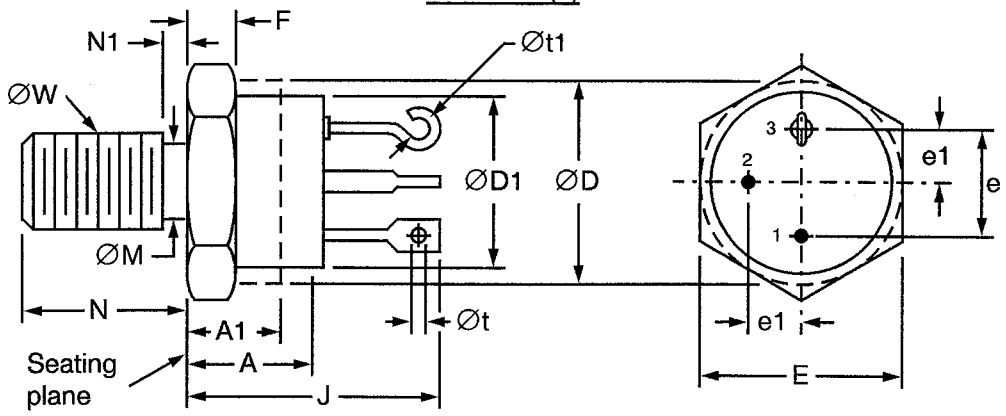
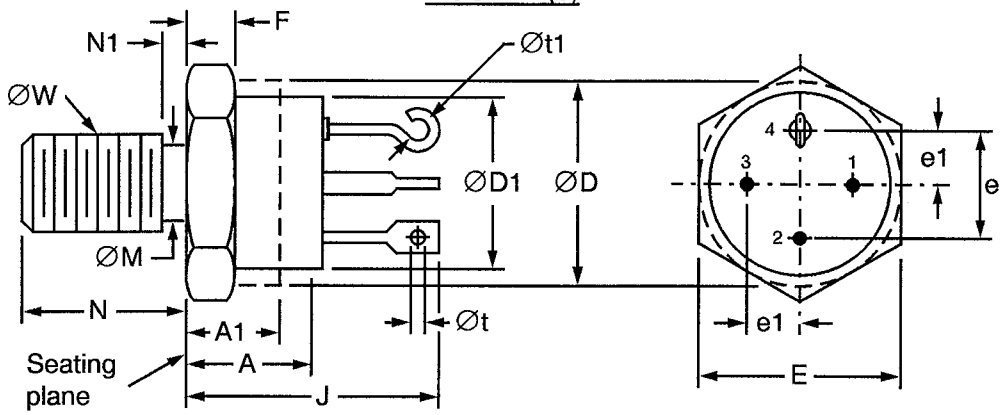


FIGURE 2(b)

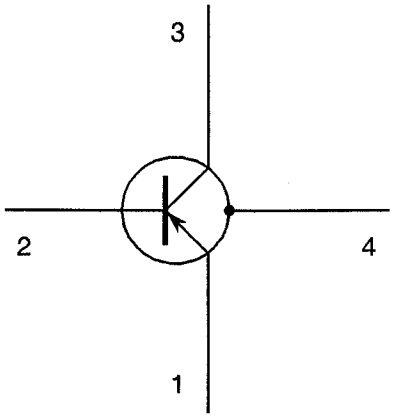


SYMBOL	MILLIMETRES		INCHES		NOTES
	MIN.	MAX	MIN.	MAX.	
A	8.13	11.89	0.320	0.468	
A1	-	6.35	-	0.250	2
ØD	9.65	11.10	0.380	0.437	2
ØD1	8.08	9.65	0.318	0.380	
E	10.77	11.10	0.424	0.437	
e	4.70	5.46	0.185	0.215	4
e1	2.29	2.79	0.090	0.110	4
F	2.29	3.81	0.090	0.150	1
J	14.48	19.38	0.570	0.763	
ØM	4.14	4.80	0.163	0.189	
N	10.16	11.56	0.400	0.455	
N1	-	1.98	-	0.078	
Øt	1.02	1.65	0.040	0.065	
Øt1	1.14	1.78	0.045	0.070	
ØW	4.212	4.310	0.1658	0.1697	3

NOTES

1. Dimension does not include sealing flanges.
2. Package contour optional within dimensions specified.
3. Pitch Diameter - Thread 10-32UNF-2A (coated).
4. Position of leads in relation to hexagon is not controlled.

FIGURE 3 - FUNCTIONAL DIAGRAM



1. Emitter.
2. Base.
3. Collector.
4. Case.

NOTES

1. Package isolated from connections 1-2-3. Terminal 4 is 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)

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 7.0 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

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.

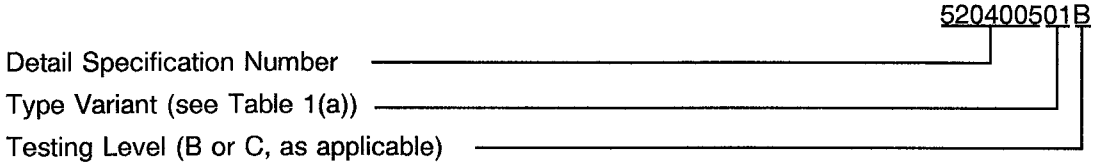
(c) Traceability Information.

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

Not applicable.

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 High Temperature Reverse Bias Burn-in

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

4.7.3 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.

4.7.4 Electrical Circuits for H.T.R.B. and Power Burn-in

Circuits for use in performing the H.T.R.B. and power burn-in tests are shown in Figure 5 of this specification.

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	$I_C = -100\mu A$ $I_E = 0A$	−100	-	V
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	3011	$I_C = -1.0mA$ $V_{BE} = 0V$ Note 1	−80	-	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	$I_E = -1.0mA$ $I_C = 0A$	−5.5	-	V
4	Collector-Emitter Cut-off Current	I_{CES}	3041	$V_{CE} = -60V$ $V_{BE} = 0V$	-	−1.0	µA
5	Emitter-Base Cut-off Current	I_{EBO}	3061	$V_{EB} = -4.0V$ $I_C = 0A$	-	−1.0	µA
6	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$I_C = -50mA$ $V_{CE} = -5.0V$	50	-	-
		h_{FE2}		$I_C = -2.5A$ $V_{CE} = -5.0V$ Note 1	70	200	
		h_{FE3}		$I_C = -5.0A$ $V_{CE} = -5.0V$ Note 1	40	-	
7	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	3071	$I_C = -5.0A$ $I_B = -0.5A$ Note 1	-	−1.5	V
8	Base-Emitter Saturation Voltage	$V_{EB(sat)}$	3066	$I_C = -5.0A$ $I_B = -0.5A$ Note 1	-	−2.2	V

NOTES

1. Pulse measurement: Pulse length ≤300µs, Duty Cycle ≤2%.

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

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
9	A.C. Forward Current Transfer Ratio	h_{fe}	3206	$I_C = -0.5A$ $V_{CE} = 5.0V$ $f = 20MHz$ Note 1	3.5	-	-
10	Output Capacitance	C_{obo}	3236	$V_{CB} = -10V$ $f = 1.0MHz$ Note 1	-	250	pF
11	Switching Time	t_{on}	-	$I_C = 5.0A$ $I_{B1} = I_{B2} = 0.5A$ Note 1	-	0.5	µs
		t_{off}			-	1.3	

NOTES

1. Measurements performed on a sample basis, LTPD7 or less.

FIGURE 4 - TEST CIRCUIT

Not applicable.

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-Emitter Cut-off Current	I_{CES}	3041	$V_{CE} = -60V$ $V_{EB} = 0V$ $T_{amb} = +150°C$	-	−500	µA
5	D.C. Forward Current Transfer Ratio	h_{FE2}	3076	$I_C = -2.5A$ $V_{CE} = -5.0V$ $T_{amb} = -55°C$	30	-	-

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
5	Emitter-Base Cut-off Current	I_{EBO}	As per Table 2	As per Table 2	±200	nA
6	D.C. Forward Current Transfer Ratio	h_{FE2}	As per Table 2	As per Table 2	±25	%
7	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	As per Table 2	As per Table 2	±100	mV

TABLE 5 - CONDITIONS FOR H.T.R.B., POWER BURN-IN AND OPERATING LIFE TESTS

HIGH TEMPERATURE REVERSE BIAS

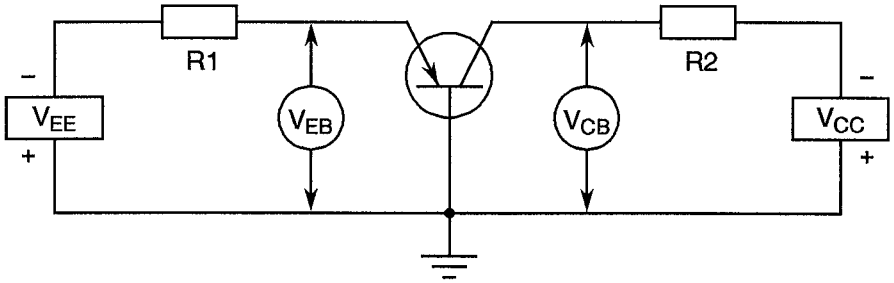
No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Case Temperature	T_{case}	+150	°C
2	Collector-Base (d.c.) Voltage	V_{CB}	80	V
3	Emitter-Base Voltage	V_{EB}	−2.0	V
4	Duration	-	48	Hrs

POWER BURN-IN AND OPERATING LIFE TEST

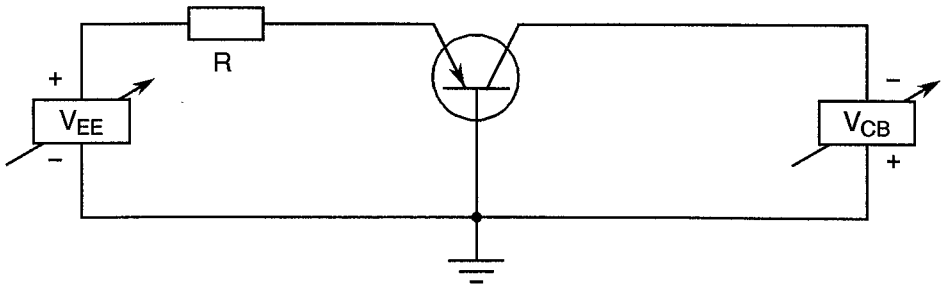
No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Case Temperature	T_{case}	+100	°C
2	Power Dissipation	P_{tot}	33	W
3	Collector-Base Voltage	V_{CB}	20	V

FIGURE 5 - ELECTRICAL CIRCUITS FOR H.T.R.B., POWER BURN-IN AND OPERATING LIFE TESTS

HIGH TEMPERATURE REVERSE BIAS



POWER BURN-IN AND OPERATING LIFE TEST



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. The measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

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 power 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 as shown in Figure 5 for the power burn-in test.

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.	
4	Collector-Emitter Cut-off Current	I_{CES}	As per Table 2	As per Table 2	-	- 1.0	µA
6	D.C. Forward Current Transfer Ratio	h_{FE2}	As per Table 2	As per Table 2	70	200	-
7	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	As per Table 2	As per Table 2	-	- 1.5	V