



**TRANSISTORS, HIGH POWER, NPN**  
**BASED ON TYPE 2N6033**  
**ESCC Detail Specification No. 5203/026**

**ISSUE 1**  
**October 2002**



	ESCC Detail Specification		PAGE ii ISSUE 1
--	---------------------------	--	--------------------

### **LEGAL DISCLAIMER AND COPYRIGHT**

European Space Agency, Copyright © 2002. All rights reserved.

The European Space Agency disclaims any liability or responsibility, to any person or entity, with respect to any loss or damage caused, or alleged to be caused, directly or indirectly by the use and application of this ESCC publication.

This publication, without the prior permission of the European Space Agency and provided that it is not used for a commercial purpose, may be:

- copied in whole in any medium without alteration or modification.
- copied in part, in any medium, provided that the ESCC document identification, comprising the ESCC symbol, document number and document issue, is removed.



europaean space agency  
agence spatiale européenne

Pages 1 to 19

**TRANSISTORS, HIGH POWER, NPN**

**BASED ON TYPE 2N6033**

**ESA/SCC Detail Specification No. 5203/026**





**space components  
coordination group**

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 3	August 1984	-	-
Revision 'A'	February 1992	<i>P. Pommeroy</i>	<i>J. Labeyrie</i>



**DOCUMENTATION CHANGE NOTICE**

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		<p>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:-</p> <p>Table 1(b) : Note 1 added to P<sub>tot</sub> and Table reformatted</p> <p>Para. 4.4.2 : Lead Material amended</p> <p>Table 2 : Reformatted</p> <p>Table 2 a.c. : Reformatted</p> <p>Figure 4 : t<sub>on</sub> and t<sub>off</sub> redefined</p> <p>Tables 3 and 4 : Reformatted</p> <p>Table 6 : Reformatted</p>		<p>23172</p> <p>22299</p> <p>23172</p> <p>23172</p> <p>23124</p> <p>23172</p> <p>23172</p>
'A'	Feb. '92	<p>P1. Cover page</p> <p>P2. DCN</p> <p>P5. Para. 1.2 : Paragraph amended</p> <p>P6. Table 1(a) : "Lead Material and/or Finish" column added</p> <p>P9. Para. 2 : "ESA/SCC Basic Spec. No. 23500" added</p> <p>Para. 4.2.2 : Bond Strength and Die Shear Test deviations deleted</p> <p>: PIND deviation deleted</p> <p>Para. 4.2.3 : Radiographic Inspection deviation deleted</p> <p>Para. 4.2.4 : Bond Strength and Die Shear Test deviations deleted</p> <p>P16. Table 3 : Note 2 deleted</p>	<p>None</p> <p>None</p> <p>21021</p> <p>21025</p> <p>21025</p> <p>23499</p> <p>21043</p> <p>21049</p> <p>23499</p> <p>21047</p>	
		<p>This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.</p>		

 	<p style="text-align: center;">ESA/SCC Detail Specification No. 5203/026</p>		<p>PAGE 3 ISSUE 3</p>
---	--	--	---------------------------

**TABLE OF CONTENTS**

		<u>Page</u>
<b>1.</b>	<b><u>GENERAL</u></b>	<b>5</b>
1.1	Scope	5
1.2	Component Type Variants	5
1.3	Maximum Ratings	5
1.4	Parameter Derating Information	5
1.5	Physical Dimensions	5
1.6	Functional Diagram	5
<b>2.</b>	<b><u>APPLICABLE DOCUMENTS</u></b>	<b>9</b>
<b>3.</b>	<b><u>TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS</u></b>	<b>9</b>
<b>4.</b>	<b><u>REQUIREMENTS</u></b>	<b>9</b>
4.1	General	9
4.2	Deviations from Generic Specification	9
4.2.1	Deviations from Special In-process Controls	9
4.2.2	Deviations from Final Production Tests (Chart II)	9
4.2.3	Deviations from Burn-in and Electrical Measurements (Chart III)	9
4.2.4	Deviations from Qualification Tests (Chart IV)	9
4.2.5	Deviations from Lot Acceptance Tests (Chart V)	9
4.3	Mechanical Requirements	10
4.3.1	Dimension Check	10
4.3.2	Weight	10
4.3.3	Terminal Strength	10
4.4	Materials and Finishes	10
4.4.1	Case	10
4.4.2	Lead Material and Finish	10
4.5	Marking	11
4.5.1	General	11
4.5.2	Lead Identification	11
4.5.3	The SCC Component Number	11
4.5.4	Traceability Information	11
4.5.5	Marking of Small Components	11



	<u>Page</u>
4.6 Electrical Measurements	12
4.6.1 Electrical Measurements at Room Temperature	12
4.6.2 Electrical Measurements at High and Low Temperatures	12
4.6.3 Circuits for Electrical Measurements	12
4.7 Burn-in Tests	12
4.7.1 Parameter Drift Values	12
4.7.2 Conditions for Burn-in	12
4.7.3 Electrical Circuits for Burn-in	12
4.8 Environmental and Endurance Tests	18
4.8.1 Electrical Measurements on Completion of Environmental Tests	18
4.8.2 Electrical Measurements at Intermediate Points and on Completion of Endurance Tests	18
4.8.3 Conditions for Operating Life Tests (Part of Endurance Testing)	18
4.8.4 Electrical Circuits for Operating Life Tests	18
4.8.5 Conditions for High Temperature Storage Test (Part of Endurance Testing)	18

**TABLES**


1(a) Type Variants	6
1(b) Maximum Ratings	6
2 Electrical Measurements at Room Temperature - d.c. Parameters	13
Electrical Measurements at Room Temperature - a.c. Parameters	14
3 Electrical Measurements at High and Low Temperatures	16
4 Parameter Drift Values	16
5 Conditions for Burn-in	17
6 Electrical Measurements at Intermediate Points and on Completion of Endurance Testing	19

**FIGURES**

1 Parameter Derating Information	7
2 Physical Dimensions	8
3 Functional Diagram	8
4 Test Circuit	15
5 Electrical Circuit for Burn-in	17

**APPENDICES (Applicable to specific Manufacturers only)**

None.

	<p style="text-align: center;">ESA/SCC Detail Specification No. 5203/026</p>	<p style="text-align: center;">Rev. 'A'</p>	<p style="text-align: right;">PAGE 5 ISSUE 3</p>
--	--	---	--

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

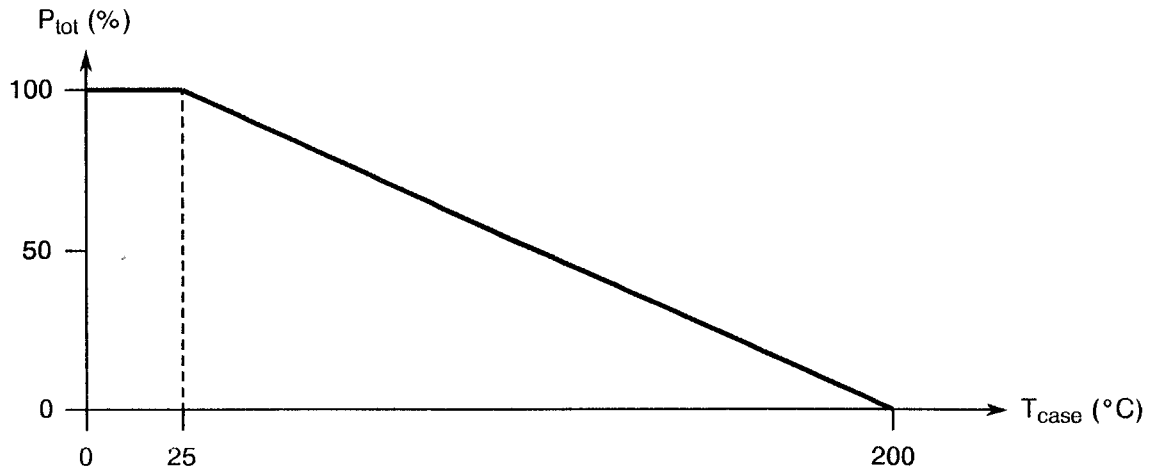
**NOTES**

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





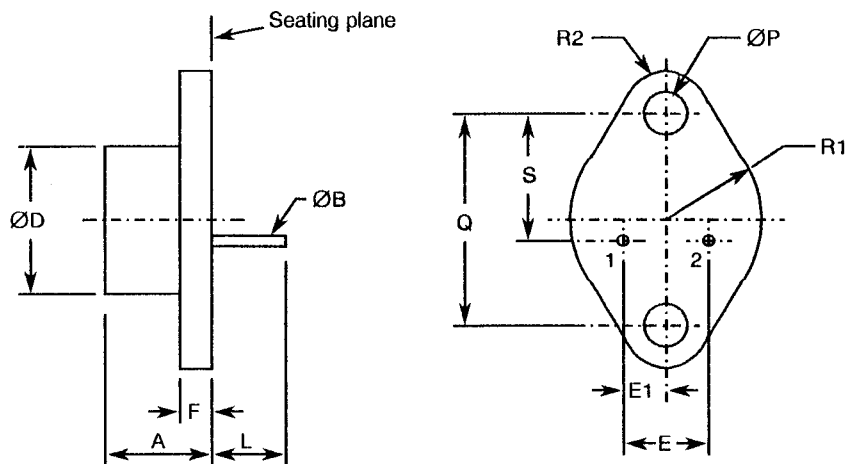
**FIGURE 1 - PARAMETER DERATING INFORMATION**



Power Dissipation versus Temperature



**FIGURE 2 - PHYSICAL DIMENSIONS**

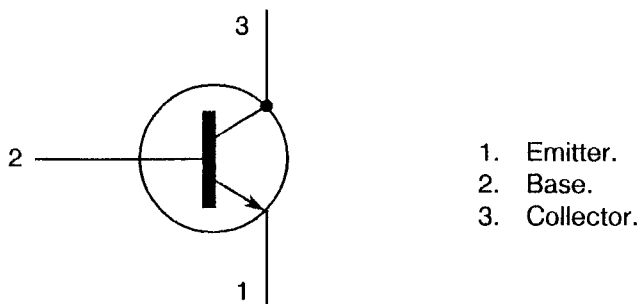


SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.35	11.43	
ØB	0.059	0.061	1.50	1.55	2
ØD	-	0.875	-	22.22	
E	0.420	0.440	10.67	11.18	
E1	0.205	0.225	5.21	5.72	
F	0.050	0.135	1.27	3.43	
L	0.312	-	7.92	-	2
ØP	0.151	0.161	3.84	4.09	
Q	1.177	1.197	29.90	30.40	
R1	0.495	0.525	12.57	13.34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

	<p style="text-align: center;">ESA/SCC Detail Specification No. 5203/026</p>	<p style="text-align: right;">PAGE 10 ISSUE 3</p>
--	--	---

#### 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/mm<sup>2</sup> Elongation Sup. or equal to 25%.
- (ii) Resistivity = less than 0.60Ω mm<sup>2</sup>/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:-

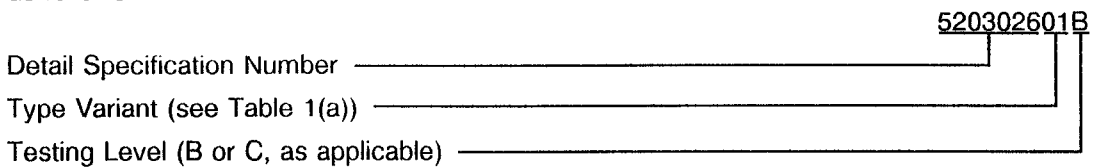
- (a) Lead Identification.
- (b) The SCC Component Number.
- (c) Traceability Information.

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 ( $\Delta$ ) 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	$\mu s$
12	Storage Time	$t_s$	-	4	$I_C = 40A$ $I_{B1} = 4.0A$ $I_{B2} = -4.0A$ $V_{CC} = 30V$	-	1.5	$\mu s$
13	Turn-off Time	$t_f$	-	4	$I_C = 40A$ $I_{B1} = 4.0A$ $I_{B2} = -4.0A$ $V_{CC} = 30V$	-	0.5	$\mu s$

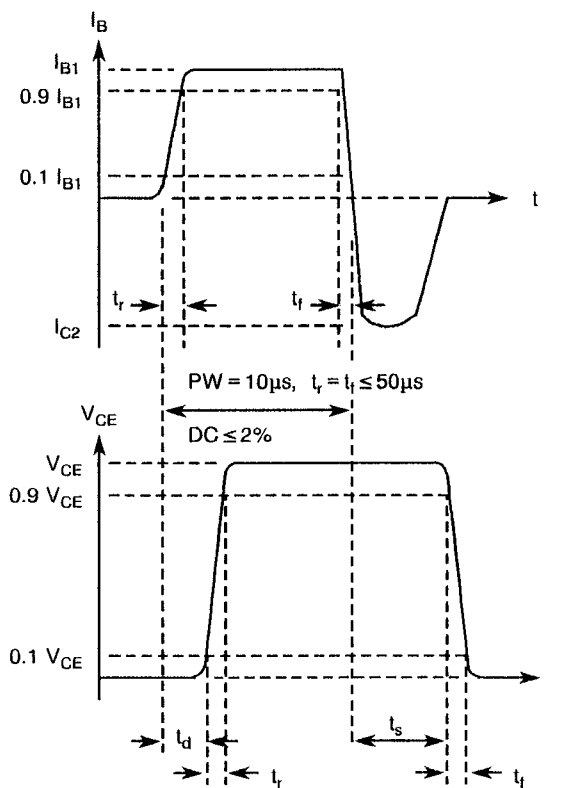
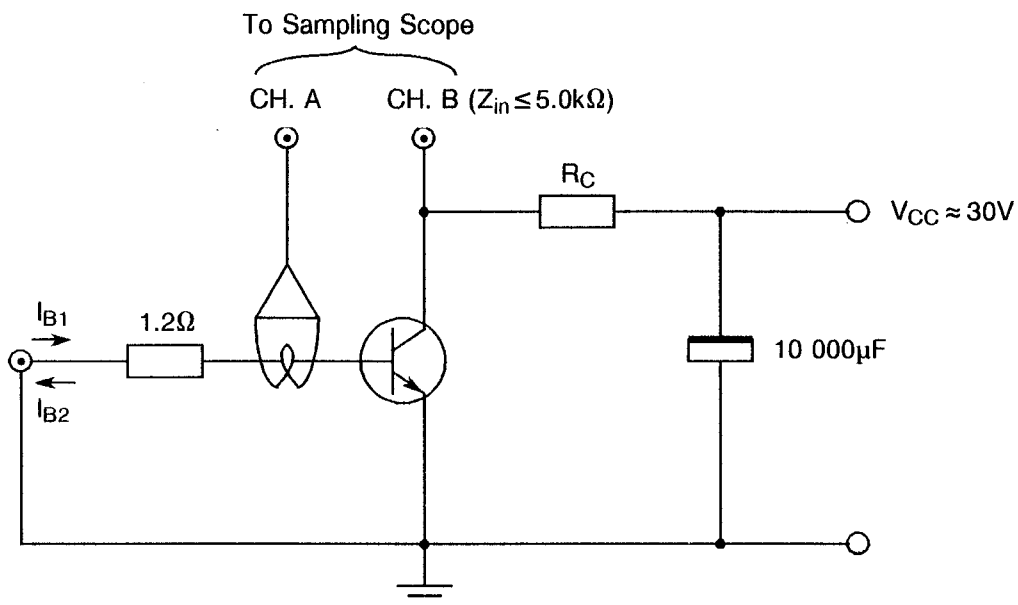
**NOTES**

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**

- 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 ( $\Delta$ )	UNIT
4	Collector-Emitter Cut-off Current	$I_{CEO}$	As per Table 2	As per Table 2	$\pm 1.0$ or (1) $\pm 100$	mA %
5	Emitter-Base Cut-off Current	$I_{EBO}$	As per Table 2	As per Table 2	$\pm 1.0$ or (1) $\pm 100$	mA %
7	Collector Saturation Voltage	$V_{CESat}$	As per Table 2	As per Table 2	$\pm 100$	mV
8	Base-Emitter Saturation Voltage	$V_{BESat}$	As per Table 2	As per Table 2	$\pm 100$	mV

**NOTES**

- 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.



- 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 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