TRANSISTORS, HIGH POWER, NPN

BASED ON TYPE 2N5154

ESCC Detail Specification No. 5203/010

ISSUE 1

October 2002

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Pages 1 to 19

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ESA/SCC Detail Specification No. 5203/010

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 4	January 1998		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 3 and incorporates the changes agreed in the following DCRs:-		
		Cover Page		None
		DCN		None
		Para. 1.2	: Existing text deleted and new text added	221399
		Para. 2	: Item (c) deleted	221399
		Table 1(a)	: Format amended and Variants 04 and 05 added	221399
		Table 1(b)	: Nos. 1 to 3, "Breakdown" deleted from Characteristics and "(BR)" from Symbol	221399
			: Nos. 4 and 5, "(Continuous)" added to Characteristics	221399
			: No. 6, "1" added to Characteristics and Symbol, "Variants 01 to 03" added to existing entry and Variants 04 to 05 entry added. "V_{CE} = +40V" deleted from Remarks	221399
			: No. 7, "2" added to Characteristics and Symbol, "Variants 01 to 03" added to existing entry and Variants 04 to 05 entry added	221399
			: No. 8, "T_{amb} or T_{case}" added to Remarks	221399
			: No. 10, Existing Remarks deleted and "Note 2" added	221399
			: No. 11, New No. 11 added	221399
			: Notes, New Note 2 added	221399
		Figure 1	: Subtitle added to existing Figure	221399
			: New Figure 1(b) added	221399
		Figure 2	: Subtitle added to existing Figure	221399
			: New Figure 2(b) added	221399
		Figure 3	: Notes amended	221399
		Para. 4.2.3	: Existing text deleted and new text added	221399
		Para. 4.3.2	: Existing text deleted and new text added	221399
		Para. 4.3.3	: "Variants 01 to 03" added to existing text and new text for Variants 04 to 05 added	221399
		Para. 4.4.1	: Existing text deleted and new text added	221399
		Para. 4.4.2	: Existing text modified and new text added	221399
		Para. 4.5.1	: Existing text deleted and new text added	221399
		Para. 4.5.5	: Deleted in toto	221399
		Para. 4.6.1	: Second sentence amended	221399
		Para. 4.7.2	: New Para. 4.7.2 added	221399
			: Existing Para. 4.7.2 renumbered to "4.7.3" and title and text amended	221399
		Para. 4.7.3	: Renumbered as "4.7.5" and title and text amended	221399
		Para. 4.7.4	: New Para. 4.7.4 entry added	221399
		Para. 4.7.6	: New Para. 4.7.6 added	221399
		Table 5(a)	: Entry added	221399
		Table 5	: Title renumbered to "5(b)" and amended	221399
			: Subtitle added to existing Table and in No. 2, "1" added to Characteristics and Symbol	221399
			: Table added for Variants 04 to 05	221399
		Figure 5(a)	: Entry added	221399
		Figure 5	: Renumbered to "5(b)" and title amended	221399
		Para. 4.8.1	: Text added to the beginning of the second sentence	221399
		Para. 4.8.2	: Second sentence added	221399
		Para. 4.8.3	: In the second sentence, text amended	221399
		Para. 4.8.4	: Text amended	221399

TABLE OF CONTENTS

Page

TABLES

FIGURES

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 2N5154.

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

Variants of the basic transistors specified herein, which also covered by this specification, are given in 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-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.

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.

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.

TABLE 1(a) - TYPE VARIANTS

VARIANT	BASED ON TYPE	CASE	FIGURE	LEAD MATERIAL AND FINISH
01	2N5154	TO39	2(a)	D2
02	2N5154	TO39	2(a)	D3 or D4
03	2N5154	TO39	2(a)	D7
04	2N5154	TO257	2(b)	H2
05	2N5154	TO257	2(b)	H4

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}	6.0	V	
4	Collector Current (Continuous)	I_C	5.0	A	
5	Base Current (Continuous)	I_B	1.0	A	
6	Power Dissipation 1 Variants 01 to 03 Variants 04 to 05	P_{tot1}	 1.0 3.3	W	$T_{amb} \leq +25°C$ Note 1
7	Power Dissipation 2 Variants 01 to 03 Variants 04 to 05	P_{tot2}	 8.75 35	W	$T_{case} \leq +25°C$ Note 1
8	Operating Temperature Range	T_{op}	−65 to +200	°C	T_{amb} or T_{case}
9	Storage Temperature Range	T_{stg}	−65 to +200	°C	
10	Soldering Temperature	T_{sol}	+260	°C	Note 2
11	Thermal Resistance Variants 01 to 03 Variants 04 to 05	$R_{TH(J-C)}$	 20 5.0	°C/W	

NOTES

1. For derating at T_{amb} or $T_{case} > +25°C$, 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

FIGURE 1(a) - POWER DISSIPATION VERSUS TEMPERATURE

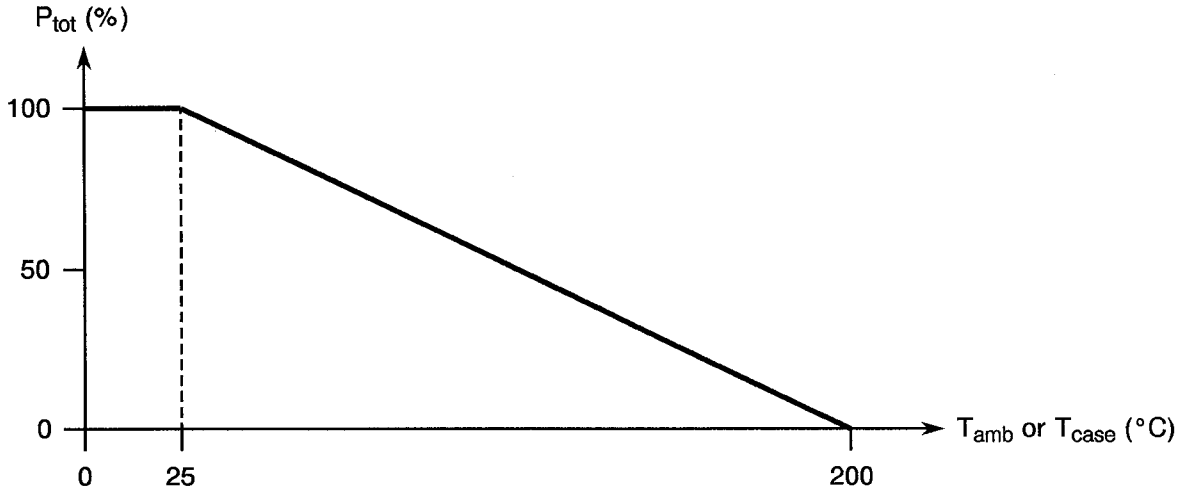
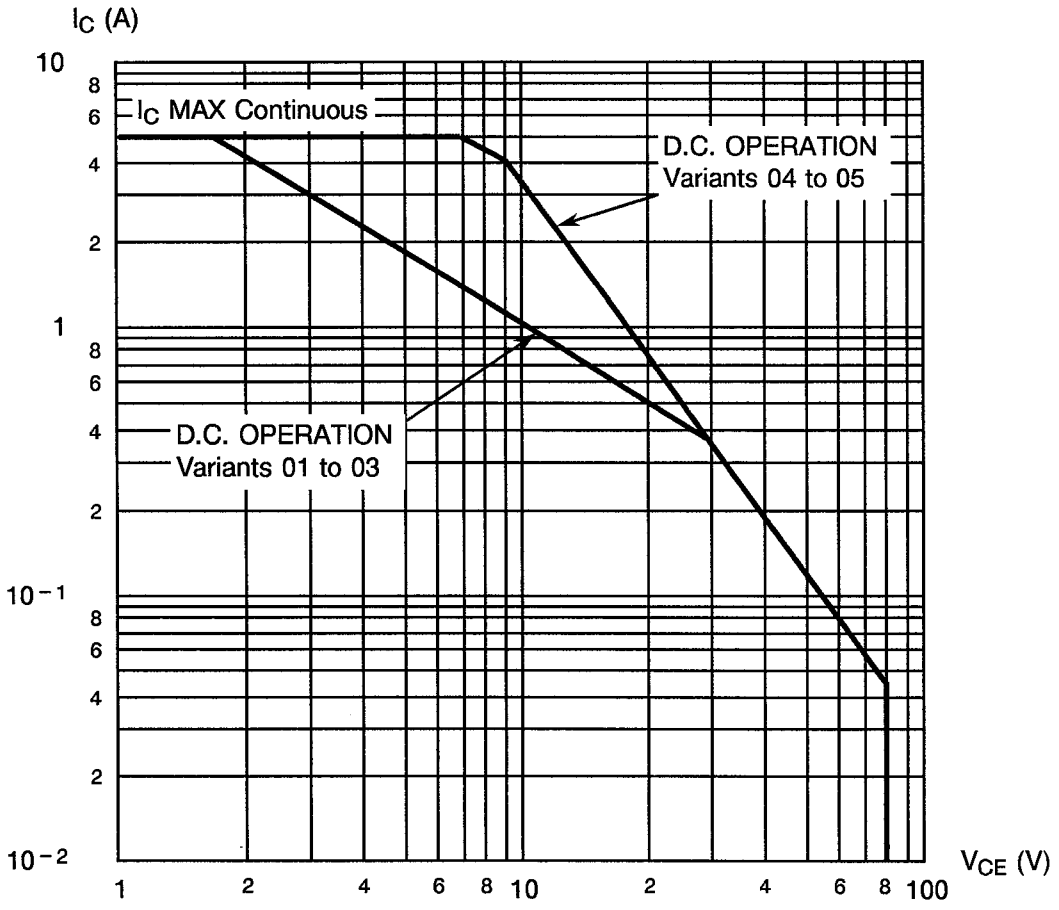


FIGURE 1(b) - FORWARD BIAS SAFE OPERATING AREA (MAXIMUM CONTINUOUS D.C.)



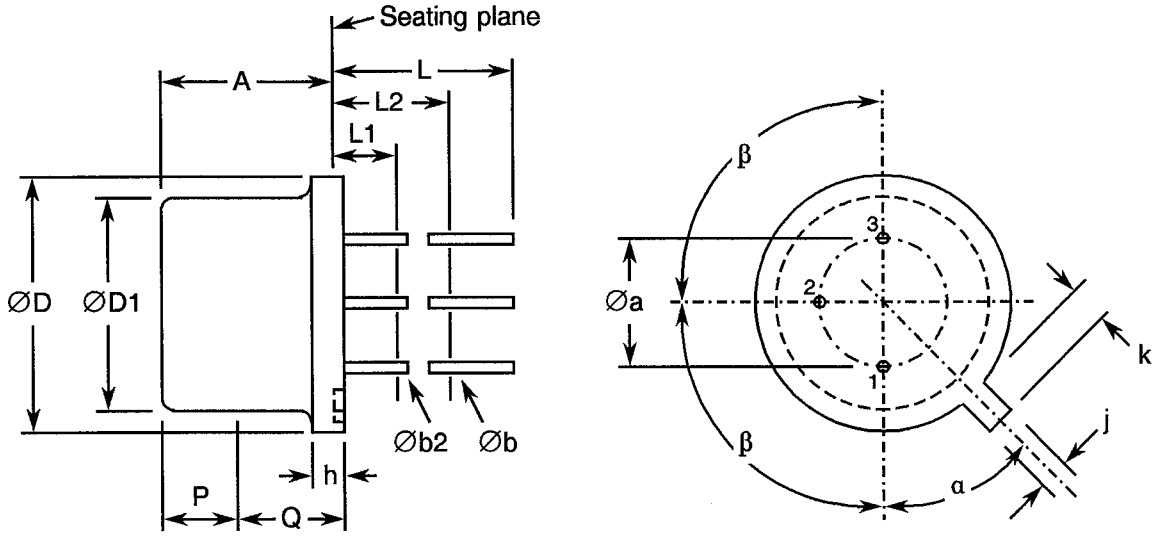
Collector Current versus Collector-Emitter Voltage

NOTES

1. See Para. 4.7.6.

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a) - VARIANTS 01 to 03



SYMBOL	MILLIMETRES		NOTES
	MIN.	MAX.	
Øa	4.83	5.33	
A	6.10	6.60	
Øb	0.406	0.533	2
Øb2	0.406	0.483	2
ØD	8.89	9.40	
ØD1	8.00	8.51	
h	0.229	3.18	
j	0.711	0.864	
k	0.737	1.02	3
L	12.70	-	2
L1	-	1.27	2
L2	6.35	-	2
P	2.54	-	1
Q	-	-	4
α	45° NOM.		
β	90° NOM.		

NOTES

1. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.254mm.
2. 3 leads. Dimension Øb2 applies between L1 and L2. Dimension Øb applies between L2 and 12.70mm from the seating plane. Diameter is uncontrolled in L1 and beyond 12.70mm from the seating plane.
3. Measured from maximum diameter of the actual device.
4. Details of outline in this zone is optional.

FIGURE 2 - PHYSICAL DIMENSIONS (CONT.)

FIGURE 2(b) - VARIANTS 04 to 05

SYMBOL	MILLIMETRES	
	MIN.	MAX.
A	10.41	10.67
B	10.41	10.67
C	16.51	16.76
D	4.7	5.33
E	0.89	1.14
∅F	3.56	3.81
G	13.39	13.64
H	5.13	5.38
I	0.64	0.89
J	2.92	3.18
K	2.41	2.67
L	15.24	16.51
M	2.29 Typical	
N	-	0.71
R	1.65 Typical	

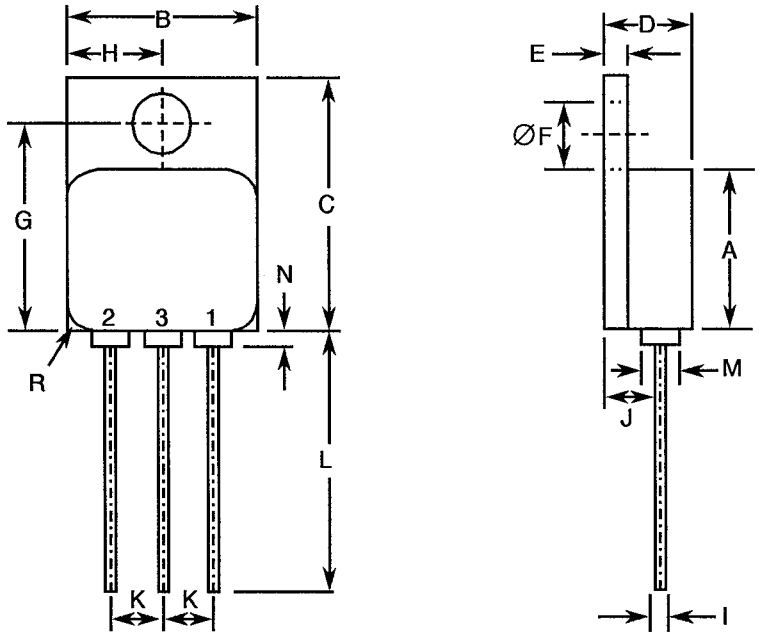
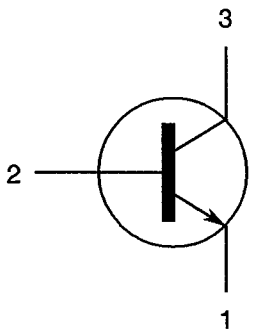


FIGURE 3 - FUNCTIONAL DIAGRAM



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

NOTES

1. For Variants 01 to 03, the collector is internally connected to the case.
2. For Variants 04 to 05, the collector is isolated from the case.

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) Para. 7.1.1(a), "High Temperature Reverse Bias" test and subsequent electrical measurements related to this test shall be omitted.

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 1.5 grammes for Variants 01 to 03 and 5.0 grammes for Variants 04 to 05.

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:-

Variants 01 to 03

Test Condition : 'E' Lead Fatigue.

Variants 04 to 05

Test Condition : 'A' (Tension).
Applied Force : 10 N.
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

For Variants 01 to 03, 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.

For Variants 04 to 05, the case shall be hermetically sealed and have a metal body, the Fe/Ni copper core pin shall pass through a ceramic eyelet brazed into the frame and the lid shall be welded.

4.4.2 Lead Material and Finish

For Variants 01 to 03, the lead material shall be Type 'D' with either Type '2', Type '3 or 4' or Type '7' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500. (See Table 1(a) for Type Variants).

For Variants 04 to 05, the lead material shall be Type 'H' with either Type '2' or Type '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 and the following paragraphs. When the component is too small to accomodate all of the marking specified, as much as space permits shall be marked and the marking information, in full, shall accompany the component in its primary package.

The information to be marked and the order of precedence, shall be as follows:-

(a) Lead Identification.

(b) The SCC Component Number.

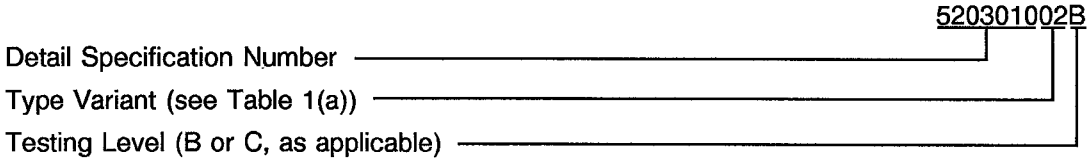
(c) Traceability Information.

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.

4.6 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 stated, 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 Table 2 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 High Temperature Reverse Bias Burn-in (Table 5(a))

Not applicable.

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(b) of this specification.

4.7.4 Electrical Circuit for High Temperature Reverse Bias Burn-in (Figure 5(b))

Not applicable.

4.7.5 Electrical Circuit for Power Burn-in

A circuit for use in performing the power burn-in tests is shown in Figure 5(b) of this specification.

4.7.6 Verification of Safe Operating Area

The requirement for the verification of the Safe Operating Area are specified in Section 9 of ESA/SCC Generic Specification No. 5000. The test method shall be as follows:-

Maximum continuous d.c. in accordance with MIL-STD-750, Method 3052 and Figure 1(b) of this specification, at $T_{case} = +25$°C and for an operating time of 100ms maximum.

For Variants 01 to 05: $I_C = 0.35$A, $V_{CE} = 25$V.

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 = 100mA I_B = 0A Note 1	80	-	V
2	Collector-Emitter Cut-off Current	I_{CES}	3041	V_{CE} = 60V V_{BE} = 0V	-	1.0	µA
3	Collector-Emitter Cut-off Current	I_{CEO}	3041	V_{CE} = 40V I_B = 0A	-	50	µA
4	Emitter-Base Cut-off Current 1	I_{EBO1}	3061	V_{EB} = 5.0V I_C = 0A	-	1.0	µA
5	Emitter-Base Cut-off Current 2	I_{EBO2}	3061	V_{EB} = 6.0V I_C = 0A	-	1.0	mA
6	D.C. Forward Current Transfer Ratio 1	h_{FE1}	3076	V_{CE} = 5.0V I_C = 50mA Note 1	50	-	-
7	D.C. Forward Current Transfer Ratio 2	h_{FE2}	3076	V_{CE} = 5.0V I_C = 2.5A Note 1	70	200	-
8	D.C. Forward Current Transfer Ratio 3	h_{FE3}	3076	V_{CE} = 5.0V I_C = 5.0A Note 1	40		-
9	Collector-Emitter Saturation Voltage 1	$V_{CE(SAT)1}$	3071	I_C = 5.0A I_B = 0.5A Notes 1 and 2	-	1.5	V
10	Collector-Emitter Saturation Voltage 2	$V_{CE(SAT)2}$	3071	I_C = 2.5A I_B = 0.25A Notes 1 and 2	-	1.45	V
11	Base-Emitter Saturation Voltage 1	$V_{BE(SAT)1}$	3066	I_C = 2.5A I_B = 0.25A Notes 1 and 2	-	1.45	V
12	Base-Emitter Saturation Voltage 2	$V_{BE(SAT)2}$	3066	I_C = 5.0A I_B = 0.5A Notes 1 and 2	-	2.2	V

NOTES

1. Pulsed measurement: Pulse Width ≤300µs, Duty Cycle ≤2.0%.
2. Saturation voltages 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	
13	A.C. Forward Current Transfer Ratio	h_{fe}	3206	-	V_{CE} = 5.0 I_C = 0.5A f = 20MHz	3.5	-	-
14	Output Capacitance	C_{obo}	3236	-	V_{BE} = 10V I_C = 0A f = 1.0MHz	-	250	pF
15	Turn-on Time	t_{on}	-	4	I_C = 5.0A I_{B1} = 0.5A I_{B2} = − 0.5A V_{BB} = − 4.0V V_{CC} = 30V V_{IN} ≈ + 51V	-	0.5	µs
16	Turn-off Time	t_{off}	-	4	I_C = 5.0A I_{B1} = 0.5A I_{B2} = − 0.5A V_{BB} = − 4.0V V_{CC} = 30V V_{IN} ≈ + 51V	-	1.3	µs

NOTES

1. Measurements shall be performed on a sample basis, LTPD7.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

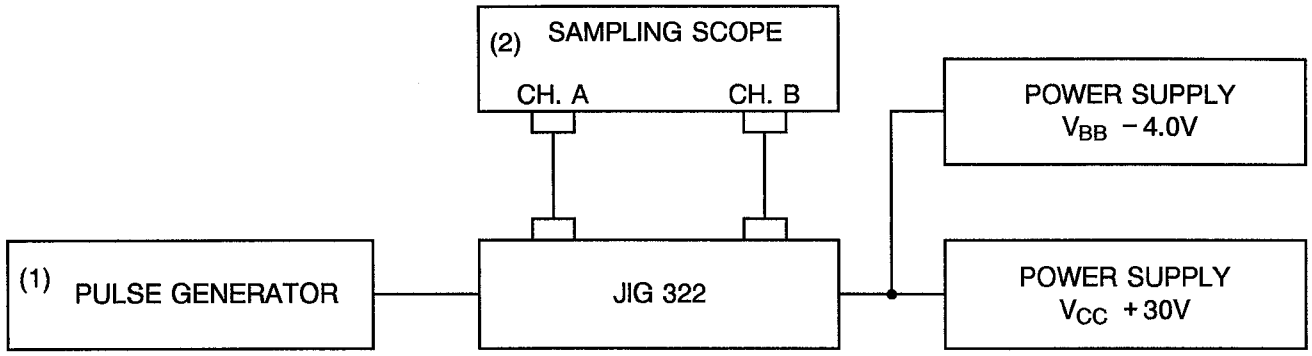
No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
2	Collector-Emitter Cut-off Current	I_{CES}	3041	V_{CE} = 60V V_{BE} = 0V T_{amb} = + 150 °C	-	10	µA
7	D.C. Forward Current Transfer Ratio 2	h_{FE2}	3076	V_{CE} = 5.0V I_C = 2.5A T_{amb} = − 55 °C Note 1	35	-	-

NOTES

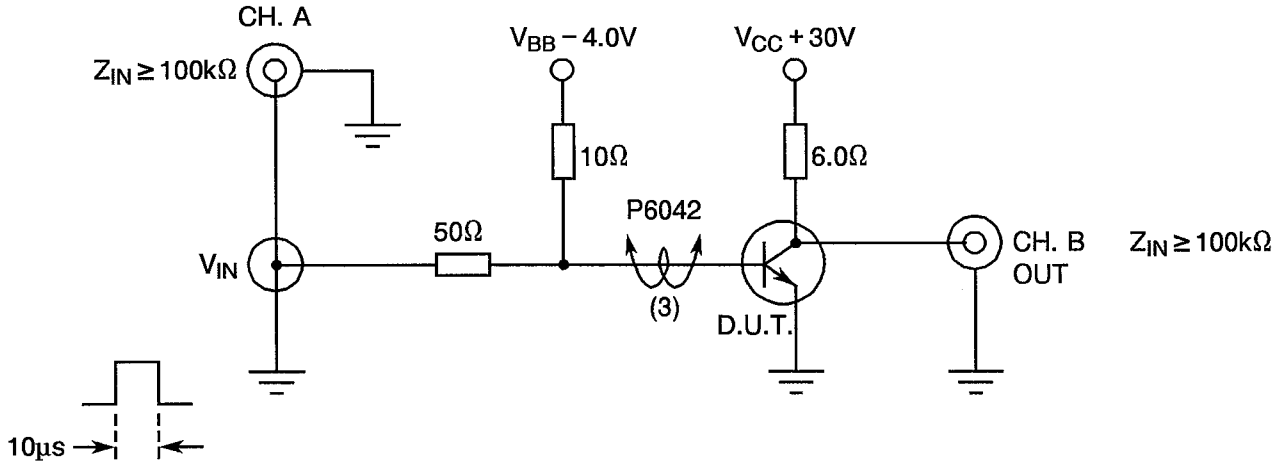
1. Pulsed measurement: Pulse Width ≤ 300µs, Duty Cycle ≤ 2.0%.

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

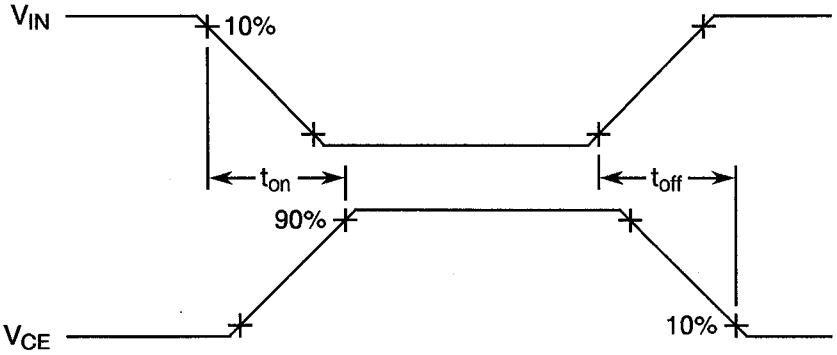
BLOCK DIAGRAM



EQUIVALENT TEST CIRCUIT



VOLTAGE WAVEFORMS



NOTES

1. Pulse generator Type EH132 or equivalent, $t_r \leq 20ns$, $t_p = 10\mu s$, Duty Cycle = 1.0%.
2. Sampling Scope Tetroniks 568 or equivalent.
3. Adjust V_{IN} − V_B with current probe P6042.

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
2	Collector-Emitter Cut-off Current	I_{CES}	As per Table 2	As per Table 2	±100	nA
7	D.C. Forward Current Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	±25	%
9	Collector-Emitter Saturation Voltage 1	$V_{CE(SAT)1}$	As per Table 2	As per Table 2	±100	mV

TABLE 5(a) - CONDITIONS FOR HIGH TEMPERATURE REVERSE BIAS BURN-IN

Not applicable.

TABLE 5(b) - CONDITIONS FOR POWER BURN-IN AND OPERATING LIFE TESTS

VARIANTS 01 TO 03

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Ambient Temperature	T_{amb}	+20 to +50 (1)	°C
2	Power Dissipation 1	P_{tot1}	Maximum rating at T_{amb} according to derating curve (See Figure 1(a))	W
3	Collector-Emitter Voltage	V_{CE}	20	V

NOTES

1. No heat sink forced air directly on the device shall be permitted.

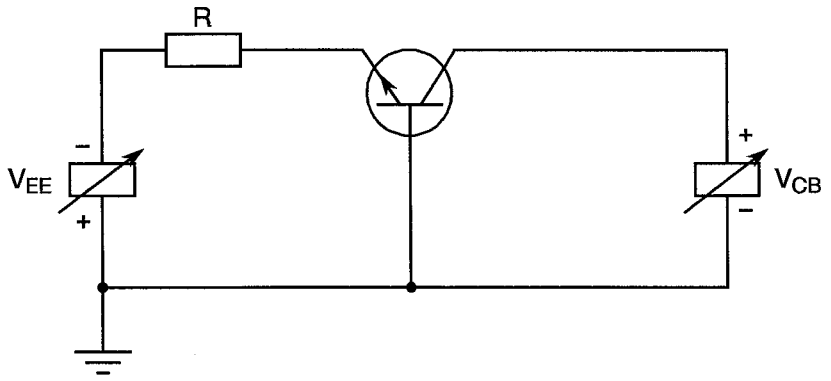
VARIANTS 04 TO 05

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Case Temperature	T_{case}	+100(+0−5)	°C
2	Power Dissipation 2	P_{tot2}	Maximum rating at T_{amb} according to derating curve (See Figure 1(a))	W
3	Collector-Emitter Voltage	V_{CE}	20	V

FIGURE 5(a) - ELECTRICAL CIRCUIT FOR HIGH TEMPERATURE REVERSE BIAS BURN-IN

Not applicable.

FIGURE 5(b) - ELECTRICAL CIRCUIT FOR POWER BURN-IN AND OPERATING LIFE TESTS



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. Unless otherwise stated, 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. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm$ °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 the same as specified in Table 5(b) for the power burn-in test.

4.8.4 Electrical Circuit for Operating Life Tests

The electrical circuit for performing the operating life test is the same as that shown in Figure 5(b) for power 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.	
2	Collector-Emitter Cut-off Current	I_{CES}	As per Table 2	As per Table 2	-	1.0	µA
7	D.C. Forward Current Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	70	200	-
9	Collector-Emitter Saturation Voltage 1	$V_{CE(SAT)1}$	As per Table 2	As per Table 2	-	1.5	V