TRANSISTORS, HIGH POWER, NPN,

BASED ON TYPE 2N2814

ESCC Detail Specification No. 5203/031

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Pages 1 to 20

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ESA/SCC Detail Specification No. 5203/031

space components
coordination group

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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE Reference	CHANGE Item	Approved DCR No.
		This Issue incorporates all modifications agreed on the basis of Policy DCR 21016 for adaptation to new qualification requirements and Policy DCR 21019, "Appendices to Detail Specifications".		
'A'	Feb. '92	P1. Cover page		None
		P2. DCN		None
		P5. Para. 1.2	: Paragraph amended	21021
		P6. Table 1(a)	: "Lead Material and/or Finish" column added	21025
		P10. Para. 2	: MIL-STD-1276 deleted, "ESA/SCC Basic Spec. No. 23500" added	21025
		Para. 4.2.2	: PIND deviation deleted	21043
		P11. Para. 4.4.2	: Paragraph amended	21025
		P17. 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.		

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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 2N2814.

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) and Figure 1(a).

1.4 PARAMETER DERATING INFORMATION

The derating information applicable to the transistors specified herein is shown in Figure 1(b).

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.

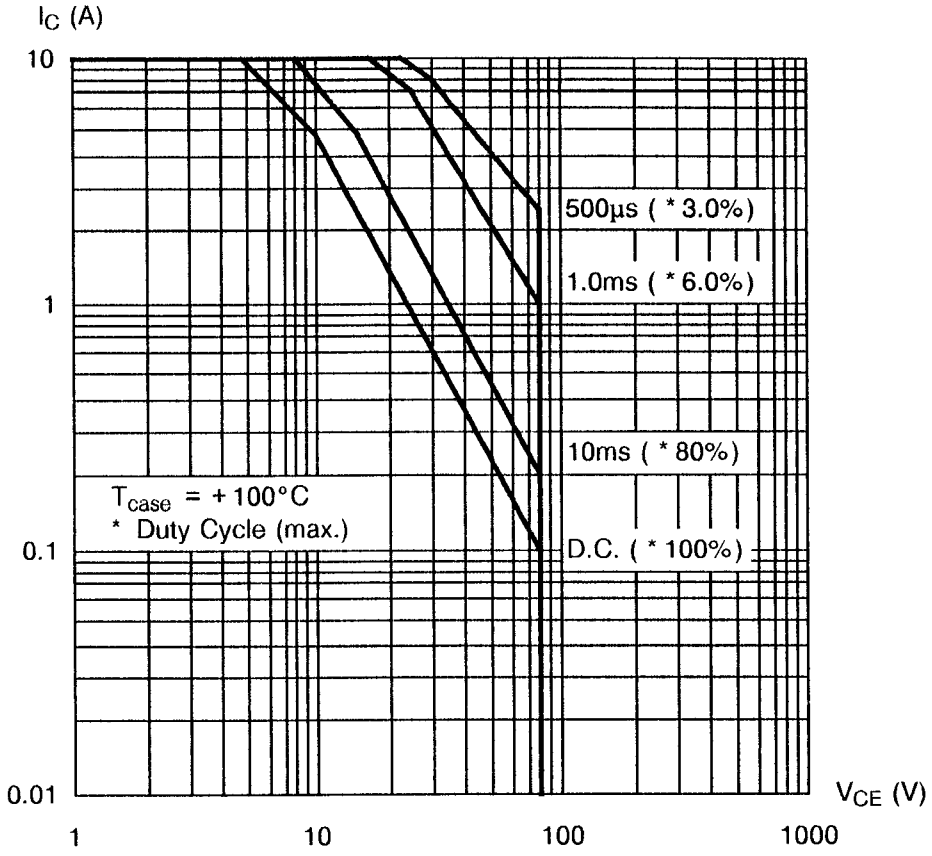
TABLE 1(a) - TYPE VARIANTS

VARIANT	BASED ON TYPE	LEAD MATERIAL AND FINISH
01	2N2814	D2

TABLE 1(b) - MAXIMUM RATINGS

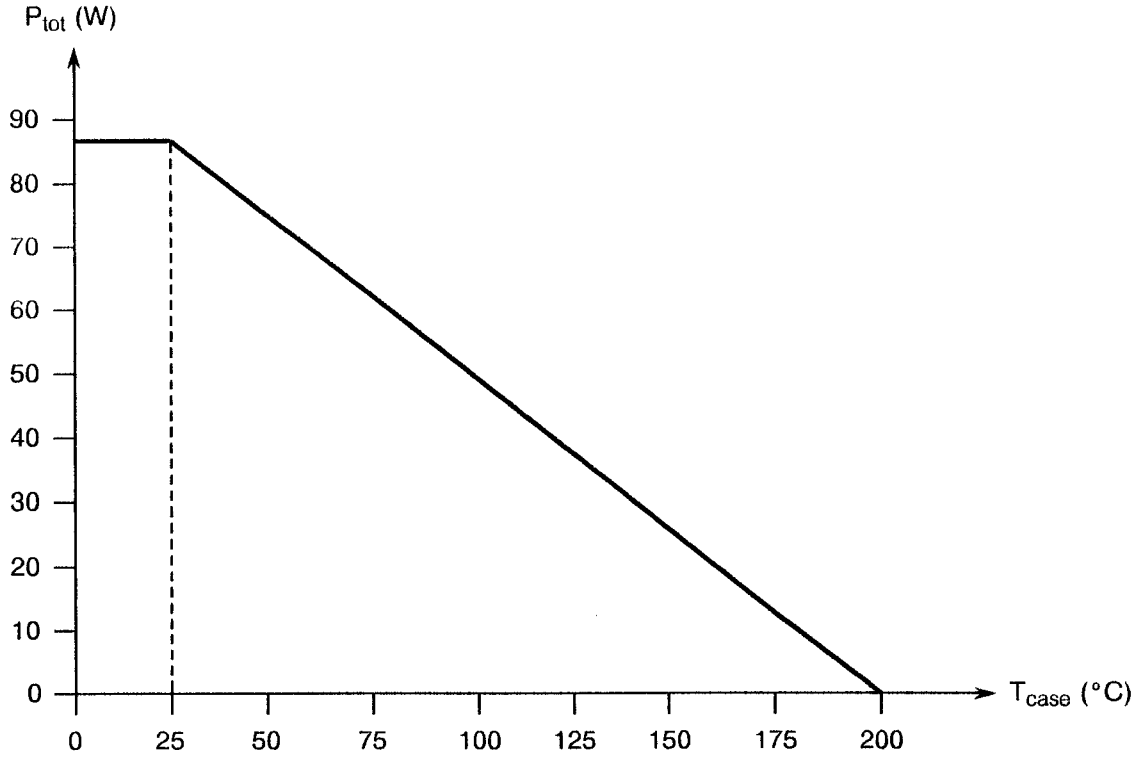
No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Breakdown Voltage	V_{CBO}	120	V	
2	Collector-Emitter Breakdown Voltage	V_{CEO}	80	V	
3	Emitter-Base Breakdown Voltage	V_{EBO}	8.0	V	
4	Collector Current	I_C	10	A	See Figure 1(a)
5	Power Dissipation	P_{tot}	50	W	T_{case} = +100°C
			4.0		T_{amb} = +25°C
6	Operating Temperature Range	T_{op}	−65 to +200	°C	T_{amb}
7	Storage Temperature Range	T_{stg}	−65 to +200	°C	
8	Soldering Temperature	T_{sol}	+300	°C	Time: ≤60s

FIGURE 1(a) - MAXIMUM RATINGS (SAFE OPERATING AREA)



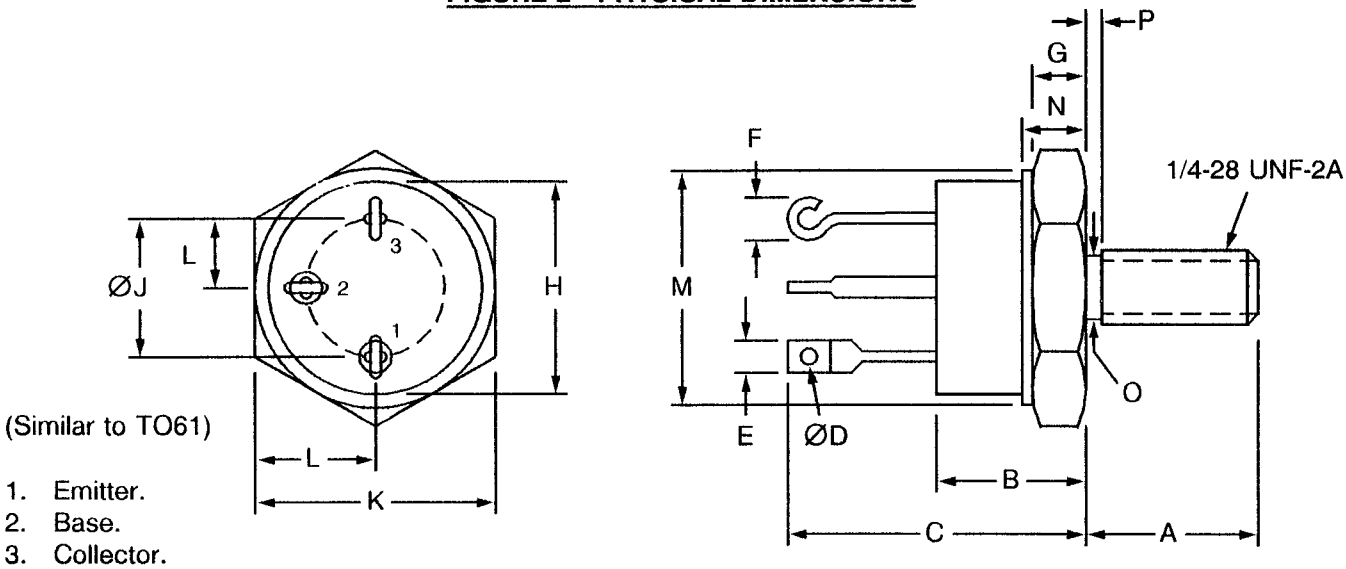
Collector Current versus Collector-Emitter Voltage

FIGURE 1(b) - PARAMETER DERATING INFORMATION



Total Power Dissipation versus Case Temperature

FIGURE 2 - PHYSICAL DIMENSIONS



(Similar to TO61)

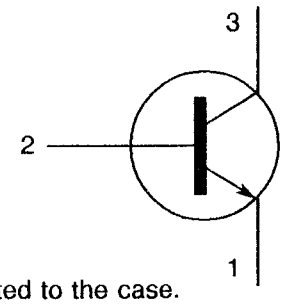
1. Emitter.
2. Base.
3. Collector.

SYMBOL	INCHES		MILLIMETRES	
	MIN.	MAX.	MIN.	MAX.
A	0.422	0.455	10.72	11.56
B	0.325	0.450	8.26	11.69
C	0.640	0.875	16.26	22.23
ØD	0.047	0.072	1.19	1.83
E	0.095	0.115	2.41	2.92
F	-	0.150	-	3.81
G	0.090	0.150	2.29	3.81
ØH	0.570	0.610	14.48	15.49
ØJ	0.340	0.415	8.64	10.54
K	0.667	0.687	16.94	17.45
ØL	0.170	0.213	4.32	5.41
ØM	0.610	0.687	15.49	17.45
N	-	0.270	-	6.86
ØO	0.220	0.249	5.59	6.32
P	-	0.090	-	2.29

NOTES

1. The collector shall be electrically connected to the case.

FIGURE 3 - FUNCTIONAL DIAGRAM



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

NOTES

1. The collector shall be electrically 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)

Add the following test after Para. 9.11 (Dimension Check):-

Safe Operating Area (continuous d.c.) in accordance with Method 3051 of MIL-STD-750. The test conditions shall be as follows:-

T_{case} = +100°C.

Values of V_{CE} and I_C: (a) V_{CE} = 5.0V, I_C = 10A.

(b) V_{CE} = 10V, I_C = 5.0A.

(c) V_{CE} = 80V, I_C = 0.1A.

Operating time: 60 seconds at (a), (b) and (c).

Before and after test, I_{CBO} shall be measured. Any change in I_{CBO} must be within the accuracy of the measuring equipment. Devices with I_{CBO} measurement failing this criterion shall be rejected.

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

(a) The High Temperature Reverse Bias (H.T.R.B.) test is not required.

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 15 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 to JEDEC TO-61 (filled with 85% N - 15% He - 5 PPM H_2O maximum).

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. (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) Lead Identification.

(b) The SCC Component Number.

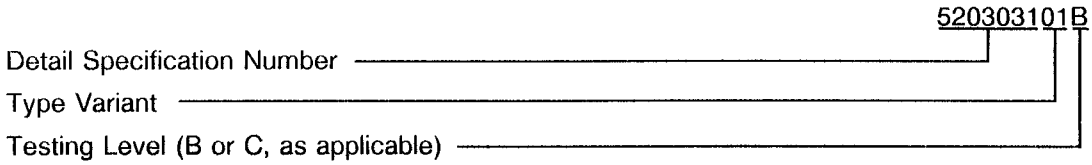
(c) Traceability Information.

4.5.2 Lead Identification

Lead identification shall be as shown in Figure 2.

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 (Figure 4)

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 (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

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-Base Breakdown Voltage	$V_{(BR)CBO}$	3001D	$I_C = 10\mu A$ $I_E = 0V$	120	-	V
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	3011	$I_C = 100mA$ $V_{BE} = 0V$ Note 1	80	-	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026D	$I_E = 10\mu A$ $I_C = 0A$	8.0	-	V
4	Collector-Emitter Cut-off Current	I_{CEX}	3041	$V_{CE} = 60V$ $V_{EB} = 0.5V$	-	1.0	µA
5	Collector-Base Cut-off Current	I_{CBO}	3036	$V_{CB} = 80V$ $I_E = 0A$	-	0.1	µA
6	Emitter-Base Cut-off Current	I_{EBO}	3061D	$V_{EB} = 6.0V$ $I_C = 0A$	-	0.1	µA
7	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$V_{CE} = 5.0V$ $I_C = 1.0A$	50	150	-
		h_{FE2}		$V_{CE} = 5.0V$ $I_C = 5.0A$ Note 1	40	120	
		h_{FE3}		$V_{CE} = 5.0V$ $I_C = 10A$ Note 1	15	-	
8	Collector Saturation Voltage	V_{CESAT1}	3071	$I_C = 5.0A$ $I_B = 0.5A$ Note 1	-	0.5	V
		V_{CESAT2}		$I_C = 10A$ $I_B = 1.0A$ Note 1	-	1.5	
9	Base Saturation Voltage	V_{BESAT}	3066	$I_C = 5.0A$ $I_B = 0.5A$ Note 1	-	1.2	V

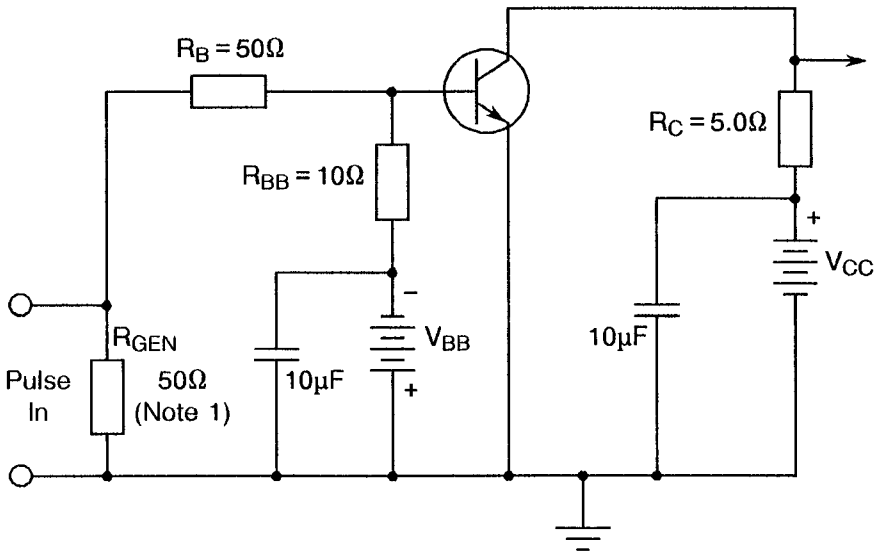
NOTES

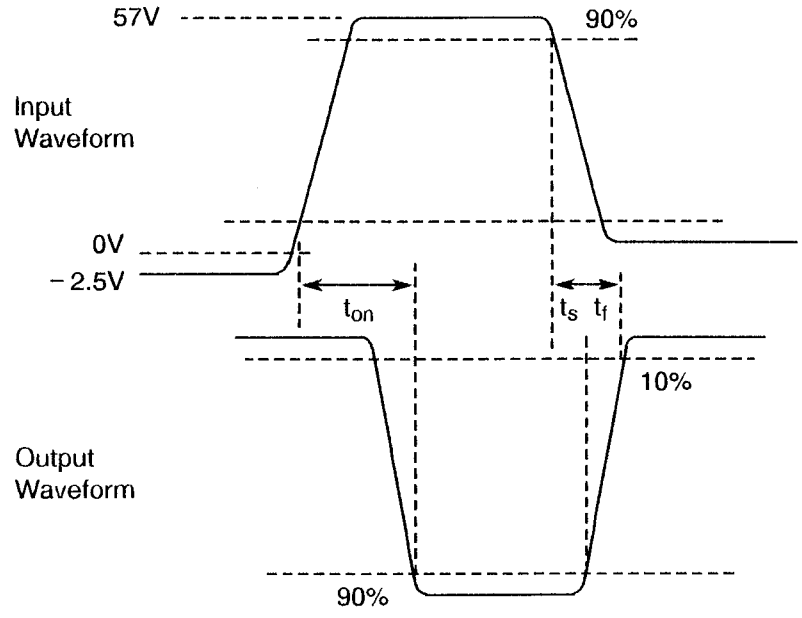
1. Pulse measurement: Pulse Length $\leq 300\mu s$, Duty Cycle $\leq 1.0\%$.

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

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST FIG.	TEST CONDITIONS	LIMITS		UNIT
						MIN	MAX	
1	A.C. Forward Current Transfer Ratio	h_{fe}	3206	-	$V_{CE} = 5.0V$ $I_C = 1.0A$ $f = 10MHz$	1.5	-	-
2	Output Capacitance	C_{ob}	3236	-	$V_{CB} = 10V$ $f = 1.0MHz$	-	350	pF
3	Turn On Time	t_{on}	-	4	$I_C = 5.0A$ $I_{B1} = I_{B2} = 0.5A$ $V_{CC} = 25.5V$ $V_{BB} = 5.0V$	-	0.5	µs
	Storage Time	t_s				-	1.5	
	Fall Time	t_f				-	0.3	

FIGURE 4 - TEST CIRCUIT FOR ELECTRICAL MEASUREMENTS





NOTES

1. The input waveform is supplied by a generator with the following characteristics:- $t_r \leq 15$nsec, $t_f \leq 15$nsec, $Z_{out} = 50\Omega$, $t_p = 20\mu$s, duty cycle $\leq 2.0\%$.
2. Waveforms are monitored on an oscilloscope with the following characteristics:- $t_r \leq 15$nsec, $R_{in} \geq 10M\Omega$, $C_{in} \leq 11.5$pF.
3. Resistors must be non-inductive types.
4. The d.c. power supplies may require additional by-passing in order to minimise ringing.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
1	Collector-Base Cut-off Current	I_{CBO}	3036	T_{amb} = +150°C V_{CB} = 80V I_E = 0V	-	100	µA
2	D.C. Forward Current Transfer Ratio	h_{FE2}	3076	T_{amb} = −55°C I_C = 5.0A V_{CE} = 5.0V Note 1	20	-	-

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
1	Collector-Base Cut-off Current	I_{CBO}	3061D	V_{CBO} = 80V I_C = 0A	10 or (2) +100	nA %
2	D.C. Forward Current Transfer Ratio	h_{FE2}	3076A	V_{CE} = 5.0V I_C = 5.0A Note 1	+20, −10	%
3	Collector Saturation Voltage	V_{CESAT}	3071	I_C = 5.0A I_B = 0.5A Note 1	±50	mV

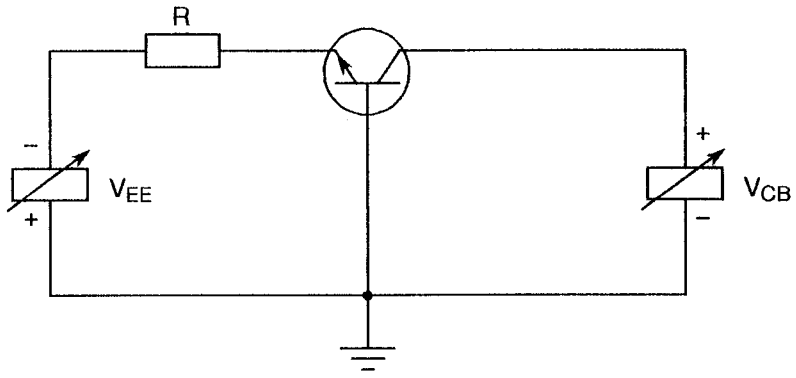
NOTES

1. Pulse measurement: Pulse Length ≤300µs, Duty Cycle ≤2.0%.
2. 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 ± 3	°C
2	Collector-Emitter Voltage	V_{CE}	10	V
3	Power Dissipation	P_{tot}	50	W

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN



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 performing the operating life tests is shown in Figure 5 of this specification.

4.8.5 Conditions for High Temperature Storage Test (Part of Endurance Testing)

Not applicable.

TABLE 6 - ELECTRICAL MEASUREMENTS INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	D.C. Forward Current Transfer Ratio	h_{FE2}	3076	$I_C = 5.0A$ $V_{CE} = 5.0V$ Note 1	40	120	-
2	Collector-Emitter Saturation Voltage	V_{CESAT}	3071	$I_C = 5.0A$ $I_B = 0.5A$ Note 1	-	0.1	µA
3	Collector-Base Cut-off Current	I_{CBO}	3041	$V_{CBO} = 80V$ $I_E = 0A$	-	0.1	µA

NOTES

1. Pulse measurement: Pulse Length $\leq 300\mu s$, Duty Cycle $\leq 2.0\%$.