TRANSISTORS, HIGH POWER, NPN

BASED ON TYPE 2N6032

ESCC Detail Specification No. 5203/021

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space components
coordination group

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		SCCG Chairman	ESA Director General or his Deputy
Issue 3	August 1984	-	-
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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 agreed on the basis of Policy DCR's 21022 and 21025 and the following DCR's:-		
		Table 1(b)	: Note 1 added to P_{tot} and Table reformatted	23172
		Para. 4.4.2	: Lead Material amended	22299
		Table 2	: Reformatted	23172
		Table 2 a.c.	: Reformatted	23172
			: t_{off} changed to t_f	23126
		Figure 4	: t_{on} and t_{off} redefined	23126
		Tables 3 and 4	: Reformatted	23172
		Table 6	: Reformatted	23172
'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
		P9. Para. 2	: "ESA/SCC Basic Spec. No. 23500" added	21025
		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 2 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, NPN, based on Type 2N6032.

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	2N6032	See Para. 4.4.2

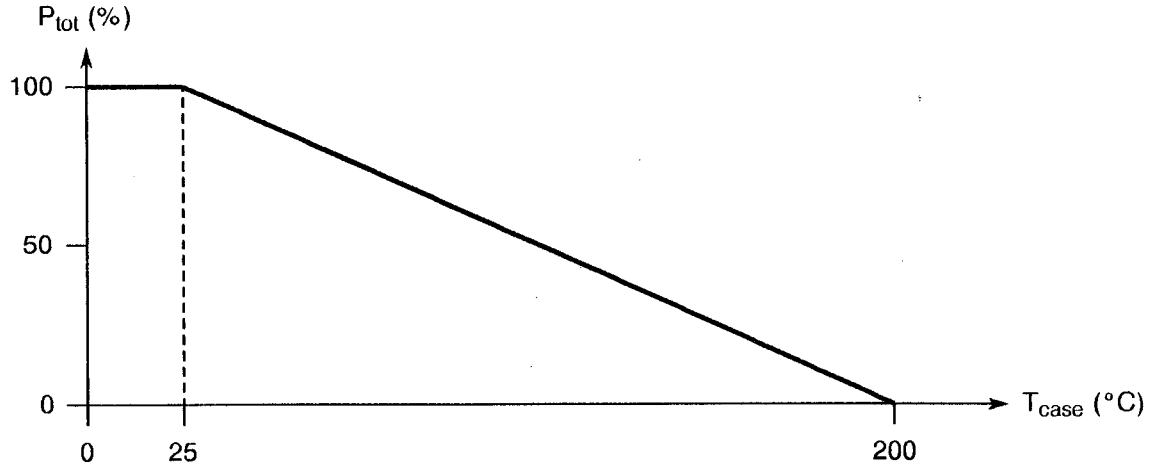
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	120	V	
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	90	V	
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	7.0	V	
4	Collector Current	I_C	50	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}	+260	°C	Time: ≤10s Distance from case ≥1.5mm

NOTES

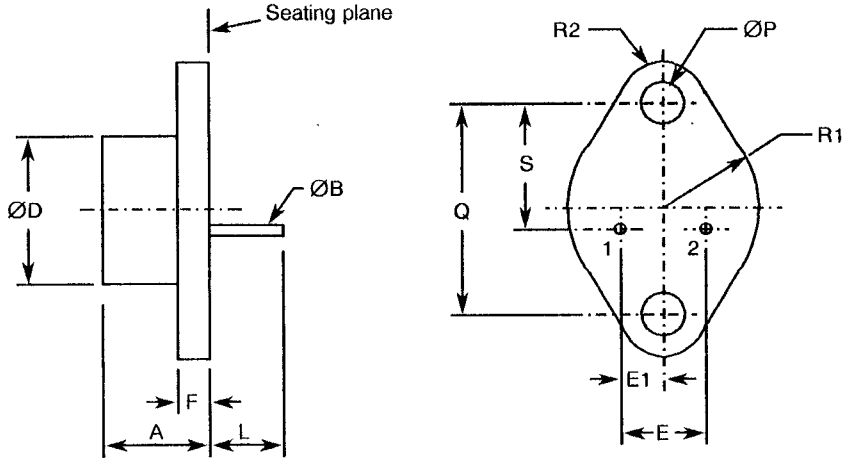
1. At $T_{case} \leq +25°C$. For derating at $T_{case} > +25°C$, see Figure 1.

FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS

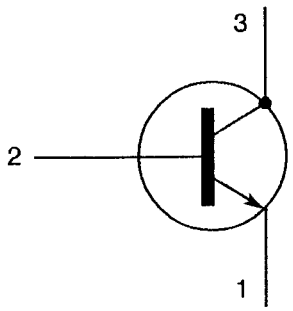


SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.35	11.43	
ØB	0.059	0.061	1.50	1.55	2
ØD	-	0.875	-	22.22	
E	0.420	0.440	10.67	11.18	
E1	0.205	0.225	5.21	5.72	
F	0.050	0.135	1.27	3.43	
L	0.312	-	7.92	-	2
ØP	0.151	0.161	3.84	4.09	
Q	1.177	1.197	29.90	30.40	
R1	0.495	0.525	12.57	13.34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



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

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.

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^2 Elongation Sup. or equal to 25%.

(ii) Resistivity = less than 0.60Ω mm^2/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.

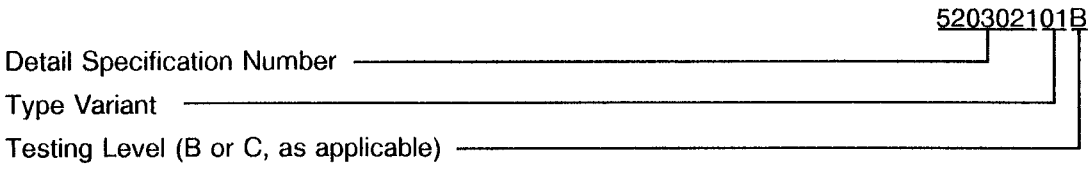
(c) Traceability Information.

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 (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-Emitter Breakdown Voltage	$V_{(BR)CEO}$	-	I_C = 200mA I_B = 0A See Figure 4(b) Note 1	90	-	V
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEX}$	-	I_C = 200mA V_{BE} = − 1.5V See Figure 4(b) Note 1	120		V
3	Collector-Emitter Breakdown Voltage	$V_{(BR)CER}$	-	I_C = 200mA R_{BE} = 50Ω See Figure 4(b) Note 1	110	-	V
4	Collector-Emitter Cut-off Current 1	I_{CEX1}	3041	V_{CE} = 110V V_{BE} = − 1.5V	-	12	mA
5	Collector-Emitter Cut-off Current	I_{CEO}	3041	V_{CE} = 80V I_B = 0A	-	10	mA
6	Emitter-Base Cut-off Current	I_{EBO}	3061	V_{EB} = 7.0V I_C = 0A	-	10	mA
7	D.C. Forward Current Transfer Ratio	h_{FE}	3076	I_C = 50A V_{CE} = 2.6V Note 1	10	50	-
8	Base-Emitter Voltage	V_{BE}	3020	I_C = 50A V_{CE} = 2.0V Note 1	-	2.0	V
9	Collector Saturation Voltage	V_{CEsat}	3071	I_C = 50A I_B = 5.0A Note 1	-	1.3	V
10	Base Saturation Voltage	V_{BEsat}	3066	I_C = 50A I_B = 5.0A Note 1	-	2.0	V

NOTES

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

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

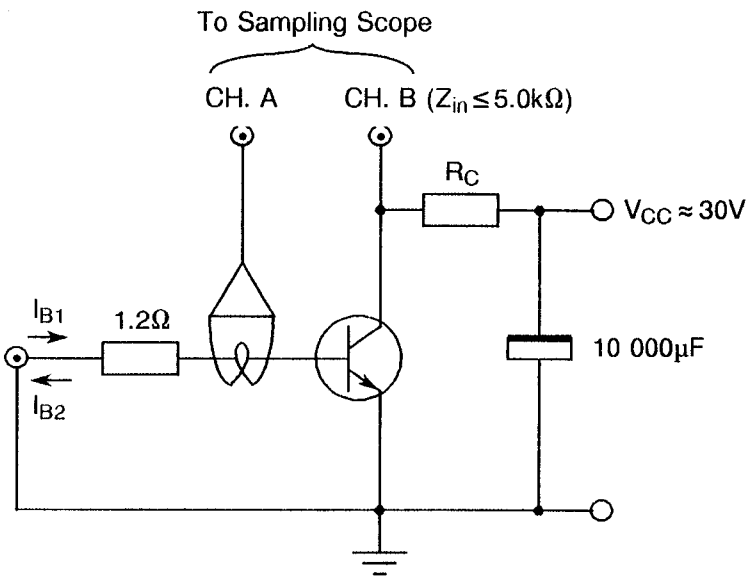
No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST FIG.	TEST CONDITIONS (NOTE 1)	LIMITS		UNIT
						MIN	MAX	
11	AC Forward Current Transfer Ratio	h_{fe}	3206	-	$I_C = 2.0A$ $V_{CE} = 10V$ $f = 5.0MHz$	10	-	-
12	Output Capacitance	C_{obo}	3236	-	$V_{CB} = 10V$ $I_C = 0A$ $f = 1.0MHz$	-	800	pF
13	Switching Times	t_{on}	3251 Cond. A	4(a)	$I_C = 50A$ $I_{B1} = 5.0A$ $I_{B2} = -5.0A$ $V_{CC} = 30V$	-	1.0	µs
14		t_s				-	1.5	
15		t_f				-	0.5	

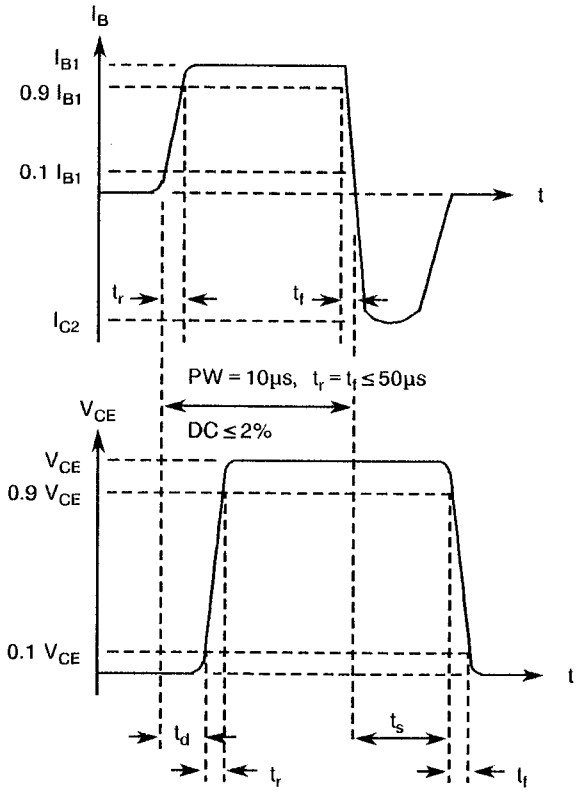
NOTES

1. Test to be performed on a sample basis, LTPD7.

FIGURE 4 - TEST CIRCUITS

FIGURE 4(a) - SWITCHING TIMES



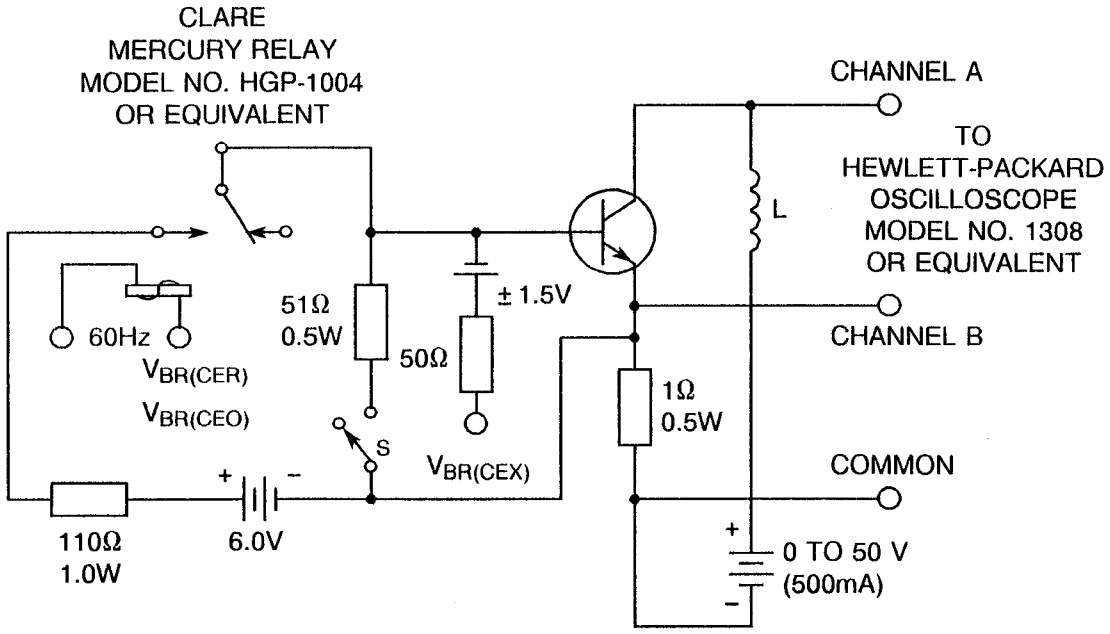


NOTES

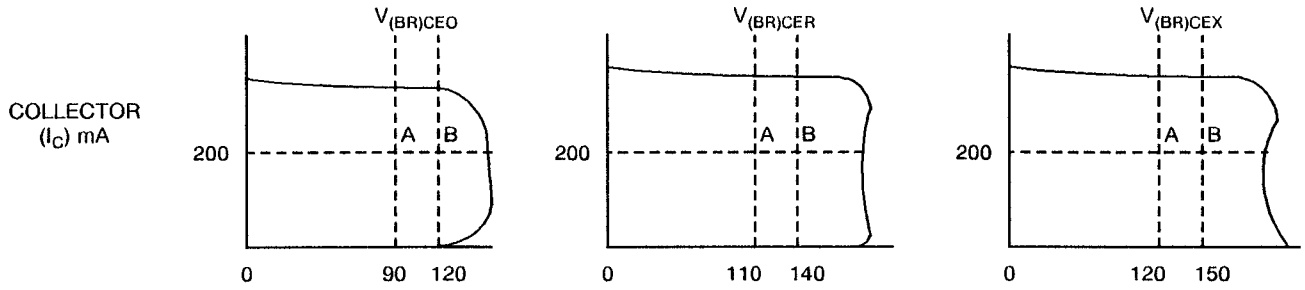
1. $R_C = 0.75\Omega$ at $I_C = 40A$.
   $R_C = 0.60\Omega$ at $I_C = 50A$.
2. I_{B1} and I_{B2} are measured with Tektronix probe P6042.
3. $t_{on} = t_d + t_r$, $t_{off} = t_s + t_f$.

FIGURE 4 - TEST CIRCUITS (CONTINUED)

FIGURE 4(b) - COLLECTOR-EMITTER BREAKDOWN VOLTAGE



L = 15mH for $V_{(BR)CEO}$, $V_{(BR)CER}$ measurements
L = 2.0mH for $V_{(BR)CEX}$ measurements



NOTES

1. $V_{(BR)CEO}$, $V_{(BR)CER}$, $V_{(BR)CEX}$ is acceptable when the trace falls to the right and above point 'A'.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
7	D.C. Forward Current Transfer Ratio	h_{FE}	3076	$T_{amb} = -55°C$ $I_C = 50A$ $V_{CE} = 2.6V$ Note 1	5.0	-	-
16	Collector-Emitter Cut-off Current 2	I_{CEX2}	3041	$T_{case} = +150°C$ $V_{CE} = 100V$ $V_{BE} = -1.5V$	-	15	mA

NOTES

1. 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 (Δ)	UNIT
5	Collector-Emitter Cut-off Current	I_{CEO}	As per Table 2	As per Table 2	500 or (1) 100	µA %
7	D.C. Forward Current Transfer Ratio	h_{FE}	As per Table 2	As per Table 2	±15	%
9	Collector Saturation Voltage	V_{CEsat}	As per Table 2	As per Table 2	±15	%

NOTES

1. 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.	
5	Collector-Emitter Cut-off Current	I_{CEO}	As per Table 2	As per Table 2	-	10	mA
7	D.C. Forward Current Transfer Ratio	h_{FE}	As per Table 2	As per Table 2	10	50	-
9	Collector-Emitter Saturation Voltage	V_{CEsat}	As per Table 2	As per Table 2	-	1.3	V