TRANSISTORS, LOW POWER, PNP,

BASED ON TYPE 2N4033

ESCC Detail Specification No. 5202/008

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space components
coordination group

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Issue 3	October 1999		
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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 defined in Revisions 'A' and 'B' to Issue 2 and the changes agreed in the following DCR's:-		
		Cover page		None
		DCN		None
		Para. 1.2	: Existing text deleted and new text added	221528
		Para. 1.7	: New paragraph added	221528
		Para. 2	: Item (c) deleted.	221528
		Table 1(a)	: Table amended and Variants 02, 03, 04 and 05 added	221528
		Table 1(b)	: Nos. 1 to 3, "(BR)" deleted from Symbol	221528
			: Nos. 5 and 8, Variant references added to Characteristics	221528
			: No. 8, Remarks deleted and Note references added	221528
			: New Notes added	221528
		Figure 1	: X axis amended	221528
		Figure 2	: Existing drawing deleted, new one added and labelled as "Figure 2(a)"	221528
			: New Figure 2(b) added	221528
		Figure 3	: Note 1 amended	221528
		Para. 4.3.2	: Text amended	221528
		Para. 4.3.3	: Second sentence modified	221528
		Para. 4.4.1	: Paragraph modified to include Variants 01 to 03 and Variants 04 to 05	221528
		Para. 4.4.2	: Existing text deleted and new text added	221528
		Para. 4.5.1	: Existing text deleted and new text added	221528
		Para. 4.5.5	: Paragraph deleted in toto	221528
		Para. 4.6.2	: Second sentence deleted	221528
		Para. 4.7.2	: Existing Para. 4.7.2 renumbered to Para. 4.7.3 and amended	221528
			: New Para. 4.7.2 entry added	221528
			: Existing Para. 4.7.3 deleted in toto	221528
		Para. 4.7.4	: New Para. 4.7.4 entry added	221528
		Para. 4.7.5	: New Para. 4.7.5 entry added	221528
		Table 2 d.c.	: Nos. 7 and 8, Characteristics corrected	221528
		Table 2 a.c.	: "(Note 1)" added to Conditions column heading	221528
			: Nos. 1 to 3 renumbered as 9 to 11 respectively	221528
		Table 3	: No. 1, renumbered as "5"	221528
			: No. 2, renumbered as "6" and Symbol to "H_{FE3}"	221528
		Table 4	: 4th column heading and 4th and 5th columns amended	221528
			: No. 1, renumbered as "5"	221528
			: No. 2, renumbered as "6" and Symbol amended to "h_{FE2}"	221528
			: Note 1 deleted and Note 2 renumbered as "1"	221528
		Table 5	: Existing Table 5 renumbered as "5(b)" and Title amended	221528
			: No. 3, Conditions amended	221528
			: New Note 1 added	221528
			: New Table 5(a) added	221528
		Figure 5	: Existing Figure 5 renumbered as "5(b)" and Title amended	221528
			: New Figure 5(a) added	221528

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		Para. 4.8.1	: "Unless otherwise stated .." added to the beginning of the second sentence	221528
		Para. 4.8.2	: "of this specification" added to the end of the first sentence and second sentence added	221528
		Para. 4.8.3	: Second sentence amended to read " ... 5(b) for power burn-in"	221528
		Para. 4.8.4	: Sentence amended to read " ... 5(b) for power burn-in"	221528
		Table 6	: 4^{th} column heading and 4^{th} and 5^{th} columns amended	221528
			: No. 1, renumbered as "6" and Symbol amended to "h_{FE2}"	221528
			: No. 2, renumbered as "7"	221528
			: No. 3, renumbered as "5" and all measurements placed in numerical sequence	221528
			: Note deleted	221528
'A'	Jan. '01	P1. Cover page		None
		P2A. DCN		None
		P8. Figure 2(a)	: Dimensions 'M and 'N' values amended	221594

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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 Transistors, Low Power, PNP, based on Type 2N4033. 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 are 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 PRECAUTION

For tin-lead plated or solder-dipped lead finish, all tests to be performed at a temperature that exceeds +125°C shall carried out in 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 Semiconductors.

(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/OR FINISH
01	2N4033	TO39	2(a)	D2
02	2N4033	TO39	2(a)	D3 or D4
03	2N4033	TO39	2(a)	D7
04	2N4033	CHIP CARRIER	2(b)	2
05	2N4033	CHIP CARRIER	2(b)	4

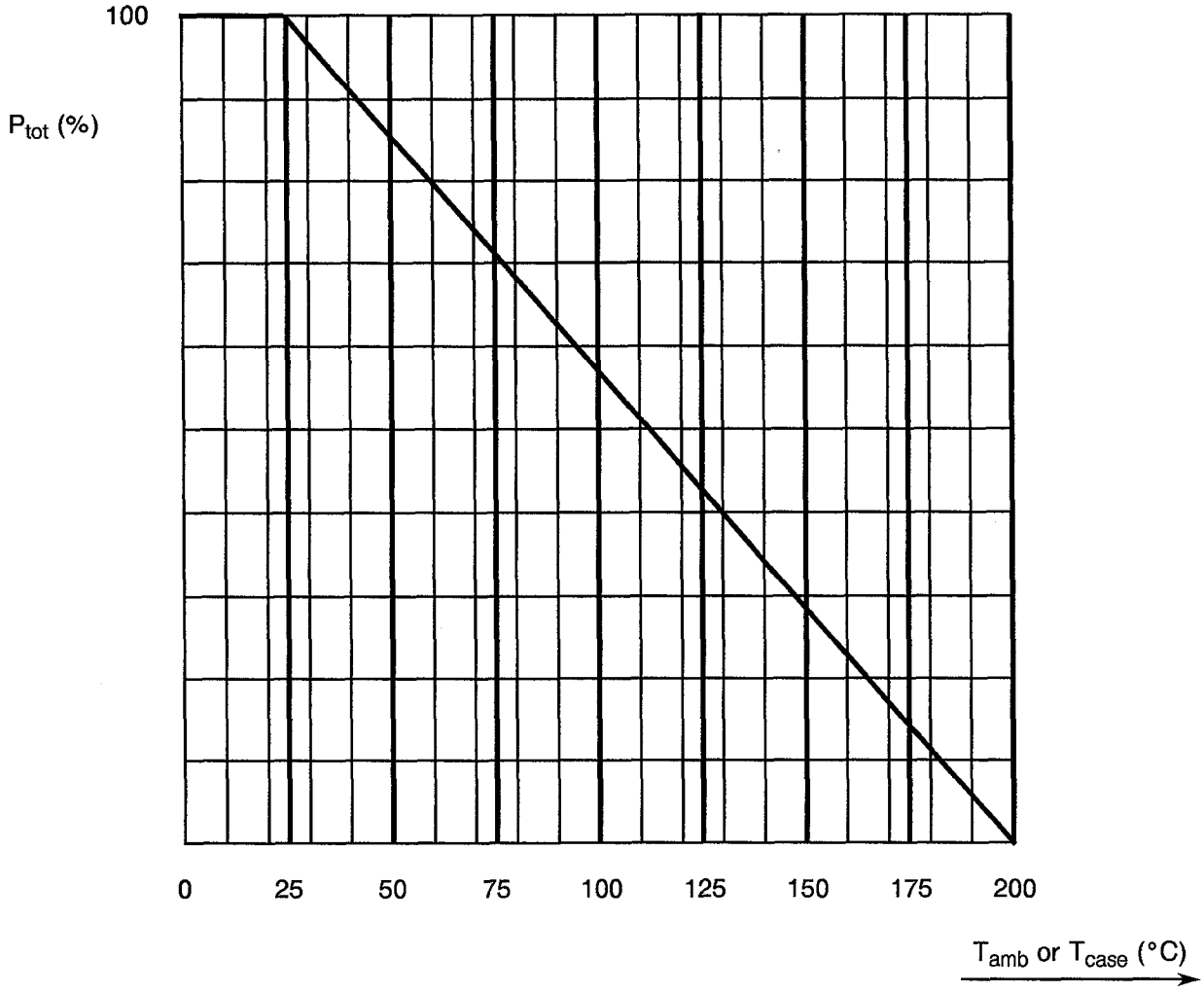
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Collector-Base Voltage	V_{CBO}	−80	V	
2	Collector-Emitter Voltage	V_{CEO}	−80	V	
3	Emitter-Base Voltage	V_{EBO}	−5.0	V	
4	Collector Current	I_C	1.0	A	
5	Power Dissipation Variants 01 to 03 Variants 04 and 05 Variants 04 and 05	P_{tot}	 0.8 0.5 0.76 (1)	W	At $T_{amb} \leq +25°C$ Note 2 Note 2
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 Variants 01 to 03 Variants 04 and 05	T_{sol}	 +260 +245	°C	 Note 3 Note 4

NOTES

1. When mounted on a 15×15×0.6mm ceramic substrate.
2. For derating at T_{amb} or $T_{case} > +25°C$, see Figure 1.
3. 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.
4. Duration 5 seconds maximum and the same terminal shall not be resoldered until 3 minutes have elapsed.

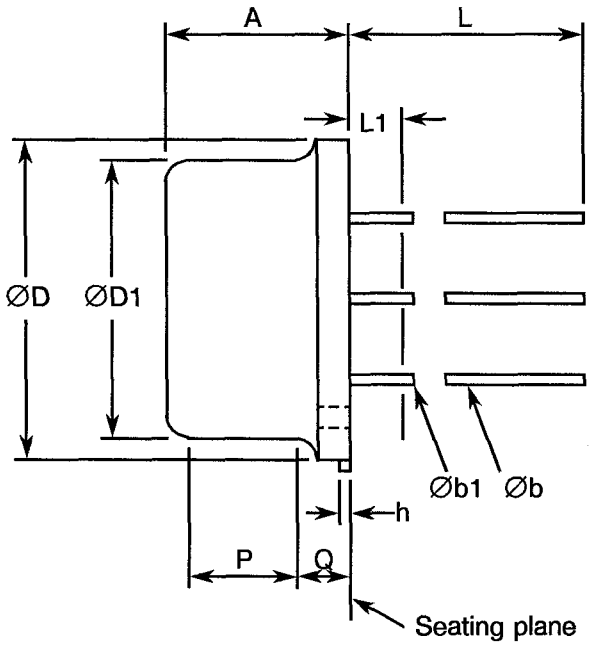
FIGURE 1 - PARAMETER DERATING INFORMATION

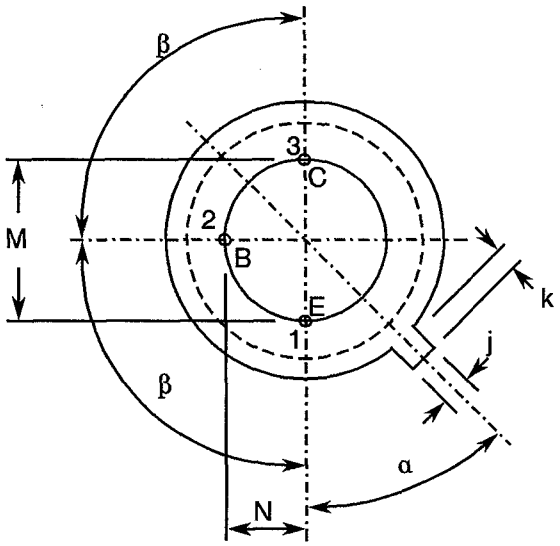


Power Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a) - VARIANTS 01 TO 03





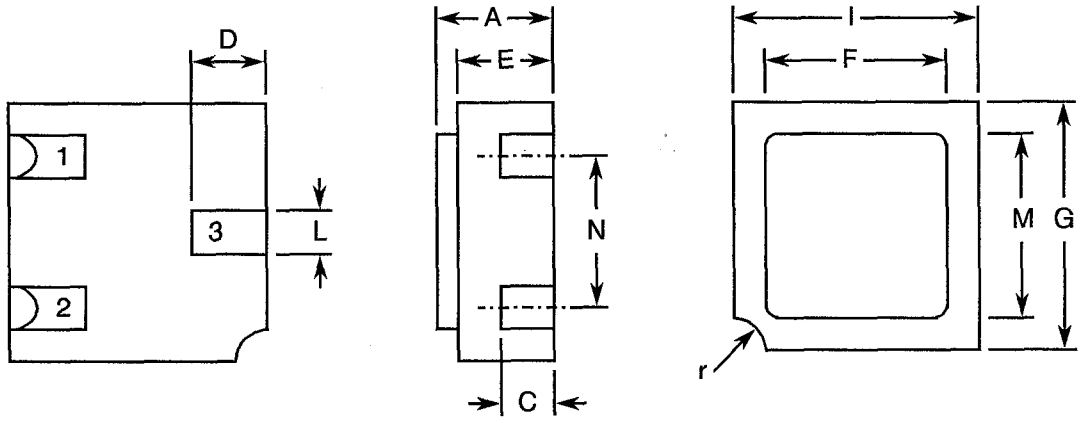
SYMBOL	MILLIMETRES		NOTES
	MIN.	MAX.	
A	6.10	6.60	
Øb	0.41	0.53	1, 7
Øb1	0.41	0.48	2, 7
ØD	8.31	9.40	
ØD1	7.75	8.51	
h	0.23	3.18	
j	0.71	0.86	
k	0.74	1.14	6
L	12.70	19.05	7
L1	-	1.27	8
M	4.83	5.33	5
N	2.41	2.67	5
P	2.54	-	3
Q	-	-	4
α	45°		
β	90°		

NOTES

1. Measured in the zone beyond 6.35mm from the seating plane.
2. Measured in the zone 1.27mm and 6.35mm from the seating plane.
3. Variations on dimension ØD1 in this zone shall not exceed 0.25mm.
4. Outline in this zone is not controlled.
5. When measured in a gauging plane 1.37(+0.03−0)mm below the seating plane of the transistor, maximum diameter leads shall be within 0.18mm of their true location relative to a maximum width tab. Smaller diameter leads shall fall within the outline of the maximum diameter lead tolerance.
6. Measured from the maximum diameter of the actual device.
7. All 3 leads.
8. Diameter of leads in this zone is not controlled.

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

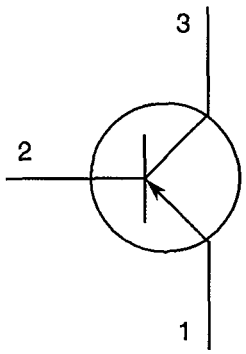
FIGURE 2(b) - VARIANTS 04 AND 05



SYMBOL	MILLIMETRES		NOTES
	MIN.	MAX	
A	1.15	1.50	
C	0.45	0.56	1
D	0.60	0.91	1
E	0.91	1.12	
F	1.90	2.15	
G	2.90	3.25	
I	2.40	2.85	
L	0.40	0.60	1
M	2.40	2.65	
N	1.80	2.00	
r	0.3 TYP.		

NOTES
1. The three pads have the same dimensions.

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.

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 1.2 grammes for variants 01 to 03 and 0.06 grammes for variants 04 and 05.

4.3.3 Terminal Strength

The requirements for terminal strength testing are specified in Section 9 of ESA/SCC Generic Specification No. 5000. For Variants 01 to 03, the test conditions shall be as follows:-

Test Condition: 'E', Lead Fatigue.
Applied Force: 2.5 ± 0.1 Newtons.

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 and 05, the case shall be hermetically sealed and have a ceramic body with a kovar lid.

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 and 05, the terminal finish shall be either Type '2' or Type '4' 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 accommodate 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.

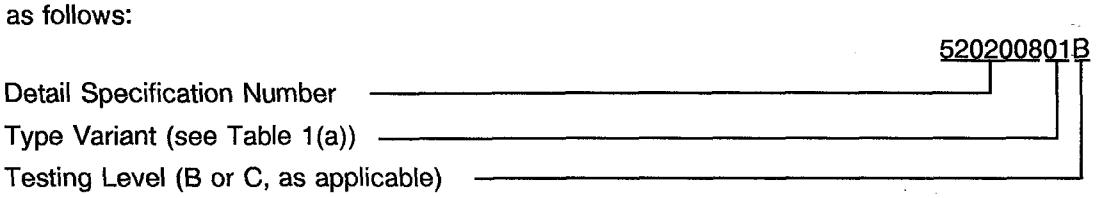
(c) Traceability Information.

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 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

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, the 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 high temperature reverse bias burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 5000. The conditions for high temperature reverse bias burn-in shall be as specified in Table 5(a) 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(b) of this specification.

4.7.4 Electrical Circuits for High Temperature Reverse Bias Burn-in Burn-in

Circuits for use in performing the high temperature reverse bias burn-in are shown in Figure 5(a) of this specification.

4.7.5 Electrical Circuits for Power Burn-in

Circuits for use in performing the power burn-in tests are shown in Figure 5(b) 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	$I_C = -10mA$ $I_B = 0mA$ Note 1	-80	-	V
2	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	$I_C = -10\mu A$ $I_E = 0mA$	-80	-	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	$I_E = -10\mu A$ $I_C = 0mA$	-5.0	-	V
4	Collector-Emitter Cut-off Current	I_{CEX}	3041	$V_{CE} = -60V$ $V_{BE} = 2.0V$	-	-25	nA
5	Collector-Base Cut-off Current	I_{CBO}	3036	$V_{CB} = -60V$ $I_E = 0mA$	-	-50	nA
6	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$I_C = -100\mu A$ $V_{CE} = -5.0V$	50	-	-
		h_{FE2}	3076	$I_C = -100mA$ $V_{CE} = -5.0V$ Note 1	100	300	-
		h_{FE3}	3076	$I_C = -500mA$ $V_{CE} = -5.0V$ Note 1	70	-	-
		h_{FE4}	3076	$I_C = -1.0A$ $V_{CE} = -5.0V$ Note 1	25	-	-
7	Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	3071	$I_C = -150mA$ $I_B = -15mA$ Note 1	-	-0.15	V
8	Base-Emitter Saturation Voltage	$V_{BE(SAT)}$	3066	$I_C = -150mA$ $I_B = -15mA$ Note 1	-	-0.9	V

NOTES

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

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

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS (NOTE 1)	LIMITS		UNIT
					MIN.	MAX.	
9	A.C. Forward Current Transfer Ratio	h_{fe}	3306	$I_C = -50mA$ $V_{CE} = -10V$ $f = 100MHz$	1.5	5.0	-
10	Output Capacitance	C_{obo}	3236	$V_{CB} = -10V$ $I_E = 0mA$ $100kHz \leq f \leq 1.0MHz$	-	20	pF
11	Switching Times	t_{on}	Figure 4	$I_C = -500mA$ $I_{B1} = -50mA$	-	100	ns
		t_s		$I_C = -500mA$ $I_{B1} = I_{B2} = -50mA$	-	350	
		t_f		$I_C = -500mA$ $I_{B1} = I_{B2} = -50mA$	-	50	

NOTES

1. Performed on a sample basis, LTPD = 7, or less.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
5	Collector-Base Cut-off Current	I_{CBO}	3076	$T_{amb} = +150°C$ $V_{CB} = -60V$ $I_E = 0mA$	-	-50	µA
6	Forward Current Transfer Ratio 3	h_{FE3}	3076	$T_{amb} = -55°C$ $I_C = -500mA$ $V_{CE} = -5.0V$ Note 1	30	-	-

NOTES

1. Pulsed measurement: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

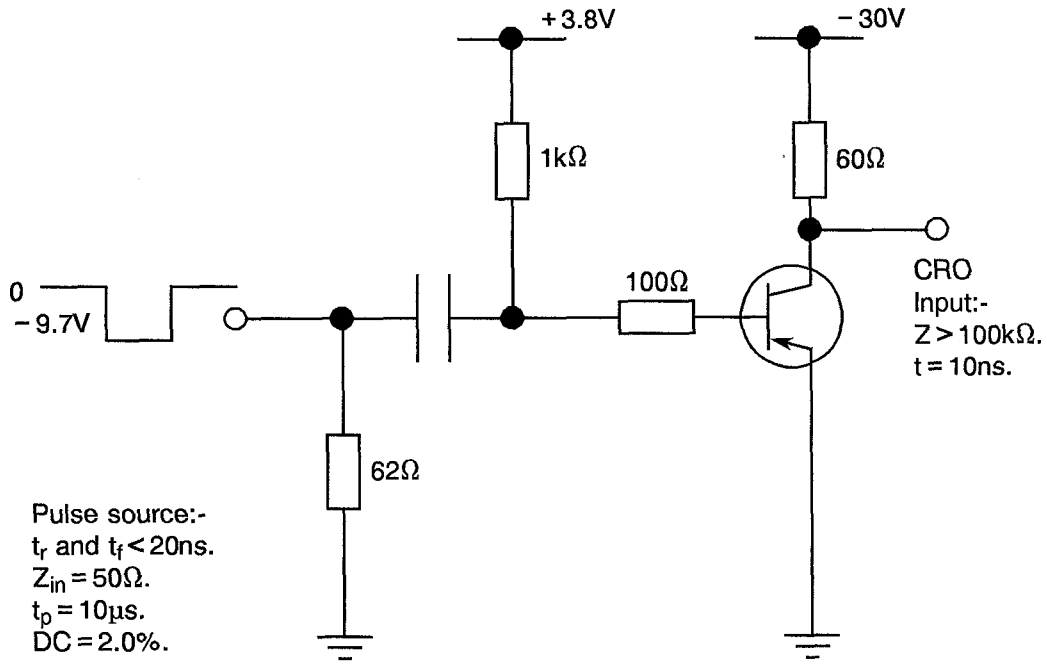


TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMIT (Δ)	UNIT
5	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	±10 or (1) ±100	nA %
6	D.C. Forward Current Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	±25	%

NOTES

1. Whichever is the greater, referred to the initial value.

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

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+150	°C
2	Emitter-Base Voltage	V_{EB}	4.0	V
3	Collector-Base Voltage	V_{CB}	40	V
4	Duration	t	48	hrs

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

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+25	°C
2	Collector-Base Voltage	V_{CB}	−40	V
3	Power Dissipation	P_{tot}	Max. rating at T_{amb} according to derating curve (Note 1)	W

NOTES 1. See Item 5 of Table 1(b) and Figure 1.

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

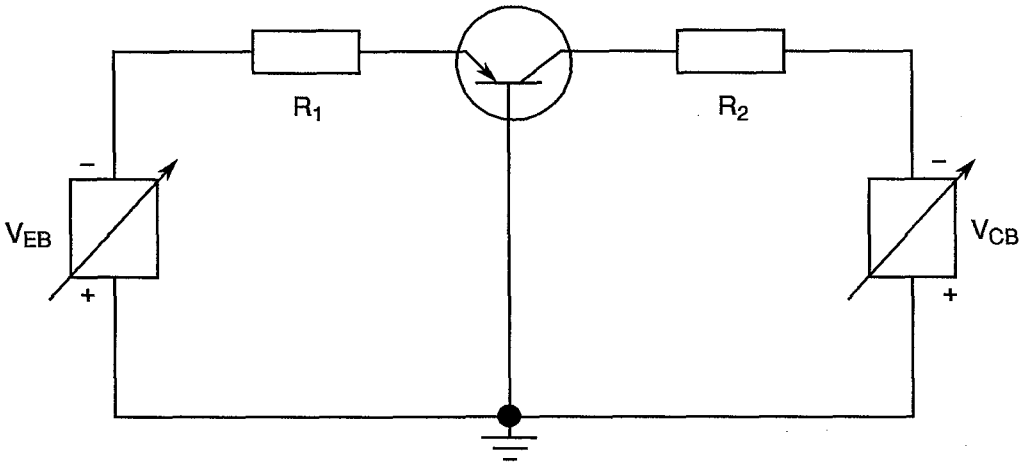
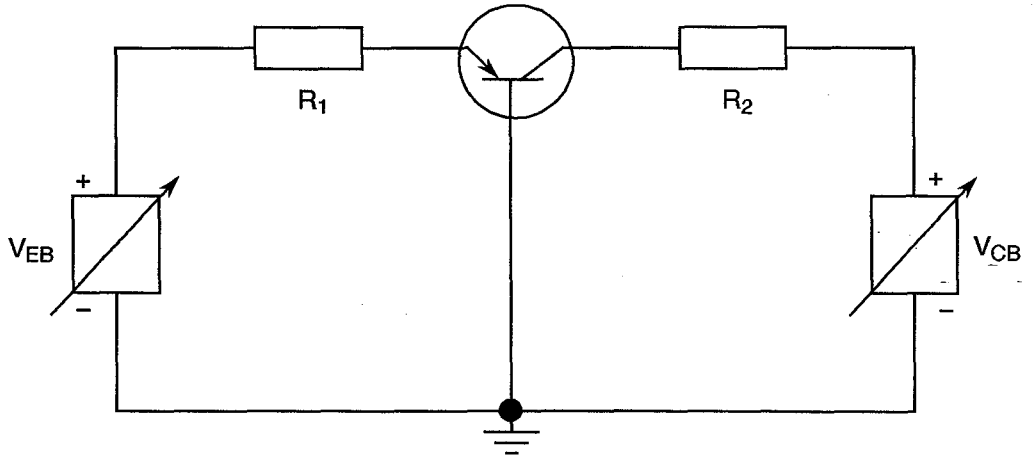


FIGURE 5(b) - ELECTRICAL CIRCUIT FOR POWER BURN-IN AND OPERATING LIFE TESTS



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 $T_{amb} = +22 \pm 3$ °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 the same as specified in Table 5(b) for power burn-in.

4.8.4 Electrical Circuits for Operating Life Tests

The circuit to be used for performance of the operating life test shall be the same as 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.	
5	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	-	50	nA
6	D.C. Forward Current Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	100	300	-
7	Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	As per Table 2	As per Table 2	-	−0.15	V