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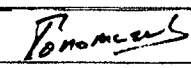

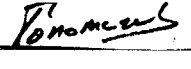
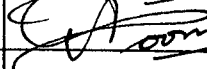
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**TRANSISTORS, LOW POWER, NPN,  
BASED ON TYPES 2N3498, 2N3499,  
2N3500 AND 2N3501**

**ESA/SCC Detail Specification No. 5201/013**



**space components  
coordination group**

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 4	March 1995		
Revision 'A'	November 1995		

**DOCUMENTATION CHANGE NOTICE**

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 3 and incorporates all modifications defined in Revisions 'A', 'B' and 'C' to Issue 3 and the following DCR's:-		
		Cover page		None
		DCN		None
		Para. 1.2	: Text inserted	23721
		Table 1(a)	: Variants 11 and 12 added	221156
		Table 1(b)	: Nos. 1, 2, 4, in Characteristics, "11, 12" added to 05, 06, 07, 08	221156
			: No. 5, in Remarks, "T <sub>amb</sub> " added	221156
			: No. 6, in Remarks, "T <sub>case</sub> " added	221156
			: No. 7, Symbol amended and "T <sub>amb</sub> " added to Remarks	23721
		Figures 2(a), (b)	: Imperial Dimensions deleted from Table and Notes	23721
		Para. 2	: Item (c) deleted	23721
		Para. 4.2.3	: "Para. 7.1.1" added to text	23721
		Para. 4.5.1	: Text deleted and new text added	23721
		Para. 4.5.3	: "(see Table 1(a))" added to Type Variant	23721
		Para. 4.5.5	: Deleted in toto	23721
		Para. 4.6.1	: "Unless otherwise specified" added to second sentence	23721
		Para. 4.7.2	: New Title and reference added	23721
			: Original paragraph renumbered and Title and text amended	23721
		Para. 4.7.3	: Renumbered as "4.7.5" and Title and text amended	23721
		Para. 4.7.4	: New Title and reference added	23721
		Table 2 d.c.	: Nos. 1, 2, 4, 9, 11, in Conditions, "11, 12" added to 05, 06, 07, 08	221156
			: Nos. 6, 7, in Conditions, Variants amended	221156
			: No. 8, in Conditions, Variants amended and "11, 12" added	221156
			: Nos. 10, 12, in Conditions, Variants deleted	221156
			: Nos. 11, 12, Characteristics corrected	23721
		Table 2 a.c.	: Nos. 14, 18, 20, in Conditions, "11, 12" added to 05, 06, 07, 08	221156
			: No. 15, in Conditions, Variants amended	221156
		Table 3	: No. 4, in Conditions, "11, 12" added to 05, 06, 07, 08	221156
			: No. 7, in Conditions, Variants amended	221156
		Table 5(a)	: Title and reference added	23721
		Table 5	: Title amended	23721
			: No. 3, in Characteristics, "11, 12" added to 05, 06, 07, 08 and Variants moved to Conditions column	221156
		Figure 5(a)	: Title and reference added	23721
		Figure 5	: Title amended	23721
		Para. 4.8.1	: Second sentence completed	23721
		Para. 4.8.2	: Second sentence added	23721
		Table 6	: Nos. 4, 9, in Characteristics, "11, 12" added to 05, 06, 07, 08 and Variants moved to Test Conditions column	221156
			: No. 7, in Characteristics, Variants amended and moved to Test Conditions column	221156

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No. 5201/013

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**DOCUMENTATION CHANGE NOTICE**

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
'A'	Nov. '95	P1. Cover page P2A. DCN P3. T of C P5. Para. 1.7	: Page added : New Para. 1.7 entry added : New Para. 1.7 entry added	None None 21083 21083

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**APPENDICES (Applicable to specific Manufacturers only)**  
None.

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**1. GENERAL****1.1 SCOPE**

This specification details the ratings, physical and electrical characteristics, test and inspection data for Transistors, Low Power, NPN, based on Types 2N3498, 2N3499, 2N3500 and 2N3501. 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 type transistor 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 as scheduled in Table 1(b).

**1.4 PARAMETER DERATING INFORMATION**

The parameter 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-lead plated or solder-dipped lead finish, all tests to be performed at a temperature that exceeds +125°C shall be carried out in 100% inert atmosphere.

**2. APPLICABLE DOCUMENTS**

The following documents for 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	2N3501	TO5	2(a)	D2 (1)
02	2N3501	TO39	2(b)	D2 (1)
03	2N3500	TO5	2(a)	D2 (1)
04	2N3500	TO39	2(b)	D2 (1)
05	2N3499	TO5	2(a)	D2 (1)
06	2N3499	TO39	2(b)	D2 (1)
07	2N3498	TO5	2(a)	D2 (1)
08	2N3498	TO39	2(b)	D2 (1)
09	2N3501	TO39	2(b)	E/B = D2, C = F2 (2)
10	2N3501	TO39	2(b)	E/B = D4, C = F4 (2)
11	2N3499	TO39	2(b)	E/B = D2, C = F2 (2)
12	2N3499	TO39	2(b)	E/B = D4, C = F4 (2)

**NOTES**

- All leads.
- E = Emitter, B = Base, C = Collector.

**TABLE 1(b) - MAXIMUM RATINGS**

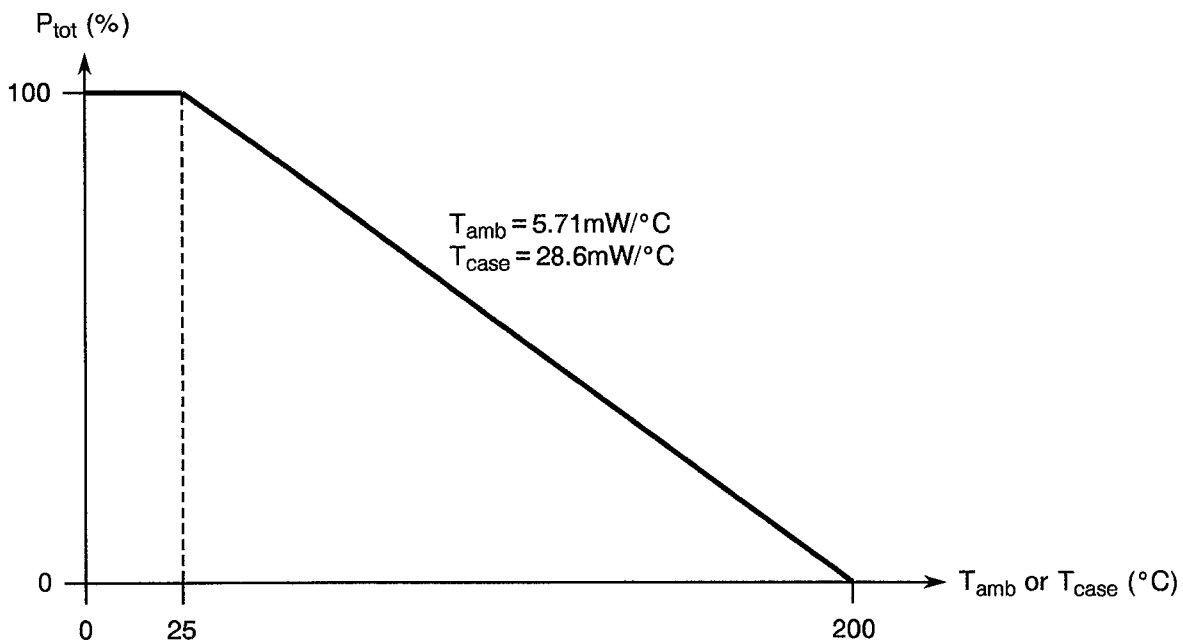
No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Voltage Variants 01-02-03-04-09-10 Variants 05-06-07-08-11-12	$V_{CBO}$	150 100	V	
2	Collector-Emitter Voltage Variants 01-02-03-04-09-10 Variants 05-06-07-08-11-12	$V_{CEO}$	150 100	V	
3	Emitter-Base Voltage	$V_{EBO}$	6.0	V	
4	Collector Current Variants 01-02-03-04-09-10 Variants 05-06-07-08-11-12	$I_C$	300 500	mA	
5	Power Dissipation 1	$P_{tot1}$	1.0	W	Note 1 $T_{amb}$
6	Power Dissipation 2	$P_{tot2}$	5.0	W	Note 1 $T_{case}$
7	Operating Temperature Range	$T_{op}$	- 55 to + 200	°C	$T_{amb}$
8	Storage Temperature Range	$T_{stg}$	- 65 to + 200	°C	
9	Soldering Temperature	$T_{sol}$	+ 260	°C	Note 2

**NOTES**

- At  $T_{amb}/T_{case} = +25^{\circ}\text{C}$ . For derating at  $T_{amb}/T_{case} > +25^{\circ}\text{C}$ , see Figure 1.
- Duration 10 seconds maximum at a distance of not less than 1.5mm from the case and the same lead shall not be resoldered until 3 minutes have elapsed.



**FIGURE 1 - PARAMETER DERATING INFORMATION**



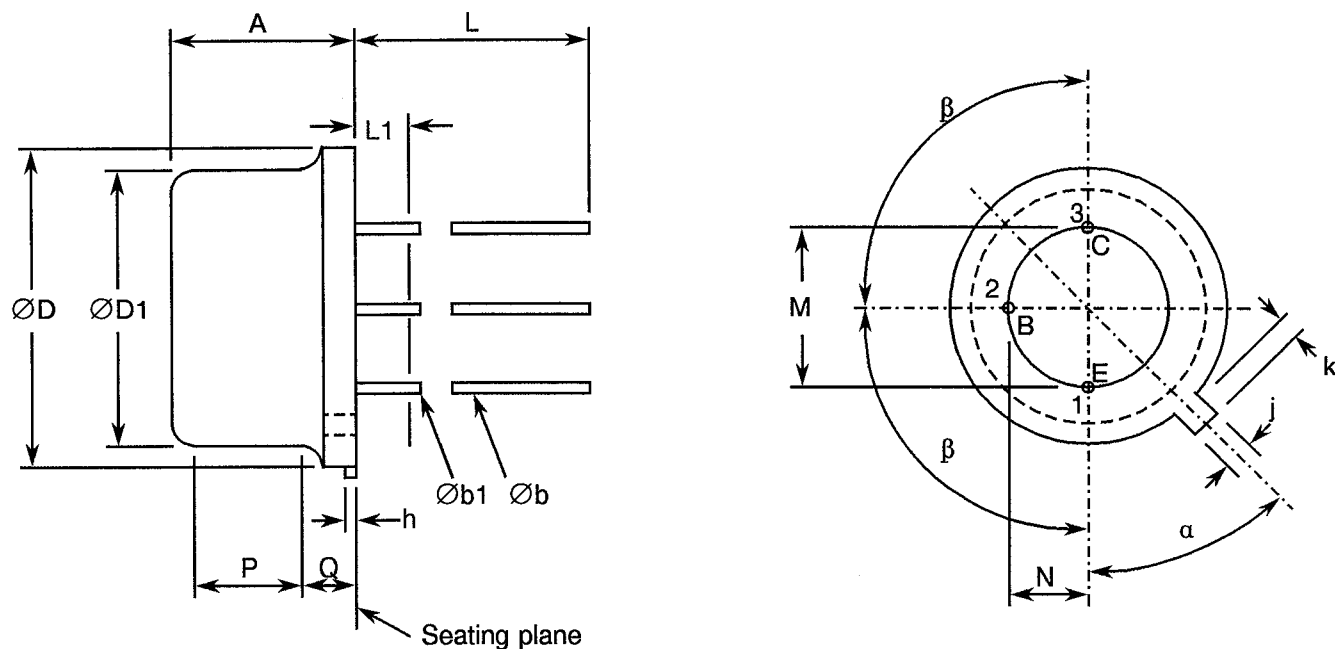
Power Dissipation versus Temperature





**FIGURE 2 - PHYSICAL DIMENSIONS**

**FIGURE 2(a) - TO5 CASE**



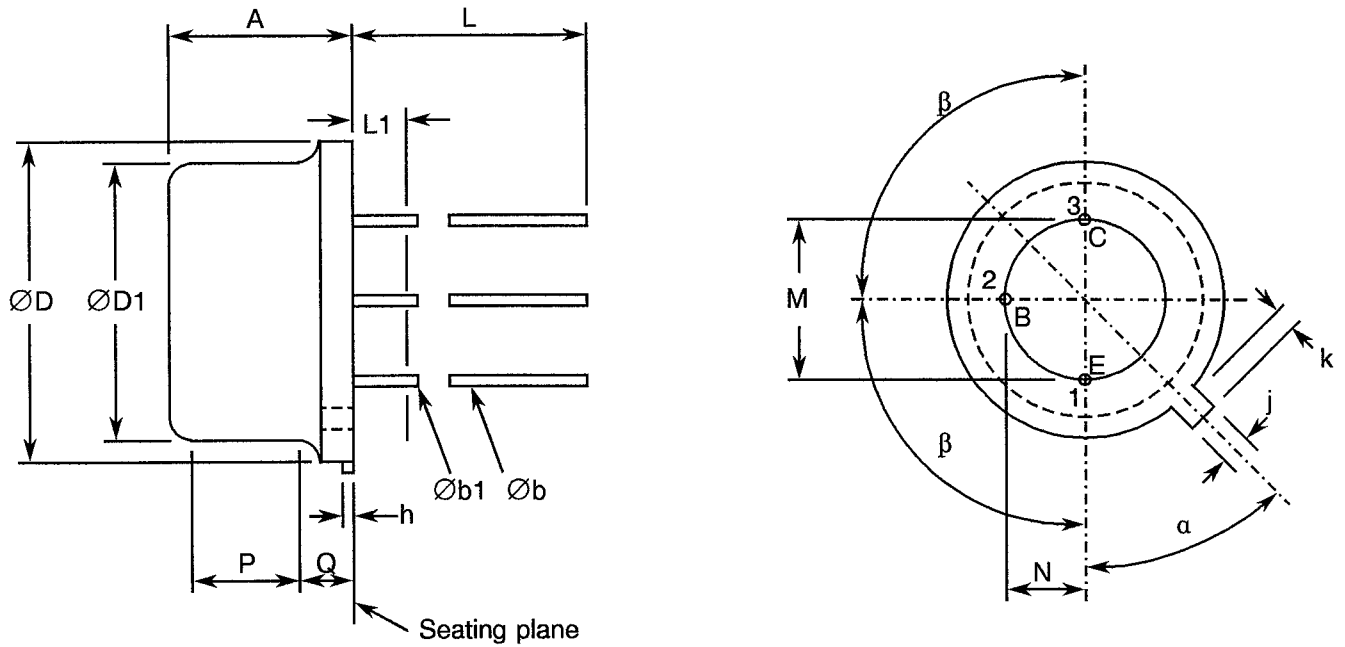
SYMBOL	MILLIMETRES		NOTES
	MIN.	MAX.	
A	6.10	6.60	
Øb	0.41	0.53	1, 7
Øb1	0.41	0.48	2, 7
ØD	8.51	9.40	
ØD1	7.75	8.51	
h	0.23	3.18	
j	0.71	0.86	
k	0.74	1.14	6
L	38.10	44.45	7
L1	-	1.27	8
M	3.591 NOM.		5
N	1.796 NOM.		5
P	2.54	-	3
Q	-	-	4
α	45°		
β	90°		

**NOTES:** See Page 10.



**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)**

**FIGURE 2(b) - TO39 CASE**

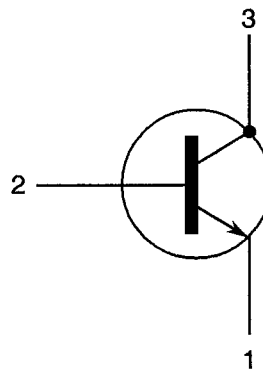


SYMBOL	MILLIMETRES		NOTES
	MIN.	MAX.	
A	6.10	6.60	
Øb	0.41	0.53	1, 7
Øb1	0.41	0.48	2, 7
ØD	8.51	9.40	
ØD1	7.75	8.51	
h	0.23	3.18	
j	0.71	0.86	
k	0.74	1.14	6
L	12.70	19.05	7
L1	-	1.27	8
M	3.591 NOM.		5
N	1.796 NOM.		5
P	2.54	-	3
Q	-	-	4
a	45°		
β	90°		

**NOTES:** See Page 10.

**FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)****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  $\varnothing D1$  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 3 - FUNCTIONAL DIAGRAM**

1. Emitter
2. Base
3. Collector

**NOTES**

1. The collector is electrically connected to 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 are 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 Tests (Chart III)

(a) Para. 7.1.1(a), "High Temperature Reverse Bias (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 1.2 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: 'E' (Lead Fatigue).

Applied Force:  $2.5 \pm 0.1$  Newtons, 3 bends at 45°.

##### 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 TO5 and TO39.

4.4.2 Lead Material and Finish

The lead material shall be either Type 'D' or Type 'F' 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 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:-

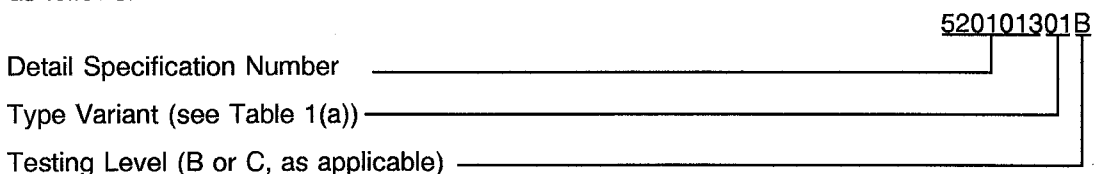
- (a) Lead Identification.
- (b) The SCC Component Number.
- (c) Traceability Information.

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, measurements shall be performed at  $T_{amb} = +22 \pm 3 \text{ }^\circ\text{C}$ .

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 for a given parameter, the appropriate limit value specified 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 Circuits for High Temperature Reverse Bias Burn-in (Figure 5(a))

Not applicable.

##### 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	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
1	Collector-Emitter Sustaining Voltage	$V_{CEO(Sust)}$	3011	$I_C = 10mA$ $I_B = 0$ Variants 01-02-03-04-09-10 Variants 05-06-07-08-11-12 Note 1	150 100	- -	V
2	Collector-Base Breakdown Voltage	$V_{(BR)CEO}$	3001	$I_C = 10\mu A$ $I_E = 0$ Variants 01-02-03-04-09-10 Variants 05-06-07-08-11-12	150 100	- -	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	$I_E = 10\mu A$ $I_C = 0$	6.0	-	V
4	Collector-Base Cut-off Current	$I_{CBO}$	3036	Variants 01-02-03-04-09-10 $V_{CB} = 75V$ $I_E = 0$ Variants 05-06-07-08-11-12 $V_{CB} = 50V$ $I_E = 0$	- -	50 50	nA
5	Emitter-Base Cut-off Current	$I_{EBO}$	3061	$V_{CB} = 4.0V$ $I_C = 0$	-	25	nA
6	d.c. Forward Current Transfer Ratio 1	$h_{FE1}$	3076	$V_{CE} = 10V$ $I_C = 0.1mA$ Variants 01-02-05-06-09-10-11-12 Variants 03-04-07-08 Note 1	35 20	- -	-
7	d.c. Forward Current Transfer Ratio 2	$h_{FE2}$	3076	$V_{CE} = 10V$ $I_C = 150mA$ Variants 01-02-05-06-09-10-11-12 Variants 03-04-07-08 Note 1	100 40	300 120	-
8	d.c. Forward Current Transfer Ratio 3	$h_{FE3}$	3076	Variants 01-02-09-10 Variants 03-04 $V_{CE} = 10V$ $I_C = 300mA$ Variants 05-06-11-12 Variants 07-08 $V_{CE} = 10V$ $I_C = 500mA$ Note 1	20 15 20 15	- - - -	-

**NOTES:** See Page 16.



**TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - d.c. PARAMETERS (CONT'D)**

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
9	Collector-Emitter Saturation Voltage 1	$V_{CE(SAT)1}$	3071	Variants 01-02-03-04-09-10 $I_C = 150mA$ $I_B = 15mA$ Variants 05-06-07-08-11-12 $I_C = 300mA$ $I_B = 30mA$ Note 1	-	0.4	V
10	Collector-Emitter Saturation Voltage 2	$V_{CE(SAT)2}$	3071	$I_C = 10mA$ $I_B = 1.0mA$ Note 1	-	0.2	V
11	Base-Emitter Saturation Voltage 1	$V_{BE(SAT)1}$	3066	Variants 01-02-03-04-09-10 $I_C = 150mA$ $I_B = 15mA$ Variants 05-06-07-08-11-12 $I_C = 300mA$ $I_B = 30mA$ Note 1	-	1.2	V
12	Base-Emitter Saturation Voltage 2	$V_{BE(SAT)2}$	3066	$I_C = 10mA$ $I_B = 1.0mA$ Note 1	-	0.8	V

**NOTES:** See Page 16.





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

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST FIG.	TEST CONDITIONS	LIMITS		UNIT
						MIN	MAX	
13	Input Capacitance	$C_{iBO}$	3240	-	$V_{EB} = 0.5V$ $I_C = 0$ $f = 100kHz$	-	80	pF
14	Output Capacitance	$C_{oBO}$	3236	-	$V_{CB} = 10V$ $I_E = 0$ $f = 100kHz$ Variants 01-02-03-04-09-10 Variants 05-06-07-08-11-12	- -	8.0 10	pF
15	a.c. Forward Current Transfer Ratio	$h_{fe}$	3306	-	$V_{CE} = 10V$ $I_C = 10mA$ $f = 1.0kHz$ Variants 01-02-05-06-09-10 Variants 03-04-07-08-11-12	75 50	375 300	-
16	Common-Emitter a.c. Forward Current Transfer Ratio	$ h_{fe} $	3306	-	$V_{CE} = 20V$ $I_C = 20mA$ $f = 100MHz$	1.5	8.0	-
17	Gain-Bandwidth Product	$f_T$	3621	-	$V_{CE} = 20V$ $I_C = 20mA$ $f = 100MHz$	150	-	MHz
18	Delay Time	$t_d$	-	4	Variants 01-02-03-04-09-10 $V_{CC} = 100V$ $V_{BE(OFF)} = -2.0V$ Variants 05-06-07-08-11-12 $V_{CC} = 66V$ $V_{BE(OFF)} = -2.0V$ Note 2	- -	40 40	ns
19	Rise Time	$t_r$	-	4	$I_C = 150mA$ $I_{B1} = 15mA$ Note 2	-	70	ns
20	Storage Time	$t_s$	-	4	Variants 01-02-03-04-09-10 $V_{CC} = 100V$ $I_C = 150mA$ Variants 05-06-07-08-11-12 $V_{CC} = 66V$ $V_{BE(OFF)} = -3.8V$ $I_C = 150mA$ Note 2	- -	900 900	ns
21	Rise Time	$t_f$	-	4	$I_{B1} = I_{B2} = 15mA$ Note 2	-	240	ns

**NOTES**

1. Pulse measurement, pulse length  $\leq 300\mu s$ , Duty Cycle  $\leq 2.0\%$ .
2. Measurements shall be performed on a sample basis, LTPD7 or less.



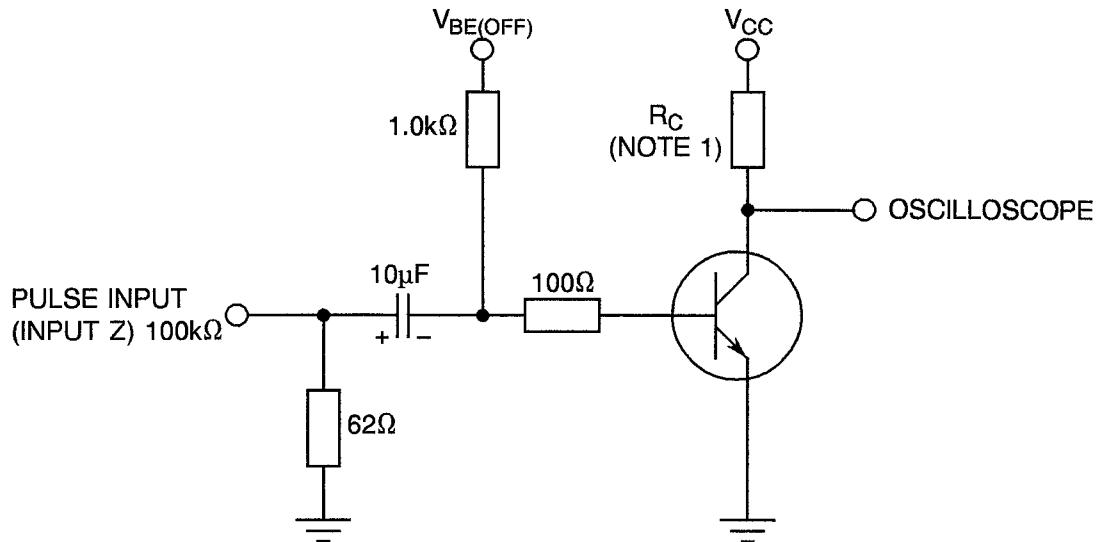
**TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES**

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
4	Collector-Base Cut-off Current	$I_{CBO}$	3036	$T_{amb} = +150^{\circ}C$ Variants 01-02-03-04-09-10 $V_{CB} = 75V$ $I_E = 0$ Variants 05-06-07-08-11-12 $V_{CB} = 50V$ $I_E = 0$	-	50	$\mu A$
7	d.c. Forward Current Transfer Ratio 2	$h_{FE2}$	3076	$T_{amb} = -55^{\circ}C$ $V_{CE} = 10V$ $I_C = 150mA$ Variants 01-02-05-06-09-10- 11-12 Variants 03-04-07-08 Note 1	50	-	-
					22	-	

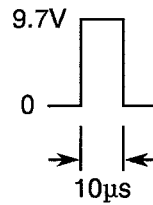
**NOTES:** See Page 16.



**FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS**



INPUT PULSE



Duty Cycle  $\leq 2\%$ ,  $t_r = t_f \leq 20\text{ns}$ .

**NOTES**

1.  $R_C = \frac{V_{CC}}{I_C}$  ( $\Omega$ )

**TABLE 4 - PARAMETER DRIFT VALUES**

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS ( $\Delta$ )	UNIT
4	Collector-Base Cut-off Current	$I_{CBO}$	As per Table 2	As per Table 2	$\pm 10$ or (1) $\pm 100$	nA %
7	d.c. Forward Current Transfer Ratio 2	$h_{FE2}$	As per Table 2	As per Table 2	$\pm 15$	%
9	Collector-Emitter Saturation Voltage 1	$V_{CE(SAT)1}$	As per Table 2	As per Table 2	$\pm 50$ or (1) $\pm 15$	mV %

**NOTES**

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

**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**

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Ambient Temperature	$T_{amb}$	$+ 25 \pm 3$	$^{\circ}C$
2	Power Dissipation	$P_{tot}$	1.0	W
3	Collector-Base Voltage	$V_{CB}$	Variants 01-02-03-04-09-10: 100 Variants 05-06-07-08-11-12: 60	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**

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. 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 tests 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 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(b) for the burn-in test.

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.	
4	Collector-Base Cut-off Current	$I_{CBO}$	As per Table 2	As per Table 2 Variants 01-02-03-04-09-10 Variants 05-06-07-08-11-12	- -	50 50	nA
7	d.c. Forward Current Transfer Ratio 2	$h_{FE2}$	As per Table 2	As per Table 2 Variants 01-02-05-06-09-10-11-12 Variants 03-04-07-08	100 40	300 120	-
9	Collector-Emitter Saturation Voltage 1	$V_{CE(SAT)1}$	As per Table 2	As per Table 2 Variants 01-02-03-04-09-10 Variants 05-06-07-08-11-12	- -	0.4 0.6	V