TRANSISTORS, HIGH POWER, NPN,

BASED ON TYPES 2N5660 THROUGH 2N5663

ESCC Detail Specification No. 5203/037

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ESA/SCC Detail Specification No. 5203/037

space components
coordination group

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		SCCG Chairman	ESA Director General or his Deputy
Issue 2	December 1988	-	-
Revision 'A'	February 1992		
Revision 'B'	August 1996		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 1 and incorporates all modifications defined in the following DCR's:-		
		Cover page	: Title amended	22372
		DCN		None
		Table of Contents	: Amended	None
		Para. 1.2	: Amended	22372
		Para. 1.7	: Paragraph added	22372
		Table 1(a)	: Variants "03 to 12" added	22372
			: Table layout standardised	23325
			: Lead Material and Finish amended to "D3 or D4" for Even Variants	22372
		Table 1(b)	: Variants added and maximum Ratings amended	22372
			: Nos. 1, 2 and 3, "Breakdown" deleted from Characteristics and "(BR)" from Symbol	23325
			: No. 4, "(Continuous)" added to Characteristics	22619
			: No. 11, Symbol amended	23325
			: Note 1 amended	22372/ 23325
		Figure 1	: Title changed to "Figure 1(a)" and amended	22372/ 23325
			: Figure amended	22372/ 23325
			: Figures "1(b)" and "1(c)" added	22372
		Figure 2	: Subtitle "Figure 2(a)" added, old Figure and Table deleted and new added	22372
			: New Figures "2(b)" and "2(c)" added	22372
			: New Notes "1" and "2" added	22372
		Figure 3	: New Subtitle "Figure 3(a)" added	22372
			: New "Figure 3(b)" added	22372
		Paras 4.2.2 to 4.2.4	: ESA/SCC 5000 Reference Para. Nos. added to individual tests	23325
		Para. 4.2.4	: Deviation "(c)" deleted	22619
		Para. 4.2.5	: Deviation deleted	22619
		Para. 4.3.2	: Amended	22372
		Para. 4.3.3	: Amended	22372/ 23325
		Para. 4.4.1	: Amended	22619
		Para. 4.4.2	: Amended	22372
		Para. 4.5.3	: Part Number corrected	23325
		Para. 4.6.3	: "and 3" deleted from second line	23325
		Para. 4.7.2	: New Paragraph "4.7.2" added	23325
			: Old Para. 4.7.2 renumbered "4.7.3" and Title and Text amended	23325
		Para. 4.7.3	: Old Para. 4.7.3 renumbered "4.7.4", Title amended and Text deleted	23325

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		Table 2 d.c.	: Test Figure column deleted	23325
			: Old Nos. 1, 2 and 3, Symbols amended	22372
			: Old Nos. 1, 2, 4, 5 and 7, in Test Conditions, Variants added. Limits amended	22372
			: Old No. 5 changed to "5 to 6", Symbol changed to "I_{CBO1}" and "I_{CBO2}" added	22372
			: New No. 8, "h_{FE1}" added. Old Nos. 6, 7 and 8 renumbered "8, 9 and 10" and Symbols changed to "h_{FE2}, h_{FE3} and h_{FE4}" respectively.	22372
			: New No. 11, "$V_{CE(Sat)1}$" added	22372
			: Old No. 9 changed to "12" and Symbol to "$V_{CE(Sat)2}$"	22372
			: New No. 13, "$V_{BE(Sat)1}$" added	22372
			: Old No. 10 changed to "14" and Symbol to "$V_{BE(Sat)2}$"	22372
			: New Nos. 11 to 14, in Test Conditions "Note 2" added	22372
		Table 2 a.c.	: In Test Conditions column heading, "(Note 3)" added	22619
			: Old Nos. 11 to 14 renumbered "15 to 18" and in Test Conditions, "See Note 2" deleted	22372/ 22619
			: Old No. 11, in Test Conditions, I_C Unit corrected to "Adc"	22372
			: Old Nos. 13 and 14, Test Figures amended, Variants added. Limits added for new Variants	22372
		Notes	: Note 1 amended	22372
			: New Note 2 added	22372
			: Old Note 2 renumbered "3" and rewritten	22372
		Table 3	: In Test Conditions column heading, "(Note 3)" added	22372
			: No. 4, in Test Conditions, "(See Note 2)" deleted and Variants added	22372
			: Old No. 6 changed to "8" and Symbol to "h_{FE2}". In Test Conditions, "See Note 2" deleted and Variants added. Limits amended	22372
			: Old Nos. 15 and 16 deleted. New "No. 19" added	22372
		Figure 4	: New Subheading "Figure 4(a)" added to old Figure	22372
			: Values added to input waveform	23325
			: New "Figure 4(b)" added	22372
			: Notes added	22372

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		Table 4	: No. 4, in Change Limits "(*)" deleted and "or 1)" substituted	22372
			: No. 6 changed to "8" and Symbol to "h_{FE2}"	22372
			: No. 9 changed to "12" and Symbol to "$V_{CE(sat)2}$"	22372
		Note	: "(*)" replaced by "1)" and Note expanded	22372/ 23325
		Table 5	: Title amended	23325
			: Nos. 2 and 3, Variants added and Value for new Variants added	22372
		Figure 5	: Reference to Figure added	23325
		Para. 4.8.2	: Second sentence added	23325
		Para. 4.8.3	: Second sentence amended	23325
		Table 6	: Title amended	23325
			: No. 2, Unit corrected	22372
			: No. 6, changed to "8" and Symbol to "h_{FE2}". Limits deleted and "See Table 2" added	22372
			: No. 9 changed to "12" and Symbol to "$V_{CE(Sat)2}$"	22372
		Appendix 'A'	: Approved DCR column deleted	23187
'A'	Feb. '92	P1. Cover page		None
		P2B. DCN		None
		P5. Para. 1.2	: Paragraph amended	21021
		Para. 2	: "ESA/SCC Basic Spec. No. 23500" added	21025
		P15. 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
		P22. Table 3	: Reference to Note 3 deleted	21047
		This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.		
'B'	Aug. '96	P1. Cover page		None
		P2B. DCN		None
		P5. Para. 1.7	: Text amended	21083

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 Types 2N5660 through 2N5663.

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.

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 a 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.

(c) ESA/SCC Basic Specification No. 23500, Requirements for Lead Materials and Finishes for Components for Space Application.

TABLE 1(a) - TYPE VARIANTS

VARIANT	BASED ON TYPE	CASE	FIGURE	LEAD MATERIAL AND FINISH
01	2N5662	TO5	2(a)	D2
02	2N5662	TO5	2(a)	D3 or D4
03	2N5663	TO5	2(a)	D2
04	2N5663	TO5	2(a)	D3 or D4
05	2N5660	TO66	2(b)	D2
06	2N5660	TO66	2(b)	D3 or D4
07	2N5661	TO66	2(b)	D2
08	2N5661	TO66	2(b)	D3 or D4
09	2N5662	TO39	2(c)	D2
10	2N5662	TO39	2(c)	D3 or D4
11	2N5663	TO39	2(c)	D2
12	2N5663	TO39	2(c)	D3 or D4

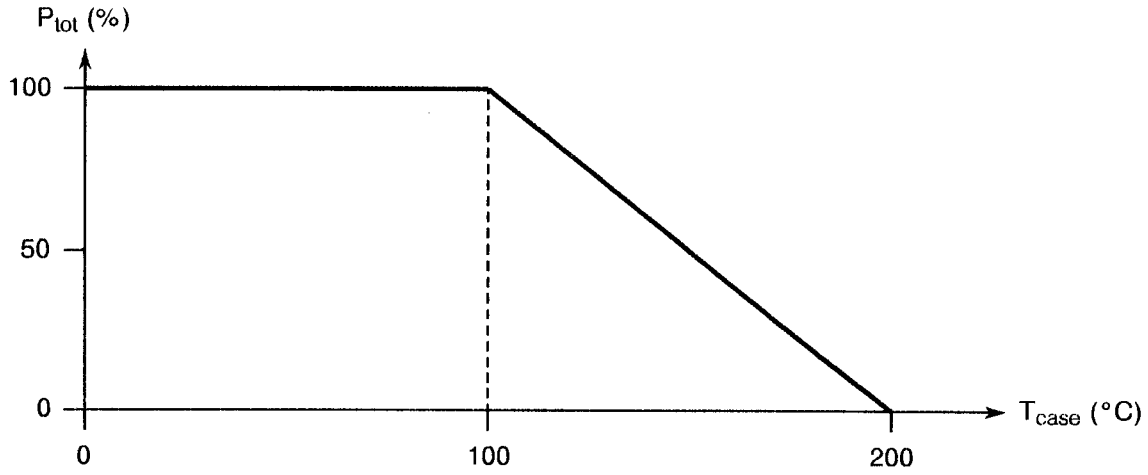
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector - Base Voltage Variants 01-02-05-06-09-10 Variants 03-04-07-08-11-12	V_{CBO}	 250 400	V	
2	Collector - Emitter Voltage Variants 01-02-05-06-09-10 Variants 03-04-07-08-11-12	V_{CEO}	 200 300	V	
3	Emitter - Base Voltage	V_{EBO}	6.0	V	
4	Collector Current (Continuous)	I_C	2.0	A	
5	Peak Collector Current	I_{CP}	5.0	Apk	
6	Base Current	I_B	0.5	A	
7	Power Dissipation Variants 05-06-07-08 Variants 01-02-03-04-09-10-11-12	P_{tot}	 20 15	W	Note 1
8	Operating Temperature Range	T_{op}	−65 to +200	°C	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 05-06-07-08 Variants 01-02-03-04-09-10-11-12	$R_{TH(J-C)}$	 5.0 6.7	°C/W	

NOTES

1. At $T_{case} \leq +100°C$. For derating at $T_{case} > +100°C$, see Figure 1(a).
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.

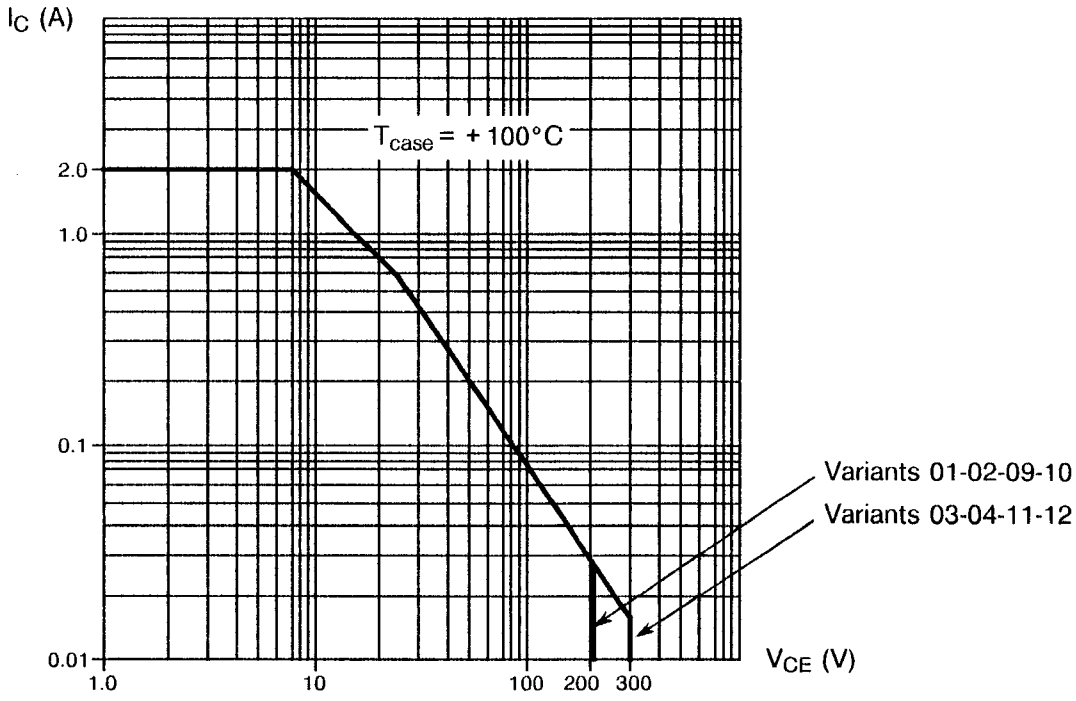
FIGURE 1(a) - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature

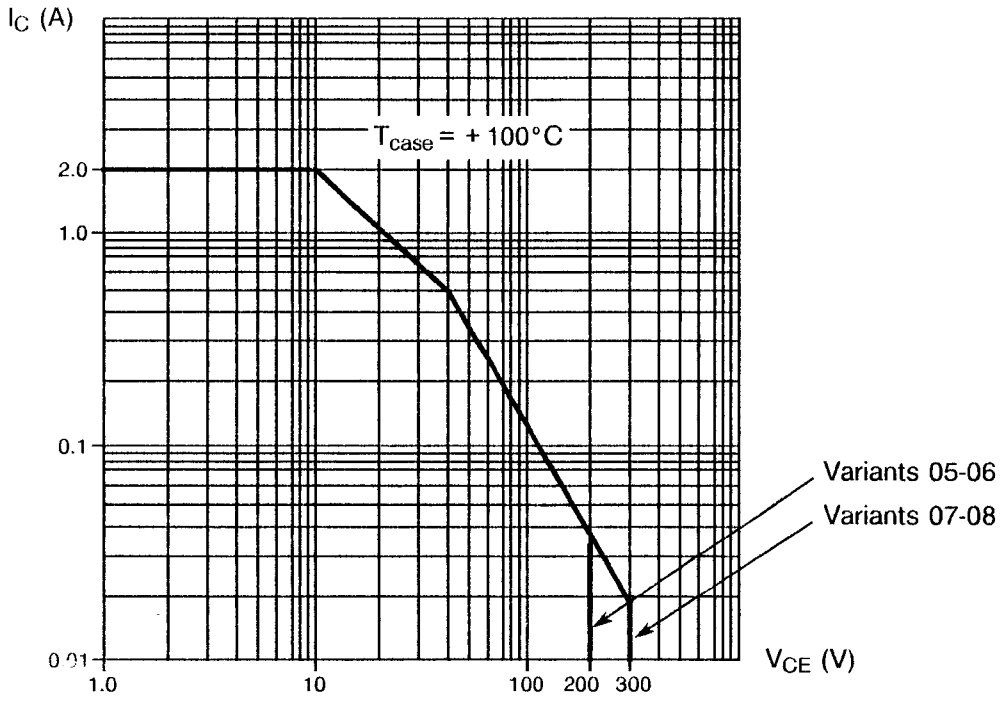
FIGURE 1(b) - FORWARD BIAS SAFE OPERATING AREA (MAXIMUM CONTINUOUS d.c.)

VARIANTS 01-02-03-04-09-10-11-12



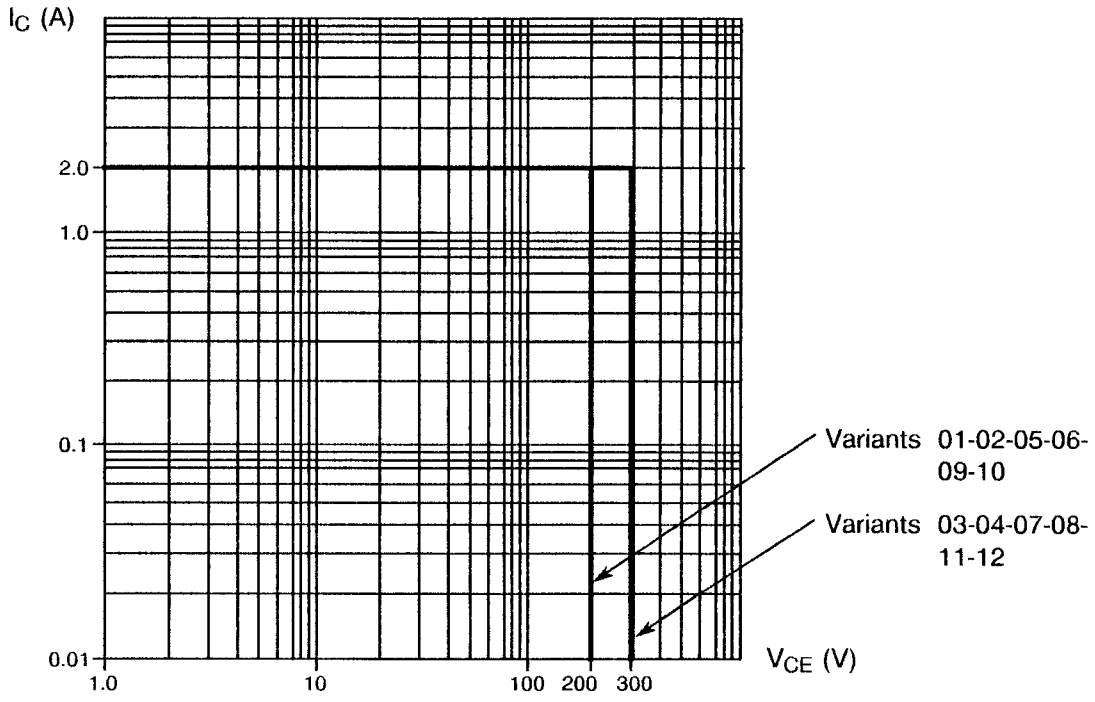
Collector Current versus Collector-Emitter Voltage

VARIANTS 05-06-07-08



Collector Current versus Collector-Emitter Voltage

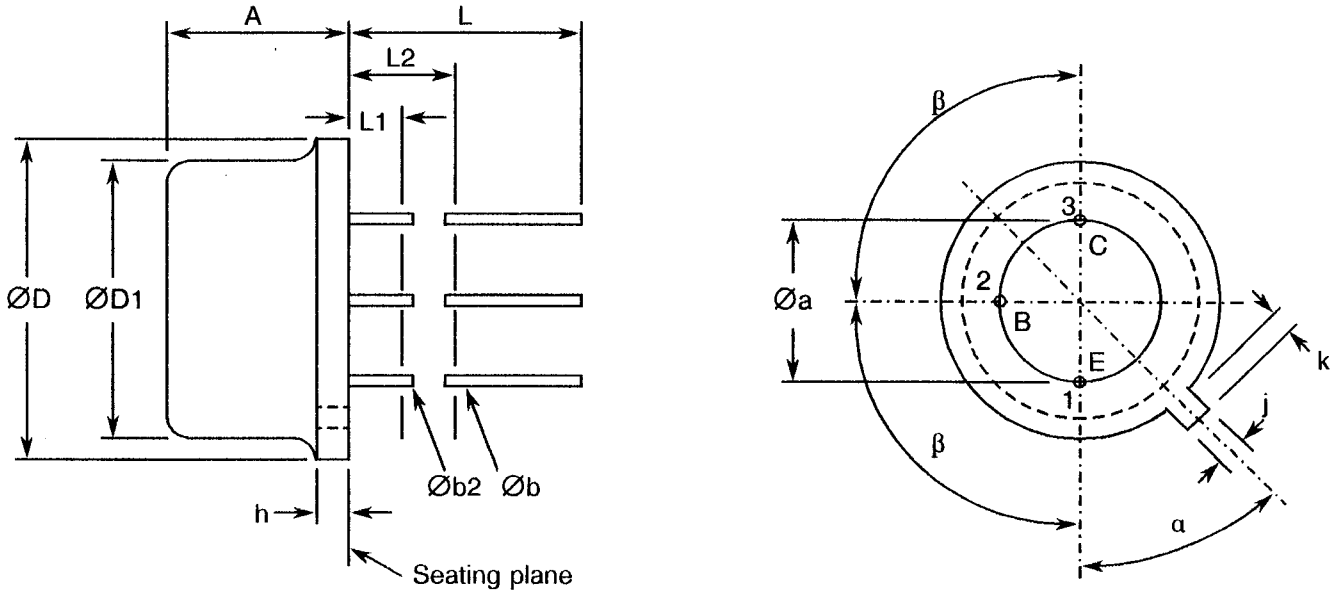
FIGURE 1(c) - FORWARD BIAS SAFE OPERATING AREA FOR SWITCHING BETWEEN SATURATION AND CUT-OFF (CLAMPED INDUCTIVE LOAD)



Collector Current versus Collector-Emitter Voltage

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a) - VARIANTS 01 TO 04 (TO5 CASE)

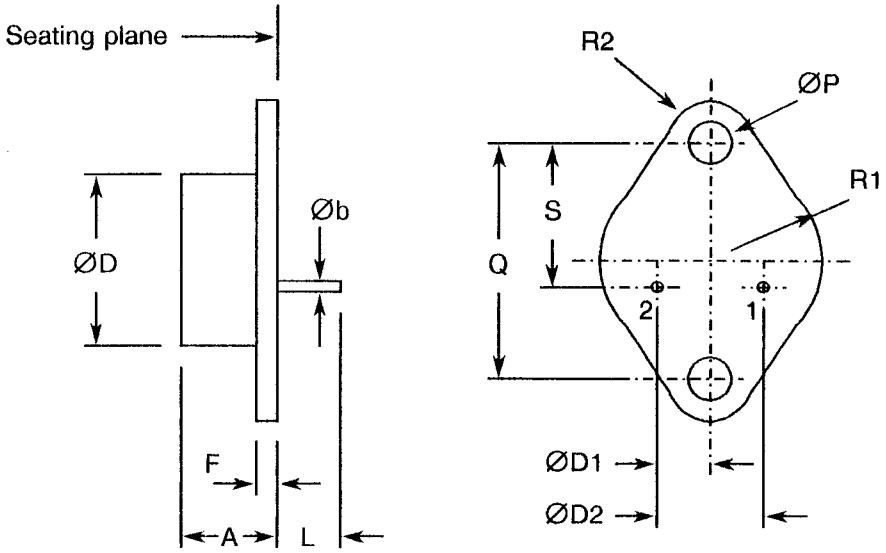


SYMBOL	MILLIMETRES		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
Øa	4.83	5.33	0.190	0.210	
A	6.10	6.60	0.240	0.260	
Øb	0.406	0.533	0.016	0.021	1
Øb2	0.406	0.483	0.016	0.019	1
ØD	8.51	9.40	0.335	0.370	
ØD1	7.75	8.51	0.305	0.335	
h	0.254	0.762	0.010	0.030	
j	0.711	0.864	0.028	0.034	
k	0.737	1.14	0.029	0.045	2
L	38.10	44.45	1.500	1.750	1
L1	-	1.27	-	0.050	1
L2	6.35	-	0.250	-	1
α	45° nominal		45° nominal		
β	90° nominal		90° nominal		

NOTES: See Page 14.

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

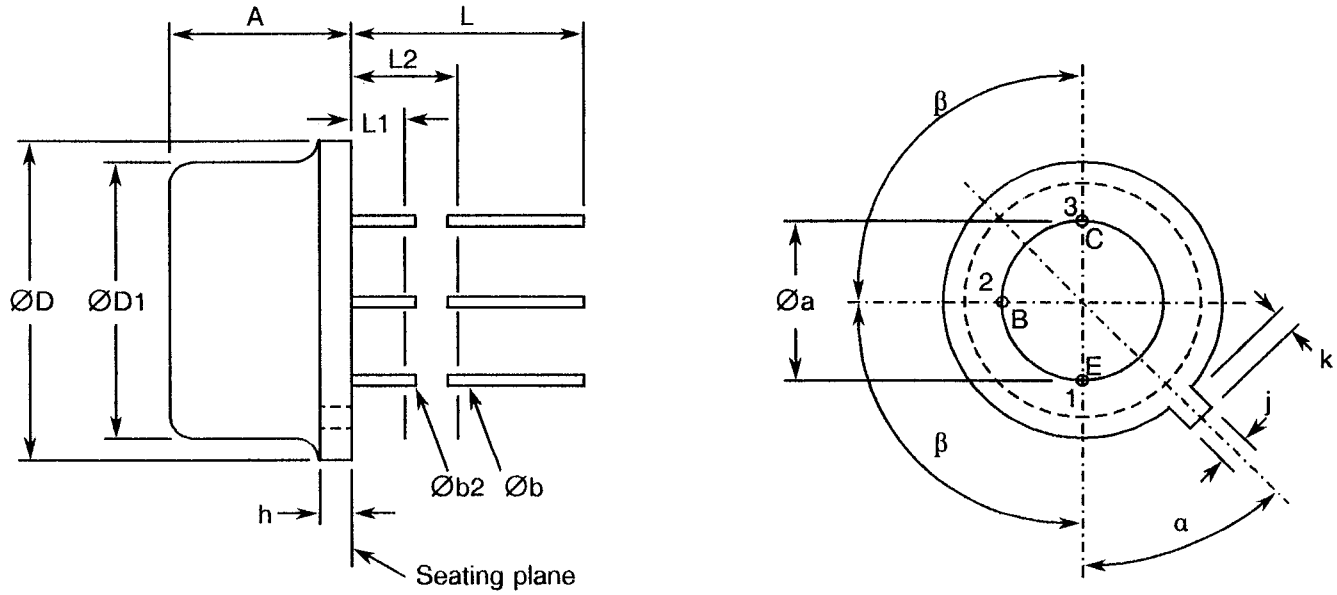
FIGURE 2(b) - VARIANTS 05 TO 08 (TO66 CASE)



SYMBOL	MILLIMETRES		INCHES		REMARKS
	MIN.	MAX.	MIN.	MAX.	
A	6.35	8.63	0.250	0.340	
Øb	0.711	0.863	0.028	0.034	
ØD	-	15.75	-	0.620	
ØD1	2.36	2.72	0.093	0.107	
ØD2	4.82	5.33	0.190	0.210	
F	1.27	1.90	0.050	0.075	
L	9.41	-	0.360	-	
ØP	3.60	3.86	0.142	0.152	Both holes
Q	24.33	24.43	0.958	0.962	
R1	-	8.89	-	0.350	
R2	-	3.68	-	0.145	
S	14.47	14.98	0.570	0.590	

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

FIGURE 2(c) - VARIANTS 09 TO 12 (TO39 CASE)



SYMBOL	MILLIMETRES		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
Øa	4.83	5.33	0.190	0.210	
A	6.10	6.60	0.240	0.260	
Øb	0.406	0.533	0.016	0.021	1
Øb2	0.406	0.483	0.016	0.019	1
ØD	8.89	9.40	0.350	0.370	
ØD1	8.00	8.51	0.315	0.355	
h	0.229	3.18	0.009	0.125	
j	0.711	0.864	0.028	0.034	
k	0.737	1.02	0.029	0.040	2
L	12.70	-	0.500	-	1
L1	-	1.27	-	0.050	1
L2	6.35	-	0.250	-	1
α	45° nominal		45° nominal		
β	90° nominal		90° nominal		

NOTES: See Page 14.

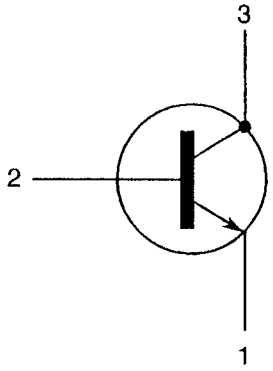
FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

NOTES

1. (3 leads) Øb2 applies between L1 and L2. Øb applies between L2 and 12.70mm (0.5 inches) from seating plane. Diameter is uncontrolled in L1 and beyond 12.70mm (0.5 inches) from seating plane.
2. Measured from maximum diameter of the actual device.

FIGURE 3 - FUNCTIONAL DIAGRAM

FIGURE 3(a) - VARIANTS 01 TO 04 AND 09 TO 12

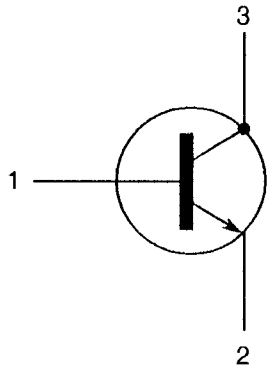


1. Emitter.
2. Base.
3. Collector.

NOTES

1. The collector is internally connected to the case.

FIGURE 3(b) - VARIANTS 05 TO 08



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

NOTES

1. The collector is internally connected to the case.

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 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 and Electrical Measurements (Chart III)

(a) Para. 9.22, 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 12 grammes for Variants 01 to 04 and 09 to 12, and 18 grammes for Variants 05 to 08.

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 05 to 08
Test Condition: 'A', Tension.
Applied Force: 10 Newtons.
Duration: 10 seconds.

Variants 01 to 04 and 09 to 12
Test Condition: 'E', Lead Fatigue.
Applied Force: 5.0 ± 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

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.

4.4.2 Lead Material and Finish

The lead material shall be either Type 'D' with either Type '2' or Type '3 or 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. Each component shall be marked in respect of:-

(a) Lead Identification.

(b) The SCC Component Number.

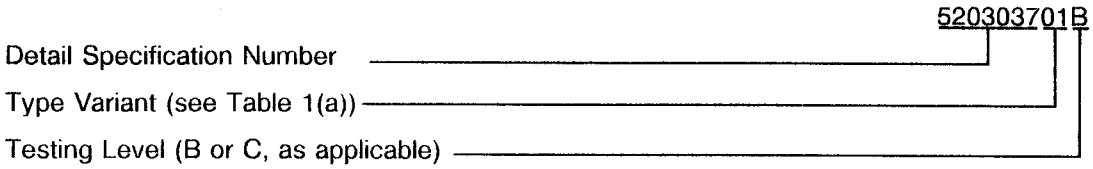
(c) Traceability Information.

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. Unless otherwise specified, measurements shall be performed at $T_{amb} = +25 \pm 3$ °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 $T_{amb} = +25 \pm 3$ °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

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 of this specification.

4.7.4 Electrical Circuit for Power Burn-in

Not applicable.

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	$V_{(BR)CER}$	3011 Bias Cond. 'B'	I_C = 10mA R_{BE} = 100Ω Variants 01-02-05-06-09-10 Variants 03-04-07-08-11-12 Note 1	 250 400	 - -	V
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011 Bias Cond. 'D'	I_C = 10mA Variants 01-02-05-06-09-10 Variants 03-04-07-08-11-12 Note 1	 200 300	 - -	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026 Bias Cond. 'D'	I_E = 10µA	6.0	-	µA
4	Collector-Emitter Cut-off Current	I_{CES}	3041 Bias Cond. 'C'	Variants 01-02-05-06-09-10 V_{CE} = 200V Variants 03-04-07-08-11-12 V_{CE} = 300V	-	0.2	µA
5 to 6	Collector-Base Cut-off Current	I_{CBO1}	3036 Bias Cond. 'D'	Variants 01-02-05-06-09-10 V_{CB} = 200V Variants 03-04-07-08-11-12 V_{CB} = 300V	-	0.1	µA
		I_{CBO2}		Variants 01-02-05-06-09-10 V_{CB} = 250V Variants 03-04-07-08-11-12 V_{CB} = 400V	-	1.0	mA

NOTES: See Page 21.

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

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
7 to 10	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	V_{CE} = 2.0V, I_C = 50mA Variants 01-02-05-06-09-10 Variants 03-04-07-08-11-12 Note 1	 40 25	 - -	-
		h_{FE2}		V_{CE} = 5.0V, I_C = 0.5A Variants 01-02-05-06-09-10 Variants 03-04-07-08-11-12 Note 1	40 25	120 75	
		h_{FE3}		V_{CE} = 5.0V, I_C = 1.0A Note 1	15	-	
		h_{FE4}		V_{CE} = 5.0V, I_C = 2.0A Note 1	5.0	-	
11 to 12	Collector-Emitter Saturation Voltage	$V_{CE(Sat)1}$	3071	I_C = 1.0A I_B = 0.1A Notes 1 and 2	-	0.4	V
		$V_{CE(Sat)2}$		I_C = 2.0A I_B = 0.4A Notes 1 and 2	-	0.8	
13 to 14	Base-Emitter Saturation Voltage	$V_{BE(Sat)1}$	3066 Bias Cond. 'A'	I_C = 1.0A I_B = 0.1A Notes 1 and 2	-	1.2	V
		$V_{BE(Sat)2}$		I_C = 2.0A I_B = 0.4A Notes 1 and 2	-	1.5	

NOTES: See Page 21.

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

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST FIG.	TEST CONDITIONS (NOTE 3)	LIMITS		UNIT
						MIN	MAX	
15	Gain-Bandwidth Product	f_T	3306	-	V_{CE} = 5.0V I_C = 0.1A f = 10MHz	20	70	MHz
16	Open Circuit Output Capacitance	C_{obo}	3236	-	V_{CB} = 10V I_E = 0A f = 1.0MHz Note 1	-	45	pF
17	Turn-on Time	t_{on}	-	4(a) 4(b)	V_{CC} = 100V I_C = 0.5A Variants 01-02-05-06-09-10 $I_{B1} = -I_{B2}$ = 15mA Variants 03-04-07-08-11-12 $I_{B1} = -I_{B2}$ = 25mA	-	0.25	µs
18	Turn-off Time	t_{off}	-	4(a) 4(b)	V_{CC} = 100V I_C = 0.5A Variants 01-02-05-06-09-10 $I_{B1} = -I_{B2}$ = 15mA Variants 03-04-07-08-11-12 $I_{B1} = -I_{B2}$ = 25mA	- -	0.85 1.2	µs

NOTES

1. Pulsed measurement: Pulse Length ≤ 300us, Duty Cycle ≤ 2.0%.
2. Devices shall be measured at less than 3.175mm (1/8 inch) from the case.
3. Measurements shall be performed on a sample basis, LTPD7 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	
4	Collector-Emitter Cut-off Current	I_{CES}	3041 Bias Cond. 'C'	Variants 01-02-05-06-09-10 V_{CE} = 200V Variants 03-04-07-08-11-12 V_{CE} = 300V T_{amb} = + 150°C	-	100	µA
8	D.C. Forward Current Transfer Ratio 2	h_{FE2}	3076	V_{CE} = 5.0V, I_C = 0.5A Variants 01-02-05-06-09-10 Variants 03-04-07-08-11-12 T_{amb} = − 65°C Note 1	 15 10	 - -	-
19	Safe Operating Area (Switching)	S.A.O.	3053 Cond. 'B'	T_{case} = + 100°C V_{CC} = 25Vdc I_C = 2.0Adc $R_L \leq 2.5\Omega$ L = 40mH $t_r + t_f \leq 10$ns Duty Cycle ≤ 2.0% $t_p \approx 4.0$ms R_S = 0.02Ω R_{BB1} = 20Ω V_{BB1} = 12.5Vdc R_{BB2} = 50Ω V_{BB2} = − 4.0Vdc Variants 01-02-05-06-09-10 Clamp Voltage = 200(+ 0 − 5) Vdc Variants 03-04-07-08-11-12 Clamp Voltage = 300(+ 0 − 5) Vdc See Figure 1(c)	-	-	-

NOTES

1. Pulsed measurement: Pulse Length ≤ 300us, Duty Cycle ≤ 2.0%.
2. Devices shall be measured at less than 3.175mm (1/8 inch) from the case.

FIGURE 4 - CIRCUITS FOR SWITCHING SPEED MEASUREMENT

FIGURE 4(a) - VARIANTS 01, 02, 05, 06, 09, 10

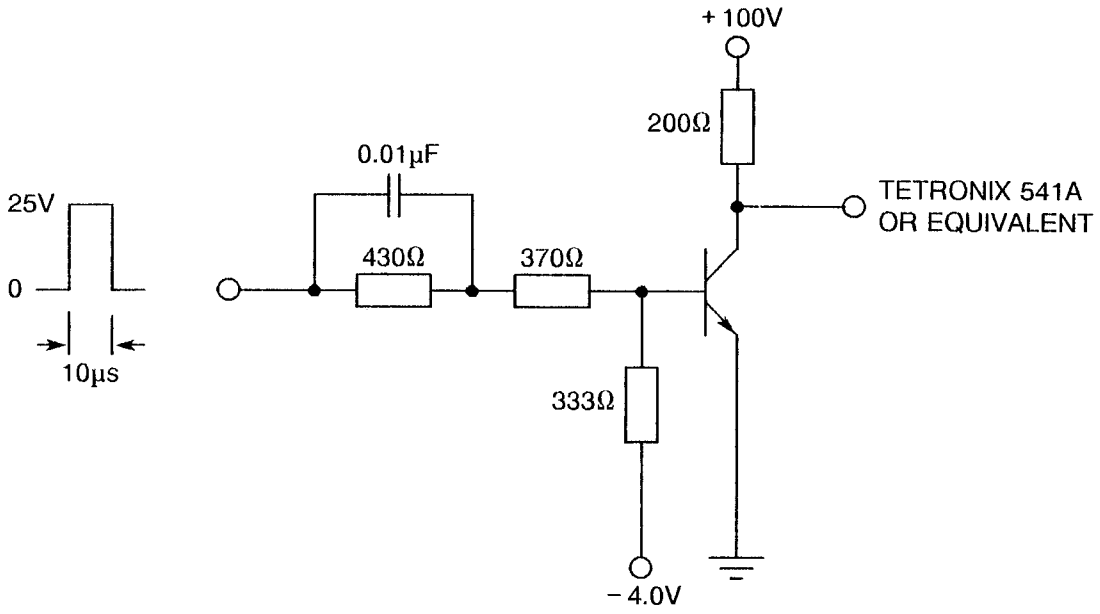
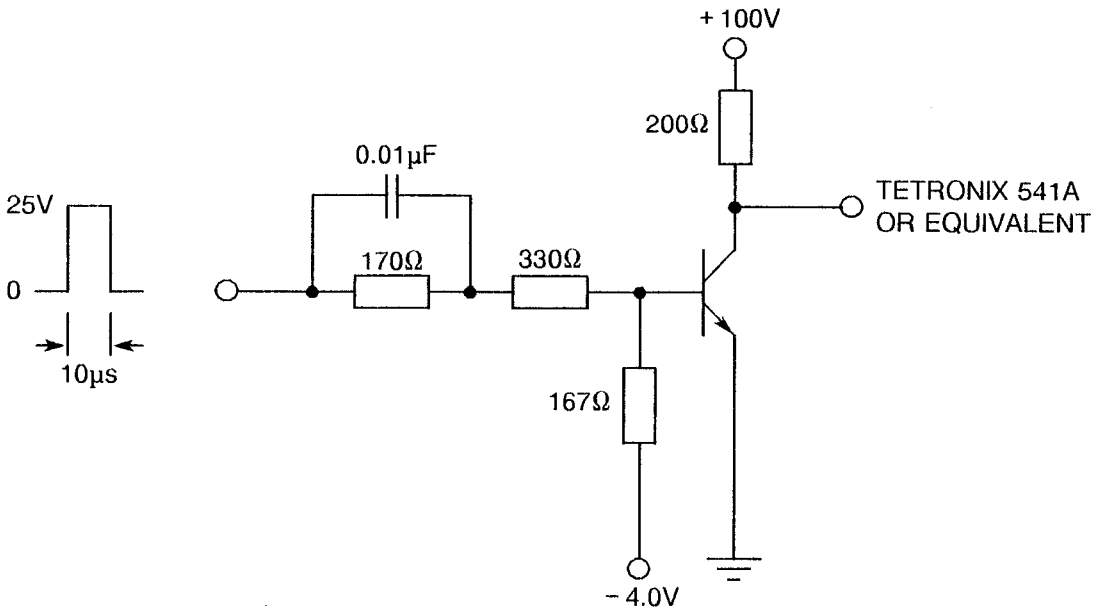


FIGURE 4(b) - VARIANTS 03, 04, 07, 08, 11, 12



NOTES

1. Input Pulse Voltage, −4.0V and +100V shall be adjusted to obtain the correct values of I_{B1}, I_{B2} and I_C.
2. Pulse Generator - t_r and $t_f \leq 15ns$, $Z_{out} = 50\Omega$, Duty Cycle $\leq 2.0\%$.
3. Resistors shall be non-inductive types.

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
4	Collector-Emitter Cut-off Current	I_{CES}	As per Table 2	As per Table 2	± 20 or (1) ± 100	nA %
8	D.C. Forward Current Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	± 25	%
12	Collector-Emitter Saturation Voltage 2	$V_{CE(Sat)2}$	As per Table 2	As per Table 2	± 100	mV

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

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

No.	CHARACTERISTICS	SYMBOL	CONDITIONS		UNIT
1	Ambient Temperature	T_{amb}	+ 25 ± 3		°C
2	Power Dissipation	P_{tot}	Variants 01 to 04 and 09 to 12: Variants 05 to 08: Note 1	1.2 2.0	W
3	Collector-Emitter Voltage	V_{CE}	Variants 01 to 04 and 09 to 12: Variants 05 to 08:	150 100	V

NOTES
1. No heatsink, or forced air directly on the device, shall be permitted.

FIGURE 5 - 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. The measurements shall be performed at $T_{amb} = +25 \pm 3$ °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. The measurements shall be performed at $T_{amb} = +25 \pm 3$ °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 for the power burn-in test.

4.8.4 Electrical Circuits for Operating Life Tests

Not applicable.

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-Emitter Cut-off Current	I_{CES}	As per Table 2	As per Table 2	-	0.2	µA
8	D.C. Forward Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	See Table 2		-
12	Collector-Emitter Saturation Voltage 2	$V_{CE(Sat)2}$	As per Table 2	As per Table 2	-	0.8	V

APPENDIX 'A'

AGREED DEVIATIONS FOR UNITRODE (USA)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Para. 4.2.2	Para. 9.1, "Internal (Pre-encapsulation) Inspection", may be performed in accordance with MIL-STD-750, Method 2074. Para. 9.10, "External Visual Inspection", may be performed in accordance with MIL-STD-750, Method 2071.
Para. 4.2.3	Para. 9.10, "External Visual Inspection", may be performed in accordance with MIL-STD-750, Method 2071. Para. 9.12, "Radiographic Inspection", may be performed in accordance with MIL-STD-750, Method 2076.
Para. 4.2.4	Para. 9.10, "External Visual Inspection", may be performed in accordance with MIL-STD-750, Method 2071.
Para. 4.2.5	Para. 9.10, "External Visual Inspection", may be performed in accordance with MIL-STD-750, Method 2071.