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Pages 1 to 19

TRANSISTORS, LOW POWER, PNP

BASED ON TYPE 2N2905A

ESA/SCC Detail Specification No. 5202/002

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 5	May 1984	-	-
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Revision 'B'	April 1992		
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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This issue supersedes Issue 4 and incorporates all modifications agreed on the basis of Policy DCR 21022, 21025 and the following DCR's:-		
		Cover sheet		None
		DCN		None
		Table 1(a)	: New Variant added	22221
		Table 1(b)	: Signs of ratings amended	23144
			: Table Reformatted	23178
		Figure 1	: T changed to T_{amb} or T_c	23178
		Table 2	: $V_{(BR)CBO}$ and V_{BESAT} conditions corrected	22221/ 23128
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		Table 2 a.c.	: C_{OBO} test method corrected and signs of conditions corrected	23144
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		Table 3	: Signs of conditions and limits amended	23144
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		Table 5	: Burn-in T_{amb} changed and HTRB duration reduced	22221
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'A'	Aug. '88	P1. Cover page		None
		P2. DCN		None
		P9. Para. 4.2.2	: PIND Test and Condition added	22675
		P11. Para. 4.5.3	: Component Number corrected	21021

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
'B'	Apr. 1992	P1. Cover page	: Page number amended	22722
		P2A. DCN	: Page added	None
		P5. Para. 1.2	: Paragraph amended	21021
		P6. Table 1(a)	: Amended to include Variants 03 and 04, and notes added	22930
		P9. Para. 2	: "ESA/SCC Basic Specification 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	: H.T.R.B. deviation deleted	23499
			: Radiographic Inspection deviation deleted	21049
		Para. 4.2.4	: Bond Strength and Die Shear Test deviations deleted	23499
		P10. Para. 4.3.3	: "Applied Force..." amended	22930
			: "Duration..." deleted	22930
		Para. 4.4.2	: Paragraph amended	22930
		P11. Para. 4.5.3	: "...(see Table 1(a))" added	22930
		P16. Table 3	: Note deleted	21047
		P20. Appendix 'A'	: Page removed	22722
'C'	June '95	P1. Cover page		None
		P2A. DCN		None
		P3. T of C	: Para. 1.7 entry added	21083
		P5. Para. 1.7	: New paragraph added	21083
		P6. Table 1(a)	: Variant 05 added	221239
		P10. Para. 4.4.2	: Type '7' finish added	221239
		This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.		
'D'	Aug. '96	P1. Cover page		None
		P2A. DCN		None
		P10. Para. 4.3.3	: Applied Force deleted	221332

TABLE OF CONTENTS

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for a Transistor, Low Power, PNP, based on Type 2N2905A.

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 as scheduled in Table 1.

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 100% inert atmosphere.

TABLE 1(a) - TYPE VARIANTS

VARIANT	BASED ON TYPE	FIGURE	LEAD MATERIAL AND FINISH
01	2N2905A	2	D2 (1)
02	2N2905A	2	D3 or D4 (1)
03	2N2905A	2	E/B = D2, C = F2 (2)
04	2N2905A	2	E/B = D4, C = F4 (2)
05	2N2905A	2	D7 (1)

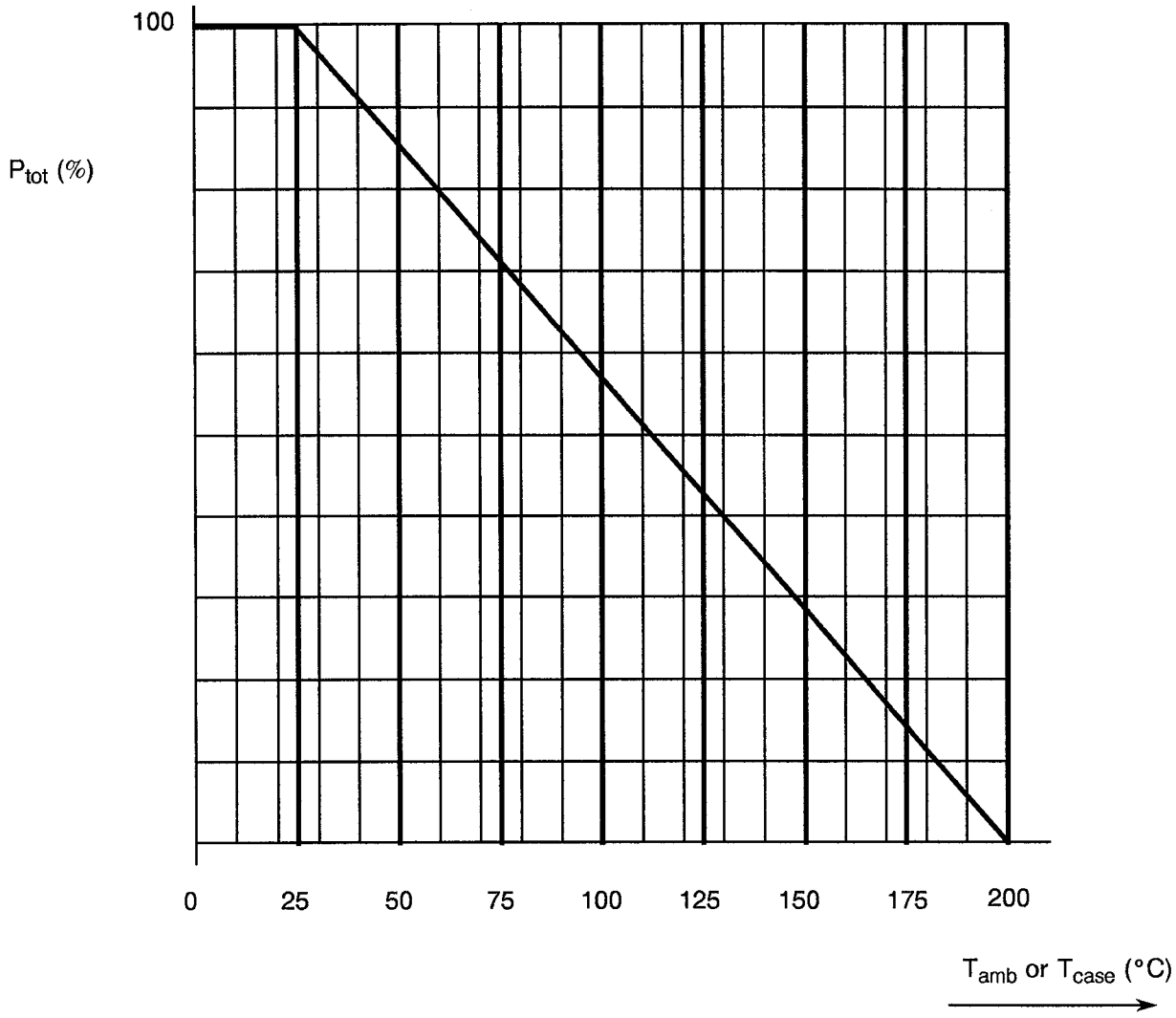
NOTES
1. All leads.
2. E = Emitter, B = Base, C = Collector.

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTIC	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	-60	V	
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	-60	V	
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	-5.0	V	
4	Collector Current	I_C	-0.6	A	
5	Power Dissipation 1	P_{tot1}	0.6	W	T_{amb} = +25°C See Note 1
6	Power Dissipation 2	P_{tot2}	3.0	W	T_{case} = +25°C See Note 1
7	Operating Temperature Range	T_{op}	−65 to +200	°C	T_{amb}
8	Storage Temperature Range	T_{stg}	−65 to +200	°C	
9	Soldering Temperature	T_{sol}	+260	°C	Time: ≤10 seconds; Distance from case: ≥ 1.5mm

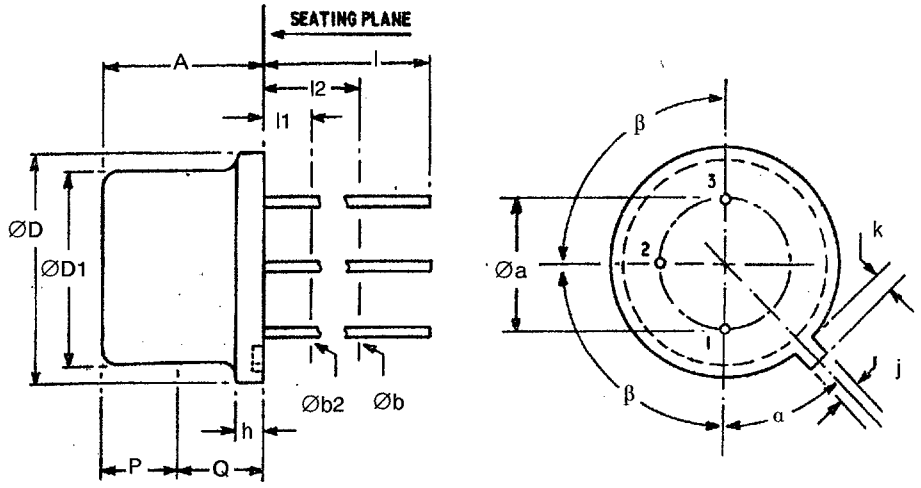
NOTES
1. For derating at T_{amb} or T_{case} > +25°C, see Figure 1.

FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS

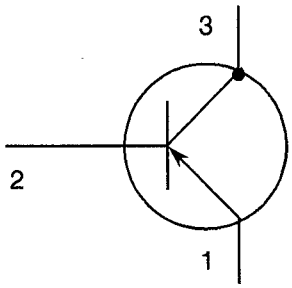


SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
Øa	0.190	0.210	4.83	5.35	
A	0.240	0.260	6.10	6.60	
Øb	0.016	0.021	0.406	0.533	2
Øb2	0.016	0.019	0.406	0.483	2
ØD	0.350	0.370	8.89	9.40	
ØD1	0.315	0.335	8.00	8.51	
h	0.009	0.125	0.229	3.18	
j	0.028	0.034	0.711	0.864	
k	0.029	0.040	0.737	1.02	3
l	0.500	-	12.70	-	2
l1	-	0.050		1.27	2
l2	0.250	-	6.35	-	2
P	0.100	-	2.54	-	1
Q	-	-	-	-	4
α	45° NOMINAL		45° NOMINAL		
β	90° NOMINAL		90° NOMINAL		

NOTES

1. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.010" (0.254mm).
2. (Three leads) Øb2 applies between l1 and l2. Ø b applies between l2 and 0.5" (12.70mm) from seating plane. Diameter is uncontrolled in l1 and beyond 0.5" (12.70mm) from seating plane.
3. Measured from maximum diameter of the actual device.
4. Details of outline in this zone optional.

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 Semiconductors.

(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 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.

4.3.4 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.

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 TO-39.

4.4.2 Lead Material and Finish

The lead material shall be either Type 'D' or Type 'F' with either Type '2', Type '3 or 4', Type '4' or Type '7' 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.

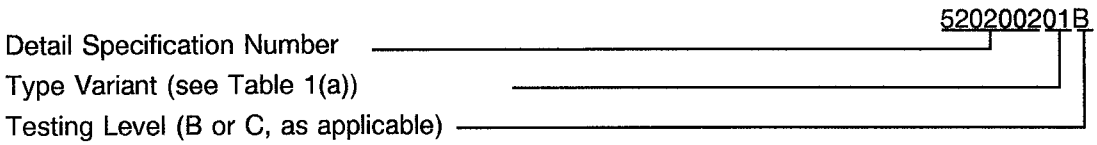
(c) Traceability Information.

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. 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 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 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.

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.

4.7.4 Conditions and Electrical Circuits for High Temperature Reverse Bias.

The requirements for the High Temperature Reverse Bias test are specified in Section 7 of ESA/SCC Generic Specification No. 5000. The conditions shall be as specified in Table 5; the electrical circuits to be used are shown in Figure 5 of this specification.

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

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
1	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	I_C = -10mA I_B = 0 See Note 1	-60	-	V
2	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	I_C = -10µA I_E = 0	-60	-	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3001	I_E = -10µA I_C = 0	-5.0	-	V
5	Collector-Base Cut-off Current	I_{CBO}	3036	V_{CB} = -50V I_E = 0	-	-10	nA
6	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	I_C = -0.1mA; V_{CE} = -10V	75	-	-
7		h_{FE2}		I_C = -1.0mA; V_{CE} = -10V	100	-	
8		h_{FE3}		I_C = -150mA; V_{CE} = -10V (1)	100	300	
9		h_{FE4}		I_C = -500mA; V_{CE} = -10V (1)	50	-	
10	Collector Saturation Voltage	V_{CEsat}	3071	I_C = -150mA I_B = -15mA See Note 1	-	-0.4	V
11	Base Saturation Voltage	V_{BEsat}	3066	I_C = -150mA I_B = -15mA See Note 1	-	-1.3	V

NOTES

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

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

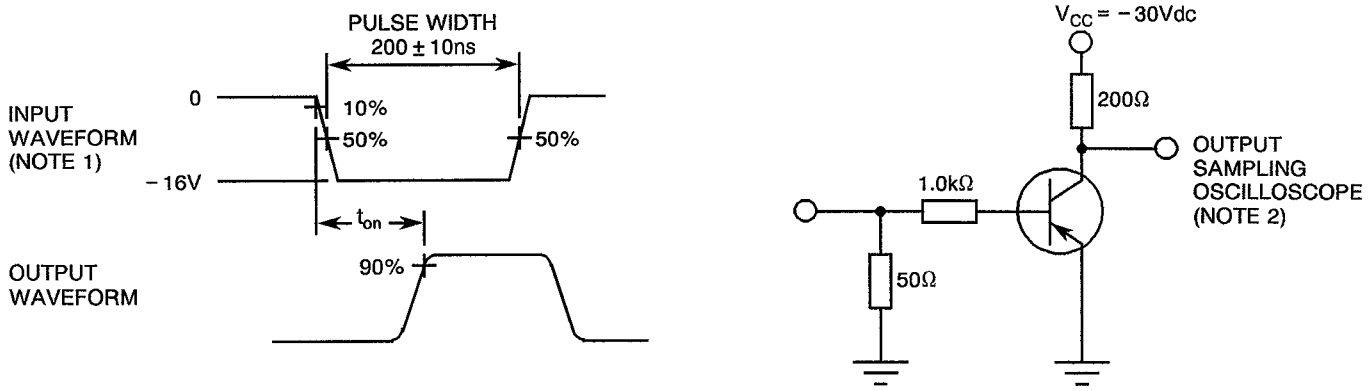
No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITION (Note 1)	LIMITS		UNIT
					MIN.	MAX.	
12	A.C. Forward Current Transfer Ratio	h_{fe}	3206	I_C = -50mA V_{CE} = -20V f = 100MHz	2.0	-	-
13	Output Capacitance	C_{obo}	3236	V_{CB} = -10V I_E = 0 100kHz ≤ f ≤ 1.0MHz	-	8.0	pF
14	Switching Times	t_{on}	Figure 4	I_C = -150mA, V_{CC} = -30V I_{B1} = -15mA	-	45	ns
15		t_{off}		I_C = -150mA, V_{CC} = -30V I_{B1} = I_{B2} = -15mA	-	300	

NOTES

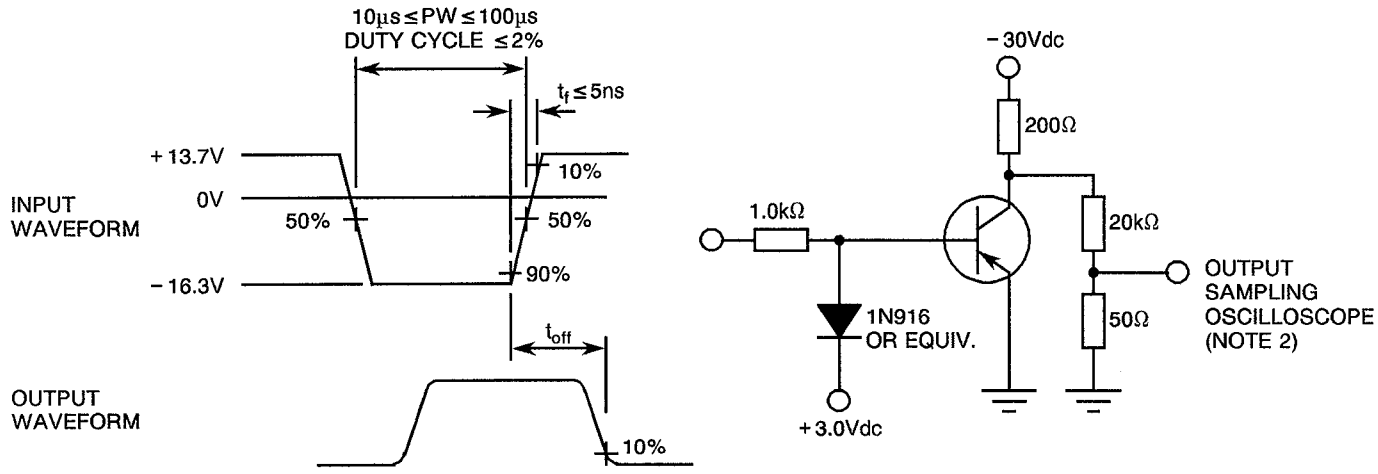
1. A.C. Parameters shall be performed on a sample basis, LTPD 7 or less.

FIGURE 4 - TEST CIRCUIT

SATURATED TURN-ON SWITCHING TIME TEST CIRCUIT



SATURATED TURN-OFF SWITCHING TIME TEST CIRCUIT



NOTES

1. The rise time (t_r) of the applied pulse shall be ≤2.0ns, duty cycle ≤2.0% and the generator source impedance shall be 50Ω.
2. Sampling Oscilloscope: Z_{in} ≥100kΩ, C_{in} ≤12pF, rise time ≤5.0ns.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
5	Collector-Base Cut-off Current	I_{CBO}	3036	V_{CB} = -50V I_E = 0 T_{amb} = +150°C	-	-10	µA

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITION	CHANGE LIMITS (Δ)	UNIT
5	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	±100 or (1) ±2.0	% nA
8	D.C. Forward Current Transfer Ratio	h_{FE3}	As per Table 2	As per Table 2	±15	%
9	Collector-Emitter Saturation Voltage	V_{CEsat}	As per Table 2	As per Table 2	±15 or (1) ±50	% mV

NOTES

1. Whichever is greater.

TABLE 5 - CONDITIONS FOR BURN-IN AND HIGH TEMPERATURE REVERSE BIAS

BURN-IN

No.	CHARACTERISTIC	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+20 to +50	°C
2	Power Dissipation	P_{tot}	Max. rating at T_{amb} according to derating curve	W
3	Collector-Base Voltage	V_{CB}	40	V

HIGH TEMPERATURE REVERSE BIAS

No.	CHARACTERISTIC	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+150	°C
2	Collector-Base (d.c.)	V_{CB}	-50	V
3	Duration	-	72	hrs

FIGURE 5 - ELECTRICAL CIRCUIT FOR POWER BURN-IN AND HTRB

Not applicable.

HIGH TEMPERATURE REVERSE BIAS

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.

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 test 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 CONDITION	LIMITS		UNIT
					MIN.	MAX.	
5	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	-	-10	nA
8	D.C. Forward Current Transfer Ratio	h_{FE3}	As per Table 2	As per Table 2	100	300	-
10	Collector-Emitter Saturation Voltage	V_{CEsat}	As per Table 2	As per Table 2	-	-0.4	V