



**TRANSISTORS, LOW POWER, PNP,  
BASED ON TYPE 2N2905A  
ESCC Detail Specification No. 5202/002**

**ISSUE 1  
October 2002**



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**TRANSISTORS, LOW POWER, PNP**

**BASED ON TYPE 2N2905A**

**ESA/SCC Detail Specification No. 5202/002**



**space components  
coordination group**

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**DOCUMENTATION CHANGE NOTICE**

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		<p>This issue supersedes Issue 4 and incorporates all modifications agreed on the basis of Policy DCR 21022, 21025 and 21026 and the following DCR's:-</p> <p>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 <math>T_{amb}</math> or <math>T_c</math> 23178  Table 2 : <math>V_{(BR)CBO}</math> and <math>V_{BESAT}</math> conditions corrected 22221/  23128  : Signs of conditions and limits amended 23144  : Reformatted 23178  Table 2 a.c. : <math>C_{OBO}</math> test method corrected and signs of conditions corrected 23144  : Table reformatted 23178  Table 3 : Signs of conditions and limits amended 23144  Tables 3 and 4 : Reformatted 23178  Table 5 : Burn-in <math>T_{amb}</math> changed and HTRB duration reduced 22221  Table 6 : Signs of limits amended 23144  : Reformatted 23178</p>		
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**DOCUMENTATION CHANGE NOTICE**

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'B'	Apr. 1992	P1. Cover page P2A. DCN P5. Para. 1.2 P6. Table 1(a)  P9. Para. 2 Para. 4.2.2 Para. 4.2.3 Para. 4.2.4 P10. Para. 4.3.3 Para. 4.4.2 P11. Para. 4.5.3 P16. Table 3 P20. Appendix 'A'	: Page number amended : Page added : Paragraph amended : Amended to include Variants 03 and 04, and notes added  : "ESA/SCC Basic Specification No. 23500" added : Bond Strength and Die Shear Test deviations deleted : PIND deviation deleted : H.T.R.B. deviation deleted : Radiographic Inspection deviation deleted : Bond Strength and Die Shear Test deviations deleted : "Applied Force..." amended : "Duration..." deleted : Paragraph amended : "... (see Table 1(a))" added : Note deleted : Page removed	22722 None 21021 22930  21025 23499 21043 23499 21049 23499 22930 22930 22930 21047 22722
'C'	June '95	P1. Cover page P2A. DCN P3. T of C P5. Para. 1.7 P6. Table 1(a) P10. Para. 4.4.2	: Para. 1.7 entry added : New paragraph added : Variant 05 added : Type '7' finish added	None None 21083 21083 221239 221239
		This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.		
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**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 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**

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

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

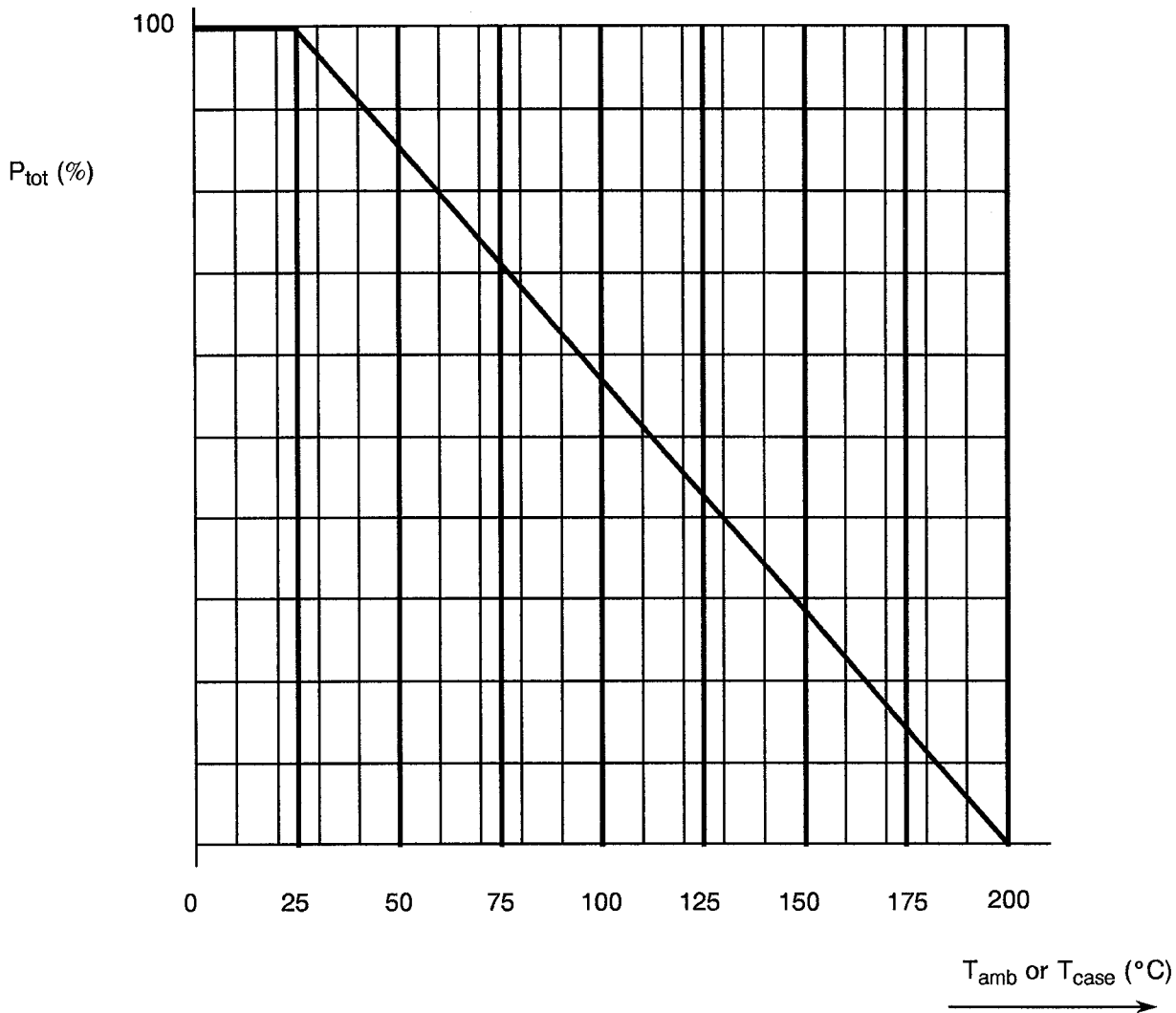
No.	CHARACTERISTIC	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	-60	V	
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	-60	V	
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	-5.0	V	
4	Collector Current	$I_C$	-0.6	A	
5	Power Dissipation 1	$P_{tot1}$	0.6	W	$T_{amb}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

**NOTES**

- For derating at  $T_{amb}$  or  $T_{case} > +25^{\circ}C$ , see Figure 1.



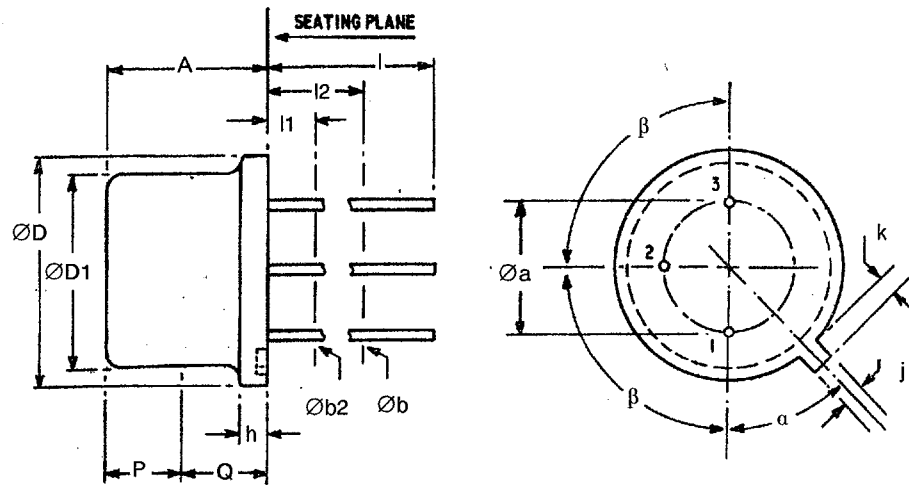
**FIGURE 1 - PARAMETER DERATING INFORMATION**



Power Dissipation versus Temperature



**FIGURE 2 - PHYSICAL DIMENSIONS**

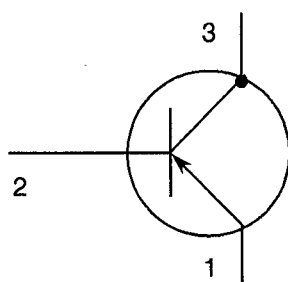


SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
Øa	0.190	0.210	4.83	5.35	
A	0.240	0.260	6.10	6.60	
Øb	0.016	0.021	0.406	0.533	2
Øb2	0.016	0.019	0.406	0.483	2
ØD	0.350	0.370	8.89	9.40	
ØD1	0.315	0.335	8.00	8.51	
h	0.009	0.125	0.229	3.18	
j	0.028	0.034	0.711	0.864	
k	0.029	0.040	0.737	1.02	3
l	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.

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**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:

Detail Specification Number		520200201B
Type Variant (see Table 1(a))		
Testing Level (B or C, as applicable)		

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 ( $\Delta$ ) 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	$I_C = -10\text{mA}$ $I_B = 0$ See Note 1	-60	-	V
2	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	$I_C = -10\mu\text{A}$ $I_E = 0$	-60	-	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3001	$I_E = -10\mu\text{A}$ $I_C = 0$	-5.0	-	V
5	Collector-Base Cut-off Current	$I_{CBO}$	3036	$V_{CB} = -50\text{V}$ $I_E = 0$	-	-10	nA
6	D.C. Forward Current Transfer Ratio	$h_{FE1}$	3076	$I_C = -0.1\text{mA}$ ; $V_{CE} = -10\text{V}$	75	-	-
7		$h_{FE2}$		$I_C = -1.0\text{mA}$ ; $V_{CE} = -10\text{V}$	100	-	
8		$h_{FE3}$		$I_C = -150\text{mA}$ ; $V_{CE} = -10\text{V}$ (1)	100	300	
9		$h_{FE4}$		$I_C = -500\text{mA}$ ; $V_{CE} = -10\text{V}$ (1)	50	-	
10	Collector Saturation Voltage	$V_{CEsat}$	3071	$I_C = -150\text{mA}$ $I_B = -15\text{mA}$ See Note 1	-	-0.4	V
11	Base Saturation Voltage	$V_{BEsat}$	3066	$I_C = -150\text{mA}$ $I_B = -15\text{mA}$ See Note 1	-	-1.3	V

**NOTES**1. Pulse measurement: Pulse length  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .





**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	$V_{CB} = -10V$ $I_E = 0$ $100kHz \leq f \leq 1.0MHz$	-	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	

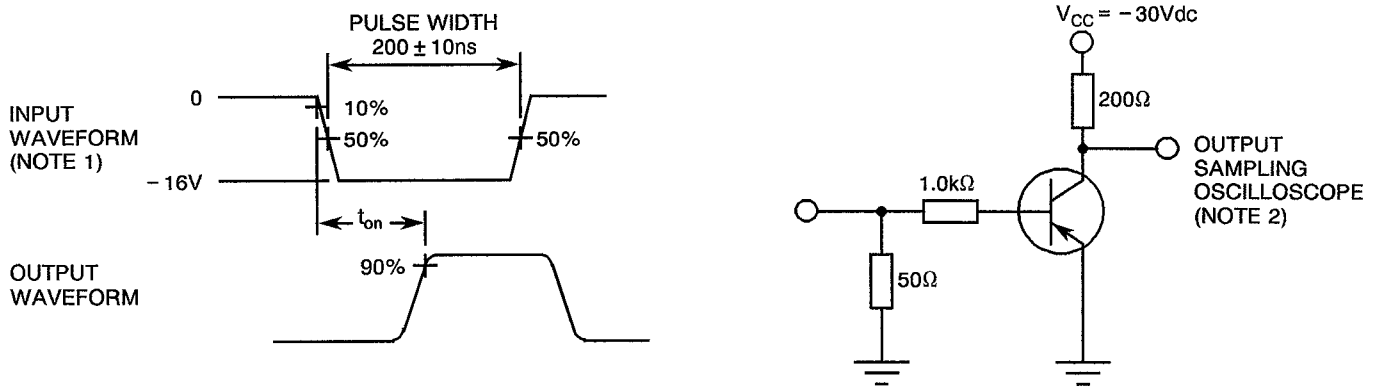
**NOTES**

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

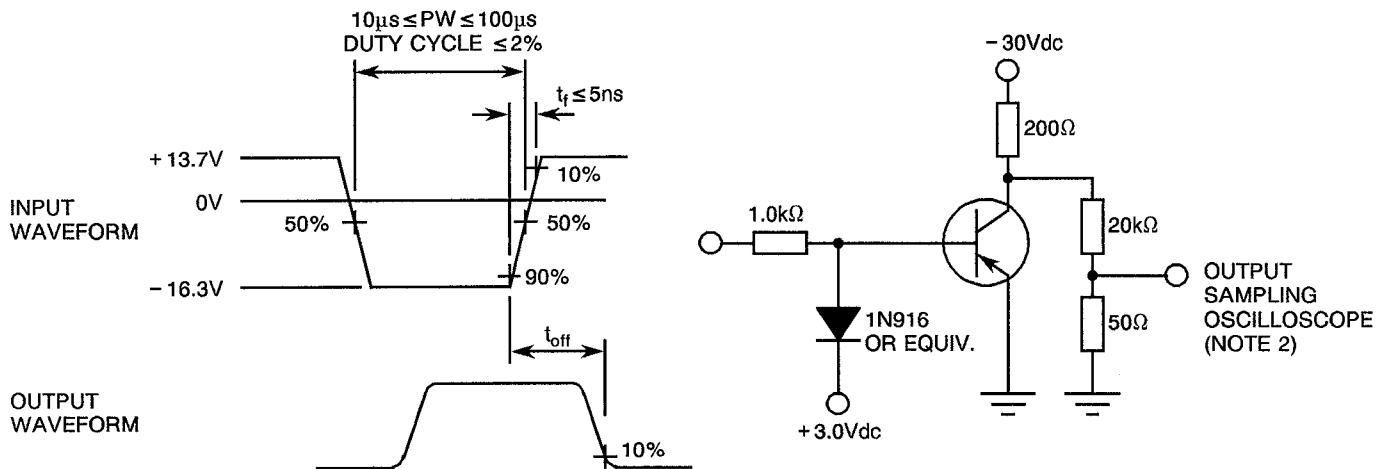


**FIGURE 4 - TEST CIRCUIT**

**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  $\leq 2.0\text{ns}$ , duty cycle  $\leq 2.0\%$  and the generator source impedance shall be  $50\Omega$ .
2. Sampling Oscilloscope:  $Z_{in} \geq 100\text{k}\Omega$ ,  $C_{in} \leq 12\text{pF}$ , rise time  $\leq 5.0\text{ns}$ .

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**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	$V_{CB} = -50V$ $I_E = 0$ $T_{amb} = +150^{\circ}C$	-	-10	$\mu A$

**TABLE 4 - PARAMETER DRIFT VALUES**

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITION	CHANGE LIMITS ( $\Delta$ )	UNIT
5	Collector-Base Cut-off Current	$I_{CBO}$	As per Table 2	As per Table 2	$\pm 100$ or (1) $\pm 2.0$	% nA
8	D.C. Forward Current Transfer Ratio	$h_{FE3}$	As per Table 2	As per Table 2	$\pm 15$	%
9	Collector-Emitter Saturation Voltage	$V_{CEsat}$	As per Table 2	As per Table 2	$\pm 15$ or (1) $\pm 50$	% 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  $T_{amb} = +22 \pm 3 \text{ }^\circ\text{C}$ .
- 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.

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**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