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Pages 1 to 19

TRANSISTORS, LOW POWER, NPN,

BASED ON TYPE 2N2219A

ESA/SCC Detail Specification No. 5201/003

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 5	January 1987	-	-
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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 defined in the following DCR's:-		
		T of C	: Para. 4.1 "Requirements" deleted from title	23257
			: Para. 4.2.1, Title amended	23257
			: Par.a 4.6, "Requirements" deleted from title	23257
			: Para. 4.6.1, Title amended	23257
			: Paras. 4.7.2 and 4.7.3, "Power" added to Title	23257
			: Table 2, Titles expanded	23257
			: Table 5, "Power" added to Title	23257
			: Figure 5, "Power" added to Title	23257
		Table 1(a)	: Case Type and Figure added	22459
		Table 1(b)	: Nos. 1, 2 and 3, Characteristics and Symbols amended	22459
			: No. 4 "(Continuous)" added to Characteristics	22459
		Figure 2	: Table and Notes re-written with metric measurements as prime	23257
		Para. 4.1	: "Requirements" deleted from title	23257
		Para. 4.2.2(c)	: PIND test and condition added	22459
		Paras. 4.2.2 to 4.2.4	: ESA/SCC 5000 Reference Para. Nos. added to subparagraphs	22459
		Para. 4.3.3	: Applied Force.."3 bends at 45°" added and duration deleted	22459
		Para. 4.4.1	: Paragraph re-written	22459

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Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		Para. 4.6	: "Requirements" deleted from title	23257
		Paras. 4.7.2 and 4.7.3	: "Power" added to Title and Text	23257
		Table 2	: Nos. 9, 10 and 11, Characteristics amended	22459
		Table 2 a.c.	: Note 2 amended	22459
		Figure 4(a)	: Collector load charge specified	22381
		Table 3	: No. 16 amended to read No. 4 and conditions aligned with Table 2	22381
			: Notes added	22459
		Table 4	: Note amended	22459
		Table 5	: "Power" added to Title	23257
		Figure 5	: "Power" added to Title	23257
		Table 6	: Tests 9 and 7 reversed in Table	23257
'A'	Feb. 1992	P1. Cover page		None
		P2A. DCN		None
		P5. Para. 1.2	: Paragraph amended	21021
		Para. 2	: ESA/SCC Basic Specification No. 23500 added	21025
		P6. Table 1(a)	: Amended to include Variants 03 and 04, and notes added	22928
		P9. Para. 4.2.2	: Bond Strength and Die Shear Test deviations deleted	23499
			: PIND deviation deleted	21043
		Para. 4.2.3	: Paragraph layout standardised	22928
			: Radiographic Inspection deviation deleted	21049
		Para. 4.2.4	: Bond Strength and Die Shear Test deviations deleted	23499
		P14. Table 2	: No. 14, "V_{CC} = 30V" added	22928
			: No. 15, "V_{CC} = 30V" added	22928
			: Note 1, "300ns" amended to read "300µs"	22928
		P16. Table 3	: Note 2 deleted	21047
		P10. Para. 4.4.2	: Text rewritten	22928

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE Reference / Item	Approved DCR No.
'B'	June '95	P1. Cover page	None
		P2B. DCN : Page added	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.	
'C'	Aug. '96	P1. Cover page	None
		P2B. DCN	None
		P10. Para. 4.3.3 : Applied Force deleted	221332

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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, NPN , based on Type 2N2219A.

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.

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.

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.

TABLE 1(a) - TYPE VARIANTS

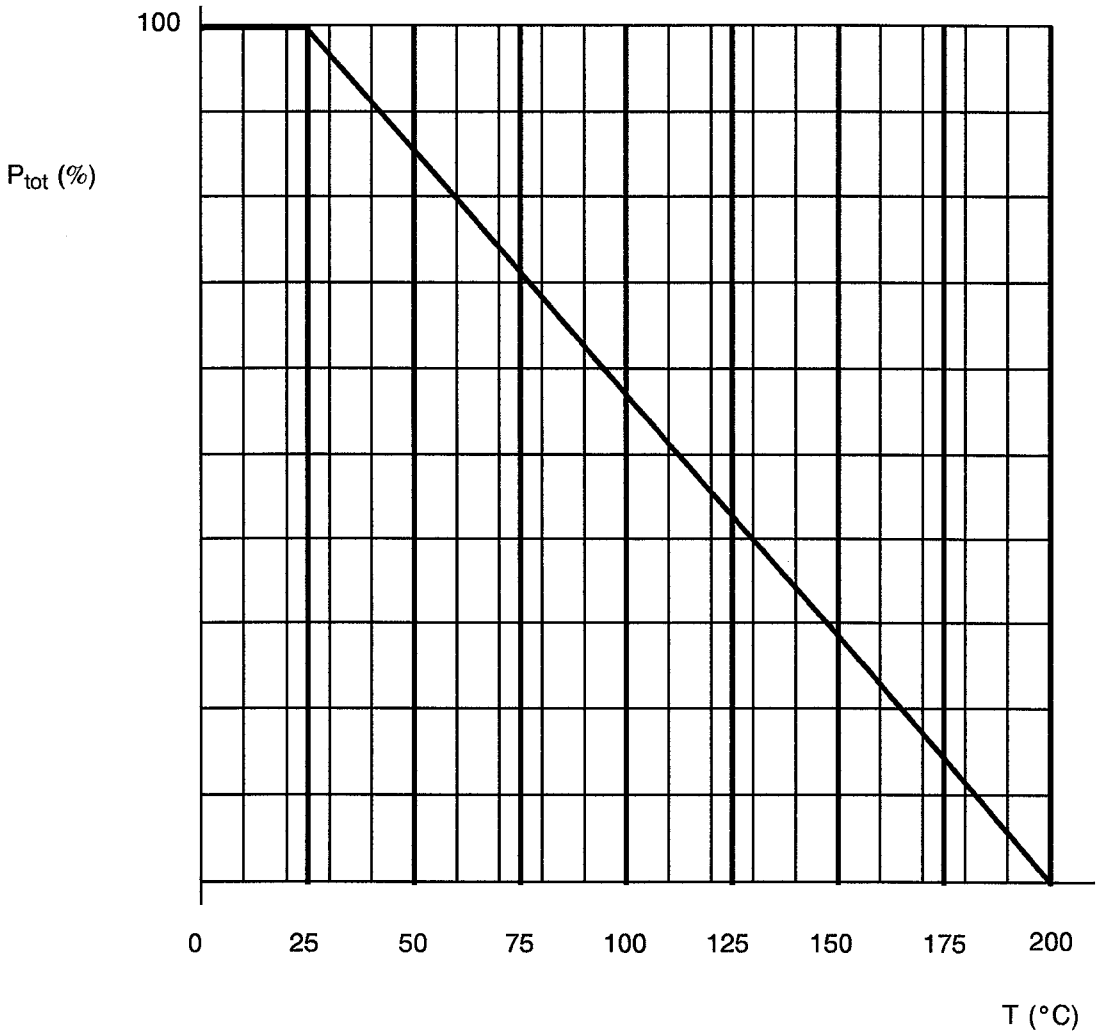
VARIANT	BASED ON TYPE	FIGURE	LEAD MATERIAL AND FINISH
01	2N2219A	2	D2 (1)
02	2N2219A	2	D3 or D4 (1)
03	2N2219A	2	E/B = D2, C = F2 (2)
04	2N2219A	2	E/B = D4, C = F4 (2)
05	2N2219A	2	D7 (1)

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

TABLE 1(b) - MAXIMUM RATINGS

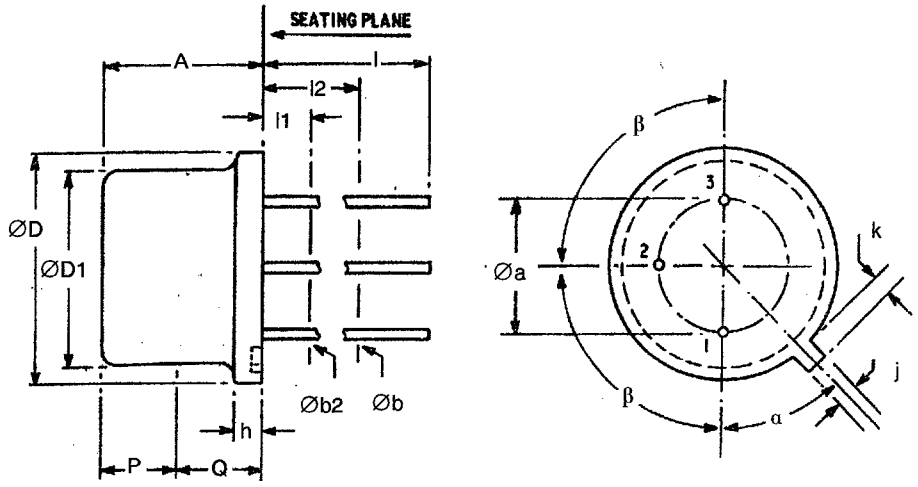
No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Collector-Base Voltage	V_{CBO}	75	V	
2	Collector-Emitter Voltage	V_{CEO}	40	V	
3	Emitter-Base Voltage	V_{EBO}	6.0	V	
4	Collector Current (Continuous)	I_C	0.8	A	
5	Power Dissipation	P_{tot}	0.8	W	$T_{amb} \leq +25°C$ (See Figure 1 for derating)
6	Power Dissipation	P_{tot}	3.0	W	$T_{case} \leq +25°C$ (See Figure 1 for derating)
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

FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS

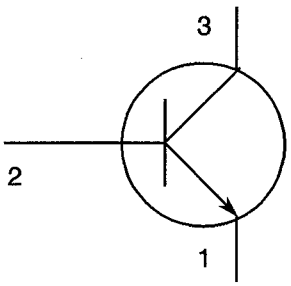


SYMBOL	MILLIMETRES		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
Øa	4.83	5.33	0.190	0.210	
A	6.10	6.60	0.240	0.260	
Øb	0.406	0.533	0.016	0.021	2
Øb2	0.406	0.483	0.016	0.019	2
ØD	8.89	9.40	0.350	0.370	
ØD1	8.00	8.51	0.315	0.335	
h	0.229	3.18	0.009	0.125	
j	0.711	0.864	0.028	0.034	
k	0.737	1.02	0.029	0.040	3
l	12.70	-	0.500	-	2
l1	-	1.27		0.050	2
l2	6.35	-	0.250		2
P	2.54	-	0.100		5
Q					4
α	45° NOMINAL		45° NOMINAL		
β	90° NOMINAL		90° NOMINAL		

NOTES

1. Imperial equivalents (to the neares 0.001 inches) are given for general information only and are based on 25.4mm = 1.0inch.
2. (Three leads) Øb2 applies between l1 and l2. Ø b applies between l2 and 12.70mm (0.5") from the Seating Plane. Diameter is uncontrolled in l1 and beyond 12.70mm (0.5") from the Seating Plane.
3. Measured from maximum diameter of the actual device.
4. Details of outline in this zone optional.
5. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.254mm (0.010").

FIGURE 3 - FUNCTIONAL DIAGRAM



1. Emitter
2. Base
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 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)

(a) Para. 9.22, HTRB 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.

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' 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.

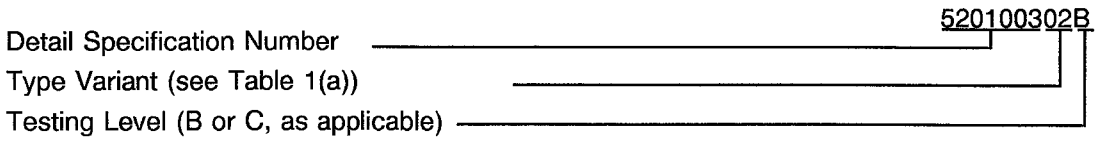
(c) Traceability Information.

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. 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 Power Burn-in

The requirements for power 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 of this specification.

4.7.3 Electrical Circuits for Power Burn-in

Circuits for use in performing the power burn-in tests 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	40	-	V
2	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	$I_C = 10\mu A$ $I_E = 0$	75	-	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	$V_{CB} = 60V$ $I_E = 0$	-	10	nA
5	Emitter-Base Cut-off Current	I_{EBO}	3061	$V_{EB} = 3.0V$ $I_C = 0$	-	10	nA
6	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$I_C = 10mA$ $V_{CE} = 10V$ See Note 1	75	-	-
7		h_{FE2}		$I_C = 150mA$ $V_{CE} = 10V$ See Note 1	100	300	
8		h_{FE3}		$I_C = 500mA$ $V_{CE} = 10V$ See Note 1	40	-	
9	Collector-Emitter Saturation Voltage	$V_{CE(sat)1}$	3071	$I_C = 150mA$ $I_B = 15mA$ See Note 1	-	0.3	V
10		$V_{CE(sat)2}$		$I_C = 500mA$ $I_B = 50mA$ See Note 1	-	1.0	
11	Base-Emitter Saturation Voltage	$V_{BE(sat)}$	3066	$I_C = 150mA$ $I_B = 15mA$ See Note 1	-	1.2	V

NOTES: See Page 14.

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

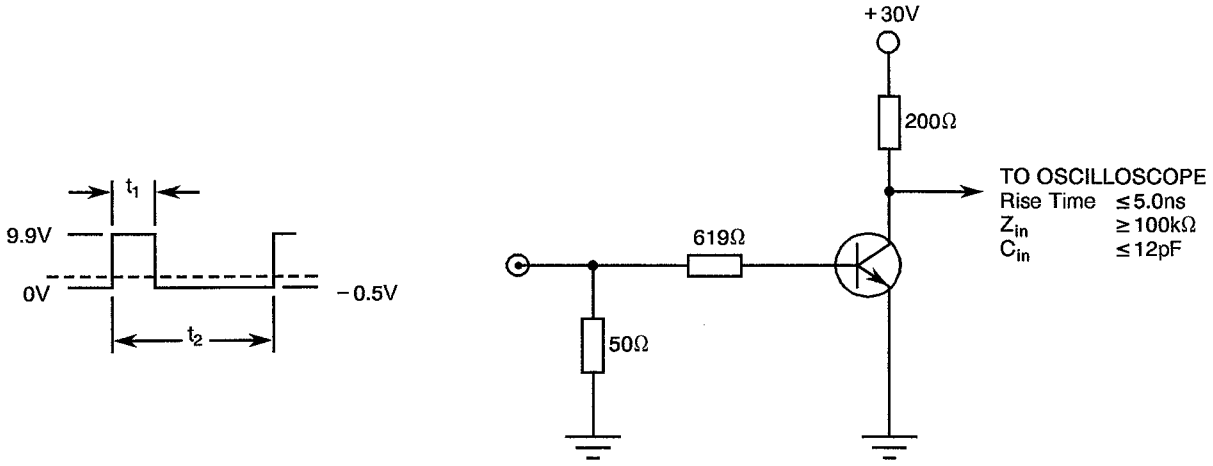
No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
12	A.C. Forward Current Transfer Ratio	h_{fe}	3206	$I_C = 20mA$ $V_{CE} = 20V$ $f = 100MHz$	2.5	-	-
13	Output Capacitance	C_{obo}	3236	$V_{CB} = 10V$ $I_E = 0$ $100KHz \leq f \leq 1.0MHz$	-	8.0	pF
14	Turn-on Time	t_{on}	Fig. 4(a)	$I_C = 150mA$ $I_B = 15mA$, $V_{CC} = 30V$	-	35	ns
15	Turn-off Time	t_{off}	Fig. 4(b)	$I_C = 150mA$, $V_{CC} = 30V$ $I_{B1} = I_{B2} = 15mA$	-	300	ns

NOTES

1. Pulse measurement: Pulse length $\leq 300\mu s$; Duty Cycle $\leq 2.0\%$.
2. Measurements performed on a sample basis, LTPD 7 or less.

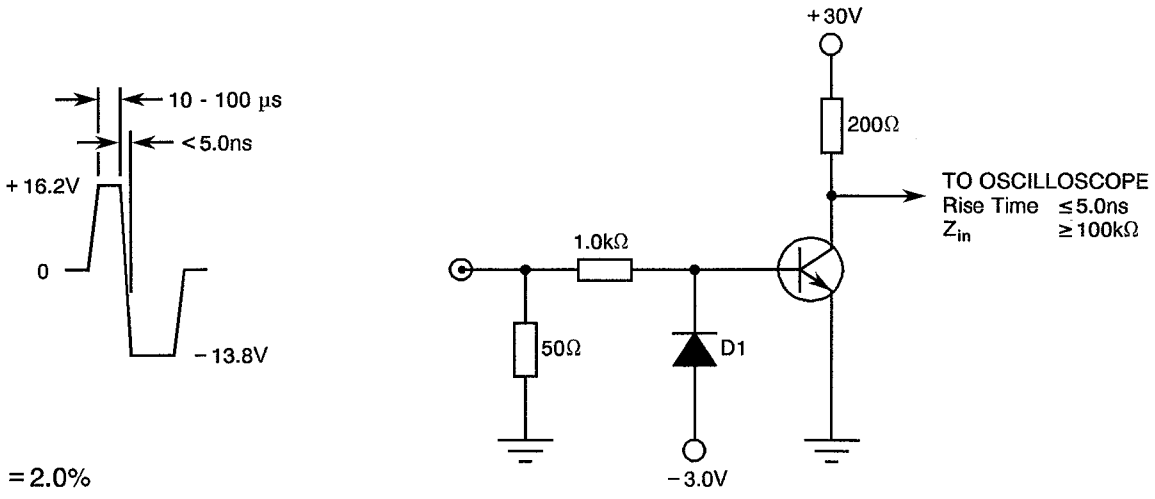
FIGURE 4 - TEST CIRCUIT

FIGURE 4(a) - TEST CIRCUIT FOR MEASUREMENT OF TURN-ON TIME



Input:
Rise time ≤2.0ns
Duty Cycle = 2.0% = $\frac{t_1}{t_2}$

FIGURE 4(b) - TEST CIRCUIT FOR MEASUREMENT OF TURN-OFF TIME



Duty Cycle = 2.0%

NOTES

1. D1 similar to 1N916.
   T_{rr} = max.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
4	Collector-Base Cut-off Current	I_{CBO}	3036	V_{CB} = 60V I_E = 0 T_{amb} = +150°C	-	10	µA
6	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	I_C = 10mA V_{CE} = 10V T_{amb} = -55°C See Note 1	35	-	-

NOTES

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

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITION	CHANGE LIMITS (Δ)	UNIT
4	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	±100 or (1) ±2	% nA
7	DC Forward Current Gain Ratio	h_{FE2}	As per Table 2	As per Table 2	±15	%
9	Collector-Emitter Saturation Voltage	$V_{CE(sat)1}$	As per Table 2	As per Table 2	±15 or (1) ±30	% mV

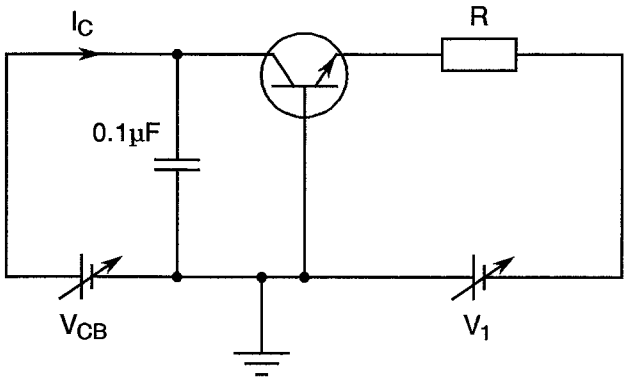
NOTES

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

TABLE 5 - CONDITIONS FOR POWER 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}	10 to 40	V

FIGURE 5 - ELECTRICAL CIRCUIT FOR POWER BURN-IN



NOTES

1. V_{CB} set for 30V.
   V_1 adjusted so that P_{tot} = max. rating at T_{amb} according to derating curve.
   R chosen according to availability of V_1, as long as: $V_1 + V_{CB} < V_{CEO}$.

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 tests 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.	
4	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	-	10	nA
7	D.C. Forward Current Transfer Ratio	h_{FE2}	As per Table 2	As per Table 2	100	300	-
9	Collector-Emitter Saturation Voltage	$V_{CE(sat)1}$	As per Table 2	As per Table 2	-	0.3	V