TRANSISTORS, HIGH POWER, NPN,

BASED ON TYPES 2N3439 AND 2N3440

ESCC Detail Specification No. 5203/011

ISSUE 1

October 2002

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space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 4	August 1996		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE Reference / Item	Approved DCR No.
		This Issue supersedes Issue 3 and incorporates all modifications defined in Revisions 'A', 'B', 'C' and 'D' to Issue 3 and the changes agreed in the following DCR's:-	
		Cover page	None
		DCN	None
		Para. 4.3.3 : Applied force deleted	221332

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TABLES

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 a Transistor, High Power, NPN, based on Types 2N3439 and 2N3440. 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-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.

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	2N3439	TO5	2(a)	D2	(1)
02	2N3439	TO39	2(b)	D2	(1)
03	2N3439	TO5	2(a)	D3 or D4	(1)
04	2N3439	TO39	2(b)	D3 or D4	(1)
05	2N3440	TO5	2(a)	D2	(1)
06	2N3440	TO39	2(b)	D2	(1)
07	2N3440	TO5	2(a)	D3 or D4	(1)
08	2N3440	TO39	2(b)	D3 or D4	(1)
09	2N3439	TO39	2(b)	E/B = D2. C = F2	(2)
10	2N3439	TO39	2(b)	E/B = D4. C = F4	(2)
11	2N3440	TO39	2(b)	E/B = D2. C = F2	(2)
12	2N3440	TO39	2(b)	E/B = D4. C = F4	(2)
13	2N3439	TO39	2(b)	D7	(1)
14	2N3440	TO39	2(b)	D7	(1)

NOTES

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

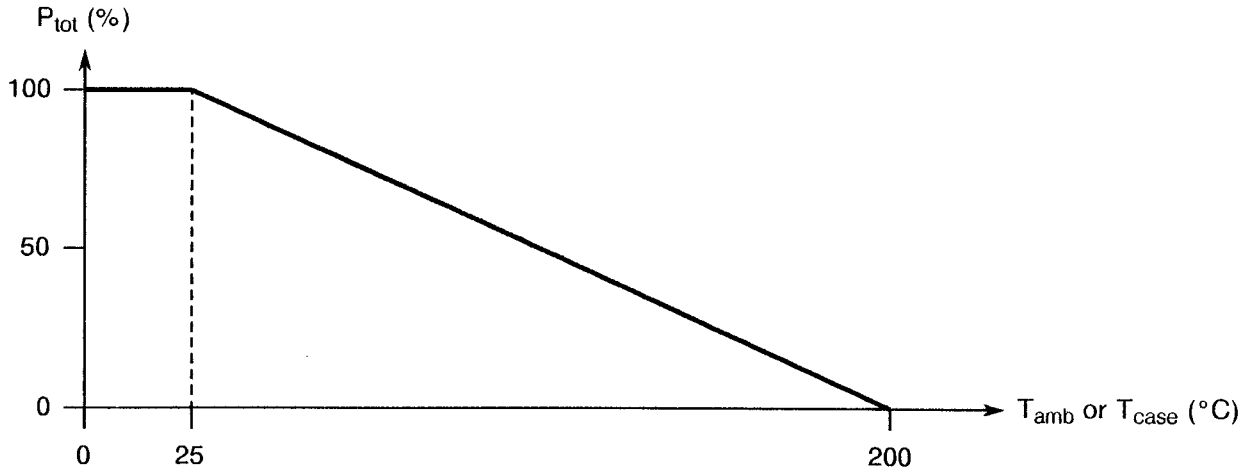
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector - Base Voltage Variants 01 to 04, 09, 10, 13 Variants 05 to 08, 11, 12, 14	V_{CBO}	 450 300	V	
2	Collector - Emitter Voltage Variants 01 to 04, 09, 10, 13 Variants 05 to 08, 11, 12, 14	V_{CEO}	 350 250	V	
3	Emitter - Base Voltage	V_{EBO}	7.0	V	
4	Collector Current	I_C	1.0	A	
5	Power Dissipation	P_{tot}	0.8	W	T_{amb} = +25°C Note 1
6	Power Dissipation	P_{tot}	5.0	W	T_{case} = +25°C Note 2
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 sec. Distance from case: ≥ 1.5mm

NOTES

1. At T_{amb} > +25°C, derate at 4.57mW/°C. See Figure 1.
2. At T_{case} > +25°C, derate at 28.5mW/°C. See Figure 1.

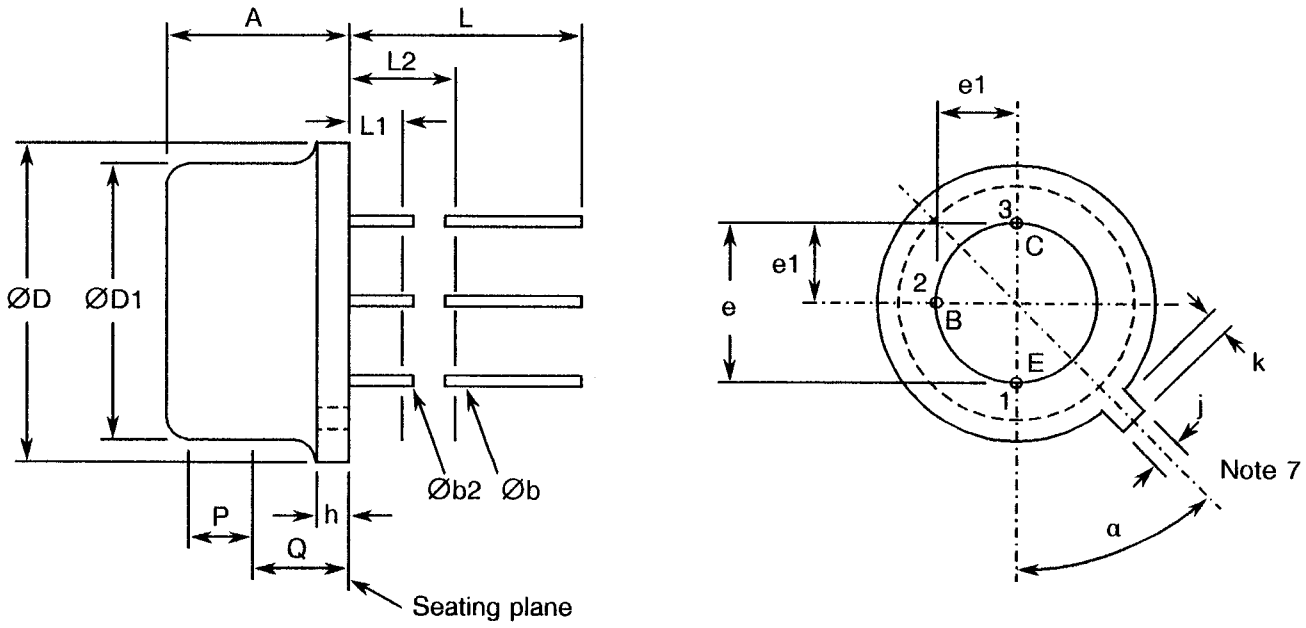
FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a) - TO5 CASE

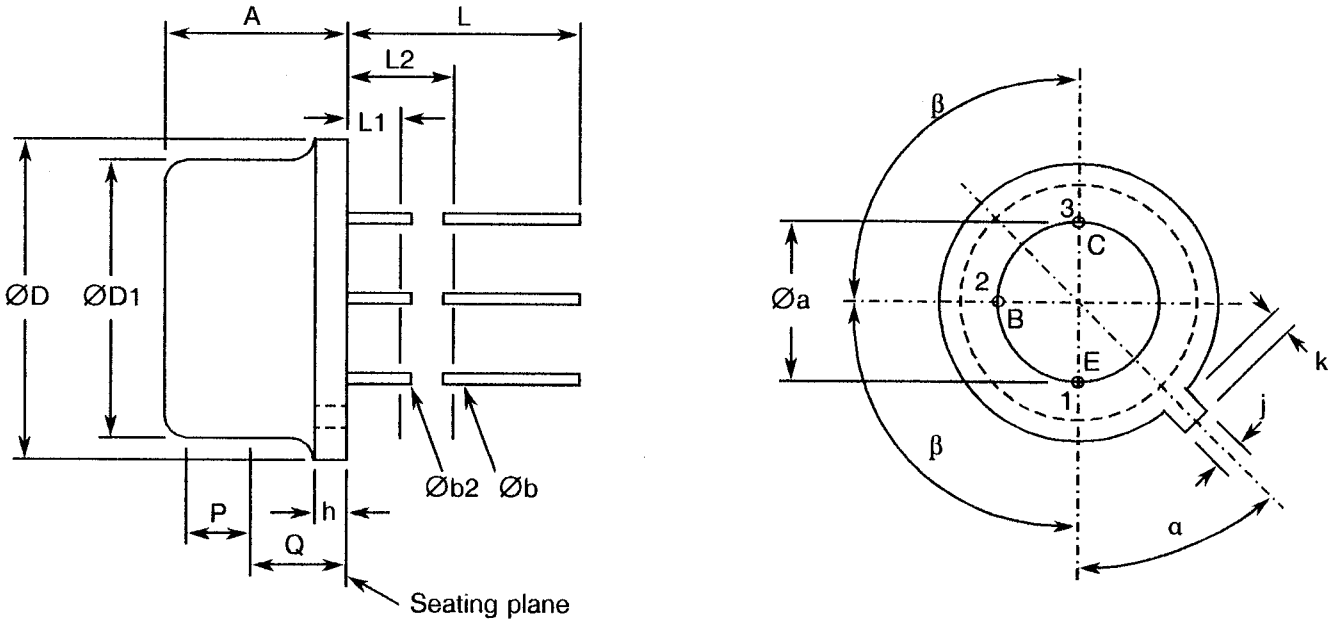


SYMBOL	MILLIMETRES		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	6.10	6.60	0.240	0.260	
Øb	0.406	0.533	0.016	0.021	2
Øb2	0.406	0.483	0.016	0.019	2
ØD	8.51	9.40	0.335	0.370	
ØD1	7.75	8.51	0.305	0.335	
e	5.08 T.P.		0.200 T.P.		4, 5
e1	2.54 T.P.		0.100 T.P.		5
h	0.229	3.18	0.009	0.125	
j	0.711	0.864	0.028	0.034	5
k	0.737	1.14	0.029	0.045	3, 5
L	12.70	-	0.500	-	2
L1	-	1.27	-	0.050	2
L2	6.35	-	0.250	-	2
P	2.54	-	0.100	-	1
Q	-	-	-	-	6
r	-	0.179	-	0.007	
α	45°				5, 7

NOTES: See Page 10.

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

FIGURE 2(b) - 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	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	-	1
Q	-	-	-	-	6
α	45°				
β	90°				

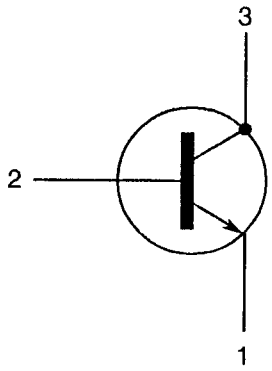
NOTES: See Page 10.

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

NOTES

1. This zone is controlled for automatic handling. The variation in actual diameter within the zone shall not exceed 0.010 inch (0.254mm).
2. (3 leads) Øb2 applies between L1 and L2. Øb applies between L2 and 1.5 inch (38.10mm) from seating plane. Diameter is uncontrolled in L1 and beyond 1.5 inch (38.10mm) from seating plane.
3. Measured from maximum diameter of the actual device.
4. Leads having maximum diameter 0.019 inch (0.483mm) measured in gauging plane 0.054 inch (1.37mm) + 0.001 inch (0.025mm) − 0.000 inch (0.000mm) below the seating plane of the device shall be within 0.007 inch (0.178mm) of their true positions relative to the maximum width tab.
5. The device may be measured by direct methods or by the gauge and gauging procedure described on gauge drawing GS-1.
6. Details of outline in this zone optional.
7. Tab centreline.
8. Imperial equivalents (to the nearest 0.001 inch) are given for general information only and are based on 25.4mm = 1.0 inch.

FIGURE 3 - FUNCTIONAL DIAGRAM



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

NOTES

1. The collector is internally 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. 9.22, 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 1.5 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 or preform soldered.

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.

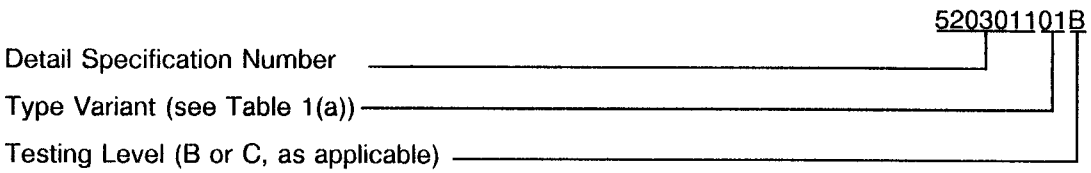
(c) Traceability Information.

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, 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, 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 power 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	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
1	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	3001	$I_C = 100\mu A$ Variants 01 to 04, 09, 10, 13 Variants 05 to 08, 11, 12, 14	 450 300	 - -	V
2	Collector-Emitter Sustaining Voltage	$V_{CEO(SUS)}$	-	$I_B = 5.0mA$ $I_C = 50mA$ Variants 01 to 04, 09, 10, 13 Variants 05 to 08, 11, 12, 14 See Figure 4	 350 250	 - -	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	$I_B = 1.0mA$ $I_C = 0A$	7.0	-	V
4	Collector-Emitter Cut-off Current	I_{CEX}	3041	Variants 01 to 04, 09, 10, 13 $V_{CE} = 250V$, $V_{BE} = -1.5V$ Variants 05 to 08, 11, 12, 14 $V_{CE} = 300V$, $V_{BE} = -1.5V$	-	500	µA
5	Collector-Base Cut-off Current	I_{CBO}	3036	Variants 01 to 04, 09, 10, 13 $V_{CB} = 360V$, $I_E = 0A$ Variants 05 to 08, 11, 12, 14 $V_{CB} = 250V$, $I_E = 0A$	-	20	µA
6	Emitter-Base Cut-off Current	I_{EBO}	3061	$V_{BE} = 6.0V$ $I_C = 0A$	-	20	µA
7	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$V_{CE} = 10V$, $I_C = 20mA$ Note 1	40	160	-
		h_{FE2}	3076	$V_{CE} = 10V$, $I_C = 2.0mA$ Note 1	30	-	
8	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	3071	$I_C = 50mA$ $I_B = 4.0mA$ Notes 1 and 2	-	0.5	V
9	Base-Emitter Saturation Voltage	$V_{BE(sat)}$	3066	$I_C = 50mA$ $I_B = 4.0mA$ Notes 1 and 2	-	1.3	V

NOTES: See Page 15.

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

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS (NOTE 3)	LIMITS		UNIT
					MIN	MAX	
10	A.C. Forward Current Transfer Ratio	h_{fe}	3206	V_{CE} = 10V I_C = 10mA f = 5.0MHz	3.0	15	-
11	Open Circuit Output Capacitance	C_{obo}	3236	V_{CB} = 10V I_E = 0A f = 1.0MHz	-	10	pF

NOTES

1. Pulsed measurement: Pulse Length ≤300us, Duty Cycle ≤2.0%.
2. Saturation voltage measured 6.0mm from header.
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	
5	Collector-Emitter Cut-off Current	I_{CBO}	3036	Variants 01 to 04, 09, 10, 13 V_{CB} = 360V, I_E = 0A Variants 05 to 08, 11, 12, 14 V_{CB} = 250V, I_E = 0A T_{amb} = +150°C	-	500	µA
7	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	V_{CE} = 10V, I_C = 20mA T_{amb} = −55°C Note 1	20	-	-

NOTES

1. Pulsed measurement: Pulse Length ≤300us, Duty Cycle ≤2.0%.

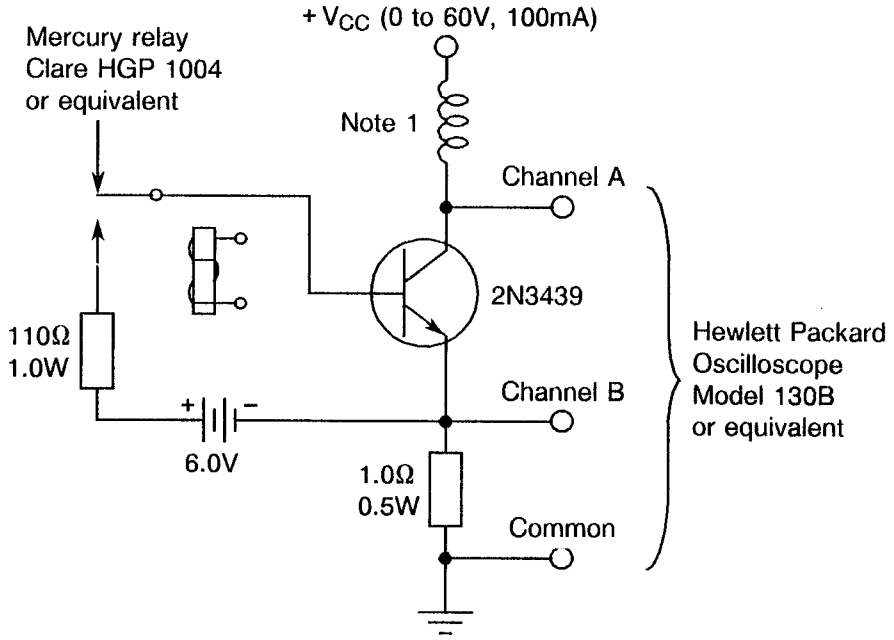
TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
5	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	±4.0	µA
7	D.C. Forward Current Transfer Ratio	h_{FE1}	As per Table 2	As per Table 2	±20	%
8	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	As per Table 2	As per Table 2	±50	mV

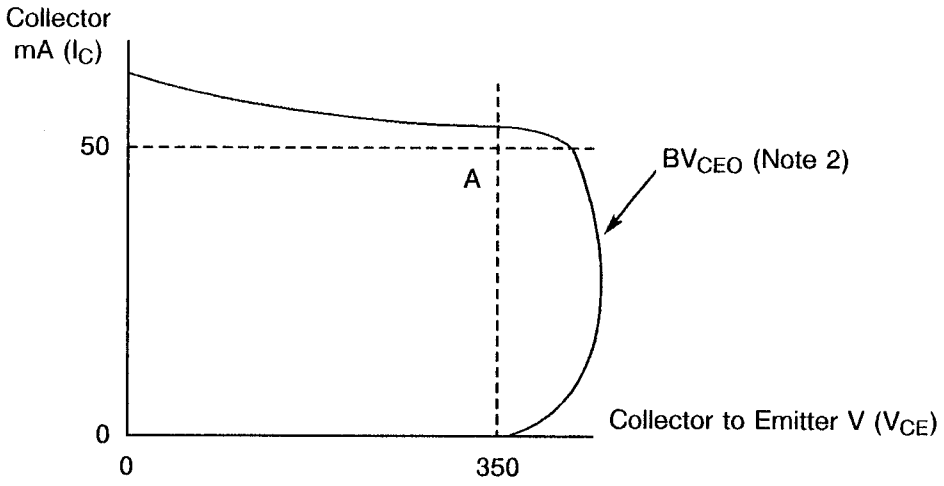
NOTES

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

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS



OSCILLOSCOPE DISPLAY



NOTES

1. L = 25mH, Q = 76, R = 83.4Ω, I = 75mA (J.W. Miller No. 6308 or equivalent).
2. BV_{CEO} is acceptable when the trace falls to the right and above point "A".

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

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Ambient Temperature	T_{amb}	$+25 \pm 3$	°C
2	Collector-Emitter Voltage	V_{CE}	250	V
3	Power Dissipation	P_{tot}	0.8 Note 1	W

NOTES

1. No heatsink 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. 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 testing 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 for the power 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 power-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 CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
5	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	-	20	µA
7	D.C. Forward Current Transfer Ratio	h_{FE1}	As per Table 2	As per Table 2	40	160	-
8	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	As per Table 2	As per Table 2	-	0.5	V