TRANSISTORS, POWER, NPN,

ISOLATED COLLECTOR,

BASED ON TYPE 2N3749

ESCC Detail Specification No. 5203/014

ISSUE 1

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Pages 1 to 24

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space components
coordination group

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		SCCG Chairman	ESA Director General or his Deputy
Issue 2	June 1983	-	-
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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 1 and incorporates all modifications agreed on the basis of Policy DCR's 21022, 21025 and the following DCR's:-		
		Table 1(a)	: Correct identification of TO 111/I case for Variants -01 to -04	23095
		Figure 2(a)	: Correct identification of TO 111/I case for Variants -01 to -04	23095
		Figure 2(b)	: Amendment of left-hand Figure and some dimensions in Table	23095
'A'	Feb. '92	P1. Cover Page		None
		P2. DCN		None
		P5. Para. 1.2	: Paragraph amended	21021
		P11. Para. 2	: "ESA/SCC Basic Spec. No. 23500" added	21025
		Para. 4.2.2	: PIND deviation deleted	21043
			: Bond Strength and Die Shear Test deviations deleted	23499
		P12. Para. 4.2.3	: Radiographic Inspection deviation deleted	21049
		Para. 4.2.4	: Bond Strength and Die Shear Test deviations deleted	23499
		P19. Tables 3(a), (b)	: 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
		P2. DCN		None
		P5. Para. 1.7	: Text amended	21083

TABLE OF CONTENTS

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 Transistors, Power, NPN, with Isolated Collector, based on Type 2N3749.

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.

1.8 BERYLLIUM OXIDE WARNING

THESE COMPONENTS CONTAIN BERYLLIUM OXIDE, THE DUST OF WHICH IS HIGHLY TOXIC. DISPOSAL BY PUBLIC WASTE SYSTEM IS STRICTLY FORBIDDEN.

TABLE 1(a) - TYPE VARIANTS

VARIANT	CASE	FIGURE	LEAD FINISH	SECOND BREAKDOWN ENERGY
01	TO 111/I	2(a)	D2	1.0 mJ
02	TO 111/I	2(a)	D3 or D4	1.0 mJ
03	TO 111/I	2(a)	D2	-
04	TO 111/I	2(a)	D3 or D4	-
05	TO 228AA	2(b)	D2	1.0 mJ
06	TO 228AA	2(b)	D3 or D4	1.0 mJ
07	TO 228AA	2(b)	D2	-
08	TO 228AA	2(b)	D3 or D4	-

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Voltage	V_{CB}	150	Vdc	
2	Collector-Emitter Voltage	V_{CE}	80	Vdc	
3	Emitter-Base Voltage	V_{EB}	8.0	Vdc	
4	Continuous Collector Current	I_C	5.0	Adc	See Figure 1(a)
5	Continuous Base Current	I_B	500	mAdc	
6	Continuous Power Dissipation	P_{tot}	30 40	W	Notes 1 and 4 Notes 1 and 5
7	Second Energy Breakdown	$E_{S/B}$	1.0	mJ	Note 2
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 3

NOTES

1. For T_{case} > +100°C, derate according to Figure 1(b).
2. Type Variants 01, 02, 05 and 06 only.
3. Duration: 10 seconds maximum at a distance of not less than 1.5mm from the can and the same lead shall not be resoldered until 3 minutes have elapsed.
4. Type Variants 01 through 04.
5. Type Variants 05 through 08.

FIGURE 1(a) - MAXIMUM SAFE OPERATING AREA

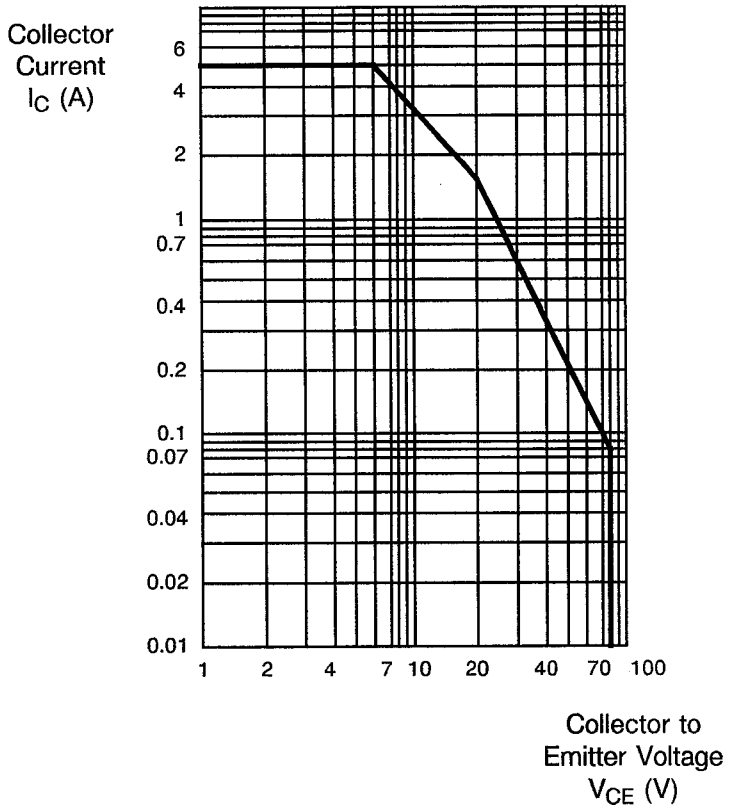


FIGURE 1(b) - DEVICE DISSIPATION DERATING WITH TEMPERATURE

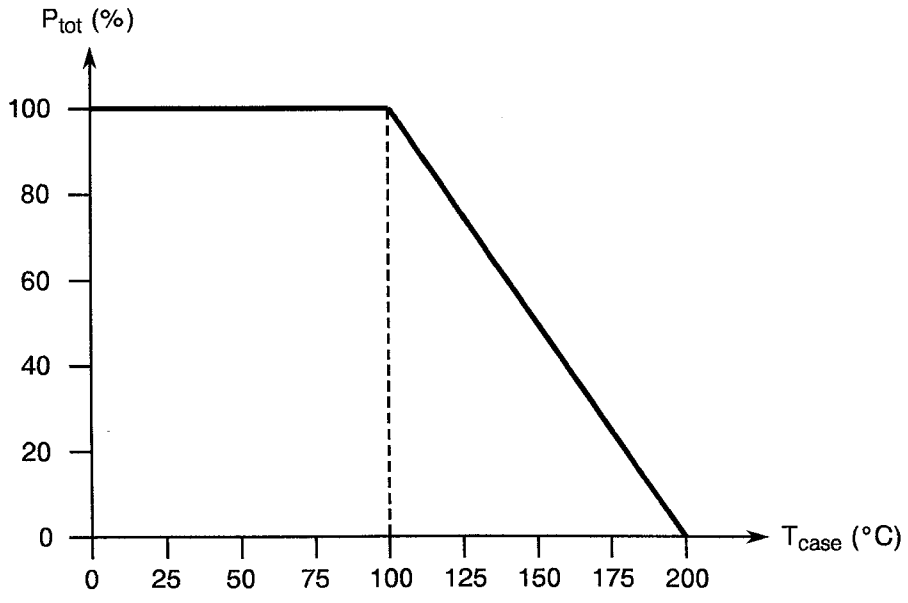
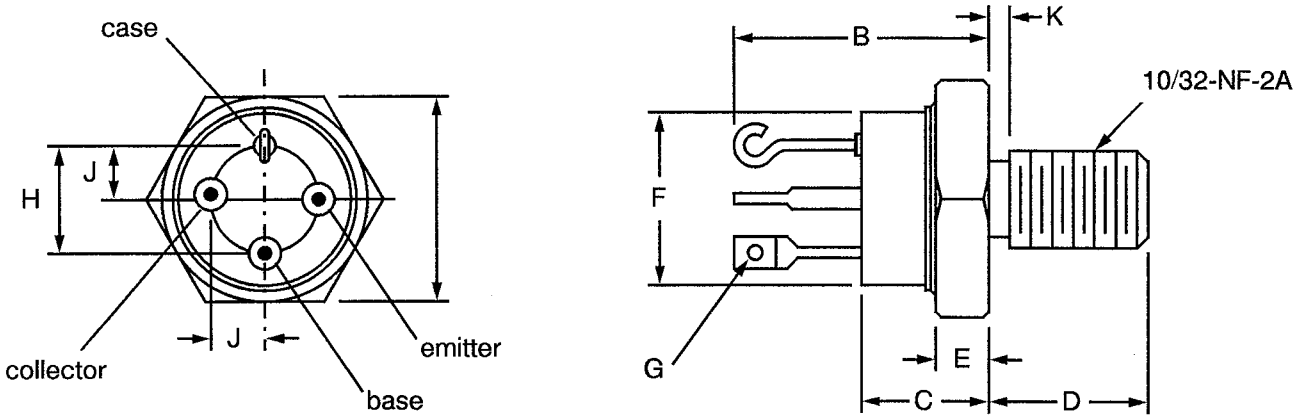


FIGURE 2 - PHYSICAL DIMENSIONS

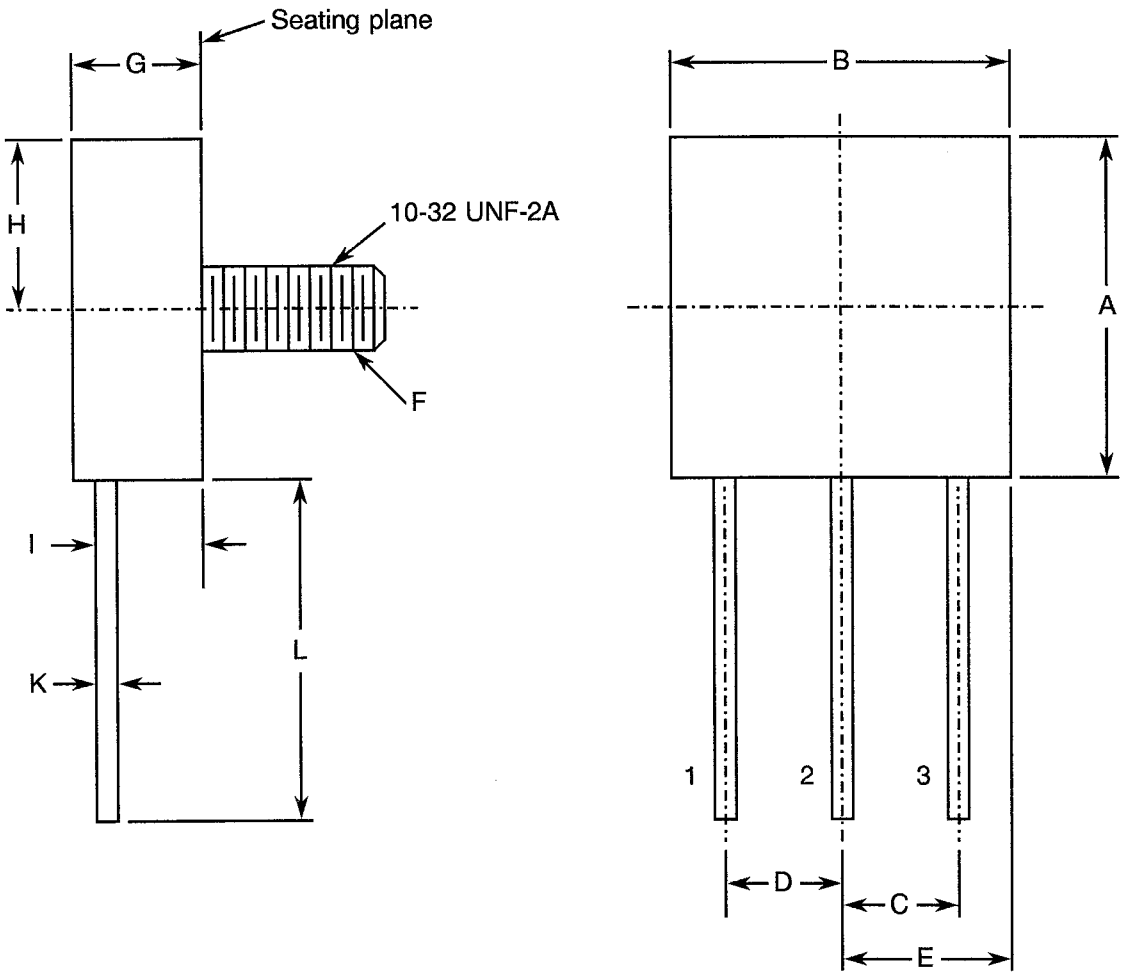
FIGURE 2(a) - TO 111/I OUTLINE



SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX	
A	0.427	0.437	10.85	11.10	
B	0.610	0.705	15.49	17.91	
C	0.345	0.400	8.76	10.16	
D	0.400	0.440	10.16	11.18	
E	0.105	0.125	2.67	3.18	
F	0.340	0.355	8.64	9.02	
G	0.050	0.065	1.27	1.65	Diameter
H	0.175	0.205	4.45	5.21	Diameter
J	0.088	0.103	2.23	2.61	
K	-	0.078	-	1.98	

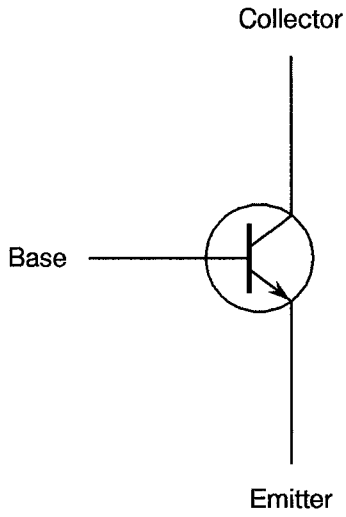
FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

FIGURE 2(b) - TO 228AA OUTLINE



SYMBOL	INCHES		MILLIMETRES	
	MIN.	MAX.	MIN.	MAX
A	0.475	0.525	12.07	13.33
B	0.475	0.525	12.07	13.33
C	0.143	0.153	3.64	3.88
D	0.143	0.153	3.64	3.88
E	0.238	0.262	6.05	6.65
F	0.390	0.440	9.91	11.17
G	0.300	0.350	7.62	8.89
H	0.238	0.262	6.05	6.65
I	0.201	0.238	5.15	6.03
K	0.035	0.045	0.89	1.14
L	0.475	0.525	12.07	13.33

FIGURE 3 - FUNCTIONAL DIAGRAM



NOTES

1. The collector is electrically isolated from 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 Semiconductor Components.

(b) MIL-STD-750, Test Methods and Procedures for Semiconductor Devices.

(c) MIL-STD-105, Sampling Procedures and Tables for Inspection by Attributes.

(d) 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. In addition, the following abbreviation shall be used:-

$E_{S/B}$ = Second Breakdown Energy.

4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the transistors specified herein shall be as 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

Not applicable.

4.2.2 Deviations from Final Production Tests (Chart II)

None.

4.2.3 Deviations from Burn-in and Electrical Measurements (Chart III)

(a) 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.

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:-

Terminals

(Variants 01 through 04)	Test Condition:	'A', Tension.
	Applied Force:	15 lb.f.
	Duration:	15 seconds.
(Variants 05 through 08)	Test Condition:	'A', Tension.
	Applied Force:	10 lbs.f.
	Duration:	15 seconds.

Stud

(All Variants)	Test Condition:	'D_2', Stud Torque.
	Applied Force:	15 lb.f. inch.
	Duration:	15 seconds.

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, or a ceramic body, and the lid shall be welded, brazed or preform soldered.

4.4.2 Lead Material and Finish

The lead material shall be 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.

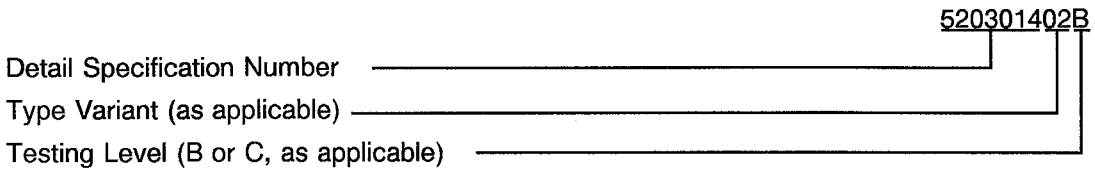
(c) Traceability Information.

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, the 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. The measurements shall be performed at $T_{amb} = +150(+0-5)$ °C and $-55(+5-0)$ °C respectively.

4.6.3 Circuits for Electrical Measurements

Circuits for use in performing the electrical measurements listed in Tables 2 and 3 are shown, where applicable, in MIL-STD-750 and in Figure 4 of this specification.

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 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 of this specification.

4.7.3 Electrical Circuits for Burn-in

Not applicable.

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

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST FIG.	TEST CONDITIONS	LIMITS		UNIT
						MIN.	MAX.	
1	Collector-Emitter Sustaining Voltage	$BV_{CEO(SUS)}$	3011 Bias Cond. D	-	I_C = 100mAdc I_B = 0Adc Note 1	100	-	V
2	Emitter-Base Breakdown Voltage	BV_{EBO}	3026 Bias Cond. D	-	I_E = 10Adc I_C = 0Adc	8.0	-	V
3	Collector-Base Cut-off Current	I_{CBO}	3036 Bias Cond. D	-	V_{CB} = 60Vdc I_E = 0Adc	-	0.1	µA
4	Collector Cut-off Current (Note 1)	I_{CEO}	3041 Bias Cond. D	-	V_{CE} = 50Vdc I_B = 0Adc	-	100	µA
5	Collector Cut-Current (Note 2)	I_{CEX}	3041 Bias Cond. A	-	V_{CE} = 150Vdc V_{EB} = 0.5Vdc	-	10	µA
6	Emitter-Base Reverse Current	I_{EBO}	3061 Bias Cond. D	-	V_{EB} = 5.0Vdc I_C = 0Adc	-	100	nA
7	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	-	V_{CE} = 5.0Vdc I_C = 1.0Adc Note 1	40	120	-
8	D.C. Forward Current Transfer Ratio	h_{FE2}	3076	-	V_{CE} = 5.0Vdc I_C = 5.0Adc Note 1	15	-	-
9	Collector Saturation Voltage	$V_{CE(SAT)1}$	3071	-	I_C = 1.0Adc I_B = 100mAdc Note 1	-	0.25	V
10	Collector Saturation Voltage	$V_{CE(SAT)2}$	3071	-	I_C = 5.0Adc I_B = 500mAdc Note 1	-	2.0	V
11	Base Saturation Voltage	$V_{BE(SAT)}$	3066 Bias Cond. A	-	I_C = 1.0Adc I_B = 100mAdc Note 1	-	1.2	V
12	Insulation Resistance	I_R	1016	-	V_{IR} = 500V Note 3	-	1000	mΩ

NOTES: See Page 18.

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

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST FIG.	TEST CONDITIONS	LIMITS		UNIT
						MIN.	MAX.	
13	Second Breakdown Energy	$E_{S/B}$	3052	-	I_C = 4.0Adc L = 125µH Note 2	1.0	-	mJ
14	High Frequency Forward Current Gain	h_{fe}	3306	-	V_{CE} = 10Vdc I_C = 1.0Adc f = 10MHz Notes 1 and 3	3.0	-	-
15	Output Capacitance	C_{obo}	3236	-	V_{CB} = 10Vdc I_E = 0Adc f = 1.0MHz Note 3	-	150	pF
16	Pulse Rise Time (Unsaturated)	$t_{r(1)}$	-	4(a)	V_{CC} = 25Vdc I_C = 1.0Adc I_B = 100mAdc V_{BB} = 10Vdc Note 3	-	80	ns
17	Pulse Storage Time (Unsaturated)	$t_{s(1)}$	-	4(a)	V_{CC} = 25Vdc I_C = 1.0Adc I_B = 100mAdc V_{BB} = 10Vdc Note 3	-	60	ns
18	Pulse Fall Time (Unsaturated)	$t_{f(1)}$	-	4(a)	V_{CC} = 25Vdc I_C = 1.0Adc I_B = 100mAdc V_{BB} = 10Vdc Note 3	-	80	ns
19	Pulse Rise Time (Saturated)	$t_{r(2)}$	-	4(b)	V_{CC} = 20Vdc I_C = 1.0Adc I_B = 100mAdc Note 3	-	300	ns
20	Pulse Storage Time (Saturated)	$t_{s(2)}$	-	4(b)	V_{CC} = 20Vdc I_C = 1.0Adc I_B = 100mAdc Note 3	-	2.0	µs
21	Pulse Fall Time (Saturated)	$t_{f(2)}$	-	4(b)	V_{CC} = 20Vdc I_C = 1.0Adc I_B = 100mAdc Note 3	-	350	ns

NOTES: See Page 18.

NOTES TO TABLES 2 AND 3

1. Pulse Measurement: Pulse length 330μs, duty cycle 2%.
2. Type Variants 01, 02, 05 and 06 only.
3. If more than 20 units have to be measured, the measurements shall be made on a sample basis in accordance with Level II, Table IIa, AQL = 1.0 of MIL-STD-105.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

TABLE 3(a) - T_{amb} = +150(+0−5) °C

No.	CHARACTERISTICS	SYMBOL	TEST METHOD MIL-STD-750	TEST FIG.	TEST CONDITIONS	LIMITS		UNIT
						MIN.	MAX.	
3	Collector-Base Cut-off Current	I_{CBO}	3036 Bias Cond. D	-	V_{CB} = 60Vdc I_E = 0Adc	-	50	µA

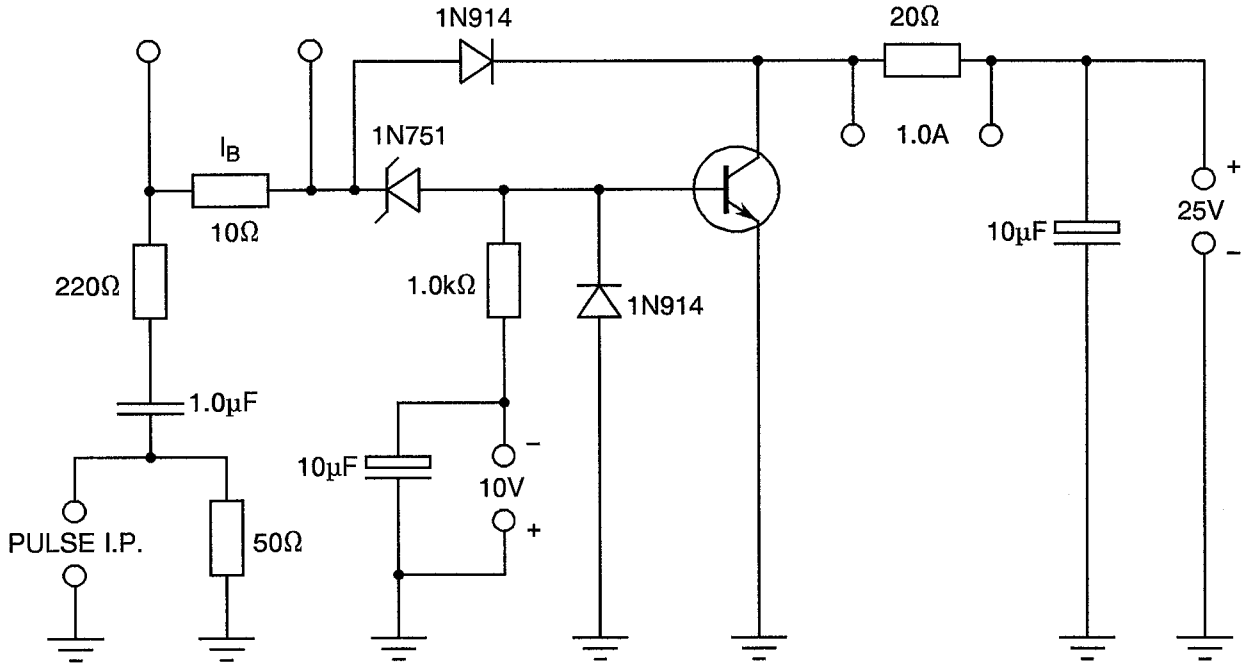
TABLE 3(b) - T_{amb} = −55(+5−0) °C

7	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	-	V_{CE} = 5.0Vdc I_C = 1.0Adc Note 1	15	-	-

NOTES: See Page 18 (Notes 1 and 2).

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

FIGURE 4(a) - SWITCHING PARAMETERS (UNSATURATED MODE)



INPUT AND OUTPUT WAVEFORMS FOR SWITCHING PARAMETERS

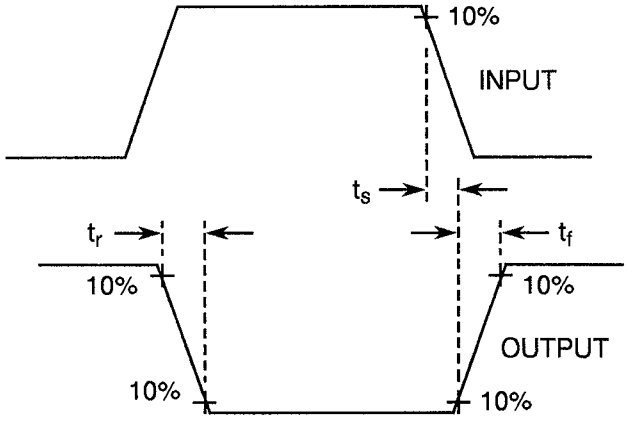


FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS (CONTINUED)

FIGURE 4(b) - SWITCHING PARAMETERS (SATURATED MODE)

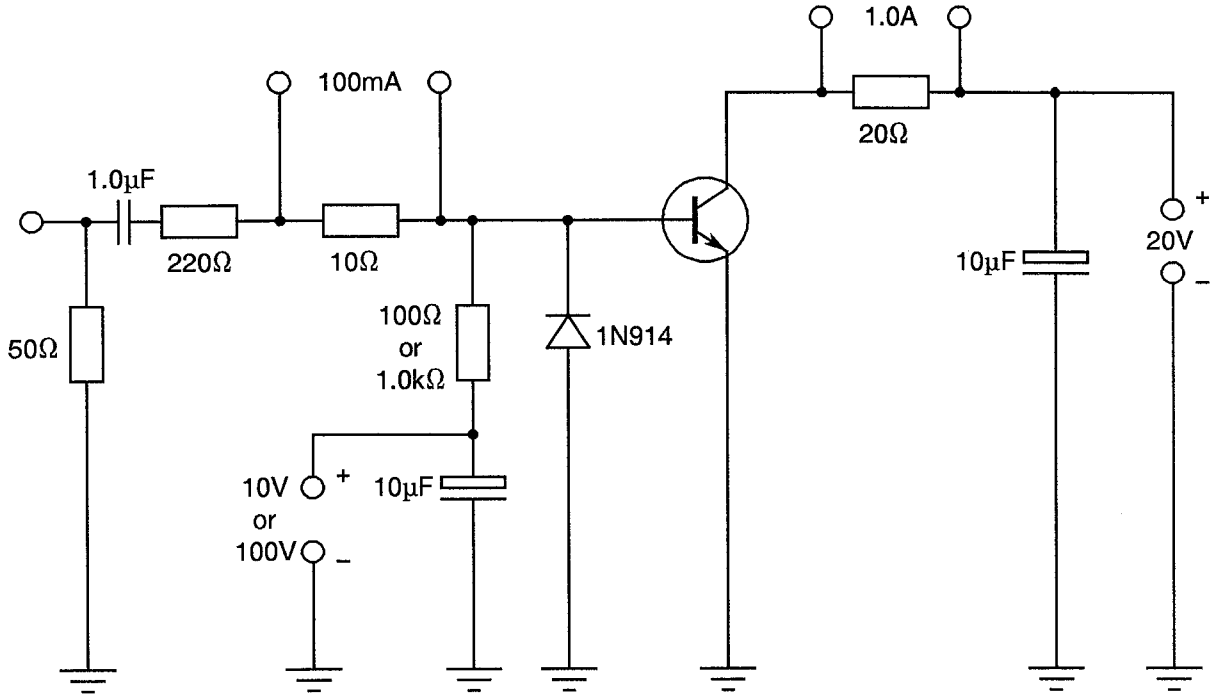


TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
5	Collector Cut-off Current (Note 2)	I_{CEX}	As per Table 2	As per Table 2	±1.0	μA
7	D.C. Forward Current Transfer Ratio (Note 1)	h_{FE1}	As per Table 2	As per Table 2	±25	%
9	Collector Saturation Voltage	$V_{CE(SAT)1}$	As per Table 2	As per Table 2	±50	mV

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

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Case Temperature	T_{case}	+100	°C
2	Power Dissipation	P_{tot}	30 (Note 1)	W
			40 (Note 2)	
3	Collector-Base Voltage	V_{CB}	10	V

NOTES

1. Variants 01 through 04.
2. Variants 05 through 08.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS

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 tests are scheduled in Table 6. 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 as specified in Table 5 for the 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 conditions for high temperature storage shall be $T_{amb} = +200(+0-5)$ °C.

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 Cut-off Current	I_{CEX}	As per Table 2	As per Table 2	-	10	µA
7	D.C. Forward Current Transfer Ratio	h_{FE1}	As per Table 2	As per Table 2	40	120	-
9	Collector-Emitter Saturation Voltage	$V_{CE(SAT)1}$	As per Table 2	As per Table 2	-	0.25	V