TRANSISTORS, HIGH POWER, NPN

BASED ON TYPE 2N5004

ESCC Detail Specification No. 5203/013

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SCC

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 3	February 1982	-	-
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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 2 and incorporates all modifications agreed on the basis of the following DCR's:-		
		Table of Contents	: Reference to Appendices	21019
			: Reference to Tables 1(a) and 1(b)	21021
		Para. 1.2	: New text	21021
		Para. 1.3	: Reference to Table 1(b)	21021
		Table 1(a)	: Added	21021
		Table 1(b)	: Retitled from Table 1	21021
		Para. 4.1	: Reference to Appendices	21019
		Para. 4.2.2	: Reference to bond strength and die shear tests	22143
		Para. 4.2.4	: Reference to bond strength and die shear tests	22143
		Para. 4.5.3	: Modification of component number	21021
		Table 2	: Test 3, test conditions changed	21022
		Table 5	: Burn-in conditions modified	21022
		Appendix 'A'	: New page added	24015
'A'	Aug. '83	P1. Cover page		None
		P2. DCN		None
		P3. Table of Contents	: Pages renumbered	None
		P9. Para. 2	: MIL-STD-1276 deleted	21025
		Para. 4.2.3	: Radiographic Inspection added	21022
		P10. Para. 4.4.2	: Text rewritten	21025
		P14. Table 2 a.c.	: Note added to tests and defined under table	22242
		P19. Appendix 'A'	: V_{CB} changed to 8.25V, SOA curve for SGS added	24021
'B'	Jul. '87	P1. Cover page		None
		P2. DCN		None
		P4. Table of Contents	: Appendix 'A' deleted and "None" added	None
		P19. Appendix 'A'	: Page removed	22512
'C'	Feb. '92	P1. Cover page		None
		P2. DCN		None
		P6. Table 1(a)	: "Lead Material and/or Finish" column added	21025
		P8. Para. 2	: "ESA/SCC Basic Spec. No. 23500" added	21025
		Para. 4.2.2	: Bond Strength and Die Shear Test deviations deleted	23499
			: PIND deviation deleted	21043
		P9. Para. 4.2.3	: Radiographic Inspection deviation deleted	21049
		Para. 4.2.4	: Bond Strength and Die Shear Test deviations deleted	23499
		P15. Table 3	: Note deleted	21047
		This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.		

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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 Type 2N5004.

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.

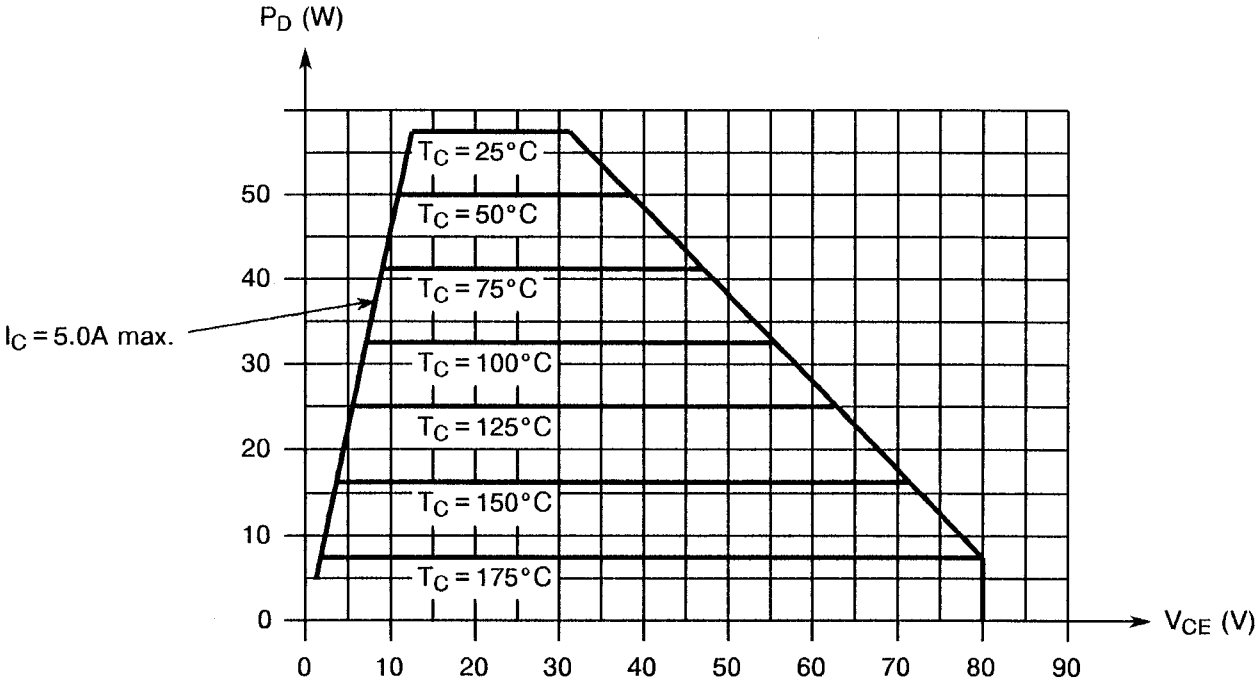
TABLE 1(a) - TYPE VARIANTS

VARIANT	BASED ON TYPE	LEAD MATERIAL AND FINISH
01	2N5004	D2

TABLE 1(b) - MAXIMUM RATINGS

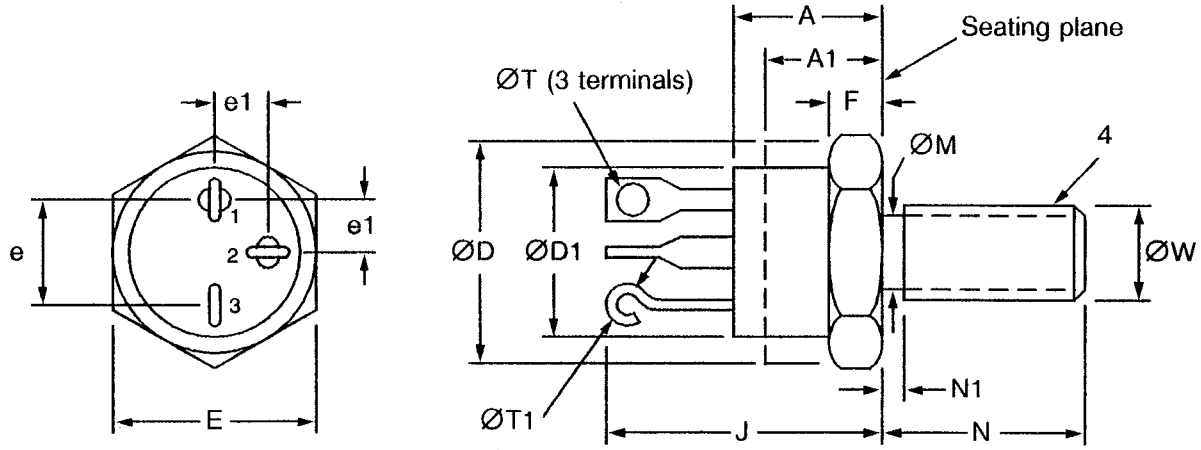
No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Collector-Base Breakdown Voltage	V_{CBO}	100	V	
2	Collector-Emitter Breakdown Voltage	V_{CEO}	80	V	
3	Emitter-Base Breakdown Voltage	V_{EBO}	6.0	V	
4	Collector Current	I_C	5.0	A	
5	Power Dissipation	P_{tot}	50	W	$T_{case} \leq +50°C$
6	Operating Temperature Range	T_{op}	−65 to +200	°C	T_{amb}
7	Storage Temperature Range	T_{stg}	−65 to +200	°C	
8	Soldering Temperature	T_{sol}	+235	°C	Time: ≤ 10 sec.

FIGURE 1 - PARAMETER DERATING INFORMATION



Rated Power Dissipation versus Temperature and Collector-Emitter Voltage

FIGURE 2 - PHYSICAL DIMENSIONS

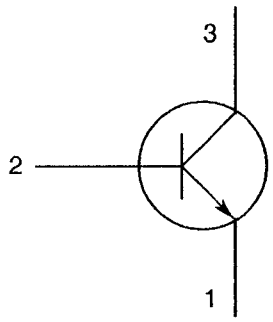


SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.320	0.468	8.13	11.89	
A1	-	0.250	-	6.35	2
ØD	0.380	0.437	9.65	11.10	2
ØD1	0.318	0.380	8.08	9.65	
E	0.424	0.437	10.77	11.10	
e	0.185	0.215	4.70	5.46	5
e1	0.090	0.110	2.29	2.79	5
F	0.090	0.150	2.29	3.81	1
J	0.570	0.763	14.48	19.38	
ØM	0.163	0.189	4.14	4.80	
N	0.400	0.455	10.16	11.56	
N1	-	0.078	-	1.98	
ØT	0.040	0.065	1.02	1.65	
ØT1	0.045	0.070	1.14	1.78	4
ØW	0.1658	0.1697	4.212	4.310	3

NOTES

1. Dimension does not include sealing flanges.
2. Package contour optional within dimensions specified.
3. Pitch diameter - thread 10-32 UNF-2A (coated).
4. This terminal can be flattened and pierced or hook type.
5. Position of leads in relation to the hexagon is not controlled.

FIGURE 3 - FUNCTIONAL DIAGRAM



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

NOTES

1. Package isolated from connections.

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) 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. 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) 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 7.0 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: 'A' (Tension).
Applied Force: 20N.
Duration: 10 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

Metal case, hermetically sealed, similar to JEDEC TO-59.

4.4.2 Lead Material and Finish

The lead material shall be Type 'D' with Type '2' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500.

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:-

520301301B

Detail Specification Number

Type Variant

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, 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 of this specification.

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.

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	$V_{(BR)CBO}$	3001D	$I_C = 100\mu A$ $I_E = 0\mu A$	100	-	V
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	3011	$I_C = 1.0mA$ $V_{BE} = 0$ Note 1	100	-	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026D	$I_E = 1.0mA$ $I_C = 0A$	6.0	-	V
4	Collector-Emitter Cut-off Current	I_{CES}	3041	$V_{CE} = 60V$ $V_{BE} = 0V$	-	1.0	µA
5	Emitter-Base Cut-off Current	I_{EBO}	3061D	$V_{EB} = 5.0V$ $I_C = 0A$	-	1.0	µA
6	D.C. Forward Current Transfer Ratio	h_{FE1}	3076	$I_C = 50mA$ $V_{CE} = 5.0V$	50	-	-
		h_{FE2}	3076	$I_C = 2.5A$ $V_{CE} = 5.0V$ Note 1	70	200	
		h_{FE3}	3076	$I_C = 2.5A$ $V_{CE} = 5.0V$ Note 1	40	-	
7	Collector Saturation Voltage	$V_{CE(sat)}$	3071	$I_C = 5.0A$ $I_B = 0.5A$ Note 1	-	1.5	V
8	Base Saturation Voltage	$V_{BE(sat)}$	3066	$I_C = 5.0A$ $I_B = 0.5A$ Note 1	-	2.2	V

NOTES

1. Pulse measurement: Pulse length $\leq 300\mu s$, Duty Cycle $\leq 2.0\%$.

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

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS (NOTE 1)	LIMITS		UNIT
					MIN	MAX	
1	AC Forward Current Transfer Ratio	h_{fe}	3206	$I_C = 0.5A$ $V_{CE} = 5.0V$ $f = 20MHz$	3.5	-	-
2	Output Capacitance	C_{ob}	3236	$V_{CB} = 10V$ $f = 1.0MHz$	-	250	pF
3	Switching Times	t_{on}	-	$I_C = 5.0A$ $I_{B1} = I_B = 0.5A$	-	0.5	µs
		t_{off}			-	1.3	

NOTES

1. Shall be performed on a sample basis, LTPD7.

FIGURE 4 - TEST CIRCUIT

Not applicable.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
1	Collector-Emitter Cut-off Current	I_{CES}	3041	T_{amb} = +150°C V_{CE} = 60V V_{BE} = 0V	-	500	µA
2	D.C. Forward Current Transfer Ratio	h_{FE}	3076	I_C = 2.5A V_{CE} = 5.0V T_{amb} = −55°C	25	-	-

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
1	Emitter-Base Cut-off Current	I_{EBO}	MIL-STD-750 Method 3061D	V_{EB} = 5.0V I_C = 0A	±200	nA
2	D.C. Forward Current Transfer Ratio	h_{FE}	MIL-STD-750 Method 3076A	V_{CE} = 5.0V I_C = 2.5A Note 1	±25	%
3	Collector Saturation Voltage	$V_{CE(sat)}$	MIL-STD-750 Method 3071	I_C = 5.0A I_B = 6.5A Note 1	±100	mV

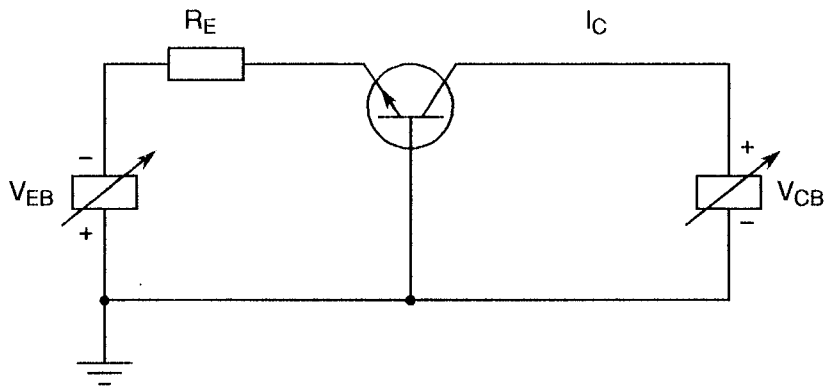
NOTES

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

TABLE 5 - CONDITIONS FOR BURN-IN

No.	CHARACTERISTICS	SYMBOL	CONDITIONS	UNIT
1	Case Temperature	T_{case}	+ 100	°C
2	Collector-Base Voltage	V_{CB}	20	V
3	Power Dissipation	P_{tot}	33	W

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN



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 of this specification.

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 performing the operating life tests shall be the same as that 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 CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	D.C. Forward Current Transfer Ratio	h_{FE}	MIL-STD-750 Method 3076	$I_C = 2.5A$ $V_{CE} = 5.0V$ Note 1	70	200	-
2	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	MIL-STD-750 Method 3071	$I_C = 5.0V$ $I_B = 0.5A$ Note 1	-	1.5	V
3	Collector-Emitter Cut-off Current	I_{CES}	MIL-STD-750 Method 3041	$V_{BE} = 0V$ $V_{CE} = 60V$	-	1.0	µA

NOTES

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