ESCC
European Space Components Coordination

Pages 1 to 19

TRANSISTORS, HIGH VOLTAGE, NPN

BASED ON TYPE 2N5551

ESCC Detail Specification No. 5201/019

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DCR No.	CHANGE DESCRIPTION
75	Specification upissued to incorporate editorial and technical changes per DCR.

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APPENDICES (Applicable to specific Manufacturers only)

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Transistors, High Voltage, NPN, based on Type 2N5551. It shall be read in conjunction with ESCC Generic Specification No. 5000, the requirements of which are supplemented herein.

1.2 COMPONENT TYPE VARIANTS

Variants of the basic transistors specified herein, which are also covered by this specification, are given in 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 100% inert atmosphere.

2. APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:-

(a) ESCC Generic Specification No. 5000 for Discrete Semiconductors.

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

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply.

TABLE 1(a) - TYPE VARIANTS

VARIANT	BASED ON TYPE	CASE	FIGURE	LEAD MATERIAL AND/OR FINISH
01	2N5551	TO18	2(a)	D2
02	2N5551	TO18	2(a)	D3 or D4
03	2N5551	TO18	2(a)	D7
04	2N5551	CHIP CARRIER	2(b)	2
05	2N5551	CHIP CARRIER	2(b)	4
06	2N5551	TO39	2(c)	D2
07	2N5551	TO39	2(c)	D3 or D4

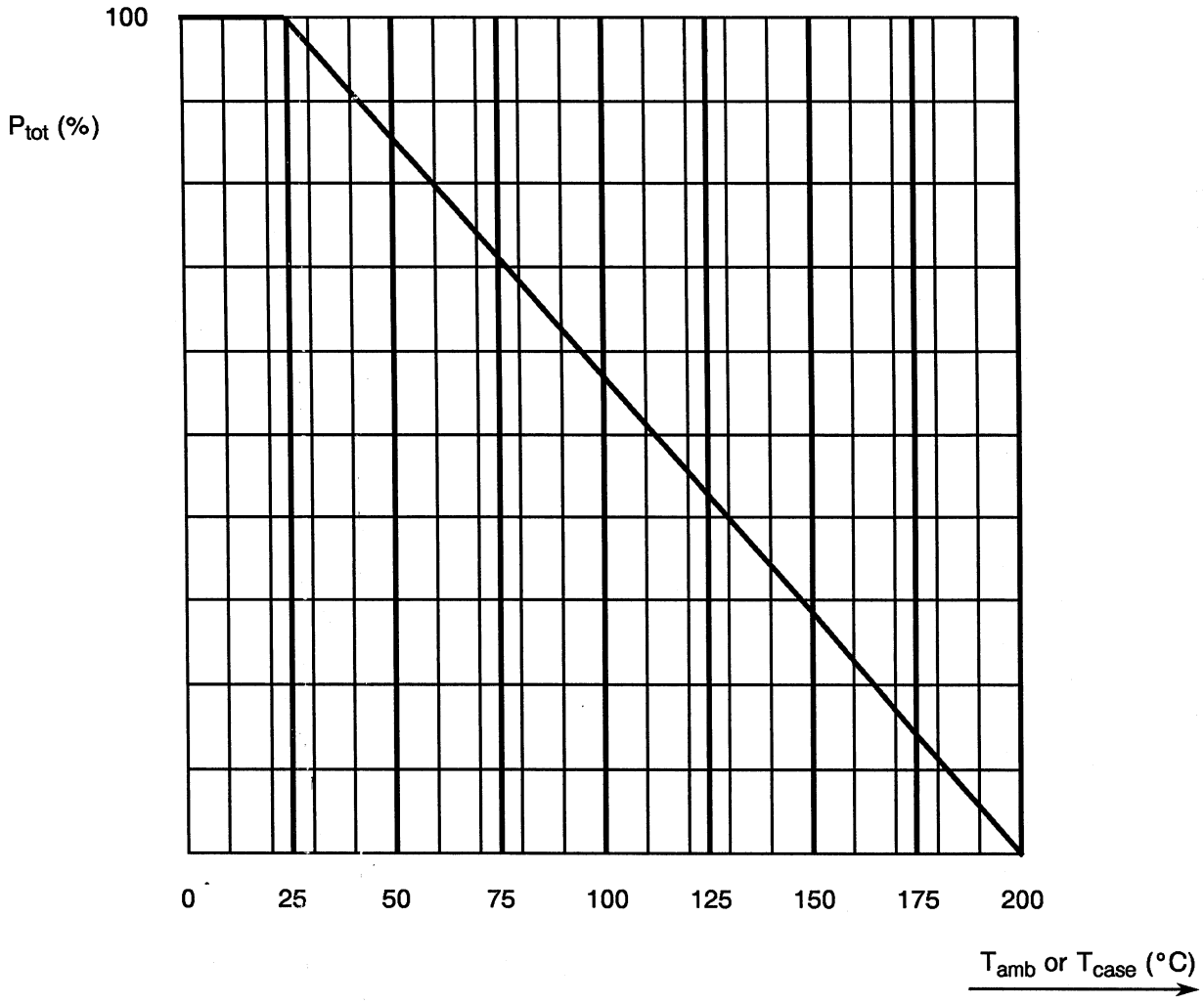
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Collector-Base Voltage	V_{CBO}	180	V	Over entire operating temperature range
2	Collector-Emitter Voltage	V_{CEO}	160	V	
3	Emitter-Base Voltage	V_{EBO}	6.0	V	
4	Collector Current (Continous) Variants 01 to 03, 06 and 07 Variants 04 and 05	I_C	 0.6 0.5	A	
5	Power Dissipation 1 All Variants Variants 04 and 05	P_{tot1}	 0.36 0.58(1)	W	At $T_{amb} \leq +25°C$ Note 2
6	Power Dissipation 2 Variants 01 to 03, 06 and 07	P_{tot2}	 1.2	W	At $T_{case} \leq +25°C$ 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 Variants 01 to 03, 06 and 07 Variants 04 and 05	T_{sol}	 +260 +245	°C	 Note 3 Note 4

NOTES

1. When mounted on an 8×10×0.6mm ceramic substrate.
2. For derating at T_{amb} or $T_{case} > +25°C$, see Figure 1.
3. Duration 10 seconds maximum at a distance of not less than 1.5mm from the device body and the same lead shall not be resoldered until 3 minutes have elapsed.
4. Duration 5 seconds maximum and the same terminal shall not be resoldered until 3 minutes have elapsed.

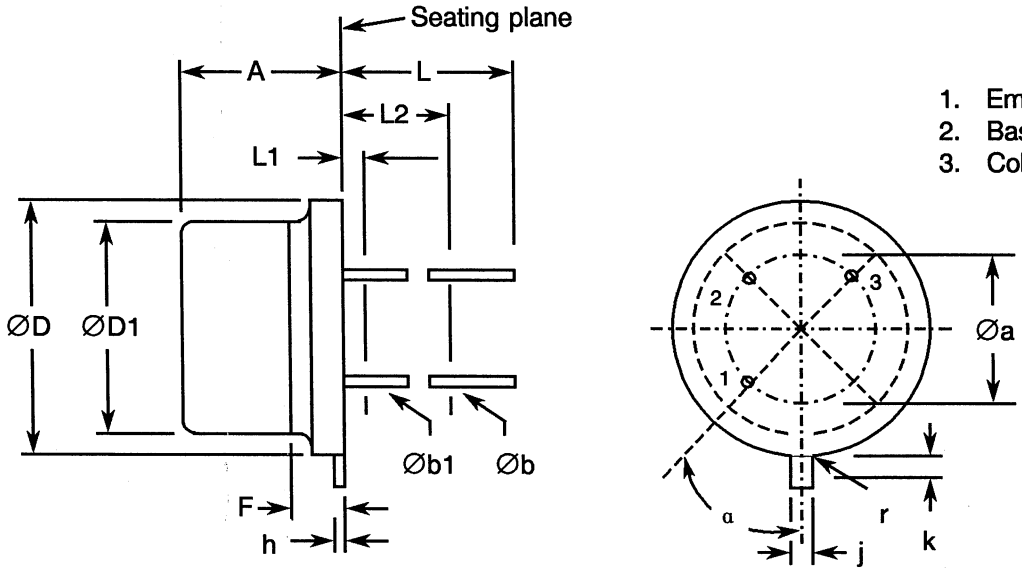
FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a) - VARIANTS 01 TO 03



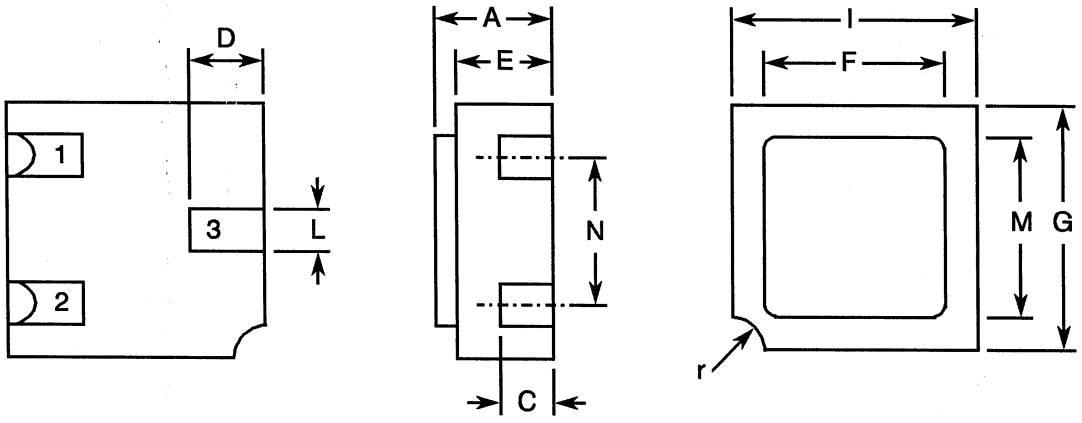
SYMBOL	MILLIMETRES		NOTES
	MIN.	MAX	
A	4.32	5.33	-
Øa	2.54 TYP.		4
Øb	0.41	0.53	5, 6
Øb1	0.41	0.48	5, 6
ØD	5.31	5.84	-
ØD1	4.52	4.95	-
F	-	0.76	3
h	0.23	1.04	-
j	0.91	1.17	1
k	0.71	1.22	1, 2
L	12.70	19.05	5, 6
L1	-	1.27	5, 6
L2	6.35	-	5, 6
r	-	0.25	8
α	45°		4

NOTES

1. Beyond r (radius) maximum, j shall be held for a minimum length of 0.28mm.
2. k measured from maximum ØD.
3. Body contour optional within zone defined by ØD, ØD1 and F.
4. Leads at gauging plane 1.37 + 0.03 - 0.00 mm below the seating plane shall be within 0.18mm radius of their true position at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by gauging procedure.
5. Øb1 applies between L1 and L2. Øb applies between L2 and L minimum. Diameter is uncontrolled in L1 and beyond L minimum.
6. All three leads.
7. The collector shall be internally connected to the case.
8. r (radius) applies to both inside corners of tab.

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

FIGURE 2(b) - VARIANTS 04 AND 05



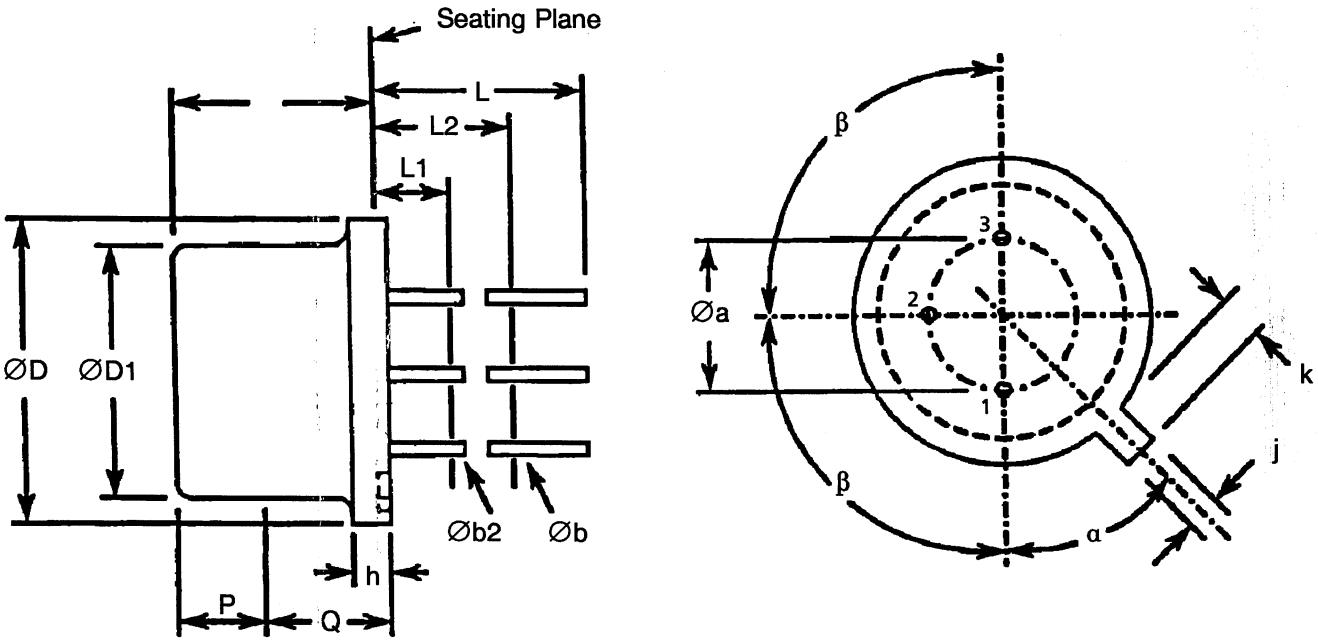
SYMBOL	MILLIMETRES		NOTES
	MIN.	MAX	
A	1.15	1.50	-
C	0.45	0.56	1
D	0.60	0.91	1
E	0.91	1.12	-
F	1.90	2.15	-
G	2.90	3.25	-
I	2.40	2.85	-
L	0.40	0.60	1
M	2.40	2.65	-
N	1.80	2.00	-
r	0.3 TYP.		-

NOTES

1. The three pads have the same dimensions.

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(c) - VARIANTS 06 AND 07

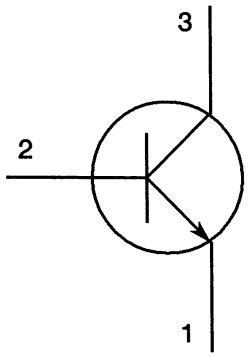


SYMBOL	MILLIMETRES		NOTES
	MIN.	MAX	
Øa	4.83	5.33	
A	6.1	6.6	
Øb	0.406	0.533	2
Øb2	0.406	0.483	2
ØD	8.89	9.4	
ØD1	8.0	8.51	
h	0.229	3.18	
j	0.711	0.864	
k	0.737	1.02	3
L	12.7	-	2
L1	--	1.27	2
L2	6.35	-	2
P	2.54	-	1
Q	-	-	4
α	45° NOMINAL		
β	90° NOMINAL		

NOTES

1. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.254mm.
2. (Three leads) Øb2 applies between 11 and 12. Øb applies between 12 and 12.7mm from seating plane. Diameter is uncontrolled in 11 and beyond 12.7mm 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. For Variants 01 to 03, the collector is internally connected to the case.

4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the transistors specified herein shall be as stated in this specification and ESCC Generic Specification No. 5000 for Discrete Semiconductors. Deviations from the Generic Specification, applicable to this specification only, are detailed 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 ESCC 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. 7.1.1 (a), High Temperature Reverse Bias test and subsequent electrical measurements related to this test shall be omitted.

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 0.4 grammes for Variants 01 to 03 and 0.06 grammes for Variants 04 and 05 and 1.5 grammes for Variants 06 and 07.

4.3.3 Terminal Strength

The requirements for terminal strength testing are specified in Section 9 of ESCC Generic Specification No. 5000. For Variants 01 to 03, 06 and 07 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

For Variants 01 to 03, 06 and 07 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.

For Variants 04 and 05, the case shall be hermetically sealed and have a ceramic body with a kovar lid.

4.4.2 Lead Material and Finish

For Variants 01 to 03, the lead material shall be Type 'D' with either Type '2', Type '3' or '4' or Type '7' finish in accordance with the requirements of ESCC Basic Specification No. 23500. (See Table 1(a) for Type Variants).

For Variants 06 and 07, the lead material shall be Type 'D' with either Type '2', Type '3' or '4' finish in accordance with the requirements of ESCC Basic Specification No. 23500. (See Table 1(a) for Type Variants).

For Variants 04 and 05, the terminal finish shall be either Type '2' or Type '4' in accordance with the requirements of ESCC 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 ESCC Basic Specification No. 21700 and the following paragraphs. When the component is too small to accommodate all of the marking specified, as much as space permits shall be marked and the marking information, in full, shall accompany the component in its primary package.

The information to be marked and the order of precedence, shall be as follows:-

(a) Lead Identification.

(b) The ESCC Component Number.

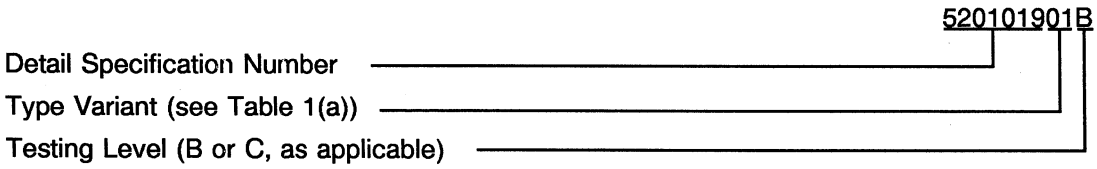
(c) Traceability Information.

4.5.2 Lead Identification

Lead identification shall be as shown in Figures 2 and 3.

4.5.3 The ESCC Component Number

Each component shall bear the ESCC 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 ESCC Basic Specification No. 21700.

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 ±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 (Figure 4)

Not applicable.

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 ±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 High Temperature Reverse Bias Burn-in (Table 5(a))

Not applicable.

4.7.3 Conditions for Power Burn-in

The requirements for power burn-in are specified in Section 7 of ESCC Generic Specification No. 5000. The conditions for power burn-in shall be as specified in Table 5(b) of this specification.

4.7.4 Electrical Circuits for High Temperature Reverse Bias Burn-in (Figure 5(a))

Not applicable.

4.7.5 Electrical Circuits for Power Burn-in (Figure 5(b))

Not applicable.

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	$I_C = 100\mu A$ $I_E = 0A$	180	-	V
2	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011	$I_C = 1.0mA$ $I_B = 0A$	160	-	V
3	Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	3026	$I_E = 10\mu A$ $I_C = 0A$	6.0	-	V
4	Collector-Base Cut-off Current	I_{CBO}	3036	$V_{CB} = 120V$	-	50	nA
5	Emitter-Base Cut-off Current	I_{EBO}	3061	$V_{EB} = 4.0V$	-	50	nA
6	Collector-Emitter Saturation Voltage 1	$V_{CE(SAT)1}$	3071	$I_C = 10mA$ $I_B = 1.0mA$ Note 1	-	0.15	V
7	Collector-Emitter Saturation Voltage 2	$V_{CE(SAT)2}$	3071	$I_C = 50mA$ $I_B = 5.0mA$ Note 1	-	0.2	V
8	Base-Emitter Saturation Voltage 1	$V_{BE(SAT)1}$	3066	$I_C = 10mA$ $I_B = 1.0mA$ Note 1	-	1.0	V
9	Base-Emitter Saturation Voltage 2	$V_{BE(SAT)2}$	3066	$I_C = 50mA$ $I_B = 5.0mA$ Note 1	-	1.0	V
10	D.C. Forward Current Transfer Ratio 1	h_{FE1}	3076	$V_{CE} = 5.0V$ $I_C = 1.0mA$	80	-	-
11	D.C. Forward Current Transfer Ratio 2	h_{FE2}	3076	$V_{CE} = 5.0V$ $I_C = 10mA$ Note 1	80	250	-
12	D.C. Forward Current Transfer Ratio 3	h_{FE3}	3076	$V_{CE} = 5.0V$ $I_C = 50mA$ Note 1	30	-	-

NOTES

1. Pulsed 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.	
13	A.C. Forward Current Transfer Ratio 1	h_{fe1}	3206	V_{CE} = 10V I_{CE} = 1.0mA f = 1.0kHz	50	200	-
14	A.C. Forward Current Transfer Ratio 2	h_{fe2}	3206	V_{CE} = 10V I_C = 10mA f > 100MHz	1.0	-	-
15	Emitter-Base Capacitance	C_{ebo}	3236	V_{EB} = 0.5V I_C = 0A f = 1.0MHz	-	20	pF
16	Output Capacitance	C_{obo}	3236	V_{CB} = 10V I_E = 0A f = 1.0MHz	-	6.0	pF

NOTES

1. Measurements performed on a sample basis, LTPD = 7 or lower.

TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
4	Collector-Base Cut-off Current	I_{CBO}	3036	T_{amb} = +150°C V_{CB} = 120V I_E = 0A	-	50	µA
11	D.C. Forward Current Transfer Ratio 2	h_{FE2}	3076	T_{amb} = −55°C V_{CE} = 5.0V I_C = 10mA Note 1	20	-	-

NOTES

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

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

Not applicable.

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITION	CHANGE LIMIT (Δ)	UNIT
4	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	±5.0 or (1) ±100	nA %
7	Collector-Emitter Saturation Voltage 2	$V_{CE(SAT)2}$	As per Table 2	As per Table 2	±30 or (1) ±15	mV %
11	D.C. Forward Current Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	±15	%

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

TABLE 5(a) - CONDITIONS FOR HIGH TEMPERATURE REVERSE BIAS BURN-IN

Not applicable.

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

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+25 to +50	°C
2	Power Dissipation 1	P_{tot1}	Max. rating at T_{amb} according to derating curve (Note 1)	W
3	Collector-Base Voltage	V_{CB}	90	V

NOTES
1. See Item 5 of Table 1(b) and Figure 1.

FIGURE 5(a) - ELECTRICAL CIRCUIT FOR HIGH TEMPERATURE REVERSE BIAS BURN-IN

Not applicable.

FIGURE 5(b) - ELECTRICAL CIRCUIT FOR POWER BURN-IN AND OPERATING LIFE TESTS

Not applicable.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESCC 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 ESCC Generic Specification No. 5000. The conditions for operating life testing shall be the same as specified in Table 5(b) for the power burn-in test.

4.8.4 Electrical Circuits for Operating Life Tests (Figure 5(b))

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 ESCC 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.	
4	Collector-Base Cut-off Current	I_{CBO}	As per Table 2	As per Table 2	-	50	nA
7	Collector-Emitter Saturation Voltage 2	$V_{CE(SAT)2}$	As per Table 2	As per Table 2	-	0.2	V
11	D.C. Forward Current Transfer Ratio 2	h_{FE2}	As per Table 2	As per Table 2	80	250	-

APPENDIX 'A'

AGREED DEVIATIONS FOR STMICROELECTRONICS (F)

<table>
<tr><th>ITEMS AFFECTED</th><th>DESCRIPTION OF DEVIATIONS</th></tr>
<tr><td>Para. 4.2.2</td><td>For Chip Carrier Variants, the visual criteria called-up by Para. 9.1, as specified in Paras. 3.2.5(i) and (j) of ESCC Basic Specification No. 2045000, may be omitted provided that a Radiographic Inspection to verify the die-attach process is performed in accordance with Para. 9.12.

The Radiographic Inspection shall be performed on a sample basis in accordance with STC Procedure 0011828.</td></tr>
<tr><td>Table 2 - Electrical Measurements at Room Temperature, AC Parameters</td><td>Characteristics No. 14, h_{fe2}, and No. 15, C_{ebo}, shall be as follows:-
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">CHARACTERISTICS</th><th rowspan="2">SYMBOL</th><th rowspan="2">MIL-STD-750 TEST METHOD</th><th rowspan="2">TEST CONDITIONS (NOTE 1)</th><th colspan="2">LIMITS</th><th rowspan="2">UNIT</th></tr>
<tr><th>MIN.</th><th>MAX.</th></tr>
<tr><td>14</td><td>AC Forward Current Transfer Ratio 2</td><td>h_{fe2}</td><td>3206</td><td>V_{CE} = 10V
I_C = 10mA
f = 20MHz</td><td>2.5</td><td>-</td><td>-</td></tr>
<tr><td>15</td><td>Emitter-Base Capacitance</td><td>C_{ebo}</td><td>3240</td><td>V_{EB} = 0.5V
I_C = 0A
f = 1MHz</td><td>-</td><td>45</td><td>pF</td></tr>
</table></td></tr>
</table>