



**TRANSISTORS, LOW POWER, NPN,
BASED ON TYPE 2N3866
ESCC Detail Specification No. 5201/010**

**ISSUE 1
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TRANSISTORS, LOW POWER, NPN,

BASED ON TYPE 2N3866

ESA/SCC Detail Specification No. 5201/010



**space components
coordination group**

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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.	
'A'	Feb. 1992	This issue incorporates all modifications agreed on the basis of Policy DCR 21016 for adaptation to new qualification requirements.			
		P1.	Cover page	None	
		P2.	DCN	None	
		P4.	T of C	: Table 1 renumbered to "1(b)"	21021
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				: "Appendices" title added	21019
		P5.	Para. 1.2	: Paragraph amended	21021
		P6.	Table 1	: Renumbered to "1(b)"	21021
			Table 1(a)	: New table added	21021
				: "Lead Material and/or Finish" column added	21025
		P9.	Para. 2	: MIL-STD-1276B deleted, "ESA/SCC Basic Specification No. 23500" added	21025
			Para. 4.1	: Additional text added	21019
			Para. 4.2.2	: PIND deviation deleted	21043
		P10.	Para. 4.4.2	: Paragraph amended	21025
		P11.	Para. 4.5.3	: "Type Variant" added	21021
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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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 2N3866.

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 as 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.

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TABLE 1(a) - TYPE VARIANTS

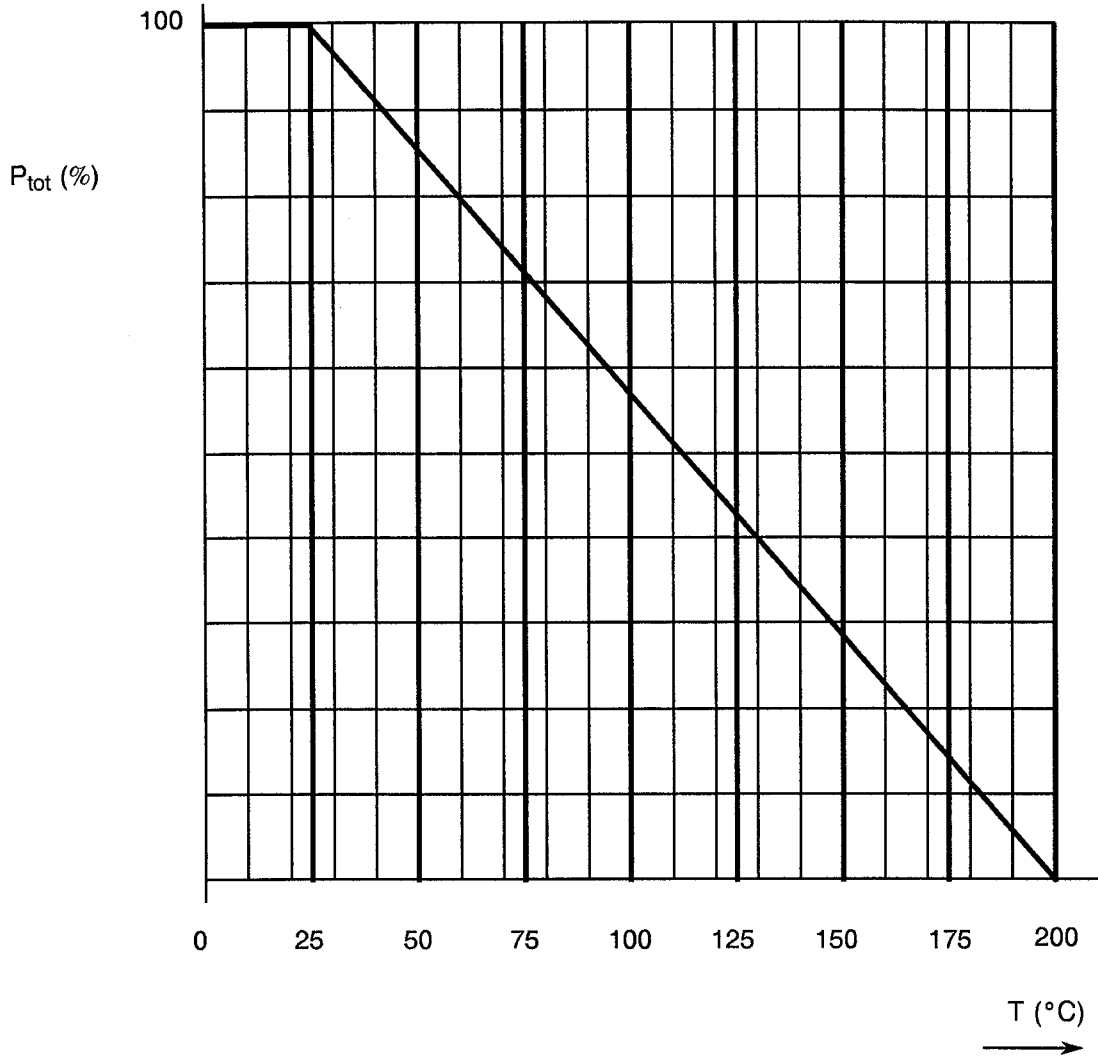
VARIANT	BASED ON TYPE	LEAD MATERIAL AND FINISH
01	2N3866	D2

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTIC	SYMBOL	MAXIMUM RATING	UNIT	REMARKS
1	Collector-to-Base Breakdown Voltage	V_{CBO}	60	V	
2	Collector-to-Emitter Breakdown Voltage	V_{CEO}	30	V	
3	Emitter-to-Base Breakdown Voltage	V_{EBO}	3.5	V	
4	Collector Current	I_C	0.4	A	
5	Power Dissipation	P_{tot}	1.0	W	$T_{amb} \leq +25^\circ\text{C}$
6	Power Dissipation	P_{tot}	5.0	W	$T_{case} \leq +25^\circ\text{C}$
7	Operating Temperature Range	T_{op}	-65 to +200	$^\circ\text{C}$	T_{amb}
8	Storage Temperature Range	T_{stg}	-65 to +200	$^\circ\text{C}$	
9	Soldering Temperature	T_{sol}	+235	$^\circ\text{C}$	Time: ≤ 10 seconds; Distance from case: $\geq 1.5\text{mm}$



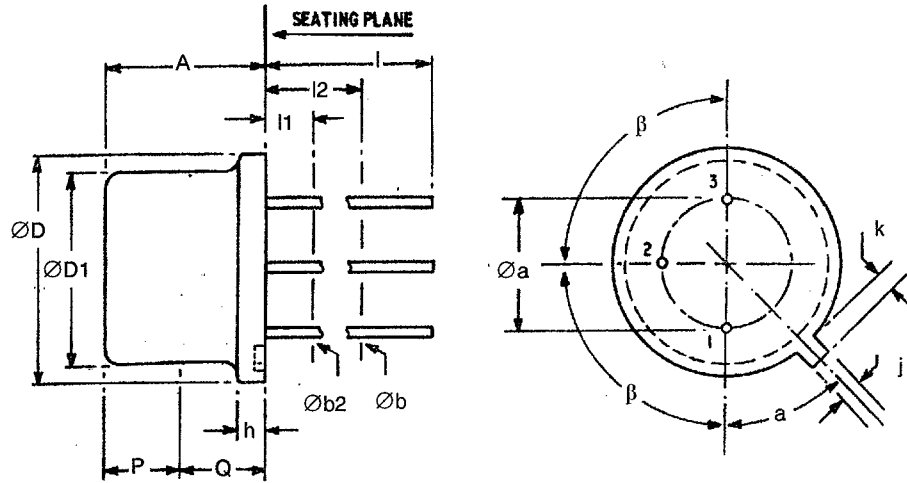
FIGURE 1 - PARAMETER DERATING INFORMATION



Power Dissipation versus Temperature



FIGURE 2 - PHYSICAL DIMENSIONS

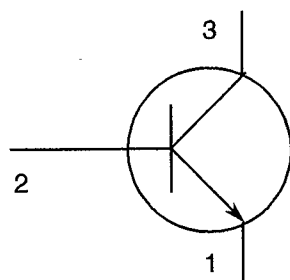


SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
Øa	0.190	0.210	4.83	5.35	
A	0.240	0.260	6.10	6.60	
Øb	0.016	0.021	0.406	0.533	2
Øb2	0.016	0.019	0.406	0.483	2
ØD	0.350	0.370	8.89	9.40	
ØD1	0.315	0.335	8.00	8.51	
h	0.009	0.125	0.229	3.18	
j	0.028	0.034	0.711	0.864	
k	0.029	0.040	0.737	1.02	3
l	0.500	-	12.70	-	2
l1	-	0.050	-	1.27	2
l2	0.250	-	6.35	-	2
P	0.100	-	2.54	-	1
Q	-	-	-	-	4
a	45° NOMINAL		45° NOMINAL		
β	90° NOMINAL		90° NOMINAL		

NOTES

1. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.010" (0.254mm).
2. (Three leads) Øb2 applies between l1 and l2. Ø b applies between l2 and 0.5" (12.70mm) from seating plane. Diameter is uncontrolled in l1 and beyond 0.5" (12.70mm) 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. The collector is internally connected to the case.

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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.

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) High Temperature Reverse Bias Test (HTRB): Not required.

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.

Applied Force : $2.5 \pm 0.1\text{N}$.

Duration : -

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.

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. (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:

Detail Specification Number		520101001B
Type Variant (see Table 1(a))		
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 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 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

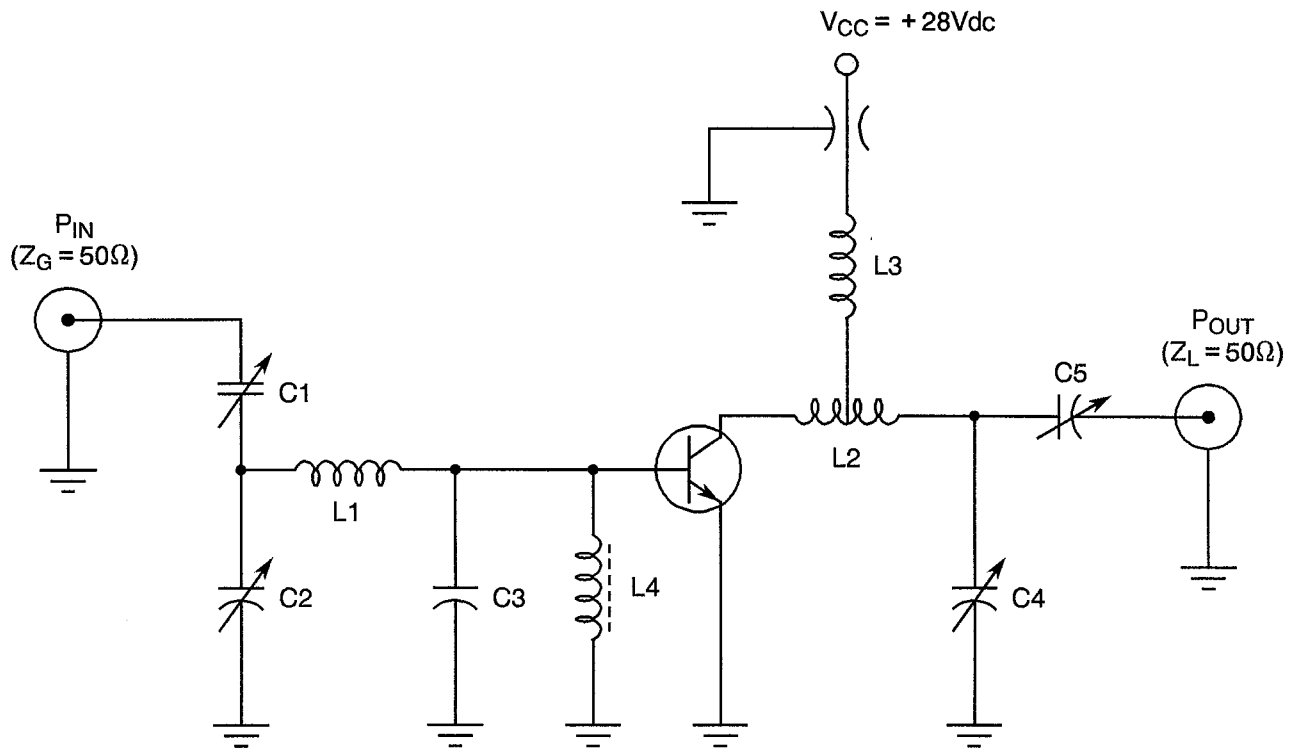
Circuits for use in performing the burn-in tests are shown in Figure 5 of this specification.

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

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
1	Collector-Base Breakdown Voltage	V_{CBO}	MIL-STD-750 Method 3001 D	$I_C = 100\mu A$	60	-	V
2	Collector-Emitter Breakdown Voltage	V_{CEO}	MIL-STD-750 Method 3011	$I_C = 5.0mA$	30	-	V
3	Emitter-Base Breakdown Voltage	V_{EBO}	MIL-STD-750 Method 3026 D	$I_E = 100\mu A$	3.5	-	V
4	Collector-Emitter Cut-off Current	I_{CEO}	MIL-STD-750 Method 3041	$V_{CE} = 28V$ $I_B = 0$	-	20	μA
5	D.C. Forward Current Transfer Ratio	h_{FE}	MIL-STD-750 Method 3076	$I_C = 50mA$ $V_{CE} = 5.0V$	15	200	-
6	Collector-Emitter Voltage (Saturated)	V_{CEsat}	MIL-STD-750 Method 3071	$I_C = 100mA$ $I_B = 10mA$	-	1.0	V

a.c. PARAMETERS

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
1	Collector-Base Capacitance	C_{obo}	MIL-STD-750 Method 3236	$V_{CB} = 28V$ $I_E = 0$ $f = 1.0MHz$	-	3.0	pF
2	Power Output	P_{out}	Fig. 4 of this specification	$V_{CE} = 28V$ $f = 400MHz$ $P_{in} = 0.15W$	1.0	2.0	W

**FIGURE 4 - TEST CIRCUIT FOR MEASUREMENT OF POWER OUTPUT**

- C1, C2, C5 = 3.0 - 35 pF.
C3 = 24pF (see Note 1).
C4 = 0.4 - 7.0 pF.
L1 = Straight piece No. 16 bare tin wire, 5/8 inch long.
L2 = 3 turns No. 16 wire, 1/4 inch ID, 5/16 inch long.
L3 = 1 turn No. 18 wire, 1/4 inch ID, 1/4 inch long.
L4 = Ferrite rf choke, Z = 450Ω.

NOTES

1. For optimum performance, C3 should be mounted as close as possible to base lead.

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TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
1	Collector-to-Emitter Cut-off Current	I_{CES}	MIL-STD-750 Method 3041	$V_{CE} = 30V$ $V_{BE} = 0$ $T_{amb} = +175^{\circ}C$	-	510	nA
2	D.C. Forward Current Transfer Ratio	h_{FE}	MIL-STD-750 Method 3076	$I_C = 50A$ $V_{CE} = 5.0V$ $T_{amb} = -55^{\circ}C$	7.0	-	

TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITION	CHANGE LIMITS (Δ)	UNIT
1	Collector-Emitter Cut-off Current	I_{CEO}	MIL-STD-750 Method 3041	$V_{CE} = 28V$ $I_B = 0$	± 2.0	nA
2	D.C. Forward Current Transfer Ratio	h_{FE}	MIL-STD-750 Method 3076A	$V_{CE} = 5.0V$ $I_C = 50mA$	± 25	%

TABLE 5 - CONDITIONS FOR BURN-IN

No.	CHARACTERISTIC	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+ 25 to + 50	°C
2	Power Dissipation	P_{tot}	Choose acc. to derating diagram	W
3	Collector Emitter Voltage	V_{CE}	28	V

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN

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. 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 test 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.

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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.	
1	D.C. Forward Current Transfer Ratio	h_{FE}	MIL-STD-750 Method 3076	$I_C = 50\text{mA}$ $V_{CE} = 5.0\text{V}$	15	200	
2	Collector-Emitter Saturation Voltage	V_{CEsat}	MIL-STD-750 Method 3071	$I_C = 100\text{mA}$ $I_B = 10\text{mA}$	-	1.0	V
3	Collector-Emitter Cut-off Voltage	I_{CEO}	MIL-STD-750 Method 3041	$V_{CE} = 28\text{V}$ $I_B = 0$	-	20	nA