# TRANSISTORS, HIGH POWER, PNP,

# BASED ON TYPE 2N5005

# ESCC Detail Specification No. 5204/005

**ISSUE 1**

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Pages 1 to 19

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# ESA/SCC Detail Specification No. 5204/005

space components
coordination group

| Issue/Rev. | Date | Approved by | |
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| | | SCCG Chairman | ESA Director General or his Deputy |
| Issue 4 | February 1988 | - | - |
| Revision 'A' | February 1992 | | |
| | | | |
| | | | |

## DOCUMENTATION CHANGE NOTICE

| Rev. Letter | Rev. Date | Reference | CHANGE Item | Approved DCR No. |
|---|---|---|---|---|
| | | This Issue supersedes Issue 3 and incorporates all modifications defined in Revision 'A' to Issue 3 and the following DCR's:- | | |
| | | Table of Contents | : Para. 4.6, "Requirements" deleted from Title | 23259 |
| | | | : Para's 4.7.2, 4.7.3 and 4.7.4, Titles amended | 23259 |
| | | | : Table 2, Titles expanded | 23259 |
| | | | : Table 5, Title amended | 23259 |
| | | | : Figure 5, Title amended | 23259 |
| | | | : Appendix 'A', entry deleted and "None" substituted | 22512 |
| | | Para. 1.2 | : Paragraph expanded | 23259 |
| | | Table 1(a) | : Variant -02 and Package added | 22319 |
| | | | : Table standardised | 22461 |
| | | Table 1(b) | : Nos. 1, 2 and 3, "breakdown" deleted from Characteristics | 23259 |
| | | | : No. 4, "(Continuous)" added to Characteristics | 22461 |
| | | | : No. 8, Symbol amended and remarks expanded | 22461 |
| | | Figure 2 | : Old Figure deleted, new Figures 2(a) and 2(b) added and Notes amended | 22319/ 22461 |
| | | | : Table rewritten with Metric measurements as prime, in Notes Column, 4 deleted and 5 amended to read "4" | 23259/ 22461 |
| | | Figure 3 | : Figure moved to Page 9, Figure and 2nd Note amended and all subsequent pages renumbered | 22319/ 22461 |

## DOCUMENTATION CHANGE NOTICE

| Rev. Letter | Rev. Date | Reference | CHANGE Item | Approved DCR No. |
|---|---|---|---|---|
| | | Para. 4.2.2 to 4.2.3 | : ESA/SCC 5000 Reference Para. Nos. added to individual Tests | 23259 |
| | | Para. 4.2.2(c) | : Test Condition added | 22461 |
| | | Para. 4.2.4 | : Chart IV added to Title and Bond Strength and Die Shear Tests added | 22461 |
| | | Para. 4.4.1 | : Paragraph rewritten | 23259 |
| | | Para. 4.5.3 | : Part Number corrected and Type Variant rewritten | 23259 |
| | | Para. 4.6 | : "Requirements" deleted from Title | 23259 |
| | | Para. 4.6.3 | : Text deleted and "Not applicable" substituted | 23259 |
| | | Paras 4.7.2, 4.7.3, 4.7.4 | : Paragraphs rearranged and rewritten | 23259 |
| | | Table 2 | : Spec. and Test method Column heading and Column entries standardised | 23259 |
| | | | : Nos. 2, 6, 7 and 8, under Test Conditions (*) deleted and "See Note" added | 23259 |
| | | | : Nos. 7 and 8, Characteristics corrected | 23259 |
| | | Table 2 a.c. | : Number 2, Symbol corrected to $C_{obo}$ | 23259 |
| | | | : Numbers corrected to run sequentially with Table 2 d.c. | 23259 |
| | | | : Note completed | 23259 |
| | | Table 3 | : "See Note" added to Title | 22461 |
| | | | : Tests renumbered and Columns, Symbols and Characteristics aligned to Table 2 | 22461 |
| | | | : Note deleted and new Note added | 22461 |
| | | Table 4 | : Tests characterised as per Table 2 and Note deleted | 23259 |

## DOCUMENTATION CHANGE NOTICE

| Rev. Letter | Rev. Date | Reference | CHANGE Item | Approved DCR No. |
|---|---|---|---|---|
| | | Table 5 | : Main Title amended | 23259 |
| | | | : In High Temperature Reverse Bias Table, "Duration" numbered as 4 | 23259 |
| | | | : Burn-in subheading amended | 23259 |
| | | Figure 5 | : Main Title amended | 23259 |
| | | | : Burn-in subheading amended | 23259 |
| | | Para. 4.8.3 & 4.8.4 | : "power" added before burn-in in text | 22461 |
| | | Para. 4.8.5 | : Last sentence amended to read ".... Table 1(b)" | 23259 |
| | | Table 6 | : Table characterised as per Table 2 and Note deleted | 23259 |
| | | Appendix 'A' | : Deleted | 22512 |
| 'A' | Feb. '92 | P1. Cover Page | | None |
| | | P2B. DCN | | None |
| | | P5. Para. 1.2 | : Paragraph amended | 21021 |
| | | Para. 2 | : "ESA/SCC Basic Spec. No. 23500" added | 21025 |
| | | P10. Para. 4.2.2 | : Bond Strength and Die Shear Test deviations deleted | 23499 |
| | | | : PIND deviation deleted | 21043 |
| | | Para. 4.2.3 | : H.T.R.B. deviation deleted | 23499 |
| | | | : Radiographic Inspection deviation deleted | 21049 |
| | | Para. 4.2.4 | : Bond Strength and Die Shear Test deviations deleted | 23499 |
| | | P16. 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. | | |

## 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 a Transistor, High Power, PNP, based on Type 2N2005.

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.

## 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.

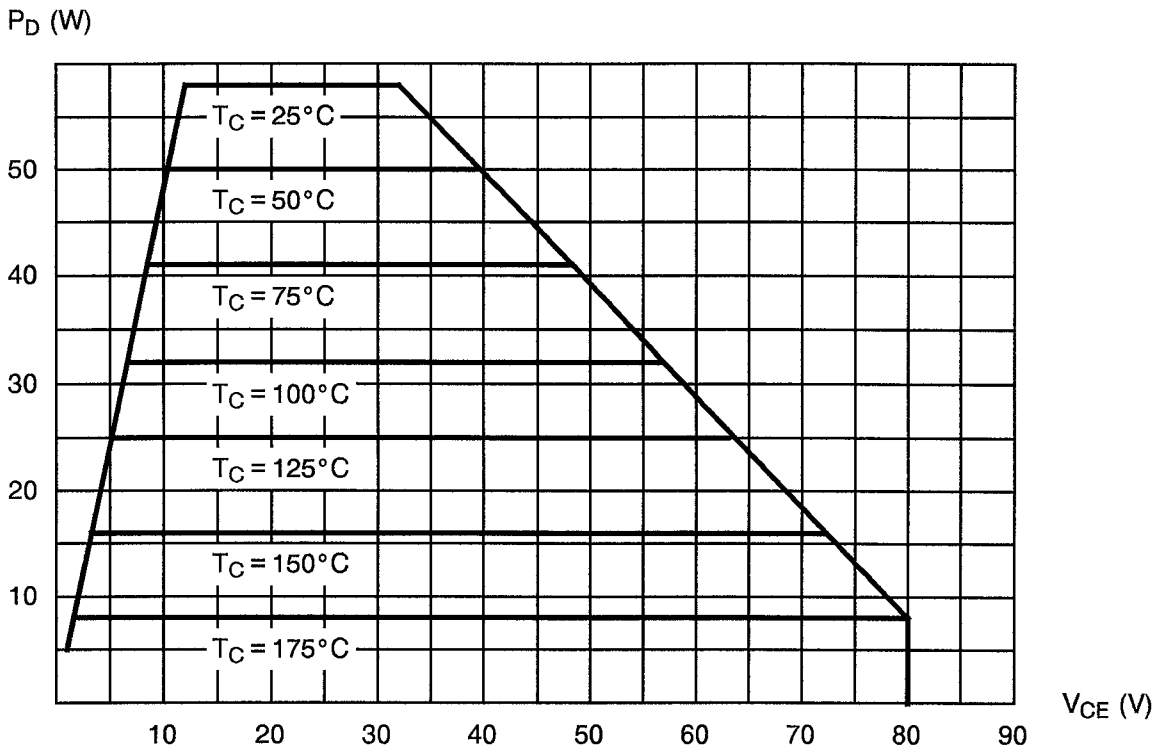
**TABLE 1(a) - TYPE VARIANTS**

| VARIANT | CASE | PACKAGE | FIGURE | LEAD MATERIAL AND FINISH |
|---|---|---|---|---|
| 01 | 2N5005 | 3 Lead | 2(a) | D2 |
| 02 | 2N5005 | 4 Lead | 2(b) | D2 |

**TABLE 1(b) - MAXIMUM RATINGS**

| No. | CHARACTERISTICS | SYMBOL | MAXIMUM RATINGS | UNIT | REMARKS |
|---|---|---|---|---|---|
| 1 | Collector-Base Voltage | $V_{CBO}$ | −100 | V | |
| 2 | Collector-Emitter Voltage | $V_{CEO}$ | −80 | V | |
| 3 | Emitter-Base Voltage | $V_{EBO}$ | −5.5 | V | |
| 4 | Collector Current (Continuous) | $I_C$ | −5.0 | A | |
| 6 | Power Dissipation | $P_{tot}$ | 50 | W | $T_C \leq 50°C$ |
| 8 | Operating Temperature Range | $T_{op}$ | −65 to +200 | °C | $T_{amb}$ |
| 9 | Storage Temperature Range | $T_{stg}$ | −65 to +200 | °C | |
| 10 | Soldering Temperature | $T_{sol}$ | +235 | °C | Time: ≤10 sec. Distance from case: ≥1.5mm |

## FIGURE 1 - PARAMETER DERATING INFORMATION




Rated Power Dissipation versus Temperature and Collector Emitter Voltage

## FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a)

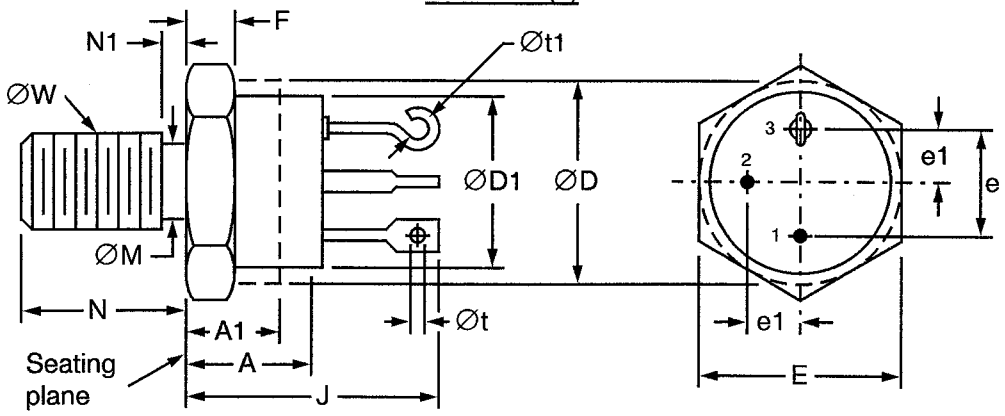
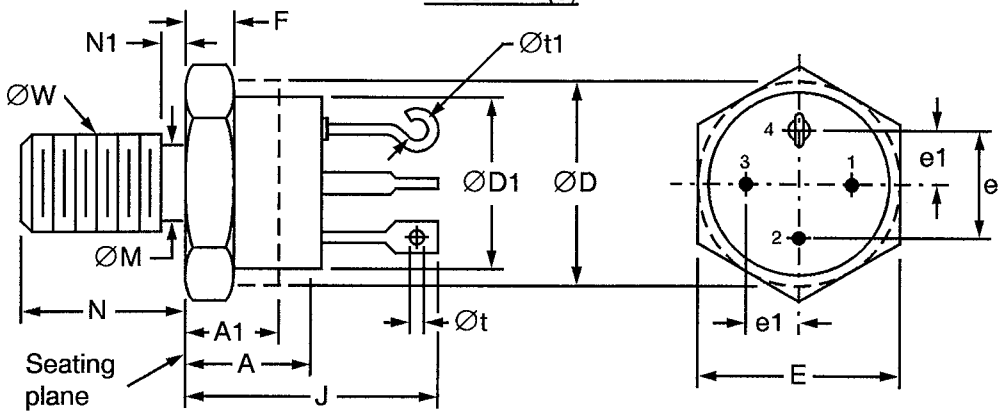



FIGURE 2(b)

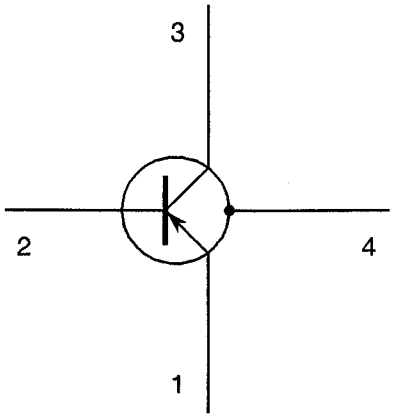



| SYMBOL | MILLIMETRES | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX | MIN. | MAX. | |
| A | 8.13 | 11.89 | 0.320 | 0.468 | |
| A1 | - | 6.35 | - | 0.250 | 2 |
| ØD | 9.65 | 11.10 | 0.380 | 0.437 | 2 |
| ØD1 | 8.08 | 9.65 | 0.318 | 0.380 | |
| E | 10.77 | 11.10 | 0.424 | 0.437 | |
| e | 4.70 | 5.46 | 0.185 | 0.215 | 4 |
| e1 | 2.29 | 2.79 | 0.090 | 0.110 | 4 |
| F | 2.29 | 3.81 | 0.090 | 0.150 | 1 |
| J | 14.48 | 19.38 | 0.570 | 0.763 | |
| ØM | 4.14 | 4.80 | 0.163 | 0.189 | |
| N | 10.16 | 11.56 | 0.400 | 0.455 | |
| N1 | - | 1.98 | - | 0.078 | |
| Øt | 1.02 | 1.65 | 0.040 | 0.065 | |
| Øt1 | 1.14 | 1.78 | 0.045 | 0.070 | |
| ØW | 4.212 | 4.310 | 0.1658 | 0.1697 | 3 |

**NOTES**

1. Dimension does not include sealing flanges.
2. Package contour optional within dimensions specified.
3. Pitch Diameter - Thread 10-32UNF-2A (coated).
4. Position of leads in relation to hexagon is not controlled.

**FIGURE 3 - FUNCTIONAL DIAGRAM**




1. Emitter.
2. Base.
3. Collector.
4. Case.

**NOTES**

1. Package isolated from connections 1-2-3. Terminal 4 is connected to case.

## 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 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

None.

#### 4.2.2 Deviations from Final Production Tests (Chart II)

None.

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

None.

#### 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: 20 Newtons.
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

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.

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.

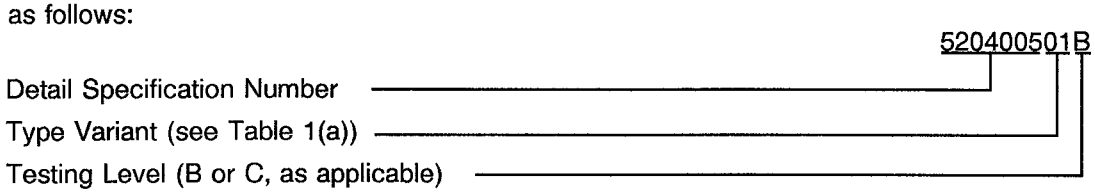
(c) Traceability Information.

### 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:




### 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 $T_{amb} = +22 \pm 3$ °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

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, measurements shall be performed at $T_{amb} = +22 \pm 3$ °C. The parameter drift values ($\Delta$) 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

The requirements for H.T.R.B. burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 5000. The conditions for H.T.R.B. burn-in shall be as specified in Table 5 of this specification.

4.7.3 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.

4.7.4 Electrical Circuits for H.T.R.B. and Power Burn-in

Circuits for use in performing the H.T.R.B. and 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 | TEST METHOD MIL-STD-750 | TEST CONDITIONS | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 1 | Collector-Base Breakdown Voltage | $V_{(BR)CBO}$ | 3001 | $I_C = -100\mu A$<br>$I_E = 0A$ | -100 | - | V |
| 2 | Collector-Emitter Breakdown Voltage | $V_{(BR)CES}$ | 3011 | $I_C = -1.0mA$<br>$V_{BE} = 0V$<br>Note 1 | -80 | - | V |
| 3 | Emitter-Base Breakdown Voltage | $V_{(BR)EBO}$ | 3026 | $I_E = -1.0mA$<br>$I_C = 0A$ | -5.5 | - | V |
| 4 | Collector-Emitter Cut-off Current | $I_{CES}$ | 3041 | $V_{CE} = -60V$<br>$V_{BE} = 0V$ | - | -1.0 | µA |
| 5 | Emitter-Base Cut-off Current | $I_{EBO}$ | 3061 | $V_{EB} = -4.0V$<br>$I_C = 0A$ | - | -1.0 | µA |
| 6 | D.C. Forward Current Transfer Ratio | $h_{FE1}$ | 3076 | $I_C = -50mA$<br>$V_{CE} = -5.0V$ | 50 | - | - |
| | | $h_{FE2}$ | | $I_C = -2.5A$<br>$V_{CE} = -5.0V$<br>Note 1 | 70 | 200 | |
| | | $h_{FE3}$ | | $I_C = -5.0A$<br>$V_{CE} = -5.0V$<br>Note 1 | 40 | - | |
| 7 | Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | 3071 | $I_C = -5.0A$<br>$I_B = -0.5A$<br>Note 1 | - | -1.5 | V |
| 8 | Base-Emitter Saturation Voltage | $V_{EB(sat)}$ | 3066 | $I_C = -5.0A$<br>$I_B = -0.5A$<br>Note 1 | - | -2.2 | V |

**NOTES**

1. Pulse measurement: Pulse length $\leq 300\mu s$, Duty Cycle $\leq 2\%$.

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

| No. | CHARACTERISTICS | SYMBOL | TEST METHOD MIL-STD-750 | TEST CONDITIONS | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 9 | A.C. Forward Current Transfer Ratio | $h_{fe}$ | 3206 | $I_C = -0.5A$<br>$V_{CE} = 5.0V$<br>$f = 20MHz$<br>Note 1 | 3.5 | - | - |
| 10 | Output Capacitance | $C_{obo}$ | 3236 | $V_{CB} = -10V$<br>$f = 1.0MHz$<br>Note 1 | - | 250 | pF |
| 11 | Switching Time | $t_{on}$ | - | $I_C = 5.0A$<br>$I_{B1} = I_{B2} = 0.5A$<br>Note 1 | - | 0.5 | µs |
| | | $t_{off}$ | | | - | 1.3 | |

**NOTES**

1. Measurements performed on a sample basis, LTPD7 or less.

## FIGURE 4 - TEST CIRCUIT

Not applicable.

## TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

| No. | CHARACTERISTICS | SYMBOL | TEST METHOD MIL-STD-750 | TEST CONDITIONS | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 4 | Collector-Emitter Cut-off Current | $I_{CES}$ | 3041 | $V_{CE} = -60V$<br>$V_{EB} = 0V$<br>$T_{amb} = +150°C$ | - | −500 | µA |
| 5 | D.C. Forward Current Transfer Ratio | $h_{FE2}$ | 3076 | $I_C = -2.5A$<br>$V_{CE} = -5.0V$<br>$T_{amb} = -55°C$ | 30 | - | - |

## TABLE 4 - PARAMETER DRIFT VALUES

| No. | CHARACTERISTICS | SYMBOL | SPEC. AND/OR TEST METHOD | TEST CONDITIONS | CHANGE LIMITS (Δ) | UNIT |
|---|---|---|---|---|---|---|
| 5 | Emitter-Base Cut-off Current | $I_{EBO}$ | As per Table 2 | As per Table 2 | ±200 | nA |
| 6 | D.C. Forward Current Transfer Ratio | $h_{FE2}$ | As per Table 2 | As per Table 2 | ±25 | % |
| 7 | Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | As per Table 2 | As per Table 2 | ±100 | mV |

## TABLE 5 - CONDITIONS FOR H.T.R.B., POWER BURN-IN AND OPERATING LIFE TESTS

HIGH TEMPERATURE REVERSE BIAS

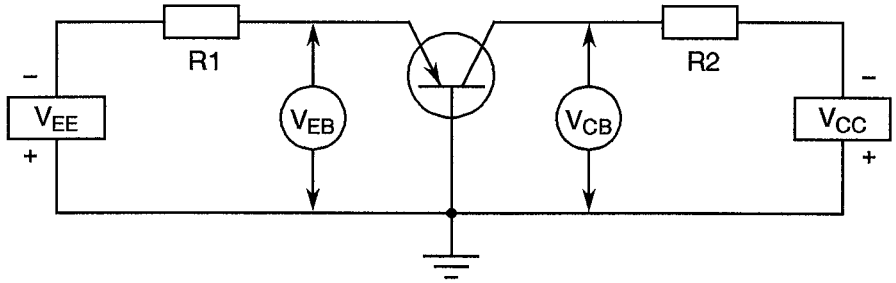
| No. | CHARACTERISTICS | SYMBOL | CONDITION | UNIT |
|---|---|---|---|---|
| 1 | Case Temperature | $T_{case}$ | +150 | °C |
| 2 | Collector-Base (d.c.) Voltage | $V_{CB}$ | 80 | V |
| 3 | Emitter-Base Voltage | $V_{EB}$ | −2.0 | V |
| 4 | Duration | - | 48 | Hrs |

POWER BURN-IN AND OPERATING LIFE TEST

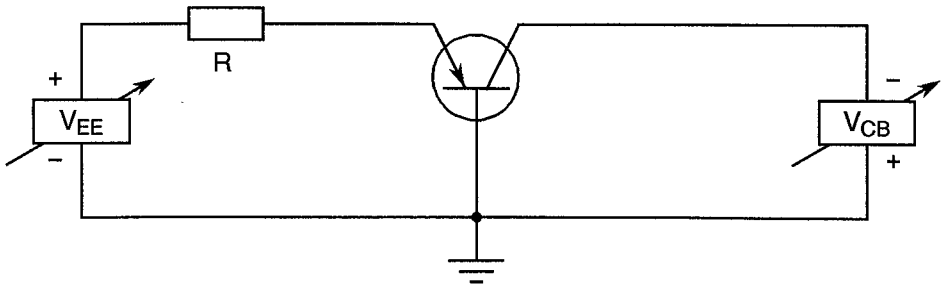
| No. | CHARACTERISTICS | SYMBOL | CONDITION | UNIT |
|---|---|---|---|---|
| 1 | Case Temperature | $T_{case}$ | +100 | °C |
| 2 | Power Dissipation | $P_{tot}$ | 33 | W |
| 3 | Collector-Base Voltage | $V_{CB}$ | 20 | V |

## FIGURE 5 - ELECTRICAL CIRCUITS FOR H.T.R.B., POWER BURN-IN AND OPERATING LIFE TESTS

HIGH TEMPERATURE REVERSE BIAS




POWER BURN-IN AND OPERATING LIFE TEST



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 tests are scheduled in Table 6. 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 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 as shown in Figure 5 for the power burn-in test.

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. | |
| 4 | Collector-Emitter Cut-off Current | $I_{CES}$ | As per Table 2 | As per Table 2 | - | −1.0 | µA |
| 6 | D.C. Forward Current Transfer Ratio | $h_{FE2}$ | As per Table 2 | As per Table 2 | 70 | 200 | - |
| 7 | Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | As per Table 2 | As per Table 2 | - | −1.5 | V |