



europaean space agency  
agence spatiale européenne

Pages 1 to 18

**TRANSISTORS, HIGH POWER, NPN**

**BASED ON TYPE BUX77**

**ESA/SCC Detail Specification No. 5203/016**





**space components  
coordination group**

| Issue/Rev. | Date         | Approved by     |                                       |
|------------|--------------|-----------------|---------------------------------------|
|            |              | SCCG Chairman   | ESA Director General<br>or his Deputy |
| Issue 4    | January 1998 | <i>San Mill</i> | <i>A.oom</i>                          |
|            |              |                 |                                       |
|            |              |                 |                                       |
|            |              |                 |                                       |

**DOCUMENTATION CHANGE NOTICE**

| Rev. Letter | Rev. Date | Reference   | CHANGE Item   | Approved DCR No. |
|-------------|-----------|---|---|------------------|
|             |           | This Issue supersedes Issue 3 and incorporates all modifications defined in Revisions 'A', 'B', 'C' and 'D' to Issue 3 and the changes agreed in the following DCRs:- |   |                  |
|             |           | Cover Page  |   | None             |
|             |           | DCN   |   | None             |
|             |           | Para. 1.2   | : Existing text deleted and new text added  | 221400           |
|             |           | Para. 2   | : Item (c) deleted  | 221400           |
|             |           | Table 1(a)  | : Format amended and Variants 06 and 07 added   | 221400           |
|             |           | Table 1(b)  | : Nos. 1 to 3, "Breakdown" deleted from Characteristics and "(BR)" from Symbol          | 221400           |
|             |           |   | : Nos. 4 and 5, "(Continuous)" added to Characteristics                                 | 221400           |
|             |           |   | : No. 6, Variants "01 to 05" added to existing entry and Variants 06 and 07 entry added | 221400           |
|             |           |   | : No. 7, "T <sub>case</sub> " added to Remarks  | 221400           |
|             |           |   | : No. 9, Existing Remarks deleted and "Note 2" added                                    | 221400           |
|             |           |   | : No. 10, New No. 10 added  | 221400           |
|             |           |   | : Notes, New Note 2 added   | 221400           |
|             |           | Figure 1  | : Subtitle added to first Figure and Figure modified                                    | 221400           |
|             |           |   | : Subtitle added to second Figure and Figure modified                                   | 221400           |
|             |           | Figure 2  | : Subtitle added to existing Figure   | 221400           |
|             |           |   | : New Figure 2(b) added   | 221400           |
|             |           | Figure 3  | : Notes amended   | 221400           |
|             |           | Para. 4.2.3   | : Existing text deleted and new text added  | 221400           |
|             |           | Para. 4.3.2   | : Existing text deleted and new text added  | 221400           |
|             |           | Para. 4.4.1   | : Existing text deleted and new text added  | 221400           |
|             |           | Para. 4.4.2   | : Existing text modified and new text added   | 221400           |
|             |           | Para. 4.5.1   | : Existing text deleted and new text added  | 221400           |
|             |           | Para. 4.5.3   | : Entry for "Type Variant" amended  | 221400           |
|             |           | Para. 4.5.5   | : Deleted in toto   | 221400           |
|             |           | Para. 4.6.1   | : Second sentence amended   | 221400           |
|             |           | Para. 4.7.2   | : New Para. 4.7.2 added   | 221400           |
|             |           |   | : Existing Para. 4.7.2 renumbered to "4.7.3" and title and text amended                 | 221400           |
|             |           | Para. 4.7.3   | : Renumbered as "4.7.5" and title and text amended                                      | 221400           |
|             |           | Para. 4.7.4   | : New Para. 4.7.4 entry added   | 221400           |
|             |           | Para. 4.7.6   | : New Para. 4.7.6 added   | 221400           |
|             |           | Table 2 d.c.  | : No. 12 deleted  | 221400           |
|             |           | Table 2 a.c.  | : Nos. 13 to 15 renumbered as "12" to "14" respectively                                 | 221400           |
|             |           | Table 3   | : No. 16 renumbered as "15"   | 221400           |
|             |           | Table 5(a)  | : Entry added   | 221400           |
|             |           | Table 5   | : Renumbered to "5(b)" and title amended  | 221400           |
|             |           |   | : No. 2, Variants added   | 221400           |
|             |           | Figure 5(a)   | : Entry added   | 221400           |
|             |           | Figure 5  | : Renumbered to "5(b)" and title amended  | 221400           |
|             |           | Para. 4.8.1   | : Text added to the beginning of the second sentence                                    | 221400           |
|             |           | Para. 4.8.2   | : Second sentence added   | 221400           |
|             |           | Para. 4.8.3   | : In the second sentence, text amended  | 221400           |
|             |           | Para. 4.8.4   | : Text amended  | 221400           |

|   |   |  |                           |
|---|---|--|---------------------------|
|  |  | <p>ESA/SCC Detail Specification<br/>No. 5203/016</p> | <p>PAGE 3<br/>ISSUE 4</p> |
|---|---|--|---------------------------|

**TABLE OF CONTENTS**

|           |   | <u>Page</u> |
|-----------|---|-------------|
| <b>1.</b> | <b><u>GENERAL</u></b>   | <b>5</b>    |
| 1.1       | Scope   | 5           |
| 1.2       | Component Type Variants   | 5           |
| 1.3       | Maximum Ratings   | 5           |
| 1.4       | Parameter Derating Information  | 5           |
| 1.5       | Physical Dimensions   | 5           |
| 1.6       | Functional Diagram  | 5           |
| 1.7       | High Temperature Test Precautions   | 5           |
| <b>2.</b> | <b><u>APPLICABLE DOCUMENTS</u></b>  | <b>5</b>    |
| <b>3.</b> | <b><u>TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS</u></b>                  | <b>5</b>    |
| <b>4.</b> | <b><u>REQUIREMENTS</u></b>  | <b>10</b>   |
| 4.1       | General   | 10          |
| 4.2       | Deviations from Generic Specification   | 10          |
| 4.2.1     | Deviations from Special In-process Controls   | 10          |
| 4.2.2     | Deviations from Final Production Tests  | 10          |
| 4.2.3     | Deviations from Burn-in and Electrical Measurements                                 | 10          |
| 4.2.4     | Deviations from Qualification Tests   | 10          |
| 4.2.5     | Deviations from Lot Acceptance Tests  | 10          |
| 4.3       | Mechanical Requirements   | 10          |
| 4.3.1     | Dimension Check   | 10          |
| 4.3.2     | Weight  | 10          |
| 4.3.3     | Terminal Strength   | 10          |
| 4.4       | Materials and Finishes  | 11          |
| 4.4.1     | Case  | 11          |
| 4.4.2     | Lead Material and Finish  | 11          |
| 4.5       | Marking   | 11          |
| 4.5.1     | General   | 11          |
| 4.5.2     | Lead Identification   | 11          |
| 4.5.3     | The SCC Component Number  | 11          |
| 4.5.4     | Traceability Information  | 12          |
| 4.6       | Electrical Measurements   | 12          |
| 4.6.1     | Electrical Measurements at Room Temperature   | 12          |
| 4.6.2     | Electrical Measurements at High and Low Temperatures                                | 12          |
| 4.6.3     | Circuits for Electrical Measurements  | 12          |
| 4.7       | Burn-in Tests   | 12          |
| 4.7.1     | Parameter Drift Values  | 12          |
| 4.7.2     | Conditions for High Temperature Reverse Bias Burn-in                                | 12          |
| 4.7.3     | Conditions for Power Burn-in  | 12          |
| 4.7.4     | Electrical Circuit for High Temperature Reverse Bias Burn-in                        | 12          |
| 4.7.5     | Electrical Circuit for Power Burn-in  | 12          |
| 4.7.6     | Verification of Safe Operating Area   | 12          |
| 4.8       | Environmental and Endurance Tests   | 17          |
| 4.8.1     | Electrical Measurements on Completion of Environmental Tests                        | 17          |
| 4.8.2     | Electrical Measurements at Intermediate Points and on Completion of Endurance Tests | 17          |
| 4.8.3     | Conditions for Operating Life Tests   | 17          |
| 4.8.4     | Electrical Circuit for Operating Life Tests   | 17          |
| 4.8.5     | Conditions for High Temperature Storage Test  | 17          |



Page

**TABLES**

|      |   |     |
|------|---|-----|
| 1(a) | Type Variants   | 6   |
| 1(b) | Maximum Ratings   | 6   |
| 2    | Electrical Measurements at Room Temperature - d.c. Parameters                         | 13  |
|      | Electrical Measurements at Room Temperature - a.c. Parameters                         | 14  |
| 3    | Electrical Measurements at High and Low Temperatures                                  | 14  |
| 4    | Parameter Drift Values  | 16  |
| 5(a) | Conditions for High Temperature Reverse Bias Burn-in                                  | N/A |
| 5(b) | Conditions for Power Burn-in and Operating Life Tests                                 | 16  |
| 6    | Electrical Measurements at Intermediate Points and on Completion of Endurance Testing | 18  |

**FIGURES**

|      |   |     |
|------|---|-----|
| 1    | Parameter Derating Information                                | 7   |
| 2    | Physical Dimensions   | 8   |
| 3    | Functional Diagram  | 9   |
| 4    | Circuits for Electrical Measurements                          | 15  |
| 5(a) | Electrical Circuit for High Temperature Reverse Bias Burn-in  | N/A |
| 5(b) | Electrical Circuit for Power Burn-in and Operating Life Tests | 16  |

**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 BUX77.

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**

Variants of the basic transistors specified herein, which 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) ESA/SCC Generic Specification No. 5000 for Discrete Semiconductor Components.
- (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 ESA/SCC Basic Specification No. 21300 shall apply.

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

| VARIANT | BASED ON TYPE | CASE  | FIGURE | LEAD MATERIAL AND FINISH |
|---------|---------------|-------|--------|--------------------------|
| 01      | BUX77         | TO66  | 2(a)   | D2                       |
| 02      | BUX77         | TO66  | 2(a)   | D3 or D4                 |
| 03      | BUX77         | TO66  | 2(a)   | F9                       |
| 04      | BUX77         | TO66  | 2(a)   | F2                       |
| 05      | BUX77         | TO66  | 2(a)   | F3 or F4                 |
| 06      | BUX77         | TO257 | 2(b)   | H2                       |
| 07      | BUX77         | TO257 | 2(b)   | H4                       |

**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   | $V_{EBO}$     | 6.0             | V             |                                     |
| 4   | Collector Current<br>(Continuous)                            | $I_C$         | 5.0             | A             |                                     |
| 5   | Base Current<br>(Continuous)                                 | $I_B$         | 0.8             | A             |                                     |
| 6   | Power Dissipation<br>Variants 01 to 05<br>Variants 06 to 07  | $P_{tot}$     | 40<br>35        | W             | $T_{case} = +25^{\circ}C$<br>Note 1 |
| 7   | Operating Temperature Range                                  | $T_{op}$      | -65 to +200     | $^{\circ}C$   | $T_{case}$                          |
| 8   | Storage Temperature Range                                    | $T_{stg}$     | -65 to +200     | $^{\circ}C$   |                                     |
| 9   | Soldering Temperature  | $T_{sol}$     | +260            | $^{\circ}C$   | Note 2                              |
| 10  | Thermal Resistance<br>Variants 01 to 05<br>Variants 06 to 07 | $R_{TH(J-C)}$ | 4.4<br>5.0      | $^{\circ}C/W$ |                                     |

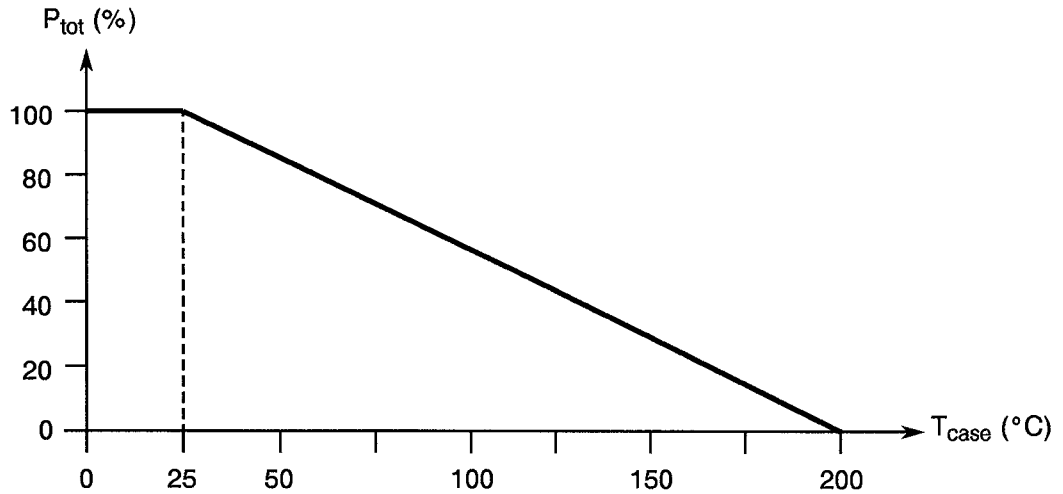
**NOTES**

- For derating at  $T_{case} > +25^{\circ}C$ , see Figure 1(a).
- 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.

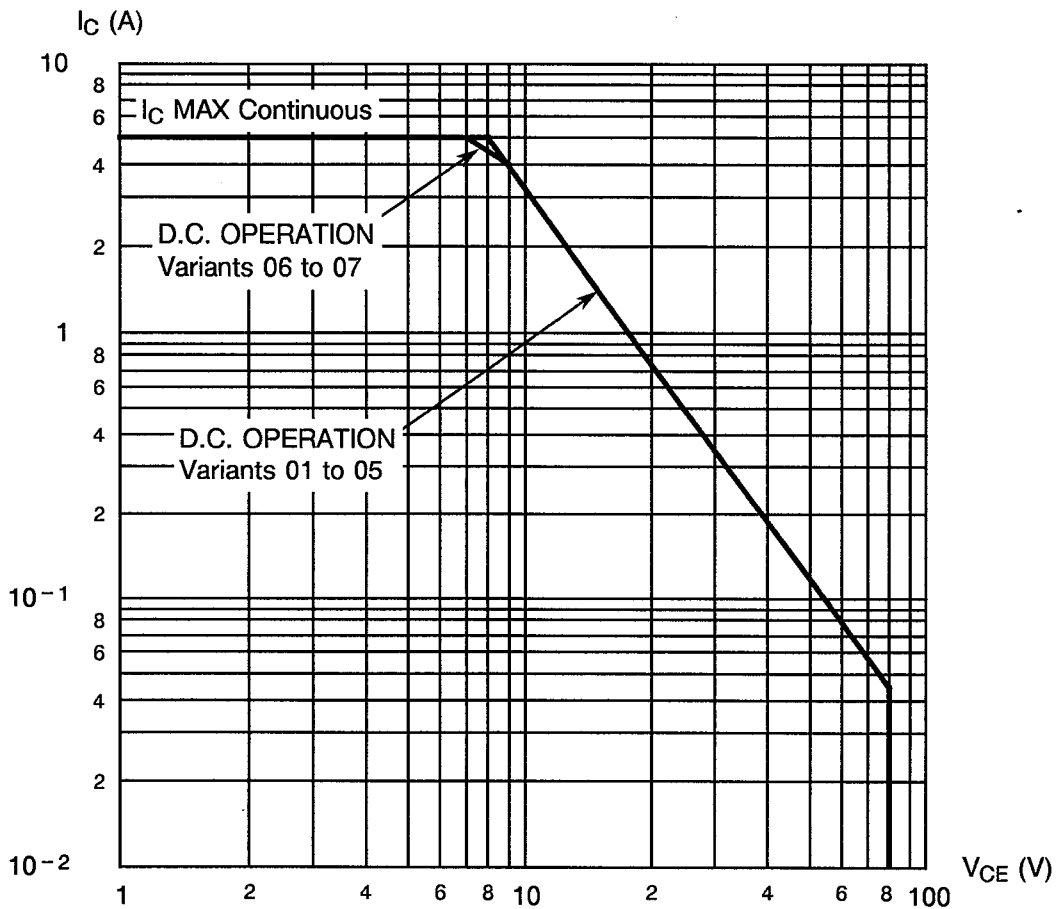


**FIGURE 1 - PARAMETER DERATING INFORMATION**

**FIGURE 1(a) - POWER DISSIPATION VERSUS TEMPERATURE**



**FIGURE 1(b) - FORWARD BIAS SAFE OPERATING AREA (MAXIMUM CONTINUOUS D.C.)**



**Collector Current versus Collector-Emitter Voltage**

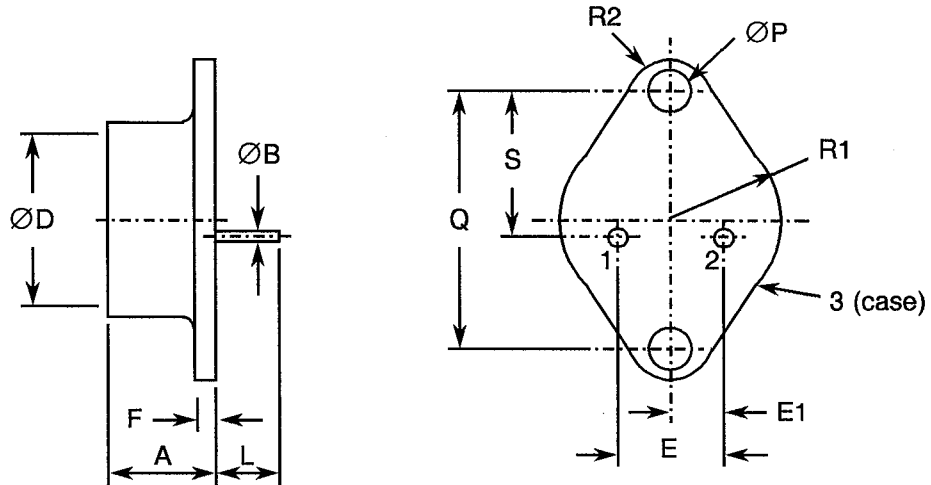
**NOTES**

- 1. See Para. 4.7.6.



**FIGURE 2 - PHYSICAL DIMENSIONS**

FIGURE 2(a) - VARIANTS 01 TO 05



| SYMBOL          | MILLIMETRES |       |
|-----------------|-------------|-------|
|                 | MIN.        | MAX.  |
| A               | 6.35        | 8.64  |
| $\varnothing B$ | 0.71        | 0.86  |
| $\varnothing D$ | 11.94       | 12.70 |
| E               | 4.83        | 5.34  |
| E1              | 2.36        | 2.72  |
| F               | 1.27        | 1.91  |
| L               | 9.14        | -     |
| $\varnothing P$ | 3.61        | 3.86  |
| Q               | 24.33       | 24.43 |
| R1              | -           | 8.89  |
| R2              | 3.61        | 3.86  |
| S               | 14.48       | 14.99 |

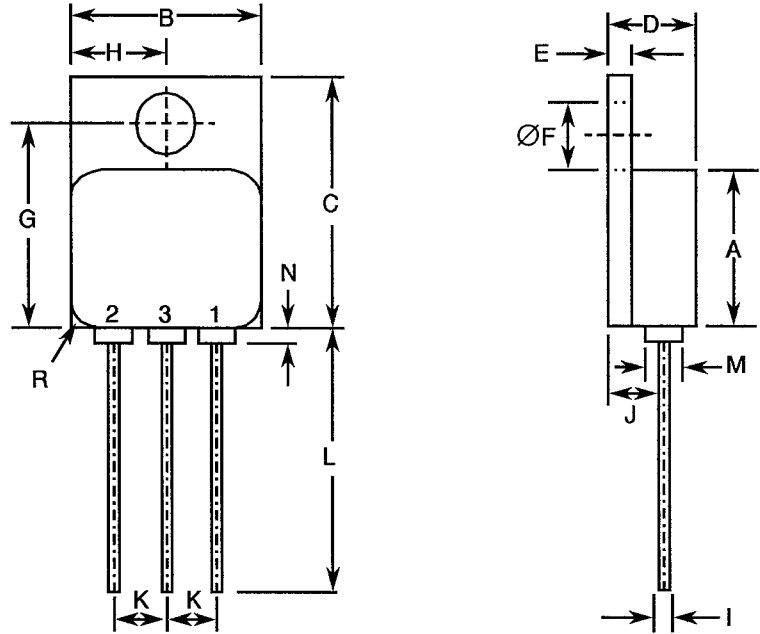




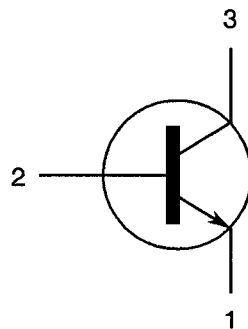
**FIGURE 2 - PHYSICAL DIMENSIONS (CONT.)**

**FIGURE 2(b) - VARIANTS 06 TO 07**

| SYMBOL | MILLIMETRES  |       |
|--------|--------------|-------|
|        | MIN.         | MAX.  |
| A      | 10.41        | 10.67 |
| B      | 10.41        | 10.67 |
| C      | 16.51        | 16.76 |
| D      | 4.7          | 5.33  |
| E      | 0.89         | 1.14  |
| ØF     | 3.56         | 3.81  |
| G      | 13.39        | 13.64 |
| H      | 5.13         | 5.38  |
| I      | 0.64         | 0.89  |
| J      | 2.92         | 3.18  |
| K      | 2.41         | 2.67  |
| L      | 15.24        | 16.51 |
| M      | 2.29 Typical |       |
| N      | -            | 0.71  |
| R      | 1.65 Typical |       |





**FIGURE 3 - FUNCTIONAL DIAGRAM**



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

**NOTES**

- 1. For Variants 01 to 05, the collector is internally connected to the case.
- 2. For Variants 06 to 07, the collector is isolated from the case.

|   |  |                    |
|---|--|--------------------|
|   | ESA/SCC Detail Specification<br>No. 5203/016 | PAGE 10<br>ISSUE 4 |
|---|--|--------------------|

#### 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) 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 6.4 grammes for Variants 01 to 05 and 5.0 grammes for Variants 06 to 07.

###### 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 : 10 N.  
 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

For Variants 01 to 05, metal case, hermetically sealed, similar to JEDEC TO-66.

For Variants 06 to 07, the case shall be hermetically sealed and have a metal body, the Fe/Ni copper core pin shall pass through a ceramic eyelet brazed into the frame and the lid shall be welded.

4.4.2 Lead Material and Finish

For Variants 01 to 05, the lead material shall be Type 'D' or Type 'F' with either Type '2' or Type '3' or 4' finish, or Type 'F' with Type '9' finish in accordance with the requirements of ESA/SCC Basic Specification No. 23500. (See Table 1(a) for Type Variants).

For Variants 06 to 07, the lead material shall be Type 'H' with either Type '2' or Type '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 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 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:-

520301601B

Detail Specification Number \_\_\_\_\_

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.

#### 4.6 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 stated, 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, 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 (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 ESA/SCC 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 Circuit for High Temperature Reverse Bias Burn-in (Figure 5(a)).

Not applicable.

##### 4.7.5 Electrical Circuit for Power Burn-in

A circuit for use in performing the power burn-in tests is shown in Figure 5(b) of this specification.

##### 4.7.6 Verification of Safe Operating Area

The requirement for the verification of the Safe Operating Area are specified in Section 9 of ESA/SCC Generic Specification No. 5000. The test method shall be as follows:-

Maximum continuous d.c. in accordance with MIL-STD-750, Method 3052 and Figure 1(b) of this specification, at  $T_{case} = +25$  °C and for an operating time of 100ms maximum.

For Variants 01 to 07:  $I_C = 2.0A$ ,  $V_{CE} = 12V$ .

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

| No. | CHARACTERISTICS                          | SYMBOL        | MIL-STD-750<br>TEST METHOD | TEST CONDITIONS  | LIMITS |     | UNIT          |
|-----|--|---------------|----------------------------|--|--------|-----|---------------|
|     |  |               |                            |  | MIN    | MAX |               |
| 1   | Collector-Emitter<br>Breakdown Voltage   | $V_{(BR)CEO}$ | 3011                       | $I_C = 50\text{mA}$<br>$I_B = 0\text{A}$<br>Note 1       | 80     | -   | V             |
| 2   | Collector-Emitter<br>Breakdown Voltage   | $V_{(BR)CES}$ | 3011                       | $I_C = 2.0\text{mA}$<br>$V_{BE} = 0\text{V}$             | 100    | -   | V             |
| 3   | Emitter-Base<br>Breakdown Voltage        | $V_{(BR)EBO}$ | 3026                       | $I_E = 1.0\text{mA}$<br>$I_C = 0\text{A}$                | 6.0    | -   | V             |
| 4   | Collector-Emitter<br>Cut-off Current     | $I_{CEO}$     | 3041                       | $V_{CE} = 60\text{V}$<br>$I_B = 0\text{A}$               | -      | 10  | $\mu\text{A}$ |
| 5   | Collector-Base<br>Cut-off Current        | $I_{CBO}$     | 3036                       | $V_{CB} = 80\text{V}$<br>$I_E = 0\text{A}$               | -      | 0.5 | $\mu\text{A}$ |
| 6   | Emitter-Base<br>Cut-off Current          | $I_{EBO}$     | 3061                       | $V_{EB} = 4.0\text{V}$<br>$I_C = 0\text{A}$              | -      | 0.5 | $\mu\text{A}$ |
| 7   | D.C. Forward Current<br>Transfer Ratio 1 | $h_{FE1}$     | 3076                       | $V_{CE} = 5.0\text{V}$<br>$I_C = 500\text{mA}$<br>Note 1 | 70     | -   | -             |
| 8   | D.C. Forward Current<br>Transfer Ratio 2 | $h_{FE2}$     | 3076                       | $V_{CE} = 5.0\text{V}$<br>$I_C = 2.0\text{A}$<br>Note 1  | 50     | 200 |               |
| 9   | D.C. Forward Current<br>Transfer Ratio 3 | $h_{FE3}$     | 3076                       | $V_{CE} = 5.0\text{V}$<br>$I_C = 5.0\text{A}$<br>Note 1  | 30     | -   |               |
| 10  | Collector-Emitter<br>Saturation Voltage  | $V_{CE(SAT)}$ | 3071                       | $I_C = 5.0\text{A}$<br>$I_B = 0.5\text{A}$<br>Note 1     | -      | 1.0 | V             |
| 11  | Base-Emitter<br>Saturation Voltage       | $V_{BE(SAT)}$ | 3066                       | $I_C = 5.0\text{A}$<br>$I_B = 0.5\text{A}$<br>Note 1     | -      | 1.3 | V             |

**NOTES**1. Pulsed measurement: Pulse Length  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

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

| No. | CHARACTERISTICS                        | SYMBOL    | MIL-STD-750<br>TEST METHOD | TEST<br>FIG. | TEST CONDITIONS<br>(NOTE 1)  | LIMITS |     | UNIT    |
|-----|--|-----------|----------------------------|--------------|--|--------|-----|---------|
|     |  |           |                            |              |  | MIN    | MAX |         |
| 12  | A.C. Forward Current<br>Transfer Ratio | $h_{fe}$  | 3206                       | -            | $V_{CE} = 5.0V$<br>$I_C = 0.5A$<br>$f = 20MHz$   | 2.5    | -   | -       |
| 13  | Turn-on Time                           | $t_{on}$  | -                          | 4            | $V_{BB} = -4.0V$<br>$V_{CC} = 40V$<br>$I_{B1} = 0.5A$<br>$I_{B2} = -0.5A$<br>$I_C = 5.0A$<br>$V_{IN} \approx +51V$ | -      | 0.3 | $\mu s$ |
| 14  | Turn-off Time                          | $t_{off}$ | -                          | 4            | $V_{BB} = -4.0V$<br>$V_{CC} = 40V$<br>$I_{B1} = 0.5A$<br>$I_{B2} = -0.5A$<br>$I_C = 5.0A$<br>$V_{IN} \approx +51V$ | -      | 0.7 | $\mu s$ |

**NOTES**

1. Measurements shall be performed on a sample basis, LTPD7.

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

| No. | CHARACTERISTICS                          | SYMBOL    | MIL-STD-750<br>TEST METHOD | TEST CONDITIONS  | LIMITS |     | UNIT    |
|-----|--|-----------|----------------------------|--|--------|-----|---------|
|     |  |           |                            |  | MIN    | MAX |         |
| 5   | Collector-Base<br>Cut-off Current        | $I_{CBO}$ | 3036                       | $V_{CB} = 80V$<br>$I_E = 0A$<br>$T_{amb} = +150^\circ C$             | -      | 150 | $\mu A$ |
| 15  | D.C. Forward Current<br>Transfer Ratio 4 | $h_{FE4}$ | 3076                       | $V_{CE} = 5.0V$<br>$I_C = 1.0A$<br>$T_{amb} = -55^\circ C$<br>Note 1 | 25     | -   | -       |

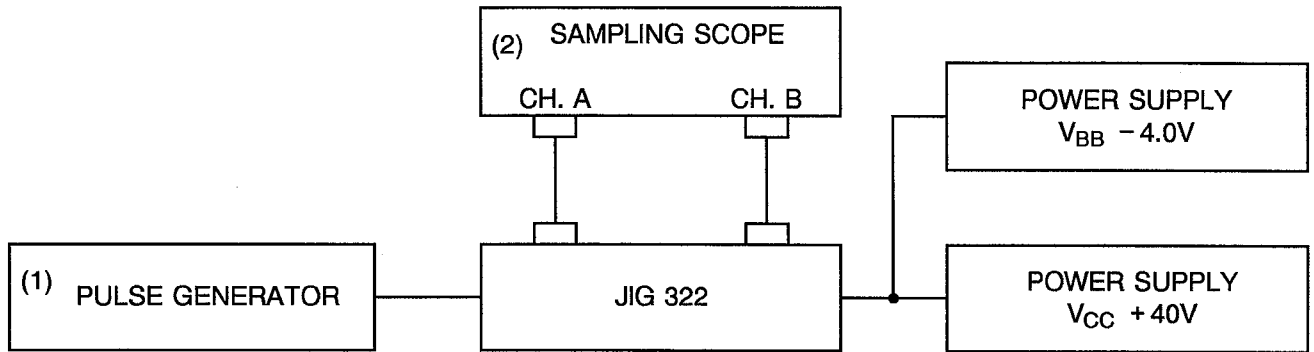
**NOTES**

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

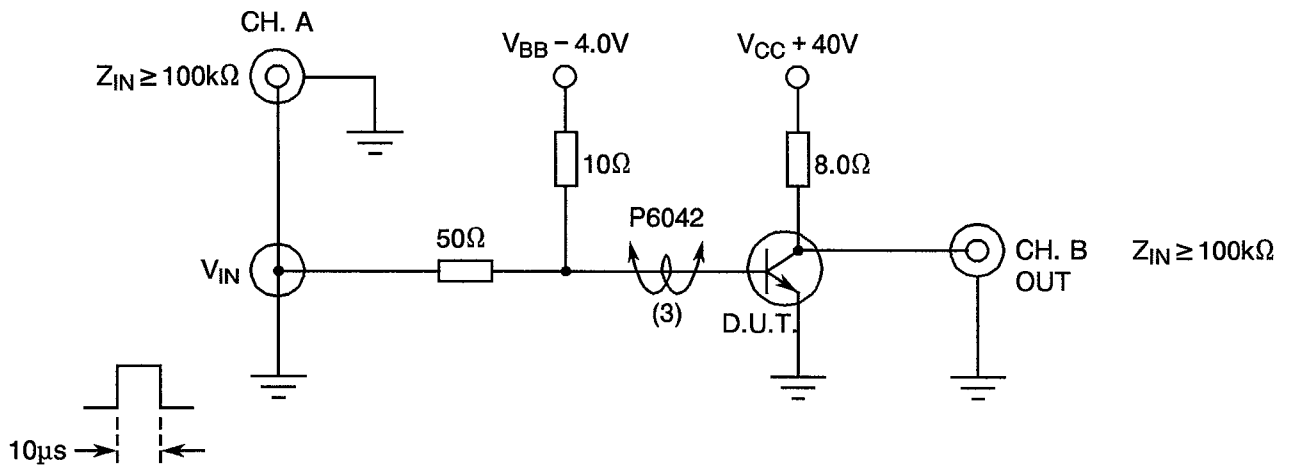


**FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS**

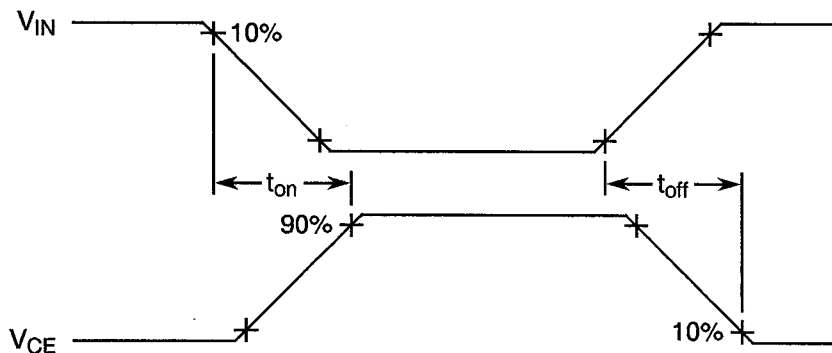
BLOCK DIAGRAM



EQUIVALENT TEST CIRCUIT



VOLTAGE WAVEFORMS



**NOTES**

1. Pulse generator Type E132 or equivalent,  $t_r \leq 20ns$ ,  $t_p = 10\mu s$ , Duty Cycle = 1.0%.
2. Sampling Scope Tetronics 568 or equivalent.
3. Adjust  $V_{IN} - V_B$  with current probe P6042.

**TABLE 4 - PARAMETER DRIFT VALUES**

| No. | CHARACTERISTICS                       | SYMBOL        | SPEC. AND/OR TEST METHOD | TEST CONDITIONS | CHANGE LIMITS ( $\Delta$ ) | UNIT |
|-----|---------------------------------------|---------------|--------------------------|-----------------|----------------------------|------|
| 6   | Emitter-Base Cut-off Current          | $I_{EBO}$     | As per Table 2           | As per Table 2  | $\pm 100$                  | nA   |
| 8   | D.C. Forward Current Transfer Ratio 2 | $h_{FE2}$     | As per Table 2           | As per Table 2  | $\pm 25$                   | %    |
| 10  | Collector-Emitter Saturation Voltage  | $V_{CE(SAT)}$ | As per Table 2           | As per Table 2  | $\pm 100$                  | mV   |

**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     | CONDITIONS                      | UNIT        |
|-----|---|------------|---------------------------------|-------------|
| 1   | Case Temperature  | $T_{case}$ | + 100 (1)                       | $^{\circ}C$ |
| 2   | Power Dissipation<br>Variants 01 to 05<br>Variants 06 to 07 | $P_{tot}$  | 22.8<br>20<br>(See Figure 1(a)) | W           |
| 3   | Collector-Emitter Voltage                                   | $V_{CE}$   | 10                              | V           |

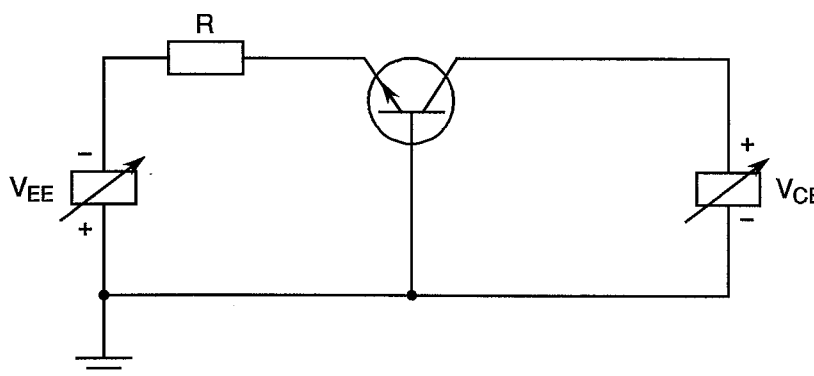
**NOTES**

- No heat sink nor forced air directly on the device shall be permitted.

**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**







- 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. 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 ESA/SCC 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 Circuit 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(b) for power 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. |         |
| 4   | Collector-Emitter Cut-off Current     | $I_{CEO}$     | As per Table 2           | As per Table 2  | -      | 10   | $\mu A$ |
| 8   | D.C. Forward Current Transfer Ratio 2 | $h_{FE2}$     | As per Table 2           | As per Table 2  | 50     | 200  | -       |
| 10  | Collector-Emitter Saturation Voltage  | $V_{CE(SAT)}$ | As per Table 2           | As per Table 2  | -      | 1.0  | V       |