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Pages 1 to 19

# TRANSISTORS, HIGH POWER, NPN,

# BASED ON TYPE BUR 14

# ESA/SCC Detail Specification No. 5203/030

space components
coordination group

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## DOCUMENTATION CHANGE NOTICE

| Rev. Letter | Rev. Date | CHANGE Reference | CHANGE Item | Approved DCR No. |
|---|---|---|---|---|
| | | This Issue incorporates all modifications agreed on the basis of Policy DCR's 21019, 21021, 21022 and 21025. | | |
| 'A' | Feb. '92 | P1. Cover page | | None |
| | | P2. DCN | | None |
| | | P5. Para. 1.2 | : Paragraph amended | 21021 |
| | | Para. 2 | : "ESA/SCC Basic Spec. No. 23500" added | 21025 |
| | | P6. Table 1(a) | : "Lead Material and/or Finish" column added | 21025 |
| | | P10. Para. 4.2.2 | : Bond Strength and Die Shear Test deviations deleted | 23499 |
| | | | : PIND deviation deleted | 21043 |
| | | Para. 4.2.3 | : Radiographic Inspection deviation deleted | 21049 |
| | | Para. 4.2.4 | : Bond Strength and Die Shear Test deviations deleted | 23499 |
| | | P16. Table 3 | : Note deleted | 21047 |
| 'B' | Jul. '93 | P1. Cover page | | None |
| | | P2. DCN | | None |
| | | P11. Para. 4.3.2 | : Maximum weight amended to 1.20g | 23560 |
| | | This document has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist. | | |
| 'C' | Aug. '96 | P1. Cover page | | None |
| | | P2. DCN | | None |
| | | P11. Para. 4.3.3 | : Applied Force deleted | 221332 |
| | | P12. Para. 4.5.3 | : Component Number corrected | 23828 |

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## 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 BUR14.

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.

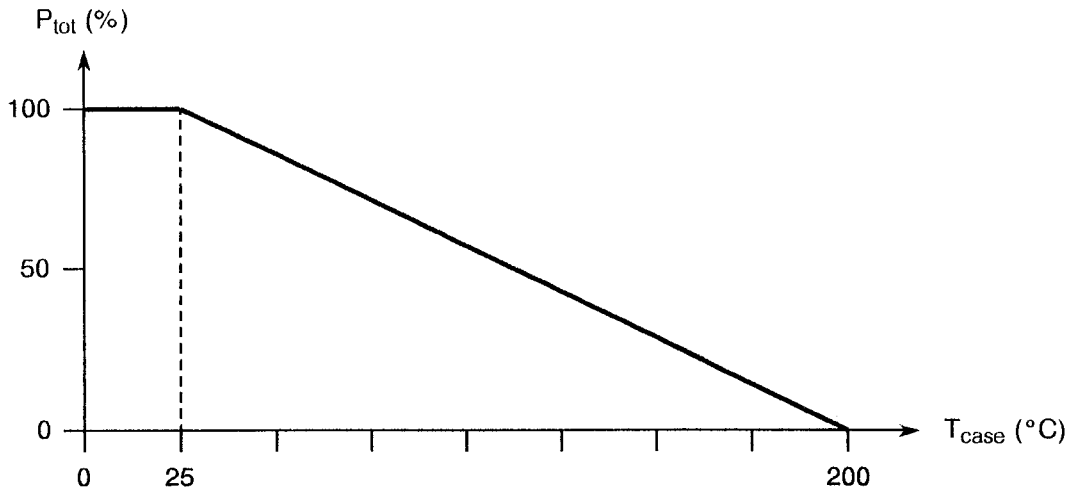
## TABLE 1(a) - TYPE VARIANTS

| VARIANT | BASED ON TYPE | CASE | FIGURE | LEAD MATERIAL AND FINISH |
|---|---|---|---|---|
| 01 | BUR14 | TO39 | 2 | D2 |

## TABLE 1(b) - MAXIMUM RATINGS

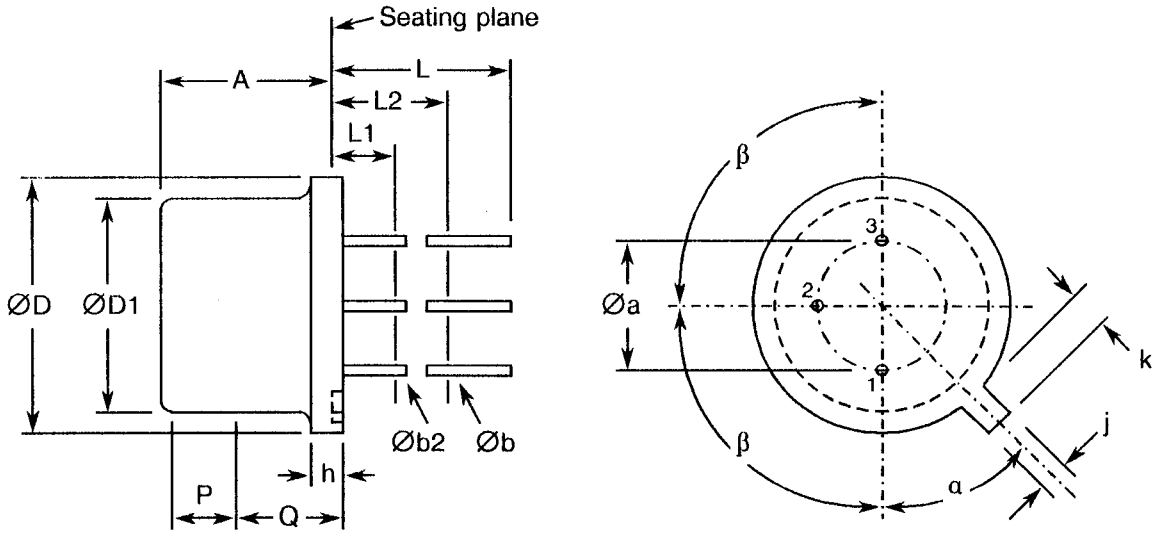
| No. | CHARACTERISTICS | SYMBOL | MAXIMUM RATINGS | UNIT | REMARKS |
|---|---|---|---|---|---|
| 1 | Collector-Base Breakdown Voltage | $V_{(BR)CBO}$ | 150 | V | |
| 2 | Collector-Emitter Breakdown Voltage | $V_{(BR)CEO}$ | 120 | V | |
| 3 | Emitter-Base Breakdown Voltage | $V_{(BR)EBO}$ | 5.5 | V | |
| 4 | Collector Current | $I_C$ | 3.0 | A | |
| 5 | Power Dissipation | $P_{tot}$ | 1.0 | W | At $T_{amb} \leq +25°C$ For derating, see Figure 1 |
| 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 | $T_{sol}$ | +300 | °C | Time: ≤60s Distance from case ≥1.5mm |
| 9 | Power Dissipation | $P_{tot}$ | 7.0 | W | At $T_{case} = +25°C$ |
| 10 | Collector Current (Peak) | $I_{CM}$ | 5.0 | A | |

## FIGURE 1 - PARAMETER DERATING INFORMATION




Power Dissipation versus Temperature

## FIGURE 2 - PHYSICAL DIMENSIONS

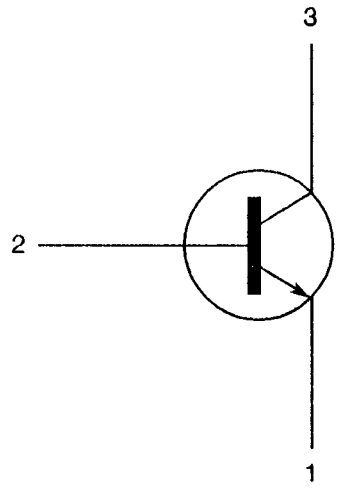



| SYMBOL | INCHES | | MILLIMETRES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| Øa | 0.190 | 0.210 | 4.83 | 5.33 | |
| A | 0.240 | 0.260 | 6.10 | 6.60 | |
| Øb | 0.016 | 0.021 | 0.406 | 0.533 | 2 |
| Øb2 | 0.016 | 0.019 | 0.406 | 0.483 | 2 |
| ØD | 0.350 | 0.370 | 8.89 | 9.40 | |
| 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 |
| α | 45° NOM. | | | | |
| β | 90° NOM. | | | | |

**NOTES**

1. This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.010 inch (0.254mm).
2. (3 leads) Øb2 applies between L1 and L2. Øb applies between L2 and 0.5 inch (12.70mm) from the seating plane. Diameter is uncontrolled in L1 and beyond 0.5 inch (12.70mm) from the seating plane.
3. Measured from maximum diameter of the actual device.
4. Details of outline in this zone is optional.

**FIGURE 3 - FUNCTIONAL DIAGRAM**




**NOTES**

1. The collector is internally connected to the 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 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) 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 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.

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-39.

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.

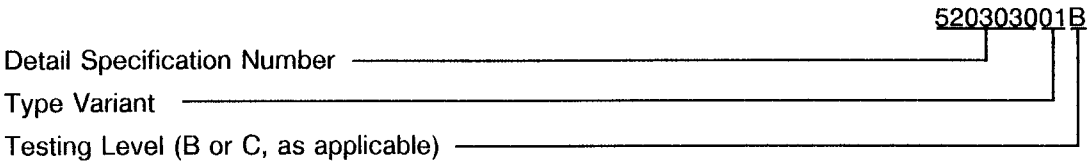
(c) Traceability Information.

### 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, 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 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-Emitter Breakdown Voltage | $V_{(BR)CEO}$ | 3011 | $I_C$ = 20mA<br>$I_B$ = 0A<br>Note 1 | 120 | - | V |
| 2 | Emitter-Base Breakdown Voltage | $V_{(BR)EBO}$ | 3026 | $I_E$ = 1.0mA<br>$I_C$ = 0A | 5.5 | - | V |
| 3 | Collector-Emitter Cut-off Current | $I_{CES}$ | 3041 | $V_{CE}$ = 100V<br>$V_{BE}$ = 0V | - | 1.0 | µA |
| | | | | $V_{CE}$ = 150V<br>$V_{BE}$ = 0V | - | 100 | |
| 4 | Emitter-Base Cut-off Current | $I_{EBO}$ | 3061 | $V_{EB}$ = 4.0V<br>$I_C$ = 0A | - | 1.0 | µA |
| 5 | D.C. Forward Current Transfer Ratio | $h_{FE1}$ | 3076 | $I_C$ = 50mA<br>$V_{CE}$ = 5.0V<br>Note 1 | 50 | - | - |
| | | $h_{FE2}$ | | $I_C$ = 250mA<br>$V_{CE}$ = 5.0V<br>Note 1 | 70 | - | |
| | | $h_{FE3}$ | | $I_C$ = 1.0A<br>$V_{CE}$ = 5.0V<br>Note 1 | 70 | 200 | |
| | | $h_{FE4}$ | | $I_C$ = 2.5A<br>$V_{CE}$ = 5.0V<br>Note 1 | 20 | - | |
| 6 | Collector Saturation Voltage | $V_{CEsat}$ | 3071 | $I_C$ = 1.0A<br>$I_B$ = 0.1A<br>Notes 1 and 2 | - | 0.5 | V |
| | | | | $I_C$ = 2.5A<br>$I_B$ = 0.25A<br>Notes 1 and 2 | - | 1.0 | |
| 7 | Base Saturation Voltage | $V_{BEsat}$ | 3066 | $I_C$ = 1.0A<br>$I_B$ = 0.1A<br>Notes 1 and 2 | - | 1.1 | V |
| | | | | $I_C$ = 2.5A<br>$I_B$ = 0.25A<br>Notes 1 and 2 | - | 1.5 | |

**NOTES**

1. Pulsed measurement: Pulse Width ≤300µs, Duty Cycle ≤2.0%.
2. Saturation voltages measured 6.0mm from header.

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

| No. | CHARACTERISTICS | SYMBOL | MIL-STD-750 TEST METHOD | TEST CONDITIONS | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN | MAX | |
| 1 | A.C. Forward Current Transfer Ratio | $h_{fe}$ | 3206 | $I_C = 0.1A$<br>$V_{CE} = 5.0V$<br>$f = 20MHz$ | 2.0 | - | - |
| 2 | Output Capacitance | $C_{obo}$ | 3236 | $V_{CB} = 20V$<br>$I_C = 0A$<br>$f = 1.0MHz$ | - | 50 | pF |
| 3 | Turn-on Time | $t_{on}$ | - | $I_C = 1.0A$<br>$I_{B1} = 0.1A$<br>$I_{B2} = -0.1A$<br>$V_{CC} = 20V$ | - | 0.5 | µs |
| | Turn-off Time | $t_{off}$ | | | - | 2.3 | |

## 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<br>$V_{CE}$ = 100V<br>$V_{BE}$ = 0V | - | 10 | µA |
| 2 | D.C. Forward Current Transfer Ratio | $h_{FE}$ | 3076 | $T_{amb}$ = −55°C<br>$I_C$ = 1.0A<br>$V_{CE}$ = 5.0V<br>Note 1 | 35 | - | - |

**NOTES**

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

## TABLE 4 - PARAMETER DRIFT VALUES

| No. | CHARACTERISTICS | SYMBOL | MIL-STD-750 TEST METHOD | TEST CONDITIONS | CHANGE LIMITS (Δ) | UNIT |
|---|---|---|---|---|---|---|
| 1 | Emitter-Base Cut-off Current | $I_{EBO}$ | 3061 | $V_{EB}$ = 4.0V<br>$I_C$ = 0A | ±200 | nA |
| 2 | D.C. Forward Current Transfer Ratio | $h_{FE}$ | 3076 | $V_{CE}$ = 5.0V<br>$I_C$ = 1.0A<br>Note 1 | ±25 | % |
| 3 | Collector Saturation Voltage | $V_{CEsat}$ | 3071 | $I_C$ = 2.5A<br>$I_B$ = 0.25A<br>Note 1 | ±100 | mV |

**NOTES**

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

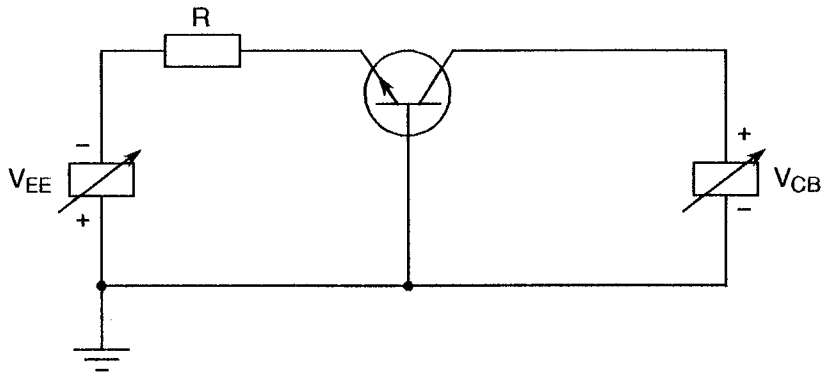
## TABLE 5 - CONDITIONS FOR BURN-IN

| No. | CHARACTERISTICS | SYMBOL | CONDITIONS | UNIT |
|---|---|---|---|---|
| 1 | Ambient Temperature | $T_{amb}$ | +25 ± 3 | °C |
| 2 | Collector-Emitter Voltage | $V_{CE}$ | 20 | V |
| 3 | Power Dissipation | $P_{tot}$ | 1.0 | W |

**NOTES**

1. No heatsink forced air directly on the device shall be permitted.

## 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 | MIL-STD-750 TEST METHOD | TEST CONDITIONS | LIMITS | | UNIT |
|---|---|---|---|---|---|---|---|
| | | | | | MIN. | MAX. | |
| 3 | Collector-Emitter Cut-off Current | $I_{CES}$ | 3041 | $V_{BE} = 0V$<br>$V_{CE} = 100V$ | - | 1.0 | µA |
| 5 | D.C. Forward Current Transfer Ratio 3 | $h_{FE3}$ | 3076 | $I_C = 1.0A$<br>$V_{CE} = 5.0V$<br>Note 1 | 70 | 200 | - |
| 6 | Collector-Emitter Saturation Voltage | $V_{CEsat}$ | 3071 | $I_C = 2.5A$<br>$I_B = 0.25A$<br>Notes 1 and 2 | - | 1.0 | V |

**NOTES**

1. Pulsed measurement: Pulse Width ≤ 300µs, Duty Cycle ≤ 2.0%.
2. Saturation voltages measured 6.0mm from header.