

## Hi-Rel 80 V - 1 A NPN bipolar transistor

### Features

|                             |                 |
|-----------------------------|-----------------|
| $BV_{CEO}$                  | 80 V            |
| $I_C$ (max)                 | 1 A             |
| $H_{FE}$ at 10 V - 150 mA   | > 100           |
| Operating temperature range | -65°C to +200°C |

- Hi-Rel NPN bipolar transistor
- Linear gain characteristics
- ESCC qualified
- European preferred part list - EPPL
- 100 krad low dose rate
- Radiation level: lot specific total dose contact marketing for specified level

### Description

The 2N3700HR is a silicon planar epitaxial NPN transistor in TO-18 and LCC-3 packages. It is specifically designed for aerospace Hi-Rel applications and ESCC qualified according to the 5201-004 specification. In case of conflict between this datasheet and ESCC detailed specification, the latter prevails.

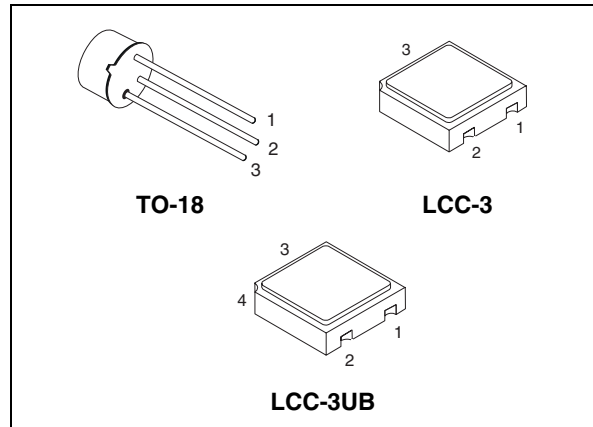


Figure 1. Internal schematic diagram

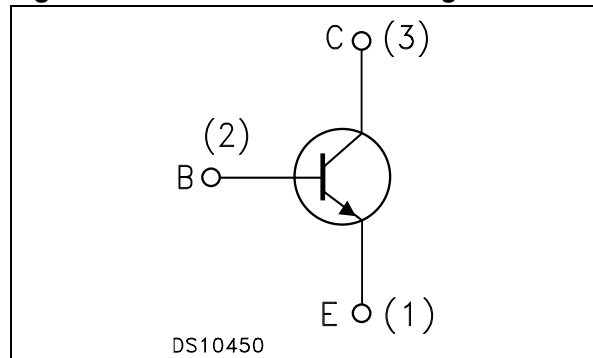


Table 1. Device summary

| Order codes | ESCC part num.    | Qual. level | Rad level | Packages | Lead finish                    | Mass (g) | EPPL |
|-------------|-------------------|-------------|-----------|----------|--------------------------------|----------|------|
| 2N37000UB1  | -                 | Eng. model  |           | LCC-3UB  | Gold                           | 0.06     | -    |
| 2N37000UBSW | 5201/004/07       | ESCC flight | 100 krad  | LCC-3UB  | Solder dip                     | 0.06     | Y    |
| 2N37000UB06 | 5201/004/06       | ESCC flight |           | LCC-3UB  | Gold                           | 0.06     | -    |
| 2N37000UB07 | 5201/004/07       | ESCC flight |           | LCC-3UB  | Solder dip                     | 0.06     | -    |
| SOC37000    | -                 | Eng. model  |           | LCC-3    | Gold                           | 0.06     | -    |
| SOC3700SW   | 5201/004/05       | ESCC flight | 100 krad  | LCC-3    | Solder dip                     | 0.06     | Y    |
| SOC3700HRB  | 5201/004/04 or 05 | ESCC flight |           | LCC-3    | Gold/Solder dip <sup>(1)</sup> | 0.06     | Y    |
| 2N3700T1    | -                 | Eng. model  |           | TO-18    | Gold                           | 0.40     | -    |
| 2N3700HR    | 5201/004/01 or 02 | ESCC flight |           | TO-18    | Gold/Solder dip <sup>(1)</sup> | 0.40     | -    |

1. Depending ESCC part number mentioned on the purchase order

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol    | Parameter                                                        | Value      | Unit |
|-----------|------------------------------------------------------------------|------------|------|
| $V_{CBO}$ | Collector-base voltage ( $I_E = 0$ )                             | 140        | V    |
| $V_{CEO}$ | Collector-emitter voltage ( $I_B = 0$ )                          | 80         | V    |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ )                               | 7          | V    |
| $I_C$     | Collector current                                                | 1          | A    |
| $P_{tot}$ | Total dissipation at $T_{amb} \leq 25\text{ °C}$<br>for 2N3700HR | 0.5        | W    |
|           | for SOC3700HRB                                                   | 0.5        | W    |
|           | for SOC3700HRB <sup>(1)</sup>                                    | 0.76       | W    |
|           | Total dissipation at $T_c \leq 25\text{ °C}$<br>for 2N3700HR     | 1.8        | W    |
| $T_{stg}$ | Storage temperature                                              | -65 to 200 | °C   |
| $T_J$     | Max. operating junction temperature                              | 200        | °C   |

1. When mounted on a 15 x 15 x 0.6 mm ceramic substrate.

**Table 3. Thermal data for through-hole package**

| Symbol     | Parameter                               | TO-18 | Unit |
|------------|-----------------------------------------|-------|------|
| $R_{thJC}$ | Thermal resistance junction-case max    | 97    | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient max | 350   | °C/W |

**Table 4. Thermal data for SMD package**

| Symbol     | Parameter                                              | SOC | Unit |
|------------|--------------------------------------------------------|-----|------|
| $R_{thJA}$ | Thermal resistance junction-ambient max                | 350 | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient <sup>(1)</sup> max | 230 | °C/W |

1. When mounted on a 15 x 15 x 0.6 mm ceramic substrate.

## 2 Electrical characteristics

$T_{\text{case}} = 25\text{ °C}$  unless otherwise specified.

**Table 5. Electrical characteristics**

| Symbol                            | Parameter                                                  | Test conditions                                                                                                                                                                                                                                                                                 | Min.                  | Typ.         | Max.            | Unit                      |
|-----------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------|-----------------|---------------------------|
| $I_{\text{CBO}}$                  | Collector cut-off current ( $I_{\text{E}} = 0$ )           | $V_{\text{CB}} = 90\text{ V}$<br>$V_{\text{CB}} = 90\text{ V}$ $T_{\text{amb}} = 110\text{ °C}$<br>$V_{\text{CB}} = 90\text{ V}$ $T_{\text{amb}} = 150\text{ °C}$                                                                                                                               |                       |              | 10<br>100<br>10 | nA<br>nA<br>$\mu\text{A}$ |
| $I_{\text{EBO}}$                  | Emitter cut-off current ( $I_{\text{C}} = 0$ )             | $V_{\text{EB}} = 5\text{ V}$                                                                                                                                                                                                                                                                    |                       |              | 10              | nA                        |
| $V_{(\text{BR})\text{CBO}}$       | Collector-base breakdown voltage ( $I_{\text{E}} = 0$ )    | $I_{\text{C}} = 100\text{ }\mu\text{A}$                                                                                                                                                                                                                                                         | 140                   |              |                 | V                         |
| $V_{(\text{BR})\text{CEO}}^{(1)}$ | Collector-emitter breakdown voltage ( $I_{\text{B}} = 0$ ) | $I_{\text{C}} = 30\text{ mA}$                                                                                                                                                                                                                                                                   | 80                    |              |                 | V                         |
| $V_{(\text{BR})\text{EBO}}$       | Emitter-base breakdown voltage ( $I_{\text{C}} = 0$ )      | $I_{\text{E}} = 100\text{ }\mu\text{A}$                                                                                                                                                                                                                                                         | 7                     |              |                 | V                         |
| $V_{\text{CE(sat)}}^{(1)}$        | Collector-emitter saturation voltage                       | $I_{\text{C}} = 150\text{ mA}$ $I_{\text{B}} = 15\text{ mA}$<br>$I_{\text{C}} = 500\text{ mA}$ $I_{\text{B}} = 50\text{ mA}$                                                                                                                                                                    |                       |              | 0.2<br>0.5      | V<br>V                    |
| $V_{\text{BE(sat)}}^{(1)}$        | Base-emitter saturation voltage                            | $I_{\text{C}} = 150\text{ mA}$ $I_{\text{B}} = 15\text{ mA}$<br>$I_{\text{C}} = 150\text{ mA}$ $I_{\text{B}} = 15\text{ mA}$<br>$T_{\text{amb}} = 110\text{ °C}$                                                                                                                                | 0.75<br>0.65          | 0.87<br>0.77 | 1<br>0.9        | V<br>V                    |
| $h_{\text{FE}}^{(1)}$             | DC current gain                                            | $I_{\text{C}} = 10\text{ mA}$ $V_{\text{CE}} = 10\text{ V}$<br>$I_{\text{C}} = 150\text{ mA}$ $V_{\text{CE}} = 10\text{ V}$<br>$I_{\text{C}} = 500\text{ mA}$ $V_{\text{CE}} = 10\text{ V}$<br>$I_{\text{C}} = 150\text{ mA}$ $V_{\text{CE}} = 10\text{ V}$<br>$T_{\text{amb}} = -55\text{ °C}$ | 90<br>100<br>50<br>40 |              | 300             |                           |
| $h_{\text{fe}}$                   | Small signal current gain                                  | $V_{\text{CE}} = 10\text{ V}$ $I_{\text{C}} = 50\text{ mA}$<br>$f = 20\text{ MHz}$                                                                                                                                                                                                              | 5                     |              |                 |                           |
| $C_{\text{CBO}}$                  | Output capacitance ( $I_{\text{E}} = 0$ )                  | $V_{\text{CB}} = 10\text{ V}$ $f = 1\text{ MHz}$                                                                                                                                                                                                                                                |                       |              | 12              | pF                        |
| $C_{\text{IBO}}$                  | Input capacitance ( $I_{\text{C}} = 0$ )                   | $V_{\text{EB}} = 0.5\text{ V}$ $f = 1\text{ MHz}$                                                                                                                                                                                                                                               |                       |              | 60              | pF                        |

1. Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 2\%$

2.1 Electrical characteristics (curves)

Figure 2. DC current gain  
( $V_{CE}=1\text{ V}$ )

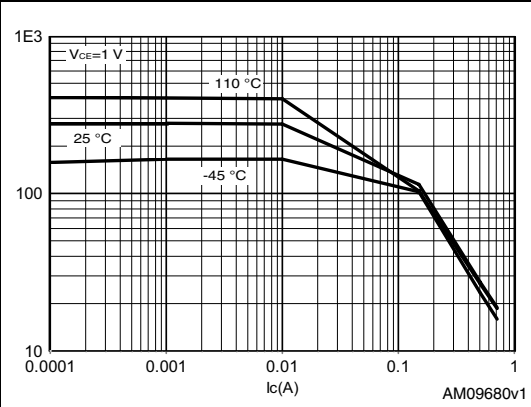


Figure 3. DC current gain  
( $V_{CE}=10\text{ V}$ )

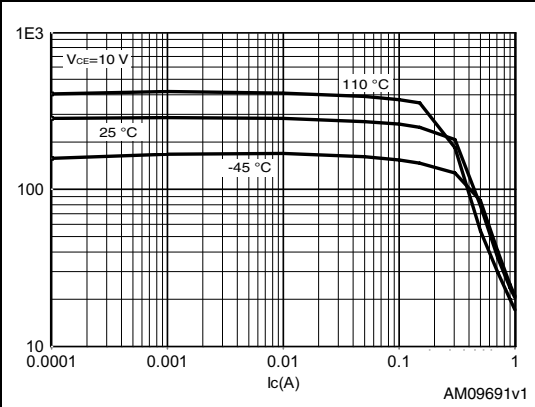


Figure 4. Collector emitter saturation  
voltage

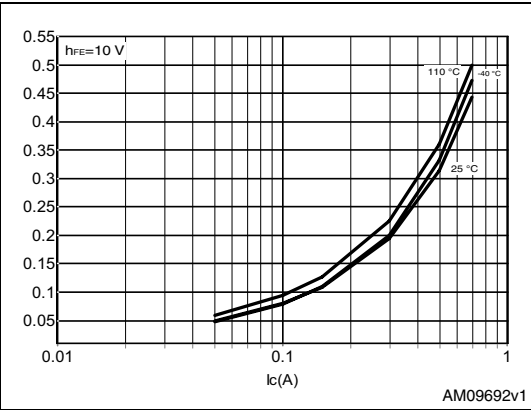
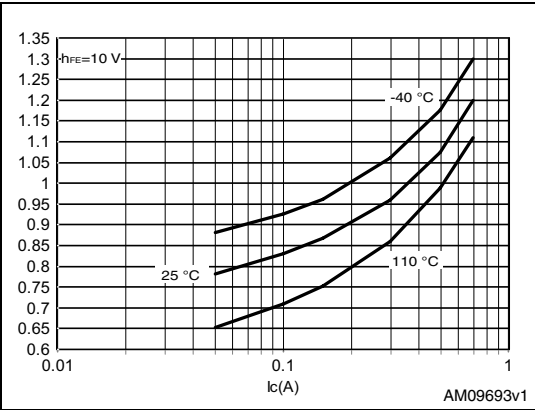
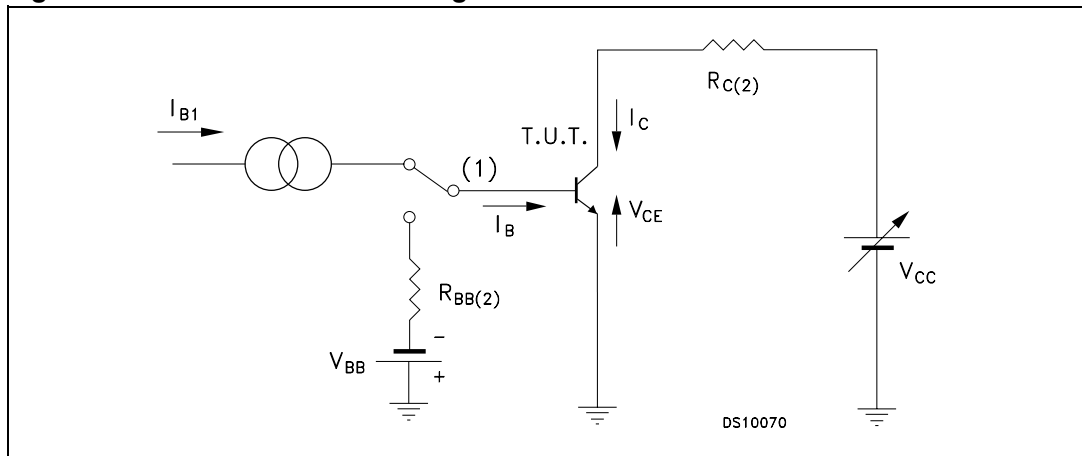


Figure 5. Base emitter saturation  
voltage



## 2.2 Test circuit

Figure 6. Resistive load switching test circuit



1. Fast electronic switch
2. Non-inductive resistor

### 3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Table 6. LCC-3UB mechanical data

| Dim. | mm.  |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 1.16 |      | 1.42 |
| C    | 0.46 | 0.51 | 0.56 |
| D    | 0.56 | 0.76 | 0.96 |
| E    | 0.92 | 1.02 | 1.12 |
| F    | 1.95 | 2.03 | 2.11 |
| G    | 2.92 | 3.05 | 3.18 |
| I    | 2.41 | 2.54 | 2.67 |
| J    | 0.42 | 0.57 | 0.72 |
| K    | 1.37 | 1.52 | 1.67 |
| L    | 0.41 | 0.51 | 0.61 |
| M    | 2.46 | 2.54 | 2.62 |
| N    | 1.81 | 1.91 | 2.01 |
| r    |      | 0.20 |      |
| r1   |      | 0.30 |      |
| r2   |      | 0.56 |      |

Figure 7. LCC-3UB drawings

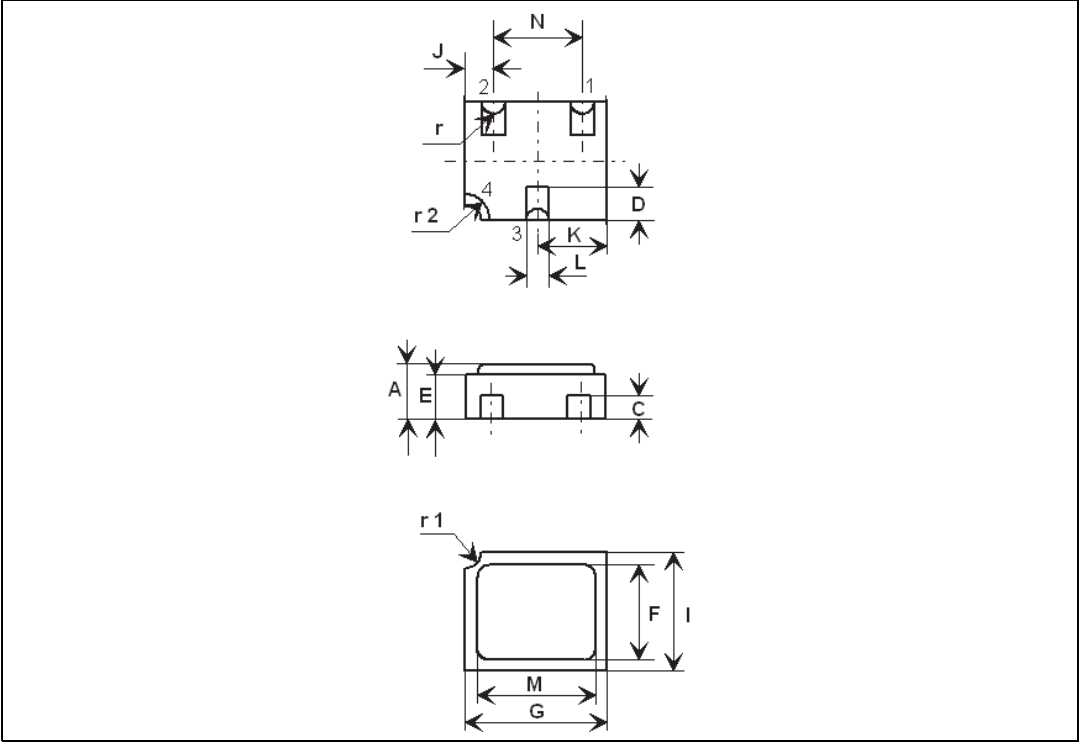


Table 7. LCC-3 mechanical data

| Dim. | mm.  |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    | 1.16 |      | 1.42 |
| C    | 0.45 | 0.50 | 0.56 |
| D    | 0.60 | 0.76 | 0.91 |
| E    | 0.91 | 1.01 | 1.12 |
| F    | 1.95 | 2.03 | 2.11 |
| G    | 2.92 | 3.05 | 3.17 |
| I    | 2.41 | 2.54 | 2.66 |
| J    | 0.42 | 0.57 | 0.72 |
| K    | 1.37 | 1.52 | 1.67 |
| L    | 0.40 | 0.50 | 0.60 |
| M    | 2.46 | 2.54 | 2.62 |
| N    | 1.80 | 1.90 | 2.00 |
| R    |      | 0.30 |      |

Figure 8. LCC-3 drawings

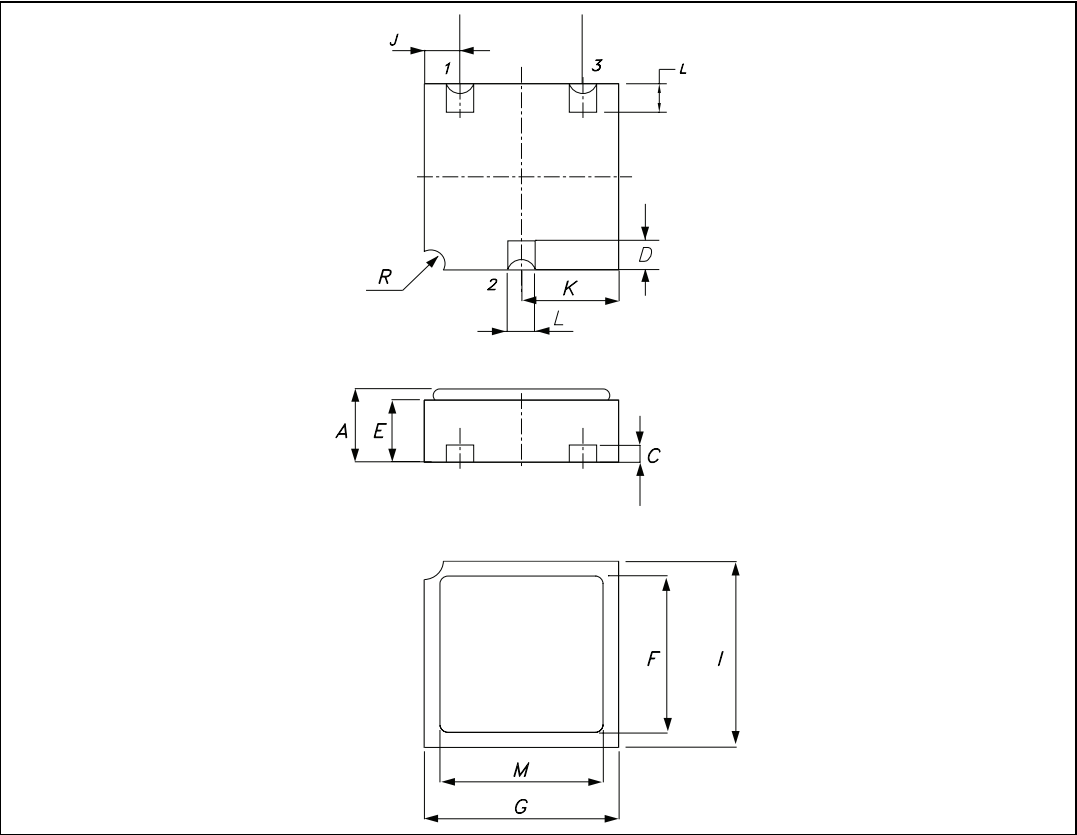
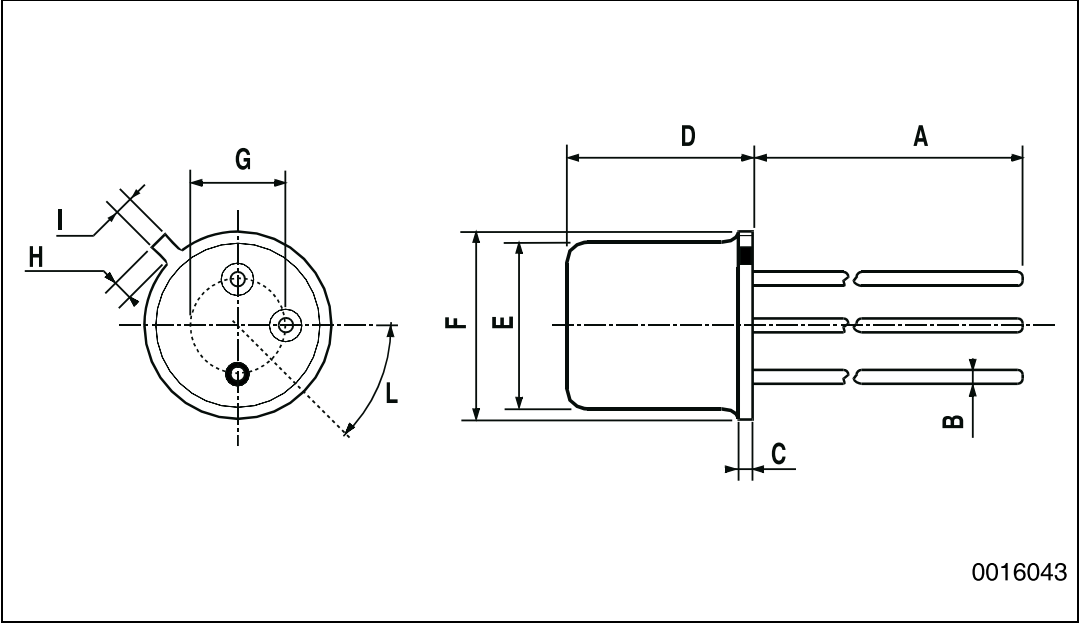




Table 8. TO-18 mechanical data

| Dim. | mm.  |      |      |
|------|------|------|------|
|      | Min. | Typ. | Max. |
| A    |      | 12.7 |      |
| B    |      |      | 0.49 |
| D    |      |      | 5.3  |
| E    |      |      | 4.9  |
| F    |      |      | 5.8  |
| G    | 2.54 |      |      |
| H    |      |      | 1.2  |
| I    |      |      | 1.16 |
| L    | 45°  |      |      |

Figure 9. TO-18 drawings



## 4 Order codes

**Table 9. Order codes**

| Order codes | ESCC Part number  | Rad level | Packages | Lead Finish                       | Marking         | EPPL | Packing     |
|-------------|-------------------|-----------|----------|-----------------------------------|-----------------|------|-------------|
| 2N37000UB1  | -                 |           | LCC-3UB  | Gold                              | 2N37000UB1      | -    | Waffle pack |
| 2N37000UBSW | 5201/004/07       | 100 krad  | LCC-3UB  | Solder Dip                        | 520100407       | Y    | Waffle pack |
| 2N37000UB06 | 5201/004/06       |           | LCC-3UB  | Gold                              | 520100406       | -    | Waffle pack |
| 2N37000UB07 | 5201/004/07       |           | LCC-3UB  | Solder Dip                        | 520100407       | -    | Waffle pack |
| SOC37000    | -                 |           | LCC-3    | Gold                              | SOC3700         | -    | Waffle pack |
| SOC3700SW   | 5201/004/05       | 100 krad  | LCC-3    | Solder Dip                        | 520100405       | Y    | Waffle pack |
| SOC3700HRB  | 5201/004/04 or 05 |           | LCC-3    | Gold or Solder Dip <sup>(1)</sup> | 520100404 or 05 | Y    | Waffle pack |
| 2N3700T1    | -                 |           | TO-18    | Gold                              | 2N3700T1        | -    | Strip pack  |
| 2N3700HR    | 5201/004/01 or 02 |           | TO-18    | Gold or Solder Dip <sup>(1)</sup> | 520100401 or 02 | -    | Strip pack  |

1. Depending ESCC part number mentioned on the purchase order

Contact ST sales office for information about the specific conditions for:

- Products in die form
- Tape and reel packing

## 5 Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                            |
|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10-Jan-2008 | 1        | Initial release                                                                                                                                                                                                                                    |
| 07-Jan-2010 | 2        | Modified <a href="#">Table 1 on page 1</a>                                                                                                                                                                                                         |
| 26-Jul-2010 | 3        | Modified <a href="#">Table 1 on page 1</a> , added <a href="#">Table 9 on page 10</a>                                                                                                                                                              |
| 30-Nov-2011 | 4        | <ul style="list-style-type: none"><li>– Modified: <a href="#">Table 5 on page 3</a></li><li>– Added: <a href="#">Section 2.1: Electrical characteristics (curves)</a></li><li>– Minor text change in the document title on the coverpage</li></ul> |

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