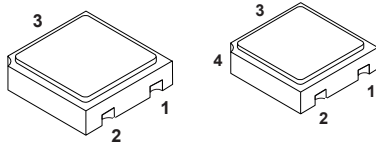
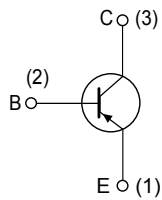


## Rad-hard 60 V, 0.6 A PNP transistor


**LCC-3**
**UB**

Pin 4 in UB is connected to the metallic lid.



DS10460

### Features

| $V_{CBO}$ | $I_C(max.)$ |       | $H_{FE}$ at 10 V,<br>150 mA | $T_J(max.)$ |
|-----------|-------------|-------|-----------------------------|-------------|
| 60 V      | ESCC        | 0.5 A | > 100                       | 200 °C      |

- Hermetic packages
- ESCC qualified
- 100 krad

### Description

The 2N2907AHR is a bipolar transistor able to operate under severe environment conditions and radiation exposure providing high immunity to total ionizing dose (TID).

Qualified as per ESCC 5202/001 specification and available in LCC-3 and UB hermetic packages, it is specifically recommended for space and harsh environment applications and suitable for low current and high precision circuits such as preamplifiers, oscillators, current mirror configuration.

In case of discrepancies between this datasheet and the relevant agency specification, the latter takes precedence.

#### Product status link

[2N2907AHR](#)

### Product summary

| Product summary |                      |                      |         |                 |
|-----------------|----------------------|----------------------|---------|-----------------|
| Part-number     | Qualification system | Agency specification | Package | Radiation level |
| 2N2907ARUBx     | ESCC Flight          | 5202/001             | UB      | 100 krad        |
| 2N2907AUBx      | ESCC Flight          | 5202/001             | UB      | -               |
| SOC2907ARHRx    | ESCC Flight          | 5202/001             | LCC-3   | 100 krad        |
| SOC2907AHRx     | ESCC Flight          | 5202/001             | LCC-3   | -               |

**Note:** See [Table 7](#) for ordering information.

## 1 Electrical ratings

*Note:* For PNP transistor voltage and current polarity is reversed.

**Table 1. Absolute maximum ratings**

| Symbol    | Parameter                                        |                             | Value      | Unit |
|-----------|--------------------------------------------------|-----------------------------|------------|------|
| $V_{CBO}$ | Collector-base voltage ( $I_E = 0$ )             |                             | -60        | V    |
| $V_{CEO}$ | Collector-emitter voltage ( $I_B = 0$ )          |                             | -60        | V    |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ )               |                             | -5         | V    |
| $I_C$     | Collector current                                |                             | 0.5        | A    |
| $P_{TOT}$ | Total dissipation at $T_{amb} \leq 25\text{ °C}$ | LCC-3 and UB                | 0.4        | W    |
|           |                                                  | LCC-3 and UB <sup>(1)</sup> | 0.73       |      |
| $T_{OP}$  | Operating temperature range                      |                             | -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 2. Thermal data**

| Symbol     | Parameter                                  | LCC-3 and UB Value          | Unit |
|------------|--------------------------------------------|-----------------------------|------|
| $R_{thJA}$ | Thermal resistance junction-ambient (max.) | 437.5<br>240 <sup>(1)</sup> | °C/W |

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

## 2 Electrical characteristics

### 2.1 Electrical characteristics

**Table 3. Electrical characteristics ( $T_{amb} = 25\text{ °C}$  unless otherwise specified)**

| Symbol              | Parameter                                            | Test conditions                                                                           | Min. | Max. | Unit          |
|---------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------|------|------|---------------|
| $I_{CBO}$           | Collector-base cut-off current<br>( $I_E = 0$ )      | $V_{CB} = 50\text{ V}$                                                                    |      | 10   | nA            |
|                     |                                                      | $V_{CB} = 50\text{ V}, T_{amb} = 150\text{ °C}$                                           |      | 10   | $\mu\text{A}$ |
| $I_{CEX}$           | Collector-emitter cut-off current                    | $V_{CE} = 30\text{ V}, V_{BE} = -0.5\text{ V}$                                            |      | 50   | nA            |
| $V_{(BR)CBO}$       | Collector-base breakdown voltage<br>( $I_E = 0$ )    | $I_C = 10\text{ }\mu\text{A}$                                                             | 60   |      | V             |
| $V_{(BR)CEO}^{(1)}$ | Collector-emitter breakdown voltage<br>( $I_B = 0$ ) | $I_C = 10\text{ mA}$                                                                      | 60   |      | V             |
| $V_{(BR)EBO}$       | Emitter-base breakdown voltage<br>( $I_C = 0$ )      | $I_C = 10\text{ }\mu\text{A}$                                                             | 5    |      | V             |
| $V_{CE(sat)}^{(1)}$ | Collector-emitter saturation voltage                 | $I_C = 150\text{ mA}, I_B = 15\text{ mA}$                                                 |      | 0.4  | V             |
| $V_{BE(sat)}^{(1)}$ | Base-emitter saturation voltage                      | $I_C = 150\text{ mA}, I_B = 15\text{ mA}$                                                 |      | 1.3  | V             |
| $h_{FE}^{(1)}$      | DC current gain                                      | $I_C = 0.1\text{ mA}, V_{CE} = 10\text{ V}$                                               | 75   |      |               |
|                     |                                                      | $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}$                                                | 100  |      |               |
|                     |                                                      | $I_C = 150\text{ mA}, V_{CE} = 10\text{ V}$                                               | 100  | 300  |               |
|                     |                                                      | $I_C = 500\text{ mA}, V_{CE} = 10\text{ V}$                                               | 50   |      |               |
| $h_{fe}$            | Small signal current gain                            | $I_C = 20\text{ mA}, f = 100\text{ MHz}, V_{CE} = 20\text{ V}$                            | 2    |      |               |
| $C_{OBO}$           | Output capacitance<br>( $I_E = 0$ )                  | $100\text{ kHz} \leq f \leq 1\text{ MHz}, V_{CB} = 10\text{ V}$                           |      | 8    | pF            |
| $t_{on}$            | Turn-on time                                         | $I_{CC} = 150\text{ mA},$<br>$I_{B1} = 15\text{ mA},$<br>$V_{CC} = 30\text{ V}$           |      | 45   | ns            |
| $t_{off}$           | Turn-off time                                        | $I_{CC} = 150\text{ mA},$<br>$I_{B1} = -I_{B2} = 15\text{ mA},$<br>$V_{CC} = 30\text{ V}$ |      | 300  | ns            |

1. Pulsed duration = 300  $\mu\text{s}$ , duty cycle  $\leq 1.5\%$

## 2.2 Radiation assurance

Radiation test are guaranteed in compliance with ESCC 22900 and ESCC 5202/001 specifications.

Each lot is tested in radiation according to the following procedure:

- Radiation condition of 0.1 rad (Si)/s.
- Test of 11 samples by wafer, 5 biased at 80% of  $V_{(BR)CEO}$ , 5 unbiased and for reference.
- Acceptance criteria in compliance with the post radiation electrical characteristics as per [Table 4](#).

**Table 4. ESCC 5202/001 post radiation electrical characteristics ( $T_{amb} = 25\text{ °C}$  unless otherwise specified)**

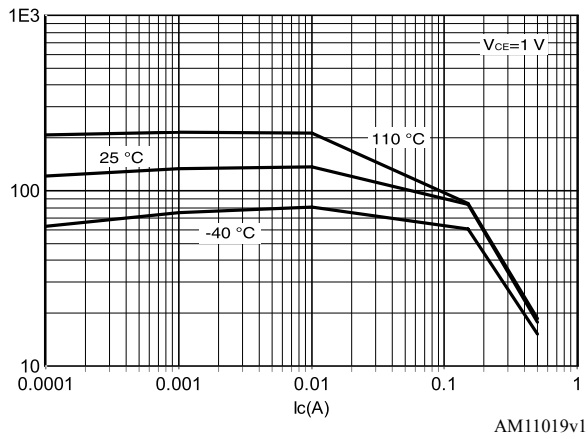
| Symbol              | Parameter                                         | Test conditions                                   | Min. | Typ. | Max | Unit |
|---------------------|---------------------------------------------------|---------------------------------------------------|------|------|-----|------|
| $I_{CBO}$           | Collector cut-off current ( $I_E = 0$ )           | $V_{CB} = 50\text{ V}$                            |      | -    | 10  | nA   |
| $I_{CEX}$           | Collector-emitter cut-off current                 | $V_{CE} = 30\text{ V}$ , $V_{BE} = -0.5\text{ V}$ |      | -    | 50  | nA   |
| $V_{(BR)CBO}$       | Collector-base breakdown voltage ( $I_E = 0$ )    | $I_C = 10\text{ }\mu\text{A}$                     | 60   | -    |     | V    |
| $V_{(BR)CEO}^{(1)}$ | Collector-emitter breakdown voltage ( $I_B = 0$ ) | $I_C = 10\text{ mA}$                              | 60   |      |     | V    |
| $V_{(BR)EBO}$       | Emitter-base breakdown voltage ( $I_C = 0$ )      | $I_E = 10\text{ }\mu\text{A}$                     | 5    | -    |     | V    |
| $V_{CE(sat)}^{(1)}$ | Collector-emitter saturation voltage              | $I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$      |      | -    | 0.4 | V    |
| $V_{BE(sat)}^{(1)}$ | Base-emitter saturation voltage                   | $I_C = 150\text{ mA}$ , $I_B = 15\text{ mA}$      |      | -    | 1.3 | V    |
| $[h_{FE}]^{(1)}$    | Post irradiation gain calculation <sup>(2)</sup>  | $I_C = 0.1\text{ mA}$ , $V_{CE} = 10\text{ V}$    | [30] | -    |     |      |
|                     |                                                   | $I_C = 10\text{ mA}$ , $V_{CE} = 10\text{ V}$     | [50] | -    |     |      |
|                     |                                                   | $I_C = 150\text{ mA}$ , $V_{CE} = 10\text{ V}$    | [50] | -    | 300 |      |
|                     |                                                   | $I_C = 500\text{ mA}$ , $V_{CE} = 10\text{ V}$    | [25] | -    |     |      |

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

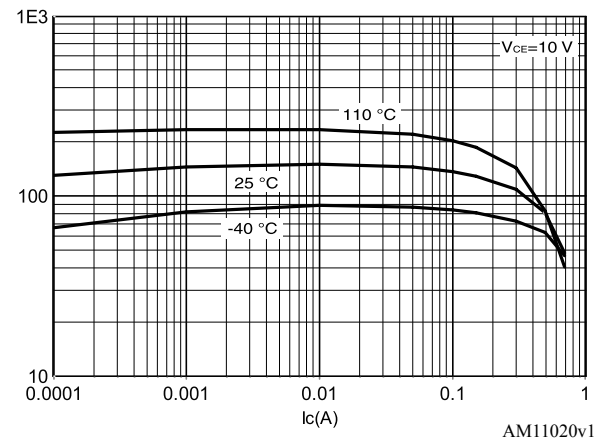
2. The post-irradiation gain calculation of  $[h_{FE}]$ , made using  $h_{FE}$  measurements from prior to and on completion of irradiation testing and after each annealing step if any, shall be as specified in MILSTD-750 method 1019.

## 2.3 Electrical characteristics (curves)

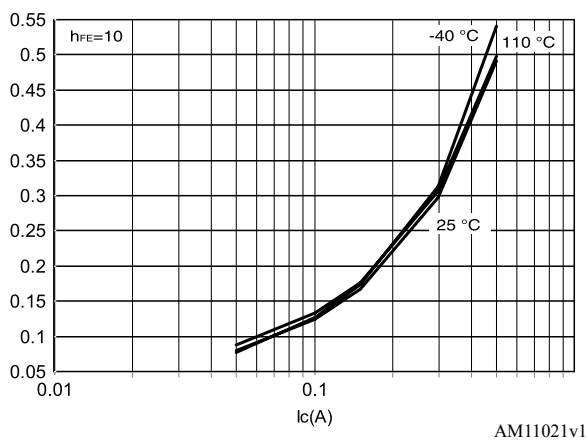
**Figure 1. DC current gain ( $V_{CE} = 1\text{ V}$ )**



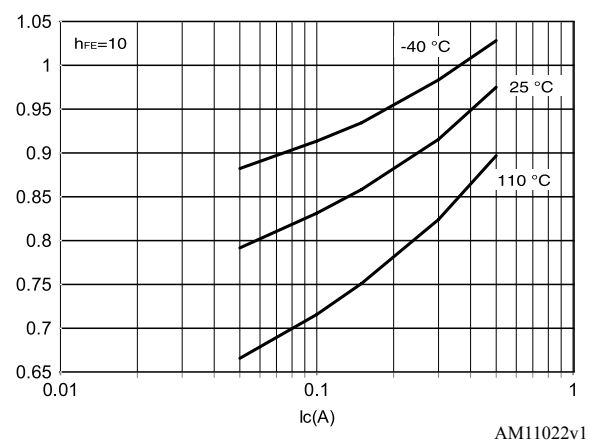
**Figure 2. DC current gain ( $V_{CE} = 10\text{ V}$ )**



**Figure 3. Collector emitter saturation voltage**



**Figure 4. Base emitter saturation voltage ( $h_{FE} = 10$ )**

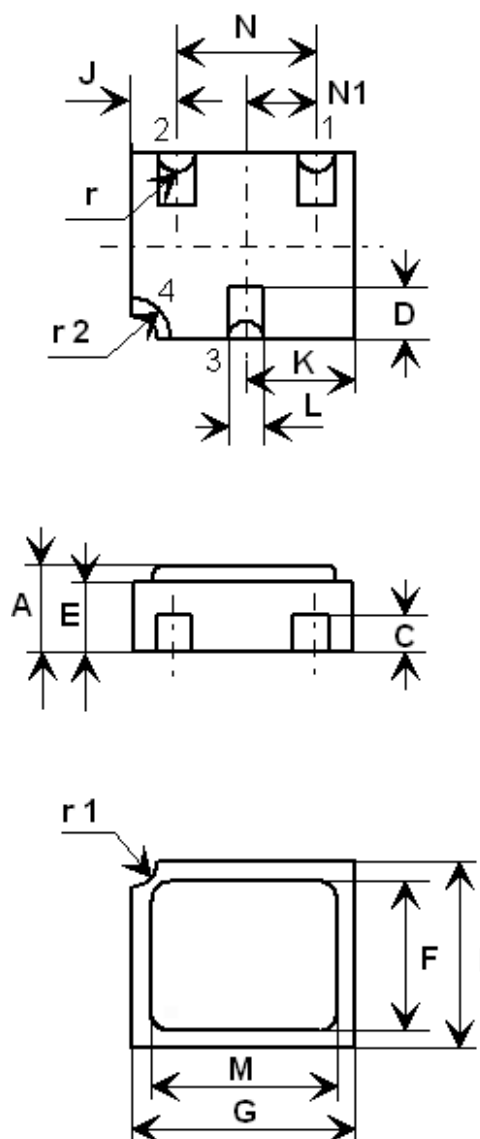


### 3 Package information

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

#### 3.1 UB package information

**Figure 5. UB package outline**



Pad 1: Emitter

Pad 2: Base

Pad 3: Collector

Pad 4: Shielding connected to the lid

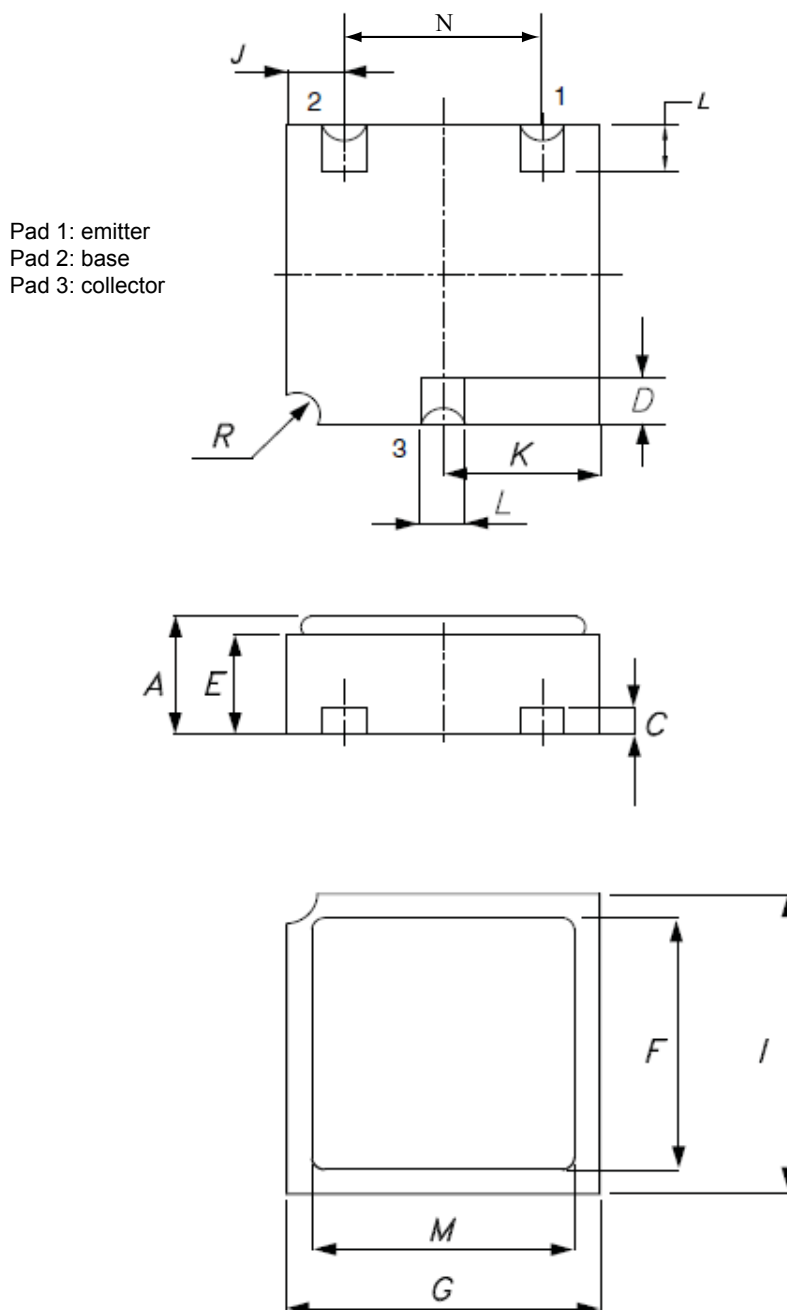
8206487

**Table 5. UB package mechanical data**

| Symbols | Dimensions in mm |      |      | Dimensions in inches (for reference only) |        |        |
|---------|------------------|------|------|-------------------------------------------|--------|--------|
|         | Min.             | Typ. | Max. | Min.                                      | Typ.   | Max.   |
| A       | 1.17             |      | 1.42 | 0.045                                     |        | 0.056  |
| C       | 0.46             | 0.51 | 0.56 | 0.018                                     | 0.020  | 0.022  |
| D       | 0.56             | 0.76 | 0.96 | 0.024                                     | 0.030  | 0.036  |
| E       | 0.92             | 1.02 | 1.12 | 0.036                                     | 0.040  | 0.044  |
| F       | 1.95             | 2.03 | 2.11 | 0.077                                     | 0.080  | 0.083  |
| G       | 2.92             | 3.05 | 3.18 | 0.115                                     | 0.120  | 0.125  |
| I       | 2.41             | 2.54 | 2.67 | 0.095                                     | 0.100  | 0.105  |
| J       | 0.42             | 0.57 | 0.72 | 0.0165                                    | 0.0225 | 0.0285 |
| K       | 1.37             | 1.52 | 1.67 | 0.054                                     | 0.060  | 0.066  |
| L       | 0.41             | 0.51 | 0.61 | 0.016                                     | 0.020  | 0.024  |
| M       | 2.46             | 2.54 | 2.62 | 0.097                                     | 0.100  | 0.103  |
| N       | 1.81             | 1.91 | 2.01 | 0.071                                     | 0.075  | 0.079  |
| N1      | 0.91             | 0.96 | 1.02 | 0.036                                     | 0.038  | 0.040  |
| r       |                  | 0.20 |      |                                           | 0.008  |        |
| r1      |                  | 0.30 |      |                                           | 0.012  |        |
| r2      |                  | 0.56 |      |                                           | 0.022  |        |

## 3.2 LCC-3 package information

Figure 6. LCC-3 package outline



0041211 rev.14

**Table 6. LCC-3 package mechanical data**

| Symbols | Dimensions in mm |      |      | Dimensions in inches (for reference only) |        |        |
|---------|------------------|------|------|-------------------------------------------|--------|--------|
|         | Min.             | Typ. | Max. | Min.                                      | Typ.   | Max.   |
| A       | 1.16             |      | 1.42 | 0.046                                     |        | 0.056  |
| C       | 0.45             | 0.50 | 0.56 | 0.018                                     | 0.020  | 0.022  |
| D       | 0.56             | 0.76 | 0.96 | 0.022                                     | 0.030  | 0.038  |
| E       | 0.91             | 1.01 | 1.12 | 0.036                                     | 0.040  | 0.044  |
| F       | 1.95             | 2.03 | 2.11 | 0.077                                     | 0.080  | 0.083  |
| G       | 2.92             | 3.05 | 3.17 | 0.115                                     | 0.120  | 0.125  |
| I       | 2.41             | 2.54 | 2.66 | 0.095                                     | 0.100  | 0.105  |
| J       | 0.42             | 0.57 | 0.72 | 0.0165                                    | 0.0225 | 0.0285 |
| K       | 1.37             | 1.52 | 1.67 | 0.054                                     | 0.060  | 0.066  |
| L       | 0.40             | 0.50 | 0.60 | 0.016                                     | 0.020  | 0.024  |
| M       | 2.46             | 2.54 | 2.62 | 0.097                                     | 0.100  | 0.103  |
| N       | 1.80             | 1.90 | 2.00 | 0.071                                     | 0.075  | 0.079  |
| R       |                  | 0.30 |      |                                           | 0.012  |        |

## Ordering information

**Table 7. Ordering information**

| Part number   | ESCC specification | Screening option  | Radiation level | Package | Mass  | Lead finish | Marking <sup>(1)</sup> | Packing       |
|---------------|--------------------|-------------------|-----------------|---------|-------|-------------|------------------------|---------------|
| 2N2907AUB1    | -                  | Engineering model | -               | UB      | 0.6 g | Gold        | 2N2907AUB1             | WafflePack    |
| SOC2907A1     | -                  |                   | -               | LCC-3   |       |             | SOC2907A1              |               |
| 2N2907ARUBG   | 5202/001/06R       | Flight model      | 100 krad        | UB      |       | Gold        | 520200106R             |               |
| 2N2907ARUBT   | 5202/001/07R       |                   |                 |         |       | Solder Dip  | 520200107R             |               |
| 2N2907ARUBTW  | 5202/001/07R       |                   |                 |         |       | Solder Dip  | 520200107R             | Tape and reel |
| 2N2907AUBG    | 5202/001/06        |                   | -               |         |       | Gold        | 520200106              | WafflePack    |
| 2N2907AUBT    | 5202/001/07        |                   | -               |         |       | Solder Dip  | 520200107              |               |
| SOC2907ARHRG  | 5202/001/04R       |                   | 100 krad        | LCC-3   |       | Gold        | 520200104R             |               |
| SOC2907ARHRT  | 5202/001/05R       |                   |                 |         |       | Solder Dip  | 520200105R             |               |
| SOC2907ARHRTW | 5202/001/05R       |                   |                 |         |       | Solder Dip  | 520200105R             | Tape and reel |
| SOC2907AHRG   | 5202/001/04        |                   | -               |         |       | Gold        | 520200104              | WafflePack    |
| SOC2907AHRT   | 5202/001/05        |                   | -               |         |       | Solder Dip  | 520200105              |               |
| SOC2907AHRTW  | 5202/001/05        |                   | -               |         |       | Solder Dip  | 520200105              | Tape and reel |

1. Specific marking only. The full marking includes in addition: For the Engineering Models: ST logo, date code; country of origin (FR). For ESCC flight parts: ST logo, date code, country of origin (FR), ESA logo, serial number of the part within the assembly lot.

Contact ST sales office for information about specific conditions for products in die form.



## 5 Other information

### 5.1 Traceability information

**Table 8. Date codes**

| Model | Date code |
|-------|-----------|
| EM    | 3yywwN    |
| ESCC  | yywwN     |

1. yy = year, ww = week number, N = lot index in the week.

### 5.2 Documentation

**Table 9. Documentation provided for each type of product**

| Quality level     | Radiation level | Documentation                                                                                                                                                     |
|-------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Engineering model | -               | Certificate of conformance                                                                                                                                        |
| Flight model      | -               | Certificate of conformance<br>ESCC qualification maintenance lot reference                                                                                        |
| Flight model      | 100 krad        | Certificate of conformance<br>ESCC qualification maintenance lot reference<br>Radiation verification test (RVT) report at 25 / 50 / 70 / 100 krad at 0.1 rad / s. |

## Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                        |
|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 09-Feb-2009 | 1        | Initial release.                                                                                                                                                                                                                                                               |
| 05-Jan-2010 | 2        | Modified Table 1: Device summary                                                                                                                                                                                                                                               |
| 30-Nov-2011 | 3        | Minor text changes in the document title and description on the coverpage                                                                                                                                                                                                      |
| 14-May-2012 | 4        | New package inserted (UB).<br>Updated:<br>– Table 1: Device summary, Table 2: Absolute maximum ratings and Table 3: Thermal data.<br>– Section 2: Electrical characteristics and Section 4: Package mechanical data.<br>Added:<br>– Section : and Section 6: Shipping details. |
| 03-Jun-2013 | 5        | Added:<br>– New section Radiation hardness assurance<br>– Corrected the revision number and dates of revision 3.                                                                                                                                                               |
| 18-Sep-2013 | 6        | Updated Table 1: Device summary and Table 13: Ordering information                                                                                                                                                                                                             |
| 05-May-2014 | 7        | Updated Table 1: Device summary, Table 13: Ordering information and Section 3: Radiation hardness assurance.<br>Added Figure 2: Safe operating area for TO-18 and Figure 3: Safe operating area for LCC-3                                                                      |
| 29-May-2014 | 8        | Added note 1 in Table 13: Ordering information.                                                                                                                                                                                                                                |
| 21-Aug-2015 | 9        | Modified: <i>Section 4.3: TO-18 package information</i><br>Minor text changes.                                                                                                                                                                                                 |
| 02-Dec-2015 | 10       | Updated <i>Figure 2.: Safe operating area for TO-18</i> and <i>Figure 3.: Safe operating area for LCC-3</i> .<br>Minor text chages.                                                                                                                                            |
| 16-Apr-2020 | 11       | Removed <i>TO-18 package information</i> . Minor text changes.                                                                                                                                                                                                                 |
| 02-Feb-2021 | 12       | Updated <i>Table 1, Table 1, Table 4, Figure 6, Table 7 and Table 9</i> .<br>Removed Radiation summary table.<br>Minor text changes.                                                                                                                                           |
| 16-Nov-2021 | 13       | Updated <i>Features, Description and Product summary</i> on cover page.<br>Updated <i>Table 1, Table 2, Table 7, Table 8 and Table 9</i> .<br>Updated Section 2 Electrical characteristics.                                                                                    |
| 10-Feb-2022 | 14       | Updated <i>Description, Section 2.2 Radiation assurance, Table 7 and Table 9</i> .                                                                                                                                                                                             |
| 11-Dec-2024 | 15       | Updated <a href="#">Figure 5</a> .                                                                                                                                                                                                                                             |

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