

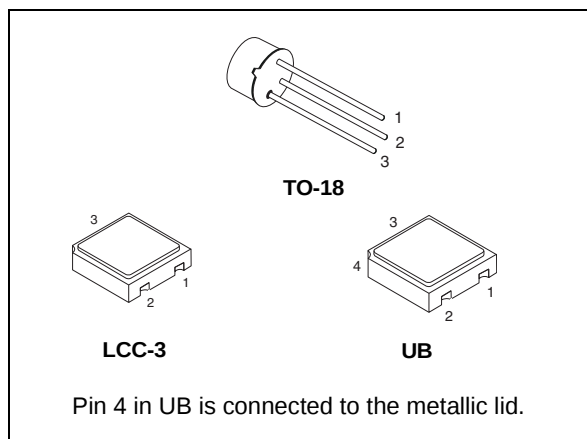
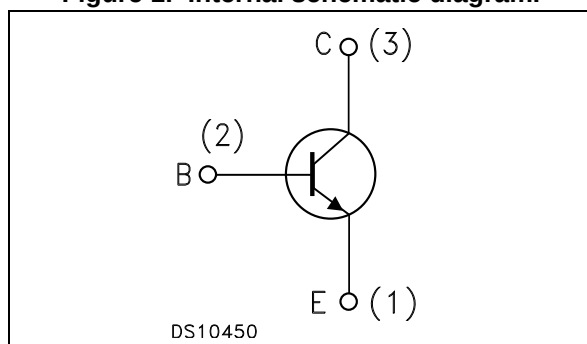


Figure 1. Internal schematic diagram



### Features

| Parameter                                          | ESCC  | JANS |
|----------------------------------------------------|-------|------|
| $BV_{CEO \text{ min}}$                             | 40 V  | 50 V |
| $I_C \text{ (max)}$                                | 0.8 A |      |
| $h_{FE} \text{ at } 10 \text{ V} - 150 \text{ mA}$ | 100   |      |

- Hermetic packages
- ESCC and JANS qualified
- Up to 100 krad(Si) low dose rate

### Description

The 2N2222AHR is a silicon planar NPN transistor specifically designed and housed in hermetic packages for aerospace and Hi-Rel applications. It is available in the JAN qualification system (MIL-PRF19500 compliance) and in the ESCC qualification system (ESCC 5000 compliance). In case of discrepancies between this datasheet and the relevant agency specification, the latter takes precedence.

Table 1. Device summary

| Device          | Qualification system | Agency specification | Package | Radiation level                 | EPPL   |
|-----------------|----------------------|----------------------|---------|---------------------------------|--------|
| JANSR2N2222AUBx | JANSR                | MIL-PRF-19500/255    | UB      | 100 krad high and low dose rate | -      |
| JANS2N2222AUBx  | JANS                 | MIL-PRF-19500/255    | UB      | -                               | -      |
| 2N2222ARUBx     | ESCC Flight          | 5201/002             | UB      | 100 krad - low dose rate        | Target |
| 2N2222AUBx      | ESCC Flight          | 5201/002             | UB      | -                               | Target |
| SOC2222ARHRx    | ESCC Flight          | 5201/002             | LCC-3   | 100 krad - low dose rate        | Yes    |
| SOC2222AHRx     | ESCC Flight          | 5201/002             | LCC-3   | -                               | Yes    |
| 2N2222ARHRx     | ESCC Flight          | 5201/002             | TO-18   | 100 krad - low dose rate        | Target |
| 2N2222AHRx      | ESCC Flight          | 5201/002             | TO-18   | -                               | -      |

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol    | Parameter                                                | Value      | Unit             |
|-----------|----------------------------------------------------------|------------|------------------|
| $V_{CBO}$ | Collector-base voltage ( $I_E = 0$ )                     | 75         | V                |
| $V_{CEO}$ | Collector-emitter voltage ( $I_B = 0$ ) for JANS devices | 50         | V                |
|           | Collector-emitter voltage ( $I_B = 0$ ) for ESCC devices | 40         | V                |
| $V_{EBO}$ | Emitter-base voltage ( $I_C = 0$ )                       | 6          | V                |
| $I_C$     | Collector current                                        | 0.8        | A                |
| $P_{TOT}$ | Total dissipation at $T_{amb} \leq 25^\circ\text{C}$     |            |                  |
|           | ESCC: TO-18                                              | 0.5        | W                |
|           | LCC-3 and UB                                             | 0.5        |                  |
|           | LCC-3 and UB <sup>(1)</sup>                              | 0.73       |                  |
|           | JANS: LCC-3UB                                            | 0.5        |                  |
|           | Total dissipation at $T_{case} \leq 25^\circ\text{C}$    |            |                  |
|           | ESCC: TO-18                                              | 1.8        |                  |
|           | Total dissipation at $T_{sp(1S)} = 25^\circ\text{C}$     |            |                  |
|           | JANS: UB                                                 | 1          | W                |
| $T_{STG}$ | Storage temperature                                      | -65 to 200 | $^\circ\text{C}$ |
| $T_J$     | Max. operating junction temperature                      | 200        | $^\circ\text{C}$ |

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

**Table 3. Thermal data**

| Symbol          | Parameter                                                             | LCC-3 and UB              | TO-18 | Unit               |
|-----------------|-----------------------------------------------------------------------|---------------------------|-------|--------------------|
| $R_{thJC}$      | Thermal resistance junction-case (max) for JANS                       | -                         | -     | $^\circ\text{C/W}$ |
|                 | Thermal resistance junction-case (max) for ESCC                       | -                         | 97    |                    |
| $R_{thJSP(1S)}$ | Thermal resistance junction-solder pad (infinite sink) (max) for JANS | 90                        | -     |                    |
|                 | Thermal resistance junction-solder pad (infinite sink) (max) for ESCC | -                         | -     |                    |
| $R_{thJA}$      | Thermal resistance junction-ambient (max) for JANS                    | 325                       | -     |                    |
|                 | Thermal resistance junction-ambient (max) for ESCC                    | 350<br>240 <sup>(1)</sup> | 350   |                    |

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

## 2 Electrical characteristics

JANS and ESCC version of the products are assembled and tested in compliance with the agency specification it is qualified in. The electrical characteristics of each version are provided in dedicated tables.

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

### 2.1 JANS electrical characteristics

Table 4. JANS electrical characteristics

| Symbol                            | Parameter                                                  | Test conditions                                                                                                                                                                                                                                                                                                                                                                                                              | Min.                               | Typ. | Max.           | Unit                                 |
|-----------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------|----------------|--------------------------------------|
| $I_{\text{CBO}}$                  | Collector cut-off current ( $I_{\text{E}} = 0$ )           | $V_{\text{CB}} = 75\text{ V}$<br>$V_{\text{CB}} = 60\text{ V}$<br>$V_{\text{CB}} = 60\text{ V}$ $T_{\text{amb}} = 150\text{ °C}$                                                                                                                                                                                                                                                                                             |                                    |      | 10<br>10<br>10 | $\mu\text{A}$<br>nA<br>$\mu\text{A}$ |
| $I_{\text{CES}}$                  | Collector cut-off current ( $I_{\text{E}} = 0$ )           | $V_{\text{CE}} = 50\text{ V}$                                                                                                                                                                                                                                                                                                                                                                                                |                                    |      | 50             | nA                                   |
| $I_{\text{EBO}}$                  | Emitter cut-off current ( $I_{\text{C}} = 0$ )             | $V_{\text{EB}} = 6\text{ V}$<br>$V_{\text{EB}} = 4\text{ V}$                                                                                                                                                                                                                                                                                                                                                                 |                                    |      | 10<br>10       | $\mu\text{A}$<br>nA                  |
| $V_{(\text{BR})\text{CEO}}^{(1)}$ | Collector-emitter breakdown voltage ( $I_{\text{B}} = 0$ ) | $I_{\text{C}} = 10\text{ mA}$                                                                                                                                                                                                                                                                                                                                                                                                | 50                                 |      |                | V                                    |
| $V_{\text{CE(sat)}}^{(1)}$        | Collector-emitter saturation voltage                       | $I_{\text{C}} = 150\text{ mA}$ $I_{\text{B}} = 15\text{ mA}$<br>$I_{\text{C}} = 500\text{ mA}$ $I_{\text{B}} = 50\text{ mA}$                                                                                                                                                                                                                                                                                                 |                                    |      | 0.3<br>1       | 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>$I_{\text{C}} = 500\text{ mA}$ $I_{\text{B}} = 50\text{ mA}$                                                                                                                                                                                                                                                                                                 | 0.6                                |      | 1.2<br>2       | V<br>V                               |
| $h_{\text{FE}}^{(1)}$             | DC current gain                                            | $I_{\text{C}} = 0.1\text{ mA}$ $V_{\text{CE}} = 10\text{ V}$<br>$I_{\text{C}} = 1\text{ mA}$ $V_{\text{CE}} = 10\text{ V}$<br>$I_{\text{C}} = 10\text{ mA}$ $V_{\text{CE}} = 10\text{ V}$<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>$I_{\text{C}} = 10\text{ mA}$ $V_{\text{CE}} = 10\text{ V}$<br>$T_{\text{amb}} = -55\text{ °C}$ | 50<br>75<br>100<br>100<br>30<br>35 |      | 325<br>300     |                                      |
| $h_{\text{fe}}$                   | Small signal current gain                                  | $V_{\text{CE}} = 20\text{ V}$ $I_{\text{C}} = 20\text{ mA}$<br>$f = 100\text{ MHz}$<br>$V_{\text{CE}} = 10\text{ V}$ $I_{\text{C}} = 1\text{ mA}$<br>$f = 1\text{ kHz}$                                                                                                                                                                                                                                                      | 2.5<br>50                          |      |                |                                      |
| $C_{\text{obo}}$                  | Output capacitance ( $I_{\text{E}} = 0$ )                  | $V_{\text{CB}} = 10\text{ V}$<br>100 kHz $\leq f \leq 1\text{ MHz}$                                                                                                                                                                                                                                                                                                                                                          |                                    |      | 8              | pF                                   |
| $C_{\text{ibo}}$                  | Output capacitance ( $I_{\text{E}} = 0$ )                  | $V_{\text{EB}} = 0.5\text{ V}$<br>100 kHz $\leq f \leq 1\text{ MHz}$                                                                                                                                                                                                                                                                                                                                                         |                                    |      | 25             | pF                                   |

Table 4. JANS electrical characteristics (continued)

| Symbol    | Parameter     | Test conditions                                                                   | Min. | Typ. | Max. | Unit |
|-----------|---------------|-----------------------------------------------------------------------------------|------|------|------|------|
| $t_{on}$  | Turn-on time  | $V_{CC} = 30\text{ V}$ $I_C = 150\text{ mA}$<br>$I_{B1} = 15\text{ mA}$           |      |      | 35   | ns   |
| $t_{off}$ | Turn-off time | $V_{CC} = 30\text{ V}$ $I_C = 150\text{ mA}$<br>$I_{B1} = -I_{B2} = 15\text{ mA}$ |      |      | 300  | ns   |

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

## 2.2 ESCC electrical characteristics

Table 5. ESCC electrical characteristics

| Symbol              | Parameter                                         | Test conditions                                                                                                                                                                                                                                                                     | Min.                        | Typ. | Max.     | Unit                |
|---------------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------|----------|---------------------|
| $I_{CBO}$           | Collector cut-off current ( $I_E = 0$ )           | $V_{CB} = 60\text{ V}$<br>$V_{CB} = 60\text{ V}$ $T_{amb} = 150\text{ }^\circ\text{C}$                                                                                                                                                                                              |                             |      | 10<br>10 | nA<br>$\mu\text{A}$ |
| $I_{EBO}$           | Emitter cut-off current ( $I_C = 0$ )             | $V_{EB} = 3\text{ V}$                                                                                                                                                                                                                                                               |                             |      | 10       | nA                  |
| $V_{(BR)CBO}$       | Collector-base breakdown voltage ( $I_E = 0$ )    | $I_C = 100\text{ }\mu\text{A}$                                                                                                                                                                                                                                                      | 75                          |      |          | V                   |
| $V_{(BR)CEO}^{(1)}$ | Collector-emitter breakdown voltage ( $I_B = 0$ ) | $I_C = 30\text{ mA}$                                                                                                                                                                                                                                                                | 40                          |      |          | V                   |
| $V_{(BR)EBO}$       | Emitter-base breakdown voltage ( $I_C = 0$ )      | $I_E = 100\text{ }\mu\text{A}$                                                                                                                                                                                                                                                      | 6                           |      |          | V                   |
| $V_{CE(sat)}^{(1)}$ | Collector-emitter saturation voltage              | $I_C = 150\text{ mA}$ $I_B = 15\text{ mA}$                                                                                                                                                                                                                                          |                             |      | 0.3      | V                   |
| $V_{BE(sat)}^{(1)}$ | Base-emitter saturation voltage                   | $I_C = 150\text{ mA}$ $I_B = 15\text{ mA}$                                                                                                                                                                                                                                          |                             | 0.87 | 1.2      | V                   |
| $h_{FE}^{(1)}$      | DC current gain                                   | $I_C = 0.1\text{ mA}$ $V_{CE} = 10\text{ V}$<br>$I_C = 10\text{ mA}$ $V_{CE} = 10\text{ V}$<br>$I_C = 150\text{ mA}$ $V_{CE} = 10\text{ V}$<br>$I_C = 500\text{ mA}$ $V_{CE} = 10\text{ V}$<br>$I_C = 10\text{ mA}$ $V_{CE} = 10\text{ V}$<br>$T_{amb} = -55\text{ }^\circ\text{C}$ | 35<br>75<br>100<br>40<br>35 |      | 300      |                     |
| $h_{fe}$            | Small signal current gain                         | $V_{CE} = 20\text{ V}$ $I_C = 20\text{ mA}$<br>$f = 100\text{ MHz}$                                                                                                                                                                                                                 | 3                           |      | 10       |                     |
| $C_{obo}$           | Output capacitance ( $I_E = 0$ )                  | $V_{CB} = 10\text{ V}$<br>100 kHz $\leq f \leq 1\text{ MHz}$                                                                                                                                                                                                                        |                             |      | 8        | pF                  |

Table 5. ESCC electrical characteristics (continued)

| Symbol    | Parameter     | Test conditions                                                                      | Min. | Typ. | Max. | Unit |
|-----------|---------------|--------------------------------------------------------------------------------------|------|------|------|------|
| $t_{on}$  | Turn-on time  | $V_{CC} = 30\text{ V}$<br>$I_C = 150\text{ mA}$<br>$I_{B1} = 15\text{ mA}$           |      |      | 35   | ns   |
| $t_{off}$ | Turn-off time | $V_{CC} = 30\text{ V}$<br>$I_C = 150\text{ mA}$<br>$I_{B1} = -I_{B2} = 15\text{ mA}$ |      |      | 285  | ns   |

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

2.3 Electrical characteristics (curves)

Figure 2. Safe operating area for LCC-3 and UB

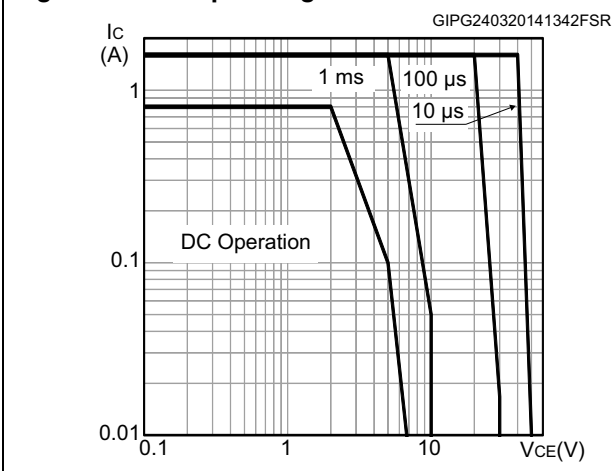


Figure 3. Safe operating area for TO-18

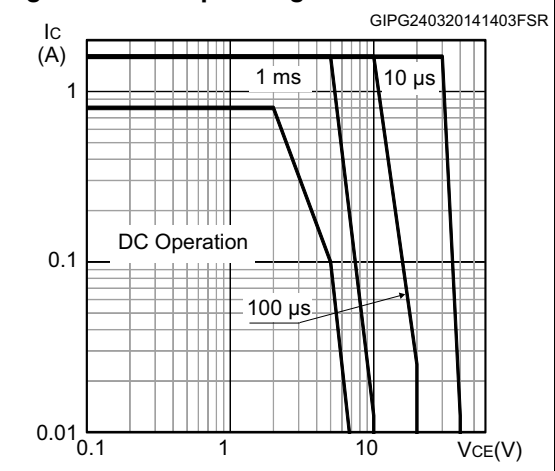


Figure 4. DC current gain

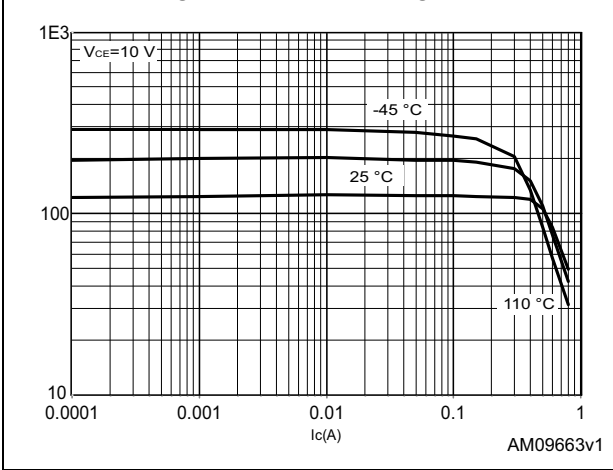


Figure 5. Collector emitter saturation voltage

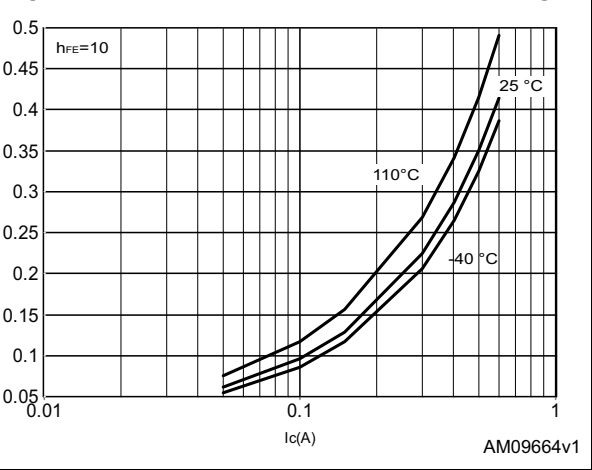
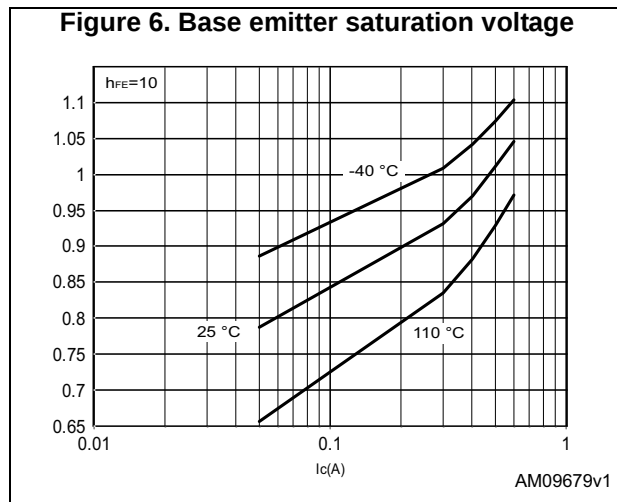


Figure 6. Base emitter saturation voltage



## 2.4 Test circuits

Figure 7. JANS saturated turn-on switching time test circuit

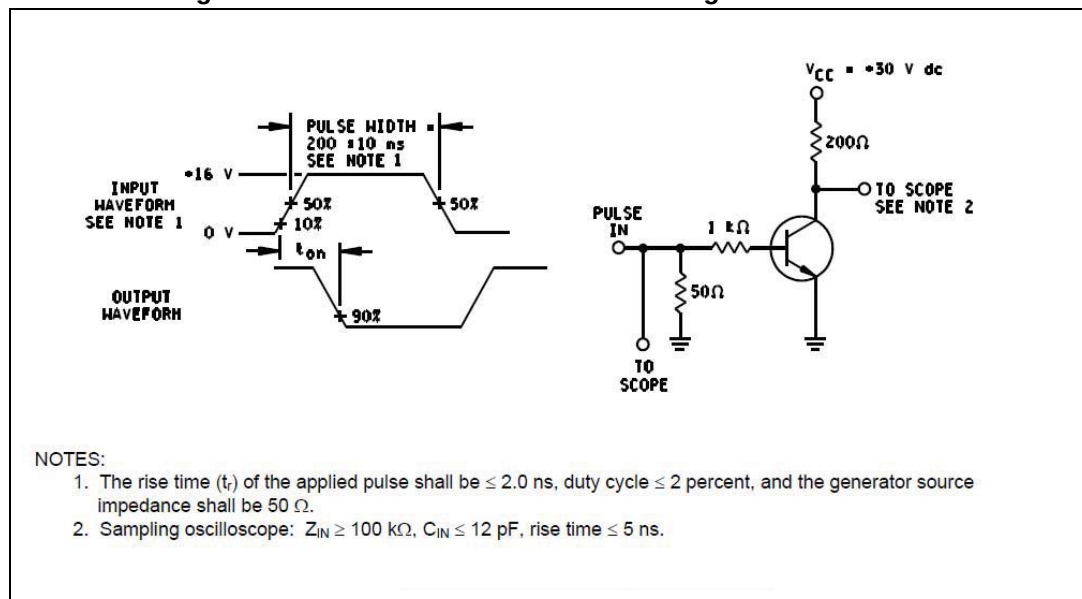


Figure 8. JANS saturated turn-off switching time test circuit

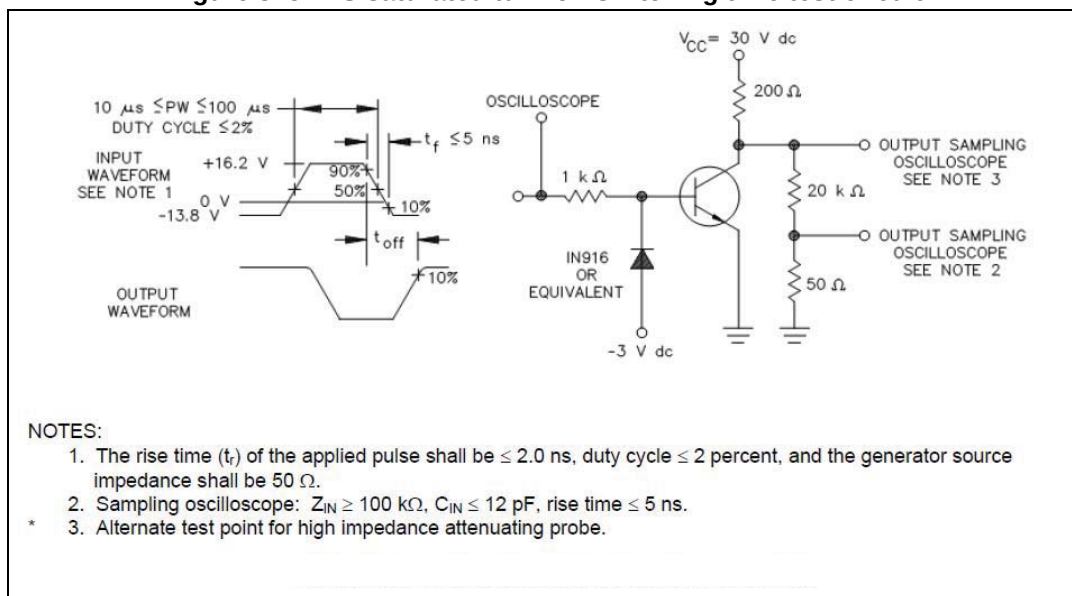
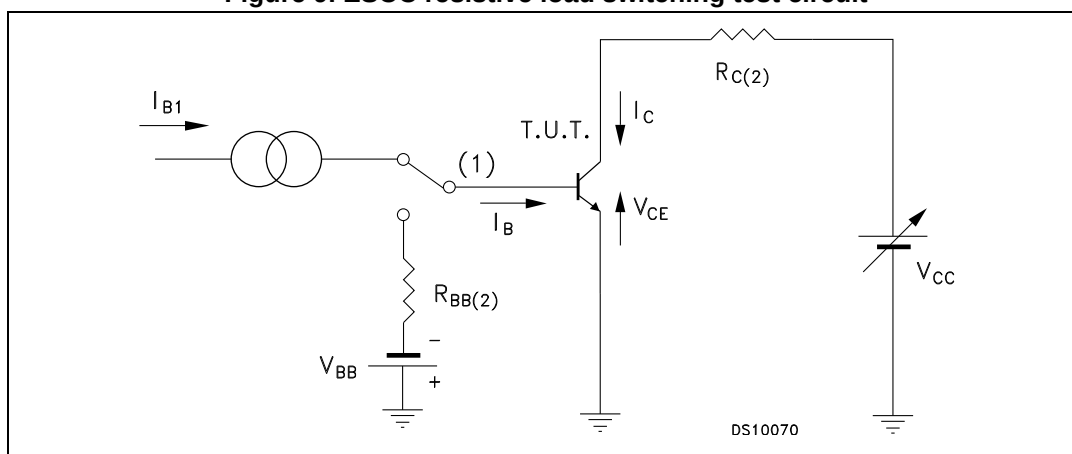


Figure 9. ESCC resistive load switching test circuit



1. Fast electronic switch
2. Non-inductive resistor

### 3 Radiation hardness assurance

The products guaranteed in radiation within the JANS system fully comply with the MIL-PRF-19500/255 specification.

The products guaranteed in radiation within the ESCC system fully comply with the ESCC 5201/002 and ESCC 22900 specifications.

#### JANS radiation assurance

ST JANS parts guaranteed at 100 krad (Si), tested, in full compliancy with the MIL-PRF-19500 specification, specifically the Group D, subgroup 2 inspection, between 50 and 300 rad/s. On top of the standard JANSR high dose rate by wafer lot guarantee, ST 2N2222AHR series include an additional wafer by wafer 100 krad Low dose rate guarantee at 0.1 rad/s, identical to the ESCC 100 krad guarantee. It is supported with the same Radiation Verification Test report provided with each shipment. A brief summary of the standard High Dose Rate by wafer lot JANSR guarantee is provided below:

- All test are performed in accordance to MIL-PRF-19500 and test method 1019 of MIL-STD-750 for total Ionizing dose.
- The table below provides for each monitored parameters of the test conditions and the acceptance criteria

**Table 6. MIL-PRF-19500 (test method 1019) post radiation electrical characteristics**

| Symbol        | Parameter                               | Test conditions               | Value                 |      | Unit    |
|---------------|-----------------------------------------|-------------------------------|-----------------------|------|---------|
|               |                                         |                               | Min.                  | Max. |         |
| $I_{CBO}$     | Collector to base cutoff current        | $V_{CB} = 75$                 |                       | 20   | $\mu A$ |
|               |                                         | $V_{CB} = 60 V$               |                       | 20   | nA      |
| $I_{EBO}$     | Emitter to base cutoff current          | $V_{EB} = 6 V$                |                       | 20   | $\mu A$ |
|               |                                         | $V_{EB} = 4 V$                |                       | 20   | nA      |
| $V_{(BR)CEO}$ | Breakdown voltage, collector to emitter | $I_C = 10 mA$                 | 50                    |      | V       |
| $I_{CES}$     | Collector to emitter cutoff current     | $V_{CE} = 50 V$               |                       | 100  | nA      |
| $h_{FE}$      | Forward-current transfer ratio          | $V_{CE} = 10 V; I_C = 0.1 mA$ | [25] <sup>(1)</sup>   |      |         |
|               |                                         | $V_{CE} = 10 V; I_C = 1.0 mA$ | [37.5] <sup>(1)</sup> | 325  |         |
|               |                                         | $V_{CE} = 10 V; I_C = 10 mA$  | [50] <sup>(1)</sup>   |      |         |
|               |                                         | $V_{CE} = 10 V; I_C = 150 mA$ | [50] <sup>(1)</sup>   | 300  |         |
|               |                                         | $V_{CE} = 10 V; I_C = 500 mA$ | [15] <sup>(1)</sup>   |      |         |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage    | $I_C = 150 mA; I_B = 15 mA$   |                       | 0.35 | V       |
|               |                                         | $I_C = 500 mA; I_B = 50 mA$   |                       | 1.15 |         |
| $V_{BE(sat)}$ | Base-emitter saturation voltage         | $I_C = 150 mA; I_B = 15 mA$   | 0.6                   | 1.38 | V       |
|               |                                         | $I_C = 500 mA; I_B = 50 mA$   |                       | 2.3  |         |

1. See method 1019 of MIL-STD-750 for how to determine  $[h_{FE}]$  by first calculating the delta ( $1/h_{FE}$ ) from the pre- and Post-radiation  $h_{FE}$ . Notice the  $[h_{FE}]$  is not the same as  $h_{FE}$  and cannot be measured directly. The  $[h_{FE}]$  value can never exceed the pre-radiation minimum  $h_{FE}$  that it is based upon.

### ESCC radiation assurance

Each product lot is tested according to the ESCC basic specification 22900, with a minimum of 11 samples per diffusion lot and 5 samples per wafer, one sample being kept as unirradiated sample, all of them being fully compliant with the applicable ESCC generic and/or detailed specification.

ST goes beyond the ESCC specification by performing the following procedure:

- Test of 11 pieces by wafer, 5 biased at least 80% of  $V_{(BR)CEO}$ , 5 unbiased and 1 kept for reference
- Irradiation at 0.1 rad (Si)/s
- Acceptance criteria of each individual wafer if as 100 krad guaranteed if all 10 samples comply with the post radiation electrical characteristics provided in [Table 8](#)
- Delivery together with the parts of the radiation verification test (RVT) report of the particular wafer used to manufacture the products. This RVT includes the value of each parameter at 30, 50, 70 and 100 krad (Si) and after 24 hour annealing at room temperature and after an additional 168 hour annealing at 100°C.

**Table 7. Radiation summary**

| Radiation test          | 100 krad ESCC              |
|-------------------------|----------------------------|
| Wafer test              | each                       |
| Part tested             | 5 biased + 5 unbiased      |
| Dose rate               | 0.1 rad/s                  |
| Acceptance              | MIL-STD-750 method 1019    |
| Displacement damage     | Optional                   |
| Agency part number (ex) | 5202/001/02 <sup>(1)</sup> |
| ST part number (ex)     | SOC2222ARHRG               |
| Documents               | CoC + RVT                  |

1. Example of the 2N2222A in LCC-3 gold finish.

Table 8. ESCC 5201/002 post radiation electrical characteristics

| Symbol              | Parameter                                         | Test conditions                                                                                                                                                                                     | Min.                             | Typ. | Max. | Unit   |
|---------------------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------|------|--------|
| $I_{CBO}$           | Collector cut-off current ( $I_E = 0$ )           | $V_{CB} = 60 \text{ V}$                                                                                                                                                                             |                                  |      | 10   | nA     |
| $I_{EBO}$           | Emitter cut-off current ( $I_C = 0$ )             | $V_{EB} = 3 \text{ V}$                                                                                                                                                                              |                                  |      | 10   | nA     |
| $V_{(BR)CBO}$       | Collector-base breakdown voltage ( $I_E = 0$ )    | $I_C = 100 \text{ }\mu\text{A}$                                                                                                                                                                     | 75                               |      |      | V      |
| $V_{(BR)CEO}^{(1)}$ | Collector-emitter breakdown voltage ( $I_B = 0$ ) | $I_C = 30 \text{ mA}$<br>$I_C = 10 \text{ mA}$                                                                                                                                                      | 40<br>50                         |      |      | V<br>V |
| $V_{(BR)EBO}$       | Emitter-base breakdown voltage ( $I_C = 0$ )      | $I_E = 100 \text{ }\mu\text{A}$                                                                                                                                                                     | 6                                |      |      | V      |
| $V_{CE(sat)}^{(1)}$ | Collector-emitter saturation voltage              | $I_C = 150 \text{ mA}$ $I_B = 15 \text{ mA}$                                                                                                                                                        |                                  |      | 0.3  | V      |
| $V_{BE(sat)}^{(1)}$ | Base-emitter saturation voltage                   | $I_C = 150 \text{ mA}$ $I_B = 15 \text{ mA}$                                                                                                                                                        |                                  |      | 1.2  | V      |
| $[h_{FE}]^{(1)}$    | Post irradiation gain calculation <sup>(2)</sup>  | $I_C = 0.1 \text{ mA}$ $V_{CE} = 10 \text{ V}$<br>$I_C = 10 \text{ mA}$ $V_{CE} = 10 \text{ V}$<br>$I_C = 150 \text{ mA}$ $V_{CE} = 10 \text{ V}$<br>$I_C = 500 \text{ mA}$ $V_{CE} = 10 \text{ V}$ | [17.5]<br>[37.5]<br>[50]<br>[20] |      | 300  |        |

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

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.

## 4 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 9. Product mass summary**

| Package | Mass (g) |
|---------|----------|
| UB      | 0.06     |
| LCC-3   | 0.06     |
| TO-18   | 0.40     |

## 4.1 UB package information

Figure 10. UB package outline

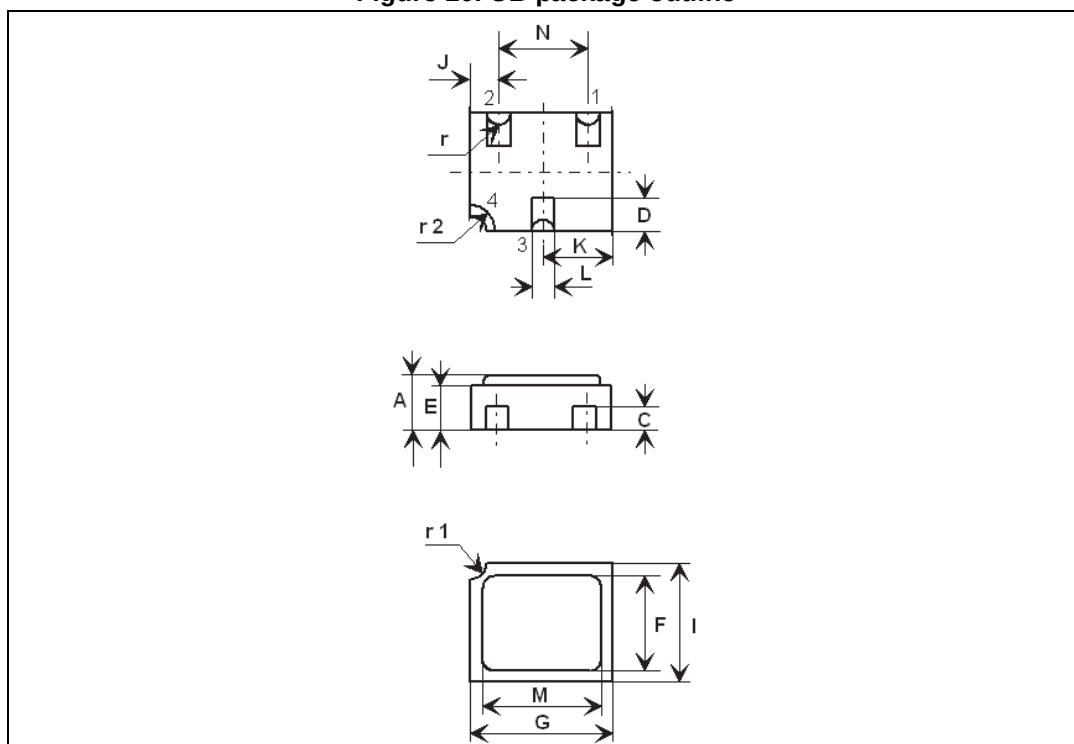


Table 10. UB mechanical data

| 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 |      |

## 4.2 LCC-3 package information

Figure 11. LCC-3 package outline

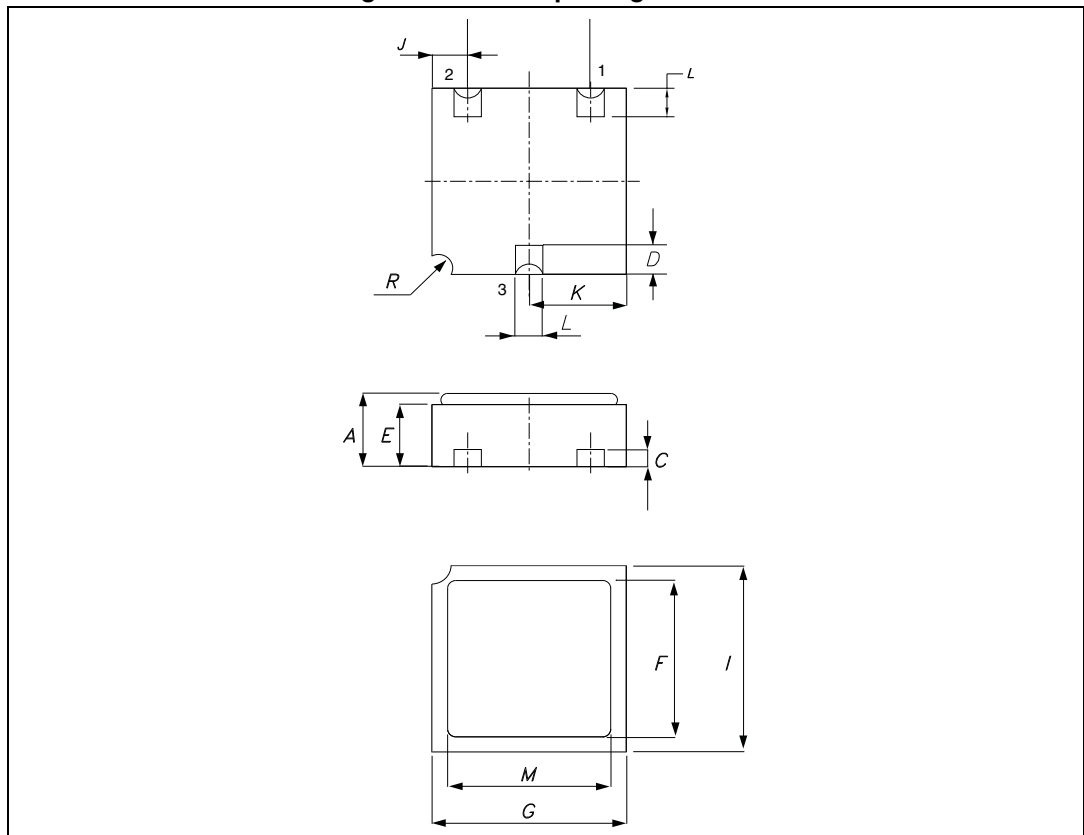


Table 11. LCC-3 mechanical data

| 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 |      |

### 4.3 TO-18 package information

Figure 12. TO-18 package outline

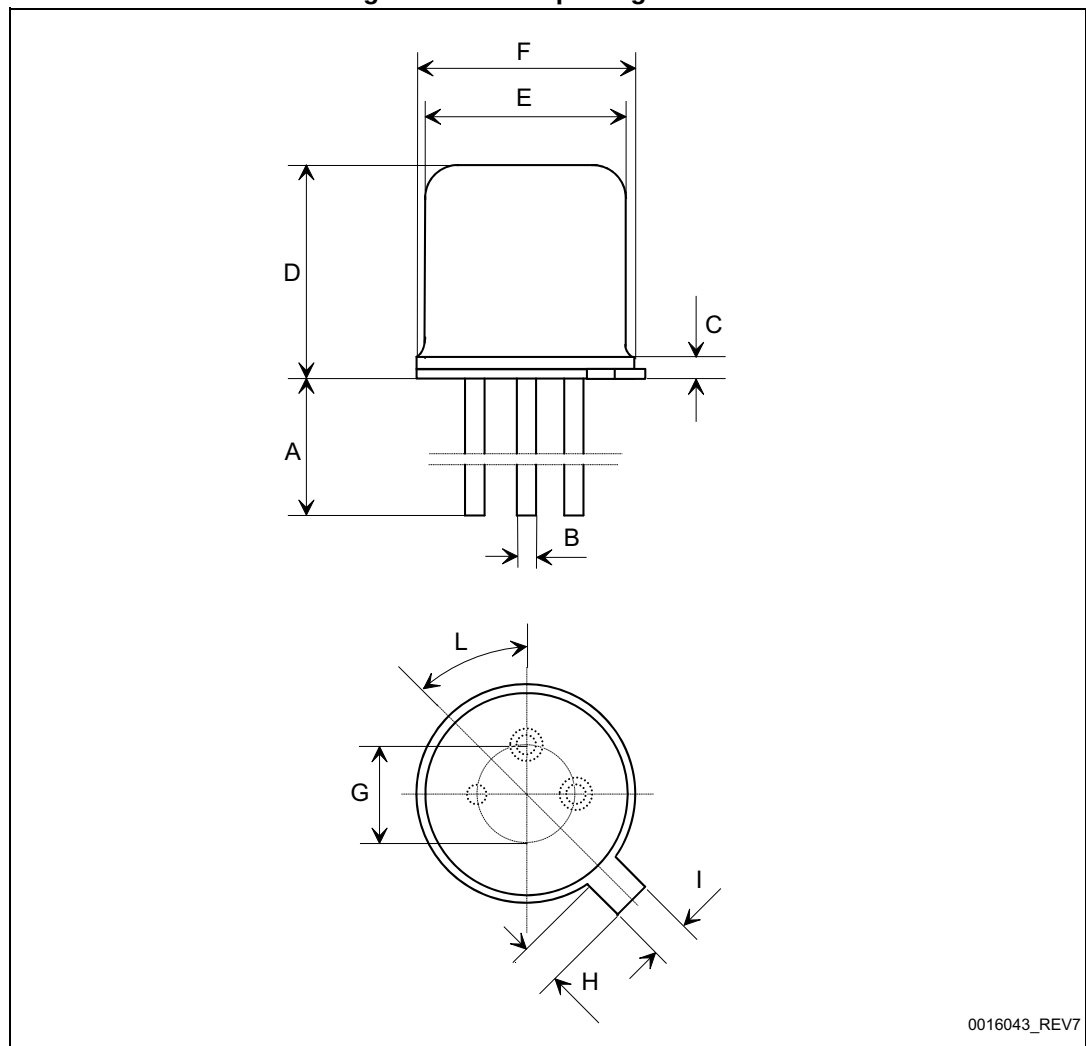


Table 12. TO-18 mechanical data

| Dim. | mm.   |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 12.70 | 13.20 | 14.20 |
| B    | 0.41  | 0.45  | 0.48  |
| C    | 0.36  |       | 0.47  |
| D    | 4.88  |       | 5.33  |
| E    | 4.63  |       | 4.70  |
| F    | 5.31  |       | 5.45  |
| G    | 2.49  | 2.54  | 2.59  |
| H    | 0.80  | 0.90  | 1.00  |
| I    | 0.95  | 1.00  | 1.05  |
| L    | 42°   | 45°   | 48°   |



## 5 Order codes

Table 13. Ordering information

| CPN             | Agency specification | EPPL   | Quality level          | Radiation level <sup>(1)</sup>  | Package | Lead finish | Marking <sup>(2)</sup> | Packing    |
|-----------------|----------------------|--------|------------------------|---------------------------------|---------|-------------|------------------------|------------|
| J2N2222AUB1     | -                    | -      | Engineering model JANS | -                               | UB      | Gold        | J2222AUB1              | WafflePack |
| 2N2222AUB1      | -                    | -      | Engineering model ESCC | -                               | UB      | Gold        | 2N2222AUB1             | WafflePack |
| SOC2222A1       | -                    | -      | Engineering model ESCC | -                               | LCC-3   | Gold        | SOC2222A1              | WafflePack |
| JANSR2N2222AUBG | MIL-PRF-19500/255    | -      | JANSR                  | 100 krad high and low dose rate | UB      | Gold        | JSR2222                | WafflePack |
| JANSR2N2222AUBT | MIL-PRF-19500/255    | -      | JANSR                  | 100 krad high and low dose rate | UB      | Solder Dip  | JSR2222                | WafflePack |
| JANS2N2222AUBG  | MIL-PRF-19500/255    | -      | JANS                   | -                               | UB      | Gold        | JS2222                 | WafflePack |
| JANS2N2222AUBT  | MIL-PRF-19500/255    | -      | JANS                   | -                               | UB      | Solder Dip  | JS2222                 | WafflePack |
| 2N2222ARUBG     | 5201/002/11R         | Target | ESCC Flight            | 100 krad - low dose rate        | UB      | Gold        | 520100211R             | WafflePack |
| 2N2222ARUBT     | 5201/002/12R         | Target | ESCC Flight            | 100 krad - low dose rate        | UB      | Solder Dip  | 520100212R             | WafflePack |
| 2N2222AUBG      | 5201/002/11          | Target | ESCC Flight            | -                               | UB      | Gold        | 520100211              | WafflePack |
| 2N2222AUBT      | 5201/002/12          | Target | ESCC Flight            | -                               | UB      | Solder Dip  | 520100212              | WafflePack |
| SOC2222ARHRG    | 5201/002/04R         | Yes    | ESCC Flight            | 100 krad - low dose rate        | LCC-3   | Gold        | 520100204R             | WafflePack |
| SOC2222ARHRT    | 5201/002/05R         | Yes    | ESCC Flight            | 100 krad - low dose rate        | LCC-3   | Solder Dip  | 520100205R             | WafflePack |
| SOC2222AHRG     | 5201/002/04          | Yes    | ESCC Flight            | -                               | LCC-3   | Gold        | 520100204              | WafflePack |
| SOC2222AHRT     | 5201/002/05          | Yes    | ESCC Flight            | -                               | LCC-3   | Solder Dip  | 520100205              | WafflePack |
| 2N2222ARHRG     | 5201/002/01R         | Target | ESCC Flight            | 100 krad - low dose rate        | TO-18   | Gold        | 520100201R             | Strip Pack |
| 2N2222ARHRT     | 5201/002/02R         | Target | ESCC Flight            | 100 krad - low dose rate        | TO-18   | Solder Dip  | 520100202R             | Strip Pack |

**Table 13. Ordering information (continued)**

| CPN        | Agency specification | EPPL | Quality level | Radiation level <sup>(1)</sup> | Package | Lead finish | Marking <sup>(2)</sup> | Packing    |
|------------|----------------------|------|---------------|--------------------------------|---------|-------------|------------------------|------------|
| 2N2222AHRG | 5201/002/01          | -    | ESCC Flight   | -                              | TO-18   | Gold        | 520100201              | Strip Pack |
| 2N2222AHRT | 5201/002/02          | -    | ESCC Flight   | -                              | TO-18   | Solder Dip  | 520100202              | Strip Pack |

1. High dose rate as per MIL-PRF-19500 specification group D, subgroup 2 inspection. Low dose rate as per ESCC specification 22900.
2. 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. For JANS flight parts: ST logo, date code, country of origin (FR), manufacturer code (CSTM), serial number of the part within the assembly lot.

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

- Products in die form
- Other JANS quality levels
- Tape and reel packing

## 6 Shipping details

### 6.1 Date code

Date code xyywwz is structured as below table:

**Table 14. Date code**

|                                              | x | yy                             | ww          | z                        |
|----------------------------------------------|---|--------------------------------|-------------|--------------------------|
| EM<br>(ESCC & JANS)                          | 3 | last two digits of<br>the year | week digits | lot index in the<br>week |
| ESCC<br>FLIGHT                               | - |                                |             |                          |
| JANS<br>FLIGHT<br>(diffused in<br>Singapore) | W |                                |             |                          |

### 6.2 Documentation

**Table 15. Documentation provided for each type of product**

| Quality level     | Radiation level | Documentation                                                                            |
|-------------------|-----------------|------------------------------------------------------------------------------------------|
| Engineering model | -               | -                                                                                        |
| JANS Flight       | -               | Certificate of conformance                                                               |
| JANSR Flight      | MIL-STD 100krad | Certificate of conformance<br>50 rad/s radiation verification test report                |
|                   | ST 100Krad      | Certificate of conformance<br>0.1 rad/s radiation verification test report on each wafer |
| ESCC Flight       | -               | Certificate of conformance                                                               |
|                   | 100 krad        | Certificate of conformance                                                               |
|                   |                 | 0.1 rad/s radiation verification test report                                             |

## 7 Revision history

**Table 16. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 04-Jan-2010 | 1        | Initial release                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 16-Apr-2010 | 2        | Added <a href="#">Table 1 on page 1</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 09-Jul-2010 | 3        | Modified: <a href="#">Table 1 on page 1</a> and <a href="#">Table 12 on page 18</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 30-Nov-2011 | 4        | <ul style="list-style-type: none"> <li>– Modified: <a href="#">Table 5 on page 5</a></li> <li>– Added: <a href="#">Section 2.3: Electrical characteristics (curves)</a></li> <li>– Modified: <a href="#">Table 1</a> and <a href="#">2</a></li> <li>– Added: <a href="#">Table 2, 11, 12</a></li> <li>– Minor text changes in the document title and description on the cover page.</li> </ul>                                                                                                                                                                                                                                                                                                                                      |
| 12-Dec-2011 | 5        | Minor text changes to improve readability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 17-Apr-2012 | 6        | <p>Updated:</p> <ul style="list-style-type: none"> <li>– Title and description in cover page.</li> <li>– <math>P_{TOT}</math> in <a href="#">Table 2: Absolute maximum ratings</a>.</li> <li>– The entire <a href="#">Section 2: Electrical characteristics</a>.</li> </ul> <p>Added:</p> <ul style="list-style-type: none"> <li>– <a href="#">Table 3: Thermal data</a>, <a href="#">Section 3: Radiation hardness assurance</a> and <a href="#">Table 13: Ordering information</a>.</li> <li>– <a href="#">Figure 7: JANS saturated turn-on switching time test circuit</a> and <a href="#">Figure 8: JANS saturated turn-off switching time test circuit</a>.</li> <li>– <a href="#">Section 6: Shipping details</a>.</li> </ul> |
| 19-Apr-2012 | 7        | Updated titles in <a href="#">Figure 7: JANS saturated turn-on switching time test circuit</a> and <a href="#">Figure 8: JANS saturated turn-off switching time test circuit</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 24-Apr-2012 | 8        | Updated $R_{thJA}$ value in <a href="#">Table 3: Thermal data</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 14-May-2012 | 9        | Updated <a href="#">Table 13: Ordering information</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 21-Feb-2013 | 10       | <p><a href="#">Table 1: Device summary</a> and <a href="#">Table 13: Ordering information</a> have been updated.</p> <p>Updated text in <a href="#">Section 3: Radiation hardness assurance</a>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 04-Apr-2013 | 11       | Inserted <a href="#">Table 7: Radiation summary</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 06-Jun-2013 | 12       | Updated package name for UB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 18-Sep-2013 | 13       | <a href="#">Table 1: Device summary</a> and <a href="#">Table 13: Ordering information</a> have been updated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 25-Mar-2014 | 14       | <p><a href="#">Table 1: Device summary</a> and <a href="#">Table 13: Ordering information</a> have been updated.</p> <p>Updated <a href="#">Section 3: Radiation hardness assurance</a> and <a href="#">Section 4: Package mechanical data</a></p> <p>Inserted <a href="#">Figure 2: Safe operating area for LCC-3 and UB</a> and <a href="#">Figure 3: Safe operating area for TO-18</a></p>                                                                                                                                                                                                                                                                                                                                       |

**Table 16. Document revision history (continued)**

| Date        | Revision | Changes                                                                                              |
|-------------|----------|------------------------------------------------------------------------------------------------------|
| 01-Apr-2014 | 15       | Modified note in package silhouette on cover page.                                                   |
| 29-May-2014 | 16       | Updated <a href="#">Table 1: Device summary</a> and <a href="#">Table 13: Ordering information</a> . |
| 17-Feb-2015 | 17       | Updated <a href="#">Table 1.: Device summary</a><br>Minor text changes.                              |
| 27-Feb-2015 | 18       | Minor text changes                                                                                   |
| 05-May-2015 | 19       | Updated <a href="#">Table 1.: Device summary</a><br>Minor text changes.                              |
| 21-Aug-2015 | 20       | Updated: <a href="#">Section 4.3: TO-18 package information</a><br>Minor text changes                |

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