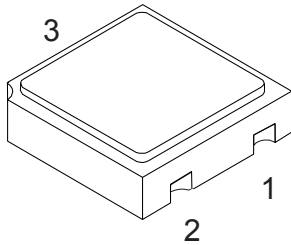
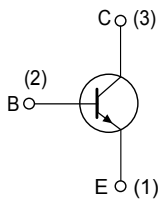


Rad-Hard 50 V, 0.8 A NPN transistor

LCC-3


DS10450

Features

| V_{ce0} | $I_C(\text{max.})$ | H_{FE} at 10 V, 150 mA | $T_j(\text{max.})$ |
|-----------|--------------------|-----------------------------|--------------------|
| 50 V | 0.8 A | > 100 | 200 °C |

- Hermetic packages
- ESCC qualified
- 100 krad

Description

The SOC2222AHR 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 5201/002 specification and available in LCC-3 hermetic package, it is specifically recommended for space and harsh environment applications and suitable for low current and high precision circuits such preamplifiers, oscillators, current mirror configuration.

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

Product status link

SOC2222AHR

Product summary

| Product summary | | | | |
|-----------------|----------------------|----------------------|---------|-----------------|
| Part-number | Qualification system | Agency specification | Package | Radiation level |
| SOC2222ARHRx | ESCC Flight | 5201/002 | LCC-3 | 100 krad |
| SOC2222AHRx | ESCC Flight | 5201/002 | LCC-3 | - |

Note: See [Table 6](#) for ordering information.

1 Electrical ratings

Table 1. 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) | 50 | 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} ≤ 25 °C | 0.5 0.73 ⁽¹⁾ | W |
| 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 | Value | Unit |
|-------------------|---|--------------------|------|
| R _{thJA} | Thermal resistance junction-ambient (max) | 350 | °C/W |
| | | 240 ⁽¹⁾ | |

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

2 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 ($I_E = 0$) | $V_{CB} = 60\text{ V}$ | | 10 | nA |
| | | $V_{CB} = 60\text{ V}, T_{amb} = 150\text{ °C}$ | | 10 | μA |
| I_{EBO} | Emitter-base 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 ($I_B = 0$) | $I_C = 10\text{ mA}$ | 50 | | V |
| $V_{(BR)EBO}$ | Emitter-base breakdown voltage ($I_C = 0$) | $I_C = 100\text{ }\mu\text{A}$ | 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 |
| $h_{FE}^{(1)}$ | DC current gain | $I_C = 0.1\text{ mA}, V_{CE} = 10\text{ V}$ | 35 | | |
| | | $I_C = 10\text{ mA}, V_{CE} = 10\text{ V}$ | 75 | | |
| | | $I_C = 150\text{ mA}, V_{CE} = 10\text{ V}$ | 100 | 300 | |
| | | $I_C = 500\text{ mA}, V_{CE} = 10\text{ V}$ | 40 | | |
| | | $I_C = 10\text{ mA}, T_{amb} = -55\text{ °C}, V_{CE} = 10\text{ V}$ | 35 | | |
| h_{fe} | Small signal current gain | $I_C = 20\text{ mA}, f = 100\text{ MHz}, V_{CE} = 20\text{ V}$ | 2.5 | | |
| C_{OBO} | Output capacitance ($I_E = 0$) | $100\text{ kHz} \leq f \leq 1\text{ MHz}, V_{CB} = 10\text{ V}$ | | 8 | pF |
| t_{on} | Turn-on time | $I_{CC} = 150\text{ mA},$ $I_{B1} = 15\text{ mA},$ $V_{CC} = 30\text{ V}$ | | 35 | ns |
| t_{off} | Turn-off time | $I_{CC} = 150\text{ mA},$ $I_{B1} = I_{B2} = 15\text{ mA},$ $V_{CC} = 30\text{ V}$ | | 285 | ns |

1. Pulsed duration = 300 μs , duty cycle $\leq 1.5\%$

2.1 Radiation assurance

Radiation test are guaranteed in compliance with ESCC 22900 and ESCC 5201/002 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 5201/002 post radiation electrical characteristics ($T_{amb} = 25\text{ °C}$ unless otherwise specified)

| Symbol | Parameter | Test conditions | Min. | 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 ($I_B = 0$) | $I_C = 10\text{ mA}$ | 50 | | 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 ⁽²⁾ | $I_C = 0.1\text{ mA}$, $V_{CE} = 10\text{ V}$ | [17.5] | | |
| | | $I_C = 10\text{ mA}$, $V_{CE} = 10\text{ V}$ | [37.5] | | |
| | | $I_C = 150\text{ mA}$, $V_{CE} = 10\text{ V}$ | [50] | 300 | |
| | | $I_C = 500\text{ mA}$, $V_{CE} = 10\text{ V}$ | [20] | | |

1. Pulsed duration = 300 μs , 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.

2.2 Electrical characteristics (curves)

Figure 1. DC current gain

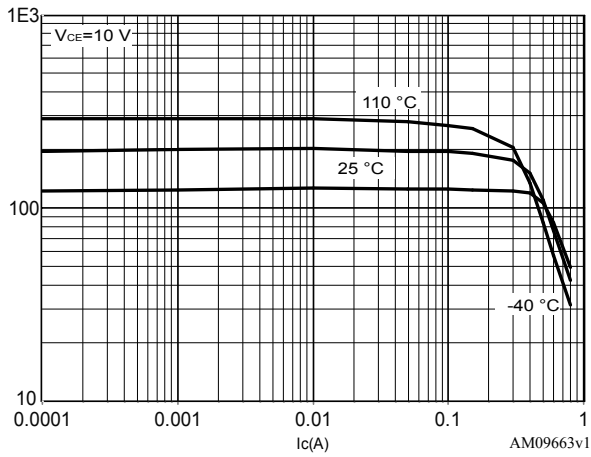


Figure 2. Collector emitter saturation voltage

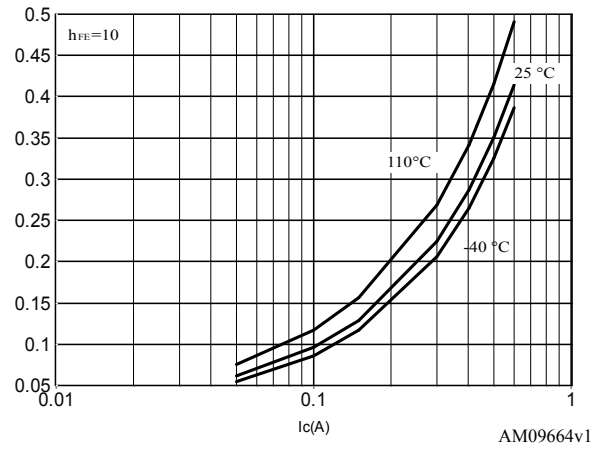
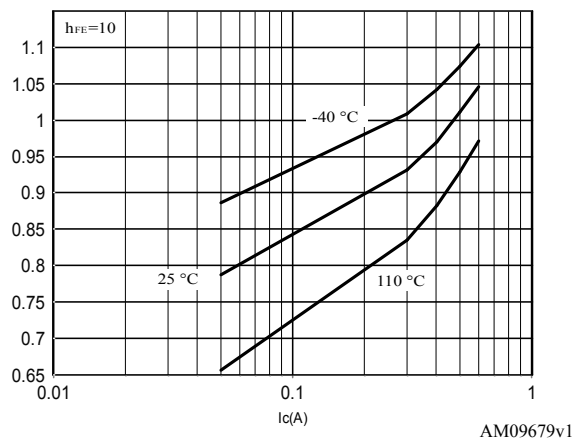
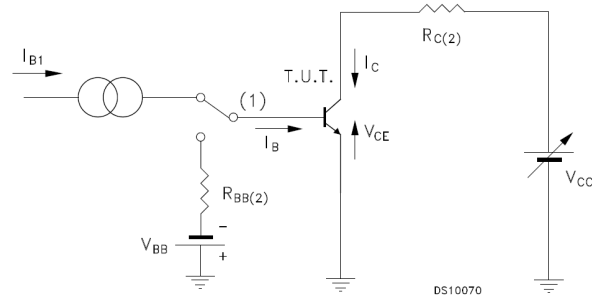


Figure 3. Base emitter saturation voltage



2.3 Test circuits

Figure 4. ESCC resistive load switching test circuit



Note: (1) Fast electronic switch

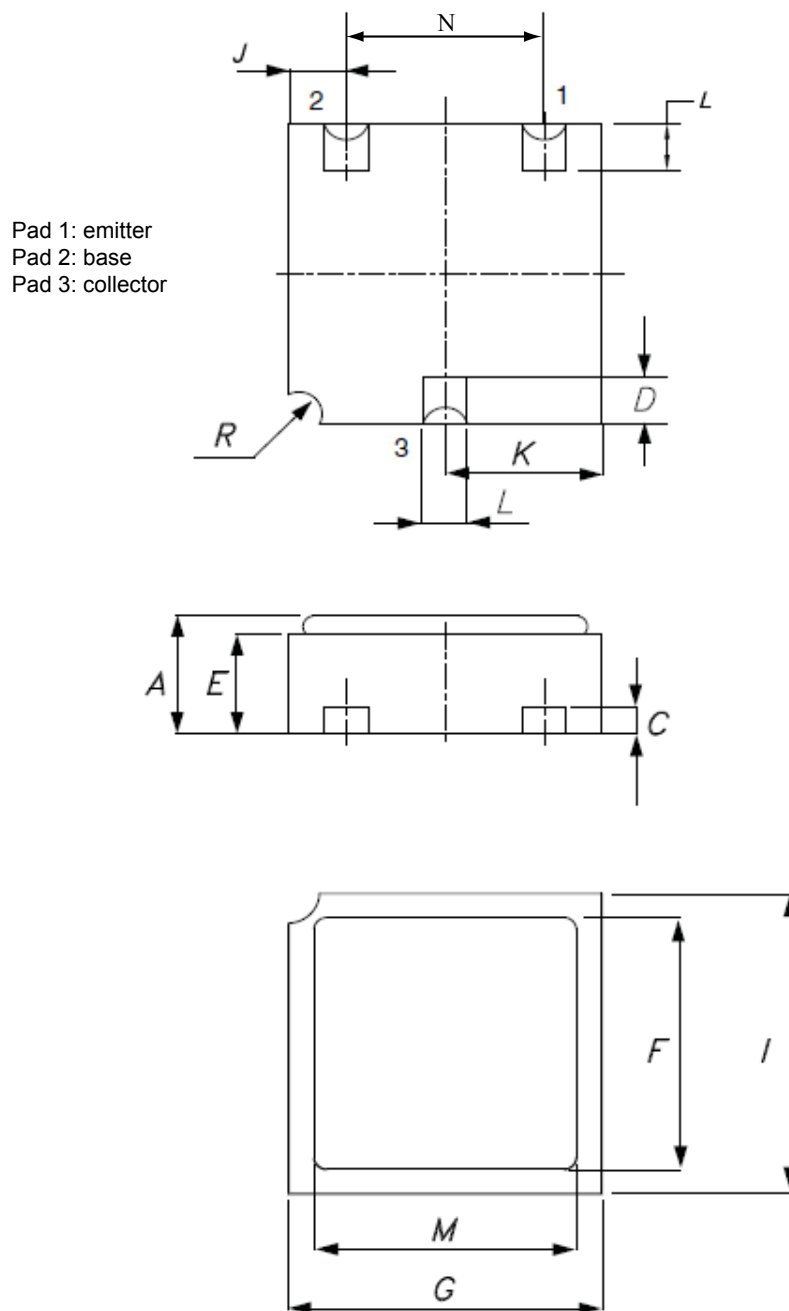
Note: (2) Non-inductive resistor

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. ECOPACK is an ST trademark.

3.1 LCC-3 package information

Figure 5. LCC-3 package outline



0041211 rev.14

Table 5. 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 | 0.60 | 0.56 | 0.96 | 0.024 | 0.022 | 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 | |

4 Ordering information

Table 6. Ordering information

| Part number | ESCC specification | Screening option | Radiation level | Package | Mass | Lead finish | Marking ⁽¹⁾ | Packing | |
|---------------|--------------------|-------------------|-----------------|---------|-------|-------------|------------------------|---------------|---------------|
| SOC2222A1 | - | Engineering model | - | LCC-3 | 0.6 g | Gold | SOC2222A1 | WafflePack | |
| SOC2222ARHRG | 5201/002/04R | Flight model | 100 krad | | | Gold | 520100204R | WafflePack | |
| SOC2222ARHRT | 5201/002/05R | | | | | Solder Dip | 520100205R | Tape and reel | |
| SOC2222ARHRTW | 5201/002/05R | | Solder Dip | | | 520100205R | Tape and reel | | |
| SOC2222AHRG | 5201/002/04 | | Gold | | | 520100204 | WafflePack | | |
| SOC2222AHRT | 5201/002/05 | | Solder Dip | | | 520100205 | WafflePack | | |
| SOC2222AHRTW | 5201/002/05 | | - | | | - | Solder Dip | 520100205 | Tape and reel |
| | | | - | | | - | Solder Dip | 520100205 | 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 7. 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 8. Documentation provided for each type of product

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

Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|-------------|----------|------------------|
| 11-Sep-2024 | 1 | Initial release. |

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