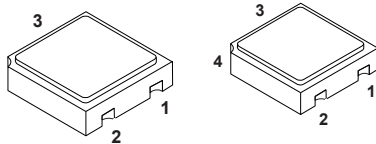
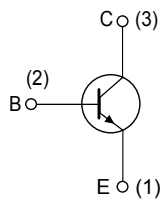


## Rad-Hard 160 V, 0.5 A NPN bipolar transistor


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

Pin 4 in UB is connected to the metallic lid.



DS10450

### Features

$V_{ce0}$	$I_C(\text{max.})$	$H_{FE}$ at 5 V, 10 mA	$T_j(\text{max.})$
160 V	0.5 A	> 80	200 °C

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

### Description

This bipolar transistor is able to operate under severe environment conditions and radiation exposure providing high immunity to total ionizing dose (TID). All part numbers are guaranteed up to 100 krad with low dose rate at 0.1 rad/s as per ESCC 22900.

Qualified as per ESCC 5201/019 and MIL-PRF-19500/767 specifications 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 circuits.

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

#### Product status link

[2N5551HR](#)

### Product summary

Product summary				
Device	Qualification system	Agency specification	Package	Radiation level
JANSR2N5551UBx	JANSR	MIL-PRF-19500/767	UB	100 krad
JANS2N5551UBx	JANS	MIL-PRF-19500/767	UB	-
2N5551RUBx	ESCC Flight	5201/019	UB	100 krad
2N5551UBx	ESCC Flight	5201/019	UB	-
SOC5551RHRx	ESCC Flight	5201/019	LCC-3	100 krad
SOC5551HRx	ESCC Flight	5201/019	LCC-3	-

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter		Value	Unit
$V_{CBO}$	Collector-base voltage ( $I_E = 0$ )		180	V
$V_{CEO}$	Collector-emitter voltage ( $I_B = 0$ )		160	V
$V_{EBO}$	Emitter-base voltage ( $I_C = 0$ )		6	V
$I_C$	Collector current		0.5	A
$P_{TOT}$	Total dissipation at $T_{amb} \leq 25\text{ °C}$	LCC-3 and UB for ESCC and JANS LCC-3 and UB <sup>(1)</sup>	0.36 0.58	W
	Total dissipation at $T_{SP(IS)} = 25\text{ °C}$	UB for JANS	1	W
$T_{STG}$	Storage 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 for SMD package**

Symbol	Parameter	LCC-3 and UB Value	Unit
$R_{thJSP(IS)}$	Thermal resistance junction-solder pad (infinite sink) (max) for JANS	85	°C/W
$R_{thJA}$	Thermal resistance junction-ambient (max) for JANS	280	°C/W
	Thermal resistance junction-ambient (max) for ESCC	486	
	Thermal resistance junction-ambient <sup>(1)</sup>	302	

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 ( $I_E = 0$ )	$V_{CB} = 120\text{ V}$		50	nA
		$V_{CB} = 120\text{ V}, T_{amb} = 150\text{ °C}$		50	$\mu\text{A}$
$I_{CEO}$	Collector-emitter cut-off current ( $I_B = 0$ )	$V_{CE} = 100\text{ V}$		50	nA
$I_{EBO}$	Emitter-base cut-off current ( $I_C = 0$ )	$V_{EB} = 4\text{ V}$		50	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage ( $I_E = 0$ )	$I_C = 100\text{ }\mu\text{A}$	180		V
$V_{(BR)CEO}^{(1)}$	Collector-emitter breakdown voltage ( $I_B = 0$ )	$I_C = 1\text{ mA}$	160		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage ( $I_C = 0$ )	$I_E = 10\text{ }\mu\text{A}$	6		V
$V_{CE(sat)}^{(1)}$	Collector-emitter saturation voltage	$I_C = 10\text{ mA}, I_B = 1\text{ mA}$		0.15	V
		$I_C = 50\text{ mA}, I_B = 5\text{ mA}$		0.2	
$V_{BE(sat)}^{(1)}$	Base-emitter saturation voltage	$I_C = 10\text{ mA}, I_B = 1\text{ mA}$		1	V
		$I_C = 50\text{ mA}, I_B = 5\text{ mA}$		1	
$h_{FE}^{(1)}$	DC current gain	$I_C = 1\text{ mA}, V_{CE} = 5\text{ V}$	80		
		$I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$	80	250	
		$I_C = 50\text{ mA}, V_{CE} = 5\text{ V}$	30		
		$I_C = 10\text{ mA}, T_{amb} = -55\text{ °C}, V_{CE} = 5\text{ V}$	20		
$h_{fe}$	Small signal current gain	For ESCC: $V_{CE} = 10\text{ V}, I_C = 10\text{ mA}, f > 100\text{ MHz}$	1		200
		$V_{CE} = 10\text{ V}, I_C = 1\text{ mA}, f = 1\text{ kHz}$	50		
		For JANS: $I_C = 10\text{ mA}, f = 20\text{ MHz}, V_{CE} = 10\text{ V}$	2.5		
$C_{OBO}$	Output capacitance, ( $I_E = 0$ )	$f = 1\text{ MHz}, V_{CB} = 10\text{ V}$		6	pF
$C_{EBO}$	Emitter-base, ( $I_C = 0$ )	For ESCC: $f = 1\text{ MHz}, V_{EB} = 0.5\text{ V}$		20	pF
		For JANS: $f = 1\text{ MHz}, V_{EB} = 0.5\text{ V}$		45	

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

## 2.1 Electrical characteristics (curves)

Figure 1.  $h_{FE}$  at  $V_{CE} = 5\text{ V}$

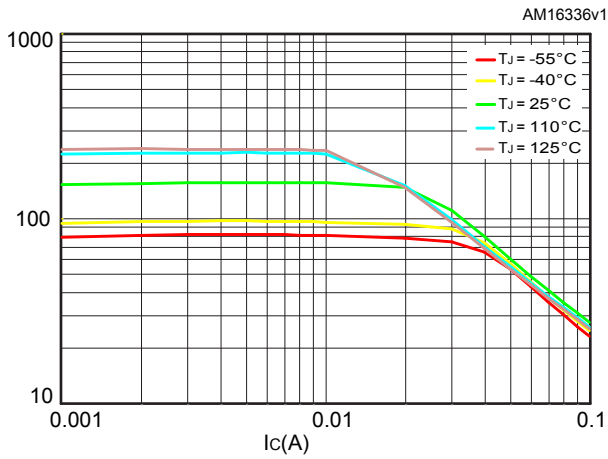


Figure 2.  $V_{CE(sat)}$  at  $h_{FE} = 10$

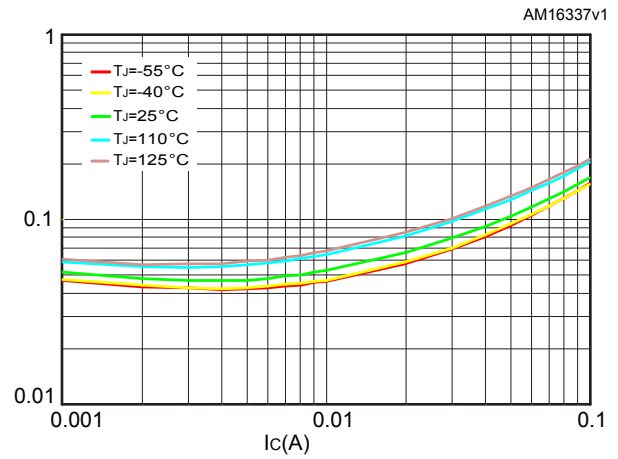
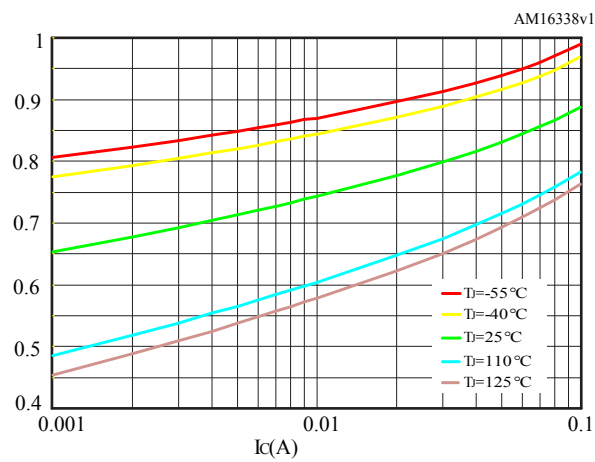


Figure 3.  $V_{BE(sat)}$  at  $h_{FE} = 10$



### 3 Radiation hardness assurance

#### 3.1 JANS radiation assurance

JANSR2N5551 is guaranteed at 100 krad in compliance with the MIL-PRF-19500, Group D between 50 and 300 rad/s with an additional guarantee at 0.1 rad/s as per ESCC 22900.

Radiation verification test report is provided with each shipment.

**Table 4. MIL-PRF-19500 post radiation electrical characteristics ( $T_{amb} = 25\text{ °C}$  unless otherwise specified)**

Symbol	Parameter	Test conditions	Min.	Max	Unit
$I_{CBO}$	Collector to base cutoff current	$V_{CB} = 120\text{ V}$		100	nA
$I_{EBO}$	Emitter to base cutoff current	$V_{EB} = 4\text{ V}$		100	nA
$V_{(BR)CEO}^{(1)}$	Collector-emitter breakdown voltage	$I_C = 1\text{ mA}$	160		V
$V_{(BR)BCO}$	Base-collector breakdown voltage	$I_C = 100\text{ }\mu\text{A}$	180		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage	$I_{EB} = 10\text{ }\mu\text{A}$	6		V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$I_C = 10\text{ mA}, I_B = 1\text{ mA}$		0.1725	V
		$I_C = 50\text{ mA}, I_B = 5\text{ mA}$		0.23	
$V_{BE(sat)}$	Base-emitter saturation voltage	$I_C = 10\text{ mA}, I_B = 1\text{ mA}$	0.6	1.15	V
		$I_C = 50\text{ mA}, I_B = 5\text{ mA}$		1.15	
[hFE]	Post irradiation gain calculation	$I_C = 1\text{ mA}, V_{CE} = 5\text{ V}$	[40] <sup>(2)</sup>		
		$I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$	[40] <sup>(2)</sup>	250	
		$I_C = 50\text{ mA}, V_{CE} = 5\text{ V}$	[15] <sup>(2)</sup>		

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

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

### 3.2 ESCC radiation assurance

This products is guaranteed in radiation as per ESCC 22900 and in compliance with ESCC 5201/019 specification.

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 of each wafer at 100 krad if all 10 samples comply with the post radiation electrical characteristics as per Table 5.
- Radiation verification test (RVT) report is delivered with the lot manufactured with the wafer of the tested samples.

RVT includes the value of each parameter at 30, 50, 70 and 100 krad (Si), post annealing at 24 hour / 25 °C and post annealing at 168 hours / 100°C.

**Table 5. ESCC 5201/019 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 ( $I_E = 0$ )	$V_{CB} = 120\text{ V}$		50	nA
$I_{CEO}$	Collector-emitter cut-off current ( $I_B = 0$ )	$V_{CE} = 100\text{ V}$		50	nA
$I_{EBO}$	Emitter cut-off current ( $I_C = 0$ )	$V_{EB} = 4\text{ V}$		50	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage ( $I_E = 0$ )	$I_C = 100\text{ }\mu\text{A}$	180		V
$V_{(BR)CEO}^{(1)}$	Collector-emitter breakdown voltage ( $I_B = 0$ )	$I_C = 1\text{ mA}$	160		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage ( $I_C = 0$ )	$I_E = 10\text{ }\mu\text{A}$	6		V
$V_{CE(sat)}^{(1)}$	Collector-emitter saturation voltage	$I_C = 10\text{ mA}, I_B = 1\text{ mA}$		0.15	V
		$I_C = 50\text{ mA}, I_B = 5\text{ mA}$		0.2	
$V_{BE(sat)}^{(1)}$	Base-emitter saturation voltage	$I_C = 10\text{ mA}, I_B = 1\text{ mA}$		1	V
		$I_C = 50\text{ mA}, I_B = 5\text{ mA}$		1	
$[h_{FE}]^{(1)}$	Post irradiation gain calculation <sup>(2)</sup>	$I_C = 1\text{ mA}, V_{CE} = 5\text{ V}$	[40]		
		$I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$	[40]	250	
		$I_C = 50\text{ mA}, V_{CE} = 5\text{ V}$	[15]		

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

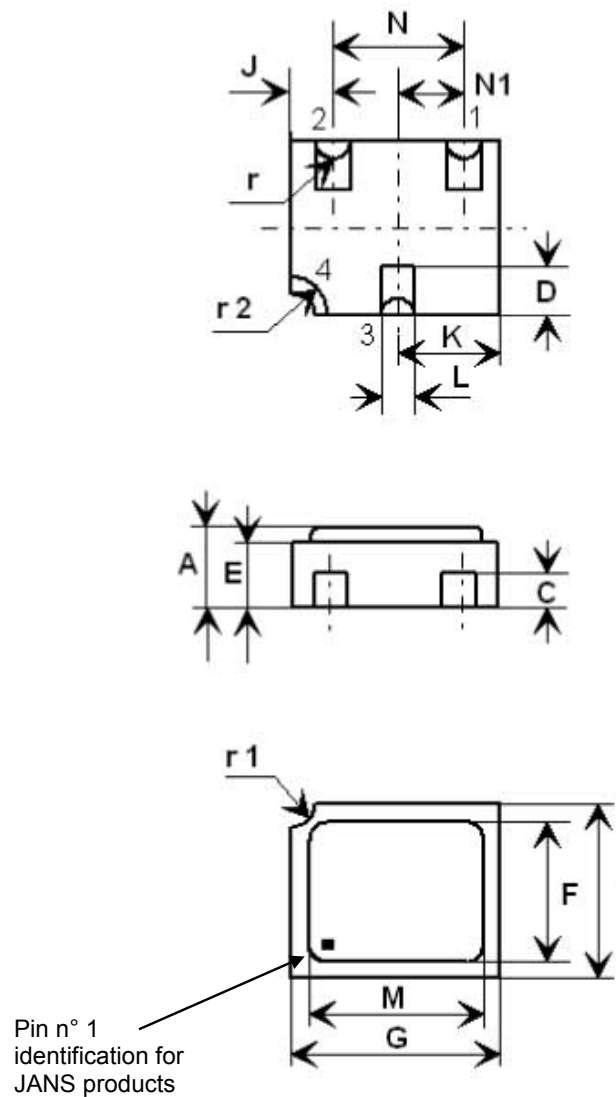
2. The post-irradiation gain calculation of  $[h_{FE}]$ , made using  $h_{FE}$  measurements from prior to and on completion of irradiation testing and after each annealing step if any, shall be as specified in MILSTD-750 method 1019.

## 4 Package information

In order 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.

### 4.1 UB package information

Figure 4. UB package outline



Pad 1: Emitter

Pad 2: Base

Pad 3: Collector

Pad 4: Shielding connected to the lid

8206487 rev.6

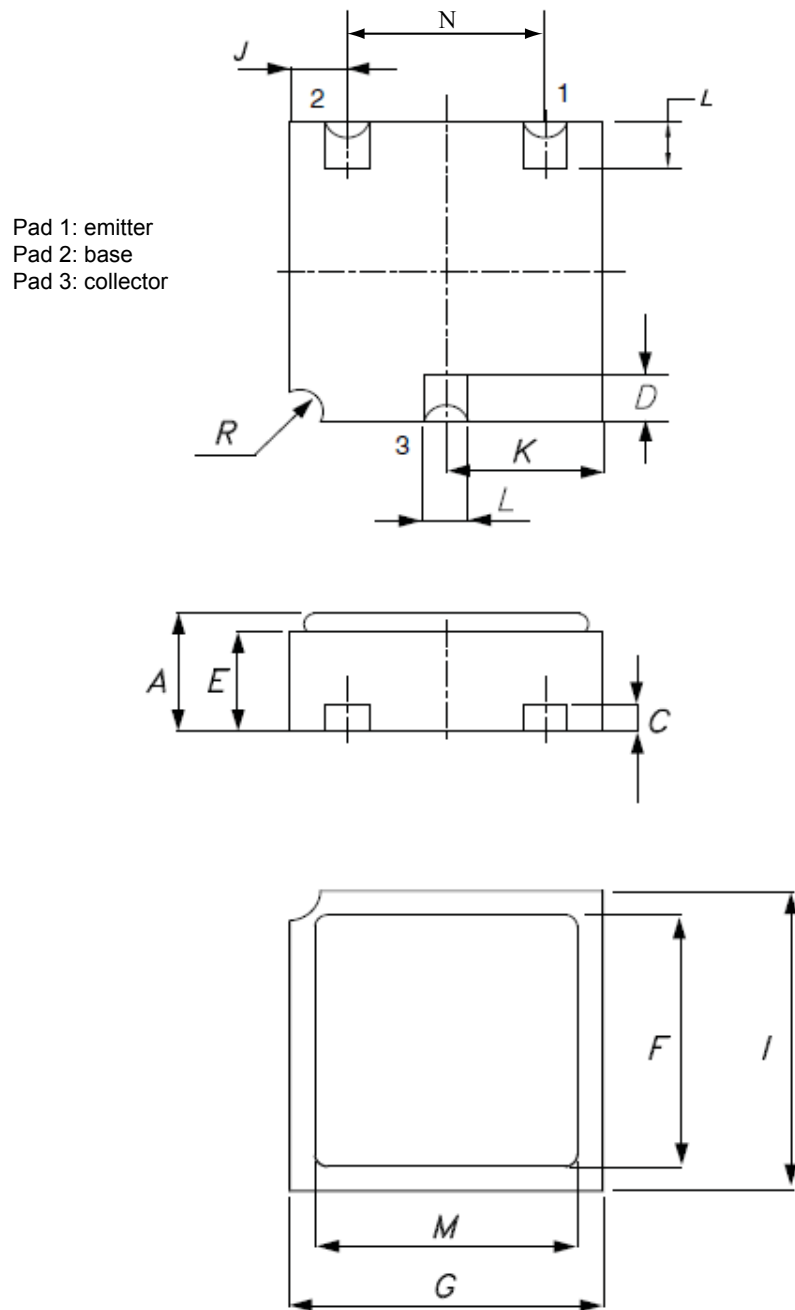
**Table 6. UB package mechanical data**

Symbols	Dimensions in mm			Dimensions in inches (for reference only)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.16		1.42	0.045		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	



## 4.2 LCC-3 package information

Figure 5. LCC-3 package outline



0041211 rev.14

Table 7. 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	

## 5 Ordering information

Table 8. Ordering information

Part number	Agency specification	Quality level	Radiation level <sup>(1)</sup>	Package	Mass	Lead finish	Marking <sup>(2)</sup>	Packing			
J2N5551UB1	-	Engineering model JANS	-	UB	0.6 g	Gold	J5551UB1	WafflePack			
2N5551UB1	-	Engineering model ESCC	-				2N55511UB1				
SOC55511	-	Engineering model ESCC	-	LCC-3			SOC55511				
JANSR2N5551UBG	MIL-PRF-19500/767	JANSR	100 krad	UB			0.6 g		Solder Dip	JSR5551	
JANSR2N5551UBT		JANSR				JSR5551					
JANS2N5551UBG		JANS	-			Gold			JS5551		
JANS2N5551UBT		JANS				Solder Dip			JS5551		
2N5551RUBG	5201/019/08R	ESCC Flight	100 krad			UB			0.6 g	Gold	520101908R
2N5551RUBT	5201/019/09R									Solder Dip	520101909R
2N5551UBG	5201/019/08									Gold	520101908
2N5551UBT	5201/019/09				Solder Dip			520101909			
SOC5551RHRG	5201/019/04R		100 krad		Gold			520101904R		WafflePack	
SOC5551RHRT	5201/019/05R							Solder Dip			520101905R
SOC5551RHRTW	5201/019/05R			LCC-3	Gold		520101905R	Tape and reel			
SOC5551HRG	5201/019/04						Gold	520101904		WafflePack	
SOC5551HRGW	5201/019/04		-		Gold		520101904	Tape and reel			
SOC5551HRT	5201/019/05		-		Solder Dip		520101905	WafflePack			

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.

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



## 6 Other information

### 6.1 Traceability information

Date code information is described in the table below.

**Table 9. Date codes**

Model	Date code <sup>(1)</sup>
EM	3yywwN
ESCC	yywwN

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

### 6.2 Documentation

**Table 10. Documentation provided for each type of product**

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

## Revision history

**Table 11. Document revision history**

Date	Revision	Changes
04-Jan-2010	1	Initial release.
17-May-2010	2	Modified: Table 1: Device summary and Table 9 on page 12.
12-Jul-2010	3	Modified: Table 1: Device summary and Table 9 on page 12.
13-Nov-2012	4	Added: Section 2.1: Electrical characteristics (curves).
12-Dec-2013	5	Updated Table 1: Device summary, Table 2: Absolute maximum ratings and Section 4: Package mechanical data. Added Section 5: Order codes and Section 6: Shipping details
27-Mar-2014	6	Updated Table 1: Device summary, Section 3: Radiation hardness assurance, Figure 7: UB package outline, Section 5: Order codes and Table 13: Documentation provided for each type of product. Minor text changes.
01-Apr-2014	7	Inserted note in package silhouette on cover page.
14-Jul-2014	8	Updated Table 1: Device summary and Table 11: Order codes.
05-Jun-2015	9	Updated Table 10: UB mechanical data.
20-Aug-2015	10	Updated: Section 4.2: TO-18 package information Minor text changes.
19-Jan-2017	11	Updated agency specification number for JANS and JANSR qualification system. Updated Figure 5: LCC-3 package outline.
29-Sep-2020	12	Removed TO-18 package information. Minor text changes.
30-Sep-2020	13	Updated Table 4.
18-Oct-2021	14	Updated Description, Table 3 and Table 8.

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