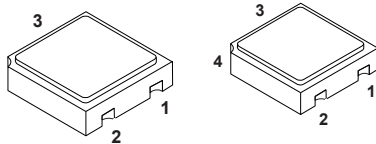


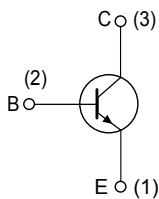
Rad-Hard 160 V, 0.5 A NPN bipolar transistor



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	-

Note: See [Table 8](#) for ordering information.

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 ⁽¹⁾	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 ⁽¹⁾	302	

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

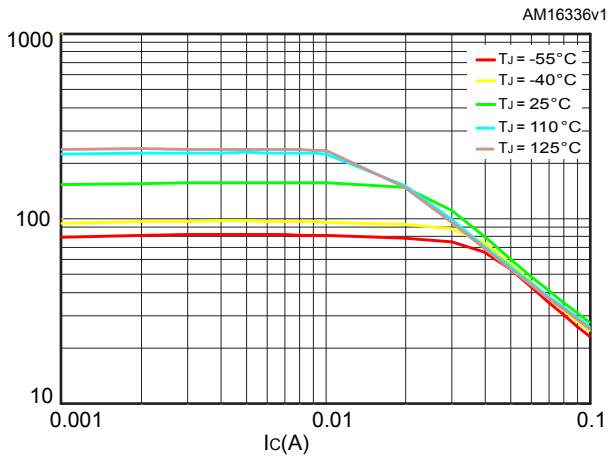
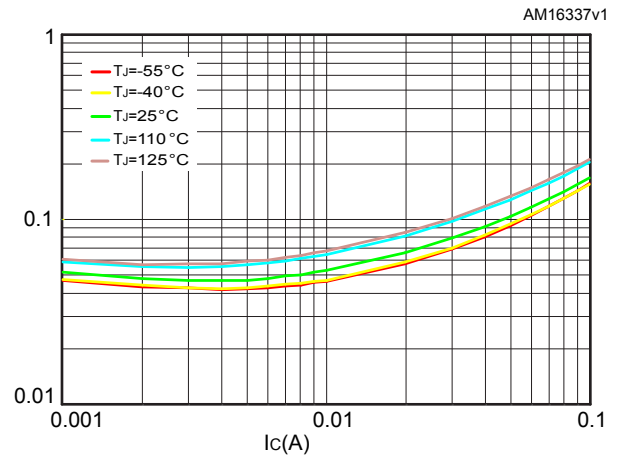
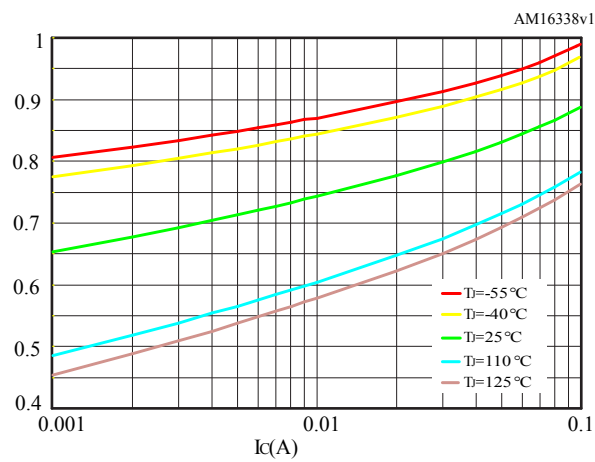
2 Electrical characteristics

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	μA
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 μs , 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 ($T_{amb} = 25\text{ }^{\circ}\text{C}$ 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] ⁽²⁾		
		$I_C = 10\text{ mA}, V_{CE} = 5\text{ V}$	[40] ⁽²⁾	250	
		$I_C = 50\text{ mA}, V_{CE} = 5\text{ V}$	[15] ⁽²⁾		

1. Pulsed duration = 300 μs , 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 ⁽²⁾	$I_C = 1\text{ mA}, V_{CE} = 5\text{ V}$	[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 μs , duty cycle $\geq 2\%$

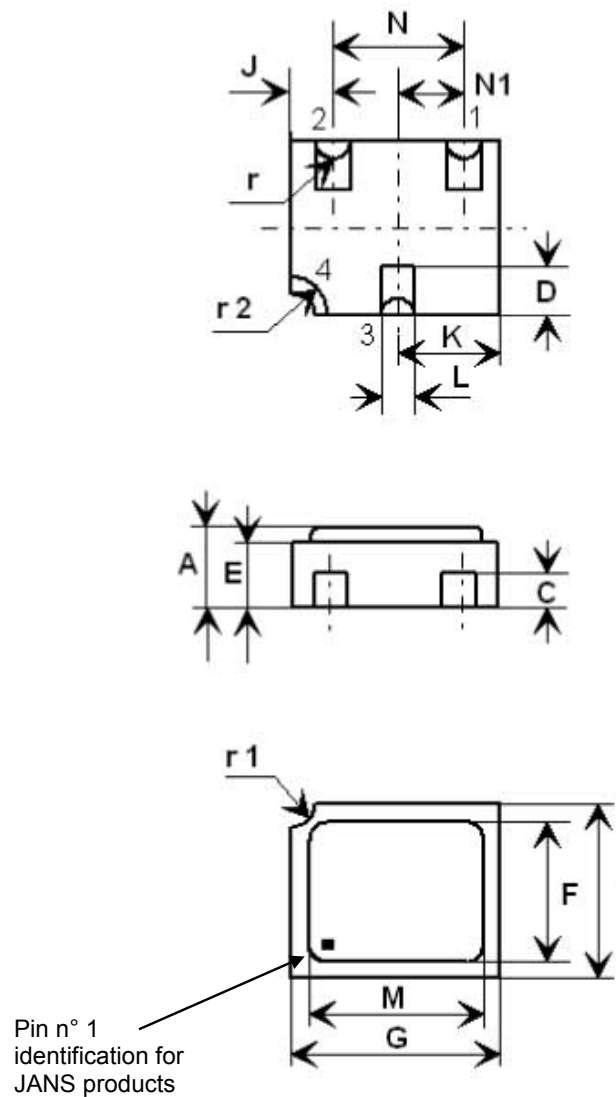
2. The post-irradiation gain calculation of $[h_{FE}]$, made using h_{FE} measurements from prior to and on completion of irradiation testing and after each annealing step if any, shall be as specified in MILSTD-750 method 1019.

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. 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

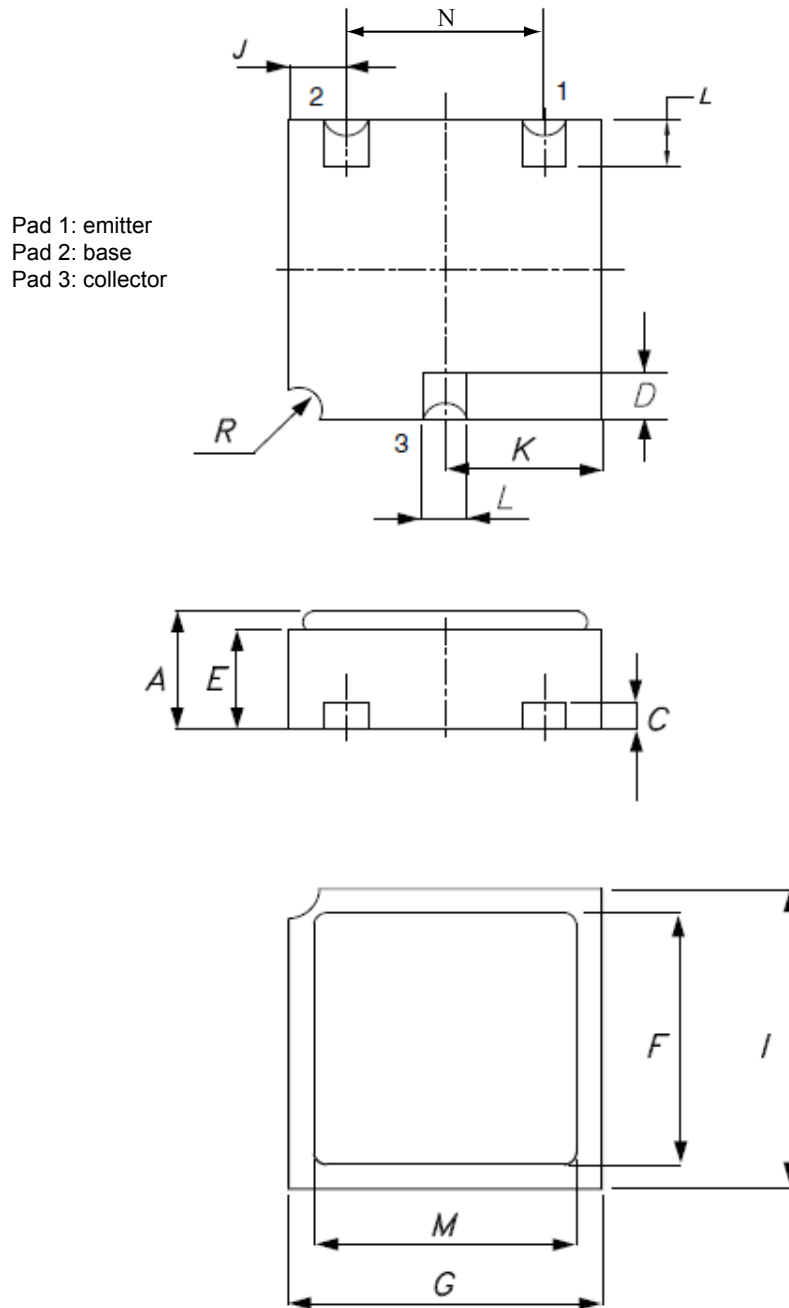
8206487 rev.6

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 ⁽¹⁾	Package	Mass	Lead finish	Marking ⁽²⁾	Packing					
J2N5551UB1	-	Engineering model JANS	-	UB	0.6 g	Gold	J5551UB1	WafflePack					
2N5551UB1	-	Engineering model ESCC	-				2N5551UB1						
SOC55511	-	Engineering model ESCC	-	LCC-3			SOC55511						
JANSR2N5551UBG	MIL-PRF-19500/767	JANSR	100 krad	UB		0.6 g	Solder Dip		JSR5551	WafflePack			
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	WafflePack
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	-	LCC-3	0.6 g		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 ⁽¹⁾
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.
02-Jan-2023	15	Updated Table 8.

Contents

1	Electrical ratings	2
2	Electrical characteristics	3
2.1	Electrical characteristics (curves)	4
3	Radiation hardness assurance	5
3.1	JANS radiation assurance	5
3.2	ESCC radiation assurance	6
4	Package information	7
4.1	UB package information	7
4.2	LCC-3 package information	9
5	Ordering information	11
6	Other information	12
6.1	Traceability information	12
6.2	Documentation	12
	Revision history	13

IMPORTANT NOTICE – READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgment.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to www.st.com/trademarks. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2023 STMicroelectronics – All rights reserved