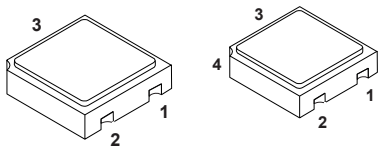
2N5551HR

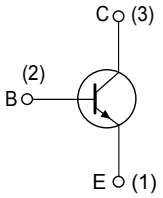
Datasheet

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_{ceo}	I_C(max.)	H_{FE} at 5 V, 10 mA	T_j(max.)
160 V	0.5 A	> 80	200 °C

- Hermetic packages
- ESCC qualified
- 100 krad

Description

The 2N5551 and SOC5551 are bipolar transistors able to operate under severe environment conditions and radiation exposure providing high immunity to total ionizing dose (TID).

Qualified as per ESCC 5202/019 specification and available in LCC-3 and UB hermetic packages, they are 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
2N5551HR

Product summary

Product summary				
Device	**Qualification system**	**Agency specification**	**Package**	**Radiation level**
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 7 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 $T_{amb} \leq 25$ °C	LCC-3 and UB LCC-3 and UB(1)	0.36 0.58	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 for SMD package

Symbol	Parameter	LCC-3 and UB Value	Unit
R_{thJA}	Thermal resistance junction-ambient (max.) for LLC-3 and UB.	302(1)	°C/W

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

2 Electrical characteristics

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

Symbol	Parameter	Test conditions	Min.	Max.	Unit
I_{CBO}	Collector-base cut-off current (I_E = 0)	V_{CB} = 120 V		50	nA
		V_{CB} = 120 V, T_{amb} = 150 °C		50	µA
I_{CEO}	Collector-emitter cut-off current (I_B = 0)	V_{CE} = 100 V		50	nA
I_{EBO}	Emitter-base cut-off current (I_C = 0)	V_{EB} = 4 V		50	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage (I_E = 0)	I_C = 100 µA	180		V
$V_{(BR)CEO}$ (1)	Collector-emitter breakdown voltage (I_B = 0)	I_C = 1 mA	160		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage (I_C = 0)	I_E = 10 µA	6		V
$V_{CE(sat)}$ (1)	Collector-emitter saturation voltage	I_C = 10 mA, I_B = 1 mA		0.15	V
		I_C = 50 mA, I_B = 5 mA		0.2	
$V_{BE(sat)}$ (1)	Base-emitter saturation voltage	I_C = 10 mA, I_B = 1 mA		1	V
		I_C = 50 mA, I_B = 5 mA		1	
h_{FE} (1)	DC current gain	I_C = 1 mA, V_{CE} = 5 V	80		
		I_C = 10 mA, V_{CE} = 5 V	80	250	
		I_C = 50 mA, V_{CE} = 5 V	30		
		I_C = 10 mA, T_{amb} = -55 °C, V_{CE} = 5 V	20		
h_{fe}	Small signal current gain	V_{CE} = 10 V, I_C = 10 mA, f > 100 MHz	1		
		V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	50	200	
C_{OBO}	Output capacitance, (I_E = 0)	f = 1 MHz, V_{CB} = 10 V		6	pF
C_{EBO}	Emitter-base, (I_C= 0)	f = 1 MHz, V_{EB} = 0.5 V		20	pF

1. *Pulsed duration = 300 µs, duty cycle ≤ 1.5%*

2.1 Electrical characteristics (curves)

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

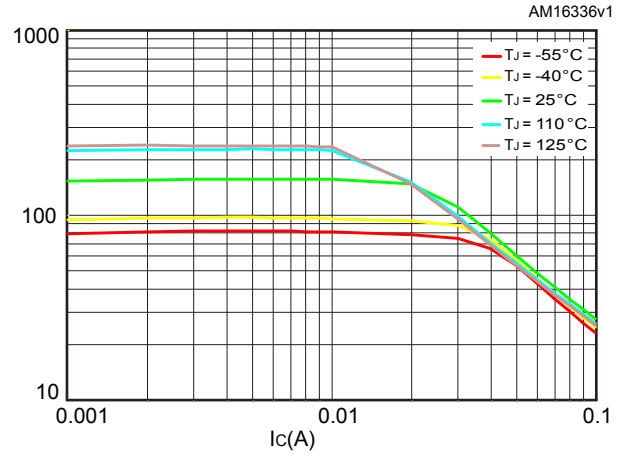


Figure 2. $V_{CE(sat)}$ at h_{FE} =10

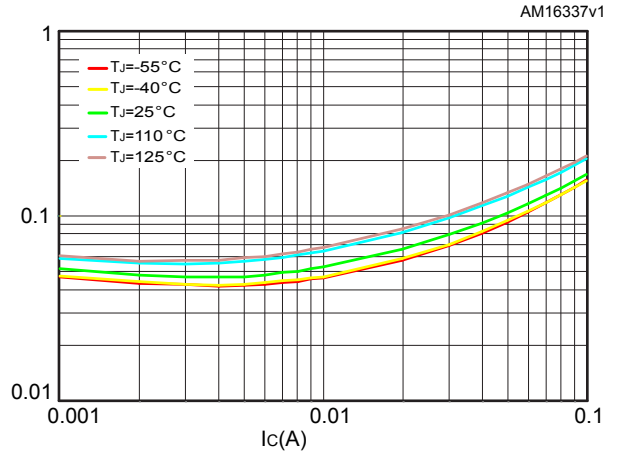
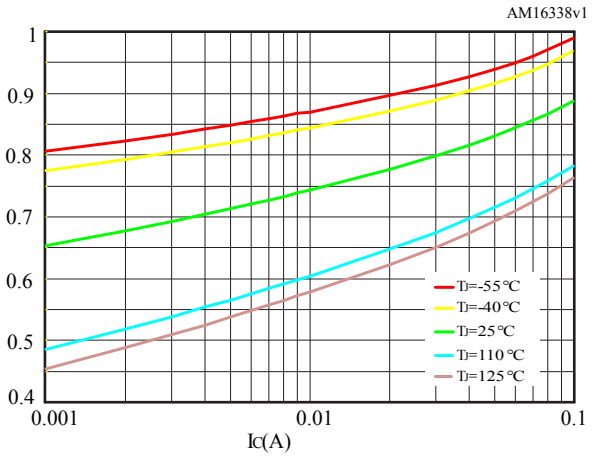


Figure 3. $V_{BE(sat)}$ at h_{FE} =10



3 Radiation assurance

Radiation test are guaranteed in compliance with ESCC 22900 and ESCC 5201/019 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 5201/019 post radiation electrical characteristics (T_{amb} = 25 °C unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Max	Unit
I_{CBO}	Collector cut-off current (I_E = 0)	V_{CB}= 120 V		50	nA
I_{CEO}	Collector-emitter cut-off current (I_B = 0)	V_{CE}= 100 V		50	nA
I_{EBO}	Emitter cut-off current (I_C= 0)	V_{EB} = 4 V		50	nA
$V_{(BR)CBO}$	Collector-base breakdown voltage (I_E= 0)	I_C= 100 µA	180		V
$V_{(BR)CEO}$[1]	Collector-emitter breakdown voltage (I_B = 0)	I_C = 1 mA	160		V
$V_{(BR)EBO}$	Emitter-base breakdown voltage (I_C= 0)	I_E = 10 µA	6		V
$V_{CE(sat)}$[1]	Collector-emitter saturation voltage	I_C=10 mA, I_B = 1 mA		0.15	V
		I_C= 50 mA, I_B = 5 mA		0.2	
$V_{BE(sat)}$[1]	Base-emitter saturation voltage	I_C=10 mA, I_B = 1 mA		1	V
		I_C= 50 mA, I_B = 5 mA		1	
$[h_{FE}]$[1]	Post irradiation gain calculation [2]	I_C= 1 mA, V_{CE}= 5 V	[40]		
		I_C= 10 mA, V_{CE}= 5 V	[40]	250	
		I_C= 50 mA, V_{CE}= 5 V	[15]		

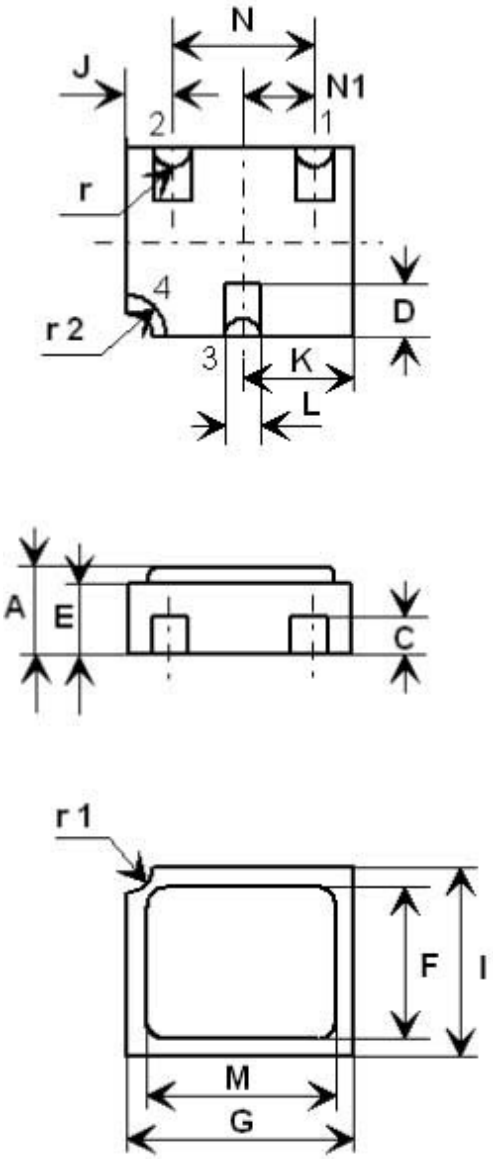
1. *Pulsed duration = 300 µs, duty cycle ≥ 2 %*
2. *The post-irradiation gain calculation of $[h_{FE}]$, made using h_{FE} measurements from prior to and on completion of irradiation testing and after each annealing step if any, shall be as specified in MILSTD-750 method 1019.*

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

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Table 5. **UB package mechanical data**

Symbols	Dimensions in mm			Dimensions in inches (for reference only)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.17		1.42	0.046		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**

Pad 1: emitter
Pad 2: base
Pad 3: collector

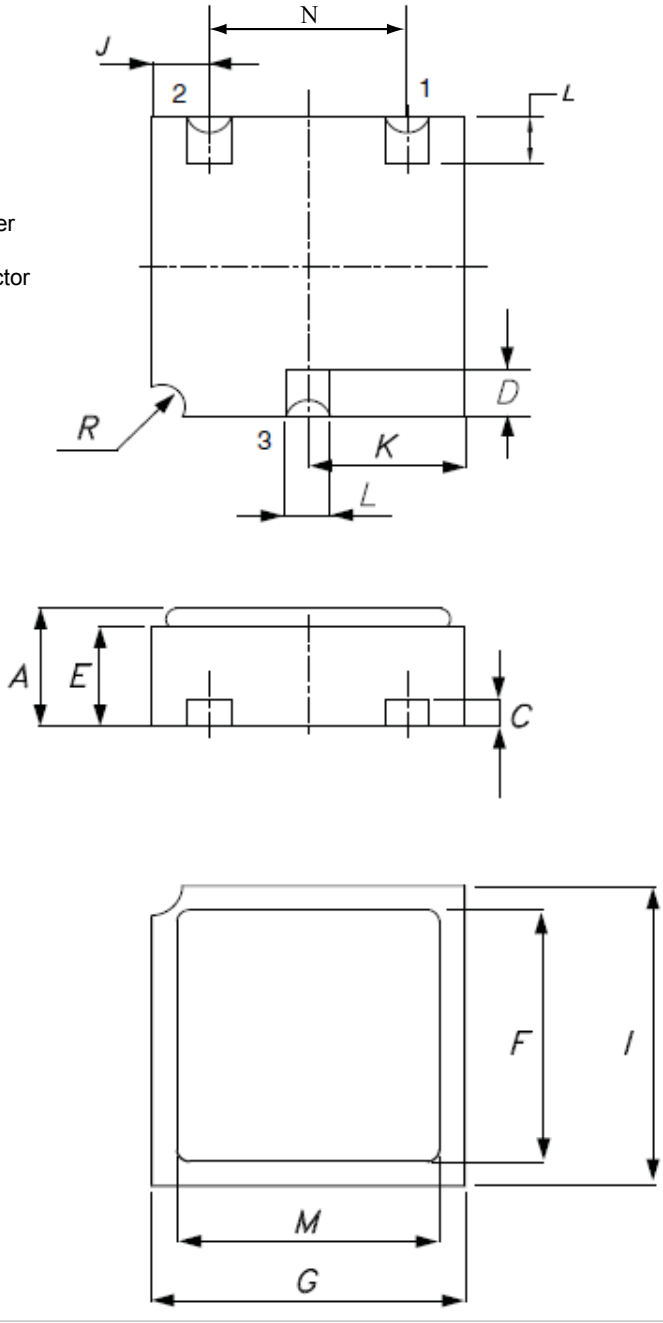

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Table 6. **LCC-3 package mechanical data**

Symbols	Dimensions in mm			Dimensions in inches (for reference only)		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.16		1.42	0.046		0.056
C	0.45	0.50	0.56	0.018	0.020	0.022
D	0.60	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 7. Ordering information

Part number	Agency specification	Quality level	Radiation level	Package	Mass	Lead finish	Marking[1]	Packing
2N5551UB1	-	Engineering model	-	UB	0.6 g	Gold	2N55511UB1	WafflePack
SOC55511	-	Engineering model	-	LCC-3			SOC55511	
2N5551RUBG	5201/019/08R	Flight model	100 krad	UB		Gold	520101908R	
2N5551RUBT	5201/019/09R					Solder Dip	520101909R	
2N5551UBG	5201/019/08		-			Gold	520101908	
2N5551UBT	5201/019/09		-			Solder Dip	520101909	WafflePack
SOC5551RHRG	5201/019/04R		100 krad	LCC-3		Gold	520101904R	
SOC5551RHRT	5201/019/05R					Solder Dip	520101905R	
SOC5551RHRTW	5201/019/05R						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. *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

Table 8. 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 9. 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
	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 10. **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*.
22-Sep-2023	16	Removed JANS products. Minor text changes.
19-Feb-2024	17	Updated Table 7, and Table 9.

Contents