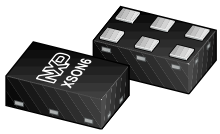


BGU8019

SiGe:C Low Noise Amplifier MMIC for GPS, GLONASS, Galileo, and Compass

Rev. 5 — 21 May 2021 Product data sheet

1 Product profile

1.1 General description

The BGU8019 is, also known as the GPS1202M, a Low Noise Amplifier (LNA) for GNSS receiver applications, available in a small plastic 6-pin extremely thin leadless package. The BGU8019 requires one external matching inductor.

The BGU8019 adapts itself to the changing environment resulting from co-habitation of different radio systems in modern cellular handsets. It has been designed for low power consumption and optimal performance when jamming signals from co-existing cellular transmitters are present. At low jamming power levels it delivers 18.5 dB gain at a noise figure of 0.55 dB. During high jamming power levels, resulting for example from a cellular transmit burst, it temporarily increases its bias current to improve sensitivity.

1.2 Features and benefits

- Cover full GNSS L1 band, from 1559 MHz to 1610 MHz
- Noise figure (NF) = 0.55 dB
- Gain = 18.5 dB
- High input 1 dB compression point of -7 dBm
- High out of band $IP3_i$ of 6 dBm
- Supply voltage 1.5 V to 3.1 V
- Self-shielding package concept
- Integrated supply decoupling capacitor
- Optimized performance at a supply current of 4.6 mA
- Power-down mode current consumption < 1 μA
- Integrated temperature stabilized bias for easy design
- Require only one input matching inductor
- Input and output DC decoupled
- ESD protection on all pins (HBM > 2 kV)
- Integrated matching for the output
- Available in 6-pins leadless package 1.1 mm × 0.7 mm × 0.37 mm; 0.4 mm pitch: SOT1232
- 180 GHz transit frequency - SiGe:C technology
- Moisture sensitivity level of 1

1.3 Applications

LNA for GPS, GLONASS, Galileo, and Compass (BeiDou) in:

- smart phones
- feature phones,
- tablet PCs
- digital still cameras
- digital video cameras
- RF front-end modules
- complete GNSS modules
- personal health applications

1.4 Quick reference data

Table 1. Quick reference data

f = 1575 MHz; V_{CC} = 2.85 V; $V_{I(ENABLE)} \geq 0.8$ V; $P_i < -40$ dBm; T_{amb} = 25 °C; input matched to 50 Ω using a 6.8 nH inductor, see Figure 1; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		1.5	-	3.1	V
I_{CC}	supply current		-	4.6	6.6	mA
G_p	power gain	no jammer	16.5	18.5	20.5	dB
NF	noise figure	P_i = -40 dBm, no jammer [1]	-	0.55	1.1	dB
$P_{i(1dB)}$	input power at 1 dB gain compression		-11	-7	-	dBm
$IP3_i$	input third-order intercept point	[2]	0	6	-	dBm
		[3]	0	6	-	dBm

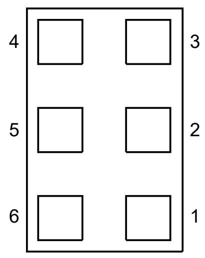
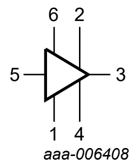
[1] PCB losses are subtracted.

[2] f_1 = 1713 MHz; f_2 = 1851 MHz; P_i = -20 dBm per carrier

[3] f_1 = 1713 MHz, P_i = -20 dBm; f_2 = 1850 MHz, P_i = -65 dBm

2 Pinning information

Table 2. Pinning

Pin	Description		Simplified outline	Graphic symbol
1	GND			
2	V_{CC}			
3	RF_OUT			
4	GND_RF			
5	RF_IN			
6	ENABLE			

3 Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BGU8019	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1.1 × 0.7 × 0.37 mm	SOT1232
OM7848	EVB	BGU8019 evaluation board, MMIC only	-
OM7849	EVB	BGU8019 evaluation board, front-end EVB	-

4 Marking code

Table 4. Marking code

Type number	Marking code	Date code
BGU8019	A	YWW

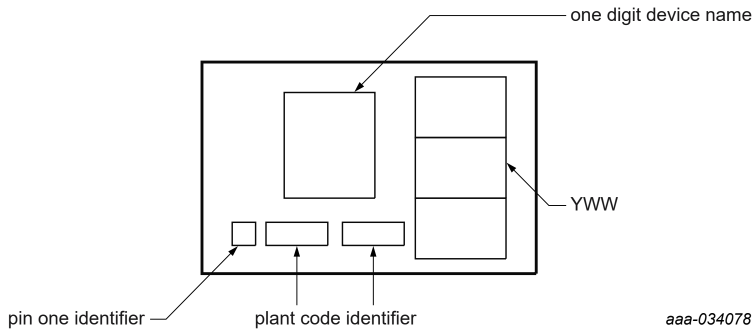


Figure 1. Marking diagram

5 Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Absolute Maximum Ratings are given as Limiting Values of stress conditions during operation, that must not be exceeded under the worst probable conditions.

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CC}	supply voltage	RF input AC coupled	[1]	-0.5	5	V
$V_{I(ENABLE)}$	input voltage on pin ENABLE	$V_{I(ENABLE)} < V_{CC} + 0.6$ V	[1][2]	-0.5	5	V
$V_{I(RF\_IN)}$	input voltage on pin RF_IN	DC, $V_{I(RF\_IN)} < V_{CC} + 0.6$ V	[1][2][3]	-0.5	5	V
$V_{I(RF\_OUT)}$	input voltage on pin RF_OUT	DC, $V_{I(RF\_OUT)} < V_{CC} + 0.6$ V	[1][2][3]	-0.5	5	V
P_i	input power		[1]	-	10	dBm
P_{tot}	total power dissipation	$T_{sp} \leq 130$ °C		-	55	mW
T_{stg}	storage temperature			-65	150	°C
T_j	junction temperature			-	150	°C
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM) According to ANSI/ESDA/JEDEC standard JS-001		-	±2	kV
		Charged Device Model (CDM) According to JEDEC standard JESD22-C101C		-	±1	kV

[1] Stressed with pulses of 200 ms in duration, with application circuit as in Figure 1.

[2] Warning: due to internal ESD diode protection, the applied DC voltage shall not exceed V_{CC} + 0.6 V and shall not exceed 5.0 V in order to avoid excess current.

[3] The RF input and RF output are AC coupled through internal DC blocking capacitors.

6 Recommended operating conditions

Table 6. Operating conditions

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{CC}	supply voltage			1.5	-	3.1	V
T_{amb}	ambient temperature			-40	25	85	°C
$V_{I(ENABLE)}$	input voltage on pin ENABLE	OFF state		-	-	0.3	V
		ON state		0.8	-	-	V

7 Thermal characteristics

Table 7. Thermal characteristics

Symbol	Parameter	Conditions		Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point			225	K/W

8 Characteristics

Table 8. Characteristics at V_{CC} = 1.8 V

f = 1575 MHz; V_{CC} = 1.8 V; $V_{I(ENABLE)}$ ≥ 0.8 V; P_i < -40 dBm; T_{amb} = 25 °C; input matched to 50 Ω using a 6.8 nH inductor, see Figure 1; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CC}	supply current	$V_{I(ENABLE)}$ ≥ 0.8 V				
		P_i < -40 dBm	-	4.4	6.4	mA
		P_i = -20 dBm	-	9	-	mA
		$V_{I(ENABLE)}$ ≤ 0.3 V	-	-	1	μA
G_p	power gain	no jammer	16	18	20	dB
		P_{jam} = -20 dBm; f_{jam} = 850 MHz	-	20	-	dB
		P_{jam} = -20 dBm; f_{jam} = 1850 MHz	-	20	-	dB
RL_{in}	input return loss	P_i < -40 dBm	9	12	-	dB
		P_i = -20 dBm	-	20	-	dB
RL_{out}	output return loss	P_i < -40 dBm	8	13	-	dB
		P_i = -20 dBm	-	12	-	dB
ISL	isolation		27	30	-	dB
NF	noise figure	P_i = -40 dBm, no jammer [1]	-	0.55	1.1	dB
		P_i = -40 dBm, no jammer [2]	-	0.60	1.15	dB
		P_{jam} = -20 dBm; f_{jam} = 850 MHz [2]	-	0.9	-	dB
		P_{jam} = -20 dBm; f_{jam} = 1850 MHz [2]	-	1.3	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression		-13	-10	-	dBm
$IP3_i$	input third-order intercept point	[3]	-3	3	-	dBm
		[4]	-3	3	-	dBm
IMD3	third-order intermodulation distortion	measured at output pin [3]	-	-47	-	dBm
		measured at output pin [4]	-	-89	-	dBm
t_{on}	turn-on time	time from $V_{I(ENABLE)}$ ON, to 90 % of the gain	-	-	2	μs
t_{off}	turn-off time	time from $V_{I(ENABLE)}$ OFF, to 10 % of the gain	-	-	1	μs

[1] PCB losses are subtracted
[2] Including PCB losses
[3] f_1 = 1713 MHz; f_2 = 1851 MHz; P_i = -20 dBm per carrier
[4] f_1 = 1713 MHz, P_i = -20 dBm; f_2 = 1850 MHz, P_i = -65 dBm

Table 9. Characteristics at V_{CC} = 2.85 V

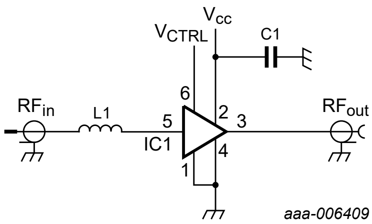
f = 1575 MHz; V_{CC} = 2.85 V; $V_{I(ENABLE)} \geq 0.8$ V; $P_i < -40$ dBm; T_{amb} = 25 °C; input matched to 50 Ω using a 6.8 nH inductor, see Figure 1; unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CC}	supply current	$V_{I(ENABLE)} \geq 0.8$ V					
		$P_i < -40$ dBm		-	4.6	6.6	mA
		$P_i = -20$ dBm		-	10	-	mA
		$V_{I(ENABLE)} \leq 0.3$ V		-	-	1	μA
G_p	power gain	no jammer		16.5	18.5	20.5	dB
		P_{jam} = -20 dBm; f_{jam} = 850 MHz		-	20.0	-	dB
		P_{jam} = -20 dBm; f_{jam} = 1850 MHz		-	20.5	-	dB
RL_{in}	input return loss	$P_i < -40$ dBm		8	13	-	dB
		$P_i = -20$ dBm		-	22	-	dB
RL_{out}	output return loss	$P_i < -40$ dBm		8	13	-	dB
		$P_i = -20$ dBm		-	12	-	dB
ISL	isolation			27	30	-	dB
NF	noise figure	$P_i = -40$ dBm, no jammer	[1]	-	0.55	1.1	dB
		$P_i = -40$ dBm, no jammer	[2]	-	0.60	1.15	dB
		P_{jam} = -20 dBm; f_{jam} = 850 MHz	[2]	-	0.9	-	dB
		P_{jam} = -20 dBm; f_{jam} = 1850 MHz	[2]	-	1.3	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression			-11	-7	-	dBm
$IP3_i$	input third-order intercept point		[3]	0	6	-	dBm
			[4]	0	6	-	dBm
IMD3	third-order intermodulation distortion	measured at output pin	[3]	-	-53	-	dBm
		measured at output pin	[4]	-	-96	-	dBm
t_{on}	turn-on time	time from $V_{I(ENABLE)}$ ON, to 90 % of the gain		-	-	2	μs
t_{off}	turn-off time	time from $V_{I(ENABLE)}$ OFF, to 10 % of the gain		-	-	1	μs

[1] PCB losses are subtracted
[2] Including PCB losses
[3] f_1 = 1713 MHz; f_2 = 1851 MHz; P_i = -20 dBm per carrier
[4] f_1 = 1713 MHz, P_i = -20 dBm; f_2 = 1850 MHz, P_i = -65 dBm

9 Application information

9.1 GNSS application



For a list of components see Table 10.

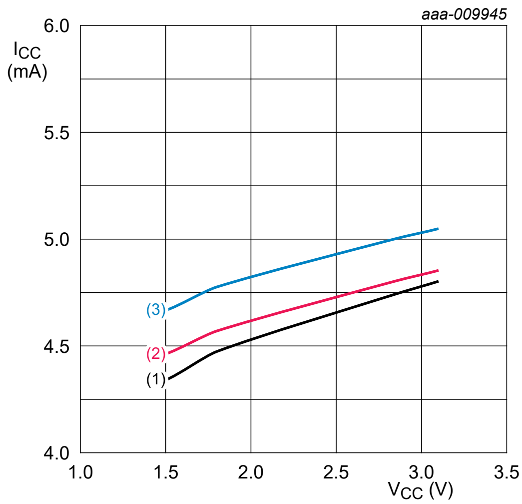
Figure 2. Schematics GNSS evaluation board

Table 10. List of components

For schematics see Figure 1.

Component	Description	Value	Remarks
C1	decoupling capacitor	1 nF	to suppress power supply noise
IC1	BGU8019	-	NXP
L1	high-quality matching inductor	6.8 nH	Murata LQW15A

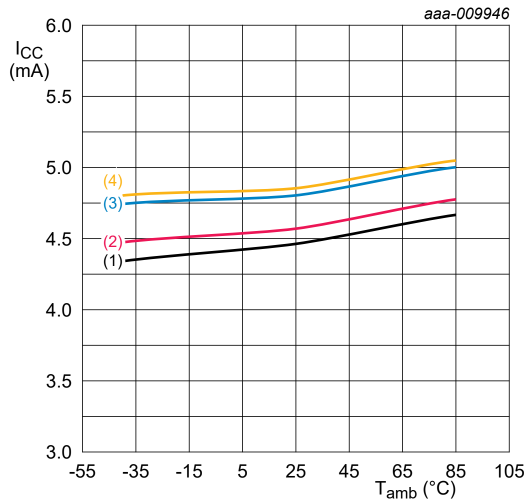
9.2 Graphs



P_i = -45 dBm.

1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

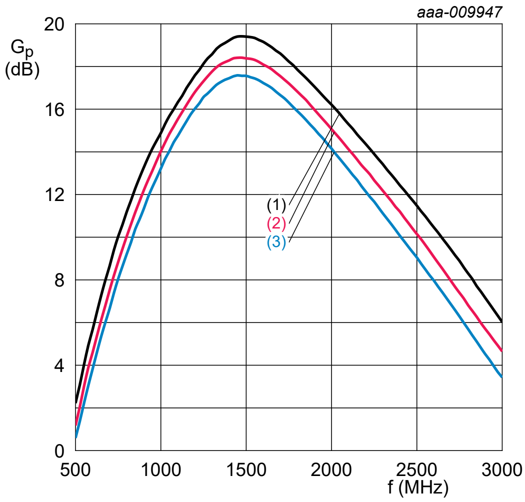
Figure 3. Supply current as a function of supply voltage; typical values



P_i = -45 dBm.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

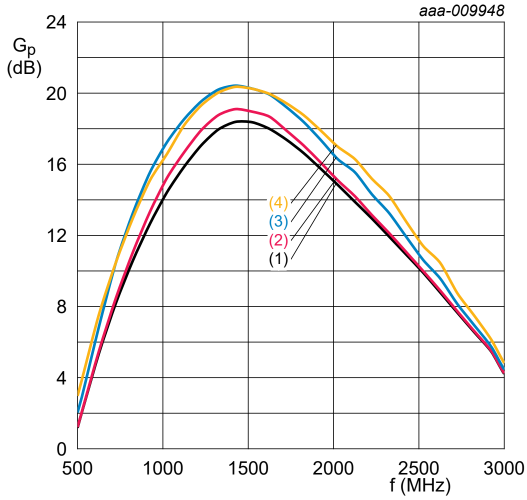
Figure 4. Supply current as a function of ambient temperature; typical values



P_i = -45 dBm; V_{CC} = 1.8 V.

1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

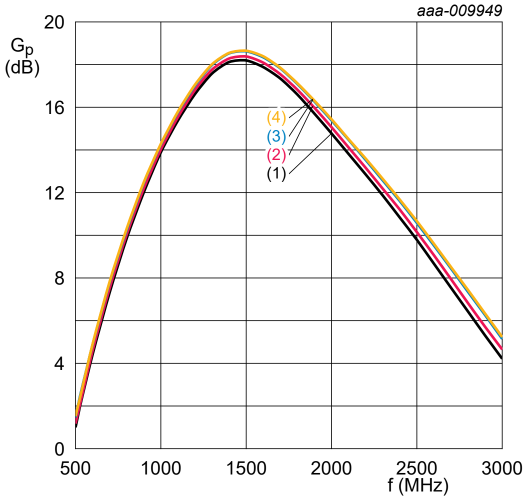
Figure 5. Power gain as a function of frequency; typical values



T_{amb} = 25 °C; V_{CC} = 1.8 V.

1. P_i = -45 dBm
2. P_i = -30 dBm
3. P_i = -20 dBm
4. P_i = -15 dBm

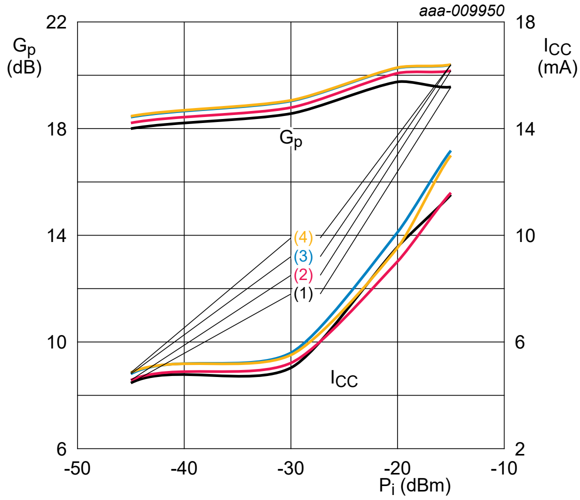
Figure 6. Power gain as a function of frequency; typical values



P_i = -45 dBm; T_{amb} = 25 °C.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

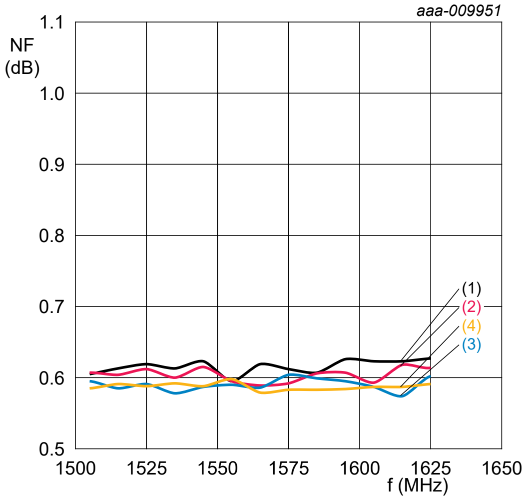
Figure 7. Power gain as a function of frequency; typical values



f = 1575 MHz; T_{amb} = 25 °C.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

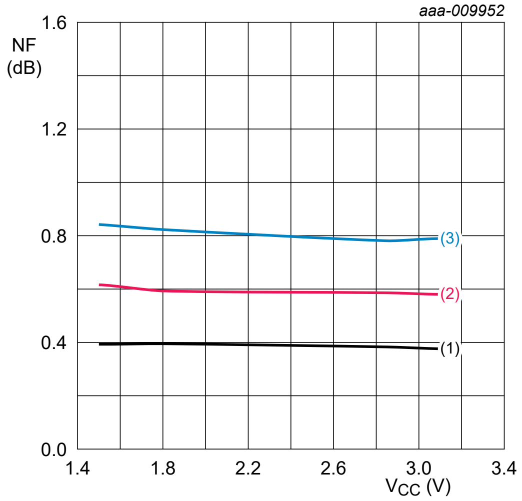
Figure 8. Power gain and supply current as function of input power; typical values



T_{amb} = 25 °C; no jammer, including PCB losses.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

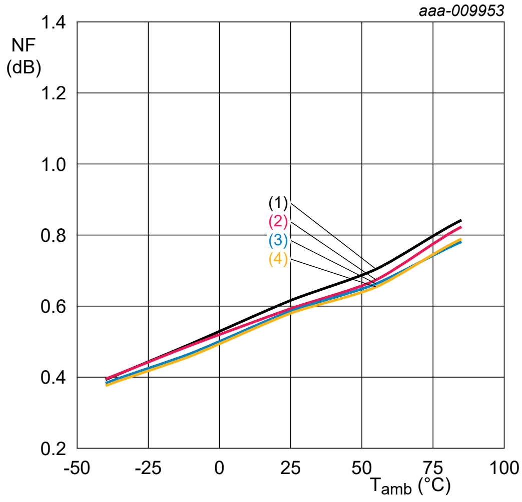
Figure 9. Noise figure as a function of frequency; typical values



f = 1575 MHz; no jammer, including PCB losses.

1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

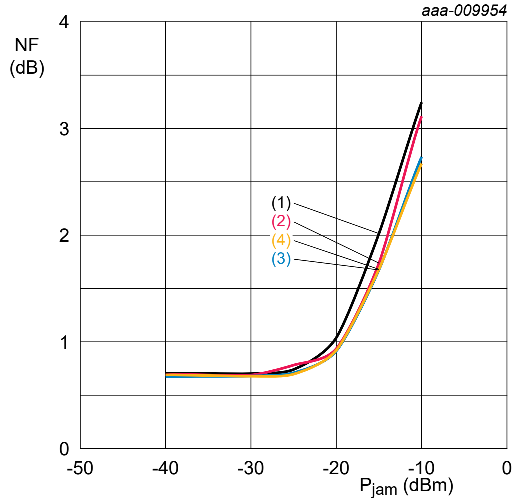
Figure 10. Noise figure as a function of supply voltage; typical values



f = 1575 MHz; no jammer, including PCB losses.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

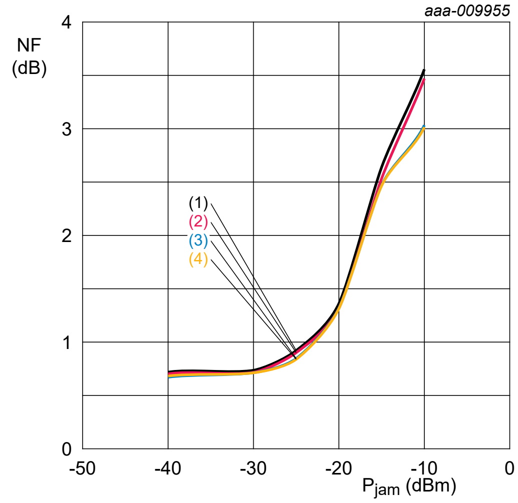
Figure 11. Noise figure as a function of ambient temperature; typical values



f_{jam} = 850 MHz; T_{amb} = 25 °C; f = 1575 MHz; including PCB losses.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

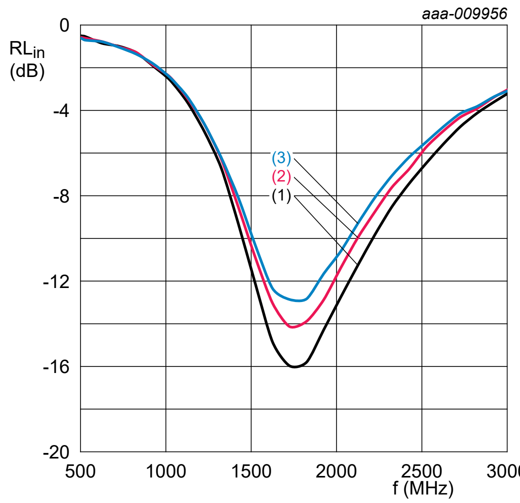
Figure 12. Noise figure as a function of jamming power; typical values



f_{jam} = 1850 MHz; T_{amb} = 25 °C; f = 1575 MHz; including PCB losses.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

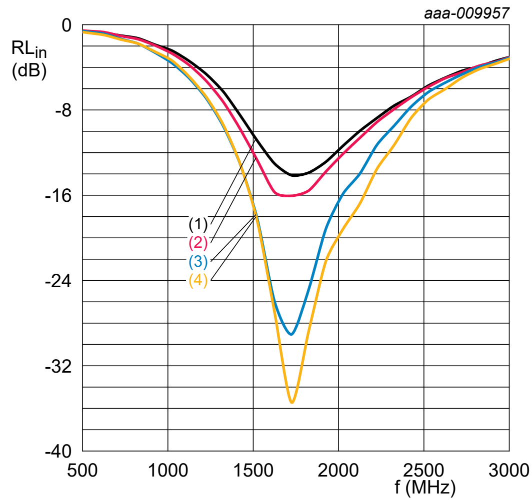
Figure 13. Noise figure as a function of jamming power; typical values



P_i = -45 dBm; V_{CC} = 1.8 V.

1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

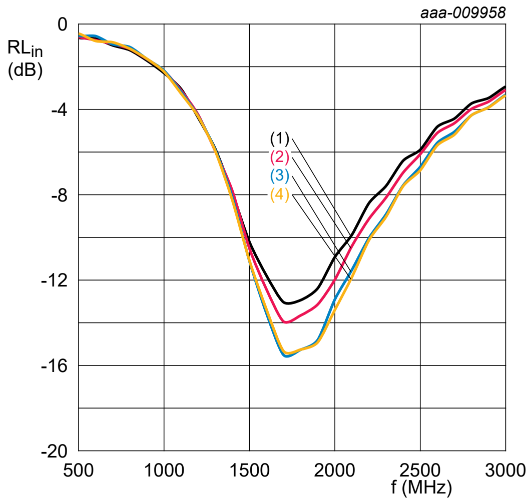
Figure 14. Input return loss as a function of frequency; typical values



T_{amb} = 25 °C; V_{CC} = 1.8 V.

1. P_i = -45 dBm
2. P_i = -30 dBm
3. P_i = -20 dBm
4. P_i = -15 dBm

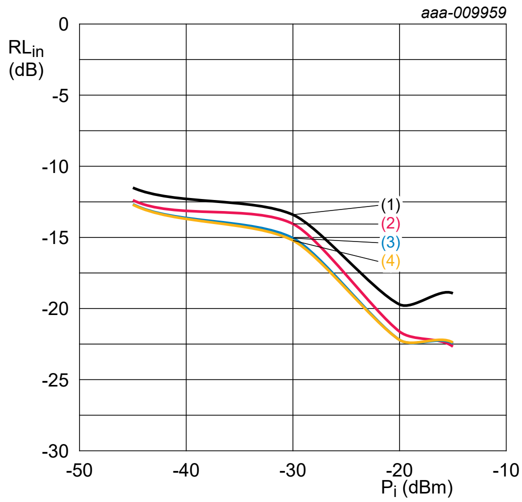
Figure 15. Input return loss as a function of frequency; typical values



P_i = -45 dBm; T_{amb} = 25 °C.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

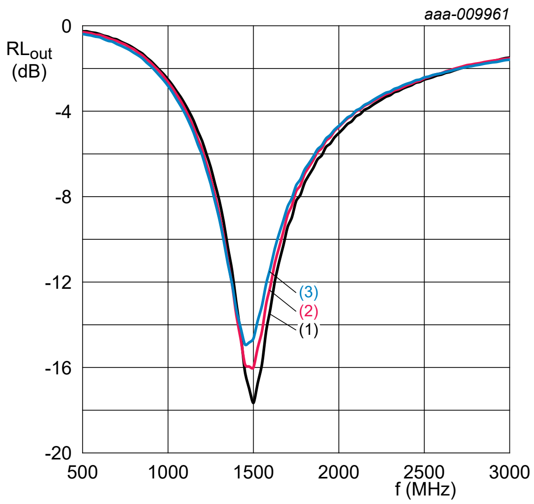
Figure 16. Input return loss as a function of frequency; typical values



f = 1575 MHz; T_{amb} = 25 °C.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

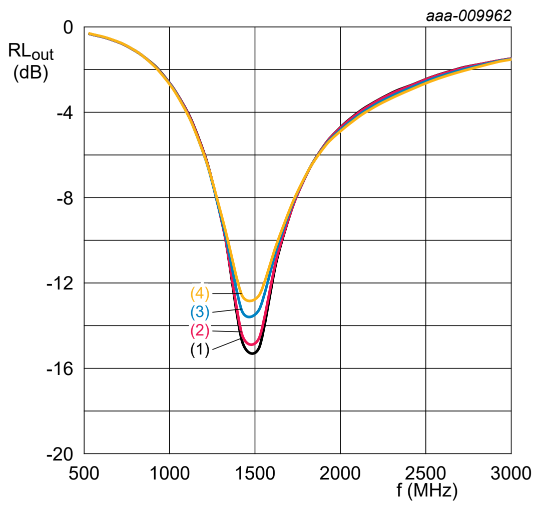
Figure 17. Input return loss as a function of input power; typical values



P_i = -45 dBm; V_{CC} = 1.8 V.

1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

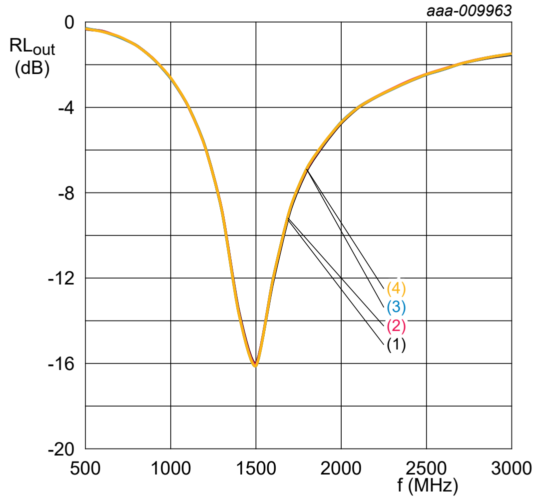
Figure 18. Output return loss as a function of frequency; typical values



T_{amb} = 25 °C; V_{CC} = 1.8 V.

1. P_i = -45 dBm
2. P_i = -30 dBm
3. P_i = -20 dBm
4. P_i = -15 dBm

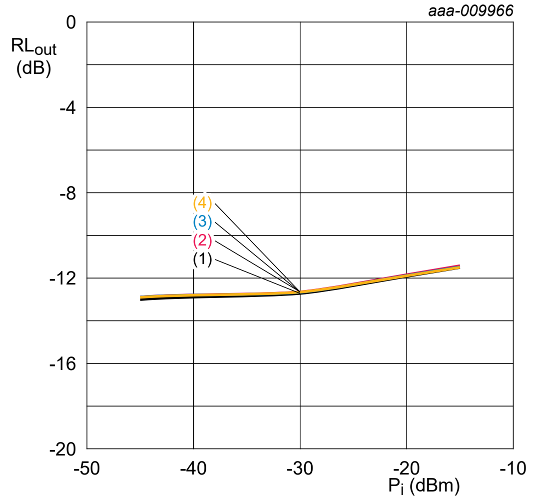
Figure 19. Output return loss as a function of frequency; typical values



P_i = -45 dBm; T_{amb} = 25 °C.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

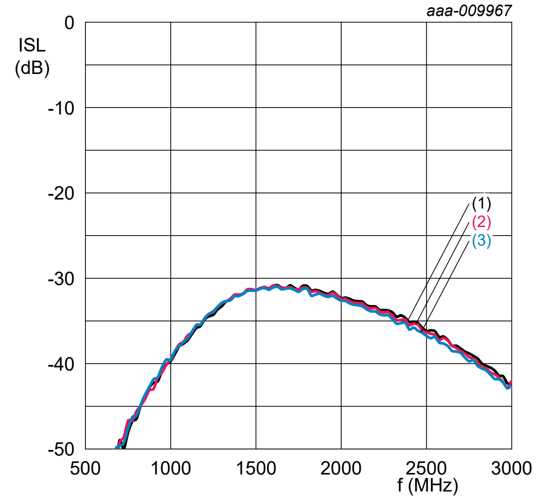
Figure 20. Output return loss as a function of frequency; typical values



f = 1575 MHz; T_{amb} = 25 °C.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

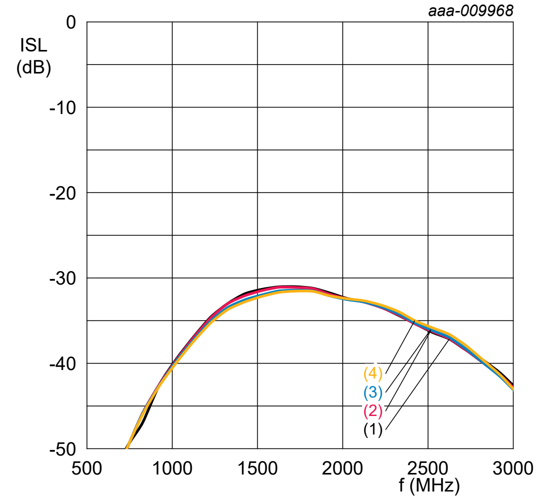
Figure 21. Output return loss as a function of input power; typical values



P_i = -45 dBm; V_{CC} = 1.8 V.

1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

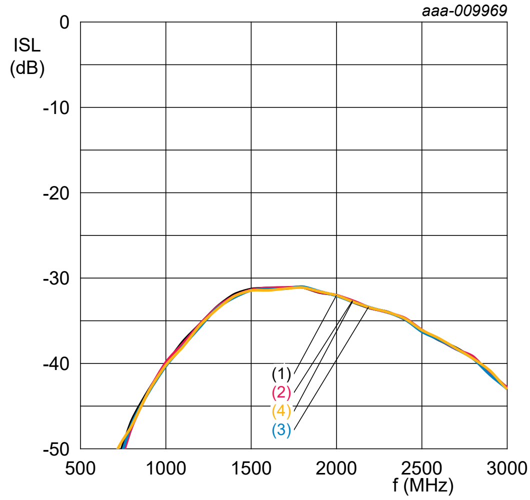
Figure 22. Isolation as a function of frequency; typical values



T_{amb} = 25 °C; V_{CC} = 1.8 V.

1. P_i = -45 dBm
2. P_i = -30 dBm
3. P_i = -20 dBm
4. P_i = -15 dBm

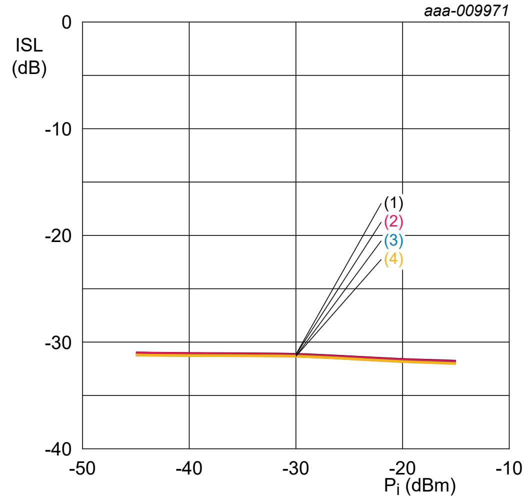
Figure 23. Isolation as a function of frequency; typical values



P_i = -45 dBm; T_{amb} = 25 °C.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

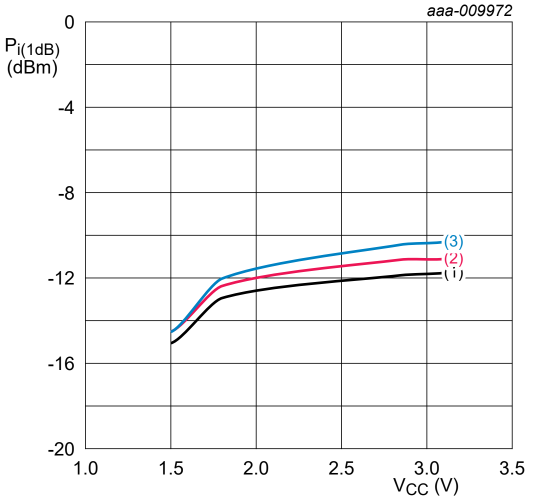
Figure 24. Isolation as a function of frequency; typical values



f = 1575 MHz; T_{amb} = 25 °C.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

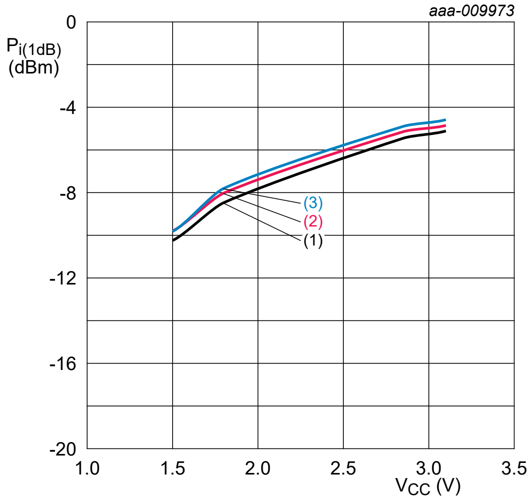
Figure 25. Isolation as a function of input power; typical values



f = 850 MHz.

1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

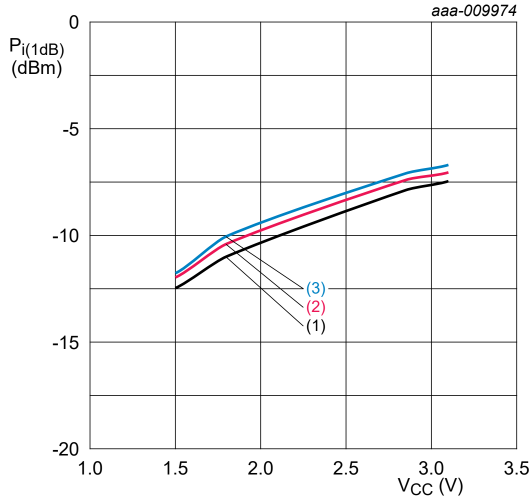
Figure 26. Input power at 1 dB gain compression as a function of supply voltage; typical values



f = 1850 MHz.

1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

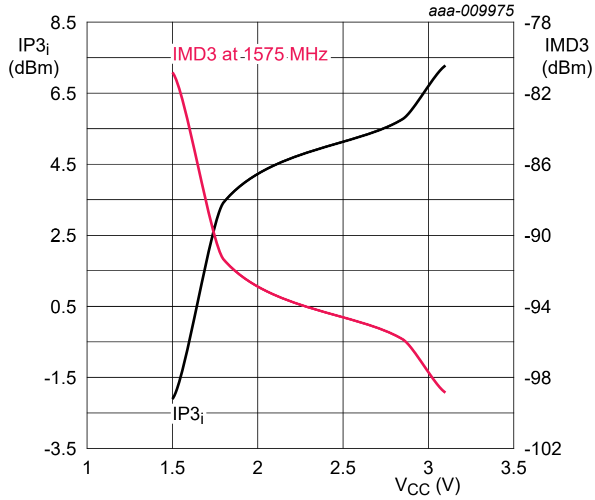
Figure 27. Input power at 1 dB gain compression as a function of supply voltage; typical values



f = 1575 MHz.

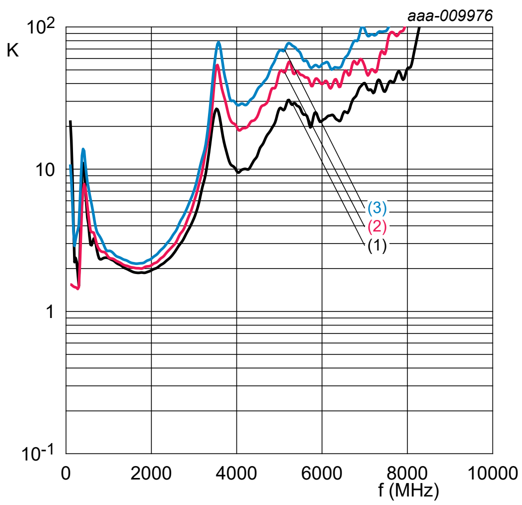
1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

Figure 28. Input power at 1 dB gain compression as a function of supply voltage; typical values



f_1 = 1713 MHz; f_2 = 1851 MHz; Pi = -20 dBm at f_1; Pi = -65 dBm at f_2; T_{amb} = 25 °C.

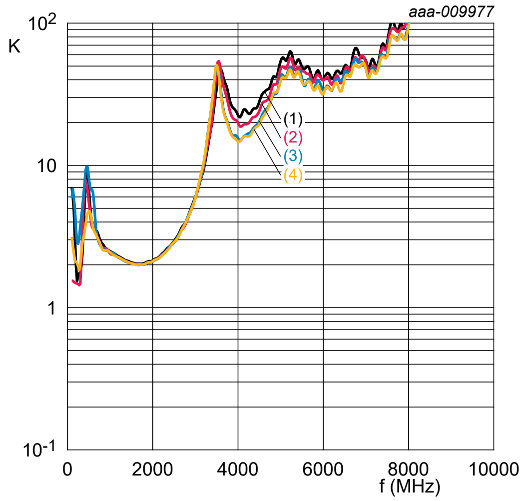
Figure 29. Input third order intercept point and third order intermodulation distortion as function of supply voltage; typical values



P_i = -45 dBm; V_{CC} = 1.8 V.

1. T_{amb} = -40 °C
2. T_{amb} = +25 °C
3. T_{amb} = +85 °C

Figure 30. Rollett stability factor as a function of frequency; typical values



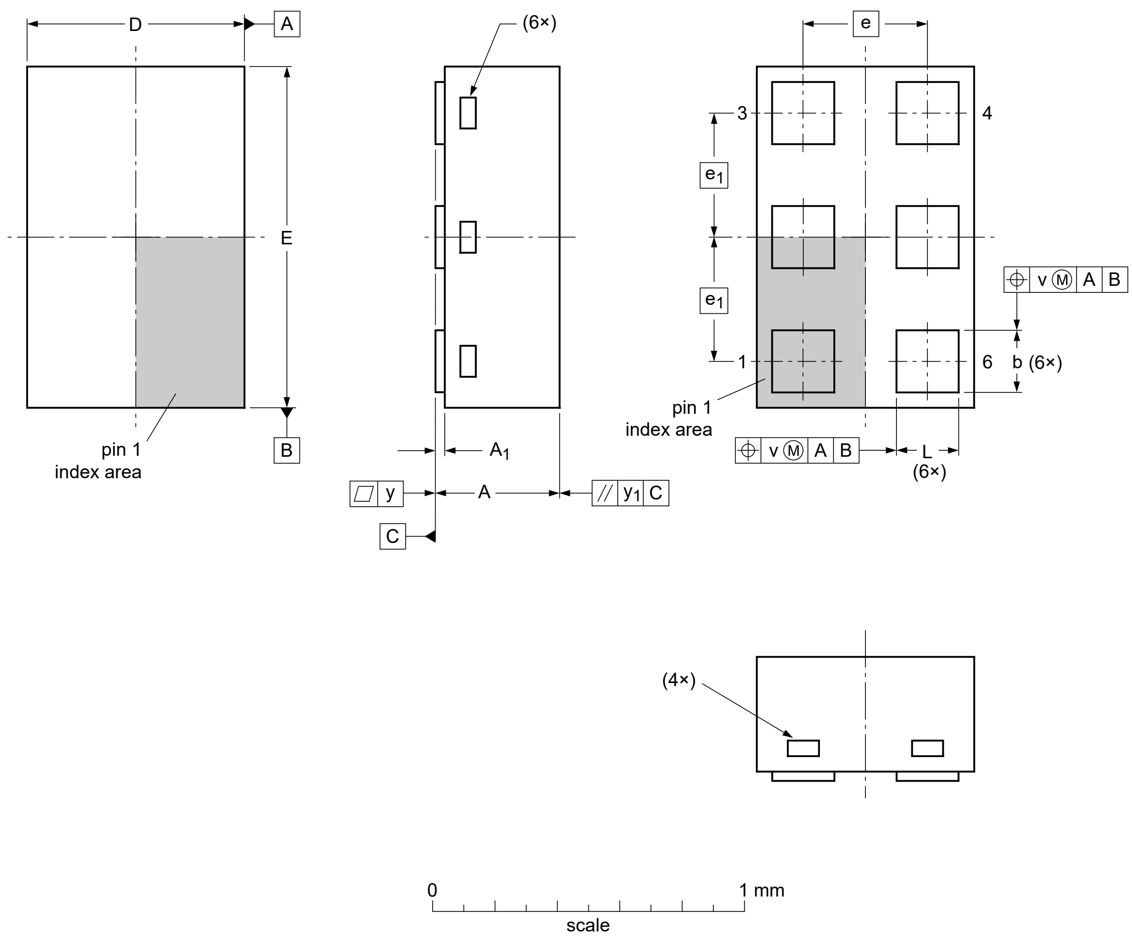
P_i = -45 dBm; T_{amb} = 25 °C.

1. V_{CC} = 1.5 V
2. V_{CC} = 1.8 V
3. V_{CC} = 2.85 V
4. V_{CC} = 3.1 V

Figure 31. Rollett stability factor as a function of frequency; typical values

10 Package outline

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1.1 x 0.7 x 0.37 mm **SOT1232**



Dimensions (mm are the original dimensions)

Unit		A	A_1	D	E	e_1	e	b	L	V	Y	Y_1
mm	min	0.34		0.65	1.05			0.17	0.17			
	nom	0.37		0.70	1.10	0.4	0.4	0.20	0.20	0.1	0.05	0.1
	max	0.40	0.04	0.75	1.15			0.25	0.25			

Note
1. Dimension A is including plating thickness.

sot1232_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1232						~~13-04-12~~ 13-11-08

Figure 32. Package outline SOT1232 (XSON6)

11 Handling information

CAUTION

This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.
Such precautions are described in the *ANSI/ESD S20.20, IEC/ST 61340-5, JESD625-A* or equivalent standards.

12 Abbreviations

Table 11. Abbreviations

Acronym	Description
ESD	electrostatic discharge
GLONASS	global navigation satellite system
GNSS	global navigation satellite system
GPS	global positioning system
HBM	human body model
MMIC	monolithic microwave-integrated circuit
PCB	printed circuit board
SiGe:C	silicon germanium carbon

13 Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGU8019 v.5	20210521	Product data sheet	2021050321	BGU8019 v.4.2
Modifications:	• added Min, and or Max values to some characteristics at 2.85 V • changed conditions, footnotes, and Minimum, and Typical values on $IP3_i$ • added extra Typical value, and footnote to IMD3			
BGU8019 v.4.2	20190516	Product data sheet	-	BGU8019 v.4.1
Modifications:	• added general Marking diagram			
BGU8019 v.4.1	20190510	Product data sheet	-	BGU8019 v.4
Modifications:	• adapted date code notation to the Marking code table			
BGU8019 v.4	20181123	Product data sheet	-	BGU8019 v.3
Modifications:	• adapted different min and max values in the characteristics • adapted in band, and out of band condition to $IP3_i$ parameter • changed the name of the application into GNSS application			
BGU8019 v.3	20170118	Product data sheet	-	BGU8019 v.2
Modifications:	• Section 1: added GPS1202M according to our new naming convention			
BGU8019 v.2	20140603	Product data sheet	-	BGU8019 v.1
BGU8019 v.1	20131112	Preliminary data sheet	-	-

14 Legal information

14.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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