GPS1502L

SiGe:C low-noise amplifier MMIC for GPS, GLONASS, Galileo and COMPASS

Rev. 5 — 22 March 2019 Product data sheet

1 General description

The GPS1502L is a Low-Noise Amplifier (LNA) for GNSS receiver applications and is available in a small plastic 6-pin extremely thin leadless package. The GPS1502L requires only one external matching inductor.

The GPS1502L 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 17 dB gain at a noise figure of 0.6 dB and a supply current of 4.2 mA. During high jamming power levels, resulting, for example, from a cellular transmit burst, it temporarily increases its bias current to improve sensitivity.

The GPS1502L is optimized for 1164 MHz to 1299 MHz.

2 Features and benefits

- Covers full GNSS lower L-band, from 1164 MHz to 1299 MHz
- Noise figure = 0.6 dB
- Gain 17 dB
- High-input 1 dB compression point of -13 dBm
- High in-band $IP3_i$ of -1 dBm
- Supply voltage 1.5 V to 3.1 V
- Optimized performance at a low supply current of 4.2 mA
- Integrated RF supply decoupling capacitor
- Power-down mode current consumption < 1 µA
- Integrated temperature stabilized bias for easy design
- Requires only one input matching inductor
- Integrated DC blocking at both RF input and output
- Integrated matching for the output
- ESD protection on all pins
- Self-shielding package concept
- Low Bill of Materials
- 6-pin leadless package: 1.1 mm × 0.7 mm × 0.37 mm; 0.4 mm pitch
- 180 GHz transit frequency - SiGe:C technology
- Moisture sensitivity level 1

3 Applications

- Smart phones
- Feature phones
- Tablets
- Digital still cameras
- Digital video cameras
- RF front-end modules
- Complete GNSS modules
- Personal health applications

4 Quick reference data

Table 1. Quick reference data

f = 1176 MHz; V_{CC} = 1.8 V; $V_{I(ENABLE)}$ ≥ 0.8 V; P_i = -45 dBm; T_{amb} = 25 °C; input matched to 50 Ω (see Figure 3 and Table 10). Unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CC}	supply current			2.3	4.2	6.1	mA
G_p	power gain			15.6	17	18	dB
NF	noise figure		[1]	-	0.6	0.8	dB
$P_{i(1dB)}$	input power at 1 dB gain compression			-15	-13	-	dBm
$IP3_i$	input third-order intercept point	Δf = 1 MHz		-6	-1	-	dBm

[1] PCB losses are subtracted.

5 Ordering information

Table 2. Ordering information

Type number	Orderable part number	Package		
		Name	Description	Version
GPS1502L	GPS1502LX	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1.1 mm × 0.7 mm × 0.37 mm	SOT1232

6 Marking

Table 3. Marking code

Type number	Marking code
GPS1502L	L

7 Block diagram

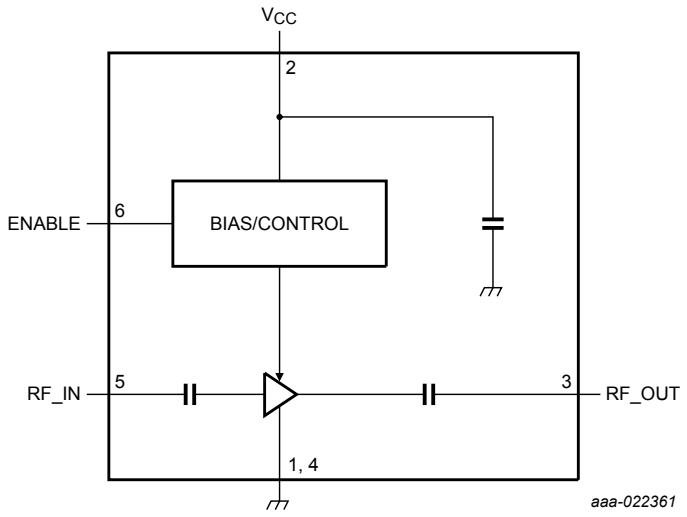


Figure 1. Block diagram

8 Pinning information

8.1 Pinning

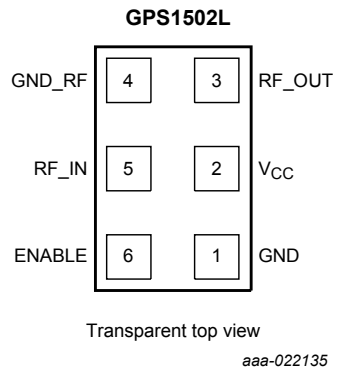


Figure 2. Pin configuration

8.2 Pin description

Table 4. Pin description

Symbol	Pin	Description
GND	1	ground
V_{CC}	2	supply voltage
RF_OUT	3	RF output
GND_RF	4	ground RF
RF_IN	5	RF input
ENABLE	6	enable

9 Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	+6.0	V
$V_{I(ENABLE)}$	input voltage on pin ENABLE	$V_{I(ENABLE)} < V_{CC} + 0.5$ V	-0.5	+5.0	V
$V_{I(RF\_IN)}$	input voltage on pin RF_IN	DC [1]	-0.5	+0.5	V
$V_{I(RF\_OUT)}$	input voltage on pin RF_OUT	DC; $V_{I(RF\_OUT)} < V_{CC} + 0.5$ V [1]	-0.5	+5.0	V
P_i	input power	RF; ON state, OFF state	-	15	dBm
T_{stg}	storage temperature		-65	+150	°C
T_j	junction temperature		-	150	°C
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM); according to JEDEC standard JS-001	-	±2	kV
		Charged Device Model (CDM); according to JEDEC standard JS-002	-	±1	kV

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

10 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	0.0	-	0.3	V
		ON state	0.8	-	V_{CC}	V

11 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

12 Characteristics

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

f = 1176 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 (see Figure 3 and Table 10). Unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CC}	supply current	$V_{I(ENABLE)}$ ≥ 0.8 V				
		P_i < -40 dBm	2.3	4.2	6.1	mA
		P_i = -20 dBm	-	4.9	-	mA
		$V_{I(ENABLE)}$ ≤ 0.3 V	-	-	1	µA
G_p	power gain	no jammer	15.6	17	18	dB
		P_{jam} = -21 dBm; f_{jam} = 915 MHz	-	17	-	dB
		P_{jam} = -21 dBm; f_{jam} = 1427 MHz	-	17	-	dB
RL_{in}	input return loss		8	11	-	dB
RL_{out}	output return loss		7	10	-	dB
ISL	isolation		25	27	-	dB
K	Rollett stability factor		1	-	-	
NF	noise figure	no jammer [1]	-	0.60	0.80	dB
		P_{jam} = -22 dBm; f_{jam} = 915 MHz [1]	-	0.80	-	dB
		P_{jam} = -22 dBm; f_{jam} = 1427 MHz [1]	-	0.90	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression		-15	-13	-	dBm
$IP3_i$	input third-order intercept point	Δf = 1 MHz	-6	-1	-	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.

Table 9. Characteristics at V_{CC} = 2.8 V

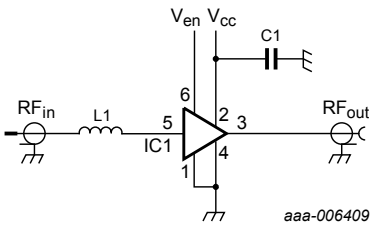
f = 1176 MHz; V_{CC} = 2.8 V; $V_{I(ENABLE)}$ ≥ 0.8 V; P_i < -40 dBm; T_{amb} = 25 °C. Input matched to 50 Ω (see Figure 3 and Table 10. Unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CC}	supply current	$V_{I(ENABLE)}$ ≥ 0.8 V				
		P_i < -40 dBm	2.4	4.4	6.4	mA
		P_i = -20 dBm	-	5.1	-	mA
		$V_{I(ENABLE)}$ ≤ 0.3 V	-	-	1	µA
G_p	power gain	no jammer	15.6	17	18	dB
		P_{jam} = -21 dBm; f_{jam} = 915 MHz	-	17	-	dB
		P_{jam} = -21 dBm; f_{jam} = 1427 MHz	-	17	-	dB
RL_{in}	input return loss		9	12	-	dB
RL_{out}	output return loss		7	10	-	dB
ISL	isolation		25	27	-	dB
K	Rollett stability factor		1	-	-	
NF	noise figure	no jammer [1]	-	0.65	0.85	dB
		P_{jam} = -22 dBm; f_{jam} = 915 MHz [1]	-	0.85	-	dB
		P_{jam} = -22 dBm; f_{jam} = 1427 MHz [1]	-	0.95	-	dB
$P_{i(1dB)}$	input power at 1 dB gain compression		-11	-9	-	dBm
$IP3_i$	input third-order intercept point	Δf = 1 MHz	-6	0	-	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.

13 Application information

13.1 GNSS application



For a list of components, see Table 10.

Figure 3. Schematics GNSS evaluation board

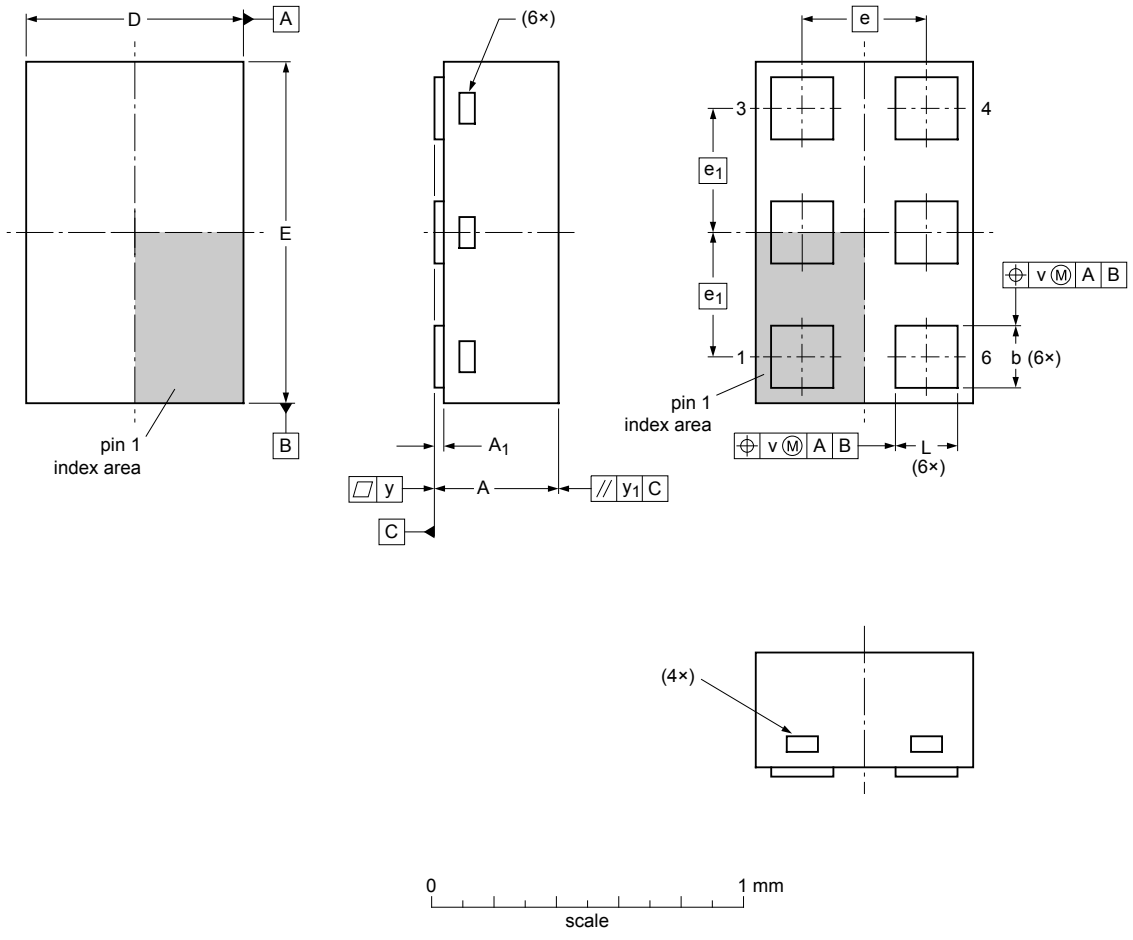
Table 10. List of components

For schematics, see Figure 3.

Component	Description	Value	Remarks
C1	decoupling capacitor	1 µF	The total capacitance on the V_{CC} node must be at least 1 µF. It must be positioned at a short distance from the V_{CC} pin (preferably within 15 mm). Typically, such capacitance is already present at the output of the V_{CC} voltage regulator.
IC1	GPS1502L	-	NXP Semiconductors
L1	high-quality matching inductor	11 nH	Murata LQW15A

14 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
	min	0.34		0.65	1.05			0.17	0.17			
mm	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 4. Package outline SOT1232 (XSON6)

15 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.

16 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
LNA	low-noise amplifier
MMIC	monolithic microwave-integrated circuit
PCB	printed-circuit board
SiGe:C	silicon germanium carbon

17 Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
GPS1502L v.5	20190322	Product data sheet	-	GPS1502L v.4.2
Modification	• Changed the status of the data sheet from company confidential to public			
GPS1502L v.4.2	20181207	Product data sheet	-	GPS1502L v.4.1
Modification	• adapted the Ordering information table			
GPS1502L v.4.1	20181130	Product data sheet	-	GPS1502L v.4
Modification	• adapted the orderable partnumber to GPS1502LX			
GPS1502L v.4	20181026	Product data sheet	-	GPS1502L v.3
Modification	• Status cahanged to Product data sheet			
GPS1502L v.3	20180831	Preliminary data sheet	-	GPS1502L v.2.1
Modification	• updated min max values for various conditions			
GPS1502L v.2.1	20180730	Preliminary data sheet	-	GPS1502L v.2
Modification	• data sheet changed to Preliminary • Characteristics value on 1.8 V changed for input and output return loss			
GPS1502L v.2	04192018	Objective data sheet	-	GPS1502L v.1.1
Modification	• Changed max values for VCC and P_i on limiting values			
GPS1502L v.1.1	03302018	Objective data sheet	-	-
Modification	• revision update revision update			
GPS1502L v.1	03292018	Objective data sheet	-	-

18 Legal information

18.1 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".
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