AN11420

NXP GPS LNA - GPS LNA voltage supply via a coax cable coming from the GPS receiver

Rev. 1 — 4 October 2013

Application note

Document information

Info	Content
Keywords	GPS, GNSS, LNA, AEC-Q100, automotive, voltage supply, coax cable
Abstract	This application note describes how to supply NXP GPS LNA voltage via a coax cable coming from the GPS receiver

Revision history

Rev	Date	Description
1	20131004	First publication

Contact information

For more information, please visit: http://www.nxp.com

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1. Introduction

GPS LNAs are needed in active antenna applications due to the losses of a long cable between the antenna and the receiver.

This application note gives practical information how to supply an NXP GPS LNA via a coax cable coming from the GPS receiver. This applies to automotive qualified BGU7004 and BGU7008 since they both have the same architecture. They are AEC-Q100 qualified Low Noise Amplifiers (LNAs) for GPS receiver applications in a plastic leadless 6-pin, extremely small SOT886 package. Both of them require only one external matching inductor and one external decoupling capacitor. They adapt itself to the changing environment resulting from co-habitation of different radio systems in modern cellular handsets. During high jamming power levels, resulting for example from a cellular transmit burst, it temporarily increases its bias current to improve sensitivity. Both of them cover full GNSS L1 band, from 1559 MHz to 1610 MHz and work with a supply voltage from 1.5 V to 2.85 V.

The BGU7004 and BGU7008 performance information is available in their datasheets.

2. System features

- AEC-Q100 qualified
- Covers full GNSS L1 band, from 1559 MHz to 1610 MHz
- Noise figure = 0.85 dB for BGU7008 and 0.9 dB for BGU7004
- Gain 18.5 dB for BGU7008 and 16.5 dB for BGU7004
- High 1 dB compression point of −12 dBm for BGU7008 and -11 dBm for BGU7004
- High out of band IP3$_i$ of 4 dBm for BGU7008 and 9 dBm for BGU7004
- Supply voltage 1.5 V to 2.85 V, optimized for 1.8 V
- Power down mode current consumption < 1 uA
- Optimized performance at low supply current of 4.8 mA for BGU7008 and 4.5 mA for BGU7004.
- Integrated temperature stabilized bias for easy design
- Requires only one input matching inductor and one supply decoupling capacitor
- Input and output DC decoupled
- ESD protection on all pins (HBM > 2 kV)
- Integrated matching for the output
- Small 6-pin leadless package 1 mm × 1.45 mm × 0.5 mm
- 110 GHz transit frequency - SiGe:C technology

3. Application Information

The application circuit shows how to supply the NXP GPS LNA voltage in an active antenna application via a coax cable coming from the GPS receiver is depicted in Figure 1. Table 1 shows the bill of materials.

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3.1 NXP GPS LNA voltage supply in an active antenna application via a coax cable coming from the GPS receiver
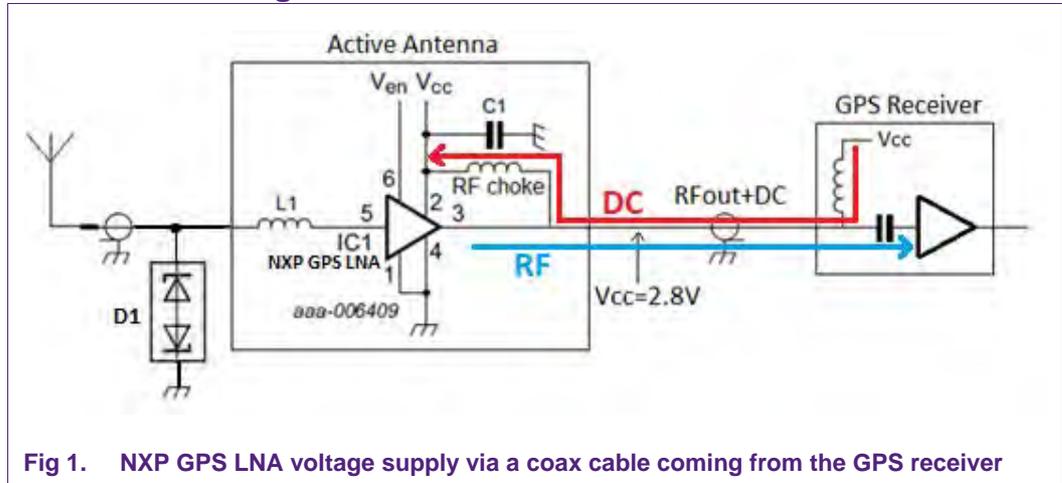

Fig 1. **NXP GPS LNA voltage supply via a coax cable coming from the GPS receiver**

A GPS signal comes from antenna to the NXP GPS LNA. An optional external ESD protection diode can be used to increase the system's ESD performance from 2kV up to 10kV. At the input of the GPS LNA only one external coil L1 is needed for the matching. At the input there is no external DC blocking capacitor needed since the NXP GPS LNA has an integrated input DC blocking capacitor.

Note that now at the output of the GPS LNA, there are an RF signal and a DC voltage. For the voltage supply of the GPS LNA, since the voltage supply comes from the GPS receiver to the output of the GPS LNA via a coax cable, the voltage supply is tapped from the output of the GPS LNA to the voltage supply Vcc of the GPS LNA via an RF choke, which blocks the RF signal and passes the DC supply voltage.
Close to the Vcc pin (pin 2) of the GPS LNA, an external decoupling capacitor C1 is needed to decouple and to give an extra filtering of the RF signal in the DC supply line.
At the output of the GPS LNA, there is no external DC blocking capacitor needed either because the NXP GPS LNA has an integrated output DC blocking capacitor as well, which blocks the DC supply voltage and passes the RF signal.

The enable (pin 6 of the GPS LNA) voltage can be connected to Vcc for "always on" or supplied separately. Pin 1 and 4 of the GPS LNA are grounded. The BGU7004 and BGU7008 pinning information is available in their datasheets.

Figure 2 until Figure 5 show the comparison for BGU7008 at 2.85V between the default application and the one using supply voltage via a coax cable in term of NF, Gain, Input Return Loss, and Output Return Loss respectively. The figures show that there are no significant differences in term of performance between the default application and the one using supply voltage via a coax cable.
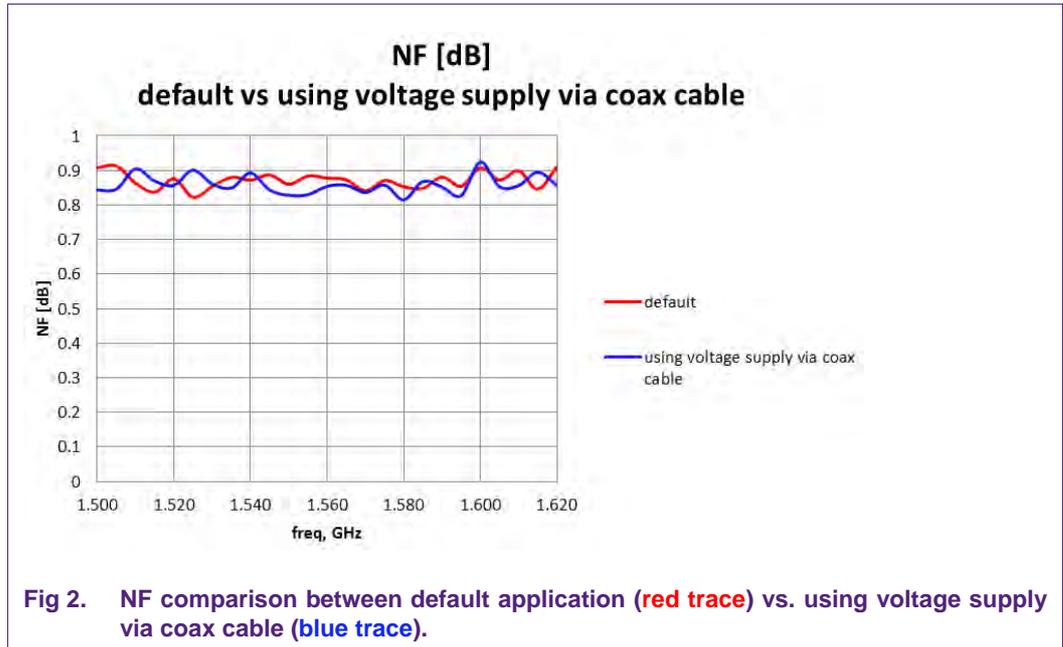
Fig 2. NF comparison between default application (**red trace**) vs. using voltage supply via coax cable (**blue trace**).
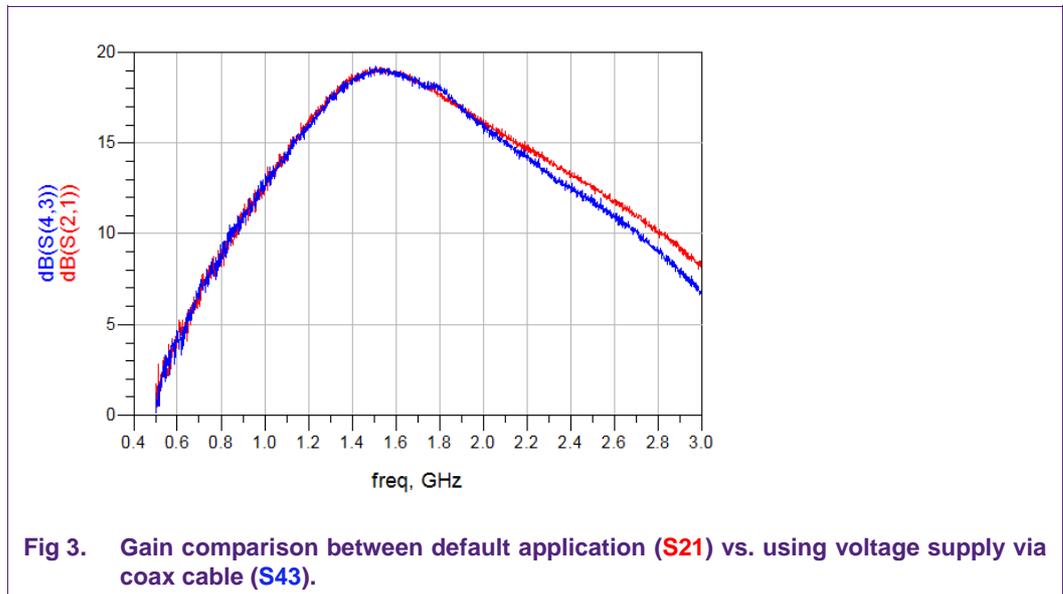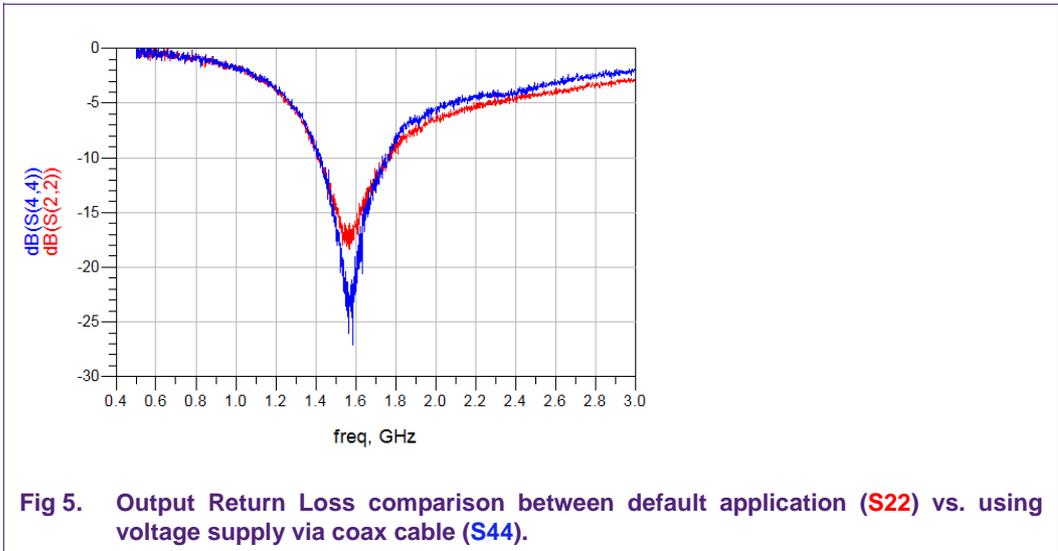

Fig 3. Gain comparison between default application (**S21**) vs. using voltage supply via coax cable (**S43**).

Fig 4. **Input Return Loss comparison between default application (S11) vs. using voltage supply via coax cable (S33).**
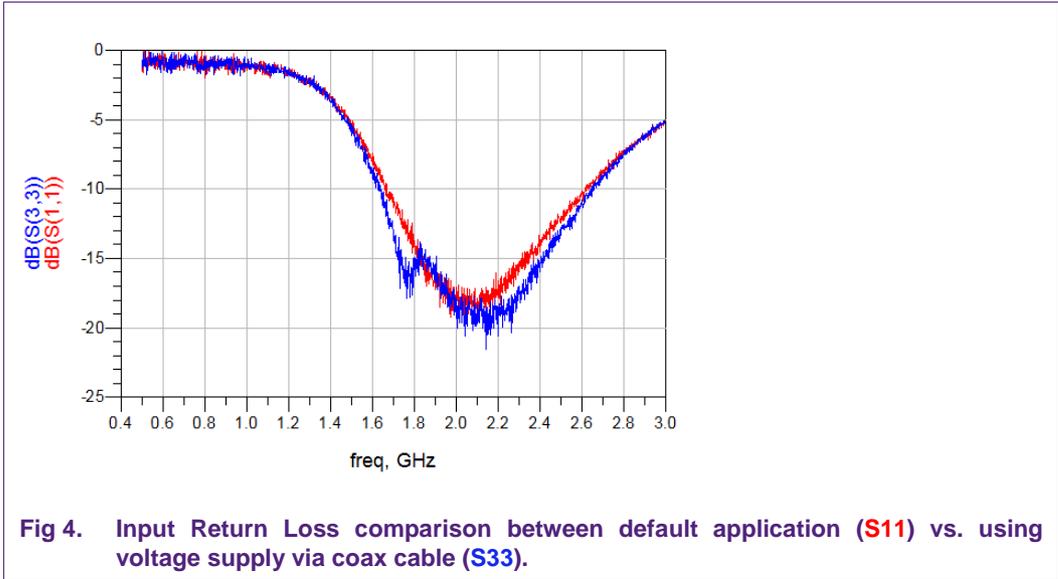

Fig 5. **Output Return Loss comparison between default application (S22) vs. using voltage supply via coax cable (S44).**

3.2 Bill of materials

Table 1. **Evaluation board BOM**

Component	Description	Value	Supplier
C1	Decoupling capacitor	1 nF	various
IC1	BGU7004 or BGU7008 GPS LNA	-	NXP
L1	High quality matching inductor	5.6 nH	Murata LQW15A
RF choke	RF choke	100 nH	Murata LQG15HS
D1	ESD Diode (optional)	PESD5V0F1BL	NXP

4. Abbreviations

Table 2. **Abbreviations**

Acronym	Description
DC	Direct Current
RF	Radio Frequency
GPS	Global Positioning System
LNA	Low Noise Amplifier
GNSS	Global Navigation Satellite System
ESD	Electro Static Discharge
HBM	Human Body Model
SiGe:C	Silicon Germanium Carbon

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