

GPS Applications Using SL1206 and SL1204 Active Antennas

ABSTRACT

GPS Navigation systems requiring superior performance typically use an active antenna, consisting of an antenna and a high performance Low Noise Amplifier. An electrical guideline is presented, for the integration of Sarantel's active antennas.

INTRODUCTION

The Sarantel GeoHelix[®] active GPS Antennas are designed to operate with GPS receivers from many manufacturers. The active design using the standard SL1200-GeoHelix[®] -P2 antenna, helps the designer to achieve high performance and robust antenna solutions with significantly reduced development time in “otherwise difficult to achieve” GPS applications. The antenna module can be fully embedded in the housing or the enclosure can include an external protective radome for applications where an external antenna is required.

The active antenna module's electrical circuitry is contained underneath the soldered metal can. The major elements include a quadrifilar helix antenna, high temperature plastic support, Low Noise Amplifier (LNA) and the protective antenna Radome or sleeve. The device has been designed and tuned to receive the L1 band GPS satellites at a frequency of 1575.42MHz. The Sarantel GeoHelix[®] active antenna has an inbuilt radio frequency filtering characteristic that significantly reduces the out-of-band interfering signals but the GeoHelix[®] active also contains additional filtering in order to increase the signal suppression outside the GPS band.

Sarantel 's active antennas offer the following advantages for difficult GPS environments and Applications:

- High Gain and Low Noise Figure
- Low current consumption
- Low profile dimensions
- Small PCB footprint
- Shielded Low Noise Amplifier

TYPICAL PARAMETERS

| | Gain _{Typ} [dBi] | NF _{LNA} [dB] | 3dB Beam width | Supply Voltage [V] | Current [mA] |
|---------------|------------------------------|---------------------------|-------------------|-----------------------|-----------------|
| SL1206 | 25 | 1.2 | 135° | 2.8 – 3.6 | 13 |
| SL1204 | 18 | 0.8 | 135° | 1.8 – 3.6 | 3.3 |

SL1206 AND SL1204 IN TYPICAL GPS APPLICATIONS

The SL1206 (GeoHelix[®]-S) and SL1204 (GeoHelix[®]-M) are active components with LNA incorporated into the device and hence need an electrical power source for their operation. There are two ways to provide the necessary electrical power for the LNA. One way is to directly connect the active antenna to an existing DC source in the final device via a choke inductor. This configuration is independent from the GPS receiver module so may require power control logic (or a power switch circuit) in order to prevent unnecessary power consumption when the receiver module is not in use. Placing additional supervisory circuit can be avoided by simple using the receiver module DC bias line to switch the supply to the active antenna. Alternatively, and the easiest way is to bias the LNA by using a GPS receiver module with active antenna support feature. The majority of the GPS receivers can provide the necessary DC power from their antenna input pins to the LNA. This allows the active antenna to connect directly to the receiver and no additional components or PCB layout changes are required between the active antenna and the receiver module. Most receiver modules incorporate a standard or optional antenna supervision circuitry which can supply 20-50mA bias current at their antenna input pins and also automatically detects the current and shuts down the bias voltage immediately if there is a short circuit at the antenna pin. The majority of the applications use the active antennas soldered directly to the motherboard but connecting it to the receiver via coaxial cable is also an option.

Biasing the SL1206

Using the SL1206 active antenna requires a power source of 3.0V-3.3V DC and a current of 13mA. Figure 1 shows a typical biasing method for the SL1206 using an available DC supply source from other circuitry within the device. The SRF of the choke inductor should be considered for this application. The inductor should be chosen so the SRF is near the GPS frequency. The C1 capacitor value is not critical and can be selected between 18pF and 100pF. It is not necessary to add C1 if the receiver has its own internal DC block capacitor, please refer to the receiver module or chipset manufacturer's documentation. The total area occupied by the active antenna's PCB is 20.5mm x 14.6mm.

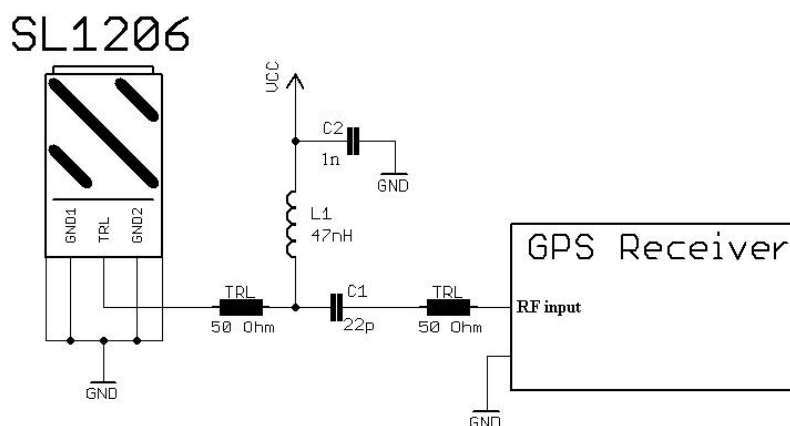


Figure 1

In Figure 2 a standard connection to the GPS receiver is shown. The receiver module provides the DC bias voltage through the 50 Ohm PCB transmission line or cable.

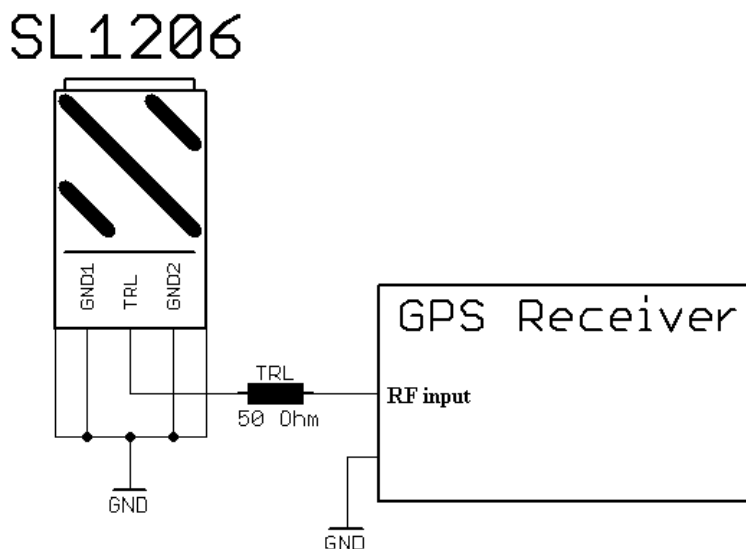


Figure 2

Biasing the SL1204

Supply voltage for the SL1204 is 1.8V to 3.6V DC with typical current consumption 3.4mA. The typical receiver “independent” bias circuit is shown in Figure 3. Most GPS receiver modules incorporate a SAW filter therefore additional filtering is not necessary. An external SAW filter can be connected between the active antenna and the receiver if there is no GPS band pass filter (SAW or Dielectric filter) present in the receiver module or if a GPS chip is being used. Refer to the receiver module or chipset datasheet for guidance on whether this is required. Components L1 and C1 have the same functions as described earlier in this document. SAW filters generally have maximum rated DC voltage 0V...7V which needs to be considered and will determine whether the DC block capacitor (C1) is necessary. The total area occupied by the SL1204 active antenna’s PCB is 10.3mm x 11.0mm.

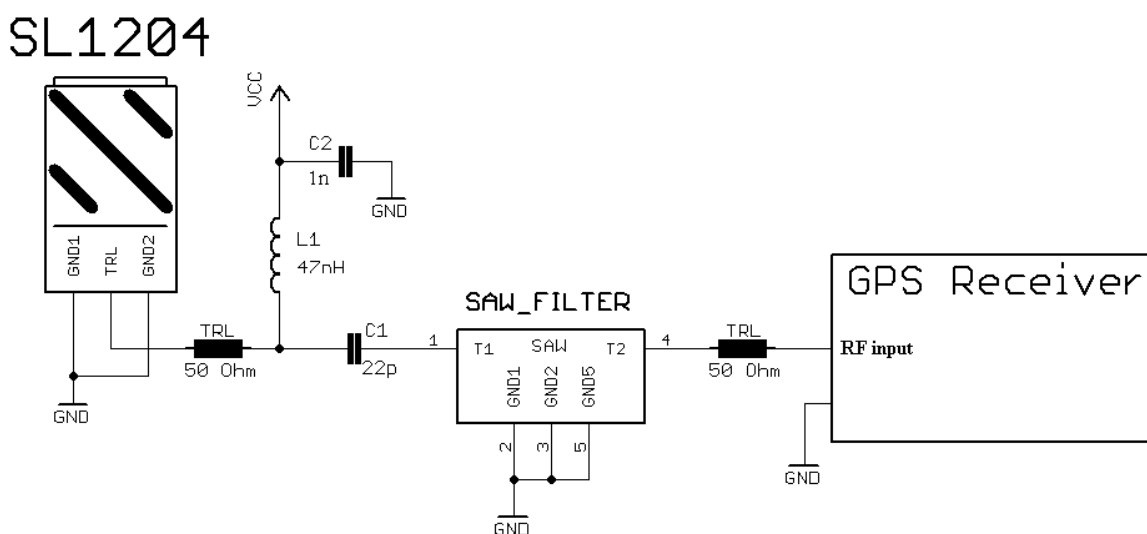


Figure 3

A schematic of a receiver directly providing the bias voltage for the SL1204 active antenna can be seen in Figure 4.

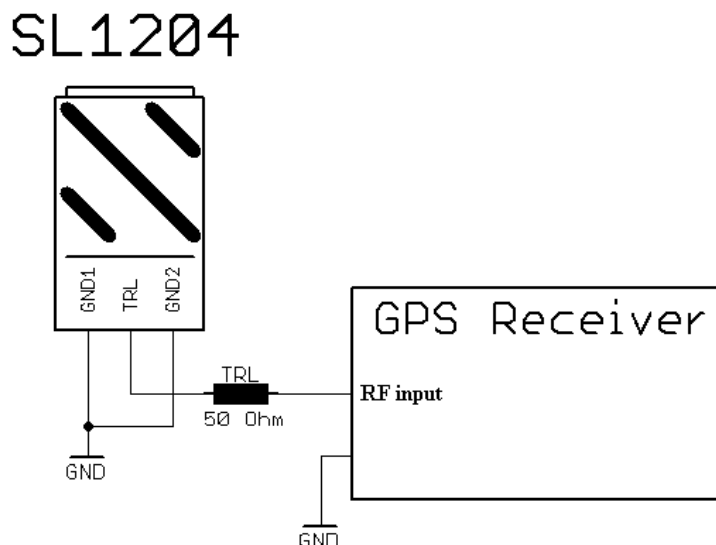


Figure 4

Bill of Materials

Table 1

| Comp. Name | Value | Package | Function | Manufacturer |
|------------|-------------------------------------|---------------|------------------|--------------|
| C1 | 22pF ¹ GRM1555 series | 0402 | DC block | Murata |
| C2 | 1nF GRM1555 series | 0402 | RF block | Murata |
| L1 | 47nH ² LQG15HS series | 0402 | Bias feed | Murata |
| SAW | SAFEB1G57KB0F00 | 1.4mm x 1.1mm | Band pass filter | Murata |

1: between 18pF and 100pF, 2: between 39nH and 56nH

The component values listed in the table above can be sourced from many other manufacturers but other component parameters should be considered (for example SRF for L₁ or RoHS compliance)

PCB LAYOUT

In order to establish a good signal path between the active antenna and the receiver, general RF layout rules needs to be considered during the PCB design. Regarding trace widths, an online PCB calculator or RF design software can be used in order to find the trace widths for a given PCB stack-up. The track between the active antenna and receiver should be designed to be 50 Ohms. Placing the components as close as possible is also a preferred method to minimize the loss along the RF signal path.

The recommended layouts (in gerber format) for the four different bias circuit configurations can be downloaded from Sarantel’s website.

IMPORTANT NOTICE

The SL1206 and SL1204 incorporates active ESD protective circuits, however the Active Antennas contain active circuitry which has some sensitivity to damage by electrostatic discharge (ESD). Sarantel recommend using standard ESD precautions handling the antenna unit.

REVISION LOG

| Version | Release Date | Description |
|---------|--------------|------------------|
| 1.0 | APRIL 2009 | Initial revision |
| | | |
| | | |

Integration Guides: <http://www.sarantel.com/technology/technicalnotes>

More Information

For technical support: www.sarantel.com/contact/

For samples: <https://samples.sarantel.com/>

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