



NanoCom GS100

Datasheet

Dual-radio ground station solution for NanoCom AX100

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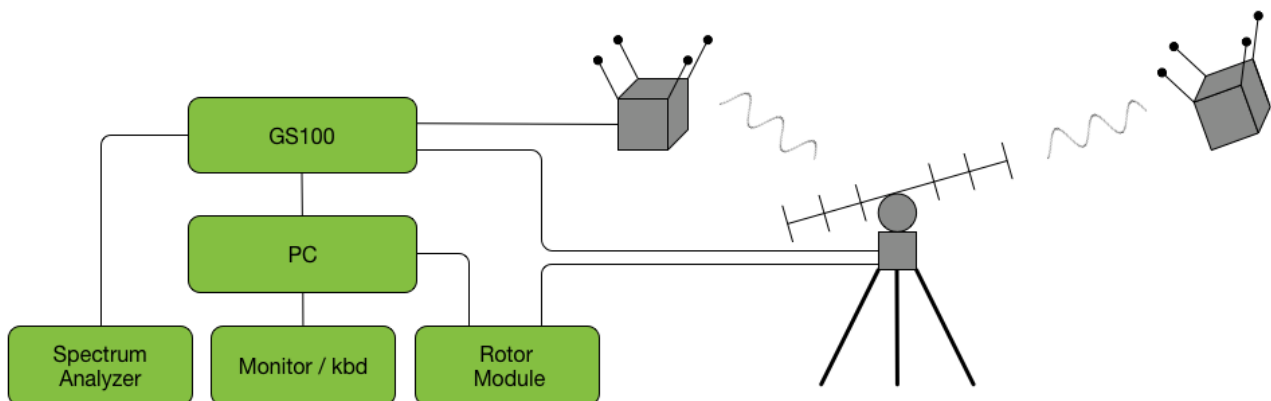
2 Overview

The NanoCom GS100 (GS100) is designed specifically as a ground station radio for the NanoCom AX100 (AX100) radio board. The GS100 is a 19" rack mounted unit that contains two none flight qualified AX100 radio modules, placed on a special carrier board. Three versions are available, with different frequency ranges: VHF 143-150 MHz, UHF 395-405 MHz, UHF and 430-440 MHz.

As both the satellite and the GS100 use the AX100 radio to receive and transmit, it gives optimal performance, and minimizes the risk of implementation losses. An added benefit is full control of the ground station radio and eliminating the need for expensive FM/USB transceivers and custom hardware/software TNC solutions.

The ground station radio will be an integrated component of the satellite, responding to CSP (CubeSat Space Protocol) requests, just like the satellite radio. This means that satellite monitoring and configuration software, can be used to control both satellite and the ground station. Furthermore, issuing changes to the radio-link parameters is now as simple as transmitting a new configuration, first to the satellite, then to the ground station. With both radios accepting the same message and configuration format, the time spent on developing ground software is drastically reduced.

Together with a PC, monitor, rotor module, spectrum analyzer and an antenna you should have a complete ground station that can communicate with your satellite.



The GS100 can come in a Laboratory configuration (GS100L). The Lab module is designed to work as Electrical Ground Support Equipment (EGSE). The GS100L contains only one AX100 with one antenna connector, USB to PC connector.

2.1 GS100 Highlighted Features

- Dual AX100 Radio modules for Polarization Diversity, none flight qualified
- Centralized mission control and Doppler tracking
- Internal Power Amp, 25 W
- Ground station network support
- Quad FTDI USB to USART interface
 - Two command line (GOSH) interfaces for AX100 modules
 - Two separate CSP/KISS interfaces for AX100 modules
- Output for spectrum analyzer
- 19" rack-cabinet with external 12 V supply
- LED's for Power/RX/TX

2.2 Block Diagram

2.2.1 Block Diagram for GS100

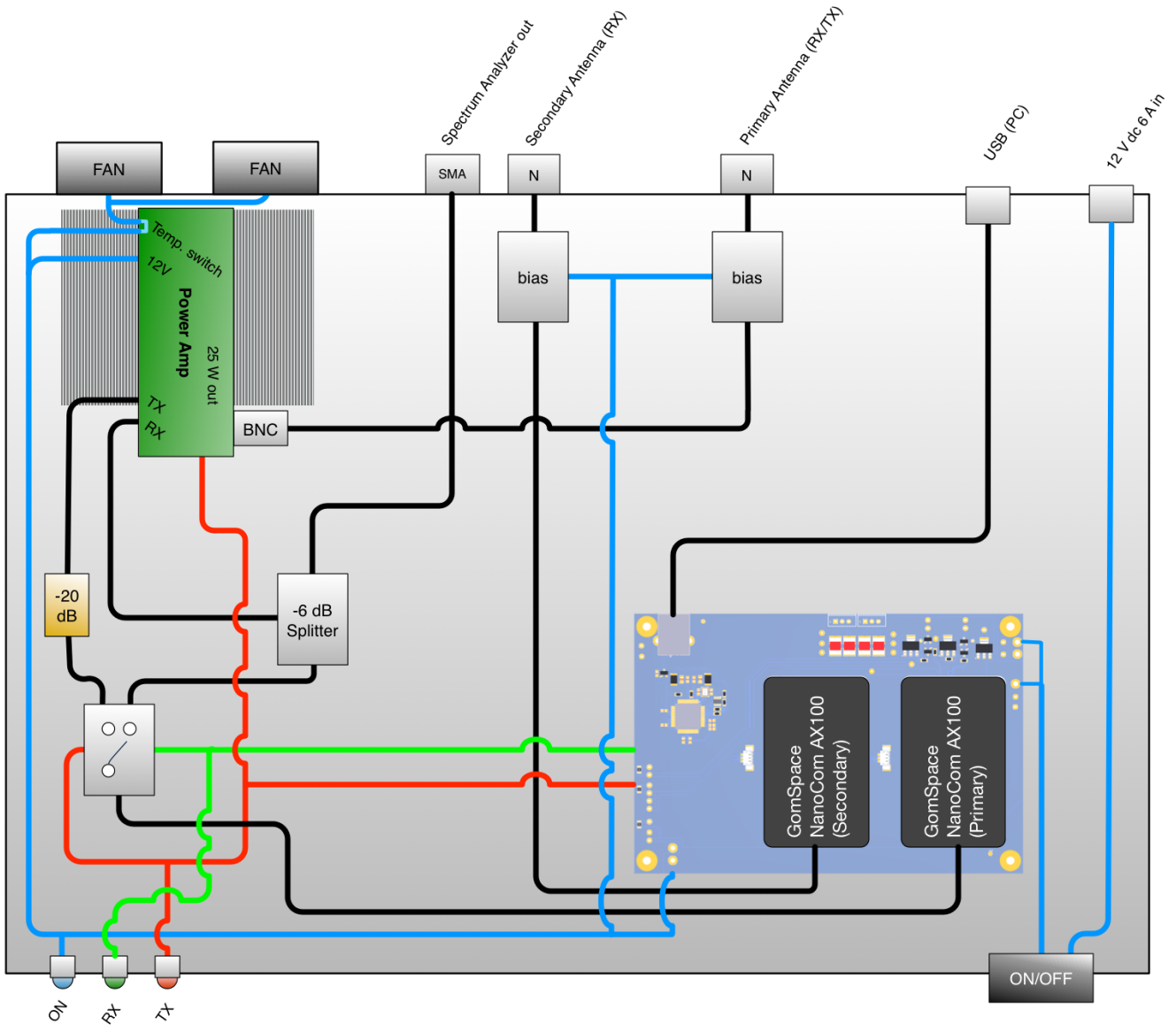


Figure 1 GS100 Block Diagram

The GS100 contains:

- Carrier board with two AX100 transceivers, serving as primary and secondary radio.
- USB for KISS and GOSH access.
- Two antenna connectors with 12VDC bias voltage to power external LNAs.
- 25W Power Amplifier, with temperature controlled fans and RX/TX switch insertion on primary radio link.
- SMA output to monitor the RF signal of the primary radio using a Spectrum Analyzer.

2.2.2 Block Diagram for GS100L

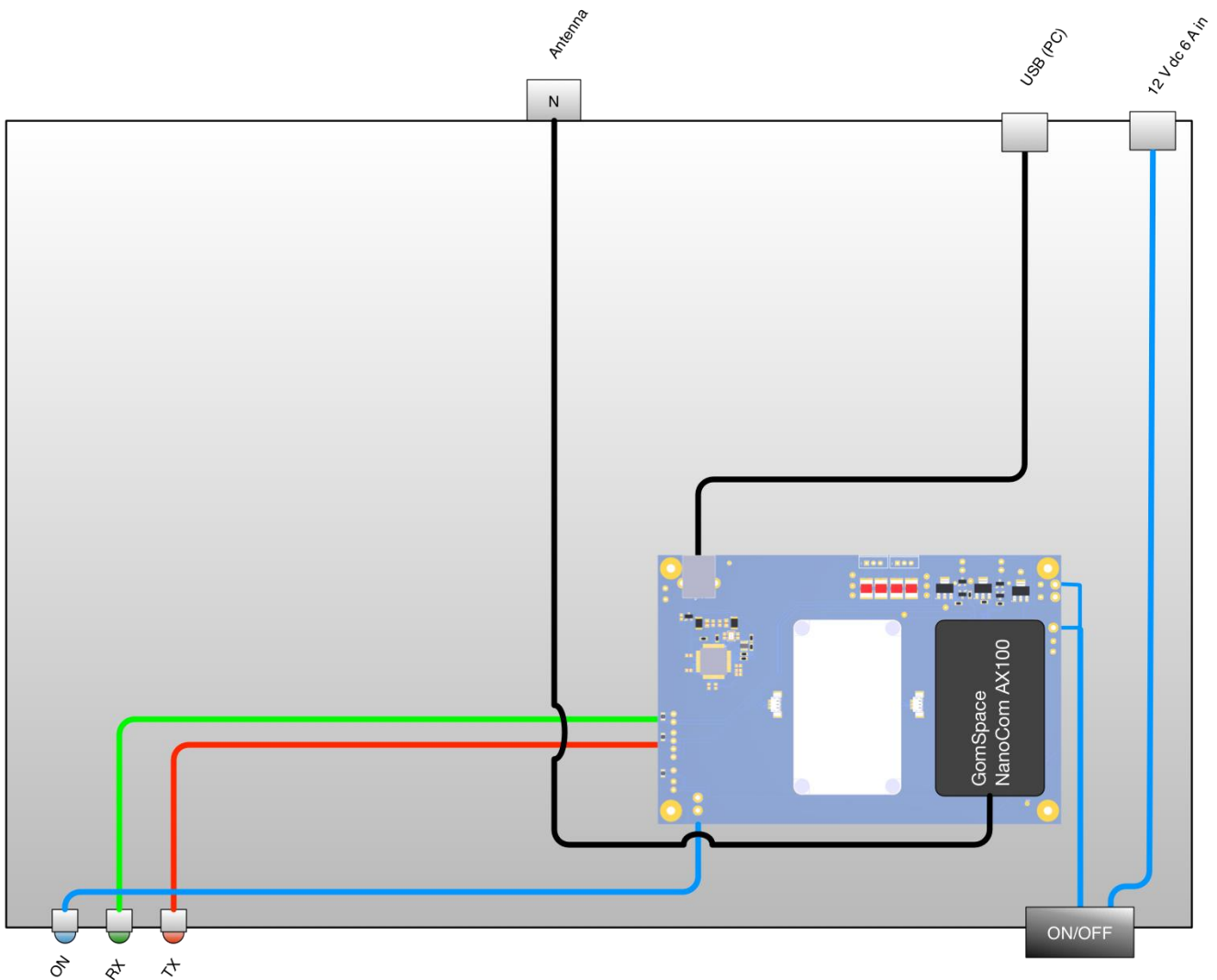


Figure 2 GS100L block diagram (Lab-version without relays)

The GS100L contains:

- Carrier board with one AX100 transceiver.
- USB for KISS and GOSH access.
- One antenna connector.

2.3 Available ordering options

The GS100 comes in several variants a U for UHF, UL for UHF-Low and V for VHF. The difference is in the RF match and output filters used.

Variant	Description
GS100U	UHF 430-440 MHz (except 431.9 – 432.1 and 439.9 – 440.1 MHz) ¹
GS100UL	UHF-Low 395-405 MHz (except 399.9 – 400.1 MHz) ¹
GS100V	VHF 143-150 MHz (except 143.9 – 144.1 MHz) ¹

¹ The hole in the range is caused by intermodulation with the reference XO in AX100 and will cause spurs if selected closer than 100 KHz to a multiple of 16 MHz for AX100V and 8 MHz for AX100U / UL operating at up to 38400 bps.

3 Interface on the Front



The following two subsections describe the connectors from left to right.

3.1 Front LED

The interface on the front has been routed to three LED's, which displays the Power/RX/TX status of the primary radio module.

- Blue LED = Power on
- Green LED = RX on
- Red LED = TX on

3.2 Power

On the right, there is a switch to turn the GS100 on/off.

4 Interfaces on the Back



The following four subsections describe the connectors from left to right.

4.1 Power supply

Plug in the external 12 V, 6 A power supply that comes with the GS100/GS100L. Connector KPJX-PM-4S.

4.2 USB to PC

Interface with the GS100/GS100L and your satellite through this USB Type-B port.

The GS100/GS100L board has a built-in FTDI USB to serial converter, which provides four serial ports to the ground station computer. These ports are mapped as follows:

- TTYUSB0: Primary radio CSP/KISS interface
- TTYUSB1: Primary radio serial/GOSH interface
- TTYUSB2: Secondary radio CSP/KISS interface
- TTYUSB3: Secondary radio serial/GOSH interface

All interfaces are 500.000 baud, 8n1.

4.3 RF/Antenna

The GS100 has two RF Type N connectors, one for the primary and one for the secondary transceiver. The GS100L only has a single RF connector.

Two connectors, left to right:

- Primary Antenna (RX/TX)
- Secondary Antenna (RX)

4.4 Spectrum Analyzer

Connect a spectrum analyzer here for frequency offset estimation. This is useful in the early stages of spaceflight. Note that the GS100L does not have this connector.

5 Absolute maximum ratings

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the GS100 and AX100 modules. Exposure to absolute maximum rating conditions for extended periods may affect the reliability.

Symbol	Description	Min.	Max.	Unit
V_{sup}	Supply voltage		12.5	V
P_i	Absolute maximum input power at receiver input		-10	dBm
T_{amb}	Operating Temperature	20	40	°C
T_{stg}	Storage Temperature	-20	80	°C
VSVR	Output Load VSWR		10:1	

6 Electrical Characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
V_{sup}	Supply voltage	6	12	12.5	V
I_{sup}	Supply current	4	5		A

6.1 Transmitter

Consult the NanoCom AX100 datasheet.

6.2 Receiver

Consult the NanoCom AX100 datasheet.

7 Diversity Reception

The GS100 has been designed to eliminate the need for a polarization switch by using two AX100's to receive on both the vertical and horizontal polarization simultaneously. This method of receiving is called polarization diversity where both the vertical and horizontal channels are available simultaneously. Using this method, the ground station will be able to receive any type of polarization with a maximum of 3 dB polarization loss. This has an effect on satellites that are tumbling and/or does not provide a consistent antenna pattern to the ground station.

The GomSpace NanoCom ANT430 is an omni-directional circular polarized canted turnstile antenna. This antenna will be either left-hand or right-hand polarized when pointed directly towards or away from the ground station. However, in the 90-degree pointing angle, the antenna is not circular, but has elliptic/linear polarization. A linear ground station receiver on either Vertical or Horizontal will therefore not suffice without either polarization diversity or an active controller / operator with a mechanical polarization switch. A typical setup for polarization diversity would be crossed Yagi antennas with LNA on both the vertical and horizontal elements, which are subsequently fed into the V and H channels of the GS100.

Another usage of two AX100 receivers could be frequency diversity, where two receivers listen on different frequencies. This can be utilized in the case where multiple satellites transmit on different frequencies, or on satellite acquisition where the Doppler shift and frequency offset are still unknown.

8 Changes to the AX100 Software Setup in the GS100

Below is a list of changes done to the standard AX100 settings to make it possible to operate a GS100.

GS100 Primary AX100

```
nanocom nanocom-ax # param mem 0
nanocom-ax # param set csp_node 24
nanocom-ax # param set extptt_en 1
nanocom-ax # param set i2c_en 0
nanocom-ax # param set max_tx_time 100
nanocom-ax # param set tx_pwr 0
nanocom-ax # param save 0 0
nanocom-ax # config unlock
nanocom-ax # config update_default all
nanocom-ax # config lock
```

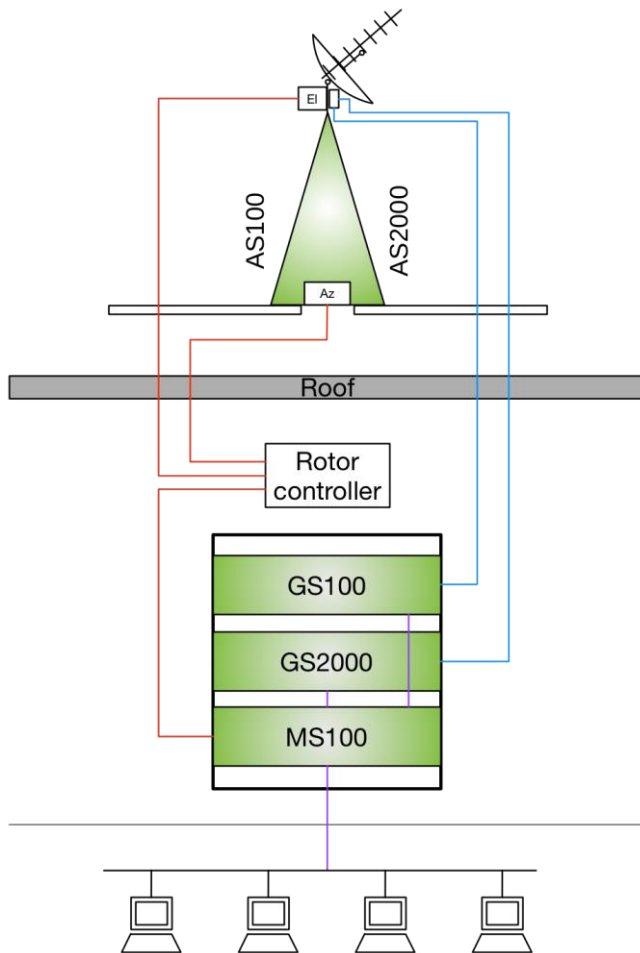
GS100 Secondary AX100

```
nanocom-ax # param mem 0
nanocom-ax # param set csp_node 25
nanocom-ax # param set extptt_en 1
nanocom-ax # param set i2c_en 0
nanocom-ax # param set tx_pwr 0
nanocom-ax # param save 0 0
nanocom-ax # config unlock
nanocom-ax # config update_default all
nanocom-ax # config lock
```

Consult the NanoCom AX100 manual for further information.

9 GS100 with other GomSpace Products

GomSpace offers a complete ground station system. The GS100 combined with a rack PC unit NanoCom MS100 and a rooftop antenna system AS100/AS2000 is everything you need to connect and control your LEO satellite.



NanoCom AS100

Rooftop antenna that can receive VHF and UHF. It includes a tower and two rotors and a controller to point the antenna in any direction.

NanoCom AS2000

A rooftop S-Band antenna. It includes a tower and two rotors and a controller to point the antenna in any direction. As an option a UHF antenna can be added.

NanoCom GS2000

A radio rack unit that can receive S-Band.

NanoCom MS100

A 19" rack mounted PC containing software relevant to controlling and communicating with a satellite. The unit has ethernet interface for remote access.

Software includes:

- Linux OS
- Rotor controller
- GSweb – tools for housekeeping (optional)
- Tracker software to control antenna movement
- Doppler compensation for the radio
- SDK

10 Disclaimer

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