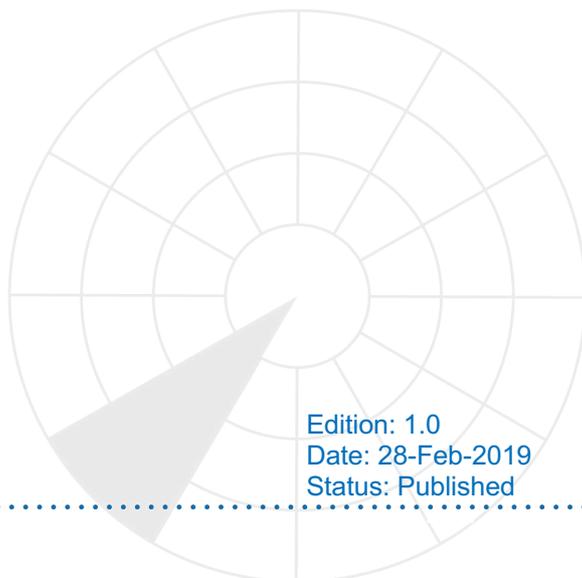


RGI1193 Recorder Manual

User Manual



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1. CHANGE HISTORY

Edition	Date	Reason for Change
0.1	19 Feb 2019	Initial version
1.0	28 Feb 2019	General review of document Publication of document



2. GLOSSARY OF TERMS

Abbreviation	Expansion
ACP	Azimuth Change Pulse
ACPR	Amount of ACP's per revolution
ARP	Azimuth Reference Pulse
AP	Access Point
DHCP	Dynamic Host Configuration Protocol
FFT	Fast Fourier Transform
IP	Internet Protocol
OSC	Oscillator
PPI	Plan Position Indicator
PSR	Primary Surveillance Radar
Radar	Radio Detection And Ranging
RASS-S	Radar Analysis Support Systems – Site measurements
RGI	Radar Gyroscope and Inclinometer
RP-SMA	Reverse polarity - SubMiniature version A
RTI	Radar Timing Interface
SSID	Service Set Identifier (network name)
SSR	Secondary Surveillance Radar
Wh	Watt-hour
WLAN	Wireless LAN



3. INTRODUCTION

The Radar Gyroscope and Inclinometer RGI1193 provides a tool to perform mechanical check-up and analysis of the antenna system. The azimuth information of the encoder is recorded by the Radar Timing Interface RTI966.

The RGI1193 basically has two co-related functions, measuring:

- the quality of the encoder system
- the leveling of the platform

The RGI1193 also allows you to evaluate the mechanical and structural design of the antenna support and tower under wind-loads, temperature, etc. It measures the angular velocity and planar angle of the antenna. For this purpose the device is mounted on the rotating part of the (SSR or PSR) antenna and the data is logged in the RGI1193's internal memory.

At the same time an RTI966 (Radar Timing Interface) installed close to the interrogator's cabinet measures and records the azimuth information from the encoder (ACP and ARP).

After the measurement, the data recorded in the RGI1193 is saved to the computer connected to the RTI966. The RGI1193 can be operated on USB or using a WiFi connection. Where previously (RGI596) after the recording, the RGI needed to be taken down from the antenna, now the RGI1193 can stay on the antenna while the data is transferred using the WiFi link.

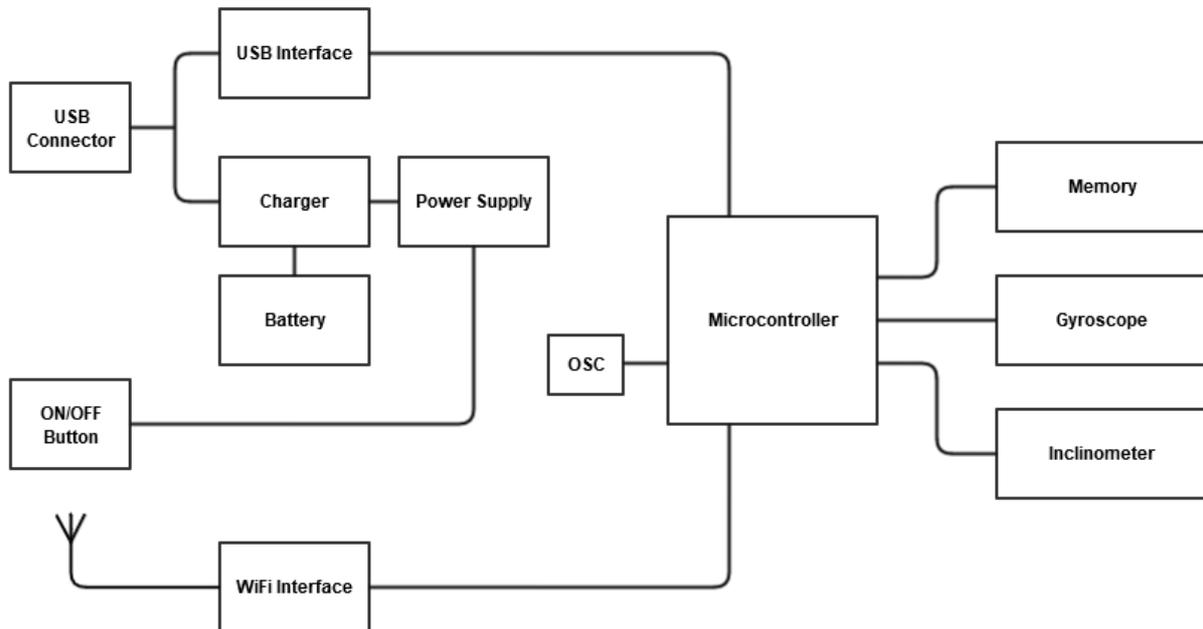
The rotational information data combined with the encoder signal provide essential information on encoder accuracy and platform leveling. Note that deviation on the instantaneous azimuth (=encoder error) is measured, because biases (e.g. wind-load) are simultaneously recorded at encoder (RTI966) and antenna level (RGI1193). These two signals plus their difference are shown in the software.

Antenna start-up and stop are also recorded and provide information about the mechanical stiffness of the radar tower.



4. RGI1193 DEVICE DESCRIPTION

4.1. Block Diagram



4.1.1. Interfaces – External connectors

- USB connector (Data and charging)
- Charge LED
- Recording LED
- WiFi antenna (RP-SMA)

4.2. Technical Specifications

4.2.1. Gyro Module

Maximum angular rate	Configurable: <ul style="list-style-type: none"> • $\pm 60^\circ/s$ • $\pm 120^\circ/s$ • $\pm 240^\circ/s$ • $\pm 720^\circ/s$
Resolution	16-bit
Self calibrated using radars North and time reference.	

4.2.2. Inclino Module

Measuring range	$\pm 15^\circ$
-----------------	----------------

Sensitivity	0.01°
-------------	-------

4.2.3. Battery

Battery Type	Li-Ion
Capacity	2350mAh
Nominal Voltage	3.6V
Watt-hour rating	8Wh (acc. To UN38.3)
Weight	43g
Built in Safety Unit (over voltage, under voltage, current limit)	
System runtime – WiFi disabled	15 hours
System runtime – WiFi enabled	10 hours

4.2.4. WiFi

Type	802.11bgn
Mode	Access Point
Output Power	17dBm

4.2.5. Recording

Sample Rate	Configurable up to 1000Hz, default 200Hz
Time	10 hours (at 200Hz)

4.3. General Specifications

Charge Temperature	10 to 45°C
Operating Temperature	-20 to 60°C
Storage Temperature	-40 to 85°C
Size	120x120x90mm
Weight	1240g



5. GYRO-INCLINO RECORDING

5.1. Mechanical Placement of the RGI on the Antenna

An RGI1193 connection diagram leaflet is delivered with the RGI1193 showing the correct connections and set-up. This connection diagram can also be loaded through the Help menu of the Gyro-Inclino Recording software. A Tutorial explaining how to use the RGI1193 together with a DTI529 (Didactical Test Interrogator) to practice the gyro measurement can also be found in the Help menu.

The RGI recording software will ask to connect/disconnect the RGI at certain times to/from the host computer. Before the measurement you need to connect it to start sampling and after the measurement it is re-connected to stop sampling and in order to save the data to file. No connections to the RGI at all are required during the recording. Approximately 10 hours of the logging can be retained in the internal memory of the RGI1193 when sampling at 200Hz (default). The RGI will stop recording when the memory is full.

In the following picture the mechanical placement is shown. During the measurement the RGI should be installed horizontally on the rotator, i.e. the antenna. For large antenna systems it is advisable to measure at the top and at the base of the antenna pedestal. By correlating to the amount of wind the bending and stiffness of the system can be verified. Also, place the RGI close to the middle of the antenna to minimize any radial forces. The RGI must be placed with the straight arrow pointing to the antenna beam direction. The label showing the arrows must be at the top (don't put it upside down) since clockwise is the correct rotational direction.

Note: Before starting the recording, make sure the RGI is fully charged!

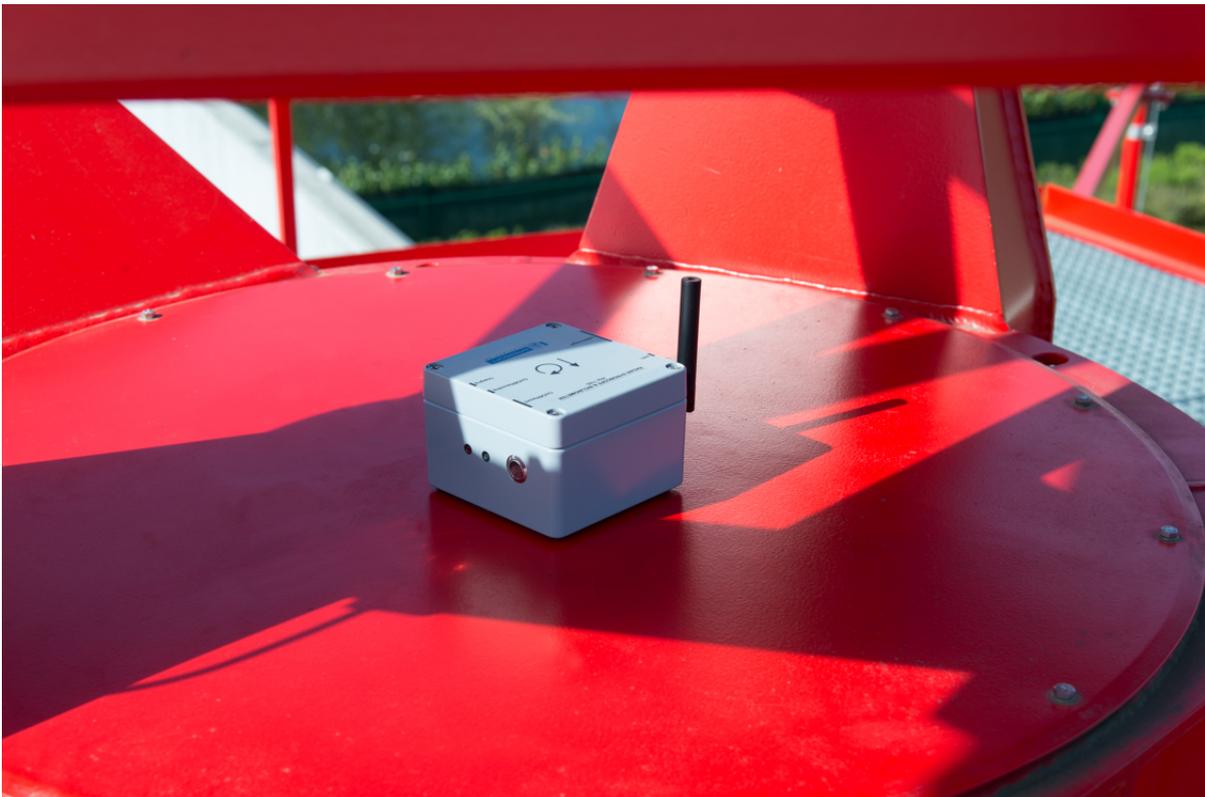


Figure 1 RGI1193 Placement

For the inclinometer it is important to place the RGI1193 within 1m of the rotational center. This is necessary to avoid saturation of the inclinometer module. It measures inclination using a liquid. Due to the centrifugal force on the liquid, it is required to keep the device close to the center of rotation. Once saturation is reached (max inclination level of the module), the changes in inclination cannot be measured anymore. This can be mechanically compensated by placing the inclinometer under a certain positive inclination, allowing a larger radius.

The RGI can be placed on different sections of the antenna construction for evaluation of separate antenna components. Velcro is used for a temporary fixing. Installing or changing the position of the RGI requires only a few minutes. When positioning the device, choose the location of the RGI such that it will have the least amount of vibration.

5.2. RGI1193 and RTI966 Measurement Setup

Before starting the Gyro-Inclino Recorder please make sure to build the setup as shown in the connection diagram delivered with equipment and available through the *Help* menu.

The Gyro-Inclino Recorder will handle the devices as follows:

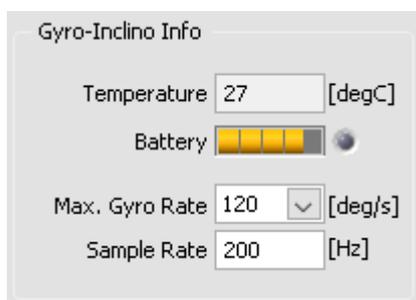
- The RTI software will be started in the background and will check the availability of a Radar Timing Interface (required to sample the encoder signals ACP/ARP) when the Gyro-Inclino Recorder is launched.
- When the 'Rescan' button is clicked the program will check for the availability of the RGI1193 (or RGI59x) and RTI966 and when devices are available, their serial number(s) will be listed.
- Please make sure not to disconnect the RTI966 while the recorder is running, since the RTI software expects it to be connected while running.
- The Gyro-Inclino Recorder continuously checks for the availability of the RGI1193. When connected, all functions will be available, when disconnected a number of functions will be disabled (grayed out).

You will need to configure the RTI966 prior to performing a Gyro-Inclino recording. Follow the instructions in the RTI966 user manual to correctly configure the Radar Timing Interface RTI966.

5.2.1. Charge the RGI1193 Battery

Make sure the RGI1193 battery is fully charged before placing it onto the antenna. The RGI1193 battery can be charged from the USB port of your PC. It will take 6 to 7 hours to fully charge it. Another option is to use the USB charger that was delivered with the RGI1193. It can charge the battery with 1A, therefore the charging time will be approx. 4 hours.

The 'RGI1193 Info' window gives a rough indication about the charge state of the battery in steps of 20%. The charging LED indicates whether the battery is still charging or not.



5.2.2. Preparing for a Gyro-Inclino Recording

5.2.2.1. Launch the Gyro-Inclino Recorder

The RGI1193 Recording software can be started from the RASS-S Toolbox or from the Windows Start menu.



The RGI1193 tool is available in the toolbox from the 'Mechanical' Menu

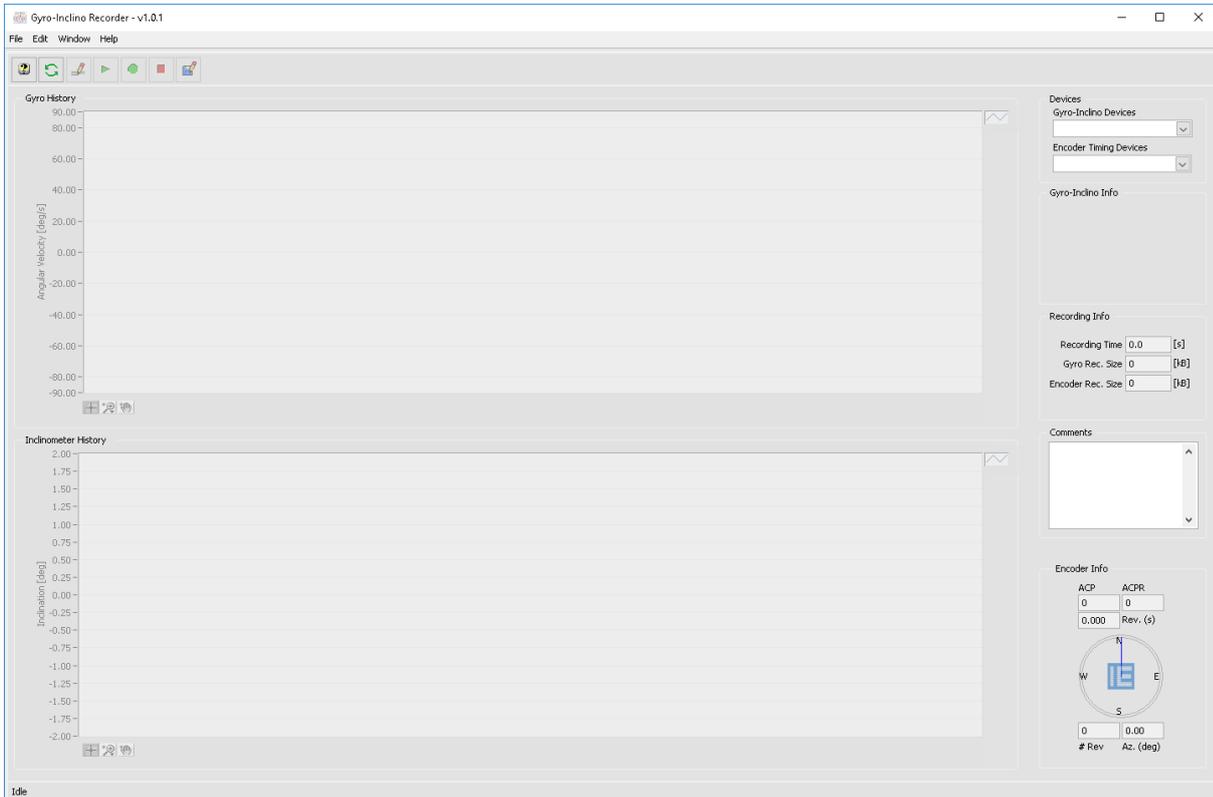
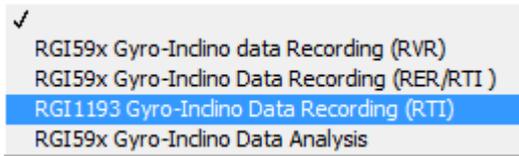


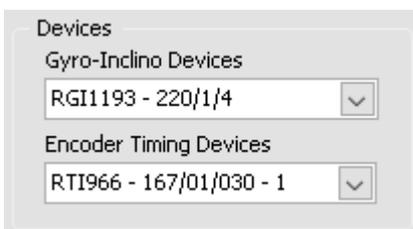
Figure 2 Gyro-Inclino Recorder

5.2.2.2. Scan for Connected Devices

Once the application is launched, first click the Rescan button to scan for connected gyro devices (RGI596/RGI1193) and connected timing recording devices (RTI966):



The detected devices will be listed in the 'Devices' section.



The 'Gyro-Inclino Devices' selector will list the following devices

- RGI59x devices connected on USB
- RGI1193 devices connected on USB or connected via WiFi



The 'Encoder Timing Devices' selector will list the RTI966 Radar Timing Interface devices as detected by the RTI Device Server (launched on startup of the Gyro-Inclino Recorder).

5.2.2.3. Using the RGI1193 on USB

Connect the RGI1193 to the PC using the USB interface and click the Rescan button. The detected RGI1193s will be listed.

The RGI1193 can fully operate on USB and the software will operate similar to the RGI596 recording software. In this case, the RGI1193 may only be disconnected after the recording is started and needs to be reconnected before the recording is stopped. Dialog boxes will appear to indicate when to connect or disconnect the RGI. The complete recording sequence is explained in the section 'Performing a recording'

Only when connected on USB, it is possible to change the configuration of the built-in WiFi Access Point.

When using an RGI1193 for the first time it will therefore be necessary to first connect on USB and configure the built-in AP (access point) before it will be possible to connect to the RGI1193 over WiFi. Only when connected over USB the 'Preferences' button will be enabled.

5.2.2.4. Configure the RGI1193

Click the 'Preferences' button to read the settings from the device and open the configuration window for viewing or editing. The 'RGI1193 Configuration' window allows you to configure the RGI1193's Gyro module as well as the built-in WiFi access point.



Opens the Configuration Window of the selected RGI, if available.

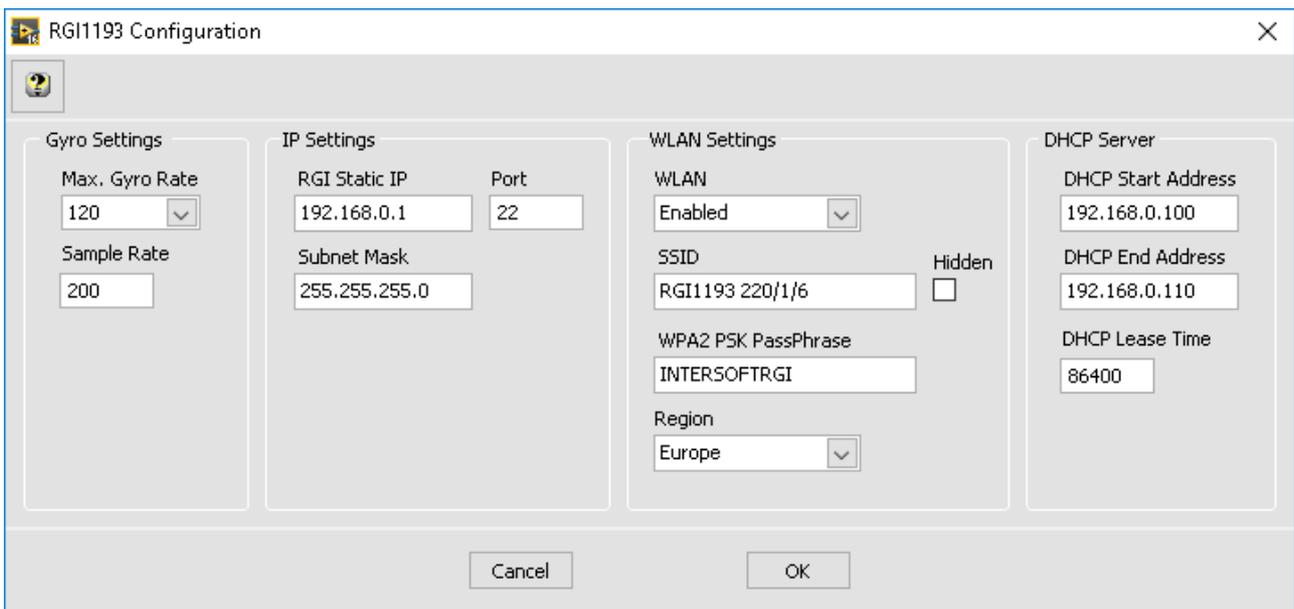


Figure 3 RGI1193 Configuration Window

The settings are subdivided in the following categories:

Gyro settings

Max. Gyro Rate	Selectable 60, 120, 240 or 720 deg/s Sets the sensitivity of the gyro module and therefore also the maximum rotation rate that can be handled.
----------------	---



Sample Rate	Default: 200Hz Sets the sample rate used when recording the gyro and inclinometer signals.
-------------	---

IP Settings

RGI Static IP	Default: 192.168.0.1 IP address used to communicate with the RG1193 over wireless LAN.
Port	Default: 22 TCP Port used to communicate with the RG1193
Subnet Mask	Default: 255.255.255.0 Subnet mask of the WiFi network.

WLAN Settings

WLAN	Enabled/Disabled Turn the WiFi interface on or off.
SSID	Default: RG1193 220/<Version>/<Serial Number> f.e. 'RG1193 220/1/1' Network name of the WiFi network.
Hidden	Disables broadcasting the SSID in order to create a 'hidden' WiFi network.
WPA2 PSK PassPhrase	Default: INTERSOFTRGI The wireless network is secured using WPA2-PSK. Please enter the network password to be used for connecting to the RG1193.
Region	Default: Europe Please set the region according to the country where you are using the RG1193. This way the channels allowed in your region are used.

DHCP Server

DHCP Start Address	Default: 192.168.0.100 Lowest IP address that can be assigned to a WiFi client.
DHCP End Address	Default: 192.168.0.200 Highest IP address that can be assigned to a WiFi client.
DHCP Lease Time	Default: 86400 Sets the period of time a given IP address will be assigned to the same client when it is disconnected/ reconnected.

Click 'OK' to write the settings to the device and close the window. Click 'Cancel' to disregard the changes and close the window.

Once the WiFi AP on the RG1193 is enabled, its WiFi network will become available and the PC can be connected to it in the same way as is done with any wireless network.

5.2.2.5. Using the RG1193 on WiFi

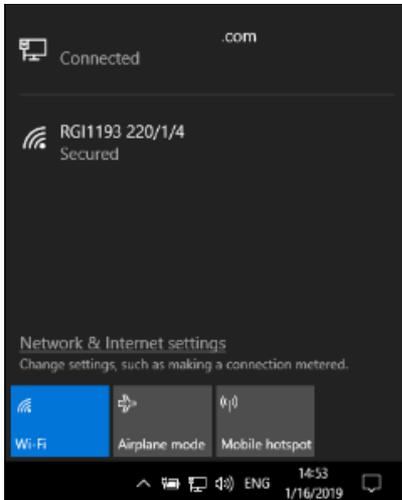
When the WiFi access point is configured and enabled, the wireless network with the selected SSID will become available. For short distances between the PC and the RG1193, the built-in WiFi interface of the PC



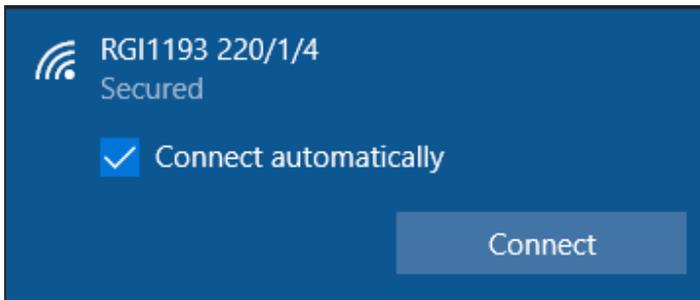
can be used. For setups where the RGI is placed on a high tower, or in case the PC with the RT1966 connected to the encoder signals is placed inside a metal or concrete shelter, it will be required to obtain a range extender that can be placed outside in order to connect to the RGI WiFi network.

Either way, first the connection to the network has to be made. In case of using the built-in WiFi interface of a laptop click the network icon in the taskbar. It is assumed that the WiFi interface is setup to receive its network address automatically.

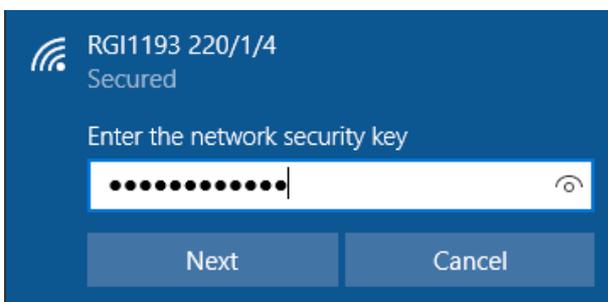
1. List the available networks. The RGI1193 WiFi network should be listed:



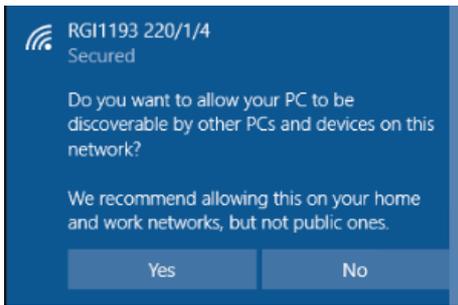
2. Select to reconnect automatically so the PC will reconnect to the Gyro whenever the network was temporarily lost.



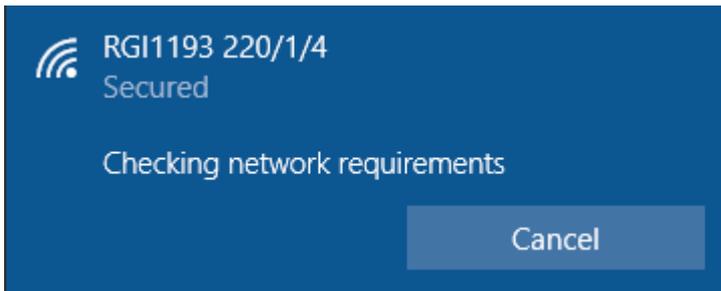
3. Enter the network passphrase as was setup in the 'RGI1193 Configuration' window.



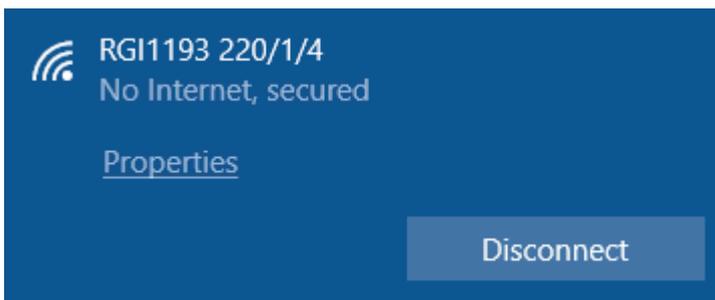
4. Select 'No' to disallow discoverability of your PC, setting it up as being connected to a 'Public' network.



- 5. Windows will connect to the WiFi network. This can take some time, even up to 60 seconds.



- 6. The PC is now connected to the RGI1193 WiFi network.



Once connected on WiFi, the PC and RGI1193 can stay connected during the complete measurement duration.

The Gyro can be fully controlled over WiFi, except for the configuration of the WiFi access point. Starting and stopping sampling and recording, reading the data from the device, transferring the recorded data to save it to file, is all possible using the WiFi connection. Therefore it is not necessary anymore to remove the gyro from the antenna between successive measurements.

When performing a recording while connected over WiFi, it is not needed to disconnect/reconnect the RGI1193. However a dialog box will appear to indicate the RGI1193 needs to be placed onto the antenna, each time the recording is started.

When using a WiFi range extender to connect to the RGI WiFi network please make sure to disable the WiFi interface of your laptop !



5.2.3. Perform a Gyro-Inclino Recording

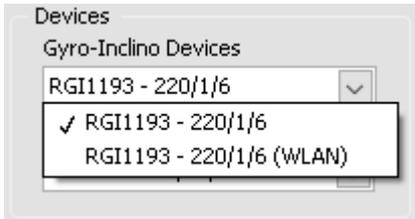
5.2.3.1. Check for Connected Devices

First make sure both RGI1193 and RTI966 are connected to the computer and are powered on.

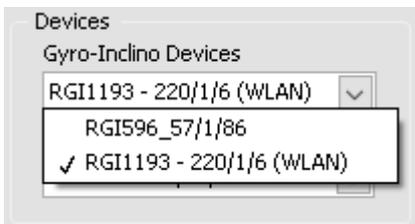


Click the Rescan button to scan for connected devices. The software will list the serial numbers of the RTI966 and the RGI1193 that were detected.

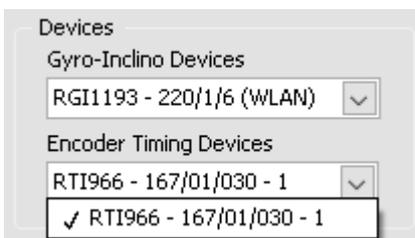
When the RGI1193 is connected both on USB and WiFi, the device is listed twice. You could now disconnect the USB cable and click the Rescan button again. The RGI would then only be listed on WiFi (WLAN suffix).



Both RGI596 and RGI1193 are supported:



If multiple RTI's were connected, these would also be listed in the menu. In this case only one RTI is connected:

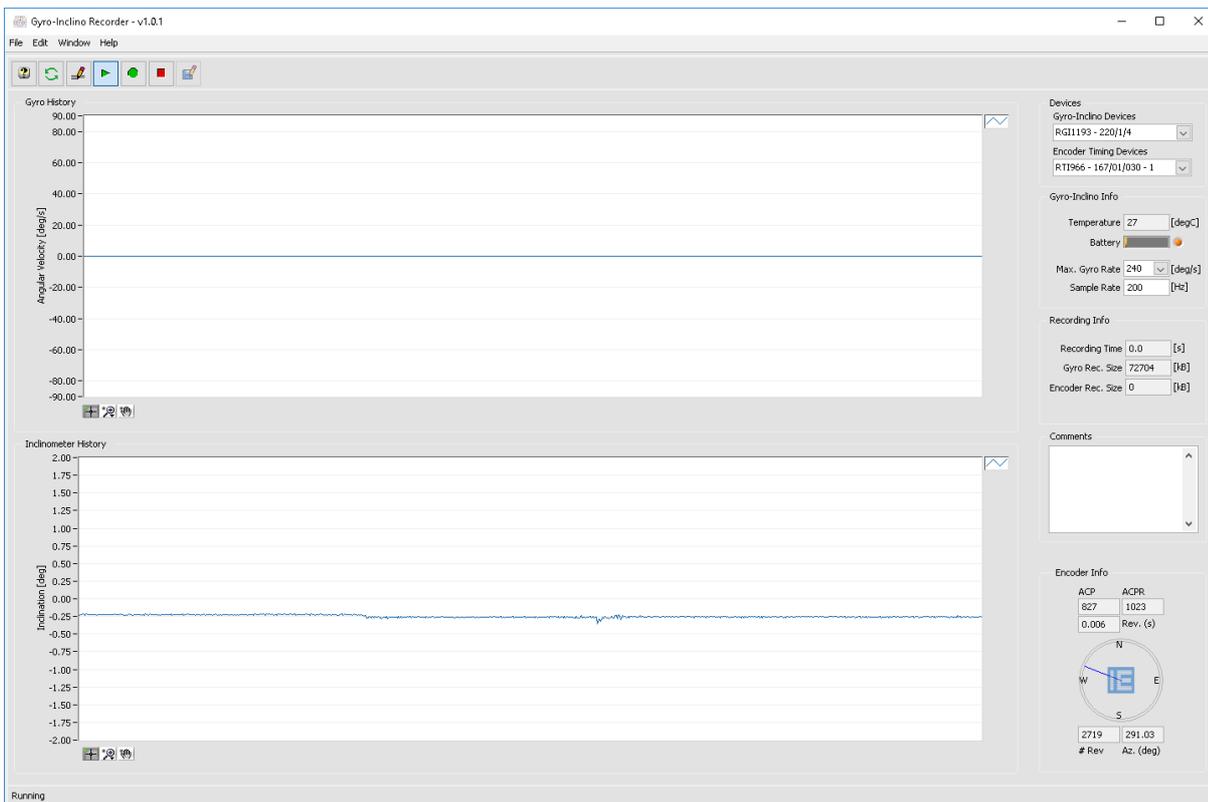


5.2.3.2. Start Sampling ACP/ARP en Gyro Signals

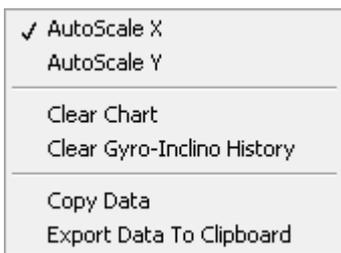


Click the Start button.

The PPI picture in the 'Encoder Info' section will now be updated according to the encoder signals (sampled using the RTI966). The gyro and inclino data will also be sampled and the graphs for the angular speed (gyro deg/s) and the inclination (deg) will be updated at a rate of approx. 10 Hz.



It is possible to autoscale and zoom on the Gyro History and Inclino History by using the right-click menu



The Gyro-Inclino Info section will be loaded depending on the Gyro model connected. The RGI596 has no specific info and controls while for the RGI1193 temperature, battery status and charging state are indicated. The Max. Gyro Rate and sample rate can also be set in the Gyro-Inclino Info section. That way these controls are available even if the RGI1193 is connected using WiFi.



When sampling is started, the record button will become enabled.

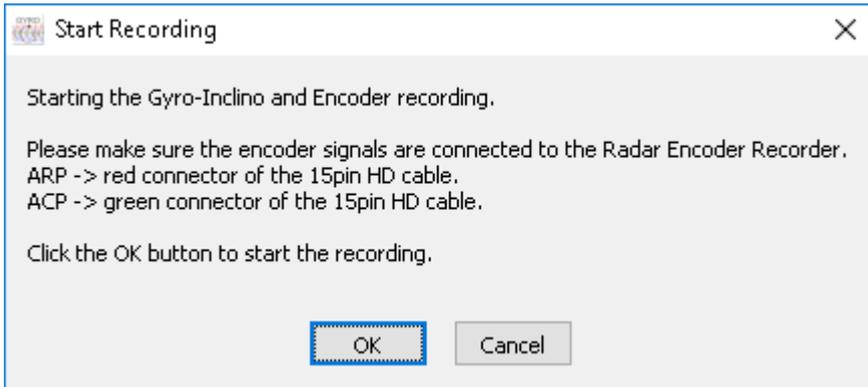
5.2.3.3. Start Recording



Click the  *Record* button to start recording. The program will now ask you to check the initial connections for the measurement procedure.



A dialog box will remind you that the encoder signals need to be connected before starting rotation. To close the dialog box, you can click the OK button.

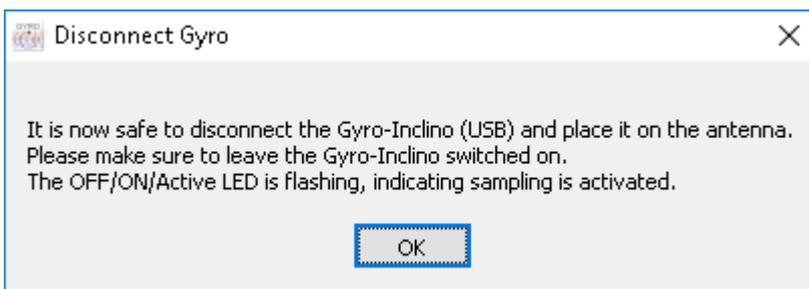


The RGI1193 will record its data to internal memory. Its 'Active' LED will blink indicating it is recording. When connected using WiFi, the RGI data will also be available (at a lower rate) for displaying. The RTI966 (encoder) data will be saved in a temporary recording file on the PC hard disk.

Recording duration and data counters are updated during recording. Please verify that the measurement data is updated as expected.

5.2.3.4. Disconnect RGI (USB Only)

When the RGI1193 and RTI966 recording is started, a dialog appears explaining you can now disconnect the USB cable to install the RGI1193 onto the radar antenna.



Please leave the RGI1193 switched on while climbing the tower and placing it on the pedestal.

Please note that in case of usage on WiFi it is perfectly OK to first place the RGI1193 on the antenna and then start the sampling and recording.

Make sure to place the RGI1193 correctly on the antenna pedestal. On the RGI1193 sticker the normal rotation direction is indicated. (Normally it is automatically placed correctly when the sticker is pointing up). For inclinometer measurements, it is required that the arrow points in the same direction as the radar antenna. Place the RGI on the Antenna Platform

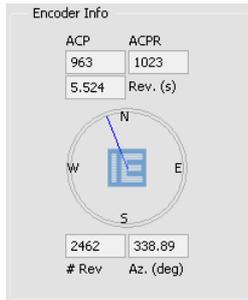
No electrical connections are required. The only limitation are the available memory for recording and the battery autonomy.

5.2.3.5. Start Antenna Rotation

The Gyro and Inclinometer will now measure the angular velocity and tilt change during startup, during the revolutions that the antenna is rotating and also while the antenna is stopped until stand still.



If the ARP and ACP signals are connected correctly, the dial on the front panel of the tool should start rotating and the indicators will regularly be updated, showing the following data:



- *ACP*: ACP counter based on ACP/ARP signals of the encoder connected to the RTI966.
- *ACPR*: The ACPR Counter shows the amount of ACP pulses per revolution.
- *Rev.(s)*: Time difference between the last 2 ARPs
- *# rev*: Each time the antenna passes North, the *# rev* (revolution) indicator is incremented.
- *Az.(deg)*: ACP recalculated to azimuth using ACPR

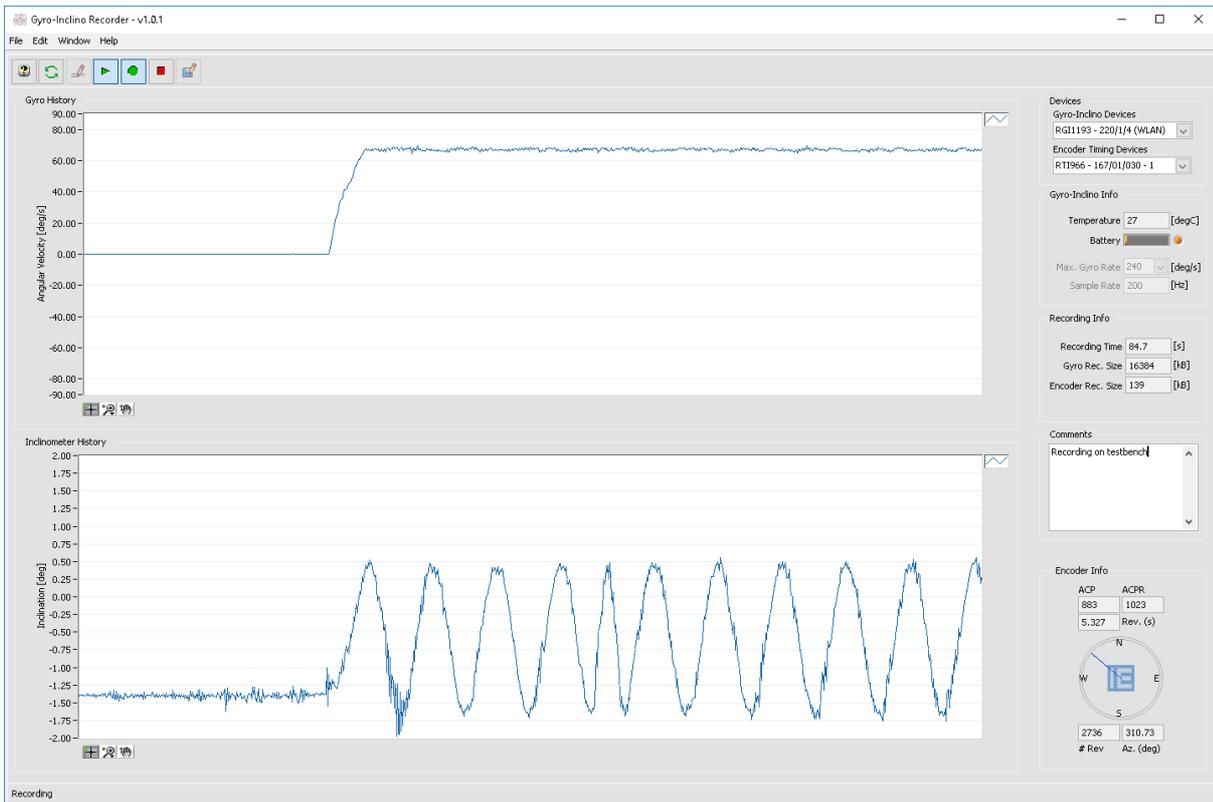
In case the RGI1193 is connected via WiFi, the RGI graphs are also updated

- *Gyro History*: The gyro voltage is recalculated to angular speed (deg/s) using the calibration file. The last 2000 samples are shown.
- *Inclino History*: The inclinometer voltage is recalculated to inclination using the calibration file. The last 2000 samples are shown.

During recording, the Recording Info is continuously updated. In case the Gyro is connected using USB, the Gyro record size is obviously not available.

- *Recording Time*: Indication of the time in seconds elapsed since start of the Gyro-Inclino and Encoder recording.
- *Gyro Rec. Size*: Size of the recording on the RGI device.
- *Encoder Rec. Size*: Size of the temp file containing the encoder timing recorded on disk.





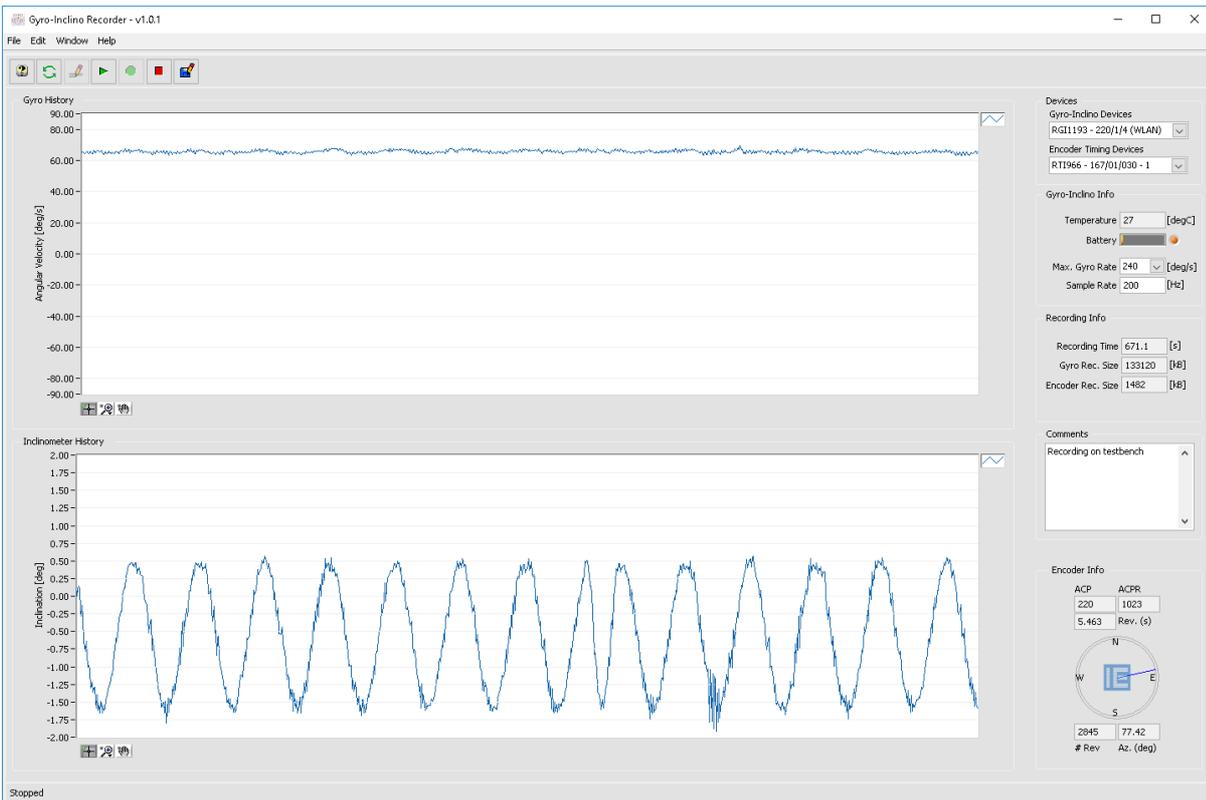
5.2.3.6. Stop Antenna Rotation

A few minutes of rotation are in general sufficient to gather the data required to analyze encoder eccentricity. The antenna can be stopped and before proceeding to the next steps it is best to await full stop of the antenna.

5.2.3.7. Stop Recording

In case the RGI1193 recording was started using the USB interface, the device needs to be collected from the antenna and re-connected to the host computer. In case of WiFi usage, the RGI can stay on the antenna.

Stop the recording by clicking the  *Stop* button. The device will stop recording and stop sampling.



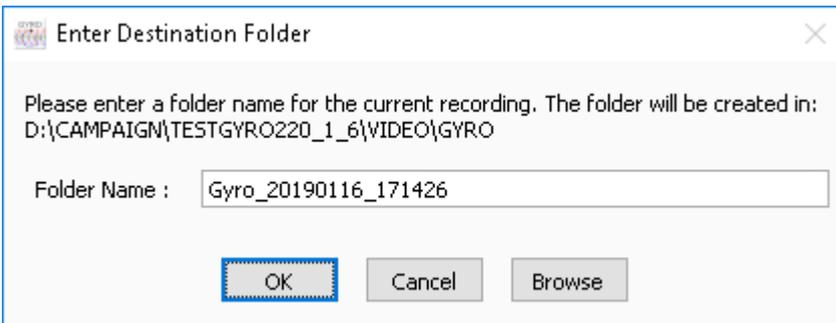
5.2.3.8. Save Recording

Now it is time to save the data to a logfile. The RTI966 data (ARP, ACP timing info) and the RGI1193 data (Gyro samples, Inclino samples) are saved in separate files in the selected recording folder. The contents of the 'Comments' are saved to a text file.



Click the  Save button to save the data.

A dialog box will appear, suggesting a default name for the recording based on current date and time.



Click **OK** to accept the folder name and the folder will be created in the current campaign folder.

Click the **Browse** button in case you want to name the folder yourself. A *Folder Selection* dialog will appear. Click the **New** button to create a new folder. Enter a name for the recording folder and click **Create**.

The new folder is created and already selected in the *Folder Selection* dialog. Click **Select** and the software will start saving the recorded data to the newly created folder.

The recorded data can now be analyzed using the Gyro-Inclino Analysis software tool (described in the corresponding user manual).

