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Rotator Genius Manual

During the time of writing the firmware and app versions are 1.4.3
Revision 4.

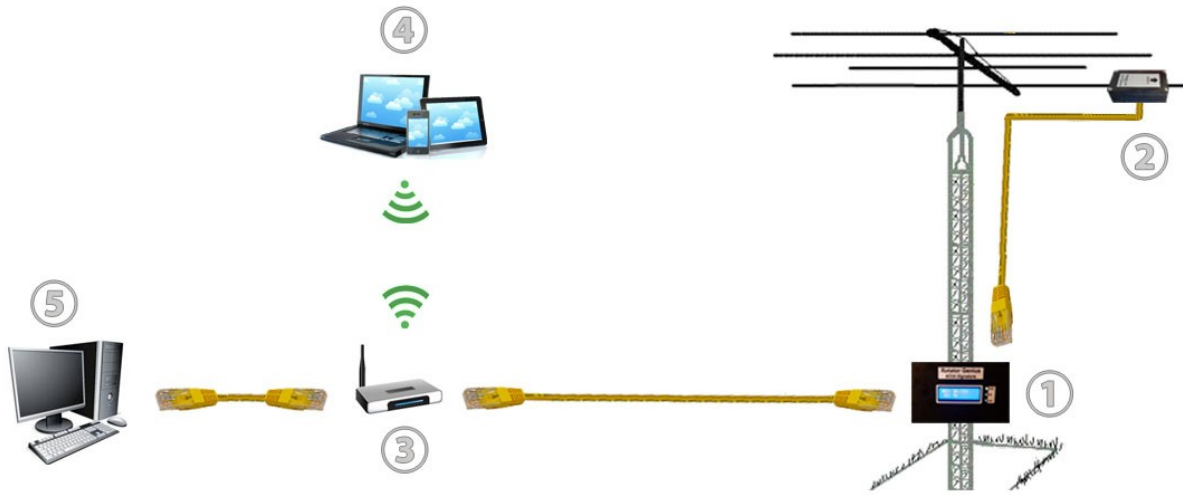# Table of Contents

Abbreviations:

RG	Rotator Genius
PSU	Power Supply Unit
IPv4	Internet Protocol version 4

1. Introduction and overview

A diagram of a typical Rotator Genius setup with a single sensor, controlling a single rotator:

① **Rotator Genius** is wired to the rotor motor. It is mounted on the base of the tower in a waterproof housing. Alternatively it could be hung on a wall in the shack.

② **Rotator Genius Sensor** is an electromagnetic compass. It features a waterproof housing and is mounted on a boom. It is connected to the Rotator Genius by a standard Cat5 Ethernet cable.

③ You can use a typical Small Office **Home Router** found in homes worldwide to connect Rotator Genius to your local network. A "dumb" switch will also work. RG uses IPv4 and is compatible with most switches and routers on the market.

④ You can control and interact with RG using a wireless **Android or Windows device**.

⑤ Most users will use the same shack **Windows PC** running various other control and logging software.

You can control your RG remotely over the internet as well. Setting this up requires some understanding of your networking equipment and technology. You must use a VPN connection since there is no security implemented on the device.

2. Power Supply

RG will work with any power supply between 13.8V and 48V DC. Choose a power supply with **at least the same voltage as the rotor** you intend to control.

You can choose a bigger power supply as well. RG can supply 100%, 75%, 50% or 25% of your power supply voltage to the rotor motors. This will be covered in more detail in this in the **3. Connecting Rotators** and 3.8 Rotator Connection Examples sections.

Screw in your power supply wires to the terminal block green terminal block.
Connect the terminal block to the DC IN connector. **+** and **-** are marked on the pictures below.

DC IN

As soon as you power the device the LED display will show azimuth values for the connected sensors. If the sensors are not connected, azimuth values will be shown as N/A (not available).

2.1 Buttons and Controls
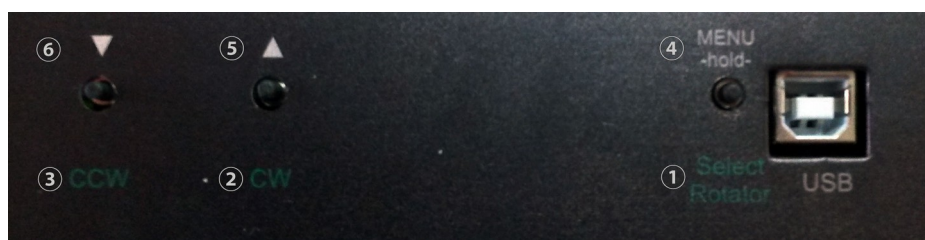
The bottom of the device features three buttons. The buttons have dual functions. They are used for either manual control of your rotors or configuration.

① **Select Rotator** Pressing and releasing this button instantly (releasing under one second) toggles rotor selection. If R1 is selected it will select R2 and vice versa. On the front LCD display you will see the ➡ symbol next to the selected rotor (# was used in earlier versions). On the picture below R1 is currently selected.
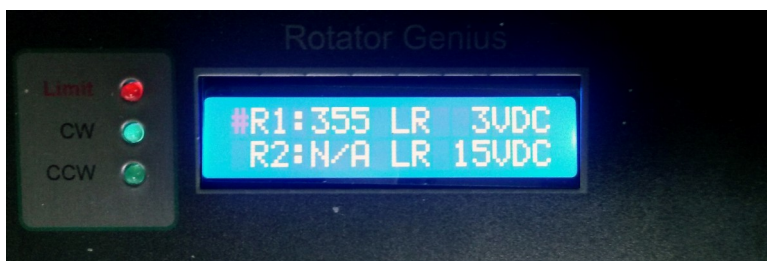
② **CW** Pressing and holding this button rotates the currently selected rotor in clockwise direction. The green CW led on the front of the device will light up, and the arrow on the display next to the selected rotor will start moving.

③ **CCW** Pressing and holding this button rotates the currently selected rotor in counter clockwise direction. The green CW led on the front of the device will light up, and the arrow on the display next to the selected rotor will start moving.

④ **MENU** Press and hold this button for two seconds to enter the settings menu. RG app will be offline and you won't be able to control your rotors while using this menu. Details about these settings are covered in the next chapter.

⑤ ▲ Pressing and releasing this button instantly while in the settings menu scrolls trough the menu items in the right direction. If a value is selected it will increment the selected value.

⑥ ▼ Pressing and releasing this button instantly while in the settings menu scrolls trough the menu items in the left direction. If a value is selected it will decrement the selected value.

2.2 Network / Offset Setup

IP address configuration is done using the on device settings menu (using the device buttons and LCD display).

Enter the menu by holding the MENU button for two seconds. Use ▲ and ▼ buttons to navigate between items.
When you navigate to an item in the menu this item will be considered selected.
Select Rotator will be abbreviated as **Select**.

Settings menu items:

LOCAL IP
Configures the IP address of the device. The default IP address is 192.168.1.250
When the LOCAL IP item is selected press the **Select** button to edit the IP address.
The first octet (first three number portion of the address) will start blinking. This is 192 in the default address case. Use ▲ and ▼ buttons to increase or decrease this value.
When done, press the **Select** button to move to the next octet. This is 168 in the default case.
Again use the ▲ and ▼ buttons to alter the value then press **Select** to move to the next octet.
Repeat the same procedure for the last two octets. The selected octet will always blink.
When done with all 4 no value will be blinking and the address will remain static.
Use ▲ to select the next item.

NETMASK
Configures the netmask of the device. The default netmask is 255.255.255.0
When the NETMASK item is selected press the **Select** button to edit the netmask.
The first octet (first three number portion of the address) will start blinking. That is 255 in the default case. Use ▲ and ▼ buttons to increase or decrease this value.
When done, press the **Select** button to move to the next octet. 255 in the default case. Again use the ▲ and ▼ buttons to alter the value then press **Select** to move to the next octet.
Repeat the same procedure for the last two octets. The selected octet will always blink.
When done with all 4 no value will be blinking and the netmask will remain static.
Use ▲ to select the next item.

GATEWAY
Configures the gateway address of the device. The default gateway address is 192.168.1.1
When the GATEWAY item is selected press the **Select** button to edit the IP address.
The first octet (first three number portion of the address) will start blinking. This is 192 in the default address case. Use ▲ and ▼ buttons to increase or decrease this value.
When done, press the **Select** button to move to the next octet. This is 168 in the default case.
Again use the ▲ and ▼ buttons to alter the value then press **Select** to move to the next octet.
Repeat the same procedure for the last two octets. The selected octet will always blink.
When done with all 4 no value will be blinking and the address will remain static.
Use ▲ to select the next item.

PORT
Configures the TCP port for the RG Windows app. Default port is set to 9006.
It is strongly recommended to keep it at its default value and change it only if necessary.
In case a service on your network uses the same port change it to some other value.
Remember to change it in the Windows application as well.
Again, use ▲ and ▼ to increase and decrease the value.
While in editing mode, the item will blink.
Press the **Select** button when done.
Use ▲ button to navigate to next item.

OFFSET R1
This is where you set the magnetic declination for Rotator 1.
This value varies depending on your current geographical location. You can calculate it online using a service such as: http://www.ngdc.noaa.gov/geomag-web/
It is a value to be subtracted or added to the azimuth value.
It will be subtracted if the value is negative.
It will be added if the value is positive.
Press the **Select** button to edit the item.
Use ▲ and ▼ buttons to increase or decrease its value.
Press the **Select** button when done.

Use ▲ button to navigate to next item.

OFFSET R2 This is where you set the magnetic declination for Rotator 2.
This value varies depending on your current geographical location. You can calculate it online using a service such as: http://www.ngdc.noaa.gov/geomag-web/
It is a value to be subtracted or added to the azimuth value.
It will be subtracted if the value is negative.
It will be added if the value is positive.
Press the **Select** button to edit the item.
Use ▲ and ▼ buttons to increase or decrease its value.
Press the **Select** button when done.
Use ▲ button to navigate to next item.

SAVE&EXIT When this item is selected press the **Select** button to save the changes you made.
The device will return to the normal operating state.

If you made a mistake and don't want to apply changes you made either go back and modify the values or power toggle the device.

# 3. Connecting and Wiring The Rotors

Rotator Genius can control five different categories of rotors:

1. **Low Range DC motors** - 3 to 48V, up to 15A of current.
2. **Low Range AC motors** - 3 to 48V, up to 15A of current.
3. **High Range AC motors single phase** - 110 to 220V.
4. **High Range AC three phase motors** - 110 to 380V.
5. **Prop Pitch** motors.

DIP Switches on the back of RG are used to configure the type of rotor you intend to control.

First RG series have wrong stickers if this is the case know that the DIP switches are always next to the Sensor connectors as on the picture below.
The remaining 8 DIP switches next to the ethernet connector serve no purpose in the current version and are reserved for future use.
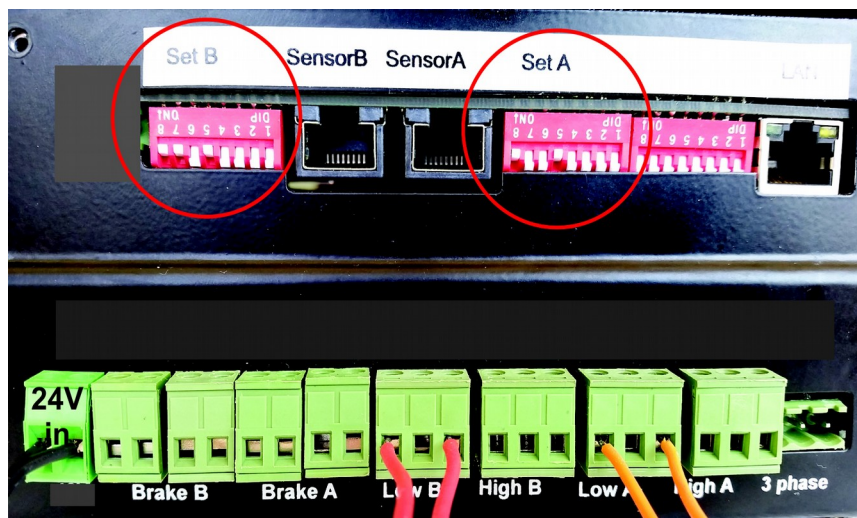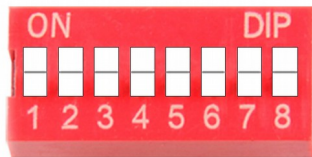
The table below briefly sums up each DIP switch function.

Details are covered in separate chapters.

	OFF	ON
DIP1: Low Range or High Range?	Low Range Motor	High Range Motor
DIP2: Reverse CW and CCW	CW and CCW normal	CW and CCW reversed
DIP3: Prop Pitch	Not using Prop Pitch	Using Prop Pitch
DIP4: Using Breaks?	Not using breaks	Using breaks
DIP5: Using Soft Start?	Soft Start Disabled	Soft Start Enabled
DIP6: AC or DC motor?	DC Motor	AC Motor

DIP7 and **DIP8**: Percentage of the power supply voltage supplied to the rotor motor?

DIP7	**DIP8**	
OFF	OFF	25% of power supply voltage to the rotor motor
OFF	**ON**	50% of power supply voltage to the rotor motor
ON	OFF	75% of power supply voltage to the rotor motor
ON	**ON**	100% of power supply voltage to the rotor motor

3.1 DIP1: Low Range or High Range

High Range should be selected if your motor is single or three phase between 110 and 380V AC.
Set **DIP1** to ON to configure your rotor as High Range.

Low range should be selected if your motor is 3V to 48V AC or DC. Maximum current is 15A.
Set **DIP1** to OFF to configure your rotor as Low Range.

Note that even though you can control 3V motors the minimum power required for Rotator Genius to work properly is at least 12V (13.8V recommended).

3.2 DIP2: CW and CCW Reversed

Set **DIP2** to **ON** to reverse the CW and CCW direction.

This can be used to avoid rewiring if you connected your rotor the wrong way.

3.3 DIP3: Prop Pitch

Set **DIP3** to **ON** if you are using a **Prop Pitch** motor.

3.4 DIP4: Rotor Brakes

Breaks are commonly found on Low Range motors.

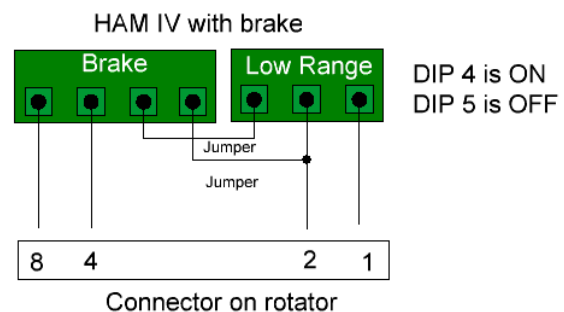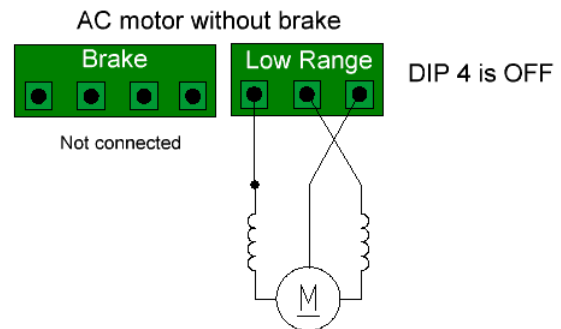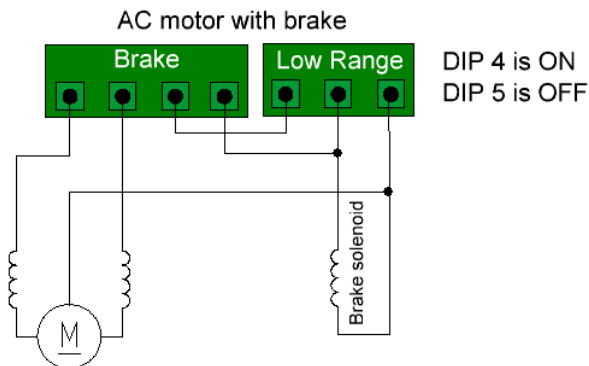Voltage on the breaks must be the same as the voltage on the rotor motor.

Set **DIP4** to **ON** to enable using breaks.
Set **DIP5** to **OFF** to disable soft start (these features are not comparable).

Rewire your rotor to match the diagram below.

Common wire of AC motor is connected to the center pin.
Motor ends are connected over the brake relays as shown on the diagram below.

When you execute the CW or CCW command the brake solenoid will be powered first about half a second before the motor. When you release the command, the motor will stop being powered and the break will be powered for half a second more. This enables the release of activation of the brake, by properly sequencing it.

3.5 DIP5: Soft Start

Soft Start uses PWM to gradually start and stop your rotor instead of using full power for the entire time.

Soft Start is supported on Low Range AC and DC rotors.

Soft Start can not be used if the break feature is used.

Set **DIP5** to ON to enable Soft Start.

3.6 DIP6: AC or DC

Configure Low Range motor as AC or DC.

Set **DIP6 as ON** to configure the rotor as **AC**.

Set **DIP6** as **OFF** to configure the rotor as **DC**.

3.7 DIP7 and DIP8: Voltage Configuration

You can use DIP7 and DIP8 switches to configure supplying 25%, 50%, 75% or 100% of your power supply voltage to your rotor. This only applies to Low Range motors.

Take a look at the table with examples of 12V, 24V, 36V and 48V:

DIP Switch 7 and 8
Low range voltage selector.

0/0 - 25%
7 8

0/1 - 50%
7 8

1/0 - 75%
7 8

1/1 -100%
7 8

Example - Input voltage

12V	24V	36V	48V
3V	6V	9V	12V
6V	12V	18V	24V
9V	18V	27V	36V
12V	24V	36V	48V
OUT Voltage	**OUT** Voltage	**OUT** Voltage	**OUT** Voltage

If the 25% increments are not accurate enough, you can use a small potentiometer inside the device on the PCB for fine tuning.

3.8 Rotor Connection Examples

The examples below are designed to provide you with a clear idea of how to connect your rotor to the RG. Models may vary over time, so make sure you double check your rotors documentation before connecting.

3.8.1 Low Range DC Rotors

AlfaSpid (Spid in Europe) motors are mostly 12V DC electric motors. This includes: [BIG-RAK](), [BIG-RAS](), [RAEL](), [RAK](), [RAS,]() [RAU](), [SPID RING - 01]() and [SPID RING - 02]() models.

Using a **24V PSU**, the DIP Switch configuration and wiring look like this:
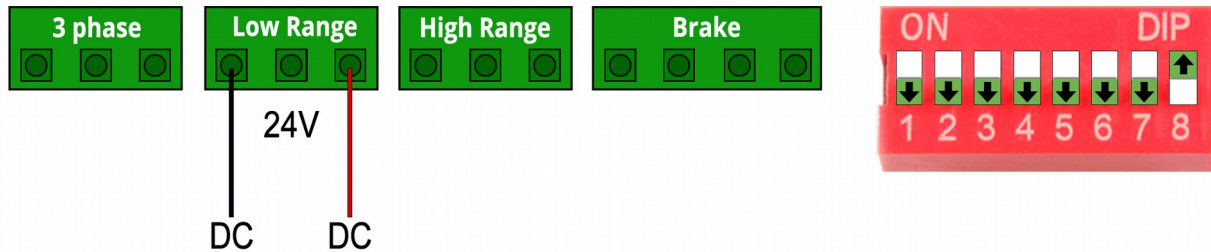
	OFF	ON
DIP1: Low Range or High Range?	**Low Range Motor**	High Range Motor
DIP2: Reverse CW and CCW	**CW and CCW normal**	CW and CCW reversed
DIP3: No Function	***none***	*none*
DIP4: Using Breaks?	***Not using breaks***	*Using breaks*
DIP5: Using Soft Start?	**Soft Start Disabled**	Soft Start Enabled
DIP6: AC or DC motor?	**DC Motor**	AC Motor

DIP7	DIP8	
OFF	OFF	25% of power supply voltage to the rotator motor
OFF	**ON**	50% of power supply voltage to the rotator motor
ON	OFF	75% of power supply voltage to the rotator motor
ON	ON	100% of power supply voltage to the rotator motor

A **16V PSU** would have the same wiring and settings except the DIP7 and DIP8 would be set to 75% voltage:
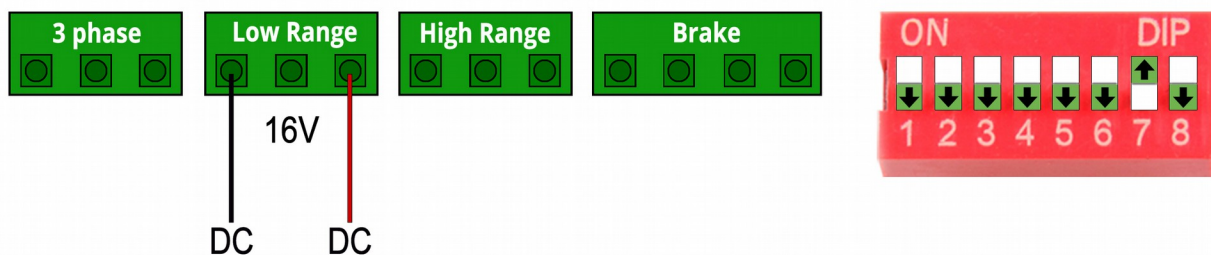
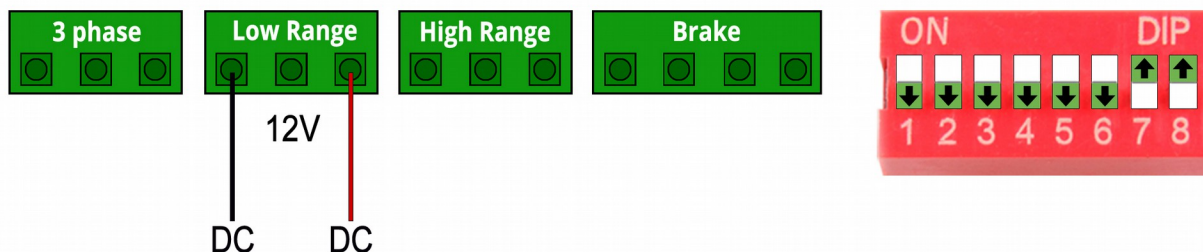| DIP7	DIP8	
OFF	OFF	25% of power supply voltage to the rotator motor
OFF	ON	50% of power supply voltage to the rotator motor
ON	OFF	75% of power supply voltage to the rotator motor
ON	ON	100% of power supply voltage to the rotator motor

Lastly a **12V PSU** configuration would look like. DIP7 and DIP8 set power with 100% voltage:

In order to verify you connected the rotors correctly, use the CW and CCW buttons on the device control your rotor manually. Use Select to switch between the selected rotators.

3.8.2 Low Range AC Rotors
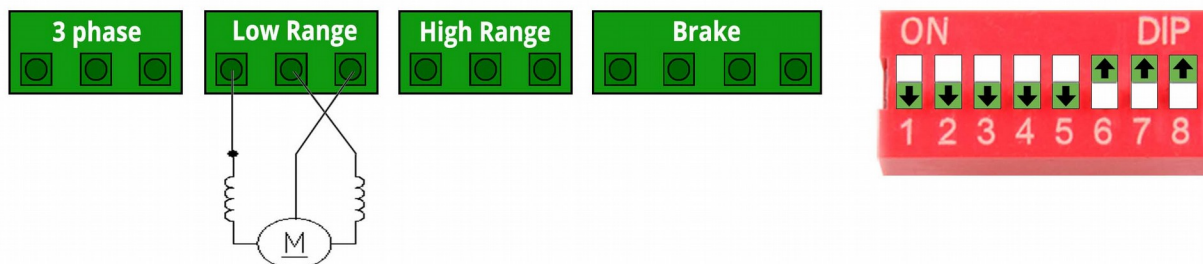
Low range AC motors are AC motors that use between 3V and 48V.

RG can convert the supplied DC power to AC for powering rotor motors.

Make sure to set **DIP6** to **ON** to supply AC voltage.

Common wire is connected to PIN3 (pins are counted from left to right).
CW and CCW lines are connected to PIN1 and PIN2.

If you swap CW and CCW lines you can use DIP2 to reverse them in software rather then rewire.

DIP7 and **DIP8** are configured to 100% voltage in this example. This will vary depending on your setup.

3.8.3 Single Phase High Range AC Motors

Set DIP switch 1 for your corresponding rotor (A or B) to ON. This configures the rotor to high range.

Supply the AC power for driving the rotor on to the dedicated **3 phase port**. This power will be outputted over the **High Range port**. Connect your rotor on to the **High Range output port** as shown on the diagram below.
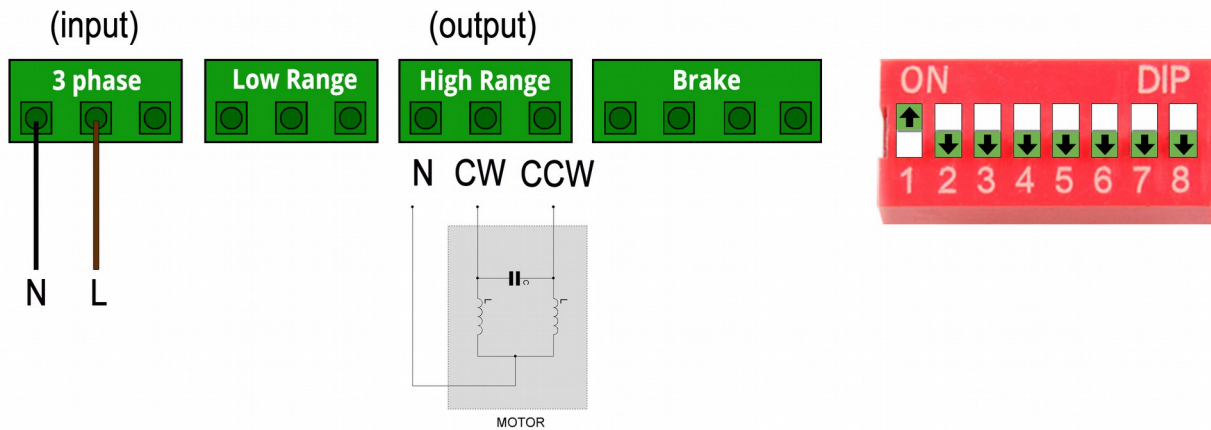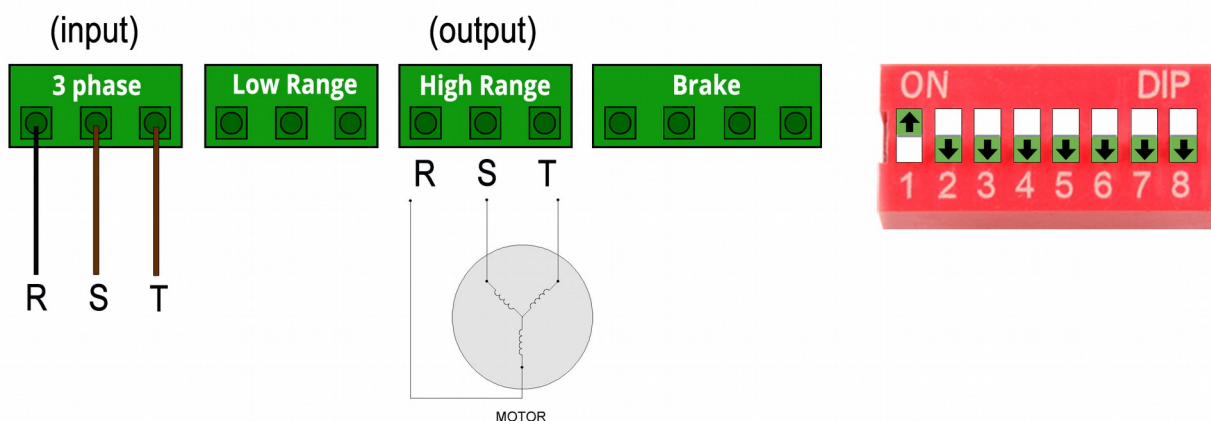

At least 13.8VDC (up to 48VDC) of additional is needed to power the RG logic and sensors regardless of the AC power.

Important: Make sure to connect the N (neutral) wire properly to avoid damaging your rotor.

3.8.4 Three Phase High Range AC Motors

Set DIP switch 1 for your corresponding rotor (A or B) to ON. This configures the rotor to high range.

Supply the AC power for driving the rotor on to the dedicated **3 Phase port**. This power will be outputted over the **High Range port**. Connect your rotor on to the High Range output port as shown on the diagram below.

Motor shown on the diagram is in a triangle configuration as an example. RG supports both triangle and star configurations.

At least 13.8VDC (up to 48VDC) of additional is needed to power the RG logic and sensors regardless of the AC power.

3.8.4 Prop Pitch Motors
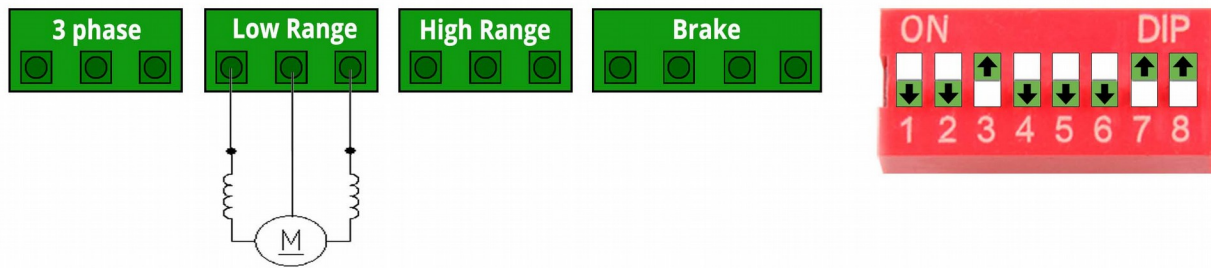
Common wire is connected to PIN2 (pins are counted from left to right).
CW and CCW lines are connected to PIN1 and PIN3.

Make sure to set **DIP3** to **ON**, this specifies the special case Prop Pitch motor.
Set **DIP1** to **ON** to configure the motor as DC.

DIP7 and **DIP8** are configured to 100% voltage in this example. This will vary depending on your setup.

3.9 Testing and Verifying

Use the **CW** and **CCW** buttons to move your rotor manually to ensure proper connections/configuration has been made.
Use the **Select Rotator** button to switch between the rotors.
An arrow on the most left on the LCD screen is the indication of the selected motor.

4. The Electromagnetic Sensor

Sensors read the magnetic azimuth and send the position to the RG. Sensors are carefully calibrated in the factory and you can use them out of the box.

The arrow on the sticker shows the direction it is pointing.
This sensor must be as parallel to the ground as you can get it- not tilted at all.

Place the Sensor at least 80cm away from any metal materials and ferromagnetics.
You can mount it to the aluminum antenna boom.

The sensor is placed in a plastic waterproof housing.
It is very light so you can use plastic cable strips for mounting.

In order to connect the sensor open it by unwinding the four screws on the box.
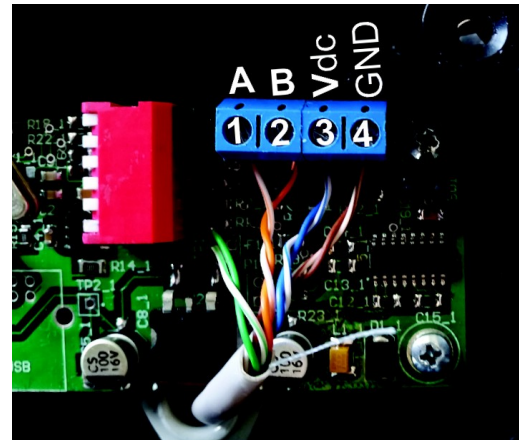
Data is sent over UTP network cable using the RS485 protocol.
Two wires are used for VDC, two wires for GND and single wires in A and B for data.

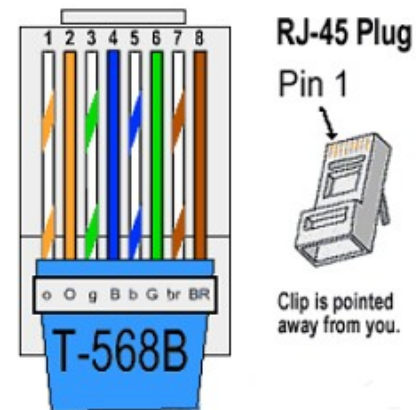Sensor wiring:

1. **ORANGE/WHITE**   to   **A**

2. **ORANGE**   to   **B**

3. **BLUE** and **BLUE/WHITE**   to **VDC**

4. **BROWN** and **BROWN/WHITE**   to **GND**

Green is unused. We recommend to cut it off completely on this end.

For the device side RJ45 wiring the T-568B standard is used:

1. **ORANGE/WHITE**
2. **ORANGE**
3. **GREEN/WHITE**
4. **BLUE**
5. **BLUE/WHITE**
6. **GREEN**
7. **BROWN/WHITE**
8. **BROWN**

Once connected, the azimuth value will be displayed on the Rotator Genius LCD screen. Move it around and verify it works before installing it on your antenna. It should be parallel to the floor and moved only in X and Y axis so place it on some flat surface like a table.

Again make sure there are no metal materials and/or ferromagnetics around while testing.
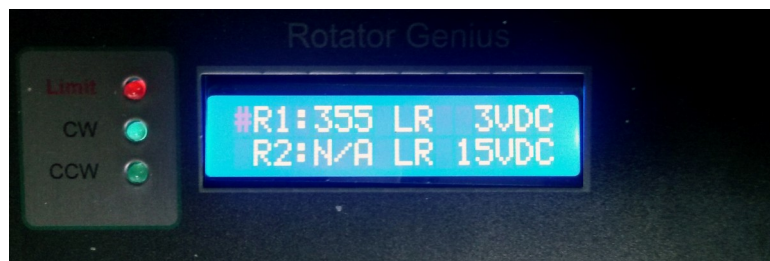
On the front display you can see the azimuth value of connected sensors as well as the set output voltage to motor.

Green LEDs will indicate if a rotator is out of configured limits, and if it's being rotated in CW or CCW direction.

The red LED is a warning indicating your rotor is outside defined software limits. More on this in the software section.

4.1 Sensor Correction

In case of sensor inaccuracies caused by disturbances in the EM field we can recalculate the azimuth using our correction algorithm.

You can choose to do correction using four or eight points.

Four point algorithm has a maximum deviation of +/- 45 degrees.
Eight point algorithm has a maximum deviation of +/- 22 degrees.

You will need to experiment and see which option works best in your case.

Before proceeding you will need:

1. Paper and pen to write the measured values down.

2. A regular compass for real world reference points.

The sensor should be attached to the boom in the same way it is going to be used.

Do not open the sensor correction window before doing the measurements because it will prevent you from using the RG app.
You will need your app to move your antenna.

Four Point Sensor Correction Procedure:

1. Rotate the antenna to actual North. Write down the value the sensor reads in this position.

2. Rotate the antenna to actual East. Write down the value the sensor reads in this position.

3. Rotate the antenna to actual South. Write down the value the sensor reads in this position.

4. Rotate the antenna to actual West. Write down the value the sensor reads in this position.

5. Open the Sensor Correction menu.

6. Tick Active box.

7. Select Four points.

8. Enter the values to the corresponding boxes.

9. Press Save.

Rotator Genius will now take into account the real world values and recalculate the azimuth accordingly.

You can uncheck the Active box at any point to revert to raw sensor data.

Eight Point Sensor Correction procedure works exactly the same with additional values for NE, SE, SW, NW.

4.2 Recalibrating the sensor

Sensors are carefully calibrated in the factory. If the sensor is showing bad azimuth values try using the sensor correction algorithm first. (chapter 4.1)

The only time you would need to do this is if we don't calibrate a sensor at all by mistake.
A symptom for this is a sensor that shows a fixed value constantly no matter where you point it at.

So please do not attempt to do this unless you are absolutely sure it is necessary – all factory calibration data will be lost permanently.

Calibration requirements:

The sensor should be attached to the boom in the same way it is going to be used.
1.   Your boom must be able to make full 360 degree turns.
2.   The more full rotations you can make the higher the precision will be. Around five rotations is considered is optimal.
3.   You can rotate in any direction, CW, CCW or mixed. Main point is letting the sensor sense all 360 points.
4.   The slower you rotate while calibrating the higher the precision will be in the end.

Calibration process:

1.   In order to start the calibration process you need to disconnect the sensor from the device, and open the casing.
2.   Set **PIN 1** and **PIN 6** to **ON**, as shown on the picture. Do NOT use a metal screwdriver for this because it will mess up the readings.
3.   Connect the sensor back to Rotator Genius.
4.   There will be no reading on the LCD display or Panel Application during the calibration mode.
5.   Make five full rotations in any direction, back and forth, one way, doesn't matter.
6.   When done, set **PIN 1** and **PIN 6** to **OFF**.
7.   The sensor should now be calibrated. You will see a reading on your LCD display and Panel Application.
8.   Repeat the process if not satisfied with the results.
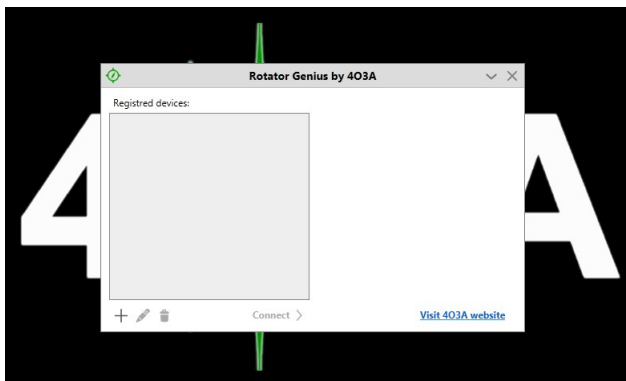9.   When done seal the sensor box.
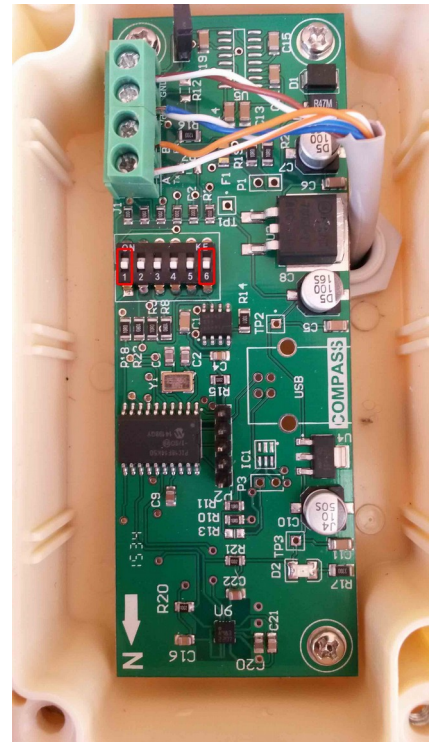
Calibration pins

5. Control software

5.1 Windows App

Download and install the latest Panel and firmware software from http://4o3a.com/index.php/downloads
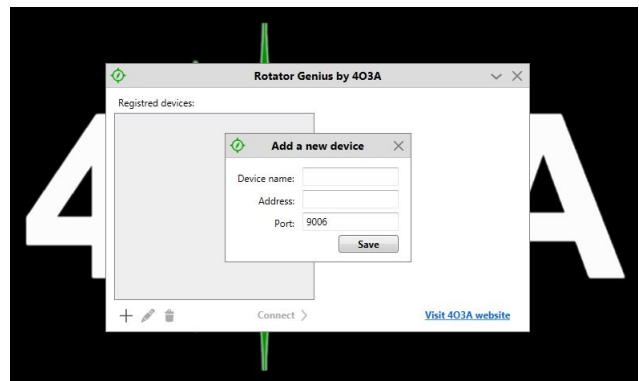
The app is designed Windows 7, Windows 8 and Windows 10. It can be used on a Windows tablet and phone as well.

Follow the setup. Rotator Genius icon will appear on your desktop.

Device selection

Add device

This is how your window looks like when you first open the application. You first need to add your device to the list.

Press the **+** button to add.

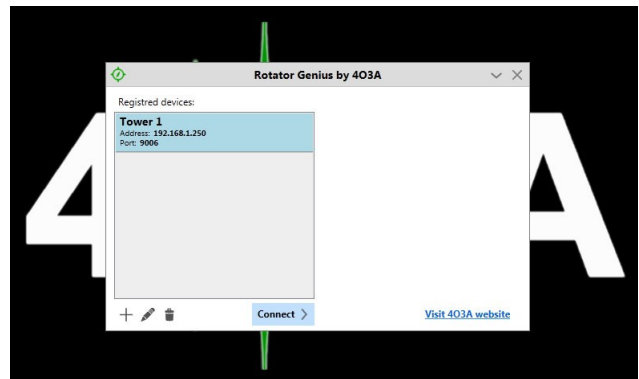The button to its right is the edit button, and finaly delete.

Name your device and enter its IP address and port number.

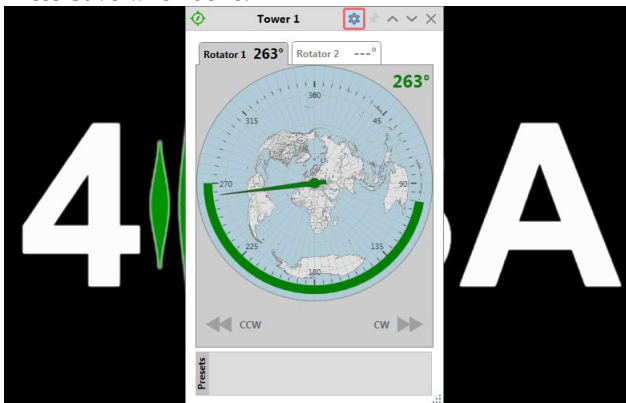Check how to set your IP address and port number in the NETWORK SETTINGS section above.
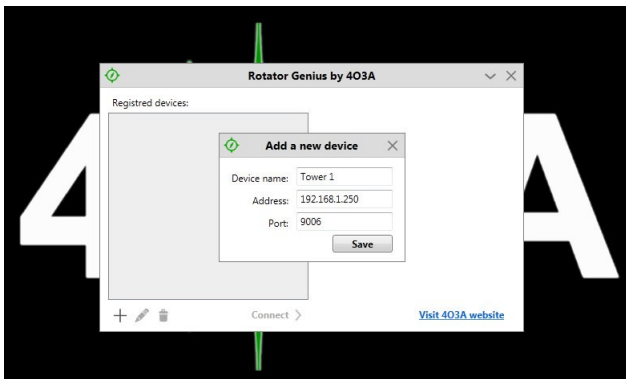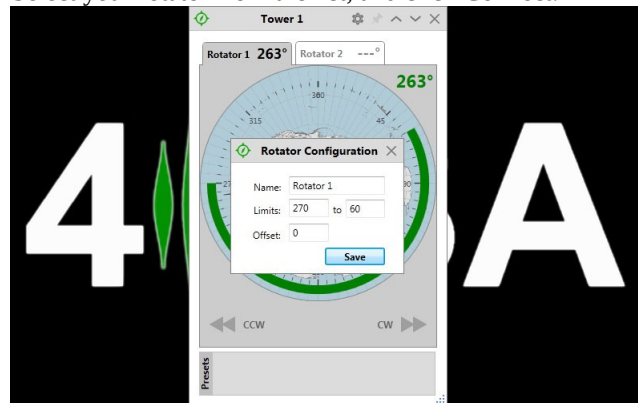

*Adding the device*

Connect

Press Save when done.

Select your rotator from the list, and click Connect.

RG Control Panel

Rotator configuration

This is the RG Control Panel. You can see your status and send commands from here.

It is recommended configure your rotators before attempting to move them.

Click the settings icon on the top of the window.

Name your rotator, and set the limits if you do not want your rotator to go beyond a certain point.

You will not be able to give it a target beyond the limits. However, if external factors move the antenna out of bounds, you will be able to use the CW and CCW buttons to move it back to the allowed aria.

In case your rotator has some inertia when stopping, you can compensate by adding the offset. This will stop the rotator the amount of set degrees before its final location.

Click Save when done.
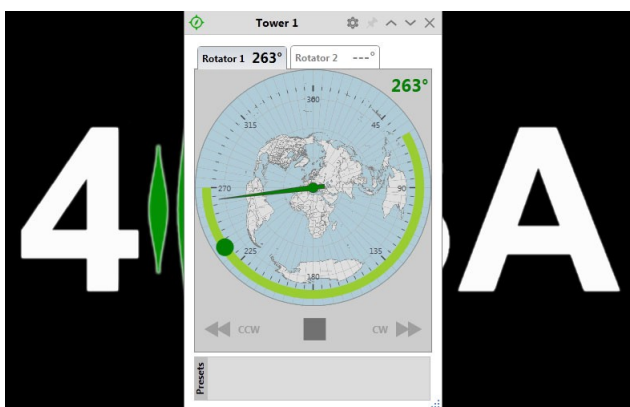
Setting the target
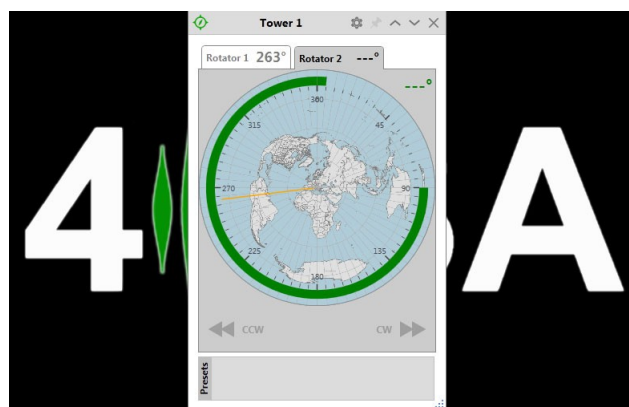
Tabs

You can double click anywhere within limits to easily move your antenna to the desired azimuth. The green aria will start to flash, and the stop button will appear below the gadget. You can use it to stop at any time.
You can use the CW and CCW buttons to manually move if needed.

There is a tab for each rotator. At the moment, Rotator 2 does not have a sensor connected.
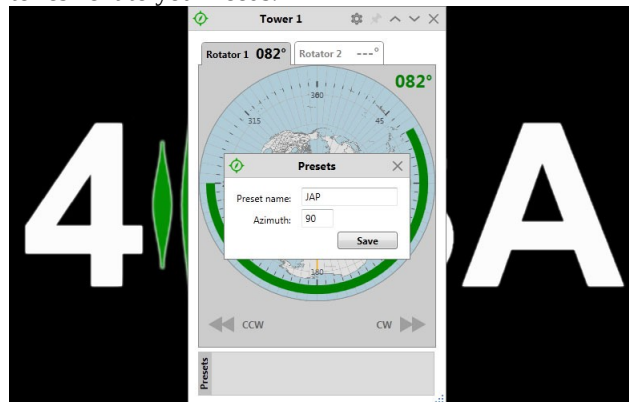The other rotator azimuth is represented as the orange line at all times.
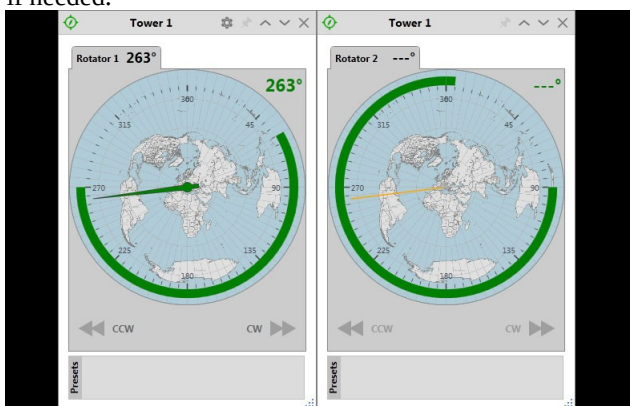
Separating tabs
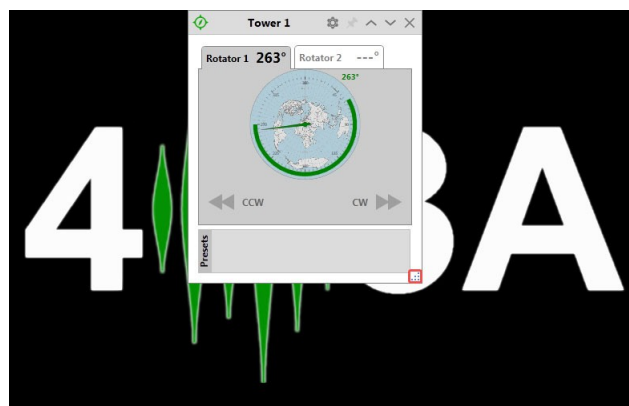
Resizing

You can right click the tab with your mouse to separate the windows.
If you close a tab they will merge back.

In the bottom right corner you will find the re-size icon. Left click it with your mouse, hold, and move your mouse to resize it to your needs.

Add preset

Adding the preset

After finding your optimum antenna positions you should save them as presets.
Click on the Add button.

Enter your preset name, and the corresponding azimuth. Click Save when done.

Preset examples

We recommend naming your presets with the maximum of three letters, though it is not a technical limitation.

5.1 Windows App – new features in 1.3.0

Move by clicking the GO button

Rotate Manually

As well as double clicking you can now click on the azimuth you want to move once to and click the GO button below the gauge.

You can click on the Azimuth in the top right corner and enter a value manually, then click Rotate.
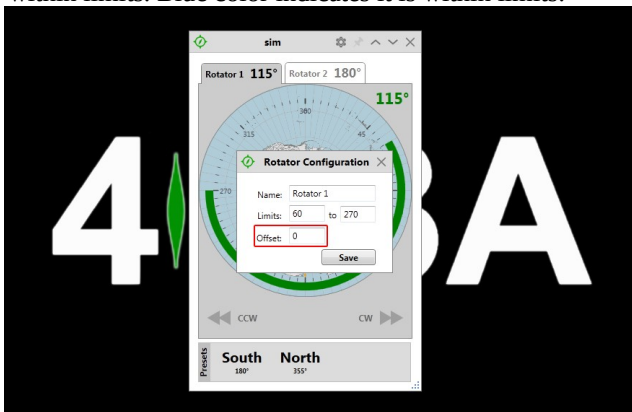
New Preset Features

Invalid Preset Value

The presets now show the saved value on the label. When you mouse over them, they will let you know if they are within limits. Blue color indicates it is within limits.
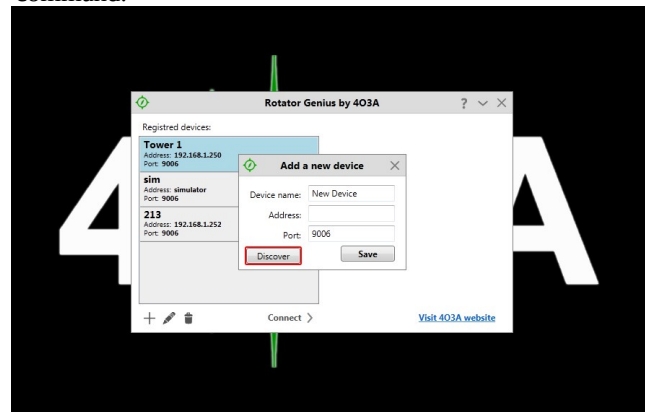
Presets marked in red are indicating your preset value is out of bounds of limits. Clicking it will not issue a go command.

Offset

Discovery Protocol
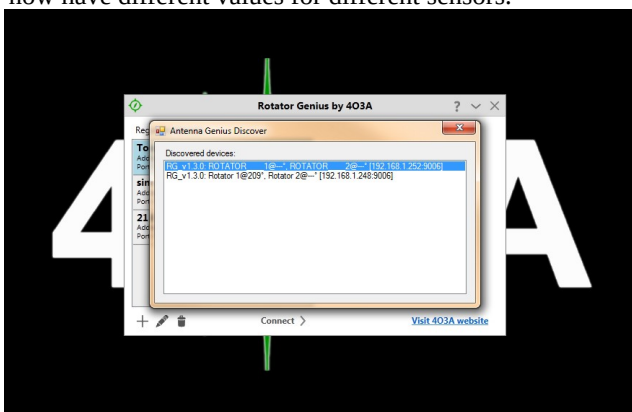
Declination is replaced by offset, both on the device and the panel. Instead of having one declination setting you now have different values for different sensors.
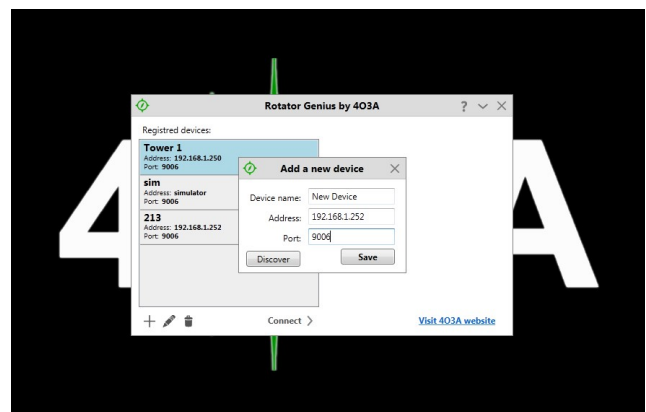
The discovery protocol was implemented, allowing you to find your devices on the network easily.

Discovering Devices

Adding a discovered device

Double click the discovered device to add it to your registered device list.

Change the name if you wish and click save.

5.2 Android App

You can use the Android App to control your rotors, but not configure them. Download the app from the Google App Store

directly.