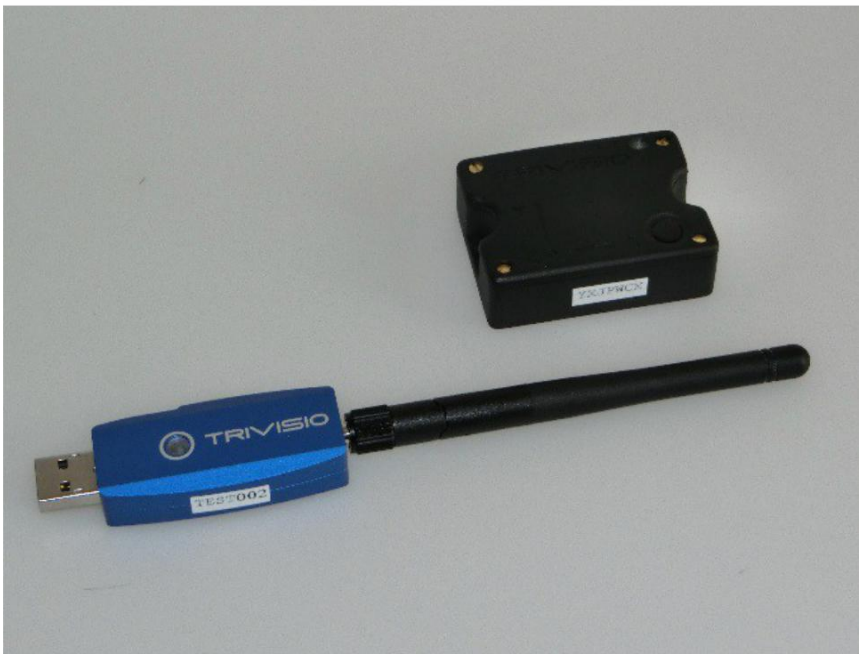
User Manual

Colibri-Wireless

Inertial Motion Tracker



Version 1.0

Subject to technical modifications

1 Table of Contents

1.1 Inteded Use

The product is designed to measure inertial movements and to transfer acceleration, angular rate and magnetic field via a wireless dongle to a PC. Power is supplied by a lithium polymer battery.

1.2 Advice

To ensure the correct position of the device during the measurement session, make sure that the tracker is securely attached to object or body being measured.

1.3 Warning for Electrical Products

Avoid using or storing the devices at wet, humid, dusty and smoky surroundings or extreme temperatures.

Do not use devices at temperatures below 0°C or above +55C.

Always switch off and unplug the Colibri and the dongle if not in use.

In case of damage contact your retailer. There are no user serviceable parts. Only qualified service personnel should perform any service required on this product.

2.1 Parts of the Colibri Wireless System

This system contains:
1.Colibri wireless tracker (sometimes also called "Node") (up to 10 trackers per USB dongle)

2.USB dongle (sometimes also called "Gate"

3.Micro USB charger (chargers may vary)

2.2 Colibri wireless tracker

Getting to know the Colibri wireless tracker.

1.Power button
Push the power button to turn on the tracker. Without a connection to USB power source the tracker will turn itself off automatically after 10 minutes. Keeping the power button pressed for over 2 seconds will set the tracker to scanning mode.

2.Status LED
Displays the status of the tracker.

LED colour is battery state:
Green: (when connected to USB): tracker is on and fully charged.

Green: (when NOT connected to USB): tracker is on.

Orange: tracker is charging.

Red: battery is low.

LED flashing is tracker's mode:

Steady: tracker is in stand-by mode.

Slow flashing: tracker is in measuring mode.

Fast flashing: tracker is in scanning mode.

3.Serial Number
The serial number is unique to each individual tracker. The serial number is important in establishing a connection between the USB dongle and the tracker.

4.Reset hole
To reset the tracker, insert a straightened paper clip into the reset hole.

5.Micro USB connector
To charge the tracker and to update firmware.
It takes two hours to charge the battery completely.

2.3 USB Dongle

Getting to know the USB dongle:

1.USB Connector
Connects to you Desktop or mobile PC USB port. (sometimes also called "Gate")

2.Status LED

Displays the status of the dongle.
Standby:

Green:
Solid: dongle is ready for use.

Green/Orange:
*Flashing:*RF Channel change.

While measuring:

black:
*Flashing:*data sample repeated once

orange:
*Flashing:*data sample repeated more than once

Red:
*Flashing:*data sample lost

3.Wireless antenna
2.4 GHz wireless antenna. Without this antenna the dongle does not work.

4.Serial number
The serial number is unique to each individual dongle. The serial number is important in establishing a connection between the USB dongle and the tracker.

5.2,5mm Plug for master-slave cable
To link two dongles together in one network. (Do not connect earphones or speakers here).

1.Charge the tracker(s) with the provided charger for two hours.
(When the status LED changes from orange to green the tracker(s) is(are) ready for use.)

2.Please install the Colibri driver software downloaded from www.trivisio.com **before connecting the USB dongle to your PC** for the first time. Microsoft Windows® will recognize the new hardware automatically.

3.Run the setup file "ColibriAPI-x.x.yyyyyyyy-winzz.exe*" and follow the instructions. More details can be found in the separate manual "ColibriAPI Documentation", which can be found in the installation folder (Start, Programs, ColibriAPI x.x.yyyyyyyy (zz-bit)* or downloaded separately from our website www.trivisio.com.

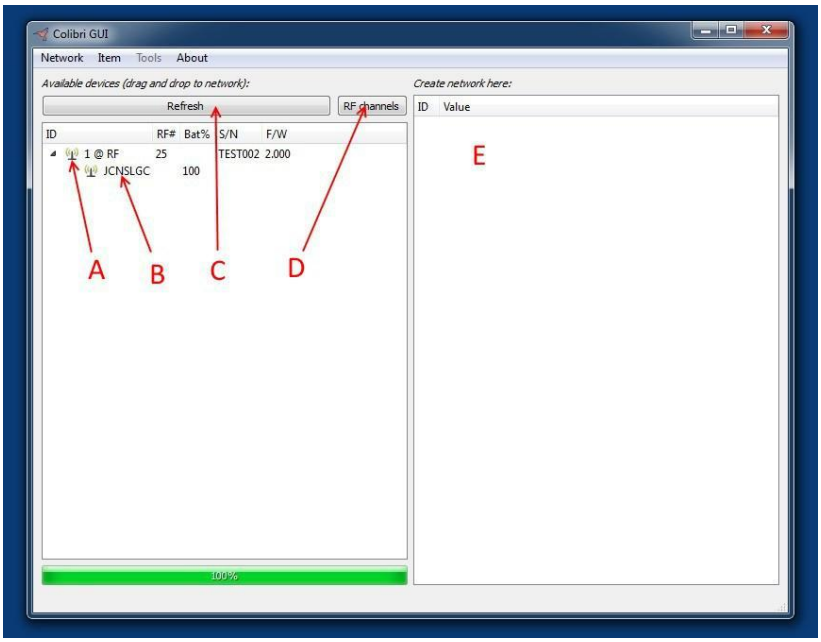
4.Connect the USB dongle to a free USB port on your pc. Push the power button on the tracker for one second.

5.Start the Colibri GUI by double clicking on the Colibri icon:

*

x.x	: Version of colibri api.
yyyyyyyy	: date of the build yyyy.mm.dd
zz:	: 32 or 64-bit version of api.

Colibri GUI - brief description:



A. USB dongle with serial number

B. Tracker with serial number

C. Refresh. To search for new switched on trackers.

D. RF channels: To check for free frequencies in the frequency range of the 2,4 Ghz Band.

E. Create network here: working dongles and working trackers.

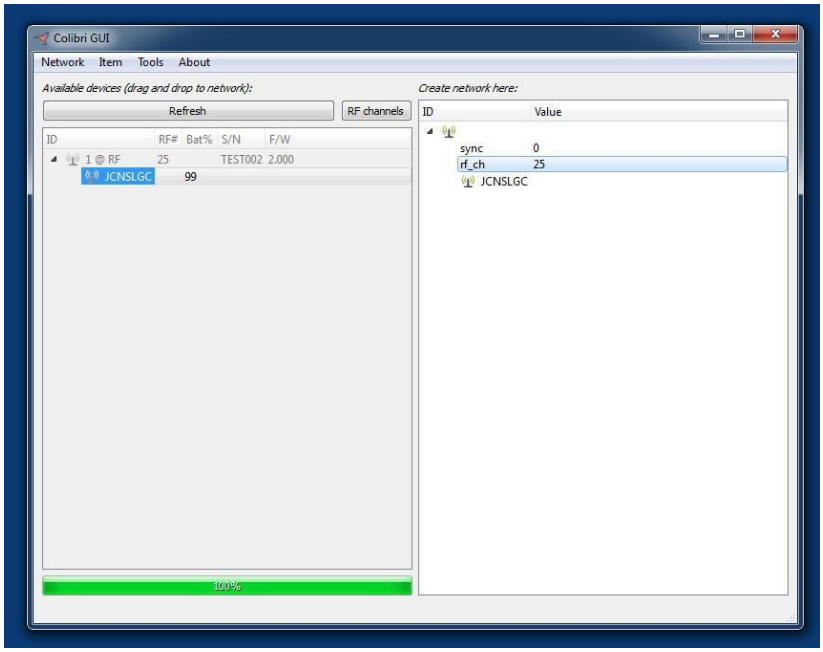
6.Click on the USB dongle icon, drag to "Create network here" box and drop.

7.Click on the tracker icon, drag to the antenna icon at "Create network here" box and drop.

8.Then select "Tools">" Quick Config" to finish the configuration of the network.

9.By clicking "Network">" Safe to Hardware" the configuration is saved to the USB dongle. This means you do not have to repeat steps 6-7 again.

Your Colibri GUI should look like this:

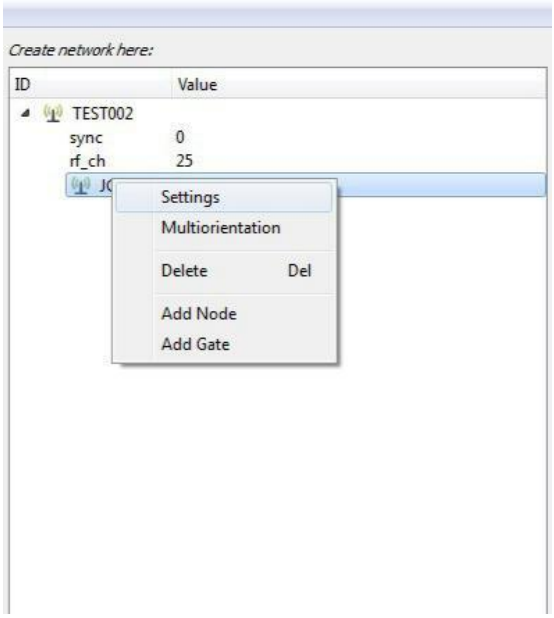


Use "Tools">" Multiorientation" to test the tracker.

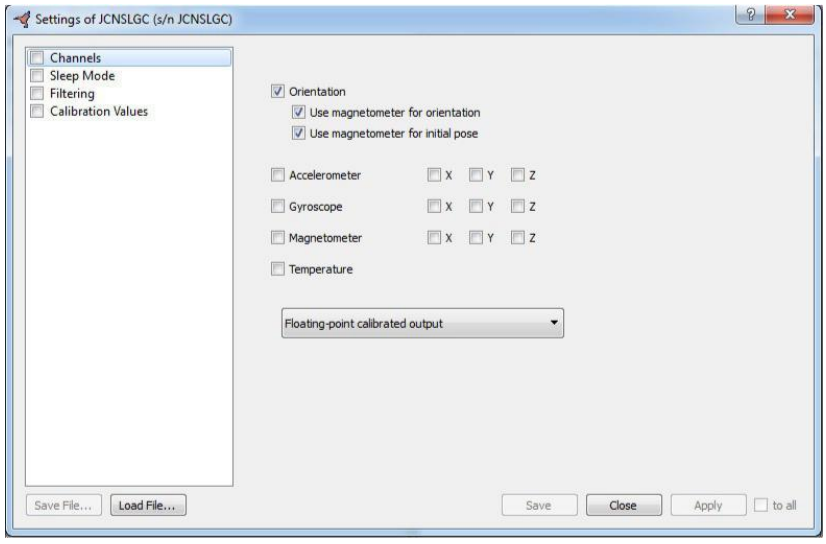
Magnetometer calibration

The Colibri sensors are factory calibrated and tested before being shipped. However, the magnetic calibration is very sensitive to environmental changes. Especially metal and electromagnetic fields emitted by other devices can influence the quality of the tracking results. To obtain the best possible orientation estimates, the Colibri should have its magnetometers recalibrated once it has been mounted in the way it is intended to be used. Not doing so will result in degraded orientation estimates.

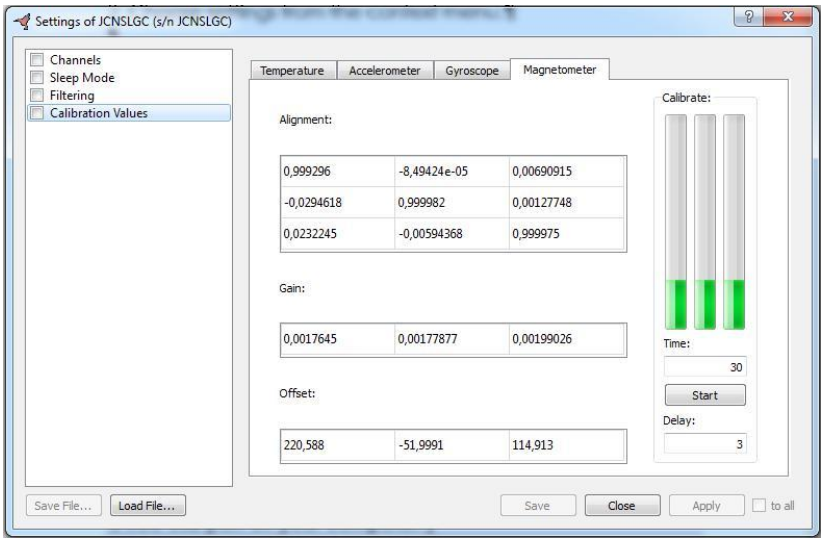
1.Choose the tracker that you want to calibrate. (Magnetometer calibration must be done for every tracker separately).



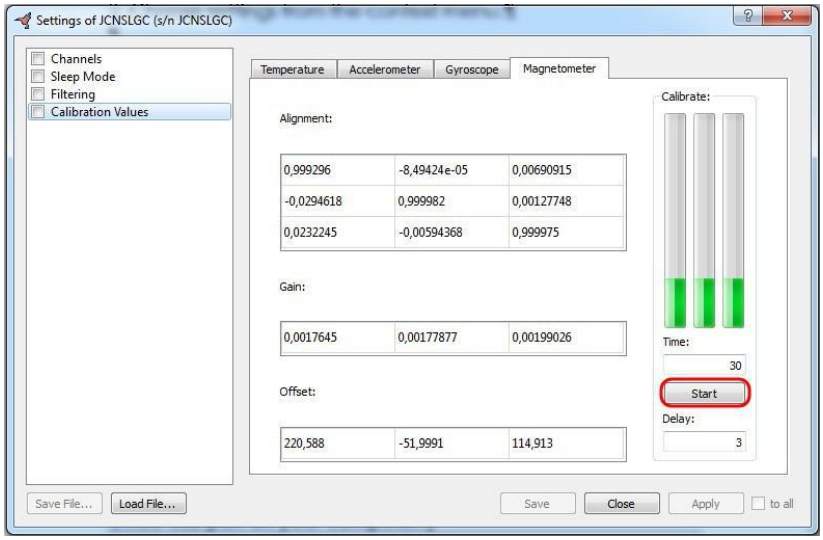
2. Choose settings from the context menu.



3.Choose Calibration Values from the left upper corner.



4.Click "Start" to start to calibration procedure



5.Start calibration. After the countdown, 3 progress bars will increment successively.

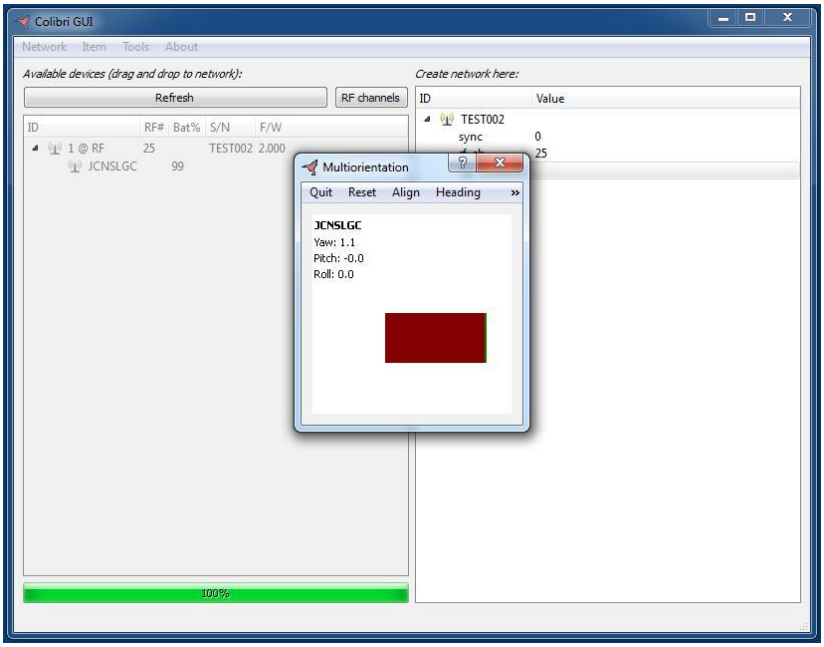
6.During this process, slowly rotate sensors in all directions. We suggest to perform 3 full turns in horizontal plane around Z, X and Y axes. Progress bars will help you estimate the necessary time for every turn.

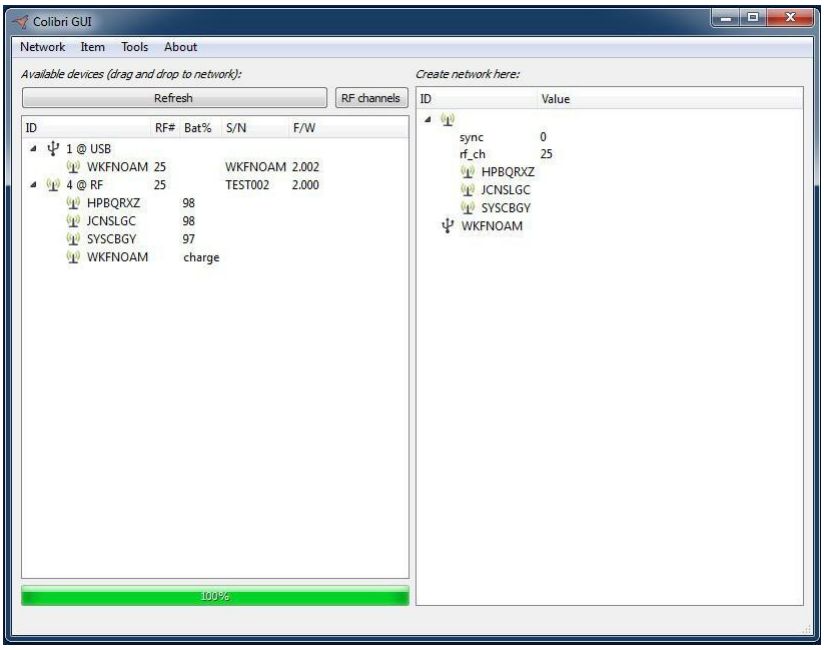
7.If Alignment at the end of calibration is similar to the identity matrix - apply it.

8.Check the calibration using Multiorientation. We suggest to place the sensor on a flat surface far from iron objects and electric appliances. Align the sensor. Rotate sensor by 90-180-270-360 degrees. We consider calibration successful if the angle error is less than 3 degrees.

9.Save in case of good calibration.

10.Use “Tools”>” Multiorientation” to check the sensor.





Colibri GUI is used to configure the Colibri trackers, to check the battery level, to perform magnetometer calibration and so forth.

4.1 Top Menu

Network

New
To establish a new network.

Load from Hardware
To load a configuration previously created from an USB dongle.

Open…
To load a configuration from a *.xml file.

Save…
To save a configuration to a *.xml file.

Save to Hardware
To save a configuration to an USB dongle.

Exit
To quit the application.

ITEM

Add Node
To add to network a new node. (May be added a node to a gate).

Add Gate
To setup a new wireless gate.

Delete
To delete nodes and gates from the "create network here" box.

Tools

Quick Configuration
After placing the trackers and dongles icons in the "Create network here" box click on "Quick configuration" to finish the configuration. By clicking on "Quick Configuration" you disable all tracker channels (Accelerometer, Gyroscope, Magnetometer, Temperature). Enable the orientation only.

Multiorientation
To test the function of all trackers currently placed in the "Create network here" box.

Multiorientation…
To change the settings for Multiorientation.

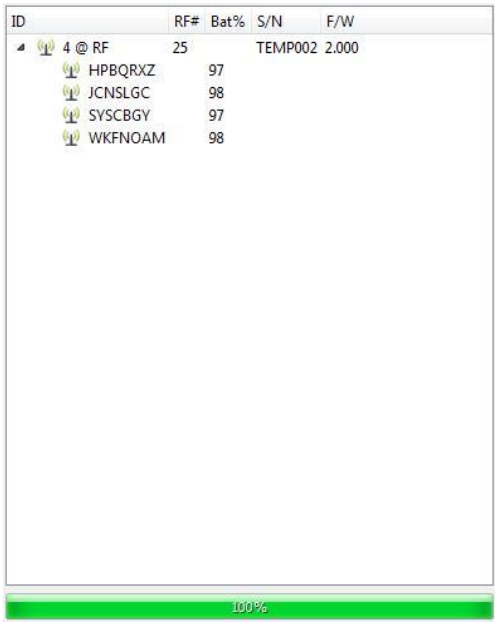
Settings
To change the settings for trackers.

About
To display the version of Colibri GUI.

Refresh
To search for new connected trackers.

RF channels
To check for free frequencies in the frequency range of the 2,4 Ghz Band.

4.2 Available devices box



Here are all trackers and dongles listed that are recognised by the Colibri GUI software.

Let's have a closer look at the devices recognised by the software:

ID: Displays the type and/or the serial number

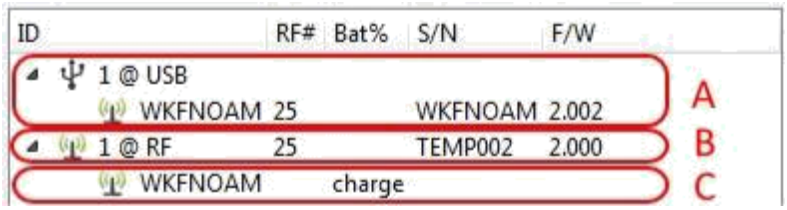
RF#: Radio channel of the dongles or trackers (notice: only if a wireless sensor is connected via USB, is the RF# being displayed here. Radio channel can be altered here.

BAT%: Shows the battery status in percent.
charge=battery is charging
0%=battery empty
100%=battery fully charged

S/N: Serial number (notice: only if a wireless sensor is connected via USB, is S/N being displayed here).

F/W: Firmware version (notice: only if a wireless sensor is connected via USB, is the F/W being displayed here).

Green bar with 100% Status of refresh



Example of one tracker connected to USB and also via wireless connection with one dongle.

A. Shows a wireless tracker connected via USB. The USB icon is showing at the top- left corner of the red square.1 shows the amount of trackers connected via USB. WKFNOAM is the serial number of the tracker. 25 is the RF channel of the tracker. It can be changed by clicking on the channel number. 2.002 is the firmware version of the tracker. You can change the Name (alias) of the tracker. To do so double click on the name or the antenna icon,enter a new name. Then disconnect and reconnect to USB port.(Notice: You can´t chance the serial number of the the device.

B. Shows a USB dongle connected via USB. Here you can see the transmitter icon with RF. RF# shows the Radio channel that the dongle is tuned into.You can change the channel number by double clicking on the channel number. TEMP002 is the serial number and the 2.000 is the firmware version of the device. (Notice: dongle and tracker must have the same channel.)

C. Shows a wireless tracker connected via wireless through a dongle. Here you have only two pieces of information. The serial number shown at ID WKFNOAM and the status of the battery, which is charging.

4.3 Create network here Box

ID: Shows the serial numbers of the trackers only.

Value: Shows settings of the dongles.

sync
Master-slave operation for 2 dongles.
master = for master operation
slave = for slave operation
0 = for single dongle operation

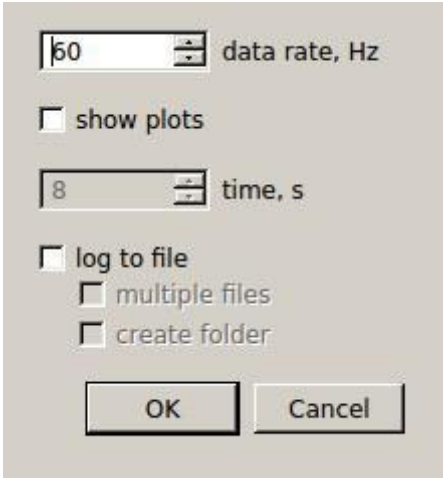
rf_ch
Changing the radio channel of the dongle.
(notice: dongle and tracker must have the same channel).

4.4 Multiorientation

Multiorientation is a data-capturing and visualization tool. When you run it via "Tools">" Multiorientation" menu, it starts with current parameters. By default, it only shows a rotating color cube for every sensor. You may customize *Multiorientation* view using "Tools">" Multiorientation…" customizing Multiorientation

show plots
Shows oscilloscope-like window with possibility to see plots of measurements – 4 independent channels capable to show every enabled measurement of any node.

time
Horizontal full-scale of plots.



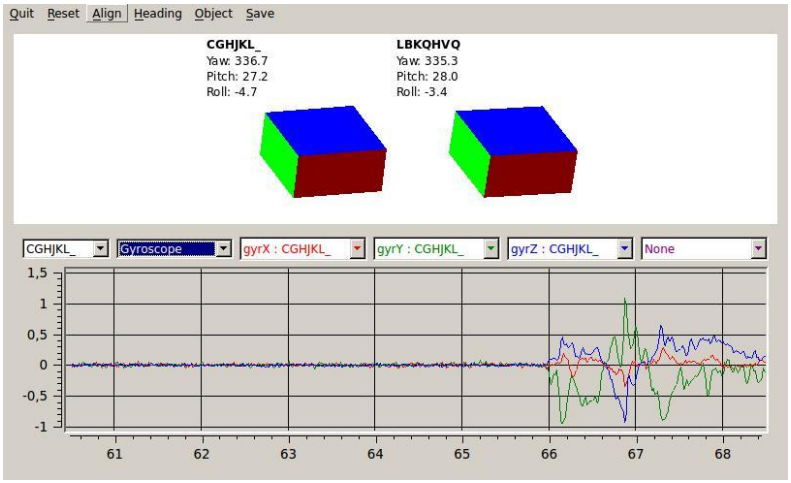
log to file
Every time measurement will be saved to disk in space separated values format (1-st line is header).

multiple files
Separate files are created for every node, named with node ID. Otherwise all measurements will be stored in single file, named output.txt. Different node measurements are separated by semicolon. If data of one or several sensors is missing – measurements are filled with zero, including timestamp.

create folder
Eith every run of Multiorientation a folder named current date/time will be created to store log files.

Running Multiorientation

Multiorientation dialog has several alignment options in menu:



Reset
No alignment is used

Align
Heading and object combination.

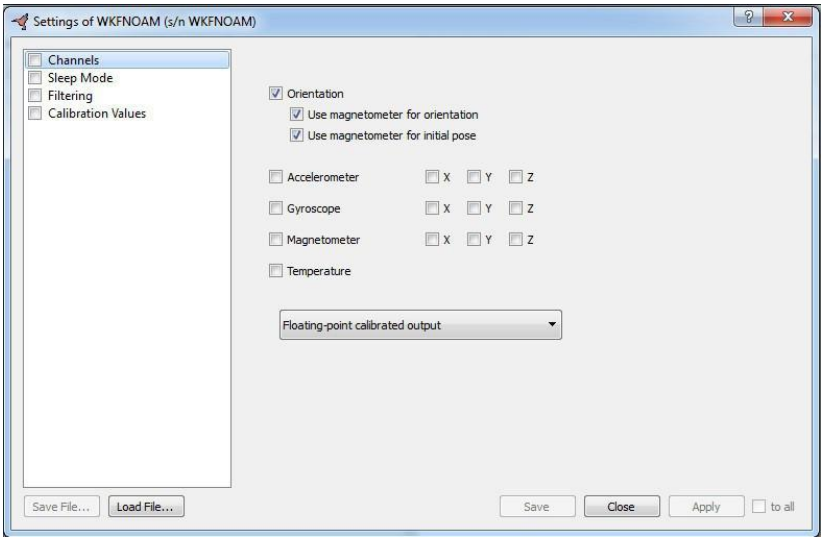
Heading
Set yaw to zero.

Object
Set pitch and roll to zero (horizontal orientation). New X-axis is the projection of sensor's X-axis to horizontal plane.

Save
Save alignment to sensor's flash memory and quit Multiorientation

4.5 Settings

With “Tools”>” Settings” you may change settings of one or all sensors in network. Right-click one of nodes in the Network window, and choose “Settings”. You will see multi-group Settings dialog, with settings of the chosen node. From the left you see the list of settings groups. Only settings from checked groups will be processed. After changing settings, you may:



1.Apply them on the device, without saving in flash memory.

2.Save them to the device’s flash memory.

3.Save to XML-file.

If **to all** flag is checked, settings from chosen groups will be transferred to all network's sensors.

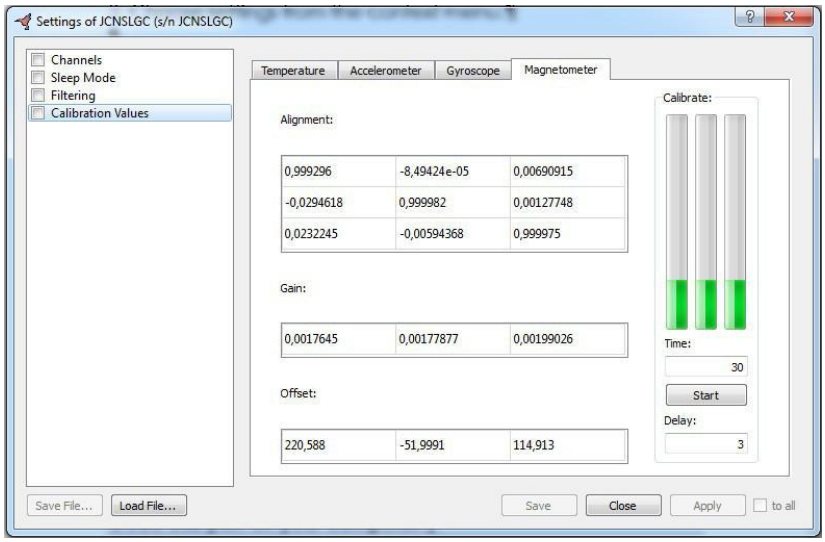
Measurement-channels
Choosing measurement channels, format and sensor fusion type.

Sleep Mode
Customizing sleep delay and wake-up method.

Calibration values
Calibration values may not be edited by user. GUI allows to make some sensor's calibrations. You may perform calibrations on all the sensors of network and check to all flag to transfer values to all the sensors, even if you see only calibration values of the current sensor.

4.6 Magnetometer calibration

Often users need to calibrate magnetic sensor at his place. It's necessary after embedding sensor in user's system, containing electronics and iron details. Magnetometer calibration will change Alignment, Gain and Offset values. Delay gives you some time to prepare devices before calibration starts, for example walk away from PC or from big iron objects.



1. Start calibration. After the countdown, 3 progress bars will increment successively.

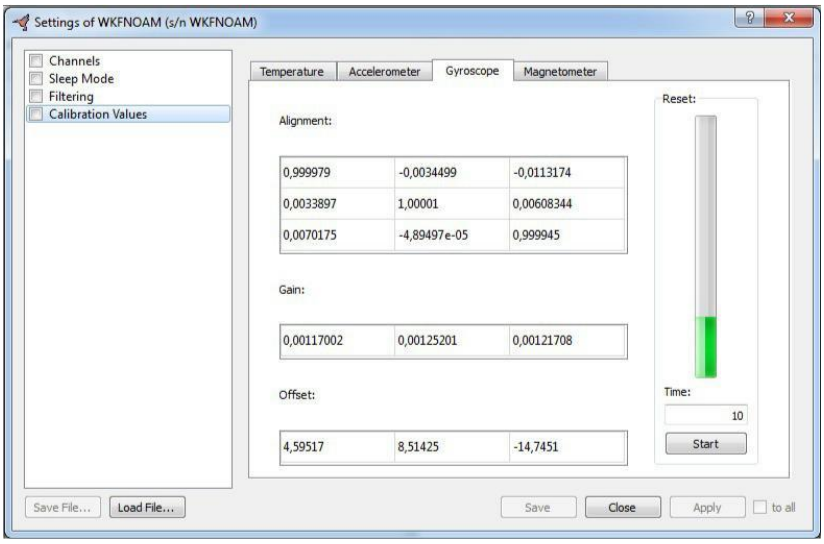
2.During this process, slowly rotate sensors in all directions. We suggest to perform 3 full turns in horizontal plane around Z, X and Y axes. Progress bars will help you estimate the necessary time for every turn.

3.If Alignment at the end of calibration is similar to the identity matrix - apply it.

4.Check the calibration using Multiorientation. We suggest to place the sensor on a flat surface far from iron objects and electric appliances. Align the sensor. Rotate sensor by 90-180-270-360 degrees. We consider calibration successful if the angle error is less than 3 degrees.

5.Save in case of good calibration.

4.7 Resetting Gyro Offsets



Gyroscope offsets can change over time and due to varying temperature during operation. Big gyro offsets will lead to orientation drift if you do not use magnetometers, or to greater noise in orientation, so you may want to reset it. To do so choose the reset time (the longer, the better), push Start and leave sensors motionless. Apply changes in the end.

4.8 Setup Radio Channels

Let's put together all the steps needed to switch the network to another radio-channel:

1.click "Network">" New from Hardware" to create network from currently available hardware, loading list of trackers and dongles from gate's flash memory.

2.Change dongles radio-channel by modifying "rf_ch" in the "create network here".

3.Click "Network">" Save to Hardware" to save radio-channels and list of trackers and dongles.

4.Click "Tools">" Multiorientation". You will see tracker/node not found! error message.

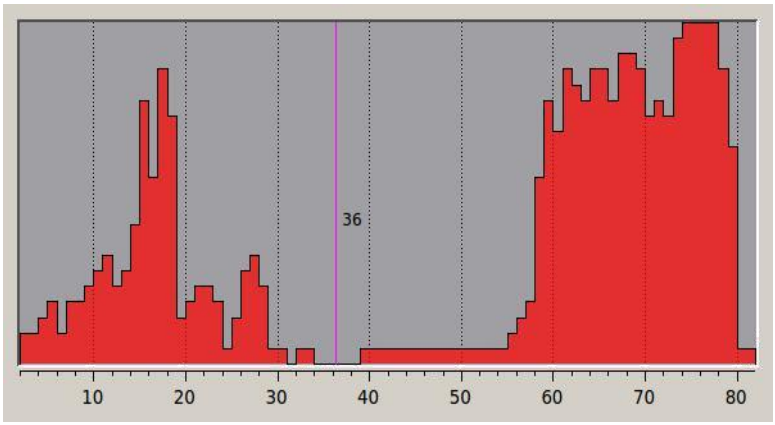
5.Put all trackers to scanning mode by holding trackers power button until LED starts to blink quickly. Then close GUI's error message with OK. Dongle will start to ping (during 20 seconds) all its nodes and make them switch to dongles radio-channel. Dongle blinks green/orange while there are still some trackers to switch. Trackers will stop blinking when it's switched to dongles radio-channel.

6.Click again "Tools"> "Multiorientation" and you will see visualization of working network.

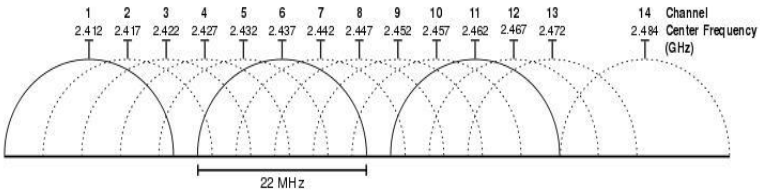
7.Close Multiorientation.

8.Click "Network"> "Save to hardware" to save radio-channels in trackers.

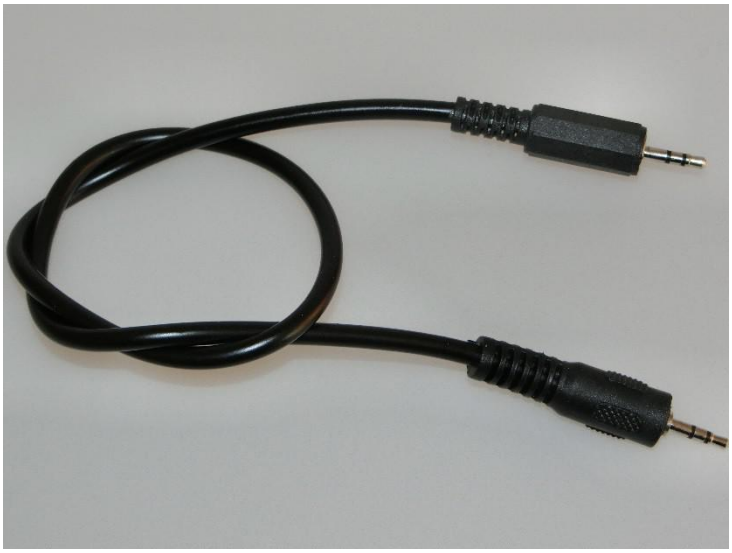
Use **RF channels** button to find a radio-channel, suitable for work. Channels where the interference was detected are red. The longer you wait, the more precise will be the histogram.



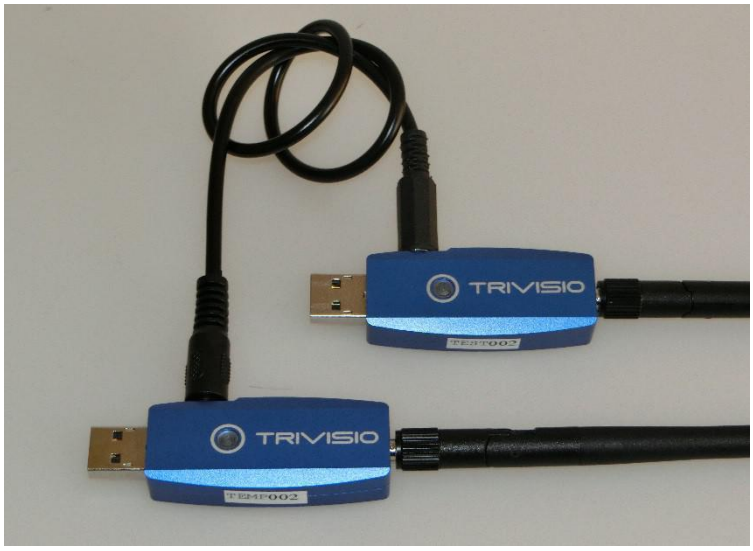
Channels are in range from **2** to **81**. It corresponds to 2.4**02** . . . 2.4**81** GHz. Please see correspondence of Wi-Fi and Colibri channels at following figure (picture by *wikimedia.org*):



If you want to use more than 10 trackers at one location, it is necessary to use a dongle link cable.



Colibri dongle Master Slave cable

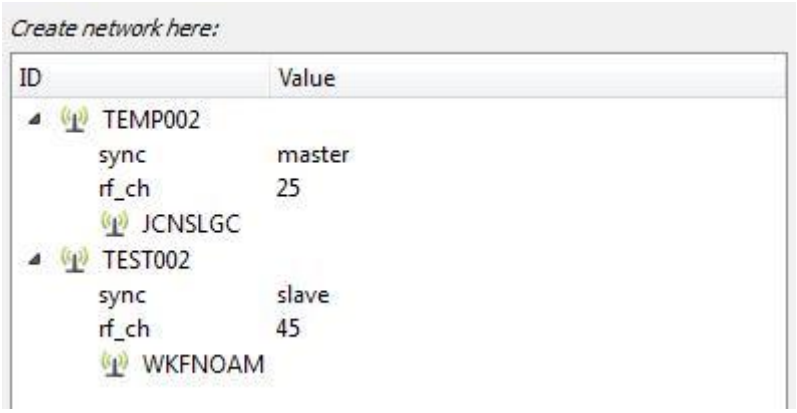


Colibri Master Slave configuration

1.You have to configure the channels of the colibri so that you have at least 20 space between both dongles. For example, dongle one set to channel 25, dongle two set to channel 45.

2.Set one dongle to master the other so slave via the “create Network here box” sync parameter.

3.Configure max 10 trackers to channel 25 and the other 10 trackers to channel 45.



Example of a network with two dongles, two trackers, different channel numbers and master-slave configuration.

6 Software Development Kit (SDK)

More details about developing own applications using the Colibri is available in the separate manual "ColibriAPI Documentation". This manual describes the API and structure of the Colibri software. The manual can be found in the installation folder (Start, Programs, ColibriAPI x.x.yyyyyyyy (zz-bit) or downloaded separately from our website www.trivisio.com.

7 Maintenance and Cleaning Instructions

To clean the trackers and dongles, use a damp cloth. Do not use any kind of cleaning liquids .

In case of damage contact your retailer. There are no user serviceable parts. Only qualified service personnel should perform any service required on this product.

Problem	Cause	Remedy
dongle not detected by MS-Windows	Windows conflict.	Try unplugging and re-connecting USB cable again.
Software does not detect the dongle	Drivers not installed	check your device in the Microsoft Windows® device manager
Software and GUI does not work correctly	Old firmware	Update firmware to version supplied with the GUI.
Problems with Magnetometer	Magnetic interference	Pay attention to any Ferro magnetic metal in the surrounding. This could be for example table-legs. Recommended is a distance of >1m. 2. Calibrate the magnetometers in working conditions (attached to the tracking object) described in 4.1
Tracker won´t turn on	Empty battery	Charge the battery for 2 hours
Dongle don´t find any trackers	Wrong RF Channel set in tracker or dongle	Do procedure describe in 5.6 Setup Radio Channels

If you have still problems write a e-mail to: info@trivisio.com

9 Returning used electronic devices in EU countries

	This Colibri inertial measurement unit (IMU) and accessories shall not be treated as household waste. The separate collection is a condition for reuse, recycling and utilisation of used electronic devices, which ensures the protection of resources. To comply with German ElektroG (Ruecknahme und Entsorgung von Elektro- und Elektronikaltgertaeten) and European WEEE (Waste Electrical and Electronic Equipment) electronic used devices from private households can be returned free of charge. For details please contact your local distributor or directly Trivisio Prototyping GmbH (www.trivisio.com).

Tracker Specifications

Accelerometer		
	Scale:	±6 g
	Resolution:	13-bit
Gyroscope		
	Scale:	±2000 °/s
	Resolution:	16-bit
Magnetic sensor		
	Scale:	±1.3 Ga
	Resolution:	12-bit
Temperature sensor		
	Accuracy:	±0.5 °C
Operation Temperature:		0 to+55 °C (self-powered) 0 to+40 °C (charging)
Working frequency		100 Hz
Orientation accuracy		Pitch/ Roll: 0.5 ° Yaw: 2.0 °
Non-volatile memory for user data		1024 bytes
Power consumption		3.7V Li-Pol battery 595mAh 40 mA
Dimensions		56 x 42 x 17 mm
Weight		41 grams

Subject to technical modifications

RoHS Certificate of Compliance

Trivisio Prototyping GmbH hereby declares and certifies that the motion sensors Colibri-wireless are manufactured RoHS compliant according to the definitions and restrictions given by the European Parliament (Directive 2002/95/EC) and the Council of January 27, 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, except as those noted below. Trivisio Prototyping GmbH hereby states that any of the following list of banned substances are not in any part of the prototypes we supply except as noted.

Lead (Pb) 0.1 %
Hexavalent Chromium (Cr+6) 0.1 % Mercury (Hg) 0.1 %
Cadmium (Cd) 0.01 %
Polybrominated Biphenyls (PBB) 0.1 %
Polybrominated Biphenyl Ethers (PBDE) 0.1 %