Getting Started

Welcome to the 1042 user guide! In order to get started, make sure you have the following hardware on hand:

- 1042 Spatial Phidget
- USB cable and computer

Next, you will need to connect the pieces:

1. Connect your device to your computer using the USB cable.

Now that you have everything together, let's start using the 1042!

Using the 1042

Phidget Control Panel

In order to demonstrate the functionality of the 1042, the Phidget Control Panel running on a Windows machine will be used.
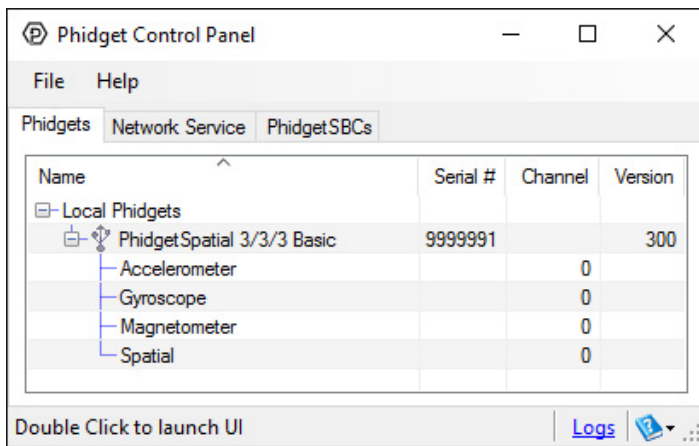
The Phidget Control Panel is available for use on both macOS and Windows machines. If you would like to follow along, first take a look at the getting started guide for your operating system:

- Getting started with Windows
- Getting started with macOS

Linux users can follow the getting started with Linux guide and continue reading here for more information about the 1042.

First Look

After plugging the 1042 into your computer and opening the Phidget Control Panel, you will see something like this:
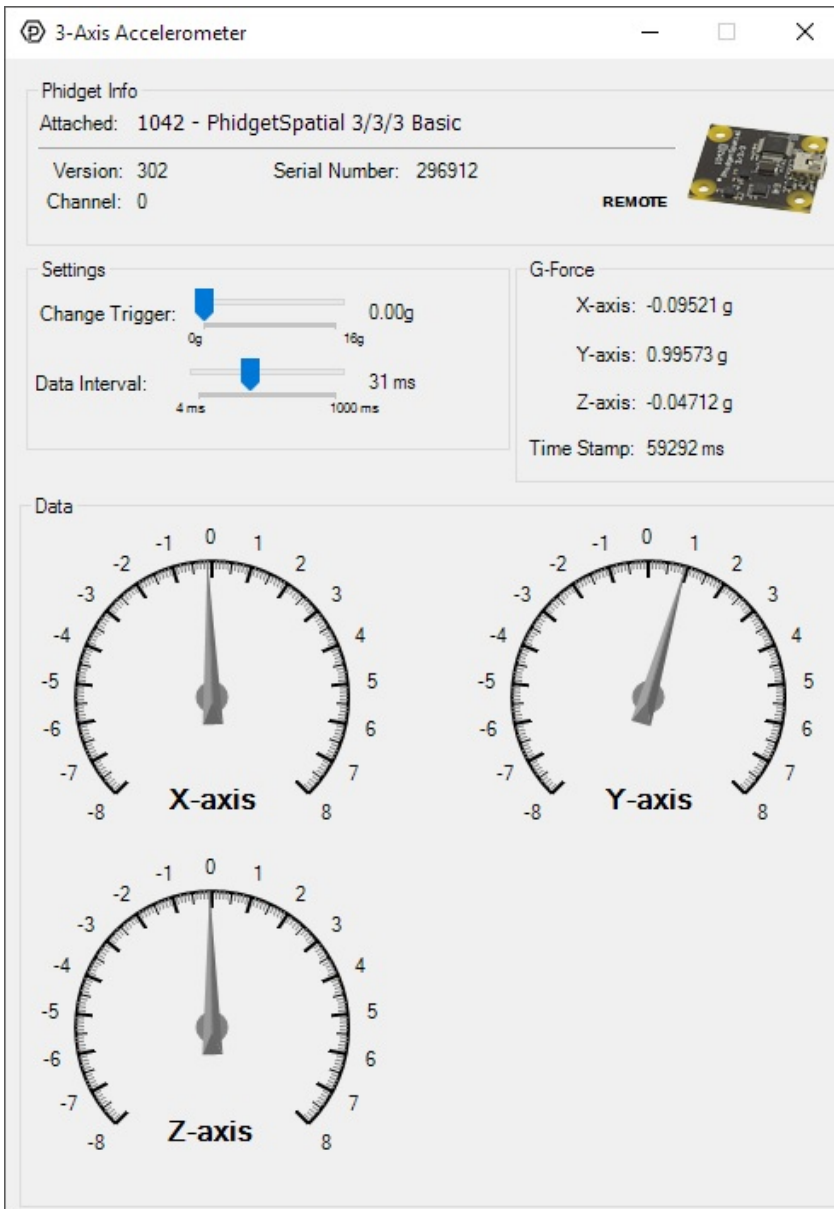
The Phidget Control Panel will list all connected Phidgets and associated objects, as well as the following information:

- Serial number: allows you to differentiate between similar Phidgets.
- Channel: allows you to differentiate between similar objects on a Phidget.
- Version number: corresponds to the firmware version your Phidget is running. If your Phidget is listed in red, your firmware is out of date. Update the firmware by double-clicking the entry.

The Phidget Control Panel can also be used to test your device. Double-clicking on an object will open an example.

Accelerometer

Double-click on the Accelerometer object in order to run the example:

3-Axis Accelerometer   —   □   ✕

Phidget Info
Attached: 1042 - PhidgetSpatial 3/3/3 Basic

Version: 302   Serial Number: 296912
Channel: 0   REMOTE

Settings

Change Trigger: ▼———————— 0.00g
                0g   16g

Data Interval: ——▼———— 31 ms
               4 ms   1000 ms

G-Force

X-axis: -0.09521 g

Y-axis: 0.99573 g

Z-axis: -0.04712 g

Time Stamp: 59292 ms

Data

X-axis

Y-axis

Z-axis

General information about the selected object will be displayed at the top of the window. You can also experiment with the following functionality:

- Modify the change trigger and/or data interval value by dragging the sliders. For more information on these settings, see the data interval/change trigger page.
- The measured values reported in g-force can be seen via labels as well as graphical dials. Try tilting the 1042 in different directions to see the labels and graphics change.
- An extremely accurate timestamp is also reported with the g-force values.

Gyroscope

Double-click on the Gyroscope object in order to run the example:

General information about the selected object will be displayed at the top of the window. You can also experiment with the following functionality:

- Modify the change trigger and/or data interval value by dragging the sliders. For more information on these settings, see the data interval/change trigger page.
- The *Zero Gyro* button is used to compensate for the drift that is inherent to all gyroscopes. The gyroscope primer has more information about this subject.
- The measured values reported in degrees per second can be seen via labels as well as graphical dials. Try rotating the 1042 in different directions to see the labels and graphics change.
- An extremely accurate timestamp is also reported with the g-force values.

Magnetometer

Double-click on the Magnetometer object in order to run the example:

General information about the selected object will be displayed at the top of the window. You can also experiment with the following functionality:

- Modify the change trigger and/or data interval value by dragging the sliders. For more information on these settings, see the data interval/change trigger page.
- Use the *Set Params...* button to set the calibration parameters. For more information about calibration, see the technical section.
- The measured values reported in Gauss can be seen via labels as well as a graphical diagram. The diagram can help you visualize the magnetic field vector.
- An extremely accurate timestamp is also reported with the Gauss values.

Spatial

Double-click on the Spatial object in order to run the example:

The Spatial example demonstrates that you can receive data from the accelerometer, gyroscope, and magnetometer all at once by using the Spatial object rather than the other three objects individually.
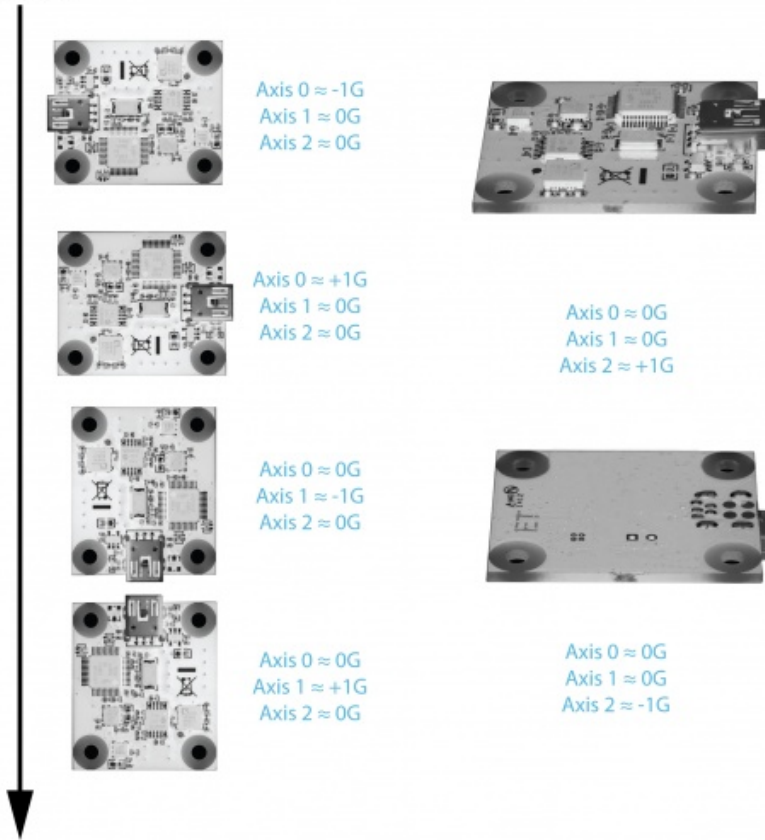
Technical Details

3-Axis Accelerometer

The 1042 has a 3-Axis accelerometer that can measure ±8 g (±78 m/s2) per axis. It will measure both dynamic acceleration (change in velocity) and static acceleration (gravity vector).

Orientation

GRAVITY

Axis 0 ≈ -1G
Axis 1 ≈ 0G
Axis 2 ≈ 0G

Axis 0 ≈ 0G
Axis 1 ≈ 0G
Axis 2 ≈ +1G

Axis 0 ≈ +1G
Axis 1 ≈ 0G
Axis 2 ≈ 0G

Axis 0 ≈ 0G
Axis 1 ≈ -1G
Axis 2 ≈ 0G

Axis 0 ≈ 0G
Axis 1 ≈ +1G
Axis 2 ≈ 0G

Axis 0 ≈ 0G
Axis 1 ≈ 0G
Axis 2 ≈ -1G

When working with an accelerometer it is important to know which is the positive and negative direction on each of the axes. This can be determined by orienting the accelerometer along each axis and checking the output. The above image shows what the axis readings should be for each orientation of the 1042.

For more information on how to use the accelerometer, check the Accelerometer Primer.

3-Axis Gyroscope

For more information on the gyroscope, see the Gyroscope Primer.

3-Axis Magnetometer (Compass)

The magnetometer reports the sum of all magnetic fields acting on the 1042. The Earth's magnetic field is only one source that affects this measurement. In order to get accurate bearing data from the magnetometer (i.e. to find magnetic north as a compass) any interfering magnetic effects need to be calibrated out. For more information about calibration, see the section below, or the Compass Primer.
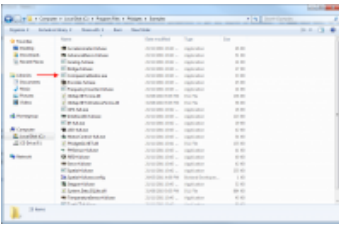
Any magnetic field that is stationary with respect to the 1042, and less than ± 3 Gauss, can be calibrated out of the magnetic field measurement. This includes both hard and soft iron effects caused by nearby ferrous and magnetic materials. Interfering magnetic fields that vary in strength and orientation with respect to the 1042 can not be easily calibrated out.

Magnetic field data will become unavailable during every other sample as the compass performs internal calibrations. When this happens, the magneticField array in the SpatialData structure will either have a length of zero, or each element will equal PUNK_DBL, depending on the API being used. This needs to be handled explicitly in the event handling code to avoid erroneous program behavior. The maximum sampling rate of the compass is 125 Hz.
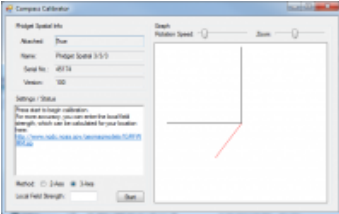
Magnetic Error Correction (Calibration)

In order to get numbers of useful accuracy from the 1042's compass you will need to provide calibration parameters. To make determining them easy, we distribute a program with our drivers that does this for you.
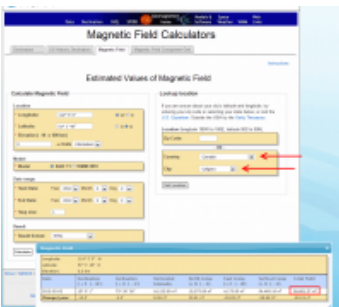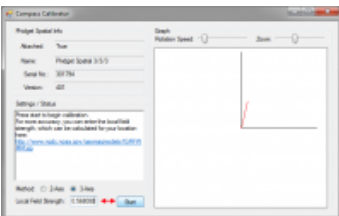
To calibrate your compass:

- Navigate to the Phidgets installation folder on your computer. Open the 'examples' folder and find the Compass Calibrator program.

- Start the program and find the link in the Settings/Status text box. Go to the website listed. (http://www.ngdc.noaa.gov/geomag-web/#igrfwmm)

- Select your country and city. Click 'Get Location' and then 'Compute'. A table of values will show up in an overlaid window. The value you will need is the 'Total Field' value in nT.
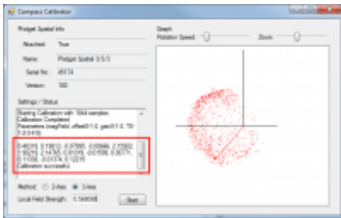

- Enter the magnetic field value into the calibration program. Note that it wants the field strength in Gauss, not nT like the website gives you. 1T = 10000 Gauss so you can divide by 1x10^5 to convert to Gauss.
- Depending on what your application is this step as well as the next step might be a bit different. If you are intending on mounting the 1042 onto a large vehicle such as a car then you should mount the 1056 securely to the vehicle in its final intended position then check the 2-axis bubble, click the 'Start' button.
- If you are using a smaller, more easily handled vehicle such as a small robot (something you could physically pick up) you will mount the 1042 and use the 3-axis calibration instead. Click 'Start'.

- Rotate the compass around (including whatever equipment you have mounted it to) such that the red dots being generated on screen outline as much of a full sphere (in 3-axis) as possible. This will take several minutes. Being perfect is not necessary but try to be as thorough as time permits. Once done, click stop.
- If you are in a large vehicle, you will be aiming to fill out a disc instead of a sphere. This can be done by simply driving around for a few minutes making sure to do complete turns in the process.

- Take the parameters displayed in the text box and use them for your compass. For example in C#:

```
setCompassCorrectionParameters(0.51075, 0.18820, -0.07456, -0.02209, 1.87163, 1.87640, 2.125
```

For more information on magnetometers (compasses), see the Compass Primer.

What to do Next

- Software Overview - Find your preferred programming language here to learn how to write your own code with Phidgets!
- General Phidget Programming - Read this general guide to the various aspects of programming with Phidgets. Learn how to log data into a spreadsheet, use Phidgets over the network, and much more.
- Phidget22 API - The API is a universal library of all functions and definitions for programming with Phidgets. Just select your language and device and it'll give you a complete list of all properties, methods, events, and enumerations that are at your disposal.