

Using a magnetometer with a SimpleBGC 32 bit controller

A magnetometer helps avoid horizontal drift of the gyroscope, the same way as an accelerometer does with vertical drift. But the use of a magnetometer is not always justified, since the process of measuring Earth's magnetic field is much less accurate and reliable than measuring gravitational acceleration when using the accelerometer. Furthermore, with installation of a magnetic sensor on the gimbal comes the need to exclude the impact of the distortions caused by structural metal elements, permanent magnets and motor windings, which may further complicate the process and reduce the sensor's effectiveness in application.

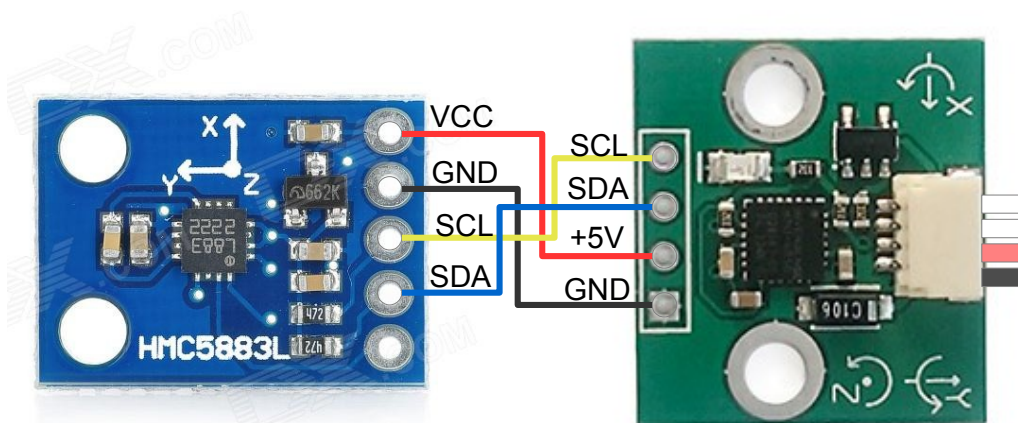
The use of the magnetometer is justified when shooting lengthy scenes in the Lock mode to avoid the direction drift or in order to determine the exact orientation of the camera in the 3D space based on all three coordinates, so as to allow for external GPS-aimed control.

Supported sensors and connectivity

The HMC5883L sensor is a currently supported affordable and popular model. A wide variety of modules using this sensor are available for purchase. When selecting a sensor, bear in mind the following requirements:

- It must support +5V
- It must be compatible with 3.3V logic (no LLC 5V for Arduino).
- There should be no pull-up on the SDA and SCL lines; they should be connected to the embedded +3.3V voltage regulator, not to the +5V!

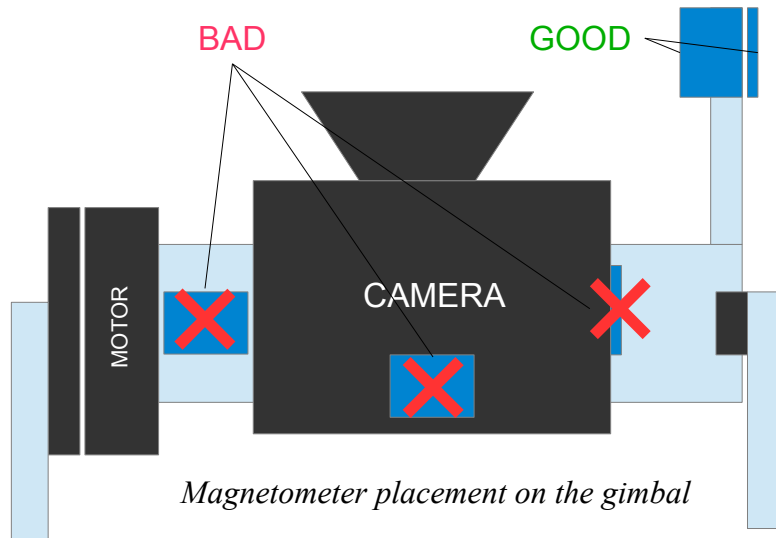
The GY-273 module meets these requirements. As an example, the module's connection to the main IMU is shown:



Magnetometer connection

Installation on the gimbal

The sensor is mounted on the same platform as the camera. The axes may be oriented randomly, but it is important to ensure that the axes of the magnetometer are positioned parallel to the axes of the main IMU sensor. If the gimbal or the camera contain metal parts with ferromagnetic properties (iron, steel, etc.), the sensor must be mounted as far from them as possible. The sensor must also be mounted as far as possible from the motors. For instance, the sensor can be offset on a 10-20 cm boom.



Setting up the magnetometer in the GUI

Once the magnetometer is properly connected to the I2C bus, and 2.50b4 or greater firmware is loaded, a new "Mag.Sensor" tab will appear in the GUI, enabling the magnetometer's calibration and setup.

Position of the axes

To ensure its proper operation, the position in which the sensor is mounted on the gimbal must be specified. First, if the sensor's axes are not indicated on the module, determine their direction by using the key spot on the sensor chip:



In the Axis TOP parameter, specify which axis is aiming up. In the Axis RIGHT parameter, specify which axis is aiming right, as viewed in the direction of the shooting (as shown in the example, Axis TOP = Z, RIGHT = Y). Enter the settings in the controller and wait for it to reboot.

Magnetometer calibration

Attention! For proper calibration, the sensor must be mounted on the gimbal!

Make sure that the Magnetometer Trust parameter is set at a value different from 0 (because the 0 setting disables the magnetometer).

Only simple calibration is currently supported. Press the Calibrate... button to launch Calibration Assistant. In the window that opens, press the RESET button to reset the existing calibration. Then press the CALIBRATE button. You will have about 40 seconds to locate the points with minimum and maximum values on all three axes of the sensor. Monitor the sensor readings using the diagram, where the current highs are marked with risks. Turn one of the sides of the sensor roughly to the north and randomly rotate it up and down by ± 90 degrees. Repeat for the other two sides. Do the same on the reverse sides of the sensor. Once the calibration is complete, data is automatically recorded in the EEPROM. If the procedure is executed correctly, the sensor will display values in the range of ± 1 on the diagram on random movements.

Monitoring the magnetometer's effectiveness

The calibration window displays the absolute difference between the North direction measured by the magnetometer and the same angle measured by the gyroscope. As you know, in the short term, the gyroscope (along with a properly calibrated accelerometer) provides a very accurate reading. If the error remains in the green or yellow sector during all the camera pans and tilts, this means that the magnetometer is working correctly and can be used to correct the drift of the gyroscope. If the error increases significantly, the magnetometer should not be used. This may be due to a number of reasons:

1. The orientation is set incorrectly. Check axis TOP, RIGHT settings;
2. Inaccurate calibration;
3. Improper installation, resulting in an impact of moving metal structures of the gimbal or motor magnets;
4. There are strong disturbances or distortions of the magnetic field of the earth at this point, and the magnetometer is not working properly (for example, near the poles, the magnetic field is directed vertically and is virtually useless for determining the direction of the North. Metal structures of buildings may have a similar effect, so inside buildings magnetometer should be used with great care).

Other settings

- **Magnetometer trust:** the greater the parameter, the stronger the correction of the current heading direction (YAW angle) by the magnetometer. If the result of the effectiveness test is good, you can use higher settings (50-100). Setting it at 0 disables the magnetometer.
- **Magnetic declination** – Magnetic declination refers to the angle between the geographic and magnetic meridians on the Earth's surface where you are. The exact number can be found in reference sources or on this map <https://upload.wikimedia.org/wikipedia/commons/2/28/Mv-world.jpg> This parameter is only required for systems that rely on the precise location of the geographical North (for example, for coordinating camera movements with a GPS when). In most cases, it can be set at 0.