Frequently Asked Questions (FAQs)

OS5000 & OS4000 Family of Compasses FAQ Document Rev. 2.0

Important Notes: Please also reference the OS5000 family user guide & OS4000 user guide on our download page.

Q. What is the standard OS5000/OS4000 string and can I change it to a different format ?
A. OceanServer's standard digital compasses output heading, pitch, roll and temperature. You can change the displayed parameters such as adding the raw 3 axis accelerometer and 3 axis magnetic sensor data. There are also several different compass formats to choose from (Standard Compass String: $C320.5P0.2R-18.3T19.0*3C)

Q. Is there any way to check the heading accuracy?
A. A precision compass will measure the field very accurately. If you're near ferrous metals, DC currents or magnetic devices (motors), etc, the earth's field will be distorted. This can cause a large error in heading. You can verify the field distortion by using a second compass and comparing results to the OS5000/OS4000 (for example: a low cost magnetic needle compass is a quick and simple way to see how your equipment shifts the position of true north).

Q. Can I use the OceanServer factory calibration for my compass application?
A. No, you will want to run your own calibration. The calibration from the factory is mainly a functional test to confirm everything is working properly with your new compass. You will want to run your own calibration once you have installed the compass in the end device and also consider running both hard and soft iron calibration routines for the best accuracy.

Q. How often do I have to calibrate my compass?
A. The compass calibration removes the magnetic effects of the enclosure where the compass is contained. If this device has very low ferrous structures (non-magnetic or non-iron like) it may be able to hold its calibration indefinitely. If the system has magnetic materials whose properties shift as the device is magnetized or components

shift, you should recalibrate. Remember just moving your system through the earth's magnetic field can be enough to change the magnetization.

 In the example of our Iver2 AUV (Underwater Robot) which has battery packs (steel cases are very magnetic) and motors (rare earth magnets);

   Case #1: If we mount the compass above the battery rack the batteries are like strong bar magnets and produce a very large field, 3x the earth's field.   When mounted here the calibration can shift in a day and have a 5 degree error in heading.

   Case #2: Mounting the compass in front nose of the AUV away from the batteries (14" distance) the background field is less than an order of magnitude.   A calibration in Fall River (OceanServer office) will provide accurate results when the device is shipped 2000 miles by UPS.

The moral of this story is that distance from ferrous components is key, the effect falls off as the $1/d^3$ (the cube of the distance).

Q. Should I be concerned about other components in my system in the near vicinity of the compass?
A. Yes, many components contain ferrous materials. Nickel will commonly be found in integrated circuit designs. Other components such as batteries, speakers, power transistors with iron, microphones can all present issues. The compass should be kept a safe distance from these items. The fields fall off as an inverse cube or square of the distance so doubling the distance reduces the field strength by ¼ or 1/16.

Q. Where do I mount the compass in my device for the most accurate operation?
A. The compass accuracy is effected by hard iron (material that can become magnetized like Iron and Nickel) and soft iron (material that can distort magnetic fields but not before being magnetized).   The solution to the problem is twofold:
   1) Mount the compass as far as possible from these materials. The effects of a magnetic dipole fall off as $1/d^3$ (one over the cube of the distance) so its effects get weak fast, and the effects of soft iron fall off as $1/d^2$ (one over the square of the separation distance).
   2) Calibration to remove the effects of hard iron and soft iron. The calibration is valid as long as the background effects do not change too much.   In the case of battery packs the cases are almost always made of steel and they are magnets and can change magnetization.

Q. Can I degauss my device or the compass to reduce the effects of hard iron?
A: Yes, you can degauss or demagnetize your device before calibration.   If it re-magnetizes you will have to re-calibrate the compass but this need is reduced by keeping a larger distance between the compass and any ferrous material in your system.   In the case of our AUV we lower the field strength of our battery packs and they typically do not get re-magnetized anywhere near this level from moving through the earth's magnetic field.   Ref. large commercial degasser: http://www.rbannis.com/products/demags.html

*** The notes on fields falling off at 1/d^2 should say 1/d^3.

Q. Can the compass be calibrated indoors in a metal building?
A. For the highest accuracy you should calibrate the compass in its final mounting outdoors away from cars or metal structures. The compass will learn a hard iron offset of the steal building if calibrated indoors and will have errors in a clean environment.

Q. What is the impact of metal structures in the field?
A. The compass calibration routine will make corrections for the device in which the compass is mounted. The earth's magnetic field will be distorted by magnetic anomalies that may existed in the outside world such as a steel bridge, building etc. The compass heading will be impacted by the degree of the distortion while passing by such stationary structures. This is the case with any digital compass since they can only measure the earth's magnetic field, which is present.

Q. Can I add a declination value?
A. Yes, a fixed heading offset can be applied to all heading output data. In most cases this is used to adjust for local compass deviation in your area. This information can be found on the web using the World Magnetic Model and you local Latitude, Longitude.

Q. Can I shield my compass against disruptive magnetic fields?
A. In most cases, it is probably not recommended. Shielding material selection should be carefully chosen to not block the earths magnetic field to the sensor, or placed too close to the compass when both electric and magnetic field shielding is necessary. OS5000/OS4000 compasses do offer both soft and hard iron calibration routines.

Q: What if I put my compass near a receiving or transmitting radio antenna?
A: In most cases, there are no performance issues with the compass, very strong electric fields should be looked at closely. Precautions should be taken if the electric field strength gets excessive and impacts the OS5000/OS4000 module directly.

Q. Will the compass operate at the North and South Poles?
A: No, at the North and South poles, the magnetic field is vertical and gives no indication of direction. This is the case with all compasses.

Q. How should the compass board be oriented?
A: The factory mounting is always horizontal to the earth's surface. Additional, mounting positions can be selected in the firmware (with some exceptions). These are covered in the user manuals. Once the compass is put in a new orientation, it is critical to run a fresh calibration.

Q: I want to mount my compass on a moving platform with motors and or generators in the near vicinity. Will this impact the OS5000/OS4000 compass?
A: Yes, electric motors usually generate magnetic fields that can disturb the compass. Shielding motor or generator housings can reduce interference but you should be careful

not to shield the compass from the earth's magnetic field. Some trial and error maybe required to locate the compass when mounting near motors.

Q. Can you measure 360 degrees of tilt?
A: Yes. Roll data is measured at +/-180 degrees (full 360 degrees). Pitch angle is +/- 90 degrees. However, at high angles the accuracy of the angle estimate is decreased and worse near vertical angles (note accuracy specifications in user guide).

Q. What is the sample rate of the compass?
A. The factory default rate is 7MHz (7 samples per second). Users can set the compass output rate between -50 to +40. Rate is in samples per second and negative are seconds per sample. .i.e. 20=20 samples/second, -10=10 seconds per sample. A rate of 0 will stop the compass output completely. Note, it is always better to run at a higher baud rate, if you increase the compass output rate towards 40 MHz you need to increase the baud rate to 115k.

Q. When should I calibrate the compass?
A. You should run through the calibration process once the compass is installed in the device where it will be used and mounted (see the OS5000/OS4000 family user guide for step by step instructions). This calibration will be saved going forward. You can always recall the original factory calibration if required. You should consider recalibrating the compass in the event a significant design change is made to the device where the compass is installed.

Q. What if I make a mistake while calibrating the compass?
A. Just start over, it only takes a few minutes (reference the user guide).

Q. How is the compass impacted by applications that have a lot of dynamic motion such as UAVs?
Most digital compasses use accelerometers to measure the force of gravity to determine tilt. This measurement is used to calculate an accurate magnetic heading, pitch and roll data. Accelerometers will provide disturbed data in applications with lots of dynamic motion (such as UAVs performing banking turns). Such applications will most likely require sensors that include gyroscopes and not just accelerometers.

Q. Is there anything I can do about vibration that is impacting my compass?
A. Accelerometers are impacted by dynamic motion and vibration. OceanServer digital compasses have several filters that can be tried to lessen the impact of vibration (reference the user guide). Applications with lots of vibration are not well suited for accelerometer based products.

Q. What software programming help is available with the compass?
A. Visit OceanServer's download page and look at the software programming notes at the end of the user guides. http://www.ocean-server.com/download.html

Q. How do I know if the compass will fit in my product?
A. The OS5000 family of compasses are all 1" Square and the OS4000 is .6" square. Users can also visit the OceanServer download page and pull down 3D Models (IGES

files) and Mechanical Drawings. http://www.ocean-server.com/download.html

Q. What metals and other factors should I be concerned with in my device?
A. Non-ferrous metals (not including iron) like aluminum, copper, or brass do not block the earth's magnetic fields although currents can flow through them which can impact compasses. Ferrous metals such as nickel, steel, and iron will distort magnetic fields. Given that compasses use the earth's magnetic field, ensure the compass has sufficient distance from ferrous objects that could bend the field. Hard iron issues are typically cancelled out by the standard calibration, however, digital compasses should not be fully incased in a ferrous design. Also note; batteries typically contain a magnetic signature and electric motors generate magnetic fields that will impact compass performance

Q. What is the difference between soft and hard iron distortions?
A. "Soft-iron" effects are caused by un-magnetized ferrous materials in the vicinity of the OS5000/OS4000 compass. "Hard-iron" effects are caused by magnetized ferrous materials and constant for a fixed position . Hard-iron effects are typically cancelled out when you calibrate your compass. Soft-iron effects should be addressed in the design stage, by giving the sensors appropriate clearance from ferrous content. OS5000/OS4000 compasses with firmware 1.4 and later have the option to run a soft iron calibration routine.

Q: I want to make or source my own cables, what is the pin out for my compass?
A: The pin out and connector information is covered in the user guide. The user guide can be found on the download page. http://www.ocean-server.com/download.html

Q: Are the magnetic sensor products RoHS compliant?
A: Yes, with some limited acceptations.

Q: My OS5000/OS4000 compass does not seem to work? How do I determine if the product is not working or just a setup issue?
A: You should first check that there are no cabling issues and that power is applied. All compass designs present themselves as serial port devices, the default data settings are 19200bps, 8-bit data with 1- stop bit and ASCII formatted syntax. Compass data can be viewed in a terminal program such as hyperterm or by using OceanServer's compass demo program. Assuming all setting are correct OS5000/OS4000 compasses send a 7MHz streaming data string once power is applied. Note the OS5000-US (only) which offers both USB and Serial requires the installation of a driver for the bridge chip used on the board.   If this does not work send email to support@ocean-server.com for more suggestions.

Customer Support

Send technical questions to: support@ocean-server.com

Related Publications:

For more information on the OS5000 and OS4000 Compasses download the hardware user guides (link below).

http://www.ocean-server.com/download.html