

Top View

MicroPilot



Front View

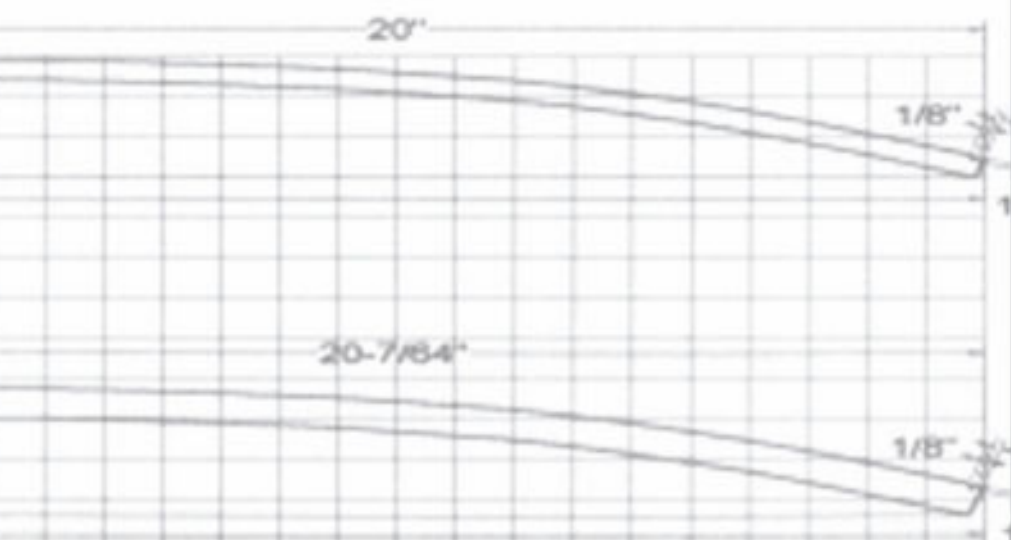
Spar
Make 4

Electronic Compass User Guide

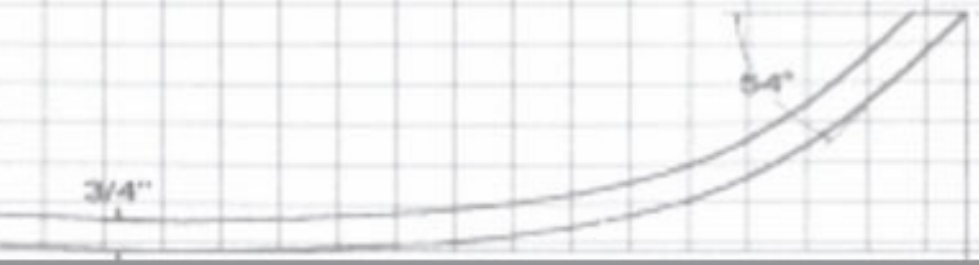


Side View

Front View
Strut
Make 12



Rib



3/4"

54°



Electronic compass user guide

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The compass module is a three dimensional compass that can compensate for pitch and roll. Use the compass module in applications where GPS headings are inaccurate or unreliable, such as

- In a hovering aircraft which cannot use the GPS for direction when hovering
- In slow moving aircraft, like a blimp, in which GPS headings are unreliable
- For dead reckoning if the GPS is lost
- When operating the autopilot in strong winds

About compass heading and GPS heading

The compass heading is the direction in which the nose of the aircraft is pointed. The GPS heading is the direction in which the aircraft is travelling. Because wind causes the aircraft to drift, compass heading and GPS heading are rarely the same.

In an extreme example, assume the wind is 80 km/hr from the north, the aircraft has a compass heading of north, and an airspeed of 60 km/hr. The GPS will indicate that the aircraft is moving south with a groundspeed of 20 km/hr.

When flying in a quartering headwind you would turn the aircraft slightly into the wind to hold to the planned flight path. The GPS indicates the direction the aircraft is moving. The compass indicates the direction the aircraft is pointing.

If you know the compass heading, GPS heading, airspeed, and ground speed, you can calculate the direction and intensity of the wind.

Autopilot requirements

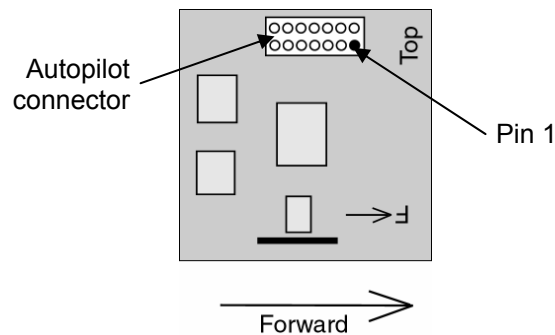
- MP2028^g or newer MicroPilot autopilot
- Autopilot firmware version 20030912 or later

You can download the most up to date firmware from the MicroPilot support web site at <http://www.micropilot.com/support/>. You will need a user name and password to open this site. Email MicroPilot at license@micropilot.com to arrange access.

Installation

The electronic compass (Figure 1) has a double sided connector which connects to the expansion connector (P3) on the autopilot board with an expansion cable. The cable connects to the bottom of the module and other expansion modules stack on top.

Figure 1 Compass module



When mounting the compass module in the aircraft make sure that it is

- Mounted in the correct direction

Figure 1 shows the correct orientation of the module.

- Not near ferrous metals

Metals, such as iron and steel, will affect the accuracy of the compass. Non-ferrous metals, such as aluminum and brass, are okay.

Be especially careful not to mount the compass near ferrous metals that move during normal operation, such as steel pushrods. If you must mount the compass near moving metal, replace the moving part with one made of a non-ferrous metal, such as brass or aluminum.

Wiring and batteries are also common sources of ferrous metals and electromagnetic fields. Mount the compass as far away as practical from these sources.

- Far away from servos and electric motors

The electromagnetic fields created by these devices will affect compass accuracy, as will the electric fields around any of the wiring connecting servos and motors.

- Not affected by the induction and discharge a gas engine ignition system

Many gas engines use a magnet to generate a spark. The magnet is mounted on a flywheel which creates a varying magnetic field which will make the compass unusable.

When a spark plug discharges, there is a rapid change in the local magnetic field, which is sensed by the compass causing it to read incorrectly.

If you suspect that there is a problem, verify it by turning the engine over with a starter.

To prevent interference you could use an electronic ignition or a glow engine, mount the compass further away, or shield the engine.

For more information about magnetic field shielding, see the following Web sites. (These links were last checked on 03Dec2004)

- <http://www.magnetic-shield.com/faq/faq.html> for general information about shielding
- <http://www.lessemf.com/mag-shld.html> for information about shielding products
- http://www.mushield.com/design_guide.html for information about MuShield products

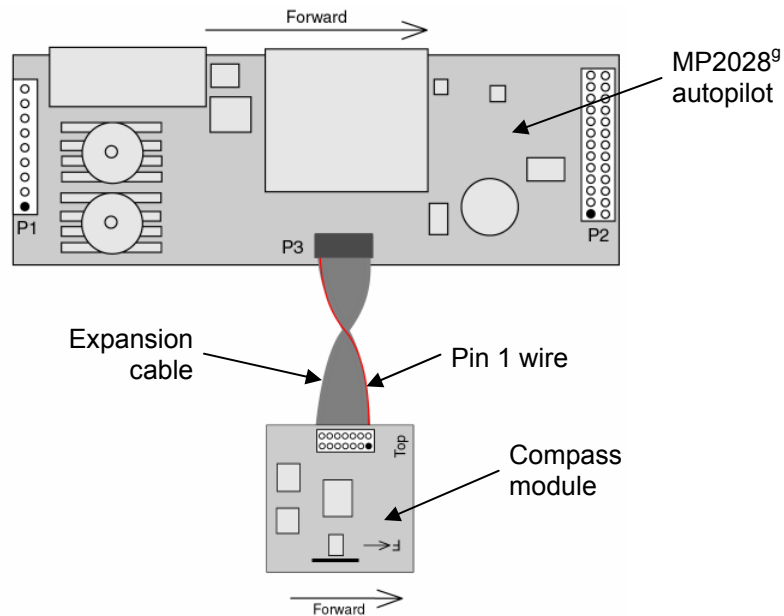
► **To install the compass module**

1. Mount the compass in the aircraft.

Make sure that the module is facing forward and is as far away as possible from ferrous metal, servos, and electric motors.

2. Connect the compass module to the autopilot with the expansion cable.

Figure 2 Autopilot and compass orientation



The expansion cable connects to the underside of the compass module.



The connectors on the expansion cable are **not** keyed. Take care to ensure that pin 1 from the P3 connector on the autopilot is connected to pin 1 on the ADC module.

Setup Calibration

Before using the compass for the first time you must calibrate it. If you move or replace the compass, you must perform the calibration again.

Calibrate the compass after you've installed it in the aircraft. By calibrating it after it's installed, the calibration process compensates for the effect of the fixed ferrous metals in the aircraft.

During calibration, it's very important to keep the compass horizontal or vertical, depending on the stage of the calibration. The closer the compass is to true horizontal and vertical, the more accurate the calibration will be. You can use plastic bubble levels to help keep the compass in the correct position during calibration.

If you are regularly calibrating the compass in the same UAV model, you might find it more efficient to build a support that tilts and rotates the aircraft during calibration. The support must not have any metallic parts, including screws, bolts, or nails. To fasten pieces, use dowels and glue or plastic bolts. Again, plastic bubble levels are useful for indicating precise position.

Don't set the declination until after the compass is calibrated. It's easier to check the accuracy of the calibration if you don't have add declination to the hand-held compass reading.



Do not calibrate the compass near ferrous metals, inside a metal building, or near electromagnetic interference. We recommend that you perform calibrations outside.

► **To calibrate the compass**

1. Mount the autopilot and compass in the aircraft as described in [Installation](#) on page 2.

Make sure that autopilot and compass are in the correct orientation as shown in [Figure 2](#) on page 4.

2. Connect the autopilot to your computer using a serial cable and initialize the autopilot. Position the computer within reach of the aircraft.
3. Start HyperTerminal and connect to the autopilot. (See chapter 4 of the *MP2028^g Installation and Operations* guide.)
4. Change field ID 94 (useCompass) to 1. (See chapter 13 of the *MP2028^g Installation and Operations* guide.)
5. Type KKKK to enter calibration mode.
6. Make sure that the compass is level and the aircraft is pointing north. Press <Enter>.
7. Slowly rotate the aircraft through 360°, keeping it level, then press <Enter>.
8. Roll the aircraft 90° so that it is on its side, then press <Enter>.
9. While the aircraft is on its side, slowly rotate it through 360°, then press <Enter>.

The autopilot writes the calibration data to flash.

10. Cycle the power on the autopilot.

Before using the compass, verify that accuracy of the calibration using the following procedure.

► **To verify the calibration**

1. Connect the autopilot to the computer using the serial cable and initialize the autopilot.
2. Start HyperTerminal and connect to the autopilot.
When the compass is enabled, the autopilot transmits the compass heading to HyperTerminal.
3. Using a hand-held compass as a guide, point the aircraft to the north and check the heading against the heading displayed in HyperTerminal.
The headings should be within 10 degrees of each other.
4. Repeat for east, west, and south headings.
5. Pitch the aircraft up 30 degrees and check north, south, east, and west headings.
6. Roll the aircraft 30 degrees and check north, south, east, and west headings.

If the electronic compass headings are not within 10 degrees of the hand-held compass, recalibrate. It may be necessary to reposition the electronic compass to achieve accurate readings.

Enable compass

The compass module is optional so the default setting in the `.vrs` file enabling the compass is off. The easiest way to enable the compass is to use the HORIZON^{mp} ground control software.

► **To enable the compass module**

1. Start HORIZON^{mp} and in the **Flight Files** list, double-click on the `.vrs` file you will be using.

The **Options** dialog box opens.

2. Click the **Sensors** tab.
3. In the **Sensor Parameters** group, select the **Enable Compass** check box.
4. Click **Save**.

HORIZON^{mp} confirms that it saved the file and reminds you to upload the `.vrs` file to the autopilot.

5. Connect the autopilot to the computer running HORIZON^{mp}.

See chapter 4 of the *MP2028^g Installation and Operations* guide for detailed instructions.

6. In the **Flight Files** list, select the `.vrs` file and click the **Transmit** button



HORIZON^{mp} transmits the `.vrs` file to the autopilot.

Declination

Declination (sometimes called variation) is the angle between magnetic north and true north. This angle varies with location.

Before you fly, ensure that the declination in the configuration (.vrs) file is correct for your location.



Here are two Web based tools for calculating local declination. (These links were last checked on 03Dec2004.)

- The Geological Survey of Canada Geomagnetism web site at http://www.geolab.nrcan.gc.ca/geomag/mirp_e.shtml (In French at http://www.geolab.nrcan.gc.ca/geomag/mirp_f.shtml)

If your latitude is south or longitude is east, make sure that you enter those coordinates as negative numbers.

- NOAA's Geophysical Data Center Web site at <http://www.ngdc.noaa.gov/seg/geomag/jsp/struts/calcDeclination>

The page will return an error if you don't enter the complete coordinates in the format *dd mm ss*.

► To set local declination

1. Start HORIZON^{mp} and in the **Flight Files** list, double-click on the .vrs file you will be using.

The **Options** dialog box opens.

2. Click the **Sensors** tab.
3. In the **Sensor Parameters** group, enter the declination of the flight location in the **Declination (deg)** box.
4. Click **Save**.

HORIZON^{mp} confirms that it saved the file and reminds you to upload the .vrs file to the autopilot.

5. Connect the autopilot to the computer running HORIZON^{mp}.

See chapter 4 of the *MP2028^g Installation and Operations* guide for detailed instructions.

6. In the **Flight Files** list, select the .vrs file and click the **Transmit** button



HORIZON^{mp} transmits the .vrs file to the autopilot.



If you prefer you can also change both the **Enable Compass** and **Declination** settings directly in the *.vrs* file.

1. Open the *.vrs* file that you will be using for the flight in Notepad or the text editor of your choice.

2. Scroll down to line 92.

The default condition is

92 0 (declination) Declination

3. Edit the line by changing the 0 to the declination of the flight location.

A positive value indicates declination to the west and a negative value indicates declination to the east. For example, if your declination is 5E, enter -5.

4. Scroll down to line 94.

The default condition is

94 0 (useCompass) Enable Compass

5. Edit the line by changing the 0 to 1.

6. Save the file.

7. Using HORIZON^{mp}, transmit the *.vrs* file to the autopilot.