COMPASS MODULE INSTALLATION & OPERATION MANUAL

RMI

ROCKY MOUNTAIN INSTRUMENT
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Technical Specifications

Physical

Size:	2.5W x 3.3L x 1.2H inches 15.9W x 8.4L x 3H cm
Weight:	3.75 ounces 105 grams

Electrical

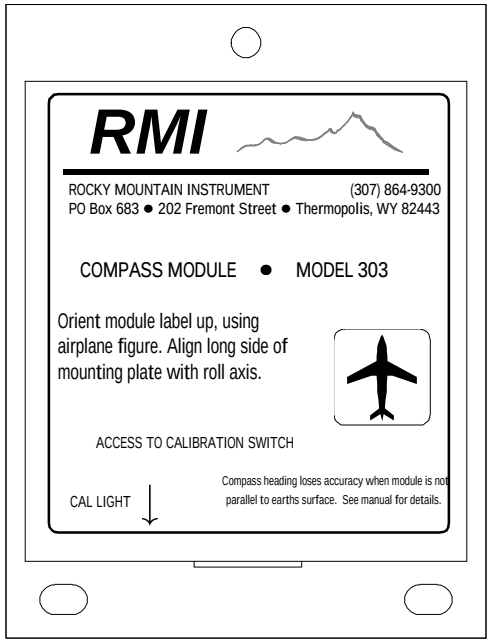
Operating Voltage:	+8 to +30 VDC
Operating Current:	less than 50ma
Output:	RS232

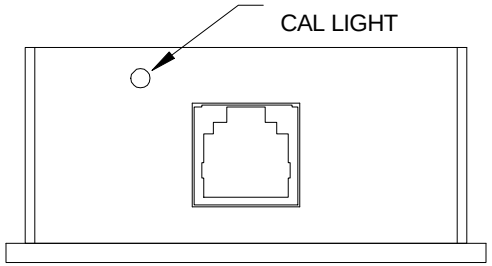
Mechanical

Operating Temperature:	-20°C to +70°C
Storage Temperature:	-30°C to +90°C
Operation Altitude:	-2000 to +35000 feet
Accuracy:	2° RMS when level

Installation

What's Where?





The compass module housing is shown to the left.

The left or right edge of the housing plate should align with the roll axis of the aircraft—just like the airplane on the label. Some label's mounting instructions mention the yaw axis in error.

Three holes in the housing plate are to mount the housing. The two oblong holes allow the rear of the housing to be adjusted left and right to aid roll axis alignment.

The calibration switch access hole is on top as shown on the label.

The location of the calibration light is also shown on the label and the drawing to the left. The light is actually back inside the hole in the housing.

Mounting the Module

Location of the module is not critical except for magnetic fields as will be described.. It can be mounted under a seat, in the tail or behind the instrument panel, for example.

Things to keep in mind in determining the location are: 1) magnetic fields; 2) leveling the compass with the surface of the earth (during flight); 3) alignment of the compass along the roll axis of the aircraft; 4) room to access the calibration switch; and 5) being able to see the calibration light. All of these are detailed below.

Magnetic Fields

The compass module can calibrate for constant magnetic fields in the aircraft as long as they do not saturate the sensors (this takes some pretty strong fields). Static (unchanging) magnetic fields create "hard-iron" distortion (an example: the total aircraft itself). These fields can be mathematically modeled as a constant offset when they are always in the same place with respect to the compass. This means the compass module can compensate for hard iron in the aircraft because the compass module is within the aircraft. Note that the farther the compass module is from a source of a magnetic field, the better.

Magnetic fields from sources which are not part of the aircraft system will interfere with the calculation of compass heading. Thus, the compass can calibrate for its host, but it cannot compensate for some other vehicle driving by or for a steel hanger. For example, the calculated heading can be thrown off a few degrees by a small car that drives about 10 feet away from the compass.

The compass module cannot be calibrated for magnetic fields that are not static (such as a magnetic field change from a flap or gear motor). Its simple calibration routine also cannot compensate for "soft-iron" distortion, which is created by ferrous metals . In this case, “soft iron” is described as a big hunk of ferrous iron that changes its magnetic field depending on how it is aligned with the earth’s magnetic field.

Soft-iron materials distort the magnetic field in different ways when they point in different directions in the earth's field. If a compass is strapped to a piece of soft-iron and the compass/soft-iron combination is pointed in different directions, the compass measures different offsets from the soft-iron. With hard-iron, the compass measures a constant offset. The effect of soft-iron cannot be modeled as a constant. Therefore, the compass module needs to be as far away from sources of soft-iron distortion as possible -- even a few centimeters of separation can be helpful, as the strength of the field is inversely proportional to the square of the distance. Basically... stay away as far as possible from big hunks of metal.

It is best to use brass, aluminum or non-magnetic stainless steel screws for mounting. You can test stainless screws with a magnet... they should not be attracted at all.

Alignment

Orient the Compass module using the aircraft icon on the label. Use either side of the mounting plate to align the housing with the roll axis of the aircraft. Note that the two mounting holes toward the tail are oblong to allow small adjustments in alignment before tightening the mounting screws.

Leveling

Another important requirement is keeping the base of the mounting flange of the compass module aligned parallel to the earth’s surface when in normal cruise flight. Accuracy is degraded when the compass is tilted.

You may wish to make provisions in the mounting to be able to shim up the nose or tail of the compass housing to adjust the housing about the pitch axis after checking actual level in cruise flight.

CAUTION: Note that heading accuracy is degraded when aircraft is in a bank.

Calibration Switch Access

Note the location of the calibration switch access hole on top of the housing. A non-magnetic tool will need to reach down thru the hole to the switch. The tool only needs to be long enough to reach through the hole an activate the switch—about 1/4 inch. The switch is rubber-covered so do not use a pointed tool.

If your location is such that it is impossible to access the switch, one of the wires that connect to the back of the microEncoder can duplicate the calibration switch by being shorted to ground. This arrangement does require increased complexity of the wiring harness at the microEncoder, however.

Calibration Light Access

It is nice to be able to see the calibration light to note the beginning and end of the calibration cycle (described later) even if you do have to use the wire harness instead of the internal switch to start and stop the calibration process. If the wire harness is

used, care must be taken in closing the calibration wire to ground to act as the switch—an improper activation may look like two activations representing both the beginning and end of the calibration cycle.

Wiring at the Compass Module

Inserting the modular jack that is attached to the cable provided is the only wiring at the compass module.

Wiring at the μEncoder

The compass module cable contains six wires with these functions:

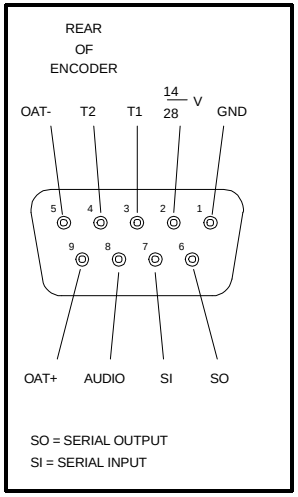
white - ground
black - power
red - calibration, open=normal operation, grounded=calibration mode
green - compass data
yellow - baud rate, open = 9600 baud, grounded = 1200 baud
bare - shield wire

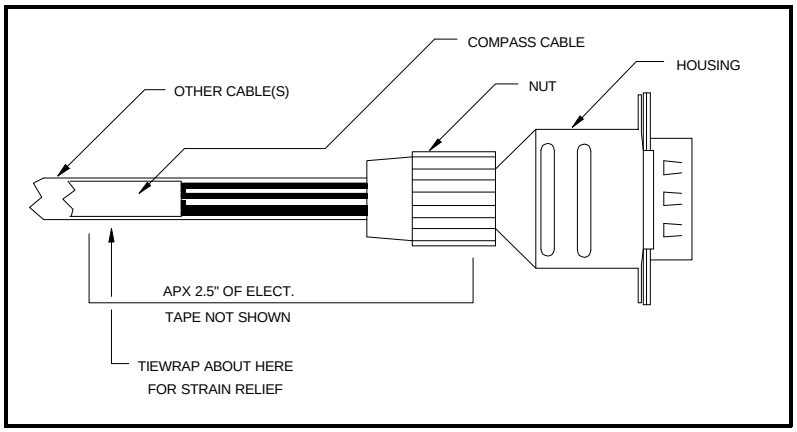
Normally, only the ground, power, data and shield wires are needed. If you can't get to the calibration switch directly on the compass module, you will need to make provisions to be able to switch the red lead to ground to operate the calibration mode.

There are three wires connecting the compass module to the μEncoder: power, ground and serial data. All three connect to the 9 pin D-sub connector at the back of the μEncoder.

ground/white connects to GND/pin1
power/black connects to OAT+/pin9
data/green connects to SI/pin7

Carefully strip back the insulation on the compass module flat cable. If there is ample room for the flat cable to go clear into the 9 pin D-sub housing (through the black strain relief nut), strip the insulation back about 1-1/2 inch. If the cables already going into the housing fill up the hole in the strain relief, then strip the insulation back about 3 inches.





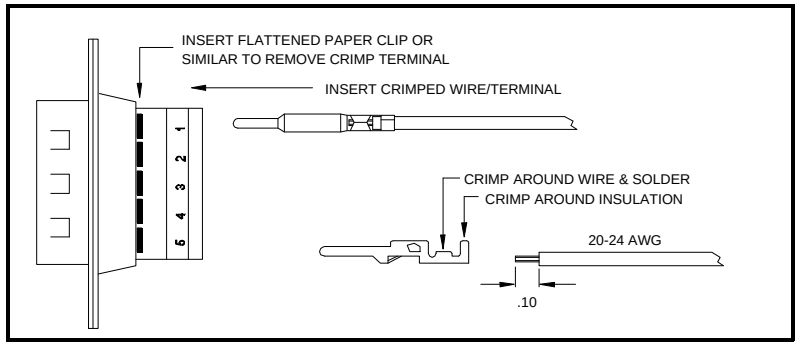
Cut off the yellow baud rate wire. If you have access to the calibration switch on the compass module, cut off the red calibration wire.

The drawing above shows the case when the compass module cable does not have enough room to go through the strain relief nut with the other cable(s) (stripped 3 inches). Only the four small, individual wires go through the strain relief nut. You need to keep the stripped end back far enough for the strain relief nut to slide far enough back from the housing to assemble. You should apply a thin wrap of black electrical tape to hold the compass module cable in place over the length shown because the main insulation of the compass module cable cannot be secured by the strain relief nut. Additionally, add a tiewrap around the tape and cables at the point shown to provide strain relief for the compass module cable..

If you're connecting the compass module wires to a previously wired D-sub connector, we recommend that you very carefully burn away (solder iron) about 1/4 inch of insulation on the OAT+ wire (pin9) and the GND wire (pin1) to bare the wire. Then wrap and solder the stripped end of the matching compass module wire around the bare wire, solder the two wires and then tape the junction. The final data wire needs to have a crimp terminal installed and plugged into pin7.

If you are connecting the compass module wires at the same time as other wires, we recommend that you attach a crimp terminal to a one inch long wire for the OAT+ and GND connections. Then the wires from compass module and normal wires from outside can be arranged AS IF a wire-nut were to be applied, soldered and then taped.

The shield wire will go under the relief nut with other shield wires to make contact with the metal shell. The drawing below shows how to install a crimp terminal onto the wires and into the D-sub housing. Solder the wire to the crimp terminal ONLY if you do not have access to a crimping tool.



Programming the μEncoder

The compass module obtains its power from the μEncoder so it is in operation whenever the μEncoder is operating. For the compass heading to appear in the μEncoder's serial output and/or on the display, the μEncoder must be programmed properly as described in the μEncoder programming manual. Pertinent programming information is also detailed in this section. For complete details, refer to the μEncoder programming manual.

The program mode can be entered at any time when the μEncoder is operating in its normal mode, which is after **tESt** has cleared the display after the unit is turned on. Press and hold [ACK] and then press both [ALRT] & [DALT] until the display blanks and **OPt** appears in the lower left. The **OPt** is one of the 1st level menu choices. The control combination was chosen to be awkward so there is no possibility of entering program mode by mistake.

μEncoder Display Control

First decide whether you would like the compass heading to continuously appear in place of the digital portion of the VSI or only appear when the [DALT] switch is pressed and held.

Continuing from above, press [DALT] to enter the options menu. **brSEt** will appear in the center of the display. Turn the [SET] knob counter-clockwise three clicks until **HdGvt** appears in the center. This selection controls the temporary display of compass heading in the VSI position. Press [DALT] to enter this menu. **NO** or **YES** will appear. Turn the knob either direction to select yes or no. The yes selection will enable showing the compass heading when the [DALT] switch is pressed. When the selection is as desired, press [ALRT] to leave this menu selection.

Now turn the [SET] knob one click counter-clockwise and the center of the display will show **HdGvP**. This selection controls the continuous display of compass heading in the VSI position. Press [DALT] to enter this menu. **NO** or **YES** will appear. Turn the knob either direction to select yes or no. The yes selection will enable continuous showing of the compass heading . When the selection is as desired, press [ALRT] to leave this menu selection.

Only one of the above choices should be yes. Both can be no, however.

Program the Serial Input Port

Continuing from above, press [ALRT] again. Only **OPt** should be in the lower part of the display. Turn the knob counter-clockwise two clicks. **SEr** should appear in the lower left of the display.

Press [DALT] to enter the serial port menu. **OUtPt** will appear in the center of the display. Turn the [SET] knob clockwise one click until **InPUt** appears in the center. This selection controls the function of the serial input port. Press [DALT] to enter this menu. Turn the knob until **C-HdG** appears. The serial input port is now set to receive data from the compass module. Press [ALRT] once. Turn the knob one click clockwise. **bAUd** will appear in the center of the display. Press [DALT] to enter this menu. Turn the knob until the proper baud rate is set. The compass module baud rate is 9600. If you have, for some reason, grounded the baud control wire so the compass module is operating at 1200 baud, then set the baud rate of the μEncoder to 1200. Note that this baud rate setting controls both the serial input and output ports... you can't mix the two. Press [ALRT] three times to return the unit to normal operation.

If you have programmed the unit to show compass heading either continuously or temporarily in the VSI position, then test that the heading is being received.

Even if you do not desire to show the heading on the display, whenever the compass module is attached the compass heading will be included in the serial output data if the selected output format contains a magnetic heading data block.

Error "Blinking"

Should the compass module fail, there are two error "messages" that may help in diagnosing the problem. Check the calibration light on the compass module and see if it is blinking. If so, determine if the blink rate is two times per second or four times per second.

A blink rate of two times per second indicates that the internal CPU program is corrupted and the module must be sent for service. There is no correction.

A blink rate of four times per second indicates that the internal nonvolatile memory is corrupted. The memory can be re-initialized, although doing so will result in loss of calibration. To re-initialize the memory, start with the μEncoder power off, then hold the calibration switch down and turn the power to the μEncoder back on. The calibration light will turn on. Then press the calibration switch twice more to activate the re-initialization. When complete, the light will go off. If the light again returns to the four per second blink rate, send the unit for service. Remember to re-calibrate the compass.

Calibration

Doing the "180"

After the compass module is installed and operating, point the aircraft in any convenient direction where you can determine a direction 180° in the opposite direction. Make sure the compass module is as level as possible. You will probably need to lift the tail of a tailwheel aircraft and set on an appropriate height block or jack.

With the μEncoder and compass module turned on, press the calibration switch. The calibration light will come on and stay on even after releasing the switch. If the light goes out, you probably inadvertently pressed the switch twice. If that is the case, press the switch again so that the light stays on.

Leaving the μEncoder and compass module operating (light still on), turn the aircraft 180°. You do not need to maintain level while turning the aircraft. Once level again, again press the calibration switch. The light will go off and stay off after releasing the switch. If the light comes back on, you may have inadvertently pressed the switch twice. In that case, you will need to start all over, although you don't need to turn the aircraft back to the first position... just use the current position as the first point.

Delays are built into the calibration switch operation, so it is difficult and rare to press the switch twice.

Note that the compass module will output heading information before, during and after calibration. It is up to the user to know that calibration has been performed. Once calibration is performed, the results are stored in a nonvolatile memory. You should only have to recalibrate if the compass module is moved or additional hard iron equipment is installed near the compass module.

Serial Data

Output Format

This section is provided for those users that are not attaching the compass module to the μEncoder. It details the serial output format from the compass module.

All output is ASCII, 8 bits, 1 start bit, one stop bit and no parity. The baud rate is defaulted to 9600 but can be changed to 1200 by grounding the red wire attached to the compass module.

The format is:

$HCHDM,ddd.d,M*cc<cr><lf>

Where:

ddd.d is the compass heading in tenths of a degree from 000.0 to 359.9 degrees.

cc is two nibbles representing the checksum. To check, perform an XOR of all bytes starting at 'H' and ending with 'M', including punctuation. This value when XOR'd with the checksum should equal zero.

<cr><lf> are carriage return and linefeed