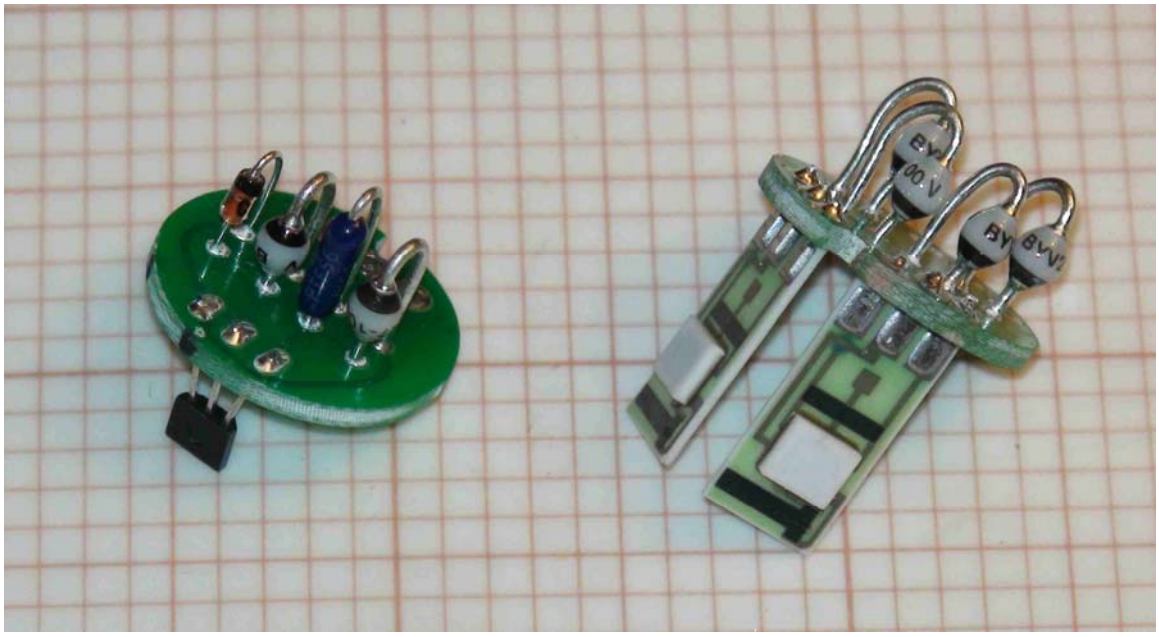
Micrio WS1 Replacement Wind Speed Sensor and WC1 Replacement Wind Compass Sensor for Raymarine ST50 and ST60 Wind Instruments.

Rev 4.4

The Micrio WS1 Wind Speed Sensor and WC1 Compass Sensor are direct replacements for the wind instrument sensors in the appropriate Raymarine products.



The Micrio WS1 and WC1 sensors.

The Raymarine wind sensors can fail for a number or reasons; lightning, water corrosion, or mechanical damage. Since these parts are unavailable from the manufacturer you were left with only one option; buy a new masthead transducer. The Micrio WS1 and WC1 are cost effective alternatives.

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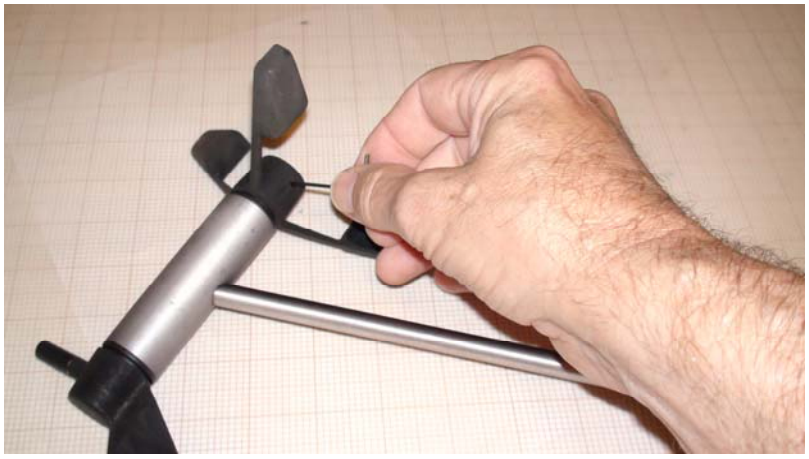
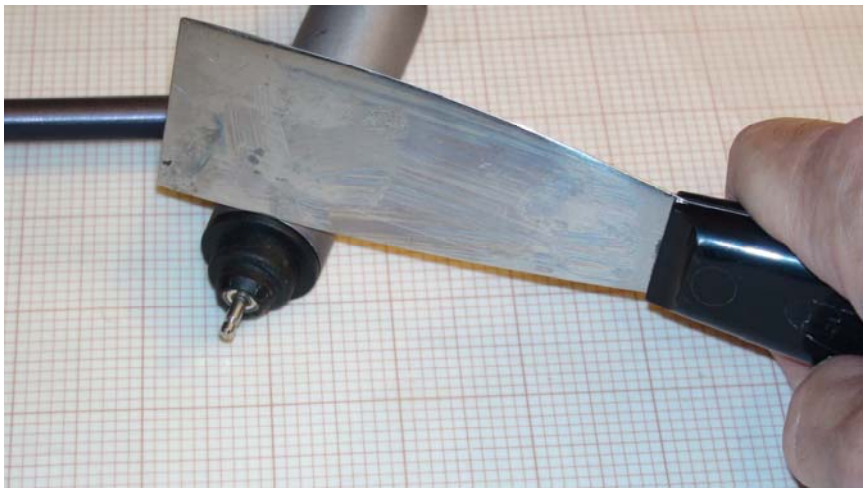
Disassembly.

Disassembling the Raymarine masthead wind instrument is straightforward. First step, remove the anemometer or feather with a 1.5mm hex wrench. They both use the same size hex wrench. It is a good idea to remove both the anemometer and feather so as to avoid breaking them while working on the masthead transducer.



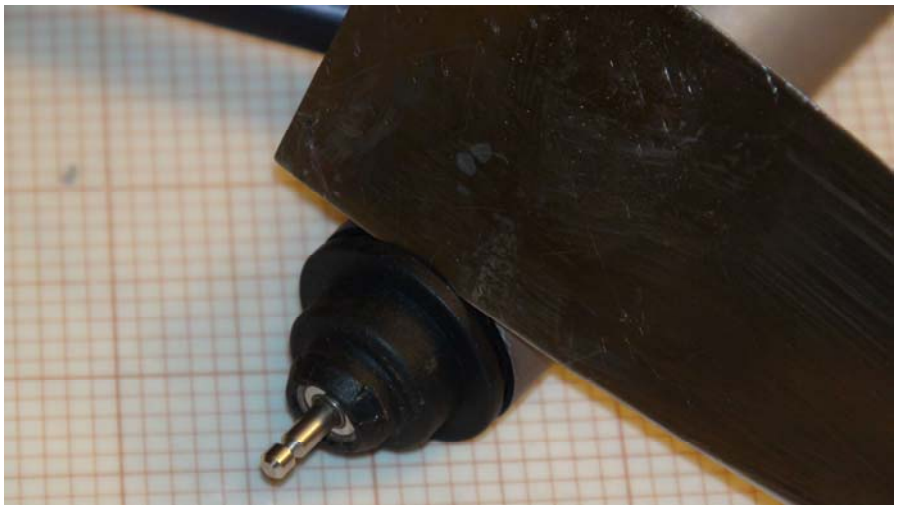
Remove Anemometer.

The wind sensor modules are held in the aluminum housing by two "O" rings. The module will slide out of the housing using a thin bladed tool like a knife or putty knife. A screw driver is not a good choice since it can mar the sensor module and the aluminum housing.



Gently pry out the sensor module.

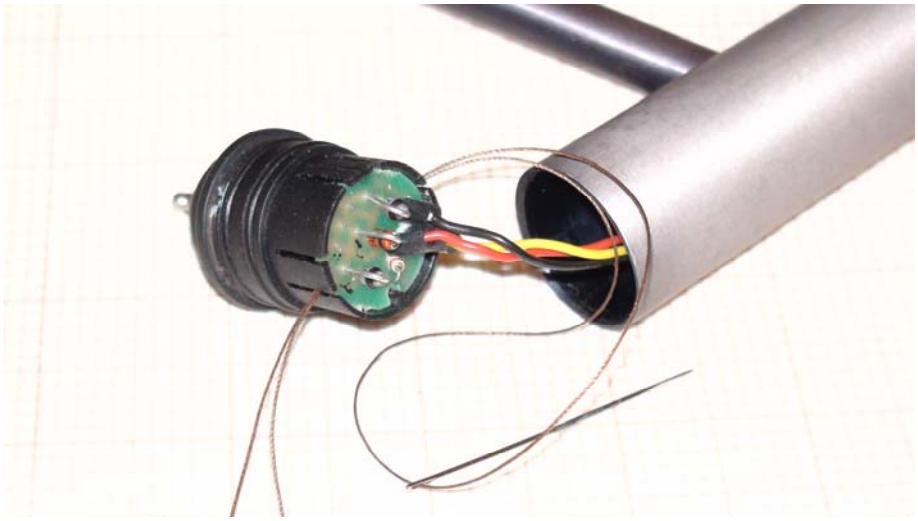
The sensor module is not held in by anything other than friction from the two "O" rings.



Slide out the sensor module.

The sensor module will slide out easily exposing the sensor circuit board. The board is held in by 3 plastic snaps. Also note the key in the plastic housing that prevents the circuit board from rotating.

It can be tricky to lift the three snaps at the same time while pulling on the circuit board. This job can be made easier by feeding some heavy thread under the circuit board. A sewing needle makes passing the thread through the module easy. Be sure to keep the needle close to the circuit board when passing it through so as to avoid catching the magnetic rotor.



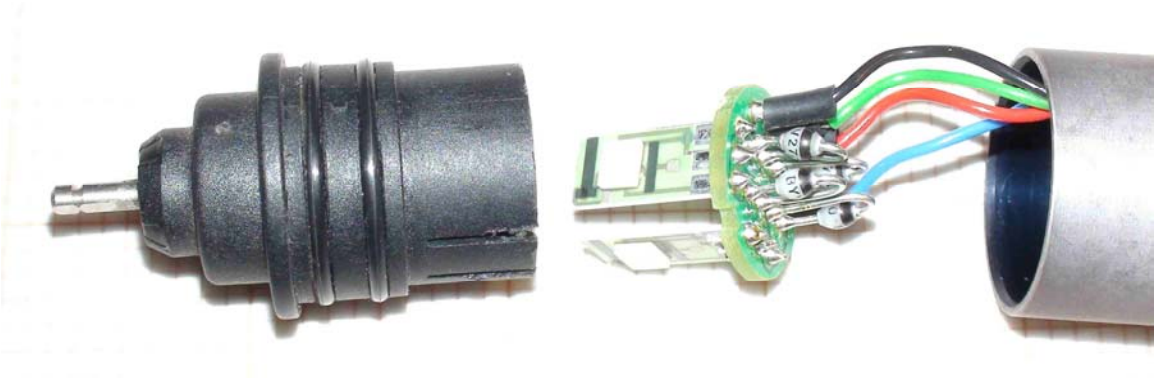
Thread and needle.

It is necessary to pull on the thread while lifting the snaps. To make this easier tie the thread into a loop and attach the loop to something like a door knob. Now you can pull the module with one hand and use the other hand to lift the snaps. I find that a thin bladed knife like an Exacto knife works well to lift the snaps. You must lift each

snap over the edge of the circuit board before the board will be released. Often you will have to lift each one in succession going around multiple times to be successful.

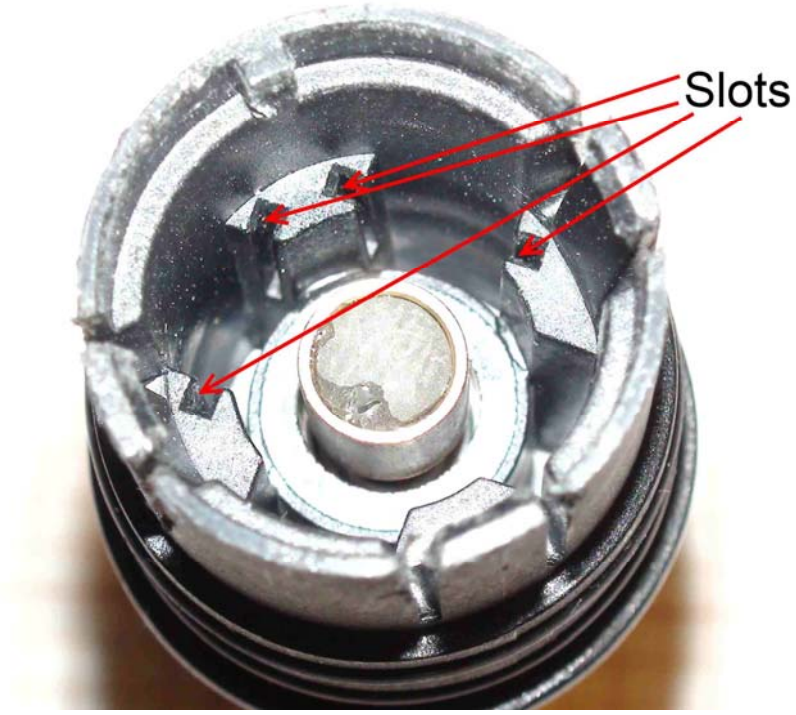
Compass Sensor.

The compass sensor is particularly tricky. It must slide out straight because the two magnetic pickup chips are held in slots in the module housing.



The Wind Compass assembly.

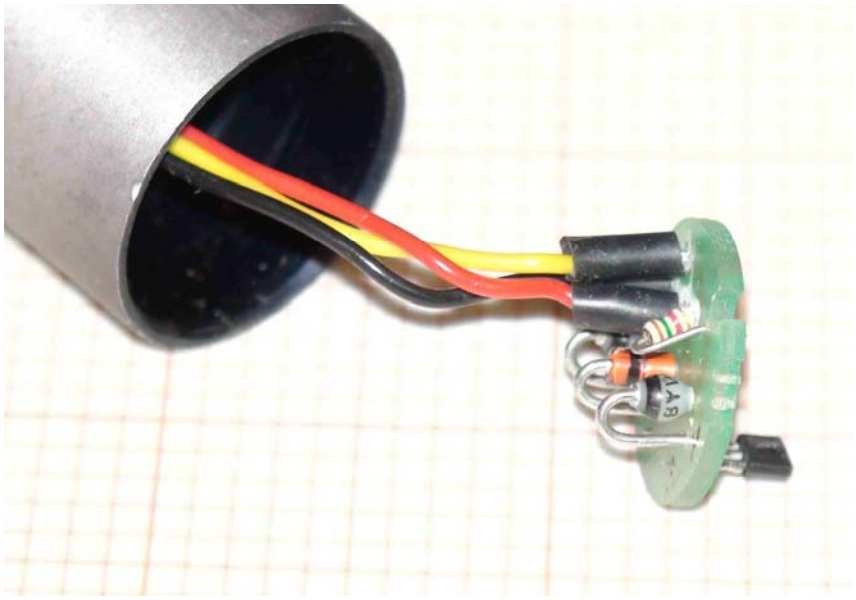
The two pickups can only be extracted from these slots by pulling the circuit board straight out. The mounting slots can be seen in this picture. The magnetic pickups are thin ceramic which is brittle so care must be taken to not bend them.



Module Housing showing the slots for the magnetic pickups.

Speed Sensor.

The wind speed sensor is easier because the magnetic pickup is not held in slots. When the board is lifted past the edge of each snap it will pop out.

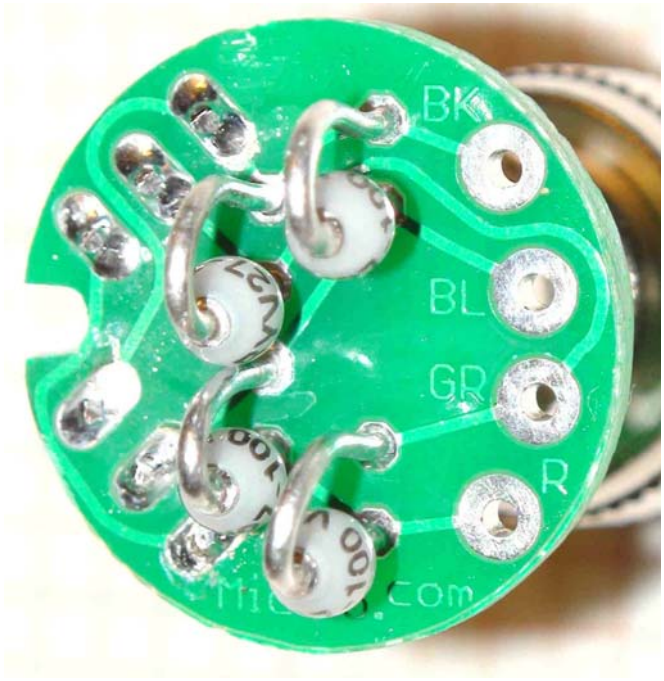


The Wind Speed sensor.

Installation.

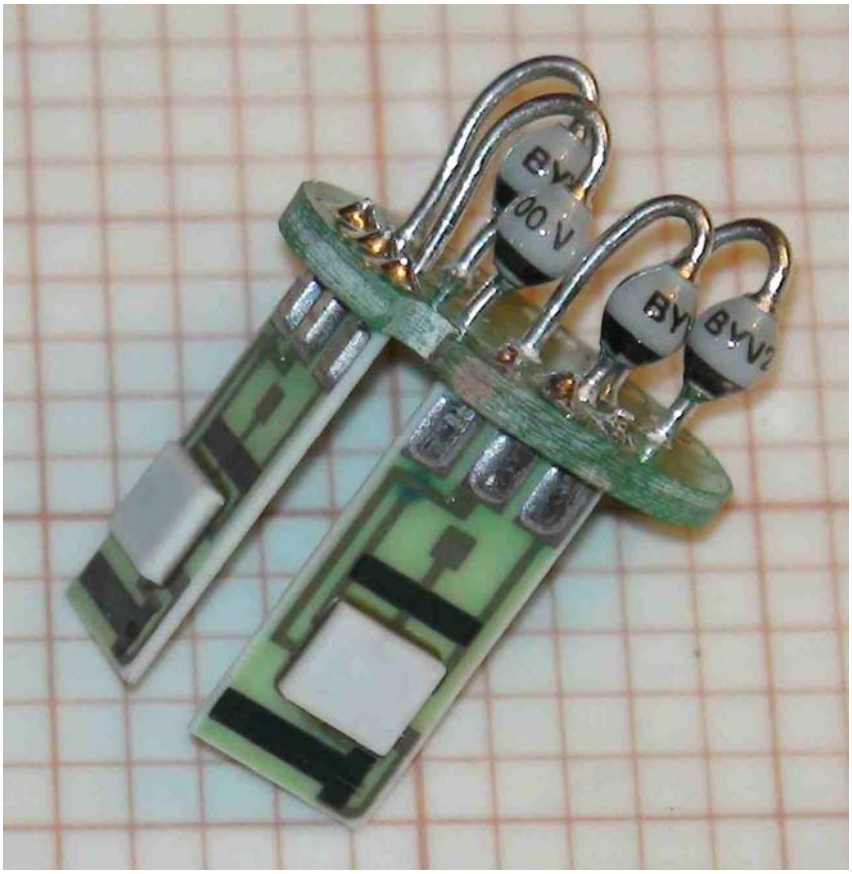
Compass Sensor.

There are 4 connections to the wind compass sensor. The wires are color coded: red, blue, green, and black. Simply cut the wires from the original board as close as possible to the sensor board. Strip a small amount of insulation from the ends of the wires and solder them to the replacement sensor. The wires should be soldered to the appropriate pad on the new sensor board. The pads are labeled “R” for the red wire, “BL” for the blue wire, “GR” for the green wire, and “B” for the black wire. Be careful to get the right wire into the right pad. A wrong connection will destroy the sensor!



Solder pads are on the right.

Before inserting the wind compass sensor into the module housing insure that the two magnetic pickups are straight and parallel. They must slide into the two slots in the module housing. These sensors are assembled using carefully calibrated jigs. The sensor should slide in easily and without binding.

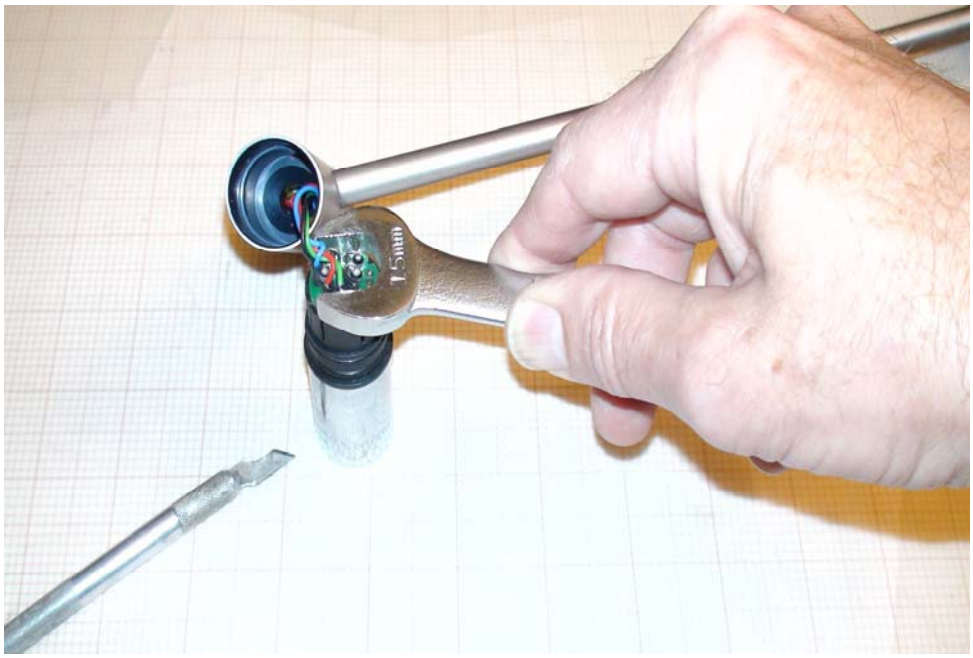


The WC1 wind compass sensor.

These tools will help assembling the sensor with minimal risk to breaking the magnetic pickups. A 17mm socket will provide a stable holder for the plastic sensor housing. A 15mm open ended wrench provides a way to press the sensor circuit board into the housing. A thin bladed knife, like an Xacto knife, can be used to lift the 3 snaps that hold the board into place.

Assembly tools.

As shown below, place the sensor housing in the 17mm socket. Insert the WC1 wind sensor into the housing insuring that the two magnetic pickups slide into the slots in the housing. The sensor should slide in easily with no force applied. The sensor should then rest against the edge of the housing.



Assembly process.

Place the 15mm wrench on the sensor circuit board. Insure that the wrench is pressing against the board and not against the solder connections. Press the wrench flat against the board. Do not attempt to rock the board into the housing because you may

break the brittle magnetic pickups. While pressing the wrench, lift the snaps one by one, around the housing. When all of the snaps are on the edge of the circuit board it will pop into place. Insure that each snap is over the edge of the circuit board and gripping it securely.

Note:

The wind compass and wind speed module housings look similar. The plastic module housing is the same for both the wind compass and wind speed sensor but the magnetic rotor is not. The wind compass uses a single magnet in the rotor. The wind speed uses 4 magnets in the rotor. You must not mix them up. Also the wind compass sensor shaft has a flat cut in it where the feather attaches. The wind speed sensor shaft is round and has no flat.

Speed Sensor.

There are only 3 connections to the speed sensor. The wires are color coded: red, black, and yellow. Simply cut the wires from the original board as close as possible to the sensor board. Strip a small amount of insulation from the ends of the wires and solder them to the replacement sensor. The wires should be soldered to the appropriate pad on the new sensor board. The pads are labeled “R” for the red wire, “Y” for the yellow wire, and “B” for the black wire.

Solder pads on the left.

Insure that the magnetic pickup is straight up and not bent over as shown below;

WS1 Magnetic pickup.

The sensor must be close to but must not touch the rotating magnets in the module housing. After soldering the three wires to the appropriate pads on the circuit board place the new sensor circuit board against the plastic housing module. Insure that the key notch is aligned with the ridge in the module housing. The wind speed magnetic pickup is not held in slots, unlike the wind compass sensor.

The assembly process is the same for the wind speed sensor as for the wind direction sensor and is described above.

Insert module into masthead arm.

Complete the process by sliding the module into the masthead arm. There are no alignment keys to worry about. Do not use any grease or other lubricant on the O rings. The sensor module is held in place by friction alone. Anything that reduces the friction could cause the sensor module to slide out while in use. In extreme cases where the O rings will not slide into the masthead arm, use a small amount of soapy water as a lubricant. After assembly the soap can be washed out.

Sometimes the wires can get caught between the sensor module and a ridge inside the masthead arm. This can be avoided by twisting the wires together gently such that each conductor is held in the wire bundle. The bundle is less likely to get caught on the edge. If you cannot press the sensor module fully into the masthead arm then it is likely that the wires are caught on the edge.

If one of the snap fingers was permanently bent such that it sticking out, it can get caught on the edge in the aluminum housing and prevent the module from fully sliding into place. This presents a dilemma. If the snap is only slightly out of place then the snap can be filed at an angle so that it slides over the edge. In extreme cases you might have to remove the snap. The board will be securely held if only two snaps remain. If only one or even no snaps remain in place then glue is probably necessary to hold the circuit board in place.

The anemometer does not need calibration after replacement. However if you have removed the wind direction module then a re-calibration is necessary. The wind direction module is not keyed into the masthead arm. Re-installing it will likely have it in a different position. Simply removing the feather does not disturb the calibration since the shaft is keyed and the feather will be re-installed in the same position.

Testing.

The electrical connections to the Raymarine Wind Instrument display are easily accessible. The wind vane and anemometer masthead transducer connect to the 5 terminals on the lower right of the display as shown below. They are color coded red, green, blue, yellow, and gray. The red carries +8 volts to both the anemometer and the compass sensors. The gray is ground. The signals from the compass connect to the green (starboard) and blue (port) terminals. The anemometer signal connects to the yellow. While testing apply the normal +12 volts to a SeaTalk connector.

Back of ST60 Wind Display.

Compass Sensor.

The signals from the compass sensor are two voltages that vary above and below 4 volts. You can check these signals by connecting a voltmeter to each terminal and rotating the feather. Connect the voltmeter's negative probe to the gray terminal. Connect the voltmeter's positive probe to the green terminal. As you rotate the feather the voltage will go above 4 volts at a certain direction. When the feather is moved 180 degrees the voltage should go below 4 volts by the same amount. Next check the blue terminal in the same way. The peek voltage for the green terminal should be 90 degrees rotation from the peek voltage for the blue connection.

The amount of the variation in voltage above and below 4 volts will be different in different systems. The variation can be as much as from 1 volt to 7 volts or as little as 3 volts to 5 volts. Within this range the amount of variation does not matter. The wind instrument display accounts for such differences during the calibration process.

Speed Sensor.

The Raymarine ST60 anemometer can be easily tested with a voltmeter. The signal from the anemometer is pulse train with two pulses for each revolution of the anemometer. As the wind speed increases the pulse rate increases. On the net, some people have said that the signal is a varying voltage; this is not correct.

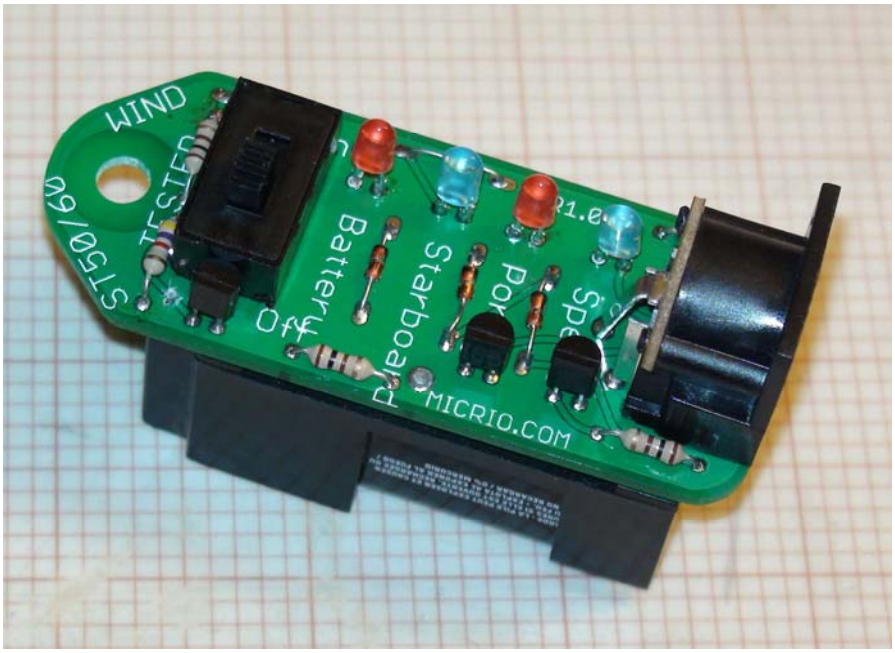
The anemometer signal is on the yellow wire at the back of the ST60 wind instrument. Attach a voltmeter between the yellow wire (positive) and the gray wire (negative). The two connections are adjacent pins on the ST60 instrument.

The voltage should pulse from about 2.1 volts to close to 8 volts. If the wind is driving the anemometer too fast, the voltmeter may not be able to read the pulses. If the rotational speed of the anemometer is less than one rotation per second you should see the pulses. If you do not see pulses at a slow rotational speed, then the sensor has failed.

You also can check the power going to the anemometer module. Read the voltage between the gray wire (negative) and the red wire (positive) which should be about 8 volts. If this is not correct then the instrument or the wiring may be at fault.

Using the Micrio ST50, ST60, and ST60+ Tester.

The easiest way of testing your masthead sensor is to use our Wind Instrument Tester. This simple device plugs into the masthead connector and is able to perform a full set of tests. It will allow you to identify which sensors have failed. After replacing failed parts the tester will confirm proper operation.

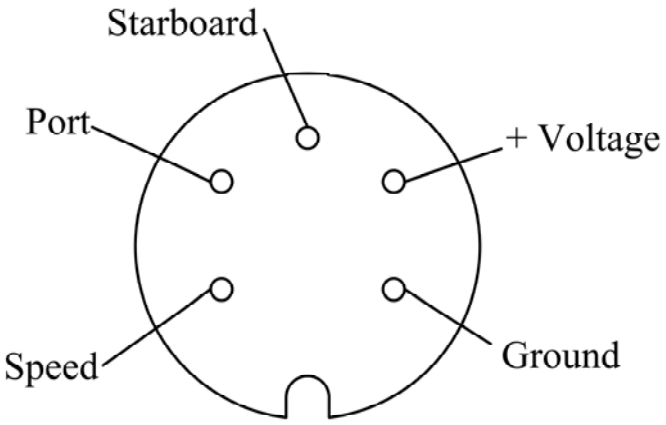


The Micrio ST50, ST60, and ST60+ tester.

Testing the masthead sensor independently.

The Raymarine masthead transducer can be tested separately from the display unit. The masthead transducer operates on 8 volts supplied from the display unit. However the sensors used for wind speed and wind direction can operate on as much as 12 volts. This allows for testing using an ordinary 9 volt battery. Care must be taken to insure that the polarity is correct or you will destroy the sensor chips and diodes.

This is a view of the masthead transducer connector as you look at the pins.



Masthead transducer connector

Connect a 9 volt battery to the two power pins. The + terminal of the battery should be connected to the + voltage pin. The – terminal of the battery should be connected to the ground pin. Do not let these connections touch any other pins or the sensor chips will be destroyed. These signals are carried by the cable from the masthead sensor to the display using the following color wires:

- Ground – Gray
- + Voltage – Red
- Starboard – Green
- Port – Blue
- Speed – Yellow

Connect the black (negative) probe of your voltmeter to the ground pin. Now you are ready to test the wind speed and direction sensors.

Warning: Don't let any connections short!

Testing the anemometer sensor.

The wind speed sensor sends pulses as the anemometer turns. There will be two pulses for each rotation. Connect the red (positive) probe of your voltmeter to the positive voltage pin of the masthead connector. Connect the black (negative) probe to the speed pin on the masthead connector. The speed signal is normally carried by the yellow wire in the cable running from the masthead instrument to the display. Rotate the anemometer by hand. You should see the voltage change from high to low and back to high again as you rotate the anemometer. The voltages should go from about 2.1 volts to 9 volts. If you do not see this change then it is likely that the speed sensor is bad.

The voltmeter is connected in this way because the speed sensor depends on a pull-up resistor that is in the wind display. The sense signal cannot supply current but can sink current. When you connect the voltmeter between the positive supply and the sense pin the voltmeter is acting as a pull-up.

Testing the compass sensor.

The wind compass sensor sends two signals to the display as the wind feather rotates. These two signals vary up and down continuously; they are not pulses. The names of the pins are port and starboard which only indicate their relative position. The names do not relate to the position of the boat. The wind display uses these signals to calculate the true wind direction.

Connect the red (positive) probe of your voltmeter to the port pin. This should be the blue wire in the cable. Rotate the feather. You should see the voltage vary from above 4 volts to below 4 volts. The total amount of the variation is not important. There will be one variation cycle for a full rotation of the feather. The variation can be as much as from 1 volt to 7 volts or as little as 3 volts to 5 volts. If you see this variation then the port sensor is OK.

Next connect the red (positive) probe of your voltmeter to the starboard pin. This should be the green wire in the cable. Rotate the feather and observe the variation in the voltage above and below 4 volts. The variation should be about the same as with the port pin. If you do not see about the same variation as with the port sensor then the compass sensor is bad. The two sensor chips should have the have about the same range of variation, about .25 volts. The voltage should peak on each signal with the feather position different by a quarter of a turn.

Mating connectors.

It is easier and safer to do these tests with a mating connector. You are far less likely to destroy the sensors in the masthead transducer if you use a mating connector. This allows you to solder wires onto a test connector and reduce the risk that a slipped wire will cause a short circuit.

A standard 6 pin DIN connector will mate with the masthead transducer. They are available from many different sources. One such connector is a SD-60K from CUI Inc. This is carried by DigiKey at;

http://www.digikey.com/product-detail/en/SD-60J/CP-1160-ND/97011

The 6 pin standard DIN female connector mates with the 5 pin masthead transducer connector. The extra pin is not used.

Maintenance Tip.

The wind speed anemometer is on the bottom of the masthead transducer. The anemometer hub forms a cup where rain will collect. Raymarine anticipated this and put a small hole in the bottom of the cup to let the rain out. However, over time dirt also collects in this cup and will block the hole. During a rain storm the cup fills with water causing the small ball bearing on the anemometer shaft to run under water. Actually, by now it is muddy water. The dirt will enter the bearing and cause it to lock-up and fail.

The solution is to clean this hole periodically. It might be a good idea to drill extra holes in some circumstances.