ASSEMBLING YOUR RAIN GAUGE

Seen much rain lately? From shower to drought, your rain gauge will sense the rainfall!

Check (✔) the Parts List

Before you start construction, match parts with the list below. If any parts are missing or if you have any questions you may contact us toll-free at **1.800.683.5487** (**503.296.8579**), email **help@FascinatingElectronics.com** or visit our website at **www.FascinatingElectronics.com**.

- ❑ (1) funnel, 8" diameter
- ❑ (1) aluminum splash shield
- ❑ (1) PVC rectangle / round adapter (drilled)
- ❑ (1) 3" pipe (drilled)
- ❑ (1) magnetic switch, 1-½" x 5/16"-24 with hex nuts
- ❑ (1) neodymium magnet
- ❑ (1) aluminum rain collector
- ❑ (1) aluminum separator for the rain collector
- ❑ (1) brass rod, 1/16" diameter, 2-¾" long
- ❑ (1) brass tube, 3/32" diameter, 2-½" long
- ❑ (2) aluminum mounting brackets with foam tape
- ❑ (2) wood screws, for mounting bracket
- ❑ (2) #6 stainless steel machine screws, ¾" long
- ❑ (2) #6 stainless steel nyloc nuts
- ❑ (2) aluminum calibration screw brackets
- ❑ (2) #6 stainless steel machine screws, ¼" long
- ❑ (2) #6 stainless steel hex nuts
- ❑ (4) #6 stainless steel flat washers
- ❑ (2) #6 stainless steel lock washers
- ❑ (2) #6 stainless steel sheet metal screws, ½" long
- ❑ (1) heatshrink, 3/32" diameter, ½" long
- ❑ (1) heatshrink, ¼" diameter, 1-¾" long

Also available from Fascinating Electronics (not included in the rain gauge kit):

- ❑ Rain gauge cable with modular plug. Available in standard lengths: 50 feet (CAB-RN50) or 7 feet (CAB-RN7). Custom lengths available.

Adhesives required (not included in the kit):

- ❑ Clear two part "5-Minute" epoxy, available at most hardware stores.
- ❑ Clear "Marine Goop" or "E6000" or "UV6800" adhesive / sealant by Eclectic Products, Inc., available in tubes at many hardware and automotive stores. This provides better durability and adhesion than ordinary silicone calking materials.

Theory of Operation

While reading this section you may wish to refer to the drawing on the last page.

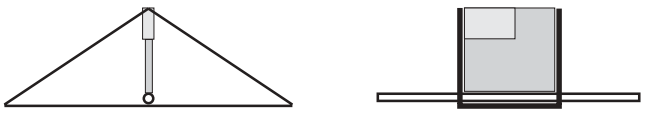
The rain gauge is built upon a 2" by 3" rectangle / round adapter. A short section of 3" pipe connects the rectangle / round adapter to an 8" diameter funnel. A thin aluminum splash shield directs water into the funnel. The funnel channels rainwater into an aluminum collector.

The collector is hinged and balanced so that when sufficient water accumulates on one side the collector tips, dumping the water and enabling collection on the other side. Machine screws stop the travel of the collector, and adjust the tipping point. During the tip a magnet swings past a magnetic switch making one switch closure.

First Epoxy Assembly

- ❑ Slide the 2-½" brass tube through the two holes in the aluminum collector. Center the brass tube evenly on each side of the collector.
- ❑ Lay the aluminum separator on a sheet of **waxed** paper. The neodymium magnet will be glued in the notch in the separator. See the figure below.
- ❑ Clamp the aluminum calibration screw brackets in a vise with the holes facing up. Place the round part of the nyloc nuts in the holes in the brackets.
- ❑ Mix up a small batch of two part epoxy.
- ❑ Epoxy the brass tube in the collector, being very careful to make sure that exactly the same amount of brass tube extends on each side of the collector. We've found it is helpful to place the epoxy along the top of the brass tube with a toothpick, then rotate the brass tube to move the epoxy completely under the tube. Be sure there are no gaps to leak!
- ❑ Coat epoxy along the bottom edge and side of the magnet then fit it in the notch in the aluminum separator, laying the items flat on the **waxed** paper. Be sure that the magnet is pressed firmly into the separator. Put a dab of epoxy over the joint to reinforce it.
- ❑ Using a generous amount of epoxy around the hex sides, glue the nyloc nuts to the brackets.
- ❑ **Leave the items alone until the epoxy hardens.**

Rain Collector Assembly



Side View End View

Second Epoxy Assembly

- ❑ Carefully remove the separator from the wax paper.
- ❑ Mix up a small batch of two part epoxy.
- ❑ Epoxy the calibration screw brackets in the rectangle / round adapter as shown in drawing on page 4.
- ❑ Epoxy the separator vertically in the aluminum collector right on top of the brass tube, carefully epoxying seams on both sides to form two watertight sections.
- ❑ Put a reinforcing dab of epoxy on the joint between the magnet and the aluminum square (on the side that hasn't been reinforced).
- ❑ Be sure the separator stays vertical! You may have to hold it for a minute or two until the epoxy thickens.
- ❑ **Leave the assembly alone until the epoxy hardens.**

WEA-RNKIT-A

Mechanical Assembly

- ❏ Using the plastic nuts provided, install the magnetic switch in the 5/16" diameter hole in the rectangle / round adapter. Adjust so the switch extends about 1" inside the adapter, and gently tighten. We will adjust the switch position after the collector has been installed.
- ❏ Insert the 2-¾" long brass rod through one of the 5/64" diameter holes on the long sides into the rectangle / round adapter. Orient the collector assembly so that the magnet is toward the magnetic switch and slip the brass rod through the brass tube on the collector assembly and out into the other 5/64" diameter hole in the adapter. If necessary, adjust the magnetic switch position in or out so that as the collector tips the magnet just clears the end of the switch. Make sure the separator tips freely and the separator **doesn't hit the switch**!
- ❏ Connect the magnetic switch to an ohm meter or continuity tester. Verify that the magnetic switch closes each time the magnet passes. If your meter has a slow response rate it may be necessary to move the magnet rather slowly.
- ❏ The 5/64" holes should be covered to keep the rod from falling out. A small bit of transparent tape covered with a dab of epoxy would work nicely. Take care not to glue the rod to the rectangle / round adapter. The rod should pivot freely in the base. If it is stuck in place it will decrease the accuracy of the rain gauge.
- ❏ Place the rain gauge on a flat surface. Peel the backing paper from the foam tape on the mounting brackets. Slide the mounting brackets up to the long sides of the rectangle / round adapter and apply firmly.
- ❏ Install the calibration screws in the brackets and adjust for desired initial calibration. The further the screws are screwed in the more sensitive the rain gauge will be. With the screws fully in the sensitivity is about 0.1 mm of rainfall per tip. With the screws in the full up position the sensitivity is about 0.01 inch of rainfall per tip.

Collector Funnel Assembly

- ❏ Clean the collector funnel for best glue adhesion. Slide the 3" pipe into the rectangle / round adapter with the two holes in the pipe away from the adapter. Put the funnel on the pipe positioned so the point on the funnel spout is centered over the pivot. If the funnel point is located off to one side or the other it may not fill the collector evenly. Temporarily tape the funnel to the pipe.
- ❏ Drill 3/32" pilot holes through the holes in the pipe into the funnel and secure the funnel to the pipe with the #6 sheet metal screws.
- ❏ Remove the tape and secure the funnel in place by running a bead of adhesive / sealant between pipe and funnel. Allow the adhesive / sealant to dry.
- ❏ Assemble the splash ring using #6-¼" machine screws, with a flat washer on each side and a lockwasher securing the hex nut.
- ❏ Insert the splash ring into the recess in the funnel and hold in place with masking tape applied to the inside. Apply a bead of adhesive between the ring and the funnel lip. Let dry before removing the tape.

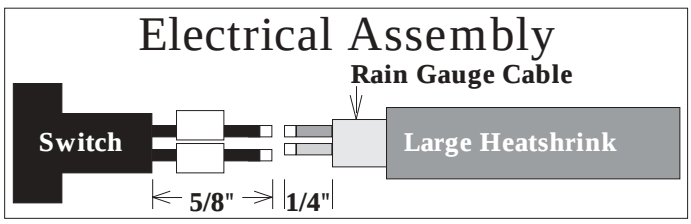
Electrical Assembly

While attaching the cable you may want to refer to the electrical assembly diagram below.

- ❏ Cut the wires coming from the magnetic switch to 5/8" length. Strip about 1/16" insulation from the wires and tin with solder.
- ❏ Cut the white 3/32" diameter heatshrink into two ¼" pieces and slide over each magnetic switch wire.

The following instructions were written for the CAB-RN50. If you are using a different cable you may need to modify the procedure a bit.

- ❏ Cut away the yellow and green wires in the cable, leaving only the black and red wires. Trim the black and red wires to length.
- ❏ Separate the black and red wires. Use a bit of solder on the tip of your soldering iron to melt back the insulation and tin the wires, about 1/16".
- ❏ Slide the ¼" diameter heatshrink over the cable.
- ❏ Solder the switch wires to the red and black wires.
- ❏ Using a hot air gun, shrink the small heat shrink over the connections.
- ❏ Slide the large heatshrink over the body of the magnetic switch, then using a hot air gun shrink it over the switch body and cable.



Electrical Interface

This rain gauge was originally designed for the Fascinating Electronics computerized Observer Meteorological Station. The rain gauge has a very simple electrical interface, just a simple switch closure, so it can be interfaced to just about any digital system.

If you are building an Observer simply slip the modular plug on the rain gauge cable into the right-most modular jack on the interface. Run the WeatherView software that came with your Observer and proceed to test your rain gauge as described below.

If you are using weather station electronics from another company, such as Matt Parnell's WeatherStamp II from Parallax, follow their directions for connecting the rain gauge.

If you are building your own electrical interface here are a few suggestions:

The usual means of connecting a switch to a digital circuit is to ground one side of the switch and connect the other side of the switch to a 10K (or so) pullup resistor (the other side of the resistor is connected to +5) and to the digital input. Because mechanical switch contacts tend to "bounce" making a jagged electrical signal when opening or closing it is typical to put a 0.1 µF capacitor across the switch.

Another way of smoothing out the signal is to use a one-shot circuit. The switch is used to trigger the one shot, which is set to generate a pulse for a few milliseconds. This span of time is sufficiently long that all of the contact bounce will have settled out before the pulse has ended and the one-shot is ready to pulse again. An LM555 timer may be configured as a one-shot.

If you are using a microcontroller to count the pulses from the rain gauge, the contact debounce may be easily performed in software. The microcontroller would be programmed to start timing when a pulse is detected and to ignore any pulses that occur before a few milliseconds have elapsed.

Testing

Before installing the rain gauge outdoors, be sure to connect it to whatever electronic interface you are using and test it. Verify that the rainfall count increments once per tip. Verify that the collector does not overflow. Verify that the magnet swings close to the magnetic switch, but does not touch it.

If you are building one of our Observer Meteorological stations, run WeatherView and select the calibration menu. Drip water through the rain gauge and verify that the count increments by one for each tip. Set the initial calibration value for the rain gauge to 0.005 inches. You may then calibrate the rain gauge as described below to get very accurate measurements.

Calibration

The rain gauge must be calibrated for accurate rainfall measurement. It can be mechanically adjusted over approximately the range from 0.004 inches (0.1 mm) to 0.01 inches (.254 mm) of rainfall per tip (switch closure).

Given sufficient patience it is possible to mechanically adjust the rain gauge to an exact value. You could place the rain gauge next to a manual rain gauge and after sufficient rainfall (or using a sprinkler) determine from the number of tips counted and the amount of rain collected in the manual rain gauge the actual rainfall per tip. You could then lift off the 3" pipe and funnel assembly from the rectangle / round adapter and adjust the screws appropriately to adjust the calibration and repeat as necessary to achieve the desired level of accuracy. Be sure to align the point of the funnel over the pivot so that water drips evenly to each side of the rain collector.

An easier way to get accurately calibrated measurements is to perform the calibration in software. Rather than by adjusting the rain gauge itself, you simply increment the rainfall count by the whatever the rainfall per tip happens to be. For example, if you find that your rain gauge measures 0.0045" per tip, then for each tip increment your rainfall count by 0.0045. The easiest way to determine the rainfall per tip is to use the manual rain gauge method described above.

Installation

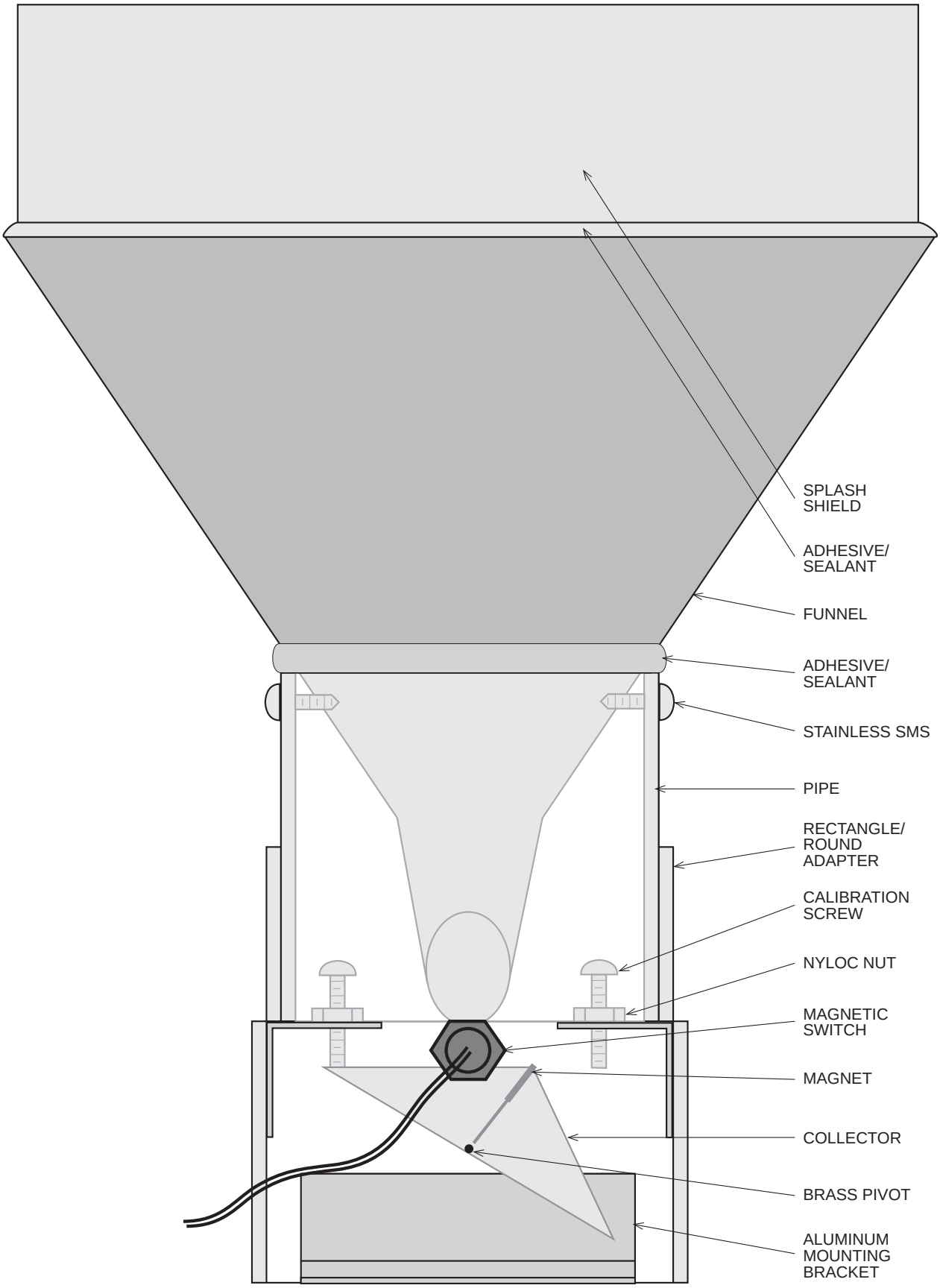
The rain gauge must be installed on a level surface. If the surface is not level the collector will not accumulate evenly, and may even stick in one position.

Install the rain gauge in an accessible area. Debris tends to find its way into a rain gauge funnel, and to maintain optimum accuracy you may occasionally need to clean leaves and bugs out of the funnel and collector.

Because wind gusts may cause the collector to tip with less than a full sample it is best to locate the rain gauge in a wind sheltered area, or surround it with a low wall to block the wind.

And obviously avoid areas where rainfall is blocked by trees or structures. Remember that windblown rain does not fall straight down! ■

RAIN GAUGE



Rev. J