ASSEMBLING YOUR WIND VANE

Which way is the wind blowing? Your wind vane will tell you with precision!

Have Fun!

When finished you will have a sensitive, rugged, great looking wind instrument **that you have built yourself!** Take your time, work carefully, and enjoy the project.

Check (✔) the Parts List

Before you start construction, match the parts that came in your kit with the parts list below. If any parts are missing, call us at 1-800-683-KITS. We will mail a replacement part immediately, along with our profuse apologies.

- ❑ (1) tail fin, gold anodized aluminum (punched and folded)
- ❑ (1) PVC cap, 2" schedule 40 (precision drilled)
- ❑ (1) PVC cap, 1-½" schedule 40 (precision drilled)
- ❑ (1) PVC pipe, 1-½" schedule 40, 5" long (drilled)
- ❑ (1) sealed dual wiper potentiometer, lock washer, hex nut
- ❑ (1) potentiometer mounting bracket
- ❑ (1) 3.8 oz. streamlined lead weight with #8 mounting stud
- ❑ (1) poly tube, 2" long, 0.17" inside diameter
- ❑ (2) #8 nylon washers
- ❑ (1) large nylon spacer, 0.17" ID, 0.50" OD, 1.00" long
- ❑ (1) small nylon spacer, 0.17" ID, 0.25" OD, 0.25" long
- ❑ (1) ball bearing, ¼" ID, ¾" OD, shielded

The following components are stainless steel:

- ❑ (1) #8-32 machine screw, 3" long
- ❑ (1) #8-32 machine screw, ½" long
- ❑ (1) #8-32 machine screw, ¼" long
- ❑ (2) #8 sheet metal screws, ½" long
- ❑ (5) #8-32 hex nuts
- ❑ (3) #8 internal tooth lock washers
- ❑ (1) #8 external tooth lock washer

Also available from Fascinating Electronics (not included in the wind vane kit):

- ❑ CAB-ANWV100, 100' cable with modular plug and heat shrink.
- ❑ WEA-WTKIT-A, "T" mount kit for anemometer and wind vane.

Also required (not included in the kit):

- ❑ metal to plastic two-part epoxy (Devcon Plastic Welder or similar)
- ❑ thread locking adhesive (Loctite or similar)
- ❑ super glue
- ❑ ¾" electrical tape

Mechanical Assembly

As you build your wind vane you may wish to refer to the mechanical drawing on page 4.

In order to make your wind vane as durable as possible there are several types of adhesive you should use. When securing the ball bearing into the stationary cap two-part epoxy specially formulated for bonding metal to plastic, such as Devcon Plastic Welder, will greatly increase the strength of the unit. Do not use PVC pipe cement, as this does not bond to steel.

Install the ball bearing assembly:

- ❑ Using a tissue moistened with alcohol, clean any grease from the outside of the **bearing**.
- ❑ Mix a small amount of plastic welder epoxy. Lay the **bearing** on a sheet of wax paper. Use a toothpick to spread a small amount of epoxy around the **inside** of the ¾" hole in the **1-½" cap**.
- ❑ Grasp the **1-½" cap**, and press it onto the **bearing**. Press until the bearing is flush with the top of the cap.
- ❑ Inspect the cap and verify that the bearing is flush with the top of the cap. Set the cap aside for a few minutes, until the epoxy hardens.

Install the tail on the rotating cap:

- ❑ The **tail** attaches to the **2" cap** on the side with two holes. Slip the **½" machine screw** through a **nylon washer** and through a hole in the **tail**. Drive the screw through the **upper hole** on the side of the cap, but do not completely tighten yet.
- ❑ Place a drop of super glue in the lower hole in the side of the **2" cap** (this hole is threaded). Slip the **¼" machine screw** through the other **nylon washer** and through the remaining hole in the tail. Thread into the lower hole in the **2" cap**. Tighten snugly, but do not over tighten as this could strip the threads in the cap.
- ❑ Slip an **internal tooth lock washer** over the end of the **½" machine screw**, put a drop of thread locking adhesive on the screw, thread on a **hex nut** and tighten securely. Make sure that a flat side of the hex nut is facing down, not a point. This increases the clearance between the hex nut and the stationary cap.

Install the lead weight on the rotating cap:

- ❑ Thread a **hex nut** on the mounting stud on the **lead weight**. Slip on an **internal tooth lock washer**, and thread the stud into the hole in the side of the **2" cap**. Slip on another **internal tooth lock washer**, then thread on a **hex nut**. Do **NOT** use thread lock at this time. Leave lots of room between the hex nuts and the 2" cap. The position of the weight will be adjusted below.

Balance and secure the rotating cap:

- ❑ Thread the **3" machine screw** into the threaded hole in the top of the rotating cap. Tighten the screw, but be careful not to strip the threads in the plastic cap. Slip the **large nylon spacer** on the screw and thread on a **hex nut**. Tighten securely.

WEA-WVKIT-A

- ❑ Slide the **small nylon spacer** on the **3" screw**. Slide the stationary cap over the screw, with the ¼" diameter hole in the **bearing** fitted snugly over the **small nylon spacer**. Slip the **external tooth lock washer** on the screw. Thread on a **hex nut** and tighten gently. *Verify that the rotating assembly turns freely, without rubbing on the stationary cap.*
- ❑ Grasp the **stationary cap** and turn the assembly sideways. Rotate the **lead weight**, moving it in or out as necessary to balance the weight of the **tail**.
- ❑ When balanced, remove the **stationary cap** from the **rotating assembly**. Apply drops of thread locking adhesive on the **lead weight stud** next to the cap, and tighten the **hex nuts** to secure the **lead weight** in position. Again, it is good to make sure that a flat side of the inside **hex nut** is facing down to maximize clearance. Reinstall the **stationary cap**, **external tooth lockwasher** and **hex nut** then tighten securely.

Wire & Mount

The following instructions are written for the optional six conductor anemometer and wind vane cable (CAB-ANWV100). You may substitute almost any type of wire.

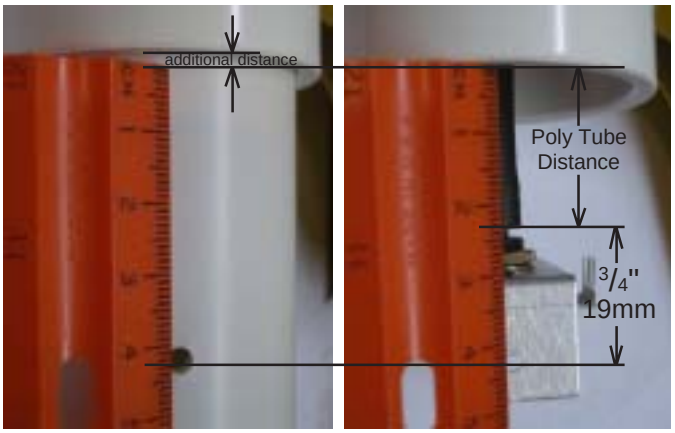
The wind vane is usually mounted with an anemometer on a "T" mount. Build the "T" mount and route the wire through it before continuing on from this point. Because it provides more slack in the cable between the instruments, install and wire the anemometer on the "T" mount before proceeding.

Prepare the dual wiper potentiometer:

- ❑ Secure the **potentiometer** to its **mounting bracket** with the **⅜" hex nut** and **lock washer**. Tighten securely, but **do not overtighten**. See drawing, p. 4.
- ❑ Install the 5" drilled **PVC pipe** on one arm of the "T" mount using PVC cement.
- ❑ Route the wire through the "T" mount, and through the 5" drilled PVC pipe.
- ❑ The blue, yellow, green, and red wires in the cable connect to the potentiometer in that sequence from left to right. The white and black wires are only used by the anemometer and may be trimmed from the end of the cable. Put ½" long pieces of 3/64" diameter **semirigid heat shrink tubing** (included with the CAB-ANWV100) over these four wires, and slide up to the silver cable jacket. Use your soldering iron, with plenty of fresh solder, to melt back the insulation and tin about 1/16" of each of the four wires.
- ❑ Solder the wires, in sequence, to the **potentiometer pins**. Slide the **heat shrink** over the connection from the wires to the potentiometer pins for strain relief. Use a hot air gun to shrink the heat shrink, being careful not to blast the potentiometer, which could be damaged by excessive heating.

Final assembly:

- ❑ The **3" screw** connects the rotating assembly to the **potentiometer** shaft through the **poly tube**. The position of the **poly tube** on the **3" screw** must be just right so that the pot **mounting bracket holes** will align with the **PVC pipe holes**. Grasping only the **stationary cap** gently test fit the stationary cap on the **PVC pipe**. **Do not grip the rotating cap, or you could break the epoxy joint between the bearing and the stationary cap, or damage the ball bearing.** Don't force the cap all the way down or it will be hard to remove. Allowing what you judge to be the **additional distance** needed when you will tightly press the **stationary cap** onto the **PVC pipe**, measure the distance to the **PVC pipe holes** as seen in the **left photo below**.



- ❑ The distance from the **mounting bracket holes** to the end of the **poly tube** is about 19 mm (¾"). Subtract this distance from the stationary cap to PVC pipe hole distance you measured. In the photo: 42 -19 = 23mm. For the parts in the photo, 23mm is the distance that the **poly tube** must extend beyond the **stationary cap**.
- ❑ Wrap a piece of vinyl **electrical tape** lengthwise on the **3" screw** so that the poly tube will fit snugly. Trim any excess. Push the **poly tube** onto the **3" screw** so it extends the distance you just calculated beyond the **stationary cap**.
- ❑ Now push the **poly tube** onto the **potentiometer shaft**. Verify the distance from the **stationary cap** to the **mounting bracket holes**.
- ❑ Proper routing of the wire is important. Do not loop the wire up by the potentiometer shaft. The wire may drag on the poly tube. Instead route the wire downward immediately, as shown on page 4.
- ❑ Line up the **mounting bracket holes** with the **PVC pipe holes**. Slide the bracket into the pipe, then **grasping the stationary cap ONLY** begin to seat it on the pipe. Watch for the holes in the mounting bracket to line up with the holes in the tube. It may be necessary to use a pointed tool, like an awl or tiny screw driver, to pry the holes into alignment. When the **mounting bracket holes** line up with the **PVC pipe holes**, install the **½" sheet metal screws**.

Test

- ❑ Spin the **rotating assembly** a few turns in each direction, feeling for any rubbing.
- ❑ To test that the unit is working correctly, connect the two outer pins on the potentiometer (the red and blue wires) to +5 volts and ground. Measure the voltage between wiper 1 and ground. As you rotate the wind vane the voltage should vary between 0 and 5 volts, with about a 90° deadband. Repeat for wiper 2.

The wind vane is complete!

Electrical Interface

The potentiometer gives the wind vane very high resolution. There is no "dead-band" in the readings because of the special dual wiper potentiometer. The two wipers are set set 180° apart. With this configuration at least one wiper is always in contact with the resistive element and providing position information. By using both wipers there is never any deadband in the readings.

Depending on the measurement system you are using you may need to add 1 MΩ resistors from each wiper to ground (so that the voltage will go to 0 when a wiper is in its deadband), and parallel 0.1 uF capacitors (to minimize electrical noise as the wipers move).

Installation

Before installing the wind vane outdoors, be sure to connect it to your measurement electronics and test it. The wind "T" is designed to mount on a vertical 1-½" schedule 40 PVC pipe. The pipe should be mounted solidly. Since PVC pipe is somewhat flexible, you should not make the PVC pipe too long. About four feet is a reasonable upper limit. For greater heights mount the wind "T" on a wood post or galvanized steel pipe. The wind instruments must obviously be located away from obstructions that would block the wind.

If you live in an area where lightning is common, site your wind instruments conservatively. Don't make them the best target around. And for best protection, unplug your wind instruments before lightning comes near.

Table 1: Wind Instrument Connections

Wire Color	Signal	Modular Pin
White	Anemometer Switch	1
Black	Anemometer Switch	2
Red	Potentiometer +5 Volts	3
Green	Wiper 1	4
Yellow	Wiper 2	5
Blue	Potentiometer Ground	6

Creating Your Own Software

Many of our customers build their own measurement electronics and write their own software. Here are some hints to help you:

You must measure the voltages on both wipers, using one wiper for each 180° coverage. There is a region where both wipers are not in the deadband, typically about 700 millivolts wide. That is, one wiper will be in the range from 0 to 0.7 volts or in the range from 4.3 to 5.0 volts. Use the wiper that is **not** in this 700 millivolt region to determine the bearing.

When a wiper moves into the deadband from the 5 volt end of the potentiometer, there is a brief period of time when the voltage transitions from 5 volts to 0 volts. During this time you may measure intermediate voltages. The best thing to do is to not update your bearing information when both wipers are reading in the intermediate range. Just report the previous bearing. When the voltage on the deadband wiper has fallen into the 0 to 0.7 volt range, then use the other wiper to determine a new bearing.

The following snippet of code, written to use the Experimenter to make the analog measurements, converts the voltage reading from the two wipers into a direction. Note that the Experimenter measures voltages in the range of 0 to 5115 millivolts for a 5.12 volt supply across the potentiometer.

The 700 millivolt value is called "delta" in this code snippet. Since 700 millivolts is just a typical value, the code updates the delta value when both wipers are near the wiper switching point.

If you have questions about this algorithm, or anything else related to our wind vane kit, you can email your questions to Ron@FascinatingElectronics.com. ■

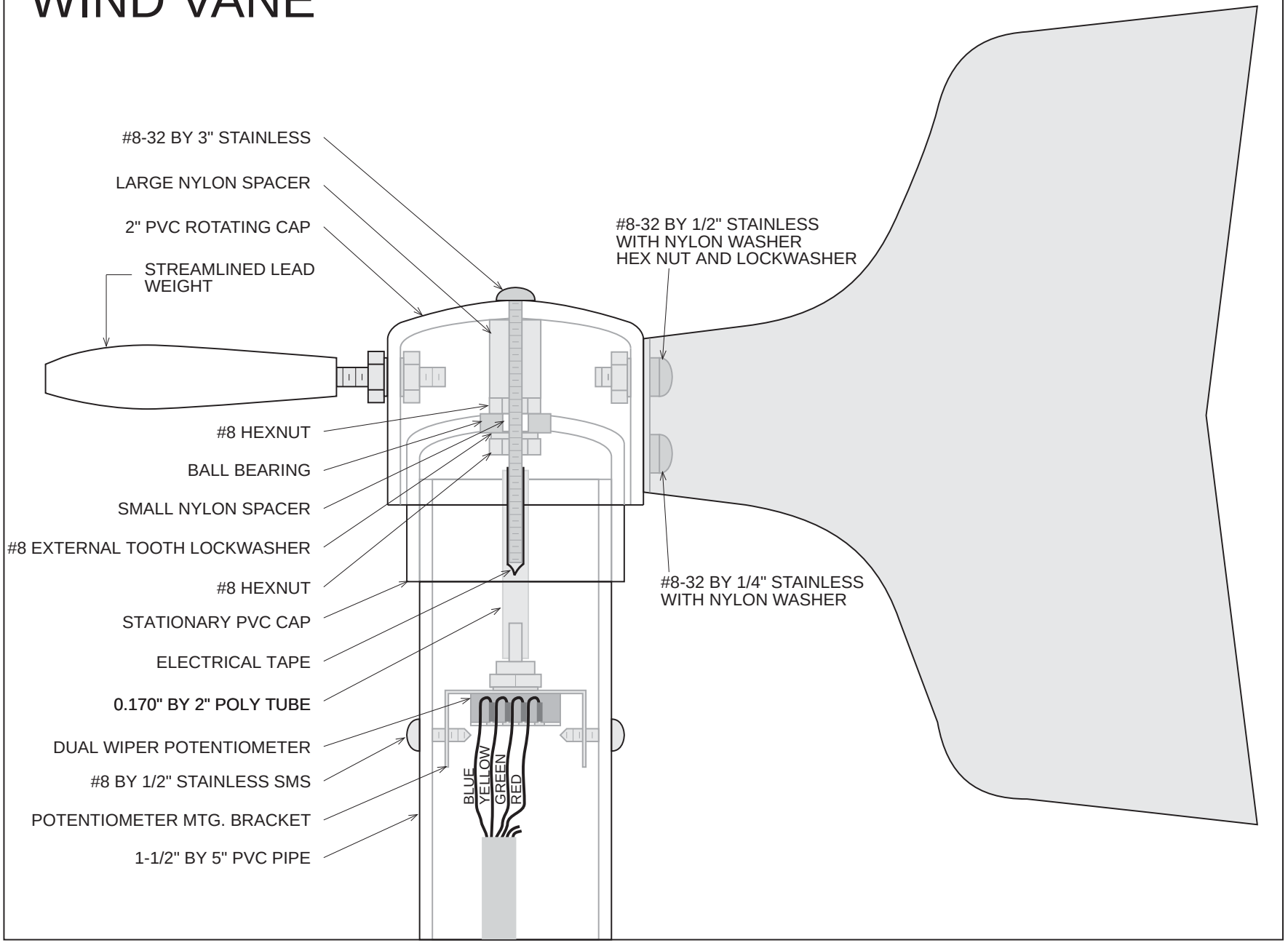
```
delta = 700                          'delta is the overlap between wipers
DO WHILE UCASE$(INKEY$) <> "Q"
  PRINT #1, "A 6"
  INPUT #1, w1                       'voltage on one wiper, analog input 6 on Experimenter
  PRINT #1, "A 7"
  INPUT #1, w2                       'voltage on other wiper, analog input 7 on Experimenter

  ' Decide if we should update the delta value.
  IF w1 > 5120 - 2 * delta AND w1 < 4920 AND w2 < 2 * delta AND w2 > 200 THEN
    delta = (9 * delta + (w2 + 5120 - w1) / 2) / 10
  ELSEIF w2 > 5120 - 2 * delta AND w2 < 4920 AND w1 < 2 * delta AND w1 > 200 THEN
    delta = (9 * delta + (w1 + 5120 - w2) / 2) / 10
  END IF

  ' Decide if we have a valid bearing off of one of the wipers.
  IF (w1 > delta AND w1 < 5120 - delta) AND (w2 > 5120 - delta OR w2 < delta) THEN
    bearing = 180 * (w1 - delta) / (5120 - 2 * delta)
  ELSEIF (w2 > delta AND w2 < 5120 - delta) AND (w1 > 5120 - delta OR w1 < delta) THEN
    bearing = 180 + 180 * (w2 - delta) / (5120 - 2 * delta)
  END IF

  ' Print current results for bearing and delta.
  PRINT USING "Bearing = ###.#   Delta = ####.#"; bearing; delta
LOOP
```

WIND VANE



Rev. L