Chapter 7.0 – Determining Wind Direction

Section 7.1

Overview of Wind Direction

The wind direction is a measure or indication of where the air movement originated from. The wind direction can be measured through the use of a wind sock, wind vane, or a light object attached to a pole and string (example: A ping pong ball attached to a string which is tied to a stick). Wind direction is generally reported in either Azimuth degrees or Cardinal direction. Azimuth uses a circle with the northern most position indicating 0 degrees. The Cardinal direction system gives an Azimuth degree value a name. For example, 180 degrees is South(S) and 270 degrees is West (W) (See Figure 18 - A basic compass rose).

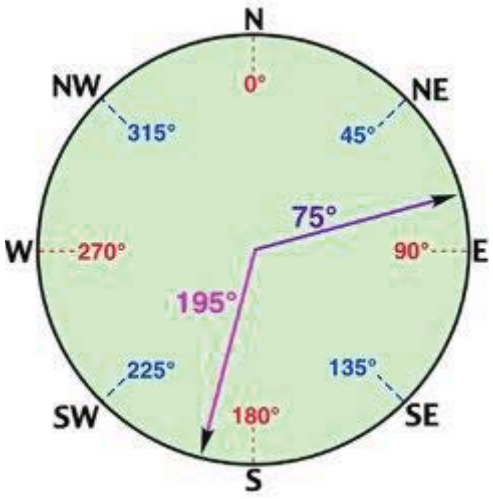

Figure 18 - A basic compass rose

Section 7.2

Overview of the homemade Wind Vane

The wind vane used in this design was a homemade wind vane using a miniature absolute magnetic shaft encoder. The encoder chosen for use was the MA3 produced by US Digital. The purpose for choosing this specific encoder in regards to this design was that the MA3 met four (4) critical objectives. First, the MA3 was the correct size for the application. Second, the MA3 uses an analog output of 0 volts to 5 volts with respect to the current positions (See Figure 19 – MA3 Output behaviour)

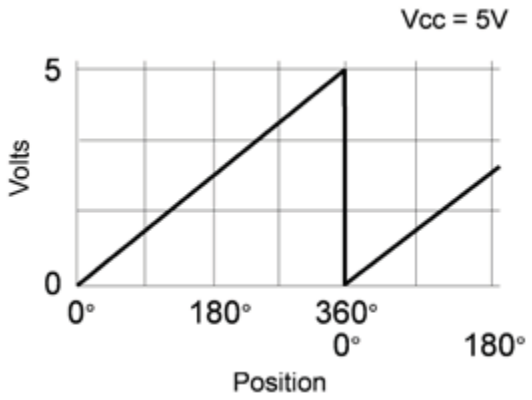

Figure 19 – MA3 Output behaviour

Third, the MA3 uses a 5 volt input. This was a major consideration when choosing an encoder as a 5 volt input allowed for a more simple integration. Fourth, and final, the MA3 met the requirements of being able to function in an adverse environment, having an operational temperature of -40 ºC to +125 ºC.

The shaft of the wind vane was attached to the shaft of the MA3 using an adhesive and a metal coupler (See Page 47, Figure 20 – Joining the MA3 shaft and Wind Vane shaft).

Figure 20 – Joining the MA3 shaft and Wind Vane shaft

The shaft of the Wind Vane and MA3 are housed inside a length of PVC tubing to prevent elemental damage and to provide support for the shafts.

The shaft of the Wind Vane was then bonded to the balancing point of the arrow. The arrow of the wind vane consists of a brass shaft 1 foot long. Attached to the shaft of the arrow is an aluminum tail and tip (See Figure 21 – The Wind Vane)

Figure 21 – The Wind Vane

Section 7.3

Using the Wind Vane

The wind vane position is determined by using the analog 0 volt to 3.3 volt output of the MA3 absolute encoder. To convert this analog value to a numerical representation, the microcontrollers Analog to Digital (AD) feature is used. The P18F45J10 features a 10 bit, 13 channel AD converter. For the application of the weather station, only one analog channel is used (AN0). By using a 10 bit AD converter, a resolution of 3.22 mV is available. The span of values that the AD can return is 0x00 to 0x400 hexadecimal, 0 to 1024 decimal respectively.

When the microcontroller is instructed to sample the MA3 analog output, the MA3_SamplePosition function is invoked. This returns the voltage equivalent of the position of the shaft. Using a transfer function of

, the Azimuth representation of the analog output can be determined. This value is returned to the invoking variable.

To determine the cardinal point direction of the MA3, the AD result must be compared multiple times (See Page 49, Table 5 – Cardinal point versus AD result). After the compare is complete, a value for a LCD screen array position is returned. This simulates that the LCD is updating the same screen with a new direction.

AD Result (in Decimal)	Cardinal point direction
(958 or >958) – 30	North
31 – 92	North North East
93 – 153	North East
154 – 215	East North East
216 – 277	East
278 – 339	East South East
340 – 401	South East
402 – 463	South South East
464 – 526	South
526 – 557	South South West
558 – 649	South West
650 – 711	West South West
712 – 773	West
774 – 835	West North West
836 – 897	North West
898 - 957	North North West

Table 5 – Cardinal point versus AD result

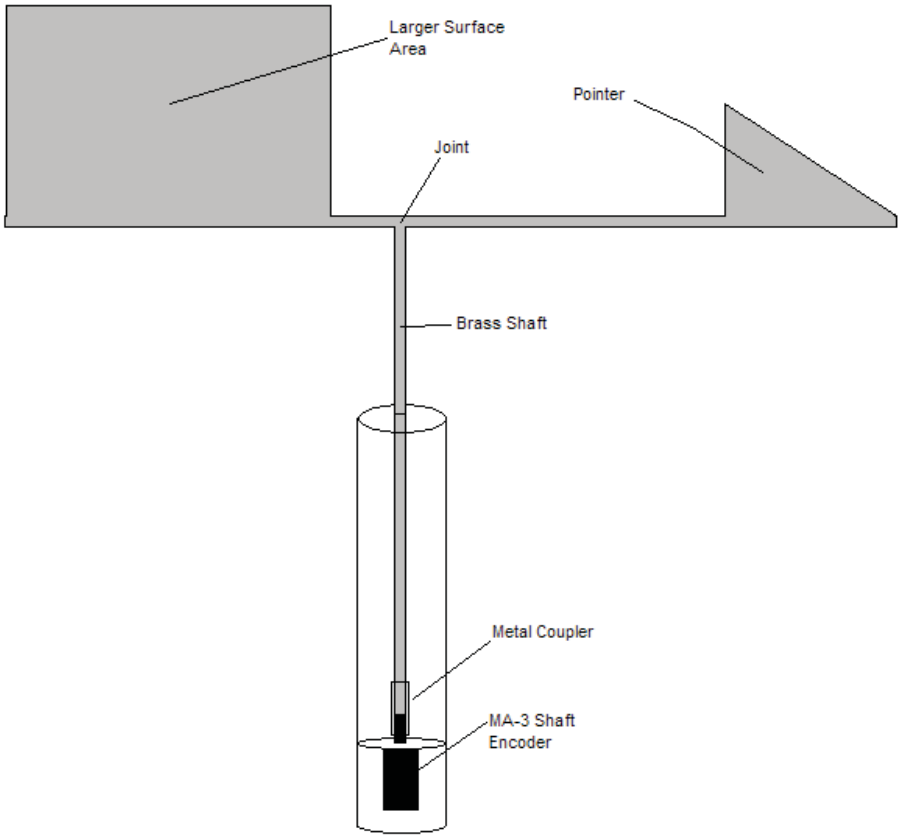

Diagram of how the wind vane was constructed

The physical construction of the wind vane

Waiting for the adhesive to set, joining the shaft of the MA3 and Wind Vane

The completely assembled weather stations