

Weather Station

The weather station consists of five main components, a MoteIV mote for broadcasting weather data wirelessly to a host controller, two pyranometers for measuring global and diffuse radiation, an anemometer and a wind vane. An auxiliary circuit board attached onto the mote provides amplification for the radiation sensors and circuitry for the wind vane.

Sensors

Pyranometers

From the LI-COR instructional manual, “A pyranometer is an instrument for measuring solar radiation received from a whole hemisphere. It is suitable for measuring global sun plus sky radiation”.

A radiation intensity of 1000 Watt / m^2 will drop approximately 16mV across a 200 ohm resistor connected in series with the pyranometer. This voltage is then passed through an amplifier to a range more optimally sensed by the mote’s ADC.

Notes:

The photodiode is not meant to be used under artificial lighting or within plant canopies.

Reflected radiation can also provide erroneous results.

The sensor can be mounted at any angle, but it must be level.

The vertical edge of the diffuser must be kept clean.

Anemometer

The anemometer provides a voltage output up to 2.4V that varies linearly with wind speed. This means the output can be connected directly to the mote’s ADC’s for a reading.

Wind vane

The wind vane contains a potentiometer in which the resistive element varies depending on the angular position of the vane. This resistance can be calculated by forming a resistive divider network with another resistor and applying a known voltage.

Power

Several steps were taken to ensure minimal power usage. First, because this mote is not expected to receive any messages, the radio is turned off whenever the mote is not sending a message. This means a longer delay between messages will result in a lower average power usage. When the mote is idling after sending a message and before taking the next reading from the sensors, power is turned off to the amplifier and the resistive divider. Assuming the mote is powered by a pair of 2000mAh AA batteries, the mote should be able to last 46 months. However, this does not take into account the intrinsic battery drain at the fact that there is still energy left if the batteries are replaced at 2.5V.

Issues

Pyranometers

With the default resistors attached at the output of the pyranometers, the output can only go up to 10mV. This is not high enough voltage for Telos's ADC to get a good resolution. This problem is solved by adding an amplifier to amplify the signal. An appropriate gain must be chosen, in this case, 68, to ensure that the maximum output doesn't exceed the ADC's reference voltage. To save power, the supply pin to the amplifier is turned off whenever the pyranometer's ADCs aren't in use.

Amplifier

The current board contains an amplifier rated for a 3V minimum supply. However, the amplifier appears to be working in this configuration down to at least 2.7 volts.

Wind vane

Since we are measuring the resistance of the potentiometer using a resistive divider, the reading will change as a function of battery voltage. In order to get a more accurate reading, the battery voltage is taken into account when calculating the potentiometer resistance.

Anemometer

The anemometer can output up to 2.4 volts. This means instead of using the 1.5V reference voltage, we need to use the 2.5V voltage reference if we are to be able read up to the maximum voltage output. If we use the 2.5V voltage reference, we must ensure the AA battery supply must not fall below 2.5V.

Battery voltage sensor

We can measure battery voltage between 1.5V and 3.0V using the 1.5V voltage reference and between 2.5V and 5.0V using the 2.5V voltage reference. Since we already need to maintain a 2.5V battery supply (see issues with the Anemometer), and monitoring battery voltage above 3.0V seemed useful, we chose to use the 2.5V voltage reference to measure the battery voltage.

