Functional Requirement #2- Inclusion of Wattage and Power Factor

Deriving Wattage:

The meter measurement file takes samples for current and voltage then calculates the RMS voltage and current values over a time period when they are requested from the server. Upon request, this file can return a wattage, or apparent power, measurement by multiplying current, voltage, and power factor. This file can also return a volt-amp, or real power, measurement by multiplying only current and voltage. The purpose of having both apparent and real power depends on the customer that is using the meter. Residential customers are billed in Watts, while commercial customers are billed in Volt-Amps and either customer can use these measurements to compare to their power bill.

Plausibility of Adding Power Factor:

There are several ways to find power factor, but it involves finding at least two of the three: real power, apparent power, or reactive power. As we have already begun the process of finding current and voltage readings, it is easy to calculate the apparent power (S=V*I). The difficulty is within finding the phase difference between the voltage and current waveforms, so we can calculate real or reactive power.

Upon initial consideration, we thought this might be easy to find by simply attaching an oscilloscope to our circuit and observing/calculating the phase difference. However, because we want our project to be an independent product, this is not feasible. That being said, the next idea considered was to implement a phase comparator.

Phase comparators require two signal inputs, and then just like the name suggests, compare the phase angles. In this case, the two signal inputs would be provided by the current sensor and optocoupler board. Additionally, two phase comparators were considered: a zero-crossing detector and a phase-frequency detector.

Zero-crossing detectors measure the phase of each input signal at the point in which the waveform crosses the x-axis or zero-reference. These can provide time signature data points that can be compared between the current and voltage waveforms. These times, along with the assumed frequency of 60Hz can be used to calculate the phase difference.

Phase-frequency detectors identify the phase difference between two input signals and produce a varying voltage at a frequency equal to the frequency difference. This type of phase detector can be integrated using dual D-type flips flops and a NAND gate. Furthermore, this assimilation has a low power consumption and minimal time delay.

Unfortunately, the potentials of harmonic distortion and real-life power absorption make the sinusoidal aspect of voltage and current waveforms unreliable, which is what phase detectors are based off of. Upon further discussions with a professor, Dr. Tony Pinar, we've discovered a much simpler solution. The instantaneous power can be found by multiplying voltage and amperage at multiple points throughout the cycle and then averaged to find real power. We can then use data points of the detected

RMS voltage and current values to calculate our apparent power and thus calculate power factor. This strategy will be implemented in the following semester.