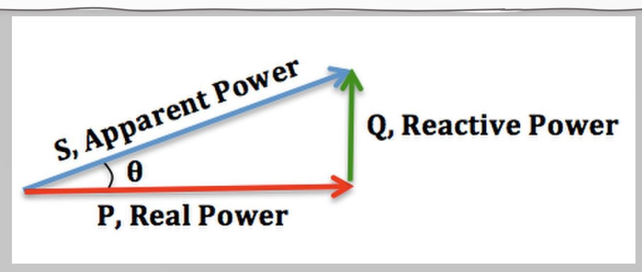
Integrated test and measurement device with graphical phasor display for single phase AC motor experiments

Doğancan YOSUL – Semih SAYIM

Supervisor: Prof. Dr. Uğur BAYSAL
Electrical and Electronics Engineering, Hacettepe University

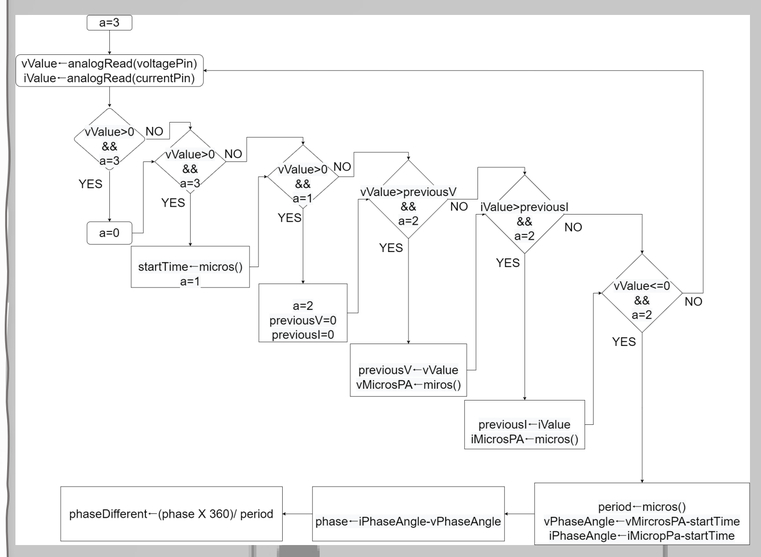
Introduction

The power consumed by AC electric motors in industry is very important. Since AC motors are wound devices, they consume inductive power. In terms of electrical efficiency, apparent power and active power should be close to each other. in which the cos Ø value should approach one. In this case, it is important to know the reactive power it consumes. If the phase difference between current and voltage can be calculated, we can learn the reactive power of AC motors.



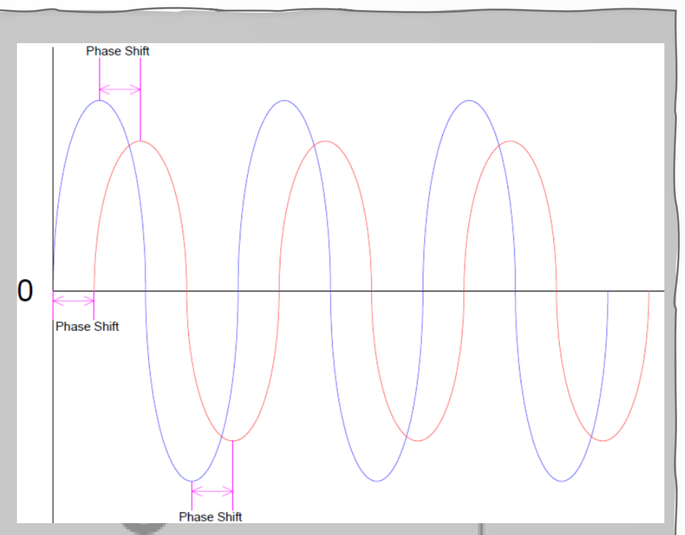
In the project we have done, we have designed a device that calculates the phase difference between current and voltage of single-phase AC motors. The device notifies the user of the results it has obtained through the screens it has on it, and in cases where the user cannot interact with the device directly, user can check the data on the internet.

Solution Methodology

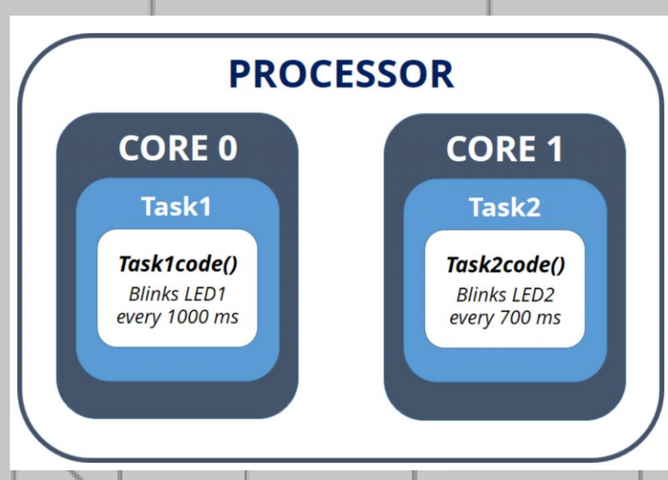


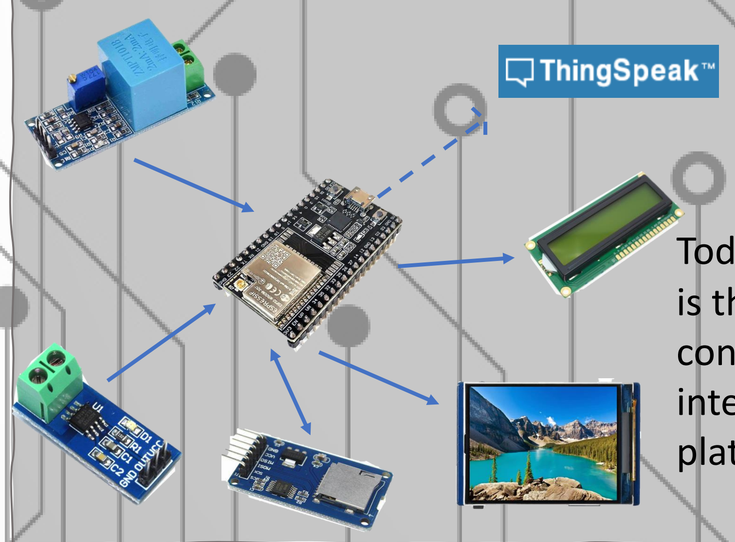
The working principle of the algorithm we use when calculating the phase difference is as shown on the right. Voltage value is taken as reference. When the voltage value is greater than zero, each value taken is compared with the value taken in the previous cycle, the point where the current value is less than the previous value is recorded as the peak. the same thing is repeated for the data from the current sensor and the time difference between the two peaks is found. The phase difference is calculated with the formula

$$PD = \frac{difference\ between\ peaks\ x360}{Period}$$



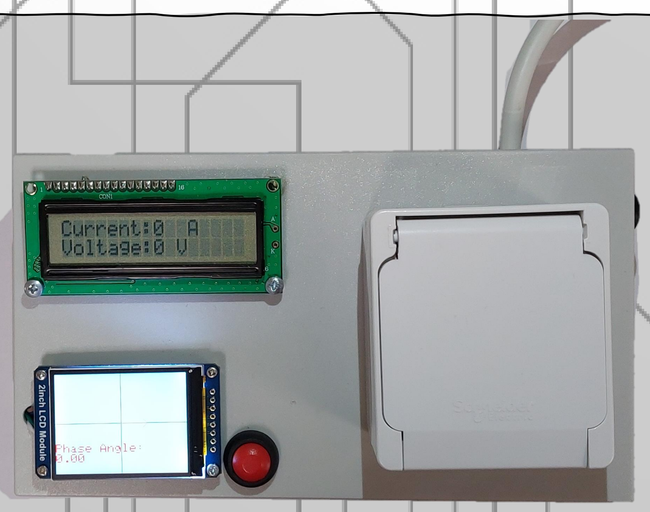
The fact that the microcontroller is dual-core causes the measurements to give more accurate results. In the first core, the data is received from the sensor without loss, while in the other core, the necessary processes are carried out to publish the results.





Today, the internet is at the center of life in a location that everyone can easily access and use. While this is the case, we technology developers must provide access to the internet in our projects. By connecting the test and measurement integrated device for the AC motors we have built to the internet, we have enabled users to access the data online. We published the data on the ThingSpeak platform, which is frequently used by IoT developers, with the WiFi module included in the ESP32.

Results and Discussion



The need for the project was a device that tests measures AC motors and sends the results to the relevant people in various ways. The project was largely successful. Data from sensors can be transmitted to users. However, the phase difference algorithm we created failed due to the harmonics occurring in the current and voltage signals. In order to solve this problem we noticed, the phase difference algorithm needs to be recreated. We couldn't solve this problem because we didn't have enough time. When the deficiencies of the project are eliminated, it will be a cheap, portable and rechargeable device that can be used to test and measure AC motors.

Features of Our Device

- It shows the results on a 2x16 dot matrix screen and a graphical display.
- It saves results on SD card.
- It publishes the measurements on thinkspeak.com.
- Powered by a rechargeable battery.

Reference

https://solarduino.com/
https://randomnerdtutorials.com/
https://www.diagrams.net/
https://thingspeak.com/

Acknowledgements

This project was completed within the context of ELE401-401 Graduation Project courses in Hacettepe University, Faculty of Engineering, Department of Electrical and Electronics Engineering.

We thank Prof. Dr. Uğur BAYSAL for his/her invaluable contributions to our project.