

# Implementation of Arduino Based AC Voltage Controller Using Single Phase Controller Techniques

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**Abstract:** -- This paper introduces a high-efficiency AC voltage regulator based on an AC/AC buck converter cascaded by a transformer in series with the input voltage. The AC/AC converter uses an overlap time in the gate signals to solve the commutation problem. Non-use of any snubbed circuits and current sensors leads to lower cost, smaller size and simpler hardware. The converter generates only the compensation term which results in smaller switches and, thus, lower cost. Simulation and experimental results verify the performance of the proposed topology.

**Keywords:** Aurdino UNO, AC Voltage Regulator, AC Chopper, AC/AC Buck Converter, Power Electronics, Light Emitting Device.

## I. INTRODUCTION

### About AC regulator:

A voltage controller also called an AC voltage controller or AC regulator is an electronic module based on either thyristors, TRIACs, SCRs or IGBTs, which converts a fixed voltage, fixed frequency alternating current (AC) electrical input supply to obtain variable voltage in output delivered to a resistive load. This varied voltage output is used for dimming street lights, varying heating temperatures in homes or industry, speed control of fans and winding machines and many other applications, in a similar fashion to an autotransformer. Voltage controller modules come under the purview of power electronics. Because they are low-maintenance and very efficient, voltage controllers have largely replaced such modules as magnetic amplifiers and saturable reactors in industrial use. A regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages

## II. IMPLIMENTATION SETUP COMPONENTS

### A. Arduino Board:

Arduino is a tool for making computers sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or

sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or communicate with software running on your computer. There are many other microcontrollers and micro-controller platforms available for physical computing. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino is also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems.

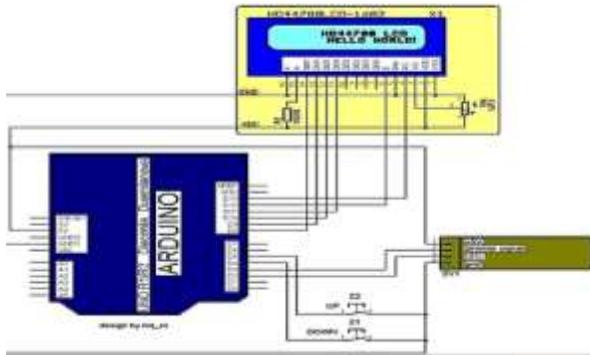


*Fig Arduino board*

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the USB-to-serial driver chip.

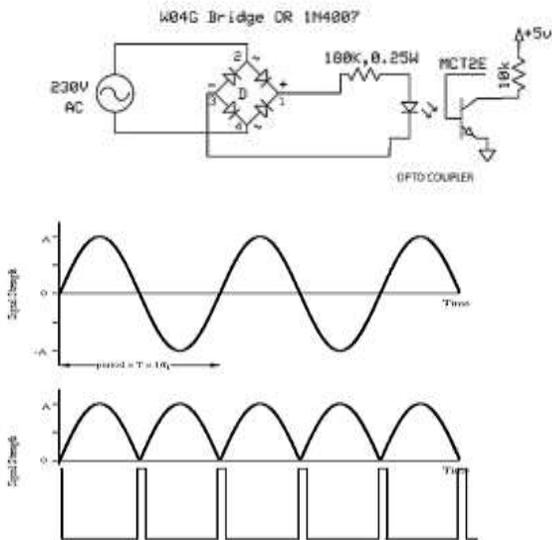
Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. Arduino Uno is an open source computing platform based on a simple input/output board and a development environment that implements the Processing Language.

**AC REGULATOR CIRCUIT DIAGRAM:**



Circuit diagram

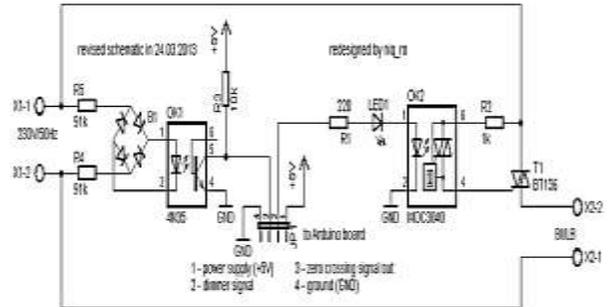
**III. ZERO CROSSING DETECTOR**



**Fig: Zero Crossing Detector**

A Zero Cross Circuit (or zero crossing circuit) is an electrical circuit that starts operation with the AC load voltage at close to 0 Volts in the AC cycle. This is in relation to solid state relays, such as triacs and silicon controlled rectifiers. The purpose of the circuit is to start the triac conducting very near

the time point when the load voltage is crossing zero volts (at the beginning or the middle of each AC cycle represented by a sine wave), so that the output voltage begins as a complete sine-wave half-cycle.



In other words, if the controlling input signal is applied at any point during the AC output wave other than very close to the zero voltage point of that wave, the output of the switching device will "wait" to switch on until the output AC wave reaches its next zero point. The point where the AC line voltage is 0 V is the Zero Cross Point. When a triac is connected in its simplest form, it can clip the beginning of the voltage curve, due to the minimum gate voltage of the triac. A zero cross circuit works to correct this problem, so that the triac functions as well as possible. This is typically done with thyristors in two of the three phases.

**IV. AC REGULATOR USING AURDINO**

**Working Model :**

In this paper, adjustment of lamp brightness is done by connecting to the circuit through serial port. The brightness can be changed according to the commands provide to the serial port using these particular commands in this Arduino project, and design a Pulse Wave Modulated (PWM) dimmer circuit which will use an IN4007 in a diode bridge which is used to control the voltage across the bulb with pulse wave modulation (PWM). To start, we have the diode D6, the load resistor R5, and the capacitor C2 connected. This forms our rectifier. Also, in the circuit, the positioning of the resistor R5 is such that it limits the current pulses through D6 to about 1.5A. This shows that the rectifier is not a pure peak rectifier. Talking about the capacitor C2, the voltage across it is regulated to a maximum value of 10V by the resistors R3 and R4, capacitor C1, and diode D1. The opt coupler and the remaining resistor R2 are used for driving the gate. The function of R1 is to protect the LED in the opto coupler. Like R5, R1 also limits the current so that a 'hard' voltage can be applied safely. The opto coupler, MCT2E, provides class-II isolation. This is good enough to ensure safety to the regulator. For this, connect the transistor in the opt coupler to the positive power supply. have to make a compromise

**International Journal of Engineering Research in Electrical and Electronic Engineering (IJEREEE)**  
**Vol 4, Issue 2, February 2018**

between the switching loss and the inductive voltages as keep the rating of R2 a bit high, i.e., 22 K-ohm. This is done to reduce the switching spikes as a consequence of parasitic inductances.

Steps for uploading the program into Arduino Uno Board:

**Step1:**

Arduino microcontrollers come in a variety of types. The most common is the arduino Uno, but there are specialized variations. Before you begin building.

**Step2:**

To begin, you'll need to install the arduino programmer, aka the integrated development environment (ide).

**Step3:**

Connect your arduino to the usb port of your computer. This may require a specific usb cable. Every arduino has a different virtual serial-port address, so you will need to reconfigure the port if you're using different arduinos.

**Step4:**

Set the board type and the serial port in the arduino programmer.

**Step5:**

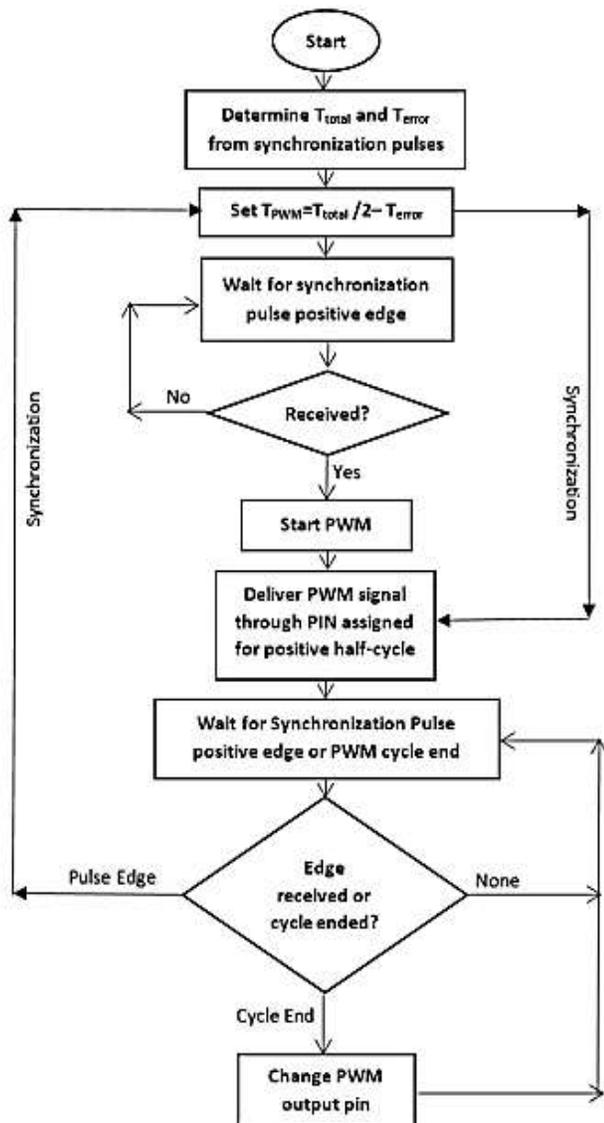
Test the microcontroller by using one of the preloaded programs, called sketches, in the arduino programmer. Open one of the example sketches, and press the upload button to load it. The arduino should begin responding to the program: if you've set it to blink a led light, for example, the light should start blinking.

**Step6:**

To upload new code to the arduino, either you'll need to have access to code you can paste into the programmer, or you'll have to write it yourself, using the arduino programming language to create your own sketch. An arduino sketch usually has five parts: a header describing the sketch and its author; a section defining variables; a setup routine that sets the initial conditions of variables and runs preliminary code; a loop routine, which is where you add the main code that will execute repeatedly until you stop running the sketch; and a section where you can list other functions that activate during the setup and loop routines. All sketches must include the setup and loop routines.

**Step7:**

Once you've uploaded the new sketch to your arduino, disconnect it from your computer and integrate it into your project as directed.



*Flow chart of synchronization*



**Circuit showing all the components**

The above figure shows all the components of the project.

The components are :

- 1) Step down transformer

- 2) Arduino uno
- 3) PCB main circuit board
- 4) 9 Watt LED bulb
- 5) Holder
- 6) Switch



Completed HARDWARE VIEW

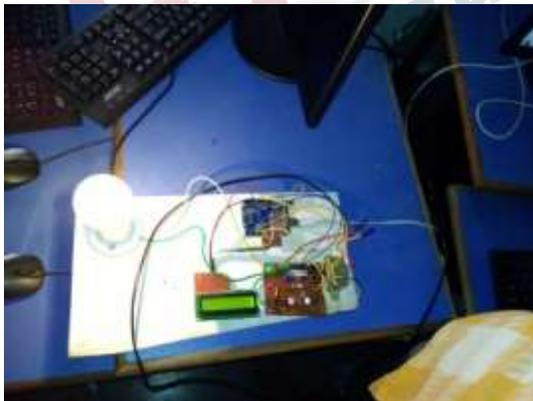
**Advantages:**

- Construction of AC regulator is simple and compact.
- External commutation circuits are not required.
- Maintenance required is very less.
- Running cost is also less.
- Efficiency is high.

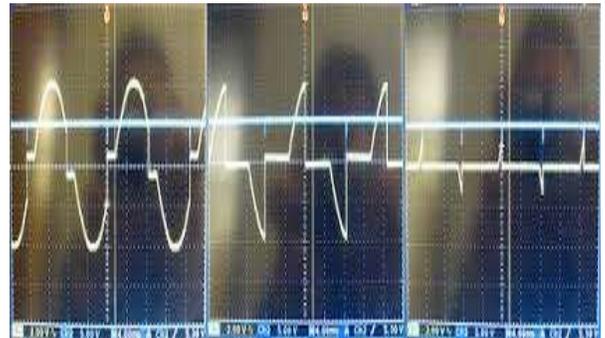
**Disadvantages:**

- In ON-OFF control strategy periodic power is sent to the load which influence load performance
- In phase control strategy harmonics are produced in supply current because of non-sinusoidal load current

**V. RESULTS**



*FIG: Circuit during ON Condition.*



*FIG: RMS Voltage Varying at different firing angle*

**V. CONCLUSION**

The study of feasibility and evaluation was done in the proposed project with simulation studies and hardware implementation. A UNO microcontroller-based was designed to increase its efficiency. The prototype can be extended by replacing the SCR pair with high power SCRs. To reduce the harmonic content some adaptive filtering techniques must be used to improve the design.

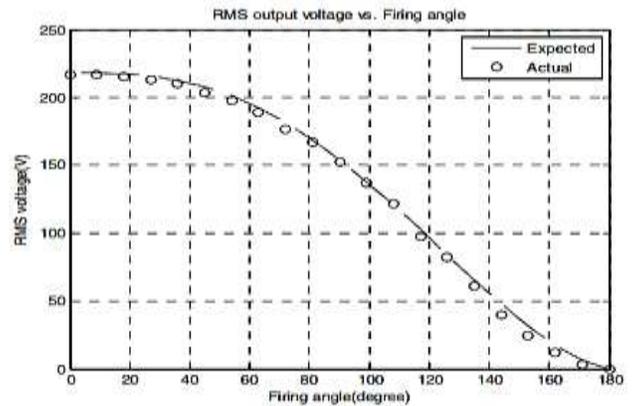


Fig. RMS output voltage vs. firing angle

**REFERENCES**

[1] Park, C. Y., Kwon, J. M., & Kwon, B. H. 'Automatic voltage regulator based on series voltage compensation with ac chopper', IET J. Power Electronics, 2012, 5, (6), pp. 719 – 725.

[2] Jimichi, T., Fujita, H., Akagi, H. 'A dynamic voltage restorer equipped with a high-frequency isolated DC-DC converter', Industry Applications, IEEE Transactions on, 47, (1), pp. 169-175.

**International Journal of Engineering Research in Electrical and Electronic  
Engineering (IJEREEE)  
Vol 4, Issue 2, February 2018**

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- [3] Amirabadi, M., Baek, J., Toliyat, H. 'Bidirectional Soft Switching Series AC-Link Inverter', Industry Applications, IEEE Transactions on, 51, (3), pp. 2312 – 2320.
- [4] Harada, K., Anan, F., Yamasaki, K., Jinno, M., Kawata, Y., Nakashima, T.: 'Intelligent Transformer' Proc. of the IEEE Power Electronics Specialist Conference, Baveno, Jun 1996, 2, pp. 1337-1341.
- [5] Ma Huasheng, Zhao Liang, Zhang Bo, Zheng Jianchao.: 'AC/AC Buck Converter Instantaneous Value Control Modeling, System Analyzing and Designing', Proc. of the IEEE Electrical Machines and Systems Conference, Nanjing, Sept 2005, 2, pp. 1391 – 1395.
- [6] Rosas-Caro, J.C., Mancilla-David, F., Ramirez-Arredondo, J.M., Bakir, A.M.: 'Two-switch three-phase ac-link dynamic voltage restorer', IET J. Power Electronics, 2012, 5, (9) , pp. 1754-1763.
- [7] Jothibasu, S., Mishra, M.K., 'An Improved Direct AC–AC Converter for Voltage Sag Mitigation', IEEE Transactions on Industrial Electronics, 2015, 62, (1), pp. 21- 29.
- [8] Subramanian, S., Mishra, Mahesh Kumar, 'Interphase AC–AC Topology for Voltage Sag Supporter', IEEE Transactions on Power Electronics, 2010, 25, (2), pp. 514-518.
- [9] Minh-Khai Nguyen, Young-cheol Lim, Yong-Jae Kim: 'A Modified Single-Phase Quasi-Z-Source AC–AC Converter', IEEE Transactions on Power Electronics, 2012, 27, (1), pp. 201-207.
- [10] Amirabadi, M., Toliyat, H.A., Alexander, W.C.: 'Single-stage soft- switching ac-link AC-AC and DC-AC buck-boost converters with unrestricted load power factor', 29th Conf. on Power Electronics (APEC), Fort Worth, TX , March 2014, pp. 1268 – 1275.
- [11] Khan, M. M., Rana, A., Fei Dong: 'Improved ac/ac choppers-based voltage regulator designs', IET J. Power Electronics,