Firing Angle Controlled of a Power and Fact Controller

1Janvi Nimje,2 Chetan Bhoskar, 3Megha Khandait, 4Santosh Urade

Department Of Electrical Engineering,
Wainganga College of Engineering and Management, Dongargaon, Wardha Road, Nagpur , India.

Dr. D.R. Tutakne
Assistant professor, Department Of Electrical Engineering,

Wainganga College of Engineering and Management, Dongargaon, Nagpur, India.

ABSTRACT: Our project aims at a firing angle control of ac power and facts controller developed FACTS devices voltage increases and decrees is traditionally operated through manual. The system allows user to easily perform this operation through the use of a simple using system traic circuit. Relation between firing angle and output voltage- As the firing angle increases, the output voltage is more chopped compared to the input, and therefore the mean output voltage decreases.Traic are high-speed solid-state devices which can be used to control bulb. It operated by ac power supply using fact device controller. It is used the firing angle controlling to operating used output signal show oscilloscope. FACTS controllers, their application in AC network, and the control and operating principles applicable to their use in power systems.

Keywords: Capacitor Ceramic capacitor, Microcontroller 8051, Resistor, Transformer, Multimeter, Soldering wire, Soldering paste, Cutter, Pcb board, Bulb,.

1. INTRODUCTION

This Paper work deals with the analysis, design and implementation of firing angle controlled of ac power and fact controller**.** Economic growth of the country is directlydepicted with the development of electric power sector. As electricity demand continues to rise, there is an immediate need to increase the quality and reliability of today's highly complex power systems. Traditional power flows from power stations to the nearest big city are giving way to more complex patterns. Growth in the use of renewable sources also becomes a problem, as these generations are often located in remote regions where the power grid is traditionally weak. Construction of new transmission systems is not always the best option due to environmental crisis, land use, permit granting and cost considerations. In these aspects Flexible AC Transmission Systems (FACTS) technology with relatively low investment, Compared to new transmission or generation facilities allows the industries to enhance power system performance, improve quality of supply and also provide an optimal utilization of the existing resources. Flexible AC Transmission Systems (FACTS) are the perfect solution for increasing the reliability of AC grids, ensuring stability, and boosting transmission efficiency. With these modular and customized solutions from a single source, high voltage fluctuations and power failures can be prevented, network assets can be optimally utilized, and load-induced disturbances can be mitigated. Siemens Energy supports

customers around the world with innovative FACTS to help them master the challenges of energy transitions.

1.1. Objective

The objective of our project is to construct a circuit which can control the firing angle of TRIAC. At controlling the AC power by using the concept of firing angle control of triac. The required output is obtained by varying the conduction time firing angle of these switching devices. There are different methods for generating such control gate signals. In this project, the gate signals will be generated using the circuit can generate a firing angle signal that can be varied between 90° to 180°. Ac output voltage and the ac power flow to the load is controlled by varying (adjusting) the trigger angle 'α' To control the ac power flow: 1 On-Off control 2.Phase control

2. DATA COLLECTION AND ANALYSIS

2.1 Firing angle

"During ferrite voltage applied to a gate to start an AC cycle, you'll know it has a firing angle…" The angle in the AC cycle at which the thyristor starts conducting at the application of positive voltage to gate is known as the firing angle α.The number of degrees from the beginning of the cycle when SCR is switched on is firing angle. Any SCR would start conducting at a particular point on the ac source voltage. The particular point is defined as the firing angle. The earlier in the cycle the SCR is gated ON, the greater will be the voltage applied to the load. Firing angle of a converter Firing Angle of SCR is defined as the angle between the instant SCR would conduct if it were a diode and the instant it is triggered. We know that, there are two conditions which must be satisfied for turn on of an SCR. SCR must be forward biased i.e. its anode voltage must be positive with respect to cathode voltage.

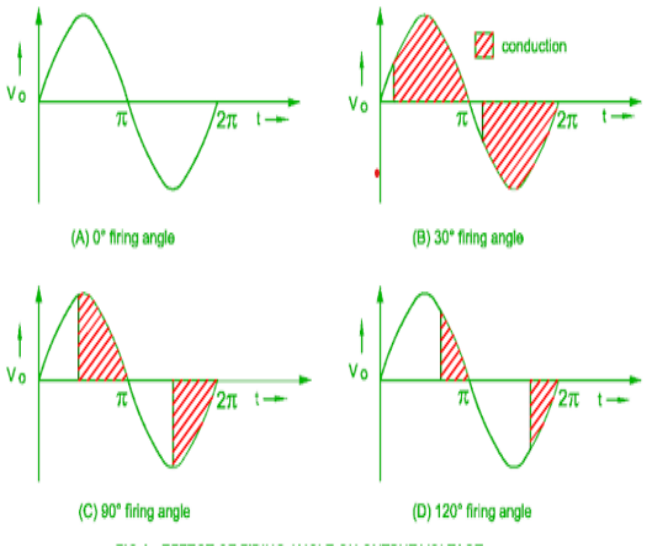


Fig 2.1 Effect of firing angle on output voltage

2.2 Phase angle firing

Phase Angle Control is a Traic Firing Technique that controls the conduction angle of an AC signal which in turn controls the average AC voltage across the load. By regulating the AC Voltage, the AC current drawn by the load is controlled. Thyristor Power Controllers incorporate Phase Angle Control Technique.

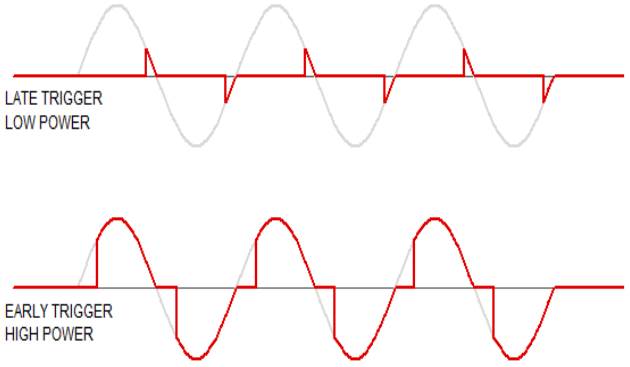
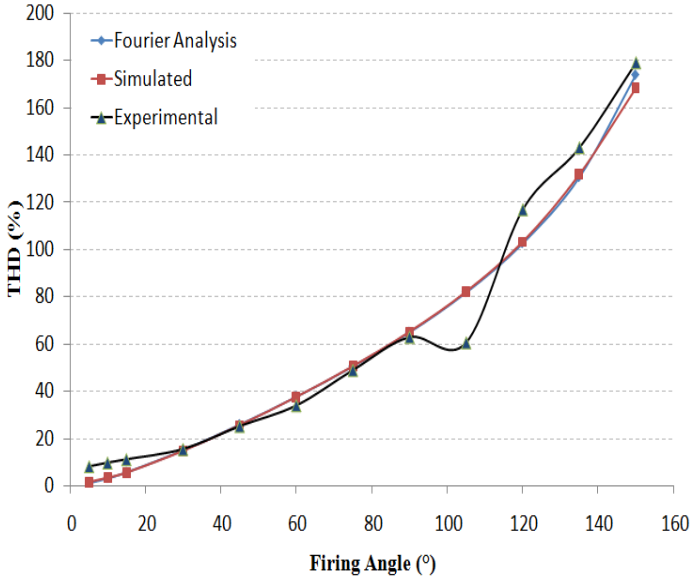


Figure .2.2 Full phase angle control waveforms

3.1 Function of firing angle

Firing Angle Control: Basically by controlling the firing angle means managing the point on the AC signal waveform when the SCR is going to be triggered or in other words, the time corresponding to the AC signal waveform when the SCR gate is going to be given DC supply voltage.



3.Need of Facts Devices in Power System

In a power system, coordination between the generation and demand is necessary. The demand for electrical energy increases day by day. To meet this demand, it is necessary to operate all components at their maximum efficiency. The FACTS devices are nothing but the device used to increase the efficiency of the transmission system. There are three types of power; Active power, Reactive power, and apparent power. Active power is the useful power or true power that we want to transmit. But load consists of various energy stored elements that causes the reactive power. There are two types of reactive power; inductive type and capacitive type. Reactive power is necessary to remain a balance between inductive reactive power and capacitive reactive power. Otherwise, the reactive power will flow through the transmission network. And reactive power reduces the capacity of transferring active power. So, the techniques used to make a balance between inductive and capacitive reactive power are known as compensation techniques. The inductive and capacitive reactive power supply or absorbs by these techniques. In this way, it improves the quality of power and efficiency of the transmission network.

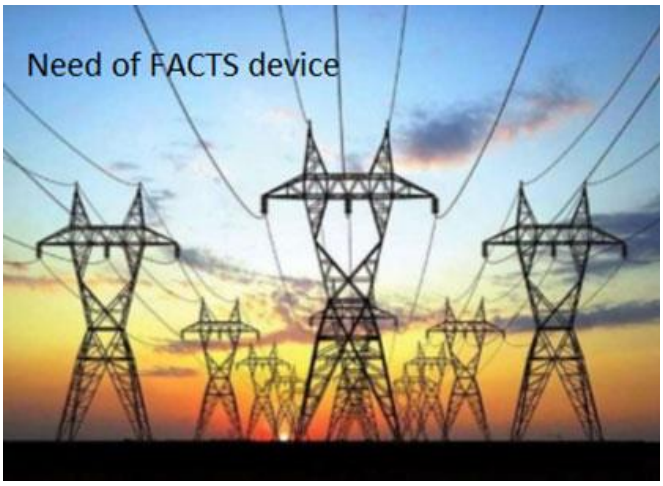


Fig 3 Facts Devices in Power System

3.2 AC Power Supplies

An AC power supply is a type of power supply used to supply alternating current (AC) power to a load. The power input may be in an AC or DC form. The power supplied from wall outlets (mains supply) and various power storage devices is oftentimes incompatible with the power needed by the load.

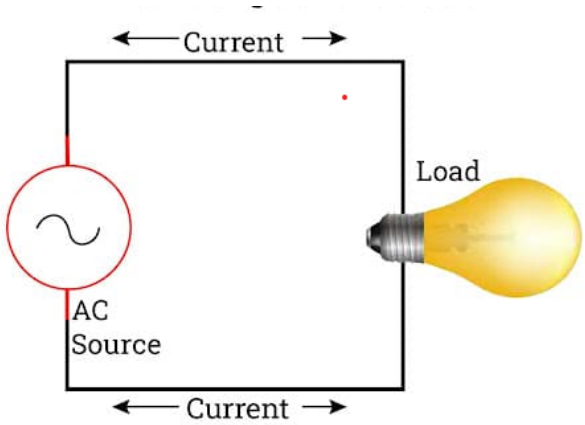


Fig 3.2Alternating current circuit

3.3 Single-Phase Power Supply

A single-phase power supply consists of two current-carrying conductors: the phase wire and the neutral wire.

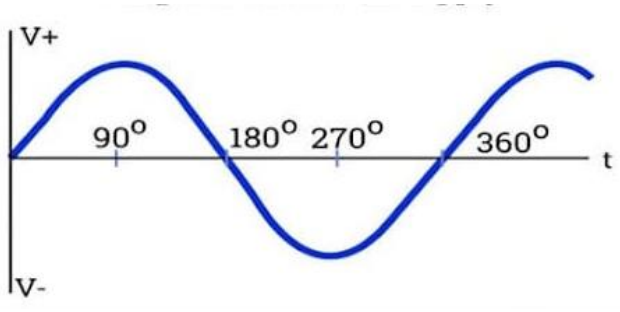
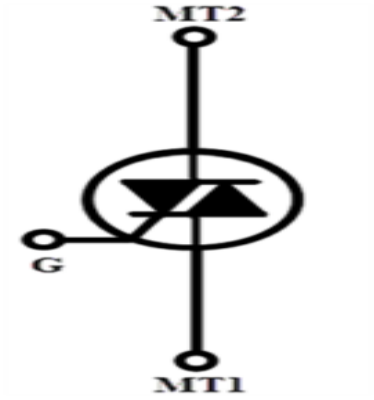


Fig 3.4.single-phase power supply

4. Triac

Triac is an acronym that stands for "Triode for Alternating Current". Triac is switching electronics device has three terminal. It is different from the other silicon controlled rectifiers (SCR) because it conducts in both the directions, whether the applied gate signal is positive or negative. Those control the current flow in a circuit. It belongs to the thyristor family.



The resistor R2 employed in the circuit controls the point of beginning of conduction.

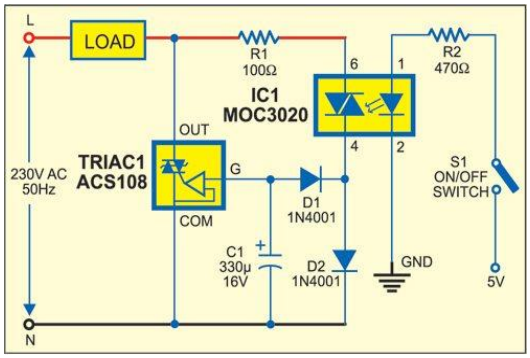


Fig 4.1 Block diagram TRIAC control circuit

4.1Triac control circuit

During the positive half and negative half of the input cycle, ac power is controlled to load by switching between on and off. The positive half forward biases D1 and reverse biases D2 and the gate is positive with respect to A1.

However, during the negative half cycle, D2now gets forward biased but D1 gets reverse biased and the gate is positive with respect to terminal A2.

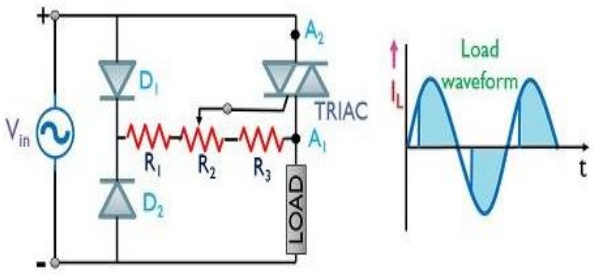


Fig 4.1Ac power control using traic

5 Hardware compound

5.1 Driver IC (ULN2003 16 pin)

ULN2003 is a 16 Pin IC, consisting of 7 Darlington pairs (each pair protected with suppression diode) and thus has the capability to handle a maximum of 7 loads (could be inductive). In simple words, we have 7 drivers in a single ULN2003 chip and thus can control a maximum of 7 loads.

Fig 5.1 Driver IC

5.2 Opt coupler MOC3021- 6 PIN IC

The MOC3021 is a Non-Zero Crossing opt coupler. The MOC3021 comes in an internal light-emitting diode and a TRIAC based light activating based transistor. This opt coupler provides protection from HIGH resistive and inductive loads.

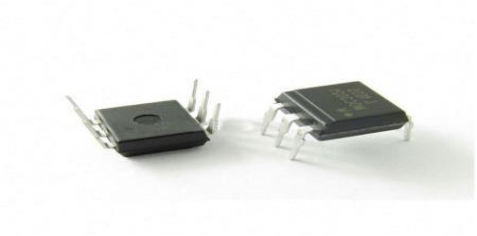


Fig 5.2 Opt coupler

5.3 Regulator 7805 3-pin

IC 7805 is a 5V Voltage Regulator that restricts the output voltage to 5V output for various ranges of input voltage.

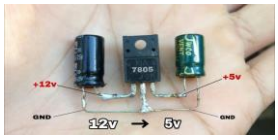


Fig 5.3 Regulator connection with capacitor

6. Experimental setup

This project is designed to traic using firing angle control from AC power supply. The firing angle is obtained from a regulator system that is controlled by a traic. Whereas the AC power is deployed on a optocuplar composed of diodes and a triac to achieve required control from microcontroller (of 8051 family).

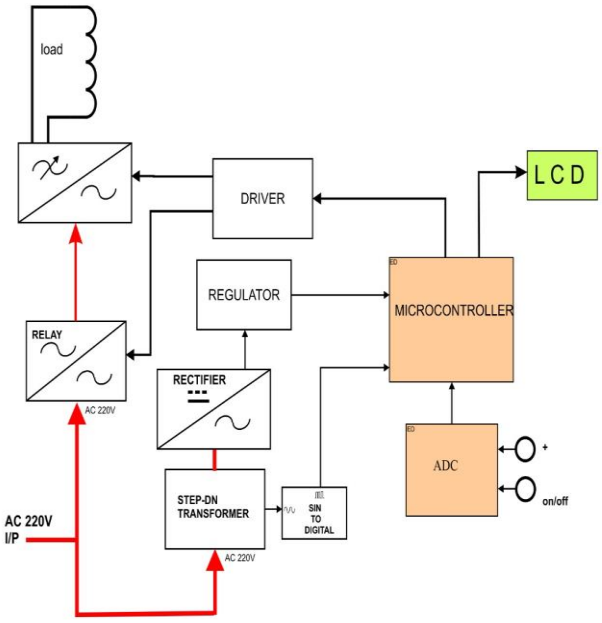
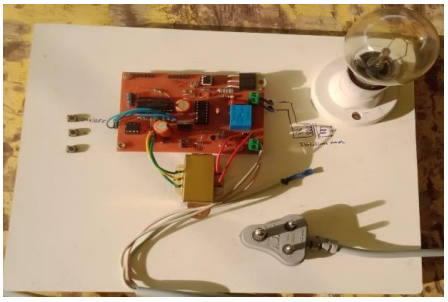


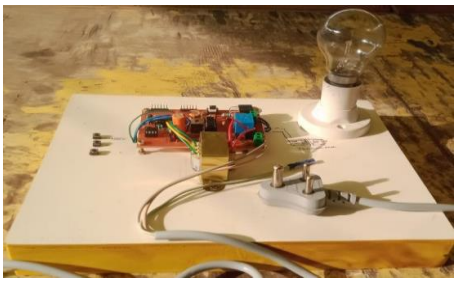
Fig 6 :block diagram -firing angle controlled of ac power a nd fact controller

6.1 PCB Design

Top view

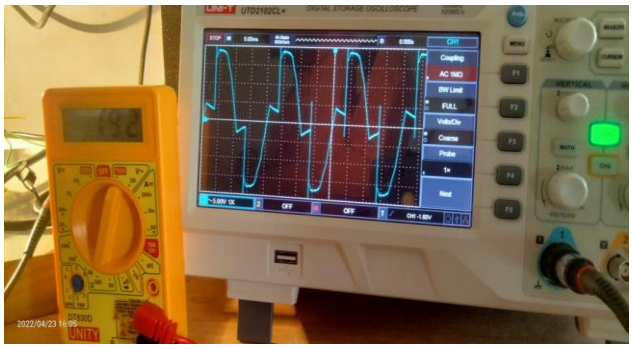


Front view

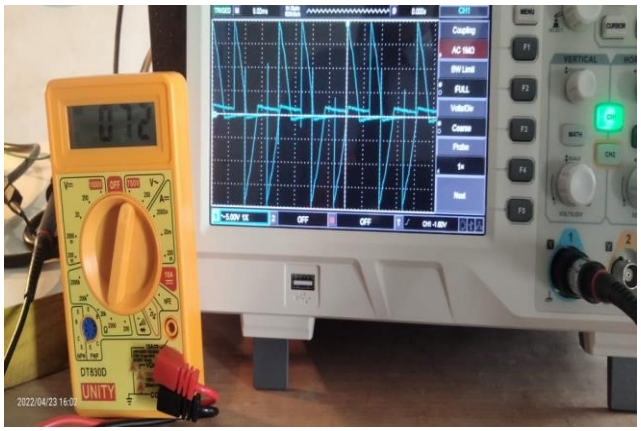


6.3Waveform

1.Draw the corresponding waveforms for different values of firing angle.



2.Simulation of firing angle control circuit for triac



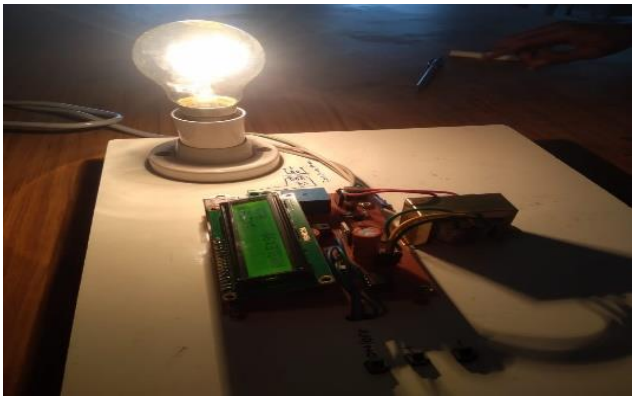
6.4 Observational result

Sr no.	FIRING ANGLE	LOAD VOLTAGE	INCREASE / DECREASE
1	132	52	DECREASE
2	143	35	DECREASE
3	150	26	DECREASE
4	157	21	DECREASE
5	108	100	INCREASE
6	97	120	INCREASE
7	76	70	INCREASE
8	65	171	INCREASE

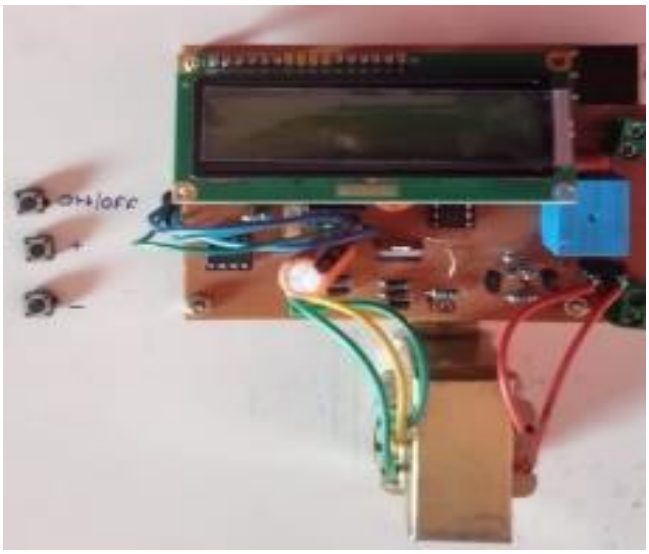
Table 6.4Observational result for waveform

6.2 Testing

1. Turn on power supply to the module, vary the firing angle and observe the output.



2. Microcontroller using control Ac power supply is for operation control, LCD display for displaying firing angle 0 to 180 degree .



3. Turn on push button to the module, Switch on the AC power supplies

7. Conclusion

In this paper the design and implementation of a control system

According to the design, the firing angle is expected to be presents the generation of gate pulse for TRIAC using PIC AT89C2051 microcontroller in details. The generated gate pulse is applied to the gate terminal of TRIAC for phase angle control. For this, simulation as well as experimental results has been obtained. The delay time between the zero-crossing and the applied gate pulse to the TRIAC controls the load voltage. Thus, the power flow to the load is controlled by phase angle control.

7.1 Future scope of work

Works on the topic never ends with limited application. It has much more area of application such as damping of the power swings from local and inter-area oscillations, Voltage regulation of local network, reduction of short-circuit current The technology behind phase-controlled thyristor-based FACTS controllers has been present for several decades and is therefore considered mature. More utilities are likely to adopt this technology in the future.

7.2 References

[1] N. H. Hingorani, "Flexible AC transmission systems,"IEEE Spectrump. 4045, 225-242, Apr. 1993

[2]Integrated electronics: Analog and Digital Circuit and system Jacob Millman Halkias

[3]Anil K. M. (2007), Digital Electronics: Principles, Devices ,Applications, John Wiley & Sons, Ltd.

[4] Twinkle Wahane, Kajal Khobragade, Rahul Argelwar, "Application of Phase Angle Control of Triac for Speed Control of Induction Motor," Journal of Network Communications and Emerging Technologies (JNCET), Vol. 6, No. 4, April, 2016.

[5]Muhammad Ali Mazidi –"THE 8051 MICROCONTROLLER AND EMBEDDED SYSTEMS", Pearson education,

[6]Ayala- "INTRODUCTION TO 8051 MICROCONTROLLER"

[7]Facts Controllers in Power Transmission and Distribution K.R. Padiyar, Power System Dynamics - Stability and Control,(Second Edition), BS Publications, Hyderabad, 2002.