PIC MICROCONTROLLER BASED AC VOLTAGE STABILIZER USING POWER ELECTRONIC CONVERTERS

Dinesh S[1], Narendranath V[2], Sowndharya K[3], Tamilselvan S[4]

[1]*Assistant Professor, Department of Electrical and Electronics Engineering, Dr.Mahalingam College of Engineering and Technology, Pollachi, Tamil Nadu, India*
[2,3,4]*Student, Department of Electrical and Electronics Engineering, Dr.Mahalingam College of Engineering and Technology, Pollachi, Tamil Nadu, India*

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Abstract - *The open loop behavior of buck boost converter is designed to operate under Continuous conduction mode (CCM). By knowing the open loop converter behavior, a closed loop converter is designed. DC-DC converter is designed to specific voltage and load conditions. There is a deviation of the circuit operation from the desired nominal behavior due to changes in the voltage levels and load conditions. So we have designed a proper controller or to overcome this situation of the circuit operation. The closed loop control of buck boost converter is used for providing constant voltage level by increasing and decreasing the pulse width modulation signals. The PWM control is provided by pic microcontroller. Through this method, the transformer is replaced by power electronic converter in AC voltage stabilizer. This proposed system provides more accuracy and efficiency compared to the conventional AC voltage stabilizer.*

Key Words: **Rectifier, Buck-Boost converter, Inverter, Astable multivibrator, Voltage sensor, Microcontroller**

1. INTRODUCTION

Voltage stabilizers are commonly used in large household systems like refrigerator, air conditioner etc. The main objective behind the usage of voltage stabilizers is to protect the devices against voltage fluctuations. This is due to the electrical appliances are designed to operate under a specific voltage to give desired performance.

The embedding of microcontroller with power electronic devices in the design of AC voltage stabilizers tend to produce high-quality, stable voltage supply even in the variation of input voltage and load levels.

Like advancement in the conventional relay type voltage stabilizers, modern stabilizers use high performance solid state control circuits and digital control circuits that eliminate potentiometer adjustments and allow the user to set the desired voltage through a keypad, with output start and stop facility. The automatic voltage regulator is used to regulate the output voltage. It takes the fluctuated voltage and changes them into a constant voltage. The fluctuation in the voltage mainly occurs due to the variation in load in the supply system. The variation in the voltage causes the damage to the equipment of the power system. The variation in the voltage can be controlled by several measures like installing the voltage control equipment near the transformers, generator, feeders, etc. The voltage regulator is provided in more than one point in the power system for maintaining the constant voltage.

1.1 Existing System

A voltage stabilizer stabilizes the voltage if the supply voltage varies or fluctuates over a desired range. It is an electrical appliance that feeds constant voltage to a load during under and over voltage conditions. This device detects these voltage conditions and correspondingly brings the voltage to desired output range. If this voltage is above or above certain voltage level, the electrical appliance would malfunction or might operate at worse condition or even it might get damage. Voltage stabilizers regulate the supply voltage to the load. These are not meant to provide a constant voltage output, instead it operates the load or system in an acceptable voltage range.

Transformers are used in the voltage stabilizer to maintain desired constant voltage level. Constant Voltage Transformer i.e. saturating transformer is used. These voltage stabilizers use a tank circuit composed of a capacitor to generate nearly constant average output voltage with a high-voltage resonant winding and varying input current. By the magnetic saturation winding, the secondary section is used for maintaining the voltage.

Tap changing transformers can also be used for maintaining the desired constant output voltage level. In the tap-changing transformers, servomechanism control is used for switching the tap. By switching the tap of the secondary of the transformers, output voltage can be maintained constant. For buck operation, the number of turns in the secondary side can be reduced and for boost operation, the number of turns in the secondary side can be increased.

1.2 Proposed System

Our proposed system is done for maintaining constant desired voltage irrespective of input supply and load, using microcontroller based Solid state devices. In the existing system, step up or step down can be done by using transformers. Due to this existing system, winding losses would occur and thus reduces the accuracy and efficiency.

But our proposed system uses solid state devices instead of transformers, relays, etc..

Our system mainly consists of three major functions such as rectification, buck-boost conversion, inverter function. Buck-boost converter plays a major role in maintaining constant output voltage level. Buck-Boost converter uses MOSFET to maintain the desired constant output voltage level. It is a feedback control system that measures the output voltage of the load, compares that output to a set point, and generates an error signal, that is used to adjust the pulse for the MOSFET. As the Pulse Width Modulation for the MOSFET increases, its voltage will increase. This proposed system is used to regulate the voltage. It takes the fluctuated voltage and changes them into a constant voltage. The regulation in this proposed system is instantaneous, thus it is suitable for the applications, which need precise regulated power.

When the variation of load occurs, this system is used to maintain the constant voltage level. The fluctuation in the voltage mainly occurs due to the variation in load and on the supply. The variation in the voltage will damage the equipment. But this proposed system will protect the equipments from the damages.
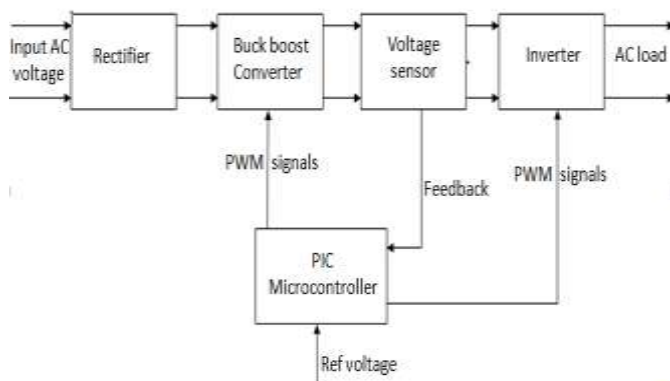
2. BLOCK DIAGRAM

Fig 1: Block diagram

2.1. BLOCK DIAGRAM DESCRIPTION

2.1.1. RECTIFIER:

A rectifier is an electronic device that converts Alternating Current or Voltage to Direct Current or Voltage. The output of the rectifier is not a straight line so that the addition of filter make the rectified output to be pure dc. Here, for rectification process BR1010 is used.

2.1.2. BUCK BOOST CONVERTER:

The buck boost converter may be a DC to DC converter. The output voltage of the DC to DC converter is greater than or lesser than the input voltage. The output voltage value depends on the duty cycle. By varying the duty cycle, the output of the voltage is maintained desired value.

2.1.3. INVERTER:

A inverter is an electronic circuit that converts Direct current or voltage to Alternating current or voltage. The output of the inverter is not sinusoidal by adding filter, the sinusoidal AC voltage is obtained.

2.1.3.1. ASTABLE MULTIVIBRATOR:

An Astable Multivibrator is the multivibrator which has no stable states. Its output oscillates continuously between its two unstable states without the help of external triggering. Here the astable multivibrator is used for giving pwm to the inverter. Astable multivibrator circuit is achieved by making timer 555 IC. Pulse Width Modulation with 50% is required for triggering the inverter circuit.
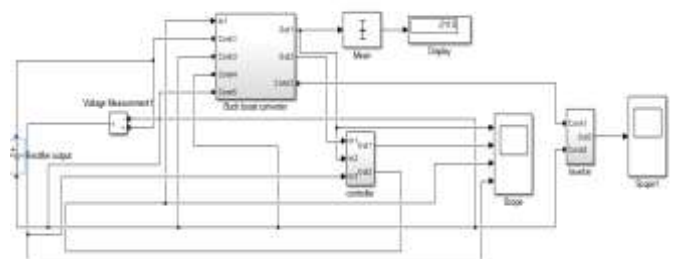
2.1.4. VOLTAGE SENSOR:

Sensors are basically a device which can sense or identify and react to certain types of electrical or some optic signals. A voltage sensor is a potential divider network which gives information of voltage available at the battery as an analog value. Analog voltage will be converted into digital by the ADC of the microcontroller. This voltage will be used for calculation of the power available and power drawn from the battery.
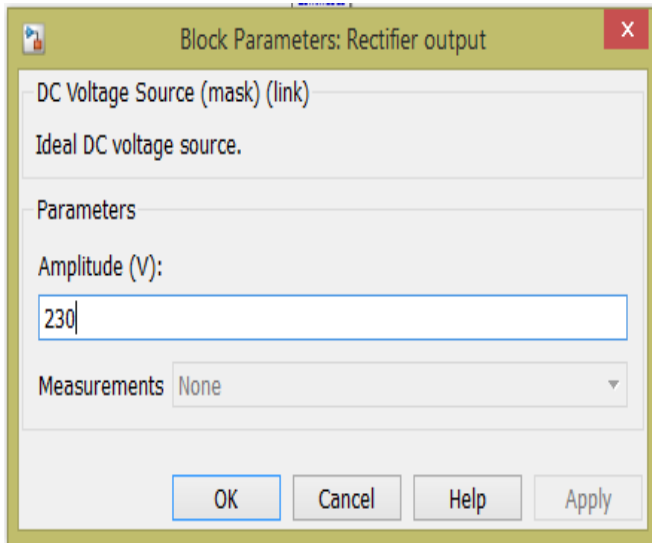
2.1.5. MICROCONTROLLER:

Microcontroller is the major part in the control system used. The information from the sensor will be stored by the microcontroller and are used for the calculation for the output based on the predefined algorithm which is programmed in it. The microcontroller will use the data from the sensors and process it for the calculation for maintaining the constant voltage level.
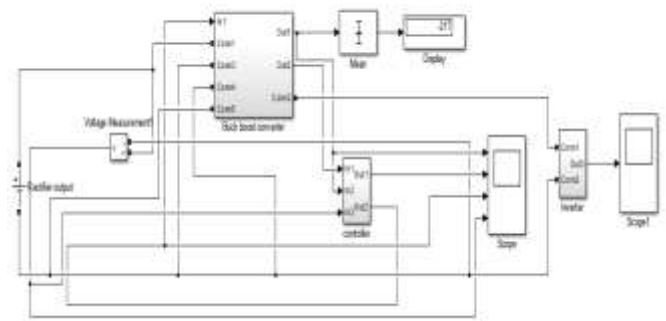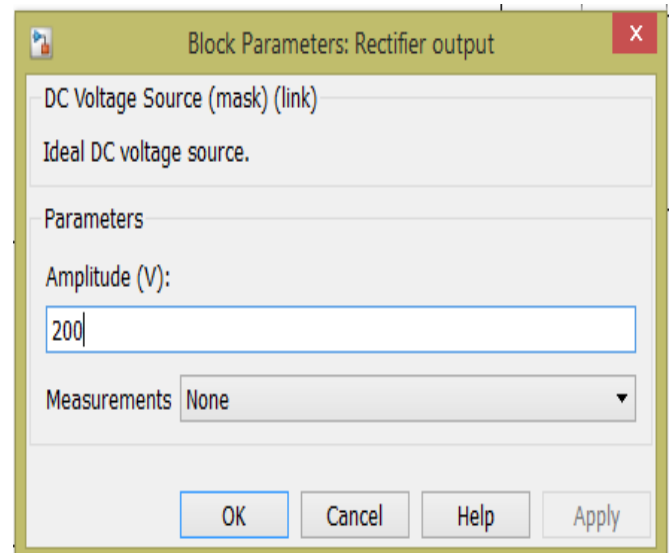
3. SIMULATION

3.1. SIMULATION FOR BUCK MODE
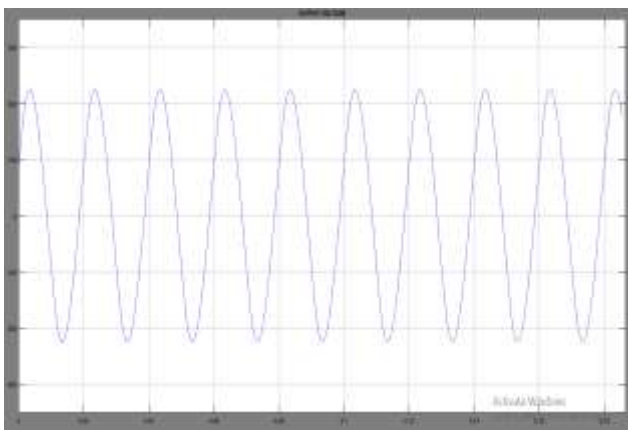
3.1.1. INPUT WAVEFORM IN BUCK MODE

3.1.2. OUTPUT IN BUCK MODE

3.1.3. RESULT IN BUCK MODE

Thus the simulation of the proposed system is done and output was obtained. Here the system operated in buck mode.

      INPUT VOLTAGE=230V

      OUPUT VOLTAGE=220V

      REFERENCE VOLTAGE=220V

3.2. SIMULATION IN BOOST MODE

3.2.1. INPUT WAVEFORM IN BOOST MODE

3.2.2. OUTPUT IN BOOST MODE

3.2.2. RESULT IN BOOST MODE

Thus the simulation of the proposed system was done and its output was obtained .Here the system operated in boost mode.

INPUT VOLTAGE=200V

OUTPUT VOLTAGE=220V

REFERENCE VOLTAGE=220V

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