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HIGH-EFFICIENCY SINGLE-STAGE BRIDGELESS CONVERTER FOR PFC APPLICATION

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Abstract : Nowadays, electronic circuits are used in a wide range of electrical devices. Any electrical circuit relies heavily on a power supply unit. Various converter circuit layouts are used to convert utility-supplied AC power to DC. The most effective method to receive DC power is using a switch mode power supply. As full-wave control rectifiers, power factor correction (PFC) and single-phase AC/DC converters are used in a variety of power electronics systems to ensure high levels of efficiency while enhancing the quality of electricity. This paper proposes a single-phase, bridgeless AC/DC PFC converter with a high output gain voltage. The rectifier's job is to reduce high input voltage to a lower output voltage, which is needed for products with low output voltage. With no bridge-diodes needed, the suggested rectifier efficiency may be increased because of reduced input conduction losses. The suggested rectifier does not need a current-loop circuit since it works in a discontinuous conduction mode. In addition, the rectifier's control circuit is simplified by using just one switch. In the rectifier, a simple translation technique is described to have the positive output voltage in the interleaved converter to lower the component count and the cost as well.

***Index Terms* - Single phase, AC, DC, Diodes, Rectifier.**

I. INTRODUCTION

The switched-mode power supply industry has grown quickly in the last several years. The majority of electronic switched-mode power supplies are utilised to convert AC sources to DC sources in various applications. Although a DC output voltage may be readily achieved by the use of a transformer, bridge rectifier, and capacitors, the input current may be substantially distorted. As a result, AC-DC conversion necessitates PFC converters. For PFC applications, a wide range of circuit topologies have been devised. Full-bridge rectifier and boost converter are used in typical PFC converters. Because of its ease of use, the converter is quite popular. To compensate for this spike in the converter's output voltage, we might say that it's always larger than its input. The output voltage is desirable in various applications, such as low-voltage and low-power supplies. Thomas Mishima et al (2013) Using an unique soft-switching high-frequency (HF) resonant inverter for induction heating (IH) applications, the IH load resonant current may be adjusted continuously while operating in broad range soft-switching conditions, such as when switching between two half-bridge inverter units. It is also suggested to improve efficiency at low output power levels by using an inverter unit with a dual mode power regulation system based on PS angle control and asymmetrical pulse-width modulation (PWM). In an experiment using its 1kW-60 kHz HF-R inverter prototype, the key performance characteristics of output power regulation and soft switching operations are proven, and the topological validity is then analysed from a practical standpoint. Researchers Bishwajit Saha and Rae-Young Kim (2013) came up with a novel architecture for a voltage fed high frequency series load resonant inverter that includes an inherently lossless capacitor and an auxiliary switching cell for induction heaters. A capacitor-clamped half-bridge ZVS high frequency inverter circuit with PWM control may achieve high power density by including a switched capacitor cell. Using an asymmetrical duty cycle PWM control approach, the suggested inverter circuit operates as intended. Experiments with soft-switching operating ranges of high-frequency AC regulation and power conversion efficiency characteristics demonstrate their operational performance.

II. PROPOSED SYSTEM

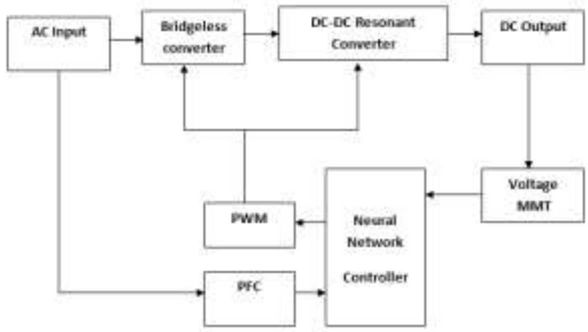


Fig.1 Planned System's Flow Chart

The creation and deployment of intelligent systems are now critical components in the advancement of improved control systems. With the introduction of artificial neural networks, issues that linear systems cannot answer are answered. Our human brain is replicated in an artificial neural network. The sixth sense of the human brain is the capacity to comprehend, recognise, categorise, cluster, detect, and rectify errors, all of which are made possible via the use of an artificial neural network. In other words, it's a virtual representation of the brain's neural network. Human brain-like characteristics may be found in the following aspects of neural networks.

- ✓ It gains information through studying.
- ✓ The information is kept in synaptic weights, the strength of inter-neuronal connections.

  Both linear and non-linear interactions may be represented by the artificial neural network. Being able to discover these associations from the data itself. As a result, in the following scenarios, a neural network may be used:
- ✓ Algorithmic solutions are not possible to formulate
- ✓ Additionally, there are other examples of the desired behaviour.
- ✓ Identify the structure of the data that is currently accessible.

Neural Network Applications

It is a tool that may be utilised in a variety of fields. Neural network controllers may be used in a variety of industries, as seen in Figure 2. We use it for everything from animal behaviour analysis to stock market forecasting to fraud detection to machinery condition monitoring to traffic control to traffic control to medical diagnosis and medical research to credit assignment to machine condition monitoring to fraud detection to photos and fingerprints to voice recognition to weather forecasting to music composition data mining to animal behaviour analysis to etc.

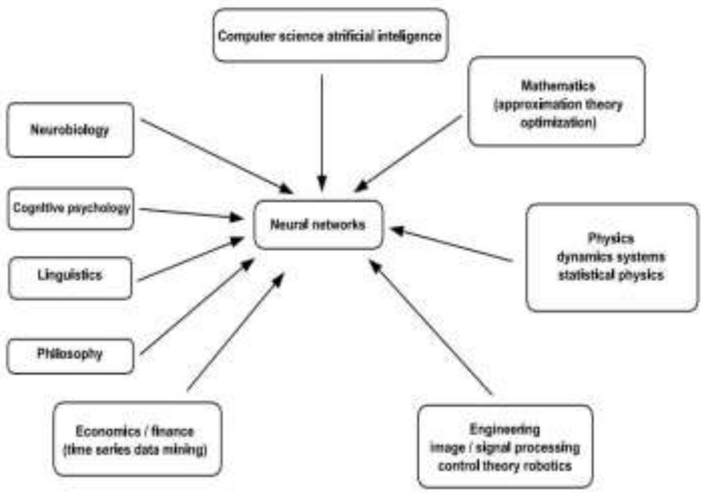


Fig. 2 Applications of Neural Networks

Multilayer Artificial Neural Network

Artificial neural networks with several layers, referred to as Deep Neural Networks, are the focus of Deep Learning. When Dr. Hinton and his colleagues first created the back propagation technique for training multilayer neural networks in 1986, there was a dearth of interest in neural networks after the development of Rosenblatt perception in the 1950s. The multi-layer neural network is seen in Figure 3. It contains three levels, one of which is buried. The term "deep ANN" refers to an ANN that contains more than one hidden layer. A feed-forward artificial neural network, such as an MLP, is a common example. The ith activation unit of the lth layer is shown here as. A neural network's hyper parameters include the number of layers and the number of neurons. It is necessary to apply cross-validation methods in order to discover the optimal values for these variables. Back propagation is used in the weight-reduction training. Neural networks with more layers are more efficient at analysing data. On the other hand, deeper layers may cause an issue with the gradient disappearing. In order to address this problem, special algorithms are needed.

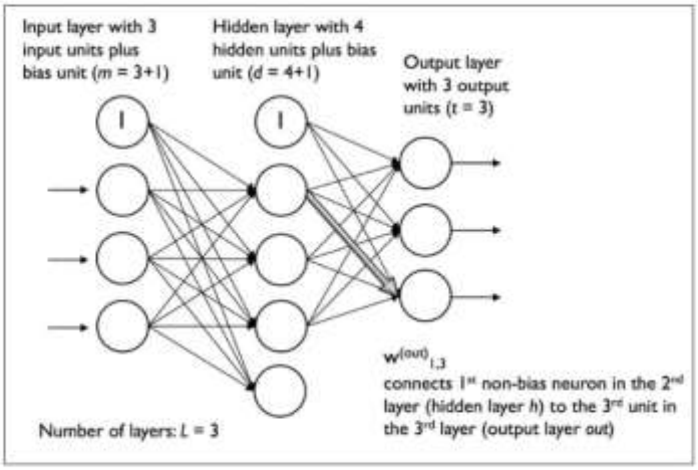


Fig. 3 Multi-layer neural network

Power Factor

The power factor of an AC electric power system is a value between 0 and 1 (sometimes stated as a percentage, e.g.,.5 pf = 50% pf) that represents the ratio of actual power to perceived power. Real power is a circuit's ability to accomplish work in a certain period of time. The circuit's apparent power is equal to the sum of its current and voltage. The perceived power may be larger than the true power because of energy stored in the load and returned to the source, or because a non-linear load distorts the wave form of the current pulled from the source. Losses in a power distribution network are exacerbated by low-power-factor loads, which raise energy expenditures..

- Based on the instantaneous and average power generated by calculating the AC voltage and current with a unity power factor (φ=0, cosφ=1).
- AC voltage and current are used to determine instantaneous and average power with a zero power factor (φ=90, cosφ=0)
- A lagging power factor is used to determine both instantaneous and average power from AC voltage and current (φ=45, cosφ=0.71)

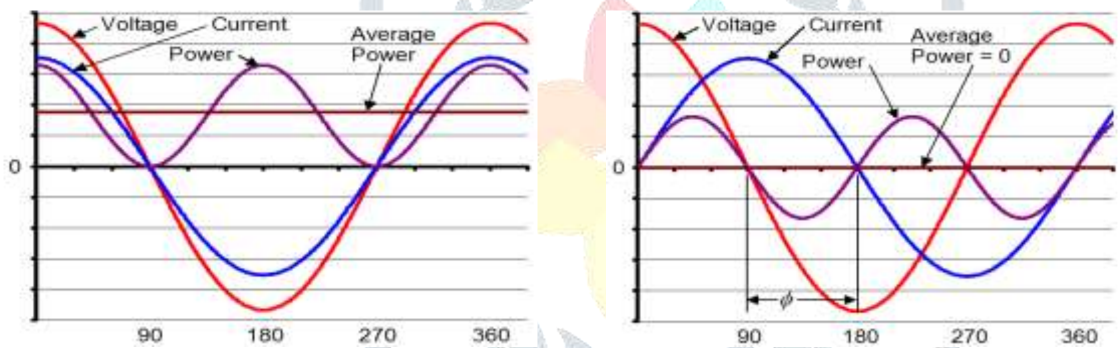


Fig. 4 The three components of AC power flow

Reactive power (Q) is measured in reactive volt-amperes (RVA), while actual power (P) is measured in watts (W), and apparent power (S) is measured in volt-amperes (VA) (VAr). The power factor is a dimensionless number between 0 and 1 since the units are constant. On every cycle, the stored energy in a load returns to the source. This is known as a zero power factor. In a system with a power factor of 1, all of the source's energy is used up by the load. The phase angle's sign is shown by stating whether the power factor is "leading" or "lagging," with "leading" denoting a negative value. When a power source is linked to a totally resistive load, current and voltage reverse polarity in phase, resulting in a power factor of one (1) and a single-direction flow of energy across the network. Reactive power is used by inductive loads such as transformers and motors (or any wrapped coil). Current phase always precedes voltage when applied to capacitive loads like capacitor banks or buried wire. When the AC cycle is complete, both kinds of loads will return the energy they absorbed during the first portion of the cycle back to the source during the second half of the cycle. If the power factor is one, then 1 kVA of apparent power must be transmitted in order to get 1 kW of actual power (1 kW 1 = 1 kVA). Low power factors need the transmission of more apparent power in order to get the same actual power. A total of 5 kVA of apparent power must be transmitted to achieve 1 kW at a power factor of 0.2. The power factor of a system may typically be adjusted to very close to unity. Inductors and capacitors may be used to rectify the power factor, a procedure known as power factor correction. Locally coupled capacitors, for example, may reduce the inductive impact of motor loads. The power factor of an AC electric power system is a value ranging from 0 to 1, which represents the ratio of actual power to perceived power. Real power is a circuit's ability to accomplish work in a certain period of time. The circuit's apparent power is equal to the sum of its current and voltage. Whether owing to energy stored in the load and returned to it, or a non-linear load that causes distortion in the waveform of the current being pulled from it, the perceived power will be equal or larger than the actual power. In a power distribution system, low power factor loads increase losses and hence raise the cost of electrical energy usage.

Voltage and current waveforms in a pure resistive AC circuit change polarity simultaneously at each cycle. Reactive loads, such as capacitors or inductors, store energy and cause a delay between the voltage and current waveforms. As a result, it is no longer accessible to do work at the load. There will be more currents to transmit per unit of power in a circuit that has a low power factor than a circuit with a high power factor. 1.0 is the power factor of circuits that exclusively include heating components (such as filament lights, strip heaters, and cooking stoves). Inductive and capacitive components (light ballasts, motors, etc.) commonly have a power factor lower than 1.0 in their circuits. NPF ballasts, for example, normally have a value of (0.4) in electric lighting circuits (0.6). High power factor ballasts have a power factor of at least (0.9). (HPF). The utility companies give clients with volt-amperes, but charge them for watts, hence the power factor is important. Utilities that have power factors below 1.0 must produce more volt-amperes than is required to deliver the actual output power (watts). As a result, the expenses of production and distribution go up. A power factor of 0.85 or 85 percent is regarded to be a good one. There are extra fees for consumers with power factors that go below certain thresholds.

Circuit Description:

In order to determine the power factor, this circuit is used. Using a potential and current transformer, one may measure the voltage and current of the electrical lines. The mains supply voltage is stepped down to a low voltage level using a potential transformer. 440V AC to 6V AC is the voltage range. Finally, a Zero Crossing Detector is used to monitor the transformer's output voltage. A current transformer is used to measure the amount of current being drawn by the load. The shunt resistor transforms the output current from the current transformer into voltage, which is then used to power the load. The zero crossing detector is then fed the appropriate AC voltage. Square wave signals are generated using a zero crossing detector. The operational amplifier LM 741 is used to build the zero crossing detectors. The potential transformer and current transformer terminals are linked to the input terminals of the inverting and non-inverting inputs, respectively. As a result, the sine wave signal is transformed into square waves. The level of the square signal lies between +12v and -12v. That signal is then sent to the base of the BC 547 switching transistor to change the TTL voltage 0V to 5V level, as shown. To determine the phase angle difference between voltage and current, the two ZCD outputs are sent into a logical XOR gate 74LS86. With the aid of software, the XOR gate output is sent to the microcontroller or PC for power factor calculation.

Importance of Power Factor

If the power factor is less than one, the electric utility business has to deliver more current to the user for the same amount of power usage. This is the objective of every electric utility company. As a result, they suffer increased line losses. In addition, they must have equipment with a higher capacity on hand than would otherwise be required. Consequently, if the power factor of an industrial facility is significantly different from 1, it will be penalised. "Lagging power factor" is a common problem for industrial facilities, when the current lags the voltage (like an inductor). For the most part, this is due to the fact that there are a number of electric induction motors in the system. Inductive motor windings may be compensated for by using capacitors, which have the opposite effect. Large banks of capacitors may be installed at industrial locations only for the aim of bringing the power factor back to unity in order to save money on electricity bills.

Resistor AC Response

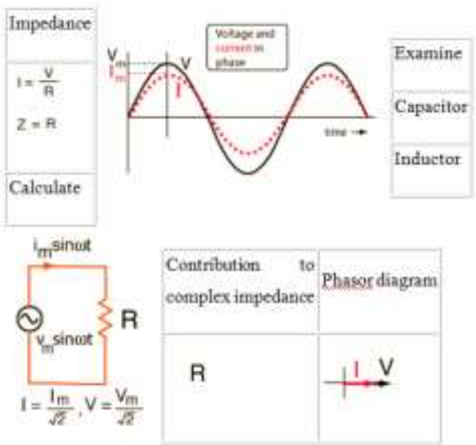


Fig.5 AC Response of the Resistor

In the presence of typical currents and frequencies, a resistor behaves as a heat-generating dissipative element. It doesn't matter which way the current flows or what frequency it is. As a result, we may conclude that a resistor's AC impedance and DC resistance are identical. Assuming you are using the AC RMS or effective volts and volts in the AC scenario, then this is correct.

Inductor AC Response

Because the Lenz law behaviour opposes the accumulation of current, the applied voltage takes a limited amount of time to push the accumulation of current to its maximum.

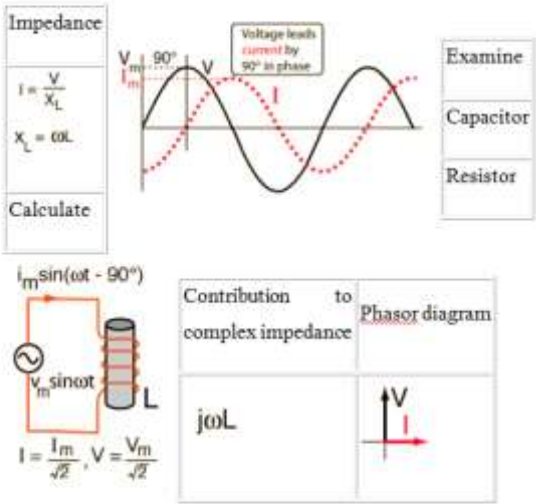


Fig.6 Resistor AC Response

Capacitor AC Response

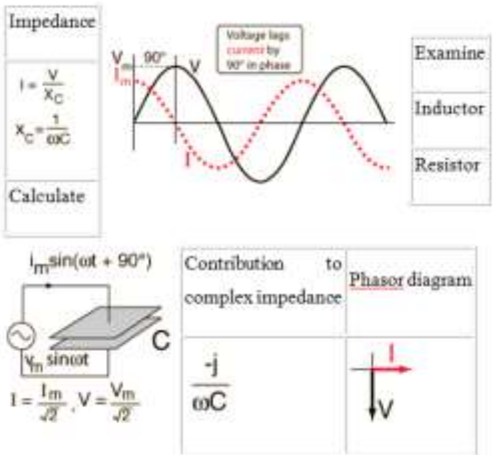


Fig.7 Capacitor AC Response

Due to the fact that current must flow through a capacitor to charge it, the voltage across the capacitor plate is inversely related to the charge that is being built up.

PWM

Modern electronic power switches have made pulse-width modulation (PWM) and pulse-duration modulation (PDM) feasible techniques for managing power to inertial electrical devices. When the switch between supply and load is turned on and off quickly, an average voltage (and current) is maintained. The more power is sent to the load when the switch is on for a longer length of time than when it is off. The PWM switching frequency must be substantially quicker than the load, i.e. the device that consumes the power, in order to avoid damaging the load. If you're using an electric stove, for example, you'll often need to switch many times each minute; if you're using an audio amplifier or computer power supply, you'll typically need to switch several times every second.

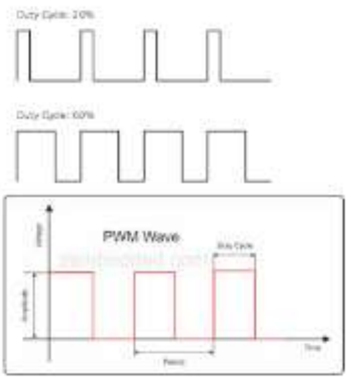


Fig.8 Pulse-width modulation (PWM)

Duty cycle is a measure of how much time is spent 'on' compared to a regular interval or 'period,' and a low duty cycle indicates that the device is using less power since the electricity is turned off for the majority of the time. Effort is indicated as a percentage, with 100% indicating complete power. The minimal power loss in the switching devices is the primary benefit of PWM. The voltage drop across a switch is essentially nonexistent when the switch is off and almost nonexistent when the switch is on. Because voltage and current are their products, the power loss in both circumstances is near to zero. Digital controllers can simply establish the required duty cycle using PWM because of their on/off nature. There have been instances in which the duty cycle of PWM has been used to transmit data across a communications channel as well.

Rectifier

Direct current (DC) can only flow in one direction, hence the process of rectification is used to convert alternating current (AC) to direct current (DC). Rectifiers may be used for a variety of purposes, including power supply components and radio signal detectors. Solid-state diodes, vacuum tube diodes, mercury arc valves, and other components may be used to construct rectifiers. When a device converts from DC to AC, it is known as an inverter. Reconfigure AC by blocking the negative or positive section of its waveform with a diode. The distinction between diode and rectifier is primarily a matter of use, as the word rectifier defines the diode that is being used for AC-DC conversion. With only one diode, a rectifier can't perform as well as one that has many diodes in a certain layout. Vacuum tube diodes and copper(I) oxide or selenium rectifier stacks were utilised before the introduction of silicon semiconductor rectifiers. A "cat's whisker" of tiny wire pressing on a crystal of galena (lead sulphide) used as a point-contact rectifier or "crystal detector" in early radio receivers, known as crystal radios. Aside from generating DC current, rectification may be used for various purposes Flame rectification, for example, is used to detect the existence of flame in gas heating systems. A current route is provided by two metal electrodes in the flame's outer layer, and the plasma will rectify an applied alternating voltage, but only if the flame is there to create it.

Types Of Rectifier

The Half-Wave Rectifier

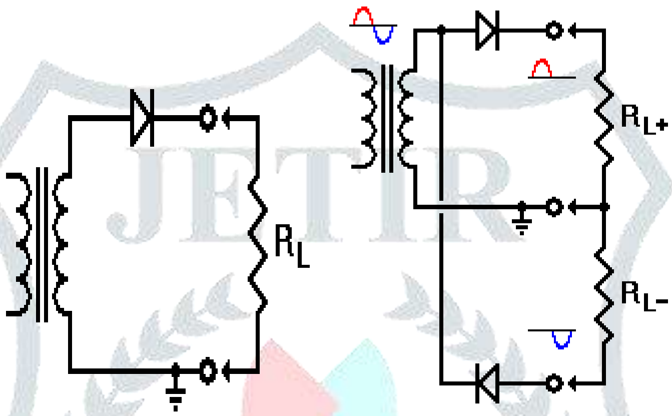


Fig.9 The Half-Wave Rectifier

There is nothing more complicated than a diode linked in series with the ac input to form the simplest rectifier circuit. When an ac wave enters, only half of it will make it to the rectifier's output, since a diode can only flow current in one way. Here we have a simple half-wave rectifier. The output voltage has a positive dc component due to the fact that the diode only passes the positive half-cycle of the ac input. It is possible to reverse the diode in such a way that the negative half-cycle is passed, resulting in a dc component of the output with a negative polarity. It doesn't matter either way you look at it: vp/ = 0.3183vp, where vp is the peak voltage from the transformer secondary winding. The second picture on the right shows how two half-wave rectifiers may be used together. Positive and negative voltages are generated using half of the input ac cycle for each output. It's important to note that the lower transformer connection acts as a common reference point for the output in all circumstances. It is usually linked to the overall circuit's common ground through a ground wire. Depending on the application, this may be critical. There is no electrical connection between the transformer's windings and iron core, which is generally grounded by being fastened to the metal chassis (box) that serves as the circuit's support structure. By additionally grounding the secondary winding's one end, we assist prevent the insulation on this winding from being overloaded and causing damage to the transformer.

The Full-Wave Rectifier

Despite its simplicity, the half-wave rectifier is not particularly effective. Wastes all of the energy available in the other half of the incoming ac cycle We'd want to be able to use both half of the incoming ac for maximum efficiency. This may be done by increasing the diameter of the secondary winding and connecting it to the core. To achieve full-wave rectification, we may then alternate half-cycles between two half-wave rectifiers. To the right, you can see the circuit diagram. This is because only half of the transformer's secondary winding is being utilised at a time, therefore 2vp/ = 0.6366vp is now the DC component of the output waveform, where vp is the peak voltage produced. Like the half-wave rectifier, this design requires that one of the transformer's secondary conductors be grounded. When it comes to this scenario, it's the secondary winding's central connection, or "centre tap."

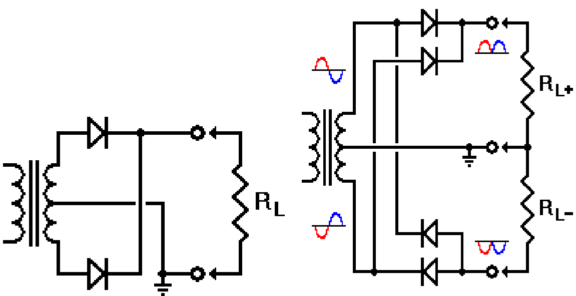


Fig.10 Full-Wave Rectifier

The output voltage of the full-wave rectifier may still be set to a negative value instead of a positive one. Additionally, as illustrated in the figure to the right, two full-wave rectifiers may be used to provide outputs in both directions simultaneously. The output of a full-wave rectifier may be either positive or negative, depending on how it divides the alternating current cycle in half. This results in a greater supply of energy to the output, without long stretches of time when no energy is accessible at all. As a result, the full-wave rectifier outperforms the half-wave rectifier in terms of efficiency. Due to the input AC's frequency, a full-wave rectifier's secondary winding must be twice as large as one for a half-wave rectifier in order to provide enough power for each half-cycle of output polarity. Actually, it's not all that awful since the current drain on the transformer's winding is reduced by the utilisation of both half-cycles. It's not necessary for one half-cycle to generate enough power to carry the load through an unused half-cycle, since power is delivered on both half-cycles. In certain cases, however, a single output polarity full-wave rectification might be preferable than using the complete transformer winding at all times.

The Full-Wave Bridge Rectifier

An AC output from one transformer winding may be rectified using the four-diode rectifier circuit illustrated to the right. The four diodes in a Wheatstone Bridge have the same diamond arrangement as the resistors. The term "bridge rectifier" refers to this particular rectifier circuit as well as any collection of components configured in this manner. The diode connections in this circuit are identical to those in the dual-polarity full-wave rectifier above. There has only been one change: the secondary winding's centre tap has been deleted, and we are now using the negative output as a ground reference instead. This implies that the secondary of the transformer is never grounded directly, but is instead connected to ground through a forward-biased diode at one end. Most contemporary circuits don't have this issue..

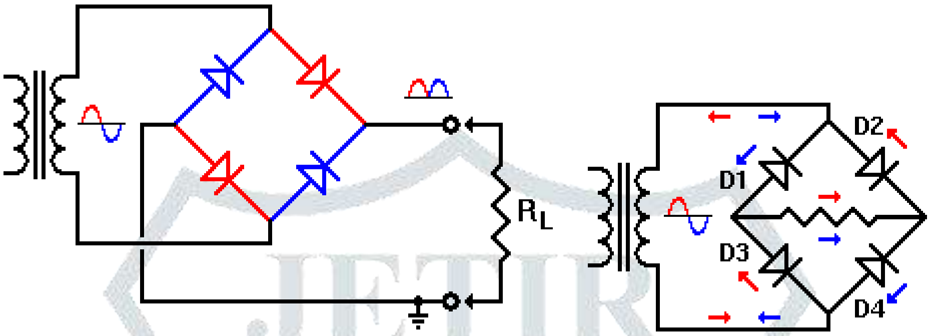


Fig.11 Full-Wave Bridge Rectifier

Consider the diagram on the right to see how a bridge rectifier can only provide current in one direction to a load. The load is a simple resistor, and the four diodes have been numbered so that they can be identified. The top end of the transformer winding is positive during the positive half-cycle, depicted in red. Consequently, electrons flow from the transformer's bottom end, via D3 which is forward biassed, and into the load resistor in the direction shown in blue and yellow. The forward-biased D2 conducts the electrons to the top of the transformer's winding. Flowing current is possible since this is a full circuit. There are no current flows via D1 and/or D4 since they are both reverse biassed. The top end of the transformer winding is negative during the negative half-cycle. For the first time ever, D1 is in the positive and D4 is negative. As a result, electrons flow in a straight line from D1 to D4 as seen by the arrows. When conducting electrons, electrons go in a clockwise direction via a resistor. As a result, the diodes alternately switch the transformer connections to the resistor, ensuring that current through the resistor always flows in a single direction. The bridge rectifier behaves the same even if we substitute the resistor with any other circuit, including additional power supply circuitry (such as the filter).

MOSFET

Traditional MOS structures are made by depositing silicon dioxide (SiO_2) and metal on top of a semiconductor die. Polycrystalline silicon is typically used instead of metal in MOS structures since it is non-toxic. SiO_2 has the structure of a planar capacitor with a semiconductor in lieu of one electrode due to its dielectric nature. The charge distribution in a semiconductor changes when a voltage is applied across a MOS structure. VGB from the gate to the body forms a depletion layer by driving positively-charged holes away from the gate-insulator/semiconductor interface and exposing a carrier-free zone of immobile, negatively charged acceptor ions. Doping may be seen here (semiconductor). It is possible to produce a large concentration of negative charge carriers in a thin layer near to the semiconductor-insulator contact when VGB is high enough MOS capacitor electrons are generated through thermal generation rather than from source/drain electrodes as in MOSFETs, which are explained below.) It is well knowledge that the "threshold voltage" is the gate voltage at which the inversion layer's electron volume density is equal to the body's hole volume density. With this structure as its foundation, we may build N-type MOSFETs by simply including N-type source and drain regions.

An NMOS without a channel in the cross section: NMOS in the OFF state, with a channel generated in the cross section: status of on

The MOS capacitance between a body electrode and a gate electrode positioned above the body and isolated from all other device areas is the basis for a metal–oxide–semiconductor field-effect transistor (MOSFET). The source and drain terminals of the MOSFET are linked to distinct, highly doped portions of the device's body. They may be p or n type, but both must be of the same type, and the body area must be p type. For example, a "+" denotes a source or drain area that is substantially doped. The absence of a '+' indication indicates that the body is not substantially doped. Source and drain are "n+" areas if the MOSFET is an n-channel or n MOS FET, while the body is a "p" region. As previously stated, electrons from the source (and perhaps the drain) enter the inversion layer or n-channel at the interface between the p region and the oxide when a significant gate voltage is applied over a threshold voltage value. Whenever a voltage is placed between the source and the drain, current flows across this conducting channel. Only a limited amount of leakage current may travel between the source and drain when the gate voltage is below the threshold value. There is a p-channel or p MOS FET if the MOSFET has a source and drain that are both 'p+' regions and the body is an n-channel. An comparable situation occurs in the p-channel scenario when a negative gate-source voltage (positive source gate) is applied, creating a channel at the n-region surface, but with opposite polarities of charges and voltages. An very low sub threshold current may flow between the source and drain when the gate and source are connected to each other with a voltage less than the threshold value (negative voltage for the p-Channel). For n-channels, the source is where charge carriers (electrons or holes) enter the channel; for p-channels, the source is where charge carriers exit.

RESULT AND DISCUSSION

MATLAB

High-performance technical computer language MATLAB. Visualization and programming are integrated in an easy-to-use environment where issues and solutions may be represented in common mathematical notation.

- ✓ Typical applications include:
- ✓ Math and computation
- ✓ Algorithm design
- ✓ Modeling, simulation and prototyping
- ✓ Exploration and display of data
- ✓ Applied mathematics and physics
- ✓ Development of applications and their graphical user interfaces (GUIs)

Interactive system MATLAB's fundamental data element is an array that does not need to be dimensionalized. Programming in non-interactive languages like C or FORTRAN would take you far longer to answer many technical computer issues, particularly ones involving matrix and vector formulas..

Application development tools.

- ➢ Modeling and Simulation
- ➢ Image Processing
- ➢ Signal Processing
- ➢ Control System
- ➢ Communications
- ➢ Neural Network
- ➢ Instrument Control
- ➢ Aerospace
- ➢ Fuzzy Logic
- ➢ Embedded matlab

- The many ways in which a user may engage with the computer system.
  User interface
  - Running the GUI
  - Creation of batch jobs for applications using MATLAB batch
  - Batch management, batch execution, including use of MATLAB scripts to run batch jobs on multiple datasets with very little user interaction
- Application development
  - Requirements on code structure of application
  - Introduction to internal representation of batch configurations
  - Introduction to writing batch configuration scripts
  - Integration of an application into configuration management and GUI
- Implementation
  - Classes used
  - Methods
  - Details about job management, runtime etc.

Modeling and Simulation: Math Works, Inc. distributes a number of supplementary Matlab Toolboxes that may be used to build models and simulate dynamical systems. The System Identification Toolbox, the Optimization Toolbox, and the Control System Toolbox are all included. The m-files in these toolboxes have been compiled for specific purposes. Simulink, a specialist application, may be used for dynamic system modelling and simulation in real time.

System Identification: Among the numerous features of the System Identification Toolbox is the ability to analyse experimental data and to test multiple models by adjusting the values of model parameters. It is especially helpful for dealing with dynamical systems data and time series analysis. Matlab instals on all ITS servers contain this toolbox. With the id demo command at a Command Window prompt, you may get a step-by-step demonstration of the identification process.

Using Simulink: Simulink is a simulation tools library for dynamical systems. Any system in nature can roughly be thought of as a “black box” receiving an input vector u and eliciting a unique output vector y. In the case that both u and y vary with time we are talking about dynamic systems.

In the context of a system, the so-called "state vector" holds the information at time that, when combined with knowledge of input for time more than, uniquely defines the output. Ordinary differential and algebraic equations may be used to represent a generic continuous dynamical system.

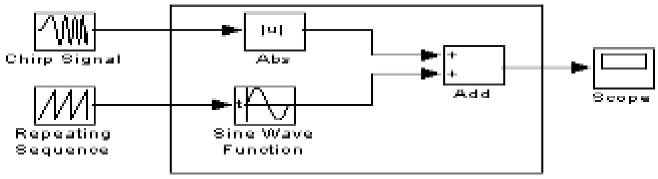
Simulink Subsystems:

Using functions in Matlab programming makes it possible to reuse computations across several projects, saving time and effort often spent on duplicating code. Additional benefits include shielding its caller script from having to deal with the technical specifics of a function. Subsystems perform a similar function in Simulink. Using subsystems in Simulink provides several benefits.

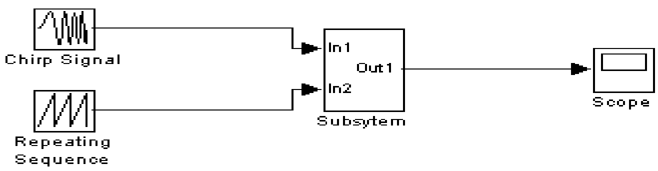
- It reduces the number of blocks that are shown in the model.
- Blocks that have a similar function may be stored together.
- With it, a hierarchical block diagram can be created, in which each tier of a subsystem is represented by a separate block. In Simulink, a subsystem can be created in two ways:
- Create a new subsystem out of the model's individual building components and then organise them into a new subsystem.
- In the alternative method, you first add a Subsystem block to the model, then open that block and install the subsystem components to the subsystem window.

Grouping existing blocks into a Subsystem:

Adding a subsystem is as simple as putting together blocks that already exist in your model. Identify the blocks and channels of communication that you wish to include in the subsystem. As an example, see the graphic to the right for a model that processes signals. A bounding box is used to choose the blocks that do signal conversions. A mouse click at the top left corner of the box, followed by a drag with the right mouse button to the lower left corner, selects the box..



When the mouse button is released, the box's components will be chosen. From the Edit menu, choose the option to create a subsystem. The specified blocks are replaced with a Subsystem block in Simulink. The following image depicts the model after the Create Subsystem command was selected. The Subsystem block may be enlarged if required in order to read the port labels.



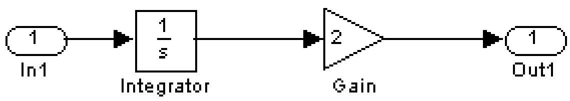
Creating a Subsystem by adding a Subsystem block:

To begin building a subsystem, there are typically three key processes involved.

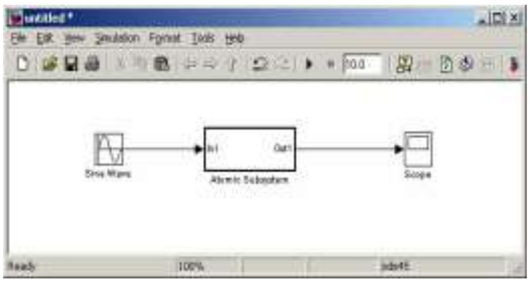
1. Your model should include the Subsystem block from the Ports & Systems library.
2. Double-click on the Subsystem block to access the subsystem. Depending on the model window reuse option that you choose, Simulink opens the subsystem in either the current or a new model window.
3. Create a subsystem in the blank Subsystem window. To represent external input, use Inport blocks, and external output, use Outport blocks.

Here is an example which models an integrator system.

1. Open the Simulink Library Browser and go to the Ports & Subsystems directory there. Simply click and drag the Atomic Subsystem block into the Model window to get started.
2. Double-clicking the subsystem block will allow you to access it.
3. Remove the connection between the In1 block and the Out1 block.
4. As shown in the image below, place blocks in this subsystem window. Then, adjust the block arrangement and connections between blocks.

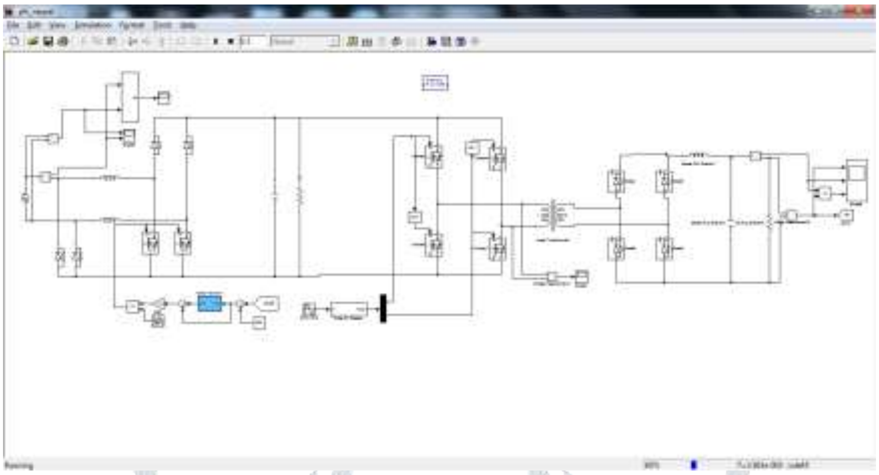


5. Select View > or click the Go to parent system button. Utilize the navigation bar to access the Parent. This will return you to the Model window that is below.
6. To add sine wave function and scope blocks to the Model window, return to the Simulink Library Browser and follow the instructions below.

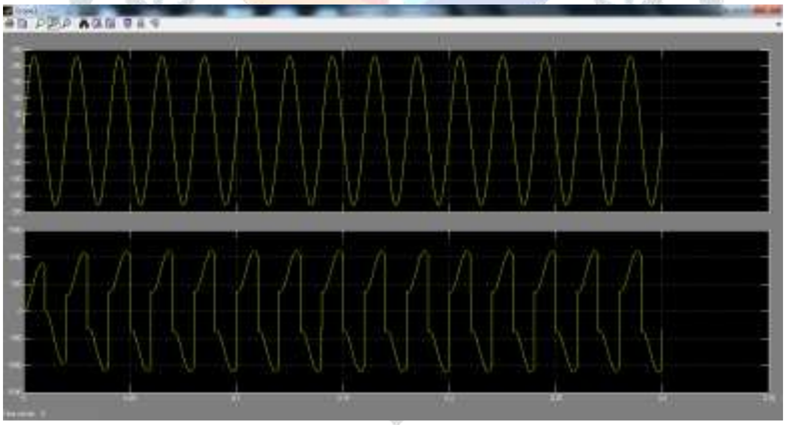


7. Start the simulation by choosing Simulation > Start from the navigation bar or by clicking the Start button on the toolbar. Double clicking on the scope block will reveal the results.

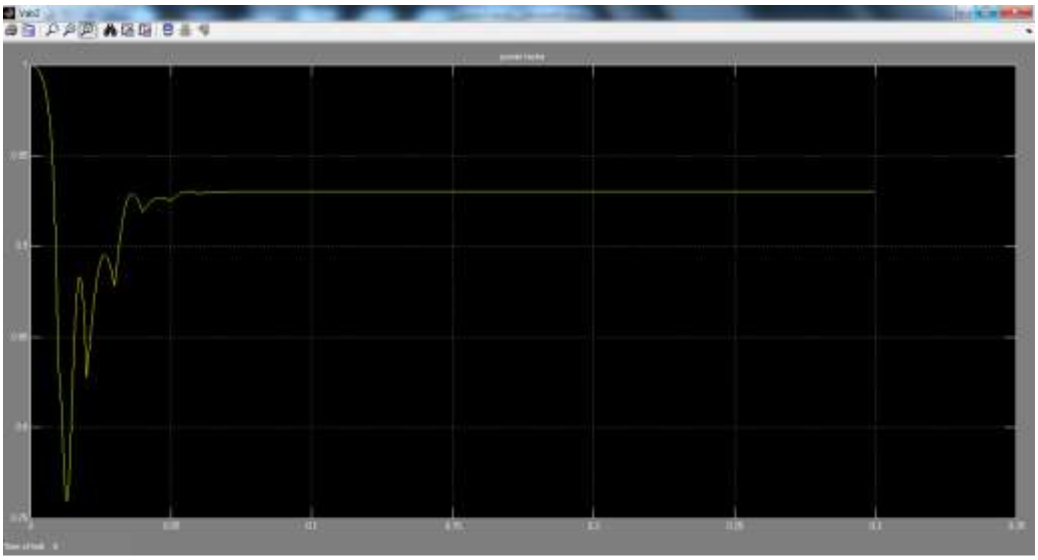
Simulation Result



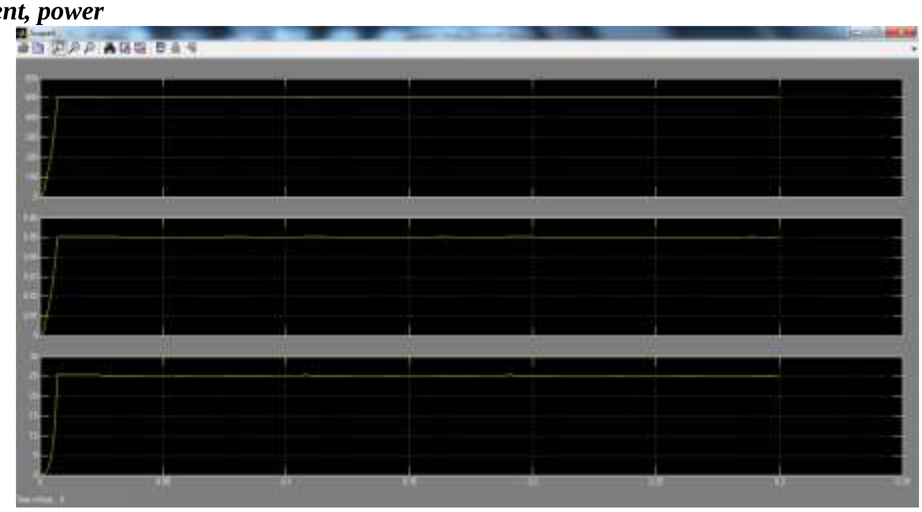
Input Voltage and Current



Power Factor



Output voltage, current, power



CONCLUSIONS

It has been suggested and experimentally proved to use a bridgeless PFC converter with a high gain output voltage. The experimental data and the anticipated waveforms examined in the research exhibit high agreement. The circuit's power factor is present for each of the required input and output circumstances. The suggested circuit makes it simple to satisfy the criteria. Additionally, the suggested topology may be used to the majority of consumer electrical items with ratings on the market due to its improved efficiency and high power factor. Additionally, the built system control circuit makes it easy to apply any PWM control to obtain high power factor with only a single switch used.

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