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Solar Energy Implementation with Grid Interfacing

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***Abstract*— This paper proposes a grid interfaced solar photovoltaic power generating system consisting of photovoltaic cell, DC-DC boost converter, Inverter, Capacitor bank, transformer, single phase grid feeder. A reference grid current are taken from the single phase is given to microcontroller, which is used to detect zero crossing and auxiliary power supply to the microcontroller. Here we interface solar energy with grid taking frequency into consideration. We are using solar energy since it is one of the most renewable forms of energy which is found to be abundance in all part of the world. During peak hours voltage fluctuation problems occurs in the transmission line, at this condition the load get damaged. To avoid this battery is connected parallel to the solar panel.**

Index Terms— ***Photovoltaic cell, Single Phase grid feeder, Transmission line***

I. INTRODUCTION

Renewable energy systems such as photovoltaic power generation, wind power generation and fuel cells are receiving a huge attention globally. Eco-friendly power generation is the best feature of renewable energy systems. Renewable energy systems emit no pollution into the atmosphere when they generate electricity. However, most power plants such as thermal power generation and nuclear power generation plants have produced most of the power supply. Thermal power plants emit the carbon dioxide into the atmosphere, and nuclear power plants have potential danger and discharge nuclear wastes. On the other hand, renewable energy systems are very clean on a large-scale from the perspective of return of investment. In this paper, we propose a management system to maximize the efficiency of a photovoltaic power system in application's aspect.

II. PROPOSED SYSTEM

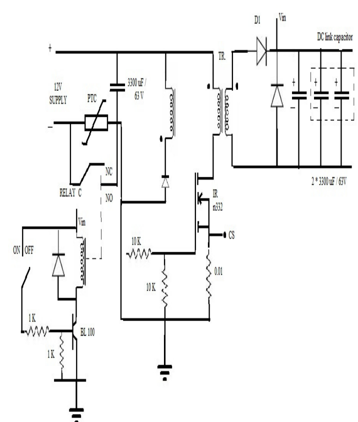

Fig.1. Circuit Diagram of DC-DC converter section1

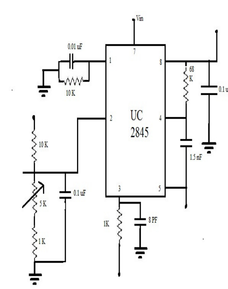

Fig.2. Circuit diagram of DC-DC converter section 2

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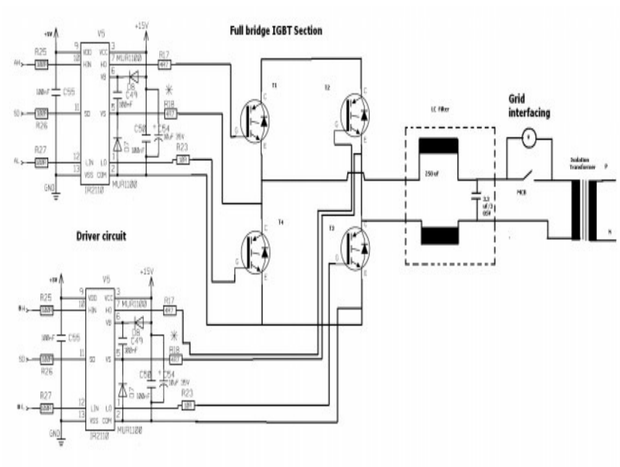

Fig.3. Circuit diagram of Inverter section

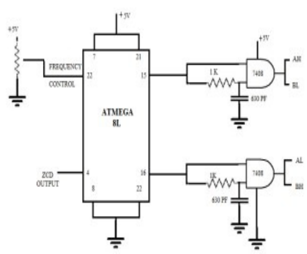

Fig.4. Circuit diagram of Microcontroller section

A solar panel (also solar module, photovoltaic module or photovoltaic panel) is a packaged, connected assembly of photovoltaic cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each panel is rated by its DC output power under standard test conditions, and typically ranges from 100 to 320 watts. The efficiency of a panel determines the area of a panel given the same rated output - an 8% efficient 230 watt panel will have twice the area of a 16% efficient 230 watt panel. Because a single solar panel can produce only a limited amount of power, most installations contain multiple panels. A photovoltaic system typically includes an array of solar panels, an inverter, and sometimes a battery and or solar tracker and interconnection wiring.

Solar panels use light energy (photons) from the sun to generate electricity through the photovoltaic effect. The majority of modules use wafer-based crystalline silicon cells or thin-film cells based on cadmium telluride or silicon. The structural (load carrying) member of a module can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture. Most solar panels are rigid, but semi-flexible ones are available, based on thin-film cells.

Electrical connections are made in series to achieve a desired output voltage and/or in parallel to provide a desired current capability. The conducting wires that take the current off the panels may contain silver, copper or other non-magnetic conductive transition metals. The cells must be connected electrically to one another and to the rest of the system. Externally, popular terrestrial usage photovoltaic panels use MC3 (older) or MC4 connectors to facilitate easy weatherproof connections to the rest of the system. Bypass diodes may be incorporated or used externally, in case of partial panel shading, to maximize the output of panel sections still illuminated. The p-n junctions of mono-crystalline silicon cells may have adequate reverse voltage characteristics to prevent damaging panel section reverse current. Reverse currents could lead to overheating of shaded cells. Solar cells become less efficient at higher temperatures and installers try to provide good ventilation behind solar panels. Some recent solar panel designs include concentrators in which light is focused by lenses or mirrors onto an array of smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way

A transformer is an electrical device used to convert AC power at a certain voltage level to AC power at a different voltage, but at the same frequency. The transformer is based on the working principle of “Faradays Law of Electromagnetic induction”. According to the voltage level we can classify the transformer into two types. They are step up transformer and step down transformer.

The construction of a transformer includes a ferromagnetic core around which multiple coils, or windings, of wire are wrapped. The input line connects to the 'primary' coil, while the output lines connect to 'secondary' coils. The alternating current in the primary coil induces an alternating magnetic flux that 'flows' around the ferromagnetic core, changing direction during each electrical cycle. The alternating flux in the core in turn induces an alternating current in each of the secondary coils. The voltage at each of the secondary coils is directly related to the primary voltage by the turns ratio, or the number of turns in the primary coil divided by the number turns in the secondary coil. For instance, if the primary coil consists of 100 turns and carries 480 volts and a
secondary coil consists of 25 turns, the secondary voltage is then:

secondary voltage = (480 volts) * (25/100) = 120 volts.

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), current that flows in only one direction, a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals

Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, and other components. A device which performs the opposite function (converting DC to AC) is known as an inverter. When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform, the difference between the

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term diode and the term rectifier is merely one of usage, i.e., the term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper(I) oxide or selenium rectifier stacks were used.

Electronic filters are electronic circuits which perform signal processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones, or both. Electronic filters can be:

1. Passive or active
2. Analog or digital
3. High-pass, low-pass, band-pass, band-reject (band reject; notch), or all-pass.
4. Discrete-time (sampled) or continuous-time
5. Linear or non-linear
6. Infinite impulse response (IIR type) or finite impulse response (FIR type)

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. It may use an electromechanical mechanism, or passive or active electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. With the exception of passive shunt regulators, all modern electronic voltage regulators operate by comparing the actual output voltage to some internal fixed reference voltage. Any difference is amplified and used to control the regulation element in such a way as to reduce the voltage error. This forms a negative feedback control loop; increasing the open-loop gain tends to increase regulation accuracy but reduce stability (avoidance of oscillation, or ringing during step changes). There will also be a trade-off between stability and the speed of the response to changes. If the output voltage is too low (perhaps due to input voltage reducing or load current increasing), the regulation element is commanded, up to a point, to produce a higher output voltage - by dropping less of the input voltage (for linear series regulators and buck switching regulators), or to draw input current for longer periods (boost-type switching regulators); if the output voltage is too high; the regulation element will normally be commanded to produce a lower voltage. However, many regulators have over-current protection; so that they will entirely stop sourcing current (or limit the current in some way) if the output current is too high, and some regulators may also shut down if the input voltage is outside a given range.

DC to DC converters are important in portable electronic devices such as cellular phones and laptop computers, which are supplied with power from batteries primarily. Such electronic devices often contain several sub-circuits, each with its own voltage level requirement different from that supplied by the battery or an external supply (sometimes higher or lower than the supply voltage). Additionally, the battery voltage declines as its stored power is drained. Switched DC to DC converters offer a method to increase voltage from a partially lowered battery voltage thereby saving space instead of using multiple batteries to accomplish the same thing. Most DC to DC converters also regulate the output voltage. Some exceptions include high-efficiency LED power sources, which are a kind of DC to DC converter that regulates the current through the LEDs, and simple charge pumps which double or triple the input voltage.

A power inverter, or inverter, is an electrical power converter that changes direct current (DC) to alternating current (AC); the converted AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Solid-state inverters have no moving parts and are used in a wide range of applications, from small switching power supplies in computers, to large electric utility high-voltage direct current applications that transport bulk power. Inverters are commonly used to supply AC power from DC sources such as solar panels or batteries. The inverter performs the opposite function of a rectifier. The electrical inverter is a high-power electronic oscillator. It is so named because early mechanical AC to DC converters were made to work in reverse, and thus were "inverted", to convert DC to AC.

Voltage from solar panel is stored in a 12V battery is been given to the DC-DC boost converter. In the boost converter PTC coil is placed to avoid over voltage. The heat sink is provided for the MOSFET to avoid overheating. The driver circuit is used to switch ON & OFF the MOSFET. The output of the boost converter is 24.6V. The output of the boost converter is given to the Inverter through the capacitor bank. Microcontroller is used to synchronize solar frequency with grid frequency. Step-down transformer 230V to 12V is given to microcontroller for auxiliary power supply and for the detection of zero crossing. Output of the inverter is given to Step-up transformer to a manual breaker. This step-up transformer gives the output of 230V which is fed to the grid.

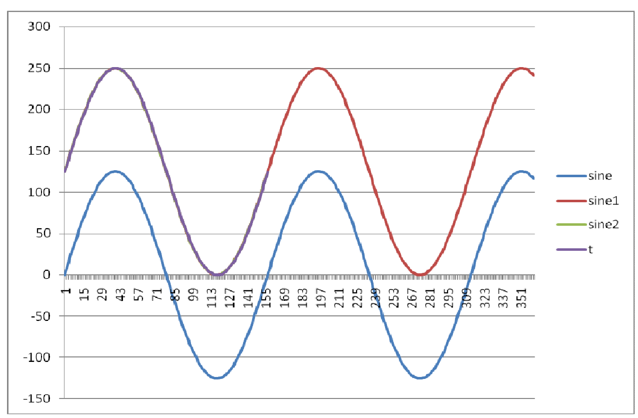

Fig.5. Synchronized Output

III. CONCLUSION

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