TAU SKILLS ACADEMY

Hybrid electrical energy supplier:

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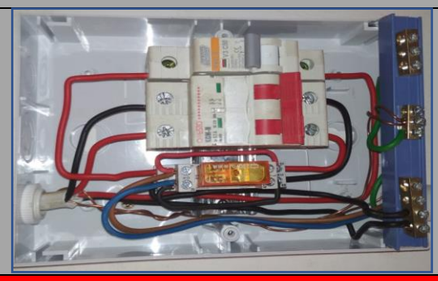
ROOFTOP

Inverter



Relay Circuit / Manual Switch

Abstract—Due to the unpredictable nature of power in South Africa, an alternating reliable and efficient source of power must be investigated. This alternative source must also be able to save power. The proposed solution herein is a solar powered hybrid energy source. This system will incorporate a photovoltaic (PV) panel, charge-controller, Inverter, battery bank and 230 V ac-double pole, double through relay /manual switch (DPDT). The system has been configured to utilize solar- derived electricity as a primary power source; this makes solar energy a dominant power supplying unit until there is a power surge or it can no longer match the load consumptions. In a case of relay, the coil of a switching relay and its normally closed inputs are connected to the output of the DC to ac Inverter, whilst the grid supply is applied only to the normally closed input of the same relay. When the inverter loses its energy supply, the relay coil energy will collapse and releases the contacts to connect the normally closed to the common section; ultimately the grid supply takes over as the power source. The system is very reliable and efficient as a solar energy has been made the primary energy source. Hybrid solar lighting provides an exciting new means of reducing energy consumption while also delivering significant ancillary benefits associated with natural lighting in buildings. The results have revealed that the system performance is based on the strength of the sun's irradiance and the current that is drawn by the load from the battery bank. We used a random combination of six 18 W ac florescence lights and two laptops to load this system under clear-sky weather conditions. This system successfully charged these laptops and powered the lights for a total duration of nine hours. This makes this system to be beneficial for the non-interruptive of services such as churches and education. Also promotes use of clean energy.

(1) Methods

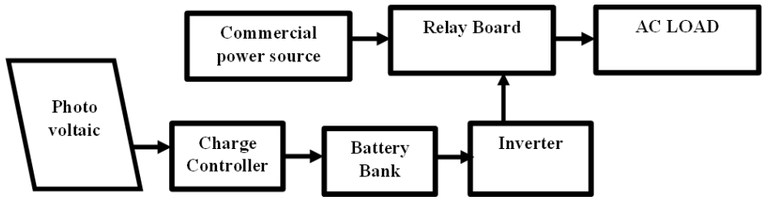


Figure 1: Solar based power supply for remote electronic laboratories.

Figure 1 illustrates a photovoltaic pannel that is exposed to the sun's rays to harvest solar energy and translates them to battery charging current. The charge controller prevents the battery from being overcharged or battery discharging through the solar panel array at night. In addition, a battery bank is core storage system for solar derived electrical energy. The power inverter changes DC power from battery to conventional ac power that is used to operate all kinds of devices. Energy consuming appliances that may be connected to this system are not limited to electric lights, TVs, etc. A double pole double through relay /manual switching circuitry (DSDT) have input and output terminals and are designed to control the voltage supply selection. The switching selects solar derived electricity whenever it is available, otherwise the commercial supply. Overall, this design offers a hybrid electrical supply system that uses solar energy as a primary supply, which is backed by a domestic residential electrical supply. The system thereby enables the use of solar derived electricity to minimize connections to a local grid and ultimately saves energy. This system is also beneficial during grid power outages, as consumers will be able have a continued electrical supply that is good enough to power selected electronic equipment as mentioned earlier.

(2) Results that are based on 1000 W PSW inverter

As illustrated by Figure 2, the charge current is influenced by the strength of the sun's irradiance for the entire day. It has reached the maximum value of 7.47 A at 12h30 (Mid-day). On the other hand, the load supply current is in proportion with connected load. At 10h00, two fully discharged laptops were connected to create an initial peak current of 10 A, which was reduced as the laptop batteries recovers.

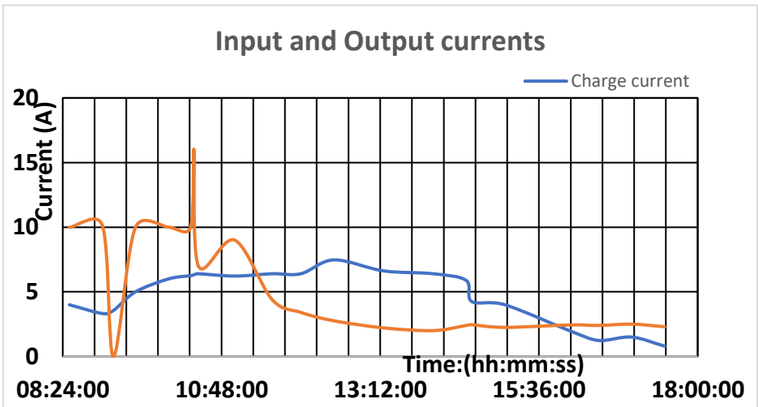


Figure 2: Graphs illustrating day-light system performance

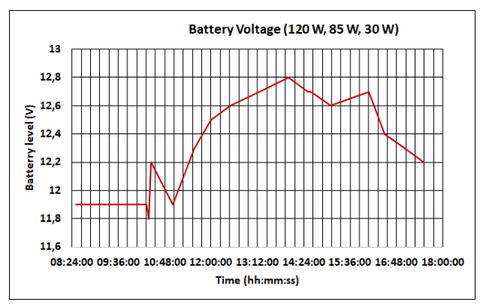


Figure 3: confirms that the battery charging varies in proportion with the solar intensity.

SOLAR ELECTRICAL ENERGY PRODUCTION

- *Work can only be done through the application of energy. As an example, you need energy to walk from ground floor of the building to its fifth floor. The same energy you use is almost equal, but of different form to what the elevator uses to carry you up to the same height.*

- *Energy can not be created or destroyed but may only be converted from one form to the other. As per previous example, you may not move up the escalator until you apply electrical energy to it.*

- *Electrical energy may be produced from wind turbines, coal reactors, nuclear reactors, batteries, and photovoltaic cells (units that forms solar panels). The last two sources produce non varying electricity that is called "Direct Current" (DC), whilst the first three sources produce electricity that varies (alternating current), preferable fifty variations in one second (50 Hz).*

- *Solar electrical energy is derived from received sun's light rays. Solar panels are receptors of arrays from the sun, and they often used to supply connected rechargeable batteries with charge current. The charge controller regulates solar charge current before it enters the battery bank (a cluster of interconnected batteries). You may think of solar pannel as water pump that supply consumers with water (analogous to electricity) and at the same time filling up tanks (batteries).*

- *DC energy is not easy to transmit and also not compatible with many domestic electrical equipment. It is therefore beneficial to convert a portion of the solar produced electrical energy from DC to alternating current (ac). Invertors are used to do the task.*
- *Inverters exists under two broader categories: pure sine waves and modified sinewave. Modified sinewave inverters are cheaper but yet display poor performance.*

EXAMPLE OF SOLAR BASED EQUIPMENT CONNECTIONS

- Solar supply unit consists of solar panel(s), charge controller, battery, and the inverter.

- Power refers to the speed of delivering energy or doing work. A 1000 W kettle requires more time to boil same litters of water than 4000 W, i.e., takes it four times longer.

- Electrical power result from the product of voltage and current. As a result, high current yields to less voltage for equal values of power.

- Inverters therefore draws higher currents from low voltage batteries to produce high output ac voltage for the same power rating.

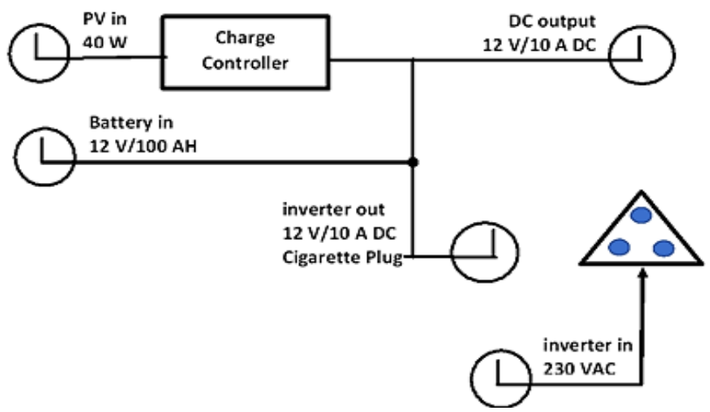


Figure 3: Connection diagram of a Universal solar based electricity solar system

As illustrated by Figure 1, the example system configuration allows for connection of a 12 V - 40 W photovoltaic panel. The solar pannel will charge an external 12 V -100 AH battery via a charge controller. There are two types of DC outputs. A cigarette lighter output that powers an external inverter and the banana plugs for general DC loads. The output of the inverter is fed back to the system via a computer type socket (IEC) to produce an ac output supply through the three-pin wall socket. The system was designed to feature few units; it therefore relies upon external supplied units for a full functionality. In other words, the configuration will enable non expert users to rapidly arrange the solar based units to suits their need. Overall, this structure offers more flexibility in terms of installation efforts and cost.

SOLAR ENERGY LOAD OPTIMIZATION

- Equipment that connects to the electrical supplier are referred to as electrical load. Connection of units that consumes excessive electrical power result to what so called over-load. System overload should be avoided as it may damage electrical production units.

- Loadshedding is currently a strategy that is used to prevent damages by overloading of the national grid (electricity hub). In other words, damages due to overloading may be avoided by load reduction or increasing generated power.

- Batteries are also strained by excessive discharging and should therefore be protected from over discharge.

- Energy saving schemes include usage of energy efficient equipment, motion sensors and day night switches.

The following explanation highlight the performance of the system in Figure 1: As illustrated by Figure 2 and Table 1, the system was able to supply energy to a variety of loads for the entire day. The solar current is seen to be in proportion with the strengths of the sun's irradiance. As the load current rises, the battery current is seen to also increase, but battery voltage decays quickly. The battery voltage is also seen to rise with solar current for lower load current consumptions. Therefore,this battery can charge.

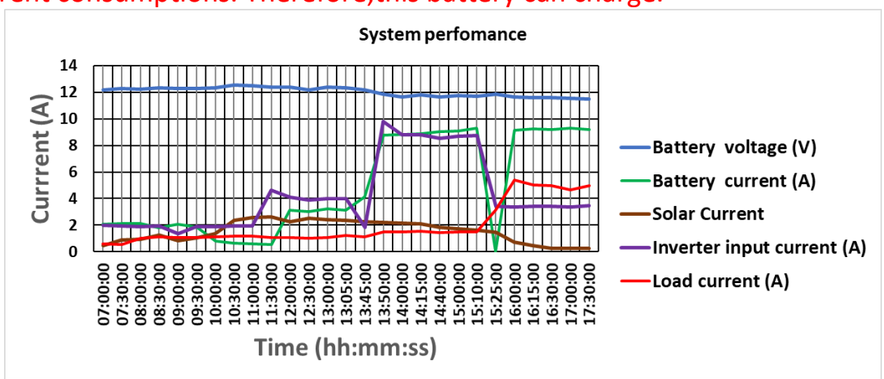


Figure 2: Graphs illustrating day-light system performance

Table 1: confirms that the system performance deteriorated with the sun

Comments	Time	Battery voltage (V)	Battery current (A)	Solar Current (A)	Inverter input current (A)	Load current (A)
AC/DC Lights	07:00:00	12,2	2,06	0,47	2,01	0,61
DC lights	10:00:00	12,31	0,83	1,34	1,91	1,1
Soldering + DC lights+ Sol	12:00:00	12,37	3,11	2,26	4,12	1,05
Soldering + DC lights + DC F + S	13:05:00	12,35	3,13	2,34	3,98	1,21
100 W Bulb + DC lights +sol	13:50:00	11,88	8,79	2,19	9,78	1,48
60 W DC light + DC light sol	14:40:00	11,64	9,06	1,84	8,55	1,45
INV OFF	15:25:00	11,85	5,8-	1,46	3,42	3,12
60 W DC light + DC light sol	16:00:00	11,67	9,14	0,72	3,37	5,4