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Solution to stop battery bank drain-up at lower insolation For Back-up Photovoltaic Power Systems

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Abstract – The paper presents an overview of the state ofthe art ofbattery bank drain-up issue for PV power plants at lower insolation for low and medium level (1kW...50kW) power plants, mainly intended for rooftop applications. Theinverters are categorized according to the configuration of thePV system. The paper focuseson-site problem and challenges to stop thebattery bank drain-upissue at low insolation conditions.Thistopologyhas big advantageslike low cost, volume and maintenance. In addition,it often reacheshigher priority than topologies with back-up inverters. Therefore the new concepts are important for future developments.

Key words: Battery Bank, Off-grid, Comparator, Voltage amplifier, Power contactor.

I. INTRODUCTION

Renewable energy sources become a more and more importantcontribution to the total energy consumed in the world.It is independence from limitedfuels and very low impact on the environment. Today the contribution from photovoltaic (PV) energy compared to the other energy sources is very low, but due to decreasing system prices the market for PV systems is one of the most stable and fastest growing in the world. If this trend continues, PV will be one of the most important energy sources in the future. To maintain the further spread of PV systems it is important to decrease the cost and valuable improvements can be made on the side of battery back-up PV-systems; at the same time improve the efficiency and reliabilityof these systems.

In the part of improvements in the battery back-up system, the battery drain-up issue overcome by using this simplest topology with very economical level.

II. OVERVIEW AND STATE OF THE TOPOLOGY

The inverter and PV-generator are treated as a system, if this system grid independence, and then it is called as stand-alone or off grid system.

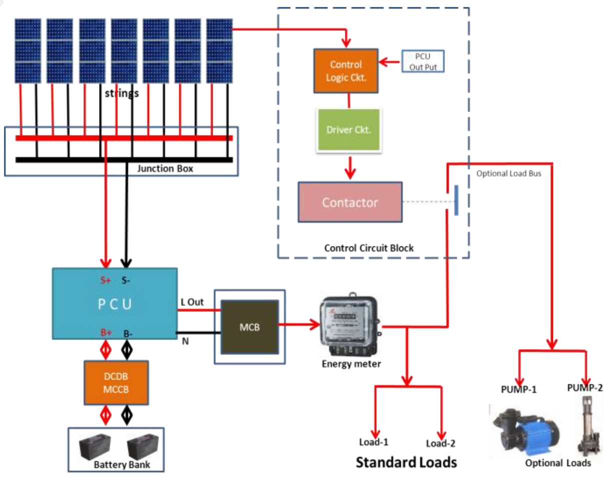

Fig.1. Configuration of topology arrangement.

PV-modules are connected in combinations of series and parallel configurations to get a higher power level for the PV system. Very common is a series connection of modules (the cells inside the modules are connected in series, too). The series connection of modules is calledastring.

The optional load connection arrangement shown in the figure 1, basically it is flip-flop logic, in this concept the output loads (i.e. optional loads) are monitored/controlled by sun intensity-level in the entire day time, by using electronic circuitry.

III. FUNCTIONAL BLOCKS OF THE CIRCUIT

The Insolation monitor circuit (electronic circuitry) divided in to 3-sections:-

1) Power Supply section.
2) Irradiation Voltage amplifier section.
3) Power-contactor driver section.

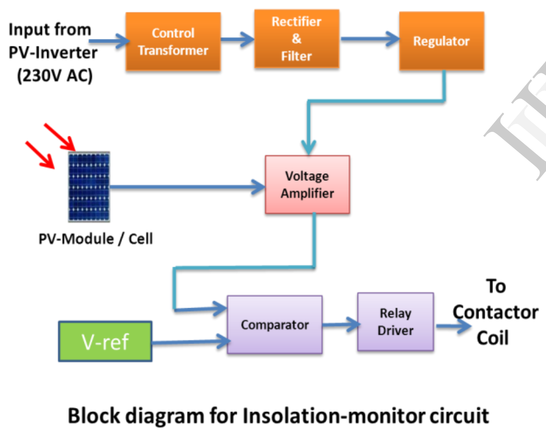

Fig. 2 Block diagram of the circuit.

1) Power supply section: It is a power supply for entire circuit, to activate the components of electronic circuit, it consists,

-->Small control transformer,
-->Bridge / Centre taped full-wave rectifier,
--> Filter capacitors with voltage regulators.

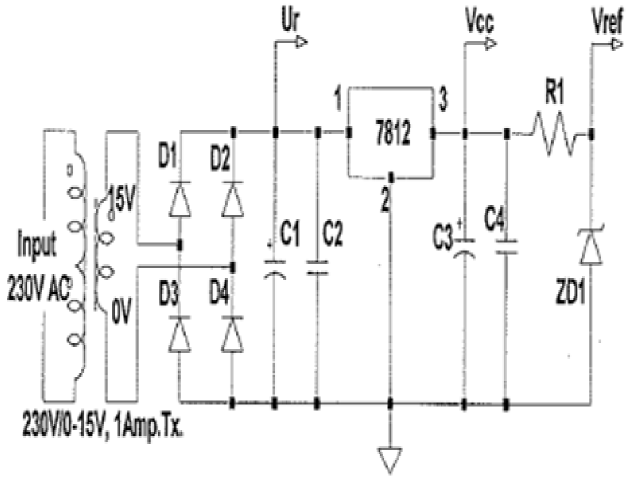

Fig. 3 Power supply section with filter capacitor.

Ur = Un-regulated power supply for relay driving.
Vcc = Regulated 12v dc supply for IC's etc.
Vr = Reference voltage(3.3V) for comparator.

2) Irradiation Voltage amplifier section: This section will play vital-role in the circuit. The circuit diagram shown Fig.4, it consists,

--> Irradiation amplifier section,
-->Comparator section.

Irradiation amplifier section: The voltage drop across shunt resistance of SPV-cell/module is amplified in to millivolts to volts;this amplified voltage will compare with Vr (3.3V ref. voltage) to switch-ON/OFF the relay/contactor, as per pre decided sun-intensity.

3)Power-contactor driving section: This section will activates / deactivate the relay coil, to switch-ON or switch-OFF the contactor. The Fig.5 shows the detailed circuit.

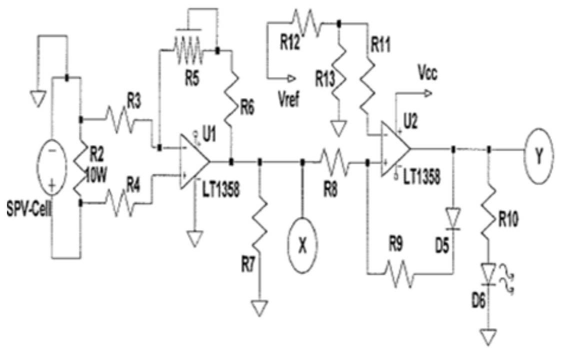

Fig. 4 Circuit diagram for Irradiation amplifier &comparator section.

The main-components are:-

- LM 358 IC (for comparators)
- SL 100-NPN Transistors (to drive the 12V relays)
- 12V dc, 1C/O. 6Amps relays (to drive the power-contactor

Power wiring: -It requires some modification in the output section. The output of the system will be connected to the optional loads via power-contactor. The connection diagram shown in the figure.1

As per sun-intensity the optional loads will added / subtracted from inverter output, to maintain battery bank healthiness from the inverter output.

Most of the battery drain-up issues will be resolves with this new-proposed solution.

We can charge the batteries in the day-time; utilize it as a backup in the night time for standard loads.

No power will export to the optional loads at lower sun intensity withthis solution from the battery bank.

As per this concept not required any bidirectional inverters, AS-Box and other stuff etc.

It is a SPV-load management solution.As per sun-irradiation, the optional loads will come into picture.It monitors the sun-Irradiation, as per sun intensity, the optional loads added or subtracted at Inverter's output.

For this, I designed a prototype-model automatic logic circuit at our PMG – Lab.

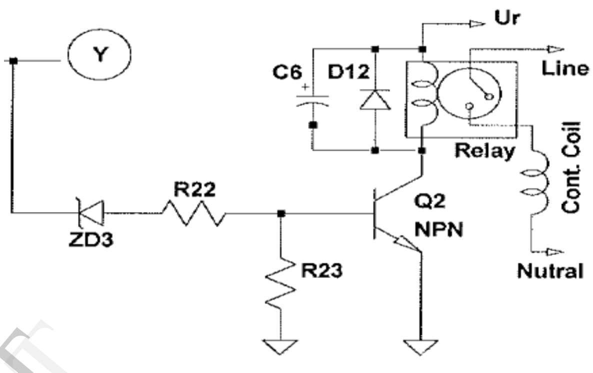

Fig. 5 Relay / Contactor driver circuit diagram.

IV. CONCLUSION

PV-systems offer a wide range of possibilities and configurations for the use of power electronic converters, In addition some problems from the application side.

This given topology and the technology are presented as promising for the future. Future work will be, to compare the topologies with special respect to the simulation and measurements on an experimental setup.

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