

# **Compact Integrated Energy System for Distributed Generation**

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**ABSTRACT:** A Distributed generation systems consists of locally placed energy sources, energy storages devices, regulators and connected loads. The renewable energy source having the more Importance Worldwide. It's demand get increases day by day, it is one useful for the nature and harmless. Power converter for renewable energy sources operate below their capacity for period of time. So we need integration between renewable source and storage device. The application of the distributed generation (DG) in the distribution system acquired more smoothing DC **Source**. Addressing this concern, a number of integrated energy generation systems that use 25% lesser semiconductors are proposed.

**KEYWORDS:-** Distributed Generation (DG), Battery, Ultra-Capacitor, Grid, Inverters.

## **I. INTRODUCTION**

Distributed generation (DG) concept came into existence with two major thrust areas, i.e. utilisation of local energy sources and reducing the power transmission losses. The concept gained a good attention in the form of micro-grids. The technology was well supported by researches in the area of Energy storage as the power generated by most renewables are depended on environmental conditions, so it fluctuates throughout the day. To maintain continuity & reliability, a good volume & efficient storage is required. Also, it can be used for smoothing the power available. Another architecture implemented to improve DG systems are the use of different types of sources, whose generation characteristics complement each other. But even after all this, there is a question on its reliability issues. [1] Also including too many converters to a system might at times introduce too much costly redundancy, and is common in renewable energy generations due to intermittent generation. This forces the system to operate at lower performance levels.[2]

## **II. NONINTEGRATED ENERGY SYSTEM**

Fig.1 shows the typical block representation of a common solar energy generation system drawn here for example. Each source or storage included is accompanied by its own dc–dc boost or charging converter tied to a common dc link. The harnessed energy is then forwarded to a dc–ac inverter for conditioning before channeling it to the grid. The inverter can either be single or three phase, even though the latter is explicitly drawn in the diagram. It is also not necessary for the dc–ac inverter to tie to the grid if the energy generated is meant for immediate load consumption in an islanded local microgrid. The dc–ac inverter in an islanded microgrid can also be replaced by a dc–dc converter if the loads are dc by nature. DC network is certainly a possibility, but based on present advancement, ac output would probably continue to dominate for many more.

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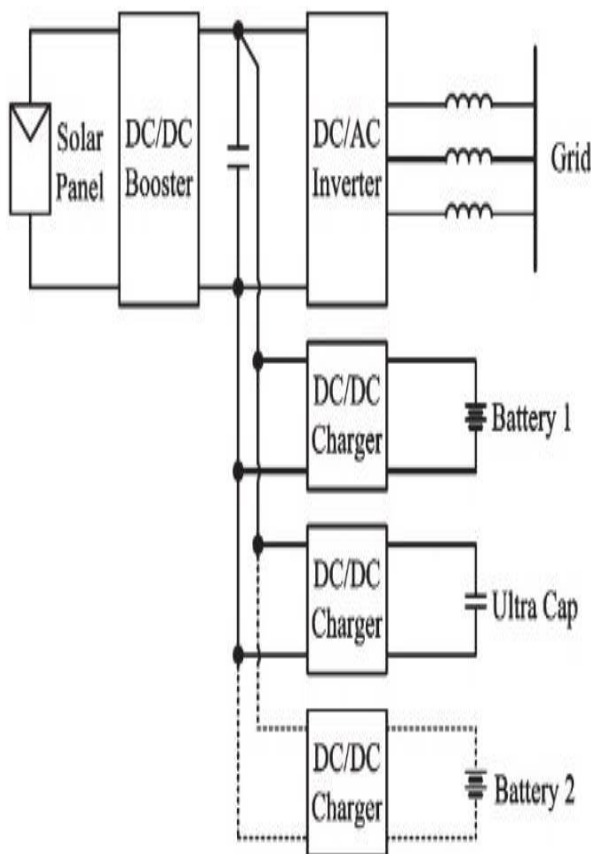


Fig.1 Block Diagram of PV Generation System

Eleven of the devices are controllable switches with the remaining one being an uncontrollable diode. The diode  $S_c^1$  can be replaced by a controllable switch if the indicated solar panel in is replaced by another type of source that can absorb backward flow of energy

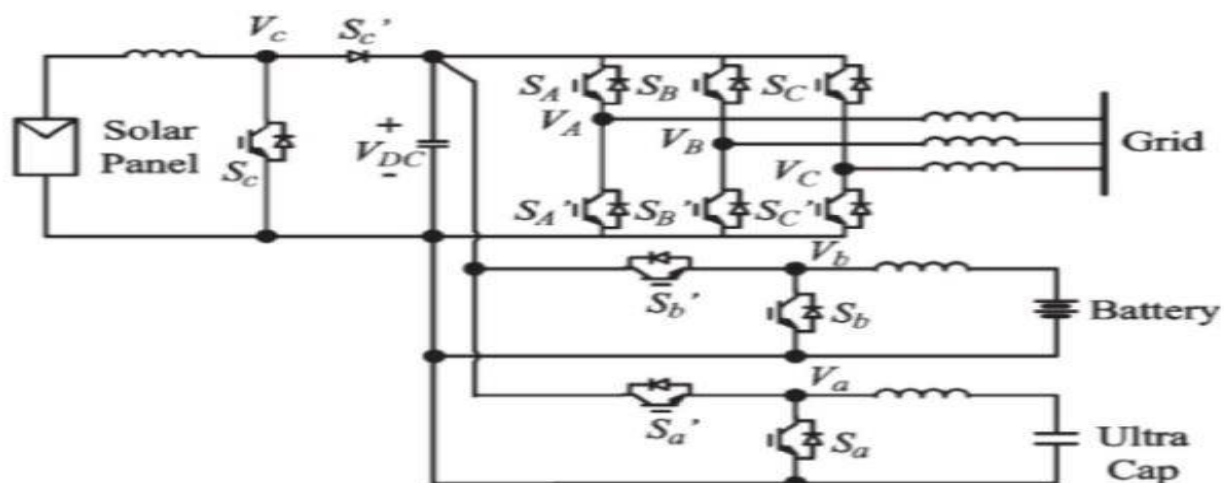


Fig.2 Non-integrated Energy System

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## III. DISTRIBUTED GENERATION SYSTEM

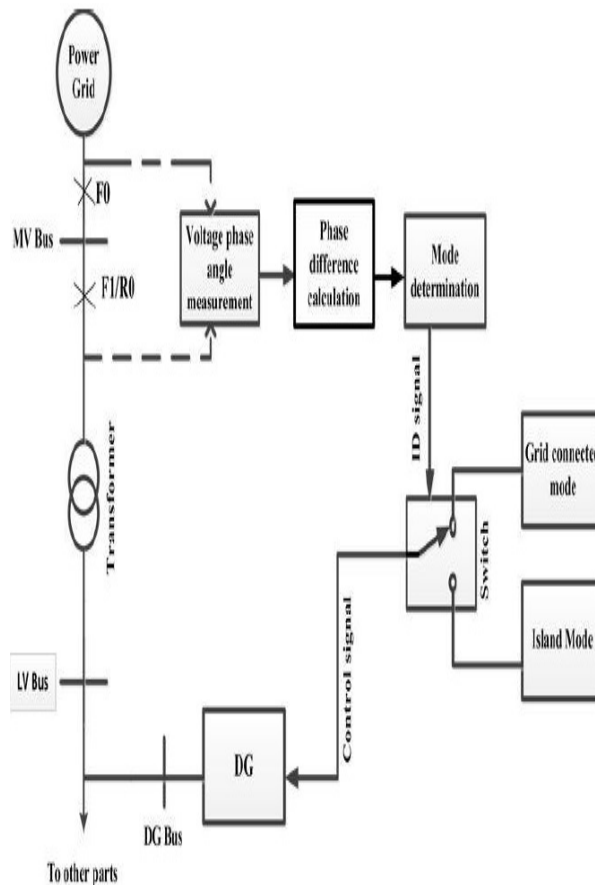


Fig. 3 Distributed Generation System

Distributed generation is termed for a system that employs minor generation technologies to generate electricity very close to the load side of power. DG technologies often consist of modular generators, and they offer a number of benefits. In many cases, distributed generators can generate electricity at lower cost and higher reliability and continuity of power. It also offers security with fewer environmental consequences than traditional power generators. Distributed generation takes place on two-levels:

- The Local level
- The Endpoint level.

Local level power generation plants often runs on renewable energy generation systems that are specific to the locality, such as wind turbines, geothermal energy production, solar systems, and some micro-hydro or gas turbine plants. These plants tend to be smaller and less centralized than the traditional plants. They provide more energy generation than required and cost efficient and reliable. An end-point distributed system is majorly implemented for backup generation, like modular internal combustion engines, connected as backup. Many DG technologies can also operate in isolated "islanded" mode of electric energy production or they can serve as small contributors to the power grid.

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## IV. INTEGRATED ENERGY SYSTEM

### A. Method of Integration

For each of the phase legs, shown in figure above, its two switches must be switched in complement to each other, i.e., when one switch is on, the other must be off. Terminal voltage of the phase leg under consideration can be used to produce two discrete values identified as  $V_{DC}$  and 0 V. The same applies to the other phase legs that shown in figure. Terminal voltages of the two phase legs can then be any of the four sets of values indicated in Table I.

Table I: SWITCHING STATES AND OUTPUT VOLTAGES

$S_A$	$S_A^1$	$S_a^1$	$S_a$	$V_A$	$V_a$
ON	OFF	ON	OFF	$V_{DC}$	$V_{DC}$
ON	OFF	OFF	ON	$V_{DC}$	0
OFF	ON	OFF	ON	0	0
OFF	ON	ON	OFF	0	$V_{DC}$

Table II: REDUCED SWITCHING STATES & VOLTAGE STATUS

$S_A$	$S_{Aa}$	$S_a$	$V_A$	$V_a$
ON	ON	OFF	$V_{DC}$	$V_{DC}$
ON	OFF	ON	$V_{DC}$	0
OFF	ON	ON	0	0

Applying the same integration to the remaining two pairs of phase-legs with switches  $\{S_B, S_B^1, S_b^1, S_b\}$  and  $\{S_C, S_C^1, S_c^1, S_c\}$  then results in the integrated energy system shown in Fig. 4. The system in Fig. 3 uses nine switches as compared to twelve for the non-integrated system shown in Fig. 1(b). The same six terminal voltages are retained with the upper three produced by the dc-ac inverter formed by the upper three switches  $\{S_A, S_{Aa}, S_a\}$  and middle three switches  $\{S_B, S_{Bb}, S_b\}$ . On the other hand, the lower three voltages are produced by three dc-dc converters formed by the middle three switches  $\{S_B, S_{Bb}, S_b\}$  and lower three switches  $\{S_C, S_{Cc}, S_c\}$ . The middle three switches are obviously shared by the inverter and converters, which will surely introduce some constraints as already identified (fourth combination of  $V_A=0V$  and  $V_a=V_{DC}$  cannot be produced).

### B. Modulation Principles

In order to make the new configuration produce the same terminal voltages would require sharing of same modulation theories. The phase leg connected to the DC source is controlled by a DC reference and a triangular or Saw-tooth carrier. The second phase leg connected to a phase of the 3-phase AC grid is controlled by a sine wave reference and a triangular carrier. The carriers of the two phase-legs need not be same, but in practice, using one carrier has the benefit of involving only one timer. It is hence advisable to imply a common carrier and two independent references for the circuit.

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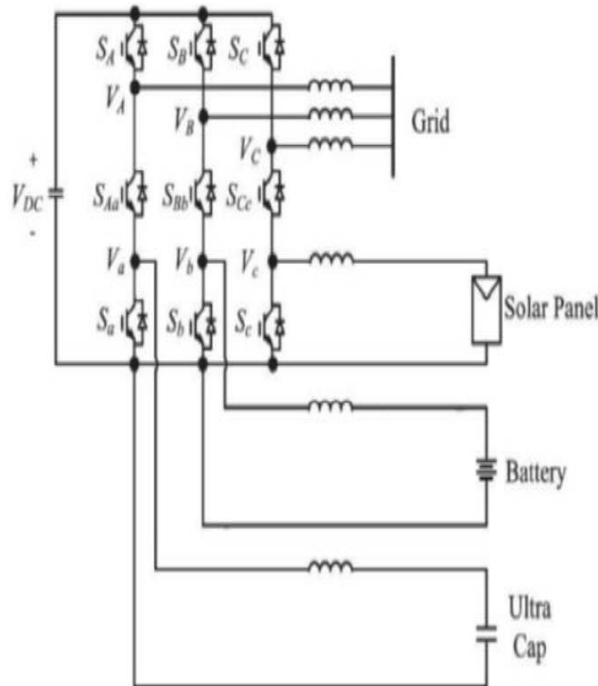


Fig.4 Integrated Generation system

An example illustrating the three-switch modulation is shown in Fig. 5, where a single carrier band is clearly divided into  $h_1$  and  $h_2$ . The upper sub-band  $h_1$  is assigned to the upper terminal, and hence confines the sinusoidal reference. Similarly, the lower sub-band  $h_2$  is assigned to the lower terminal, and hence encompasses the linear reference. Comparing the references with the single common carrier based on the following rules then leads to those gating signals for  $S_A$  and  $S_a$  shown at the bottom of Fig. 5.

$$S_A = \begin{cases} 1, & \text{reference} \geq \text{carrier} \\ 0, & \text{reference} < \text{carrier} \end{cases}$$

$$S_a = \begin{cases} 0, & \text{reference} \geq \text{carrier} \\ 1, & \text{reference} < \text{carrier}. \end{cases}$$

To ensure that only two switches are on and hence produce any of the three combinations shown in Table II, gating signal for the middle switch must be derived from the earlier two based on the following.

$$S_{Aa} = S_A \oplus S_a - (!S_A) \oplus (!S_a)$$

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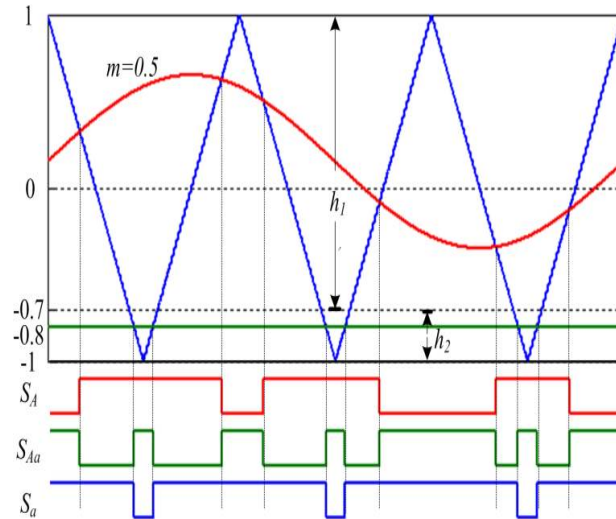


Fig.5 Carrier band division and gating signal generation per phase-leg.

## V.CONCLUSION

This paper proposes a number of integrated energy systems based on a compact converter topology. The circuit Slightly Complex with reduced switch count, compactness and switching losses are reduced. The switches carries same current. Experimental testing has already confirmed their conceptual validity and practicality, regardless of whether implemented in single- or three-phase form.

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