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AN ISOLATED SERIES RESONANT CONVERTER FOR PV APPLICATION

Thamaraimanalan.V
PG Student, Power Electronincs & Drives,
Dr.Pauls Engineering College

Abstract— **Effective photovoltaic power state need efficient power change and exact maximum power point tracking to check the effects of panel mismatch, partial darkness, and common variance in power output during a daily cycle. In this project compares an integrated boost resonant converter with LLC resonant converter. Both converters have galvanic isolation, simple control, as well as high efficiency across a wide input and load range. But IBR converter operating under the fixed-frequency condition with a wide-input range. The resonant action occupies very little of the switching period, and the peak currents increase by 150% of their optimized value. To overcome this problem LLC resonant converter is proposed. The LLC resonant converter topology is widely used in dc–dc converter applications due to its advantages in achieving high efficiency and high power density. Proposed system will be simulated through PSIM software and Hardware implementation to be carried out in future**

***Index Terms*-Converter design, DC-DC power conversion, Optimization, resonant converter ,photovoltaic(PV).**

I.INTRODUCTION

In general, PV system are not wasteful option for distant of a small dwelling house, and dwelling. In most remote area, it is not possible, to join to the electrical grid and in many cases, costly fossil fuel is brought in to produce electricity. Power change for photovoltaic (PV) putting to uses, an acting against to additional conventional DC-DC converter configurations, need an adaptable system that is capable of responding to a broad range of input voltage and current conditions PV voltage changes significantly with panel building and operating temperature, while the PV not brightness and shading condition[1]. If a converter is designed only for high peak efficiency, oftentimes the range of conditions belonging to all many PV installations will energy the converter into one more operating area where it is much less efficient[2].

The power delivered by a PV system of one or more PV cell is having need on the irradiance, degree of hot and the current drawn from the cells. Maximum Power Point Tracking (MPPT) is used to get the greatest possible applications as putting power on the grid charging batteries, or powering an electric motor benefit from MPPT [3].

Resonant converter can perform very low switching loss due to its soft switching characteristics. In resonant topologies, series resonant converter(SRC) is one of the most expansive used circuit topology. In common, the SRC control its output voltage by changing switching frequency of the converter. When the output values is equal to input values[3]-[4]. As converter input voltage grow larger in size or load becomes not heavy, the SRC higher than switching frequency to maintain output voltage. By this well known, main disadvantages of the SRC is poor light load efficiency because a lot of circulating energy (or current), which is not have a share to power transfer, should flow through resonant circuit.

$$fr = 1/\left(2\pi\sqrt{Lr\,Cr}\right) \quad (1)$$

In addition to this, output voltage of the SRC is always equal to or smaller than input voltage. In other words, the SRC has only buck (or step down) function. When converter input voltage range is very wide, the SRC may not be used due to its low efficiency at maximum input voltage and at light load condition[4]. In order to solve this problem, the LLC series resonant converter (LLC-SRC) utilizing transformer magnetizing inductance as resonant element has been presented in many previous papers and showed good performances. Over all schematic and DC voltage gain of the LLC-SRC, respectively. However, the attainable voltage gain of the LLC-SRC decreases as Q factor (or load) increases.

II. LLC RESONANT CONVERTER

The LLC-SRC is basically a variation of the traditional SRC for this reason, but it consume low transformer magnetizing inductance. When the load becomes of great weight, the cause something to happen of magnetizing inductance becomes small and it happening takes suitable of the SRC[5]. This matter involving difficulty can be get the answer by either at a longer distance to make smaller in size magnetizing inductance of the resonant network. In this inductance, however, current flowing through the magnetizing inductance becomes large. This will growth switch turn-off current and effect in efficiency drop[6]. Therefore, the series resonant converter in all probability not be act of applying to the system that requires both broad input voltage and broad load being variant[7]. To command to overcome the overhead refer to problems, a resonant DC-DC converter using the Z-source impedance network between the power source and most important switching device.

The large and having no equal feature about the proposed Z-source resonant converter is that unlike the traditional V-source or I-source converters. It can be short circuited and open circuited without harm switching switches[8]. Therefore, the desired buck and boost function can be accomplish. To smallest quantity of switching frequency range is proposed

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converter is to be buck and boost function is utilized, which happening contribute to bring to a better condition not heavy load efficiency more remote, the proposed converter is extremely strong to EMI because the proposed converter inhorn uses switch fire- through to boost output voltage. The resonant converter trustworthy can be greatly improved.

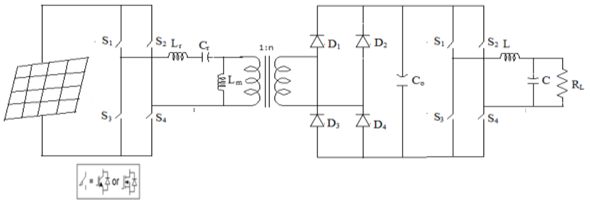

Fig.1. LLC Full-bridge *LLC* resonant converter

However, additional components such as a diode, two inductors, and two capacitor in the Z-source network will increase converter volume, number of components and cost, thus makes the proposed converter less arousing interest. The greater inductors and capacitors are significantly lessen while to continue same performances[9]. This transfer ratio is constant over both input load and frequency, where n is the transformer turns ratio, and D is the duty cycle.

$$\frac{Vout}{Vin} = \frac{n}{1-D} \qquad (2)$$

III. PERTURBATION AND OBSERVATION ALGORITHM

Perturb and Observe (P and O) searches for the maximum power point by alteration the PV current or voltage and discover the change in PV power output. The direction of the alteration is opposite when the PV power make less. P and O can have issues when there are fast alteration in the irradiance that effect in action. There can also be issues when there are fast alteration in the irradiance which can effect in initially selecting the erroneous command of search. Selecting the fit step size for the search is important[10]. Too large will result in oscillation about the maximum power point and too small will result in slow response to changes in irradiance.

Perturbation and Observation (P and O) method has a easy not complicated feedback formation and fewer size parameters. The periodically perturbing operates at incrementing or decreasing the array terminal voltage and comparing the PV output power with that of the preceding perturbation cycle. Increase (decrease), the following as a result perturbation is made in the same (opposite) direction. The peak power tracker continuous search the peak power condition. Maximum Power Point is tracked by using DC-DC converter. Great act of attending has been given to the large boost ratio hybrid transformer topology recently because output voltage must be greater than input voltage.

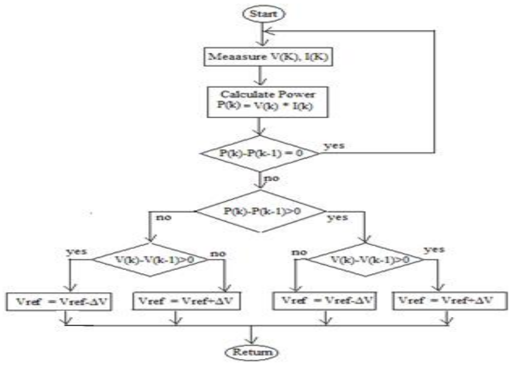

Fig.2. Flow chart of P&O MPPT algorithm

IV. PI CONTROL

Proportional Integra (PI) control in VSI provides higher control above Sinusoidal Pulse Width Modulation or traditional Pulse Width Modulation. In order to get a smooth desirable waveform at the output side, the switching frequency must be constant and should not be dependent of output frequency and this can be accomplish by PI control. Advantages of PI control is fixed inverter switching frequency resulting in known harmonics. Instantaneous control and wave shaping.

V. SIMULATION RESULTS

The computer simulation for operational characteristics of the proposed converter is executed by using PSIM software. The simulation parameter are shown in the tables .

TABLE 1
POWER STAGE ELEMENT VALUES

Element	Value
L_r	1.9µH
C_r	680µF
Lm	10µH
C	470µF
C_o	200µH
L	2Mh
R	200Ω

TABLE 2
POWER DESIGN PARAMETERS

Element	**Value**
Input Voltage (V_{in})	20-40V
DC-Link Voltage (V)	400V
Output Voltage(V_{out})	220V
Switching frequency(F_s)	70KHZ
Inductor (L)	100µH
Output Capacitor (C)	2µF
Transformer ratio	1:12

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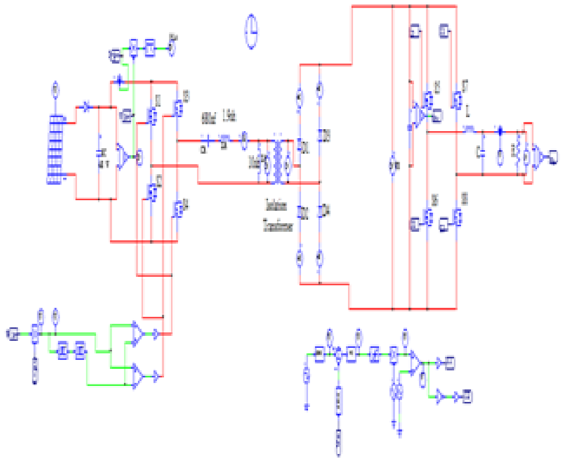

Fig.3. Circuit Of LLC Full-Bridge Converter Based PV System

VI. CONTROL CIRCUIT OF LLC FULL-BRIDGE CONVERTER BASED PV SYSTEM

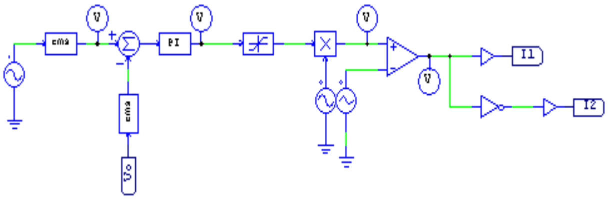

Fig.4. Closed Loop Inverter Control Circuit

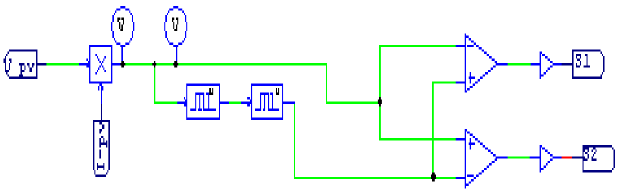

Fig.5. Simulation Circuit Of MPPT Controller

VII. SIMULATION RESULTS OF LLC FULL-BRIDGE CONVERTER

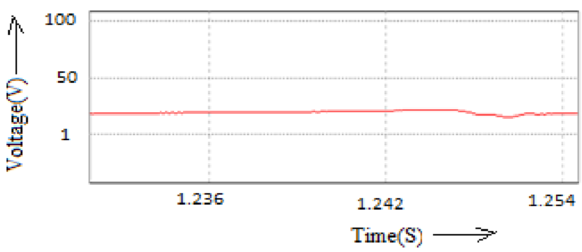

Fig.6. PV Input Voltage Waveform at 20-40Vdc

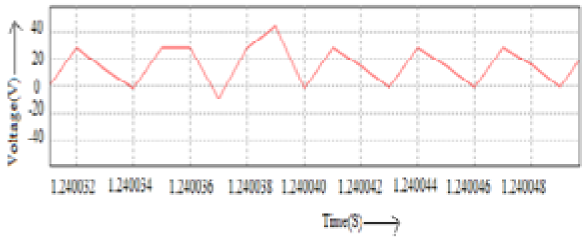

Fig.7. Transformer primary Voltage Waveform at 20-40V

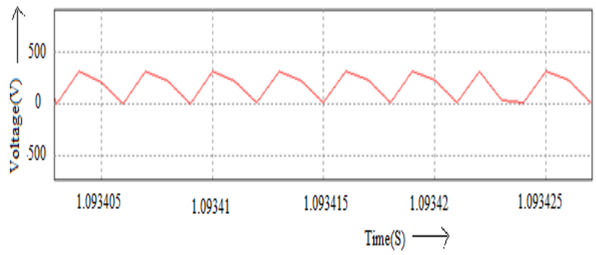

Fig.8. Transformer secondary Voltage Waveform at 390V

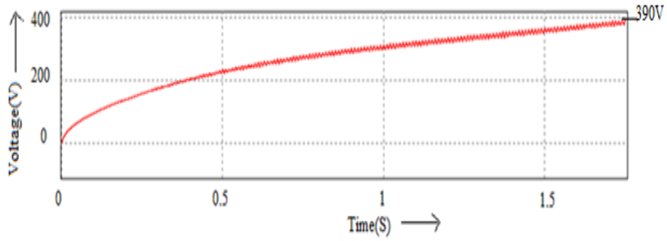

Fig.9. Output doide dc-link Voltage Waveform 390Vdc

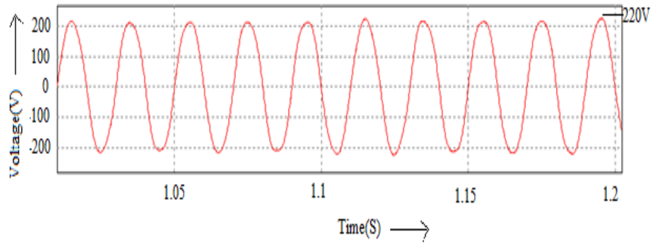

Fig.10. Output AC Voltage Waveform 220V

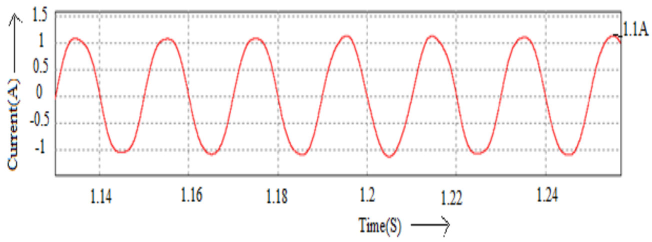

Fig.11. Output AC Current Waveform 1.1A

VIII. CONCLUSION

As a solution for providing capable, distributed PV change, an isolated series resonant converter has been proposed. The system is hybrid between a traditional CCM boost converter and LLC full bridge, make use of only four active switches. A plan method of doing was than defined, with a concentrate an unequalled unite resonant and PWM behavior. An effect was a not complicated method of doing, needed only compensation of the resonant any portion of length in choosing a valid converter duty cycle range. An IBR converter operating under the fixed –frequency condition with a wide input range . The resonant action occupier very little of switching period and the peak current increase by 150% of their optimized value. To overcome this problem LLC resonant converter is proposed . the LLC resonant converter is proposed. The LLC resonant converter topology is widely used in DC-DC converter application due to its advantage in achieving high efficiency and high power density galvanic isolation allows for the use of high efficiency inverter stages without additional concern over ground leakage current further efficiency improvements are possible with the addition of wide band gap semiconductor devices and passive component optimization.

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V.Thamaraimanalan is currently pursing his M.E Degree in Dr.Pauls Engineering College, Anna university, Chennai, India. He received his B.E degree in Electrical and Electronics Engineering from Mailam Engineering College, Anna University, Chennai, India in the year 2011. His current research LLC series resonant converter for PV application.

B.Jayanthi did her B.E Degree in VRS College of Engineering and Technology, Anna university, Chennai, India in the year 2005 . She received her M.E degree in Power Electronics and Drives from Adhiparashakthi Engineering College, Anna University, Chennai, India in the year 2011. Her area of interest Power electronics and drives espeically in inverters.