AN SVPWM BASED CSI FOR GRID CONNECTED PV SYSTEM

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ABSTRACT

In this paper we are proposed the single-phase to single- stage transformer-less current source inverter depended grid connected photovoltaic system is implemented. The systems preferred without using the transformer and maintain the maximum power point conversion for sensing the maximum power point is interconnected to the to the grid from the photovoltaic array, the fuzzy logic controller is used to regulate the maximum power point requirements. The current injection in grid side is maintained by the placing of proportional-resonant controllers. To enhance the system stability and performance is achieved by the double tuned parallel resonant converter circuit is implemented to compensate the second and fourth order harmonics in the inverter dc side of the array. A well-organized space vector pulse width modulation (SVPWM) is implemented for the current source inverter to excite the dc-link inductor in the active switching cycle period for the each and every time modules. The simulation results are tested and verified in the MATLAB/SIMULINK model for to identify the dynamic response and power quality performance and reliability of the implemented system.

Index Terms*: Grid Connected Maximum Power Point Tracking Arrangement (MPPT), Photovoltaic Cells, Current Source Inverter (CSI) And The Space Vector Pulse Width Modulation Control Strategy (SVPWM).*

I. INTRODUCTION

DUE to the energy disasters and environmental problems, non- conventional energy sources have fascinated the concentration of researchers and developers. Among the available non-conventional energy sources, the photovoltaic (PV) system arrangement is selected to be a most effective and promising technology, since of its fittingness in distributed generation (DG), satellite arrangements, and transportation system respones.

In distributed generation featured applications, the PV system functioned in two different operation modes: grid-connected operation mode and island operation mode. In the grid-connected stage, maximum power is improved from the PV arrangement to supply maximum obtainable power into the grid surface. Single- and two-stage grid-connected model arrangements are frequently used technologies in single- and three-phase PV application features.

In a single-stage grid-interfaced system, the PV system includes a single conversion mechanism (dc/ac power inverter) to identify the maximum power point requirement (MPP) and communicate with the PV model to the grid.

In this circuit model PV maximum power is injected into the grid with high performance, low in size, and low investment cost. Nevertheless, to fulfill grid necessities, such a topology necessitates atleast a step-up transformer, which reduces the system efficiency and increases initial cost, or a PV selection with a high dc necessary voltage. High-voltage system agreement produces from hotspots throughout partial investigation and enhanced leakage current involving the panel and the circuit ground though parasitic type capacitances.

Furthermore, inverter control is difficult since the control arrangements, such as MPP tracking arrangement (MPPT), power factor improvement, and harmonic decrease, are concurrently measured. Other side, a two-stage grid-interfaced PV system performed in two conversion stages: the boosting and required PV output voltage and tracking technique of MPP by maintained by a dc/dc converter, and usage of dc/ac inverter for interconnecting the PV technique to the grid.

In such arrangements, a high-voltage PV cells is not necessary, because of the dc voltage boosting control strategy. Nevertheless, this two-stage scheme process from reduced efficiency, large investment cost, and high in size. Beginning the above mentioned demerits of this technique.

The existing grid related PV process patterns; it is noticeable that the performance and track of the two-stages of the grid-connected circuit are not efficient for the required.

Consequently, single-stage converters have improved concentration, particularly in low voltage application manner. Special single-stage topologies have been implemented and an assessment of the obtainable interface cases is obtainable. The traditional voltage source inverter (VSI) technologies are the most frequently used interconnected unit in grid-associated PV process technique.

Due to its straightforwardness and accessibility. Nevertheless, the voltage buck functions of the VSI enlarged the requirement of using a massive transformer or superior dc voltage. Furthermore, an electrolytic capacitor, which represents a dangerous point of malfunction, is also desirable.

Various multilevel inverters have been implemented to enhance the ac-side characteristic performance, minimized the electrical stress and pressure on the power electronic switches, and decreased the power losses owing to a high sampling frequency. Still, the compensation is targeted at the expenditure of a more multifaceted PV system. Furthermore, a massive transformer and an undependable electrolytic capacitor are necessary to produce high performance.

The current source inverter technique (CSI) has not been expansively researched for grid- associated non-conventional energy resources. Nevertheless, it might be a viable substitute strategy for PV dispersed generation grid correlation for the following specifications:

1) The input current of the dc is permanent which is significant for a PV featured application;

2) System performance is enlarged by interchanging the shunt connected electrolytic capacitor in input side with a series connected input inductor;

3) The CSI voltage boosting competence permits a low-voltage PV cells to be grid boundary exclusive of the consideration of a transformer or a supplementary boost stage. Grid-associated PV system performs using a CSI has been implemented

The 3-phase CSI for PV grid connection implemented, Personal use is permitted. For any other reasons, agreement must be obtain from the IEEE by generalizing pubs-permissions productively injected PV power to the grid, without complicated and identified the ac output produced current, with a total harmonic distortion occurrence (THD) of 4.5%. Nevertheless, ac current loop is important in the grid connected submission in order to perimeter the current and speedily recover the grid current variation during varying weather surroundings.

A dynamic represented diagram and control structure for a single-stage grid-interfaced PV three-phase system using a CSI is implemented. The current additional into the grid has a less THD and unity power factor under different weather limits. Nevertheless, the controller requires of only current loop stages, which involve system reliability.

Unlike the 3-phase grid-interfaced CSI, the single-phase circuit has even harmonics on the dc side, which distress MPPT, diminish the PV life span, and are connected, with odd-order harmonics on the grid side of the inverter. Consequently, vanishes the dc side even harmonics its very important to improve the efficiency of the PV system based applications.

Various techniques have been designed to minimize the even harmonic belongings in CSI PV applications. The predictable solution to the dc current fluctuation is to use a bulky inductor, which is competent to reducing the even-order harmonics.

Basically, the CSI inverter generates high amount dc current; consequently, an inductor with a bulky value is usually immense and large in size. Accordingly, this method is virtually offensive. To abolish the harmonics exclusive of using huge inductance, two technologies have been developed in the explanation; those are feedback current control loop technique and hardware implementation techniques.

Particularly designed feedback current compensators proposed to abolish the odd harmonics on the ac side exclusive of using large inductance are designed in the strategy. In the literature, the oscillate power consequence from the grid is reduced by applying a tuned proportional resonant controller for the elimination of third harmonics.

Nonlinear pulse width modulation (NPWM) has been designed to recover harmonic improvement. NPWM is depended on employing logical operations, like as a band-pass filter, a phase-shifter block, and different compensation technologies division functions to dig out the second-order harmonic constituent from the dc-link in progress.

In the power oscillating effect is compensated by using a adjustment of the carrier signal reference on pulse amplitude modulation process (PAM). The reference signal is diverged with the second-order harmonic contents in the dc-link current to eradicate its consequence on the grid current process.

These techniques are not appropriate for a single-stage grid-connected PV arrangement, since the dc current fluctuations are high, which effects high equipment system losses and decrease its lifespan of the circuit. In the hardware implementation solution developed for the second-order harmonics are compensated by including a supplementary parallel resonant model on the dc-side inductor.

Although the hardware method has required extra costs, losses, and size, it is painstaking to be a practical explanation for CSI-based PV models. Frequently, the collision of second-order harmonics presented in the dc-side current can extensively involve the ac-side generated current. Furthermore, the fourth-order harmonic contents in the dc-side current might be affecting the ac-side flowing current at larger modulation phenomena.

In this strategy, a single-stage single-phase grid-associated PV model on a CSI is suggested. A doubled-twisted parallel resonant track is designed to abolish the second- and fourth order harmonics on the dc side converters. Additionally, a adapted reference based modulation process is developed to supply a permanent corridor for the dc-side current after each active sampling period of the designed cycle.

The control organization incorporated of MPPT, an ac current loop agreement, and a voltage loop controller. To exhibit the helpfulness and toughness of the implemented system, computer-used simulation results and sensible results are included to authenticate the system performance.

II. SYSTEM DESCRIPTION

A grid-interfaced PV model using a single-phase Current Source Inverter is exposed in Fig. 1. The circuit has four insulated-gate bipolar transistors (IGBTs) indicated as (S1–S4) and four conventional diodes named as (D1–D4). Each diode is coupled in series with an IGBT power electronic switch for reverse blocking competence. A doubled-composed parallel resonant model is connected in series with the dc-link inductor *L*DC is applied for controlling the dc link current. To neutralize the switching distortions, a *C*–*L* filter is used to diminish the harmonics in the inverter ac side of this model.

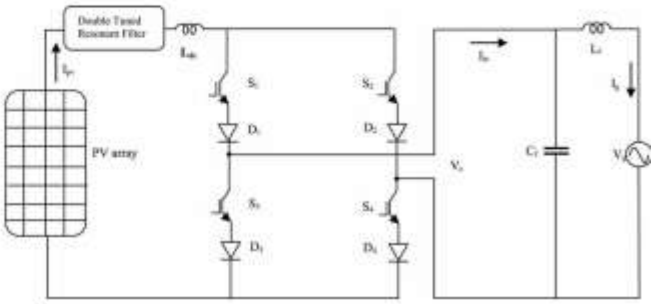

Fig1. Single-phase grid connected current source inverter

In a single-phase CSI, the effervescent immediate power of twice the system operating frequency produces even distortions in the dc-link current. These harmonics reproduce onto the ac side as short order odd harmonics in the voltage and current.

Inopportunely, these even order fluctuations concern MPPT in PV model applications and decrease the PV life span. In order to moderate the contact of these dc-side ripples on the output side and on the PV, the dc-link passive element like inductance have to be large enough to restrain the dc-link current distortions generated by these losses. Virtually, higher dc-link inductance is not satisfactory, because of its initial cost, compatibility and weightiness, and these are shows that it slow in MPPT transient response conditions.

To decrease the necessary dc-link parameter i.e. capacitor, a parallel resonant model strategy is suggested to tuned to the second-order distortion is applied in series with the dc-link parameter. The filter is competent of diminishing the dc-link current by considering relatively miniature inductances.

Although the crash of the second-order harmonic contents is most considerable in the dc-link current competences, the fourth-order distortions also create some problems in the dc-link current, particularly when the CSI performs at high intonation index. Consequently, in an challenge to recover the parallel resonant circuit, this paper implemented a double-tuned parallel reverberating modeled designed at the second- and fourth-order fluctuations, as listed and illustrated in Fig. 2

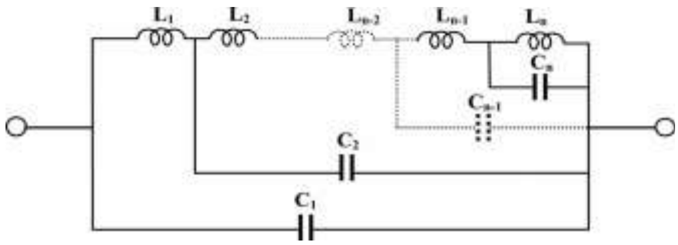

Fig.2 Proposed double-tuned resonant filter for eliminating *n* harmonics.

In order to monitor the resonant filter to the preferred harmonic sampled frequencies, the impact of the *C*1 and the total consideration of *L*1, *L*2, and *C*2 be supposed to have identical values of reverse sign.

For smoothness, presuppose component resistances are little and thus to choose the best possible values for the designed filter parameters, the possessions of changeable resonant models inductance are calculated the developed filter perception can be comprehensive to eradicate any number of distortions by applying the desired values.

III. OPEARATION DESCRIPTION

The proposed circuit model has the major parameters like as PV array, CSI and fuzzy logic controller strategy is required. In this output power is influenced with the fuzzy logic controllers with the sinusoidal pulse width modulation techniques are used to compensate the harmonics in the grid side and the inverter side of the generated output voltage.

The calculation of currents in the grid side and inverter side and the transfer function and the stability analysis corresponding functions are calculated and listed below

$$I_{g,peak}=MI_{pv}$$

$$V_{pv}=\frac{1}{2}MV_{g,peak}S$$

$$\Delta p = P(K) - P(K-1)$$

$$\Delta I_{pv} = I_{pv}(K) - I_{pv}(K-1)$$

$$Z(S)= K_i \frac{s}{s^2+\omega_0^2}e(S)$$

$$\frac{dZ(t)}{dt} = K_i e - \omega(t)$$

$$Y=K_p e(t) + Z(t)$$

$$W(K+1)=W(K)+ T_s \omega_0^2 Z(K)$$

$$Z(K+1)= Z(K) + T_s(K_i e(K)-W(K+1))$$

$$Y(K+1)= K_p e(K) + Z(K+1)$$

The fuzzy logic loop controller their major assigning of block parameter and the controlling strategies are given in the below mentioned table the differential values and functions are given.

	NB	NS	PS	PB
NB	PB	PB	NB	NB
NS	PS	PS	NS	NS
PS	NS	NS	PS	PS
PB	NB	NB	PB	PB

Table 1: fuzzy logic based rules

The controller side and the usage of current source inverter and the SVPWM to produce high performance to the grid connected PV model.

IV. CONCLUSION

In the proposed single phase to single phase grid connected PV system without using the transformer. In this we are proposed a maximum power tracking arrangement for the grid connected PV system with the fuzzy logic controller to maintain the MPPT requirements.

In this we are utilized the proportional resonant converter circuit for the PV system to enhance the dynamic response and stability of the implemented arrangement, the current injection is achieved by the association of the current source inverter in the inverter in the grid connected PV system that current source inverter is controlled by the space vector pulse width modulation technique (SVPWM).

Without using the transformer in this system then the system has reduced electromagnetic effect and the insulation requirement is reduced and the losses of the system is also reduced and hence the performance of the system is enhanced.

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