International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 2, February 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Analysis of Reconfigurable Solar Converter using MPPT Techniques

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ABSTRACT

In this paper a converter called reconfigurable sunlight based converter (RSC) for photovoltaic (PV)- battery applications is presented, particularl utility-scale PV-battery application. The fundamental idea of the RSC is to utilize a solitary force transformation framework to perform diverse activity modes, for example, PV to lattice (dc to air conditioning), PV to battery (dc to dc), battery to matrix (dc to air conditioning), and battery/PV to network (dc to air conditioning) for sun powered PV frameworks with vitality stockpiling. This converter arrangement is engaging for PV-battery application, since it limits the quantity of change stages, along these lines improving productivity and lessening cost, weight, and volume. The examination of the converter is finished by PI controller and fluffy controller to decide yield voltage, PV current and voltage, battery current and voltages. Improvement of the model and Simulation is finished utilizing MATLAB/SIMULINK software.

KEYWORDS: *Converter, energy storage, fuzzy logic, photovoltaic (PV), solar*

How to cite this paper: Shalini Sharma | Gaurav Srivastava "Analysis of Reconfigurable Solar Converter using MPPT Techniques" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-2, February 2020, pp.159-164, URL: www.ijtsrd.com/papers/ijtsrd29918.pdf

IJTSRD29918

INRODUCTION

There are various alternatives for incorporating vitality stockpiling into an utility-scale sun powered PV framework. In particular, vitality stockpiling can be incorporated into the either air conditioning or dc side of the sun oriented PV power change frameworks which may comprise of numerous transformation stages [3]-[10]. Each reconciliation arrangement has its focal points and disservices. Diverse mix arrangements can be contrasted with respect with the quantity of intensity stages, productivity, stockpiling framework adaptability, control multifaceted nature, and so forth.

Reconfigurable sun based converter (RSC) is a solitary stage sun based force converter. The essential idea of the RSC is to utilize a solitary force change framework to perform distinctive activity modes, for example, PV to network (dc to air conditioning), PV to battery (dc to dc), battery to lattice (dc to air conditioning), and battery/PV to matrix (dc to air conditioning) for sunlight based PV frameworks with vitality stockpiling. The RSC idea emerged from the way that vitality stockpiling mix for utility-scale sun oriented PV frameworks bodes well if there is an enough hole or an insignificant cover between the PV vitality stockpiling and discharge time.

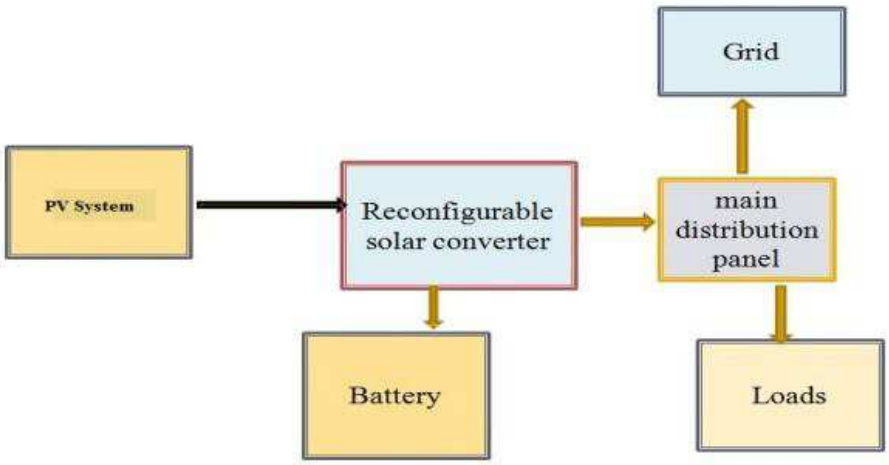

Figure1: Block diagram of reconfigurable solar converter

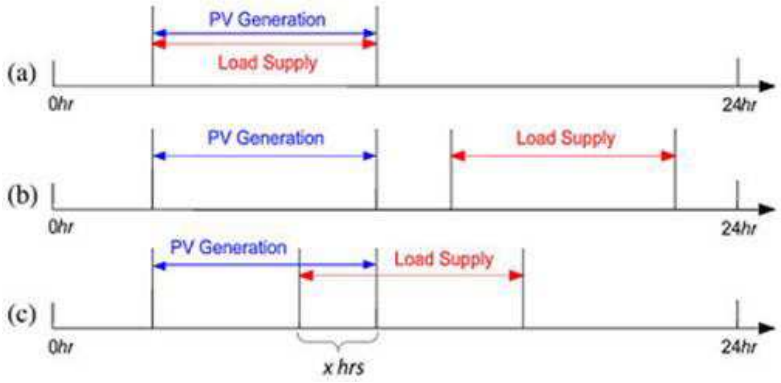

Figure2: Different scenarios for PV generation and load supply sequence.

Fig 2 shows various situations for the PV created power time of utilization. In the event that (a), the PV vitality is constantly conveyed to the framework and there is fundamentally no need of vitality stockpiling. Be that as it may, for cases (b) and (c), the PV vitality ought to be first put away in the battery and afterward the battery or both battery and PV supply the heap. In cases (b) and (c), reconciliation of the battery has the most elevated worth and the RSC gives noteworthy advantage over other incorporation alternatives when there is the time hole among age and utilization of intensity [7].

MODELLING OF RSC

The RSC has a few adjustments to the regular Three-stage PV inverter framework. These adjustments enable the RSC to incorporate the charging capacity in the traditional three stage PV inverter framework. Accepting that the regular utility-scale PV inverter framework comprises of a three-stage voltage source converter and its related segments the RSC requires extra links and mechanical switches, as appeared in Fig. 3. Discretionary inductors are incorporated if the air conditioner channel inductance isn't sufficient for the charging reason. The schematic of the proposed RSC is displayed in Fig. 3

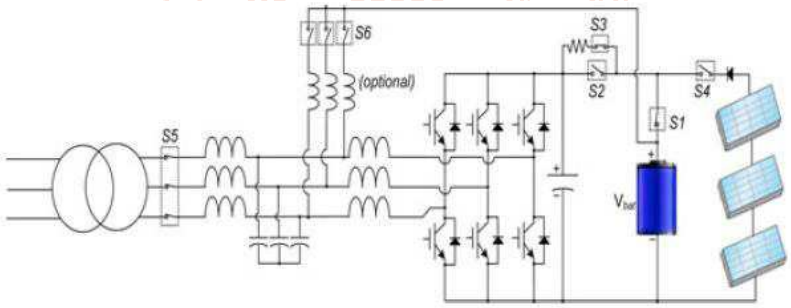

Figure3: Schematic of the proposed RSC circuit

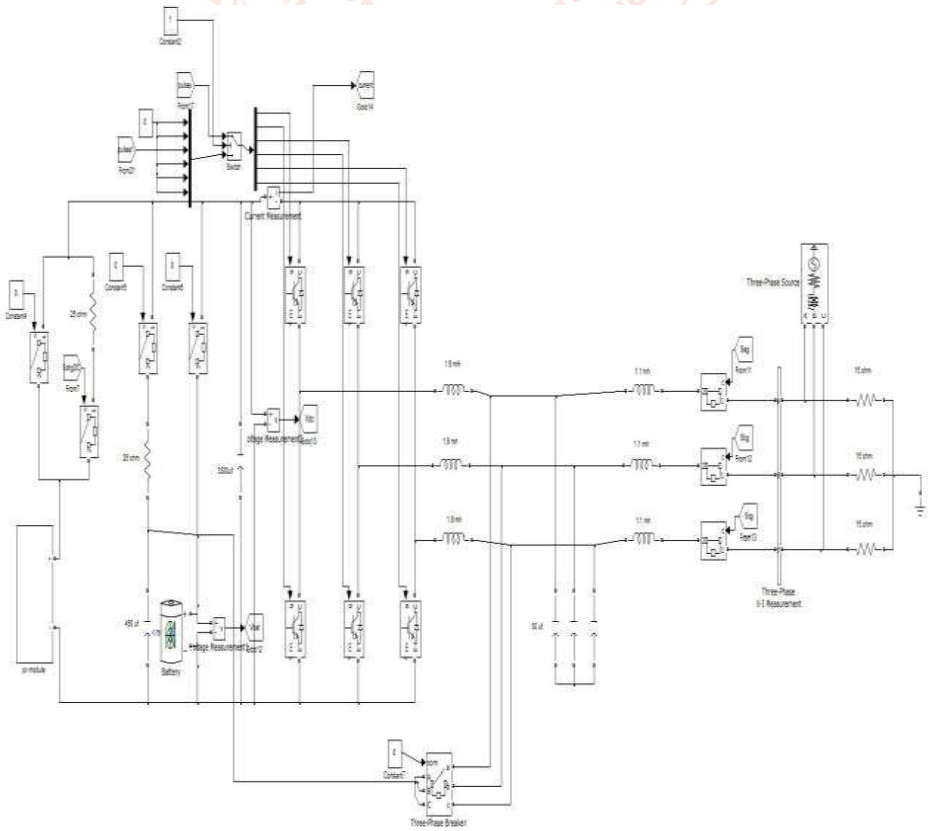

Figure4: simulink module of rsc

All conceivable activity modes for the RSC are displayed in Fig. 5. In Mode 1, the PV is straightforwardly associated with the framework through a dc/air conditioning activity of the converter with probability of most extreme force point following (MPPT) control and the S1 and S6 switches stay open. In Mode 2, the battery is accused of the PV boards through the dc/dc activity of the converter by shutting the S6 switch and opening the S5 switch. In this mode the MPPT work is performed accordingly, most extreme force is produced from PV. There is another mode that both the PV and battery give the ability to the network by shutting the S1 switch. This activity is appeared as Mode 3. In this mode, the dc-connect voltage that is equivalent to the PV voltage is authorized by the battery voltage hence, MPPT control is preposterous. Mode 4 speaks to an activity mode that the vitality put away in the battery is conveyed to the lattice.

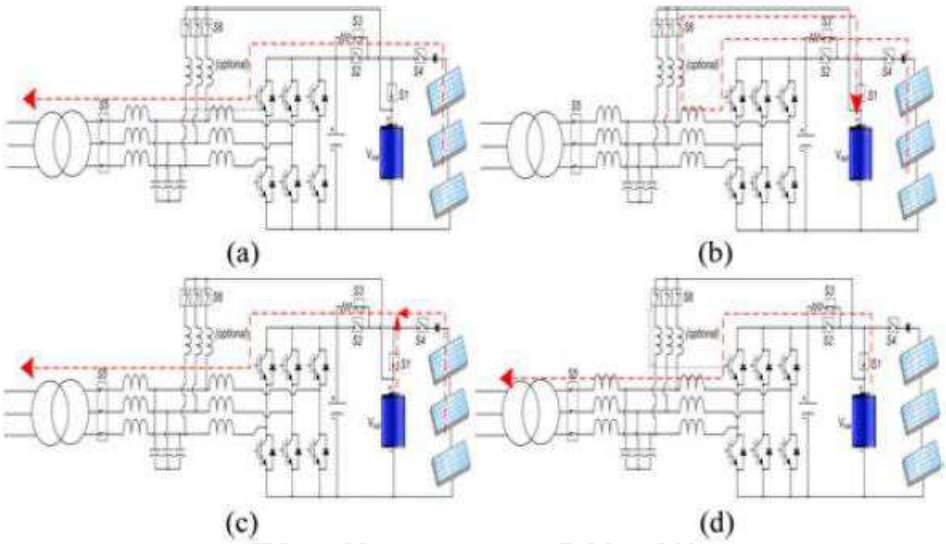

Figure5: operation modes of the RSC. (a) Mode 1- PV to grid. (b) Mode2-PV to battery. (c) Mode 3-PV/battery to grid. (d) Mode 4-battery to grid.

A. Control of the RSC in the dc/ac operation modes

The dc/ac conditioning activity of the RSC is used for conveying power from PV to matrix, battery to network, PV and battery to framework. The RSC plays out the MPPT calculation to convey most extreme force from the PV to the network. Like the traditional PV inverter control, the RSC control is executed in the synchronous reference outline. The synchronous reference outline relative essential current control is utilized. In a reference outline pivoting synchronously with the basic excitation, the essential excitation signals are changed into dc signals

[17]-[18]. Subsequently, the present controller framing the deepest circle of the control framework can manage air conditioning flows over a wide recurrence go with high data transfer capacity and zero consistent state mistake. For the beat width regulation (PWM) plot, the customary space vector PWM conspire is used.

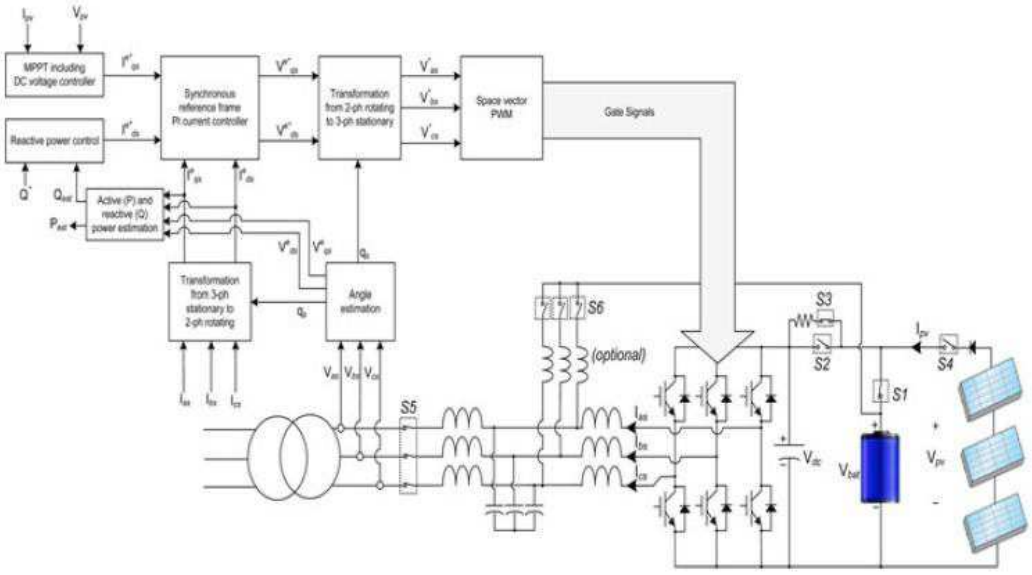

Fig. 6 presents the overall control block diagram of the RSC in the dc/ac operation.

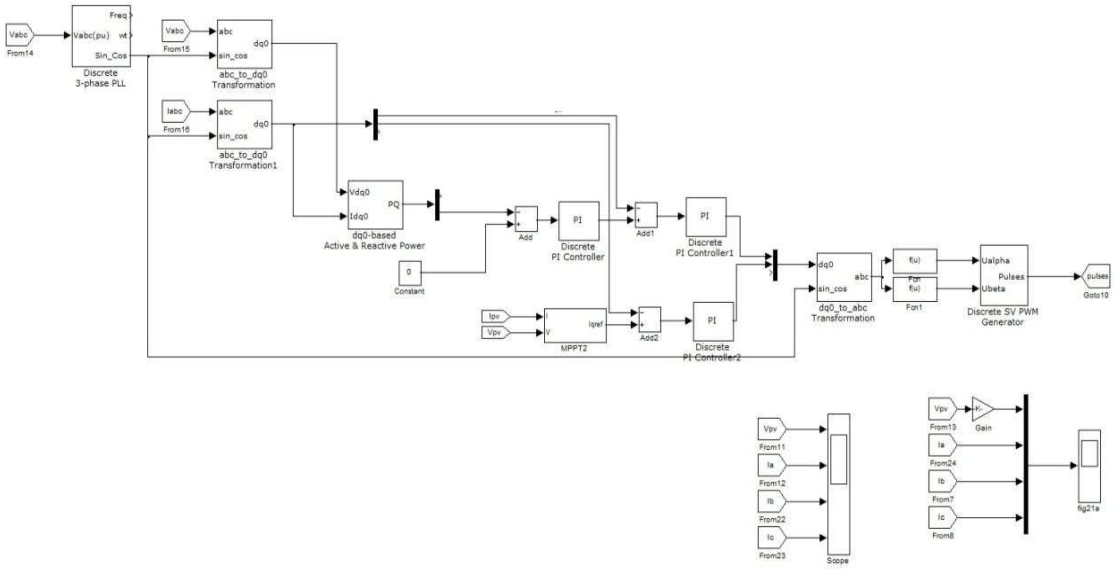

Figure7: control circuit for dc/ac mode using pi controller

B. Control of the RSC in the dc/dc operation mode

The dc/dc activity of the RSC is likewise used for conveying the most extreme force from the PV to the battery. The RSC in the dc/dc activity is a lift converter that controls the present streaming into the battery. Li-particle battery has been chosen for the PV-battery frameworks. Li-particle batteries require a consistent current, steady voltage sort of charging calculation. As it were, a Li-particle battery ought to be charged at a set current level until it arrives at its last

voltage. At the last voltage, the charging procedure should switch over to the consistent voltage mode, and give the present important to hold the battery at this last voltage. In this way, the dc/dc converter performing charging process must be fit for giving stable control to keeping up either present or voltage at a steady worth, contingent upon the condition of the battery. Commonly, a couple of percent limit misfortunes occur by not performing consistent voltage charging.

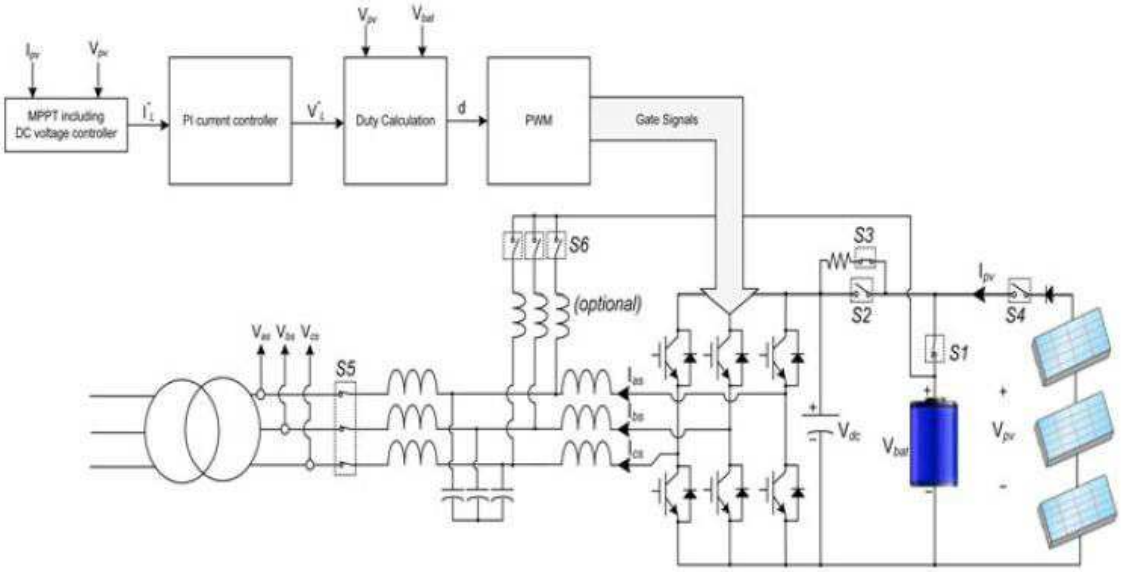

Figure8: Overall control block diagram of the RSC in the dc/dc operation

Nonetheless, it isn't phenomenal just to utilize consistent current charging to disentangle the charging control and procedure. The last has been utilized to charge the battery. In this manner, from the control perspective, it is only adequate to control just the inductor current. Like the dc/air conditioning activity, the RSC plays out the MPPT calculation to convey most extreme force from the PV to the battery in the dc/dc activity. Fig. 8 shows the general control square outline of the RSC in the dc/dc activity.

SIMULATION RESULTS

A. Simulink results for the dc/ac operation modes

Fig.9 shows the steady-state performance of dc/ac control in Mode 1. In this test, the voltage on the dc side VDC of the inverter is set to 200 V. The current reference is set to 5Apeakfor the frequency of 60 Hz. As shown in Fig.12 a satisfactory steady state performance is obtained.

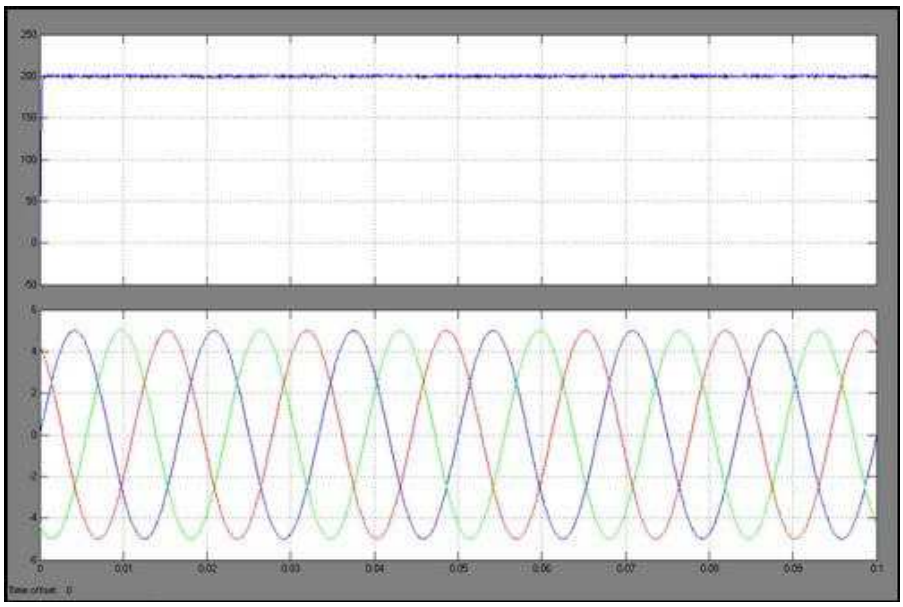

Figure9: Steady-state performance of dc/ac control in Mode 1.

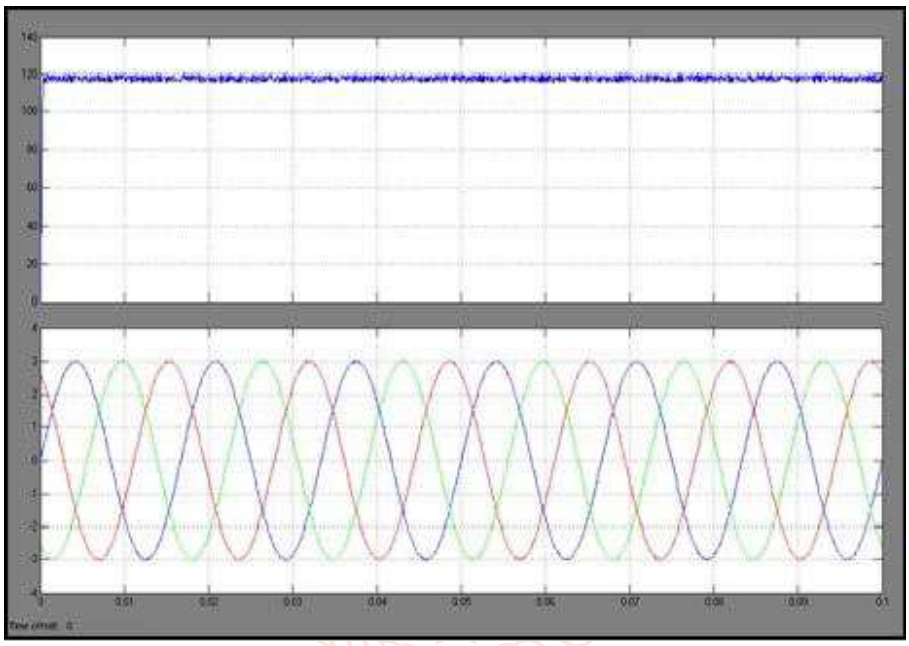

Figure10 a: Steady-state performance of dc /ac control in Mode 4.

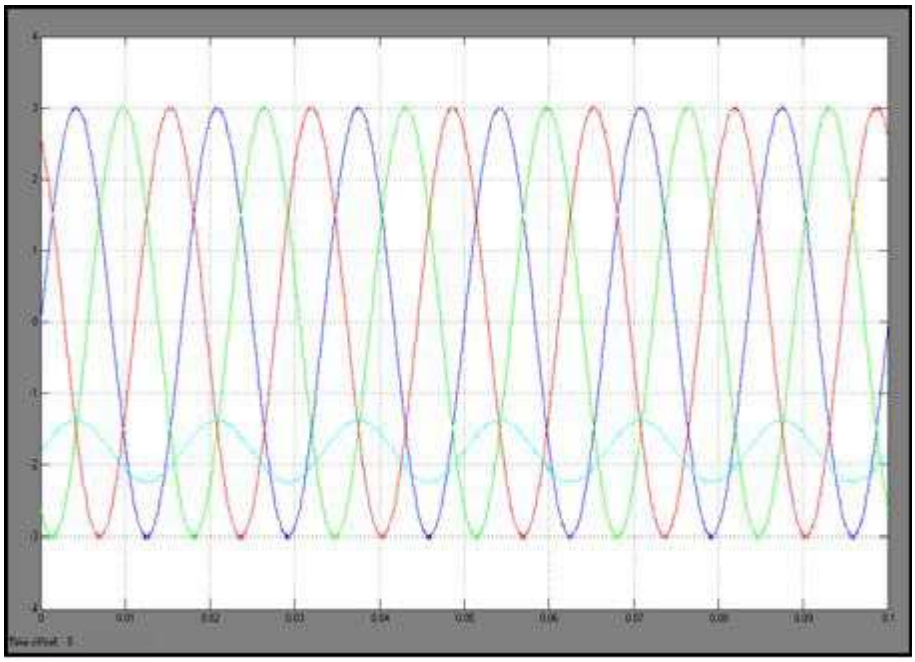

Fig10 b: Steady-state performance of dc /ac control showing current flowing in a battery

Fig. 10a shows the consistent state execution of dc/air conditioning control in Mode 4. In the test, the voltage on the dc side VDC of the inverter is 118 V which is the battery voltage. The present reference is set to 3Apeak for the recurrence of 60 Hz. As appeared in Fig. 10a, the acceptable dc/air conditioning relentless state execution is gotten. In Fig.13b, the present streaming into the battery is displayed. The normal battery charging current is 1.8 A. The battery charging current has about 0.85 Apk-pk current wave with the recurrence of 60 Hz.

CONCLUSION AND FUTURE WORK

Conclusion

A converter called reconfigurable sun powered converter (RSC) is proposed for PV battery applications. RSC arrangement is exceptionally appealing for PV-battery application, since it limits the quantity of change stages, in this way improving productivity and decreasing cost, weight, and volume. The model is created and assessed for various working modes and mode change conditions and so forth, and the reproduction results approve the usefulness of the proposed converter under various working conditions .Simulation results shows that progressively exact qualities can be gotten by utilizing fluffy controller over pi controller.

Future scope

This concept can also be applied to single-phase application. Development of RSC for wind energy power plant can be done as a future enhancement. Battery overcharging also can be avoided by implementing a control logic block.

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