



Investigation On Unified Control And Power Management Scheme For PV-System

KATHIRAVAN.V¹, Dr.M.KARTHIKEYAN²

¹M.E-II(PSE),Velammal Engineering College, Chennai.

²Asst.Prof/EEE-Velammal Engineering College, Chennai.

venkatkathir1989@gmail.com

April 25, 2018

Abstract

The sunlight based irradiance and qualities of Photo-voltaic(PV) boards are making the power variances on PV-framework, to over-come the vacillations a battery storage system is utilized with nearby planetary group and it must have the capacity to bal-ance out the transport volt-ages. This paper proposes another control and power man-agement scheme(CAPMS) to alleviate the power changes of DC and AC transport voltages for both network associated and islanded modes. The proposed CAPMS is effectively balancing the DC and AC transport voltages and controls the power stream in the framework precipitously, for dif-ferent activity of exchanging modes and loads, variance of irradiances and tempera-ture. The contextual analyses and reproduc-tion are done to confirm the execution of the pro-posed strategies.

Key Words:Solar system, power system stability, bat-tery storage, control and power management scheme.

1 INTRODUCTION

In recent years, Power system plays a major role in economics of country. To mitigate the demand of energy and to reduce environmental pollutions, the Distributed Generations(DG) are used. the renewable energy sources such as solar energy is successfully used to reduce the demand of power. The nature of PV panels, solar irradiances and temperature are resulting a constant fluctuations on output of PV system[1]. To overcome power fluctuations and increasing power flow flexibly a battery storage is employed with PV system and CAPMS technique is used to control the PV system for both DC and AC voltages[2].

a. POWER SYSTEM STABILITY

The proposed CAPMS is used to control the bus voltages and balances the power flow with flexibly. Thus the output of both DC and AC bus voltages are stabilized automatically under different operations and various disturbance.

b. BATTERY STORAGE

To beat the power adjusting issues in PV-framework, the battery bank must be utilized with DC transport and controlled by bidirectional DC/DC converter[3]. The reference energy of battery in network associated mode is set by CAPMS as $DC_ref_Ctrl=0$, and the battery control stream is (Pbat). Where releasing and charging methods of battery is $Pbat>0$, $Pbat<0$ individually. For islanded mode the reference control is $DC_ref_Ctrl=1$ set by CAPMS.

2 METHODOLOGY

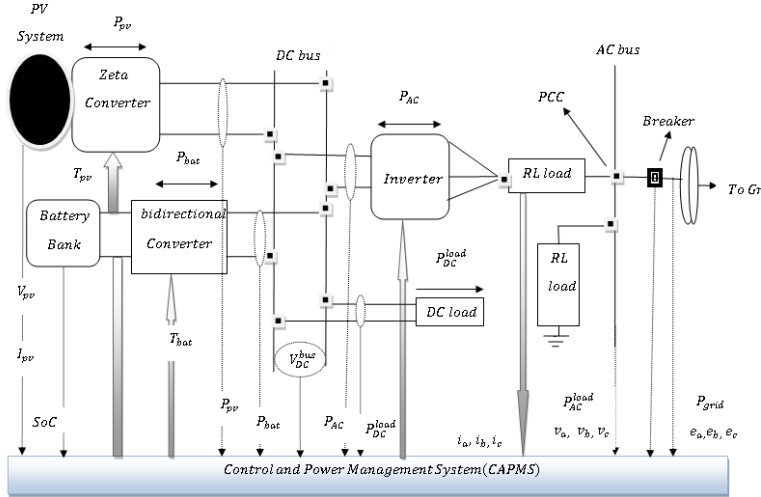


Figure 1: Control and Power Management Scheme(CAPMS)

The proposed system is mainly focused on grid connected and islanded modes. The grid is connected with AC bus with the help of point of common coupling(PCC). However the breaker is used to disconnect the grid for islanded mode.

A bidirectional DC/DC converter is employed with battery as well as DC bus in the PV-system. The Multilevel inverter(7 level) is used to interface both DC and AC buses and maximum power point tracking(MPPT) technique is used to track the maximum power values from PV system[4],[5]. For this smart grid method, the solar system is creating a fluctuations in the power flow of both DC and AC buses.

This proposes a new control scheme, that is CAPMS which is used to control both DC and AC bus voltages and to maintain the system stability. The control and power management scheme is based on the following criteria

for Grid-connected:

$$P_{pv} + P_{bat} = P_{dc}^{load} + P_{ac}^{load} + P_{grid} \quad (1)$$

for Islanded:

$$P_{pv} + P_{bat} = P_{dc}^{load} + P_{ac}^{load} \quad (2)$$

the grid receiving power is mentioned as $P_{grid} < 0$, and the sending power is $P_{grid} > 0$. where $P_{dc}^{load}, P_{ac}^{load}$ are DC and AC loads, respectively[6].

A zeta converter is associated with PV board with DC transport, and it is a fourth request non direct framework being that, concerning vitality input, it can seen as buck-boost- buck converter and as to the yield, it can be viewed as lift boost-buck-boost converter [7].

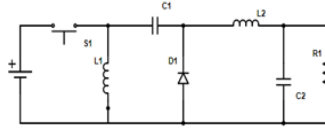


Figure 2: Basic circuit diagram of Zeta con-verter

The PV exhibit changes over sun based vitality into DC control through Zeta DC/DC convert-er. Be that as it may, because of nonlinear at-tributes of PV boards and the stochastic vacillations of sun based irradiance, there is de-pendably a maximum power point (MPP) for each particular working circumstance of a PV exhibit. In this manner, most extreme power point following (MPPT) calculations are ordi-narily executed in PV framework to separate the greatest power a PV cluster can give. The proposed CAPMS utilizes a standout amongst the most mainstream techniques, the WODE calculation MPPT[8], which gives a reference voltage V_{MPPT} that the PV exhibit will track to create the greatest power under different task conditions (distinctive mixes of irradiance and temperature.) There are three conceivable control plans for the PV exhibit: MPPT control, control refer-ence control, and DC transport voltage control, contingent upon the circumstance of the PV-battery framework.

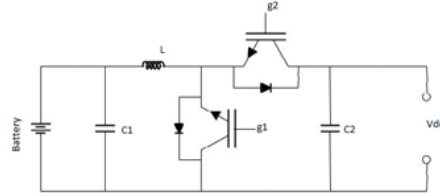


Figure3: Bidirectional DC/DC converter for the Battery bank.

As a vitality cushion, battery bank is im-portant in PV frame-works for control adjust-ing. The battery bank of this framework is as-sociated with the DC transport and is con-trolled by a bidirec-tional DC/DC converter (Fig. 3) which incorporates two switches, T1 and T2, that control the charging/releasing pro-cedure. In ma-trix associated mode, with the order DC ref Ctrl = 0, the converter controls the power stream (P_{bat}) in or out of the bat-tery, where in releasing mode $P_{bat} \geq 0$, and in charging mode $P_{bat} \leq 0$. The last yield of the battery controller is a two-dimensional ex-changing signal $T_{bat}(g1; g2)$. In Islanded mode, the control summon DC ref Ctrl is set to "1" by the CAPMS, which changes the con-verter to work in voltage reference mode. The yield voltage of converter, which is additional-ly the DC transport voltage, is controlled to take after the reference so the DC stack volt-age is settled. The CAPMS screens the state of condition(SoC) of the battery and authorizes its upper and lower limits ($SoC_{upperlimit} = 90\%$ and $SoC_{lowerlimit} = 10\%$ in this investi-gation) so as to build the life cycle. Note that the determinations of as far as possible don't in-fluence the execution of the controller.

3 CASE STUDIES

With a specific end goal to confirm the execution of the proposed CAPMS, vari-ous reenactment and trial contextual in-vestigations are completed in this area utilizing Mat-lab/Simulink. PV battery parameters recorded in Table I. Note that the parameters for the PV exhibit are un-der standard testing condition (STC, irra-diance = 1000 W/m^2 , temperature= 25° C). The battery bank utilizes a general Ni-Cd trademark demonstrate whose limit is es-timated by the IEEE Standard 1562-2007 [9] to help 5 days of independence

activity (for 282.1W Loads) under low irradiance conditions. The proposed CAPMS screens the required factors out of the PV battery framework. furthermore, as per the circumstance watched, switches the control plots naturally. The contextual analyses test the CAPMS's reactions for different situations that the PV-battery framework is working in or changing to. Results are examined exclusively for each situation.

TABLE 1
BASIC PARAMETERS OF THE PV-
BATTERY SYSTEM UNDER STC

Parameters	Values
PV power	282.1W
PV Voltage	35V
Battery Capacity	70.4Ah
Batter charging voltage	312V
Battery rated Voltage	300V
Battery Max charge/releasing power	700W
DC bus voltage	400V
AC bus L-L voltage	400V

A. Simulation Verification: Grid-Connected Mode.

The primary case is the typical task circumstance of the PV-battery framework in matrix associated mode, when the battery is completely accessible for control adjusting ($10\% < \text{SoC} < 90\%$). PV cluster is working in MPPT mode, following the voltage reference (V_{MPPT}) assessed by the MPPT module. DC and AC loads are provided by the transports. Contingent upon the measure of generation, load, and re-request asked for by the grid (Pgrid), the battery is adjusting the power by en-grossing or discharging power. For AC transport the yield voltage and current is 400V and 10A separately. The reen-actment result is appeared in the figure 4.

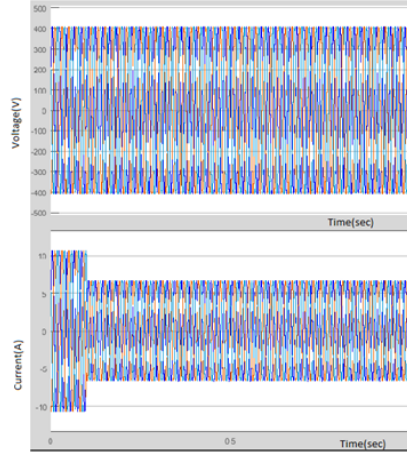


Figure4: Simulation result for both Grid con-nected mode and Islanded mode

B. Simulation Verification: Islanded mode

At the point when the PV-battery framework works in islanded mode, the accessible power is given by PV or battery just, and the power adjust model takes after condition

$$P_{PV} + P_{bat} = P_{DC}^{load} + P_{AC}^{load}.$$

Under ordinary task conditions, where the battery SoC is inside the lower (10%) and upper (90%) limits, PV exhibit tracks V_{MPPT} gave by the MPPT module and gives energy to the DC and AC loads. Power experiencing the battery converter may be in either course, contingent upon the heap request and PV yield. The yield voltage and current is 400V, 7A separately as appeared in the outcome figure 4.

The simulation output voltage (V_{dc}) of DC bus is shown in the figure5.

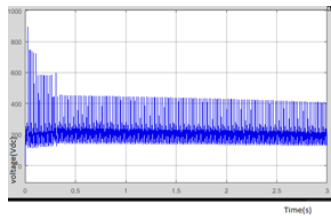


Figure5: Simulation result for DC output volt-age(Vdc)

4 Conclusion

Hence the paper proposes a control and power management scheme (CAPMS) for crossover PV-battery frameworks that is, DC and AC transports amid grid associated and islanded modes, by executing the WODE calculation for MPPT. As expressed, the CAPMS can deal with the power streams in an adaptable and productive path in all the converter units.

References

- [1] T. A. Nguyen, X. Qiu, J. D. G. II, M. L. Crow, and A. C. Elmore, Performance characterization for photovoltaic- vanadium redox battery microgrid systems, *IEEE Trans. Sustain. Energy*, vol. 5, no. 4, pp. 13791388, Oct 2014.
- [2] Zhehan Yi, Wanxin Dong, Amir H. Etemadi " A unified control and power management scheme for PV-battery- based hybrid microgrids for both grid connected and islanded modes." *IEEE Trans. Smart grid*. vol. PP. pp1-1, May 2017.
- [3] A. Merabet, K. Ahmed, H. Ibrahim, R. Beguenane, and A. Ghias, Energy management and control sys-tem for laboratory scale microgrid based wind-PV-battery, *IEEE Trans. Sustain. Energy*, vol. PP, no. 99,11, 2016.
- [4] Y. Guan, J. C. Vasquez, J. M. Guerrero, Y. Wang, and W. Feng, Frequency stability of hierarchically controlled hybrid photovoltaic-battery-hydropower microgrids, *IEEE Trans. Ind. Appl.*, vol. 51, no. 6,47294742, Nov 2015.
- [5] J. Philip, C. Jain, K. Kant, B. Singh, S. Mishra, A. Chandra, and K. Al-Haddad, Control and imple-mentation of a standalone solar photovoltaic hybrid system, *IEEE Trans. Ind. Appl.*, vol. 52, no. 4, pp. 34723479, July 2016.
- [6] Y. Riffonneau, S. Bacha, F. Barruel, and S. Ploix, Optimal power flow management for grid connected PV systems with batteries, *IEEE Trans. Sustain. Energy*, vol. 2, no. 3, pp. 309320, July 2011.

- [7] J.S.Salenga, E.R.Magsino” Dynamic Analysis of a Two-Input Zeta Converter Topology For Modular Hybrid PV-Wind Microgrid System” TENCON-2015 IEEE conference 2015 region 10,pp 1-6
- [8] Nitshant kumar, Ikhlq Hussan, bhim singh, Bijaya ketan panigrahi ” MPPT in dynamic condition of partial shaded PV system by using WODE technique”, IEEE Trans. sus-tain.energy, vol. 8, pp1204-1214, Feb 2017.
- [9] ” IEEE guide for array and battery sizing in stand-alone photovoltaic (PV) system” IEEE std 1562-2007, pp i-22, May 2008.