ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Operational Control of Two-String MPPT's in a DC Distribution System

K.Sasikala
PG Scholar,
Dept of EEE,
Madanapalle Institute of Technology & Science, Chittoor, A.P, India.

K.Malleswari
PG Scholar,
Dept of EEE,
Madanapalle Institute of Technology & Science, Chittoor, A.P, India.

Shaik.Ali Ahmad
PG Scholar,
Dept of EEE,
Madanapalle Institute of Technology & Science, Chittoor, A.P, India.

Abstract:

In this project work, the maximum power point trackers will be developed for a two-string photo voltaic (PV) panels in a dc distribution system which will be connected to an ac grid through a bidirectional inverter. Buck and boost converters will be used for obtaining wide output range of PV panels. In order to determine the input current of MPPTs, the PV-string configuration check will be accomplished online.In this project, the first step is the system configuration and principle of the proposed MPPT l and then the perturb and observe method will be applied and its mode transition determination will be obtained. The obtained results will be verified with the practical data using MATLAB/ Simulink Software and conclusions will be drawn and also total harmonic distortion(%THD) is determined using FFT analysis for P&O method.

Keywords:

DC distribution system, Maximum Power point tracking, Photovoltaic (PV), solar power, Perturb and observe.

I.INTRODUCTION:

We know that non-conventional sources which are also known as renewable energy resources are becoming more popular now a days as they are available nature free. Renewable energy sources are defined as the sources which can be replenished from nature again and again once even they used. There are so many advantages in these renewable energy resources comparing to non-renewable energy source. Some of the advantages are renewable energy sources are cost free and also pollution free compared to non-renewable resources.

Some of the main examples for this renewable resources are solar, wind, tidal etc. Here in this project work we are considering solar as the source and obtaining maximum power from the sun by using maximum power point trackers(MPPT's).There are several methods for tracking the power such as perturb and observe, incremental conductance, fuzzy control etc.Among these methods, in this project work we are considering perturb and observe technique for tracking maximum power. Comparing to all the other methods this method is less complexity. Perturb and observe controller is ueful in tracking the maximum power under various atmospheric conditions[1] and also it affects the output power.The main use of MPPT is that it will transfer power from solar module to the load[4,5].

II. 50-KW DC DISTRIBUTION SYSTEM:

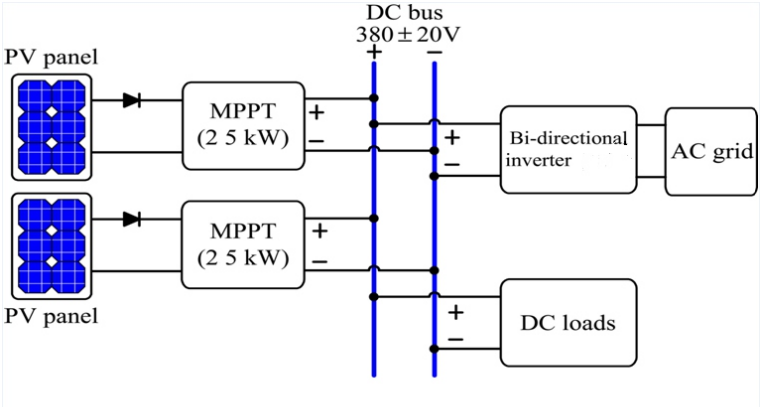


Fig.1. Configuration of the 50-KW dc distribution system.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Two trackers are implementing in this project of 50KW distribution of DC system and the rating of each MPPT is 25KW which are present in between DC bus and PV panels and after that MPPT's are fed to DC bus and then to AC grid through an inverter. The PV panel voltage vary from 0-600V. MPPT can be formed using the buck- boost converters in order to operate at a dc voltage of 530 volts which in turn reduces the inverter voltage stresses.

III. MPPT CONTROL ALGORITHM:

A.Perturbation and Observation method (P&O):

Here in this method of maximum power point tracking , at first a slight perturbation[7] is used which will change the power of PV module. The power will be raised and then it will continue in the same direction[7] after reaching the peak point and then it will fall and then it will alters. This point will alternate at the peak point when the steady state comes.

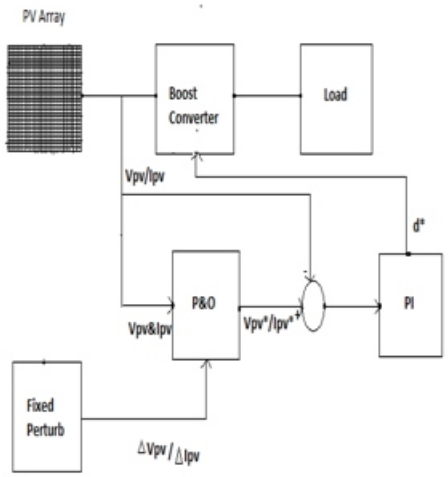


Fig 2: Block diagram of perturb and observe MPPT

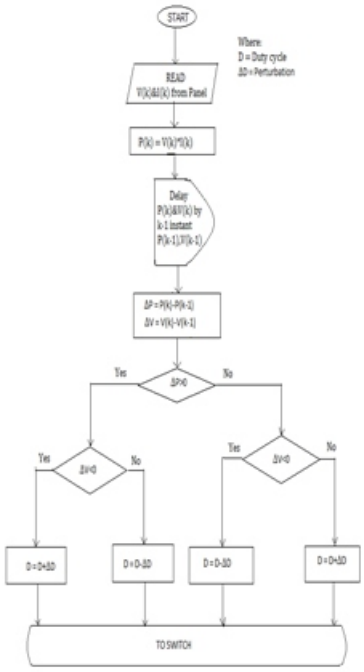


Fig.3. flow chart for P&O method

III DC-DC CONVERTER:

A.BUCK CONVERTER:

This converter is popularly known as a step-down converter because it converts an input voltage to a lower output voltage[15]. The conversion ratio M = Vo/Vi varies with the duty ratio D of the switch.

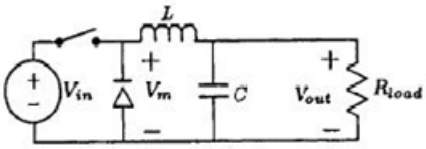


Fig 4:Ideal Buck Converter Circuit

B. BOOST CONVERTER:

Boost converter is popularly known as the step-up converter because it converts low input-voltage to a high out-put voltage.

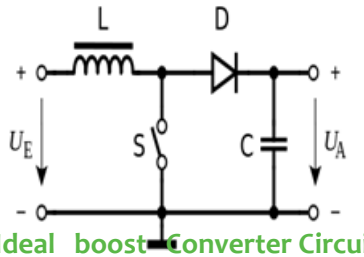


Fig.5. Ideal boost converter Circuit

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

REAL TIME VALUES:
Specifications for 175W photo voltaic module (BP 4175T)

Description Of Item **Specification**
Electrical characteristics

1.Max. DC output of Array (Volt) : 424.8V@STC (Vmpp)

2.Current of one module at Pmax :4.94A @ STC (Impp)

3.Voltage of one module at Pmax (Vmpp) :35.4V @ STC

4.Short circuit current :5.45 Amp @STC

5.Open circuit voltage : 43.6V @ STC

6.Module efficiency : 14%

7.Tolerance : -3 / +5%

8.Nominal voltage : 24V

9.Efficiency reduction at 200W / Sq.m : <5% reduction (efficiency 13.3%)

10.Limiting reverse current : 5.45 A

11.Temperature coefficient of Isc: (0.065±0.015)%/°C

12.Temperature coefficient of Vs : (0.36 ±0.05)% /°C

13.Temperature coefficient of Pmax : (0.5 ±0.05)% /°C

14.NOCT : 47±2°C

15.Maximum series fuse rating : 20A

16.Application class : Class A

17. Maximum system voltage : 600V

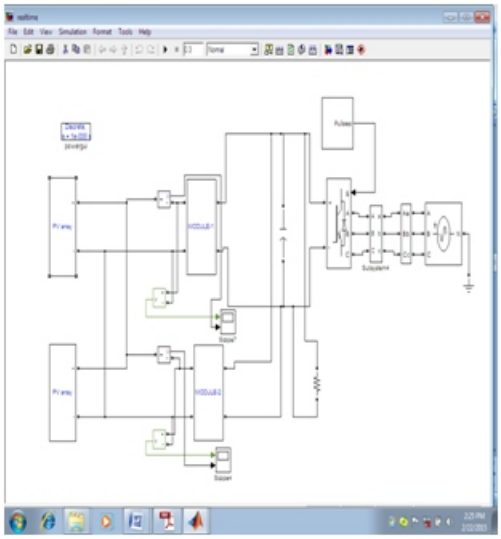
18. No. of panels in series : 12

19. No. of panels in parallel : 24

By considering the above mentioned real time values we designed two-string maximum power point trackers for a 50KW dc distribution syatem which is present in national atmospheric research labouratory (NARL) near gadhanki village, nendragunta mandal, chittoor dist. The following results are obtained by considering per-turb and observe method as a tracking technique and also determined the total harmonic distortion(%THD) for inverter output voltage and also module conver-sion efficiency(%efficiency).The curves of power versus voltage(P-V) and also current versus voltage (I-V) also obtained by using MATLAB/SIMULINK software for 50KW dc distribution system and obtained open cir-cuit voltage(Voc) and short circuit current(Isc) from I-V curve and then maximum voltage(Vpm) and maximum power(Pmax) will be obtained in P-V curve. Current at the maximum point(Ipm) will be determined by using maximum voltage value which is obtained in the P-V curve in I-V curve.

Finally inverter input is set as 530volts and correspond-ing output voltage for inverter is obtained from the simulink is 440volts three-phase which in turn fed to three phase ac loads as shown in figure given below. Also obtained the conversion efficiency of solar mod-ule as 96.24% and also total harmonic distorsion(%THD) for both 60Hz and 50Hz fundamental frequencies as 38.76% and 30.99% Respectively Using Fast Fourier Transformation(FFT) in powergui.The following are the simulation circuits and simulation results obtained by considering the above practical data for a two-string maximum power point trackers in a 50KW dc distribu-tion system.

V. SIMULATION RESULTS:



ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Fig 6: simulink diagram for obtaining P-V and I-V curves for 50KW DC Distribution system

By simulating the above given model we can obtain the following results:

Open circuit voltage, Voc=530V
power at maximum point, Pmax=50KW
short circuit current, Isc=130A
voltage at maximum point, Vpm=430V
current at maximum point, Ipm=120A

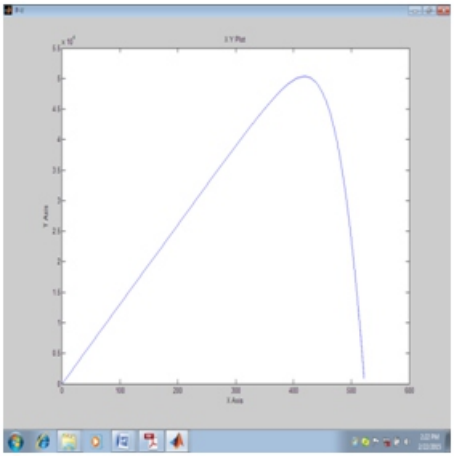


Fig 7: P-V Curve

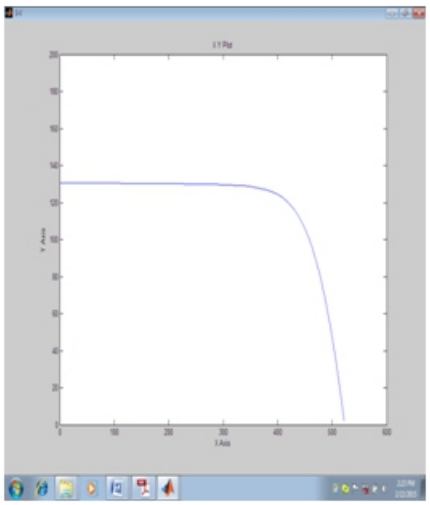


Fig 8: I-V Curve

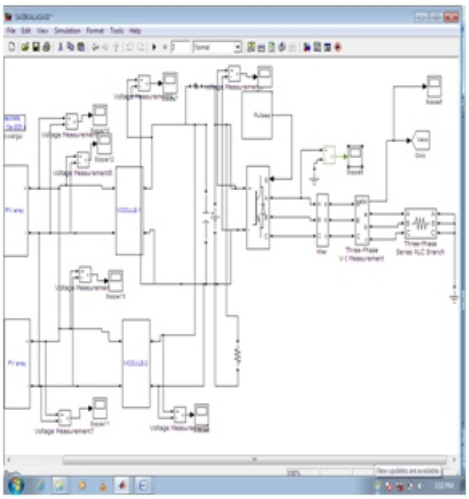


Fig 9: simulink diagram of 50KW DC Distribution system using perturb and observe method.

From above simulink diagram the following value are obtained

Inverter input voltage(DC)=530V
Inverter output voltage(AC) =440V

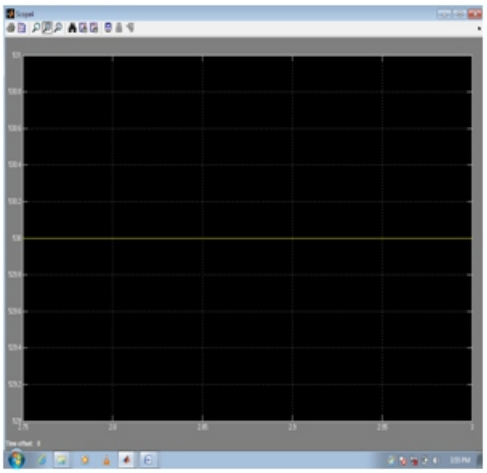


Fig 10: input voltage of universal bridge inverter

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

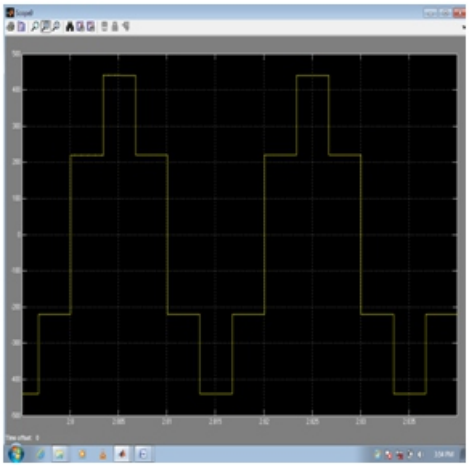


Fig 11 : output voltage of universal bridge inverter

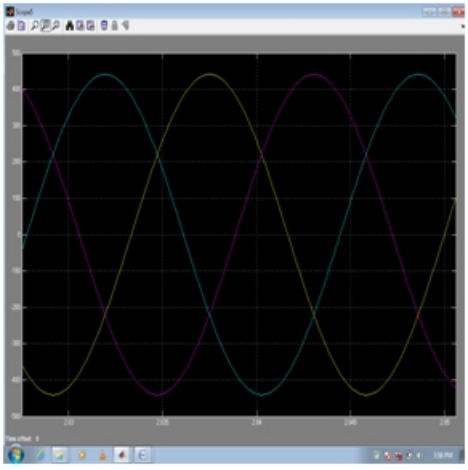


Fig 12: output voltage of AC load

Total Harmonic Distortion (%THD) Analysis Using FFT:

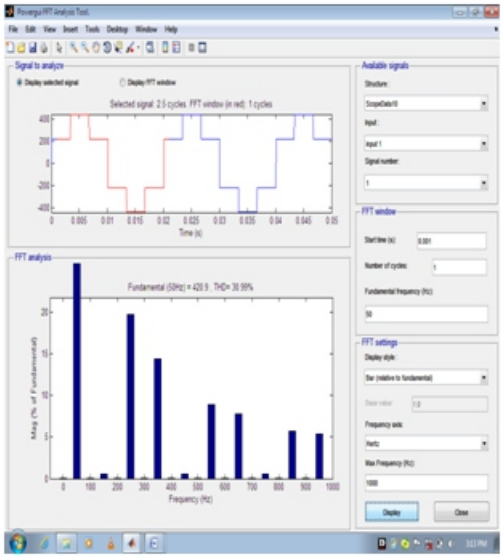


Fig 13. Total harmonic distortion (%THD) obtained for 50Hz fundamental frequency

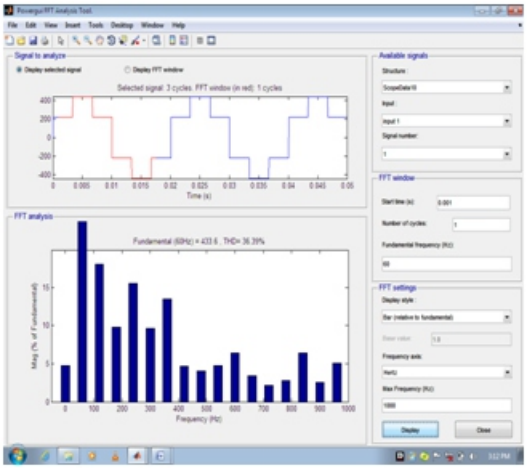


Fig 14. Total harmonic distortion (%THD) obtained for 60Hz fundamental frequency.

Sl.no	Fundamental frequency (Hz)	Total harmonic distortion(%THD)
1	60Hz	38.76%
2	50Hz	30.99%

Table 1. Total harmonic distortion(%THD) obtained at different fundamental frequencies using FFT analysis.

CONCLUSION:

This paper gives a Perturb and Observe Controller with universal bridge inverter. Finally, obtained the power versus voltage and current versus voltage curves for practical data using MATLAB/SIMULINK software and also calculated the total harmonic distortion (%THD) for P&O method as 30.99% and conversion efficiency is 96.24%.

REFERENCES:

[1] Yuan- Chih Chang, Chia- Ling Kuo, Li, "Development and Operational Control of Two-String Maximum Power Point Trackers in DC Distribution Systems " IEEE Trans. Power Electron., vol. 28, no. 4, APRIL 2013.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

[2] R. S.Lewis, "Antartic Research, and Relevant of Science," in Bulletin of the Atomic Scientists, vol. 26, pp. 2,1970.

[3] Y.-H. Chang and C.-Y. Chang, "A Maximum Power Point Tracking of PV System by Scaling Fuzzy Control," presented at International Multi Conference of Engineers and Computer Scientists, Hong Kong, 2010.

[4] S.Mekhilef, "Performance, of grid connected inverter with, maximum power, point tracker and power factor control,"International Journal of Power Electronics, vol. 1, pp. 49-62, 2008.

[5] M.E. Ahmad, and S. Mekhilef, "Design and Implementation of a Multi Level , Three-Phase Inverter with Less Switches and Low ,Output Voltage Distortion,"

[6] S. Chin, J. Ga dson, "Maximum Power Point Tracker," Tufts University ,Department of Elec.Engg and Computer Science.

[7] R. Fara nda, and S. Leva, "Energy ,Comparison of MPPT techniques for PV Systems," WSES Transaction on Power Systems, vol. 3, pp. 446- 455, 2008.