



















Trackers (MPPT) as shown in fig. 11. The MPPTs use the "Perturb and Observe" technique to vary the voltage across the terminals of the PV array in order get the maximum possible power.

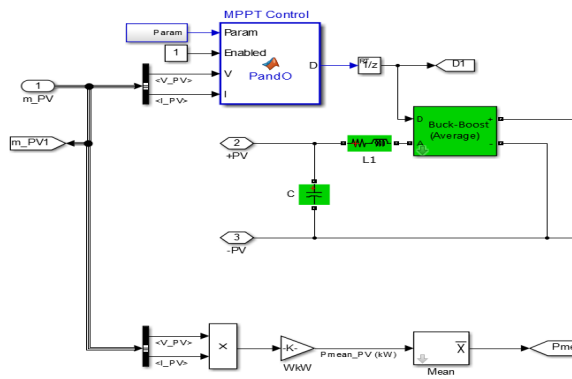


Fig.11 buck-boost converter controlled by Perturb & Observe algorithm

A three-phase Voltage Source Converter (VSC) converts the 500 V DC to 260 V AC and keeps unity power factor. A 400-kVA 260V/25kV three-phase coupling transformer is used to connect the converter to the grid. The grid model consists of typical 25-kV distribution feeders and 120-kV equivalent transmission system.

In the average model the buck-boost and VSC converters are represented by equivalent voltage sources generating the AC voltage averaged over one cycle of the switching frequency. Such a model does not represent harmonics, but the dynamics resulting from control system and power system interaction is preserved. This model allows using much larger time steps (50 us), resulting in a much faster simulation.

**6.2 The Results**

The partial shading effected on the four PV modules gradually to illustrate the advantages of decoupling system of the 4 cascaded DC/Dc converter as shown in table 3; and the output wave form of each module shown in fig. 23(a, b).

TABLE III. The irradiance at each module during the cycle time

Time (us)	PV 1 irradiance (w/m <sup>2</sup> )	PV2 irradiance (w/m <sup>2</sup> )	PV3 irradiance (w/m <sup>2</sup> )	PV4 irradiance (w/m <sup>2</sup> )
0	1000	1000	1000	1000
0.5	500	1000	1000	1000
1	500	1000	1000	350
1.3	500	1000	600	350
1.5	500	200	600	350
2	500	200	600	1000
2.2	500	1000	600	1000
2.3	1000	1000	1000	1000

Fig.23 (a) illustrated that when the PV module 1 exposed to full irradiance (0 to 0.5 us) the buck converter stepped the voltage down to keep the operating voltage point of the PV 1 and when the PV1 exposed to partial shading (0.5 to 2.2 us) the boost converter step the voltage up to keep the operating voltage point of the PV1. The same occurred for the others modules. The buck-boost converters are controlled by perturb and observe operation. This cause the output power of the grid and power of the grid didn't effected by the partial shading as shown in fig. 24.

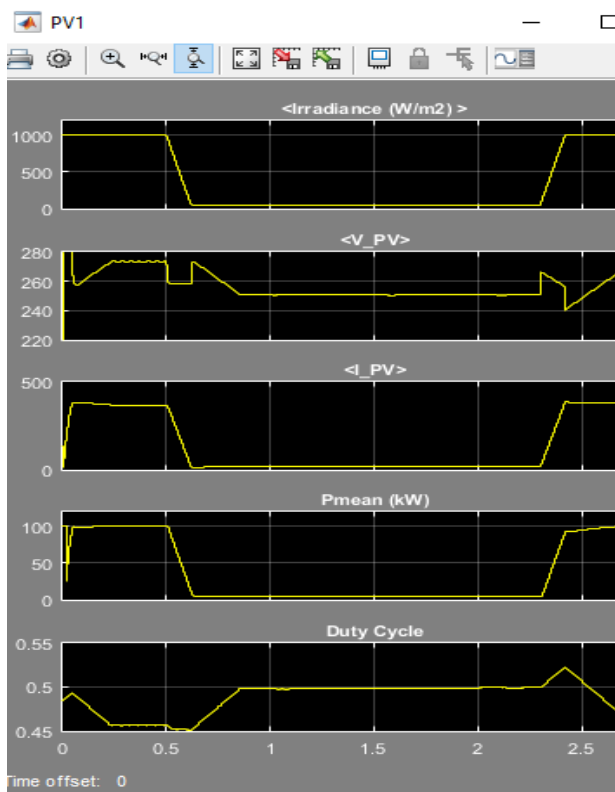


Fig. 23(a) the output wave form of the PV module 1 with MPP.

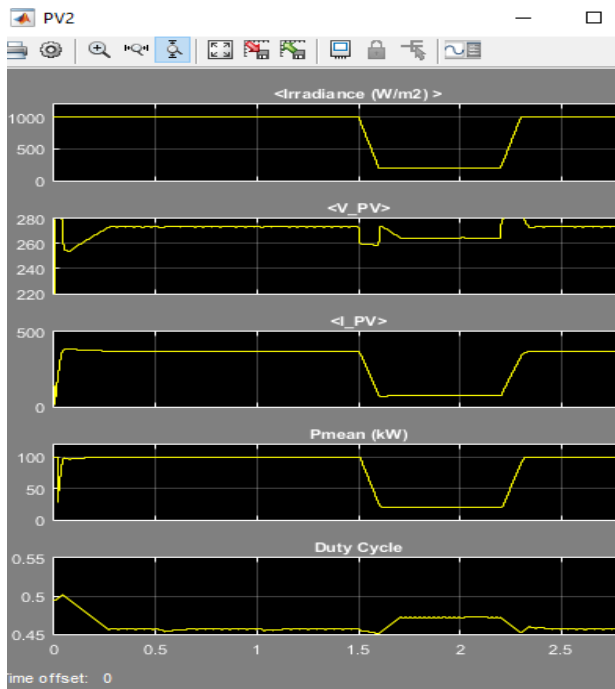


Fig. 23(b) the output wave form of the PV module 2 with MPP.

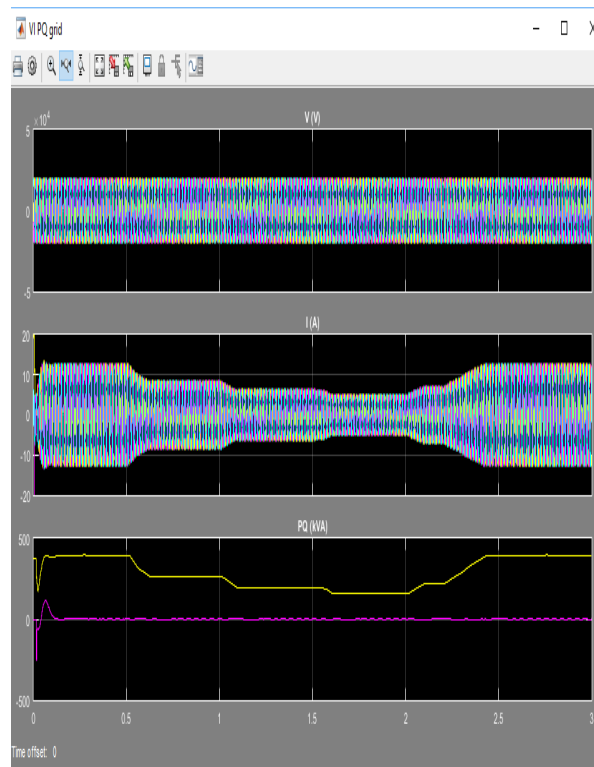


Fig. 24 the output wave form of the voltage, current and apparent power of the grid with MPP

## 7. Conclusion

In this paper, the components of the PV array system interconnected with utility are discussed. Modeling of single diode model is introduced and performing a comparison between different maximum power point techniques. The cascaded buck-boost converter controlled by Perturb and observe presented. Simulation of the 400 KW PV array interconnected to 250 KW with decoupling cascaded DC/Dc converter which keep the output power of each module maximum power even if partial shading occurs on the Modules. Analysis of results under different irradiance during the cycle with fast switching are introduced and the effect on the grid voltage, current and apparent power.

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