Enhancement of Power Quality in Microgrid

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Abstract : In this paper, a power quality controller suitable for microgrid is proposed, which can cater for the peculiar requirements of microgrid power quality, such as the harmonic high penetration and frequent voltage fluctuations. A dynamic voltage restorer (DVR) is proposed to improve voltage quality in a micro-grid. A DVR is a DC to-AC switching converter that injects three single phase AC output voltages in series with the distribution feeder and in synchronism with distribution system voltage. It is an interface equipment between utility and customer, connected in series between the supply and load to mitigate the three major power quality problems namely, the voltage sags, swells and interruptions. One of the major problems dealt here is the voltage sag and swell. DVR is the most efficient and effective modern custom power device having fast dynamic response to the disturbances. Simulation result showed that proposed topology is able to minimize power quality issues like voltage sag and swell.

IndexTerms **- Microgrid, Dynamic Voltage Restorer, Maximum Power Point Tracking, Voltage sag ,Voltage Swell**

I. INTRODUCTION

Microgrids are modern, localized, small-scale grids consisting of distributed energy sources & loads capable of operating in parallel with, or independently from, the main power grid. It reduce the impact on large power grid, and minimize the system losses. Power quality problem of micro-grid is much more serious than that of the traditional grid because of the intermittency and randomness of DERs[1]-[2].A Dynamic Voltage Restorer (DVR) is a series connected solid state device that injects voltage into the system in order to regulate the load side voltage. Its main function is to monitor the load voltage waveform constantly by injecting missing voltage in case of sag or swell. A reference voltage waveform has to be created which is similar in magnitude and phase angle to that of supply voltage. During any abnormality of voltage waveform it can be detected by comparing the reference and the actual waveform of the voltage.[4]-[6]

II. DVR

A Dynamic Voltage Restorer (DVR) is a series connected device that injects voltage into the system in order to regulate the load side voltage. Its main function is to monitor the load voltage waveform constantly by injecting missing voltage in case of sag. A reference voltage waveform has to be created which is similar in magnitude and phase angle to that of supply voltage. During any abnormality of voltage waveform it can be detected by comparing the reference and the actual waveform of the voltage.

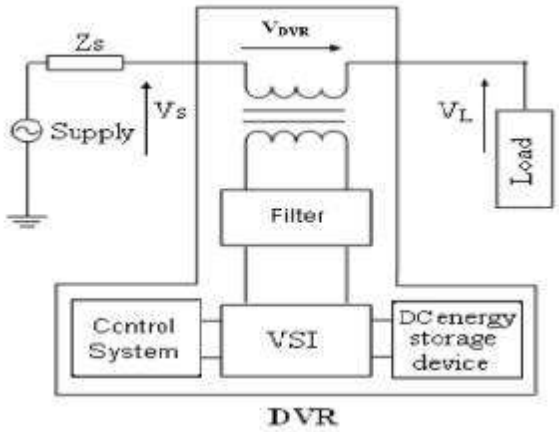

Fig. 1. General configuration of DVR.

`During the normal operation as there is no sag, DVR will be in standby mode and do not supply any voltage to the load. During any voltage fluctuation like voltage sag/swell then the difference between the pre sag voltage and the sag voltage is injected by the DVR by supplying the real power from the energy storage element together with the reactive power.

III. POPOSED METHOD

The proposed method consist of series connected active filter DVR, conventional power grid and microgrid comprising battery system, photovoltaic system, R
load and a harmonic load. The detailed system configuration of the proposed system is shown in Fig.2.

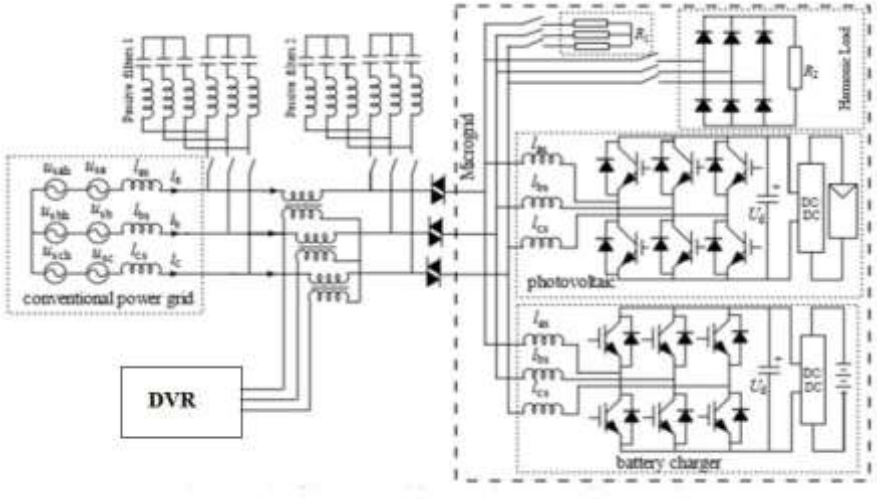

Fig 2. Circuit diagram of the proposed system.

IV. SIMULATION RESULTS

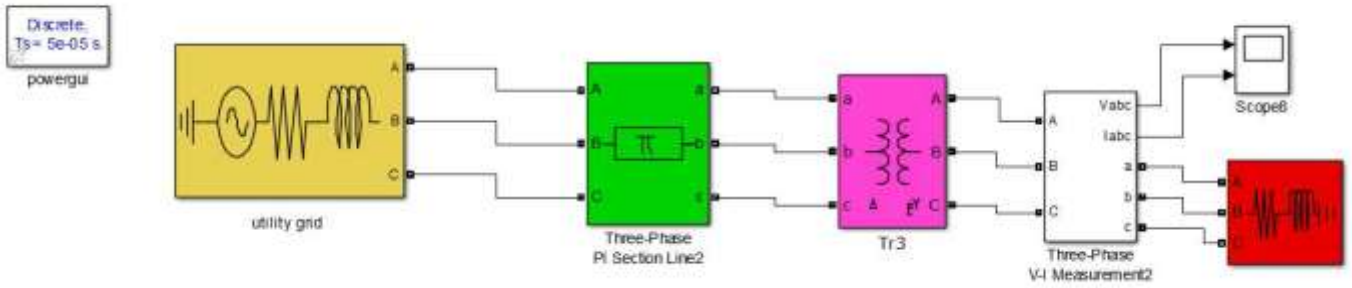

Fig 3 Simulation of conventional grid

The simulation of conventional grid with RL load is shown in Fig 3.The rating of utility grid is 5000VAR. It is connected to section transmission line for a transmission distance of 100 Km.

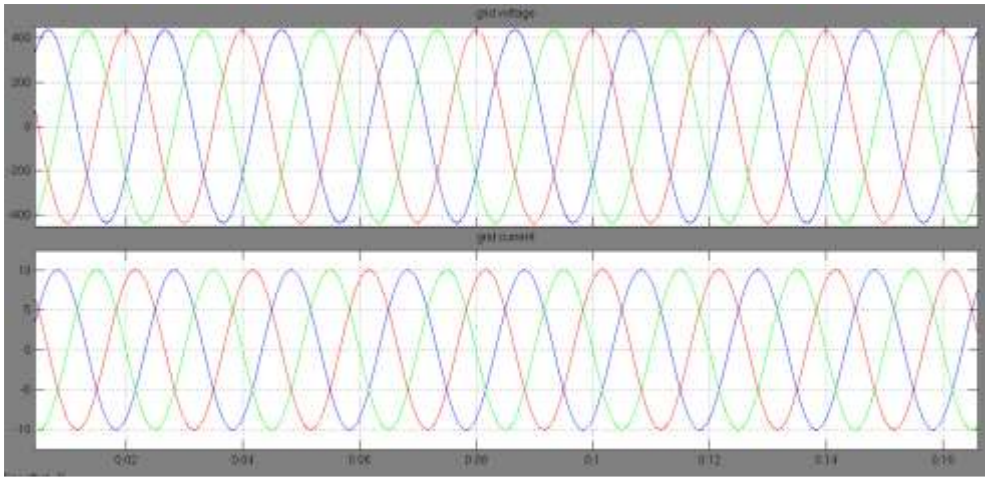

Fig 4 Simulation output of conventional grid

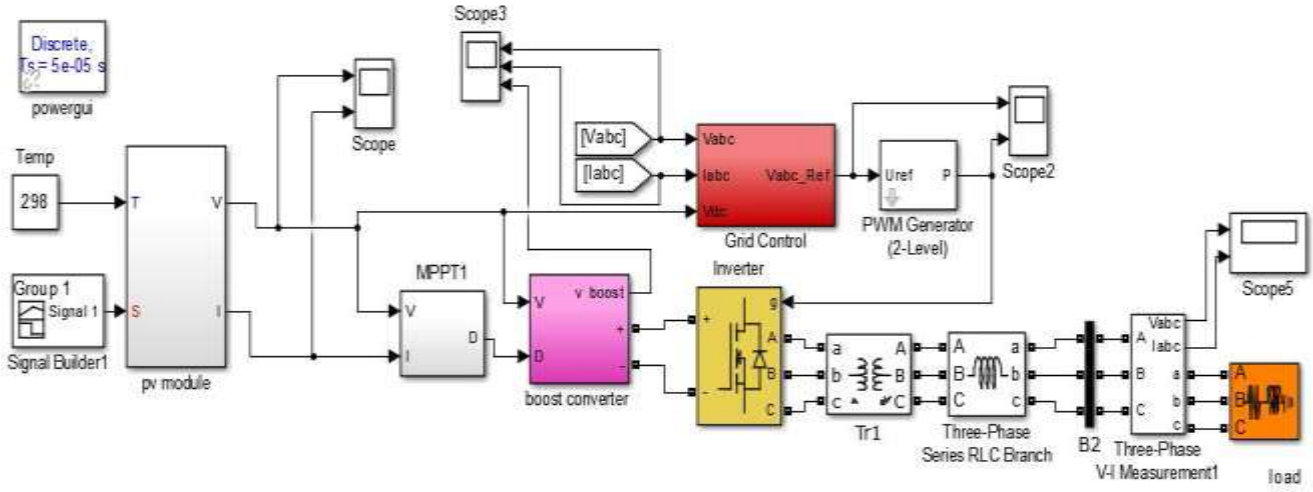

Fig 5 Simulation of Solar Photovoltaic system with MPPT

The simulation of PV system with RL load is shown in Fig 5.Here 4 PV module is connected in series to obtain output voltage of 140V. The input voltage of boost converter is 140 V and the output obtained is 400V.

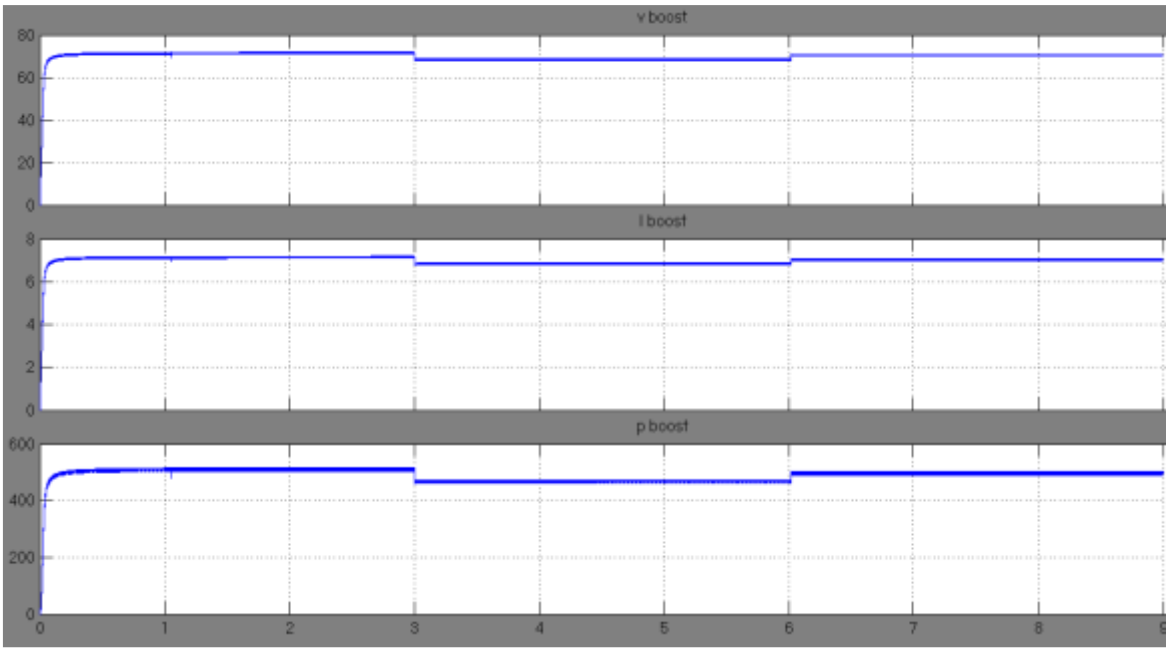

Fig 6 Output voltage ,current and power waveform of boost converter

The output voltage of the boost converter is 400 V is shown in Fig 6 . Here solar irradiance of 1000W/m2 500W/m2 and 800W/m2 is given to check the MPPT.

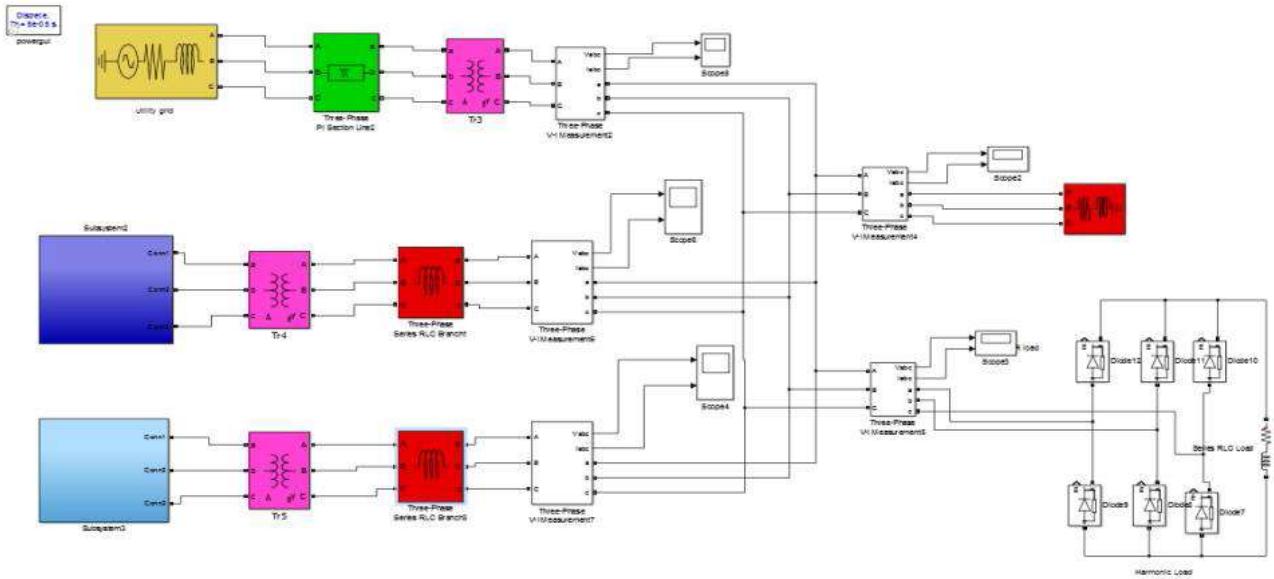

Fig 7 .Simulation of system without DVR

Simulation of the system is done after connecting PV and battery system to the conventional grid. In this topology DVR is not implemented

Fig. 8 shows the outputs obtained when the DVR is not operated with grid connected hybrid system. Here the entire system is connected to RL load and harmonic load.

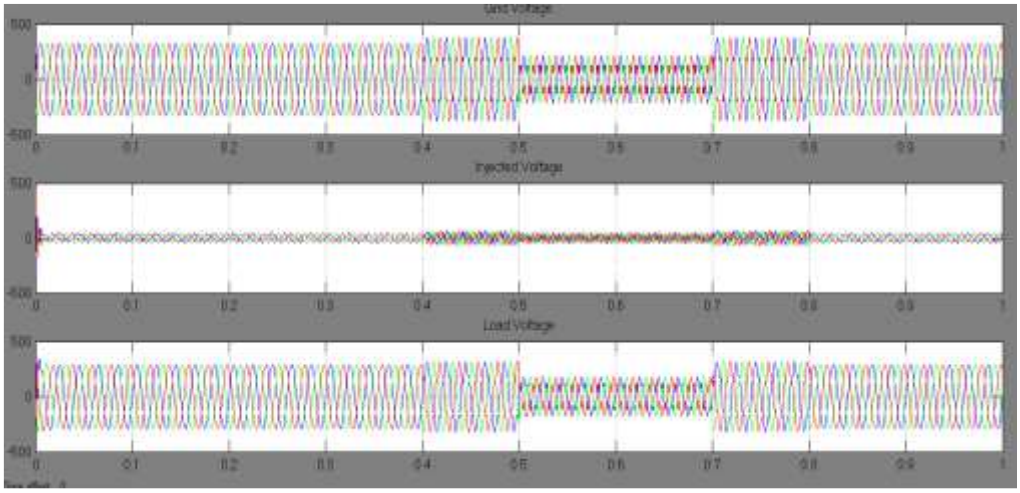

Fig 8 .Simulation output of system without DVR

V. CONCLUSION

In this paper a power electronic based equipment DVR to improve power quality issues in microgrid like voltage sags and swell has been presented. When the DVR is in operation the voltage sag and swell is mitigated almost completely, and the RMS voltage at the sensitive load point is maintained at about 90%.The proposed method has been verified by matlab simulation results.

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