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## **Harmonic currents Compensator Grid-Connected Inverter at the Microgrid**

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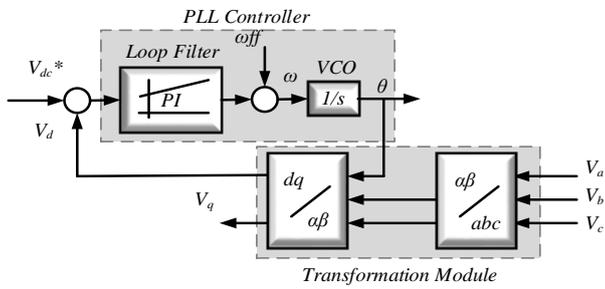
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**Fig. 2** PLL structure of the three-phase

The  $dq$  rotating frame converts back to  $abc$  stationary frame uses inverse Park's transformation Eq. 7, 8 and 9, by extracting reference signal.

$$i_{sa}^* = i_d \sin(\omega t) + \cos(\omega t) \quad (7)$$

$$i_{sb}^* = i_d \sin\left(\omega t - \frac{2\pi}{3}\right) + \cos\left(\omega t - \frac{2\pi}{3}\right) \quad (8)$$

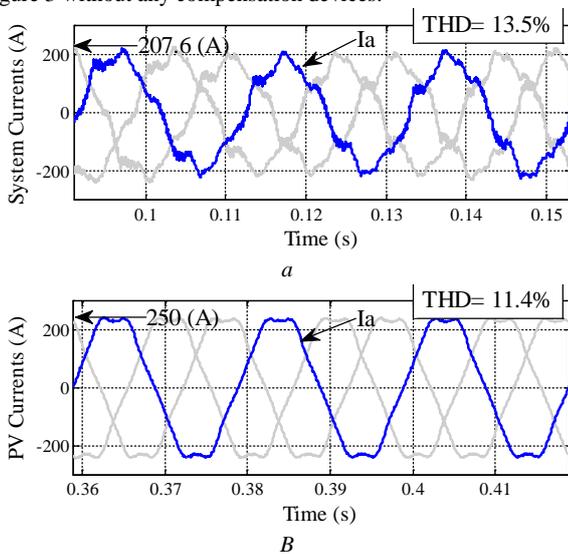
$$i_{sc}^* = i_d \sin\left(\omega t + \frac{2\pi}{3}\right) + \cos\left(\omega t + \frac{2\pi}{3}\right) \quad (9)$$

The unit of control compensation of harmonic currents uses DC quantities. The design compensation current is injected by appropriate gate plus for inverter which is transferred by gate driver controller to extract reference signal.

**Simulation results:** The basic MG in this letter includes the MT, the fuel cell, wind turbine and PV array which are connected to the grid by the interface inverter. The proposed control methods is applied to the PV. Furthermore, a fuel cell has an output of 50 kW and a grid-connected PV array has an output of 100 kW and also a 9 MW wind farm and 25MW MT are connected to the grid by AC/DA/AC converter. Another side of this system consists of two non-linear loads, which produced the distorted waveform. In the grid and MG the voltage is assumed sinusoidal. In the simulation, two case study are taken into account.

#### A. Case study I

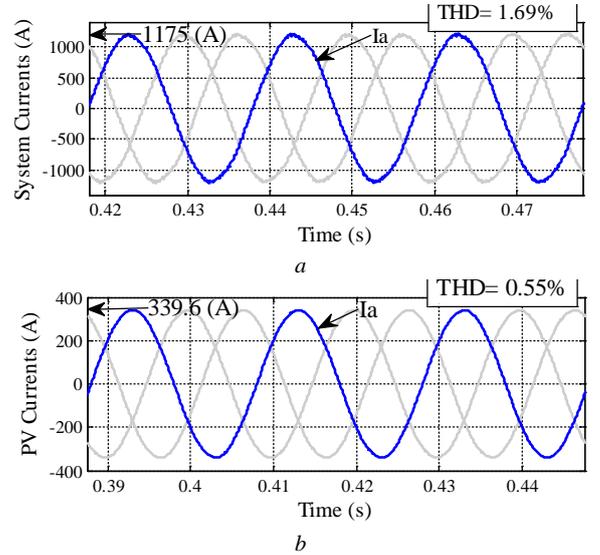
The resulting system waveforms consist of grid, PV currents are shown in Figure 3 without any compensation devices.



**Fig. 3** System, DG units current waveforms without any compensation: (a) System currents; (b) PV currents

#### B. Case study II

This case study has an improved power quality with the absence of compensation devices such as passive, active and LCL filters in the MG. Figures 4 (a) and (b) show the effective compensation values of the harmonic current for the grid and the PV. When all of the loads and DGs are connected, the Total Harmonic Distortion (THD) current without any compensation was 13.5%. As shown in Figure 4 (a), THD is reduced to 1.69% in the system with the proposed control method. The Current and THD value of study system is given in Tables 1.



**Fig. 4** System and DG unit current waveforms with propose control method; (a) System currents; (b) PV currents

**Table 1:** Current and THD Result

	Before Compensation		After Propose Control Method	
	Current (A)	THD %	Current (A)	THD %
System	207.6	<b>13.55</b>	1175	<b>1.69</b>
PV	250	<b>11.43</b>	339.6	<b>0.55</b>

**Conclusion:** This Letter proposes a new control strategy for harmonic current compensation for photovoltaic inverter between PCC and MG and also is responsible for controlling the power injection to the grid, and compensating unbalanced load. The presented simulation results show that the PCC harmonic currents due to unbalanced load, NLL and DGs are compensated to the desired value. This strategy can be used for single-phase and three-phase systems.

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#### References

- Chen, Z., Blaabjerg, F., Pedersen, JK.; 'Hybrid compensation arrangement in dispersed generation systems', *Power Deliv IEEE Trans. IEEE*, 2005, **20**, (2), pp. 1719–27
- Panda, SK., Chitti Babu, B.; 'Improved phase detection technique for grid synchronization of DG systems during grid abnormalities', In: *Engineering and Systems (SCES), 2013 Students Conference on. IEEE*, 2013, pp. 1–6
- Hui, P., Zi-ping, L., Ling, L., Chun-ming, P.; 'Hybrid compensation for harmonic, reactive power and unbalance under dq0 coordinates', In: *Electrical Machines and Systems, ICEMS 2008 International Conference on. IEEE*, 2008, pp. 2004–7.