CONTROL OF SINGLE PHASE GRID CONNECTED INVERTER BY OCC

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Abstract : Grid connected inverters are essential for transferring power to grid. Control of grid connected inverter should be done in such a way that inverter output current will be in phase with grid voltages, so that unity power factor operation can be achieved. There are various methods to control grid connected inverters. Here, in this paper one cycle control (OCC) method is used to achieve this. One cycle control realizes PWM and fast nonlinear control in one go by modulating the slope of the sawtooth waveform. Simulation results are shown.

***IndexTerms* - Grid, One cycle control, Nonlinear, PWM, OCC**

I. INTRODUCTION

One cycle control is a universal method to control single or three-phase MOSFET, IGBT, or GTO power modules to realize four quadrant power converters that are capable of serving as grid connected inverters, active power filters, power factor corrected rectifiers, flexible ac transmission system components, and etc.

Due to its fast speed, simplicity, stability, and universal adaptability, one cycle control promises unmatched performance, lower cost, and high reliability.

II. GRID CONNECTED INVERTER

The single-phase full bridge voltage source inverter topology is shown in Figure 1. It is composed of a dc voltage source, four power switches and interfacing inductor. DC voltage source may be anything like PV, wind or fuel cell etc.

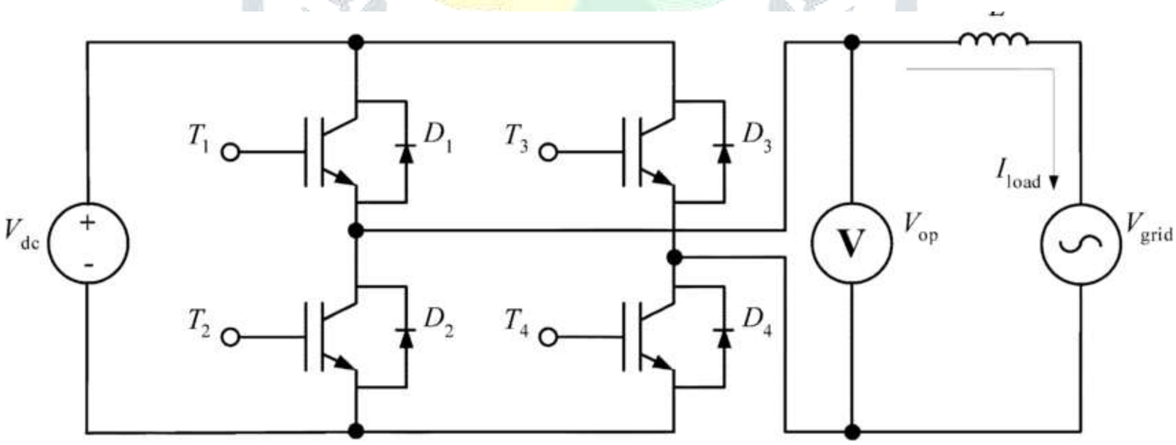

Figure 1: Grid connected inverter

2.1 Features for grid-connected inverters

- Low line current distortion and high power factor. Usually the inverter is controlled so as to generate the output current in phase with the grid voltage to achieve the maximum active output power by minimizing the reactive output power.
- High efficiency. The overall efficiency of alternative energy generation will be highly dependent on the efficiency of the inverter.
- High switching frequency. The inductors of the output filter can be smaller.
- Simple circuitry. Low cost and high reliability should be achieved

III. ONE CYCLE CONTROL METHOD

For high power applications, such as three phase power factor correction rectifications, active power filters , grid connected inverter, and FACTS components, the control functions are getting much more complicated by using the traditional PWM method.

One cycle control (OCC) is a nonlinear pulse-width modulation method. In contrast to the traditional PWM method, OCC control realizes PWM and fast nonlinear control in one go by modulating the slope of the sawtooth waveform. The implementation circuit is very simple and yet universal[1].

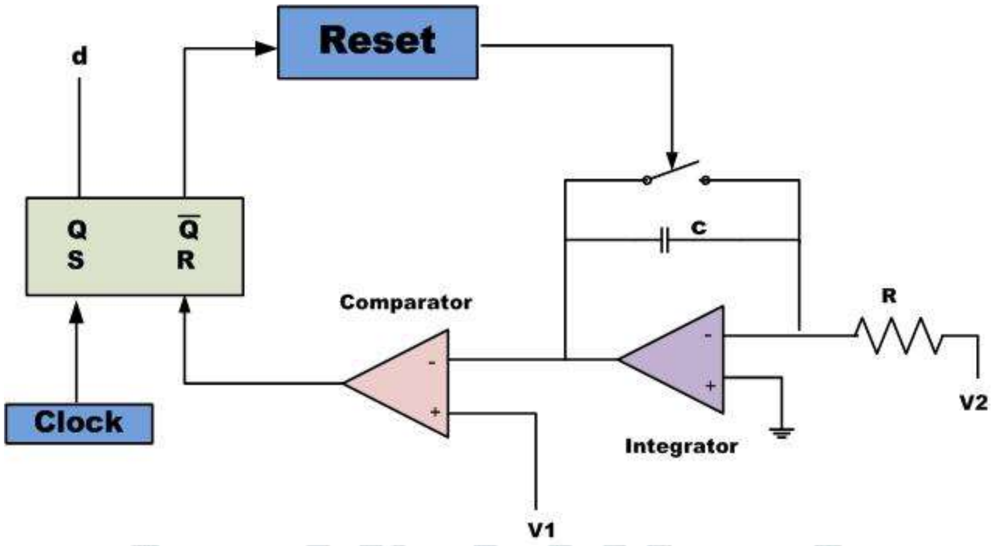

Figure 2: One cycle control method block diagram

In Figure 2, a basic control core is shown. A clock generates a periodic pulse train that sets the flip flop at the beginning of the each switching cycle. Signal V_2, at the input of the integrator, is integrated and the output value is compared to signal V_1. When both signals at the two inputs of the comparator approach one another, the comparator changes its state, which in turn resets the flip flop and the integrator to zero. This operation can be expressed below:

$$\frac{1}{\mathrm{RC}}\int_0^{dT} v_2\, dt = v_1$$

Where T is the switching period and d is the duty ratio, R and C are the value of the resistor and capacitors of the integrator respectively. This process repeats each switching cycle. With this OCC circuit, the duty ratio of the switch is controlled such that the chopped signal of V_2 has an average in each switching cycle that is equal to or proportional to signal V_1 . The duty ratio is modulated as

$$v_2.d = v_1$$

This has established a solver for the first order polynomial function of d.

Researchers at UCI have demonstrated the control functions of most switching converters, GCIs, PFC rectifiers, APFs, and some FACTS components are first order polynomial equation matrix, therefore they can be implemented by the OCC circuit.

IV. SIMULATION RESULTS:

Simulations of single phase and three phase grid connected inverter based on one cycle control are carried out under MATLAB environment.

4.1 Single phase grid connected inverter based on one cycle control

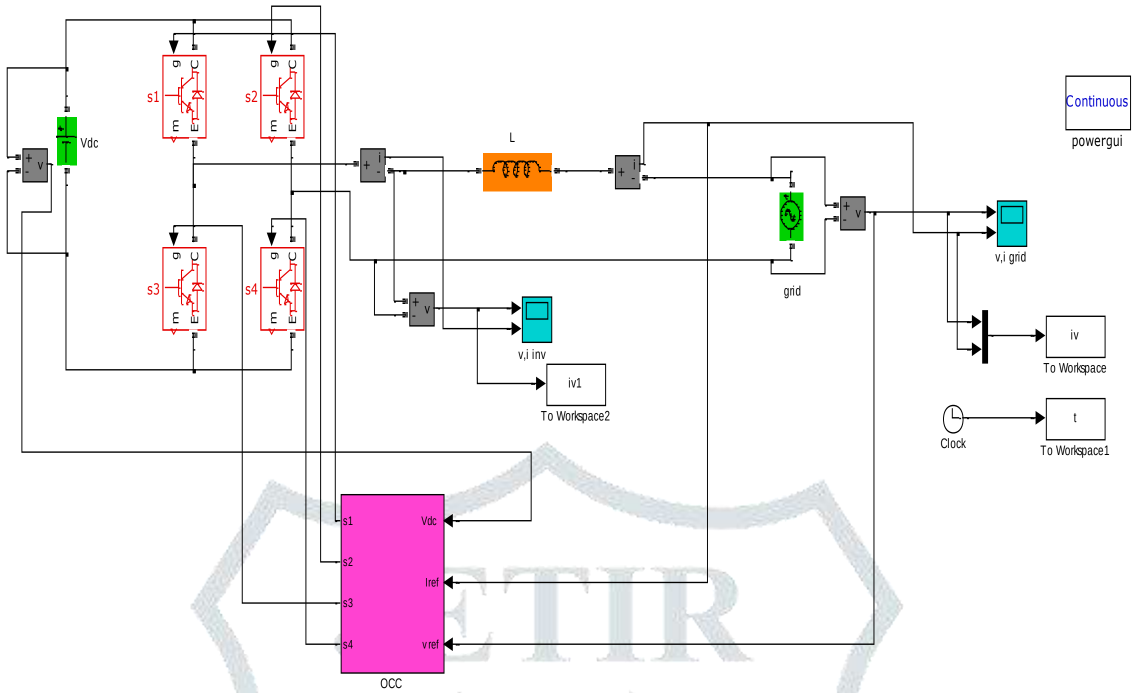

Figure 3: Model

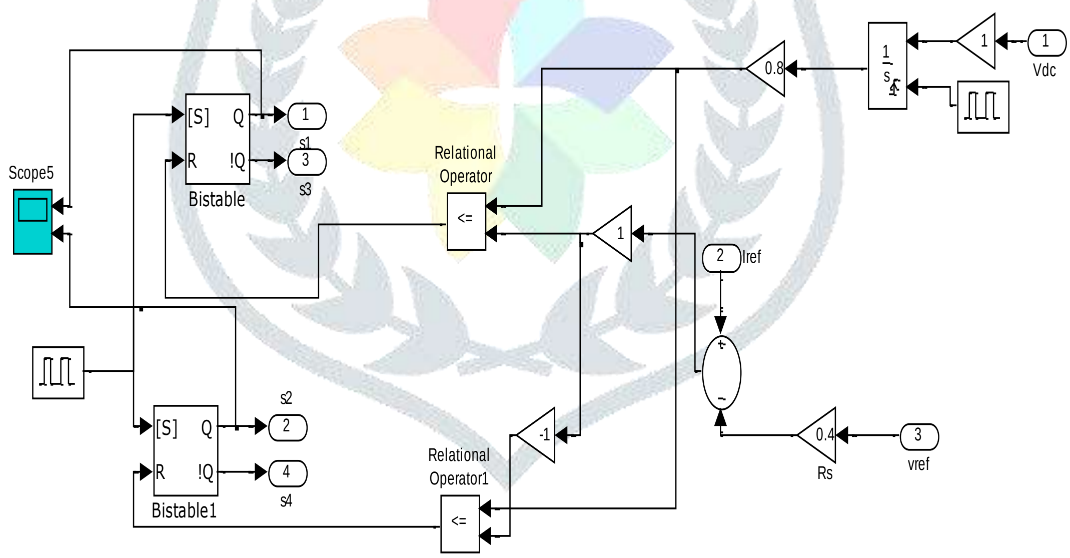

Figure 4: Subsystem of OCC

4.2 Parameters and Waveforms

V_{dc}= 300 V
V_{grid}=120 V rms
L=2e-3 H
Switching frequency= 10 kHz

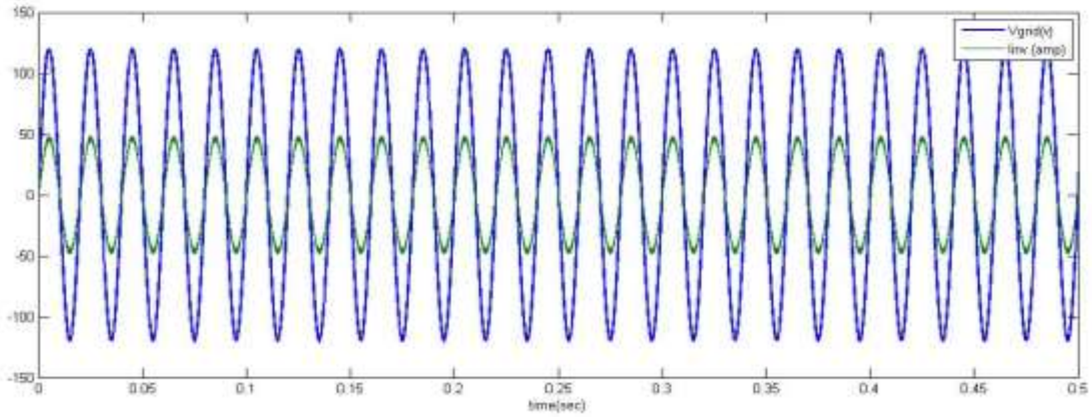

Figure 5: Inverter output current and grid voltages

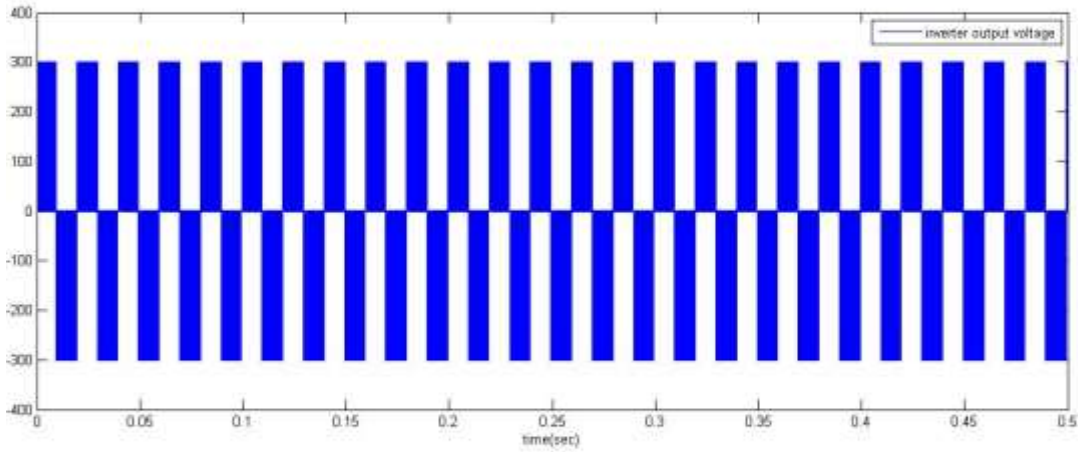

Figure 6: Inverter output voltage

THD in inverter output current=2.60 %
Power factor=1

V. CONCLUSION:

From simulation results, it is concluded that grid connected inverter with one cycle control method give sinusoidal inverter output current with lower THD and these inverter output currents are in phase with grid voltages. So, unity power factor operation is achieved.

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