Industrial Power Control by Integral Cycle Switching Without Generating Harmonics

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Abstract – This paper present integral cycle switching control for industrial power control. In this method voltage control is achieved by connecting load to source for some – on cycle and then disconnecting some load for off-cycle.Principle of operation and circuit description are presented in this paper. The result are simulated using MATLAB SIMULING Integral Cycle control introduces less harmonica into the supply system

Key Words: Integral Cycle Control, Harmonics, Welding, high power factor, single phase induction motor, Control Strategies, MATLAB Simulation and Heating Application.

1. INTRODUCTION

AC voltage controller is a power electronic circuit in which fixed ac is converted to variable ac without changing the frequency. The converter circuit consists of SCR as switches and provides variable ac to the load.

Speed control of induction motor, Industrial heating and lighting, on load tap changing transformers, soft start of induction motors, ac magnet controls, etc. The most commonly used power electronic circuit for controlling the ac voltage is using two SCR's connected in anti-parallel between source and load. The control strategy depends upon the gate pulse given to the SCR's [1].

We induction motor controller for reducing harmonics for controlling ATmega8 pin to provide fast and reliable control operations. The controller also includes 28 digital input/output pins. This has wide applications in manufacturing, light dimmer, induction motor speed controlling etc.

$V_o = V\ [1/\ \pi\ \{(\pi - \alpha) - 1/\ 2 \sin 2\ \alpha\}]\ 1/2$

$P\ F = V_o\ /\ V$

where input supply voltage $v(t) = V_m \sin \omega t$; V_m and V are maximum and rms values of the supply voltage and α is the switching angle of the circuit.Where I is the fundamental value of the line or input supply current and I_i are represents the harmonic current components of I. When α varies between 60 and 120, the supply voltage is close to its Peak value (86.7% to 100%) and the corresponding voltage control range is from 44.2% to 89.7%. At the switching instant (ω t = α), the line current jumps from zero to almost its peak value. Thus, di /dt is high over a wide range of control. Moreover, there is heavy inrush current when furnace element R is heated from cold. At a higher value of α, PF is also low and THD is significantly high [2].

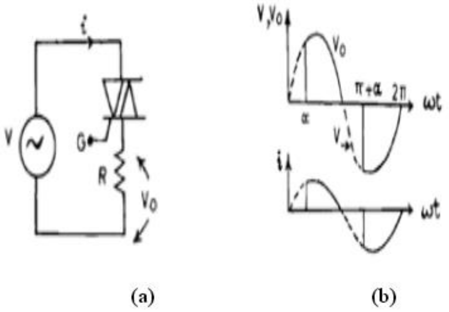

Fig-1(a): Switching arrangement of phase control circuit,

1(b): Waveforms of phase control circuit

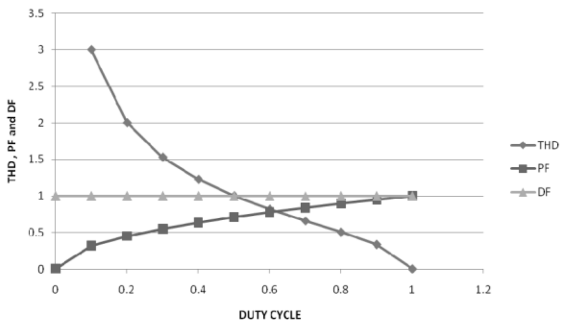

Fig-3: Variation of PF, THD with Switching angle α in Deg.

2. PRINCIPLE OF OPERATION

Integral cycle control is used for controlling power to AC load by permitting few full cycles to power the load followed by off period. This is repeated cyclically. The duty cycle is controlled for changing the output power basically on - off control similar to the obtained through SCR switches except that integral number of cycle are passed. In literature, ICC is also described as On - Off control, Burst firing, Zero Voltage Switching, Cycle Selection and Cycle Syncopation [2]. Fig. 3 Variation of PF, THD with Switching angle α in Deg.

When the power is ON, during N cycle the speed or temperature increases exponentially from a minimum value and reaches a maximum at the end of the Nth cycle. If N us the number of full cycles passed per M cycles of the source voltage then it is said to have a duty cycle of $\delta = N / (N + M)$. The difference between maximum of temperature and the minimum temperature is called the differential.[3]

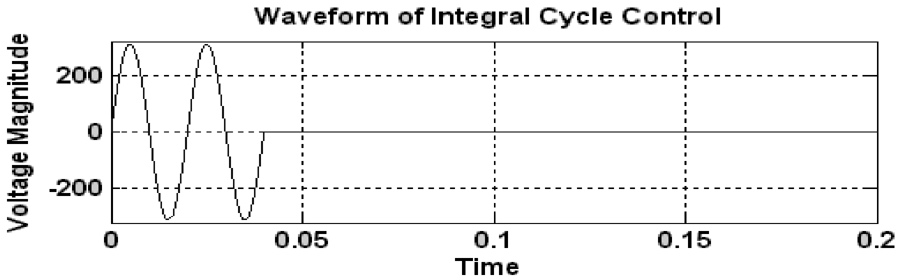

Fig-4: describes the output voltage waveform in ICC with duty cycle D= 0.2 and harmonics

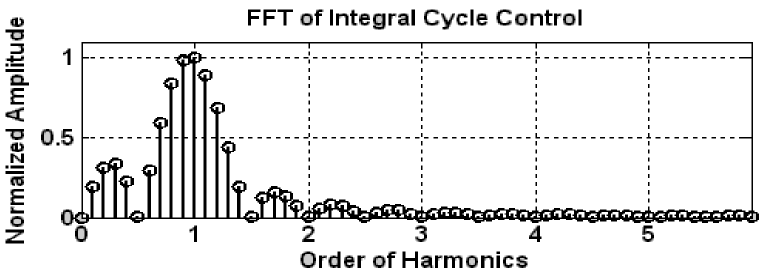

Fig-5: Output Voltage in ICC with D= 0.2 and harmonic profile

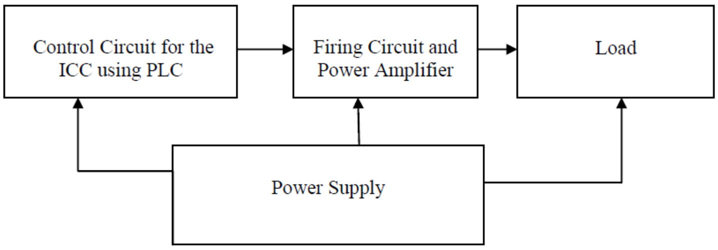

Fig-6: Block Diagram of the ICC

3. Block Diagram

Block Diagram of ICC circuit involves the basic three sections. First section comprises of a power supply stage to drive all internal amplifier and feed the gate energy to the power semiconductor devices. In second section a zero voltage detecting stage, which sense the instant of zero supply voltage. This stage releases the power amplifier for a short duration pulse this cross over point so that they may trigger the power semiconductor if required or separate some other more continuous drive circuit. Finally in third section an amplifier stage is required which magnifies the control signal to provide the drive needed to turn on the power switch on. As shown in the block diagram, the control block consists of control circuit for the ICC, Firing Circuit and Power Amplifier (FCPA) and power supply for controlling the load.[4]

4. IMPLEMENTATION & RESULTS

Here system is described by ATmega32 micro-controlling programing which can control the motor speed.In implementation of LCD (LM016L) is a 16× 2 pixels there will be number of cycle are display in the simulation.

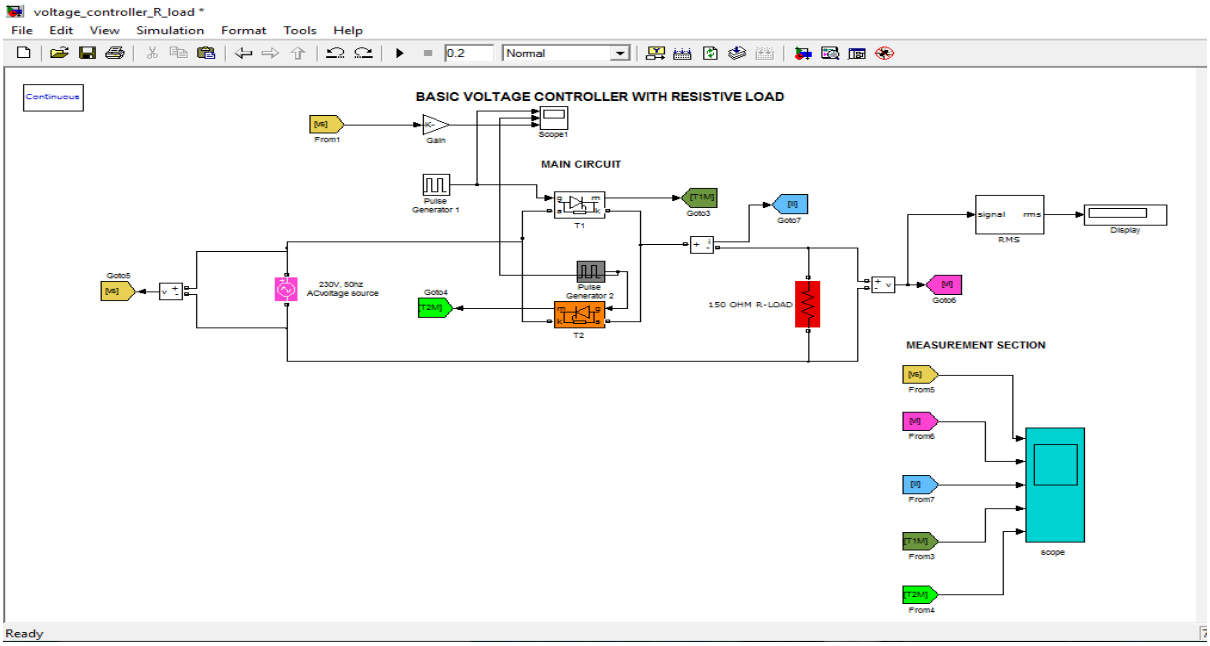

Fig-7: Simulation diagram for Integral cycle switching control

5. RESULTS

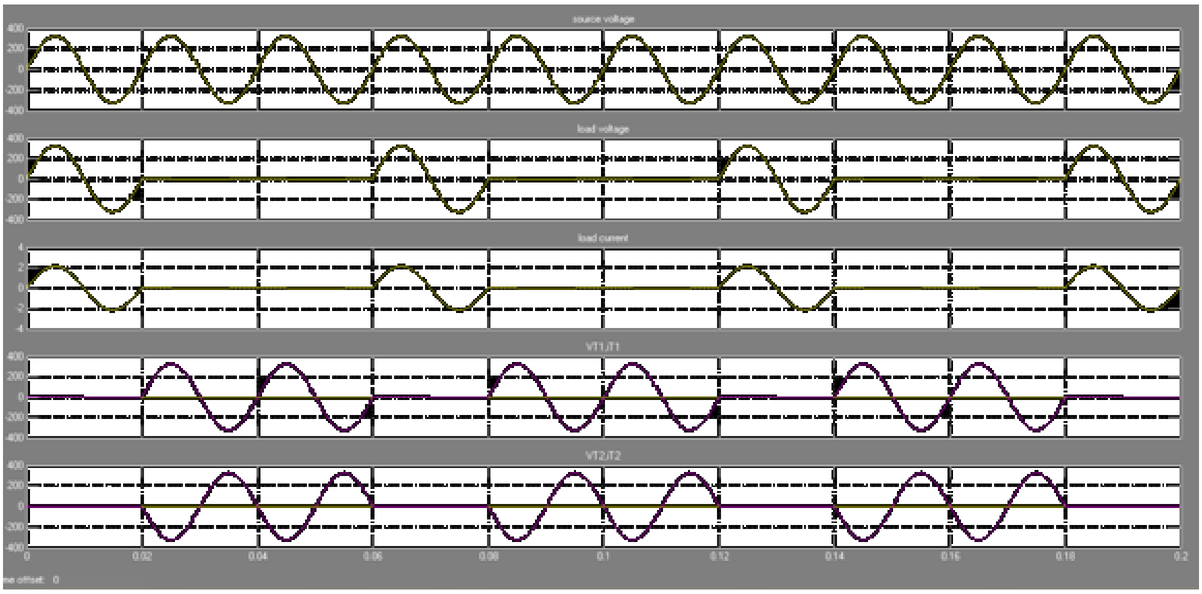

Fig-8: load output voltage and current waveform for firing angle = 30 deg and duty cycle 0.06

7. CONCLUSION

In this paper voltage is controlled through integral cycle switching and controlling AC power is used. Through integral cycle output signal we get pure sine wave so it reduces harmonics and improving power factor. It has low cost and easy to operate. Less AC power losses. So better efficiency output in AC power.

7. REFERENCES

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