# The power factor correction technology based on UCC28019

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*Abstract*—**The power factor correction controller is needful for the well operation of power grid in order to eliminate the higher harmonics and improve the power-factor of electrical loadings. In the design of this system with the boost chopper as the core, the power-factor correction control chip named UCC28019 is chosen to produce PWM waveform to realize double closed loop feedback control and implement voltage output instead of the normal UC3854. The experiment results show that: when the ac voltage at the power input and the dc current of load change in a wide range, the output voltage of the dc power supply remains high stability. The ac power factor of power supply reaches 97%, therefore, it has the good effect of power factor correction. In addition to that, the functions such as the 2.5A over-current protection, the power factor measurement or display and so on are realized in this system.**

*Keywords-power-factor;switching; power supply; UCC28019; correction; boost circuit;*

## I. INTRODUCTION

The boost type power electronic converter who has the power-factor correction is widely used in power system. For example, the boost converter who has the power MOS field-effect tube as switching device and UC3854 as the power-factor adjusting controller can effectively eliminate the higher harmonics of power-grid and improve the power-factor of electrical loadings[1][2][3]. It is routine method for the intelligent and green power.

At present, the digital control scheme or BOOST + UC3854 scheme are more common [4] [5]. The advantages of the former scheme whose parameter adjustment is achieved through control software are that the debugging of system is simple and the number of components is reduced. The defects of the former scheme are the difficulty of software programming and the complicated sampling algorithm in order to achieve high sampling frequency [6]. The latter scheme is the more active power-factor correction method used now. Although the programming of this scheme is simple, the overall effect is excellent. It is a pity that peripheral circuit is complex and debugging is very difficult [7].

In this paper, the research achievements about boost PFC control in recent years are referenced by and the BOOST+UCC28019 digital/analog hybrid control scheme is adopt. The dedicated UC28019 PFC control chip is used to complete the system power-factor correction and adjustment. The test results showed that the effect of this approach is good.

## II. PRINCIPLE OF ACTIVE POWER-FACTOR CORRECTION

The basic idea of active power factor correction (APFC) is as followings [8]：After the full-wave rectification for the ac input voltage, the DC/DC conversion will be start. By appropriate control, the waveform of input current will automatically follow the waveform of voltage which has been rectified by the full-wave rectifier. The waveform of input current remains sinusoidal meanwhile the output voltage remains stability. The key component there is the active DC/DC switching converter which is inserted between the rectifier and the load. The voltage-current feedback technology is used to ensure the waveform of input current to follow the input sine voltage waveform and the power factor can be improved.

The circuit of active power-factor correction usually includes voltage-control loop and current-control loop. The function of voltage-control loop which is necessary for APFC is to maintain a stable output voltage which is higher than the peak value of input voltage. The current-control loop can follows the Sine wave signal synchronously, in other words, the input current synchronously follows the input voltage in order to complete PFC. the principle of active PFC is shown in Fig. 1.
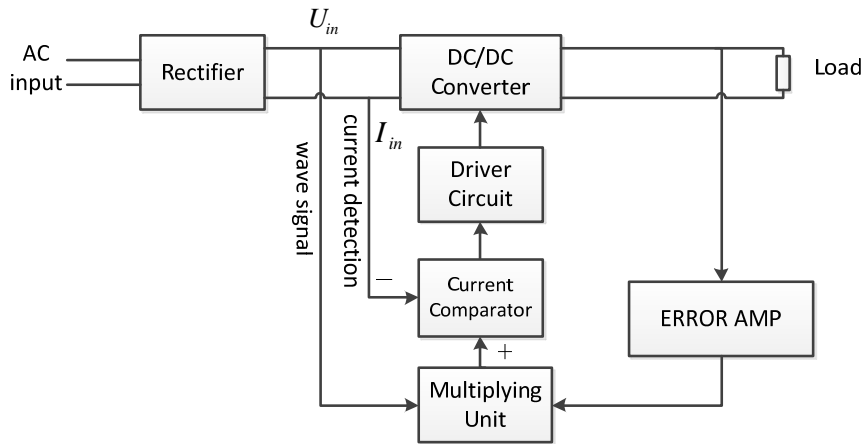
Figure 1.   The principle of active power factor correction

The part of DC/DC conversation circuit in Fig.1 is called the main circuit. The outer loop consists mostly of a voltage error amplifier and an analog multiplier. The inner loop consists of the driver circuit and the current comparator. The dual (voltage or current) closed-loop control method is used in the control circuit. The sampling signal of the current feedback network is the inductance current of the step-up transformer and the sampling signal of the voltage feedback network is the output voltage of the regulator. The single phase dual half-wave sine voltage signal which is got by the rectification against the single phase alternating current (ac) is input to the power-factor correction controller and then the output signal of the controller is induced to one of the two input ports of the analog multiplier. The signal of the voltage feedback network is input to another port of the analog multiplier. The operation result of the analog multiplier, which is viewed as the reference value of current, is compared with the actual sampling current value so that the driven signal is got by the driver circuit to control the current or voltage signal of the DC/DC converter.

III.   CONTROLLER BASED ON UCC28019 PFC

A.   *Introduction of the main chip UCC28019*

UCC28019 is an 8 pin switch-mode controller who can get close to the unit power-factor with minimal harmonic distortion and therefore, it is very suitable for low cost PFC application. This device has a general broad input range from 100W to 2000W. UCC28018 is mainly used in the boost topology structure of PFC. It works in a mode named continuous conduction (CCM) with fixed switching frequency. The very simple periphery circuit is needed to complete the flexible compensation design on account of the voltage-loop and current-loop.

- GND (pin1) : Chip ground terminal.
- ICOMP (pin2) : Current loop compensation.
- ISENSE (pin3) : Inductor current.
- VINS (pin4) : Ac input voltage detection.
- VCOMP (pin5) :The voltage loop compensation.
- VSENSE (pin6) : Output voltage detection.
- VCC (pin7) :The chip work power.
- GATE (pin8) : Gate drive.

B.   *PFC control overall scheme*

The 220V AC is first step-down to 24 V AC through the isolation transformer and then this signal is input to the PFC circuit controlled by UC28019 chip after the one direction's AC-DC rectification circuit. The sampling signals operated respectively in the point of input of the AC-DC circuit and of the load are fed back to the UCC28019 to generate the PWM wave which is used to adjust the switch tube and stable the voltage of load. The block diagram of the system is shown in Fig.2.
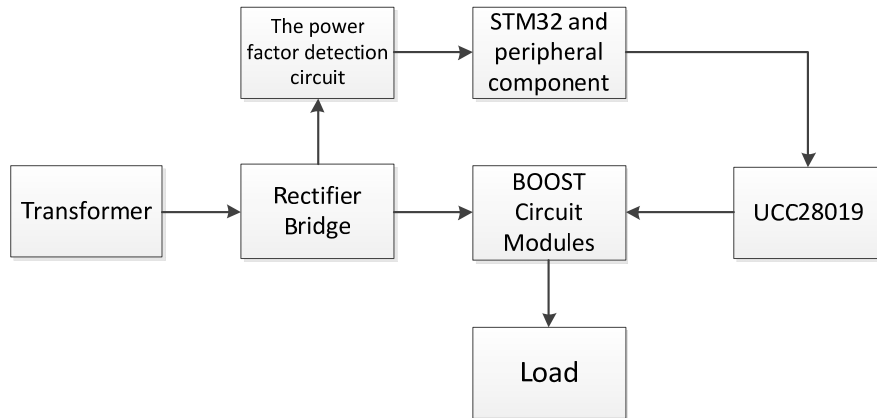
Figure 2. The block diagram of system with UCC28019

## IV. CIRCUIT DIAGRAM

The main circuit with the boost structure is shown in Fig.3. It consists of a 220V～24V 50W ac isolation autotransformer, the EMI filter, metal packaging KBPC2510 Rectifier Bridge, IRFP250 field-effect tube, continuous flow diode IN5408 and 10mh input inductance [9].

The UCC28019 is the main control chip in the PFC control circuit. With the aid of the voltage or current sampling on account of the main boost circuit, the output PWM wave can be adjusted and then the power-factor correction is realized [10]. This structure is shown in Fig.4.

## V. CONCLUSION

After the fitting of this designed circuit, a few simple measurements are done. If the output dc current is 2A, the average value of output dc voltage is 36V with the deviation of $\pm 0.1V$. The well voltage stability is shown.

The digital electric parameter measuring instrument has been used to measure the power factor of this design. The average value of three measurements is 0.979.

In this paper, the UCC28019 chip is used as power-factor adjustment controller in the design of boost circuit. The power factor measured is more than 97% and it is a valuable project for power grid to be intelligential and greening.
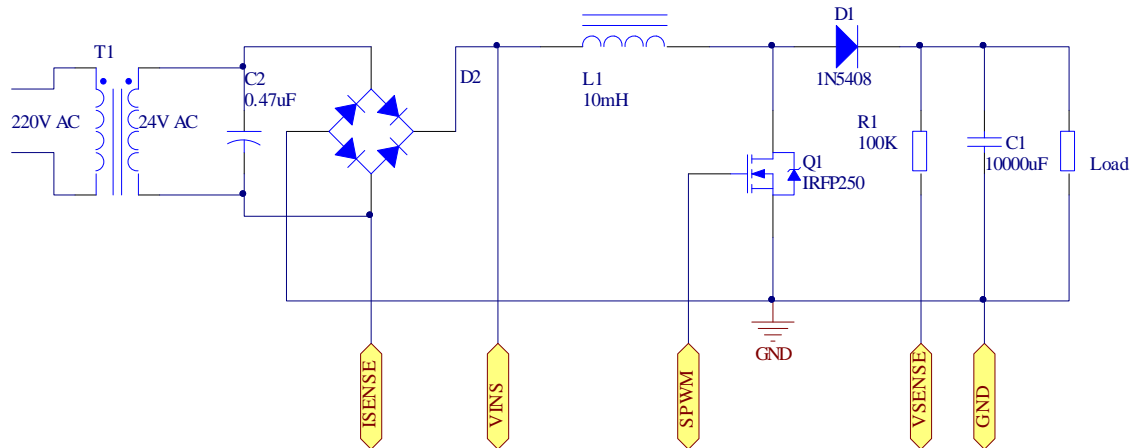


Figure 3. The main boost circuit

Figure 4.   The control circuit based on UCC28019

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