LED Driving Power Online Detection System

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Abstract: LED driving power is a necessary product for LED lighting; the behaviors of pursuing low-cost of some small and medium-sized enterprise producers in China directly affect the quality of LED power. Therefore, it is necessary to detect the reliability of the LED driving power. There are 4 main factors for the over-burning of the LED driving power: lightning oscillation frequency, voltage mutation frequency, switch motion frequency and static discharge frequency.

For the above problems, this paper raises the LED driving power online detection system, including: surge voltage input module, main control module, pulse width modulation module, power module, thyristor control module, current transformer, amplifier, RMS-DC conversion module, A/D conversion module, display module, main control module connecting to surge voltage input module.

The main operating principle is that the main control module connects the pulse width modulation module, which connects the thyristor control pole of the thyristor control module, the first anode thereof connects the power module; the primary side of current transformer connects the second anode of the thyristor control module through two wire switches, and the secondary side thereof connects the amplifier, which connects the RMS-DC conversion module; RMS-DC conversion module connects the A/D conversion module, which connects the main control module; the main control module also connects the display module. In addition, the project also provides the detection functions of LED output current, voltage digital display and different loads.

Keywords: Rotary encoder; Current transformer; Output current locus curve; RMS-DC conversion module

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1. Design Background

By analyzing the particularity during the detection of the LED driving power to compare the problems on LED driving power detection of the traditional power frequency parameter measuring instrument, aiming at particularity of the measured parameters, a measuring method of improving the frequency response of measurement, combining with 4 frequency response test plans is proposed to improve the veracity of measure. Nowadays, for pursuing profits, LED power production enterprises drop the parameter indexes of capacitance of input circuit, voltage dependent resistor, and winding resistance of LED power. In addition, most tests of most LED power production enterprises are still the traditional ones, lacking of the test for surge current, thus the quality of the LED power on the market cannot be guaranteed. Especially in LED elevator panels, frequently starting the elevator causes voltage jumps, thus leading to over-burning of the LED power. Proceed from 4 factors of lightning oscillation frequency, static discharge frequency, voltage mutation frequency and switch motion frequency which affect surge current of LED power, combining with each frequency test, the research simulates 4 factors and switches 4 different channels to generate the surge current, which have substantial meaning to monitor the output cur-

rent curve.

2. Research Thought

The main research object of the project is the detection of the surge current affecting the quality of LED power, and brings up new demands for the quality of the LED driving power.

Multi-functional and efficient LED driving power detector with the system, consisting of a high speed DSP (TMS320LF2812) module, frequency control input module, 4-channel high-frequency thyristor control module, voltage and current collection module and output display module, can estimate the quality of LED driving power through detections of voltage, current, power, input circuit of the LED driving power.

3. Operating Principles

System operating principle: conduct precision adjustment in the frequency ranges of lightning oscillation frequency, voltage mutation frequency and static discharge frequency by rotary encoder, and then the frequency will be divided into 4-channel to 4 bi-directional controllable silicone control electrodes by frequency divider. 4 bi-directional controllable silicons connect to 4 voltages of 110 V, 150 V, 220 V and 250 V after series connection to the live wire of LED driving board power supply respectively as the pulse switching voltage, which should enter the input terminal of LED driving power through current transformer and convertor module. On the output terminal of the driver board of LED power, the pulse switching voltage enters the high speed DSP (TMS320LF2812) main control module through comparative amplification and A/D conversion and then interface circuit of the output module monitors the output current locus curve. The overall design drawing of the system is as shown in Figure 1.

3.1 Main Control Module

The output module consists of lightning oscillation frequency, voltage mutation frequency, switch motion frequency, static discharge frequency and interrupt signal. After the interruption, the frequency enters the main control module and produces PWM signals through high speed DSP (TMS320LF2812) and regulates input frequency by rotary encoder. By frequency divider, the frequency is divided into 4-channel to enter the thyristor control pole and simulates voltage mutation frequency by switching 4 different voltages, inputs into the live wire of the LED driving power through current transformer and RMS-DC

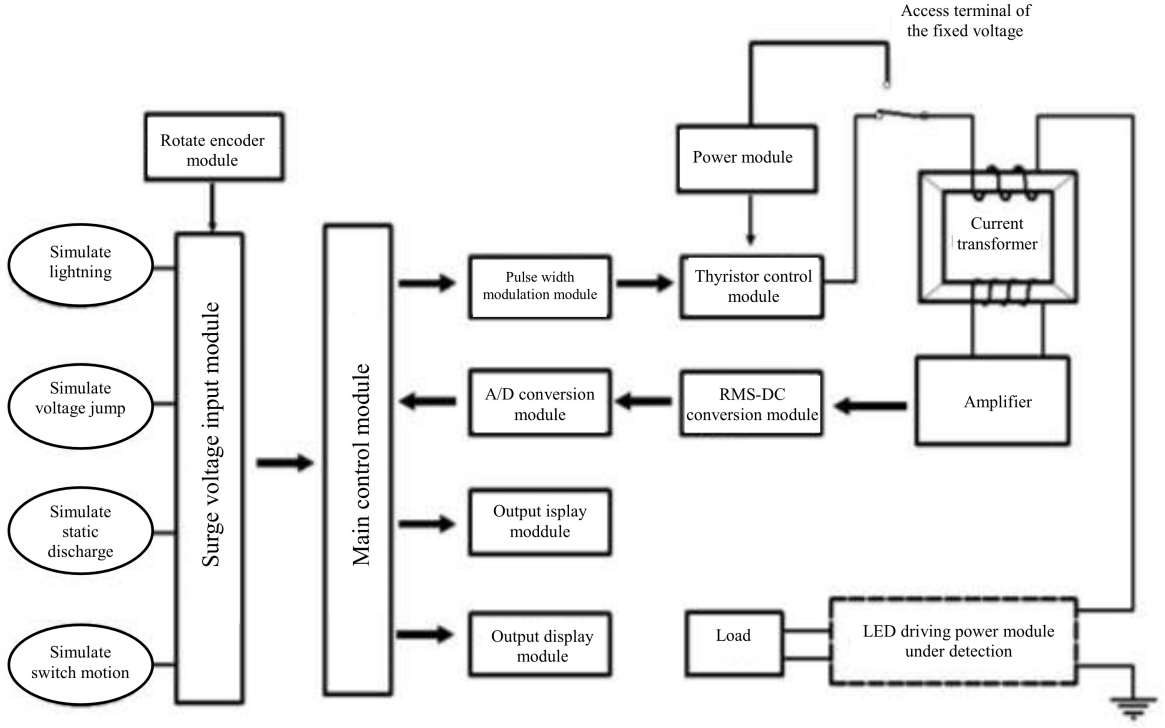

Figure 1. System principle block diagram

convertor and enters the main control module through comparative amplification and A/D conversion module on the output terminal of the driving power.

3.2 Display Module

It consists of LCD, IC/IO interface and output driver. The signal, after the A/D conversion, outputs current locus curve, current display and voltage display on LCD through the IO interface and output driver by calculating and processing of main control module.

3.3 Sampling Module

Adopting PWM technology of MCU, the system produces self-oscillation frequency of impulse wave, which can simulate 4 frequencies affecting surge current: lightning oscillation frequency, static discharge frequency, voltage mutation frequency and switch motion frequency, and adjusts the pulse frequency ranges by rotary encoder, delivers the frequency into the control electrode of controllable silicone, through switching 4 groups of voltage entering input terminal of the LED power driving board to simulate surge current generation, feeds the surge current back to the MCU from the output terminal of LED driving power and generates output current locus curve on the LCD after controlling of the A/D conversion operation of MCU.

4. System Hardware Design

Software can be divided into 4 modules: processing module of frequency signal, current and voltage collection module, high-voltage switching control module and display module. Design drawing of software is shown in Figure 2.

Processing module of frequency signal: through simulating 4 actual environment frequencies: (lightning oscillation frequency, switch motion frequency, voltage mutation frequency and static discharge frequency) generate interruption and deliver the frequency into MCU.

Set the frequency fine adjustment function. PWM of MCU outputs frequency, deliver the same into the frequency divider, divide it into 4-channel to enter thyristor control pole by rotary encoder.

Current and voltage collection module: according to the designed current and voltage circuit process and sampling, through A/D conversion and re-analysis, voltage and current will display on the display plant.

High-voltage switching control module: set the frequency of the rotary encoder through processor and deliver it into controllable silicon to control voltage switching of each channel.

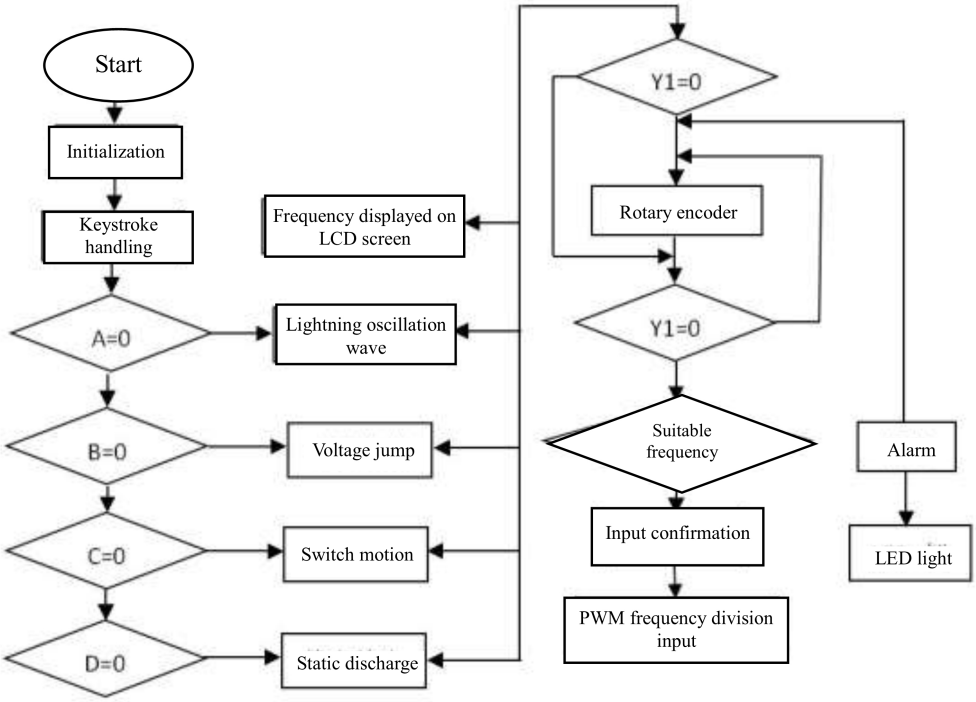

Figure 2. Design drawing of software

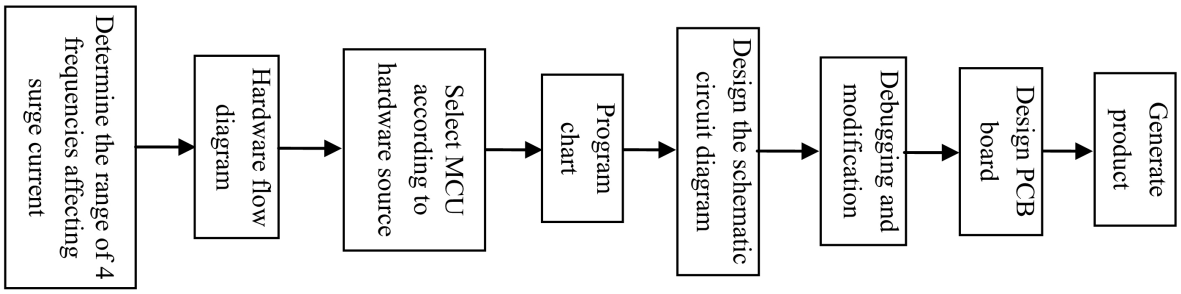

Figure 3. Technical process

Display module: it consists of 12864 LCD displaying the current locus curve, voltage meter, current meter and 4-bit nixie tube; among which, the nixie tube is used for displaying frequency, which can be adjusted by the rotary encoder.

5. Key Technical Problems

1) 4-channel frequency division output of the PWM signal through MCU.

2) Controllable silicone switches 4 groups of voltage (110 V, 150 V, 220 V and 250 V) to the input and output terminals of the LED power.

3) The output current locus curve is displayed on LCD through LED.

6. Design and Production Procedures

See Figure 3 for the design and production procedures.

7. System Characteristics

The system conducts increase and decrease adjustment for lightning oscillation frequency, switch motion frequency, voltage mutation frequency, and static discharge frequency through rotary encoder and generates deviation signal through real-time sampling of the current transformer and adopts LCD to display output current locus curve, thus estimating the quality of the LED driving power. With the characteristics of simpleness and practicality, operation convenience, low power consumption, high stability, high accuracy, free of distance limit, quick and low cost, the device is the innovative attempt of LED power test equipment in domestic industry. Different from the VPS variable frequency AC power, it refers to the lightning oscillation frequency, static discharge frequency, voltage mutation frequency and switch motion frequency which affect the surge current to simulate the these frequencies and conducts fine adjustment in each frequency range through rotary encoder and monitors the output current locus curve on output terminal on the LED power through MCU.

8. Function Realization

1) Accurately adjust the signal frequency from the MCU PWM port by rotary encoder.

2) The project uses surge current test to simulate the lightning oscillation frequency, voltage mutation frequency, static discharge frequency and switch motion frequency in the actual environment and uses 4 different voltages of 110 V, 150 V, 220 V and 250 V to simulate voltage jump test.

3) Adopt bi-directional controllable silicone to switch 4 groups of voltage and transmit it into the input terminal of LED power to simulate the surge current.

4) Due to the current transformer, when measuring the surge current, induction signal generates a deviation signal in the secondary coil by RMS-DC convertor and monitors the output current locus curve on LCD.

The functions of the tester include: voltage, current, power, apparent power, power factor, crest factor, current crest, and surge current, easy to use.

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