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The Design of Measurement System on Furnace Top Material Collision Wall Signal

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Abstract：In this paper, a measurement control circuit is designed on collision information from vibrating rod which is furnace wall collision transmission device. Through measuring the amplitude, frequency and attenuation ratio of the collision, we can preliminary judge whether the material impacts the inner wall of the furnace body.

Introduction

With the rapid development of China's iron and steel, people in the work environment, work style and work safety and so on, are constantly put forward new requirements, especially in terms of safety protection. The material falling collision furnace wall is that the material impacts the furnace body wall. If the vibration and sound generated by the collision can be transformed into material collision to the measuring equipment, and makes the device vibrate which is sent out in some way for measurement, then we distribute multiple points to measure around the furnace body, finally, the information of multiple points is put together. This can make the measured signal be less affected by the environment impact, more reliable, and error reduction. Based on the above considerations, this paper designs a collision information measurement system.

Overview of measurement system

In this paper, the collision information is transformed into a collision pickup rod to measure the vibration information. The vibrating rod is distributed around the furnace body, and a measuring terminal is arranged on each vibration rod. According to the size of the furnace, we placed a measuring terminal at intervals, and we in this paper chose to use 8 measurement terminals. The distance between the terminal and the terminal is relatively close, so the wired communication is selected. However, the measured signal is also summarized and analyzed, a master controller is needed. The communication between the main controller and the measuring terminal is also wired, and the main controller is also connected with material slot controller.

Chute inclination and rotation angle are obtained by the main controller, and combined measurement information，thus we judge whether there is a collision. When the collision occurs, material slot controller is used to transfer the collision information, and material slot

controller can control the chute to avoid collision. The main controller is placed next to the measuring terminal. However, the fabric controller is far away from the measuring terminal, and the communication and wiring between the main controller and material slot controller is not convenient because of the distance, therefore, the communication between the main controller and material slot controller is selected by wireless transmission mode via wireless interface. At the same time, the main controller can communicate with the host computer through the wireless interface. The hardware block diagram of the measurement system is shown in figure 1.

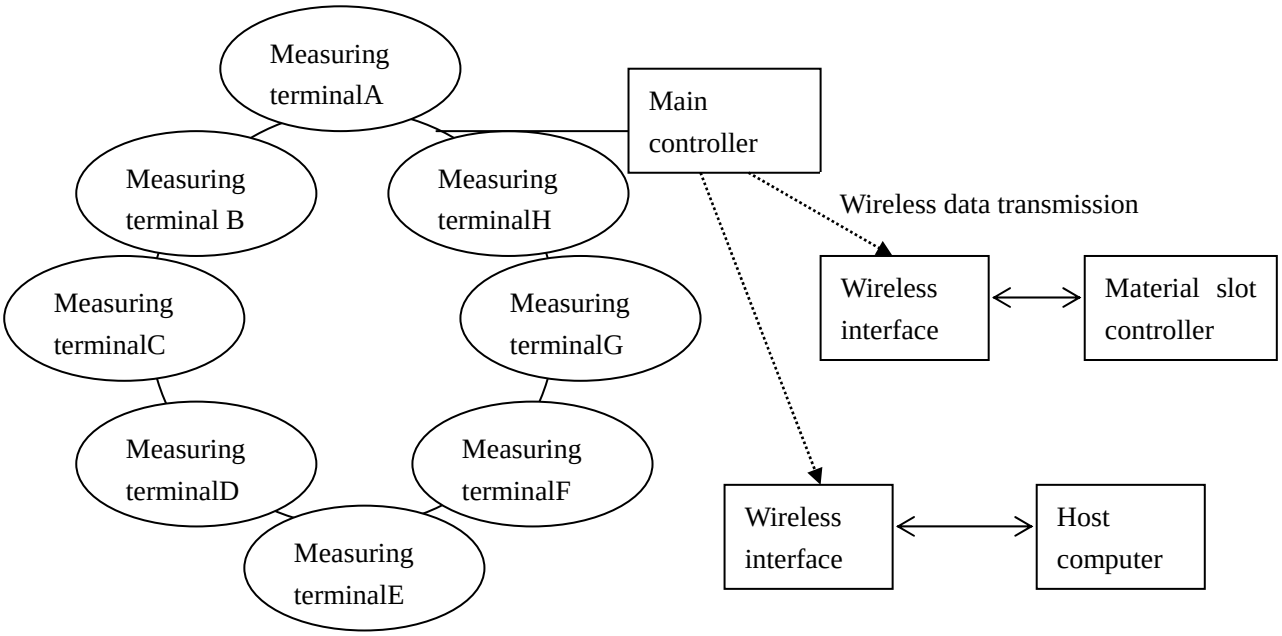

Fig.1 Measurement system hardware parts diagram

Terminal circuit design

Design of measuring terminal circuit structure

In order to measure whether or not there is a collision, it is necessary to use the sensor to measure the vibration information, at the same time, in order to meet the measurement, the converted electrical signals need to be filtered. And because the measured signal intensity is relatively weak, it needs to be amplified before entering the A/D conversion. In order to obtain all the waveform of the measured signal, the absolute value amplifier is used, and then it entered the A/D conversion. After analysis, we obtain the amplitude, frequency of waveform information and so on.

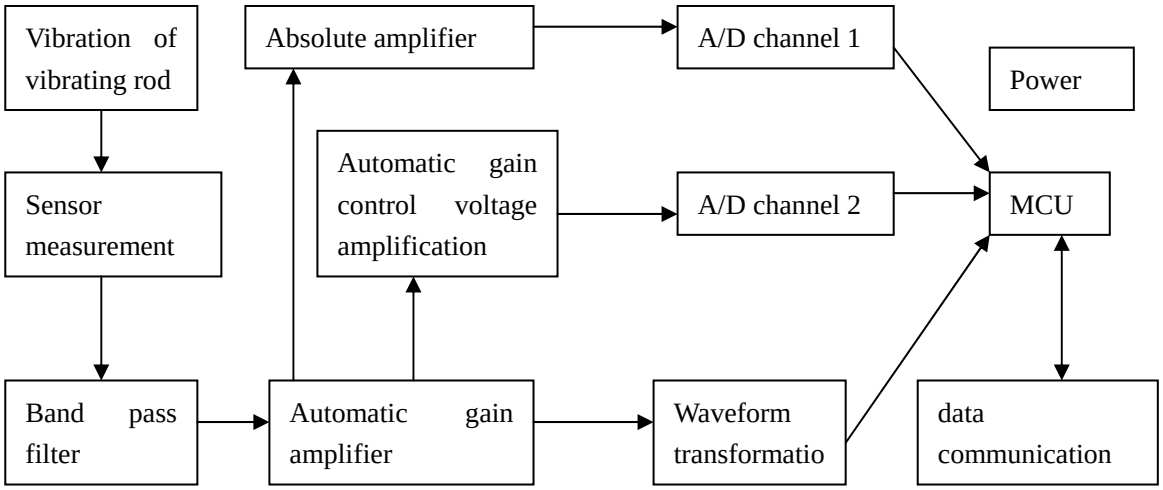

Fig.2 Measuring terminal hardware structure diagram

Due to the uncertainty of the initial amplitude of the collision initial signal, an automatic gain amplifier is designed. The signal can meet the need after the automatic gain amplifier. At the same time, in order to accurately measure the amplitude of the collision signal, the control voltage of the automatic gain amplifier is amplified and then converted to A/D, so the signal amplitude can be obtained by the conversion of two A/D values. At the same time, that the waveform after automatic gain amplifier also needs to be transformed by the hysteresis comparator provide MCU interrupt signal.

Design of measuring circuit for measuring terminal

The design of the measurement circuit is mainly to design the measurement circuit of the piezoelectric sensor which the key is to design a high sensitivity and high input impedance preamplifier.One of its functions is the impedance transformation that the high impedance output of the piezoelectric sensor is converted into a low impedance output; the two is the signal amplification taht the weak signal output of the piezoelectric sensor is amplified[1]. According to the working principle and equivalent circuit of the piezoelectric sensor, its output can be either a charge signal or a voltage signal. Therefore, the preamplifier has two forms, one is the charge amplifier, which output voltage is proportional to the input charge; the other is the voltage amplifier, which output voltage is proportional to the input voltage proportional.

The purpose of this paper is to determine whether there is a material impact furnace wall, and it is transformed into the material whether the collision pickup rod. In order to restore the waveform of the collision, we design the amplifier circuit. At the same time, because of the uncertainty of the initial signal, an automatic gain amplifier is designed with the filter part, and the appropriate electronic components are selected to meet the requirements of the amplifying circuit.

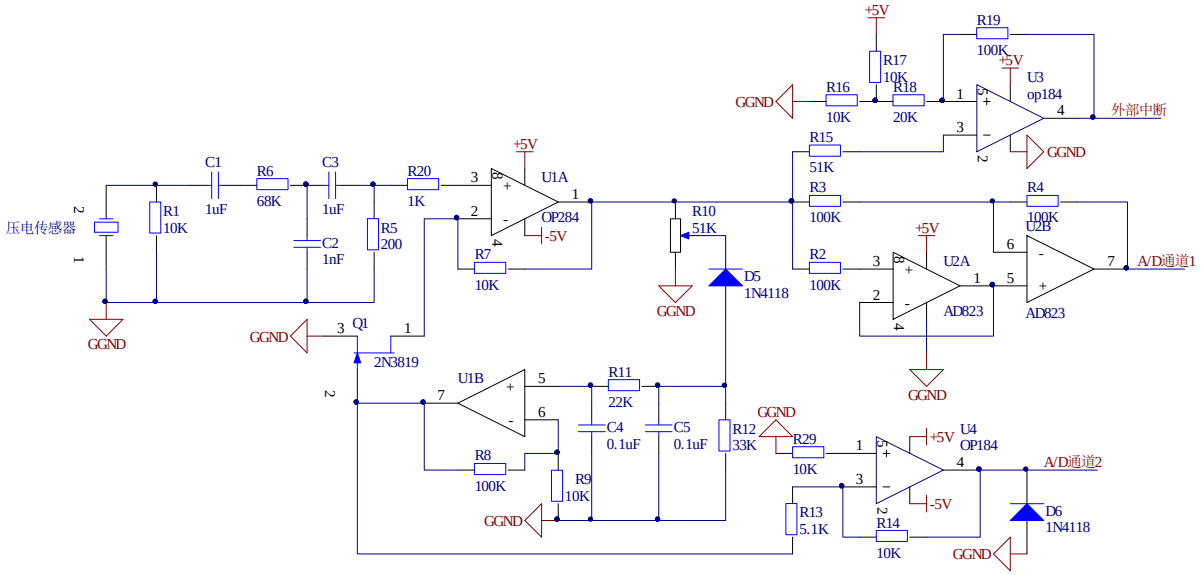

Fig.3Measuring amplifier circuit

Measuring terminal hardware master chip

In this paper, the 51 series of STC can meet the requirements for the measurement of the terminal processor we choose STC12C5608AD. This system mainly uses the A/D conversion function, timing counting function and interrupt function.The output of the signal to be measured is connected to the A/D port on the microcontroller, and after the software configuration, the waveform of the measurement signal can be realized. After schmidt shaping signal has accessed to SCMMCU external interrupt pin, there is a square wave signal when a collision occurs. Thus the microcontroller responses interrupt and gets into the signal processing procedures, at the same time, it can make use of the timing function of a single product to count its timing.

Data transmission of measurement terminal

In this paper, the data is transmitted by RS-485 and we choose ADM2483 chip，which is an enhanced RS-485 transceiver with isolation. It comprises a three channel isolator, a differential driver with a three state output and a differential receiver with a three state input.The receiver input impedance of its 1/8 unit load can allow up to 256 transceivers to access the bus, whici highest transmission rate up to 500Kbps, logical end is compatible with the 3V/5V power supply, the bus terminal is powered by 5V power supply.

Hardware circuit design of main controller

The function of the main controller is to collect the signal from the measuring terminal.The data transmission between the measuring terminal and the main control is transmitted by RS-485 mode, so the main controller must design the RS-485 circuit. At the same time, the main controller communicates with the material slot controller.Due to the distance between the two, we choose to send and receive data wirelessly. Another important function of the controller is to analyze the information to determine whether there is a collision. Therefore, the external hardware circuit mainly includes the hardware circuit of the RS-485 mode, which is the same as the the measuring terminal circuit. RF transceiver chip CC1101 external circuit is shown in Figure 4.

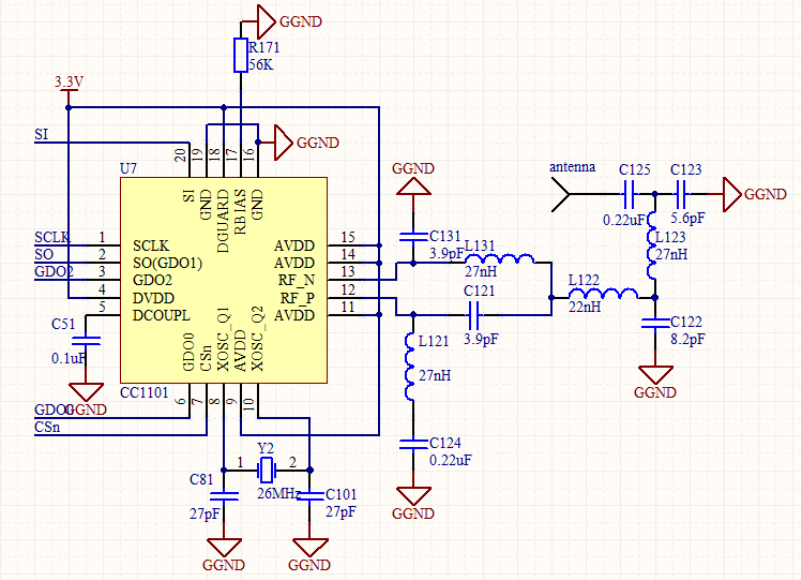

Fig 4 CC1101 external circuit is recommended

Power supply circuit of measuring system

The system uses the 485 way communication between the measurement terminal and the main controller. Because the long wire will cause a certain voltage loss, the system uses 12V power supply.At the same time, the terminal is used to measure 5V and isolation +5V, -5V,and the main controller uses isolated 3.3V power supply.

Main controller power supply

The main controller uses the wireless transceiver chip to send and receive data, and The working voltage range of wireless transceiver chip is 1.8V-3.6V, so the main control board on the MCU using 3.3V power supply. So the control MCU of the control panel uses 3.3V power supply.Due to the need for a long time consumption, it is necessary that we design to obtain the required voltage from 220V AC conversion,a it also supplies power to the measuring terminal at the same time,so we need to convert from 220V to 12V power supply. The main controller 12V turn the 5V circuit and 5V to turn off the 3.3V circuit is shown in Figure 5

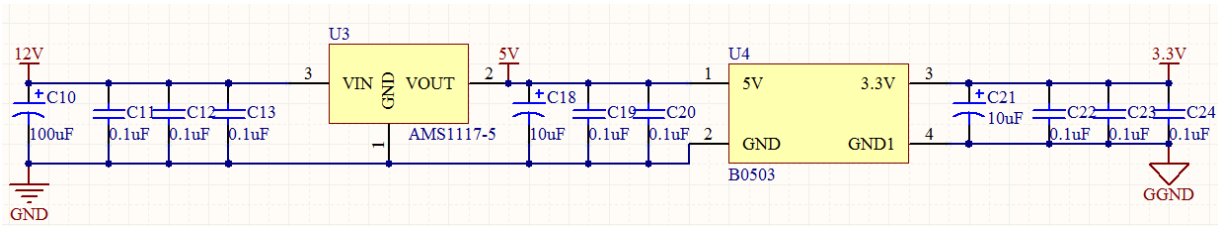

Fig.5 Master controller 12 V to5V、 3.3 V power supply

Measuring terminal power supply

The 5V power in the measuring terminal is the same as that in the main controller, and the isolation of the +5V power supply we chose the isolated DC/DC power supply B0505 (X) T-W2, the isolation of the -5V power supply conversion chip ICL766.Isolated +5V power supply selects isolated DC/DC power supply B0505 (X) T-W,and isolated -5V power supply selects power conversion chip ICL766. ICL7660 is a small power polarity reversal power converter produced by Maxim company,which input voltage range is 1.5~10V. ICL7660 is mainly used in devices that need to generate -5V power from the +5V logic power supply. The

power on the measurement terminal is shown in figure 6.

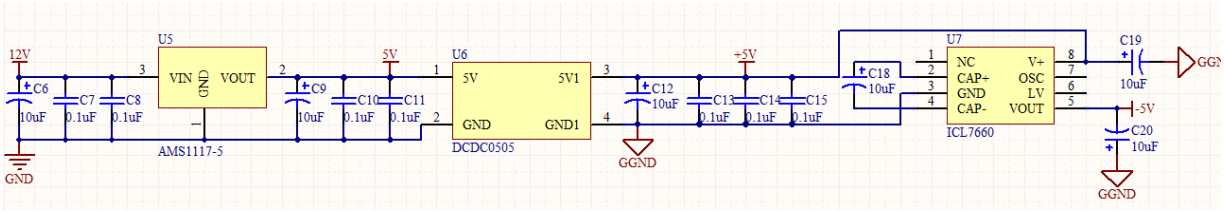

Fig.6 Measuring terminal power supply

System software programming

Measurement terminal program

A single measurement terminal can determine whether there is a collision by amplitude, frequency, attenuation ratio. The first factor is the waveform amplitude, when the wave amplitude in a certain frequency range exceeds a certain point, we can think that there is a collision.Through the reasonable choice of hardware, the signal can be filtered in a certain range. Because the amplitude of the non collision signal is small, the amplitude of the collision signal is larger,and a falling edge is generated by the appropriate magnification. Because he amplitude of the small signal has been low, there is no falling edge ,which can not interrupt and open the A/D conversion, then it will reduce the operation of scm.

Main controller main program

Collecting the analytical data of the measurement terminal is the main task of the main controller in this system and is used to analyze the collision information based on the angle of the chute,then we pass the data obtained through analysis to material slot controller. It should be noted that the received data is received in the serial port interrupt program.

The main controller will collect all the data sent by the measurement terminal and distinguish the measurement terminal A~H. We can identify the data sent through the number to determine whether the master controller is sending correctly and reply to the measurement terminal. Determine whether the master controller is sending correctly,we can get the CRC check code by the data sent over, and then determine whether the CRC check code and send the check codes are the same.The same means that the transmission is successful,not the same as the failure to send. If the transmission fails the master controller will resend the data command.

Conclusion

Through the hardware and software design of the system and the main technical aspects of the simulation experiment, the basic measurement system can meet the design requirements,which provides a practical reference for practical use.

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