Design of electric power remote meter reading system

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Abstract. Recording the electricity consumption of users is a monthly routine of the electric power department, which often requires a lot of material and manpower. Therefore, using new technical methods, with the help of automatic remote and local meter reading technology, to achieve the purpose of automatic meter reading to monitor the electric energy meter, work efficiency is improved, and the real automatic power management is realized, and the remote electric meter reading system becomes Alternative meter reading problem solutions for grid companies. This system can meet the remote data recording, collection and real-time monitoring functions of the user's electric energy meter in the remote power meter reading system within a certain range.

1. Introduction

Nowadays, the reformation of electric meters is proceeding in an orderly manner. The development of remote automatic meter reading technology has a positive effect on the improvement of users' power management level. The main characteristics of computers are high precision and fast speed. These characteristics can be used for remote meter reading. It is used in the design of the system to reduce the work intensity of meter readers, avoid unnecessary labor loss, and at the same time help reduce tolerance rate and leakage. Therefore, it can be said that the remote automatic meter reading system is fundamentally Solve all the drawbacks of manual meter reading.

According to the provincial company's meter reading work requirements for high and low voltage users, closed-loop operation and maintenance support is used to support high and low-voltage users, daily work adjustments are made on the WEB side of the closed-loop operation and maintenance system, and on-site daily routines are adjusted with the help of on-site handheld computers. In this article, the composition and principle of the remote meter reading system, the working principle of the concentrator and the functions of the main modules are introduced.
2. Composition of remote meter reading system

![Figure 1. Block diagram of remote power meter reading system](image)

Figure 1 shows the composition of the remote meter reading system. The main function of the user carrier meter in the figure is to load the carrier terminal. After that, it can use the power carrier communication to record the voltage, electricity and used power. The concentrator has on the same power distribution transformer, the data can be recorded in time-sharing according to the designed data, and the calculation results should be saved in time. The computer of the main station can also use the telephone network and other communications for the concentration period. The issuance of instructions can also remotely realize the changes of related settings. It can comprehensively read and manage data for the concentrator. At the same time, it can also realize the power-off control for each meter under the concentrator, so that it can remotely read the meter. This development has strengthened the country’s control over the power grid, significantly improved the economic benefits of the society, and reduced the use of labor and costs to a certain extent, which laid a solid foundation for the modernized management of power in the future.

3. Working principle of concentrator

The role of the concentrator in the entire remote automatic meter reading system is equivalent to the human brain. The core of the computer is the CPU. This is also the most critical part of the communication meter reading device. It can be used to complete the serial port between the concentrator and the central server. Communication function, with the help of RS232 and RS485 two interface modules, it can realize the communication function between the collector and the concentrator. At the same time, it stores the Flash memory sent from the collector, and the LCD and keyboard are used to initialize and parameterize the collector. Set up. Its working principle can be expressed as shown in Figure 2.
The concentrator can copy the meter control plan according to the different bands that have been programmed and set, and carry out two-way video data real-time transmission to the meter master station of various load bands. The internal circuit can be connected to the wireless broadcast time bus of the control system, and can perform automatic timing reading Control commands of the meter, store real-time data of the master station of the meter reading, and exchange real-time data with the master station of meter reading through a variety of wireless network media. The function of the concentrator is to connect the local carrier radio frequency electric energy meter located in the frequency conversion zone with the local network equipment of the station. It can automatically record the station data in real time and collect the relevant data of the management terminal and the station carrier electric energy meter. It can be stored and stored in real time. Through the mobile phone line or mobile phone line, the data is automatically transmitted or sent to the computer data center in the State Power Administration.

4. The components of the concentrator

The main components of the data concentrator include RAM, CPU, indicating circuit, DC power supply and interface. It mainly uses RS232 interface and carrier interface to communicate with the external SCM system.

The following are the main components:
(a). DC power supply: a DC power supply with a voltage of 5V
(b). LCD-based touch display circuit: The chip of TSC2200IRHB is mainly used.
(c). Control module: control chip type is STM32F103ZET6
(d). Interface circuit: mainly two dedicated interfaces, RS485 and RS232. These two interfaces mainly rely on cables to realize the communication between the computer and the meter reader.
(e). NAND FLASH memory module: NAND FLASH memory can store user data transferred from the collector.
(f). Emulator interface: connect to the computer for debugging, using the chip ARM JTAG.

Working principle, the working principle of CPU and RAM is not much different from traditional computers. This article will introduce the specific working principle of the interface.
RS232 interface: RS232 interface mainly includes two kinds of DB9 interface and DB25. This article mainly uses 9-pin D socket and external equipment to transmit data. For TXD and RSD, "1"=-3V~15V, "0"=+3~+15V, on the control lines of CTS, RTS, DTR, DSR and DCD: signal is valid (on, ON state, positive voltage) = +3V~+15V signal is invalid (off, OFF state, Negative voltage) = -3V~15V

The level signals on all pins of the D-type socket are EIA level: "1"=-3V~15V, "0"=+3~+15V. After the EIA level needs to be transmitted through a wire up to 100 meters long, and at the same time after the consumption of the wire is attenuated, it is still possible to distinguish between "1" or "0". Therefore, when the data concentrator transmits the signal to the D type When the socket is connected, some other
signals must be converted into D-type signals, and the signal transmitted through the D-type socket to other signals requires the help of EIA level conversion to other levels. The conversion of the level function is RS232 The primary function of, needs to maintain the consistency of the signal in order to communicate perfectly.

RS485 mainly uses the negative logic of the differential signal, +2V~+6V can be represented by "1", and -6V~−2V can be represented by "0". RS485 mainly includes two wiring methods, two-wire system and four-wire system.

The half-duplex communication method is mainly based on the two-wire system, while the full-duplex communication method is mainly based on the four-wire system.

The communication link connecting RS-485 is only to connect the "A" and "B" ends of each interface through a double glue line. However, this signal connection method is not connected to the signal ground. Although it can work normally on many occasions, it leaves hidden dangers for use. There are two main reasons:

(a). Common mode interference problem: The RS-485 interface transmits signals in a differential mode, which does not require signal detection relative to a certain reference point. The system only needs to detect the signal difference between the two differential lines. However, people have overlooked a practical problem, that is, the transceiver has a certain range of common-mode voltage. For RS-485, the common-mode voltage range of the transceiver is -7~+12V. Only when this condition is met, The entire network will work normally. When the common-mode voltage in the network cable is greater than the above-mentioned range, it will affect the stability of the communication signal and even damage the interface.

(b). EMI problem: The common mode part of the output signal of the driver must be transmitted through a return path. If there is no return path with low impedance (usually signal ground), radiation will be generated to the source end, and the entire bus will become a huge The antenna transmitter radiates electromagnetic waves.

5. STM32F103ZET6 chip test
The last full-page circuit test tested whether the STM32F103ZET6 chip has any problems such as false soldering, component soldering, short circuit, open circuit, etc. After completing all the checks, it is necessary to test the chip I/O function and each pin function.

You can use a multimeter to test the STM32F103ZET6. The main checkpoints include whether there is a short circuit between adjacent pins or virtual soldering between the pins and the PCB. If there is a short circuit, the chip may be burnt, and the normal operation of the chip may be affected if there is a virtual solder. After testing one by one, STM32F103ZET6 has no short-circuit and virtual soldering. The system power supply voltage measured after power-on is +−5V, and all the pins of STM32F103ZET6 connected to the power supply are 3.3V, everything is normal.

5.1. Reset pin, crystal oscillator pin, serial communication pin test
Reset pin: After the circuit system is powered up and down on the power line, NRST (pin 25) is a high level. After pressing a reset button, NRST (pin 25) changes to a low level, so we can Accurately determine the normal operation of each reset pin circuit.

Crystal oscillator pin: Observe the STM32F103ZET6 crystal oscillator pin with the help of an oscilloscope. You can see a sine wave with the same frequency as the crystal oscillator, with an amplitude of about 1V, which proves that the crystal oscillator circuit can work normally.

Serial port communication pins: Write the corresponding program in keil, so that a certain pin can output a square wave signal, and compile and download it to STM32F103ZET6 at the same time. With the help of an oscilloscope, the square wave signal can be seen near the pin, which proves that the circuit and The connection between the serial communication pins is normal.
5.2. **I/O port function test program design**

The I/O port is the channel for data exchange between STM32F103ZET6 and external components. The I/O port has two working modes, one is bus mode and the other is I/O port. Due to the numerous peripheral devices of the system, and most of them are based on position control, the I/O mode is adopted.

(a). Test byte output mode

STM32F103ZET6 has seven groups of I/O ports, mainly PA, PB, PC, PD, PE, PF, PG. The so-called byte output method is to allow a certain group of I/O ports of STM32F103ZET6 to output one byte. When testing, only one group of I/O ports of STM32F103ZET6 can output one byte according to the corresponding program. Prove that the byte output method is normal. After the test, the port output of all bytes proved to be correct.

(b). Test bit output mode STM32F103ZET6 has a total of 8 bits for each group of I/O ports, and the bit output mode is to make any bit of each group output 0 or 1. When testing, just let STM32F103ZET6 each group of 8 bits output 0 or 1 according to the program, which can show that the bit output mode is normal. After the test, every bit output mode of all ports is normal.

6. **Conclusion**

Refers to the meter reading system can be said to be a perfect combination of modern metering technology, information communication technology, and computer technology, capable of taking into account data collection and processing, energy consumption measurement, etc. Combining urban residents' energy consumption information and comprehensive governance can not only greatly improve departmental work efficiency, but also meet the new demands of users for payment today.

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