



Research Article

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## IC card filling machine controller based on LPC microcontroller design

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### ABSTRACT

*This paper realizes the design based on LPC2119 single chip processor for refueling IC card controller, through the installation of equipment in the existing filling machine, can not only make the refueling machine with the functions of IC card refueling and IC card clearing, at the same time, fuelling record and some configuration information can be stored in the local of ferroelectric memory. For the transformation of gas station, don't need to replace the expensive refueling machine, only need to add an IC card controller based on the existing filling machine, thereby greatly reducing the cost of upgrading the gas station, but also laying the foundation of the next step of information upgrade for gas station.*

**Keywords:** LPC2119 micro controller; logic of smart card of SLE4442; Interface; Ferroelectric memory

### INTRODUCTION

In recent years, with the rapid development of China's national economy, the continuous improvement of transportation infrastructure and the rapid increase of vehicles, gas station has become an indispensable part of people's lives. In the 50s, the gas station amount to only 70 or so; at the end of the 60s less than 200 or so; at the end of the 70s development to around 600; national gas station about 3600 seat in 1985; at the end of 1990 to more than 5000; in 1993 soared to around 38000; at the end of 1996 reached 42600; by the end of 2000, the national gas station total to more than 80000; by the end of 2011, a total of 100371 gas station, among them, petrochina proprietary and licensed gas station number is 19362, accounting for the total number of gas station nearly 2; Sinopec proprietary and licensed gas station number is 30121, accounting for the total number of gas station about 1/3; other gas station a total of 50888 seats, accounting for 50.7% of the total number of the gas station. So far, Sinopec and PetroChina's gas station have been realized the functions of IC card refueling and IC card clearing, other gas station have also been realized partially implemented the functions of IC card refueling and IC card clearing; There is a large part of smaller private gas station do not achieve the functions of IC card refueling and IC card clearing, this kind of gas station still stays in the single mode operation, model of artificial refueling, aiming at this phenomenon, we put forward a design scheme of refueling IC card controller, based on the existing filling machine, by increasing the IC card controller, which makes the gas station refueling machine also has the functions of IC card refueling and IC card clearing, laying the foundation of the next step of information upgrade for gas station[1-2].

### 2. Main Chip Introduction

Philips ARM chip LPC2119. The micro controller LPC2119 is based on a real-time simulation and tracking of 16/32 ARM7TDMI-S CPU, and a high speed Flash memory with 128/256k byte (KB) embedded. The memory interface of 128 bit width and the unique accelerating structure can make 32 bit code operate at a maximum clock rate. The applications which have strict control of code size can use 16 bit Thumb mode reducing code size by more than 30%, and the performance loss is very small.

Because LPC2119's smaller 64 and 144 pin package, low power consumption, a plurality of 32-bit timers, 4 road 10 bit ADC, 2/4 road CAN or 8 road 10 bit ADC, 2/4 road CAN (64 pin and 144 pin package) and up to 9 external interrupt make them particularly suitable for industrial control, medical system, access control and POS.

In the 64 pin package, 46 GPIO can be used at most. In the 144 pin package, the GPIO can be used as high as 76 (the use of external memory) to 112 (monolithic application). Because of the serial communication interface built in a wide range, they are also very suitable for the application in the communication protocol converter, gateway, embedded soft modern and various other types of.

### **The logical IC card SLE4442**

Logic encryption card SLE4442 is an intelligent byte EEPROM card company launched by German Siemens with write protection function and confidentiality logic of 256, and it has the following features: the two-wire communication protocol, serial interface, contact configuration, erasable at least 10000 times and data can be maintained for more than 10 years, a wide range of working temperature: -35 °C ~80 °C.

SLE4442 memory is divided into main memory and secure memory, main memory is 256 bytes, divided into protection memory and application memory. Protection memory address unit is 00H~1FH, the application memory address unit is 20H ~ FFH. The protection memory relative to application memory is different, and it has a protective function, can be written the corresponding protection and protected. After the protection, protected unit cannot be erased; if not protected, the use and application of memory are exactly the same. In addition, the protection function is not reversible, a certain unit of protection memory once protected cannot remove protection, a 32-bit memory and protect is the corresponding to the 32 bytes of memory protection.

Typically, the curing information of SLE4442 memory protection:

00H ~ 03H: reset the response information (ATR).

04H ~ 07H: chip manufacturer code and card type code (curing factory).

15H ~ 1AH: application identifier.

Secure memory has 4 bytes, including 1-byte error counter (EC) and 3 bytes of secret code (PSC). SLE4442 goes on password logic operation through the secure memory to control the whole main memory erased. After it was powered, the entire memory can only be read except the password, only when the password to verify correct can erase, three consecutive cryptographic checksum error chip self-locking, and never to erase.

A non-volatile ferroelectric random access memory FM24CL64. FM24CL64 is a 64K bit non-volatile memory adopting advanced technology manufacturing ferroelectric technology. Ferroelectric random access memory (FRAM) with a non-volatile, and can read and write as quickly as RAM, data can be kept for 10 years after power failure, compared to EEPROM or other nonvolatile memory, FRAM system with high reliability, simple structure etc.. Unlike the EEPROM series, FM24CL64 writing at bus speed, high reliability's ferroelectric manufacturing process, without delay. After data sent to FM24CL64 directly to specific unit address, the next bus operation can start immediately. FM24CL64's reading and writing life is as a lot of times as EEPROM's, but also because there is no need to boost circuit by internal voltage, during a write operation FM24CL64's power consumption is much lower than that of EEPROM. These characteristics make the FM24CL64 very ideal more for some non-volatile applications, in these situations, the system operating frequency and the speed of reading and writing require very highly. For example, in data acquisition applications, systems has a high requirement on the write cycle, longer write cycle of EEPROM may cause loss of data, the comprehensive properties of FM24CL64A enable the system write faster speed and have less overhead.

FM24CL64 provides the convenience for the users of using serial EEPROM, it can directly replace the EEPROM in hardware. FM24CL64 using two wire interface of industrial standard, bus speed can reach 1MHZ, upward compatible with 100K and 400K bus speed, unlimited number of read and write, data remain for 10 years after power-fail, 8 pin SOIC package, operating temperature range: -40 °C to +85 °C, working voltage: 2.7V ~ 3.6V, dynamic working current: 75uA (100KMZ), the quiescent current: 1uA.

### **3. Hardware Design**

IC card controller not only can control refueling machine through the IC card can also control remotely through communication interface, IC card controller also has the function of data storage, records of refueling tanker can be stored in local in ferroelectric memory. Managing computer remotely manage the tankers through communication interface, real-time state while refueling machine can come on record and also manage the computer through the interface to upload.

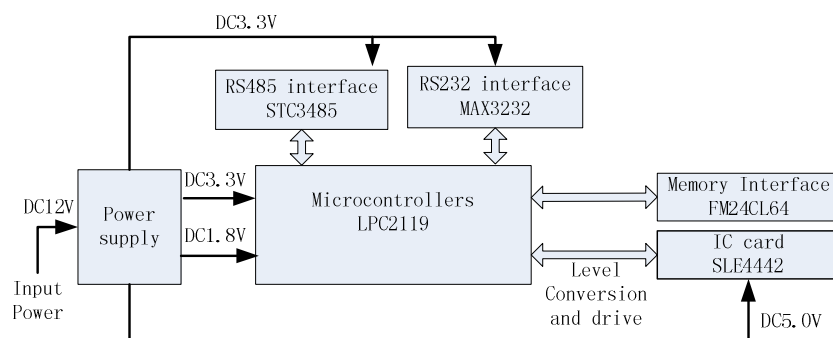


Fig.1 The realizing principle diagram of the system

The principle of realization. IC card controller adopt Philips ARM7TDMI structure based on LPC2119 microprocessor as the core processor, using 1.8V and 3.3V system; to match with processor level signal, peripheral interface circuit chip adopts 3.3V power supply system; IC card uses SLE4442 logic encryption card made by Germany Siemens, but because the SLE4442 card uses the 5V power supply system, so increasing the voltage conversion interface circuit between SLE4442 and controller, in order to meet the level matching; the entire power system with 5V, 3.3V and 1.8V power output, the input power supply using DC12V power system[3-4], The principle of realizing the system as shown in Fig.1.

### Communication interfaces design

Communication consists of two interfaces, one is with the filling machine real-time communication interface, this interface uses the RS232 interface standard communication, interface chip adopts low voltage (3.3V) chips MAX3232, SOIC16 pin package, the interface chip with 2 RS232 interfaces, in the application we only use 1 way of them; The second is a communication interface to exchange data and command, the interface uses the RS485 interface standard communication, interface chip adopts low voltage (3.3V) chips STC3485, SOIC8 pin package, the communication interface for slave mode, communication with PC using a answer Type[5-8]. The interface circuit as shown in Fig.2:

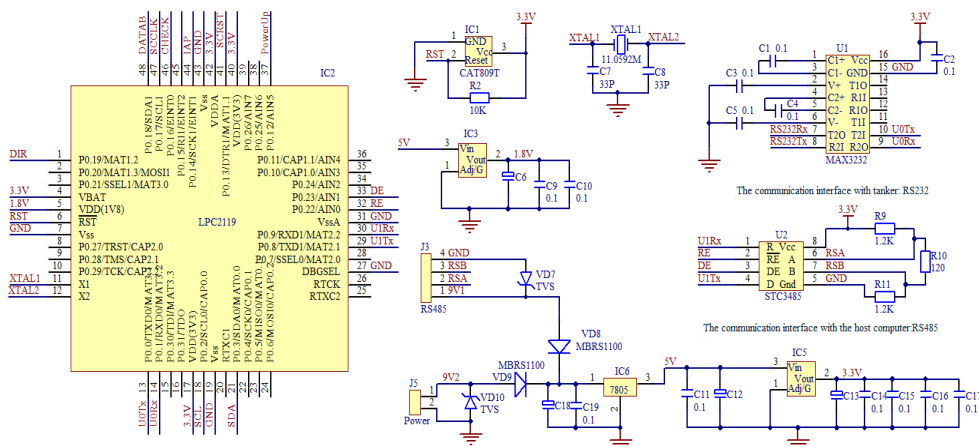
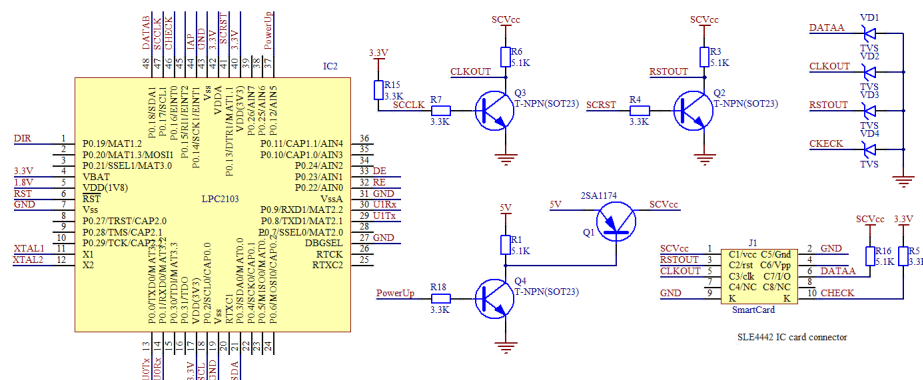
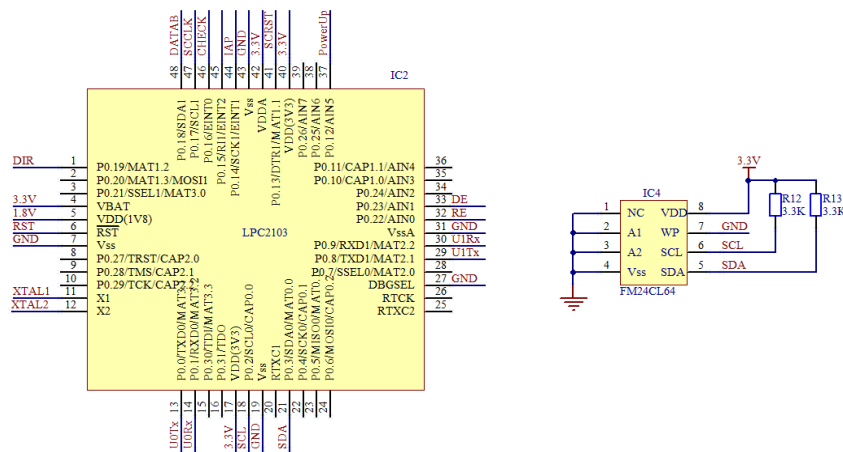


Fig.2 Communications, power interface circuit schematics

**The design of SLE4442 interface logic encryption card.** IC card is the core of this application, the reliability is especially important. In order to improve the reliability, The following processing interface circuit:1, the IC card is using the 5V power system, but the SCM uses 3.3V power system, in order to satisfy the matching interface level, interface increases transistors between the IC card and the chip;2, because the IC often pull plug, to prevent the surge damage of the interface, interface increases the anti surge protection diode TVS; 3, the power of the IC card using on-demand treatment, only when the system detects the IC card inserted, the system will give an IC card power (send electrical power), once detected IC card out, the system immediately cuts off the power supply[9]. The interface circuit as shown in Fig.3.

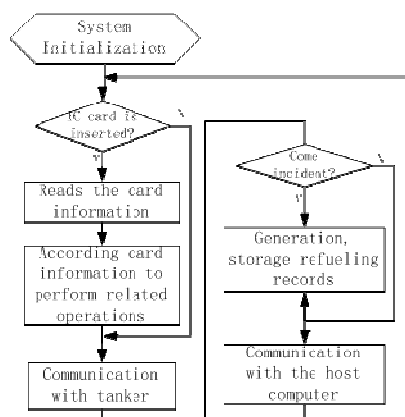


**The ferroelectric memory's interface design.**The controller uses FRAM memory of the I2C serial interface to store data, model for the FM24CL64, the memory has a storage capacity of 64K[10]. interface circuit, as shown in Fig.4.



## 4. Software design

The software is written by C language, development tools for ADS V1.2. Software adopts modular design, a total of three function modules: serial communication module, IC card function module, I2C memory module; application software to complete the system by calling the three basic function module,the software flow chart as shown in Fig.5.



Serial ports communication module. Data communication using interrupt mode to receive data, serial communication module package has the following basic functions:

A. omunication port initialization function: void UARTInit (eUARTNUM UARTNum, uint32 Bps).

B. The data receiving interrupt function 1: void\_irq UART0ISR (void).

C. The data receiving interrupt function 2: void\_irq UART1ISR (void).

D. The baud rate setting function: uint32SetUARTBaudRate (eUARTNUM UARTNum, uint32 Bps).

IC card function module. IC card of IC card read-write function module in the insertion detection using interrupt mode, the function module has the following functions:

A. IC initialization function: void SmartCard\_init (void).

B. IC card to receive data function: uint8 SmartCard\_ReceiceData (void).

C. IC card data sending function: uint8 SmartCard\_SendData (uint8 SendData).

D. IC card to reset function: uint8 SmartCard\_Reset (void).

E. IC card to read Memery function: void Read\_SmartCard\_memery (uint8 command, uint8 address, uint8 \*RD\_string, uint8 number).

F. IC card to write Memery function: void Write\_SmartCard\_Main\_Memery (uint8 command, uint8 address, uint8 \*WD\_string).

G. IC card detection function: void\_irq SCcheck\_ISR (void).

The I2C memory function module. The I2C memory function module uses the micro controller I2C serial interface to make data communication with ferroelectric memory, the function module has the following basic functions:

A. Communication interrupt service function: void\_irq I2C\_ISR().

B. Port initialization function: void I2CInit (void).

C. Read the data function: uint8 Read\_FM2464 (uint16 FmSubAdd).

D. Write data storage function: uint8 Write\_FM2464 (uint16 FmSubAdd, uint8 TxChar).

## CONCLUSION

After the actual test the IC card controller, fully meet the design requirements, and reliable data storage, data stored in the PC can be read correctly by interface, can be controlled to work by the IC card refueling tanker, according to different function IC card inserted, can realize different control, when pulling out the IC card, refueling locked immediately, button keyboard stops working, the IC card controller has been implemented small batch production trial.

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