

Design of a High Precision Data Acquisition System Based on Microcomputer

Yuxi Sheng^a, Chao Fan^b

Changchun University of Science and Technology, Changchun 130022, China

^a1019221428@qq.com, ^b18686684024@163.com

Abstract. MSP430 microcomputer is selected as the core, a high precision, multifunction, low power data acquisition system is developed. It can also achieve the function of remote wireless data transmission through message wireless communication, it ensure that remote monitoring data in unattended environment.

Keywords: MSP430 microcomputer; GSM; ADS1224; AT45DB161B.

1. Introduction

Data acquisition system has found wide application in the field of automatic control. This paper choose MSP430F149 microcomputer as the core, by extending some modules, design a high precision, multifunction, low power data acquisition system. System structure diagram is as Fig.1.

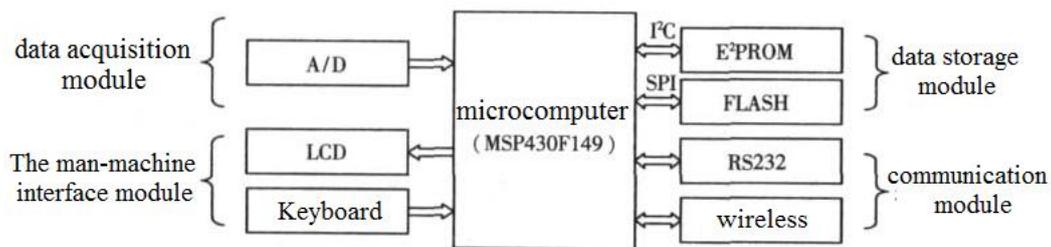


Fig.1 System structure diagram

2. Microcomputer

This design adopts MSP430F149 produced by TI Company. It has the following characteristics: ultra low power consumption; strong processing ability, on-chip registers, rich addressing method, concise command. It also integrates dozens of I/O port, 12-bit A/D, the watchdog circuit etc. It can realize online editing process by using FLASH memory and JTAG technology.

3. Data acquisition module

3.1 Analog acquisition

The maximum sampling rate of 12 digits A/D converter integrated in MSP430F149 can be 200Ksps. In this design, A0-A2 pin is acquisition pin. At the same time, in order to realize the high precision measure, this design extends a 4 channels 24-bit serial A/D converter ADS1224. ADS1224 is a successive approximation serial 24-bit high speed CMOS A/D converter produced by Burr-Brown Company. It offers excellent performance and low power. Its Integral nonlinearity (INL) can be 0.015%, and its sampling frequency is 240sps. Its differential input signal ranges from 500mV to VCC.

3.2 Switch signal acquisition

This design realize the 4 channels switch signal acquisition. The external switch signal through photoelectric isolation inputs to P1.0-P1.3 port of MSP430F149. P1.0-P1.3 port is defined to be interrupt input pin.

Data acquisition module diagram is as Fig.2.

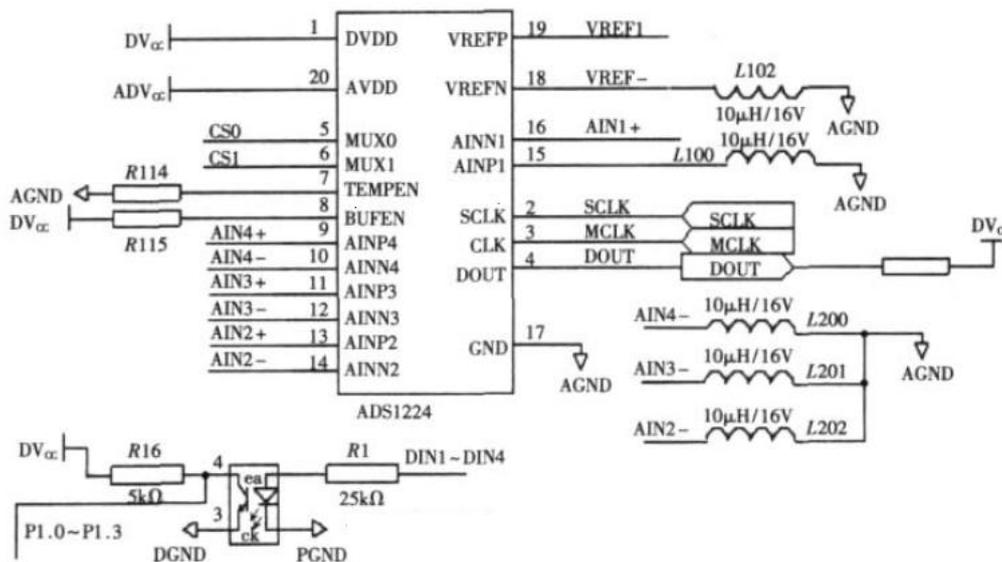


Fig.2 Data acquisition module diagram

4. Man-machine interface module

4.1 4*4 keyboard

This design can realize the parameter setting, mode selection function by using matrix 4*4 keyboard. This design also solved the problems of keyboard debounce, composite keys distinguish.

4.2 LCD

This design use CA240128E dot matrix LCD display. It built in 7602 commonly used simplified character, national standard GB code font, and multiple groups of half width characters. Matrix number is 240(column)*128(line). Graphics, characters can be displayed well.

5. Data storage module

5.1 E2PROM storage

The FM24CL64 is a 64-kilobit nonvolatile memory employing an advanced ferroelectric process. It communicates with microcomputer through I2C bus structure. It provides reliable data retention for 10 years while eliminating the complexities, overhead, and system level reliability problems caused by EEPROM and other nonvolatile memories. The FM24CL64 performs write operations at bus speed. No write delays are incurred. Data is written to the memory array mere hundreds of nanoseconds after it have been successfully transferred to the device.

5.2 Flash storage

The AT45DB161 is a 2.7-volt only, serial interface Flash memory suitable for in-system reprogramming. Its 17,301,504 bits of memory are organized as 4096 pages of 528 bytes each. In addition to the main memory, the AT45DB161 also contains two SRAM data buffers of 528 bytes each. The buffers allow receiving of data while a page in the main memory is being reprogrammed. Unlike conventional Flash memories that are accessed randomly with multiple address lines and a parallel interface, the Data Flash uses a serial interface to sequentially access its data. The simple serial interface facilitates hardware layout, increases system reliability, minimizes switching noise, and reduces package size and active pin count. The device is optimized for use in many commercial and industrial applications where high density, low pin count, low voltage, and low power are essential.

6. Communication module

6.1 Communication module interface

The GPRS module in this design is SIM100 produced by SIMCOM Company. SIM100 is a dual band GSM/GPRS module of SIMCOM, it mainly provides interfaces for voice, message and data transmissions. SIM100 integrated full RF circuit and GSM base band processor; it is suitable for GSM/GPRS wireless applications.

6.2 Characteristics of SIM100 system functions

Both 3.0V SIM card and 1.8V SIM card are supported by the module. SIM100 can auto detect and adapt different cards. In order to prevent electrostatic damage, the transient voltage suppression diode is placed near the SIM card pin positions. ESDA6V1W5 is composed of 4 one-way diodes; it can achieve highest static 25kV Transient protection. And it has small volume, suitable for this design.

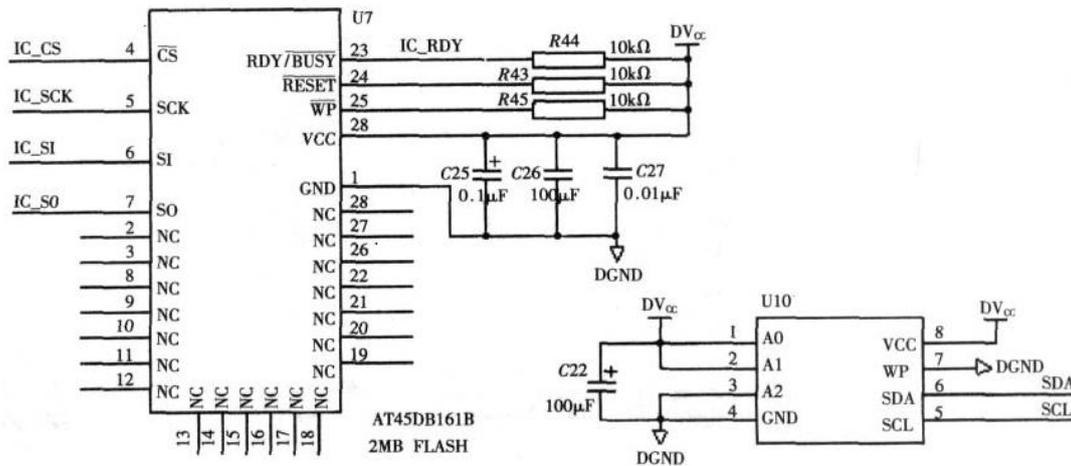


Fig.3 Diagram of the data storage module

6.3 Design of communication module program

The essence of this part is the communication between MSP430 and GPRS wireless module. The difficulty is the setup and the using of AT command. The operations such as the establishment of wireless channel, the data transmission, and so on, are accomplished through AT command. MSP430 send AT command to the module and receive the return value by some protocol, then carry out the corresponding check.

Modular software design makes detection more flexible, and improves equipment's generality and expansibility. It mainly consists of system initialization module, parameter configuration module, GPRS link establishment module, data transmission module, GPRS disconnect module.

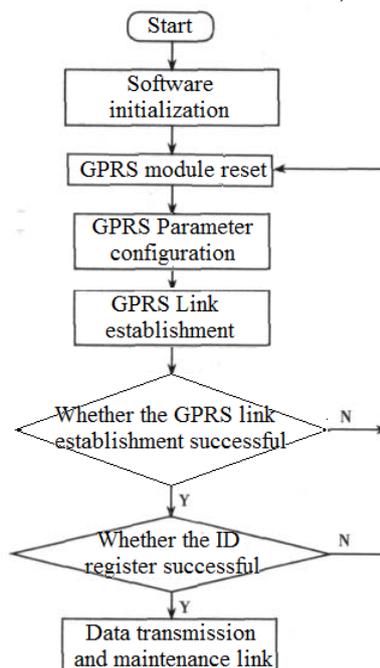


Fig.4 Design of GPRS communication module

7. Conclusion

This design chooses MSP430F149 microcomputer as the core, realized of some functions includes: accurate acquisition, real time display, real time storage, human-computer interaction, wireless communication. It has a good application prospect in wireless remote data monitoring field.

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