



# SPMC75F2413A EVM Board User's Guide

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## Revision History

Revision	Date	By	Remark
1.2	02/20/2006	Chih-Ming Huang	1. New EVM board circuit design. 2. Add I2C eeprom, key input, serial interface display and ADC. 3. Rename u'nSP IDE to unSP IDE
1.1	03/15/2005	Chih-Ming Huang	4. New EVM board circuit design. 5. Add SPI DAC, clock source selection, UART selection and motor control interface, etc.
1.0	01/04/2005	Chih-Ming Huang	Initial version

## 1 General requirement

### 1.1 Software Requirement

The SUNPLUS unSP IDE 2.0A or later version development tool for windows version.

### 1.2 Hardware Requirement

1. IBM compatible personal computer (Parallel port or USB port is required).
2. ICE Probe (DB25 x 1 or USB x 1).
3. SPMC75F2413A EVM board x1.
4. One AC to DC adapter for ICE and EVM board, the specification should be:
  - Output Voltage: DC 9V.
  - Output Current: DC 1.2A.
5. View of SPMC75F2413A EVM Board is shown as follows:

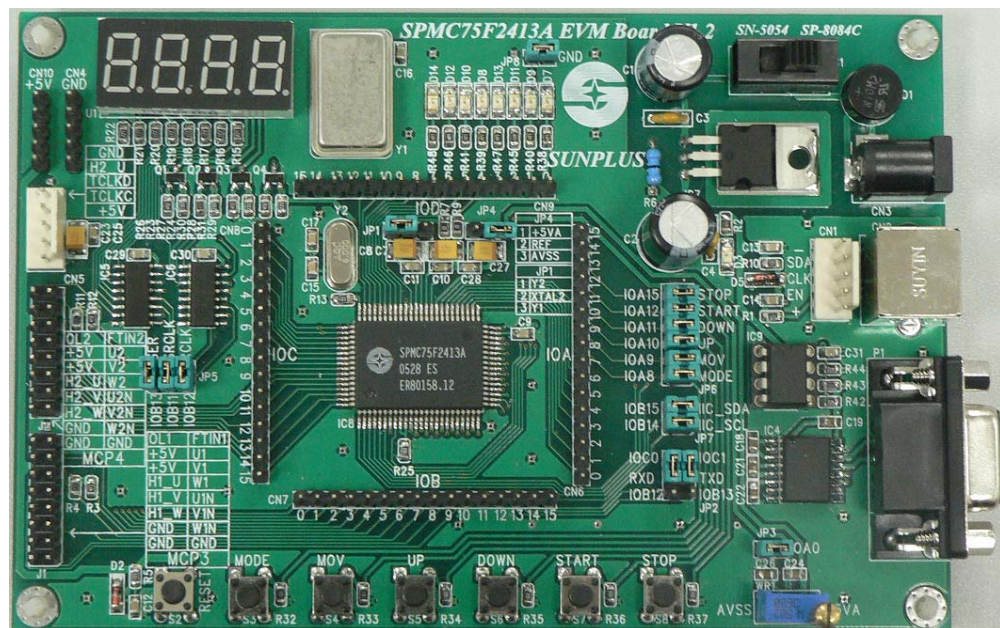


Figure 2-1 the real view of SPMC75F2413A EVM Board

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## 2 Getting Start

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### 2.1 Introduction

The ICE PROBE is connected through the parallel port or USB port to PC that runs the unSP IDE development tool. Connecting steps are listed below. SUNPLUS strongly recommends you to connect them according to following order.

### 2.2 Installing The Hardware

1. Turn off the PC;
2. Insert parallel (USB) connector of ICE cable into PC parallel (USB) interface;
3. Insert the other end of ICE cable into the ICE connector CON1 on the EVM board;
4. Turn on the PC;
5. Insert connector of DC 9V into J10 connector, and then turn on the DC 9V.

### 2.3 SPMC75F2413A EVM Board Hardware Setup

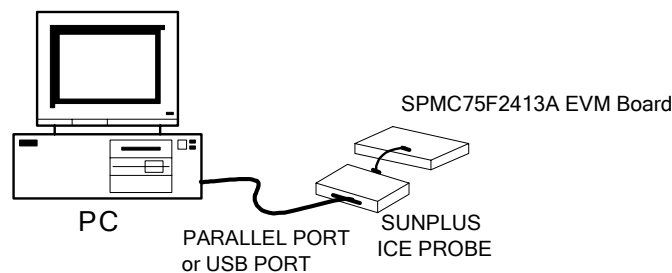


Figure 2-1 SUNPLUS ICE Probe with SPMC75F2413A EVM Board

### 2.4 Installing The Software

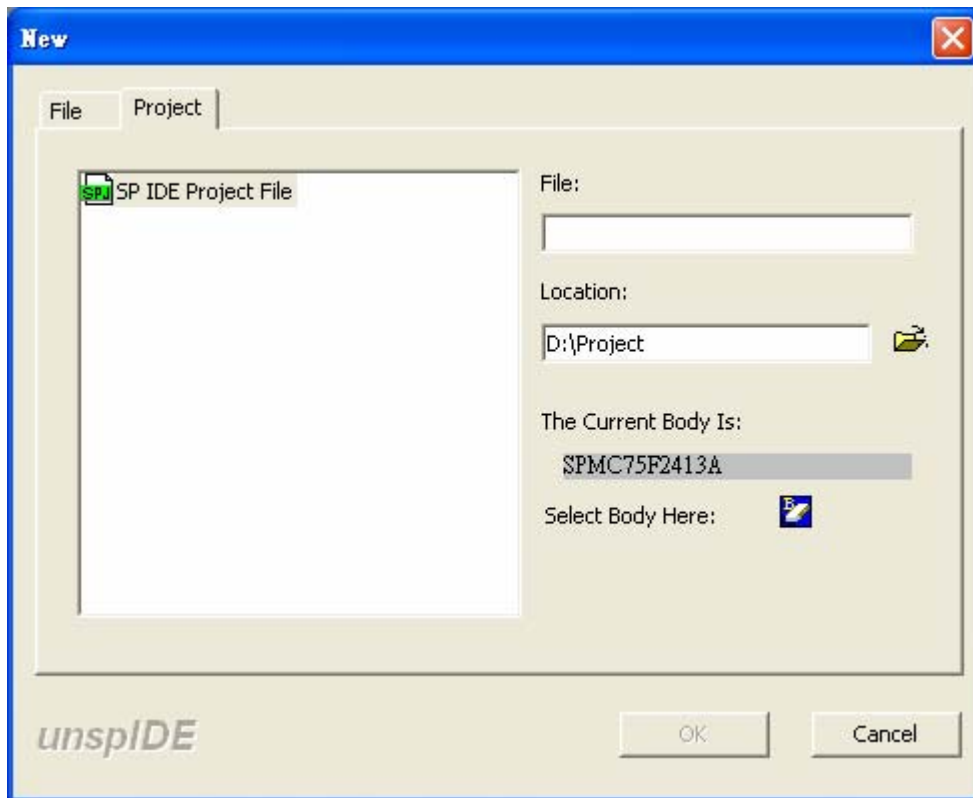
The SUNPLUS unSP IDE V2.0A or later version is for an integrated development environment for SPMC75F2413A. Some features are project management, text edit, program compile, and debug capabilities. User could not only edit your program but also debug it by unSP IDE tool. The following steps could guide you to open a project and execute your program quickly. Certainly, By means of SUNPLUS unSP IDE development environment, User could develop program easily and efficiently.

**Step1:** Insert the unSP development software into your computer CD-ROM driver.

**Step2:** Manually, Run "Setup.exe" file to install the unSP IDE tool.

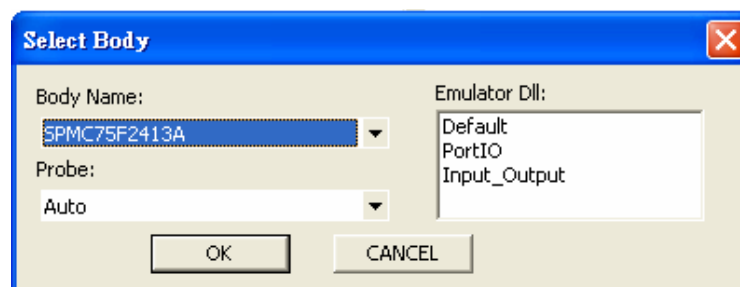
**Step3:** After unSP IDE tool installed, you could click **unSP IDE 2.0A** or later version to execute unSP tool.

**Step4:** From the main menu, choose **File -> New**. The following dialog box will appear. Click "**project**" to create a new project.



**Figure 2-2** The Creation New Project Dialog Box

**Step5:** Key-in the new project name and select a specify MCU body name as SPMC75F2413A you want to develop on EVM board, and click “finish”. The project which included both \*.h and \*.rc files was created. Finally, You still need to create a \*.asm file or \*.c to make the entry point for your project. The main() function is the default entry point in C language development environment.

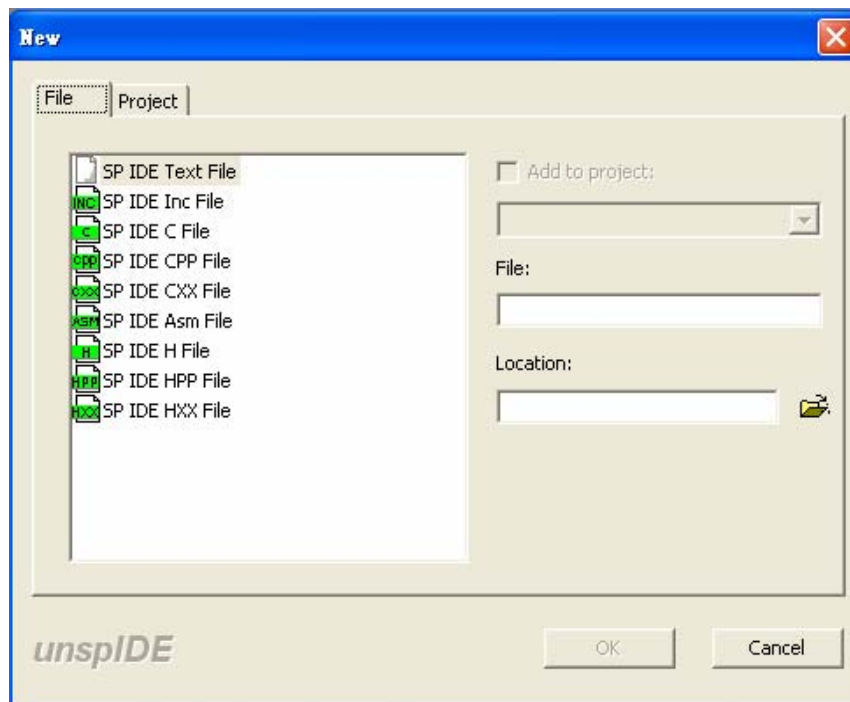


**Figure 2-3** Selection of MCU body

**Step6:** From the main menu, Choose File > New. Click “File” to create a new file. For example, new a C example file **Example.c**.

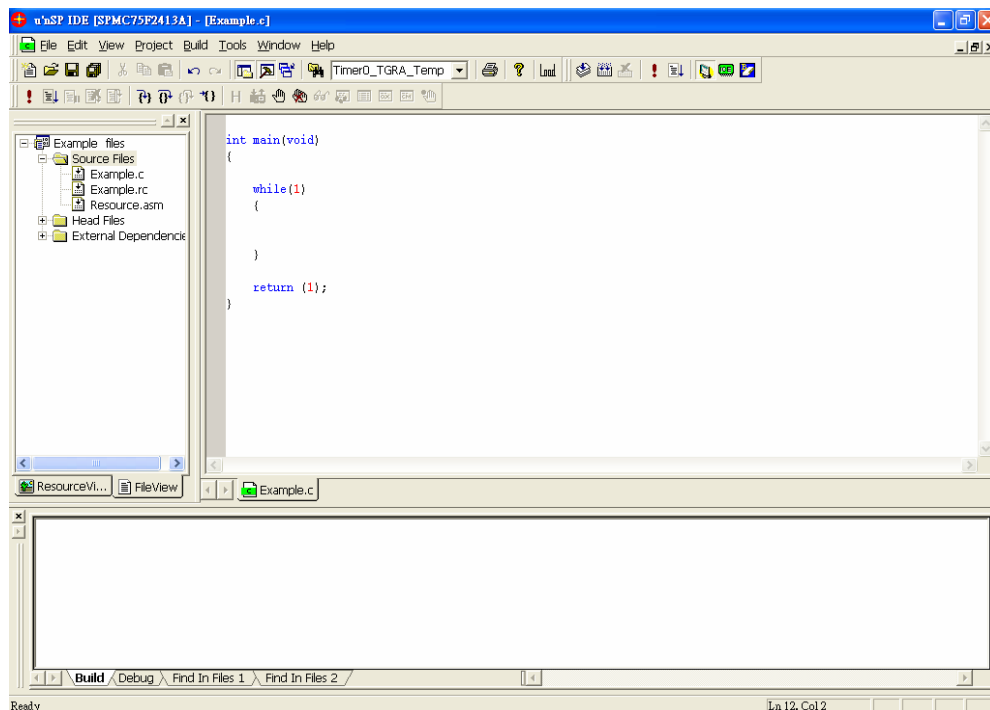
**Step7:** After clicking “File”, the following dialog box will appear.

You have nine kinds of files to choose. Choose “SP IDE C File” and key in file name, then click “OK”.



**Figure 2-4** Creation file Dialog Box

**Step8:** When step1 to step7 have already been executed, from the main menu, choose **View -> Workspace**. A window would be displayed as following picture. With selection **Example.c** on workspace, you could edit your source code on the right side of window.



**Figure 2-5** Edition session Started



- Step9:** After finishing your source code, you could compiler and linker your source code by following steps.
- Step10:** From the main menu, choose **Build > Build all**. The User interface would display the result of execution.
- Step11:** From the main menu, choose **Build -> Start Debug -> Go**. Your program would be downloaded to memory with associated address and executed.

Congratulations! You have successfully completed this tutorial!

You can continue to experiment with the unSP IDE interface. For an in-depth guide of all of the user interface features, select **Help -> Help Topic** for detail.

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## 3 SPMC75F2413A EVM Boards Components

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### 3.1 Introduction

The SPMC75F2413A EVM Board has the following hardware features:

- ◆ The SPMC75F2413A Micro-controller can be on-chip programming the developer's application software and debug in unSP IDE environment through the embedded ICE logic.
- ◆ A standard connector for SUNPLUS Probe use.
- ◆ A connector for DC power input 9V, 1.2A.
- ◆ A push-button switch connected to reset MCU (S2).
- ◆ Eight high-efficiency LEDS connected to GPIO IOD[7:0]. User could use the LED port to output status for indicating the MCU operating state. The LED output will be disabled by opening jumper JP8.
- ◆ Six push-button switch connected to IOA[8:12, 15]. The default name are MODE, MOV, UP, DOWN, START and STOP which are useful for manually key input in inverter-based application. These signals can be disabled by opening the jumpers JP6.
- ◆ A UART transceiver circuit connected to the ports IOC0/IOC1 or IOB12/IOB13 depending on jumper JP2 settings. The MCU can communicate to PC with Hyper-terminal software.
- ◆ The SPI pins, SDI, SCLK and SDO are connected to a four-digit display device. These signals can be disabled from opening the jumpers JP5.
- ◆ A I2C eeprom circuit which are connected to IOB[14:15]. These signals can be disabled by opening the jumpers JP7.
- ◆ The clock source can be selected either from crystal device or external oscillator. It can be done through the jumper JP1.
- ◆ Two channels motor control and position input interface which are reserved at J1 and J2 connectors. The default fault input FTINx and overload input OLx will be pull to high by external resistors.

This chapter will describe the major components on the SPMC75F2413A EVM board and hardware interface which connected to SPMC75F2413A chip. It includes the power circuit, EEPROM, IO expansion, encoder input interface, motor control interface, LED display, four-digit segment display, UART, key input and ADC interface.

### 3.2 SPMC75F2413A EVM Board Connectors Location

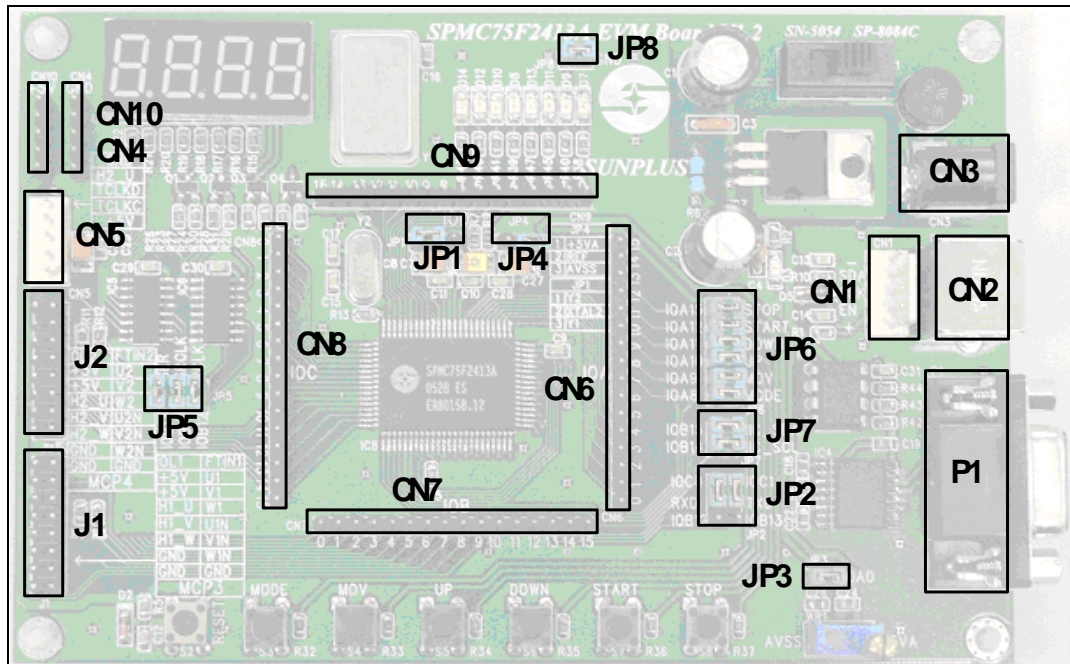


Figure 3-1 Connectors Location of SPMC75F2413A EVM Board

### 3.3 Power

Figure 3-2 shows the power circuit of EVM board. The input is from 9V adapter and rectified by diode bridge D1. The output is connected to a regulator LM7805 and supply +5V voltage to whole EVM board. The 3.3V is output from a simple zener voltage clamp circuit.

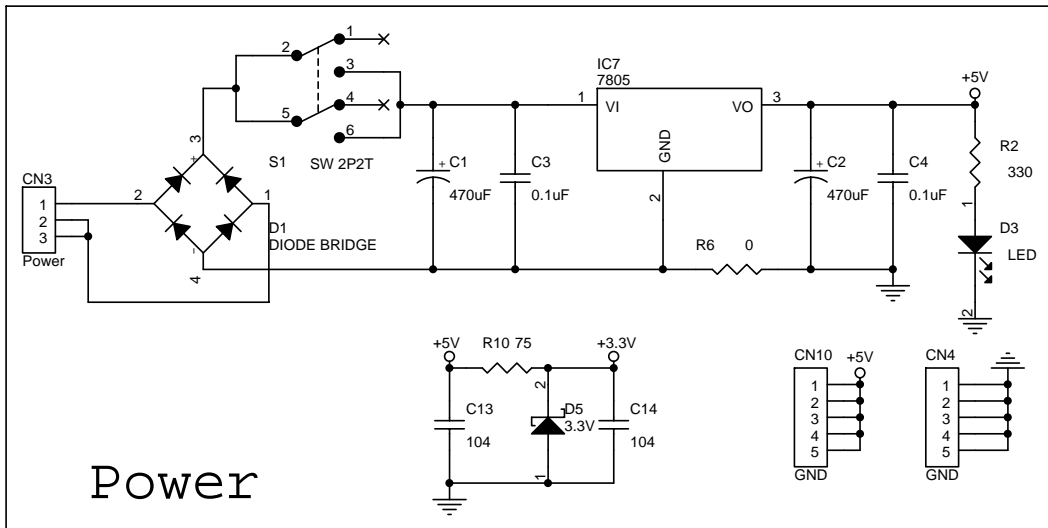


Figure 3-2 Power circuit of EVM board

### 3.4 EERPOM

The EEPROM storage circuit is shown in Figure 3-3. It consists of a 4K byte EEPROM AT24C04 and communicate with SPMC75F2413A by using I2C protocol. The SPMC75F2413A use software and polling method to simulate I2C protocol and access the data of EEPROM. The EEPROM access signal will be disabled by opening jumper JP7.

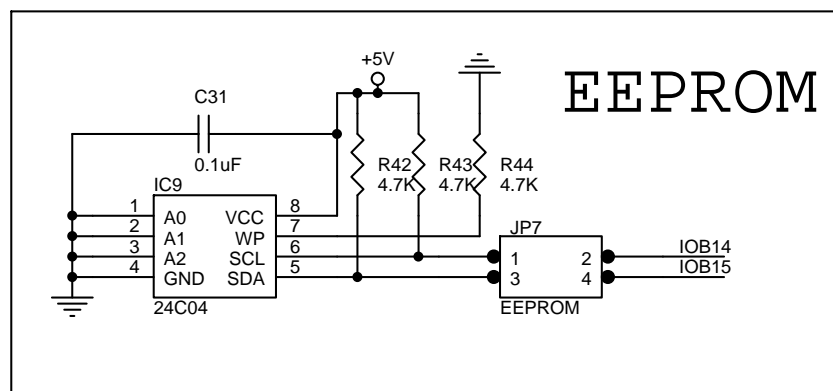


Figure 3-3 I2C EEPROM data storage circuit

### 3.5 I/O Expansion

The I/O expansion circuit is shown in Figure 3-4. The I/O ports are expanded to connector CN6, CN7, CN8 and CN9 which represents the GPIO port A, B, C and Dm, respectively. User can use the expansion ports

to connect other application circuits and can also measure the signal on I/O port.

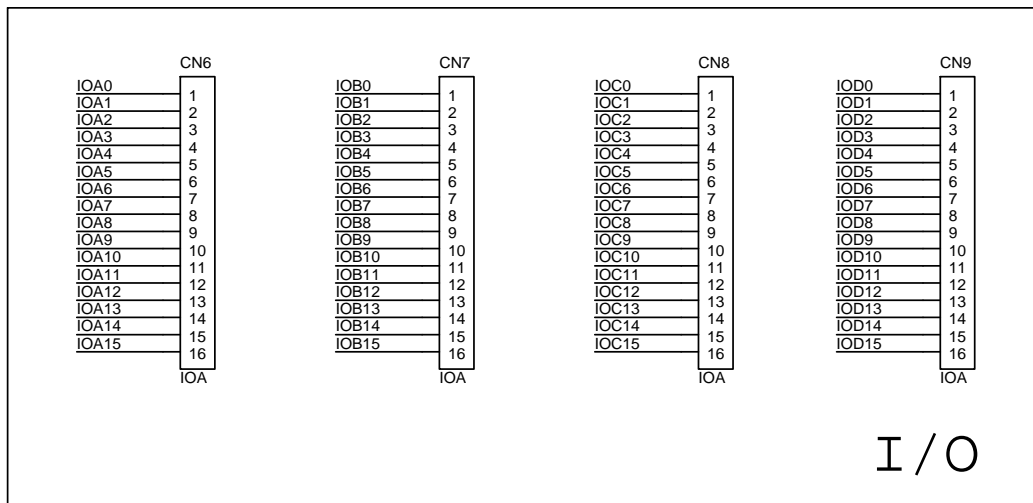


Figure 3-4 I/O expansion circuit

### 3.6 Encoder Input Interface

There are totally two encoder input interface on SPMC75F2413A which named as phase counting input. The EVM board has one encoder input connector CN5. Use IOA13 and IOA14 as two quadrature encoder pulse input signal which are the phase A and phase B. And the IOC5 pulse input (phase Z) is used to clear the encoder counting value.

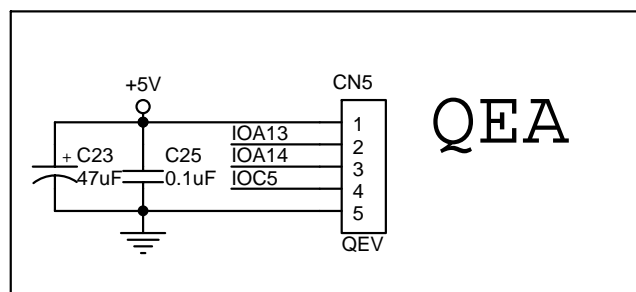


Figure 3-5 Encoder input circuit

### 3.7 Motor Control Interface

The connector J1 and J2 are reserved for motor control applications. Each connector is the expansion port for MCP and PDC timer which consists of PWM output pins and position input pins. The external fault input pins and overload input pins are pull to high level by external resistors.

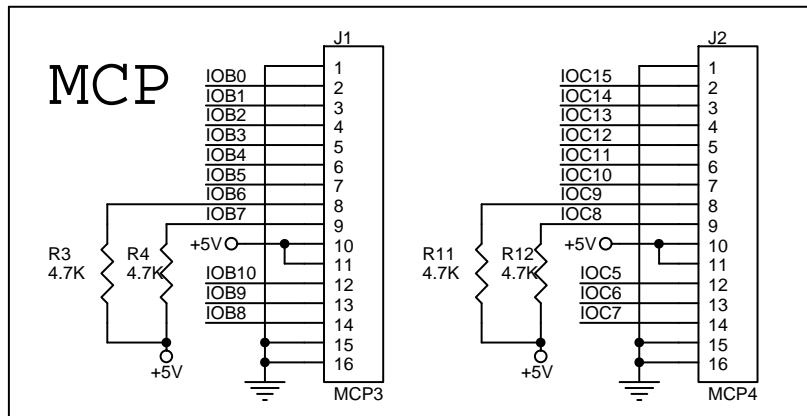


Figure 3-6 Motor control interface circuit

### 3.8 LED Display

There are eight LED display on EVM board. The LED display is shared the low eight bits of GPIO port D. The LED display can be disabled by opening jumper JP8.

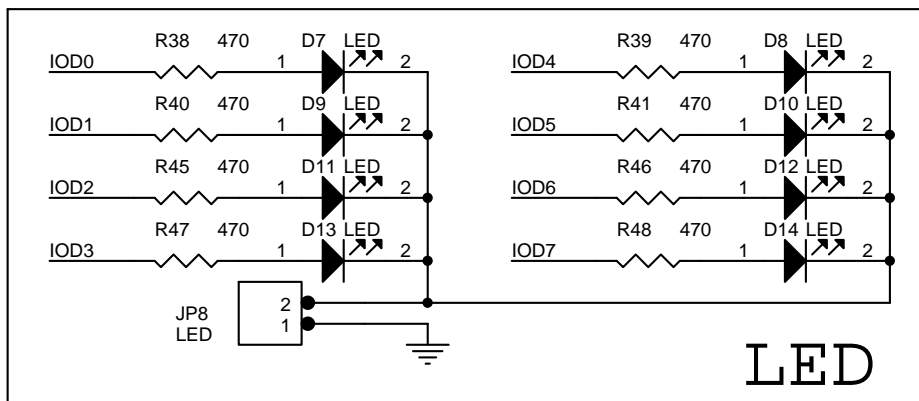


Figure 3-7 LED display circuit

### 3.9 Four-Digit Segment Display

The four-digit segment display circuit is shown in Figure 3-8. The circuit uses two 74HC595 to transmit serial data and latch data to display information. The SPMC75F2413A uses SPI interface to transmit serial data to 74HC595 and use IOB12 to latch the data. All of digit selection signal and LED segment selection signal are all active low. The SPMC75F2413A first transmit high byte digit selection value then low byte segment selection value. Figure 3-9 shows the transmit timing. The signals SER, SRCLK and RCLK will be disabled when opening jumper JP5.

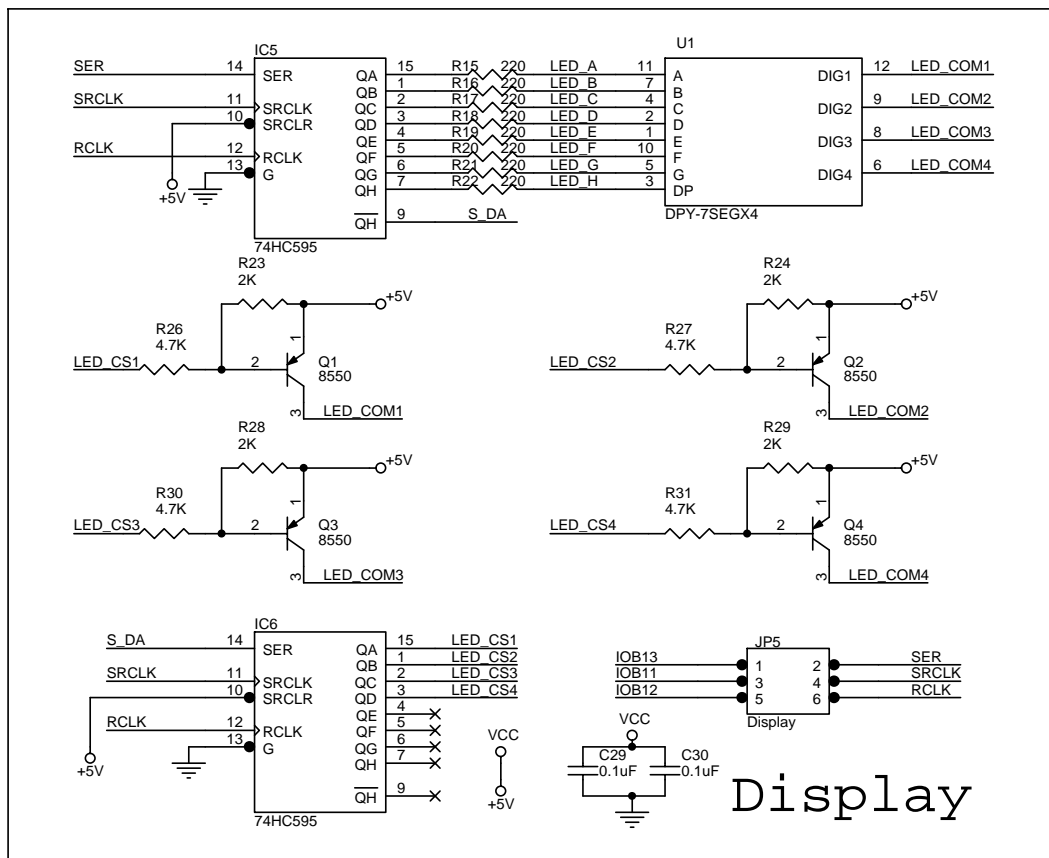


Figure 3-8 Four-digit segment display circuit

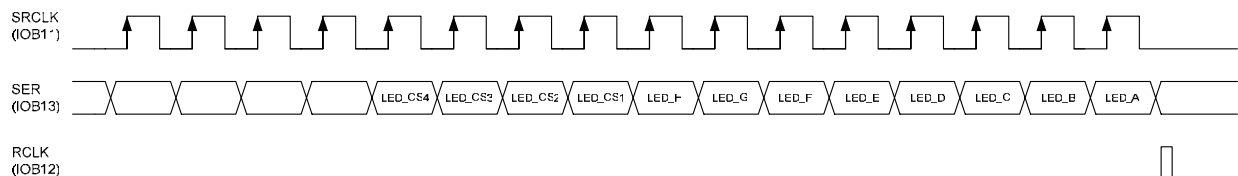


Figure 3-9 Serial data transmit timing

### 3.10 UART

The SPMC75F2413A EVM Board has on-board UART transceiver circuit which the receive and transmit signals can be either from IOC0/IOC1 and IOB12/IOB13. The UART serial port P1 can be used to communicate the hyper-terminal software on the host PC. Table 3-1 shows the UART transceiver path selection of SPMC75F2413A and Figure 3-10 shows the UART application circuit.

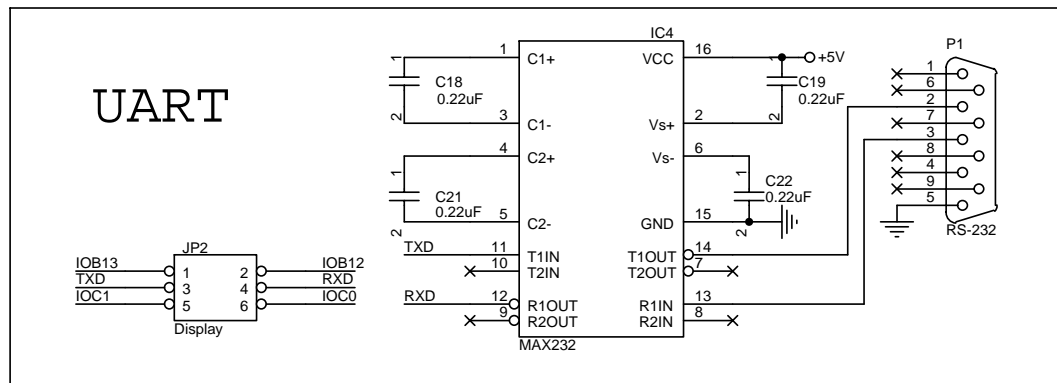


Figure 3-10 UART application circuit

**Table 3-1** UART transceiver signals selection

Jumpers	Location for TXD	Location for RXD
JP2	1-3, IOB13 for TXD (default)	2-4, IOB12 for RXD (default)
	3-5, IOC1/TXD	4-6, IOC0 for RXD

### 3.11 Key Input

The key input circuit is shown in Figure 3-11. The circuit contains six push buttons and default states are at low level. When a key is pressed, the corresponding voltage level is raised to high level and can be detected as key-change event on SPMC75F2413A. The key input signals will be disabled when opening jumper JP6.

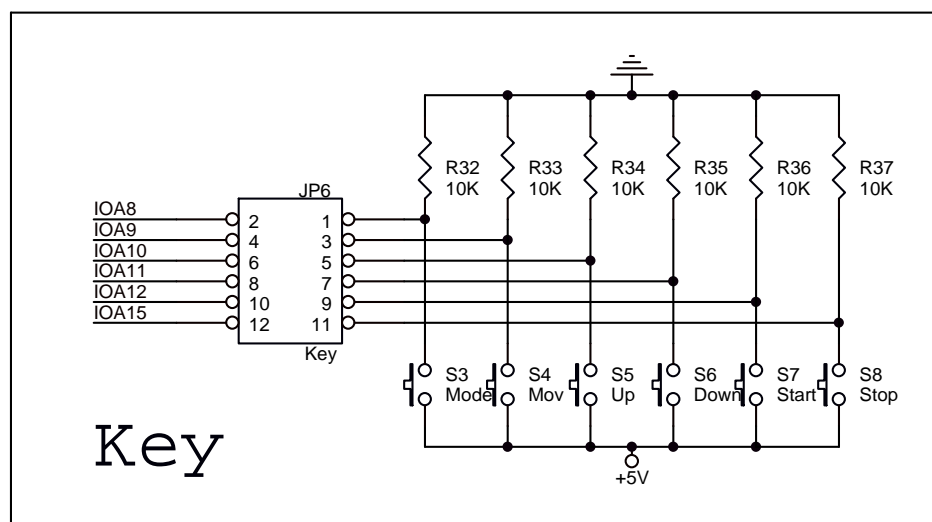


Figure 3-11 Key input circuit

### 3.12 Analog-to-Digital Converter

The SPMC75F2413A has an on-chip, eight channels, 10-bit analog-to-digital converter (ADC) module. The voltage reference of ADC module is either AVDD (+5V DC) or external voltage reference. The jumper JP4 is



used to select the voltage reference source. When choosing external input as ADC reference voltage, the voltage reference should be connected to pin 2 and 3 of JP4 and opening JP4.

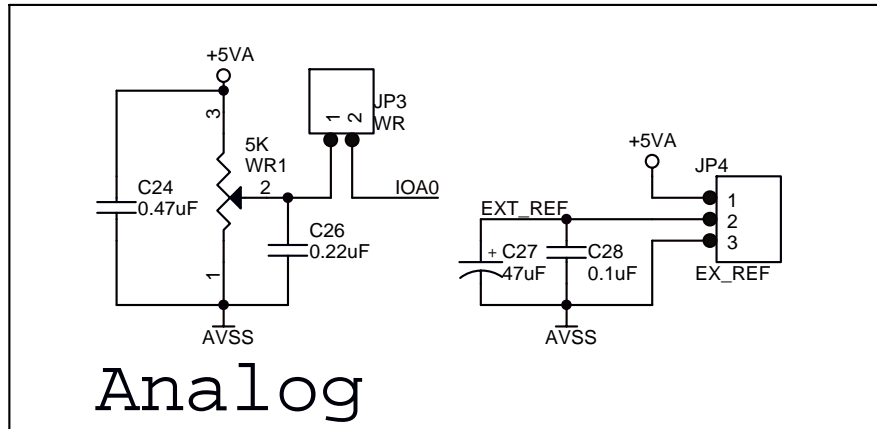


Figure 3-12 ADC circuit

### 3.13 Clock Sources

The SPMC75F2413A is a 16bit unSP microcontroller and operating speed is 24.0 MHz. The clock source can be either from a crystal or oscillator device. The clock path selection is from the jumper JP1. The table 3-2 shows the configurations and default settings.

**Table 3-2** clock source selection – JP1

Jumper	location	function
JP1	1-2 (default)	Crystal mode, crystal connected to XTAL2
	2-3	Oscillator mode, crystal connected to XTAL2

When user needs to change the clock source, it is also necessary to change the system option settings in P\_System\_Option register to match the changes of JP1. It can be done through directly modify the information window settings of unSP IDE environment as shown in Figure 3-13.

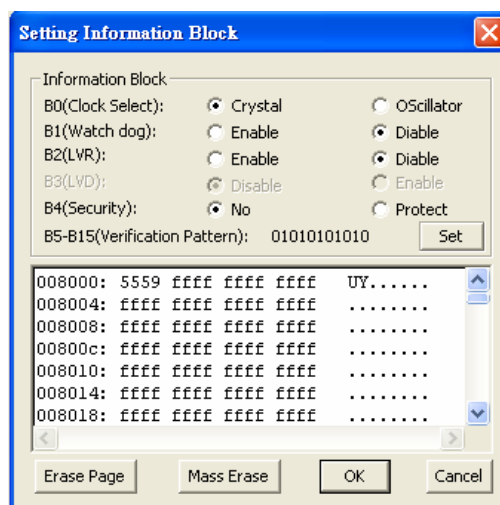


Figure 3-13 Information window of SPMC75F2413A

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## 4 Appendix

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### 4.1 SPMC75F2413A EVM Board Schematic

SPMC75F2413A EVM board contains the following blocks:

1. SPMC75F2413A MCU
2. External reset circuit
3. External crystal and oscillator circuit
4. Four GPIO ports extension
5. LED display and four-digit segment display circuits
6. I2C AT24C04 EEPROM interface circuit
7. UART interface circuit
8. Motor control interface and encoder input connector
9. ADC circuit
10. Key input circuit
11. USB/Parallel port probe connector

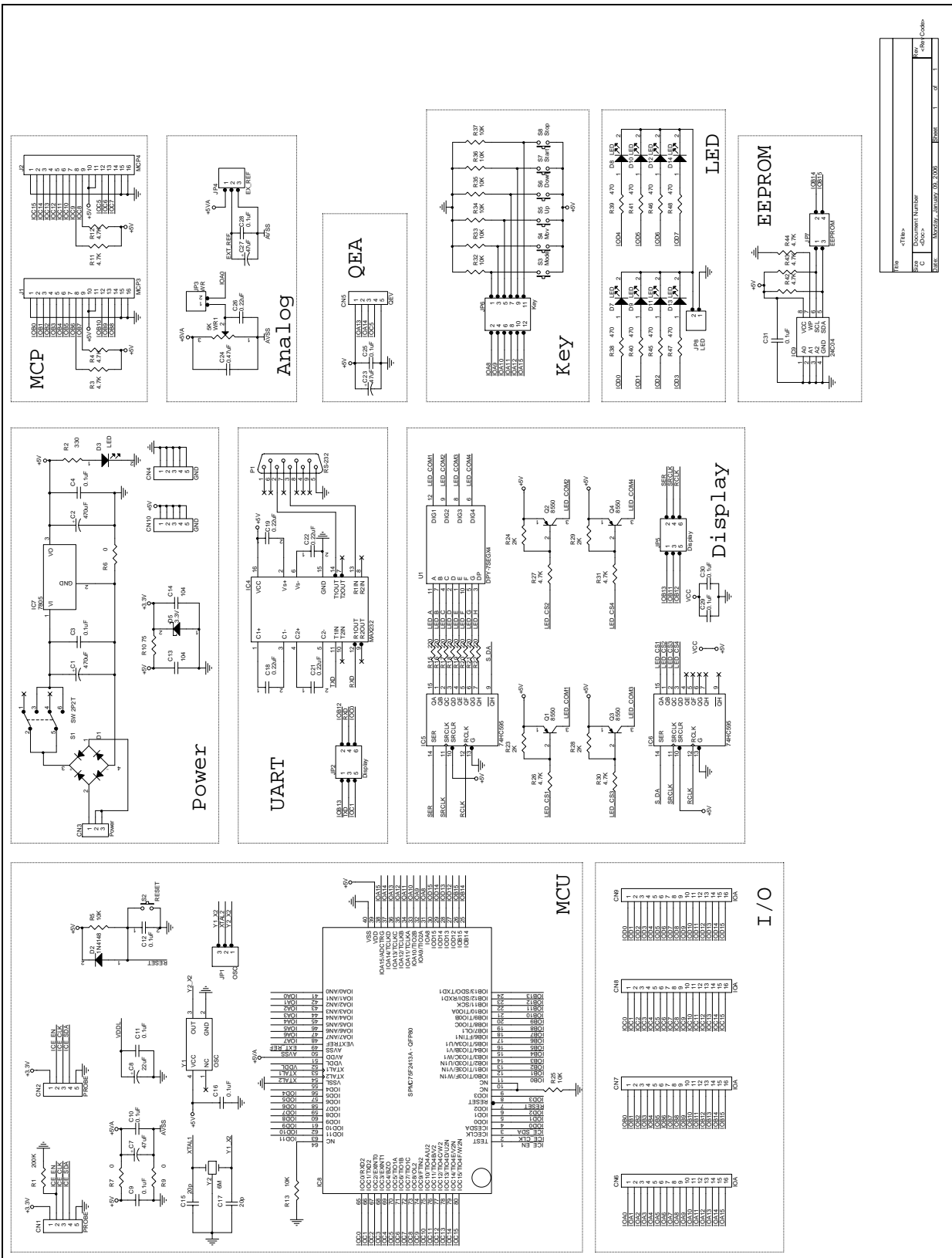


Figure 4-1 SPMC75F2413A EVM Board Schematic

## 4.2 Connectors Descriptions

Connector	Function	Pin No.	Function Descriptions
P1	UART interface	-	Standard DB9-F UART communication interface
CN1	ICE Probe Connector A	1	+3.3V
		2	ICE Probe enable signal (ICE_EN)
		3	ICE Probe serial clock output signal (ICE_CLK)
		4	ICE Probe serial data input/output signal (ICE_SDA)
		5	GND
CN2	ICE Probe Connector B	1	+3.3V
		2	ICE Probe enable signal (ICE_EN)
		3	ICE Probe serial clock output signal (ICE_CLK)
		4	ICE Probe serial data input/output signal (ICE_SDA)
		5	GND
		6	NC
CN3	Power input	-	External 9V DC/AC input
CN4	GND testing pads	1~5	GND
CN5	Encoder input	1	+5V
		2	Phase A encoder pulse input
		3	Phase B encoder pulse input
		4	Phase Z pulse input for clear encoder counting value
		5	GND
CN6	IOA ports	1~16	IOA expansion ports : IOA0~IOA15
CN7	IOB ports	1~16	IOB expansion ports : IOB0~IOB15
CN8	IOC ports	1~16	IOC expansion ports : IOC0~IOC15
CN9	IOD ports	1~16	IOD expansion ports : IOD0~IOD15
CN10	+5V testing pads	1~5	+5V
J1	Motor 1 drive interface	1、15、16	GND
		2~7	MCP3 timer six channels PWM output : W1N、V1N、U1N、W1、V1、U1
		8	External fault input signal for protect MCP3 timer drive circuit : FTIN1
		9	Overload input signal for protect MCP3 timer drive circuit : OL1

Connector	Function	Pin No.	Function Descriptions
		10、11	+5V
		12~14	Rotor position signal input : H1_U、H1_V、H1_W
J2	Motor 2 drive interface	1、15、16	GND
		2~7	MCP3 timer six channels PWM output : W2N、V2N、U2N、W2、V2、U2
		8	External fault input signal for protect MCP4 timer drive circuit : FTIN2
		9	Overload input signal for protect MCP4 timer drive circuit : OL2
		10、11	+5V
		12~14	Rotor position signal input : H2_U、H2_V、H2_W