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1. Introduction

1.1 Purpose of This Manual

This manual describes the functional specifications, and operation of CREEK Robot Board (CRB). Within this manual, there are hardware description, application notes, software user guide, board tests, schematics and demonstrations to help you fully utilize all the features found on the board. Additional data sheets for components on the CRB board and other references can be found in the disk we provide.

Suggestions and corrections are always welcome!

1.2 Introduction of CREEK Robot Board

CREEK Robot Board (CRB) was developed in order to use as a controller of a robot, with CRB you could make you robot more intelligent, more interesting, ever more powerful than others if you use it in competitions.

Here is a picture of CRB.

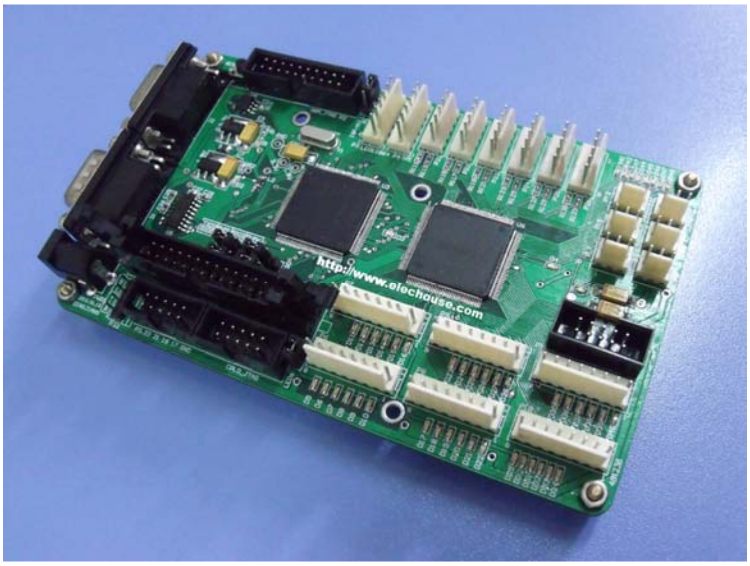


Figure 1   CREEK robot board

The CRB is based on 16/32-bit ARM microcontroller LPC2214 and Altera MAX II CPLD EPM1270. The peripheries of LPC2214 include a LCD12864 monitor connector, a ISP communication connector, an analog input header, a reset button, two DB9 connectors for RS232 interface, a power jack, eight digital input/output pins (general ports), a motor control signal connector, etc. The periphery of EPM1270 include six encoder connectors, six switch signal input connectors (switches are not integrated within this board), a servo motor control connector, six connectors for general I/O usually used for line tracing sensors, etc. These are a data bus and an address bus between LPC2214 and EPM1270 to guarantee the data exchange of the two chips. All details could be seen in related sections of this manual.

1.3 Board Features

-LPC2214. 16/32 bit ARM7TDMI-S™ CPU, 256 KB Flash Program Memory, 16 KB on-chip static RAM, high speed 60 MHz operation. In System Programming (ISP). Standard JTAG interface for programming/debugging, 144 pin package, low power consumption.

-EPM1270. Altera MAX II device, 1270 logic elements, 980 equivalent macrocells, 144 pin package, standard Built-in Joint Test Action Group (JTAG) for downloading programs, Low-cost, low-power.

- 11.0592MHz quartz crystal for LPC2214 and 50MHz crystal oscillator IC for EPM1270.
- 3 flashing LEDs indicator of power supply for LPC2214 and EPM1270.
- Power supply plug in jack. 5V(±4%)~2A(current depend on devices you use) is needed at minimum.
- $\mu C\ OS\ II$ capable (only for LPC2214).
- Dimensions 141×86mm (approximately 5.5×3.5inches)

LPC2214 peripheries:

- 2 DB9 connector for RS232 interface.
- LCD12864 monitor by serial input mode.
- SPI communication connector.
- Analog input header of 4 ports.
- Reset module with a button.
- General connector with eight digital input/output pins.
- Motor control signal connector.
- Standard JTAG connector for programming/debugging.
- A jumper for ISP mode and four jumpers for RS232 interface and PWM interface (motor control).
- LEDs indicate for 3.3V and 1.8V power supply.

EPM1270 peripheries:

- Six encoder input connectors.
- Six switch signal input connectors.
- Servo motor control signal connector.
- Six connectors for general I/O usually used for line tracing sensors.
- Eight LEDs.
- Standard JTAG connector for programming.
- A LED indicates 3.3V power supply.

1.4 Board Layout

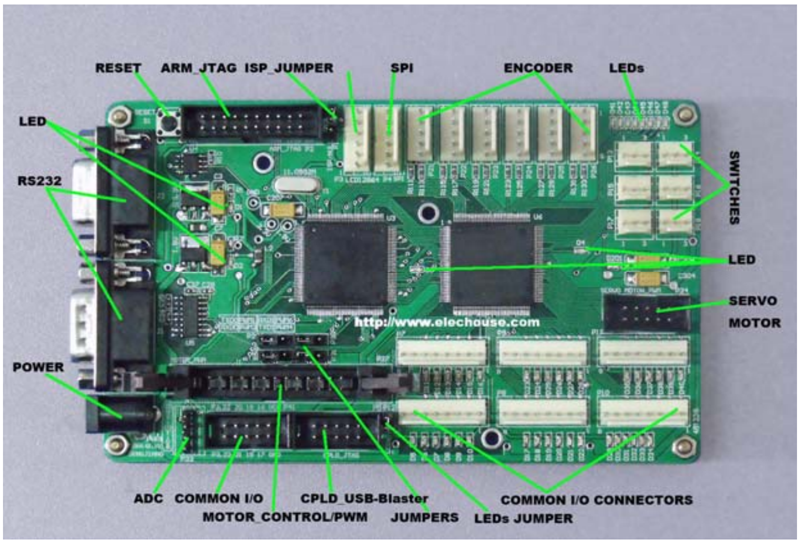


Figure 2 board layout

Power Supply

WARNING

CRB power supply is suggested to be 5V regulated, within a tolerance of ±4% is OK. A power supply much above 5V may destroy this board, so make sure your power supply is good enough. When CRB is powered, three LEDs will be lighted, one indicates 3.3V pad power supply for LPC2214, another indicates 1.8V core power supply, and the other indicates 3.3V power supply for EPM1270.

The Power Jack inner pin is positive.

Reset Module Circuit

The LPC2214 chip on CRB can be reset through the power on reset mode or through the manual reset mode by a button. The EPM1270 chip doesn't have a reset circuit.

Clock Circuit

LPC2214 generates its internal clock with PLL and uses a single 11.0592MHz quartz crystal connected to LPC2214 pin 142 (XTAL1) and pin 141 (XTAL2). EPM1270 uses a 50MHz crystal oscillator connected to pin 91 (IO/GCLK3).

Jumpers Description

Several mini jumpers used in the peripheries of LPC2214 in order to choose special function of the same pins. And a jumper used in the peripheries of EPM1270 to light the LEDs which indicate common IO inputs which are always used as line tracing sensor input connectors.

Jumper for ISP mode

You could choose ISP mode to program LPC2214, thus pin 92 (P0.14/DCD1/EINT1) need to connect to low level. On CRB, P1 defines the ISP mode. Connect pin 2 and pin 3 to enable ISP mode, connect pin 1 and pin 2 to exit ISP mode. You can find a string "ISP/NULL" on the board which used to indicate the position of jumper. We suggest connecting it in NULL position to reduce reset mistake.

CAUTION

When programming is finished, remember disable ISP mode otherwise the chip will not work. Details about ISP programming could be found in related sections.

Jumpers for RS232/PWM mode

LPC2214 has the same pins for UART0 with PWM1 and PWM3, also UART1 with PWM4 and PWM6. Jumpers P28~P31 are designed for user to choose different function of these pins. Generally, we suggest that TXD0/1 or RXD0/1 should be jumped at the same time, but you can choose TXD0 and PWM3 functions or others for special use, etc. As Figure 3 shows, this could be found on the board.

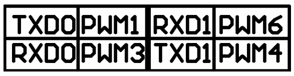


Figure 3 RS232/PWM mode choose jumper

Connectors/Headers Description

The first pin of connectors and headers are marked on the reverse side of CRB, some on the obverse side. For some big ones, two or four pin numbers are marked. Compared with schematics, every pin's connection or definition is clear.

1.5 Block Diagram & Mechanical Dimensions

As Figure 4 shows.

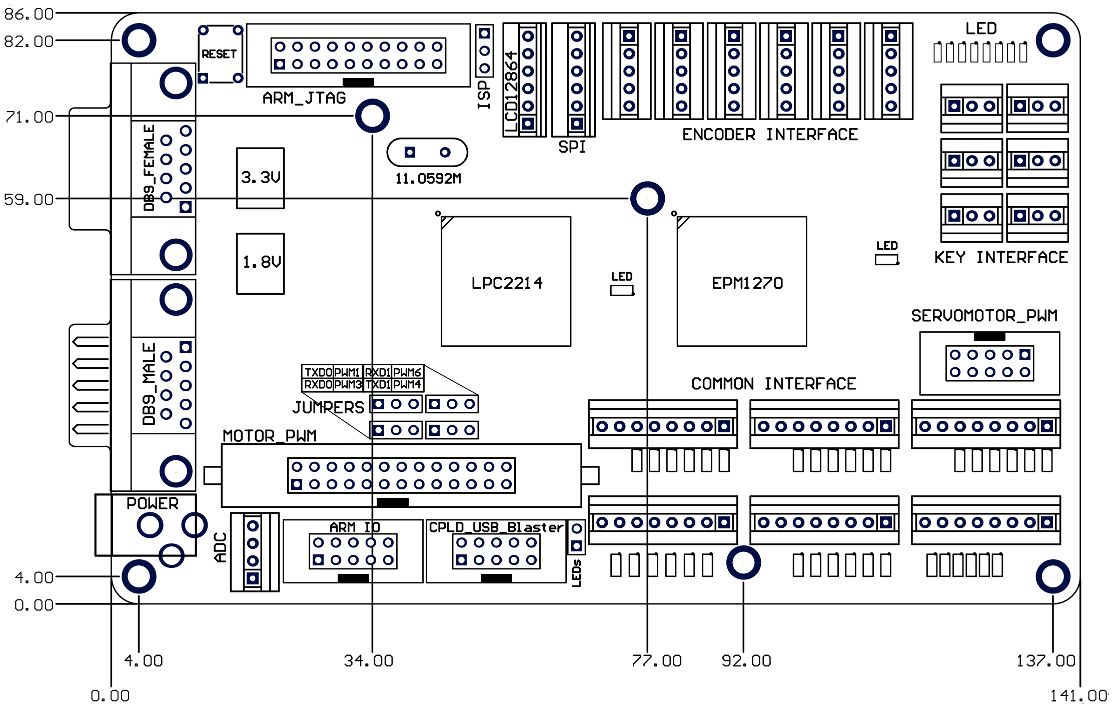


Figure 4 mechanical dimensions

2. Product & Accessories

2.1 Main Product

WARNING

The CREEK robot board is shipped in **protective anti-static packaging**. The board must not be subject to high electrostatic potentials. General practice for working with static sensitive devices should be applied when working with this board.

2.2 Accessories

1. Data CD, including this user manual, some free version software, demonstrations, references, and others.
2. 100" 2.54mm mini jumper packaging.
3. 2.54mm Polarized Female/Male Connectors packaging, including 3 pins, 4pins, 5pins, 6 pins, 8 pins types, and crimp pins.
4. A LCD12864, Dot Matrix Blue Backlight monitor with a connector.

Those below, you could choose to buy from us.

5. USB-Blaster with an USB cable, Standard A to 5 Pin Mini B Device Cable, male to male.
6. RS232 cable, 9 pin DB9 female to female, straight through.
7. Power adapter 5V~3.0A.

    Input voltage: AC 100V-240V~50-60Hz

    Output voltage：DC 5V~3.0A.

    Polarity & Size:

      Positive Inner - 2.1mm Diameter

      Negative Outer - 5.5mm Diameter

It's our duty to check the product and accessories carefully before sending you the package, but we still suggest you to check them when you receive the Parcel, make sure nothing is damaged.

3. Quick Start

3.1 Board Use Requirements

Hardware

1. CREEK robot Board.
2. A computer with a RS232 ports and an USB port at least.
3. A RS232 female-to-female cable. You might need other cables in case of other programmers/debuggers. If you have a programmer/debugger like SEGGER JLINK V7, it's much better.
4. USB-Blaster download cable.
5. Power supply of 5V~2A.
6. Others.

Software

1. Metrowerks CodeWarrior for ARM developer Suite v1.2 (ADS).
2. Flash Magic, version 3.39.175.
3. RS232 monitor.
3. Altera Quartus II 8.1 software.
4. Windows XP, which is much better than Windows Vista or Windows 7 or other OS.

Flash Magic and RS232 monitor can be found on the disk we provide. They are located at

\CREEKROBOTBOARD\SOFTWARE.

When all prepared, let's start!

3.2 USB-Blaster Driver

An USB-Blaster download cable is provided in order to download the programs into EPM1270. Before using it, make sure Altera Quartus II 8.1 software is installed. Connect it with your computer through USB interface, and then there will be a Pop-up window, follow its tips to install drivers for the USB-Blaster. Locate the driver at X:\altera\81\quartus\drivers\usb-blaster (X is the disk where Quartus II is installed). For details, please refer to Installation_and_USB-Blaster _Driver.pdf.

NOTE: When refer to a PDF file, it's always in this folder: \CREEKROBOTBOARD\REFERENCES. This user guide will not tell you again.

Details about usage of USB-Blaster download cable, please refer to USB-Blaster_User_Guide.pdf.

3.3 Board test

This part is to test whether the two main microchips can work normally. It can also help you to learn how to program the board. It is assumed that the requirements mentioned in 3.1 are ready and USB-Blaster has been driven.

3.1.1 LPC2214 Test

Follow the steps blow to test LPC2214.

(1) Set jumper P1 to ISP mode.

(2) Set jumpers P28 and P29 to choose TXD0 and RXD0.

(3) Connect J1 on the board and computer with a RS232 female-to-female cable.

(4) Supply power to the board with the 5V adapter.

(5) Open the file folder, which located at \CREEKROBOTBOARD\DEMO\LPC2214\LED, and you will see the project's file and folders as Figure 5 shows.

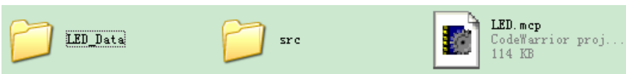


Figure 5 project's file and folders

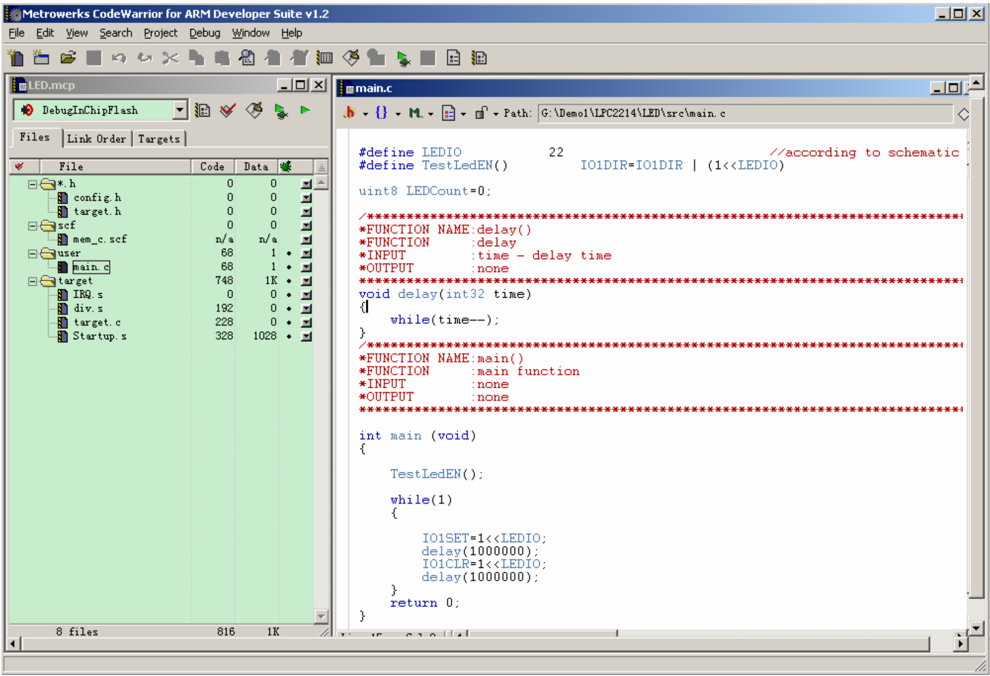


Figure 6 ADS user interface

(6) **Delete the folder LED_Data**, then open the project file LED.mcp as Figure 6 shows.

(7) Remember to choose DebugInChipFlash as Figure 7 shows if the acquiescent is not.

Figure 7 choose DebugInChipFlash

(8) Press setting icon  to set the project as Figure 8 and Figure 9 shows.

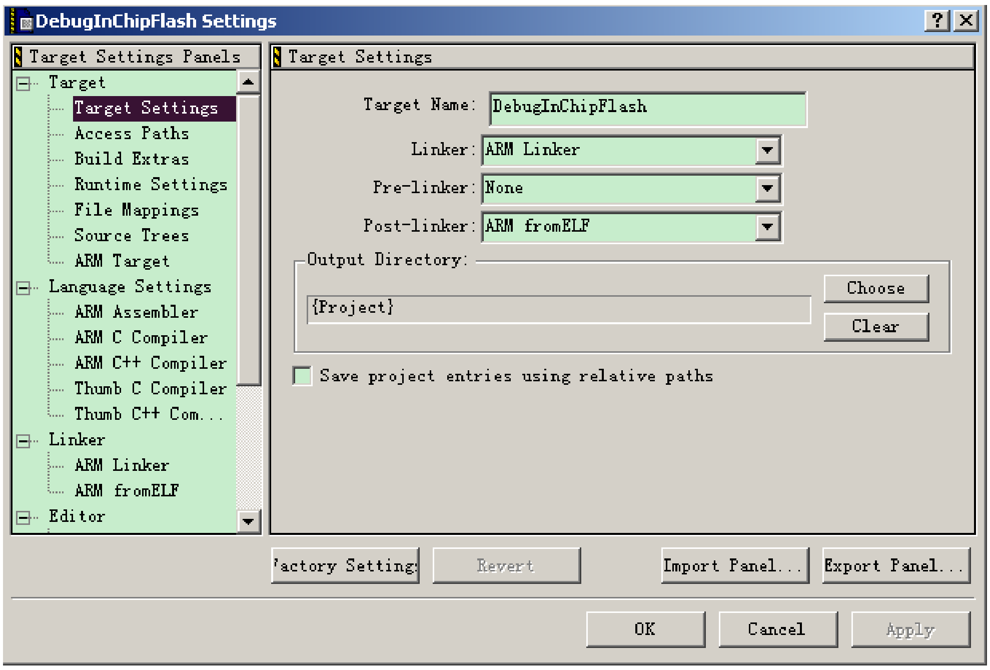


Figure 8 Target Settings

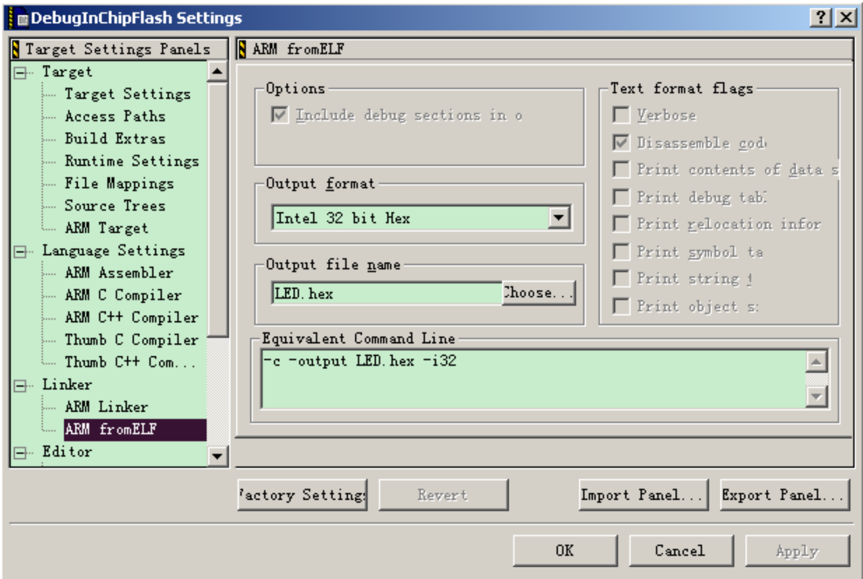


Figure 9 ARM fromELF

(9) Press MAKE icon  to compile the project, make a hex file with a name in Figure 9.

(10) Open the software Flash Magic (install it before using), and set as Figure 10 shows. Note that the setting of **COM port** and the path of **Hex File** should be modified based on the actual situation.

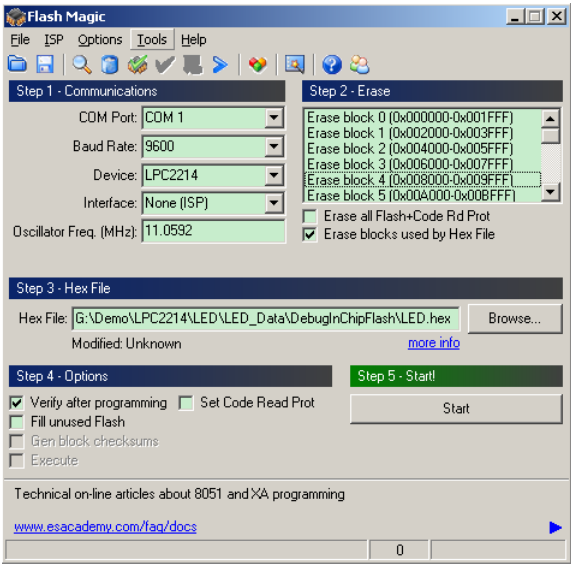


Figure 10 Flash Magic ISP download

(11) Press the button **Start** to download the program.

Exit ISP mode by connecting the pin 1 with pin 2 of Jumper P1. Reset LPC2214, and it's going to run the program. At any situation except ISP mode, **connect pin 1 and pin 2**, otherwise it may not be correctly reset when you press reset button.

(12) Set jumper P1 to NULL mode, and reset the board. Then LED **D3** will flash.

3.1.2 EPM1270 Test

(1) Connect the CPLD JTAG connector on the board and computer with USB-Blaster by a USB cable.

(2) Open the file folder, which located at \CREEKROBOTBOARD\DEMO\EPM1270\LED_test, and double click the project file LED_test.qpf as Figure 11 shows.

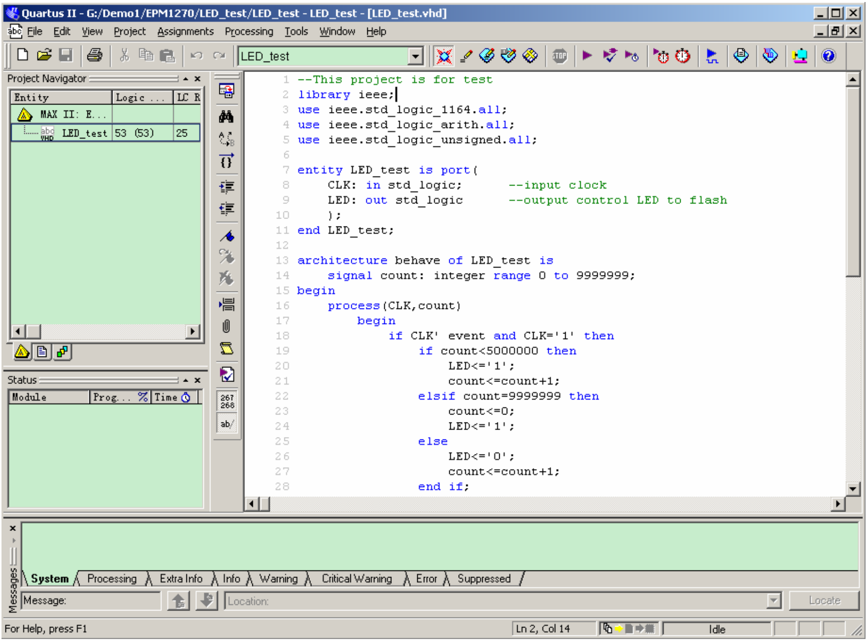
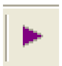


Figure 11 Altera Quartus II 8.1 user interface

(3) Press icon  to compile the project.

(4) Press icon , and reach the window in Figure 12.

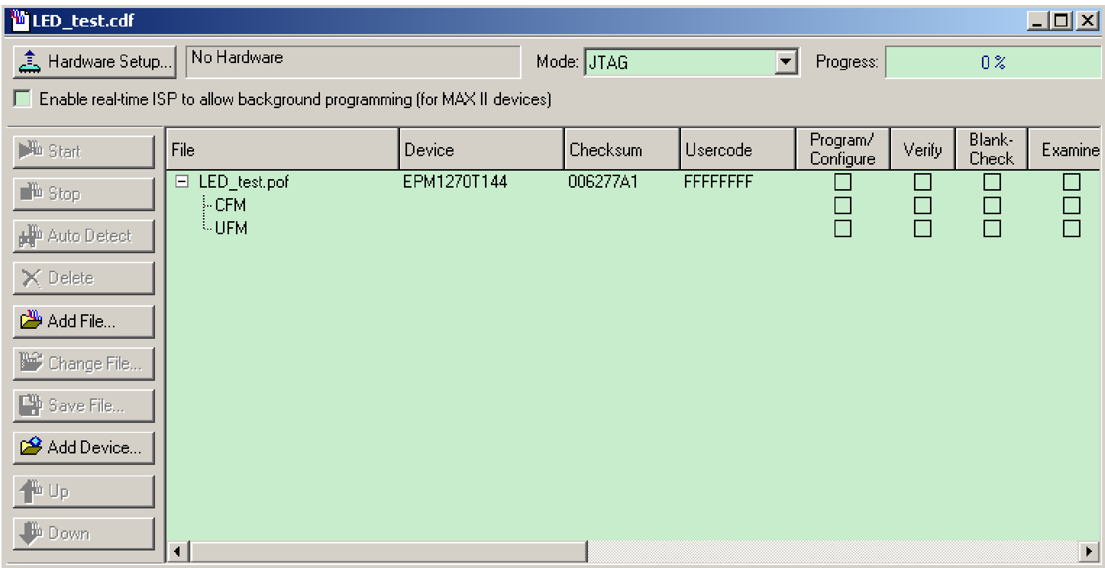


Figure 12 Quartus II Program window

(5) Click on the **Hardware Setup** box, and choose the USB-Blaster as Figure 13 shows. Then press the button **Close**.

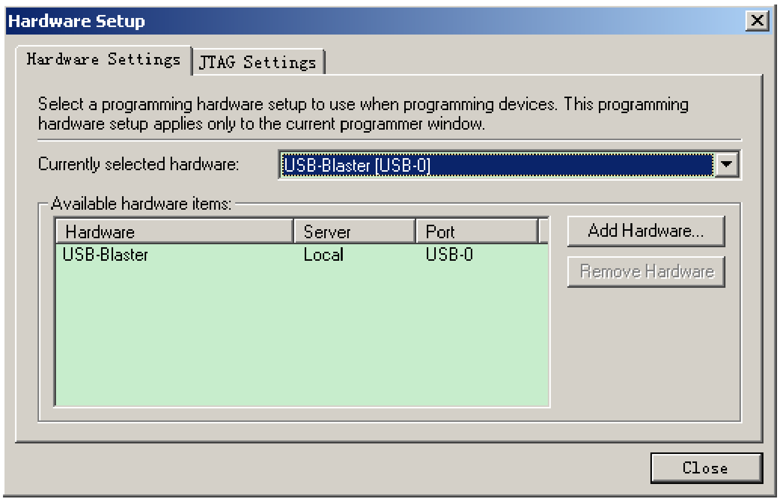


Figure 13 Hardware Setup window

(6) Click on the **Program/Configure** and press the icon  to download the configuration file into EPM1270. When finished, LED **D4** will flash, **without a reset**.

3.4 ADS1.2 & LPC2214

Since the use of the software ADS1.2 is not very easy for a beginner, we provide a tutorial ADS_CodeWarriorIDEGuide.pdf for the user to refer to. It is suggested that the user read some other tutorials to handle the software.

For the details about the chip LPC2214, please refer to LPC2114_2124_2212_2214 user manual.pdf and PHILIPS_LPC2214.pdf.

3.5 Use Template Project for LPC2214

For user's convenience, a template project for LPC2214 is provided, which was developed in ADS.
Demo program location: \CREEKROBOTBOARD\DEMO\LPC2214_TEMPLATE.

In the project, all source files could be edited, but we advice not to edit them except main.c, of course you could add other files when needed.


When copying a whole project folder form a computer to another, **delete the folder *projectname*_Data**. Otherwise there may be some mistakes in the hex file.

If you have a SEGGER JLINK V7 programmer/debugger connect to the ARM_JTAG port on CRB, you could press  to debug or  to run the program immediately. Also, there must be some configuration to do before using, refer to its user guide.

3.6 Quartus II 8.1 & EPM1270

Since Quartus is not very easy to handle for a beginner, we advise that you should refer to other references, and we provide you some files:

1. QuartusII_Handbook_8.1.pdf form Altera. This manual is designed for the novice Quartus II software user and provides an overview of the capabilities of the Quartus II software in programmable logic design.

2. Quartus_Quick_Start.pdf from Altera. It is quite simple than the first reference, and will show you how to set up a Quartus® II project, enter timing requirements, and compile the design into an Altera® device.
3. Altera_Quartus_II_Tutorial_a.pdf and Altera_Quartus_II_Tutorial_b.pdf. Thanks to Waseem Ahmad from Department of Electrical and Computer Engineering in University of Illinois at Chicago. Following these two tutorials, you will be very familiar with the usage of Altera Quartus II software.
For the details about the chip EPM1270, please refer to EPM1270.pdf.
Of course, VHDL skill is necessary, because we provide the demonstrations with VHDL in next section.

4. Schematics & Demonstrations

On CREEK robot board there are two primary chips, LPC2214 and EPM1270, so the peripheries described here are based on the two different chips.

4.1 LPC2214 Peripheries

LPC2214 peripheries include two DB9 connectors for RS232 interface, a LCD12864 monitor connector, a ISP communication connector, an analog input header for ADC, a reset module, a motor control signal connector, eight digital input/output pins (general ports), JTAG debug interface, etc. details are shown below.

4.1.1 Power Supply

On CREEK robot board, there are three power regulators, LM1117. But the power supply is 5V regulated. Some devices, such as MAX3232ESE for RS232 interface, encoders, etc, are connected to 5V power supply directly. **Before using this robot control board, please check it carefully at first.**

4.1.2 RS232 Interface

Hardware Description and Schematic

On CREEK robot board, there are two DB9 connectors, one is male and another female. By them, your board can communicate with other devices or computers with RS232 interface. Note that UART interface and PWM interface of LPC2214 are using the same pins as Table 1 shows, you have to set jumpers before using different functions. Detail is shown at the first section of JUMPER DESCRIPTION on page 4, you can find that on the board too.
Details about RS232 interface, please refer to RS_232_Interface.pdf and RS232_Serial.pdf.

Table 1 UART and PWM ports

LPC2214 Pin No.	Description
42	P0.0/TXD0/PWM1
49	P0.1/RXD0/PWM3
75	P0.8/TXD1/PWM4
76	P0.9/RXD1/PWM6

RS232 circuit is shown as Figure 14. Labels TXD0, RXD0, TXD1 and RXD1 are connected to pin 42, 49, 75 and 76 of LPC2214 via jumpers, respectively.

SPECIAL NOTES: In common RS232 communication, three wires are sufficient: transmit data, receive data, and signal ground. You could see this in Figure 14. But definitions of ports are different except signal ground pin 5. **As a computer's port (male port commonly), pin 2 is used to receive data, pin 3 is used to transmit data, while as a terminal device's port, the usage of these two pins are opposite.** So, on CREEK robot board, pin 2 is used to transmit data, pin 3 is used to receive data. When communicate with a computer, you need a female to female RS232 cable, **straight through**, when communicate with other devices, check the ports definition at first.

In Figure 14, two resistors are used to restraint current to protect IO ports of LPC2214.

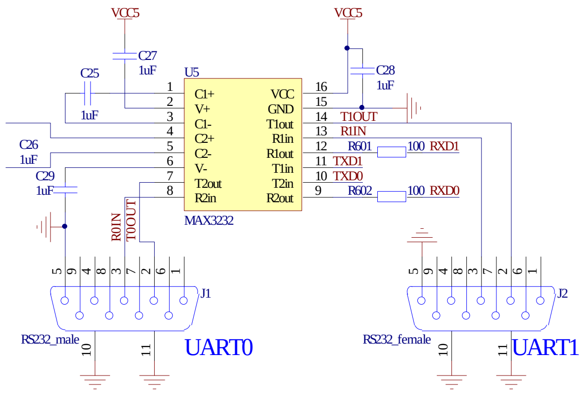


Figure 14 RS232 interface

Demonstration

The function of this demo program is to communicate with your computer by RS232 interface. At first, CRB receive data from your computer, and then, it transmits them back to computer. The software you have to install in your computer is called RS-232 Monitor, which you can find it the CD, its user interface is shown in Figure15. But this software is not free, you can use it 30 days or make 100 runs after installation. Other software with similar functions is OK too.

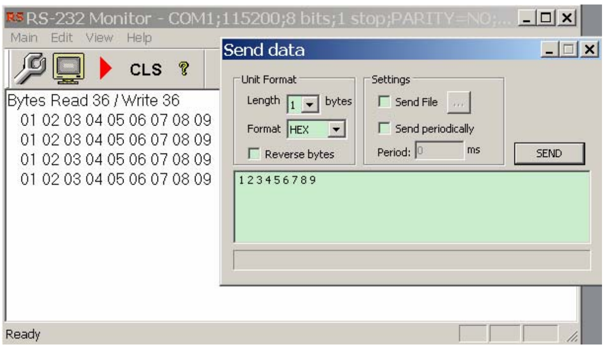
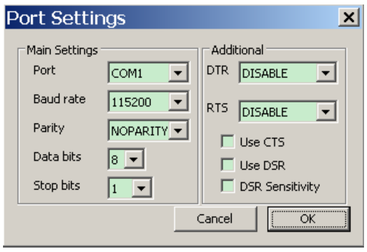
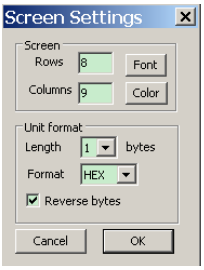


Figure 15 RS-232 monitor graphical user interface

Set port and set screen as Figure 16 and Figure 17 shows. Then press send data icon, the screen is shown as Figure 18. Please notice that the formats in Figure 17 and Figure 18 are the same. Press SEND button in Figure 18, you could see the result of this demo, show as Figure 15.

Demo program location: \CREEKROBOTBOARD\DEMO\LPC2214\UART.





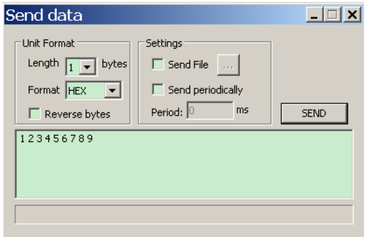


Figure 16 set port *Figure 17 set screen* *Figure 18 send data*

4.1.3 LCD12864

Because screen display is not a main task of robot control, we use a LCD12864 monitor simply, and just use it to display some important data. LCD12864 has 20 pins, but we only use 5 of them as P3 in Figure 19. Details about the usage of LCD12864, please refer to program code. You could just using these functions in files LCD12864.h and LCD12864.c when you need. It's quite simple. The result of this demo program is shown as Figure 20. We still provide you ST7920.pdf to refer to, but it's written in Chinese.

NOTE: ST7920 is the driver IC of this LCD12864 monitor.

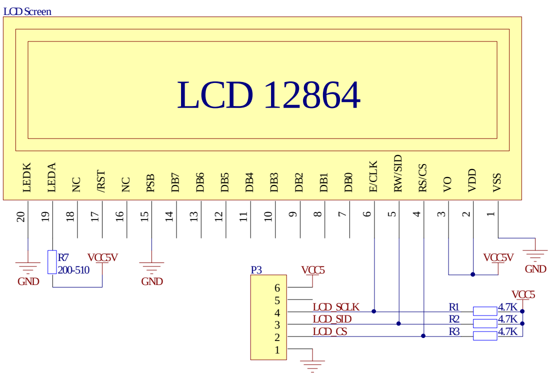


Figure 19 LCD12864 screen and port

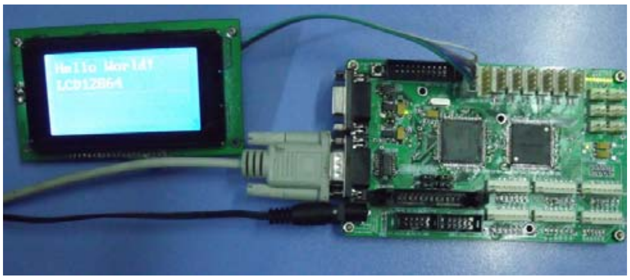


Figure 20 LCD12864 screen and port

Demo program location: \CREEKROBOTBOARD\DEMO\LPC2214\LCD12864.

4.1.4 Reset Circuit

CAT1025 is a Supervisory Circuits with I2C Serial 2k-bit CMOS EEPROM and Manual Reset mode IC. S1 is the reset button mentioned in other sections of this user guide. Circuit is shown in Figure 21.

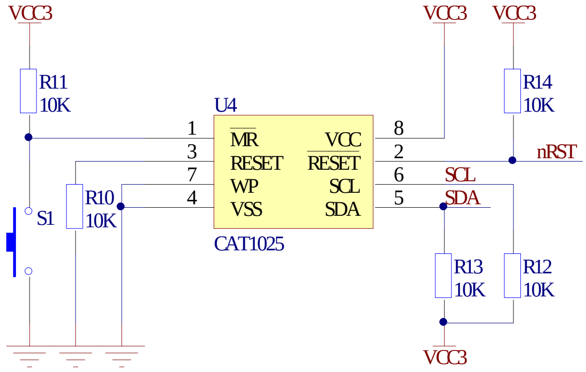


Figure 21 reset circuit

Labels SCL and SDA are connected to pin 50 and 58 of LPC2214, and you could use this to load some configuration when the board power on or be reset.

4.1.5 JTAG Programming/Debugging Connector

ARM JTAG port is a standard debug port, as Figure 22 shows. So we reserved this for some advanced users. Detail usage of JTAG, please turn to JTAG supplier for help.

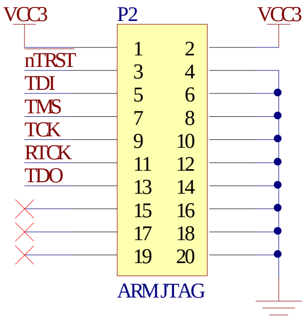


Figure 22 standard JTAG connector for LPC2214

4.1.6 SPI Communication

SPI is a full duplex serial interface. It can handle multiple masters and slaves being connected to a given bus. Only a single master and a single slave can communicate on the interface during a given data transfer. During a data transfer the master always sends a byte of data to the slave, and the slave always sends a byte of data to the master. There are four signals in SPI communication. They are SCK, SSEL, MISO and MOSI. The function of the four signals is shown in Table 2.

There is a SPI connector on CREEK board, as Figure 23 shows, and it is designed for master.

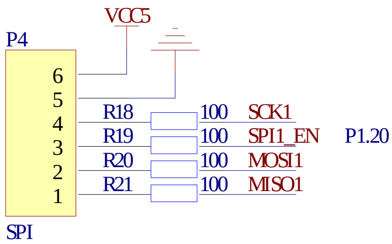


Figure 23 SPI connector

Table 2 signal description

Signal name	Description
SCK	**Serial Clock**. It is a clock signal used to synchronize the transfer of data across the SPI interface. The clock is always driven by the master and received by the slave. The clock is programmable to be active high or active low. The clock is only active during a data transfer. Any other time, it is either in its inactive state, or tri-stated.
SSEL	**Slave Select**. The SPI slave select signal is an active low signal that indicates which slave is currently selected to participate in a data transfer. Each slave has its own unique slave select signal input. The SSEL must be low before data transactions begin and normally stays low for the duration of the transaction. If the SSEL signal goes high any time during a data transfer, the transfer is considered to be aborted. In this event, the slave returns to idle, and any data that was received is thrown away. There are no other indications of this exception. This signal is not directly driven by the master. It could be driven by a simple general purpose I/O under software control.
MISO	**Master In Slave Out**. The MISO signal is a unidirectional signal used to transfer serial data from the slave to the master. When a device is a slave, serial data is output on this signal. When a device is a master, serial data is input on this signal. When a slave device is not selected, the slave drives the signal high impedance.
MOSI	**Master Out Slave In**. The MOSI signal is a unidirectional signal used to transfer serial data from the master to the slave. When a device is a master, serial data is output on this signal. When a device is a slave, serial data is input on this signal.

When communicate with other devices, CREEK robot board can only performance as master, because pin 123(also SSEL1) is pulled up to 3.3 volts. And it use a common IO port P1.20 to pull down the slave when communicate. We don't provide you a demo program of this.

Detail about usage of SPI interface, please refer to LPC2114_2124_2212_2214_User_Manual.pdf.

4.1.7 Pulse Width Modulator (PWM)

Hardware Description and Schematic

LPC2214 Pulse Width Modulator is based on standard Timer 0/1. Seven match registers allow up to 6 single edge controlled or 3 double edge controlled PWM outputs, or a mix of both types. The ability to separately control rising and falling edge locations allows the PWM to be used for more applications. For instance, multi-phase motor control typically requires three non-overlapping PWM outputs with individual control of all three pulse widths and positions.

For details of relevant registers and usage method, please refer to LPC2114_2124_2212_2214_User_Manual.pdf.

Optical Isolation is strongly suggested when control motors, please refer to section 5.

Table 3 shows the pins with PWM interface. Please notice that PWM1, PWM3, PWM4, PWM6 use the same pins with UART0 and UART1 (as Table 1 shows) in LPC2214, the user must set jumpers on P28, P29, P30, P31 before using, refer to Figure 3.

Table 3 PWM interface

LPC2214 Pin No.	PWM Signal
P0.0	PWM1
P0.7	PWM2
P0.1	PWM3
P0.8	PWM4
P0.21	PWM5
P0.9	PWM6

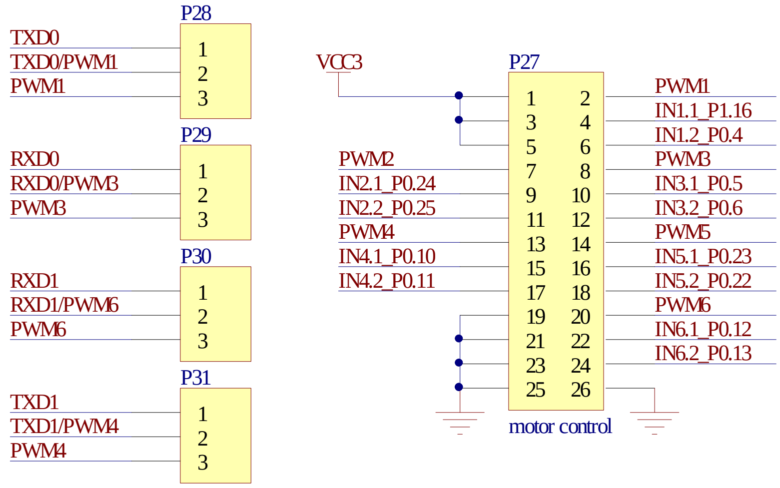


Figure 24 jumpers and motor control port

Demonstration

The function of this demo program is to simply output PWM1 and PWM2 signals, the duty cycle is about 52%, frequency is about 36 KHz. However, with the other functions defined in the PWM.h and PWM.c, you can go with complex control parameters to motors, such as speed and direction. Without a motor driver, you could watch PWM signals by an oscillograph, from pin 2 and 7 of P27 on the board.

Demo program location: \CREEKROBOTBOARD\DEMO\LPC2214\PWM.

4.1.8 Others

Other peripheries such as common IO ports, ADC port and power supply circuit, please refer to schematics we provide.

4.2 EPM1270 Peripheries

EPM1270 peripheries include power supply circuit, a JTAG program connector, servo motor control connector, six encoder connectors, six connectors for general I/O, eight LEDs, and six switch signal input connectors, etc. Actually, these ports' pins are almost the same but used in different purpose. Details are shown below.

4.2.1 Power Supply

While LM1117 can provide a current of 1A, EPM1270 using a single power regulator. You could see this in the schematics we provide.

4.2.2 JTAG Program Connector

Altera CPLD JTAG connector is a standard one, as Figure 25 shows, which is necessary for programming. Connected to a USB-Blaster, you could download programs into EPM1270.

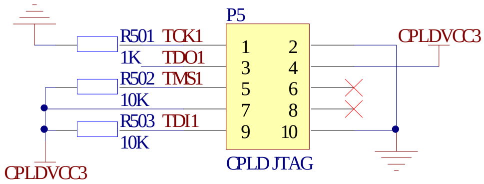


Figure 25 CPLD JTAG connector

4.2.3 Communication between LPC2214 and EPM1270

Hardware Description

LPC2214 communicates with EPM1270 by 8 bits (in fact 7 bits, A0 is not used) address bus and 16 bits data bus. Figure 26 shows the circuit connection. A0 is null because A0 is not used when the data bus is 16 bits for LPC2214 (refer to LPC2114_2124_2212_2214_User_Manual.pdf). EPM1270 works like an external memory, LPC2214 can control or read statuses of the equipments connected with EPM1270 by reading and writing the bus. For the mapping between address and data in EPM1270, the user can configure as needed by programming.

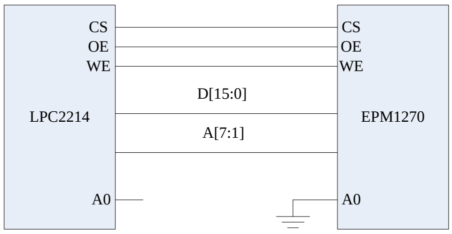


Figure 266 bus connections between LPC2214 and EPM1270

Demonstration

This is a basic demonstration of communication between LPC2214 and EPM1270, some other demonstrations are based on it. Actually when control a robot, this is very useful, and this is the main feature of CREEK robot board. On the other hand, LPC2214 doesn't have so many I/O pins, so EPM1270 is used for I/O ports extension. Also, EPM1270 can reduce lots burden of LPC2214, in this way, LPC2214 can used as a robot brain to make decisions only.

The function of this demo program is to test bus communication, and both EPM1270 and LPC2214 need a program. When LPC2214 read bus successfully, it will write data to eight LEDs' address, and they will be lighted alternately. And the user can extend its functions according to actual situation.

Demo program location: \CREEKROBOTBOARD\DEMO\LPC2214\BUS_TEST for LPC2214 and \CREEKROBOTBOARD\DEMO\EPM1270\BUS_TEST for EPM1270.

4.2.4 Servo Motor Connector

Hardware Description and Schematic

When control a robot, servo motors are sometimes very useful. We suggest you to use a HITEC servo motor, which is shown in Figure 27. We also suggest you to use optical isolation when control servo motors.

A common servo motor control signal is shown in Figure 28, obviously, it's a PWM signal. But different servos usually need different pulse width. As HITEC servo, the signal pulse width is always 0.9ms to 2.1ms.

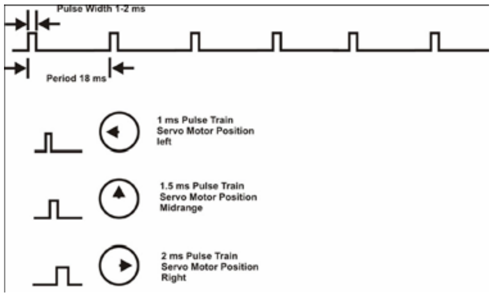


Figure 27 HITEC servo motor *Figure 28 servo motor control signal*

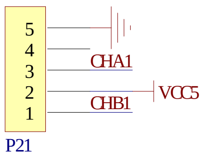
Demonstration

The function of this demo program is to generate a PWM signal with period 20 ms by EPM1270, while the pulse width is controlled by LPC2214, so this program is based on the communication of these two chips. You could watch PWM signals by an oscillograph, from pin 1 of P34 of board.
Demo program location: \CREEKROBOTBOARD\DEMO\LPC2214\ SERVO_MOTOR for LPC2214 and \CREEKROBOTBOARD\DEMO\EPM1270\ SERVO_MOTOR for EPM1270.

4.2.5 Encoder Connectors

Hardware Description

There are six rotary encoder connectors on the board, and they are designed based on OMRON Incremental optical encoder, as Figure 29 shows. There are two outputs called phase A and phase B, which are called quadrature outputs as they are 90 degrees out of phase. With different direction of rotation, the phase relation between A and B is different, as Figure 31 shows.



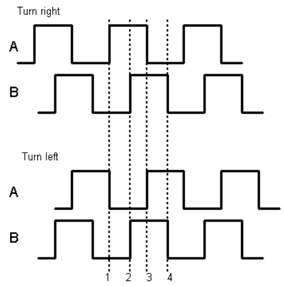


Figure 29 OMRON encoder *Figure 30 a encoder connector* *Figure 31 two phases*

The power supply to encoders is 5 volts. When phase A and phase B input into EPM1270, we use resistors to divide the voltage to protect the chip's I/O ports.

Demonstration

This demo program is a demonstration of encoder counter, which needs a real encoder. Connect it to connector P21 or P22, check its ports Sequence before testing. Download programs into LPC2214 and EPM1270, respectively. And connect LCD12864 to the board, restart the board, numbers on the LCD will change when you rotate the encoder.
Demo program location: \CREEKROBOTBOARD\DEMO\LPC2214\ ENCODER for LPC2214 and \CREEKROBOTBOARD\DEMO\EPM1270\ ENCODER for EPM1270.

4.2.6 Common I/O Connectors

There are six connectors for 36 I/O ports. Usually, we use it for line tracing sensors. Since we don't provide you some sensors, it's hard to give you demonstrations. Actually, you can use them any way you want. Note that the power supply to devices connected to it is 5 volts, and when input lower level signals, LEDs will be light on if you set the LEDs' jumper.

4.2.7 Switch Signal Connectors

There are six Switch signal connectors. You can use it for simple signal input, such as limit switch, photoelectric Switch, etc. As Figure 32 shows, the power supply for devices connect to it is inserted by a resistor, this is for switches use. For photoelectric switch, you need to short the resistor, 5 volts power will supply to the devices. It's simple, so no demo program is provided.

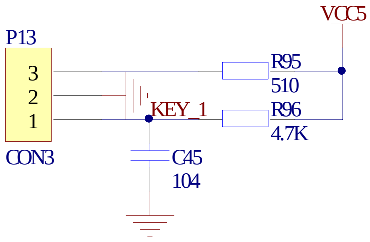


Figure 32 switch signal connector

4.2.8 LEDs

Please refer to schematics.

5 Optical Isolation suggestions

CREEK Robot Board is a digital circuit mainly based on two digital chips, this board is a controller used to control robots or other automatons, so be isolated from a load by optical isolation is essential, and thus could reduce interference big loads and protect the board.

Some devices are not suggested to be isolated while it's current is not strong, such as encoders, LCD screens, and programmers/debuggers, etc. Other devices, such as a motor driver, optical isolation is necessary.

Figure 33 is an example of optical isolation circuit used between a controller and a motor driver. VCC3.3_CRB represents 3.3 volts of CREEK robot board, 5V_MOTORDRIVER represents 5 volts of a motor driver, and GND_MOTORDRIVER represents ground of the motor driver. **Make sure that GND_MOTORDRIVER is not connected with ground of CREEK robot board,** otherwise the optical isolation makes no sense. Component TLP521 is an optocoupler works below a frequency of 500Hz, while 6N137 works at a very high speed up to 10 MBit/s. Several optocoupler are provided, they are located at \CREEKROBOTBOARD\REFERENCES\OPTOCOUPLER.

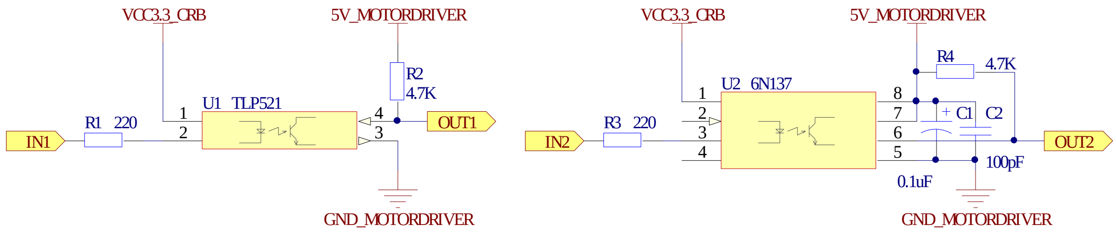


Figure 33 optical isolation circuit

6 Other information

CREEK Robot Board

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