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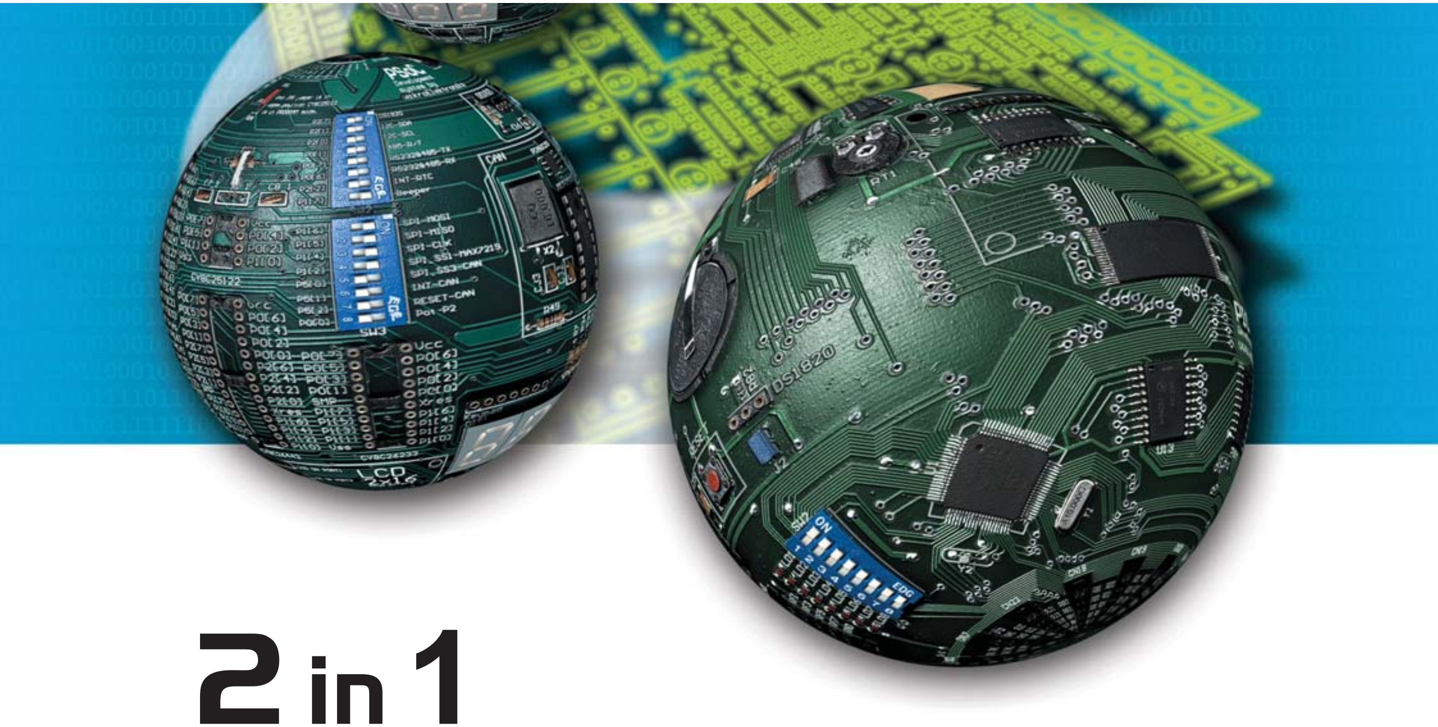
EasyARM User's Manual



2 in 1

USB 2.0 IN-CIRCUIT PROGRAMMER

PHILIPS ARM DEVELOPMENT BOARD

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Software and Hardware solutions for Embedded World

mikro e

Second edition
December 2006

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CONTENTS

CONNECTING THE SYSTEM

The development system box contains the development system, product CD, USB cable, RS232 cable and this manual.

Step no.1 The first thing to do is to take the system out of the box. Unpack the USB cable and connect it to the PC. Please use USB ports on the back of the PC with direct connection to the motherboard.

Step no.2 Install the ARMFlash programmer and drivers. Start the installation from the product CD: CD_Drive:\product\zip\ARMFlash_setup.exe.

Step no.3 After the installation connect the USB cable to the EasyARM board. You will be asked for the ARMflash drivers. Point to them in order to finish the driver installation. They are placed in folder:
System_Drive:\Program Files\Mikroelektronika\ARMFLASH\Driver.NT

Step no.4 Run and use ARMflash as it is explained in the PDF document '*ARMflash programmer*': CD_Drive:\product\pdf\armprog_manual.pdf

After these 4 steps, your EasyARM is installed and ready for use. You can try to read a program from the chip or to load an example from the product CD:
CD_Drive:\product\zip\easyarm_examples.zip.

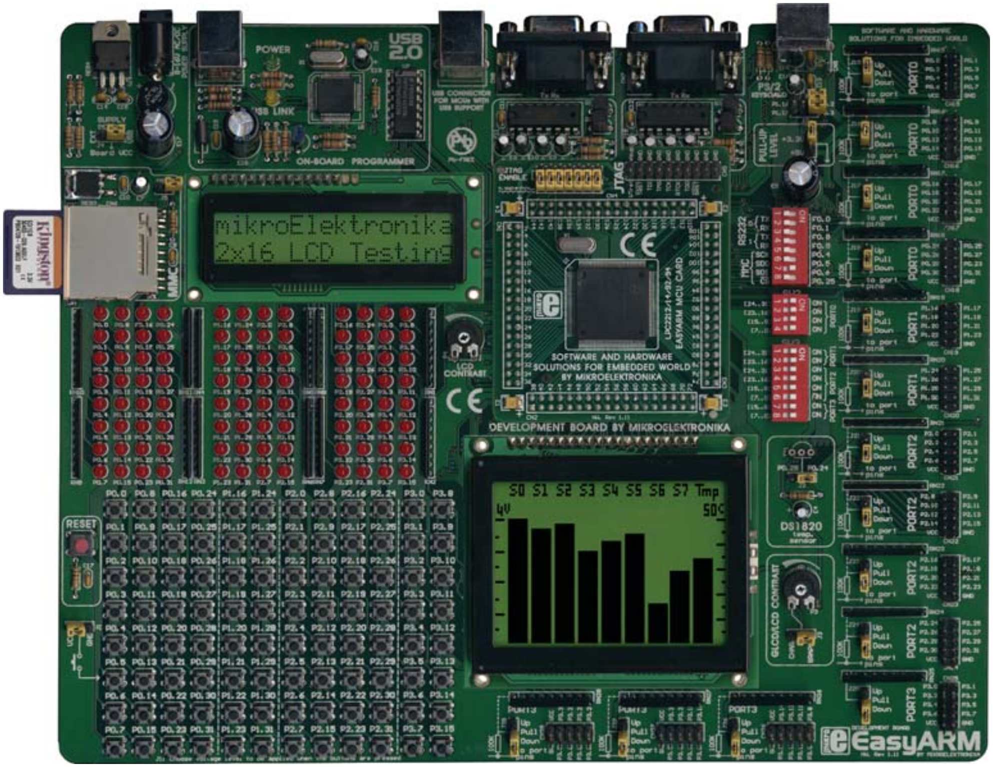
PHILIPS ARM DEVELOPMENT BOARD

INTRODUCTION

The EasyARM development system is a full-featured development board for Philips ARM microcontrollers. It has been designed to allow students and engineers to easily exercise and explore the capabilities of ARM microcontrollers. It allows ARM microcontrollers to be interfaced with external circuits and a broad range of peripheral devices, allowing the user to concentrate on software development.

Figure 1 illustrates the development board. On a silkscreen, there are identification marks next to each component. These marks describe connections to the microcontroller, operation modes and provide other useful notes. The need for additional schematics is minimized as all relevant information is printed on the board.

Figure 1. EasyARM development board



SWITCHES

The EasyARM development board features many peripherial devices. In order to enable these devices before programming, you need to check if appropriate jumpers or switches have been properly set.

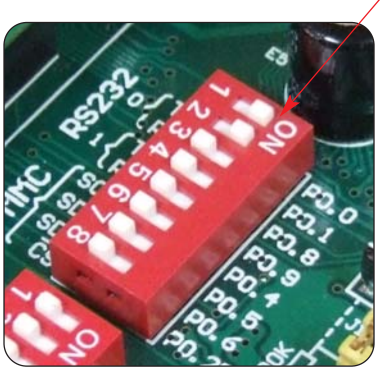
Switches are devices that have two positions - ON and OFF, which have a role to establish or break a connection between two contacts. The EasyARM development system has three groups of switches.

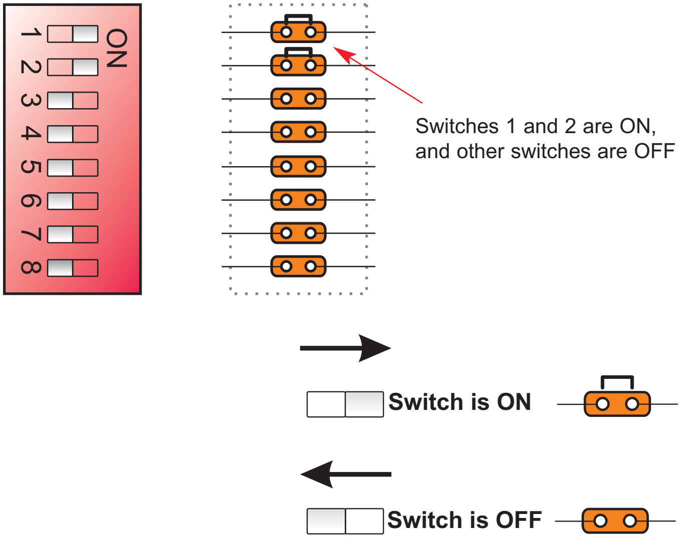
The switches of **SW1** enable connections among the microcontroller pins and both RS232 communication devices and also among the microcontroller pins and MMC/SD Card via SPI communication. The first two switches are used for RS232-0 communication lines, while the second two are used for RS232-1 communication lines and the last four are used for MMC/SD Card.

The switches of **SW2** and **SW3** are used to enable LEDs connected to PORT0, PORT1, PORT2 and PORT3. For example, if switch PORT0[7..0] is OFF, all LED's from P0.0 to P0.7 will be turned off.

Figure 2.

Group of 8 switches





Switches 1 and 2 are ON, and other switches are OFF

Switch is ON

Switch is OFF

JUMPERS

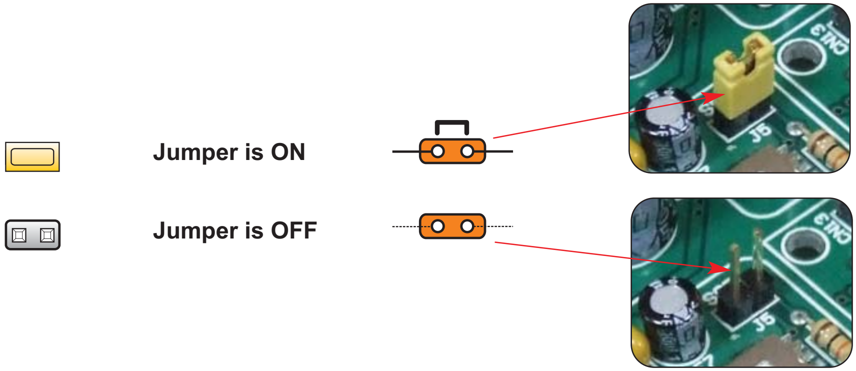
JUMPERS

Jumpers, like switches, can break or establish a connection between two points. Beneath the plastic cover of the jumper is a metal contact, which makes a connection when the jumper is placed between two disconnected pins.

For example, the jumper J5 is used to connect or disconnect pull-up resistor to the Slave Select pin. A connection is made when the jumper is placed between two contacts.

Figure 3.

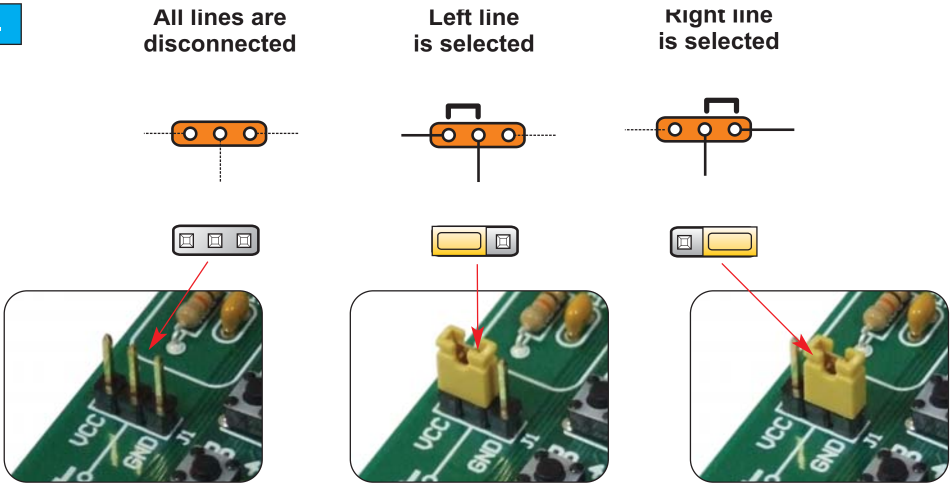
Jumper as a switch



More often, jumpers are used as a selector between two possible connections using a three pin connector. As illustrated in Fig. 4, the middle connector can be connected to the left or right pin, depending on the jumper's position.

Figure 4.

Jumper as a multiplexer



MCU CARD

The EasyARM development board has a 144-pin MCU Card. If you want to use some other microcontroller, all you have to do is to change MCU Cards. EasyARM MCU Card is shown on the following picture:

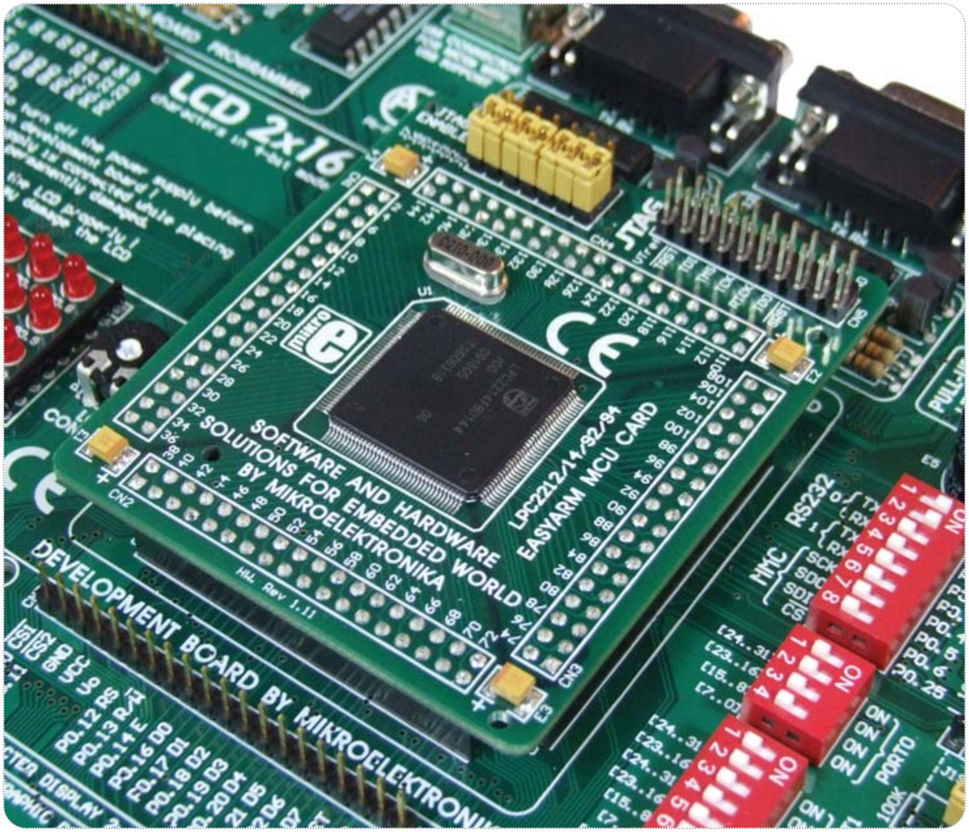
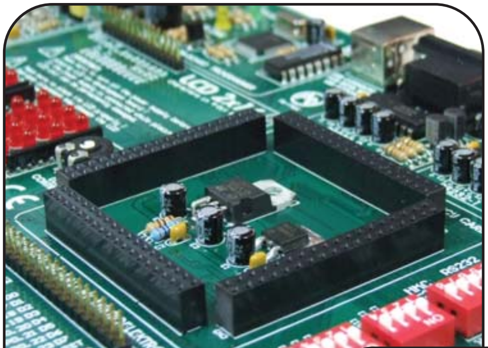

LPC2212/14/92/94
EASYARM MCU CARD
SOFTWARE AND HARDWARE SOLUTIONS FOR EMBEDDED WORLD BY MIKROELEKTRONIKA
DEVELOPMENT BOARD BY MIKROELEKTRONIKA
LCD 2x16
JTAG
RS232
MMC

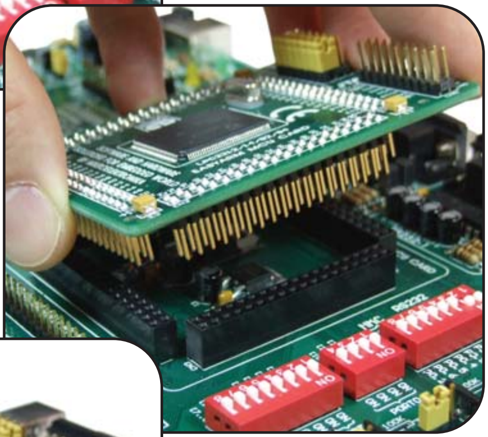
Figure 5. MCU Card

When you are placing MCU Card on the EasyARM MCU socket, you must follow these steps:



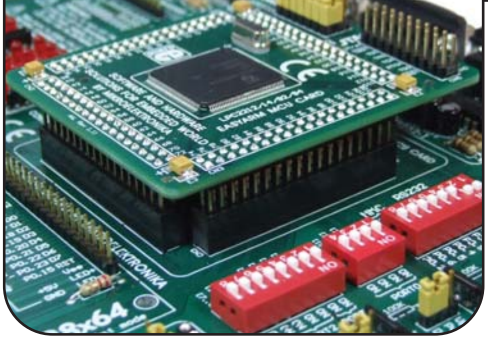
Step no.1

If there is already MCU Card placed on EasyARM, you must remove it by slowly pulling it up.



Step no.2

Place MCU Card on the board. Note that JTAG connector on the MCU Card must be at the upper-right corner.



Step no.3

When MCU Card is on the place, push it down by applying the pressure on all edges at the same time.

The microcontroller's pins are routed to various peripherials as illustrated in Fig.6. All ports have direct connections to Direct Port Access connectors. Such connectors are typically used for connecting external peripherials to the board, or for providing useful points for connecting digital logic probes.

All ports are connected to pull-up/down resistors and many of them are connected to LEDs and push-button switches, allowing easy digital pin state monitoring and testing.

Some of the pins are connected to other peripherials such as the DS1820 temperature sensor, RS-232 communication, LCD, etc.

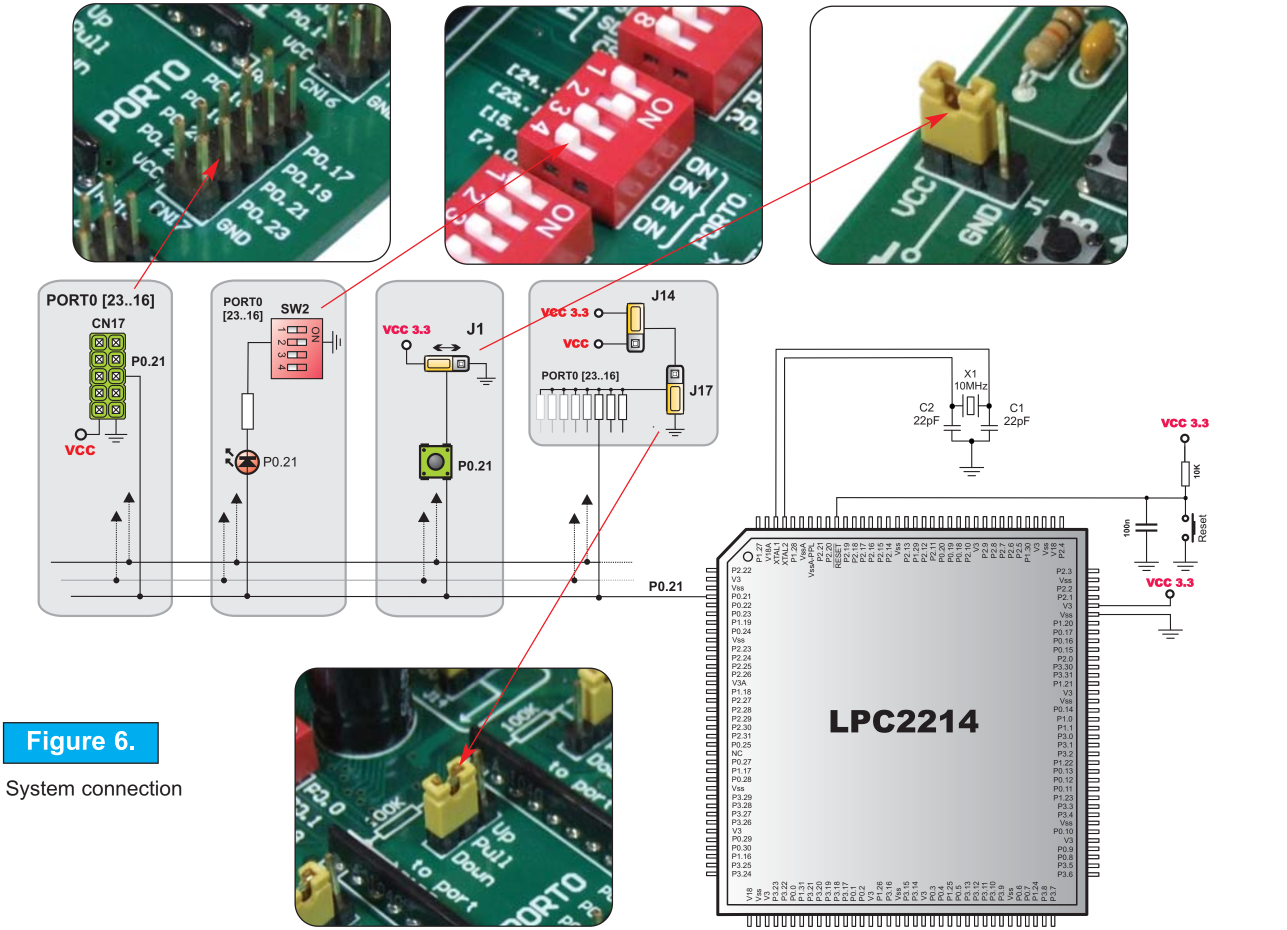


Figure 6.

System connection

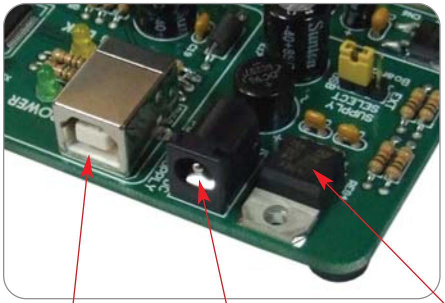
POWER SUPPLY

As a power supply source, user can select either a regulated supply from USB cable (default) or an external non-regulated power supply.

In case of the USB power supply, the system should be connected to a PC using the USB programming cable and jumper J4 should be set in the right-hand position.

In case of an external power supply, the EasyARM board produces +5V using an LM7805 voltage regulator. The external power supply can be AC or DC, with a voltage between 8V and 16 V and the jumper J4 should be set in the left-hand position. In Fig. 7 you can see the power connectors : USB (left) and external (right).

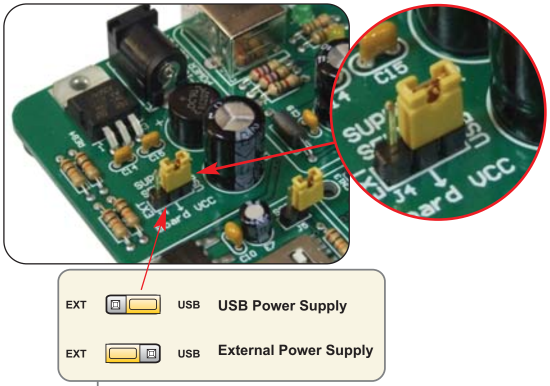
Figure 7. USB and power supply connectors



USB connector

External power supply connector

Figure 8. Power supply select jumper

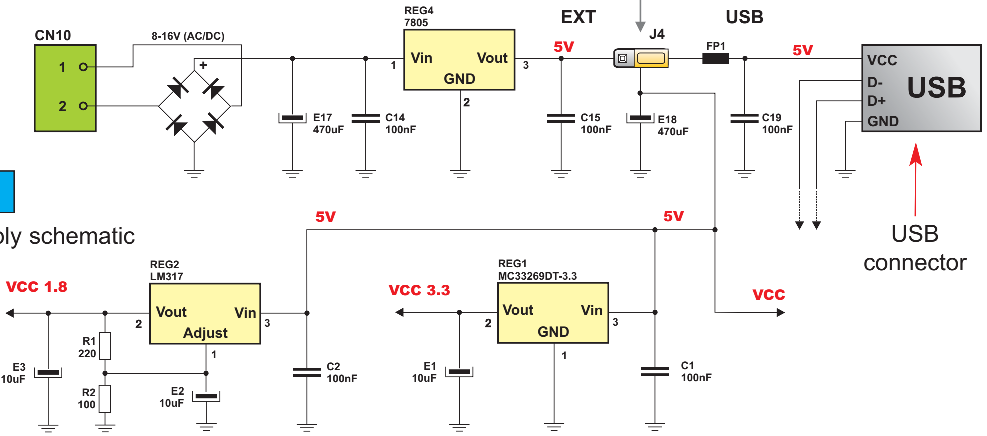


J4 in the left-hand position: system will take power from the external AC/DC power adapter.

J4 in the right-hand position: system will take power from the USB cable.

Figure 9.

Power supply schematic



ON-BOARD USB 2.0 PROGRAMMER

There is no need for the use of external equipment during programming, as the EasyARM development system has its own on-board USB 2.0 programmer.

All you need to do is connect the system to a PC using the USB cable. Then, load your program into the microcontroller via the *ARMflash* programming software, which is supplied with the board.

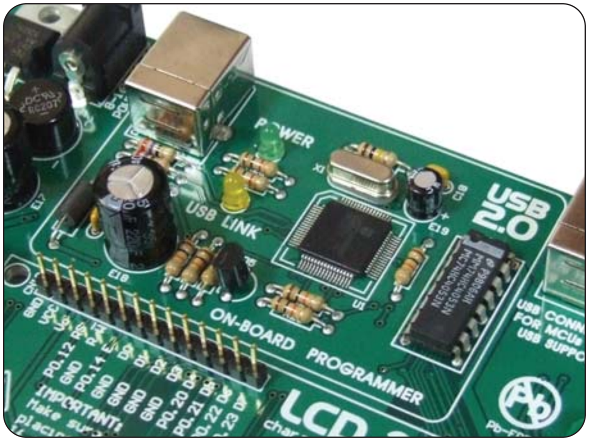


Figure 10. On-Board USB programmer

Note: There is no need for manually reseting MCU after programming. The programmer will reset the MCU automatically.

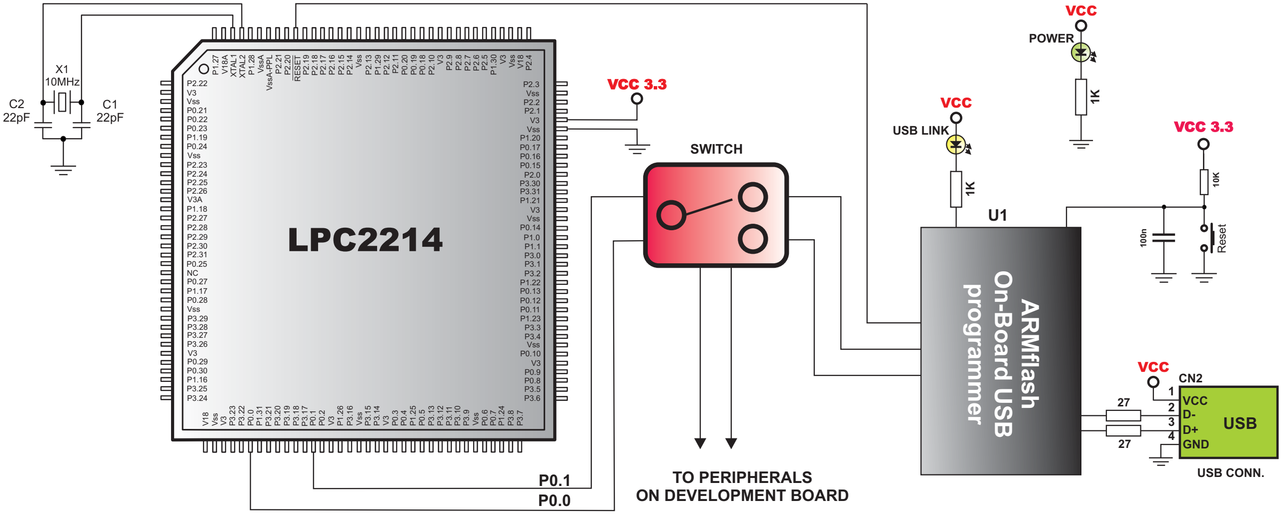


Figure 11. Switch schematic

LEDs

Light Emitting Diodes (LEDs) are the most commonly used components, usually for displaying pin's digital state. The EasyARM has 96 LEDs that are connected to the microcontroller's ports PORT0, PORT1, PORT2 and PORT3.

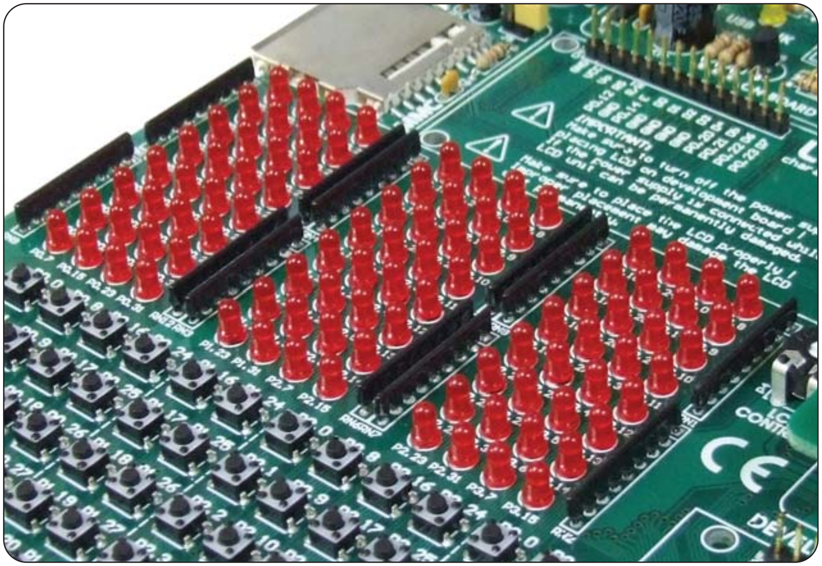


Figure 12. Light Emitting Diodes

Each group of eight LEDs can be enabled or disabled using switch SW2 and SW3. Fig. 14. illustrates the connection of a LEDs to port P0[15..8] of the microcontroller. A resistor is used in series with the LED to limit the LED's current. In this case the resistor's value is 1K.

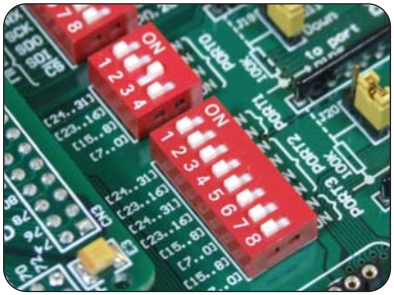


Figure 13.

SW2 and SW3 switches

All LEDs from one port are connected to a common point through these resistors, which can then be connected or disconnected to ground by the corresponding switch on SW2. The LEDs are enabled when connected to a ground and will display the state of the corresponding microcontroller pin; otherwise the LEDs will always be off, no matter what the pin state is, because no current can flow through them.

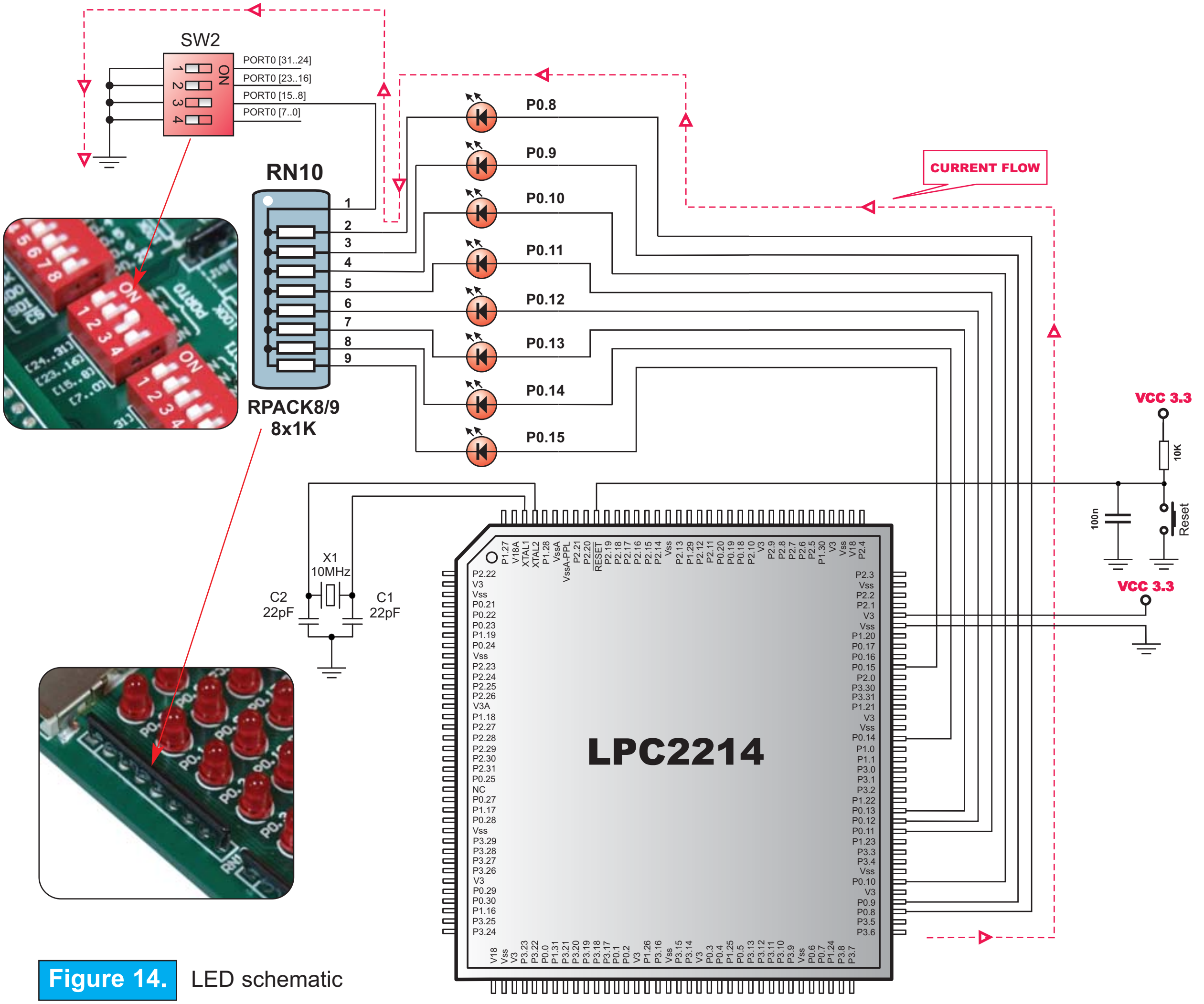
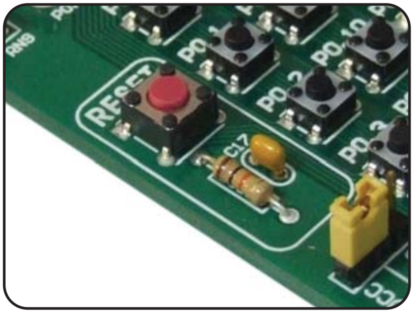


Figure 14. LED schematic

PUSHBUTTON SWITCHES



The EasyARM has 96 push buttons, which can be used to provide digital inputs to microcontroller's ports. There is also one push button that acts as a RESET (Figure 15).

Figure 15. Reset button

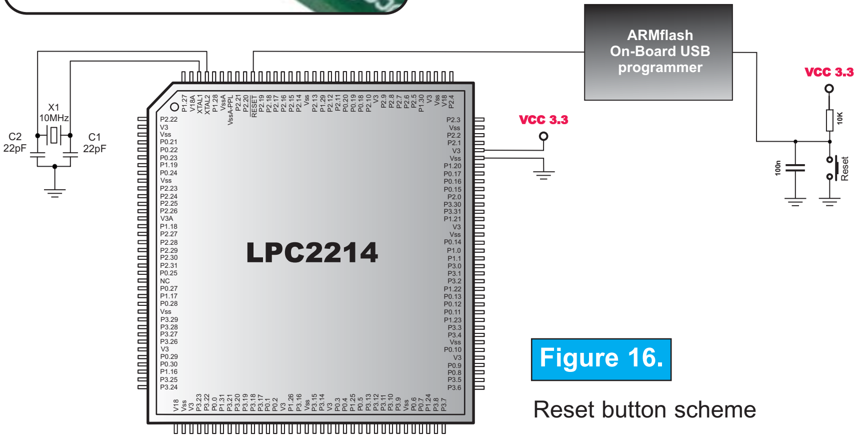


Figure 16.

Reset button scheme

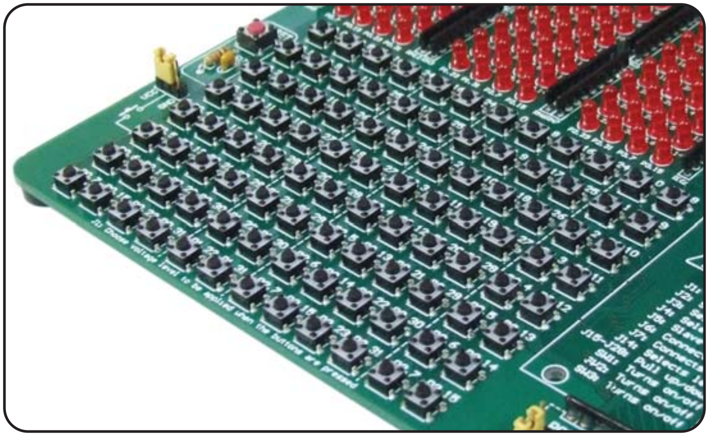


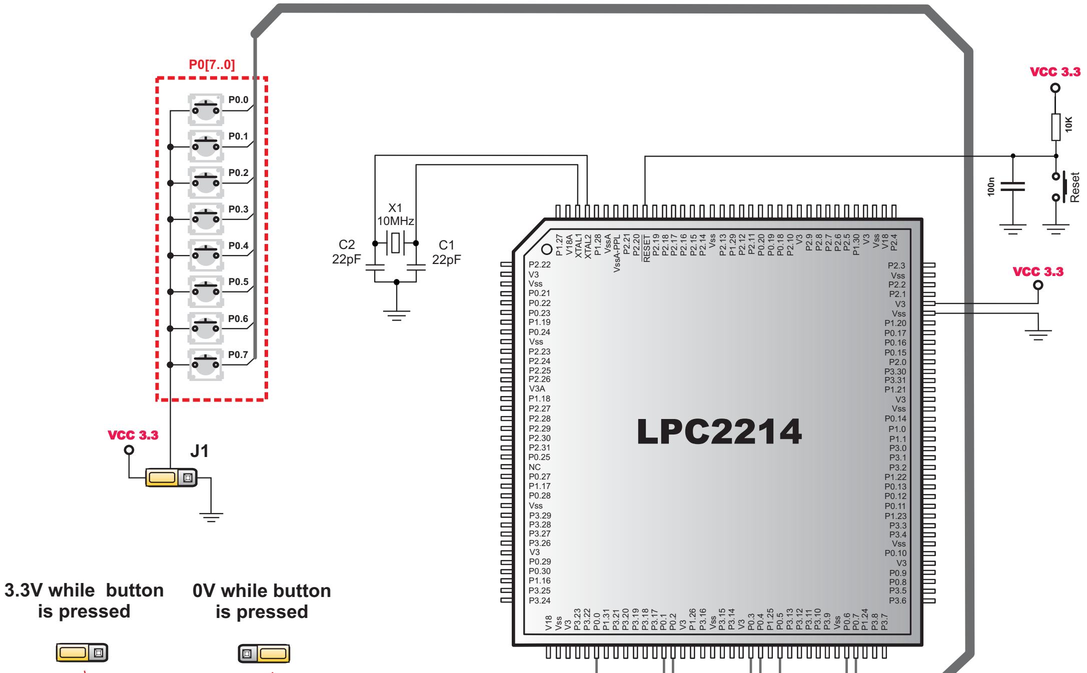
Figure 17.

Pushbutton switches

Buttons connections to port P0[7..0] is shown in Fig. 18. Jumper J1 determines whether a button press will bring logical zero or logical one to the appropriate pin.

When the button is not pressed, the pin state is determined by the pull-up or pull-down port jumpers.

In the example shown in Fig. 18, J1 is connected to +5V, so pressing the buttons will bring logical one to the appropriate pins.


P0[7..0]
P0.0
P0.1
P0.2
P0.3
P0.4
P0.5
P0.6
P0.7
VCC 3.3
J1
X1
10MHz
C2
22pF
C1
22pF
VCC 3.3
10K
100n
Reset
VCC 3.3
LPC2214
P1.27 V18A XTAL1 XTAL2 P1.28 VssA VssA-PPL P2.21 P2.20 RESET P2.19 P2.18 P2.17 P2.16 P2.15 P2.14 Vss P2.13 P1.29 P2.12 P2.11 P0.20 P0.19 P0.18 P2.10 V3 P2.9 P2.8 P2.7 P2.6 P2.5 P1.30 V3 Vss V18 P2.4
P2.22 V3 Vss P0.21 P0.22 P0.23 P1.19 P0.24 Vss P2.23 P2.24 P2.25 P2.26 V3A P1.18 P2.27 P2.28 P2.29 P2.30 P2.31 P0.25 NC P0.27 P1.17 P0.28 Vss P3.29 P3.28 P3.27 P3.26 V3 P0.29 P0.30 P1.16 P3.25 P3.24
P2.3 Vss P2.2 P2.1 V3 Vss P1.20 P0.17 P0.16 P0.15 P2.0 P3.30 P3.31 P1.21 V3 Vss P0.14 P1.0 P1.1 P3.0 P3.1 P3.2 P1.22 P0.13 P0.12 P0.11 P1.23 P3.3 P3.4 Vss P0.10 V3 P0.9 P0.8 P3.5 P3.6
V18 Vss V3 P3.23 P3.22 P0.0 P1.31 P3.21 P3.20 P3.19 P3.18 P3.17 P0.1 P0.2 V3 P1.26 P3.16 Vss P3.15 P3.14 V3 P0.3 P0.4 P1.25 P0.5 P3.13 P3.12 P3.11 P3.10 P3.9 Vss P0.6 P0.7 P1.24 P3.8 P3.7
3.3V while button is pressed
0V while button is pressed

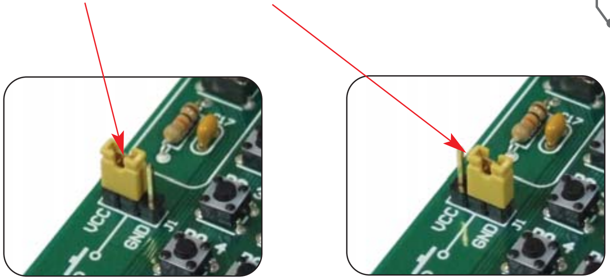


Figure 18.

Buttons schematic

On Fig. 19 the J17 jumper is set to pull-up, so when the button is not pressed pull-up resistor pulls the microcontroller's P0.22 pin to +5V or +3.3V depending on the J14 jumper selection.

A button press causes the port pin to be connected to ground (J1is in the lower position).

Thus, only when the button is pressed the microcontroller will sense a logical zero; otherwise the pin state will always be logical one.

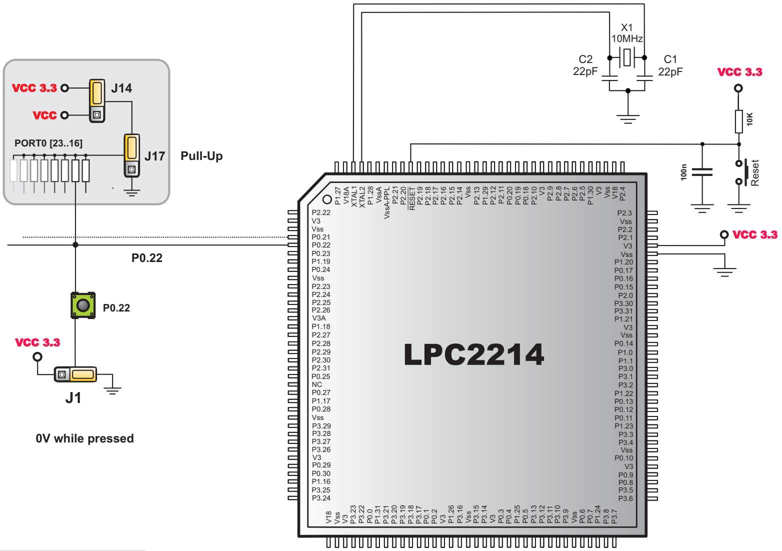


Figure 19. Button with pull-up resistor

On Fig. 20 the J17 jumper is set to pull-down, so when the button is not pressed pull-down resistor sets the microcontroller's P0.22 pin to 0V.

A button press causes the port pin to be connected to +3.3V (J1 is in the upper position).

Thus, only when the button is pressed the microcontroller will sense a logical one; otherwise the pin state will always be logical zero.

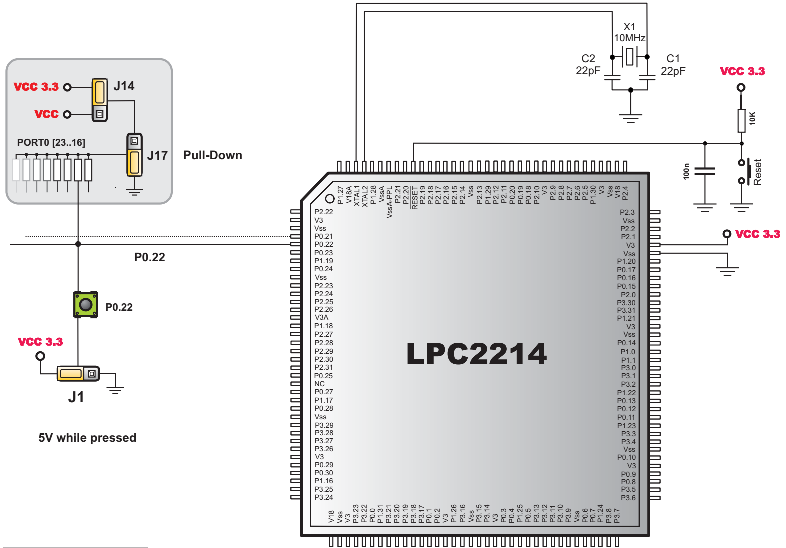


Figure 20. Button with pull-down resistor

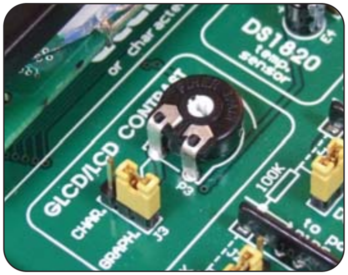
GRAPHIC LCD CONNECTOR ON-BOARD

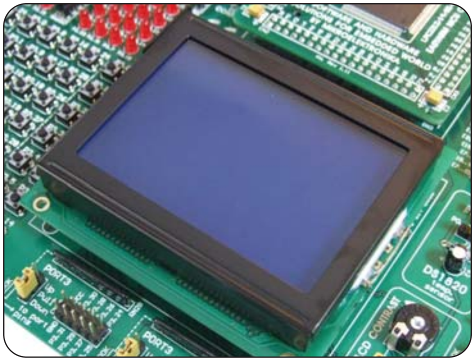
GRAPHIC LCD

A graphic LCD (GLCD) allows advanced visual messages to be displayed. While a character LCD can display only alphanumeric characters, a GLCD can be used to display messages in the form of drawings and bitmaps. The most commonly used graphic LCD has the screen resolution of 128x64 pixels. Before a GLCD is connected, the user needs to set the jumper J3 (Fig. 21) to the right-hand side. The GLCD's contrast can be adjusted using the potentiometer P3. Jumper J3 and potentiometer P3 are placed to the right of the GLCD.

Figure 21.

GLCD selection jumper





GLCD Figure 22.

In order to enable GLCD jumper J3 should be set to the right-hand side, labeled as GRAPH.

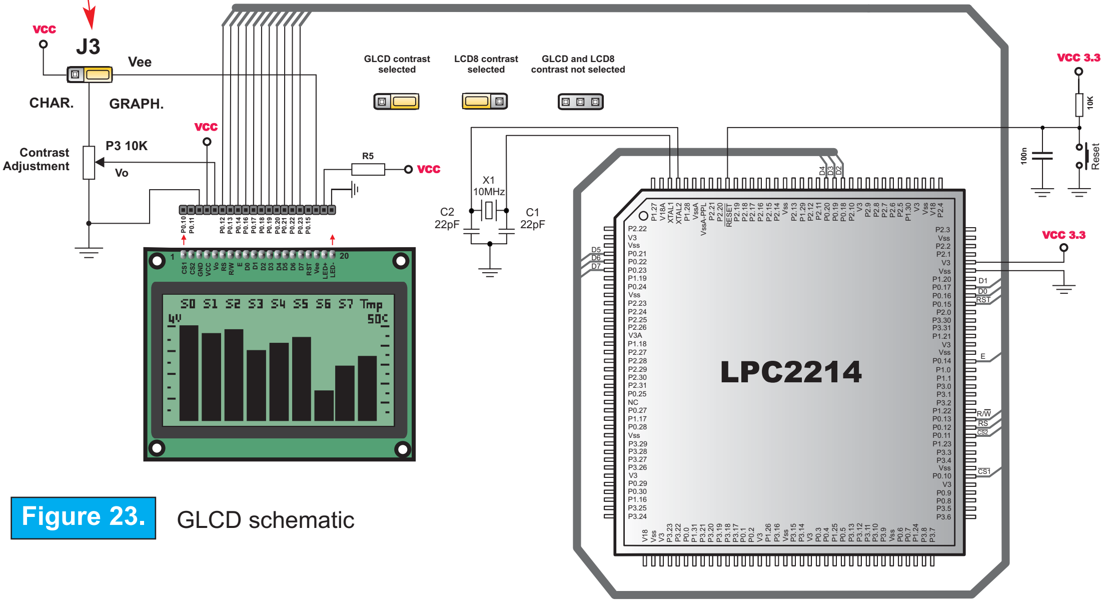


Figure 23. GLCD schematic

2x16 LCD CONNECTOR

2x16 LCD

ON-BOARD

LCD 2X16 IN 4-BIT MODE

The standard character LCD is probably the most widely used data visualization component. Usually, it can display two lines of 16 alphanumeric characters, each character made up of 5x8 pixels. The character LCD communicates with the microcontroller via a 4-bit or 8-bit data bus, each requiring the use of a different connector on the EasyARM development board. For 4-bit data bus use, the LCD should be placed in the upper left of the board, above the LEDs. The connection to the microcontroller is shown in Fig. 25 where there are only four data lines. It is important that the LCD is only inserted or removed from the EasyARM when the power is off.

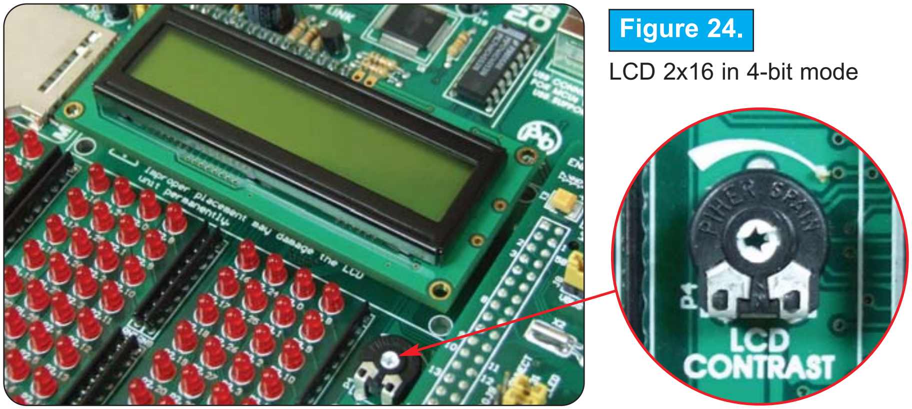


Figure 24.

LCD 2x16 in 4-bit mode

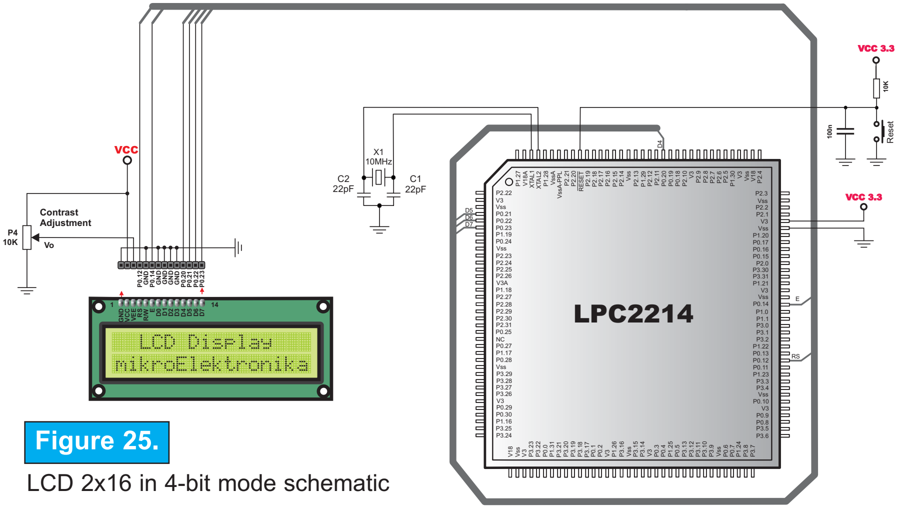


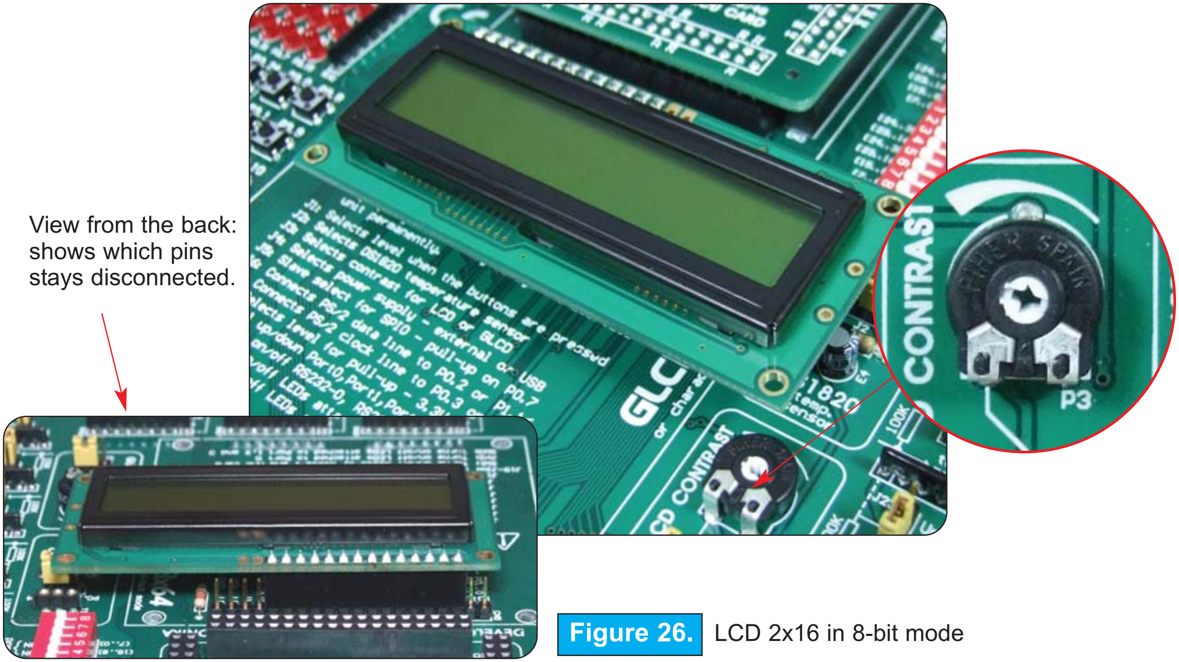
Figure 25.

LCD 2x16 in 4-bit mode schematic

2x16 LCD CONNECTOR
2x16 LCD
ON-BOARD

LCD 2X16 IN 8-BIT MODE

When using a character LCD in 8-bit mode, it should be placed on the GLCD connector. Since GLCD connector has 20 pins and the character LCD has only 14 pins, special attention is required when placing the LCD. Otherwise the LCD can be permanently damaged. The LCD must be placed in the marked position with two free pins to the left and four free pins to the right. When you add or remove LCD be sure that the power supply is off.

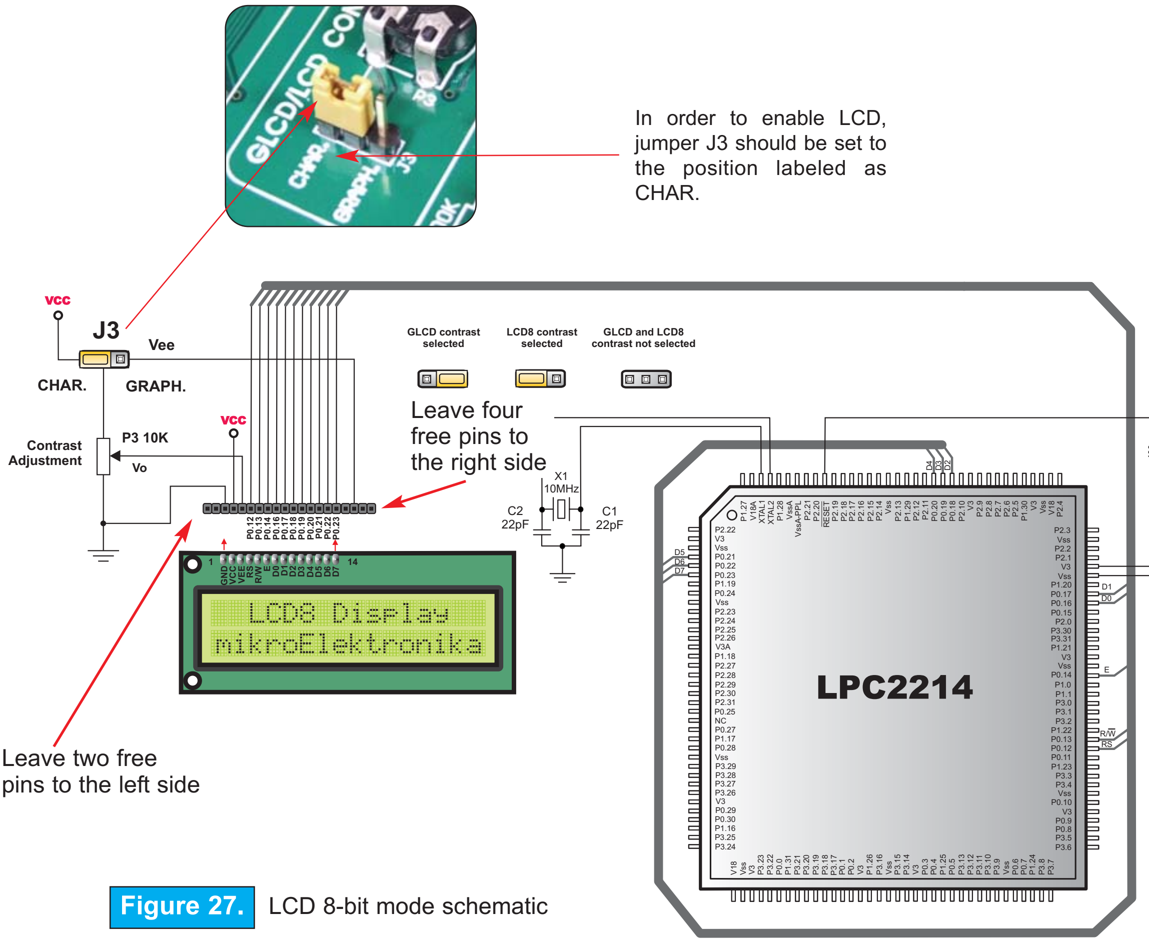


View from the back: shows which pins stays disconnected.

Figure 26. LCD 2x16 in 8-bit mode

Before adding the LCD, set the jumper J3 to the left-hand side, labeled as CHAR. The LCD's contrast can be adjusted using potentiometer P3, which is located to the right of the GLCD/LCD connector (Fig. 26).

NOTE: Special attention is required when placing the LCD. Otherwise the LCD can be permanently damaged.



In order to enable LCD, jumper J3 should be set to the position labeled as CHAR.

Leave four free pins to the right side

Leave two free pins to the left side

Figure 27. LCD 8-bit mode schematic

RS-232 COMMUNICATION

RS-232 communication enables point-to-point data transfer. It is commonly used in data acquisition applications, for the transfer of data between the microcontroller and a PC. Since the voltage levels of a microcontroller and PC are not directly compatible with each other, a level transition buffer such as the MAX232 must be used.

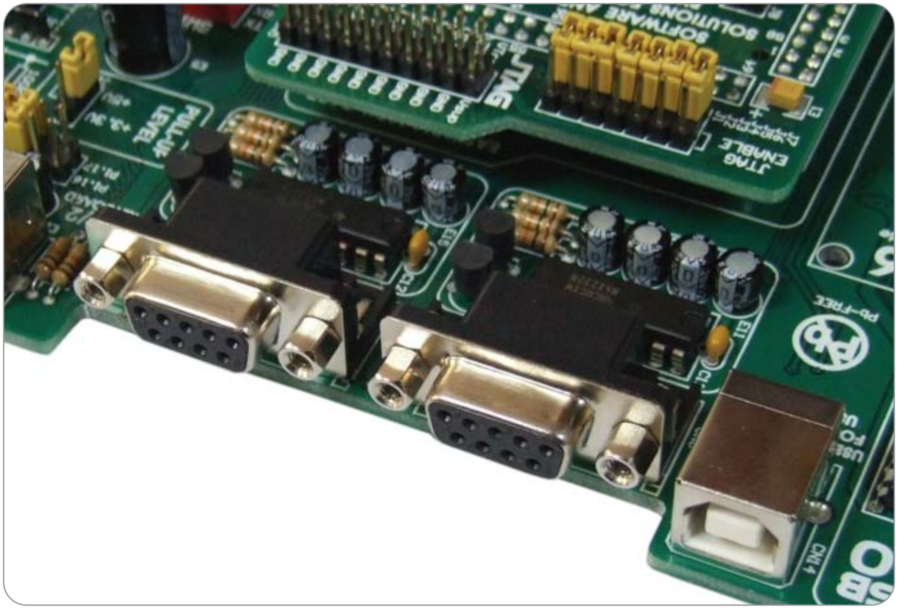


Figure 28. RS-232 connectors

EasyARM development board have two RS-232 communication devices, RS-232-0 and RS-232-1. In order to provide a more flexible system, the microcontroller is connected to the MAX232 through DIP-switch SW1. The first two switches on SW1 are used to connect Rx and Tx lines from microcontroller to RS-232-0 port, and the second two for connecting Rx and Tx lines to RS-232-1.

Transistors Q1, Q2 and Q3, Q4 are used for adjusting voltage level of Tx line signal. Microcontroller's output level (for logic one) is +3.3V and MAX232 input level is +5V.

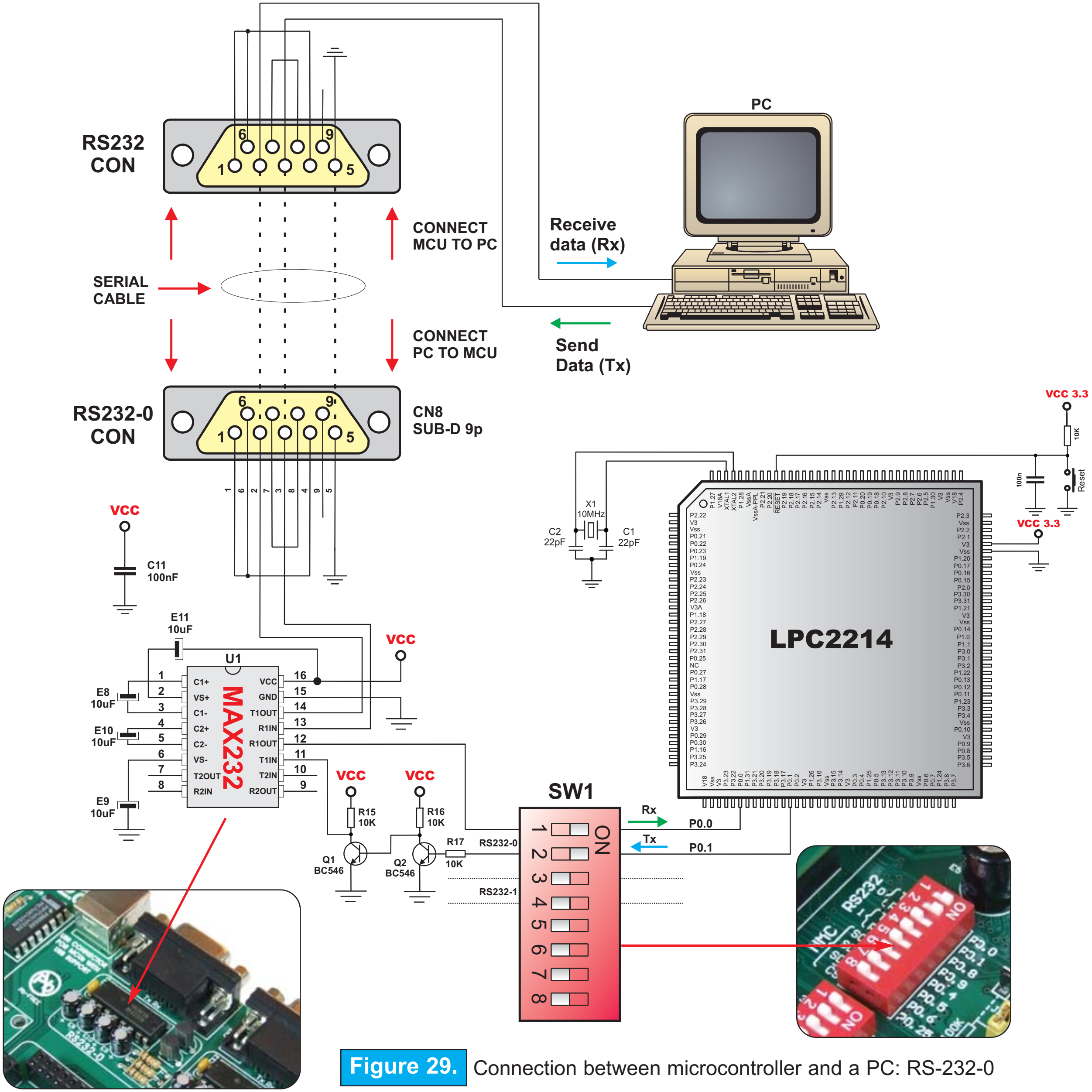


Figure 29. Connection between microcontroller and a PC: RS-232-0

RS-232 COMMUNICATION

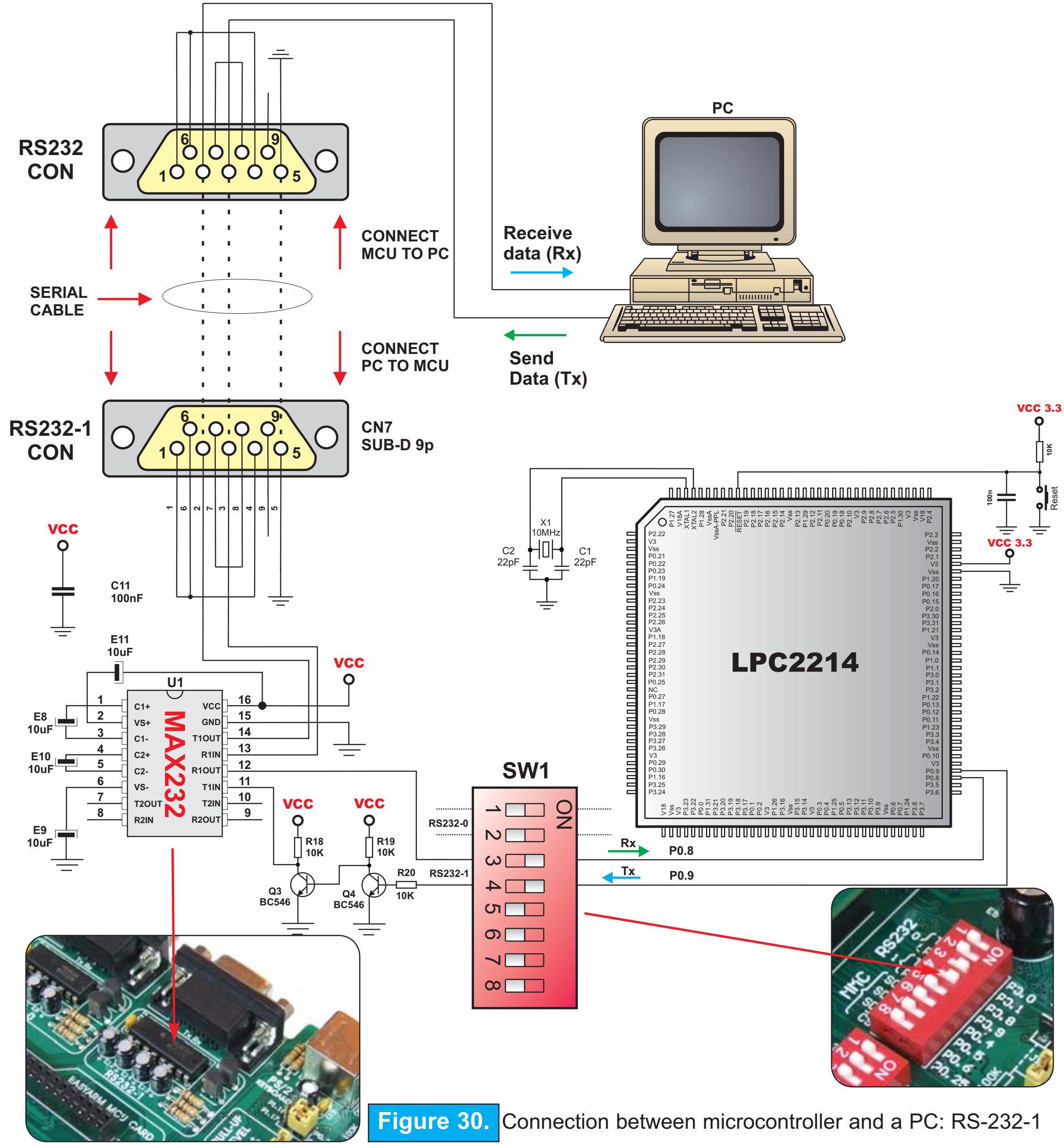


Figure 30. Connection between microcontroller and a PC: RS-232-1

DS1820 DIGITAL THERMOMETER

The DS1820 digital thermometer is well suited to environmental temperature measurement, having the temperature range of -55°C to 125°C and the accuracy of +/-0.5°C. It must be placed correctly in the 3-pin socket provided on the EasyARM, with its rounded side to the upper side of the board (Fig 31). Otherwise the DS1820 could be permanently damaged. In order to work, DS1820 must be connected to microcontroller's P0.24 or P0.28 pin, by placing jumper J2 to the right-hand or the left-hand side, respectively.

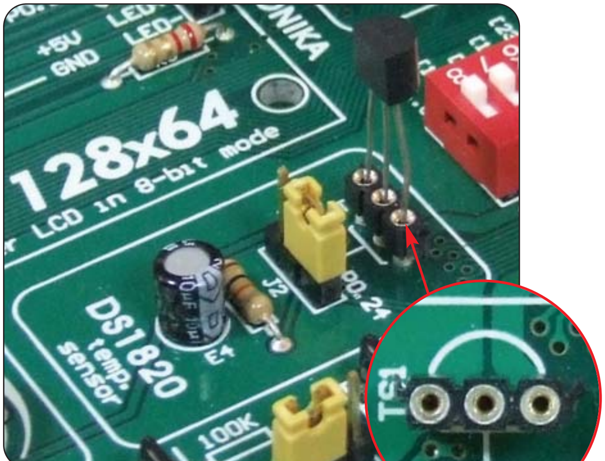
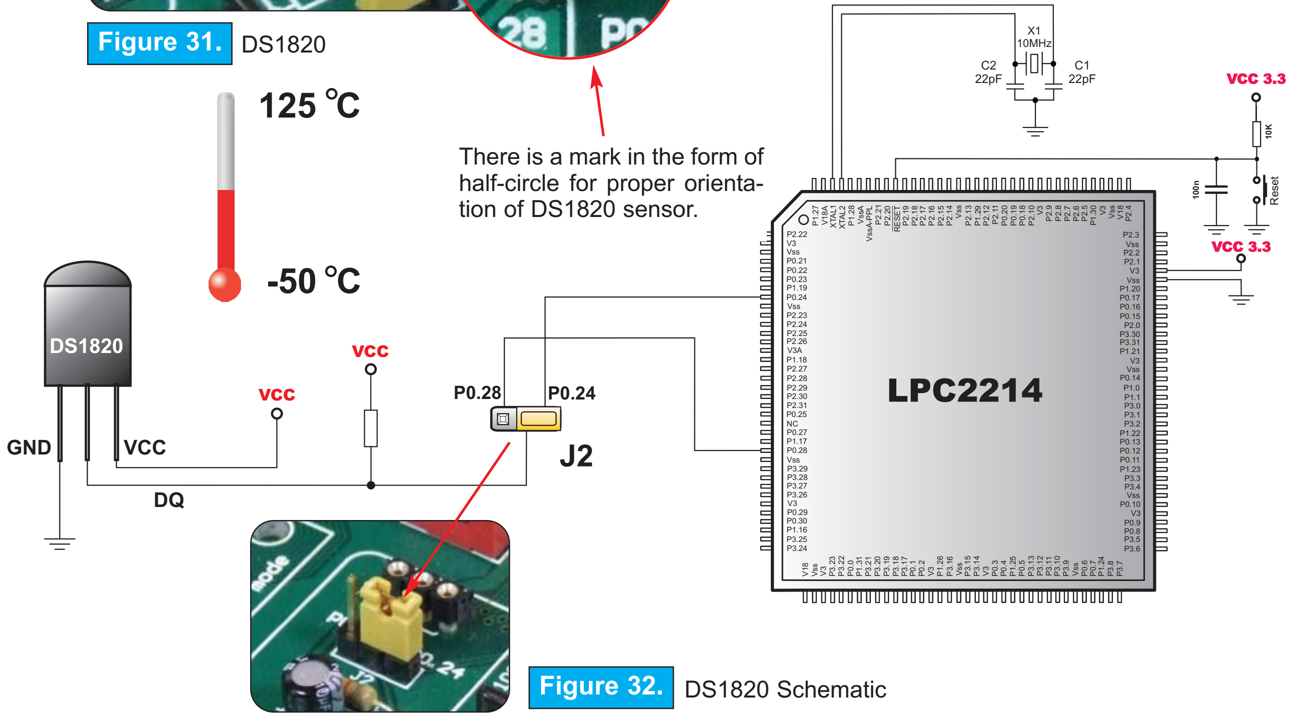


Figure 31. DS1820



There is a mark in the form of half-circle for proper orientation of DS1820 sensor.

Figure 32. DS1820 Schematic

PS/2 (KEYBOARD) CONNECTOR

The PS/2 connector allows direct connection between EasyARM and devices that use PS/2 communication, such as PC, keyboard or mouse. For example, the microcontroller can be connected to a keyboard to capture pressed keys or it can be connected to a PC to act as a keyboard. DATA and CLK lines are used for data tansfer. They can be connected either to P0.2 and P0.3 pins or to P1.16 and P1.17 pins, respectively.

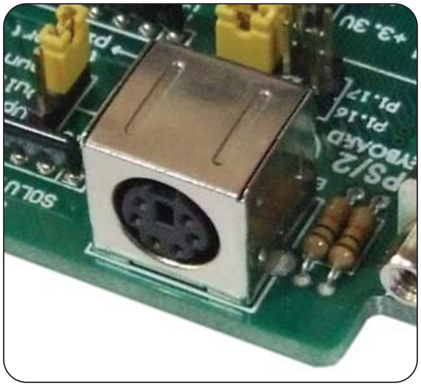


Figure 33. PS/2 connector

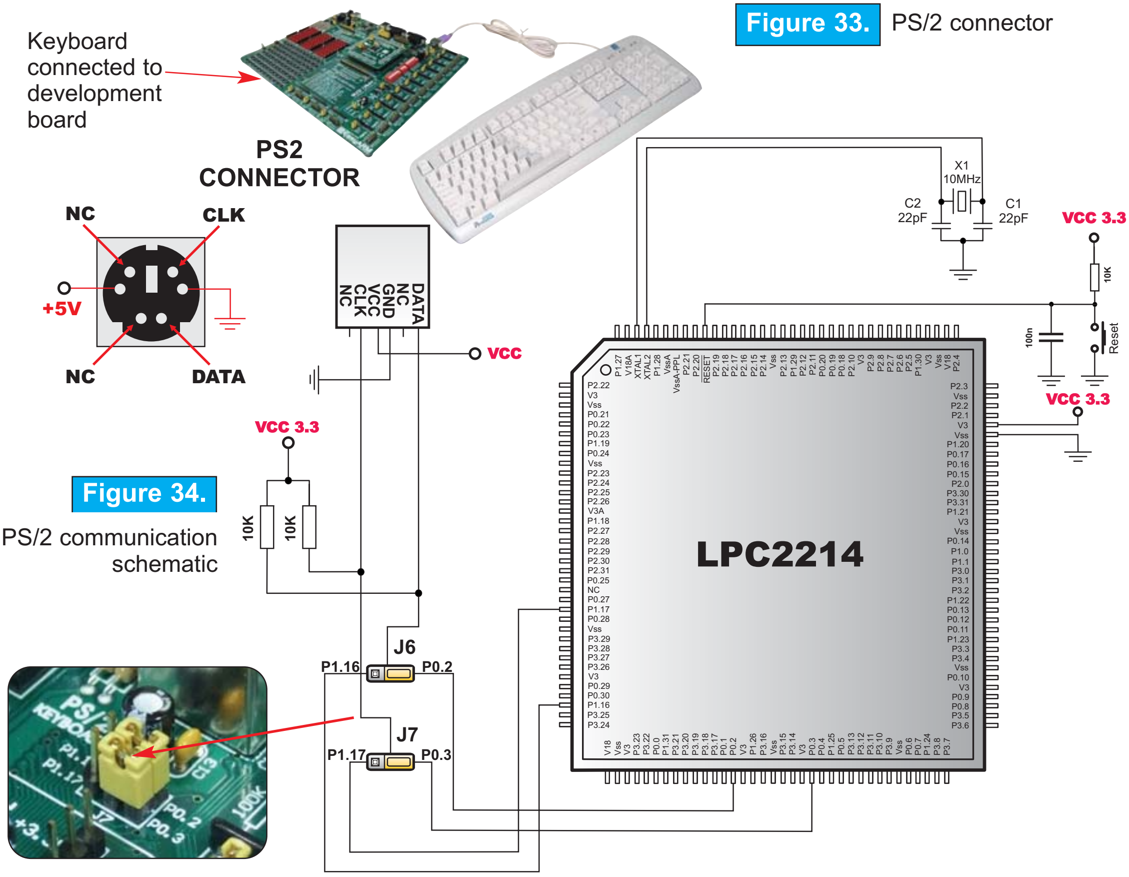


Figure 34. PS/2 communication schematic

DIRECT PORT ACCESS

All microcontroller input/output pins can be accessed via connectors placed along the right side of the board. For each of PORT0, PORT2 and PORT3 there are four 10-pin connectors providing VCC, GND and eight port pins (ARMs are 32-bit MCUs). Only PORT1 have two 10-pin connectors.

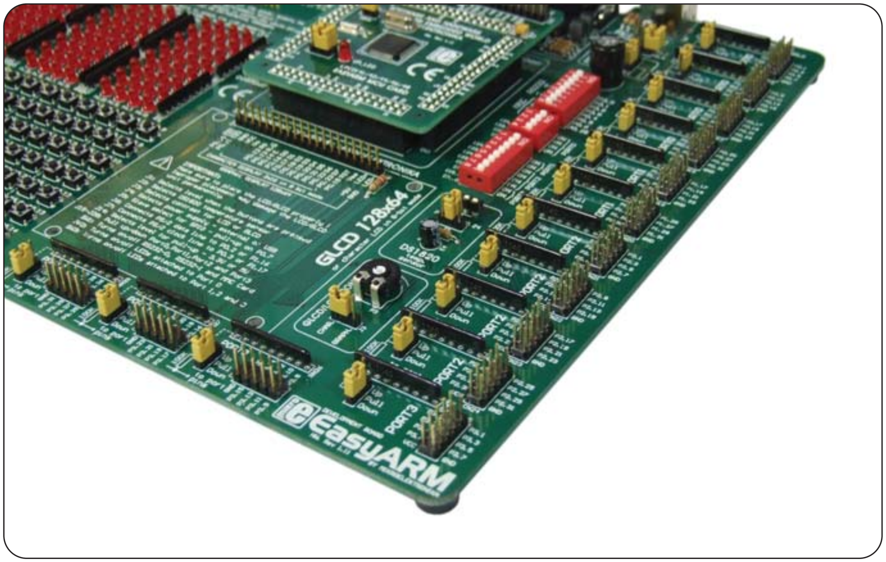


Figure 35. Direct port access connectors

These connectors can be used for system expansion with external boards such as Serial Ethernet, Compact Flash, MMC/SD, ADC, DAC, CAN, RTC, RS-485, etc. Ensure that the on-board peripherals are disconnected from microcontroller by setting the appropriate jumpers, while external peripherals are using the same pins. The connectors can also be used for attaching logic probes or other test equipment.

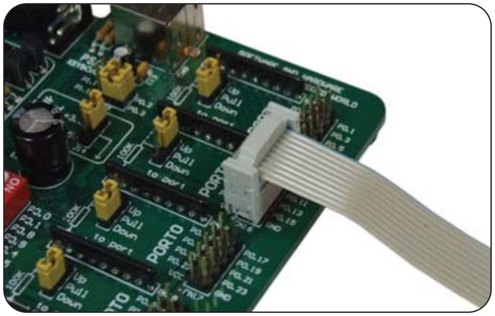
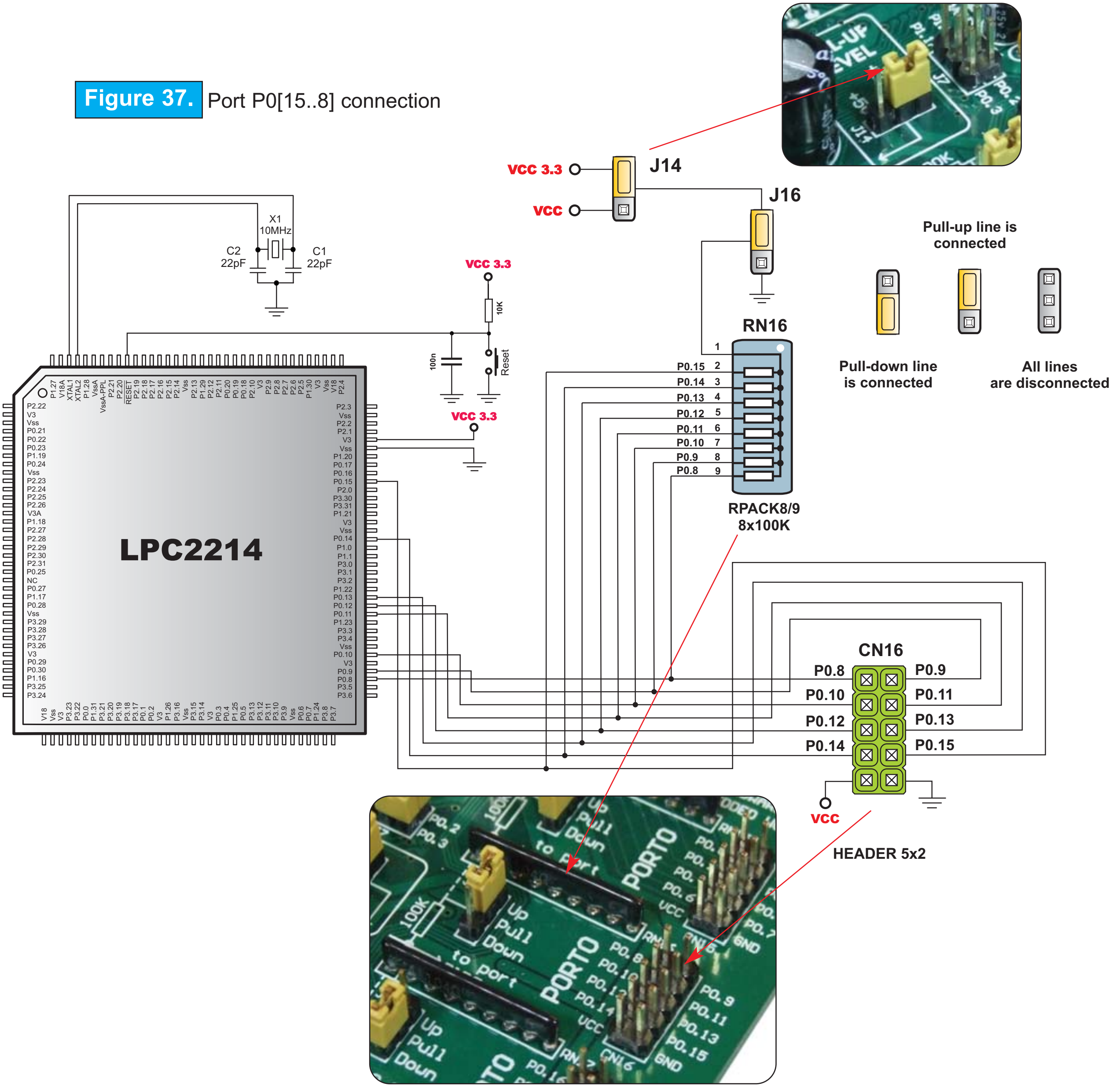


Figure 36.

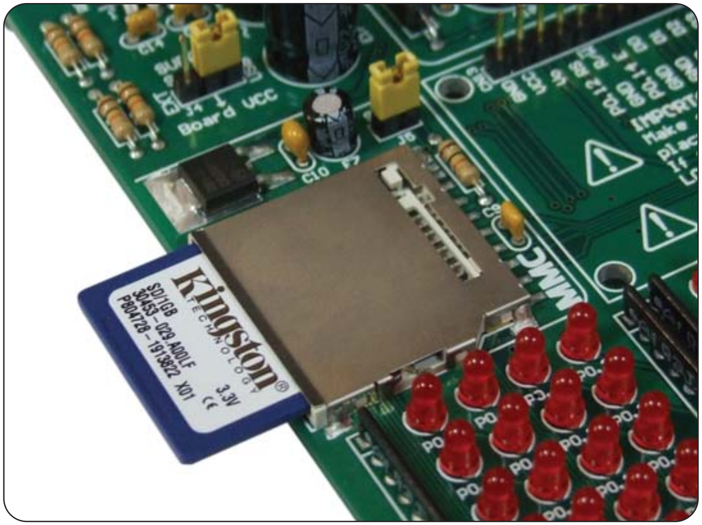
Example of how to connect external peripheral with flat cable

Figure 37. Port P0[15..8] connection



MMC/SD (MULTIMEDIA CARD)

MMC card is used as storage media for a portable devices, in a form that can easily be removed for access by a PC. For example, a digital camera would use an MMC card for storing image files. With an MMC reader (typically small box that connects via USB or some other serial connection) you can easily transfer data from MMC card to your computer. Microcontroller on EasyARM communicates with Multi Media Card via SPI communication.

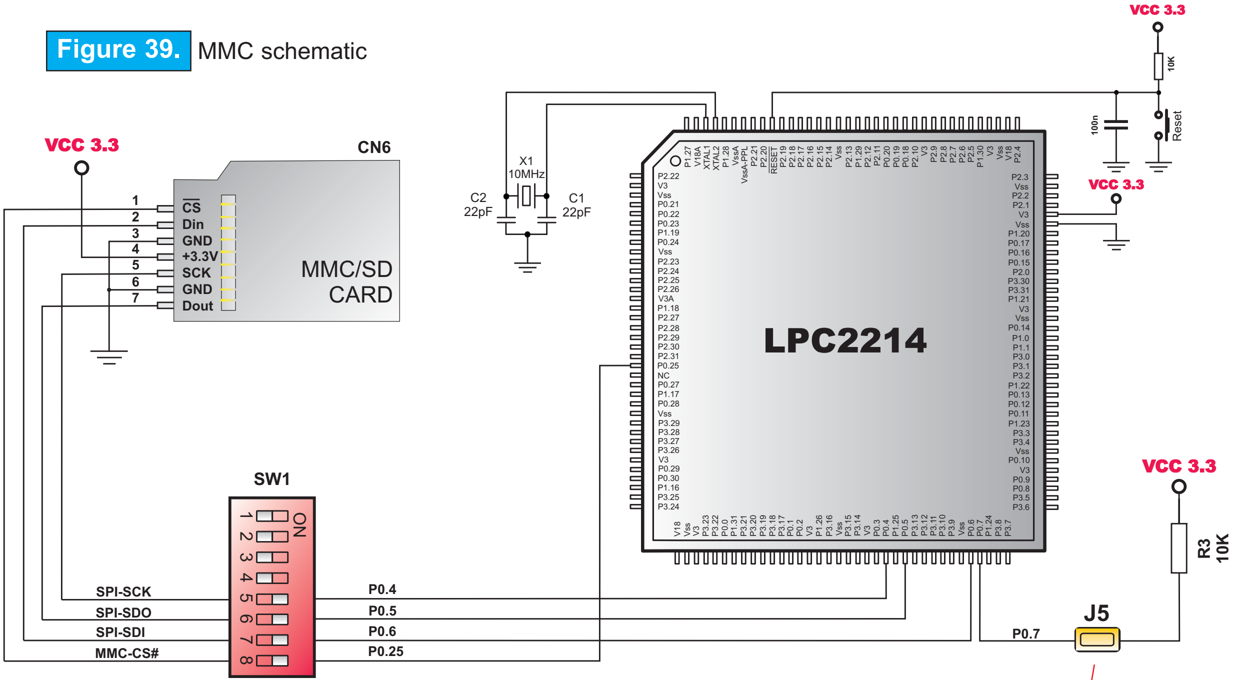


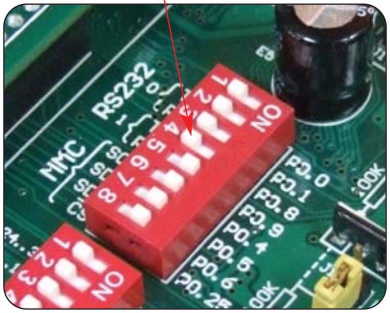
Modern computers, both laptops and desktops, often have SD slots, which can read MMC cards.

Figure 38.
MMC slot on-board

To enable MMC card you must turn on switches 5, 6, 7 and 8 on SW3 and enable jumper J5. By doing that, microcontrollers's SPI comunnication lines (SDI, SDO and SCK) and Chip Select are connected to MMC and Slave select line (pin P0.7) is connected to pull-up resistor.

Figure 39. MMC schematic





USB COMMUNICATION

The USB communication connector is placed in the upper side of the EasyARM next to the On-Board programmer. It is used with specific ARM microcontrollers that have USB support, such as LPC2148. Note that the USB communication connector cannot be used for programming and that the USB programming connector cannot be used for communication.

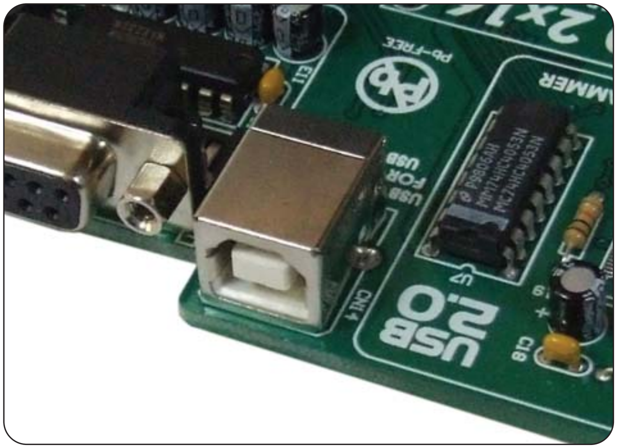


Figure 40.
USB communication connector

There are two groups of jumpers on the LPC2148 MCU Card. Jumper J8 labeled as VBUS is for connecting VBUS line from USB communication connector to the MCU's P0.23 pin. This is for detecting when some other USB device is connected to USB communication line. Jumpers J9 and J10 are for displaying USB connection status (Connected/Disconnected) on the Led lebeled as UP_LED.They can also be used for controlling connection status by software (Connecting/Disconnecting).

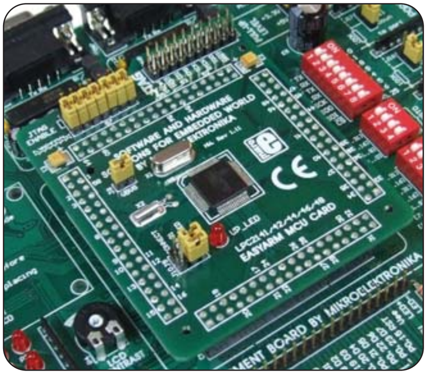
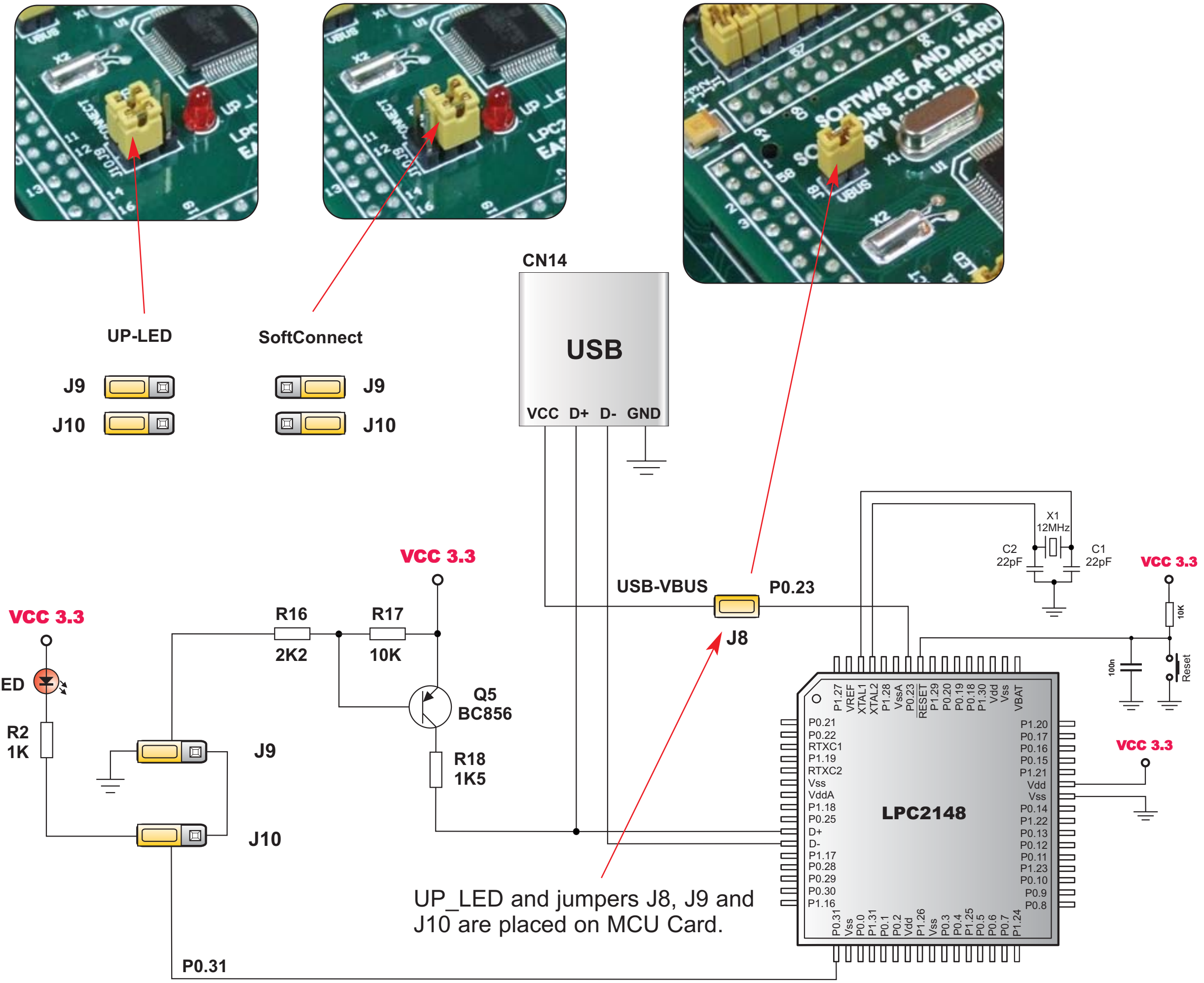


Figure 41.
LPC2148 MCU Card

Figure 42. USB communication schematic


UP-LED
SoftConnect
J9
J10
J9
J10
CN14
USB
VCC D+ D- GND
USB-VBUS
P0.23
J8
X1
12MHz
C2
22pF
C1
22pF
VCC 3.3
10K
100n
Reset
VCC 3.3
R16
2K2
R17
10K
Q5
BC856
R18
1K5
VCC 3.3
UP_LED
R2
1K
J9
J10
P0.31
LPC2148
P1.27 VREF XTAL1 XTAL2 P1.28 VssA P0.23 RESET P1.29 P0.20 P0.19 P0.18 P1.30 Vdd Vss VBAT
P0.21 P0.22 RTXC1 P1.19 RTXC2 Vss VddA P1.18 P0.25 D+ D- P1.17 P0.28 P0.29 P0.30 P1.16
P1.20 P0.17 P0.16 P0.15 P1.21 Vdd Vss P0.14 P1.22 P0.13 P0.12 P0.11 P1.23 P0.10 P0.9 P0.8
P0.31 Vss P0.0 P1.31 P0.1 P0.2 Vdd P1.26 Vss P0.3 P0.4 P1.25 P0.5 P0.6 P0.7 P1.24
VCC 3.3

UP_LED and jumpers J8, J9 and J10 are placed on MCU Card.

JTAG CONNECTOR

JTAG connector can be used as serial programming interface or On-Chip debug system. For the On-chip Debug system, in addition to the JTAG interface pins, the RESET pin is monitored by the debugger to be able to detect external reset sources. The debugger can also pull the RESET pin low to reset the whole system. The JTAG interface is accessed through six of the microcontroller's pins:

- TDO: Test Data Out,
- TDI: Test Data In,
- TCK: Test Clock,
- TMS: Test Mode Select
- TRST#: Test Reset,
- RTCK: Returned Test Clock.

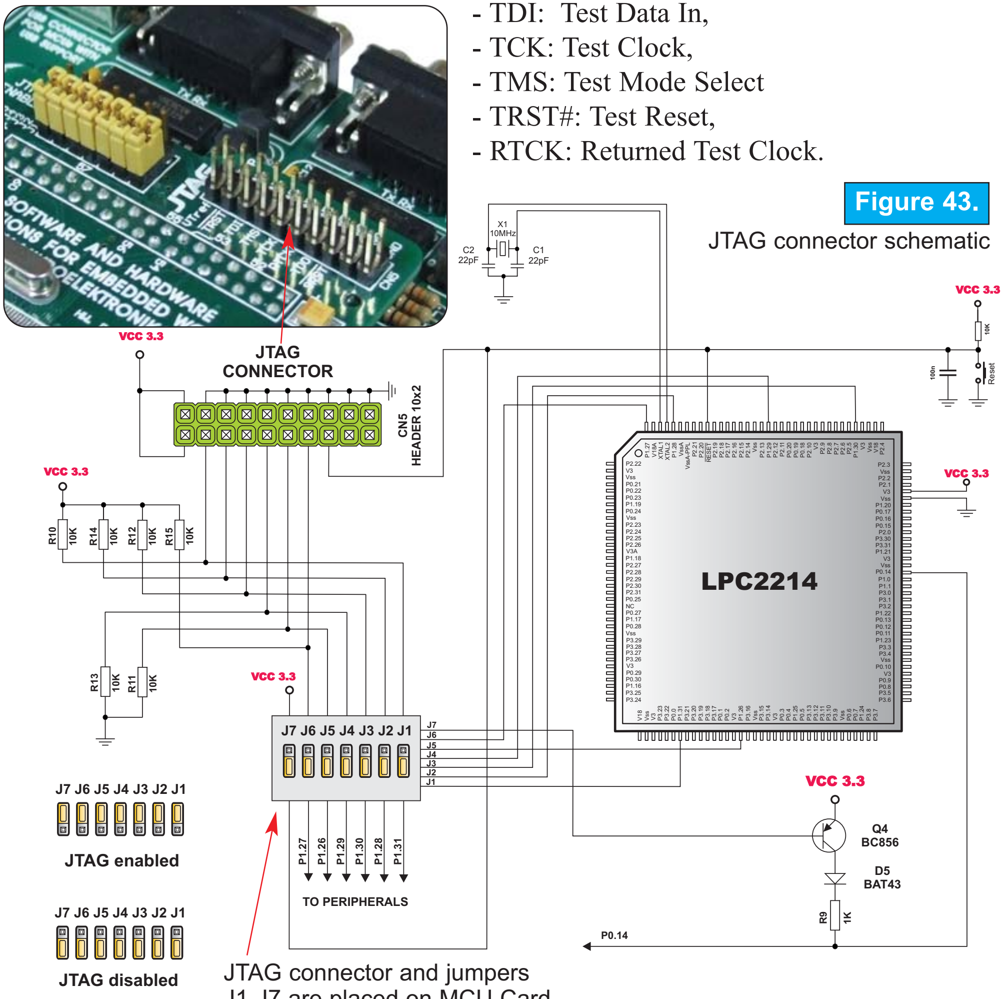


Figure 43.

JTAG connector schematic

JTAG connector and jumpers J1-J7 are placed on MCU Card.

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support@mikroe.com

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