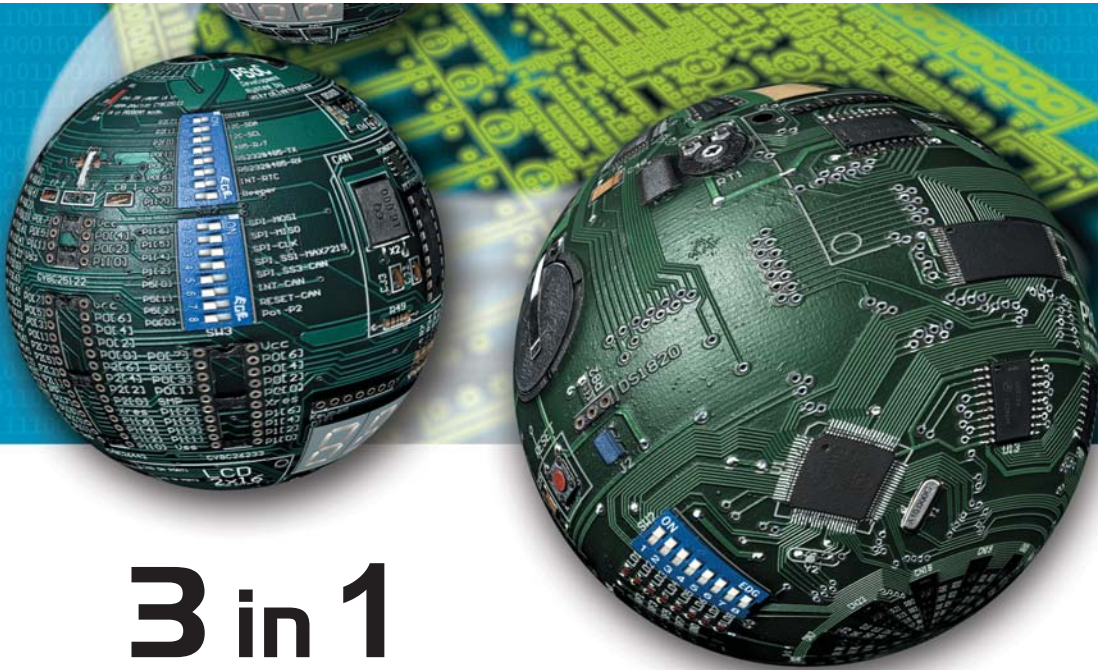


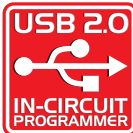
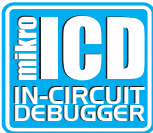
SOFTWARE AND HARDWARE SOLUTIONS FOR THE EMBEDDED WORLD

MikroElektronika
Development tools - Books - Compilers

EasyPIC4 User's Manual



3 in 1



With useful implemented peripherals, plentiful practical code examples and a broad set of additional add-on boards (Serial Ethernet, Compact Flash, MMC/SD, ADC, DAC, CAN, RTC, RS-485, etc.), MikroElektronika development boards make fast and reliable tools that can satisfy the needs of experienced engineers and beginners alike.

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Second edition January 2007

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CONTENTS

CONNECTING THE SYSTEM	page 4
INTRODUCTION	page 5
DESCRIPTION OF THE DEVELOPMENT SYSTEM	page 5
Switches	page 6
Jumpers	page 7
MCU sockets	page 8
Power Supply	page 10
On-board USB 2.0 programmer	page 11
Oscillator	page 13
mikroICD (In-Circuit Debugger)	page 15
LEDs	page 16
Pushbutton switches	page 18
7-segment displays	page 21
Graphic LCD	page 22
LCD 2x16 in 4-bit mode	page 23
LCD 2x16 in 8-bit mode	page 24
RS-232 Communication	page 26
USB Communication	page 27
PS/2 keyboard	page 28
DS1820 Digital Thermometer	page 29
A/D Converter input	page 30
Direct Port Access	page 32

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 PICFLASH2 programmer and drivers. Start the installation from the product CD:
`CD_Drive:\product\zip\PICFlash_setup.exe`.
- Step no.3** After the installation connect the USB cable to the EasyPIC4 board. You will be asked for the PICprog drivers. Point to them in order to finish the driver instalation. They are placed in the folder:
`System_Drive:\Program Files\Mikroelektronika\PICFLASH-mikroICD\Driver.NT`
- Step no.4** Run and use PICFLASH2 as explained in the document '*PICflash2 programmer*'.
`CD_Drive:\product\pdf\picflash_manual_v4.pdf`

After these 4 steps, your EasyPIC4 is installed and ready for use. You should try to read a program from the chip or to load an example from the examples folder of mikroElektronika's compilers for PIC or from the product CD:
`CD_Drive:\product\zip\easyPIC4_examples.zip`.

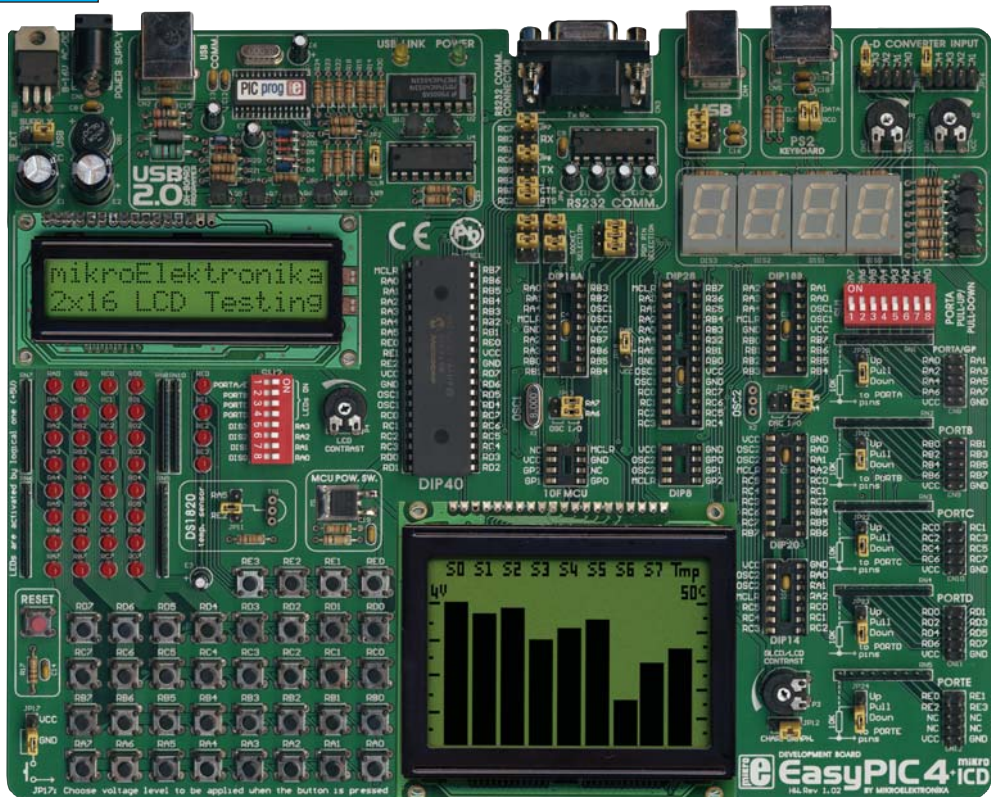


INTRODUCTION

The EasyPIC4 development system is a full-featured development board for Microchip PIC microcontrollers. It has been designed to allow students and engineers to easily exercise and explore the capabilities of PIC microcontrollers. It allows PIC microcontrollers to be interfaced with external circuits and a broad range of peripheral devices, allowing a user to concentrate on software development.

Figure 1 illustrates the development board. Each component is marked on a silkscreen, both top and bottom. These marks describe connections to the microcontroller, operation modes, and provide some useful notes. The need for additional schematics is minimized since all relevant information is printed on the board.

Figure 1. EasyPIC4 development board



SWITCHES

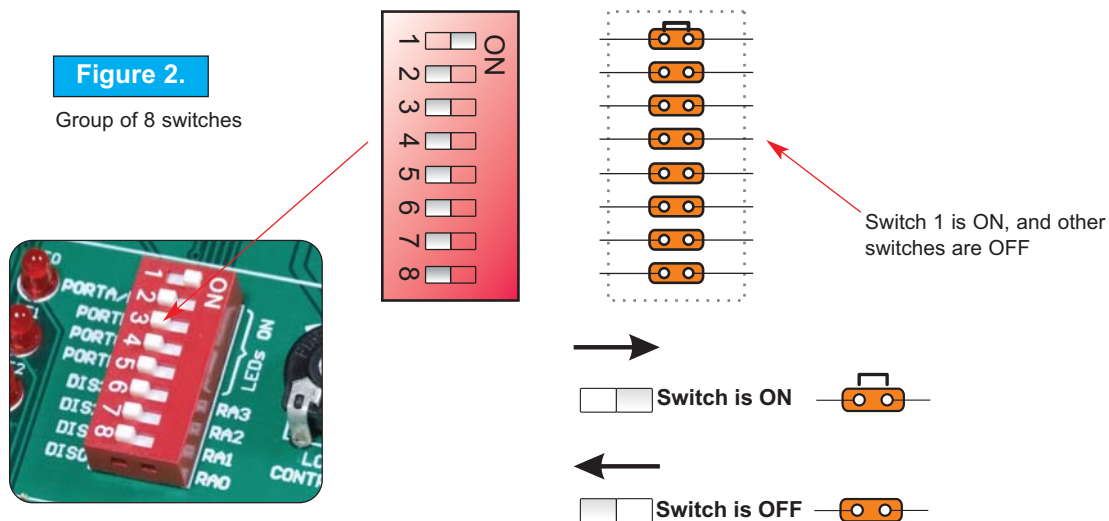
The EasyPIC4 development board features a number of peripheral devices. In order to enable these devices before programming, you need to check if appropriate jumpers or switches have been properly set.

Switches are devices that have two positions - ON and OFF, which have a role to establish or break a connection between two contacts. The EasyPIC4 development board has two groups of switches.

The first group, **SW1**, enables connections between the microcontroller port with analog capabilities (PORTA) and external pull-up/down resistors. The pull-up/down resistors should be disconnected from the analog input pins, otherwise they will affect the input voltage level. When PORTA pins are used as digital inputs/outputs, the appropriate pull-up/down resistors should be enabled.

The upper four switches of **SW2** are used to enable LEDs connected to PORTA/E, PORTB, PORTC and PORTD. For example, if the switch for PORTB is OFF, all PORTB LEDs will be turned off.

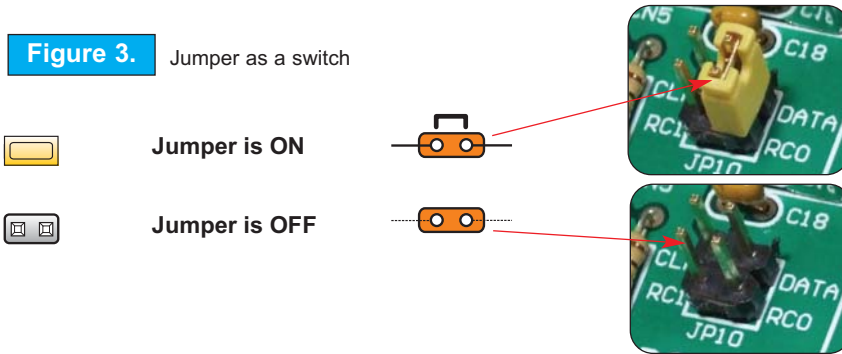
The lower four switches of **SW2** are used to enable the 7-segment displays. If you don't need the 7-segment displays in your project, these switches should be OFF.



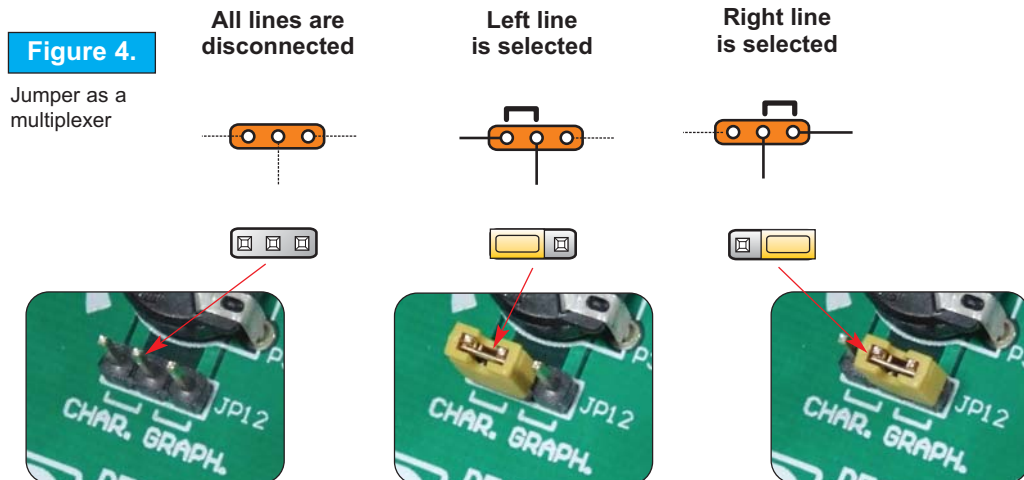
JUMPERS

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 if the jumper is placed between two disconnected pins.

For example, the jumper group JP10 have two jumpers used as switches. They are used to connect or disconnect PS/2 CLK pin to RC1 and PS/2 DATA pin to RC0 pin of the microcontroller. A connection is made when the jumpers are placed between two contacts.



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



MCU SOCKETS

EasyPIC4 is delivered with a 40-pin microcontroller. Users can remove this one and fit a different microcontroller in DIP40, DIP28, DIP20, DIP18, DIP14 or DIP8 packages of an adequate pinout.

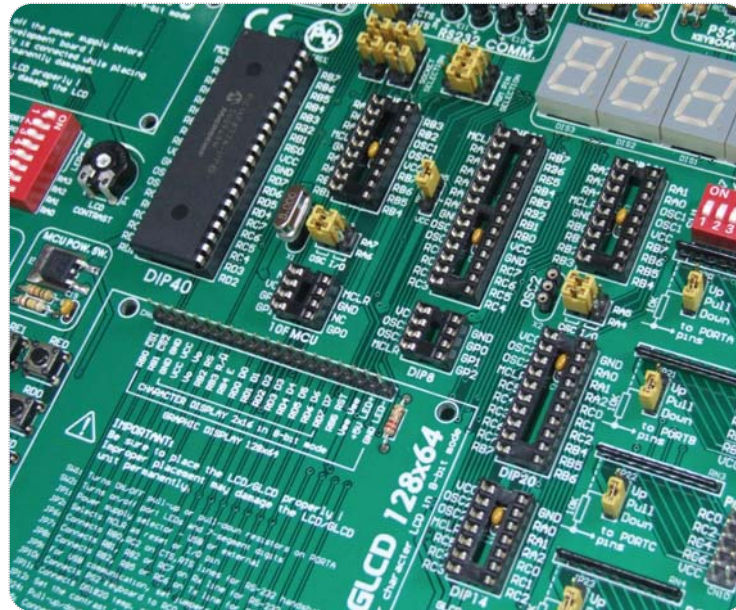


Figure 5. MCU sockets



Note: There are two DIP18 sockets, with different pinouts (DIP18A and DIP18B). When putting 18-pin microcontroller into DIP18 socket choose the one with corresponding pinout. For example, PIC18F1220 uses DIP18A socket, while PIC16F628A uses DIP18B socket. The 10F MCU socket is used only for PIC10F family and the DIP8 socket is used for all other 8-pin microcontrollers.



Note: Since all packages have parallel connections, there must not be more than one microcontroller on the board at a time.

Note: Make sure to place jumper JP18 in lower position (labeled as VCC) while using PIC18F2331 microcontroller. When using some other 28-pin MCU this jumper must be at upper position (labeled as RA5).

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

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

Some pins are connected to other peripherals such as the DS1820 temperature sensor, RS-232 communication, 7-segment displays, LCD, etc.

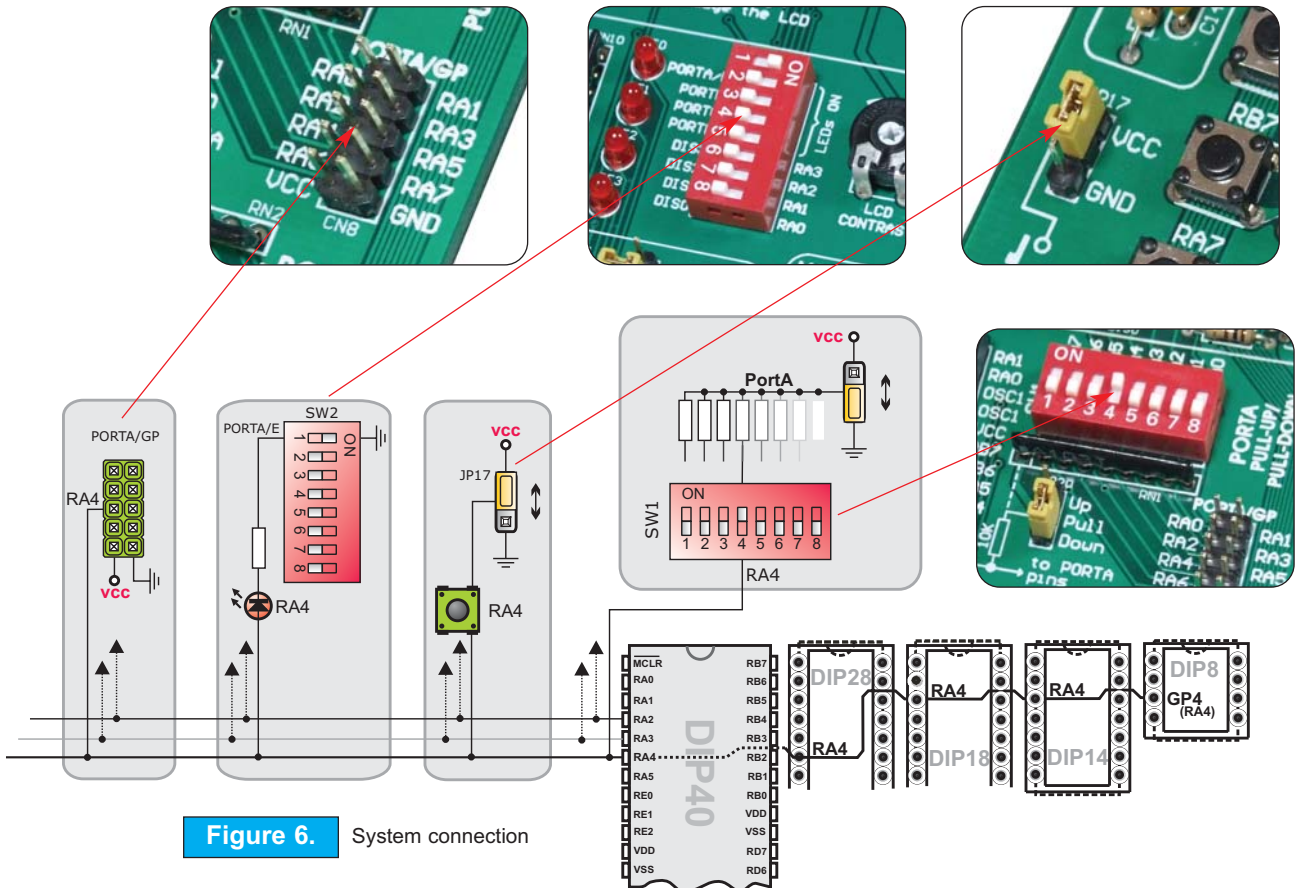


Figure 6. System connection

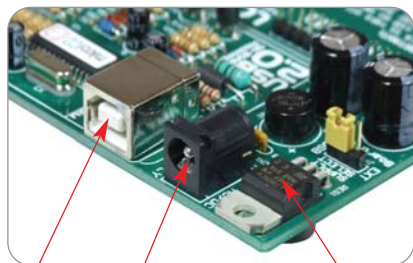


POWER SUPPLY

As a power supply source, users can select either a regulated supply from the USB cable (default) or an external power supply. In case of the USB power supply, the system should be connected to a PC using the USB programming cable, while the jumper JP1 should be set in the right-hand position.

In the case of an external power supply, the EasyPIC4 board produces +5V using an LM7805 voltage regulator. The external power supply can be AC or DC, with a voltage between 8V and 16V and the jumper JP1 should be set in the left-hand position. In Fig. 7 you can see USB and external power supply connectors.

Figure 7. USB and power supply connectors



USB connector

External power supply connector

JP1 in the left-hand position: system will take power from the external AC/DC power adapter.

JP1 in the right-hand position: system will take power from the USB cable.

Figure 8. Power supply select jumper

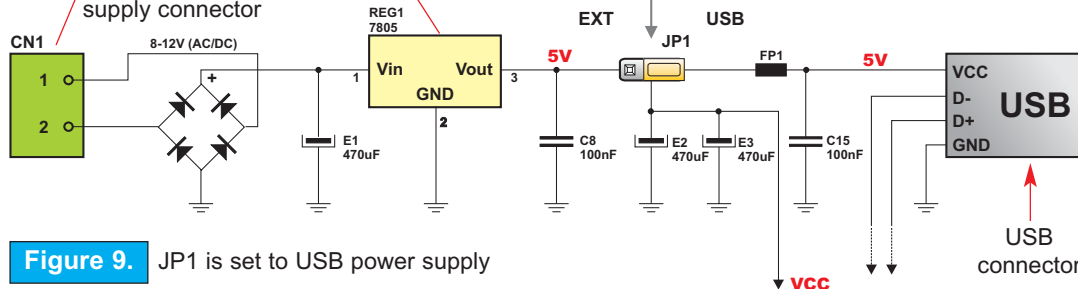
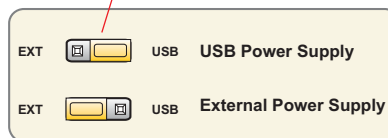
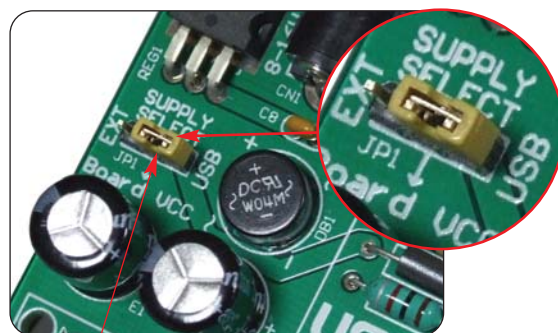


Figure 9. JP1 is set to USB power supply



ON-BOARD USB 2.0 PROGRAMMER

There is no need for the use of external equipment during programming as EasyPIC4 development system has its own on-board USB programmer. All you need to do is connect the system to a PC using USB cable. Then, load your program into the microcontroller via the *PICFlash2* programming software which is supplied with EasyPIC4.

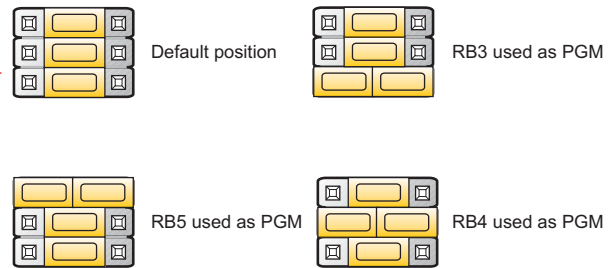
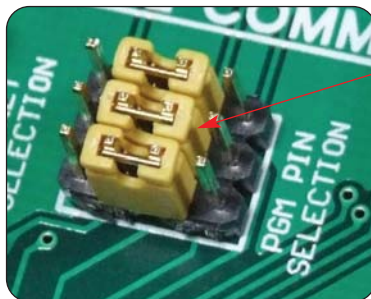


Figure 10. USB 2.0 programmer



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

On the right of the USB programmer there is the JP5 jumpers group. These jumpers are used for PGM pin selection. There are two different programming modes for PIC MCUs: Low-Voltage and High-Voltage programming mode. PICflash2 supports only High-Voltage programming mode which can be applied regardless of MCU's programming state. Since some PIC MCUs are being shipped with Low-Voltage programming mode as default, you must select a proper PGM pin (depending on chip). For most of the MCUs you don't have to use PGM selection and the JP5 jumpers group should stay in the Default position.



JP5 jumpers explanation **Figure 11.**

Figure 12.

JP3 and JP4 for DIP40,
DIP28, DIP18A and DIP18B

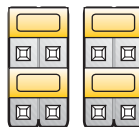


Figure 13.

JP3 and JP4 for DIP20,
DIP14 and DIP8



When using DIP40, DIP28, DIP18A and DIP18B sockets, jumpers JP3 and JP4 should be in the upper position (default) as shown in Fig. 12.

For DIP20, DIP14 and DIP8 sockets, these jumpers should be in the lower position (Fig. 13).

Jumper JP2 allows using the MCLR pin as RESET or as digital I/O. It can be RE3, RA5 or RA3 pin depending on MCU that you are using.

When JP2 is in the lower position the hardware reset (pressing reset button) is enabled and MCLR pin can not be used as an I/O pin.

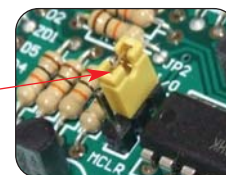
When JP2 is in the upper position the MCLR pin can be used as an I/O pin but the hardware reset is disabled.

Figure 14.

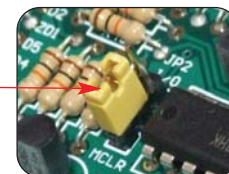
JP2 jumper
explanation



**MCLR pin
used as I/O**



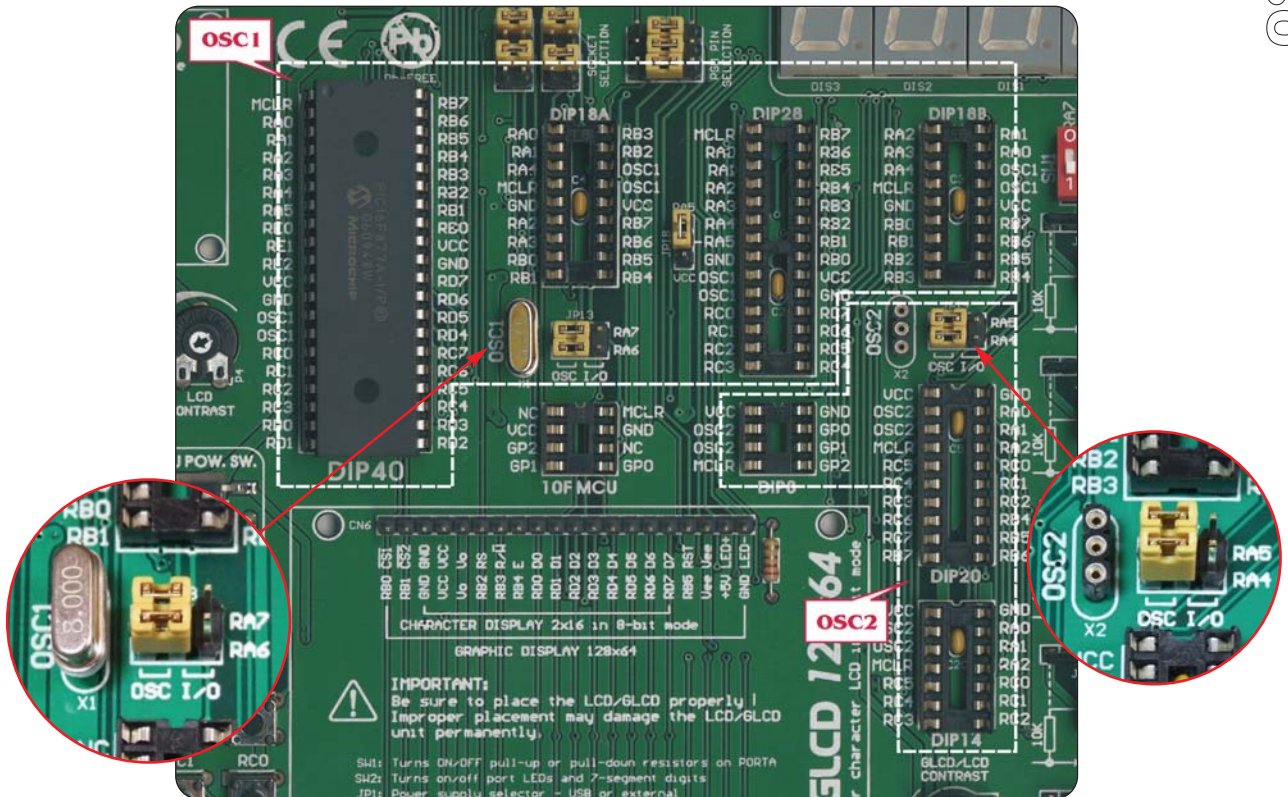
**MCLR pin
used as RESET**



OSCILLATOR

Since there are so many sockets on EasyPIC4 board, there are two oscillators that are connected with two main sections of the MCU sockets. The first oscillator is labeled as OSC1 and is connected to DIP40, DIP28, DIP18A and DIP18B socket. The second oscillator is labeled as OSC2 and is connected to DIP20, DIP14 and DIP8 socket.

Oscillators **Figure 15.**



Note: As you can see from the picture above, 10F MCU socket is not connected to any of the two oscillators. This MCUs have only an internal oscillator and they can't be used with an external crystal.

For some microcontrollers oscillator input pins can also be used as digital input/output pins. In order to implement this feature EasyPIC4 has jumpers for connecting MCU either to oscillator or to digital I/O pins. You can see the schematics for OSC1 oscillator on Fig. 16.

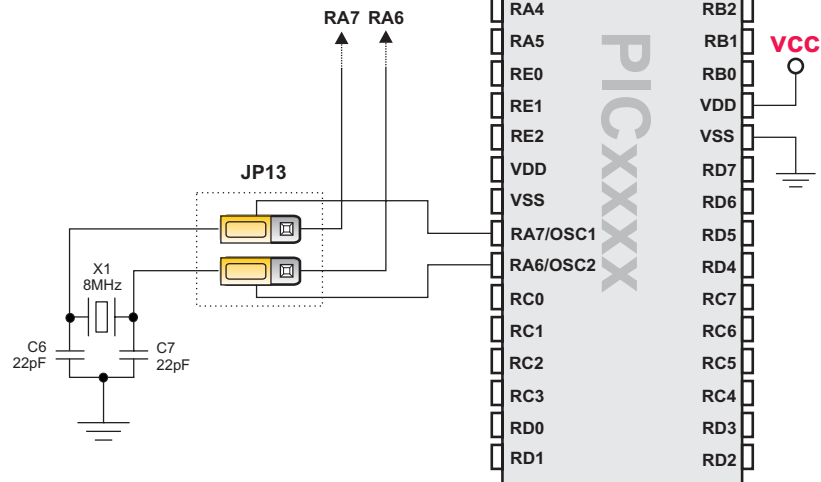


Figure 16.

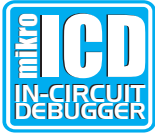
Oscillator connection with MCU

RA6 and RA7 pins are used as oscillator input

RA6 and RA7 pins are used as digital I/O



Note: If the used DIP's oscillator pins are labeled with OSC1 then the oscillator should be placed in the OSC1 connector. If the used DIP's oscillator pins are labeled with OSC2 then the oscillator should be placed in the OSC2 connector.



mikroICD (Real-Time Hardware In-Circuit Debugger)

mikroICD is highly effective tool for Real-Time debugging on hardware level. mikroICD debugger enables you to execute a program on a PIC microcontroller and view variable values, Special Function Registers (SFR) and EEPROM as the program is running.

You can use mikroICD within any of MikroElektronika's compilers for PIC (mikroC, mikroBasic or mikroPascal). All you have to do is to select appropriate build type (Release or ICD Debug), build the project, program the MCU, select appropriate debugger (mikroICD Debugger) and you are ready to go.



Note: For more information on how to use mikroICD debugger please refer to the mikroICD documentation: "*mikroICD User's Manual*". You can also find it within the Help documentation inside any of the mentioned compilers.

mikroICD debugger uses on-board programmer to communicate with the compiler and it supports common debugger commands:

Start Debugger	[F9]
Run/ Pause Debugger	[F6]
Toggle Breakpoints	[F5]
Run to cursor	[F4]
Step Into	[F7]
Step Over	[F8]
Flush RAM	[F2]
Stop Debugger	[Ctrl+F2]

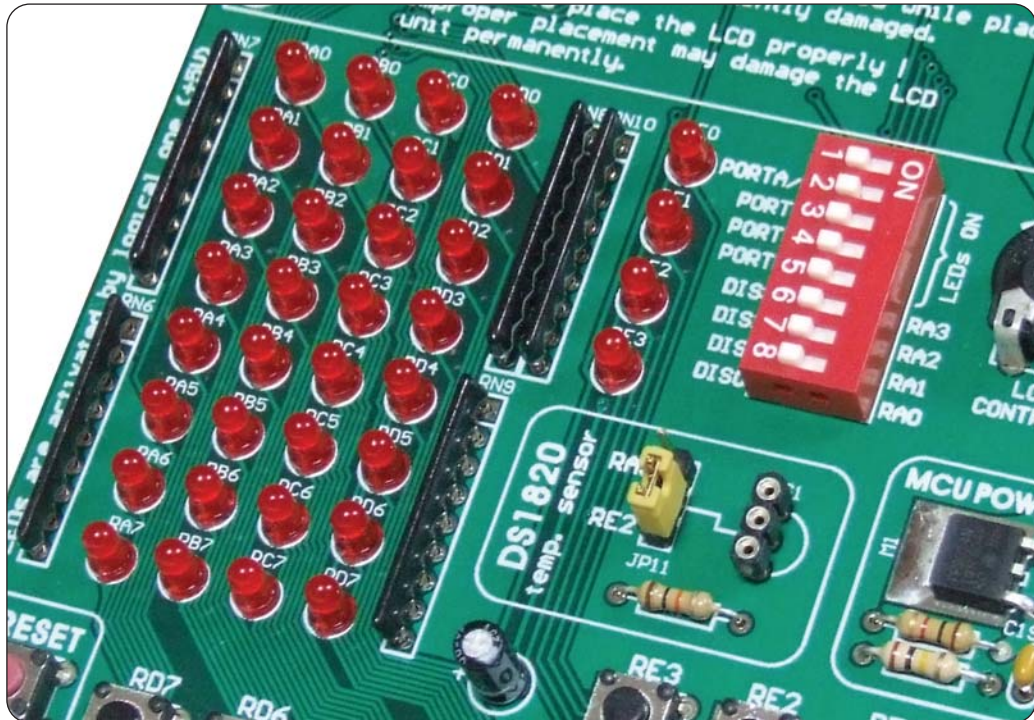


Figure 17. On-Board USB programmer with mikroICD

LEDs

Light Emitting Diodes (LEDs) are the most commonly used components, usually for displaying pin's digital state. EasyPIC4 has 36 LEDs that are connected to the microcontroller's PORTA, PORTB, PORTC, PORTD and PORTE.

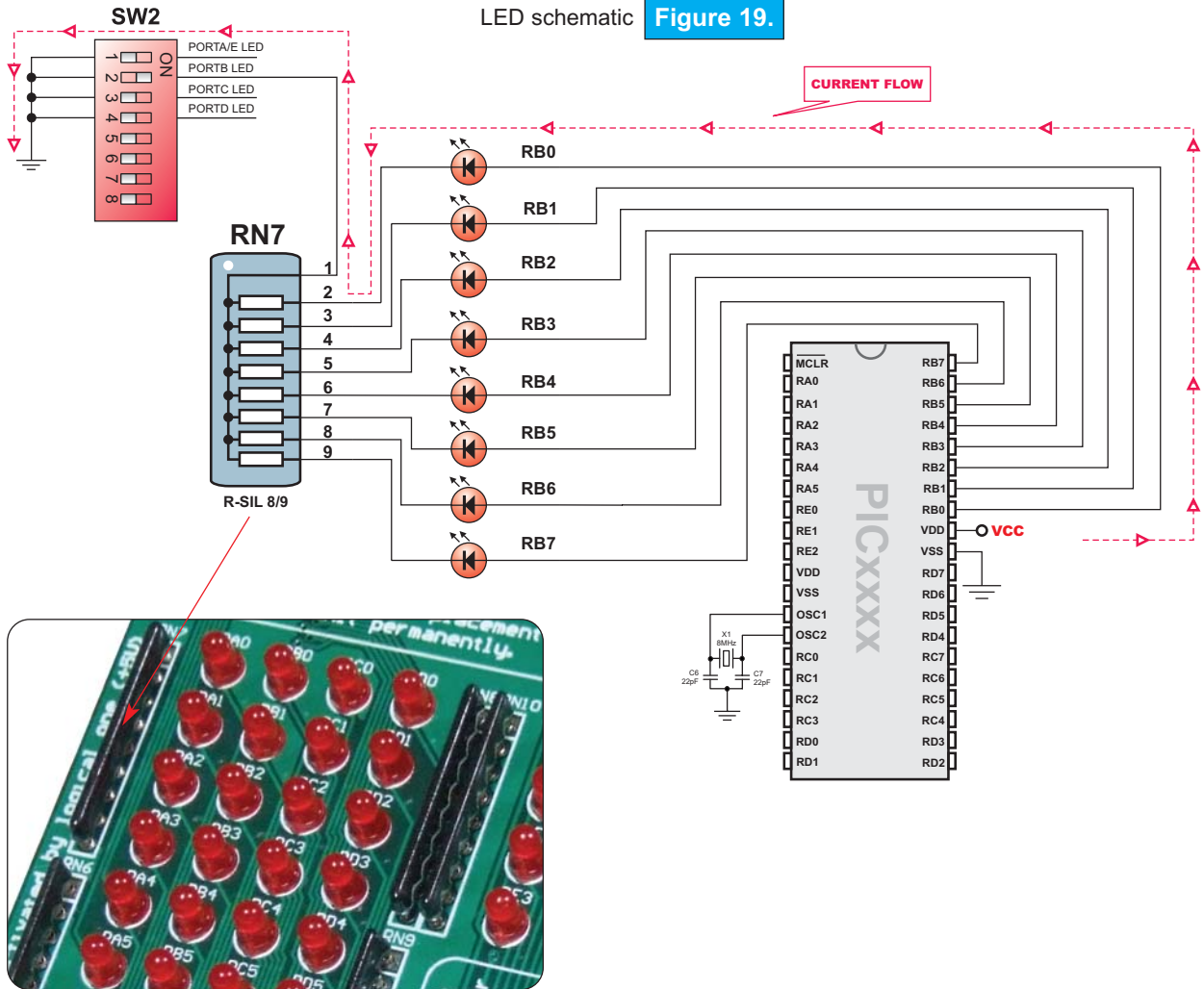
Figure 18. Light Emitting Diodes



Each group of eight LEDs can be enabled or disabled using the switch SW2. The exception is PORTE which has 4 LEDs and is connected to the same switch as PORTA.

Fig. 19. illustrates the connection of a LEDs to PORTB 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.

The LEDs are enabled when the corresponding switch on SW2 is on. When enabled, LEDs will display the state of the corresponding microcontroller pin; otherwise the LEDs will always be off, no matter what the port state is, as no current can flow through LED.

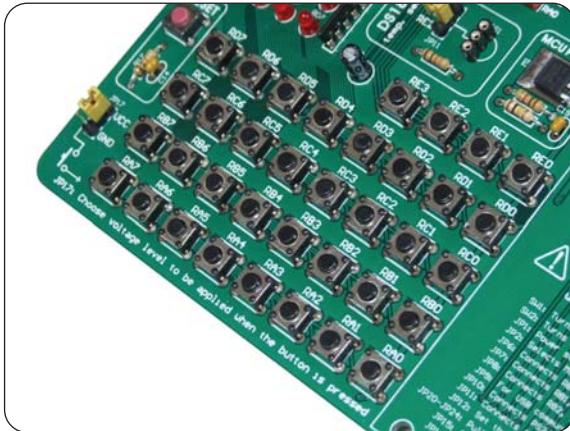
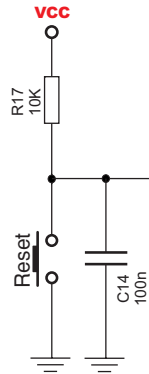


PUSHBUTTON SWITCHES

EasyPIC4 has 36 push buttons, which can be used to change states of digital inputs to microcontroller's ports. There is also one switch that acts as a RESET. Reset switch schematic is shown in Figure 21.

Figure 21.

Reset switch schematic



Reset switch **Figure 20.**

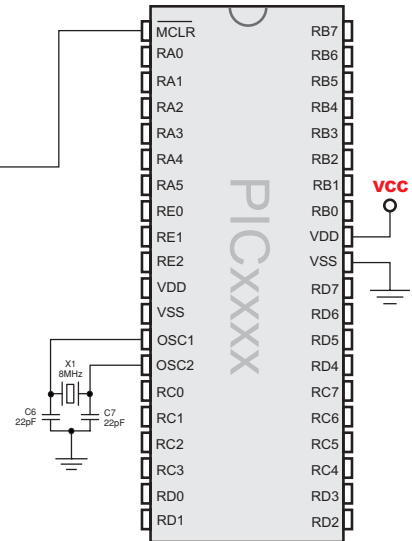


Figure 22.

Pushbutton switches

Buttons connections to PORTA, PORTB, PORTC, PORTD and PORTE are shown in Fig. 23. Jumper JP17 determines whether a button press will bring logical zero or logical one to the appropriate pin.

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

In the example shown in Fig. 23, JP17 is connected to +5V, therefore pressing the buttons will bring logical one to the appropriate pins.

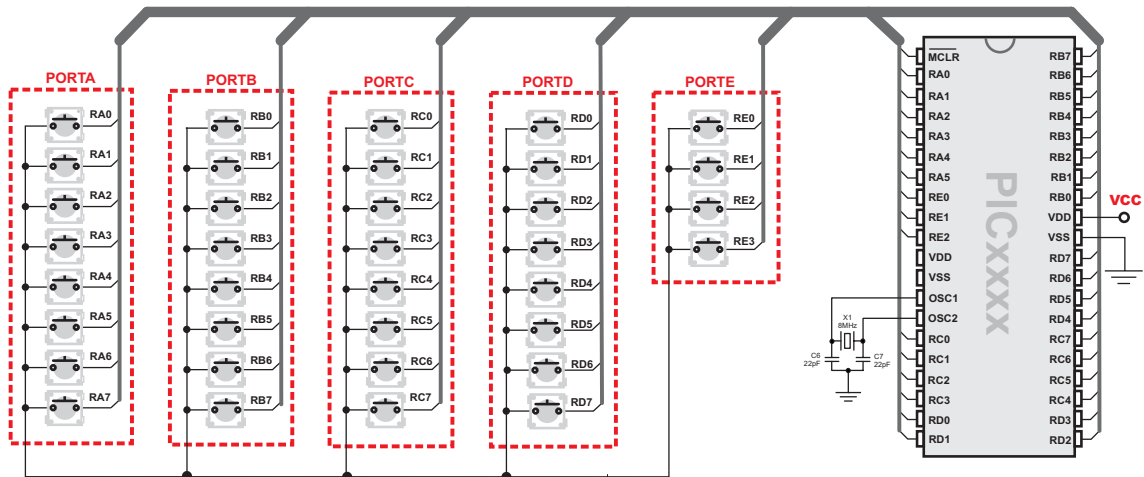
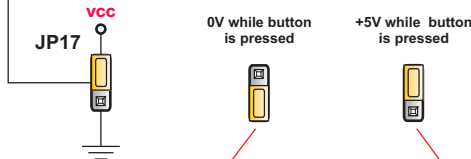


Figure 23.

Buttons schematic



On Fig. 24 the JP21 switch is set to pull-up, therefore when the button is not pressed, pull-up resistor pulls the microcontroller's RB4 pin to +5V.

A button press causes the port pin to be connected to ground (JP17 is 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.

On Fig. 25 the JP21 switch is set to pull-down, therefore when the button is not pressed, pull-down resistor pulls the microcontroller's RB4 pin to 0V.

A button press causes the port pin to be connected to +5V (JP17 is in the higher position).

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

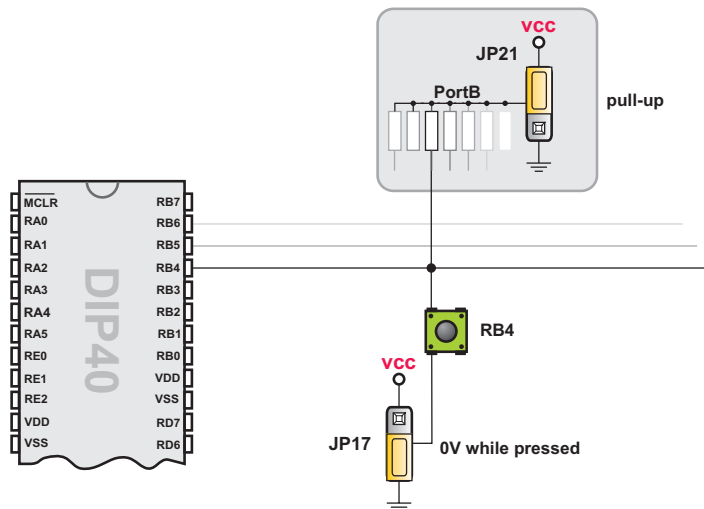


Figure 24. Button with pull-up resistor

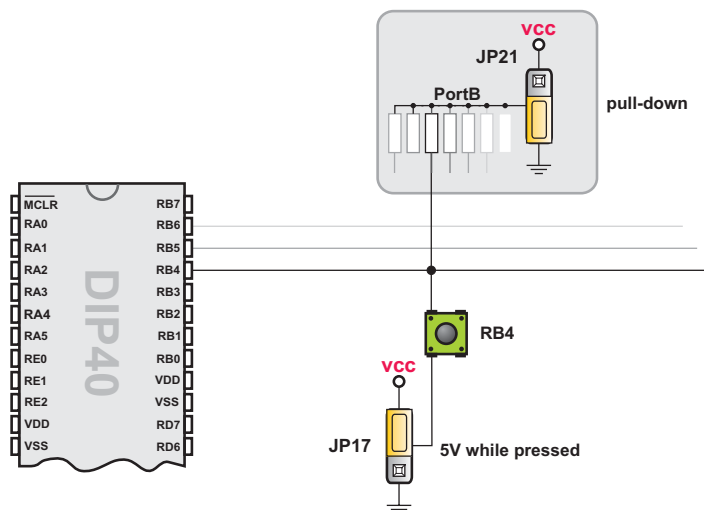


Figure 25. Button with pull-down resistor



7-SEGMENT DISPLAYS

EasyPIC4 has four 7-segment displays in multiplex mode. Data lines are connected to PORTD, while each display is enabled through the lower four bits of PORTA.

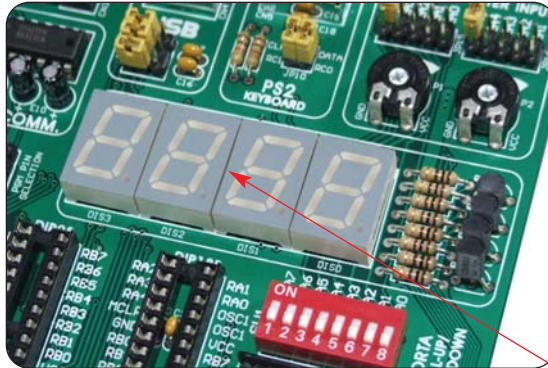
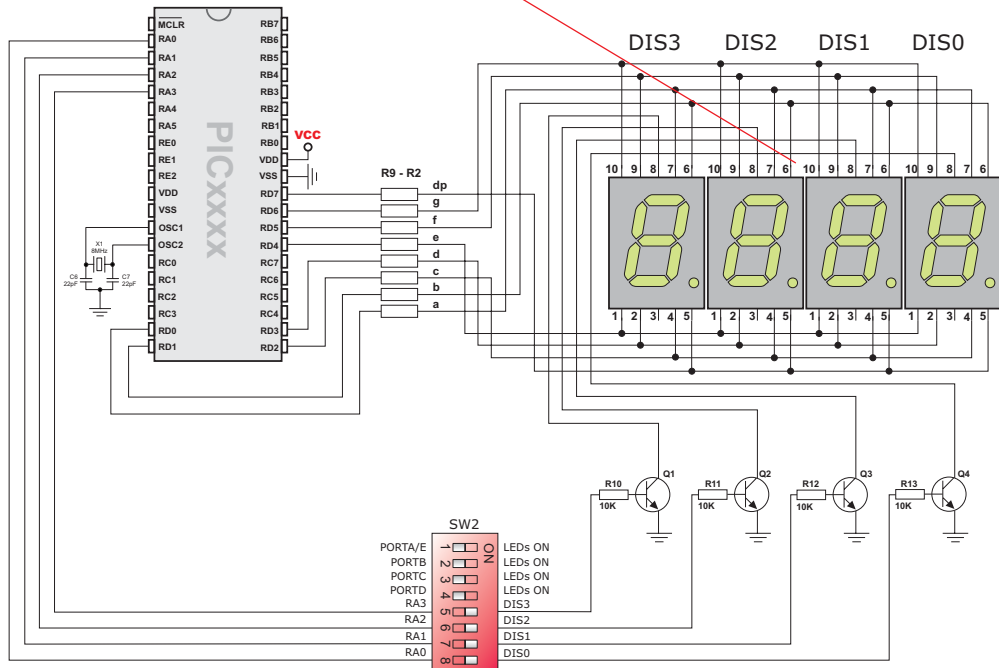
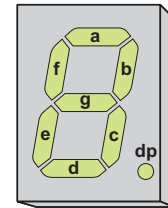


Figure 26.

7-segment displays



7-segment displays schematic **Figure 27.**



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 JP12 (Fig. 28) to the right-hand position. The GLCD's contrast can be adjusted using the potentiometer P3, which is placed to the right of the GLCD.

GLCD **Figure 29.**



Figure 28.

GLCD selection jumper



In order to enable GLCD, jumper JP12 should be set to the right-hand position, labeled as GRAPH.

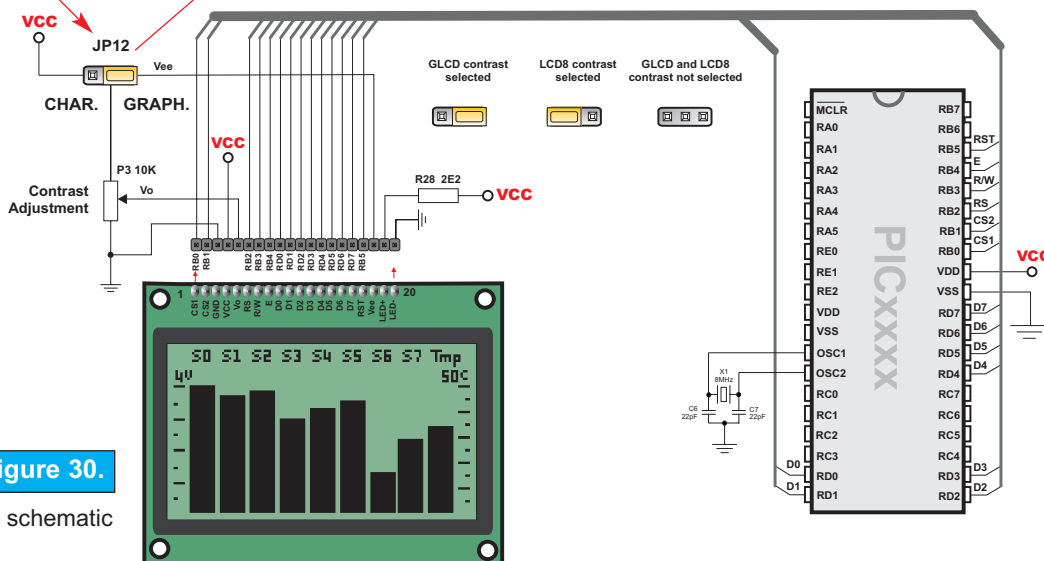


Figure 30.

GLCD schematic



LCD 2X16 IN 4-BIT MODE

A standard character LCD is probably the most widely used data visualization component. Usually, it can display two lines of 16 alphanumeric characters, each 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 EasyPIC4. For 4-bit data bus use, the LCD should be placed in the upper left of the board, just above the LEDs. The connection to the microcontroller is shown in Fig. 32 where there are only four data lines. It is important to note that the LCD should be placed or removed from EasyPIC4 only when the power is off.



Figure 31.

LCD 2x16 in 4-bit mode

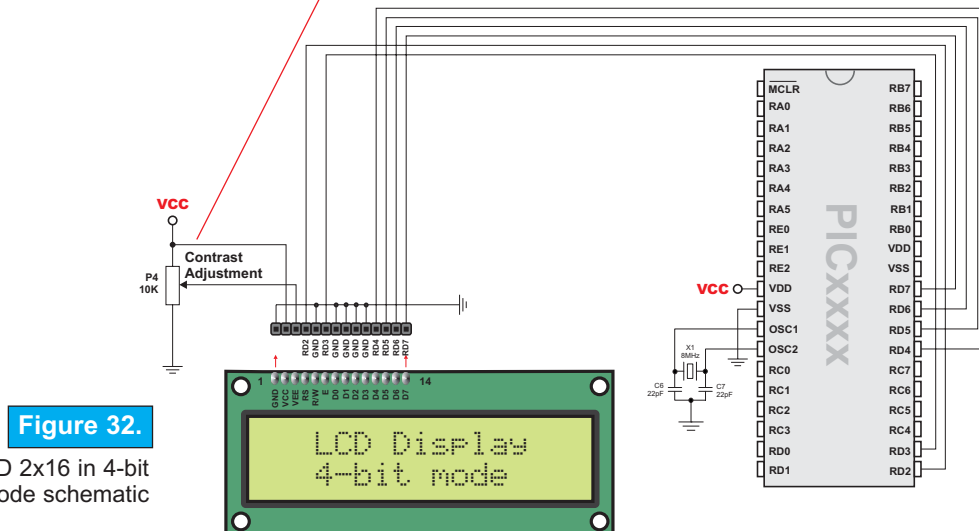


Figure 32.

LCD 2x16 in 4-bit mode schematic



LCD 2X16 IN 8-BIT MODE

When using a character LCD in 8-bit mode, the connector that is shared with the GLCD should be used. Since this 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.

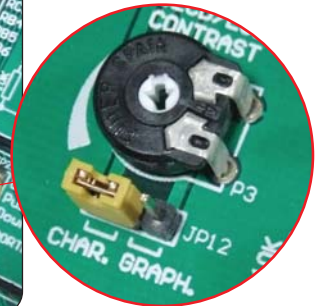


Figure 33.

LCD 2x16 in 8-bit mode

View from the back:
shows which pins
stays disconnected.

The LCD must be placed in the marked position with two free pins to the left and four free pins to the right. It is important to note that the LCD should be placed or removed from EasyPIC4 only when the power is off. Before attaching the LCD, set jumper JP12 to the left position. The LCD's contrast can be adjusted using potentiometer P3 which is located to the right of the GLCD/LCD connector.



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

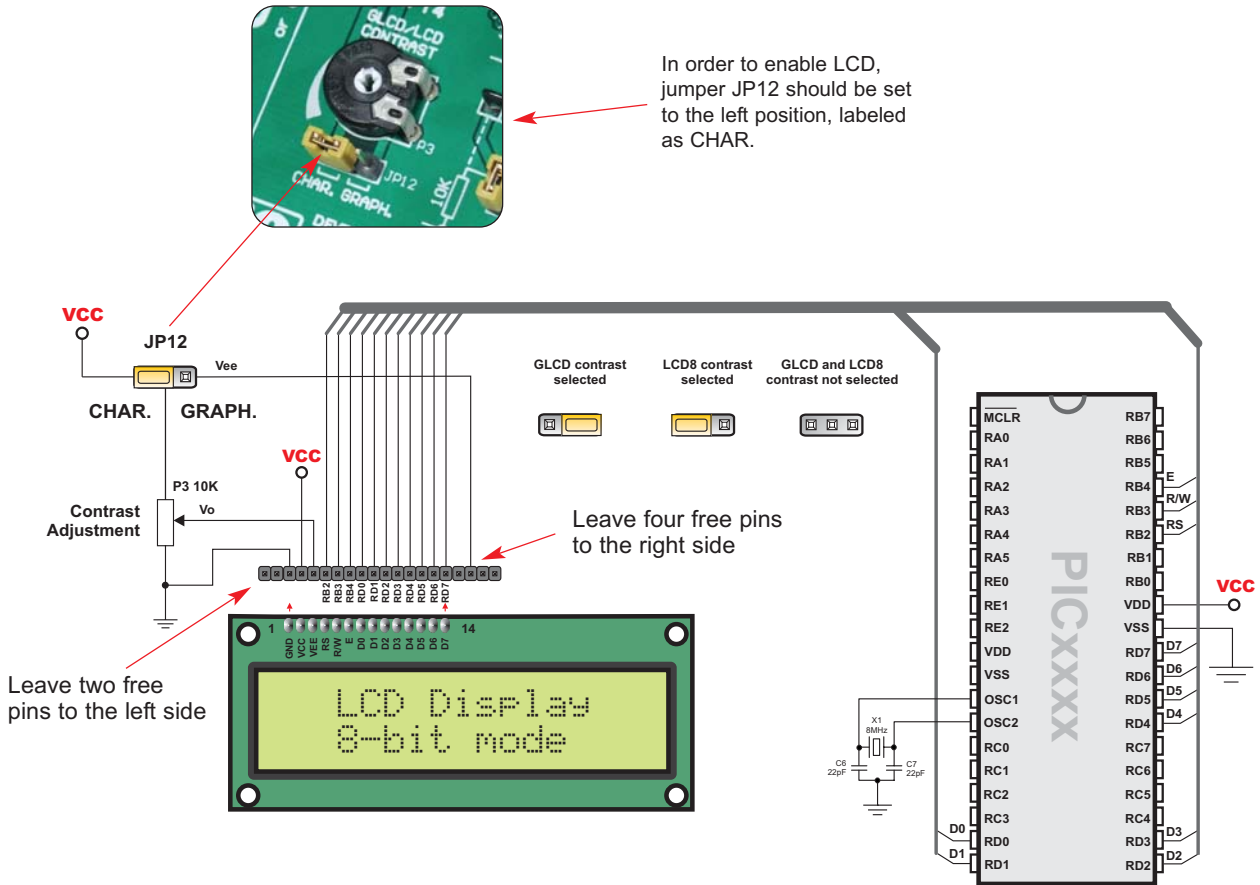


Figure 34. LCD 8-bit mode schematic

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 microcontroller and a PC. Since the voltage levels of a microcontroller and PC are not directly compatible with those of RS-232, a level transition buffer, such as the MAX232, must be used. In order to provide a more flexible system, the microcontroller is connected to the MAX232 through the two jumper groups: JP7 and JP8. The jumper group JP7 is used to connect the Rx line to RC7, RB2 or RB1. The jumper group JP8 is used to connect the Tx line to RC6, RB5 or RB2. Note that JP7 and JP8 must not be connected to RB2 at the same time. JP6 enables the connections of RB0 pin to CTS and RC2 pin to RTS line for implementing hardware handshaking.



Figure 35.

RS232 connector

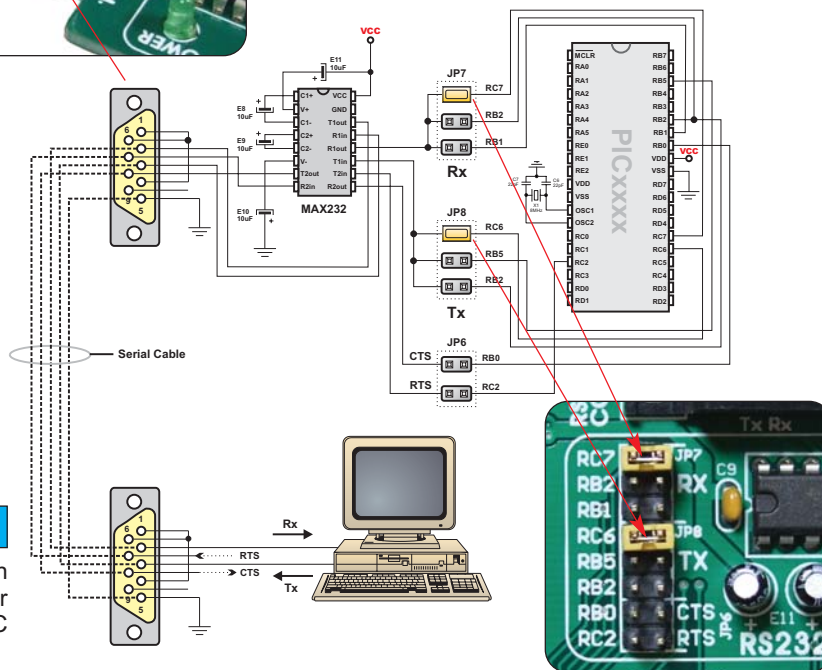


Figure 36.

Connection between microcontroller and a PC

USB COMMUNICATION

The USB communication connector is placed in the upper right corner of the EasyPIC4. It is used with specific PIC microcontrollers that have USB support, such as PIC18F2450 or PIC18F4550. Note that the USB communication connector cannot be used for programming and that the USB programming connector cannot be used for communication. In order to enable connection between the microcontroller and USB communication connector, the JP9 jumpers group should be set to the right position. As the result, microcontroller pins RC3, RC4 and RC5 are disconnected from the rest of the system and connected to the USB communication connector.

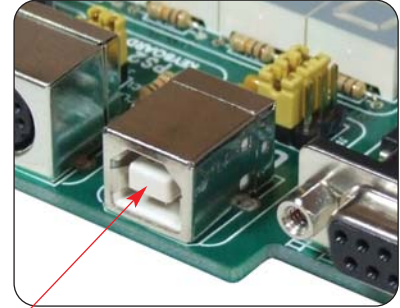


Figure 37.

USB communication connector

To enable USB communication all three jumpers have to be set to the right side.



Figure 38.

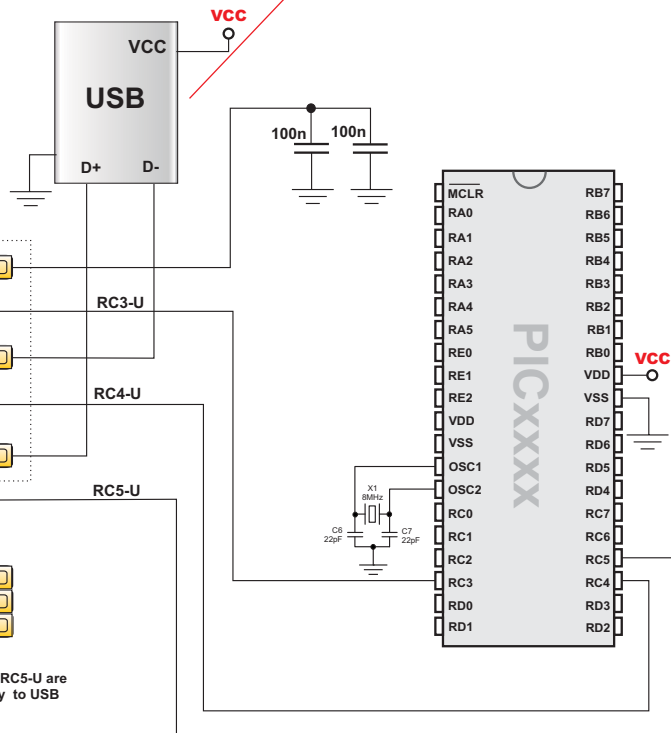
USB communication schematic



RC3-U, RC4-U, RC5-U are available to other peripherals



RC3-U, RC4-U, RC5-U are connected only to USB





PS/2 COMMUNICATION

The PS/2 connector allows direct connection between EasyPIC4 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. CLK and DATA lines are used for data transfer. In this case, they are connected to pins RC1 and RC0 respectively.



Figure 40.

Keyboard connected to development board

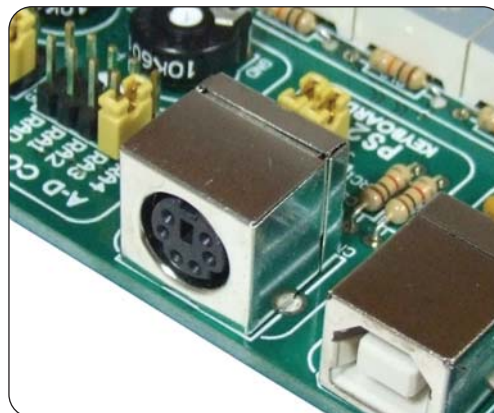


Figure 39.

PS/2 connector

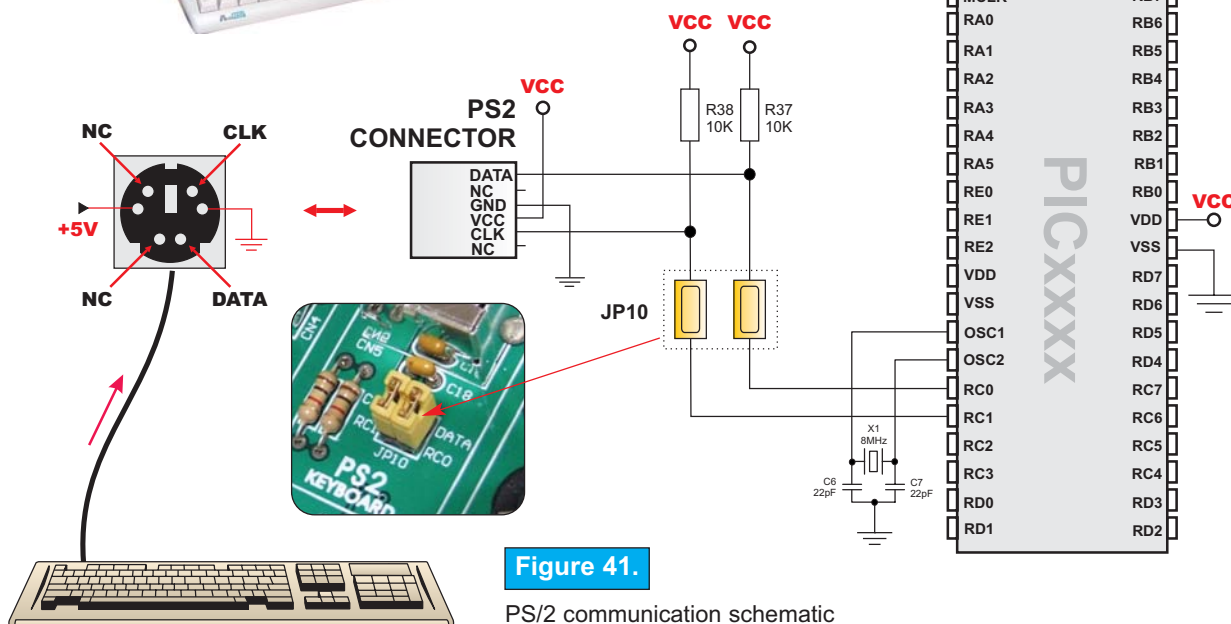


Figure 41.

PS/2 communication schematic

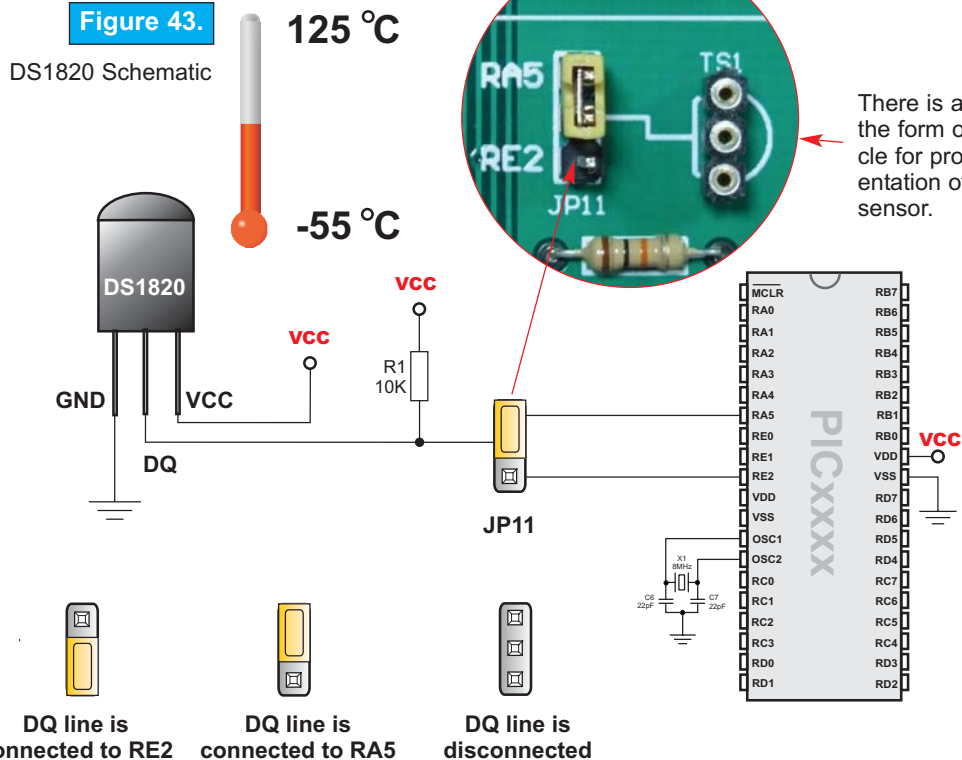
DS1820 DIGITAL THERMOMETER

DS1820 digital thermometer is well suited to environmental temperature measurement, having the temperature range of -55°C to 125°C and the accuracy of $\pm 0.5^{\circ}\text{C}$. It must be placed correctly in the 3-pin socket provided on EasyPIC4, with its rounded side to the right, as marked on the board (see Fig. 42) otherwise the DS1820 could be permanently damaged. DS1820's data pin can be connected to either RA5 or RE2 pin, which is determined by jumper JP11.

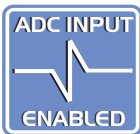


Figure 42.

DS1820



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



A/D CONVERTER INPUT

EasyPIC4 development board has two potentiometers for working with Analog to Digital Converter (ADC). Both potentiometers outputs are in the range of 0V to 5V. Two analog signals can be connected on two different analog input pins at the same time. The jumpers group JP15 enables connection between potentiometer P1 and one of the following pins: RA0, RA1, RA2, RA3 or RA4. The jumpers group JP16 enables connection between potentiometer P2 and one of the following pins: RA1, RA2, RA3, RA4 or RA5.



Figure 44.

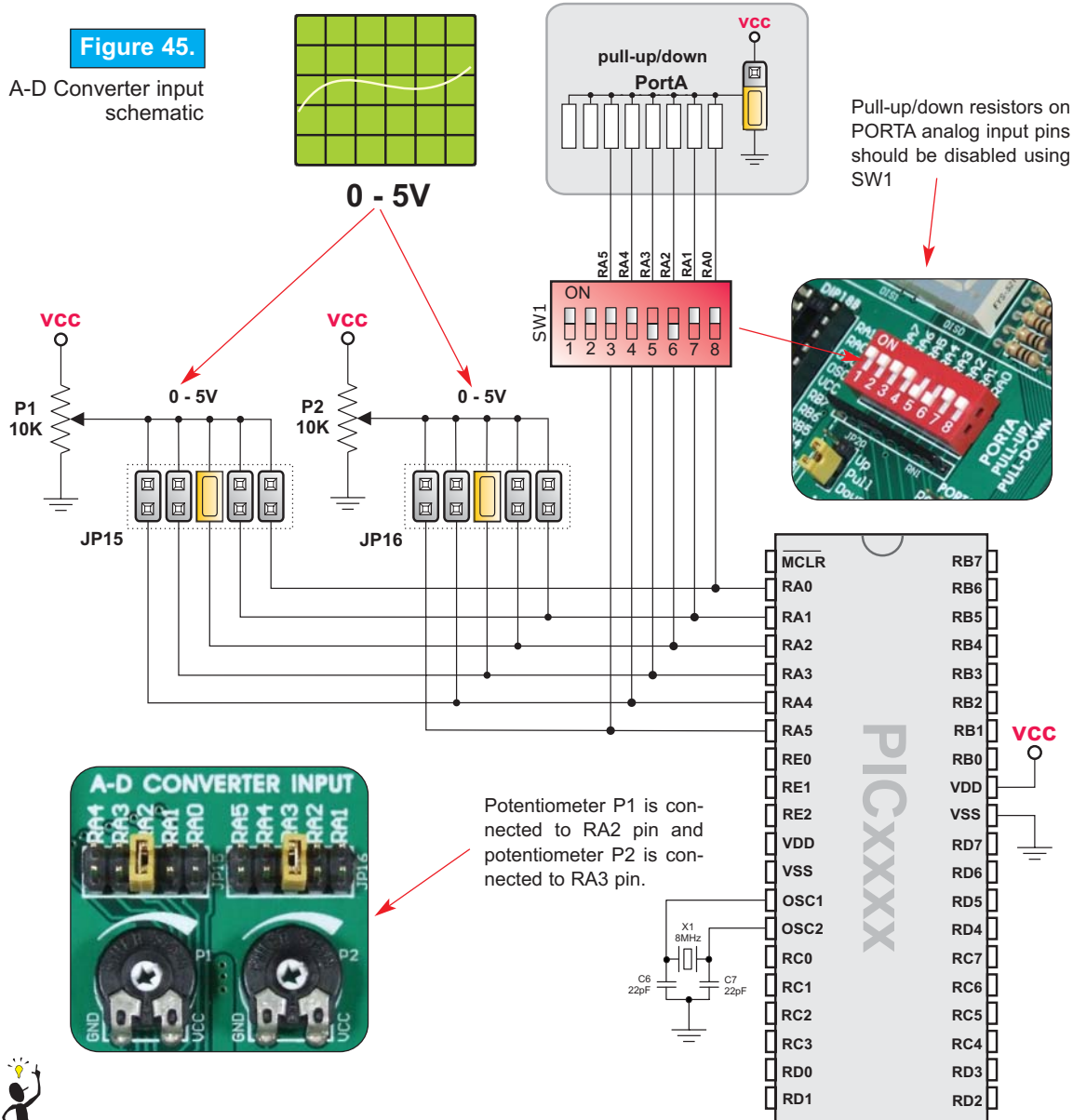
A-D Converter input

In order to measure analog signal without interference, turn the corresponding switch on SW1 to OFF position. This will disable connection of the used PORTA pin to the pull-up/down resistors.

Applications of A-D Conversion are various. Microcontroller takes analog signal from its input pin and translates it into a digital value. Basically, you can measure any analog signal that fits in range acceptable by PIC. That range is 0V to 5V.

Figure 45.

A-D Converter input schematic



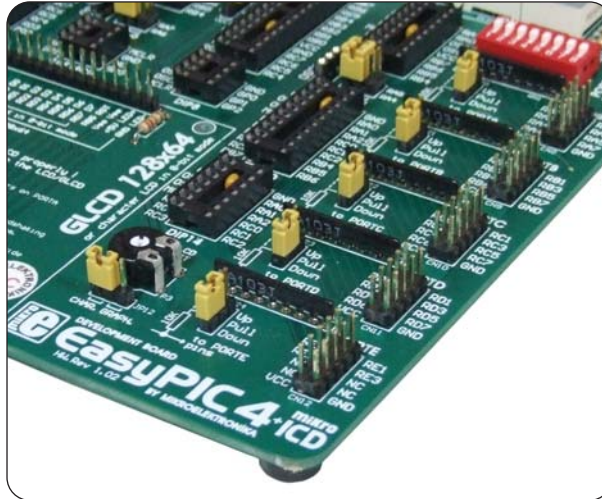
NOTE: Jumpers JP15 and JP16 should not select the same pin.

ANALOG TO DIGITAL CONVERTER INPUT



DIRECT PORT ACCESS

All microcontroller input/output pins can be accessed via connectors placed along the right side of the board. For each of PORTA, PORTB, PORTC, PORTD and PORTE there is one 10-pin connector providing VCC, GND and up to eight port pins.



Direct port access connectors **Figure 46.**

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 47.

Example of how to connect external peripheral with flat cable

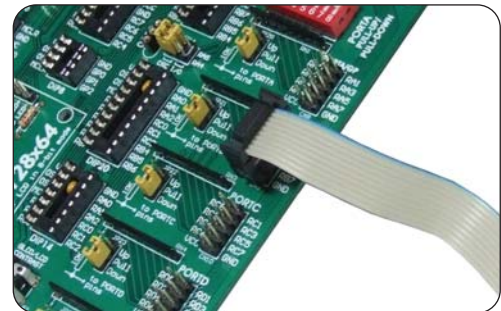
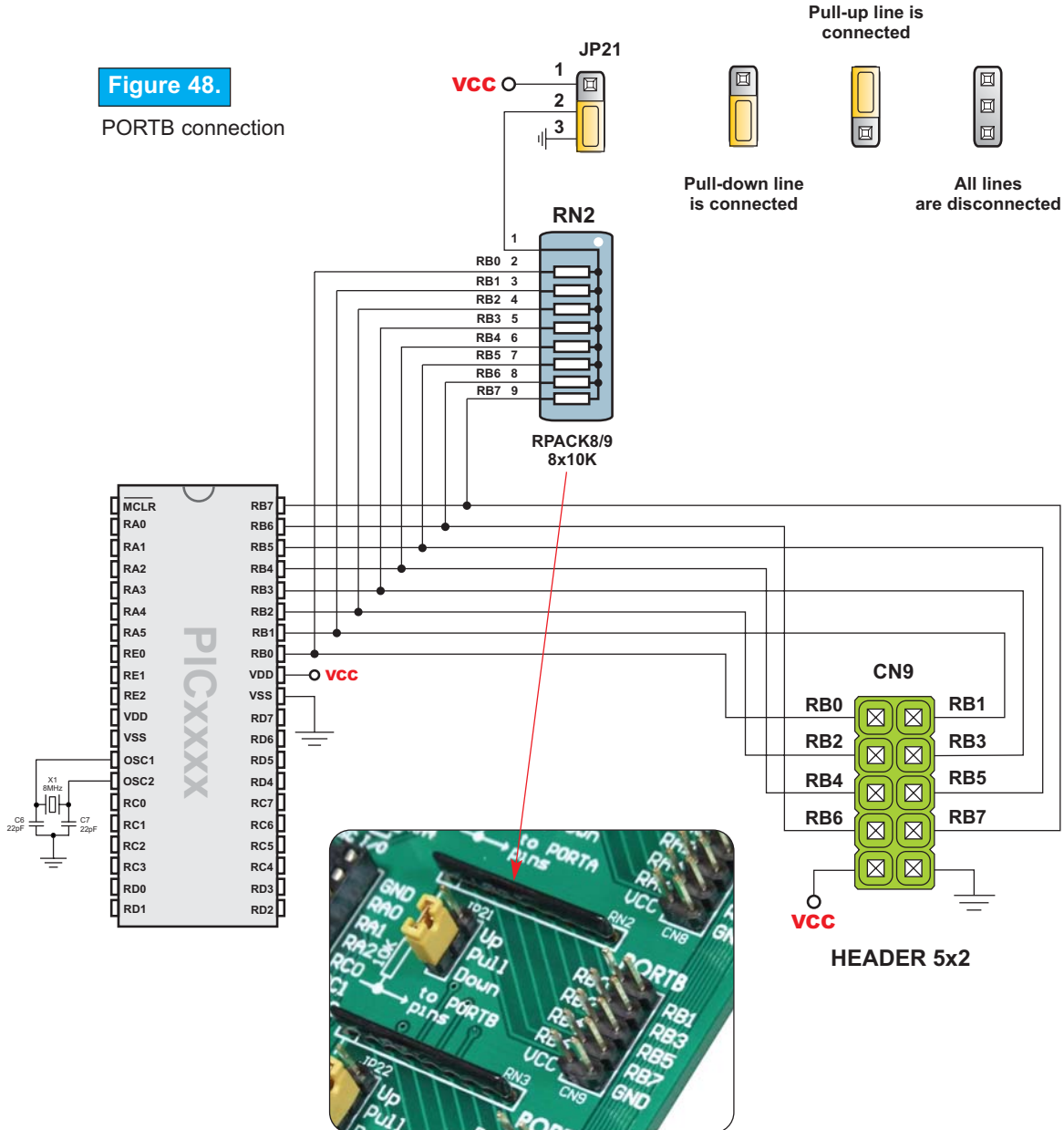


Figure 48.

PORTB connection



DIRECT PORT ACCESS

If you are experiencing problems with any of our products or you just want additional information, please let us know. We are committed to meeting your every need.

Technical Support :
support@mikroe.com

If you have any other question, comment or a business proposal, please contact us:

E-mail: office@mikroe.com
Web: www.mikroe.com
Forum: www.mikroe.com/forum/

