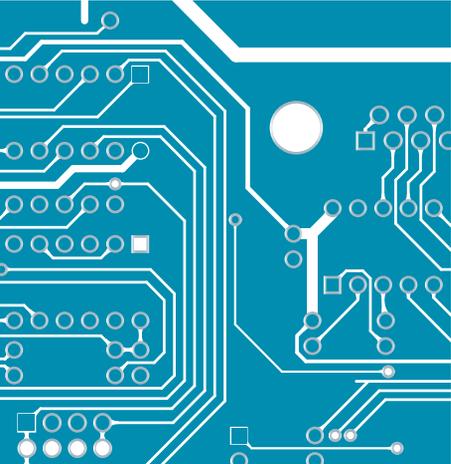


EasyPIC5



USER'S MANUAL

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Nebojša Matić
General Manager

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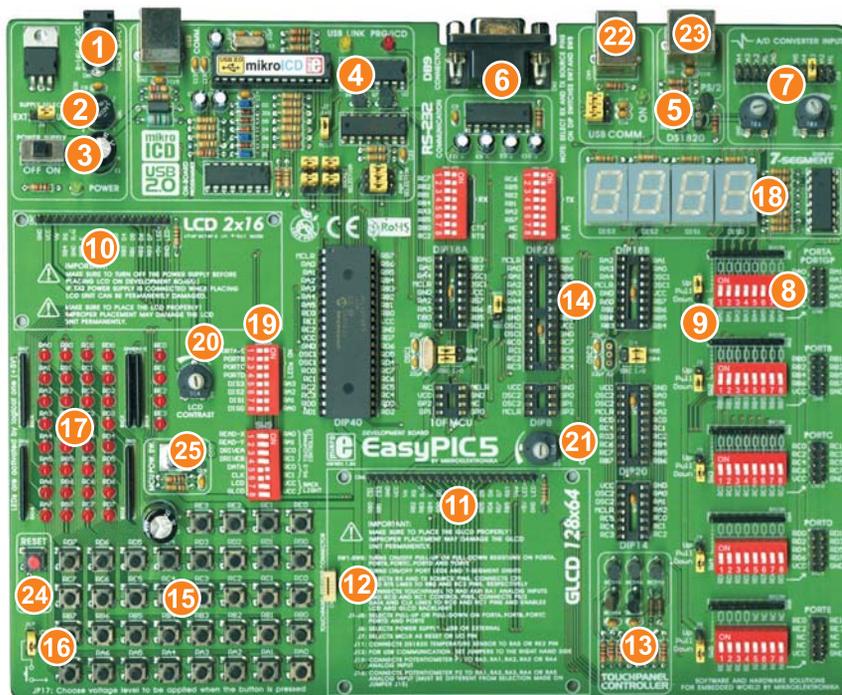
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EasyPIC5 KEY FEATURES



1. External power supply 8 - 16 V AC/DC.
2. Choose between external and USB power supply. When using USB port, there is no need for an external power supply.
3. Power supply ON - OFF switch.
4. Very fast and flexible on-board USB programmer with mikroICD (In-Circuit Debugger). The key feature is ability to upgrade. By downloading new software, it will be possible to program new MCUs in coming years.
5. DS1820 temperature sensor allows temperature measurement with 0.5 °C accuracy.
6. RS232 communication with selectable TX and RX for all microcontrollers.
7. For testing purposes, pins RA0-RA5 can be connected to the potentiometers P1 and P2. These pins can be used as inputs for measuring adjustable voltages set by these potentiometers.
8. PORTA is connected to a resistor network, using the switch group SW1. If a switch is OFF, the appropriate pin does not have resistor attached. Simultaneously, it enables PORTA pins to be used in analog mode as well as an ordinary digital I/O pins.
9. Jumper to determine port performance in idle state (pull-up or pull-down). Select pull-up if port pins should detect signals of logic zero (0) and vice versa.
10. 16 pin connector allows easy connection of LCD.
11. 20 pin connector allows easy connection of graphic LCD.
12. Connector for touch panel.
13. Touchpanel controller.
14. EasyPIC5 supports microcontrollers in DIP8, DIP14, DIP18, DIP20, DIP28 and DIP40 packages. Therefore, almost the entire range of Microchip microcontrollers may be used on EasyPIC5.
15. 36 pushbuttons allow control of every pin on the micro controller.
16. Jumper to select high/low state of the input pin when the appropriate pushbutton is pressed.
17. 36 LEDs connected to the microcontroller I/O ports.
18. 7- segment displays in multiplex mode.
19. Turn ON or OFF the LEDs on ports A, B, C, D and E. You can choose which port you want LEDs to be connected to. Also, these switches turn on / off digits on 7-segment LED displays. Finally, these DIP switches let you disconnect all LEDs from MCU pins.
20. Potentiometer for LCD contrast.
21. Potentiometer for graphic LCD contrast.
22. USB port for MCU with USB support.
23. PC keyboard connector.
24. Reset circuit.
25. MCU power switch.



CONNECTING THE SYSTEM

Apart from this manual, development system box contains development system, product CD, USB cable, RS232 cable and user's manuals for *PICflash programmer*, *mikroICD Debugger* and *Installing USB drivers*. In order to use EasyPIC5 properly, follow the steps below:

- Step no.1** Take the system board and product CD out of the box. First of all, insert the product CD in CD drive. Do not connect development system to PC yet.
- Step no.2** Install PICflash programmer software. It enables program written on PC to be transferred to the microcontroller chip. Detailed instructions on how to install it are contained in '*PICflash programmer*' manual.
- Step no.3** Install USB drivers on your PC. They enable programmer's hardware to operate properly on EasyPIC5 board. For information on their installation, refer to '*Installing USB drivers*' manual.
- Step no.4** Connect EasyPIC5 to PC using USB cable. Please use one of USB ports on the back of the PC because they have direct connection to the computer motherboard.
If you turn ON the power supply switch on the EasyPIC5 board for the very first time, your PC will immediately detect a new hardware. After that, a message asking if Windows update should search for new drivers will appear on the screen. Select the option '*No, not this time*' and click '*Next*'. In a window to appear you just have to click '*Next*' and the operating system will find them automatically. To complete this process click '*Finish*'. After that, you can run and use PICflash as explained in '*PICflash programmer*' manual.
In case you have already powered your EasyPIC5 during driver installation, Windows will not ask for update drivers again.

After these four steps, your EasyPIC5 is installed and ready for use. Now, you can read a program from the chip or write a new one to it. The product CD provides numerous simple program examples which will make your first steps Easy...

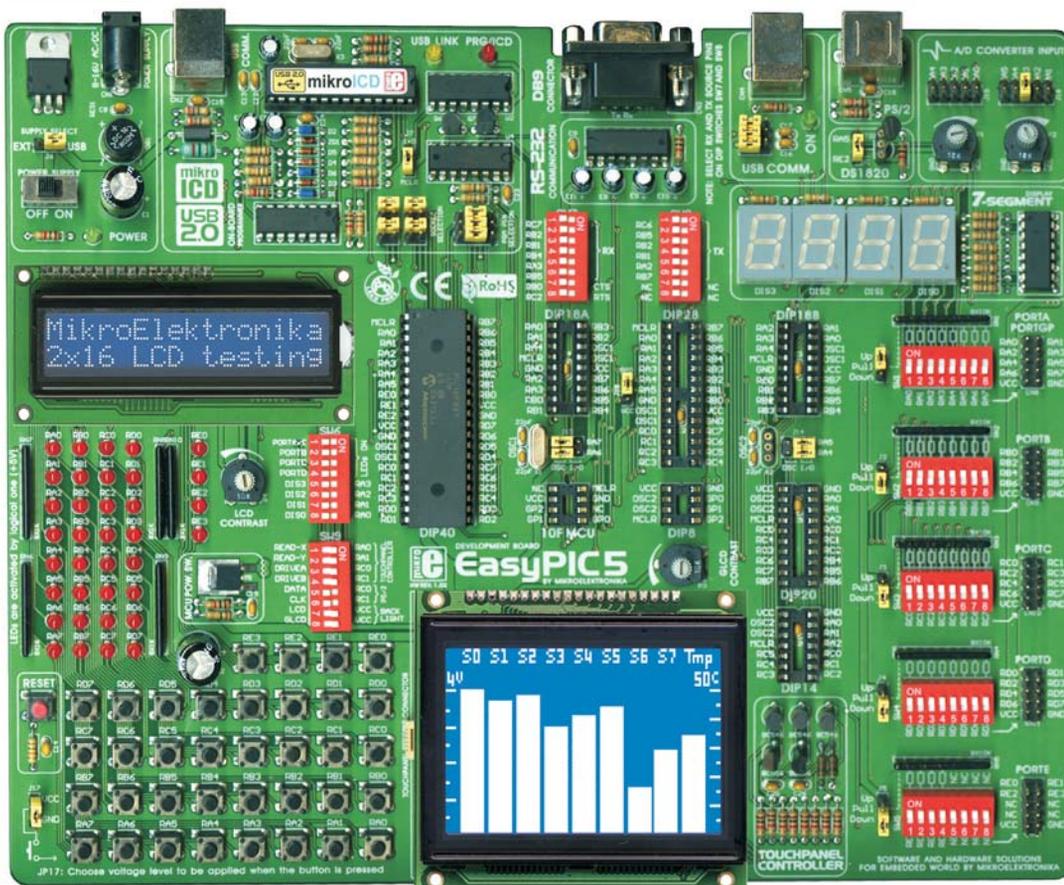


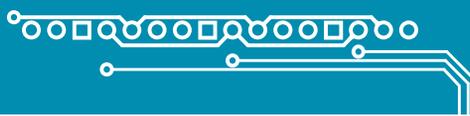
INTRODUCTION

The EasyPIC5 development system is a full-featured development board for almost all Microchip PIC microcontrollers. It is designed to allow students and engineers to easily test and explore the capabilities of PIC microcontrollers. It also allows PIC microcontrollers to be interfaced with external circuits and a broad range of peripheral devices. The user can therefore concentrate on software development only.

Figure 1 illustrates the development board. There are identification marks beside each component on a silkscreen, both on the top and bottom. These marks describe connections to the microcontroller, operation modes, and provide additional useful information. Since all relevant information is provided on the board, there is almost no need for additional schematics.

Figure 1 EasyPIC5 development board





SWITCHES

The EasyPIC5 development board features a number of peripheral devices. In order to enable them before programming, the appropriate jumpers or switches have to be properly set. Switches are devices which have two positions - ON and OFF. Their function is to establish or break connection between two contacts. The EasyPIC5 development board has nine groups of switches.

Switch groups **SW1 - SW5** are used to enable external pull-up/pull-down resistors on port pins. Each pull-up/pull-down resistor is individually enabled.

Switch group **SW6** is used to enable/disable LEDs connected to the microcontroller ports. Each group of 8 port LEDs has its own switch. Four lower switches in this group are used to enable/disable 7 segment LED display drivers. That means that each LED display can be individually enabled.

Switch groups **SW7** and **SW8** are used for selecting RX and TX serial communication pins.

Switch group **SW9** is used to control both LCD backlights, communication via PS/2 connector and driver for touch panel.

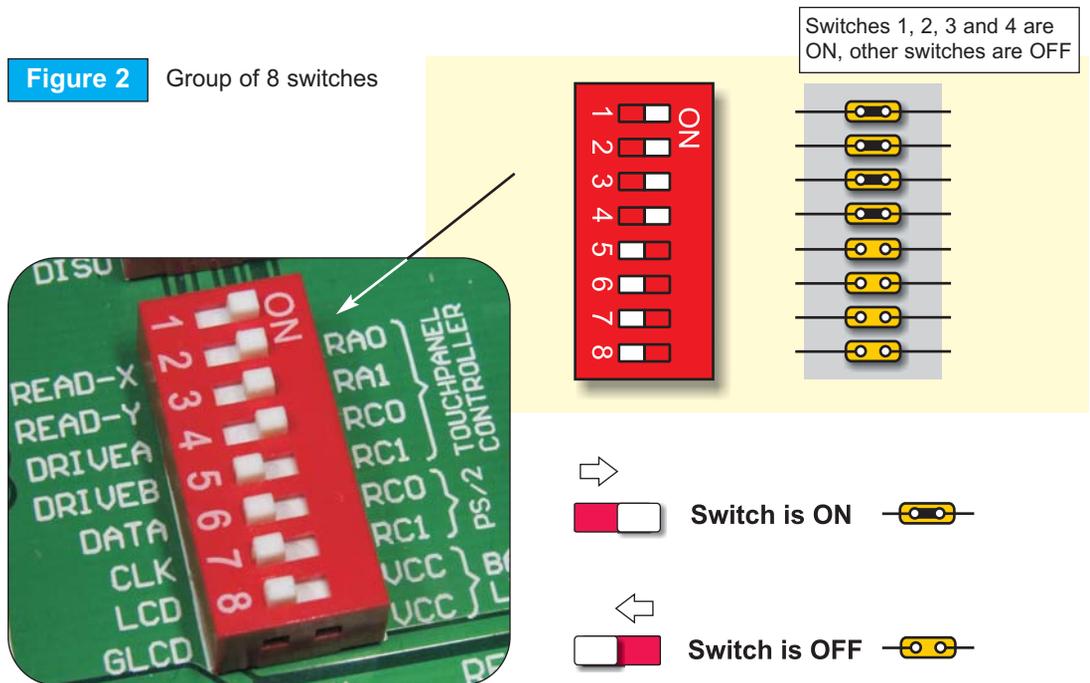
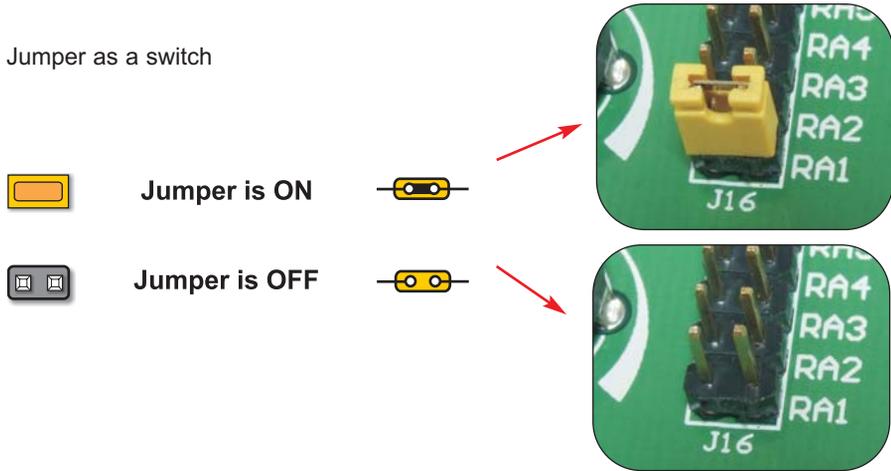


Figure 2 Group of 8 switches

JUMPERS

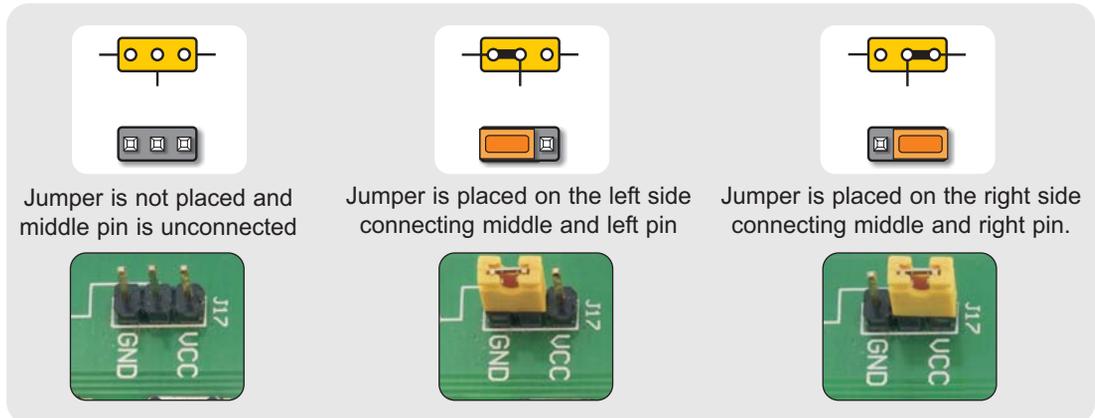
Jumpers, like switches, can break or establish connection between two points. Under the plastic cover of a jumper, there is a metal contact which establishes connection when the jumper is placed over two pins.

Figure 3 Jumper as a switch



Jumpers are commonly used as selectors between two possible connections via 3-pin connector. As illustrated in figure 4, the middle connector pin can be connected to the left or right pin, depending on the jumper's position.

Figure 4 Jumper as a multiplexer

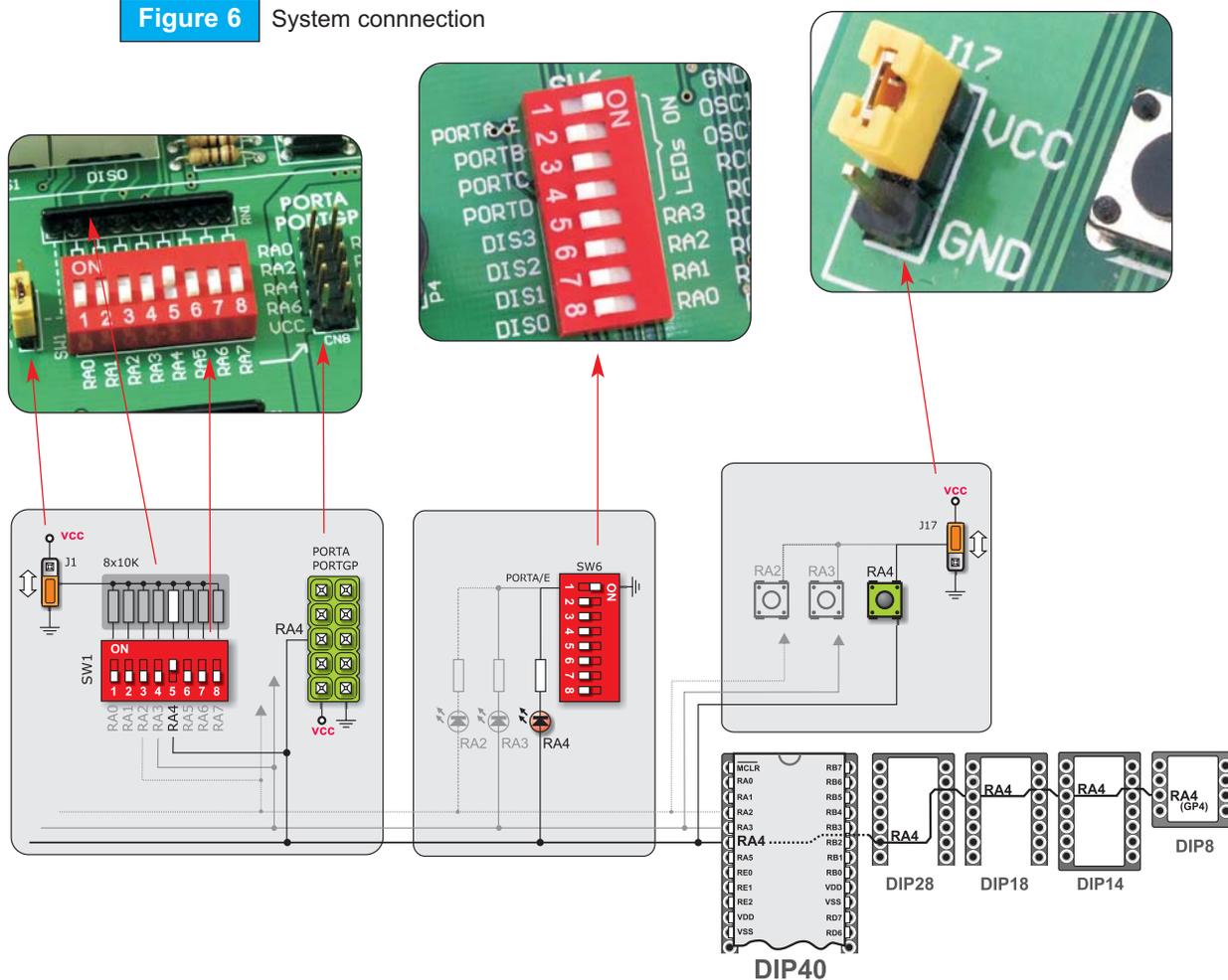


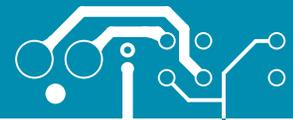
Microcontroller pins are routed to various peripherals as illustrated in figure 6. All MCU ports are directly connected to 2 x5 connectors on right side of the board. Direct Port Access connectors. Such connectors are normally used for connecting external peripherals to the board or for digital logic probes for testing and measurement.

Also, all ports are connected to LEDs and push-button switches which allows easy monitoring and testing digital pin state.

Some pins are connected to other peripherals such as DS1820 temperature sensor, RS-232 communication, 7-segment displays, LCD etc. depends on MCU internal peripheral organization.

Figure 6 System connection





POWER SUPPLY

EasyPIC5 has two power supply sources - regulated supply from the USB cable (by default) and external power supply. In case of the USB power supply, the system should be connected to PC using the USB programming cable, while the jumper J1 should be set in the right-hand position.

In case of the external power supply, the EasyPIC5 board produces +5V using LM7805 voltage regulator. The external power supply can be AC or DC. While power supply voltage can be in the range of 8 - 16V. The jumper J1 should be set in the left-hand position. Figure 9 illustrates USB and external power supply connectors.

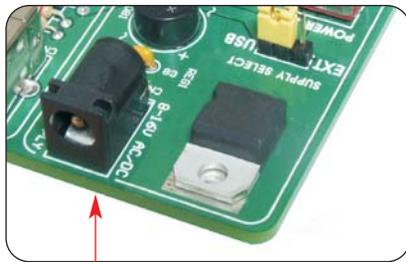


Figure 7 Power supply connector

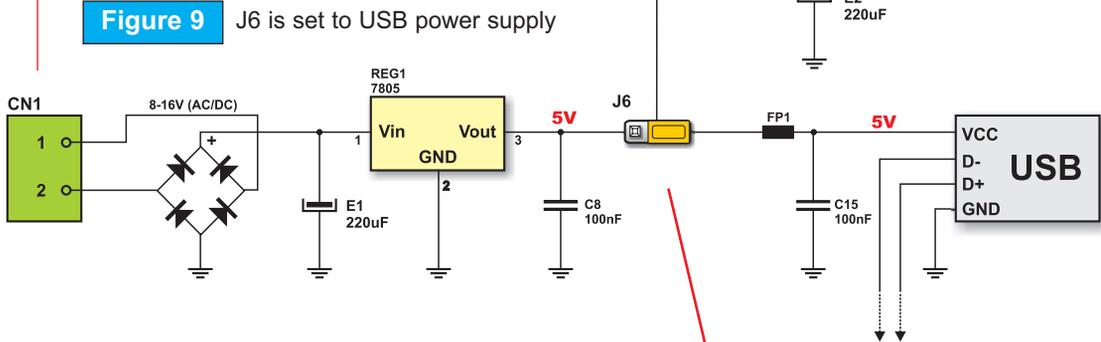


Figure 8 Power supply select jumper



J6 in the left-hand position: system is powered from the external AC/DC power adapter.



J6 in the right-hand position: system is powered from the USB cable.



ON-BOARD USB 2.0 PROGRAMMER

There is no need to use external equipment during programming as the EasyPIC5 development system has its own on-board USB 2.0 programmer. All you need to do is to connect the system to PC using the USB cable. Then, load your program into the microcontroller via the *PICflash* programming software supplied with EasyPIC5.

Please refer to *PICflash* documentation for more information.



Figure 10 USB 2.0 programmer

On the right of the USB programmer there is the jumper group J10. These jumpers are used for PGM pin selection. There are two different programming modes for PIC MCUs: Low-Voltage and High-Voltage programming mode. PICflash supports High-Voltage programming mode which can be applied regardless of MCU programming state. Some PIC MCUs are shipped with Low-Voltage programming mode by default. In order to use this programmer you must select the appropriate PGM pin (depending on chip). For most MCUs there is no need to use PGM selection. The jumper group J10 should remain in default position.

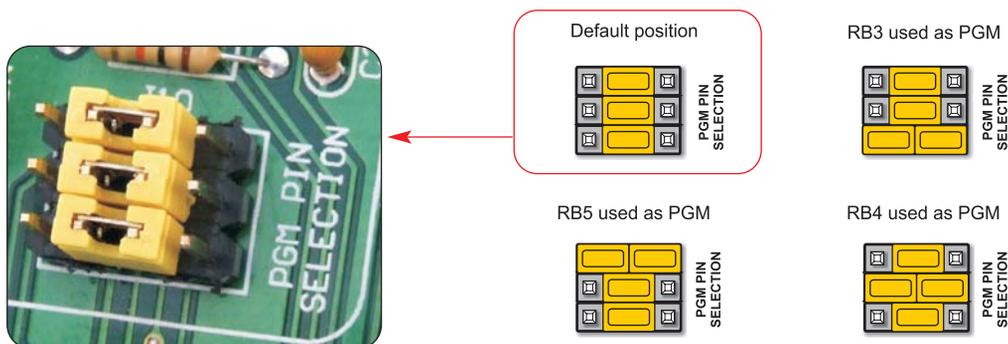


Figure 11 J10 jumpers



Note: There is no need to reset MCU after programming because programmer will reset the MCU automatically.



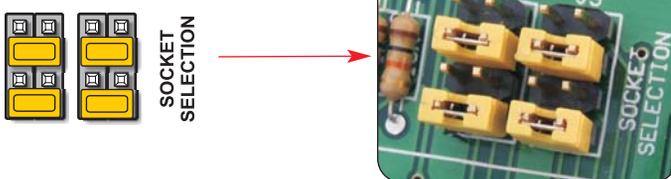
Figure 12

J8 and J9 for DIP40, DIP28, DIP18A and DIP18B



Figure 13

J8 and J9 for DIP20, DIP14 and DIP8



When using DIP40, DIP28, DIP18A and DIP18B sockets, jumpers J8 and J9 should be in upper position (default) as shown in figure 12.

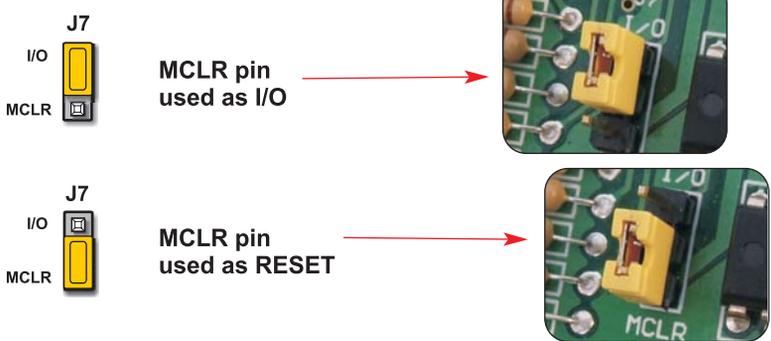
When using DIP20, DIP14 and DIP8 sockets, these jumpers should be in lower position (Figure 13).

Jumper J7 allows the use of MCLR pin as RESET or digital I/O. It can be RE3, RA5 or RA3 pin depending on MCU in use.

When J7 is in lower position, the hardware reset is enabled by pressing reset button. The MCLR pin cannot be used as I/O pin.

When J7 is in upper position, the MCLR pin can be used as I/O pin. Hardware reset is disabled in this case.

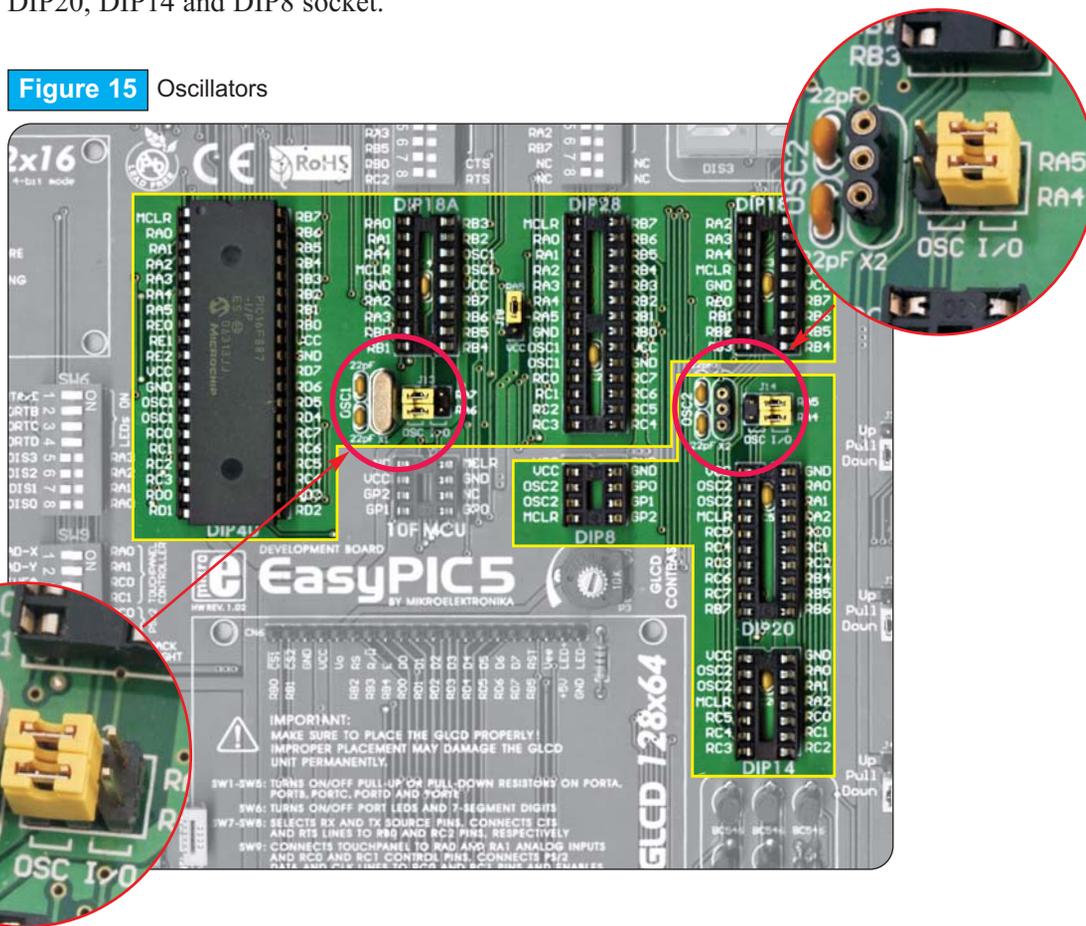
Figure 14 J2 jumper



OSCILLATOR

Since there are so many sockets on the EasyPIC5 board, there are two oscillators connected to two main sections of the MCU sockets. One oscillator designated as OSC1 is connected to DIP40, DIP28, DIP18A and DIP18B socket. Another one designated as OSC2 is connected to DIP20, DIP14 and DIP8 socket.

Figure 15 Oscillators



Note: As seen in the figure above, 10F MCU socket is not connected to oscillators. These MCUs have only an internal oscillator and cannot be used with external crystal.



On some microcontrollers, oscillator input pins can be also used as digital input/output pins. In order to implement this feature, EasyPIC5 has jumpers for connecting MCU either to oscillator or digital I/O pins. Refer to the schematic of the OSC1 oscillator in figure 16.

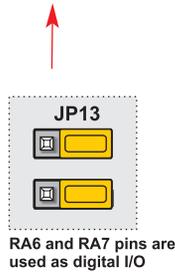
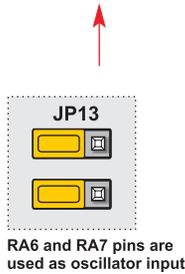
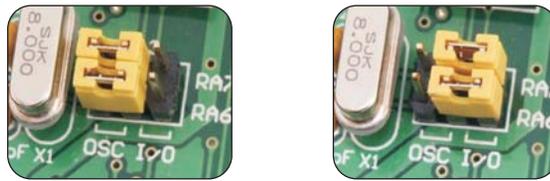
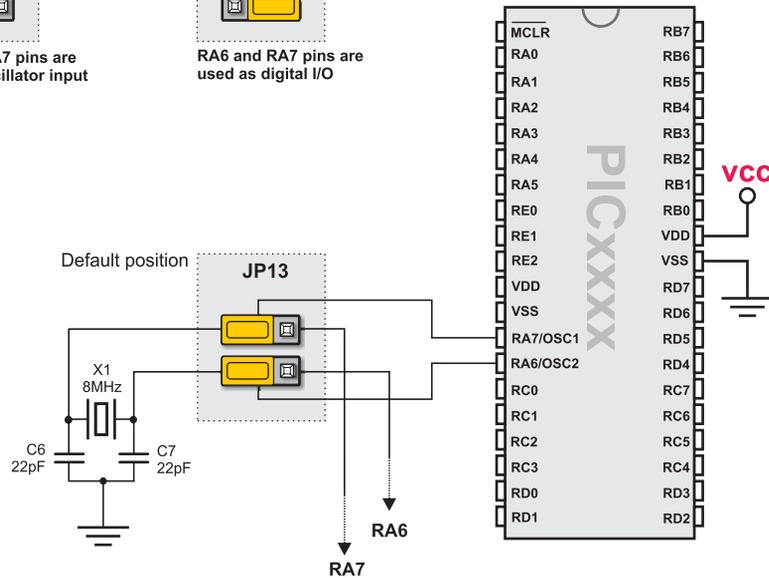


Figure 16

Oscillator connection with MCU



Note: Silkscreen identification marks beside each MCU socket determine which oscillator should be used. If two microcontroller pins are designated as OSC1, oscillator should be placed in the OSC1 connector. If two microcontroller pins are designated as OSC2, oscillator should be placed in the OSC2 connector.



MikroICD (HARDWARE IN-CIRCUIT DEBUGGER)

MikroICD is a highly effective tool for Real-Time debugging on hardware level. The mikroICD debugger enables you to execute a program on the PIC microcontroller and view variable values, special function registers (SFRs) and EEPROM while the program is running. MikroICD can be used with any PIC compiler manufactured by MikroElektronika (mikroC, mikroBasic or mikroPascal). You just have to select the appropriate build type (Release or ICD Debug), build the project, program the MCU and run debugger.

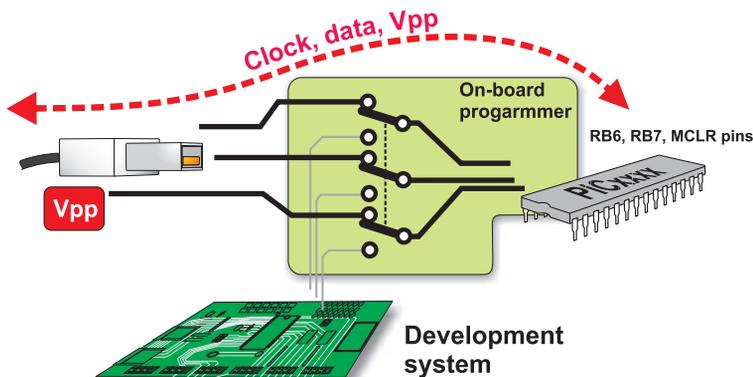
The mikroICD debugger uses on-board programmer to communicate with the compiler and supports common debugger commands:

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

Program debugging



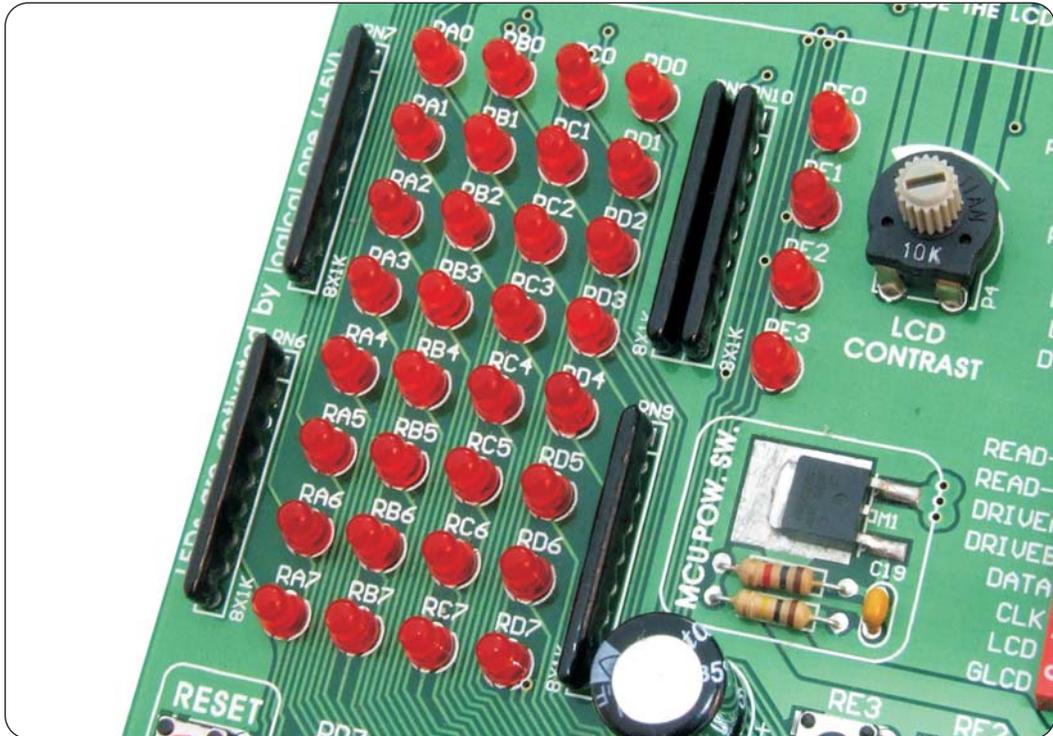
Note: For more information on how to use mikroICD debugger please refer to the mikroICD documentation “*mikroICD User’s Manual*”. You can also find it in Help documentation inside any of the mentioned compilers.



LEDs

Light Emitting Diodes (LEDs) are most commonly used components, usually for displaying pin digital state. EasyPIC5 has 36 LEDs connected to the microcontroller PORTA, PORTB, PORTC, PORTD and PORTE.

Figure 18 LEDs on board

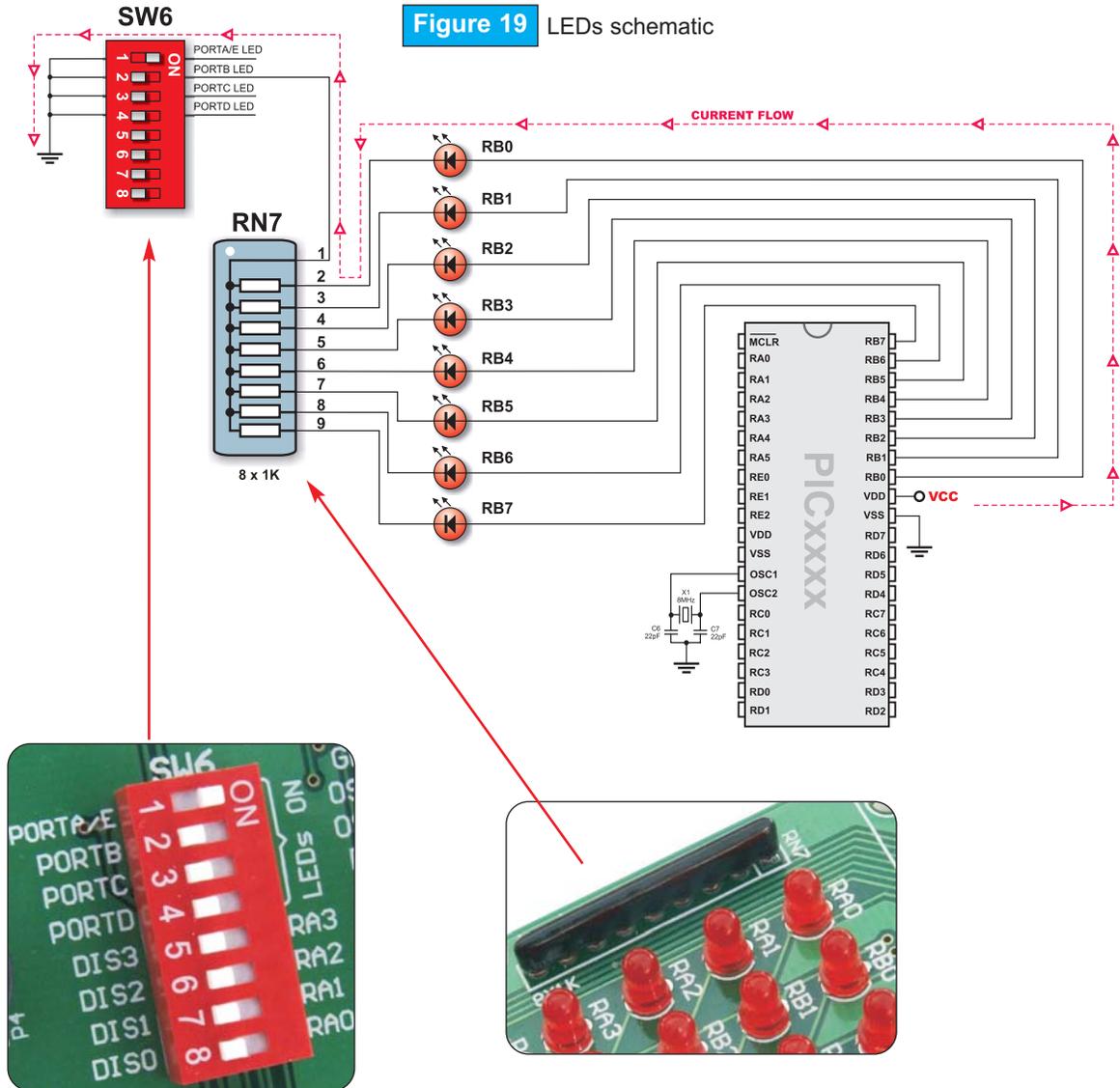


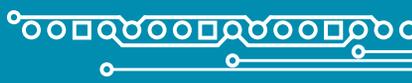
Each group of eight LEDs can be enabled or disabled using switches on the SW6. The exception is PORTE which has 4 LEDs and is connected to the same switch as PORTA.

The LEDs are enabled when the corresponding switch on the SW6 is ON. When enabled, LEDs will display the state of the corresponding microcontroller pin. Otherwise, the LEDs are always off, no matter what the port state is, as no current can flow through them.

Figure 19 illustrates the connection between LEDs and PORTB on the microcontroller. A resistor is serially connected to the LEDs in order to limit their current. In this case the resistor value is 1K.

Figure 19 LEDs schematic

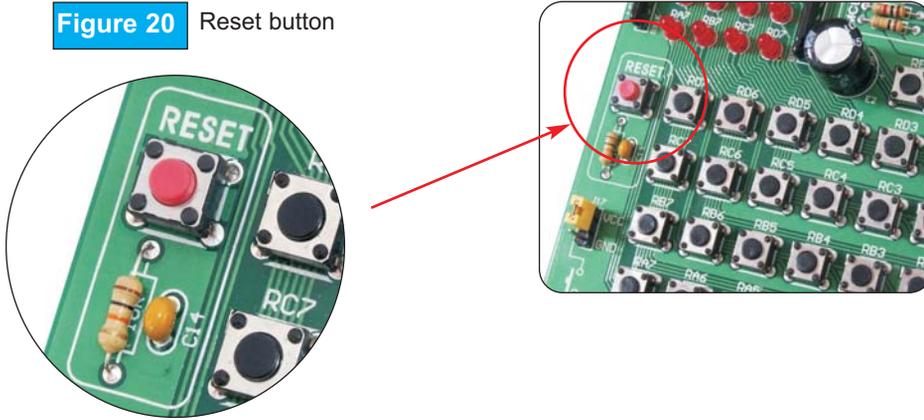




RESET CIRCUIT

Among other pushbuttons, there is one red button on the far left marked as RESET. It is used for MCU reset.

Figure 20 Reset button



You can see in figure below that the microcontroller MCLR pin is connected to programmer circuit instead to RESET button directly.

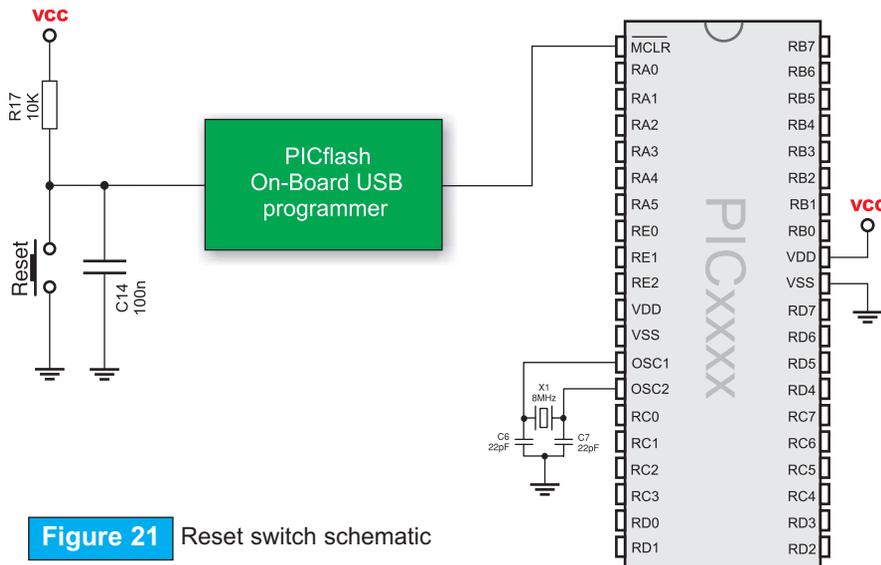
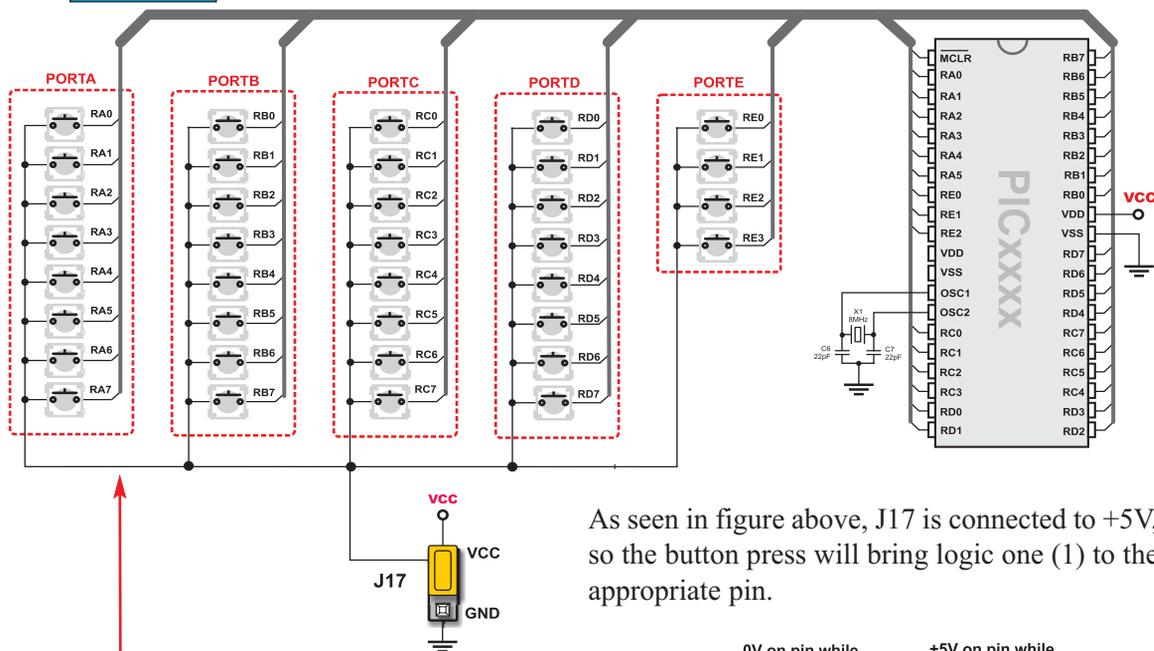


Figure 21 Reset switch schematic

PUSHBUTTON SWITCHES

EasyPIC5 has 36 pushbuttons which can be used to change states of digital inputs on the microcontroller ports. Connection between buttons and PORTA, PORTB, PORTC, PORTD and PORTE is shown in figure 22. Jumper J17 determines whether a button press will bring logic zero (0) or logic one (1) to the appropriate pin. When button is released, pin state is determined by pull-up or pull-down port jumpers.

Figure 22 Buttons schematic



As seen in figure above, J17 is connected to +5V, so the button press will bring logic one (1) to the appropriate pin.

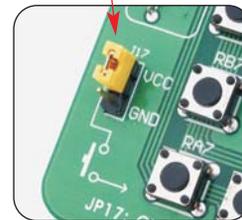
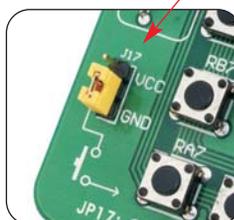


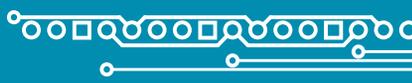
Figure 23 Pushbuttons

0V on pin while button is pressed



+5V on pin while button is pressed





In figure 24, jumper J2 is set to pull-up, so that when the button is realised, pull-up resistor pulls the microcontroller RB4 pin to +5V.

By pressing button, the port pin is connected to ground (J17 is in lower position).

Thus, only when the button is pressed the microcontroller will sense a logic zero (0). Otherwise, the pin state will always be logic one (1).

Figure 24 Button with pull-up resistor

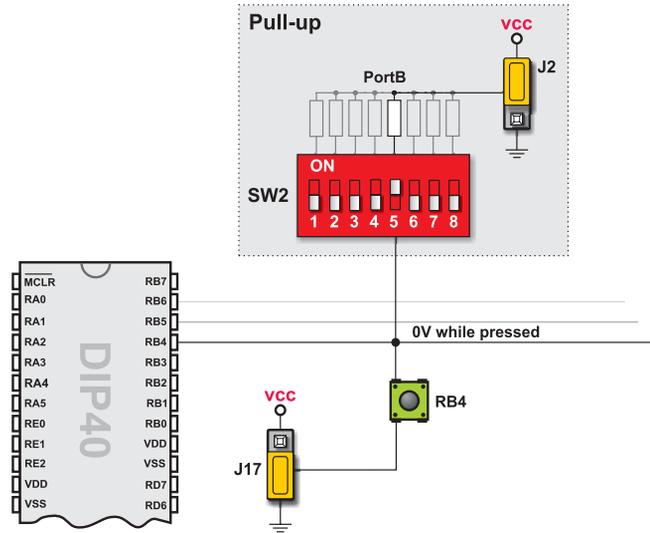
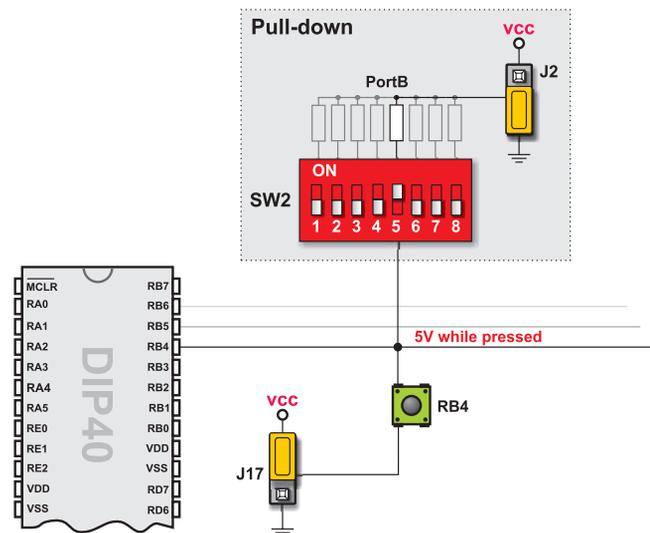


Figure 25 Button with pull-down resistor

In figure 25, switch J2 is set to pull-down, so that when the button is released, pull-down resistor pulls the microcontroller RB4 pin to 0V.

By pressing button, the port pin is connected to +5V (J17 is in higher position).

Thus, only when the button is pressed the microcontroller will sense a logic one (1). Otherwise, the pin state will always be logic zero (0).



7-SEGMENT DISPLAYS

EasyPIC5 has four 7-segment displays in multiplex mode. Data lines are connected to PORTD, while each display is enabled by four PORTA low bits.

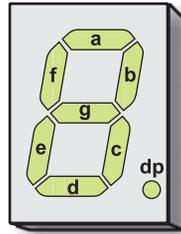


Figure 26 7-segment displays

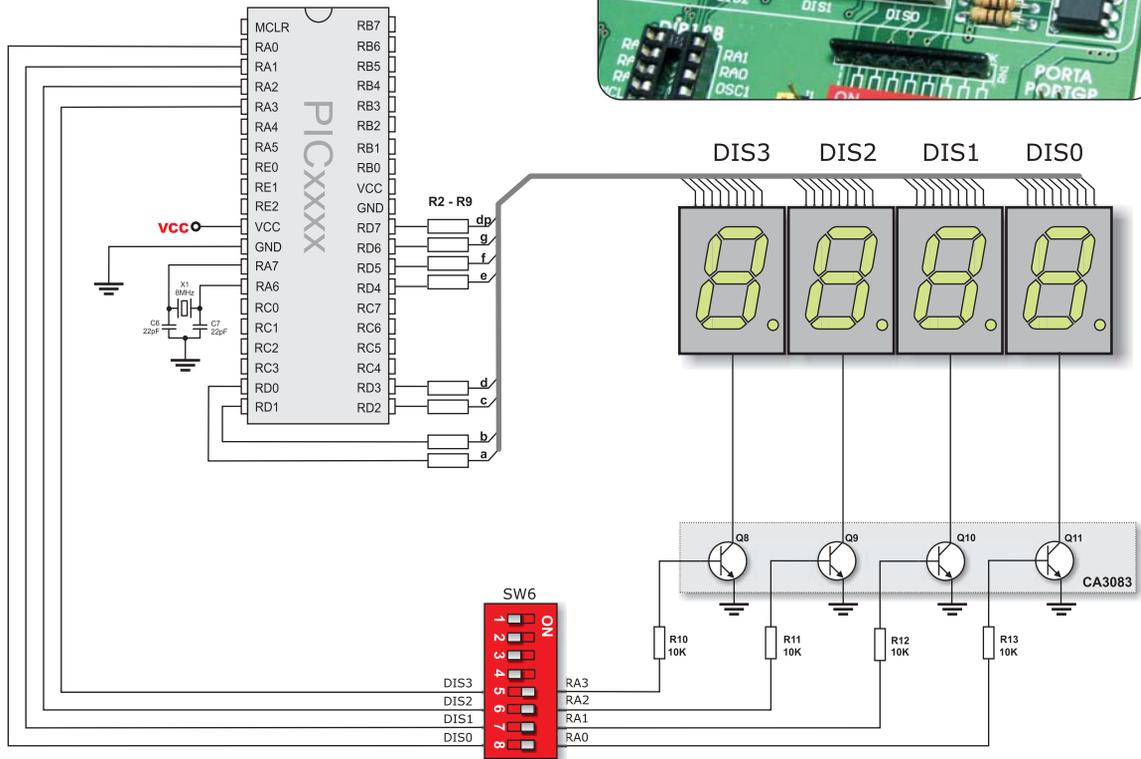


Figure 27 7-segment displays schematic



2X16 CHARACTER LCD

A standard character LCD is probably the most widely used data visualization component. It usually can display two lines of 16 alphanumeric characters, each made up of 5x8 pixels. The character LCD communicates with the microcontroller via 4-bit data bus. The connection to the microcontroller is shown in figure 29.

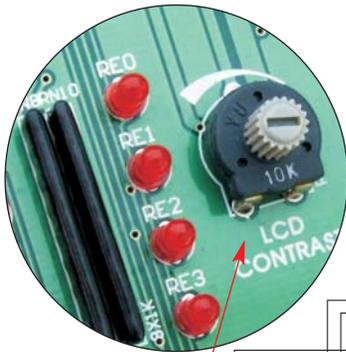


Figure 28 LCD 2x16 in 4-bit mode

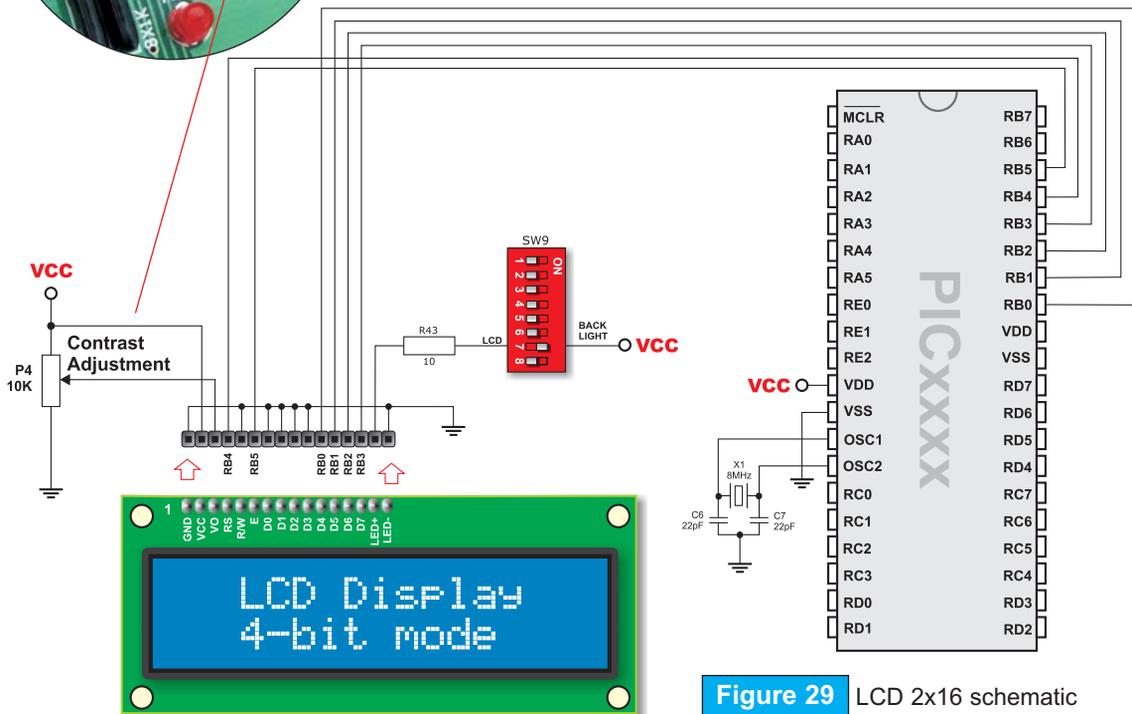


Figure 29 LCD 2x16 schematic



Note: It is important to know that LCD should be placed or removed from EasyPIC5 only after the power is turned off.

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. The GLCD contrast can be adjusted using the potentiometer P3 placed right above the GLCD.

Figure 31 GLCD contrast adjustment potentiometer

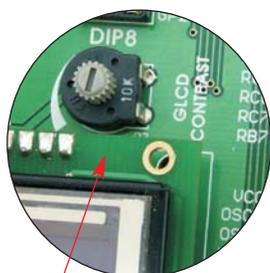


Figure 30 GLCD

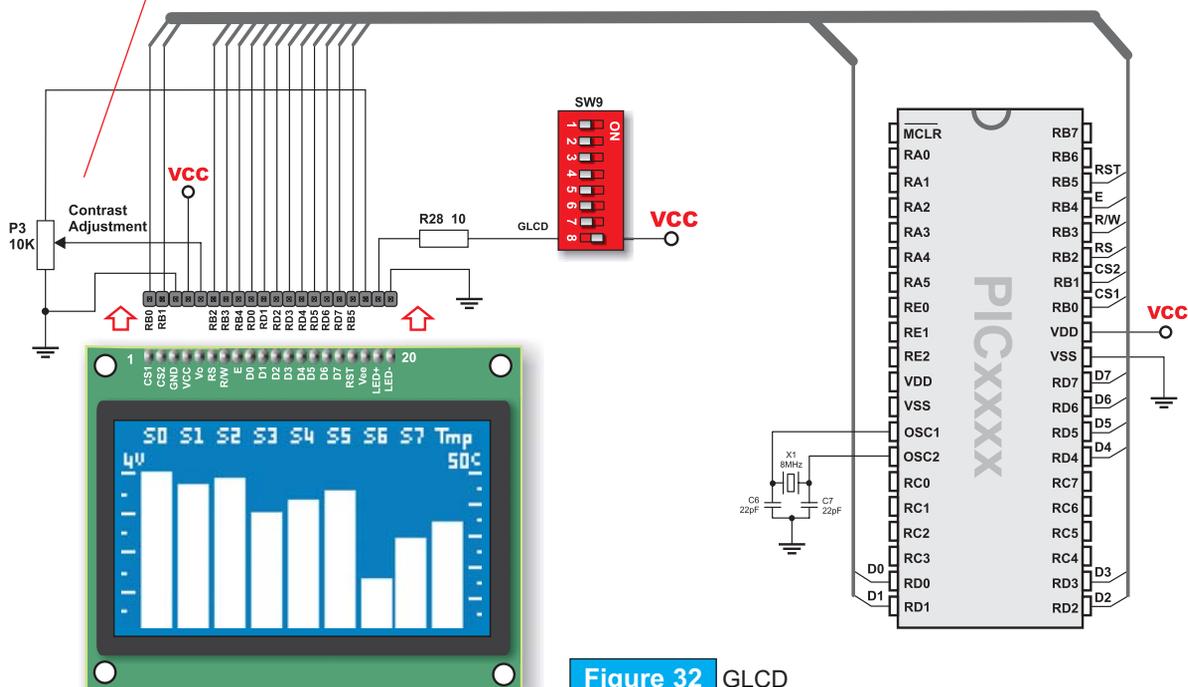
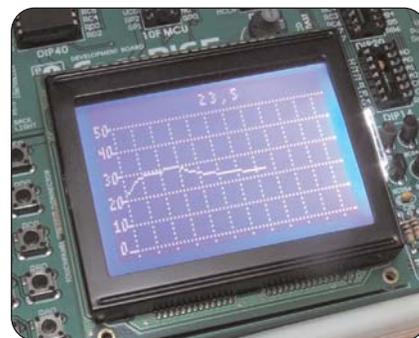


Figure 32 GLCD



TOUCH PANEL

Touch panel is a tin, self-adhesive, transparent foil which could be placed over screen of graphic LCD. It consists of two separate foils which form “sandwich” structure. They are very sensitive to press so that even a soft touch causes some changes on output signal. It is used in various “user friendly” devices in combination with graphic LCD.

Connector CN13 enables this device to be connected to on-board touch panel controller whose active part consists of 5 discrete transistors. Four switches of the SW9 enable or disable connection between this controller and RA0, RA1, RC0 and RC1 pins.

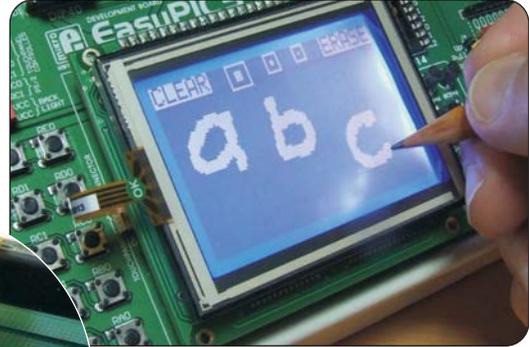


Figure 34

Touch panel connector

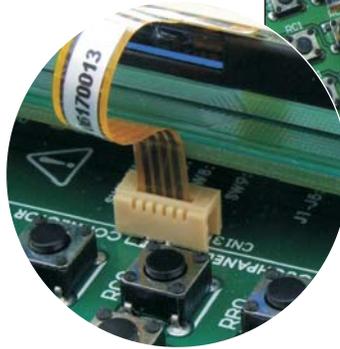
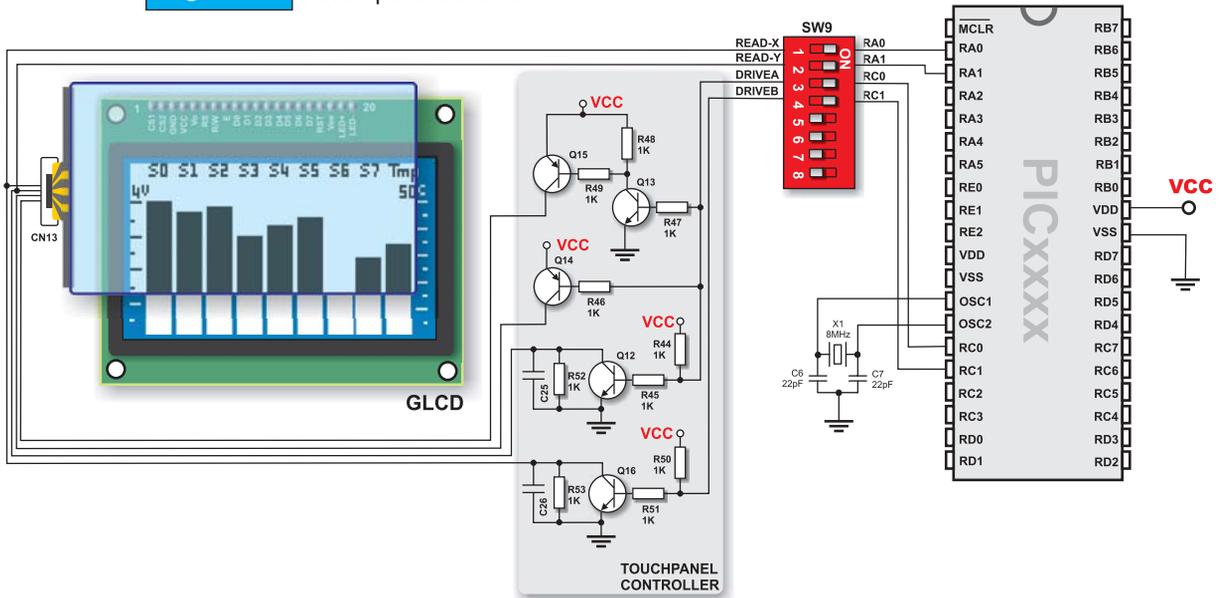


Figure 33 Touch panel mounted on graphic LCD

Figure 35 Touch panel schematic



RS-232 COMMUNICATION

RS-232 communication enables point-to-point data transfer. It is commonly used in data acquisition applications for data transfer between the microcontroller and PC. Since the voltage levels of the microcontroller and PC are not directly compatible with those of RS-232, a level transition buffer such as MAX232, must be used. In order to provide a more flexible system, the microcontroller is connected to the MAX232 via the switch groups SW7 and SW8. The switch group SW7 is used to connect Rx line to RC7, RB2, RB1, RB4, RA3 or RB5. The switch group SW8 is used to connect Tx line to RC6, RB5, RB2, RB1, RA2 or RB7. Note that pins RB1 and RB2 must not be simultaneously connected. SW7 enables connections between RB0 pin and CTS and RC2 pin and RTS line in order to implement hardware handshaking.

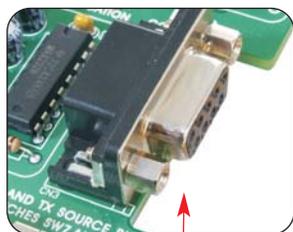


Figure 36 RS232 connector

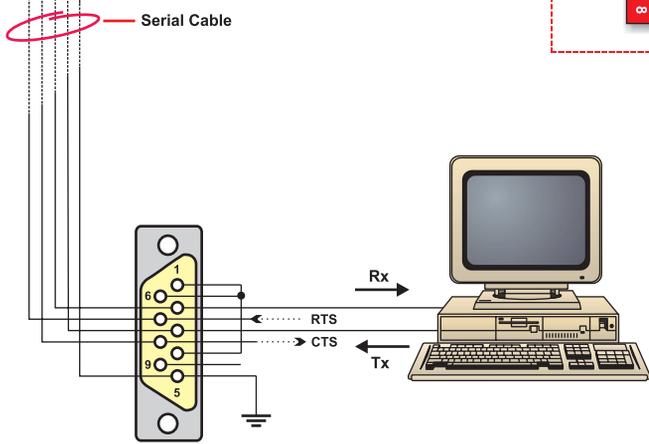
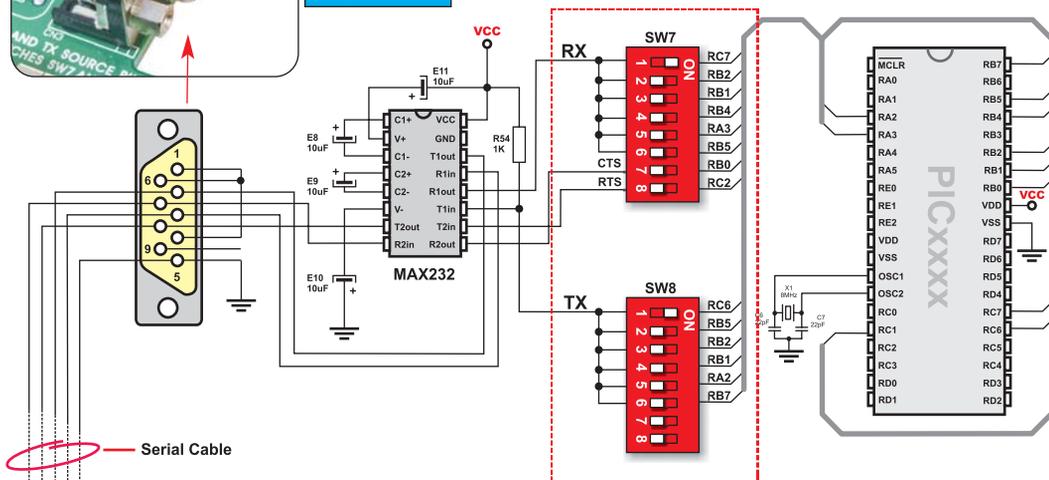
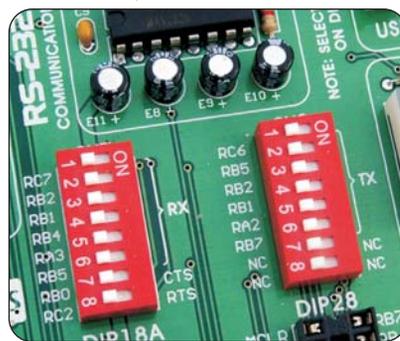
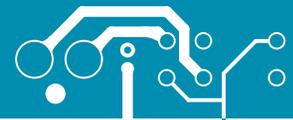


Figure 37 Connection between microcontroller and PC





USB COMMUNICATION

USB communication connector is placed in the upper right corner of the EasyPIC5. It is used with specific PIC microcontrollers which have USB support, such as PIC18F2450 or PIC18F4550. Note that USB communication connector cannot be used for programming while the USB programming connector can not be used for communication. In order to enable connection between the microcontroller and USB communication connector, the J12 jumper group should be set to right position. In consequence of that, the microcontroller pins RC3, RC4 and RC5 are disconnected from the rest of the system and connected to the USB communication connector.

Figure 39

USB communication schematic

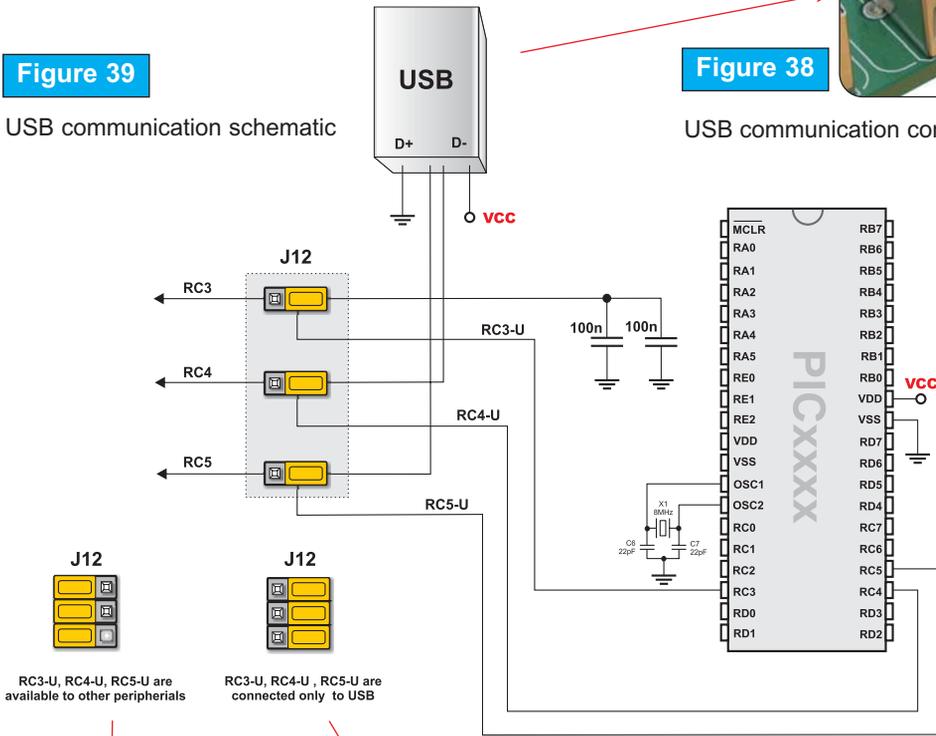
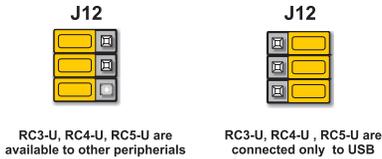
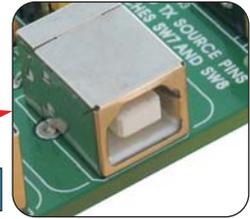


Figure 38

USB communication connector



To enable USB communication all three jumpers must be set to right position.

PS/2 COMMUNICATION

PS/2 connector allows direct connection between EasyPIC5 and devices using PS/2 communication, such as PC, keyboard or mouse. For example, the microcontroller can be connected either to a keyboard to capture pressed keys or to PC to act as a keyboard. CLK and DATA lines are used for data transfer. In this case, they are connected to the pins RC1 and RC0 respectively.

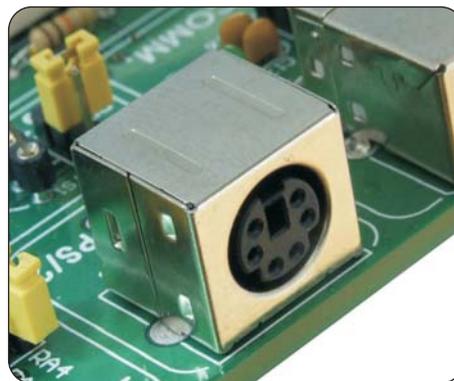
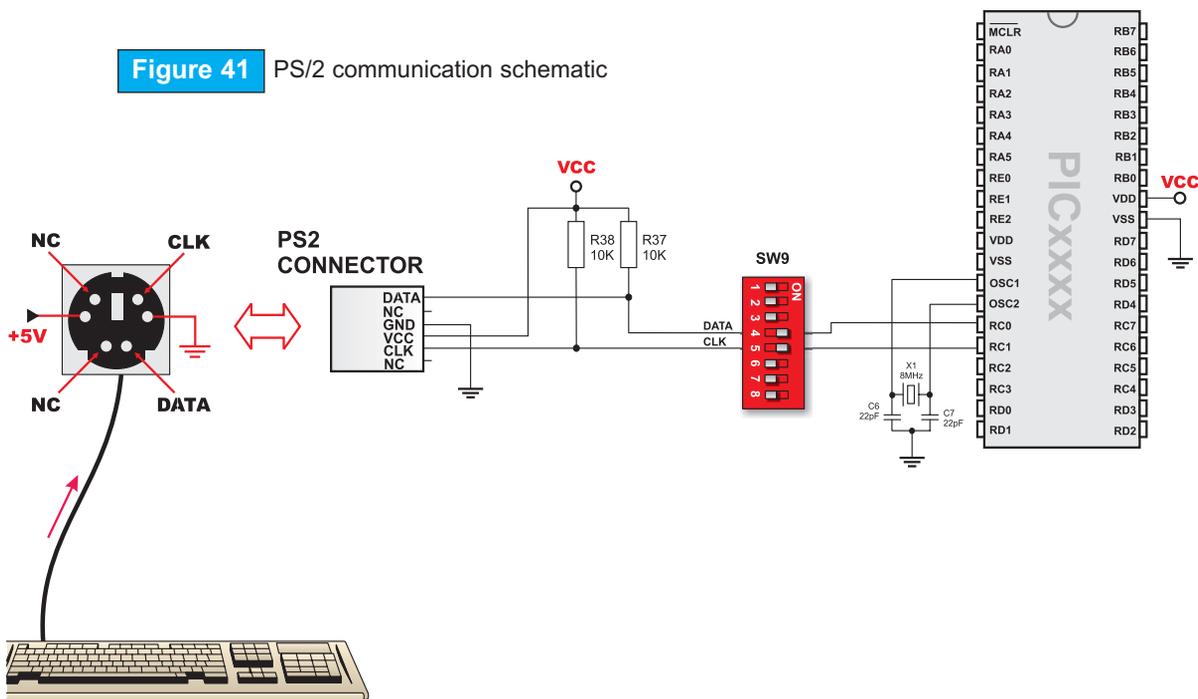


Figure 40 PS/2 connector

Figure 41 PS/2 communication schematic





DS1820 DIGITAL THERMOMETER

DS1820 digital thermometer is convenient for environmental temperature measurement, having the temperature in the range of -55°C to 125°C with $\pm 0.5^{\circ}\text{C}$ accuracy. It must be properly placed in the 3-pin socket provided on EasyPIC5, with its rounded side to the right, as marked on the board (see figure below). Otherwise the DS1820 could be permanently damaged. DS1820 data pin can be connected to either RA5 or RE2 pin, which is determined by the jumper J11.



Figure 42 DS1820

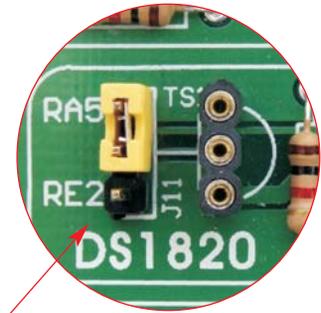
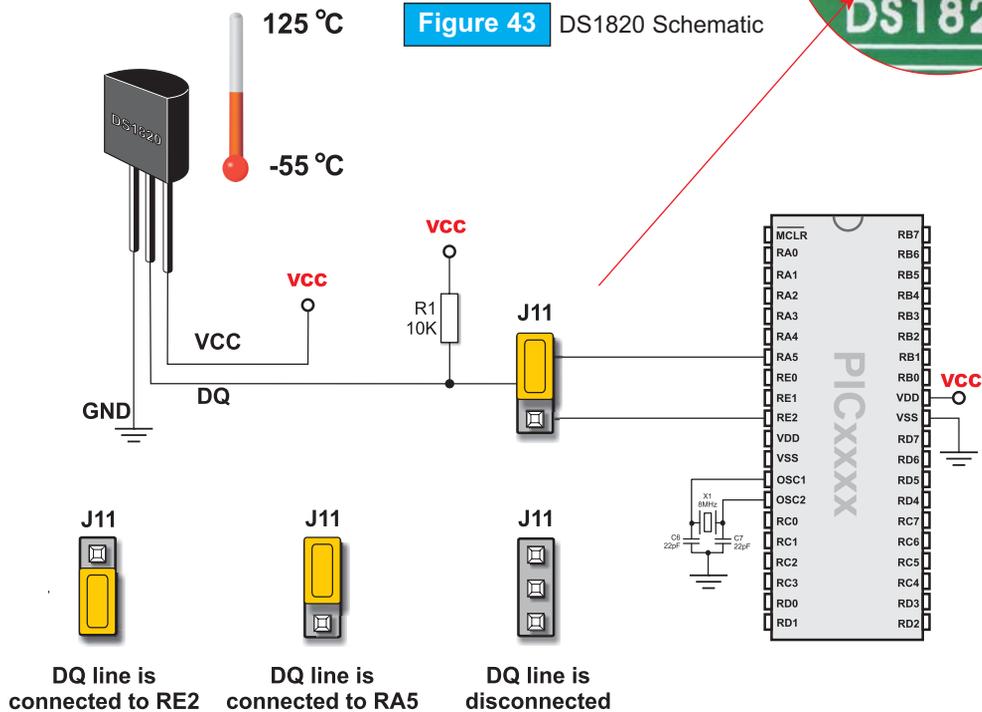


Figure 43 DS1820 Schematic



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

A/D CONVERTER INPUT

The EasyPIC5 development board has two potentiometers for working with analog-to-digital converter (ADC). Both potentiometers outputs are in the range of 0 - 5V. Two analog signals can be connected to two different analog input pins simultaneously. The jumper group J15 enables connection between potentiometer P1 and one of the following pins: RA0, RA1, RA2, RA3 or RA4. The jumper group J16 enables connection between potentiometer P2 and one of the following pins: RA1, RA2, RA3, RA4 or RA5.

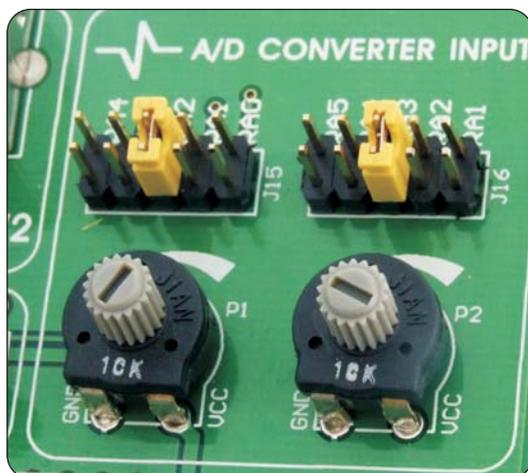


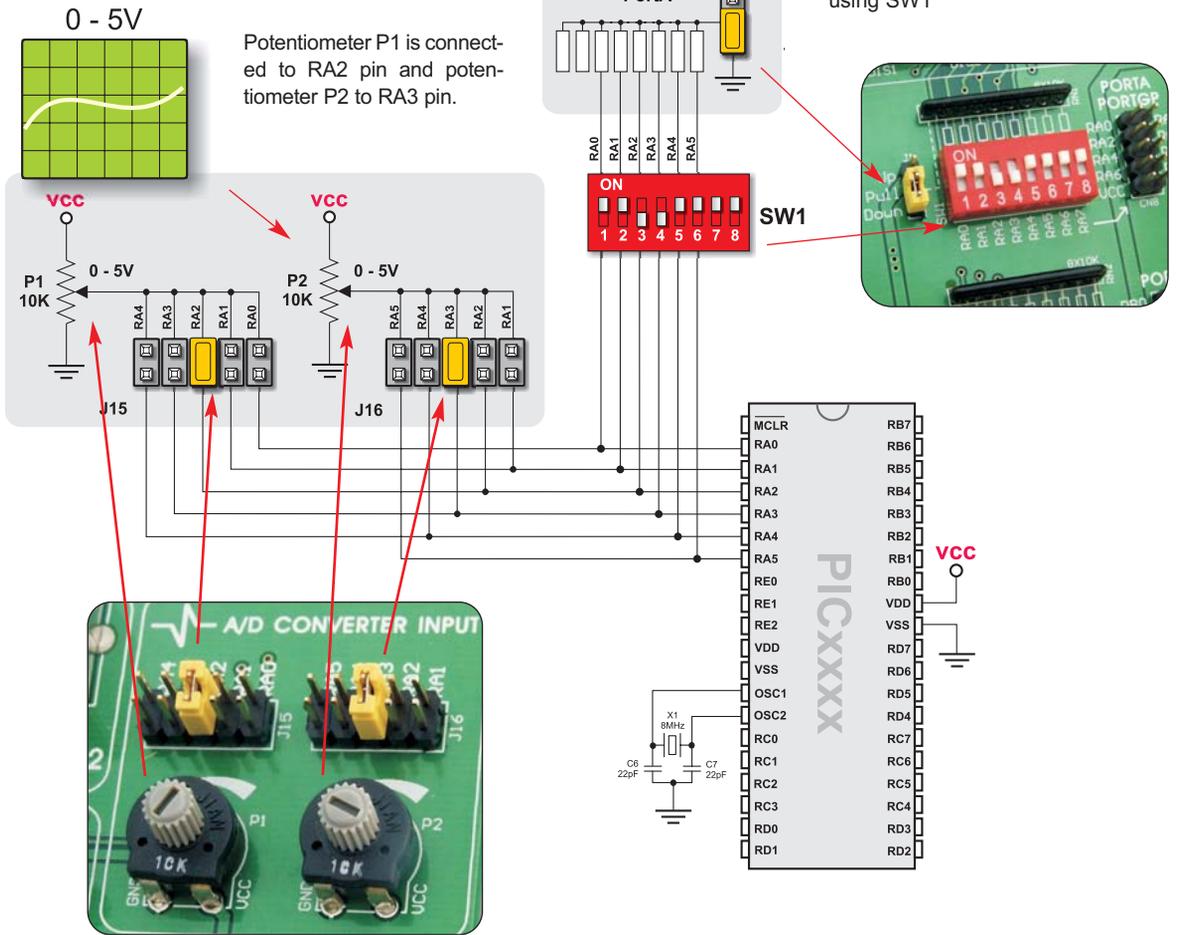
Figure 44 A/D Converter input

In order to measure analog signal without interference, turn off the corresponding switch on the SW1. This will disable connection between PORTA pins and pull-up/down resistors.

There are many applications of A/D conversion. The microcontroller takes analog signal from its input pin and converts it into digital value. Basically, you can measure any analog signal that fits in the range acceptable by PIC. That range is 0 - 5V.



Figure 45 A-D Converter input



NOTE: Jumpers J15 and J16 should not select the same pin.

DIRECT PORT ACCESS

All microcontroller input/output pins can be accessed via 2 x 5 connectors placed along the right side of the board. For each PORTA, PORTB, PORTC, PORTD and PORTE there is one 10-pin connector providing VCC, GND and maximum eight port pins.

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

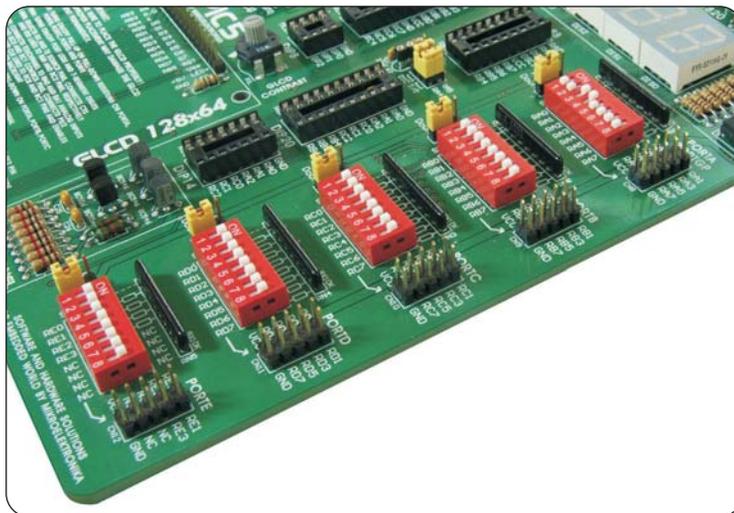


Figure 46 Direct port access connectors

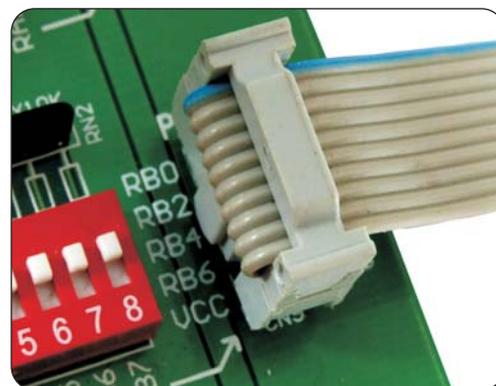


Figure 47 Example of how to connect external peripheral via flat cable

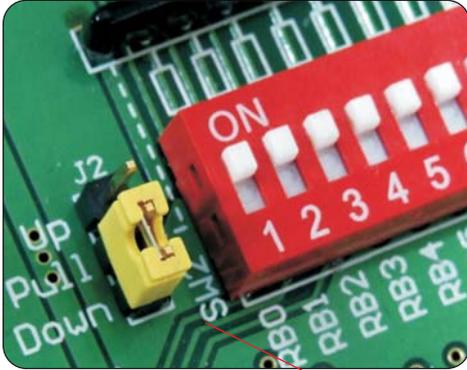
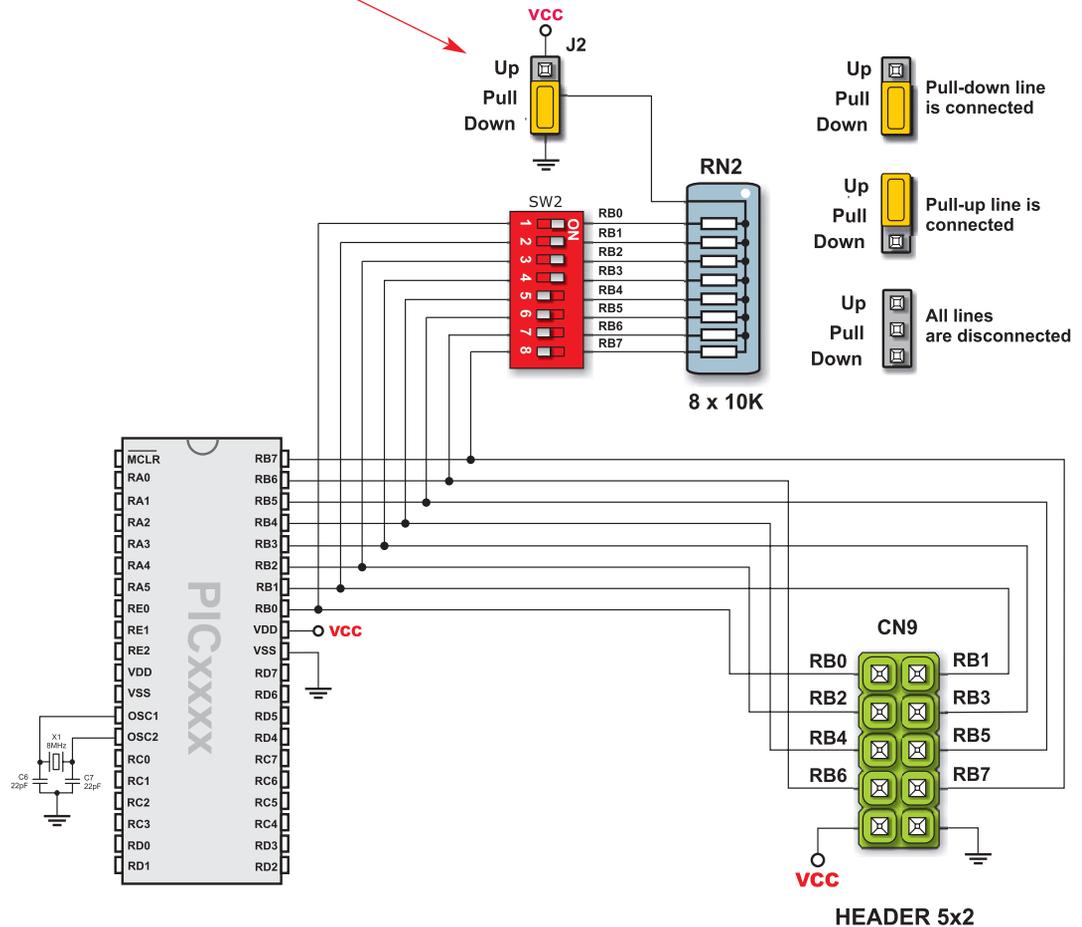


Figure 48 PORTB connection



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