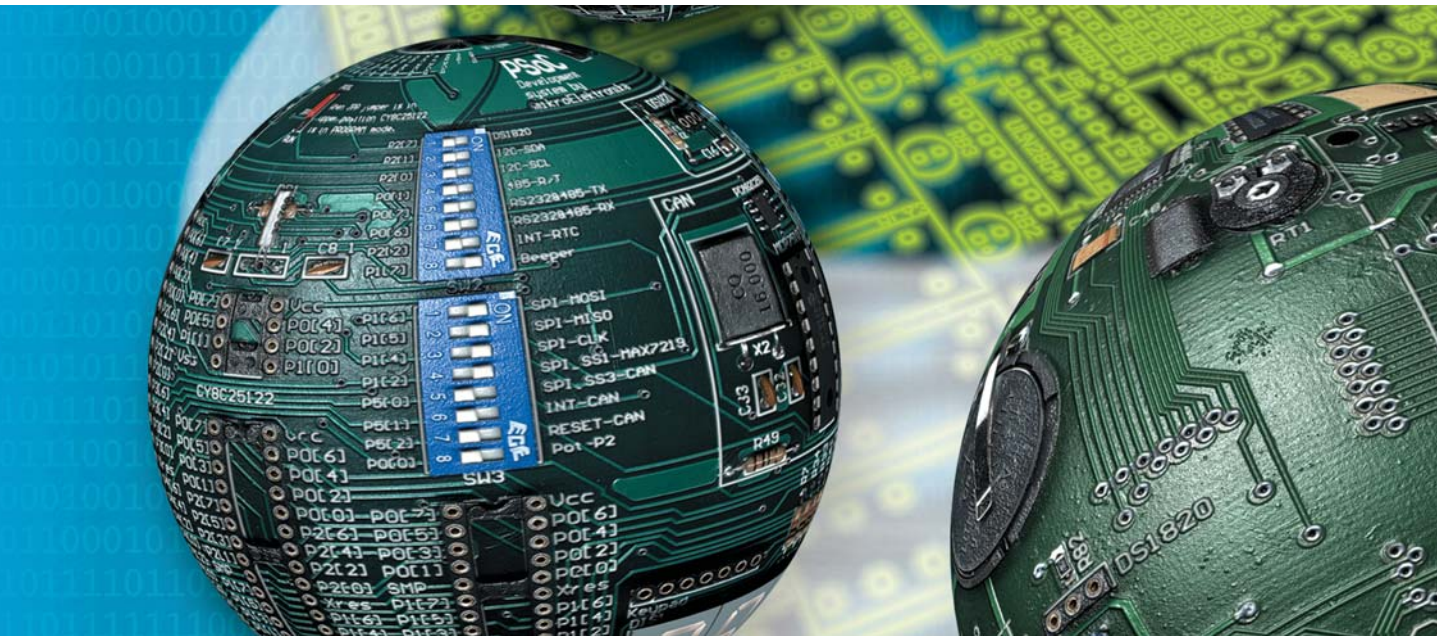
SOFTWARE AND HARDWARE SOLUTIONS FOR THE EMBEDDED WORLD

MikroElektronika
Development tools - Books - Compilers

LV 24-33
User's Manual



3 in 1

mikro ICD IN-CIRCUIT DEBUGGER

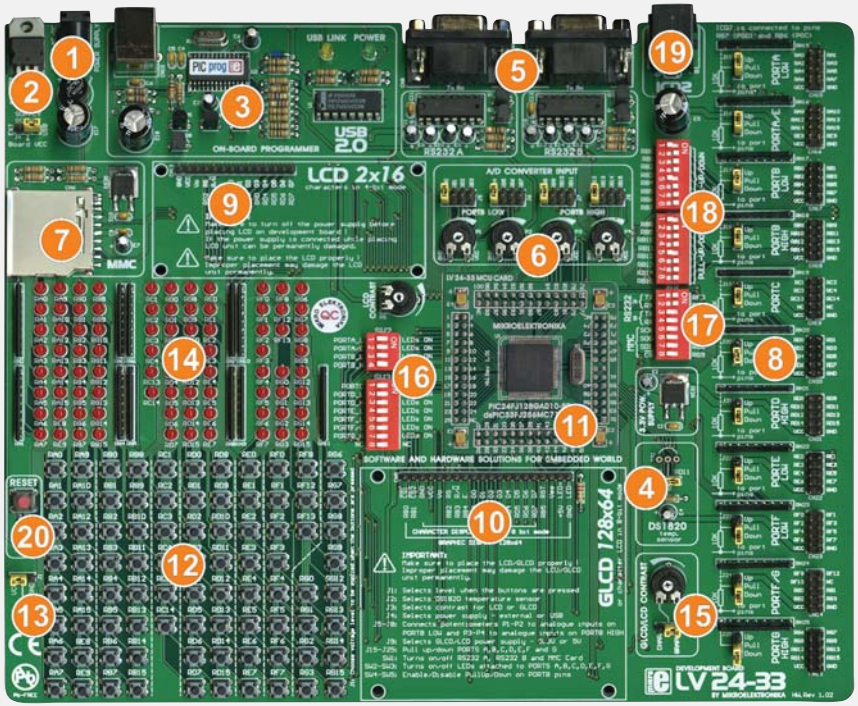
USB 2.0 IN-CIRCUIT PROGRAMMER

MICROCHIP 24/33 DEVELOPMENT BOARD

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.

Software and Hardware solutions for Embedded World

LV 24-33
KEY FEATURES



1. External power supply from 8 to 16 V AC/DC.
2. Choose between external and USB power supply. When powering from your PC's USB port, you don't need an external supply.
3. Very fast and flexible USB programmer on board. The key feature is expandability. By downloading new software, you will be able to program new MCUs in coming years.
4. DS1820 temperature sensor allows you to measure temperature with 0.5°C accuracy.
5. Two RS232 communication ports - RS232-A and RS232-B.
6. For presentation purposes, all PORTB pins are connected to, and can be used for measuring voltages set by, the potentiometers P1, P2, P3 and P4.
7. MMC/SD slot for multimedia cards with up to 2GB storage space.
8. Setting the jumper to the upper position sets the pins of the appropriate port to logical one (pull-up). If the jumper is set to the lower postion, pins are set to logical zero (pull-down). It is very important to select pull-up for a port if you expect logical zero on its inputs and vice versa.
9. You can connect an LCD if you need it for your application in 4-bit mode.
10. You can connect a Graphic LCD if you need it for your application or LCD in 8-bit mode.
11. LV 24-33 supports 80-pin and 100-pin PIC24 and dsPIC33 microcontrollers.
12. 85 buttons allow you to control every pin on your microcontroller.
13. You can choose how pressing the button will affect the pin, high state or low state.
14. See all the signals - each pin has an LED.
15. Set LCD contrast according to your display characteristics.
16. All switches on SW2 and SW3 turns ON or OFF the LEDs on all PIC24 or dsPIC33 ports. You can choose which port you want LEDs to be connected to. In certain applications, it is important to remove all unnecessary connections from pins. These DIP switches let you disconnect all LEDs from MCU pins.
17. On-Board peripherals are connected to the microcontroller using SW1. MMC/SD Card is connected to the microcontroller through the switches 5, 6, 7 and 8. Both RS232 communication ports are connected to MCU using first four switches on SW1.
18. PORTB is connected to a resistor network, using switches SW4 and SW5. If a switch is in OFF position, the appropriate pin has either pull-up or pull-down resistor attached. This is very important as it enables PORTB to be used in analog mode as an A/D converter as well as an ordinary digital I/O port.
19. ICD2 (In-Circuit Debugger) connector.
20. Reset circuit - if the reset button is pressed a hardware reset will take place (MCU will start executing from the beginning).

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 LvPICFlash programmer and drivers. Start the installation from the product CD: CD_Drive:/product/zip/LvPICFlash_setup.exe.

Step no.3 After the installation connect the USB cable to the LV 24-33 board. You will be asked for the LvPICFlash drivers. Point to them in order to finish the driver installation. They are placed in folder:
System_Drive:\Program Files\Mikroelektronika\LVPICFLASH\Driver.NT

Step no.4 Run and use LvPICFlash as it is explained in the PDF document '*LvPICFlash programmer*':
CD_Drive:/product/pdf/lvpicflash_manual.pdf

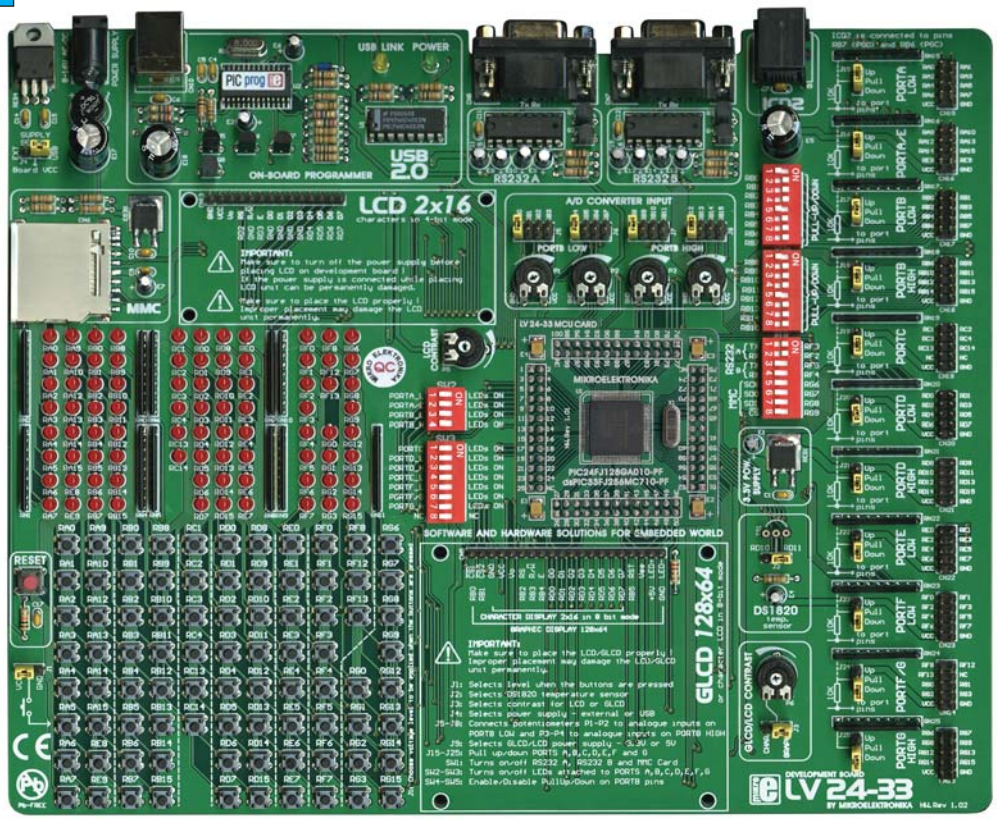
After these 4 steps, your LV 24-33 is installed and ready for use. You can try to read a program from the chip or to load an example from the examples folder of mikroElektronika's compilers for dsPIC or from the product CD:
CD_Drive:/product/zip/lv24_33_examples.zip.

INTRODUCTION

The LV 24-33 development system is a full-featured development board for Microchip PIC24 and dsPIC33 microcontrollers. It has been designed to allow students and engineers to easily exercise and explore the capabilities of PIC24 and dsPIC33 microcontrollers. It allows PIC24 and dsPIC33 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. LV 24-33 development board



SWITCHES

The LV 24-33 development board features a number of 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 LV 24-33 development board has four groups of switches.

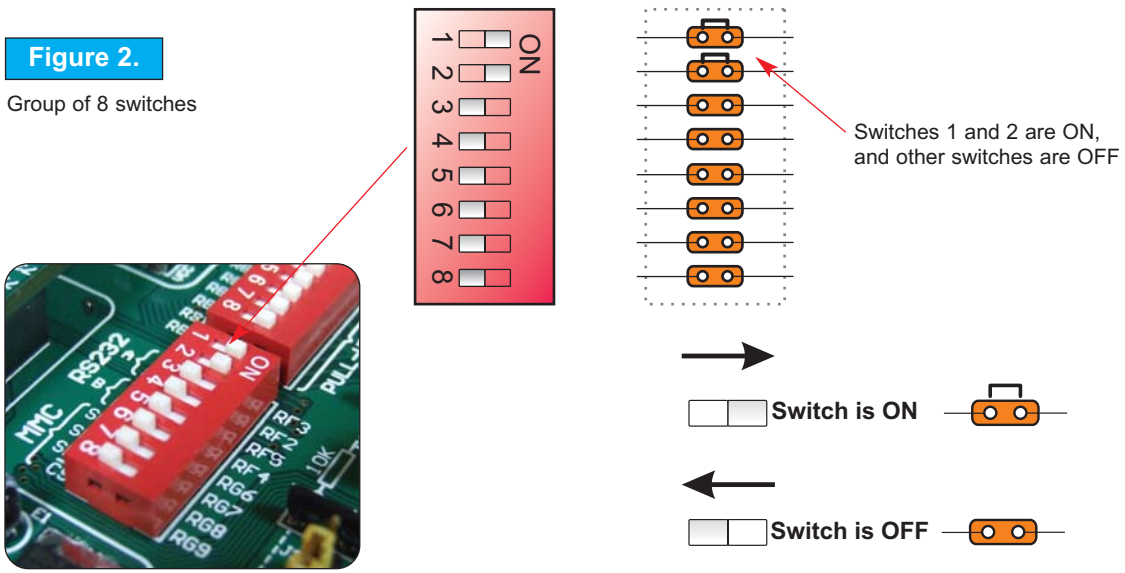
The switches on **SW1** are used to enable connection between the microcontroller pins and both RS232 communication devices. The first two switches are used for RS232 A communication lines, while the second two are used for RS232 B communication lines. Switch **SW1** is also used to enable SPI communication and to enable connection between the microcontroller pin and CS pin for MMC/SD Card.

The switches on **SW2** and **SW3** are used to enable LEDs connected to PORTA, PORTB, PORTC, PORTD, PORTE, PORTF and PORTG.

The switches on **SW4** and **SW5** are used to enable a connection between the microcontroller PORTB with external pull-up/down resistors. When PORTB pins are used as digital inputs/outputs, the appropriate pull-up/down resistors should be enabled.

Figure 2.

Group of 8 switches



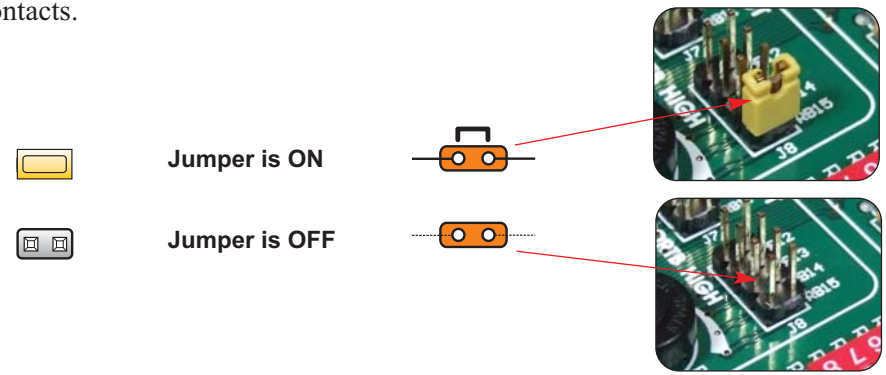
JUMPERS

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 jumpers group J8 is used to connect or disconnect potentiometer P4 to RB12, RB13, RB14 or RB15 line. A connection is made when the jumper is placed between two contacts.

Figure 3.

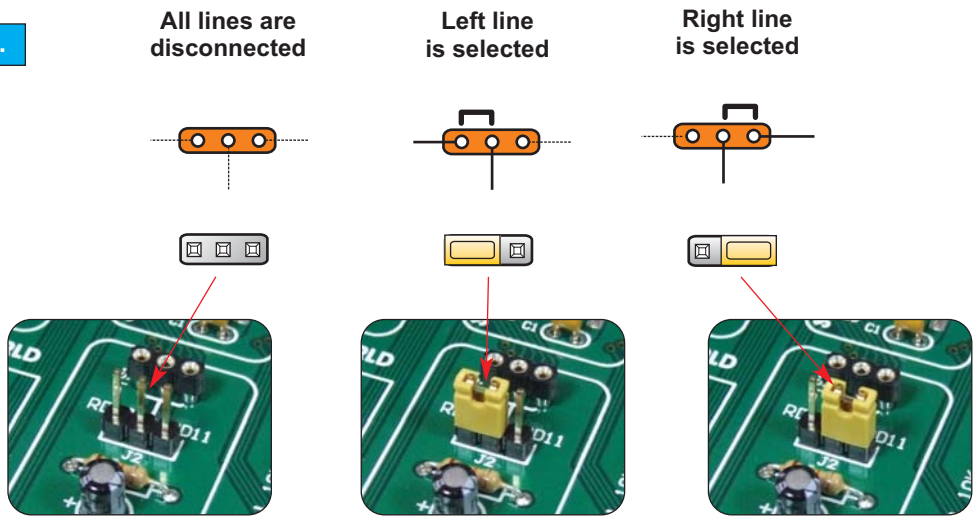
Jumper as a switch



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.

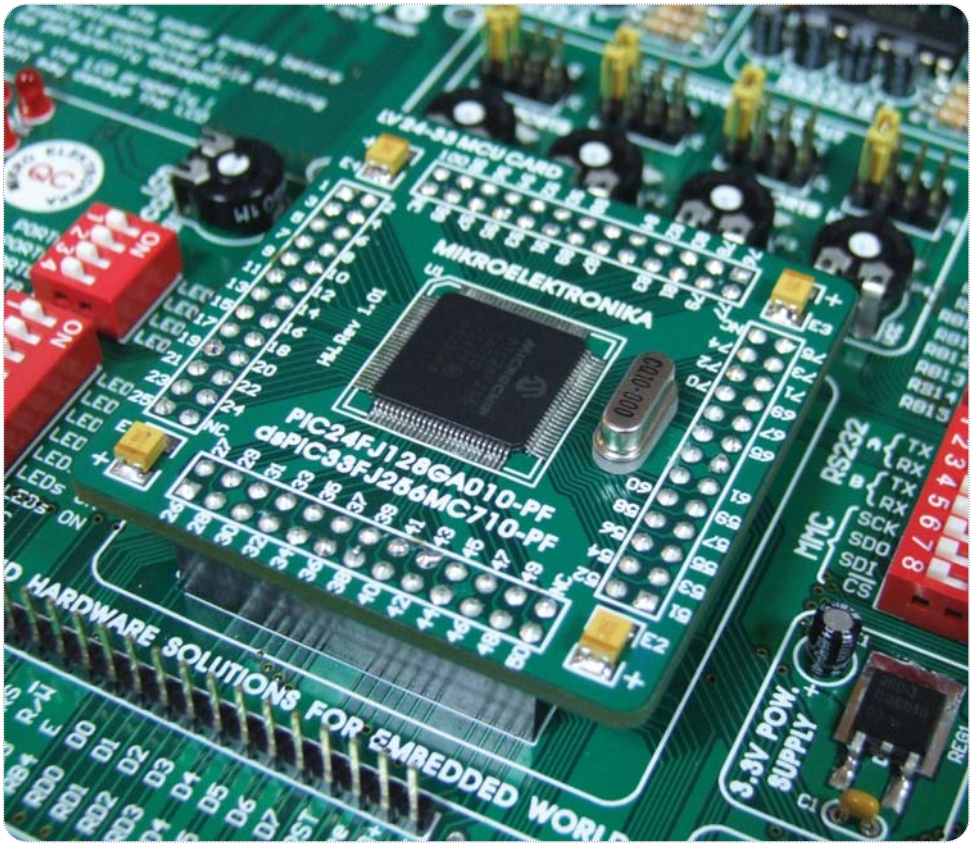
Figure 4.

Jumper as a multiplexer



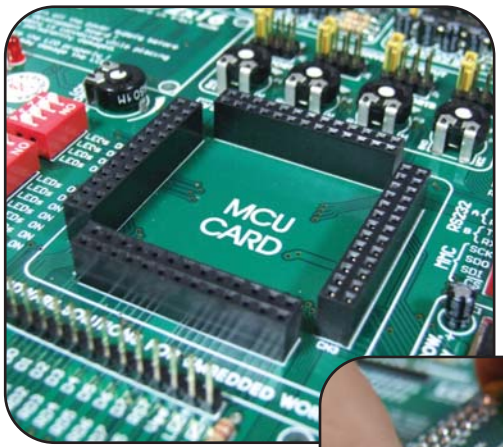
MCU CARD

The LV 24-33 development board has a 104-pin MCU Card. If you want to use some other microcontroller, all you have to do is to change MCU Cards. You can use 80-pin MCUs (PIC24FJ128GA008 for example) or 100-pin MCUs (dsPIC33FJ256GP710 for example). LV 24-33 MCU Card is shown on the following picture:



MCU Card **Figure 5.**

When you are placing MCU Card on the LV 24-33 MCU socket, you must follow these steps:

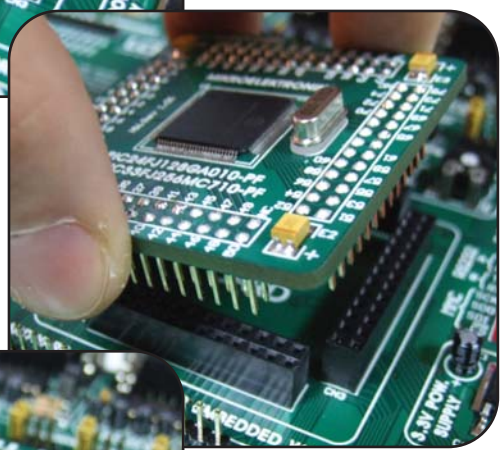


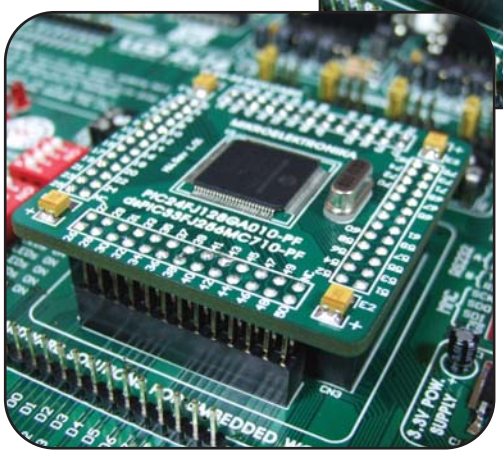
Step no.1

If there is already MCU Card placed on LV 24-33, you must remove it by slowly pulling it up.

Step no.2

Place MCU Card on the board. Note that label on the MCU Card must be at the upper-left corner as it is drawn on the LV 24-33 board.





Step no.3

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

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 peripherials such as the DS1820 temperature sensor, RS-232 communication, LCD, etc.

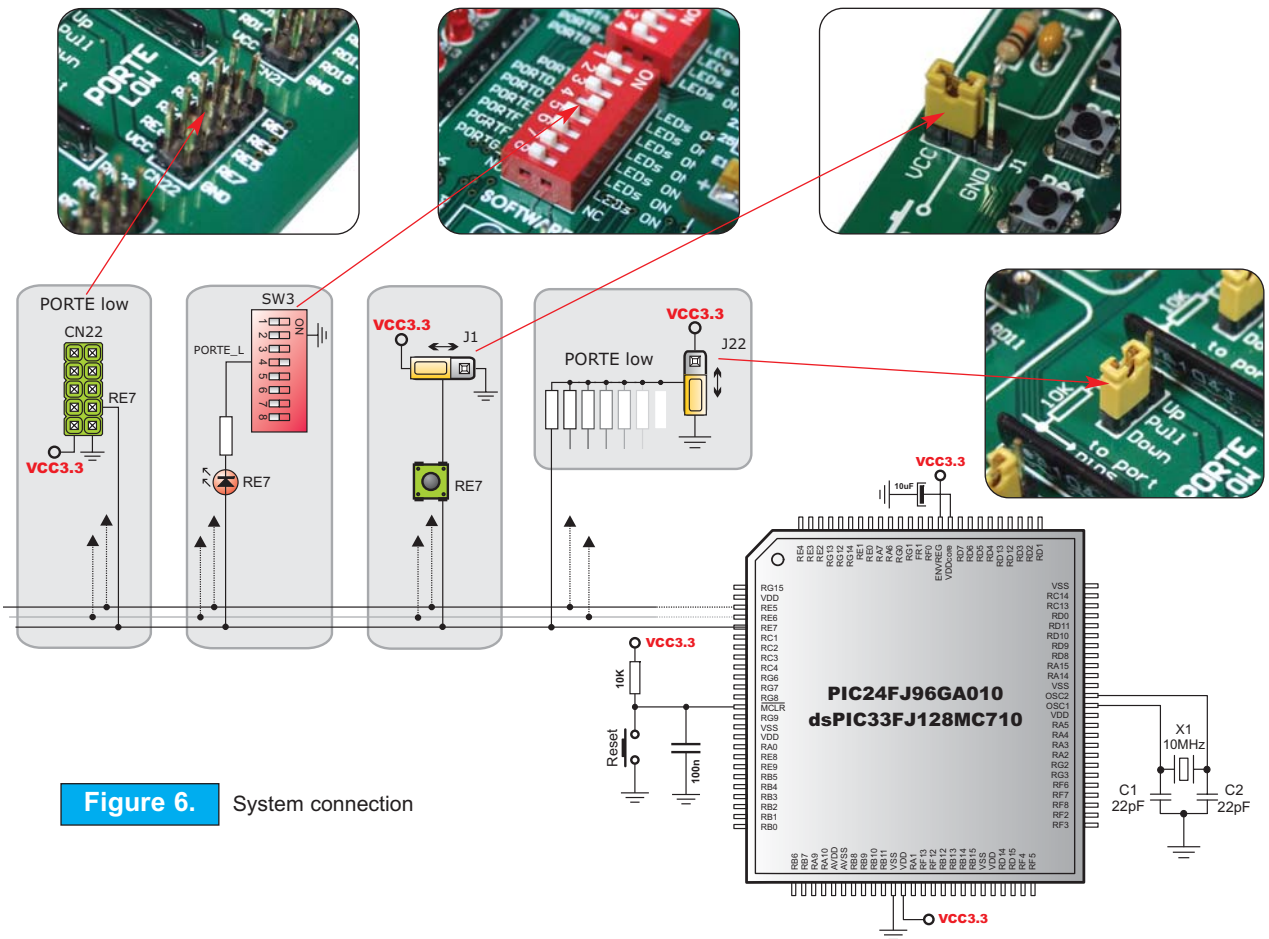


Figure 6. System connection

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 J4 should be set in the right-hand position.

In the case of an external power supply, the LV 24-33 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 J4 should be set in the left-hand position. In Fig. 7 you can see USB and external power supply connectors. There is also 3.3V voltage regulator (MC33269DT-3.3) for 3.3V power supply.

Figure 7. USB and power supply connectors

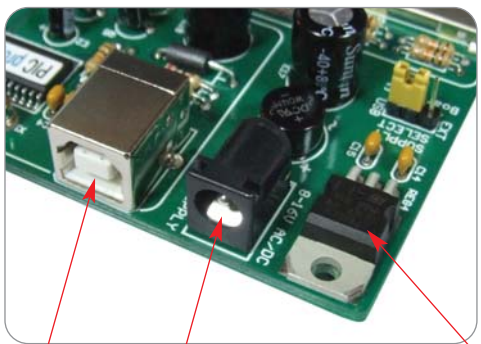
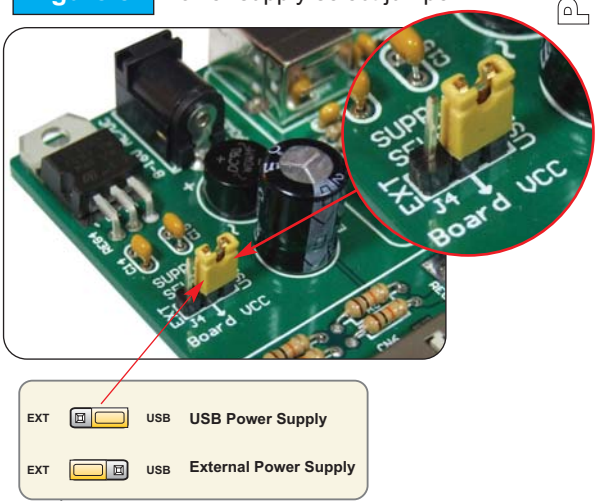


Figure 8. Power supply select jumper



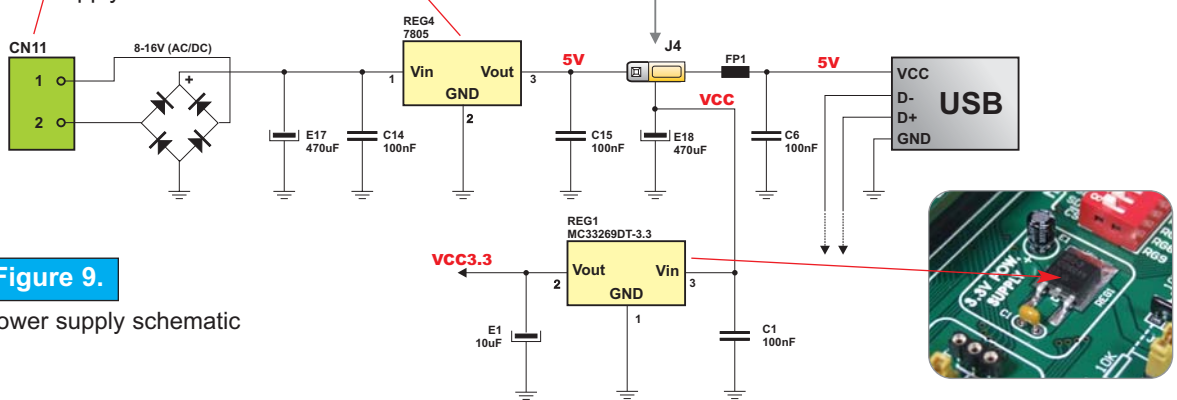


Figure 9. Power supply schematic

ON-BOARD USB 2.0 PROGRAMMER

There is no need for the use of external equipment during programming, as the LV 24-33 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 *LvPICFlash* programming software, which is supplied with the board.

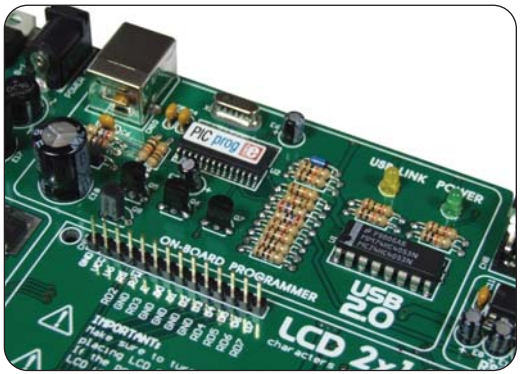


Figure 10. On-Board USB programmer

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

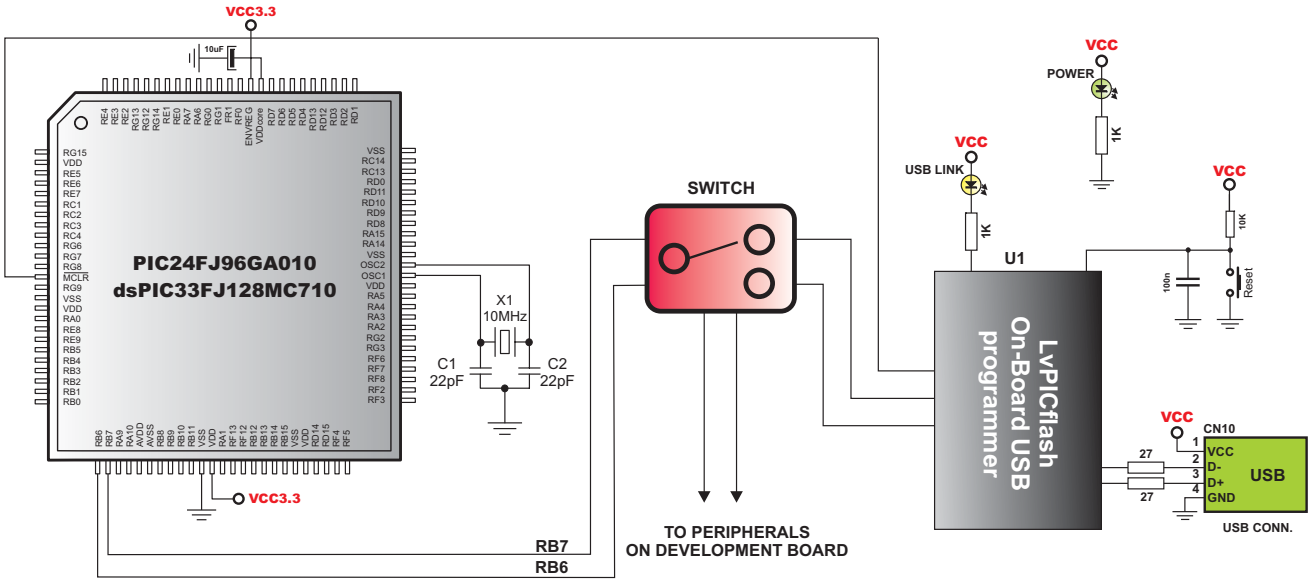
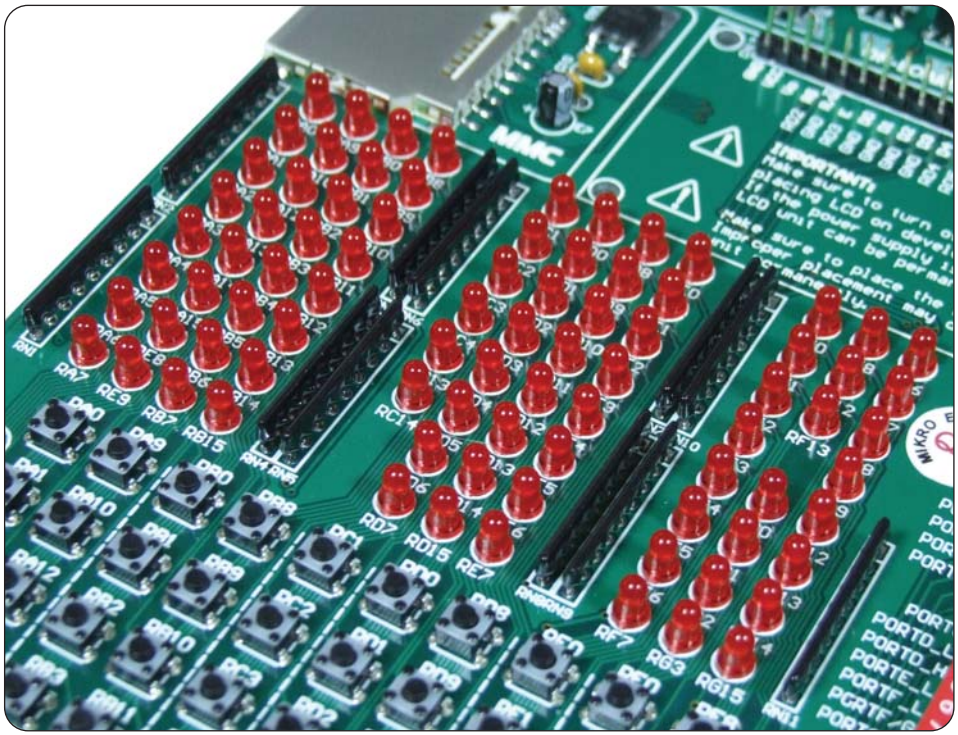


Figure 11. Switch schematic

LEDs

Light Emitting Diodes (LEDs) are the most commonly used components, usually for displaying pin's digital state. LV 24-33 has 85 LEDs that are connected to the microcontroller's PORTA, PORTB, PORTC, PORTD, PORTE, PORTF and PORTG.

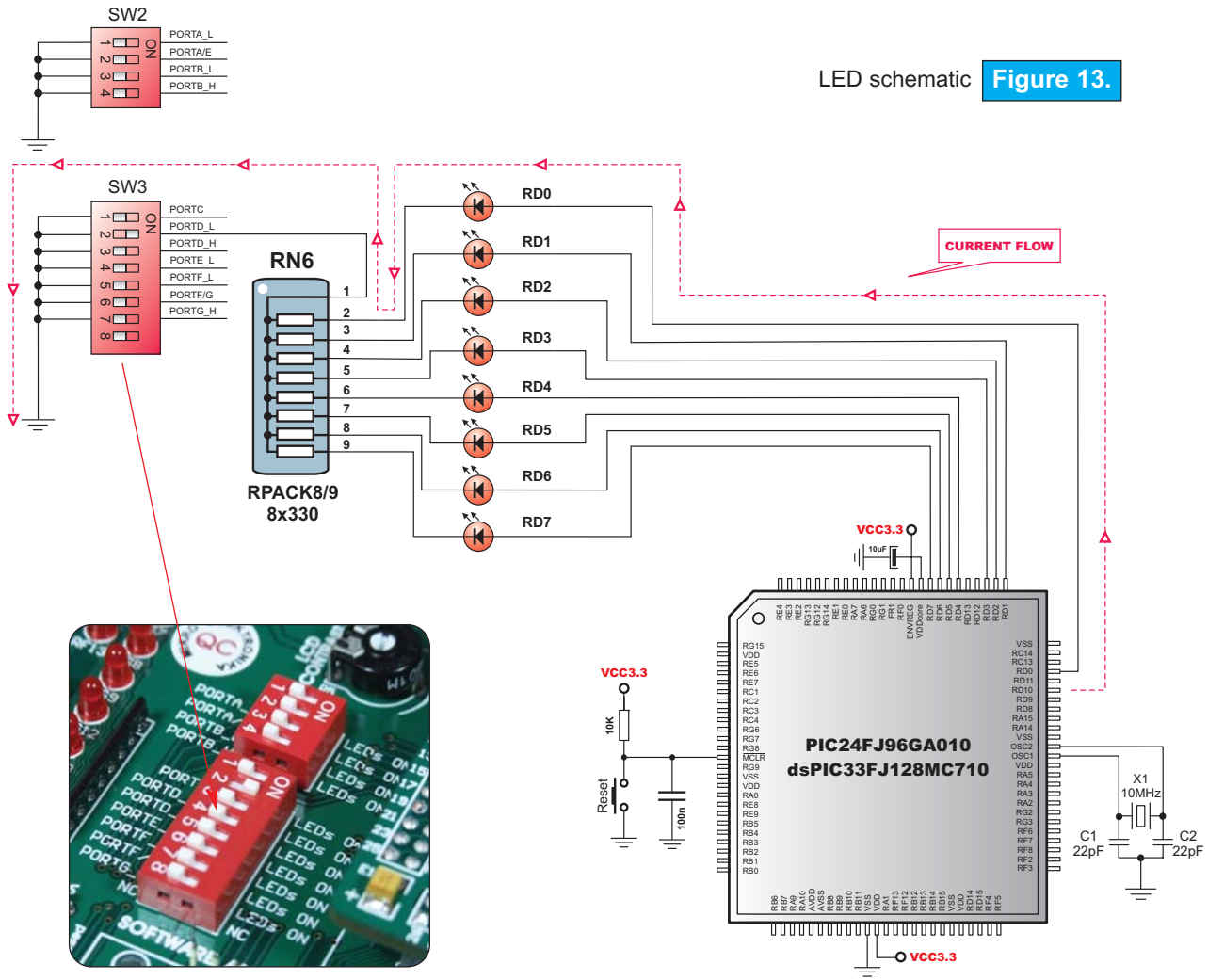
Figure 12. Light Emitting Diodes



Each group of LEDs can be enabled or disabled using the switches SW2 and SW3. Fig. 13. illustrates the connection of a LEDs to PORTD LOW 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 and SW3 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.

LED schematic **Figure 13.**



PUSHBUTTON SWITCHES

LV 24-33 has 85 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 14.

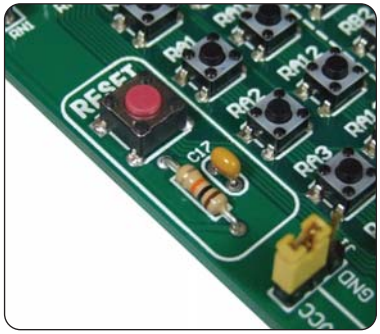
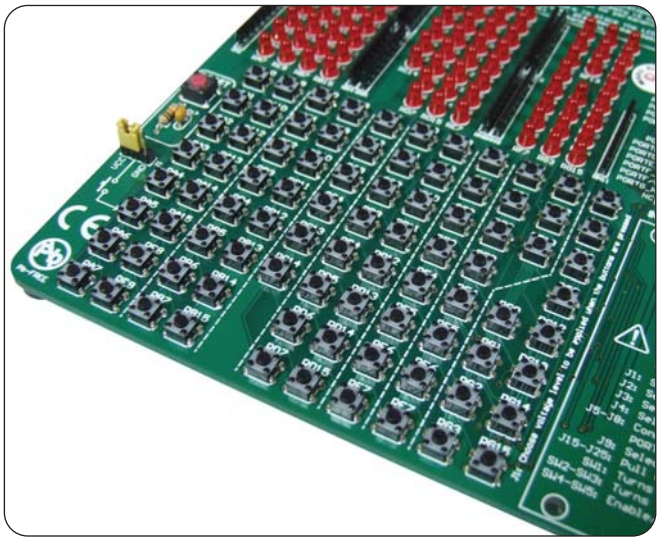


Figure 15. Reset switch



Pushbutton switches **Figure 16.**

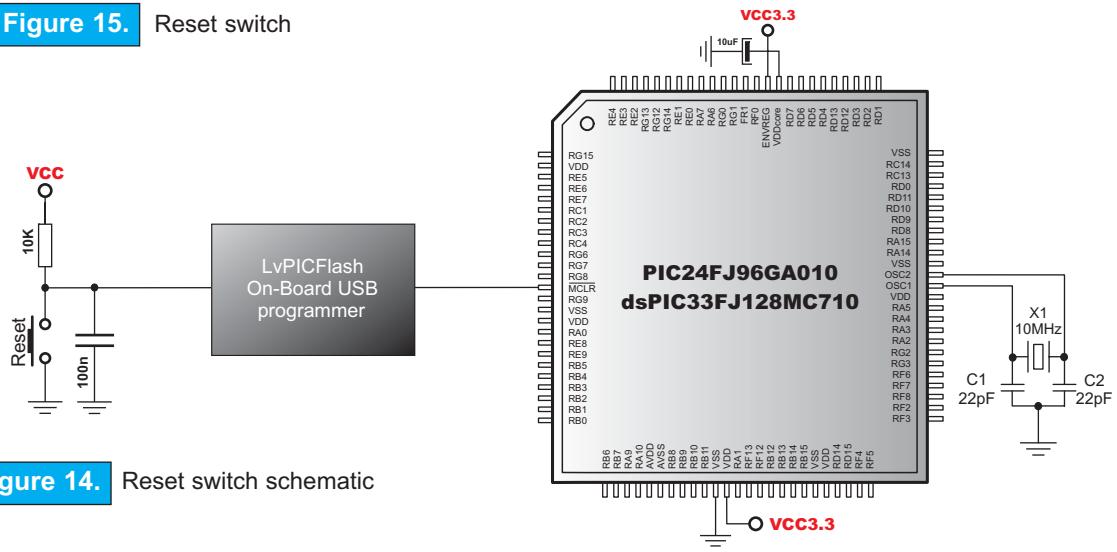
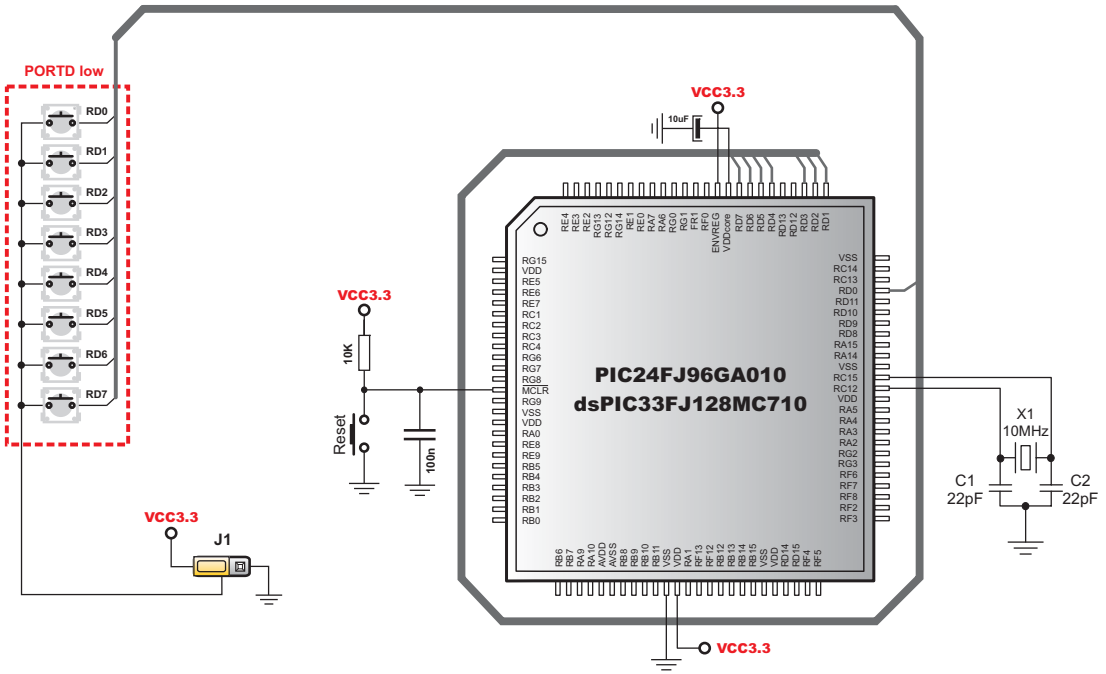


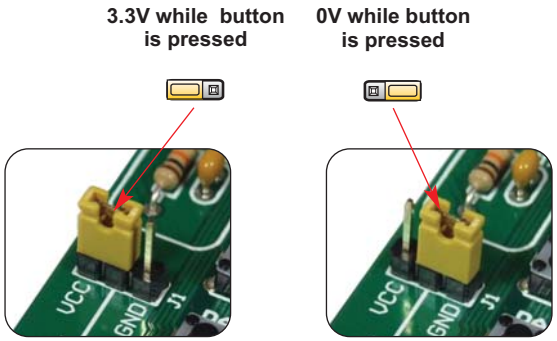
Figure 14. Reset switch schematic

Buttons connections to PORTD low is shown in Fig. 17. Jumper J1 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. 17, J1 is connected to +3.3V, therefore pressing the buttons will bring logical one to the appropriate pins.





Buttons schematic **Figure 17.**

On Fig. 18 the J21 jumper is set to pull-up, therefore when the button is not pressed, pull-up resistor pulls the microcontroller's RD8 pin to +3.3V.

A button press causes the port pin to be connected to ground (J1 is in the right hand position).

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

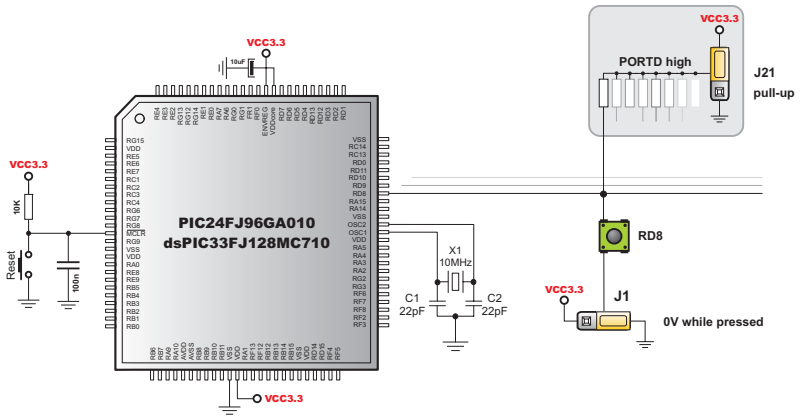


Figure 18. Button with pull-up resistor

On Fig. 19 the J21 jumper is set to pull-down, therefore when the button is not pressed, pull-down resistor pulls the microcontroller's RD8 pin to 0V.

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

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

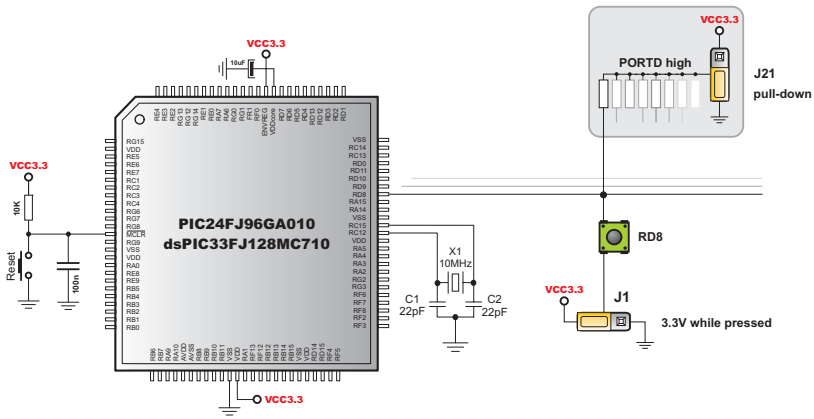


Figure 19. Button with pull-down resistor

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 position. The GLCD's contrast can be adjusted using the potentiometer P6, which is placed to the right of the GLCD.

Figure 20. GLCD

NOTE: Make sure to turn off the power supply before placing GLCD on development board! If the power supply is connected while placing, GLCD unit can be permanently damaged!

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

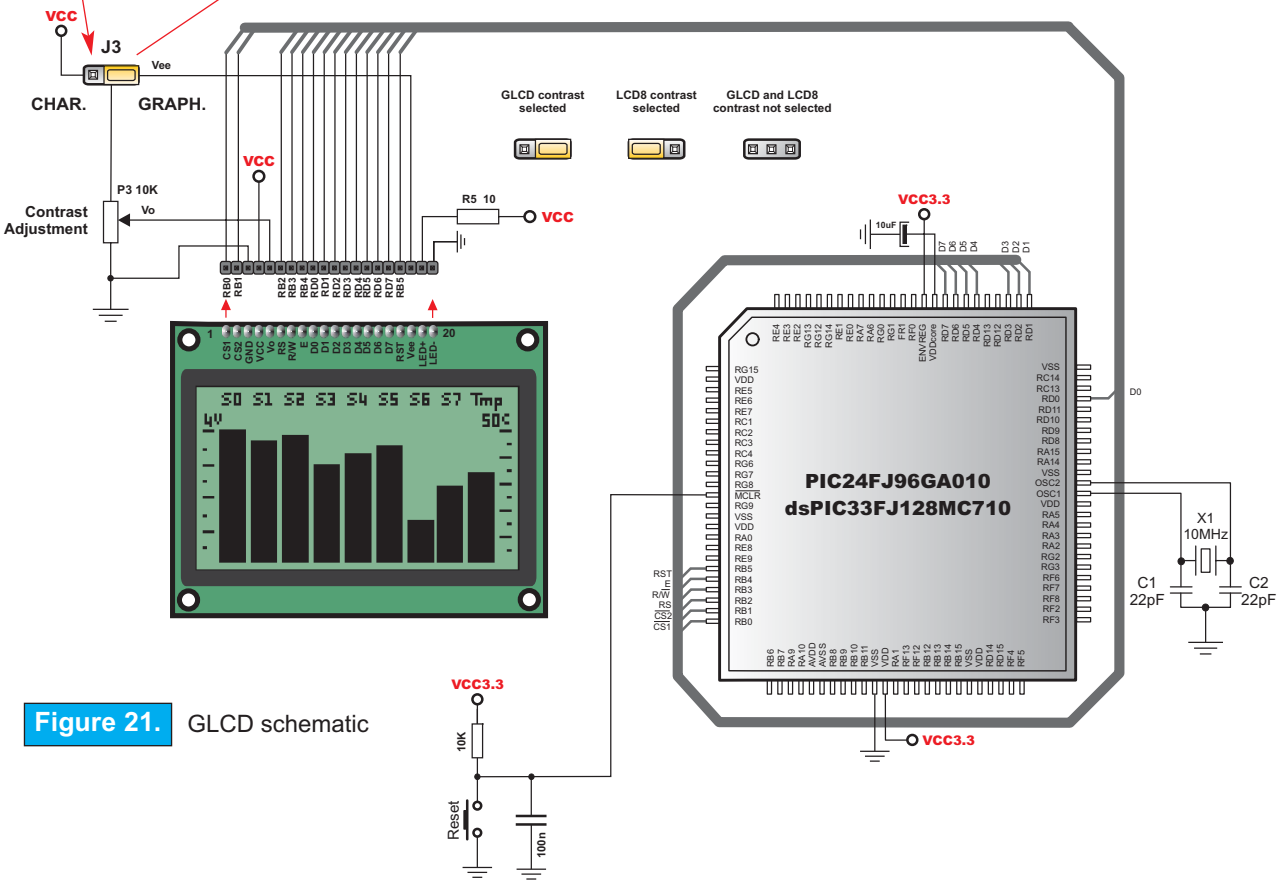


Figure 21. GLCD schematic

CONNECTOR 2x16 LCD ON-BOARD

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 LV 24-33. 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. 23 where there are only four data lines. It is important to note that the LCD should be placed or removed from LV 24-33 only when the power is off.

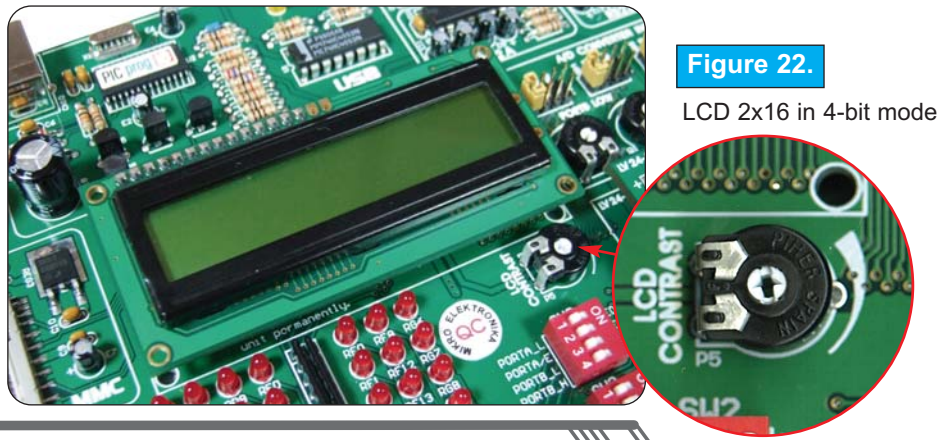


Figure 22.
LCD 2x16 in 4-bit mode

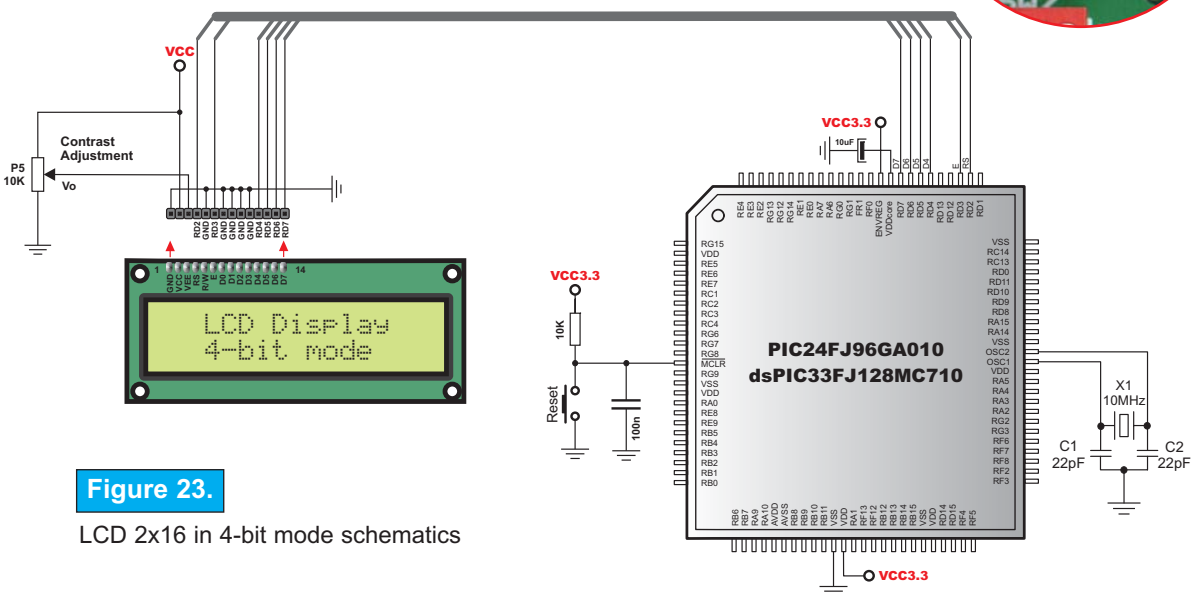


Figure 23.
LCD 2x16 in 4-bit mode schematics

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.

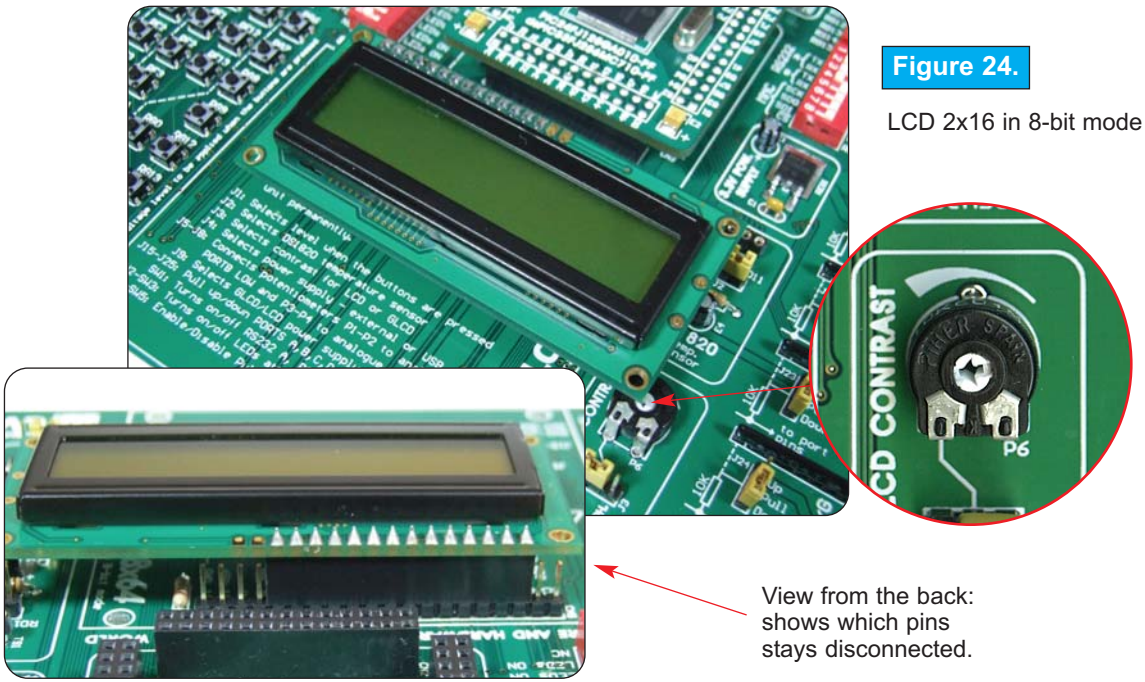


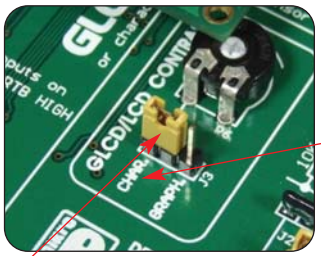
Figure 24.

LCD 2x16 in 8-bit mode

NOTE: Make sure to turn off the power supply before placing GLCD on development board! If the power supply is connected while placing, GLCD unit can be permanently damaged!

NOTE: Make sure to place the LCD properly! Improper placement may damage the LCD unit permanently!

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 LV 24-33 only when the power is off. Before attaching the LCD, set jumper J3 to the left hand position. The LCD's contrast can be adjusted using potentiometer P6 which is located to the right of the GLCD/LCD connector.



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

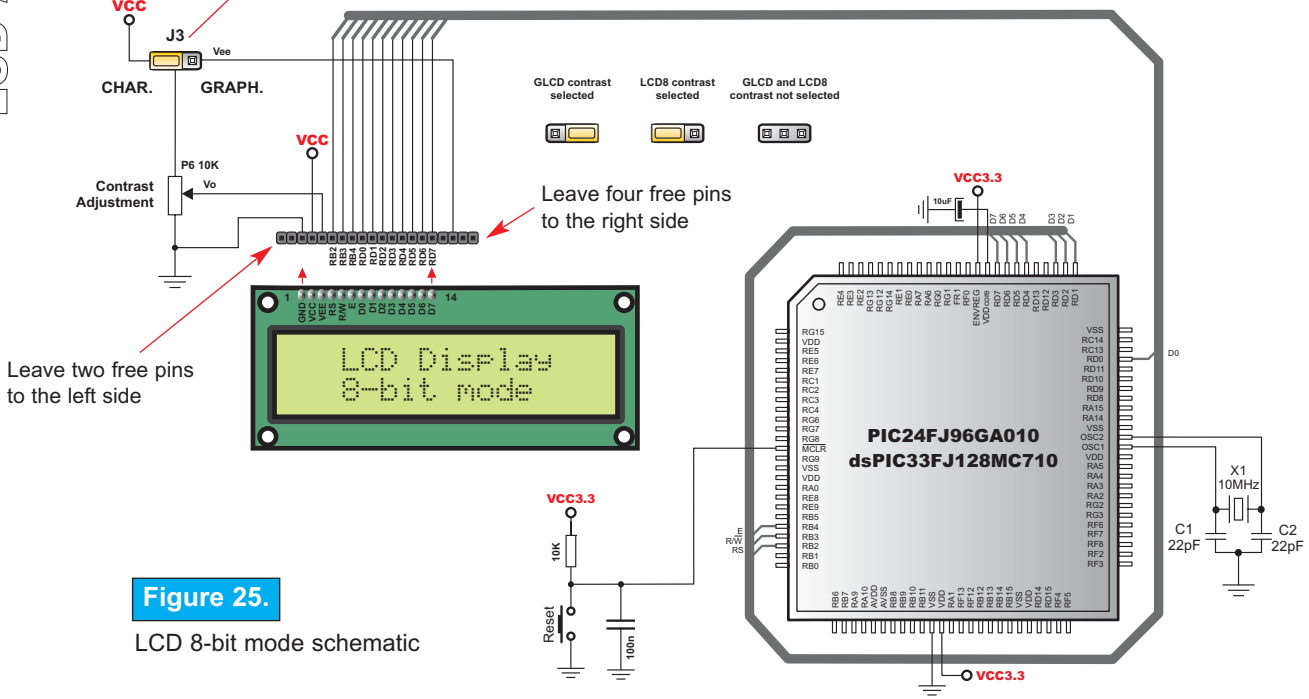


Figure 25.

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.

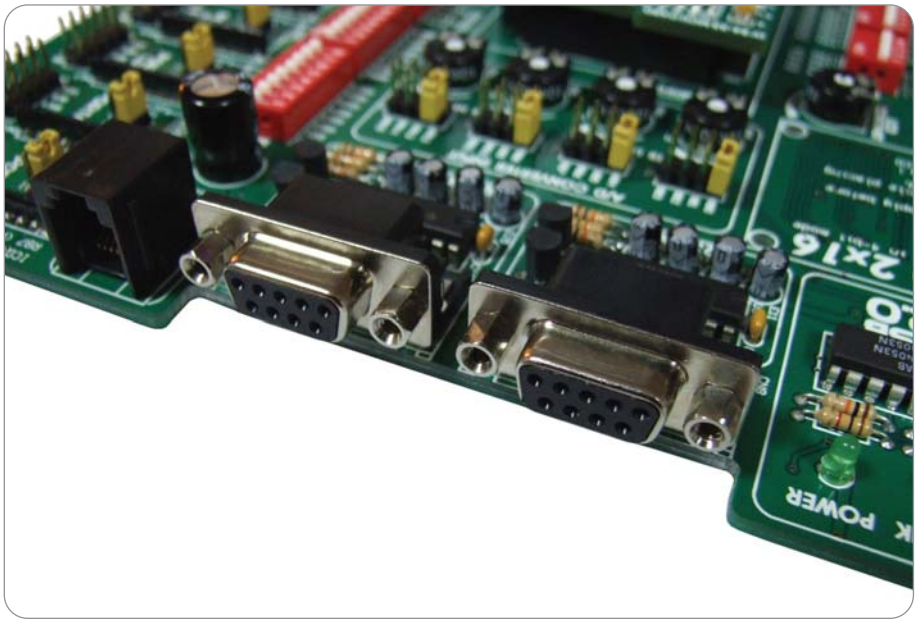


Figure 26. RS232 connectors

In order to provide a more flexible system, the microcontroller is connected to the MAX232 through the switches 1 and 2 on SW1 for the RS232 A port and the switches 3 and 4 on SW1 for the RS232 B port. Rx and Tx lines for the RS232 A port are connected to PF2 and PF3 pins, respectively. Rx and Tx lines for the RS232 B port are connected to PF4 and PF5 pins, respectively.

Figure 27.

Connection between microcontroller and a PC: RS232 A

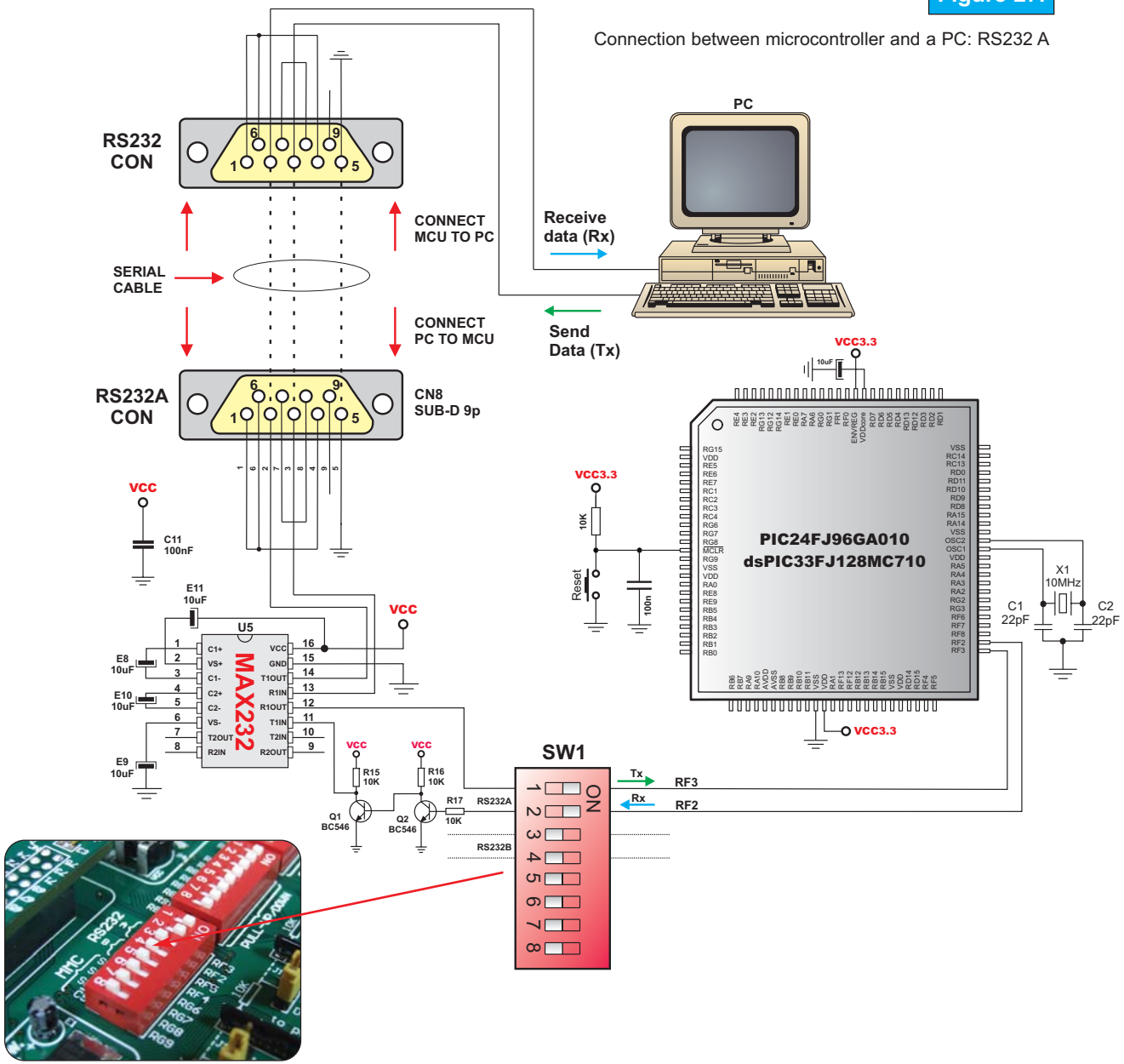
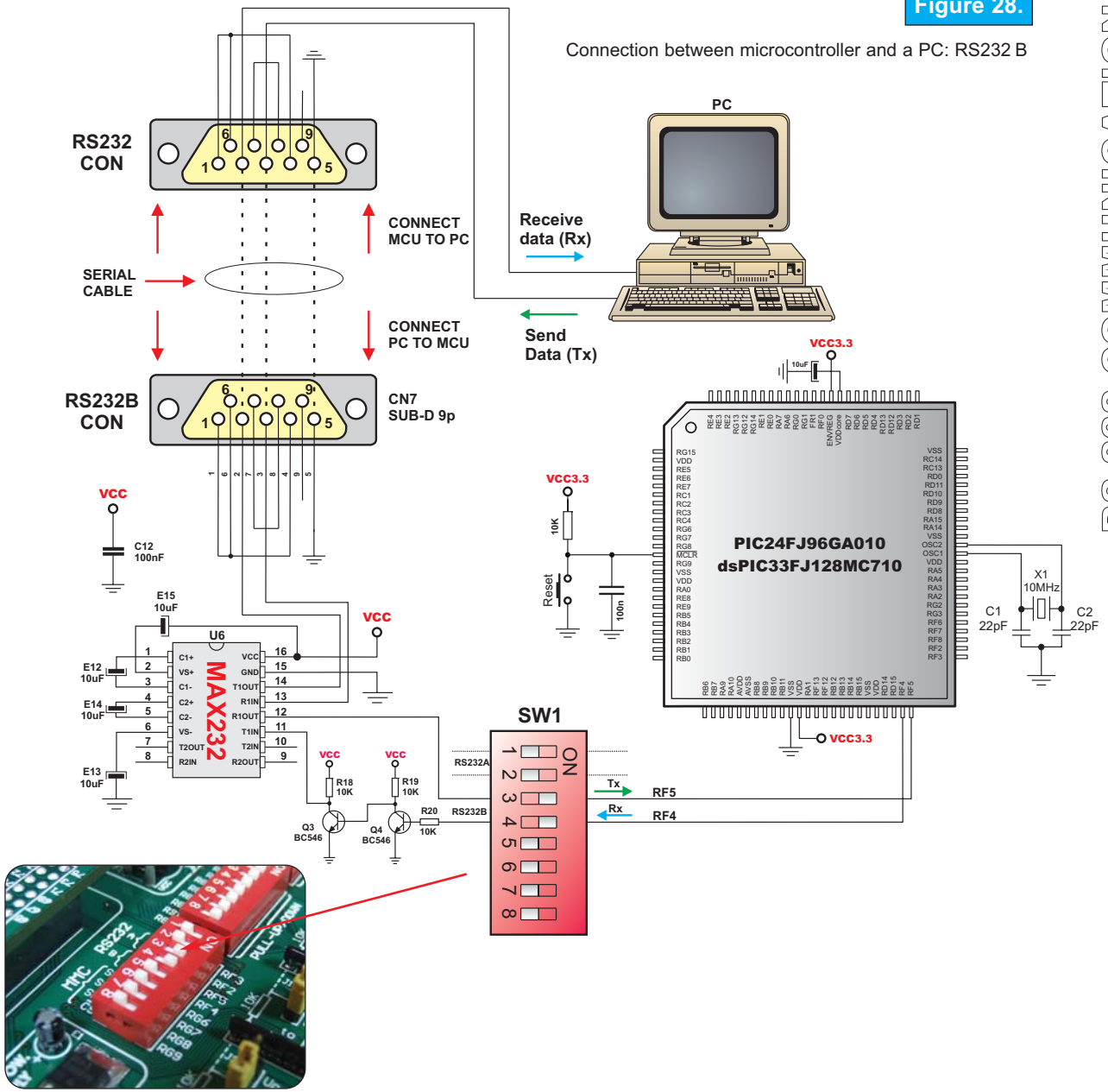


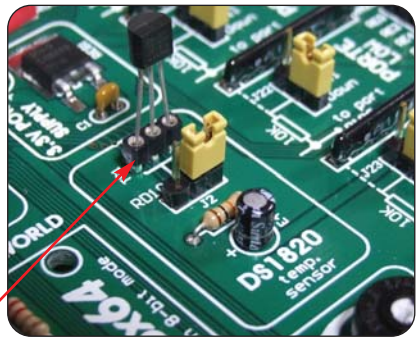
Figure 28.

Connection between microcontroller and a PC: RS232 B



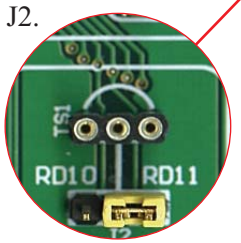
DS1820 DIGITAL THERMOMETER

DS1820 digital thermometer is well suited to environmental temperature measurement, having the temperature range of -55°C to 125°C and the accuracy of +/- 0.5°C. It must be placed correctly in the 3-pin socket provided on LV 24-33, with its rounded side to the upper edge of the board (see Fig. 29) otherwise the DS1820 could be permanently damaged. DS1820's data pin can be connected to either RD10 or RD11 pin, which is determined by jumper J2.



DS1820 **Figure 29.**

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



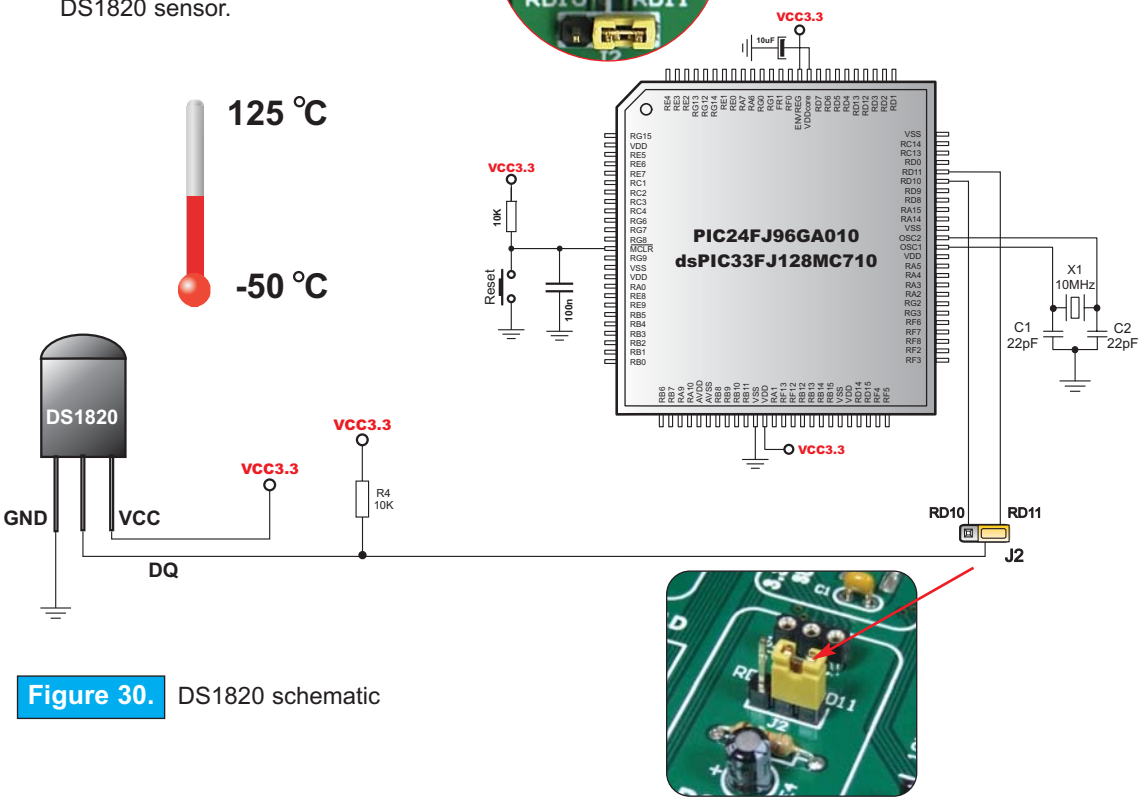
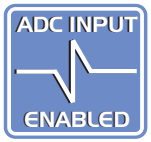


Figure 30. DS1820 schematic



A/D CONVERTER INPUT

LV 24-33 development board has four potentiometers for working with A/D Converter (Analog-to-Digital Converter). All potentiometers outputs are in the range of 0V to 3.3V. Each potentiometer can be connected on four different analog input pins. The jumpers group J5 enables connection between potentiometer P1 and RB0, RB1, RB2 or RB3 pin. The jumpers group J6 enables connection between potentiometer P2 and RB4, RB5, RB6 or RB7 pin. The jumpers group J7 enables connection between potentiometer P3 and RB8, RB9, RB10 or RB11 pin. The jumpers group J8 enables connection between potentiometer P4 and RB12, RB13, RB14 or RB15 pin.

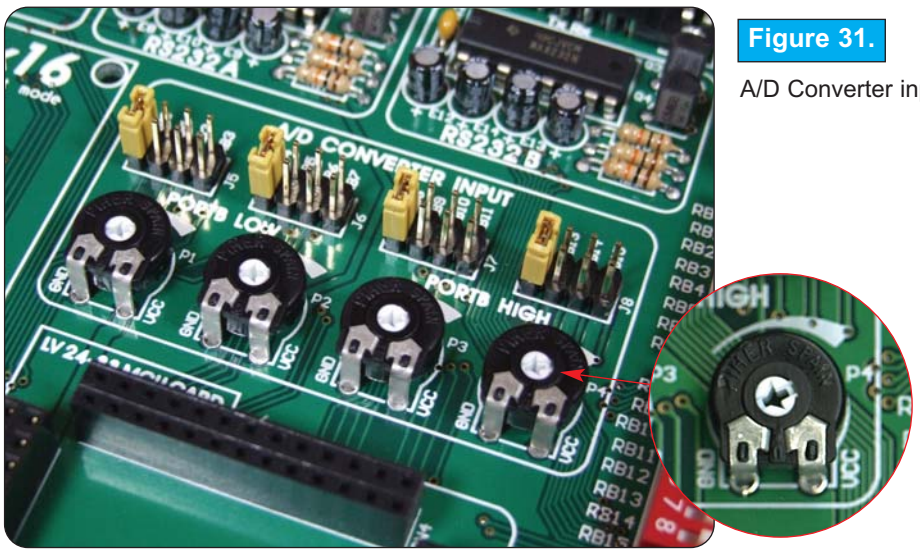


Figure 31.

A/D Converter input

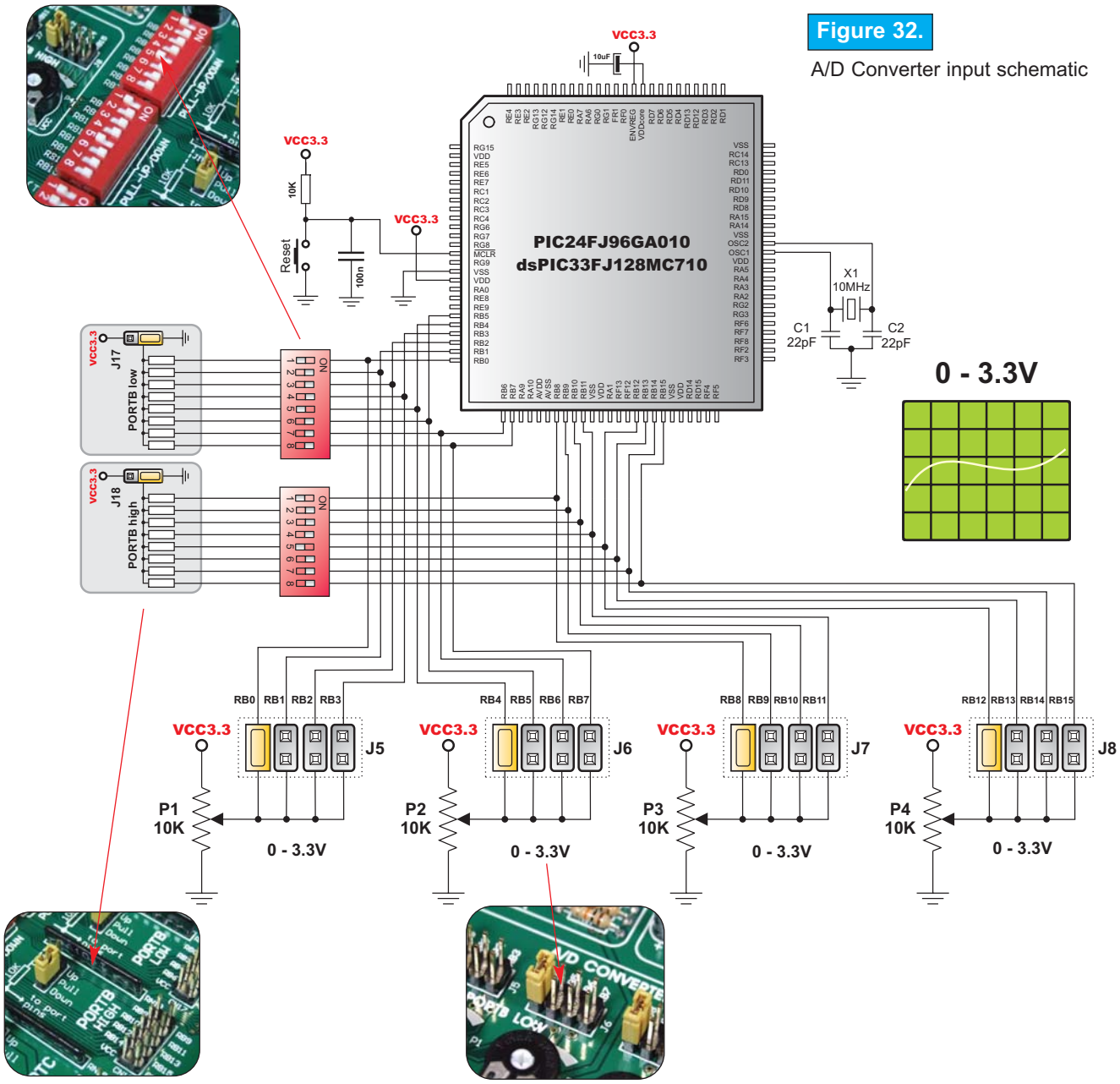
In order to measure analog signal without interference, turn the coresponding switch on SW4 and SW5 to OFF position. This will disable connection of the used PORTB pin to the pull-up/down resistors.

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 PIC24 or dsPIC33. That range is 0V to 3.3V.

ANALOG TO DIGITAL CONVERTER INPUT

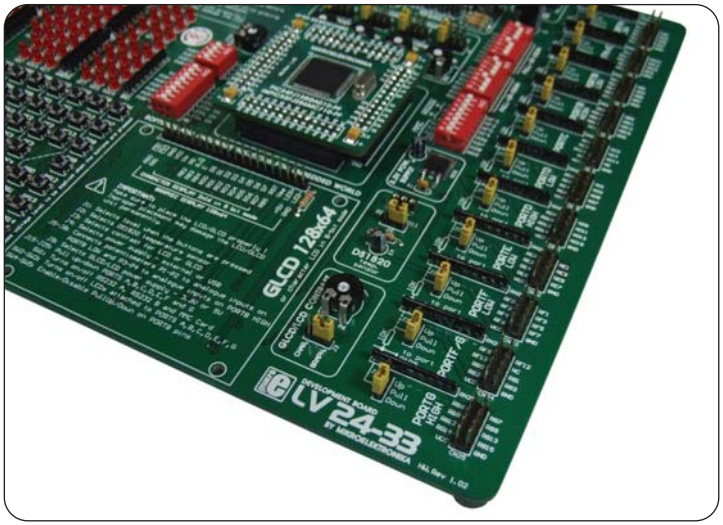
Figure 32.

A/D Converter input 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 PORTA, PORTB, PORTC, PORTD, PORTE, PORTF and PORTG there is one or two 10-pin connectors each providing VCC, GND and up to eight port pins.

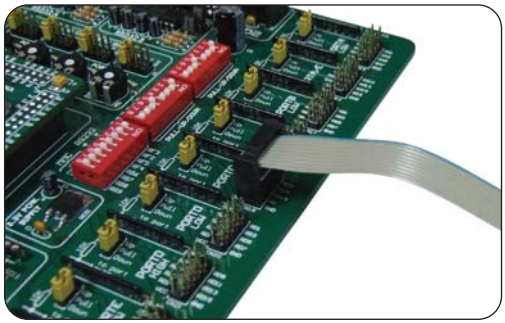


Direct port access connectors **Figure 33.**

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 and switches, while external peripherals are using the same pins. The connectors can also be used for attaching logic probes or other test equipment.

Figure 34.

Example of how to connect external peripheral with flat cable



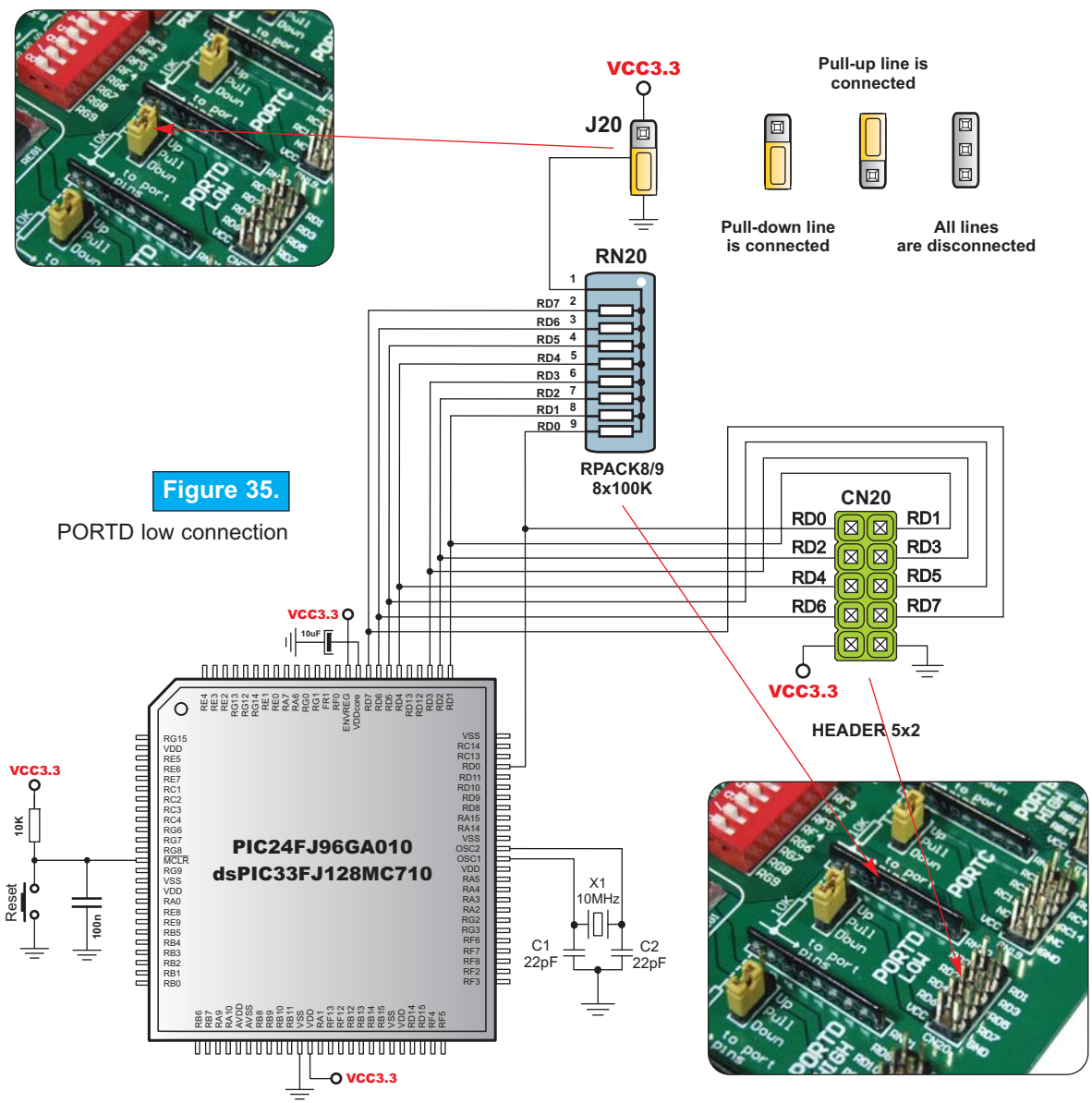


Figure 35.

PORTD low connection

ICD2 (IN-CIRCUIT DEBUGGER) CONNECTOR

The ICD2 is low-cost In-Circuit Debugger (ICD) and In-Circuit Serial Programmer (ICSP). ICD2 is intended to be used as an evaluation, debugging and programming aid in a laboratory enviroment.

The ICD2 offers these features:
- Real-time and single-step code execution
- Breakpoints, Register and Variable Watch/Modify
- In-Circuit Debugging
- Target VCC monitor

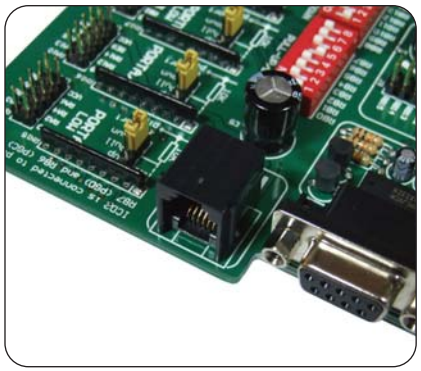


Figure 36.
ICD2 connector

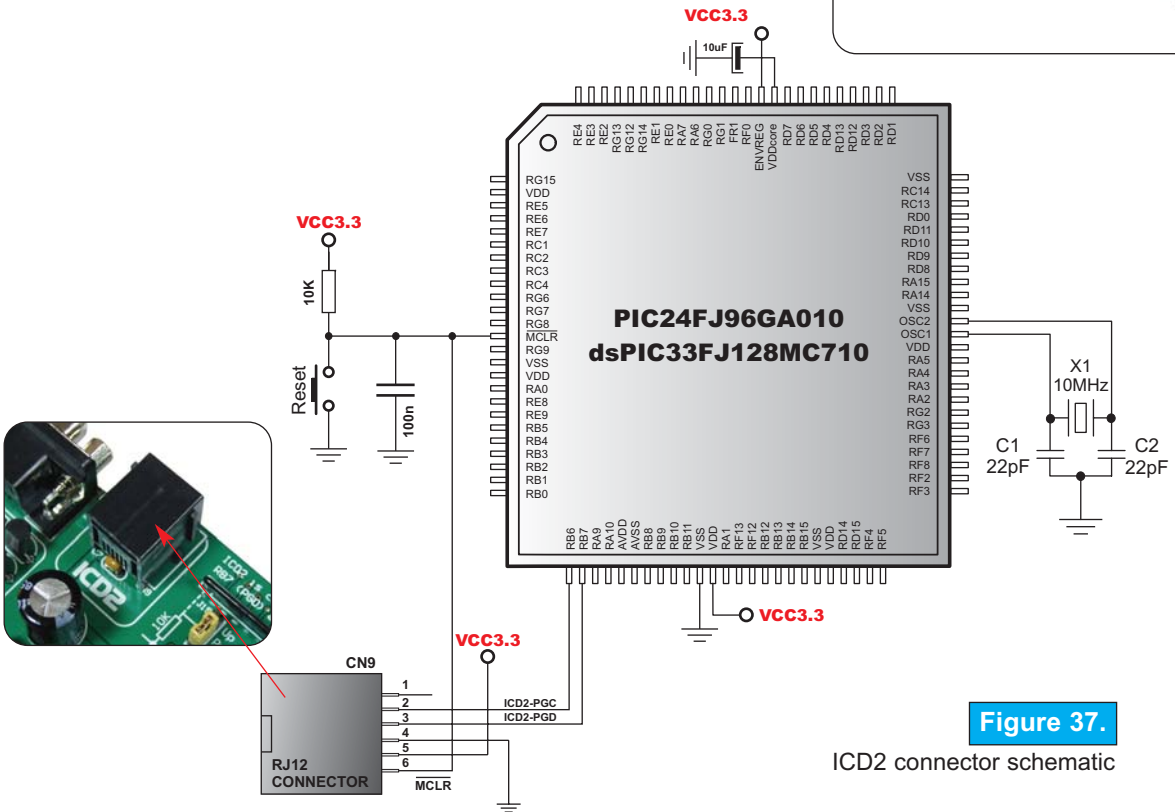


Figure 37.
ICD2 connector schematic

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 LV 24-33 communicates with Multi Media Card via SPI communication.

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

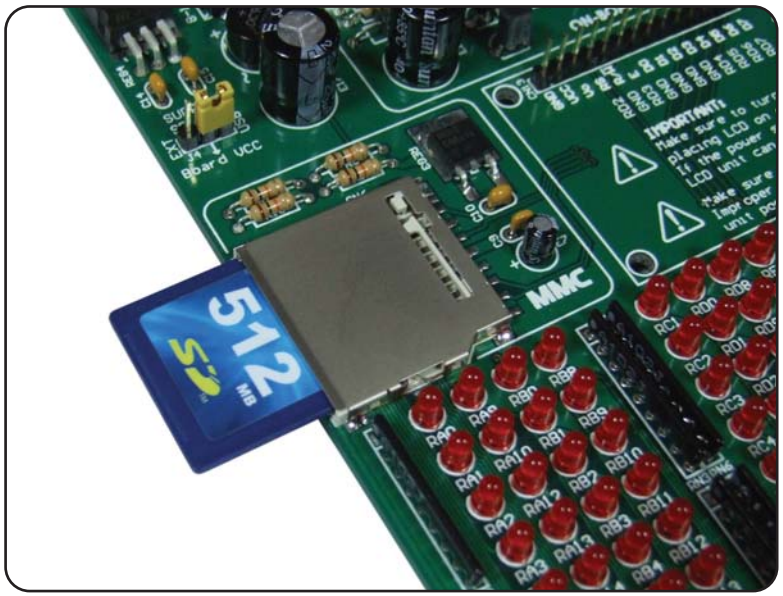
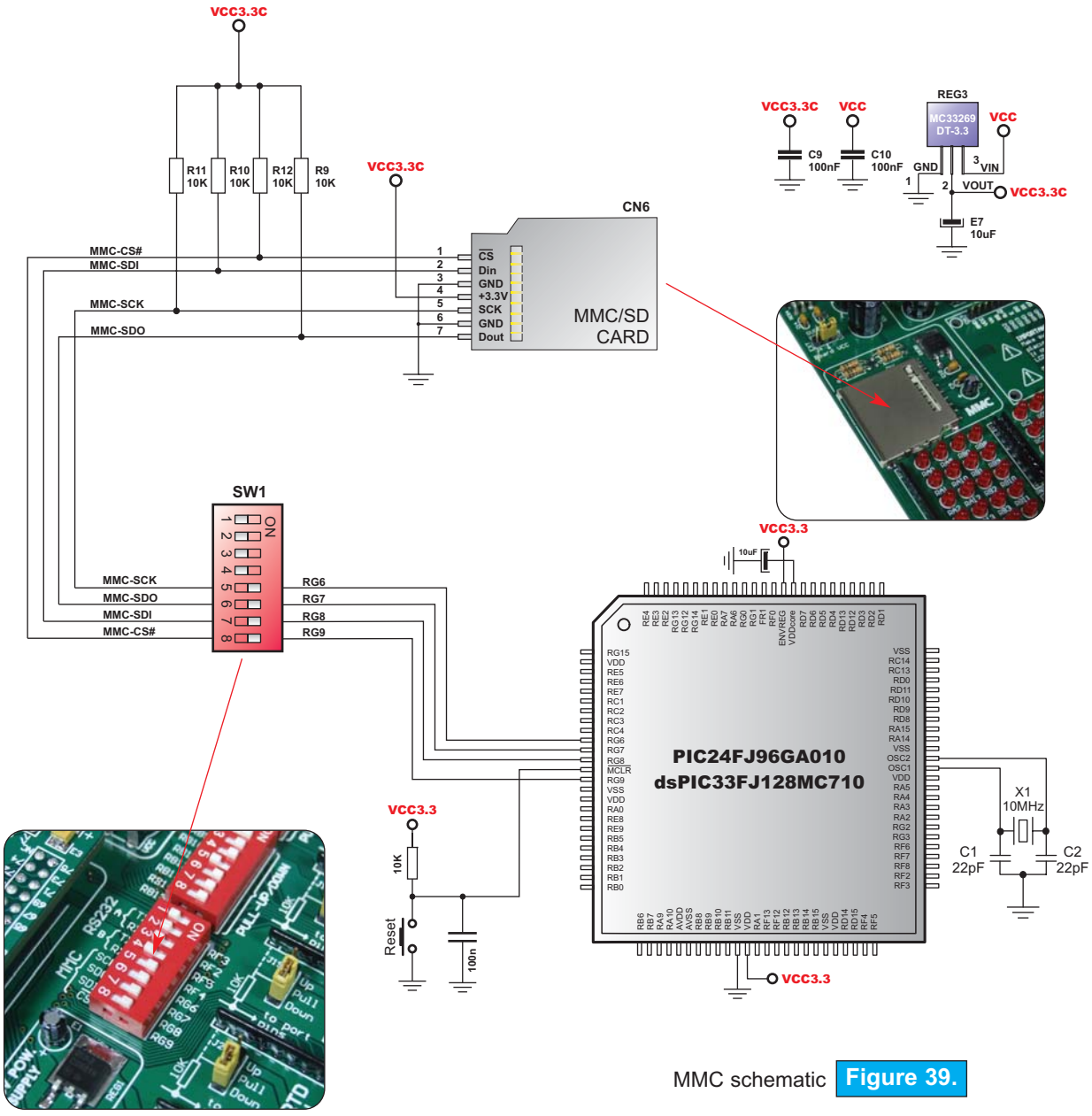


Figure 38.
MMC slot on-board

To enable MMC card you must turn on switches 5, 6, 7 and 8 on SW1. By doing that, microcontroller's SPI comunnication lines (SDI, SDO and SCK) and Chip Select are connected to MMC. Working voltage of MMC card is 3.3V DC. Because of that, there is a voltage regulator on-board with MMC card (MC33269DT-3.3).



MMC schematic **Figure 39.**

Second edition
January 2007

LV 24-33

Development tool for MICROCHIP PIC24 and DSPIC33 MCUs

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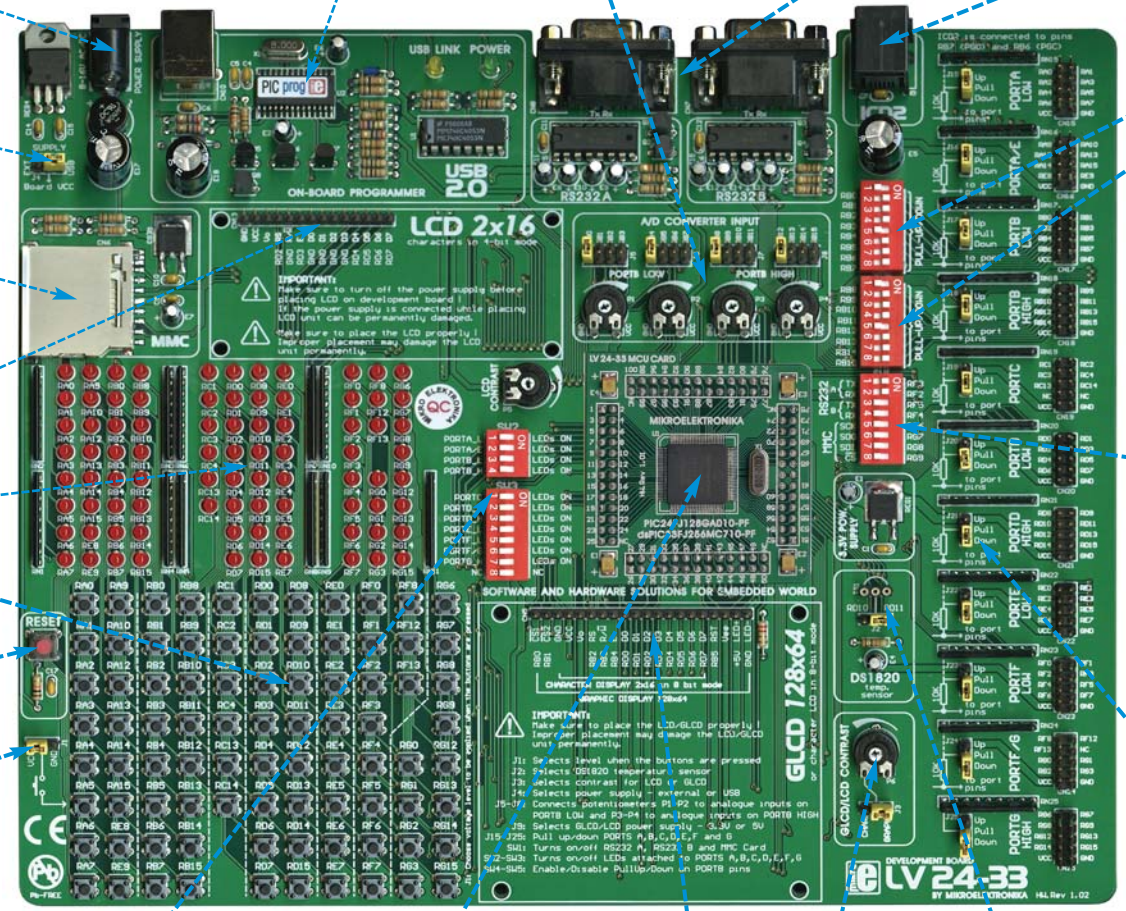

External power supply from 8 to 16 V AC/DC

Choose between external or USB power supply. With USB power supply selected, you don't need external supply

MMC/SD slot for multimedia cards

You can connect an LCD if you need it four your application in 4-bit mode

See all the signals - each pin has an LED

Buttons for simulating pins high state or low state

Reset circuit

Choose how pressing the button will affect the pin, high state or low state

Very fast and flexible USB 2.0 programmer

PORTB pins are connected to potentiometers P1, P2, P3 nad P4

RS232 communication ports

ICD2 (In-Circuit Debugger) connector

PORTB is connected to a resistor network, using switches SW5 and SW5. If a switch is in the OFF position, the appropriate pin has either pull-up or pull-down resistor attached.

EnablesMMC/SD Card and RS232 communication.

Setting jumper to the upper position sets the pins of the appropriate port to logical one (pull-up). If jumper is set to the lower postion, pins are set to logical zero (pull-down).

Switshes on SW2 and SW3 turns ON and OFF the LEDs on all PIC24 or dsPIC33 ports

LV 24-33 supports 80-pin and 100-pin PIC24 and dsPIC33 microconntroler

Graphic LCD connector

GLCD/LCD contrast

DS1820 temperature sensor.

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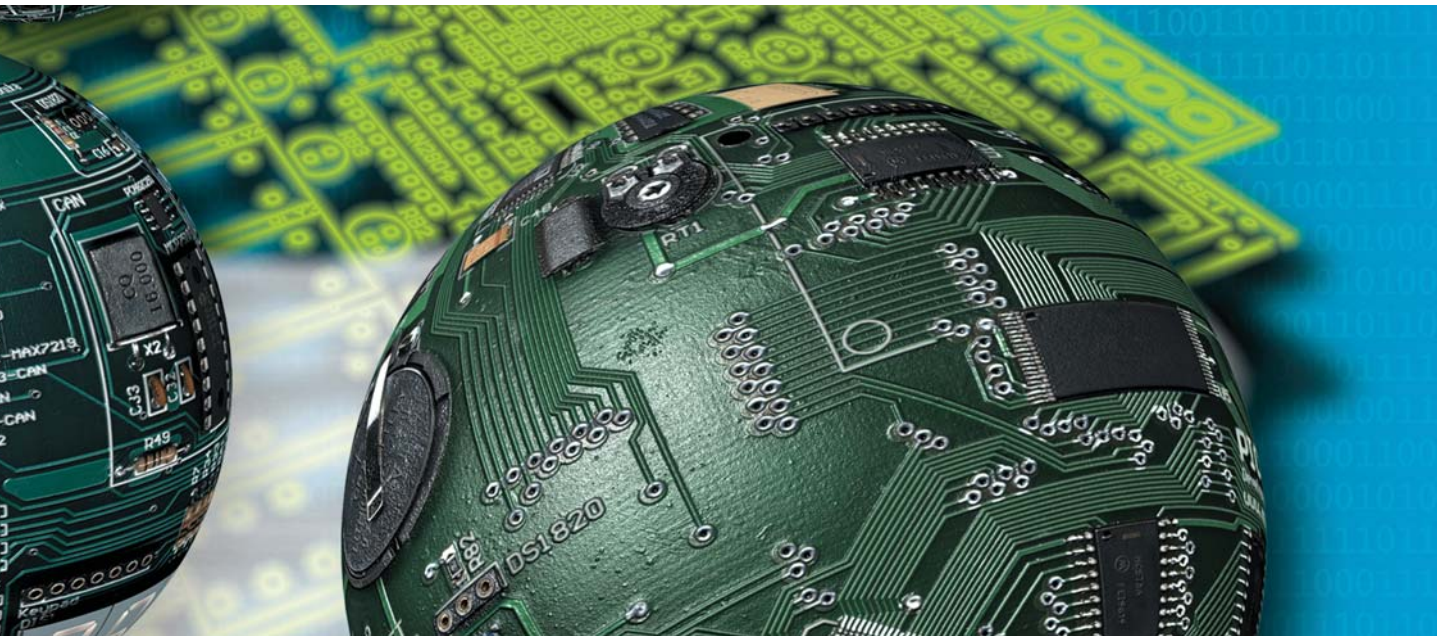

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