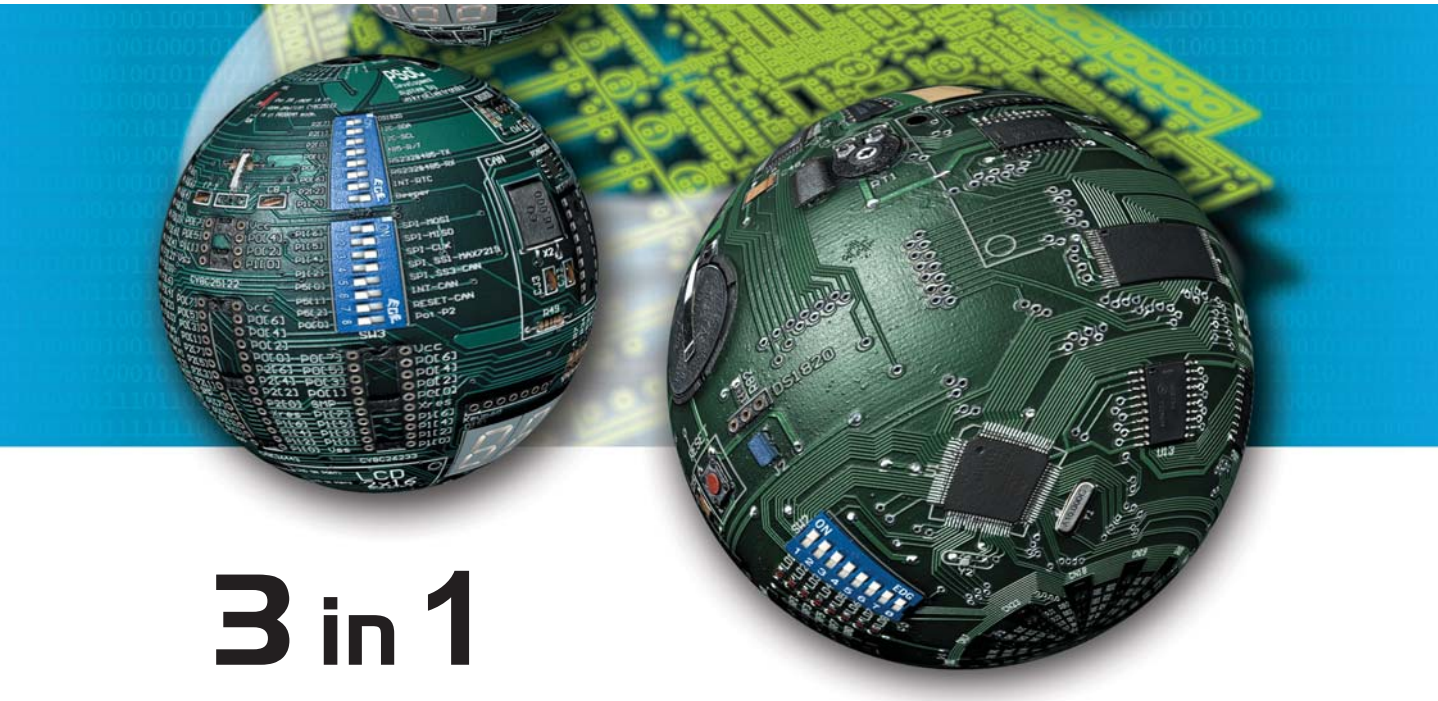
SOFTWARE AND HARDWARE SOLUTIONS FOR THE EMBEDDED WORLD

MikroElektronika
Development tools - Books - Compilers

BigPIC4
User's Manual



3 in 1

mikro ICD IN-CIRCUIT DEBUGGER

USB 2.0 IN-CIRCUIT PROGRAMMER

MICROCHIP PIC 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

Second edition
December 2006

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 PICFLASH 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 BIGPIC4 board. You will be asked for the PICFLASH drivers. Point to them in order to finish the driver installation. They are placed in the folder:
System_Drive:\Program Files\Mikroelektronika\PICFLASH\Driver.NT

Step no.4 Run and use PICFLASH as explained in the document '*PICflash programmer*'.
CD_Drive:\product\pdf\picprog_manual.pdf.

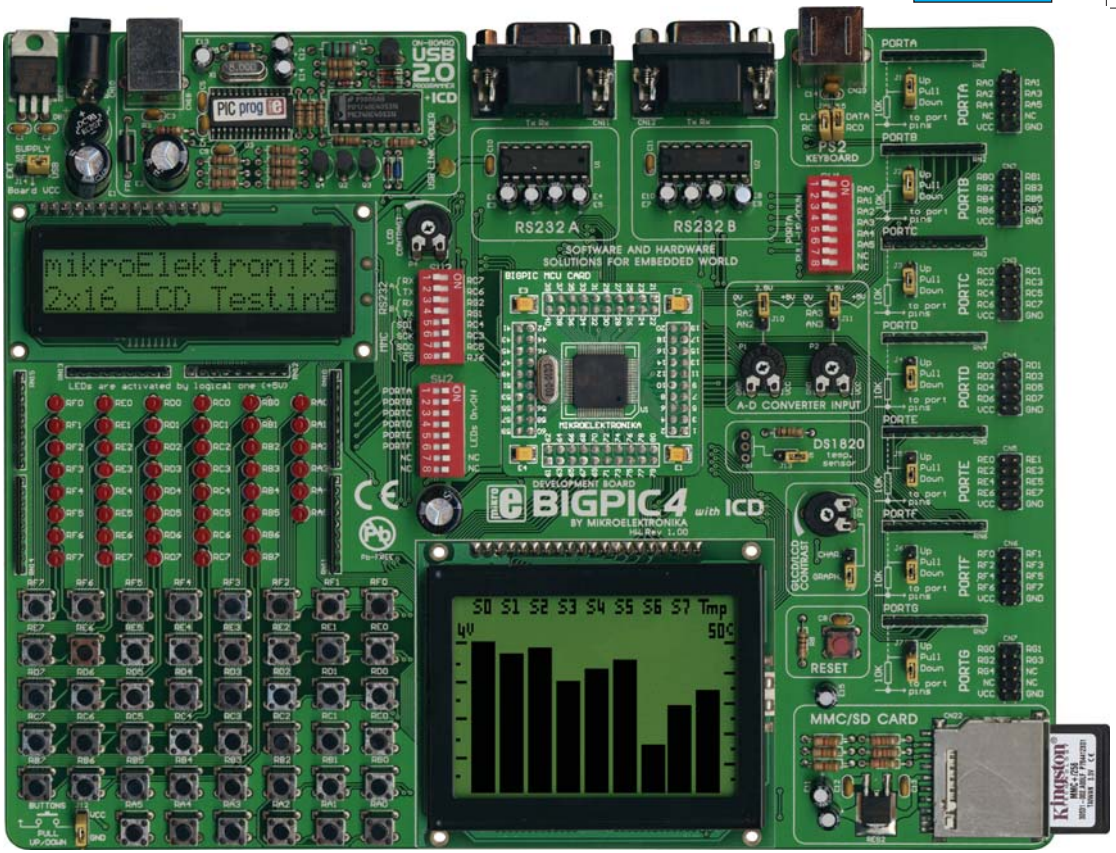
After these 4 steps, your BIGPIC4 is installed and ready for use. You can try to read a program from the chip or to load an example from the examples folder of mikroElektronika's compilers for PIC or from the product CD:
CD_Drive:\product\zip\bigpic4_examples.zip.

INTRODUCTION

The BIGPIC4 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 the user to concentrate on software development.

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

BIGPIC4 development board **Figure 1.**



SWITCHES

The BIGPIC4 development board features many peripherial devices. In order to enable these devices before programming, you need to check if appropriate jumpers or switches have been properly set.

Switches are devices that have two positions - ON and OFF, which have a role to establish or break a connection between two contacts. The BIGPIC4 development system has three groups of switches.

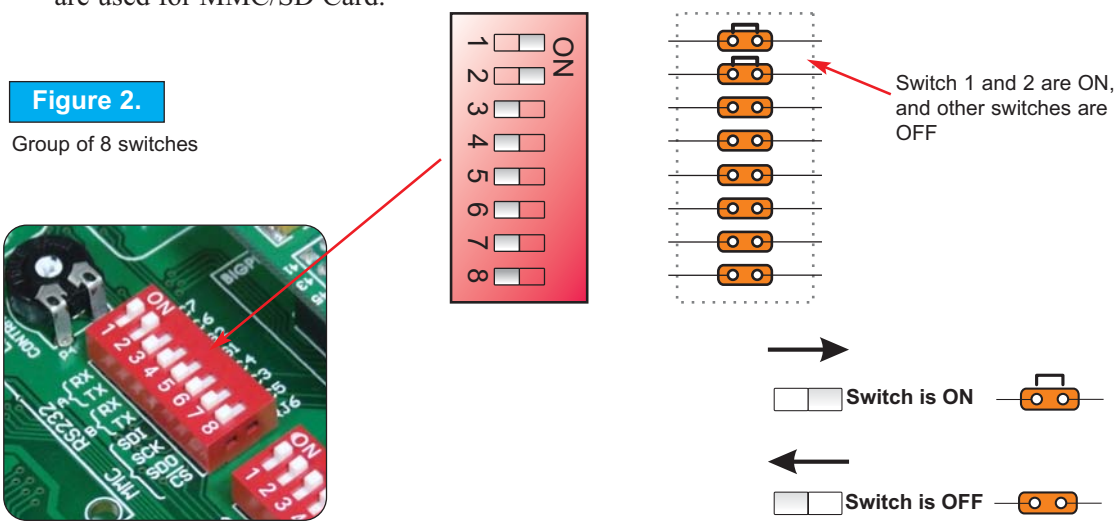
The first group, **SW1,** enables a connection between the microcontroller PORTA with external pull-up/down resistors. When PORTA pins are used as digital inputs/outputs, the appropriate pull-up/down resistors should be enabled.

The switches of **SW2** are used to enable LEDs connected to PORTA, PORTB, PORTC, PORTD, PORTE and PORTF. For example, if switch PORTB is OFF, all PORTB LED's will be turned off.

The switches of **SW3** enable connections among the microcontroller pins and MMC/SD Card via SPI communication and also among 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 and the last four are used for MMC/SD Card.

Figure 2.

Group of 8 switches



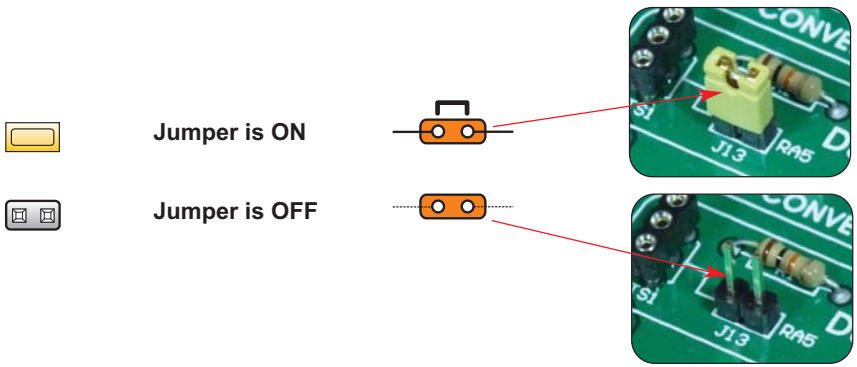
JUMPERS

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 jumper J10 is used to connect or disconnect potentiometer for analog input. A connection is made when the jumper is placed between two contacts.

Figure 3.

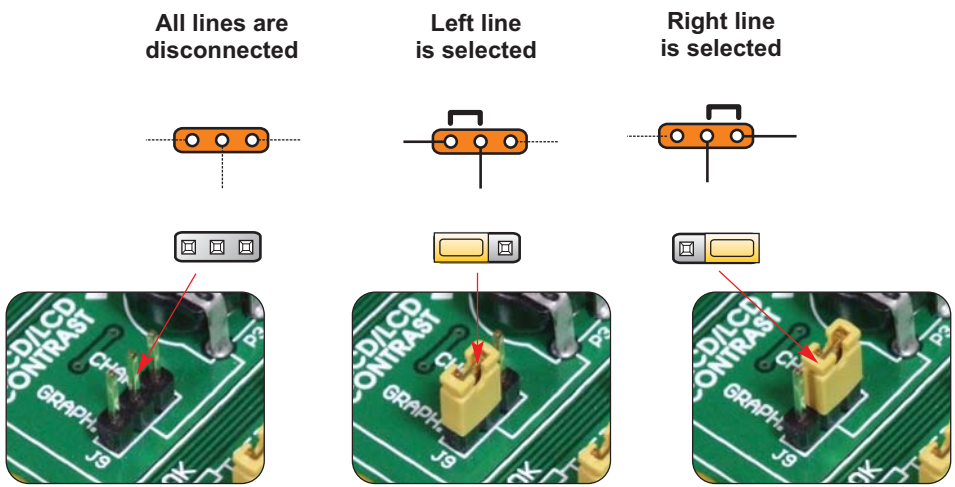
Jumper as a switch



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 BIGPIC4 development board has a 80-pin MCU Card. If you want to use some other microcontroller, all you have to do is to change MCU Cards. BIGPIC4 MCU Card is shown on the following picture:

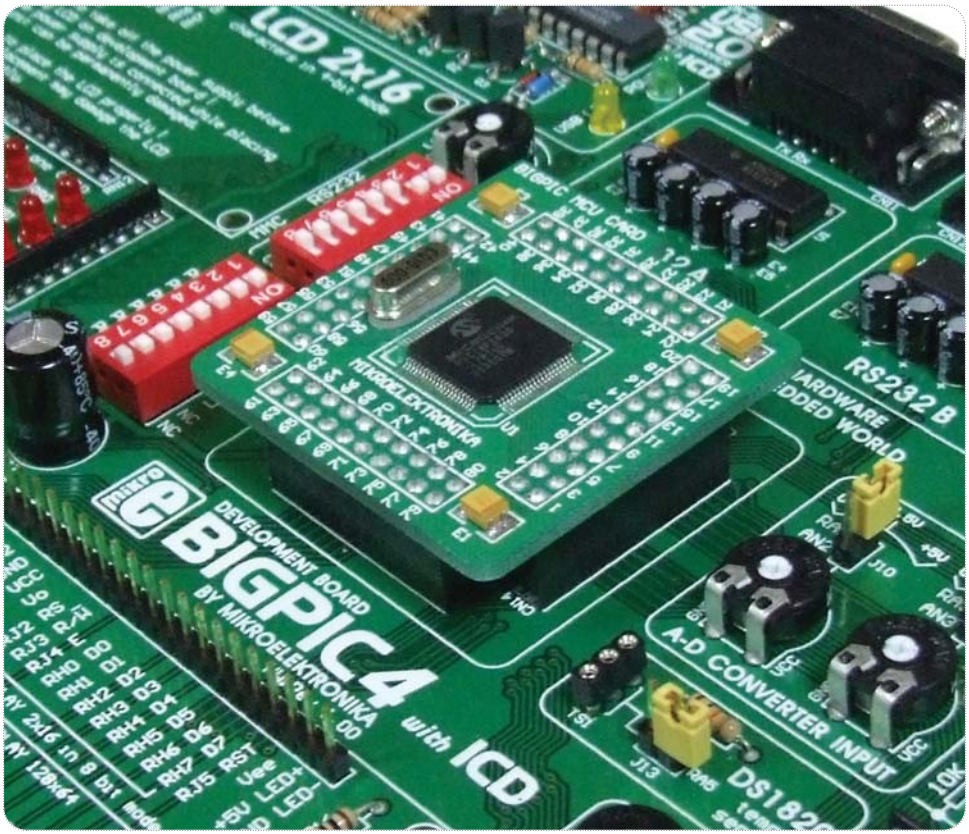
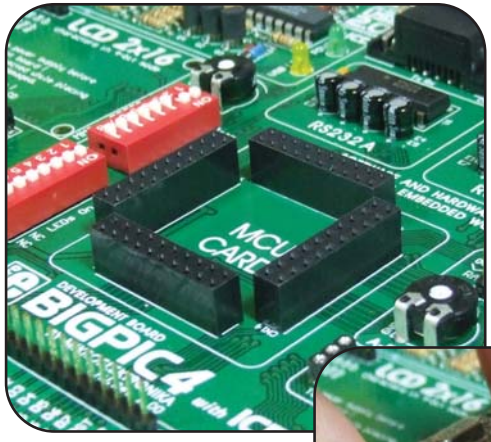


Figure 5. MCU Card

When you are placing MCU Card on the BIGPIC4 MCU socket, you must follow these steps:

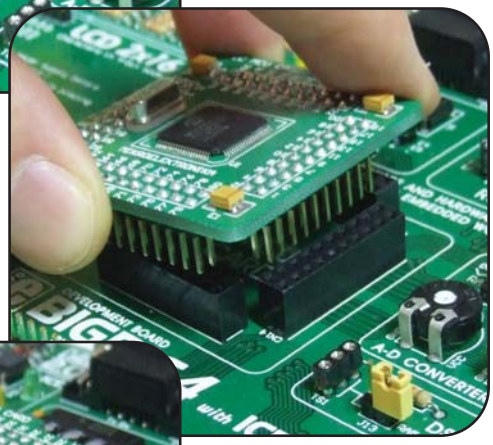


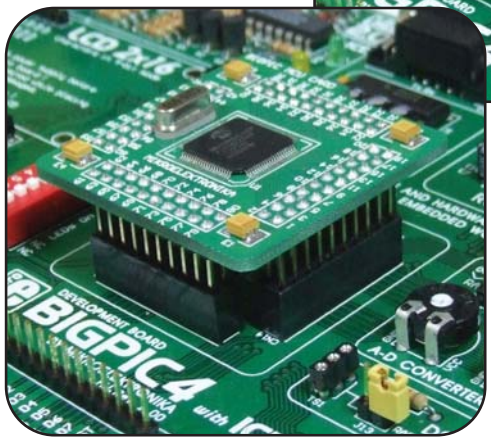
Step no.1

If there is already MCU Card placed on BIGPIC4, 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 BIGPIC4 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.

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

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

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

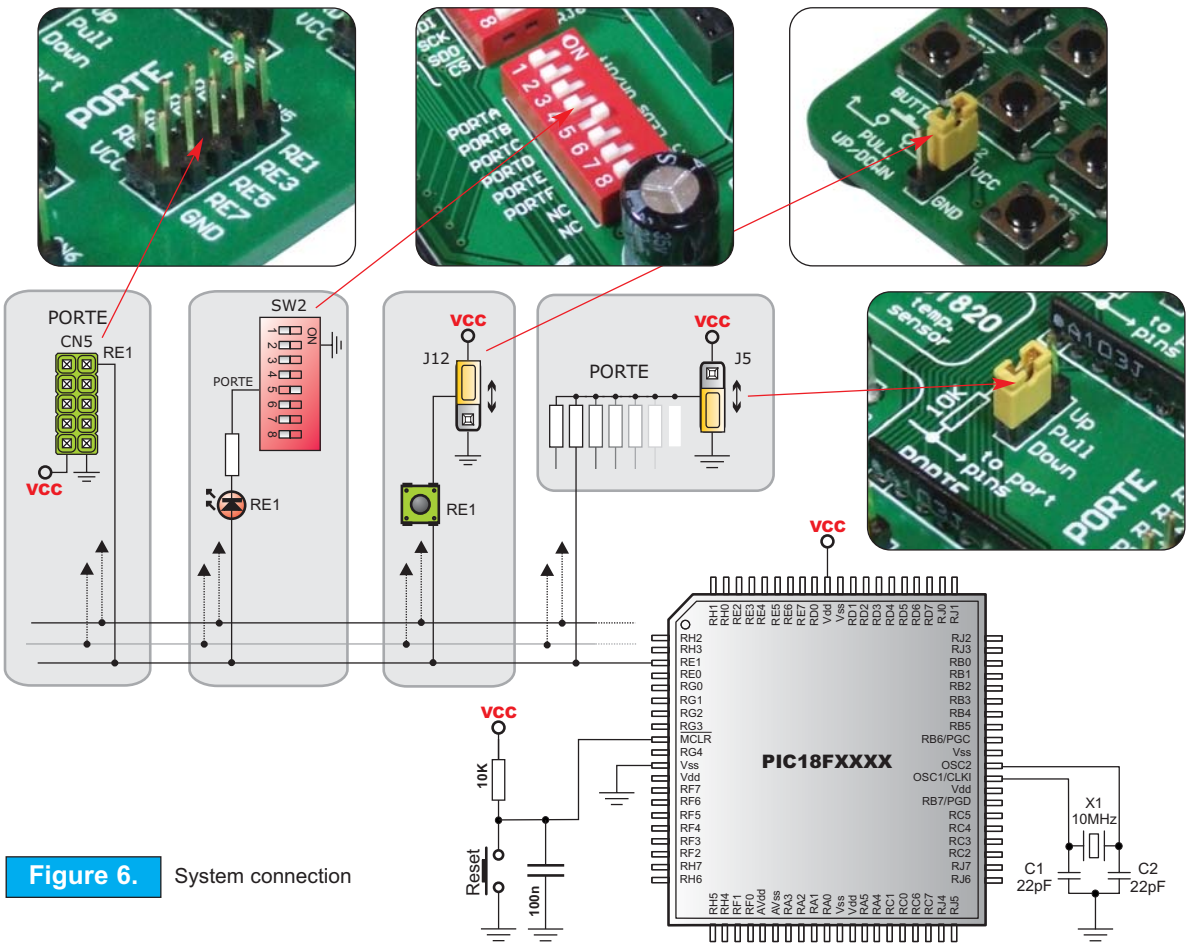


Figure 6. System connection

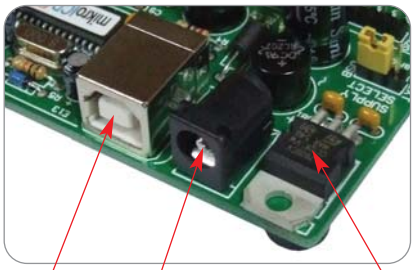
POWER SUPPLY

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

In case of the USB power supply, the system should be connected to a PC using the USB programming cable and jumper J14 should be set in the right-hand position.

In case of an external power supply, the BIGPIC4 board produces +5V using an LM7805 voltage regulator. The external power supply can be AC or DC, with a voltage between 8V and 16 V and the jumper J14 should be set in the left-hand position. In Fig. 7 you can see the power connectors : USB (left) and external (right).

Figure 7. USB and power supply connectors



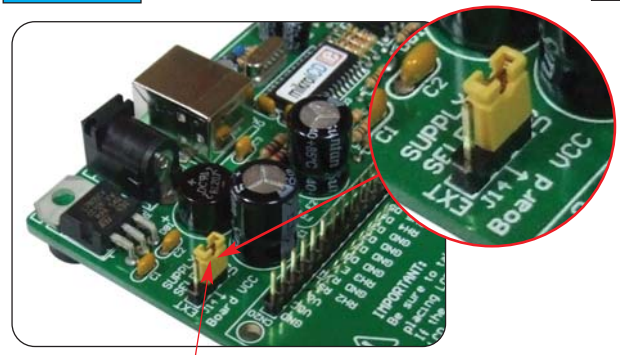
USB connector

External power supply connector

J14 in the left-hand position: system will take power from the external AC/DC power adapter.

J14 in the right-hand position: system will take power from the USB cable.

Figure 8. Power supply select jumper



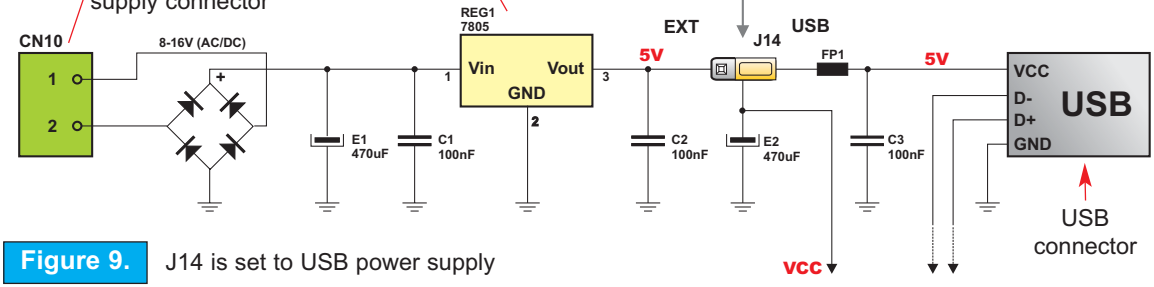


Figure 9. J14 is set to USB power supply

ON-BOARD USB 2.0 PROGRAMMER

There is no need for the use of external equipment during programming, as the BIGPIC4 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 *PICflash* programming software, which is supplied with the board.

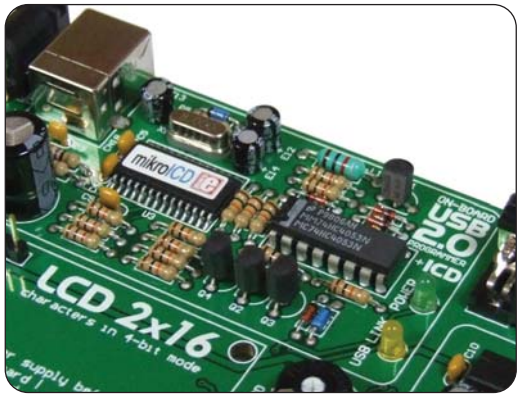


Figure 10. On-Board USB programmer

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

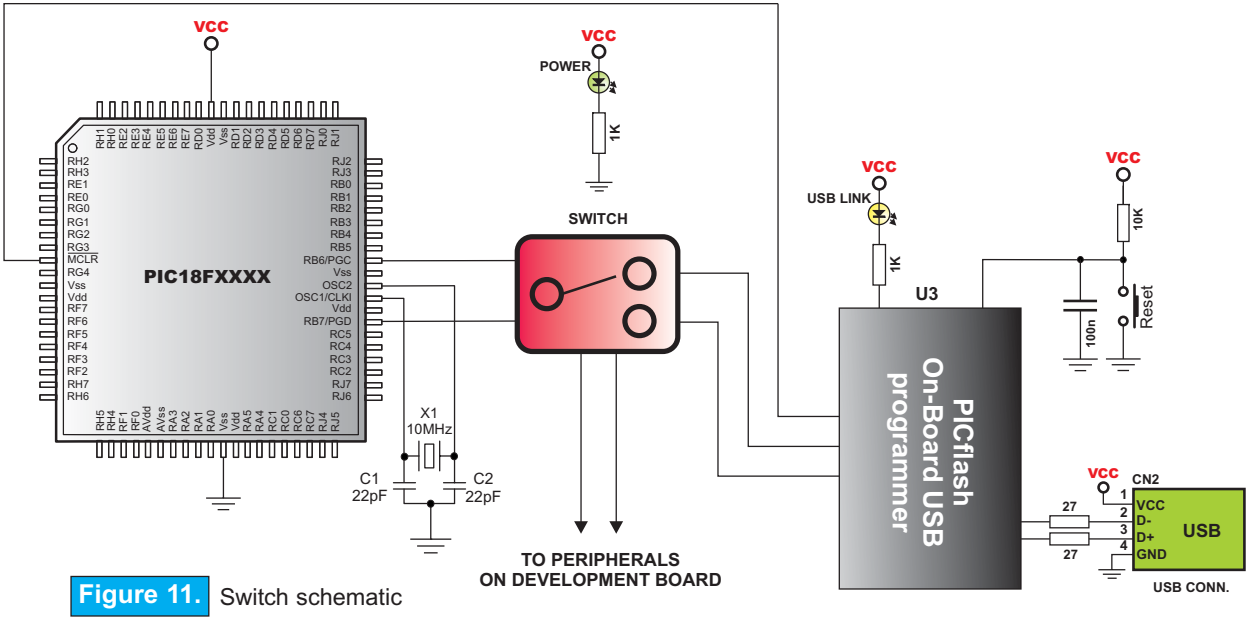
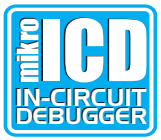


Figure 11. Switch schematic



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]
Step Out	[Ctrl+F8]
Flush RAM	[F2]
Stop Debugger	[Ctrl+F2]

Figure 12. On-Board USB programmer with mikroICD

LEDs

Light Emitting Diodes (LEDs) are the most commonly used components, usually for displaying pin's digital state. The BIGPIC4 has 46 LEDs that are connected to the microcontroller's ports PORTA, PORTB, PORTC, PORTD, PORTE and PORTF.

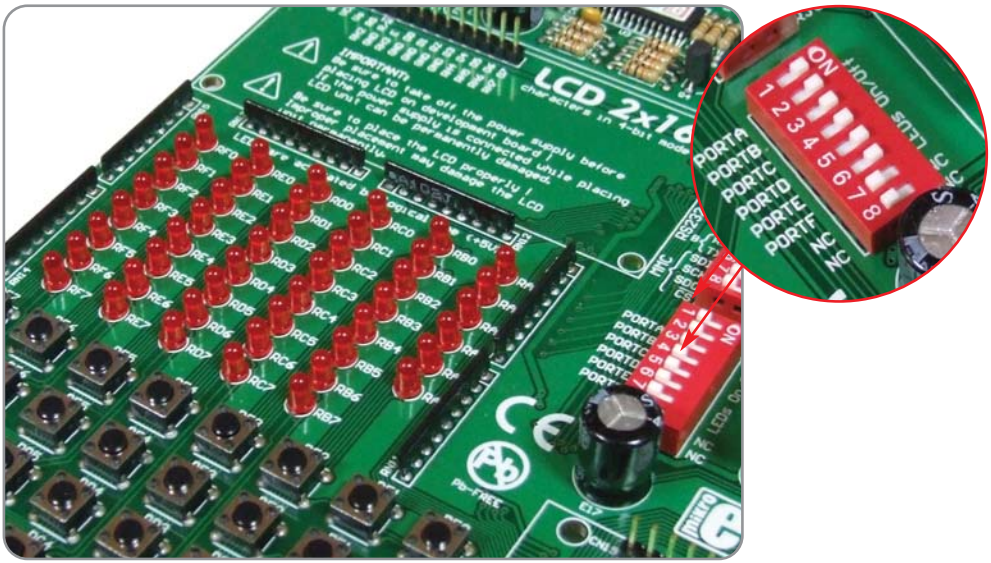


Figure 13. Light Emitting Diodes

Each group of eight LEDs (except PORTA which has 6 LEDs) can be enabled or disabled using switch SW2, as shown in Fig. 13.

Fig. 14. illustrates the connection of a LEDs to PORTD 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.

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

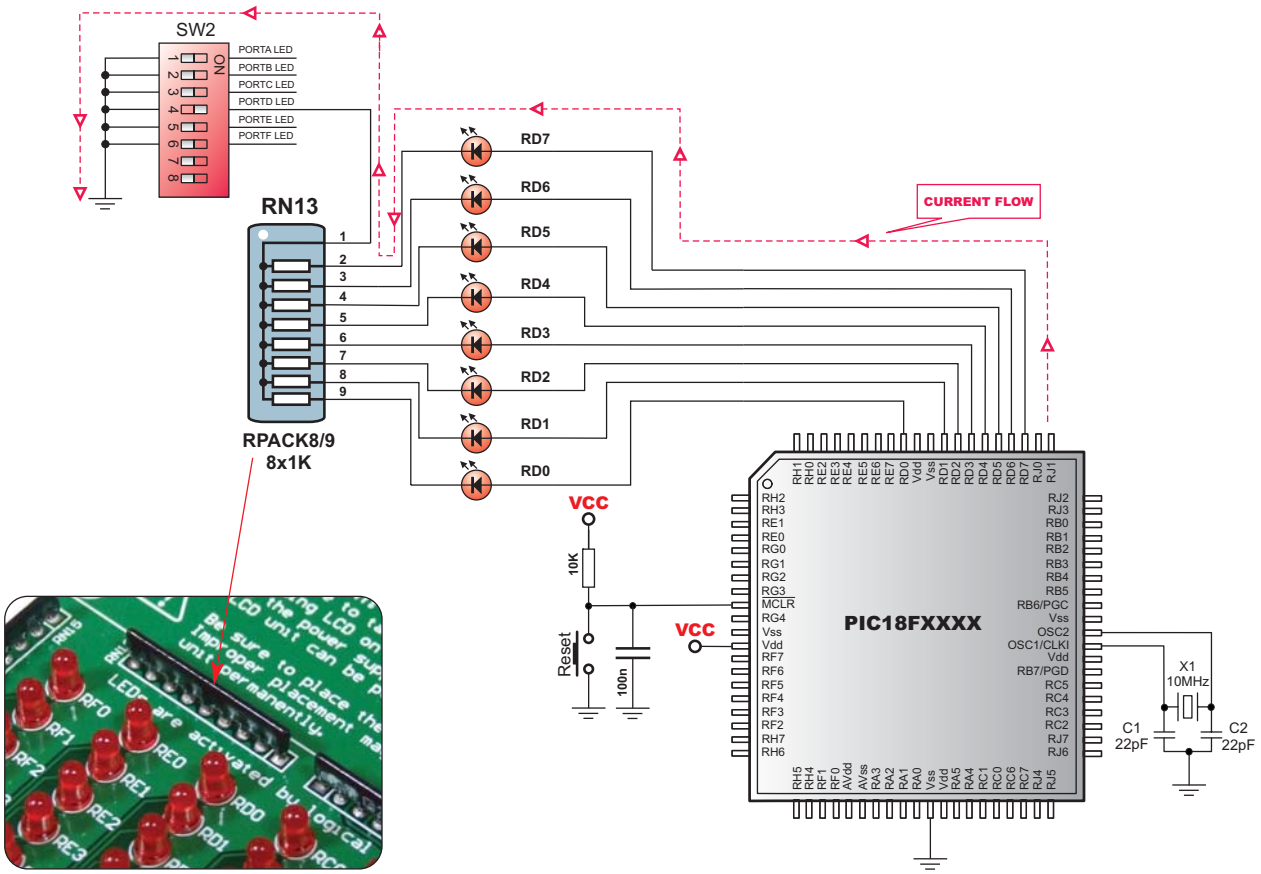
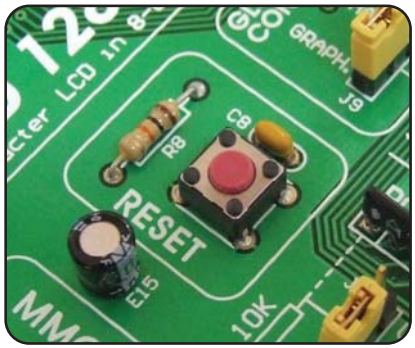


Figure 14. LED schematic

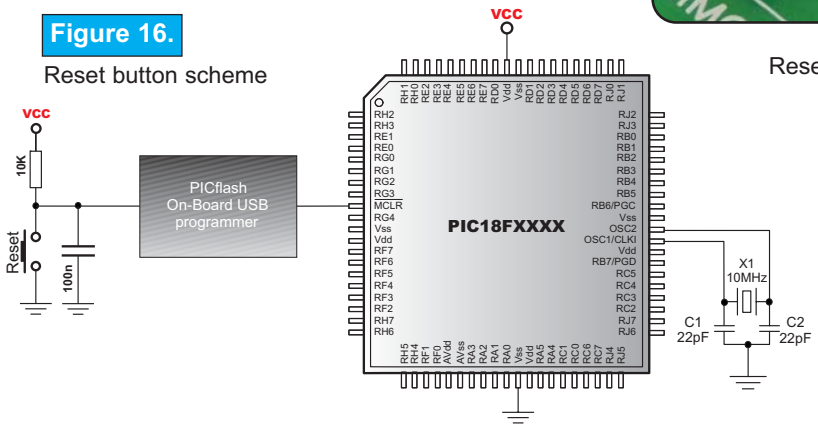
PUSHBUTTON SWITCHES

The BIGPIC4 has 46 push buttons, which can be used to provide digital inputs to microcontroller's ports. There is also one push button that acts as a RESET (Figure 15).



Reset button **Figure 15.**

Figure 16.
Reset button scheme



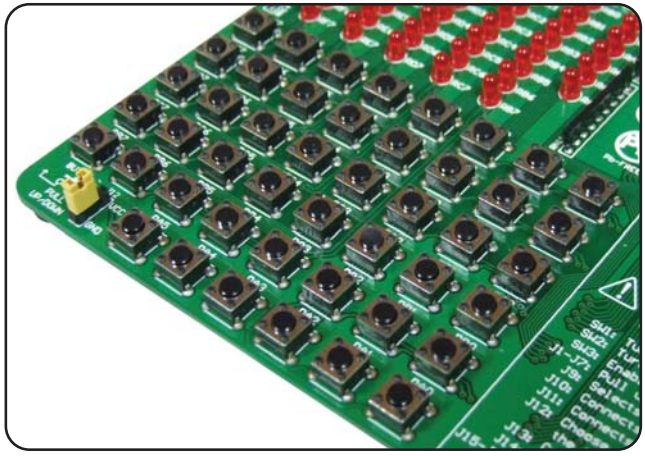


Figure 17.
Pushbutton switches

Buttons connections to PORTA, PORTB, PORTC, PORTD, PORTE and PORTF are shown in Fig. 18. Jumper J12 determines whether a button press will bring logical zero or logical one to the appropriate pin.

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

In the example shown in Fig. 18, J12 is connected to +5V, so pressing the buttons will bring logical one to the appropriate pins.

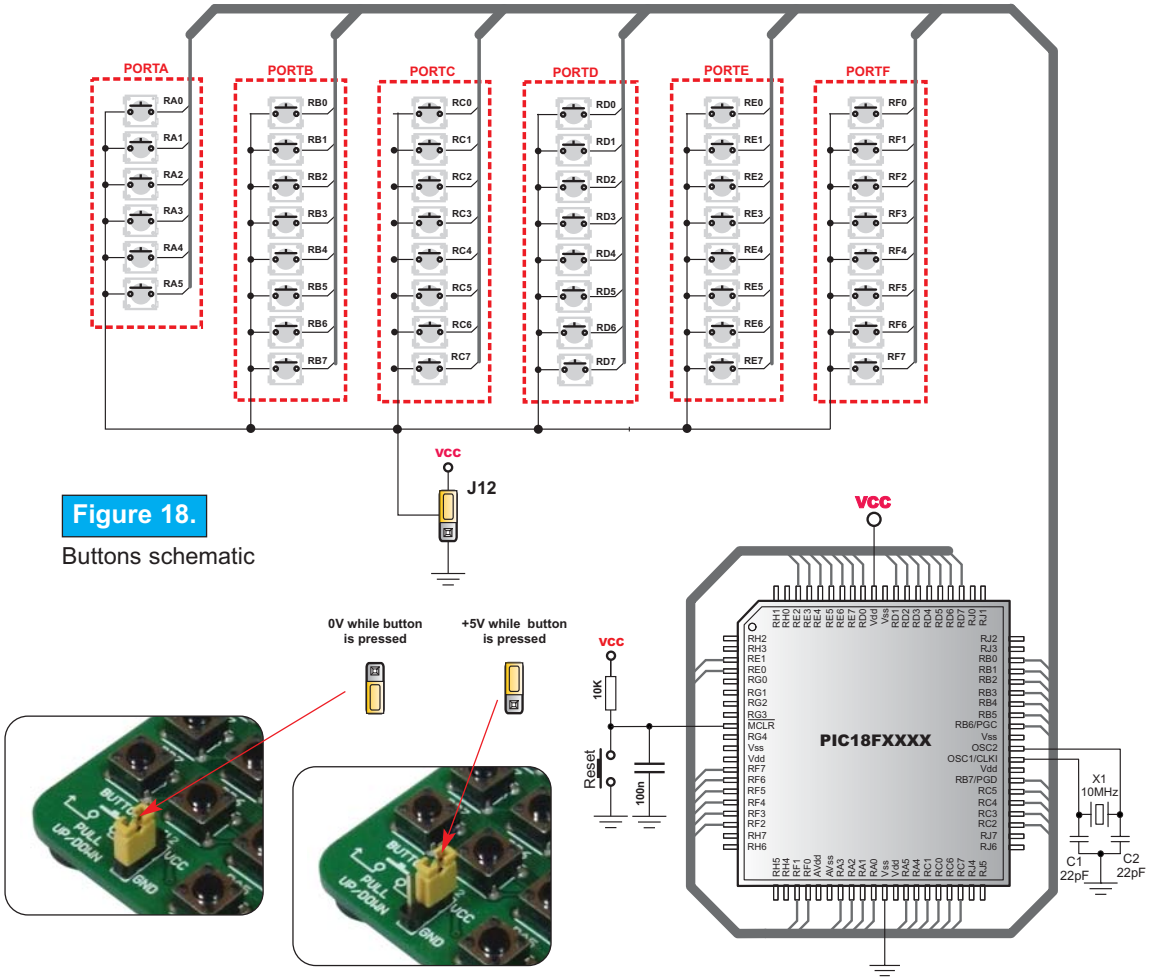


Figure 18.
Buttons schematic

On Fig. 19 the J5 jumper is set to pull-up, so when the button is not pressed pull-up resistor pulls the microcontroller's RE0 pin to +5V.

A button press causes the port pin to be connected to ground (J12 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.

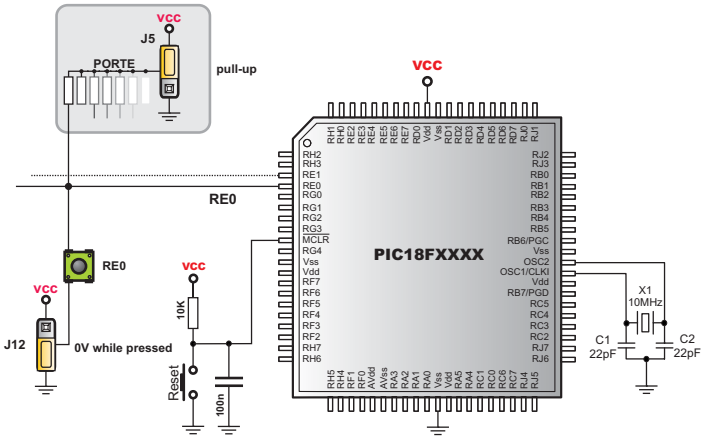


Figure 19. Button with pull-up resistor

On Fig. 20 the J5 jumper is set to pull-down, so when the button is not pressed pull-down resistor sets the microcontroller's RE0 pin to 0V.

A button press causes the port pin to be connected to +5V (J12 is in the upper position).

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

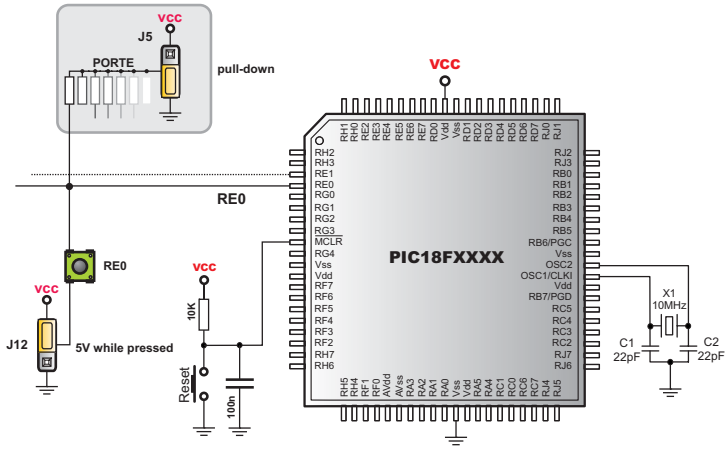


Figure 20. Button with pull-down resistor

GRAPHIC LCD CONNECTOR ON-BOARD

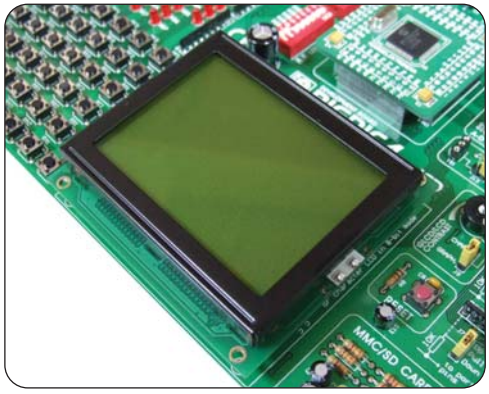
GRAPHIC LCD

A graphic LCD (GLCD) allows advanced visual messages to be displayed. While a character LCD can display only alphanumeric characters, a GLCD can be used to display messages in the form of drawings and bitmaps. The most commonly used graphic LCD has the screen resolution of 128x64 pixels. Before a GLCD is connected, the user needs to set the jumper J9 (Fig. 21) to the lower position. The GLCD's contrast can be adjusted using the potentiometer P3. Jumper J9 and potentiometer P3 are placed to the upper-right of the GLCD.

Figure 21.

GLCD selection jumper

In order to enable GLCD jumper J9 should be set to the lower position, labeled as GRAPH.



GLCD **Figure 22.**

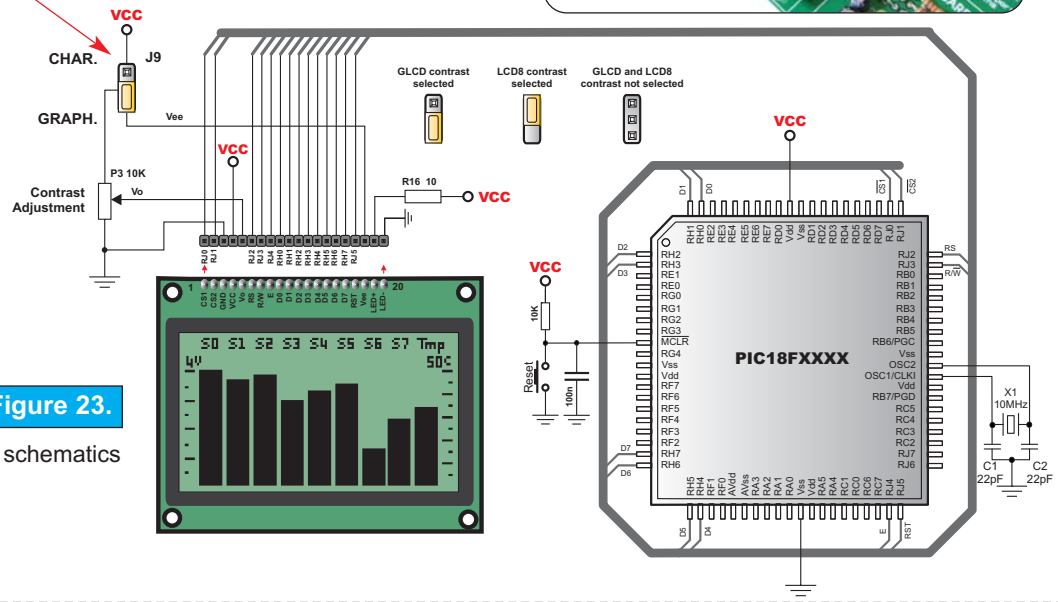


Figure 23.

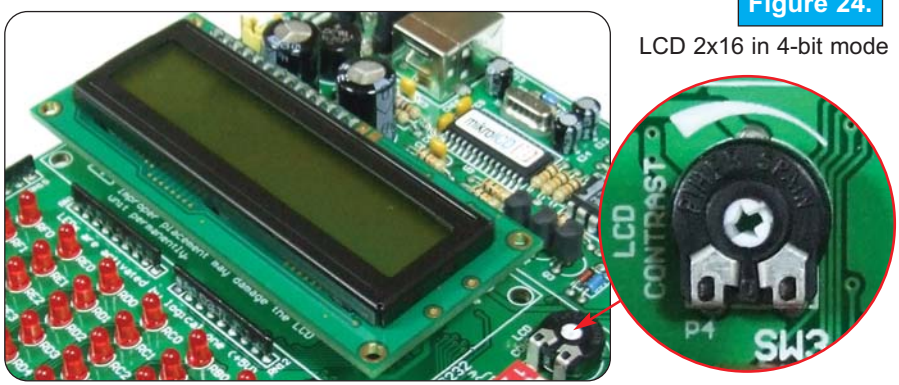
GLCD schematics

2x16 LCD CONNECTOR
2x16 LCD
ON-BOARD

LCD 2X16 IN 4-BIT MODE

The standard character LCD is probably the most widely used data visualization component. Usually, it can display two lines of 16 alphanumeric characters, each character made up of 5x8 pixels. The character LCD communicates with the microcontroller via a 4-bit or 8-bit data bus, each requiring the use of a different connector on the BIGPIC4 development board. For 4-bit data bus use, the LCD should be placed in the upper left of the board, above the LEDs. The connection to the microcontroller is shown in Fig. 25 where there are only four data lines. It is important that the LCD is only inserted or removed from the BIGPIC4 when the power is off.

Figure 24. LCD 2x16 in 4-bit mode



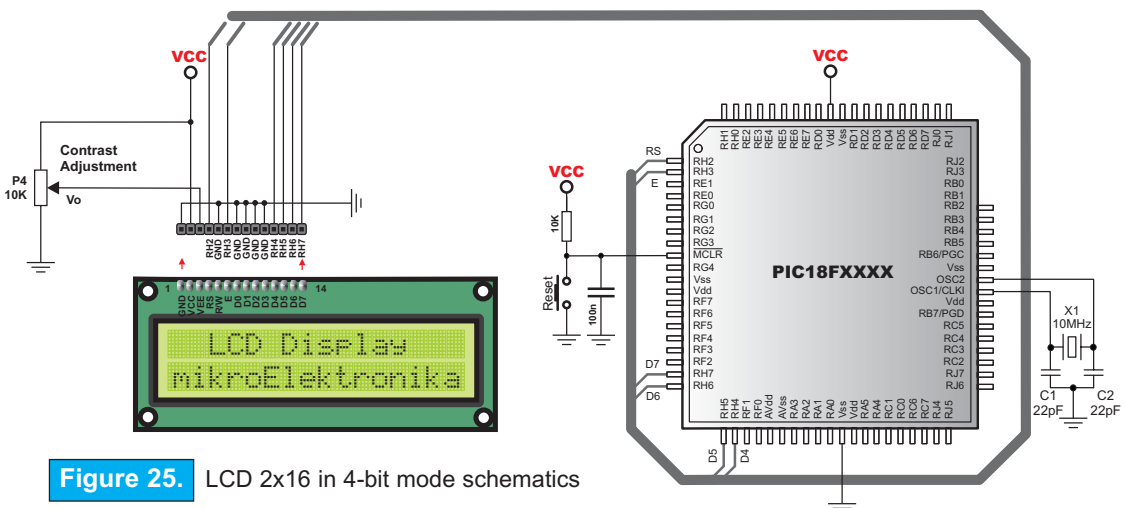


Figure 25. LCD 2x16 in 4-bit mode schematics

LCD 2X16 IN 8-BIT MODE

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

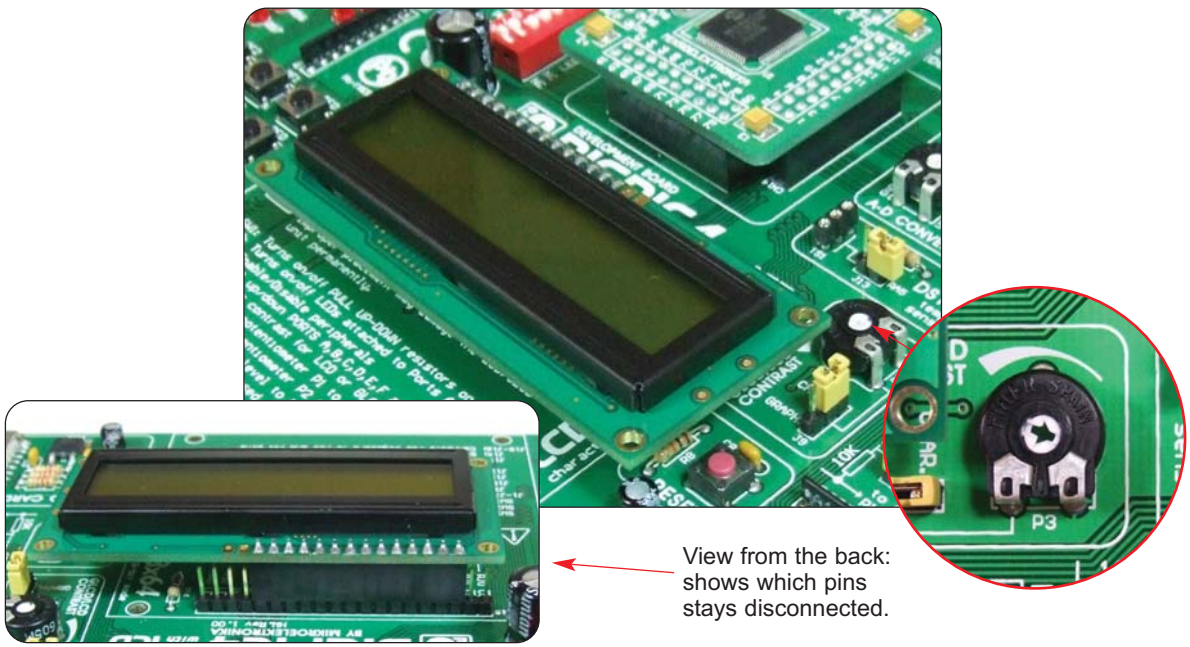
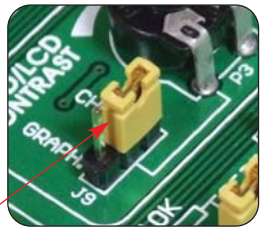


Figure 26. LCD 2x16 in 8-bit mode

Before adding the LCD, set the jumper J9 to the upper position, labeled as CHAR. The LCD's contrast can be adjusted using potentiometer P3, which is located to the upper-right of the GLCD/LCD connector (Fig. 26).

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



In order to enable LCD, jumper J9 should be set to the position labeled as CHAR.

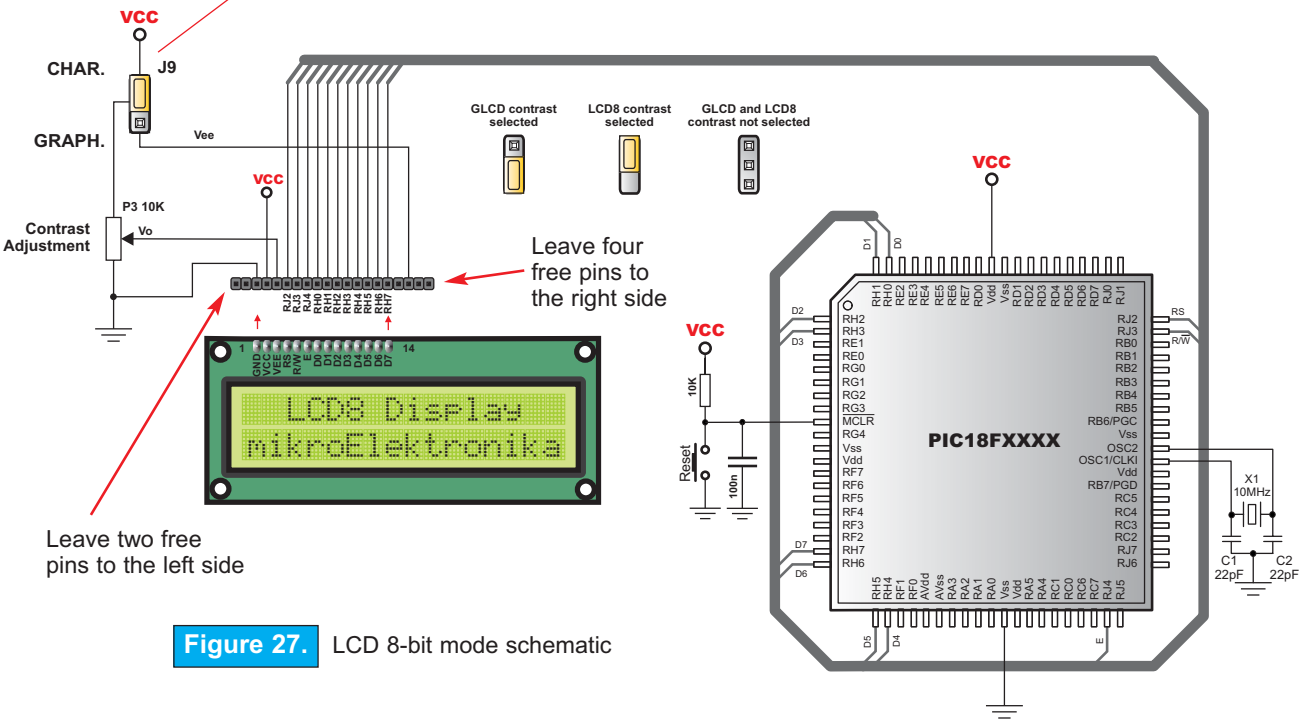


Figure 27. LCD 8-bit mode schematic

RS-232 COMMUNICATION

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

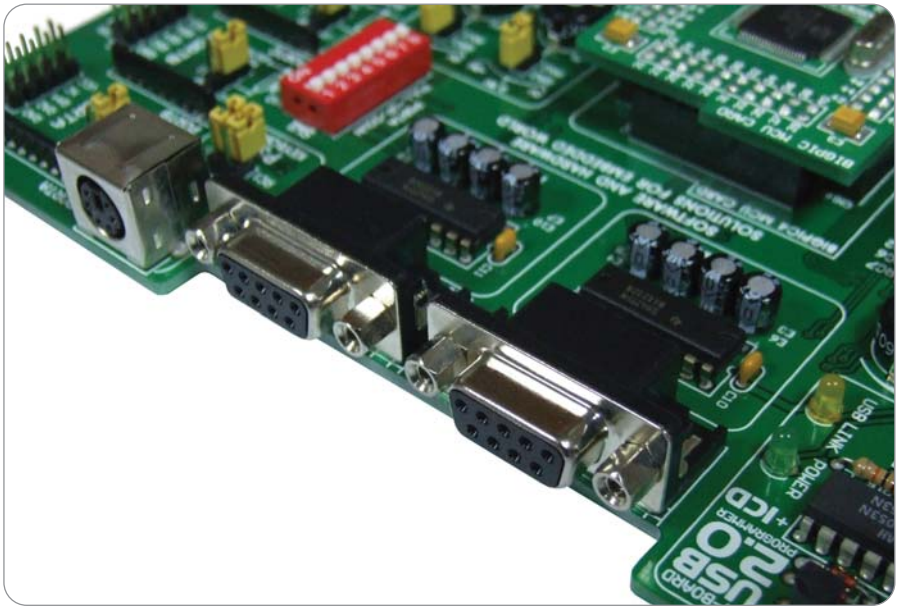


Figure 28. RS232 connectors

BIGPIC4 development board have two RS-232 communication devices, RS-232 A and RS-232 B. In order to provide a more flexible system, the microcontroller is connected to the MAX232 through DIP-switch SW3. The first two switches on SW3 are used to connect Rx and Tx lines from microcontroller to RS-232 A port, and the second two for connecting Rx and Tx lines to RS-232 B.

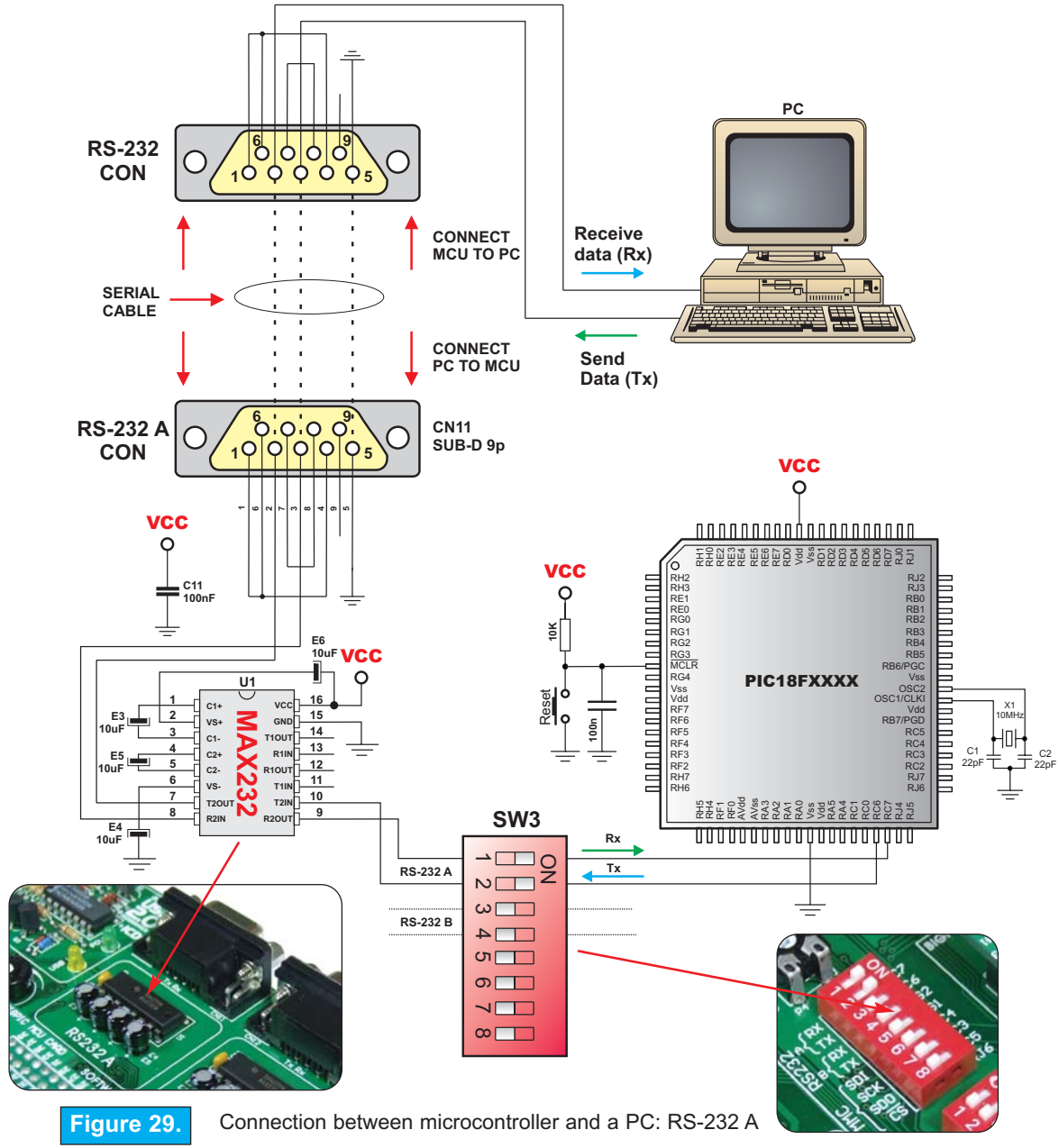
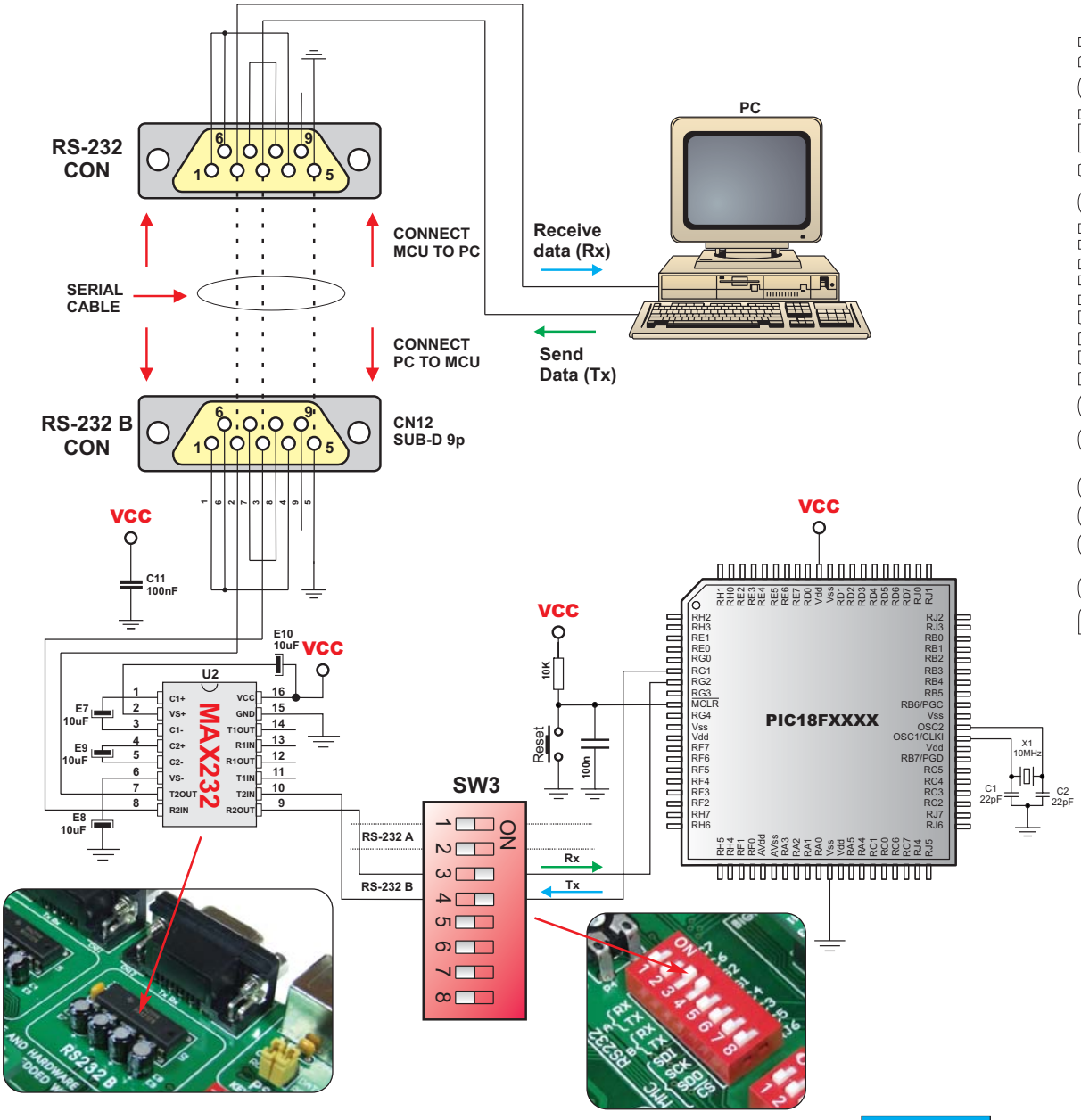


Figure 29. Connection between microcontroller and a PC: RS-232 A



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

DS1820 DIGITAL THERMOMETER

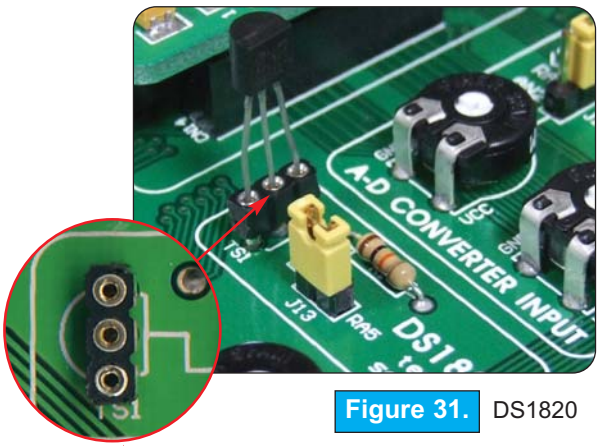


Figure 31. DS1820

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

The DS1820 digital thermometer is well suited to environmental temperature measurement, having the temperature range of -55°C to 125°C and the accuracy of +/-0.5°C. It must be placed correctly in the 3-pin socket provided on the BIGPIC4, with its rounded side to the left, as marked on the board (Fig 31). Otherwise the DS1820 could be permanently damaged. In order to work, DS1820 must be connected to microcontroller's RA5 pin, by enabling jumper J13.

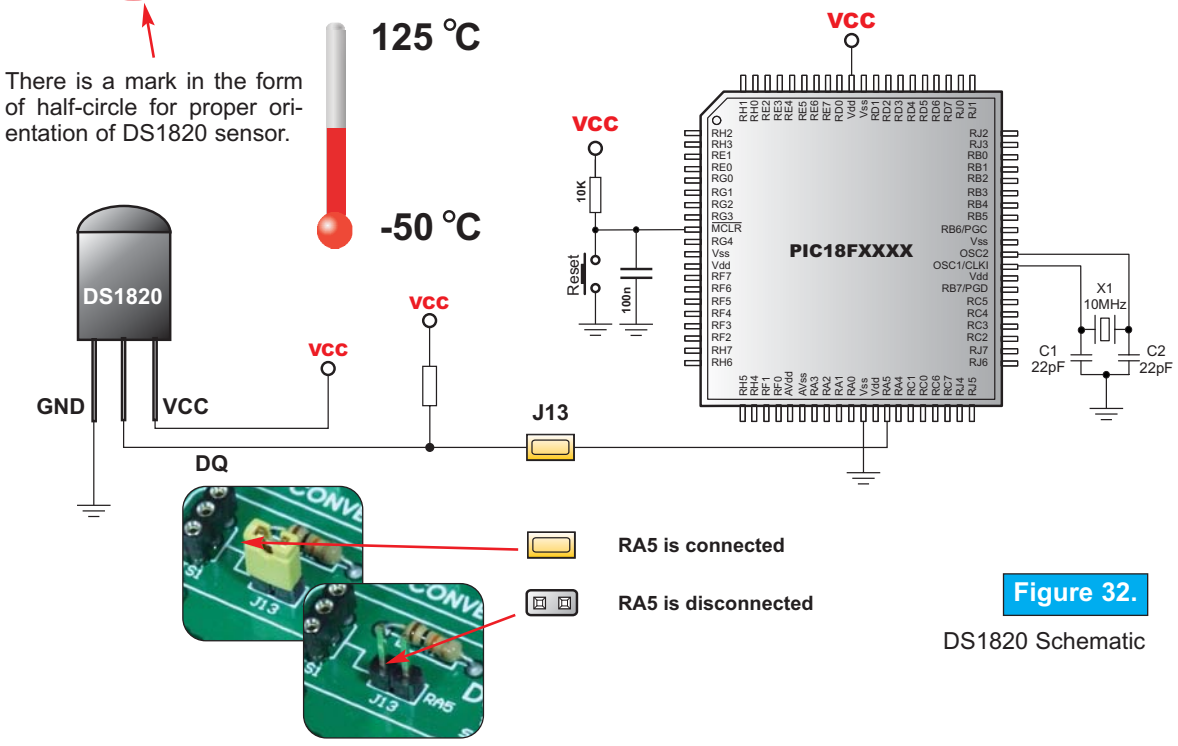
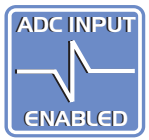


Figure 32.
DS1820 Schematic



A-D CONVERTER INPUT

BIGPIC4 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 jumper J10 enables connection between potentiometer P1 and pin RA2. The jumper J11 enables connection between potentiometer P2 and pin RA3.

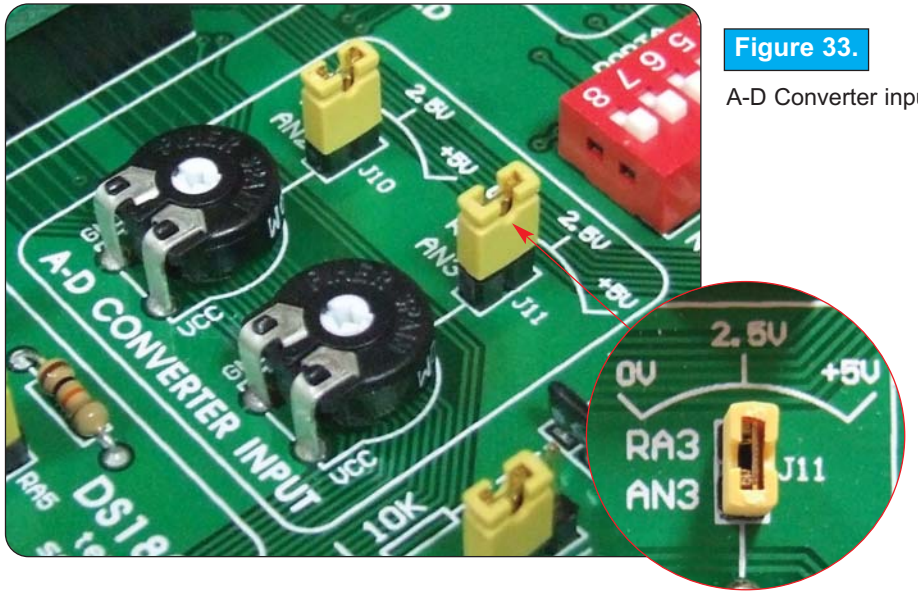


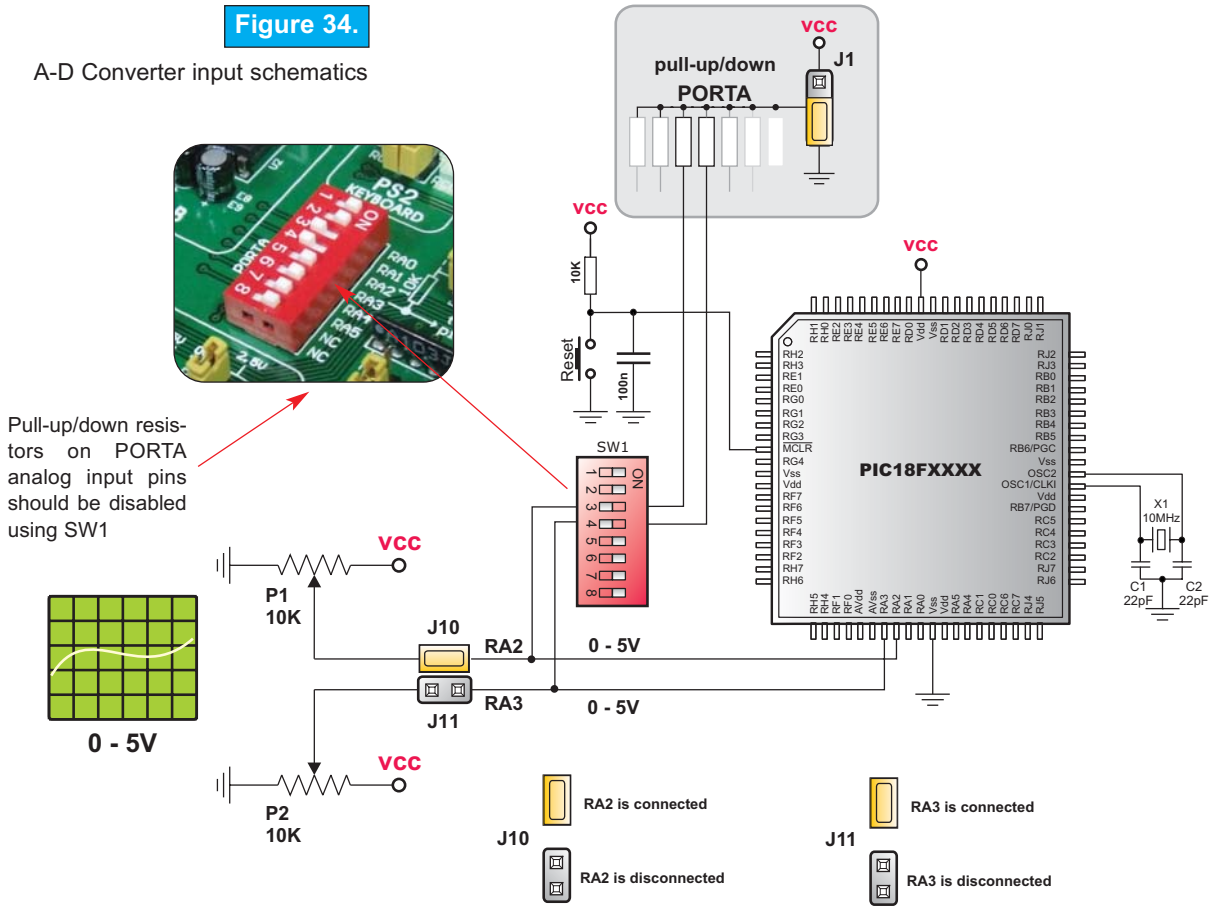
Figure 33.
A-D Converter input

In order to measure analog signal without interference, turn the coresponding switch on SW1 to OFF position. This will disable connection from 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 34.

A-D Converter input schematics



Potentiometer P1 is connected to RA2 pin and potentiometer P2 is connected to RA3 pin.

Potentiometers P1 and P2 are disconnected from the microcontroller.

PS/2 READY
DEVELOPMENT

PS/2 (KEYBOARD) CONNECTOR

The PS/2 connector allows direct connection between BIGPIC4 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 tansfer. In this case, they are connected to pins RC1 and RC0 respectively.

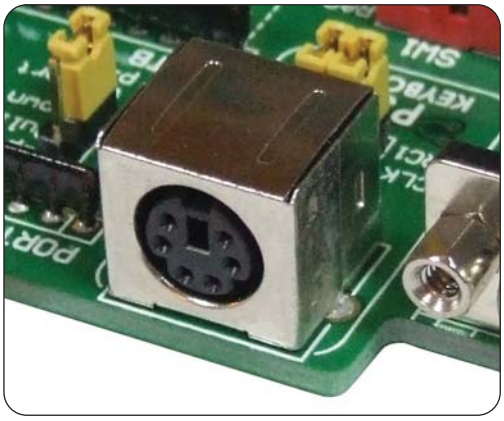


Figure 35.
PS/2 connector

Keyboard connected to development board

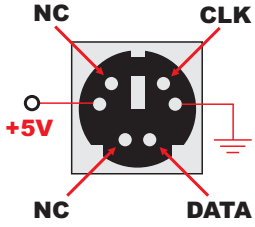
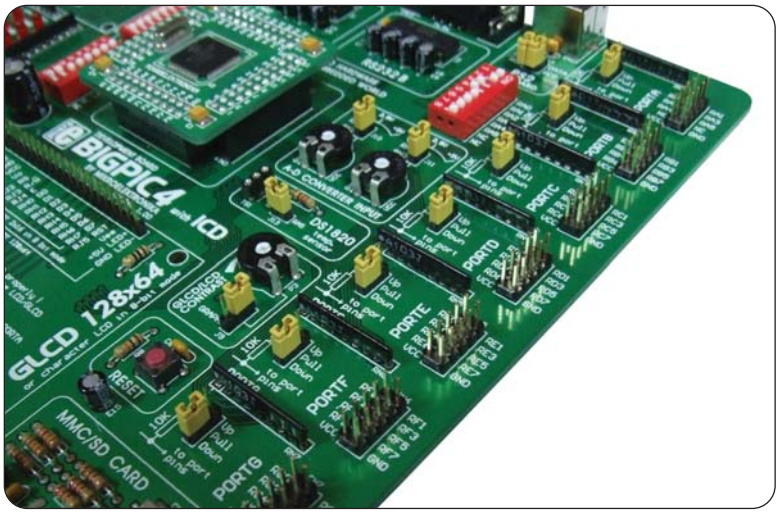


Figure 36.
PS/2 communication schematic

CLK and DATA lines are connected to RC1 and RC0 pins respectively.

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 10-pin connector providing VCC, GND and up to eight port pins.



Direct port access connectors **Figure 37.**

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.

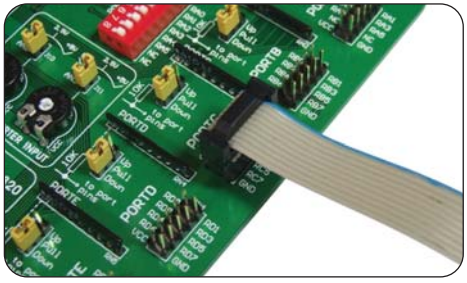
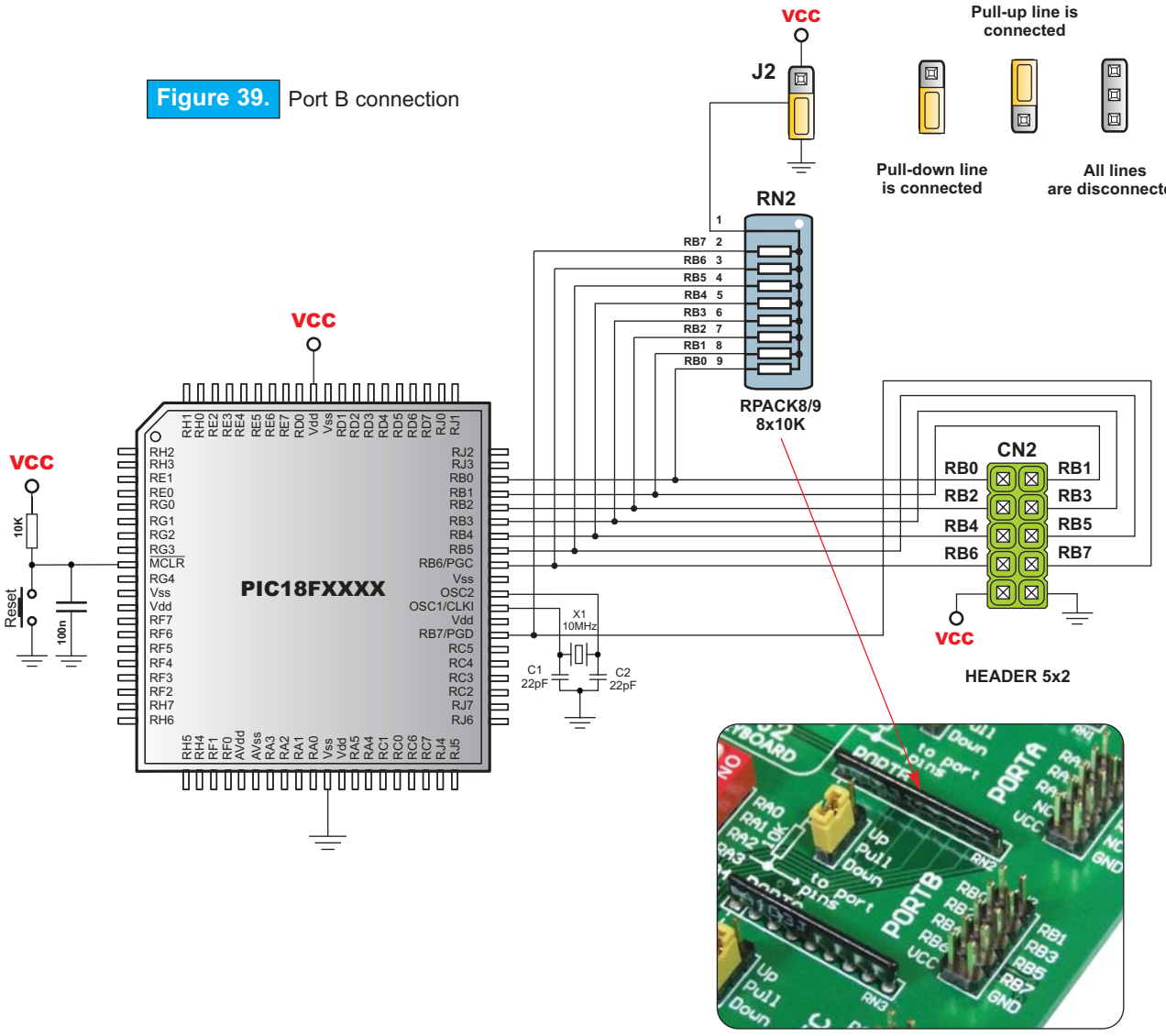


Figure 38.

Example of how to connect external peripheral with flat cable

Figure 39. Port B connection



MMC/SD (MULTIMEDIA CARD)

MMC card is used as storage media for a portable devices, in a form that can easily be removed for access by a PC. For example, a digital camera would use an MMC card for storing image files. With an MMC reader (typically small box that connects via USB or some other serial connection) you can easily transfer data from MMC card to your computer. Microcontroller on BIGPIC4 communicates with Multi Media Card via SPI communication.

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

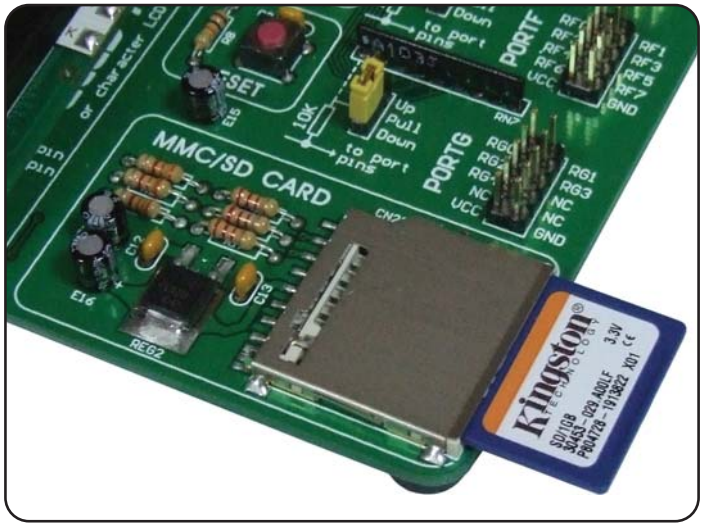
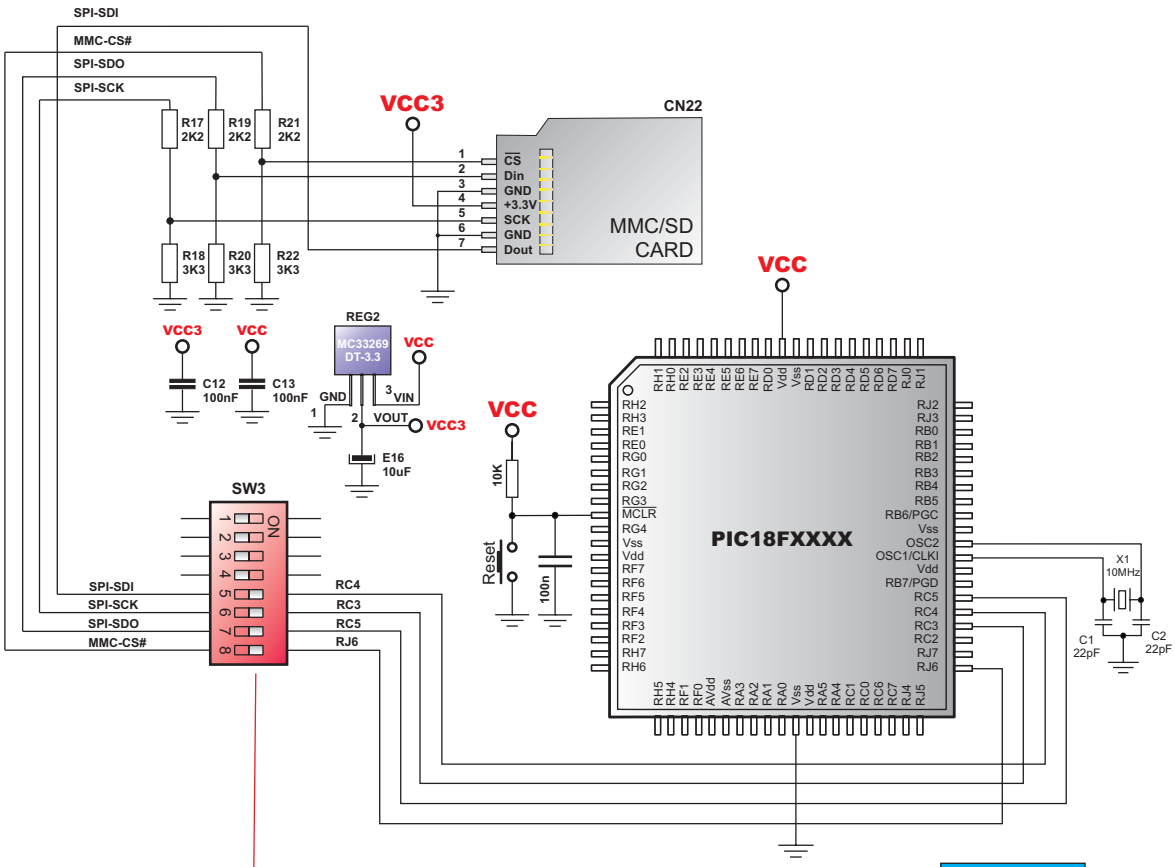
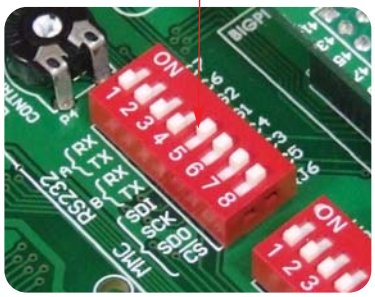


Figure 40.
MMC slot on-board

To enable MMC card you must turn on switches 5, 6, 7 and 8 on SW3. By doing that, microcontrollers's SPI comunnication lines (SDI, SDO and SCK) and Chip Select are connected to MMC. Working voltage of BIGPIC4 is 5V DC, while 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). Data lines from microcontroller to MMC card must be also adjusted to 3.3V. It is done with resister voltage dividers as shown on Figure 41.



MMC schematic **Figure 41.**



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