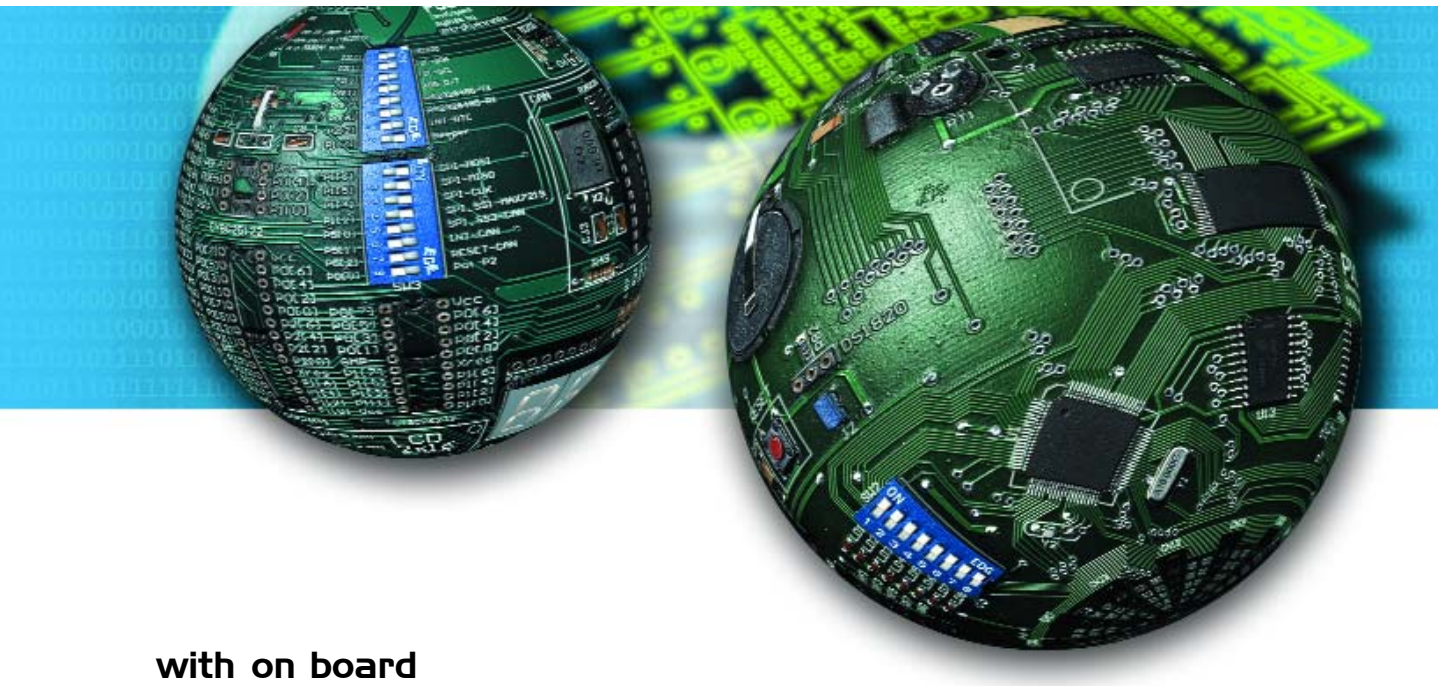
SOFTWARE AND HARDWARE SOLUTIONS FOR THE EMBEDDED WORLD

MikroElektronika
Development tools - Books - Compilers

dsPICPRO User's Manual



with on board
USB
2.0 programmer

With useful implemented peripherals, plentiful practical code examples and a broad set of additional add-on boards (ADC potentiometer, two RS-232, RS485, Compact Flash, CAN 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

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CONNECTING THE SYSTEM

The development system box contains a development system, CD, USB cable and serial cable.

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

Step no.2 Connect the USB cable to the dsPICPRO board.

Step no.3 The PC will start the procedure for installing the USB driver for the on-board USB 2.0 programmer. Follow the procedure from the document ' *Installing Driver for USB programmer'* and install the USB driver.

Step no.4 Copy dsPICFLASH2.exe file to the folder of your choice. You can find this file in the dsPICFLASH folder on the CD.

Step no.5 Run and use dsPICFLASH2.exe as explained in the document 'ds*PICflash programmer*'.

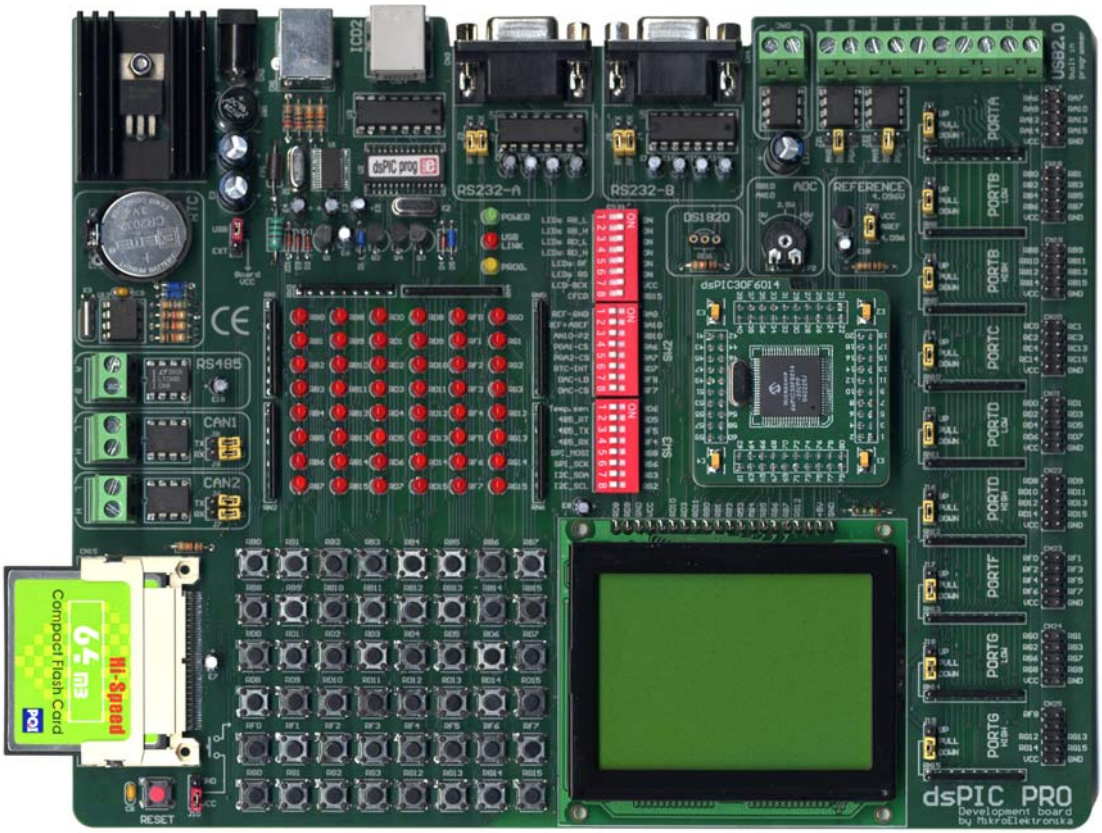
After these 5 steps, your dsPICPRO is installed and ready for use. You should try to read a program from the chip or to load an example from the examples folder.

INTRODUCTION

The dsPICPRO development system is a full-featured development board for Microchip dsPIC microcontrollers. It has been designed to allow students and engineers to easily exercise and explore the capabilities of dsPIC microcontrollers. It allows dsPIC 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 beside each component. These marks describe connections to the microcontroller, operation modes, and provide some useful notes. The need for additional schematics is minimized as all the information is printed on the board.

Figure 1. dsPICPRO development board



SWITCHES

The dsPICPRO 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.

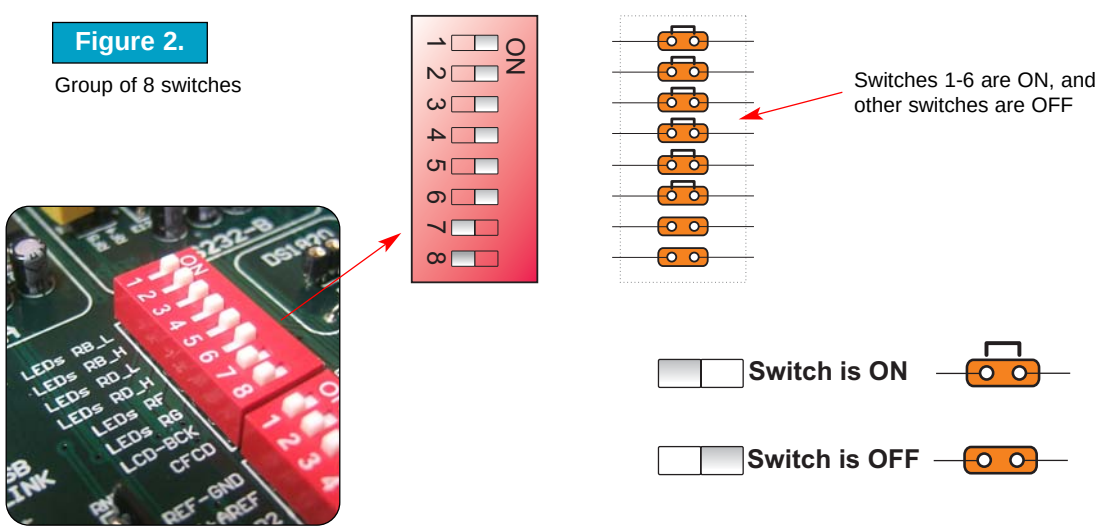
Switches are devices that have two positions - ON and OFF, which have a role to establish or break a connection between two contacts.

The first switch, **SW1,** is used to enable LEDs connected to ports RB_L, RB_H, RD_L, RD_H, RF and RG. For example, if switch RB_L is OFF, all RB lower LED's will be turned off.

The switches **SW2** and **SW3** are used to enable connections between various peripheral devices and microcontroller pins.

For example, **SW2** and **SW3**, enables a connection between the microcontroller pins and temperature sensor, programmable gain amplifier (PGA), real time clock (RTC), RS-485 communication etc.

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.

Jumpers are used as a selector between two possible connections using a three pin connector. As illustrated in Fig. 3, middle connector can be connected to the left or right pin, depending on the jumper's position.

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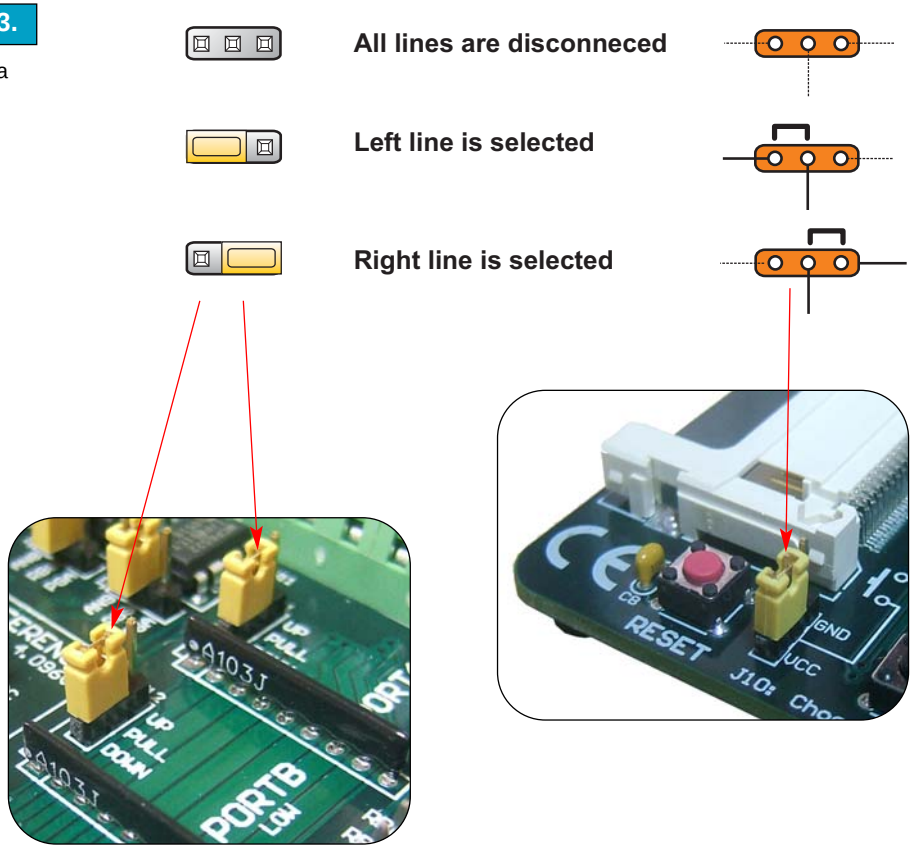
Figure 3.

Jumper as a multiplexer



MCU CARD

The dsPICPRO development board have a 80-pin MCU Card as shown on the following picture:

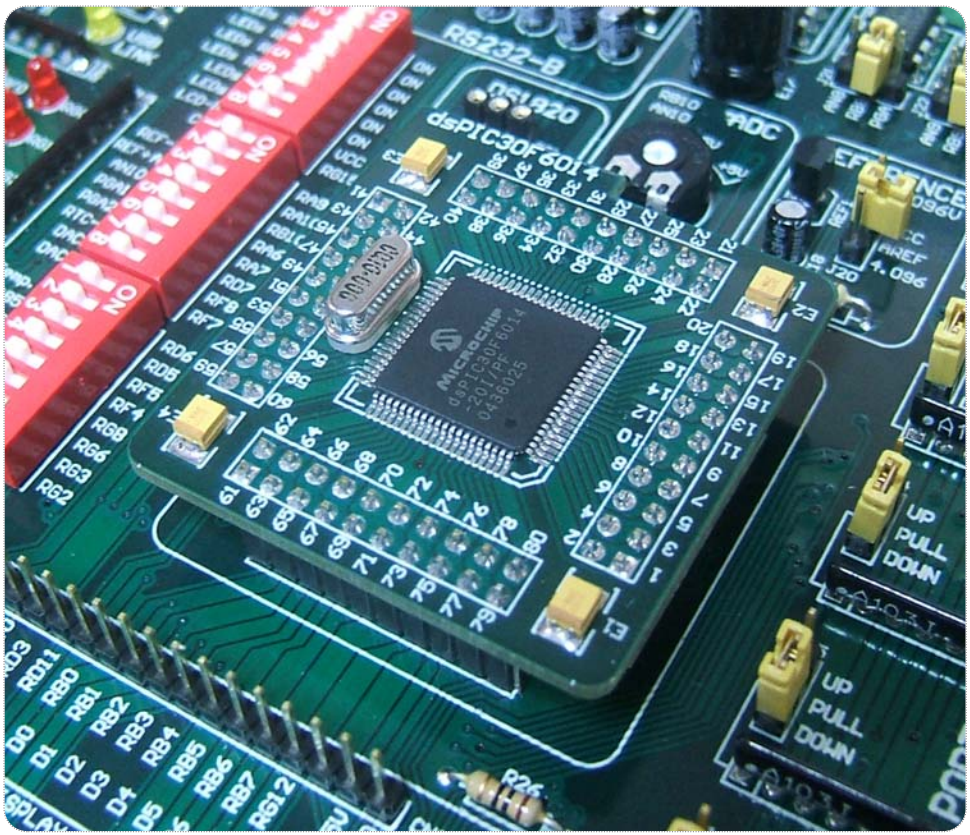
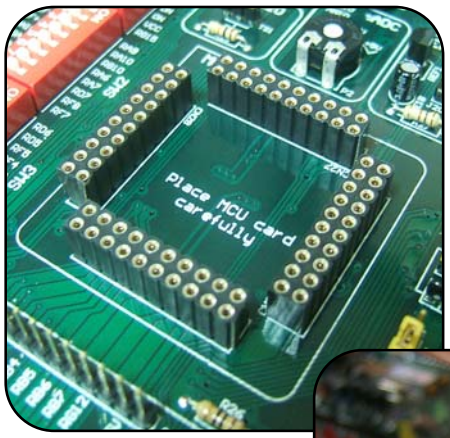


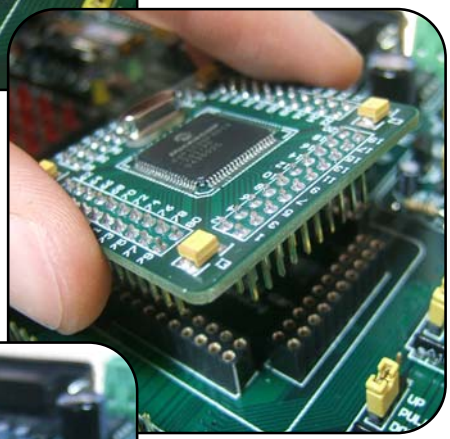
Figure 4. MCU Card

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



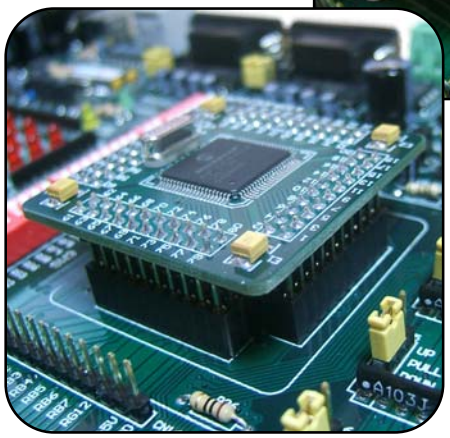
Step no.1

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



Step no.2

Label on the MCU Card must be at the upper-left corner as it is drawn on the dsPICPRO 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.5. 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 , which allow for 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.

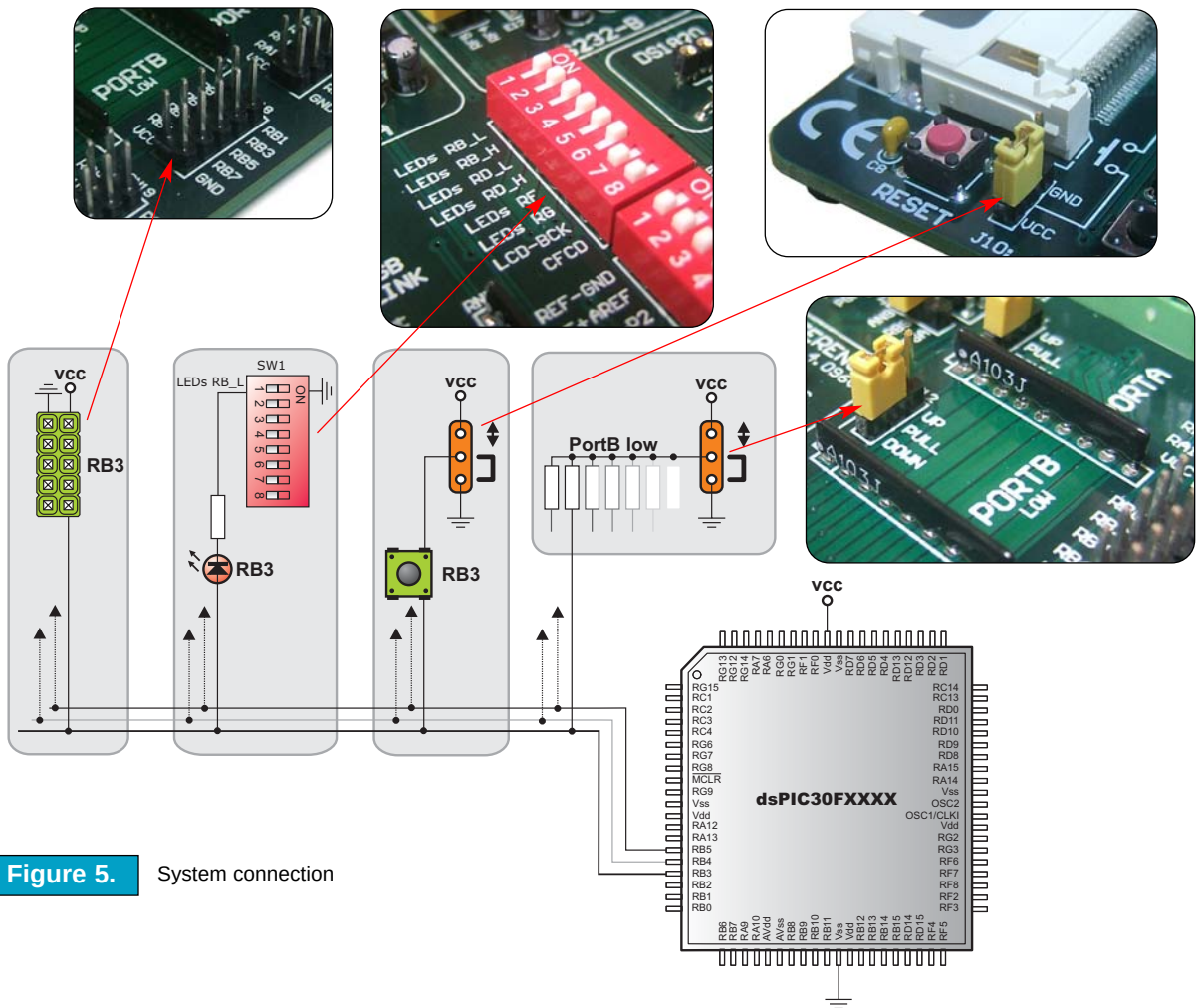


Figure 5. System connection

POWER SUPPLY

As a power supply source, users 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 sholud be connected to a PC using the USB programming cable and jumper J1 should be set in the upper position.

In case of an external power supply, the dsPICPRO board produces +5V using an LM7805 voltage regulator. The external power supply can be AC or DC, with a voltage between 9V and 16 V, and jumper J1 should be set in the lower position. In Fig. 7 you can see the USB (left) and power supply (right) connectors.

Figure 6. Power supply select jumper

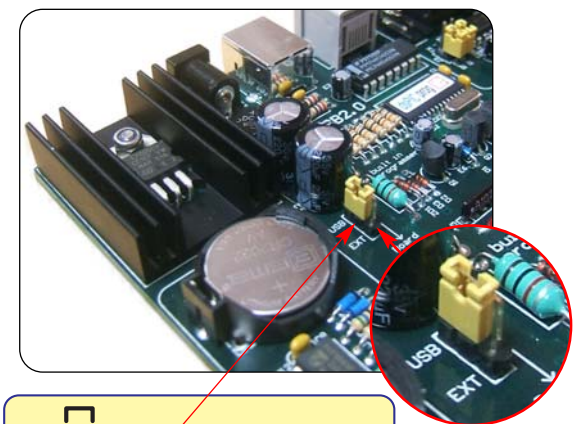
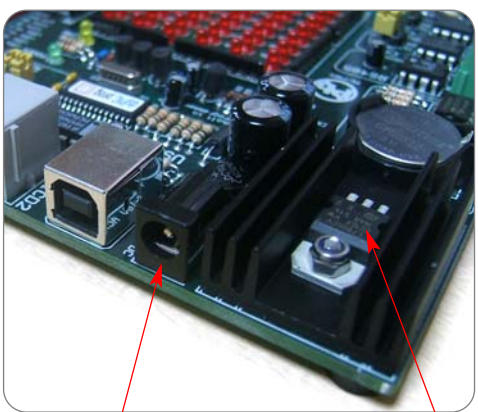


Figure 7. USB and power supply connectors



J1 in the lower position: system will take power from the external AC/DC power adapter.

J1 in the upper position: system will take power from the USB cable.

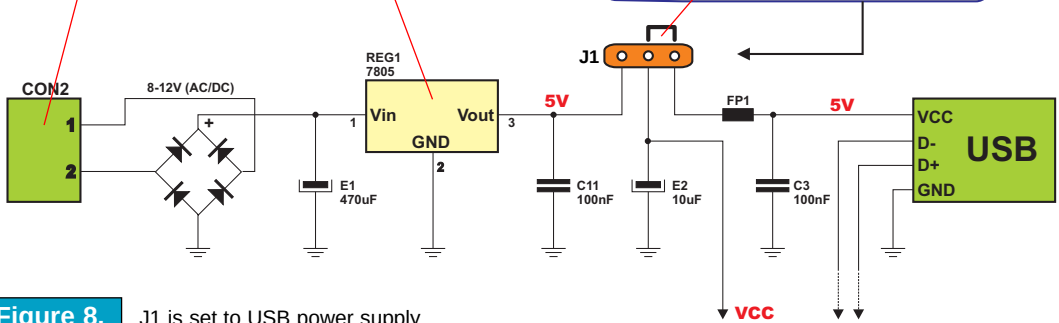


Figure 8. J1 is set to USB power supply

ON-BOARD USB PROGRAMMER

There is no need for the use of external equipment during programming, as the dsPICPRO development system has its own on-board USB 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 *dsPICFLASH2* programming software, which is supplied with the board.

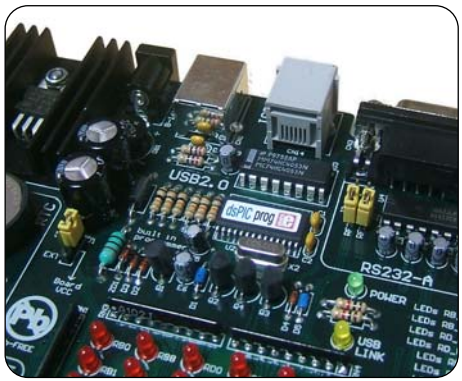


Figure 9. On-Board USB programmer

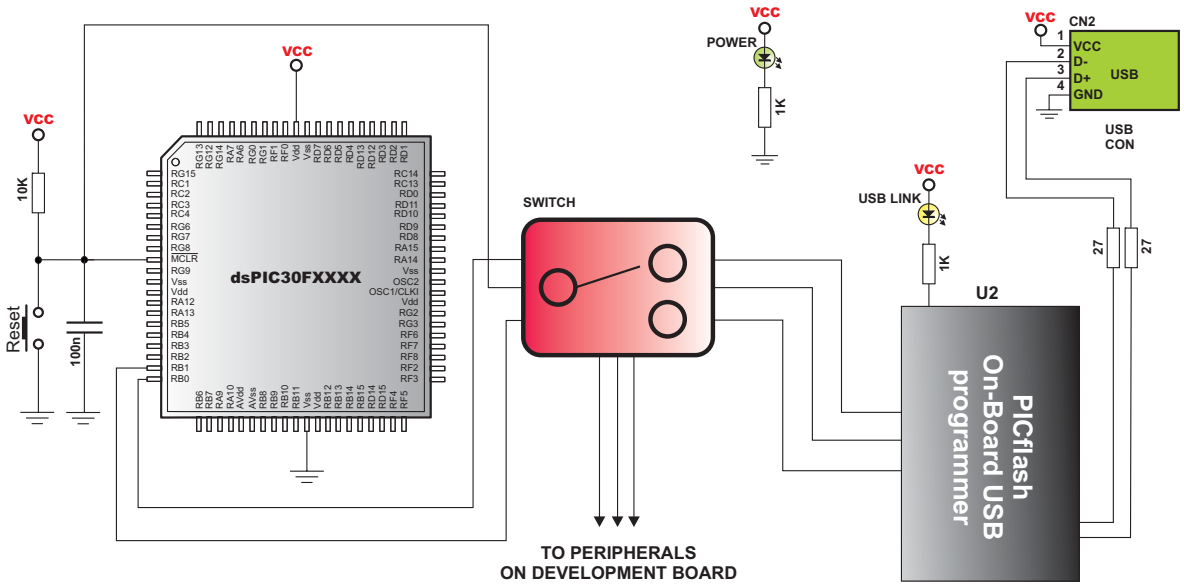


Figure 10. Switch scheme

LIGHT EMITTING DIODES

Light Emitting Diodes (LEDs) are the most commonly used components, usually for displaying pin's digital state. The dsPICPRO have 48 LEDs that are connected to the microcontroller's ports RB low, RB high, RD low, RD high, RF and RG.

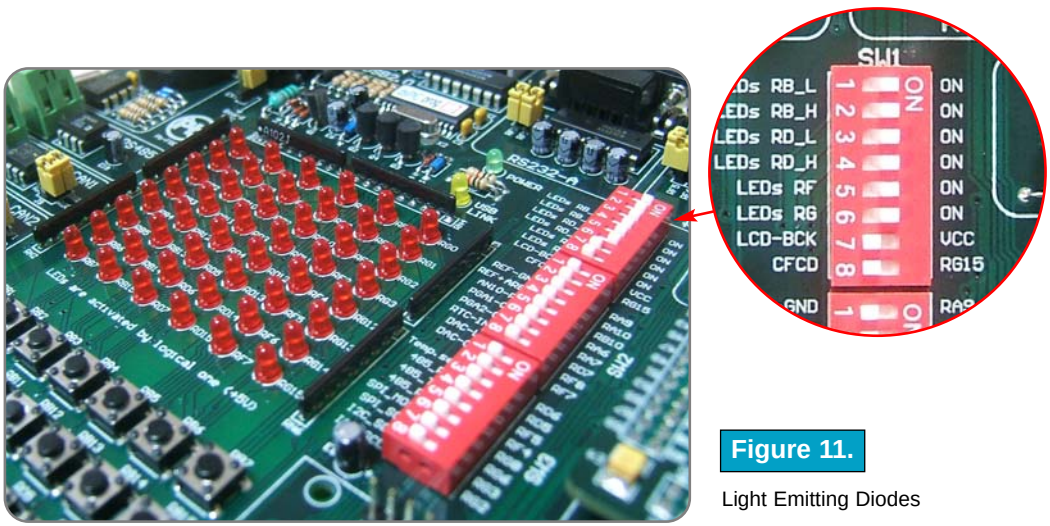


Figure 11.

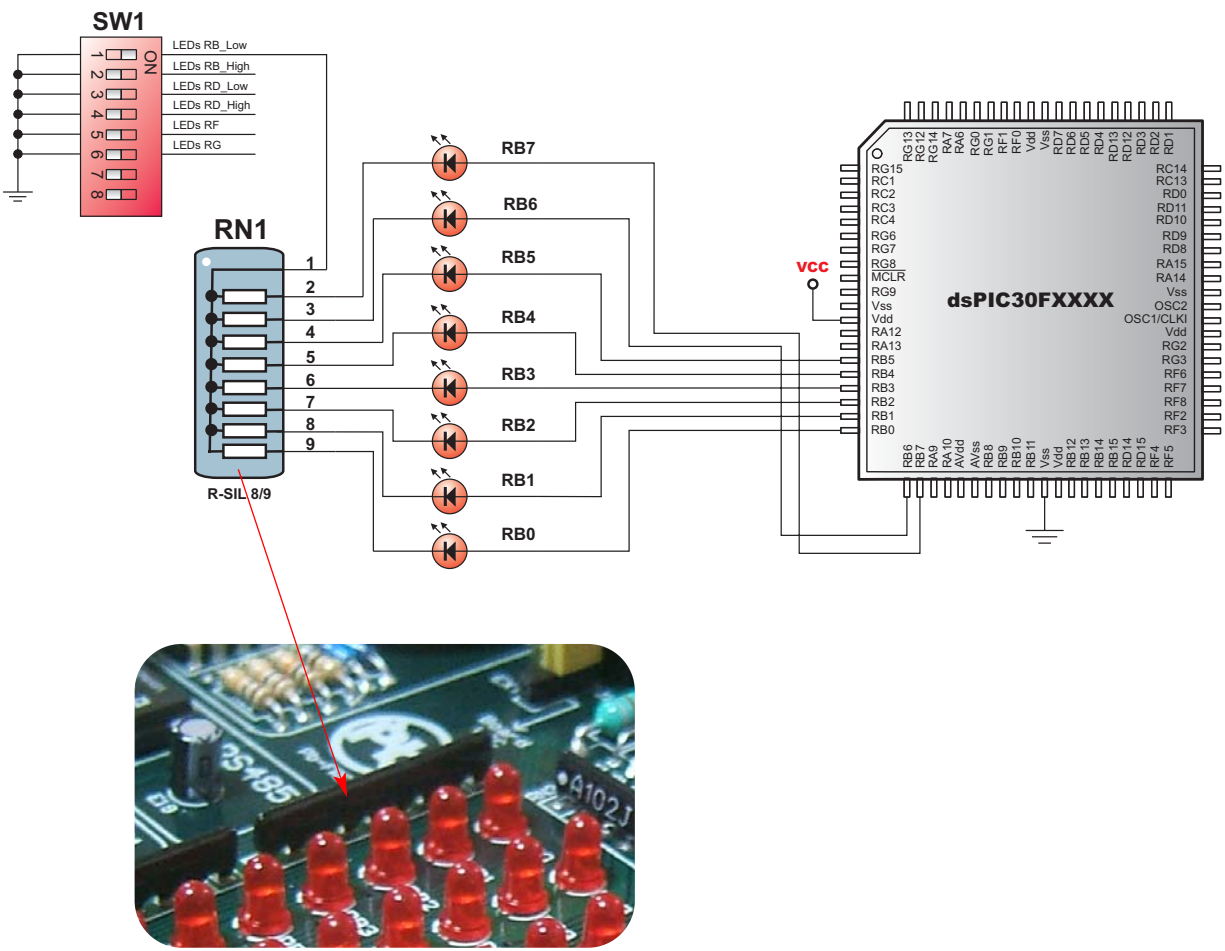
Light Emitting Diodes

Each group of eight LEDs can be enabled or disabled using switch SW1, as shown in Fig. 11.

Fig. 12. illustrates the connection of a LEDs to lower PortB of the microcontroller. A resistor is used in series with the LED to limit the LED's current. In this case the resistor's value is 1K.

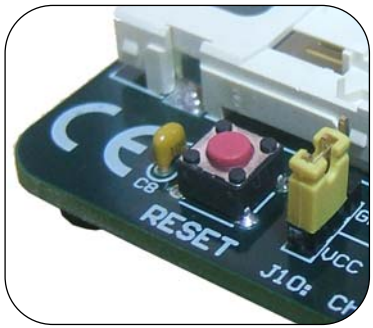
All LEDs from one port are connected to a common point through these resistors, which can then be connected or disconnected to ground by the corresponding switch on SW1. The LEDs are enabled when connected to a ground and will display the state of the corresponding microcontroller pin; otherwise the LEDs will always be off, no matter what the pin state is, because no current can flow through it.

Figure 12. LED schematic

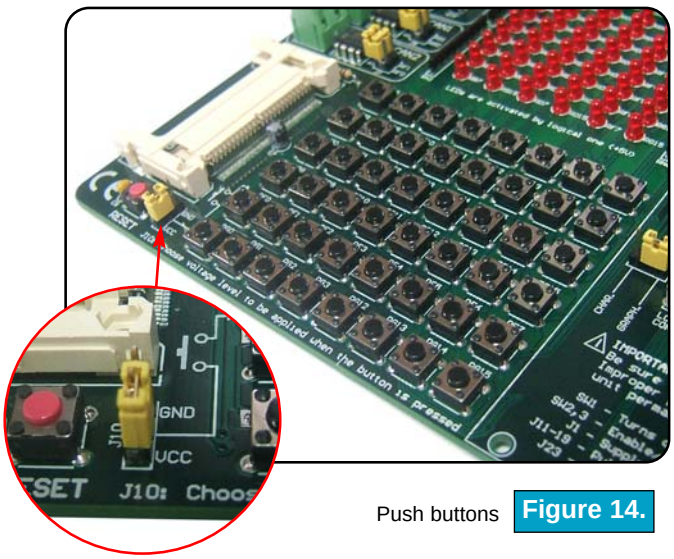


PUSH BUTTONS

The dsPICPRO has 48 push buttons, which can be used to provide digital inputs to the microcontroller's ports. There is also one push button that acts as a RESET (Figure 13).



Reset button **Figure 13.**



Push buttons **Figure 14.**

Jumper J10 (zoomed on the figure 14) determines whether a button press will bring logical zero or logical one to the appropriate pin.

Buttons connection to ports RB_Low, RB_High, RD_Low, RD_High, RF and RG is shown in Fig. 15. In this example, the buttons are connected to +5V. In order to detect a button state, pull-up or pull-down resistors should be used.

Which one of those two, depends on how J10 is set. It is illustrated on the next page. For the example shown in Fig. 15, pull-down resistors would be required.

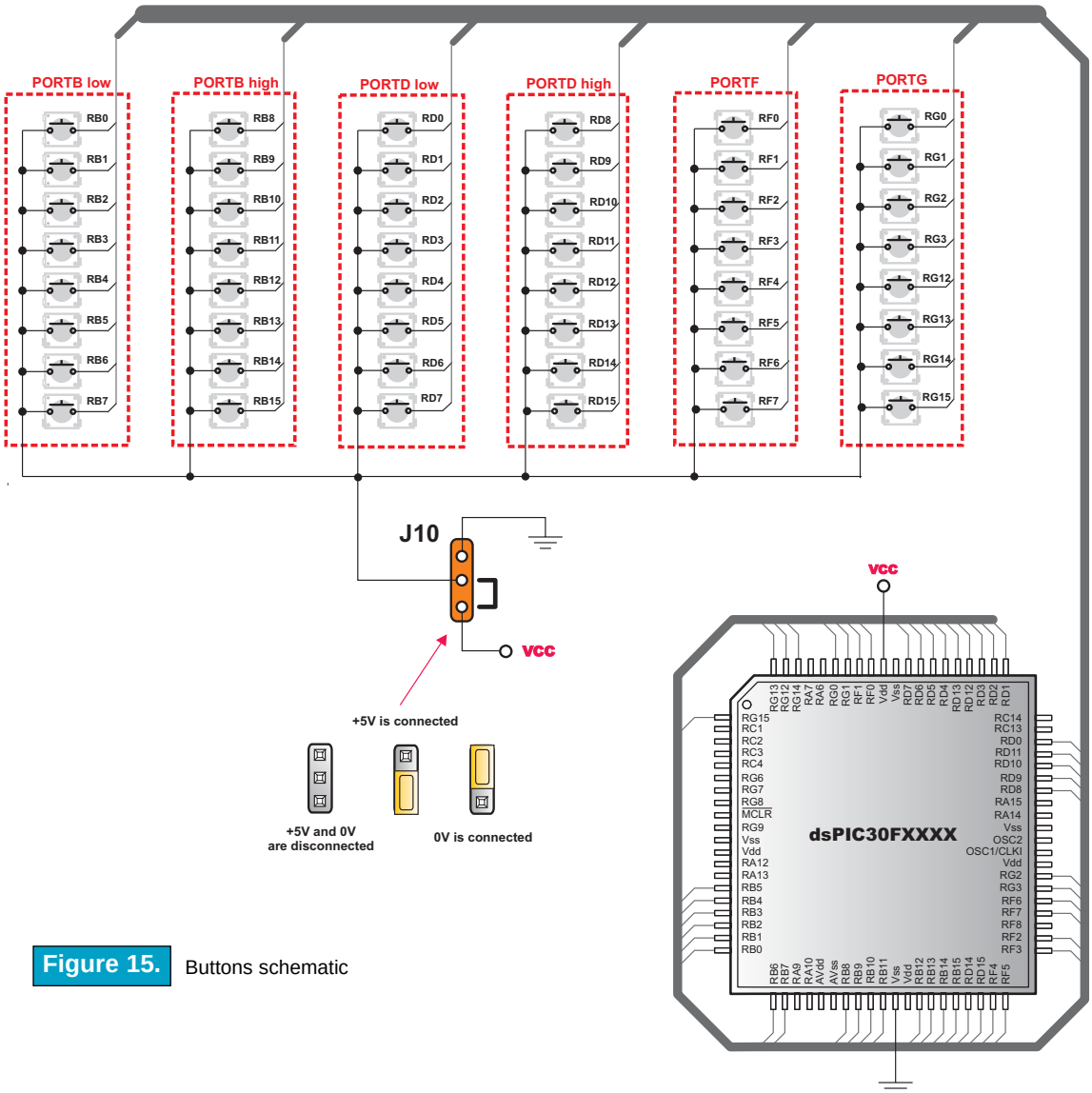


Figure 15. Buttons schematic

In the case of Fig. 16 the pull-up resistor pulls the microcontroller port pin to +5V when the button is not pressed. A button press causes the port pin to be connected to ground (J10 is in the lower position). Thus, only when the button is pressed will the microcontroller sense a logical zero; otherwise the pin state will always be logical one.

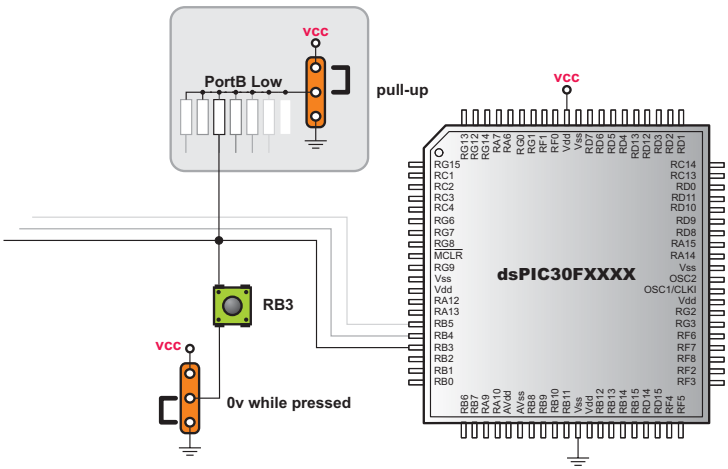


Figure 16. Button with pull-up resistor

In the case of Fig. 17 the pull-down resistor pulls the microcontroller port pin to ground when the button is not pressed. A button press causes the port pin to be connected to +5V (J10 is in the upper position). Thus, only when the button is pressed will the microcontroller sense a logical one; otherwise the pin state will always be logical zero.

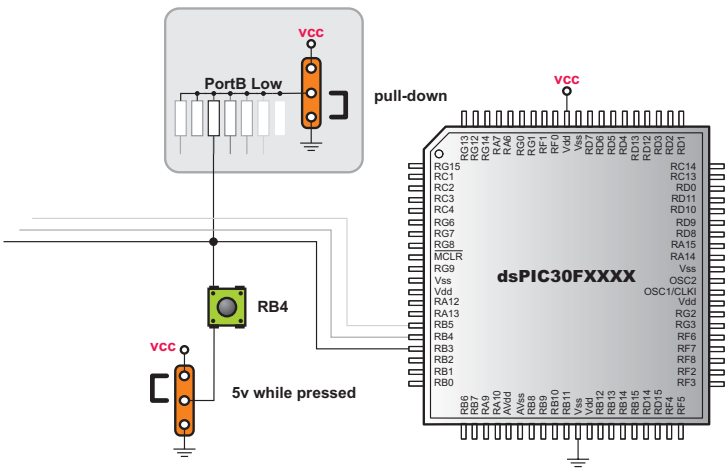
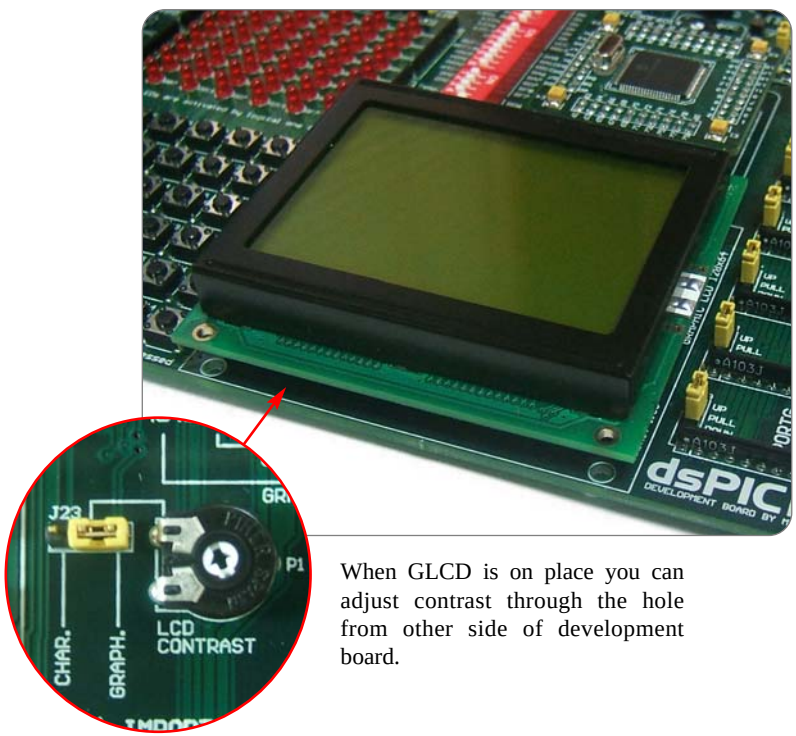


Figure 17. Button with pull-down resistor

GRAPHIC LCD

The 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 a screen resolution of 128x64 pixels. Before a GLCD is connected, the user needs to set jumper J23 (Fig. 18) to the right-hand position. The GLCD's contrast can be adjusted using potentiometer P1. Jumper J23 and potentiometer P3 are placed on the area of the GLCD. When GLCD is on place you can adjust contrast through the hole from other side of development board.

Figure 18. GLCD



When GLCD is on place you can adjust contrast through the hole from other side of development board.

In order to enable GLCD, jumper J23 should be set to the position labeled as GRAPH.

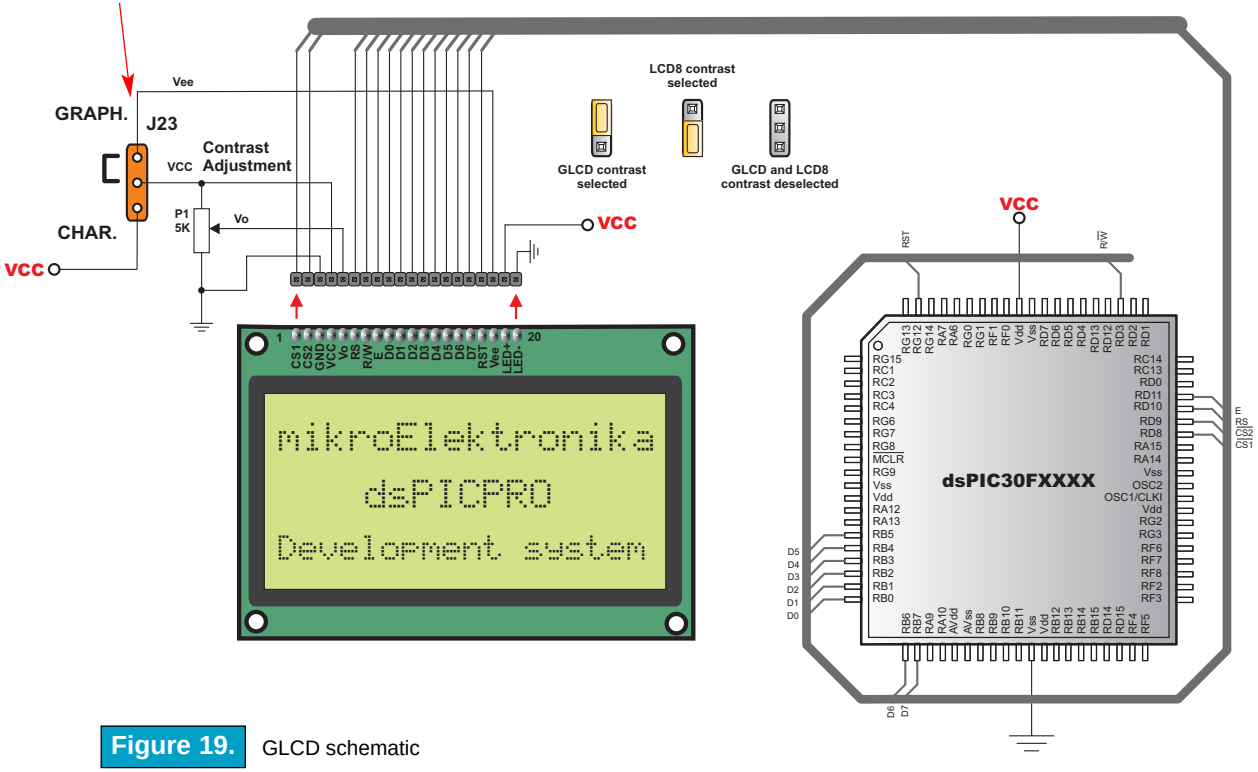


Figure 19. GLCD schematic

LCD 2X16

When using a character LCD, 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.

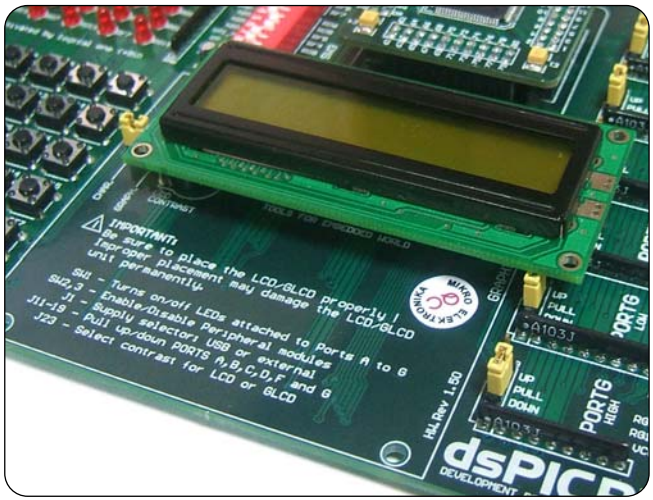


Figure 20.

LCD 2x16

Before adding the LCD, set jumper J23 to the left-hand position, labeled as CHAR. The LCD's contrast can be adjusted using potentiometer P1. Jumper J23 and potentiometer P3 are placed on the area of the GLCD. When GLCD is on place you can adjust contrast through the hole from other side of development board.

In order to enable LCD, jumper J23 should be set to the position labeled as CHAR.

LCD 8-bit mode schematic **Figure 21.**

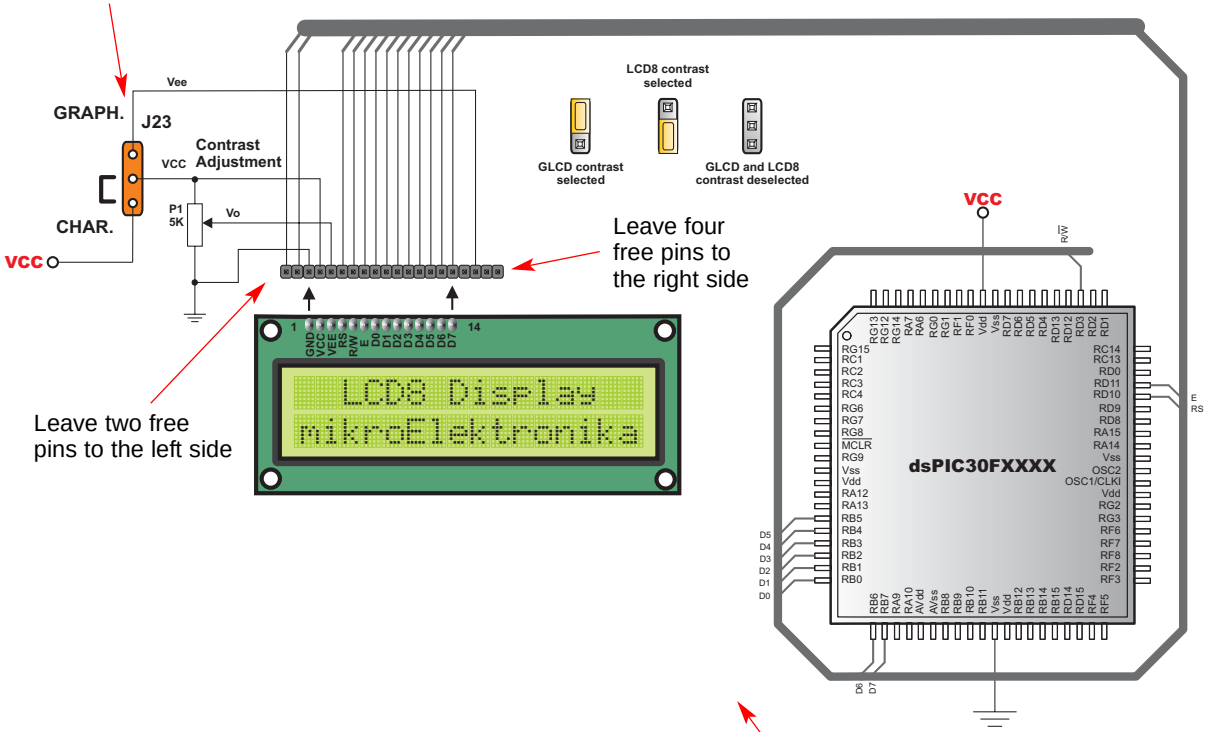
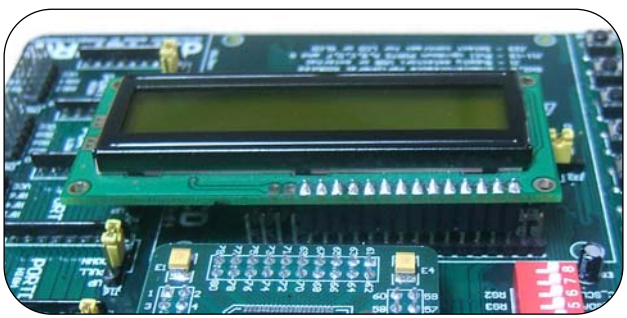


Figure 22. LCD shown from back



This schematic shows the connection for LCD in 8-bit mode. Only difference for connection of LCD in 4-bit mode is that LCD use only D0-D4 data lines.

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.

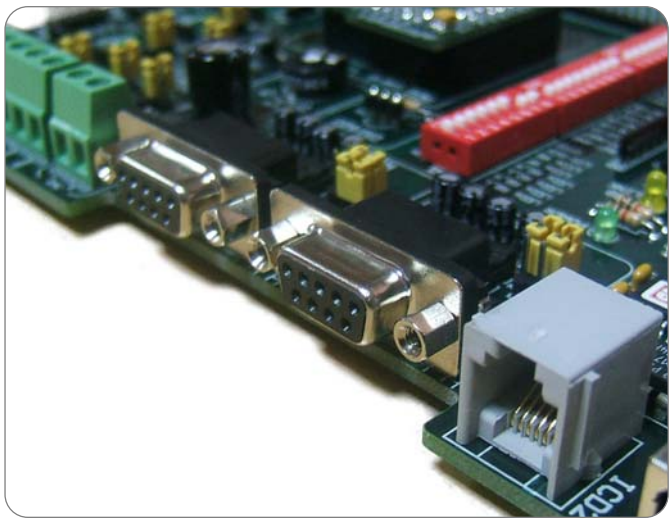


Figure 23.

RS232 connectors

dsPICPRO development board have two RS-232 communication devices, RS232-A and RS232-B. In order to provide a more flexible system, the microcontroller is connected to the MAX232 through jumpers. First two jumpers J2 and J3 are used to connect Rx and Tx lines from microcontroller to RS232-A port, and second two jumpers J4 and J5 for connecting Rx and Tx lines to RS232-B.

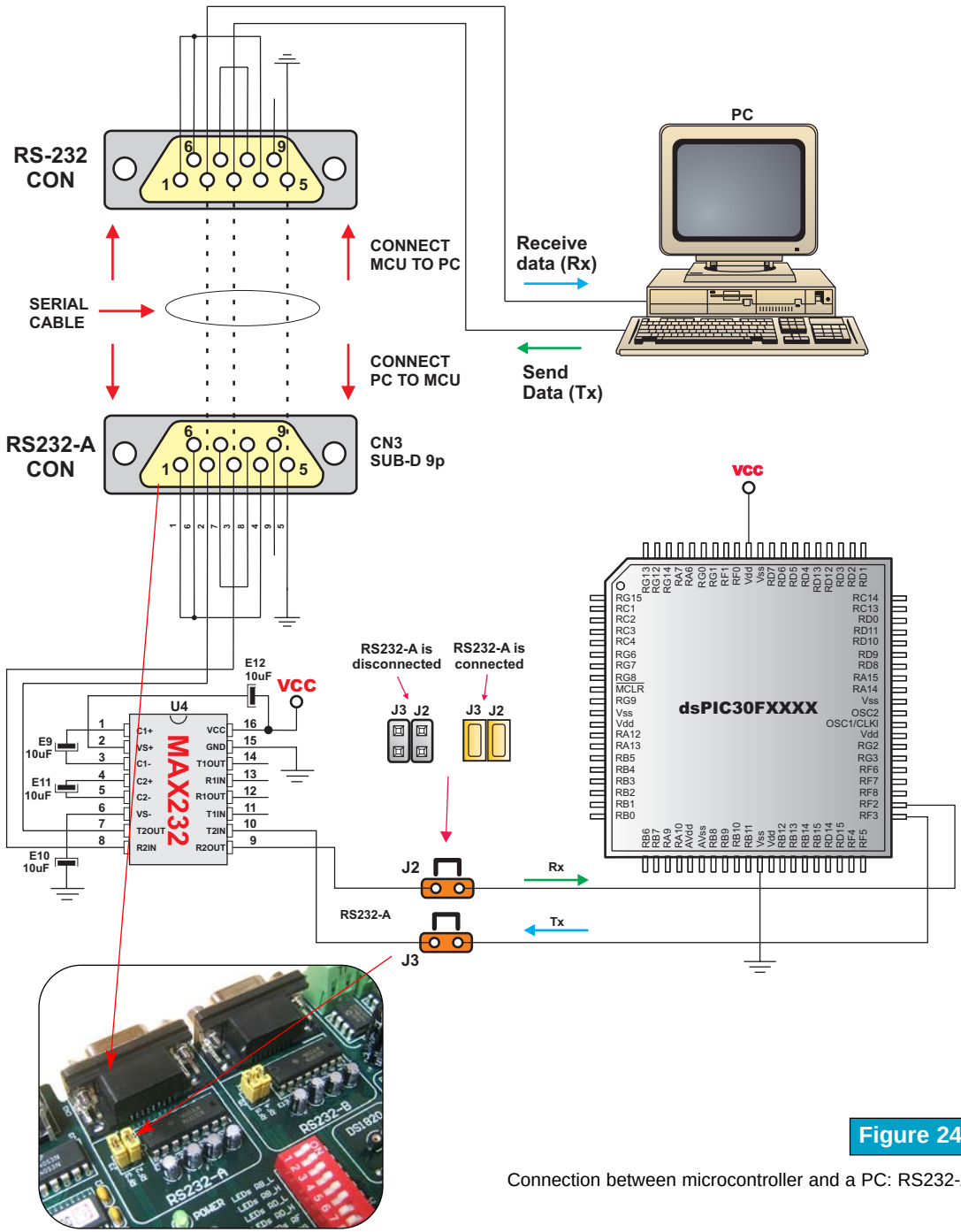


Figure 24.

Connection between microcontroller and a PC: RS232-A

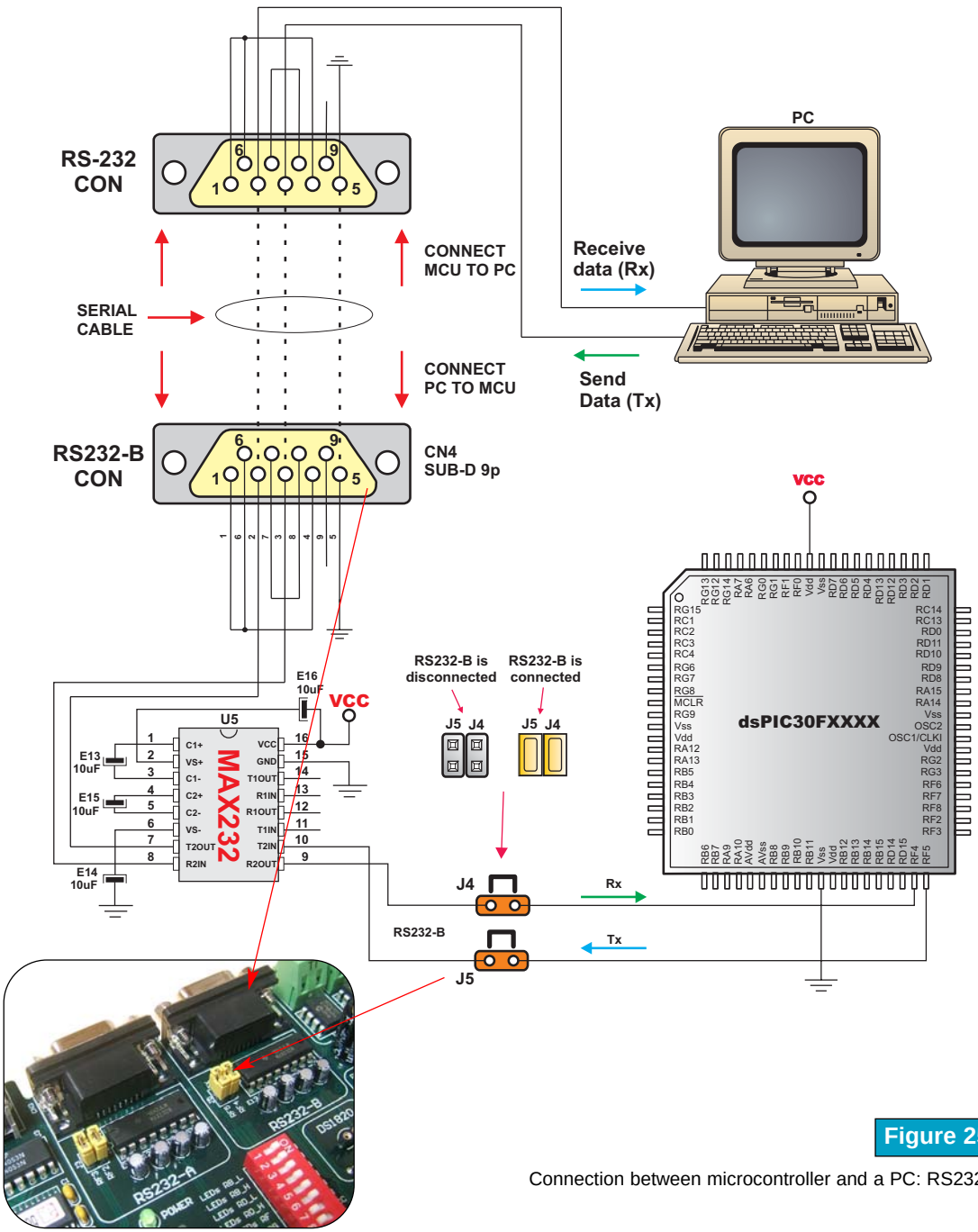


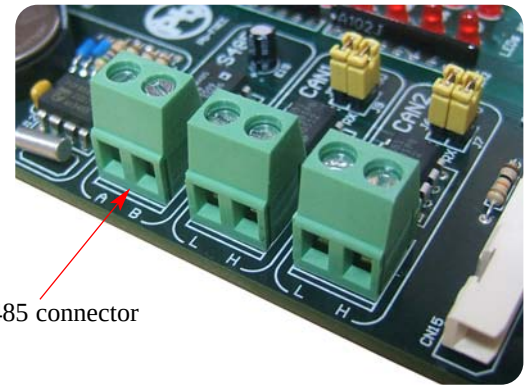
Figure 25.

Connection between microcontroller and a PC: RS232-B

RS-485 COMMUNICATION

RS-485 communication enables point-to-point and point-to-multipoint data transfer. It is commonly used for data transfer between several microcontrollers. LTC485 interface tranciever is used for transforming signal from microcontroller's Rx and Tx lines to differential signal on A and B output lines.

Figure 26. RS-485 connector



dsPICPRO development board have one RS-485 communication device. In order to provide a more flexible system, the microcontroller is connected to the LTC485 through three switches on **SW3**. Switches 2, 3 and 4 are used to connect Rt, Tx and Rx lines from microcontroller to RS-485 port.

LTC485 and RS-485 connector **Figure 27.**

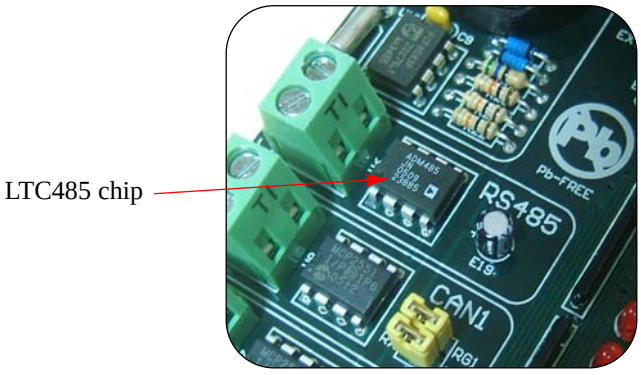
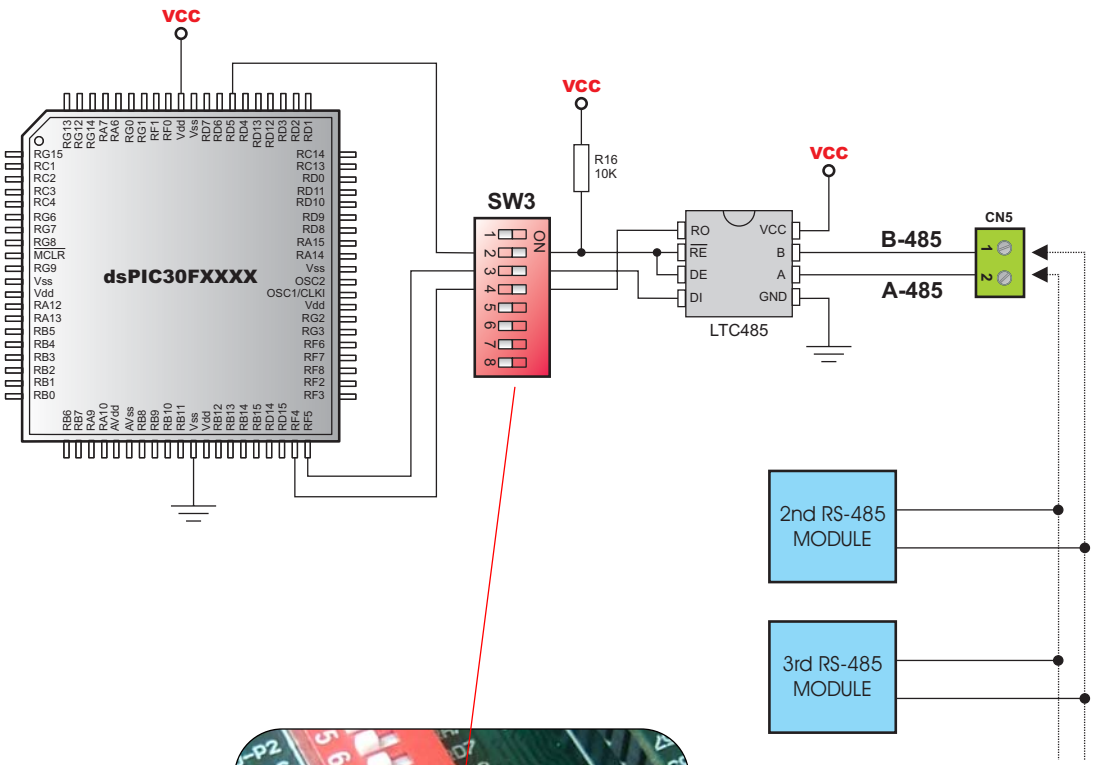


Figure 28. RS-485 schematic and connection to other RS-485 modules



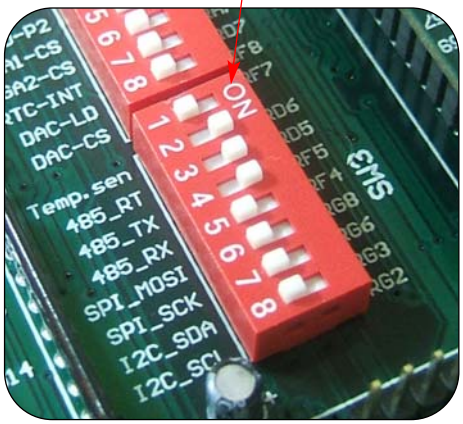
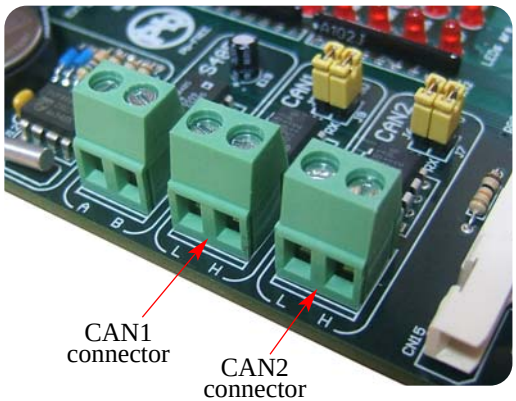


Figure 29.
RS-485 switches on SW3

CAN

CAN (Controller Area Network) is a serial network that was originally designed for the automotive industry, but has also become a popular bus in industrial automation as well as other applications. CAN is the network established among microcontrollers. It is a two-wire, half-duplex, high-speed network system. Half-duplex means that microcontroller can send and receive data, but only one way at a time.

Figure 30. CAN connectors



dsPICPRO development board have two CAN communication devices. In order to provide a more flexible system, the microcontroller is connected to the PCA82C250 through two jumpers for every CAN communication device. Jumpers J8 and J9 are used to connect Tx and Rx lines from microcontroller (pins RG1 and RG0) to CAN1. Jumpers J6 and J7 are used to connect Tx and Rx lines from microcontroller (pins RF1 and RF0) to CAN2.

CAN connectors and jumpers **Figure 31.**

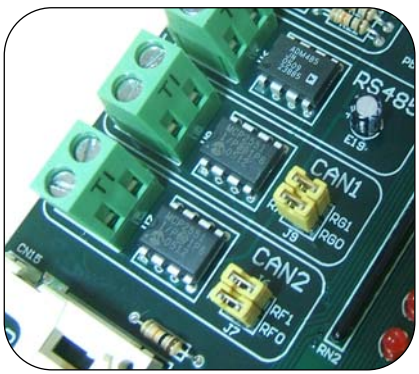
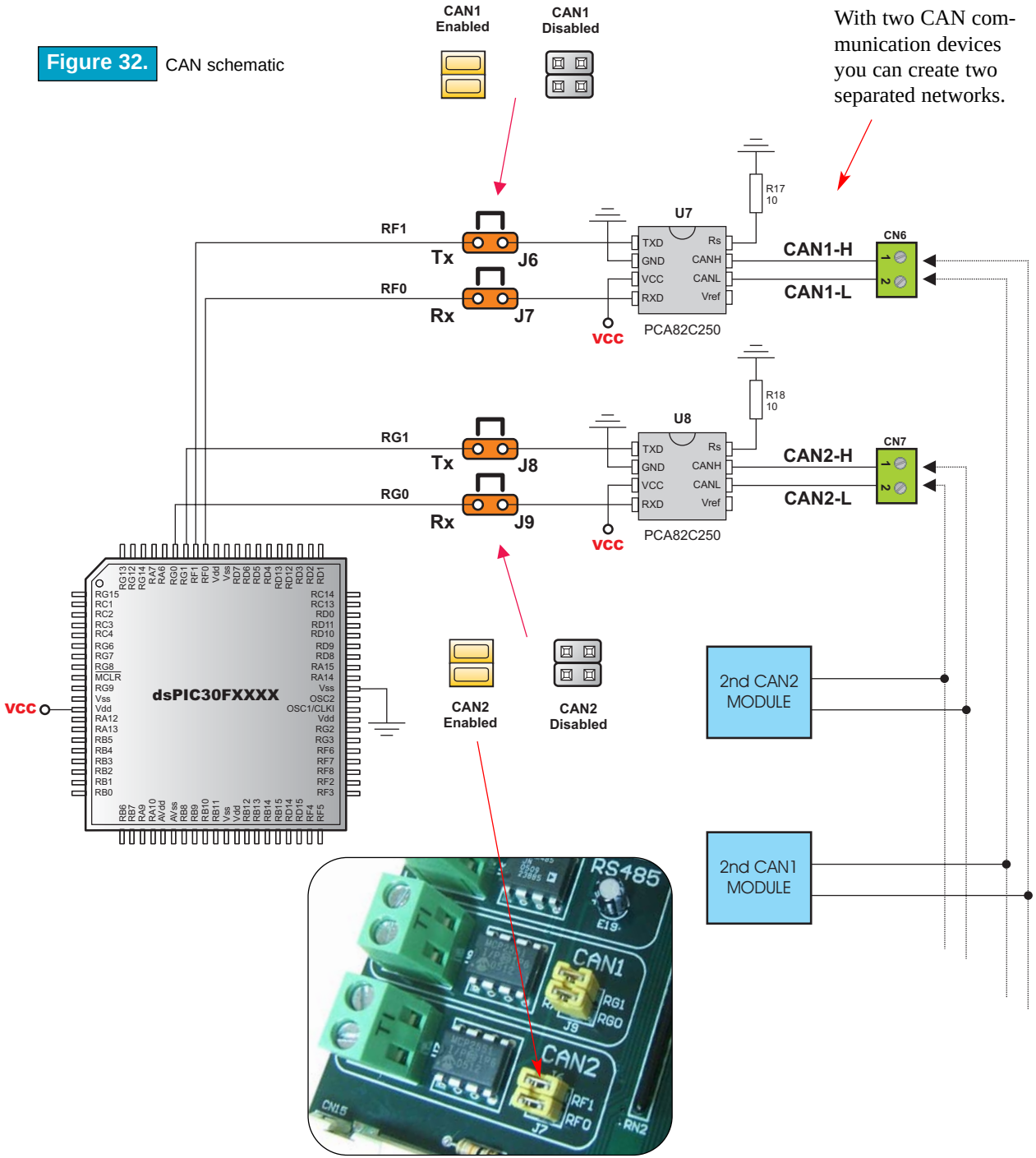


Figure 32. CAN schematic



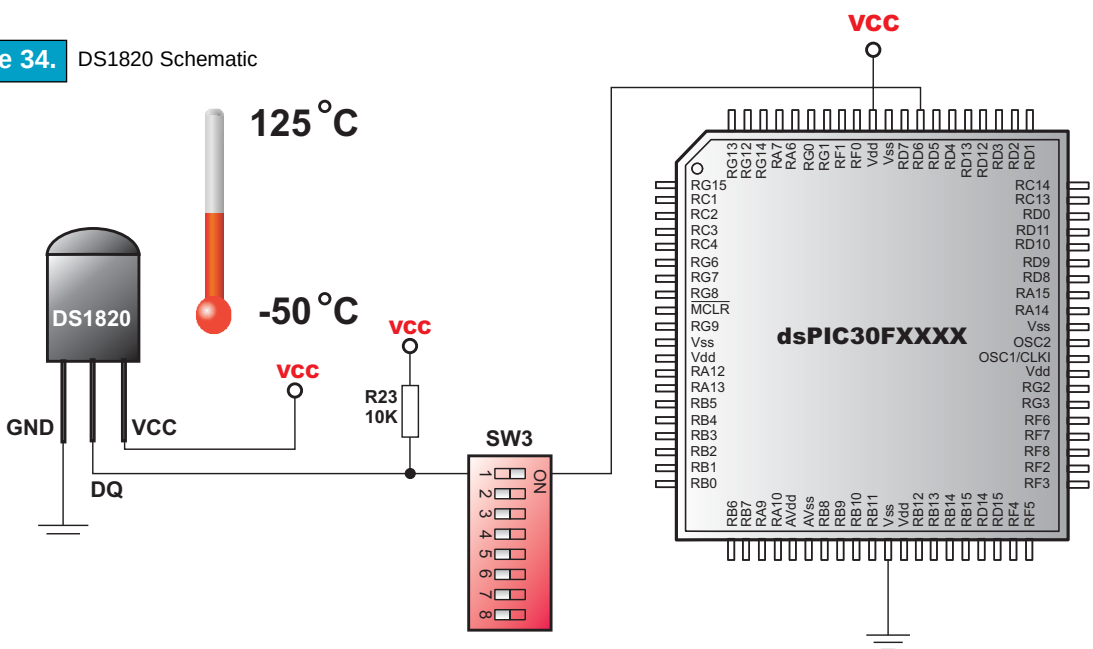
DS1820 DIGITAL THERMOMETER

Figure 33. 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 a temperature range of -55C to 125C and an accuracy of +/-0.5C. It must be placed correctly in the 3-pin socket provided on the dsPICPRO, with its rounded side to the bottom, as marked on the board. Otherwise the DS1820 could be permanently damaged. In order to work, DS1820 must be connected to microcontroller's RD6 pin, by enabling switch 1 on **SW3**.

Figure 34. DS1820 Schematic



A-D CONVERTER INPUT

dsPICPRO development board have eight analogue signal inputs for working with ADC. One of that inputs, potentiometer P2, is active when switch 3 on **SW2** is enabled and gives analogue signal to microcontroller's RB10 pin. Potentiometer analogue output is in the range of 0V to 5V as drawn on the board.

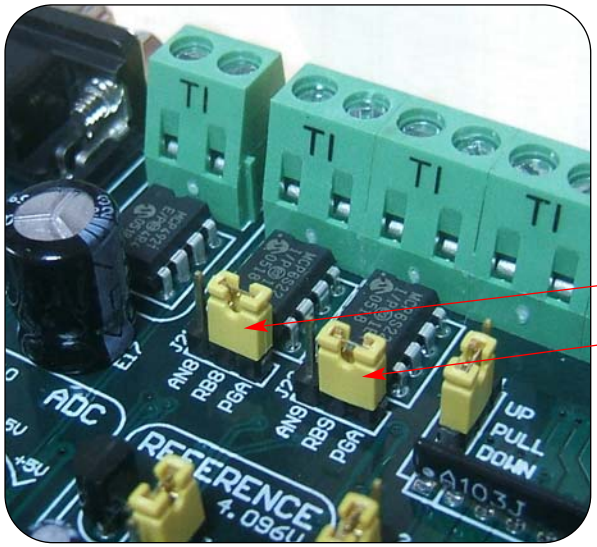


Figure 35.

Jumpers J21 and J22, PGA1 and PGA2

Jumpers J21 and J22 for connecting RB8 and RB9 directly to microcontroller or through PGA1 and PGA2

Connectors for analogue input are placed on the upper-right side of development board. Inputs AN10 to AN15 are connected directly to microcontroller RB10 to RB15 pins. Inputs AN8 and AN9 are connected to microcontroller RB8 and RB9 pins through jumpers J21 and J22, respectively. If jumpers J21 and J22 are placed on the left-hand position, then AN8 and AN9 are connected directly to pins RB8 and RB9, but if placed to the righ-hand position than AN8 and AN9 are connected to PGA (Programmabile Gain Amplifier).

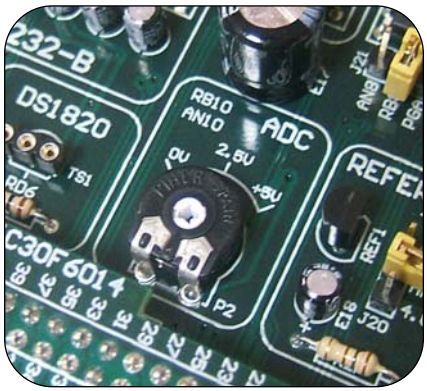


Figure 36.

Potentiometer P2

Both PGA integrated circuits (MCP6S22) are connected to microcontroller through SPI communication and have CS signal (Chip Select). In order to work properly, SPI communication must be enabled by setting switches 5 and 6 on **SW3** in ON position (needs only SCK and MOSI because PGA only receives data from microcontroller - data about amount of gain that will be applied to input signal). Also, PGA-CS1 and PGA-CS2 must be enabled (switches 4 and 5 on **SW2**). In order to measure an analogue signal without interference, the pull-up/down jumper should be removed from PORTB high. In this way high pins of PORTB remain floating.

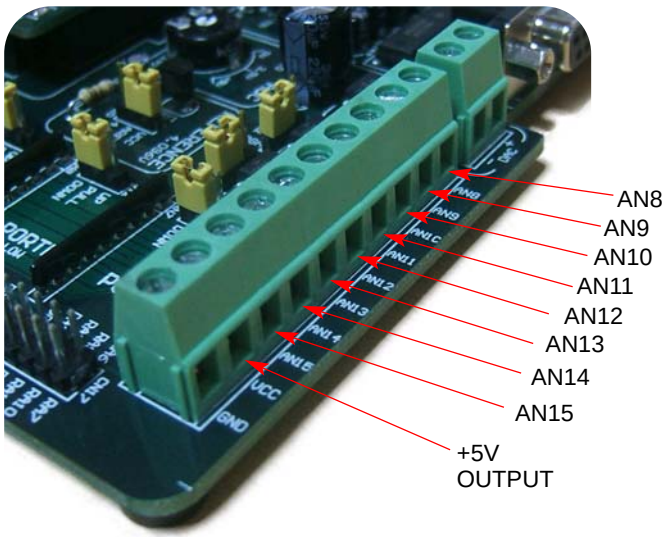
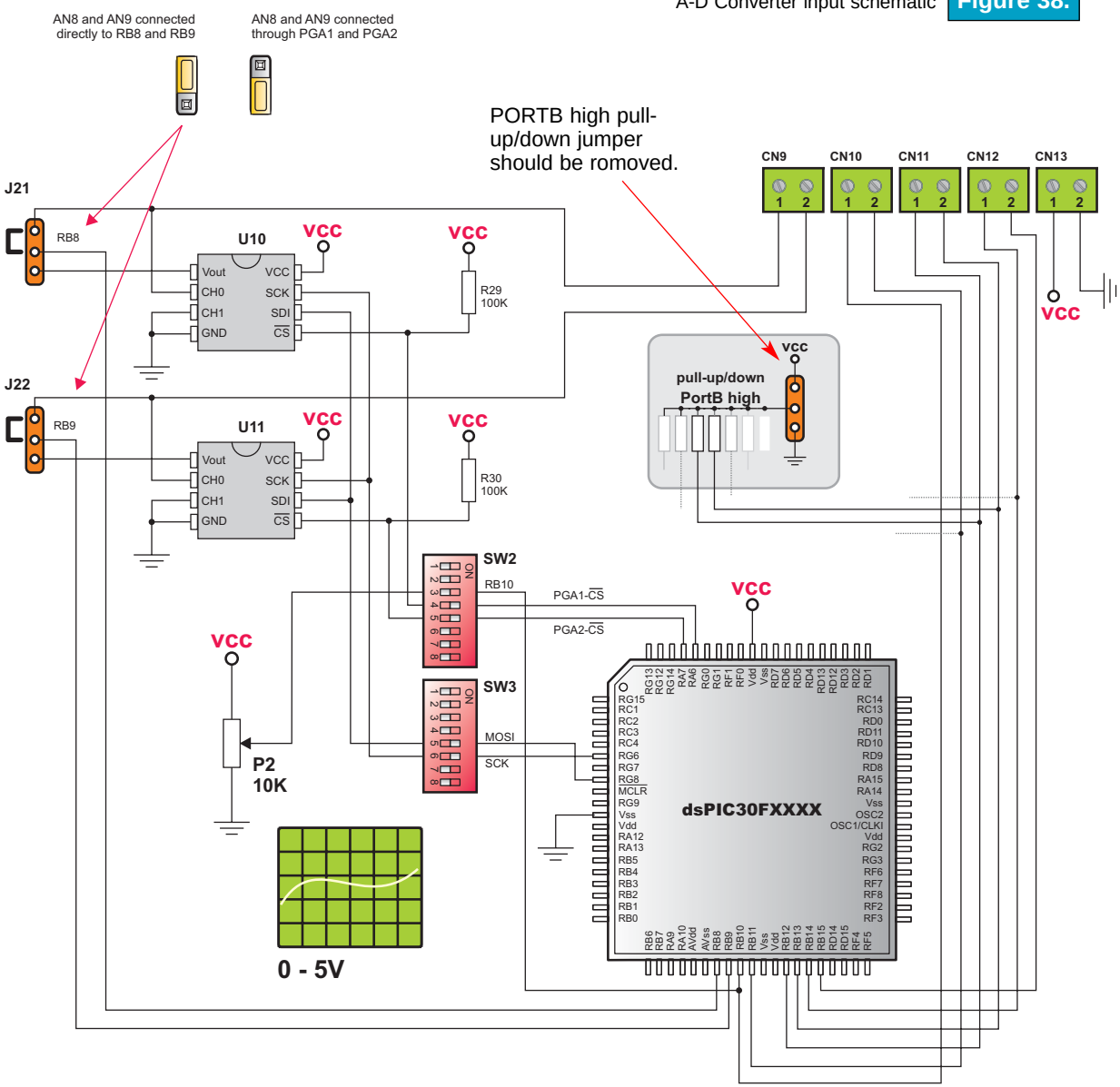


Figure 37. Analogue input connectors

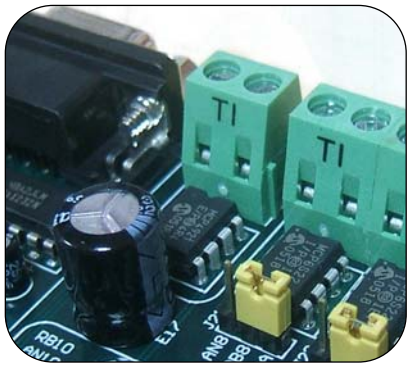
Complete A-D Converter input schematic, along with PGA, is shown on the next page.

A-D Converter input schematic **Figure 38.**



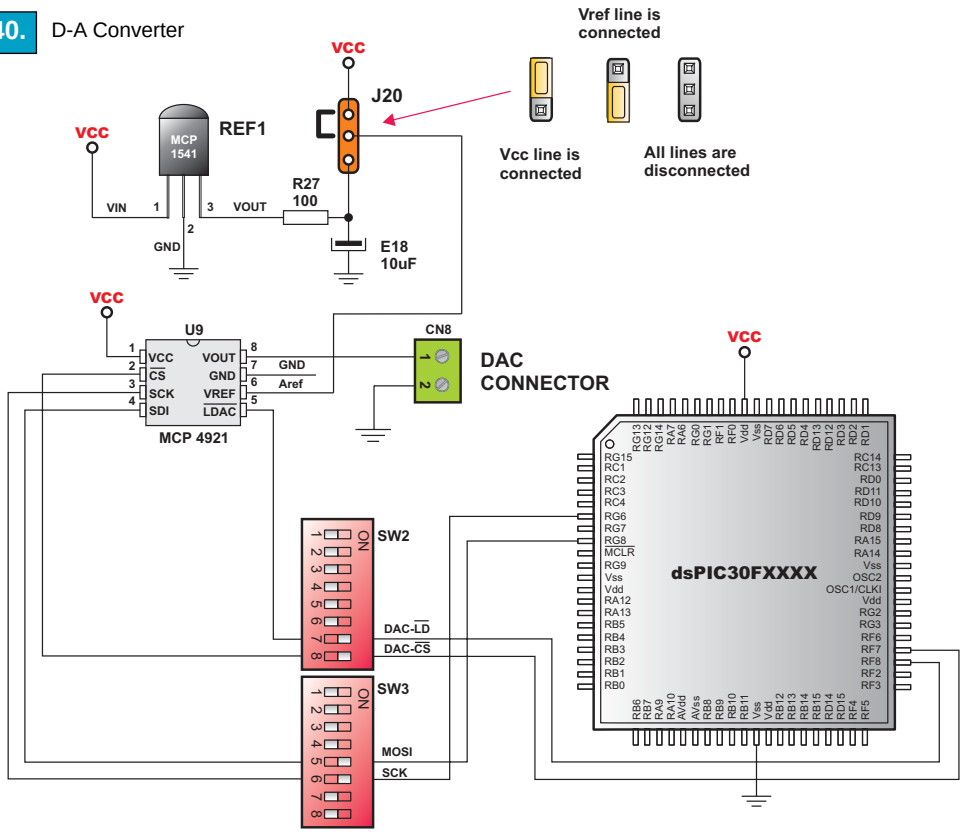
D-A CONVERTER OUTPUT

DsPICPRO development board have DAC (Digital-to-Analogue Converter) that can simulate analogue output from 0-5V or from 0-4.096V depending of voltage reference. DAC-LD# and DAC-CS# pins must be connected from microcontroller to DAC, which is established by putting switches 7 and 8 on **SW2** in ON position. Also reference must be chosen by placing jumper J20 in desired position (reference voltage 5V or 4.096V). DAC use SPI communication so sitches 5 and 6 on **SW3** must be enabled.



D-A Converter **Figure 39.**

Figure 40. D-A Converter



DIRECT PORT ACCESS

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

These connectors can be used for system expansion with external boards such as Serial GLCD, IrDA, Compact Flash, RS-485, etc. Ensure that the on-board peripherals are diconnected from microcontroller by setting the appropriate jumpers or switches, while external peripherals are using the same pins. The connectors can also be used for attaching logic probes or other test equipment.

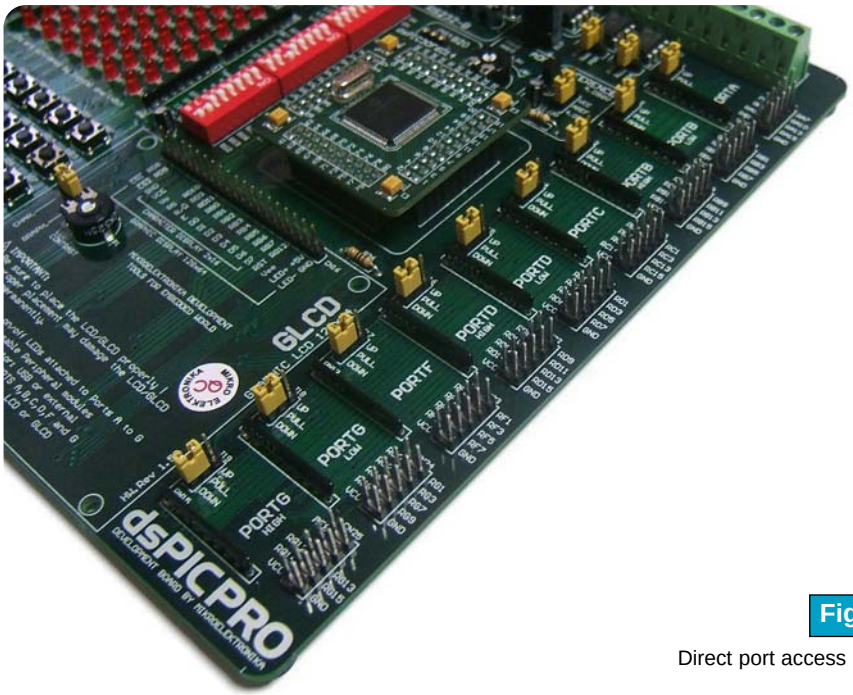
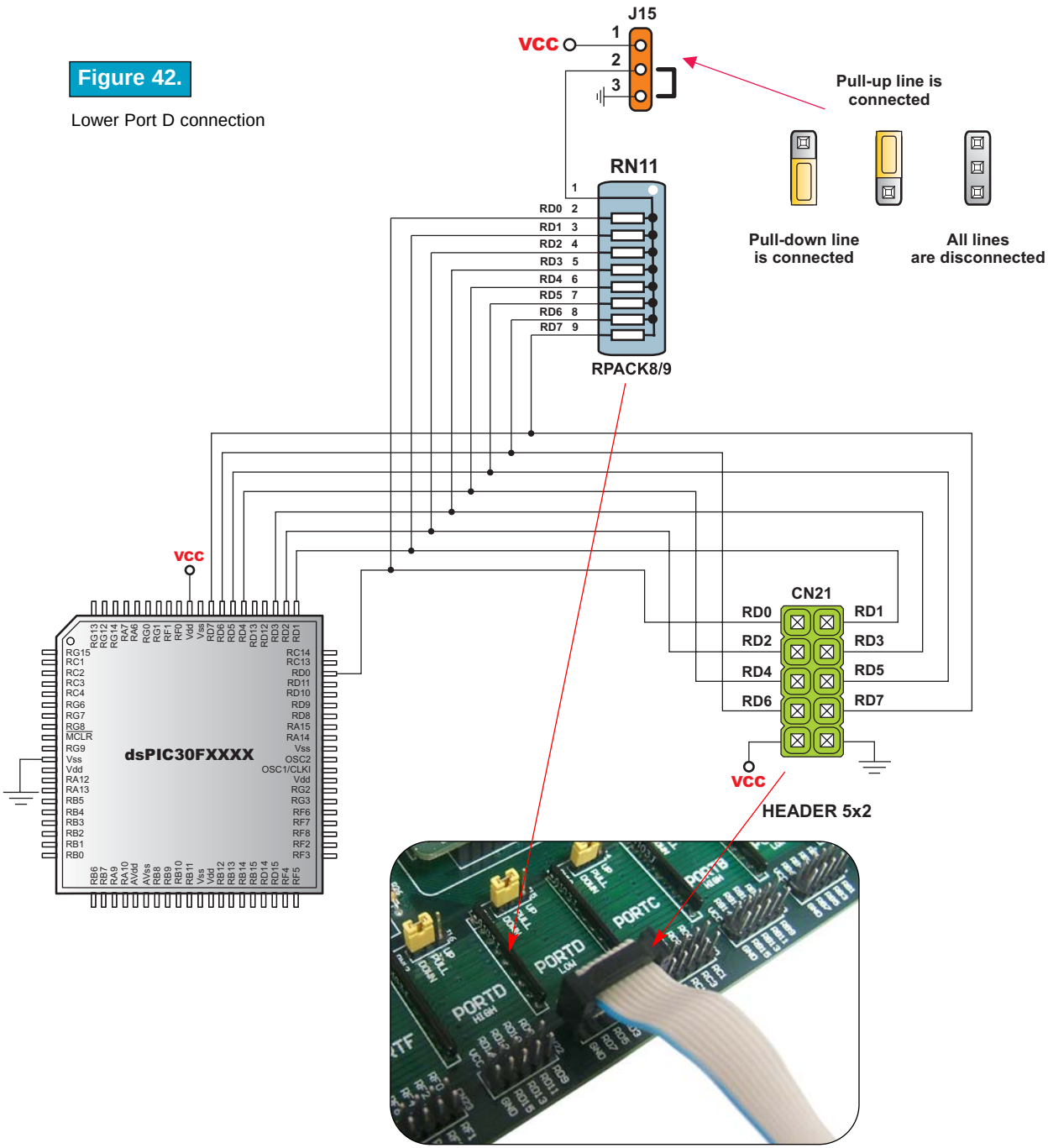


Figure 41.
Direct port access connectors

Figure 42.

Lower Port D connection



COMPACT FLASH

Compact Flash is a small removable mass storage device. The application of Compact Flash include digital cameras, digital music players, desktop computers, handheld PCs, personal communicators, Palm PCs, Auto PCs etc. so you can easily exchange data from them and dsPICPRO development board. Compact Flash have non-volatile storage solution that does not require a battery to retain data indefinitely.

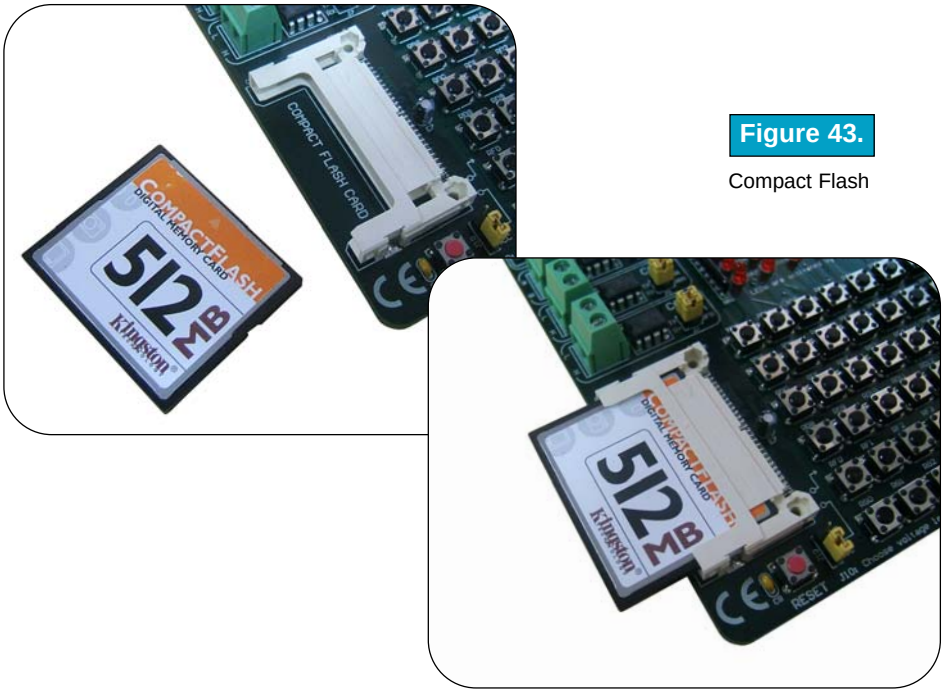
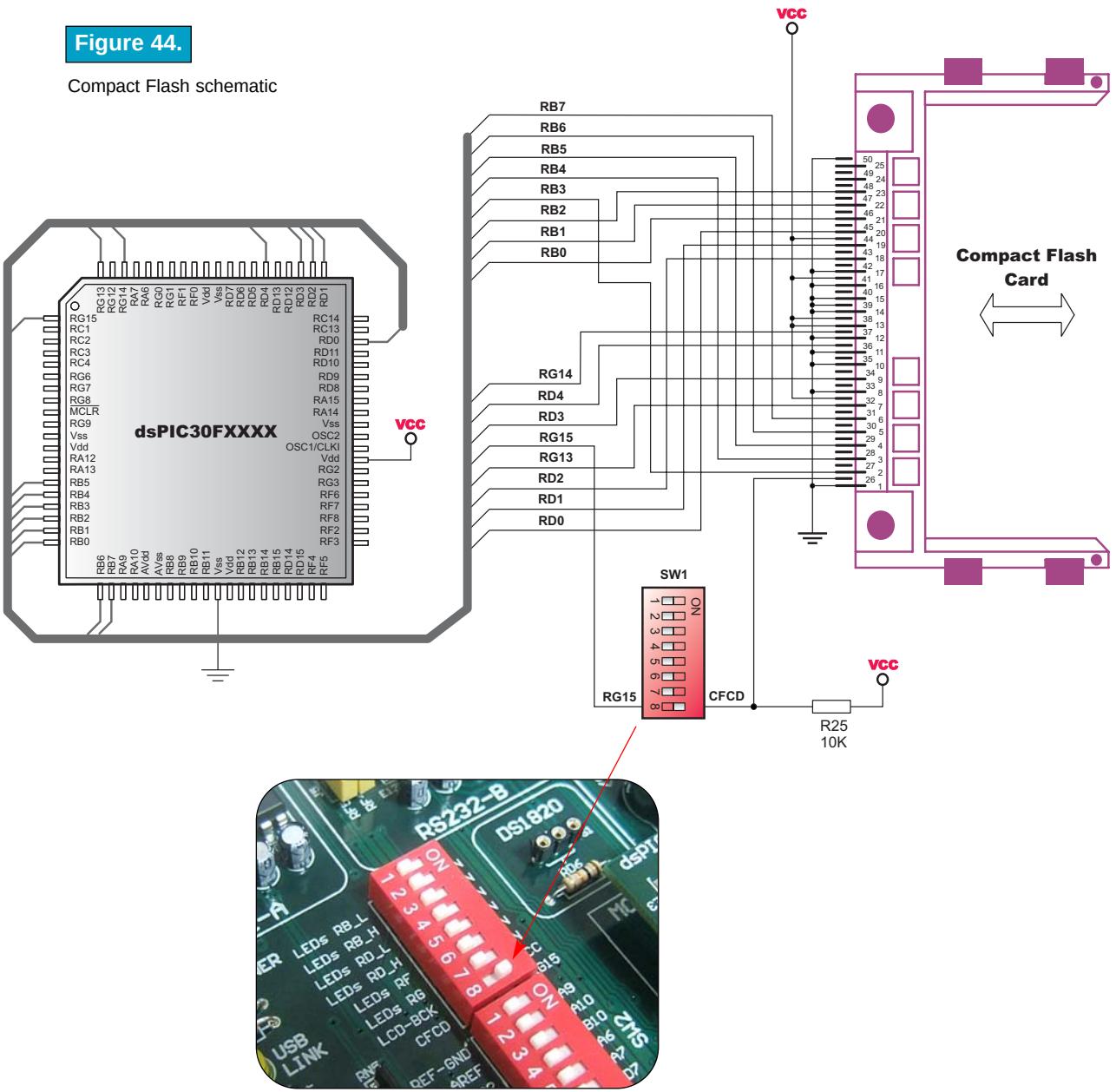


Figure 43.
Compact Flash

In order to detect when Compact Flash card is inserted, CFCD line is pulled high and it must be connected to microcontroller's pin RG15 by placing switch 8 on **SW1** in ON position. When Compact Flash card is inserted it drops CFCD level low and it can be detected by microcontroller. Compact Flash schematic is shown on Figure 44.

Figure 44.

Compact Flash schematic



REAL TIME CLOCK (RTC)

Figure 45. Real Time Clock

In many hardware projects there are needs for real time clock or delay source. Such devices as clocks, timers, etc. are impossible to product without knowledge of exact time. Real Time Clock on dsPICPRO development board is PCF8583P, and it use I2C serial communication to exchange informations with microcontroller. Also, it has one interrupt output. In order to work properly, both interupt and I2C communication lines must be connected to microcontroller by placing switch 6 on **SW2**, and switches 7 and 8 on **SW3** in ON position.

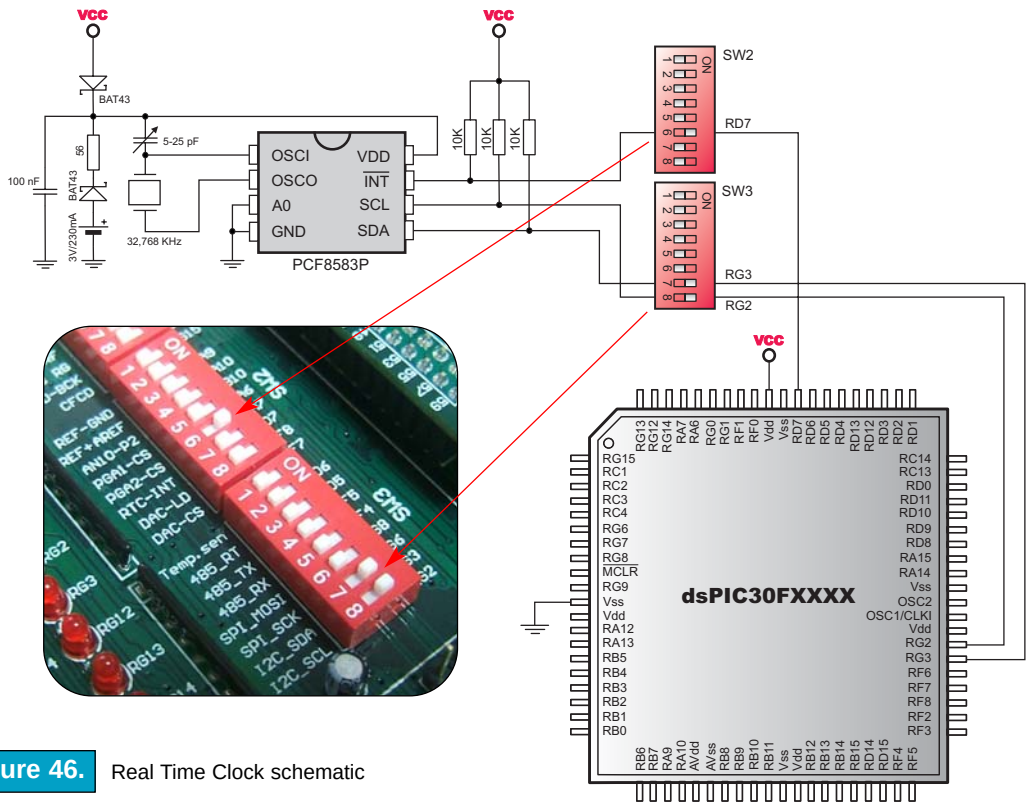


Figure 46. Real Time Clock schematic

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