LV 18F v6™

User manual

All MikroElektronika´s development systems represent irreplaceable tools for programming and developing microcontroller-based devices. Carefully chosen components and the use of machines of the last generation for mounting and testing thereof are the best guarantee of high reliability of our devices. Due to simple design, a large number of add-on modules and ready to use examples, all our users, regardless of their experience, have the possibility to develop their project in a fast and efficient way.

Development System

MikroElektronika

SOFTWARE AND HARDWARE SOLUTIONS FOR EMBEDDED WORLD ...making it simple

TO OUR VALUED CUSTOMERS

I want to express my thanks to you for being interested in our products and for having confidence in mikroElektronika.
The primary aim of our company is to design and produce high quality electronic products and to constantly improve the performance thereof in order to better suit your needs.

Nebojsa Matic
General Manager

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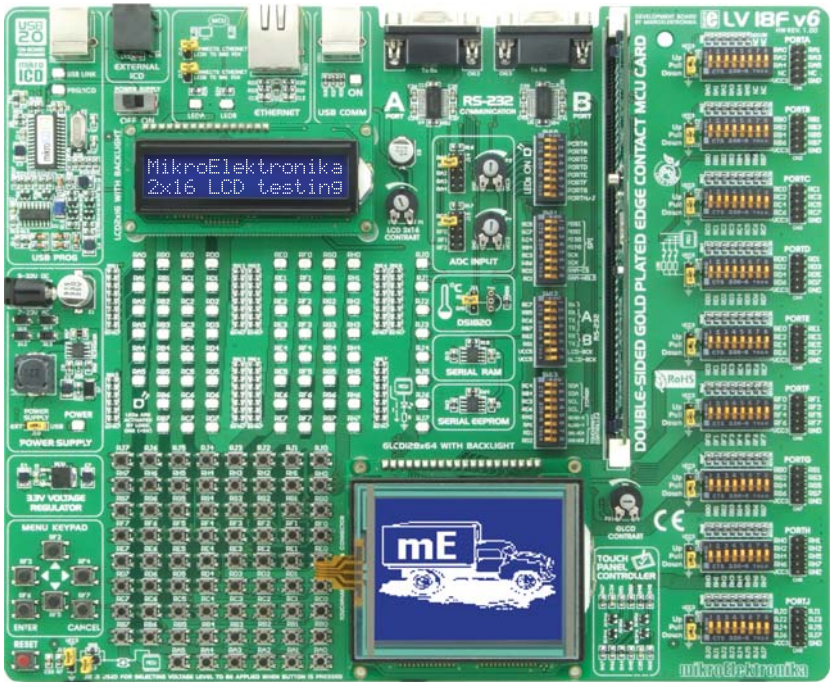
Introduction to LV 18F v6 Development System

The *LV 18F v6*™ development system is an extraordinary development tool suitable for programming and experimenting with PIC® microcontrollers from Microchip®. The system includes an on-board programmer with mikroICD™ support providing an interface between the microcontroller and a PC. You are simply expected to write a program in one of the PIC compilers, generate a .hex file and program your microcontroller using the on-board *LV18PICprog*™ programmer. Numerous on-board modules, such as 128x64 graphic LCD display, alphanumeric 2x16 LCD display, serial EEPROM etc, are provided on the board and allow you to easily simulate the operation of the target device.



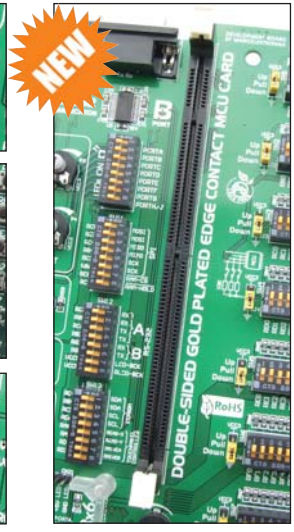
Full-featured and user-friendly development system for PIC 18Fxx microcontroller based devices

USB 2.0 on-board programmer

Hardware In-Circuit Debugger for step by step debugging at hardware level

Bult-in voltage regulator providing 3.3V required for the microcontroller operation

Graphic LCD display with backlight



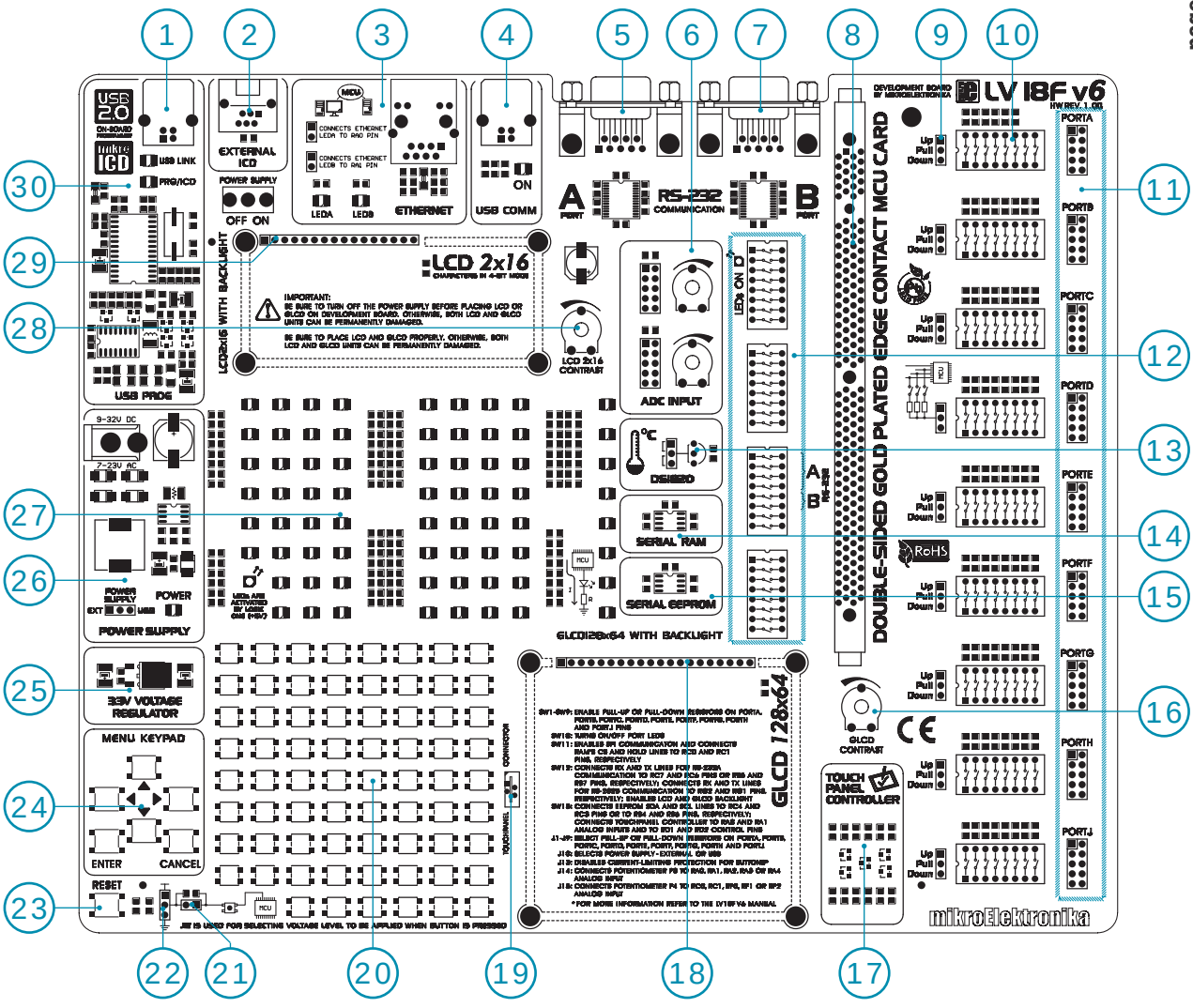
The *LV18PICflash* program for programming provides a complete list of all supported microcontrollers. The latest version of this program with updated list of supported microcontrollers can be downloaded from our website at **www.mikroe.com**

Package contains:

Development System:	*LV 18F v6*
CD:	product CD with appropriate software
Cables:	USB cable
Documentation:	*LV 18F v6* and *LV18PICFlash* manuals, quick guide for installing USB drivers, electrical schematic of the system

System specification:

Power supply:	over a DC connector (7-23V AC or 9-32V DC); or over a USB cable for programming (5V DC)
Power consumption:	40mA in idle state when all on-board modules are off
Dimension:	26,5 x 22cm (10,4 x 8,6inch)
Weight:	~404g (0.89lbs)



Key Features

1. On-board programmer's USB connector
2. Connector for Microchip's debugger (ICD2 or ICD3)
3. Ethernet module
4. USB communication interface
5. A connector for RS-232 communication
6. A/D converter test inputs
7. B connector for RS-232 communication
8. DIMM-168P connector for MCU card
9. Pull-up/pull-down resistor selection
10. DIP switch enables pull-up/pull-down resistors
11. I/O port connectors
12. DIP switch turns on/off integrated modules
13. DS1820 temperature sensor
14. Serial RAM
15. Serial EEPROM
16. Graphic LCD display contrast adjustment
17. Touch panel controller
18. Graphic LCD display connector
19. Touch panel connector
20. Push buttons simulate digital inputs
21. Shorting jumper for protective resistor
22. Selector for pins' logic state
23. Reset button
24. MENU keypad
25. 3.3V voltage regulator
26. Power supply voltage regulator
27. 70 LEDs indicate pins' logic state
28. Alphanumeric LCD display contrast adjustment
29. Alphanumeric LCD display connector
30. USB 2.0 with mikroICD support programmer

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1.0. Connecting the System to a PC

Step 1:

Follow the instructions provided in the relevant manuals and install the *LV18PICflash* program and USB drivers from the product CD. USB drivers are necessary for the proper operation of the on-board programmer.
In case you already have some of the MikroElektronika's PIC compilers installed on your PC, there is no need to reinstall USB drivers as they will automatically be installed along with the compiler.

Step 2:

Use the USB cable to connect the *LV 18F v6* development system to a PC. One end of the USB cable, with a connector of the USB **B** type, should be connected to the development system, as shown in Figure 1-2, whereas the other end of the cable (USB **A** type) should be connected to a PC. When establishing a connection, make sure that jumper J10 is placed in the USB position as shown in Figure 1-1.

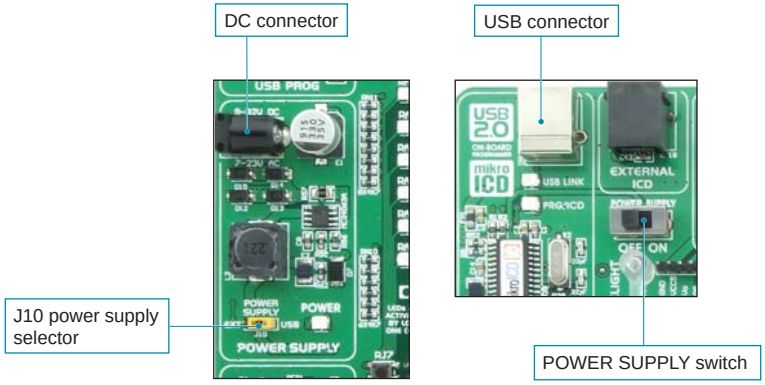


Figure 1-1: Power supply

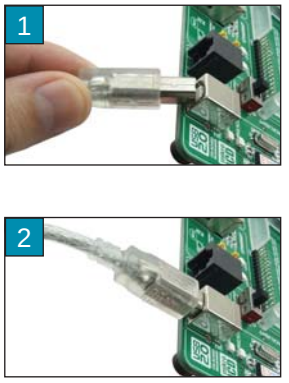


Figure 1-2: Connecting USB cable

Step 3:

Turn on your development system by setting the POWER SUPPLY switch to the ON position. Two LEDs marked as POWER and USB LINK will automatically illuminate indicating that your development system is ready to use. Use the on-board programmer and the *LV18PICflash* program to dump a code into the microcontroller and employ the system to test and develop your projects.

NOTE: If some additional modules are used, such as LCD, GLCD etc, it is necessary to place them properly on the development system while it is turned off. Otherwise, either can be permanently damaged. Refer to Figure below for the proper placing of additional modules.

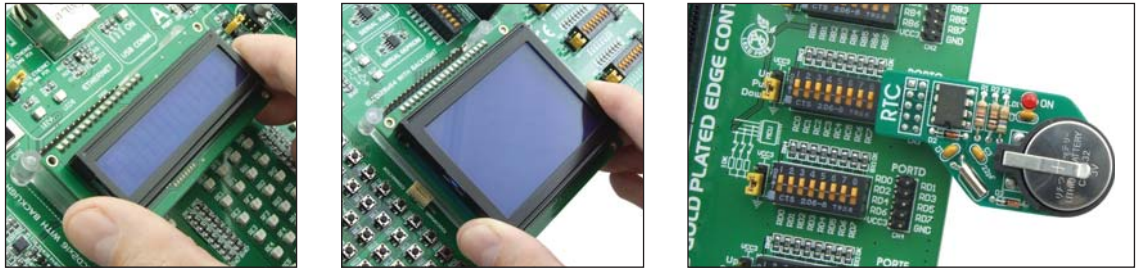


Figure 1-3 : Placing additional modules on the board

2.0. Supported Microcontrollers

The *LV 18F v6* development system provides a DIMM-168P connector to place an MCU card into. Such development system comes with an MCU card with an 80-pin microcontroller in TQFP package soldered on it, Figure 2-3. Besides, the MCU card alone provides an oscillator as well as 80 soldering pads connected to microcontroller pins. Each pad is marked same as the pin it is connected to. Soldering pads also make connection between the MCU card and target device's modules easy.

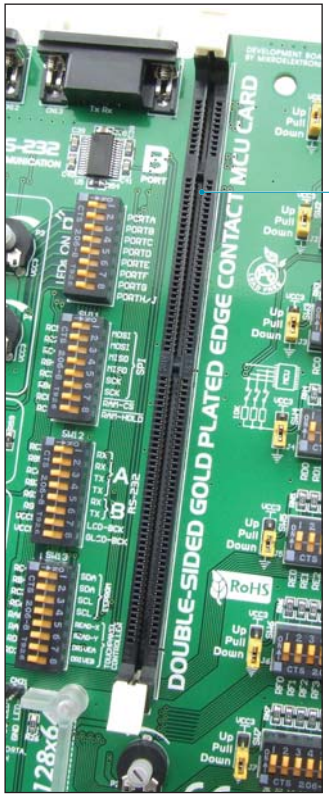


Figure 2-1: DIMM-168P connector

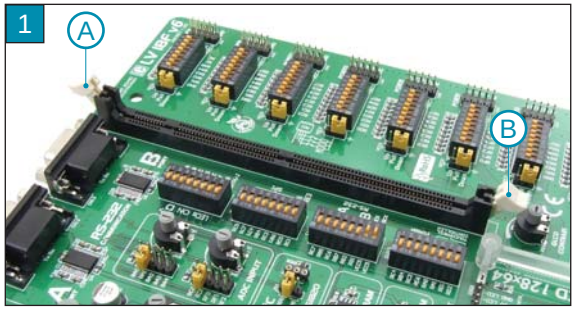
DIMM-168P connector for placing MCU card with microcontroller in TQFP package

Figure 2-2: DIMM-168P connector with MCU card placed

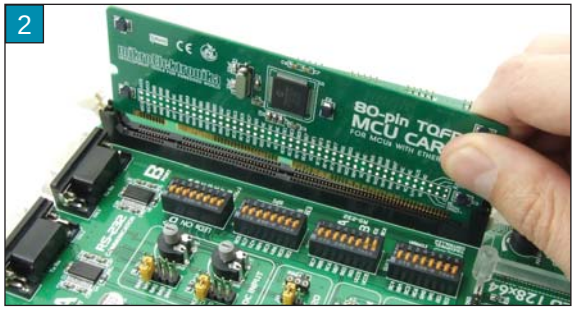
Figure 2-3: MCU card with 80-pin microcontroller in TQFP package soldered on it

Figure 2-4: Schematic of the DIMM-168P connector's pinout

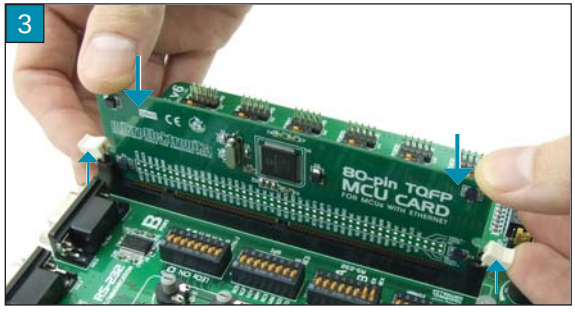
Placing MCU card into the DIMM-168P connector is performed as follows:



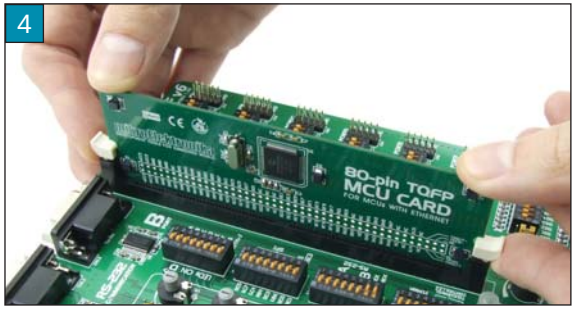
Open extraction levers A and B



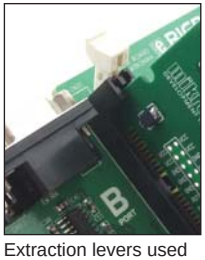
Place the MCU card into the DIMM-168P connector

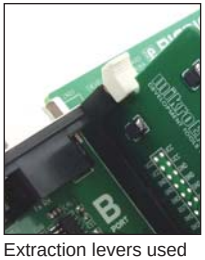


Push the MCU card down gently into the DIMM-168P connector and lift extraction levers slowly at the same time



Close the extraction levers when the MCU card is properly placed into the connector


Extraction levers used for fixing MCU card in the ‘open’ position


Extraction levers used for fixing MCU card in the ‘closed’ position

In addition to the MCU card with 80-pin microcontroller in TQFP package, there are also MCU cards with 64-pin microcontrollers in TQFP package which can be ordered separately. They are placed into the appropriate connector in the same manner as described above.

3.0. On-board USB 2.0 LV18PICprog with mikroICD Programmer

A programmer is a necessary tool when working with microcontrollers. The *LV 18F v6* has an on-board *LV18PICprog* programmer with *mikroICD* support which provides an interface between the microcontroller and the PC. The *LV18PICflash* program is used for loading a .hex file into the microcontroller. Figure 3-2 shows connection between the compiler, *LV18PICprog with mikroICD* programmer and the microcontroller.

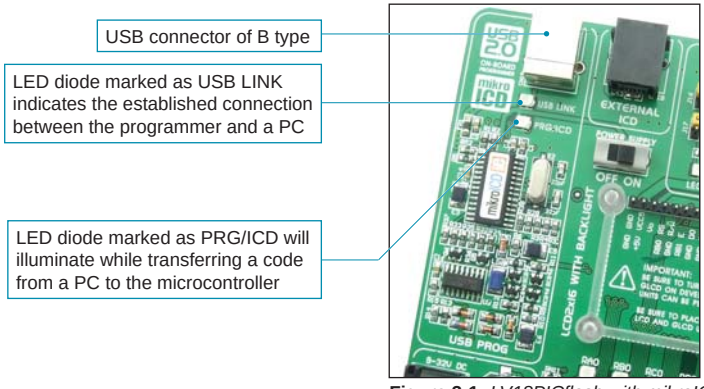


Figure 3-1: *LV18PICflash with mikroICD* programmer

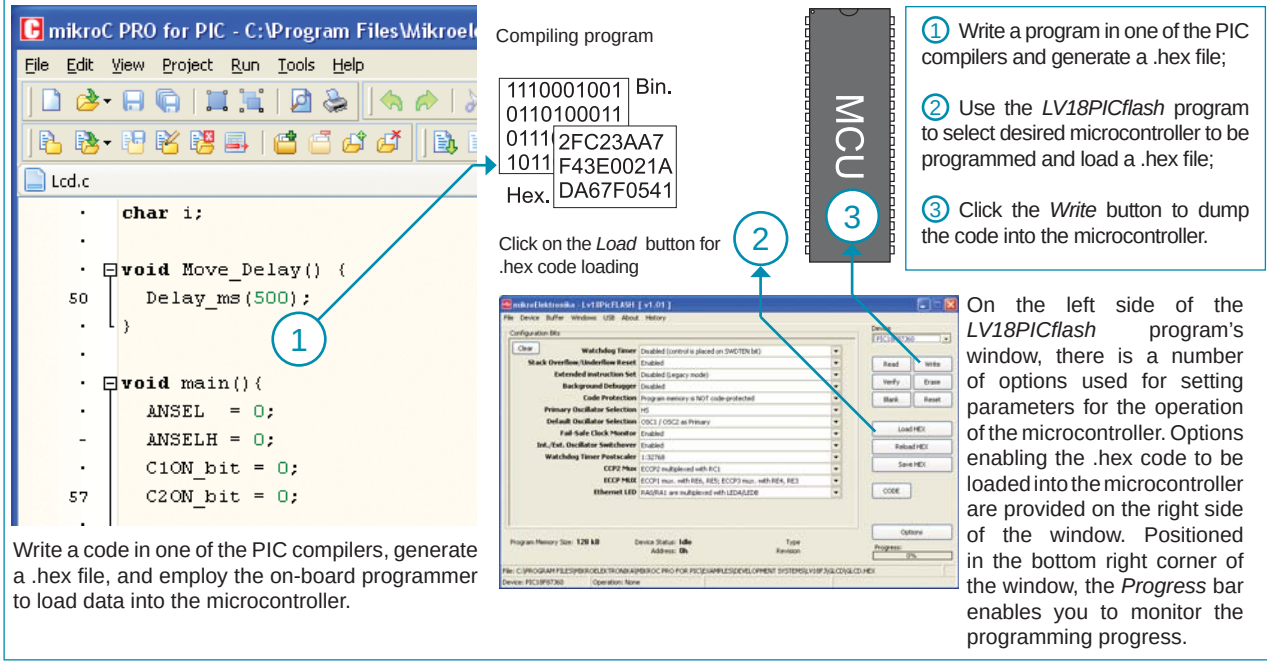


Figure 3-2: The process of programming

NOTE: For more information on the *LV18PICflash with mikroICD* programmer refer to the relevant manual provided with the system.

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All the settings related to the programming of the microcontrollers are automated. However, there is a number of options which enable additional programming settings provided in the *LV18PICflash* program. Beginners are not advised to use them.

One of the advantages offered by the on-board *LV18PICprog with mikroICD* programmer is a multiplexer. The principle of operation of the programmer with integrated multiplexer is shown in Figure 3-3.

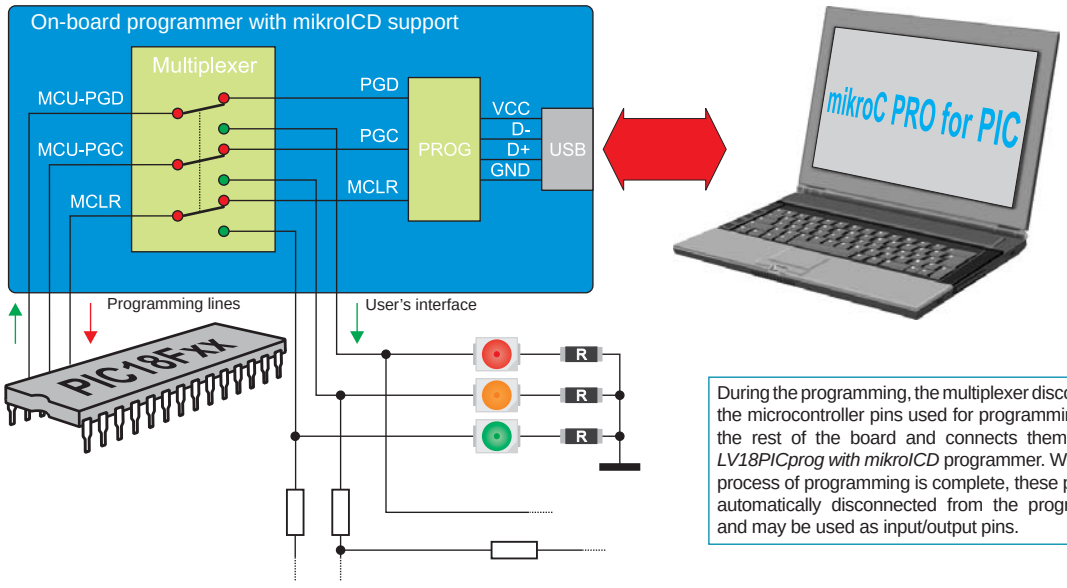
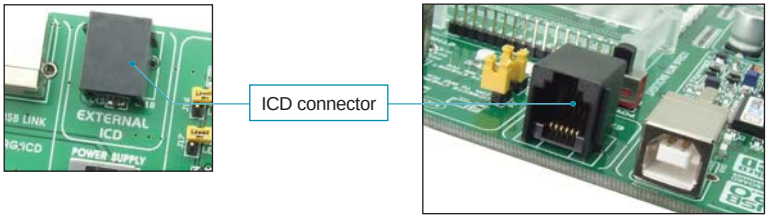


Figure 3-3: The principle of programmer's operation

4.0. ICD Connector

ICD connector (In-circuit Debugger) enables communication between the microcontroller and an external ICD debugger from Microchip (ICD2 or ICD3). Such connector is directly connected to the microcontroller and therefore no additional settings are needed.



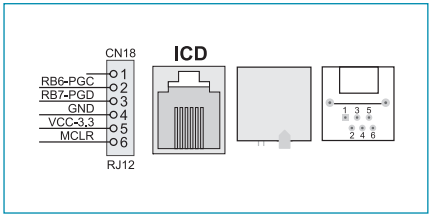


Figure 4-1: ICD connector's pinout and pin designations

5.0. mikroICD (In-Circuit Debugger)

The *mikroICD* (In-Circuit Debugger) is an integral part of the on-board programmer. It is used for testing and debugging programs in real time. The process of testing and debugging is performed by monitoring the state of all registers within the microcontroller while it operates in real environment. The *mikroICD* software is integrated in all PIC compilers designed by mikroElektronika (mikroBASIC PRO™, mikroC PRO™, mikroPASCAL PRO™ etc.). As soon as the *mikroICD* debugger starts up, the *Watch Values* window, as shown in Figure 5-1, appears on the screen. Communication between the *mikroICD* debugger and microcontroller is enabled via pins used for programming.

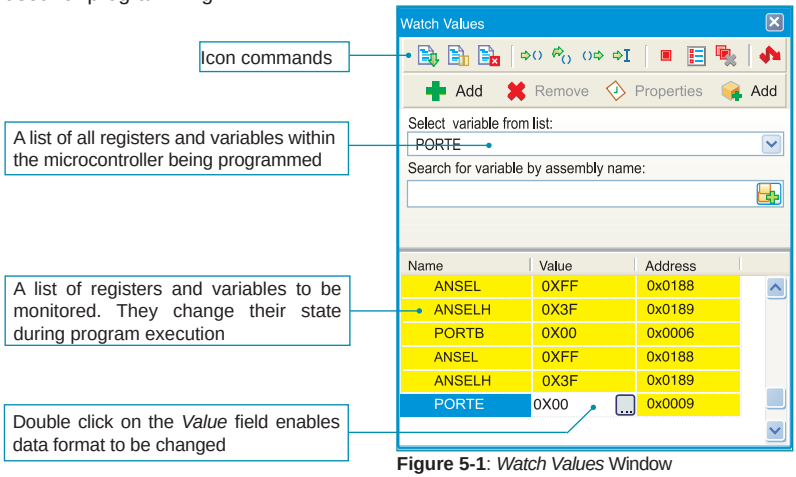


Figure 5-1: *Watch Values* Window

mikroICD debugger options:

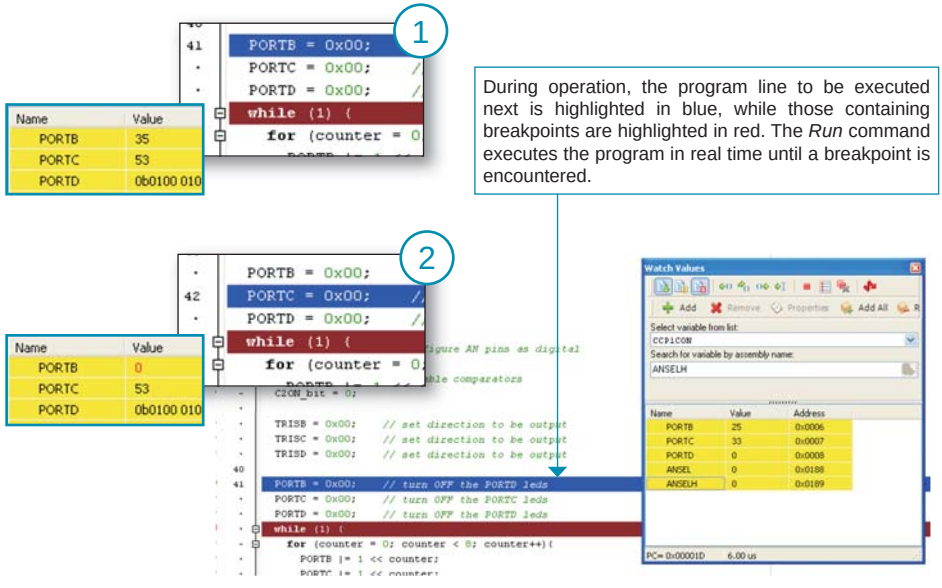
Start Debugger	[F9]
Run/Pause Debugger	[F6]
Stop Debugger	[Ctrl+F2]
Step Into	[F7]
Step Over	[F8]
Step Out	[Ctrl+F8]
Toggle Breakpoint	[F5]
Show/Hide Breakpoints	[Shift+F4]
Clear Breakpoints	[Ctrl+Shift+F4]

Each of these commands is activated via keyboard shortcuts or by clicking appropriate icon within the *Watch Values* window.

The *mikroICD* debugger also offers options such as running a program step by step (single stepping), pausing the program execution to examine the state of currently active registers using breakpoints, tracking values of some variables etc. The following example illustrates a step-by-step program execution using the *Step Over* command.

Step 1:
In this example the 41st program line is highlighted in blue, which means that it will be executed next. The current state of all registers within the microcontroller can be viewed in the *Watch Values* window.

Step 2:
After the *Step Over* command is executed, the microcontroller will execute the 41st program line. The first next line to be executed is highlighted in blue. The state of registers being changed by executing the last instruction may be viewed in the *Watch Values* window.



During operation, the program line to be executed next is highlighted in blue, while those containing breakpoints are highlighted in red. The *Run* command executes the program in real time until a breakpoint is encountered.

NOTE: Find more information on the *mikroICD* debugger in the relevant manual.

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6.0. Power supply

The *LV 18F v6* development system may use one of two power supply sources:

1. +5V PC power supply through the USB programming cable;
2. External power supply connected to a DC connector provided on the development board.

The MC34063A voltage regulator and Gretz rectifier are used to enable external power supply voltage to be either AC (in the range of 7V to 23V) or DC (in the range of 9V to 32V). Jumper J10 is used as a selector for a power supply source. To make advantage of the USB power supply, jumper J10 should be placed in the USB position. When using external power supply, jumper J10 should be placed in the EXT position. The development system is turned on/off by switching the position of the POWER SUPPLY switch.

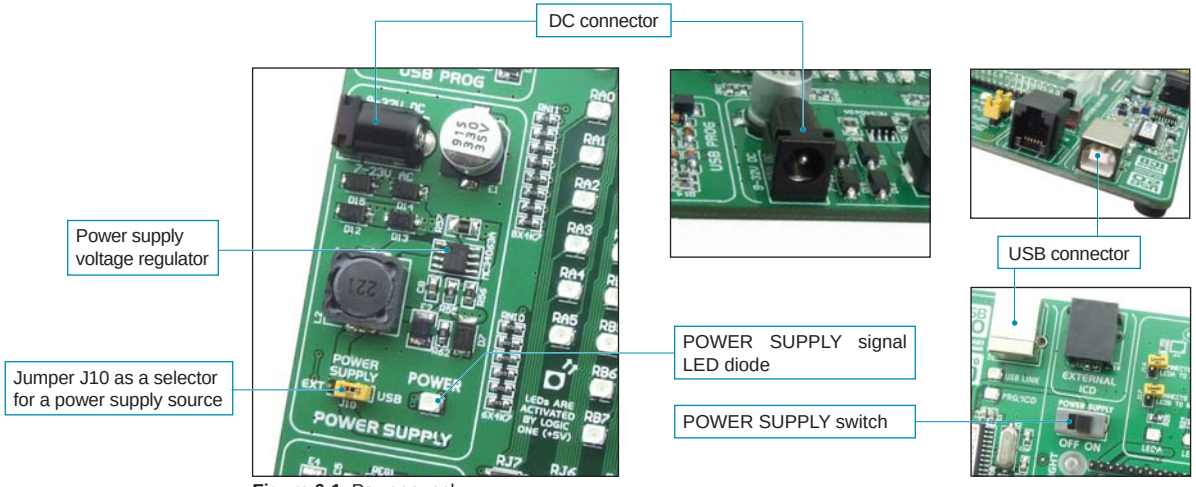

Figure 6-1: Power supply

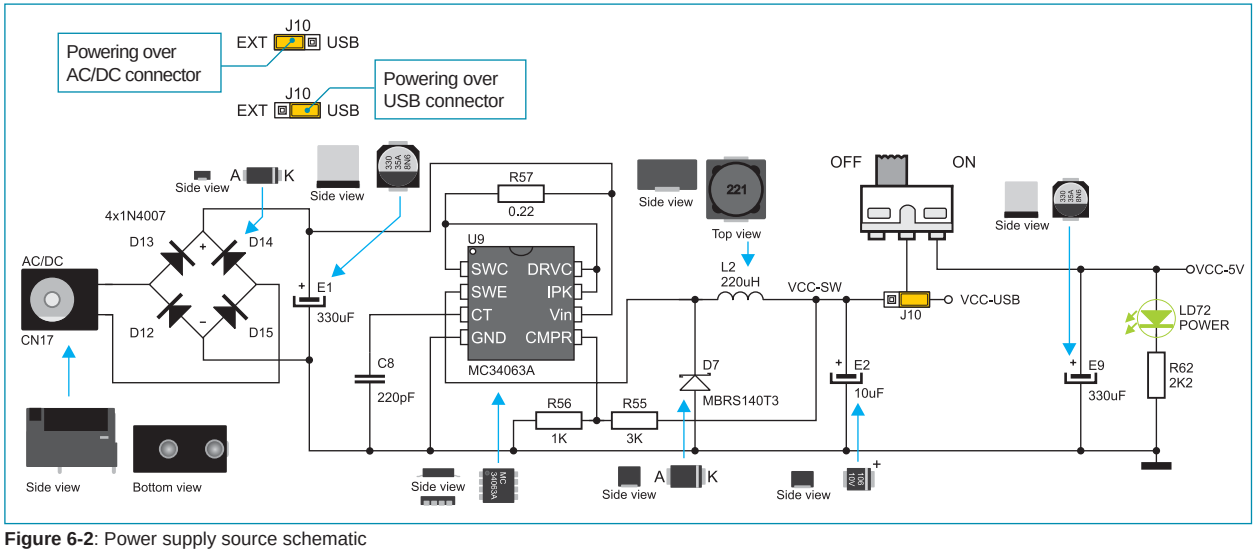

Figure 6-2: Power supply source schematic

7.0. 3.3 V Voltage Regulator

The microcontroller uses 3.3V power supply voltage for its operation. To reduce the power supply voltage from 5V to 3.3V, a voltage regulator is needed. The *LV 18F v6* development system includes the MC33269DT-3.3 circuit which is used as a voltage regulator. Its key features are stable output voltage 3.3V, 800mA output current, thermal protection etc.

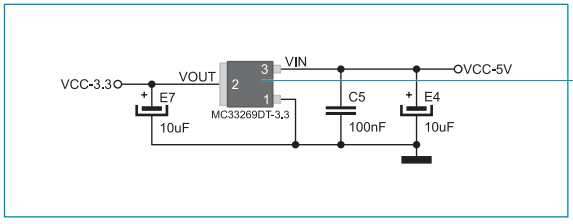

Figure 7-1: Voltage regulator schematic

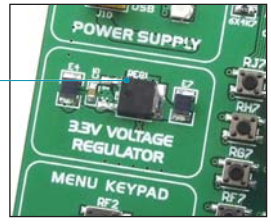

Figure 7-2: Voltage regulator

8.0. USB Communication Interface

The CN11 USB connector enables PIC microcontrollers with built-in USB interface to be connected to peripheral modules. The microcontroller is connected to the CN11 USB connector via USB-DM and USB-DP lines. The function of the LED diode marked as USB ON is to indicate connection between USB devices and development system, hence the microcontroller.

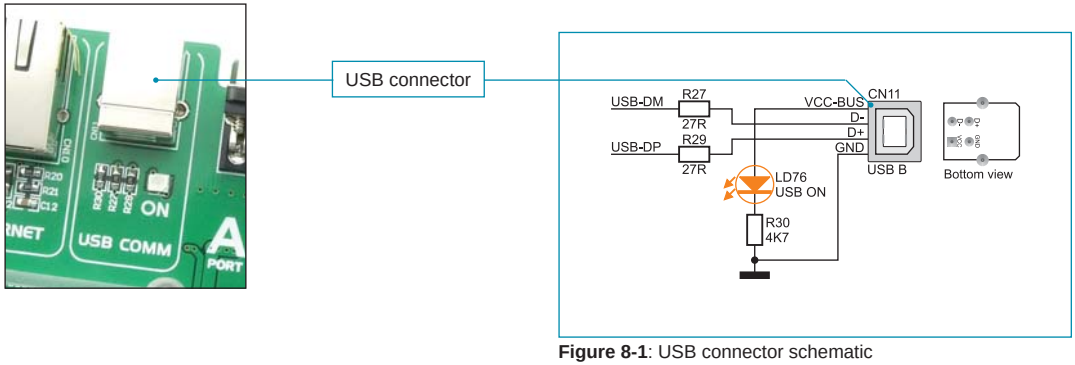

Figure 8-1: USB connector schematic

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9.0. RS-232 Communication Interface

The USART (*Universal Synchronous/Asynchronous Receiver/Transmitter*) is one of the most common ways of exchanging data between the PC and peripheral units. RS-232 serial communication is performed through a 9-pin SUB-D connector and the microcontroller USART module. The *LV 18F v6* provides two RS-232 ports, RS-232A and RS-232B. Use switches marked as RX232-A (RC7 or RB5 pin) and TX232-A (RC6 or RB7 pin) on the DIP switch SW12 to enable port RS-232A. Likewise, use switches RX232-B (RG2 pin) and TX232-B (RG1 pin) on the DIP switch SW12 to enable port RS-232B. The microcontroller pins used in such communication are marked as follows: RX - *receive data line* and TX - *transmit data line*. Baud rate goes up to 115 kbps.

In order to enable the USART module of the microcontroller to receive input signals with different voltage levels, it is necessary to provide a voltage level converter such as MAX3238E.

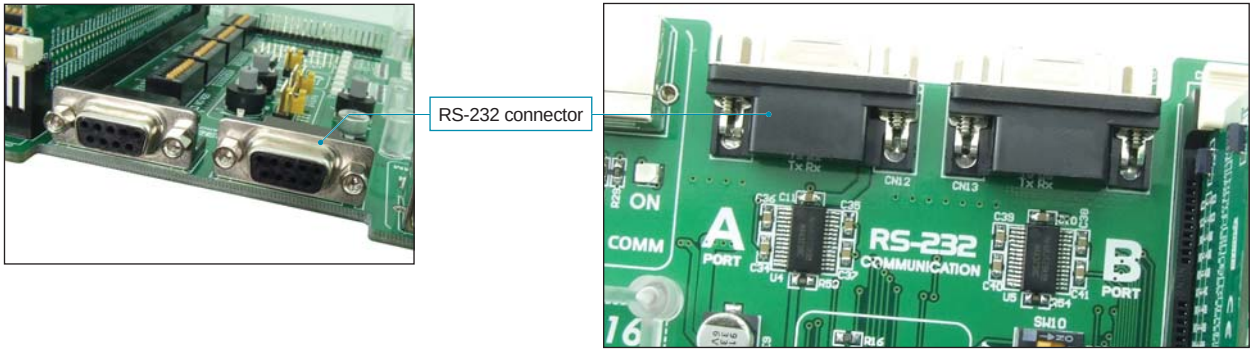
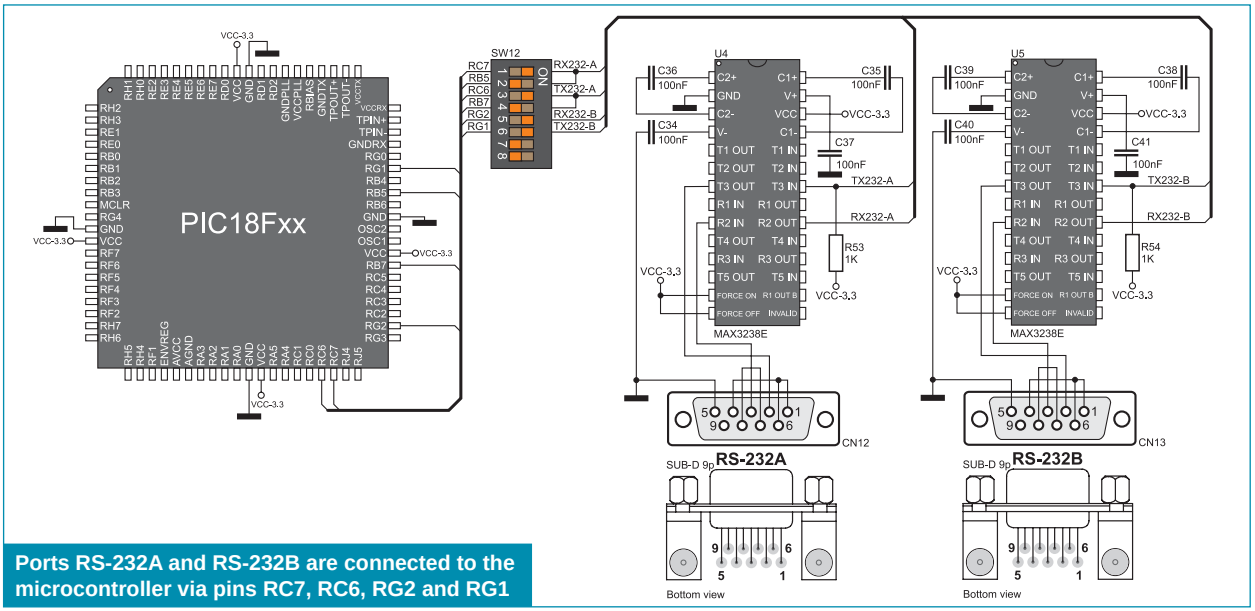


Figure 9-1: RS-232 module

The function of switches 1-6 on the DIP switch SW12 is to determine which of the microcontroller pins are to be used as RX and TX lines, Figure 9-2.



Ports RS-232A and RS-232B are connected to the microcontroller via pins RC7, RC6, RG2 and RG1

Figure 9-2: RS-232 module schematic

NOTE: Make sure that your microcontroller is provided with the USART module as it is not necessarily integrated in all PIC microcontrollers.

10.0. Ethernet

An ethernet connector is provided on the *LV 18F v6*. Here, ethernet is used to connect the microcontroller to a LAN (local area network). The ethernet connector is directly connected to the microcontroller and no additional settings are needed. Such connection is established via microcontroller pins TPOUT+, TPOUT-, TPIN+ and TPIN-. Jumpers J16 and J17 enable LED indicating ethernet operation to be connected to the microcontroller. Jumper J16 is used to interface LED marked as LEDA to the RA0 pin, whereas jumper J17 is used to interface LED marked as LEDB to the RA1 microcontroller pin.

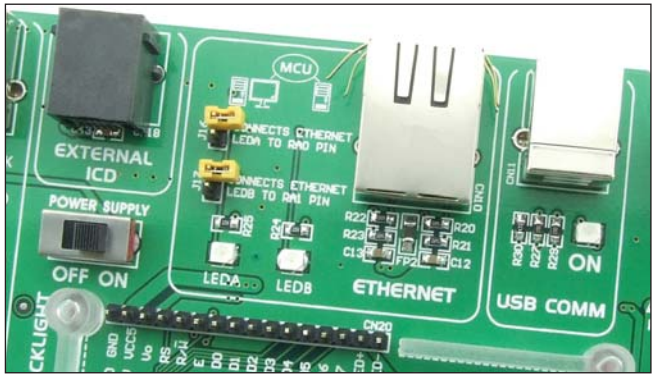


Figure 10-1: Ethernet module

Ethernet connector is directly connected to the microcontroller pins

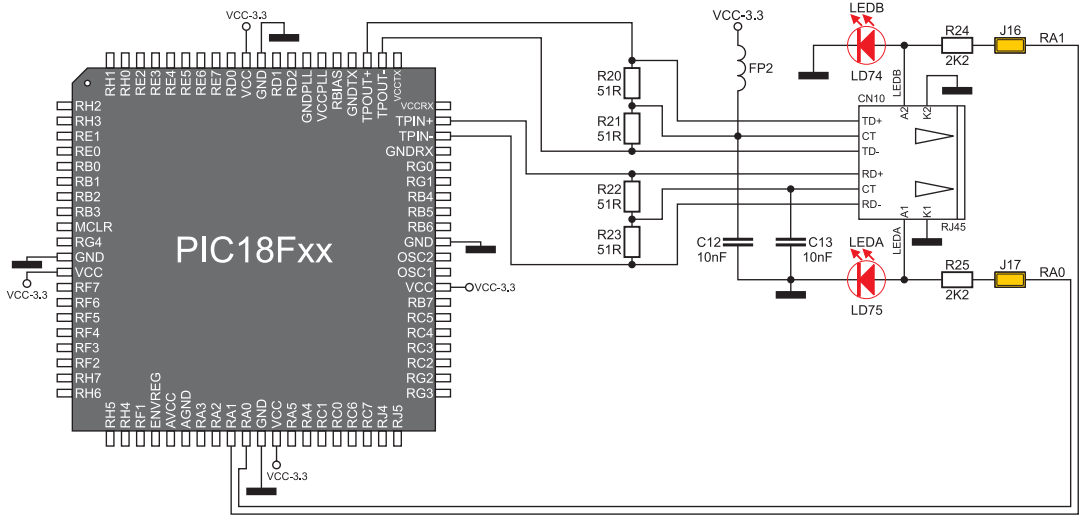


Figure 10-2: Ethernet module schematic

page

11.0. Serial RAM

Thanks to the built-in 23K640 circuit, the development system has 64Kbit RAM memory that can be connected to the microcontroller via SPI serial connection. SPI serial communication is enabled by means of DIP switch SW11. Switches 7 and 8 on the DIP switch SW11 enable RAM-CS and RAM-HOLD. RAM-CS is used for controlling the access to RAM memory, whereas RAM-HOLD is used to temporarily disable communication between the microcontroller and RAM.

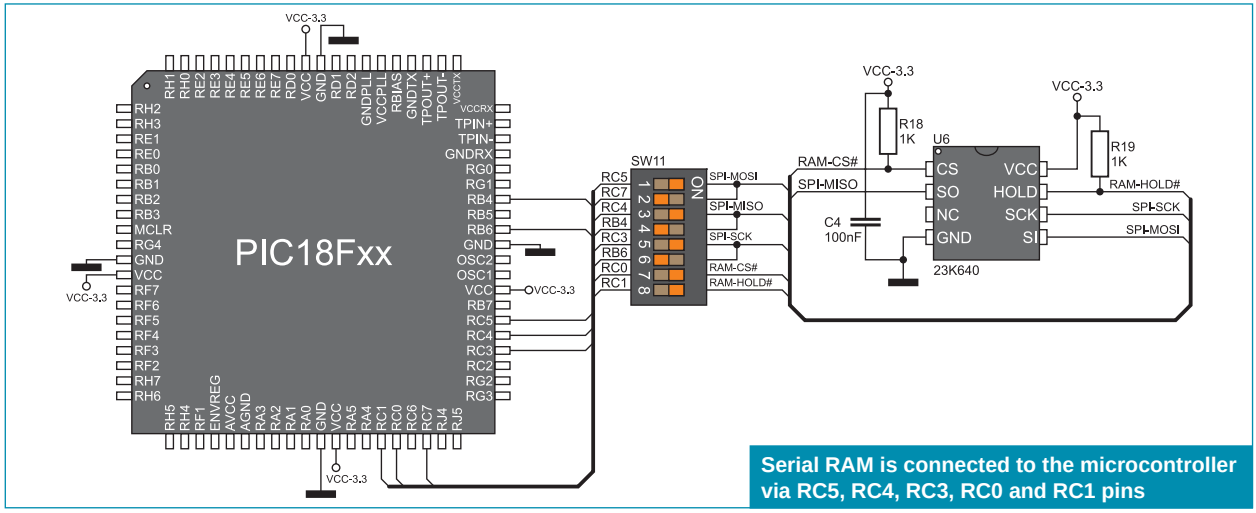


Figure 11-1: Serial RAM schematic

12.0. Serial EEPROM

EEPROM (Electrically Erasable Programmable Read-Only Memory) is a built-in memory module used to store data that must be saved when power goes off. The 24AA01 circuit is capable of storing up to 1Kbit data. It communicates to the microcontroller via RC4, RB4, RC3 and RB6 pins by means of serial I^2C communication. To establish connection between the EEPROM module and the microcontroller, it is necessary to set switches 1 and 3 on the DIP switch SW13 to the ON position. Switches 2 and 4 can also be used for this purpose depending on which pins are to be used for serial communication.

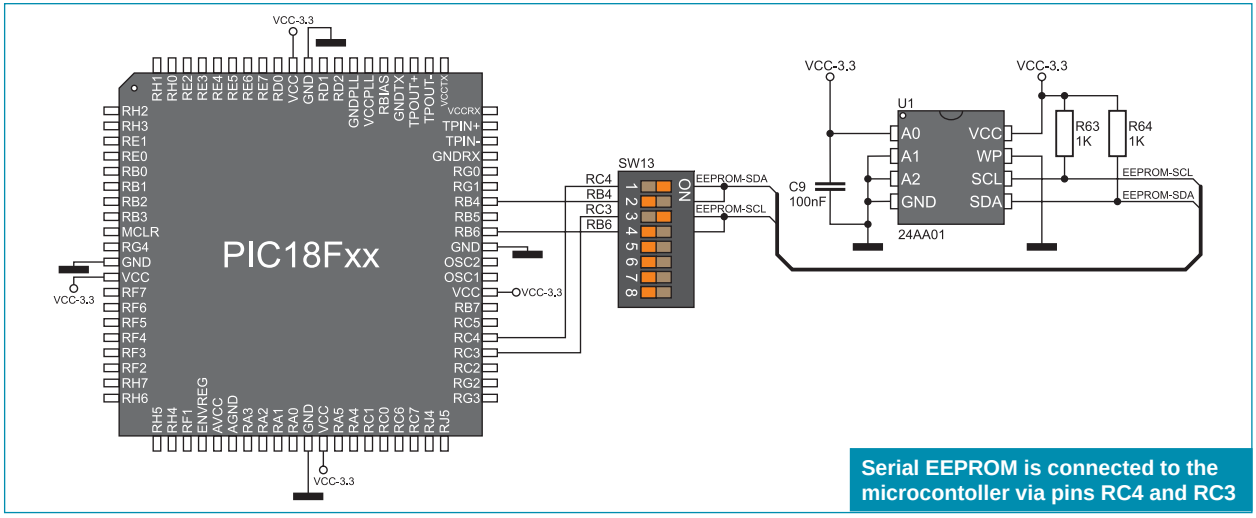


Figure 12-1: Serial EEPROM schematic

13.0. A/D Converter Test Inputs

An A/D converter is used for converting an analog signal into the appropriate digital value. A/D converter is linear, which means that converted number is linearly dependent on the input voltage value. The A/D converter integrated into the microcontroller converts an analog voltage value into a 10-bit number. The microcontroller with a built-in A/D converter is supplied with DC voltages varying from 0 to 5V over test inputs. Jumpers J14 and J15 are used for selecting some of the following pins RA0, RA1, RA2, RA3, RC0, RC1, RC2 and RC3 for A/D conversion. Resistors R16 and R17 have a protective function and are used for limiting current flow through the potentiometer or the microcontroller pin. The value of the input analog voltage can be changed linearly using potentiometers P3 and P4.

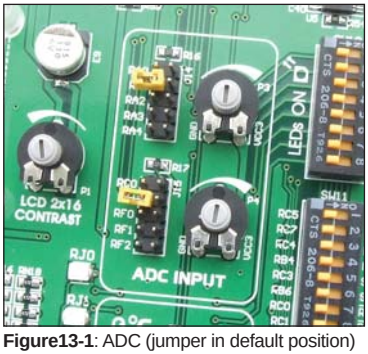


Figure13-1: ADC (jumper in default position)

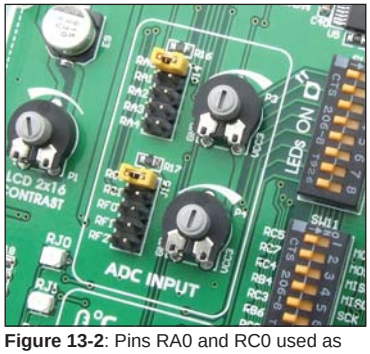


Figure 13-2: Pins RA0 and RC0 used as input pins for A/D conversion

A/D conversion is performed via microcontroller pins RA0 and RC0

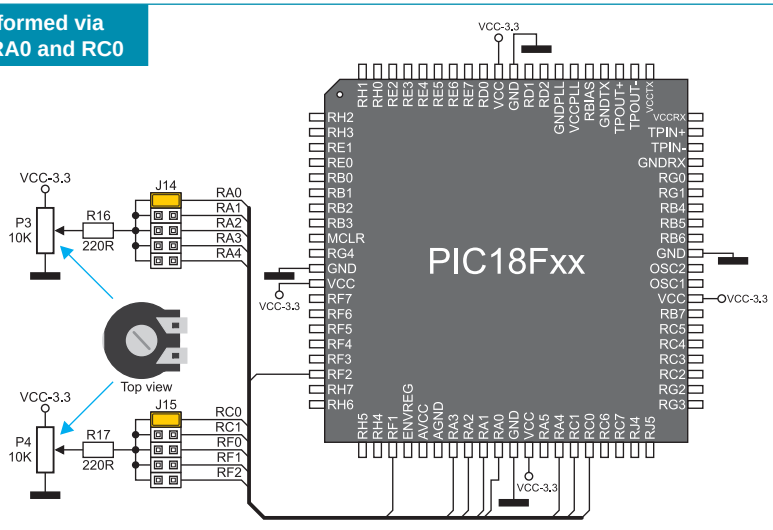


Figure 13-3: Microcontroller and A/D converter test inputs connection schematic

NOTE: In order to enable the microcontroller to accurately perform A/D conversion, it is necessary to turn off LEDs and pull-up/pull-down resistors on the port pins used by the A/D converter.

page

14.0. DS1820 Temperature Sensor

1-wire® serial communication enables data to be transferred over a single communication line while the process itself is under control of the *master* device. The advantage of such communication is that only one microcontroller pin is used. All *slave* devices have by default a unique ID code, which enables the *master* device to easily identify all devices sharing the same communication interface.

The DS1820 is a temperature sensor that uses 1-wire communication for its operation. It is capable of measuring temperatures within the range of -55 to 125°C and provides ±0.5°C accuracy for temperatures within the range of -10 to 85°C. A power supply voltage of 3V to 5.5V is required for its operation. It takes maximum 750ms for the DS1820 to calculate temperature with 9-bit resolution. The *LV 18F v6* development system provides a separate socket for the DS1820. It uses either RD0 or RA5 pin for communication with the microcontroller, which depends on the position of jumper J11. In Figure 14-5, jumper J11 is placed in the RD0 position, which means that 1-wire communication is enabled via the RD0 microcontroller pin.

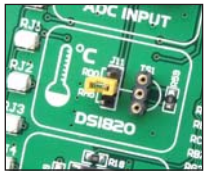


Figure 14-1: DS1820 connector (DS1820 is not placed)

Figure 14-2: DS 1820 is plugged into the connector

NOTE:
Make sure that half-circle on the board matches the round side of the DS1820

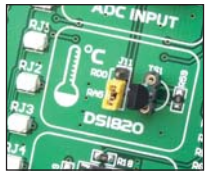


Figure 14-3: DS1820 is connected to the microcontroller via the RA5 pin

Figure 14-4: DS1820 is connected to the microcontroller via the RD0 pin

Temperature sensor is connected to the microcontroller via the RD0 pin

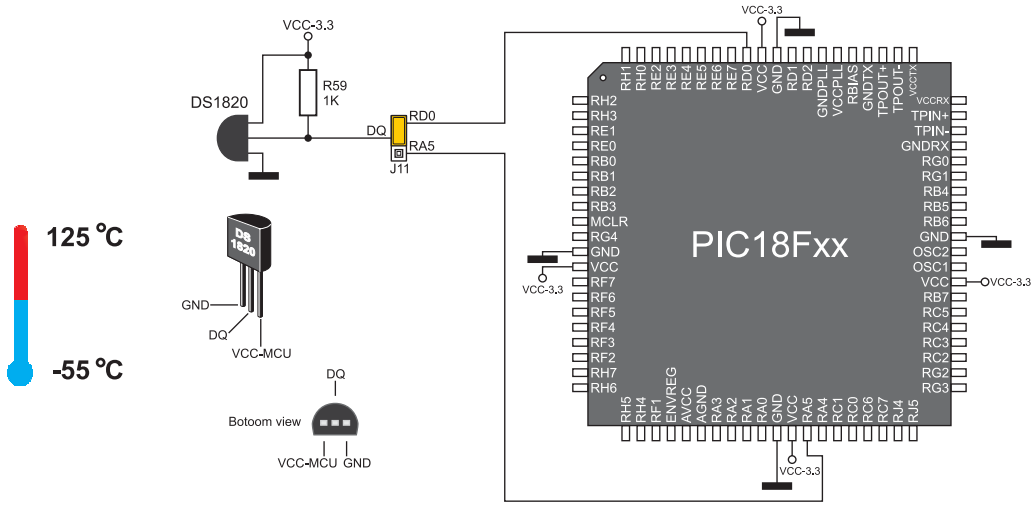
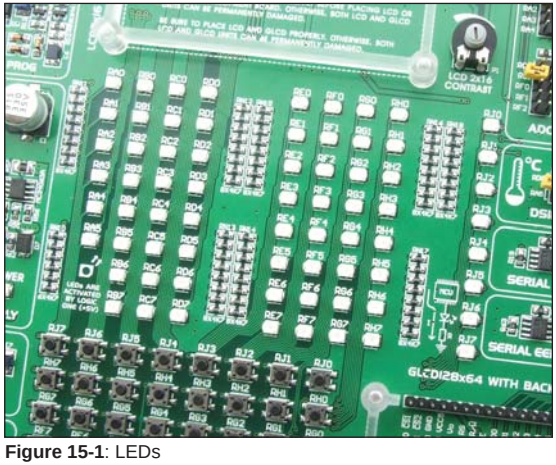


Figure 14-5: DS1820 and microcontroller connection schematic

15.0. LEDs

LED (Light-Emitting Diode) is a highly efficient electronic light source. When connecting LEDs, it is necessary to use a current limiting resistor. A common LED diode voltage is approximately 2.5V, while the current varies from 1 to 20mA depending on the type of LED. The *LV 18F v6* uses LEDs with current I=1mA.

There are 70 LEDs provided on the *LV 18F v6* development system which visually indicate the state of each microcontroller I/O pin. An active LED indicates that a logic one (1) is present on the pin. In order to enable the pin state to be shown, it is necessary to select appropriate port (PORTA, PORTB, PORTC, PORTD, PORTE, PORTF, PORTG, PORTH or PORTJ) using DIP switch SW10.



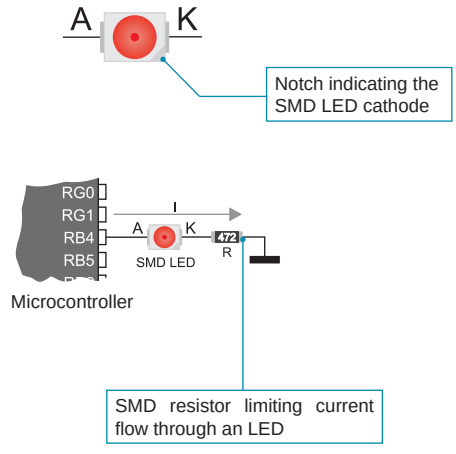


Figure 15-1: LEDs

Port PORTC LEDs illuminate

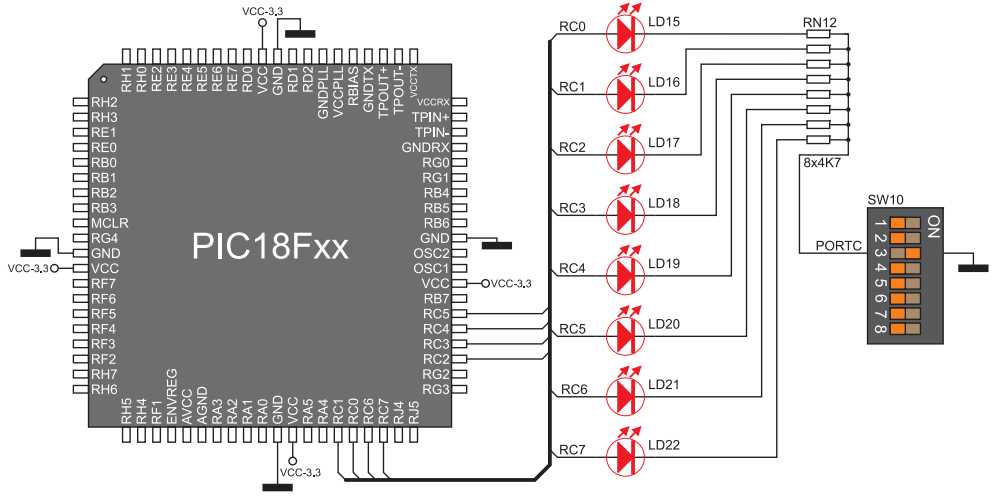


Figure 15-2: LEDs and port PORTC connection schematic

page

16.0. Push Buttons

The logic state of all microcontroller input pins may be changed by means of push buttons. Jumper J12 is used to determine the logic state to be applied to the desired microcontroller pin by pressing appropriate push button. The function of the protective resistor is to limit the maximum current, thus preventing a short circuit from occuring. If needed, advanced users may shorten such resistor using jumper J13. Right next to the push buttons, there is a RESET button connected to the MCLR pin over the on-board programmer.

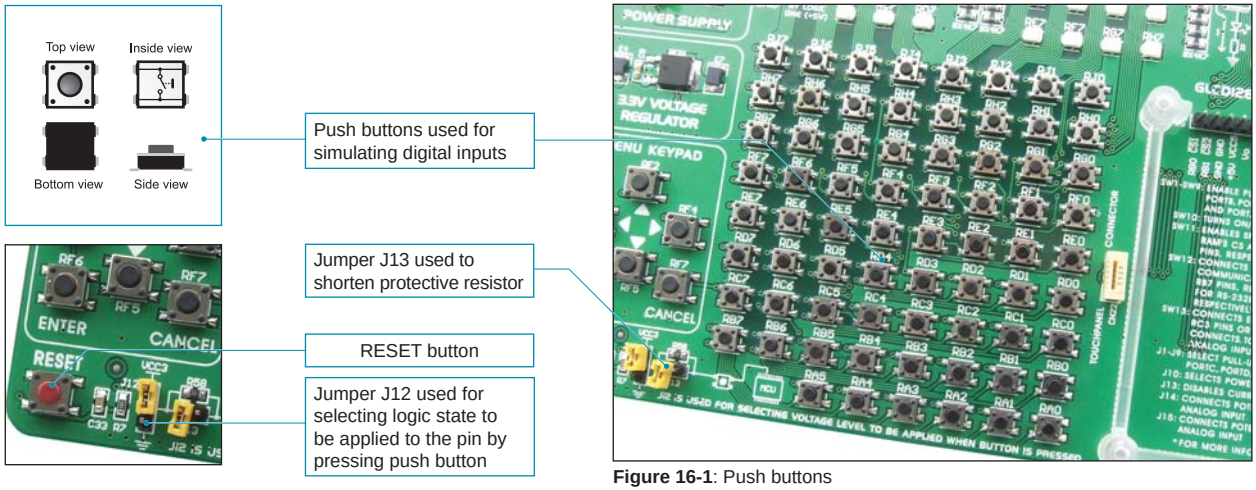


Figure 16-1: Push buttons

By pressing any push button when jumper J12 is in the VCC position, a logic one (3.3V) will be applied to the appropriate microcontroller pin as shown in Figure 16-2.

Jumper J12 is in the VCC position

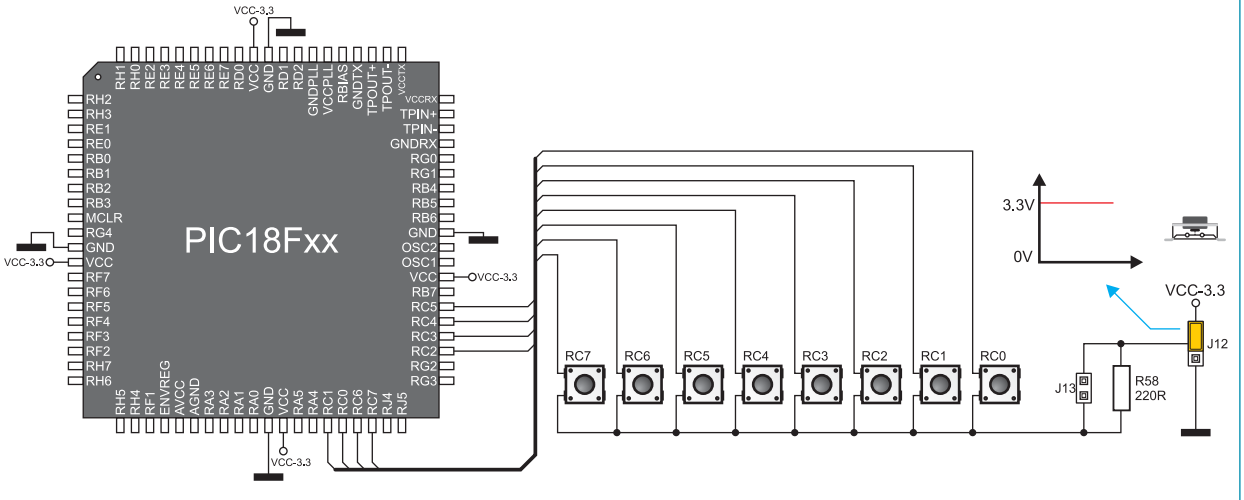


Figure 16-2: Push buttons and port PORTC connection schematic

17.0. MENU Keypad

There is a group of push buttons which form a navigation keypad called MENU provided on the *LV 18F v6* development system. The main advantage of such keypad is the button arrangement, i.e. it consists of four push buttons marked as left, right, up and down arrow. In addition to them, there are two push buttons marked as ENTER and CANCEL. The MENU push buttons are connected in the same way as the port PORTF push buttons. Their function is determined by the user when writing a program for the microcontroller.

Have in mind when writing a program for the microcontroller that MENU keypad is connected to the PORTF port

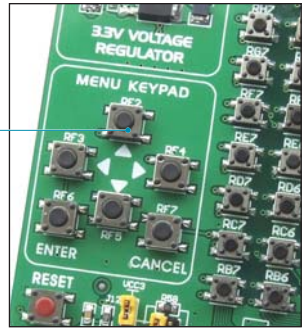


Figure 17-1: MENU keypad

MENU push buttons are connected the same as port PORTF push buttons

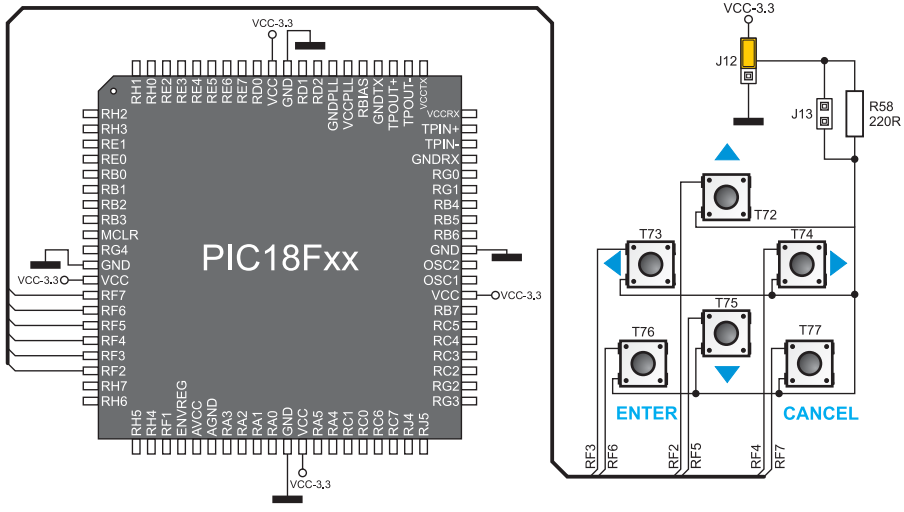


Figure 17-2: MENU keypad and microcontroller connection schematic

page

18.0. 2x16 LCD Display

The *LV 18F v6* development system provides an on-board connector for the alphanumeric 2x16 LCD display. Such connector is linked to the microcontroller via the PORTB port. Potentiometer P1 is used to adjust display contrast. The LCD-BCK switch on the DIP switch SW12 is used to turn the display backlight on/off.
Communication between the LCD display and the microcontroller is performed in a 4-bit mode. Alphanumeric digits are displayed in two lines each containing up to 16 characters of 7x5 pixels.

Figure 18-1. Alphanumeric LCD display connector

Figure 18-2: Alphanumeric 2x16 LCD display

LCD display backlight is on

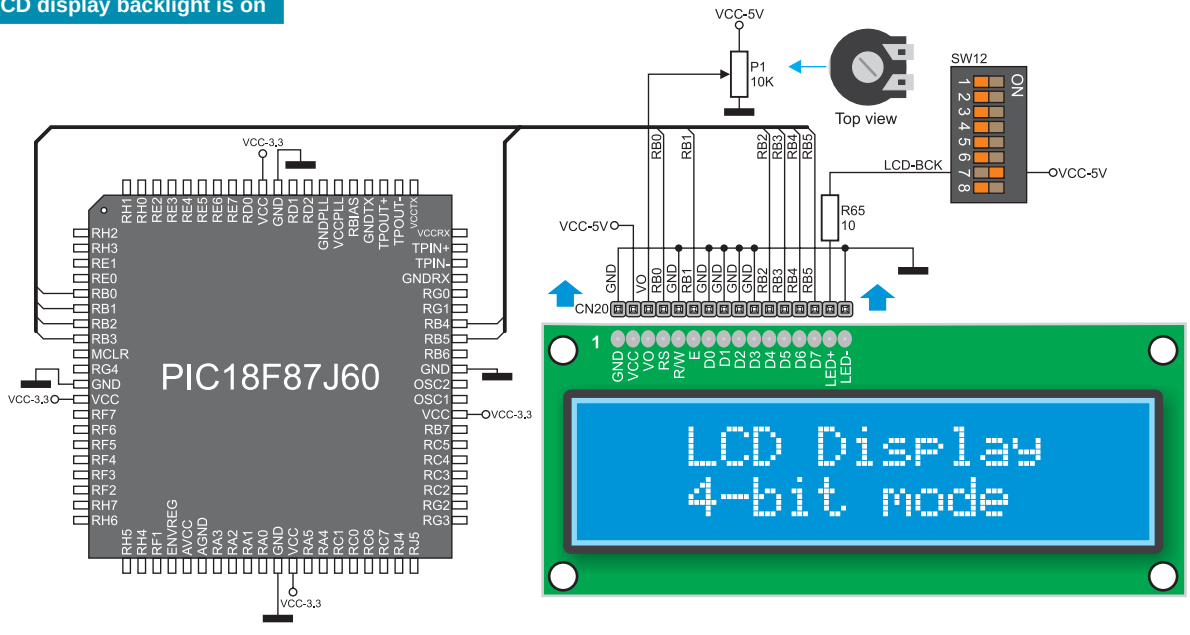


Figure 18-3: Alphanumeric 2x16 LCD display connection schematic

19.0. 128x64 Graphic LCD Display

128x64 graphic LCD display (GLCD) is connected to the microcontroller via PORTB and PORTE ports and enables graphic content to be displayed. It has the screen resolution of 128x64 pixels, which allows diagrams, tables and other graphic content to be displayed. Since the PORTB port is also used by the alphanumeric 2x16 LCD display, it is not possible to use both displays simultaneously. Potentiometer P2 is used for the GLCD display contrast adjustment. Switch 8 (GLCD-BCK) on the DIP switch SW12 is used to turn the display backlight on/off.

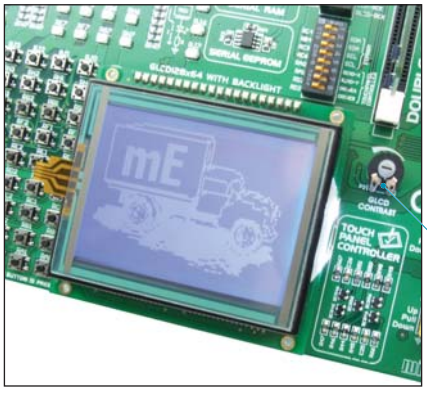


Figure 19-1: GLCD display

Figure 19-2: GLCD connector

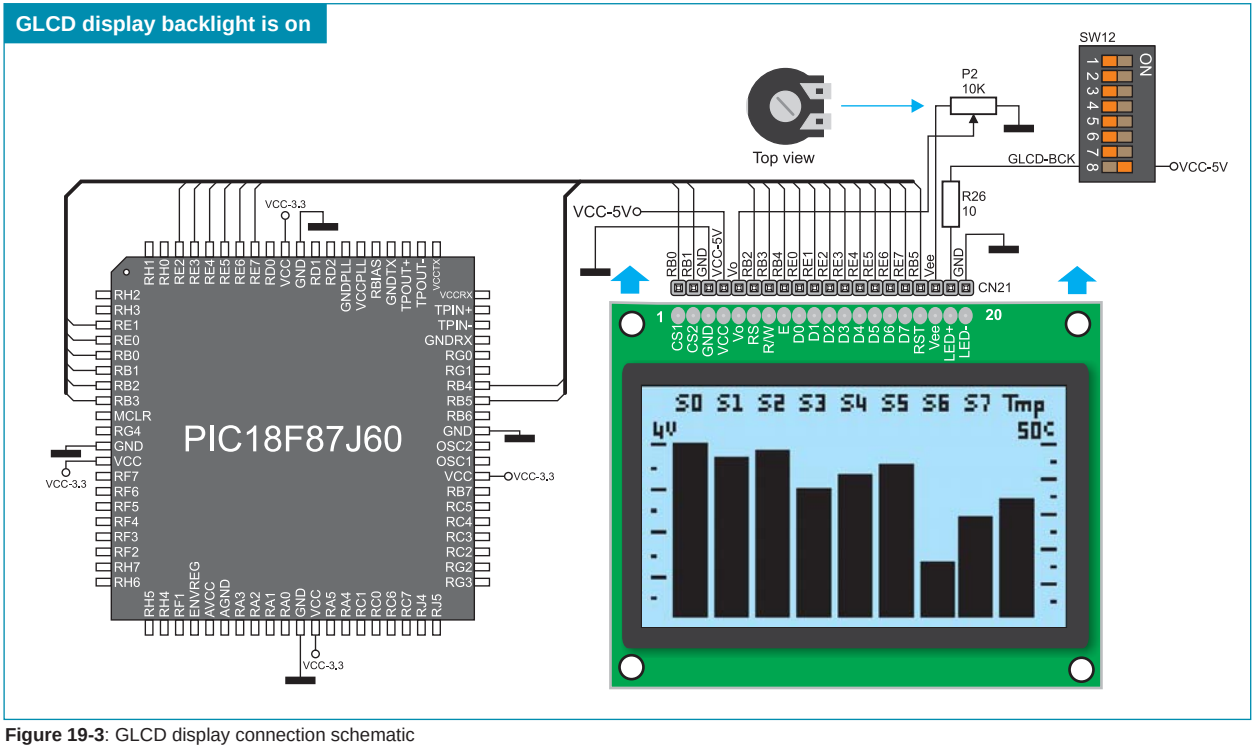


Figure 19-3: GLCD display connection schematic

page

20.0. Touch Panel

The touch panel is a thin, self-adhesive, transparent, touch-sensitive panel. It is placed over a GLCD display. Its main function is to register pressure at some specific display point and to forward its coordinates in the form of analog voltage to the microcontroller. Switches 5, 6, 7 and 8 on the DIP switch SW13 are used for connecting these two units.

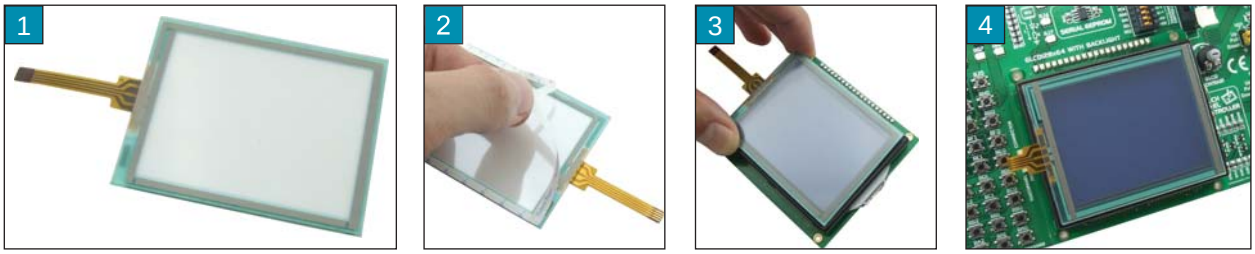


Figure 20-1: Touch panel

Figure 20-1 shows how to place a touch panel over a GLCD display. Make sure that the flat cable is to the left of the GLCD display, as shown in Figure 4.

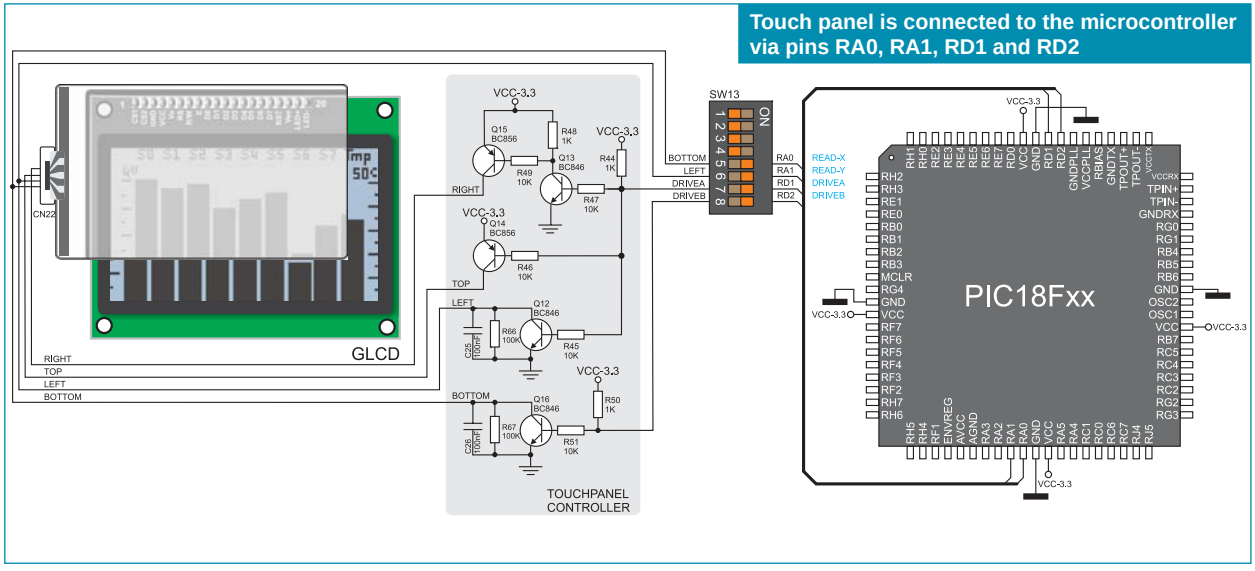


Figure 20-2: Touch panel connection schematic

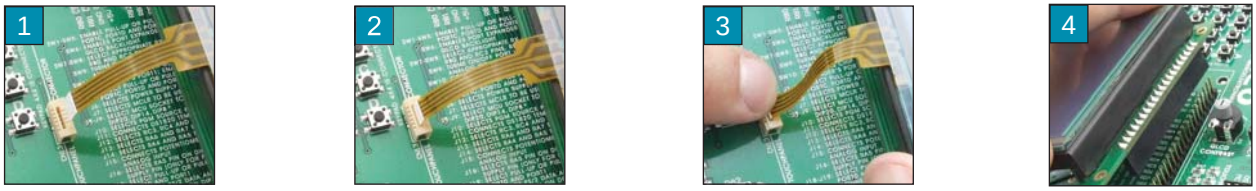


Figure 20-3: Placing touch panel

Figure 20-3 shows in detail how to connect a touch panel to the microcontroller. Bring the end of the flat cable close to the CN22 connector (Figure 1). Plug the cable into the connector (Figure 2) and press it easily so as to fully fit the connector (Figure 3). Now, a GLCD display can be plugged into the appropriate connector (Figure 4).

NOTE: LEDs and pull-up/pull-down resistors on ports PORTA and PORTD must be off when using a touch panel.

21.0. Input/Output Ports

Along the right side of the development system, there are nine 10-pin connectors which are connected to the microcontroller's I/O ports. Pins RB6 and RB7 are used for programming and therefore are not directly connected to the appropriate 10-pin connector, but via the programmer's multiplexer. DIP switches SW1-SW9 enable each connector pin to be connected to one pull-up/pull-down resistor. Whether pins of some port are to be connected to a pull-up or a pull-down resistor depends on the position of jumpers J1-J9.

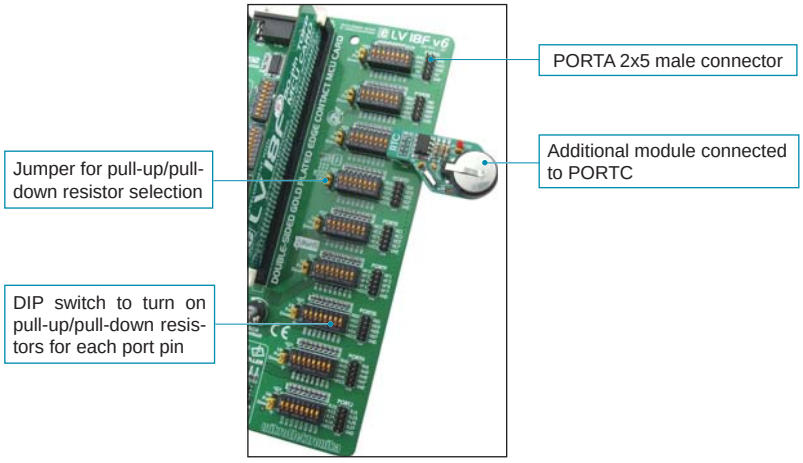


Figure 21-1: I/O ports

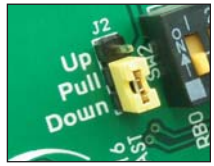


Figure 21-2: J2 in the pull-down position

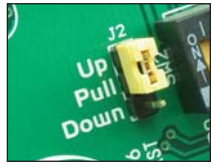


Figure 21-3: J2 in the pull-up position

Microcontroller port PORTC pins connected to pull-down resistors

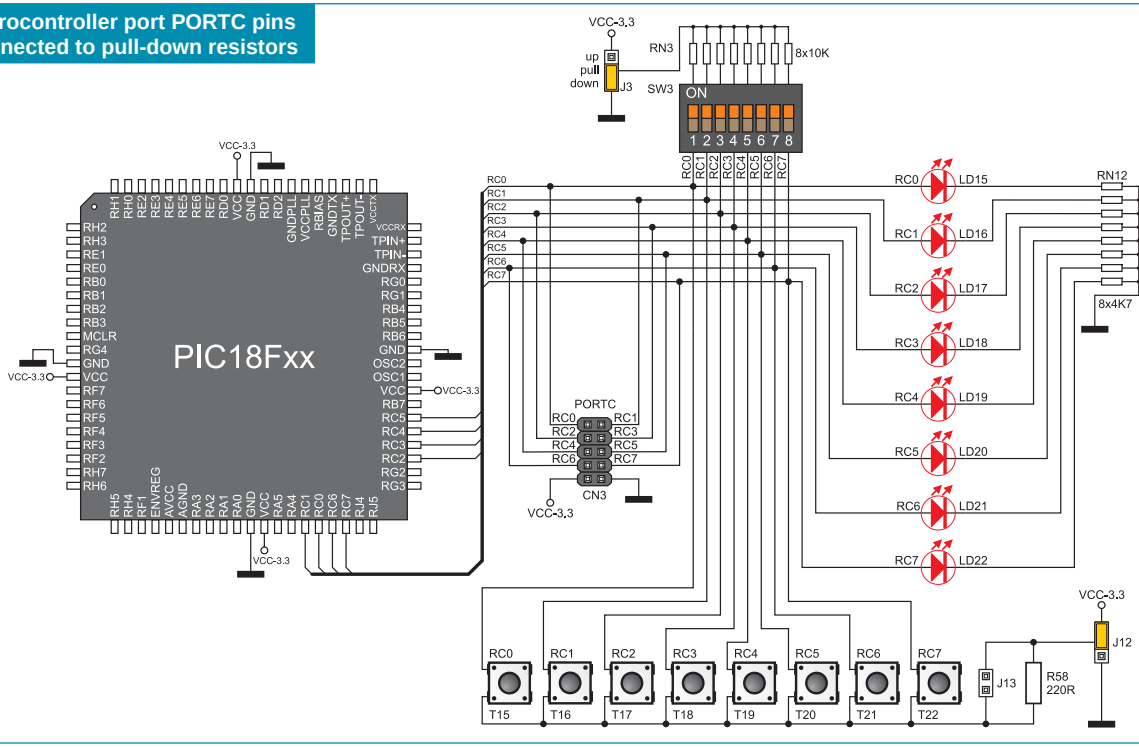


Figure 21-4: Port PORTC connection schematic

page

Pull-up/pull-down resistors enable you to set the logic level on all microcontroller's input pins when they are in idle state. Such level depends on the position of the pull-up/pull-down jumper. The RG0 pin with the relevant DIP switch SW7, jumper J7 and RG0 push button with jumper J12 are used here for the purpose of explaining the performance of pull-up/pull-down resistors. The principle of their operation is the same as for all other microcontroller pins.

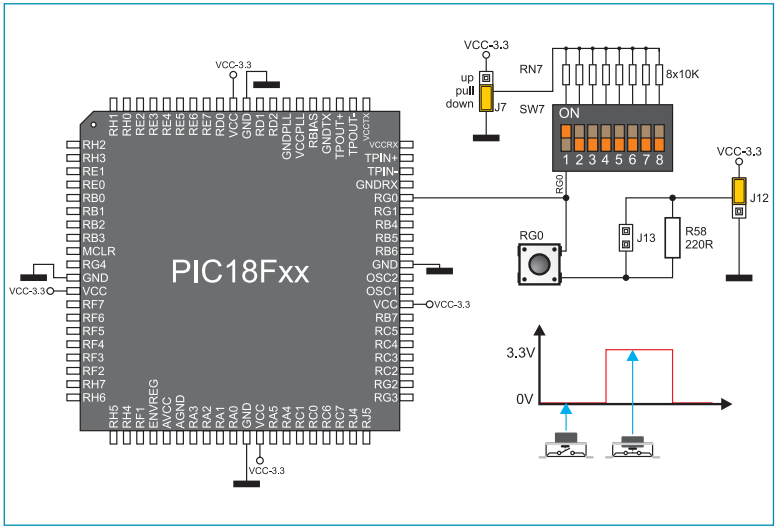


Figure 21-5: Jumper J7 in pull-down position and jumper J12 in pull-up position

In order to enable the PORTG port pins to be connected to pull-down resistors, it is necessary to place jumper J7 in the *Down* position first. This enables any PORTG port pin to be supplied with a logic zero (0V) in idle state over jumper J7 and 8x10k resistor network. To provide the RB0 pin with such signal, it is necessary to set the RG0 switch on the DIP switch SW7 to the ON position.

As a result, every time you press the RG0 push button, a logic one (VCC voltage) will appear on the RG0 pin, provided that jumper J12 is placed in the VCC position.

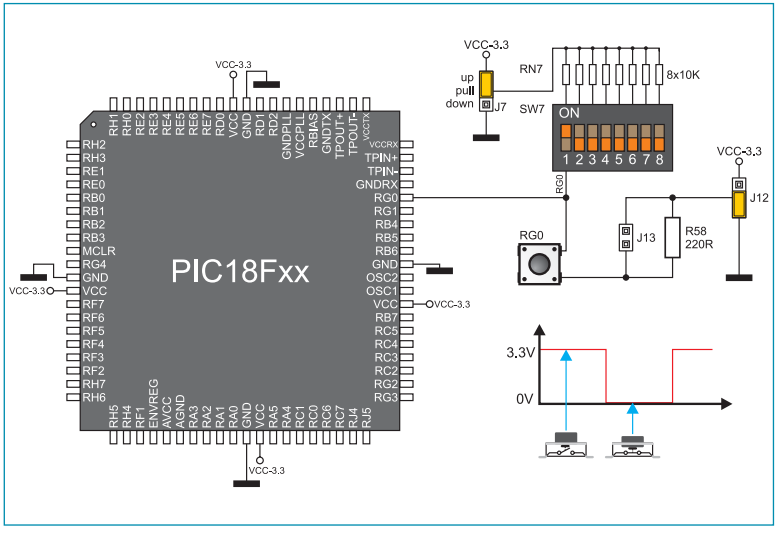


Figure 21-6: Jumper J7 in pull-up and jumper J12 in pull-down position

In order to enable port PORTG pins to be connected to pull-up resistors and the port input pins to be supplied with a logic zero (0), it is necessary to place jumper J7 in the *Up* position and jumper J12 in the GND position. This enables any port PORTG input pin to be driven high (5V) in idle state over the 10k resistor.

As a result, every time you press the RG0 push button, a logic zero (0V) will appear on the RG0 pin, provided that the RG0 switch is set to the ON position.

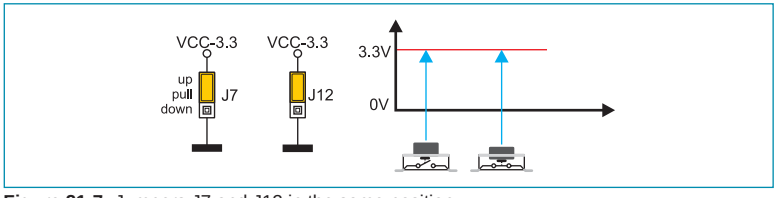


Figure 21-7: Jumpers J7 and J12 in the same position

In case that jumpers J7 and J12 have the same logic state, pressure on any button will not cause input pins to change their logic state.

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