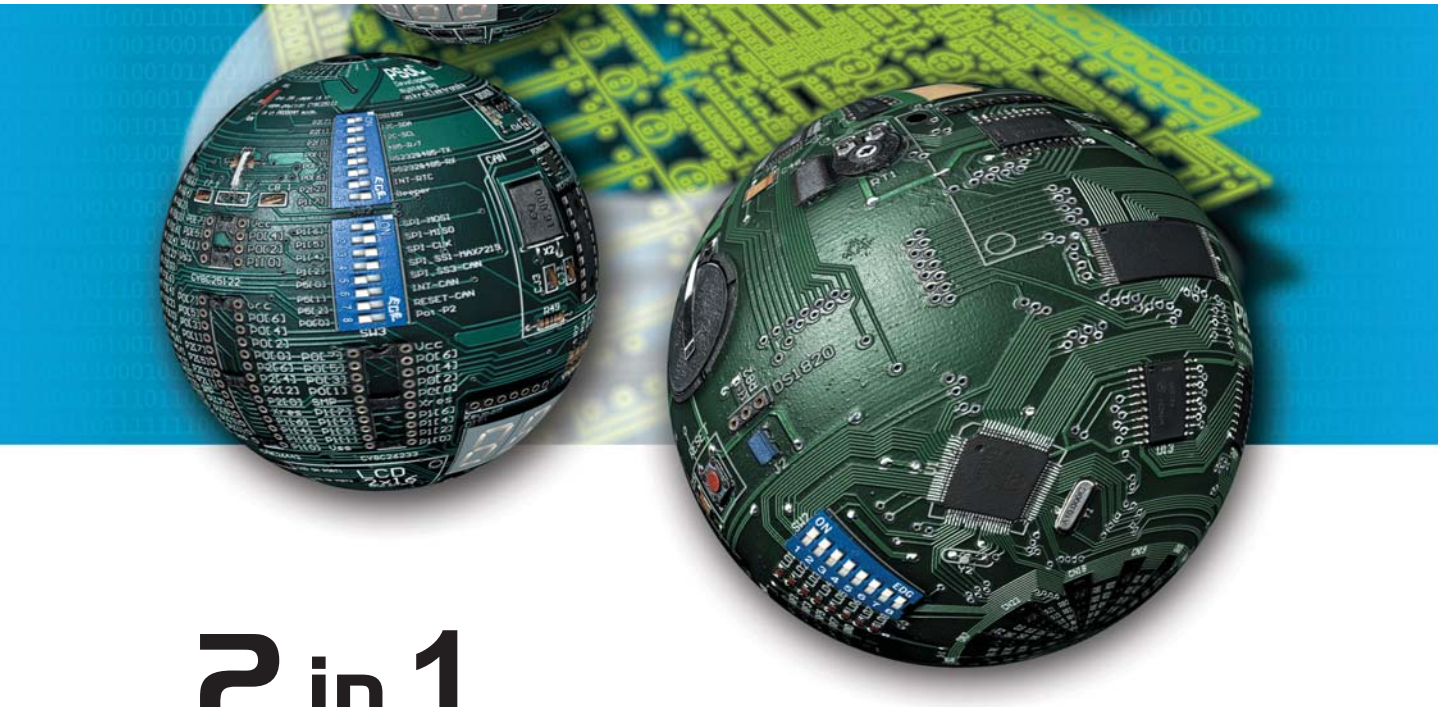
SOFTWARE AND HARDWARE SOLUTIONS FOR THE EMBEDDED WORLD

MikroElektronika
Development tools - Books - Compilers

Easy8051A User's Manual



2 in 1

USB 2.0 IN-CIRCUIT PROGRAMMER

ATMEL 8051 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

First edition
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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 8051Flash programmer and drivers. Start the installation from the product CD: CD_Drive:/product/zip/8051Flash_setup.exe.

Step no.3 After the installation connect the USB cable to the Easy8051A board. You will be asked for the 8051Flash drivers. Point to them in order to finish the driver installation.

Step no.4 Run and use 8051Flash as it is explained in the PDF document '*8051Flash programmer*'.

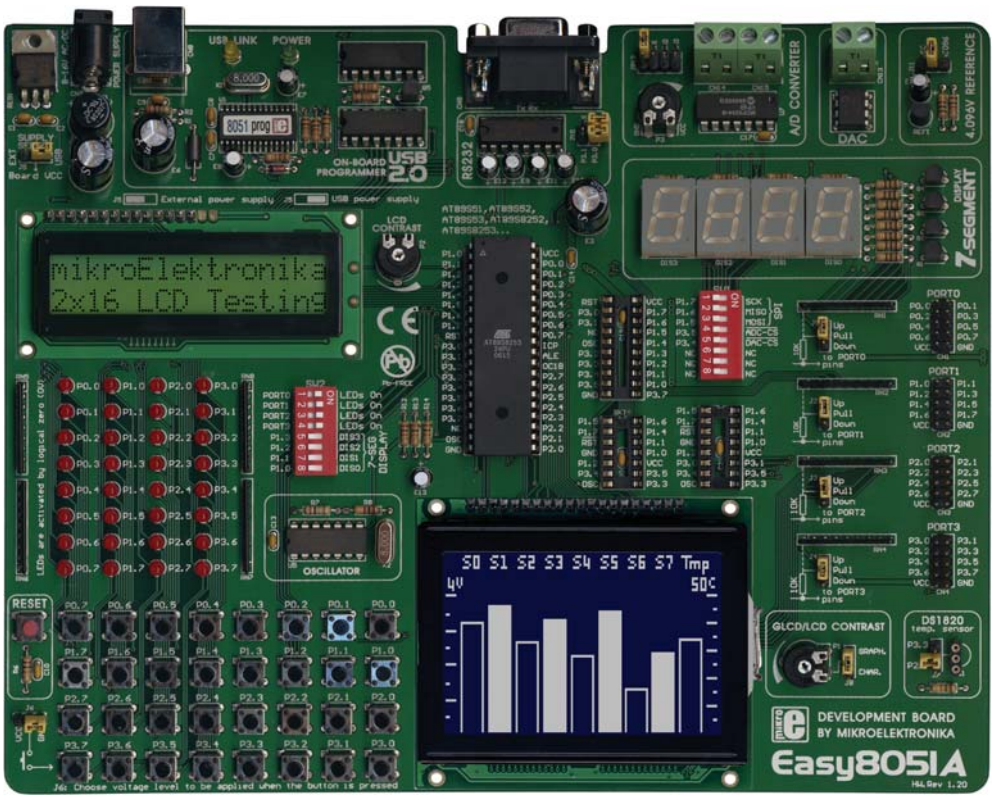
After these 4 steps, your Easy8051A is installed and ready for use. You can try to read a program from the chip or to load an example from the product CD: CD_Drive:/product/zip/easy8051a_examples.zip.

INTRODUCTION

The Easy8051A development system is a full-featured development board for Atmel 8051 microcontrollers. It has been designed to allow students and engineers to easily exercise and explore the capabilities of 8051 microcontrollers. It allows 8051 microcontrollers to be interfaced with external circuits and a broad range of peripheral devices, allowing a user to concentrate on software development.

Figure 1 illustrates the development board. Each component is marked on a silkscreen, both top and bottom. These marks describe connections to the microcontroller, operation modes, and provide some useful notes. The need for additional schematics is minimized since all relevant information is printed on the board.

Figure 1. Easy8051A development board



SWITCHES

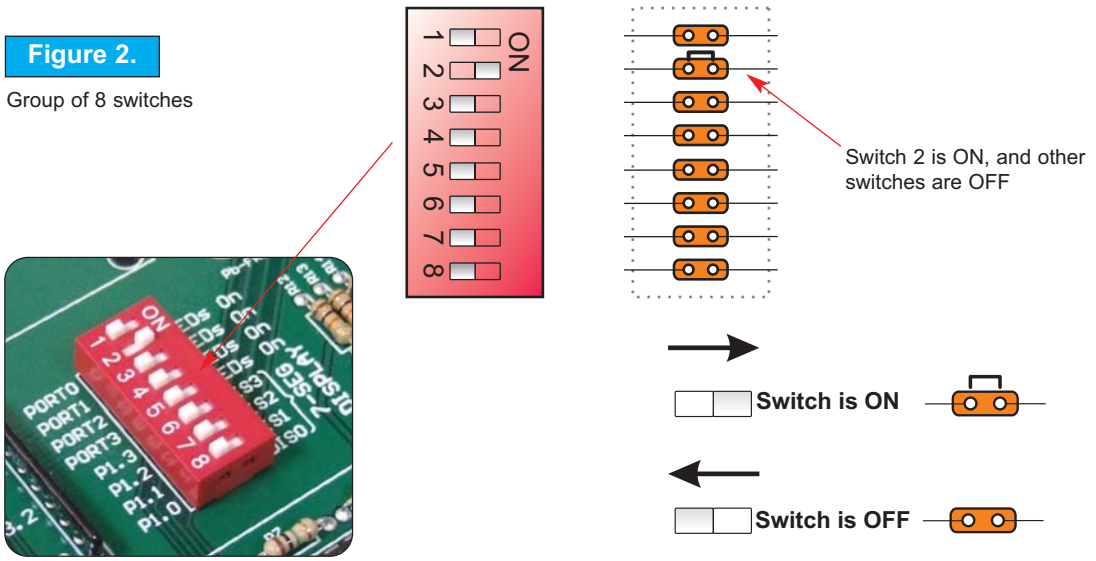
The Easy8051A development board features a number of peripherial devices. In order to enable these devices before programming, you need to check if appropriate jumpers or switches have been properly set. Switches are devices that have two positions - ON and OFF, which have a role to establish or break a connection between two contacts. The Easy8051A development board has two groups of switches.

The first group, **SW1**, is used to enable SPI communication for interfacing with A/D Converter and D/A Converter and for connecting ADC CS (Chip Select) and DAC CS to microcontroller pins.

The upper four switches of **SW2** are used to enable LEDs connected to PORT0, PORT1, PORT2 and PORT3. For example, if the switch for PORT1 is OFF, all PORT1 LEDs will be turned off. The lower four switches of **SW2** are used to enable the 7-segment displays. If you don't need the 7-segment displays in your project, these switches should be OFF.

Figure 2.

Group of 8 switches



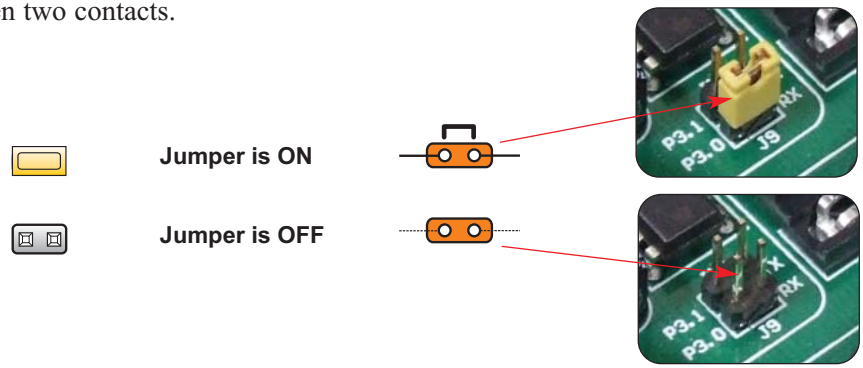
JUMPERS

Jumpers, like switches, can break or establish a connection between two points. Beneath the plastic cover of the jumper is a metal contact, which makes a connection when the jumper is placed between two disconnected pins.

For example, the jumpers J9 and J10 are used to connect or disconnect Rx and Tx lines to the P3.0 and P3.1 pins, respectively. A connection is made when the jumper is placed between two contacts.

Figure 3.

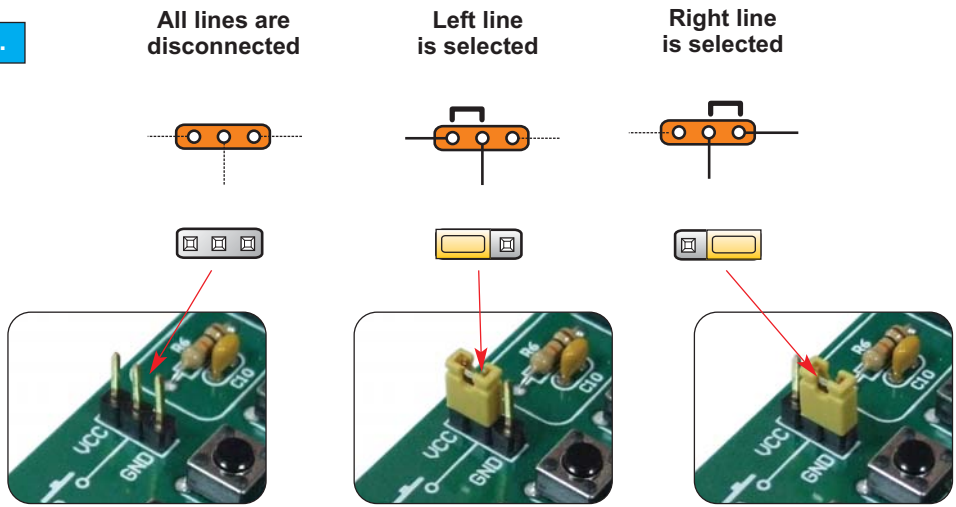
Jumper as a switch



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.

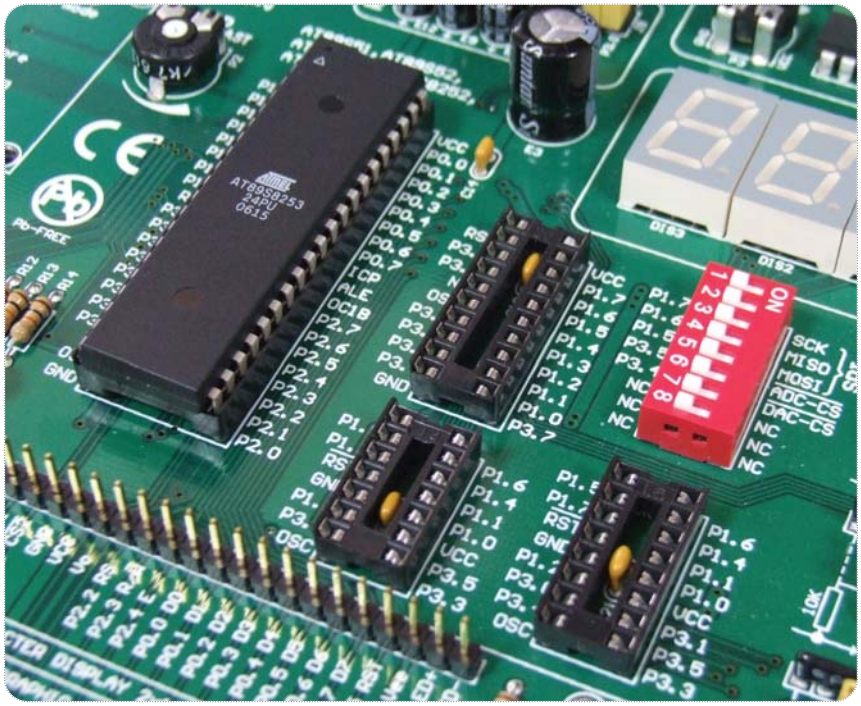
Figure 4.

Jumper as a multiplexer



MCU SOCKETS

Easy8051A is delivered with a AT89S8253 40-pin microcontroller. Users can remove this one and fit a different microcontroller in DIP40, DIP20, DIP16 or DIP14 packages of an adequate pinout.



MCU sockets **Figure 5.**

Note: Since all packages have parallel connections, there must not be more than one microcontroller on the board at a time.

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

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

Some pins are connected to other peripherials such as the DS1820 temperature sensor, RS-232 communication, 7-segment displays, LCD, etc.

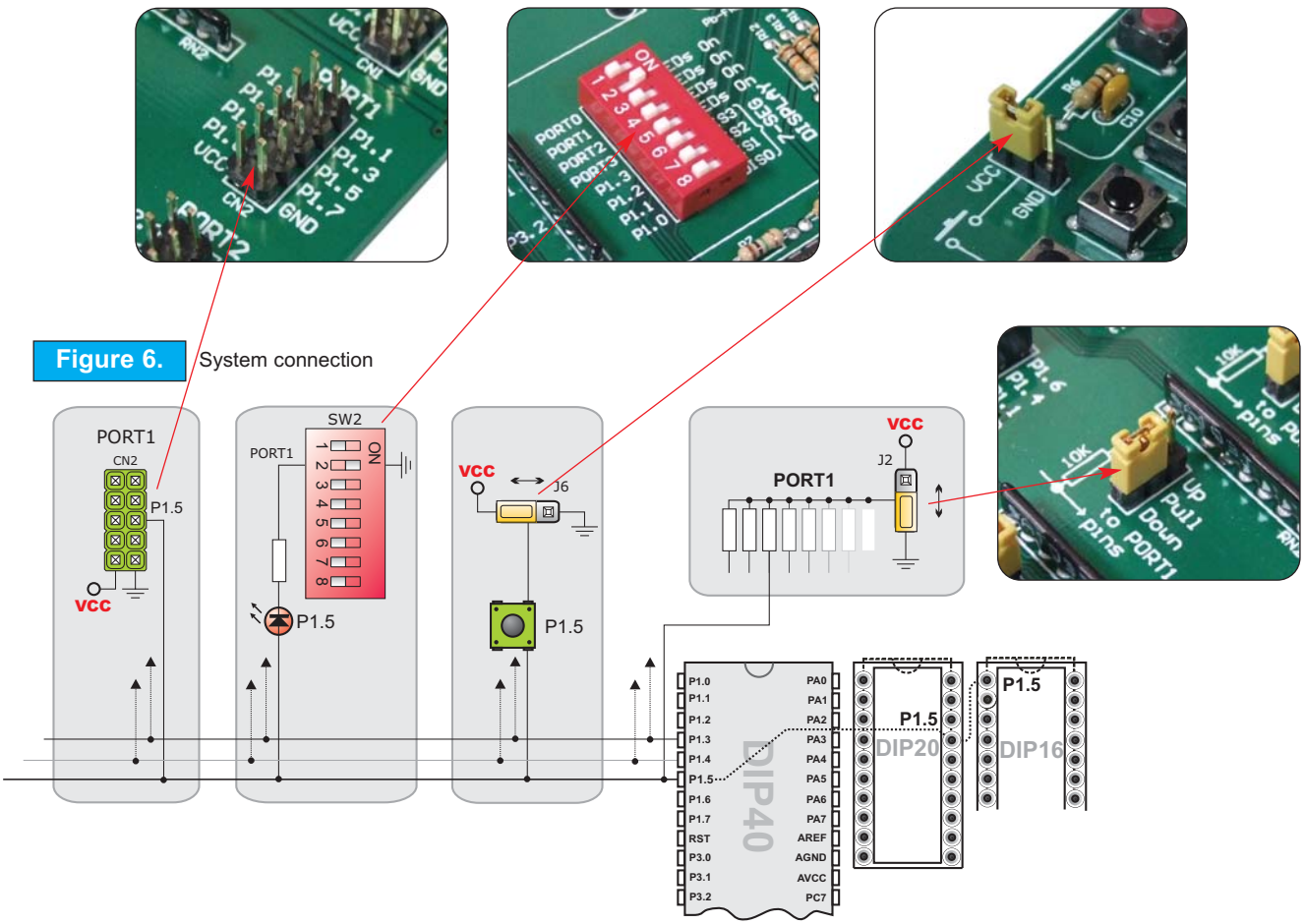


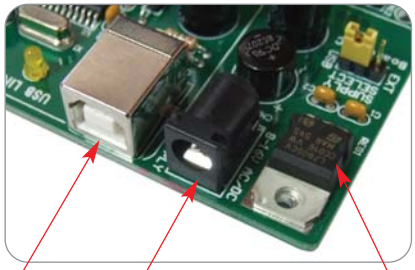
Figure 6. System connection

POWER SUPPLY

As a power supply source, users can select either a regulated supply from the USB cable (default) or an external power supply. In case of the USB power supply, the system should be connected to a PC using the USB programming cable, while the jumper J5 should be set in the right-hand position.

In the case of an external power supply, the Easy8051A board produces +5V using an LM7805 voltage regulator. The external power supply can be AC or DC, with a voltage between 8V and 16V and the jumper J5 should be set in the left-hand position. In Fig. 7 you can see USB and external power supply connectors.

Figure 7. USB and power supply connectors



USB connector

External power supply connector

Figure 8. Power supply select jumper

J5 in the left-hand position: system will take power from the external AC/DC power adapter.

J5 in the right-hand position: system will take power from the USB cable.

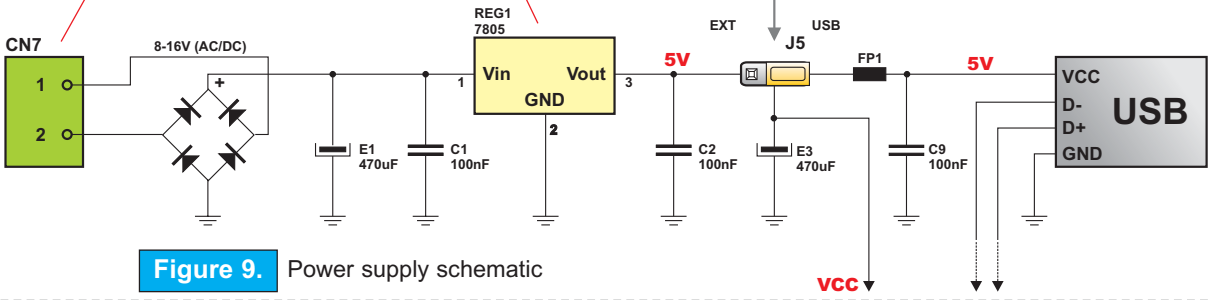


Figure 9. Power supply schematic

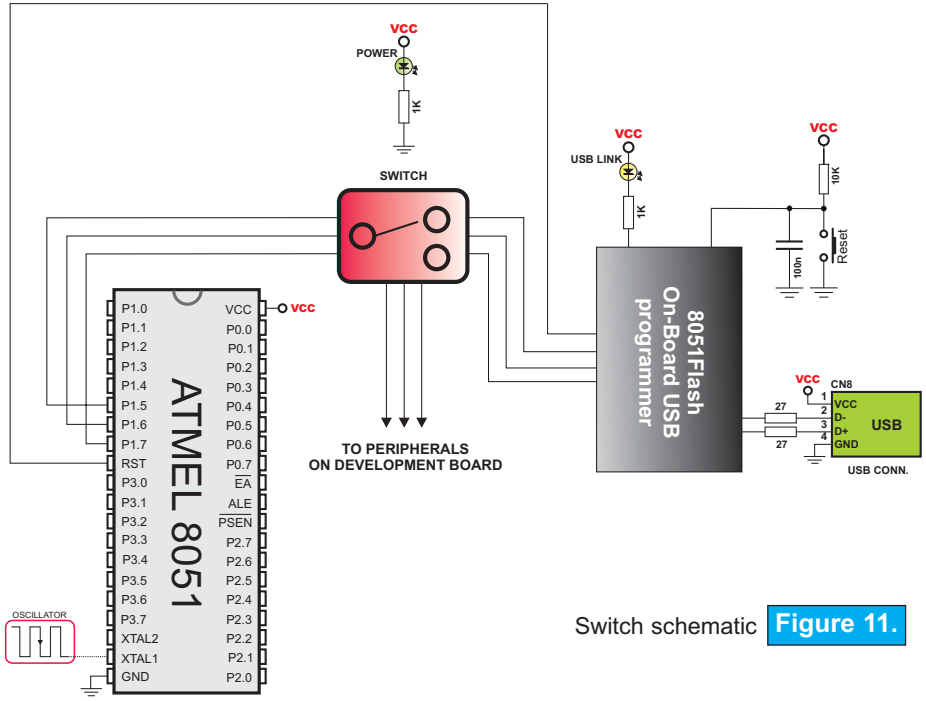
ON-BOARD USB 2.0 PROGRAMMER

There is no need for the use of external equipment during programming, as the Easy8051A 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 *8051Flash* 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.



Switch schematic **Figure 11.**

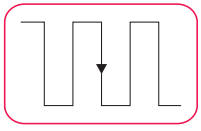
OSCILLATOR

Easy8051A development board has on-board oscillator circuit for generating microcontroller's clock input. Within the *8051Flash* programmer you can either choose internal RC oscillator or external clock. External oscillator is connected to the XTAL1 pin of the microcontroller.

Figure 12.
Oscillator

Figure 13.
Oscillator schematic

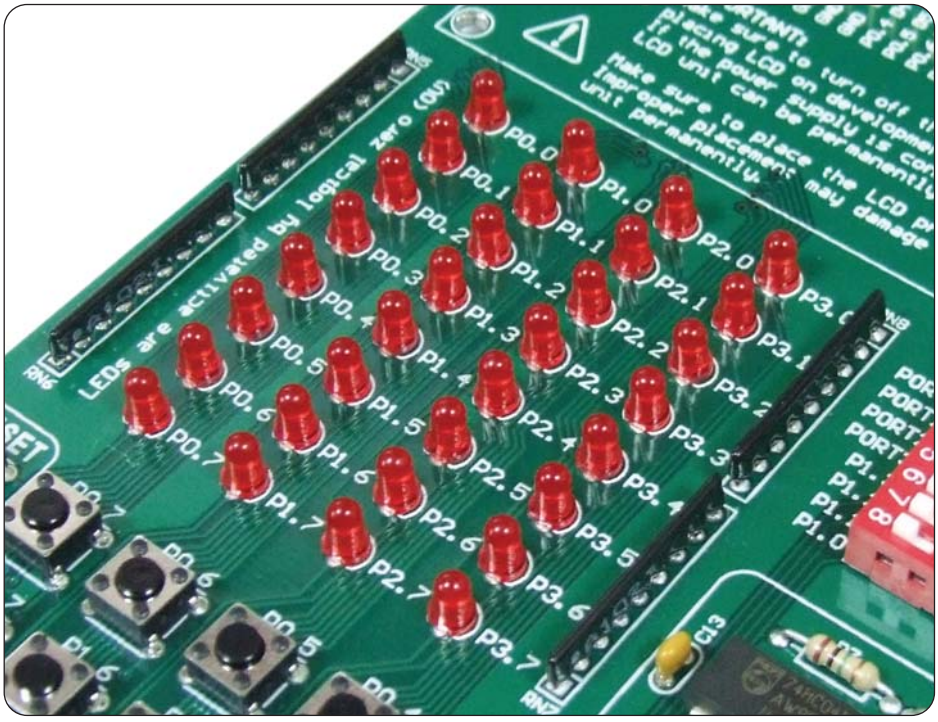
Note: In order to simplify the schematics in this manual, the oscillator circuit is represented by this symbol.



LEDs

Light Emitting Diodes (LEDs) are the most commonly used components, usually for displaying pin's digital state. Easy8051A has 32 LEDs that are connected to the microcontroller's PORT0, PORT1, PORT2 and PORT3.

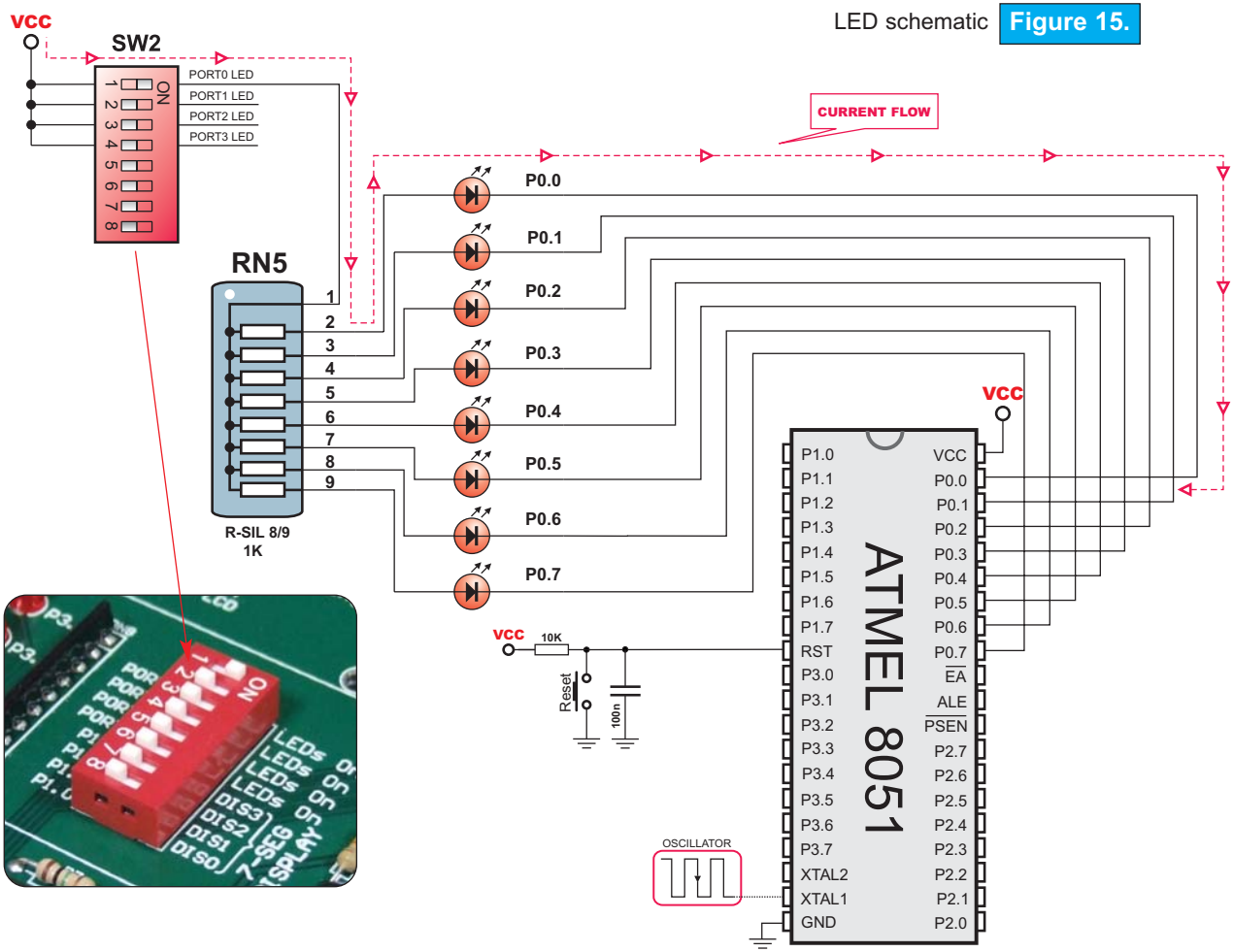
Figure 14. Light Emitting Diodes



Each group of eight LEDs can be enabled or disabled using the switch SW2. Fig. 15. illustrates the connection of a LEDs to PORT0 of the microcontroller. A resistor is used in series with the LED to limit the LED's current. In this case the resistor's value is 1K.

The LEDs are enabled when the corresponding switch on SW2 is on. When enabled, LEDs will display the state of the corresponding microcontroller pin; otherwise the LEDs will always be off, no matter what the port state is, as no current can flow through LED.

LED schematic **Figure 15.**



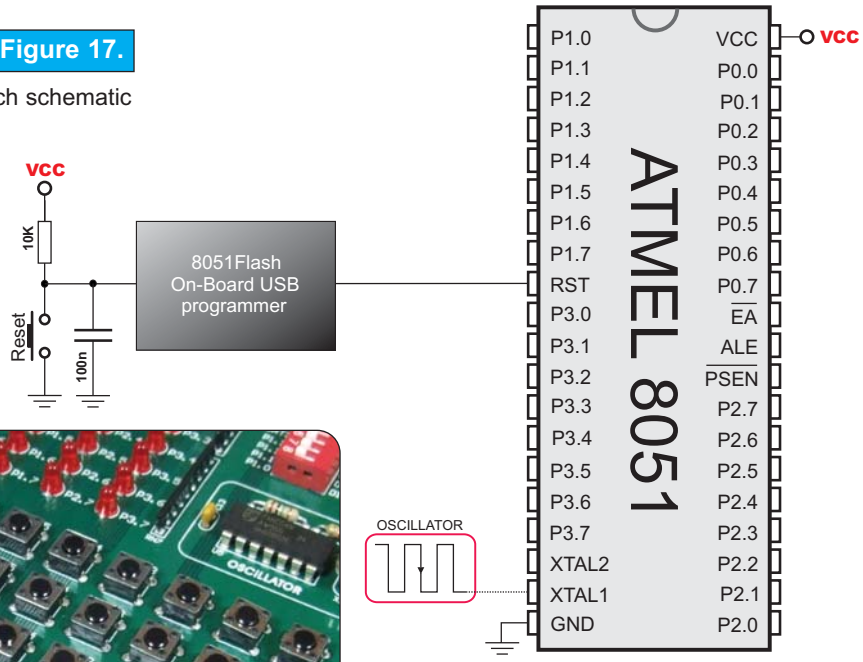
PUSHBUTTON SWITCHES

Easy8051A has 32 push buttons, which can be used to change states of digital inputs to micro-controller's ports. There is also one switch that acts as a RESET. Reset switch schematic is shown in Figure 17.

Reset switch **Figure 16.**

Figure 17.

Reset switch schematic



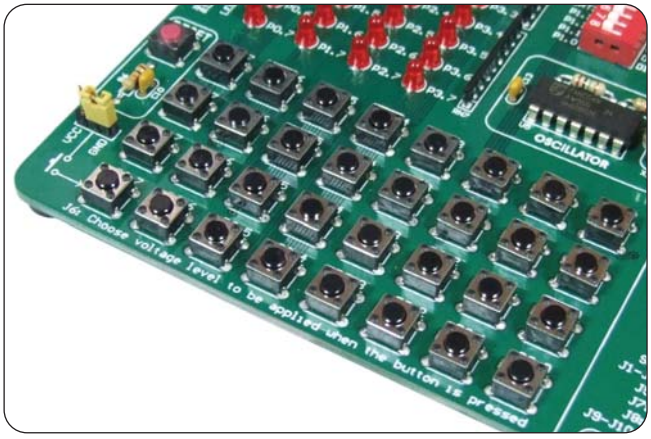


Figure 18.

Pushbutton switches

Buttons connections to PORT0, PORT1, PORT2 and PORT3 are shown in Fig. 19. Jumper J6 determines whether a button press will bring logical zero or logical one to the appropriate pin.

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

In the example shown in Fig. 19, J6 is connected to +5V, therefore pressing the buttons will bring logical one to the appropriate pins.

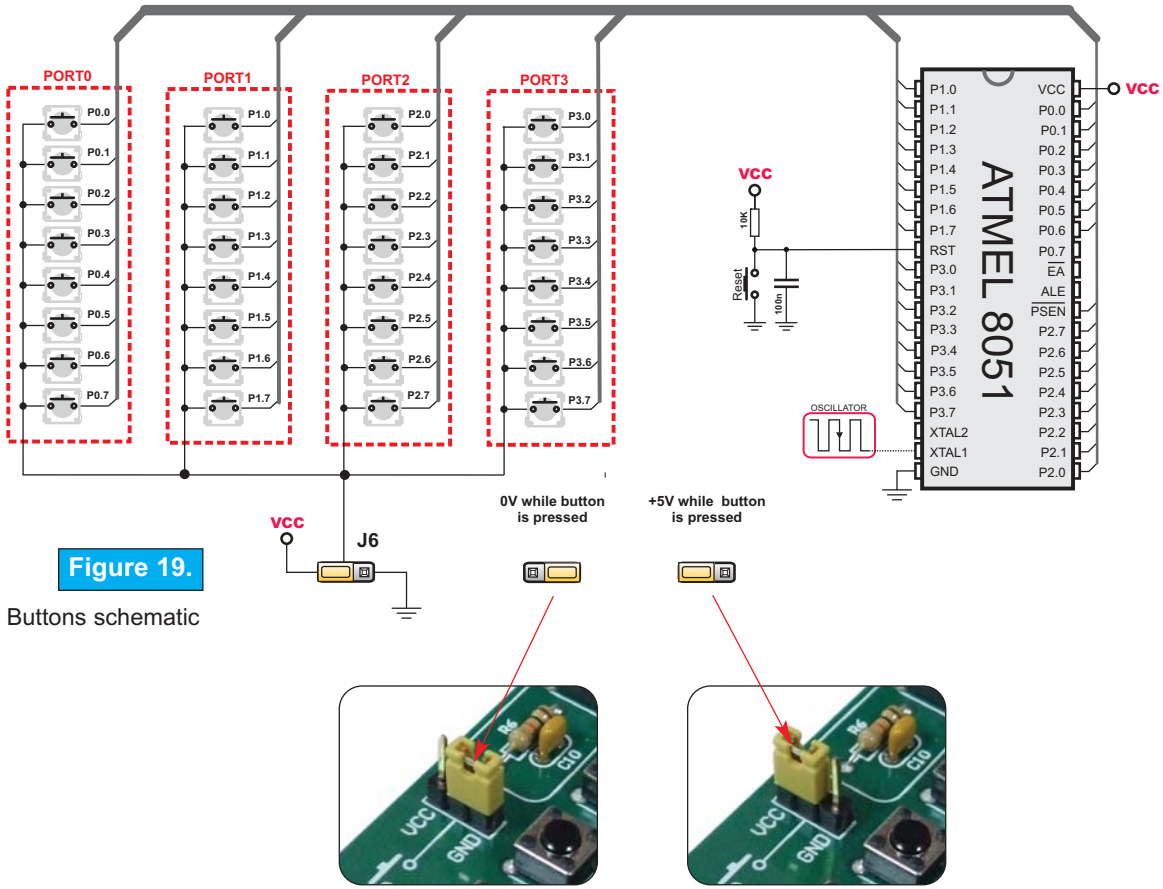


Figure 19.

Buttons schematic

On Fig. 20 the J1 jumper is set to pull-up, therefore when the button is not pressed, pull-up resistor pulls the microcontroller's PA3 pin to +5V.

A button press causes the port pin to be connected to ground (J6 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.

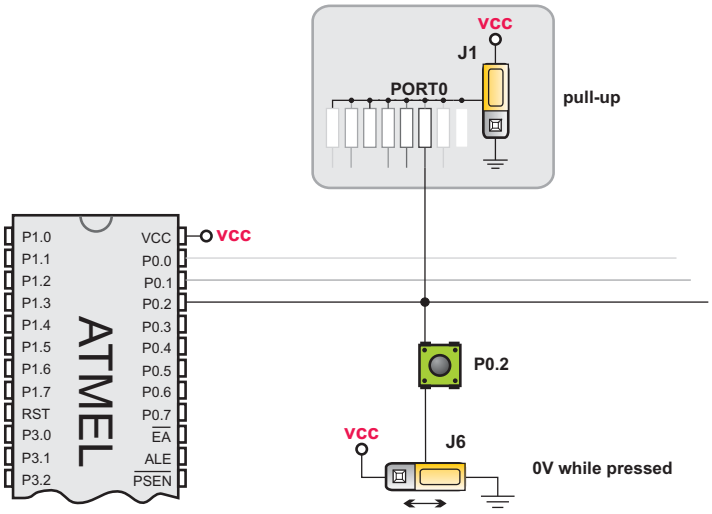


Figure 20. Button with pull-up resistor

On Fig. 21 the J6 jumper is set to pull-down, therefore when the button is not pressed, pull-down resistor pulls the microcontroller's PA3 pin to 0V.

A button press causes the port pin to be connected to +5V (J6 is in the higher position).

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

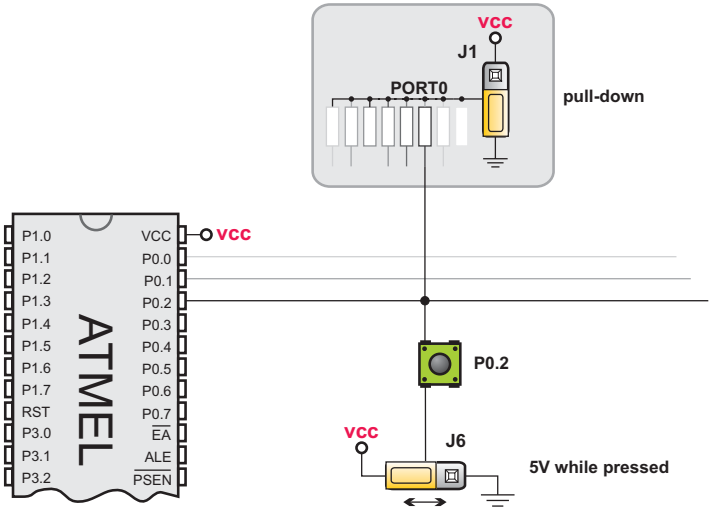


Figure 21. Button with pull-down resistor

7-SEGMENT DISPLAYS

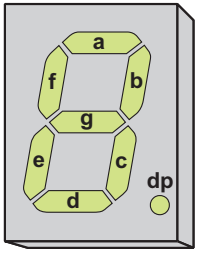
Easy8051A has four 7-segment displays in multiplex mode. Data lines are connected to PORT0, while each display is enabled through the lower four bits of PORT1.

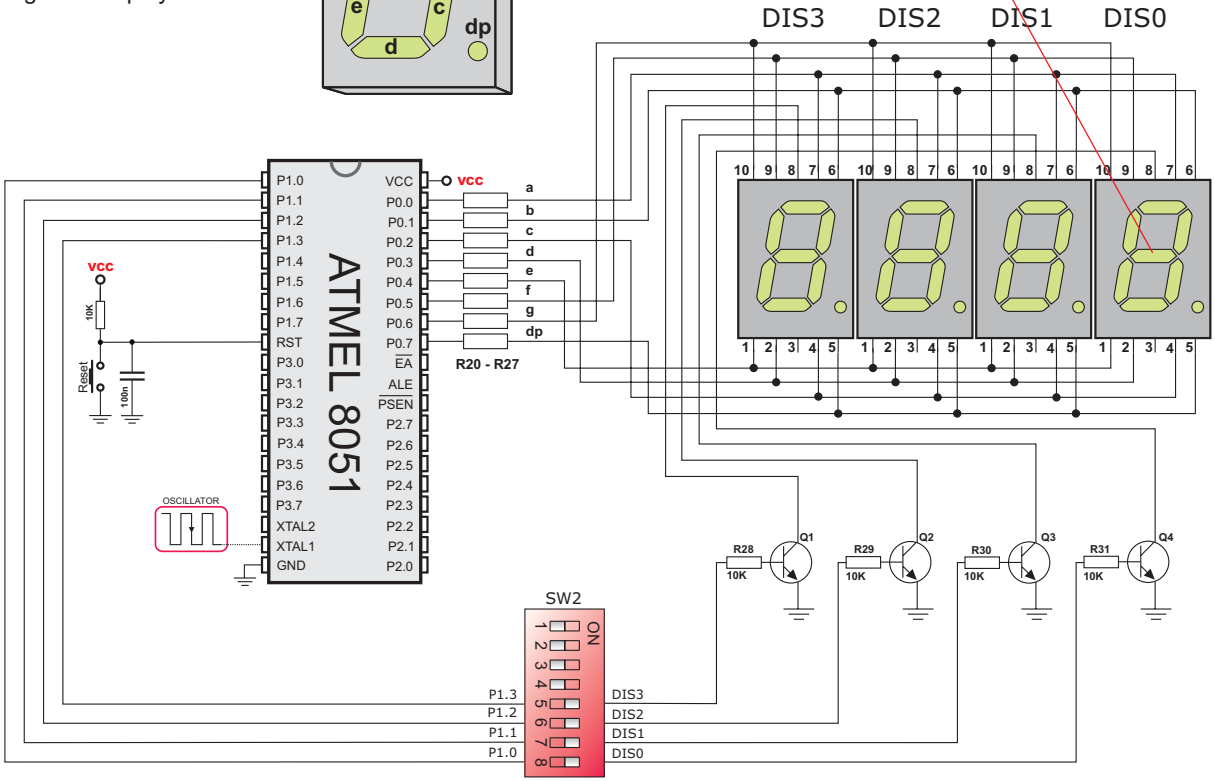
Figure 22.

7-segment displays

Figure 23.

7-segment displays schematic





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 J8 (Fig. 24) to the upper position. The GLCD's contrast can be adjusted using the potentiometer P1, which is placed to the right of the GLCD.

Figure 25.

GLCD

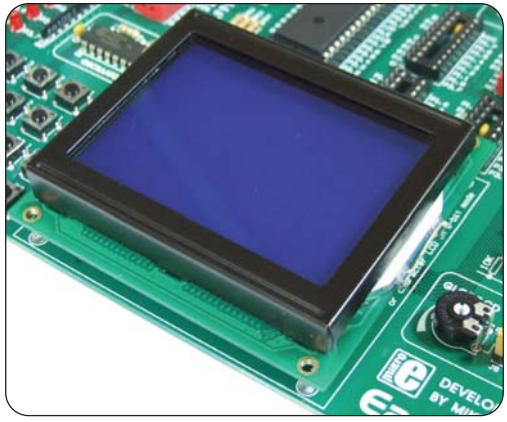


Figure 24.

GLCD selection jumper

In order to enable GLCD, jumper J8 should be set to the upper position, labeled as GRAPH.

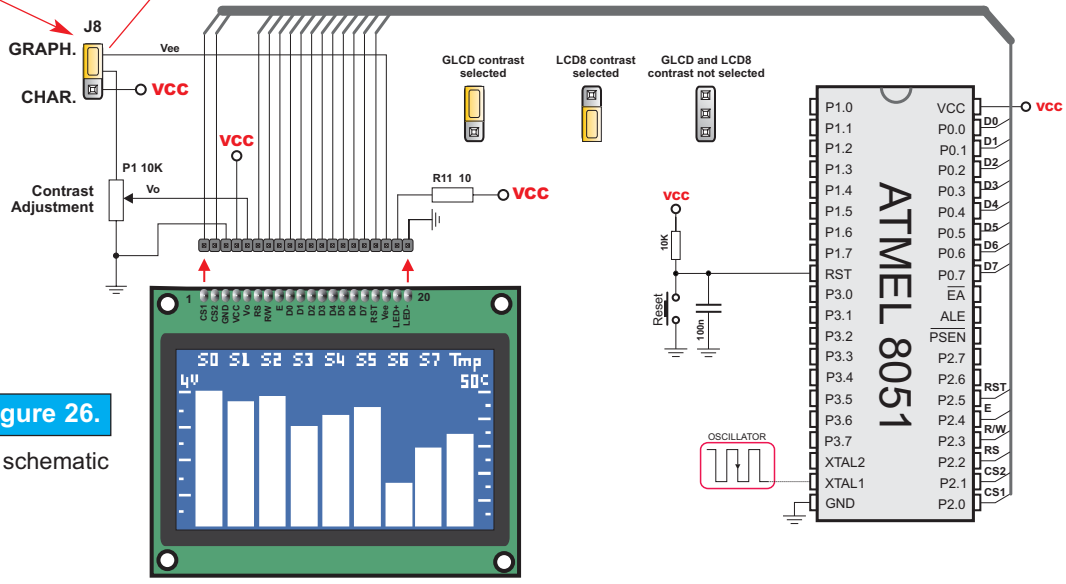


Figure 26.

GLCD schematic

CONNECTOR 2x16 LCD ON-BOARD

LCD 2X16 IN 4-BIT MODE

A standard character LCD is probably the most widely used data visualization component. Usually, it can display two lines of 16 alphanumeric characters, each made up of 5x8 pixels. The character LCD communicates with the microcontroller via a 4-bit or 8-bit data bus, each requiring the use of a different connector on Easy8051A. For 4-bit data bus use, the LCD should be placed in the upper left of the board, just above the LEDs. The connection to the microcontroller is shown in Fig. 28 where there are only four data lines. It is important to note that the LCD should be placed or removed from Easy8051A only when the power is off.

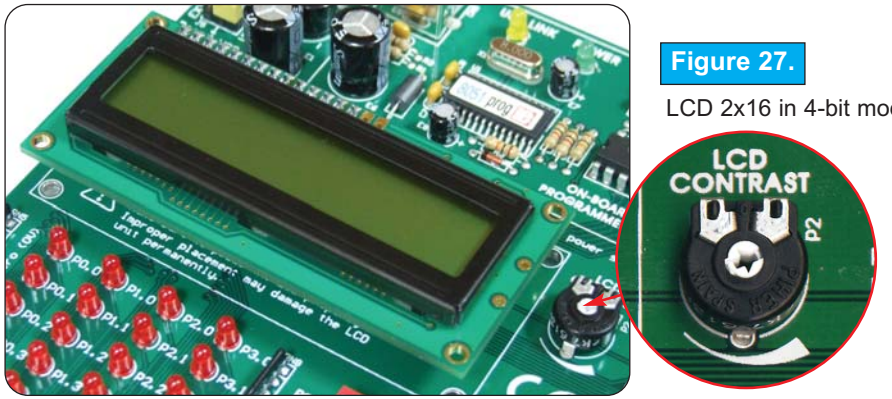


Figure 27.
LCD 2x16 in 4-bit mode

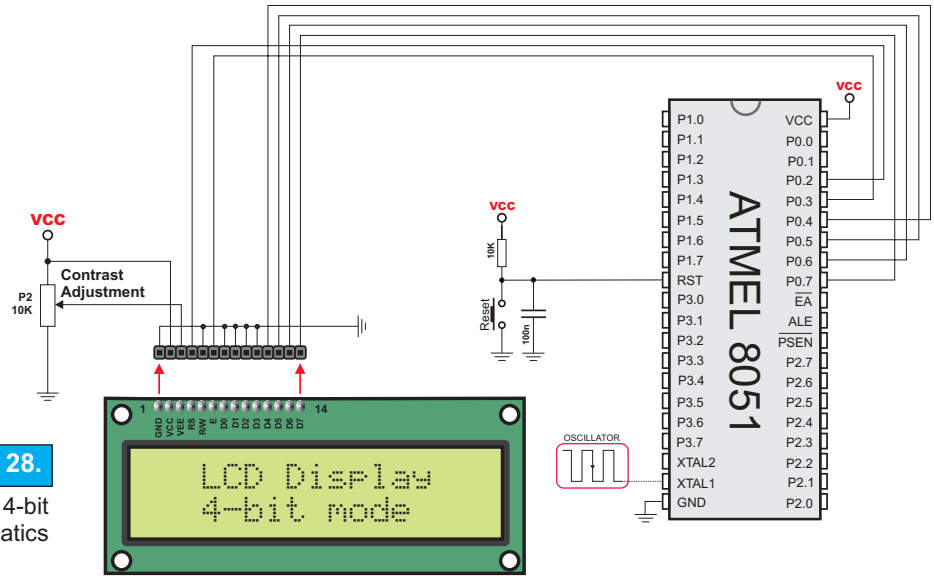


Figure 28.
LCD 2x16 in 4-bit mode schematics

LCD 2X16 IN 8-BIT MODE

When using a character LCD in 8-bit mode, the connector that is shared with the GLCD should be used. Since this connector has 20 pins and the character LCD has only 14 pins, special attention is required when placing the LCD. Otherwise the LCD can be permanently damaged.

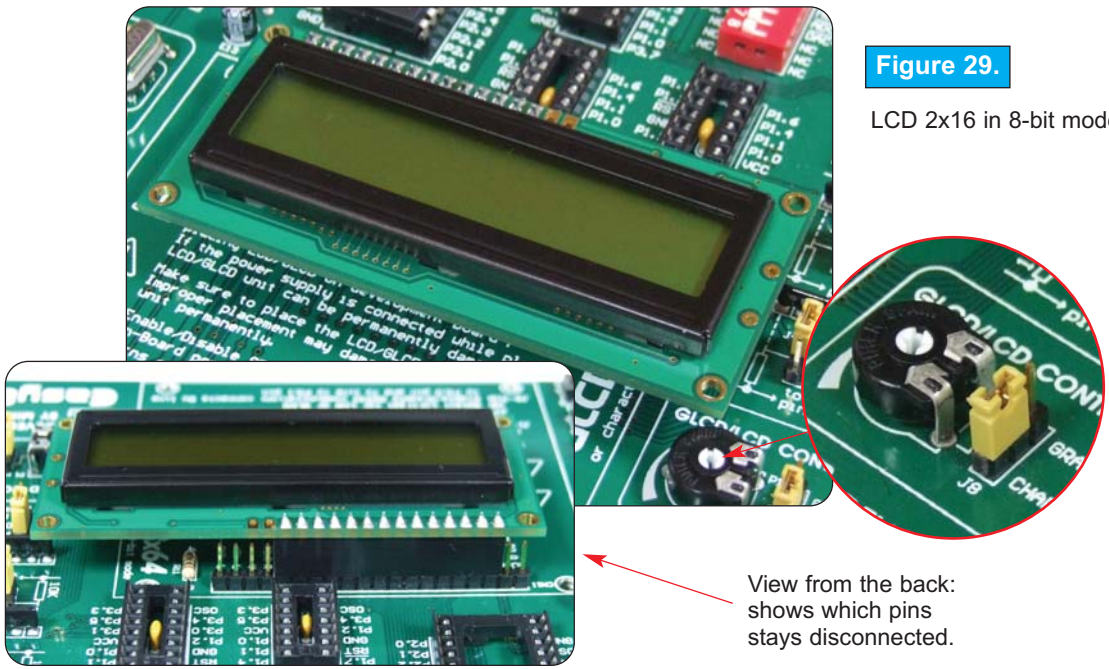


Figure 29.

LCD 2x16 in 8-bit mode

The LCD must be placed in the marked position with two free pins to the left and four free pins to the right. It is important to note that the LCD should be placed or removed from Easy8051A only when the power is off. Before attaching the LCD, set jumper J8 to the lower position. The LCD's contrast can be adjusted using potentiometer P1 which is located to the right of the GLCD/LCD connector.

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

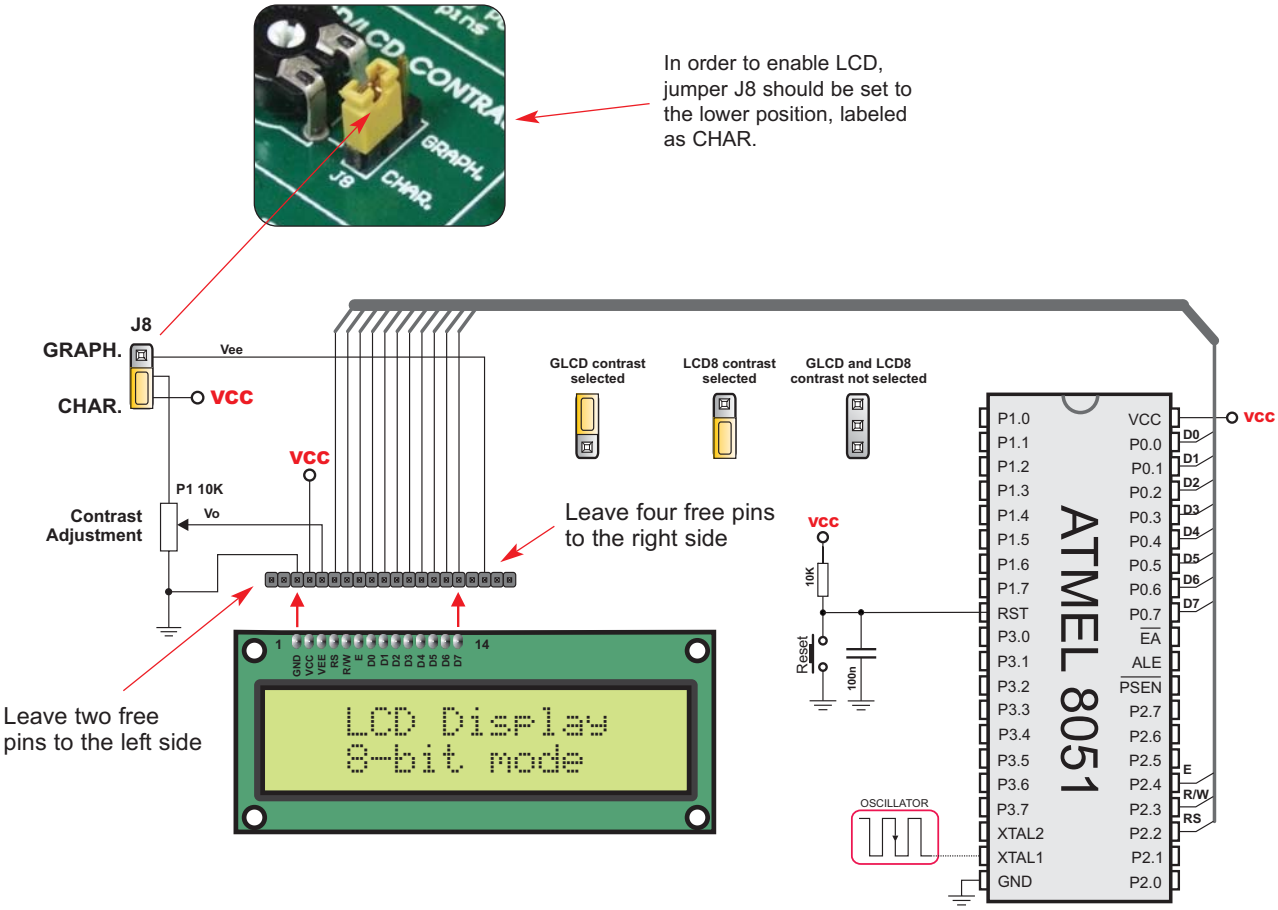


Figure 30. LCD 8-bit mode schematic

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.

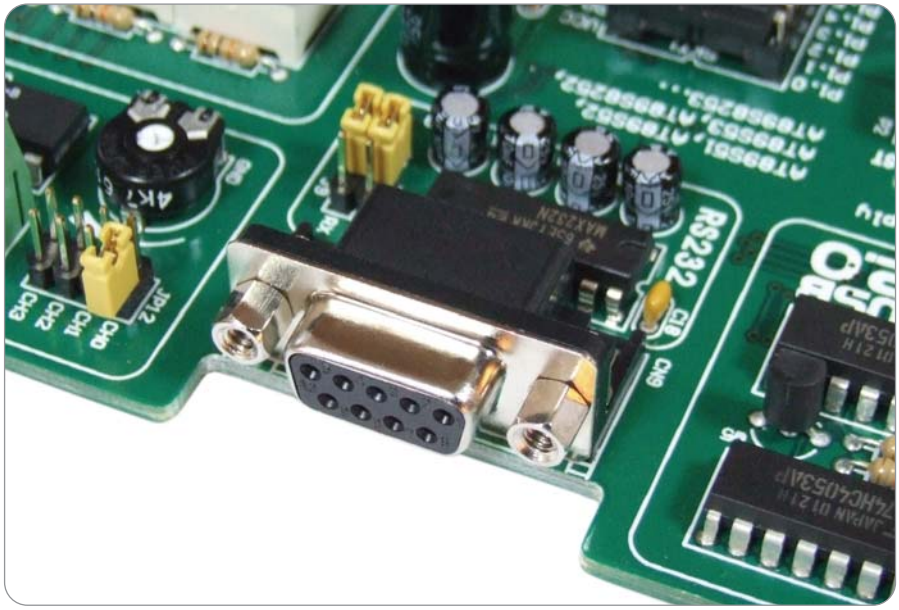
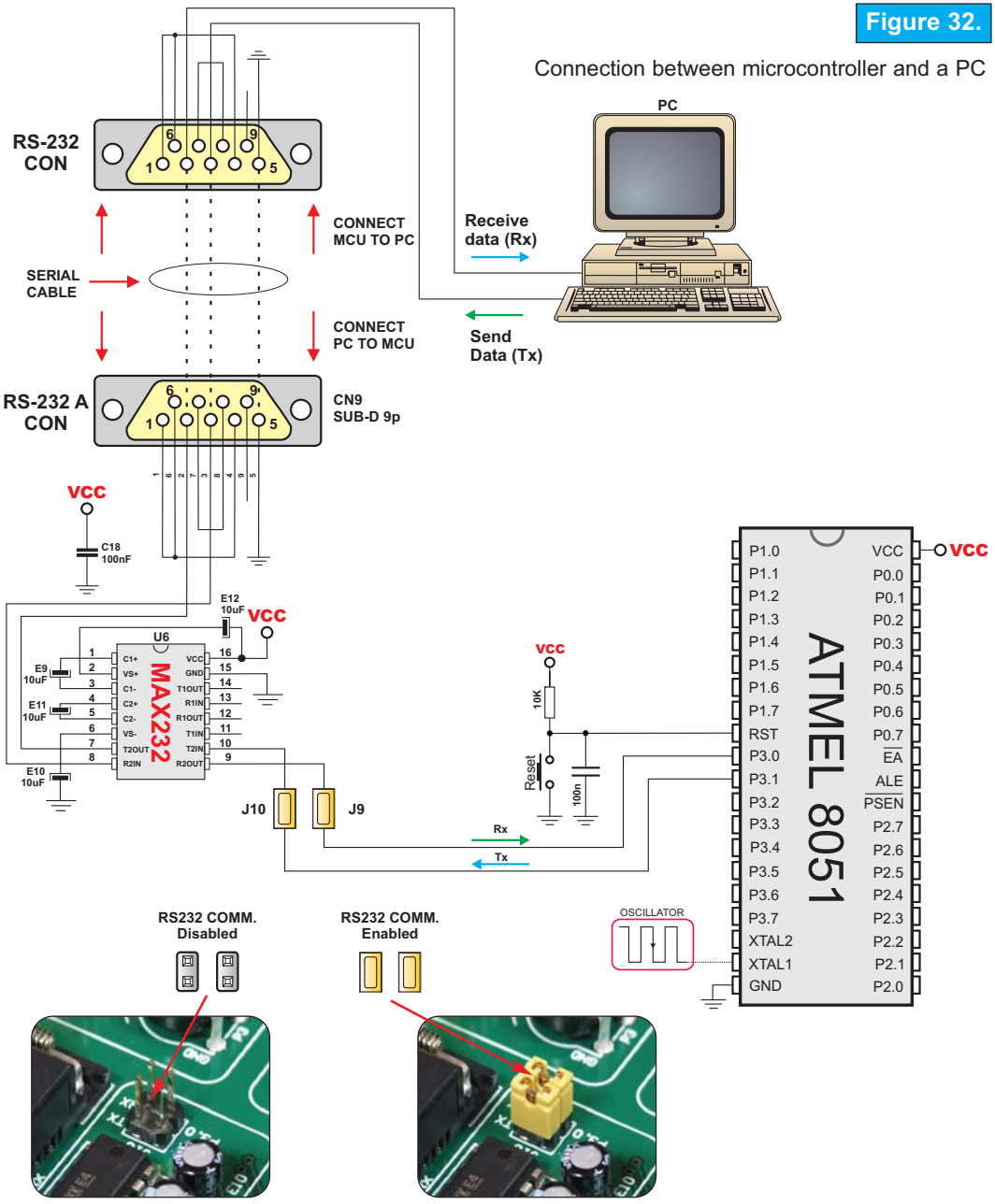


Figure 31. RS232 connectors

In order to provide a more flexible system, the microcontroller is connected to the MAX232 through the two jumpers: J9 and J10. The jumper J9 is used to connect the Rx line to P3.0 pin. The jumper J10 is used to connect the Tx line to P3.1 pin.

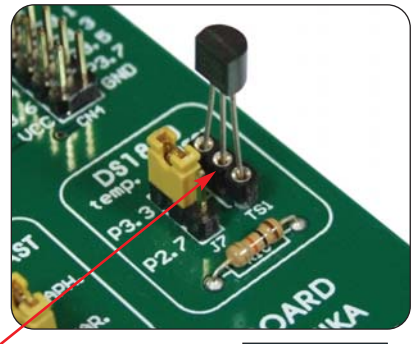
Figure 32.

Connection between microcontroller and a PC



DS1820 DIGITAL THERMOMETER

DS1820 digital thermometer is well suited to environmental temperature measurement, having the temperature range of -55°C to 125°C and the accuracy of +/- 0.5°C. It must be placed correctly in the 3-pin socket provided on Easy8051A, with its rounded side to the right edge of the board (see Fig. 33) otherwise the DS1820 could be permanently damaged. DS1820's data pin can be connected to either P2.7 or P3.3 pin, which is determined by jumper J7.



DS1820 **Figure 33.**

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

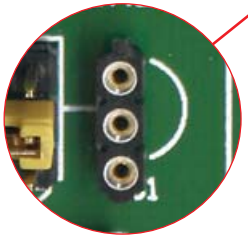


Figure 34.

DS1820 schematic

ADC INPUT ENABLED

VREF 4.096V ON-BOARD

A/D CONVERTER

The Easy8051A development system has 4-channel 12-Bit A/D Converter (Analog-to-Digital Converter) with SPI serial interface (MCP3204). In order to use it the switches 1,2,3 and 4 on SW1 must be enabled. In order to simulate an analog input, potentiometer P3 should be connected to one of four analog inputs through jumper group J12. MCP1541 is used as a 4.096V voltage reference for ADC.

A/D Converter **Figure 35.**

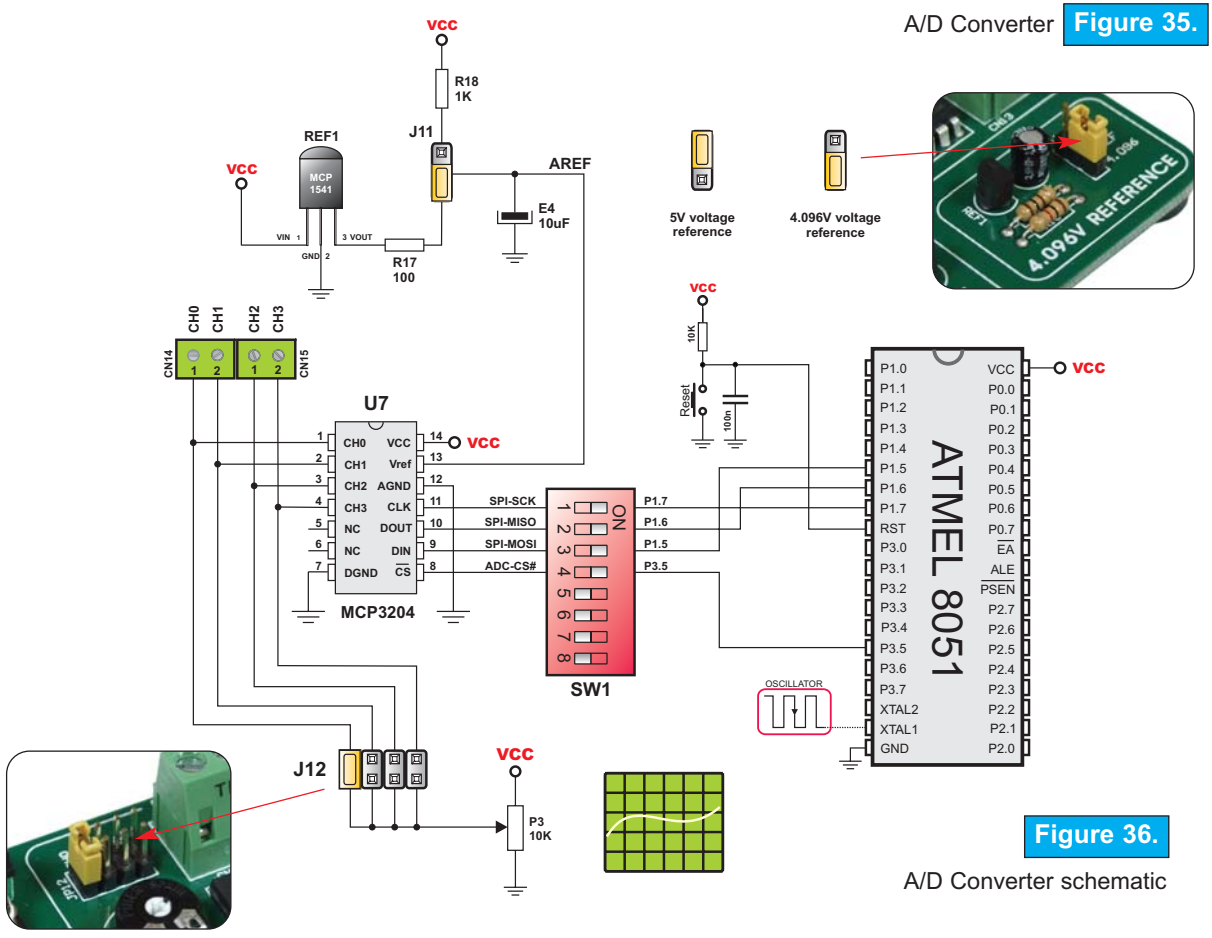


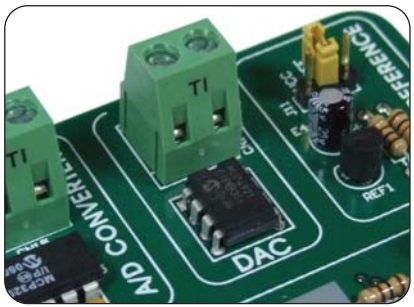
Figure 36.

A/D Converter schematic

VREF 4.096V ON-BOARD

D/A CONVERTER

The Easy8051A development system has 12-Bit D/A Converter (Digital-to-Analog Converter) with SPI serial interface (MCP4921). In order to use it the switches 1, 3 and 5 on SW1 must be enabled. Analog voltage output from DAC chip is connected to the CN13 connector and it is in range from 0V to Vref. MCP1541 is used as a 4.096V voltage reference for DAC.



D/A Converter **Figure 37.**

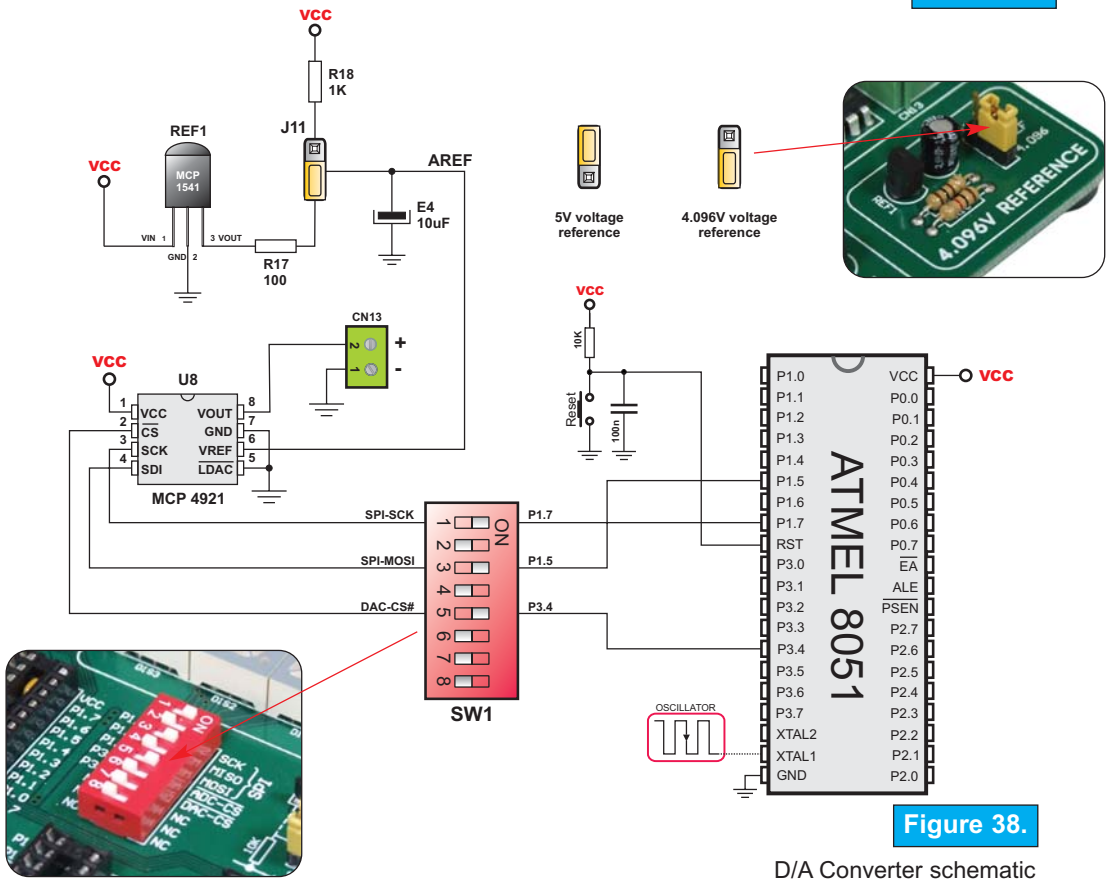
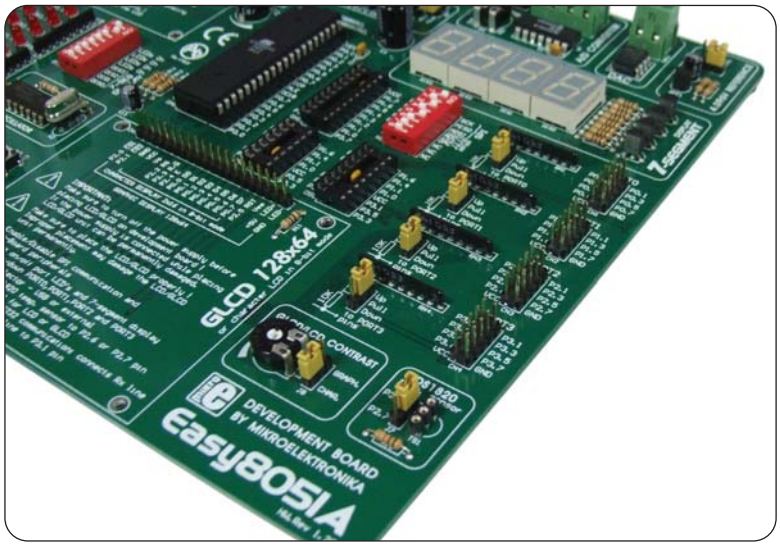


Figure 38.

D/A Converter schematic

DIRECT PORT ACCESS

All microcontroller input/output pins can be accessed via connectors placed along the right side of the board. For each of PORT0, PORT1, PORT2 and PORT3 there is one 10-pin connector providing VCC, GND and eight port pins.

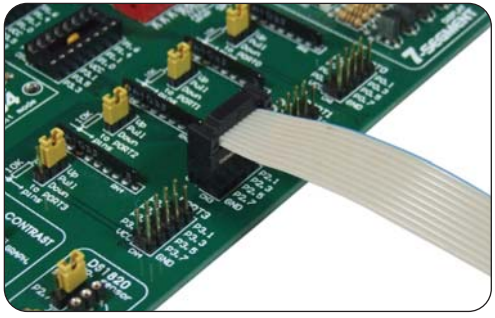


Direct port access connectors **Figure 39.**

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

Figure 40.

Example of how to connect external peripheral with flat cable



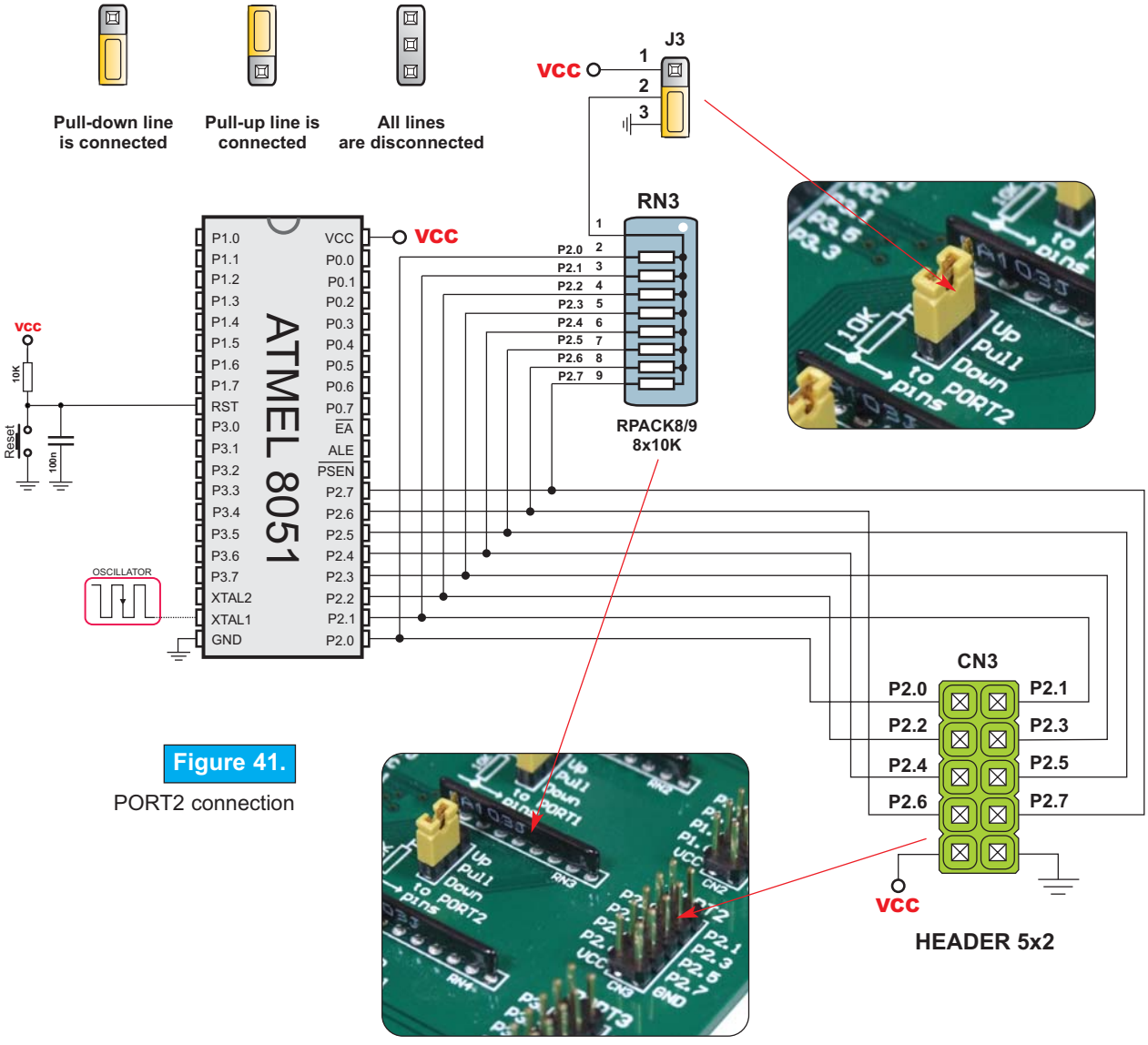


Figure 41.

PORT2 connection

If you are experiencing problems with any of our products or you just want additional information, please let us know. We are committed to meeting your every need.

Technical Support :
support@mikroe.com

If you have any other question, comment or a business proposal, please contact us:

E-mail: ***office@mikroe.com***
Web: ***www.mikroe.com***
Forum: ***www.mikroe.com/forum/***