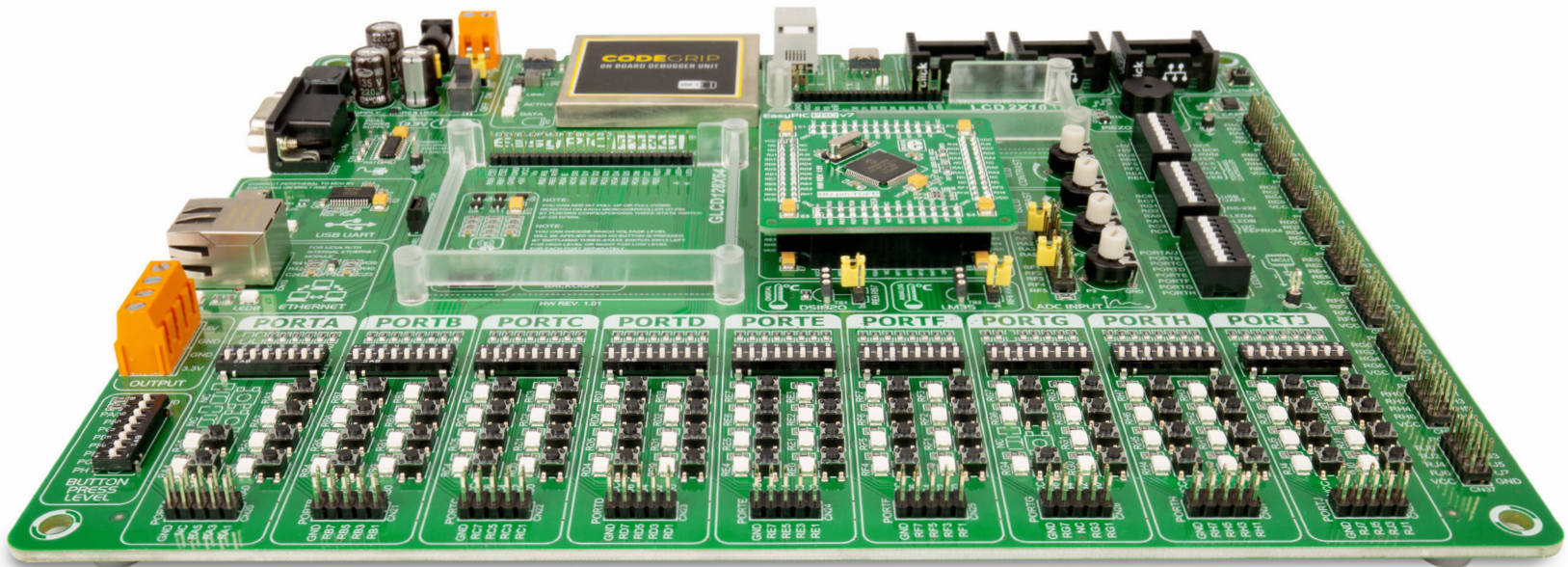# EasyPIC PRO v7a
CONNECTIVITY

170+

MCUs
SUPPORTED

CODEGRIP
ON BOARD

mikroBUS™
SOCKETS

AMAZING
CONNECTIVITY

3.3V — 5V

DUAL POWER
SUPPLY

MIKROE

Thank you for being our valued customer!

From day one, we at Mikroe are committed to changing the embedded electronics industry through the use of industry standard hardware and software solutions.

We are excited to have the opportunity to present you the NEW generation of our flagship development board – the **EasyPIC PRO v7a!**

The A generation of the board brings you some awesome new features. We hope that you will like it as much as the previous one.

Use it wisely and have fun!

Nebojsa Matic,
CEO

Table of contents

All images shown in the manual are for illustration purpose only.

INTRODUCTION

EasyPIC PRO is an old friend. Supporting microcontrollers in both 5V and 3.3V power supply technology, this board is truly fantastic tool for development. We have put a lot of effort into board design, making it easy to use, and we have placed lots of modules that will help you in your work. MCU sockets are well organized and cover all high-pin-count PIC® microcontrollers in TQFP packaging.

We asked ourselves what we can do to make such a great board even greater. And we equiped it with our revolutionary **new programmer & debugger - CODEGRIP**. We now present you with the **new version 7a** that brings so much more, and we hope that you will be thrilled with your new board, just as we are.

2 CONNECTORS FOR EACH PORT

Amazing connectivity

EasyPIC PRO v7a is all about onnectivity. Having two different connectors for each port, you can connect accessory boards, sensors and your custom electronics easier then ever before.

EVERYTHING IS ALREADY HERE

CODEGRIP on board

Powerful on-board CODEGRIP USB-C programmer and In-Circuit debugger can program and debug over 170 microcontrollers. You will need it, whether you are a professional or a beginner.

3.3V AND 5V POWER SUPPLY

Dual Power Supply

EasyPIC PRO v7a is among few development boards which support both 3.3V and 5V microcontrollers. This feature greatly increases the number of supported MCUs. It's like having two boards instead of one!
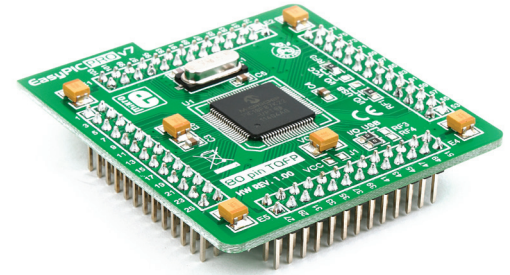
FOR EASIER CONNECTIONS

mikroBUS™ support

Just plug in your Click board, and it's ready to work. We picked up a set of the most useful pins you need for development and made a pinout standard you will enjoy using.

CODEGRIP
ON BOARD DEBUGGER UNIT
USB-C

9-32V DC
7-23V AC
ON
OFF
POWER SUPPLY

LINK
ACTIVE
DATA

DBG SEL
R14 ON
USB COMM

mikroBUS 1
RST/RC0   RB0/INT
CS/RE0   RC7/RX
SCK/RC3   RC6/TX
MISO/RC4   RC3/SCL
MOSI/RC5   RC4/SDA
+3.3V   +5V
GND   GND

mikroBUS 2
RST/RA4   RB1/INT
CS/RE1   RC7/RX
SCK/RC3   RC6/TX
MISO/RC4   RC3/SCL
MOSI/RC5   RC4/SDA
+3.3V   +5V
GND   GND

mikroBUS 3
RST/RE5   RB2/INT
CS/RE2   RG2/RX
SCK/RC3   RG1/TX
MISO/RC4   RC3/SCL
MOSI/RC5   RC4/SDA
+3.3V   +5V
GND   GND

RESET

LCD 2X16
CHARACTERS IN 4-BIT MODE

IMPORTANT:
BE SURE TO TURN OFF THE POWER SUPPLY BEFORE
PLACING LCD OR GLCD ON DEVELOPMENT BOARD.
OTHERWISE, BOTH LCD AND GLCD UNITS CAN BE
PERMANENTLY DAMAGED.
BE SURE TO PLACE LCD AND GLCD PROPERLY.
OTHERWISE, BOTH LCD AND GLCD UNITS CAN BE
PERMANENTLY DAMAGED.

PIEZO BUZZER

I2C EEPROM

DUAL POWER SUPPLY
3.3V 5V

CONNECT PERIPHERAL TO MCU
BY SWITCHING ON
SW5.3 AND SW5.4
TX - RX

DEVELOPMENT BOARD
EasyPIC PRO v7a
BY MIKROELEKTRONIKA

EasyPIC PRO v7
HW REV. 1.01

LCD CONTRAST
P1

GLCD CONTRAST
P4

SW4
+5V
+5V
RG3
RB6
RF5
RF2
RE4
RE5
LCD BCK
GLCD BCK
BCK PWM
BUZZER
READ-X
READ-Y
DRIVEA
DR VEB
TOUCHPANEL CONTROLLER

SW5
RC7
RC6
RG1
RG2
RA0
RA1
RC3
RC4
TX USB
RX UART
TX RS-232
RX
ETH-LEDA
ETH-LEDB
SCL I2C
SDA EEPROM

CONNECT PERIPHERAL TO MCU BY
SWITCHING ON SW5.1 AND SW5.2

TOUCHPANEL CONTROLLER

GLCD128X64

NOTE:
YOU CAN ADD 4k7 PULL-UP OR PULL-DOWN
RESISTOR ON EACH MICROCONTROLLER I/O PIN
BY PUSHING CORRESPONDING THREE-STATE SWITCH
UP OR DOWN.

NOTE:
YOU CAN CHOOSE WHICH VOLTAGE LEVEL
WILL BE APPLIED WHEN I/O BUTTON IS PRESSED
BY SWITCHING THREE-STATE SWITCH SW13 LEFT
FOR HIGH LEVEL OR RIGHT FOR LOW LEVEL
FOR EACH PORT SEPARATELY.

80 pin TQFP
Microchip

RIGHT TOP LEFT BOTTOM
BACKLIGHT

HW REV. 1.01

USB UART
TX RX

FOR MCUs WITH
INTERNAL ETHERNET
MODULE

LINK-PP
LPJ0026GENL
China M 2102

ETHERNET
LEDA LEDB

DIGITAL
DS1820 J3 R6 RB7
ADC INPUT

ANALOG
LM35 J4 RF4 RA3

ADC INPUT

SW6
PORTA/J
PORTB
PORTC
PORTD
PORTE
PORTF
PORTG
PORTH
LEDs ON

MCU

OUTPUT
5V
GND
GND
3.3V

PA/J
PB
PC
PD
PE
PF
PG
PH
BUTTON PRESS LEVEL
VCC GND

PORTA
PORTB
PORTC
PORTD
PORTE
PORTF
PORTG
PORTH
PORTJ

PORTA   CN29
RA0 RA1
RA2 RA3
NC NC
RA4 RA5
VCC GND

PORTB   CN30
RB0 RB1
RB2 RB3
RB4 RB5
RB6 RB7
VCC GND

PORTC   CN31
RC0 RC1
RC2 RC3
RC4 RC5
RC6 RC7
VCC GND

PORTD   CN32
RD0 RD1
RD2 RD3
RD4 RD5
RD6 RD7
VCC GND

PORTE   CN33
RE0 RE1
RE2 RE3
RE4 RE5
RE6 RE7
VCC GND

PORTF   CN34
RF0 RF1
RF2 RF3
RF4 RF5
RF6 RF7
VCC GND

PORTG   CN35
RG0 RG1
RG2 RG3
NC RG4
RG6 RG7
VCC GND

PORTH   CN36
RH0 RH1
RH2 RH3
RH4 RH5
RH6 RH7
VCC GND

PORTJ   CN37
RJ0 RJ1
RJ2 RJ3
RJ4 RJ5
RJ6 RJ7
VCC GND

IT'S GOOD TO KNOW!

PIC18F87K22 is the default microcontroller!

PIC18F87K22 is the default chip of **EasyPIC PRO v7a**. Featuring nanoWatt XLP™ technology, it has **16 MIPS** operation, **128K bytes** of linear program memory, **3896 bytes** of linear data memory, and support for a wide range of power supply from **1.8V to 5V**. It's loaded with great modules: 69 General purpose **I/O pins**, 24 Analog Input pins **(AD)**, internal Real time clock and calendar **(RTCC)**, support for Capacitive Touch Sensing using Charge Time Measurement Unit **(CTMU)**, six **8-bit timers** and five **16-bit timers**. It also has ten **CCP** modules, three **Comparators** and two **MSSP** modules which can be either **SPI** or **I2C**.

SYSTEM SPECIFICATIONS

POWER SUPPLY
7–23V AC or 9–32V DC
or via USB cable (5V DC)

POWER CONSUMPTION
~90mA at 5V
when all peripheral modules
are disconnected

BOARD DIMENSION
266 x 220 mm
[10.47 x 8.66 inch]

BOARD WEIGHT
475g
[1.0472 lbs]

PACKAGE CONTAINS

1 Damage resistant protective box

2 EasyPIC PRO v7a development board
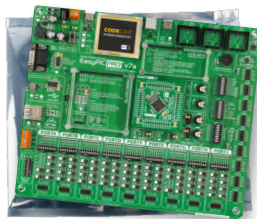
3 USB cable

4 User Manual & Schematics

DUAL POWER SUPPLY

Board contains switching power supply that creates stable voltage and current levels necessary for powering each part of the board. Power supply section contains two power regulators: **MC34063A**, which generates VCC-5V, and **MC33269DT3.3** which creates VCC-3.3V power supply. The board can be powered in three different ways: with **USB power supply (CN1)**, using external adapters via **adapter connector (CN19)** or **additional screw terminals (CN18)**. External adapter voltage levels must be in range of **9-32V DC or 7-23V AC**. Use jumper **J2** to specify which power source you are using and jumper **J1** to specify whether you are using 5V or 3.3V power supply. Upon providing the power using either external adapter or USB power source you can turn on power supply by using **SWITCH 1 (Figure 1)**. Power **LED (Green ON)** will indicate the presence of power supply.

Figure 1: Dual power supply unit of EasyPIC PRO v7a

Figure 2: Dual power supply unit schematic

3.3V VOLTAGE REGULATOR

5V SWITCHING POWER SUPPLY
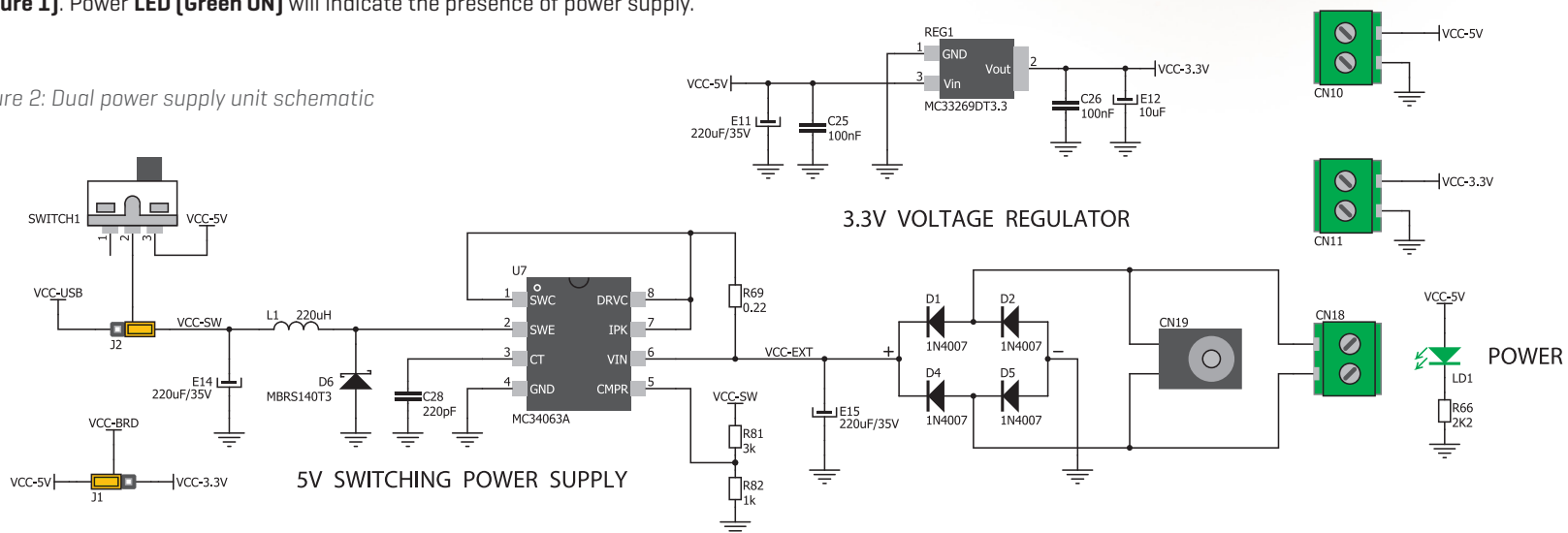
HOW TO POWER THE BOARD?

DUAL PWR SUPPLY

3.3V ⟳ 5V

The EasyPIC PRO v7a development board supports both 3.3V and 5V power supply on a single board. This feature enables you to use wide range of peripheral boards.

POWER SUPPLY:
Via DC connector or screw terminals [7V to 23V AC or 9V to 32V DC], or via USB cable [5V DC]

POWER CAPACITY:
Up to 500mA with USB, and up to 600mA with external power supply

1. With USB cable

To power the board with USB cable, place jumper **J2** in USB position and place jumper **J1** in 5V or 3.3V position. You can then plug in the USB cable as shown on image Figure 3, and turn the power switch ON.
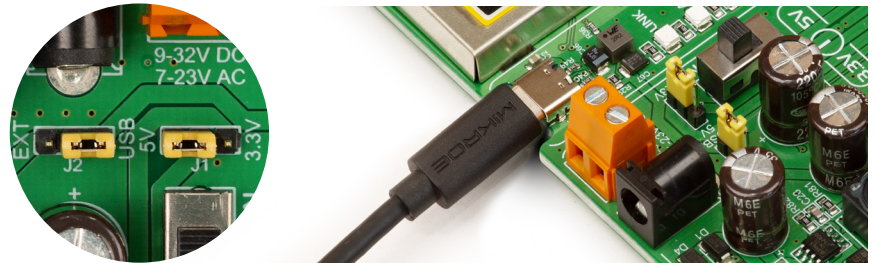
Figure 3: Powered by USB

2. By using wall-adapter

To power the board via adapter connector, place jumper **J2** in EXT position, and place jumper **J1** in 5V or 3.3V position. You can then plug in the adapter cable as shown on image Figure 4, and turn the power switch ON.
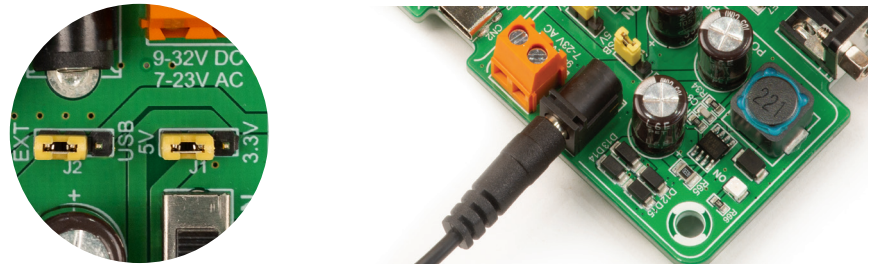
Figure 4: Powered by wall-adapter

3. With laboratory PSU

To power the board using screw terminals, place jumper **J2** in EXT position, and place jumper **J1** in 5V or 3.3V position. You can then screw-on the cables in the screw terminals as shown on image Figure 5, and turn the power switch ON.
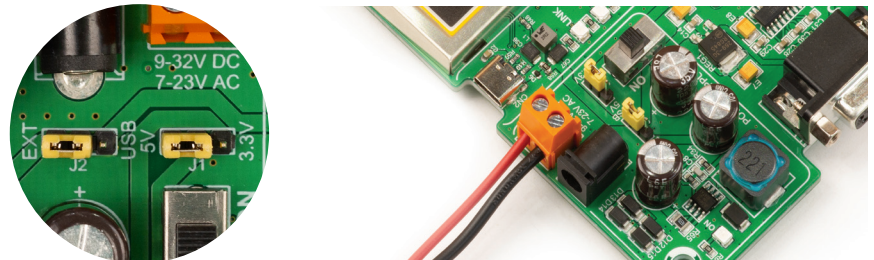
Figure 5: Powered by laboratory PSU

Default MCU card

Microcontrollers are supported using specialized MCU cards containing 104 pins, which are placed into the on-board female MCU socket. Currently, there are three types of cards: **Standard 80-pin TQFP, Ethernet 80-pin TQFP card and Ethernet 100-pin TQFP PF card.** Standard card supports 80-pin PIC18Fxxxx, PIC18FxxJxx and PIC18FxxKxx microcontrollers, with or without USB support. It contains several SMD jumpers, which are supposed to be placed or removed, depending on the microcontroller.

Default MCU card that comes with the EasyPIC PRO v7 package is shown on Figure 6. It contains **PIC18F87K22** microcontroller which is loaded with on-chip modules and is a great choice for both beginners and professionals. After testing and building the final program, this card can also be taken out of the board socket and used in your final device.
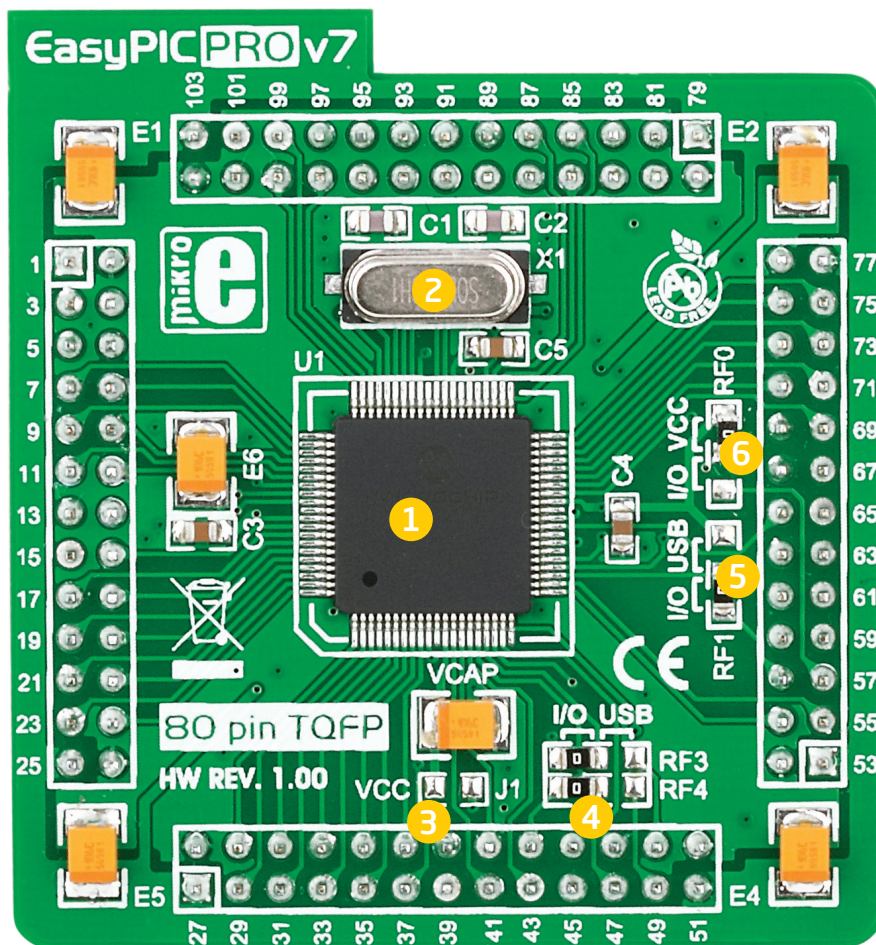
Figure 6: Default MCU card with PIC18F87K22

1 **PIC18F87K22 microcontroller.** Featuring nanoWatt XLP™ technology, it has 16 MIPS operation, 128K bytes of linear program memory, 3896 bytes of linear data memory, and support for a wide range of power supply from 1.8V to 5V.

2 **16MHz crystal oscillator.** We carefully chose the most convenient crystal value that provides clock frequency which can be used directly, or with the PLL multipliers and dividers to create higher MCU clock value.

3 **VCAP jumper.** Some PIC18FK and all PIC18FJ microcontrollers have cores that work on 1.8V-2.5V voltage range, and peripherals that work with 3.3V and 5V voltages. Internally, those microcontrollers have power regulators which adjust the core voltage levels. In order for those devices to have a stable operation of the core, manufacturer recommends that decoupling capacitive filters should be provided, and connected between specific microcontroller pins designated with VCAP and GND. This MCU card provides a VCAP jumper which is used for this purpose. **Jumper is removed by default.**

4 **USB communication lines.** These two jumpers, when in USB position, connect **D+** and **D-** lines of the on-board USB connector with **RF3** and **RF4** microcontroller pins. Since PIC18F87K22 doesn't support USB, **jumpers are in I/O position.**

5 **VUSB line jumper.** For PIC18F8xJ5x devices, this jumper should be connected to VCC for enabling internal USB controller. Since PIC18F87K22 doesn't support USB, **this jumper is in I/O position.**

6 **ENVREG selection jumper.** PIC18FJ and PIC18FK microcontrollers are using internal voltage regulator which is enabled by placing this jumper in **VCC position.**

Figure 7: Default MCU card schematics
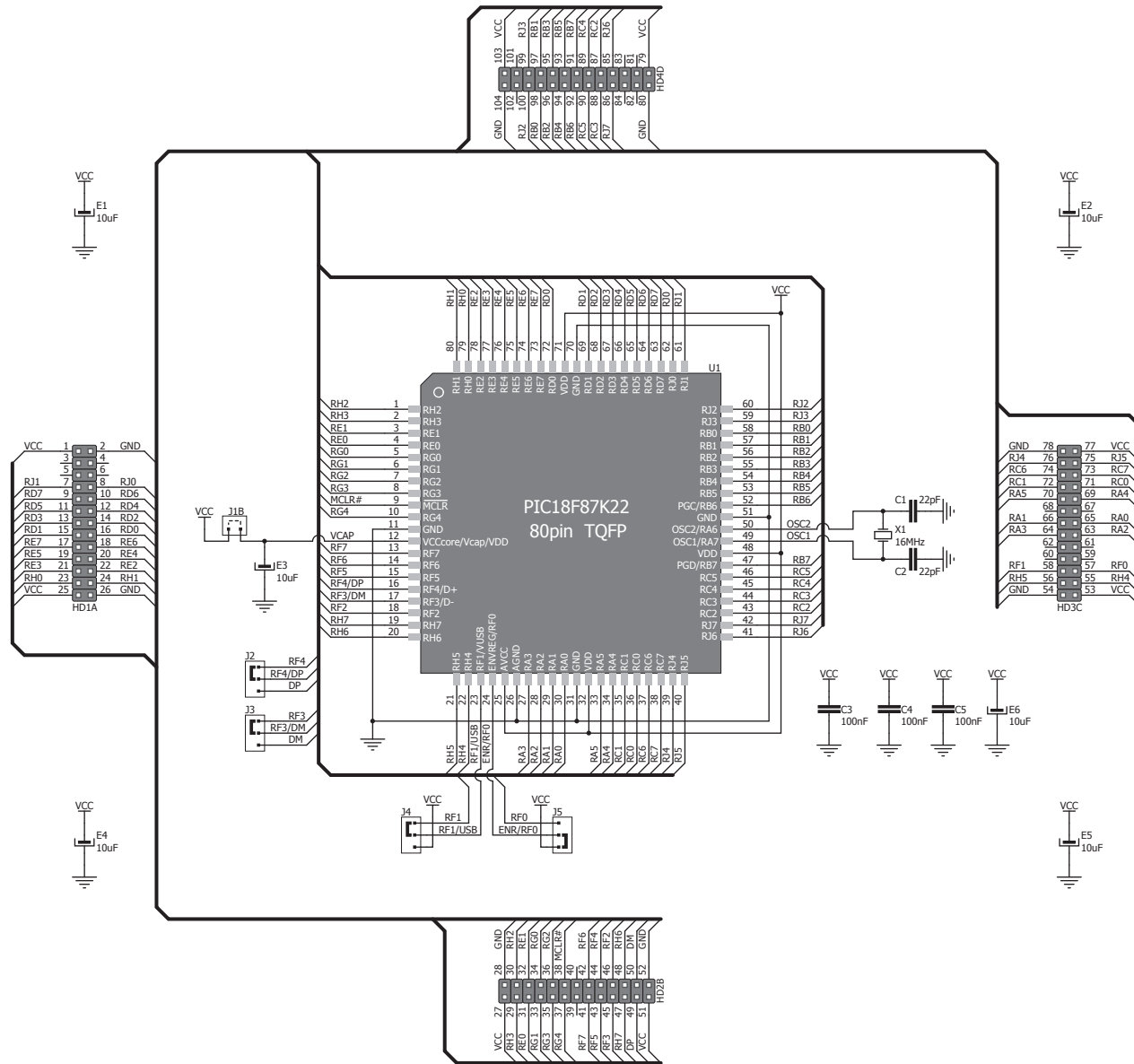
# How to properly place your MCU card into the socket?

Before you plug the microcontroller card into the socket, make sure that the power supply is turned off. Images below show how to correctly plug the card. First make sure that MCU card orientation matches the silkscreen outline on the EasyPIC PRO v7a board MCU socket. Place the MCU card over the socket, so each male header encloses the right angle with the female socket, as shown in Figure 9. Then put the MCU card slowly down until all the pins match the socket. Check again if everything is placed correctly and press the MCU card until it is completely plugged into the socket as shown in Figure 10. If done correctly, all pins should be fully inserted. Only now you can turn on the power supply.
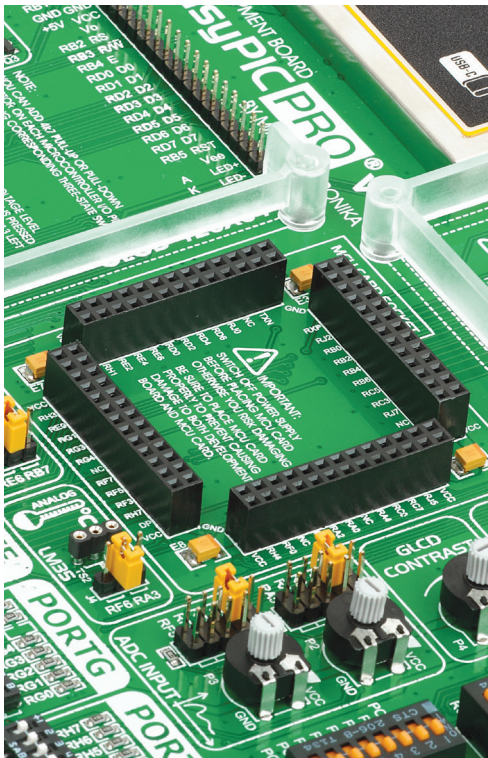
1 *Figure 8: On-board MCU socket has silksreen markings which will help you to correctly orient the MCU card before inserting.*
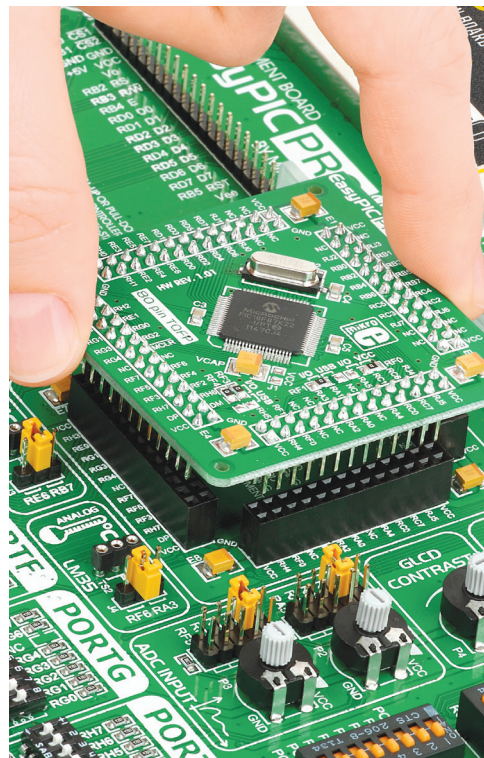
2 *Figure 9: Place the MCU card on the socket so the pins are aligned correctly.*
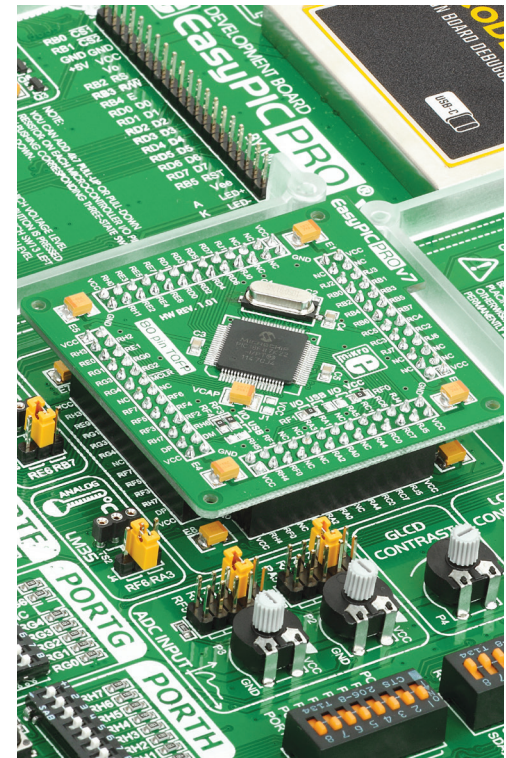
3 *Figure 10: Properly placed MCU card will have equally leveled pins.*

Other supported MCU cards

Mikroe currently offers total of five populated MCU cards with different microcontrollers. You can also purchase empty PCB cards that you can populate on your own and solder any supported microcontroller you need in your development. This way your EasyPIC PRO v7a board becomes truly flexible and reliable tool for almost any of your PIC projects. MCU cards can also be used in your final devices. For complete list of currently available MCU cards, please visit the board webpage:

www.mikroe.com/easypic-pro-v7a

List of other available populated MCU cards

with Ethernet! support

Besides default MCU card that comes with EasyPIC PRO v7a, Mikroe offers three other standard 80-pin TQFP cards with PIC18F87J50, PIC18F8520 and PIC18F8722 microcontrollers. Additional 80-pin TQFP Ethernet card with PIC18F87J60 enables you to utilize the ethernet connector and build ethernet applications easily.
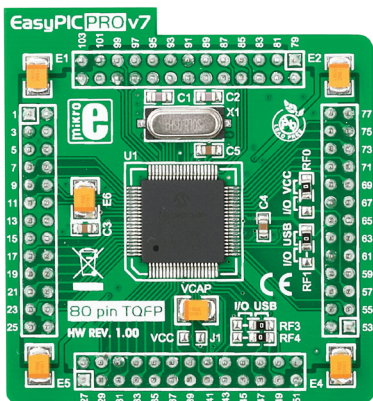
1 *Figure 11: Standard 80-pin MCU card with PIC18F87J50, which supports USB.*
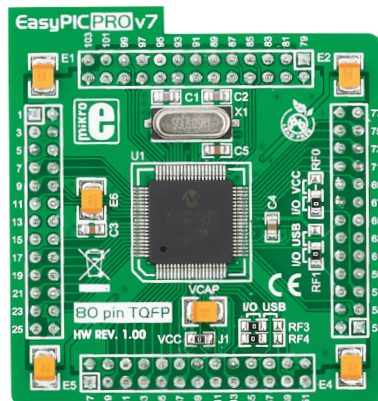
2 *Figure 12: Standard 80-pin MCU card with PIC18F8520.*
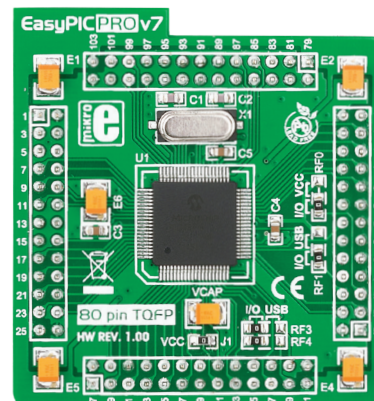
3 *Figure 13: Standard 80-pin MCU card with PIC18F8722.*
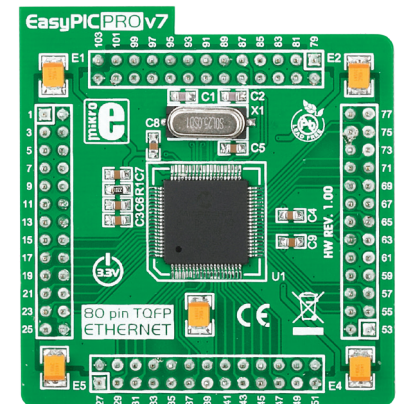
4 *Figure 14: Ethernet 80-pin MCU card with PIC18F87J60 microcontroller with internal ethernet module.*

ON BOARD PROGRAMMER

WHAT IS CODEGRIP?

CODEGRIP is a unified solution, designed to perform programming and debugging tasks on a range of different microcontroller devices (MCUs) based on the Microchip PIC architecture. The USB-C connector offers improved performance and reliability, compared to traditionally used USB Type A/B connectors.

EasyPIC PRO v7a development board is supported by a powerful CODEGRIP Suite, offering complete control over the development board. It is used to intelligently manage programming and debugging tasks, and to configure various other options and settings, providing visual feedback through its clean and comprehensive Graphical User Interface (GUI).

To better understand how to operate and configure EasyPIC PRO v7a development board and its integrated CODEGRIP module, check out the CODEGRIP Suite quick start guide on the **www.mikroe.com/easypic**

WHERE TO START?

In order to start using CODEGRIP and program your microcontroller, you just have to follow two simple steps:

1. Install the necessary software
- Install CODEGRIP Suite software

2. Power up the board, and you are ready to go!
- Plug in the programmer USB cable
- LINK LED should light up.

PROGRAMMING WITH ICD2/ICD3/ICD4

EasyPIC PRO v7a is equipped with RJ-12 connector compatible with Microchip® ICD2 and ICD3 external programmers. You can either use the on-board CODEGRIP programmer or external programming tools as long as you use only one of them in the same time. But you still have to **set the appropriate jumpers**, as described in the previous page. Insert your ICD programmer cable into connector **CN8**, as shown in image.

The DIP switch located next to the RJ-12 connector allows control of the interface between onboard CODEGRIP module and target MCU:

ONBOARD (left): Interface is enabled **[1]**. If an external debugger probe-device is connected, there is a possible collision in communication.

EXTERNAL (right): Interface is disabled **[2]**. External debugger probe-device can reliably communicate with target MCU.
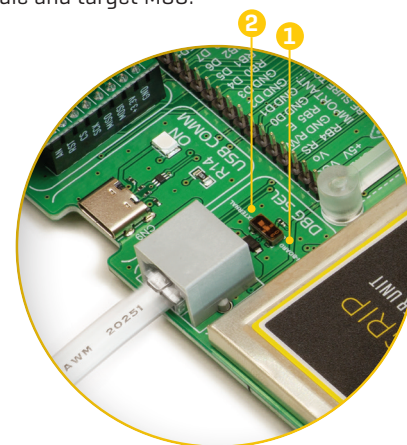

Figure 15: RJ-12 connector view

Ethernet communicaton

Ethernet is a popular computer networking technology for local area networks (LAN). Systems communicating over Ethernet divide a stream of data into individual packets called frames. Each frame contains source and destination addresses and error-checking data so that damaged data can be detected and re-transmitted. EasyPIC PRO v7a features standard RJ-45 connector which enables microcontrollers that support Ethernet communication to establish a connection with a computer, router or other devices. All four ethernet lines (TPOUT+, TPOUT-, TPIN+ and TPIN-) are routed to the MCU card socket. Only microcontrollers containing embedded ethernet module soldered to 100-pin or 80-pin TQFP Ethernet MCU cards can use these lines and utilize ethernet connector. Additional signalization LEDs are available on the board.

Enabling Eth. LEDs
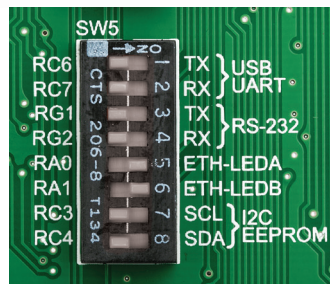
In order to enable ethernet LEDs, you must enable **SW5.5** (RA0) and **SW5.6** (RA1) DIP switches. This connects the **LEDA** and **LEDB** lines to appropriate microcontroller pins.
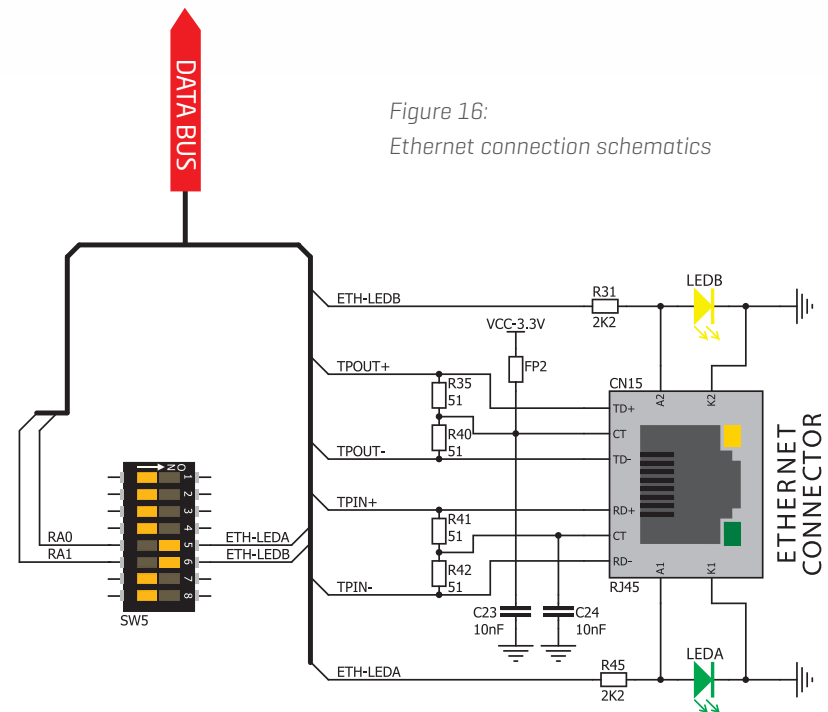
Figure 16:
Ethernet connection schematics
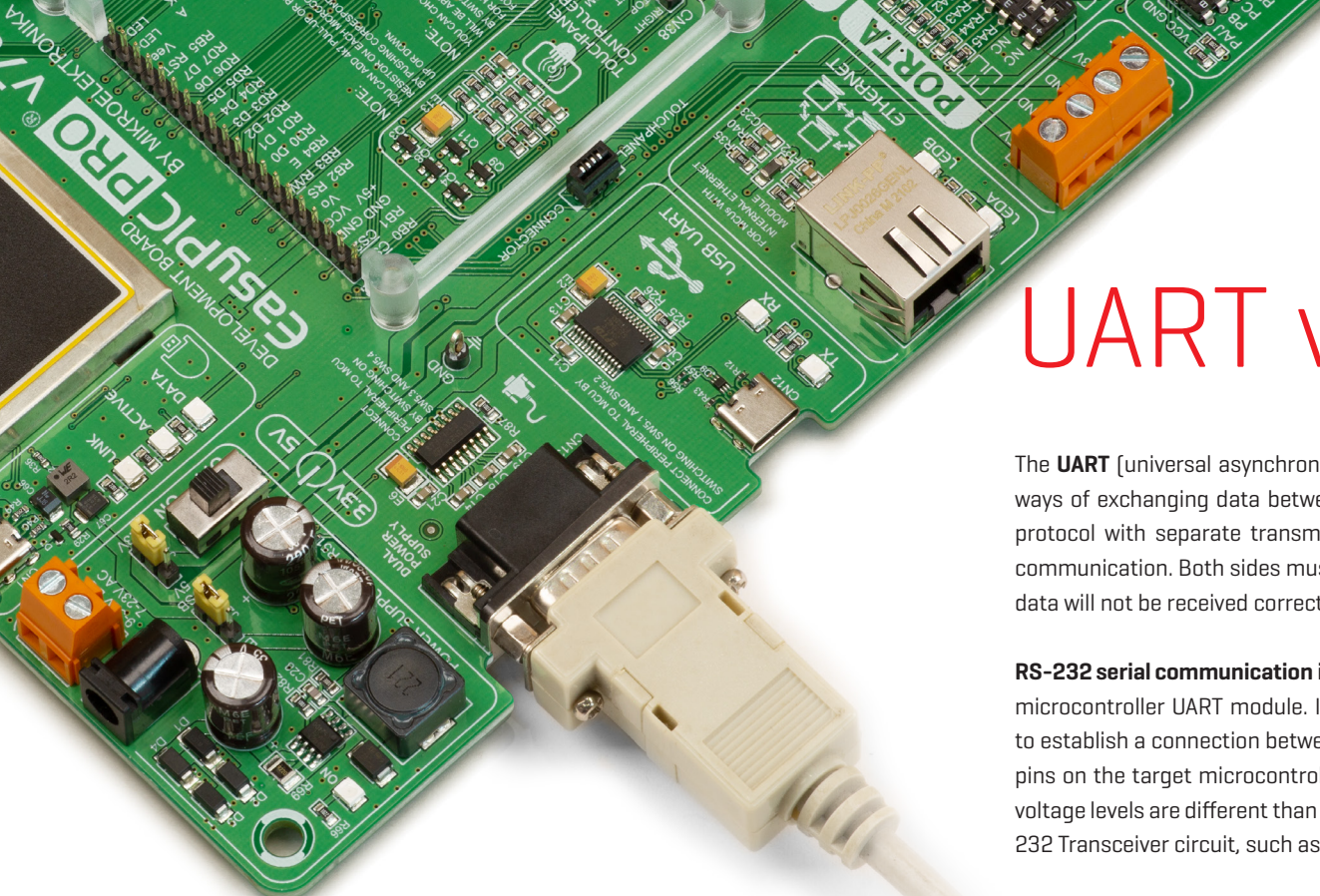
UART via RS-232

The **UART** (universal asynchronous receiver/transmitter) is one of the most common ways of exchanging data between the MCU and peripheral components. It is a serial protocol with separate transmit and receive lines, and can be used for full-duplex communication. Both sides must be initialized with the same baud rate, otherwise the data will not be received correctly.

RS-232 serial communication is performed through a 9-pin SUB-D connector and the microcontroller UART module. In order to enable this communication, it is necessary to establish a connection between **RX** and **TX** lines on SUB-D connector and the same pins on the target microcontroller using DIP switches. Since RS-232 communication voltage levels are different than microcontroller logic levels, it is necessary to use a RS-232 Transceiver circuit, such as **MAX3232** as shown on **Figure 17**.

Enabling RS-232

In order to enable RS-232 communication, you must push **SW5.3** (RG1) and **SW5.4** (RG2) to ON position. This connects the **RX** and **TX** lines to appropriate microcontroller pins and its second UART module.
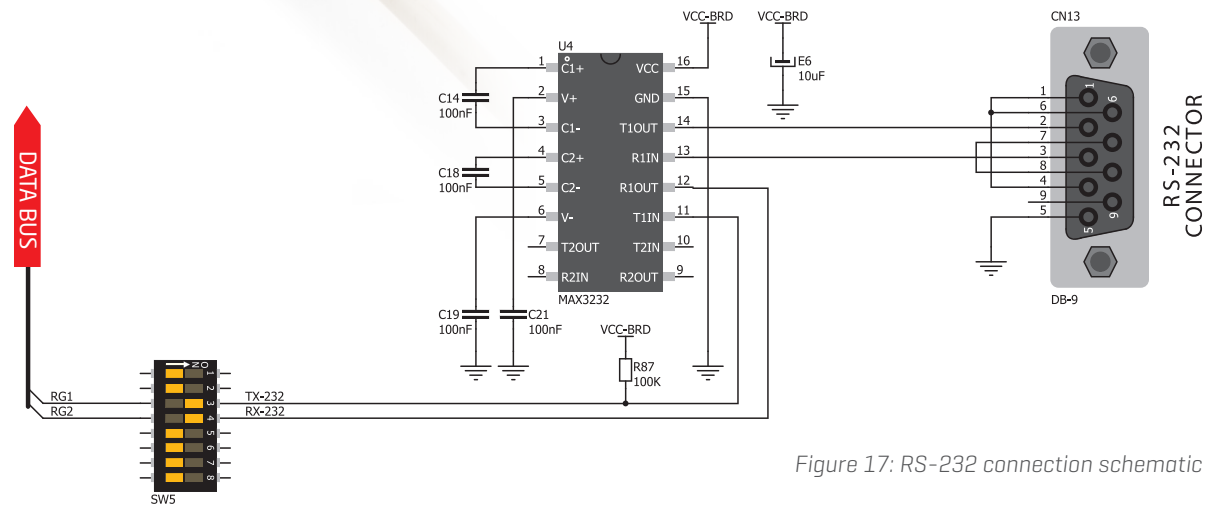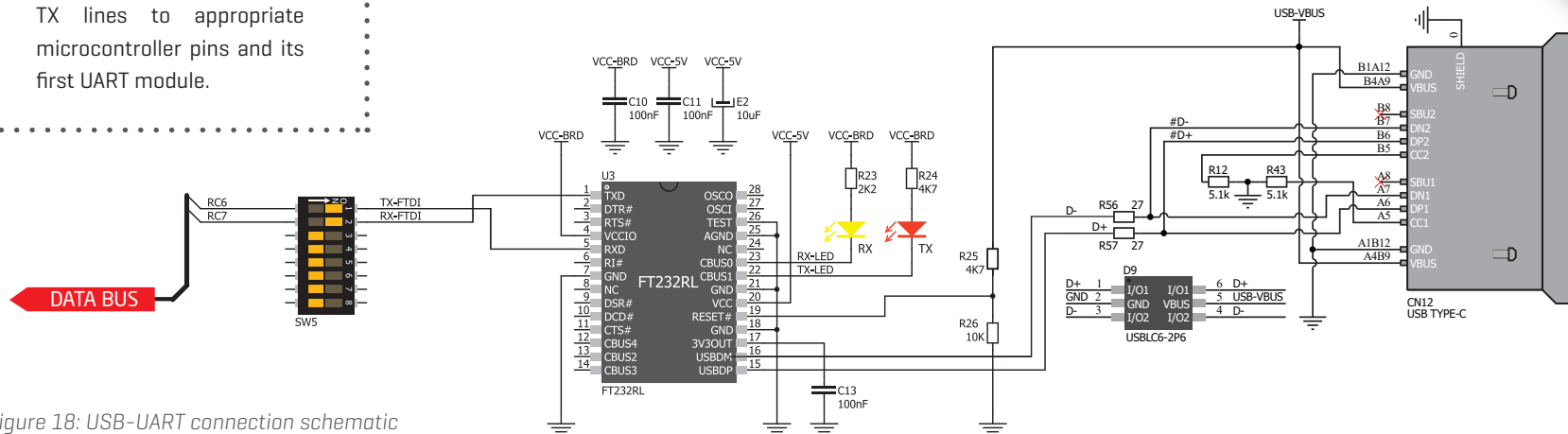

Figure 17: RS-232 connection schematic

UART via USB

Modern PC computers, laptops and notebooks are no longer equpped with RS-232 connectors and UART controllers. They are nowdays replaced with USB connectors and USB controllers. Still, certain technology enables UART communication to be done over USB connection. Controllers such as **FT232RL** from FTDI® convert UART signals to the appropriate USB standard. In order to use USB-UART module on EasyPIC PRO v7a, you must first install FTDI drivers on your computer. Drivers can be found on the following link: *www.ftdichip.com/Drivers/VCP.htm*

USB-UART communication is being done through a FT232RL controller, USB connector **(CN12)**, and microcontroller UART module. To establish this connection, you must connect **RX** and **TX** lines of the microcontroller to the appropriate input and output pins of the FT232RL. This connection is done using DIP switches **SW5.1** and **SW5.2**.

Enabling USB-UART

In order to enable USB-UART communication, you must push **SW5.1** (RC6) and **SW5.2** (RC7) to ON position. This connects the RX and TX lines to appropriate microcontroller pins and its first UART module.


Figure 18: USB-UART connection schematic

USB device communication

USB is the acronym for Universal Serial Bus. This is a very popular industry standard that defines cables, connectors and protocols used for communication and power supply between computers and other devices. EasyPIC PRO v7a contains USB DEVICE connector (CN9) which enables microcontrollers that support USB communication to establish a connection with the target host (eg. PC, Laptop, etc). USB data lines comming from the MCU socket are dedicated to USB connector only, and are not available via PORT headers. To enable USB communication, you have to solder SMD jumpers on the MCU card to the appropriate USB position. This only makes sense if the MCU card contains microcontroller with integrated USB controller. One of these cards is Standard 80-pin MCU card with PIC18F87J50 microcontroller.

Enabling USB
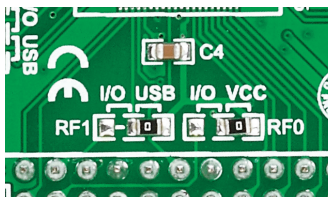
Microcontroller with USB support should be soldered to the MCU card with dedicated USB SMD jumpers. Make sure to solder RF1, RF3 and RF4 jumpers to USB position in order to connect USB lines to USB connector.

Figure 19: USB connection schematics
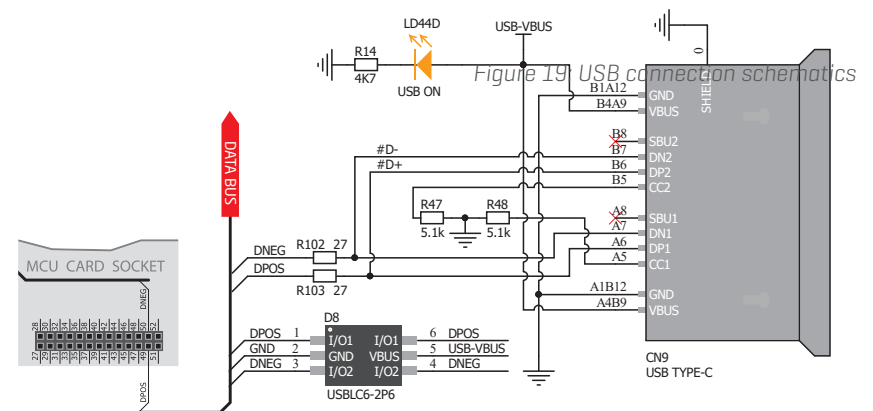
mikroBUS™ SOCKETS

The superior connectivity features of the EasyPIC PRO v7a development board are rounded up with three standardized mikroBUS™ host connectors. It is a considerable upgrade for the board, as it allows interfacing with the vast amount of **Click boards™**.

mikroBUS™ is the add-on board standard that offers maximum expandability with the smallest number of pins. More information at **www.mikroe.com/mikrobus**
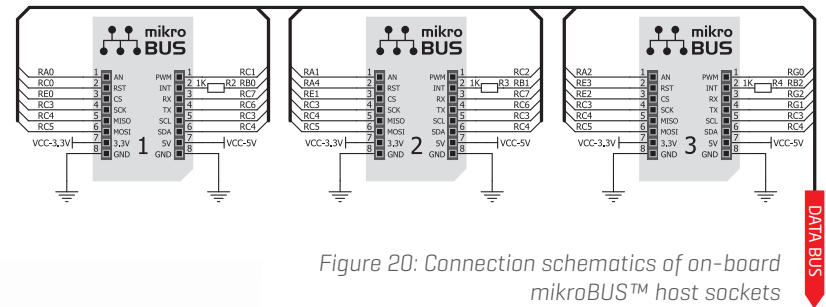
All the **mikroBUS™ sockets** are now redesigned and improved. They became much sturdier, allowing a better grip of the Click board™. In addition to added horizontal supports between two 8-pin connectors, the right lower edge is chamfered at the angle of 45°, the same as the Click board™, making it seamlessly fit into the mikroBUS™ socket. The new mikroBUS™ socket is now a fully-fledged, standardized monolithic component with all its pins clearly labeled, offering very good grip for the Click board™, preventing it to flip over or to be placed incorrectly.

The mikroBUS™ socket supports the following communication interfaces: **SPI, UART**, and **I²C**. There are also single pins reserved for **PWM**, **Interrupt**, **Analog input**, **Reset**, and **SPI Chip Select**. The mikroBUS™ socket also contains pins with the two power rails (**3.3V and 5V**), along with the **GND pins**.

Integrate mikroBUS™ in your design

mikroBUS™ is not made to be only a part of our development boards. You can freely place mikroBUS™ host connectors in your final PCB designs, as long as you clearly mark them with mikroBUS™ logo and footprint specifications. For more information, logo artwork and PCB files visit our website: **www.mikroe.com/mikrobus**

Figure 20: Connection schematics of on-board mikroBUS™ host sockets

mikroBUS™ SOCKET IN DETAIL

Analog pin – **AN**	**PWM** - PWM output line
Reset pin – **RST**	**INT** - Hardware Interrupt line
SPI Chip Select line – **CS**	**RX** - UART Receive line
SPI Clock line – **SCK**	**TX** - UART Transmit line
SPI Slave Output line – **MISO**	**SCL** - I2C Clock line
SPI Slave Input line – **MOSI**	**SDA** - I2C Data line
VCC-3.3V power line – **+3.3V**	**+5V** - VCC-5V power line
Reference Ground – **GND**	**GND** - Reference Ground

Click Boards™

THE LARGEST AND FASTEST-GROWING BASE OF ADD-ON BOARDS IN THE WORLD!

Click boards™ are standardized add-on boards that carry a variety of different electronic devices. They are designed to perfectly fit the mikroBUS™ socket. Engineered to deliver the best performances for the used components, they save developers of testing and troubleshooting often associated with the prototyping phase. They enhance rapid development and accelerate time to market. These ready-to-use boards require no additional hardware configuration. More information at **www.mikroe.com/click**

CODE EXAMPLES

It's easy to get your Click board™ up and running. We provided the examples for mikroC, mikroBasic and mikroPascal compilers on our **Libstock community website**. Just download them and you are ready to start:
www.libstock.mikroe.com

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CATEGORY: ALL CODES
<<

(E) GSM click - Example

Rating: ☆☆☆☆☆

Author: MikroElektronika Team

Version: 1.0.0.0

Last Updated: 2014-05-09

Category: GSM / GPRS

Downloaded: 7921 times

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Description

This is a sample program which demonstrates the use of **GSM click**. Program uses GSM module GL865 for sending/receiving SMS and establishing calls with dialed number. Dialing is done using GLCD+Touch Panel GUI.

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(E) microSD click - Example

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▸ GPS (11)
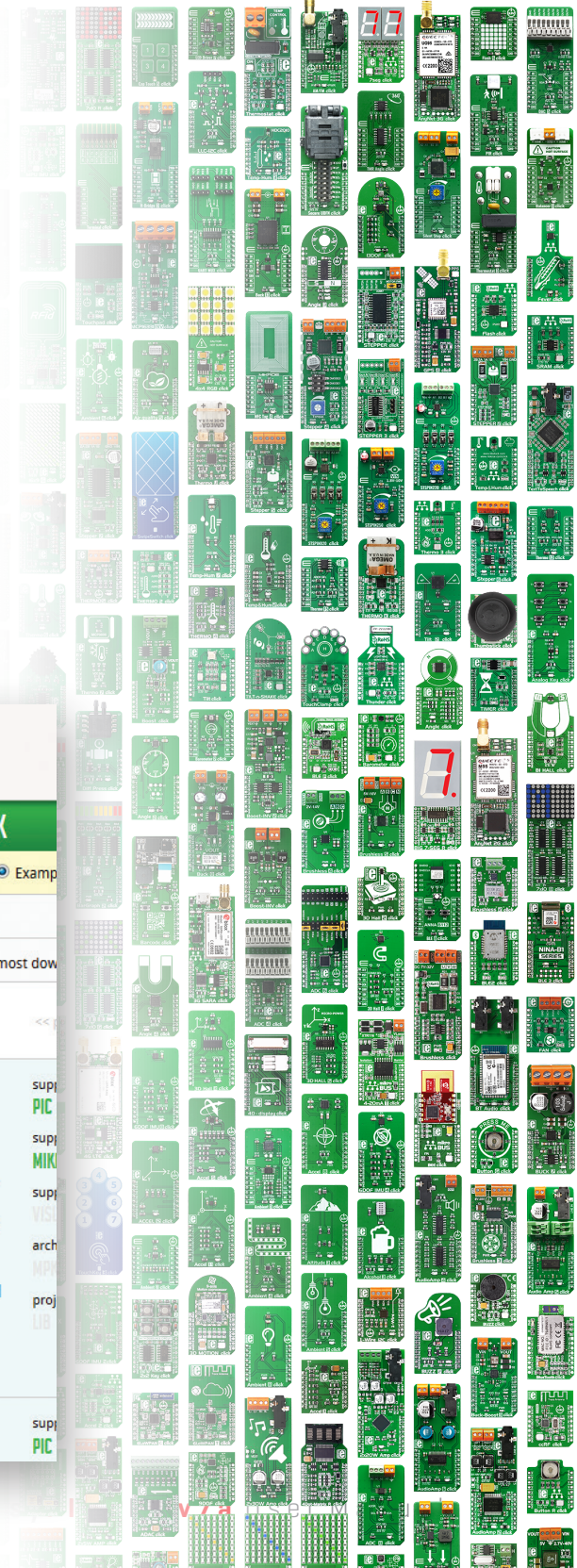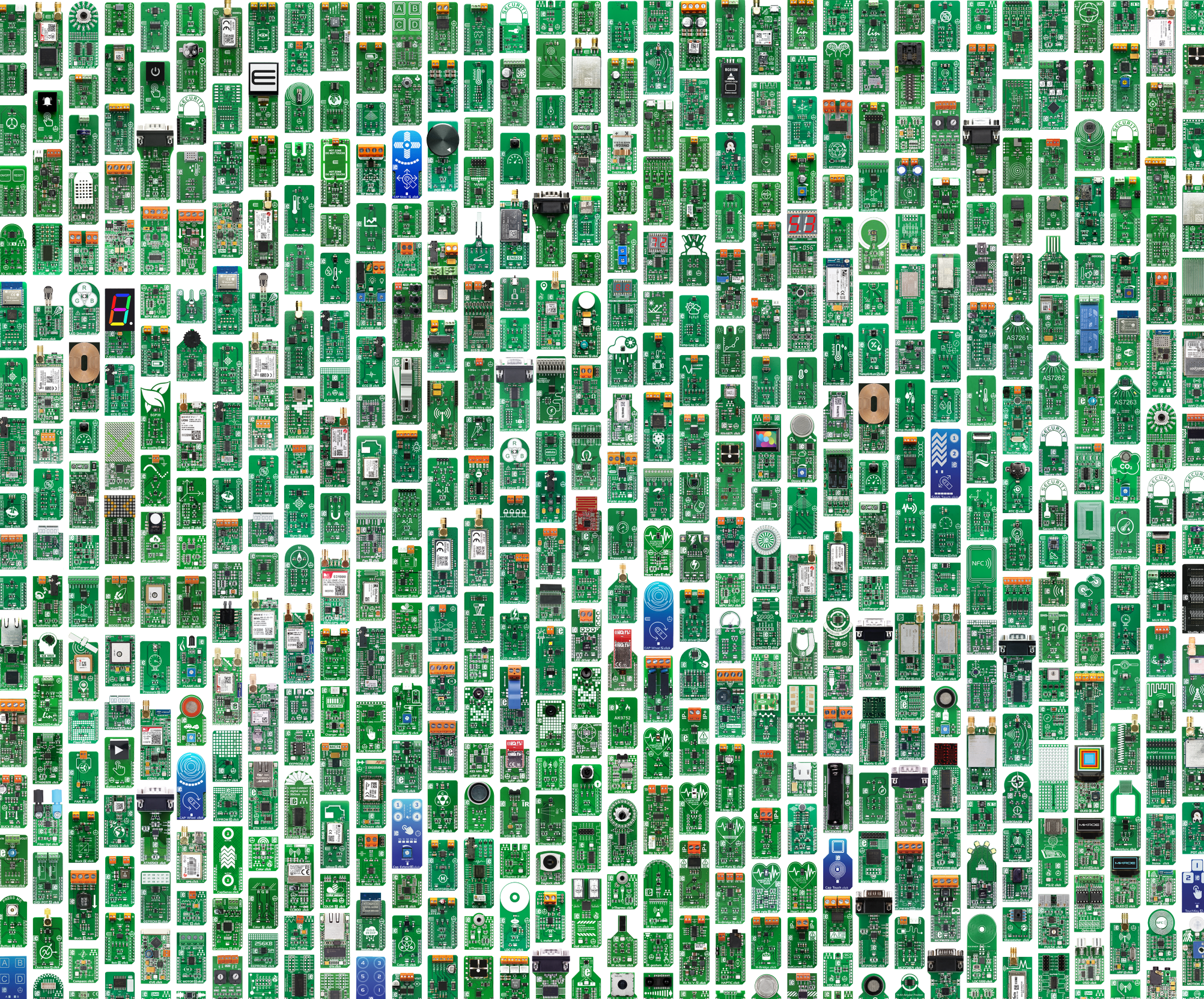
INPUT/OUTPUT GROUP

One of the most distinctive features of EasyPIC PRO v7a is Input/Output PORT groups. They add so much to the connectivity potential of the board. These groups contain buttons, LEDs and headers. They allow interaction with the EasyPIC PRO v7a, either by pressing buttons, displaying states of its pins on the LEDs, or using headers to interface it to an external device.

EVERYTHING IS GROUPED TOGETHER

PORT **headers**, PORT **buttons** and PORT **LEDs** are next to each other, and grouped together. It makes development easier, and the entire EasyPIC PRO v7a cleaner and well organized. We have also provided an **additional PORT headers** on the right side of the board, so you can access any pin you want from the right side of the board.

TRI-STATE DIP SWITCHES

Tri-state DIP switches, like **SW7** on **Figure 23**, are used to enable 4K7 pull-up or pull-down resistor on any desired port pin. Each of these switches has three states:

1. **MIDDLE POSITION** disables both pull-up and pull-down feature from the PORT pin
2. **UP POSITION** connects the resistor in pull-up state to the selected pin
3. **DOWN POSITION** connects the resistor in pull-down state to the selected PORT pin.

Figure 23: Tri-state DIP switch on PORTC

Figure 21: Tri-state DIP switch on PORTC
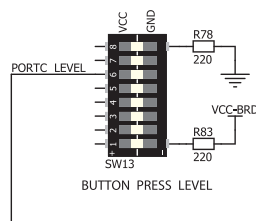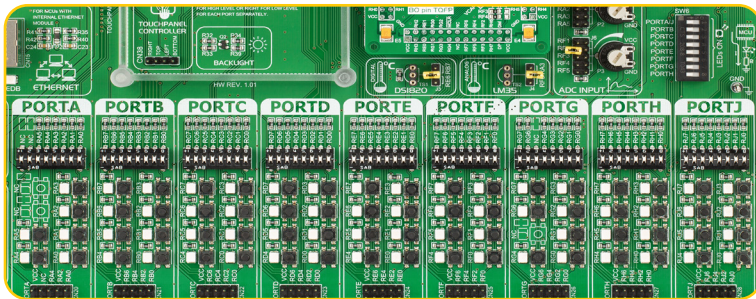
Figure 22: Schematic of the single I/O group connected to microcontroller PORTC
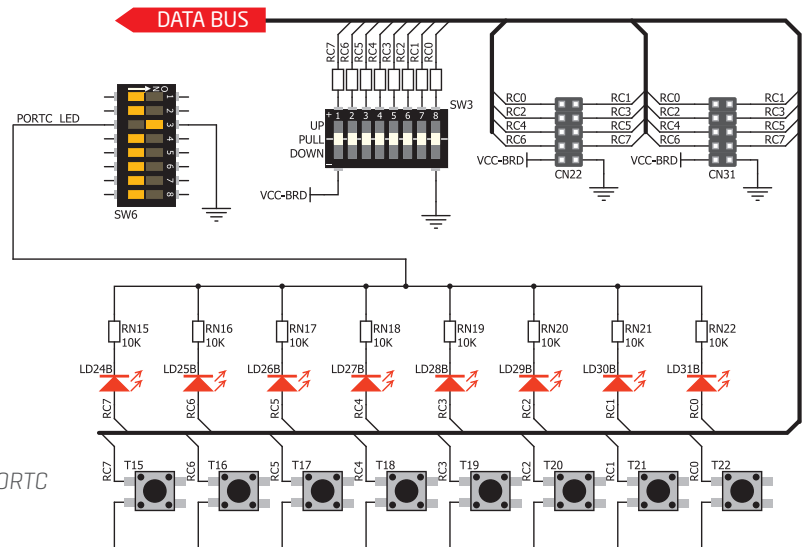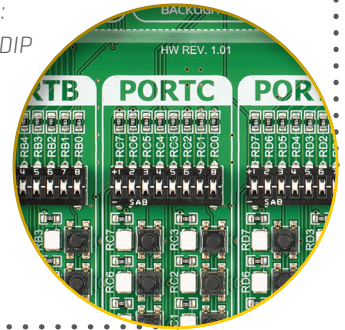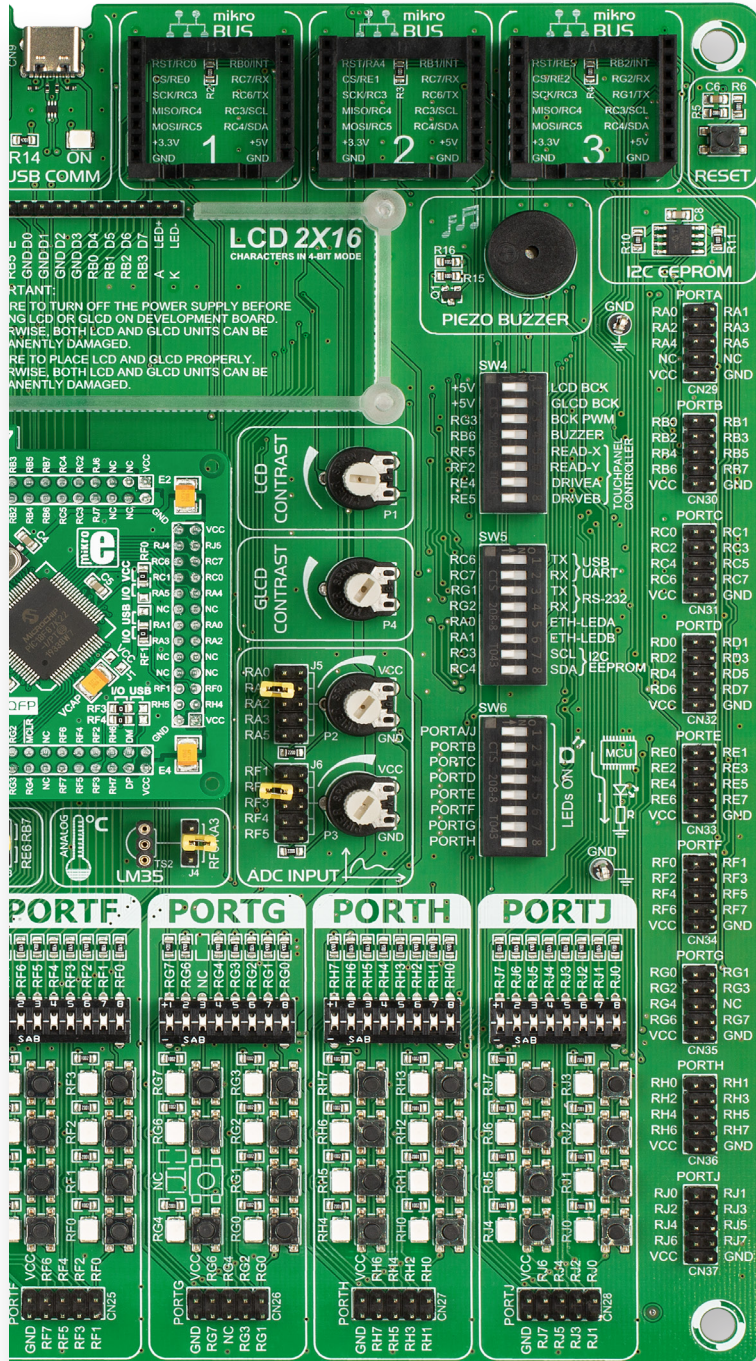
Figure 24: INPUT/OUTPUT ports view

HEADERS

With enhanced connectivity as one of the key features of EasyPIC PRO v7a, we have provided **two connection headers for each PORT**. I/O PORT group contains two male IDC10 headers. These headers are all compatible with over 1000 MikroElektronika accessory boards, and enable simple connection.

> *Because of it's orientation, header on the bottom side of the board is not* **NOTE**
> *meant for placing accessory boards directly. Instead, use wire jumpers or*
> *other ways to establish connection and utilize these pins.*

BUTTONS

The logic state of all microcontroller digital inputs may be changed using **push buttons.** Tri-state DIP switch **SW13** is available for selecting which logic state will be applied to corresponding MCU pin when button is pressed, for each I/O port separately. If you, for example, place **SW13.3** in **VCC** position, then pressing of any push button in PORTC I/O group will apply logical one to the appropriate microcontroller pin The same goes for **GND**. If the DIP switch is in the middle position, then all push buttons of the associated PORT will be disconnected from the microcontroller pin.

Reset Button – In the far upper right section of the board, there is a **RESET button**, which can be used to manually reset the microcontroller. This button is directly connected to the microcontroller **MCLR pin**.
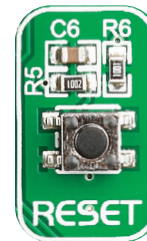
LEDs
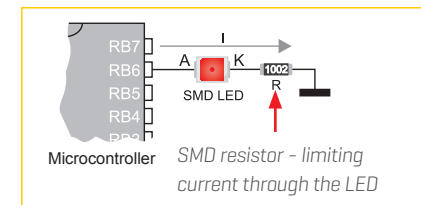
LED (Light-Emitting Diode) is a highly efficient electronic light source. When connecting LEDs, it is necessary to place a current limiting resistor in series so that LEDs are provided with the current value specified by the manufacturer. The current varies from 0.2mA to 20mA, depending on the type of the LED and the manufacturer.. The EasyPIC PRO v7a board uses low-current LEDs with typical current consumption of 0.2mA or 0.3mA, depending of VCC voltage selection. Board contains 69 LEDs which can be used for visual indicativon of the logic state on PORT pins. An active LED indicates that a logic high (1) is present on the pin. In order to enable PORT LEDs, it is necessary to enable the corresponding DIP switches on **SW6**.
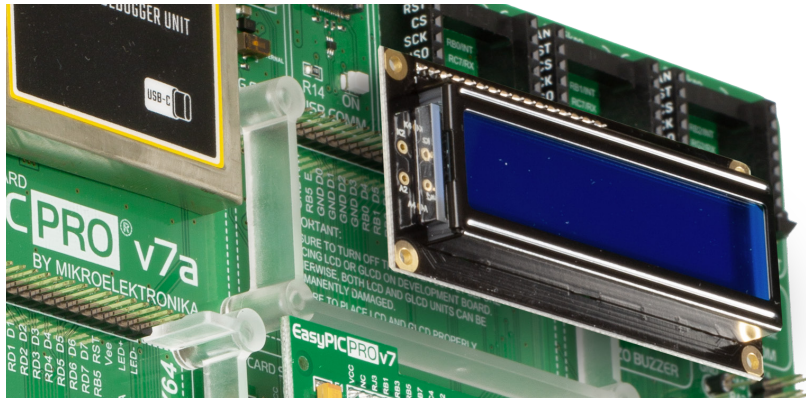
LCD 2x16 characters

Figure 25: 2x16 LCD connector and display view

Liquid Crystal Displays or **LCDs** are cheap and popular way of representing information to the end user of some electronic device. Character LCDs can be used to represent standard and custom characters in the predefined number of fields. EasyPIC PRO v7a provides the connector and the necessary interface for supporting **2x16 character LCDs** in 4-bit mode. This type of display has two rows consisted of 16 character fields. Each field is a 7x5 pixel matrix. Communication with the display module is done through **CN14** display connector. Board is fitted with uniquely designed plastic display distancer, which allows the LCD module to perfectly and firmly fit into place.

Standard & PWM-driven back-light

We have allowed LCD back-light to be enabled in two different ways:

1. It can be **turned on with full brightness** using **SW4.1** switch.
2. Brightness level can be determined **with PWM signal** from the microcontroller, allowing you to write custom back-light controlling software. This back-light mode is enabled with **SW4.3** switch.

NOTE   *In order to use PWM back-light, both SW4.1 and SW4.3 switches must be enabled at the same time.*

CONNECTOR PINOUT EXPLAINED

GND and VCC - Display power supply lines

Vo - LCD contrast level from potentiometer P4

RS - Register Select Signal line

E - Display Enable line

R/W - Determines whether display is in Read or Write mode. It's always connected to GND, leaving the display in Write mode all the time.

D0–D3 - Display is supported in 4-bit data mode, so lower half of the data byte interface is connected to GND.

D4–D7 - Upper half of the data byte

LED+ - Connection with the back-light LED anode

LED- - Connection with the back-light LED cathode

NOTE   *Make sure to turn off the power supply before placing LCD onto the board. Otherwise your display can be permanently damaged.*
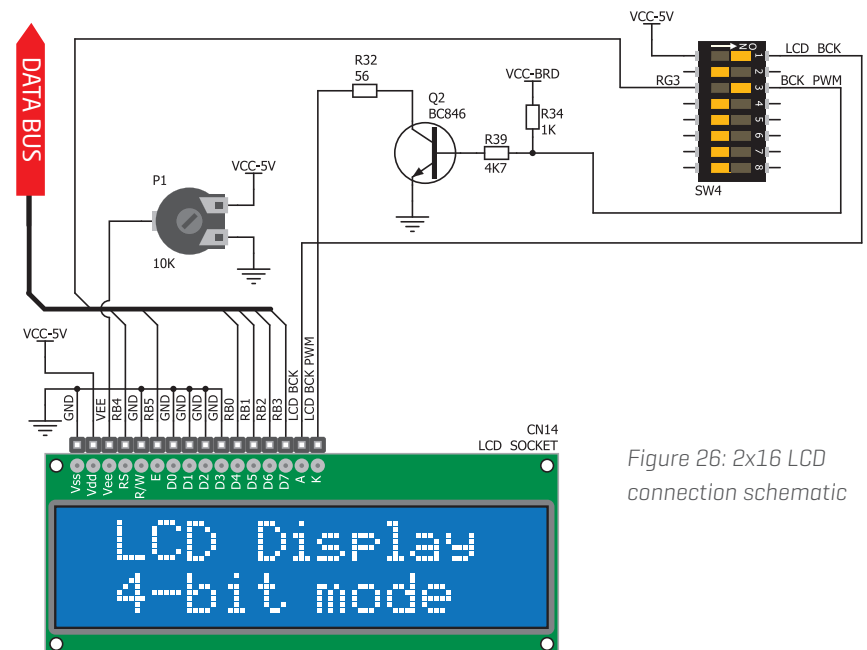

*Figure 26: 2x16 LCD connection schematic*

GLCD 128x64

Graphical Liquid Crystal Displays, or **GLCDs** are used to display monochromatic graphical content, such as text, images, human-machine interfaces and other content. EasyPIC v7a provides the connector and necessary interface for supporting GLCD with resolution of 128x64 pixels, driven by the KS108 or compatible display controller. Communication with the display module is done through **CN16** display connector. Board is fitted with uniquely designed plastic display distancer, which allows the GLCD module to perfectly and firmly fit into place.

Figure 27: GLCD 128x64 connection schematic

Display connector is routed to PORTB (control lines) and PORTD (data lines) of the microcontroller sockets. Since the same ports are used by 2x16 character LCD display, you cannot use both displays simultaneously. You can control the display contrast using dedicated potentiometer **P4**. Full brightness display back light can be enabled with **SW4.2** switch, and PWM-driven back light with **SW4.3** switch.

Figure 28: GLCD 128x64 connector and display view

Standard & PWM-driven back-light

As for LCD, we have allowed GLCD back-light to be enabled in two different ways:

1. It can be **turned on with full brightness** using **SW4.2** switch.
2. Brightness level can be determined **with PWM signal** from the microcontroller, allowing you to write custom back-light controlling software. This back-light mode is enabled with **SW4.3** switch.

CONNECTOR PINOUT EXPLAINED

CS1 & **CS2** - Controller Chip Select lines

VCC - +5V display power supply

GND - Reference ground

Vo - GLCD contrast level from potentiometer P3

RS - Data (High), Instruction (Low) selection line

R/W - Determines whether display is in Read or Write mode.
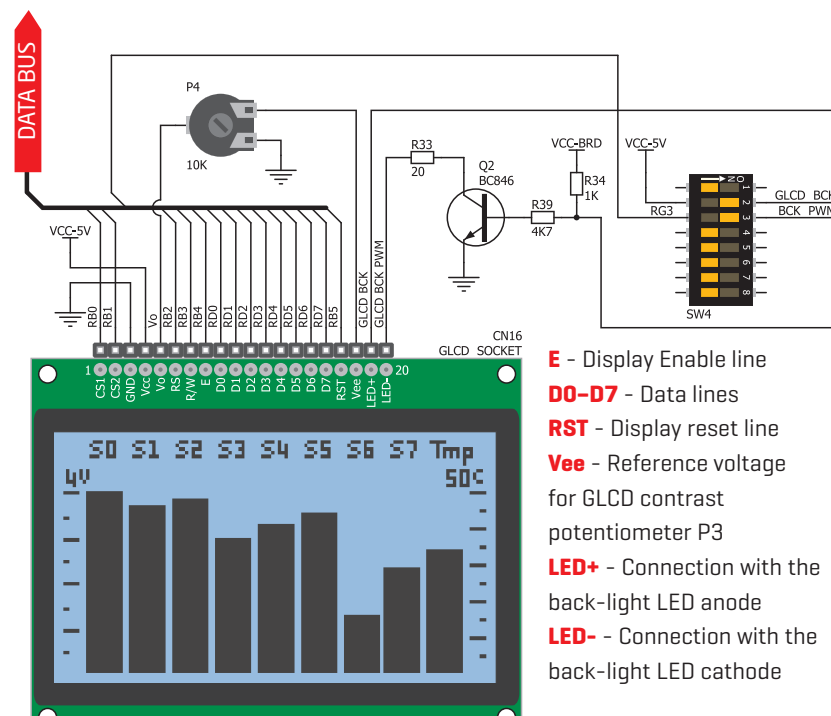
E - Display Enable line

D0-D7 - Data lines

RST - Display reset line

Vee - Reference voltage for GLCD contrast potentiometer P3

LED+ - Connection with the back-light LED anode

LED- - Connection with the back-light LED cathode

In order to use PWM back-light both, SW4.2 and SW4.3 switches must be enabled at the same time. **NOTE**

TOUCH PANEL CONTROLLER
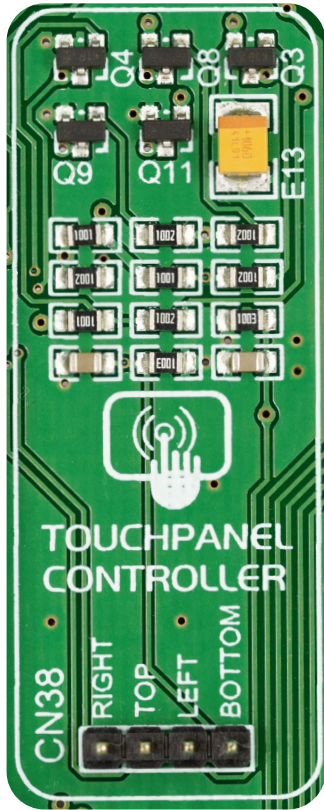
Touch panel is a glass panel whose surface is covered with two layers of resistive material. When the screen is pressed, the outer layer is pushed onto the inner layer and appropriate controllers can measure that pressure and pinpoint its location. This is how touch panels can be used as an input devices. EasyPIC PRO v7a is equipped with touch panel controller and connector for **4-wire resistive touch panels**. It can very accurately register pressure at a specific point, representing the touch coordinates in the form of analog voltages, which can then be easily converted to X and Y values. Touch panel comes as a part of display.

Figure 29: Touch panel controller module view

CORRECTLY PLACING THE TOUCH PANEL CABLE INTO THE CONNECTOR
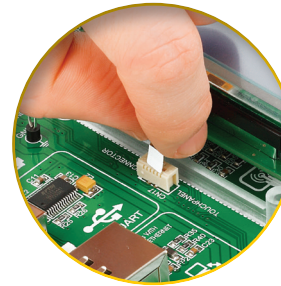
Figure 30: Put and push Touch panel flat cable in the connector
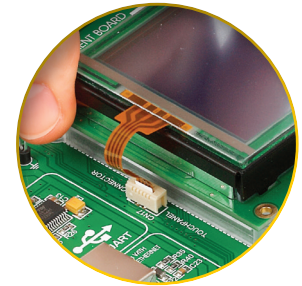
Figure 31: Now place GLCD with Touch panel into GLCD socket
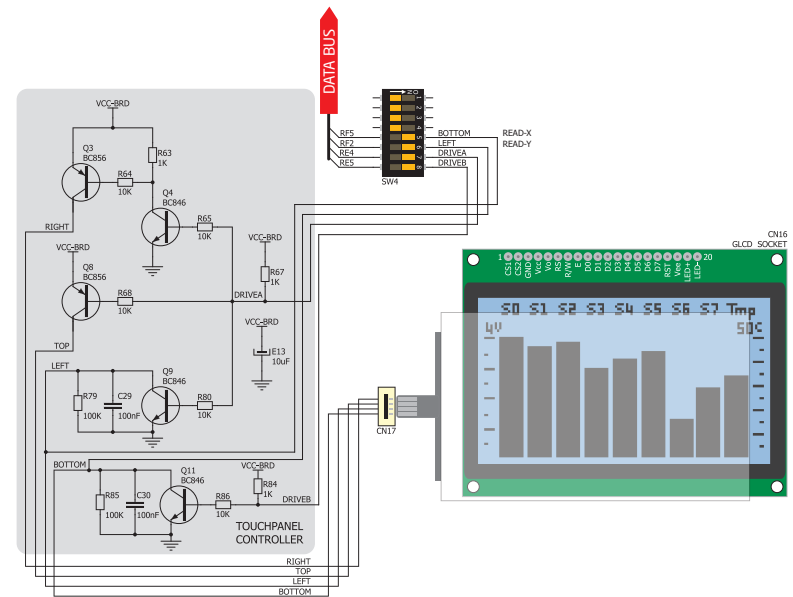
Figure 32: Touch Panel controller and connection schematic

Enabling Touch panel

Touchpanel is enabled using **SW4.5**, **SW4.6**, **SW4.7**, and **SW4.8** switches. They connect **READ-X** and **READ-Y** lines of the touchpanel with RF5 and RF2 analog inputs, and **DRIVEA** and **DRIVEB** with **RE4** and **RE5** digital outputs on microcontroller sockets. Do not connect additional boards or otherwise interfere with these lines while you use touchpanel, because you may corrupt the results of the readings and get inacurate touch coordinates.

Figure 33: DS1820 module view
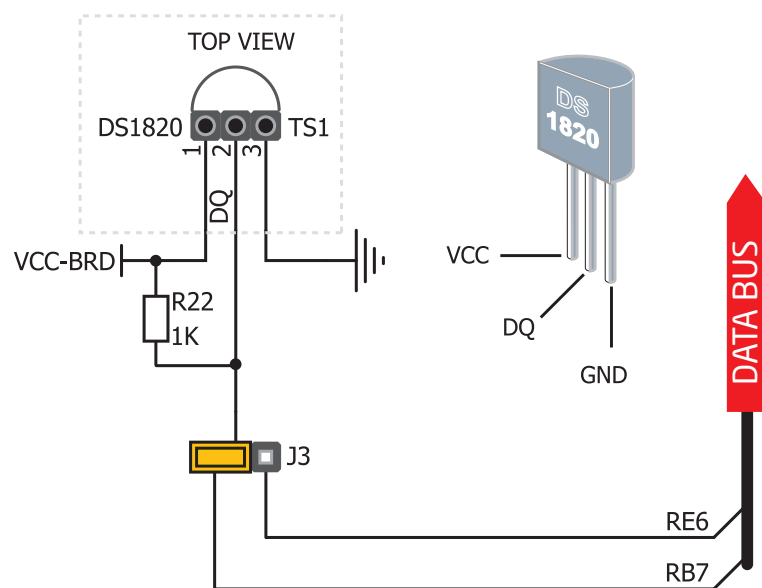
DS1820 - DIGITAL TEMP. SENSOR

DS1820 is a digital temperature sensor that uses **1-wire® interface** for it's operation. It is capable of measuring temperatures within the range of -55 to 128°C, and provides ±0.5°C accuracy for temperatures within the range of -10 to 85°C. It requires 3V to 5.5V power supply for stable operation. It takes max. of 750ms for the DS1820 to calculate temperature with 9-bit resolution. **1-wire® serial communication** enables data to be transferred over a single communication line, while the process itself is under the control of the master microcontroller. The advantage of such communication is that only one microcontroller pin is used. Multiple sensors can be connected on the same line. All slave devices by default have a unique ID code, which enables the master device to easily identify all devices sharing the same interface.

EasyPIC PRO v7a provides a separate socket (**TS1**) for the DS1820. Communication line with the microcontroller is connected via jumper **J3**.

Enabling DS1820 sensor
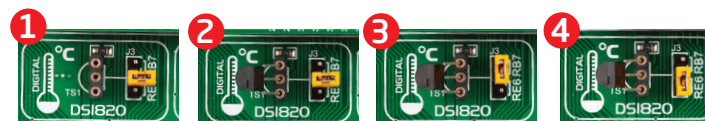
Figure 35: DS1820 not connected

Figure 36: DS1820 placed in socket

Figure 37: DS1820 connected to RB7 pin

Figure 38: DS1820 connected to RE6 pin

EasyPIC PRO v7a enables you to establish 1-wire® communication between DS1820 and the microcontroller over RE6 or RB7 pins. The selection of either of those two lines is done using J3 jumper. When placing the sensor in the socket make sure that half-circle on the board's silkscreen markings matches the rounded part of the DS1820 sensor. If you accidently connect the sensor the other way, it may be permanently damaged and you might need to replace it with another one. During the readings of the sensor, make sure that no other device (except those in 1-wire network) uses the selected line, because it may interfere with the data.

Figure 34: DS1820 connected to RB7 pin schematic

LM35 – ANALOG TEMP. SENSOR

The **LM35** is a low-cost precision integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. It has a linear +10.0 mV/°C scale factor and less than 60 μA current drain. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air. EasyPIC PRO v7a enables you to get analog readings from the LM35 sensor in restricted temperature range from +2°C to +150°C. Board provides a separate socket (**TS2**) for the LM35 sensor in TO-92 plastic packaging. Readings are done with microcontroller using single analog input line, which is selected with jumper **J4**. Jumper connects the sensor with either **RA3** or **RF6** microcontroller pins.

Figure 39: LM35 module view

Enabling LM35 sensor

EasyPIC PRO v7a enables you to get analog readings from the LM35 sensor using **RA3** or **RF6** microcontroller pins. The selection of either of those two lines is done using **J4** jumper. When placing the sensor in the socket make sure that half-circle on the board's silkscreen markings matches the rounded part of the LM35 sensor. If you accidently connect the sensor the other way, it can be permanently damaged and you might need to replace it with another one. During the readings of the sensor, make sure that no other device uses the selected analog line, because it may interfere with the readings.

LM35 not connected

LM35 placed in socket
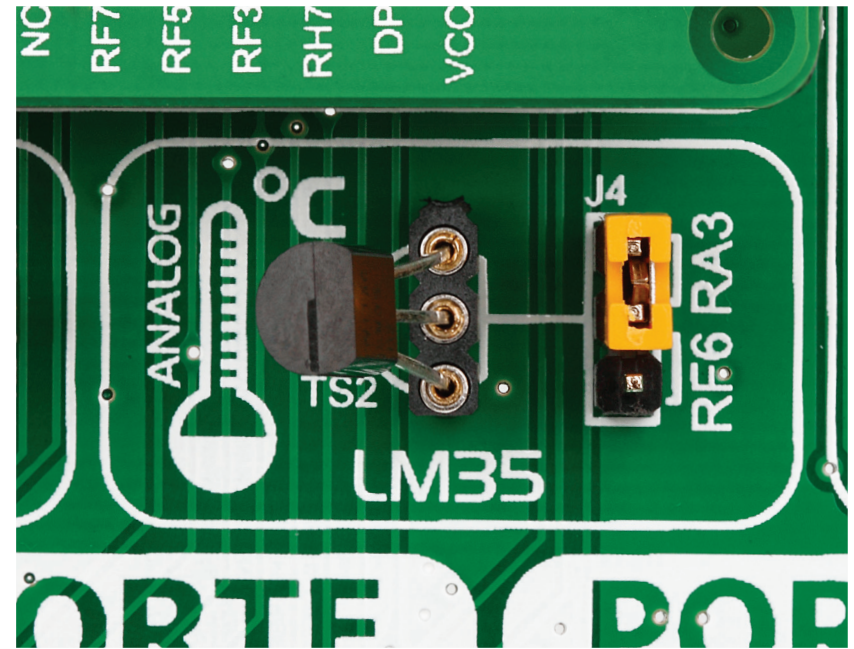
LM35 connected to RF6 pin

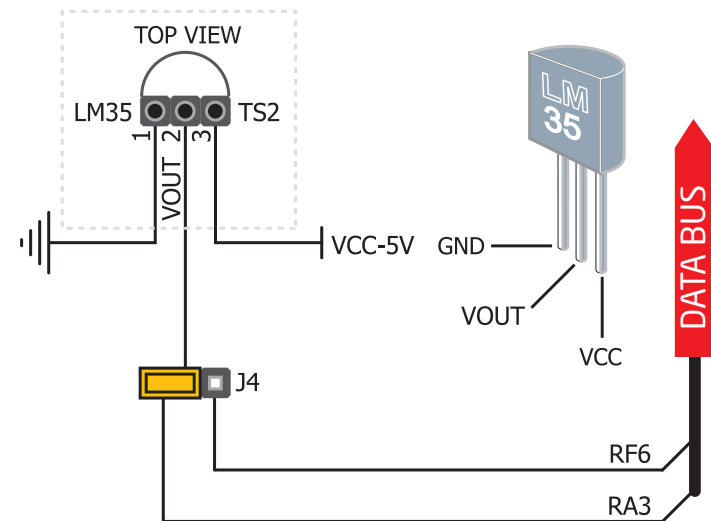*LM35 connected to RA3 pin*

Figure 40: LM35 connected to RA3 pin schematic

ADC INPUTS
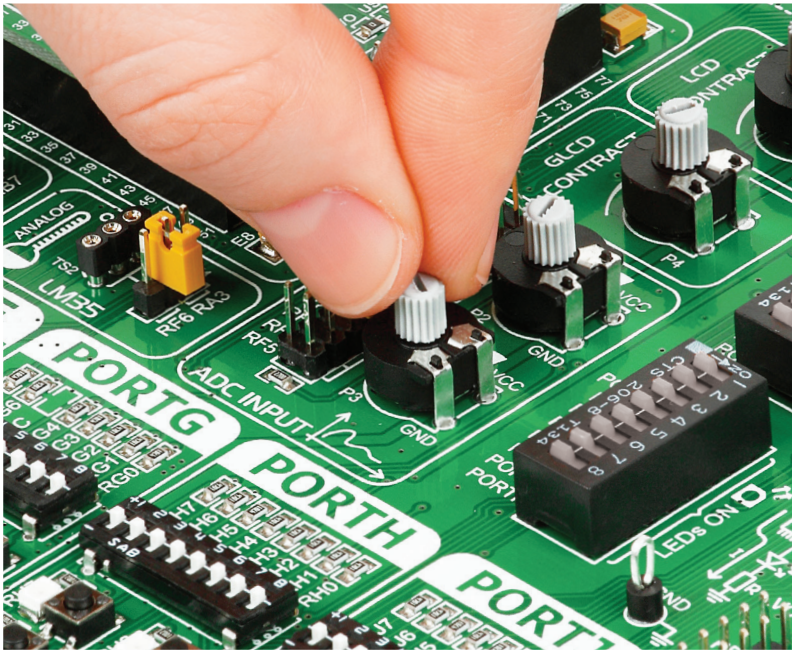

Figure 41: ADC INPUT module view

Digital signals have **two discrete states**, which are decoded as **high** and **low**, and interpreted as **logic 1** and **logic 0**. **Analog signals**, on the other hand, **are continuous**, and can have any value within defined range. **A/D converters** are specialized circuits which can convert analog signals (voltages) into a digital representation, usually in form of an **integer number**. The value of this number is **linearly dependent** on the input voltage value. Most microcontrollers nowadays internally have A/D converters connected to one or more input pins. Some of the most important parameters of A/D converters are **conversion time** and **resolution**. Conversion time determines how fast can an analog voltage be represented in form of a digital number. This is an important parameter if you need fast data acquisition. The other parameter is resolution. Resolution represents the number of discrete steps that supported voltage range can be divided into. It determines the sensitivity of the A/D converter. Resolution is represented in maximum number of bits that resulting number occupies. PIC18F87K22 microcontroller which comes on MCU card with the EasyPIC PRO v7a board has 12-bit resolution, meaning that maximum value of conversion can be represented with 12 bits, which converted to integer is $2^{12}=4096$. This means that supported voltage range, for example from 0-5V, can be devided into 4096 discrete steps of about 1.22mV.

EasyPIC PRO v7a provides an interface in form of two potentiometers for simulating analog input voltages that can be routed to any of the 10 supported analog input pins.
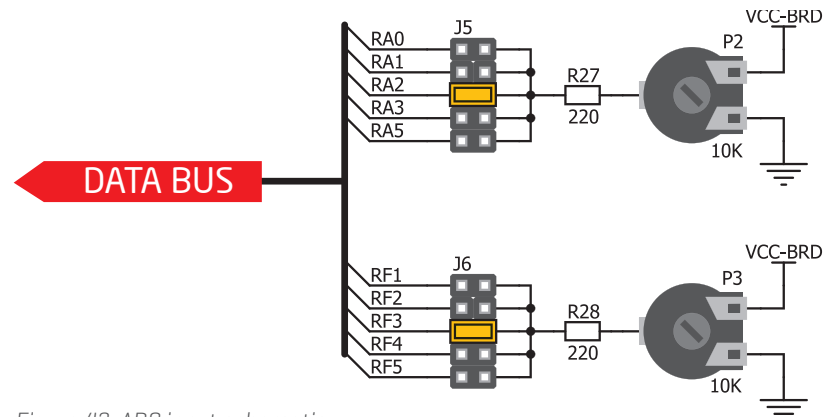
Enabling ADC inputs

In order to connect the output of the potentiometer **P2** to **RA0, RA1, RA2, RA3** or **RA5** analog microcontroller inputs, you have to place the jumper **J5** in the desired position. If you want to connect potentiometer **P3** to any of the **RF1 – RF5** analog microcontroller inputs, place jumper **J6** in the desired position. By moving the potentiometer knob, you can create voltages in range from **GND** to **VCC**.

Figure 42: use J5 and J6 jumpers to connect analog input lines with potentiometers P2 and P3

Figure 43: ADC input schematic

I²C EEPROM

EEPROM is short for **Electrically Erasable Programmable Read Only Memory**. It is usually a secondary storage memory in devices containing data that is retained even if the device looses power supply. Because of the ability to alter single bytes of data, EEPROM devices are used to store personal preference and configuration data in a wide spectrum of consumer, automotive, telecommunication, medical, industrial, and PC applications.

EasyPIC PRO v7a supports serial EE-PROM which uses **I²C communication interface** and has **1024 bytes** of available memory. Board contains socket for serial EEPROMs in DIP8 packaging, so you can easily exchange it with different memory size EEPROM IC. EEPROM itself supports single byte or 16-byte (page) write and read operations. Data rates are dependant of power supply voltage, and go up to 1 MHz with 5V power supply, and 400 kHz for 3.3V power supply.

WHAT IS I2C?

I²C is a multi-master serial single-ended bus that is used to attach low-speed peripherals to computer or embedded systems. I²C uses only two open-drain lines, **Serial Data Line (SDA)** and **Serial Clock (SCL)**, pulled up with resistors. **SCL** line is driven by a master, while **SDA** is used as bidirectional line either by master or slave device. Up to 112 slave devices can be connected to the same bus. Each slave must have a unique address.

Enabling I²C EEPROM
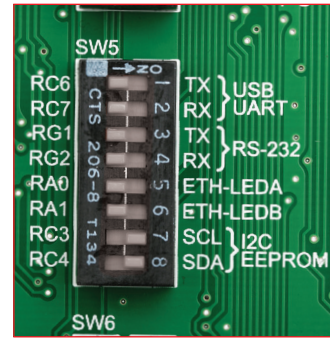
Figure 44: Activate SW5.7 and SW5.8 to connect MCU I2C lines to Serial EEPROM

In order to connect I²C EEPROM to the microcontroller you must enable **SW5.7** and **SW4.8** switches, as shown on **Figure 27. 1k**◦ pull-up resistors necessary for I²C communication are already provided on **SDA** and **SCL** lines once switches are turned on. Prior to using EEPROM in your application, make sure to disconnect other peripherals, LEDs and additional pull-up or pull-down resistors from the interface lines in order not to interfere with signal/data integrity.
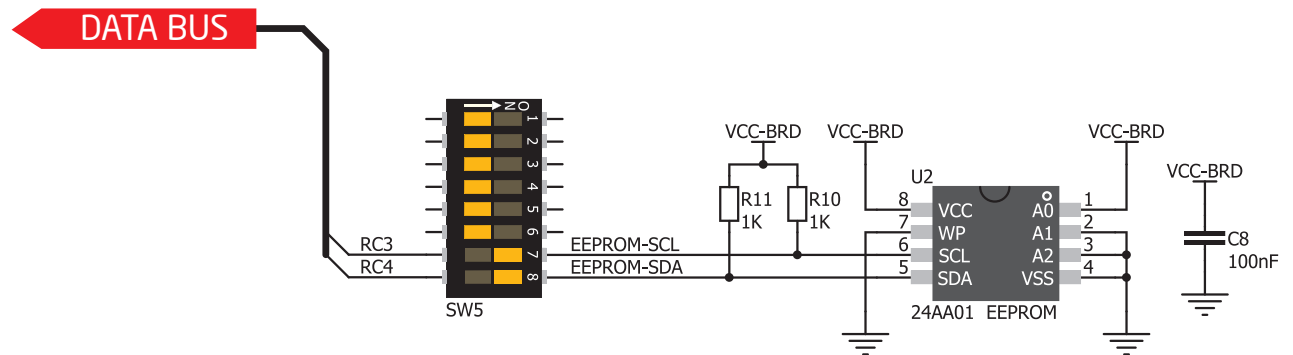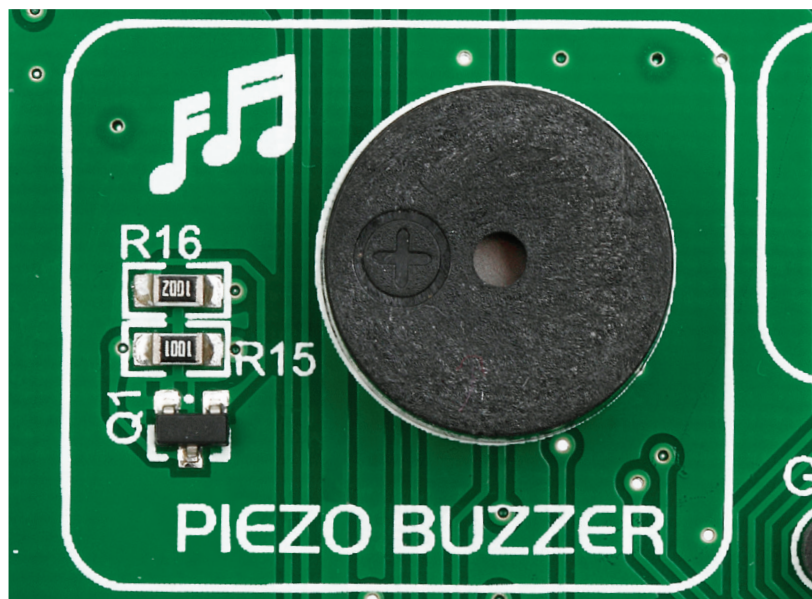

Figure 45: I²C EEPROM module schematic
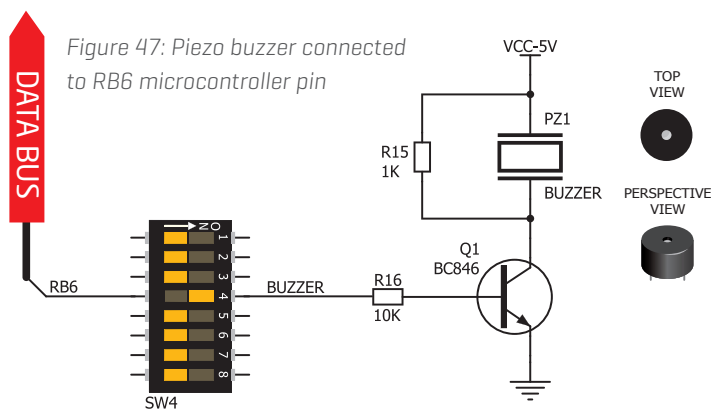
Figure 46: PIEZO BUZZER module view

PIEZO BUZZER

Piezo electricity is the charge which accumulates in certain solid materials in response to mechanical pressure, but also providing the charge to the piezoelectric material causes it to physically deform. One of the most widely used applications of piezo electricity is the production of sound generators, called piezo buzzers. **Piezo buzzer** is an electric component that comes in different shapes and sizes, which can be used to create sound waves when provided with analog electrical signal. EasyPIC PRO v7a comes with piezo buzzer which can be connected to **RB6** microcontroller pin. Connection is established using SW4.4 DIP switch. Buzzer is driven by transistor **Q1 (Figure 47)**. Microcontrollers can create sound by generating a PWM (Pulse Width Modulated) signal – a **square wave** signal, which is nothing more than a sequence of logic zeros and ones. Frequency of the square signal determines the pitch of the generated sound, and duty cycle of the signal can be used to increase or decrease the volume in the range from 0% to 100% of the duty cycle. You can generate PWM signal using hardware capture-compare module, which is usually available in most microcontrollers, or by writing a custom software which emulates the desired signal waveform.

Figure 47: Piezo buzzer connected to RB6 microcontroller pin

SUPPORTED SOUND FREQUENCIES

Piezo buzzer's resonant frequency (where you can expect it's best performance) is **3.8kHz**, but you can also use it to create sound in the range between **2kHz** and **4kHz**.

Enabling Piezo Buzzer

In order to use the on-board Piezo Buzzer in your application, you first have to connect the transistor driver of piezo buzzer to the appropriate microcontroller pin. This is done using **SW4.4** DIP switch. Once the switch is in ON position, it connects the buzzer driver to **RB6** microcontroller pin.

HOW TO MAKE IT SING?

Buzzer starts "singing" when you provide PWM signal from the microcontroller to the buzzer driver. The pitch of the sound is determined by the frequency, and amplitude is determined by the duty cycle of the PWM signal.

Freq = 3kHz, Duty Cycle = 50%

Freq = 3kHz, Duty Cycle = 80%

Freq = 3kHz, Duty Cycle = 20%

Freq = 3kHz, Volume = 50%

Freq = 3kHz, Volume = 80%

Freq = 3kHz, Volume = 20%
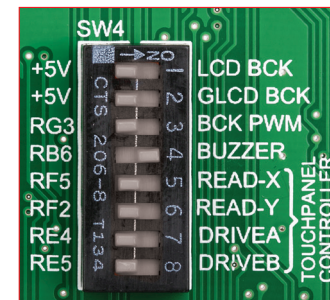
Output voltages

EasyPIC PRO v7a contains two additional pairs of screw terminals which can be used to get power supply output for your external devices. There are two available output voltages: **5V** and **3.3V**. Depending on which power source you use (adapter, laboratory power supply, or USB), maximum output currents can vary. Power consumption of the on-board modules can also affect maximum output power which can be drawn out of the screw terminals. Big power consumers, such as Ethernet, or even GLCD with backlight can alone drastically reduce the maximum output power. On-board switching power supply can give maximum of 600mA of current if used with adapter or laboratory power supply. When used with USB power supply it can give no more than 500mA.

Purpose of the output voltage terminals is not to be the main power source of big consumers, but more a power source for remote small consumers.
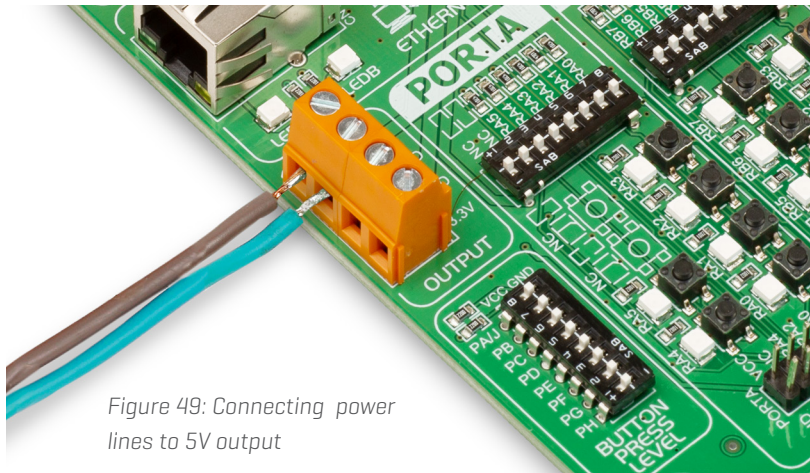
Figure 49: Connecting power lines to 5V output
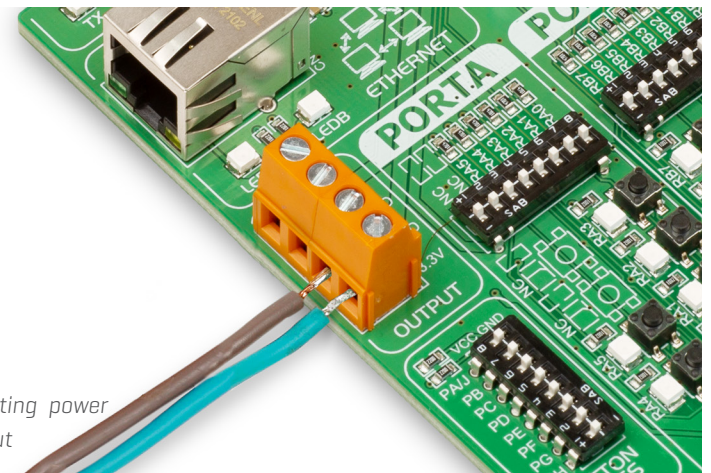
Figure 50: Connecting power lines to 3.3V output

ADDITIONAL GNDs

EasyPIC PRO v7a contains three **GND pins** located in three different sections of the board, which allow you to easily connect oscilloscope GND reference when you monitor signals on microcontroller pins, or signals of on-board modules.
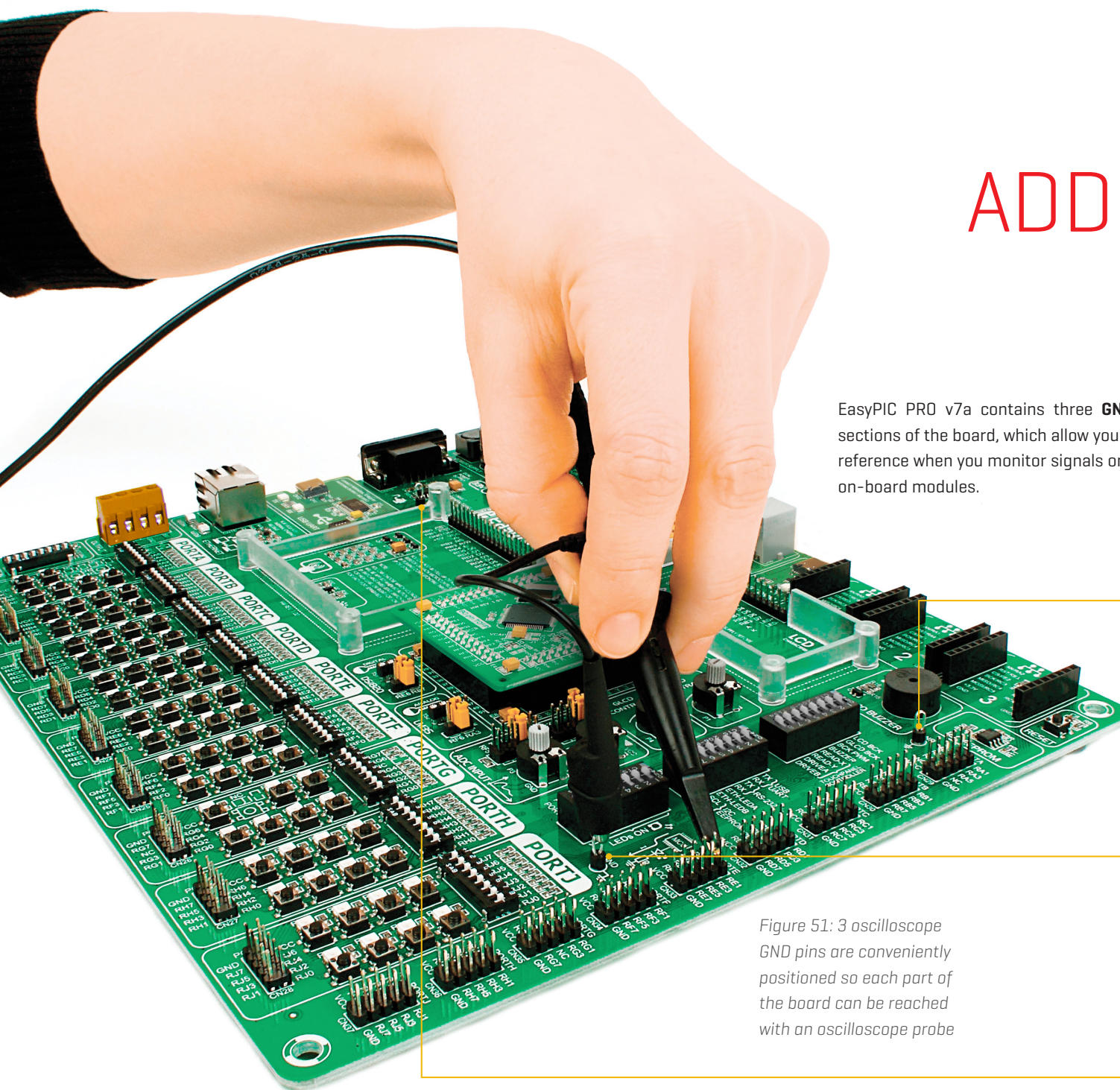
1

GND pin located near the piezo buzzer, next to PORTA heade PORTA header

2
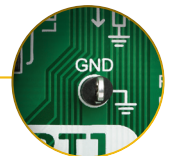
GND pin located above PORTJ I/O group, next to PORTF header

3

GND pin located near the RS-232 connector

Figure 51: 3 oscilloscope GND pins are conveniently positioned so each part of the board can be reached with an oscilloscope probe

What's Next?

You have now completed the journey through each and every feature of the EasyPIC PRO v7a development board. You have become familiar with its modules, organization, and the programmer/debugger. Now you are ready to start using your new board. We suggest following steps which are highly recommended to begin with.

1 COMPILERS

Easy programming, clean interface, powerful debugging, great support - our compilers come in three different flavors: mikroC PRO for PIC, mikroBASIC PRO for PIC and mikroPASCAL PRO for PIC, offering a complete rapid embedded development solution for these 3 major programming languages.
www.mikroe.com/compilers/compilers-pic

Fast, professional, multiplatform, and multi-architectural **Necto Studio** is already in the air. Support for PIC compiler inside the Necto studio is just around the corner. For more information, please visit: *www.mikroe.com/necto*

2 PROJECTS

Once you have chosen your compiler, and since you already got the board, you are ready to start writing your first projects. We have equipped our compilers with dozens of examples that demonstrate the use of each and every feature of the EasyPIC PRO v7a development board. This makes an excellent starting point for future custom projects. Just load the example, read well commented code, and see how it works on hardware.

3 COMMUNITY

We invite you to join thousands of users of Mikroe development tools. You will find useful projects and tutorials and get help from a large user community. If you want to download free projects and libraries, or share your own code, please visit the Libstock website. With user profiles, you can get to know other programmers, and subscribe to receive notifications on their code.
www.libstock.mikroe.com

4 SUPPORT

Mikroe offers free Tech Support to the end of its life span, so if anything goes wrong, we are ready and willing to help. We know how important it is to be able to rely on someone in the moments when we are stuck with our projects for any reason, or facing a deadline. This is why our Support Department, as one of the pillars upon which our company is based, now also offers the Premium Technical Support to business users, ensuring even shorter timeframe for solutions. The WiFi debugger feature offers additional level of technical support, allowing our team to provide help by directly connecting to the end users hardware.
https://helpdesk.mikroe.com/

DISCLAIMER

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