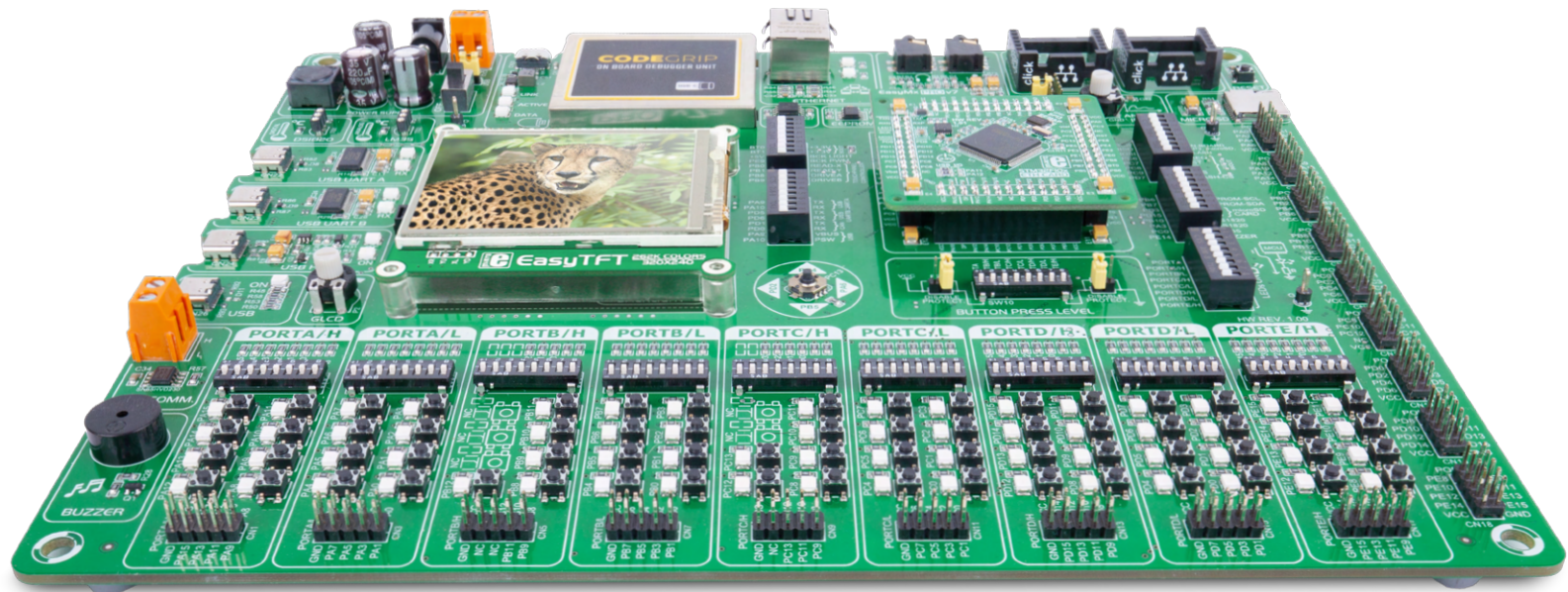


EasyMx PRO v7a

for STM32



USER MANUAL

857+

MCUs
SUPPORTED



CODEGRIP
ON BOARD



mikroBUS™
SOCKETS



AMAZING
CONNECTIVITY



MULTIMEDIA
PERIPHERALS

MIKROE

Thank you for being our valued customer!

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

From the day one, we in MikroElektronika gave ourselves the highest possible goals in pursuit of excellence. That same day, the idea of EasyMX development board was born. And we all grew together with EasyMX. In its each and tiniest piece we had put all of our energy, creativity and sense of what's the best for an engineer. I've personally assembled hundreds of early EasyMx boards myself with my home soldering iron.

Today, in 2022, we present you the **A** generation of the board, which brings us some awesome new features. We hope that you will like it as much as the previous one.

Use it wisely and have fun!

A handwritten signature in black ink, appearing to read 'NM', with a stylized flourish extending to the right.

Nebojsa Matic,
CEO

Table of contents

Introduction

Introduction	4
It's good to know	6

Power supply unit

Power supply	7
How to power the board?	8

Supported MCUs

Default MCU Card	9
How to properly place your MCU into the DIP socket?	11
Other supported MCU cards	12

Programmer/debugger

On-board programmer	13
---------------------	----

Connectivity

INPUT/OUTPUT group	15
Headers, buttons, LEDs	16
mikroBUS™ sockets	17
Click boards™	18

Communication

USB UART A	20
USB UART B	21
USB host	22
USB device	23
Ethernet	24
CAN	25

Multimedia

Audio I/O	26
microSD card slot	27
TFT display	28
Touch panel controller	29
GLCD 128x64	30
Navigation switch	31

Other modules

DS1820 Digital temp. sensor	32
LM35 Analog temp. sensor	33
Serial Flash Memory	34
I2C EEPROM	35
ADC INPUTS	36
Piezo buzzer	37
Additional GNDs	338

INTRODUCTION

ARM® Cortex™-M0, Cortex™-M3, Cortex™-M4 and Cortex™-M7 are vastly popular microcontrollers. They are rich with modules, with high performance and low power consumption, so creating a development board the size of **EasyMx PRO v7a for STM32** was really a challenge. We wanted to put as many peripherals on the board as possible, to cover many internal modules.

We asked ourselves what we can do to make such a great board even greater. And we equipped 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

EasyMx PRO v7a is all about connectivity. Having two different connectors for each port, you can connect accessory boards, sensors and your custom electronics easier than 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 850 microcontrollers. You will need it, whether you are a professional or a beginner.



ALL KINDS OF DEVELOPMENT

Multimedia peripherals

TFT 320x240 with touch panel, stereo mp3 codec, audio input and output, navigation switch and microSD card slot make a perfect set of peripherals for multimedia development.



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

9-32V DC 7-23V AC

POWER SUPPLY

ON OFF

EXT USB

LINK ACTIVE DATA

ETHERNET

FLASH

E2PROM

AUDIO IN/OUT

ANALOG INPUT

MICRO SD

RESET

DS1820

LM35

USB UART A

USB UART B

USB HOST

USB

GLCD

DEV BOARD EasyMx PRO v7a for STM32 ARM

EasyTFT 262K COLORS 320X240

EasyMx PRO v7

STM32FX10H CARD

BUTTON PRESS LEVEL

HW REV. 1.00

PORTA/H
PA15 PA14 PA13 PA12 PA11 PA10 PA9 PA8 CN1

PORTA/L
PA7 PA6 PA5 PA4 PA3 PA2 PA1 PA0 CN3

PORTB/H
PB15 PB14 PB13 PB12 PB11 PB10 PB9 PB8 PB7 PB6 PB5 PB4 PB3 PB2 PB1 CN5

PORTB/L
PB7 PB6 PB4 PB3 PB2 PB1 CN7

PORTC/H
PC15 PC14 PC13 PC12 PC11 PC10 PC9 CN9

PORTC/L
PC7 PC6 PC4 PC3 PC2 PC1 CN11

PORTD/H
PD15 PD14 PD13 PD12 PD11 PD10 PD9 PD8 CN13

PORTD/L
PD7 PD6 PD4 PD3 PD2 PD1 CN15

PORTE/H
PE15 PE14 PE13 PE12 PE11 PE10 PE9 PE8 PE7 PE6 PE5 PE4 PE3 PE2 PE1 CN17

PORTC/H
PC8 PC9 PC10 PC11 PC12 PC13 VCC GND

PORTC/L
PC0 PC1 PC2 PC3 PC4 PC5 PC6 PC7 VCC GND

PORTD/H
PD0 PD1 PD2 PD3 PD4 PD5 PD6 PD7 PD8 PD9 PD10 PD11 PD12 PD13 VCC GND

PORTD/L
PD0 PD1 PD2 PD3 PD4 PD5 PD6 PD7 VCC GND

PORTE/H
PE8 PE9 PE10 PE11 PE12 PE13 PE14 PE15 VCC GND

PORTD/H
PD0 PD1 PD2 PD3 PD4 PD5 PD6 PD7 PD8 PD9 PD10 PD11 PD12 PD13 PD14 PD15 VCC GND

PORTE/H
PE8 PE9 PE10 PE11 PE12 PE13 PE14 PE15 VCC GND

PORTC/H
PC8 PC9 PC10 PC11 PC12 PC13 VCC GND

PORTC/L
PC0 PC1 PC2 PC3 PC4 PC5 PC6 PC7 VCC GND

PORTD/H
PD0 PD1 PD2 PD3 PD4 PD5 PD6 PD7 PD8 PD9 PD10 PD11 PD12 PD13 VCC GND

PORTD/L
PD0 PD1 PD2 PD3 PD4 PD5 PD6 PD7 VCC GND

PORTE/H
PE8 PE9 PE10 PE11 PE12 PE13 PE14 PE15 VCC GND

PORTD/H
PD0 PD1 PD2 PD3 PD4 PD5 PD6 PD7 PD8 PD9 PD10 PD11 PD12 PD13 PD14 PD15 VCC GND

PORTE/H
PE8 PE9 PE10 PE11 PE12 PE13 PE14 PE15 VCC GND

PORTC/H
PC8 PC9 PC10 PC11 PC12 PC13 VCC GND

PORTC/L
PC0 PC1 PC2 PC3 PC4 PC5 PC6 PC7 VCC GND

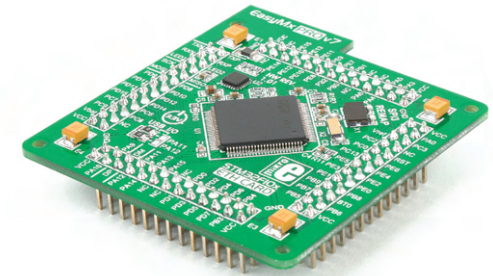
PORTD/H
PD0 PD1 PD2 PD3 PD4 PD5 PD6 PD7 PD8 PD9 PD10 PD11 PD12 PD13 VCC GND

PORTD/L
PD0 PD1 PD2 PD3 PD4 PD5 PD6 PD7 VCC GND

PORTE/H
PE8 PE9 PE10 PE11 PE12 PE13 PE14 PE15 VCC GND

IT'S GOOD TO KNOW!

STM32F207VGT6 is the default microcontroller!



STM32F207VGT6 belongs to **ARM®Cortex™-M3 family**. It has **120MHz** frequency, **1 Mbyte** of Flash memory, **128K + 4K bytes** of general-purpose SRAM, integrated Ethernet controller, USB 2.0 (OTG, Host, Device), 83 General purpose I/O pins, 12x16-bit and 2x32-bit timers, 3x12-bit A/D [24 channels], 2x12-bit D/A, 4xUSARTs, 2xUARTs, internal Real time clock (RTC), 2xI2C, 3xSPI and 2xCAN controllers. It has Serial wire debug (SWD) and JTAG interfaces for programming and debugging.

SYSTEM SPECIFICATIONS



POWER SUPPLY
7–23V AC or 9–32V DC
or via USB cable [5V DC]



POWER CONSUMPTION
~76mA when all peripheral
modules are disconnected



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



BOARD WEIGHT
~500g
[1.1 lbs]

PACKAGE CONTAINS

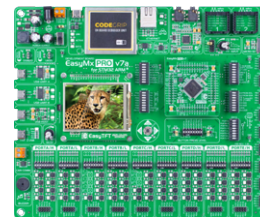
1

Damage
resistant
protective
box



2

EasyPIC v7a
development
board

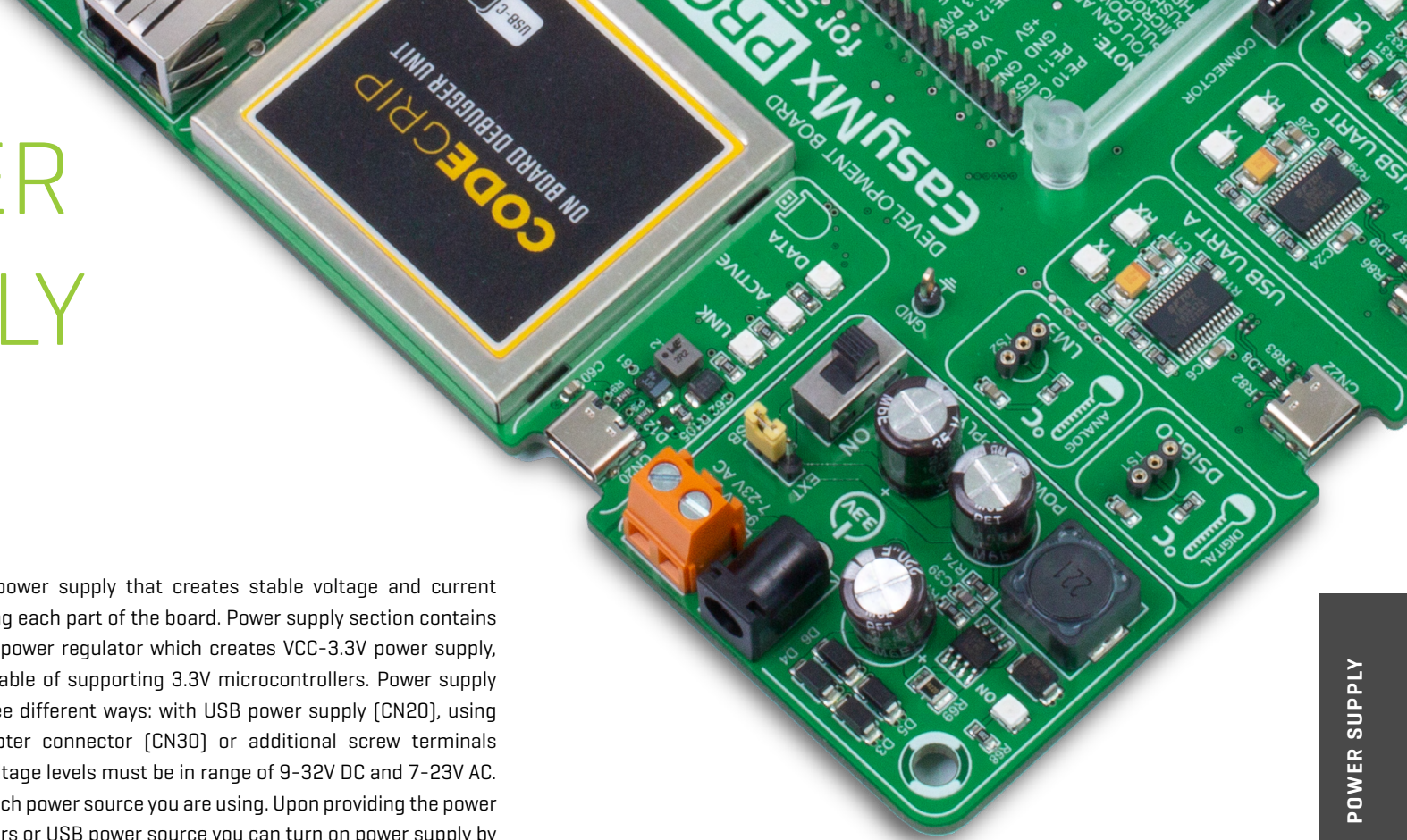


3

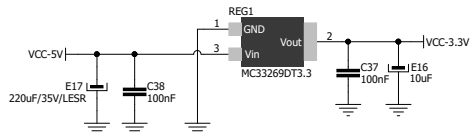
USB
cable



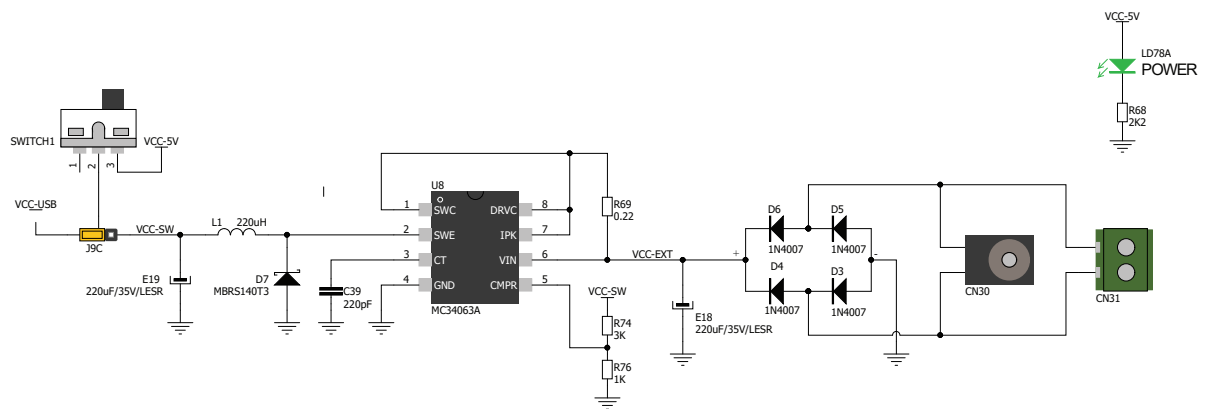
POWER SUPPLY



Board contains switching power supply that creates stable voltage and current levels necessary for powering each part of the board. Power supply section contains specialized MC33269DT3.3 power regulator which creates VCC-3.3V power supply, thus making the board capable of supporting 3.3V microcontrollers. Power supply unit can be powered in three different ways: with USB power supply [CN20], using external adapters via adapter connector [CN30] or additional screw terminals [CN31]. External adapter voltage levels must be in range of 9-32V DC and 7-23V AC. Use jumper J9 to specify which power source you are using. Upon providing the power using either external adapters or USB power source you can turn on power supply by using SWITCH 1 (Figure 3-1). Power LED ON (Green) will indicate the presence of power supply.



3.3V VOLTAGE REGULATOR



5V SWITCHING POWER SUPPLY

HOW TO POWER THE BOARD?



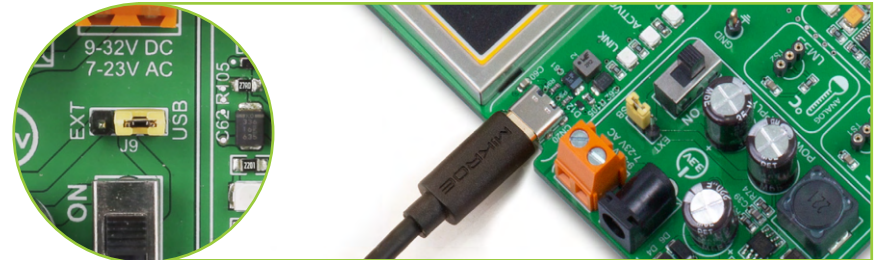
Board power supply creates stable 3.3V necessary for operation of the microcontroller and all on-board modules.

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

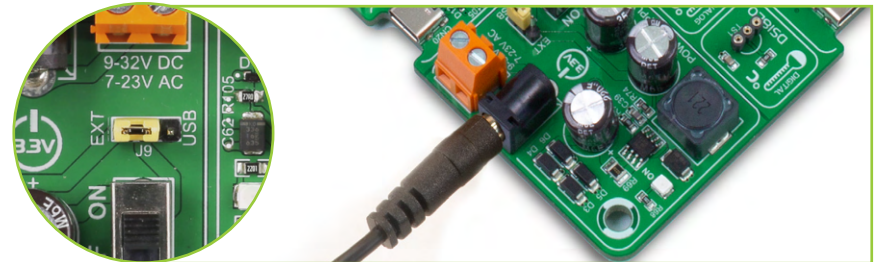
To power the board with USB cable, place jumper **J9** in USB position. You can then plug in the USB cable as shown on images, and turn the power switch ON.



Powered by USB

2. Using adapter

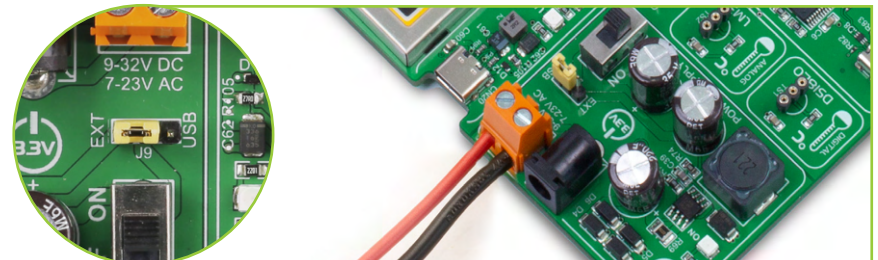
To power the board via adapter connector, place jumper J9 in EXT position. You can then plug in the adapter cable as shown on images, and turn the power switch ON.



Powered by wall-adaptor

3. With laboratory PSU

To power the board using screw terminals, place jumper J9 in EXT position. You can then screw-on the cables in the screw terminals as shown on images, and turn the power switch ON.



Powered by laboratory PSU

Default MCU card

Microcontrollers are supported using specialized MCU cards containing 104 pins, which can be placed into the on-board female MCU socket. There are several types of cards which cover multiple microcontroller families of STM32® and different architectures. The Default MCU card that comes with the EasyMx PRO™

v7a for STM32® package is shown on Figure 4-1. It contains STM32F207VGT6 microcontroller with on-chip peripherals 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.

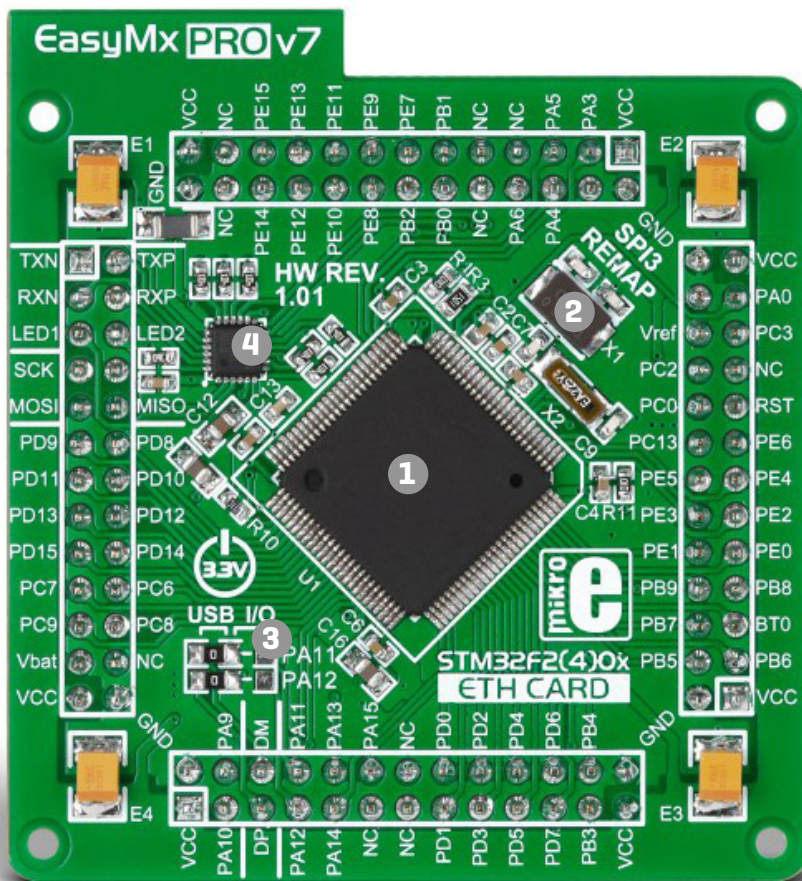


Figure 4-1: Default MCU card with STM32F207VGT6

- 1 STM32F207VGT6** is the default chip of EasyMx PRO v7a. It has 120MHz frequency, 1 Mbyte of Flash memory, 128K + 4K bytes of general-purpose SRAM, integrated Ethernet controller, USB 2.0 (OTG, Host, Device), 83 General purpose I/O pins, 12x16-bit and 2x32-bit timers, 3x12-bit A/D [24 channels], 2x12-bit D/A, 4xUSARTs, 2xUARTs, internal Real time clock (RTC), 2xI2C, 3xSPI and 2xCAN controllers.
- 2 25MHz crystal oscillator.** We carefully chose the most convenient crystal value that provides clock frequency which can be used directly, or with the PLL multipliers to create higher MCU clock value. MCU card also contains 32.768 kHz crystal oscillator which provides external clock for RTC module.
- 3 USB communications lines.** These two jumpers, when in USB position, connect D+ and D- lines of the on-board USB connector with PA11 and PA12 microcontroller pins. Since **STM32F207VGT6** supports USB, jumpers are in USB position.
- 4 Ethernet transceiver.** Default MCU card contains single-chip Ethernet physical [PHY] layer transceiver which provides additional Ethernet functionality to STM32F207VGT6 controller

With STM32® Cortex™-M3 and Cortex™-M4 microcontrollers you have the ability to select specific boot space [User flash memory, system memory or embedded SRAM], depending on the boot pins value [BTO, PB2]. Boot pins are set to ground [0] through 100K resistors. In order to set BTO and PB2 pins to VCC [1], you must push SW11.1 and SW11.2 DIP switches to ON position, Figure 4-2. The values on the BOOT pins are latched on the fourth rising edge of system clock after a reset.

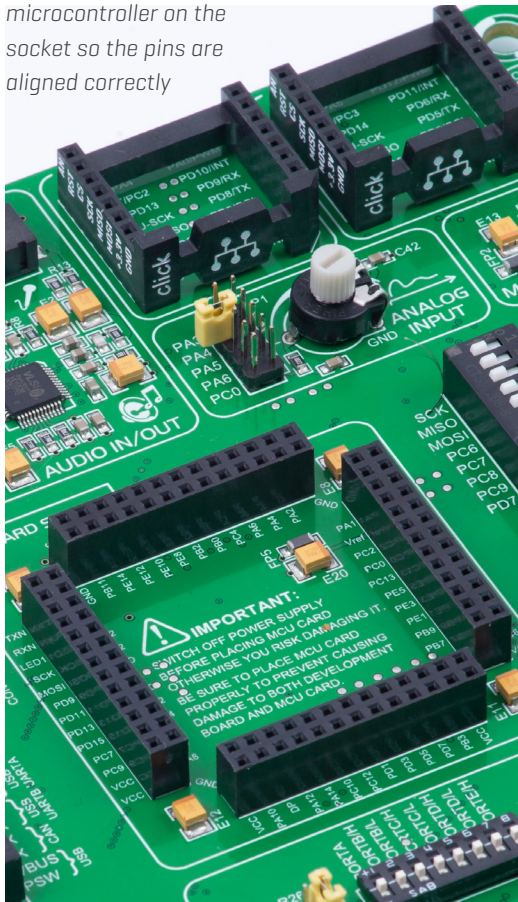
How to properly place your microcontroller into the DIP socket?

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 microcontroller. First make sure that a half circular cut in the microcontroller DIP packaging matches

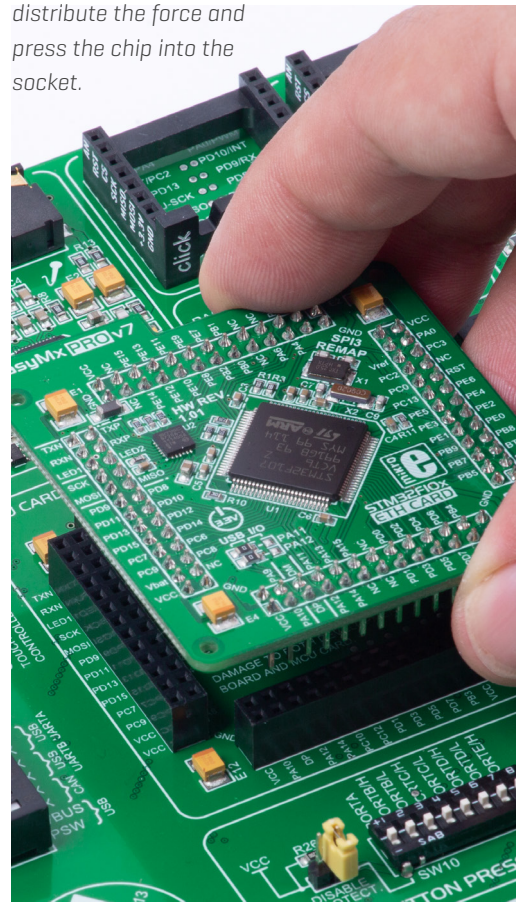
the cut in the DIP socket. Place both ends of the microcontroller into the socket as shown on the first image. Then put the microcontroller slowly down until all the pins match the socket as shown on the second image. Check again if everything is placed

correctly and press the microcontroller until it is completely plugged into the socket as shown on the third image. If done correctly all pins should be fully inserted. Only now can you turn on the power supply.

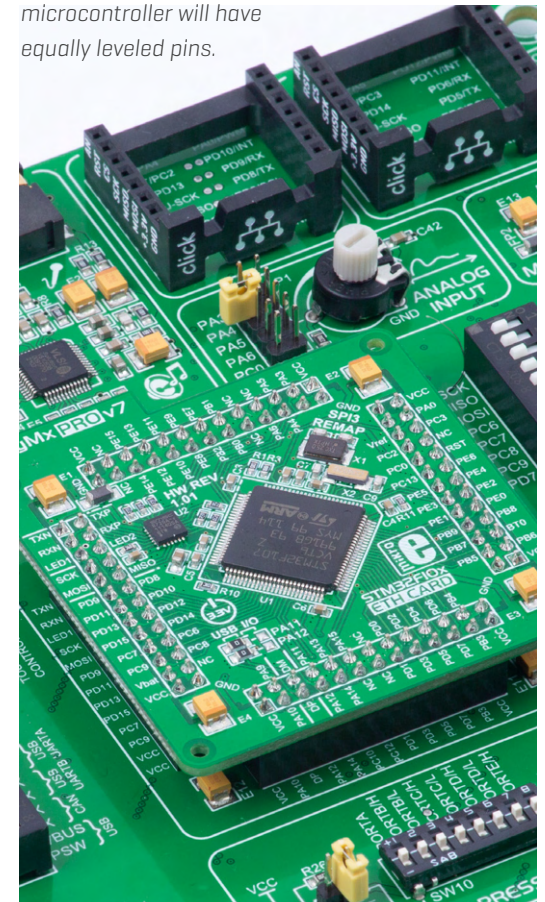
Place both ends of microcontroller on the socket so the pins are aligned correctly



With both fingers, evenly distribute the force and press the chip into the socket.



Properly placed microcontroller will have equally leveled pins.

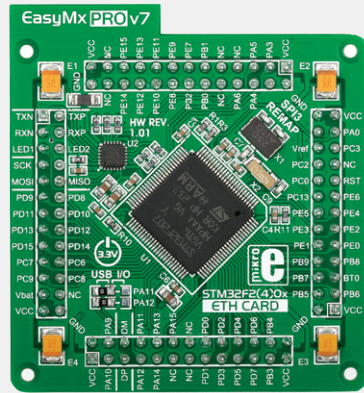


Other supported MCU cards

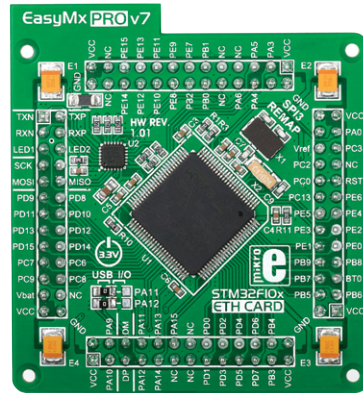
MIKROE currently offers total of four populated MCU cards. Two with Cortex™-M3, STM32F207VGT6 microcontroller [default], STM32F107VCT6 microcontroller, one with Cortex™-M4 STM32F407VGT6 MCU, and one with Cortex™-M7 STM32F746VGT6 MCU. You can also purchase empty PCB cards that you can populate on your own and solder any supported microcontroller you need in your development. There are total of four

empty PCB cards available. This way your EasyMx PRO v7a board becomes truly flexible and reliable tool for almost any of your ARM® projects. MCU cards can also be used in your final devices. For complete list of currently available MCU cards, please visit the board webpage:

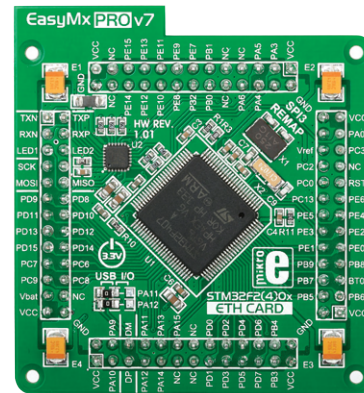
<http://www.mikroe.com/easymx-pro-v7a-for-stm32>



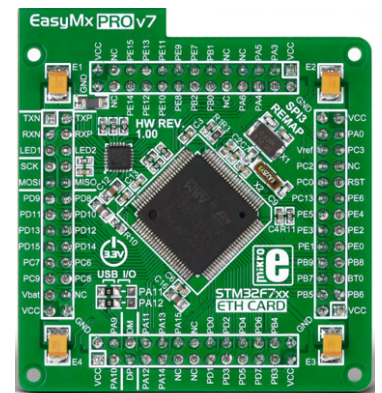
Standard 100-pin HP ETH MCU card with STM32F207VGT6



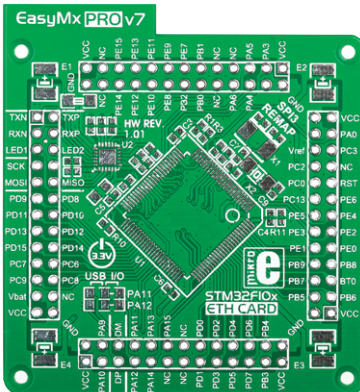
Default 100-pin ETH MCU card with STM32F107VCT6



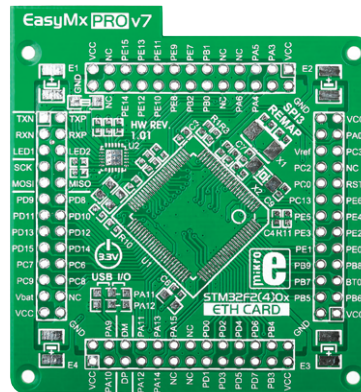
Standard 100-pin HP ETH MCU card with STM32F407VGT6



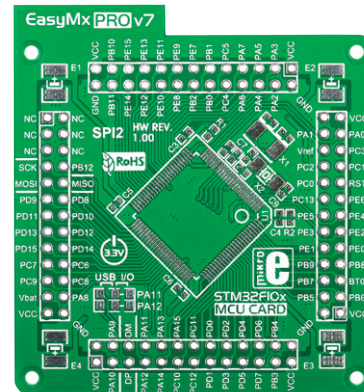
Standard 100-pin HP ETH MCU card with STM32F746VGT6



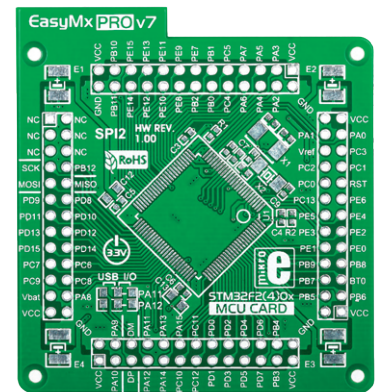
Empty ETH MCU card for 100-pin STM32F10x MCUs



Empty ETH HP MCU card for 100-pin STM32F2(4)0x MCUs



Empty MCU card for 100-pin STM32F10x MCUs



Empty HP MCU card for 100-pin STM32F2(4)0x MCUs

NOTE: "HP" [High performance] - Empty MCU cards that support only high performance STM32F20x and STM32F40x microcontrollers family.

"ETH" [Ethernet] - Empty MCU cards with single-chip Ethernet PHY layer transceiver which provides additional Ethernet functionality to microcontrollers

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.

EasyMx 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 EasyMx PRO v7a development board and its integrated CODEGRIP module, check out the CODEGRIP Suite quick start guide on the <http://www.mikroe.com/easymx-pro-v7a-for-stm32>

WHERE TO START?

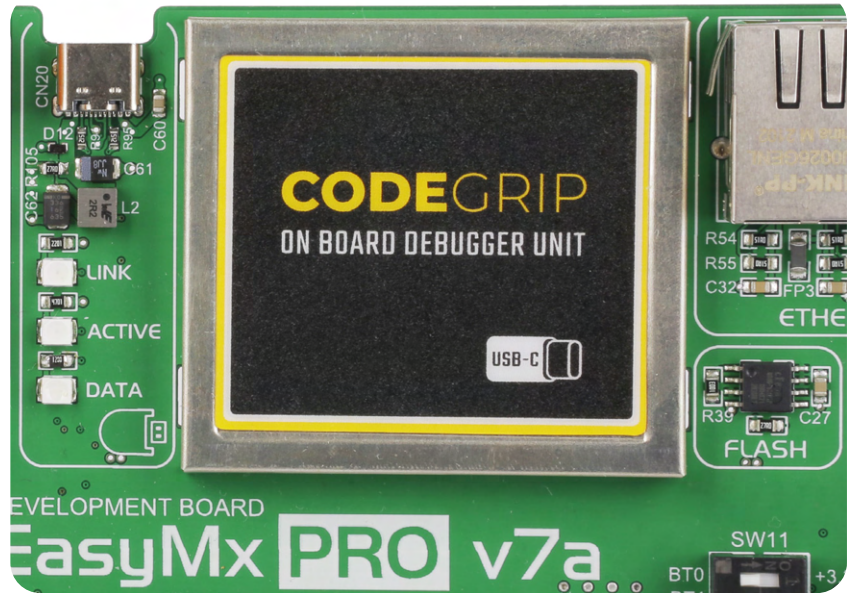
In order to start using CODEGRIP and program your microcontroller, you just have to follow two simple steps:

1. Install the necessary software

- Install USB drivers
- Install CODEGRIP Suite software

2. Power up the board, and you are ready to go!

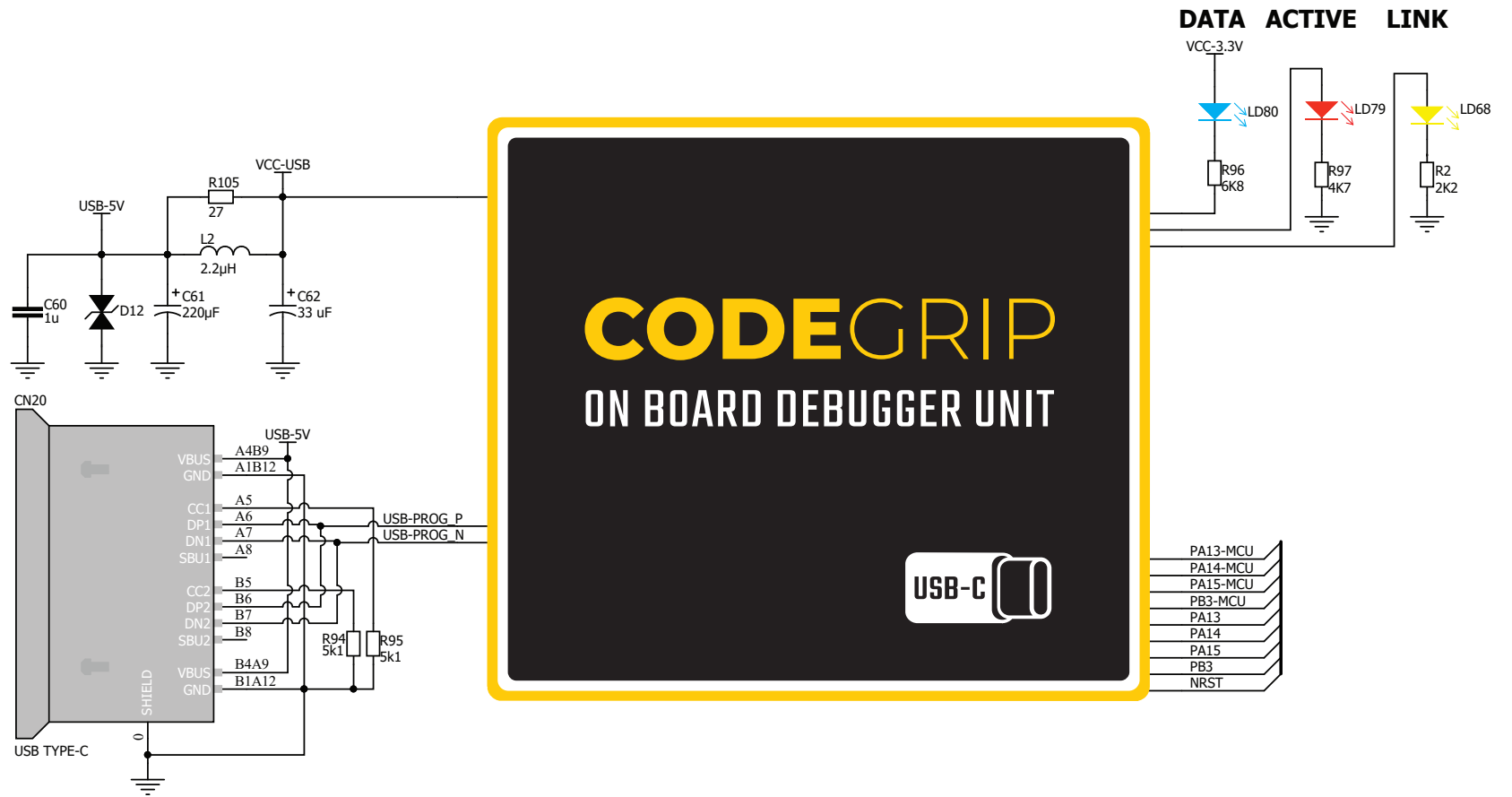
- Plug in the programmer USB cable
- LINK LED should light up.



CODEGRIP on board programmer

Why so many LEDs?

- Three LEDs indicate specific programmer operation. **Link** LED lights up when USB link is established with your PC, **Active** LED lights up when programmer is active. **Data** is on when data is being transferred between the programmer and PC software. [Compiler or CODEGRIP].



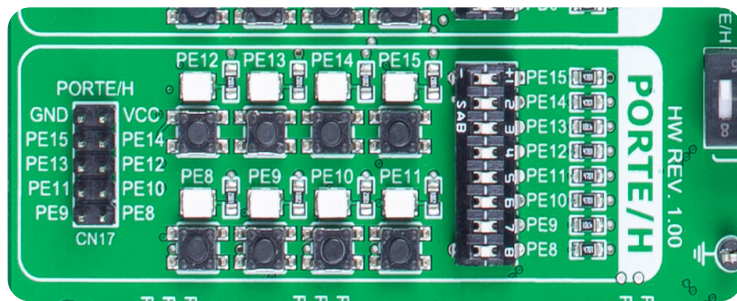
CODEGRIP on board programmer schematic

INPUT/OUTPUT GROUP

One of the most distinctive features of EasyMx PRO v7a are its Input/Output PORT groups. They add so much to the connectivity potential of the board.

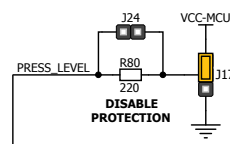
EVERYTHING IS GROUPED TOGETHER

PORT **headers**, PORT **buttons** and PORT **LEDs** are next to each other, and grouped together. It makes development easier, and the entire EasyMx 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 that side of the board too.



Tri-state DIP switch on PORTE/H

Schematic of the single I/O group connected to microcontroller PORTC

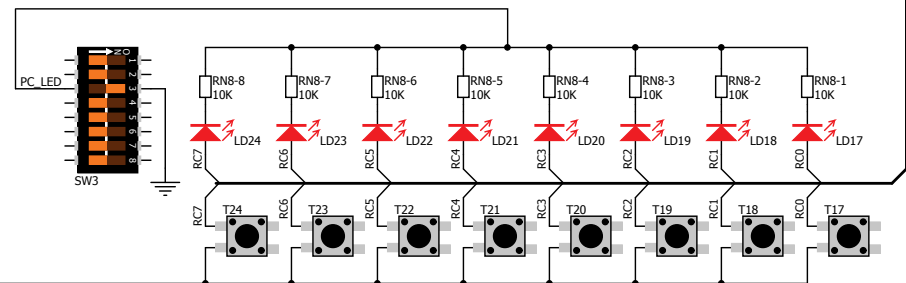
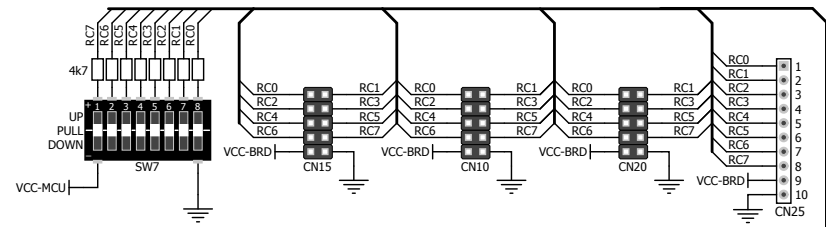
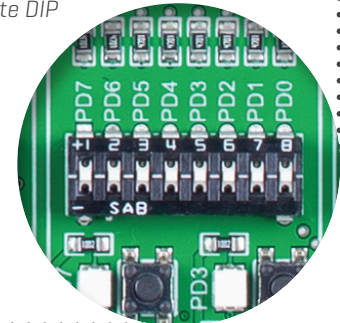


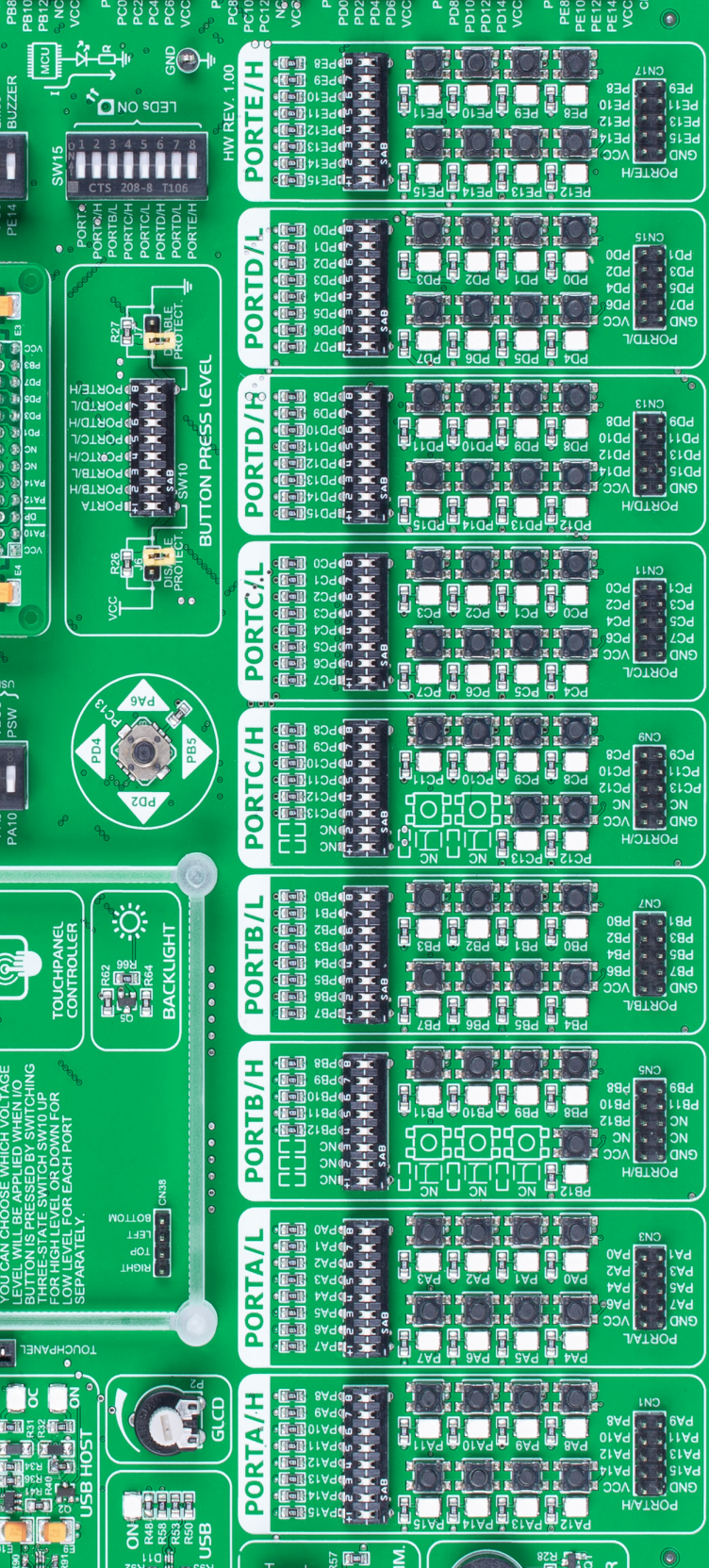
TRI-STATE DIP SWITCHES

Tri-state DIP switches, like SW15 on the image below, are used to enable 4K7 pull-up or pull-down resistor on any desired port pin. Each of those switches has three states:

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

Tri-state DIP switch





INPUT/OUTPUT ports view

HEADERS

With enhanced connectivity as one of the key features of EasyMx PRO v7a, we have provided **four connection headers for each PORT**. I/O PORT group contains two male IDC10 headers. These headers are all compatible with MIKROE accessory boards, and enable simple connection. There is **one more IDC10 header** available on the left side of the board, next to the section with displays.

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

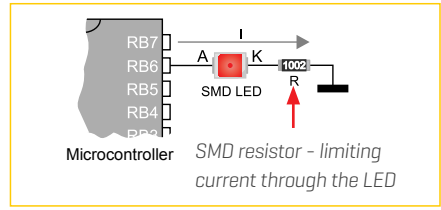
NOTE

I/O PORT group also contains 1x10 connection pad which can be used for connecting MIKROE PROTO boards, or custom user boards.

BUTTONS

The logic state of all microcontroller digital inputs may be changed using push buttons. Tri-state DIP switch SW10 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 SW10.1 in VCC position, then pressing of any push button in PORTA/H I/O group will apply logic one to the appropriate microcontroller pin. The same goes for GND. If DIP switch is in the middle position neither of two logic states will be applied to the appropriate microcontroller pin. You can disable pin protection 220ohm resistors by placing jumpers J6 and J7, which will connect your push buttons directly to VCC or GND. Be aware that doing so you may accidentally damage MCU in case of wrong usage.

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 v7a board uses low-current LEDs with typical current consumption of 0.2mA or 0.3mA, depending of VCC voltage selection. Board contains 36 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 **SW3**.

mikroBUS™ SOCKETS

The superior connectivity features of the EasyMx PRO v7a development board are rounded up with two 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

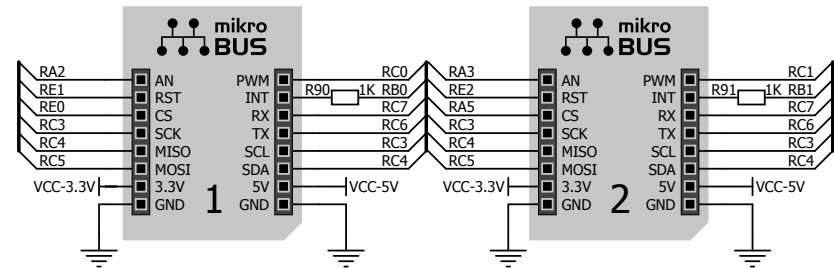
All the **mikroBUS™ sockets** are now redesigned and improved. They became much sturdier, allowing a better grip of the Click board™. In addition to added horizontal supports between two 8-pin connectors, the right lower edge is chamfered at the angle of 45°, the same as the Click board™, making it seamlessly 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

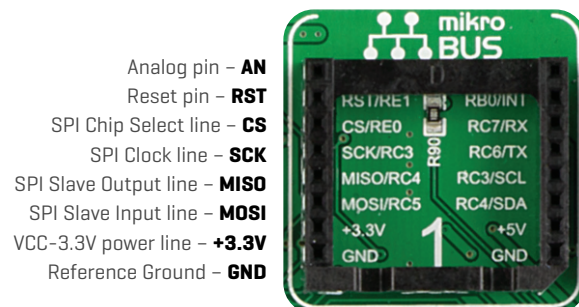
mikroBUS™ is not made to be only a part of our development boards. You can freely place mikroBUS™ host connectors in your final PCB designs, as long as you clearly mark them with mikroBUS™ logo and footprint specifications. For more information, logo artwork and PCB files visit our website:

www.mikroe.com/mikrobus



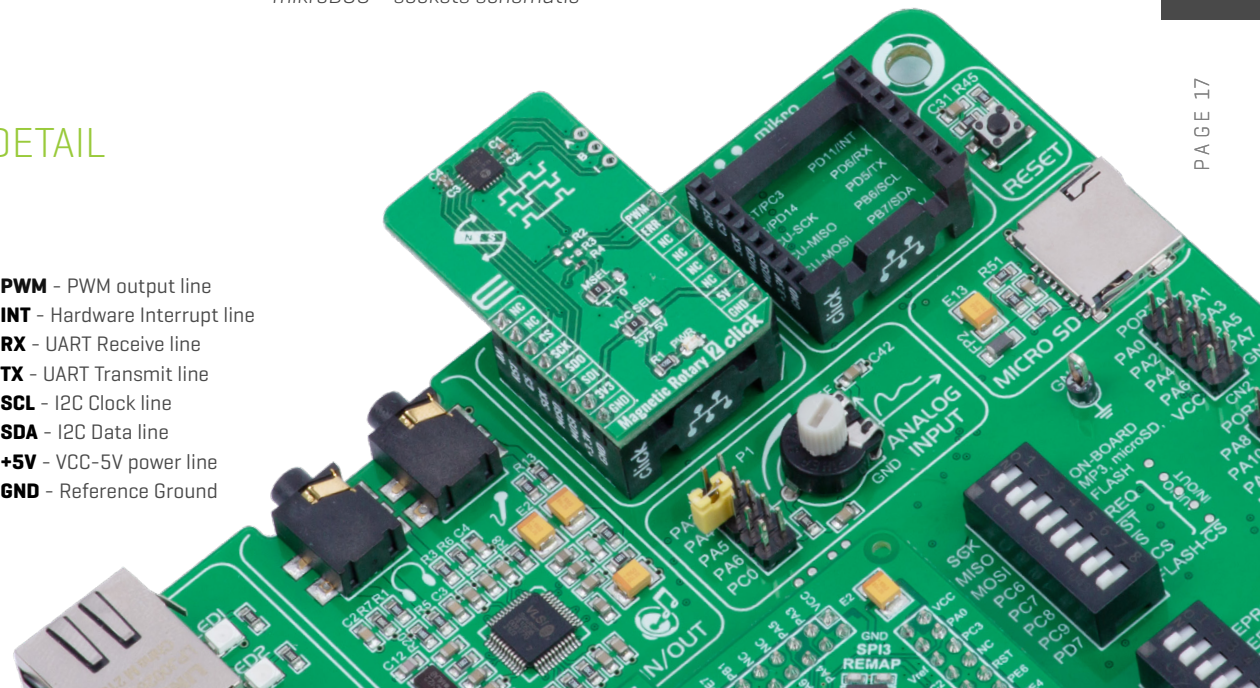
mikroBUS™ sockets schematic

mikroBUS™ SOCKET IN DETAIL



- Analog pin - **AN**
- Reset pin - **RST**
- SPI Chip Select line - **CS**
- SPI Clock line - **SCK**
- SPI Slave Output line - **MISO**
- SPI Slave Input line - **MOSI**
- VCC-3.3V power line - **+3.3V**
- Reference Ground - **GND**

- PWM** - PWM output line
- INT** - Hardware Interrupt line
- RX** - UART Receive line
- TX** - UART Transmit line
- SCL** - I2C Clock line
- SDA** - I2C Data line
- +5V** - VCC-5V power line
- GND** - Reference Ground



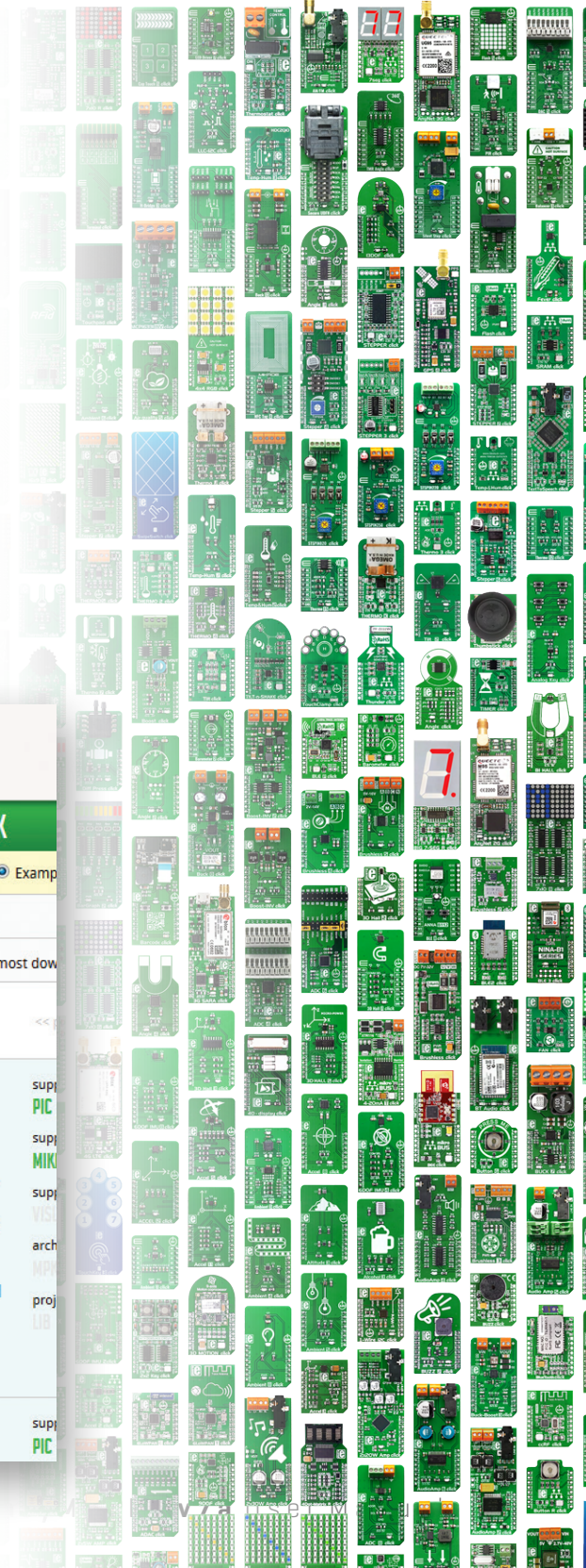
Click Boards™

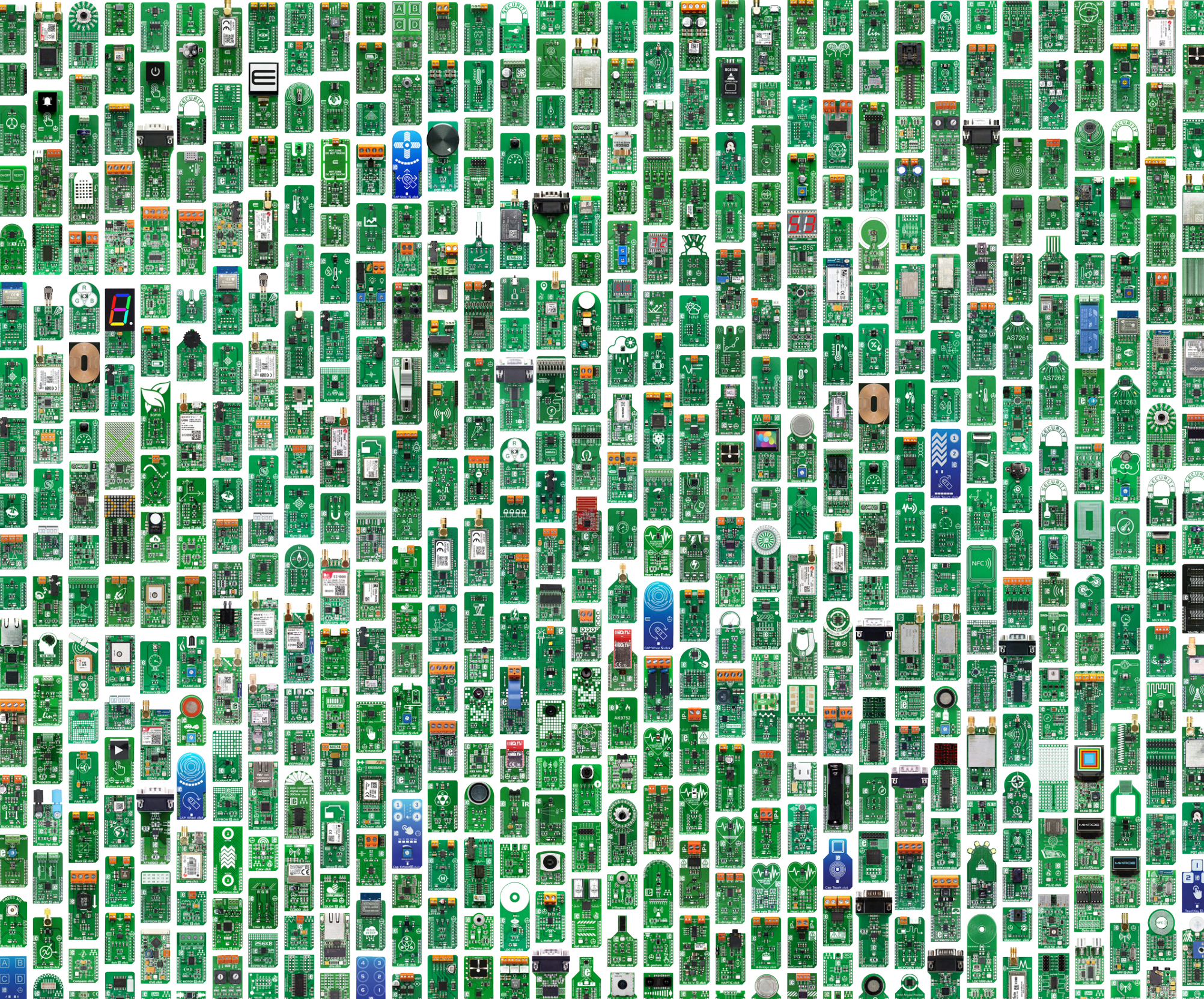
THE LARGEST AND FASTEST-GROWING BASE OF
ADD-ON BOARDS IN THE WORLD!

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

The screenshot shows the Libstock website interface. At the top, there's a navigation bar with 'LIBSTOCK' and 'A PLACE FOR CODE'. Below it are tabs for 'BROWSE CODE', 'SHARE CODE', 'REQUEST CODE', and 'ABOUT LIBSTOCK'. The main content area is divided into several sections:

- CODE EXAMPLES:** A section on the left with the heading 'CODE EXAMPLES' and text: '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'
- LOGIN:** A section with a 'LOGIN' button and fields for 'Username:' and 'Password:'. Below it, a link says 'Not registered? Sign Up for free!'.
- CATEGORIES:** A section with 'All codes' selected, and other options for 'Libraries', 'Projects', 'Visual Projects', and 'Examples'. Below this are 'COMPILERS' (mikroC, mikroBasic, mikroPascal, Other Compilers) and 'SORT BY' (best rank, oldest, by author, alphabetically, most down).
- CATEGORY: ALL CODES:** A section showing a list of code examples. The first one is 'GSM click - Example' with a rating of 5 stars, author 'MikroElektronika Team', version '1.0.0.0', last updated '2014-05-09', category 'GSM / GPRS', downloaded '7921 times', and followed by '2 users'. It includes a 'Download [648.97KB]' button and a '[learn more]' link. The description says: '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.'
- CODE CATEGORIES:** A section with 'All codes (789)' and a list of categories: Audio & Speech (20), Communication (194), Graphics & LCD (94), GSM / GPRS (12), and GPS (11).



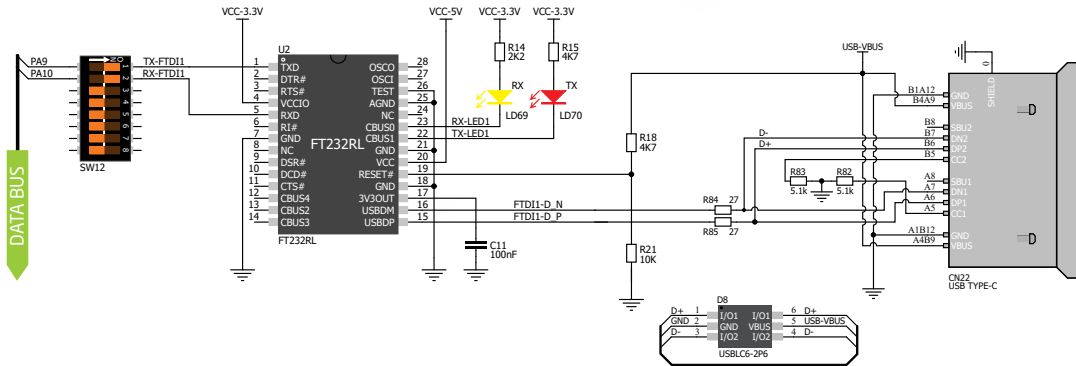
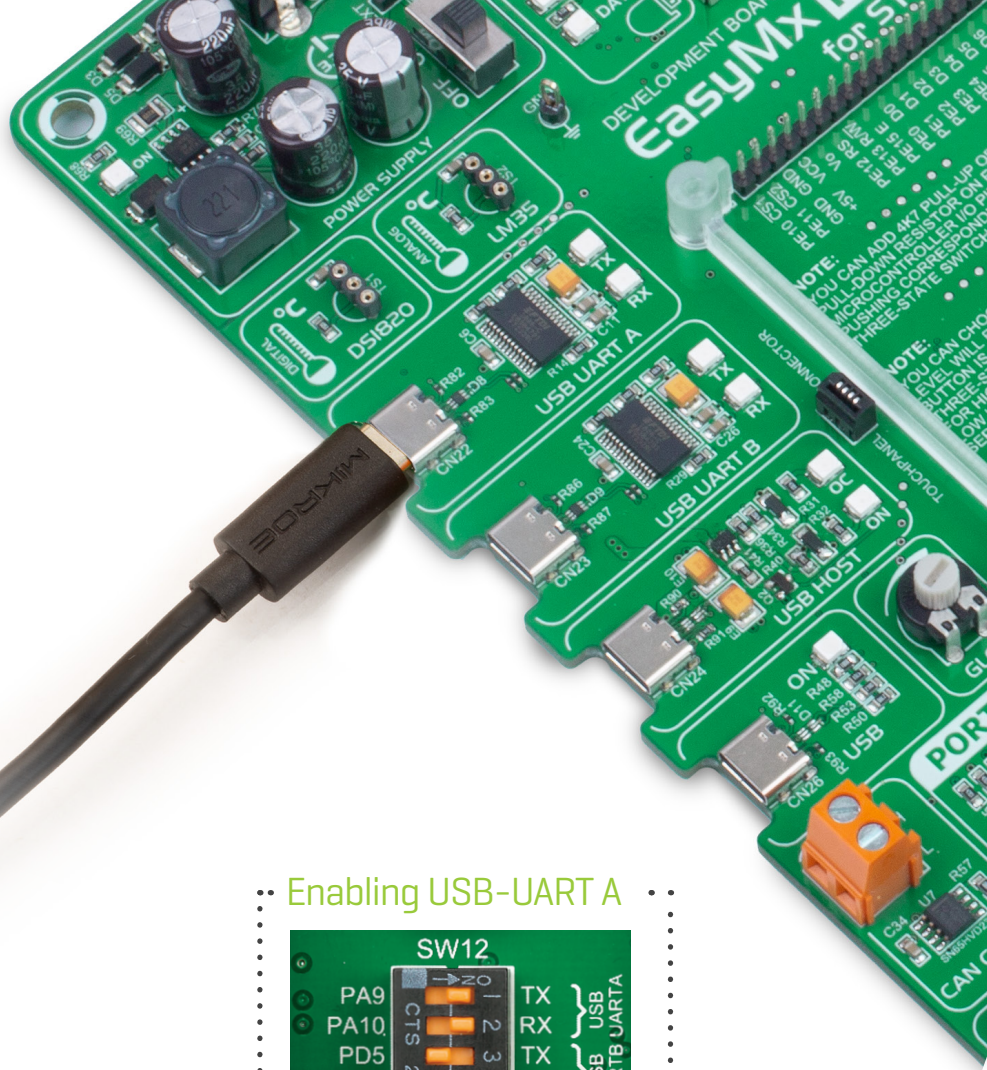


USB-UART A

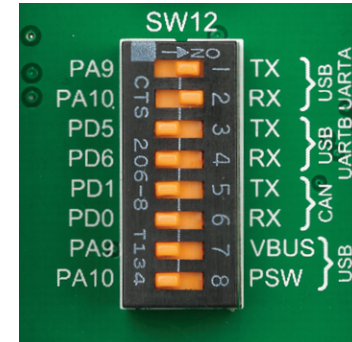
The **UART** [universal asynchronous receiver/transmitter] is one of the most common ways of exchanging data between the MCU and peripheral components. It is a serial protocol with separate transmit and receive lines, and can be used for full-duplex communication. Both sides must be initialized with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

Modern PC computers, laptops and notebooks are no longer equipped with RS-232 connectors and UART controllers. They are nowadays replaced with USB connectors and USB controllers. Still, certain technology enables UART communication to be done via USB connection. Controllers such as **FT232RL** from FTDI® convert UART signals to the appropriate USB standard.

USB-UART A communication is being done through a FT232RL controller, USB connector **(CN22)**, 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 selection is done using DIP switches **SW12.1** and **SW12.2**.



Enabling USB-UART A



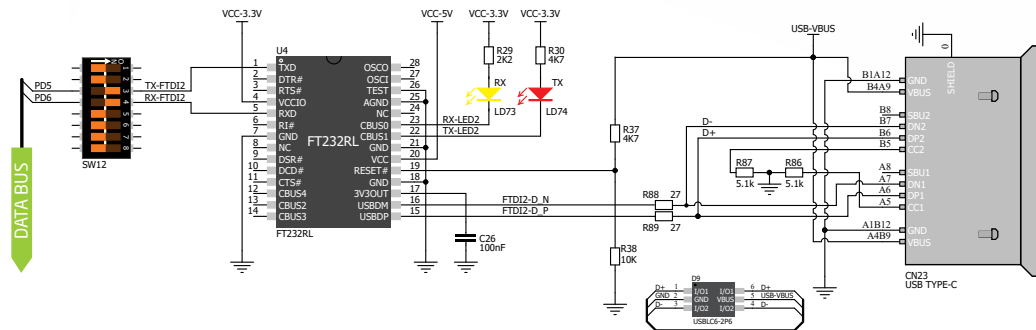
In order to enable USB-UART A communication, you must push **SW12.1** (PA9) and **SW12.2** (PA10) to **ON** position. This connects the **TX** and **RX** lines to **PA9** and **PA10** microcontroller pins and its UART module.

USB-UART B

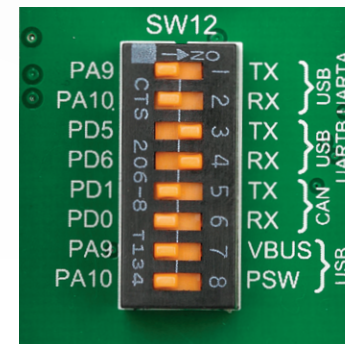
If you need to use more than one USB-UART in your application, you have another **USB-UART B** connector available on the board too. Both available USB-UART modules can operate at the same time, because they are routed to separate microcontroller pins.

USB-UART B communication is being done through a FT232RL controller, USB connector **[CN23]**, 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 selection is done using DIP switches **SW12.3** and **SW12.4**.

When using either USB-UART A or USB-UART B, make sure to disconnect all devices and additional boards that could interfere with the signals and possibly corrupt the sent or received data.



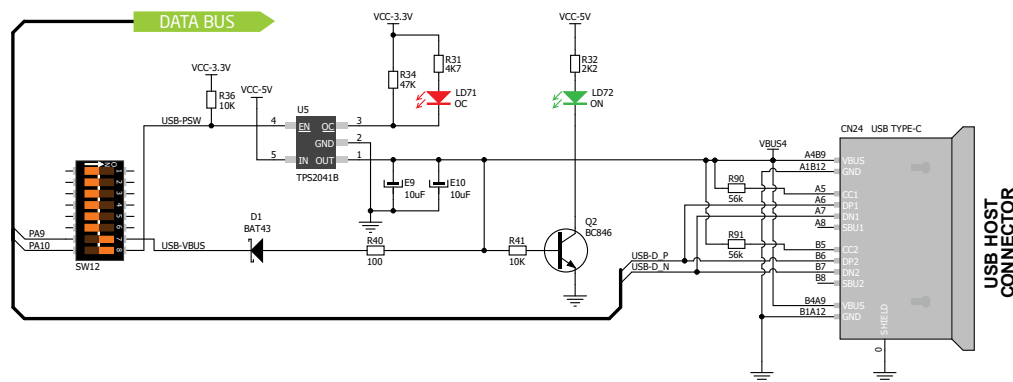
Enabling USB-UART B



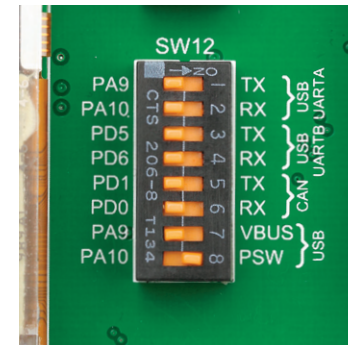
In order to enable USB-UART B communication, you must push **SW12.3** (PD5) and **SW12.4** (PD6) to **ON** position. This connects the **TX** and **RX** lines to **PD5** and **PD6** microcontroller pins and its UART module.

USB HOST 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. EasyMx PRO v7a contains USB HOST connector **(CN24)** for USB Standard Type C plug, which enables microcontrollers that support USB communication to establish a connection with the target device (eg. USB Keyboard, USB Mouse, etc). USB host also provides the necessary 5V power supply to the target via **TPS2041B** IC. Detection whether USB device is connected to HOST connector can be done through **VBUS** line. Connection of USB HOST **VBUS** line and **PA9** pin is established when **SW10.7** is on.



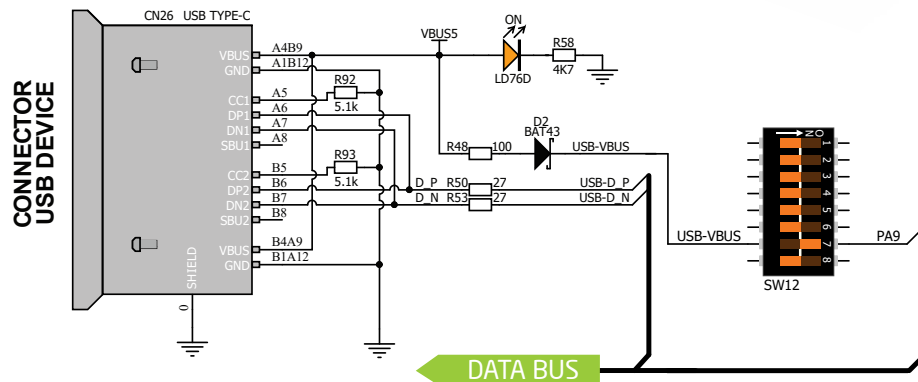
Powering USB device



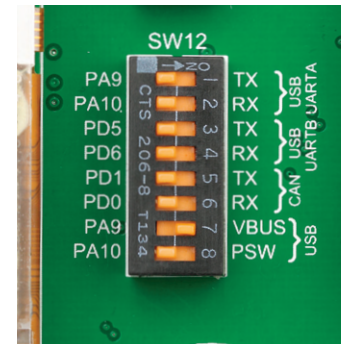
You can enable or disable power supply to USB device connected to HOST, through microcontroller **PA10** pin. In order to connect EN TPS2041B IC pin to microcontroller, you must push **SW10.8** to **ON** position.

USB device communication

EasyMx PRO v7a for also contains USB DEVICE connector **[CN26]** which enables microcontrollers that support USB communication to establish a connection with the target host (eg. PC, Laptop, etc.). It lets you build a slave USB device (HID, Composite, Generic, etc.). Connector supports USB Standard Type C plug. Detection whether USB device is connected to HOST can be done through **VBUS** line. This line is traced to microcontroller **PA9** pin. Connection of USB DEVICE **VCC** line and **PA9** pin is established when **SW12.7** DIP switch is in ON position. When connected to HOST, dedicated amber-colored power LED will light up as well. This VCC line cannot be used for powering the board. It's only used for detecting connection.



Detecting connection



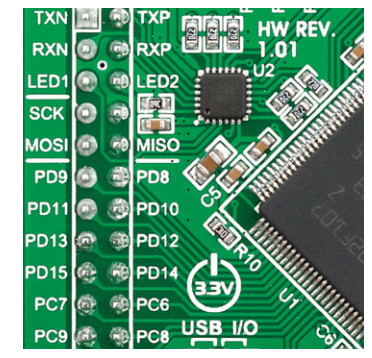
You can detect whether USB device is plugged into the USB device connector using **VBUS** power detection line (**PA9**). Before using this feature, you must connect **PA9** pin to USB connector using **SW12.7** DIP switch.



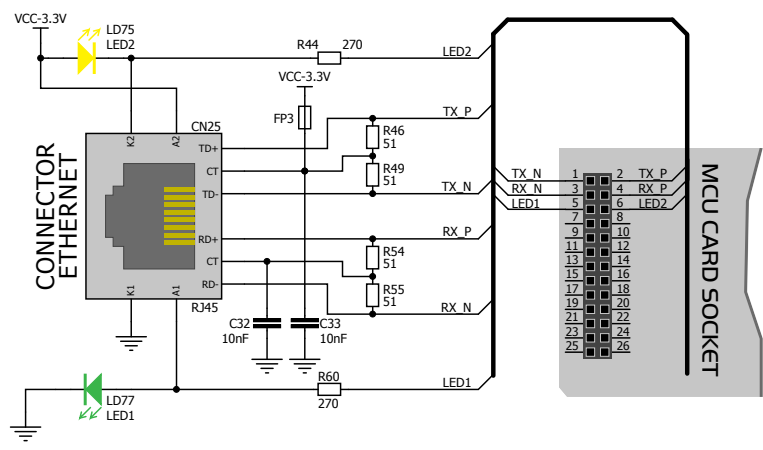
Ethernet communication

Ethernet MCU cards

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. EasyMx 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 directly to the MCU card socket and cannot be accessed via PORT headers. Additional signalization LEDs (green and yellow) are provided on the Board next to **RJ-45** connector.



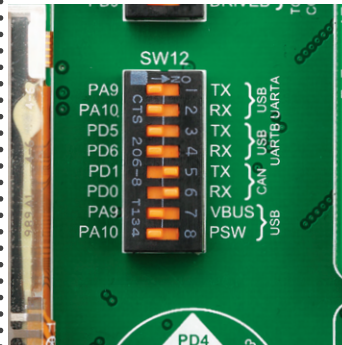
Ethernet communication (TPOUT+, TPOUT-, TPIN+ and TPIN-) and signalization lines (LED1, LED2) are routed directly to the MCU card socket and can be used only with a Ethernet MCU cards (ETH MCU, HP ETH MCU, **Page 11**).



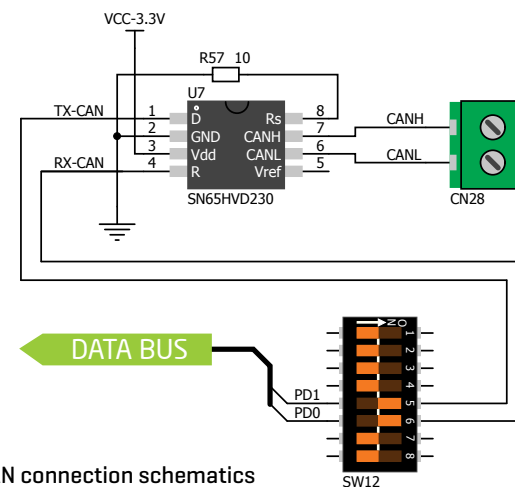
CAN communication

Controller Area Network [CAN or CAN bus] is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other within a vehicle without a host computer. CAN is a message-based protocol, designed specifically for automotive applications but now also used in other areas such as industrial automation and medical equipment. EasyMx PRO v7a is equipped with **SN65HVD230** - a 3.3V CAN Transceiver and a pair of screw terminals which provide microcontrollers with integrated CAN controller with the necessary physical interface for CAN communication. Make sure to correctly connect negative and positive differential communication lines before using this module.

Enabling CAN



In order to enable CAN communication, you must push **SW12.5** [PD1] and **SW12.6** [PD0] to **ON** position. This connects the **TX** and **RX** lines to appropriate microcontroller pins and its CAN module.

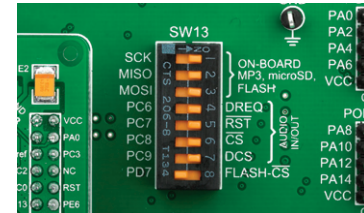


CAN connection schematics

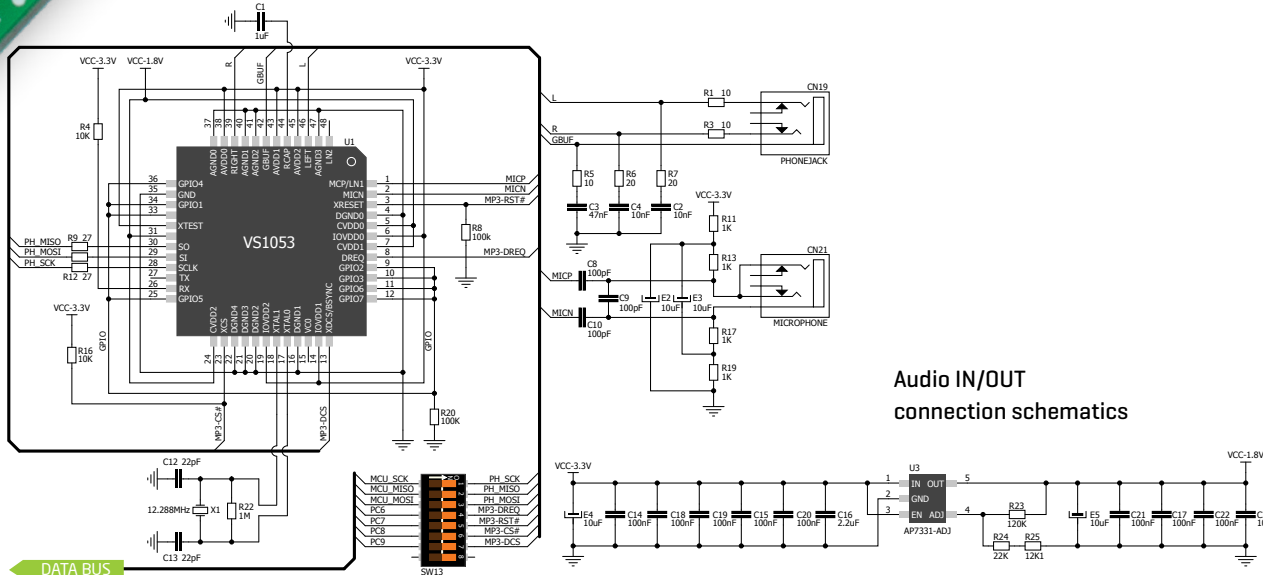
Audio I/O

It's hard to imagine modern multimedia devices without high quality audio reproduction modules. Sounds and music are almost as important as graphical user interfaces. Along with other multimedia modules, EasyMx PRO v7a contains high end stereo **VS1053** audio codec. It features Ogg Vorbis/MP3/AAC/WMA/FLAC/WAVMIDI **audio decoder**, as well as an PCM/IMA ADPCM/Ogg Vorbis **encoder** on a single chip. Board also contains **two stereo audio connectors** for interfacing with standard 3.5mm stereo audio jacks. VS1053 receives the input bit stream through a serial input bus, which it listens to as a system slave. The input stream is decoded and passed through a digital volume control to an 18-bit oversampling, multi-bit, sigma-delta Digital to Analog Converter [DAC]. The decoding is controlled via a serial control bus. In addition to the basic decoding, it is possible to add application specific features like DSP effects to the user RAM memory. You can build music players, audio recording devices, internet radio player applications, and much more.

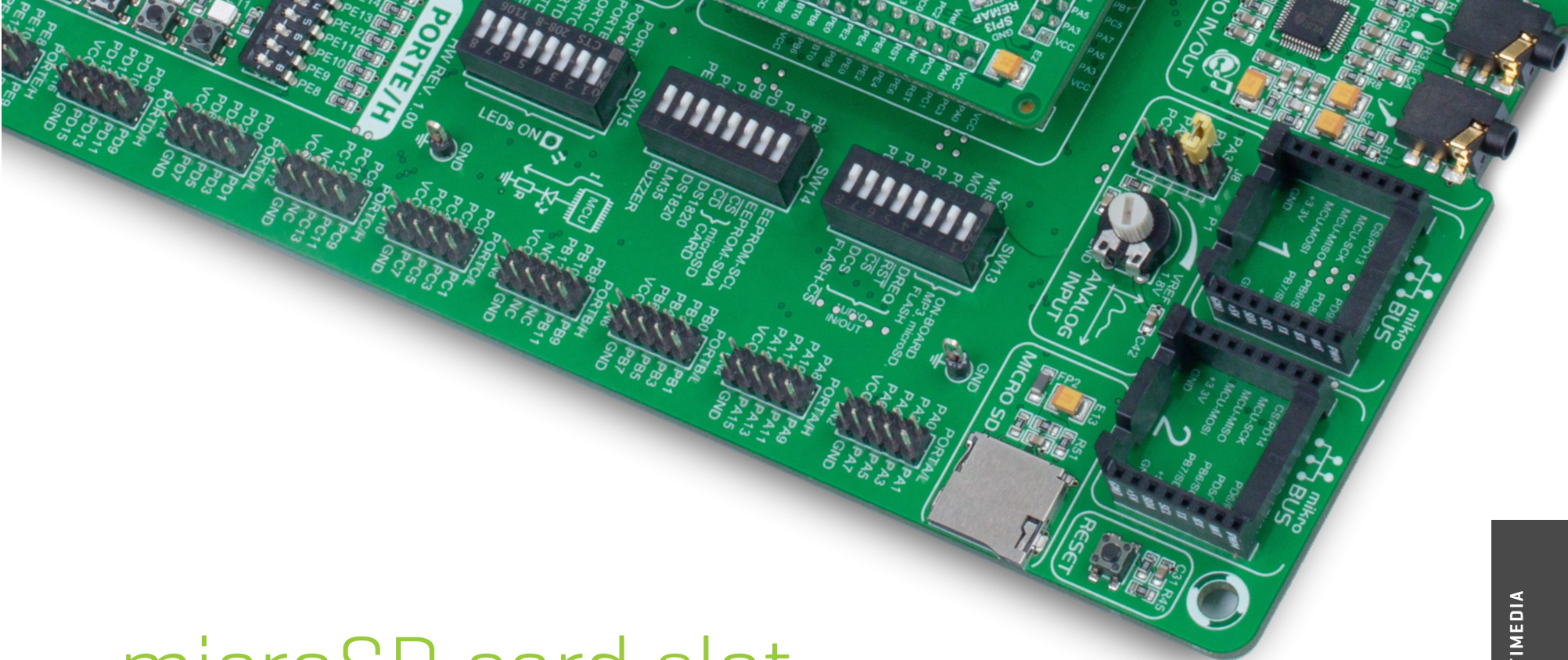
Enabling Audio I/O



In order to use Audio I/O module, you must connect data and Audio control lines of the microcontroller with the VS1053 audio codec. To do this, push **SW13.1-SW13.7** switches to **ON** position. This will connect SPI data lines with MCU_SCK, MCU_MISO and MCU_MOSI microcontroller pins, and audio control and chip select lines with PC6, PC7, PC8 and PC9 pins.



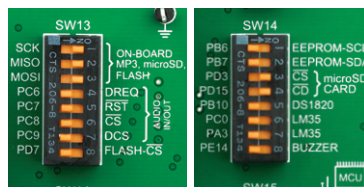
Audio IN/OUT connection schematics



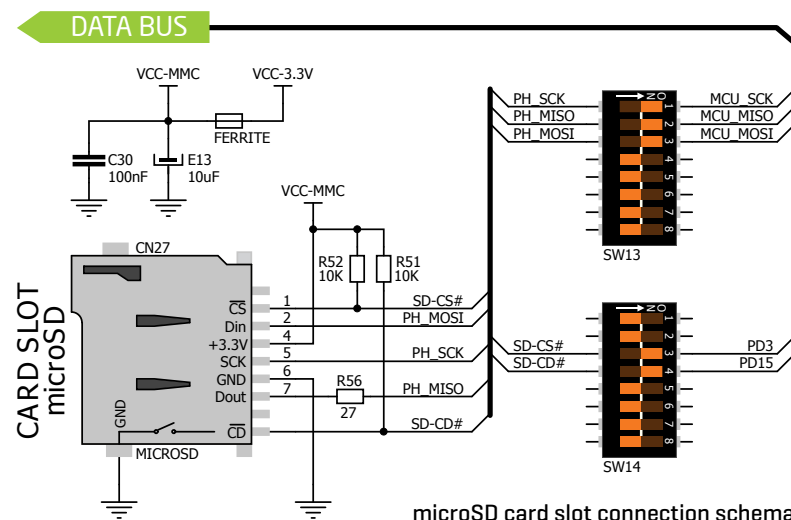
microSD card slot

Secure Digital [SD] is a non-volatile memory card format developed for use in portable devices. It comes in different packages and memory capacities. It is mostly used for storing large amounts of data. EasyMx PRO v7a features the **microSD card slot**. The microSD form factor is the smallest card format currently available. It uses standard SPI user interface with minimum additional electronics, mainly used for stabilizing communication lines which can be significantly distorted at high transfer rates. Special ferrite is also provided to compensate the voltage and current glitch that can occur when pushing-in and pushing-out microSD card into the socket.

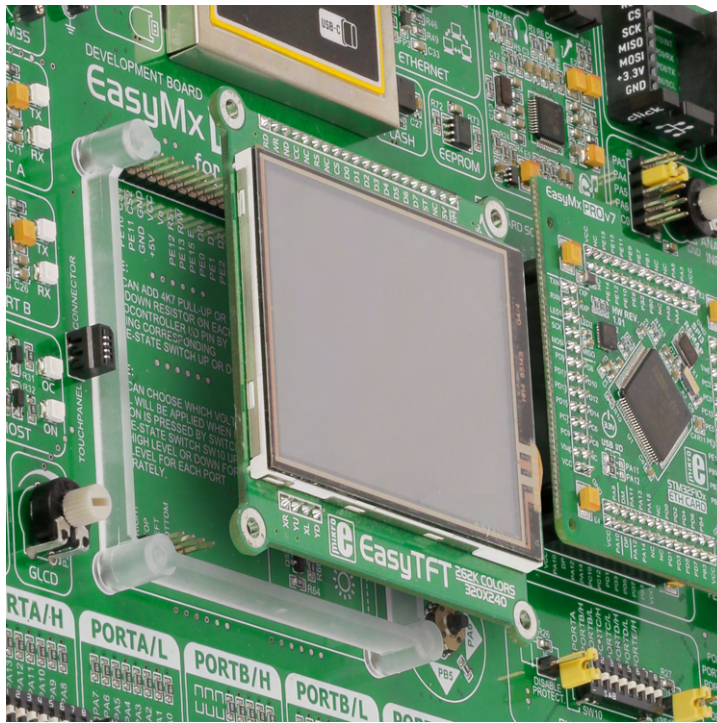
Enabling microSD



In order to access microSD card, you must enable SPI communication lines using **SW13.1 - SW13.3** DIP switches, as well as Chip Select [CS] and Card Detect [CD] lines using **SW14.3** and **SW14.4** switches.



microSD card slot connection schematics



TFT display 320x240 pixels

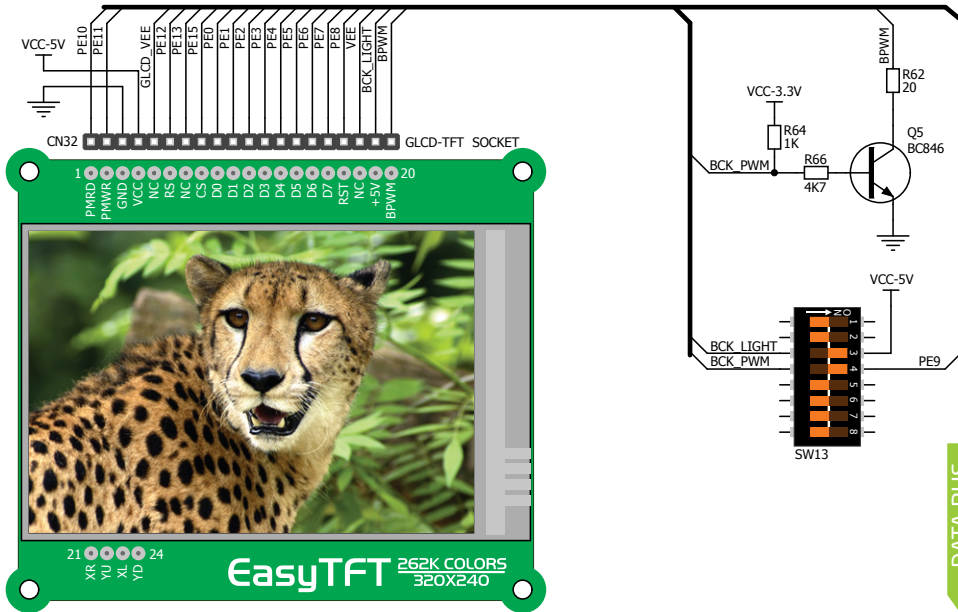
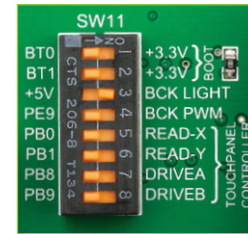
One of the most powerful ways of presenting data and interacting with users is through color displays and touch panel inputs. This is a crucial element of any multimedia device. EasyMx v7a features EasyTFT board carrying 320x240 pixel 2.83" color TFT display with LED back-light and **HX8347D** controller.

Each pixel is capable of showing 262,144 different colors. TFT display is connected to microcontroller PORTE using standard 8080 parallel 8-bit interface, with additional control lines. Board features back-light driver which besides standard mode can also be driven with PWM signal in order to regulate brightness in 0 to 100% range.

IMPORTANT:

*In order to use PWM back-light both **SW11.3** and **SW11.4** switches must be enabled at the same time.*

Driving Display Back-light

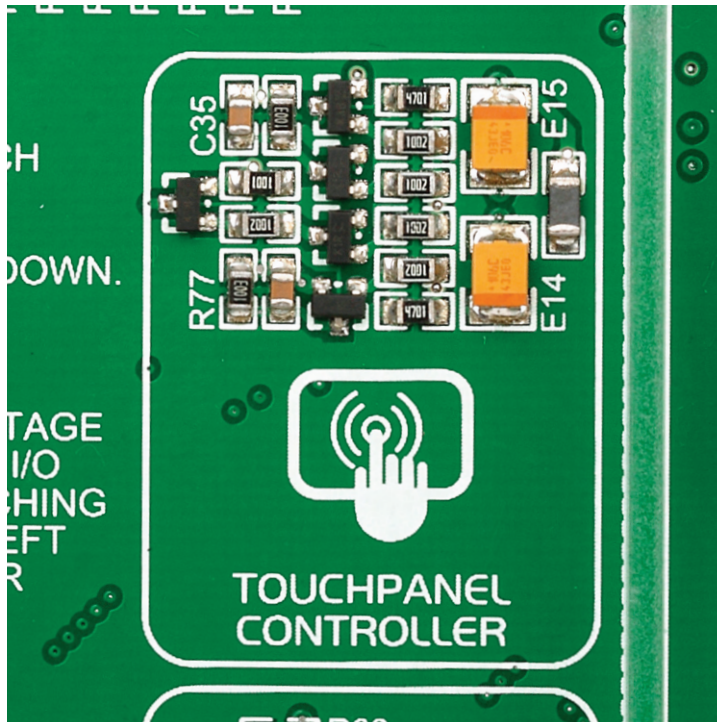


TFT display is enabled using **SW11.3** and **SW11.4** DIP switches. Back-light can be enabled in two different ways:

1. It can be **turned on with full brightness** using **SW11.3** 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 when both **SW11.3** and **SW11.4** switches are in ON position.

TOUCH PANEL CONTROLLER

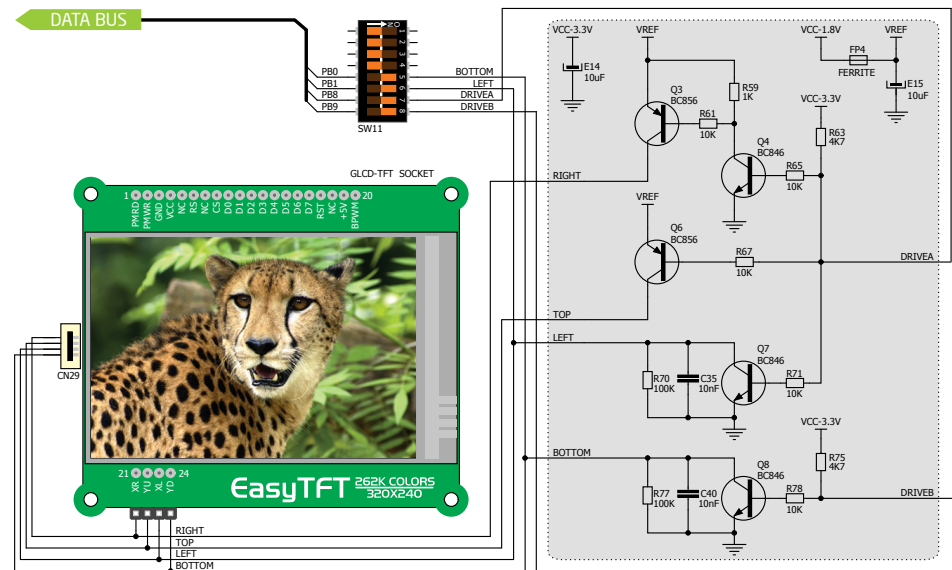
Touch panel is a glass panel whose surface is covered with two layers of resistive material. When the screen is pressed, the outer layer is pushed onto the inner layer and appropriate controllers can measure that pressure and pinpoint its location. This is how touch panels can be used as an input devices. EasyMx 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 TFT 320x240 display.

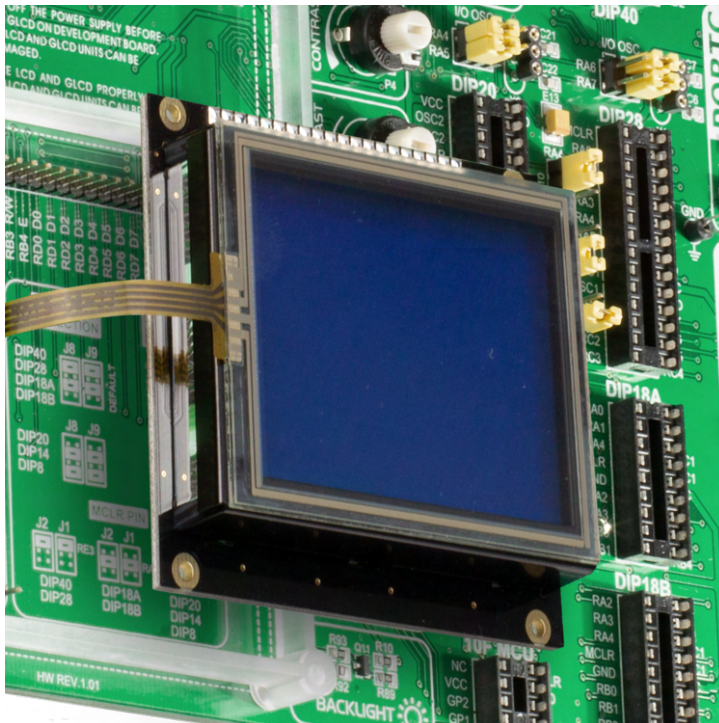


Enabling Touch panel



Touch panel is enabled using **SW11.5**, **SW11.6**, **SW11.7** and **SW11.8** switches. They connect **BOTTOM** and **LEFT** lines of the touch panel with **PB0** and **PB1** analog inputs, and **DRIVEA** and **DRIVEB** with **PB8** and **PB9** digital outputs on microcontroller sockets. Prior to using Touch panel in your application, make sure to disconnect other peripherals, LEDs and additional pull-up or pull-down resistors from the interface lines that could interfere with signals and cause data corruption.





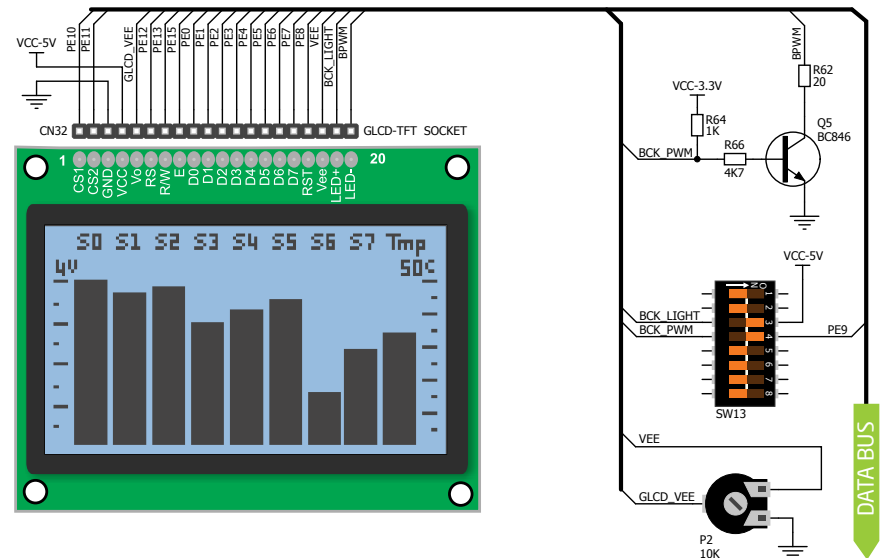
GLCD 128x64

Graphical Liquid Crystal Displays, or **GLCDs** are used to display monochromatic graphical content, such as text, images, human-machine interfaces and other content. EasyMx PRO 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 **CN32** display connector. Board is fitted with uniquely designed plastic display distancer, which allows the GLCD module to perfectly and firmly fit into place.

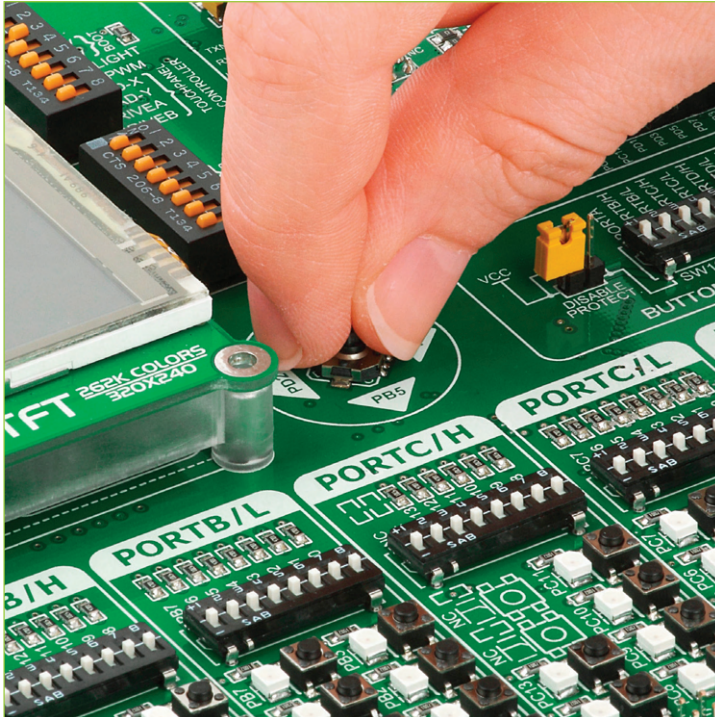
Display connector is routed to PORTE [control and data lines] of the microcontroller sockets. PORTE is also used by TFT display. You can control the display contrast using dedicated potentiometer P2. Full brightness display back-light can be enabled with SW11.3 switch, and PWM-driven back-light with SW11.4 switch.

Connector pinout explained

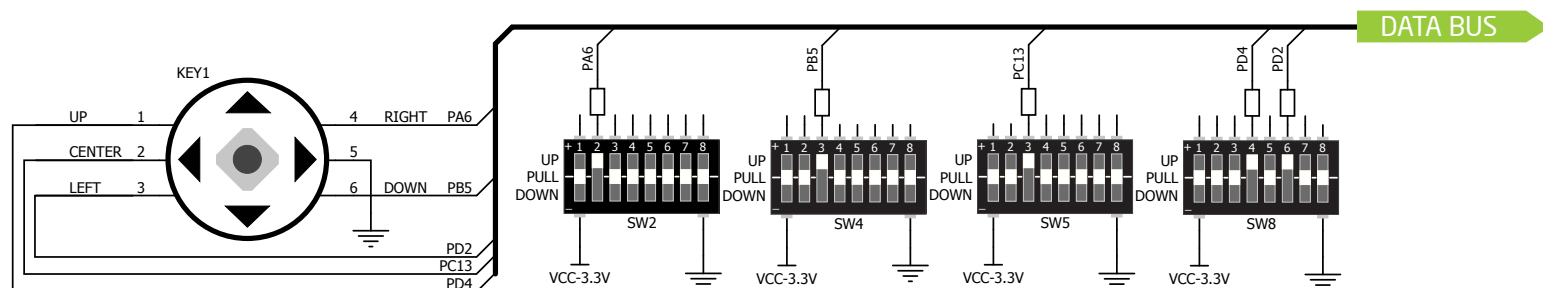
- CS1** and **CS2** - Controller Chip Select lines
- VCC** - +5V display power supply
- GND** - Reference ground
- Vo** - GLCD contrast level from potentiometer P3
- RS** - Data [High], Instruction [Low] selection line
- R/W** - Determines whether display is in Read or Write mode.
- E** - Display Enable 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



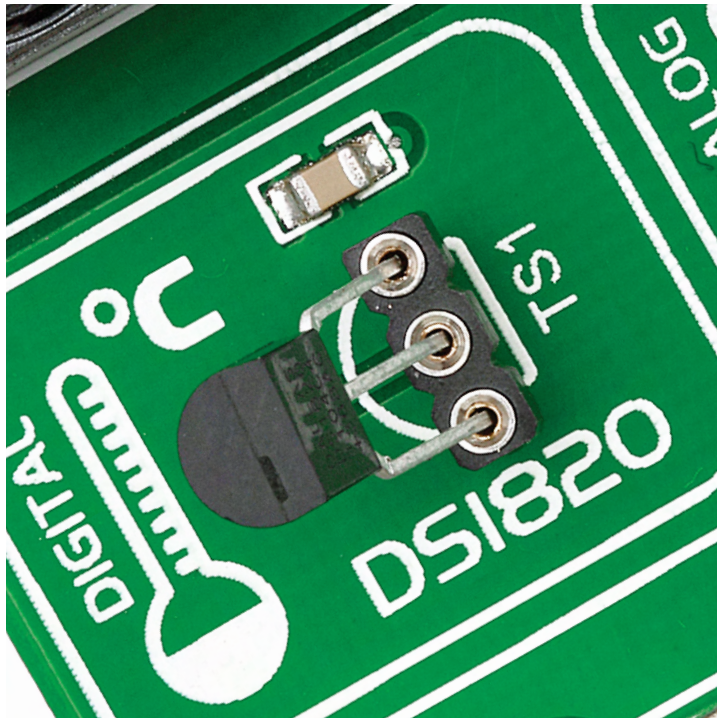
Navigation switch



When working with multimedia applications it is far more intuitive to use a single joystick than several different push buttons that are more far apart. This is more natural for users and they can browse through on-screen menus, or even play games much easier. EasyMx PRO v7a features navigation switch with five different positions: **Up**, **Down**, **Left**, **Right** and **Center**. Each of those acts as a button, and is connected to one of the following microcontroller pins: **PD4**, **PB5**, **PD2**, **PA6**, **PC13** [respectively]. Before using the navigation switch, it is necessary to pull-up mentioned microcontroller pins using tri-state DIP switches located in I/O groups. After pressing the navigation switch in desired direction, associated microcontroller pins are connected to GND, which can be detected in user software.



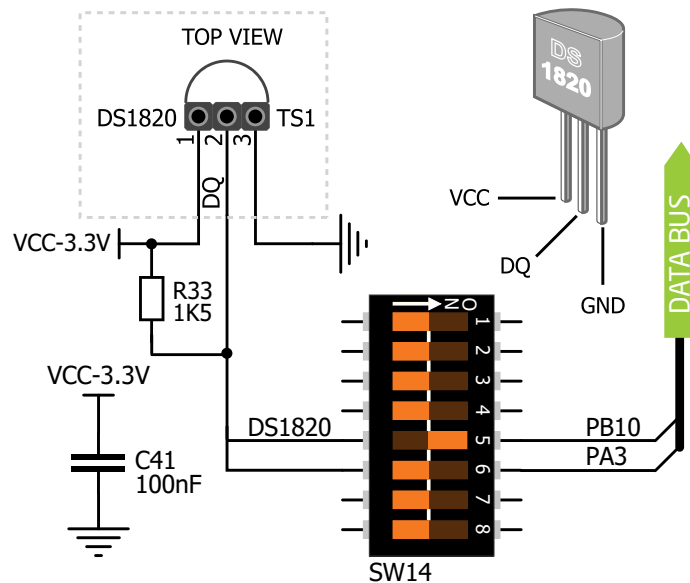
Navigation switch connection schematics. Pull-up resistors should be enabled during operation



DS1820 - DIGITAL TEMP. SENSOR

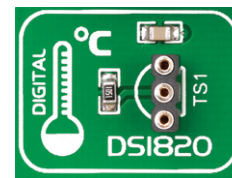
DS1820 is a digital temperature sensor that uses **1-wire® interface** for its operation. It is capable of measuring temperatures within the range of -55 to 128°C , and provides $\pm 0.5^{\circ}\text{C}$ accuracy for temperatures within the range of -10 to 85°C . It requires 3V to 5.5V power supply for stable operation. It takes maximum 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.

Board provides a separate socket [TS1] for the DS1820. Communication line with the microcontroller is established using SW14.5 or SW14.6 DIP switch [ON position].



DS1820 connected to PB10 pin schematic

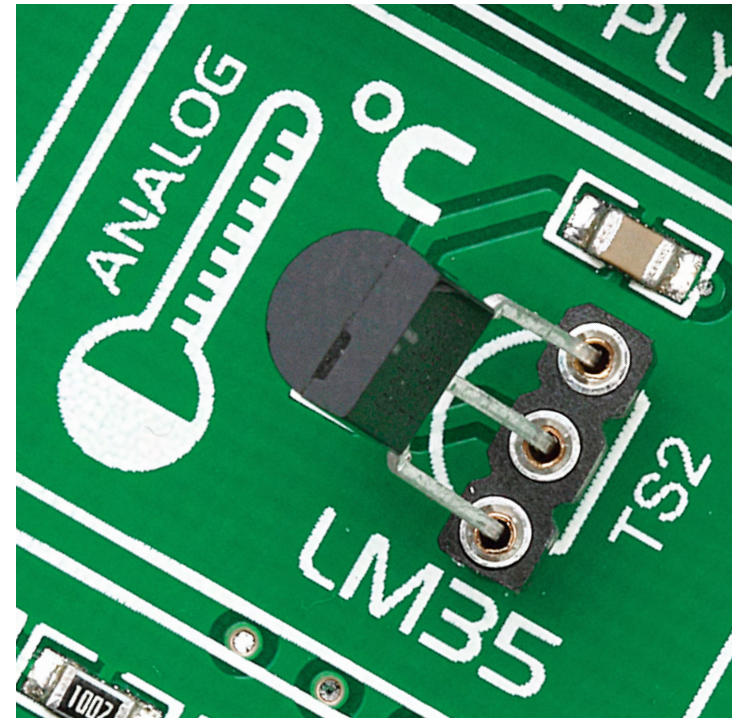
Enabling DS1820 sensor



EasyMx PRO v7a for STM32 enables you to establish 1-wire® communication between DS1820 and the microcontroller over PB10 or PA3 pin. The connection is done placing SW14.5 or SW14.6 DIP switch to ON position. 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 accidentally 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.

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 $+10.0 \text{ mV}/^\circ\text{C}$ scale factor and less than $60 \text{ }\mu\text{A}$ current drain. As it draws only $60 \text{ }\mu\text{A}$ from its supply, it has very low self-heating, less than 0.1°C in still air. EasyMx PRO v7a enables you to get analog readings from the LM35 sensor in restricted temperature range from $+2^\circ\text{C}$ to $+150^\circ\text{C}$. 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 DIP switch **SW14**. Switch connects the sensor with PC0 microcontroller pin.

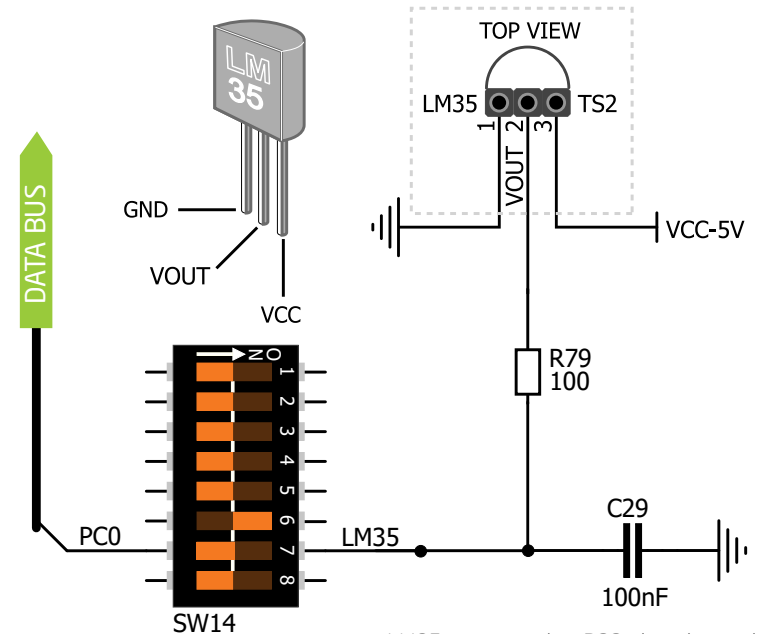


LM35 module view

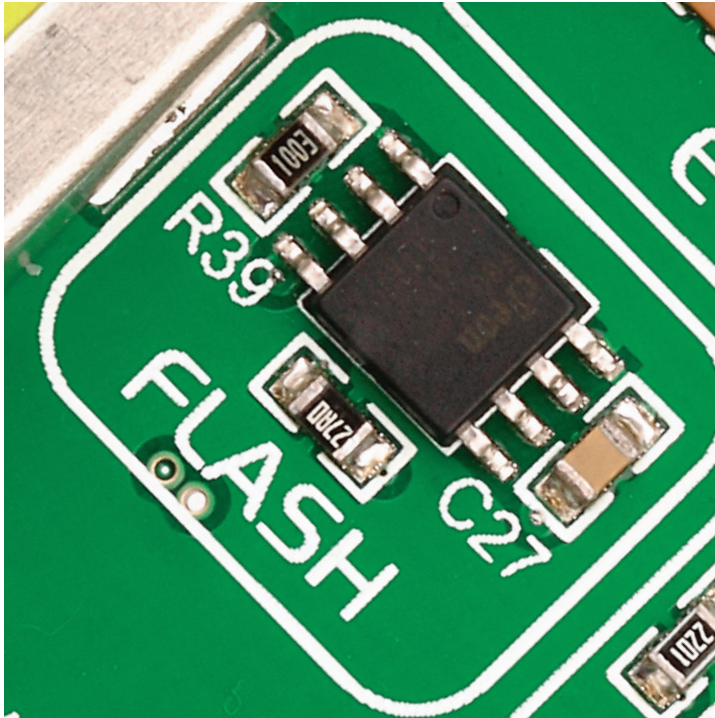
Enabling LM35 sensor



EasyMx PRO v7a for STM32 enables you to get analog readings from the LM35 sensor using PC0 microcontroller pin. The connection is done placing SW14.7 DIP switch to ON position. 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 accidentally 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.



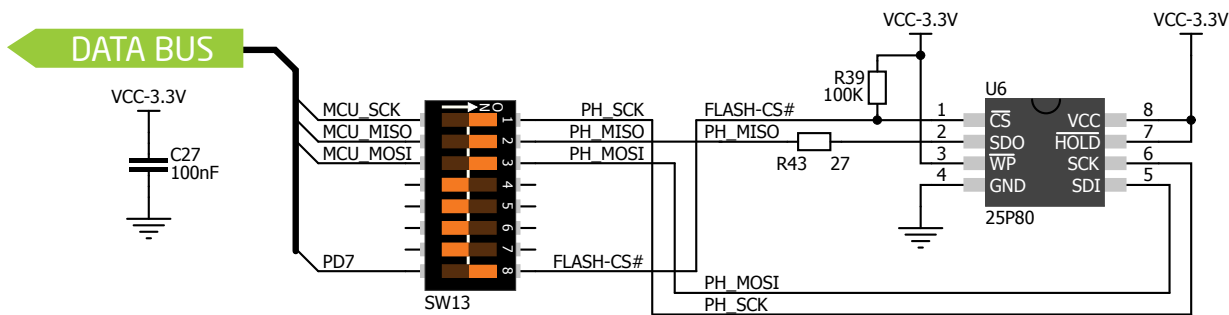
LM35 connected to PC0 pin schematic



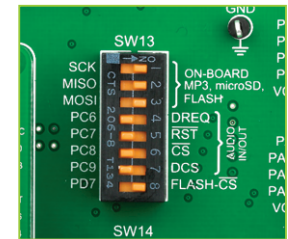
Serial FLASH memory

Flash memory is a non-volatile storage chip that can be electrically erased and reprogrammed. It was developed from EEPROM [electrically erasable programmable read-only memory] and must be erased in fairly large blocks before these can be rewritten with new data. The high density NAND type must also be programmed and read in [smaller] blocks, or pages, while the NOR type allows a single machine word [byte] to be written or read independently. Flash memories come in different sizes and supporting different clock speeds. They are mostly used for mass storage, as in USB Flash Drives, which are very popular today.

EasyMx PRO v7a features M25P80 Serial Flash Memory which uses SPI communication interface and has 8 Mbits of available memory, organized as 16 sectors, each containing 256 pages. Each page is 256 bytes wide. Thus, the whole memory can be viewed as consisting of 4096 pages, or 1,048,576 bytes. Maximum clock frequency for READ instructions is 40MHz.



Enabling Serial Flash



In order to connect Serial Flash Memory to the microcontroller you must enable **SW13.1**, **SW13.2**, **SW13.3** and **SW13.8** switches. This connects SPI lines to **MCU_MOSI**, **MCU_MISO**, **MCU_SCK** and **PD7** [CS] microcontroller pins.

I²C EEPROM

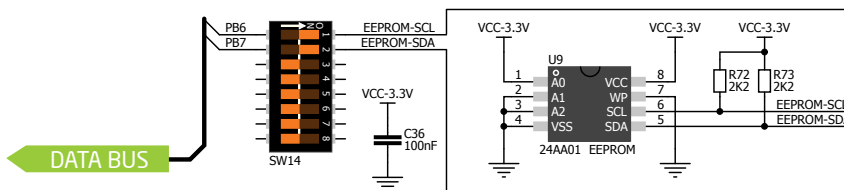
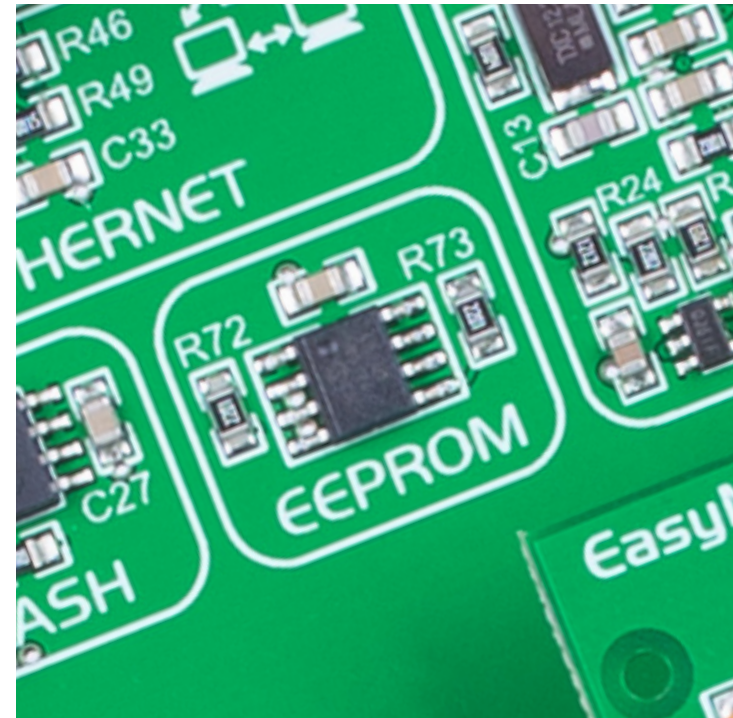
EEPROM is short for **Electrically Erasable Programmable Read Only Memory**. It is usually a secondary storage memory in devices containing data that is retained even if the device loses power supply. Because of the ability to alter single bytes of data, EEPROM devices are used to store personal preference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

EasyMx PRO v7a supports serial EEPROM which uses **I²C communication interface** and has **1024 bytes** of available memory. EEPROM itself supports single byte or 16-byte [page] write and read operations. Data rates are dependent of power supply voltage, and go up to **400 kHz** for 3.3V power supply. EEPROM address on I²C bus is **0xA2**

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.

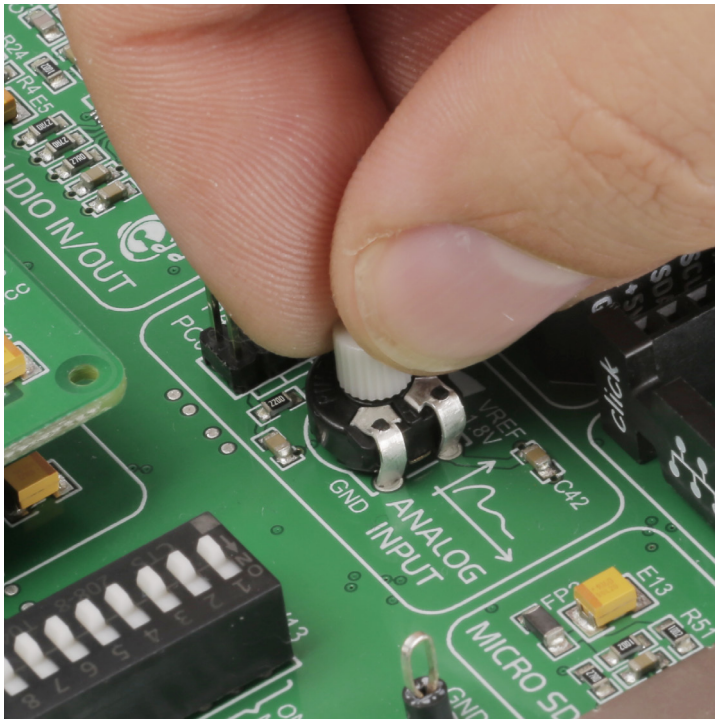
SCL line is driven by a master, while **SDA** is used as bidirectional line either by master or slave device. Up to 112 slave devices can be connected to the same bus. Each slave must have a unique address.



Enabling I²C EEPROM

In order to connect I²C EEPROM to the microcontroller you must enable **SW14.1** and **SW14.2** switches, as shown on **Figure 23-2**. **4K7** 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 **PB6** and **PB7** communication lines that could interfere with the data signals and cause data corruption.

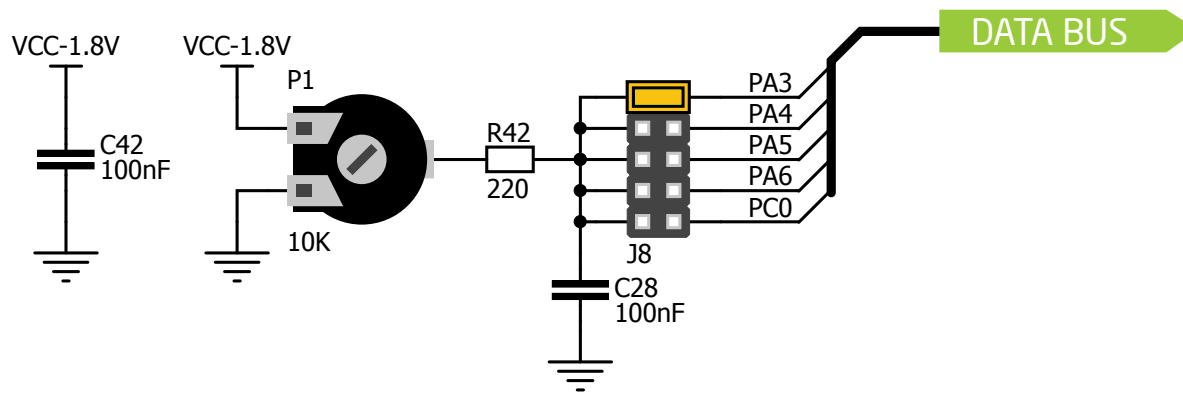
ADC INPUTS



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. Most microcontrollers have 10-bit resolution, meaning that maximum value of conversion can be represented with 10 bits, which converted to integer is $2^{10}=1024$. This means that supported voltage range, for example from 0-1.8V, can be divided into 1024 discrete steps of about 1.758mV. EasyMx PRO v7a provides an interface in form of potentiometer for simulating analog input voltages that can be routed to any of the 5 supported analog input pins..

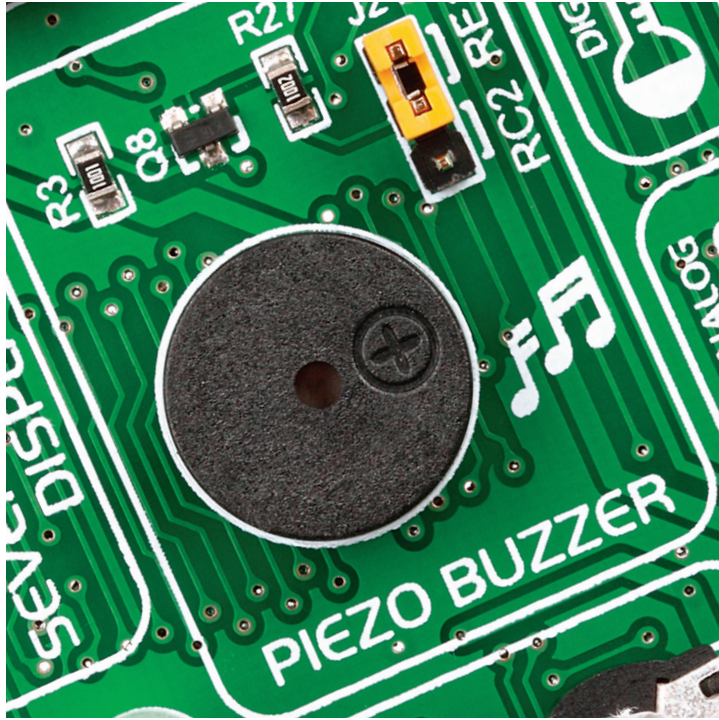


ADC input schematic

Enabling ADC inputs



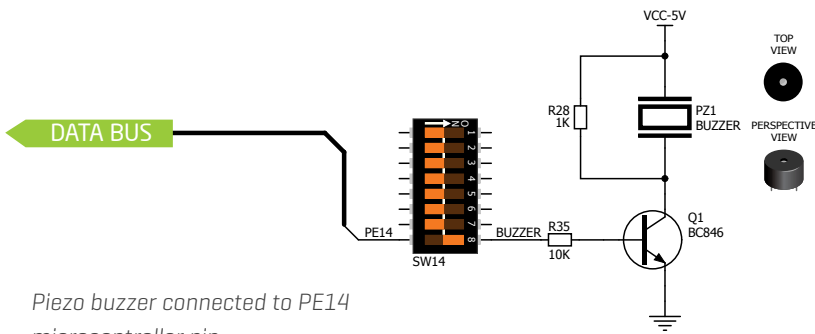
In order to connect the output of the potentiometer **P1** to **PA3**, **PA4**, **PA5**, **PA6** or **PC0** analog microcontroller inputs, you have to place the jumper **J8** in the desired position. By moving the potentiometer knob, you can create voltages in range from **GND** to **VCC**.



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 piezo electric 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. EasyMx PRO v7a f comes with piezo buzzer which can be connected to **PE14** microcontroller pin. Connection is established using **SW14.8** DIP switch. Buzzer is driven by transistor **Q1**. 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.

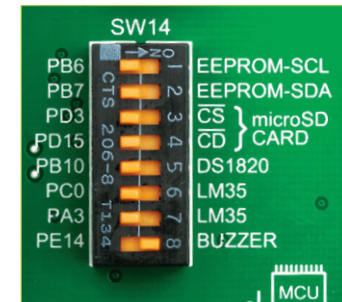


Piezo buzzer connected to PE14 microcontroller pin

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 **SW14.8** DIP switch which connects it to **PE14** pin.

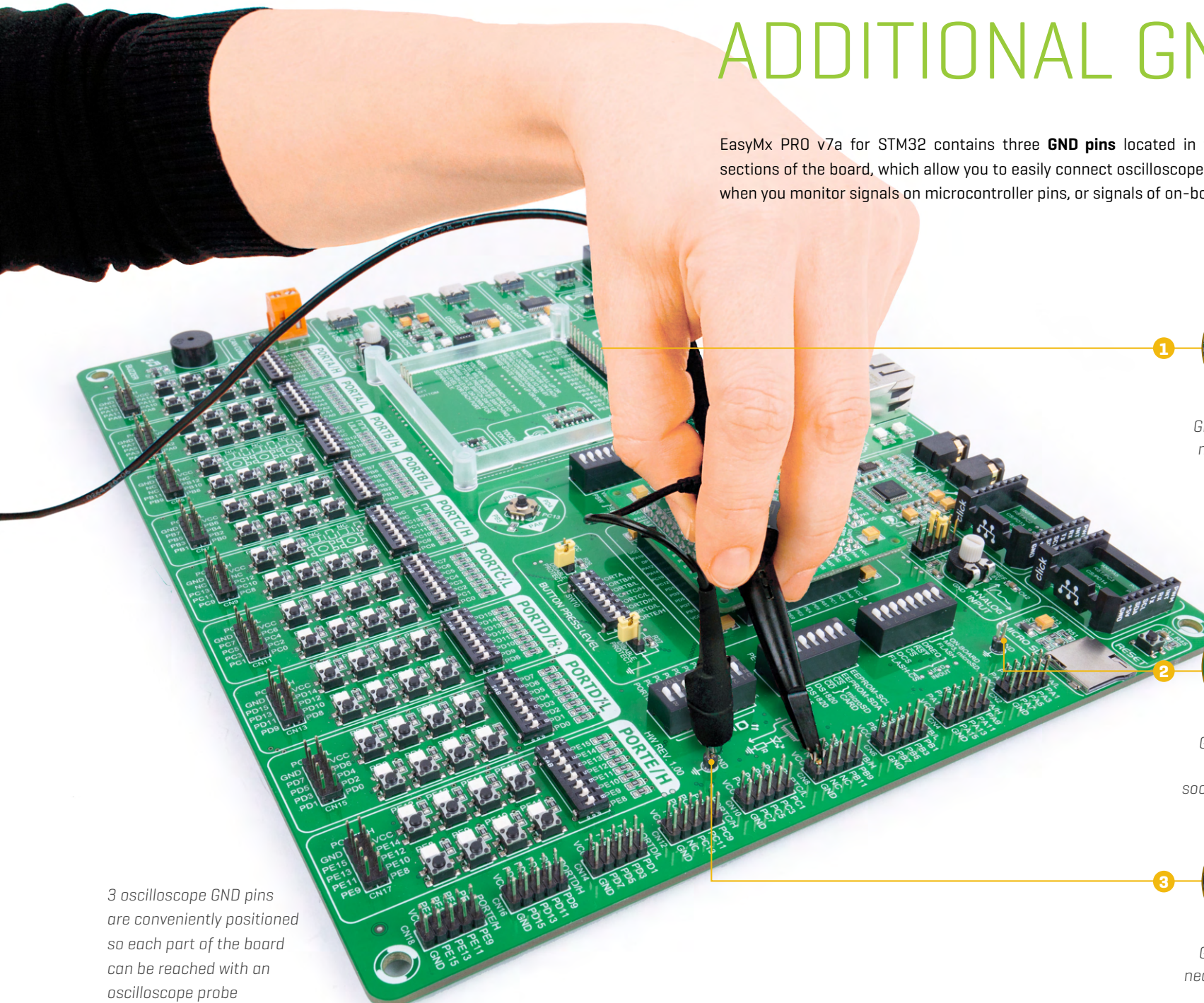
HOW TO MAKE IT SING?

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.



ADDITIONAL GNDs

EasyMx PRO v7a for STM32 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 4 digit 7-seg display

2



GND pin located near the DIP28 socket and PORTD

3



GND pin located near the DIP8 and DIP18B socket

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 EasyMx PRO v7a for STM32 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 ARM, mikroBASIC PRO for ARM and mikroPASCAL PRO for ARM, offering a complete rapid embedded development solution for these 3 major programming languages.

www.mikroe.com/compilers/compilers-arm

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**

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

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 EasyMx PRO v7a for STM32 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.

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

All the products owned by MikroElektronika are protected by copyright law and international copyright treaty. Therefore, this manual is to be treated as any other copyright material. No part of this manual, including product and software described herein, must be reproduced, stored in a retrieval board, translated or transmitted in any form or by any means, without the prior written permission of MikroElektronika. The manual PDF edition can be printed for private or local use, but not for distribution. Any modification of this manual is prohibited.

MikroElektronika provides this manual 'as is' without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties or conditions of merchantability or fitness for a particular purpose.

MikroElektronika shall assume no responsibility or liability for any errors, omissions and inaccuracies that may appear in this manual. In no event shall MikroElektronika, its directors, officers, employees or distributors be liable for any indirect, specific, incidental or consequential damages [including damages for loss of business profits and business information, business interruption or any other pecuniary loss] arising out of the use of this manual or product, even if MikroElektronika has been advised of the possibility of such damages. MikroElektronika reserves the right to change information contained in this manual at any time without prior notice, if necessary.

HIGH RISK ACTIVITIES

The products of MikroElektronika are not fault – tolerant nor designed, manufactured or intended for use or resale as on – line control equipment in hazardous environments requiring fail – safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication boards, air traffic control, direct life support machines or weapons systems in which the failure of Software could lead directly to death, personal injury or severe physical or environmental damage ['High Risk Activities']. MikroElektronika and its suppliers specifically disclaim any expressed or implied warranty of fitness for High Risk Activities.

TRADEMARKS

The MikroElektronika name and logo, the MikroElektronika logo, mikroC, mikroBasic, mikroPascal, mikroProg, mikromedia, EasyPIC, Click boards™ and mikroBUS™ are trademarks of MikroElektronika. All other trademarks mentioned herein are property of their respective companies.

All other product and corporate names appearing in this manual may or may not be registered trademarks or copyrights of their respective companies, and are only used for identification or explanation and to the owners' benefit, with no intent to infringe.

Copyright © MikroElektronika, 2022. All Rights Reserved.

MIKROE

Time-saving embedded tools

If you want to learn more about our products, please visit our website at www.mikroe.com

If you are experiencing some problems with any of our products or just need additional information, please place your ticket at www.mikroe.com/support

If you have any questions, comments or business proposals, please contact us at office@mikroe.com