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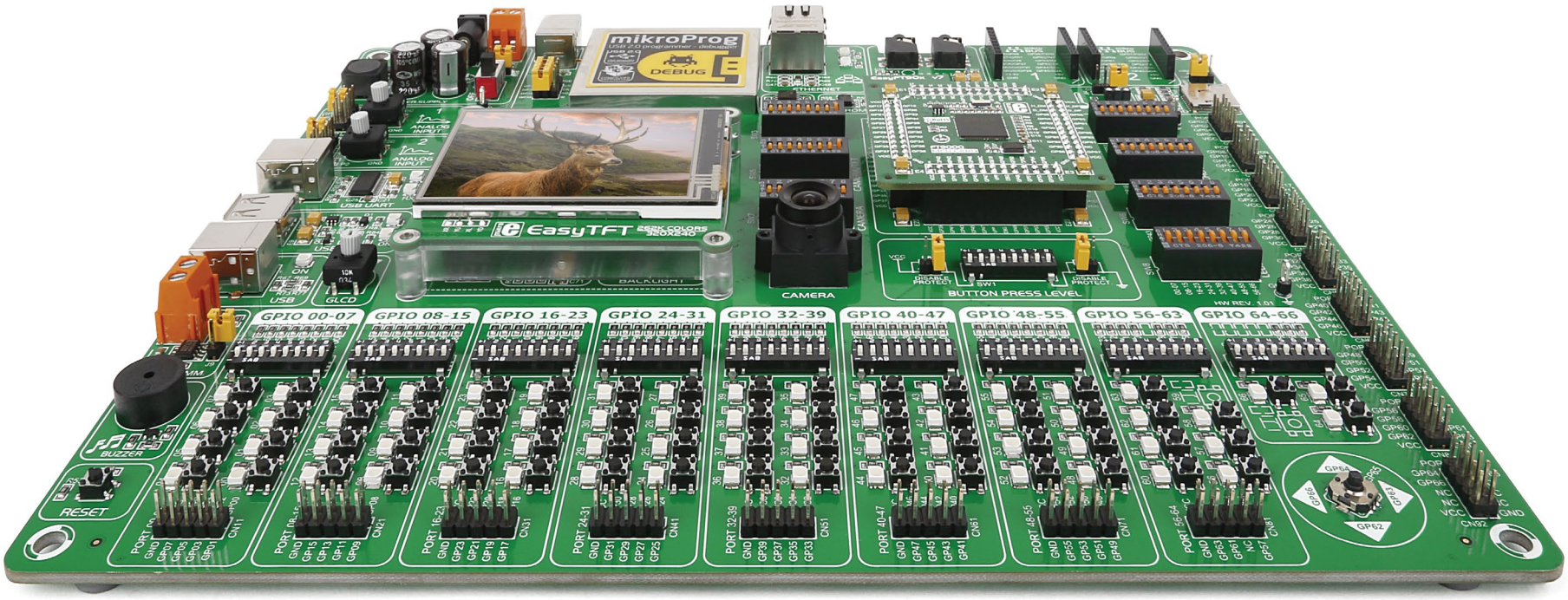
EasyFT90x v7



CMOS image sensor
Onboard camera

Many on-board modules
Multimedia peripherals

Easy-add extra boards
mikroBUS™ sockets

Two connectors for each port
Amazing connectivity

Fast USB 2.0 programmer and
In-circuit debugger

MikroElektronika
DEVELOPMENT TOOLS | COMPILERS | BOOKS

To our valued customers

EasyFT90x v7 is our first development board for FT90x, a new and exciting 32-bit MCU architecture from FTDI Chip. We put all our expertise into designing it. Our team relied on tried and tested concepts that define our range of “Easy” boards, but we also incorporated innovations that utilize some standout features specific to FT90x.

You made the right choice. But the fun has only just begun!

Nebojsa Matic,
Owner and General Manager
of MikroElektronika

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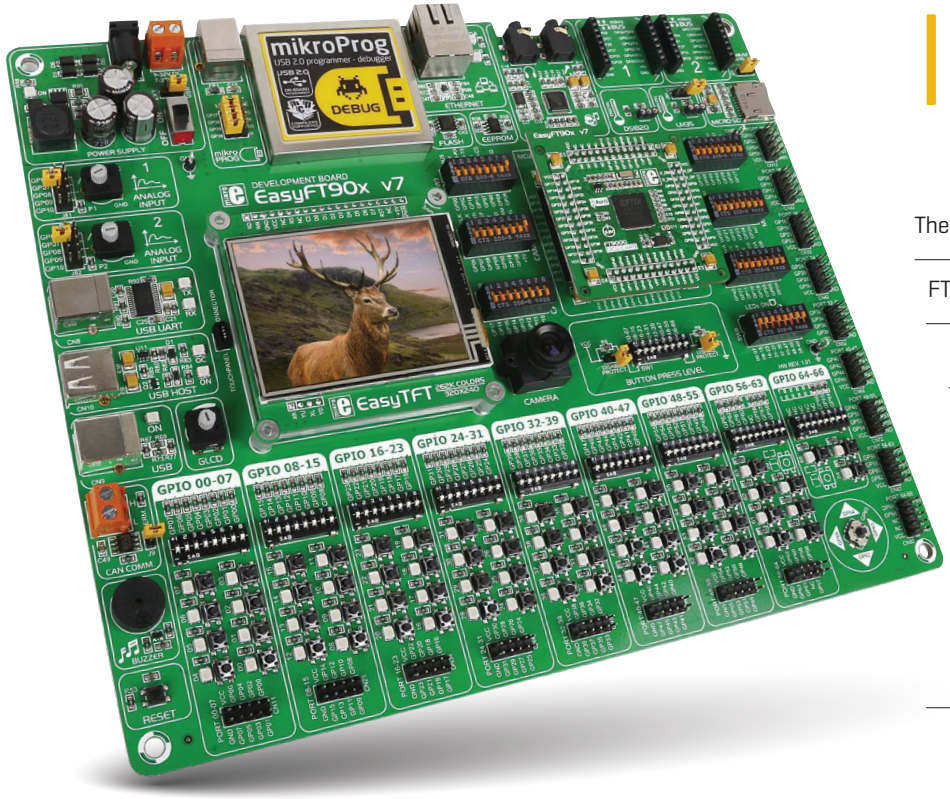


Introduction

The FT90x family of MCUs is based on FTDI Chip's proprietary 32-bit RISC core called FT32. The most exciting feature of this new architecture is its ability to execute instructions from Shadow RAM. This enables FT90x MCUs to operate at zero wait states at up to 100Mhz, which translates to 310DMIPS. Performance-wise, this places FT90x high above many MCUs with similar clock rates. The high speed also made it possible to integrate a camera interface into FT90x.

Taking advantage of that feature, EasyFT90x is our first "Easy" boards that incorporates a camera along with all other modules and connectors.

EasyFT90x v7 development Team

Supporting video

Onboard camera

EasyFT90x is the first of our development boards with a camera, taking advantage of the camera interface of FT90x MCUs. The board also boasts a multitude of other multimedia features.

Everything is already here

mikroProg™ on board

Powerful on-board mikroProg™ programmer and In-Circuit debugger supports all existing FT90x MCUs. It features fast enhanced programming and rich set of debugging instructions.

Two connectors for each port

Amazing connectivity

EasyFT90x v7 is all about connectivity. Having two different connectors for each port, you can connect accessory boards, sensors and your custom electronics easier then ever before.

For easier connections

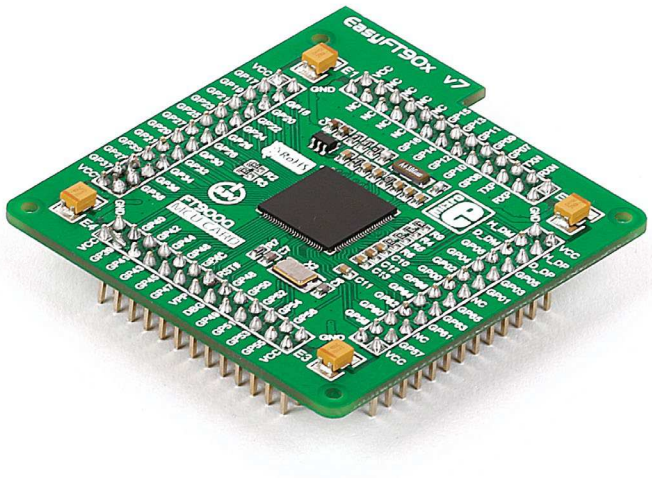
mikroBUS™ support

This innovative socket allows you to use dozens of click add-on boards with almost no hardware adjustments. Adding new functionality to your device was never so easy.

It's good to know

FT900 - default microcontroller

FT900 is the default chip of EasyFT90 v7. It operates at a 100MHz, has 256K bytes of program/shadow memory, 64K bytes of data memory, a parallel camera interface, USB2.0 Hi-Speed (480Mbps) host controller with BCD emulation, I²S master/slave interface (24.57/22.57MHz), 65 General purpose I/O pins, 4x16-bit timers with prescale and watchdog funtion, two 10 bit DACs, 2 programmable UARTs, 7xpwm, master/slave I²C, one master and two slave SPI, and 2xCAN controllers.



- *Great choice for both beginners and professionals*
- *Rich with modules*
- *Comes with examples for mikroC, mikroBasic and mikroPascal compilers*

System specification

power supply
7–23V AC or 9–32V DC
or via USB cable (5V DC)

power consumption
~72-80mA when all peripheral modules are disconnected

board dimensions
266 x 220mm
(10.47 x 8.66 inch)

weight
~500g
(1.1 lbs)

Package contains

1. Damage resistant protective box

2. EasyFT90x v7 board in antistatic bag

3. USB cable

4. User manual and board schematics

Power supply

The board contains a 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 (CN7)**, using external adapters via adapter connector **(CN34)** or additional screw terminals **(CN35)**. External adapter voltage levels must be in range of **9-32V DC and 7-23V AC**. Use jumper **J1** to specify which power source you are using. Upon providing the power using either external adapters or USB power source you can turn on the power with **SWITCH 1 (Figure 3-1)**. Power **LED ON** indicates the presence of a power supply.

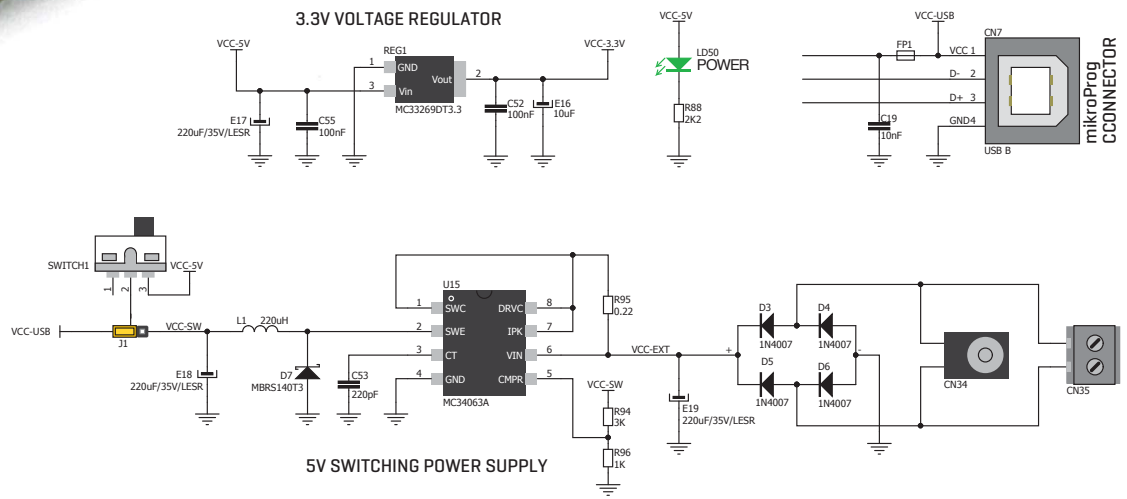


Figure 3-2: Power supply unit schematic

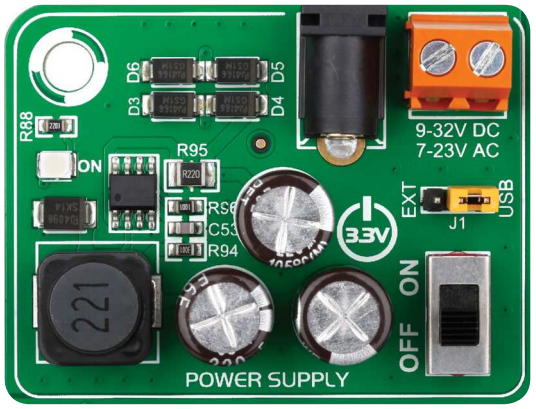


Figure 3-1: Power supply unit of EasyFT90x v7

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)

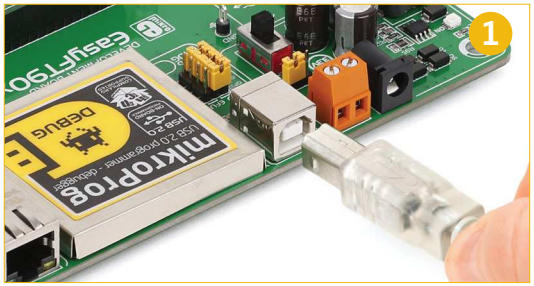
Power capacity: up to 500mA with USB, and up to 1500mA with external power supply

How to power the board?

1. With USB cable

Set J1 jumper to USB position

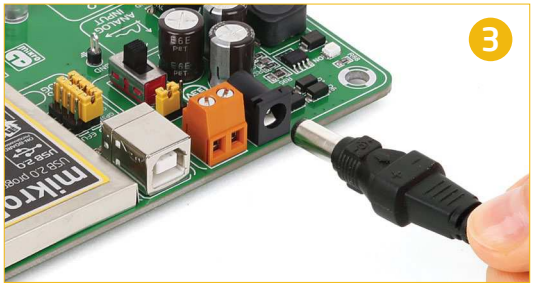
To power the board with a USB cable, place jumper **J**1 in USB position. You can then plug in the USB cable as shown on images 1 and 2, and turn the power switch ON.

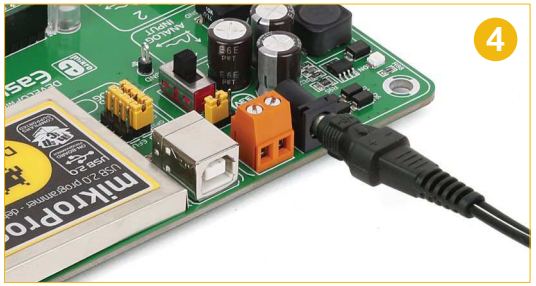


2. Using adapter

Set J1 jumper to EXT position

To power the board via adapter connector, place jumper **J1** in EXT position. You can then plug in the adapter cable as shown on images 3 and 4, and turn the power switch ON.

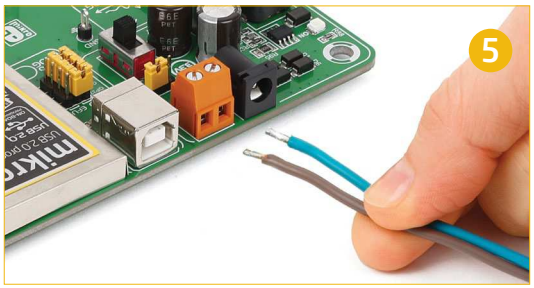


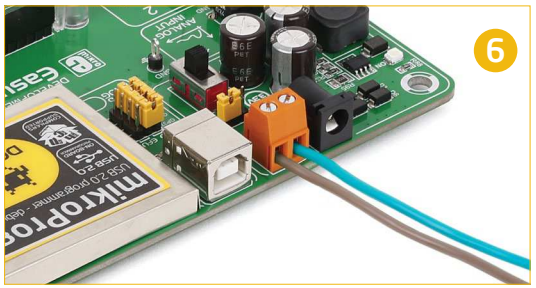


3. With laboratory power supply

Set J1 jumper to EXT position

To power the board using screw terminals, place jumper **J1** in EXT position. You can then screw-on the cables in the screw terminals as shown on images 5 and 6, and turn the power switch ON.

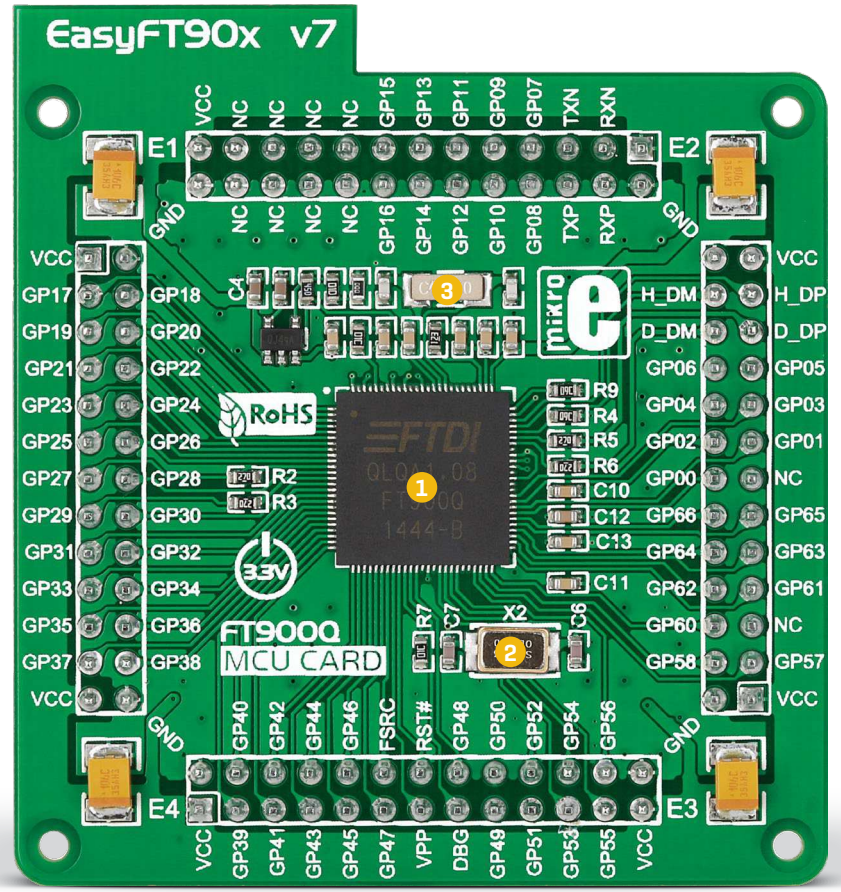




MCU cards

Microcontrollers are supported using specialized MCU cards containing 104 pin, which are placed into the on-board female MCU socket (Figure 4.1). The default card contains the FT900 microcontroller with on-chip peripherals. After testing and building the final program on the development board, this card can also be taken out of the socket and used in your final device.

Figure 4-1: MCU card with FT900



1. FT900 has 100MHz maximum frequency, 256KB of Flash, 64KB of on-chip data memory and 256KB of Shadow program memory. It has an integrated Parallel Camera Interface, Ethernet, USB (Host, Device), 65 General purpose I/O pins, 4 x 16-bit timers with 32-bit watchdog function, 7 Analog Input pins (ADC), 2 UARTs, I^2S master/slave interface, internal slow clock oscillator, 2 x I^2C (master/slave), SPI (master/slave) and 2xCAN controllers, and a debug interface.

2. 12MHz crystal oscillator. We carefully chose the most convenient crystal value that provides clock frequency for the PLL multipliers.

3. MCU card also contains 32.768 kHz crystal oscillator which provides external clock waveform for the internal RTCC module.

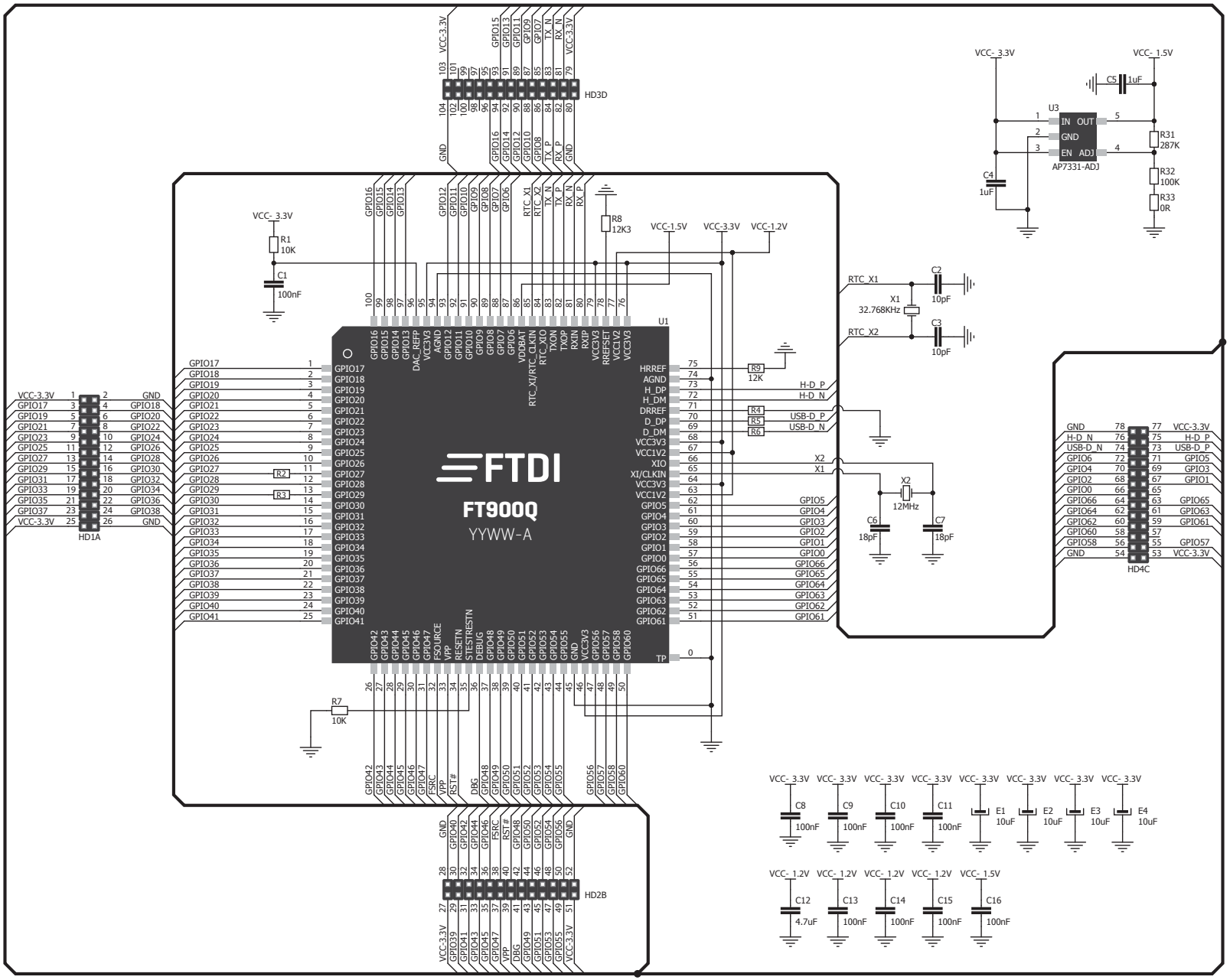


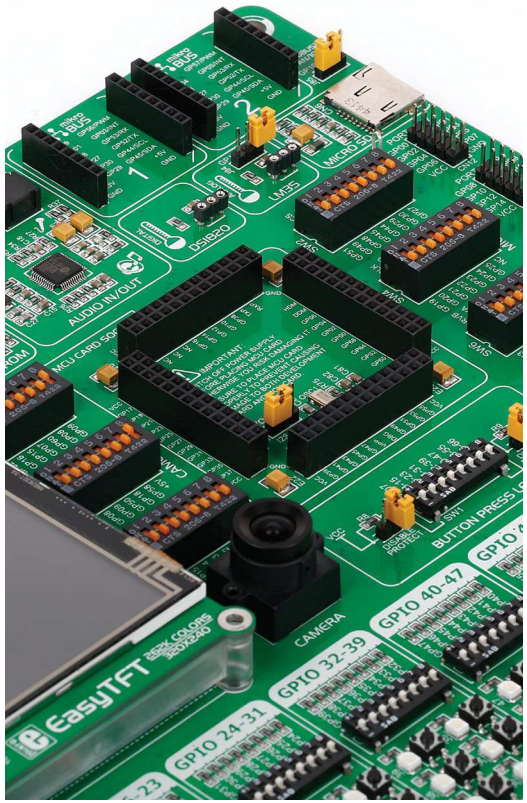
Figure 4-2: MCU card schematic

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 MCU card. First make sure that MCU card orientation matches the silkscreen outline on the EasyFT90x v7 board MCU socket. Place the MCU card over the socket so each male header is properly aligned with the female socket as shown in **Figure 4-4**. 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 4-5**. If done correctly all pins should be fully inserted. Only now can you turn on the power supply.

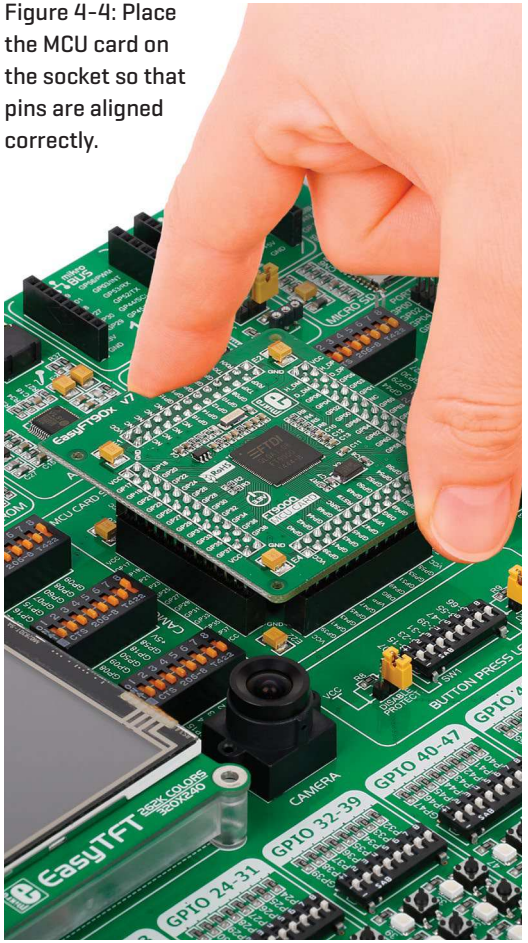
1

Figure 4-3: On-board MCU socket has silkscreen markings which will help you to correctly orient the MCU card before inserting.



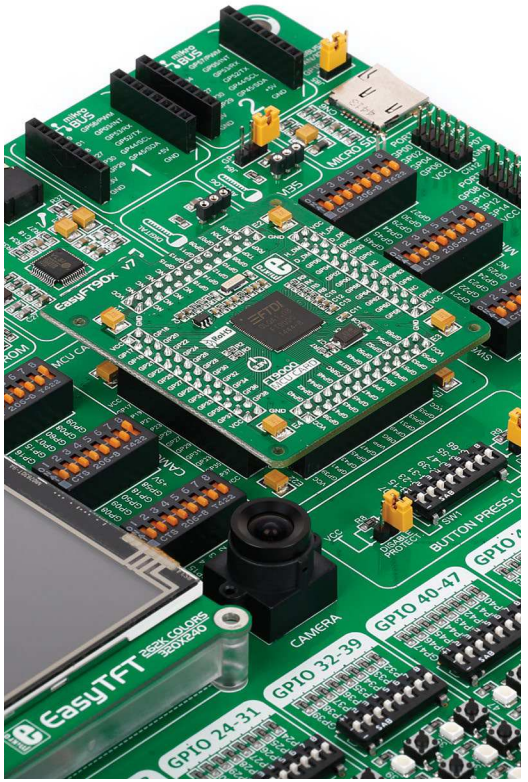
2

Figure 4-4: Place the MCU card on the socket so that pins are aligned correctly.



3

Figure 4-5 Properly placed MCU card.



On-board programmer

What is mikroProg™?

mikroProg™ is a fast programmer and debugger for FT90x devices, the first of its kind. The programmer supports all currently available FT90x devices. It also features a powerful debugger which will be of great help in your development. Outstanding performance and easy operation are among it's top features.

How do I start?

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

1. Install the necessary software

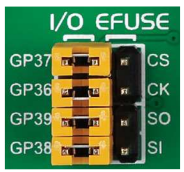
- Install programmer drivers
- Install mikroProg Suite™ for FT90x software

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

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

mikroProg™ or eFUSE

In addition to mikroProg™, EasyFT90x allows eFUSE programming. eFUSE permanently programs the chip, disabling further altercations. eFUSE is chiefly used when the microcontroller is to be installed in a final device, for security reasons. To enable this method of programming, switch the four jumpers under the mikroPROG™ USB port into the EFUSE position.



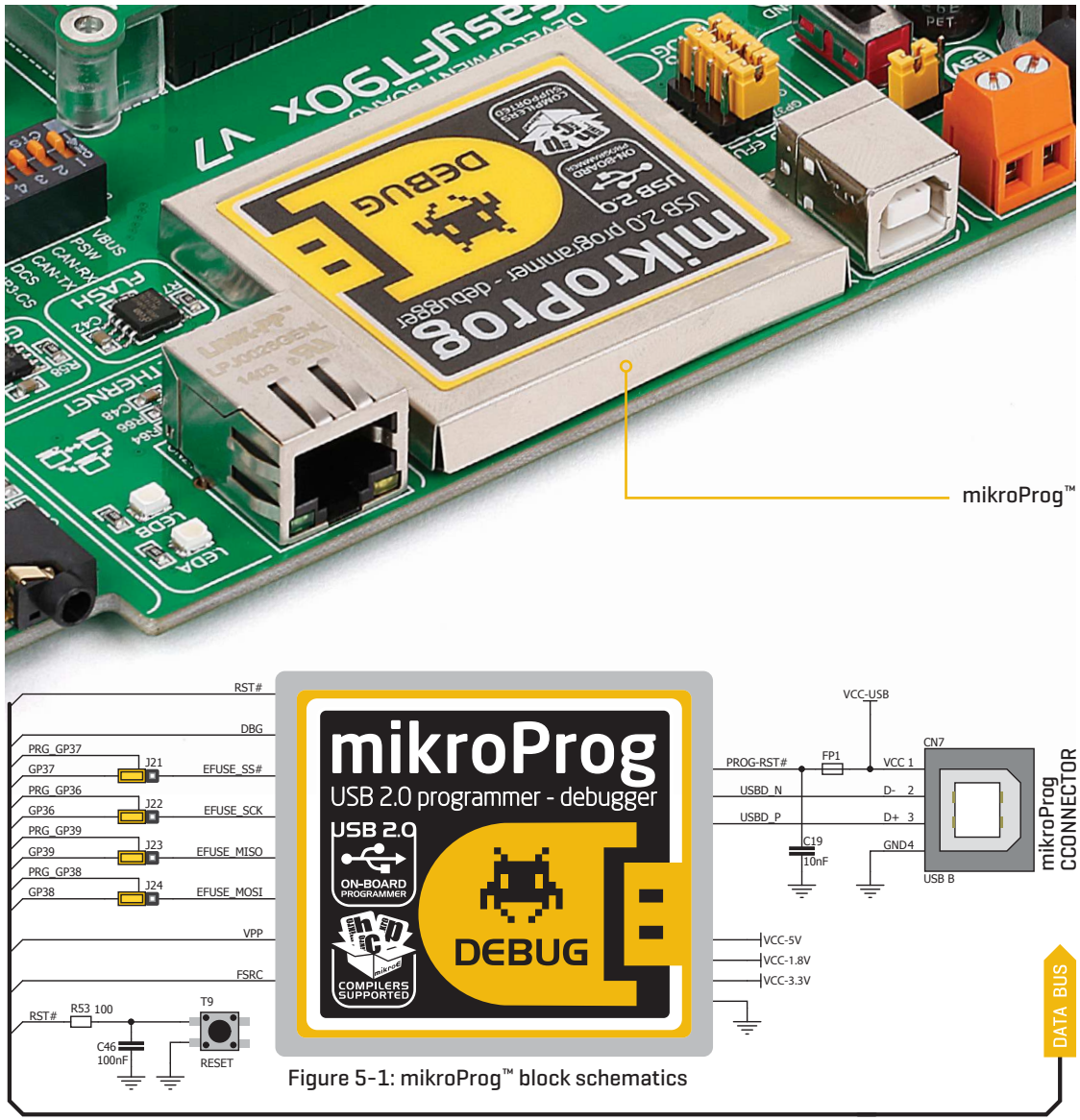


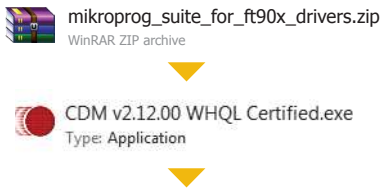
Figure 5-1: mikroProg™ block schematics

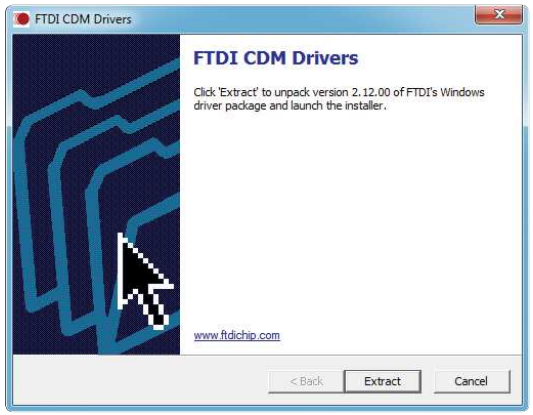
Installing programmer drivers

On-board mikroProg™ requires drivers in order to work. Drivers are located on the link below:

www.mikroe.com/downloads/get/2216/mikroprog_suite_for_ft90x_drivers.zip

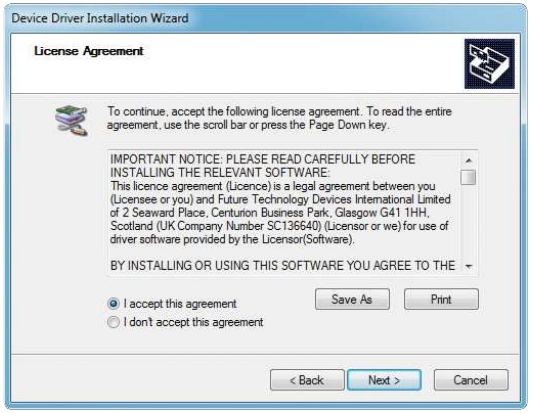
When you locate the drivers, please extract the setup file from the ZIP archive. You should be able to locate the driver setup file. Double click the setup file to begin installation of the programmer drivers.





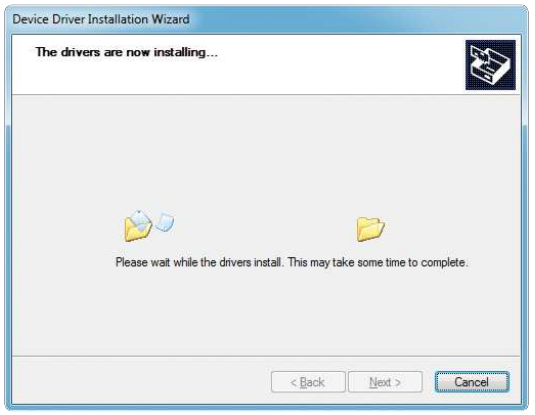
Step 1 - Start Installation

Welcome screen of the installation. Just click on **Next** button to proceed.



Step 2 - Select Destination

Click **Change** button to select new destination folder or use the suggested installation path.



Step 3 - Installing drivers

Drivers are installed automatically in a matter of seconds.

Step 4 - Finish installation

You will be informed if the drivers are installed correctly. Click on **Finish** button to end installation process.

Programming software

mikroProg Suite™ for FT90x

A standalone programming software utility called **mikroProg Suite™ for FT90x** is available as an alternative to programming the MCU directly from the FT90x compiler. This software is used for programming of all supported FT90x microcontrollers. The software has an intuitive interface and **SingleClick™** programming technology. To begin, first locate the installation archive on our web site:

www.mikroe.com/downloads/get/2215/mikroprog_suite_ft90x_v100.zip

After downloading, extract the package and double click the executable setup file, to start the installation.

Quick Guide

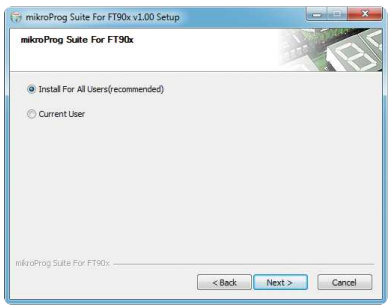
1. Click the **Detect MCU** button in order to recognize the device ID.
2. Click the **Read** button to read the entire microcontroller memory. You can click the **Save** button to save it to target HEX file.
3. If you want to write the HEX file to the microcontroller, first make sure to load the target HEX file. You can drag and drop the file onto the software window, or use the **Load** button to open the **Browse dialog** and point to the HEX file location. Then click the **Write** button to begin programming.
4. Click the **Erase** button to wipe out the microcontroller memory.

‹ Figure 5-2: mikroProg Suite™ window

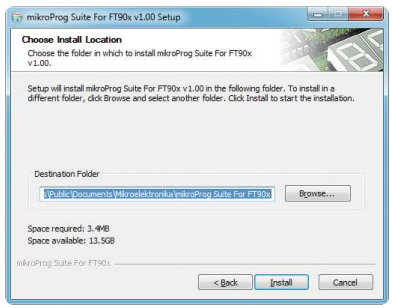
Installation wizard - 6 simple steps

Step 1 - Start Installation

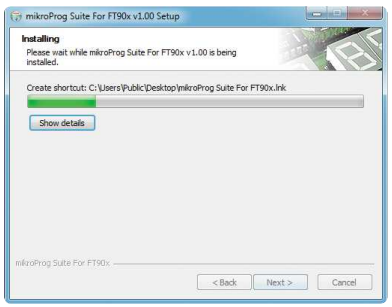
Step 2 - Accept EULA and continue



Step 3 - Install for All users or current user



Step 4 - Choose destination folder



Step 5 - Installation in progress

Step 6 - Finish Installation

Hardware Debugger

What is Debugging?

Every developer comes to a point where he has to monitor the code execution in order to find errors in the code, or simply to see if everything is going as planned. This hunt for bugs, or errors in the code is called **debugging**. There are two ways to do this: one is **the software simulation**, which enables you to simulate what is supposed to be happening on the microcontroller as your code lines are executed, and the other, most reliable one, is monitoring the code execution on the chip itself. And this latter one is called **hardware debugging**. "hardware" means that it is the real deal — code executes right on the target device.

What is hardware debugger?

The on-board **mikroProg**™ programmer supports a **hardware debugger** — a highly effective tool for **Real-Time debugging** on hardware level. The debugger enables you to execute your program on the host FT90x microcontroller and view variable values, Special Function Registers (SFR), RAM, CODE along with the code execution on hardware. Whether you are a beginner, or a professional, this powerful tool, with an intuitive interface and convenient set of commands will enable you to track down bugs quickly. mikroProg debugger is one of the fastest, and most reliable debugging tools on the market.

Supported Compilers

All MikroElektronika compilers, **mikroC™**, **mikroBasic™** and **mikroPascal™** for FT90x natively support mikroProg™ for FT90x. Specialized DLL module allows compilers to exploit the full potential of fast hardware debugging. Along with compilers, make sure to install the appropriate **programmer drivers** and **mikroProg Suite™ for FT90x** programming software, as described on **pages 14** and **15**.

How do I use the debugger?

When you build your project for debugging, and program the microcontroller with this HEX file, you can start the debugger using **[F9]** command. Compiler will change layout to debugging view, and a blue line will mark where code execution is currently paused. Use **debugging toolbar** in the **Watch Window** to guide the program execution, and stop anytime. Add the desired variables to Watch Window and monitor their values.

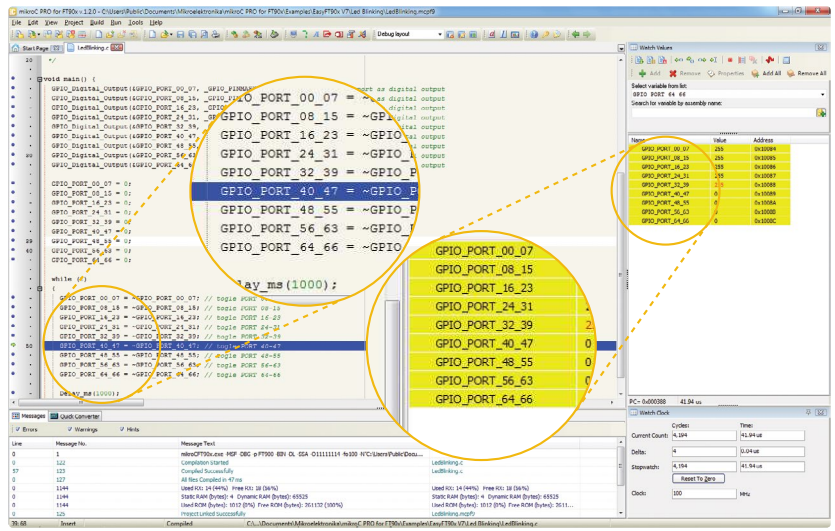


Figure 5-3:
mikroC PRO for FT90x compiler in debugging view, with SFR registers in Watch Window

Debugger commands

Here is a short overview of which debugging commands are supported in MikroElektronika compilers. You can see what each command does, and what are their shortcuts when you are in debugging mode. It will give you some general picture of what your debugger can do.

Toolbar Icon	Command Name	Shortcut	Description
	Start Debugger	[F9]	Starts Debugger.
	Run/Pause Debugger	[F6]	Run/Pause Debugger.
	Stop Debugger	[Ctrl + F2]	Stops Debugger.
	Step Into	[F7]	Executes the current program line, then halts. If the executed program line calls another routine, the debugger steps into the routine and halts after executing the first instruction within it.
	Step Over	[F8]	Executes the current program line, then halts. If the executed program line calls another routine, the debugger will not step into it. The whole routine will be executed and the debugger halts at the first instruction following the call.
	Step Out	[Ctrl + F8]	Executes all remaining program lines within the subroutine. The debugger halts immediately upon exiting the subroutine.
	Run To Cursor	[F4]	Executes the program until reaching the cursor position.
	Toggle Breakpoints	[F5]	Toggle breakpoints option sets new breakpoints or removes those already set at the current cursor position.
	Show/Hide breakpoints	[Shift+F4]	Shows/Hides window with all breakpoints
	Clears breakpoints	[Shift+Ctrl+F5]	Delete selected breakpoints
	Jump to interrupt	[F2]	Opens window with available interrupts (doesn't work in hardware debug mode)

Input/Output Group

One of the most distinctive features of EasyFT90x v7 for 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. This layout givest the EasyFT90x a clean, well organized look and it makes development easier. We have also provided 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 pull-up/down DIP switches

Tri-state DIP switches, like **SW11** on **Figure 6-3**, 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 PIN.

Figure 6-3: Tri-state DIP switch on PORT00-07

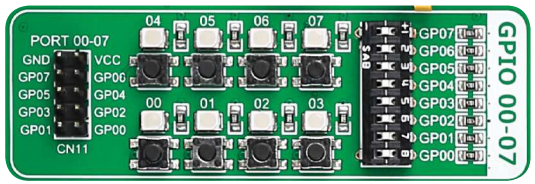


Figure 6-1: I/O group 00-07 contains PORT header, tri-state pull up/down DIP switch, buttons and LEDs all in one place

Button press level tri-state DIP switch is used to determine which logic level will be applied to port pins when buttons are pressed

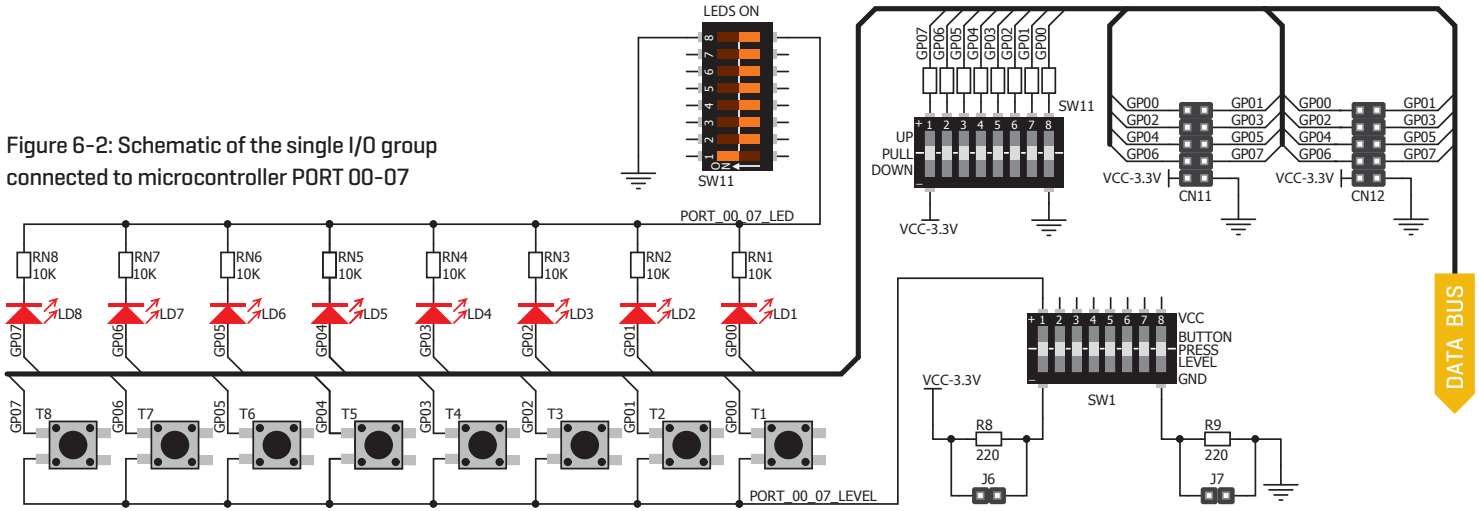


Figure 6-2: Schematic of the single I/O group connected to microcontroller PORT 00-07

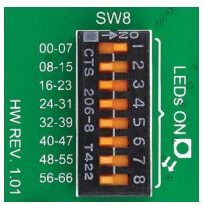
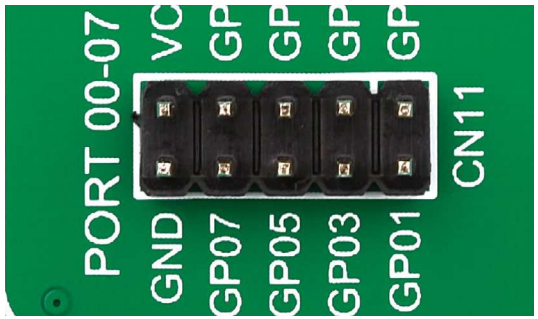


Figure 6-4: Switch SW8.1 enables LEDs on PORT group 00-07

Headers



With enhanced connectivity as one of the key features of EasyFT90x v7, we have provided **two connection headers for each PORT**. I/O PORT group contains one male IDC10 header (like **CN11 shown above**). There is **one more IDC10 header** available on the right side of the board, next to DIP switches (like **CN12** on **Figure 6-4**). These headers can be used to connect accessory boards with IDC10 female sockets.

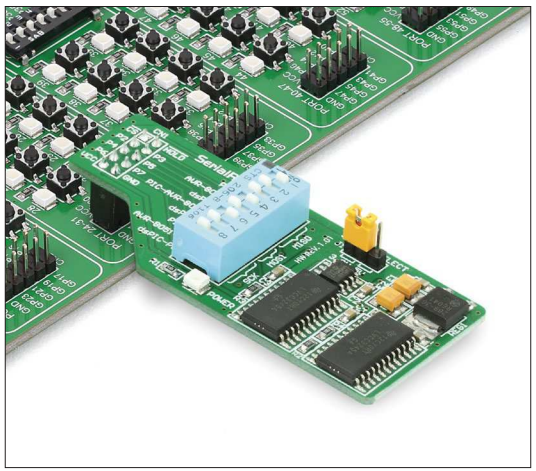


Figure 6-4: IDC10 male headers enable easy connection with MikroElektronika accessory boards

Buttons

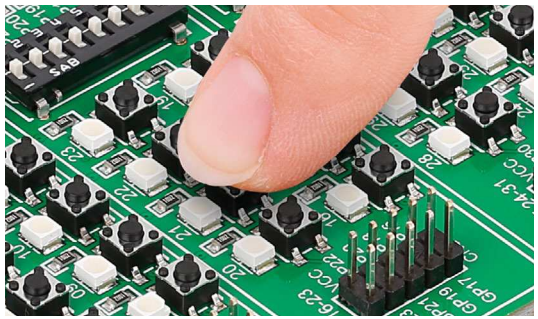


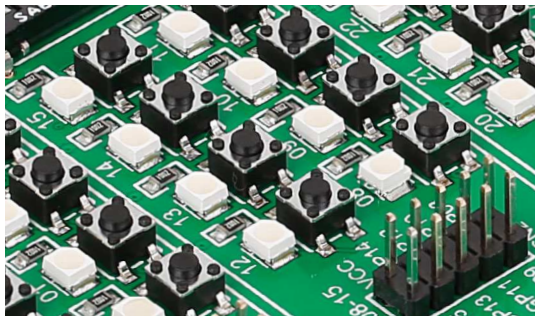
Figure 6-5: Button press level DIP switch (tri-state)

The logic state of all microcontroller digital inputs may be changed using **push buttons**. Tri-state DIP switch **SW11** 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 **SW11.1** in **VCC** position, then pressing any push button on PORT 00-07 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 the MCU in case of wrong usage.

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.

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 EasyFT90x v7 board uses low-current LEDs with typical current consumption of 0.2mA or 0.3mA. Board contains 67 LEDs which can be used for visual indication 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 switch on **SW8** (**Figure 6-6**).

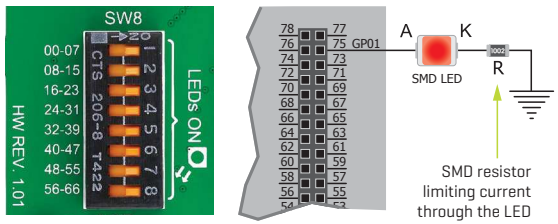


Figure 6-6: SW8.1 through SW8.8 switches are used to enable PORT LEDs

mikroBUS™ sockets

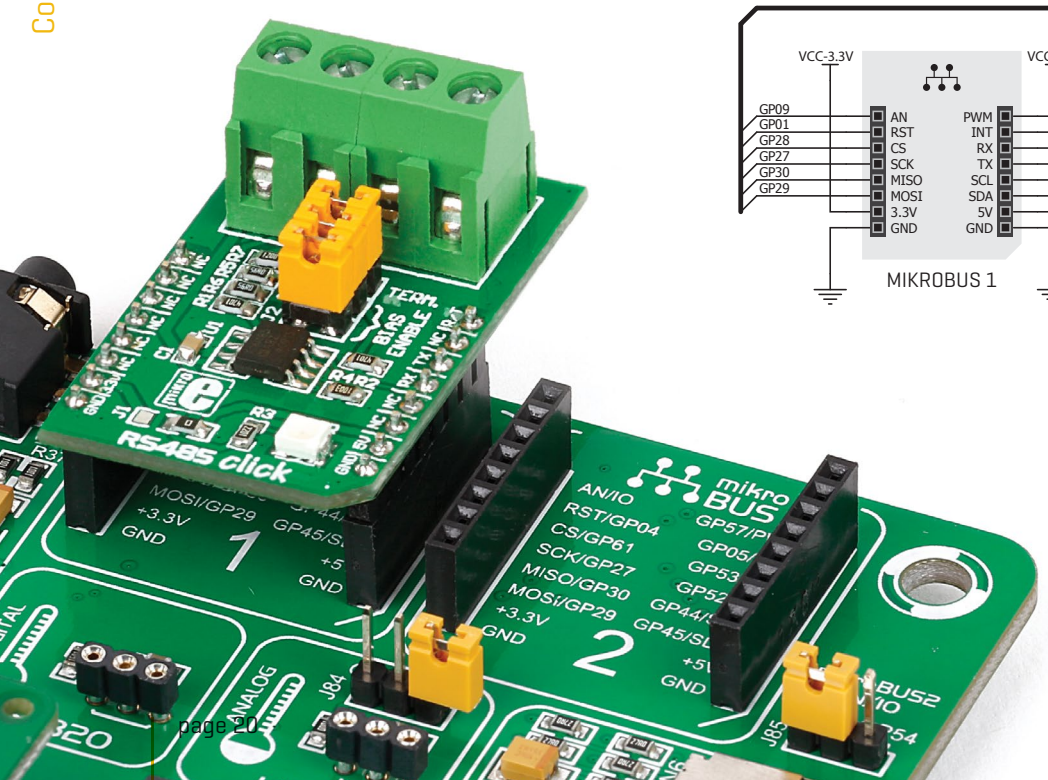
Easier connectivity and simple configuration are imperative in modern electronic devices. Success of the USB standard comes from its simplicity of usage and high and reliable data transfer rates. As we in MikroElektronika see it, Plug-and-Play devices with minimum settings are the future in the embedded world too. This is why our engineers have come up with a simple, but brilliant pinout with lines that most of today's accessory boards require, which almost completely eliminates the need for additional hardware settings. We called this new standard the **mikroBUS™.** EasyFT90x v7 supports mikroBUS™ with two on-board sockets. As you can see, there are no additional DIP switches, or jumper selections. Everything is already routed to the most appropriate pins of the microcontroller sockets.

mikroBUS™ host connector

Each mikroBUS™ host connector consists of two 1x8 female headers containing pins that are most likely to be used in the target accessory board. There are three groups of communication pins: **SPI**, **UART** and **I²C** communications. There are also single pins for **PWM**, **Interrupt**, **Analog input**, **Reset** and **Chip Select**. Pinout contains two power groups: **+5V and GND** on one header and **+3.3V and GND** on the other 1x8 header.

mikroBUS™ pinout explained

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



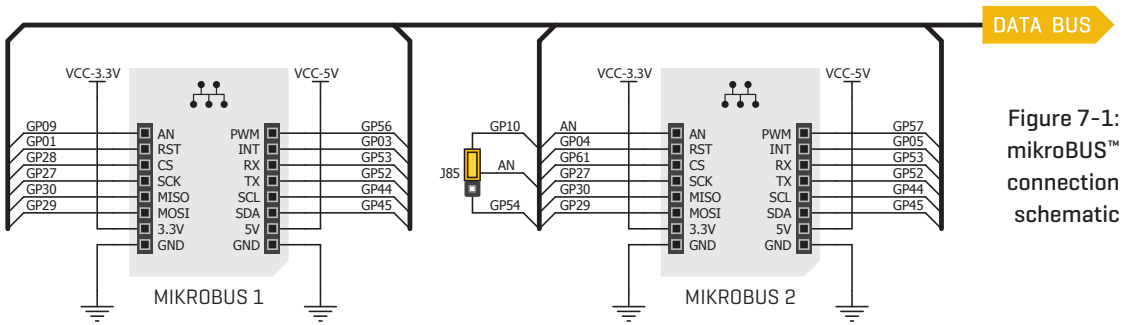


Figure 7-1: mikroBUS™ connection schematic

Integrate mikroBUS™ in your design

mikroBUS™ is not made only to be 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:

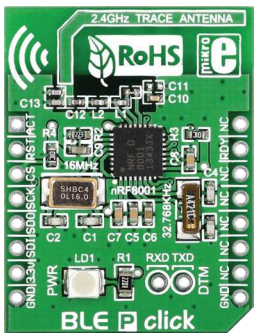
www.mikroe.com/mikrobus

click™ boards are plug-and-play!

For a few years now, we have been expanding our range of click™ boards. Almost **each month several new click™ boards are released, carrying all types of sensors and communication modules.** There are over a 100 click™ boards to choose from. You'll be able to **expand your EasyFT90x v7 board with additional functionality with literally zero hardware configuration**. Just plug and play.

For the complete list of available click™ boards, please visit:

www.mikroe.com/click



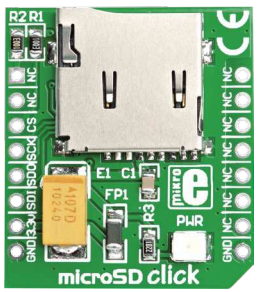
BLE P click™

BlueTooth click™

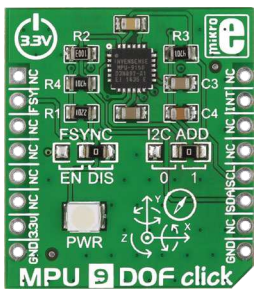
GPS click™

WiFi *PLUS* click™

GSM click™

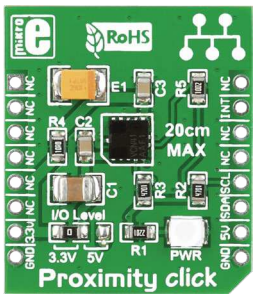


microSD click™

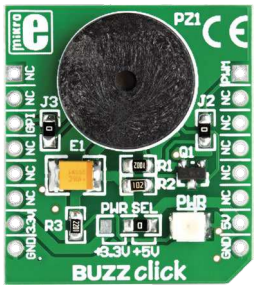


MPU 9DOF click™

nRF C click™

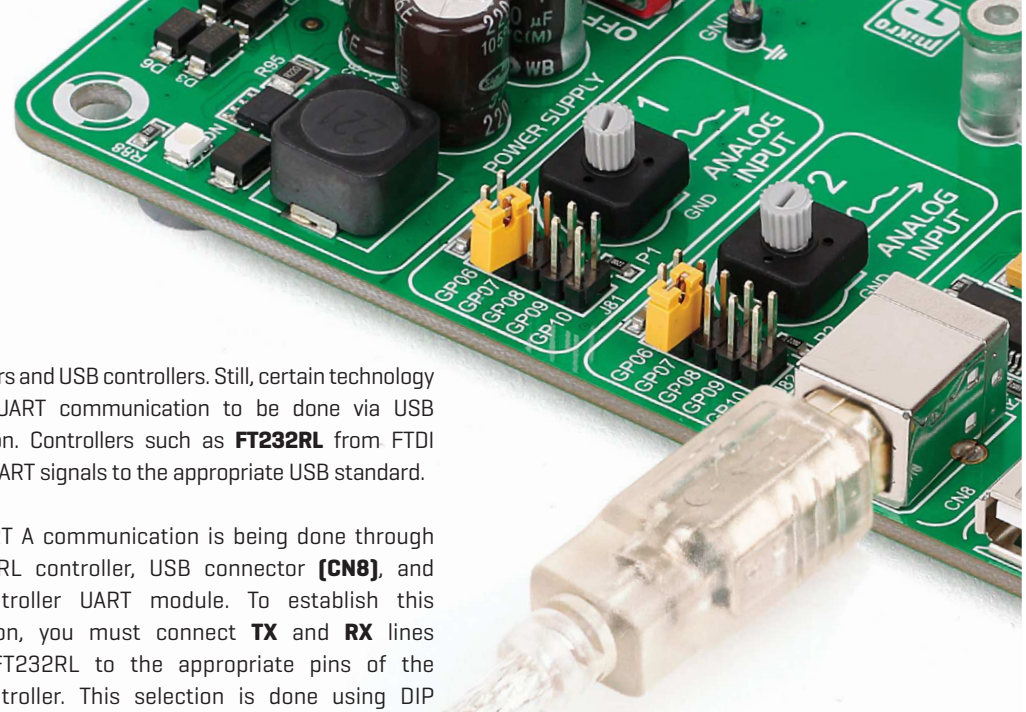


Proximity click™



BUZZ click™

USB-UART



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 that 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 **(CN8)**, and microcontroller UART module. To establish this connection, you must connect **TX** and **RX** lines of the FT232RL to the appropriate pins of the microcontroller. This selection is done using DIP switches **SW2.2** and **SW2.3**.

In order to use the USB-UART module on EasyFT90x v7, you must first install FTDI drivers on your computer. Drivers can be found on link below:

www.ftdichip.com/Drivers/VCP.htm

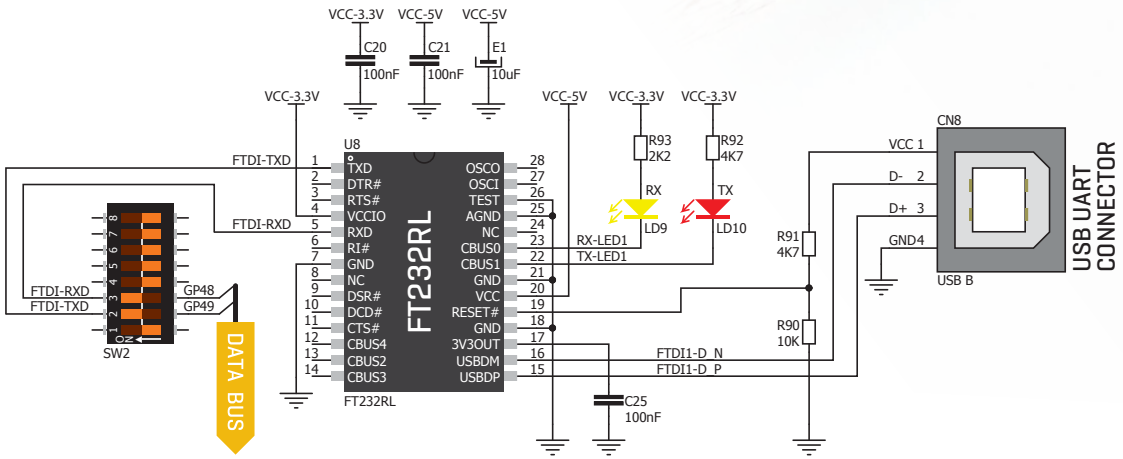
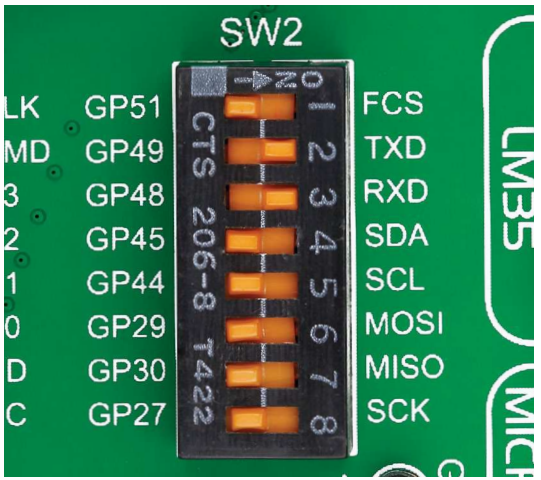
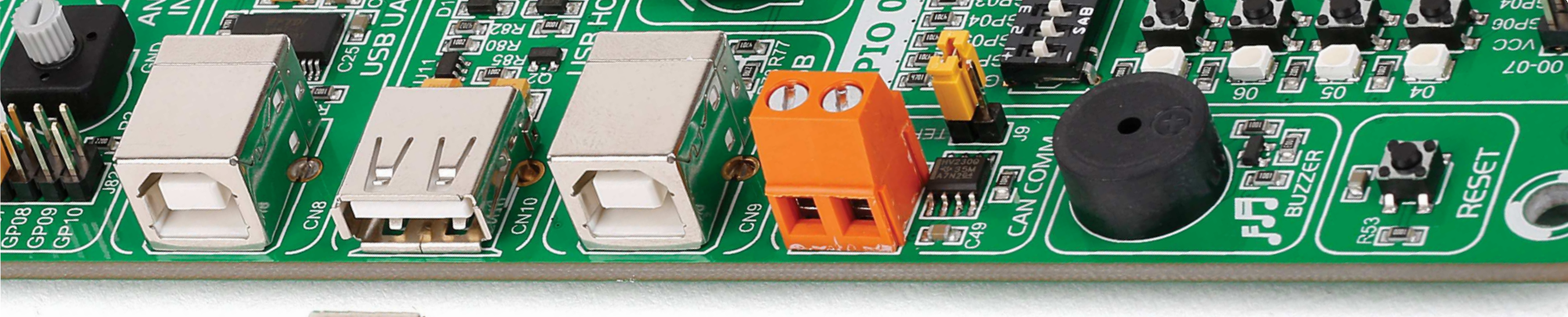


Figure 8-1: USB-UART connection schematic

Enabling USB-UART



In order to enable USB-UART communications, you must push **SW2.2** (GP49) and **SW2.3** (GP48) to **ON** position. This connects the **RX** and **TX** lines to **GP48** and **GP49** microcontroller pins.



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. EasyFT90x v7 contains a USB HOST connector **(CN10)** for a USB Standard Type A 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 **GP00** pin is established when **SW3.1** is on.

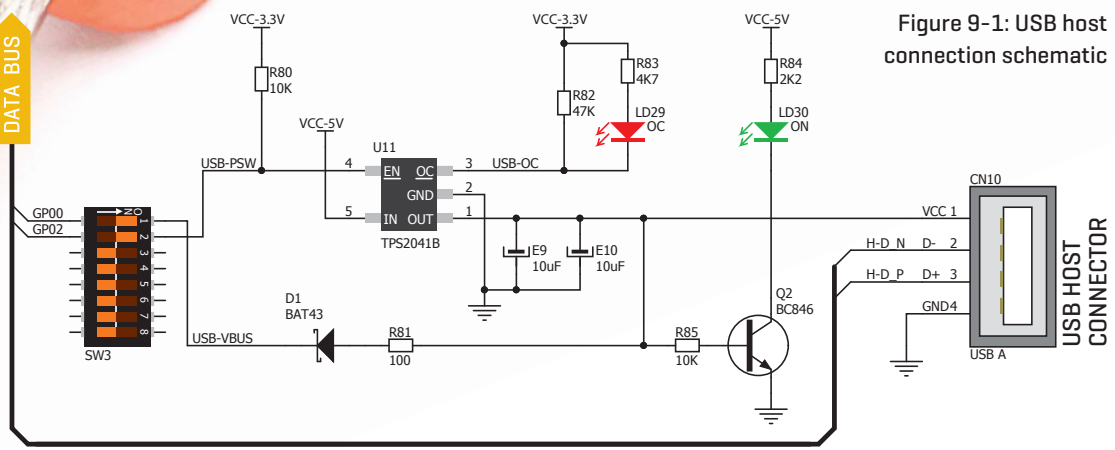


Figure 9-1: USB host connection schematic

Powering USB device

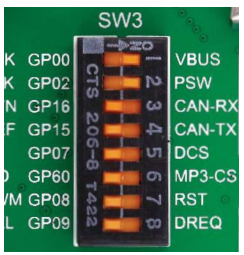


Figure 9-2: Powering USB device through PSW line

You can enable or disable power supply to USB device connected to HOST, through microcontroller **GP02** pin. In order to connect EN TPS2041B IC pin to microcontroller, you must push **SW3.2** to **ON** position.

USB device communication

EasyFT90x v7 also contains USB DEVICE connector **(CN9)** 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 B plug. USB Device is directly connected to MCU pins GP03, USBD-N and USBD-P (no switches to flip). When connected to HOST, dedicated amber-colored power LED will light up as well.

Figure 10-1: USB host connection schematic

Ethernet communication

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. EasyFT90x v7 features a 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.

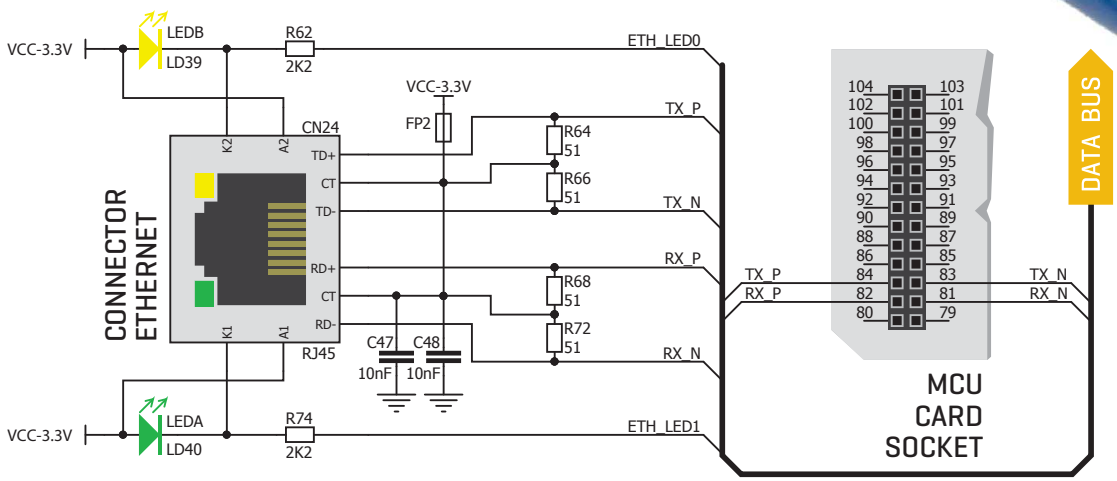


Figure 11-1: Ethernet connection schematic