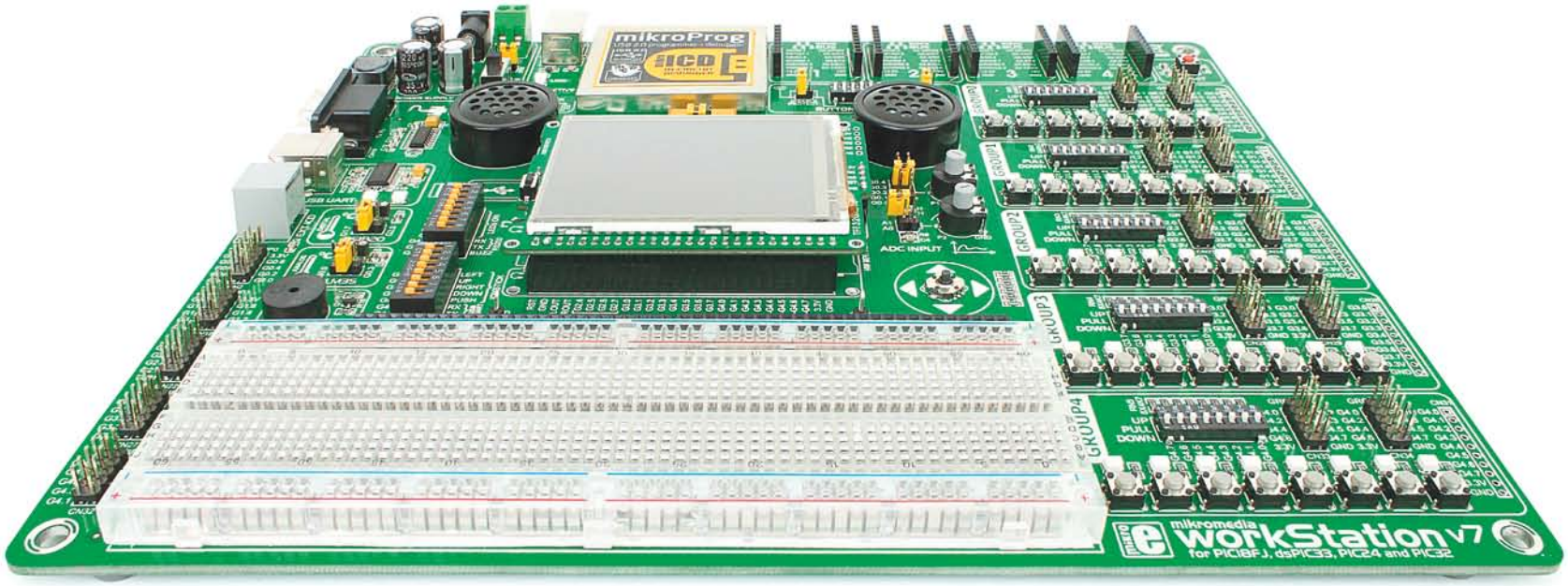
USER'S GUIDE

mikromedia workStation™ v7

for PIC18FJ®, dsPIC33®, PIC24® and PIC32®



mikromedia

6 mikromedia boards supported
PIC18FJ®,dsPIC33®/PIC24® and PIC32®

Many on-board modules
Multimedia peripherals

mikro BUS

Easy-add extra boards
mikroBUS™ sockets

connectivity

Four connectors for each port
Amazing Connectivity

Fast USB 2.0 programmer and
In-Circuit Debugger

MikroElektronika
DEVELOPMENT TOOLS | COMPILERS | BOOKS

To our valued customers

mikromedia™ has developed into a well-known brand. Not only that we set new standards in design and selection of on-board modules, but we also created an entire ecosystem of users who use our visual tools and compilers to develop TFT applications faster and easier than ever before. The ease of use is our top priority. This is why we wanted to take things to the next level.

mikromedia™ workStation v7 is unlike anything you have seen before. With custom pin markings it will revolutionize the way people look at different architectures. Switching from one mikromedia to another while using virtually the same code is a very powerful concept. We are confident this will be especially interesting in education and among developers who need flexibility and rapid prototyping.

Nebojsa Matic,
Owner and General Manager
of mikroElektronika

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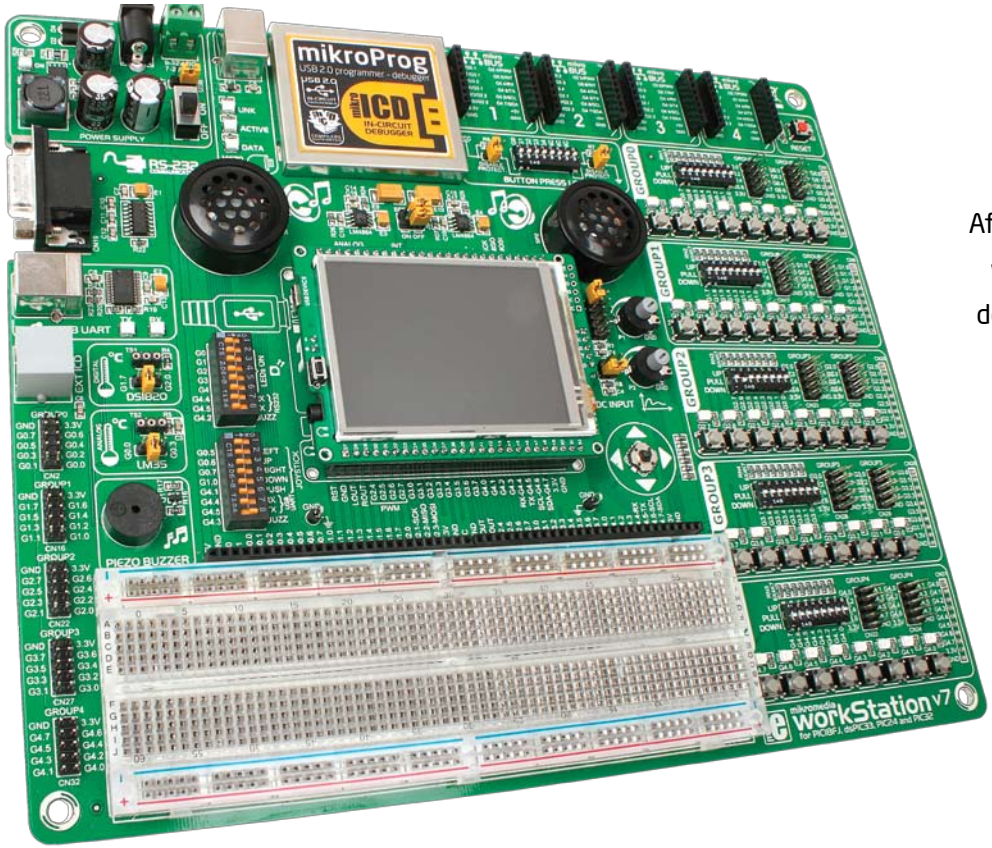


Introduction

After several years of successful production of mikromedia™ boards, we have decided to delight users of our products and make a new development system that expands functionality of all mikromedia™ boards with Microchip® microcontrollers. The idea was to make a development system with as many peripherals as possible to cover multimedia modules. On the other hand we wanted to fit in dimensions of other development systems with 2-layer PCB. We present you the board which is powerful, well organized, with high-quality components, on-board programmer and debugger and it's ready to be your strong ally in development. We hope you will enjoy it as much as we do.

mikromedia™ workStation v7 Development Team

Supports all Microchip® mikromedias

Perfect for education

This is a perfect tool for education. Since board supports mikromedia boards for PIC18®, dsPIC®, PIC24® and PIC32®, you can easily switch to one you need in your development.

It's like the body for the brain

mikromedia with wires

Workstation helps you to connect your mikromedia board to the rest of the world. Button, LED and four headers for each pin are the arsenal you need. mikromedia becomes the brain of your device.

Debugger on board

Debugger on board

Powerful on-board mikroProg™ programmer and In-Circuit debugger can program and debug all supported mikromedias. Once you use it, you won't be able to imagine a development without it.

For easier connections

Four mikroBUS sockets

Not two, not three but four different mikroBUS host sockets enable you to do do whatever you imagine. Simply snap in your Click board, and add a whole new functionality.

It's good to know

System Specifications

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

power consumption
~135 mA (all modules
are disconnected)

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

weight
515 g
(1.135 lbs)

Package contains

1 Damage resistant protective box

2 mikromedia™ workStation v7 board for PIC®

3 USB cable

4 Wire jumpers

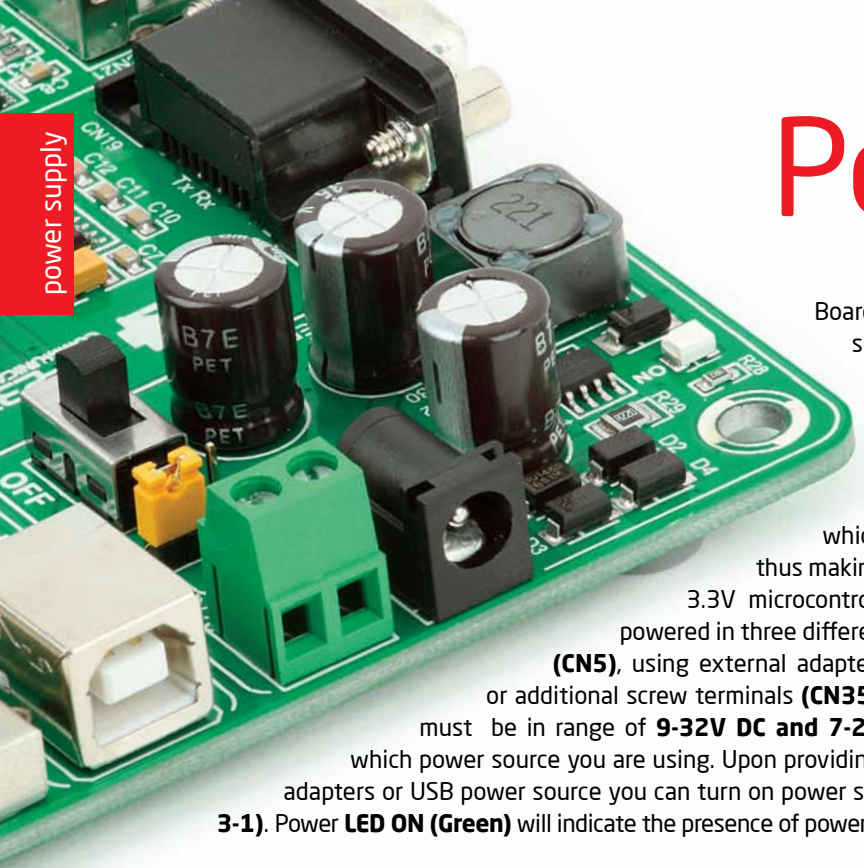
5 User Manual

6 Board schematic

7 mikroProg Suite™ and mikroICD™ manuals

8 DVD with examples and documentation

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 (CN5)**, using external adapters via adapter connector **(CN36)** 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 power supply by using **SWITCH 1 (Figure 3-1)**. Power **LED ON (Green)** will indicate the presence of power supply.

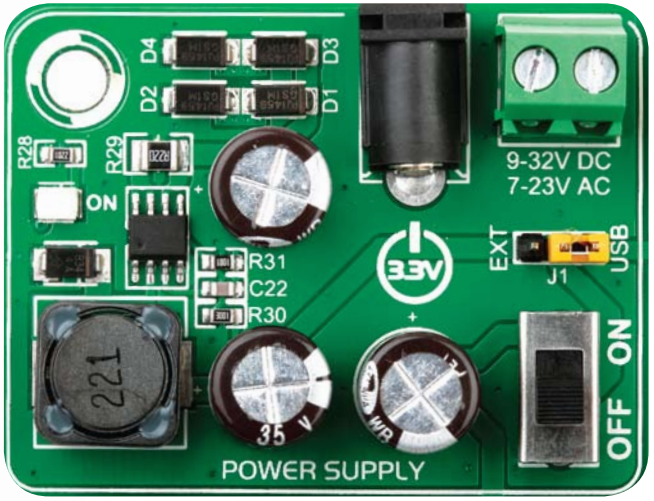


Figure 3-1: Power supply unit of mikromedia™ workStation v7

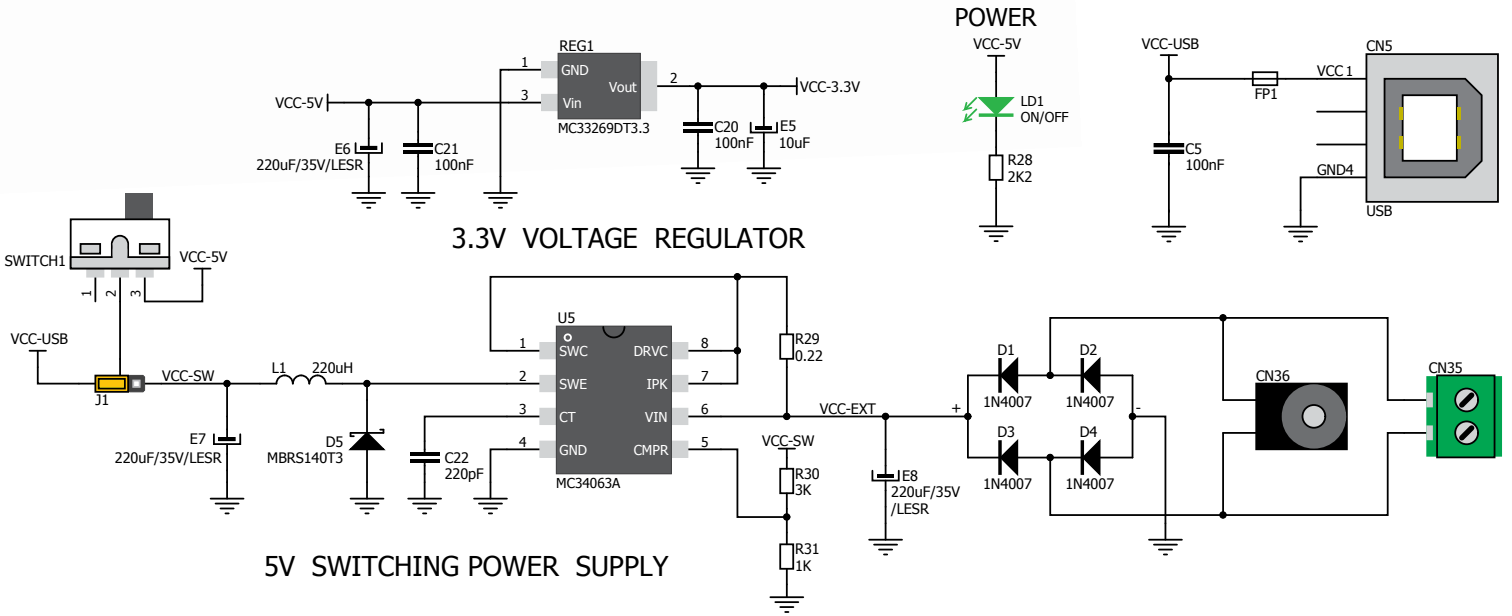


Figure 3-2: Power supply unit schematic

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)

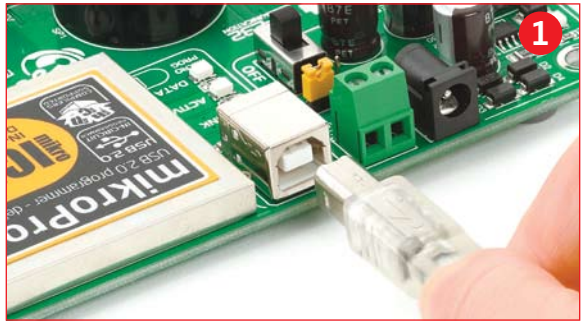
Power capacity: up to 500mA with USB, and up to 600mA with external power supply

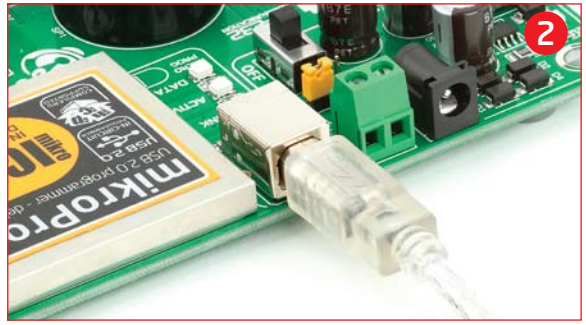
How to power the board?

1. With USB cable

Set J1 jumper to USB position

To power the board with USB cable, place jumper **J1** in USB position. You can then plug in the USB cable as shown on images 1 and 2 and turn the power switch ON.

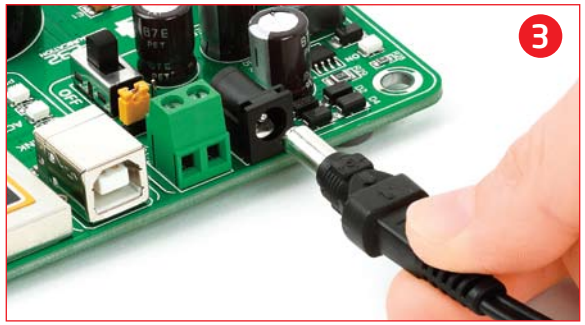


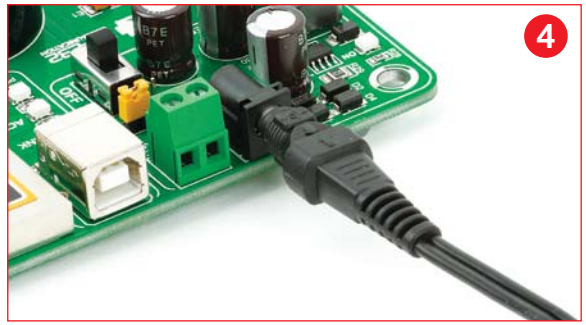


2. Using adapter

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.

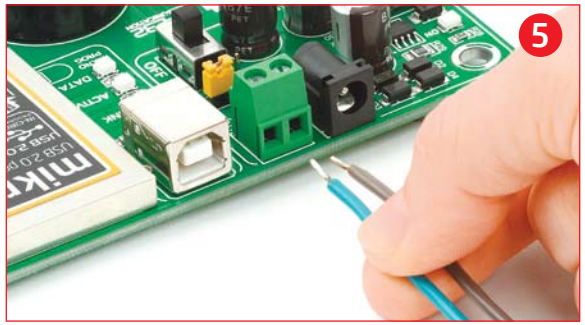


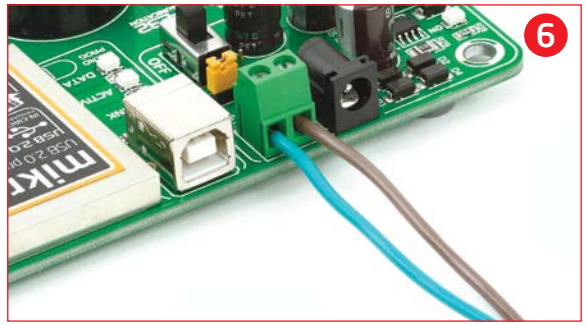


3. With laboratory power supply

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.





mikromedia™ board socket

mikromedia™ workStation v7 contains four female headers that together form a socket for specialized small development boards with a microcontroller and on-chip modules, called mikromedia™ boards. Two of them are used for general purpose I/O and power pins (1x26). The other two are used for the mikroProg™ programmer (1x5) or ICD2/3 (1x6). Before placing the mikromedia™ board into the appropriate socket (Page 10), you have to solder two 1x26 male headers to the side pads and one 1x5 male header for mikroProg™ programmer. Currently, six mikromedia™ boards are supported, but there is a tendency to increase the number:

1. mikromedia for **PIC18FJ®**
2. mikromedia for **PIC24®**
3. mikromedia for **PIC24EP®**
4. mikromedia for **dsPIC33®**
5. mikromedia for **dsPIC33EP®**
6. mikromedia for **PIC32®**

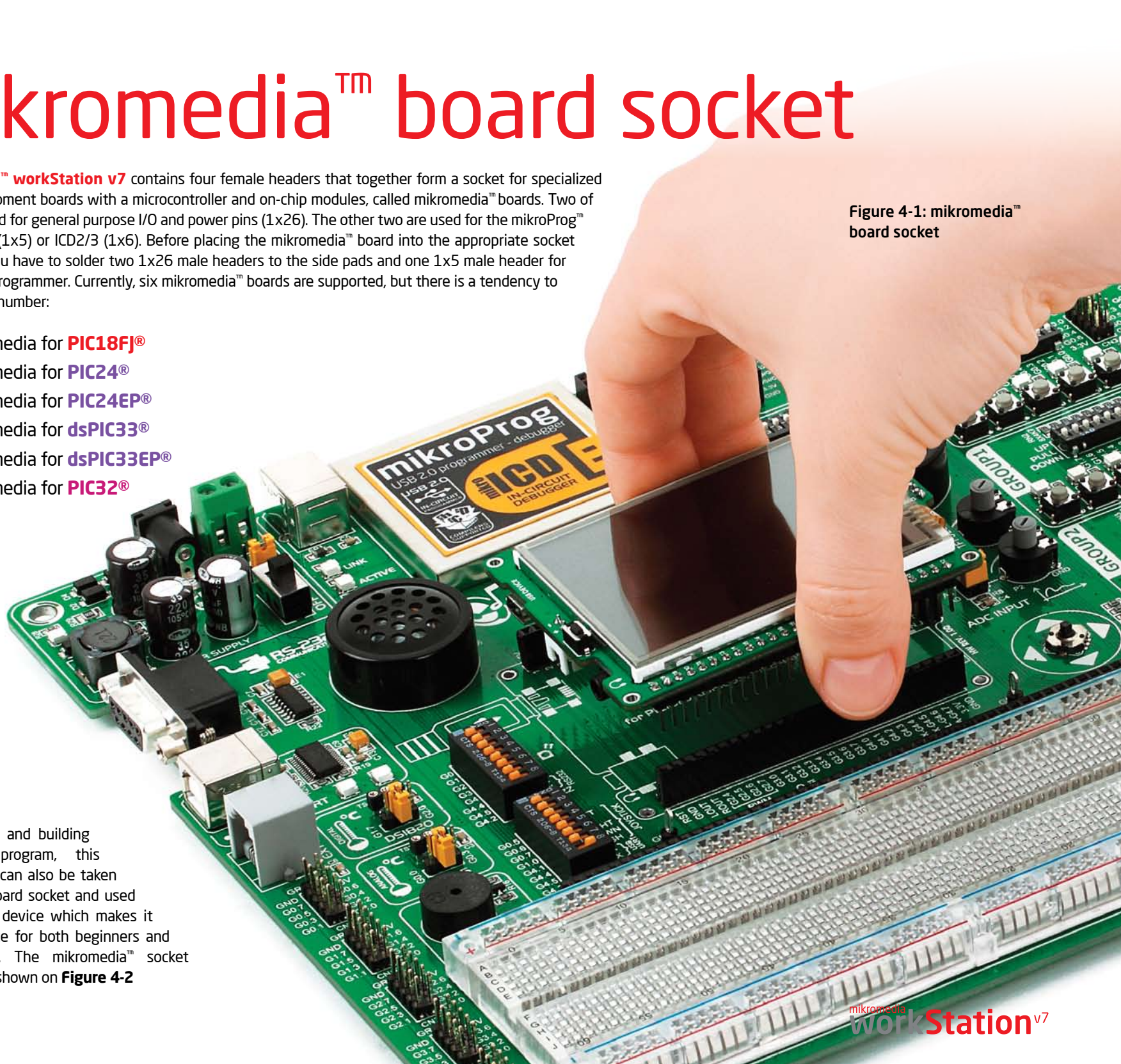


Figure 4-1: mikromedia™ board socket

After testing and building the final program, this mikromedia™ can also be taken out of the board socket and used in your final device which makes it a great choice for both beginners and professionals. The mikromedia™ socket schematic is shown on **Figure 4-2**

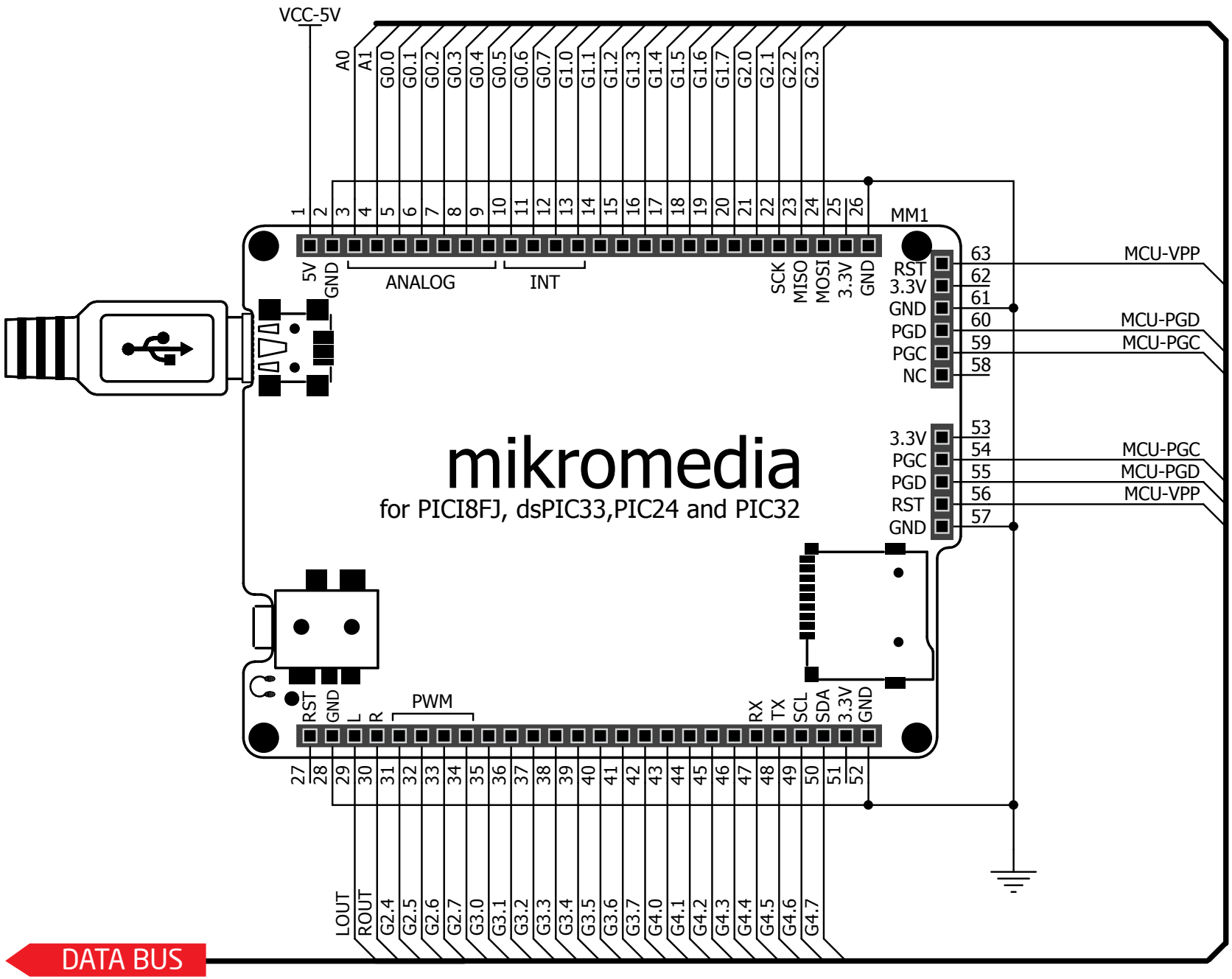


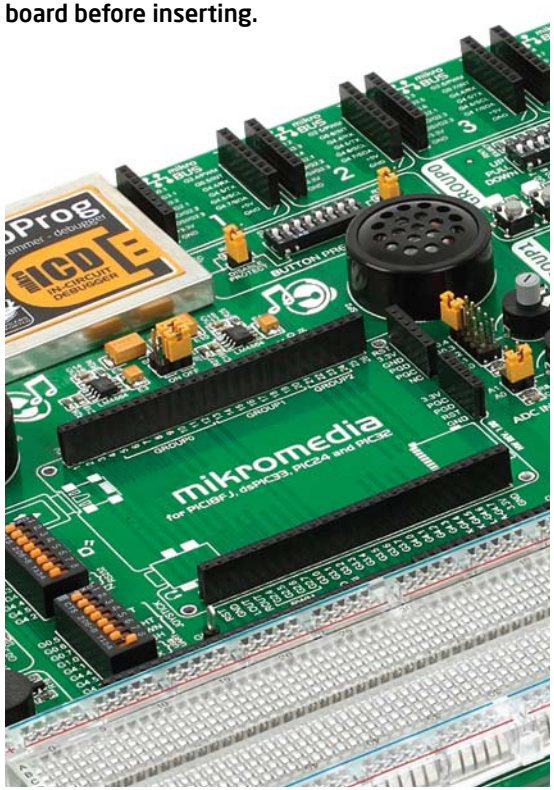
Figure 4-2: mikromedia™ board socket schematic

How to properly place your mikromedia™ board into the socket?

Before you plug the mikromedia™ board into the socket, make sure that the **power supply is turned off.** Images below show how to correctly plug the board. First make sure that mikromedia™ board orientation matches the silkscreen outline on the mikromedia™ workStation v7 board socket. Place the mikromedia™ board over the socket so that each male header is properly aligned with the female socket, as shown in **Figure 4-4**. Then put the mikromedia™ board slowly down until all the pins match the socket (make sure you don't push the screen). Check again if everything is placed correctly and press the mikromedia™ board until it is completely plugged into the socket as shown in **Figure 4-5**. Now you can turn the power supply on.

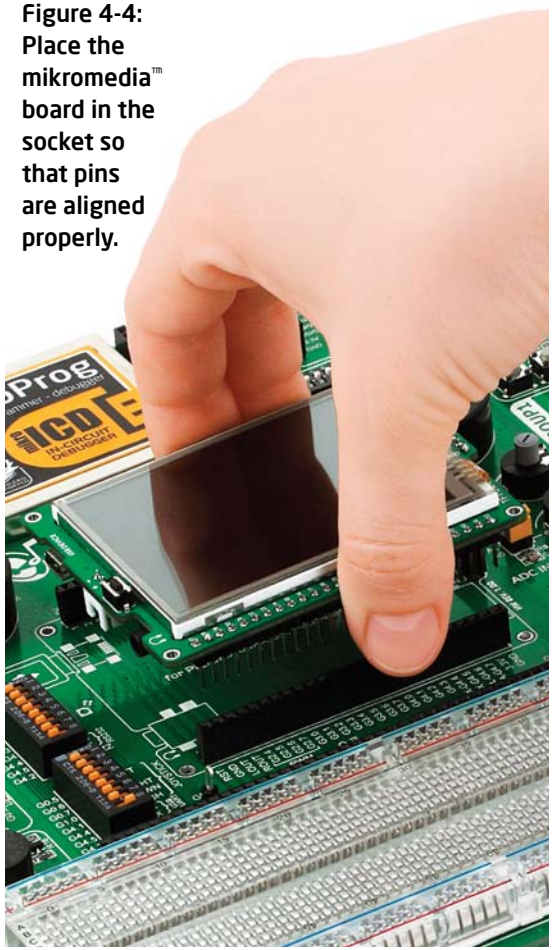
1

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



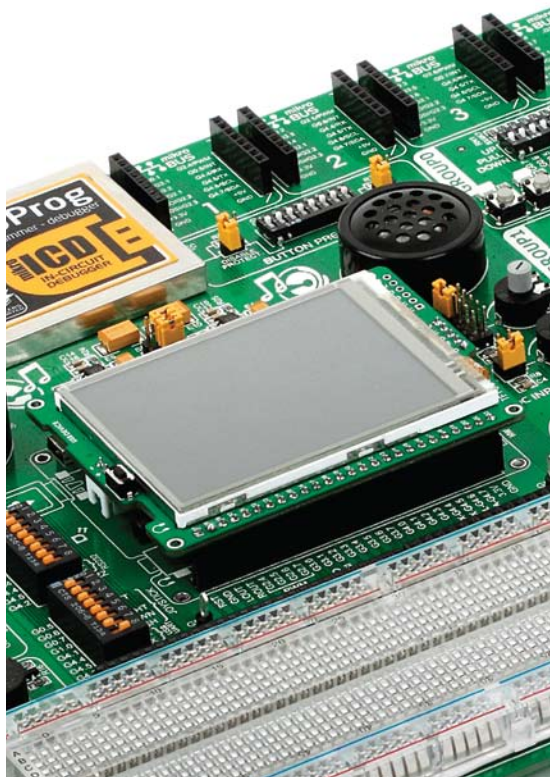
2

Figure 4-4: Place the mikromedia™ board in the socket so that pins are aligned properly.



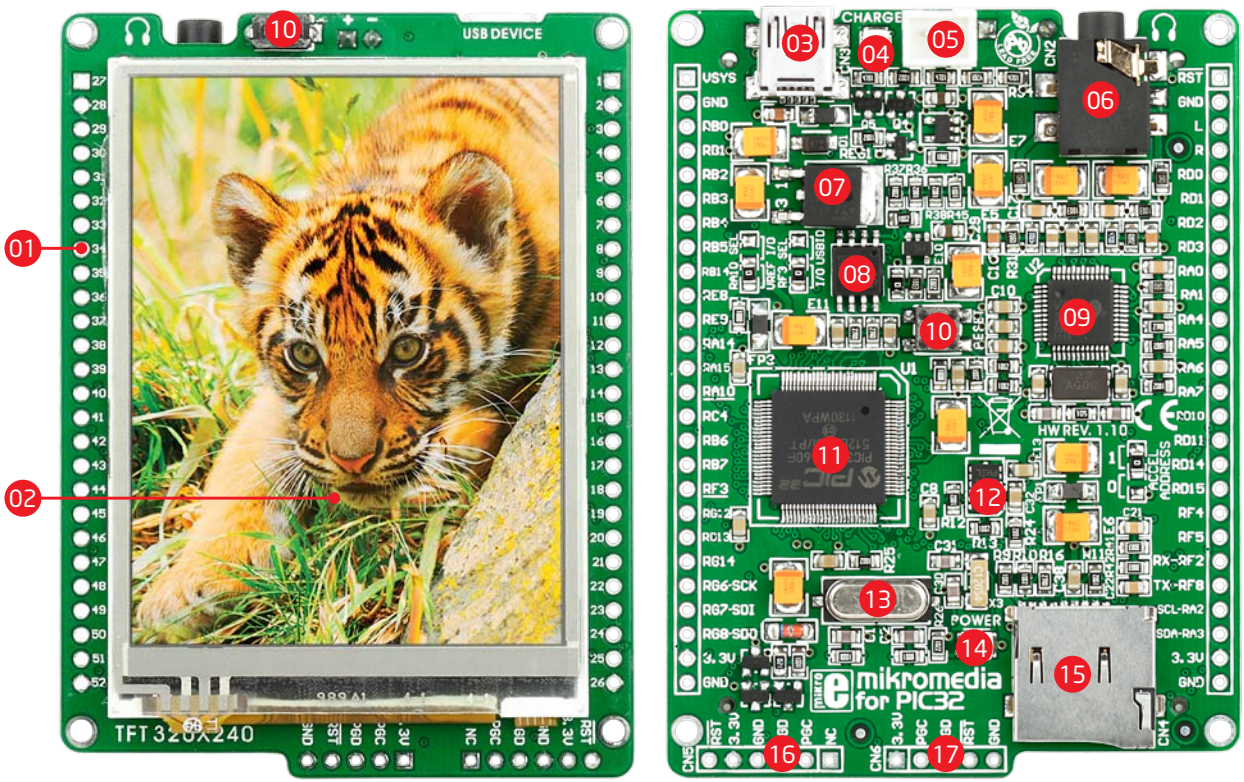
3

Figure 4-5: Properly placed mikromedia™ board.



What is mikromedia™ board?

The **mikromedia**™ board is a compact development system with lots of on-board peripherals which allow development of devices with multimedia content. The central part of the system is a **PIC18FJ®**, **PIC24®**, **dsPIC33®** or **PIC32®** microcontroller, depending on mikromedia™ board. The mikromedia™ features integrated modules such as Audio module (with stereo MP3 codec and 3.5mm audio connector for headphones), resistive **TFT 320x240** touch screen display (with 262.144 different colors), battery charger, accelerometer, microSD card slot and 8 Mbit flash memory. mikromedia™ board also contains a MINI-B USB connector, two 1x26 connection pads, LI-Polymer battery connector and other. It comes pre programmed with bootloader, but can also be programmed with standalone programmers, such as mikroProg™ or ICD2/3. mikromedia™ is compact and slim, and perfectly fits in the palm of your hand, which makes it a convenient platform for mobile devices. It can be powered through a USB MINI-B cable or battery supply. When you put any of them in **mikromedia™ workStation v7** system number of modules and functionality significantly increase.
Key components are marked as in the example of **mikromedia for PIC32®** (**Figure 4-6**) and are similar for other mikromedia™. The most important differences between mikromedia™ boards are shown on page 12 and 13. A detailed description can be found in appropriate manuel provided with the mikromedia™ board.



01 Connection Pads
02 TFT 320x240 display
03 USB MINI-B connector
04 CHARGE indication LED
05 Li-Polymer battery connector
06 3.5mm headphone connector
07 Power supply regulator
08 Serial Flash memory
09 VS1053 Stereo mp3 coder/decoder
10 RESET button
11 microcontroller (PIC32MX460F512L)
12 Accelerometer
13 Crystal oscillator
14 Power indication LED
15 microSD Card Slot
16 ICD2/3 connector
17 mikroProg™ connector

Figure 4-6: Key components of mikromedia for PIC32® board

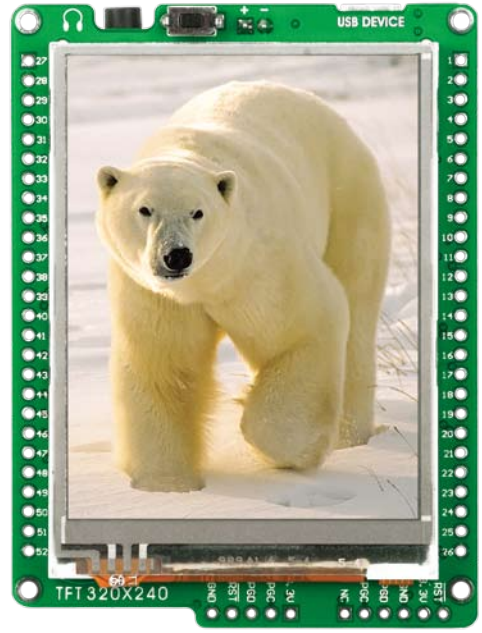
Which one to use?

mikromedia for PIC18FJ

Architecture:	**8-bit**
CPU speed:	**12 MIPS**
Flash memory:	**128 kB**
RAM memory:	**3,904 Bytes**
Operating MCU Voltage:	**2 - 3.6 V**
USB DEVICE:	**Yes**
USB UART:	**No**
Consumption (back light is ON):	**51.7 mA**
Back light current:	**42mA**
Max I2C speed:	**400 kHz**
Max microSD SPI speed:	**12 MHz**
Max Flash memory SPI speed:	**12 MHz**
Max Audio codec SPI speed:	**3 MHz**

mikromedia for PIC24

Architecture:	**16-bit**
CPU speed:	**16 MIPS**
Flash memory:	**256 kB**
RAM memory:	**16 kB**
Operating MCU Voltage:	**2 - 3.6 V**
USB DEVICE:	**Yes**
USB UART:	**No**
Consumption (back light is ON):	**56.2 mA**
Back light current:	**42mA**
Max I²C speed:	**400 kHz**
Max microSD SPI speed:	**16 MHz**
Max Flash memory SPI speed:	**16 MHz**
Max Audio codec SPI speed:	**2 MHz**



mikromedia for PIC24EP

Architecture:	**16-bit**
CPU speed:	**70 MIPS**
Flash memory:	**512 kB**
RAM memory:	**52 kB**
Operating MCU Voltage:	**3 - 3.6 V**
USB DEVICE:	**Yes**
USB UART:	**No**
Consumption (back light is ON):	**57 mA**
Back light current:	**42mA**
Max I²C speed:	**400 kHz**
Max microSD SPI speed:	**35 MHz**
Max Flash memory SPI speed	**35 MHz**
Max Audio codec SPI speed:	**2.1 MHz**

For now we are giving you the choice to choose between 6 mikromedia boards. Each of them is specific in its own way. The main idea here is to show you comparative key features in one place, which makes it easier for you to choose.

mikromedia for dsPIC33

Architecture:	**16-bit**
CPU speed:	**40 MIPS**
Flash memory:	**256 kB**
RAM memory:	**30 kB**
Operating MCU Voltage:	**3 - 3.6 V**
USB DEVICE:	**No**
USB UART:	**Yes**
Consumption (back light is ON):	**59.7 mA**
Back light current:	**42mA**
Max I²C speed:	**400 kHz**
Max microSD SPI speed:	**16 MHz**
Max Flash memory SPI speed:	**16 MHz**
Max Audio codec SPI speed:	**4 MHz**

mikromedia for dsPIC33EP

Architecture:	**16-bit**
CPU speed:	**70 MIPS**
Flash memory:	**512 kB**
RAM memory:	**52 kB**
Operating MCU Voltage:	**3 - 3.6 V**
USB:	**Yes**
USB-UART:	**No**
Consumption (back light is ON):	**56.2 mA**
Back light current:	**42mA**
Max I²C speed:	**400 kHz**
Max microSD SPI speed:	**35 MHz**
Max Flash memory SPI speed:	**35 MHz**
Max Audio codec SPI speed:	**2.1 MHz**

mikromedia for PIC32

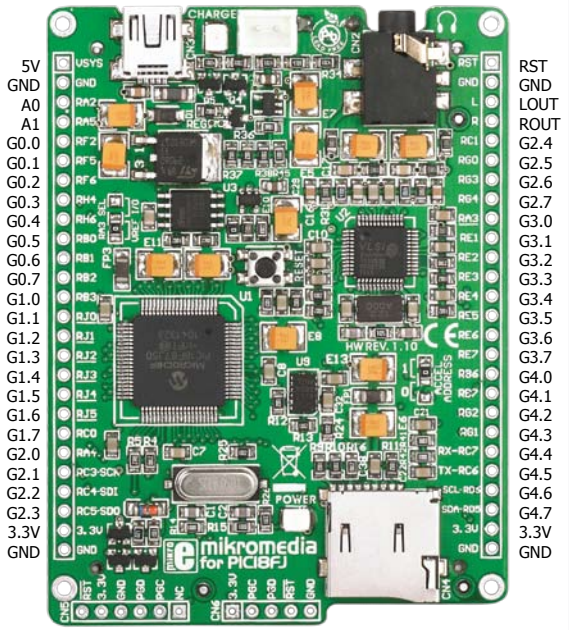
Architecture:	**32-bit**
CPU speed:	**120 MIPS**
Flash memory:	**512 kB**
RAM memory:	**32 kB**
Operating MCU Voltage:	**2.3 - 3.6 V**
USB DEVICE:	**Yes**
USB UART:	**No**
Consumption (back light is ON):	**113 mA**
Back light current:	**42mA**
Max I²C speed:	**400 kHz**
Max microSD SPI speed:	**20 MHz**
Max Flash memory SPI speed:	**40 MHz**
Max Audio codec SPI speed:	**3.33 MHz**

BSP* makes programming easier

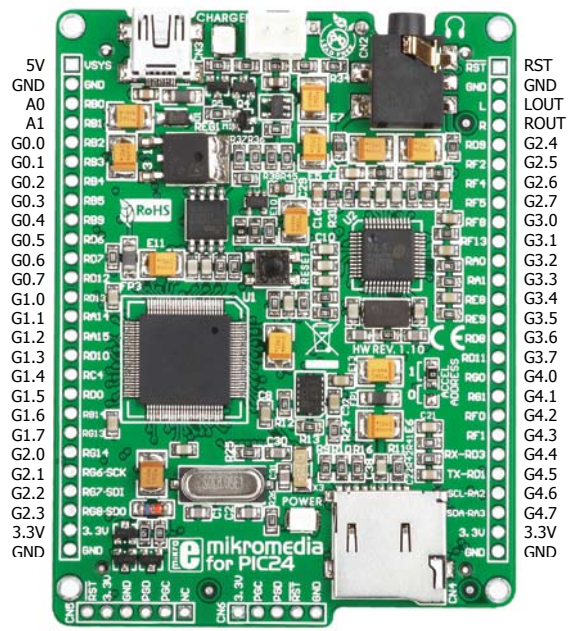
★ Board Support Package in mikroElektronika compilers

What is BSP?

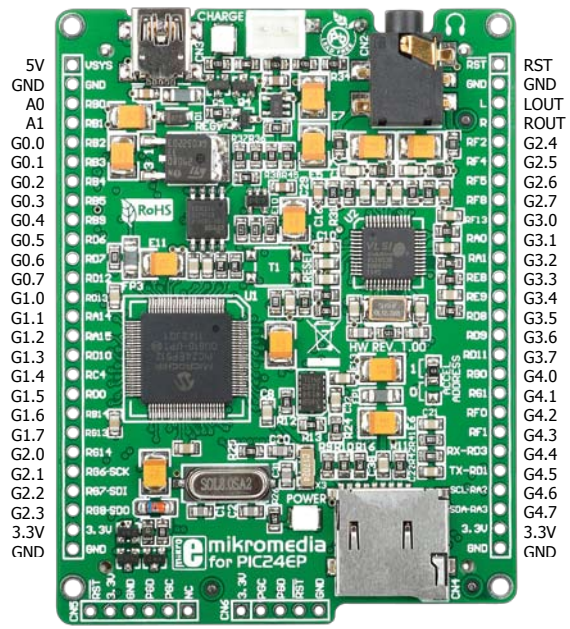
In embedded world, BSP or Board Support Package is the common name for all hardware-specific codes which simplifies working with the board. That is why we made a BSP package support for mikromedia™ workStation v7 board, to make programming of mikromedia™ boards much easier. Various mikromedia boards have different connections of microcontroller pins on side pads. mikromedia™ workStation v7 development system has a unique set of markings on a silk screen which enables you to use each pin connected to mikromedia™ side pads with the well organized layout, combined together into five I/O groups labeled as G0, G1, G2, G3 and G4. BSP abstracts what's "underneath the hood" and enables you to have one development system for various mikromedia™ boards. For example, pin number 5 on the side pad of mikromedia for PIC18FJ is connected to the RF2 microcontroller pin. On the other hand, pin number 5 on the side pad of mikromedia for PIC32 is connected to the RB2 microcontroller pin. BSP package and mikromedia workStation v7 offers you the possibility to use this pin with the unique name G0.0, and this stands for all PIC mikromedia boards. In addition to simple I/O functions, BSP package also provides you a simple way of using ADC, I2C, SPI and UART libraries without knowing, for example if it is UART1 or UART2 module connected to mikromedia™ side pads. Before using, you need to choose the appropriate BSP package depending on the programming language (C, Basic, Pascal) and the type of mikromedia (PIC18FJ®, PIC24®, PIC24EP®, dsPIC33®, dsPIC33EP®, PIC32®). BSP can only be used with Mikroelektronika compilers. If you use other compilers or if you do not want to use BSP, connections between mikromedia™ side pads and workStation board pins are as shown on the images below.



mikromedia for PIC18FJ



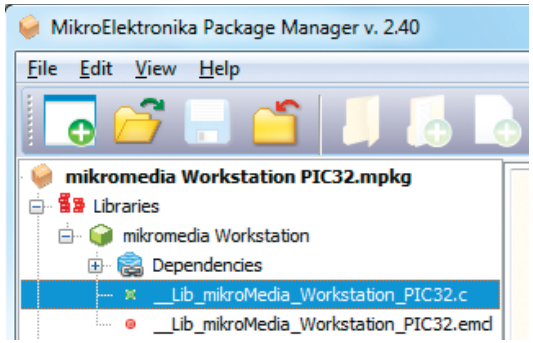
mikromedia for PIC24



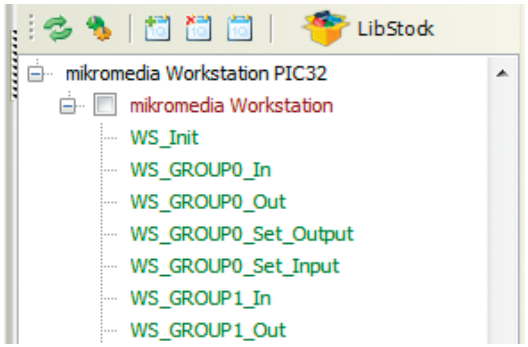
mikromedia for PIC24EP

Install board support package (BSP) in 3 simple steps:

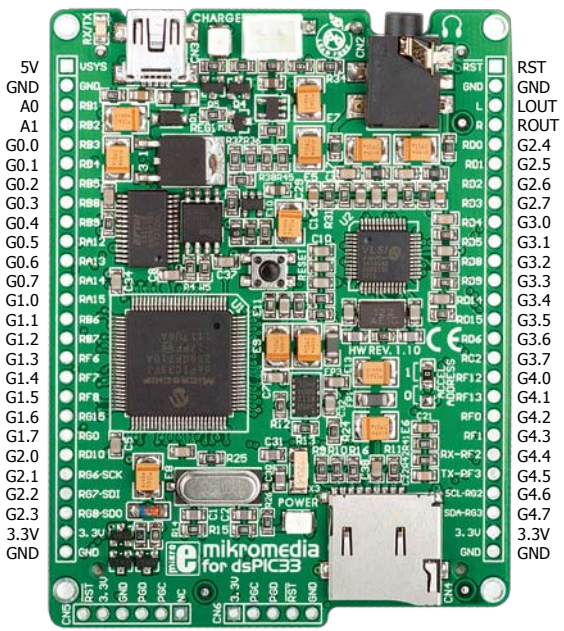
1. Download package from libstock website



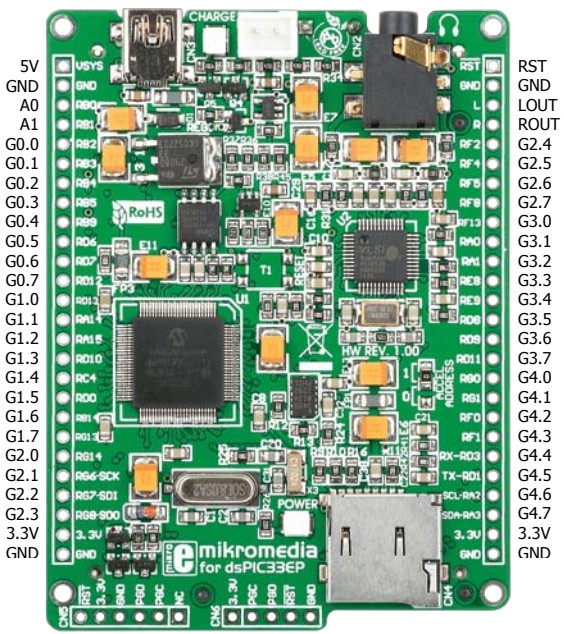
2. Install it with Package manager software



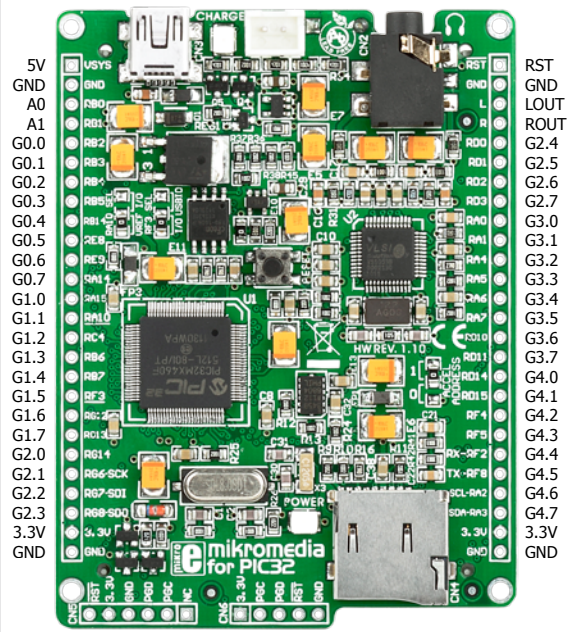
3. Use it as a library in mikroE compilers



mikromedia for dsPIC33



mikromedia for dsPIC33EP



mikromedia for PIC32

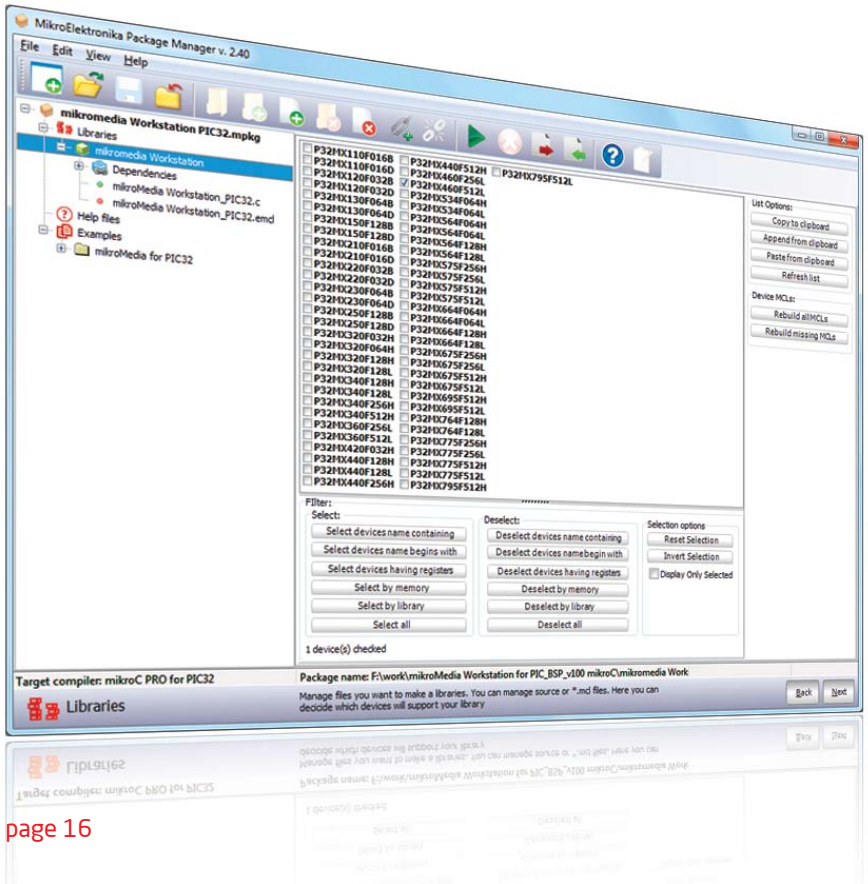
Package Manager

What is the Package manager?

Package manager is a free software which enables you to integrate your libraries into all MikroElektronika Compilers for PIC®, dsPIC®, PIC24® and PIC32®. Package manager can also make a redistributive archive with goal to be installed on other computers. Packages can contain other valuable information such as Library files, Help files and Examples. To begin, first locate the installation archive on the Product DVD:

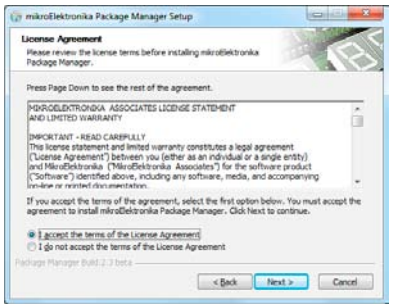
DVD:\\download\eng\software\compilers\package-manager\package_manager_v240.zip

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

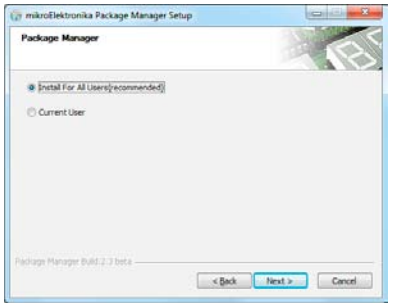


Installation wizard - 6 simple steps

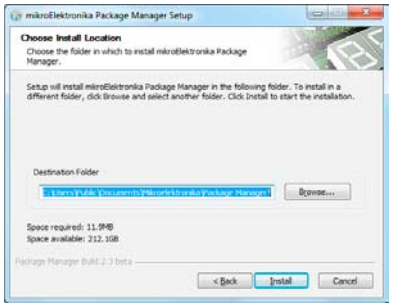
Step 1 - Start Installation



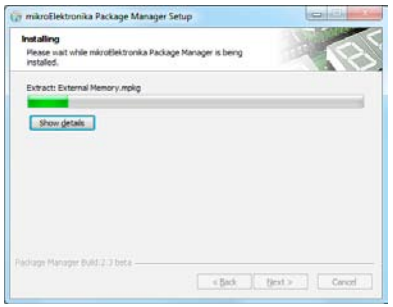
Step 2 - Accept EULA and continue



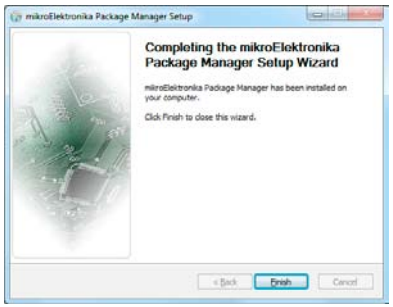
Step 3 - Install for All users or current user



Step 4 - Choose destination folder



Step 5 - Installation in progress



Step 6 - Finish Installation

Installing BSP libraries

1. Download libraries from Libstock website

Libstock is a community website created by mikroElektronika where users can share and download projects, libraries and examples for free.

In order to install BSP libraries, you need the appropriate .MPKG file which can be downloaded from following address on LibStock website:

www.libstock.com/projects/view/368/mikromedia-workstation-v7-bsp

2. Open package with Package manager

After downloading run the package file (.MPKG) and Package Manager window will appear (**Figure 4-7**).

1. **Navigation section** shows the contents of the package (libraries, help files and examples).
2. **Information section** shows the list of supported microcontrollers (appropriate controller is automatically marked
3. "Install package" button to install package
4. "Uninstall package" button to uninstall package

3. Install packages

All you need to do is to click on the "Install package" button, and the opened package will start to install in previously chosen compiler. The installation process is complete when the "Finished successfully" massage appears in Information section, **Figure 4-8.**

Open the appropriate Mikroelektronika Compiler and in the "Library Manager" section (at the end of the list) you will see unmarked "mikromedia Workstation" library.

For more information, see the Help within each package.

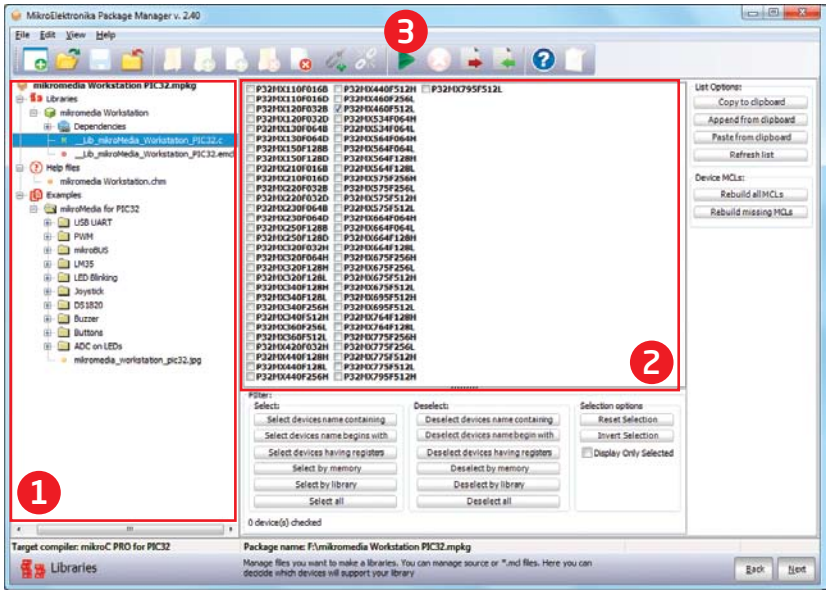


Figure 4-7: Package Manager window

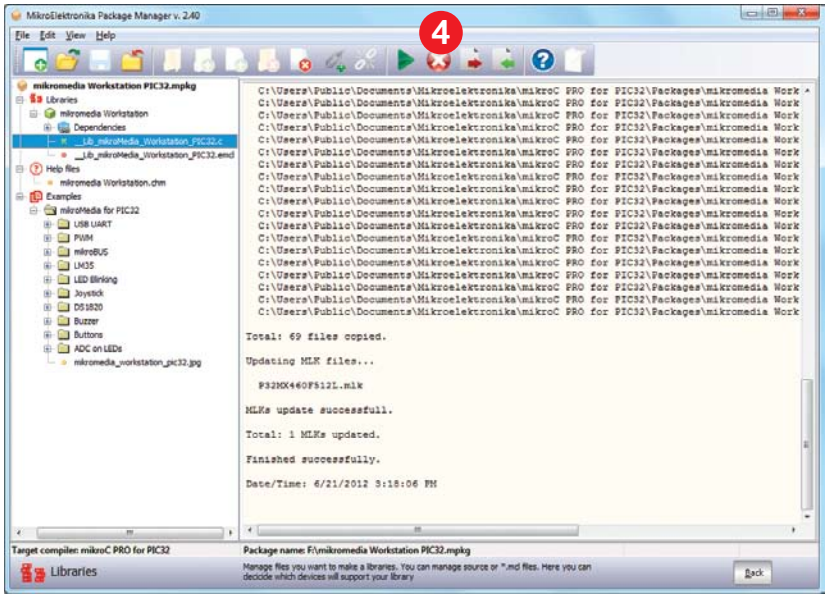


Figure 4-8: Installation is complete

On-board programmer

What is mikroProg™?

mikroProg™ is a fast USB 2.0 programmer with mikroICD™ hardware In-Circuit Debugger. Smart engineering allows mikroProg™ to support all PIC10, PIC12, PIC16, PIC18, PIC24, dsPIC30/33, PIC32 MCU families in a single programmer! It supports over 570 microcontrollers from Microchip®. 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 USB drivers (**Page 20**)
- Install mikroProg Suite™ for PIC® software (**Page 21**)

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

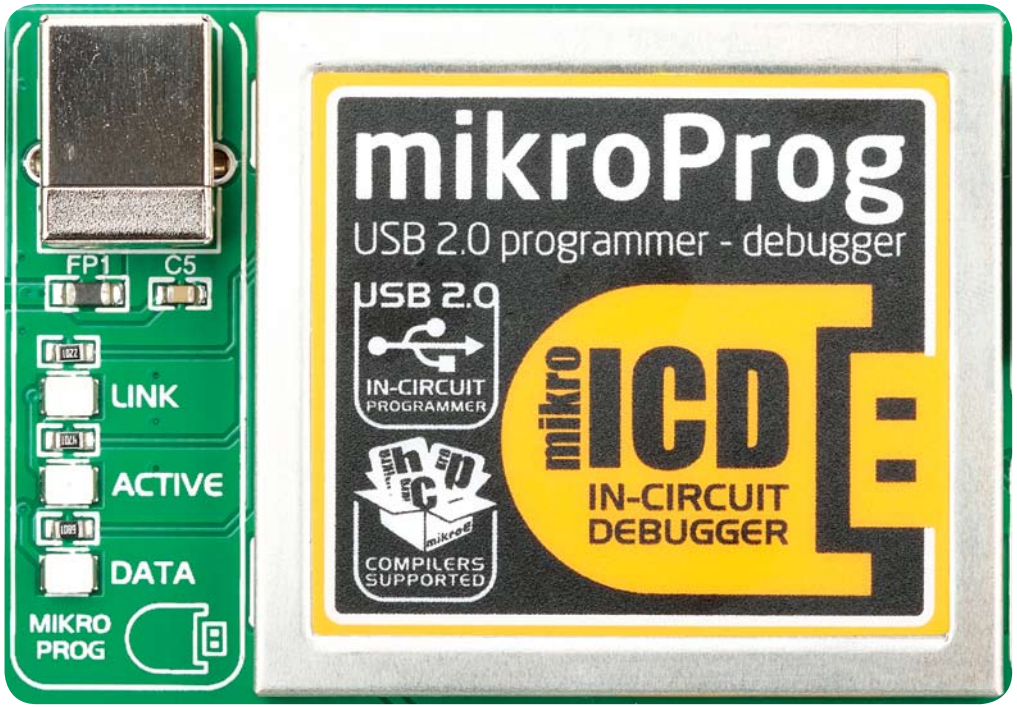


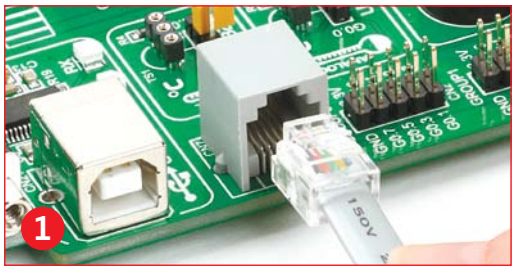
Figure 5-1: mikroProg™ is well protected under metal casing

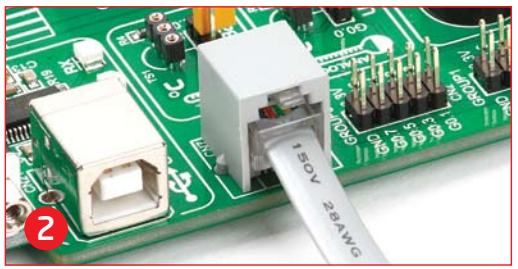
Why so many LEDs?

Three LEDs indicate specific programmer operation, **Figure 5-1**. **Link** LED lights up when USB link is established with your PC, **Active** LED lights up when programmer is active. **Data** LED lights up when data is being transferred between the programmer and PC software (compiler or mikroProg Suite™ for PIC®).

Programming with ICD2/ICD3

mikromedia™ workStation v7 is equipped with RJ-12 connector compatible with Microchip® ICD2® and ICD3® external programmers. You can either use the on-board mikroProg™ programmer or external programming tools as long as you use only one of them at the same time. Insert your ICD programmer cable into connector **CN7**, as shown in images 1 and 2.





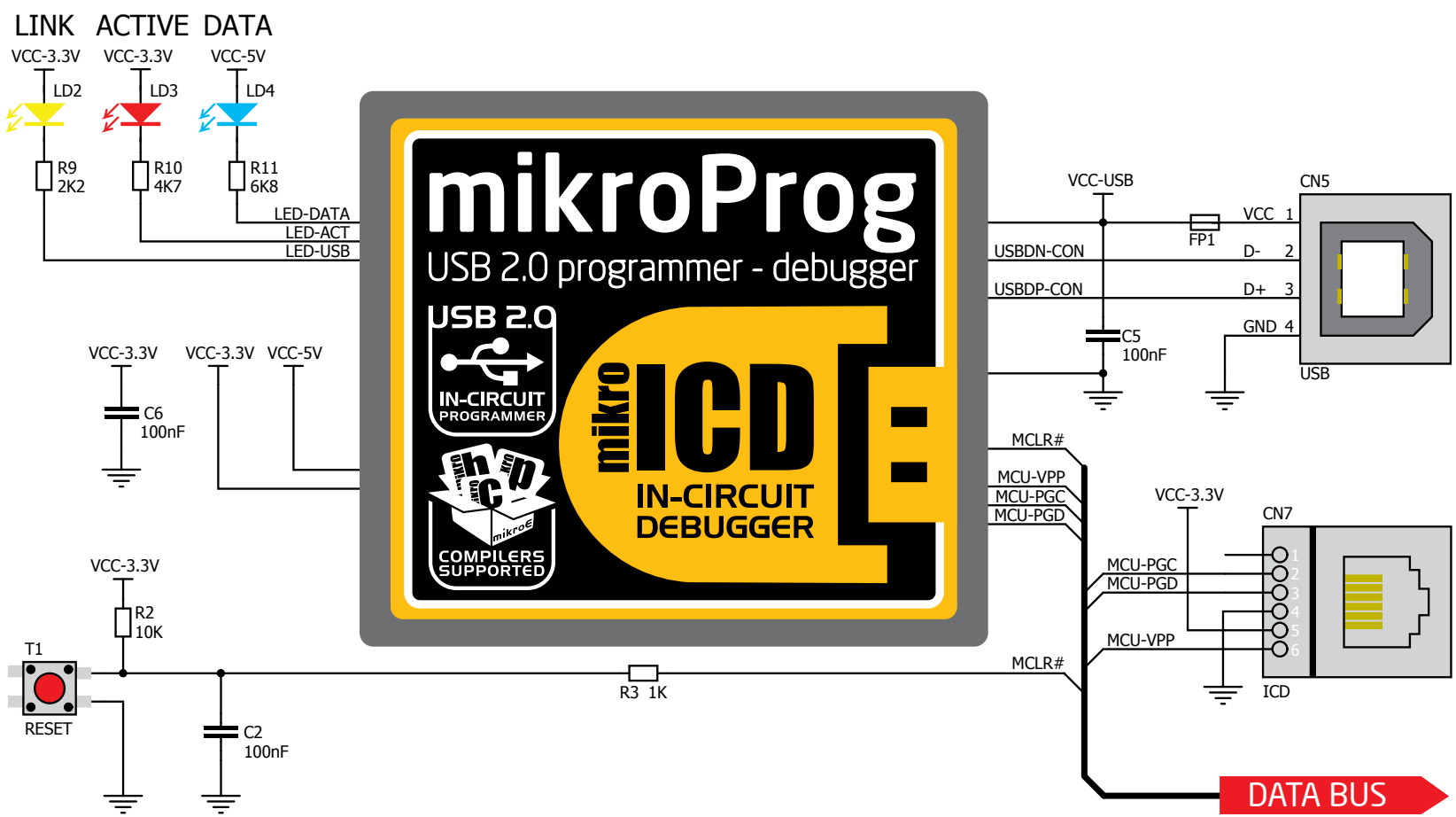


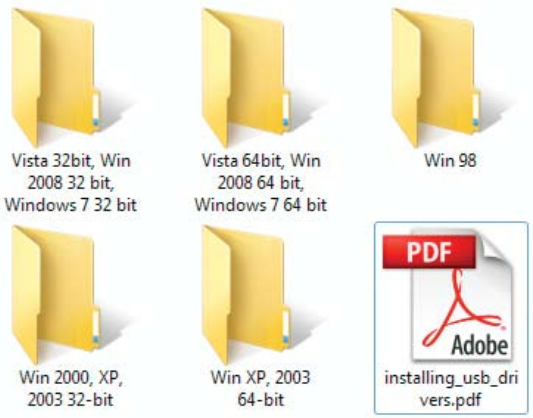
Figure 5-2: mikroProg™ block schematic

Installing programmer drivers

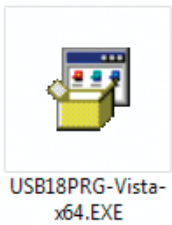
On-board mikroProg™ requires drivers in order to work. Drivers are located on the **Product DVD** that you received with the mikromedia™ workStation v7 package:

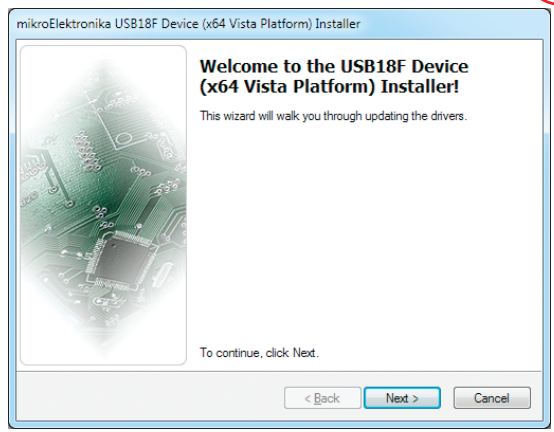
DVD://download/eng/software/development-tools/universal/mikroprog/mikroprog_for_pic_drivers_v200.zip

When you locate the drivers, please extract files from the ZIP archive. Folder with extracted files contains sub folders with drivers for different operating systems. Depending on which operating system you use, choose adequate folder and open it.



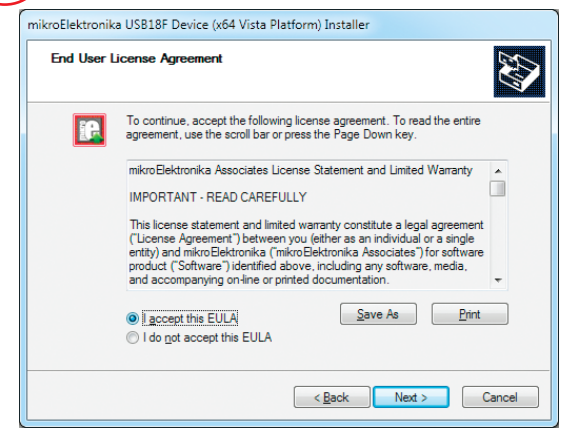
In the opened folder you should be able to locate the driver setup file. Double click on setup file to begin installation of the programmer drivers.





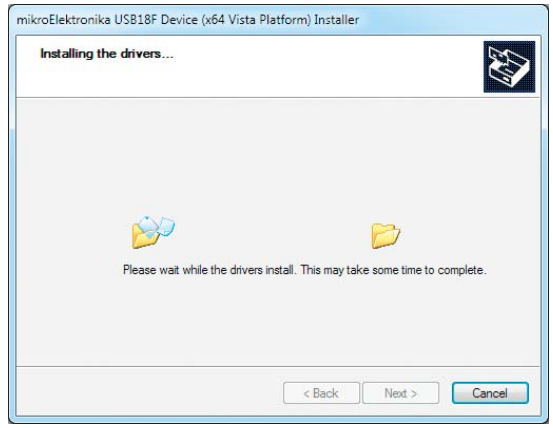
Step 1 - Start Installation

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



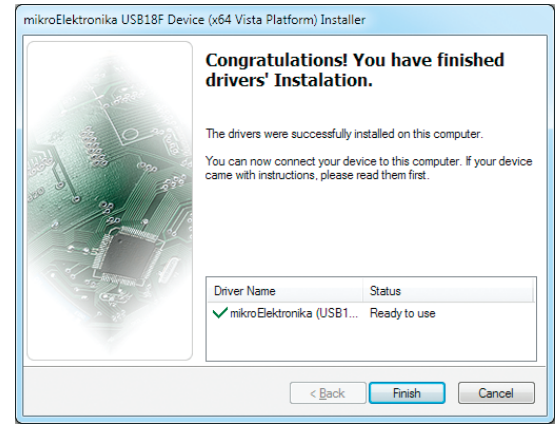
Step 2 - Accept EULA

Carefully read **E**nd **U**ser **L**icense **A**greement. If you agree with it, click **Next** to proceed.



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.

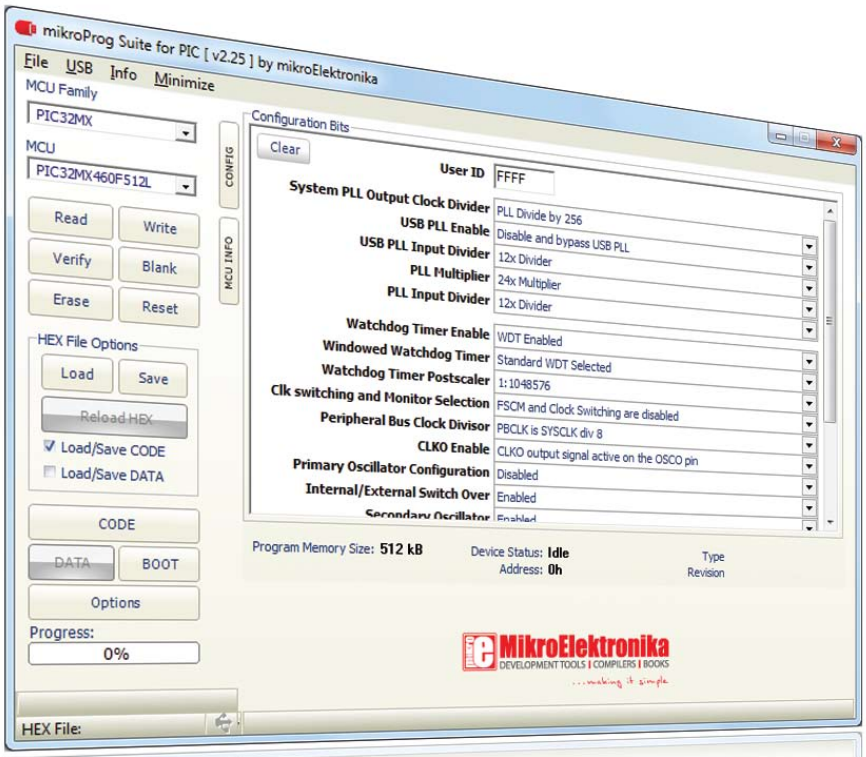
Programming software

mikroProg Suite™ for PIC®

On-board **mikroProg™** programmer requires special programming software called **mikroProg Suite™ for PIC®**. This software is used for programming all of Microchip® microcontroller families, including PIC10, PIC12, PIC16, PIC18, dsPIC30/33, PIC24 and PIC32. Software has intuitive interface and **SingleClick™** programming technology. To begin, first locate the installation archive on the Product DVD:

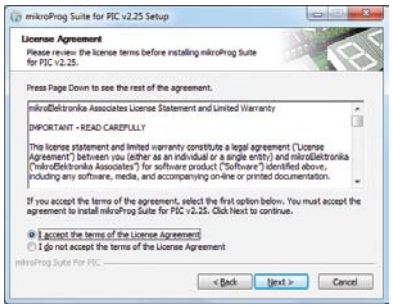
DVD://download/eng/software/development-tools/universal/mikroprog/mikroprog_suite_for_pic_v225.zip

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

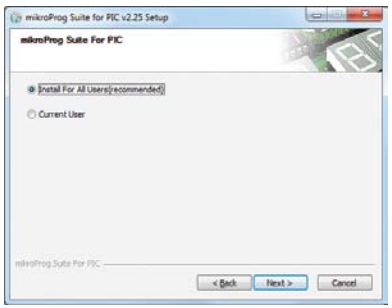


Installation wizard - 6 simple steps

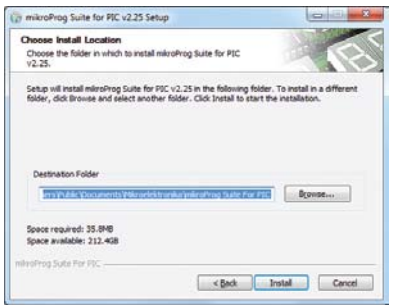
Step 1 - Start Installation



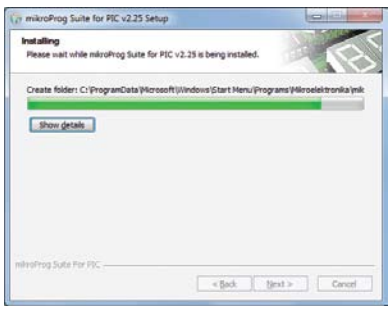
Step 2 - Accept EULA and continue



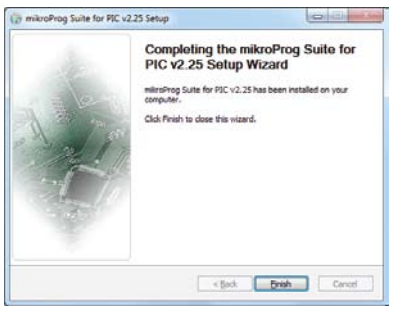
Step 3 - Install for All users or current user



Step 4 - Choose destination folder



Step 5 - Installation in progress



Step 6 - Finish Installation

mikroICD™ - In Circuit 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 planed. 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 MCU itself. And this latter one is called **In-Circuit debugging**. "In-Circuit" means that it is the real deal - code executes right on the target device.

What is mikroICD™?

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

Supported Compilers

All MikroElektronika compilers, **mikroC**, **mikroBasic** and **mikroPascal** for PIC®, dsPIC® and PIC32® natively support mikroICD™. Specialized mikroICD 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 PIC®** programming software, as described on **pages 20** and **21.**

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 and monitor their values. Complete guide to using mikroICD™ with your compiler is provided within the mikromedia™ workStation v7 package.

Figure 5-3: mikroICD™ manual explains debugging thoroughly

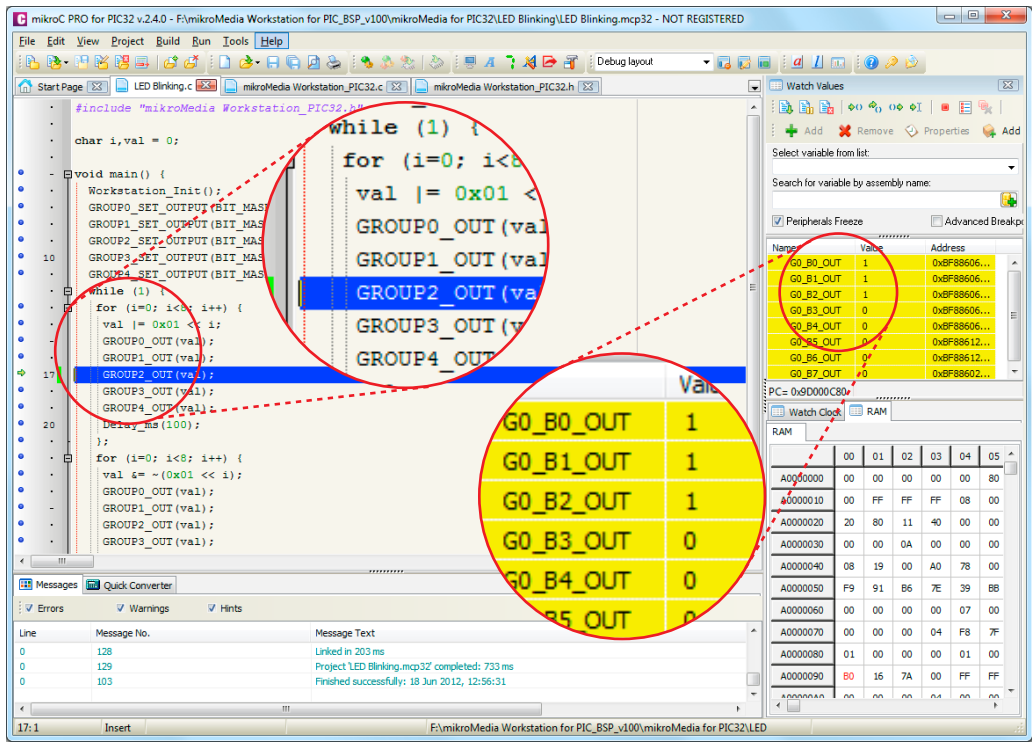


Figure 5-4: mikroC PRO for PIC32® compiler in debugging view, with SFR registers in Watch Window

mikroICD™ 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 Breakpoint	[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 mikroICD™ mode)

Input/Output Group

One of the most distinctive features of mikromedia ™ workStation v7 are it's Input/Output PORT groups. They add so much to the connectivity potential of the board.

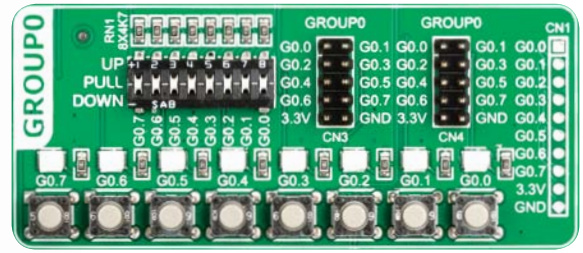


Figure 6-1: I/O group contains PORT headers, tri-state pull up/down DIP switch, buttons and LEDs all in one place

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 mikromedia™ workStation v7 cleaner and well organized. We have also provided an **additional PORT headers** on the left 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

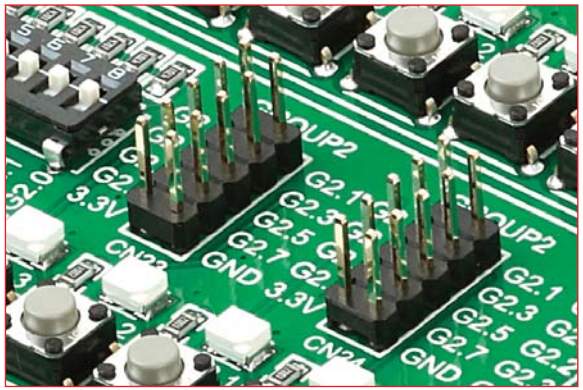
Figure 6-2: Tri-state DIP switch on GROUP0

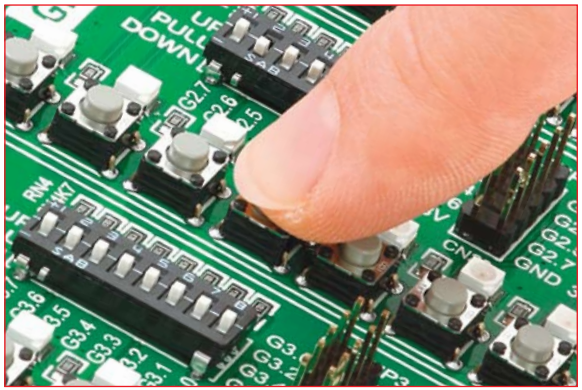
Tri-state DIP switches, like **SW1** on **Figure 6-3**, are used to enable 4K7 pull-up or pull-down resistor on any desired port pin. Each of these switches has three states:

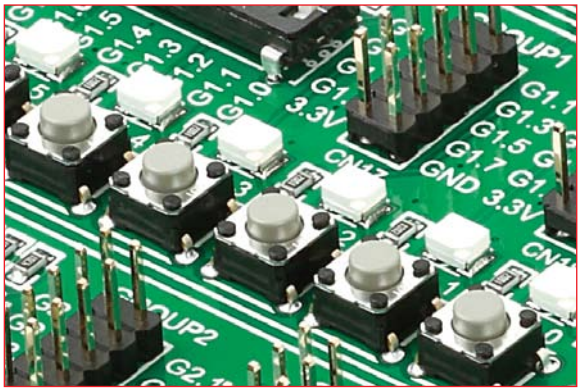
1. **middle position** disables both pull-up and pull-down feature from the PORT pin
2. **up position** connects the resistor in pull-up state to the selected pin
3. **down position** connects the resistor in pull-down state to the selected PORT pin.

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 6-3: Schematic of the single I/O GROUP0







Headers

With enhanced connectivity as one of the key features of mikromedia™ workStation v7, we have provided **four connection headers for each PORT**. I/O PORT group contains two male IDC10 header (like **CN3 and CN4 Figure 6-3**) and one 1x10 row of connection pads (like **CN1 Figure 6-3**). There is **one more IDC10 header** available on the left side of the board next to breadboard. IDC10 can be used to connect accessory boards with IDC10 female sockets.

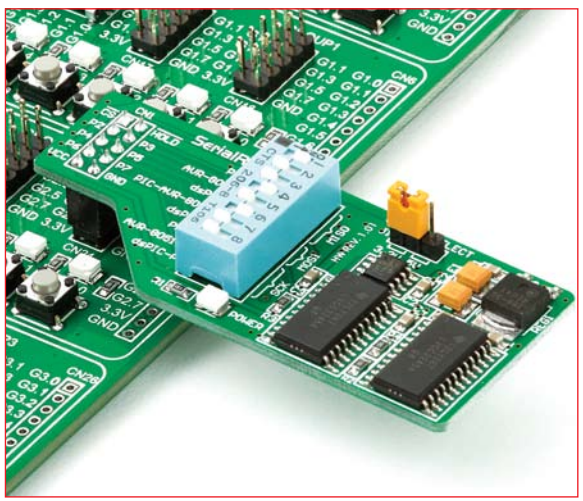


Figure 6-4: IDC10 male headers enable easy connection with mikroElektronika accessory boards

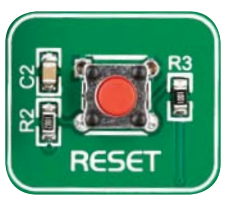
Buttons

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

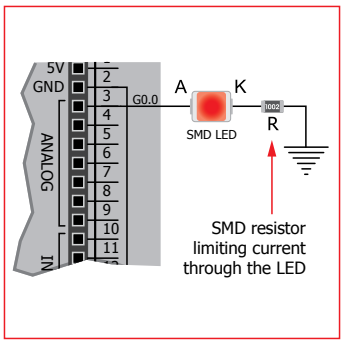
The logic state of all microcontroller digital inputs may be changed using **push buttons**. Tri-state DIP switch **SW2** is available for selecting which logic state will be applied to corresponding MCU pin when button is pressed, for each I/O port separately. If you, for example, place **SW2.1** in **VCC** position, then pressing of any push button in GROUP0 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 **J5** and **J6**, 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.

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. There is an additional button at the top of the mikromedia™ board.



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 mikromedia™ workStation v7 board uses low-current LEDs with typical current consumption of 0.2mA or 0.3mA. Board contains 40 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 GROUP LEDs, it is necessary to enable the corresponding DIP switch on **SW3** (**Figure 6-6**).

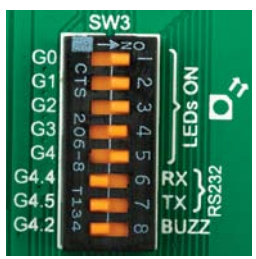


Figure 6-6: SW3.1 through SW3.5 switches are used to enable GROUP LEDs

mikroBUS™ sockets

Easier connectivity and simple configuration are imperative in modern electronic devices. Success of the USB standard comes from it's 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 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 of additional hardware settings. We called this new standard the **mikroBUS™.** mikromedia™ workStation v7 supports mikroBUS™ with four on-board host 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.

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 - 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

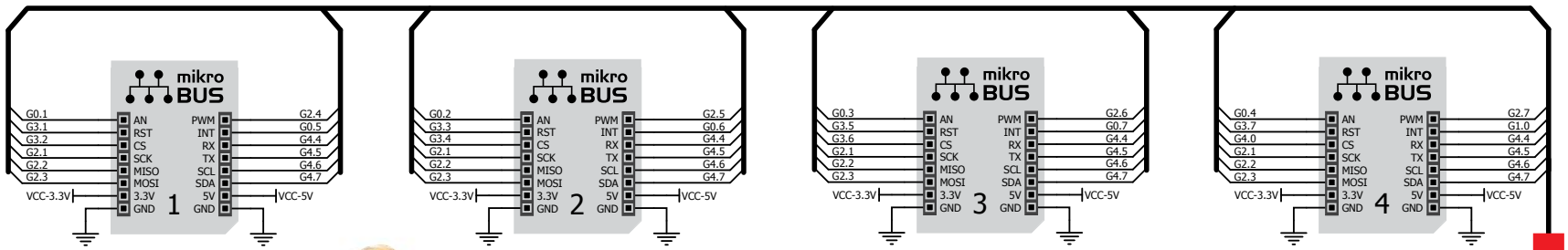
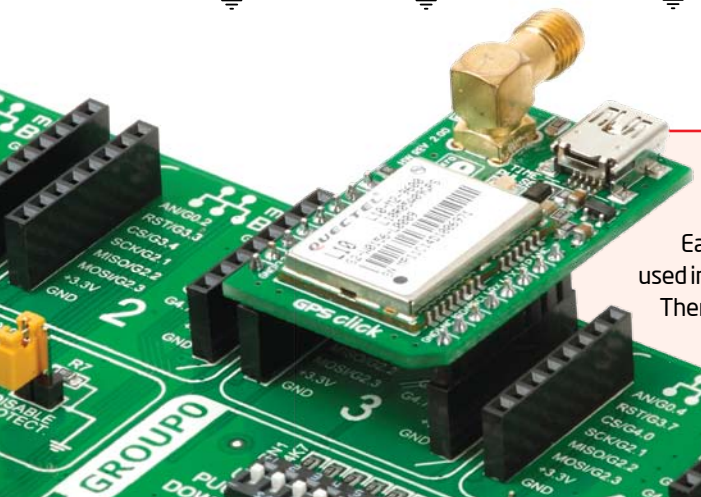


Figure 7-1: Connection schematic of on-board mikroBUS™ host sockets



mikroBUS™ host connector

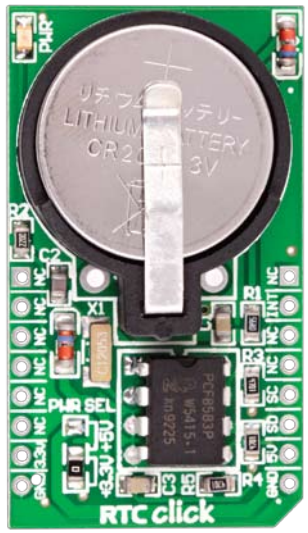
Each mikroBUS™ host connector consists of two 1x8 female headers containing pins that are most likely to be used in the target accessory board. There are three groups of communication pins: **SPI**, **UART** and **I²C** communication. There are also single pins for **PWM**, **Interrupt**, **Analog input**, **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.

GPS click™

BEE click™

ETH click™

WiFi PLUS click™

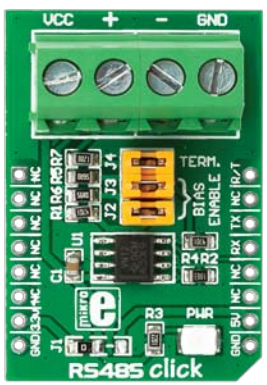


RTC click™

Click Boards™ are plug-n-play!

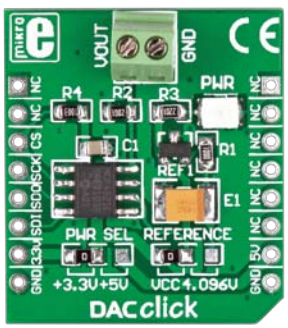
mikroElektronika portfolio of over 200 accessory boards is now enriched by an additional set of mikroBUS™ compatible **Click Boards™**. Almost each month several new Click boards™ are released. It is our intention to provide the community with as much of these boards as possible, so you will be able to expand your mikromedia™ workStation v7 board with additional functionality with literally zero hardware configuration. Just plug and play. mikromedia™ workStation v7 supports **only 3.3V Click Boards™**. Visit the Click boards™ web page for the complete list of available boards:

http://www.mikroe.com/eng/categories/view/102/click-boards/

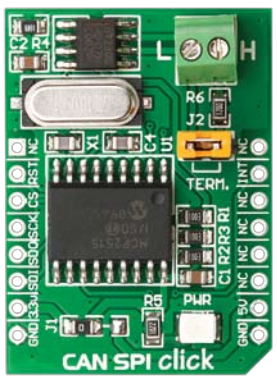


RS485 3.3V click™

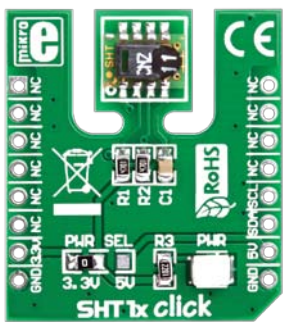
BlueTooth click™



DAC click™



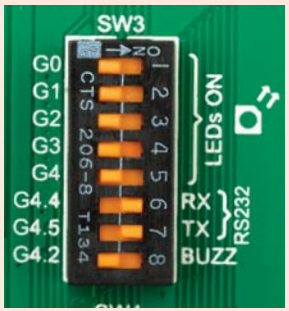
CAN SPI 3.3V click™



SHT1x click™

UART via RS-232

Enabling RS-232



In order to enable RS-232 communication you must push **SW3.6** (G4.4) and **SW3.7** (G4.5) to **ON** position. This connects the **RX** and **TX** lines to appropriate mikromedia™ board UART module.

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

RS-232 serial communication is performed through a 9-pin SUB-D connector and the microcontroller UART module. In order to enable this communication, it is necessary to establish a connection between **RX** and **TX** lines on SUB-D connector and the same pins on the target microcontroller using DIP switches. Since RS-232 communication voltage levels are different than microcontroller logic levels, it is necessary to use a RS-232 Transceiver circuit, such as **MAX3232** as shown on **Figure 8-1**.

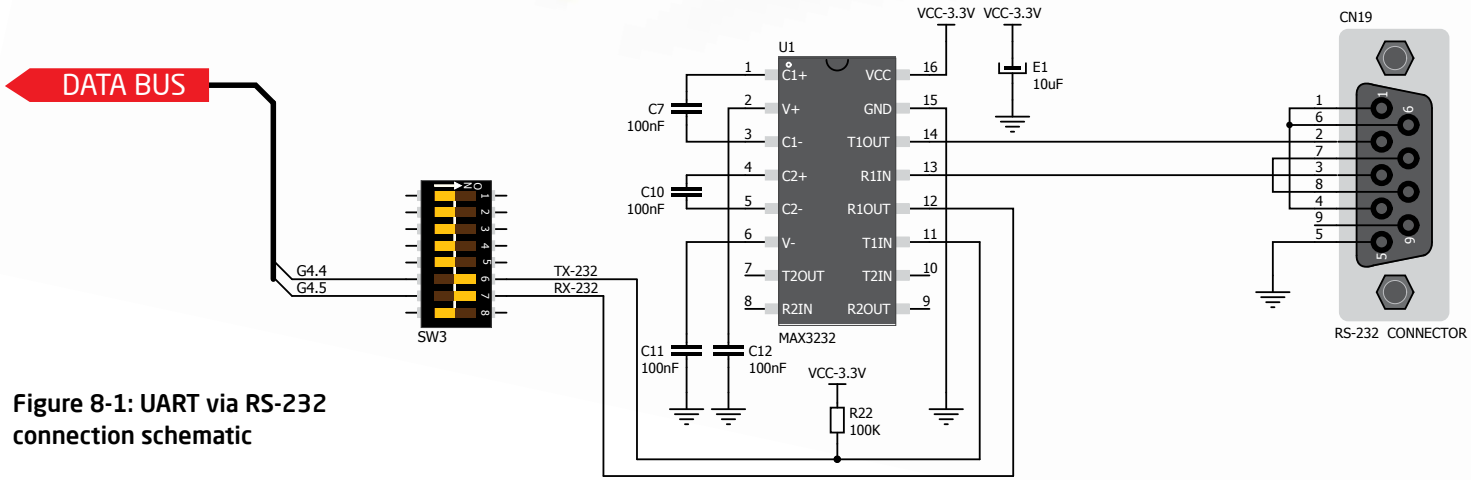
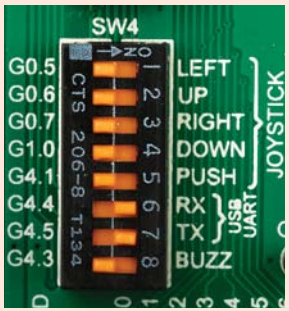


Figure 8-1: UART via RS-232 connection schematic

UART via USB

Enabling USB-UART



In order to enable USB-UART communication, you must push **SW4.6** (G4.4) and **SW4.7** (G4.5) to **ON** position. This connects the **RX** and **TX** lines to appropriate mikromedia™ board UART module.

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. **FT232RL** from FTDI® convert UART signals to the appropriate USB standard. In order to use USB-UART module on mikromedia™ workStation v7 board, you must first install FTDI drivers on your computer. Drivers can be found on **Product DVD**:

DVD://download/eng/software/development-tools/universal/ftdi/vcp_drivers.zip

USB-UART communication is being done through a FT232RL controller, USB connector **(CN21)**, and microcontroller UART module. To establish this connection, you must connect **RX** and **TX** lines to the appropriate pins of the mikromedia™ board. This connection is done using DIP switches **SW4.6** and **SW4.7**.

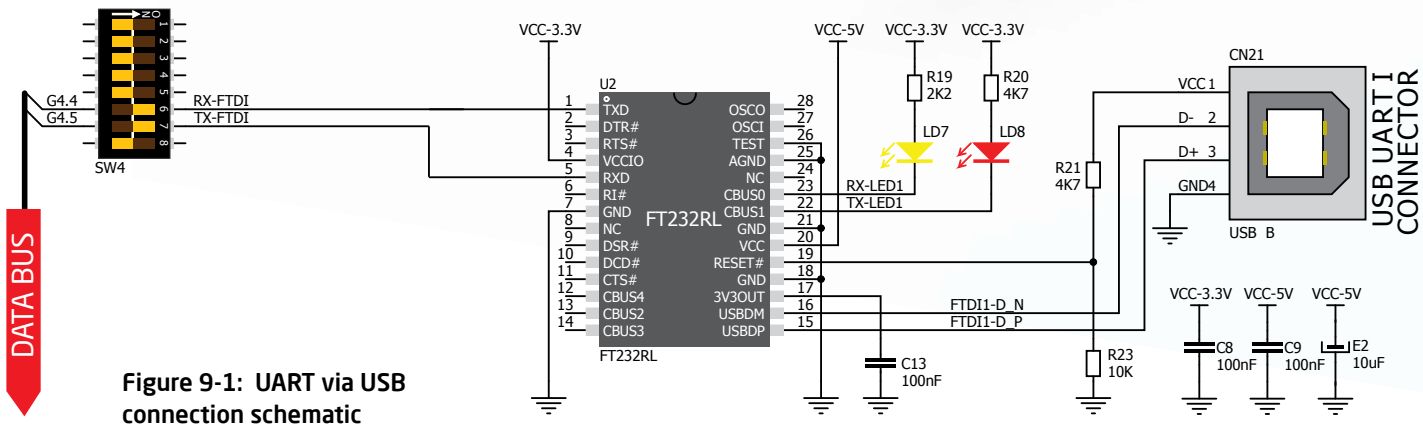


Figure 9-1: UART via USB connection schematic

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. mikromedia™ workStation v7 features navigation switch with five different positions: **Up**, **Down**, **Left**, **Right** and **Push**. Each of those acts as a button, and is connected to one of the following microcontroller pins: **G0.6**, **G1.0**, **G0.5**, **G0.7**, **G4.1** (respectively). After pressing the navigation switch in desired direction, associated microcontroller pins are connected to GND, which can be detected in user software. To enable **LEFT**, **UP**, **RIGHT**, **DOWN**, **PUSH** ports you must turn on DIP switches **SW4.1-SW4.5**.

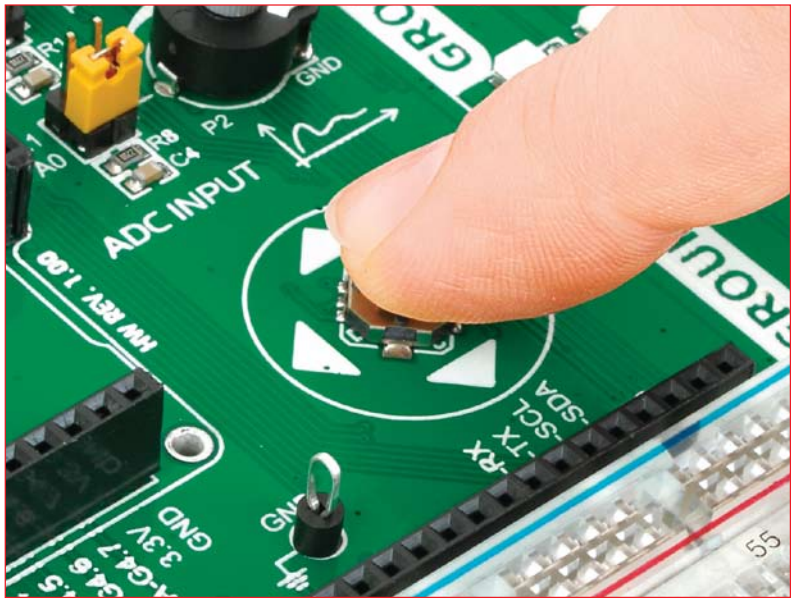


Figure 10-2: Navigation switch is an intuitive solution for browsing through on-screen menus.

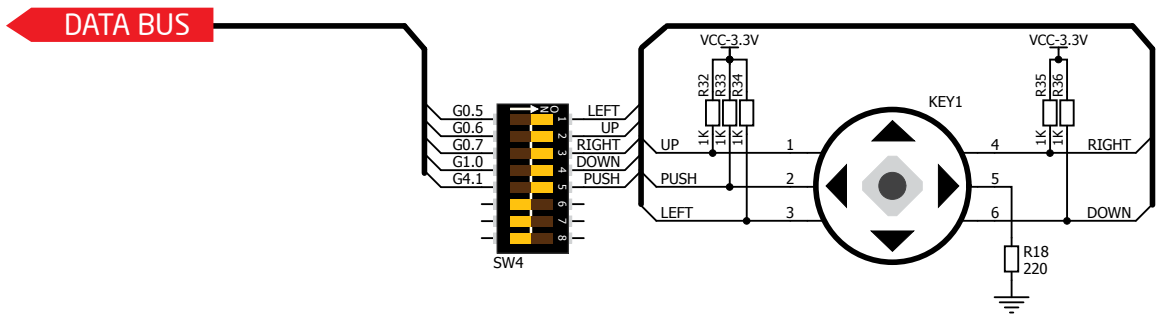
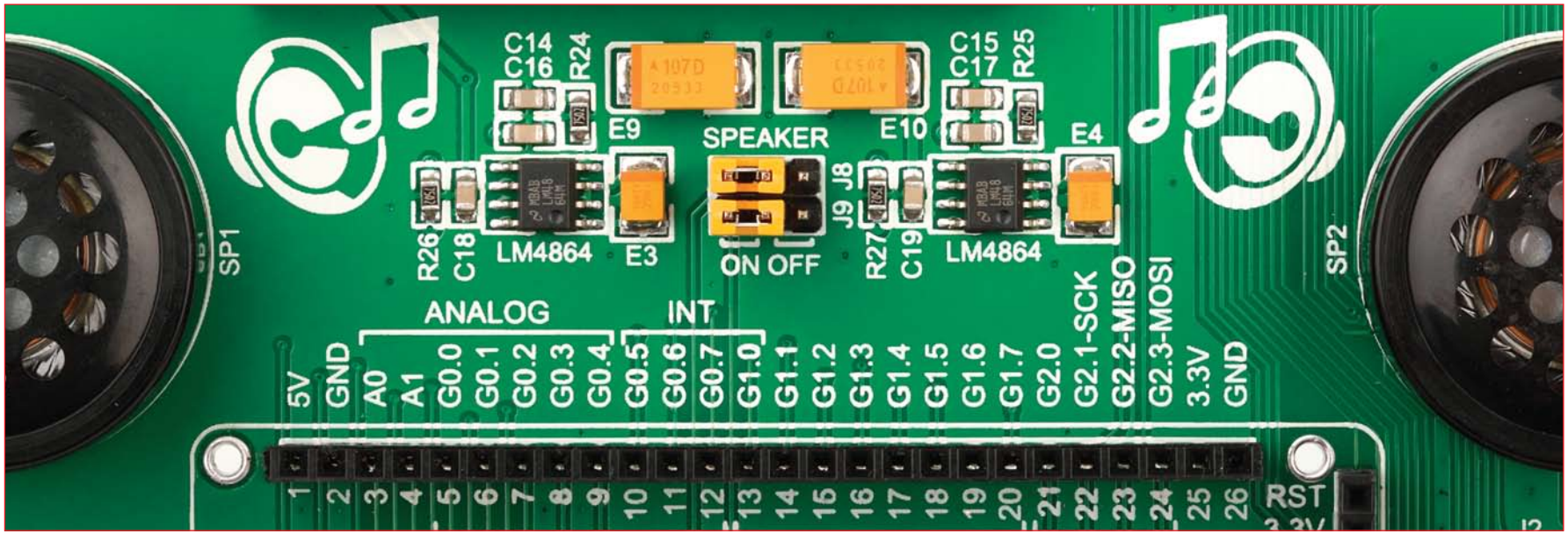


Figure 10-1: Navigation switch connection schematic.

Audio module



It's hard to imagine modern multimedia devices without high quality audio reproduction modules. Sound and music are almost important as graphical user interface. mikromedia™ workStation v7 contains two audio power amplifiers capable of delivering 675mW of continuous average power into an 8Ω load. Amplifiers are connected each with one speaker, thus with mikromedia stereo **VS1053** audio codec making a stereo audio system. Speakers has maximum power of 0.20W with 81dB maximum output sound level. Left and right audio signals are brought to the board directly from the mikromedia board (socket) via two connection pins LOUT and ROUT (left and right stereo signals). You can disconnect each off the amplifiers, from the mikromedia socket **LOUT** and **ROUT** pins, by placing **J8** and **J9** jumpers in OFF position, respectively. After programming and testing Stereo system can be implement in your final design.

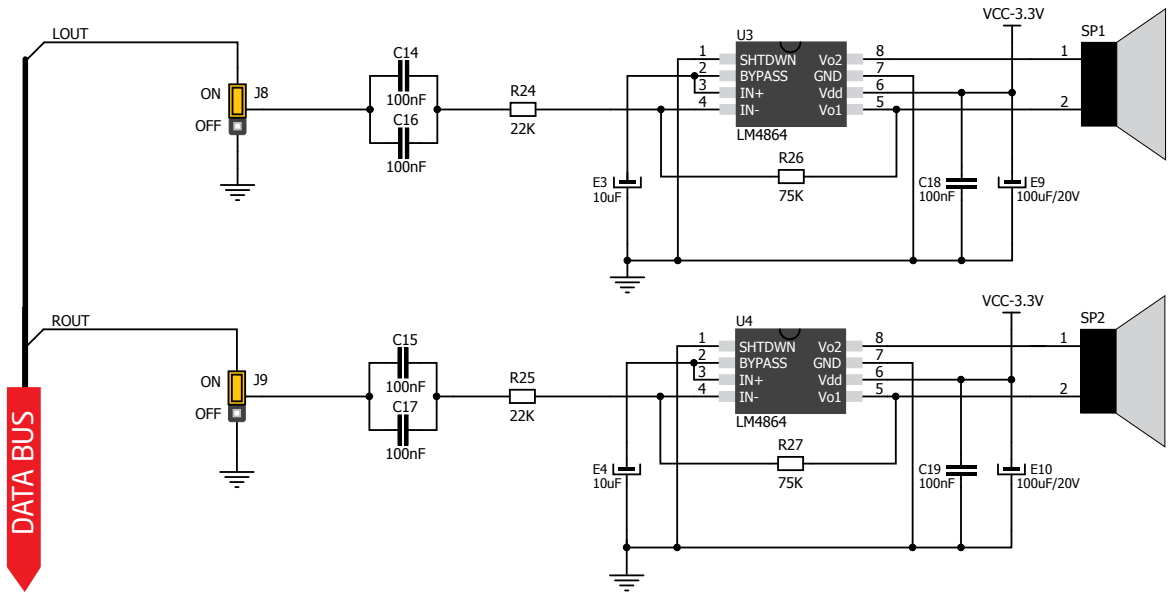
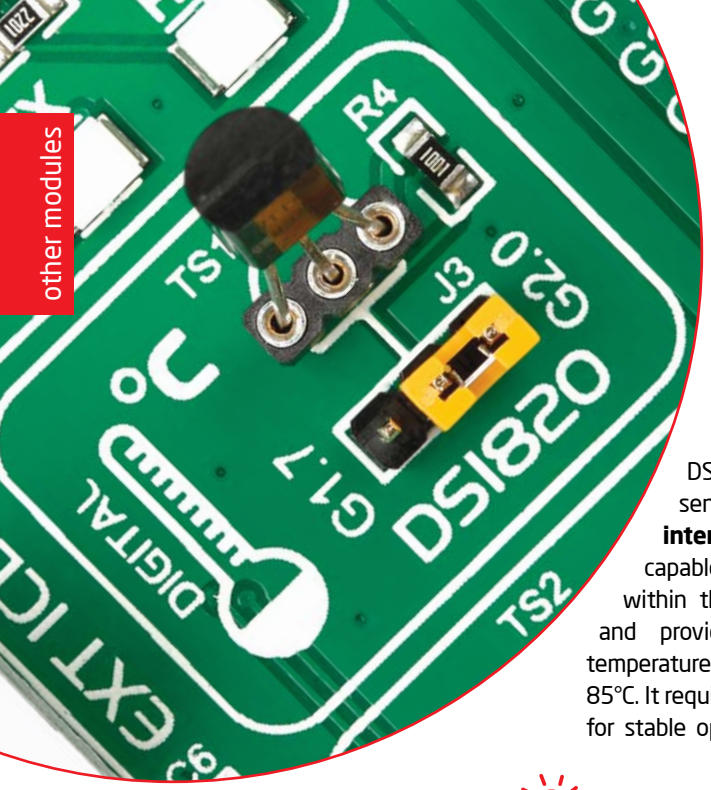


Figure 11-1: Audio module connection schematic.



DS1820 - Digital Temperature Sensor

DS1820 is a digital temperature sensor that uses **1-wire® interface** for it's operation. It is capable of measuring temperatures within the range of -55 to 128°C, and provides ±0.5°C accuracy for temperatures within the range of -10 to 85°C. It requires 3V to 5.5V power supply for stable operation. It takes 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 selected with a **J3** jumper.

Enabling DS1820 Sensor

1

Figure 12-1: DS1820 not connected

2

Figure 12-2: DS1820 placed in socket

3

Figure 12-3: DS1820 connected to G1.7 pin

4

Figure 12-4: DS1820 connected to G2.0 pin

mikromedia™ workStation v7 enables you to establish 1-wire® communication between **DS1820** and the microcontroller over **G1.7** or **G2.0** pins. The selection of either of those two lines is done using **J3** jumper. When placing the sensor in the socket make sure that half-circle on the board's silkscreen markings matches the rounded part of the DS1820 sensor. If you accidentally connect the sensor the other way, it may be permanently damaged. Make sure to disconnect other peripherals (except those in 1-wire network), LEDs and additional pull-up or pull-down resistors from the interface lines in order not to interfere with signal/data integrity.

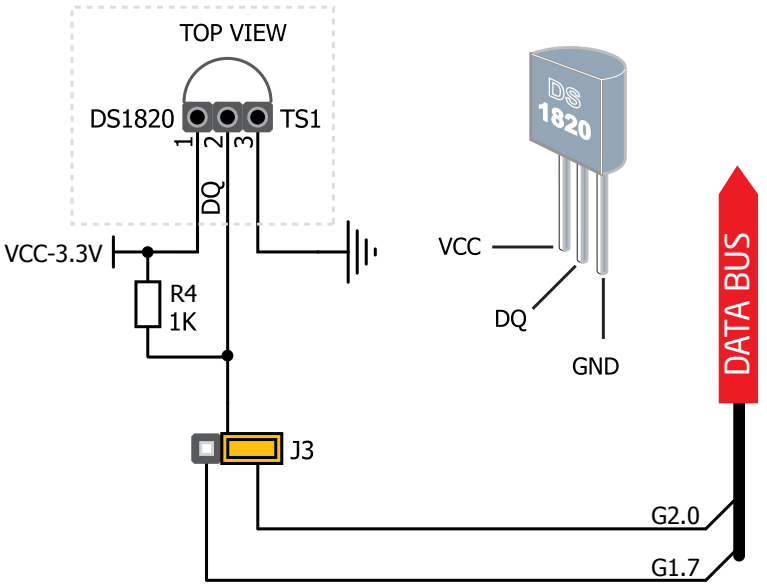
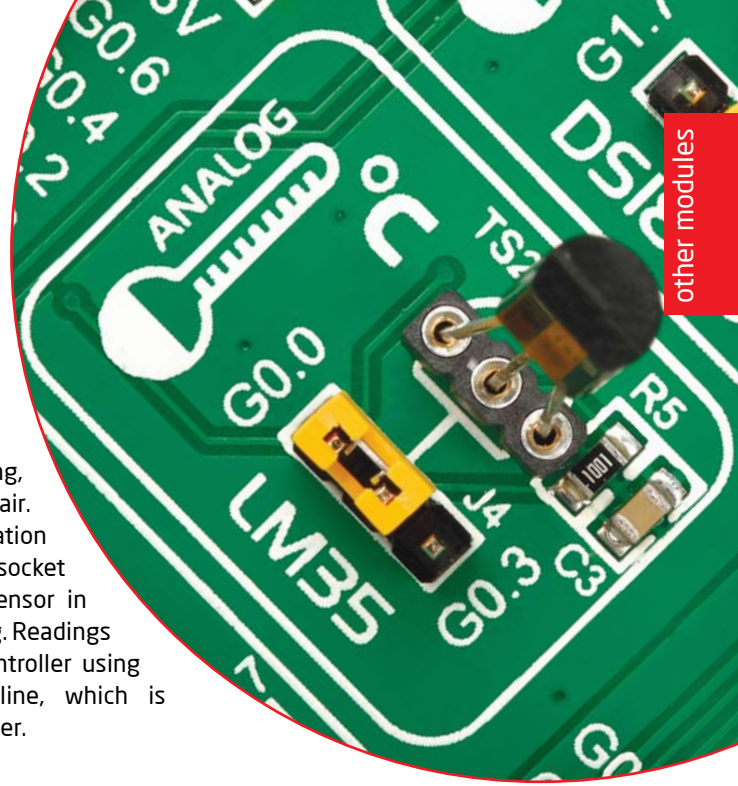


Figure 12-5: DS1820 connected to G2.0 pin

LM35 - Analog Temperature 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. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55 to +150°C temperature range. It has a linear + 10.0 mV/°C scale factor and less than 60 µA current drain. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. mikromedia™ workStation v7 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 a **J4** jumper.

Enabling LM35 Sensor

1

Figure 13-1: LM35 not connected

2

Figure 13-2: LM35 placed in socket

3

Figure 13-3: LM35 connected to G0.3 pin

4

Figure 13-4: LM35 connected to G0.0 pin

mikromedia™ workStation v7 enables you to get analog readings from the LM35 sensor using **G0.0** or **G0.3** microcontroller pins. The selection of either of those two lines is done using **J4** jumper. When placing the sensor in the socket make sure that half-circle on the board's silkscreen markings matches the rounded part of the LM35 sensor. If you accidentally connect the sensor the other way, it can be permanently damaged and you might need to replace it with another one. During the sensor readings make sure that no other device is using the selected analog line, as that may interfere with the readings.

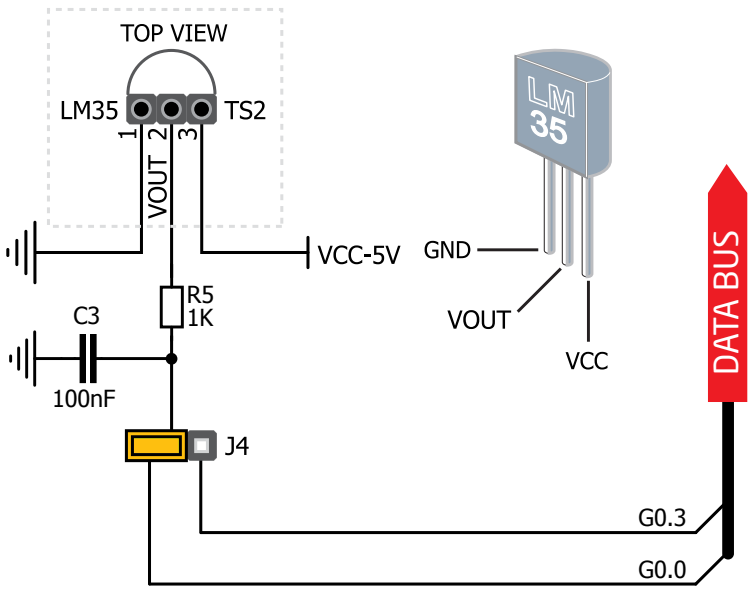
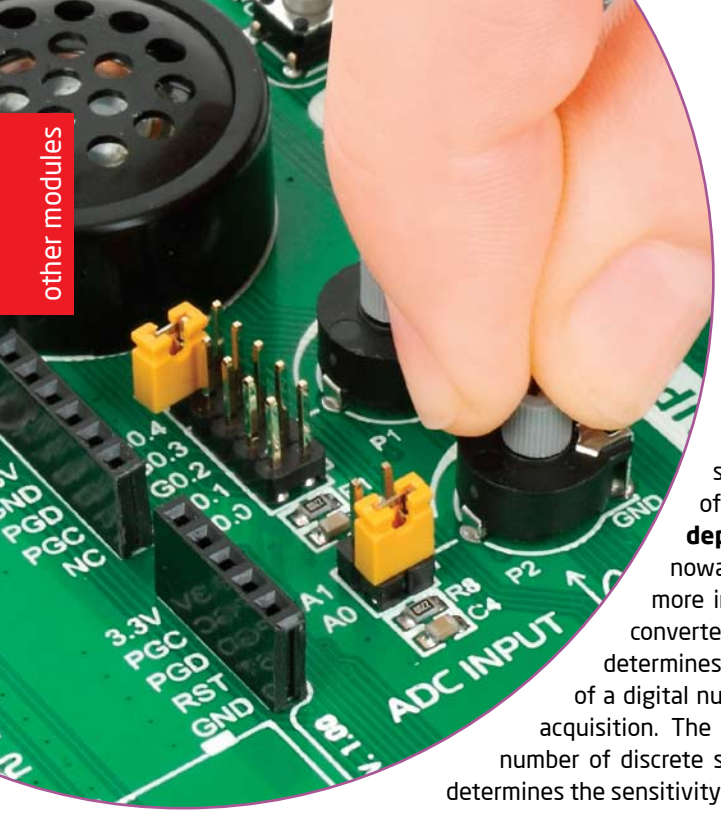


Figure 13-5: LM35 connected to G0.0 pin

ADC inputs



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. For example if microcontroller has 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 0-3.3V, can be divided into 1024 discrete steps of about 3.22mV.

mikromedia™ workStation v7 board provides an interface in form of two potentiometers for simulating analog input voltages that can be routed to any of the 7 supported analog input pins of mikromedia™ board.

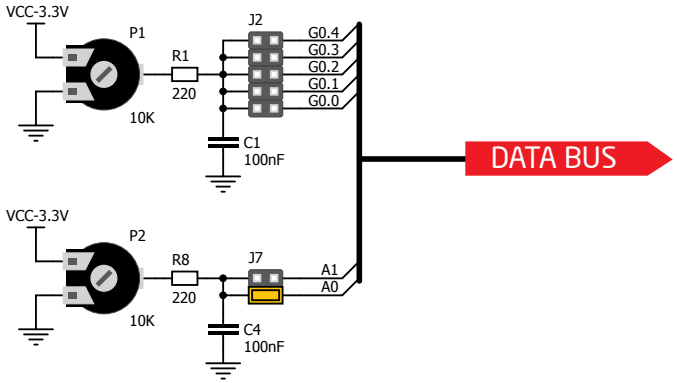


Figure 14-2: Schematic of ADC input

Enabling ADC inputs

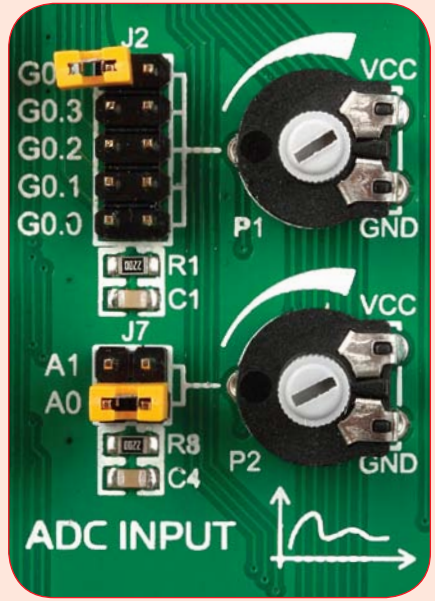


Figure 14-1: use J2 and J7 jumpers to connect analog input lines with potentiometers P1 and P2

In order to connect the output of the potentiometer **P1** to **G0.0**, **G0.1**, **G0.2**, **G0.3** or **G0.4** analog mikromedia™ inputs, you have to place the jumper **J2** in the desired position. If you want to connect potentiometer **P2** to **A0** or **A1** analog mikromedia™ inputs, place jumper **J7** in the desired position. By moving the potentiometer knob, you can create voltages in range from **GND** to **VCC**.

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. mikromedia™ workStation v7 comes with piezo buzzer which can be connected to **G4.2** or **G4.3** microcontroller pin. Connection is established using **SW3.8** or **SW4.8** DIP switch. Buzzer is driven by transistor **Q1** (**Figure 25-1**). 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.

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**.

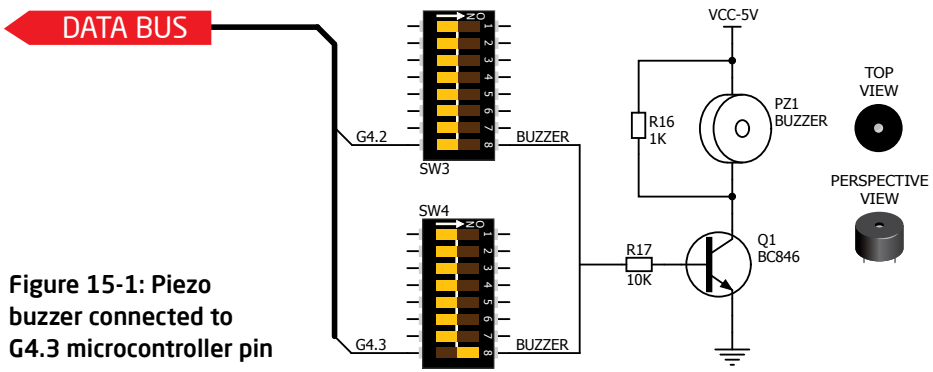
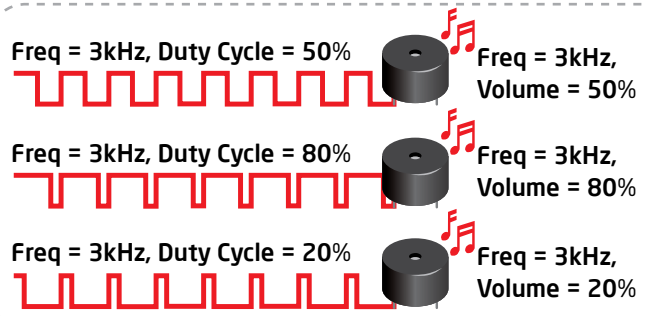


Figure 15-1: Piezo buzzer connected to G4.3 microcontroller pin

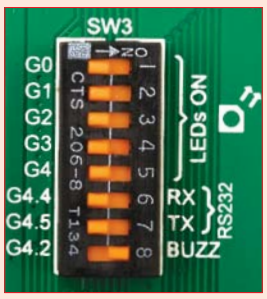


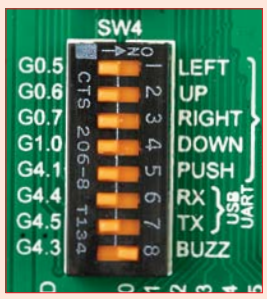
How to make it sing?

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

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 pin. This is done using **SW3.8** or **SW4.8** DIP switch (never in the same time). Once the switch is in ON position, it connects the buzzer driver to **G4.2** or **G4.3** pin.



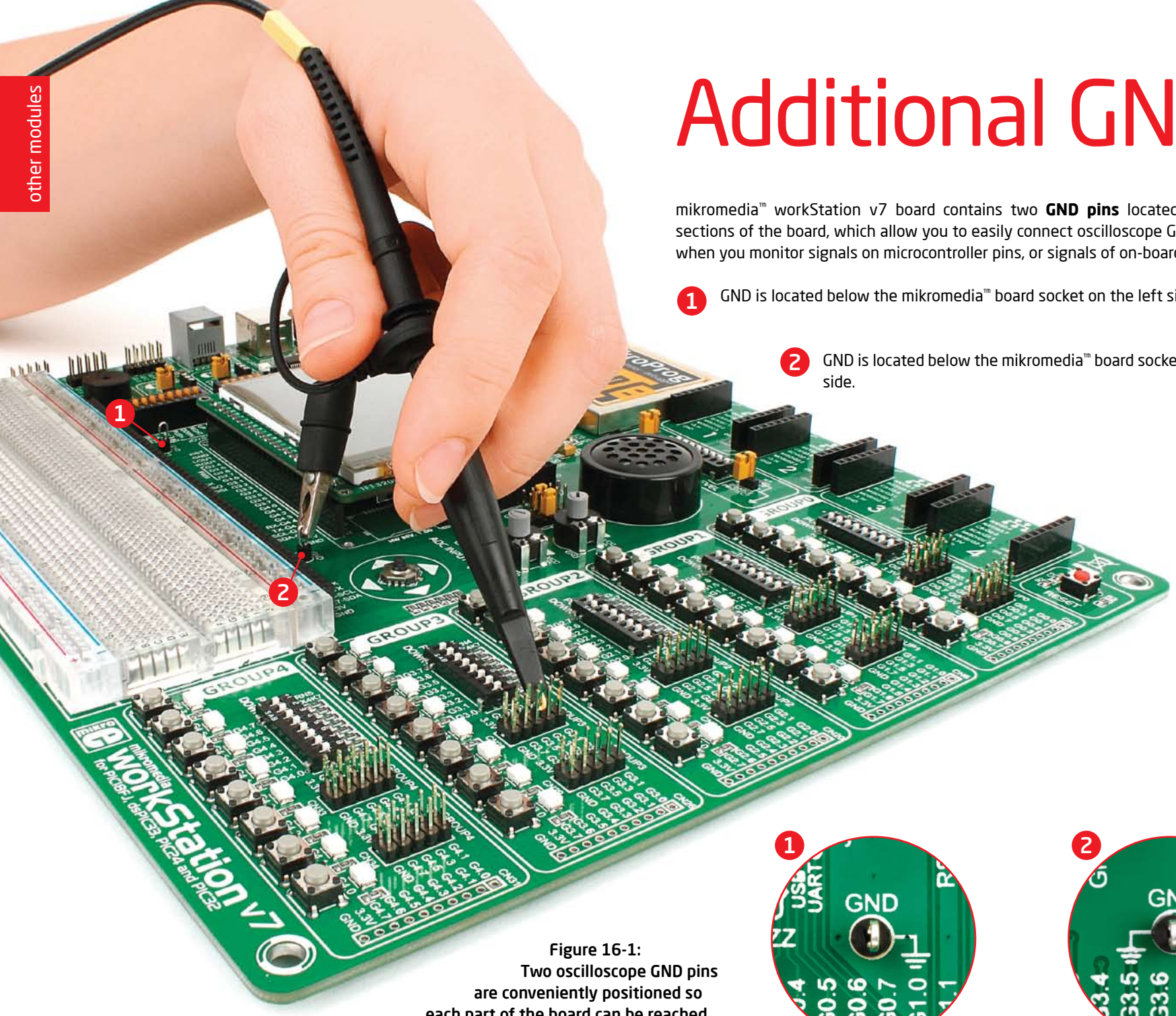


Additional GNDs

mikromedia™ workStation v7 board contains two **GND pins** located in 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 is located below the mikromedia™ board socket on the left side.

2. GND is located below the mikromedia™ board socket on the right side.



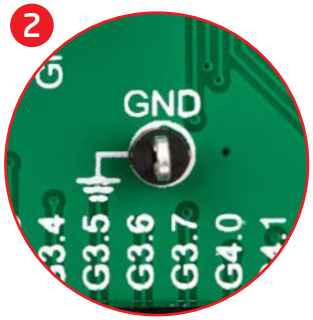


Figure 16-1:
Two oscilloscope GND pins are conveniently positioned so each part of the board can be reached with an oscilloscope probe

Breadboard area

mikromedia™ workStation v7 contains Breadboard area as well as additional 1x52 female header, side by side. That allows you to expand your mikromedia™ workStation v7 board with additional functionality. That can be done by placing your additional components (such as resistors, LED diodes, motors, DIP IC's, etc.) on available Breadboard area. There are 63 vertical lines on both halves of the Breadboard area.

Each line consists out of 5 female connectors (connected together). There are also four horizontal lines for GND and VCC. Female connectors are arranged in standard distance form factor. 1x26 female header allows you to easily connect Breadboard connectors to mikromedia socket pins, using male to male wire jumpers provided with the package. Example is shown on **Figure 17-1.**

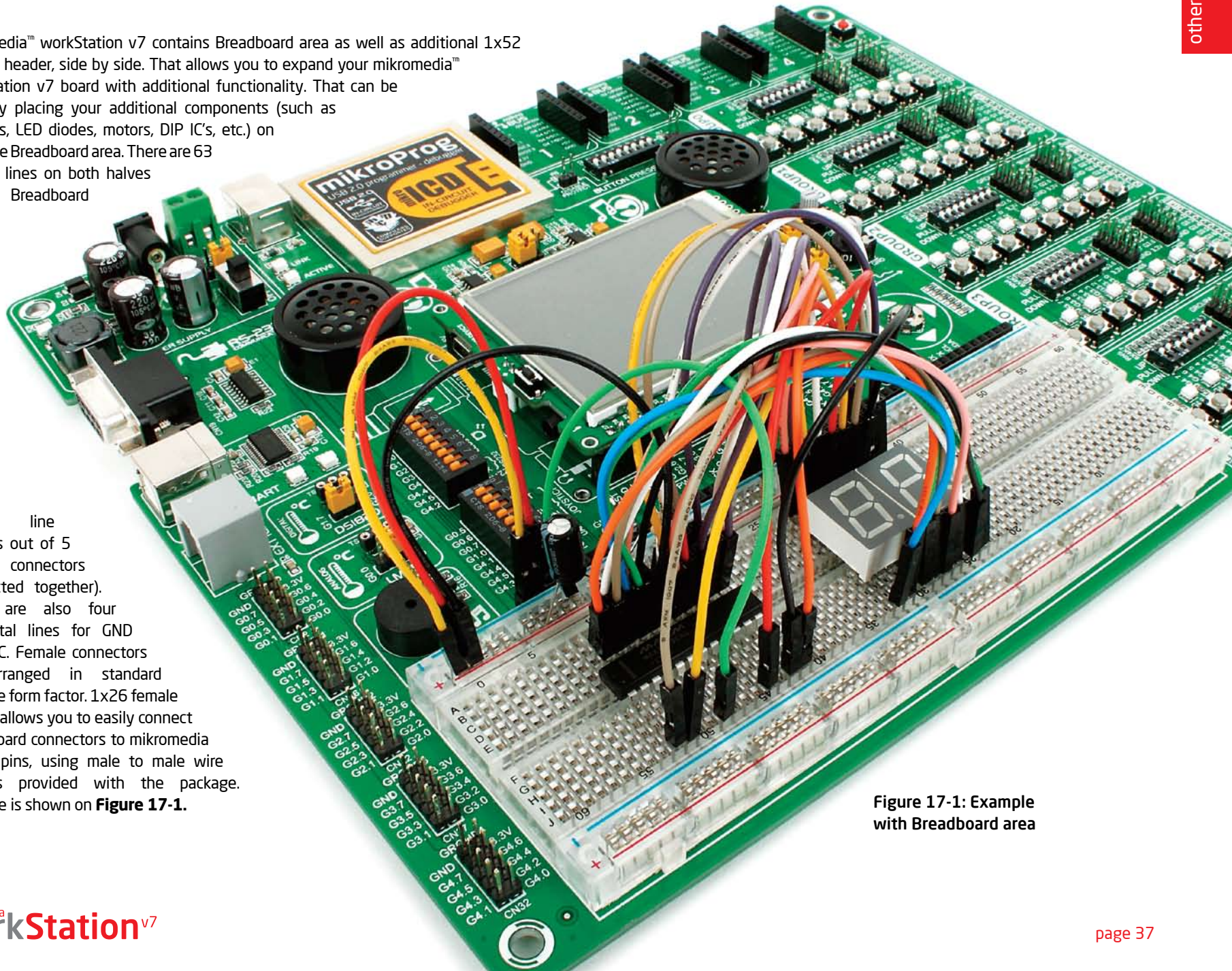


Figure 17-1: Example with Breadboard area

What's Next?

You have now completed the journey through each and every feature of **mikromedia™ workStation v7 board**. You got to know it's modules, organization, supported microcontrollers, programmer and debugger. Now you are ready to start using your new board. We are suggesting several steps which are probably the best way to begin. We invite you to join thousands of users of mikromedia™ brand. You will find very useful projects and tutorials and can get help from a large ecosystem of users. Welcome!

1 Compiler

You still don't have an appropriate compiler? Locate **PIC®**, **dsPIC®** or **PIC32® compiler** that suits you best on the **Product DVD** provided with the package:

DVD://download/eng/software/compilers/

Choose between **mikroC**, **mikroBasic** and **mikroPascal** and download fully functional demo version, so you can begin building your PIC®, dsPIC® and PIC32® applications.

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 mikromedia™ workStation v7 board, and all of our accessory boards as well. This makes an excellent starting point for your future projects. Just load the example, read well commented code, and see how it works on hardware. Browse through the compiler **Examples** path to find the following folder:

\Development Systems

3 Community

If you want to find answers to your questions on many interesting topics we invite you to visit our forum at **http://www.mikroe.com/forum** and browse through more than 150 thousand posts. You are likely to find just the right information for you. On the other hand, 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.

http://www.libstock.com/

4 Support

We all know how important it is that we can rely on someone in moments when we are stuck with our projects, facing a deadline, or when we just want to ask a simple, basic question, that's pulling us back for a while. We do understand how important this is to people and therefore our Support Department is one of the pillars upon which our company is based. MikroElektronika offers **Free Tech Support** to the end of product lifetime, so if something goes wrong, we are ready and willing to help!

http://www.mikroe.com/esupport/

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