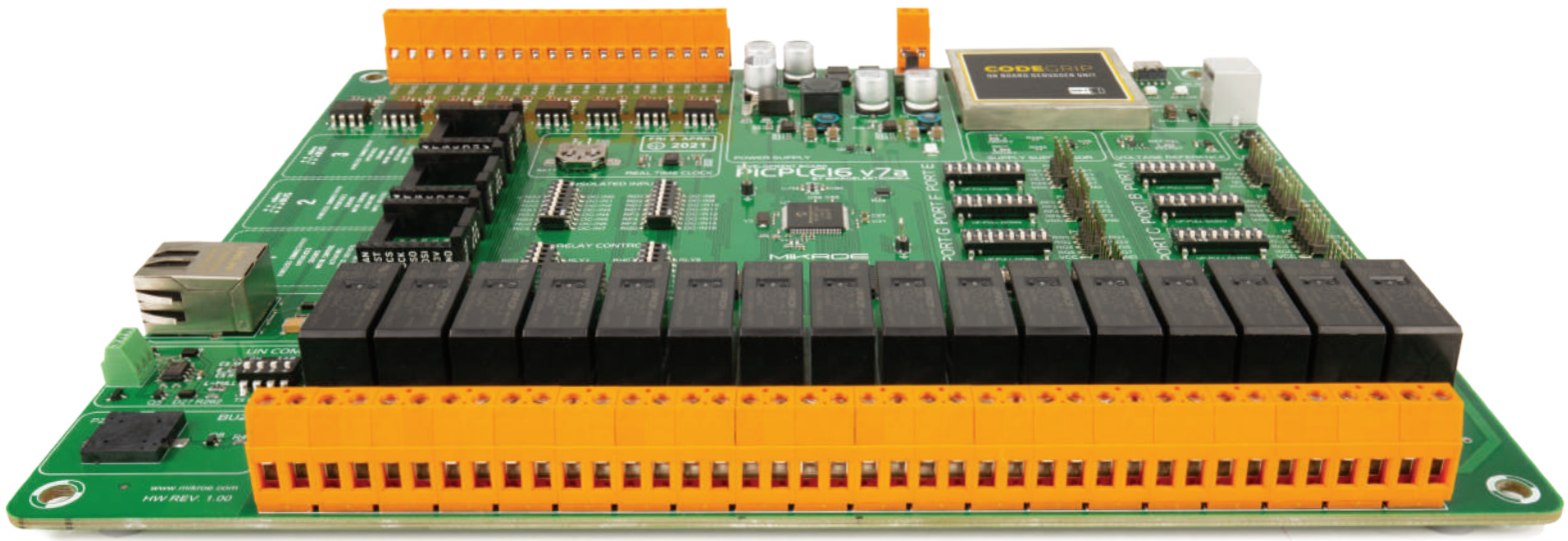
PIC PLC16 v7a

INDUSTRIAL



USER MANUAL

16
POWER
RELAYS

C-
CODEGRIP
ON BOARD

mikro BUS
mikroBUS™
SOCKETS

AMAZING
CONNECTIVITY

16
ISOLATED
INPUTS

MIKROE

Thank you for being our valued customer!

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

We are excited to have the opportunity to present you the NEW generation of our flagship development board – the **PICPLC16 v7a**!

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

Use it wisely and have fun!

Nebojsa Matic,
CEO

MIKROE

Time-saving embedded tools

Table of contents

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

INTRODUCTION

The **PICPLC16 v7a** development system provides a development environment for experimenting with industrial devices. With **16 opto-inputs** and **16 relays** (for currents up to 16A), you can develop PIC-based industrial, home or office automation devices the easy way.

We equipped it with our revolutionary new programmer & debugger - **CODEGRIP** and **mikroBUS™** support. We now present you with the new version 7a that brings so much more, and we hope that you will be thrilled with your new board, just as we are.

A CONNECTOR FOR EACH PORT

Amazing connectivity

PICPLC16 v7a offers amazing connectivity options. Ethernet, LIN, and pin headers for each port, you can connect accessory boards, sensors and your custom electronics with ease.

EVERYTHING IS ALREADY HERE

CODEGRIP on board

Powerful on-board CODEGRIP USB-C programmer and In-Circuit debugger will simplify programming and debugging, whether you're an experienced professional or a begginer.

INDUSTRIAL CONTROL

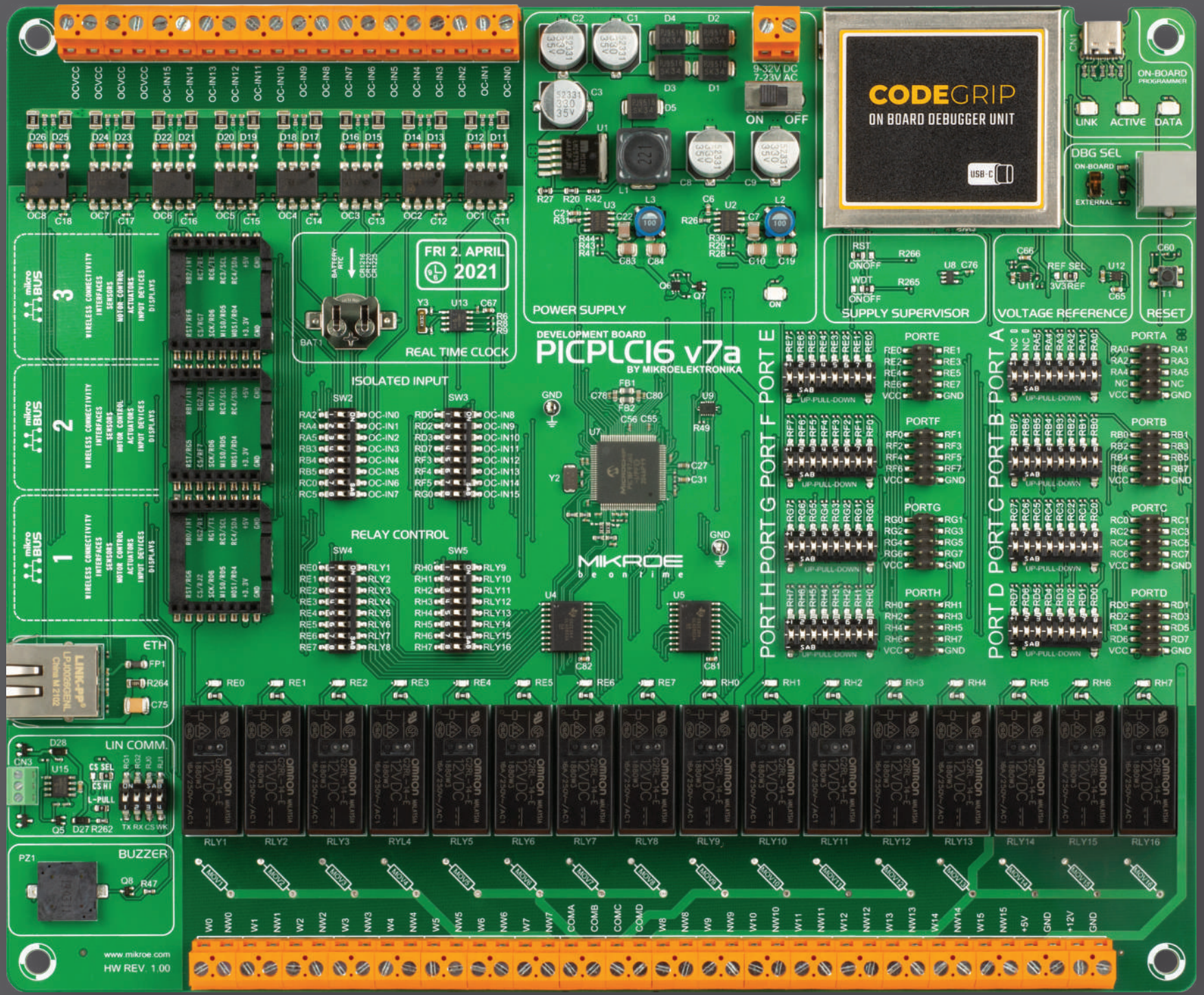
Relays and optocouplers

Develop complex industrial, home or office control systems with 16 optocouplers and 16 relays that allow you to connect the MCU to high -powered external industrial (but also home or office) devices.

FOR EASIER CONNECTIONS

mikroBUS™ support

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


CODEGRIP
ON BOARD DEBUGGER UNIT
USB-C
ON-BOARD PROGRAMMER
LINK
ACTIVE
DATA
DBG SEL
ON-BOARD
EXTERNAL
9-32V DC
7-23V AC
ON
OFF
POWER SUPPLY
SUPPLY SUPERVISOR
VOLTAGE REFERENCE
RESET
FRI 2. APRIL
2021
REAL TIME CLOCK
DEVELOPMENT BOARD
PICPLC16 v7a
BY MIKROELEKTRONIKA
ISOLATED INPUT
RELAY CONTROL
PORT A
PORT B
PORT C
PORT D
PORT E
PORT F
PORT G
PORT H
ETH
LIN COMM.
BUZZER
www.mikroe.com
HW REV. 1.00

IT'S GOOD TO KNOW!

PIC18F97J60 is the on-board microcontroller!

PIC18F97J60 is the on-board chip of **PICPLC16 v7a**. It has operating frequency **up to 42 MHz**, **128K bytes** of flash memory, and **4K** RAM memory. It's a feature rich PIC18 Microcontroller with an integrated **10Mbps** Ethernet communications peripheral. This single-chip solution is ideal for applications requiring remote control and monitoring. Target applications include Industrial Automation, Building Automation, Home control, Security and Instrumentation.

SYSTEM SPECIFICATIONS

POWER SUPPLY
7–23V AC or 9–32V DC

POWER CONSUMPTION
~55mA
(when all on-board modules are off)

BOARD DIMENSION
266 x 220 mm
(10.47 x 8.66 inch)

BOARD WEIGHT
490g
(1.080 lbs)

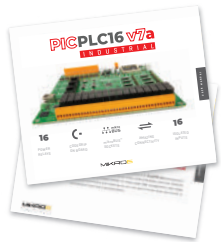
PACKAGE CONTAINS

1 Damage resistant protective box

2 PICPLC16 v7a development board

3 USB cable

4 User Manual & Schematics



POWER SUPPLY

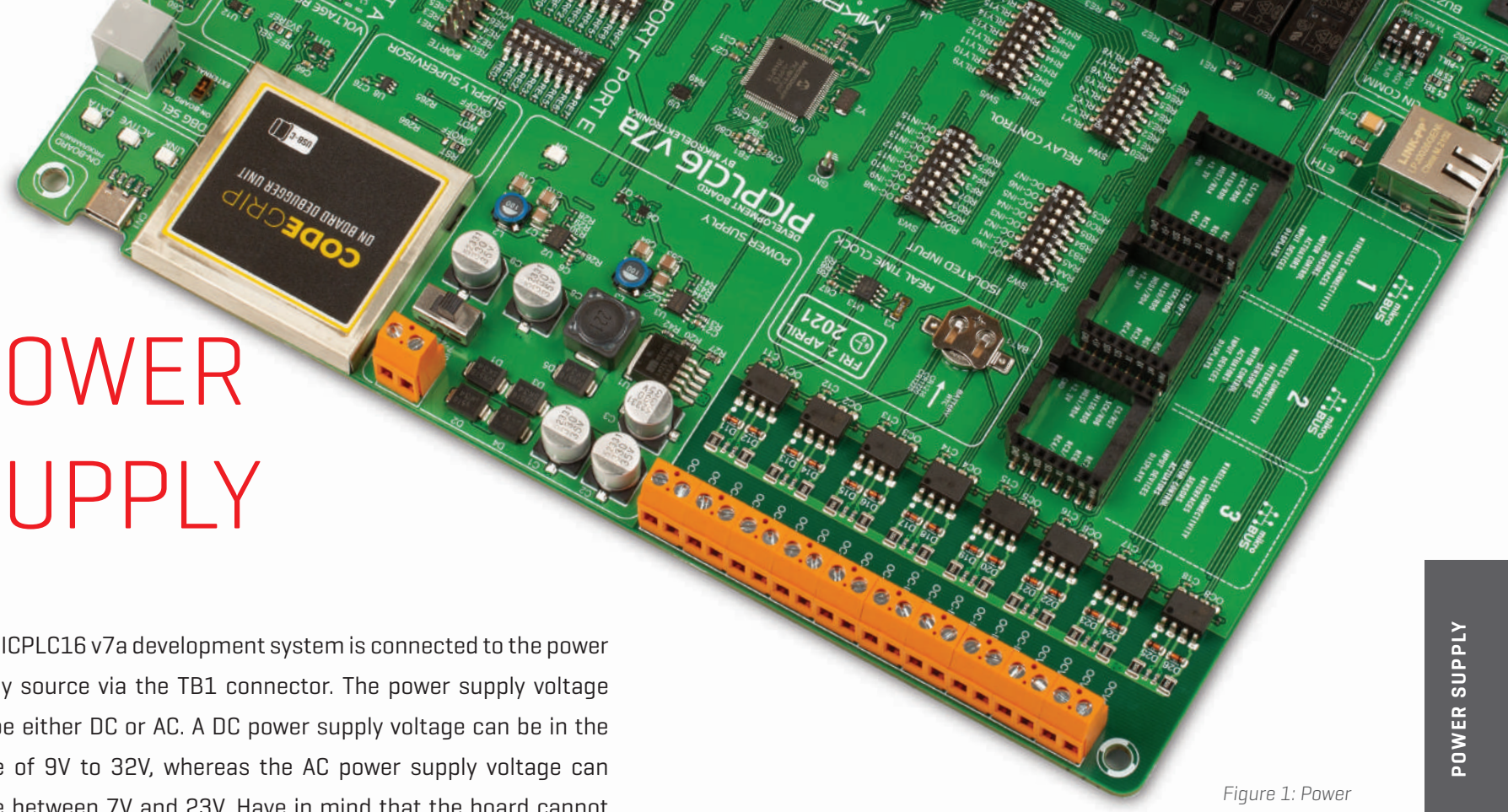


Figure 1: Power supply unit of PICPLC16 v7a

The PICPLC16 v7a development system is connected to the power supply source via the TB1 connector. The power supply voltage can be either DC or AC. A DC power supply voltage can be in the range of 9V to 32V, whereas the AC power supply voltage can range between 7V and 23V. Have in mind that the board cannot operate without being connected to the power supply source although it is connected to a PC via the USB cable.

On-board is a very accurate, programmable voltage reference (VREF) in the range from 0V to 3.3V. VREF is very useful for many different applications including A/D and D/A converters, comparators, etc. The programmable voltage output can be controlled over the CODEGRIP Suite.

The voltage supervisor device, MCP1320T from Microchip, keep a microcontroller in reset until the system voltage has reached and stabilized at the proper level of stabilized for reliable system operation. MCP1320T also provides an external Watchdog Timer functionality, to monitor the operation of the system. WDT period is 1.6s, an edge transition on the WDI

HOW TO POWER THE BOARD?

The PICPLC16 v7a development board is powered with external power supply source. Make sure the power supply source is connected. Otherwise, the on-board programmer cannot be enabled.

POWER SUPPLY:
Via screw terminal (7V to 23V AC or 9V to 32V DC)

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

STEP 1

To power the board using screw terminals, screw-on the cables in the screw terminals as shown on image Figure 2, and turn the power switch ON.

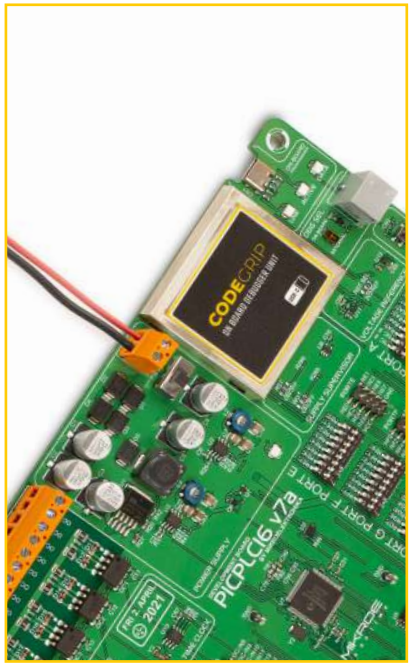


Figure 2: Powered by laboratory PSU

STEP 2

When the development system is connected to the power supply source, it is necessary to plug in a USB cable into the on-board USB connector. Connection between the USB cable and the development system makes the on-board programmer to be connected to a PC.

Figure 3: Powered by wall-adapter

ON BOARD PROGRAMMER

WHAT IS CODEGRIP?

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

PICPLC16 v7a development board is supported by a powerful CODEGRIP Suite, offering complete control over the development board. It is used to intelligently manage programming and debugging tasks, and to configure various other options and settings, providing visual feedback through its clean and comprehensive Graphical User Interface (GUI).

To better understand how to operate and configure PICPLC16 v7 development board and its integrated CODEGRIP module, check out the CODEGRIP Suite quick start guide on the ***www.mikroe.com/picplc16-v7a***

WHERE TO START?

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

1. Install the necessary software

- Install CODEGRIP Suite software

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

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

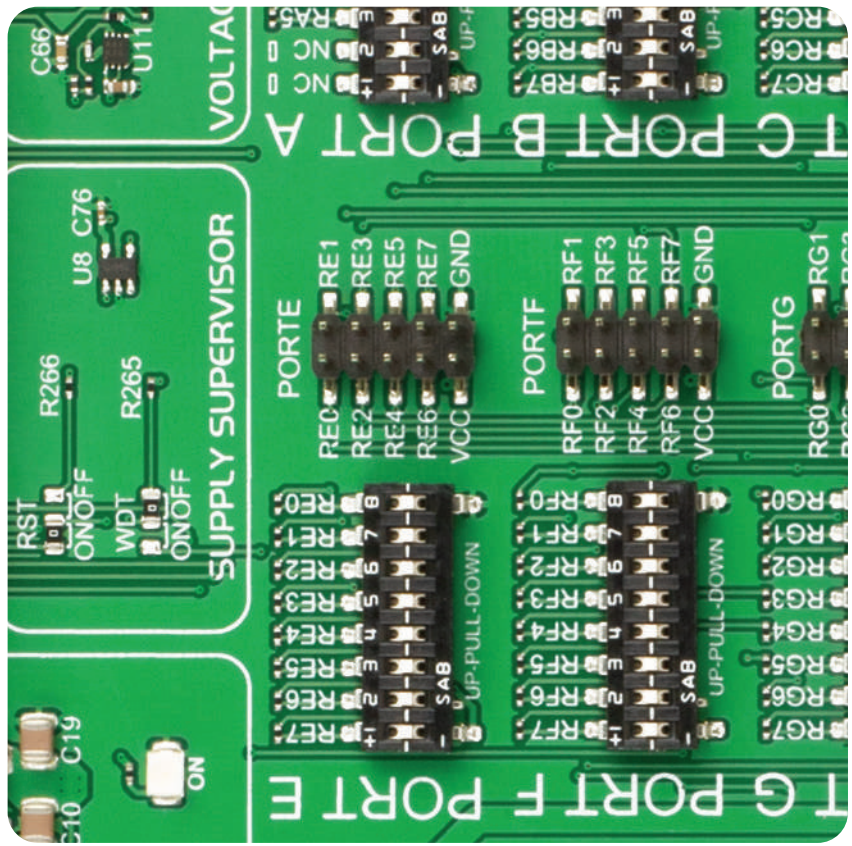
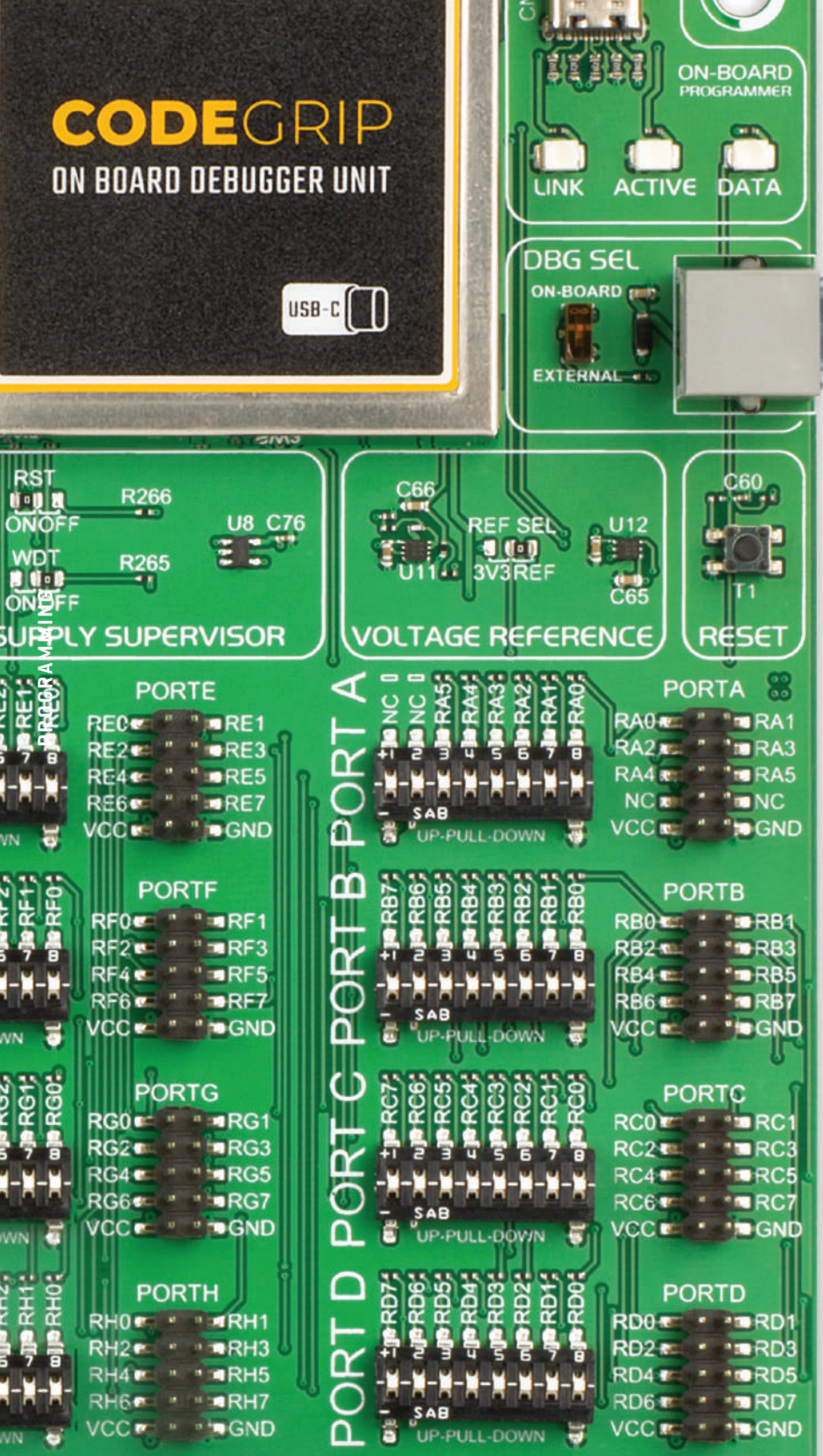


Figure 4: CODEGRIP on board programmer

Why so many LEDs?

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



PROGRAMMING WITH ICD2/ICD3/ICD4

PICPLC 16 v7a is equipped with RJ-12 connector compatible with Microchip® ICD2, ICD3, and ICD4 external programmers. You can either use the on-board CODEGRIP programmer or external programming tools as long as you use only one of them in the same time. Insert your ICD programmer cable into connector **CN9**, as shown in image.

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

ONBOARD (up): Interface is enabled. If an external debugger probe-device is connected, there is a possible collision in communication.

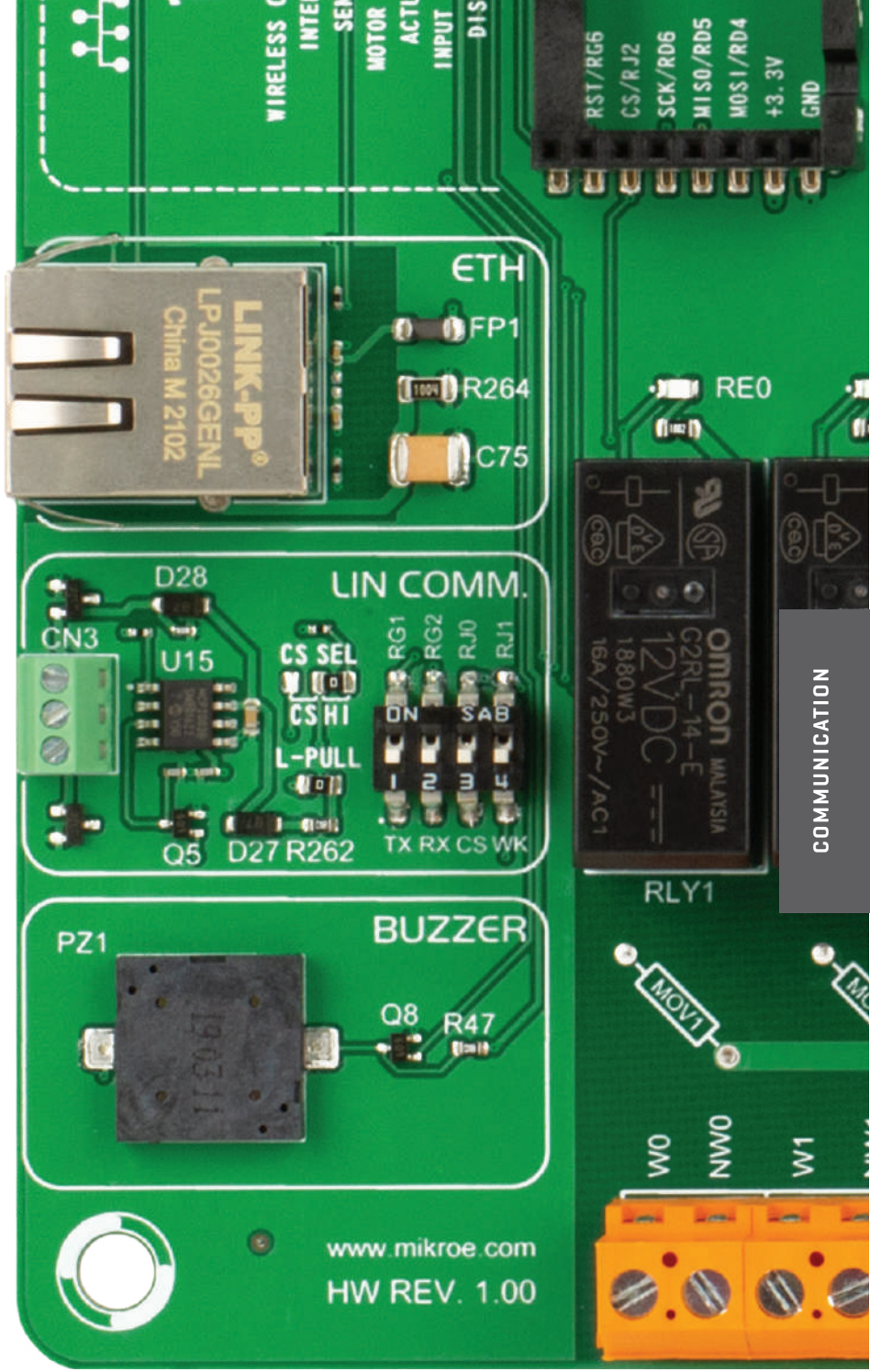
EXTERNAL (down): Interface is disabled. External debugger probe-device can reliably communicate with target MCU.

Figure 5: RJ-12 connector view

ETHERNET

Ethernet is a popular networking technology for local area networks (LAN). Systems communicating over Ethernet divide a stream of data into individual packets, known as frames. Each frame contains source and destination addresses and error-checking data so that damaged data can be detected and re-transmitted. This makes the Ethernet protocol very popular for communication over longer distances or in noisy environments.

The PICPLC16 v7a features standard **RJ-45 Ethernet connector** to establish a connection with a personal computer, network router, or other Ethernet network device. PIC18F97J60 MCU feature an embedded Ethernet controller module. This is **a complete connectivity solution**, including full implementations of both Media Access Control (MAC) and Physical Layer (PHY) transceiver modules.



LIN COMMUNICATION

LIN (Local Interconnect Network) is a inexpensive serial network protocol used for communication between components in vehicles, It effectively supports remote application within a car's network. The LIN Bus is particularly intended for mechatronic nodes in distributed automotive applications, but is equally suited to industrial applications.

The PICPLC16 v7a utilizes the **MCP2003B**, it provides a physical interface to automotive and industrial LIN systems, in accordance to the LIN Bus Specifications Revision 2.2, SAE J2602 and ISO 17987. It is short circuit and overtemperature protected by internal circuitry. MCP2003B communicates with the target board MCU through the UART interface (RXD, TXD), with additional functionality provided by the CS and WAKE pins.

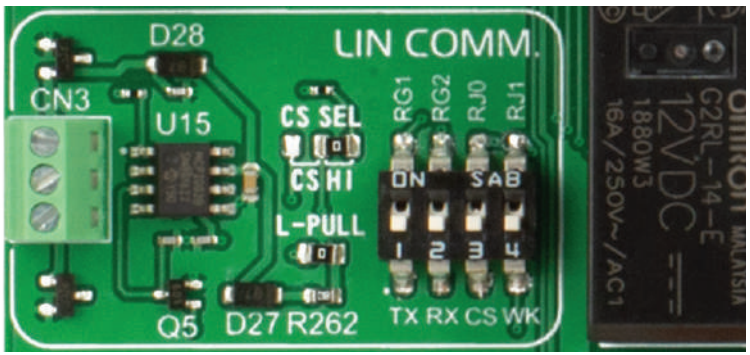


Figure 7: LIN Communication view

A four-pole DIP switch (SW16) located in the LIN COMM. section of the board, allow fully independent control of the UART RX and TX lines, and CS and WAKE lines.

- **SW16.1 (TX)**

  ON (up): connects the RG1 pin to the transmit data input
  OFF (down): disconnects the RG1 pin from the transmit data input

- **SW16.2 (RX)**

  ON (up): connects the RG2 pin to receive data output
  OFF (down): disconnects the RG2 pin from the receive data output

- **SW16.3 (CS)**

  ON (up): connects the RJ0 pin to the chip select input
  OFF (down): disconnects the RJ0 pin from the chip select input

- **SW16.4 (WK)**

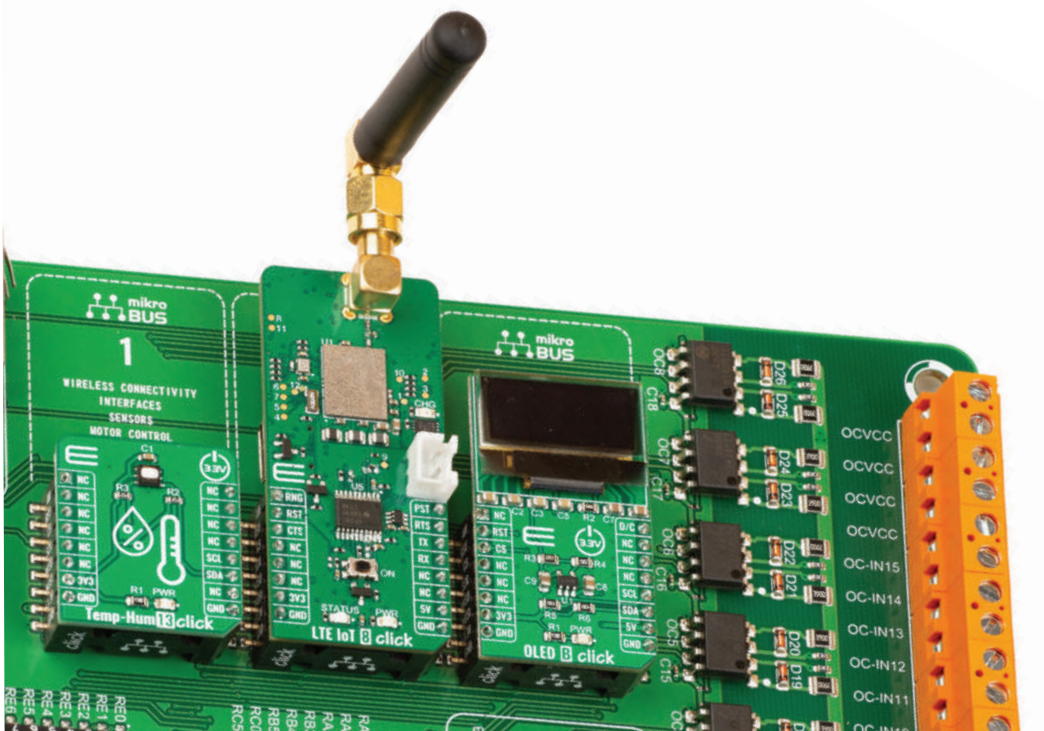
  ON (up): connects the RJ1 pin to the wake up input
  OFF (down): disconnects the RJ1 pin from the wake up input

mikroBUS™ SOCKETS

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

mikroBUS™ is the add-on board standard that offers maximum expandability with the smallest number of pins. More information at ***www.mikroe.com/mikrobus***

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



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

mikroBUS™ SOCKET IN DETAIL

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

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

Integrate mikroBUS™ in your design

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

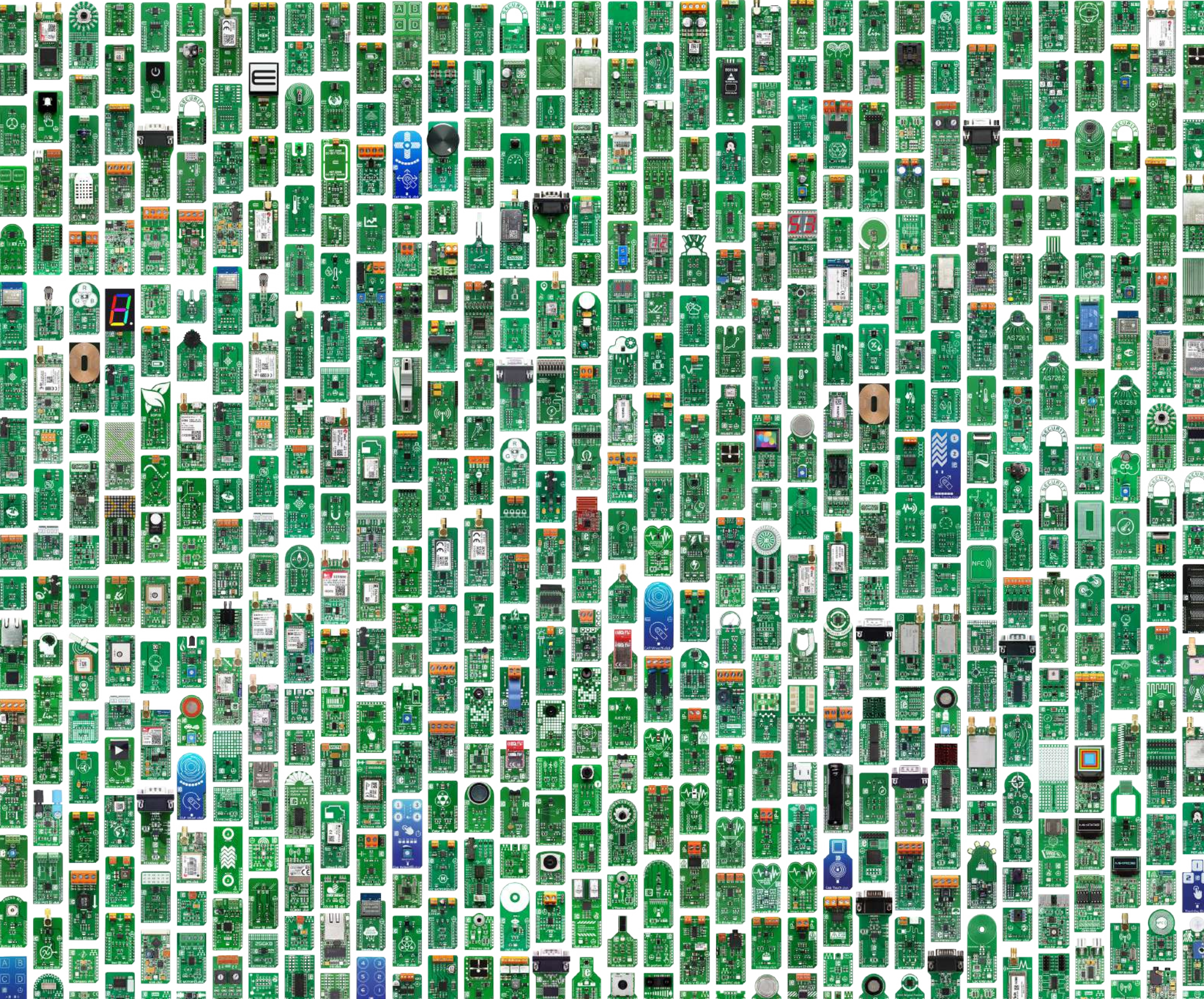
Click Boards™

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

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

CODE EXAMPLES

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



INPUT/OUTPUT GROUP

I/O pins of MCU are internally grouped as PORTs. The same grouping concept is kept throughout the development board as well, offering a clean and organized user interface.

EVERYTHING IS GROUPED TOGETHER

There are eight PORTs on the PICPLC16 v7a development board, labeled from PORTA to PORTH. The PORTs are located along the right side of the board, each containing a an eight-pole DIP switch, and a single 2x5 pin header with the standard 2.54mm pitch. The PORTs are labeled according to the MCU PORT they are routed to, and they add so much to the connectivity potential of the There are eight PORTs on the PICPLC16 v7a development board, labeled from PORTA to PORTH. The PORTs are located along the right side of the board, each containing a an eight-pole DIP switch, and a single 2x5 pin header with the standard 2.54mm pitch. The PORTs are labeled according to the MCU PORT they are routed to, and they add so much to the connectivity potential of the board.

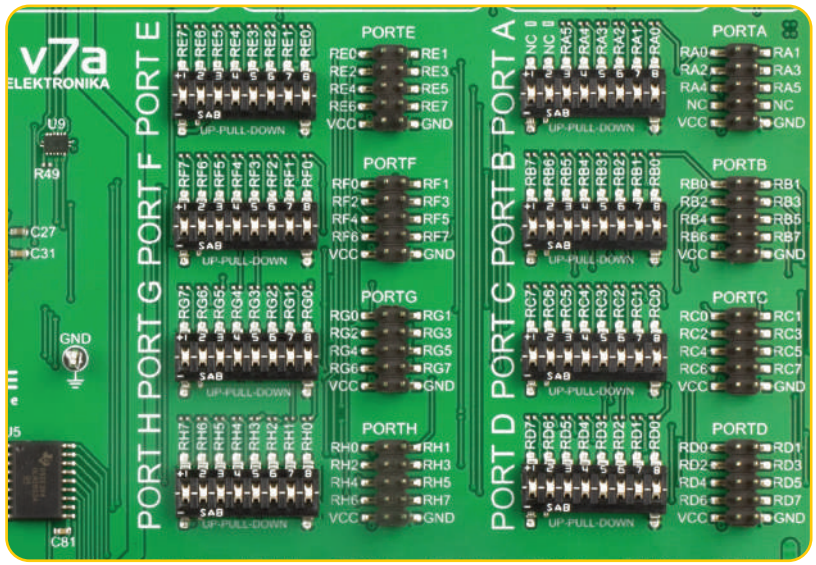


Figure 8: Input/Output group

TRI-STATE DIP SWITCHES

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

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

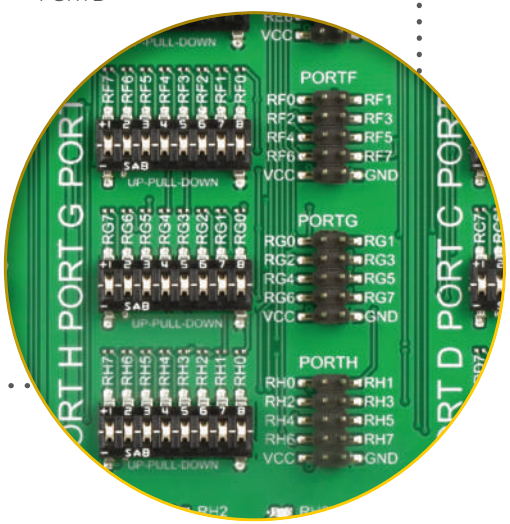


Figure 9: Tri-state DIP switch on PORTB

Real-Time Clock (RTC)

A real-time clock is widely used in alarm devices, industrial controllers, consumer devices etc. An external real-time clock peripheral module (RTC) in combination with the button cell battery allow continuous tracking of time, even if the main power supply is OFF. Extremely low power consumption of the RTC peripheral allows these batteries to last very long.

The **main features** of the built-in real-time clock MCP79411 from Microchip are:

- Providing information on seconds, minutes, hours, days in a week and dates including correction for a leap year
- I2C serial interface
- Automatic power-fail detection
- Power consumption around 900nA

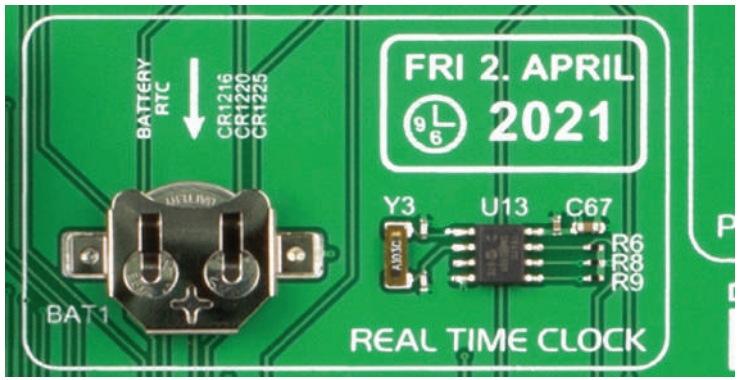


Figure 10: Real Time Clock view

MAGNETIC BUZZER

A buzzer is a simple device capable of reproducing sound. It is driven by a small pre-biased transistor. The buzzer can be driven by applying a PWM signal from the MCU at the base of the transistor: the pitch of the sound depends on the frequency of the PWM signal, while the volume can be controlled by changing its duty cycle. Since it is very easy to program, it can be very useful for simple alarms, notifications, and other types of simple sound signalization.

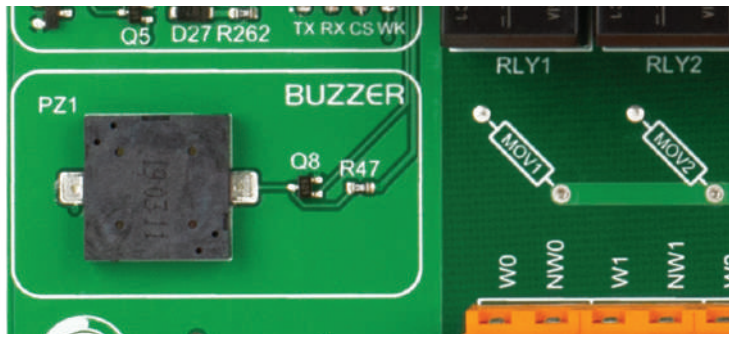


Figure 11: Buzzer view

RELAYS AND OPTOCOUPLERS

Industrial devices usually utilize more power than the microcontroller can provide via its I/O ports. To enable the microcontroller to be connected to such devices, the development system is provided with 16 relays by means of which it is possible to provide up to 250V/16A power supply. Each relay has one normally-open (WO, W1...) and one normally-closed (NWO, NW1...) contact. Sixteen relays are divided in four groups each consisting of four relays. Relays of one group are connected to one common contact. Accordingly, there are COMA, COMB, COMC and COMD common contacts.

In addition to relays, the development system also features optocouplers, the function of which is to galvanically isolate signals brought to the microcontroller inputs from industrial devices. Isolated digital inputs are designed specifically as digital input receivers for programmable logic control (PLC), motor control and grid applications to interface between field-side inputs and a host controller. Input voltage is 5V, and optocouplers are also linked to one common connector OCVCC.

EIGHT-POLE DIP SWITCHES

Two eight-pole DIP switches marked as SW4 and SW5 are used to connect the MCU pins to the relay control circuitry:

ON(right): MCU pins are connected to the relay control circuitry

OFF(left): MCU pins are not connected to the relay control circuitry

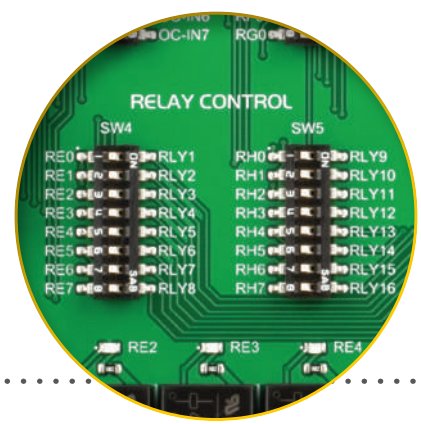


Figure 12: Relay Control view

Two eight-pole DIP switches marked as SW2 and SW3 are used to connect the MCU pins to the optocoupler circuitry:

ON(right): MCU pins are connected to the optocoupler circuitry

OFF(left): MCU pins are not connected to the optocoupler circuitry

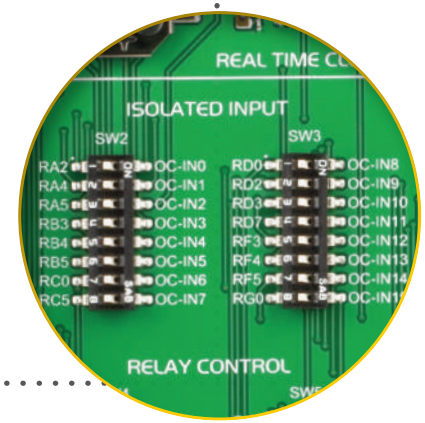
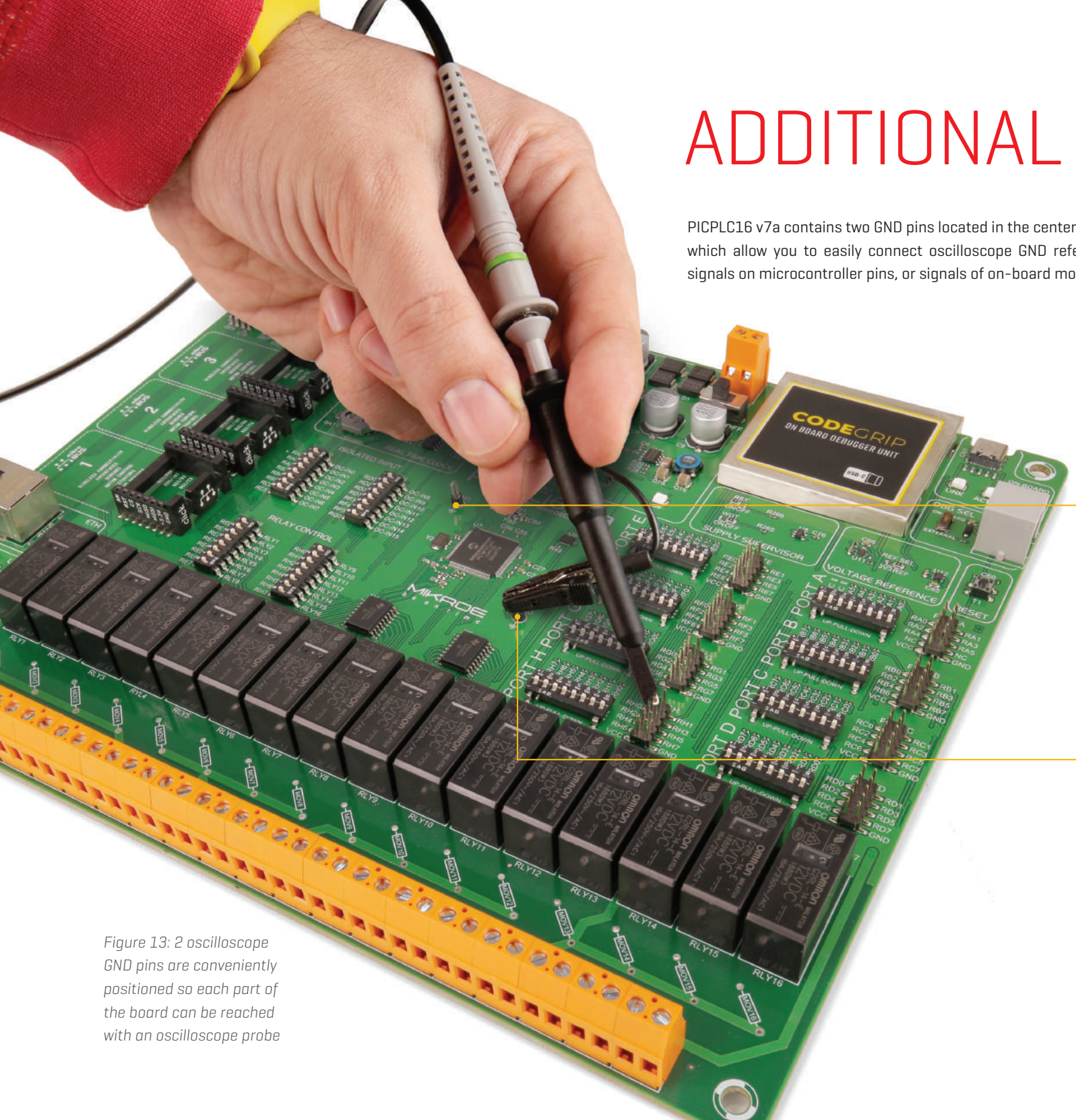


Figure 12: Isolated Input view

ADDITIONAL GNDs

PICPLC16 v7a contains two GND pins located in the center of the board, which allow you to easily connect oscilloscope GND reference when you monitor signals on microcontroller pins, or signals of on-board modules.



1 *GND pin located near the MCU and mikroBUS™ sockets*

2 *GND pin located near the MCU and I/O ports*

Figure 13: 2 oscilloscope GND pins are conveniently positioned so each part of the board can be reached with an oscilloscope probe

What's Next?

You have now completed the journey through each and every feature of the PICPLC16 v7a development board. You have become familiar with its modules, organization, and the programmer/debugger. Now you are ready to start using your new board. We suggest following steps which are highly recommended to begin with.

1 COMPILERS

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

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

2 PROJECTS

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

3 COMMUNITY

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

4 SUPPORT

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

DISCLAIMER

HIGH RISK ACTIVITIES

TRADEMARKS

MIKROE

Time-saving embedded tools

If you want to learn more about our products, please visit our website at **www.mikroe.com**
If you are experiencing some problems with any of our products or just need additional information, please place your ticket at **www.mikroe.com/support**
If you have any questions, comments or business proposals, please contact us at **office@mikroe.com**