

MIKROE



for KINETIS v8 DEVELOPMENT BOARD

USER MANUAL

It's time to rethink the way you approach rapid prototyping

Let us introduce you to the latest generation of Mikroe development boards – Fusion for KINETIS v8

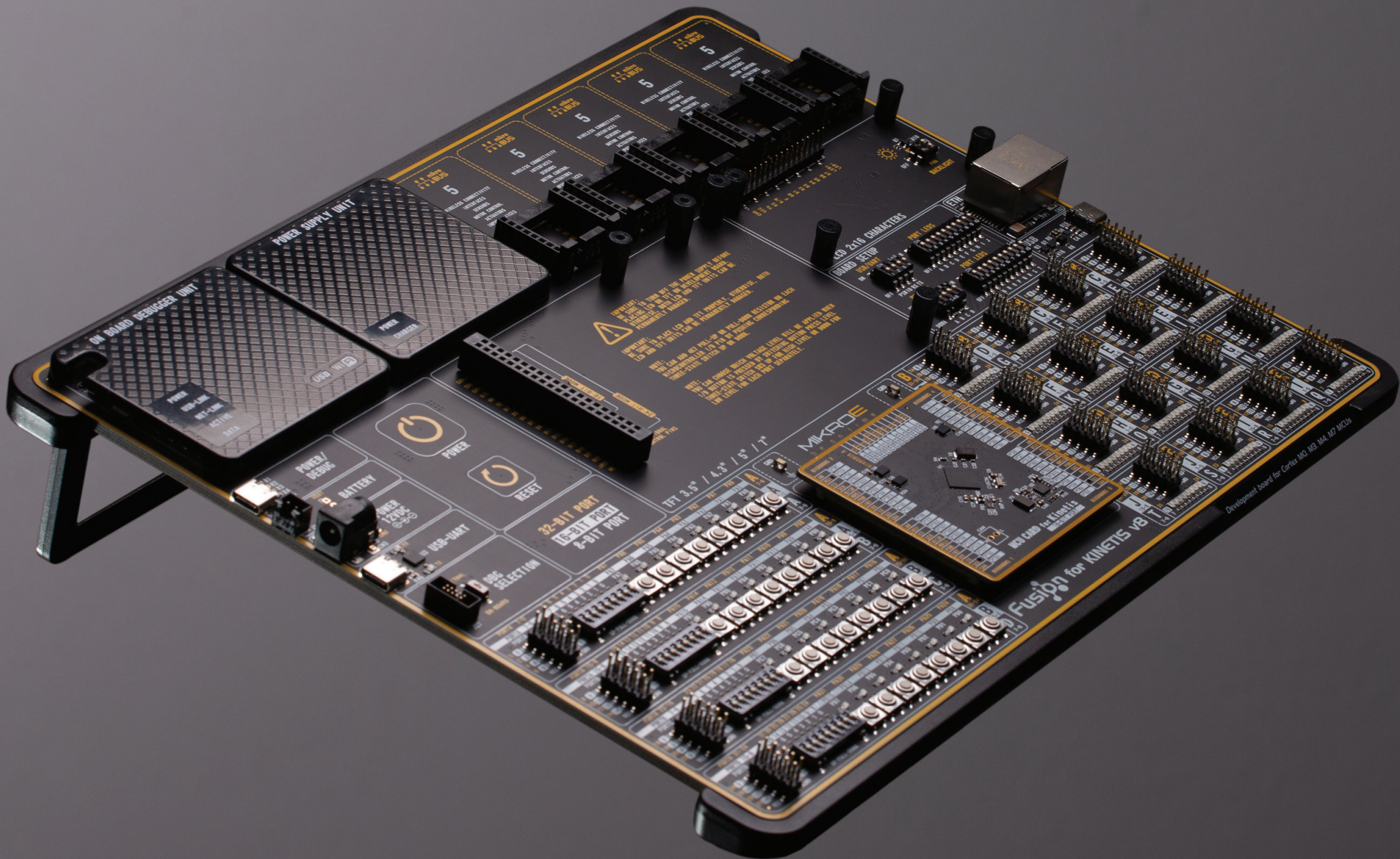
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Time saving embedded tools

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



ON BOARD DEBUGGER UNIT

POWER SUPPLY UNIT

POWER/DEBUG

BATTERY

LOGIC SELECTION

32-BIT PORT  
15-BIT PORT  
8-BIT PORT

Mikroe

Fusion for KINETIS v8

Development board for Cortex M0, M3, M4, M7 MCUs



IMPORTANT: TO USE THE POWER SUPPLY FEATURE, THE BOARD MUST BE PLACED ON A NON-CONDUCTIVE SURFACE. THE BOARD MUST BE PLACED ON A SURFACE THAT IS AT LEAST 10 CM FROM ANY METAL OBJECTS. THE BOARD MUST BE PLACED ON A SURFACE THAT IS AT LEAST 10 CM FROM ANY METAL OBJECTS. THE BOARD MUST BE PLACED ON A SURFACE THAT IS AT LEAST 10 CM FROM ANY METAL OBJECTS.

TFT 3.5" / 4.3" / 5" / 7"

KSP 2416 CONNECTORS

BOARD SETUP

PORT LEDS

PORT LEDS

PORT LEDS

PORT LEDS

PORT LEDS

PORT LEDS

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PORT LEDS

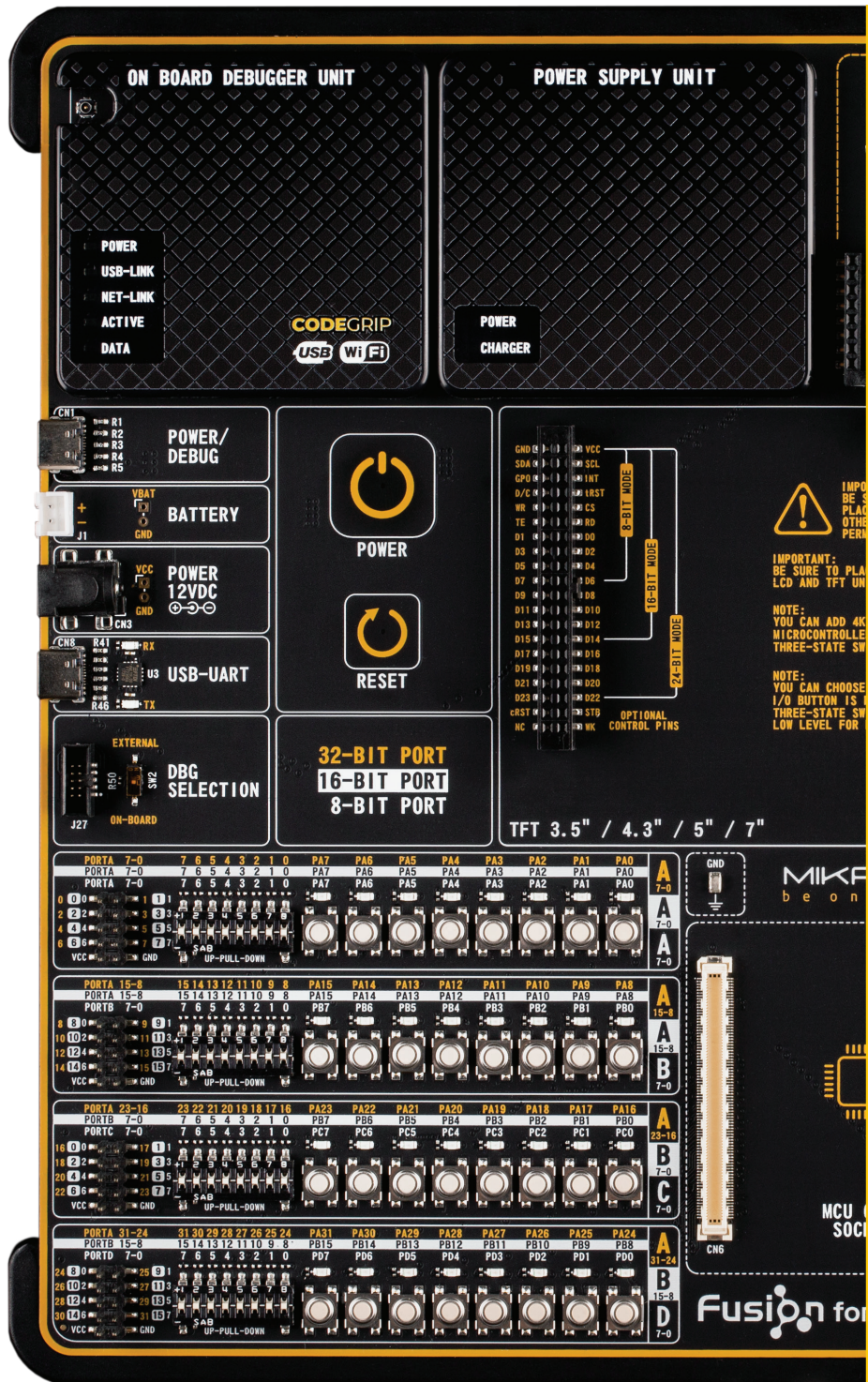
PORT LEDS

PORT LEDS

**Fusion for KINETIS v8** is a development board designed for rapid development of embedded applications. Redesigned from the ground up, it offers broad **set of standard**, as well as several **unique features** never seen before in the world of embedded electronics: **programming and debugging over WiFi network**, support for a large number of **different ARM® Cortex®-M based microcontrollers** by NXP regardless of their pin number, and more.

The development board is designed so that the developer has everything that might be needed, following the Swiss Army knife concept: a highly **advanced programmer/debugger module**, a powerful and clean **power supply module**, a huge set of connectivity options including **USB, Ethernet, CAN (on the MCU Card, if supported), UART**, as well as set of Mikroë proprietary standards and technologies, including the well-established **mikroBUS™ standard, a standardized MCU Card socket, and a standardized 2x20 display connector**. A number of interactive options is also available, including buttons, LEDs, switches, and more... All these features are packed on a single development board, which itself uses innovative manufacturing technologies, delivering fluid and immersive working experience.

Fusion for KINETIS v8 development board is also an integral part of the Mikroë rapid development ecosystem. Natively **supported by the Mikroë Software toolchain**, backed up by **hundreds of different Click board™ designs** with their number growing on a daily basis, it covers many different prototyping and development aspects, thus **saving precious development time**.



# Development board overview

The Fusion for KINETIS v8 development board features a clean and intuitive layout, allowing the user to instantly understand how to set it up and how to easily tune it according to needs. The development board is divided into several sections, arranged so that all the related interactive components such as switches, buttons, indicators, and connectors, are logically positioned and grouped together.

Each section of the development board contains components important for a reliable operation of the board itself. The Power Supply Unit (PSU), the CODEGRIP programmer/debugger module, and five mikroBUS™ sockets are located at the upper section of the development board. This is where the microcontroller unit (MCU) is powered from, programmed, and interfaced with various Click boards™.

The **PSU module** provides a clean, regulated voltage for the development board. It can use a wide range of external power sources, including a battery, an external 12V power supply, and a power source over the USB Type-C (USB-C) connector. It supports the power OR-ing function for uninterrupted operation. The onboard PSU module regulates, filters, and distributes the power across all the connected peripherals. The development board is equipped with two touch-sensitive buttons labeled as POWER and RESET. These buttons are used to power up the board and reset the MCU. Their sleek design and flawless responsiveness add up to the whole experience. These touch-sensitive buttons are resistant to wear over time and do not exhibit any bouncing effect, unlike mechanical switches.

The powerful **CODEGRIP module**, an ARM® Cortex®-M compatible programmer/debugger, supports a wide range of different ARM® Cortex®-M based MCUs, produced by NXP. It allows in-place programming and debugging of all supported microcontrollers, offering many options, including the support for JTAG, SWD and SWO Trace (Single Wire Output), seamless integration with the Mikro software environment, and some powerful and unique features such as the programming/debugging over WiFi; a feature that will revolutionize the way that the embedded applications are developed.

The CODEGRIP module uses the USB-C connector for a reliable and secure connection with the personal computer (host PC). It does not require any additional drivers

because it utilizes an HID driver model, natively supported by the computer's operating system (OS). The USB-C connector is also used to power the development board, simplifying the cable management.

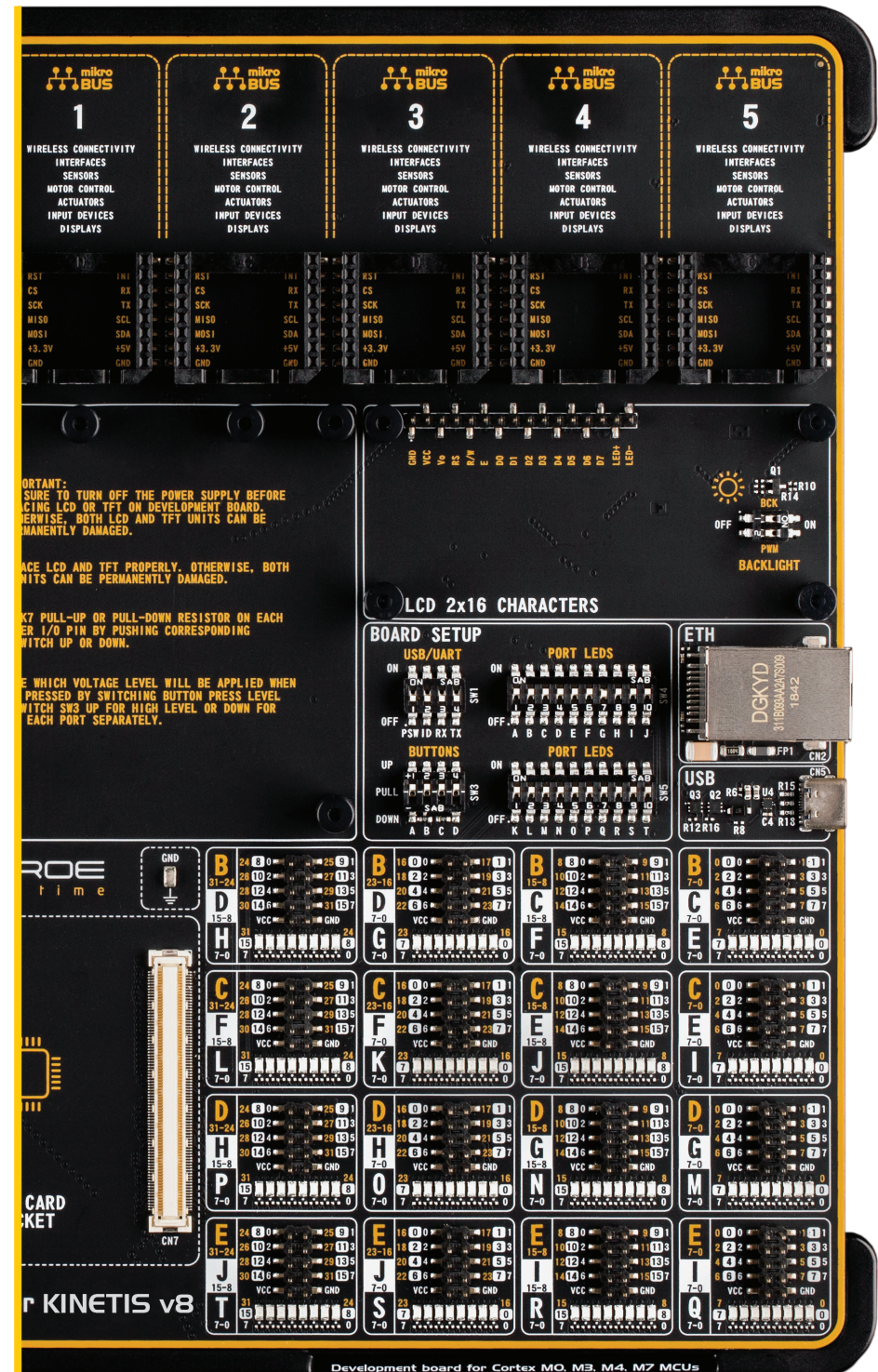
Fusion for KINETIS v8 offers **five improved mikroBUS™** sockets, allowing interfacing with a vast amount of electronic circuits and reference designs, standardized under the Click board trademark. Click boards™ are simple to use, require no additional hardware configuration and can be easily connected to the development board by inserting them into any of the available mikroBUS™ sockets. A new design of the mikroBUS™ socket allows even easier interfacing with the Click board™ line of products: it has a sturdier design which helps aligning the Click board™ correctly. To read more about development improvements and huge benefits offered by the mikroBUS™ and Click board™ line of products, visit the official Mikroë web page at [www.mikroe.com](http://www.mikroe.com)

Fusion for KINETIS v8 development board is equipped with **two display connectors**, located in the middle section of the board. One connector is a single row 16-pin header which supports 2x16 characters Liquid Crystal Display (LCD) in 4-bit mode, offering an optional PWM backlight driving feature. The second display connector is a standardized 2x20-pin female socket, which supports a vast number of display boards, featuring different display modules, such as **TFT Board line of products**. TFT Board displays come in different sizes, they support various resolutions, and they feature different capabilities. All these display boards can be easily mounted to the existing connector offering complete freedom of choice. For more information, please visit the official Mikroë web page at [www.mikroe.com](http://www.mikroe.com)

The **I/O (Input/Output) section** occupies the lower part of the development board and contains available MCU pins routed to 2x5-pin headers for easy access. Some of them are equipped with configurable pull-up or pull-down resistors and buttons for applying logic states to MCU pins, while all of them are equipped with LED indicators. Pins are divided into groups following the grouping concept used on the MCU itself. This section is where the most interaction with the MCU takes place.

**Communication** options such as **USB-UART, USB HOST/DEVICE, CAN** and **Ethernet**, are also included. The CAN connector is hosted on the MCU card (if supported by MCU), the respective USB, USB-UART, and Ethernet connectors are positioned at the edges of the development board, so they can be easily accessed. This is also true for the power connectors, as well as for the external programmer/debugger connector. This allows clean and clutter-free cable management.

Fusion for KINETIS v8 development board is supported by a powerful **CODEGRIP Suite**, offering complete control over the Fusion for KINETIS v8 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 Fusion for KINETIS v8 development board and its integrated CODEGRIP module, a separate manual is provided at [www.mikroe.com/manual/codegrip](http://www.mikroe.com/manual/codegrip)



# Power supply unit

The Power supply unit (PSU) [1] module provides a clean and regulated power, necessary for continuous operation of the development board. The MCU along with the rest of the onboard peripherals, demands regulated and noise-free power supply. Therefore, the PSU module is carefully designed to regulate, filter, and distribute the power to all parts of the Fusion for KINETIS v8 development board.

The PSU module also contains a battery charging circuit, which utilizes the most suitable power source to safely charge the connected single-cell Li-Po or Li-Ion battery.

The digitally controlled programmable voltage output can be used as a voltage reference for various purposes, including A/D or D/A converters, comparators, and other peripherals that require or can use an external reference voltage. The programmable voltage output can be controlled over the CODEGRIP Suite.

The power OR-ing function is also supported by the PSU module: it will automatically switch to the most appropriate power source in the case when multiple sources are connected at once. This allows uninterrupted operation when one of the power sources is removed. For example, the battery will continue to supply power if the USB cable is removed, avoiding the board reset during the transition period.

The advanced design of the PSU module allows several types of power sources to be used, offering unprecedented flexibility: when powered by a Li-Po/Li-Ion battery, it offers an ultimate degree of autonomy. For situations where the power is an issue, it can be powered by an external power supply, connected over the barrel connector. Power is not an issue even if it is powered over the USB cable. It can be powered over the USB-C connector, delivering sufficient power, even for the most power demanding applications.

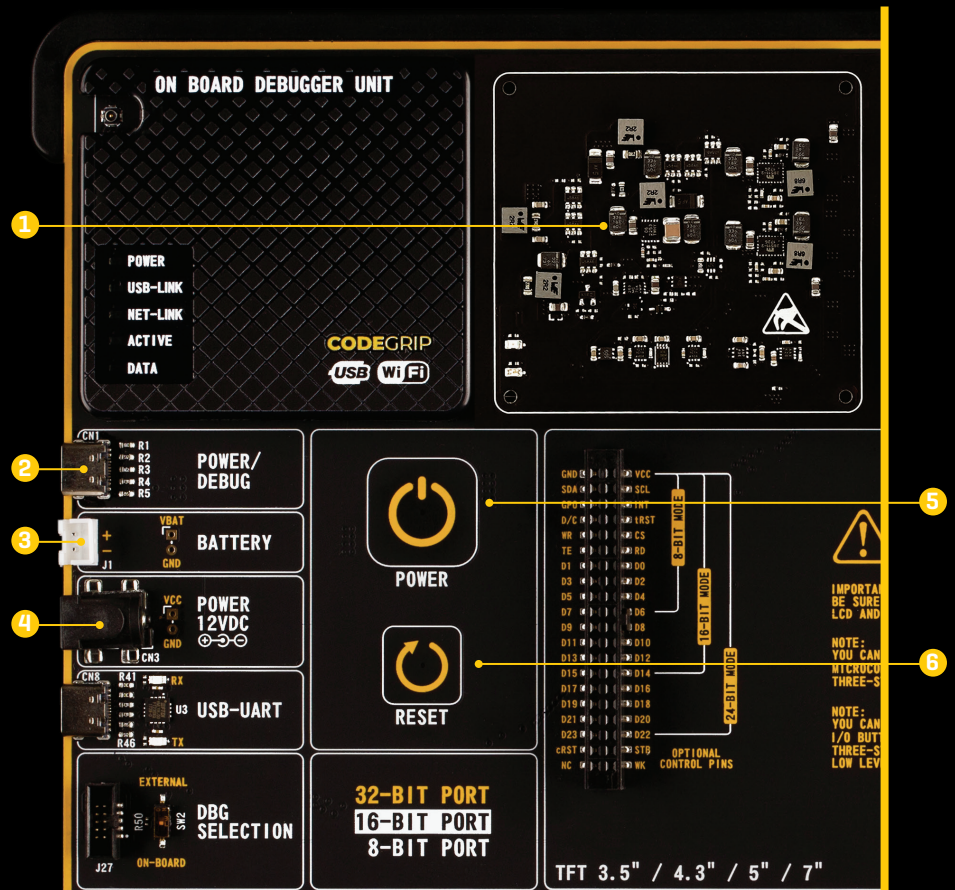
There are three power connectors, each with its unique purpose:

**POWER/DEBUG**, USB-C connector [2]

**BATTERY**, standard 2.5mm pitch XH battery connector [3]

**POWER 12VDC**, barrel type male 2mm x 6.5mm power connector [4]

As soon as a valid power source is connected, the development board will enter the Stand-By mode. When the capacitive POWER button [5] is pressed, the PSU module will start distributing the power to the rest of the development board. This is indicated by the POWER LED indicator, located on the PSU module itself.



[1] This image is only for demonstration purpose, please do not remove the PSU plastic cover nor touch any of the components below. The development board can be permanently damaged.

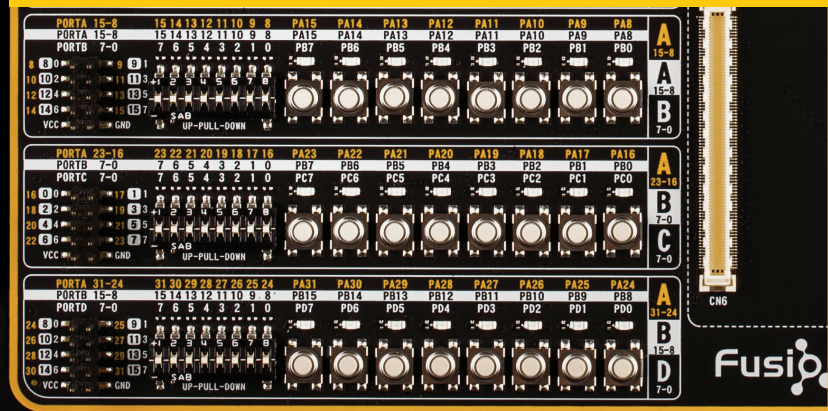


Figure 1: Power supply unit view



Right under the POWER LED, there is a CHARGE LED, indicating the charging status for the Li-Po or Li-Ion single cell battery, if connected. A complete battery power supply section, including the battery charger circuit, is explained in the respective chapter of this manual.

Below the POWER capacitive button, there is a RESET [6] capacitive button which is not entirely power-related, but it has a similar function: it is routed to the MCU reset pin. Pressing this button will trigger a reset of the host MCU.

## Power/debug, USB-C connector

The development board can be powered over the USB-C connector, labeled as POWER/DEBUG [2]. This connector provides power from the USB host, USB power bank, or USB wall adapter. When powered over the USB connector, the available power will depend on the source capabilities.

Maximum power ratings, along with the allowed input voltage range in the case when the USB power supply is used, are given in the table below:

| USB Power Supply  |     |                    |                 |               |
|-------------------|-----|--------------------|-----------------|---------------|
| Input Voltage [V] |     | Output Voltage [V] | Max Current [A] | Max Power [W] |
| MIN               | MAX | 3.3                | 1.8             | 6.6           |
| 4.4               | 5.5 | 5                  | 1.4             | 7.5           |
|                   |     | 3.3 & 5            | 0.8 & 0.8       | 7.5           |

Figure 2: USB Power supply table

When using PC as a power source, the maximum power can be obtained if the host PC supports the USB 3.2 interface, and is equipped with USB-C connectors. If the host PC has a USB 2.0 interface, it will be able to provide the least power, since only up to 500 mA [2.5W at 5V] is available from the host in that case.

Note that when using long USB cables or USB cables of low quality, the voltage may drop outside the rated operating voltage range, causing unpredictable behavior of the development board.

**NOTE** If the host PC is not equipped with the USB-C connector, a Type A to Type C USB adapter may be used.

## Power 12VDC, external power supply

An external 12V power supply can be connected over the DC barrel connector, labeled as POWER 12VDC [4]. When using an external power supply, it is possible to obtain an optimal amount of power, since one external power supply unit can be easily switched for another, while its power and operating characteristics can be decided per application. The development board allows maximum current of 3A per power rail, when using an external 12V power supply.

The development board will be able to maintain its operating voltages within the specified limits, as long as the voltage of the external power supply stays within the range stated below, in the table. Having in mind all the additional peripherals that can be connected to the development board, as well as their power consumption, the external power supply should be considered as a primary power source, especially for the most power demanding applications.

Maximum power ratings, along with the allowed input voltage range in the case when the external power supply is used, are given in the table below:

| External Power Supply |     |                    |                 |               |
|-----------------------|-----|--------------------|-----------------|---------------|
| Input Voltage [V]     |     | Output Voltage [V] | Max Current [A] | Max Power [W] |
| MIN                   | MAX | 3.3                | 2.8             | 9.24          |
| 10.6                  | 14  | 5                  | 2.8             | 14            |
|                       |     | 3.3 & 5            | 2.8 & 2.8       | 23.24         |

Figure 3: External Power supply table

When connecting an external power supply over a barrel connector, make sure that the polarity of the barrel connector is matched with its counterpart on the development board, according to the image printed next to the male DC connector.

**NOTE**

## Battery power supply

When powered by a single-cell Li-Po or Li-Ion battery, the development board offers an option to be operated remotely. Combined with the fact that the board can be

remotely programmed and debugged over the WiFi network, the Fusion for KINETIS v8 development board allows complete autonomy, allowing it to be used in some very specific situations: hazardous environment, agricultural application and etc.

**NOTE** It is advised to disable the battery charging circuitry if there is no battery connected to the Fusion for KINETIS v8 development board. This can be done using CODEGRIP Suite. For more information, please consult the CODEGRIP manual, which can be found on this link: [www.mikroe.com/manual/codegrip](http://www.mikroe.com/manual/codegrip)

The battery connector used on the development board is a 2.5mm pitch XH connector. It allows a range of Li-Po and Li-Ion batteries to be used. The development board offers battery charging functionality from both the USB connector, and the external power supply. The battery charging circuitry of the PSU module manages the battery charging process, allowing the optimal charging conditions and longer battery life. Charging process is indicated by a CHARGER LED indicator.

The battery charging current can be configured by using the CODEGRIP Suite, which offers a choice between 100mA and 500mA when the USB power supply is used, or between 100mA and 200mA, when the external 12V power supply is used. In the case when the Fusion for KINETIS v8 development board is powered down, the charging current will be set to 500mA by default (200mA with the external power supply).

If both the external 12V power supply and the USB cable are connected to the development board, the battery will be charged from the external 12V power supply, thus minimizing the USB power consumption.

Maximum power ratings at fully charged battery, along with the allowed input voltage range when the battery power supply is used, are given in the table below:

| Battery Power Supply |     |                    |                 |               |
|----------------------|-----|--------------------|-----------------|---------------|
| Input Voltage [V]    |     | Output Voltage [V] | Max Current [A] | Max Power [W] |
| MIN                  | MAX | 3.3                | 1.6             | 5.28          |
| 3.5                  | 4.2 | 5                  | 1.2             | 6             |
|                      |     | 3.3 & 5            | 0.7 & 0.7       | 5.81          |

Figure 4: Battery Power Supply table



Using USB hubs, long USB cables, and low-quality USB cables, may cause a significant USB voltage drop, which can obstruct the battery charging process.

# CODEGRIP programmer / debugger module

Envisioned as the unified development platform, Fusion for KINETIS v8 development board is equipped with the onboard CODEGRIP programming/debugging module, which supports various ARM® Cortex®-M based MCUs, produced by NXP. The CODEGRIP module can be interfaced with the host computer over the USB-C connector.

Besides the USB cable, the CODEGRIP module **[1]** can be accessed over the WiFi network. This is a revolutionary new feature, which allows some unique usage scenarios, currently not available on any other programming/debugging solution in the world. The WiFi connectivity option of the CODEGRIP module offers a complete autonomy of the development board. Running in hazardous environment while debugging the software in real time, programming the MCU with a new software during exposure, having the sensor responses collected and logged remotely from several different base points, debugging a drone firmware while it is in mid-air... These are just a simple examples of what Fusion for KINETIS v8 development board can offer.

CODEGRIP module is equipped with LED indicators that provide visual feedback about its status:

**POWER (GREEN)** indicates that the development board is powered on

**USB-LINK (YELLOW)** After the host OS completes the USB enumeration of the CODEGRIP module, this LED will indicate that the connection has been established

**NET-LINK (AMBER)** When the CODEGRIP module is connected to the WiFi network, this LED will indicate that the connection has been established

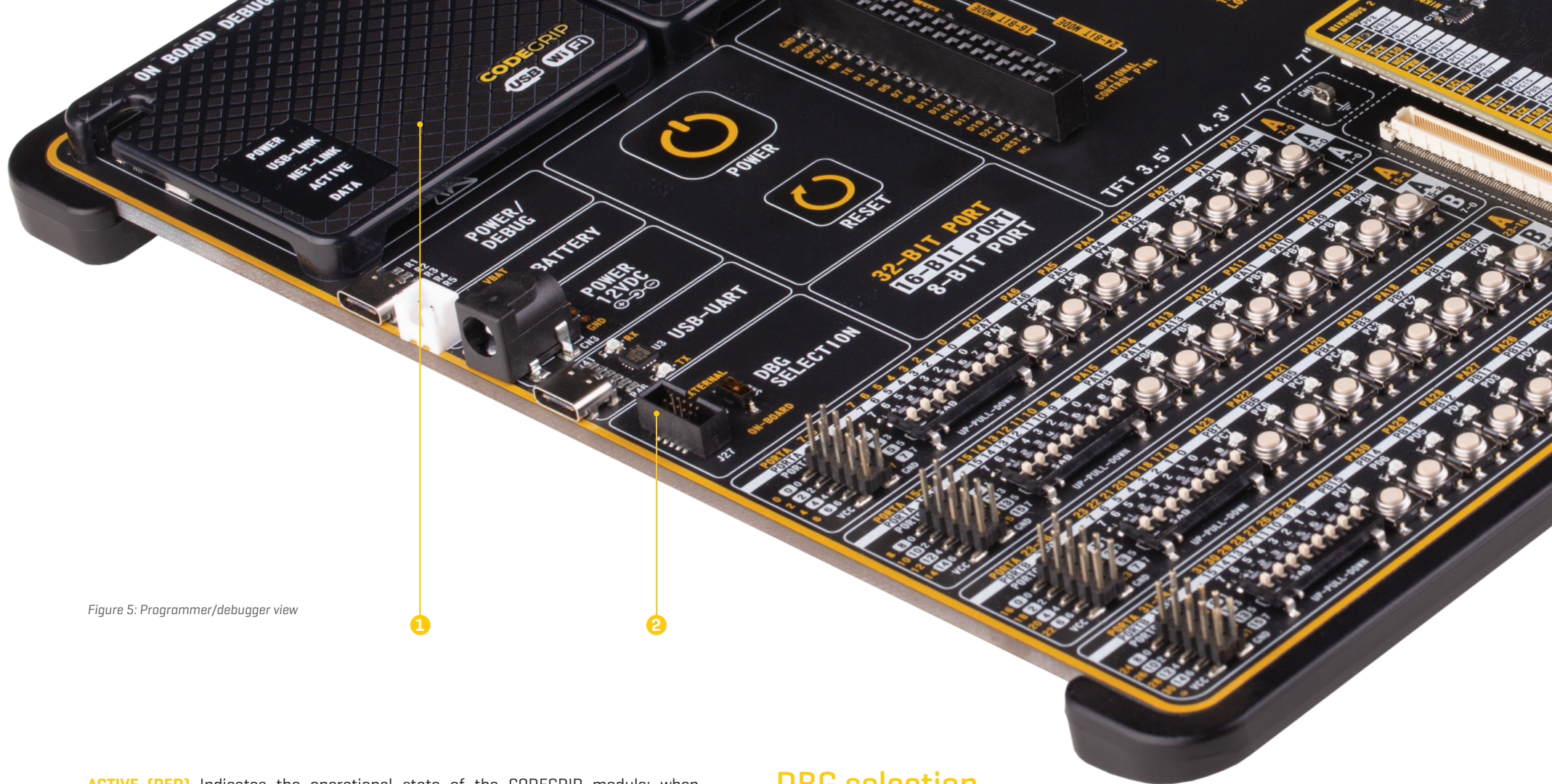


Figure 5: Programmer/debugger view

**ACTIVE (RED)** Indicates the operational state of the CODEGRIP module: when CODEGRIP module is in the bootloader mode, this indicator will blink. Normal operation of the CODEGRIP module is indicated by the ACTIVE LED being constantly turned ON

**DATA (BLUE)** Indicates that there is a data transfer ongoing between the MCU and the CODEGRIP module

The onboard CODEGRIP module **[1]** requires no additional drivers, as it utilizes a HID driver model, which is natively supported by the computer OS. This makes its installation very easy and straightforward in the case when the USB cable is used. As soon as the USB cable is connected to the host PC, the CODEGRIP module is enumerated and the development board is ready to be used.

CODEGRIP module is supported by CODEGRIP Suite. Detailed explanation on how to configure and use the CODEGRIP module on the Fusion for KINETIS v8 development board, can be found in the CODEGRIP manual, and can be downloaded on the following link: [www.mikroe.com/manual/codegrip](http://www.mikroe.com/manual/codegrip)

## DBG selection

The Fusion for KINETIS v8 development board is equipped with the standard 2x5-pin JTAG/SWD connector **[2]** with the 0.05" [1.27mm] pitch, allowing an external programmer/debugger to be connected. If an external programmer/debugger is connected, the onboard CODEGRIP module should be disabled to avoid data corruption. A DIP switch labeled as SW2, located next to the 2x5 JTAG/SWD connector, allows the user to select a programmer/debugger that will be used for the MCU programming:

**EXTERNAL (up):** an external programmer/debugger is connected, the onboard CODEGRIP module is disabled

**ONBOARD (down):** an external programmer is not connected, the onboard CODEGRIP module is enabled

# Connectivity

One of the key features of the Fusion for KINETIS v8 development board is its connectivity.

It features a diverse amount of connecting options, making the board very versatile, adaptable to any situation, and very easy to work with.

It has two display connectors [1x16 LCD connector and 2x20 display connector], Ethernet, USB-UART, USB HOST/DEVICE, an external programmer/debugger connector and many more. The PORT I/O section is the most distinctive connectivity option, which takes up the entire lower half of the board. It allows direct connection to the available MCU pins. This section also contains LEDs for visual indication of pin states, BUTTONS for applying the desired logic states to the pins, and DIP switches for configuring pull-up or pull-down resistors.

All the LEDs, buttons, and headers are logically organized and grouped as PORTS, following the pin organization topology of the MCU.

The presence of five standardized mikroBUS™ sockets is something that makes the Fusion for KINETIS v8 development board very special: the world of Click boards™ is now just under your fingertips. By combining up to 5 different Click boards™, virtually an unlimited number of combinations is possible, considering the fact that the Click board™ repository already has several hundreds of various Click boards™, with more added on a daily basis. Tight integration of the Fusion for KINETIS v8 board with the whole Mikroe ecosystem, allows seamless and effortless prototyping, and truly rapid embedded application development. For more info about the mikroBUS™ standard and the Click board™ line of products, please visit the official Mikroe web page at [www.mikroe.com](http://www.mikroe.com)





Easily create an IoT Weather Station with the Fusion for KINETIS v8 development board. Use the following tools:

**Fusion for KINETIS v8 development board**

**MCU Card for STM32**  
**TFT Board 5**

**G2C click**  
**OLED C click**  
**Temp-Log 2 click**  
**Thunder click**  
**LPS22HB click**

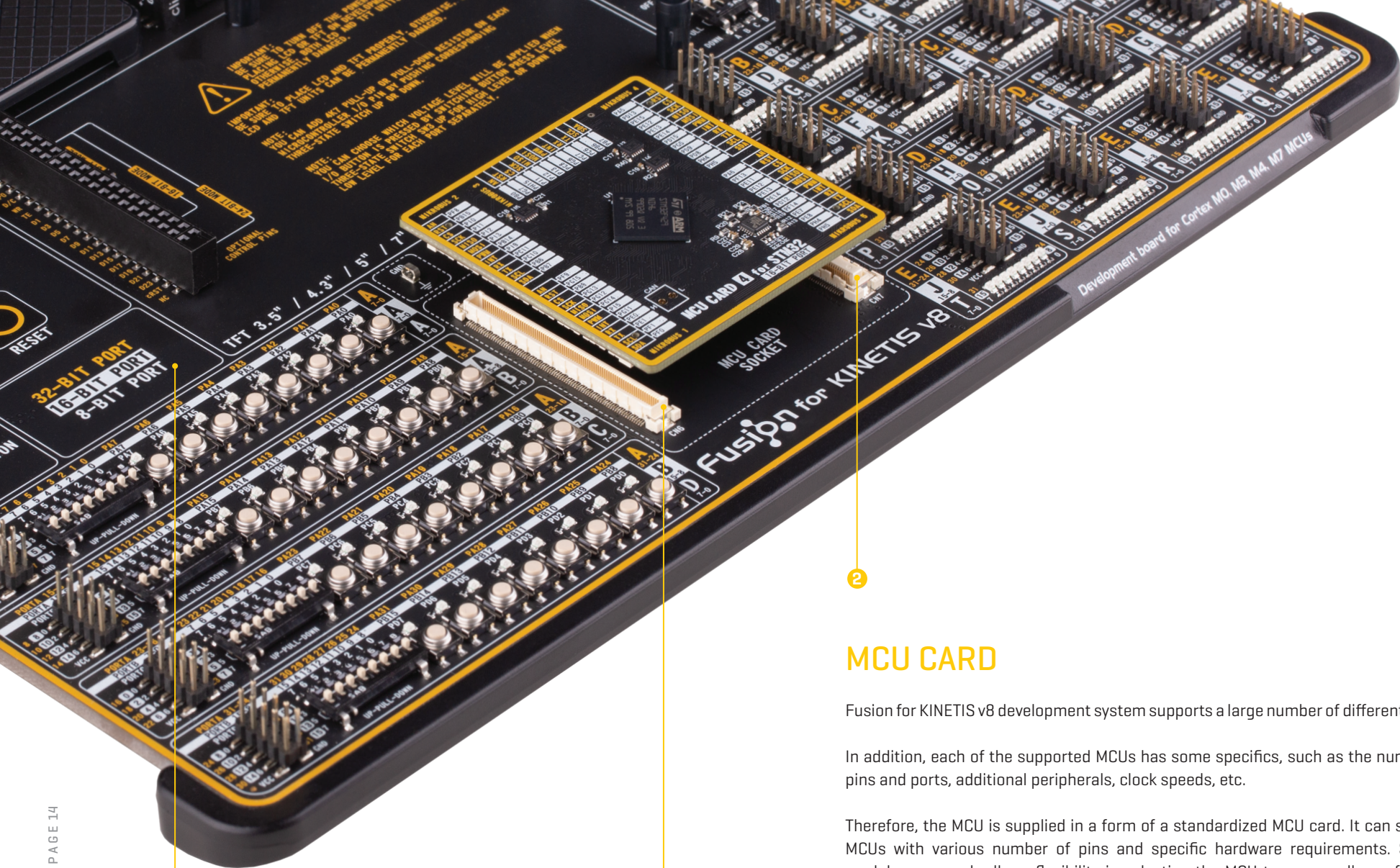


Figure 6: Main board with MCU card socket view

## MCU CARD

Fusion for KINETIS v8 development system supports a large number of different MCUs.

In addition, each of the supported MCUs has some specifics, such as the number of pins and ports, additional peripherals, clock speeds, etc.

Therefore, the MCU is supplied in a form of a standardized MCU card. It can support MCUs with various number of pins and specific hardware requirements. Such a modular approach allows flexibility in selecting the MCU type, regardless of its pin number or specific hardware requirements.

The MCU card itself contains two 168-pin mezzanine connectors providing support for MCUs with a very high pin count, as well as for additional electronic components, necessary for a proper operation of the MCU. One connector is a female connector **[1]**, while the other is a male connector **[2]**.

The development board is likewise, equipped with a pair of complementary connectors, eliminating any possibility of incorrect orientation and placement of the MCU card. Besides these two connectors, an MCU card can also include multiplexing circuits, Ethernet PHY ICs, CAN connectors, CAN PHY ICs, crystal oscillators/clock generators, voltage filtering capacitors, and some other MCU-specific components, necessary

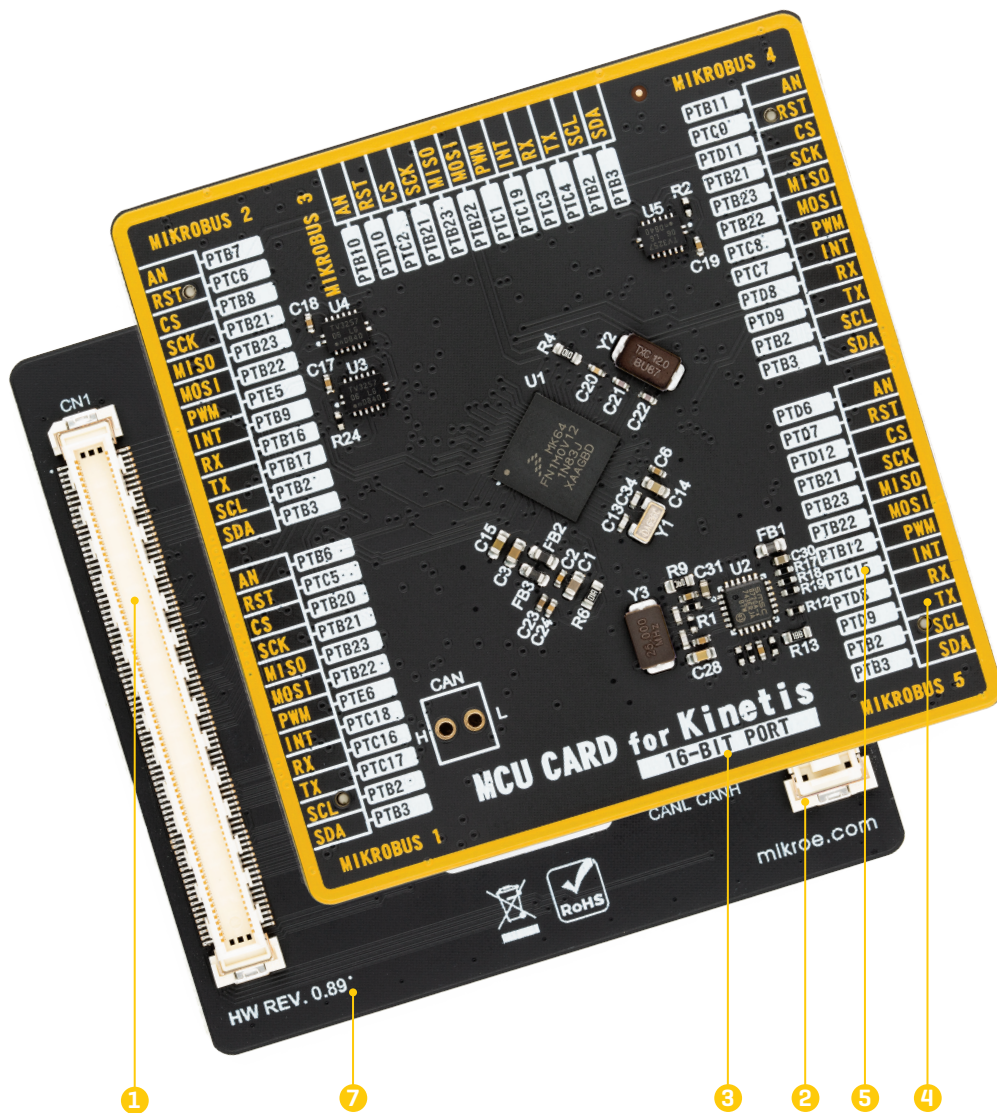


Figure 7: MCU card back and front view

**NOTE** The picture shown is for illustration purpose only. Actual MCU card may vary depending on the installed MCU.

for reliable operation. This makes each MCU card self-contained unit, allowing the development board to operate on a logic level, not having to facilitate specific requirements of many different MCUs. This also allows the MCU to be freely chosen, not having to worry about the pin compatibility and similar issues. Most importantly,

it allows very simple swapping between different MCU types during the development phase, without any hardware interventions.

From the top side, each MCU card has a clearly labeled MCU type it is designed for [MCU CARD for KINETIS], as well as its PORT width, printed just below the MCU type label [8-BIT PORT, 16-BIT PORT, 32-BIT PORT] [3].

In addition, pins are grouped in accordance to mikroBUS™ sockets to which they are routed. Therefore, there are 5 groups of pins. The pins labeled with yellow color [4] belong to mikroBUS sockets, while the white labels [5] represent corresponding pins on the MCU.

On the bottom side of the MCU card, users can find the hardware revision number of the card itself [7].

## INPUT / OUTPUT section

In general, I/O pins of any MCU are internally grouped as PORTs. Such pin grouping scheme is kept throughout the development board as well, offering a clean and organized interface.

However, not all MCU cards have the same PORT width or PORT configuration.

MCU cards have their ports routed as either 8-bit, 16-bit or 32-bit ports. Therefore, the PORT width is printed out on the MCU card below the MCU name label [3], as previously described.

To visually distinguish these ports, they are printed using different color-coding schemes [6]. This makes it easy to follow the correct pin labels.

Before you plug the MCU card into the socket, make sure that the power supply is turned off. Check the MCU card orientation so it matches the printed outline of the MCU card on the development board. Place the MCU card so that both connectors are properly aligned with their onboard counterparts. Then gently press down the MCU card, if there is a physical resistance, please do not try to force the MCU card into the socket.



## 8-BIT port

Pin labels that belong to 8-bit ports are represented by white text on a black background **(1)**. There is a total of twenty 8-bit ports, ranging from PORTA to PORTT. Ports ranging from PORTA to PORTD are routed to the EXPANDED PORTS section **(4)**, while ports ranging from PORTE to PORTT are routed to the COMPACT PORTS **(5)** section.

## 16-BIT port

Pin labels that belong to 16-bit ports are represented by a black text on a white background **(2)**. There is a total of ten 16-bit ports, labeled from PORTA to PORTJ. Ports ranging from PORTA to PORTB are routed to the EXPANDED PORTS section **(4)**, while ports ranging from PORTC to PORTJ are routed to the COMPACT PORTS section **(5)**.

## 32-BIT port

Pin labels that belong to 32-bit ports are represented by a yellow text on a black background **(3)**. There is a total of five 32-bit ports, labeled from PORTA to PORTE. PORTA is routed to the EXPANDED PORTS section **(4)**, while ports ranging from PORTB to PORTE are routed to the COMPACT PORTS section **(5)**.

## EXPANDED ports

There are four distinctive EXPANDED PORTS, located at the lower left side of the board **(4)**, each containing a set of eight buttons, eight LEDs, a single eight-pole DIP switch, and a single 2x5 pin header with 2.54mm pitch. These EXPANDED PORTS are labeled according to the MCU PORT they are routed to, with respect to the aforementioned color-coded labeling scheme.

## COMPACT ports

The lower right side of the board **(5)** is divided into several smaller sections, each with a single 2x5 pin header with 2.54mm pitch, and a group of 8 LEDs. These sections are simplified versions of the EXPANDED PORTS. The COMPACT PORT sections are labeled according to the MCU PORT they are routed to, with respect to the color-coded labeling scheme, discussed above.

## PORT buttons

Port buttons can be used to apply the desired logic state to pins of the MCU PORT they are routed to. These buttons are small tactile SPST switches that work in conjunction with a DIP switch, labeled as BUTTONS **(6)** (also labeled as SW3 on the schematic – separately included). This DIP switch is located in the BOARD SETUP section **(7)**. These buttons apply a logic level to a pin, according to the color labeling scheme as discussed earlier.

## BUTTONS DIP switch

This four-position (poles), tri-state DIP switch, allows the button to apply a LOW logic level to an MCU pin when pressed (connecting it to a reference GND), or to apply a HIGH logic level when pressed (connecting it to the power rail). It can also completely disconnect the button, preventing accidental button presses. To limit the pin current and prevent the excessive inrush of currents when a button is pressed, a protective 220Ω resistor is used, connected in series with the switch. Each position of the BUTTONS DIP switch is used to determine the applied logic level of a button press for the entire PORT, there are only four poles on this DIP switch, allowing control of all four groups of buttons.

**UP position:** a button applies HIGH logic level to the corresponding PORT pins (according to 8-bit labeling)

**MID position:** a button is completely disconnected

**LOW position:** a button applies LOW logic level to the corresponding PORT pins (according to 8-bit labeling)

## UP-PULL-DOWN DIP switch

Besides the buttons, each of the four EXPANDED PORTS has a single eight-pole, tristate DIP switch **(8)**, labeled as UP-PULL-DOWN (SW6 through SW9 on the schematic – separately included), used to enable a pull-up or a pull-down resistor for the specific pin, or to leave the specific pin in a floating state:

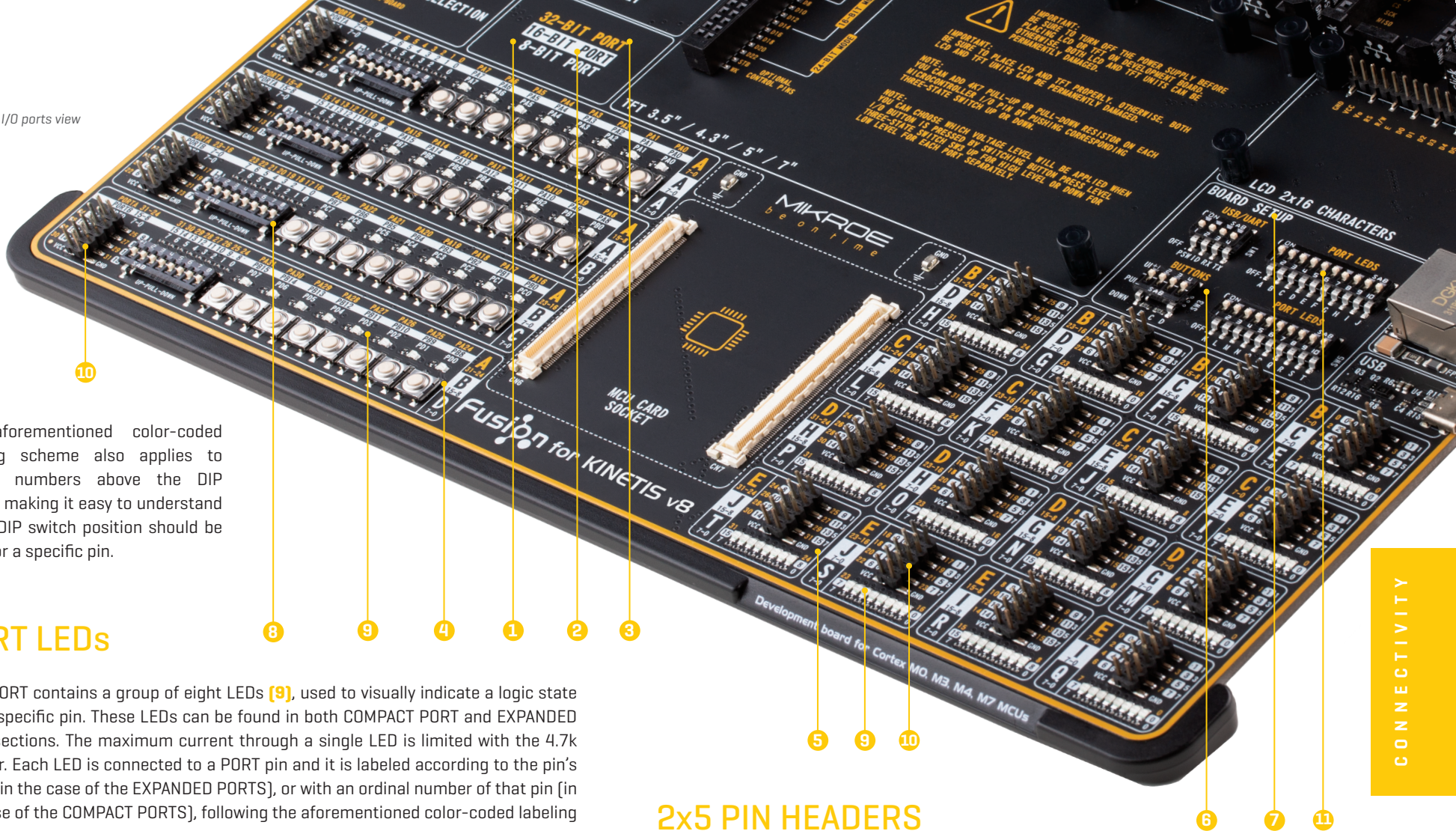
**UP position:** connects a 4.7 kΩ resistor between the MCU power rail and the pin associated with the particular DIP switch position (a pin is pulled-up)

**MID position:** disables both pull-up and pull-down resistor connections from the pin associated with the particular DIP switch position, leaving it in a floating state

**DOWN position:** connects the 4.7 kΩ resistor between the GND and the pin associated with the particular DIP switch position (a pin is pulled-down)



Figure 8: I/O ports view



The aforementioned color-coded labeling scheme also applies to ordinal numbers above the DIP switch, making it easy to understand which DIP switch position should be used for a specific pin.

## PORT LEDs

Each PORT contains a group of eight LEDs [9], used to visually indicate a logic state of the specific pin. These LEDs can be found in both COMPACT PORT and EXPANDED PORT sections. The maximum current through a single LED is limited with the 4.7k resistor. Each LED is connected to a PORT pin and it is labeled according to the pin's name [in the case of the EXPANDED PORTS], or with an ordinal number of that pin [in the case of the COMPACT PORTS], following the aforementioned color-coded labeling scheme.

LEDs on each PORT can be disabled, when they are not needed. Having a LED on a communication line or an A/D converter input might alter expected results, since LED represents an additional electrical load on a particular pin.

There are two DIP switches with ten positions (poles), with each pole assigned to a specific PORT. These DIP switches are labeled as PORT LEDS [11] on the development board [SW4 and SW5 provided separately on the schematic]. A single DIP switch position is used to disable a group of LEDs which belong to a PORT:

**ON position [up]:** enables LEDs for a specific PORT, associated with the particular DIP switch position [according to the 8-bit labeling scheme]

**OFF position [down]:** disables LEDs for a specific PORT, associated with the particular DIP switch position [according to the 8-bit labeling scheme]

## 2x5 PIN HEADERS

Besides LEDs, there are also 2x5 pin headers [10] in both COMPACT PORT and EXPANDED PORT sections. All the pins which belong to a specific PORT are routed to the 2x5 pin header located in that PORT section, along with the GND and the power rail. Pins on these headers are labeled with ordinal numbers which correspond to the ordinal numbers of the pins within the specific MCU PORT. They are labeled following the color coding scheme.

These 2x5-pin headers can be used to expand the connectivity of the Fusion for KINETIS v8 development board, allowing interfacing with other devices, peripherals, and measurement equipment, either by using IDC10 extension cables, IDC10 female sockets, or simply by using jumper wires. Enhanced connectivity is one of the key features of Fusion for KINETIS v8 development board, there are many connectivity options provided. However, 2x5-pin headers allow the most extensive connectivity as they expose all the available GPIO MCU pins to the outside world.

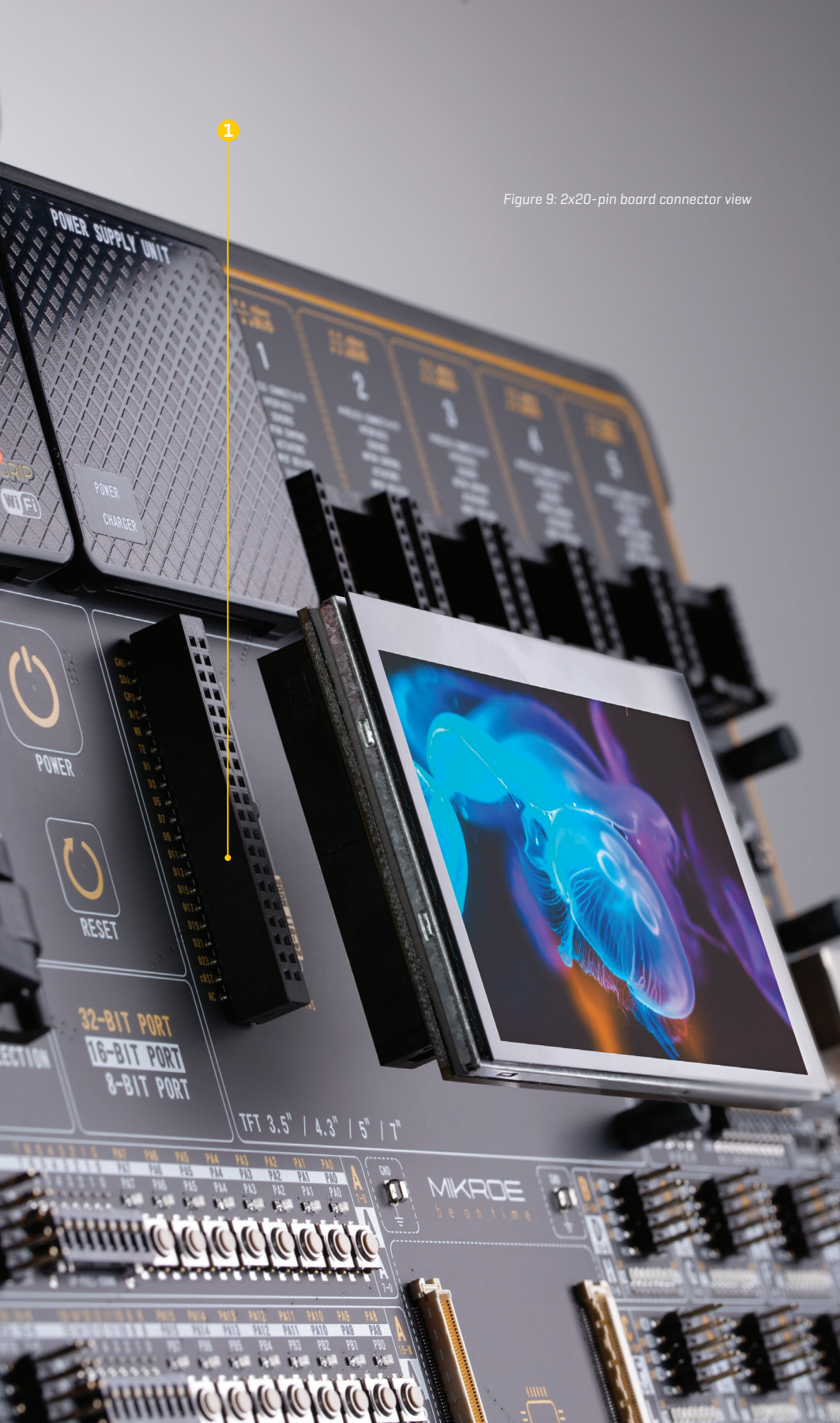


Figure 9: 2x20-pin board connector view

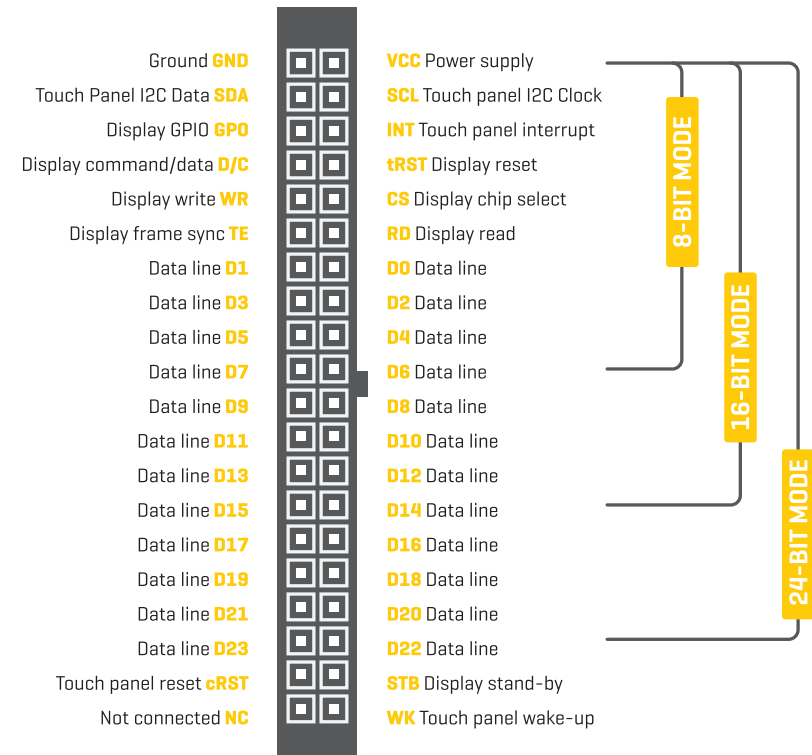
## 2x20 display connector

Fusion for KINETIS v8 development board features a standardized 2x20-pin display connector. This connector consists of the 8080 parallel interface, offering support for displays with up to 8 bits per color (up to 24-bit mode, 16 million colors). Besides the 8080 interface, this connector also contains pins related to touch panel controller,

Make sure to turn off the power supply before placing the display module on the board. Otherwise, the display module or the board can be permanently damaged.



interfaced over dedicated I2C bus lines. The power supply rails are also routed to this connector. Using the standardized pinout ensures compatibility with the existing (i.e. TFT Board Capacitive line of displays), as well as the future versions of display boards. More information can be found at [www.mikroe.com/manual/tft-boards](http://www.mikroe.com/manual/tft-boards)



## 1x16 display connector

Liquid Crystal Display (LCD) is a cheap and popular way of representing application results, messages, or some other type of information to users. Fusion for KINETIS v8 natively supports 2x16 characters LCD module, connected in 4-bit mode. It offers a dedicated 1x16-pin header [2] that can host a compatible LCD. Each pin of the connector is labeled on the development board and should be connected with the respective pin of the LCD:

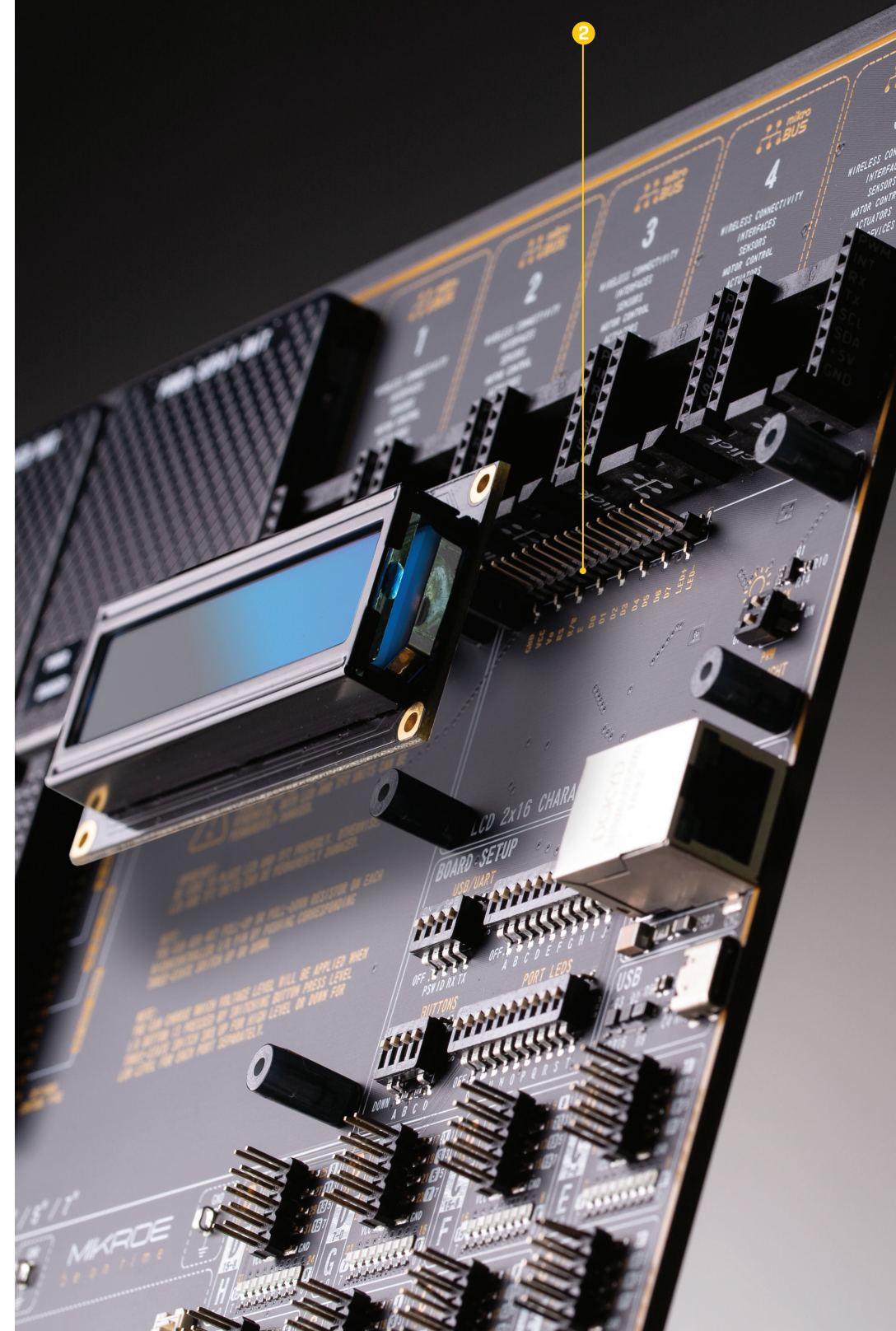
|             |   |                            |
|-------------|---|----------------------------|
| <b>GND</b>  | □ | Ground                     |
| <b>VCC</b>  | □ | LCD power supply           |
| <b>Vo</b>   | □ | LCD contrast               |
| <b>RS</b>   | □ | Register select            |
| <b>R/W</b>  | □ | LCD Read/Write mode select |
| <b>E</b>    | □ | LCD enable                 |
| <b>D0</b>   | □ | Lower four data lines      |
| <b>D1</b>   | □ |                            |
| <b>D2</b>   | □ |                            |
| <b>D3</b>   | □ |                            |
| <b>D4</b>   | □ | Upper four data lines      |
| <b>D5</b>   | □ |                            |
| <b>D6</b>   | □ |                            |
| <b>D7</b>   | □ |                            |
| <b>LED+</b> | □ | LCD backlight anode        |
| <b>LED-</b> | □ | LCD backlight cathode      |

Figure 10: 1x16 display header view

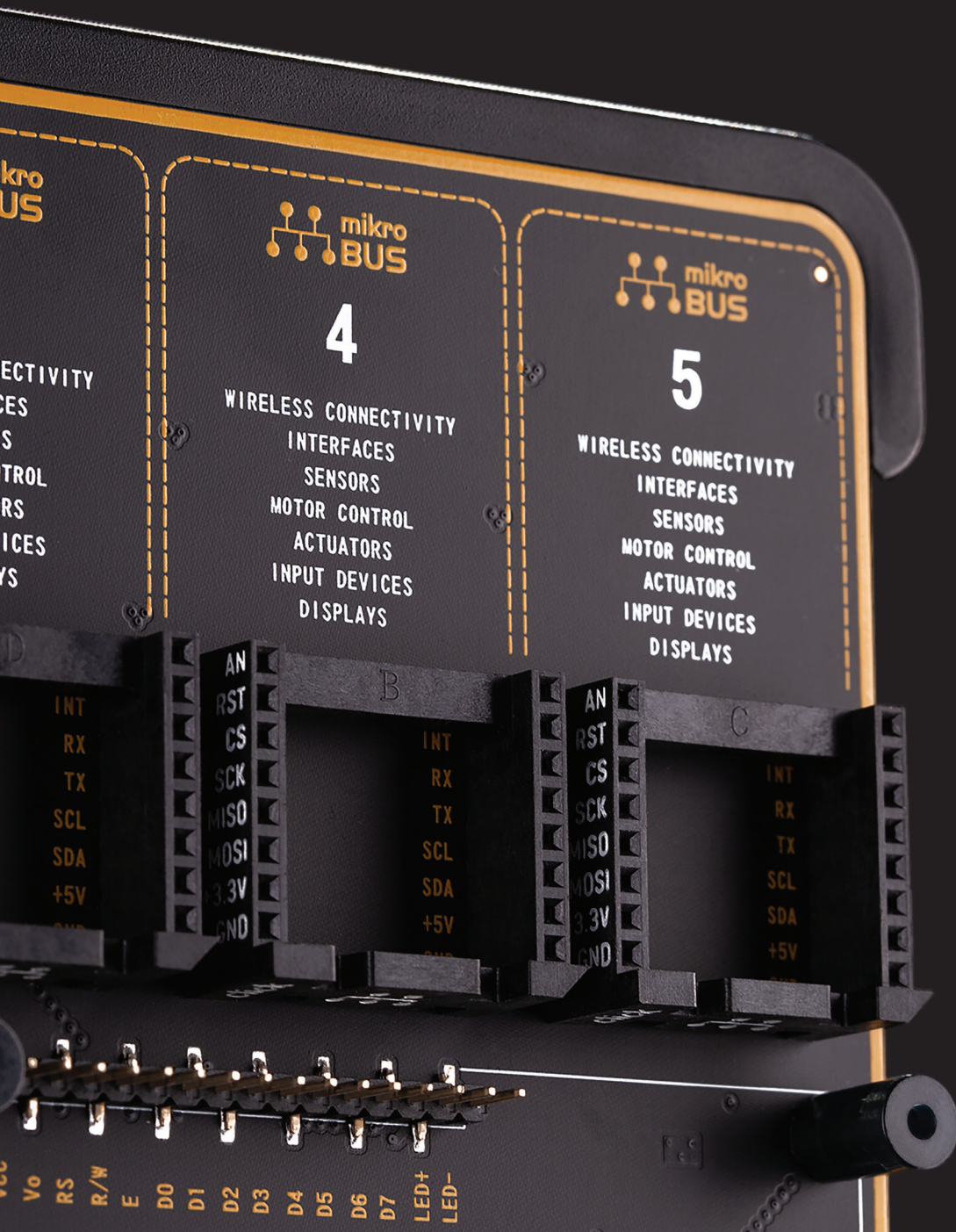
To configure optional backlight settings of the LCD, a two-pole DIP switch can be used, labeled as BACKLIGHT, located in the LCD 2x16 CHARACTERS section of the board:

- SW11.1 ON (up):** LCD backlight is ON;  
**OFF (down):** LCD backlight is OFF
- SW11.2 ON (up):** PWM signal from the MCU controls the LCD backlight brightness;  
**OFF (down):** the brightness amount is fixed and can't be controlled by the MCU

**NOTE** There are four plastic spacers used to provide physical support for both types of connected displays, ensuring a reliable connection and preventing bending of their pins.



# mikroBUS™ sockets



The superior connectivity features of the Fusion for KINETIS v8 development board are rounded up with five 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](http://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.

Each MCU card has different pins routed to the mikroBUS™ sockets, depending on the particular MCU. Therefore, each mikroBUS™ socket is labeled on the development board with its ordinal number, by which the connector is referenced to in the Mikroe development environment, software applications, tutorials, etc.

Also, each MCU card has the pins routed to the corresponding mikroBUS™ clearly labeled on the MCU card itself, as described in the MCU CARDS section. This allows users to instantly know which MCU pin is routed to a pin on the specific mikroBUS™ socket.

Figure 11. Main board with mikroBUS™ socket close up view

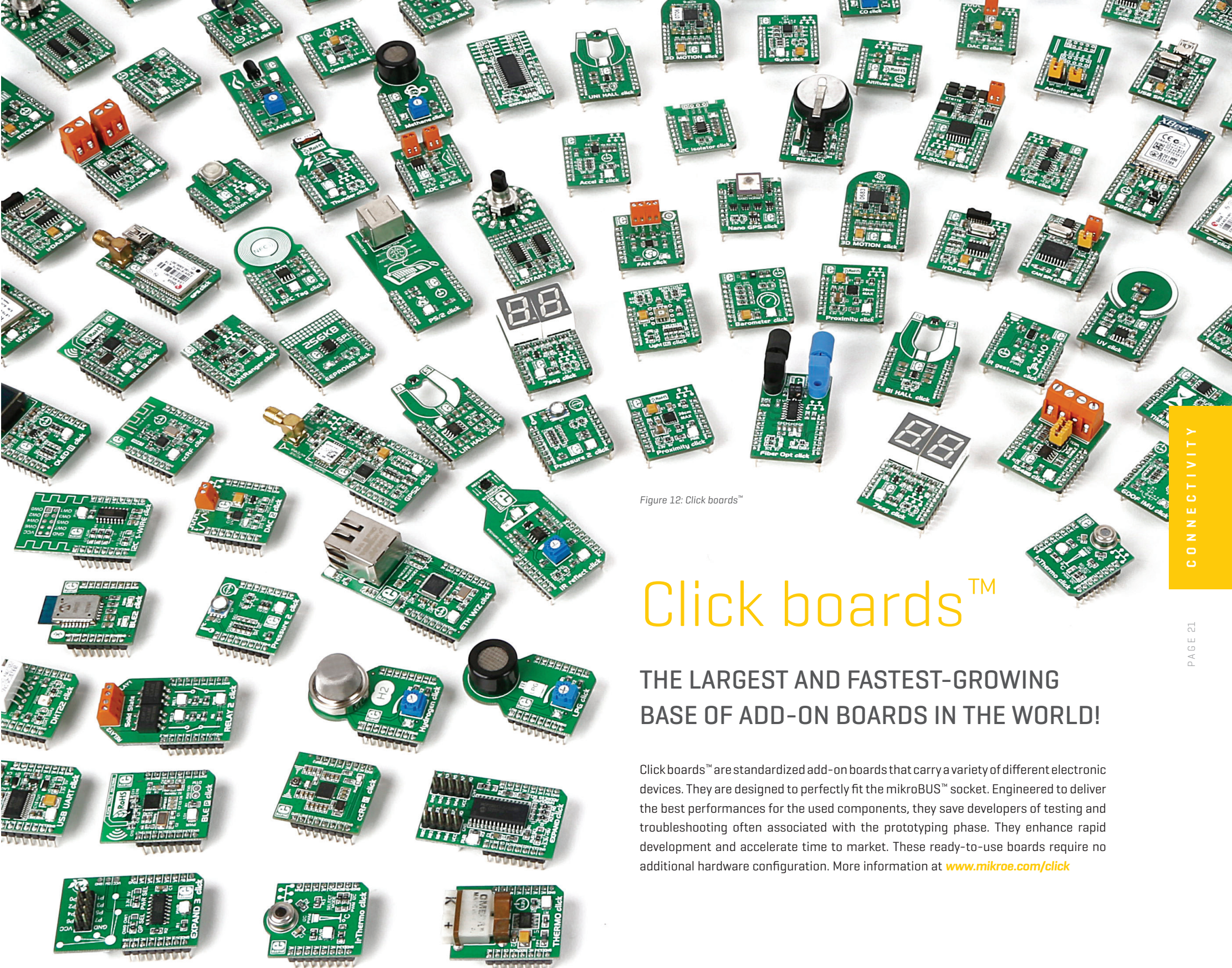


Figure 12: Click boards™

# 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](http://www.mikroe.com/click)

# Communication

Communication connectors allow the development board to be connected with many different devices that use high-layer communication protocols such as Ethernet, USB, etc. Also, there is a USB-UART converter, offering simplified communication with the personal computer over the emulated serial interface. Each of these connectors will be described in more details, in the following sections of the manual.

## USB-UART

UART (Universal Asynchronous Receiver/Transmitter) interface is one of the most common interfaces for data exchange between the MCU and other external devices. Fusion for KINETIS v8 development board offers the UART connectivity over the USB-C connector **[1]** by utilizing the FT230XQ, a popular USB-UART bridge IC, produced by FTDI Chip. This IC contains the complete USB stack necessary for the interface bridging between the UART peripheral of the MCU and the USB interface of the PC. FT230XQ drivers are available for download from the Fusion for KINETIS v8 product web page, as well as from the official FTDI drivers download web page.

To enable data exchange via the USB-UART connector, the MCU UART peripheral lines must be connected to the corresponding pins of the FT230XQ IC. This can be done using the four-pole DIP switch, labeled as USB/UART (SW1 on the schematic). Only two switch positions are used for the UART setup, while the other two switch positions are reserved for USB HOST/DEVICE functions:

- SW1.3** **ON (up):** connects the UART RX pin from the MCU to the FT230XQ IC;  
**OFF (down):** disconnects the UART RX pin from the FT230XQ IC
- SW1.4** **ON (up):** connects the UART TX pin from the MCU to the FT230XQ IC;  
**OFF (down):** disconnects the UART TX pin from the FT230XQ IC

## USB

USB (Universal Serial Bus) **[2]** is a very popular industry standard that defines cables, connectors, and protocols used for communication and power supply between devices. USB-C (USB Type-C connector) is the latest version of the USB connector, developed by the USB Implementation Forum (USB-IF). Due to its many advantages including symmetrical pinout, higher current capacity, and faster supported data rates, it is probably going to replace all the previous USB connector types. USB-C connector supports both USB HOST and USB DEVICE modes. This enables MCUs equipped with the USB peripheral to act either as a USB HOST or as a USB DEVICE, allowing development of a range of various USB based applications.

The USB mode selection is done using an a specialized controller IC solution. This IC provides Configuration Channel (CC) control logic detection and indication functions. The HOST/DEVICE detection pin (USB ID), as well as the HOST/DEVICE configuration pin (USB PSW) of the MCU, can be connected with the logic control circuit by using the DIP switch (SW1), located in the BOARD SETUP section:

- SW1.1** **ON (up):** connects the HOST/DEVICE configuration pin of the MCU with the PTN5150 logic control circuit;  
**OFF (down):** disconnects the HOST/DEVICE configuration pin from the PTN5150 logic control circuit
- SW1.2** **ON (up):** connects the HOST/DEVICE detection pin of the MCU with the logic control circuit;  
**OFF (down):** disconnects the HOST/DEVICE detection pin from the logic control circuit

To set up Fusion for KINETIS v8 development board as the USB HOST, the PSW pin should be set to a LOW logic level [0] by the MCU. If set to a HIGH logic level [1] the development board acts as a DEVICE. In HOST mode, Fusion for KINETIS v8 development board provides the power over the USB-C connector for the attached device.

The USB ID pin is used to detect the type of the device attached to the USB port, according to USB OTG specifications: the USB ID pin connected to GND indicates a HOST, while the USB ID pin set to a high impedance state (HI-Z) indicates that the connected peripheral is a DEVICE.

# 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.

Fusion for KINETIS v8 features standard RJ-45 Ethernet connector [3] which enables MCUs that support Ethernet communication to establish a connection with a personal computer, network router, or other Ethernet network device. All four Ethernet lines (TX P, TX N, RX P, and RX N), as well as the LED indicator lines (LED1, LED2+, LED2-) are routed directly to the MCU card socket and cannot be accessed via PORT headers.

# Additional GNDs

Fusion for KINETIS v8 development board contains two exposed GND pins just above the MCU card, which can be used to connect measurement or testing equipment. These additional GND pins allow secure connection with the instrumentation probes, avoiding loose cables or unreliable contacts that might compromise the accuracy of the readings.

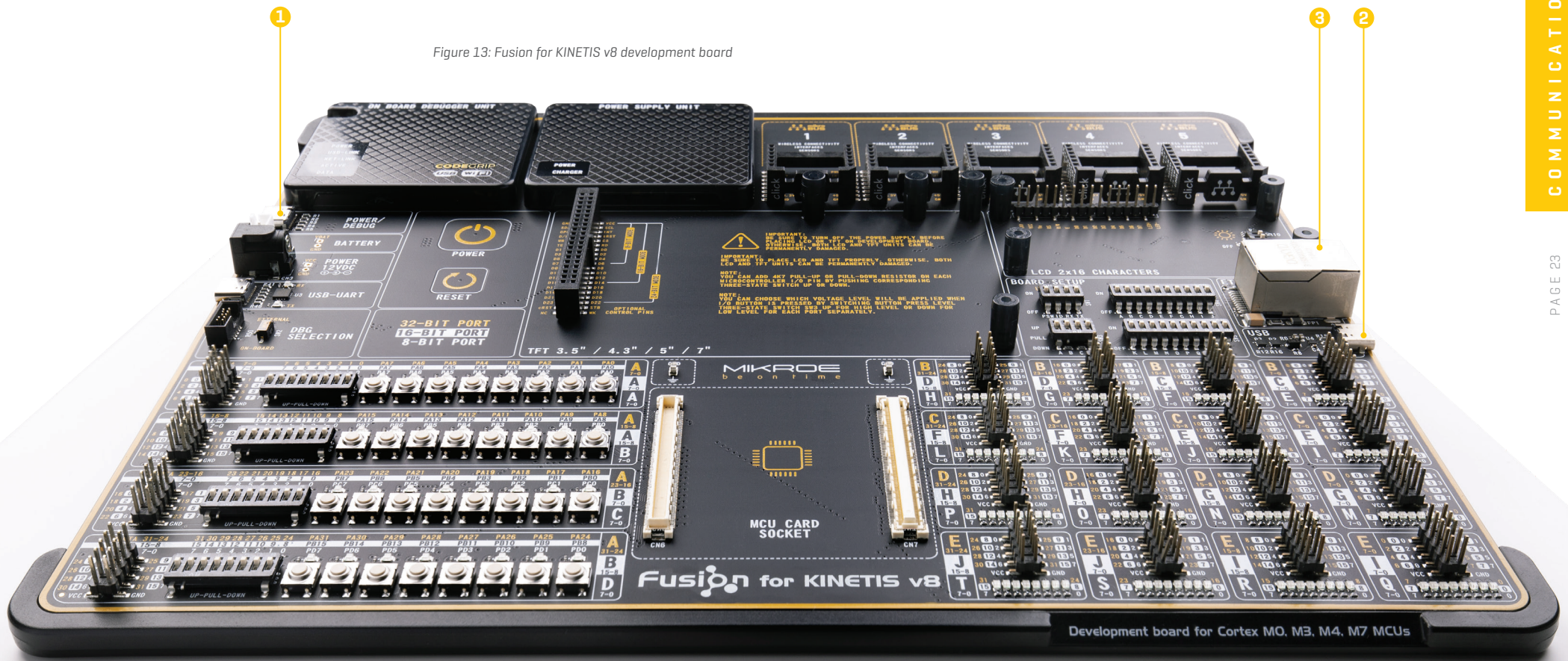



Figure 13: Fusion for KINETIS v8 development board

A detailed workshop scene featuring a robotic arm in the foreground holding a tray of tools. A glowing light fixture is positioned above the tools, and another glowing light fixture is visible in the upper right corner. The background is a blurred grid pattern.

What makes you want to be an embedded developer? Is it the recognition of your skills, invention, or the development process? Whatever the reason is, we want to let you know that we are here for you every step of the way.

You can enjoy the process focused, yet relaxed – everything else is taken care of.

Enjoy premium.





# What's Next?

You have now completed the journey through each and every feature of the Fusion for KINETIS v8 development board. You have become familiar with its modules, organization, and the programmer/debugger. Now you are ready to start using your new board. We suggest following steps which are highly recommended to begin with.

## 1 COMPILERS

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

## 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 Fusion for KINETIS v8 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](http://www.libstock.mikroe.com)

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