MIKROE

mikromedia ^{3}
for PIC CAPACITIVE FPI

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Elegant on the surface, yet extremely powerful on the inside, we have designed it to inspire outstanding achievements.
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MIKROE
Time-saving embedded tools

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Pick your own look

Identical in the back, choices up front.

1. *mikromedia 3 for PIC Capacitive FPI with bezel*
2. *mikromedia 3 for PIC Capacitive FPI with frame*

mikromedia 3 for PIC CAPACITIVE is a compact development board designed as a complete solution for the rapid development of multimedia and GUI-centric applications. By featuring a 3.5" capacitive touch screen driven by the powerful graphics controller that can display the 24-bit color palette (16.7 million colors), along with a DSP-powered embedded sound CODEC IC, represents a perfect solution for any type of multimedia application.

At its core, there is a powerful 8-bit PIC18F97J94 microcontroller (referred to as "host MCU" in the following text), produced by Microchip, which provides sufficient processing power for the most demanding tasks, ensuring fluid graphical performance and glitch-free audio reproduction.

However, this development board is not limited to multimedia-based applications only: mikromedia 3 for PIC CAPACITIVE ("mikromedia 3" in the following text) features USB, digital motion sensor, battery charging functionality, SD-Card reader, and much more, expanding its use beyond the multimedia.

The usability of mikromedia 3 FPI does not end with its ability to accelerate the prototyping and application development stages: it is designed as the complete solution which can be implemented directly into any project, with no additional hardware modifications required. We offer two types of mikromedia 3 for PIC CAPACITIVE FPI boards. The first one has a TFT display with a bezel around it and is ideal for handheld devices. The other mikromedia 3 for PIC CAPACITIVE FPI board has a TFT display with a metal frame, and four corner mounting holes that enable simple installation in various kinds of industrial appliances. Each option can be used in smart home solutions, as well as wall panel, security and automotive systems, factory automation, process control, measurement, diagnostics and many more. With both types, a nice casing is all that you need to turn the mikromedia 3 for PIC CAPACITIVE FPI board into a fully Pick your own look functional design.

This manual, in its entirety, showcases just one option of mikromedia 3 for PIC CAPACITIVE FPI for illustration purposes. The manual applies to both options. **NOTE**

1. Key microcontroller features

At its core, mikromedia 3 for PIC CAPACITIVE uses the **PIC18F97J94** MCU.

PIC18F97J94 is the high-performace 8-bit MCU, produced by Microchip. It features a rich peripheral set, like CTMU, hardware RTC, 12 bit A/D, along with the standard ones. Key features include:

- 128 KB of Flash memory
- 4 KB of RAM memory
- nanoWatt XLP technology
- Operating frequency up to 64 MHz
- High-Precision PLL for USB

For the complete list of MCU features, please refer to the PIC18F97J94 *datasheet.*
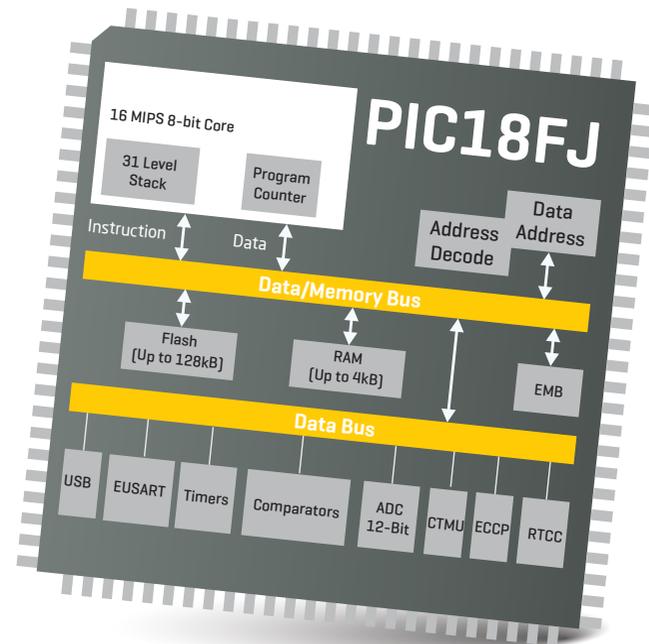
Figure 1: PIC18F97J94 MCU block schematic
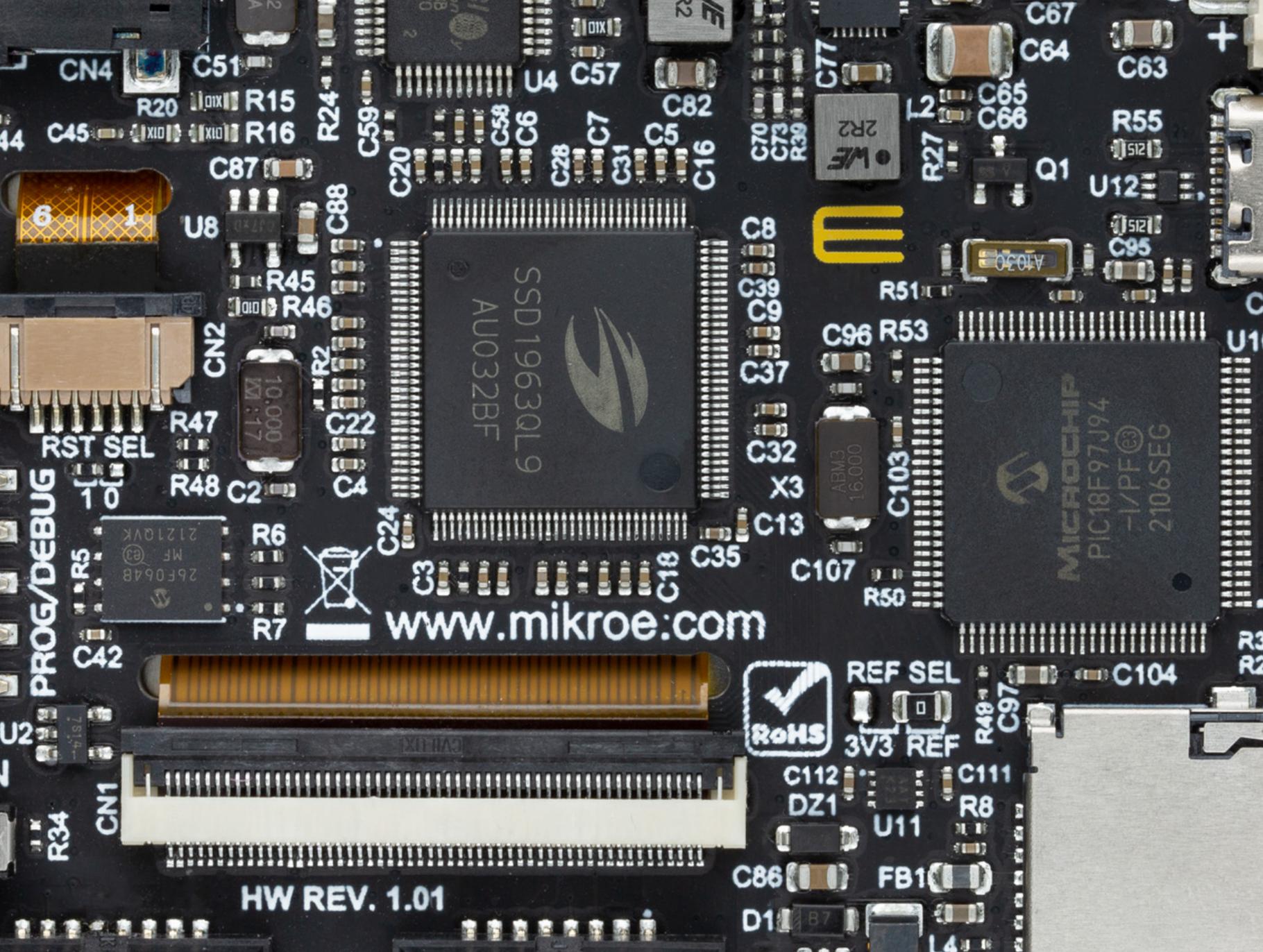
CN4

C51

R20

C45 R15 R16 R24

C87 C59 C20 C58 C6 C7 C5 C16

U8

C88

R45

R46

R2

R47

R48 C2

U4 C57

C28 C31

C82

C77

C70 C73 C39

2R2

L2

Q1

R27

C67

C64

C65 C66

C63

R55

512

U12

512 C95

A1020

R51

C8

C9

C37

C96 R53

C39

R6

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U2

R34

R42

C42

CN2

PROG/DEBUG

RST SEL

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2121QVK

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MF

10.000

:17

C22

C4

C24

C3

C18

C35

C13

C32

X3

C107

ABM3
16.000

C103

C50

U10

R49

R30

R25

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RoHS

REF SEL

3V3 REF

R46 C97

C104

C112

DZ1

U11

R8

C111

C86

FB1

CN1

HW REV. 1.01

D1

B7

SSD1963QL9
AU032BF

MICROCHIP
PIC18F97J94
-I/PF
2106SEG
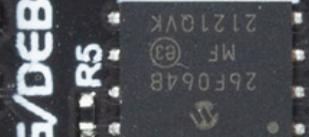
1.1 Microcontroller programming/debugging

The host MCU can be programmed and debugged over the Microchip ICSP compatible 2x5 pin header **[1]**, labeled as PROG/DEBUG. This header allows an external programmer (e.g. CODEGRIP or mikroProg) to be used.

Programming the microcontroller can also be done by using the bootloader which is preprogrammed into the device by default. All the informations about the bootloader software can be found on the following page:

www.mikroe.com/mikrobootloader

1.2 MCU reset

The board is equipped with the Reset button **[2]**, which is located on the front side of the board. It is used to generate a LOW logic level on the microcontroller reset pin.
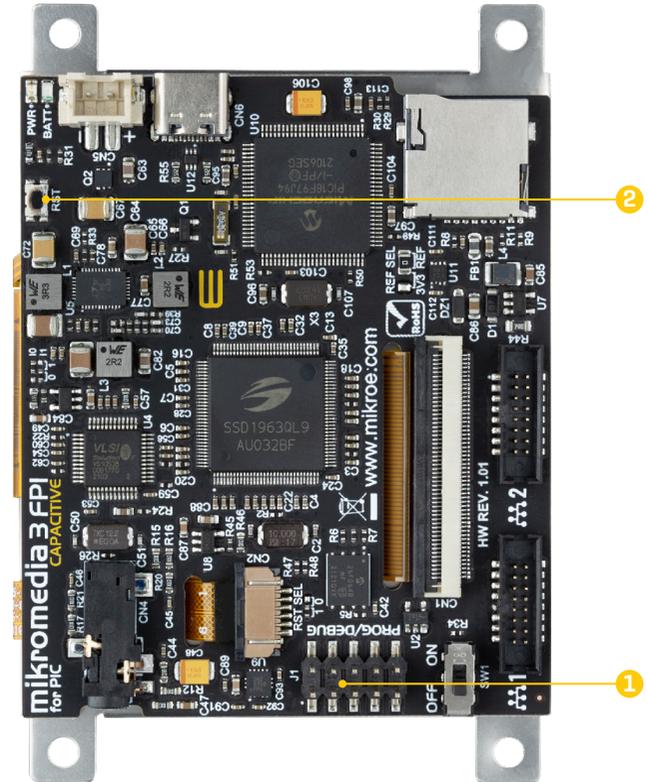

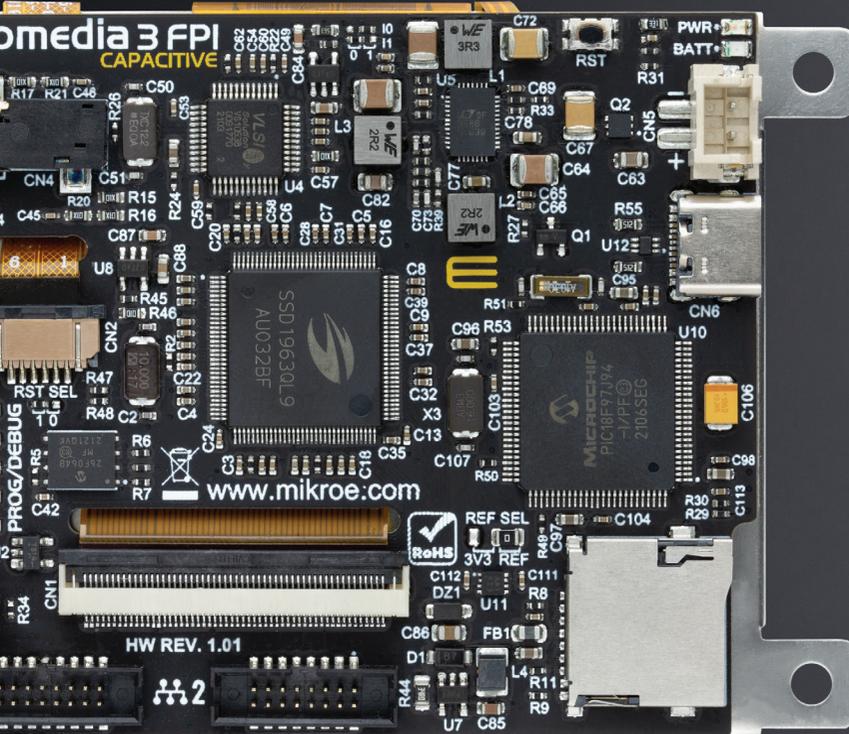*Figure 3: Back view*

2. Power supply unit

Figure 4: Power supply unit view

The power supply unit (PSU) provides clean and regulated power, necessary for proper operation of the mikromedia 3 development board. The host MCU, along with the rest of the peripherals, demands regulated and noise-free power supply. Therefore, the PSU is carefully designed to regulate, filter, and distribute the power to all parts of mikromedia 3. It is equipped with two different power supply inputs, offering all the flexibility that mikromedia 3 needs, especially when used on the field or as an integrated element of a larger system. In the case when multiple power sources are used, an automatic power switching circuit with predefined priorities ensures that the most appropriate will be used.

The PSU also contains a reliable and safe battery charging circuit, which allows a single-cell Li-Po/Li-Ion battery to be charged. Power OR-ing option is also supported, providing an uninterrupted power supply (UPS) functionality when an USB power source is used in combination with the battery.

2.1 Detailed description

The PSU has a very demanding task of providing power for the host MCU and all the peripherals onboard, as well as for the externally connected peripherals. One of the key requirements is to provide enough current, avoiding the voltage drop at the output. Also, the PSU must be able to support multiple power sources with different nominal voltages, allowing switching between them by priority. The PSU design is based on LTC3586, a highly integrated power management and battery charger IC that includes a current limited switching PowerPath manager. LTC3586 also enables battery charging over a USB connection. This IC transmits nearly all of the power available from the USB port to the load with minimal loss and heat. The PowerPath switching regulator and battery charger inside LTC3586 communicate to ensure that the input current never violates the USB specifications.

2.2 Voltage reference

The MCP1501, a high-precision buffered voltage reference from Microchip is used to provide a very precise voltage reference with no voltage drift. It can be used for various purposes: the most common uses include voltage references for A/D converters, D/A converters, and comparator peripherals on the host MCU. The MCP1501 can provide up to 20mA, limiting its use exclusively to voltage comparator applications with high input impedance. Depending on the specific application, either 3.3V from the power rail, or 2.048V from the MCP1501 can be selected. An onboard SMD jumper labeled as REF SEL offers two voltage reference choices:

- REF: 2.048V from the high-precision voltage reference IC
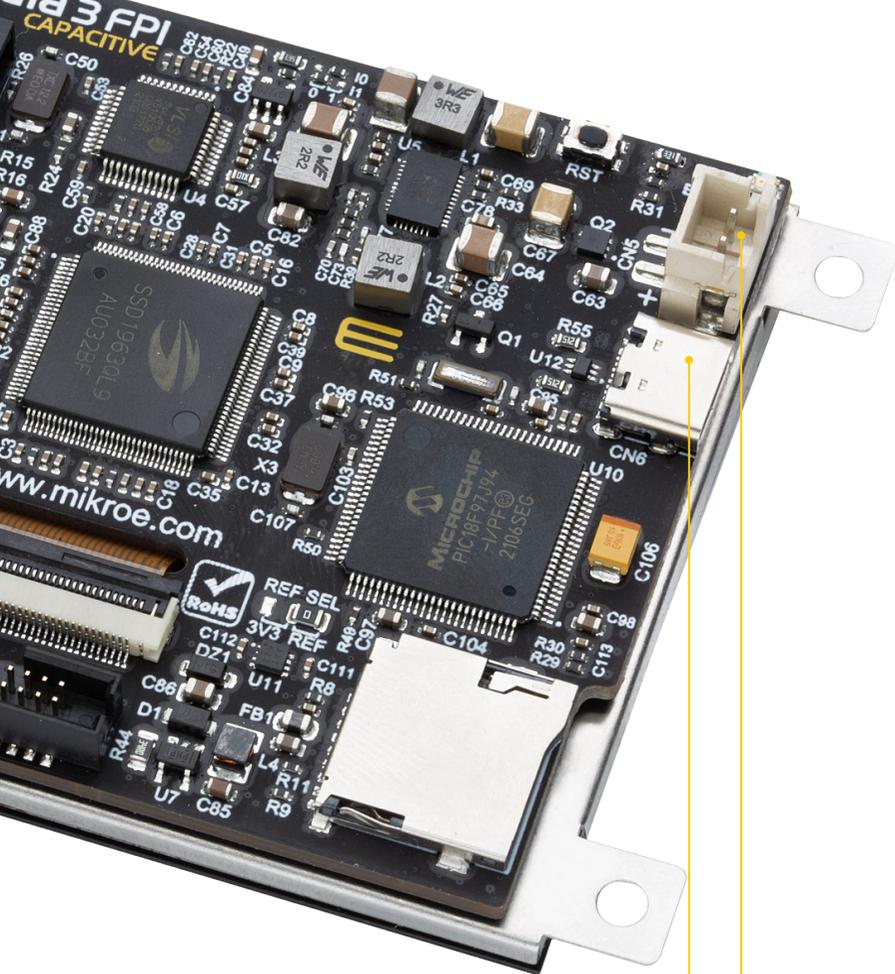- 3V3: 3.3V from the main power supply rail

2.3 PSU connectors

As explained, the advanced design of the PSU allows two 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. Power is not an issue even if it is powered over the USB cable. It can be powered over the USB-C connector, using power supply delivered by the USB HOST (i.e. personal computer), USB wall adapter, or a battery power bank.

There are two power supply connectors available, each with its unique purpose:

- CN6: USB-C connector **[1]**
- CN5: Standard 2.5mm pitch XH battery connector **[2]**

2.3.1 USB-C connector

The USB-C connector (labeled as CN6 on board) provides power from the USB host (typically PC), 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 on the following page:

Figure 5: Power supply connectors view

1 **2**

USB Power Supply				
Input Voltage [V]		Output Voltage [V]	Max Current [A]	Max Power [W]
MIN	MAX	3.3	1	3.3
4.4	5.5	5	0.8	4
		3.3 & 5	0.6 & 0.6	4.98

Figure 6: USB power supply table

When using a PC as the 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 uses the 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 in that case. Note that when using longer 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 USB host is not equipped with the USB-C connector, a Type A to Type C USB adapter may be used (included in the package).*

2.3.2 Li-Po/Li-Ion XH battery connector

Powering mikromedia 3 by a single-cell Li-Po/Li-Ion battery allows complete autonomy, allowing it to be used in some very specific situations: hazardous environments, agricultural applications, etc.

The battery connector is a standard 2.5mm pitch XH connector. It allows a range of single-cell Li-Po and Li-Ion batteries to be used. The PSU of

mikromedia 3 offers the battery charging functionality, from the USB connector. The battery charging circuitry of the PSU manages the battery charging process, allowing the optimal charging conditions and longer battery life. The charging process is indicated by BATT LED indicator, located on the front of mikromedia 3.

The PSU module also includes the battery charger circuit. Depending on the operational status of the mikromedia 3 development board, the charging current can be either set to 100mA or 500mA. When the development board is powered OFF, the charger IC will allocate all available power for the battery charging purpose. This results in faster charging, with the charging current set to approximately 500mA. While powered ON, the available charging current will be set to approximately 100 mA, reducing the overall power consumption to a reasonable level.

Maximum power ratings 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	3.3
3.5	4.2	5	0.8	4
		3.3 & 5	0.6 & 0.6	4.98

Figure 7: Battery power supply table

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

2.4 Power redundancy and uninterrupted power supply (UPS)

The PSU module supports power supply redundancy: it will automatically switch to the most appropriate power source if one of the power sources fails or becomes disconnected. The power supply redundancy also allows for an uninterrupted operation (i.e. UPS functionality, the battery will still provide power if the USB cable is removed, without resetting mikromedia 3 during the transition period).

2.5 Powering up the mikromedia 3 board

After a valid power supply source is connected in our case with a single-cell Li-Po/Li-Ion battery **[1]**, mikromedia 3 can be powered ON. This can be done by a small switch at the edge of the board, labeled as SW1 **[2]**. By switching it ON, the PSU module will be enabled, and the power will be distributed throughout the board. A LED indicator labeled as PWR indicates that the mikromedia 3 is powered ON.
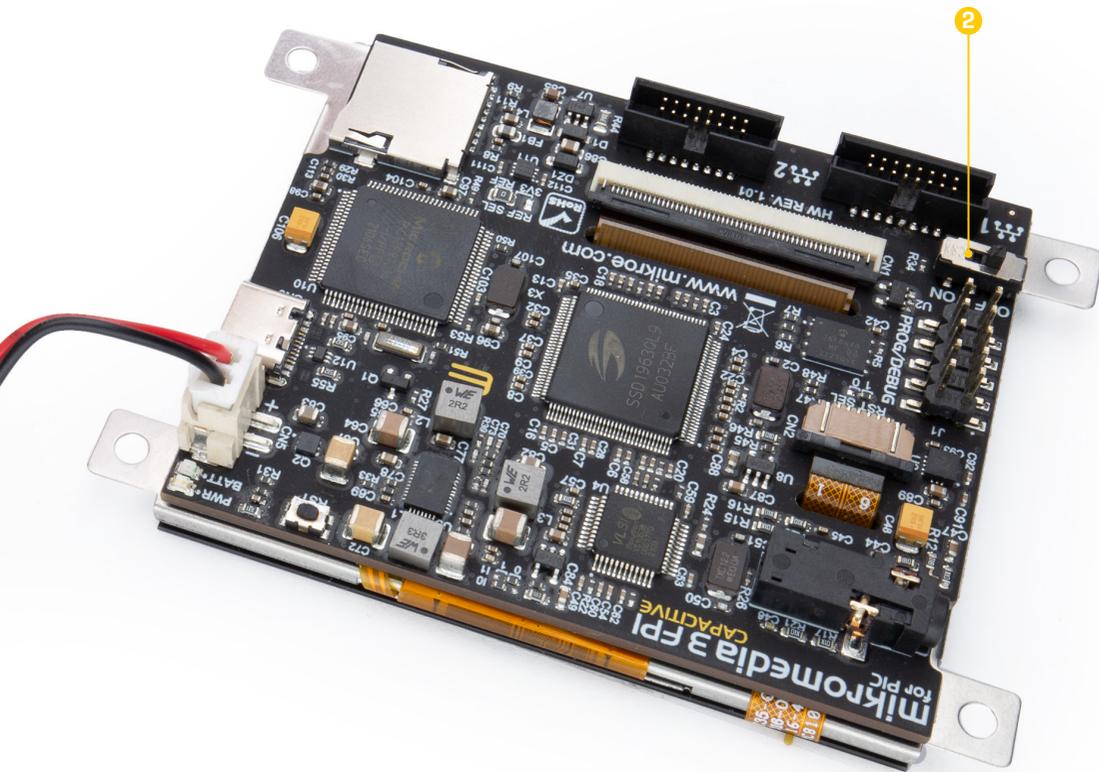
Figure 8: Battery power supply connection

3. Capacitive display

A high-quality 3.5" TFT true-color display with a capacitive touch panel is the most distinctive feature of the mikromedia 3. The display has a resolution of 320 by 240 pixels, and it can display up to 16.7M of colors (24-bit color depth). The display of mikromedia 3 features a reasonably high contrast ratio of 500:1, thanks to 6 high-brightness LEDs used for the backlighting.

The display module is controlled by the SSD1963 **[1]** graphics driver IC from Solomon Systech. This is a powerful graphics coprocessor, equipped with 1215KB of frame buffer memory. It also includes some advanced features such as the hardware accelerated display rotation, display mirroring, hardware windowing, dynamic backlight control, programmable color and brightness control, and more.

The capacitive multi-touch panel allows the development of interactive applications, offering a touch-driven control interface. The touch panel controller uses the I2C interface for the communication with the host controller.

This advanced multi-touch panel controller supports gestures, including zoom and swipe in all four directions.

Equipped with high-quality 3.5" display **[2]** and the multi-touch controller that supports gestures, mikromedia 3 represents a very powerful hardware environment for building various GUI-centric Human Machine Interface (HMI) applications.
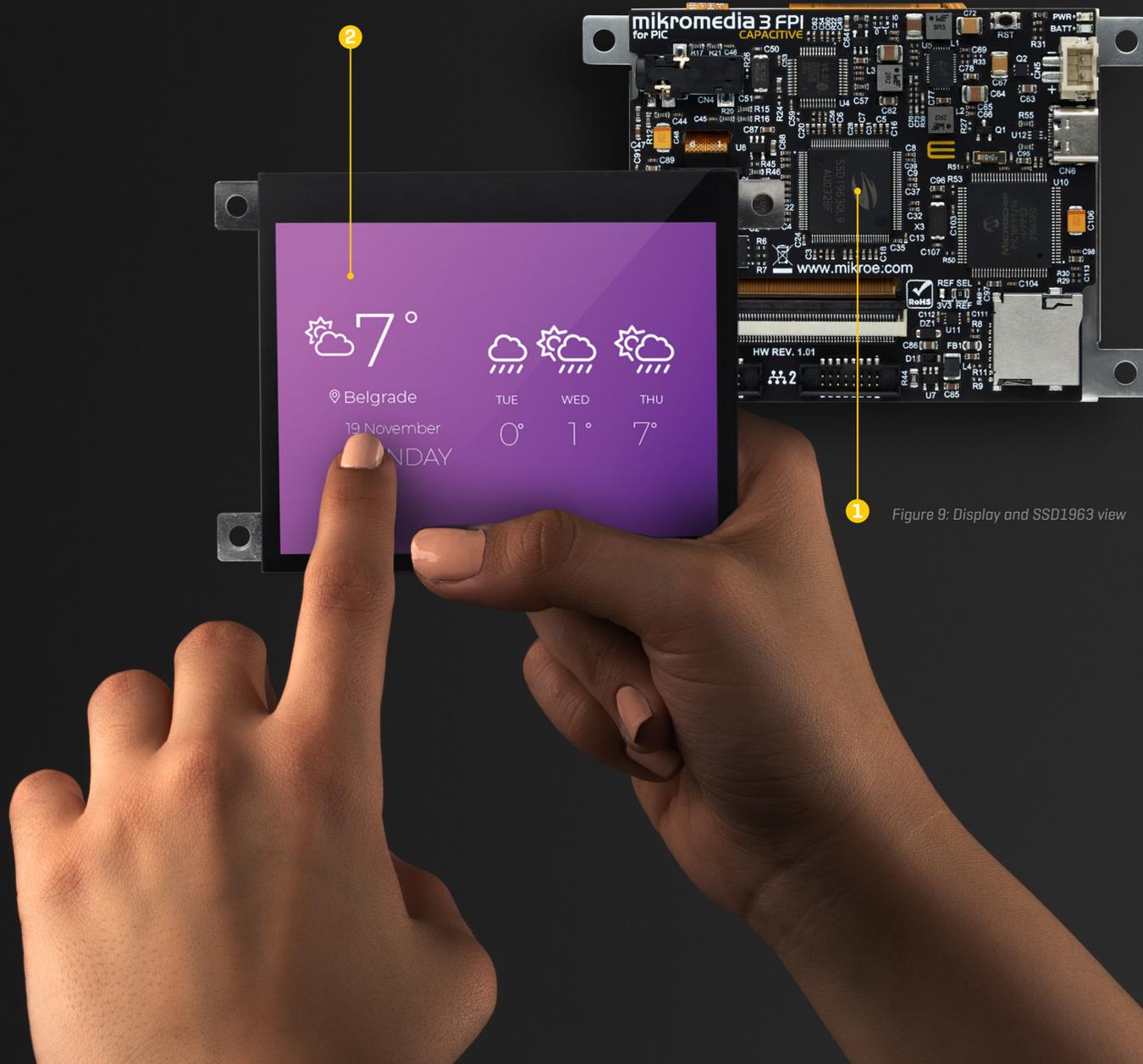
Figure 9: Display and SSD1963 view
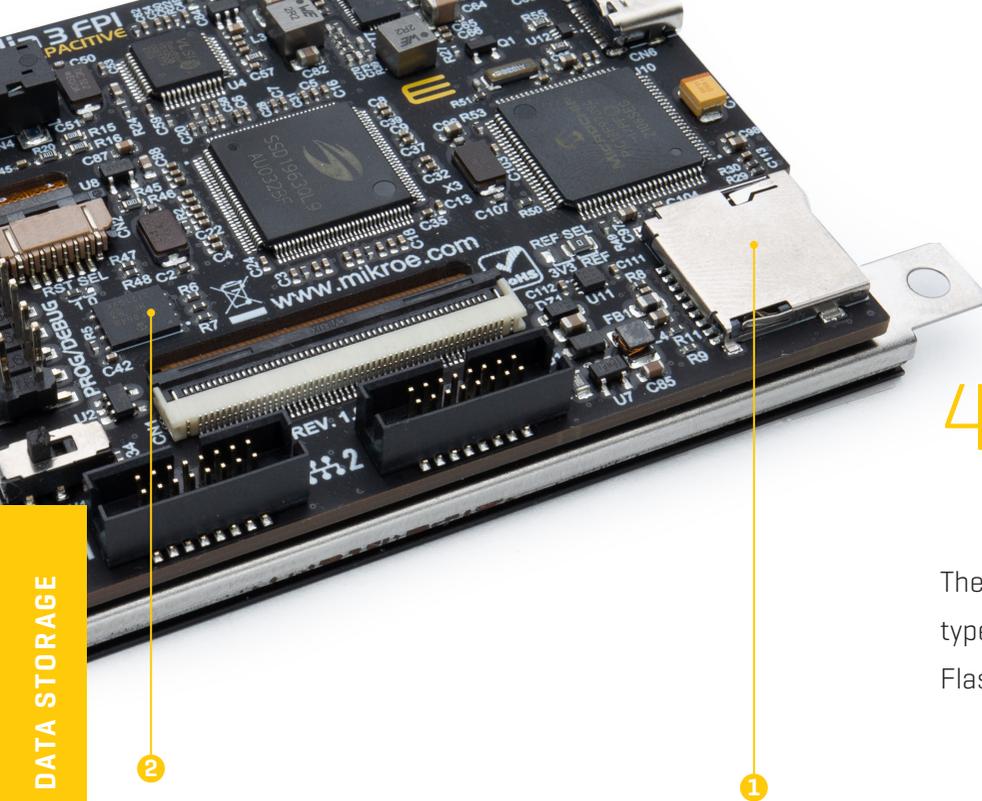
Figure 10: MicroSD card slot view

4. Data storage

The mikromedia 3 development board is equipped with two types of storage memory: with a microSD card slot and a Flash memory module.

4.1 microSD card slot

The microSD card slot **[1]** allows storing large amounts of data externally, on a microSD memory card. It uses the Serial Peripheral Interface (SPI) for communication with the MCU. The microSD card detection circuit is also provided on the board. The microSD card is the smallest SD Card version, measuring only 5 x 11 mm. Despite its small size, it allows tremendous amounts of data to be stored on it. In order to read and write to the SD Card, a proper software/firmware running on the host MCU is required.

4.2 External flash storage

mikromedia 3 is equipped with the SST26VF064B Flash memory **[2]**. The Flash memory module has a density of 64 Mbits. Its storage cells are arranged in 8-bit words, resulting in 8Mb of non-volatile memory in total, available for various applications. The most distinctive features of the SST26VF064B Flash module are its high speed, very high endurance, and very good data retention period. It can withstand up to 100,000 cycles, and it can preserve the stored information for more than 100 years. It also uses the SPI interface for the communication with the MCU.

5. Connectivity

mikromedia 3 includes support for USB (DEVICE). Besides that, it also offers two standardized mikroBUS™ Shuttle connectors. It is a considerable upgrade for the system, as it allows interfacing with the huge base of Click boards™.

Figure 11: USB-C connector view

5.1 USB

The host MCU is equipped with the USB peripheral module, allowing simple USB connectivity. USB (Universal Serial Bus) is a very popular industry standard that defines cables, connectors, and protocols used for communication and power supply between computers and other devices.

mikromedia 3 supports USB as DEVICE mode, allowing the development of a wide range of various USB-based applications. It is equipped with the USB-C connector [1], which offers many advantages, compared to earlier types of USB connectors (symmetrical design, higher current rating, compact size, etc).

5.2 mikroBUS™ shuttle connector

Mikromedia 3 for PIC CAPACITIVE FPI development board uses the mikroBUS™ Shuttle connector, a brand new addition to the mikroBUS™ standard in the form of a 2x8 pin IDC header with 1.27mm (50mil) pitch. Unlike mikroBUS™ sockets, mikroBUS™ Shuttle connectors take up much less space, allowing them to be used in cases where more compact design is required. There are two mikroBUS™ Shuttle connectors **[1]** on the development board, labeled as MB1 and MB2.

Typically, a mikroBUS™ Shuttle connector can be used in combination with mikroBUS™ Shuttle extension board but is not limited to it.

mikroBUS™ Shuttle extension board **[2]** is an add-on board equipped with the conventional mikroBUS™ socket and four mounting holes. It can be connected to the mikroBUS™ Shuttle connector by a flat cable. This ensures compatibility with the huge base of Click boards™. Using mikroBUS™ Shuttles also provides a number of additional benefits:

- When using flat cables, the position of mikroBUS™ Shuttle is not fixed
- mikroBUS™ Shuttle extension boards contain additional mounting holes for permanent installation
- An arbitrary length of flat cables may be used (depending on the particular use cases)
- Connectivity can be additionally expanded, by cascading these connectors using Shuttle click **[3]**
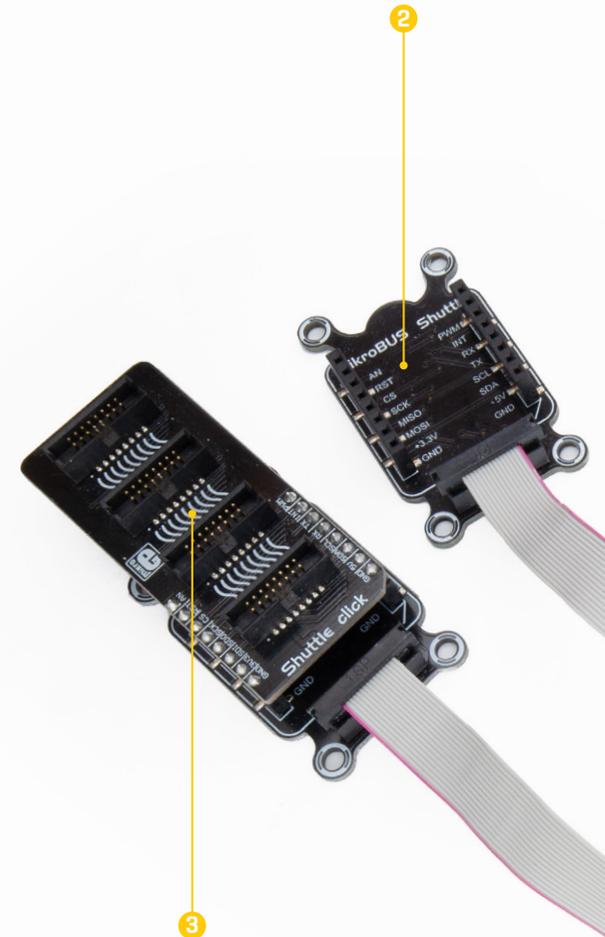
For more information about mikroBUS™ Shuttle extension board and Shuttle Click, please visit web pages:

www.mikroe.com/mikrobus-shuttle

www.mikroe.com/shuttle-click

For additional information about the mikroBUS™, please visit the official web page at **www.mikroe.com/mikrobus**
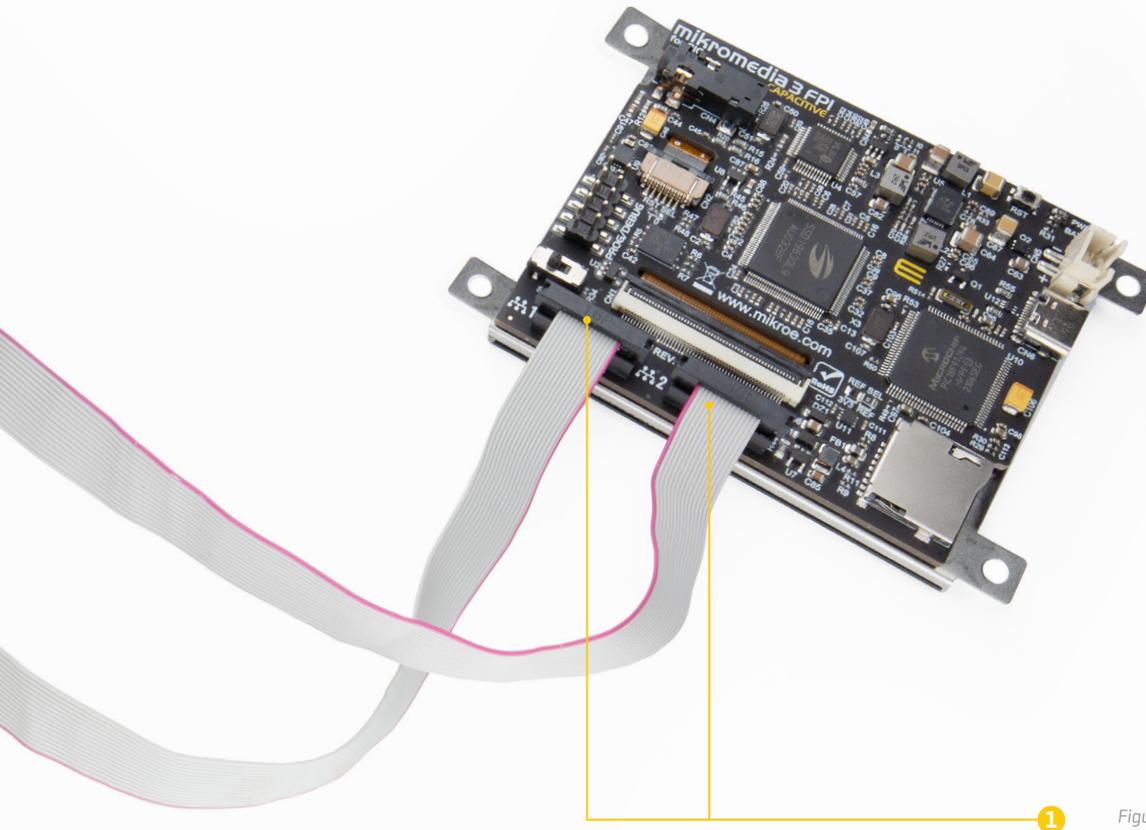
Figure 12: mikromedia 3 for PIC CAPACITIVE FPI connected to mikroBUS Shuttle view

6. Sound-related peripherals

mikromedia 3 features powerful VS1053B IC. It is an Ogg Vorbis/MP3/AAC/WMA/FLAC/WAV/MIDI audio decoder, and a PCM/IMA ADPCM/Ogg Vorbis encoder, both on a single chip. It features a powerful DSP core, high-quality A/D and D/A converters, stereo headphones driver capable of driving a 30Ω load, zero-cross detection with the smooth volume change, bass and treble controls, and much more.

6.1 Audio CODEC

By offering high-quality hardware compression (encoding), the VS1053B allows the audio to be recorded taking up much less space compared to the same audio information in its raw format. In combination with high-quality ADCs and DACs, headphones driver, integrated audio equalizer, volume control, and more, it represents an all-around solution for any type of audio application. Along with the powerful graphics processor, the VS1053B audio processor completely rounds-up the multimedia aspects of the mikromedia 3 FPI development board. The mikromedia 3 FPI board is equipped with the 3.5mm four-pole headphones jack **(2)**, allowing to connect a headset with a microphone.
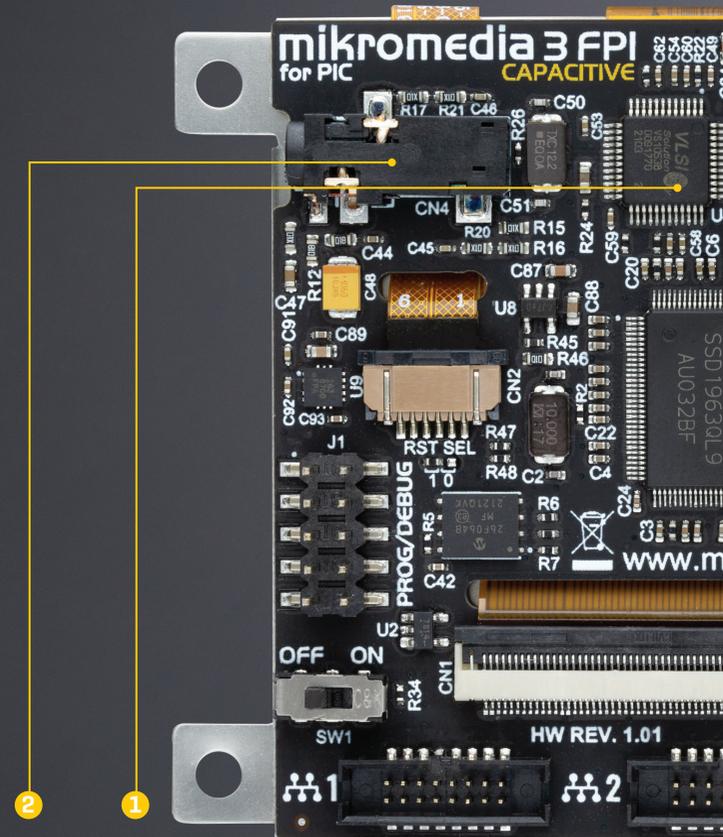
7. Sensors and other peripherals

7.1 Digital motion sensor

The FXOS8700CQ, an advanced integrated 3-axis accelerometer and 3-axis magnetometer, can detect many different motion-related events, including the orientation event detection, freefall detection, shock detection, as well as tap, and double-tap event detection. These events can be reported to the host MCU over two dedicated interrupt pins, while the data transfer is performed over the I2C communication interface. The FXOS8700CQ sensor can be very useful for display orientation detection. It can also be used to turn mikromedia 3 FPI into a complete 6-axis e-compass solution.

Figure 14: mikromedia 3 back view

RAPID DEVELOPMENT OF MULTIMEDIA AND GUI-CENTRIC APPLICATIONS

What's Next?

You have now completed the journey through each and every feature of mikromedia 3 for PIC CAPACITIVE FPI development board. You got to know its modules and organization. Now you are ready to start using your new board. We are suggesting several steps which are probably the best way to begin.

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-arm

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 mikromedia 3 for PIC CAPACITIVE FPI 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 time-frame for solutions. **www.mikroe.com/support**

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