MAKE THINGS HAPPY !

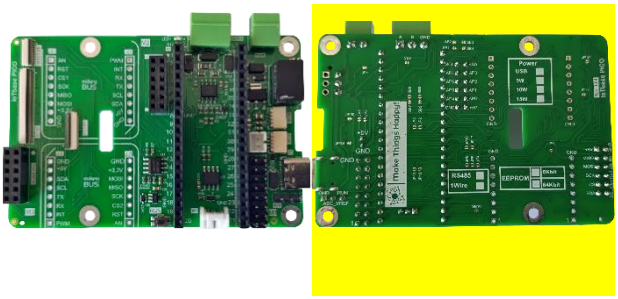
IoTbase PICO

PICO Base Module

IoTbase PICO module (rev. 3.05) is designed for installing **Raspberry Pi PICO** format modules, mezzanine modules, and **mikroBUS™** modules.
The **IoTbase PICO** module has an **EEPROM** for storing configuration and user data. The **EEPROM** capacity is either 8 Kbit or 64 Kbit.
The module's input power is non-isolated, ranging from 9VDC to 36VDC. This power can be supplied via a 2-pin terminal block with a 3.5mm pitch. The module can also be powered with 5VDC through the **USB** connector.

The module has the following slots:

- **PICO** (**P1** and **P2** connectors) for installing **Raspberry PICO** format modules
- **HOST-P12** and **HOST-S12** for installing **IoTextra** series mezzanine modules
- **M1** connector and two slots (**M2** and **M3**), compatible with **mikroBUS™**, but the **M2** and **M3** slots are covered by the mezzanine module when it is installed

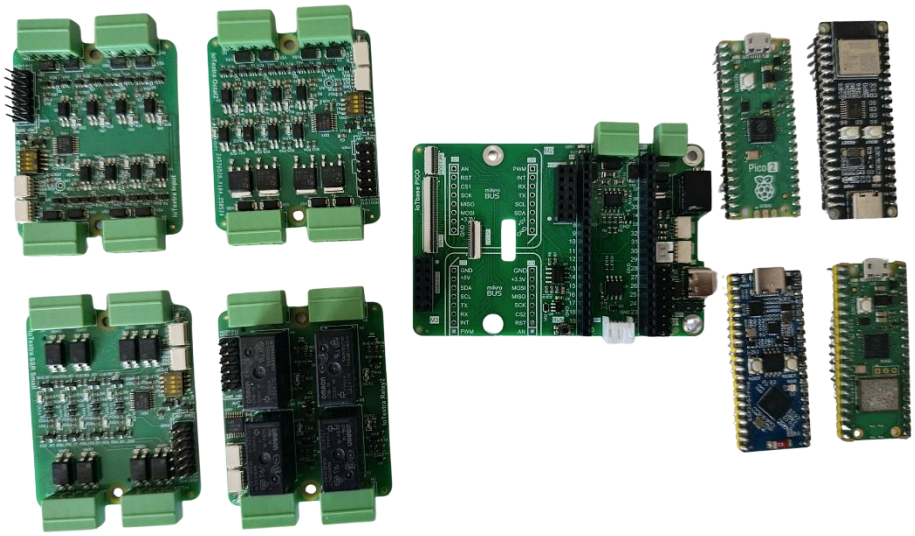


The **I²C** interface is often used when designing devices and instruments based on the **IoTbase PICO** module, so the module has two Qwiic© connectors for connecting to other modules via the **I²C** bus, which can be used to connect external devices and sensors. By default, pull-up resistors for **I²C** are connected, but they can be disconnected.
The **IoTbase PICO** module optionally supports the **RS-485** protocol. For this purpose, the module has a chip compatible with popular half-duplex **RS-485** transceivers. Speeds are up to 10Mbps.
The module can also optionally support the **1-Wire** bus.
The module is equipped with **EYESPI** connectors for connecting various displays with this bus and a 40-pin **RPI40** connector with pins corresponding to the widely used 40-pin **Raspberry Pi** connector, which can be used to organize inter-module connections.
The module has a **Watchdog** based on the **TPS3828**. The **Watchdog** can only be used in place of the auxiliary **I²C** bus (I2C1). The **Watchdog** is disabled by default.
The input voltage of 9VDC to 36VDC is converted to 5VDC by a converter. Depending on the type of converter installed, the maximum current can be 1A, 2A, or 3A.
The module also has a DC-DC converter from 5VDC to 3.3VDC. The maximum current for elements connected to the 3.3VDC voltage is 1A.
Since some of the modules installed in the **PICO** slot and modules connected to **M1** (**mikroBUS™** connector) can themselves generate 5VDC and 3.3VDC, the **IoTbase PICO** module provides the ability to flexibly manage these connections using jumpers on its bottom side.
The module size is 85×56 mm. The module format corresponds to the popular **Raspberry Pi B** board format, which greatly simplifies its use.
Primary applications of the module:

- Industry and transport
- Remote data acquisition systems and PLCs
- Ventilation, heating, and lighting
- Consumer appliances
- Environmental monitoring
- Smart home
- Power on/off
- Gaming applications

QUICK START

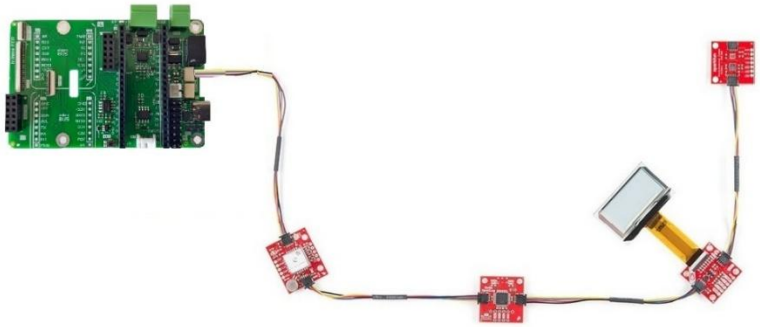
The **IoTbase PICO** module is most often used with one or another **IoTextra** series mezzanine, as together with an installed mezzanine and a **Raspberry PICO** format module, it is easy to use as a standalone device. The following photos show the **IoTbase PICO** module with various mezzanines and microcontrollers (in the **Raspberry PICO** format):



Warning! You must pay attention to the orientation of the modules installed in the **PICO** slot. In the **PICO** slot, pin "1" faces the RS-485 connector, and the SWD or antenna should be on the edge of the module. Incorrect installation can destroy the **IoTbase PICO** and **Raspberry Pi PICO** modules.

The **M1** connector and **M2-M3** slots allow the use of more than 2000 MikroElekronika **Click®** modules with the **mikroBUS™** bus:

To install **Click®** modules into the **mikroBUS™** slot, you don't need to do anything with the jumpers on the **IoTbase PICO** module (you can use the default settings for all jumpers on the module).
Numerous sensors, peripherals, and **Qwiic©**-compatible modules can also be easily connected to the **IoTbase PICO** via the **I²C** connectors:



DESCRIPTION

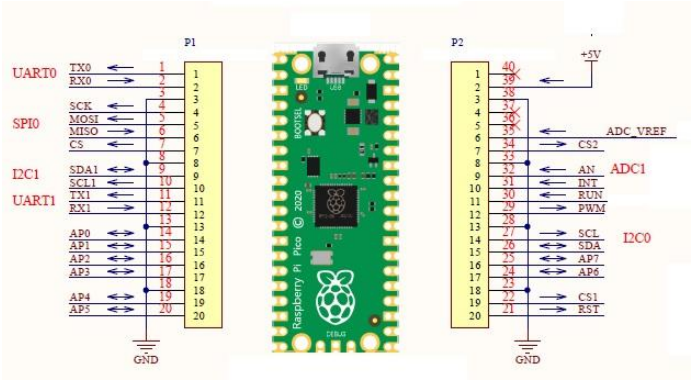
The **IoTbase PICO** module has:

- **P1** and **P2** connectors of the **PICO** slot
- **M1** connector for the **mikroBUS™** bus and **M2** and **M3** slots (not installed, but can be self-installed by the user)
- **I2C-A** and **I2C-B** connectors for the main **I²C** bus (I2C0)
- **EYESPI** connector for connecting to a display and other modules via an FFC cable
- **HOST-P12**, **HOST-S12**, and **HOST-PF** connectors for connecting to mezzanines (**HOST-PF** requires an FFC cable)
- **AUX** auxiliary connector
- **RS485** with a non-isolated RS-485 interface
- **1-Wire** bus with **W1** connector
- **PWR** power connector for 9-36VDC power
- **USB** power connector for 5VDC power via USB TYPE-C
- **EEPROM**
- Watchdog based on **TPS3828**

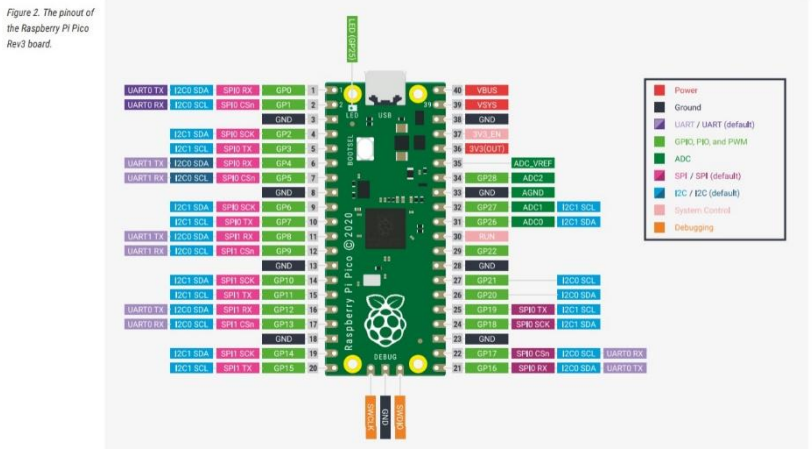
PICO slot. This slot consists of two 20-pin connectors (**P1** and P2). The following **Raspberry Pi PICO** compatible modules can be installed into this **IoTbase PICO** module slot:

- **Raspberry Pi PICO и Raspberry Pi PICO W**
- **Raspberry Pi PICO 2**
- **RP2040-Plus**
- **Waveshare RP2350-Plus** and **Waveshare RP2350B-Plus-W**
- **Pimoroni Pico Plus 2** and **Pimoroni Pico Plus 2 W**
- **Wavehare ESP32-S3-PICO**

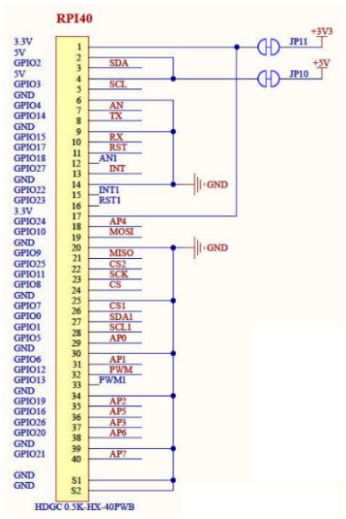
Slot structure:



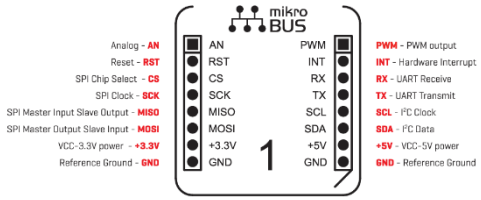
For information, we provide the **Raspberry Pi PICO** pinout:

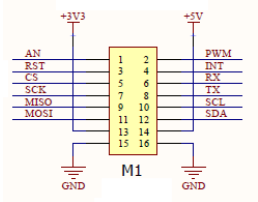


RPI40 Connector. This connector is for connecting to other modules using a 40-pin FFC cable. The connector structure corresponds to the standard **Raspberry Pi** header connector, but a breakout board, such as the one in the picture, will be required to connect to it. Connector pinout:



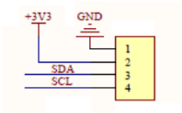
mikroBUS™ Connector and Slots. The module has an **M1** connector and space for installing **M2** and **M3** slots, which comply with the **mikroBUS™** standard. The **M2** and **M3** slots are only accessible from the top side of the module if a mezzanine is not installed. The **M2** and **M3** slots face different sides of the module. Only an **"S"** format **mikroBUS™** module that does not extend beyond the edge of the module can be installed in the **M2** slot. All **M1**, **M2**, and **M3** signals are the same except for **CS**. **M1** uses **CS**, **M2** uses **CS1**, and **M3** uses **CS2**. You should also pay attention to the pin arrangement of the **M1** connector:





Warning! Pins 1 and 2 of the **M1** connector and **M3** slot are at the edge of the module. Incorrect connection to them can lead to the destruction of the **IoTbase PICO** and **Raspberry Pi PICO** modules.
Pin 1 of the **M1** connector is indicated on the top side of the module.

Qwiic© Connectors. The **I2C-A** and **I2C-B** connectors are compatible with **Qwiic®** and have the following structure:



EYESPI Connector. The module's top side has an **EYESPI** connector. It is intended for communication with displays (indicators) using an 18-pin FFC cable. Communication with indicators is achieved due to compatibility with the 18-pin **EYESPI Cable** used by **Adafruit**. The standardization of this cable allows the following displays to be connected:

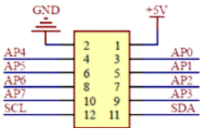
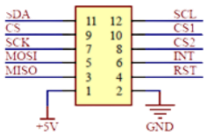
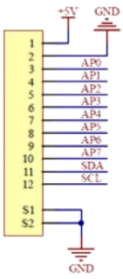
- 2.0" 320x240 Color IPS TFT Display with microSD Card Breakout
- 2.2" 18-bit color TFT LCD display with microSD card breakout
- 1.8" Color TFT LCD display with MicroSD Card Breakout
- OLED Breakout Board - 16-bit Color 1.5" w/microSD holder
- OLED Breakout Board - 16-bit Color 1.27" w/microSD holder
- Adafruit 2.7" Tri-Color eInk
- Adafruit 1.54" Monochrome eInk

Waveshare 2” Capacitive Touch Display Module can also be connected to this connector using an 18-pin FFC cable.

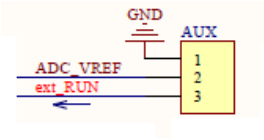
Here is the correspondence between the module's signals and the signals in the **EYESPI** connector:

EYESPI		сигналы на схеме
pin #	NAME	базовых модулей
1	VCC	+3V3
2	BACKLITE	PWM
3	GND	GND
4	SCK	SCK
5	MOSI	MOSI
6	MISO	MISO
7	DC	RX
8	RESET	RST
9	DISP_CS	TX
10	SD_CS	CS
11	MEM_CS	CS2
12	TC_CS	AN
13	SCL	SCL
14	SDA	SDA
15	INT	INT
16	GP1	SDA1
17	GP2	SCL1
18	BUSY/TE	CS1

HOST Connectors. These connectors are for connecting to application mezzanine modules that are installed on the top side of the **IoTbase PICO** module. The **IoTbase PICO** module has three **HOST** connectors: **HOST-P12**, **HOST-S12**, and **HOST-PF**.

		
HOST-P12 Connector	**HOST-S12** Connector	**HOST-PF** Connector

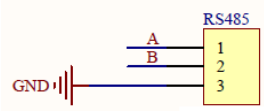
AUX Auxiliary Connector. The structure of this connector for receiving external signals is as follows:



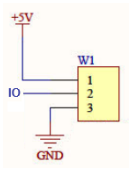
ext_RUN signal is a signal from an external (for example, on the device case panel) **RUN** button.

RS485. The module optionally has a **UART ←→ RS-485** converter for communication with external devices via the **RS-485** interface. Control is carried out via the UART1 bus (by default) or UART0. The choice is made using jumpers **SB5**, **SB6**, **SB7**, and **SB8** on the bottom side of the **IoTbase PICO** module. The data rate is from 300 to 500000 bps. It is possible to connect a 120 Ohm resistance between lines A and B using jumper **SB9** (the resistance is disconnected by default). Circuit solutions that comply with IEC 61000-4-2 are used to protect against voltage transients: ESD 30 kV (air), 30 kV (contact).

The external **RS485** connector for the RS-485 interface has the following structure:



1-Wire. The module optionally has an **I²C ←→ 1-Wire** bridge for communication with external devices that have a **1-Wire** bus. The **DS2482-100** chip used as a bridge is a **1-Wire** master for any connected **1-Wire** slave device. The external **W1** connector for the **1-Wire** bus has the following structure:



EEPROM. To store configuration and other user information, the **IoTbase PICO** module has an 8 Kbit, 1024×8 bits **EEPROM** (M24C08 or compatible) or 64 Kbit, 8192×8 bits (M24C64 or compatible).

The **I²C** address for the **EEPROM** is determined by the type and for 64 Kbit the default is 0x57. This address can be changed by the user using jumpers on the bottom-side.

Watchdog. It is based on the **TPS3828** with a fixed delay time of 200ms. The watchdog is reset using the **SDA1** signal, so **Watchdog** and I2C1 cannot be used simultaneously.

POWER SUPPLY

The module's input power is non-isolated, ranging from 9VDC to 36VDC. This power can be supplied via a 2-pin terminal block with a 3.5mm pitch (**PWR** connector). Protection against incorrect input power polarity is also provided.
The module can also be powered with 5VDC via the **USB** connector (labeled **J3** on the module's schematic). This is a USB TYPE-C connector.
All power inputs are protected against voltage transients caused by lightning and other factors. The protection level is in accordance with IEC-61000-4-2: ESD 30 kV (air), 30 kV (contact).
The input voltage of 9VDC to 36VDC is converted to 5VDC by a converter. Depending on the type of converter, the maximum current can be 1A, 2A, or 3A. The converter type is an option selected when purchasing the module.
The module also has a DC-DC converter from 5VDC → 3.3VDC. The maximum current for elements connected to the 3.3VDC voltage is 1A.
The 5VDC voltage can be distributed to other modules or received externally via the **J4** connector.

SIGNAL MATCHING

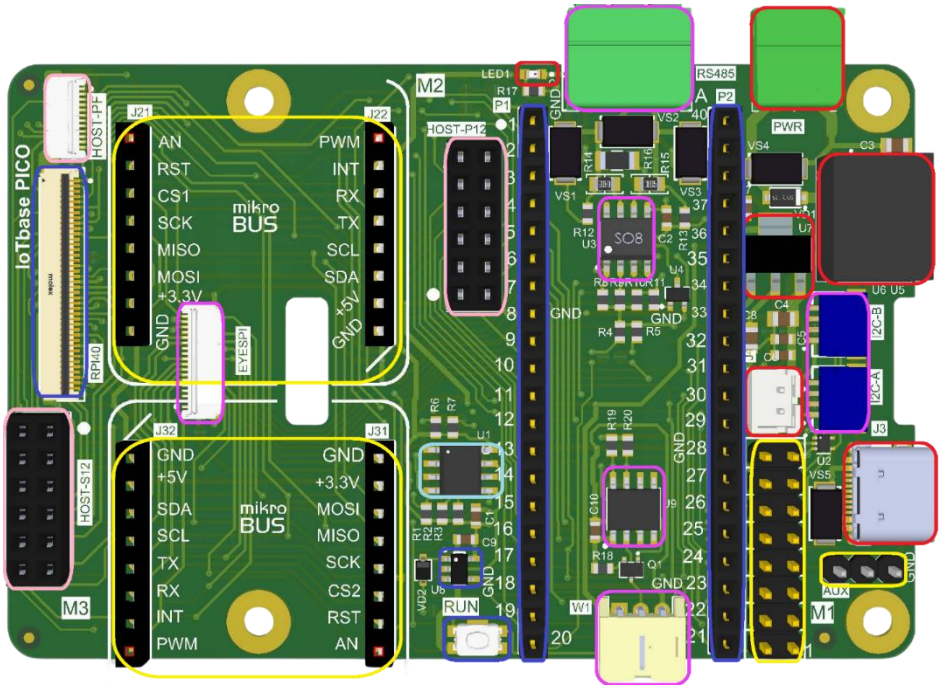
The **IoTbase PICO** module combines the **Raspberry Pi PICO**, **mikroBUS™**, **EYESPI** connector bus (for communication with displays and other modules), and **HOST** (for communication with mezzanines) buses. The correspondence between the signals of the various buses in the **IoTbase PICO** module is shown in the following table:

	Schema	IoTbase PICO pin #	RP2040 (MCU)	mikroBUS		HOST		EYESPI	
				LEFT	RIGHT	P12	S12	pin #	NAME
UART	TX0	1	GPIO00		TX			9	DISP_CS
	RX0	2	GPIO01		RX			7	DC
	TX1	11	GPIO08						
	RX1	12	GPIO09						
I2C	SDA	26	GPIO20		SDA	SDA	SDA	14	SDA
	SCL	27	GPIO21		SCL	SCL	SCL	13	SCL
	SDA1	9	GPIO06					16	GP1
	SCL1	10	GPIO07					17	GP2
SPI	SCK	4	GPIO02	SCK			SCK	4	SCK
	MOSI	5	GPIO03	MOSI			MOSI	5	MOSI
	MISO	6	GPIO04	MISO			MISO	6	MISO
	CS	7	GPIO05	CS (M1)			CS	10	SD_CS
	CS1	22	GPIO17	CS (M2)			CS1	18	BUSY/TE
	CS2	34	GPIO28	CS (M3)			CS2	11	MEM_CS
RESET	RST	21	GPIO16	RST			RST	8	RESET
	RUN	30	RUN						
PW	PWM	29	GPIO22		PWM			2	BACKLITE
INT & AN	INT	31	GPIO26		INT		INT	15	INT
	AN	32	GPIO27	AN				12	TC_CS
	ADC_VREF	35	ADC_VREF						
AP0-AP7	AP0	14	GPIO10			AP0			
	AP1	15	GPIO11			AP1			
	AP2	16	GPIO12			AP2			
	AP3	17	GPIO13			AP3			
	AP4	19	GPIO14			AP4			
	AP5	20	GPIO15			AP5			
	AP6	24	GPIO18			AP6			
	AP7	25	GPIO19			AP7			

For the **RX** and **TX** signals on the module, either the **RX0** and **TX0** signals from the **PICO** slot (direct connection) or the **TX0** and **RX0** signals (crossover connection) can be used. The connection type is set by jumpers **SB1-SB4**, with direct connection being the default.

LAYOUT

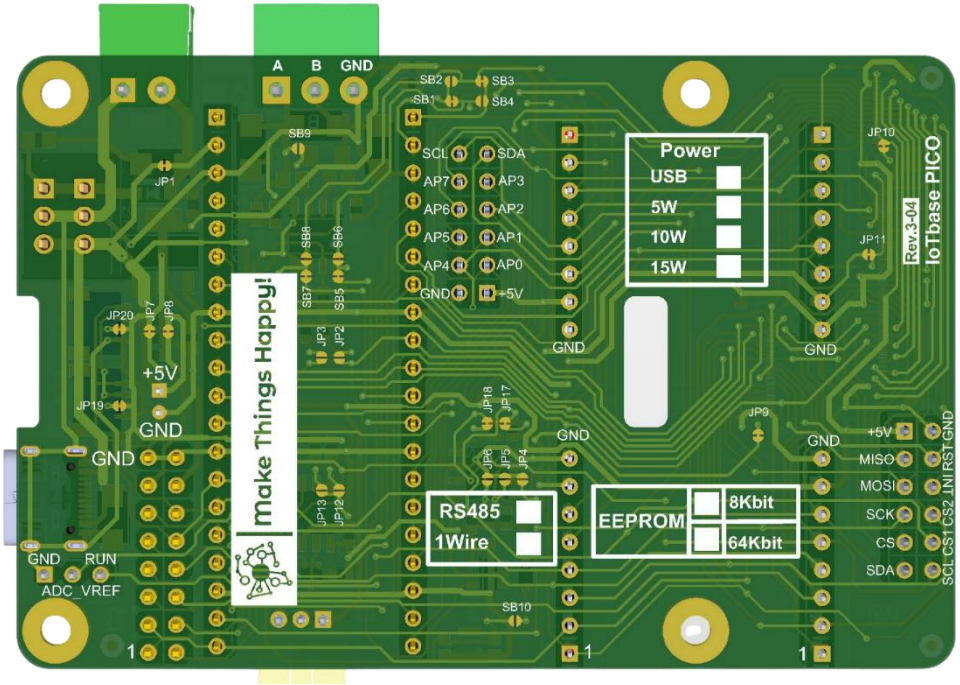
Below is the layout of the elements on the top side of the **IoTbase PICO** module:



In this picture:

- **Red** highlights power-related elements (external **PWR** power connector, **USB** power connector, VCC -> 5VDC and 5VDC -> 3.3VDC converters, **J4** connector for 5VDC, and **LED** for 3.3VDC power indication)
- **Blue** highlights the **PICO** slot connectors, **RUN** button, 40-pin **RPI40** connector for the FFC cable, and the **Watchdog**
- **Yellow** highlights the **mikroBUS™** connector and slots (**M1**, **M2** and **M3**) and **AUX** connector
- **Pink** highlights the three HOST connectors for communication with mezzanines
- **Purple** highlights the **Qwiic®** connectors for connecting peripherals via the **I²C** bus, the RS-485 controller and external **RS485** connector, the 1-Wire controller and external **W1** connector, as well as the **EYESPI** connector for communication with displays
- **Light blue** highlights the **EEPROM**

The layout of the elements on the bottom side of the **IoTbase PICO** module is provided next.



JUMPERS

All **IoTbase PICO** module jumpers are located on the bottom side:

1) **JP1**. It is designed to disconnect +5V power from the **PICO** slot. By default, +5V power is connected (CLOSE).
2) **JP2 and JP3**. For connecting pull-up resistors to the SCL1 and SDA1 signals of the additional **I²C** bus (I2C1) of the **IoTbase PICO** module. By default, they are OPEN, meaning the resistors are not connected.
3) **JP4, JP5 and JP6**. For selecting the address of the 64 Kbit E**EPROM** chip on the **I²C** bus. By default, the address is 1010111x (all jumpers are open). The table for selecting the address is provided below.

JP4 (E2)	JP5 (E1)	JP6 (E0)	EEPROM address
CLOSE	CLOSE	CLOSE	1010000x
CLOSE	CLOSE	OPEN	1010001x
CLOSE	OPEN	CLOSE	1010010x
CLOSE	OPEN	OPEN	1010011x
OPEN	CLOSE	CLOSE	1010100x
OPEN	CLOSE	OPEN	1010101x
OPEN	OPEN	CLOSE	1010110x
OPEN	OPEN	OPEN	1010111x

4) **JP7 and JP8**. They are designed to disconnect the +3V3 power (jumper **JP7**) and +5V power (jumper **JP8**) from the M1 slot with the **mikroBUS™** bus on the module. By default, power is connected (CLOSE).
5) **JP9**. **IoTbase PICO** module can be connected to displays (indicators) or other modules using FFC cables via the **EYESPI** connector. Jumper JP9 allows for the disconnection of the +3V3 power supply. By default, the jumper is closed (CLOSE), and the +3V3 power is connected.
6) **JP10 and JP11**. They determine whether the module's +5V and +3V3 are connected to the **RPI40** connector, respectively. By default, they are CLOSE, meaning they are connected.
7) **JP12 and JP13**. For selecting the address of the **DS2482-100** (**1-Wire**) chip on the **I²C** bus. By default, the address is 0011011x (all jumpers are open). The table for selecting the address is provided below.

JP13 (AD1)	JP12 (AD0)	Адрес для DS2482-100
CLOSE	CLOSE	0011000x
CLOSE	OPEN	0011001x
OPEN	CLOSE	0011010x
OPEN	OPEN	0011011x

8) **JP17 and JP18**. For connecting pull-up resistors to the **SCL** and **SDA** signals of the main **I²C** bus (I2C0) of the **IoTbase PICO** module. By default, they are CLOSE, meaning the resistors are connected.
9) **JP19**. Determines whether the module's +3V3 is connected to the **Qwiic®** connectors (**I2C-A** and **I2C-B**, respectively). By default, it is CLOSE, meaning it is connected.
10) **SB1, SB2, SB3 and SB4**. The state of these jumpers determines the type of **UART** connection (default is direct connection).

SB1	SB2	SB3	SB4	Type of UART connection
CLOSE	OPEN	CLOSE	OPEN	Direct (RX0 <- RX, TX0 -> TX)
OPEN	CLOSE	OPEN	CLOSE	Cross (RX0 <- TX, TX0 -> RX)

11) **SB5, SB6, SB7 and SB8**. The state of these jumpers determines which **UART** channel is used for the RS-485 implementation (default is UART1).

SB5	SB6	SB7	SB8	UART Channel
OPEN	CLOSE	OPEN	CLOSE	UART (RX and TX)
CLOSE	OPEN	CLOSE	OPEN	UART1 (RX1 and TX1)

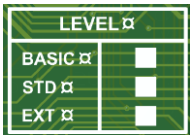
12) **SB9**. This jumper is for connecting a 120 Ohm resistance between the A and B lines of the **RS-485** bus. By default, the resistance is disconnected (jumper OPEN).
13) **SB10**. This jumper determines whether the **Watchdog** is enabled. It is disabled by default (jumper OPEN).

CONFIGURATION TABLES

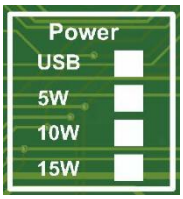
On the bottom side of the module, configuration tables provide information about the configuration of a specific module instance.
The configuration tables indicate:

The module is available in three configuration **LEVEL**s:

LEVEL	Connectors			Watchdog	EEPROM	
	EYESPI	FFC	AUX		8 Kbit	64 Kbit
BASIC	NO	NO	NO	NO	YES	NO
STD	YES	NO	NO	NO	YES	NO
EXT	YES	YES	YES	YES	NO	YES



The method of powering the module: via the **USB** connector or the power of the installed DC to 5VDC input voltage converter on the module. Depending on the type of converter installed, the maximum current can be 1A, 2A, or 3A, which corresponds to converter power of 5W, 10W, and 15W. It should be noted that a delivery option without any power supply method can be chosen, but in this case, 5VDC can be supplied via the **J4** two-pin JST connector.



Whether the **IoTbase PICO** module has **RS-485** and/or **1-Wire** support

MEZZANINES

Any mezzanine from the **IoTextra** series listed on the website **http://www.makethingshappy.io** can be used as a mezzanine.
The following figures show the **IoTbase PICO** module with different mezzanines and microcontrollers:

		
IoTbase PICO with **Waveshare Raspberry PICO2** and **IoTextra SSR Small**	**IoTbase PICO** with **Raspberry PICO2** and **IoTextra Input**	**IoTbase PICO** with **Waveshare ESP32-S3-PICO** and **IoTextra Analog**

ACCESSORIES

The following accessories may be required to use the module:

- Mating (plug) two-pin connector for module power
- Mating (plug) three-pin connector for **RS-485**
- Two-pin cable with a JST connector for the **1-Wire** bus
- 10-pin cable for connecting the **IoTbase PICO** to **IoTextra** series mezzanines during debugging
- 12-pin FFC cable for **HOST-PF** connector
- **EYESPI** cable for connecting a display (indicator) or inter-module connection, 100mm or 200mm long
- 40-pin FFC cable for **RPI40** connector
- **I²C** cable with **Qwiic©** connectors on both ends of the cable