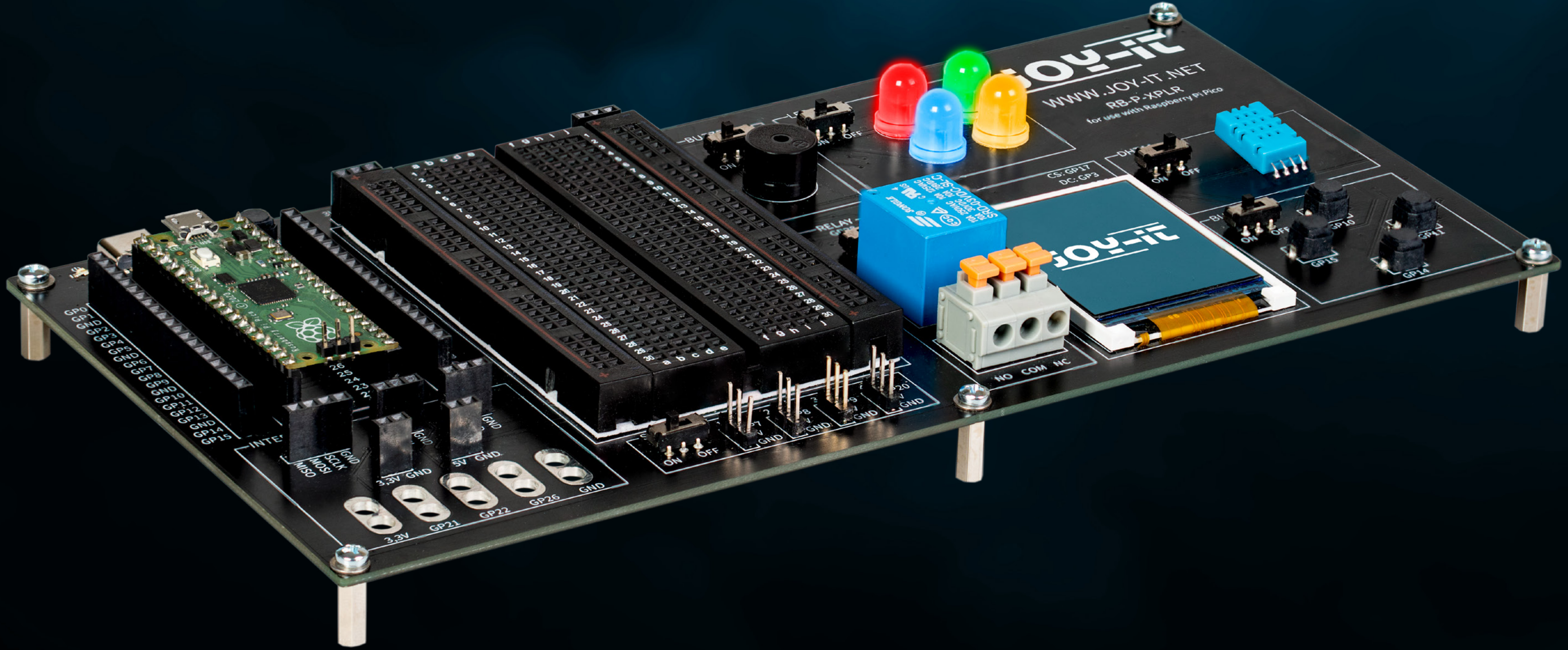
EXPLORER BOARD

RB-P-XPLR



Joy-IT powered by SIMAC Electronics GmbH - Pascalstr. 8 - 47506 Neukirchen-Vluyn - www.joy-it.net

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1. GENERAL INFORMATION

Dear customer, thank you for choosing our product. In the following, we will show you what you need to bear in mind during commissioning and use.

Should you encounter any unexpected problems during use, please do not hesitate to contact us.

These instructions were written under Micropython version 1.22.2.

2. DEVICE OVERVIEW & PIN ASSIGNMENT

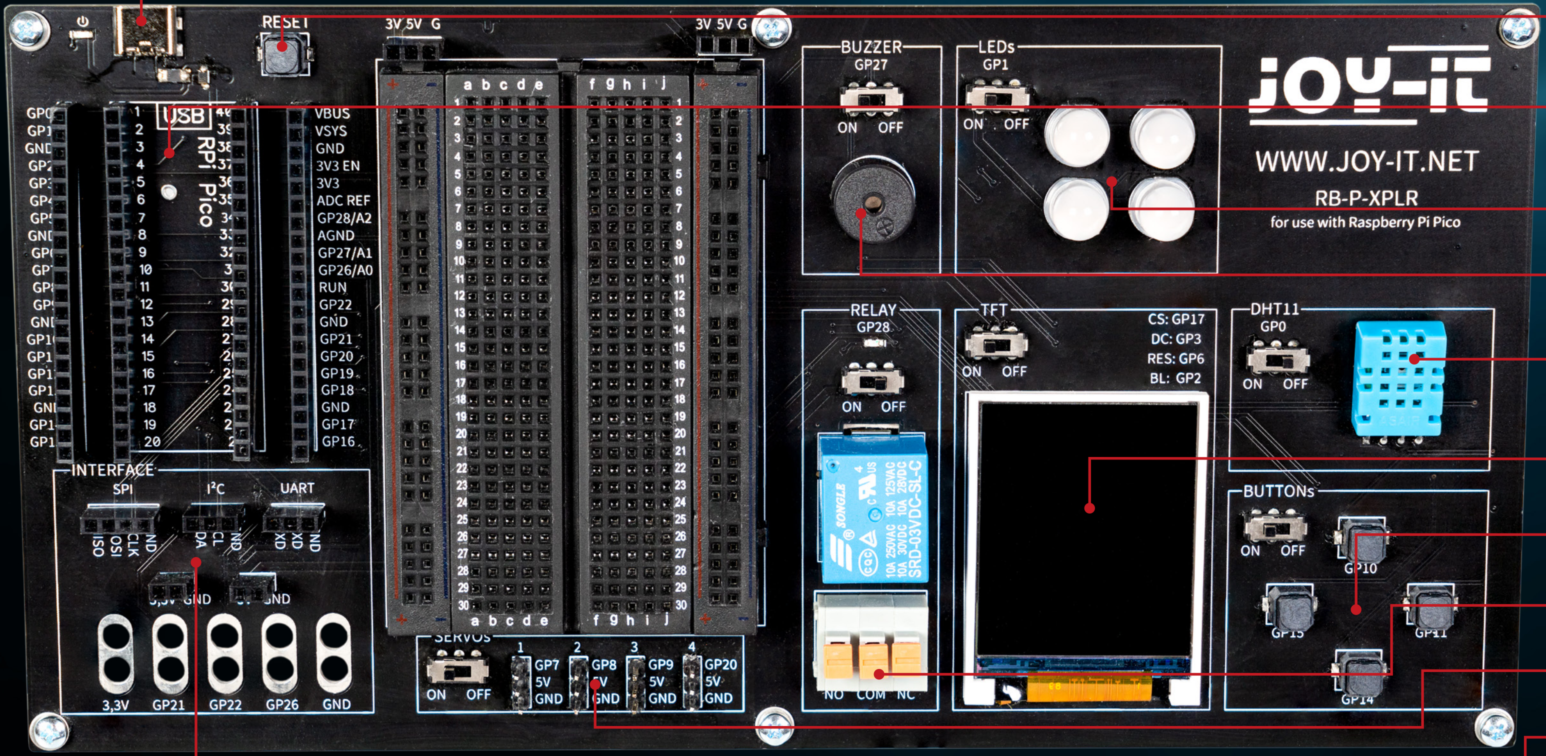
Our Explorer Board is the simple and efficient way to develop your Raspberry Pi Pico projects.

With the most important components already integrated, you save time and effort when wiring. The Explorer Board has a wide range of interface connectors, so you can connect your projects to a variety of modules and devices. With the integrated breadboard, you can quickly build and realize your own projects.

Thanks to the option of switching all modules on or off individually, you can use your pins, which are also routed separately to the outside, for other projects or experiment on the integrated breadboard at any time.

All built-in components can be switched off via the respective switch if they are not required. This means that the associated pins can also be used for other components if necessary.

To the left and right of the Raspberry Pi Pico, all pins are additionally designed. Components can be connected directly here or routed to the integrated breadboard via additional cables.



5 V USB-C power supply

Reset Button

Slot
Raspberry Pi Pico

4x RGB LED

Buzzer

DHT11 Temperature & humidity sensor

1,8" TFT Display

4x Buttons

Relay

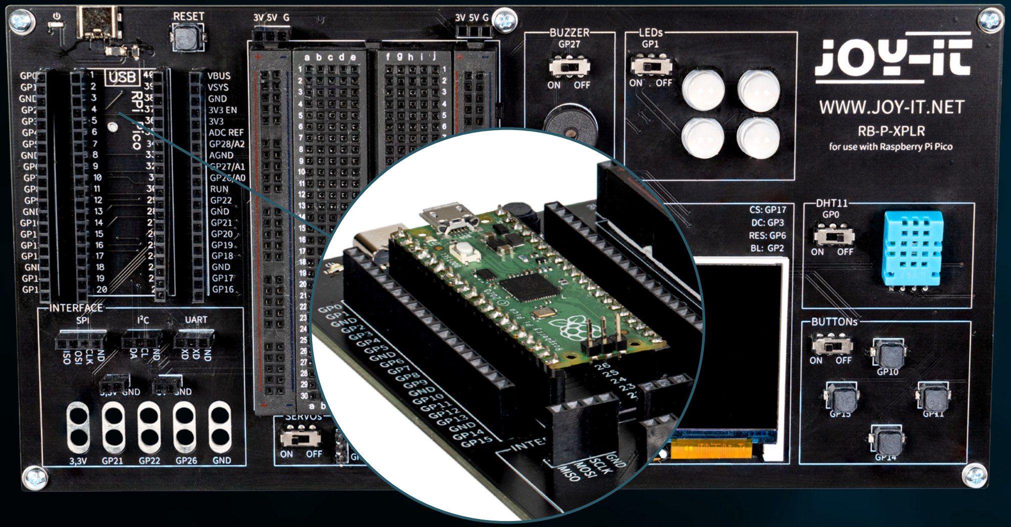
4x Servo-Interface

Interface connections

PIN ASSIGNMENT	
Buzzer	GP27
LEDs	GP1
Relay	GP28
1,8" TFT Display	CS: GP17, DC: GP3, RES: GP6, BL: GP2
DHT11	GP0
Buttons	GP10, GP11, GP14 & GP15
Servos	GP7, GP8, GP9 & GP20
UART	RXD: GP13, TXD: GP12
I2C	SDA: GP4, SCL: GP5
SPI	MISO: GP16, MOSI: GP19, SCLK: GP18

3. RASPBERRY PI PICO

First plug your Raspberry Pi Pico into the slot on your board.



Now connect a micro USB cable to your computer and to the Raspberry Pi Pico for programming.

ATTENTION! The USB-C port on the Explorer board is used exclusively for power supply. It is not used to transfer data to the Raspberry Pi.

You can use a suitable development program of your choice to transfer our sample program. We recommend the **Thonny Python IDE**.

ATTENTION! If you are new to the world of microcontrollers and electronics, don't worry! We have prepared a special beginner's guide for you. This guide is specially tailored to the needs of beginners and explains how to use the Raspberry Pi Pico step by step.

From basic configuration to running projects, this guide will walk you through the entire process. Our guide includes easy-to-understand explanations and useful tips to help you quickly and effectively develop your skills at scale with the Raspberry Pi Pico. You can download our guide **here**.

4. MODULES IN DETAIL

In the following, all modules available on the Explorer Board are explained individually with sample codes. You can download all sample codes and libraries **here**, as well as a sample code that links all modules together.

External libraries and a font file are used for the use of some modules. Download the libraries and load them into the lib folder of your Raspberry Pi Pico. Place the font file in the root directory of your Raspberry Pi Pico.

4.1 BUZZER

A buzzer produces a signal tone, similar to a loudspeaker. Unlike a loudspeaker, however, it is only suitable for a limited frequency range, so it does not produce a good sound for reproducing music or speech. However, it is ideal for generating loud warning tones in the form of beeps. Whenever an electrical device generates a warning tone, it is almost always a buzzer. For example, in alarm clocks, smoke detectors or the seatbelt reminder in cars.

The buzzer is connected to GPIO pin GP27.

```
# Load libraries
from machine import Pin, PWM
from utime import sleep

buzzerPin = Pin(27)
buzzer = PWM(buzzerPin)

while True:
    # Activate buzzer for 1 sec
    buzzer.freq(1000)
    buzzer.duty_u16(1000)
    sleep(1)
    buzzer.duty_u16(0)
    sleep(1)
```

4.2 RGB LEDS

RGB LEDs are a type of light-emitting diode that combines red, green and blue to produce a variety of colors. Much like a buzzer only produces simple tones, RGB LEDs cannot display complex images, but they are excellent at mixing and varying colors. Each LED in an RGB unit can be varied in intensity to produce different hues, from soft pastels to bright, saturated colors. This makes them ideal for mood lighting, decorative lighting and in applications where visual signals are required, such as in gaming setups or as status indicators in electronic devices. Their versatility and energy efficiency have made them a popular choice in modern lighting systems, although, like the buzzer, their simple operation means they cannot create complex images or patterns without additional control units.

The GPIO LEDs are connected to the GPIO pin GP1.

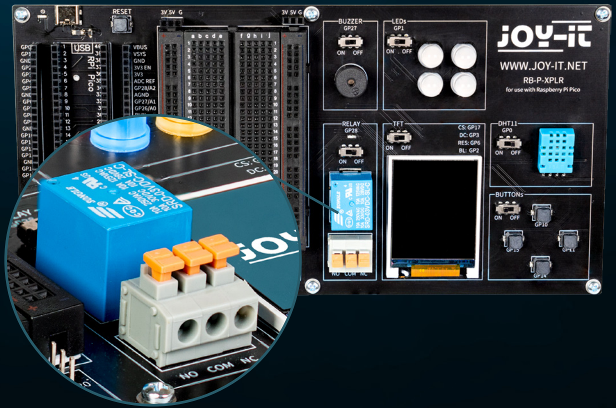
```
# Load libraries
from machine import Pin, PWM
from utime import sleep
from neopixel import NeoPixel

ledPin = 1
ledCount = 4

# Initialize GPIOs
led = Pin(ledPin, Pin.OUT)
led = NeoPixel(Pin(ledPin, Pin.OUT), ledCount)

while True:
    # Turn LEDs white
    for i in range (ledCount):
        led[i] = (255, 255, 255)
    led.write()
    sleep(1)
    # Turn LEDs red
    for i in range (ledCount):
        led[i] = (255, 0, 0)
    led.write()
    sleep(1)
    # Turn LEDs blue
    for i in range (ledCount):
        led[i] = (0, 0, 255)
    led.write()
    sleep(1)
    # Turn LEDs green
    for i in range (ledCount):
        led[i] = (0, 255, 0)
    led.write()
    sleep(1)
```

4.3 RELAY

Relays are some of the oldest electromechanical components and function as electrically controlled switches. With a small input voltage and low current, a large electrical load can be switched on and off at the output. When the relay switches through, the red LED also lights up. You can insert stripped cable ends into the terminal socket (by pressing down the orange lever) to use the three connections.

The relay is connected to GPIO pin GP28.

```
# Load libraries
from machine import Pin, PWM
from utime import sleep

relayPin = 28
# Initialize GPIOs
relay = Pin(relayPin, Pin.OUT)

while True:
    # Toggle Relay
    relay.on()
    sleep(1)
    relay.off()
    sleep(1)
```



Caution! Work on electrical systems with voltages above 60 V may only be carried out by qualified electricians. Persons without appropriate training are strongly recommended to switch only the low voltages 3 & 5 V available on the board using the relay. Improper handling can lead to serious injury or even death due to heat, fire or electric shock.

Please observe the safety regulations and consult a specialist if you are unsure.

4.4 TFT

The liquid crystal display (LCD TFT) with around 65,000 colors and a diagonal of 1.8 inches has a resolution of 128×160 pixels and can be controlled via SPI. It is suitable for displaying colorful graphics and images. Letters and other characters are displayed as graphics made up of many individual dots.

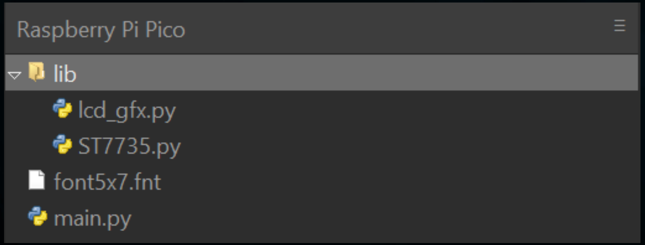
The TFT is connected to the GPIO pins GP17 (CS), GP3 (DC), GP6 (RES) and GP2 (BL).

```
from machine import Pin, SPI
import ST7735

# Initialize LCD
spi = SPI(0, baudrate=8000000, polarity=0, phase=0, sck=Pin(18), mosi=Pin(19),
miso=Pin(16))
lcd = ST7735.ST7735(spi, rst=6, ce=17, dc=3)
backlight = Pin(2, Pin.OUT)

# Turn backlight on
backlight.high()
lcd.reset()
lcd.begin()

# Display content on the LCD
lcd.fill_screen(lcd.rgb_to_565(0, 255, 0))  # Fills the screen with a green color

# Display text
lcd.p_string(20, 50, "Hello, World!")
```

In addition to texts, rectangles can also be displayed, for example:

```
# Draw red rectangle
lcd.draw_block(10, 10, 50, 50, lcd.rgb_to_565(255, 0, 0))
```

ATTENTION! Two separate library files and a font file are required for the TFT display; you can download the required files **here**. Then transfer all files from the Libraries folder to the root directory of your Raspberry Pi Pico so that the folder structure looks like this:



```
Raspberry Pi Pico
lib
    lcd_gfx.py
    ST7735.py
font5x7.fnt
main.py
```

4.5 DHT 11

The DHT11 sensor can detect temperatures from 0 °C to 50 °C (±2 °C accuracy) and relative humidity from 20 % to 80 % (±5 %) (at most once per second). Weather stations are probably the primary area of application for a sensor such as the DHT11. To test the functionality, it is sufficient to hold your mouth close to the sensor and exhale slowly. The breathing air differs from the environment in terms of temperature and humidity, which should lead to a significant change in the values.

The DHT11 is connected to the GPIO pin GP0.

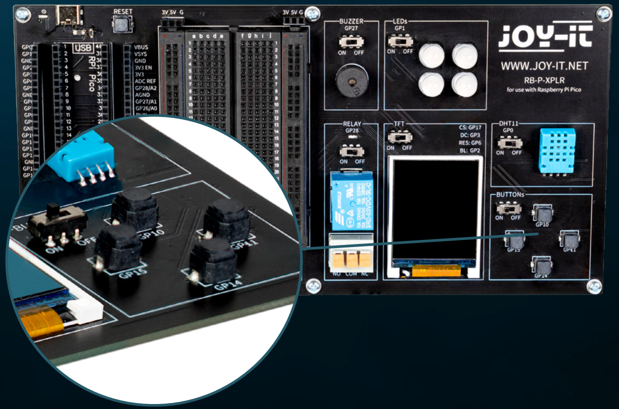
```python
from machine import Pin
from dht import DHT11
from utime import sleep

# Initialize DHT11 Sensor
dhtPin = 0
dht = DHT11(Pin(dhtPin, Pin.IN))

while True:
    # Measure DHT11 values
    dht.measure()
    temp = dht.temperature()  # Temperature in Celsius
    humid = dht.humidity()    # Relative Humidity in %

    # Print the measurements
    print('Temperature:', temp, '°C')
    print('Humidity:', humid, '%')

    sleep(2)  # Wait for 2 seconds before the next reading
```

4.6 BUTTONS

Buttons are interactive elements in user interfaces that fulfill a simple but essential function: user input. Similar to how RGB LEDs can display a variety of colors, buttons are used to initiate a wide range of commands and actions in digital environments.

The buttons are connected to the GPIO pins GP10 (top), GP11 (right), GP14 (bottom) and GP15 (left).

```
from machine import Pin

# Define button pins
buttons = [10, 11, 14, 15]

# Initialize buttons
buttonOne = Pin(buttons[0], Pin.IN, Pin.PULL_DOWN)
buttonTwo = Pin(buttons[1], Pin.IN, Pin.PULL_DOWN)
buttonThree = Pin(buttons[2], Pin.IN, Pin.PULL_DOWN)
buttonFour = Pin(buttons[3], Pin.IN, Pin.PULL_DOWN)

# Define button handler functions
def buttonUp(pin):
    print("Button Up Pressed")

def buttonRight(pin):
    print("Button Right Pressed")

def buttonDown(pin):
    print("Button Down Pressed")

def buttonLeft(pin):
    print("Button Left Pressed")

# Attach interrupt handlers to buttons
buttonOne.irq(trigger=Pin.IRQ_RISING, handler=buttonUp)
buttonTwo.irq(trigger=Pin.IRQ_RISING, handler=buttonRight)
buttonThree.irq(trigger=Pin.IRQ_RISING, handler=buttonDown)
buttonFour.irq(trigger=Pin.IRQ_RISING, handler=buttonLeft)
```

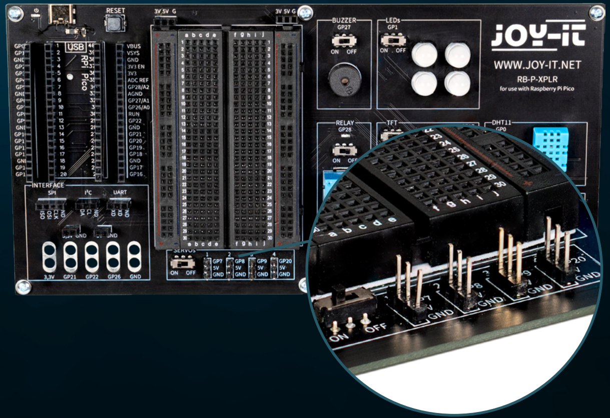


4.7 SERVOS

A servo consists of an electric motor with gearbox and control electronics. On the output side of the gearbox there is a gear wheel on which the servo horn is mounted. The servo can move the axis in a range of around 180°. Servos are used in model making, for example to control the wing or rudder position of an airplane or ship. More and more servos are also being used in automotive engineering to automatically close doors, for window regulators, mirrors and other adjustable elements.

The servo connections are the GPIO pins GP7, GP8, GP9 and GP20.

```
from machine import Pin, PWM
from utime import sleep
# Servo pin numbers
servoOnePin = 7
servoTwoPin = 8
servoThreePin = 9
servoFourPin = 20
# Initialize servos
servoOne = PWM(Pin(servoOnePin))
servoTwo = PWM(Pin(servoTwoPin))
servoThree = PWM(Pin(servoThreePin))
servoFour = PWM(Pin(servoFourPin))
# Set PWM frequency to 50 Hz for all servos
servoOne.freq(50)
servoTwo.freq(50)
servoThree.freq(50)
servoFour.freq(50)
# Servo degree positions in nanoseconds
deg0 = 500000    # 0.5 ms
deg45 = 1000000  # 1.0 ms
deg90 = 1500000  # 1.5 ms
deg135 = 2000000 # 2.0 ms
deg180 = 2500000 # 2.5 ms
```



```python
while True:
    # Move each servo through a range of angles
    for servo in [servoOne, servoTwo, servoThree, servoFour]:
        print("Moving to 0 degrees")
        servo.duty_ns(deg0)
        sleep(1)
        print("Moving to 45 degrees")
        servo.duty_ns(deg45)
        sleep(1)
        print("Moving to 90 degrees")
        servo.duty_ns(deg90)
        sleep(1)
        print("Moving to 135 degrees")
        servo.duty_ns(deg135)
        sleep(1)
        print("Moving to 180 degrees")
        servo.duty_ns(deg180)
        sleep(1)
```

4.8 INTERFACES

Interface connections play a crucial role in the world of electronics, similar to buttons in user interfaces. They enable communication and power supply between different electronic components. The following connections can therefore be found in the interface area on our Explorer Board:

SPI (Serial Perhipheral Interface): This connection is used for fast serial data transmission. It typically consists of four lines: MISO (Master In, Slave Out), MOSI (Master Out, Slave In), SCK (Serial Clock) and SS (Slave Select). SPI is ideal for situations where a high data transfer rate is required, such as when controlling LCD displays or SD cards.

I2C (Inter-Integrated Circuit): I2C is a two-wire interface consisting of a data line (SDA) and a clock line (SCL). It is commonly used in microcontroller applications for communication between different integrated circuits. Its simplicity makes it ideal for applications where not many GPIO pins are available.

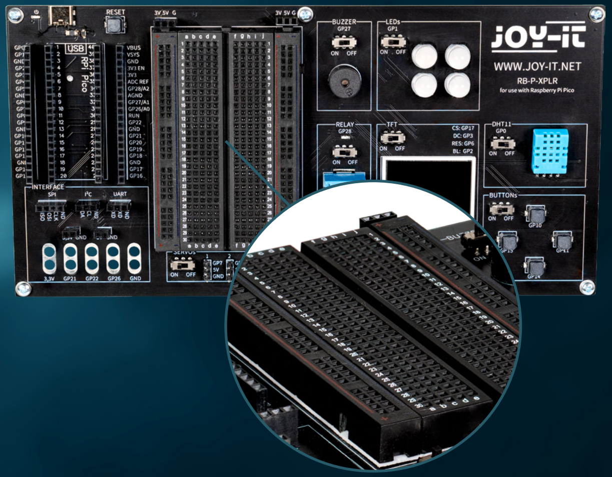
UART (Universal Asynchronous Receiver/Transmitter): This interface enables asynchronous serial communication via two lines: TX (Transmit) and RX (Receive). UART is often used for communication between microcontrollers and computers or for connecting modules such as GPS receivers or Bluetooth modules.

3.3 V and 5 V connections: These connections provide the power supply for electronic components. 3.3 V is often used for modern microcontrollers and sensors, while 5 V is often found in older or more power-hungry devices.

Connections for crocodile clips: These connectors are ideal for temporary connections or for test purposes. They enable quick and easy connection to various components or measuring devices without soldering. There are a total of five such connectors on the Explorer Board, which can be used flexibly for a variety of applications.

Each of these connectors has its specific application and meaning in electronics, similar to how different types of buttons in a user interface have different functions. They provide the necessary flexibility and functionality for building and expanding electronic systems.

4.9 BREADBOARD



Breadboards are an indispensable tool in the world of electronics, much like interface connectors are crucial for connecting different components. They allow electronic circuits to be built and tested quickly and without soldering, making them particularly popular for prototyping and educational purposes.

A breadboard typically consists of a rectangular plastic block with a large number of embedded holes arranged in rows. These holes are internally connected by metallic traces that allow components and wires to be easily plugged in and connected. The standard layout of a breadboard includes two main areas:

The main areas: These consist of a series of parallel rows of holes, usually separated by a central groove. The holes within a row are electrically connected to each other. This arrangement is ideal for inserting integrated circuits (ICs) and other components.

The power strips: At the edge of the breadboard there are usually one or two rows of holes that serve as power strips. These are connected vertically along the entire length of the breadboard and offer a convenient way of providing power and ground at various points on the circuit.

The flexibility of a breadboard lies in its reusability and the ability to build circuits without permanent changes. This makes it ideal for experimentation as errors can be easily corrected and components removed without damage. It is also an excellent learning tool as it promotes understanding of circuit logic and component functions in a practical, visual way.

In addition, breadboards are available in different sizes and with different numbers of connection points to suit different requirements. Smaller breadboards are good for simple projects and experiments, while larger ones are suitable for more complex circuits.

Despite their versatility, breadboards also have limitations. They are not well suited for very high frequencies or for circuits that require high power. Also, the connections can sometimes be less reliable than soldered connections, especially if the breadboard wears out over time.

Overall, breadboards are an essential tool for anyone working with electronics - from beginners learning the basics to experienced developers looking to prototype quickly and efficiently. They are the electronic equivalent of an artist's sketchbook: a place to explore ideas and experiment before the final work is created.

5. INFORMATION & TAKE-BACK OBLIGATIONS

OUR INFORMATION AND TAKE-BACK OBLIGATIONS UNDER THE GERMAN ELECTRICAL AND ELECTRONIC EQUIPMENT ACT (ELEKTROG)

SYMBOL ON ELECTRICAL AND ELECTRONIC EQUIPMENT:
This crossed-out garbage can means that electrical and electronic appliances do not belong in household waste. You must hand in the old appliances at a collection point. Before handing them in, you must separate used batteries and accumulators that are not enclosed by the old appliance.

RETURN OPTIONS:
As an end user, you can hand in your old appliance (which essentially fulfills the same function as the new appliance purchased from us) for disposal free of charge when purchasing a new appliance. Small appliances with no external dimensions greater than 25 cm can be disposed of in normal household quantities regardless of whether you have purchased a new appliance.

POSSIBILITY OF RETURN AT OUR COMPANY LOCATION DURING OPENING HOURS:
SIMAC Electronics GmbH, Pascalstr. 8, D-47506 Neukirchen-Vluyn

RETURN OPTION IN YOUR AREA:
We will send you a parcel stamp with which you can return the device to us free of charge. To do so, please contact us by e-mail at service@joy-it.net or by telephone.

PACKAGING INFORMATION:
Please pack your old appliance securely for transportation. If you do not have suitable packaging material or do not wish to use your own, please contact us and we will send you suitable packaging.

6. SUPPORT

We are also there for you after your purchase. If any questions remain unanswered or problems arise, we are also available to assist you by e-mail, telephone and ticket support system.

E-Mail: service@joy-it.net
Ticket-System: http://support.joy-it.net
Telephone: +49 (0)2845 9360 – 50 (Mon. - Thur.: 09:00 - 17:00 ó clock, Fri.: 09:00 - 14:30 ó clock)

For further information, please visit our website:

WWW.JOY-IT.NET