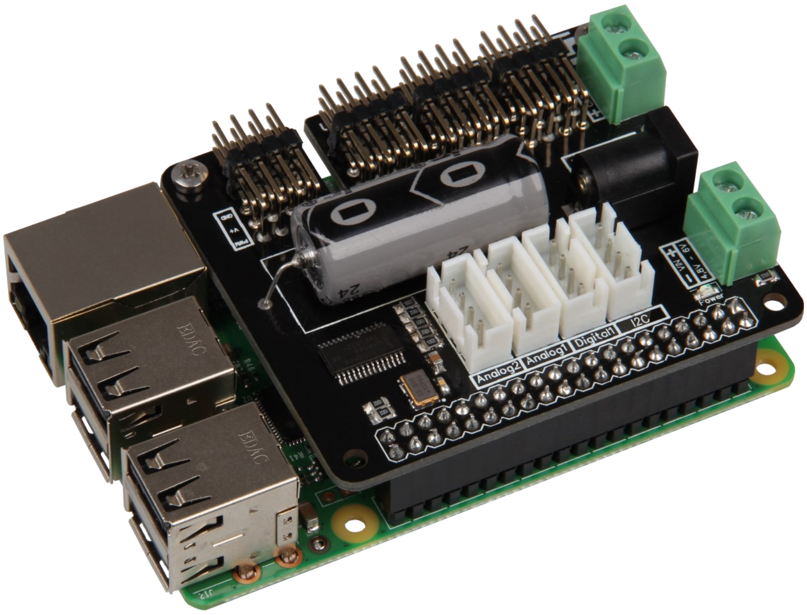
MOTOPI

Motor control for the Raspberry Pi



1. GENERAL INFORMATION

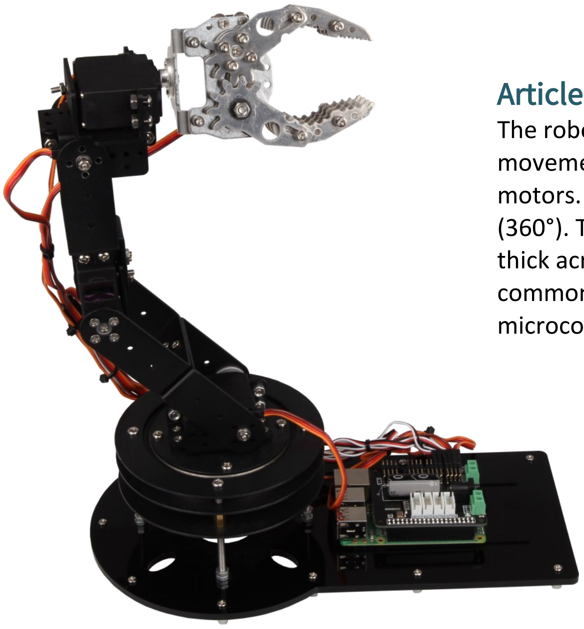
Dear customer,

Thank you for purchasing our product. In the following, we will show you which things should be noted during the use.

Should you encounter any unexpected problems, do not hesitate to contact us

2. GENERAL

The MotoPi board is an expansion board for the control and use of up to 16 PWM controlled servomotors.
The board can be supplied additionally by 4.8 - 6 V so that the ideal supply of the motors is always ensured and even greater projects can be supplied by enough power.
It is for example perfectly suited for the control of the Joy-IT robot arm.



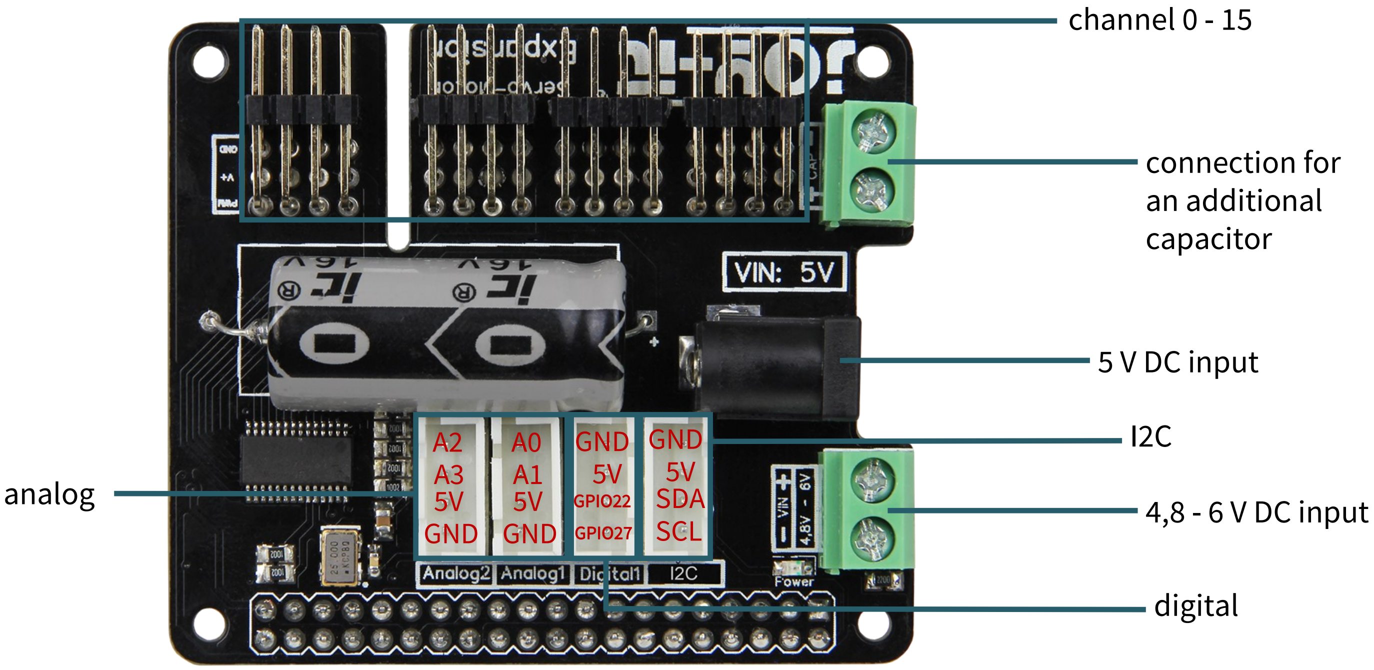
Article number: Robot02

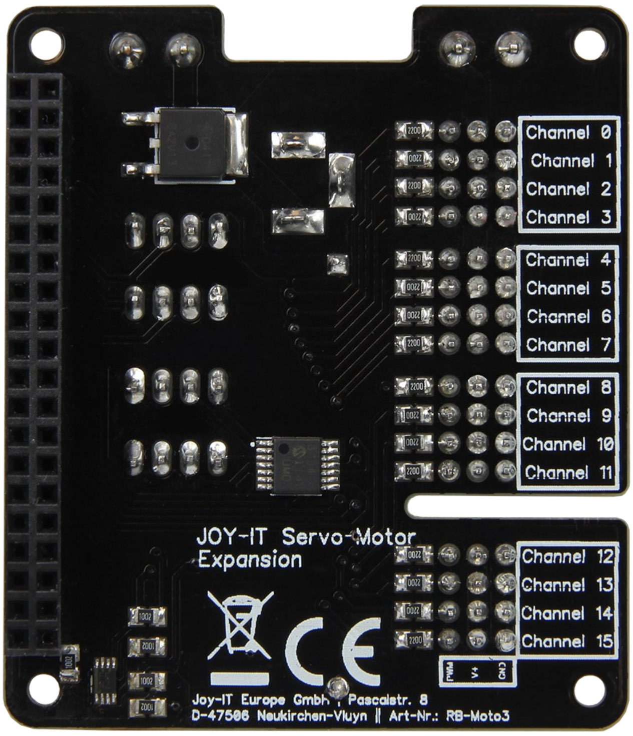
The robot arm made of aluminium gets its movement from 6 separately controllable 20 kg motors. It is mounted on a based rotary plate (360°). The base plate is made out of 4.5 mm thick acryl and has mounting holes for all common singleboard-computer and microcontollers.

3. TECHNICAL DATA & SAFETY INSTRUCTIONS

The MotoPi board is equipped with 16 channels for 5V servomotors as well as a possibility for connecting an additional capacitor.
Moreover, the board has 4 analog, 2 digital and a I2C connection facility.
The power supply is ensured by a 5 V coaxial power connector or via a power supply between 4.8 and 6 V.

It is also additionally equipped with a quartz oscillator to keep frequencies as precisely as possible and deviations as small as possible.





On the backside of the board, the numeration of the channels can be read.

The 3 pins of each channel are from top to bottom the connection for ground, voltage and signal [GND | V+ | PWM].
The board can be plugged on the GPIO pins of the Raspberry Pi and the cable of your 5V servomotors can be connected with the pins of the channels.
An additional power supply via a cable or a 5V coaxial power connector is **mandatory** necessary to operate.

To prevent sudden voltage drops, the board has a capacitor. If in special cases this is not enough, you can connect an additional capacitor parallel via the according connection.

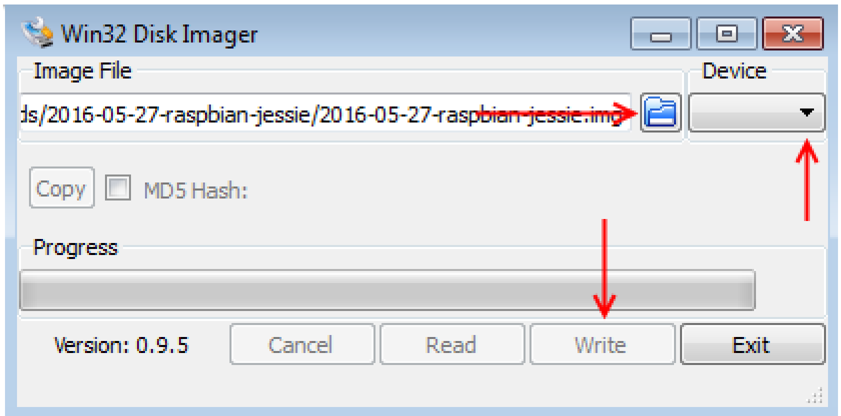
The power supply must be adjusted to the power of the connected motors. If the power supply is insufficiently dimensioned, the motors will stutter instead of moving smoothly. We recommend the use of our 4.8 power supply *RB-Netzteil2* which offers a 24 W continuous output.
After pinning the expansion board on your Raspberry Pi, connecting an additional power supply and connecting the servomotors, the board is ready to use.

Safety instructions

To prevent inverse polarity, please note the markings on the board from the according input (+ and - symbol).
An inverse polarity can cause damage to your board, the connected Raspberry Pi and other peripheries!
The motors you connect and the movement they generate can be dangerous.
Therefore, we recommend sufficient safety distance or rather to take measurements so that no one can get in touch with the moving parts.

4. INSTALLATION OF THE RASPBERRY PI

If you already use the latest Raspbian version on your Raspberry Pi, you can skip the next step and start the next step.
The latest image of the operating system can be downloaded from the Raspberry Pi website.
With the help of the Win32-Disk-Imager, you can copy the downloaded image on your SD card.
Choose therefore, like shown in the picture below the image and your SD card.
After that, you can start the writing process with *Write*.



If this step is successfull, you can put the SD card into yor Raspberry Pi and continue to the next step.

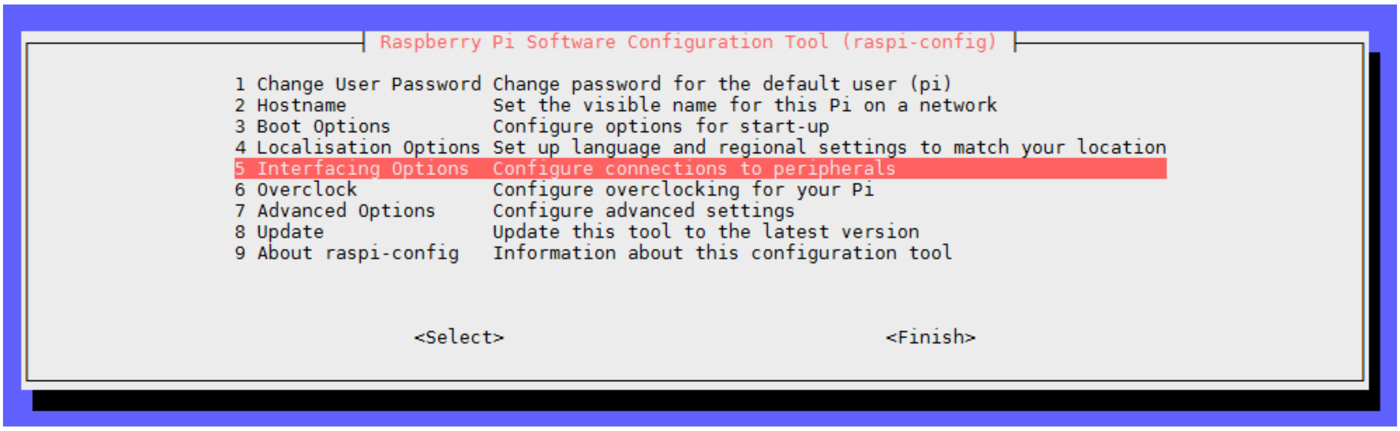
5. INSTALLATION OF THE MODULE

To use the board properly, you should activate the two functions on your Raspberry Pi: **I2C** and **SPI**

Therefore, open the configuration menu of the Raspberry Pi with the following command:

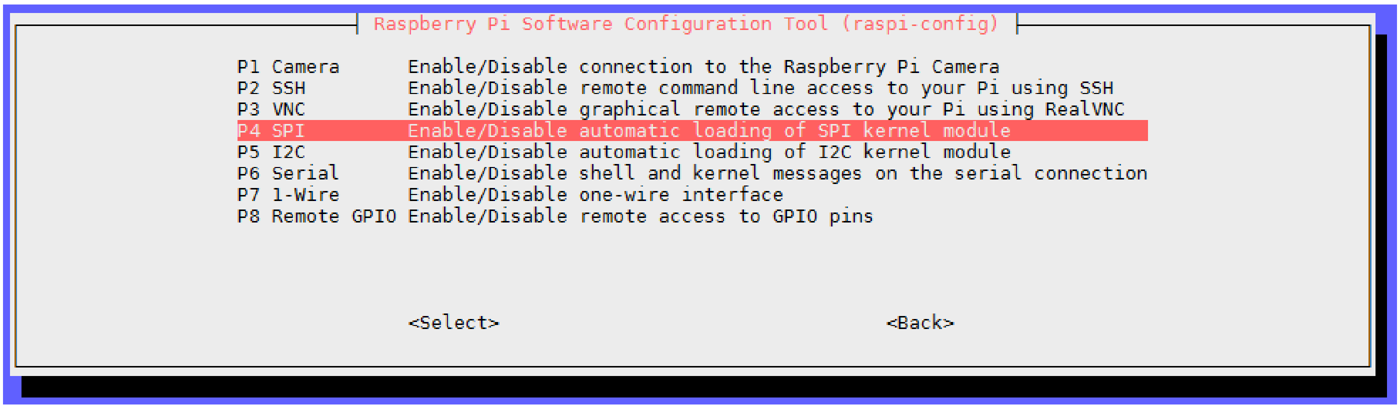
```
sudo raspi-config
```

In the just opened window, navigate to the menu point ***Interfacing Options***.



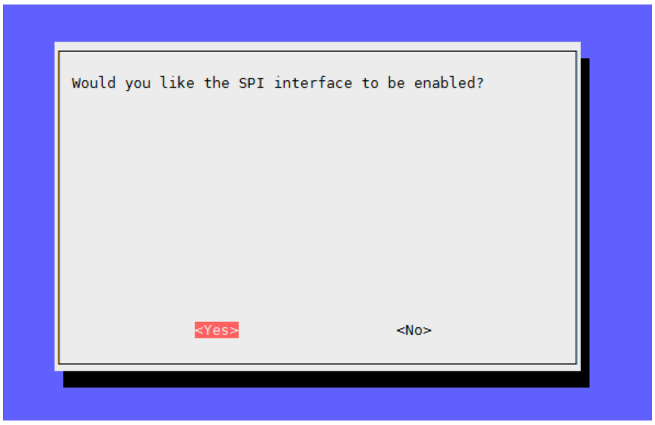
```
Raspberry Pi Software Configuration Tool (raspi-config)

1 Change User Password Change password for the default user (pi)
2 Hostname             Set the visible name for this Pi on a network
3 Boot Options         Configure options for start-up
4 Localisation Options Set up language and regional settings to match your location
5 Interfacing Options  Configure connections to peripherals
6 Overclock            Configure overclocking for your Pi
7 Advanced Options     Configure advanced settings
8 Update               Update this tool to the latest version
9 About raspi-config   Information about this configuration tool


                <Select>                                <Finish>
```

Enable the function **SPI**.

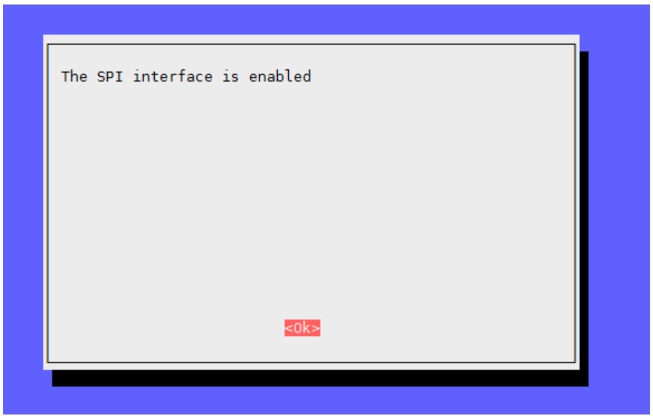


```
Raspberry Pi Software Configuration Tool (raspi-config)

P1 Camera      Enable/Disable connection to the Raspberry Pi Camera
P2 SSH         Enable/Disable remote command line access to your Pi using SSH
P3 VNC         Enable/Disable graphical remote access to your Pi using RealVNC
P4 SPI         Enable/Disable automatic loading of SPI kernel module
P5 I2C         Enable/Disable automatic loading of I2C kernel module
P6 Serial      Enable/Disable shell and kernel messages on the serial connection
P7 1-Wire      Enable/Disable one-wire interface
P8 Remote GPIO Enable/Disable remote access to GPIO pins
```

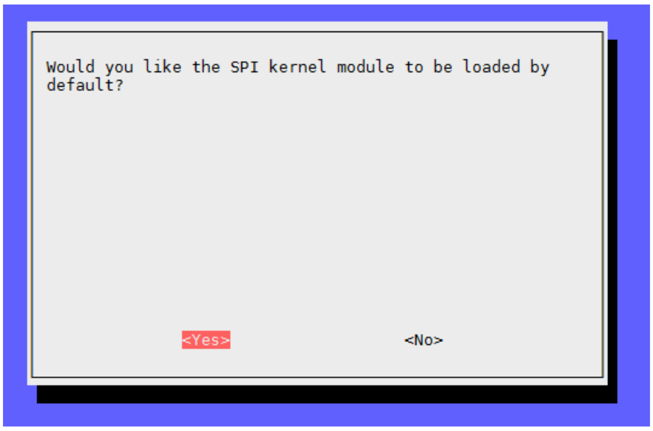
Confirm the next windows all with **Yes** or rather **Ok**.



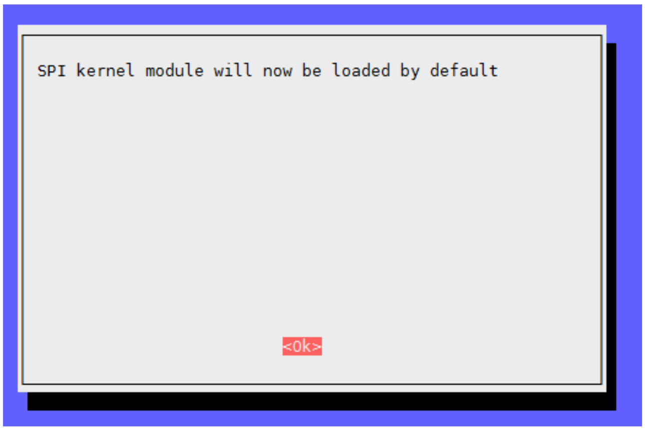
```
Would you like the SPI interface to be enabled?
```



```
The SPI interface is enabled
```

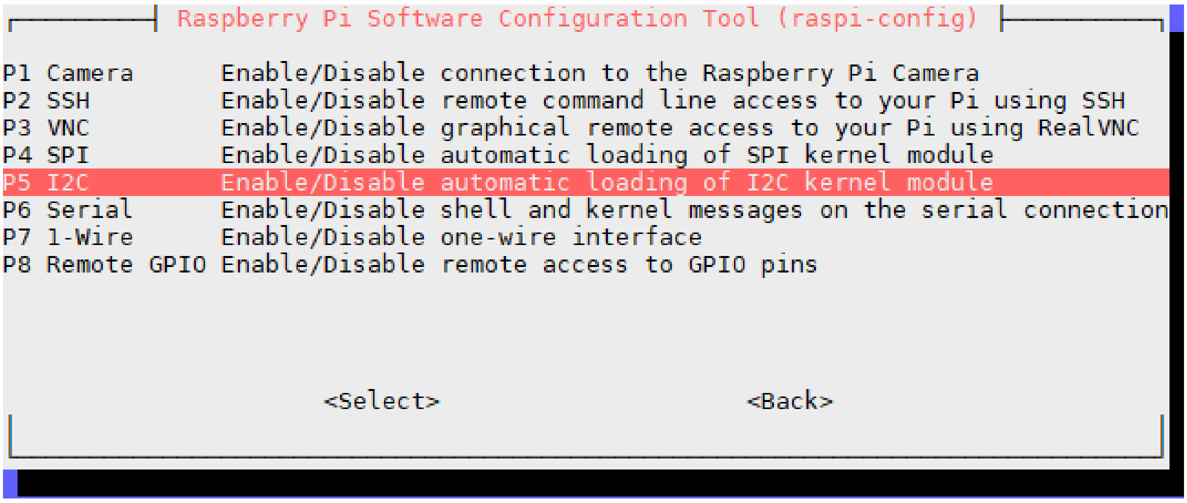


```
Would you like the SPI kernel module to be loaded by
default?
```



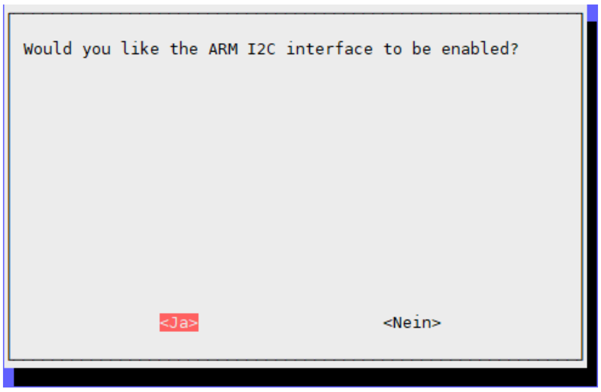
```
SPI kernel module will now be loaded by default
```

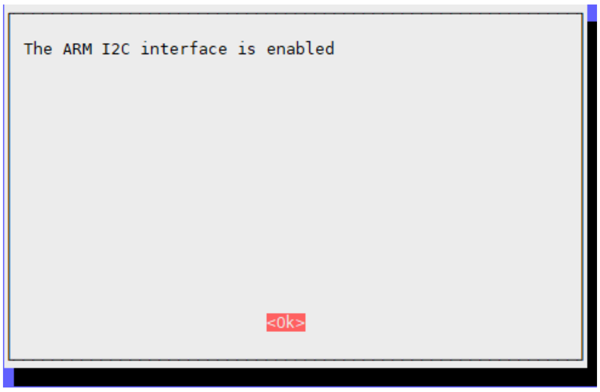
Afterwards, you must enable the function **I2C**.



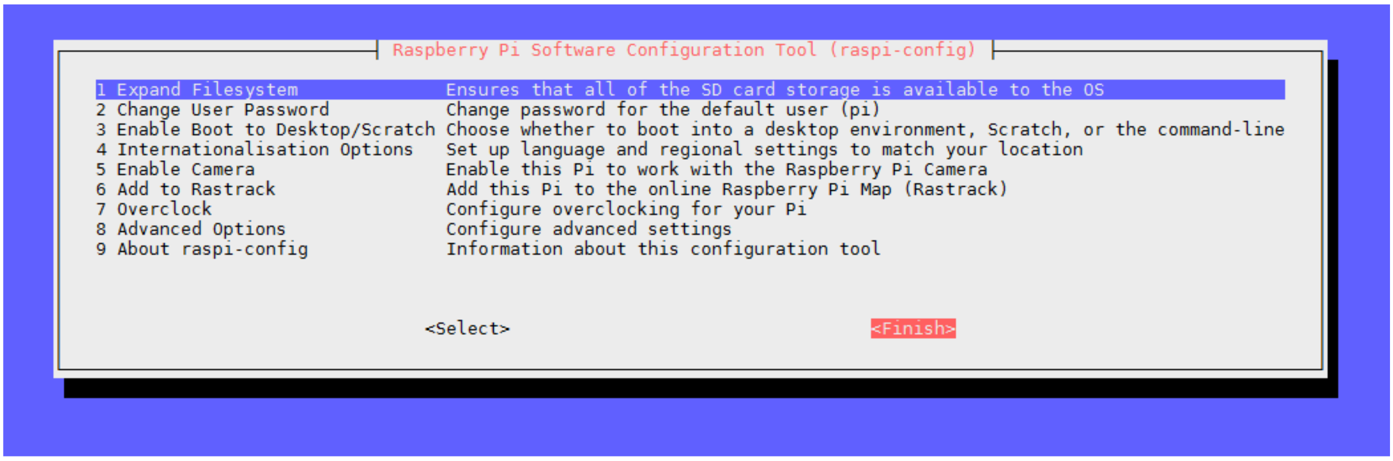
```
Raspberry Pi Software Configuration Tool (raspi-config)

P1 Camera      Enable/Disable connection to the Raspberry Pi Camera
P2 SSH         Enable/Disable remote command line access to your Pi using SSH
P3 VNC         Enable/Disable graphical remote access to your Pi using RealVNC
P4 SPI         Enable/Disable automatic loading of SPI kernel module
P5 I2C         Enable/Disable automatic loading of I2C kernel module
P6 Serial      Enable/Disable shell and kernel messages on the serial connection
P7 1-Wire      Enable/Disable one-wire interface
P8 Remote GPIO Enable/Disable remote access to GPIO pins
```

Confirm the next windows all with **Yes** or rather **Ok**.


Would you like the ARM I2C interface to be enabled?


The ARM I2C interface is enabled

Leave the configuration menu with *Finish* and restart your Raspberry Pi.


```
Raspberry Pi Software Configuration Tool (raspi-config)

1 Expand Filesystem              Ensures that all of the SD card storage is available to the OS
2 Change User Password           Change password for the default user (pi)
3 Enable Boot to Desktop/Scratch Choose whether to boot into a desktop environment, Scratch, or the command-line
4 Internationalisation Options   Set up language and regional settings to match your location
5 Enable Camera                  Enable this Pi to work with the Raspberry Pi Camera
6 Add to Rastrack                Add this Pi to the online Raspberry Pi Map (Rastrack)
7 Overclock                      Configure overclocking for your Pi
8 Advanced Options               Configure advanced settings
9 About raspi-config             Information about this configuration tool
```

```
sudo reboot
```

Since the MotoPi is equipped with an additional crystal oscillator, a special program library is required. This is based on the Adafruit_PCA9685 Python library but it is specially adjusted for our board.

We recommend using unconditionally and exclusively our own adjusted library. This library can be downloaded here .

Copy the unzipped library completely on your Raspberry Pi and navigate in the terminal into this folder. With the following command you can install the library.

```
sudo python setup.py install
```

Now Navigate into the folder *examples* and start the code example like described below.

```
cd examples
sudo python simpletest.py
```

This test script shows the fundamental functions of the motor control and the motor which is connected to the first channel, will move repeatedly from one direction to the other.

6. CONTROLL OF THE ADDITIONAL CONNECTIONS

After the restart, you must install the necessary drivers and modules. Therefore perform the following commands:

```
sudo apt-get update
sudo pip install spidev
sudo pip install wiringpi
```

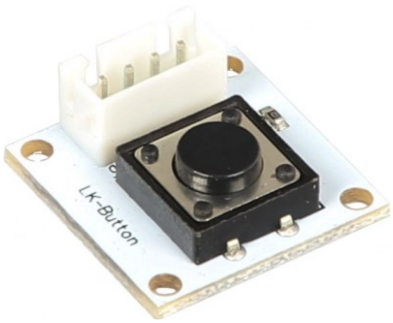
A restart is now required again.

```
sudo reboot
```

After the restart, the connections are ready to use.
Please note that the first pin of the digital connection is connected with the GPIO pin 27 and the second pin to the GPIO pin 22.

7. CODE EXAMPLE TO USE THE DIGITAL CONNECTIONS

Here, you have a short code example for controlling the digital connections. For that, we use the *LK-Button1* with a *LK-Cable-20* from our LinkerKit series.



```
import RPi.GPIO as GPIO
from time import sleep
#Initialisiere Button auf Digital-PIN 22
button = 22
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(button, GPIO.IN, pull_up_down=GPIO.PUD_UP)
while True:
    if GPIO.input(button) == GPIO.HIGH:
        #Mache etwas
        print "Ich tue etwas"
    else:
        #Mache etwas anderes
        print "Ich tue etwas anderes"
```

8. CODE EXAMPLE TO USE THE DIGITAL CONNECTIONS

Consecutively, you have a short code example for controlling the digital connections. For that, we use the *LK-Joystick* with a *LK-Cable-20* from our LinkerKit series.

Note that if not all connection are taken, the free pins can issue false values.

```
import spidev
import time
import sys

spi = spidev.SpiDev()
spi.open(0,0)
spi.max_speed_hz = 2000000

def readadc(adcnum):
    if adcnum >7 or adcnum <0:
        return-1
    r = spi.xfer2([1,8+adcnum <<4,0])
    adcout = ((r[1] &3) <<8)+r[2]
    return adcout

while True:
    if len(sys.argv) >1:
        for i in range(len(sys.argv)):
            if i == 0:
                print "_______________________________________\n"
            else:
                adc_channel = int(sys.argv[i])
                print "Channel " + str(adc_channel)
                value=readadc(adc_channel)
                volts=(value*3.3)/1024
                print("%4d/1023 => %5.3f V" % (value, volts))
                print " "
                print "_______________________________________\n"
                time.sleep(1.5)
    else:
        print "_______________________________________\n"
        print "Channel 0"
        value=readadc(0)
        volts=(value*3.3)/1024
        print("%4d/1023 => %5.3f V" % (value, volts))
        print "Channel 1"
        value=readadc(1)
        volts=(value*3.3)/1024
        print("%4d/1023 => %5.3f V" % (value, volts))
        print "Channel 2"
        value=readadc(2)
        volts=(value*3.3)/1024
        print("%4d/1023 => %5.3f V" % (value, volts))
        print "Channel 3"
        value=readadc(3)
        volts=(value*3.3)/1024
        print("%4d/1023 => %5.3f V" % (value, volts))
        print "_______________________________________\n"
        time.sleep(1.5)
```

9. OTHER INFORMATION

Our Information and Take-back Obligations according to the German Electronic Law (ElektroG)

Symbol on Electrial and Electronic Products:
This crossed-out bin means that electrical and electronic products do not belong into the household waste. You must hand over your old appliance to a registration place. Before you can hand over the old appliance, you must remove used batteries and replacement batteries which are not enclosed by the device.

Return Options:
As the end user, you can hand over your old appliance (which has essentially the same functions as the new one bought with us) free of charge for disposal with the purchase of a new device.
Small devices, which do not have outer dimensions bigger than 25 cm can be handed in for disposal independently of the purchase of a new product in normal household quantities.

1. Possibility of return at our company location during our opening hours
Simac Electronics Handel GmbH, Pascalstr. 8, D-47506 Neukirchen-Vluyn

2. Possibility of return nearby
We will send you a parcel stamp with which you can send us your old appliance free of charge. For this possibility, please contact us via e-mail at service@joy-it.net or via telephone.

Information about Package:
Please package your old appliance safe for transport. Should you not have suitable packaging material or you do not want to use your own material, you can contact us and we will send you an appropriate package.

10. SUPPORT

If any questions remained open or problems may arise after your purchase,we are available by e-mail, telephone and ticket support system to answer these.

E-Mail: service@joy-it.net
Ticket-system: http://support.joy-it.net
Telephone: +49 (0)2845 98469 – 66 (10 - 17 o'clock)

For further information visit our website:
www.joy-it.net

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