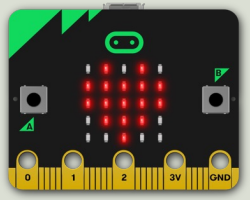
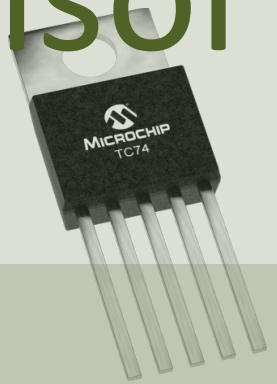
https://www.halvorsen.blog



micro:bit and I2C using TC74 Temperature Sensor



Hans-Petter Halvorsen

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Introduction to micro:bit

Hans-Petter Halvorsen

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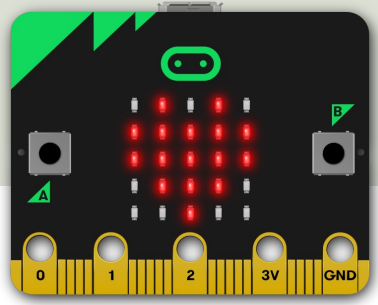
micro:bit



- micro:bit is a small microcontroller
- micro:bit is smaller than a credit card
- Price is about 150-400NOK ($15-30)
- It can be used by kids and students to learn programming and technology
- micro:bit can run a special version of Python called **MicroPython**
- MicroPython is a down-scaled version of Python
- micro:bit Python User Guide
  https://microbit.org/get-started/user-guide/python/
- micro:bit MicroPython documentation
  https://microbit-micropython.readthedocs.io

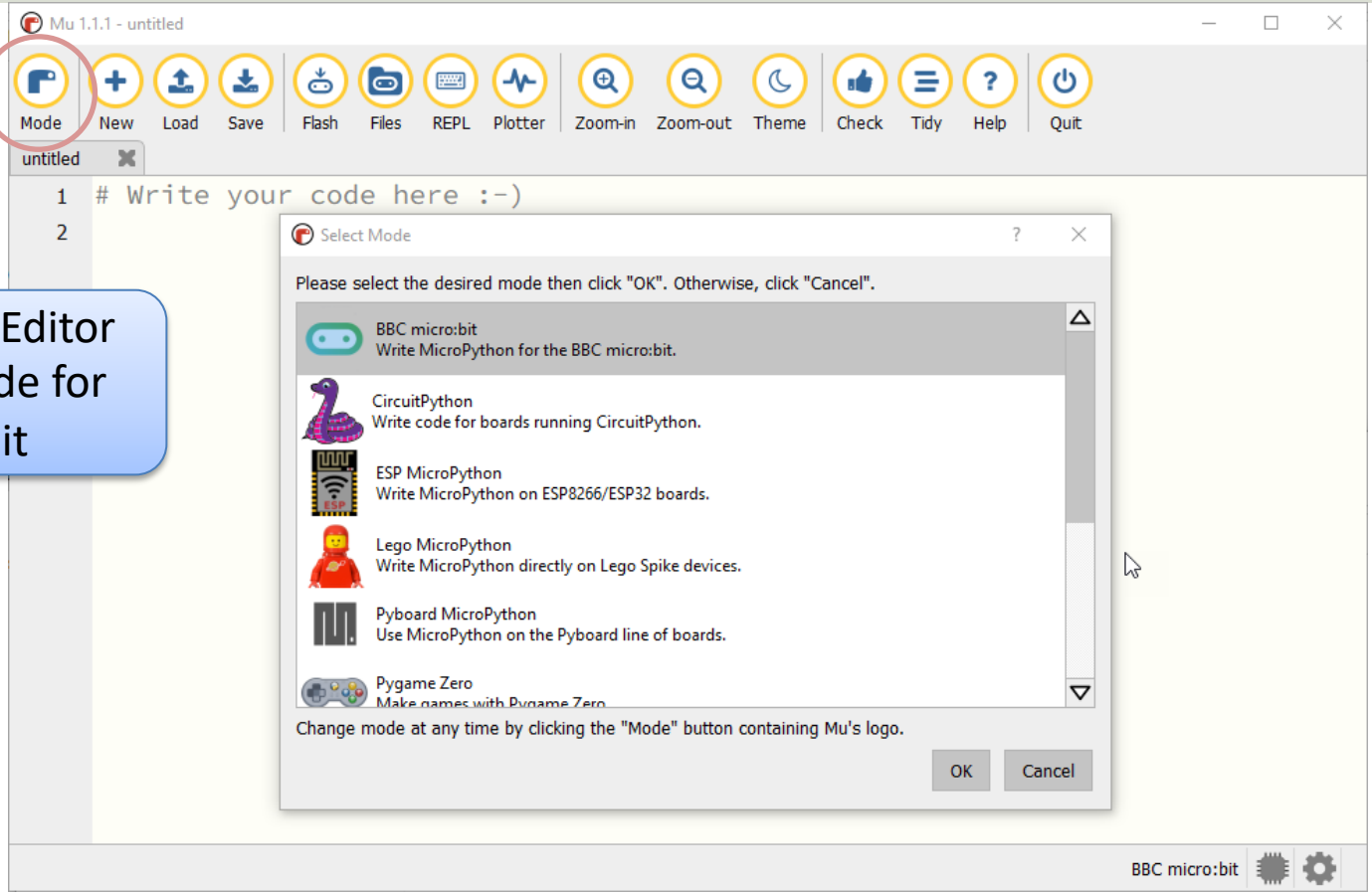
https://microbit.org

Mu Python Editor

- Mu is a Python code editor for beginners
- It is tailor-made for micro:bit programming
- Mu has a “micro:bit mode” that makes it easy to work with micro:bit, download code to the micro:bit hardware, etc.
- Mu and micro:bit Tutorials: https://codewith.mu/en/tutorials/1.0/microbit

Mu Python Editor

The Mu Python Editor has built-in Mode for the micro:bit



Built-in Temperature Sensor

Hans-Petter Halvorsen

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Temperature Sensor

- Micro:bit has a built-in Temperature Sensor (that is located on the CPU)
- This sensor can give an approximation of the air temperature.
- Just use the built-in `temperature()` function in order to get the temperature value from the sensor

Temperature Sensor

In order to read the temperature, you just use the built-in `temperature()` function:

```
from microbit import *

currentTemp = temperature()
```

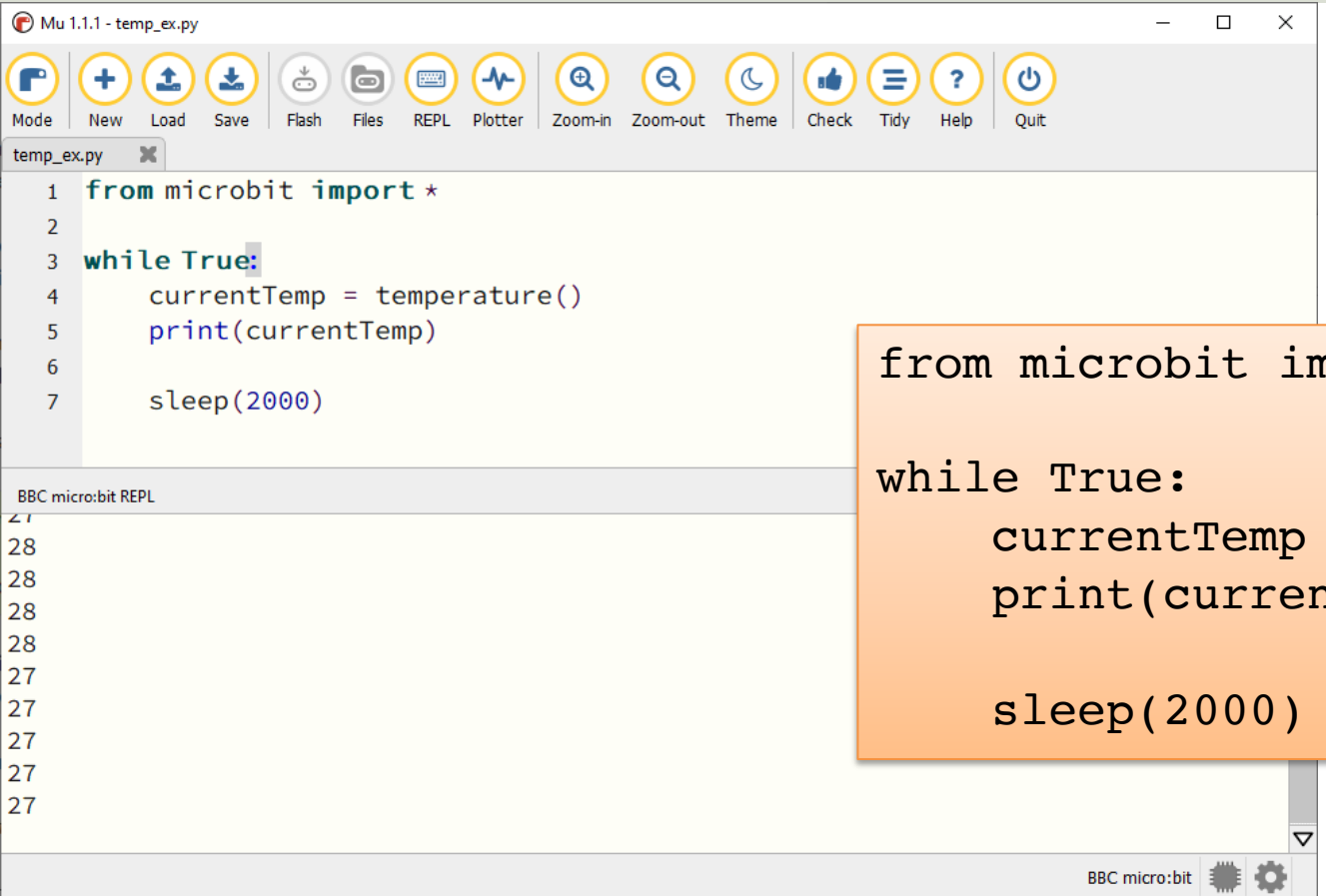
This examples displays the temperature on the LED matrix:

```
from microbit import *

while True:
    if button_a.was_pressed():
        display.scroll(temperature())
```

https://microbit.org/get-started/user-guide/features-in-depth/#temperature-sensor

Temperature Sensor

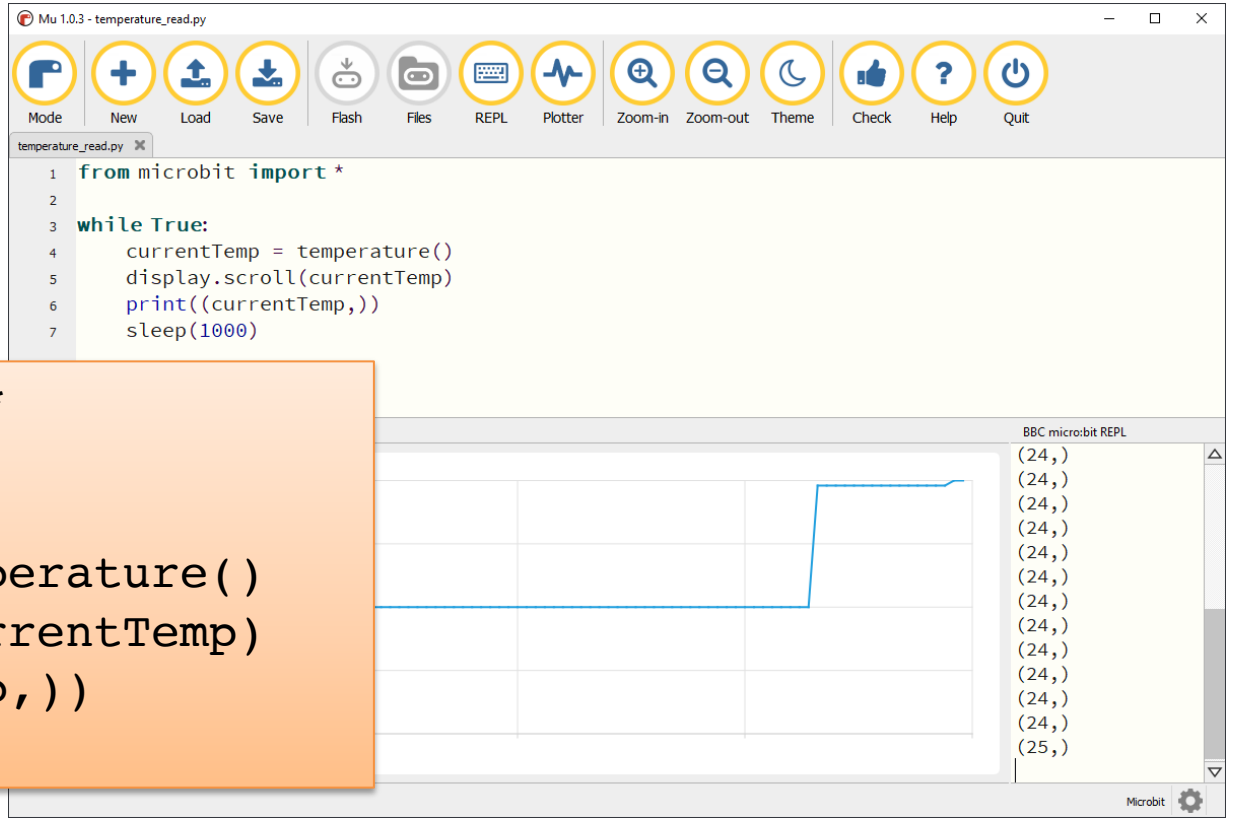



```
from microbit import *

while True:
    currentTemp = temperature()
    print(currentTemp)

    sleep(2000)
```

Temperature Sensor




```
from microbit import *

while True:
    currentTemp = temperature()
    display.scroll(currentTemp)
    print((currentTemp,))
    sleep(1000)
```

Display Min/Max Temperature

```
from microbit import *

currentTemp = temperature()
maxTemp = currentTemp
minTemp = currentTemp

while True:
    currentTemp = temperature()

    if currentTemp < minTemp:
        minTemp = currentTemp
    if currentTemp > maxTemp:
        maxTemp = currentTemp

    if button_a.was_pressed():
        display.scroll(minTemp)
    elif button_b.was_pressed():
        display.scroll(maxTemp)
    else:
        display.scroll(currentTemp)

    print((currentTemp, minTemp, maxTemp))
    sleep(2000)
```

If you do nothing, the LED matrix shows the Current Temperature.

If you click A Button, the Minimum Temperature for the period (since you started the program/turned on the Micro:bit) is shown on the LED matrix

If you click B Button, the Maximum Temperature for the period (since you started the program/turned on the Micro:bit) is shown on the LED matrix

micro:bit I/O Pins

Hans-Petter Halvorsen

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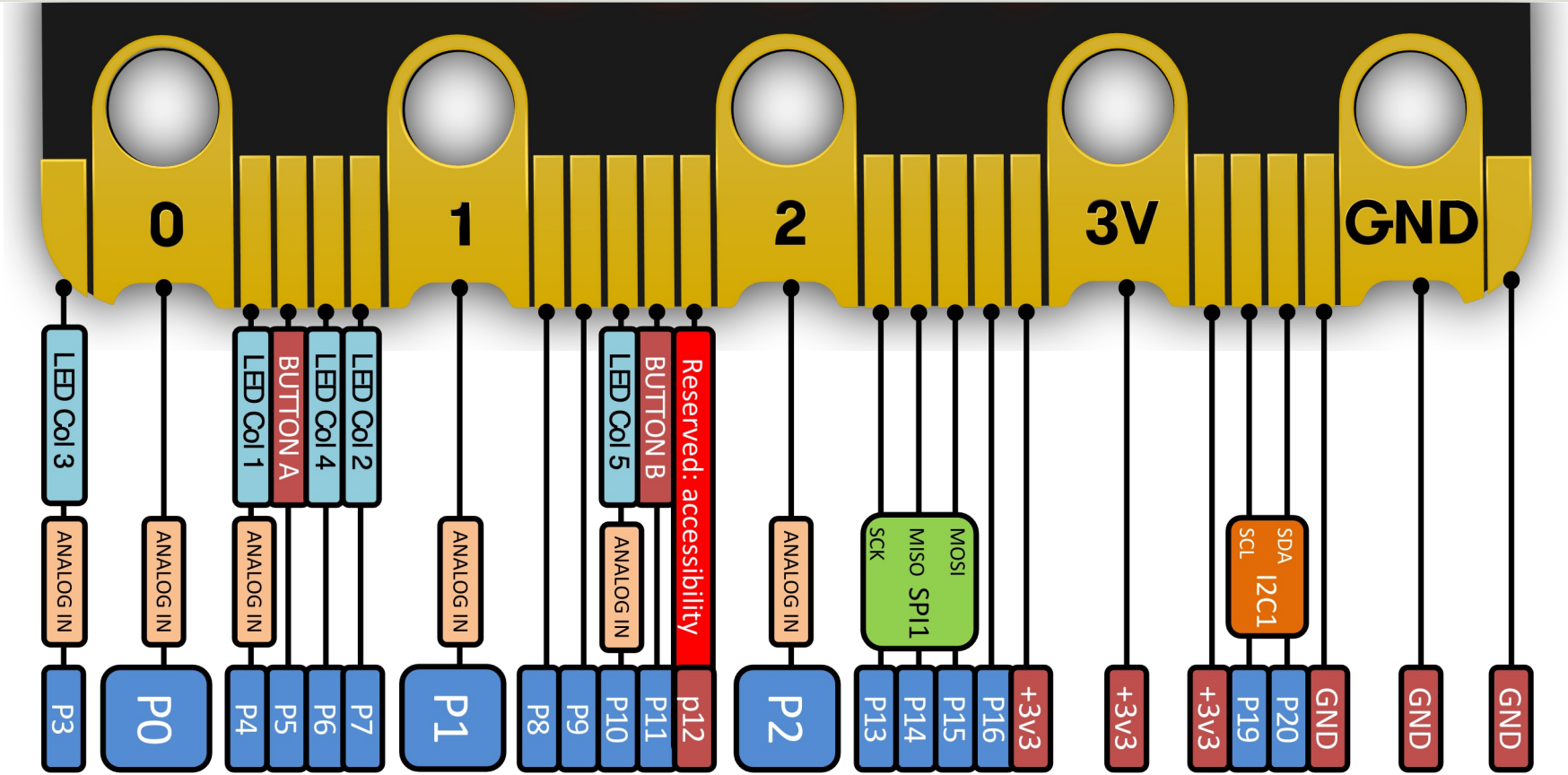
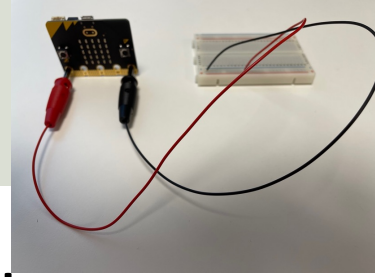
https://microbit.pinout.xyz/

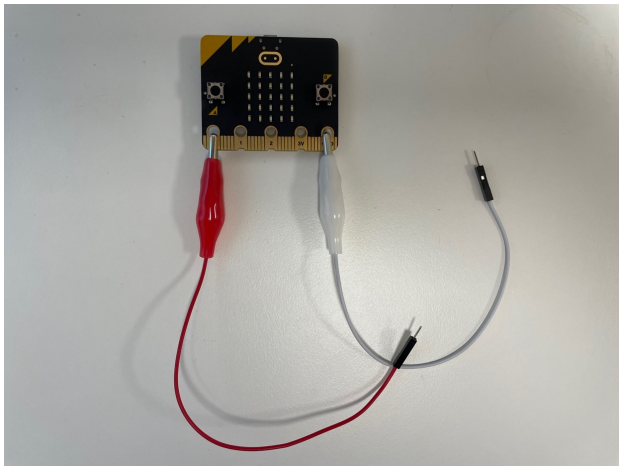
micro:bit I/O Pin Overview



I/O Pins



- We use the I/O pins to connect external components like LEDs, different types of Sensors, etc.
- You can use 4mm Banana plugs or Alligator/Crocodile clips
- Typically, you also want to use a Breadboard



https://tech.microbit.org/hardware/edgeconnector/

https://makecode.microbit.org/device/crocodile-clips

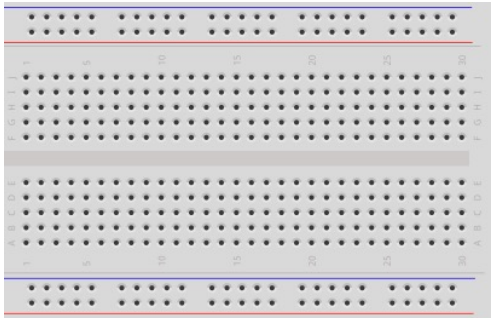
Types of I/O Pins

- **Analog/Digital Input/Output Pins**
- **Pulse Width Modulation (PWM)**
- SPI
- I2C
- UART (used for serial communication)

https://microbit-micropython.readthedocs.io/en/latest/pin.html

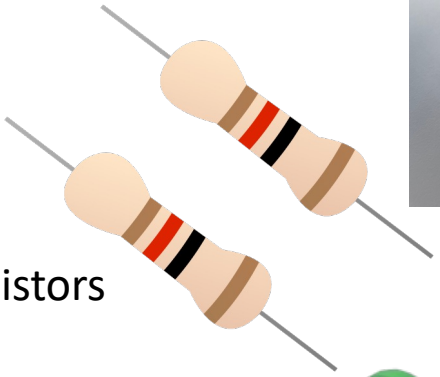
We will only use an Analog/Digital Input/Output pins in this Tutorial

Component Examples

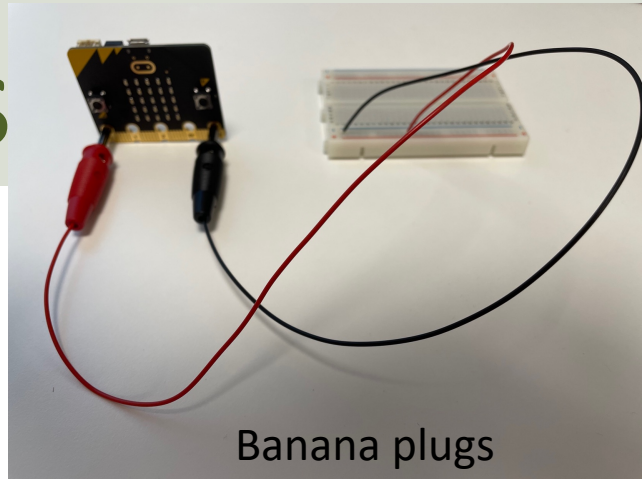


Breadboard

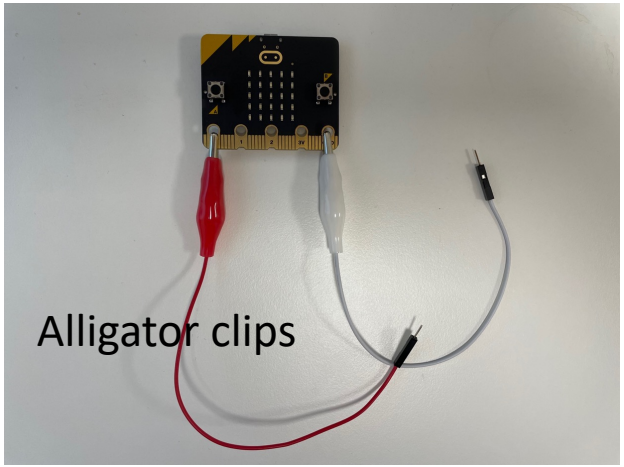
Temperature Sensor



Resistors

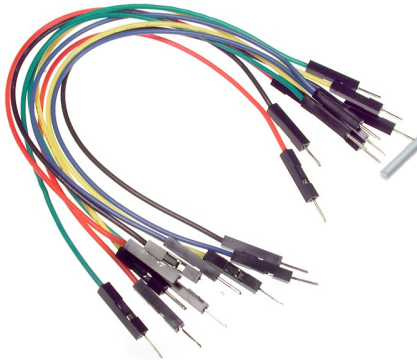


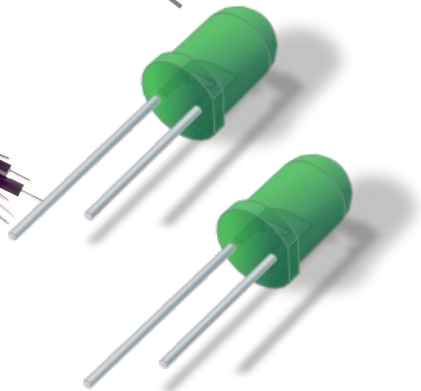
Banana plugs



Alligator clips

Wires

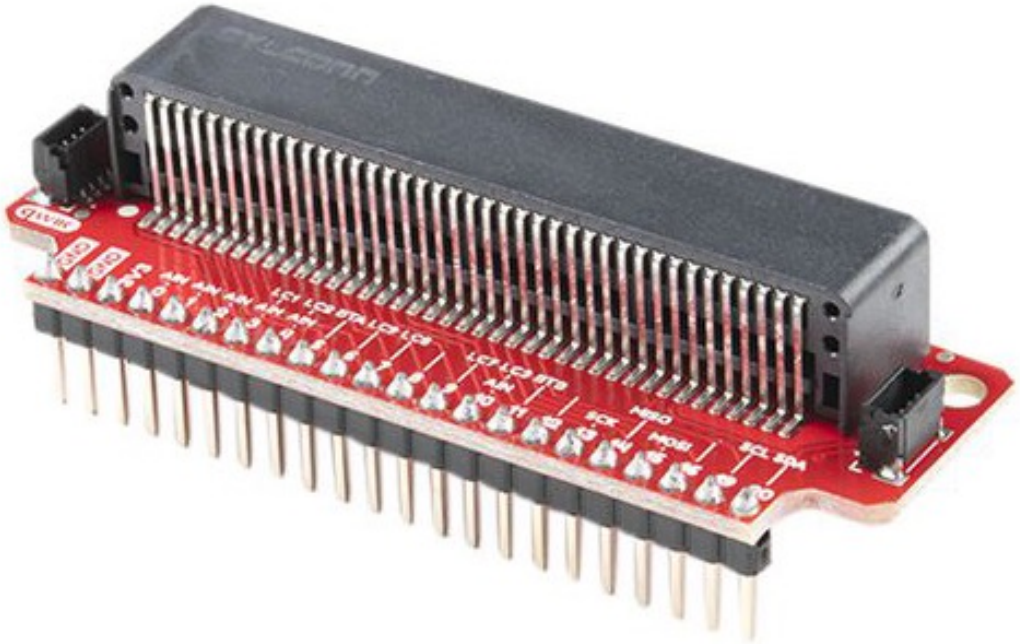




LEDs

Multimeter

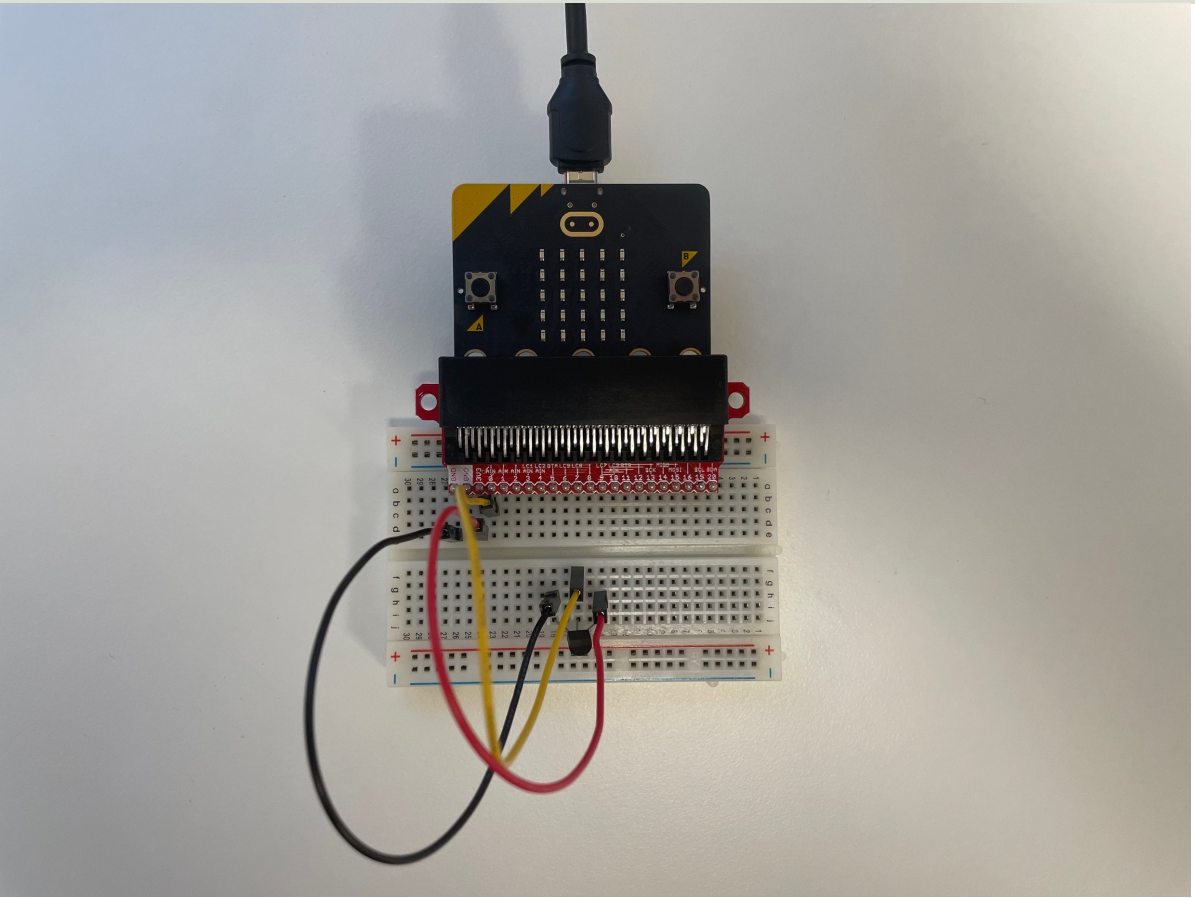
Adapter Breakout Board for micro:bit



We can also use an **Adapter Breakout Board for micro:bit** instead of Alligator/Crocodile clips

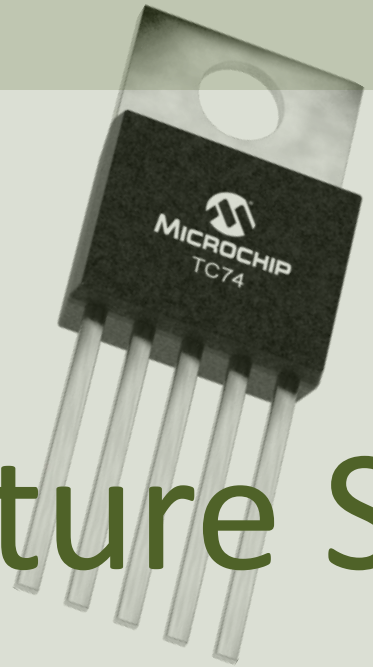
This makes it easier to wire for more advanced circuits and use of more in inputs/outputs pins

Adapter Breakout Board for micro:bit



Here you see see the wirings using an Adapter Breakout Board for micro:bit

https://www.halvorsen.blog



TC74 Temperature Sensor

Hans-Petter Halvorsen

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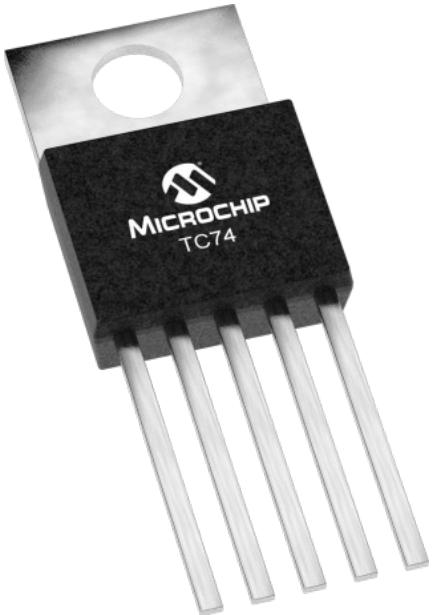
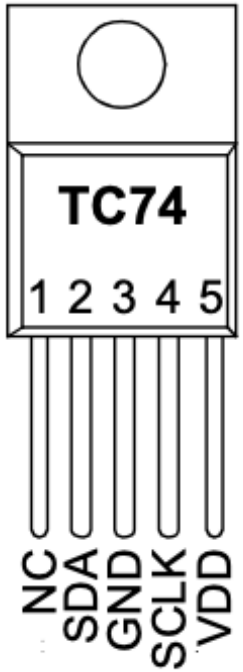
TC74 Temperature Sensor

SMBus/I2C Interface

TC74A0-5.0VAT





- The TC74 acquires and converts temperature information from its onboard solid-state sensor with a **resolution of ±1°C**.
- It stores the data in an internal register which is then read through the serial port.
- The system interface is a slave SMBus/I2C port, through which temperature data can be read at any time.
- Device Address: **0x48**

Datasheet: https://ww1.microchip.com/downloads/en/DeviceDoc/21462D.pdf

I2C

Inter-Integrated Circuit (I^2C)

Hans-Petter Halvorsen

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I2C

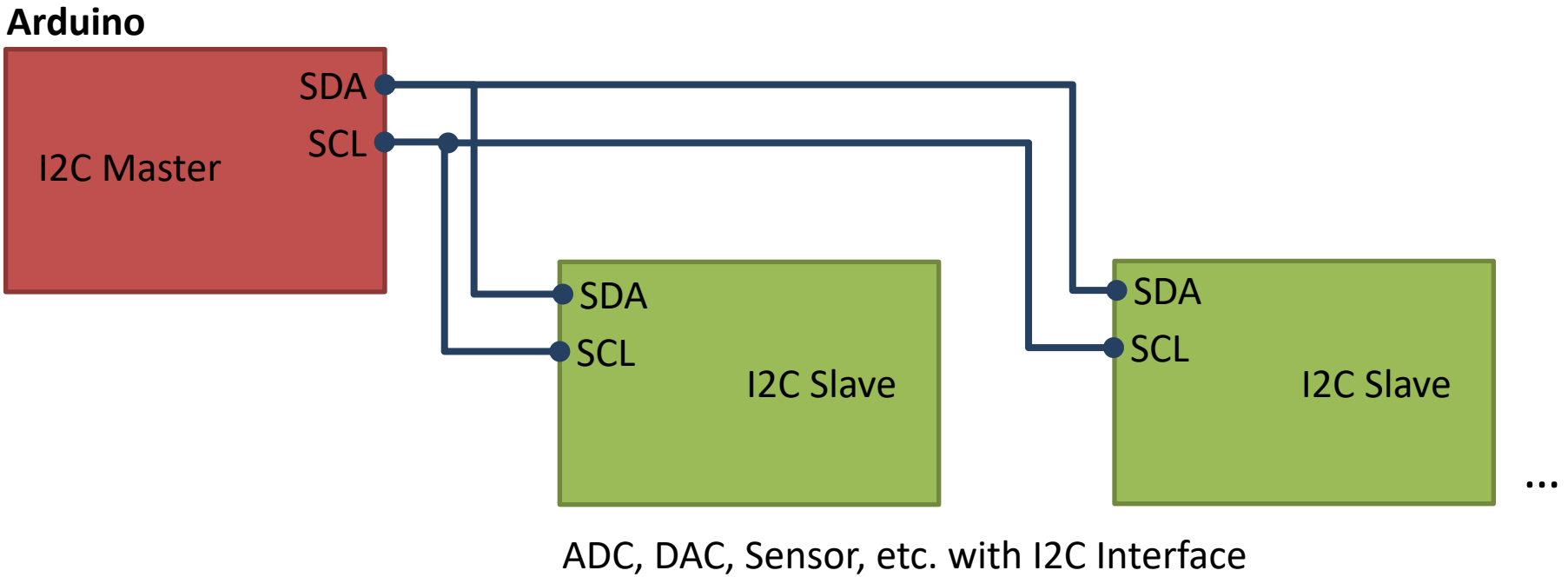
- With the I2C protocol you can communicate using just two wires, a clock and data line (+ Power and GND)
- Typically you use I2C to talk to devices like sensors, small displays, PWM or motor drivers, and other devices.
- The Sensor you want to communicate with needs to support the I2C protocol
- There exist thousands of different Sensors, etc. that support the I2C Protocol

I2C

- I2C is a multi-drop bus
- 2-Wire Protocol: SCL (Clock) + SDA (Data)
- Multiple devices can be connected to the I2C pins on the Arduino
- Each device has its own unique I2C address

I2C

Multiple devices can be connected to the I2C pins on the Arduino
Master – Device that generates the clock and initiates communication with slaves
Slave – Device that receives the clock and responds when addressed by the master.



I2C with micro:bit

Initialize I2C Communication:

```
i2c.init(freq=100000, sda=pin20, scl=pin19)
```

(No need to change anything here)

Read Data from the connected I2C device:

```
i2c.read(addr, n, repeat=False)
```

Read n bytes from the device with 7-bit address addr.
If repeat is True, no stop bit will be sent.

https://microbit-micropython.readthedocs.io/en/latest/i2c.html

TC74 and I2C Python Examples

Hans-Petter Halvorsen

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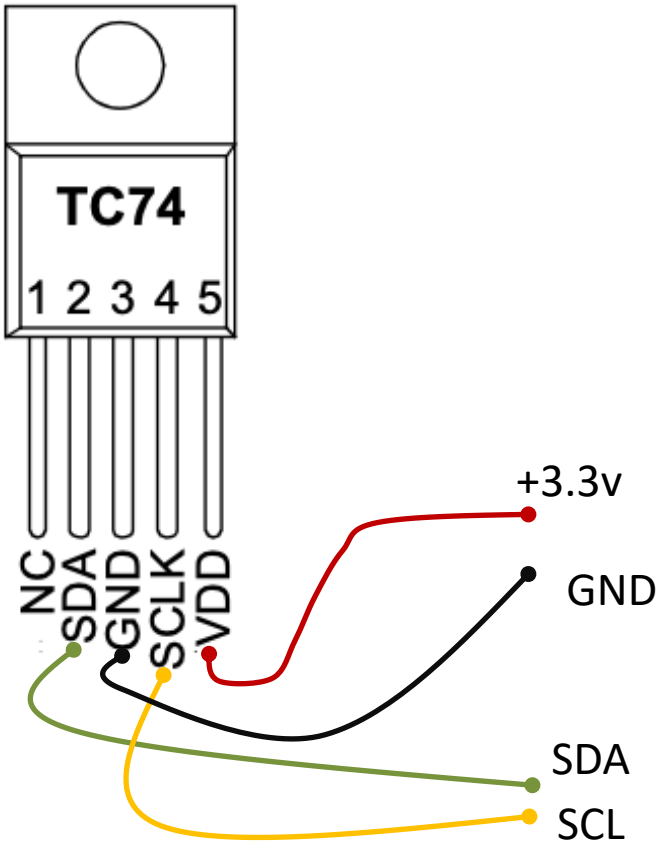
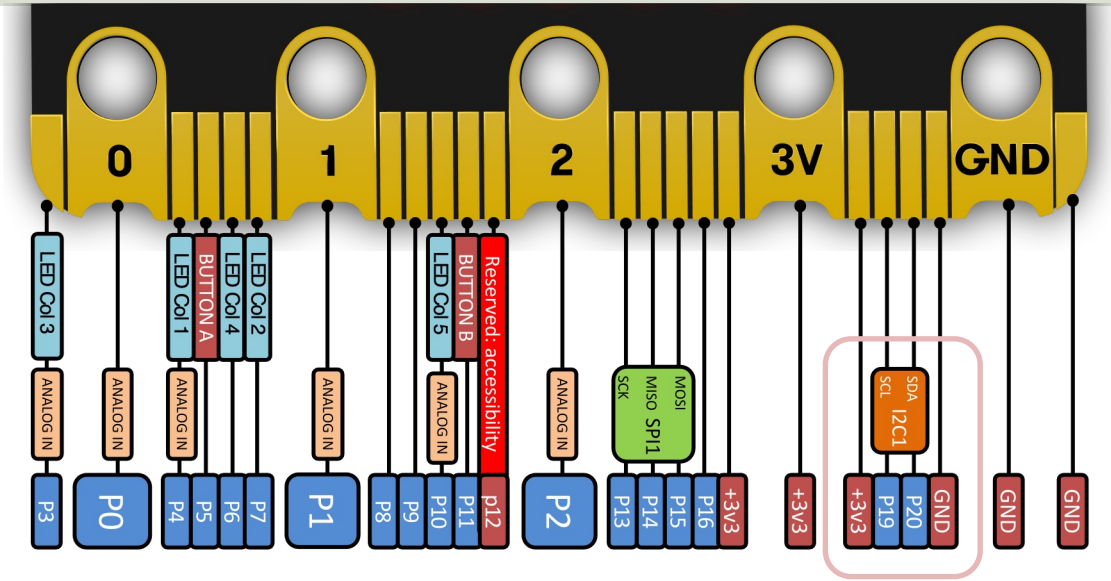
TC74 Example - Wiring

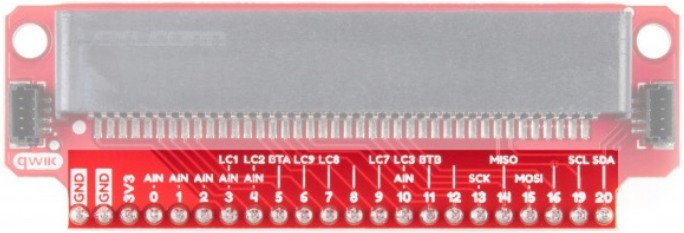




SDA - Serial Data – Bidirectional
SCLK - Serial Clock Input
VDD – Power Supply Input
GND – Ground
NC - Not in use (Not Connected)

Breakout Board

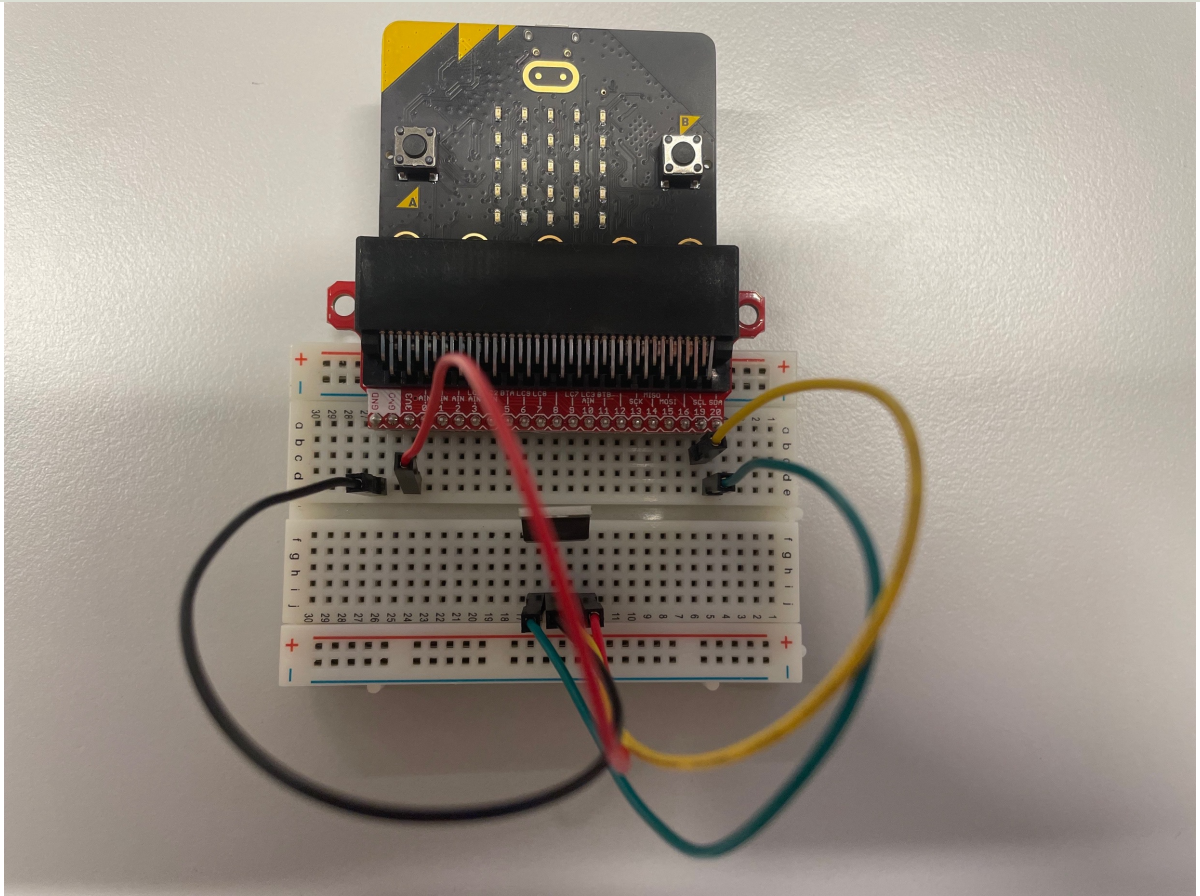
For easy wiring using I2C, a Breakout board is recommended. Many different types do exist. In this tutorial “Sparkfun Microbit Breakout“ board will be used.



Pin	Function 1	Function 2	Description
GND			Ground
GND			Ground
3V3			3.3V
0	Analog In		Connected to large pin 0
1	Analog In		Connected to large pin 1
2	Analog In		Connected to large pin 2
3	Analog In	LED Column 1	Controls part of LED array
4	Analog In	LED Column 2	Controls part of LED array
5		Button A	Connected to Button A on micro:bit
6		LED Column 9	Controls part of LED array
7		LED Column 8	Controls part of LED array
8			Open GPIO pin
9		LED Column 7	Controls part of LED array
10	Analog In	LED Column 3	Controls part of LED array
11		Button B	Connected to Button B on micro:bit
12			Open GPIO pin
13	SCK		GPIO or SPI clock
14	MISO		GPIO or SPI MISO
15	MOSI		GPIO or SPI MOSI
16			Open GPIO pin
19	SCL		GPIO or I^2 clock
20	SDA		GPIO or I^2 data

Sparkfun Microbit Breakout
https://learn.sparkfun.com/tutorials/microbit-breakout-board-hookup-guide

Wiring



Python

Basic Example

```
from microbit import *

i2c.init(freq=100000, sda=pin20, scl=pin19)

address = 0x48

data = i2c.read(address, 1, repeat=False)
print(data)  # Data received is a byte object

# Converting to int. Resolution for TC74 Sensor is +/-1°C
# byteorder is big where MSB is at start
temp = int.from_bytes(data, "big")
print(temp)
display.scroll(temp)
```

```
from microbit import *

i2c.init(freq=100000, sda=pin20, scl=pin19)

address = 0x48

while True:
    data = i2c.read(address, 1, repeat=False)
    # print(data)  # Data received is a byte object

    # Converting to int. Resolution for TC74 Sensor is +/-1°C
    # byteorder is big where MSB is at start
    temp = int.from_bytes(data, "big")
    print(temp)
    display.scroll(temp)

    sleep(5000)
```

Continues Reading Example

Mu 1.1.1 - tc74_ex2.py

Mode | New | Load | Save | Flash | Files | REPL | Plotter | Zoom-in | Zoom-out | Theme | Check | Tidy | Help | Quit

tmp36_led.py | tc74_ex.py | tc74_ex2.py

```
1  from microbit import *
2
3  i2c.init(freq=100000, sda=pin20, scl=pin19)
4
5  address = 0x48
6
7  while True:
8      data = i2c.read(address, 1, repeat=False)
9      # print(data)  # Data received is a byte object
10
11     # Converting to int. Resoulution for TC74 Sensor is +/-1°C
12     # byteorder is big where MSB is at start
13     temp = int.from_bytes(data, "big")
14     print(temp)
15     display.scroll(temp)
16
17     sleep(5000)
```

BBC micro:bit REPL

```
MicroPython v1.15-64-g1e2f0d280 on 2021-06-30; micro:bit v2.0.0 with nRF52833
Type "help()" for more information.
>>>
>>> 28
30
32
33
32
32
```

BBC micro:bit

Hans-Petter Halvorsen

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