Soil NPK Sensor with Raspberry Pi Pico

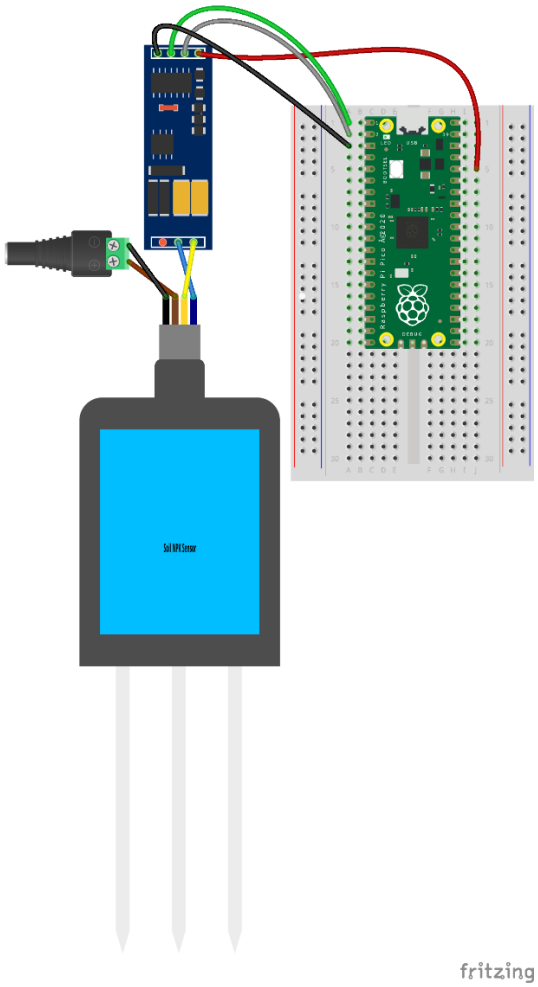
Requirement

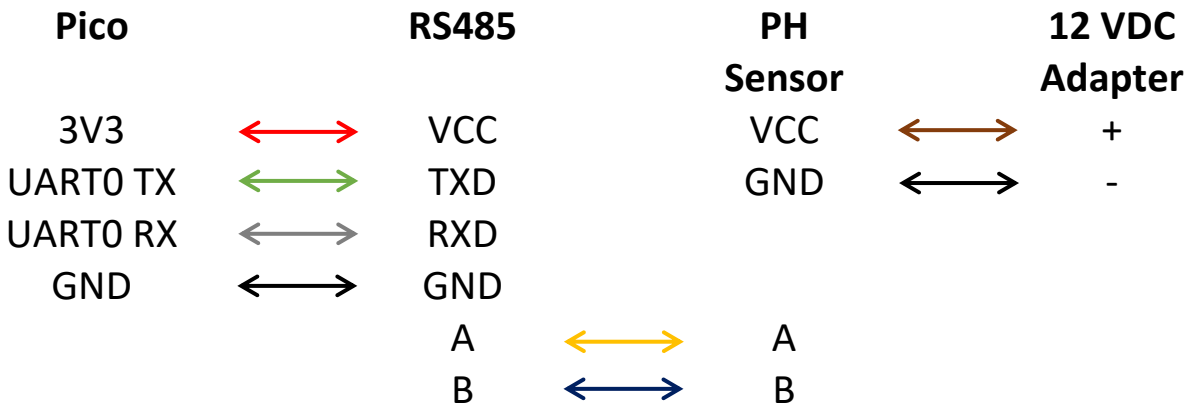
- RS-NPK-N01-TR
- Raspberry Pi Pico
- RS485 Auto Direction Module
- 12 V DC Adapter
- แจ็กแยกขั้วไฟ ตัวเมีย

Language: Micropython

IDE: Thonny

Wiring Diagram





Coding

The example program will show the value of NPK every 1 second.

1. Import the module that we use in this program. In this case we only use “machine” as module. Import “UART” and “Pin” to use UART and GPIO of our Pico. The declaration of pin is already show in the picture below.

```
'''
Wiring
    Brown   -> Power(4.5 - 30 VDC)
    Black   -> GND
    Yellow  -> A
    Blue    -> B
'''

#Import module
from machine import UART, Pin

#Declare UART object
uart0 = UART(0, baudrate = 4800, bits=8, parity=None, stop=1) # tx=0, rx=1

#Check UART object
print(uart0)
```

(Pic.1: Module import and UART object declaration)

2. To get data from the sensor via Modbus RTU Protocol, we need to send the command to request data every time. This program will use timer interrupt to send request command every 1 second. Remember that every interrupt needs a callback function. So, we define the callback function of timer interrupt and then declare timer object as the picture below (Note that every callback function needs 1 parameter).

```
18 #Define callback function for Timer Interrupt
19 def send(d):
20
21     #Check if callback is enable
22     if tim_ready == 1:
23
24         #Data-read command
25         txData = b'\x01\x03\x00\x1E\x00\x03\x65\xCD'
26
27         #Transmission command
28         uart0.write(txData)
29
30         #Check transmitted command
31         print("Sent data : " + str(txData))
32
33         #Disable callback for a while
34         tim_ready == 0
35
36 #Define timer trigger every 1 second and use send() as callback function
37 tim = machine.Timer()
38 tim.init(period = 1000, callback = send)
```

(Pic.2: Callback function definition and timer-interrupt object declaration)

3. Declare objects that we use. In this program, we will name in as “RxData”, “index”, “max_index” and “tim_ready”. RxData” is the empty list that we use to store the buffer that sensor has sent. “index” is the counting variable that use to check and limit data that Pico receive. “max_index” is variable that use to define the maximum value that “index” can reach. For this NPK sensor, maximum index is equal to 11 according to datasheet.

“tim_ready” is variable that use to check if program is ready or not. 1 means the program is ready to request data. 0 means the program is not ready to request data.

```
40 #Declaration of variable objects
41 #Each sensor has maximum data buffer, edit the max_index as your desire
42 RxData = []
43 index = 0
44 tim_ready = 0
45 max_index = 11
```

4. Create an infinity loop as a main program (all operation will run in the loop). In the picture below, we will set “tim_ready” to 1 to announce that program is ready to request data, then use loop (in line 54) to wait for data. If the data has been received, Program will be running to another loop (in line 58). This loop will add the data buffer into “RxData” and “index” will increase.

```
47 #The main loop start here
48 while True:
49
50     #Enable callback
51     tim_ready = 1
52
53     #Waiting for data to be received
54     while(uart0.any()  < 1):
55         pass
56
57     #When Data received
58     while(uart0.any()  > 0):
59
60         #Add received data to RxData list
61         RxData.append(uart0.read(1))
62
63         #Check if buffer is empty
64         index += 1
```

(Pic.4: Inside the main loop)

5. In the picture below, NPK value will be calculated after we receive all bytes of message. According to datasheet, the actual value of N is the 3rd and 4th byte, P is the 5th and 6th byte, K is the 7th and 8th byte we. In order to convert the actual value of NPK, sum all data after convert byte data into int and use bitwise operation.

```
66      #When all data has been received
67      if index == 11:
68
69          #Check received data
70          print("Received data : " + str(RxData))
71
72          #Convert received data into N, P and K value
73          N = ((int.from_bytes(RxData[3], 'big')) << 8) + (int.from_bytes(RxData[4], 'big'))
74          P = ((int.from_bytes(RxData[5], 'big')) << 8) + (int.from_bytes(RxData[6], 'big'))
75          K = ((int.from_bytes(RxData[7], 'big')) << 8) + (int.from_bytes(RxData[8], 'big'))
76
77          #Display N, P, K values
78          print("Nitrogen : " + str(N))
79          print("Phosphorus : " + str(P))
80          print("Potassium : " + str(K))
81
82          #Clear buffer
83          RxData = []
84
85          #Clear index
86          index = 0
```

(Pic.5: NPK conversion)