QuecPython BUS User Guide

LTE Standard Module Series

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History

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-	2020-11-10	Rivern/Kenney	Creation of the document
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1 Introduction

Bus refers to a common data channel between computer equipment and equipment to transmit information. The bus is a communication line connecting multiple devices in the computer hardware system. An important feature of it is that it is shared by all devices on the bus and can connect multiple devices in the computer system to the bus. If it is a dedicated signal connection between two devices or devices, it cannot be called a bus.

This document mainly introduce the basic features and approaches of the four peripheral buses, including ADC, UART, SPI and I2C.

2 Basic Features and Approaches

2.1. ADC

ADC basically converts physical variables which are analog in nature to digital signal for processing. They have high conversion efficiency and requires less power. Examples of physical variables include audio signals, temperature, pressure etc. The ADC input pin on QuecPython EVB is shown as follows.

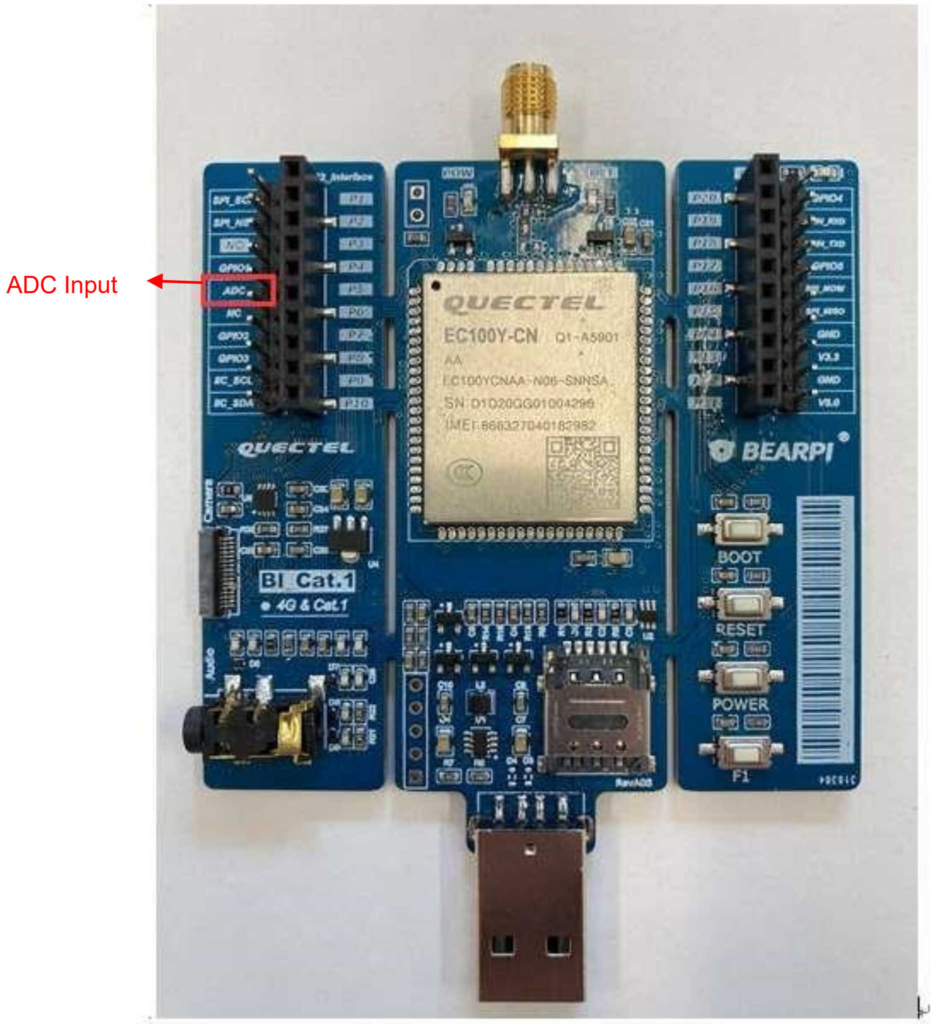


Figure 1: ADC Input Pin

Connect GPIO1 with ADC serial port, and in QuecPython, read the voltage of ADC channel by *misc* module, set the value of PIN by method *Pin.write(value)* of *Pin* class in *machine* module. For more details, refer to *Quectel_QuecPython_Class_Library_Introduction*.

```
from machine import Pin from
misc import ADC
adc = ADC adc.open()
gpio1 = Pin(Pin.GPIO1, Pin.OUT, Pin.PULL_DISABLE, 0)
gpio1.read() # Get the level of GPIO. gpio1.write(1) # Set
GPIO1 output in high-level.  adc.read(ADC.ADC0)
gpio1.write(0) # Set GPIO1 output in low-level.
adc.read(ADC.ADC0)
```

From the command line operation results, it can be seen that the ADC channel voltage changes to 1.8 V.

Figure 2: The Change for ADC Voltage Value

2.2. UART

UART is a serial asynchronous transceiver protocol, which is widely used. UART working principle is to transmit the binary bits of data bit by bit. In UART communication protocol, the high level of the status bit on the signal line represents 1, and the low level represents 0. Of course, when two devices use UART serial communication, the transmission rate and some data bits must be agreed.

The hardware connection is relatively simple, only 3 wires are required. Please make level conversion before connecting if the UART level range of the two devices is inconsistent.

- RX: Receive data. Input to receive the data from another transmitter.
- TX: Receive data. The reverse of RX, this is where the terminal equipment is transmitting serial data, using the same format and protocol that the receiver is expecting.
- GND: Signal Ground. What it does is try to make a common "ground" reference between the equipment that is being connected to compare the voltages for the other signals.

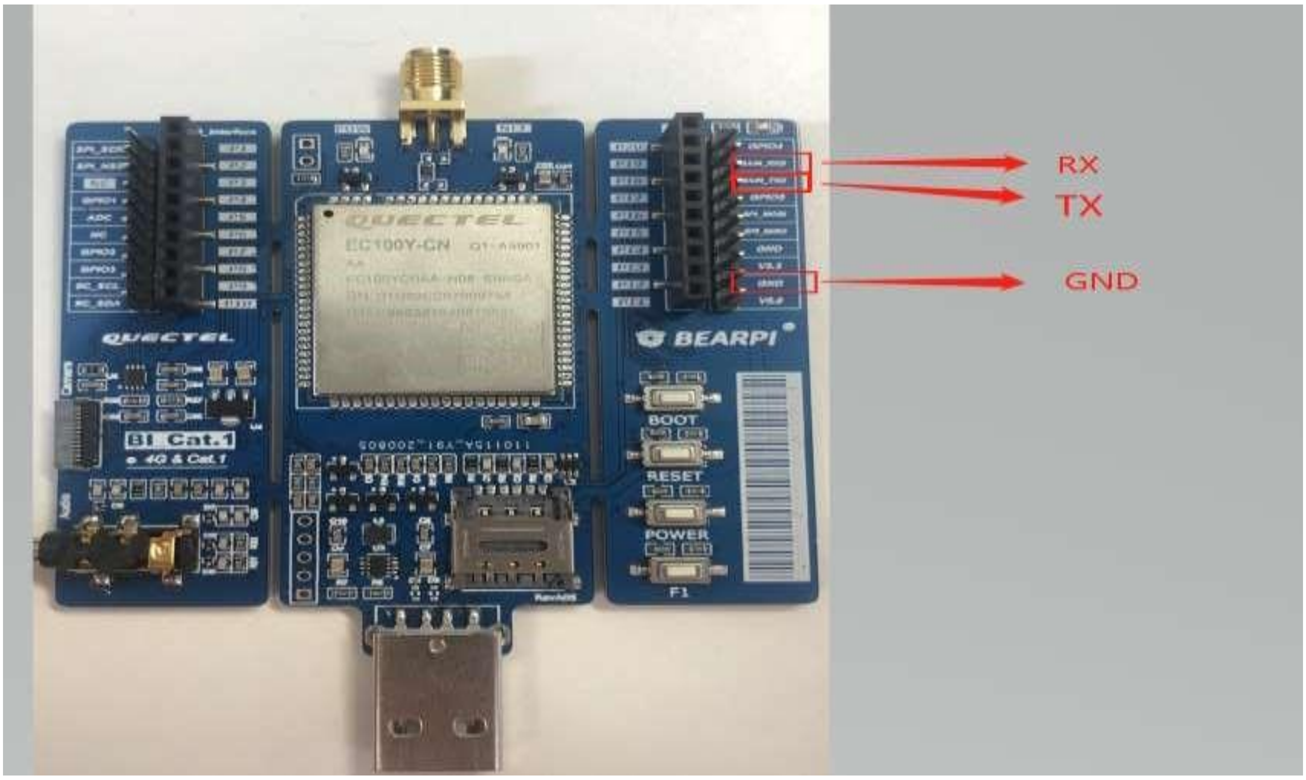


Figure 3: UART Hardware Connection

When using the UART to transmit data, connect the TX with RX on the other, and connect the RX with TX on the other. And in QuecPython, the UART data transmission can be fulfilled with the *UART* class in *machine* module. For more details, refer to *Quectel_QuecPython_Class_Library_Introdcution*.

```
>>>
>>> from machine import UART
>>> uart1 = UART(UART.UART2,9600,8,0,1,0)
>>> uart1.any()
8192
>>> uart1.read(1024)
b'$GPGGA,000102.262,,,,,0,0,,,M,,M,,*4D\r\n$GPGLL,,,,,000102.262,V,N*7F\r\n$GPGSA,A,1,,,,,,,,,,,,,,,*1E\r\n$G
00103.262,V,N*7E\r\n$GPGSA,A,1,,,,,,,,,,,,,,,*1E\r\n$GPGSV,1,1,00*79\r\n$GPRMC,000103.262,V,,,,,0.00,0.00,060
GSV,1,1,00*79\r\n$GPRMC,000104.262,V,,,,,0.00,0.00,060180,,,N*41\r\n$GPVTG,0.00,T,,M,0.00,N,0.00,K,N*32\r\n$G
80,,,N*40\r\n$GPVTG,0.00,T,,M,0.00,N,0.00,K,N*32\r\n$GPGGA,000106.262,,,,,0,0,,,M,,M,,*49\r\n$GPGLL,,,,,0001(
GGA,00'
>>>
```

Figure 4: Code Example for UART API

2.3. SPI

SPI is a very common communication protocol used for two-way communication between two devices. A standard SPI bus consists of 4 signals, namely SS, SCK, MOSI, MISO.

- **SS**: When multiple SPI devices are connected to the MCU, the SS of each device is connected to a separate pin of the MCU, while for the other SCK, MOSI, and MISO, multiple devices are connected in parallel to the same bus. And valid in low-level.
- **SCK**: The clock pulses which synchronize data transmission generated by the master. Different devices support different clock frequencies, such as SPI clock frequency of STM32 up to f PCLK / 2.
- **MOSI**: The Master line for sending data to the peripherals.
- **MISO**: The Slave line for sending data to the master.

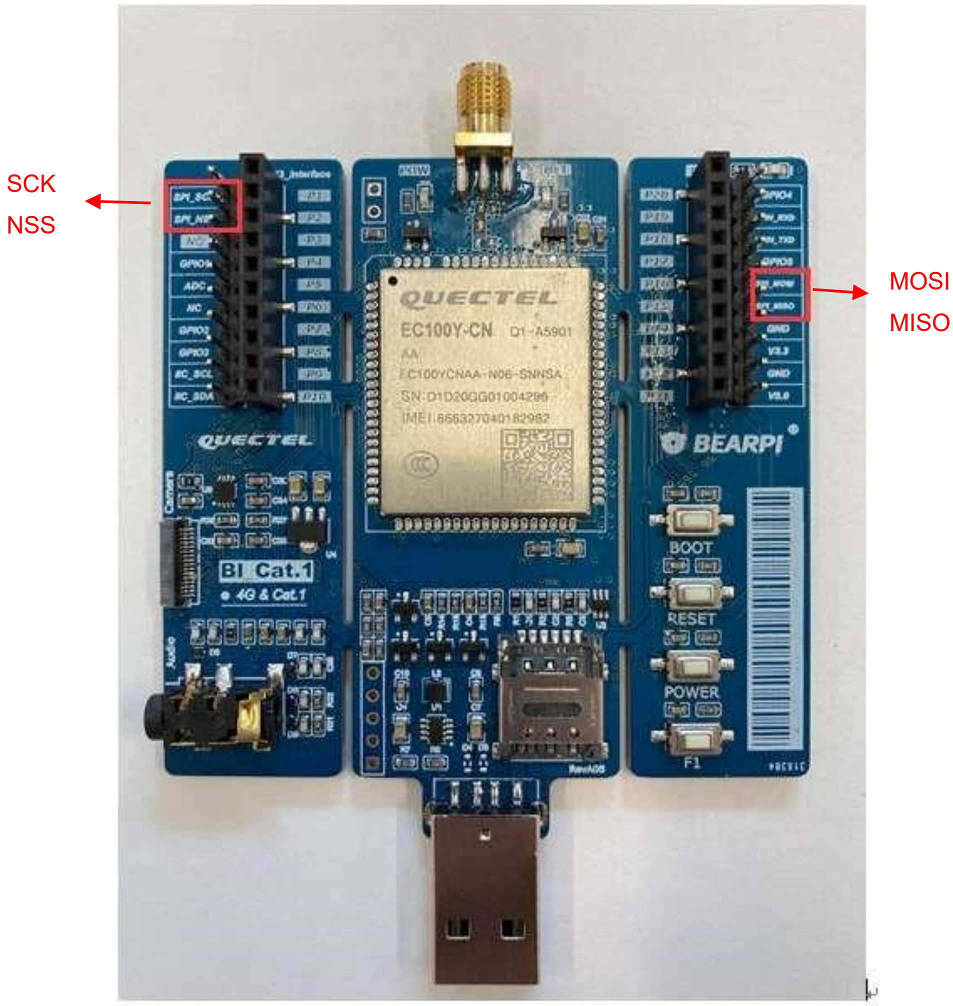


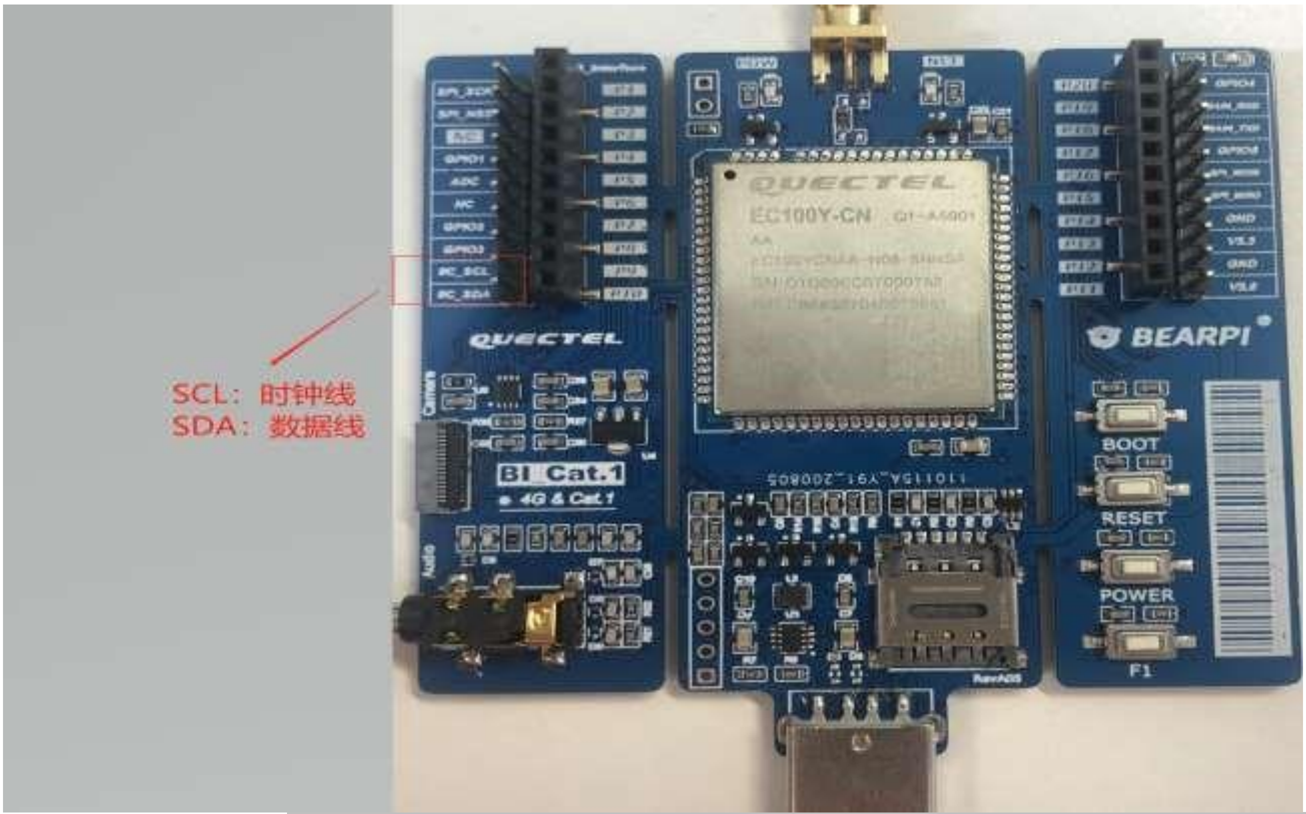
Figure 5: SPI Hardware Connection

2.4. I2C

I2C uses only two wires: SCL (serial clock) and SDA (serial data).

- SCL: The clock signal is transmitted from the master device to the slave device
- SDA: A channel for data transfer between master and slave devices.

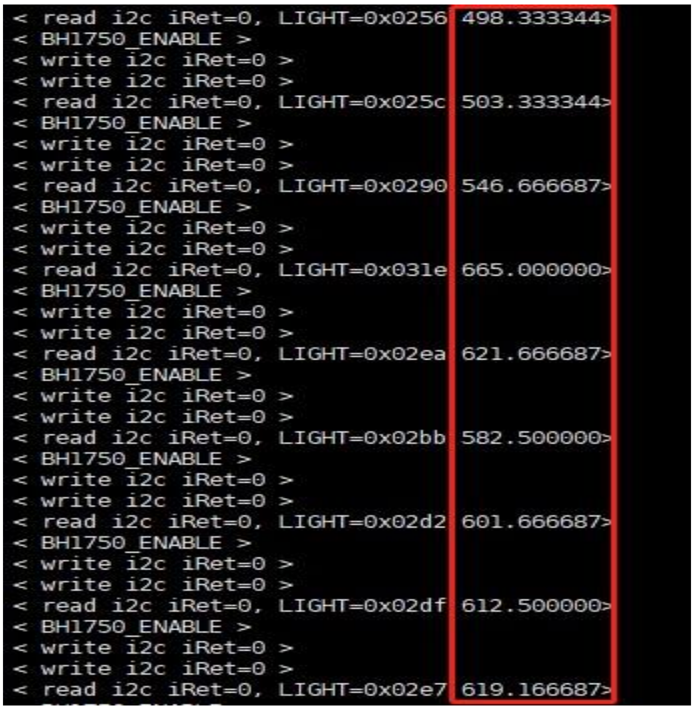
I2C is a serial communication protocol, so data is transferred bit by bit along a single wire (the SDA line). Like SPI, I2C is synchronous, so the output of bits is synchronized to the sampling of bits by a clock signal shared between the master and the slave. The clock signal is always controlled by the master.



SCL
SDA

Figure 6: I2C Hardware Connection

The following data takes the connection between I2C and light sensor as an example.



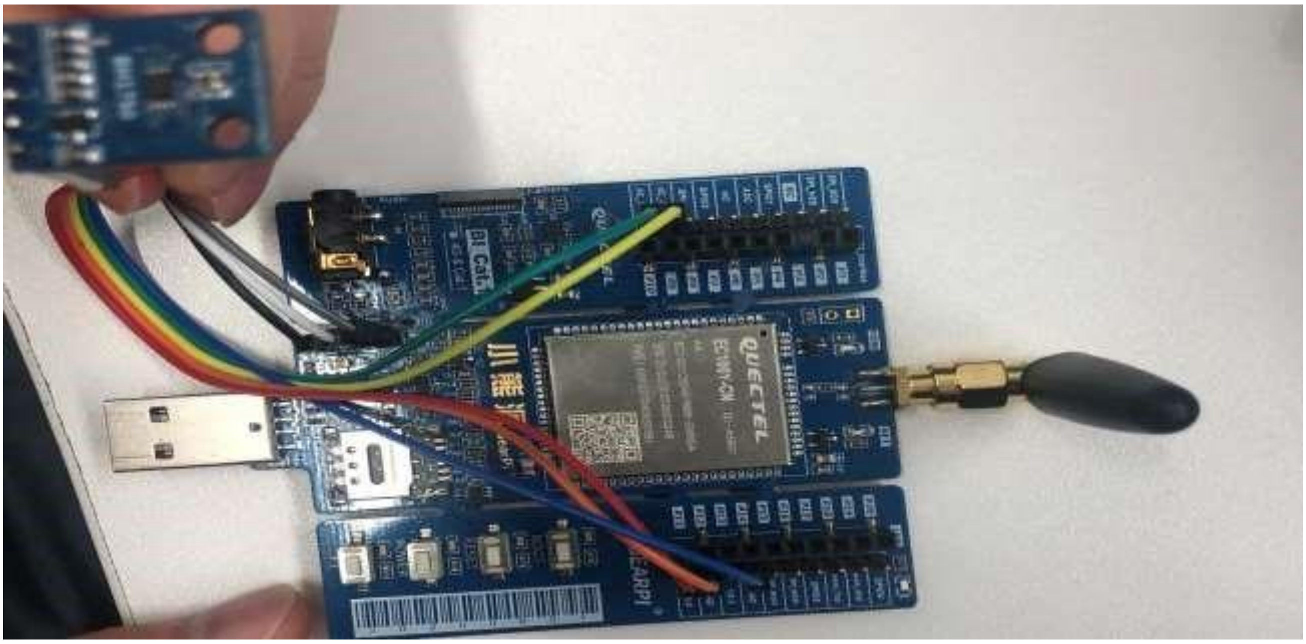


Figure 7: The Connection between the I2C and Light Sensor

3 Terms and Abbreviations

Table 1: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
API	Application Programming Interface
CPU	Central Processing Unit
UART	Universal Asynchronous Receiver/Transmitter
GND	Ground
IC	Integrated Circuit
I2C	Inter-Integrated Circuit
LCD	Liquid Crystal Display
MCU	Microprogrammed Control Unit

MISO	Master In Slave Out
MOSI	Master Out Slave In
RX	Receive
TX	Transmit
SCK	Serial Clock
SCL	Serial Clock Line
SDA	Serial Data Line
SPI	Serial Peripheral Interface
SS	Slave Select