

How to log sensor data into a file on PC via APP3.0 BLE connection

Bosch Sensortec



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1 Introduction

Application board 2.0 (APP2.0 board) has been discontinued. Users can find more information about APP2.0 board at <https://www.digikey.com/en/products/detail/bosch-sensortec/0330-AB0-111/2416313>. There is a Bluetooth module BT33 installed on APP2.0 board. When PC is searching for Bluetooth device, it will show as “Amp’ed UP”. After pairing PC will assign a virtual COM port to BT33. Therefore, when Development Desktop 2.0 (DD2.0) GUI software is launched on PC, users can choose the virtual COM port to connect PC to APP2.0 board through Bluetooth. This also means that users can use a battery pack to power on APP2.0 board with a sensor shuttle board plugged in and then use DD2.0 software to evaluate that sensor or log that sensor data into a *.csv file wirelessly.

Currently the new application board 3.0 (APP3.0 board) is available at <https://www.digikey.com/en/products/detail/bosch-sensortec/APPLICATION-BOARD-3-0/14617532>. It has ublox module NINA-B302 installed. The ublox module has Nordic nRF52840 BLE embedded. Different sensor shuttle board 3.0 can be plugged onto APP3.0 board and users can connect APP3.0 board to PC through a USB cable and then use DD2.0 GUI SW to evaluate sensor(s) or log sensor data into a file. DD2.0 GUI SW doesn’t support Bluetooth low energy (BLE) connection yet at this moment. However, Bosch Sensortec provided a way to do that. Users can download COINES SW at <https://www.bosch-sensortec.com/software-tools/tools/coines/> and then install it on PC. Users can find datalogger folder at C:\COINES\v2.8.8\datalogger where there are user manual document, APP3.0 firmware and Android APK file inside. This means that users can evaluate sensor and log sensor data into a file between APP3.0 board and an Android device through BLE connection. The logged data file is located inside ublox flash memory on the APP3.0 board, not inside the Android device memory. So there is file size limit for data logging.

This technical document presents another way about how to run Python code on PC to evaluate sensor that is plugged on APP3.0 board and log sensor data into a file on PC via BLE connection. Section 2 shows the hardware setup and section 3 shows the software needed to download and install on PC. Detailed step-by-step instructions are shown in Section 4 of this document. Two pieces of Python code “scan.py” and “ble_NUS.py” are included in Appendix A and B respectively.

2 Hardware setup

The hardware includes one APP3.0 base board, one BMA400 shuttle board 3.0 as an example and a battery pack shown in Figure 1.

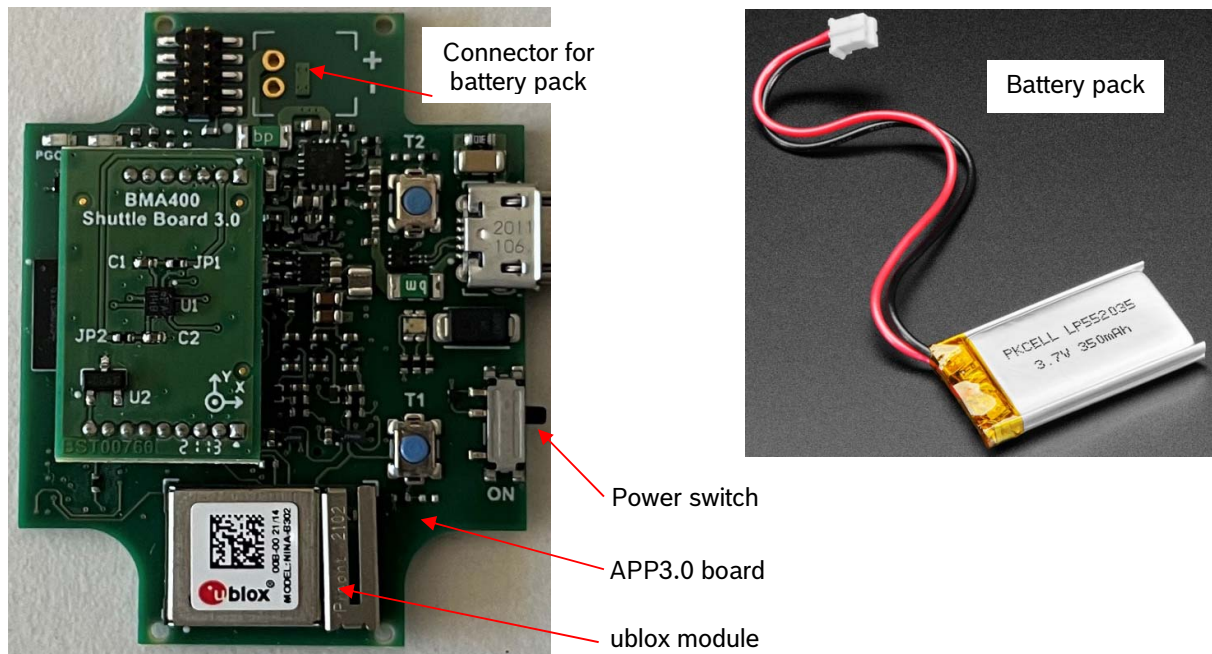


Figure 1 Hardware setup

The male connector for battery pack is available at <https://www.digikey.com/en/products/detail/molex/0532540270/1952198>. Users can buy it and then solder it on APP3.0 board.

The battery pack for APP3.0 board can be purchased at <https://www.adafruit.com/product/2750>. Users can then attach the battery pack to the bottom side of APP3.0 board for example with a piece of double stick tape. Then users can plug the battery pack female connector to the above male connector on the APP3.0 board.

Once the final firmware is downloaded to APP3.0 board from PC through a USB cable, users don't need the USB cable anymore. Users can simply switch on the power switch and run Python code on PC to log sensor data via BLE connection. After data logging is done, users can switch off the power switch. If another data logging session is needed, users can switch on the power switch again.

Since the logged data file is located on PC, the size of logged data file is up to the size of PC hard disk drive. Because BLE connection is slow there is a limit on the sampling rate when logging sensor data.

3 Software needed

In order to log sensor data into a file on PC via BLE connection, the following software is needed to download and install on PC. All the software here is free of charge to download.

- (1) COINES software – it enables users to configure sensor settings at low level and log sensor data into a file on PC. There is an example folder for different sensors in C code after installation.
- (2) TDM-GCC – this is the compiler to compile the C code after users modify COINES example code. The compiler can generate *.exe file that can be executed on local PC. It can also generate *.bin and *.elf binary files that are ready to download to the ublox module on APP3.0 board.
- (3) ARM GNU Toolchain – this is the tool to download compiled *.bin and *.elf binary files to APP3.0 as embedded firmware. Every time when the power switch of APP3.0 board is switched on the firmware will start running automatically.
- (4) Anaconda Python – this is Python environment that includes a few pre-installed packages for data scientific computing.
 - a. PyCharm community edition – this is a powerful and popular IDE for programming in Python. It offers many features such as code completion, debugging, and refactoring. It is a package for Anaconda Python.
 - b. Bleak – this is a GATT client software, capable of connecting to BLE devices acting as GATT servers. It is designed to provide a asynchronous, cross-platform Python API to connect and communicate with e.g. sensors.
 - c. Scan.py – this is a Python source code script. Running scan.py will find local BLE devices. After APP3.0 board is listed users can copy and paste the MAC address to ble_NUS.py code for data logging.
 - d. Ble_NUS.py – this is a Python source code script. After the APP3.0 MAC address is included, it can start BLE communication between PC and APP3.0 board and the sensor data will be stored in the file “BLE_receive.txt”.

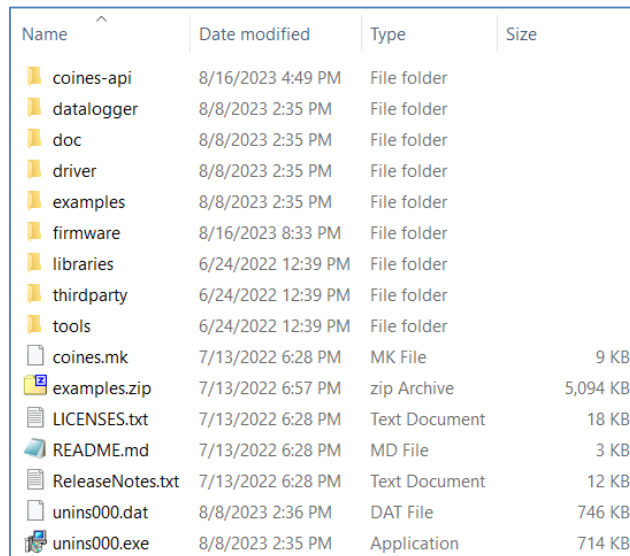
4 Getting started

The following is step-by-step instructions about how to log sensor data on PC via APP3.0 BLE connection. BMA400 shuttle board 3.0 is used here as an example.

4.1 Download and install COINES SW

COINES v2.8.8 SW can be downloaded online at https://www.bosch-sensortec.com/media/boschsensortec/downloads/software/communication_with_inertial_and_environmental_sensors_coines/v2_8/coines_external_v2-8_rc_installer.zip. Users can unzip this file and then double click “COINES_External_V2.8_RC.exe” to install the COINES SW. After installation users are able to find the folder C:/Windows/COINES/v2.8.8 as shown in Figure 2.

COINES ("COmmunication with INertial and Environmental Sensors") provides a low-level interface to APP3.0 board and each sensor shuttle board 3.0. Users can access MEMS sensors through a C interface. COINES can be used with the SensorAPI of the sensor. The SensorAPI is available at <https://github.com/BoschSensortec>. Source code of sample applications and SensorAPI are provided with the COINES library as a package. Users can modify, compile and run the sample applications.



Name	Date modified	Type	Size
coines-api	8/16/2023 4:49 PM	File folder	
datalogger	8/8/2023 2:35 PM	File folder	
doc	8/8/2023 2:35 PM	File folder	
driver	8/8/2023 2:35 PM	File folder	
examples	8/8/2023 2:35 PM	File folder	
firmware	8/16/2023 8:33 PM	File folder	
libraries	6/24/2022 12:39 PM	File folder	
thirdparty	6/24/2022 12:39 PM	File folder	
tools	6/24/2022 12:39 PM	File folder	
coines.mk	7/13/2022 6:28 PM	MK File	9 KB
examples.zip	7/13/2022 6:57 PM	zip Archive	5,094 KB
LICENSES.txt	7/13/2022 6:28 PM	Text Document	18 KB
README.md	7/13/2022 6:28 PM	MD File	3 KB
ReleaseNotes.txt	7/13/2022 6:28 PM	Text Document	12 KB
unins000.dat	8/8/2023 2:36 PM	DAT File	746 KB
unins000.exe	8/8/2023 2:35 PM	Application	714 KB

Figure 2 COINES folder

The subfolder of “datalogger” contains the APP3.0 firmware, Android APK file and user manual PDF file about how to log sensor data via BLE connection between an Android device and APP3.0 board.

The subfolder of “examples” contains subfolders of each sensor that have C source code for evaluation.

4.2 Download and install TDM-GCC compiler

Go to <https://github.com/jmeubank/tdm-gcc/releases/download/v10.3.0-tdm64-2/tdm64-gcc-10.3.0-2.exe> to download TDM-GCC compiler version 10.3.0 and then install it on PC.

4.3 Download and install ARM GNU Toolchain

Go to <https://developer.arm.com/-/media/Files/downloads/gnu/12.3.rel1/binrel/arm-gnu-toolchain-12.3.rel1-mingw-w64-i686-arm-none-eabi.exe?rev=aa6116d1af064a16bdf76e4e58ad7d9f&hash=366EA764314E1A4615E216DDBE7C437E> to download ARM GNU Toolchain.

4.4 Test one BMA400 example

- Connect APP3.0 board to PC through a USB cable. BMA400 shuttle board 3.0 is plugged onto APP3.0 board.
- Switch on the power switch of APP3.0 board. The LED close to the USB connector on APP3.0 board will light up with red color.
- Go to folder C:\COINES\v2.8.8\examples\bma400\examples\accelerometer in Windows File Explorer. Then press and hold “Shift” key on the keyboard and then right click the mouse. Select “Open PowerShell window here” as shown in Figure 3.

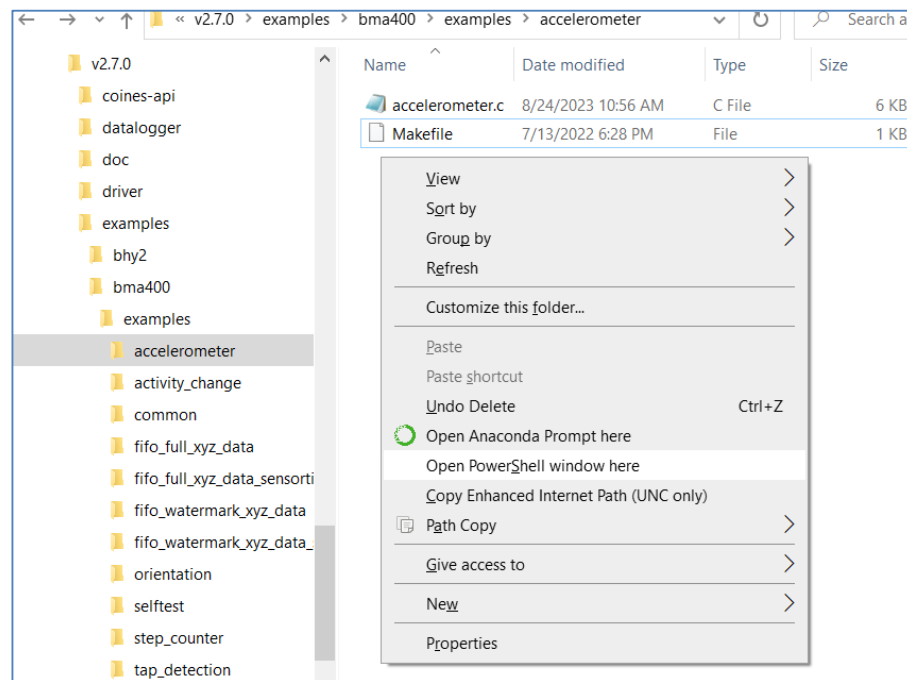


Figure 3 COINES example folder

- Type mingw32-make and then press Enter key. The “accelerometer.exe” file will be generated as shown in Figure 4.

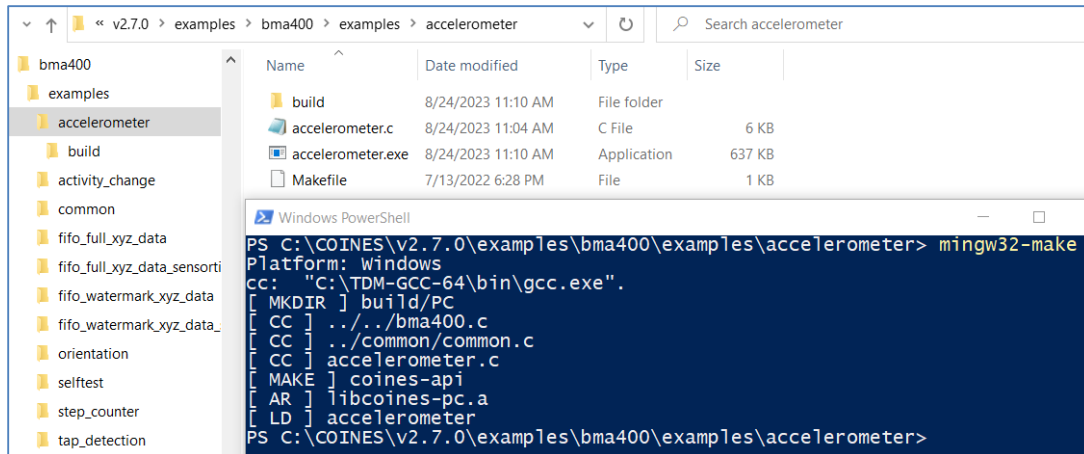


Figure 4 The EXE file is generated

- Type .\accelerometer.exe and then press Enter key. The BMA400 x/y/z raw data in the unit of LSB signed integers is printed in the command window as shown in Figure 5. The converted values in the unit of m/s^2 and sensor time are also printed.

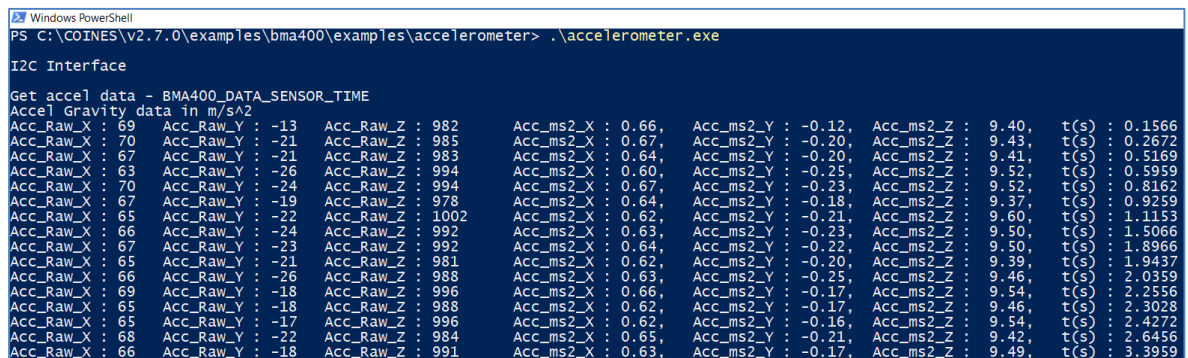


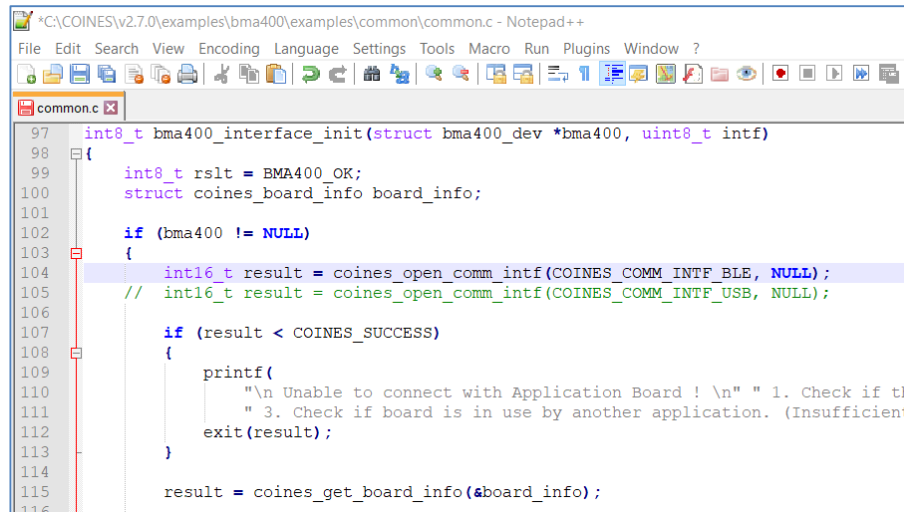
Figure 5 COINES example results of BMA400 measurements

Till now it can be seen that the hardware setup of APP3.0 board and BMA400 shuttle board 3.0 is working and the COINES SW and TDM-GCC compiler are working as well.

4.5 Modify COINES code to enable APP3.0 BLE

- Locate the common.c file in the folder C:\COINES\v2.8.8\examples\bma400\examples\common and open it with Notepad++ SW.
- Change one line code from,

int16_t result = coines_open_comm_intf(COINES_COMM_INTF_USB, NULL);
to,
int16_t result = coines_open_comm_intf(COINES_COMM_INTF_BLE, NULL);
as shown in Figure 6.



```
*C:\COINES\v2.7.0\examples\bma400\examples\common\common.c - Notepad++
File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
common.c
97 int8_t bma400_interface_init(struct bma400_dev *bma400, uint8_t intf)
98 {
99     int8_t rslt = BMA400_OK;
100     struct coines_board_info board_info;
101
102     if (bma400 != NULL)
103     {
104         int16_t result = coines_open_comm_intf(COINES_COMM_INTF_BLE, NULL);
105         // int16_t result = coines_open_comm_intf(COINES_COMM_INTF_USB, NULL);
106
107         if (result < COINES_SUCCESS)
108         {
109             printf(
110                 "\n Unable to connect with Application Board ! \n" " 1. Check if the
111                 " 3. Check if board is in use by another application. (Insufficient
112                 exit(result);
113         }
114
115         result = coines_get_board_info(&board_info);
116
```

Figure 6 Change COINES common.c file

- Save the “common.c” file and then close it.
- Locate “accelerometer.c” file in the folder
C:\COINES\v2.8.8\examples\bma400\examples\accelerometer and open it with
Notepad++ SW.
- Add **#include "coines.h"** at the beginning of the file.
- In main() function change printf(“...” to fprintf(bt_w, ...) function as shown in Figure 7.

```
*C:\COINES\v2.7.0\examples\bma400\examples\accelerometer\accelerometer.c - Notepad++
File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
common.c x accelerometer.c x
106 while (n_samples && (rslt == BMA400_OK))
107 {
108     rslt = bma400_get_interrupt_status(&int_status, &bma);
109     bma400_check_rslt("bma400_get_interrupt_status", rslt);
110
111     if (int_status & BMA400_ASSERTED_DRDY_INT)
112     {
113         rslt = bma400_get_accel_data(BMA400_DATA_SENSOR_TIME, &data, &bma);
114         bma400_check_rslt("bma400_get_accel_data", rslt);
115
116         /* 12-bit accelerometer at range 2G */
117         x = lsb_to_ms2(data.x, 2, 12);
118         y = lsb_to_ms2(data.y, 2, 12);
119         z = lsb_to_ms2(data.z, 2, 12);
120         t = (float)data.sensortime * SENSOR_TICK_TO_S;
121
122         fprintf(bt_w, "Acc Raw X : %d Acc Raw Y : %d Acc Raw Z : %d", data.x, data.y, data.z);
123         fprintf(bt_w, "\tAcc ms2 X : %.2f, Acc ms2 Y : %.2f, Acc ms2 Z : %.2f, t(s) : %.4f\n", x, y, z, t);
124         // printf("Acc Raw X : %d Acc Raw Y : %d Acc Raw Z : %d", data.x, data.y, data.z);
125         // printf("\tAcc_ms2_X : %.2f, Acc_ms2_Y : %.2f, Acc_ms2_Z : %.2f, t(s) : %.4f\n", x, y, z, t);
126         n_samples--;
127     }
128 }
```

Figure 7 Change COINES accelerometer.c file

- Save the “accelerometer.c” file and then close it. Please note that in the example “accelerometer.c” code, BMA400 is configured to +/-2g full scale range and 100Hz sampling rate. Users can change the configurations as needed.
- In PowerShell window as shown in Figure 4 type command, `mingw32-make LOCATION=FLASH TARGET=MCU_APP30` download and then press Enter key as shown in Figure 8. If users type command, `mingw32-make LOCATION=RAM TARGET=MCU_APP30` download and then press Enter key, the firmware will be downloaded to the RAM of APP3.0 MCU. When APP3.0 is powered off the firmware will be gone. Users need to run the above command again.

Name	Date modified	Type	Size
.idea	8/28/2023 11:12 AM	File folder	
build	8/28/2023 3:58 PM	File folder	
accelerometer.bin	8/28/2023 3:58 PM	BIN File	67 KB
accelerometer.c	8/28/2023 3:57 PM	C File	6 KB
accelerometer.elf	8/28/2023 3:58 PM	ELF File	1,329 KB
accelerometer.exe	8/24/2023 11:10 AM	Application	637 KB
ble_NUS.py	8/8/2023 3:55 PM	Python File	3 KB
Makefile	7/13/2022 6:28 PM	File	1 KB
scan.py	8/1/2023 8:53 AM	Python File	1 KB


```
Windows PowerShell
dfu-util 0.9

Copyright 2005-2009 Weston Schmidt, Harald Welte and OpenMoko Inc.
Copyright 2010-2019 Tormod Volden and Stefan Schmidt
This program is Free Software and has ABSOLUTELY NO WARRANTY
Please report bugs to http://sourceforge.net/p/dfu-util/tickets/

Invalid DFU suffix signature
A valid DFU suffix will be required in a future dfu-util release!!!
Opening DFU capable USB device...
ID 108c:ab3d
Run-time device DFU version 0110
Claiming USB DFU Interface...
Setting Alternate Setting #1 ...
Determining device status: state = dfuIDLE, status = 0
dfuIDLE, continuing
DFU mode device DFU version 0110
Device returned transfer size 64
Copying data from PC to DFU device
Download [=====] 100% 67840 bytes
Download done.
state(5) = dfuDNLOAD-IDLE, status(0) = No error condition is present
Done!
can't detach
Resetting USB to switch back to runtime mode
PS C:\COINER\v2.7.0\examples\bma400\examples\accelerometer>
```

Figure 8 Compile and download final firmware to APP3.0 board

- The compiled final firmware “accelerometer.bin” file will be generated and then downloaded to the ublox module flash memory. When APP3.0 board is powered on again the firmware will start running automatically.
- Switch off APP3.0 board and unplug the USB cable from PC.
- Power APP3.0 board by using battery pack or connecting USB cable to another PC or a USB wall charger for example to charge smartphone.
- Switch on APP3.0 board. Now APP3.0 board is ready to be found and then transmit data to PC via BLE connection.

4.6 Download and install Anaconda Python

Now it is time to setup Python environment and associated packages to enable BLE connection on PC side.

Go to https://repo.anaconda.com/archive/Anaconda3-2023.07-2-Windows-x86_64.exe. Download it and then install it on PC. During the installation, please check the checkbox of “Add Anaconda3 to my PATH environment variable” as shown in Figure 6. Then click the “Install” button and follow the instructions to finish the installation.

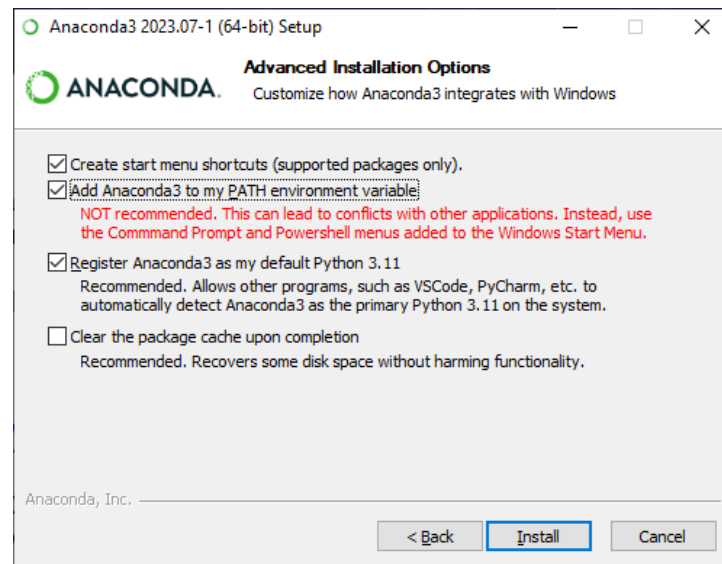


Figure 6 Anaconda installation

4.7 Download and install PyCharm Python IDE community edition

Go to <https://www.jetbrains.com/pycharm/download/download-thanks.html?platform=windows&code=PCC> to download free PyCharm community edition to PC. During installation, please check the checkbox of “Add “bin” folder to the PATH” as shown in Figure 7. Then click the “Next” button and follow the instructions to finish the installation.

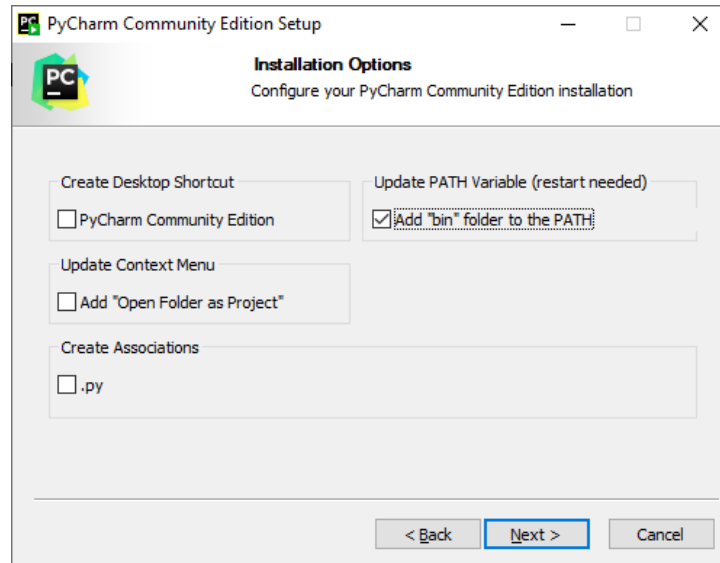


Figure 7 PyCharm installation

4.8 Download Bleak software

Go to

<https://files.pythonhosted.org/packages/87/95/a6f614fae12a6fe1cf517f860004dd6abd4af0e0e1177c03164d0637e81/bleak-0.20.2.tar.gz> to download the Bleak software.

4.9 Install Bleak software

- From Windows PC Start menu locate “Anaconda Prompt (Anaconda3)” as shown in Figure 8 and then click it.

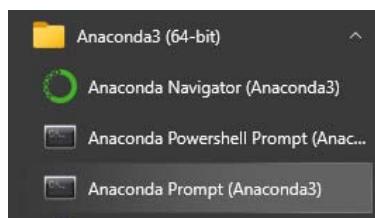


Figure 8 Launch Anaconda Prompt command window

- In the Anaconda command window type “python -m pip install bleak” as shown in Figure 9 and then press Enter key to install Bleak software.

```
Anaconda Prompt (Anaconda3)
(base) C:\>python -m pip install bleak
Defaulting to user installation because normal site-packages is not writeable
Looking in indexes: https://anu9rng:****@rb-artifactory.bosch.com/artifactory/api/pypi/python-virtual/simple
Requirement already satisfied: bleak in c:\users\xugipal\appdata\roaming\python\python39\site-packages (0.20.2)
Requirement already satisfied: bleak-wintr<2.0.0,>=1.2.0 in c:\users\xugipal\appdata\roaming\python\python39\site-packages (from bleak) (1.2.0)
Requirement already satisfied: async-timeout<5,>=3.0.0 in c:\users\xugipal\appdata\roaming\python\python39\site-packages (from bleak) (4.0.2)
(base) C:\>
```

Figure 9 Install Bleak software

4.10 Setup Python environment

- From Windows PC Start menu locate “Anaconda Navigator (Anaconda3)” as shown in Figure 8 and then click it.
- In the home window PyCharm will be shown as a package. Click PyCharm “Launch” button as shown in Figure 10 to launch PyCharm.

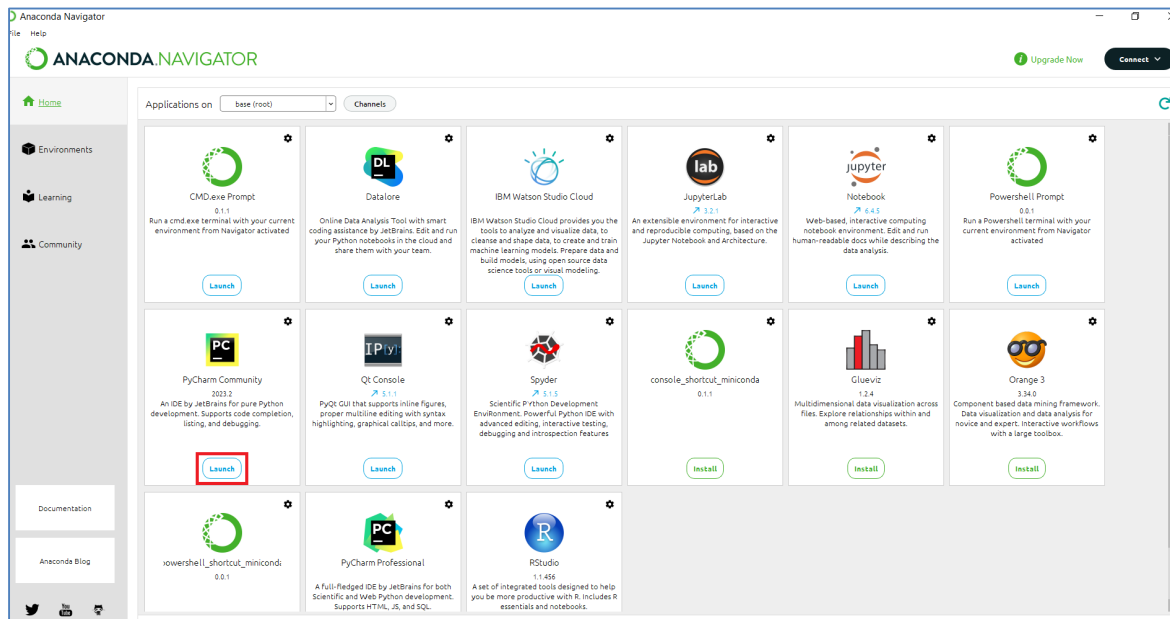


Figure 10 Launch Anaconda Navigator

- In PyCharm window click menu “File -> Open...” and then locate the COINES folder where two Python files have been copied and pasted as shown in Figure 11.

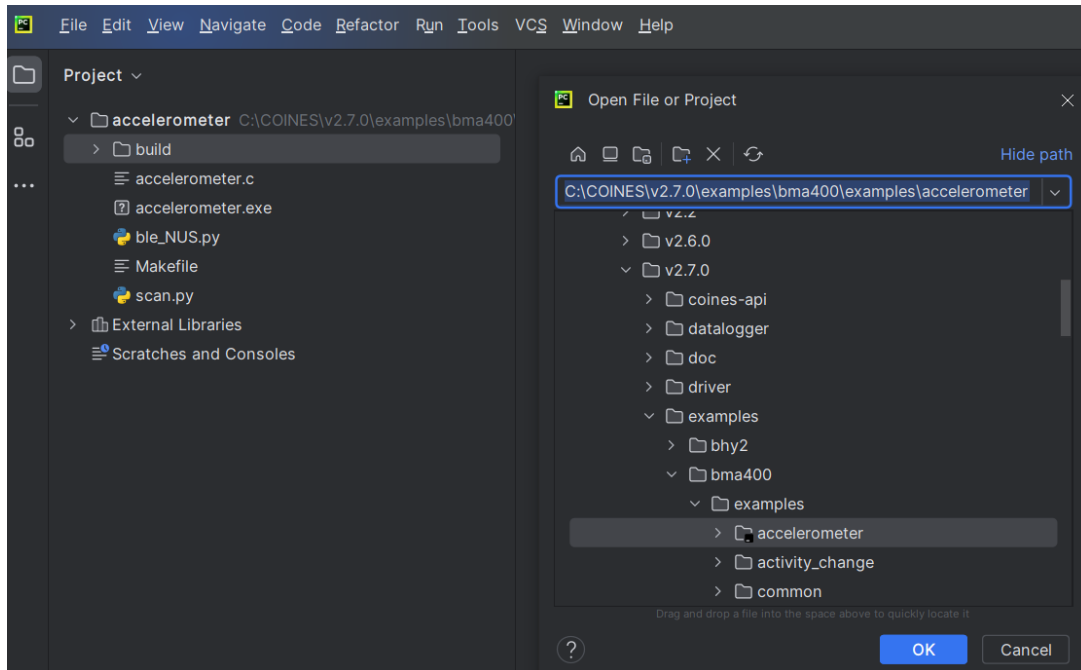


Figure 11 Locate BMA400 example folder in PyCharm

- If this is the first time setting up Python environment for PyCharm, Python Interpreter needs to be installed. Click menu “File -> Settings” and then click “Project: accelerometer -> Python Interpreter”. If there is no Python Interpreter listed, then click “Add Interpreter” in the red rectangle as shown in Figure 12. Note that Figure 12 already has Python Interpreter installed.

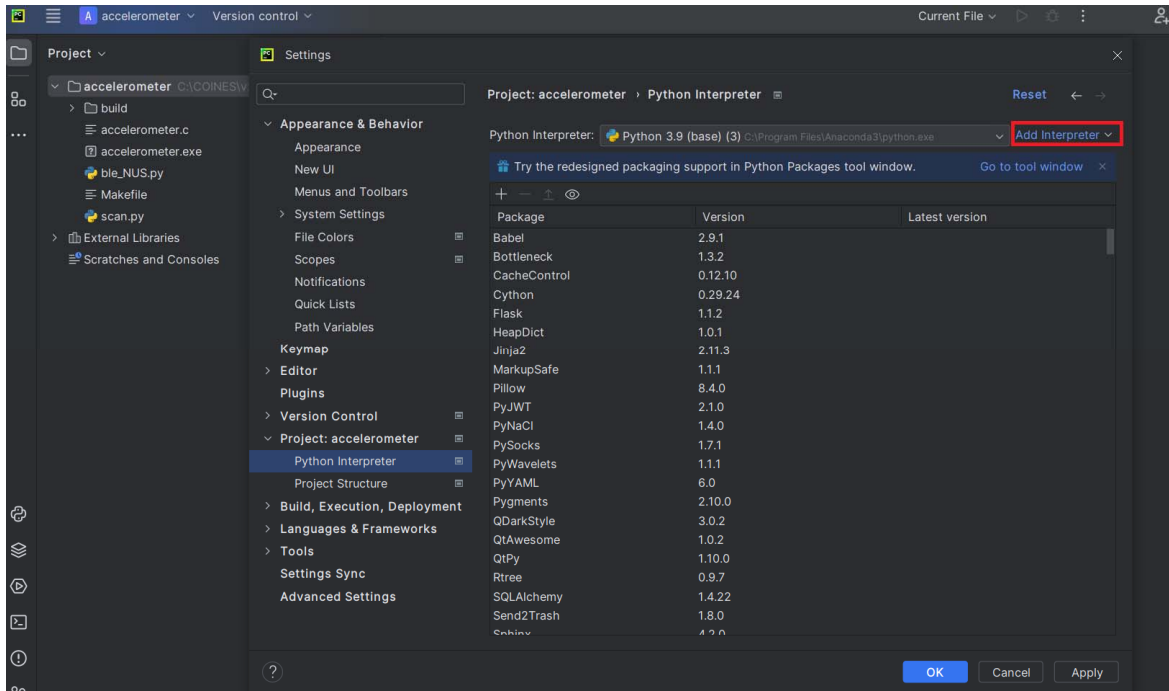


Figure 12 Add Python Interpreter 1 of 2

- In Figure 13 select “Existing” radio button and then click “...” button. Select “python.exe” and then click OK button. Users will see Figure 12 with Python Interpreter installed.

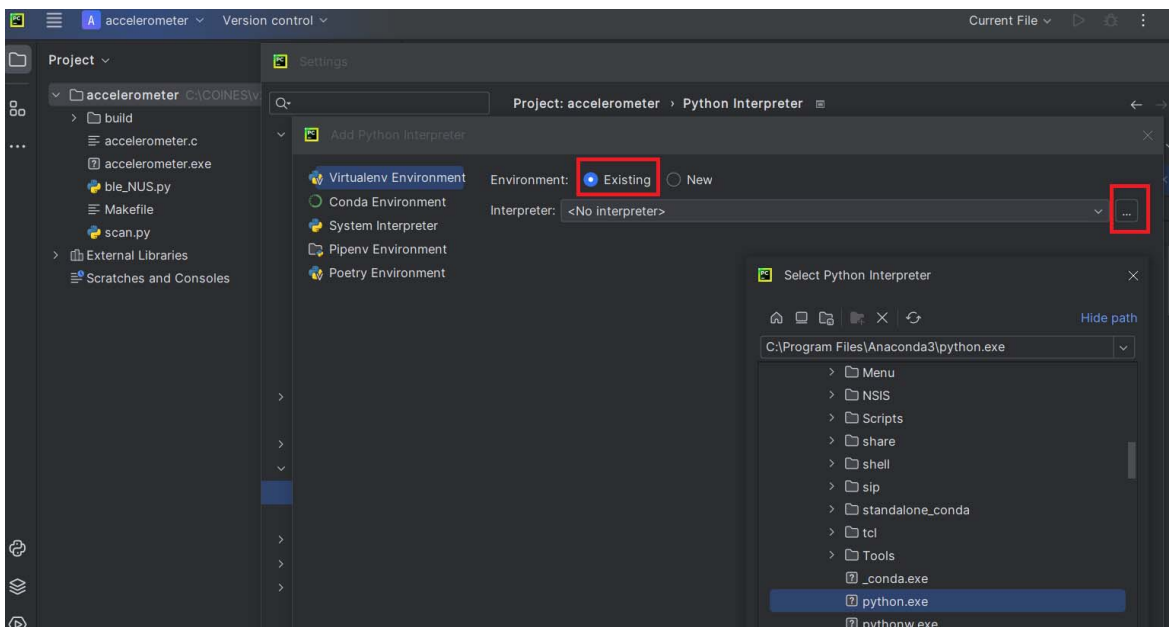


Figure 13 Add Python Interpreter 2 of 2

4.11 Test BLE connection between APP3.0 board and PC

- On the left panel under “accelerometer” project, right click “scan.py” and select “Run ‘scan’” as shown in Figure 14.

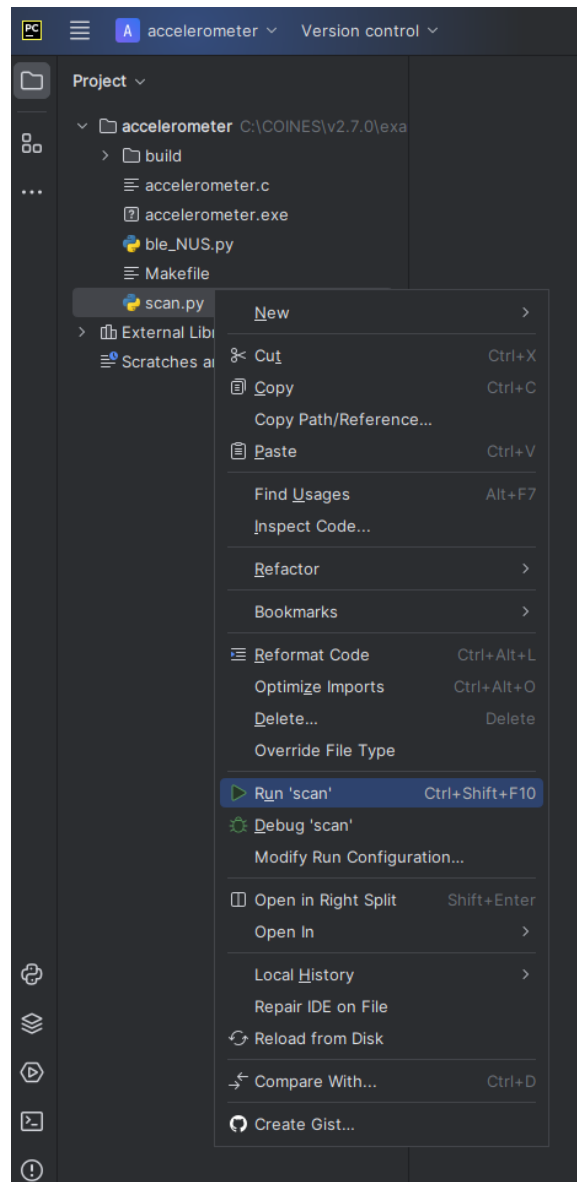
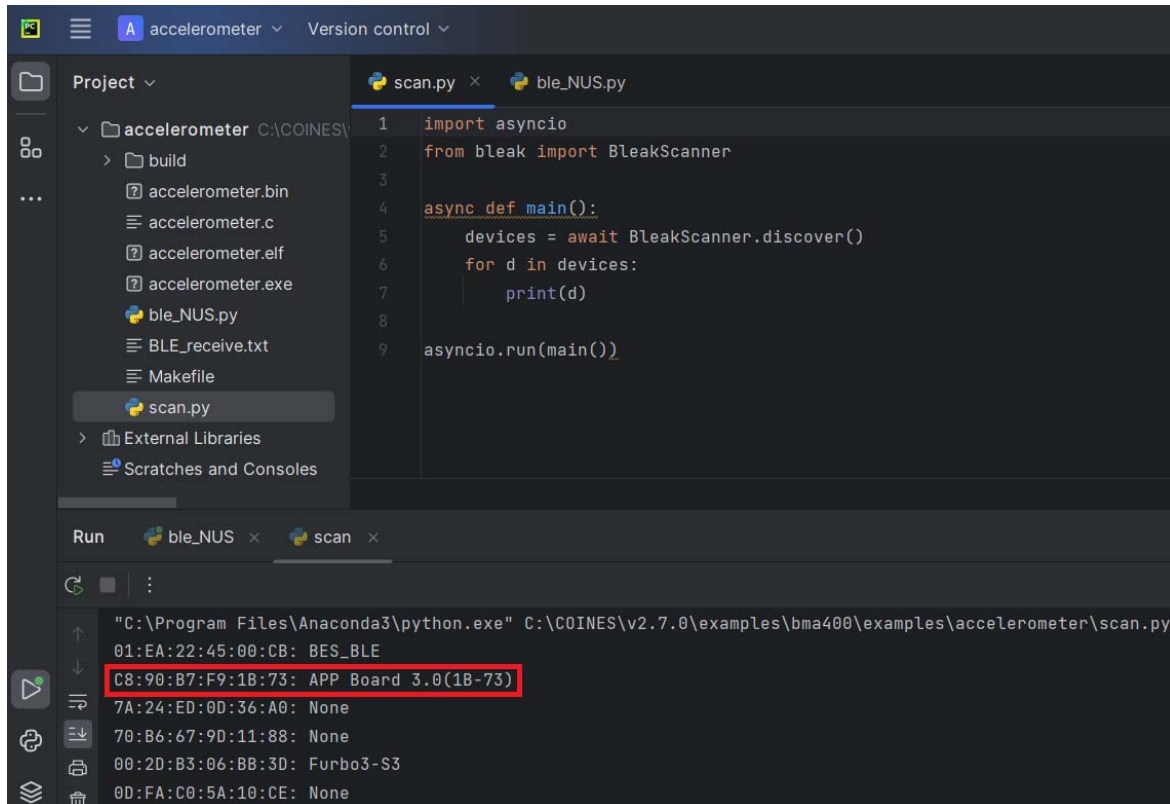


Figure 14 Run “scan.py”

- APP3.0 board will be found with MAC address listed as shown in Figure 15. The MAC address for this APP3.0 board is unique C8:90:B7:F9:1B:73.



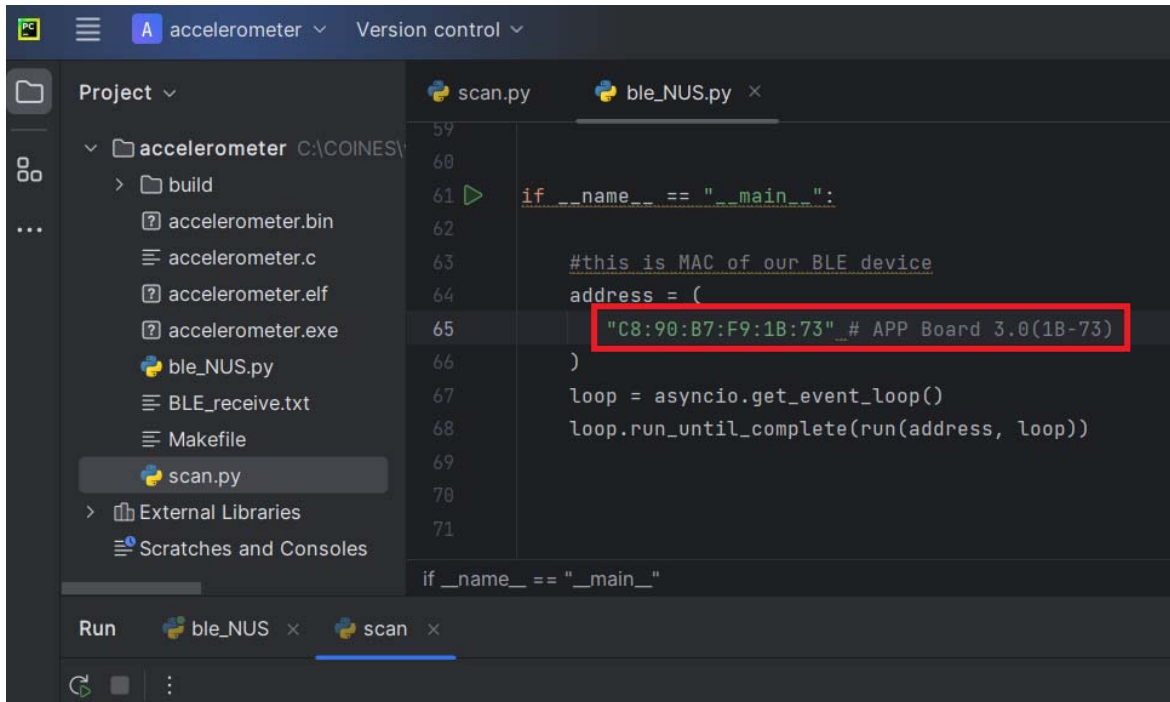
```
1 import asyncio
2 from bleak import BleakScanner
3
4 async def main():
5     devices = await BleakScanner.discover()
6     for d in devices:
7         print(d)
8
9 asyncio.run(main())
```

Run ble_NUS x scan x

```
"C:\Program Files\Anaconda3\python.exe" C:\COINES\v2.7.0\examples\bma400\examples\accelerometer\scan.py
01:EA:22:45:00:CB: BES_BLE
C8:90:B7:F9:1B:73: APP Board 3.0(1B-73)
7A:24:ED:0D:36:A0: None
70:B6:67:9D:11:88: None
00:2D:B3:06:BB:3D: Furbo3-S3
0D:FA:C0:5A:10:CE: None
```

Figure 15 Find APP3.0 MAC address for BLE communication

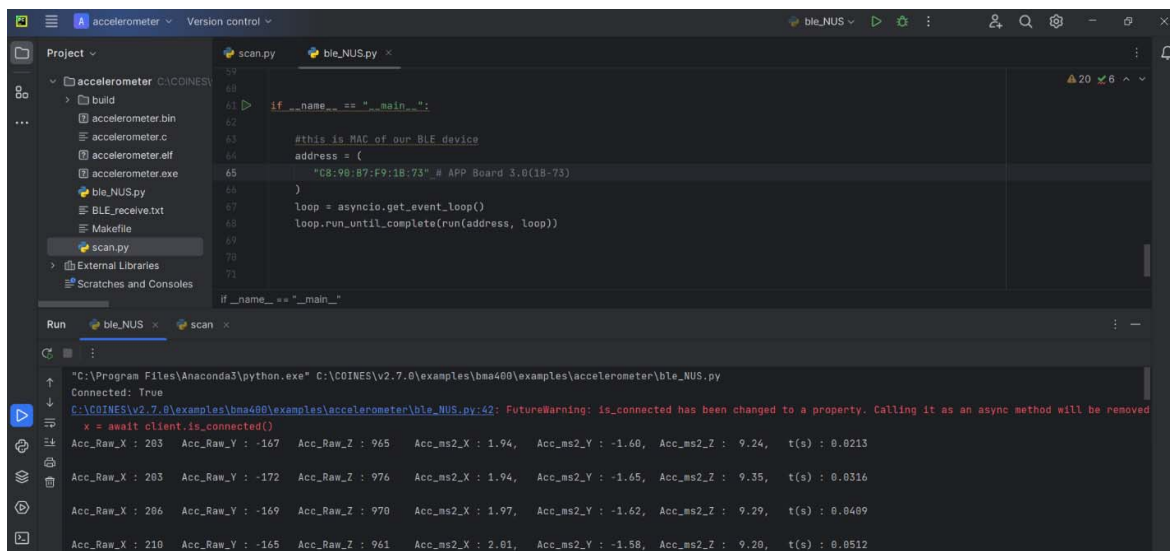
- Click “ble_NUS.py” file and paste the MAC address to the place as shown in Figure 16.



```
59
60
61 if __name__ == "__main__":
62
63     #this is MAC of our BLE device
64     address = (
65         "C8:90:B7:F9:1B:73" # APP Board 3.0(1B-73)
66     )
67     loop = asyncio.get_event_loop()
68     loop.run_until_complete(run(address, loop))
69
70
71
if __name__ == "__main__"
```

Figure 16 Copy and paste the MAC address to “ble_NUS.py” file

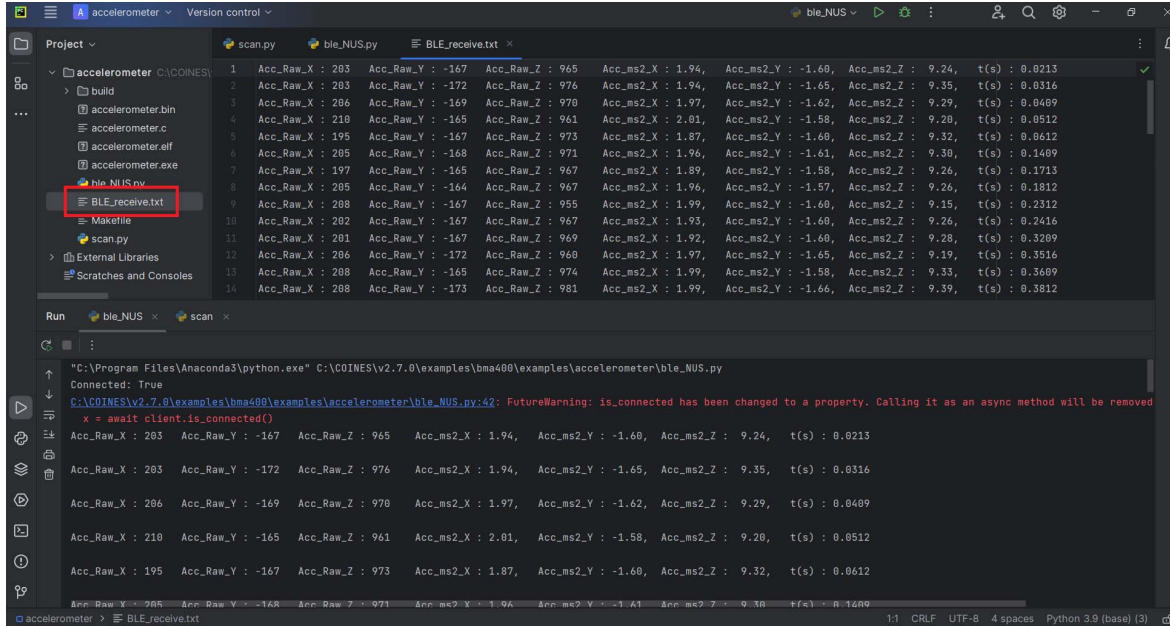
- On the left panel under “accelerometer” project, right click “ble_NUS.py” and select “Run ‘ble_NUS’”. The results are printed as shown in Figure 17.



```
Run ble_NUS x scan x
C:\Program Files\Anaconda3\python.exe C:\COINES\2.7.0\examples\bma400\examples\accelerometer\ble_NUS.py
Connected: True
x = await client.is_connected()
Acc_Raw_X : 203 Acc_Raw_Y : -147 Acc_Raw_Z : 965 Acc_ms2_X : 1.94, Acc_ms2_Y : -1.60, Acc_ms2_Z : 9.24, t(s) : 0.0213
Acc_Raw_X : 203 Acc_Raw_Y : -172 Acc_Raw_Z : 976 Acc_ms2_X : 1.94, Acc_ms2_Y : -1.65, Acc_ms2_Z : 9.35, t(s) : 0.0316
Acc_Raw_X : 206 Acc_Raw_Y : -169 Acc_Raw_Z : 970 Acc_ms2_X : 1.97, Acc_ms2_Y : -1.62, Acc_ms2_Z : 9.29, t(s) : 0.0409
Acc_Raw_X : 210 Acc_Raw_Y : -165 Acc_Raw_Z : 961 Acc_ms2_X : 2.01, Acc_ms2_Y : -1.58, Acc_ms2_Z : 9.20, t(s) : 0.0512
```

Figure 17 BMA400 data printed on PC from APP3.0 board via BLE connection

- In the meantime, BMA400 data is also logged in “BLE_receive.txt” file on PC as shown in Figure 18. It is the same as the BMA400 data printed.



```
Project - accelerometer (COINES)
├── build
├── accelerometer.bin
├── accelerometer.c
├── accelerometer.elf
├── accelerometer.exe
├── ble_NUS.py
├── BLE_receive.txt
├── Makefile
├── scan.py
├── External Libraries
└── Scratches and Consoles

Run - ble_NUS x scan x
C:\Program Files\Anaconda3\python.exe" C:\COINES\v2.7.0\examples\bma400\examples\accelerometer\ble_NUS.py
Connected: True
C:\COINES\v2.7.0\examples\bma400\examples\accelerometer\ble_NUS.py:42: FutureWarning: is_connected has been changed to a property. Calling it as an async method will be removed
  x = await client.is_connected()
Acc_Raw_X : 283 Acc_Raw_Y : -167 Acc_Raw_Z : 965 Acc_ms2_X : 1.94 Acc_ms2_Y : -1.60 Acc_ms2_Z : 9.24 t(s) : 0.0213
Acc_Raw_X : 283 Acc_Raw_Y : -172 Acc_Raw_Z : 976 Acc_ms2_X : 1.94 Acc_ms2_Y : -1.65 Acc_ms2_Z : 9.35 t(s) : 0.0316
Acc_Raw_X : 286 Acc_Raw_Y : -169 Acc_Raw_Z : 970 Acc_ms2_X : 1.97 Acc_ms2_Y : -1.62 Acc_ms2_Z : 9.29 t(s) : 0.0409
Acc_Raw_X : 210 Acc_Raw_Y : -165 Acc_Raw_Z : 961 Acc_ms2_X : 2.01 Acc_ms2_Y : -1.58 Acc_ms2_Z : 9.20 t(s) : 0.0512
Acc_Raw_X : 195 Acc_Raw_Y : -167 Acc_Raw_Z : 973 Acc_ms2_X : 1.87 Acc_ms2_Y : -1.60 Acc_ms2_Z : 9.32 t(s) : 0.0612
Acc_Raw_X : 285 Acc_Raw_Y : -168 Acc_Raw_Z : 971 Acc_ms2_X : 1.96 Acc_ms2_Y : -1.61 Acc_ms2_Z : 9.30 t(s) : 0.1409
Acc_Raw_X : 197 Acc_Raw_Y : -165 Acc_Raw_Z : 967 Acc_ms2_X : 1.89 Acc_ms2_Y : -1.58 Acc_ms2_Z : 9.26 t(s) : 0.1713
Acc_Raw_X : 205 Acc_Raw_Y : -164 Acc_Raw_Z : 967 Acc_ms2_X : 1.96 Acc_ms2_Y : -1.57 Acc_ms2_Z : 9.26 t(s) : 0.1812
Acc_Raw_X : 288 Acc_Raw_Y : -167 Acc_Raw_Z : 955 Acc_ms2_X : 1.99 Acc_ms2_Y : -1.60 Acc_ms2_Z : 9.15 t(s) : 0.2312
Acc_Raw_X : 282 Acc_Raw_Y : -167 Acc_Raw_Z : 967 Acc_ms2_X : 1.93 Acc_ms2_Y : -1.60 Acc_ms2_Z : 9.26 t(s) : 0.2416
Acc_Raw_X : 281 Acc_Raw_Y : -167 Acc_Raw_Z : 969 Acc_ms2_X : 1.92 Acc_ms2_Y : -1.60 Acc_ms2_Z : 9.28 t(s) : 0.3209
Acc_Raw_X : 286 Acc_Raw_Y : -172 Acc_Raw_Z : 960 Acc_ms2_X : 1.97 Acc_ms2_Y : -1.65 Acc_ms2_Z : 9.19 t(s) : 0.3516
Acc_Raw_X : 288 Acc_Raw_Y : -165 Acc_Raw_Z : 974 Acc_ms2_X : 1.99 Acc_ms2_Y : -1.58 Acc_ms2_Z : 9.33 t(s) : 0.3609
Acc_Raw_X : 288 Acc_Raw_Y : -173 Acc_Raw_Z : 981 Acc_ms2_X : 1.99 Acc_ms2_Y : -1.66 Acc_ms2_Z : 9.39 t(s) : 0.3812
```

Figure 18 BMA400 data logged in “BLE_receive.txt” file on PC

- Done.

5 Appendix A Source code of “scan.py” file

```
import asyncio
from bleak import BleakScanner

async def main():
    devices = await BleakScanner.discover()
    for d in devices:
        print(d)

asyncio.run(main())
```

6 Appendix B Source code of “ble_NUS.py” file

```
"""
Coyt Barringer - 2020
Test program demonstrating data transmission between Adafruit Bluefruit BLE
libraries running
on nrf52840 and Python
This uses the Nordic Uart Service (NUS) and should work concurrently with
other BLE services such as HID
On the python side, the Bluetooth Low Energy platform Agnostic Klient for
Python (Bleak) project
is used for Cross Platform Support and has been tested with windows 10
"""

import asyncio
from bleak import BleakClient

UART_TX_UUID = "6e400002-b5a3-f393-e0a9-e50e24dcca9e" #Nordic NUS
characteristic for TX
UART_RX_UUID = "6e400003-b5a3-f393-e0a9-e50e24dcca9e" #Nordic NUS
characteristic for RX

dataFlag = False #global flag to check for new data
index = 0
dataList = []
file = open("BLE_receive.txt", "w")

def notification_handler(sender, data):
    """Simple notification handler which prints the data received."""
    global file

    # print("{0}: {1}".format(sender, data))
    readstr = data.decode('utf-8')
    print(readstr)
    file.write(readstr)
    file.flush()
```

```
global dataFlag
dataFlag = True

async def run(address, loop):

    async with BleakClient(address, loop=loop) as client:

        #wait for BLE client to be connected
        x = await client.is_connected()
        print("Connected: {0}".format(x))

        #wait for data to be sent from client
        await client.start_notify(UART_RX_UUID, notification_handler)

        while True :

            #give some time to do other tasks
            await asyncio.sleep(0.0)

            #check if we received data
            global dataFlag
            if dataFlag :
                dataFlag = False

if __name__ == "__main__":

    #this is MAC of our BLE device
    address = (
        "C8:90:B7:F9:1B:73" # APP Board 3.0(1B-73)
    )
    loop = asyncio.get_event_loop()
    loop.run_until_complete(run(address, loop))
```

7 Legal disclaimer

7.1 Engineering samples

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8 Document history and modification

Rev. No	Chapter	Description of modification/changes	Date
1.0		Document creation	August 28 th , 2023
2.0	4.1	Changed to COINES v2.8.8 from v2.7.0	November 1 st , 2023

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