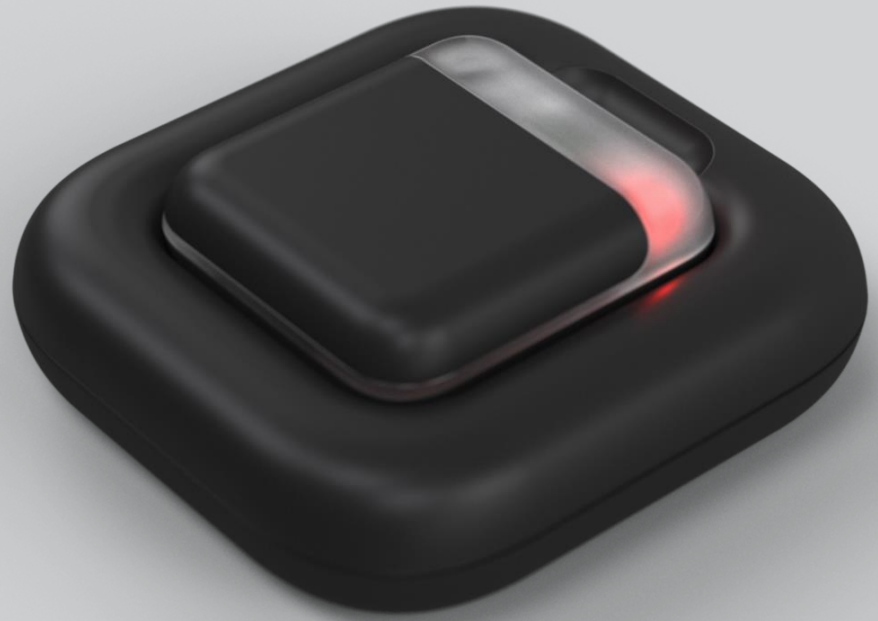


PRODUCT SPECIFICATION

Circa.E2
Revision: 2
21ST MAY 2024

cobalt

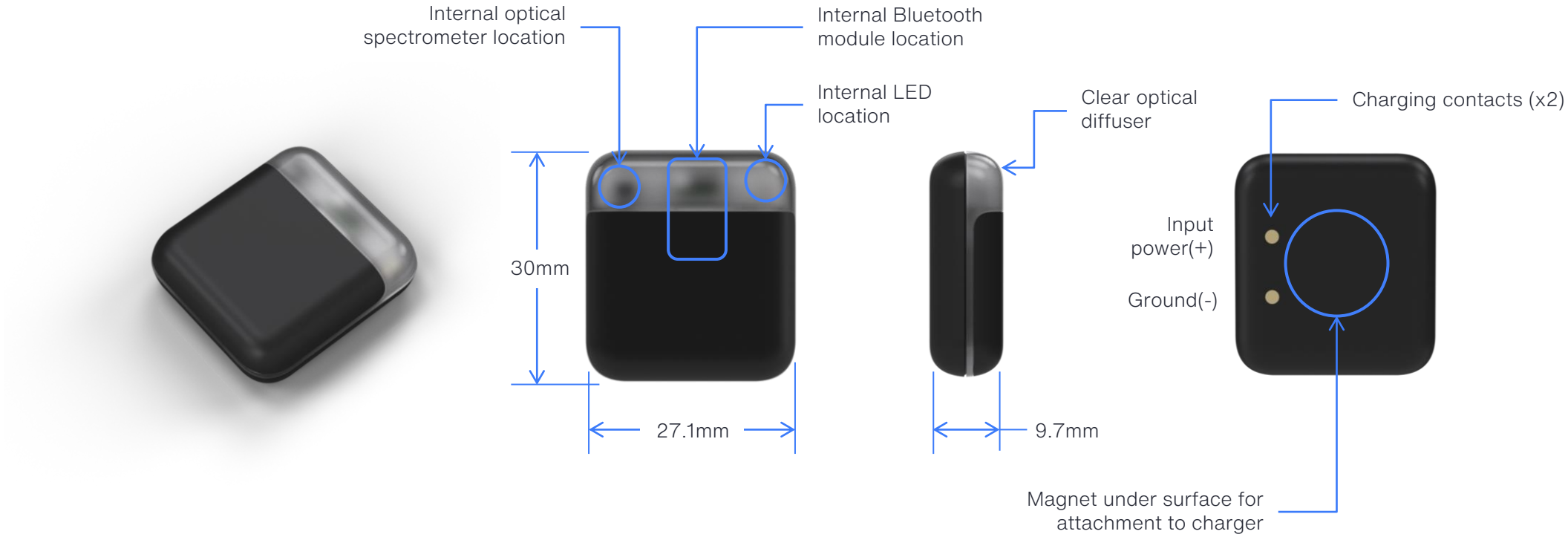
PRODUCT DETAILS

Product overview
Sensor Overview
Charger Overview
Sensor Charging
Sensor Reset

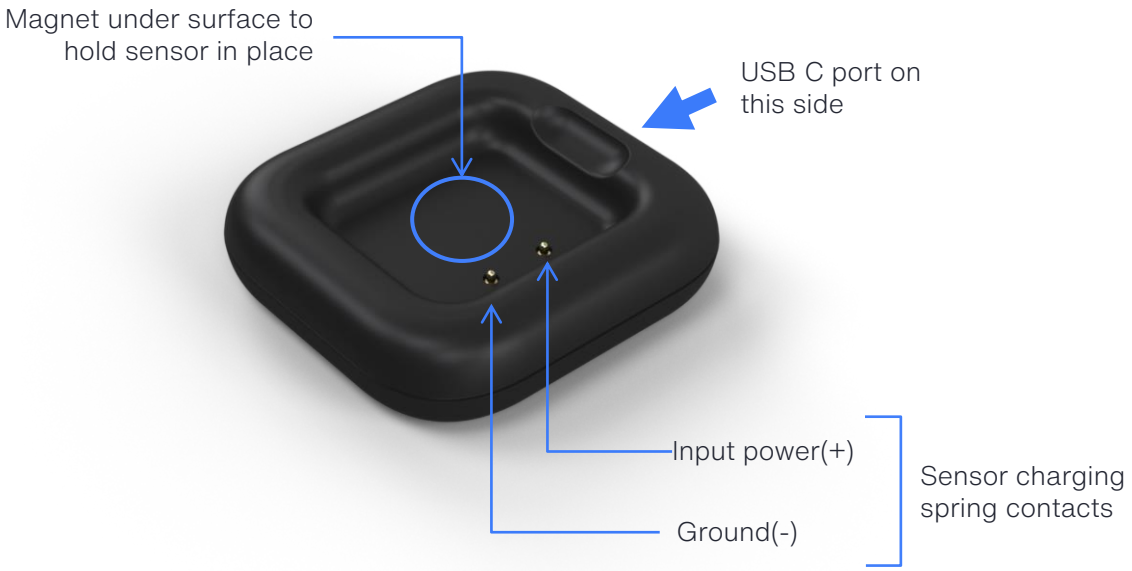
PRODUCT OVERVIEW

- The product consists of 2 main parts, including a sensor and charger.
- The sensor is designed to be worn on a user's clothing and record their exposure to light throughout the course of the day.
- The sensor is always on and therefore does not have an on/off button or switch.
- Light exposure data is logged to an internal flash memory chip.
- The sensor has BLE connectivity to communicate with an iOS app to transfer logged data.
- An integrated magnet is used for attachment to the user's clothing.
- The charger enables the sensor to be charged via USB C connection and includes a built in 'reset' button to delete Bluetooth pairing.

SENSOR OVERVIEW



CHARGER OVERVIEW

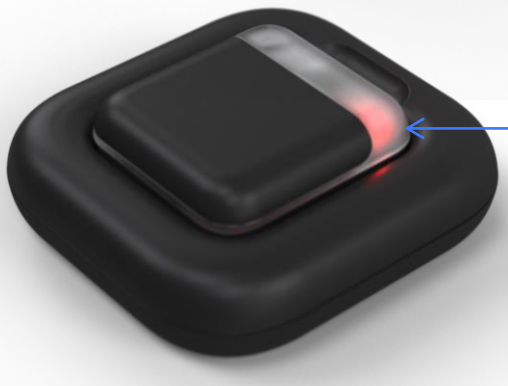


CHARGING

Charging Process

1. Connect charger to an appropriate USB power supply via a USB cable
2. Place sensor onto recess in charger. Note the diffuser window should line up with the finger recess in the charger
3. Sensor status light will illuminate red for 1 second then turn off. This indicates that charging has started.
4. Leave sensor on charger for duration of charge. This should take approx. 3.5hrs to complete.
5. Once charging is finished, the status LED will flash green for 1 second.
6. Device may now be removed

Place sensor onto charger in this orientation

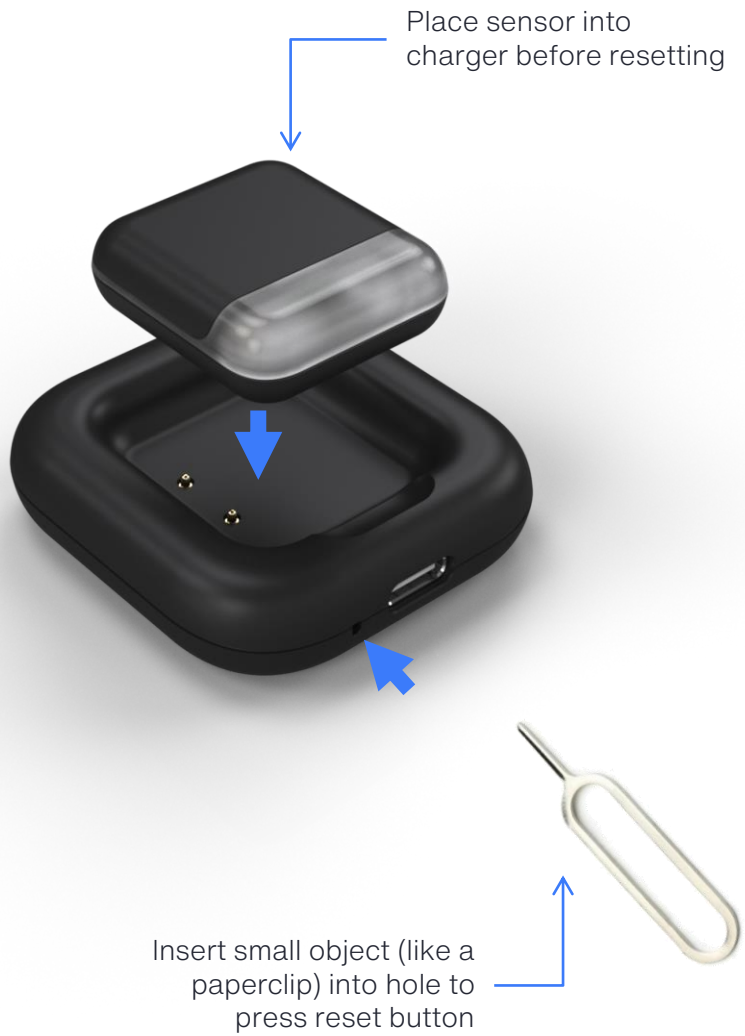


Status LED glows red to indicate charging has begun

SENSOR RESET

Sensor Reset Process

1. Connect charger to an appropriate USB power supply via a USB cable
2. Place sensor onto recess in charger. Note the diffuser window should line up with the finger recess in the charger
3. Using a small object (like an unfolded paper clip) press the reset button and hold for 10 seconds(*)
   → The hold time can be changed without any notice.
4. The sensor status LED should briefly flash white, indicating that the sensor has been successfully reset.
5. You may now remove the sensor from the charger and pair to a new device via Bluetooth



ELECTRONIC BOARDS SPECIFICATION

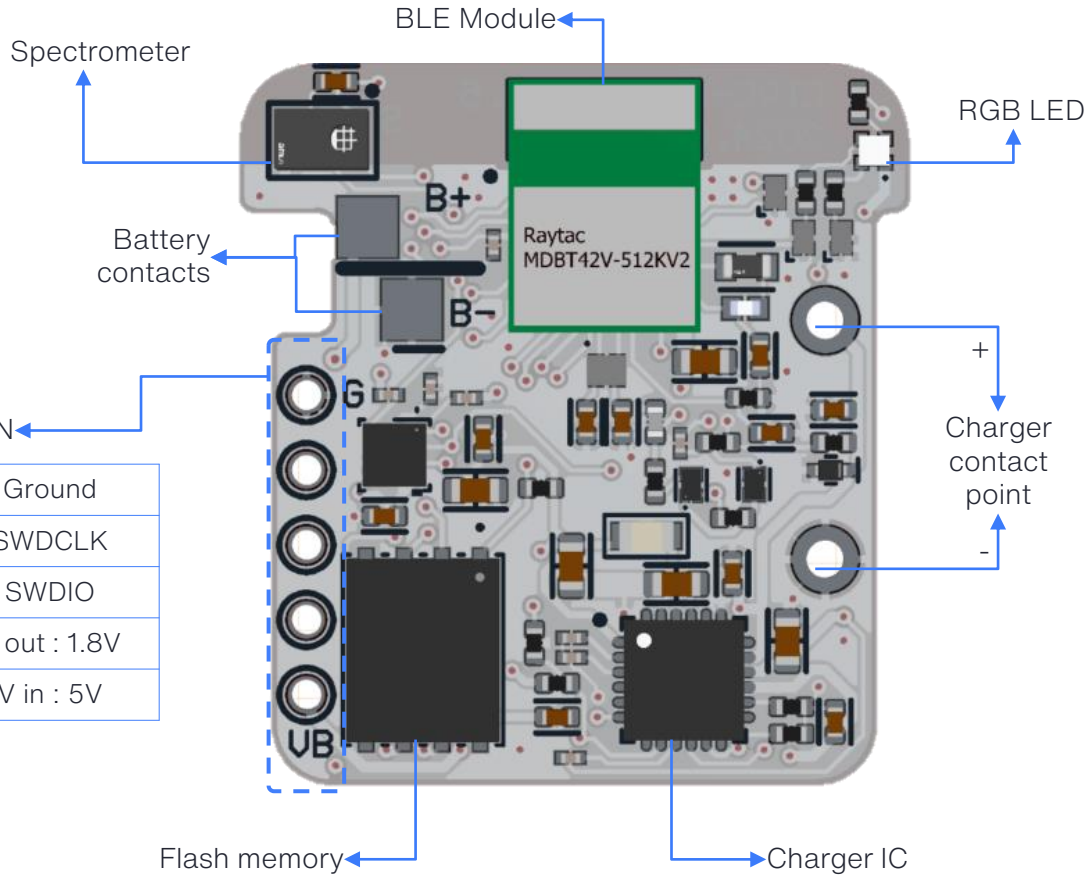
Electrical characteristic
Sensor board
Charger board

ELECTRICAL CHARACTERISTIC

Attribute		Value	Remark
Power	Charging input Voltage / Current	5V / 500mA	USB-C connector
	Digital I/O voltage	1.8V	
	Charger IC	nPM1100	Li-ion battery charger
Battery capacity	Battery voltage range	3.0 – 4.2V	
	Battery cut-off threshold	3.0V	
	Battery capacity	65mAh	
Current consumption	Advertising	0.5 – 0.6mA	
	Connection	0.6 – 0.8mA	
	Flash erase	3.2 – 3.5mA	
Main platform	BLE Module	MDBT42V-512KV2	Raytac
	BLE SoC	nRF52832	Nordic Semiconductor
	Flash	512KB	
	RAM	64KB	
	Core	64 MHz Cortex-M4 with FPU	
Connectivity		Bluetooth Low Energy	2.4GHz ISM band
Indicator LED	RGB LED	Red : Vf = max 2.4V, If = 10mA Green : Vf = max 3.1V, If = 5mA Blue : Vf = max 3.3V, If = 5mA	Iv = 25 – 80mcd Iv = 140 – 180mcd Iv = 30 – 50mcd

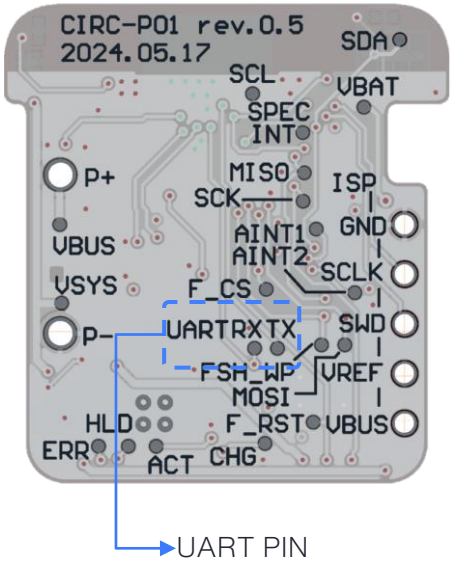
SENSOR BOARD PCBA

TOP layer



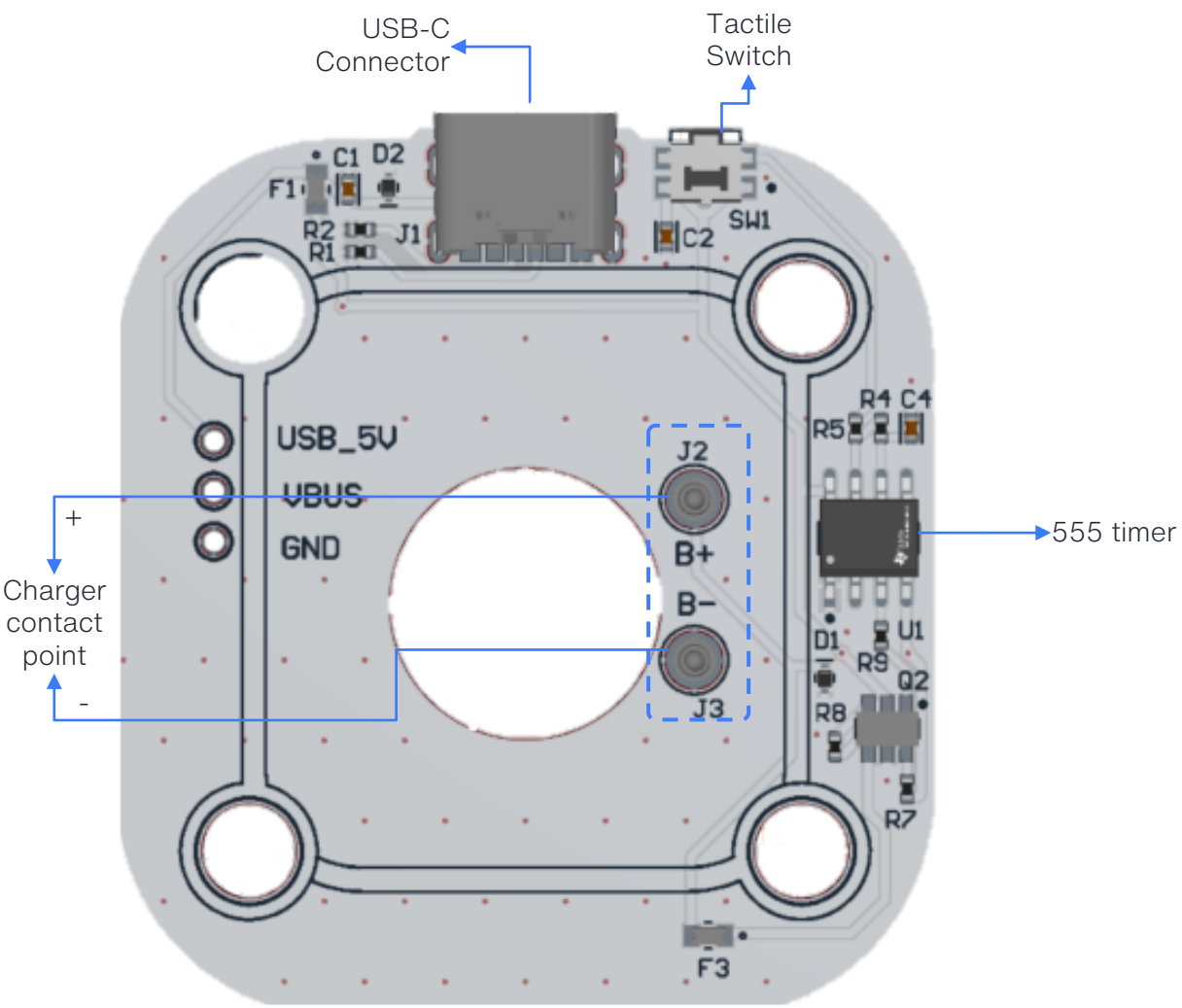
5	GND	Ground
4	SCLK	SWDCLK
3	SWD	SWDIO
2	VREF	V out : 1.8V
1	VBUS	V in : 5V

BOTTOM layer

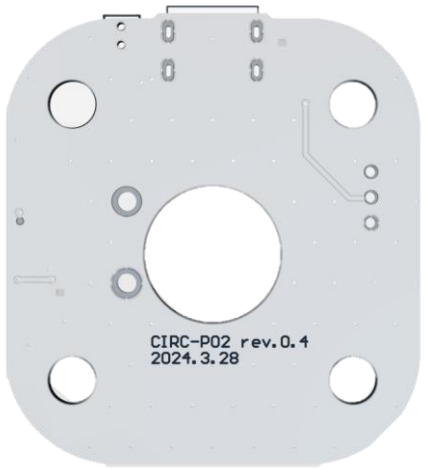


CHARGER BOARD PCBA

TOP layer



BOTTOM layer



ELECTRONIC BOARDS PROGRAMMING

Programming tool
How to program

PROGRAMMING TOOL

Software tool

1. Nordic serial command line tools

   nRF Command Line Tools - Downloads - nordicsemi.com

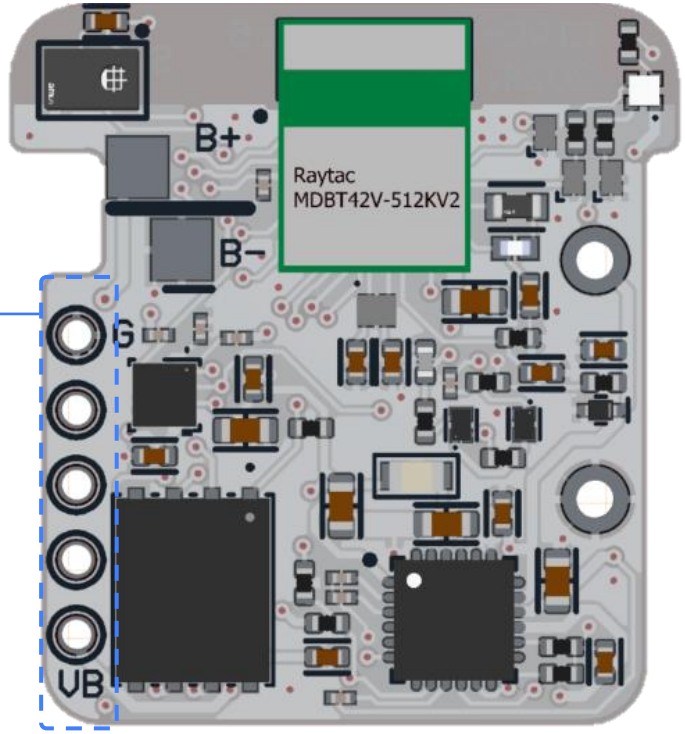
2. Programming batch file
3. Test specification with serial number generator

Hardware tool

1. J-Link or J-link OB
2. Clip programmer (Pogo probe)

Programming PIN

5	GND	Ground
4	SCLK	SWDCLK
3	SWD	SWDIO
2	VREF	V out : 1.8V
1	VBUS	V in : 5V



Pogo probe

HOW TO PROGRAM FIRMWARE

1) Prepare the programming tool

- J-Link or J-Link OB

2) Prepare the firmware programming program

- nRF connect programmer
- Firmware package
- Custom binary generator

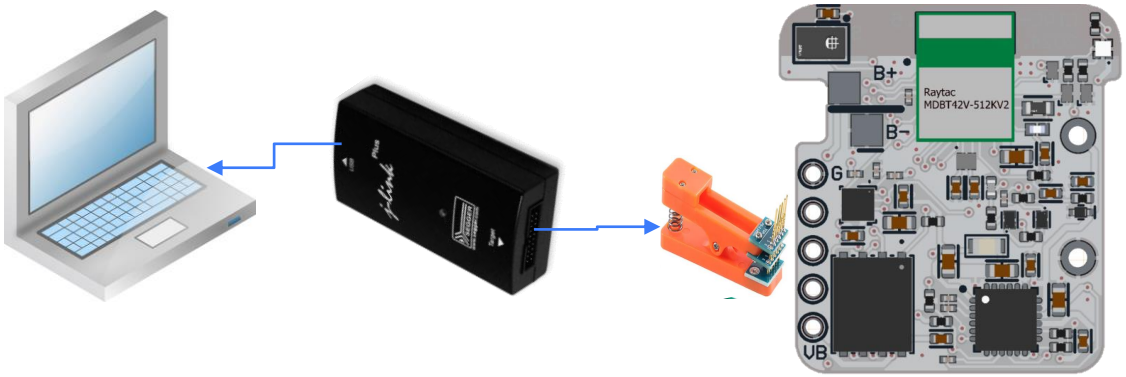
3) Connect the programming tool to PCBA

4) Use the serial number generator to get the serial numbers

5) Run the batch file to program the merged firmware and write the serial number in UICR memory.

- Batch file command
  Circa_programming [hex file name] [serial number]
- e.g) Circa_programming mieye_GH_0.15_merge.hex 0x080C0071

* Refer to the test specification for full function test including the firmware programming




```
CIRCA PROGRAMMING : Please put the target hex file
Circa_programming [hex_file] [0x:serial_no] (Do not forget to put the 0x)
1.Erase the flash
Erasing user available code and UICR flash areas.
Applying system reset.
2.Program the firmware
[ ################### ]   0.087s | Erase file - Done erasing
[ ################### ]   5.023s | Program file - Done programming
[ ################### ]   1.875s | Verify file - Done verifying
4.check UICR if it is emplty (It should be 0xFFFFFFFF)
0x10001080: FFFFFFFF                                |....|
3.write UICR
Parsing parameters.
Writing.
4.check UICR (The new serial number data should be displayed)
0x10001080: 080C0071                                |q...|
5.Reset the device
Applying hard reset.
```

BLUETOOTH FUNCTION

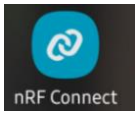
nRF Connect for Mobile APP
CTS server setting
Bluetooth connection
Bluetooth services
Spectro service mode

nRF CONNECT for Mobile APP

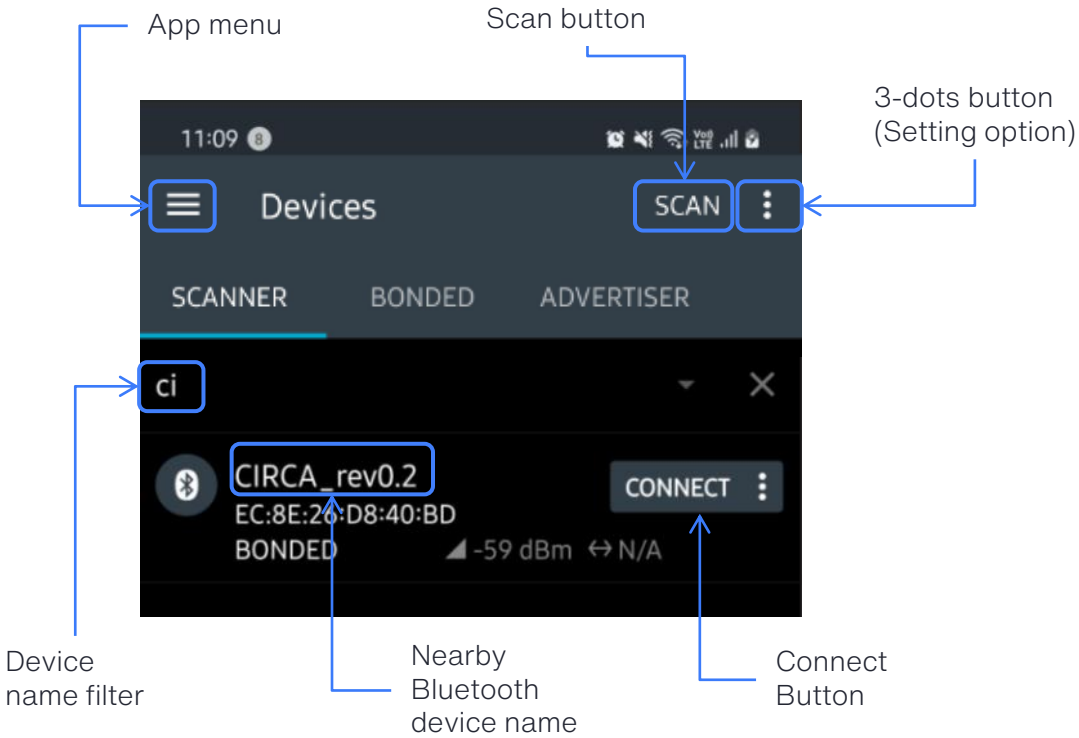
nRF Connect for Mobile APP

1. Download the 'nRF Connect for Mobile' app for your smartphone or tablet. (This app is used to communicate to the sensor via Bluetooth.)
2. Open the app and add the CTS server in Configure GATT server.
3. Scan the device by press 'SCAN' and find your sensor in the list of nearby Bluetooth devices.
   The device name should have the following format: "CIRCA#####"
4. Press 'CONNECT' to connect to the device.
5. When new tab is created, press the 3-dots button which is for setting option.
6. Press "Discover services" in the setting option.
7. You can find 2 services
   1. Battery service (UUID 0x180F)
   2. Unknown service (UUID e23f1580-.....)
8. Unknown service is "Spectro service" with the spectral data reading and mode selection.

- Please refer to the next pages for more details with screen shots.
- Screen shots can be different by the Android / iOS phones.

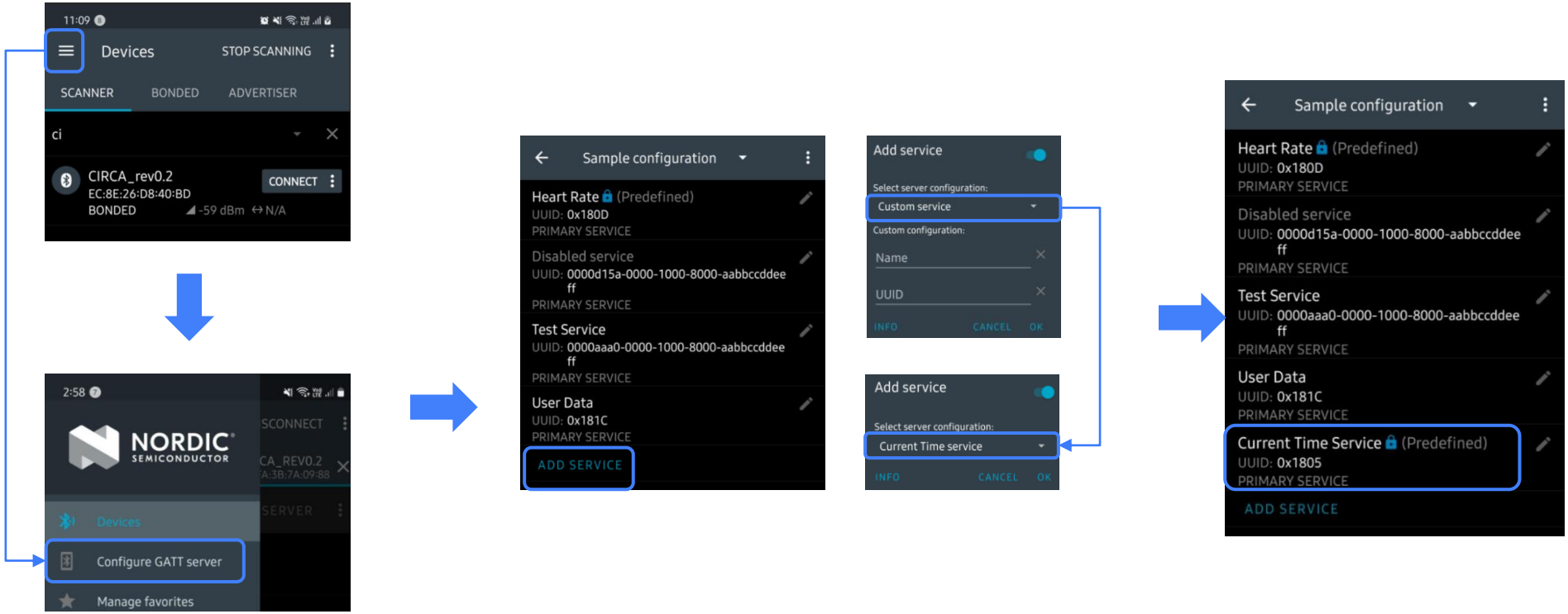


nRF Connect for Mobile



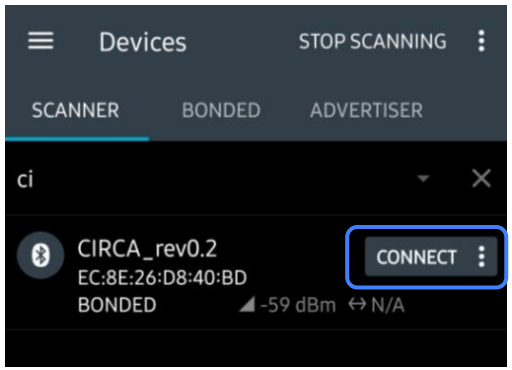
nRF CONNECT for Mobile APP : CTS SERVER

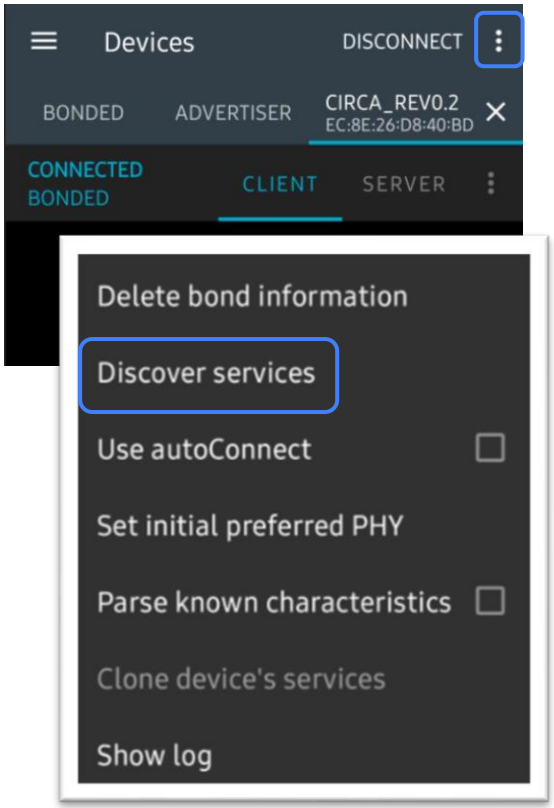
CTS (Current Time Service) server setting

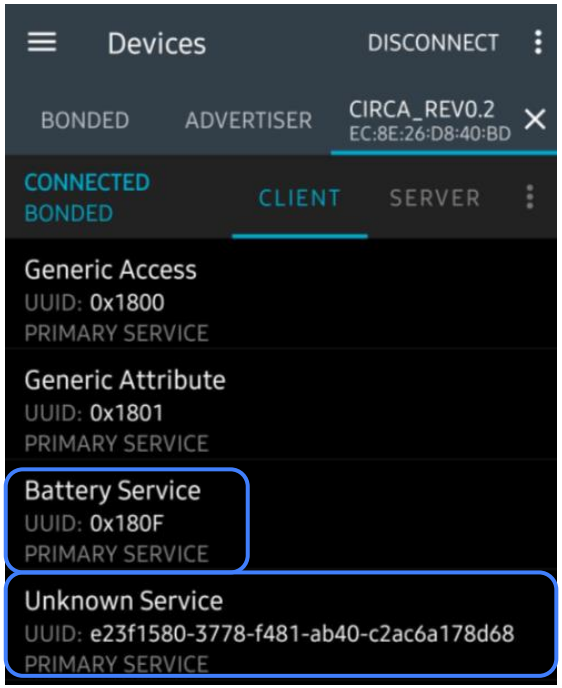


nRF CONNECT for Mobile APP : CONNECTION

1. To connect the device, press “Connect button”
2. Status LED glows blue to indicate the connection.
3. Then press “Discover service” in the setting option, to discover all Bluetooth services.

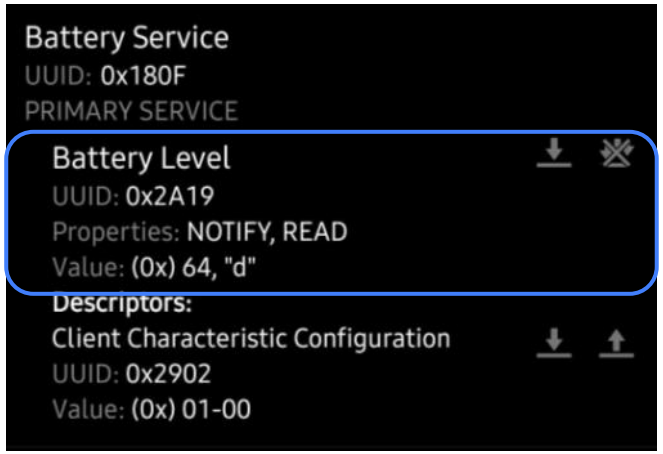




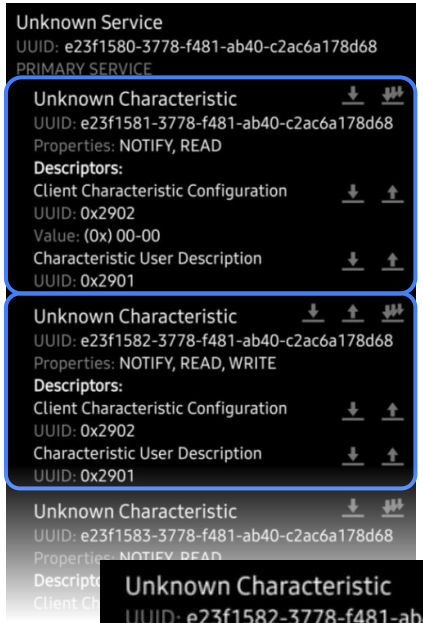


nRF CONNECT for Mobile APP : SERVICES

Battery service

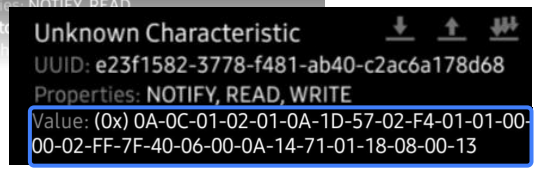


Spectro service (displayed as Unknown service)

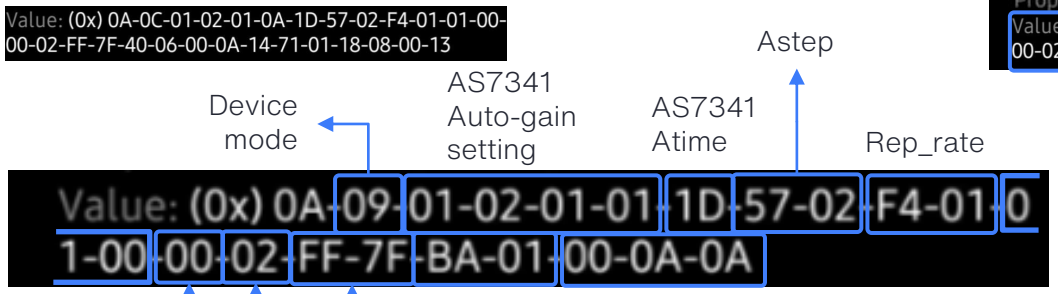


Spectral data service

Command service



In command service, you can receive the status data from the device.



Device mode

AS7341 Auto-gain setting

AS7341 Atime

Astep

Rep_rate

Log_rate

Battery Charging status

Device Colour

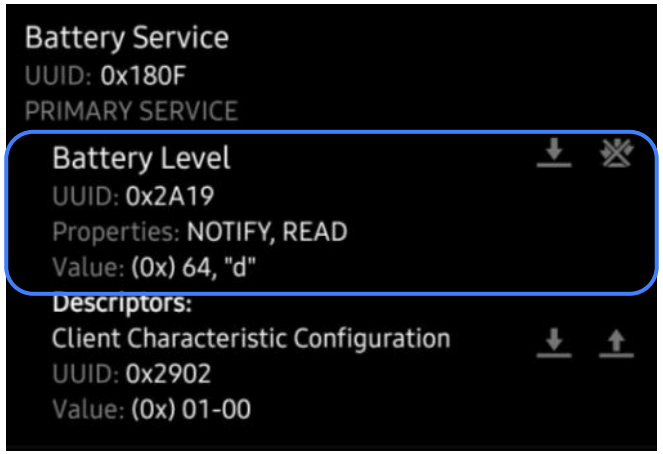
Max Flash Memory

Used flash memory pages

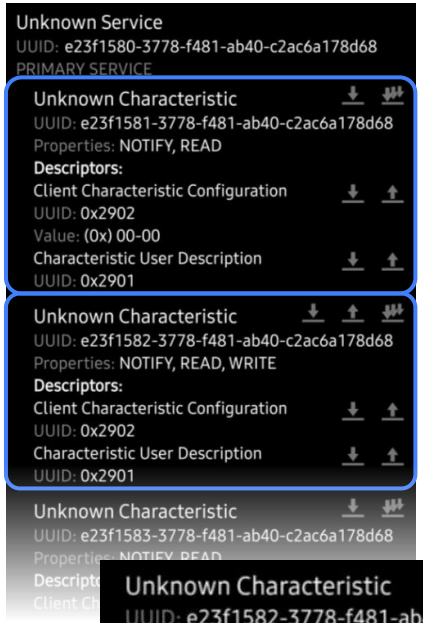
Accelerometer setting (Scale, threshold, duration

nRF CONNECT for Mobile APP : SERVICES

Battery service

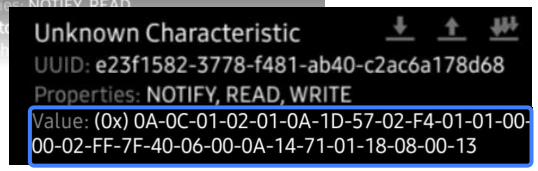


Spectro service (displayed as Unknown service)

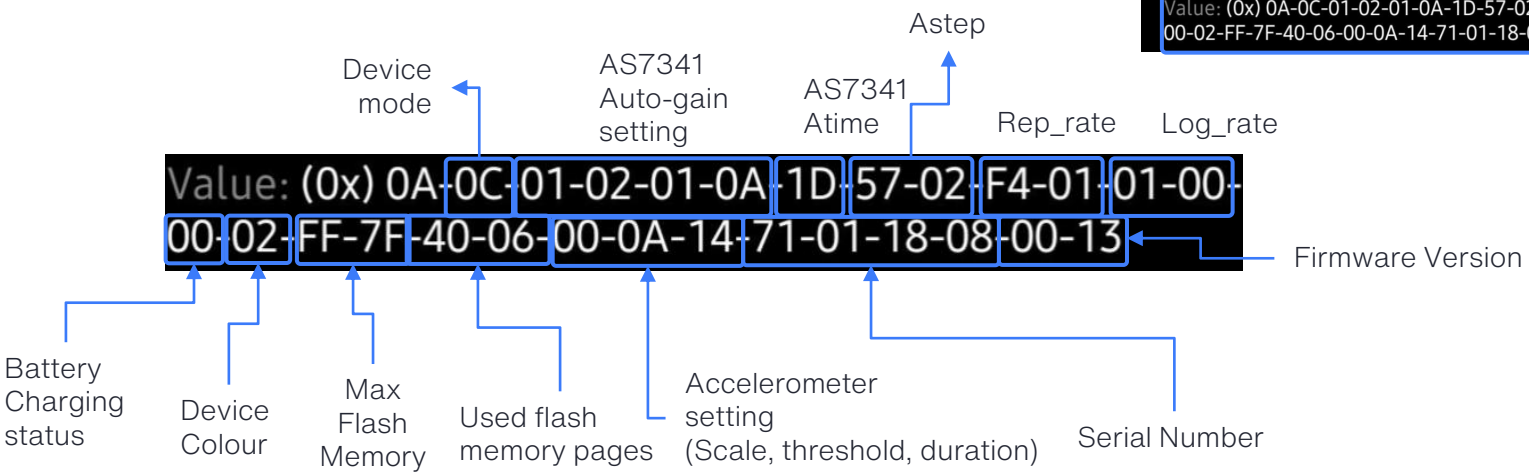


Spectral data service

Command service



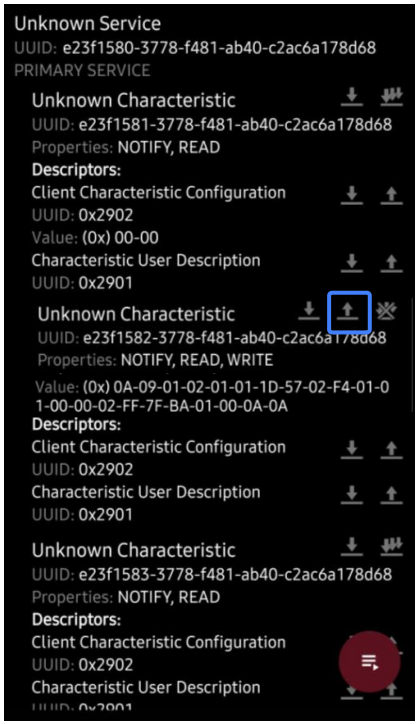
In command service, you can receive the status data from the device.

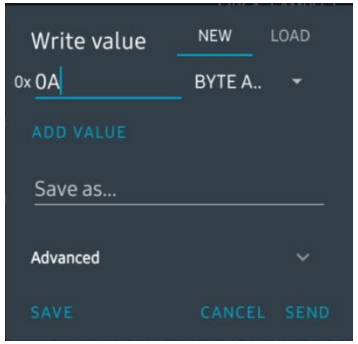


nRF CONNECT for Mobile APP : LIVE MODE

Live mode

1. Live mode is to see the spectral data in real time.
2. To enter the live mode, the mode change command(0A) should be sent to the device in the command service.
3. In the live mode, spectral data is appeared in the specral data service.



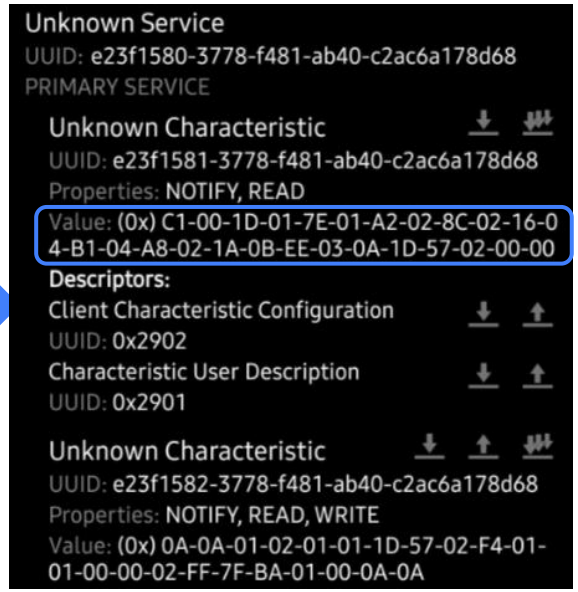


The mode is changed from Idle mode (09) to live mode (0A)

Value: (0x) 0A-09-01-02-01-0A-1D-57-02-F4-01-01-00-00-02-FF-7F-40-06-00-0A-14-71-01-18-08-00-13

Value: (0x) 0A-0A-01-02-01-0A-1D-57-02-F4-01-01-00-00-02-FF-7F-40-06-00-0A-14-71-01-18-08-00-13

Live mode

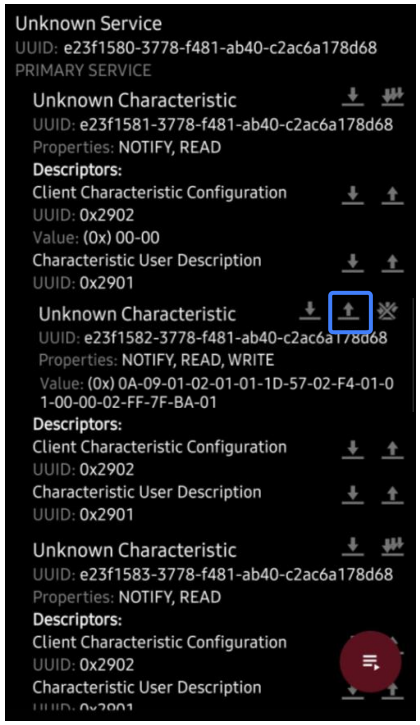


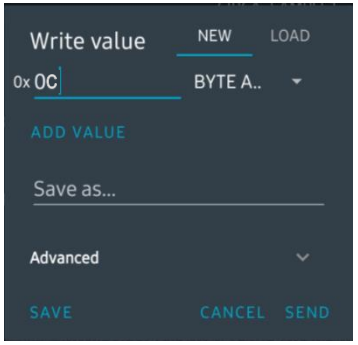
Spectral data

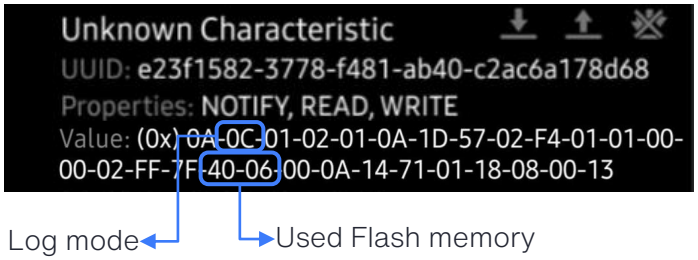
nRF CONNECT for Mobile APP : LOG MODE

Log mode

1. The Log mode is to record the spectral data in the flash memory.
2. To enter the log mode, the mode change command(0C) should be sent to the device in the command service.
3. After 8 spectral data are read, they are written in one page of the flash memory, and it increases the used flash memory.



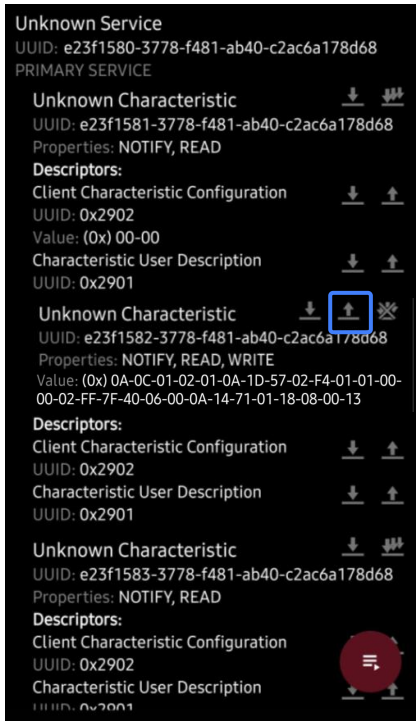


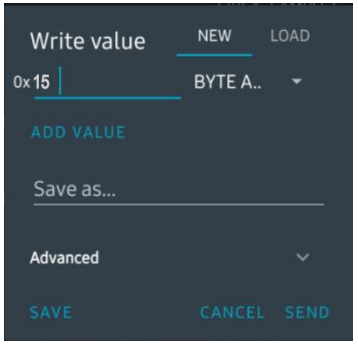


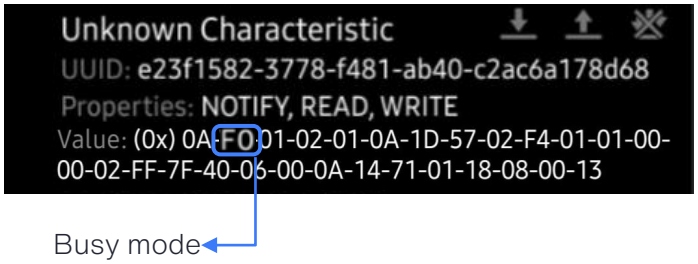
nRF CONNECT for Mobile APP : CLEAR LOG

Clear Log

1. The Clear Log command is to clear the flash memory.
2. The mode change command(15) should be sent to the device in the command service.
3. After this, the device enters in the busy mode and Status LED blinks in bright purple every one second until the flash memory is cleared fully.
4. In the busy mode, no command entry is available.



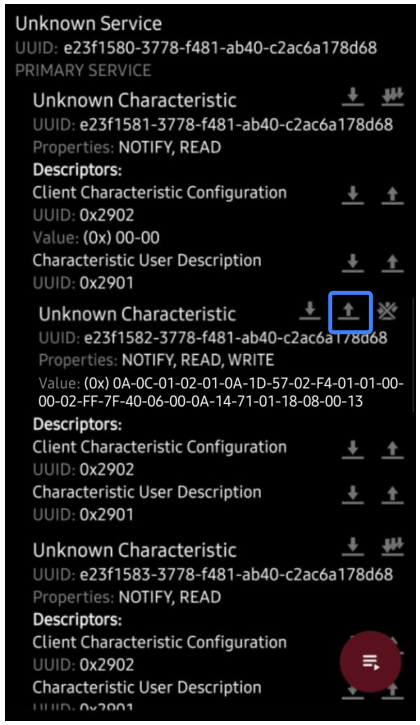


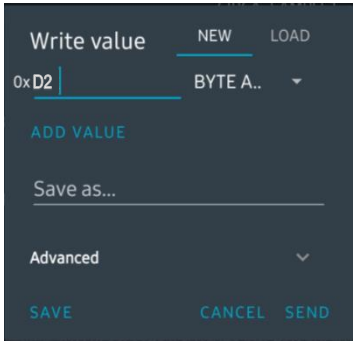


nRF CONNECT for Mobile APP : SHIPPING MODE

Shipping mode

1. The shipping mode command is to delete the bond and put the device into the sleep mode.
2. The mode change command(D2) should be sent to the device in the command service.
3. After this, the device deletes the current bonds and enters the sleep mode. Automatically, BLE connection will be lost.
4. If the board is on the charger board and detects the charging voltage, it wakes up automatically.





FCC Warning：

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and,if not installed and used in accordance with The instructions,may cause harmful interference to radio communications.However,there Is no guarantee that interference will not occur in a particular installation. If this Equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on,the use risen couraged to try to correct the Interference by one or more of the following measures:
Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver.
Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
Consult the dealer or an experienced radio/TV technician for help.
Caution:Any changes or modification to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1)This device may not cause harmful interference,and(2)this device must accept any interference received, including interference that may cause undesired operation.

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.

IC Caution:
Radio Standards Specification RSS-Gen, issue 5
- English: This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’ s licence-exempt RSS(s). Operation is subject to the following two conditions: This device may not cause interference. This device must accept any interference, including interference that may cause undesired operation of the device. RF exposure statement: The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.

- French: Cet appareil contient des émetteurs / récepteurs exemptés de licence conformes aux RSS (RSS) d’Innovation, Sciences et Développement économique Canada. Le fonctionnement est soumis aux deux conditions suivantes: Cet appareil ne doit pas causer d’interférences. Cet appareil doit accepter toutes les interférences, y compris celles susceptibles de provoquer un fonctionnement indésirable de l’appareil. Déclaration d’exposition RF: L’appareil a été évalué pour répondre aux exigences générales d’exposition aux RF. L’appareil peut être utilisé dans des conditions d’exposition portable sans restriction.

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