BLE Continuous Glucose Monitoring Sensor

1.0

Features

- BLE Continuous Glucose Monitoring and Bond Management services in GATT Server role
- Low Power mode
- Workflow status reporting through UART
- LED status indication

General Description

This example project demonstrates the BLE Continuous Glucose Monitoring Sensor application workflow. The application uses the BLE Continuous Glucose Monitoring Profile to report CGM Measurement records to the Client by the Continuous Glucose Monitoring Service and to manage bonding by the Bond Management Service. Also, the application uses the Device Information Service to assert the Device Name, etc. The PSoC 4 BLE and PRoC BLE devices are supported.

Development Kit Configuration

Default CY8CKIT-042 BLE Pioneer Kit configuration.

Project Configuration

BLE Continuous Glucose Monitoring Sensor Example Project

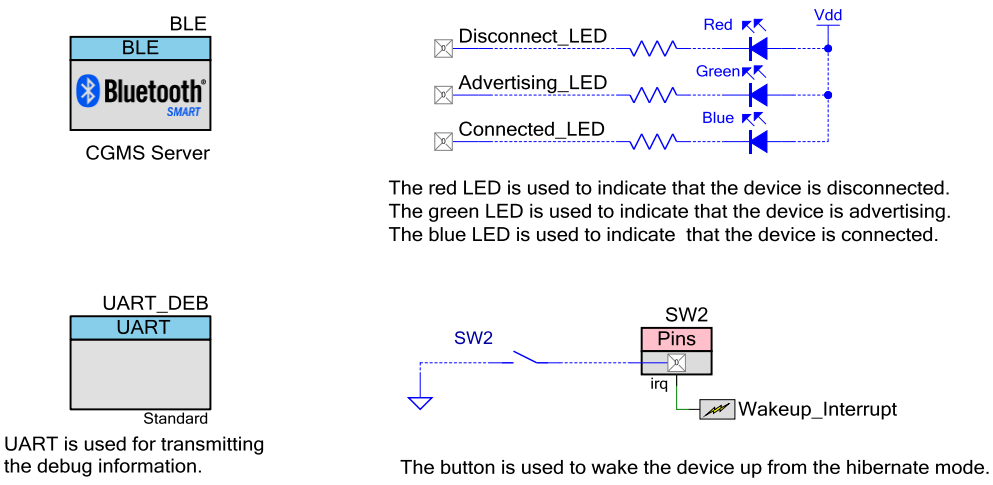


Figure 1. Top Design Schematic

The BLE component is configured as Continuous Glucose Monitoring Server in the GAP Peripheral role. Also, Bond Management and Device Information Services are included.

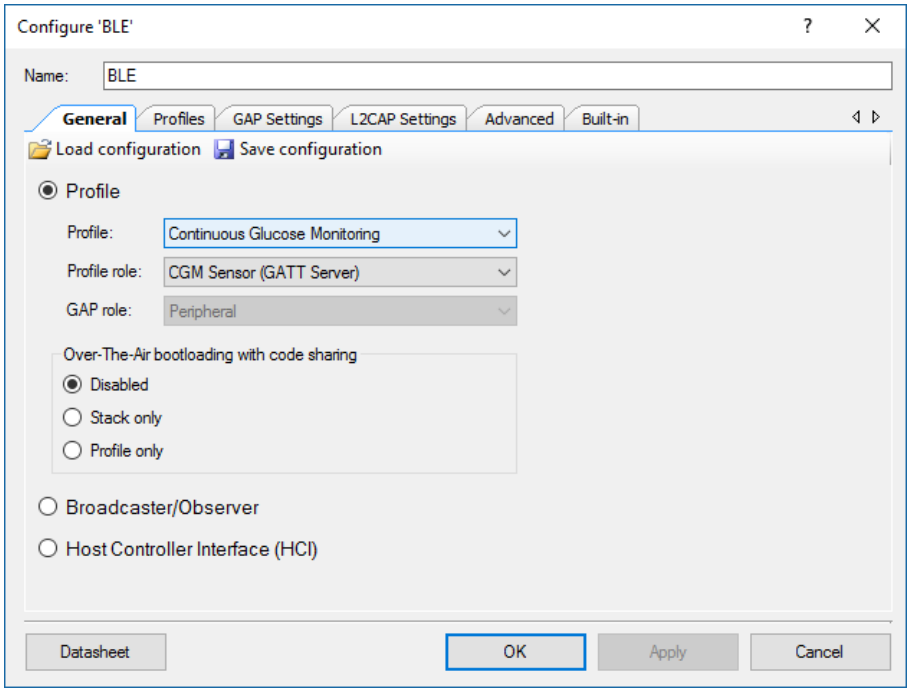


Figure 2. General Settings

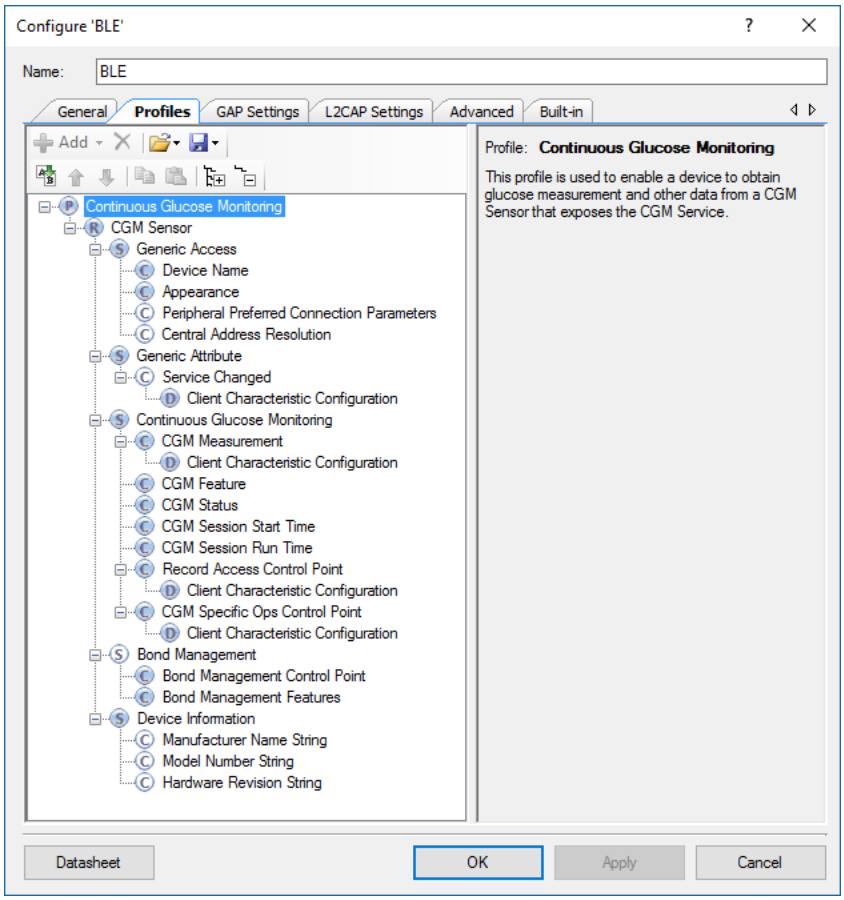


Figure 3. GATT Settings

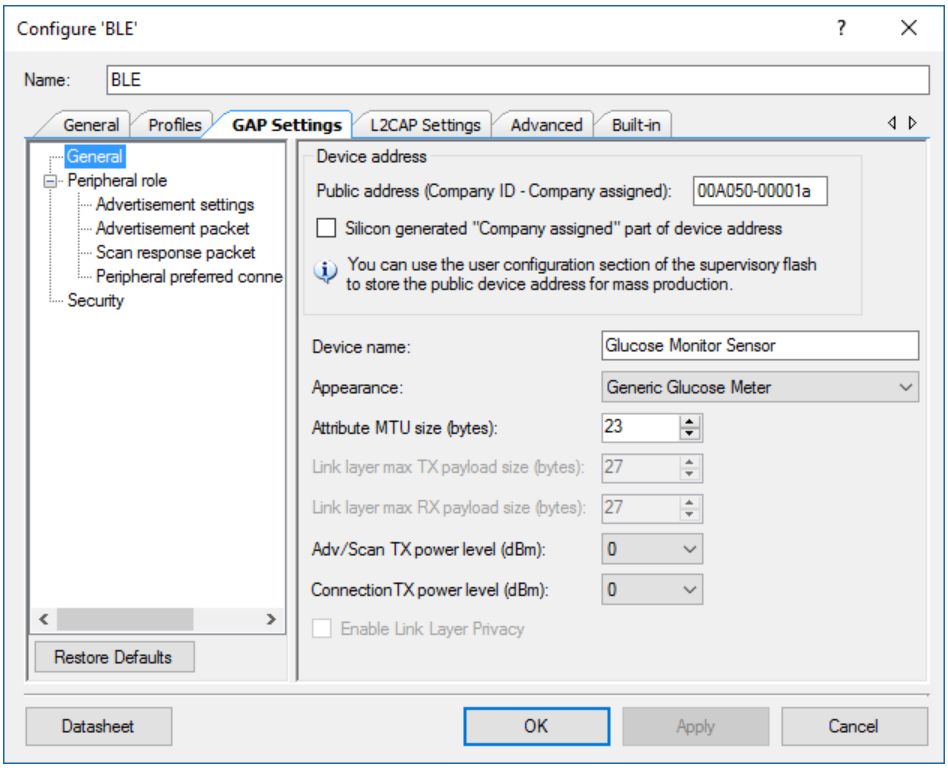


Figure 4. GAP Settings

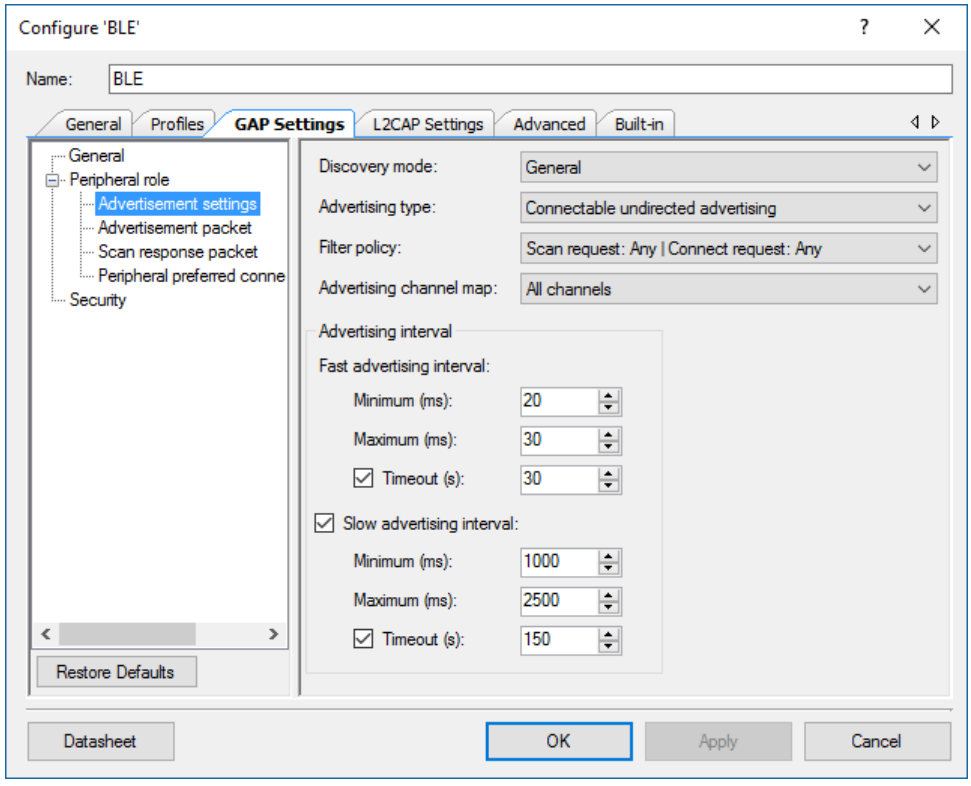


Figure 5. GAP Settings -> Advertisement Settings

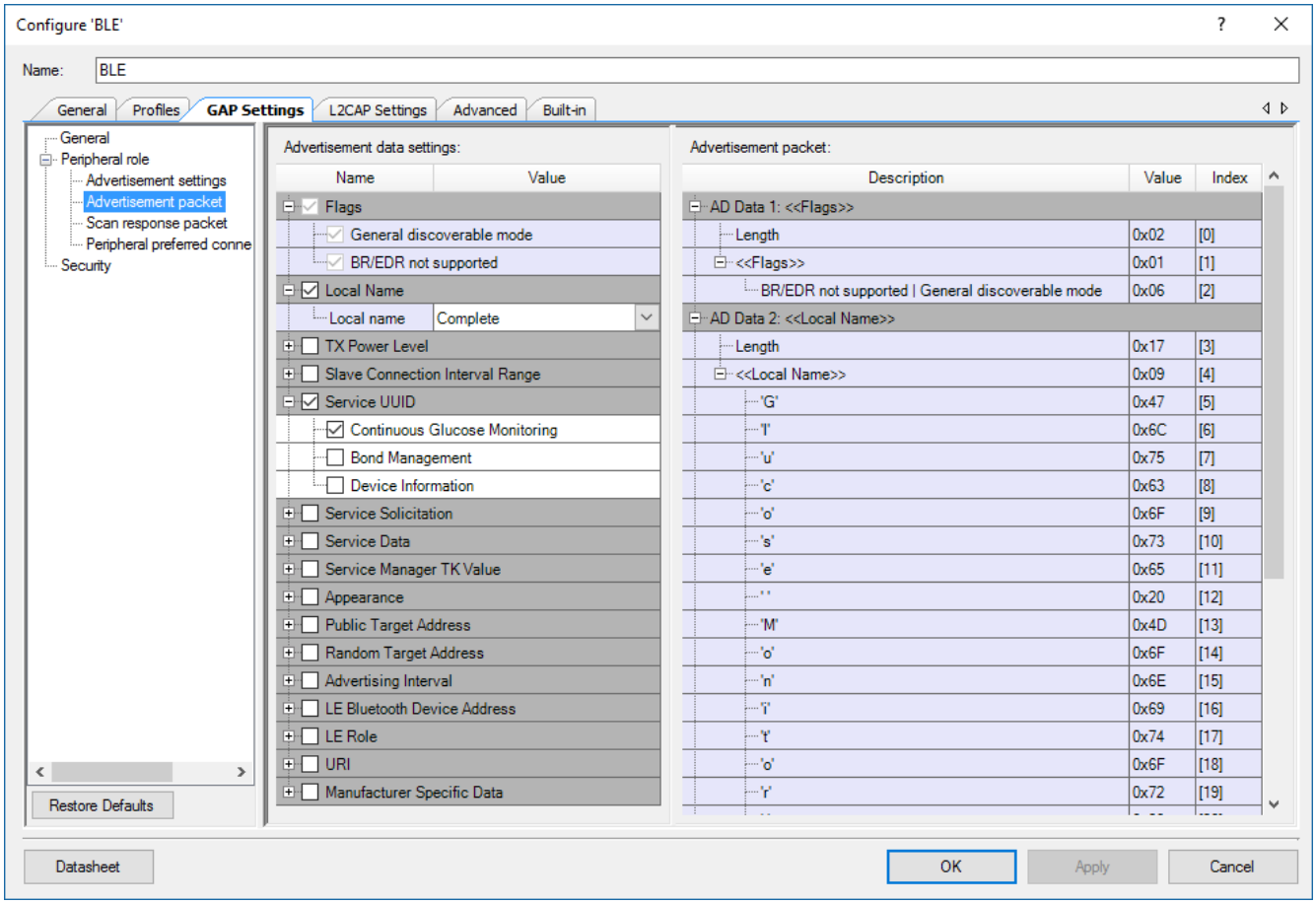


Figure 6. GAP Settings -> Advertisement Packet

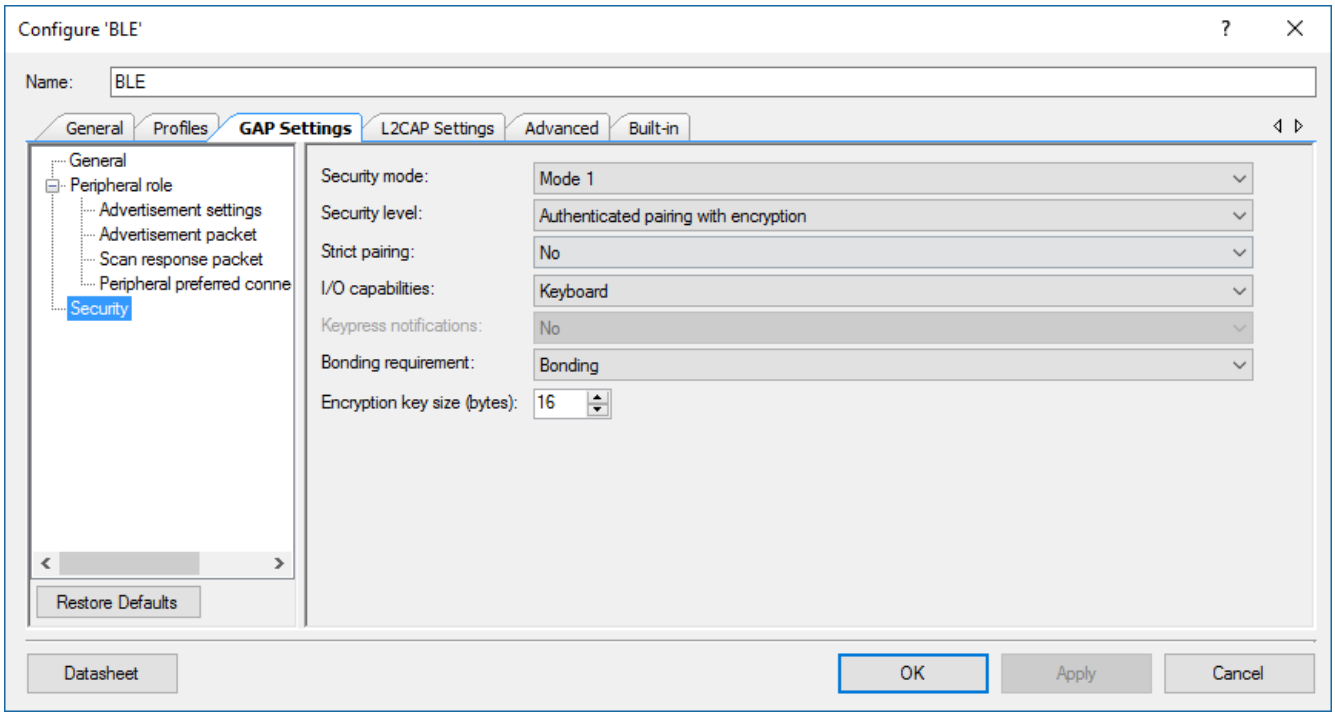


Figure 7. GAP Settings -> Security

The pin assignment is the next:

- The UART RX is connected to P1[4].
- The UART TX is connected to P1[5].
- A mechanical button is connected to P2[7].
- The red LED is connected to P2[6].
- The green LED is connected to P3[6].
- The blue LED is connected to P3[7].

Project Description

The project demonstrates the core functionality of the BLE component configured as a Continuous Glucose Monitoring Server.
Right after a startup the device performs BLE component initialization. In this project three callback functions are required for BLE operation. One callback function (AppCallBack()) is required to receive generic events from BLE Stack and service-specific callbacks CgmsCallBack() and BmsCallBack() for Continuous Glucose Monitoring and Bond Management service-specific events accordingly. The CYBLE_EVT_STACK_ON event indicates a successful initialization of BLE Stack. After this event is received, the component starts advertising with the packet structure as configured in the BLE component customizer (see **Figure 6**). The BLE component stops advertising as soon as a 180-second advertising period expires.

The Continuous Glucose Monitoring Sensor device can be connected to any BLE-compatible device (4.0 or later), configured as the GAP Central role and GATT Client which supports Continuous Glucose Monitoring Profile. Also, the Device Information Service may be optionally used.
To connect to the Continuous Glucose Monitoring Sensor device, send a connection request to the device while the device is advertising. The green LED is blinking while the device is advertising. The blue LED is turned on when the device is in connected state. The red LED is turned on when the device is in a disconnected state to indicate that no Client is connected to the device.
The Continuous Glucose Monitoring Sensor device requires authentication, the IO capability is “keyboard” (see **Figure 7**) i.e. the device requires entering the passkey that is indicated by the Client device through the UART interface (by any software, e.g. like HyperTerminal). When the Client is paired with the Continuous Glucose Monitoring Sensor, at first, the CGM Measurement characteristic notification and the Record Access Control Point (RACP) characteristic indication should be enabled. Then the RACP characteristic can be written to assert any RACP request (for details, see the Continuous Glucose Monitoring Profile and Service specifications adopted by Bluetooth SIG). When the RACP request is asserted, the Client should wait for any CGM Measurement characteristic notifications and the Record Access Control Point (RACP) characteristic indication (depending on the asserted request), or write the **Abort Operation** command into the RACP characteristic. Before writing any CGM Specific Ops Control Point (SOCP) command, the SOCP indication should be enabled.
The WDT is used for time simulations and LED blinking.

While connected to the Client and between connection intervals, the device is put into Sleep Mode.

Expected Results

The project sends the Continuous Glucose Monitoring Service characteristic's notifications/indications to the Central Client device which shows them to the user. Also, the device performs Bond Management service operations requested by the Client. LEDs are blinking as described in the *Project Description* section. And the project sends log messages through the UART.

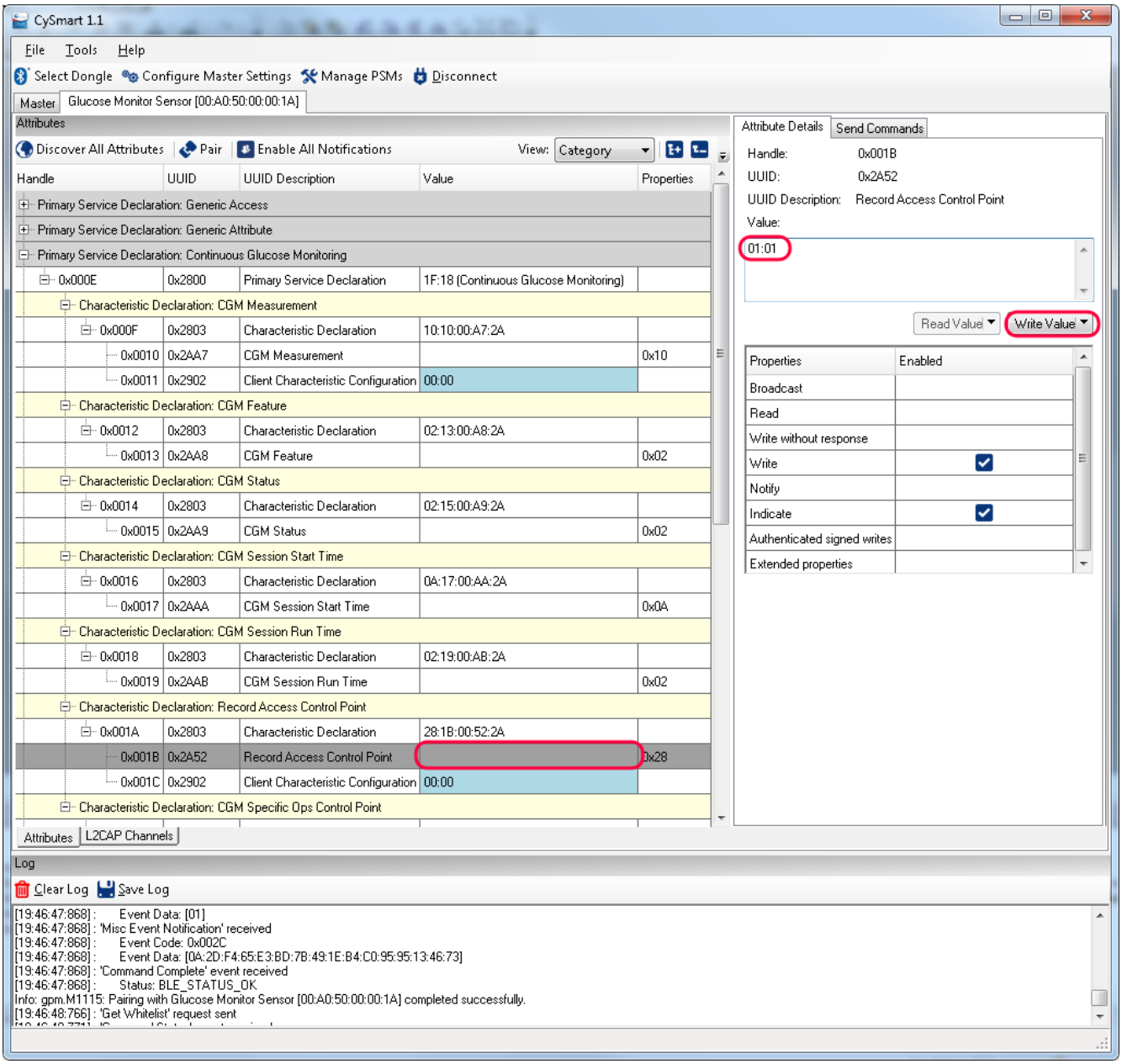
The project is intended to work in pair with any BLE-compatible device (e.g. phone, tablet) with appropriate software (e.g. Android, iOS with an installed application that supports Continuous Glucose Monitoring Profile.)

Also, the Continuous Glucose Monitoring Sensor can be used together with CySmart app for Windows. It is required to match the security settings between Continuous Glucose Monitor and CySmart Client and perform pairing (bonding) before any writing (enabling notifications etc.) into the Server's GATT database. For further instructions on how to use the CySmart application, refer to CySmart User Guide.

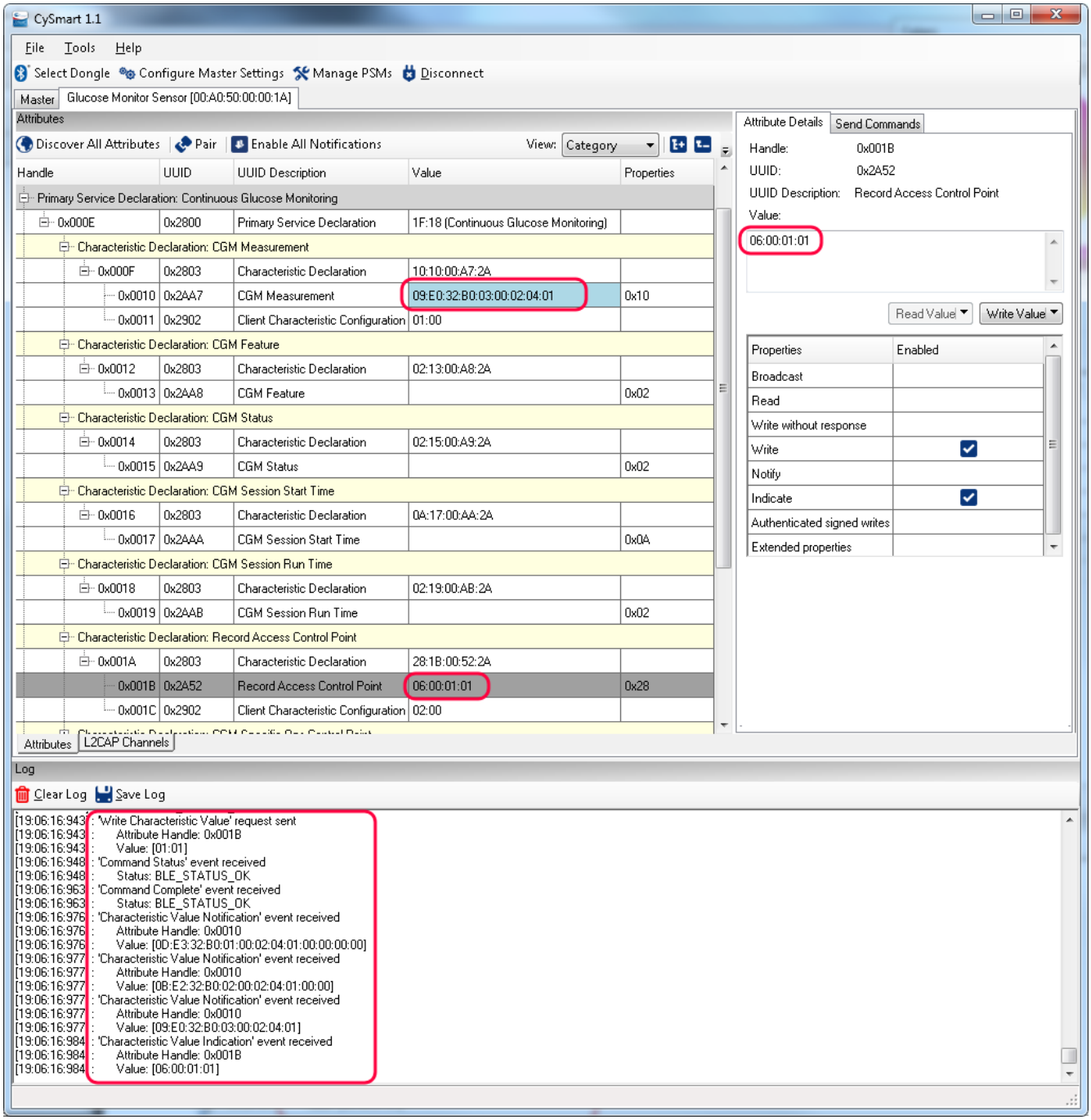
To use the CySmart Windows application as a Continuous Glucose Monitoring Service client:

- Connect the CySmart BLE dongle to a USB port on the PC.
- Launch CySmart app and select the connected dongle in the dialog window.
- Reset the development kit to start advertising by pressing the **SW1** button.
- Click the **Start Scan** button to discover available devices.
- Select the **Glucose Monitor Sensor** in the list of available devices and connect to it.
- Click **Pair**, enter a 6-digit passkey through the terminal, then **Discover All Attributes**, then **Read All Characteristics**, and finally **Enable All Notifications** in CySmart app.

- To reproduce the Continuous Glucose Monitoring Service functionality, for example, select the Record Access Control Point (RACP) characteristic value and write the command “01 01” which means “Report All Glucose Measurement Records” (all these commands are described in detail in [CGMS Specification]):



- Observe the Server send three CGM Measurement characteristic notifications with the simulated data and the RACP indication “06 00 01 01” which means “The < Report All Glucose Measurement Records > command is performed successfully”:



The correspondent example UART log is shown below:

```
Continuous Glucose Monitoring Sensor Example Project
BLE Stack Version: 3.1.0.179
CYBLE_EVT_STACK_ON
Start Advertisement with addr: 00a05000001a
CYBLE_EVT_GAPP_ADVERTISEMENT_START_STOP
state: advertising
CYBLE_EVT_GATT_CONNECT_IND: attId 0, bdHandle 4
```

```
CYBLE_EVT_GAP_DEVICE_CONNECTED: 4
CYBLE_EVT_GATTS_XCNHG_MTU_REQ
other event: 0x33
CYBLE_EVT_GAP_PASSKEY_ENTRY_REQUEST
Enter 6 digit passkey:021953 Passkey is sent
CYBLE_EVT_GAP_ENCRYPT_CHANGE: 1
CYBLE_EVT_GAP_KEYINFO_EXCHNGE_CMPLT
CYBLE_EVT_GAP_AUTH_COMPLETE: security:2, bonding:0,
ekeySize:10, authErr 0
CYBLE_EVT_GATTS_INDICATION_ENABLED
RACP Indication is Enabled
RACP Indication is Enabled
Glucose Notification is Enabled
RACP characteristic is written: 01 01
Opcode: Report stored records
Operator: All records
Cgmt Ntf: 0d e3 32 b0 01 00 02 04 01 00 00 00 00
Cgmt Ntf: 0b e2 32 b0 02 00 02 04 01 00 00
Cgmt Ntf: 09 e0 32 b0 03 00 02 04 01
RACP Ind: 06 00 01 01
RACP Indication is Confirmed
```

The details about the CGMS characteristic data structures are in the CGMS Specification.