

# BLE Heart Rate Sensor Example Project

1.0

## Features

- BLE Heart Rate Service support in the GATT Server role
- Simulating the Heart Rate data
- Reporting the workflow status through UART
- LED status indication

## General Description

This example project demonstrates the BLE Heart Rate Sensor workflow. The project simulates Heart Rate data and performs communication with BLE enabled central/client device.

## Development Kit Configuration

Configure your device as follows:

- The UART RX pin is connected to port 1 pin 4.
- The UART TX pin is connected to port 1 pin 5.
- A mechanical button (port 2 pin 7) is used to wake up the device and start re-advertising.
- The red LED (port 2 pin 6) is used to indicate the BLE disconnection state.
- The green LED (port 3 pin 6) is used to indicate the advertising state.
- The blue LED (port 3 pin 7) is used to indicate the low battery voltage.

## Project Configuration

The top design schematic is shown in **Figure 1**.

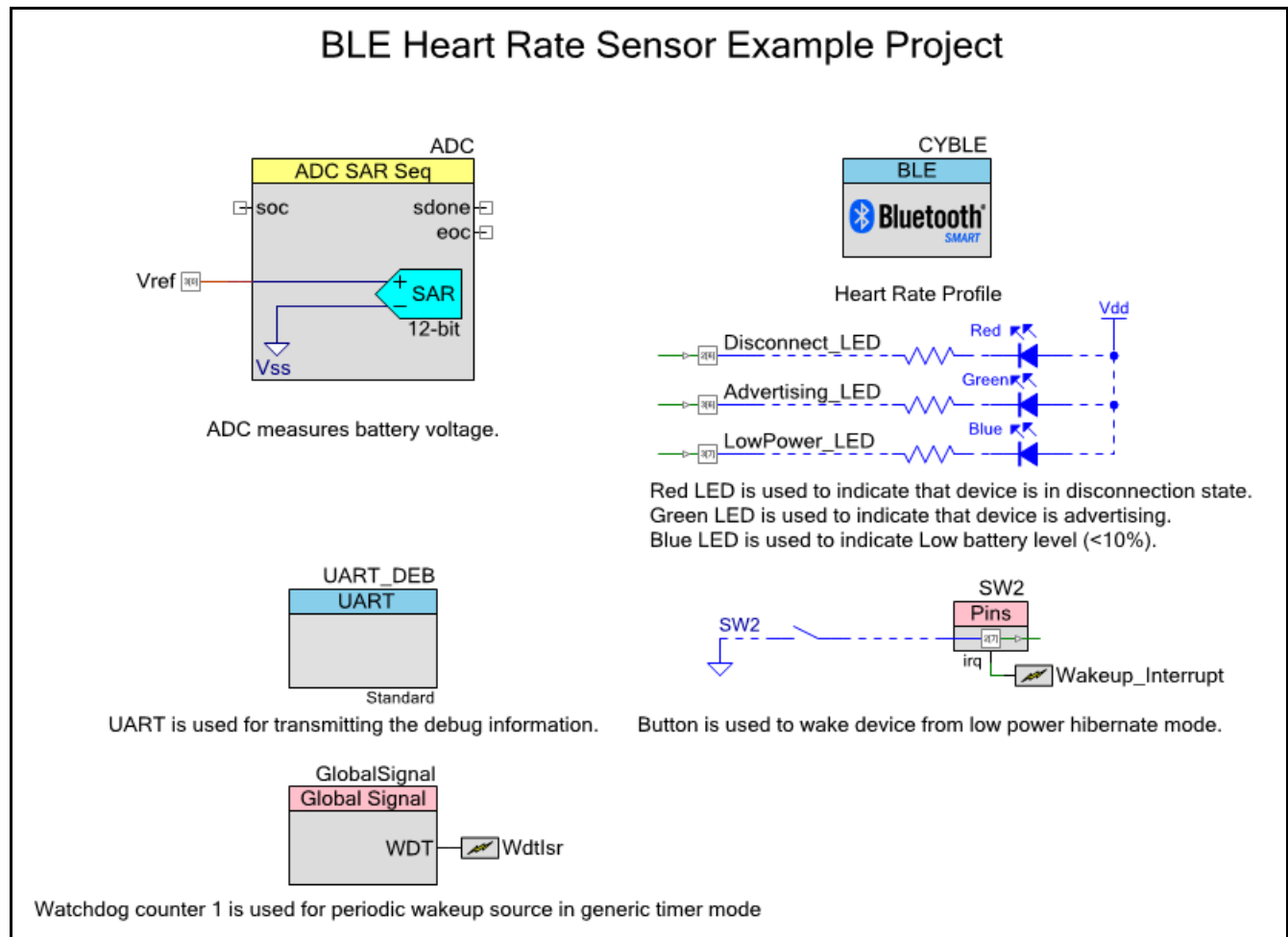


Figure 1. Top design schematic

The BLE component is configured as Heart Rate Sensor.

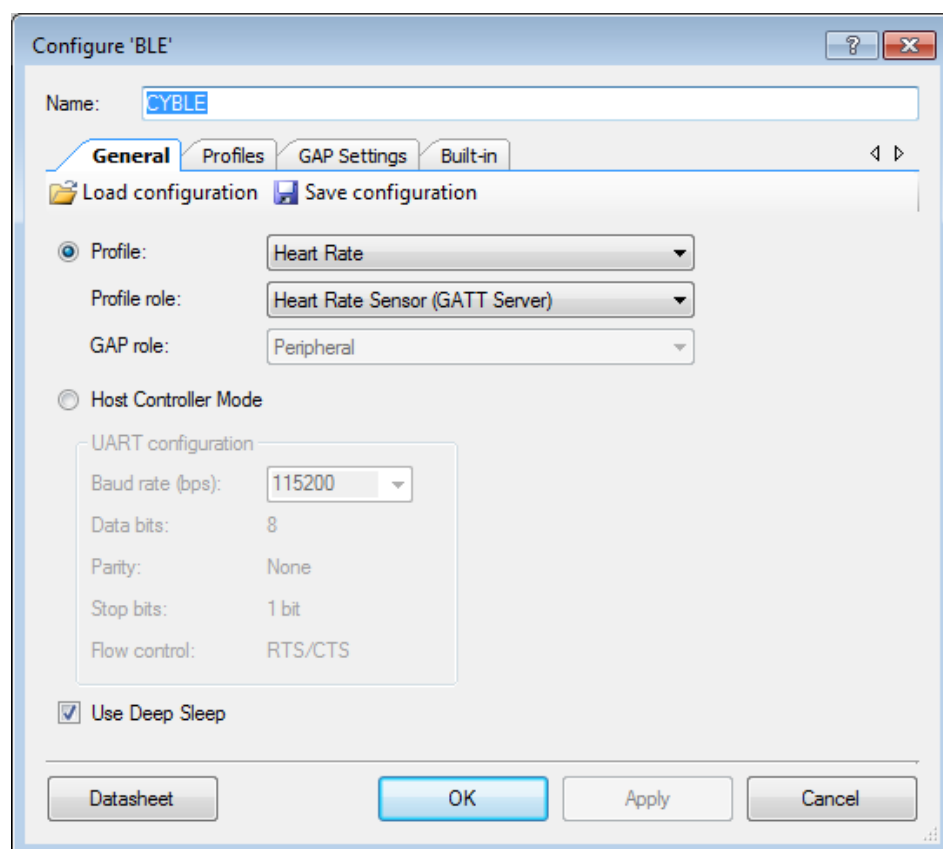


Figure 2. BLE configuration

The GATT settings:

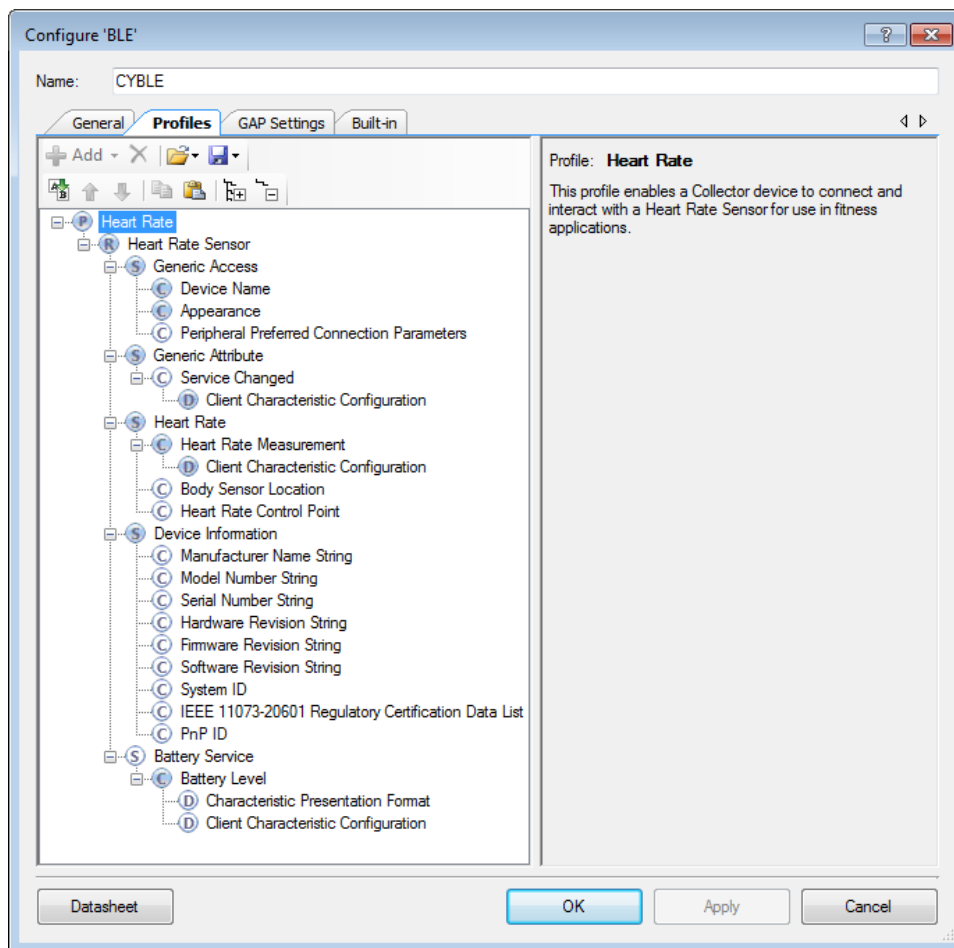


Figure 3. GATT settings

The GAP settings:

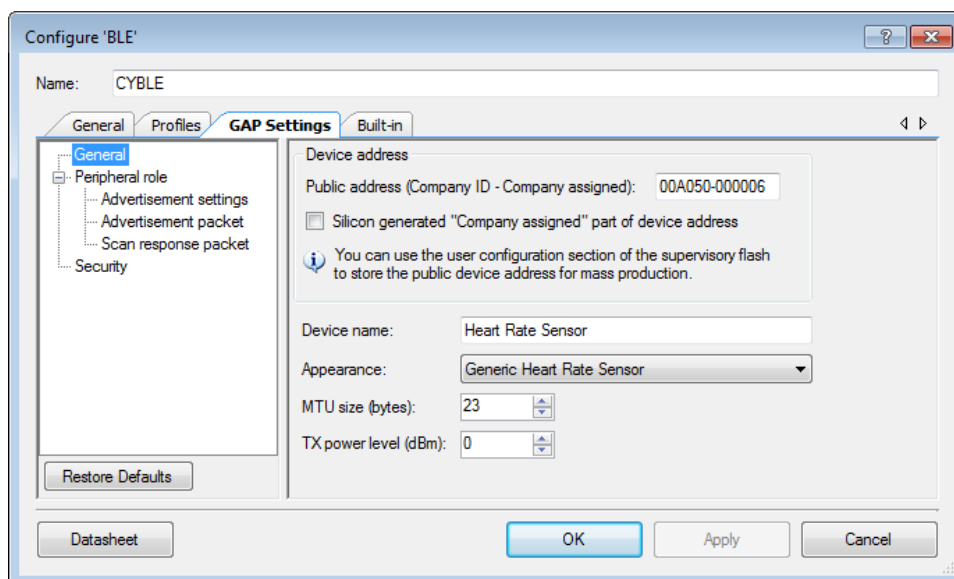


Figure 4. GAP settings

The Advertisement settings:

The screenshot shows the 'Configure BLE' dialog box with the 'GAP Settings' tab selected. The 'Name' field is set to 'CYBLE'. The left sidebar shows a tree view with 'Peripheral role' expanded, and 'Advertisement settings' selected. The main area contains the following settings:

- Discovery mode: General
- Advertising type: Connectable undirected advertising
- Filter policy: Scan request: Any | Connect request: Any
- Advertising channel map: All channels
- Advertising interval:
  - Fast advertising interval:
    - Minimum (ms): 20
    - Maximum (ms): 30
    - Timeout (s): 30
  - ☒ Slow advertising interval:
    - Minimum (ms): 1000
    - Maximum (ms): 2500
    - Timeout (s): 150
- Connection parameters:
  - Connection interval:
    - Minimum (ms): 50
    - Maximum (ms): 70
  - Slave latency: 0
  - Connection supervision timeout (ms): 300

Buttons at the bottom include 'Restore Defaults', 'Datasheet', 'OK', 'Apply', and 'Cancel'.

Figure 5. GAP settings -> Advertisement settings

The Advertisement packet:

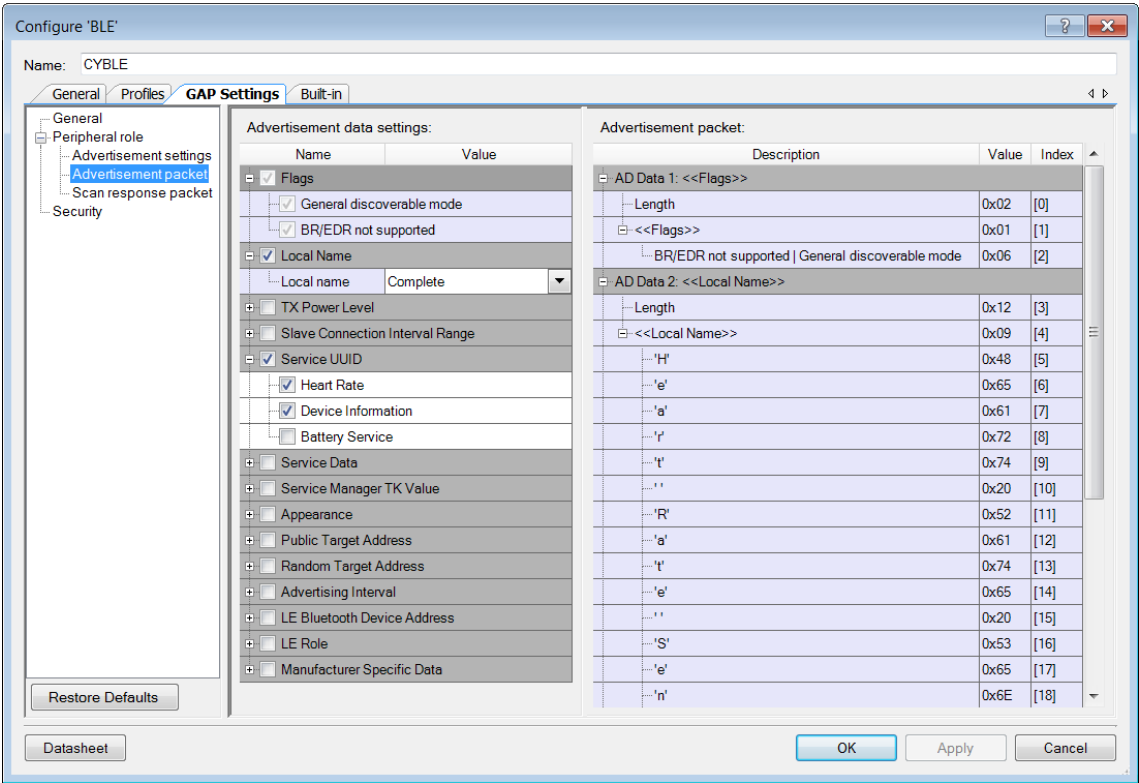


Figure 6. GAP settings -> Advertisement packet

The Scan response packet:

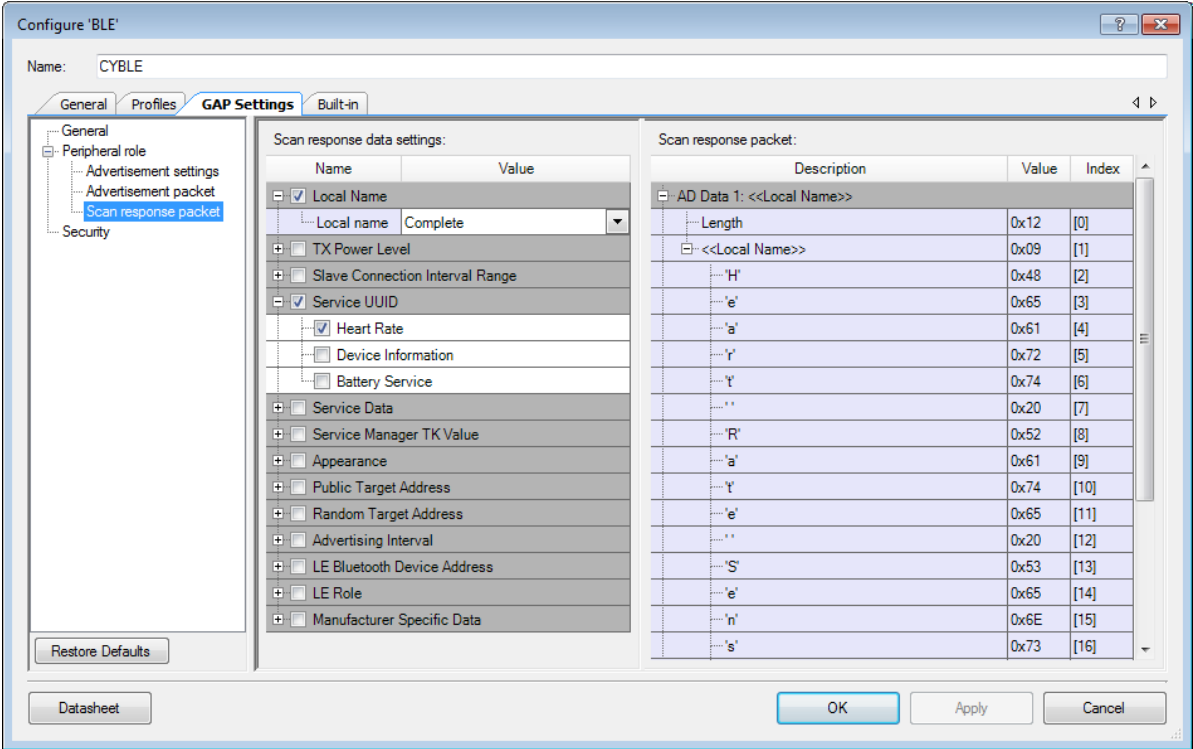


Figure 7. GAP settings -> Scan response packet

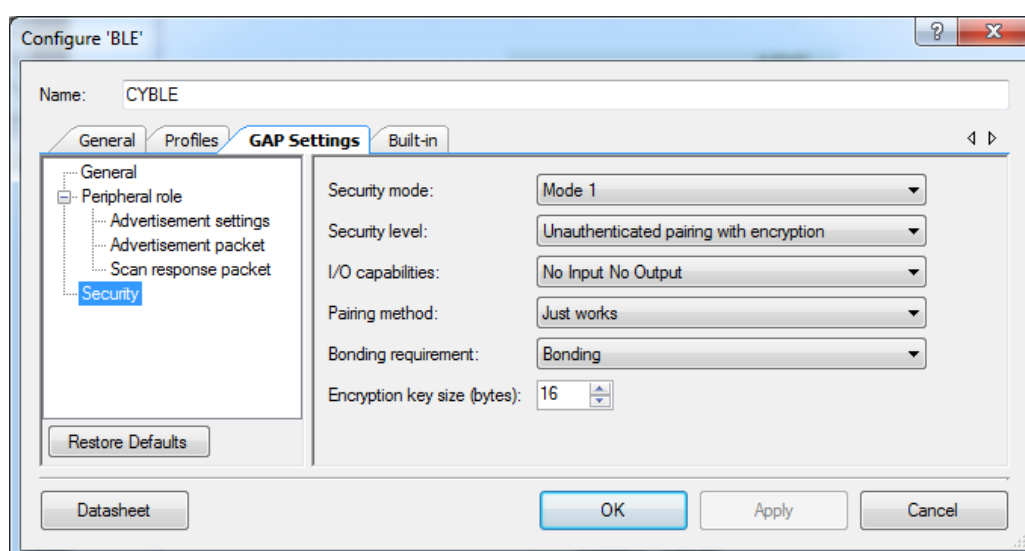
**Security settings:**

Figure 8. Security settings

## Project Description

The project demonstrates the BLE workflow procedures like advertising, connecting, notifying Heart Rate data, Battery Level, etc.

The project is designed so there is no need to initiate any of mentioned actions manually – it automatically starts the BLE Stack, then, when the Stack is on (STACK\_ON event is received), the advertising GAP procedure is initiated. The green LED is blinking while the device is advertising. Once connection request is received, it performs the connection procedure and provides its GATT database (configured in the GATT tab) for discovery process performed by client. The supported services are: Generic Access (GAP) and Attribute (GATT) Services, Heart Rate Service (HRS), Battery Service (BAS) and Device Information Service (DIS). When the Heart Rate notification is enabled by Client, the project starts to simulate all the Heart Rate Service related data (Heart Rate itself, Energy expended, R-R intervals). When the Battery Level notification is enabled by Client, the project starts to measure the voltage on Vref pin and notify the battery level. The WDT is used to timing the simulations, measurements and LED blinking. The blue LED turns on when the battery level value is less than 10%. The red LED is turned on after disconnection to indicate that no Client is connected to the device. On disconnection event the device immediately starts to advertising. When the device connects successfully, both red and green LEDs are turned off.

## Expected Results

The project sends the Heart Rate and Battery Level notifications to the Central Client device which can show them for user. LEDs are blinking as described in Project Description section.

The project is intended to work in pair with the BLE Heart Rate Collector Example Project.

However, it can work with any other BLE-compatible device (e.g. phone, tablet) with appropriate software (with e.g. Android, iOS with installed application which supports Heart

Rate Profile). For instance, you can use CySmart mobile app ([Android](#) / [iOS](#)) as Heart Rate Service client:

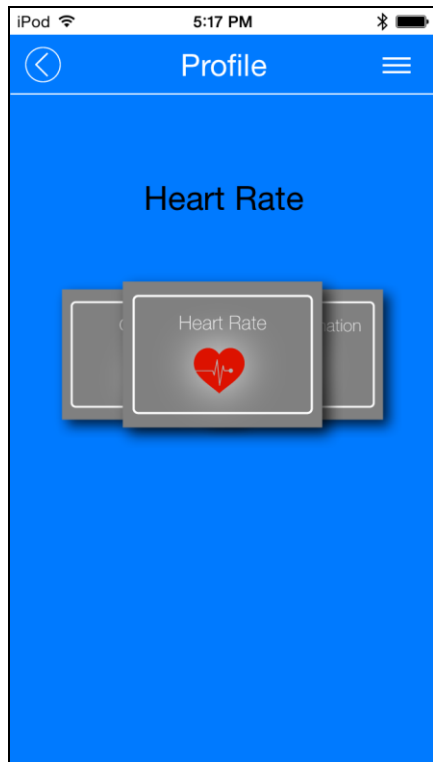


Figure 9. CySmart iOS app



Figure 10. CySmart Android app

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

Optionally project can send log messages through UART. The example log is shown below:



```
BLE Heart Rate Sensor Example Project
EVT_STACK_ON
Start Advertisement with addr: 00a050000006
EVT_ADVERTISING
EVT_GATT_CONNECT_IND: attId 0, bdHandle 4
EVT_GAP_DEVICE_CONNECTED: 4
EVT_GATTS_XCNHG_MTU_REQ
EVT_GAP_AUTH_REQ EVT_GAP_ENCRYPT_CHANGE: 1
EVT_GAP_AUTH_COMPLETE: security:2, bonding:1, ekeySize:10, authErr 0
Heart Rate Measurement Notification is Enabled
Heart Rate Notification is sent successfully, Heart Rate = 72
Heart Rate Notification is sent successfully, Heart Rate = 84
Heart Rate Notification is sent successfully, Heart Rate = 96
Heart Rate Notification is sent successfully, Heart Rate = 108
Heart Rate Notification is sent successfully, Heart Rate = 120
Heart Rate Notification is sent successfully, Heart Rate = 132
Heart Rate Notification is sent successfully, Heart Rate = 144
```

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