BLE Environmental Sensing Profile

1.0

Features

- BLE ES Service Sensor (GATT Server) role operation
- Low Power mode
- LED status indication

General Description

This example project demonstrates the Environmental Sensing Profile operation of the BLE PSoC Creator Component. The Environmental Sensor utilizes the Environmental Sensing Profile with one instance of Environmental Sensing and Device Information Services to simulate wind speed measuring. The Environmental Sensor operates with other devices that implement the Environmental Collector Profile. The device switches to the DeepSleep mode between BLE connection intervals. The BLE component supports the PSoC 4 BLE and PRoC BLE family devices.

Development Kit Configuration

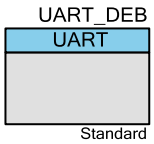
- Default CY8CKIT_042 BLE Pioneer Kit configuration

Project Configuration

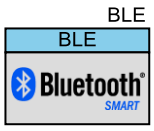
The top design schematic is shown in **Figure 1**.

Figure 1. Top Design Schematic

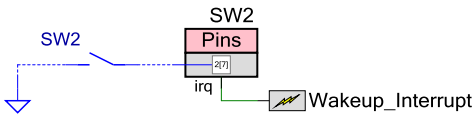
BLE Environmental Sensing Profile Example Project



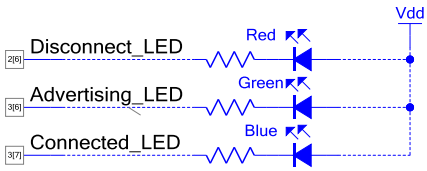
UART is used for transmitting debug information.



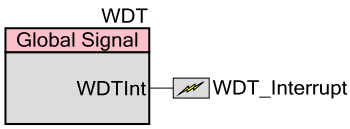
BLE component configured to demonstrate operation of Environmental Sensing Sensor device.



The button is used to wake the device up from the hibernate mode. In connected state it is used to change a value of the ES Configuration Descriptor.



The red LED is used to indicate that the device is disconnected. The green LED is used to indicate that the device is advertising. The blue LED is used to indicate that the device is connected.



WDT is used for LED blinking and for counting profile specific timeouts.

The BLE component is configured as Environmental Sensor in the GAP Peripheral role with the settings shown in the figures below.

Figure 2. GATT Settings

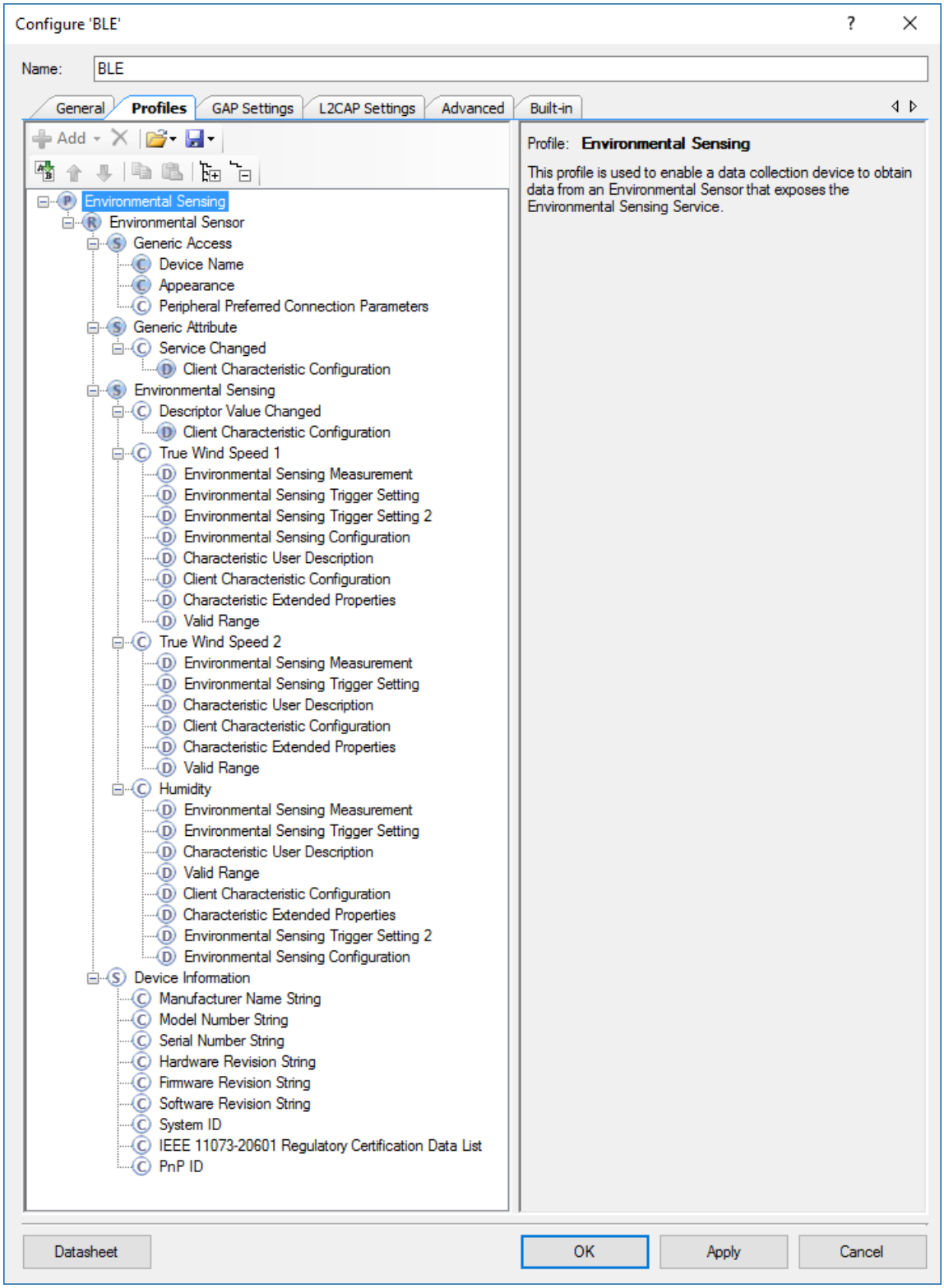


Figure 3. GAP Settings

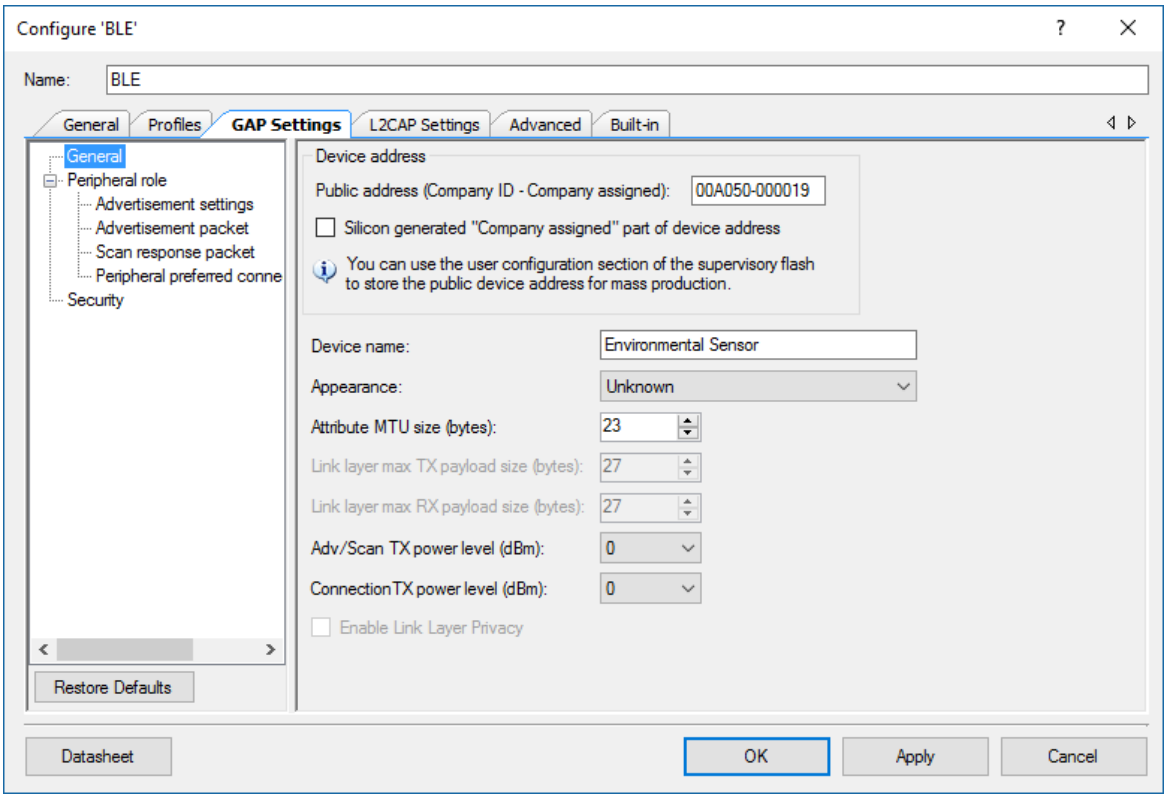


Figure 4. GAP Settings -> Advertisement Settings

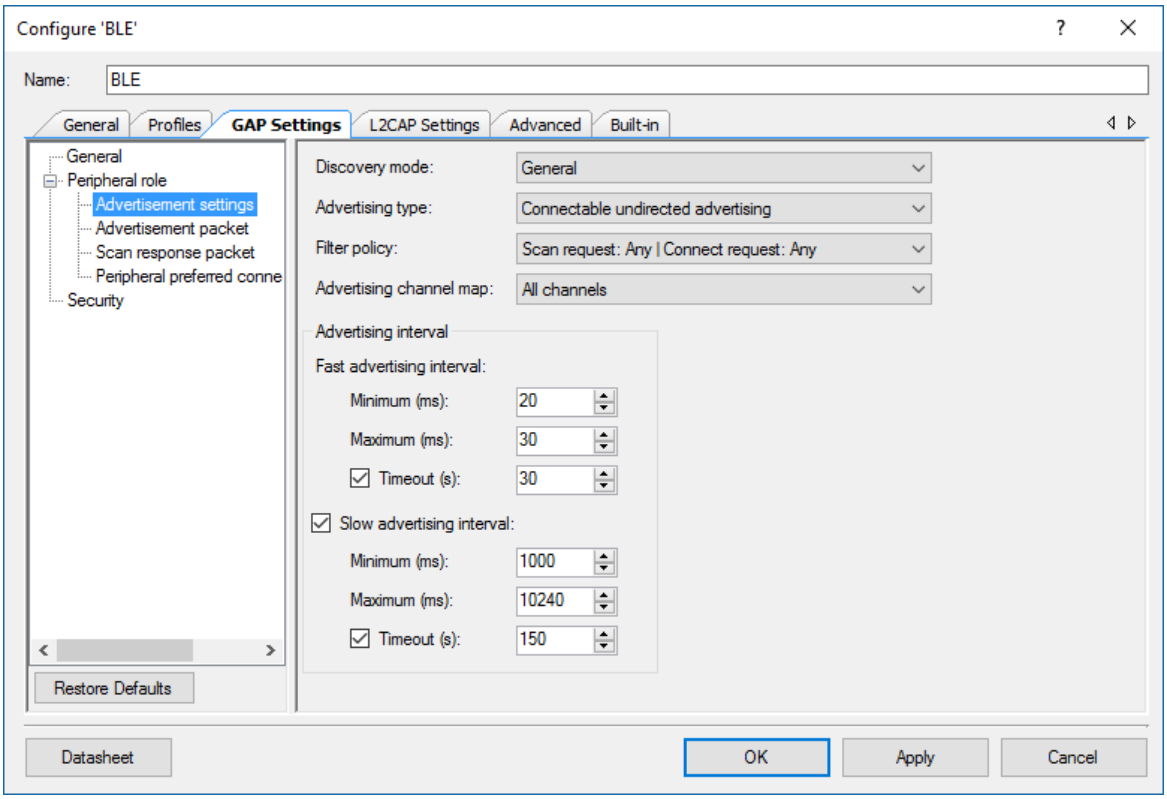


Figure 5. GAP Settings -> Advertisement Packet

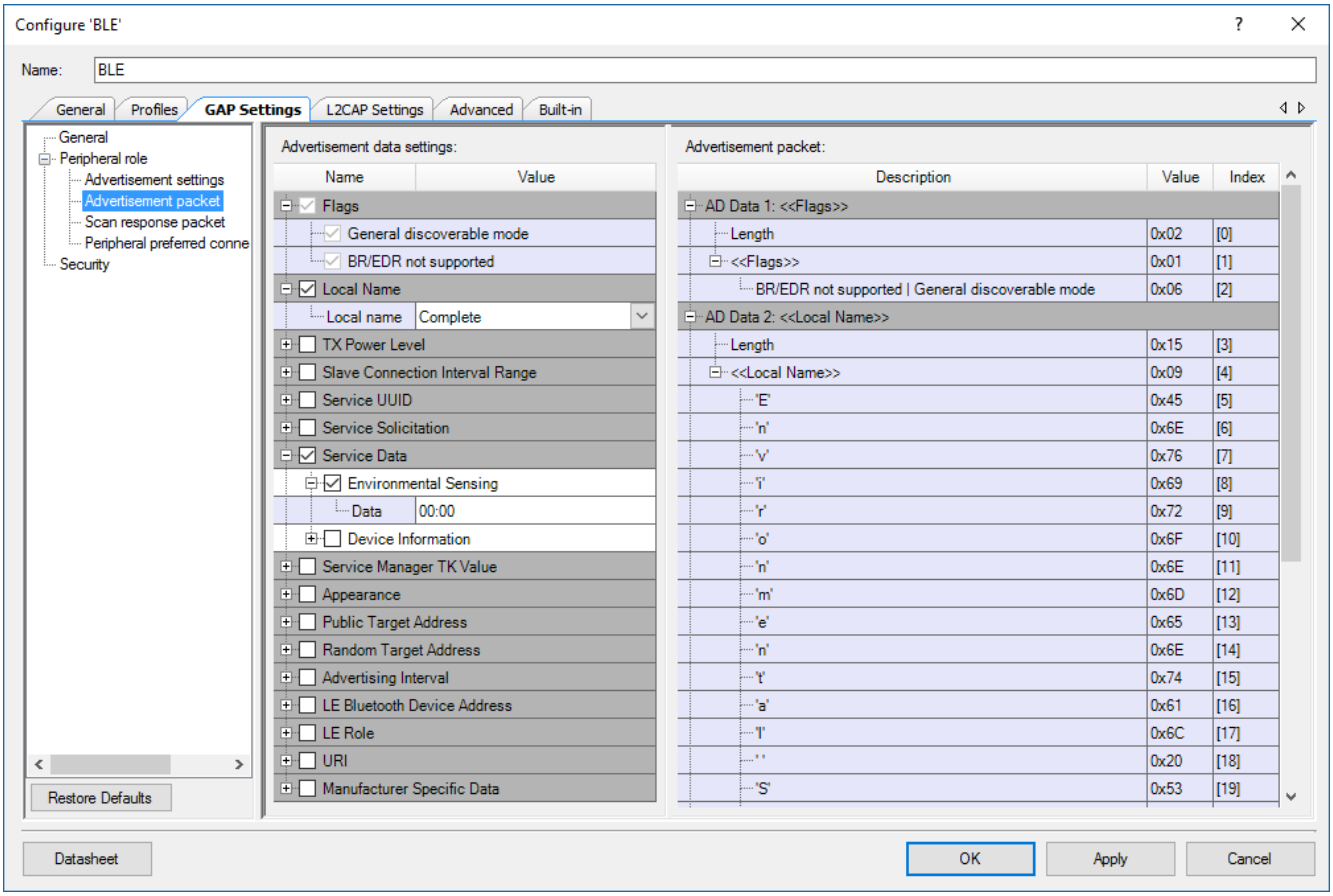
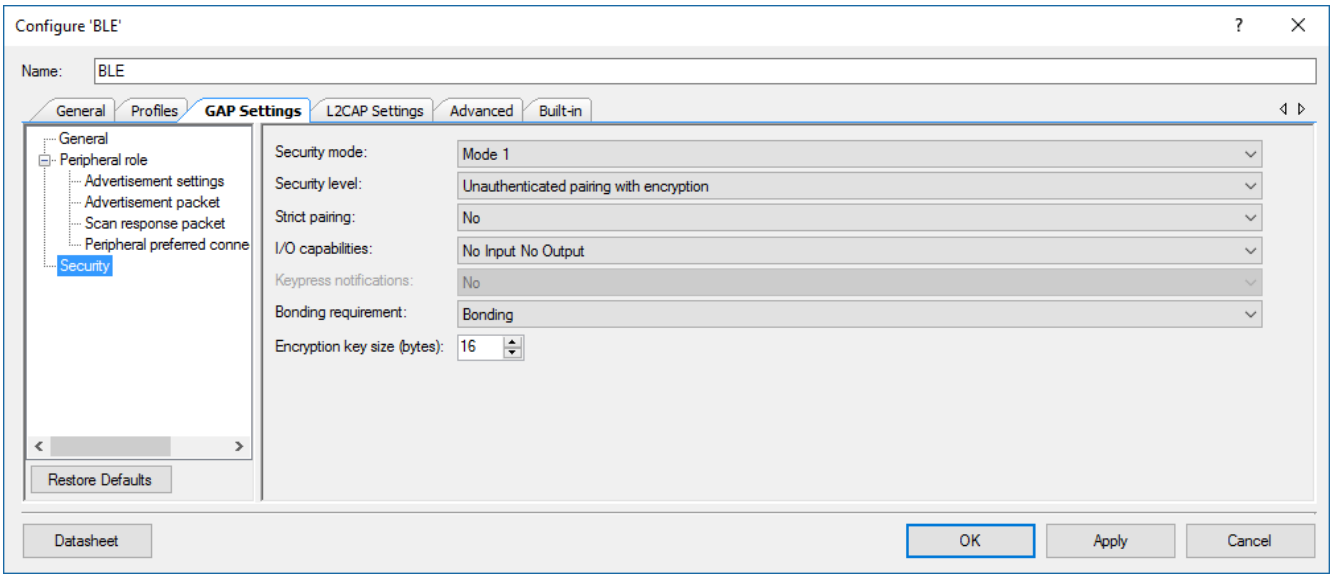


Figure 6. Security Settings



Project Description

The project demonstrates the core functionality of the BLE component configured as an Environmental Sensor.
Right after a startup the device performs initialization of the BLE component. In this project several callback functions are used for the BLE operation. One callback function (AppCallBack()) is required for receiving generic events from the BLE, EssCallBack() is required for receiving events from the Environmental Service. The CYBLE_EVT_STACK_ON event indicates successful initialization of the BLE Stack. After this event is received, the component starts fast advertising with the packet structure as configured in the BLE component customizer (see **Figure 4**). Once the 30-second advertising period expires, the component switches to the slow advertisement parameters. On an advertisement event timed out, the device goes to Low Power mode (Hibernate mode) and waits for a SW2 button press to wake up the device again.

You can connect to the Environmental Sensor device with a BLE 4.0 or BLE 4.1 compatible device configured in the GAP Central role and capable of discovering the Environmental Sensing Service. To connect to an Environmental Sensor device, send a connection request to the device when the device is advertising. The green LED is blinking while the device is advertising. If the Client is connected to the Environmental Sensor, the blue LED is turned on.

While connected to the Client and between connection intervals, the device is put into DeepSleep mode.

Wind Speed and humidity measuring simulation

The example project simulates data measured from two wind speed sensors (True Wind Speed Speed#1 and True Wind Speed Speed#2) and humidity sensor. Each of the sensors is configured to provide new measurement with respect to its Update Interval set in the ES Measurement Descriptor. Update Interval for True Wind Speed Speed#1and #2 is configured for 15 and 5 seconds respectively. Update Interval for Humidity is configured for 10 seconds. Each of the sensors also has its Measurement Period which is 60 seconds for True Wind Speed Speed#1, 90 seconds for True Wind Speed Speed#2 and 40 seconds for Humidity. For more info on Measurement Period and Update Interval refer to the Environmental Sensing Service specification. The device is configured to send notifications to the remote Client based on the trigger conditions captured in ES Trigger Settings Descriptors. Maximum number of ES Trigger Settings Descriptors is 3. Depending on the configuration in the ES Configuration Descriptor, the conditions in ES Trigger Settings Descriptors can be ORed or ANDed. The User Characteristic Descriptor is used for assigning the human-readable name of the Characteristic. The ES Trigger Settings, ES Configuration and User Characteristic Descriptor Descriptors are writable and can be set by the remote Client.

The example project allows configuring the simulation via the Customizer's GUI. The Measuring Period and Update Interval can be set in the ES Measurement Descriptor. The notification conditions can be configured in ES Trigger Settings Descriptor. Each of the characteristics can be assigned with default name through the User Characteristic Descriptor. The Valid Range Descriptor can be used to define the allowed ranges for the characteristic. In current example project the ranges are set to the maximum possible values.
The first wind sensor simulates an increase in the wind speed by 1.2 m/s each 15 seconds until it reaches the maximum of 80 m/s. Then the wind speed falls down to the minimum of 10

m/s, and then again it is increased by 1.2 m/s each 15 seconds. The second wind sensor simulates an increase in the wind speed by 0.2 m/s each 5 seconds until, it reaches the maximum of ~90 m/s. But notification of this parameter is every 20 seconds, because ES Trigger Settings Descriptor is set to **"No less than the specified time between transmissions"** in this example project and specified time is set to 20 seconds. The humidity sensor simulates an increase in the humidity by 1.40% each 10 seconds until it reaches the maximum of 99.00%. Then the humidity falls down to the minimum of 2%, and then again it is increased by 1.40% each 10 seconds. But value between 20.00% and 40.00% not notificated, because ES Trigger Settings Descriptor is set to **"While less than the specified value"** (specified value is set to 20.00)**,** ES Trigger Settings Descriptor 2 is set to **"While greater than the specified value"** (specified value is set to 40.00) and ES Configuration is set to **"Boolean OR"** for humidity in this example project. After that the speed is not updated any more holding the maximum wind speed.

Using UART for debugging

In the example project UART component is used for printing various debug information. The printing of debug information is enabled by default but it can be disabled by changing the constant DEBUG_UART_ENABLED (common.h) from "YES" to "NO".

A HyperTerminal program is required in the PC to receive debugging information. If you don't have a HyperTerminal program installed, download and install any serial port communication program. Freeware such as HyperTerminal, Bray's Terminal, Putty etc. is available on the web.

1. Connect the PC and kit with a USB cable.
2. Open the device manager program in your PC, find the COM port in which the kit is connected, and note the port number.
3. Open the HyperTerminal program and select the COM port in which the kit is connected.
4. Configure Baud rate, Parity, Stop bits and Flow control information in the HyperTerminal configuration window. By default, settings are following: Baud rate – 115200, Parity – None, Stop bits – 1 and Flow control – XON/XOFF. These settings have to match the configuration of the PSoC Creator UART component in the project
5. Start communicating with the device as explained in the project description.

Expected Results

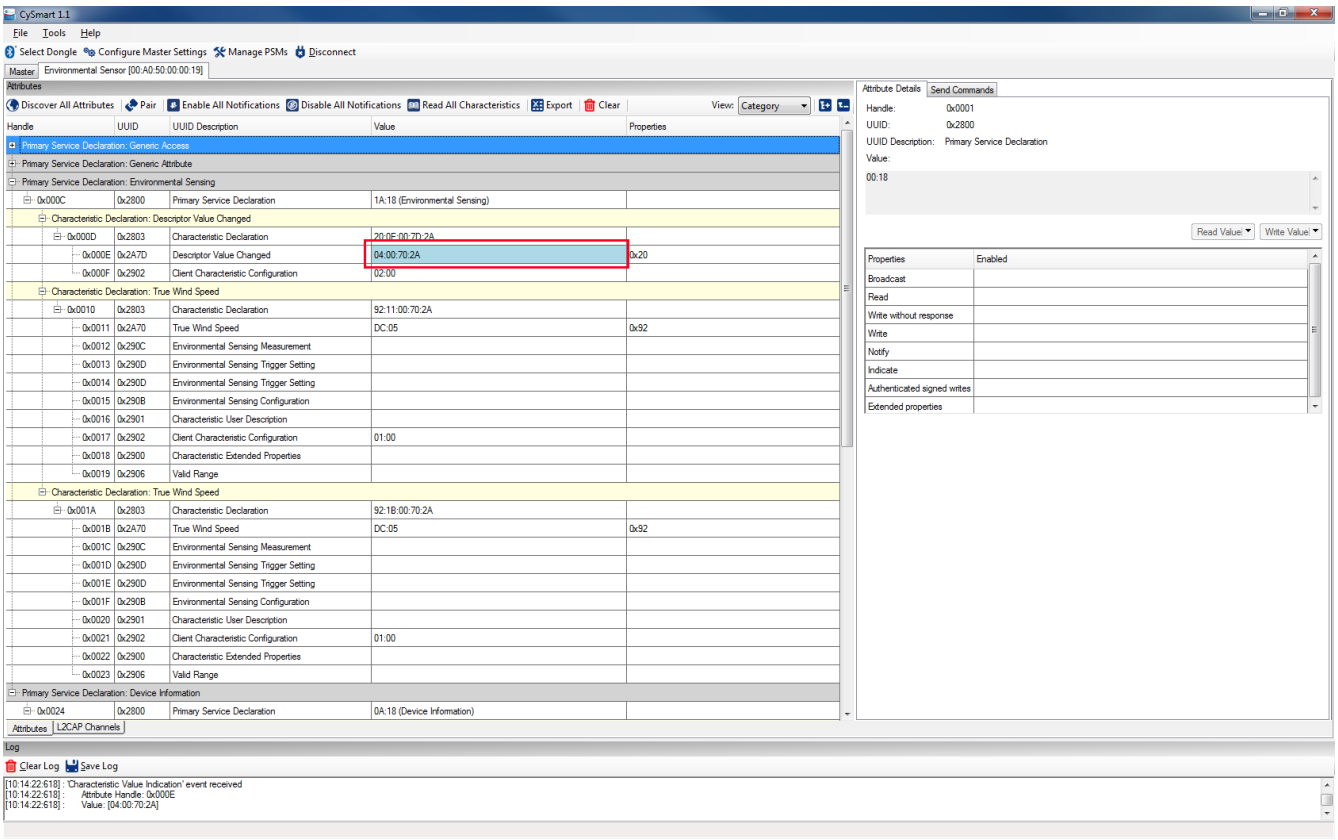
You can use CySmart app on a Windows PC, Android or iOS BLE-compatible device as a Client for connection to the Environmental Sensor.

To use the CySmart Windows application as an Environmental Sensing Client:

- Connect the CySmart BLE dongle to a USB port on the PC.
- Launch the 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.

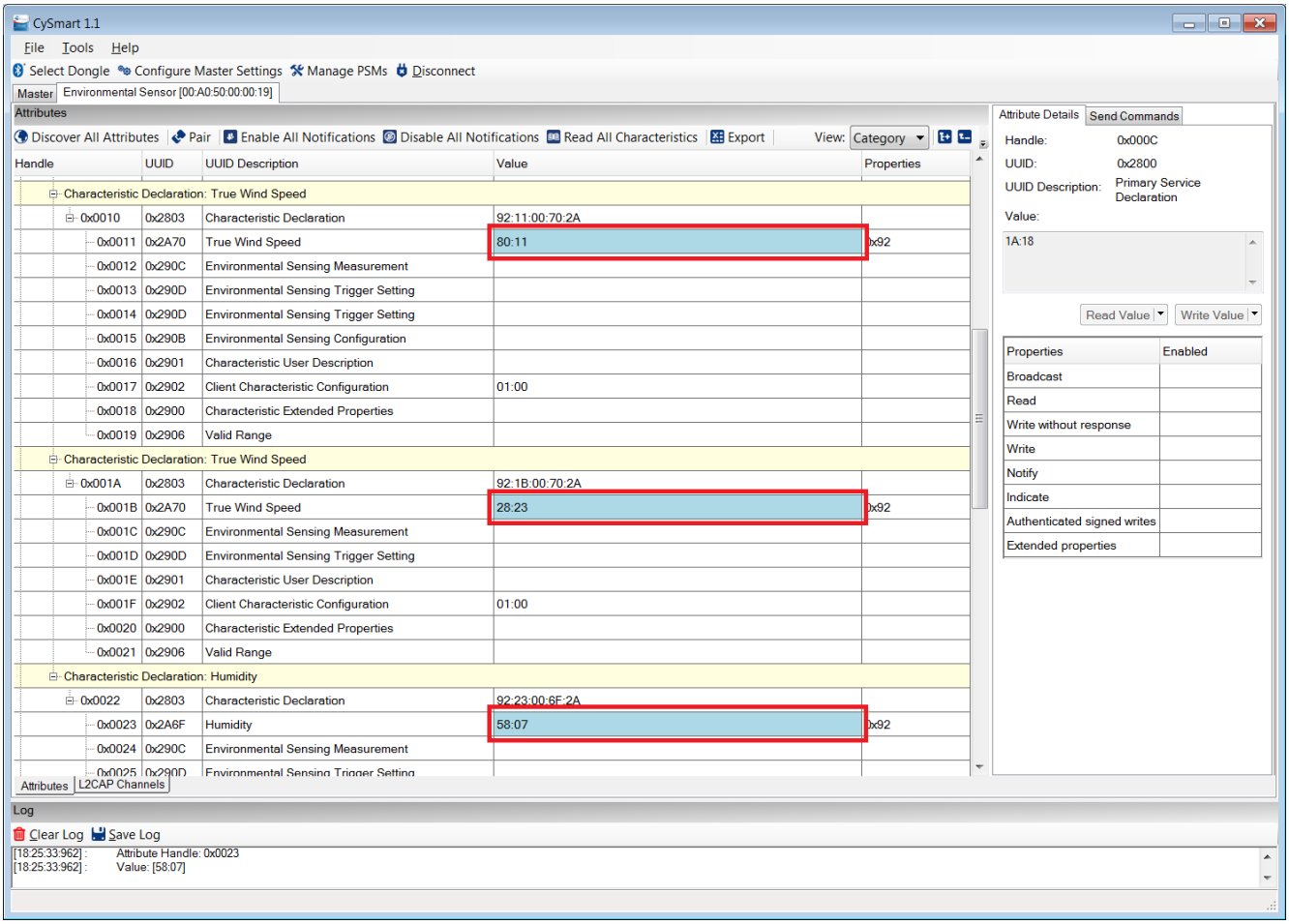
- Select **Environmental** in the list of available devices and connect to it.
- Click **Pair**, then **Discover All Attributes**, then **Read All Characteristics**, and finally **Enable All Notifications** in the CySmart app.
- Press the SW2 button on the kit and observe the indication about ES Configuration Descriptor change**:**

Figure 7. CySmart Windows app: Descriptor Value Changed Characteristic Indication



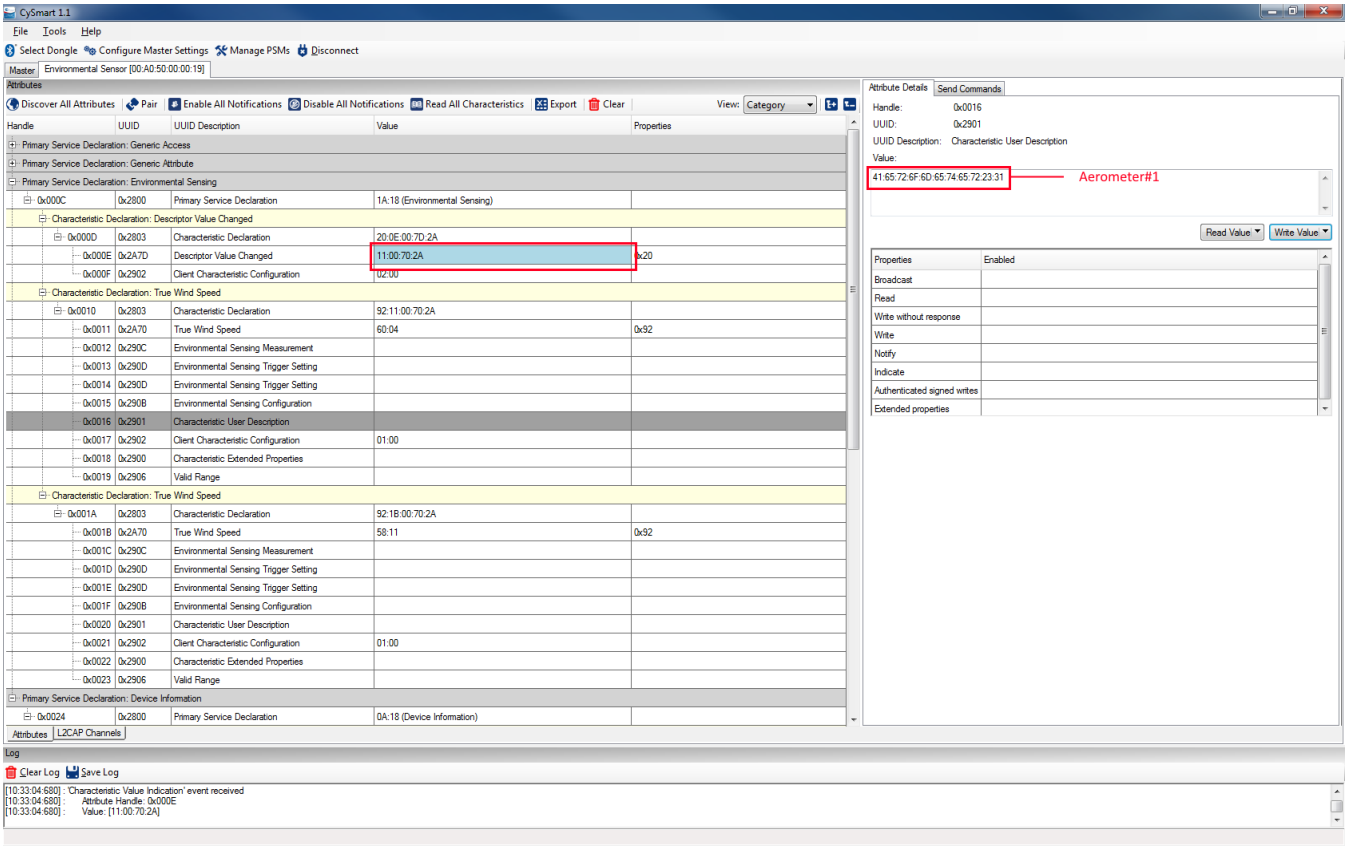
- Wait for at least 90 seconds (simulation of the measurement period) and observe that notifications for both of the True Wind Speed and Humidity Characteristics are received**:**

Figure 8. CySmart Windows app: True Wind Speed and Humidity Characteristics Notification



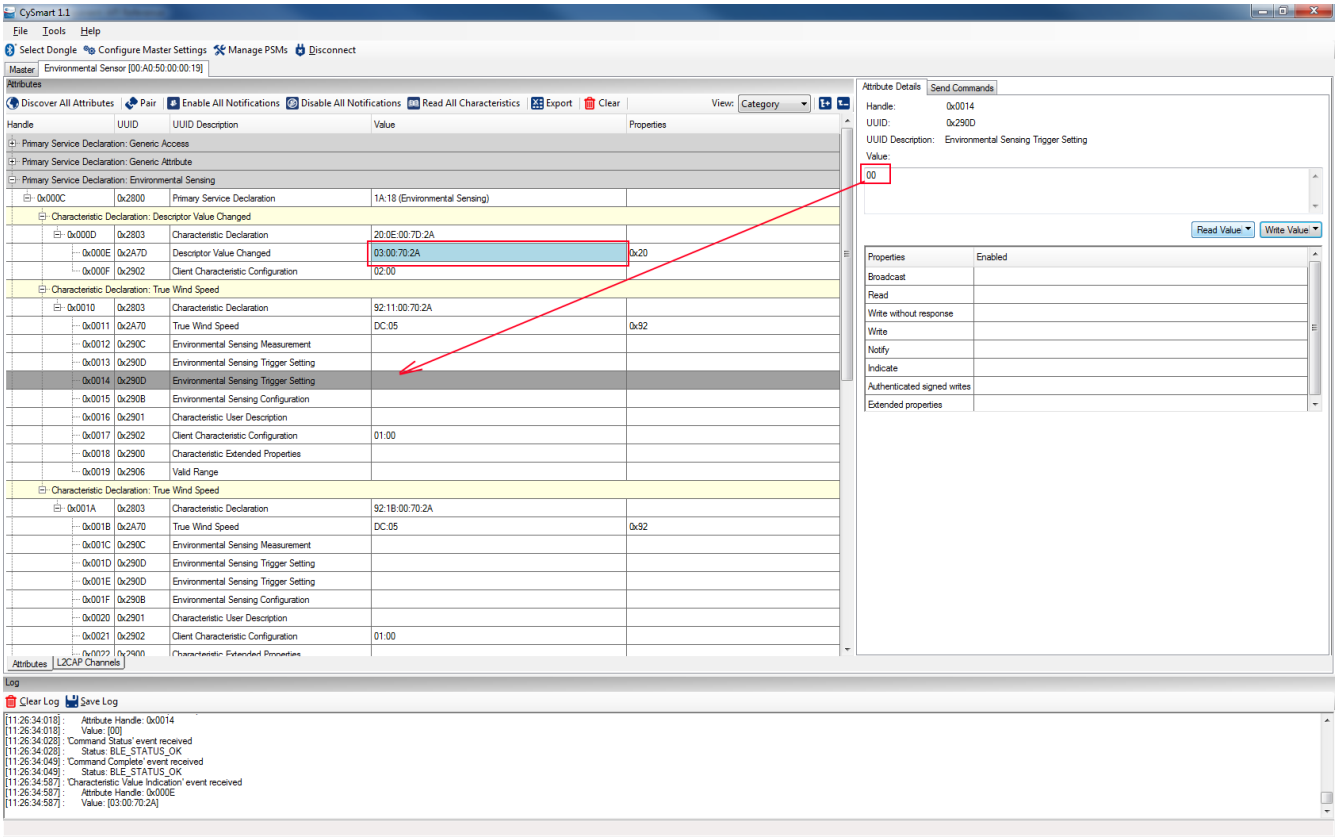
- Write a human readable name for a Characteristic to **Characteristic User Description Descriptor (UUID 0x2901),** press the **Write Value** button the press **Read Value** and observe the Descriptor Value Changed Characteristic indication with regard to that. Before writing the descriptor value should be converted to the ASCII numbers first. On the **Figure 9** the name “Aerometer#1” - 41:65:72:6F:6D:65:74:65:72:23:31 (ASCII) is used.

Figure 9. CySmart Windows app: Writing to Characteristic User Description Descriptor



- Write the **0x00** value to the second **ES Trigger Settings Descriptor (UUID 0x290D)**, press **Write Value** button and observe the Descriptor Value Changed Characteristic indication with regard to that:

Figure 10. CySmart Windows app: Writing to ES Trigger Descriptor



The details about the Environmental Sensing Service characteristic data structures are in the ESS Specification.

If you have problems with usage of the CySmart app, please, refer to CySmart User Guide.