PSoC 4 BLE - I2C-BLE Central Role

Objective

This example demonstrates how to use PSoC 4 BLE device as I2C-BLE Central device.

Overview:

This code example uses a custom BLE profile to demonstrate the I2C-BLE central functionality. It scans and connects to I2C_BLE peripheral device with a predefined data in the scan response. The notification data received is updated to I2C Read registers and the data written by the I2C master is updated to the GATT DB of the peripheral.

Requirements:

Programming Language	**:** C (GCC 4.8.4)
Associated Parts	**:** PSoC 4 BLE
Required software	**:** PSoC Creator 3.1 SP2, Bridge Control Panel 1.12.0.2043 , PSoC Programmer 3.22.3
Required hardware	**:** CY8CKIT-042-BLE Bluetooth® Low Energy (BLE) Pioneer Kit
Optional hardware	**:** Bluetooth sniffer

Project Description:

This project demonstrates the following.

- I2C-BLE Client implementation
- Connection with I2C_BLE peripheral
- Low power implementation for coin-cell operation

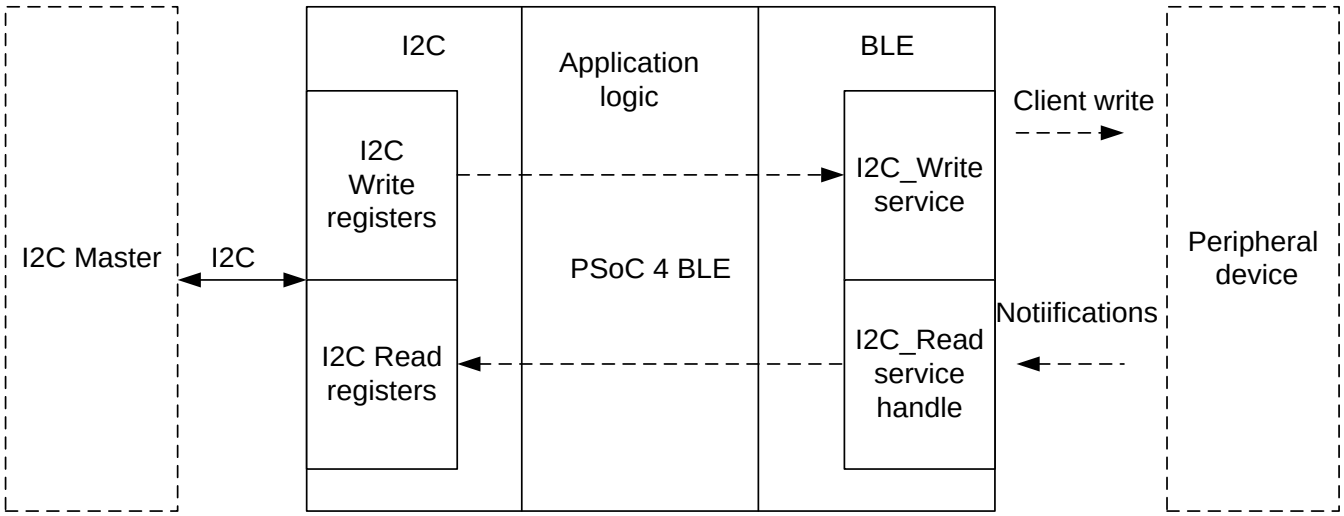
The BLE component is configured to work as GATT Client and GAP central role. Upon power on its initializes the stack and scans and connects to an I2C_BLE peripheral device which has predefined data in the scan response if it is advertising. The scan response should have manufacturing specific data with the manufacturer field set to Cypress Semiconductor and the data being the “I2C” for the central device to connect to it.

After the connection is established, it identifies the supported services, the characteristics handle and the characteristics descriptor handle with the help of predefined UUID. It also enables the notifications from the peripheral device.

The notifications data received is updated to the I2C read registers for the I2C master to read and the data written by the I2C master is updated to the GATT DB of the peripheral device.

A simple block diagram of the implementation is shown in the figure 1.

Figure 1. Block diagram of the implementation



The project consist of the following files:

Main.c/.h

These files contain the main function, which is the entry point and execution of the firmware application. It also contains function definition for initialization of the system.

App_BLE.c/.h

These files contain all the macros and function definitions related to BLE communication and operation. It contains the event callback function definition that is registered with the BLE component startup and used by the component to send BLE-related events from the BLE stack to the application layer for processing.

Low_power.c/.h

These files contain the function to handle low-power mode. This function is continuously called in the main loop and is responsible for pushing the BLE hardware block (BLESS) as well as the CPU to Deep Sleep mode as much as possible. The wakeup source is either the BLE hardware block Link Layer internal timer or the interrupt from the I2C address match. This allows for very low power mode implementation and operation using a coin cell.

App_I2C.c/.h

These files contain the function to handle the I2C read and write activity.

Config.h

This file has macros to enable or disable – Low power mode implementation and LED indication

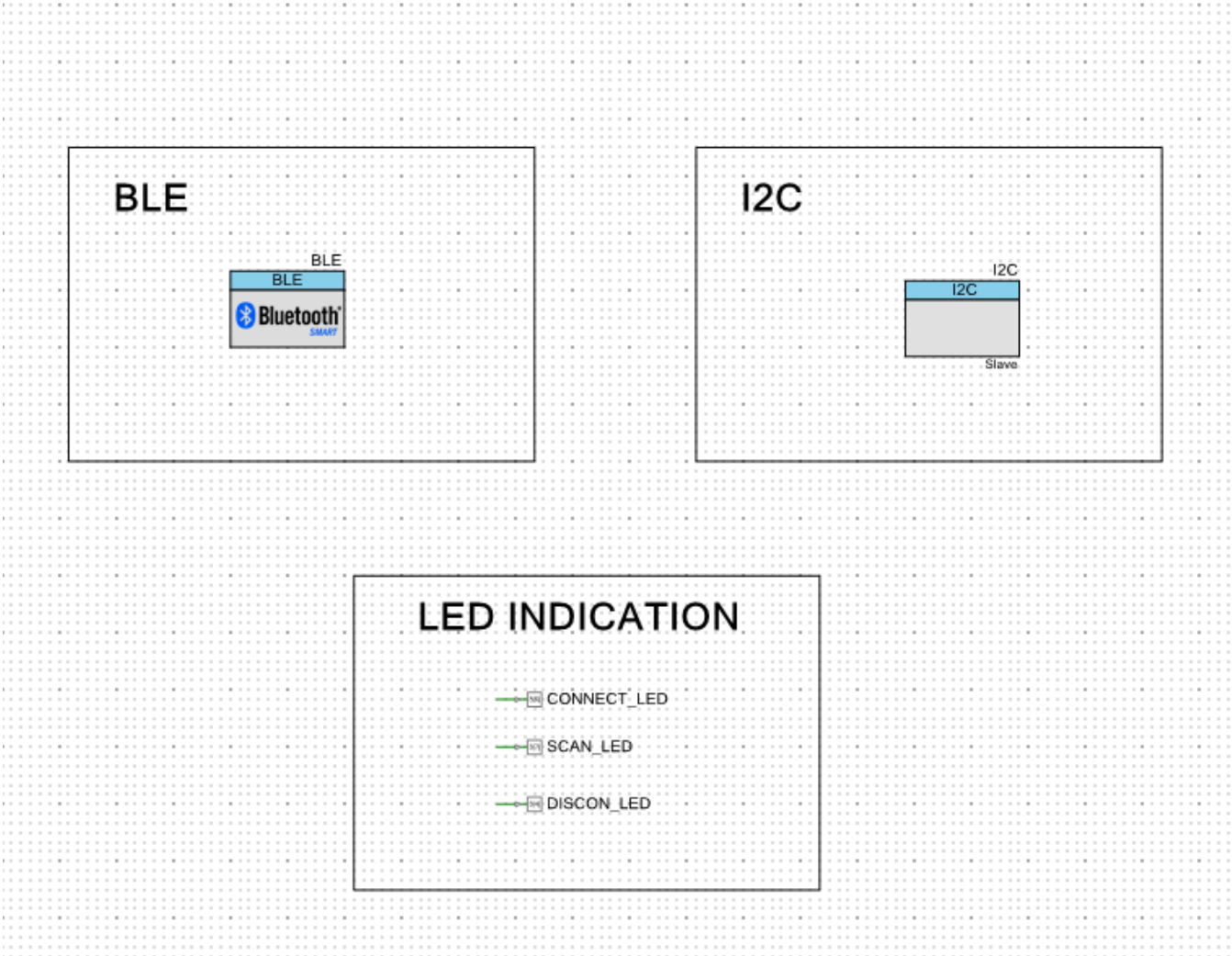
Additionally there are LED indications to show the state of the device.
BLUE LED – Device is in scanning state
RED LED – Device is in disconnected state
GREEN LED – Device is in connected state

To measure the best power consumption number, disable the LED indication.

The SWD pin are configured as GPIO to get the lowest possible current consumption number.

The top design of the project is shown in the figure 2 below.

Figure 2 Top Design for I2C_BLE peripheral Project



Hardware Connections

No specific hardware connections are required for this project because all connections are hardwired on the BLE Pioneer Baseboard. Ensure that the module is placed on the baseboard correctly.
The pin assignment for this project is in **I2C_BLE_Bridge_Client.cydwr** in the Workspace Explorer, as shown in Figure 3
Figure 3 Pin Selection for I2C_BLE_Bridge_Client Project

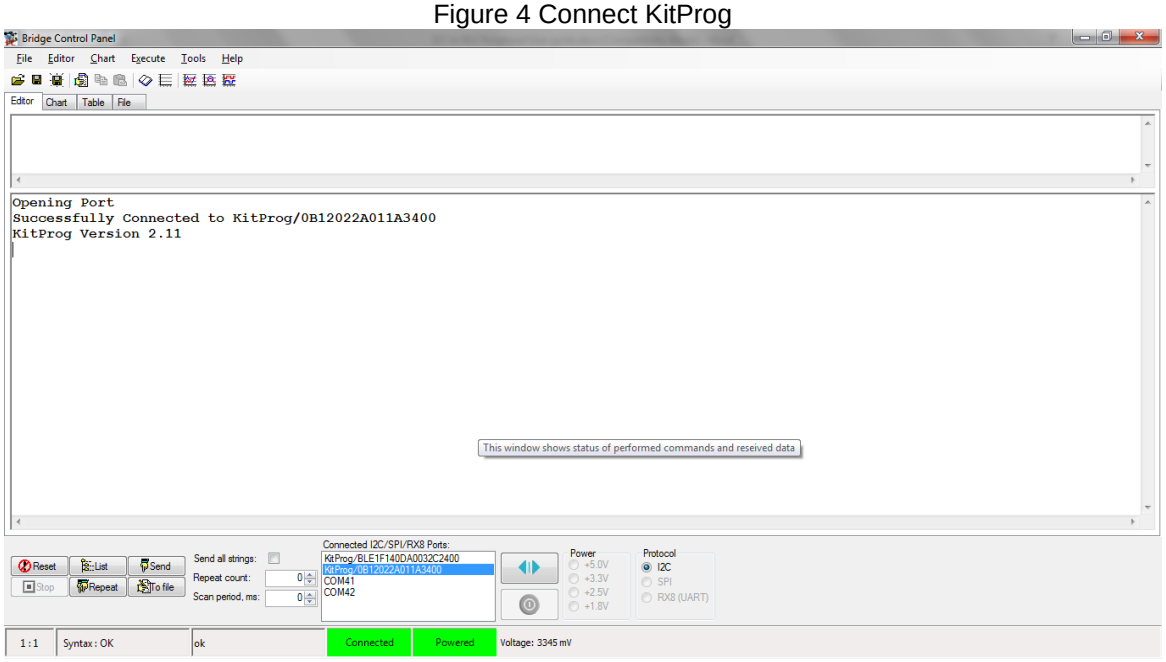
Alias	Name	Port	Pin	Lock
	\I2C:scl\	P3[5] SARMUX:pads[5], TCPWM2:line_out_compl, SCB1:uart_tx, SCB1:i2c_scl	52	☑
	\I2C:sda\	P3[4] SARMUX:pads[4], TCPWM2:line_out, SCB1:uart_rx, SCB1:i2c_sda	51	☑
	CONNECT_LED	P3[6] SARMUX:pads[6], TCPWM3:line_out, SCB1:uart_rts	53	☑
	DISCON_LED	P2[6] OA0:vplus_alt	43	☑
	SCAN_LED	P3[7] SARMUX:pads[7], TCPWM3:line_out_compl, SCB1:uart_cts, SRSS:ext_clk_lf	54	☑

Verify Output

Steps to test

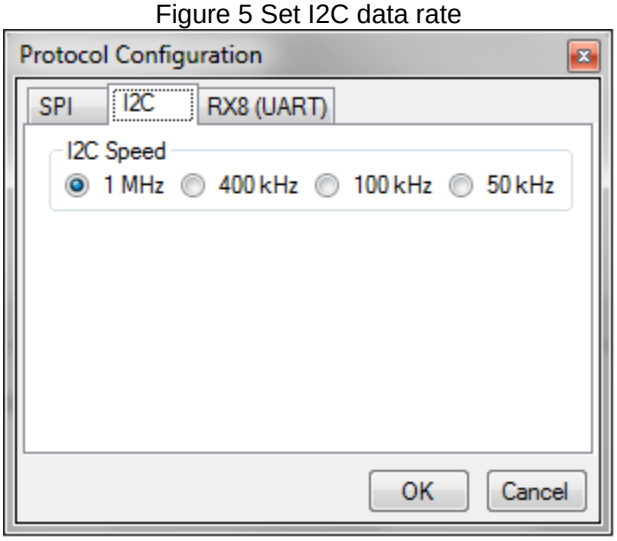
1. Place CY8CKIT-142 module on the BLE Pioneer Kit.
2. Program the BLE Pioneer Kit with the I2C_BLE_Bridge project.
3. After successful programming the BLUE LED will glow indicating that the device is in advertisement mode. This is the peripheral device
4. Repeat steps 1 to 3 on the second board.
5. Program the second kit with I2C_BLE_Bridge_Client project.
6. After successful programming the BLUE LED will glow indicating it is scanning for peripheral device. This is the central device
7. The central device will connect to peripheral indicated by GREEN LED turning on both kits.
8. Open Bridge control panel and connect Kitprog of the peripheral device

Figure 4 Connect KitProg



9. Click on Tools->Protocol configurations or press F7.
10. Set the I2C data rate to 1 Mbps

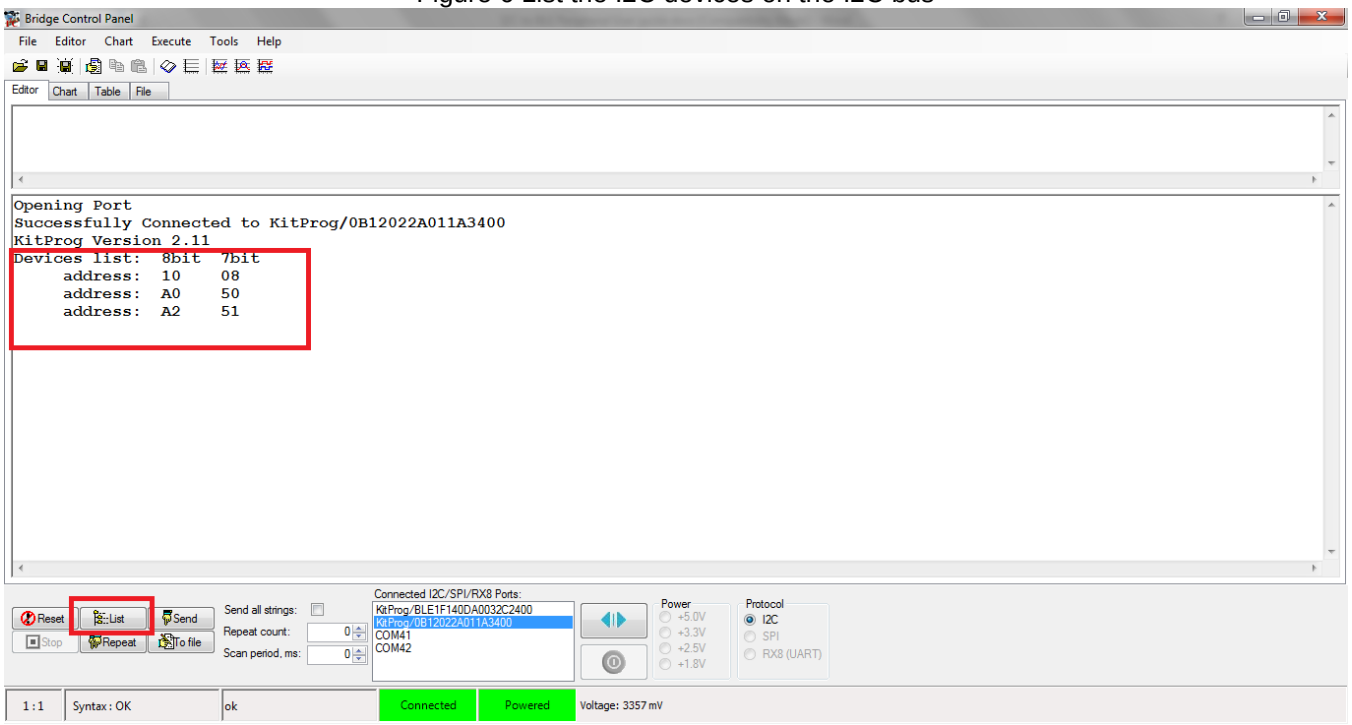
Figure 5 Set I2C data rate



11. Click on list and check if the slave address (0x08) of the PSoC 4 BLE device is present.

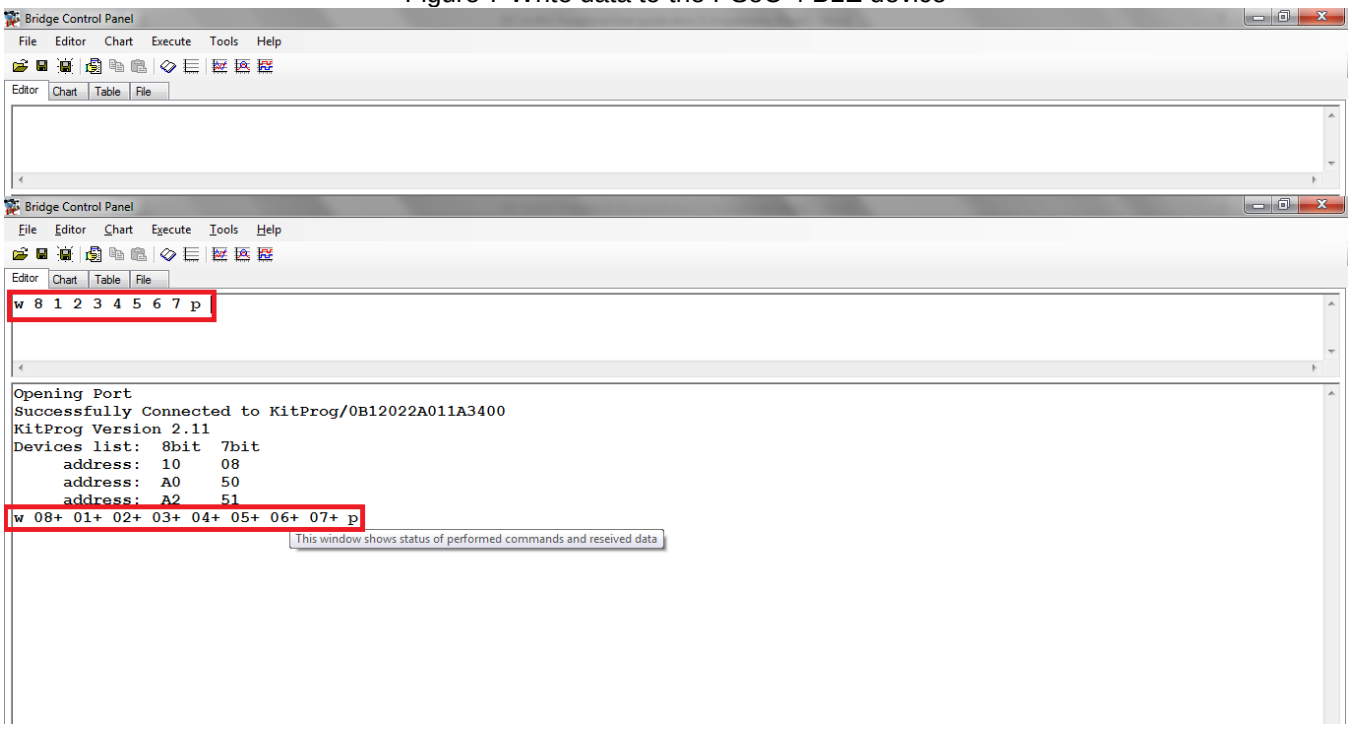
    Note: The FRAM chip on the pioneer kit base board also acts as I2C slave and hence you will see three entries.

Figure 6 List the I2C devices on the I2C bus



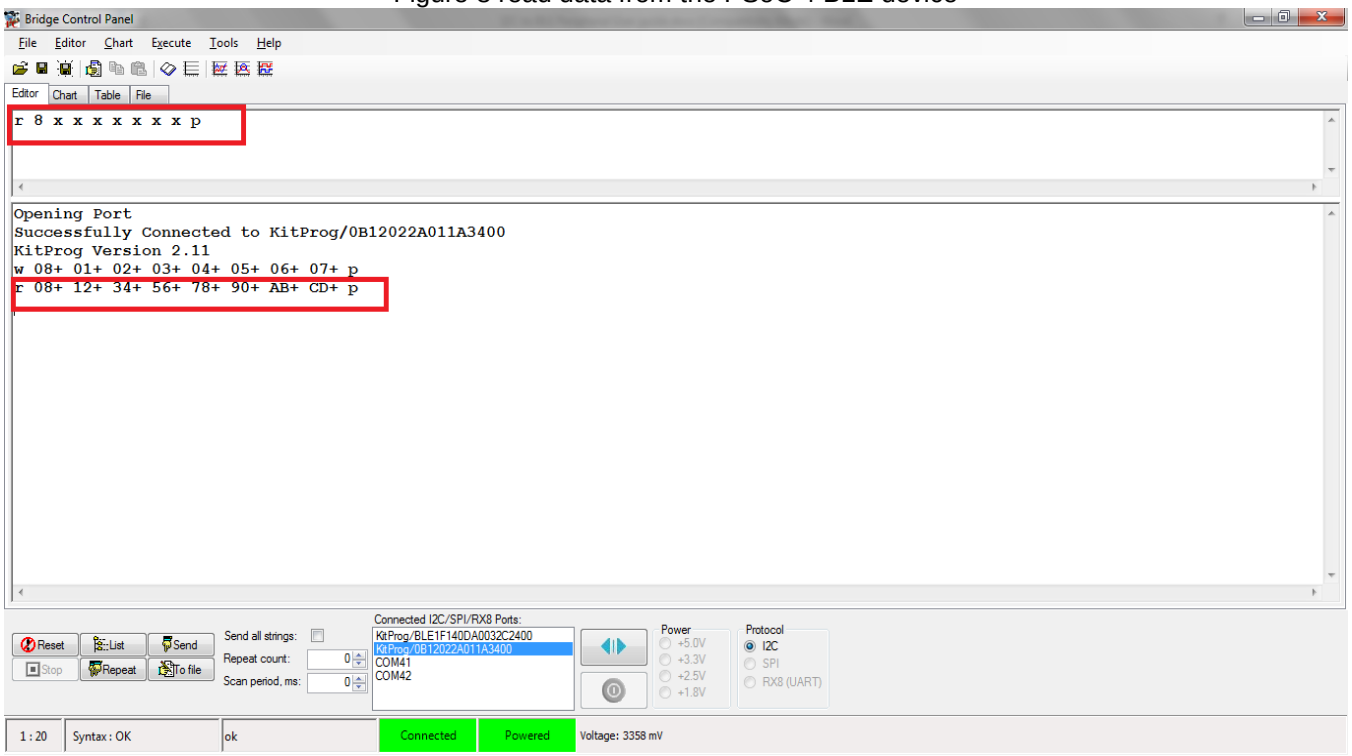
12. Repeat steps 10 to 13 this time with the central device. The slave address on the client side should be 0x09.
13. Write data to the PSoC 4 BLE device by entering the command w 8 d1 d2 d3….dn p. w stands for write, 8 is the slave address of the PSoC 4 BLE, d1 d2…dn are the data to be written to the slave.

Figure 7 Write data to the PSoC 4 BLE device



14. The data you wrote to the slave will be sent as notifications to the client.
15. On Bridge control panel, read data from the PSoC 4 BLE device by entering the command r 8 x1 x2 x3 x4 x5 x6 x7 p where r stands for read operation, 8 stands for clave address and x1 x2 x3 x4..x7 stands for number of bytes to be read from I2C slave.

Figure 8 read data from the PSoC 4 BLE device



16. Write data to the I2C peripheral device and check if the I2C data read after this on client side matches the data written on the peripheral device.
17. Write data to the I2C central device and check if the I2C data read after this on the peripheral side matches the data written on the client side.
18. Power off one device to check disconnect event indicated by RED LED followed by Scan/advertising event indicated by BLUE LED.
19. Power on the device back they will connect back automatically.