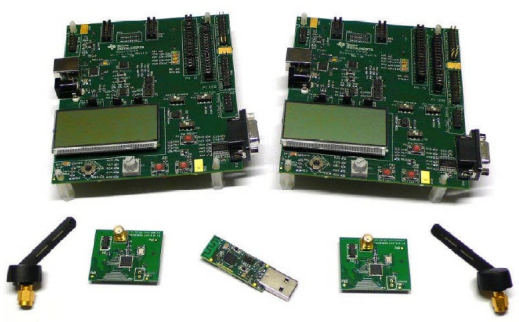
CC2540 Development Kit Quick Start Guide

Opening the Box and Running the *Bluetooth*® Low Energy SimpleBLE Demo Application

1. Kit Contents

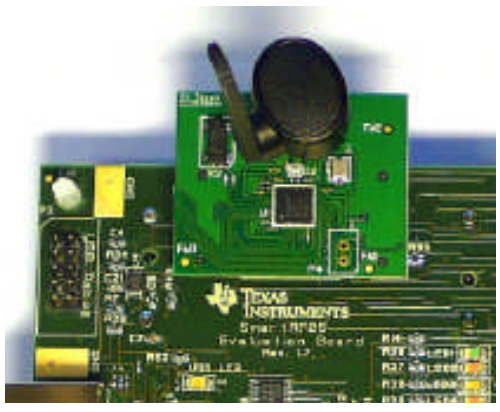


- 2 x SmartRF05EB (the two large boards)
- 2 x CC2540 Evaluation Modules
- 2 x Pulse Antennas
- 1 x CC2540 USB Dongle
- Cables
- Documentation

Please contact a TI Representative if any parts are missing from the kit.

2. Hardware Setup

Connect the antennas to the SMA connector on the RF evaluation boards. Tighten the antenna's screw firmly on to the SMA connector. If not properly connected, you might see reduced RF performance. Next, mount the CC2540 evaluation modules (CC2540EMs) on to connectors P5 and P6 on the SmartRF05EB. Make sure that the boards are pressed firmly into the connectors.



3. Power Options

There are several ways of applying power to the SmartRF05EB.

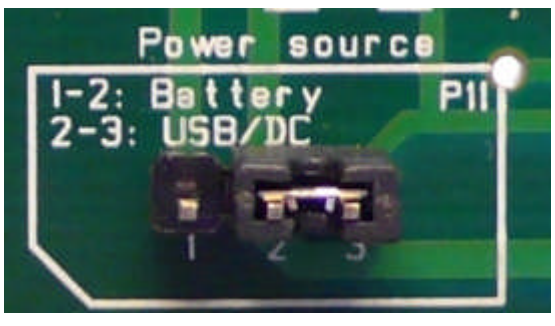
- 2 x 1.5 V AA Batteries
- USB
- External Power Supply

For the batteries and USB, there are voltage regulators on the SmartRF05EB that will set the on-board voltage to 3.3 V. The external power supply should set a voltage that does not exceed 3.3 V.

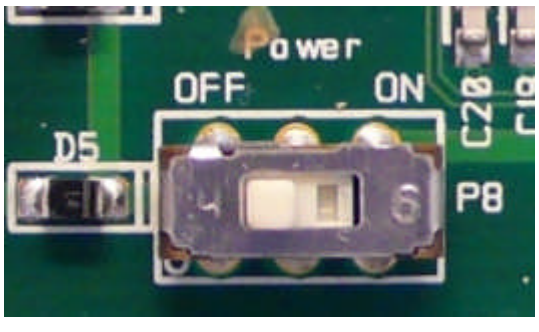
Note that there should only be one active power source at any one time.

4. Set Jumper P11

Find jumper P11 on the top side of each SmartRF05EB. This jumper is used to set the power source for the board. Set P11 to "1-2" if you are using battery power. Set P11 to "2-3" if you are using USB or an external power supply.



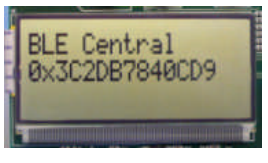
5. Turn on the Boards



Once you have set P11, find switch P8 on the top side of each SmartRF05EB. To power up the boards, flip the switch from the "OFF" position to "ON"

6. Start-up Screen

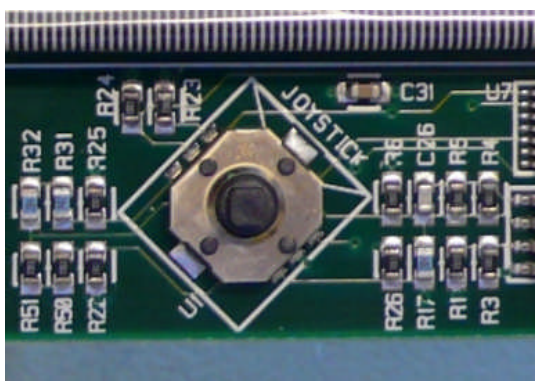
One of the CC2540EMs will be pre-loaded with the SimpleBLECentral application, while the other will be pre-loaded with the SimpleBLEPeripheral application. The LCD screens on the two SmartRF05EBs should display messages similar to those below:



The "0x…" value displayed on each board is the device address. Every CC2540 device has a unique address.

7. Using the Joystick

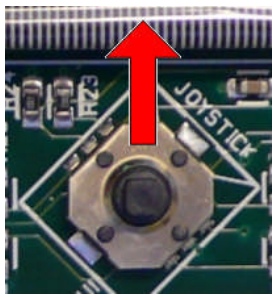
The SimpleBLEPeripheral application runs autonomously and does not require any user interaction. The SimpleBLECentral application, however, requires user interaction by means of joystick U1. Find joystick U1 on the top side of the SmartRF05EB, immediately below the LCD.



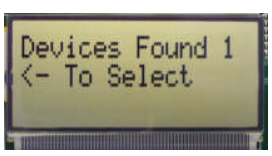
The joystick has five different movements: it can be moved up, down, left, right, and it can pressed in like a button. Each movement performs different actions depending on the state of the device.

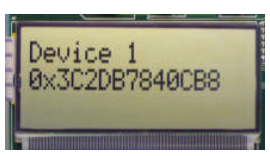
8. Device Discovery

Before the two devices can connect, the central device must first discover the peripheral device. To perform device discovery, press up on joystick U1 once. The LCD on the central device should display "Discovering…".



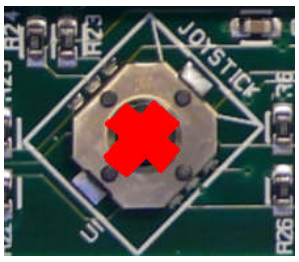
After a few seconds, it should display "Devices Found 1 / <- To Select". This means that the central device successfully discovered the peripheral. Press left on joystick U1 to view the address of the peripheral device. This address should match the address seen on the peripheral's LCD.



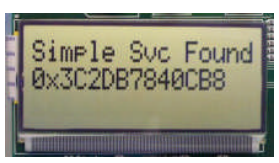


9. Establish Connection

To establish a connection with the peripheral, press joystick U1 in towards the board (push it in like it is a button). Once the connection is established, the central device will automatically perform service discovery on the peripheral using the BLE GATT protocol. This should complete within a few seconds.



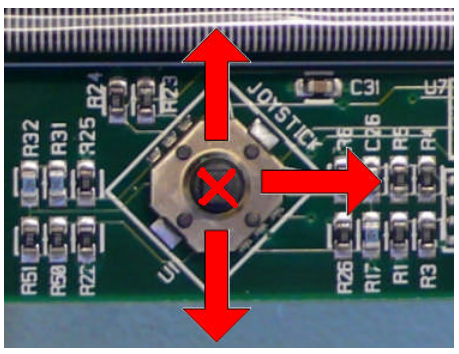
The two LCD screens should appear as in the images below, with the central still displaying the peripheral's address and the peripheral having changed from "Advertising" to "Connected":



10. Connected Operations

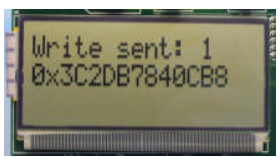
Once the connection has been established and service discovery is complete, you can perform the following operations using joystick U1 on the central device:

- Read / Write Data – U1 **UP**
- RSSI Monitoring – U1 **DOWN**
- Connection Parameter Update – U1 **RIGHT**
- Terminate Link – U1 **IN** (towards the board)



11. Read / Write Data

Pressing up on U1 will send a read request to the peripheral device. One byte of data will be read, and the value will be displayed. Pressing up again will send a write request, and one byte of data will be written to the peripheral. The peripheral's LCD should display the written value each time this is done.

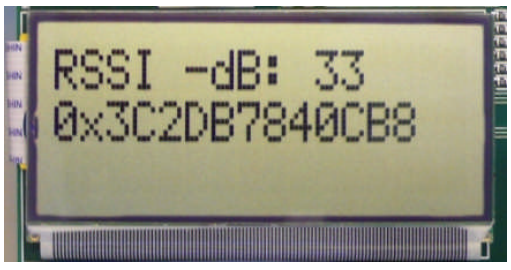


Bluetooth low energy is an ideal technology for transmission of small amounts of data between two devices while consuming very little power, as is demonstrated here.

Continuing to press up on the joystick will alternate between reads and writes, with the value incrementing each time.

12. Monitor RSSI

Pressing down on U1 will turn on RSSI (received signal strength indication) monitoring. The RSSI will be displayed on the LCD in units of negative dBm.



If the boards are moved farther apart from each other, the RSSI will drop (since the value is negative, a higher number means lower RSSI). If they are moved closer together, the RSSI should rise.

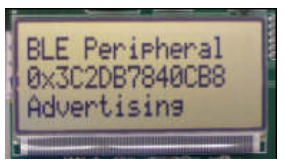
Pressing down on U1 again will turn off RSSI monitoring.

13. Connection Parameter Update

Pressing right on U1 will send a connection parameter update request to the peripheral to use a longer connection interval. This will result in much longer latency when performing data reads and writes; however the power consumed by both devices is significantly reduced.

14. Terminate Link

Pressing U1 in towards the board will terminate the link. The peripheral will return to an advertising state. The central device will display a "Reason" code, which indicates why the disconnection occurred (values are defined in the BLE stack API).



In this case, the reason code of 22 indicates that the link termination was initiated by the central device. In the event that the peripheral device goes out of range or has power disconnected from it, you will see a reason code of 8 which indicates that a link timeout has occurred.

You can now perform device discovery and re-connect to the peripheral if desired.

15. SimpleBLE Demo Source Code

The project and source code files for these applications (as well as many others) are included with the CC2540 Bluetooth low energy (BLE) stack from Texas Instruments, which can be downloaded at www.ti.com/blestack.

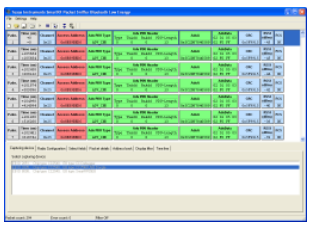
The two projects implementing this demo are called SimpleBLECentral (CC2540EM Master configuration) and SimpleBLEPeripheral (CC2540 Slave configuration). These can be modified as desired, and should provide a good framework for developing your own custom BLE applications.

More details on these projects can be found within the CC2540 BLE Software Developer's Guide, which is included with the stack. More information on the CC2540 Development Kit can be found in the CC2540DK User's Guide, which can be downloaded at www.ti.com/lit/pdf/swru301.

Additional Tools and Links

BLE Packet Sniffer

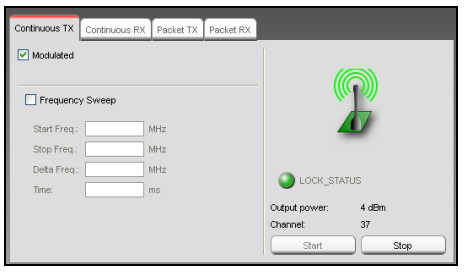
The CC2540 USB Dongle included with the development kit can be used as a BLE sniffer and monitor packets while the SimpleBLE Demo is running.



The SmartRF Protocol Packet Sniffer software can be downloaded from www.ti.com/packetsniffer

SmartRF™ Studio

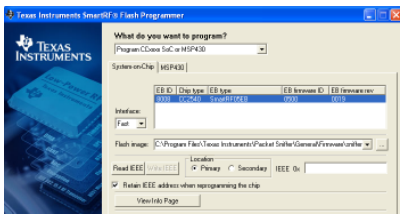
SmartRF Studio allows you to configure the radio, run RF performance tests, and run link tests between the two SmartRF05EBs.



SmartRF Studio can be downloaded from www.ti.com/smartrfstudio

SmartRF Flash Programmer

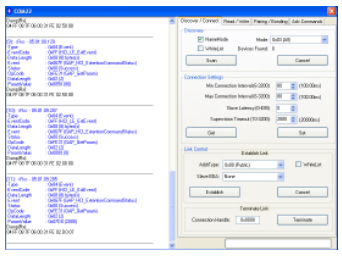
Texas Instruments has a simple tool which can be used to program and flash the CC2540



SmartRF Flash Programmer can be downloaded from focus.ti.com/docs/toolsw/folders/print/flash-programmer.html

BTool

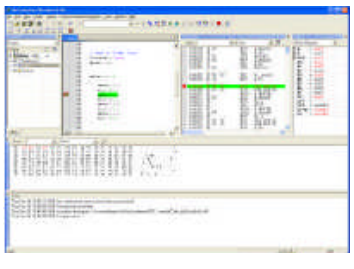
BTool is a Windows application that allows you to control a central device using the serial interface and perform various BLE functions while connected to a peripheral device.



BTool is included as part of the installation of the BLE stack (see "Useful Links" to the right).

IAR Embedded Workbench

To develop software, program, and debug the CC2540, you should use IAR Embedded Workbench for 8051.



More information on IAR EW8051, including a free evaluation version download, can be found at www.iar.com/ew8051.

Useful Links

TI BLE Stack and Software:
www.ti.com/blestack

CC2540 Development Kit User Guide:
www.ti.com/lit/pdf/swru301

CC2540 BLE Software Developer's Guide:
www.ti.com/lit/pdf/swru271

CC2540 User's Guide:
http://www.ti.com/lit/pdf/swru191

CC2540 Product Page:
www.ti.com/cc2540

For additional help, visit the TI E2E Forums:
www.ti.com/lprf-forum

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