Using UART Efficiently to Extend Battery Life
BL65x Series

Application Note v1.0

1 INTRODUCTION

This guide demonstrates how to load and run the smartBASIC sample application uclp.uart.low.power.operation.sb on the BL652 development board (DVK-BL652). This sample application shows how to close the UART when there is no UART activity and how to enable the host to reopen UART by sending a return character to make efficient use of power.

Note: This application note uses the BL652, but this can be done on any of the BL65x series modules except the BL651 which has limited flash and RAM and does not support smartBASIC.

UART peripherals are, by their nature, not power efficient. To obtain optimal overall power consumption, the UART should be closed when running a smartBASIC application if it is unnecessary for the application. In applications where UART is necessary, you can close it when not in use to conserve power.

In this sample application, once the UART is open, it operates normally and then, if there is inactivity (as determined by a timer which is restarted when there is incoming UART activity), it is closed. If a carriage return arrives through the UART from the host after a time specified by an idle open timer, the UART reopens.

2 OVERVIEW

When the UART Rx and Tx buffers are empty, a timer starts. When it expires, the UART is closed.

```c
//==============================================================================
// Called when the tx and rx buffers are empty
//==============================================================================
function HandlerUartTxEmpty() as integer
  if UartInfo(6) == 0 then
    //Start the uart inactivity timer
    TimerStart(UART_IDLE_TIMER, UART_IDLE_TIMEOUT_MS, 0)
  else
    //buffers are not empty
    TimerCancel(UART_IDLE_TIMER)
  endif
endfunc
```
As seen in the previous sample, an event is assigned to a high low transition on the UART Rx pin to detect when a character arrives from the host. In this event, a delay timer is started. When it expires, the UART is reopened and an acknowledgement character (!) is sent back to the host.

The following screenshot shows what the BL65x receives if you send a carriage return after the UART is closed. The BL65x acknowledges receiving the carriage return by printing ! and opening the UART and data can now be sent and received.

Note: The timer intervals are #defined in the sb file.
3 Requirements

The following is required for this process:

- PC running Windows XP or later
- UwTerminalX v1.10a or later
- DVK-BL652 Development Kit loaded with at v28.6.1.2 firmware or later**
- `uclp.uart.low.power.operation.sb` smartBASIC sample application. Available on our GitHub for the BL652: https://github.com/LairdCP/BL652-Applications
  (If working with BL653, BL654, or newer module please access the Applications repository for that module from Laird Connectivity GitHub)
- USB A to micro USB cable
- DVK_BL65x User Manual
- FTDI Drivers http://www.ftdichip.com/Drivers/VCP.htm (for some versions of Windows)

** The latest BL652 firmware and upgrade documentation is available at the following link https://www.lairdconnect.com/wireless-modules/bluetooth-modules/bluetooth-5-modules/bl652-series/bluetooth-v5-nfc-module under the Software tab.

(See Product Page of other BL65x modules for the appropriate documentation.)

4 Development Kit Setup

To setup the BL65x development kit, follow these steps:

1. Configure the BL65x development kit to the following settings (Figure 1):
   - 1: DC/USB power source switch (SW4) – USB
   - 2: VCC_1V8/VCC_3V3 switch (SW5) – VCC_3V3
   - 3: CR2033/VCC_3V3/1V8 switch (SW6) – VCC_3V3/1V8
   - 4: Jumper J6 (TEMP_SENS) off
   - 5: Jumpers J26 and J37 (LED1 and LED2) off
   - 6: Jumper J7 (Current Meas) off
   - 7: Jumper J5 (VSP) off

![Figure 1: Switch and jumper positions for the BL652](https://www.lairdconnect.com/wireless-modules/bluetooth-modules/bluetooth-5-modules/bl652-series/bluetooth-v5-nfc-module)
2. Connect the micro USB cable to USB1 on the development board and connect the other end of the cable to your PC. Follow the on-screen prompts. Depending on your version of Windows, you may need to install the FTDI drivers. When complete, the development board appears in the Windows device manager as a USB Serial Port.

4. Open UwTerminalX.

5. Configure the COM port with the port number seen in the device manager with the following settings (Figure 2):
   - Baudrate – 115200
   - Stop bits – 1
   - Data bits – 8
   - Handshaking – None

6. Confirm that you can communicate with the development board by typing ‘at’ followed by a carriage return. The module should respond with ‘00’ (Figure 2).

5. **LOADING AND RUNNING THE SMARTBASIC APPLICATION**

To load a smartBASIC application, follow these steps:

1. To compile and load a smartBASIC application, right-click in the main UwTerminalX window and select XCompile + Load (Figure 3).

2. Locate and open the uclp_uart_low_power_operation.sb application located in the supplied smartBASIC Applications folder downloaded from GitHub. When the application is successfully compiled and loaded, the console displays “Finished downloading file” (Figure 4).
3. Confirm that the **uclp** application is loaded by using the command `at+dir` (Figure 5).

**Note:** The file extension is truncated from files copied onto the BL65x modules. Therefore, when `uclp.uart.low.power.operation.sb` is copied to the device, its name becomes `uclp`.

![Figure 5: Directory showing “uclp” app is loaded](image)

4. To run the application, type `uclp` and press the return key.

5. To see the change in power when UART is closed compared to when it is open, remove the J7 jumper and attach a multimeter to enable current measurement. J7 is located at 4 on Figure 1. Ensure the CTS light is green while connected to the multimeter and check the connections if not.

6. The UART closes after four seconds passes with no UART activity. Press Enter to open the UART, as described in the Overview section. The multimeter should show a higher current (Figure 6) when the UART is open and a lower current (Figure 7) when the UART is closed.

![Figure 6: UART open](image)  
![Figure 7: UART closed](image)
6 REFERENCES

For more information on the UART as well as any smartBASIC commands used in this application note, refer to the smartBASIC Module user guide which can be accessed from the from any of the BL65x product pages on the Laird Connectivity website.

Additional product information can also be accessed from the same product pages:

BL652: https://www.lairdconnect.com/wireless-modules/bluetooth-modules/bluetooth-5-modules/bl652-series/bluetooth-v5-nfc-module


BL654PA: https://www.lairdconnect.com/wireless-modules/bluetooth-modules/bluetooth-5-modules/bl654pa-series/bluetooth-module

7 REVISION HISTORY

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