

OVER-THE-AIR APPLICATION DOWNLOAD

Application Note

v2.2

INTRODUCTION

This document describes how to use Laird's BL620 to perform an Over-the-Air (OTA) script load of a *smartBASIC* application to a remote BL600 module over a BLE connection using the built-in virtual serial port (vSP) service of the BL600.

With the BL600 firmware, if SIO7 input is tied to Vcc (high), and an \$autorun\$ application is **NOT** running, the BL600 populates the local GATT server table with the serial port service and then advertises for incoming connections for ten seconds. Additional detail on this functionality is available in the BL600 smartBASIC Extensions User Guide.

REQUIREMENTS

For this guide, you will need the following:

- A Windows PC
- The UwTerminal Windows Utility – available here: https://laird-ews-support.desk.com/?b_id=1945
- A DVK-BL600 development kit (DVK) with the onboard BL600 loaded with firmware v1.5.67.5 or newer
- A DVK-BL600 development kit (DVK)/BL620-US dongle with the onboard BL620 module loaded with firmware v12.2.5.5 or newer

Note: The BL620/BL600 and the DVK BL620/BL600 are the same hardware with different firmware loaded.

- The *smartBASIC* application \$autorun\$.VSP.UART.bridge.outgoing.sb. See [https://github.com/LairdCP/BL620-Applications/blob/master/\\$autorun\\$.VSP.UART.bridge.outgoing.sb](https://github.com/LairdCP/BL620-Applications/blob/master/$autorun$.VSP.UART.bridge.outgoing.sb)

Note: The referenced utilities, *smartBASIC* applications, firmware images, and app notes for firmware upgrading can be obtained at no charge from Laird's support website at https://laird-ews-support.desk.com/?b_id=1945

HARDWARE SETUP

Before you can download an application over the air to your module, you must perform hardware setup. Setup differs between the BL600 and the BL620. The hardware setup steps are outlined in the following sections.

BL600 Setup

Follow these steps to set up the BL600:

1. Plug the DVK into your PC (UART via the USB connection).
2. Locate the virtual serial COM port number. This can be obtained from the Windows Device Manager. Note the COM port number for later use.

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3. Open UwTerminal. Use the UwTerminal utility located in your matching BL600 firmware folder.

Note: For the scripts to cross-compile properly, the matching cross-compiler for the firmware version is required. The correct cross-compiler for each firmware version is included in each firmware distribution zip.

4. In the Config window, ensure that the COM port for your BL600 is selected.
5. Set the Baud rate to the specified Baud rate (9600 is the default).
6. Click **OK** to enter the Terminal tab.
7. Type **ATI 3** into UwTerminal and press **Enter** to display the firmware version. Ensure the DVK is loaded with BL600 peripheral firmware v1.5.67.5 or newer.
8. Type **ATI 4** and press **Enter** to display the MAC address and record the response, including the leading "01", for later use.

Note: Take for example this return: **01 6FA1226A12EA**. The space between the 01 and the MAC address is removed when entered later in this procedure.

9. Ensure that SIO7 is tied to Vcc (high) and shown in [Figure 1](#). SIO7 is typically tied to Vcc using a jumper between the bottom-left two pins of the connector.
10. Ensure that CON12 Switch 2 (USB-DTR/nAutoRUN) is set to ON / nAutoRUN (to the right) as shown in [Figure 1](#).



Figure 1: SIO7 tied to VCC using a jumper and CONN12 Switch 2 ON

Note: If SIO7 is tied high on a BL600 and if the module does NOT contain the *smartBASIC* application \$autorun\$, then the module adds Laird's virtual serial port service to the GATT table and advertises for ten seconds after power up or reset.

11. Ensure that the JLINK adapter (which is used to download firmware to the module) is no longer connected to the DVK. The reset buttons on the DVK do not function when the JLINK adapters are connected, and this causes the OTA process to fail. For **Rev -04** and previous this means that the ribbon cable between the JTAG and the DVK is disconnected. For **Rev -05** and newer DVKs this means that the USB for the onboard JTAG chip is not connected.

BL620 Setup

To set up the BL620, follow these steps:

1. Plug the DVK into your PC (UART via USB connection).
2. Locate the virtual serial COM port number. This number can be obtained from Windows Device Manager. Please note the COM port number for later use.

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3. Open UwTerminal. Use the UwTerminal utility located in your matching BL620 firmware folder.

Note: For the scripts to cross-compile properly, the matching cross-compiler for the firmware version is required. The correct cross-compiler for each firmware version is included in each firmware distribution zip. Use the UwTerminal utility located in your matching BL620 firmware folder.

4. In the Config window, make sure the COM port for your BL620 is selected.
5. Set the Baud rate to the specified Baud rate (9600 is the default).
6. Click **OK** to enter the Terminal tab.
7. Ensure the BL620 DVK/BL620-US dongle is loaded with BL620 central firmware v12.2.5.5 or newer.
8. Download the \$autorun\$.VSP.UART.bridge.outgoing.sb using the appropriate method for downloading smartBASIC applications. This process is documented in an application note available from Laird's support website.

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Note: This section assumes that the DVKs are set up as described in the [BL600 Setup](#) and [BL620 Setup](#) sections.

To download the OTA application, follow these steps.

1. Ensure you have the cross compiler file **xcomp_BL600r2_hhhh_hhhh.exe** in the same folder as the BL600 smartBASIC application that you want to download. (UwTerminal looks for the cross compiler for any script in either the same folder as the app or its own folder by default.)
In the BL600 UwTerminal instance, ensure that the DTR checkbox is ticked as shown in [Figure 2](#).



Figure 2: DTR checkbox checked

Note: **Step one is very important.**

Confirm that the hhhh_hhhh in the cross compiler filename matches the displayed response obtained by sending the AT+I13 command to the BL600 module. Attempts to cross compile with the non-matching cross compiler will result in an error message.

2. On the DVK-BL620, ensure that SIO7 is **not** tied to Vcc. If you are using a BL620-US, this is unnecessary.
3. In the terminal, enter **AT+DIR** and hit enter. If the terminal returns "vsp", the app is already compiled and loaded. Type **vsp** and hit **enter** to run the application. If AT+DIR does not return "vsp," perform the following steps:
 - a. **Right-click** on the terminal screen of the BL620 UwTerminal instance.
 - b. From the menu displayed, click **Xcompile + Load + Run**.
 - c. Navigate to the location of the \$autorun\$.VSP.UART.bridge.outgoing.sb file which is located in the BL620 firmware Sample Apps folder by default. Select the file then click **open**. The script will compile, load and run.
4. With the \$autorun\$.VSP.UART.bridge.outgoing.sb application running, type the following into UwTerminal and press Enter to connect to your BL600: **atd <mac address> or connect <mac address>**

Note: The <mac address> is obtained in the [BL600 Setup](#) and [BL620 Setup](#).

Note: As noted in BL600 setup, the adverts are set for a 10 second timeout after reboot of the device in virtual serial port mode. It is very likely that the connect attempt will timeout. A RESET of the BL600 may well be required just prior to sending the *atd / connect* command above.

7. The BL620 terminal will display **CONNECT,OK**. The BL620 and BL600 are now connected via vSP in Command mode. Data sent from UwTerminal is sent directly to the BL600 over the BLE connection via the VSP service.

```
>atd 01DF94CB7949AF
```

```
CONNECT  
OK
```

8. To send your application OTA, **right-click** in UwTerminal (BL620) and select **XCompile+Load**. (Remember to select apps from the appropriate BL600 folder.)
-

Note: The **AT+RUN "<scriptname>"** command does not work remotely. Using this command or **XCompile+Load+Run** command sequence remotely will result in the script being compiled and loaded, however the **AT+RUN** command (which is sent last) will return the error code 604C. To remotely start the script, you may perform either of the following:

1. Append "**\$autorun\$**." to the beginning of the script filename before compiling and loading, then enter the **ATZ** command after the script has loaded. This will remotely reset the BL600. Appending "**\$autorun\$**." to the filename causes the script to be loaded as **\$autorun\$** which results in it being loaded when the BL600 reboots.

2. Use the **AT+REN** to command to rename the remotely loaded script to **\$autorun\$** and then again use the **ATZ** command to remotely reset the remote BL600.

9. When the app finishes downloading and **+++ DONE +++** displays, you can switch from bridge mode back to command mode on the BL620. Ensure that LineMode is unchecked (as shown in [Figure 3](#)) and then send three caret characters (^^^). A return of **OK** means you can now send commands to the application.



Figure 3: LineMode unchecked

Note: These commands function within the atcmd application, not in Interactive mode.

```
^^^  
OK
```

10. To disconnect from the BL600, type **ath** or **disconnect** and press **Enter** in UwTerminal.

```
>ath  
NO CARRIER
```

- Exit the application by typing **exit** or **quit**.

```
>quit
Version 1.0
00
```

LEVERAGING THE DEMO FOR YOUR USE CASE

As has been demonstrated, the BL600 can be configured for accepting *smart*BASIC applications if SIO7 is tied to Vcc. There is currently no equivalent 'no app' solution for the BL620 side as it needs to know which device to connect to and therefore requires specific applications to be written. The sample application **cmd.ble.manager.sb** can be used as a basis for such a purpose.

On the BL600, the virtual serial port functionality can be configured using the AT+CFG command or parameters such as baud rate, advertising timeout, and preferred connection intervals. See the AT+CFG section in the BL600 User Guide for more information. A snapshot of that section at the time of this writing is reproduced below for convenience.

AT+CFG

COMMAND

AT+CFG is used to set a non-volatile configuration key. Configuration keys are comparable to S registers in modems. Their values are kept over a power cycle but are deleted if the AT&F* command is used to clear the file system.

The 'num value' syntax is used to set a new value and the 'num ?' syntax is used to query the current value. When the value is read the syntax of the response is

```
27 0xhhhhhhhhh (dddd)
```

...where *0xhhhhhhhhh* is an eight hex-digit number which is 0 padded at the left and *dddd* is the decimal signed value.

AT+CFG num value or **AT+CFG num ?**

Returns	If the config key is successfully updated or read, the response is \n00\r.
Arguments:	
<i>num</i>	Integer Constant The ID of the required configuration key. All of the configuration keys are stored as an array of 16 bit words.
<i>value</i>	Integer constant This is the new value for the configuration key and the syntax allows decimal, octal, hexadecimal or binary values.

This is an Interactive mode command and MUST be terminated by a carriage return for it to be processed.

The following Configuration Key IDs are defined:

Config Key IDs	Definition
40	Maximum size of locals simple variables
41	Maximum size of locals complex variables
42	Maximum depth of nested user defined functions and subroutines

Config Key IDs	Definition
43	The size of stack for storing user functions simple variables
44	The size of stack for storing user functions complex variables
45	The size of the message argument queue length
100	Enable/Disable Virtual Serial Port Service when in interactive mode. Valid values are:
	0x0000 Disable
	0x0001 Enable
	0x80nn Enable only if signal pin nn on module is HIGH
	0xC0n n Enable only if signal pin nn on module is LOW
	0x81nn Enable only if signal pin nn on module is HIGH and auto-bridged to UART when connected
	0xC1n n Enable only if signal pin nn on module is LOW and auto-bridged to UART when connected
ELSE Disable	
101	Virtual Serial Port Service to use INDICATE or NOTIFY to send data to client.
	0 Prefer Notify ELSE Prefer Indicate
102	This is a preference and the actual value is forced by the TX characteristic property of the service. This is the advert interval in milliseconds when advertising for connections in interactive mode and AT Parse mode. Valid values: 20 to 10240 milliseconds
103	This is the advert timeout in milliseconds when advertising for connections in interactive mode and AT Parse mode. Valid values: 1 to 16383 seconds
104	In the Virtual Serial Port Service manager, data transfer is managed. When sending data using NOTIFIES, the underlying stack uses transmission buffers of which there are a finite number. This specifies the number of transmissions to leave unused when sending a lot of data. This allows other services to send notifies without having to wait for them. The total number of transmission buffers can be determined by calling SYSINFO(2014) or in interactive mode submitting the command ATi 2014
105	When in interactive mode and connected for virtual serial port services, this is the minimum connection interval in milliseconds to be negotiated with the master. Valid values: 0 to 4000 ms. If a value of less than 8 is specified, then the minimum value of 7.5 is selected.
106	When in interactive mode and connected for virtual serial port services, this is the maximum connection interval in milliseconds to be negotiated with the master. Valid values: 0 to 4000 ms. If a value of less the minimum specified in 105, then it is forced to the value in 105 + 2 ms.
107	When in interactive mode and connected for virtual serial port services, this is the connection supervision timeout in milliseconds to be negotiated with the master. Valid range: 0 to 32000 If the value is less than the value in 106, then a value double that specified in 106 is used.
108	When in interactive mode and connected for virtual serial port services, this is the slave latency to be negotiated with the master. An adjusted value is used if this value times the value in 106 is greater than the supervision timeout in 107.
109	When in interactive mode and connected for virtual serial port services, this is the Tx power used for adverts and connections. The main reason for setting a low value is to ensure that in production, if

Config Key IDs	Definition
	<i>smart</i> BASIC applications are downloaded over the air, then limited range allows many stations to be used to program devices.
110	If Virtual Serial Port Service is enabled in interactive mode (see 100), then this specifies the size of the transmit ring buffer in the managed layer sitting above the service characteristic FIFO register. Value range: 32 to 256
111	If Virtual Serial Port Service is enabled in interactive mode (see 100), then this specifies the size of the receive ring buffer in the managed layer sitting above the service characteristic FIFO register. Value range: 32 to 256
112	If set to 1, the service UUID for the virtual serial port is as per Nordic's implementation and any other value is as per the modified Laird's service.
113	The advert interval in milliseconds when advertising for connections in interactive mode and UART Bridge mode. Valid values: 20 to 10240 milliseconds
114	The advert timeout in milliseconds when advertising for connections in interactive mode and UART Bridge mode. Valid values: 0 to 16383 seconds (0 disables the timer and makes it continuous)
115	Used to specify the UART baudrate when Virtual Serial Mode Service is active and UART bridge mode is enabled. Valid values: 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200, 230400, 250000, 460800, 921600, 1000000. If an invalid value is entered, then the default value of 9600 is used.
116	In VSP/UART Bridge mode, this value specifies the latency in milliseconds for data arriving via the UART and transfer to VSP and then onward on-air. This mechanism ensures that the underlying bridging algorithm waits for up to this amount of time before deciding that no more data is going to arrive to fill a BLE packet and so flushes the data onwards. Given that the largest packet size takes 20 bytes, if more than 20 bytes arrive then the latency timer is overridden and the data is sent immediately.

REVISION HISTORY

Revision	Date	Description	Initiated By
1.0	-	Initial Release	Jonathan Kaye
2.0	13 Feb 2015	Minor revisions	Jonathan Kaye
2.1	04 Mar 2015	Added revision history	Sue White
2.2	23 June 2015	Filenames have been updated to reflect multiple module types.	Jamie Mccrae