![Laird logo]

User Guide

BL654 USB Dongle

Laird Part # 451-00003

Version 1.0

REVISION HISTORY

Version	Date	Notes	Contributor(s)	Approver
1.0	04 July 2018	Initial version	Jamie McCrae	Jonathan Kaye

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1 OVERVIEW

The Laird BL654 USB dongle (Laird part # 451-00003) is a packaged USB Adapter version of the integrated antenna BL654 module. It uses an FTDI virtual COM port implementation to enable full Bluetooth 5 operation into the widest range of Operating System backed devices with a USB interface.

The Laird BL654 series of BLE modules features Laird's innovative event driven programming language, *smart*BASIC. More information regarding this product series, including a detailed module user's guide and *smart*BASIC user guides, are available on Laird's BL654 product page: http://www.lairdtech.com/products/bl654-ble-thread-nfc-modules

2 LAIRD BL654 USB DONGLE PART NUMBERS

Part Number	Product Description
451-00003	USB dongle containing 451-00001 module – Integrated antenna

3 BL654 USB DONGLE

This section describes the BL654 USB dongle hardware. The BL654 USB dongle is delivered with the BL654 series module loaded with integrated *smart*BASIC runtime engine firmware but no onboard *smart*BASIC application; because of this, it starts up in AT command mode by default.

Applications in *smart*BASIC are simple and easy to develop for any BLE application. Sample *smart*BASIC applications are available to download from the Laird GitHub repository on the BL654 product page at https://github.com/LairdCP/BL654-Applications.

The USB dongle allows the BL654 series module to physically connect to a PC via a USB port which provides USB-to-Virtual COM port conversion through an FTDI chip – part number FT232R. Any Windows PC (XP or later), Linux PC (Kernel 3.x or newer with an x86, x86_64 or ARMv7 CPU) or Mac (10.11 or newer), should auto-install the necessary drivers; if your PC cannot locate the drivers, you can download them from http://www.ftdichip.com/Drivers/VCP.htm.

3.1 Key Features

The BL654 USB dongle has the following features:

- BL654 series module soldered onto the board
- Self-powered by USB port, running the module at a regulated 3.3v
- USB to UART bridge (FTDI chip)
- BL654 UART can be interfaced to a PC via USB using the USB-UART bridge (FTDI chip)
- One LED and one virtual button for user interaction
- *smart*BASIC runtime engine FW upgrade capability:
  - Via UART (using the FTDI USB-UART)
- *smart*BASIC application upgrade capability:
  - Via UART (using the FTDI USB-UART)
  - Via OTA (Over-the-Air) (**Note:** This is not currently exposed)

Note: To upgrade the firmware via UART, the BL654 USB dongle must not contain an $autorun$ application. If the dongle contains an $autorun$ application, then the dongle must exist the application using built-in UwTerminalX feature (refer to the Autorun Functionality section). Once in interactive mode, the $autorun$ application must be deleted before starting the UART upgrade process.

4 UNDERSTANDING THE DONGLE

Figure 1: BL654 dongle

4.1 Four-wire UART Serial Interface

The USB dongle provides access to the BL654 module four-wire UART interface (TX, RX, CTS, RTS) through USB (via an FTDI USB-UART convertor chip). The UART connection on the BL654 series module and the FTDI IC are shown in Table 1.

Table 1: SIO/UART connections

BL654 SIO	BL654 Default Function	FTDI IC UART
SIO_06	UART_TX (output)	USB_RX
SIO_08	UART_RX (input)	USB_TX
SIO_05	UART_RTS (output)	USB_CTS
SIO_07	UART_CTS (input)	USB_RTS

4.2 Hidden Special Function Pins

The FTDI IC inside the BL654 USB dongle has I/O routed to various control lines of the BL654 module which are listed in Table 2.

Table 2: Special function SIO connections

BL654 Function	FTDI IC UART	Comments
nRESET	USB_DCD	
nAutoRUN	USB_RI	Connected through inverter
VSP	USB_DSR	Connected through inverter

These pins can be manipulated by host PC applications to change the autorun mode or enable VSP mode on the dongle. To create a custom application which controls the functionality of these pins, you will require the FTDI D2xx drivers if targeting Windows, or libusb and libftdi if targeting Linux. Please refer to the documentation of each driver and the code in UwTerminalX for details of how to use this functionality. When creating custom applications using these drivers, please ensure that USB_TX is enabled as an output to prevent the module from detecting a BREAK signal and resetting, but keep all other FTDI pins that are inputs by default as inputs to prevent bus collisions with signals driven by the BL654 module.

4.3 Autorun Functionality

By default, the BL654 USB dongle is in autorun mode. This means that, if an **$autorun$** application is present on the device, it runs when the dongle is powered (regardless of what device the dongle is plugged into; computers, USB power plugs, and battery packs all boot the dongle in autorun mode).

It is possible to exit the dongle from running the autorun application and return to interactive mode (for upgrading firmware or the application) by using the FTDI IC inputs as outputs, which is possible when using the D2xx driver, described in the section above.

To exit from autorun mode, design your application to follow the flowchart shown in Figure 2.
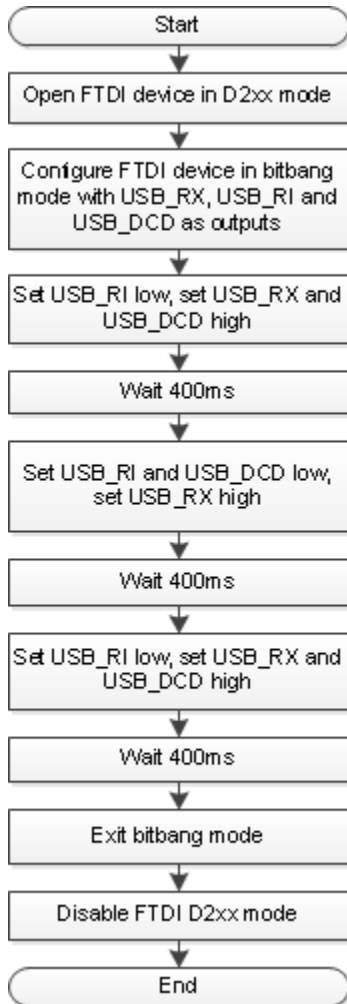
Figure 2: Flowchart for exiting autorun mode

Functionality for exiting autorun mode is built into UwTerminalX v1.10a and newer.

To escape from autorun mode on a BL654 dongle using UwTerminalX, follow these steps:

1. Ensure you are using a Windows or Linux device.
   - Windows – The SSL version of UwTerminalX is required
   - Linux – Ensure that you have followed the instructions for creating udev rules for allowing non-root users access to USB devices).
2. Plug the USB dongle into the computer.

3. Open UwTerminalX and select the serial port of the USB dongle (1) (Figure 3).
4. Ensure that the description identifies it as an FTDI device (2), and then click BL654 **USB dongle – Exit Autorun** at the top of the window (3) (Figure 3).
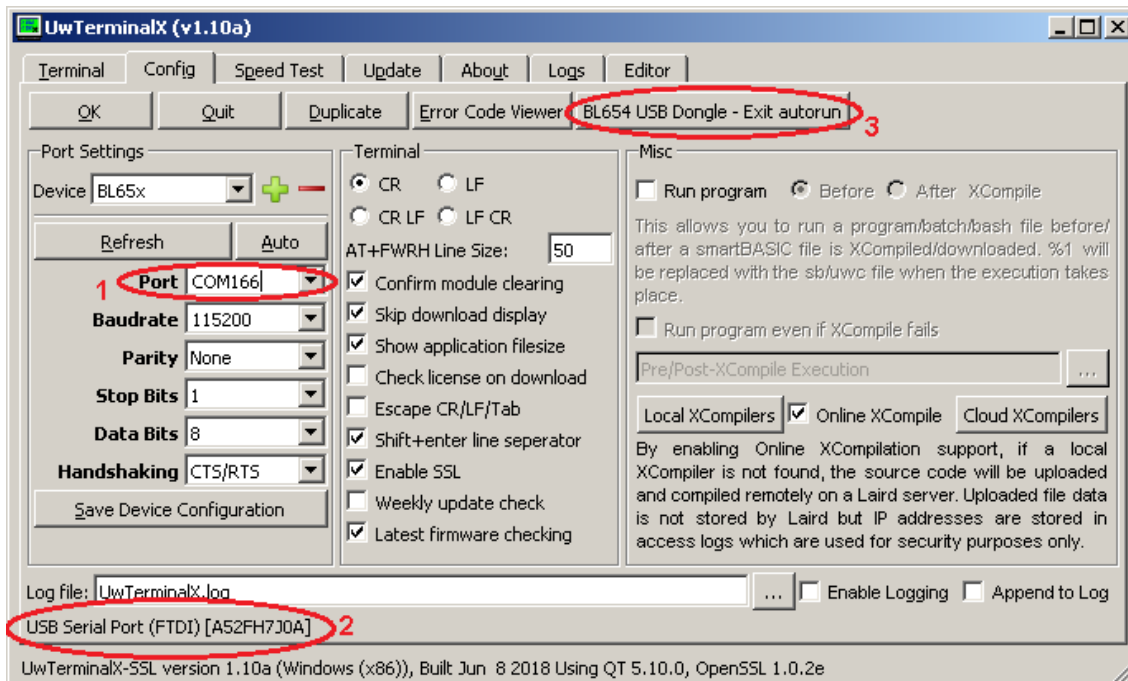

Figure 3: Getting ready to exit autorun mode

A warning message displays. Read the warning and confirm you have selected the correct serial port. Due to using FTDI input pins as output pins, if this function is used on non-BL654 USB dongle hardware, it may cause damage to the hardware and Laird accepts no responsibility for this. Click **Yes** to exit autorun mode as shown in Figure 4.
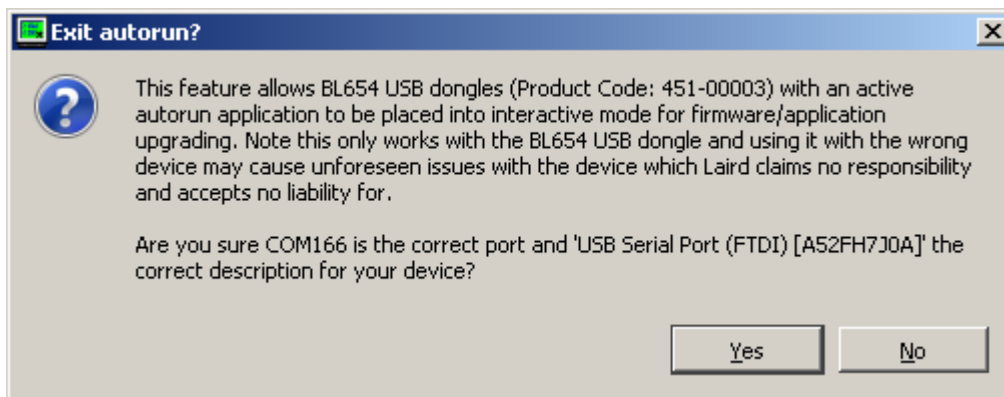

Figure 4: Confirmation dialogue that the correct device was selected

Once complete, the result of the operation displays in the status bar as shown in Figure 5.

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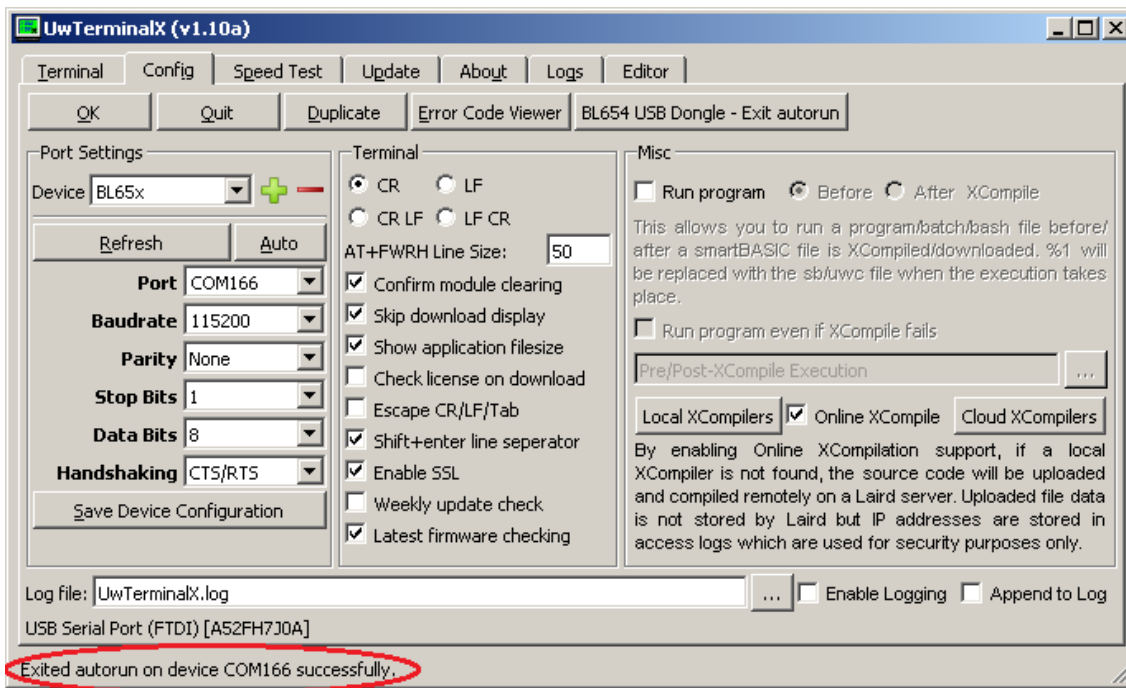Europe: +44-1628-858-940
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Figure 5: Exit from autorun mode successful

If successful, the port can now be opened in UwTerminalX and the module is in interactive mode.

To prepare for a firmware upgrade, follow these steps:

1. Remove the autorun application from the module using the command **at+del "$autorun$"** or **at&f 1** command.

    > **Note:** **at+del** does not release the flash for a new application. Additional application downloads cannot use space used by previous applications. If you download a large application, it may be too big. We recommend using the **at&f1** command to clear the application filesystem prior to downloading a replacement application.

2. Close UwTerminalX once the action is complete.

    You can now use the UART firmware upgrader application to upgrade to a newer firmware version. Refer to the documentation available on the Laird BL654 product page for instructions on using the BL654 firmware upgrade utility.

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4.4 VSP Mode

The VSP pin is wired to the FTDI chip which allows you to enable VSP bridge mode or VSP command mode. This functionality is not exposed in any Laird utilities at the current time. The process for entering VSP mode is as described in Figure 6 for entering command mode VSP and Figure 7 for bridge mode VSP.
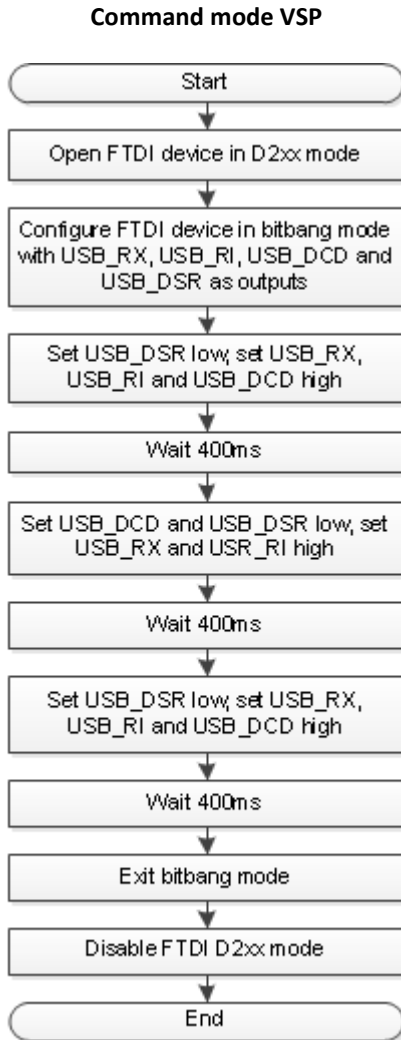
Command mode VSP   **Bridge mode VSP**

Figure 6: Flowchart for entering command mode VSP   *Figure 7: Flowchart for entering bridge mode VSP*

Refer to the BL654 user guide for information on VSP modes, available on the Laird BL654 website.

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5 SOFTWARE

The USB dongle connects the BL654 module to a virtual COM port of a PC or other device. From a PC, you can communicate with the module using Laird's UwTerminalX (cross platform software available for Windows, Mac, and Linux). This utility allows connections to serial devices using any combination of the communications parameters listed in Table 3.

Table 3: UwTerminalX communication parameters for BL654

Port (Windows)	1 to 255
Port (Mac/Linux)	Any/dev/tty device
Baud Rate	1200 to 1000000 **Note:** Baud rate default is 115200 for BL654.
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	CTS/RTS (Hardware) or None **Note:** Flow control default is CTS/RTS (Hardware)

Note: Baud rates higher than 115200 depend on the port and driver capabilities of the host PC.

The benefits of using UwTerminalX include the following:

- Continually displayed status of DSR, CTS, DCD, and RI
- Direct control of DTR on the host PC via a check box
- Direct control of RTS, if CTS / RTS Handshaking is disabled when UwTerminalX is launched
- Sending UART BREAK signals. Following provides explanation UART Break. (https://en.wikipedia.org/wiki/Universal_asynchronous_receiver/transmitter#Break_condition)
- Additional built-in features (right click in Terminal tab screen) to accelerate development including Automation and various XCompile/Load/Run options for downloading smartBASIC applications into the BL654.

Note: Full details on smartBASIC are available in the smartBASIC User Guide available at the Laird product page for BL654, along with a document giving a basic introduction to UwTerminalX. A help file is included with UwTerminalX that gives an overview of the program. Visit the BL654 product page at http://www.lairdtech.com/products/bl654-ble-thread-nfc-modules.

Tip: If the module returns a four-hex digit error code: In UwTerminalX, select those four digits, right-click, and select **Lookup Selected Error-Code (Hex)**. A description of the error is then printed on screen.

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5.1 Additional Peripherals

5.1.1 Virtual Button and LED Connected to BL654

The BL654 USB dongle has one LED and one virtual button (which can be toggled by controlling the DTR line of the UART device), the details of pin mappings are listed in Table 4.

Table 4: LED and Button to BL654 SIO signal mappings

Part	BL654 SIO	Comments
LED1	SIO_13	Set high to turn LED on
Virtual Button (UART: DTR)	SIO_11	Can be toggled in terminal applications like UwTerminalX. Same SIO as BUTTON_1 on the DVK.

6 ADDITIONAL DOCUMENTATION

Laird offers a variety of documentation and ancillary information to support our customers through the initial evaluation process and ultimately into mass production. Additional documentation can be accessed from the Documentation tab of the Laird BL654 Product Page.

For a useful Bluetooth resource, refer to the AT Interface application note and guide available from the BL654 product page in the Documentation section.