

Texas Instruments BLE Car User's Guide

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1 Introduction

The *Texas Instruments Bluetooth Low Energy Radio Controlled Car* is a demo of the TI BLE hardware and software platform. The demo consists of three parts – the BLE enabled car, an iPhone app and the keyfob from the CC2540 Mini Development Kit (fig. 1). It can be used, for example, to attract attention at exhibitions or to show off TI's products to customers directly. This document describes how to operate the demo and contains some details about how it works that might be useful to talk about when showing it off.



Figure 1. The TI BLE Car demo kit; car, iPhone app and keyfob.

2 Quick Start Instructions

1. **On the car** connect the battery and press the *EZ-SET* button on the speed controller to turn the car on, green LED will light up. Press again to turn the car off.
2. **On the iPhone** start the *TI-BLE-Car* app and press *Scan and connect*. Once the connection is completed, a green icon will appear next to the button. Press button again to disconnect.

- - OR - -

2. **On the keyfob** press and hold both buttons for 2 seconds. LED will blink yellow while scanning, then flash green once when connected. Press and hold the right button for 1 second to toggle the accelerometer on/off.

3 The Car

The car is a *Traxxas E-Revo 1/16* with a replaced radio receiver. Keep in mind that the BLE demo only utilizes about 50% of the top speed; hardware or software failure could potentially cause the car to run off uncontrollably at high speed. To turn the car on or off, press the *EZ-SET* button on the speed controller (ESC). Use the clips to secure the body (or it might fall off). The car can be turned on and off without removing the body once you know where the button is. Store the clips on the mounts when the body is off to avoid loosing them.

3.1 Charging the battery

The car's power source is a 7.2 V, 1200 mAh NiMH battery. When the car starts running slow, it is time to charge. If you have a compatible charger, use it. Otherwise, connect the battery to a bench power supply using a Traxxas battery connector or alligator clips. Charge at around 9 V and set current limiting to 0.5 A. This should charge an empty battery in 2.5 hours. If necessary, fast charging can be done in one hour with 1.2 A current limiting (this is equal to 1C, the maximum recommended charge current for NiMH, do not exceed it!).

Warning: Over charging the battery with a bench power supply could cause an explosion!

3.2 Troubleshooting

The ESC has additional features that can be used with the original controller. If one of these modes are activated, top speed can be decreased, reverse can be disabled or the car may stop moving altogether. Should any of these problems occur, go through the follow steps to put the ESC back in the right mode:

1. Turn the car off
2. Press and hold the *EZ-SET* button
3. LED will turn green, keep holding
4. LED will turn red, keep holding
5. LED will turn off, keep holding
6. LED will blink red once, release the button
7. LED will turn green, reset complete

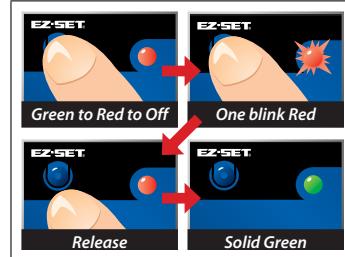


Figure 2. Instructions for resetting the speed controller.
(source: E-Revo Owner's Manual)

4 iPhone controller

Launching the TI-BLE-Car app will display the main interface as shown in figure 3(a). To connect, first turn the car on, then press *Scan and connect*. The app will scan (fig. 3(b)) and connect to the first available BLE device presenting a "car profile" with UUID 0xACC0. After the connection has been established, the app will scan the car for the throttle (0xACC1) and steering (0xACC2) characteristic values. Once these are stored, the connection is completed (fig. 3(c)) and the car may be driven using the knobs at the bottom of the screen. The left knob is the throttle and can be moved up and down, the right knob is the steering and can be moved left and right.

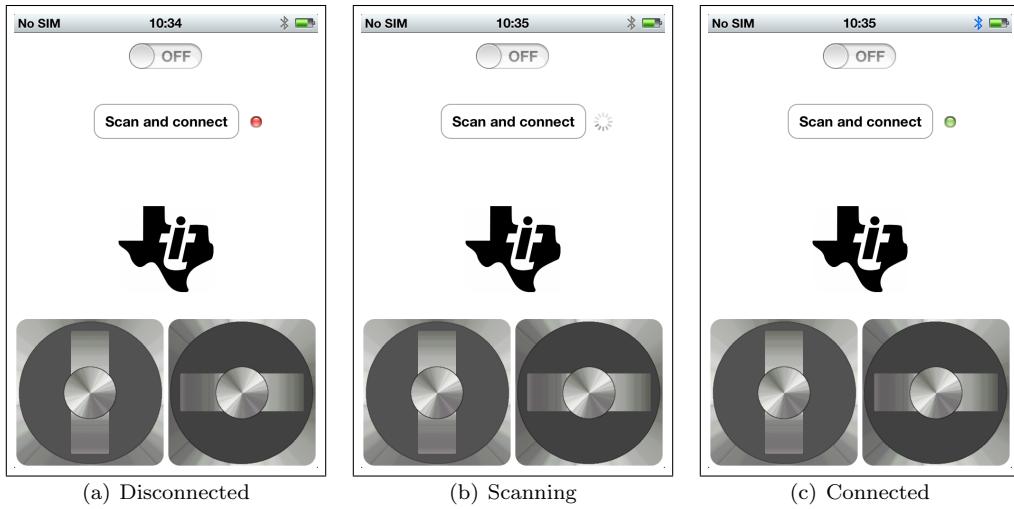


Figure 3. The app's connection states.

The app can be used in any orientation when using the on screen controls. To switch orientation simply tilt the phone and the interface will rotate. Landscape orientation (fig. 4(a)) is recommended for driving with the on-screen controls.

When in portrait mode, the built-in accelerometer of the iPhone may be used to control the car. To do this, make sure the interface is in the portrait orientation, place the phone level and turn on the switch at the top of the screen (fig. 4(b)). Next, simply tilt the phone to drive the car in the desired direction.

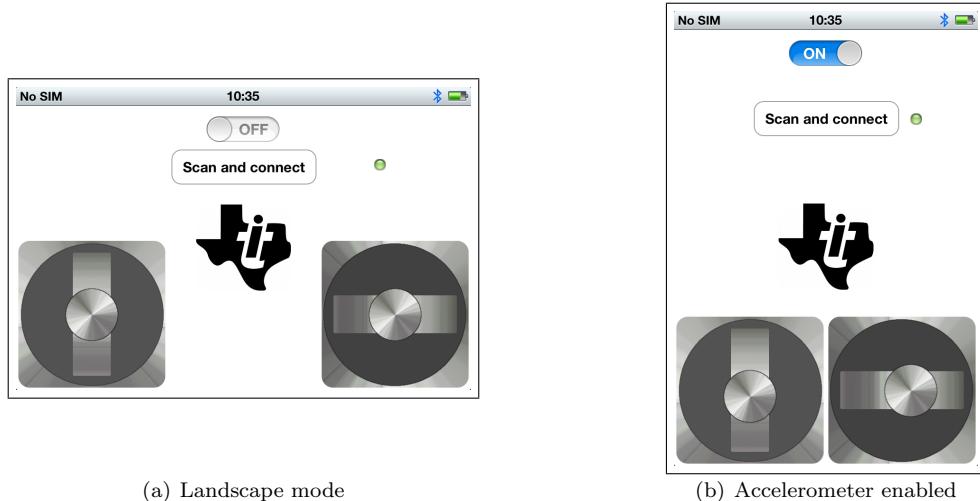


Figure 4. Additional application states.

Note: It is common for first-time users to forget about the accelerometer when they want to stop driving and simply start holding the phone like normal. Always remember to turn the switch back off!

5 Keyfob controller

In order to control the car using the keyfob from the CC2540 Mini Development Kit (fig. 5), insert the battery and mount the board in its housing. Running the keyfob without the housing is not recommended as touching certain parts of the board decreases the range and on rare occasions resets the program due to electrostatic discharge.

Connect to the car by pressing and holding both buttons for 2 seconds. The LED will blink orange while scanning and connect to the first device presenting advertising data containing vendor-specific data with TI's vendor-ID and the data 0x00CA. When connected, the keyfob will scan for the steering and throttle characteristic values and store their addresses, then signal that the connection is completed by flashing the LED with a green light. Press and hold again to disconnect, the LED will flash red. If the connection breaks for any reason, the LED will also flash red.

To enable the accelerometer, place the keyfob level and press the right button for 1 second. The LED will flash green. Drive the car by gently tilting the keyfob in the desired direction. To disable the accelerometer, press and hold the right button again for 1 second. The LED will flash orange.

While connected, the keyfob monitors the RSSI value once per second and alerts the user if it falls below a certain level by sounding the buzzer. When the buzzer sounds, do not drive the car further away as it might lose contact with the keyfob and drive off uncontrollably until the connection times out.

Note: It is common for first-time users to forget about the accelerometer when they want to stop driving and stop paying attention to its orientation. Always remember to turn the accelerometer back off!



Figure 5. The CC2540 Keyfob.

6 Additional demo

As an alternative to the car, the *TI SmartRF Evaluation Board* can display the steering and throttle values on the on-board LCD. Note that the controllers can not distinguish between the car and a SmartRF board and will connect to the device that answers first. To run the demo, simply turn the board on and connect.



(a) Advertising



(b) Connected



(c) Running

Figure 6. SmartRF running the TI BLE Car demo.