When developing Bluetooth low energy applications, you often need to establish a connection between a peripheral that is being developed and a central device that can help verify and diagnose the behavior of the peripheral.

To serve this purpose, ON Semiconductor developed the combination of the RSL10 USB Dongle and the Bluetooth® Low Energy Explorer. The Dongle is plugged into a computer that has the Bluetooth Low Energy Explorer software installed. The Dongle can then act as a generic central device with which a software developer can do anything that a typical central application would do, such as advertising scanning, establish a connection, and list services and characteristics.

1. RSL10 USB DONGLE

1.1 Key Features

- Bluetooth v.5.0, single (Bluetooth low energy) mode compliant
 - Supports Master and Slave Modes
 - Supports up to four connections
- Integrated Bluetooth low energy stack
- Radio performance
 - Transmit power: +6 dBm to -17 dBm
 - Receiver sensitivity: -94 dBm
- Host interfaces
 - USB (virtual COM port emulation)
- Bluetooth Low Energy Explorer software to diagnose Bluetooth low energy connections during application
 development
- Bluetooth 5, CE, FCC, IC and Japan certified

1.2 Electrical Characteristics

NOTE: The ratings in Table 1 are absolute maximum ratings beyond which the module can be permanently damaged. These are not maximum operating conditions. The maximum recommended operating conditions are in Table 2.

Table 1. Absolute Maximum Ratings

Rating	Min	Max	Unit
Storage Temperature	-40	+85	°C
VBUS	-0.3	6.5	V

Table 2. Recommended Operating Conditions

Rating	Min	Max	Unit
Operating Temperature Range	-40	+85	°C
VBUS	3.6	5.5	V

1.3 Certifications

1.3.1 Bluetooth

The RSL10 USB Dongle is Bluetooth qualified and listed as an End Product.

1.3.2 FCC

FCC ID: 2APD9-RSL10USB1

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

- NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

1.3.3 ISED

IC: 23763-RSL10USB1

HVIN: RSL10V1.02

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions: (1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

CAN ICES-3 (B)/NMB-3(B) – This Class B Digital Apparatus Complies with Canadian ICES-003.

Cet Appareil numerique de la classe (B) est conforme a la norme NMB-003 du Canada.

WARNING: RF Exposure Compliance

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 1 cm from all persons and must not be co-located or operating in conjunction with any other product antenna or transmitter.

L'antenne utilisée pour le produit doit être installée de manière à assurer une distance de séparation d'au moins 1 cm de toutes les personnes et ne doit pas être installée en même temps ou fonctionner en conjonction avec une autre antenne ou émetteur de produit.

1.3.4 Japan

The RSL10 USB Dongle has the Japanese certification number R209-J00300:



2. BLUETOOTH LOW ENERGY EXPLORER SOFTWARE

2.1 Introduction

Bluetooth Low Energy Explorer is a desktop application that runs on Windows®, developed to work with the RSL10 USB Dongle. The application allows developers to quickly become familiar with developing, testing, and evaluating Bluetooth low energy devices. Bluetooth Low Energy Explorer lets you scan for your device, read advertising data, connect, and discover services. You can then pair and bond to your device, read and write to characteristics, subscribe to notifications, and receive characteristics updates. The application also features a logging section, which displays the details of processes in the underlying structure, allowing for easier troubleshooting.

List of software features:

- 1. Scanning and reading advertising data
- 2. Connecting, pairing, and bonding
- 3. Service and characteristic discovery
- 4. Reading and writing of characteristics
- 5. Support for notifications and indications
- 6. Listing paired/bonded devices
- 7. Radio transmission power selection
- 8. Local device firmware updates
- 9. An external script for updating the dongle firmware

2.2 Before Using Bluetooth Low Energy Explorer

- 1. Install the Bluetooth Low Energy Explorer software.
- 2. Plug the RSL10 USB Dongle into a USB port. You might be prompted to install device driver software. You can either:
 - Follow the link in the error dialog to obtain the driver from the web.
 - Find the driver in *ON Semiconductor /Driver /CP210x_windows_Drivers.zip* where you installed the Bluetooth Low Energy Explorer. Unzip and install the appropriate *.exe* file.
- 3. Open the windows Device Manager and check which com port has been assigned (see Figure 1).

Now you can start Bluetooth Low Energy Explorer.



Figure 1. Assigned COM Port

2.3 Using Bluetooth Low Energy Explorer

In the Start Menu, browse to:

- All Programs > ON Semiconductor > > Bluetooth Low Energy Explorer
- If you are running Windows 10: ON Semiconductor > RSL10 dongle > Bluetooth Low Energy Explorer.exe

Select the Com Port which has been assigned during installation (see Figure 2, and Section 2.2, "Before Using Bluetooth Low Energy Explorer" on page 3).

Interface	COM57	•

Figure 2. Select COM Port

The Bluetooth Low Energy Explorer window is split into three main areas with an occasional fourth area, as shown in Figure 3:

- 1. List of visible Bluetooth low energy technology devices
- 2. Details of the selected device
- 3. Log information
- 4. The User action area on the right of the screen, is visible only when needed, such as for bonding data. You enter passkeys in this area when they are required.



Figure 3. Bluetooth Low Energy Explorer Window Areas

2.3.1 Establishing Connection and Discovering Services

General working procedure (see Figure 4, above):

- 1. Start Scanning by toggling the switch.
- 2. Select your device.
- 3. Make a connection to the device.
- 4. When you want to discover or update services, click the **Discover Services** button.
- 5. Switch to the new tab Services.
- 6. Depending on the services and characteristics offered by the connected device, values can be read and/or modified.

W NALLO BIDELOOTH LOW ENELGY EXPLOYED (CONID)				
Setup ?	Connect Encrypt Disconnect Updat	Dissource Convicos		
Scan Clear Get	Info Services	Discover services		B
(no name) State:Idle RSSI:-56 Bonded:No	Generic Access (1800)	14		*
(no name) State:Idle RSSI:-93 Bonded:No	Device Name 2A00	Peripheral_HealthTmp	Read	UTF8 String 👻
(no name) State:Idle RSSI:-91 Bonded:No	Appearance 2A01	0x0000	Read	Binary
(no name) State:Idle RSSI:-95 Bonded:No	Central Address Resolution 2AA6	0x00	Read	Binary
LE-Adam's Bose SoundSport State:Idle RSSI:-86 Bonded:No	Generic Attribute (1801)			
Blaze State:Idle RSSI:-52 Bonded:No	Service Changed 2A05	0x0100FFFF	Read Indication	Binary •
Peripheral_HealthTmp State:Ready RSSI:-73 Bonded:No	ev2e Information (180A)			
Meeting Room 1 TV State:Idle RSSI:-91 Bonded:No	Manufacturer Name String 2A29	(no value)	Read	UTF8 String 👻
(no name) State:Idle RSSI:-93 Bonded:No	Model Number String 2A24	(no value)	Read	UTF8 String -
(no name) State:Idle RSSI:-93 Bonded:No	Serial Number String 2A25	(no value)	Read	UTF8 String
	Hardware Revision String 2A27	(no value)	Read	UTF8 String
	Firmware Revision String 2A26	(no value)	Read	UTF8 String
	Software Revision String 2A28	(no value)	Read	UTF8 String
	System ID 2A23	(no value)	Read	Binary
	IEEE 11073-20601 Regulatory Certific	ation Data (no value)	Read	Binary -
11365.03 300 ERROR GATT Read failed (Connection/ 11365.04 200 ERROR GATT Read (Connection/200 Han 11365.04 200 ERROR GATT Read (Connection/200 Han	x00 Handleck0018 ResultInsufficientEncryptic 00 Handleck0012 ResultInsufficientEncryptic 00 Handleck0012 ResultInsufficientEncryptic deck0021 Datax0x64) deck0022 Datax0x600 deck0022 Datax0x000 deck0022 Datax0x000 deck0022 Datax0x000 deck0022 Datax0x000 deck0022 Datax0x000	n (ATT_ERR_INSUFF_ENC) n (ATT_ERR_INSUFF_ENC) n (ATT_ERR_INSUFF_ENC)		
Clear Save Log Level: INFO				Scroll Lock

Figure 4. Establish Connection

2.3.2 The Services Tab

The content of the Services tab depends on the services and characteristics offered by the connected device.

All characteristics sub-procedures are implemented; Figure 5 is an example of how some of the sub-procedures (depending on the device) might be displayed in the **Services** tab:

- Clicking **Read** reads the characteristics value.
- Clicking Write writes a change to the characteristics value.
- The characteristics writing properties Write Request or Write Without Response are displayed if either or both are supported.
- Some services offer a continuous update. Ticking the notification or indication box sets the characteristic in the service to be continuously updated.

Scan Clear Sort					
Clear Sort	Connect Encrypt Disconnect Update	Discover Services			
no name)	Info Services	Marcon McArd and		UTF8 String	
tate:Idle RSSI:-82 Bonded:No	Serial Number String 2A25	(no value)	Read	UTro Sung	•
10 name) tate:Idle R55I:-93 Bonded:No	Hardware Revision String	(no value)	Read	UTF8 String	-
o name)	2A27	(no voide)			
ate:Idle RSSI:-92 Bonded:No	Firmware Revision String	(no value)	Read	UTF8 String	•
no name)	2A26				
ate:Idle RSSI:-93 Bonded:No	Software Revision String	(no value)	Read	UTF8 String	•
-Adam's Bose SoundSport ate:Idle RSSI:-86 Bonded:No	2A28				
aze	System ID	(no value)	Read	Binary	•
ate:Idle RSSI:-52 Bonded:No	2423				
eripheral_HealthTmp tate:Ready RSSI:-75 Bonded:No	IEEE 11073-20601 Regulatory Certifico 2A2A	tion Data (no value)	Read	Binary	•
lecting Room 1 TV ate:Idle RSSI:-88 Bonded:No	PnP ID 2A50	(no value)	Read	Binary	•
o name) ate:Idle RSSI:-93 Bonded:No	Battery Service (180F)				
io name) ate:Idle RSSI:-94 Bonded:No	Battery Level 2A19	0x64	Read Votification	Binary	•
o name)	(A) Health Thermometer (1809)				
ate:Idle RSSI:-81 Bonded:No	Temperature Measurement	(no value)	Indication	Binary	•
	2A1C	(in the)			
	Temperature Type	0x00	Read	Binary	•
	2A1D				
	Intermediate Temperature	(no value)	Notification	Binary	•
	2A1E				
	Measurement Interval 2A21	100	Read Indication	8-Bit	•
	2A21	106	Write Reg		

Figure 5. Services Tab of a Connected Device

NOTE: Some parameters are only accessible over an encrypted connection (see Section 2.4, "Enable Encrypted Connection").

2.4 Enable Encrypted Connection

So far the connection has not been encrypted. To access all parameters, the connection needs to be changed to an encrypted connection.

1. The supported encryption settings can be selected in **Setup Menu** > **Security**, as shown in Figure 6. The Security Manager abbreviations are defined in Table 3 on page 8.

W KSLIU Bluetooth Low Energy Explorer (COM3)	
Setup	
Scan Clear Sort	Connect Encrypt Discoverset Update Discoverset vices 2
(no name) State:Idle RSSI:-75 Bonded:No	Info Name Peripheral_HealthTmp
(no name) State:Idle RSSI:-95 Bonded:No	Address 33:44:44:44:11 (Random Non Resolvable) Bonding - State Idle
Peripheral_HealthTmp State:Idle RSSI:-44 Bonded:No	RSSI -44 Advertisement
Blaze State:Idle RSSI:-45 Bonded:No	Flags 0x06 (LE General Discoverable Mode, BR/EDR Not Supported) Complete Local Name Peripheral_HealthTmp
(no name) State:Idle RSSI:-91 Bonded:No	Manufacturer Specific Data Company Identifier: ON Semiconductor (0x0362), Data: 0x03 Security Manager
ble_periph_server_bond State:Idle RSSI:-94 Bonded:No	Bond 🗹 Mitm 🗹
Meeting Room 1 TV State:Idle RSSI:-90 Bonded:No	Lesc V IO Caps Display & Keyboard • Ok

Figure 6. Setting the Security Options

Abbreviation	Definition
Bond	Bonding
Mitm	Man in the Middle
Lesc	LE Security Connections

- 2. To change the connection to an encrypted one without saving bond information, press the **Encrypt** button as shown in Figure 7.
- 3. To have an encrypted connection and saved pairing information, press Bond/Pair as shown in Figure 7.
- 4. If a passkey is needed, it is displayed, or can be entered in the user action area (see Section 2.3, "Using Bluetooth Low Energy Explorer" on page 4, and Figure 3 on page 5).

RSL10 Bluetooth Low Energy Explorer (COM)	114)				
Setup ?					
Scan Clear Sort		over Services			
ONsemi State:Idle RSSI:-89 Bonded:No	Info Encrypt Name Bond/Pair bond	<u></u> 2			
(no name) State:Idle RSSI:-84 Bonded:No	Address D5:BR:FF:22:11.94 (Random Static) Bonding - State Ready				
(no name) State:Idle RSSI:-90 Bonded:No	State neady RSSI -37 Advertisement				
ID115Plus HR State:Idle RSSI:-73 Bonded:No	Flags Complete Local Name	0x06 (LE General Discoverable Mode, BR/EDR Not Supported) ble_periph_server_bond			
(no name) State:Idle RSSI:-92 Bonded:No	Manufacturer Specific Data Manufacturer Specific Data	Company Identifier: ON Semiconductor (0x0362), Data: 0x- Company Identifier: ON Semiconductor (0x0362), Data: 0x-			
(no name) State:Idle RSSI:-94 Bonded:No	Connection Parameter	Interval:7.50ms Latency:0 Timeout:500ms			
(no namc) State:Idle RSSI:-91 Bonded:No	Security	Mode:1 Level:1 - No security (No authentication and no encryption)			
(no name)					



2.5 Initial Connection Settings

Figure 8 shows where you can set the initial connection settings before connecting. Once they are set, they become the default connection parameter settings for any device that you want to connect to.

To open the Connection Parameter window, press **Setup > Connection**. The numbered areas in Figure 8 are as follows:

- 1. Initial connection parameter settings before connecting to the device. For a description of the parameter settings, see Figure 9.
- 2. Minimum Connection Event Length in milliseconds
- 3. Maximum Connection Event Length in milliseconds
- 4. Scan Window in milliseconds
- 5. Scan Interval in milliseconds

RSL10 Bluetooth Low Energy	Explorer (COM14)
Setup ?	
Scan Clear	Sort 1
HA_R State:Idle RSSI:-68 Bonded:No	Connection Parameters
(no name) State:Idle RSSI:-91 Bonded:No	Connection Parameters Event Length
(no name) State:Idle RSSI:-60 Bonded:No	Interval (ms) 7.5 Min Connection Event Length (ms)
ONsemi□ State:Idle RSSI:-92 Bonded:No	Slave Latency 0 Max Connection Event Length (ms)
(no name) State:Idle RSSI:-83 Bonded:No	Timeout (ms) 500 12.5 3
(no name) State:Idle RSSI:-89 Bonded:No	
ID115Plus HR State:Idle RSSI:-85 Bonded:No	Scan Parameters Scan Interval (ms) 75 Scan Window (ms) 31.25
(no name) State:Idle RSSI:-95 Bonded:No	Scan interval (ms) 73 Scan window (ms) 5125 -
(no name) State:Idle RSSI:-94 Bonded:No	
(no name) State:Idle RSSI:-94 Bonded:No	5 ок
(no name) State:Idle RSSI:-94 Bonded:No	
(no name) State:Idle RSSI:-92 Bonded:No	
(no name) State:Idle RSSI:-84 Bonded:No	

Figure 8. General Connection Settings

Alternatively, you can update the connection parameters while connected, using the **Update** button in the Services tab, which is shown in Figure 9.

In Figure 9:

• Interval is the connection interval in multiples of 1.25 ms units

- Slave Latency is the number of connection events •
- **Timeout** is in multiples of 10 ms units. ٠

RSL10 Bluetooth Low Energy Explorer (COM14)	I)	
Setup ?		
Scan Clear Sort	Connect Encrypt Disconnect Update Discover Services	
ble_periph_server_bond State:Ready RSSI:-52 Bonded:No (no name)	Info Name ble_periph_server_bond Address D5:BB:FF:22:11:94 (Random Static)	
State:Idle RSSI:-92 Bonded:No	Bonding - OCOnnection Parameters	
LE-Adam's Bose SoundSport State:Idle RSSI:-92 Bonded:No	RSSI -52 Advertisement	
(no name) State:Idle RSSI:-57 Bonded:No	Flags Interval (ms) 7.5 Complete Local Na Manufacturer Spe	Discoverable Mode, BR/EDR bond r: ON Semiconductor (0x03
(no name) State:Idle RSSI:-85 Bonded:No	Manufacturer Spe Slave Latency 0	r: ON Semiconductor (0x03
(no name) State:Idle RSSI:-80 Bonded:No	Connection Parameter Security	atency:0 Timeout:500ms No security (No authentica
(no name) State:Idle RSSI:-62 Bonded:No	Timeout (ms) 500	
(no name) State:Idle RSSI:-92 Bonded:No	ОК	
(no name) State:/dle RSSI:-90 Bonded:No		4
(no name) State:Idle RSSI:-80 Bonded:No		

Figure 9. Connection Parameter Window Update

2.6 Bond Manager

The Bond Manager is accessible in the main menu under **Settings** > **Bonds**:

In the Bond Manager window, all currently active bonds are displayed. There is also the option to delete them. (See Figure 10.)

RSL10 Bluetooth Low Energy Explorer (COM3)	
Setup ?	
Scan Clear Sort	
	Bond Manager
	Pelete
	Close

Figure 10. Bond Manager

2.7 TX Power Update

TX power (Transmission power) in dBm ranges from +6 dBm to -17 dBm.

NOTE: If you are using a new RSL10 USB Dongle, you have to update the firmware on the dongle to get access to this feature.

To open the TX Power window, press **Setup > TX Power**, and a window like Figure 11 appears.

) RSL10 Bluetooth Low Energy Explorer (COM14) ietup ?	
Scan O Clear Sort	
	C Tx Power Update
	-6 dBm
	SAVE

Figure 11. TX Power Update Window

2.8 Dongle Information

The Bluetooth Low Energy Explorer version, and Dongle version and ID, can always be accessed in the About dialog (see Figure 12).



Figure 12. Version and ID Info

2.9 Dongle Updater

For updating the firmware on the dongle itself, a dedicated Python script is available called *updater.py*, which is in the *Firmware* subfolder of the Bluetooth Low Energy Explorer installation.

The script has the following prerequisites:

- Installed Python, version 2.7.x or ≥ 3.4
- Installed module *pyserial*, version ≥ 3.2
- CP210xRuntime.dll in the same directory as updater.py
- SiliconLabs VCP driver version $\ge 6.7.3$

The help command for the update protocol is as follows:

```
> updater.py -h
```

This command gives the following output:

```
usage: updater.py [-h] [-v] [--force] PORT FILE
```

Updates the RSL10 USB Dongle with a firmware image file. positional arguments: PORT COM port number of RSL10 USB Dongle FILE image file (.bin) to download optional arguments: -h, --help show this help message and exit -v, --version show program's version number and exit force overwrite of the bootloader --force

The following is an example of using the command with the PORT positional argument to update the firmware (the *DongleFW.bin* file is in the *Firmware* subfolder of the Bluetooth Low Energy Explorer installation):

```
> updater.py <PORT> DongleFW.bin
```

This command gives the following output and programs the new firmware into the USB Dongle:

```
Image
     : DONG_R ver=1.0.1
Application: DONG_R ver=1.0.0
Bootloader : BOOT R ver=1.0.0
*****
```

It shows the version information of the image file, the currently installed application, and the installed bootloader. For every transmitted flash sector of image data, an asterisk (*) is printed.

2.10 Dongle Hardware

The dongle has a dual color LED, which is used to represent different functions as shown in Table 4, below:

Function	LED Color
When using the DongleFW	a short flash during start up, and then off
When the dongle is in the bootloader	constant red

Table 4, LED Colors and Functions

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