

GATTBrowser for Android

R01AN3802EJ0101

Smartphone Application Instruction manual

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Introduction

This manual describes about Renesas Bluetooth® Low Energy (hereinafter call, "BLE") on how to use the Smartphone application known as "GATTBrowser". This application will be used for checking the BLE behavior during the development of BLE products with the Renesas microcontroller (RL78/G1D).

Target Device

Android 5.0.1 or later

Related Documents

The related documents referred in this document might include preliminary versions. However, the preliminary versions are not marked as such.

Document Name	Document No.
Bluetooth® Low Energy Protocol Stack	-
User's Manual	R01UW0095E
BLE Virtual UART Application	R01AN3130E
Embedded Configuration Sample Application	R01AN3319E
RL78/G1D Beacon Stack	-
Connecting and Updating Beacon Data Sample Program	R01AN3313E

Contents

1. Overview	4
2. Applicability	4
3. Restriction	4
4. Operational Environment	4
4.1 Limitations	4
5. Installation	5
6. Method of operation	5
6.1 Application launch	5
6.2 BLE devices scan list	7
6.2.1 Start scan	7
6.2.2 Stop scan	8
6.2.3 Rescan	8
6.2.4 BLE device information in short format	9
6.2.5 BLE device information with Advertising data information	10
6.2.6 BLE device connection	11
6.2.7 Filter function	12
6.2.8 Sort function	13
6.2.9 Correspondence function of UUID and name	13
6.2.10 Launch the Bluetooth setting screen	13
6.2.11 Version information	13
6.3 Service and Characteristic list	14
6.3.1 Connection Status	16
6.3.2 Display Service name & Characteristic name	16
6.3.3 Characteristic selection	17
6.4 Characteristic operation	18
6.4.1 Characteristic operation screen	18
6.4.2 Connection status	19
6.4.3 Read operation	19
6.4.4 Display mode selection	20
6.4.5 History of received data	20
6.4.6 Notification operation	20
6.4.7 Indication operation	20
6.4.8 Write operation	21
6.4.9 Write without response operation	21
6.4.10 Write mode selection	21
6.4.11 History of sending data	22
6.4.12 Historical data copying into the text field	22
6.4.13 Update of descriptors	22
6.4.14 Limitations	22
6.5 Display Renesas custom data	23

6.5.1 Renesas custom Service and Characteristic names display 23

6.5.2 Beacon data analysis dialog 24

7. Appendix 25

1. Overview

GATTBrowser is a general-purpose application that can scan BLE devices, which are advertising in vicinity and can perform the GATT-based communication with the connected BLE device. In the application, functionality has been promoting the development of BLE microcontroller, RL78/G1D device.

GATTBrowser supports the following features.

- Scan surrounding BLE devices
- Display the Advertising data
- Display the Received Signal Strength Indication (hereafter call, "RSSI")
- Connect to Renesas RL78/G1D BLE microcontroller and other BLE devices
- Display the BD Address of the connected BLE device
- Display the services and characteristics information
- Communicate with BLE device
- Support Renesas unique services and characteristics

2. Applicability

This manual explains about Android application, GATTBrowser Version 1.0.0 or later.

3. Restriction

This GATTBrowser application is intended to evaluate the BLE software. Accordingly, this GATTBrowser is not applicable to any purpose other than evaluation.

4. Operational Environment

The GATTBrowser runs on the following operating environment.

- Android 5.0.1 or later
- Use Bluetooth Low Energy (BLE) function.

4.1 Limitations

There is a problem that Android 6.0 / 6.0.1 Marshmallow can't re-connect with a paired (bonded) device.

Reference

Issue 202850, Android Open Source Project -Issue Tracker

<https://code.google.com/p/android/issues/detail?id=202850>

5. Installation

To install in Android devices, open Google Play and search for "GATTBrowser". Then get the application.
It is also possible to install from the following URL.

➤ GATTBrowser

<https://play.google.com/store/apps/details?id=com.renesas.ble.gattbrowser>

After successfully installed, the following icons will be appeared on the screen.



Figure 5-1 GATTBrowser icon.

6. Method of operation

This chapter will describe how to use GATTBrowser and the illustration are captured by using Android 6.0.1 device (MOTOROLA Nexus 6) for explaining examples.

6.1 Application launch

To start GATTBrowser, touch the GATTBrowser icon. After starting, the GATTBrowser starts scanning the BLE devices performing advertising in the surrounding area. Figure 6-1 GATTBrowser launch. shows the GATTBrowser launch screen.



Figure 6-1 GATTBrowser launch.

When the Android device is turn off the Bluetooth while starting, the GATTBrowser application notifies the message, "Bluetooth setting are turned OFF. Please turn on the Bluetooth" as shown in Figure 6-2. To use this application, the Android device must be turned on the Bluetooth function.

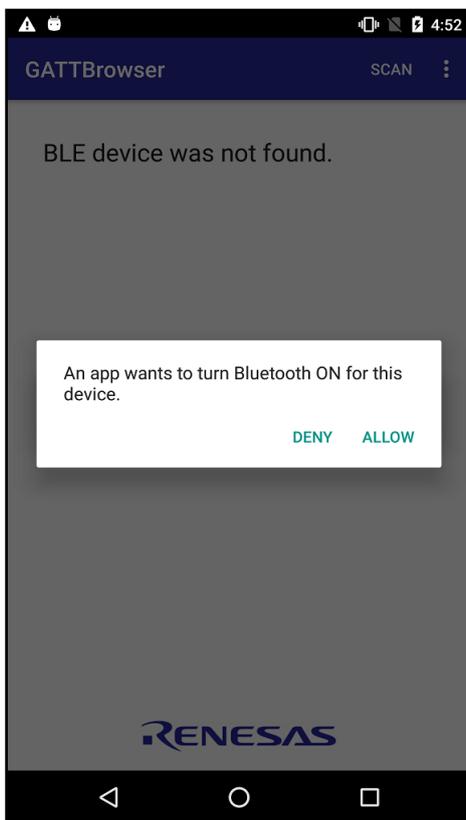


Figure 6-2 Bluetooth OFF dialog.

6.2 BLE devices scan list

6.2.1 Start scan

When starting up, the GATT Browser starts scanning BLE devices performing advertising in the surrounding area. The discovered BLE device will be displayed in the list.

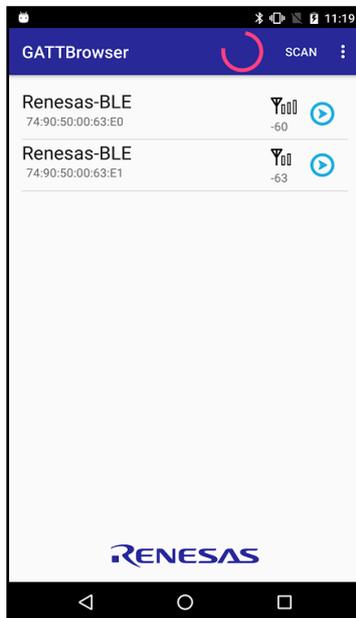


Figure 6-3 List of found BLE devices.

A circular progress bar will be displayed on the upper right side of the screen during scanning. Scanning stops after 30 seconds have elapsed since the scan started.

6.2.2 Stop scan

Tap the Overflow Menu on the upper right side of the screen to display the function items. Tap "Stop Scanning" to stop scanning.

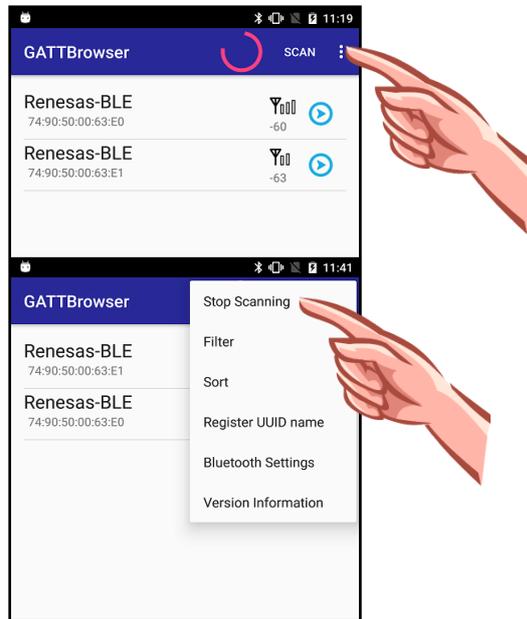


Figure 6-4 Tap on "Stop Scanning".

If the size of the screen is large such as tablet, "STOP SCANNING" button will be displayed on the upper side of the screen.



Figure 6-5 Tap on "STOP SCANNING" (Tablet devices).

Even if the BLE device starts advertising newly while scanning is stopped, it will not be added to the list. It also stops updating the display of the RSSI and displays the RSSI last observed.

6.2.3 Rescan

Tap the "SCAN" button on the upper right of the screen. After rescanning, the BLE device information displayed in the list will be cleared. Rescanning is also effective during scanning.

6.2.4 BLE device information in short format

The information of the discovered BLE device is displayed as follows.



Figure 6-6 BLE device information in short format.

Table 6-1 BLE device information

No.	Information	Description
①	Device Name	Displays the device name for BLE devices found. <ul style="list-style-type: none"> ➤ If the device previously connected, it will display the value of the Characteristic GAP Device Name. ➤ If the device never connected, it will display the device name in the advertising data. If the advertising data does not contain the device name, it will display as "<No name>".
②	BD Address	Displays the BD Address of the discovered BLE device.
③	RSSI	Displays the RSSI value of the discovered BLE device. During scanning operation, the RSSI value is periodically updated. After the scanning operation is stopped, the RSSI value last observed is displayed.
④	Connection Button	Connects to the discovered BLE devices.

6.2.5 BLE device information with Advertising data information

When the cell of the discovered BLE device is tapped, the display area of the cell is enlarged and the advertising data is displayed. Tap again to erase the advertising data and return to the original display.

For detail information about displayed parameters, refer to the Bluetooth SIG documents such as [Core Spec 4.2](#) [Vol 3, Part-C] and [CoreSpecification Supplement](#) [Part A].

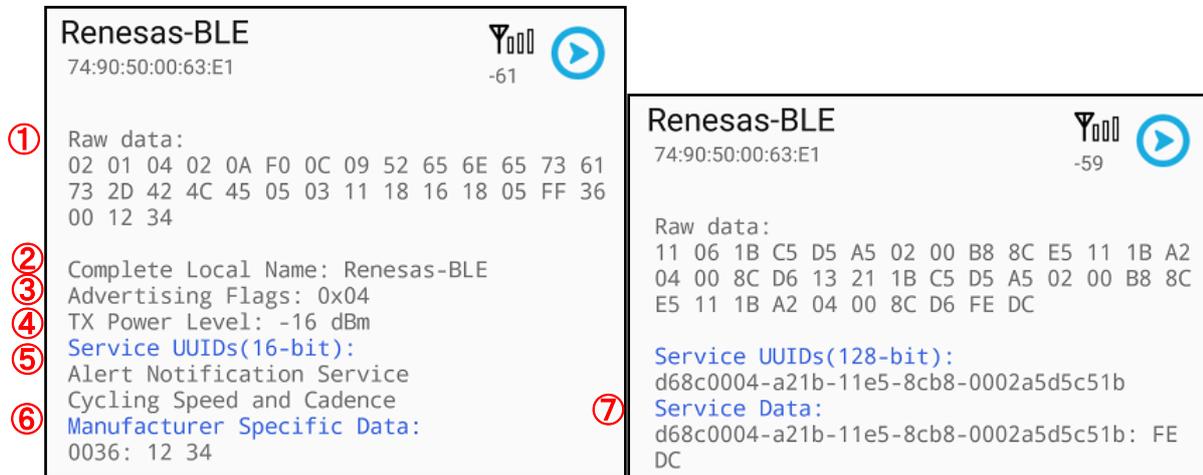


Figure 6-7 Advertising data information.

Table 6-2 Advertising data

No.	Information	Description
①	Raw Data	Raw data of the advertising data (includes the scan response data).
②	Local Name	The local name of the BLE device.
③	Flags	The flags such as discoverable mode and others.
④	TX Power Level	The transmit power of the BLE device.
⑤	Service UUIDs(16-bit) Service UUIDs(32-bit) Service UUIDs(128-bit)	Services UUID of the BLE device.
⑥	Manufacturer Specific Data	Manufacturer Specific Data of the BLE device.
⑦	Service Data	Service Data of the BLE device.

When the received Advertising data is iBeacon, detailed information on iBeacon will be displayed.

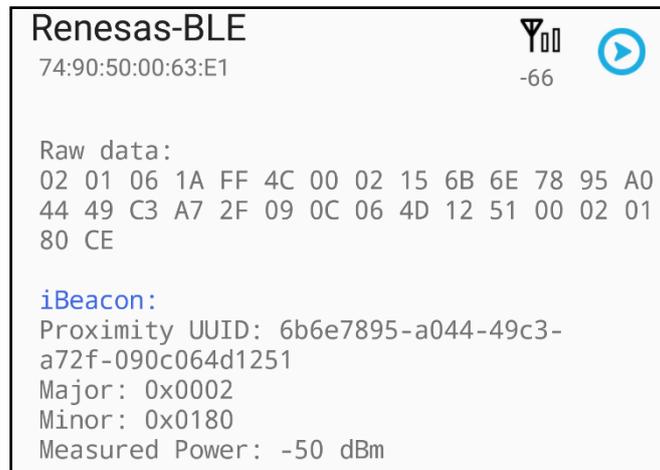


Figure 6-8 iBeacon information.

When the received Advertising data is Eddystone, detailed information on Eddystone will be displayed. Eddystone URL, Eddystone-TLM, and Eddystone-EID are supported. Tap the URL to open the URL in WebView in this application.

For detail information about displayed parameters, refer to <https://github.com/google/eddystone>



Figure 6-9 Eddystone information.

6.2.6 BLE device connection

Tap the arrow mark at the right end of the BLE device information to connect to the BLE device and move to the screen described in 6.3 **Service and Characteristic list**



Figure 6-10 BLE device connection.

6.2.7 Filter function

For the discovered BLE devices, only BLE devices corresponding to preset conditions are displayed.

Tap the Overflow Menu on the upper right side of the screen to display the function items. Tap "Filter" to display the filter selection dialog.

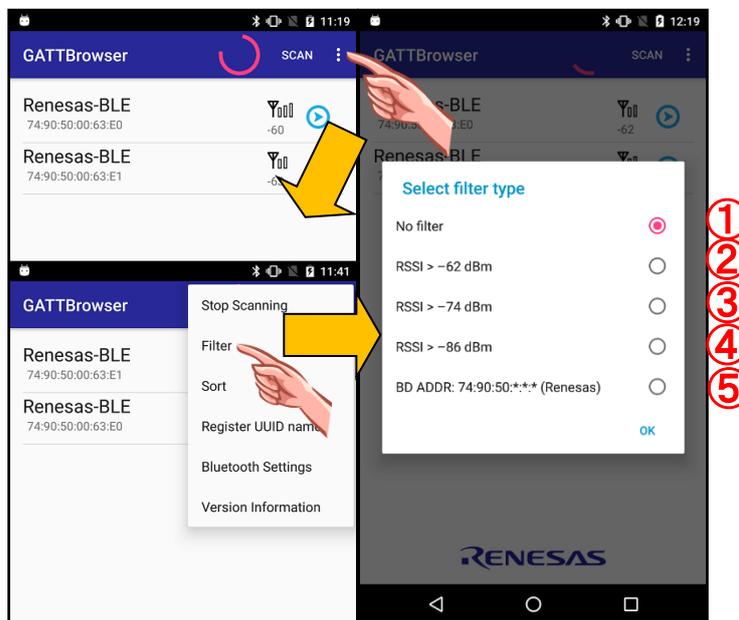


Figure 6-11 Filter function.

Table 6-3 Filter types

No.	Information	Description
①	No filter	Displays all discovered BLE devices. (Default)
②	RSSI > -62 dBm	Displays BLE devices with RSSI greater than -62 dBm.
③	RSSI > -74 dBm	Displays BLE devices with RSSI greater than -74 dBm.
④	RSSI > -86 dBm	Displays BLE devices with RSSI greater than -86 dBm.
⑤	BD ADDR: 74:90:50:*:*:*	Displays BLE devices that BD Address corresponds to vendor code of Renesas Electronics Corporation (OUI: 74 - 90 - 50)

When the RSSI filter is set, if the RSSI of the displayed BLE device falls below the RSSI set by the filter, it will be removed from the display list. If the RSSI exceeds the RSSI set by the filter, it will be displayed in the display list.

6.2.8 Sort function

Sets the order of the discovered BLE devices. Tap the Overflow Menu on the upper right side of the screen to display the function items. Tap "Sort" to display the sort selection dialog.

If scanning is in progress and sorting is enabled, the order of the BLE devices is updated approximately once every second.

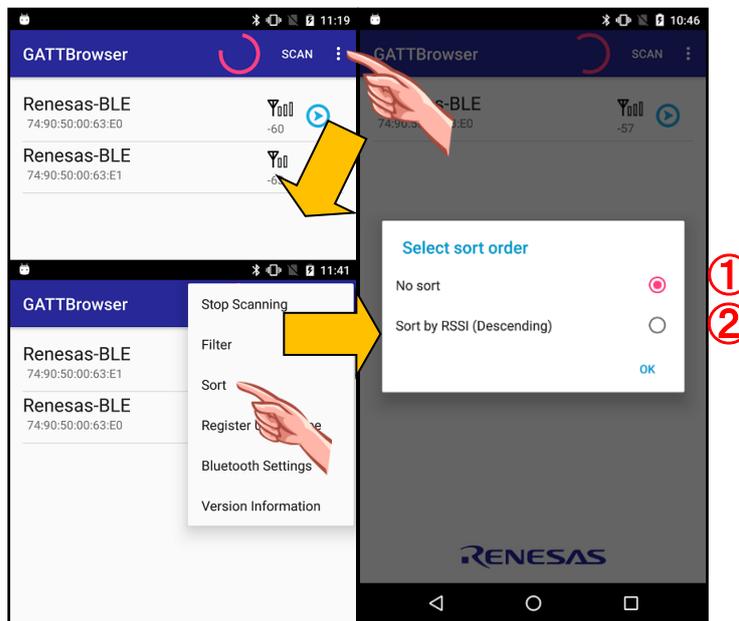


Figure 6-12 Sort function.

Table 6-4 Sort types

No.	Information	Description
①	No sort	Displays BLE devices in the order of discovery. (Default)
②	Sort by RSSI(Descending)	Display BLE devices in the order of RSSI descending.

6.2.9 Correspondence function of UUID and name

Register the name corresponding to 128 bit UUID. The name corresponding to the 128-bit UUID is displayed in the 128-bit UUID display part of "Service and Characteristic list" screen and "Characteristic operation" screen.

Tap the Overflow Menu on the upper right side of the screen to display the function items. Tap "Register UUID name" to display a dialog to register correspondence between UUID and name.

6.2.10 Launch the Bluetooth setting screen

Tap the Overflow Menu on the upper right side of the screen to display the function items. Tap "Bluetooth Settings" to launch the Android standard Bluetooth setting application.

6.2.11 Version information

Tap the Overflow Menu on the upper right side of the screen to display the function items. Tap "Version Information" to display the version information dialog of this application.

6.3 Service and Characteristic list

When you connect to the BLE device, it switches to "Service and Characteristic list" screen.

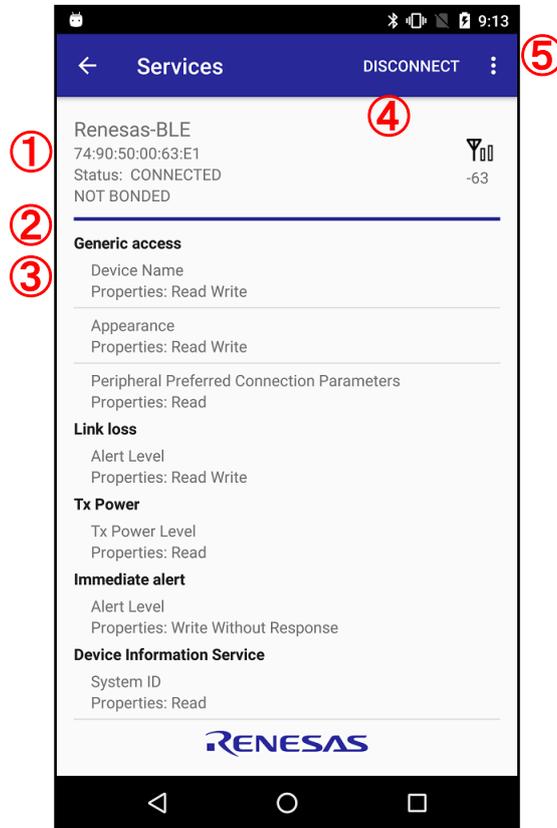


Figure 6-13 Service and Characteristic list.

Table 6-5 BLE device information

No.	Information	Description
①	Connected device information	Displays the "local name", "BD address", "connection status", "binding status", and "RSSI" of the connected BLE device.
②	Service name	Displays a list of all Service and Characteristic found by Service Discovery.
③	Characteristic name	Displays the "name" and "Properties" of the characteristic in the service.
④	DISCONNECT	Disconnects the connection.
⑤	Overflow Menu	Displays the functions items described in Table 6-6.

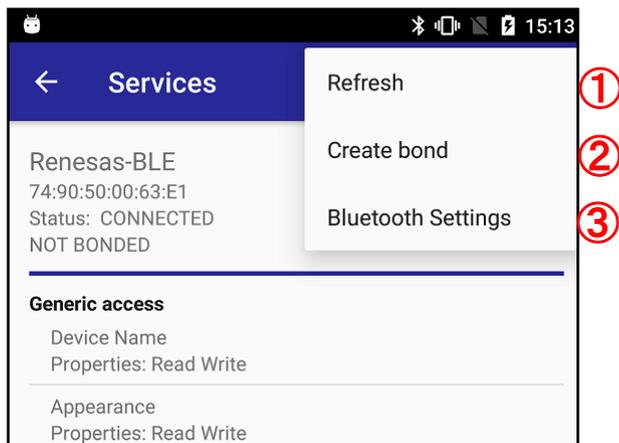


Figure 6-14 Overflow Menu.

Table 6-6 Overflow Menu items

No.	Information	Description
①	Refresh	Removes the Service and Characteristic information that Android keeps in the cache, and get information from the connected BLE device.
②	Create bond	Bonds to the connected BLE device.
③	Bluetooth Settings	Launches the Android standard Bluetooth setting application.

6.3.1 Connection Status

Displays the “device name”, “BD Address”, “Connection status”, “Bonding status”, and “RSSI value” of the connected BLE device. The “RSSI value” is updated at regular intervals. The color of the divider line changes (CONNECTED: Blue, DISCONNECTED: Red) depending on the connection state.

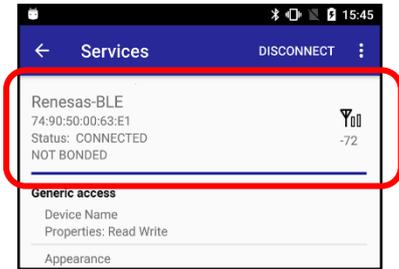


Figure 6-15 Connected.

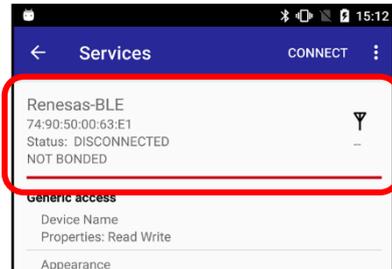


Figure 6-16 Disconnected.

6.3.2 Display Service name & Characteristic name

When UUID specified by Bluetooth SIG, Inc. is detected during Service Discovery, the service name corresponding to the UUID is displayed. For other custom UUID, the UUID is displayed as it is.

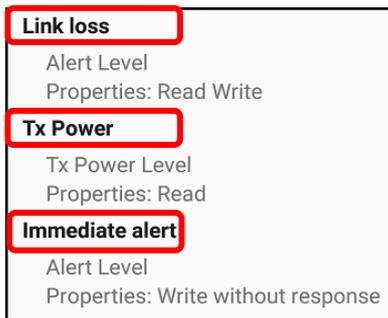


Figure 6-17 Display Service name determined by the Bluetooth SIG, Inc.

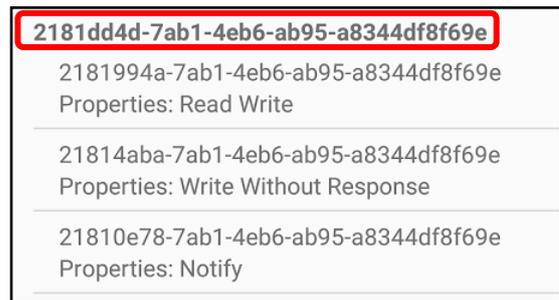


Figure 6-18 Service names of custom UUID is detected.

Likewise, when UUID specified by Bluetooth SIG, Inc. is detected during Characteristic Discovery, the characteristic name corresponding to the UUID is displayed. For other custom UUID, the UUID is displayed as it is.



Figure 6-19 Display Characteristic name determined by the Bluetooth SIG, Inc.

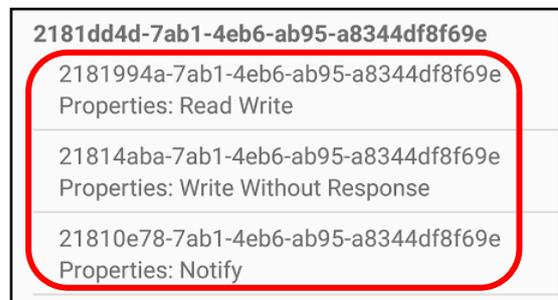


Figure 6-20 Characteristic names of custom UUID is detected.

If a custom UUID to be used in the RL78 / G1D sample application is detected, the custom service name and characteristic name will be displayed instead of the UUID. For details, see "6.5 Displaying Renesas Custom data".

6.3.3 Characteristic selection

When the characteristic you want to operate is tapped, it will move to "Characteristic operation" screen. Only one characteristic can be selected and operated at a time

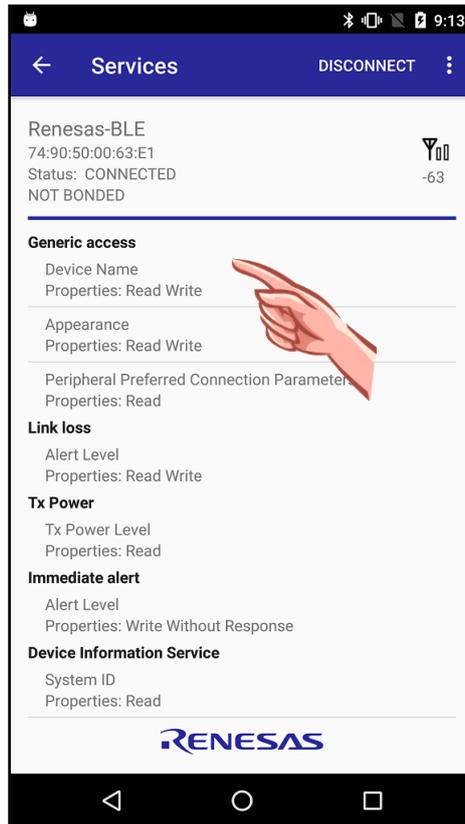


Figure 6-21 Characteristic selection.

6.4 Characteristic operation

6.4.1 Characteristic operation screen

By tapping the characteristic that you want to operate on "Service and Characteristic list" screen, the screen will move to "Characteristic operation" screen. The displayed buttons and items will change depending on the Characteristic Properties attributes of the characteristic to be operated.

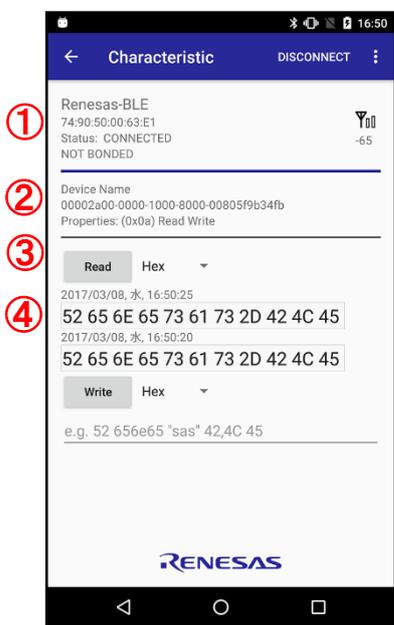


Figure 6-22 Characteristic operation 1.

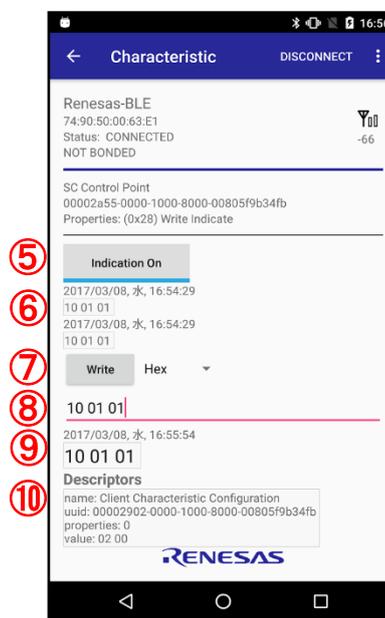


Figure 6-23 Characteristic operation 2.

Table 6-7 Characteristic operation information

No.	Information	Description
①	Connected device information	Displays "Local name", "BD address", "Connection status", "Bonding status", and "RSSI" of the connected BLE device. The displayed information is the same as the "Service and Characteristic list" screen.
②	Characteristic information	Displays "Characteristic name", "Characteristic UUID" and "Characteristic Properties" of the connected BLE device.
③	Read button & Display mode selection spinner	The "Read" button is to receive the value of the characteristic. "Display mode selection Spinner" selects the display method of received data. "Read" button and "Display mode selection" spinner is displayed based on the characteristic properties and are not displayed when there is no Read attribute in the characteristic properties.
④	History of received data	Displays the characteristic value received by operating the "Read" button. Up to three cells are displayed, and the latest data is displayed at the top.
⑤	Indication / Notification button	The Indication / Notification button is for instructing Indication / Notification. Each button is displayed based on the characteristic properties and are not displayed when there is no Indication /

		Notification attribute in the characteristic properties.
⑥	History of Indication / Notification received data	Displays the contents of the data notified of the change. Up to three cells are displayed, and the latest data is displayed at the top. Data is displayed in hexadecimal for every 8 bits.
⑦	Write button & Write mode selection spinner	The “Write” button is to write a value to the characteristic. The “Write” button is displayed based on the characteristic properties and it is not displayed when there is no Write attribute in the characteristic properties. “Write mode selection” spinner specifies the format of data to be written.
⑧	Text field of write data	The text field is to enter a value to be written to the characteristic. After entering the data here, tap the “Write” button and write the data to the target characteristic.
⑨	History of sent data	Displays the value successfully sent by the “Write” button. Up to three cells are displayed, and the latest data is displayed at the top. If sending operation fails, it will not be displayed in the history.
⑩	Descriptor information	Displays the descriptor information of the characteristic.

6.4.2 Connection status

The connection status is the same as "6.3.1 Connection Status".

6.4.3 Read operation

If the characteristic has the read attribute in the Characteristic Properties, the "Read" button and “display mode selection” spinner will be displayed. Tap the "Read" button to read the characteristic value.

The read data is displayed in the received data history field.



Figure 6-24 The “Read” button.

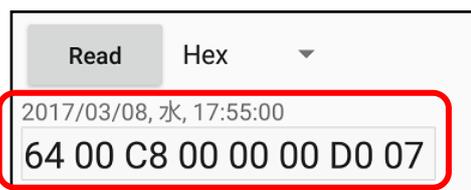
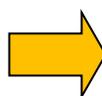


Figure 6-25 After tapping the "Read" button.

6.4.4 Display mode selection

In the “display mode selection” spinner, next to the "Read" button, select the display method of the received data. “Hex” mode and “String” mode can be selected. When “Hex” mode is selected, data is displayed in hexadecimal for every 8 bits. If “String” mode is selected, data is displayed as UTF-8 string.



Figure 6-26 Display mode selection spinner.

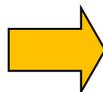


Figure 6-27 Select display mode.

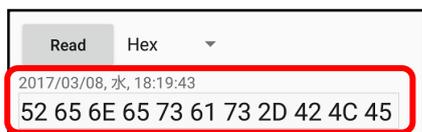


Figure 6-28 Hex mode.



Figure 6-29 String mode.

6.4.5 History of received data

The data received with the “Read” button is displayed in the received data history field. Up to three of this history are displayed, and the latest data is displayed at the top. When receiving the characteristic data when there are three histories, the oldest history at the bottom is removed and the latest data is added to the top.

6.4.6 Notification operation

If the characteristic has the Notification attribute in the Characteristic Properties, the Notification On / Off toggle button will be displayed. When this toggle button is pressed, the display changes from "Notification Off" to "Notification On", and you can receive the Notification. If the reception request for Notification fails, the button display will not be switched. In the “display mode selection” spinner, next to the Notification On/Off toggle button, select the display method of the received data. “Hex” mode and “String” mode can be selected.

The received notification data is displayed in the received notification data history field.



Figure 6-30 Notification On/Off toggle button.

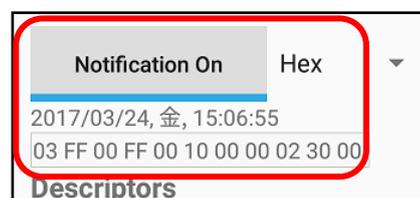
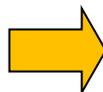


Figure 6-31 Received notification data.

6.4.7 Indication operation

If the characteristic has the Indication attribute in the Characteristic Properties, the Indication On / Off toggle button will be displayed. When this toggle button is pressed, the display changes from "Indication Off" to "Indication On", and you can receive the Indication. If the reception request for Indication fails, the button display will not be switched.

The received indication data is displayed in the received indication data history field.

6.4.8 Write operation

If the characteristic has the write attribute in the Characteristic Properties, the "Write" button, the "write mode selection" spinner, and the text field for setting write data are displayed. Tap the "Write" button to write the characteristic value.

The data that was successfully written is displayed in the sent data history field.

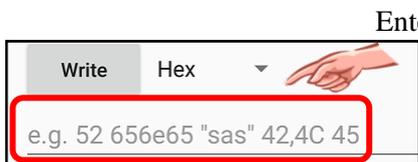


Figure 6-32 Sending text field.

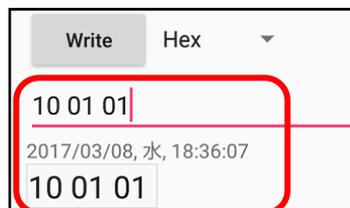
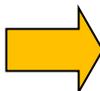


Figure 6-33 After tapping the "Write" button.

6.4.9 Write without response operation

If the characteristic has the write without response attribute in the Characteristic Properties, the "Write" button and the text field for setting write data are displayed. On the screen display, there is no difference between Write operation and Write without response operation.

6.4.10 Write mode selection

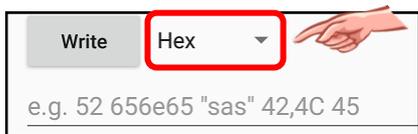


Figure 6-34 Write mode selection spinner.

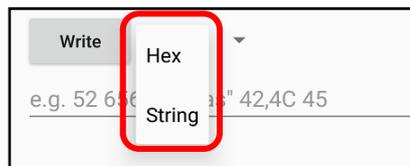
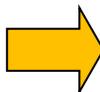


Figure 6-35 Select write mode.

In the "write mode selection" spinner, next to the "Write" button, select the specifies whether data set in the text field is handled as Hex data or String data.

In the "Hex" mode, write data is handled as a hexadecimal number. Two hexadecimal digits (8-bit data) are the minimum input unit, and the delimiter allows a space and a comma. For example, to write hexadecimal "0x000102ABCD", enter as follows.

- 000102ABCD
- 00 01 02 AB CD
- 000102ABCD
- 00,01,02,AB,CD

In addition, character strings delimited by single quotation mark or double quotation mark are decoded and written by UTF-8. For example, if you enter "00 "Renesas" FE FF", "0x0052656e65736173FEFF" will be written.

In the "String" mode, write data is decoded and written with UTF-8. For example, to write "Renesas", "0x52656e65736173" will be written.

6.4.11 History of sending data

As with the received data history, the data sent with the “Write” button is displayed in the sent data history field. Up to three of this history are displayed, and the latest data is displayed at the top. When sending the characteristic data when there are three histories, the oldest history at the bottom is removed and the latest data is added to the top.

Sent data history is displayed in hexadecimal binary format regardless of the type of the write mode selection.

6.4.12 Historical data copying into the text field

When the text field of the write data is displayed and there is a received data history, long tap on the cell of the received data history will copy the data to the text field of the write data.

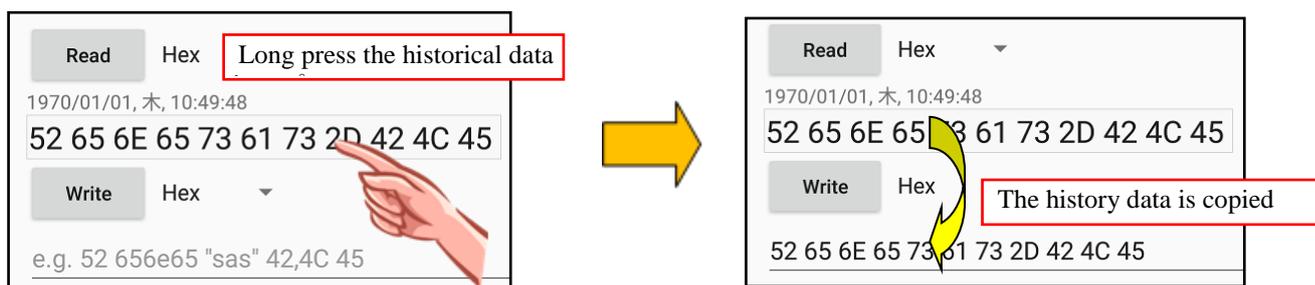


Figure 6-36 Copy historical data into the text field.

6.4.13 Update of descriptors

The descriptor information is automatically updated when requesting reception of Notification or Indication, but by tapping the cell of display information, it intentionally reads the descriptor information of the characteristic.

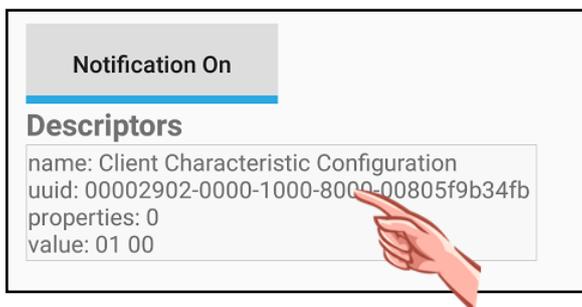


Figure 6-37 Update of descriptor.

6.4.14 Limitations

Operations on Broadcast attribute (0x01) and Extended Properties attribute (0x80) of Characteristic Properties are not supported.

6.5 Display Renesas custom data

If RL78/G1D custom UUID is not the UUID, which have been detected are used in the sample application, you will see the name of the custom services and characteristics. In addition, a dialog for information analysis will be displayed, but it is a specific characteristic.

6.5.1 Renesas custom Service and Characteristic names display

The Service name used in the RL78/G1D sample applications as below are detected and displayed the following Service/Characteristic UUID and Characteristic names.

- BLE Virtual UART application (Document No. R01AN3130E)

Table 6-8 UUID of BLE Virtual UART application

UUID	Renesas custom Service and Characteristic
D68C0001-A21B-11E5-8CB8-0002A5D5C51B	Renesas Virtual UART Service
D68C0002-A21B-11E5-8CB8-0002A5D5C51B	Indication Characteristic
D68C0003-A21B-11E5-8CB8-0002A5D5C51B	Write Characteristic

- Embedded Configuration Sample application (Document No. R01AN3319E)

Table 6-9 UUID of Embedded Configuration Sample application

UUID	Renesas custom Service and Characteristic
5BC1B9F7-A1F1-40AF-9043-C43692C18D7A	Renesas Sample Custom Service
5BC18D80-A1F1-40AF-9043-C43692C18D7A	Switch State Characteristic
5BC143EE-A1F1-40AF-9043-C43692C18D7A	LED Control Characteristic

- RL78/G1D Beacon Stack Connecting and Updating Beacon Data Sample Program (Document No. R01AN3313E)

Table 6-10 UUID of RL78/G1D Beacon Stack Connecting and Updating Beacon Data Sample Program

UUID	Renesas custom Service and Characteristic
A7660001-4B1E-4D6E-91C4-997BA9B6FC07	Renesas Beacon Updater Service
A7660002-4B1E-4D6E-91C4-997BA9B6FC07	Advertising Information
A7660003-4B1E-4D6E-91C4-997BA9B6FC07	Advertising Data
A7660004-4B1E-4D6E-91C4-997BA9B6FC07	Code Flash Memory Updated Count
A7660005-4B1E-4D6E-91C4-997BA9B6FC07	Data Flash Memory Updated Count
A7660006-4B1E-4D6E-91C4-997BA9B6FC07	Scan Response Data

6.5.2 Beacon data analysis dialog

When connecting to the sample program included in "RL78/G1D Beacon Stack Connecting and Updating Beacon Data Sample Program", if you read the characteristic value of the Advertising Information characteristic, the Advertising Data characteristic, or the Scan Response Data characteristic and tap the received data, a dedicated analysis dialog will appear. When tapping the wrote data, the dedicated analysis dialog will appear as well.

➤ Advertising Information

If you read an Advertising Information and tap history data, the Advertising Information analysis dialog will be displayed. Likewise, if you write an Advertising Information and tap the history data, the Advertising Information analysis dialog will be displayed.

Here is an example when tapping the history data of Read.

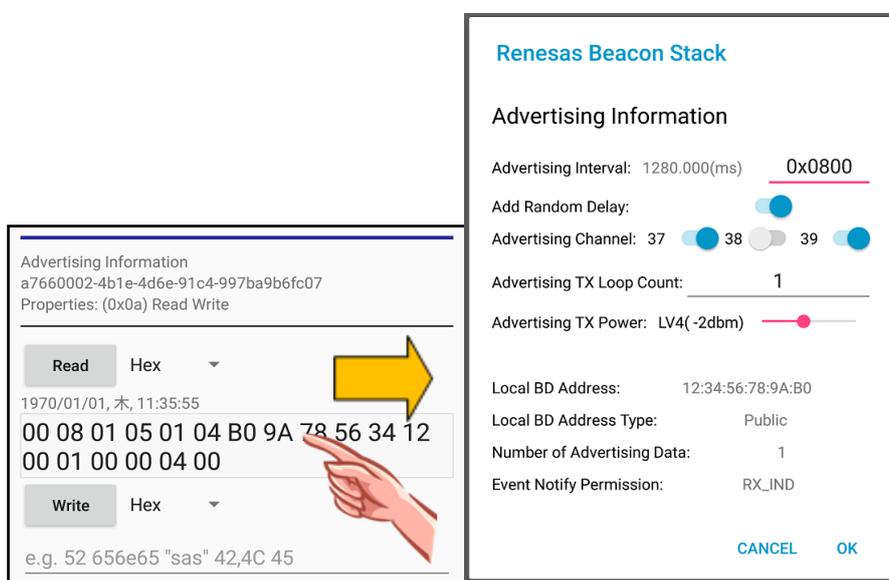


Figure 6-38 Advertising Data analysis dialog.

Parameters from "Advertising Interval" to "Advertising TX Power" can be edited in this dialog. After editing and tapping the "OK" button in the dialog, the changed parameter is set in the send text field.

If you set the write mode to Hex and tap the "Write" button, you can write the changed data to the characteristic. If you tap the "Cancel" button in the analysis dialog, the data will not be reflected in the send text field.

For details of each parameter, refer to "RL78/G1D Beacon Stack Connecting and Updating Beacon Data Sample Program" application note.

➤ Advertising Data / Scan Response Data

Just like Advertising Information, if you read an Advertising Data or a Scan Response Data and tap history data, Advertising Data analysis dialog will be displayed. Likewise, if you write an Advertising Data and tap the history data, the Advertising Data analysis dialog will be displayed.

Here is an example when tapping the history data of Read.

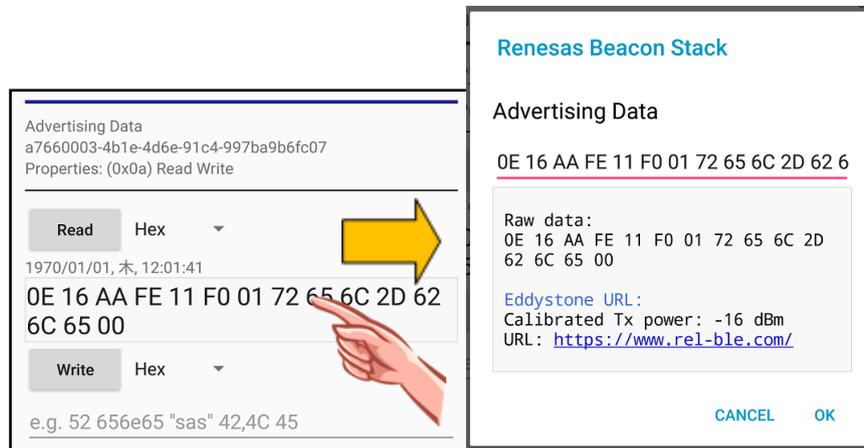


Figure 6-39 Advertising Information analysis dialog.

The tapped history data is copied to the text field at the top of the dialog and the analysis content is displayed in the analysis data field at the bottom. When editing the text field, the analysis result is reflected in the analysis data field. If the analysis data is Eddystone URL, the URL is displayed in blue and hyperlinked. Tap to open the URL in WebView in the application.

If you tap the "OK" button on the dialog after editing, the changed parameter is set in the send text field. If you set the write mode to Hex and tap the "Write" button, you can write the changed data to the characteristic. If you tap the "Cancel" button on the analysis dialog, the data will not be reflected in the send text field.

Refer to "RL78/G1D Beacon Stack Connecting and Updating Beacon Data Sample Program" application notes for details of each parameter.

7. Appendix

GATTBrowser uses the Bluetooth Low Energy(BLE) capabilities of the Android device. This feature cannot work when OFF. Turned up the GATTBrowser on the set. If you do not expect if you turned OFF the Bluetooth function during the operation.

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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Apr 11, 2017	-	First edition issued.
1.01	Jul 7, 2017	23 - 25	A7660006-4B1E-4D6E-91C4-997BA9B6FC07 (Scan Response Data) was added in Table 6-10. Also, added the description in the text.

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

Handle unused pins in accordance with the directions given under Handling of Unused Pins in the manual.

¾ The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

The state of the product is undefined at the moment when power is supplied.

¾ The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.

In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

Access to reserved addresses is prohibited.

¾ The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

¾ When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

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SALES OFFICES

Renesas Electronics Corporation

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Renesas Electronics America Inc.

2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited

9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH

Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.

Room 1709, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100191, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.

Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, P. R. China 200333
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited

Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.

13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.

80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.

Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.

No.777C, 100 Feet Road, HALII Stage, Indiranagar, Bangalore, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.

12F., 234 Teheran-ro, Gangnam-Gu, Seoul, 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141