# **BLEGUI APPLICATION**

USER GUIDE

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Version 1.7



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# **1 Version history**

Version	Comments
1.7	Bluetooth Smart SDK v.1.1 beta II updates

# **2** Introduction

BLEGUI is a simple user interface application that allows a developer to quickly test and evaluate Bluegiga's *Bluetooth* Smart products. The main purpose of BLEGUI is to hide the complexity of the binary protocol (BGAPI) used by the host to control the *Bluetooth* Smart stack. BLEGUI offers a more user friendly approach to the usage of the BGAPI. BLEGUI can however be a very good tool for quick prototyping and debugging of *Bluetooth* Smart applications.

This user guide walks you through the basic usage of BLEGUI.

MainWindow									
Tools Commands Config									
GAP									
Mode	Refresh	Bluegiga Bluetooth Lo	w Energy (COM16)		•	256000	• [	)etach	Connected
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Set Mode									
Clear Mode									
Adv Interval 1280.00 ms 2048 🚖									
Channel Map 📝 37 📝 38 📝 39									
Set Adv Parameters									
Scan									
C Limited									
Generic									
Observation									
Start									
Stop									
Scan Interval 125.00 ms 200									
Scan Window 125.00 ms 200 👻									
Active Scanning									
Set Scan Parameters									
	Interval 60	75.00 ms Timeout	100 🗣 1000ms La	itency 0	Update		Ref	resh	Clear
log									
Enter command or hex string to send here				Show: 🔽 C	Comm 📝 Text	Scroll	Copy to	Clipboard	Clear

Figure 1: BLEGUI application

# **3 Getting started**

BLEGUI works at the moment with the following products:

- BLE112 Bluetooth Smart module
- BLED112 Bluetooth Smart USB dongle
- DKBLE112 BLE112 development kit

BLUGUI can control the above products via USB or UART interfaces, so therefore an appropriate firmware must be programmed into the hardware.

- USBCDC example allows the control over USB interface
- UARTDEMO example allows the control over UART interface

# 3.1 Preparations

If you have not used BLEGUI before, you first need to do some preparations

## **Using USB**

- 1. Download the *Bluetooth* Smart software development kit from Bluegiga's Tech Forum
- 2. Extract it you your PC
- 3. Connect the BLED112 USB dongle or DKBLE112 via USB to your PC
- 4. Windows will recognize the device and prompt for a driver software, use the driver located in the *windrv* folder
  - a. If Windows does not prompt for the driver, go to *Device manager,* select the unknown device and click *Update driver software*
- 5. If Windows security gives a waring about the driver installation, choose *Install this driver software anyway*
- 6. After driver installation a device called *Bluegiga Bluetooth Low Energy* should be visible under Ports in *Windows* Device manager
- 7. If you see this, the driver installation is complete



## Using RS232

If you have BLE112 modules or DKBLE112 which use UART interface, no driver installation is needed.

- 1. Connect the BLE112 or DKBLE112 to your PC via RS232 (a 3.3V level shifter such as MAX3232 might be needed)
- 2. Make sure the DKBLE112 is power via USB, since a CR2032 cannot power a RS232 level sifter
- Notice also that the default UARTDEMO firmware has power mode 3 (PM3) enabled, which disables the UART timings. In order to communicate with the BLEGUI you need to have the wake-up pin (P0\_0) enabled

## Starting BLEGUI

Finally start the **BLEGUI** application located under *bin* folder.

A The DKLBE112 development kit comes pre-programmed with a Health Thermometer example. This is a standalone application and the DKBLE112 is not recognized over USB interface.

# 4 BLEGUI user interface

After starting the BLEGUI the main view is visible. The first thing you need to do is to select the correct device you want to use from the drop down menu.

- 1. Select one of the available Bluegiga Bluetooth Low Energy devices from the drop down menu
- 2. Click *Attach* to open the serial port connection
  - a. A green Connected light should turn on in the user interface
- 3. Execute **Commands->Info** command to read out the firmware version, to make sure the communication works and that BLEGUI version matches to the firmware version.

MainWindow	a Aquanti	Considered type and all the	on to the user relations			
Tools Commands Config						
GAP		ſ				
Mode	Refresh	Bluegiga Bluetooth Low Energy (CC	M10)	▼ 256000	▼ Detach	Connected
Set Mode						
Clear Mode						
Adv Interval 1280.00 ms 2048 🚔						
Channel Map 📝 37 📝 38 📝 39						
Set Adv Parameters						
Sran						
C limited						
Generic						
Observation						
Start						
Stop						
Scan Interval 125.00 ms 200						
Scan Window 125 00 ms 200						
Active Scanning						
Set Scan Parameters						
Services						
	Interval 60	🗧 75.00 ms Timeout 100 🚔 10	00ms Latency 0 🚔 Update		Refresh	Clear
Log						
2012.10.15 21:40:39.0302 ble_cmd_system_ge	et_info					
2012.10.15 21:40:39.0303 TX: 0000008	t info major: 1 m	sinor: 1 patch: 0 build: 32 ll version:	2 protocol version: 1 hw: 2			
zorz.io.i5 zi.40.35.0305 bie_ish_System_get	Cinto major: 1 h	mior, i pateri, o bunu, oz ii_version;				T
criter command or nex string to send here			Snow: 🔽 Comm 💟 Tex	t 🔽 Scroll	Copy to Clipbo	aru Ciear

Figure 2: BLEGUI main view

If you do not see any Bluetooth low energy devices in the drop down menu, please try the following:

- 1. Click Refresh button
- 2. If this does not help, disconnect the device from the USB port, reattach it and click Refresh
- 3. If this does not help, close BLEGUI, make sure the device is visible in the *Device manager* and restart BLEGUI

The main components in the BLEGUI are:

- **GAP** Generic Access Profile toolbar, which allows you to control the visibility, connectability, broadcast and scanning modes of a device
- Log Shows the raw and user friendly communications log between BLEGUI and the USB dongle
- Action view The center part of the user interface changes depending on the performed action. It can show discovered Bluetooth low energy devices, GATT data bases etc.

# **4.1 Generic Access Profile controls**

Generic Access Profile (GAP) controls allow you to change devices discoverability and connectability modes and scan for other *Bluetooth* Smart devices.

#### Discoverability modes:

Mode	Explanation
No	Device does not advertise itself
Limited	Device advertises itself in limited advertisement mode
Generic	Device advertises in generic advertisement mode
Broadcast	Device is in broadcast mode

#### Connectability modes:

Mode	Explanation
No	Device cannot be connected
Directed	Device can be connected only by a specific <i>Bluetooth</i> Smart device
Undirected	Device can be connected by any Bluetooth Smart device

Once the desired discoverability and/or connectability settings have been selected, **Set Mode** button enables or changes the configuration.

Clear mode button disables advertisements.

#### Advertisement parameters:

Option	Explanation
Advertisement interval	Configures the interval between advertisement events
Channel map	Selects which advertisement channels are in use
Set Adv Parameters	Send the BGAPI command to change the advertisement parameters

Set Adv Parameters changes the advertisement parameters.

#### Scanning options:

Mode	Explanation
Limited	Only devices advertising in limited advertisement mode are shown
Generic	All devices advertising are shown
Observation	Only broadcasting devices are shown

Once the desired settings have been selected, **Start** button starts scanner.

Stop button on the other hand will pause scanning.

#### Scan parameters:

Option	Explanation
Scan interval	Configures the interval at which the scan procedure is made
Scan windows	Configures the scan window, which defines how long the scan procedure lasts i.e. how long the RX is active.
Active scanning	Enables or disables the active scanning mode

Press Set Scan Parameters to send the BGAPI command to change the scan parameters

A device cannot perform scanning and advertisement at the same time.

# 4.1.1 Advertising

Advertising is an operation where **advertiser** starts to broadcasts advertisement packets. All Bluetooth low energy devices within the range can pick up these packets and discover the **advertiser**. The advertisement packets typically contain data telling if the device is connectable and bondable, transmit power level and supported services, but this may depend on the devices configuration.

To start advertising, simply:

.

- Select the device's discoverability and connectability mode
- Press Set Mode button
- Optionally you can set the advertisement parameters. If not set, firmware defaults will be used.
  - Advertisement parameters need to be configured before advertisement is started

The device starts to broadcast advertisement packets an all the advertisement channels.

p				
	Refresh	Bluegiga Bluetooth Low Energy (COM10)	▼ 256000 ▼	Detach Connect
Mode				
Discoverable Generic 🔹				
Connectable Undirected 🔹				
Set Mode				
Class Mada				
Adv Interval 1280.00 ms 2048 🚔				
Channel Map 🔽 37 👿 38 👿 39				
Set Adv Parameters				
scan				
C Limited				
Generic				
Observation				
Start				
Stop				
Scan Interval 10.00 ms 16				
Scan Window 10.00 ms				
Set Scan Parameters	Interval 60	≑ 75.00 ms Timeout 100 🚔 1000ms Latency	0 🖨 Update	Refresh Clear

Figure 3: Starting advertisement

To stop advertising:

- Set the Discoverable mode to No
- Set the Connectable mode to No
- Press Set Mode button
- Or alternatively simply press Clear Mode button

To change advertisement parameters on the fly:

- Stop advertisements
- Change advertisement parameters

Restart advertisement

# 4.1.2 Scanning devices

Scanning is an operation where a *scanner* listens on all the three advertisement channels for advertisement packets sent by the *advertisers*. When a proper advertisement packet is received from an *advertiser* a scan request is made and a remote device is discovered.

To perform scanning, simply:

- Select the scanning mode (Limited, Generic, Observation)
- Press Start button

.

Optionally you can configure the scan parameters. If not configured, firmware defaults will be used.
 Scanning parameters need to be set before before scanning is started

If Bluetooth Smart devices are discovered, they will be displayed in the action view

MainWindow	_		
Tools Commands			
SAP			
	Refresh	Bluegiga Bluetooth Low Energy (COM10)	56000 🔻 Detach Connected
Mode			
Discoverable Generic 🔹	Public: 00	):07:80:ff:f5:88	
Connectable Undirected -	DKBLE11	2 thermometer RSSI:36 (56%) Update Connect	Encrypt GATT
Set Mode	General 1	No_BREDR Connectable undirected	
Clear Mode			
Adv Interval 1280.00 ms 2048 🚔			
Channel Map 🔽 37 🔍 38 📝 39			
Set Adv Parameters			
Scan			
C Limited			
Generic			
Observation			
Start			
Stop			
Scan Interval 10.00 ms 16			
Scan Window 10.00 ms			
Set Scan Parameters			
Set Scarr arameters	Interval 60	→ 75.00 ms Timeout 100 → 1000ms Latency 0 → Update     Update	. Refresh Clear
DO			
011.11.9         20:18:37.0672         ble_cmd_gap_disc           1011.11.9         20:18:37.0674         ble_rsp_gap_disc           2011.11.9         20:18:37.0674         ble_rsp_gap_disc           2011.11.9         20:18:37.0675         blc           2011.11.9         20:18:37.0675         blc           2011.11.9         20:18:38.0124         ble_evt_gap_scan           jata:020106020a041509444b         42c45313132207           2011.11.9         20:18:38.0125         RX: 80260600210           2011.11.19         20:18:38.0441         ble_evt_gap_scan           jata:020106020a041509444b424c45313132207         2011.11.19         20:18:38.0443           XX: 80260600210         80260600200         201	over mode: 1 wer result: 0 [No 0 1_response rssi:2 46865726d6f6d6 088f5ff80070000 _response rssi:2 46865726d6f6d6 088f5ff80070000	Error"] 1 packet_type: 0 sender:88f5ff800700 address_type: 0 5746572 1020106020a041509444b424c4531313220746865726d6f6d65746572 4 packet_type: 0 sender:88f5ff800700 address_type: 0 5746572 1c020106020a041509444b424c4531313220746865726d6f6d65746572	
			Clear

Figure 4: Performing scanning

In the figure above a single device has been discovered. The device has the following features:

- Device name : DKBLE112 thermometer
- **RSSI** : 36 (56%)
- The device does not support BR/EDR
- Device is generally connectable (undirected)

The log panel shows both human readable messages and raw (BGAPI) communications between the BLEGUI and the *Bluetooth* low energy stack running either on BLE112 or BLED112.

To stop scanning:

- Press the **Stop** button or
- connect the discovered device

To change advertisement parameters:

- Stop scanningChange parameters
- Restart scanning

# 4.1.3 Opening and closing connections

To connect another *Bluetooth* Smart device, simply select one of the discovered devices from the action view and press the **Connect** button.

MainWindow	_		- 0 X
Tools Commands			
GAP			
Mode	Refresh	Bluegiga Bluetooth Low Energy (COM10)	Connected
Discoverable Generic 🔹	Public: 00	0:07:80:ff:f5:88	
Connectable Undirected	DKBLE11	2 thermometer RSSI:36 (56%) Update Disconnect Encrypt	GATT
Set Mode	Connect	ed handle:0x0	
Clear Mode			
Adv Interval 1280.00 ms 2048 テ			
Channel Map 📝 37 📝 38 📝 39			
Set Adv Parameters			
Scan			
C Limited			
Generic			
Observation			
Start			
Stop			
Scan Interval 10.00 ms 16 🚔			
Scan Window 10.00 ms 16			
Set Scan Parameters	Interval 60	↑ 75.00 ms Timeout 100 ♠ 1000ms Latency 0 ♥ Update Refresh	Clear
Log data:020106020a0415094440424C45313132207	40805720007000	55/455/2	
2011.11.19 20:47:43.0164 RX: 80260600220 2011.11.19 20:47:43.0494 ble_cmd_gap_con	088f5ff80070000 nect_direct addr	01c020106020a041509444b424c4531313220746865726d6f6d65746572 ess:88f5ff800700 addr_type: 0 conn_interval_min: 3c conn_interval_max: 3c timeout: 64 latency:	0
2011.11.19 20:47:43.0500 TX: 000f060388f5 2011.11.19 20:47:43.0515 ble_evt_gap_scan	ff800700003c00 _response rssi:2	3c0064000000 4 packet_type: 0 sender:88f5ff800700 address_type: 0	
data:020106020a041509444b424c45313132207 2011.11.19 20:47:43.0521 RX: 80260600240	46865726d6f6d6 088f5ff80070000	55746572 )1c020106020a041509444b424c4531313220746865726d6f6d65746572	
2011.11.19 20:47:43.0527 ble_rsp_gap_conn 2011.11.19 20:47:43.0529 RX: 00030603000	ect_direct result 000	: 0 [No Error] connection_handle: 0	
2011.11.19 20:47:44.0146 ble_evt_connection 2011.11.19 20:47:44.0153 RX: 800f0300000	n_status connec 188f5ff80070000	tion: 0 flags: 1 address:88f5ff800700 address_type: 0 conn_interval: 3c timeout: 64 latency: 0 3c0064000000	
			Clear

Figure 5: Successful connection to a device

A successful connection will change the **Connect** button to a **Disconnect** button, a connection handle is displayed in the action screen. In the log panel a direct connect and a connection status events are shown.



### **Connection parameters**

The *Bluetooth* low energy connection parameters can be changed from the toolbar below the action view. The following parameters can be changed:

Option	Explanation
Interval	Defines the connection interval in units of 1.25ms. Connection interval defines how often data can be exchanged between the devices. Range: 7.5ms to 4000ms
Timeout	Defines the supervision timeout in units of 10ms. If the devices cannot communicate within the defined timeout, the connection will be terminated. Range: 7.5ms to 30200 ms
Latency	Defines the slave latency i.e. how many anchor points (connection intervals) the slave can skip if it has no data to send.
<u></u>	The connection parameters can be updated any time during the connection life time by changing the value of the parameters and pressing the <b>Update</b> button.

### **Connection termination**

Terminating a connection is simply done by pressing the **Disconnect** button in the action view. A disconnect event that the connection has been closed.

# 4.2 Generic Attribute Profile controls

Once connected, the data transactions can be made using the Attribute Protocol (ATT). The Attribute Protocol gives access to the Generic Attribute Profile (GATT) remote database and allows operations like: read, write, indicate and notify. Generally speaking the ATT can be used to discover services on a device and exchange data.

## 4.2.1 Service discovery

### Service Discovery

To discover the services that a device supports you need to do the following steps:

- With BLEGUI configure a *Bluetooth* Smart device to start advertisements (device A)
- With BLEGUI scan the device A with a second *Bluetooth* Smart device (device B)
- Connect device A from the device B
   Optionally you can perform be
  - Optionally you can perform bonding and connection encryption
- Once connected simply press the **GATT** button in the action view
  - A GATT database browser will appear
- Press **Service Discover** button to perform a service discovery

II MainWindow	00	incroot	Deve	Roper Portal				
Tools Commands								
GAP								
Mada	Refresh Bluegig	a Bluetooth Low Energy	(COM10)			▼ 256000	<ul> <li>Detach</li> </ul>	Connected
Mode								*
Discoverable Generic	-Public: 00:07:80:4	::5d:81						
Connectable Undirected	(noname) RSSI:	24 (37%)	Jpdate		Disconne	ect Encr	ypt GATT	
Set Mode	Connected handle	:0x0						
Clear Mode	GATT							-
Adv Interval 1280.00 ms 2048 🚔	Handle	Group End	Uuid	Description	Raw	Value	Clear	
Channel Map 📝 37 📝 38 📝 39	1	5	1800	Generic Access			Service Discover	
Set Adv Parameters	6	12	180a	Device Information		Ch	naracteristic Discover	
Scan	13	65535	1809	Health Thermometer			Descriptors Discover	=
Limited							Read	
Generic							Read Long	
Observation							Write	
Start							Write Command	
Stop							write command	
Scan Interval 10.00 ms 16 🜩								
Scan Window 10.00 ms 16 テ								
Set Scan Parameters	Interval 60 A 75.0	ms Timeout 100 🛋	1000ms Latency				Defrech	Clear
			1000m3 Eatency					Cicui
Log	100000001200128							
2011.11.19 21:32:06.0310 ble_rsp_attclient_r	read_by_group_type conr	ection: 0 result: 0 ['No i	Error']					*
2011.11.19 21:32:06.0525 RX: 000304010000 2011.11.19 21:32:06.0557 ble_evt_attclient_c	group_found connection:	) start: 1 end: 5 uuid:0(	018					
2011.11.19 21:32:06.0596 RA: 800804020001 2011.11.19 21:32:06.0599 ble_evt_attclient_c	group_found connection:	) start: 6 end: c uuid:0a	18					
2011.11.19 21:32:06.0612 RX: 800804020006 2011.11.19 21:32:06.0625 ble_evt_attclient_c	group_found connection:	) start: d end:ffff uuid:	0918					
2011.11.19 21:32:06.0638 RX: 80080402000d 2011.11.19 21:32:06.0652 ble_evt_attclient_p	d00ffff020918 procedure_completed con	nection: 0 result:401 [T	he attribute handle	given was not valid on this server	] chrhandle: 0			_
2011.11.19 21:32:06.0665 RX: 800504010001	1040000							-
							ſ	Clear
							l	

Figure 6: Service Discovery

In the above example a service discovery has been performed and three services have been found.

The services supported by the remote device are:

Service	UUID	Handles
Generic Access Profile service (GAP)	1800	0x01 to 0x05
Device Information Service (DIS)	180a	0x06 to 0x12
Health Thermometer service (HTM)	1809	0x13 to 0x65535

## 4.2.2 Characteristics and descriptors discovery

### **Characteristics discovery**

*Bluetooth* Smart services consist of one or several characteristics. Characteristic is a value with a know type for example weight in kilograms or device name. To discover the characteristics of a service, simply select the desired service and press **Characteristics Discover** button.

II MainWindow								
Tools Commands								
GAP	Refresh Blueg	iga Bluetooth Low Energy	(COM10)			▼ 25600	00 🔹 Detach 🛛 🖸	oppected
Mode		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	()					
Discoverable Generic 🔻	Public: 00:07:80:	4c:5d:81						- 61
Connectable Undirected	(noname) RSSI:	24 (37%)	Jpdate		Connec	t E	Encrypt GATT	
Set Mode	Disconnected Re	ason: 0x208						
Clear Mode	GATT							
Adv Interval 1280.00 ms 2048 🚔	Handle	Group End	Uuid	Description	Raw	Value	Clear	
Channel Map 📝 37 📝 38 📝 39	1	5	1800	Generic Access			Service Discover	
Set Adv Parameters	2				020300002a		Characteristic Discover	
Scan	4				020500012a		Descriptors Discover	E
Limited	6	12	180a	Device Information			Read	
Generic	13	65535	1809	Health Thermometer			Read Long	
Observation						_	Write	
Start							Write Command	
Stop								
Scan Interval 10.00 ms 16								
Scan Window 10.00 ms 16								-
Set Scan Parameters	nterval 60 🌩 75.	00 ms Timeout 100 ≑	1000ms Latency	0 🜩 Update			Refresh	Clear
Log								
2011.11.19 21:38:15.0156 1X: 0008040200010 2011.11.19 21:38:15.0182 ble rsp. attrient rea	00500020328 ad by type connection	a: O result: O ENo Error'l						*
2011.11.19 21:38:15.0198 RX: 0003040200000 2011.11.19 21:38:15.0264 ble evt attclient att	0 tribute value connection	on: 0 atthandle: 2 type: 3	3 value:020300002a					
2011.11.19 21:38:15.0296 RX: 800a040500020 2011.11.19 21:38:15.0319 ble_evt_attclient_att	00305020300002a tribute_value connectio	on: 0 atthandle: 4 type: 3	3 value:020500012a	I.				
2011.11.19 21:38:15.0333 RX: 800a040500040 2011.11.19 21:38:15.0413 ble_evt_attclient_pro	00305020500012a ocedure_completed co	nnection: 0 result:40a [N	lo attribute found w	ithin the given attribute handle	erange.'] chrhandle: !	5		
2011.11.19 21:38:15.0450 RX: 80050401000a0 2011.11.19 21:38:30.0187 ble_evt_connection_	40500 disconnected connecti	ion: 0 reason:208 [ <mark>Link s</mark> i	upervision timeout h	as expired."]				_
2011.11.19 21:38:30.0219 RX: 8003030400080	2							-
								Clear
							_	.d

Figure 7: Characteristics declaration

In the figure above a characteristics discovery has been performed to the GAP service. GAP has two characteristics shown in the GATT tools view. The characteristic declarations refer to:

- **Device name** attribute which tells the friendly name of the device. From raw data we see that it has UUID: 2a00, handle: 0x0003 and properties: 0x02
- Device appearance which tells the device type. UUID: 2a01, handle: 0x0005; properties: 0x02

So the characteristics discovery can be used to find out what kind of data is exposed by a service and how the data can be accessed.

### **Descriptors discovery**

The descriptors discovery on the other hand goes through the service handle by handle and discovers the UUID of every characteristic and data fields. Select first a Primary Service then click the Descriptor Discover button to find out more about the characteristics of that service.



Figure 8: Descriptors discovery

In the figure above, after pressing the **Descriptors Discover** button the Characteristics Declarations of the GAP service are exposed in more detail, together with their related attributes.

# 4.2.3 GATT operations

### GATT procedures

Generic Attribute Profiles offers several procedures for manipulating attribute values. The procedures include:

Operation	Description	Payload	Acknowledged
Read	Reads a characteristic value	22 bytes	Yes
Write	Write characteristic value	20 bytes	Yes
Write command	Write characteristic value up to 20 bytes without Acknowledgement	20 bytes	No
Read long	Read long characteristics up to 64 KBytes	Up to 64kB*	Yes
Indication	Start characteristic indication (max payload 20 bytes)	20 bytes	Yes
Notification	Start characteristic notification (max payload 20 bytes)	20 bytes	No

\*) Depends how long attributes are supported by the attribute server

### Read

To read a remote characteristic value the GATT tool contains a **Read** button. For example to read the Device name:

- Select UUID 2A00 from the GAP service
- Press Read button

tode Discoverable Generic ▼ Connectable Undirected ▼ Set Mode Clear Mode tdv Interval 1280.00 ms 2048 ⊕ Channel Map ♥ 37 ♥ 38 ♥ 39 Set Adv Parameters	B0:4c:5d:81           S0:4c:5d:81           S1:         24 (37%)           Indle:0x0	Ipdate Uuid	Description	Disconnect	Encryp	at GATT
Ascoverable Generic   Ascoverable Generic   Connectable Undirected   Set Mode  Clear Mode  Adv Interval 1280.00 ms 2048   Set Adv Parameters  2	80:4c:5d:81 SI: 24 (37%) L ndle:0x0 dle Group End 5	lpdate Uuid	Description	Disconnect	Encryp	ot GATT
tonnectable Undirected ▼ (noname) RS Connected h Clear Mode dv Interval 1280.00 ms 2048 € hannel Map Ø 37 Ø 38 Ø 39 Set Adv Parameters 2	SI: 24 (37%) L ndle:0x0 dle Group End 5	lpdate	Description	Disconnect	Encryp	ot GATT
Set Mode     Connected h       Clear Mode     GATT       dv Interval 1280.00 ms 2048 €     Ham       hannel Map Ø 37 Ø 38 Ø 39     Set Adv Parameters	dle Group End	Uuid	Description			
Clear Mode dv Interval 1280.00 ms 2048 hannel Map @ 37 @ 38 @ 39 Set Adv Parameters 2	dle Group End	Uuid	Description			
dv Interval 1280.00 ms         2048         **         Han           hannel Map Ø 37 Ø 38 Ø 39         1         2         2           Set Adv Parameters         2         2         2	dle Group End	Uuid	Description			
aannel Map ♥ 37 ♥ 38 ♥ 39 Set Adv Parameters 2	5		Description	Raw	/alue	Clear
Set Adv Parameters 2		2800	GATT Primary S		S	ervice Discover
2		2803	GATT Character		Char	racteristic Discover
a		2a00	Device Name	444b424c45313132207468657	Der	scriptors Discover
Limited 4		2803	GATT Character			Read
Generic 5		2a01	Appearance			Read Long
Observation 6	12	180a	Device Informa			Write
Start 13	65535	1809	Health Thermo			Write Command
an Window 10.00 ms 16						
Interval 60	75.00 ms Timeout 100 ≑	1000ms Latency	0 🗧 Update			Refresh Clr
1.11.19 21:47:10.06.38 ble_evt_attclient_find_information_four	a connection: u chrnandle: :	0000:012a				
1.11.19 21:47:10.0640 RX: 800040400050002012a 1.11.19 21:47:10.0643 ble_evt_attclient_procedure_completed	connection: 0 result: 0 [No	Error'] chrhandle: 6				
1.11.19 21:47:10.0646 RX: 800504010000000600 1.11.19 21:47:13.0299 ble_cmd_attclient_read_by_handle con	ection: 0 chrhandle: 3					
1.11.19 21:47:13.0307 TX: 00030404000300						
1.11.19 21:47:13.0320 ble rsp attclient read by handle conn	ection: 0 result: 0 [No Error]	l				
L11.19 21:47:13.0327 RX: 00030404000000		value-444b474c453	121222074696572646			

Figure 9: Read device name

The Raw field is updated with device name.

0x54656d7065726174757265206d6561737572656d656e74 corresponds to "DKBLE112 thermometer" in ASCII

### **Read long**

Read long is similar to read, but it can be used to read attributes, which are longer than 22 bytes. Read long can read attribute values up to 64 KBytes.

### Write

If the attribute has a write property, then the remote value can also be written. To write a value:

- Select an attribute, which value can be written
- Select the field below the GATT tool
- Write the value in to the field
- Press Write button

ols Commands								
	Refresh Bluegia	a Bluetooth Low Energy	(COM10)			▼ 2	56000 🔻 Detach 🚺	Connect
1ode								
Discoverable Generic 💌	Public: 00:07:80:4	c:5d:81						
Connectable Undirected 💌	(noname) RSSI:	24 (37%)	Jpdate			Disconnect	Encrypt GATT	
Set Mode	Connected handle	:0x0						
Clear Mode	GATT							
dv Interval 1280.00 ms 2048 🚔	Handle	Group End	Uuid	Description	Raw	Value	Clear	
channel Map 📝 37 📝 38 📝 39	1	5	1800	Generic Access			Service Discover	
Set Adv Parameters	6	12	180a	Device Informa			Characteristic Discover	
an	13	65535	2800	GATT Primary S			Descriptors Discover	
Limited	14		2803	GATT Character			Read	
Generic	15		2a1c	Temperature M			Read Long	
Observation	16		2901	Characteristic U			Write	
Start	17		2902	Client Characte			Write Command	
Stop			2002	cheft enabeten				
can Interval 10.00 ms 16 ≑	0100							
can Window 10.00 ms 16 ≑								
Set Scan Parameters	Interval 60 🚔 75.00	0 ms Timeout 100 🚔	1000ms Latency				Refresh	Clear
			,					
		opection: u corpandie:	0.000					
1.11.19 21:49:40.0397 RX: 800604040011	100020229	nection: 0 result: 40a PN	o attribute found w	ithin the given attribute har	dle range '1 chrb	andle: 12		
1.11.19 21:49:40.0497 RX: 80050401000a	041200	. O atthe aday 11 dates	0100	and the given orthogenetic nor	laic runger j'enni			
1.11.19 21:49:45.0760 bie_cmd_attclient_ 1.11.19 21:49:45.0777 TX: 000604050011	.00020100	h: U atthandle: 11 data:	0100					
1.11.19 21:49:45.0781 ble_rsp_attclient_a 1.11.19 21:49:45.0788 RX: 000304050000	attribute_write connection	: 0 result: 0 ['No Error']						
1.11.19 21:49:45.0883 ble_evt_attclient_p	procedure_completed conr	nection: 0 result: 0 ['No	Error'] chrhandle: 1	1				
1.11.19 21:49:45.0900 RX: 800504010000	001100							

Figure 10: Writing a value

In the figure above value 0xc0ffeeee is written to characteristic with UUID 1811. The update the value on the GATT tool just press **Read**.

#### Write command

Write command is similar to Write, but Write command is not confirmed (acknowledged).

### Notify

When a characteristic is configured to be notified, a server will automatically notify the characteristic value changes to the client. The client however has to first configure the server to start notifications.

If a characteristic has a notification property it will also have an additional property called **Characteristic client configuration**. To start the notifications the client needs to write 0x01 into that characteristic. After this is done the server will automatically notify the characteristic value changes.

In the example below, a Heart Rate Service is used to demonstrate how notifications are started. Notifications are enabled by writing 0x01 to Characteristic Client Configuration.

MainWindow	-								) 🗙
Tools Commands									
GAP	Defeat	Physics Phys	staath Law Eastar	(COM10)					
Mode	Refresh	bidegiga bide	Eloouri Low Energy	(COMID)			•	ZJOUDU V Detach	nnecteu
Discoverable Generic	Public: 00	):07:80:4c:5d:8	81						ĥ
Connectable Undirected	Bluegiga	Heart Rate Der	m RSSI:	42 (65%) Up	date		Disconnect	Encrypt GATT	
Set Mode	Connecte	ed handle:0x0							
Clear Mode	GATT								
Adv Interval 1280.00 ms 2048 ≑		Handle	Group End	Uuid	Description	Raw	Value	Clear	
Channel Map 💟 37 💟 38 📝 39	1		5	1800	Generic Access			Service Discover	E
Set Adv Parameters	6		12	180a	Device Information			Characteristic Discover	
Scan	13		17	2800	GATT Primary Service Declaration			E Descriptors Discover	
C Limited	14			2802	GATT Include Declaration			Read	
Generic	15			2803	GATT Characteristic Declaration			Read Long	
Observation	16			2a37	Heart Rate Measurement	02e0		Write	
Start	17			2902	Client Characteristic Configuration			Write Command	
Stop					-			<b>.</b>	
Scan Interval 10.00 ms 16	0100								
Scan Window 10.00 ms 16									-
Set Scan Parameters	Interval 60	🗘 75.00 ms	Timeout 100 ≑	1000ms Latency	0 🖶 Update			Refresh	llear
Log									
2011.11.19 22:32:28.0939 TX: 000604050011 2011.11.19 22:32:28.0962 ble_rsp_attclient_a	.00020100 attribute_write.co	onnection: 0 re	sult: 0 [No Error]						•
2011.11.19 22:32:28.0977 RX: 000304050000 2011.11.19 22:32:29.0034 ble_evt_attclient_p	00 procedure_compl	leted connectio	on: 0 result: 0 ['No i	Error'] chrhandle: 1	1				
2011.11.19 22:32:29.0048 RX: 800504010000 2011.11.19 22:32:29.0784 ble_evt_attdient_a	001100 attribute_value c	onnection: 0 at	tthandle: 10 type:	1 value:02e0					
2011.11.19 22:32:29.0801 RX: 800704050010 2011.11.19 22:32:30.0759 ble_evt_attclient_a	00010202e0 attribute_value c	onnection: 0 at	tthandle: 10 type:	1 value:02e0					
2011.11.19 22:32:30.0777 KX: 800704050010 2011.11.19 22:32:31.0735 ble_evt_attclient_a	attribute_value c	connection: 0 at	tthandle: 10 type:	1 value:02e0					
									-
									Clear

Figure 11: Enabling notifications

Value 0x01 must be written to UUID 2902 (Characteristic client configuration), for the notifications to start.

Commands								
	Defrech	Bluegina B	luetooth Low Energy	(COM10)				256000 T Detach
de	Refreat	loudgigo o	actoon con chergy	(001120)				
scoverable Generic 💌	Public: 00	):07:80:4c:5	id:81					
nnectable Undirected 💌	Bluegiga	Heart Rate [	Dem RSSI:	42 (65%) Up	odate		Disconnect	t Encrypt GATT
Set Mode	Connecte	ed handle:0x	0					
Clear Mode	GATT							
lv Interval 1280.00 ms 2048 🚔		Handle	Group End	Uuid	Description	Raw	Value	Clear
annel Map 📝 37 📝 38 📝 39	1		5	1800	Generic Access			Service Discover
Set Adv Parameters	6		12	180a	Device Information			Characteristic Discover
an	13		17	2800	GATT Primary Service Declaration			= Descriptors Discover
Limited	14			2802	GATT Include Declaration			Read
Generic	15			2803	GATT Characteristic Declaration			Read Long
Observation	16			2a37	Heart Rate Measurement	02c8		Write
Start	17			2002	Client Characteristic Configuration			Write Command
Stop				2302	Client Characteristic Configuration			
an Interval 10.00 ms 16 🚔	0100							
an Window 10.00 ms 16 🖨								
Set Scan Parameters	Interval 60	75 00 m	s Timeout 100 🚔	1000ms Latency	0 🚔 Undate			Refresh
	11121101 00		100 (1)	2000ing Editiney	o opene			
11 19 77 37 45 0574 831 800 7090500	0000020200							
.11.19 22:37:46.0419 ble_evt_attclient	_attribute_value o	connection: 0	) atthandle: 10 type:	1 value:02e0				
.11.19 22:37:47.0394 ble_evt_attclient	_attribute_value o	connection: 0	) atthandle: 10 type:	1 value:02e0				
.11.19 22:37:47.0475 RX: 8007040500	_attribute_value o	connection: 0	) atthandle: 10 type:	1 value:02d1				
.11.19 22:37:48.0450 RX: 8007040500 .11.19 22:37:49.0344 ble evt attclient	1000010202d1 attribute value o	connection: 0	atthandle: 10 type:	1 value:02c8				
11.19 22:37:49.0429 RX: 8007040500	1000010202c8		) attheadler 10 type:	1				
.11.19 22:37:50.0318 Die_evt_attclient	:_attribute_value (	connection: u	) atthancie: 10 type:	1 Value:02c8				
.11.19 22:37:50.0399 RX: 8007040500	100001020200							

Figure 12: Notifications started

The attribute server starts the automatic notifications of characteristic with UUID 0x2a37 (Heart Rate Measurement).

### Indicate

When a characteristic is configured to be indicated, a characteristic server will automatically indicate the characteristic value changes to the client. The client however has to first configure the server to start indications.

Indications are activated similarly to notifications, but instead of writing 0x01 to the **Characteristic client configuration** value 0x02 must be used.

The difference between indications and notifications is that notifications are NOT confirmed by the attribute client, whereas indications are.

# 4.3 Tools menu

Tools menu give access to various local functions such as GATT server, PS store, IO interfaces etc.

## 4.3.1 GATT server

The GATT server tool allows attribute **read** and **write** operation to the device's local GATT database. Read operation can be used to read the local attributes and their values and the write operation on the other hand to write attribute values to the local database.

The operations are done using the attribute handles.

#### Read

Select the desired attribute handle and press **Read** button. The attribute value is displayed in hex format.

ſ	🔝 GATT	Serve	er			? ×
	Handle:	3	+ Hex:	486561727420526	Write	Read
	UUID:					Read UUID

#### Figure 13: GATT server tool

#### Write

Select the desired attribute handle, write the new value into the Hex field and press Write button.

1 If the attribute is marked as const in the the GATT database, it cannot be written even with the local GATT database tool.

# 4.3.2 Security Manager

This window can be used to control the Bluetooth low energy stacks Security Manager Protocol. The Security Manager can be used to configure the devices I/O capabilities, enable or disable Man-in-the-middle protection or perform the passkey entry.

#### The I/O capability options are:

I/O capability	Explanation
NoInputOutput	The device does not have a user interface. "Just works" mode
DisplayOnly	The device has only a display
DisplayYesNo	The device has a display and yes/no button
KeyboardOnly	The device has only a keyboard
KeyboardDisplay	The device has both display and keyboard

#### Man-in-the-middle protection

Checking the Man-in-the-middle protection check-box enabled the man-in-the-middle protection.

#### Minimum key size

This configures the minimum acceptable PIN code size

#### Bondable

When this box is checked, the device can be bonded.

#### Set parameters

When the button is pressed the security configuration command is sent to the device.

#### Passkey entry

This button can be used to enter the PIN code.

Dialog
NoInpuNoOutput   Man-in-the-middle
Minimum Key Size
🔽 Bondable
Set Parameters
Passkey Entry

Figure 14: Security Manager dialog

#### Enabling security parameters and bonding mode on the local device

1. Select I/O capabilities

- 2. Check or un-check the **MITM** protection
- 3. Check Bondable mode
- 4. Press Set Parameters button

## 4.3.3 Persistent store

Persistent Store tool can be used to modify the local devices persistent store. Persistent store can be used to permanently store data on the local devices flash memory.

#### Available operations:

Mode	Explanation
Refresh	Read all the values from the Persistent Store
Delete	Delete the selected value from the Persistent Store
Add	Add a new value into Persistent Store
Write	Write the selected value into Persistent Store
Defrag	Defragments the Persistent Store

PS-keys form 8000 to 807F can be used by the applications and each of the keys can contain up to 32 bytes of data.

# 4.3.4 IO

The I/O dialog allows flexible control of the BLE112 I/O interfaces. It enables the following functions:

Function	Explanation			
Port 0	Allows reading, writing and configuration of Port 0			
Port 1	Allows reading, writing and configuration of Port 1			
Port 2	Allows reading, writing and configuration of Port 2			
ADC	Allows reading of ADC inputs as well ADC configuration			
SPI	SPI selection, configuration and and SPI transfer functions			
Endpoints	Enables data transmission to various endpoints. Can be used to for example send data to BGscript, USB or UART			
I2C	I2C read and write functions			

2-10					720
Port U	SPI				120
Read Write	USARTO			•	Address (hex)
	Config				1 🗘 Read
Dir Pull Up Config	Negative clo	ck polarity		<b>•</b>	Write
	Data is outp	ut on MOSI when S	CK goes from CPOL	inverted to CPOL 🔻	
Port 1	LSB first			▼]	
Read Write	BAUD_E	BAUD_M	CLK(MHz)	baudrate	
	10	216	32	57617.2	
Dir Pull 🗍 Up Config			Config		
Port 2	Transfer				
1012					
Read Write			Transfer		
Dir Pull Dp Config					
ADC	Endpoints				
AINO					
64 decimation rate 🔹	test			▼	
Internal reference   Read	]			Send	

Figure 15: I/O configuration and usage dialog

# 4.4 Commands menu

The commands toolbar contains some useful functions.

#### Reset

Performs a software reset and detaches device from BLEGUI.

### DFU

Boots the device into DFU mode.

1 With the BLE dongle a DFU driver needs to be install the first time the device to booted into DFU mode.

#### Installing the firmware using DFU:

- 1. Open BLEGUI application
- 2. Select the device you want to update (COM port)
- 3. From Commands menu boot the device to DFU mode
  - a. Install the DFU driver if requested by the Windows operating system
- 4. Perform the DFU update as in the image below

Administrator: C:\Windows\system32\cmd.exe	
c:\Mikko\BLE\ble13\example\usbcdc>\\bin\bgbuild.exe project.xml	
c:\Mikko\BLE\ble13\example\usbcdc>_	
	Ŧ

Figure 16: Compiling USB dongle software example with BGBuild



Figure 17: Performing DFU update with DFUTool

#### Info

Reads the firmware version information

Always include the output of Info command when contacting Bluegiga support for any software related issues.

### **Get Address**

Reads the Bluetooth address of local device.

# 4.5 Config menu

Config Menu allows the activation or deactivation of the BGAPI protocols packet mode.

Packet mode allows the use of BLE112 over UART interface without flow control by enabling UART DMA and adding a length byte into the beginning of all BGAPI commands.

Packet mode must be enabled in the hardware configuration file of your Bluetooth Smart device

1 Please refer to the BGAPI protocols description in the API reference manual for details of the packet mode.

# 5 Known issues

BLEGUI has the following known issues and problems:

- 1. Long device names are not parsed properly by BLEGUI and "(no name)" might be shown.
- 2. BLEGUI does not display secondary services properly. Only primary services are shown.

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