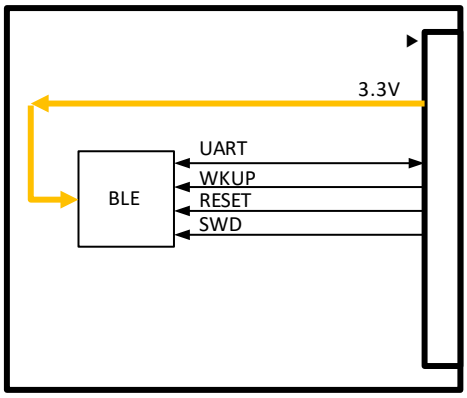
AC02A BLE Sugar

1. Description

The leaf which is equipped with the technical certification satisfied BLE module BGM11S22F256GA-V of Silicon Labs can connect with MCU leaf by UART.

2. Leaf specification

2-1. Block diagram



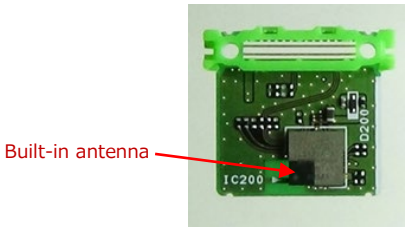
2-2. Power supply specification

Symbol	Parameter	Condition	Min.	Typ.	Max.
Vdd	Power Supply Voltage	–	2.4V	3.3V	3.8V
Idd	Operating current	Active	-	3.8mA	-
		Sleep	-	2.8uA	-

2-3. Main parts

Reference No.	Part name	Part number	Vendor name	note
IC200	BLE module	BGM11S22F256GA-V2	Silicon Labs	–

2-4. Appearance

Top Side	Back Side
	

2-5. Pinout

Name	Function
A2	TXD : UART send D9 can also be the alternative due to the replacement of chip's resistor
A1	RXD : UART receive D8 can also be the alternative due to the replacement of chip's resistor
D7	WAKEUP : wakeup H : wakeup
RESET	RST : reset
SWCLK	Debug I/F clock
SWDIO	Debug I/F data input/output
3V3	3.3V power input
GND	GND

3. BLEModule(BGM11S22F256GA-V2) Specifications

3-1. Description

Item	内容
SoC	EFR32BG1 (ARM Cortex-M4)
Bluetooth version	4.2
Frequency range	2400M ~ 2483.5MHz
Internet Security	• General Purpose CRC • Random Number Generator • Hardware Cryptographic Acceleration for AES 128/256,SHA-1, SHA-2 (SHA-224 and SHA-256) and ECC
RX sensitivity	-90 dBm @ 1 Mbit/s GFSK
TX power	+8dBm
RF certification	CE, full FCC, ISED Canada, Japan and South-Korea
Flash	256KB
RAM	32KB
Interfaces	UART

3-2. Electrical characteristics

3-2-1. Absolute Maximum Ratings

Parameter	Value
Operating Temperature	-40℃ to +85℃
Maximum Operation Voltage	3.8V

3-2-2. Rating

Symbol	Parameter	Condition	Min.	Typ.	Max.
Vdd	Power Supply Voltage	–	2.4V	3.3V	3.8V
Idd	EM0 Active mode	38 MHz HFRCO all peripherals disabled	-	3.8mA	3.99mA
	EM1 Sleep mode	38 MHz HFRCO	-	1.33mA	1.44mA

		all peripherals disabled			
	EM2 Deep Sleep mode	Full RAM retention and RTCC running from LFXO	-	33uA	-
	EM3 Stop mode	Full RAM retention and CRYOTIMER running from ULFRCO	-	2.8uA	6uA
	EM4H Hibernate mode	128 byte RAM retention, RTCC running from LFXO	-	1.1uA	-
	EM4S Shutoff mode	no RAM retention, no RTCC	-	0.04uA	0.20uA
	Receive mode, active packet reception (MCU in EM1 @38.4 MHz, peripheral clocks disabled)	1 Mbit/s, 2GFSK, F = 2.4 GHz,Radio clock prescaled by 4	-	9.0mA	-
	Transmit mode (MCU in EM1@ 38.4 MHz, peripheral clocks disabled)	0 dBm output power, Radio clock prescaled by 3	-	8.2mA	-
		2 dBm output power	-	16.5mA	-
		8 dBm output power	-	24.6mA	-

3-3. Link destination of data sheet

https://jp.silabs.com/products/wireless/bluetooth/bluetooth-low-energy-modules/bgm11s-bluetooth-sip-module

3-4.

3-4-1. The control of BLE

include file : BGLib.h(Leaf Libraies)

Definition	Description
BGLib ble112(HardwareSerial *module, HardwareSerial *output, uint8_t pMode)	Creating an instance of BGLib 【statement】 BGLib ble112(HardwareSerial *module, HardwareSerial *output, pMode) 【parameter】 ble112: the name of instance module: The instance of serial board communicating with BLE leaf output: The instance of serial board to which BLE leaf output Null fixed pMode: packet mode 0 fixed 【return value】 null

ble112.ble_cmd_le_gap_set_adv_parameters(interval_min, interval_max, channnel_map)	Set advertisement parameters 【statement】 ble_cmd_le_gap_set_adv_parameters(uint16 interval_min, uint16 interval_max, uint8 channnel_map) 【parameter】 ble112: the name of instance interval_min: Minimum advertising interval. Value in units of 0.625 ms • Range: 0x20 to 0xFFFF • Time range: 20 ms to 40.96 s Default value: 100 ms interval_max:Maxmum advertising interval. Value in units of 0.625 ms • Range: 0x20 to 0xFFFF • Time range: 20 ms to 40.96 s Default value: 200 ms channel_map: Advertising channel map which determines which of the three channels will be used for advertising. This value is given as a bitmask. • 1: Advertise on CH37 • 2: Advertise on CH38 • 3: Advertise on CH37 and CH38 • 4: Advertise on CH39 • 5: Advertise on CH37 and CH39 • 6: Advertise on CH38 and CH39 • 7: Advertise on all channels Default value: 7 【return value】 0
ble112.ble_cmd_le_gap_discover(mode)	Bluetooth discovery mode setting 【statement】 ble_cmd_le_gap_discover(uint8 mode) 【parameter】 ble112: the name of instance mode: discovery mode refer to ‘enum_le_gap_discover_mode’ 【return value】 0

ble112.ble_cmd_le_gap_set_adv_data(scan_rsp, adv_data_len, adv_data);	Set advertisement data 【statement】 ble_cmd_le_gap_set_adv_data(uint8 scan_rsp, uint8 adv_data_len, const uint8 *adv_data_data) 【parameter】 ble112: the name of instance scan_rsp: This value selects if the data is intended for advertising packets,scan response packets or advertising packet in OTA. Values: • 0: Advertising packets • 1: Scan response packets • 2: OTA advertising packets • 4: OTA scan response packets adv_data_len: advertise data length, maximum: 31 byte adv_data_data: advertise data 【return value】 0
ble112.ble_cmd_le_gap_start_advertising(handle, discover, connect)	Start advertising 【statement】 ble_cmd_le_gap_start_advertising(uint8 handle, uint8 discover, uint8 connect) 【parameter】 ble112: the name of instance handle: BLE leaf handle discover:Discoverable mode refer to 'enum_le_gap_discoverable_mode' connect: Connectable mode refer to 'enum_le_gap_connectable_mode' 【return value】 0
ble112.ble_cmd_le_gap_stop_advertising(handle)	Stop advertising 【statement】 ble_cmd_le_gap_stop_advertising(uint8 handle) 【parameter】 ble112: the name of instance 【return value】 0
ble112.checkActivity(timeout)	Wait for response 【statement】 checkActivity(uint16_t timeout) 【parameter】 ble112: the name of instance timeout: value of timeout (ms) 【return value】

	0 :nobusy 1 :busy
ble112.ble_cmd_gatt_set_characteristic_notification(connection, characteristic, flags)	Set notification to GATT Server 【statement】 ble_cmd_gatt_set_characteristic_notification(uint8 connection, uint16 characteristic, uint8 flags) 【parameter】 ble112: the name of instance connection: Connection handle characteristic:GATT characteristic handle flags: Characteristic client configuration flags • 0: Disable notifications and indications • 1: Notification • 2: Indication 【return value】 0
ble112.ble_cmd_gatt_server_send_characteristic_notification(connection, characteristic, value_len, (const uint8 *)value_data)	Send notification to GATT clients 【statement】 ble_cmd_gatt_server_send_characteristic_notification(uint8 connection, uint16 characteristic, uint8 value_len, const uint8 *value_data) 【parameter】 ble112: the name of instance connection: Connection handle • 0xff: Sends notification or indication to all connected devices. • Other: Connection handle characteristic:Characteristic handle refer to 'enum_le_gap_discoverable_mode' value_len: value length value: Value to be notified or indicated 【return value】 0

ble112.ble_cmd_gatt_write_characteristic_value(connection, characteristic, value_len, *value_data);	Set notification to GATT Server 【statement】 ble_cmd_gatt_write_characteristic_value(uint8 connection, uint16 characteristic, uint8 value_len, const uint8 *value_data) 【parameter】 ble112: the name of instance connection: Connection handle characteristic:GATT characteristic handle value_len:Characteristic value length value_data:Characteristic value 【return value】 0
ble112.ble_cmd_le_gap_set_scan_parameters(scan_interval, scan_window, active)	Set scan parameters 【statement】 ble_cmd_le_gap_set_scan_parameters(uint16 scan_interval, uint16 scan_window, uint8 active) 【parameter】 ble112: the name of instance scan_interval: Scanner interval • Time = Value x 0.625 ms • Range: 0x0004 to 0x4000 • Time Range: 2.5 ms to 10.24 s Default value: 10 ms scan_window: Scan window. The duration of the scan. • Time = Value x 0.625 ms • Range: 0x0004 to 0x4000 • Time Range: 2.5 ms to 10.24 s Default value: 10 ms Note that packet reception is aborted if it has been started before scan window ends. active : Scan type indicated by a flag • 0: Passive scanning • 1: Active scanning Default value: 0 【return value】 0
ble112.ble_cmd_le_gap_end_procedure()	Stop using current GAP procedure 【statement】 ble_cmd_le_gap_end_procedure(void) 【parameter】 ble112: the name of instance 【return value】 0

ble112.ble_cmd_le_gap_connect(address, address_type, initiating_phy)	Connect with devices 【statement】 ble_cmd_le_gap_connect(bd_addr address, uint8 address_type, uint8 initiating_phy) 【parameter】 ble112: the name of instance address: Address of the device to connect to address_type: Address type of the device to connect to refer to 'enum_le_gap_address_types' initiating_phy:The initiating PHY. • 1: LE 1M PHY • 4: LE Coded PHY 【return value】 0
ble112.ble_cmd_le_connection_close(connection)	Disconnect from devices 【statement】 ble_cmd_le_connection_close(uint8 connection) 【parameter】 ble112: the name of instance connection: Handle of the connection 【return value】 0
ble112.ble_cmd_system_reset(boot_in_dfu)	Run system reset 【statement】 ble_cmd_system_reset(uint8 boot_in_dfu) 【parameter】 ble112: the name of instance boot_in_dfu: Boot mode • 0: Normal reset • 1: Boot to UART DFU mode • 2: Boot to OTA DFU mode 【return value】 0
ble112.ble_cmd_system_halt(halt)	Shift into SLEEP mode 【statement】 ble_cmd_system_halt(uint8 halt) 【parameter】 ble112: the name of instance halt: halt mode • 1: halt • 0: resume 【return value】 0

ble112.getLastEvent()	Get last event 【statement】 getLastEvent() 【parameter】 ble112: the name of instance 【return value】 lastEvent[0] : Message class: System lastEvent[1] :Message ID

enum_le_gap_connectable_mode

Value	Name	Description
0	le_gap_non_connectable	Non-connectable non-scannable.
1	le_gap_directed_connectable	Directed connectable (RESERVED, DO NOT USE)
2	le_gap_undirected_connectable	Undirected connectable scannable. Deprecated, replaced by enum le_gap_connectable_scannable. This mode can only be used in legacy advertising PDUs.
2	le_gap_connectable_scannable	Undirected connectable scannable. This mode can only be used in legacy advertising PDUs.
3	le_gap_scannable_non_connectable	Undirected scannable (Non-connectable but responds to scan requests)
4	le_gap_connectable_non_scannable	Undirected connectable non-scannable. This mode can only be used in extended advertising PDUs.

enum_le_gap_discoverable_mode

Value	Name	Description
0	le_gap_non_discoverable	Not discoverable
1	le_gap_limited_discoverable	Discoverable using both limited and general discovery procedures
2	le_gap_general_discoverable	Discoverable using general discovery procedure
3	le_gap_broadcast	Device is not discoverable in either limited or generic discovery procedure, but may be discovered by using the Observation procedure
4	le_gap_user_data	Send advertising and/or scan response data defined by the user using le_gap_bt5_set_adv_data. The limited/general discoverable flags are defined by the user.

enum_le_gap_discover_mode

Value	Name	Description
0	le_gap_discover_limited	Discover only limited discoverable devices
1	le_gap_discover_generic	Discover limited and generic discoverable devices
2	le_gap_discover_observation	Discover all devices

enum_le_gap_address_type

Value	Name	Description
0	le_gap_address_type_public	Public address
1	le_gap_address_type_random	Random address
2	le_gap_address_type_public_identity	Public identity address resolved by stack
3	le_gap_address_type_random_identity	Random identity address resolved by stack

3-5. Event callback function

Event callback function	Description
ble_evt_gatt_server_attribute_value	The callback function pointer is being called when the attribute value in local GATT database is changed by remoted GATT client 【statement】 name.ble_evt_gatt_server_attribute_value = my_evt_gatt_server_attribute_value;
ble_evt_le_connection_opend	The callback function pointer is being called when center is connected 【statement】 name..ble_evt_le_connection_opend = my_evt_le_connection_opend;
ble_evt_le_connection_closed	The callback function pointer is being called when center is disconnected 【statement】 name.ble_evt_le_connection_closed = my_evt_le_connection_closed;
ble_evt_system_boot	The callback function pointer is being called when system is launched 【statement】 name.ble_evt_system_boot = my_evt_system_boot;
ble_evt_system_awake	The callback function pointer is being called when system has returned from sleep mode 【statement】 name.ble_evt_system_awake = my_evt_system_awake;
ble_evt_le_gap_scan_response	The callback function pointer is being called when receiving scan responce 【statement】 name.ble_evt_le_gap_scan_response = my_evt_le_gap_scan_response;

3-6. Power saving

Sleep mode saves power and can be done by the function below.

function : ble112.ble_cmd_system_halt(1)

Wakeup if the WAKEUP signal of D7 is high.