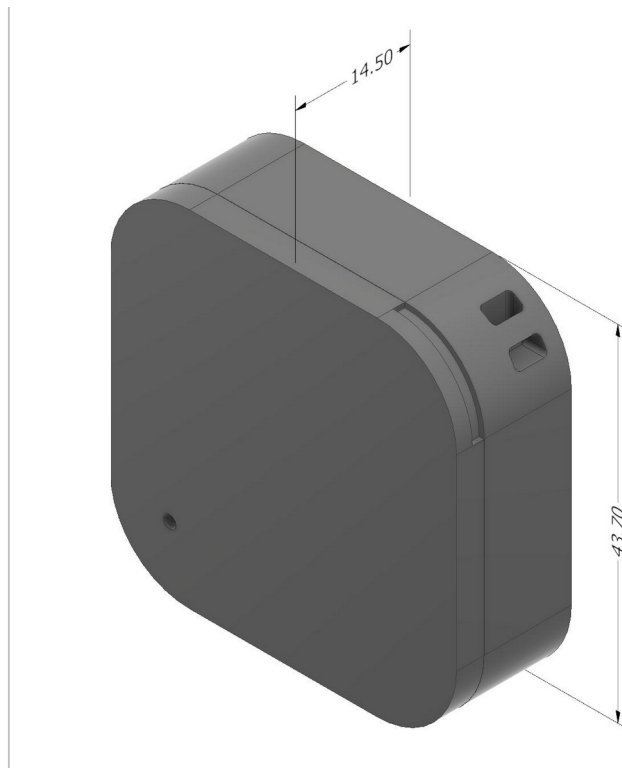

BLUE CHARM BEACONS BC052-SA
WITH TEMPERATURE HUMIDITY AND & MOTION SENSOR

BETTER SERVE YOUR BUSINESS

BRIEF DESCRIPTION



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Features:

- Working in low-power mode
- In sleep mode at the factory to save more power.
- More convenient to activate the product by pressing button.
- 5 different broadcast data to choose from
- Broadcast iBeacon and Eddystone data simultaneously
- Broadcast two fully user-defined data simultaneously
- Broadcast intervals can be adjusted
- The transmit power can be adjusted
- OTA available
- Compatible with BLE.
- High performance and low power.
- Can get information such as battery voltage from broadcast data
- High performance and low power.
- Accurate digital RSSI. Excellent link budget (up to 97dB).
- Ultra wide range tx power: 4dBm— -40dBm.
- Real-time temperature and humidity data can be obtained from broadcast data
- Up to 316K data can be stored
- The storage interval of T&H data can be adjusted
- Can store up to 80895 sensor data records
- Built-in a coin battery (type: CR2450/CR2477).
- Trigger broadcast by Button
- Trigger broadcast by Motion INT1
- Trigger broadcast by Motion INT2
- Dual channels for motion detection, support two adjustable thresholds, and detect movement of different intensities simultaneously in low-power mode
- All hardware interface completely open. Developers do not need to rely on the SDK for development. The requirement of hardware interface can be customized (achieved a certain number)
- The coin battery can be replaced

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Introduction

The BC052-SA is a high-performance product that integrates a variety of sensors with the NRF52832 Bluetooth Low-Power Chip, which features higher sensitivity, lower power consumption and Bluetooth 5.0 protocol.

This is a very comprehensive product. We define this product more as a software development kit, we hope that users will use this development kit to develop products belonging to their own application scenarios. Maybe you will not use all the functions on this product, but you can use this R & D kit to develop your own App or some other embedded applications.

In the future you can reduce the components on this version to make the cost and keep performance. At present, this product is equipped with temperature & humidity sensor, accelerometer, LED and button.

At the same time, in order to meet the higher broadcast rate, the model can easily replace the battery. It also supports a three-color light that can be used to display status and other information

The rich and versatile functions are only designed to serve your business. If our products can not meet your needs, we also provide customers with customized firmware and hardware services, all for better service. Looking forward to your choice, we will continue to improve ourselves to better serve you.

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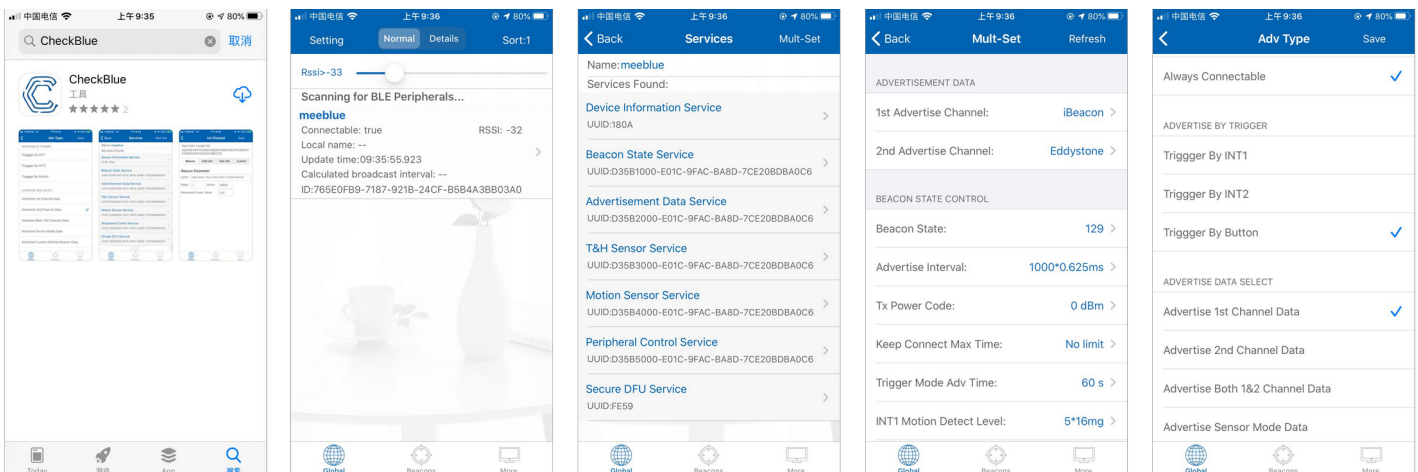
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Active The Beacon

The beacon is in trigger mode by default setting. So when you get the beacon, you need to activate it.

First please download our tool app CheckBlue from App Store or Google Play and go to the Global page. Then please take out Beacon, press and hold the button in the middle of the product, after long press button 1.5 seconds, you can see the LED start flashing. At this time, please hold Beacon close to the mobile phone, click on the displayed items to start to connect. It will pop up a box during connection, prompt to enter the verification code, at this time, please enter the corresponding verification code of the product, then you can continue to connect. The default verification code is "000000". After you enter verification code, it will jump to the Services page. On this page, you can see all the services owned by the device, and each service has a corresponding description. Click the Multi-Set button in the upper right corner to configure all the functions of Beacon accordingly.



Default Setting

- Default State: Trigger mode (Broadcast for 12 seconds after button push; can be modified to continuous broadcast)
- Default Authentication Code: 000000
- Broadcast Interval: 1022.5 ms
- Tx Power: 0 dBm
- Device Name: BlueCharm

Advertisement Data

There are five kinds of advertisement data to choose from, including:

- 1st advertisement channel data
- 2nd advertisement channel data
- 1st & 2nd advertisement channel data
- Sensor Mode fixed advertisement data
- Blue Charm defined custom beacon fixed data

1. The first channel and the second channel advertisement data can be completely defined by the user. This means that you can use these two channels to broadcast arbitrary data at the same time without any restrictions, such as broadcasting two different iBeacon data at the same time, simultaneously broadcasting two different Eddystone data, or other arbitrary data.
2. When configuring advertisement data in sensor mode, the data of the first channel and the second channel will be disabled, and only the data in this mode will be broadcast. In this mode, the broadcast data includes: Beacon's fixed ID, temperature value, humidity value, and current battery voltage value, as well

as time stamp of the countdown of the trigger mode.

- When configuring Blue Charm defined beacon fixed data, the data of the first channel and the second channel will be disabled, and only the data in this mode will be broadcast. In this mode, the broadcast data includes: Beacon's fixed ID, battery voltage value, and ten Bytes of custom data, we split these 10 bytes into 6 bytes + 2 bytes + 2 bytes mode. The first six bytes are MINI-UUID, the length is 6 bytes. The middle two bytes are Major value. The last two bytes are Minor value. And the broadcast data also contains the time stamp of the countdown of the trigger mode.

The default advertisement data of the first channel is iBeacon data

The iBeacon's BLE raw data format is as follows, with a length of 30 bytes.

0x{01 06 1A FF 4C 00 02 15 D3 5B 76 E2 E0 1C 9F AC BA 8D 7C E2 0B DB A0 C6 00 01 00 01 CB}

In these 30 bytes 0x{D3 5B 76 E2 E0 1C 9F AC BA 8D 7C E2 0B DB A0 C6} is iBeacon Proximity UUID

The immediately following 0x{00 01} is iBeacon Major value

The after 0x{00 01} is iBeacon Minor value

The last 0x{CB} is iBeacon Measured Power Value

The default advertisement data of the second channel is Eddystone-UID data

The raw data format is as follows.

0x{02 01 04 03 03 AA FE 15 16 AA FE 00 C5 D3 5B 76 E2 E0 1C 9F AC BA 8D 7C E2 0B DB A0 C6}

The part 0xC5 is Measured Power Value

The after 0x{D3 5B 76 E2 E0 1C 9F AC BA 8D} is Eddystone-UID's Namespace ID

The following 0x{7C E2 0B DB A0 C6} is Eddystone-UID's Instance ID.

The Sensor mode fixed advertisement raw data format is as follows

```
{02 01 06 03 03 00 10 15 16 00 10 E4 BD 66 D9 7B 43 45 E0 1E 5E 70 A8 60 DA D8 0C FF FF}
```

0x{02 01 06}: BLE Flag

0x{03 03 00 10}: Advertisement data service UUID 0x1000

0x{15 16 00 10 E4 BD 66 D9 7B 43 45 E0 1E 5E 70 A8 60 DA D8 0C FF FF}:Advertisement data service data.

Details for service data: 0x{E4 BD 66 D9 7B 43 45 E0 1E 5E 70 A8 60 DA D8 0C FF FF}

0x{E4 BD 66 D9 7B 43}: Device unique ID

0x{45 E0 1E 5E}: Time stamp for reading sensor data

0x{70 A8}: Temperature Data

0x{60 DA}: Humidity Data

0x{D8 0C}: Battery voltage

0x{FF FF}: Trigger mode count down second. 0xFFFF means Trigger mode disabled

T&H DATA Conversion

The temperature T is calculated by inserting temperature signal output VT into the following formula (result in °C), no matter which resolution is chosen:

$$T = -46.85 + 175.72 * V / 65536$$

The result of converting the above temperature data according to this formula is:

$$T = -46.85 + 175.72 * (0x70A8) / 65536 = 30.47 \text{ (}^\circ\text{C)}$$

With the relative humidity signal output VH the relative humidity RH is obtained by the following formula (result in %RH), no matter which resolution is chosen:

$$RH = -6 + 125 * VH / 65536$$

The result of converting the above humidity data according to this formula is:

$$RH = -6 + 125 * (0x60DA) / 65535 = 41.29\%$$

Warning: You must use these value as float format.

The Custom Beacon fixed raw data format is as follows

0x{02 01 06 03 03 00 30 17 16 00 30 E4 BD 66 D9 7B 43 C6 0C D3 5B 76 E2 E0 1C 00 01 00 01 FF FF}

0x{02 01 06}: BLE Flag

0x{03 03 00 30}: Advertisement data service UUID 0x3000

0x{17 16 00 30 E4 BD 66 D9 7B 43 C6 0C D3 5B 76 E2 E0 1C 00 01 00 01 FF FF}: Advertisement data service data.

Details for service data:0x{E4 BD 66 D9 7B 43 C6 0C D3 5B 76 E2 E0 1C 00 01 00 01 FF FF}

0x{E4 BD 66 D9 7B 43}: Device unique ID

0x{C6 0C}: Battery voltage

0x{D3 5B 76 E2 E0 1C}: Custom Beacon Mini UUID

0x{00 01}: Custom Beacon Major Value

0x{00 01}: Custom Beacon Minor Value

0x{FF FF}: Trigger mode count down second. 0xFFFF means Trigger mode disabled

Get Battery From Advertisement Data

Note: No matter in which data mode, connectable mode or non-connectable mode, the battery power, device name, and transmit power information will be broadcast automatically unless `low_power_mode` is enabled.

In Advertisement data, you will see a service data in with `0x5000`, the length is 8 bytes or 2 bytes depending on the configuration of `advertise_battery_type`.

When the length is 8 bytes. The service value like `0x{D3 5B 76 E2 E0 1C C6 0C}`

`0x{D3 5B 76 E2 E0 1C}`: Device unique ID

`0x{C6 0C}`: Battery voltage

When the length is 2 bytes. The service value like `0x{C6 0C}`

`0x{C6 0C}`: Battery voltage

Calculate battery voltage

$Battery_Voltage = 0x0C * 256 + 0xC6 = 3270\text{mv}$

Structure data analysis of Beacon State

typedef struct

```
{
    uint16_t Broadcast_Interval;
    uint16_t Trigger_Mode_Adv_Time;
    uint8_t Advertise_Type;
    int8_t Tx_Power;
    uint8_t Keep_Connect_Max_Time;
    uint8_t INT1_Motion_Strength;
    uint8_t INT2_Motion_Strength;
    uint8_t TH_Sensor_Save_Interval;
    uint8_t low_power_mode;
    uint8_t advertise_battery_type;
    uint8_t adv_ibeacon_in_sensor_mode;
    uint8_t default_advertise_data_type_in_sleep_mode;
    uint8_t Reserve[2];
    uint32_t current_time_stamp;
} Beacon_State_Data_t;
```

This structure contains the control of all the entire Beacon state, size 20 bytes. The following table shows the data of the entire structure diagram.

Name	Description	Unit	Range can be configured
Broadcast_Interval	Broadcast interval	0.625ms	160-16384
Trigger_Mode_Adv_Time	Length of time for broadcast after trigger mode trigger	100ms	5-65534
Advertise_Type	Refer to the detailed introduction below	--	--
Tx_Power	Transmit power	dBm	4,3,0,-4,-8,-12,-16,-20,-40
Keep_Connect_Max_Time	Maximum length of time allowed to connect after being connected	minute	0-255 0: Without limit
INT1_Motion_Strength	Motion Strength for INT1	16mg	2-127

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INT1_Motion_Strength	Motion Strength for INT1	16mg	2-127

INT2_Motion_Strength	Motion Strength for INT2	16mg	2-127
TH_Sensor_Save_Interval	The storage interval of temperature&humidity data	minute	1-240
low_power_mode	Advertise 31 bytes only to save battery	--	0x00: Disable 0x01: Enable
advertise_battery_type	Choose battery advertise type	--	0x00: ID+Batt 0x01: Only Batt 0x00: None
adv_ibeacon_in_sensor_mode	Active application in background mode		0x00: Disable 0x01: Enable
default_advertise_data_type_in_sleep_mode	Select advertisement data when activated by key press from sleep mode		0x01: 1st Channel Data 0x02: 2nd Channel Data 0x03: Both 1st&2nd Channel Data 0x04: Sensor mode Data 0x05: Custom Beacon Data
Reserve	Reserve data for future use	--	--
current_time_stamp	Current time stamp, please note the time zone.	second	2020-01-03 11:45

Selection of Advertise Type

Advertise type is controlled by one byte. We call this Beacon State Main.

The following table is the information represented by each bit of this byte. When the value is 1, it means enabled, when the value is 0, it means disabled.

Connectable	Trigger by INT1	Trigger by INT2	Trigger by Button	Custom-Beacon data	Sensor mode data	2 nd channel data	1 st channel data
-------------	-----------------	-----------------	-------------------	--------------------	------------------	------------------------------	------------------------------

The first four bits control the mode of Beacon broadcasting. When all trigger modes are Disabled, Beacon will continue to broadcast without interruption. The last four bits control the data content of the Beacon broadcast. Please kindly be noted that the data of the first channel and the second channel can coexist, but when Custom Beacon Data or Sensor mode data is enabled, only Custom Beacon data or only Sensor mode data will be broadcast, and Custom Beacon data has higher priority than Sensor mode data. You can also easily configure it directly through CheckBlue. The following is the introduction of each bit

□ Connectable: Whether connection is support

- Trigger by INT1: Trigger broadcast by INT1
- Trigger by INT2: Trigger broadcast by INT2
- Trigger by Button: Trigger broadcast by Button
- Custom Beacon data: Broadcast Custom Beacon fixed format data
- Sensor mode data: Broadcast data in Sensor mode
- 2nd channel data: Broadcast the configuration data of the second channel
- 1st channel data: Broadcast the configuration data of the first channel

Services Introduction

The Base UUID of Blue Charm Beacon is D35B0000-E01C-9FAC-BA8D-7CE20BDBA0C6, all UUID is a 128bit representation. When we say that the UUID is 0x1000, the actual UUID is D35B1000-E01C-9FAC-BA8D-7CE20BDBA0C6

This point will not be described later.

Service 0x1000

Characteristic	Property	Value Length	Function
0x1001	Read/Write/Notify	7 Bytes	Authentication Control
0x1002	Read/Write	10 Bytes	Beacon State Control
0x1003	Read/Write	20 Bytes	Device Name Change

Note: The value needs to be input the port should be converted to hexadecimal ASCII characters. For example, the corresponding hexadecimal ASCII for Blue Charm is {0x6d,0x65,0x65,0x62,0x6c,0x75,0x65}. When the value should be input is 0x6d6565626c7565.

Service 0x2000

Characteristic	Property	Value Length	Function
0x2001	Read/Write	20 Bytes	The begin 20 bytes of 1 st channel
0x2002	Read/Write	12 Bytes	The end 12 bytes of 1 st channel
0x2003	Read/Write	20 Bytes	The begin 20 bytes of 2 nd channel
0x2004	Read/Write	12 Bytes	The end 12 bytes of 2 nd channel
0x2005	Read/Write	10 Bytes	Custom Beacon UUID+Major+Minor

Note: The first byte of characteristic 0x2001 and 0x2003 is Effective length of the entire data.

Service 0x3000

Characteristic	Property	Value Length	Function
0x3001	Read/Notify	8 Bytes	Real-Time T&H Sensor Data
0x3002	Read/Write/Notify	20 Bytes	Sync times tamp
0x3003	Notify	Dynamic	Syncing data

Note: None

Service 0x4000

Characteristic	Property	Value Length	Function
0x4001	Read/Notify	1 Byte	Detect INT1 Motion
0x4002	Read/Notify	1 Byte	Detect INT2 Motion

Service 0x5000

Characteristic	Property	Value Length	Function
0x5001	Write	1 Byte	Light LED
0x5002	Read/Notify	1 Byte	Button Detect, 0x01: Single click, 0x02:Long press
0x5003	Read/Write	2 Bytes	Battery voltage information

Notes: When write value 0x01 to characteristic 0x5001, The LED will flash.

Electronic Parameters

Name	Details	Description
Chip model	nRF52832	Nordic Semiconductor 512K
Battery model	CR2450/CR2477	Coin battery, 3.0Vdc, 1pc
Operation Voltage	1.7-3.6V	DC
Max temperature (°C)	+85	--
Operation Frequency	2400-2483.5MHz	Programmable
Frequency Error	+/- 20KHz	--
Modulation	Q-QPSK	--
Radio current consumption with DC/DC at 3V	5.3 mA – TX at 0 dBm	7.5 mA – TX at +4 dBm
Sleep current	2.3 uA	without any sensor
Output Power	+4 to -20 dBm in 4 dB steps	Programmable
Receiving Sensitivity	-93dBm	High gain mode
Transmission distance	70meters	BER<0.1%, Open space
Antenna	50ohm	Onboard
Size	43.7 x 43.7 x 14.5mm	Based on CR2477 battery
Waterproof level	IP68	Soaked in water at a depth of 1.5 meters for more than one hour

Revision history

Date	Revision	Changes
2020-01-08	1.0.1	First release
2020-01-15	1.0.2	Fix information errors
2020-04-07	1.1.0	Fix some errors, and add battery Description