

User's Manual

**Bluetooth LE 5 Module
Model Name: AP-12SC**

VERSION: 0.3

TABLE OF CONTENTS

1. INTRODUCTIONS AND SCOPE	1
2. FEATURES	2
3. MECHANICAL CHARACTERISTICS	3
4. EXTERNAL DIMENSION	4
5. PIN ASSIGNMENT AND DESCRIPTION	5
6. HARDWARE ARCHITECTURE	8
6.1 BLOCK DIAGRAM	9
6.2 SYSTEM ARCHITECTURE	9
7. ELECTRICAL CHARACTERISTICS	9
7.1 VOLTAGE SPECIFICATION	9
7.2 TEMPERATURE SPECIFICATION	9
7.3 AUXDAC CHARACTERISTICS	9
7.4 RADIO CHARACTERISTICS	9
7.5 GPIO CHARACTERISTICS	9
8. FOOTPRINT	11
9. ANTENNA	11
10. CERTIFICATION	12
10.1 CERTIFICATION	13
10.2 FCC STATEMENT	13
10.3 NCC STATEMENT	13
11. RF WARNING MESSAGE	15
12. SHIPPING PACKAGE	15

1. INTRODUCTIONS AND SCOPE

AP-12SC is a Bluetooth low energy(BLE) module. It uses Realtek Semiconductor BLE controller RTL8762CMF, which is an ultra-low-power chipset. AP-12SC is designed for high performance wearable, medical, industrial and consumer applications. The module integrates antenna and completed controller circuit, customer can easily apply it in product.

2. FEATURES

2.1 General

- Bluetooth 5.2 Certified with LE 2Mbps Support
- Build in Arm Cortex-M4F Processor
- Build in 40MHz system clock crystal
- Bluetooth Transceiver
- Transmitting Power: -20 to +7.5 dBm
- Transmitting Distance: 100m (no disturbance)
- RX Sensitivity -97dBm (BLE min)
- Support Lower Voltage to 1.8V
- 160kByte RAM and 8Mbyte Flash Address Space
- 512kB Internal Flash Memory
- Channel Selection #2
- Support GAP, ATT/GATT, SMP, LCAP
- Support AES128/192/256 Encrypt/ Decrypt Engine
- Real Time Counter
- Support LE Long Range
- Build in PCB Antenna
- Support AT Command
- Supports OTA
- Support MESH
- Max TX Power 8dBm

2.2 Peripheral Interface

- Hardware Key Scan
- Real Time Counters
- 4 wire SPI Master/ Slave
- I2C x2
- PWM x8
- Timers x8
- 400Ksps, 12bits, 4channel AUXDAC
- Embedded IR Transceiver

3. MECHANICAL CHARACTERISTICS

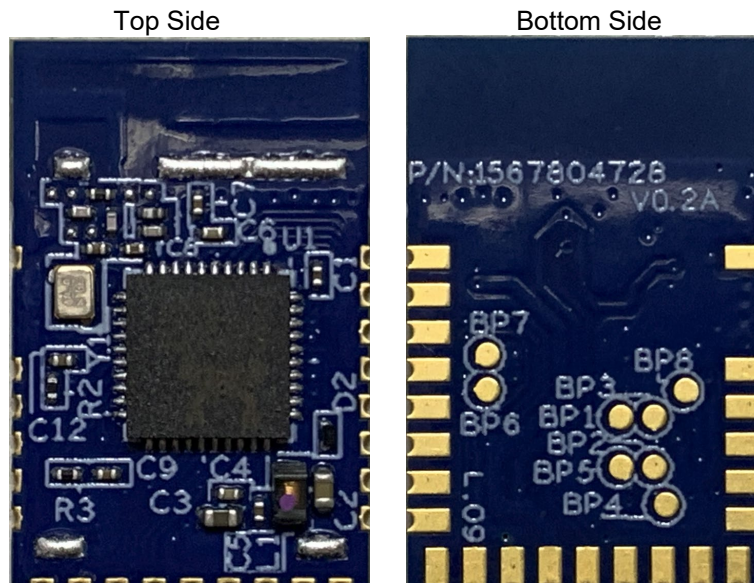
3.1 Weight and Dimension

Weight: 0.8g

Dimension: 17.1mm x 11.15mm x 2.7(L x W x H, with metal cover)

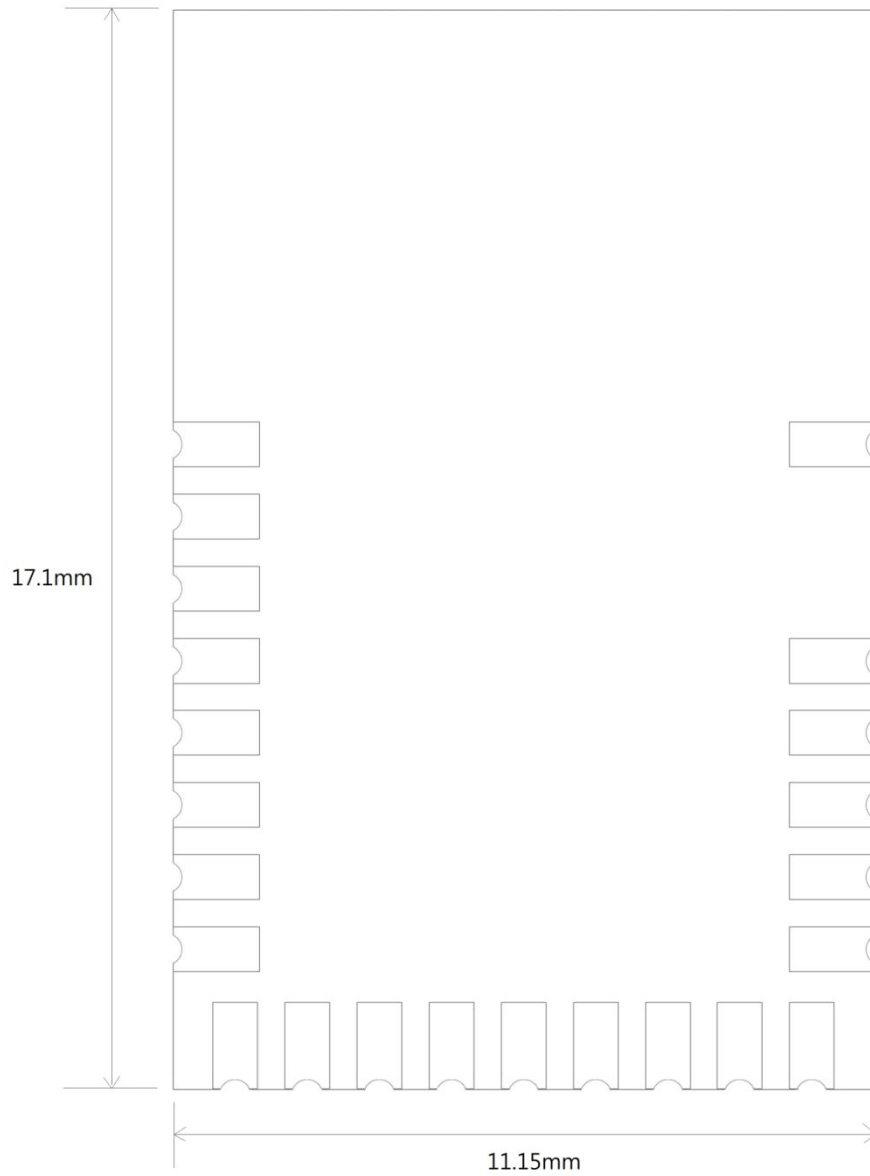
3.2 Module Picture

Reference picture below(without shielding cover):



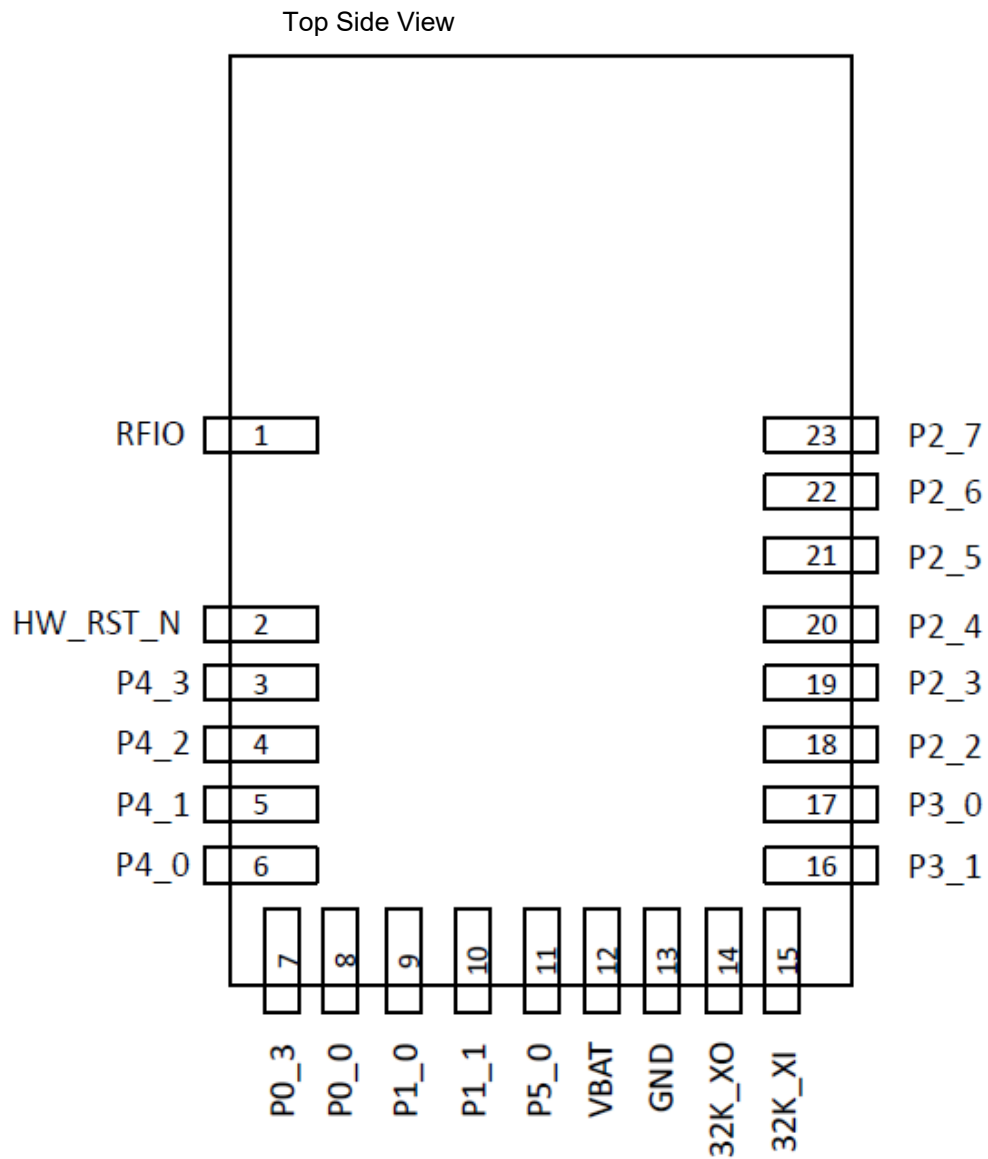
4. EXTERNAL DIMENSION

4.1 Outline Dimension of PCBA (unit: mm)



5. PIN ASSIGNMENT AND DESCRIPTION

5.1 Pin Assignment



5.2 Pin Descriptions

Pin	Symbol	I/O	ADC	Pull	Description
1	RFIO	--	--	--	BT RX/BT TX interface
2	HW_RST_N	I	--	--	Hardware reset pin; low active
3	P4_3	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down
4	P4_2	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down
5	P4_1	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down
6	P4_0	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down
7	P0_3	IO	--	--	LOG_UART TX Power on trap: Pull-up for normal operation Pull-down to bypass executing program code in flash (PAD internal pull-up by default)
8	P0_0	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down
9	P1_0	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down
10	P1_1	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down
11	P5_0	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down
12	VBAT	P	--	--	Battery voltage input DC1.8V~3.6V
13	GND				Ground
14	32K_XO	A/IO	--	--	32k crystal output or external 32k clock output(optional)

15	32K_XI	A/IO	--	--	32k crystal input or external 32k clock input(optional)
16	P3_1	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down HCI_UART_RX
17	P3_0	IO	--	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down HCI_UART_TX
18	P2_2	IO	ADC2	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down AUXADC input 2
19	P2_3	IO	ADC3	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down AUXADC input 3
20	P2_4	IO	ADC4	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down AUXADC input 4
21	P2_5	IO	ADC5	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down AUXADC input 5
22	P2_6	IO	ADC6	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down AUXADC input 6
23	P2_7	IO	ADC7	U/D	General purpose IO 8mA driving capacity with wakeup function with internal strong/ weak pull-up and pull-down AUXADC input 7

Legend:

Type: A = analog; D = digital; I = input; O = output; P = power

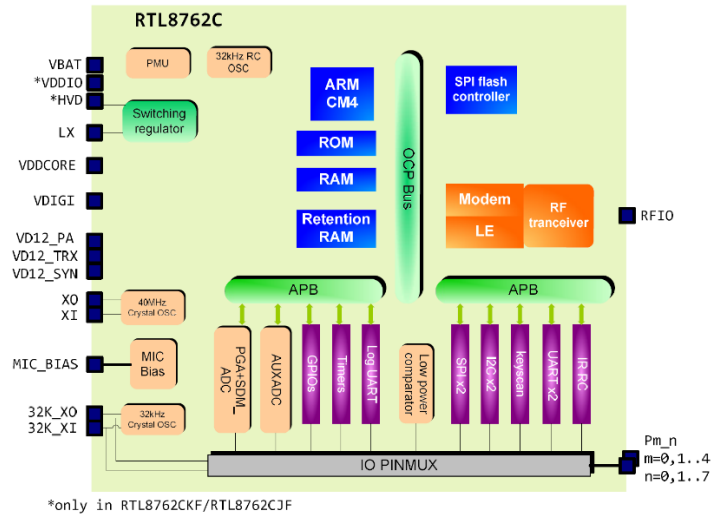
Pull(U/D) : U = pull up; D = pull down

6. HARDWARE ARCHITECTURE

6.1 Block Diagram

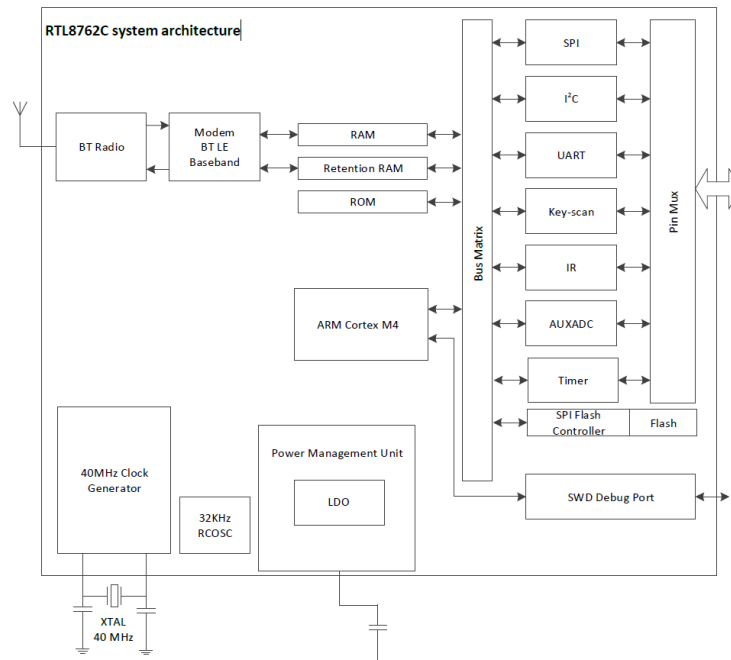
Hardware block of AP-12SC is illustrated.

- Rich peripherals
- Flexible RAM configuration
- Power Management Unit
- Clock Management Unit
- BLE module



6.2 System Architecture

Brand Name	Model Name	Antenna	Operating Frequency
RTL8762CMF	AP-12SC	PCB Antenna	40 MHz



7. ELECTRICAL CHARACTERISTICS

7.1 Voltage Specification

Symbol: VBAT

Power supply voltage range: 1.8~3.6V

Build in internal LDO regulator to provide stable power to the digital core and radio circuit

7.2 Temperature Specification

Functional temperature range: -40°C ~ 105°C

Storage temperature range: -55°C~125°C

7.3 AUXDAC Characteristics

Resolution 12bits

DNL (Single-ended mode) +/-1.5 LSB

DNL (Differential mode) +/-3 LSB

INL (Single-ended mode) +/-1 LSB

INL (Differential mode) +/-2 LSB

Maximum input voltage: VBAT

Input Impedance (bypass mode): 1Mohm

Input Impedance (resister divider mode 1/4): 500kohm

7.4 Radio Characteristics

Frequency range 2402MHz~2480MHz

RX sensitivity -97dBm (PER <= 30.8%)

RX maximum input level -1dBm (PER <= 30.8%)

TX maximum output power 8dBm

7.5 GPIO Characteristics

Input/ Output functions

Independent interrupts

3 interrupt trigger conditions (level/ edge/ dual-edge)

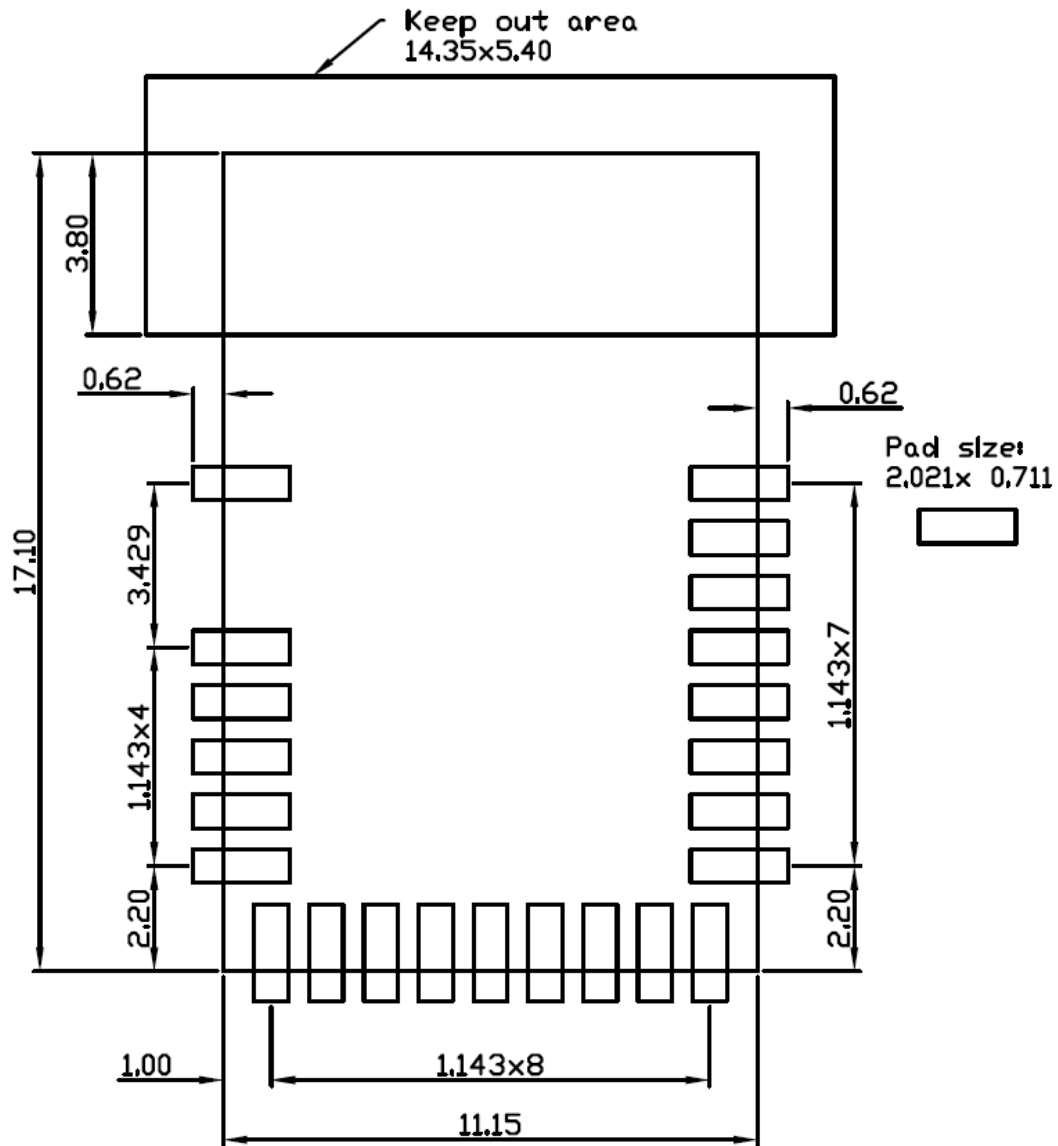
Hardware interrupt de-bounce

Parameter	Condition	Min	Typical	Max
Input high voltage	Vbat = 3.3V	2	3.3	3.6
Input low voltage	Vbat = 3.3V	--	0	0.9
Output high voltage	Vbat = 3.3V	2.97	--	3.3
Output low voltage	Vbat = 3.3V	0	--	0.33
Input high voltage	Vbat = 2.8V	1.8	2.8	3.1
Input low voltage	Vbat = 2.8V	--	0	0.8
Output high voltage	Vbat = 2.8V	2.5	--	--
Output low voltage	Vbat = 2.8V	0	--	2.8
Pull high and pull low	Vbat = 3.3V Strong pull/	--	10/100	--

resister(KOhm)	weal pull			
	Vbat = 1.8V Strong pull/ weal pull	--	20/200	--
	Vbat = 3.3 Strong pull/ weal pull V	--	5/50	--
	Vbat = 1.8 Strong pull/ weal pull V	--	2.5/25	--
Input high current(uA)	PAD configured as input mode	--	--	0.1
Input low current(uA)	PAD configured as input mode	--	--	0.1

8. FOOTPRINT

Make sure no ground pad is in the keep out area. If PCB is multi layer, there should be no ground pad in each layer inside keep out area



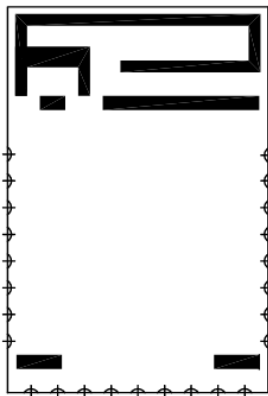
unit : mm

9. ANTENNA

Details of EUT

Product Name	AP-12
Device Manufacturer	Behavior Tech Computer Corp.
Device Model Name	AP-12SC
Device Description	AP-12SC is a Bluetooth low energy (BLE) module. It uses REALTEK BLE controller RTL8762C, which is an ultra-low-power, highly flexible multi-protocol 2.4 GHz radio chipset. AP-12SC is designed for high-performance wearable, medical, and industrial applications. The module integrates PCB antenna, crystal, and controller relative circuit, customer can easily apply it in product.
Hardware Version	Ver : 0.2A
Software Version	Ver : 1.0
Frequency Range	2400MHz ~ 2500MHz Step size: 10MHz
Antenna Type	Embedded Antenna
Antenna Model	ANPCB-2301
Antenna Brand	BTC

Antenna Pattern



Statement of Performance

The best results of antenna Performance found during testing for the BLE passive antenna are as below :

Function	Position	Gain (dBi)	Efficiency (%)
BLE passive antenna (2400MHz)	Free Space	-4.04	10.84
BLE passive antenna (2450MHz)	Free Space	-3.65	11.60
BLE passive antenna (2500MHz)	Free Space	-4.33	9.39

10. CERTIFICATION

10.1 Certification

AP-12SC is compliant with FCC, NCC, CE certification

10.2 FCC Statement

FCC Statement:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
 - Increase the separation between the equipment and receiver.
 - Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
 - Consult the dealer or an experienced radio/TV technician for help.
- Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and a human body.

If the identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module, Contains FCC ID: E5XBMAP12SC.

Co-location of this module with other transmitters that operate simultaneously are required to be evaluated using the multi-transmitter procedures.

The host integrator must follow the integration instructions provided in this document and ensure that the composite-system end product complies with the requirements by a technical assessment or evaluation to the rules and to KDB Publication 996369.

The host integrator installing this module into their product must ensure that the final composite product complies with the requirements by a technical assessment or evaluation to the rules, including the transmitter operation and should refer to guidance in KDB 996369.

10.3 NCC Statement

取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使

用。前述合法通信，指依電信管理法規定作業之無線電通信。低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

此模組於取得認證後將依規定於模組本體標示審驗合格標籤,並要求平台廠商於平台上標示本產品那含發射器模組  CCAN23Y10300T0 。

11. RF WARNING MESSAGE

The AP-12SC module has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” single-modular approval in accordance with Part 15.212 Modular Transmitter approval. Single-modular transmitter approval is defined as a complete RF transmission sub-assembly, designed to be incorporated into another device, that must demonstrate compliance with FCC rules and policies independent of any host. A transmitter with a modular grant can be installed in different end-use products (referred to as a host, host product or host device) by the grantee or other equipment manufacturer, then the host product may not require additional testing or equipment authorization for the transmitter function provided by that specific module or limited module device.

The user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

A host product itself is required to comply with all other applicable FCC equipment authorization regulations, requirements, and equipment functions that are not associated with the transmitter module portion. For example, compliance must be demonstrated: to regulations for other transmitter components within a host product; to requirements for unintentional radiators (Part 15 Subpart B), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Suppliers Declaration of Conformity (SDoC) or certification) as appropriate (e.g., Bluetooth and Wi-Fi transmitter modules may also contain digital logic functions).

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Labeling and User Information Requirements

The AP-12SC module has been labeled with its own FCC ID number, and if the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must display a label referring to the enclosed module. This exterior label must use the following wording:

Contains Transmitter Module FCC ID: E5XBMAP12SC

or

Contains FCC ID: E5XBMAP12SC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The user's manual for the finished product must include the following statement:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Additional information on labeling and user information requirements for Part 15 devices can be found in KDB Publication 784748, which is available at the FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) apps.fcc.gov/oetcf/kdb/index.cfm.

RF Exposure

All transmitters regulated by FCC must comply with RF exposure requirements. KDB 447498 General RF Exposure Guidance provides guidance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to Radio Frequency (RF) fields adopted by the Federal Communications Commission (FCC).

From the FCC Grant: Output power listed is conducted. This grant is valid only when the module is sold to OEM integrators and must be installed by the OEM or OEM integrators. This transmitter is restricted for use with the specific antenna(s) tested in this application for Certification and must not be co-located or operating in conjunction with any other antenna or transmitters within a host device, except in accordance with FCC multi-transmitter product procedures.

AP-12SC: These modules are approved for installation into mobile host platforms atleast 20cm away from the human body.

Helpful Web Sites

- Federal Communications Commission (FCC): www.fcc.gov.
- FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) apps.fcc.gov/oetcf/kdb/index.cfm.

12. SHIPPING PACKAGE

Packed by tray, 80pcs modules per tray (T.B.D)

MOQ 1200pcs

MPQ 80pcs

Carton and labels (T.B.D)

13. VERSION CHANGE LIST

- 2023/03/06 Version 01 Release
- 2023/03/20 Version 02 Release
- 2023/04/27 Version 03 Release