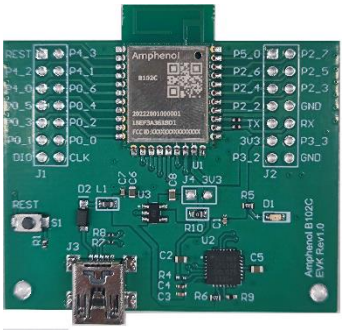
User Guide

Amphenol - Bluetooth module

B102C



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Revision History

Reversion	Date	SW release	Note
1.0	2023-04-21	1.0	Created

Aim of this Document

The aim of this document is the introduction of EVB user guide for B102C.

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1 Overview

This document introduces usage of B102C Evaluation board hardware. EVB provides hard environment to develop environment based on application of customer.

2 EVK Pattern

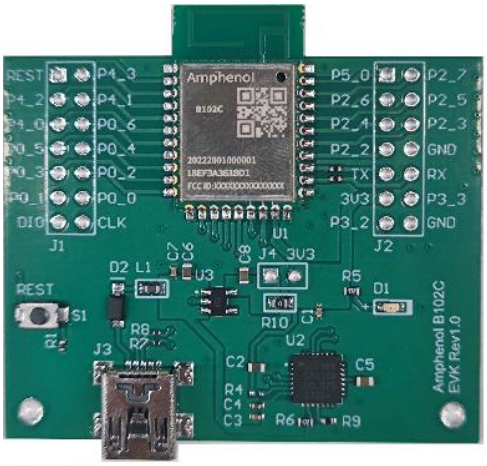


Figure 2-1 EVK Pattern

Table 2-1 Components List

No.	Description
1	B102C EVB
2	USB A to USB Mini-B cable

3 PIN Description

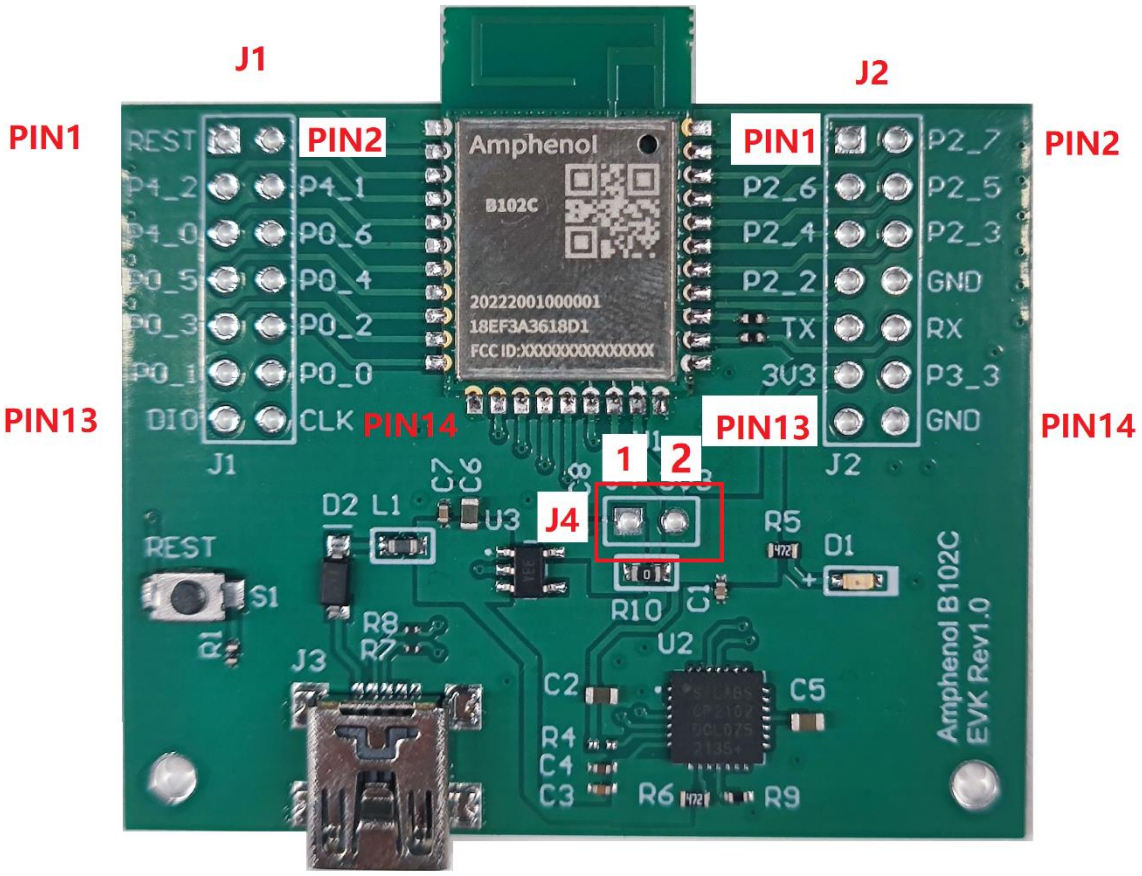


Figure 3-1 PIN MAP

Table 3-1 J1 PIN Description

Pin Number	Name	Pin Number	Name
1	RESET	2	GPIO4_3
3	GPIO4_2	4	GPIO4_1
5	GPIO4_0	6	GPIO0_6
7	GPIO0_5	8	GPIO0_4
9	GPIO0_3(UART LOG TX)	10	GPIO0_2
11	GPIO0_1	12	GPIO0_0
13	SWD_DIO	14	SWD_CLK

Table 3-2 J2 PIN Description

Pin Number	Name	Pin Number	Name
1	GPIO5_0	2	GPIO2_7
3	GPIO2_6	4	GPIO2_6
5	GPIO2_4	6	GPIO2_3
7	GPIO2_2	8	GND
9	UART_TXD	10	UART_RXD
11	VDD	12	GPIO3_3
13	GPIO3_2	14	GND

Table 3-3 J4 PIN Description

Pin Number	Name
1	Internal LDO output, 3.3V
2	External Power supply, 3.3V

Note:

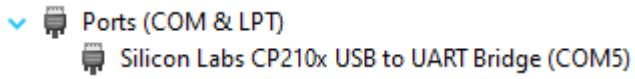
1. Jumper Cap will be used if internal LDO will be used which is power supplied by USB cable;

Table 3-4 UART connection

UART from Host controller	Normal	Log
UART_TXD of Host controller	UART_RXD (J2-PIN10)	-
UART_RXD of Host controller	UART_TXD (J2-PIN9)	UART_LOG_TXD (J1-PIN9)

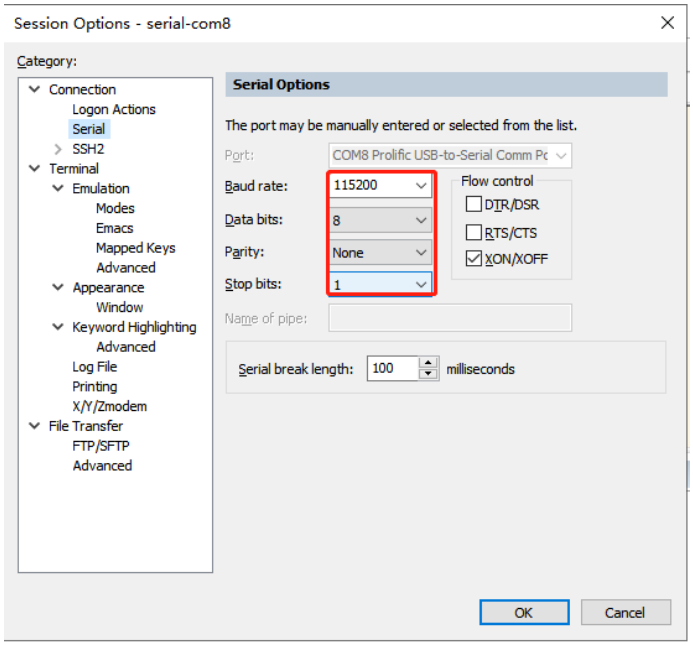
4 Power on

Connect EVB to PC by USB A to USB Mini-B cable, and then read port status through device manager. The following status means port work normally



If port don't work normally, please to download and install driver from the following link:
https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers?tab=downloads

Default Baud rate: 115200



5 AT commands

< Amphenol_B102C_AT command_V1.1 >

Datasheet

Amphenol - Bluetooth module

B102C

Document information

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1.0	2021-05-29	Created
1.1	2022-06-08	Feature update
1.2	2022-08-19	RF Feature updated
1.3	2022-11-19	RF Feature updated
1.4	2023-02-07	Feature updated

Aim of this Document

The aim of this document is to give a detailed product description including features and performance of the BT Module B102C.

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1. Introduction

B102C module is a Bluetooth module featuring BLE v5.0, powerful ARM® Cortex™-M4 MCU and state-of-the-art power performance. The embedded low power crystal improves the power consumption by enabling optimal power save modes. B102C is delivered with Amphenol firmware that could support Bluetooth low Energy Serial Port Service, beacons, and simultaneous peripheral and central roles - all configurable from a host by using AT commands.
B102C offers full flexibility for customers who prefer to add their application to run on the built-in Cortex-M4. With 4Mbits FLASH, 4Kb eFuse and 160 KB SRAM.
Additionally, Interfaces such as SPI, I2C, and UART are available. B102C has a RF pin for use with an external antenna the same time with internal PIFA antenna.

1.1 Key Features

- Based on Realtek RTL8762CMF
- Complete RF solution with integrated antenna
- Powerful 20 MHz Arm® Cortex®-M4F processor
- Over-the-Air (OTA) firmware updates
- 160KB RAM, 4Mbits Flash
- 24 General Purpose I/O Pin
- 12-bit/400KSPS ADC
- 2 X UART
- 2 x SPI (master or slave)
- Low power Real Timer Counters (RTC)

1.2 Application

- Beacons – iBeacon™, AltBeacon, Eddystone, etc
- Low-Power Sensors
- Building automation
- A4WP wireless chargers and devices
- Lighting Products
- Fitness devices
- Wearable
- Mouse, Keyboard. Multi-touch track pad
- Remote control toys

2. Module Overview

2.1 Product Overview

Table 2-1 Specification of B102C

Bluetooth	
Version	BLE Version 5.0
RF	
Frequency	2402MHz~2480MHz
Modulation	GFSK at 1Mbps, 2Mbps data rates
Antenna	On-Board PCB antenna
Current Consumption	
TX only @ 0 dBm	15.6 mA
TX only @ +4 dBm	18.8 mA
TX only @ +7 dBm	21.8 mA
RX only @ 1 Mbps	14.6 mA
Power down	450nA
Deep Sleep mode	2.5 μA
Electrical Character	
Flash	4Mb
eFuse	4Kb
Interface	SPI,UART,I2C
Power supply	3V to 3.6V
Operation Temperature	-30 to +85°C

2.2 Electrical specifications

2.2.1 Absolute maximum ratings

Table 2-2 Absolute maximum rating

Symbol	Description	Parameter	Min	Max	Unit
VCC_IN	Module supply voltage	Input DC voltage at VCC pin	-0.3	4.0	V
Temp_Storage	Storage temperature	Storage Temperature Range	-40	+125	℃

2.2.2 Maximum ESD rating

Table 2-3 Maximum ESD rating

Parameter	Min	Type	MAX	Unit	Remarks
Electrostatic discharge			±2	KV	Human body model
			±0.5	KV	Charged device model

2.2.3 Operating conditions

Table 2-4 Operating condition

Symbol	Parameter	Min	Type	MAX	Unit
VCC_IN	Module supply voltage	3.0	3.3	3.6	V
Ta	Operating Ambient Temperature Ran	-30	+25	+85	℃

2.2.4 Digital Pins

Table 2-5 Digital Pins

Pin_Name	Parameter	Min	Type	MAX	Unit
VIH	Input High Voltage	0.7VCC		VCC	V
VIL	Input Low Voltage	GND		GND + 0.9	V

3. Peripherals

3.1 UART

The UART is modeled after the industry-standard 16550. However, the register address space has been relocated to 32-bit data boundaries for APB bus implementation. The UART is used for serial communication with a peripheral, modem (data carrier equipment, DCE) or data set. Data is written from a master (CPU) over the APB bus to the UART and it is converted to serial form and transmitted to the destination device. Serial data is also received by the UART and stored for the master (CPU) to read back. The UART contains registers to control the character length, baud rate, parity generation /checking, and interrupt generation. Although there is only one interrupt output signal from the UART, there are several prioritized interrupt types that can be responsible for its assertion. Each of the interrupt types can be separately enabled or disabled by the control registers.

3.2 Timer

Timer includes three identical 32-bit Timer Counter channels. Each channel can be independently programmed to perform a wide range of functions including frequency measurement, event counting, interval measurement, pulse generation, delay timing and pulse width modulation. Each channel drives an internal interrupt signal which can be programmed to generate processor interrupts.

3.3 GPIO

- Fully programmable pin assignment

- Selectable pull-up, pull-down resistors per pin
- Pins retain their last state when system enters the sleep mode
- Ability to wakeup chip by any GPIOs in sleep mode

3.4 RF

3.4.1 BLE Specification

Table 3-1 BLE Specification

Items	Contents			
Channel	CH0 to CH39			
Modulation	GFSK			
TX Characteristics	**Min**	**Type**	**MAX**	**Unit**
Modulation Characteristics				
ΔF1avg	225	247	275	kHz
ΔF2 MAX(For at least 99.9% of all ΔF2)	185	223	-	kHz
ΔF2/ΔF1	0.8	0.95		Hz/Hz
Carrier Frequency offset and drift				
Frequency offset	-150	46	+150	kHz
Frequency Drift	-50	-2.8	+50	kHz
Max Drift Rate	-20	-1.7	+20	Hz/us
In-Band Spurious Emissions				
+/- 2M offset		-47	-20	dBm
>+/- 3M offset		-51	-30	dBm
RX Characteristics	**Min**	**Type**	**MAX**	**Unit**
Receiver Sensitivity (BER<30.8%)		-98		dBm
Maximum usable signal (BER<30.8%)		0		dBm

4. Pin Description

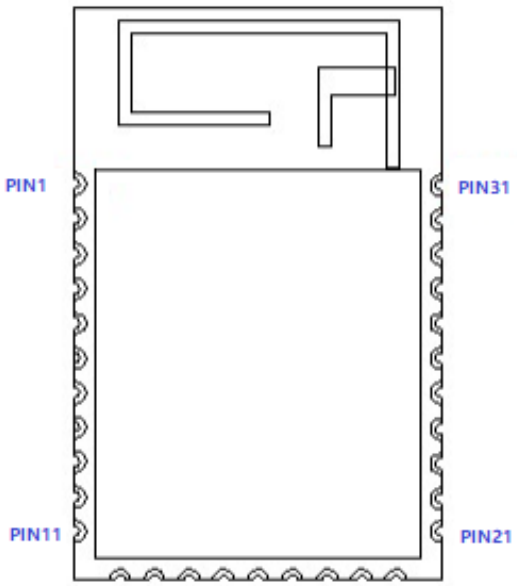


Figure 4-1 B102C Pin_out description

Table 4-1 Pin Definition

NO.	Name	Type	Note
1	GND	S	Ground
2	RESET	I	Reset, active low
3	P4_3	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
4	P4_2	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
5	P4_1	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
6	P4_0	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
7	P0_6	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
8	P0_5	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
9	P0_4	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
10	P0_3	IO	Debug log output, can't be used as other function
11	P0_2	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
12	GND	S	Ground
13	P0_1	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
14	P0_0	IO	ADC/PWM/I2C/SPI/UART, max drive current 8mA
15	P1_0	IO	SWDIO, FW programming, not recommended to use as other function
16	P1_1	IO	SWCLK, FW programming, not recommended to use as other function
17	P3_3	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
18	P3_2	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
19	VDDIO	S	DC 3.3V power supply
20	GND	S	Ground
21	GND	S	Ground

22	P3_1	IO	GPIO/PWM/I2C/SPI/UART, HCI_UART_RX
23	P3_0	IO	GPIO/PWM/I2C/SPI/UART, HCI_UART_TX
24	P2_2	IO	GPIO/PWM/I2C/SPI/UART, AUXADC input2
25	P2_3	IO	GPIO/PWM/I2C/SPI/UART, AUXADC input3
26	P2_4	IO	GPIO/PWM/I2C/SPI/UART, AUXADC input4
27	P2_5	IO	GPIO/PWM/I2C/SPI/UART, AUXADC input5
28	P2_6	IO	GPIO/PWM/I2C/SPI/UART, AUXADC input6
29	P2_7	IO	GPIO/PWM/I2C/SPI/UART, AUXADC input7
30	P5_0	IO	GPIO/PWM/I2C/SPI/UART, max drive current 8mA
31	GND	S	Ground

Note:

1) Type S ： power/ground， I/O: GPIO;
2) Both UART_TX/RX and SWD can be used for firmware programming. Pull down Debug _TX and then power on the module to enter UART programming mode.
3) All the IO pins can be used as other functions.
4) SPI date rate: 5MHz
5) 400ksps, 12bit, AUXADC

5. Size

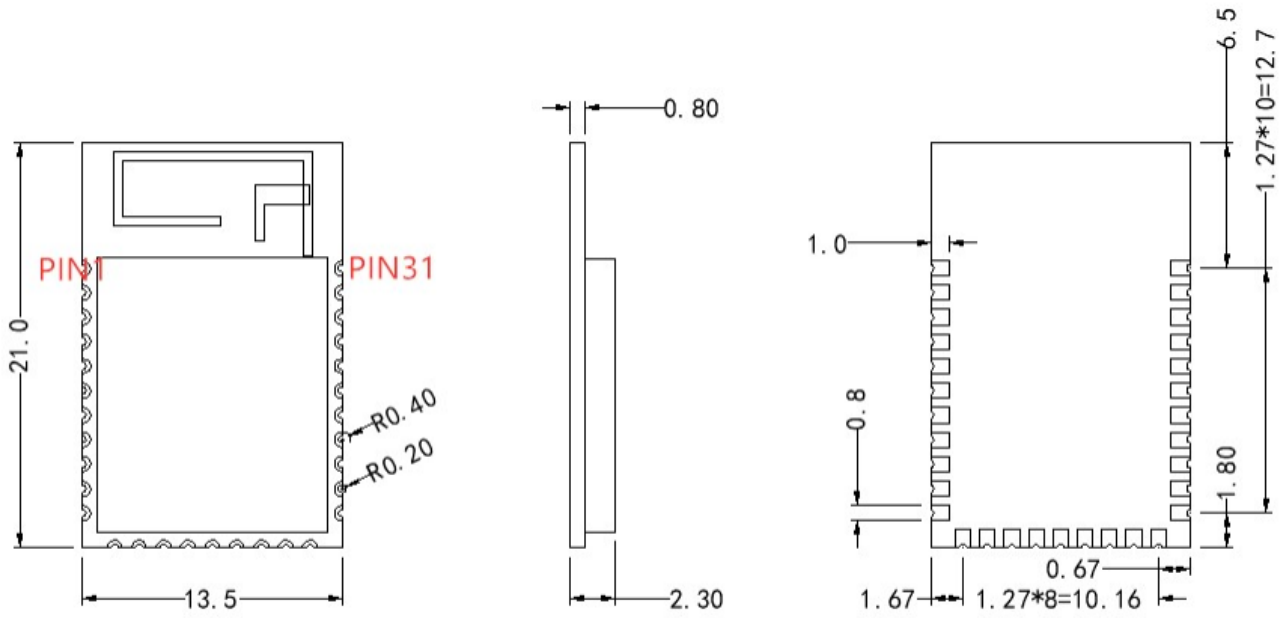


Figure 5-1Size

6. Assembly Information and Production Guidance

6.1 Production Guidance(Important)

- The stamp hole package module produced by Amphenol must completely being patched by SMT machine in 24 hours after open firmware package. Otherwise the module should be re-package by vacuum pumping and drying before patch.
- Devices for SMT patch:
  1) Reflow soldering machine
  2) AOI detector
  3) Suction nozzle with 6-8mm caliber
- Device for drying:
  1) Cabinet type oven
  2) Anti-static and high thermos tolerant tray
  3) Anti-static and high thermos tolerant gloves
- Conditions of product storage (Storage environment is shown in figure 7-1:
- Moisture bag must be stored in temperature below 30 and humidity less than 85%RH.
- Dry packaging products, the guarantee period should be from 6 months' date of packing seal.
- Humidity indicator card is in the hermetic package.

Figure 6-1 Humidity Card

- Humidity indicator card and drying situation:
  - 2 hours drying for module if the color ring at 30%, 40%, 50% in humidity indicator card is blue after unpacking;
  - 4 hours drying for module if the color ring at 30% in humidity indicator card is pink after unpacking;
  - 6 hours drying for module if the color ring at 30%, 40% in humidity indicator card is pink after unpacking;
  - 12 hours drying for module if the color ring at 30%, 40%, 50% in humidity indicator card is pink after unpacking.
- Drying parameters:
  - Drying temperature: 125℃±5℃;
  - Alarm temperature: 130℃;
  - SMT patch when the device cool down below 36℃ in natural condition;
  - Dry times: 1;
  - Please dry again if the module is unsoldering in 12 hours after last drying.
- SMT is unsuitable if the module packed over 3 months. There would be serious oxidation of the pad because of immersion gold and cause false welding and lack of weld. Amphenol does not assume the
- corresponding responsibility;
- ESD protection is required before SMT;
- SMT patch should on the basis of reflow profile diagram, maximum temperature 245℃, reflow profile diagram is shown in figure 10;
- In order to guarantee the reflow soldering qualification rate, vision and AOI detection should be done in 10% products for the first patch to make sure the rationality of temperature control, device adsorption mode and position. Detect 5 to 10 sample every hour in the following batch production.

6.2 Considerations

- Operator should wear anti-static gloves during producing;
- No more than drying time;
- Any explosive, flammable and corrosive material is not allowed to add in drying;
- Module should be put into oven with high thermos tolerant tray. Ventilation should exist between each

module and no direct contact with oven;

- Make sure oven is closed when drying to prevent temperature leaking;
- Reduce opening time or keep closing the door of the oven during drying;
- Use anti-static glove to take out module when its temperature below 36℃ by natural cool down after drying;
- Make sure no water and dirt in the bottom of the module;
- Temperature and humidity control is level 3 for initial modules. Storage and drying conditions are based on IPC/JEDEC J-STD-020.

6.3 Storage Condition

Moisture Sensitivity level 3

1. Calculated shelf life in sealed bag is 12 months at <40° C and < 90% relative humidity(RH);
2. Peak Package body temperature: 260 ° C;
3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must:
   Mounted within: 168 hours of factory conditions < 30° C/60% RH, or stored at <10% RH;
   If both of these conditions are not met, baking is required before mounting;
4. Devices require bake, before mounting if:
   a) Humidity indicator card is >10% when read at 23 ± 5° C
   b) 3a or 3b not met.
5. If baking is required, devices may be baked for 48 hours at 125 ± 5° C

6.4 Temperature Curve of Secondary Reflow

1. **Ramp Up**
   Temp: <150℃, Time: 60 ~ 90s, Ramp up degree: 1 ~ 3℃/S ;
2. **Pre-Heat**
   Temp: 150℃~200℃, time: 60-120s, Ramp up degree: 0.3-0.8 ℃/S;
3. **Curing**
   Peak temp 235℃~250℃ (Max ＜245℃), time: 30-70s;
4. **Cooling down**
   Temp: 217℃~170℃, Ramp up degree: 3 ~ 5℃/S;

Recommended reflow profile:

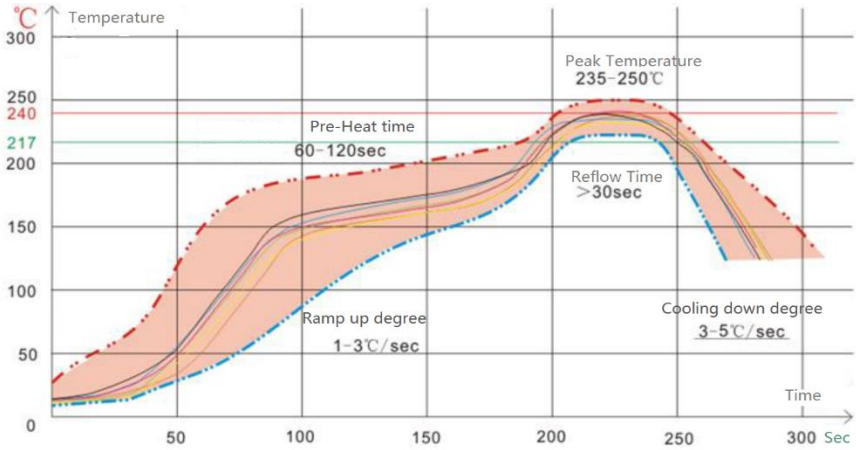
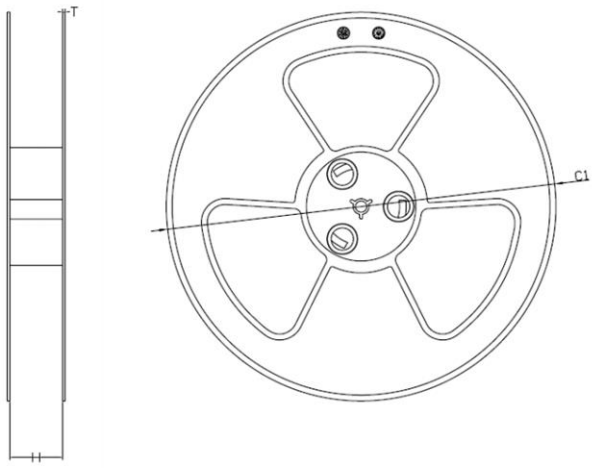
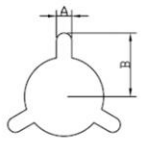


Figure 6-2 Temperature Curve of Secondary Reflow

7. Package information

Production modules are delivered in reel, 1200 modules in each reel.





spec	13″
c1±1	ϕ330
A±0. 2	2. 6
B±0. 2	10. 8
T±0. 2	2. 2
H±0. 5	44. 5

All dimensions in mm unless otherwise indicated.

8. Regulatory approval

B102C module has received regulatory approval from the following countries:
United States/FCC ID: 2BAG9-B102C00101
Europe: CE

Gain table for individual regulatory region

The default firmware uses a common gain table that meets IEEE 802.11 specifications and regulatory regions
(B102C – United States/FCC, Europe/CE). In some cases, the output power is limited by the regulatory region with the most stringent transmit power limits. If the product's destination is known, the region-specific gain table can optionally be embedded into the firmware to optimize performance.

8.1 United States

The B102C modules have received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C "Intentional Radiators" single-modular approval in accordance with Part 15.212

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).
The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

Important Note

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to application that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

End Product Labeling

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: "Contains FCC ID: 2BAG9-B102C00101"
The FCC ID can be used only when all FCC compliance requirements are met.

Antenna Installation

(1) The antenna must be installed such that 20 cm is maintained between the antenna and users,
(2) The transmitter module may not be co-located with any other transmitter or antenna.
(3) Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

Antenna type	BT/2.4GHz band Peak Gain (dBi)
On-board PCB	1.40

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

Federal Communication Commission Interference 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.
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 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.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

List of applicable FCC rules

This module has been tested and found to comply with 15.247 requirements for Modular Approval. The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

This device is intended only for OEM integrators under the following conditions: (For module device use)

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.
As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Radiation Exposure Statement

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

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

List of Applicable FCC Rules
FCC Part 15 Subpart C 15.247

Specific Operational Use Conditions
The module has Bluetooth functions.
• Operation Frequency:
– Bluetooth: 2402 ~ 2480 MHz
• Number of Channel: 40
• Type: On-Board antenna
• Gain: 1.40 dBi Max
.
The host manufacturer installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

8.2 Europe

The B102C modules is/are a Radio Equipment Directive (RED) assessed radio module that is CE marked and has been manufactured and tested with the intention of being integrated into a final product.
The B102C modules has/have been tested to RED 2014/53/EU Essential Requirements mentioned in the following European Compliance table.
The device could be used with a separation distance of 20cm to the human body.

European Compliance

Certification	Standards	Article
Safety	EN 62368	3.1 a
Health	EN 62311	
EMC	EN 301 489-1	3.1 b
	EN 301 489-17	
Radio	EN 300 328	3.2

The ETSI provides guidance on modular devices in the *"Guide to the application of harmonised standards covering articles 3.1b and 3.2 of the RED 2014/53/EU (RED) to multi-radio and combined radio and nonradio equipment"* document available at

http://www.etsi.org/deliver/etsi_eg/203300_203399/203367/01.01.01_60/eg_203367v010101p

.pdf.

8.2.1 Labeling and User Information Requirements

The label on the final product that contains B102C modules must follow CE marking requirements.

8.2.2 Conformity Assessment

From ETSI Guidance Note EG 203367, section 6.1, when non-radio products are combined with a radio product:
If the manufacturer of the combined equipment installs the radio product in a host non-radio product in equivalent assessment conditions (i.e. host equivalent to the one used for the assessment of the radio product) and according to the installation instructions for the radio product, then no additional assessment of the combined equipment against article 3.2 of the RED is required.

8.2.3 Simplified EU Declaration of Conformity

Hereby, Shanghai Amphenol Airwave Communication Electronics Co. Ltd. declares that the radio equipment type B102C is in compliance with Directive 2014/53/EU.
The full text of the EU declaration of conformity is available at the following internet address:
https://www.amphenol-mcp.com/wireless-modules/B102C;

8.2.4 Approved Antenna Types

For the B102C module, the approval is received using the on-board PCB antenna.

8.3 Other Regulatory information

If the customer needs another regulatory jurisdiction certification or to recertify the module for other reasons, contact Microchip for the required utilities and documentation.