BCM-L102-A

Specification

Revision 1.3 – 01/09/2018

CONFIDENTIAL INFORMATION

BnCOM

List of Contents

1. General

1.1 Overview

This specification covers Bluetooth module which single IC Bluetooth Low Energy solution, this module provides everything required to create a Bluetooth low energy product with RF, baseband, MCU, qualified Bluetooth v4.1 stack and customer application running.

This Module has deployed CSR µEnergy® CSR1012™ chipset.

All detailed specification including pin outs and electrical specification may be changed without notice.

1.2 Features

■ 128KB memory: 64KB RAM and 64KB ROM

■ Bluetooth® v4.1 specification

■ 7.5dBm Bluetooth low energy maximum transmit output power

■ -92.5dBm Bluetooth low energy receive sensitivity

■ Support for Bluetooth v4.1 specification host stack including ATT, GATT, SMP, L2CAP, GAP

■ RSSI monitoring for proximity applications

■ Programmable general purpose PIO controller

■ 10-bit ADC

■ 11 digital PIOs

■ 2 analogue AIOs

■ UART

■ Debug SPI

■ 4 PWM modules

■ Wake-up interrupt and watchdog timer

■ Competitive Size : 18.7mm x 10mm x 2.3mm (tolerance +/- 0.2mm), 22Pin

■ Operating temperature range (MAX -30℃ ~ 85℃)

1.3 Application

■ 2.4-GHz Bluetooth low energy Systems

■ Watch, Keyboard, Mouse, Remote Control

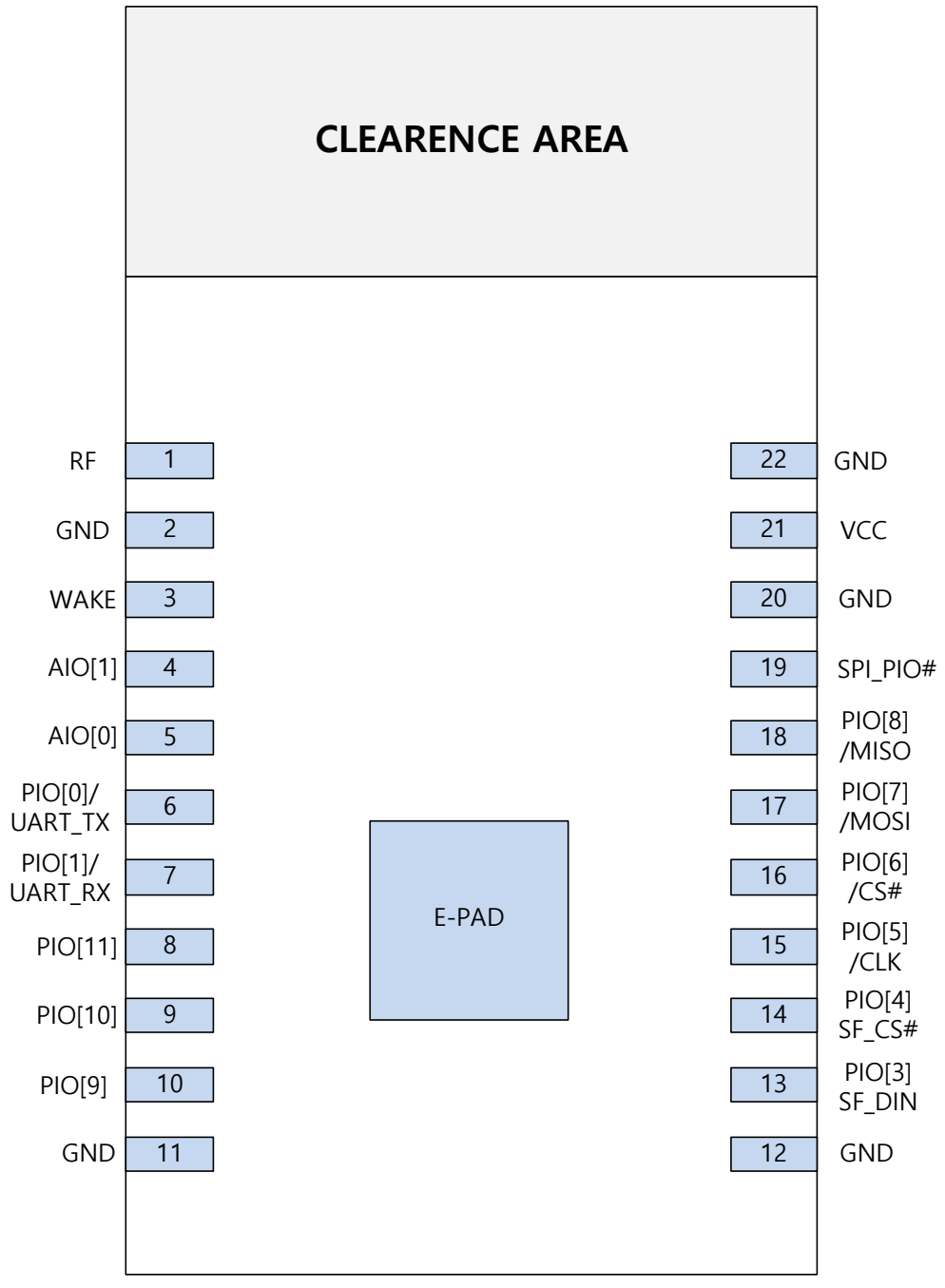
■ Sport and Fitness sensors

■ Health sensors

■ Smart Home

■ Mobile Phone Accessories

1.4 Pin Configuration & Outline Size



PIN MAP(Top view)

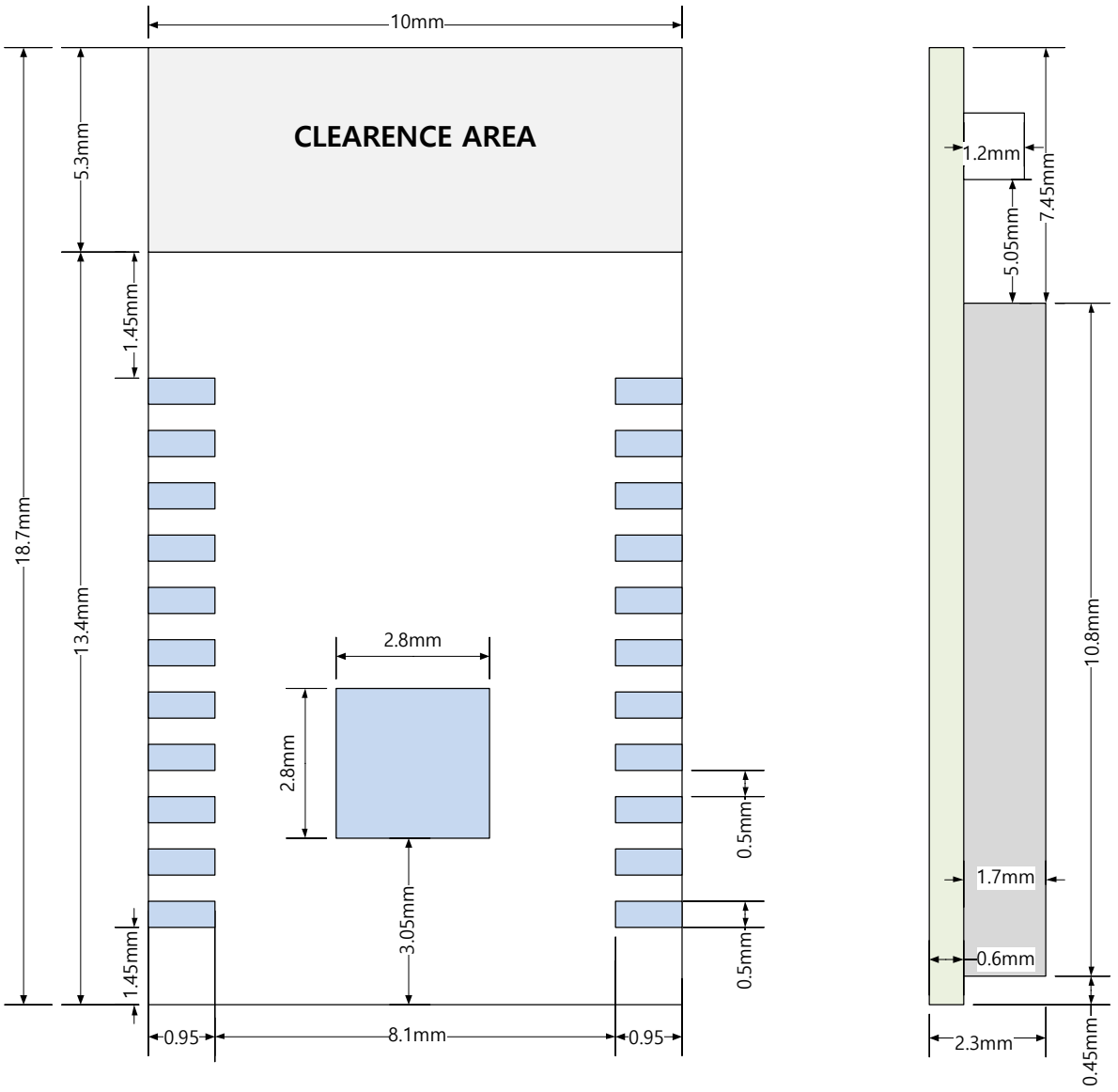
Pin Configuration (TOP VIEW)

1.5 Device Terminal Functions.

Function			Pin Name	Pin No.	Pin Type	Description	Note
RF	RF		RF	1			
AIO	AIO[0]		AIO[0]	5	Bidirectional analogue	Analogue programmable I/O line	
	AIO[1]		AIO[1]	4	Bidirectional analogue	Analogue programmable I/O line	
PIO	PIO[0]	UART_TX	PIO[0]	6	Bidirectional	Programmable I/O line or UART TX	
	PIO[1]	UART_RX	PIO[1]	7	Bidirectional	Programmable I/O line or UART RX	
	PIO[3]		PIO[3]	13	Bidirectional	Programmable I/O line	
	PIO[4]		PIO[4]	14	Bidirectional	Programmable I/O line	
	PIO[5]	SPI_CLK	PIO[5]	15	Bidirectional	Programmable I/O line or debug SPI_CLK selected by SPI_PIO#	
	PIO[6]	SPI_CS#	PIO[6]	16	Bidirectional	Programmable I/O line or debug SPI_CSB selected by SPI_PIO#	
	PIO[7]	SPI_MOSI	PIO[7]	17	Bidirectional	Programmable I/O line or debug SPI_MOSI selected by SPI_PIO#	
	PIO[8]	SPI_MISO	PIO[8]	18	Bidirectional	Programmable I/O line or debug SPI_MISO selected by SPI_PIO#	
	PIO[9]		PIO[9]	10	Bidirectional	Programmable I/O line	
	PIO[10]		PIO[10]	9	Bidirectional	Programmable I/O line	
	PIO[11]		PIO[11]	8	Bidirectional	Programmable I/O line	
Control	SPI_PIO#		SPI_PIO#	19	Input with strong internal Pull-down	Selects SPI debug on PIO[8:5]	▪High = SPI ▪Low = PIO
	WAKE		WAKE	3	Input has no internal pull-up or Pull-down	Input to wake CSR1012QFN form hibernate or dormant.	
Power	VCC		VCC	21	Power	Battery input and regulator enable (active high)	
	GND		GND	2,11,12,20,22, EPAD	GND	Ground	

1.6 Package Dimensions & Land Pattern

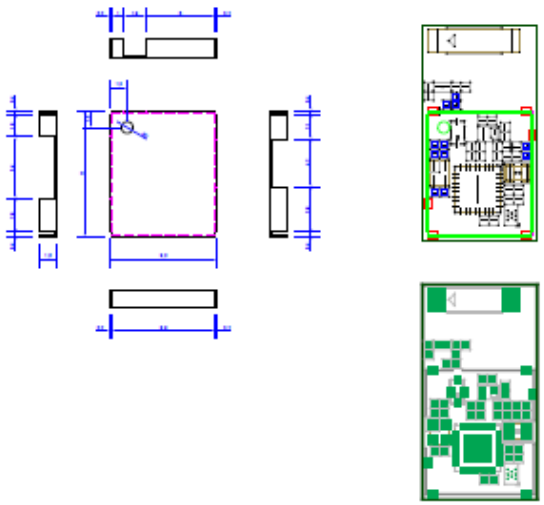
1.6.1 Package Dimensions



Package Dimensions (TOP VIEW)

1.6.2. Shield Case Dimension

NO.	TITLE	DRAW NO.	METERIAL	Q'TY	FINISH	REMARKS
1	SHIELD CASE DIMENSION	VER1	0.2T	1	–	–



NOTE	UNIT	MM	DRAWN	CHECKED	APPROVED	TITLE	SHIELD CASE DIMENSION
	SCALE	1/1	H K KANG			MODEL	
	TOL		2016.11.29			DRAW NO.	–
						FILE NAME	–

2. Characteristics

2.1 Electrical Characteristics

■ Absolute Maximum Ratings

Rating	Min	Max	Unit
Storage Temperature range	-40	85	℃
Supply (VCC) voltage	1.8	4.4	V
Other terminal voltages	VSS-0.4	VDD+0.4	V

■ Recommended Operating Conditions

Operating Condition	Min	TYP	Max	Unit
Operating temperature range	-30	-	85	℃
Supply (VCC) voltage	1.8	-	3.6	V

■ Digital Input / Output Terminal Characteristics

Input Voltage Levels	Min	TYP	Max	Unit
VIL input logic level low	-0.4	-	0.3 x VCC	V
VIH input logic level high	0.7 x VCC	-	VCC + 0.4	V
Tr/Tf	-	-	25	ns

Output Voltage Levels	Min	TYP	Max	Unit
VOL output logic level low, lOL = 4.0mA	-	-	0.4	V
VOH output logic level high, lOH = -4.0mA	0.75 x VCC	-	-	V
Tr/Tf	-	-	5	ns

■ PIO & AIO Recommended Operating Conditions

Output Voltage Levels	Min	TYP	Max	Unit
Input voltage	-	-	1.35	V
Output voltage	-	-	1.35	V

2.2 RF Characteristics

2.2.1 Transmitter

RF Characteristics		MIN	TYP	Max	Bluetooth Specification	Unit	Note
Maximum RF transmit power		3.5 @ -30℃ 3.5 @ 20℃ 2 @ 85℃	7.5 @ -30℃ 7.5 @ 20℃ 6 @ 85℃	-	-20 to 10	dBm	(1) (2)
ACP	F = F_0± 2MHz	-	-28 @ -30℃ -28 @ 20℃ -29 @ 85℃	-20	≤-20	dBm	(3) (4)
	F = F0± 3MHz	-	-32 @ -30℃ -32 @ 20℃ -35 @ 85℃	-22 @ -30℃ -22 @ 20℃ -23 @ 85℃	≤-30	dBm	(3) (4)
	F = F0± > 3MHz	-	<-55	-24 @ -30℃ -27 @ 20℃ -40 @ 85℃	≤-30	dBm	(3) (4)
Δf_{1avg} maximum modulation		225	258	275	225 < f_{1avg}< 275	kHz	-
Δ_{f2max} minimum modulation		185	197	-	≥185	kHz	-
Δf_{2avg} /Δf_{1avg}		0.8	0.86	-	≥0.80	-	-
ICFT		-35	10 @ -30℃ 5 @ 20℃ 10 @ 85℃	35	±150	kHz	(5)
Carrier drift rate		-	11 @ -30℃ 8 @ 20℃	20	≤20	kHz/50μs	-
Carrier drift		-	6 @ -30℃ 7 @ 20℃ 8 @ 85℃	50	≤50	kHz	-
2^{nd} harmonic content		-	-34	-	-	dBm	(6)
3^{rd} harmonic content		-	-32	-	-	dBm	(6)

Note:

(1) The firmware maintains the transmit power within Bluetooth v4.1specification limits

(2) Illustrative: Can be varied under firmware control on an application-dependent basis down to approximately -20dbm

(3) Measured at F0= 2440MHz

(4) CSR1012 QFN guaranteed to meet ACP performance in Bluetooth v4.1 specification

(5) Ignores any frequency error in the reference

(6) Addition of a filter attenuates the harmonics

2.2.2 Receiver

RF Characteristics	Frequency (GHz)	MIN	TYP	Max	Bluetooth Specification	Unit	Note
Sensitivity at 30.8% PER for all basic rate packet types	2.402	@ -30℃ @ 20℃ @ 85℃	-92.5 @ -30℃ -92 @ 20℃ -89 @ 85℃	-88.5 @ -30℃ -88 @ 20℃ -85 @ 85℃	≤-70	dBm	-
	2.44	-	-93 @ -30℃ -92.5 @ 20℃ -89.5 @ 85℃	-89 @ -30℃ -88.5 @ 20℃ -85.5 @ 85℃			-
	2.48	-	-93 @ -30℃ -92.5 @ 20℃ -89.5 @ 85℃	-89 @ -30℃ -88.5 @ 20℃ -85.5 @ 85℃			-
Reported PER during PER report integrity test	2.426	50	50	65.4	50 < PER < 65.4	%	(1)
Maximum received signal at 30.8% PER		-10	> -10	-	≥-10	dBm	-
Continuous power required to block Bluetooth reception (for input power of -67dBm with 30.8% PER) measured at the single-ended RF port of CSR1010A04 QFN	0.030 - 2.000	-35	> 3	-	-30	dBm	(2)
	2.000 - 2.400	-35	-3	-	-35		(2)
	2.500 - 3.000	-35	-3	-	-35		(2)
	3.000 - 12.75	-30	>3	-	-30		(2)
C/I co-channel		-	6	21	≤21	dBm	(3) (4) (5)
Adjacent channel selectivity C/I	$F = F_0 + 1MHz$	-	2	15	≤15	dB	(3) (4) (5)
	$F = F_0 - 1MHz$	-	1	15	≤15		(3) (4) (5)
	$F = F_0 + 2MHz$	-	-28	17	≤-17		(3) (4) (5)
	$F = F_0 - 2MHz$	-	-21	15	≤-15		(3) (4) (5)
	$F = F_0 + 3MHz$	-	-31	27	≤-27		(3) (4) (5)
	$F = F_0 - 5MHz$	-	-30	27	≤-27		(3) (4) (5)
	$F = F_{image}$	-	-24	-9	≤-9		(3) (4) (5)
Maximum level of intermodulation interferers		-50	-33	-	≥-50	dBm	(6)
Spurious output level		-	154	-	-	dBm / Hz	(7)

Note:

(1) Measured in accordance with the RCV-LE/CA/07/C test. Random number of packets transmitted by tester of which 50% have corrupted CRCs. Wanted signal level is -30dBm.

(2) CSR1012 QFN is guaranteed to meet the blocking performance as specified by the Bluetooth v4.1 specification.

(3) CSR1012 QFN is guaranteed to meet the C/I performance as specified by the Bluetooth v4.1 specification.

(4) Measured at F_0= 2440MHz.

(5) F_{Image}= F_0- 3MHz. However, depending on crystal frequency and channel number, the image may switch to the opposite side of the carrier. When this occurs, FImage= F_0+ 3MHz and the offsets in the table equations associated with C/I are also reversed.

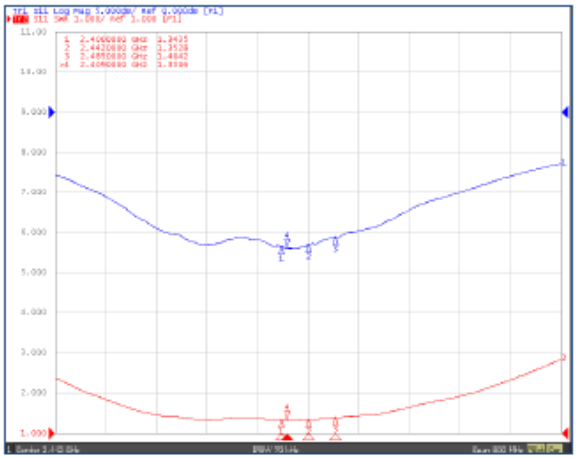
(6) Measured at f_1- f_2= ±3, 4 and 5MHz. Measurement is performed in accordance with Bluetooth RF test RCV-LE/CA/05/C, i.e. wanted signal at -64dBm.

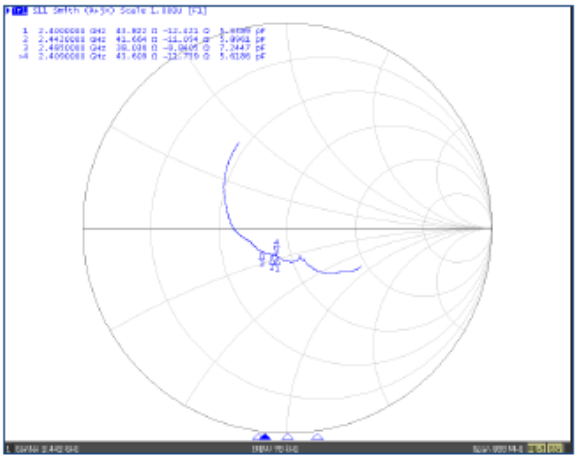
(7) Integrated in 100kHz bandwidth and normalised to 1Hz. Actual figure is typically -154dBm/Hz except for peaks of -82dBm at 1600MHz and -82dBm in-band at 2.4GHz.

2.2.3 Antenna Characteristics

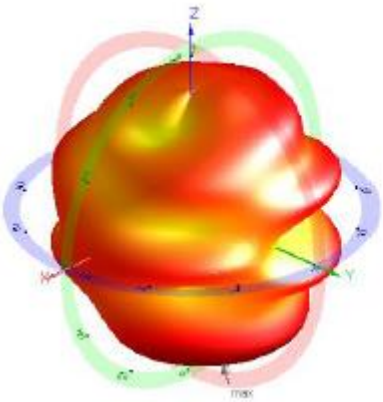
The antenna is monopole type of chip antenna. The antenna impedance matching is optimized for 1 mm ~ 2 mm mother board PCB thickness. The radiation pattern is impacted by the layout of the mother board. Typically the highest gain is towards GND plane and weakest gain away from the GND plane.

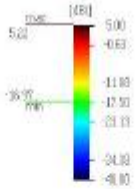
■ S-Parameter

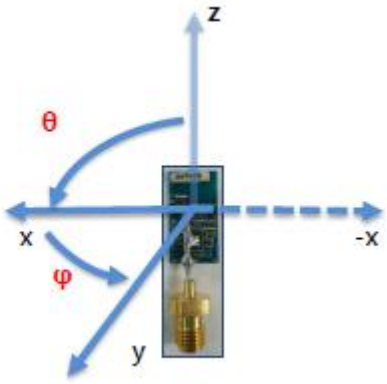




■ Radiation Gain







Freq (GHz)	Efficiency (%)	Avg. Gain (dBi)	Peak Gain (dBi)
2400 MHz	62.22	-2.06	4.18
2440 MHz	63.67	-1.96	4.11
2485 MHz	68.14	-1.67	3.99

3. Terminal Description

3.1 UART Interface

BCM-L102-A UART interface provides a simple mechanism for communicating with other serial devices using the RS232 protocol.

The 2 signals implement the UART function, UART_TX and UART_RX. When BCM-L102-A is connected to another digital device, UART_RX and UART_TX transfer data between the 2 devices. UART configuration parameters, e.g. baud rate and data format, are set using BCM-L102-A firmware.

When selected in firmware PIO[0] is assigned to a UART_TX output and PIO[1] is assigned to a UART_RX input. The UART CTS and RTS signals can be assigned to any PIO pin by the BCM-L102-A firmware

3.1.1 UART Setting

To communicate with the UART at its maximum data rate using a standard PC, the PC requires an accelerated serial port adapter card.

However, The maximum baud rate is 2400 baud during deep sleep.

Parameter		Possible values
Baud rate	Minimum	1200 baud(≤2% Error)
		9600 baud(≤1% Error)
	Maximum	2M baud(≤1% Error)
Flow control		RTS/CTS
Parity		None, Odd or Even
Number of stop bits		1 or 2
Bits per byte		8

3.2 Programming and Debug Interface

Important Note:

The BCM-L102-A debug SPI interface is available in SPI slave mode to enable an external MCU to program and control the BCM-L102-A, generally via libraries or tools supplied by CSR. The protocol of this interface is proprietary. The 4 SPI debug lines directly support this function.
The SPI programs, configures and debugs the BCM-L102-A. It is required in production. Ensure the 4 SPI signals are brought out to either test points or a header.
Take SPI_PIO# high to enable the SPI debug feature on PIO[8:5].

BCM-L102-A uses a 16-bit data and 16-bit address programming and debug interface. Transactions occur when the internal processor is running or is stopped. Data is written or read one word at a time, or the auto-increment feature is available for block access.

3.2.1 Instruction Cycle

The BCM-L102-A is the slave and receives commands on DEBUG_MOSI and outputs data on DEBUG_MISO.

1	Reset the SPI interface	Hold DEBUG_CS# high for 2 DEBUG_CLK cycles
2	Write the command word	Take DEBUG_CS# low and clock in the 8-bit command
3	Write the address	Clock in the 16-bit address word
4	Write or read data words	Clock in or out 16-bit data word(s)
5	Termination	Take DEBUG_CS# high

With the exception of reset, DEBUG_CS# must be held low during the transaction. Data on DEBUG_MOSI is clocked into the CSR1012 QFN on the rising edge of the clock line DEBUG_CLK. When reading, BCM-L102-A replies to the master on DEBUG_MISO with the data changing on the falling edge of the DEBUG_CLK. The master provides the clock on DEBUG_CLK. The transaction is terminated by taking DEBUG_CS# high.

The auto increment operation on the BCM-L102-A cuts down on the overhead of sending a command word and the address of a register for each read or write, especially when large amounts of data are to be transferred. The auto increment offers increased data transfer efficiency on the BCM-L102-A . To invoke auto increment, DEBUG_CS# is kept low, which auto increments the address, while providing an extra 16 clock cycles for each extra word written or read.

3.2.2 Multi-slave Operation

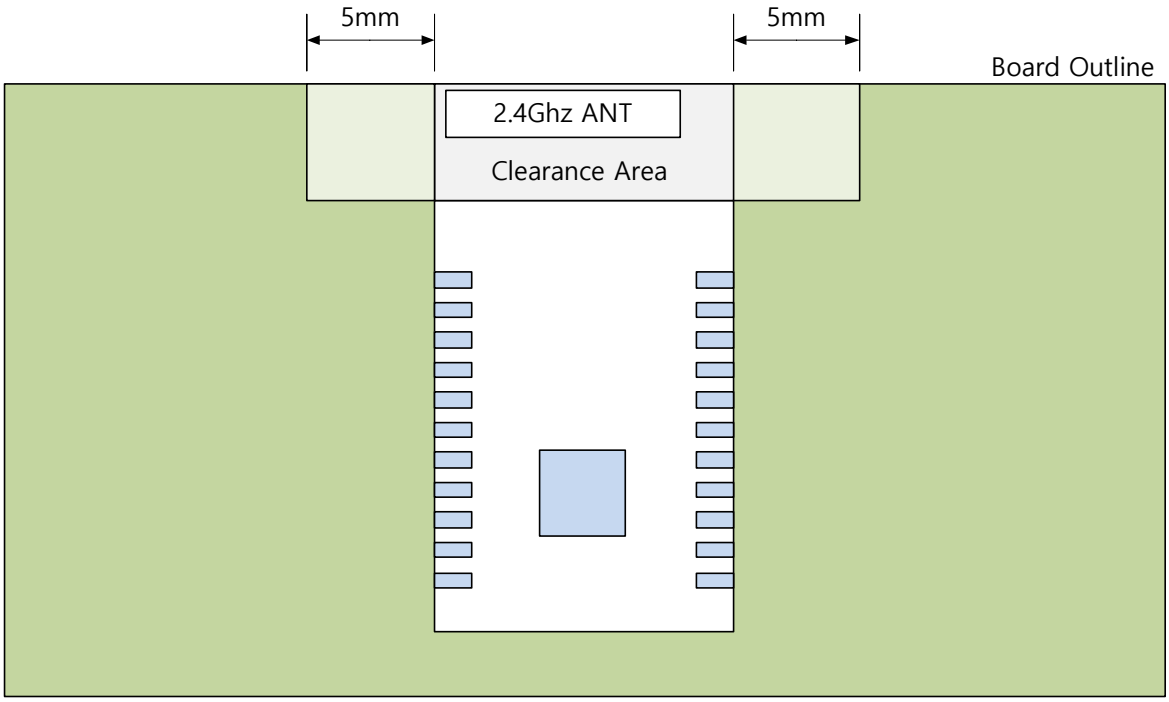
Do not connect the BCM-L102-A in a multi-slave arrangement by simple parallel connection of slave MISO lines. When BCM-L102-A is deselected (DEBUG_CS# = 1), the DEBUG_MISO line does not float. Instead, BCM-L102-A outputs “0” if the processor is running or “1” if it is stopped.

4. Layout Guide

4.1 Layout Guide

For optimal performance of the antenna place the module at the outside of the PCB

Do not place any metal (traces, components, battery etc.) within the clearance area of the antenna. Connect all the GND pins directly to a solid GND plane. Place the GND vias as close to the GND pins as possible. Use good layout practices to avoid any excessive noise coupling to signal lines or supply voltage lines. Avoid placing plastic or any other dielectric material closer than 5 mm from the antenna. Any dielectric closer than 5 mm from the antenna will detune the antenna to lower frequencies.



5. Reflow Temperature Profile

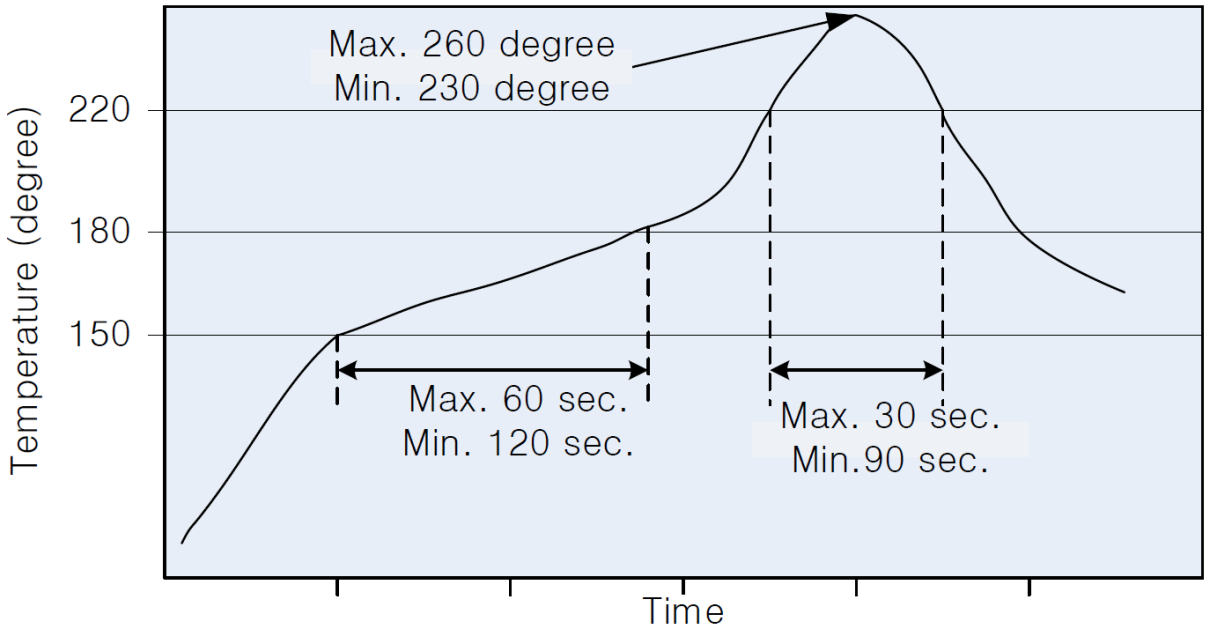
Recommended solder reflow profile are shown in below and follow the lead-free profile I accordance with JEDEC Std 20C.

Table lists the critical reflow temperatures.

Flux residue remaining from board assembly can contribute to electrochemical migration over time.

This depends on number of factors, including flux type, amount of flux residue remaining after reflow, and stress conditions during product use, such as temperature, humidity, and potential difference between pins.

Care should be taken in selecting production board/module assembly processes and materials, taking into account these factors.



Process Step	Lead-Free Solder
Ramp rate	3°C/sec
Preheat	Max. 150°C to 180°C, 60 to 180 sec
Time above liquidus	+220°C 30 to 90 sec
Peak temperature	+255°C ±5°C
Time within 5°C of peak temperature	10 to 20 sec
Ramp-down rate	6°C/sec max

6. Ordering Information

BCM - L 1 02 - A
① ② ③ ④ ⑤

1. BnCOM Code
   ① BnCOM Bluetooth Module

2. Module type.
   ② Bluetooth Type : Bluetooth Low Energy
   ③ Chipset
   ④ Revision Version

Code	Chipset Vendor	Code	Revision
1	Cambridge Silicon Radio	**00**	CSR1000
2	Texas Instruments	**01**	CSR1010
		02	CSR1012

   ⑤ Internal Antenna type.

WARNING : For The Shield can product.

If you have reflow process multiple times in your product, you must be proceed this module in the final reflow process. If not the Shield can will drop out.

FCC MODULAR APPROVAL INFORMATION EXAMPLES for Manual

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.

(2) This device must accept any interference received, including interference that may cause undesired operation.

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

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.

FCC 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.

OEM INTEGRATION INSTRUCTIONS:

This device is intended only for OEM integrators under the following conditions:

The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal on-board antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 3 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 (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module 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. In such cases, please involve a FCC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

Upgrade Firmware:

The software provided for firmware upgrade will not be capable to affect any RF parameters as certified for the FCC for this module, in order to prevent compliance issues.

End product labeling:

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains FCC ID: 2APDI-BCM-L102-A”.

Information that must be placed in the end user manual:

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.