B1BMBG22M2 Module Data Sheet

The module B1BMBG22M2 integrates the EFR32BG22C112F352GM32-C SoC from the EFR32BG22x series. This SoC is specifically designed for BLE applications, optimized for energy-efficient Bluetooth IoT devices.

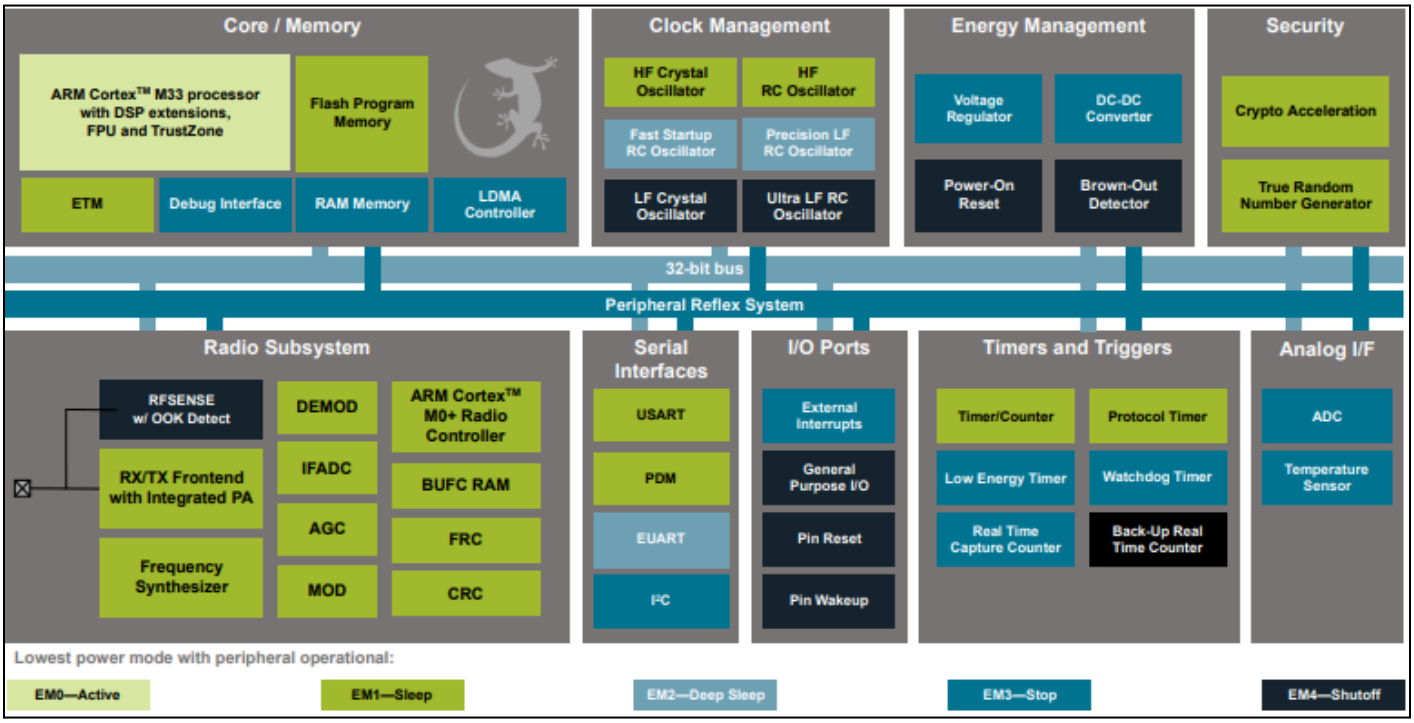
This single-chip solution integrates a 76.8 MHz Cortex-M33 processor with high-performance GHz wireless capabilities, delivering an industry-leading, energy-efficient SoC for IoT-connected applications.

Wireless Gecko applications include:

- Asset tags and beacons
- Consumer electronics remote controls
- Portable medical
- Bluetooth Mesh low-power nodes
- Sports, Fitness, and Wellness devices
- Connected Home
- Building Automation and Security

KEY FEATURES

- 32-bit ARM® Cortex®-M33 core with 76.8 MHz maximum operating frequency
- Up to 352 kB of flash and 32 kB of RAM
- Energy-efficient radio core with low active and sleep currents
- Bluetooth Direction Finding
- Integrated PA with up to 6 dBm (2.4 GHz) TX power
- Secure Boot with Root of Trust and Secure Loader (RTSL)



1. Feature List

The EFR32BG22C222F352GM32-C highlighted features are listed below.

- **Low Power Wireless System-on-Chip**
  - High Performance 32-bit 76.8 MHz ARM Cortex®-M33 with DSP instruction and floating-point unit for efficient signal processing
  - Up to 352 kB flash program memory
  - Up to 32 kB RAM data memory
  - 2.4 GHz radio operation

- **Radio Performance**
  - -106.7 dBm sensitivity @ 125 kbps GFSK
  - -98.9 dBm sensitivity @ 1 Mbit/s GFSK
  - -96.2 dBm sensitivity @ 2 Mbit/s GFSK
  - TX power up to 6 dBm
  - 2.5 mA radio receive current
  - 3.4 mA radio transmit current @ 0 dBm output power
  - 7.5 mA radio transmit current @ 6 dBm output power

- **Low System Energy Consumption**
  - 3.6 mA RX current (1 Mbps GFSK)
  - 4.1 mA TX current @ 0 dBm output power
  - 8.2 mA TX current @ 6 dBm output power
  - 27 µA/MHz in Active Mode (EM0) at 76.8 MHz
  - 1.40 µA EM2 DeepSleep current (32 kB RAM retention and RTC running from LFXO)
  - 1.75 µA EM2 DeepSleep current (32 kB RAM retention and RTC running from Precision LFRCO)
  - 0.17 µA EM4 current

- **Supported Modulation Format**
  - 2 (G)FSK with fully configurable shaping
  - OQPSK DSSS
  - (G)MSK

- **Protocol Support**
  - Bluetooth Low Energy
  - Direction finding using Angle-of-Arrival (AoA) and Angle-of-Departure (AoD)
  - Proprietary

- **Wide selection of MCU peripherals**
  - Analog to Digital Converter (ADC)
    - 12-bit @ 1 Msps
    - 16-bit @ 76.9 ksps
  - Up to 26 General Purpose I/O pins with output state retention and asynchronous interrupts
  - 8 Channel DMA Controller
  - 12 Channel Peripheral Reflex System (PRS)
  - 4 × 16-bit Timer/Counter with 3 Compare/Capture/PWM channels
  - 1 × 32-bit Timer/Counter with 3 Compare/Capture/PWM channels
  - 32-bit Real Time Counter
  - 24-bit Low Energy Timer for waveform generation
  - 1 × Watchdog Timer
  - 2 × Universal Synchronous/Asynchronous Receiver/Transmitter (UART/SPI/SmartCard (ISO 7816)/IrDA/I2S)
  - 1 × Enhanced Universal Asynchronous Receiver/Transmitter (EUART)
  - 2 × I2C interface with SMBus support
  - Digital microphone interface (PDM)
  - Precision Low-Frequency RC Oscillator to replace 32 kHz sleep crystal

- RFSENSE with selective OOK mode
- Die temperature sensor with +/-1.5 °C accuracy after single-point calibration

- **Wide Operating Range**
  - 1.71 V to 3.8 V single power supply
  - -40 °C to 125 °C

- **Security Features**
  - Secure Boot with Root of Trust and Secure Loader (RTSL)
  - Hardware Cryptographic Acceleration for AES128/256, SHA-1, SHA-2 (up to 256-bit), ECC (up to 256-bit), ECDSA, and ECDH
  - True Random Number Generator (TRNG) compliant with NIST SP800-90 and AIS-31
  - ARM® TrustZone®
  - Secure Debug with lock/unlock

2. Ordering information

Table 2.1. Ordering Information

Ordering code	SoC	Protocol stack	Max TX Power	Max CPU Speed	LFRCO	Flash(kb)	RAM(kb)	GPIO	Temp range
B1BMBG22M2	EFR32BG22C222F352GM32-C	• Bluetooth 5.x •Proprietary	6 dBm	76.8 MHz	Precision	352	32	9	-40 to 85 °C

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3. Block Diagram

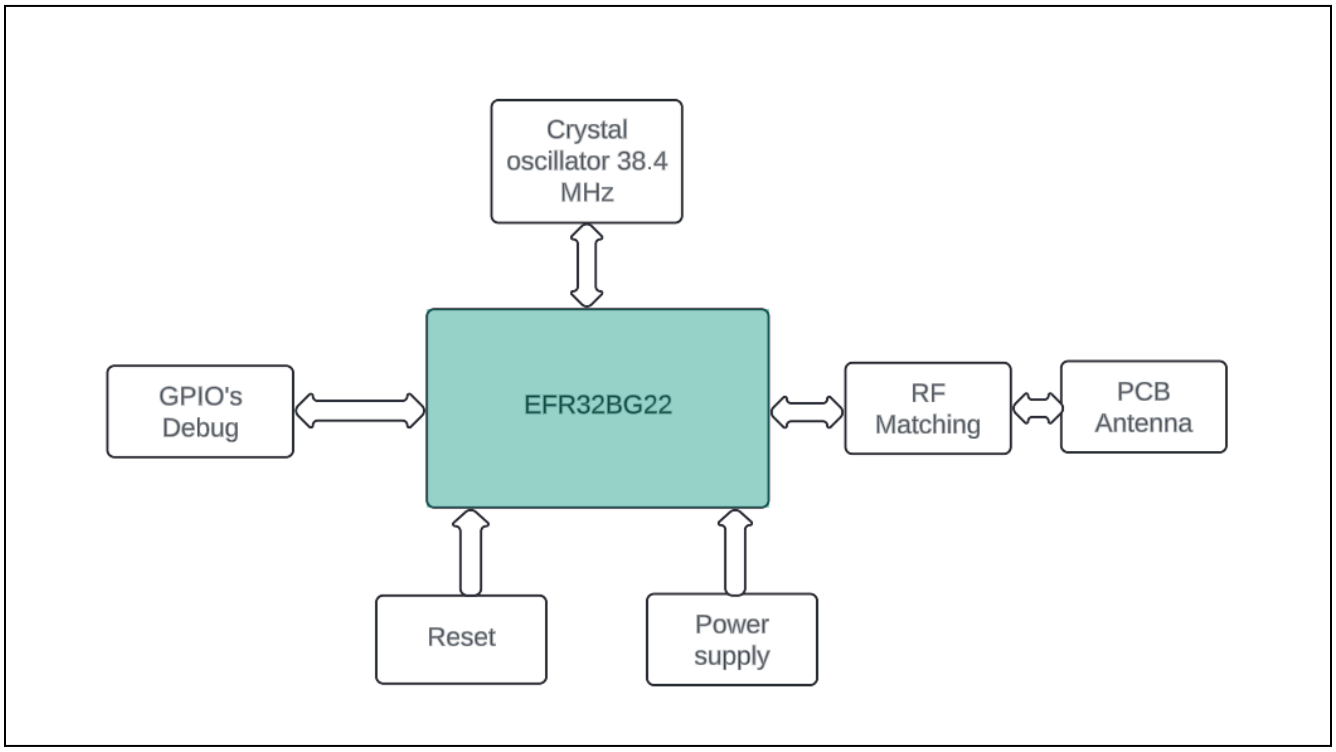

Figure 3.1. Block Diagram of BLE Module B1BMBG22M2

4. Electrical Specifications

4.1. Recommended Operating Conditions

Functional operation does not guarantee performance beyond the limits of the conditional parameter values in the table below. Long-term work beyond this limit will affect the reliability of the module more or less.

Table 4.1. Recommended Operating Conditions of BLE Module B1BMBG22M2

Items	Condition	Min.	Type.	Max.	Unit
Operating Supply Voltage	Battery Mode	1.71	3.3	3.8	V
Frequency Range		2402		2480	MHz
Operating Temperature	/	-40	+25	+85	°C
Environmental Hot Pendulum	/	-20		+20	°C/min

4.2. Handling Ratings

Table 4.2. Handling Ratings of BLE Module B1BMBG22M2

Items	Condition	Min.	Type.	Max.	Unit
Storage Temperature	Tstg	-40	+25	+125	°C
Human Body Model	HBM			±2000	V
Moisture Sensitivity level			+25	2	
Charged Device Model				±500	V

4.3. Current Consumption

Unless otherwise indicated, typical conditions are: TA = 25 °C, VREGVDD = 3.0V, AVDD = DVDD = IOVDD = RFVDD = PAVDD = 1.8 V powered from DCDC. Crystal frequency=38.4 MHz. RF center frequency 2.45 GHz. Test instruments: FLUKE15B+ multimeter, DSA1030 spectrum analyzer, offset: 0.2, RBW = 100 KHz Test Results: Data after adding an attenuator

Table 4.3. Current Consumption of BLE Module B1BMBG22M2

Stand-by	1μA		
Transmitting Current	Set Tx Power	Actual Tx Power	Actual Current
	6dBm	5.5dBm	8.0mA
	0dBm	-0.5dBm	4.0mA
Receiving Current	2.5mA		

5. GPIO Pins

5.1. Pin definitions

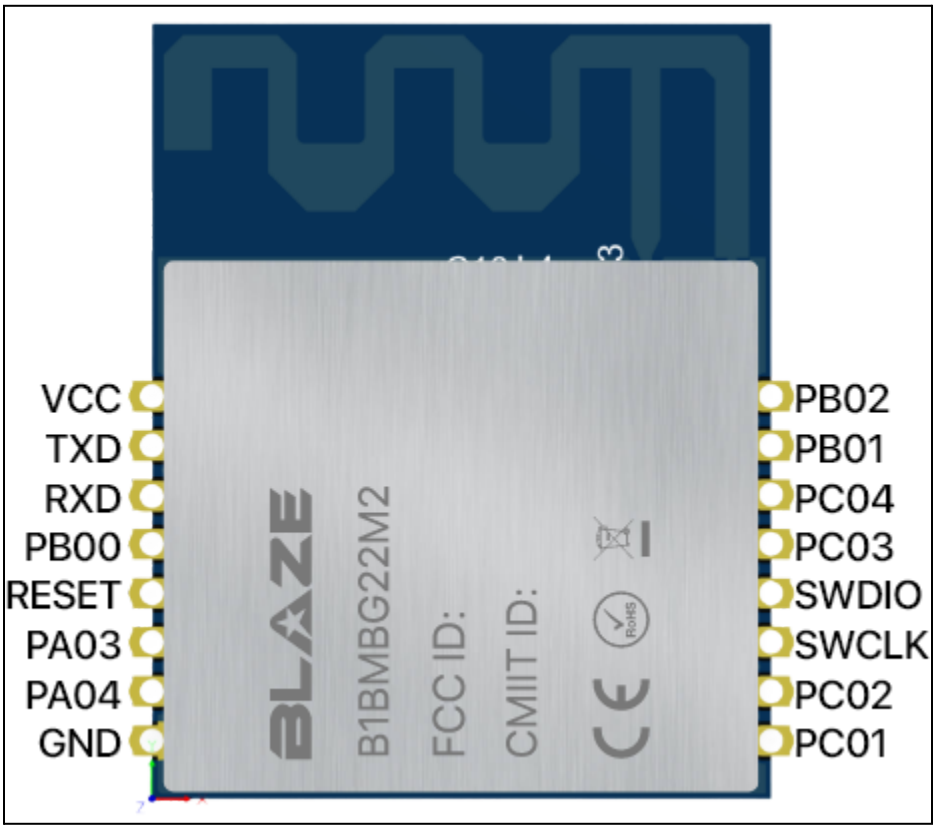

Figure 5.1. PIN Diagram of BLE Module B1BMBG22M2

Table 5.1. PIN Functions of BLE Module B1BMBG22M2

Pin name	Pins	Description	Pin name	Pins	Description
VCC	1	Power supply (+3.3V / +5V, depending on board)	PA05 (Txd)	2	UART Transmit Data (TX)
PA06 (Rxd)	3	UART Receive data (RX)	PB00	4	General-purpose-I/O pin
RESET	5	General-purpose-I/O pin	PA03	6	General-purpose-I/O pin
PA04	7	General-purpose-I/O pin	GND	8	Ground reference
PC01	9	General-purpose-I/O pin	PC02	10	General-purpose-I/O pin
SWCLK	11	Serial Wire Debug CLk	SWDIO	12	Serial Wire Debug Data I/O
PC03	13	General-purpose-I/O pin	PCO4	14	General-purpose-I/O pin
PB01	15	General-purpose-I/O pin	PB02	16	General-purpose-I/O pin

5.2 GPIO Pin Parameters

Table 5.3. GPIO Pin Parameters for BLE Module B1BMBG22M2

Parameter	Min	Max	Unit
Voltage on HFXO pins	-0.3	1.2	V
DC voltage on any GPIO pin	-0.3	VCC+0.3	V
DC voltage on the RESETn pin	-0.3	3.8	V
Current per I/O pin	-	50	mA
Current for all I/O pins	-	200	mA

6. Reference Designs

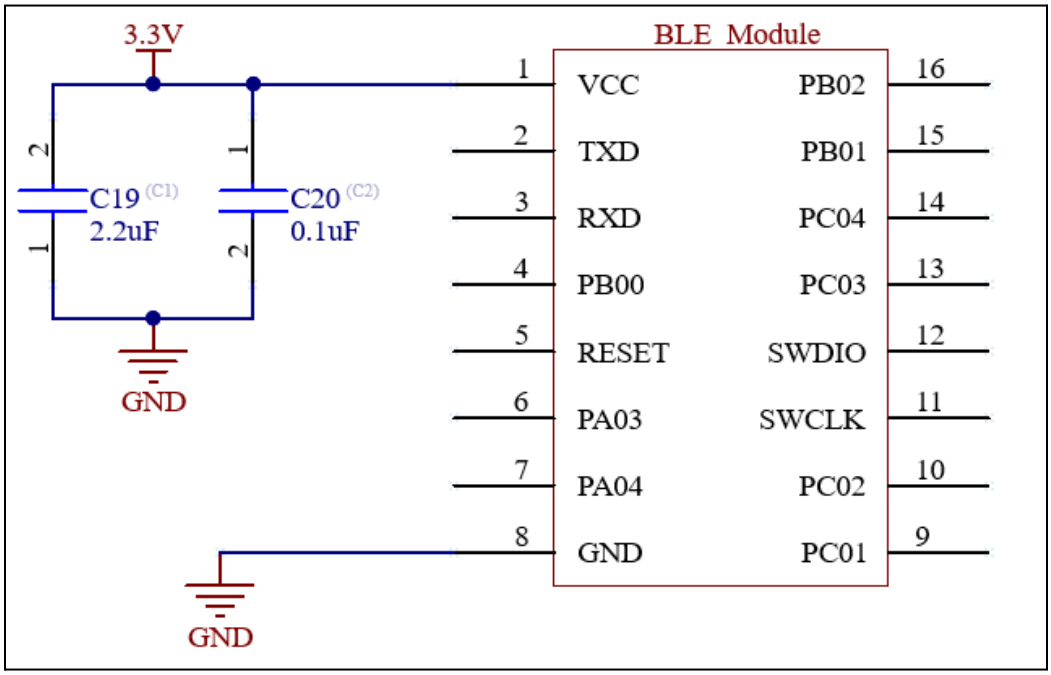

Figure 6.1. Reference Design of BLE module B1BMBG22M2

7. SoC Application

The B1BMBG22M2 with EFR32BG22C222 SoC targets applications requiring more compute power (with a 76.8 MHz M33 core), more I/Os (up to 26 GPIOs), and higher TX power (+6 dBm). The figure below shows the debugger circuit, J-link for program flashing interfaces, PCB antenna and also highlights other pins that are used in this module.

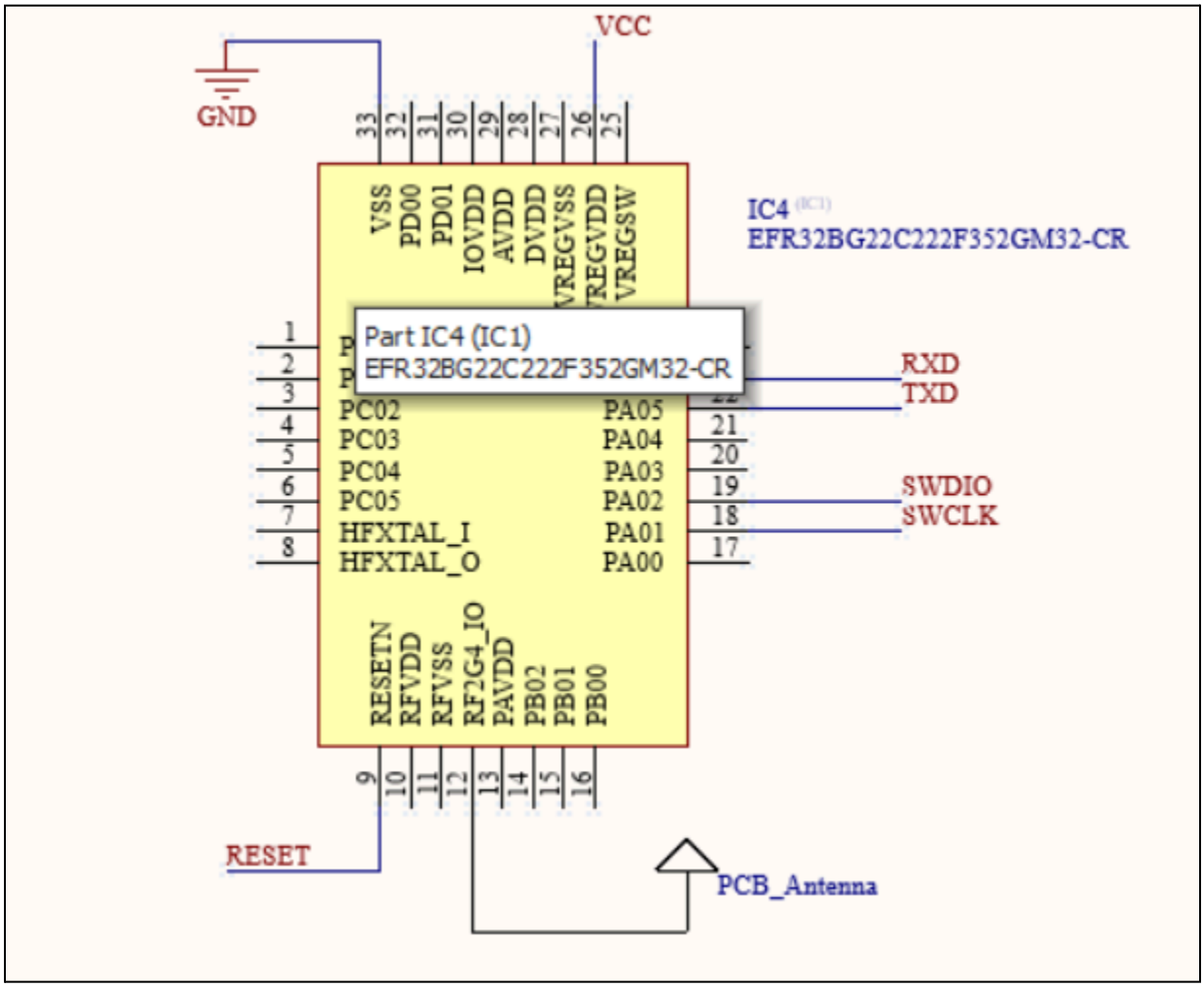

Figure 7.1. Stand-alone SoC configuration for SoC EFR32BG22C222F352GM32-C

8. Alternate Pin Functions

A diverse array of alternate features can be assigned to various pins through multiplexing. The following table shows GPIO pins with support for dedicated functions for the QFN32 Package.

Table 8.1. Alternative Pin Functions for SoC EFR32BG22C222F352GM32-C

GPIO	Alternate functions	QFN32 Package
PD00	LFX0.LFXTAL_O	Yes
PC05	GPIO.EM4WU7	Yes
PA01	GPIO.SWCLK	Yes
PA00	IADC0.VREFP	Yes
PB03	GPIO.EM4WU4	
PA04	GPIO.TDI	Yes
	GPIO.TRACECLK	Yes
PC07	GPIO.EM4WU8	
PD02	GPIO.EM4WU9	
PA03	GPIO.SWV	Yes
	GPIO.TRACEDATA0	Yes
	GPIO.TDO	Yes
PA05	GPIO.EM4WU0	Yes
PC00	GPIO.THMSW_EN	Yes
	GPIO.EM4WU6	Yes
PD01	LFXO.LFXTAL_I	Yes
	LFXO.LF_EXTCLK	Yes
PB01	GPIO.EM4WU3	Yes
PA02	GPIO.SWDIO	Yes

9. Schematic

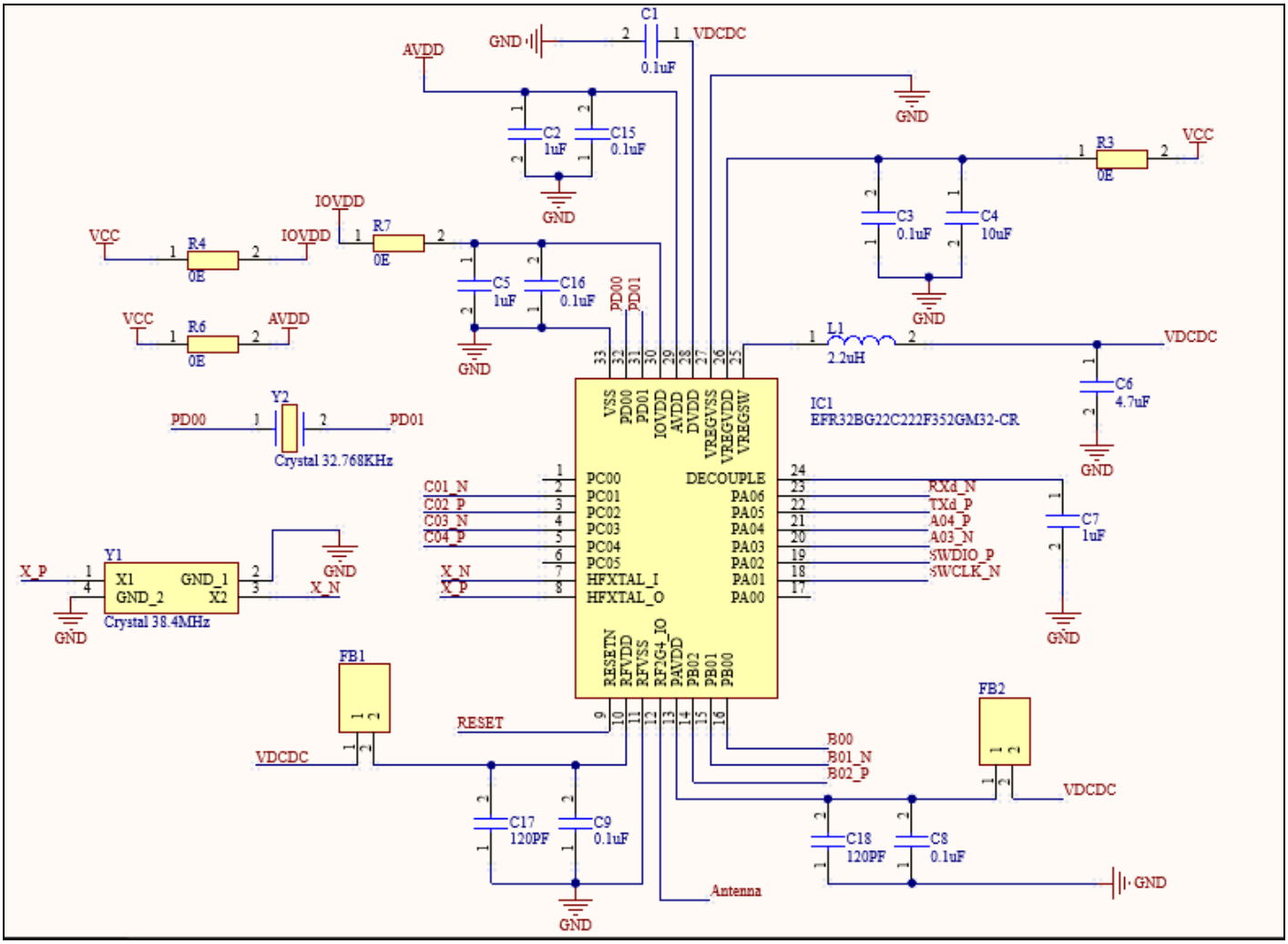

Figure 9.1. Schematic Diagram of BLE Module B1BMBG22M2

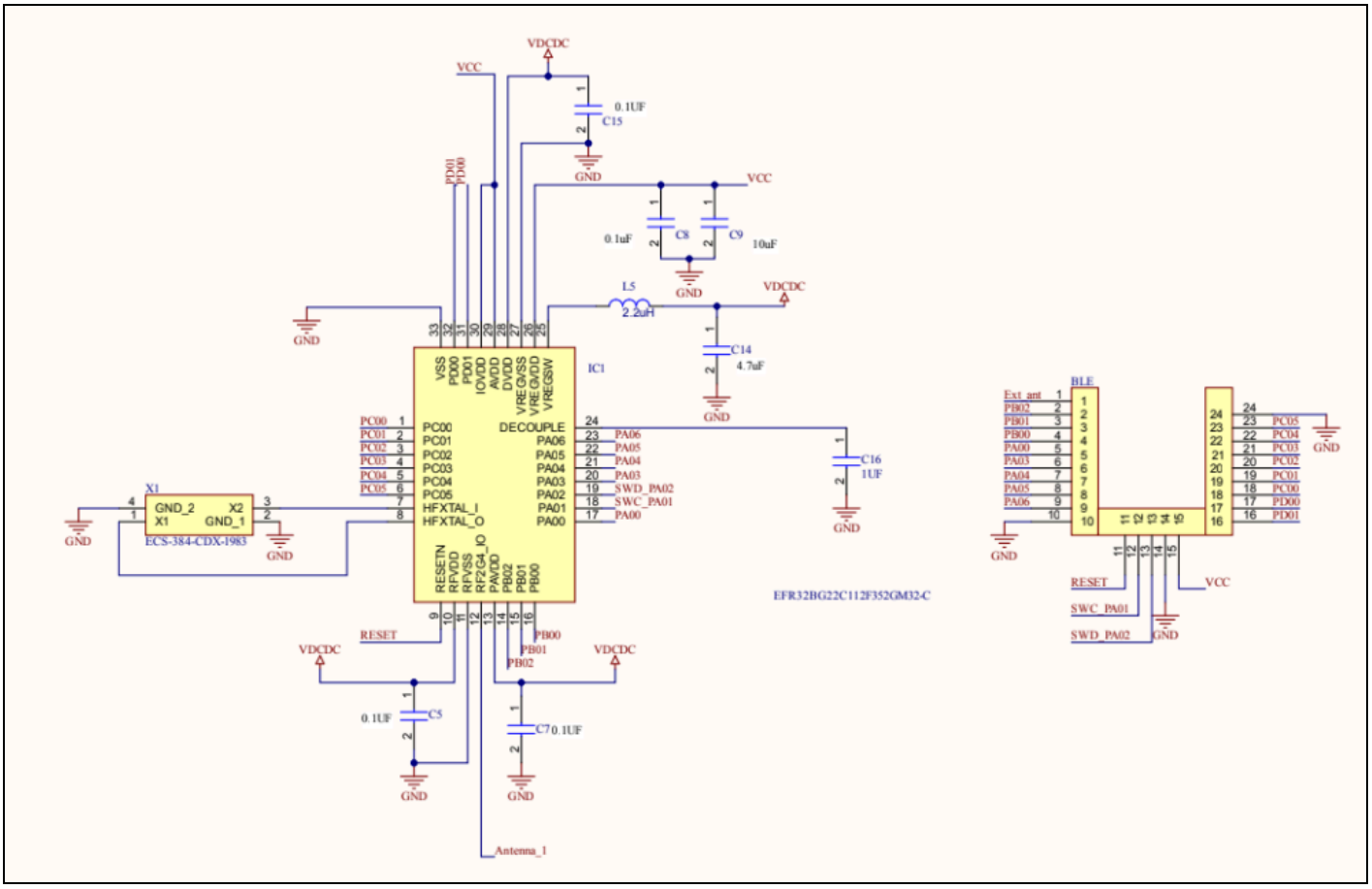

Figure 9.2. Schematic Diagram of BLE Module B1BMBG22M2

Antenna Path

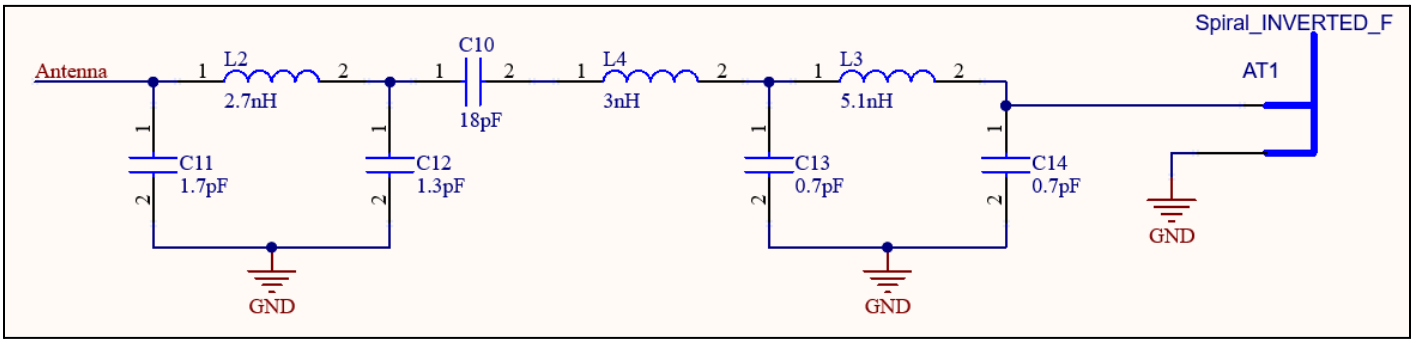

Figure 9.3. Antenna Path of BLE Module B1BMBG22M2

10. Design Guidelines

10.1. Module Placement for module B1BMBG22M2

A. BLE Module recommended placement (into HOST PCB) with Antenna portion Overhang

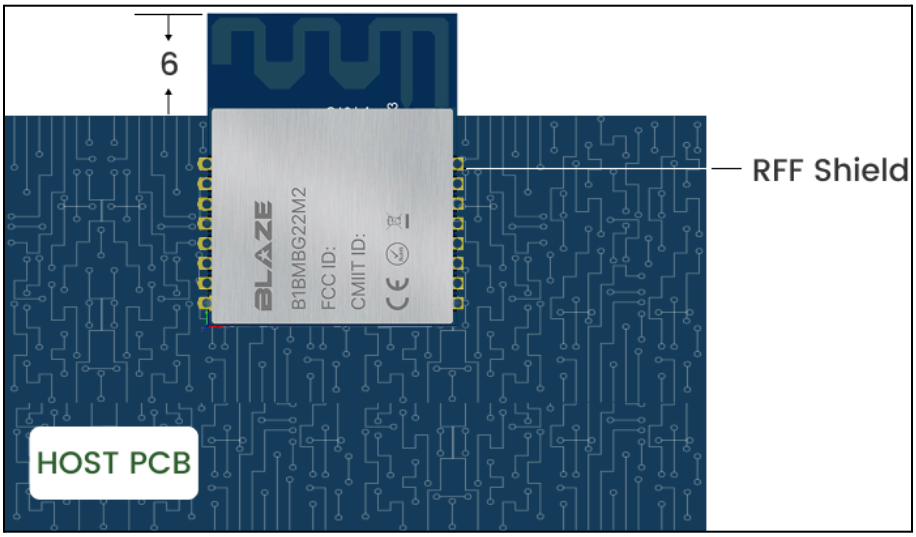

Figure 10.1. BLE Module placements with Antenna position Overhang

B. BLE Module recommended placement (into HOST PCB) with Antenna portion Overhang - Options

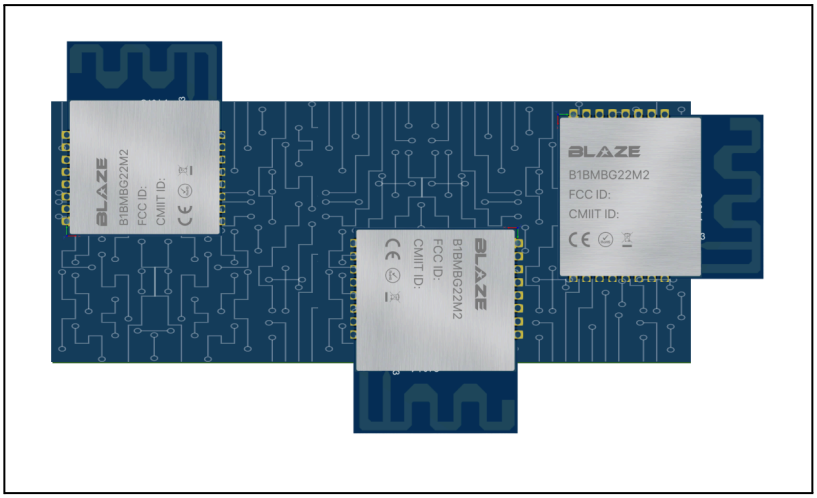

Figure 10.2. BLE Module placements with Antenna position Overhang – multiple positions

Note:-

- Never place the ground plane or route copper traces directly underneath the antenna portion of the module.
- Never place the antenna close to metallic objects.
- Keep wiring, components, and objects away from the antenna.

- Do not place the antenna in a metallic or metalized plastic enclosure.
- If possible, mount the antenna overhanging the edge of the host PCB.
- If the antenna cannot be mounted in an overhanging position, then provisions must be made to keep the area clear of copper as recommended in Figure 10.1.

C. BLE Module recommended placement (into HOST PCB) with Antenna portion NOT Overhang

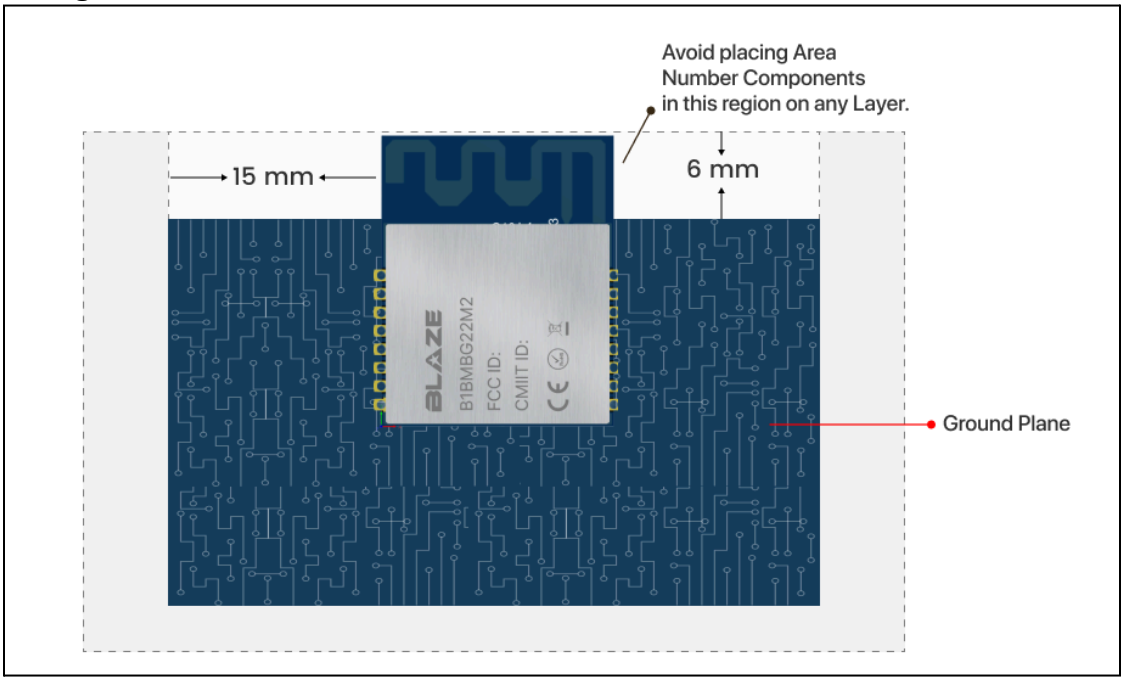

Figure 10.3. BLE Module placements with Antenna position not overhang

Note:-

- If any components containing metal conductors or conductive substances are placed close to the antenna, it might obstruct radio wave radiation, which can reduce communication distance significantly.
- Keep the antenna away from metal conductors as shown in Figure 10.2.

D. The antenna portion is away from the metal conductors

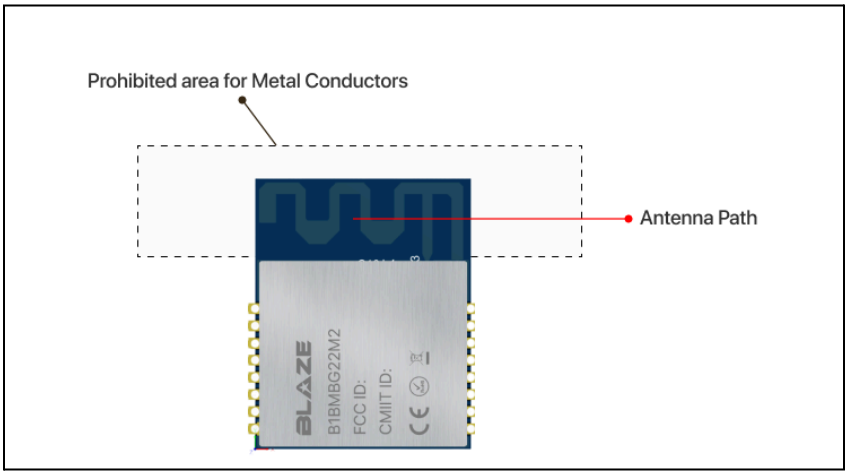

Figure 10.4. Antenna portion away from metal

Note:-

- Ensure the dotted region remains free of metal.
- Do not place any components or metal contacts in that area.

10.2. Module Placement for module B1BMBG22M2

The recommendation of antenna layout.
The inverted-F antenna position on the PCB is free space electromagnetic radiation. The location and layout of the antenna
It is a key factor in increasing the data rate and transmission range.
Therefore, the layout of the module antenna location and routing is recommended as follows:

(1) Place the antenna on the edge (corner) of the PCB.
(2) Make sure that there is no signal line or copper foil in each layer below the antenna.
(3) It is best to hollow out the antenna position in the following figure so as to ensure that S11 of the module is minimally affected.

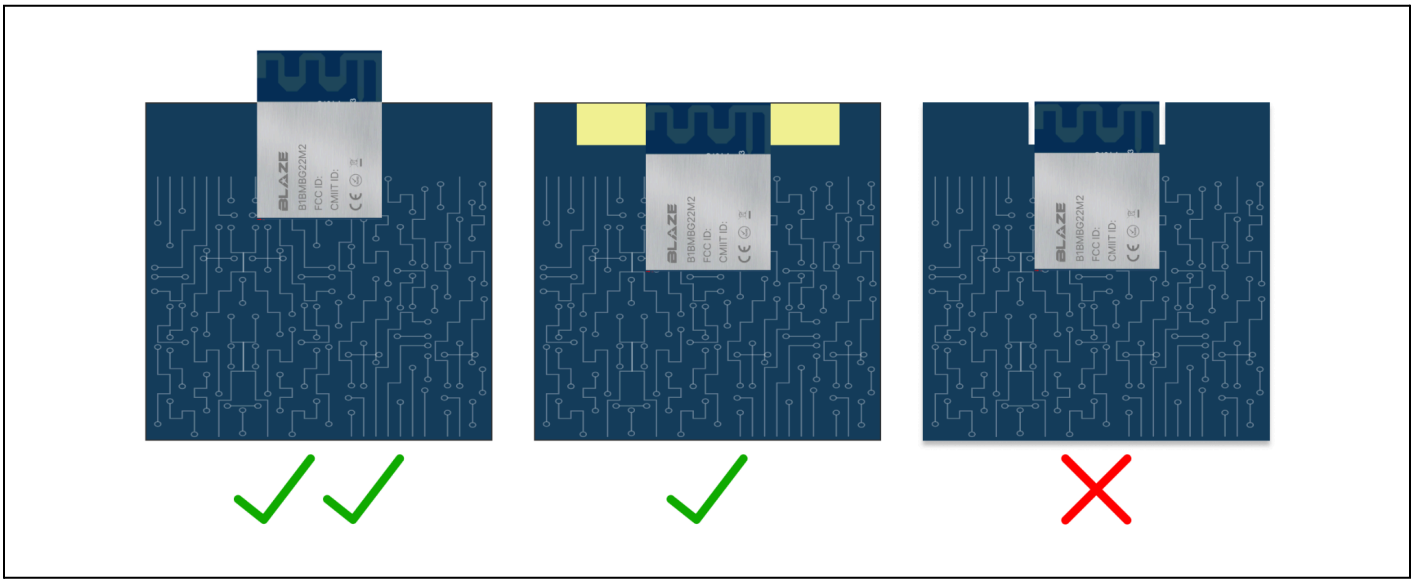

Figure 10.5 Module Placement for module B1BMBG22M2

11. Package specifications

11.1. Mechanical dimensions

Top View

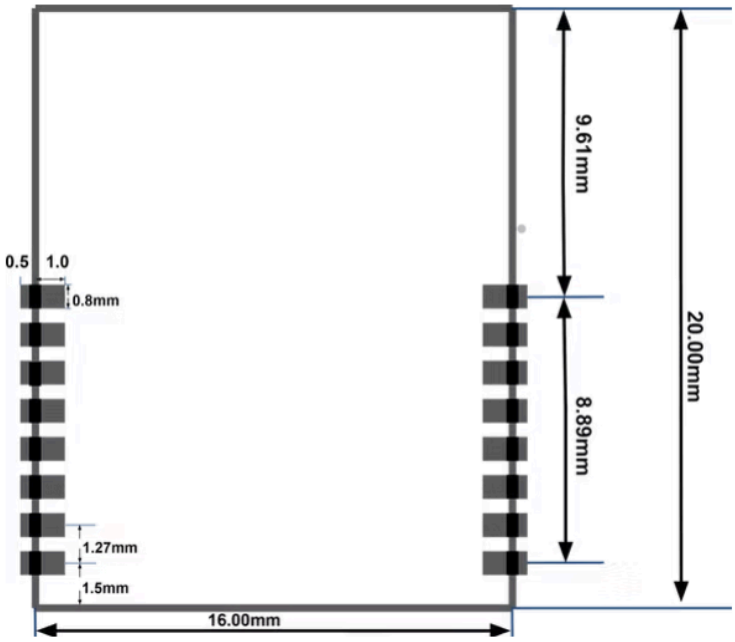

Figure 11.1. Dimensions of PCB

11.2. PCB and Pattern

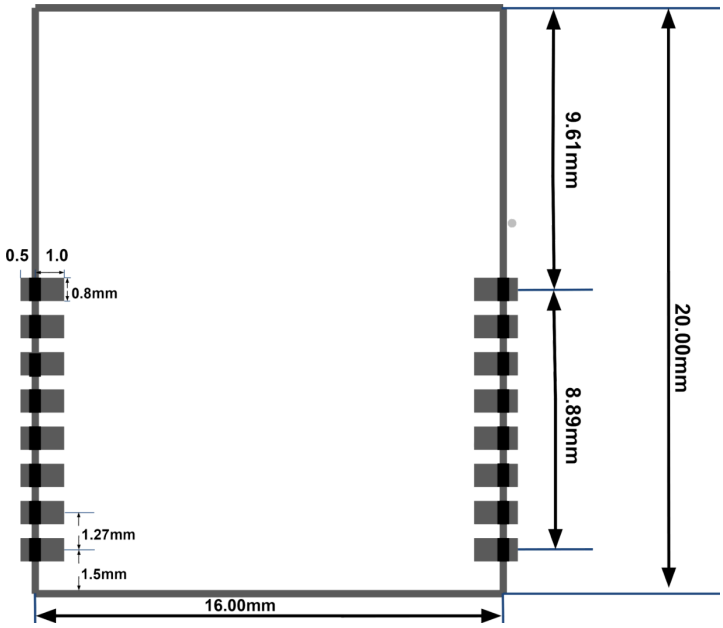

Figure 11.2. Recommended PCB Footprint of BLE Module B1BMBG22M2

12. Soldering Recommendations

- Do not exceed the peak temperature of 235°C ~ 245°C.
- Heating method: Conventional Convection or IR/convection.
- Refer to the solder paste datasheet for specific reflow profile recommendations.
- Use no-clean flux solder paste.
- Do not wash, as moisture can be trapped under the shield.
- Temperature profile: Reflow soldering shall be done according to the following temperature profile.
- Use only one flow. If the PCB requires multiple flows, apply the module on the final flow.
- Allowable reflow soldering times: 2 times based on the following reflow soldering profile.

Table 12.1. Soldering Recommendations

Profile Feature	Sn - Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63/ Pb37	Sn96.5 / Ag3.0 / Cu0.5
Min. Pre-heating Temperature (Tmin)	100°C	150°C
Max. Pre-heating Temperature (T max)	150°C	200°C
Pre-heating time (T_{min} to T_{max}) (t_1)	60s ~ 120s	60s ~ 120s
Average Ascend Rate (T_{max} to T_P)	Max. 3 ℃/s	Max. 3 ℃/s
Liquid Temperature (T_L)	183 ℃	217 ℃
Time above Liquids (t_L)	60 s ~ 90 s	30 s ~ 90 s
Peak Temperature (T_P)	220 ℃ ~ 235 ℃	230 ℃ ~ 250 ℃
Average Descend Rate (T_P to T_{max})	Max. 6 ℃/s	Max. 6 ℃/s
Time from 25 ℃ to Peak Temperature (t2)	Max. 6 minutes	Max. 8 minutes
Time of Soldering Zone (t_P)	20±10 s	20±10 s

13. Reference

https://www.silabs.com/documents/public/data-sheets/efr32bg22-datasheet.pdf

14. Review history

Release 1.4

September 18, 2025
- Added the new module design images.
- Remove **B1BMBG22M5** Module

Release 1.3

March 18, 2025
- Added the new module design images.
- Modified the Pinout description tables 5.1 and 5.2.
- Modified the ordering information table.
- Added 13. References

Release 1.2

November 11, 2024
- Added the B1BMBG22M5 PCB pattern and mechanical dimensions
- Added B1BMBG22M5 antenna placement recommendations

Release 1.1

October 15, 2024
- Added 2. Ordering information
- Modified 3. Block diagram
- Added 5.GPIO Pins
- Added 7.SoC Application
- Added 8. Alternate Pin Functions

Revision 1.0

October 3, 2024

Initial release.