General Description

BDE-BDM209B is a Bluetooth 5.1 Basic Rate (BR), Enhanced Data Rate (EDR) and Low Energy (LE) Dual-Mode module.

The module offers a unique combination of Bluetooth Classic and Bluetooth Low Energy radio (CC2564C) from Texas Instruments (TI) and an ultra-low-power Arm® Cortex®-M4 32-bit MCU (STM32L431). It integrates all required external components, including level shifters, clocks, power supply, band-pass filter, and antenna, at an affordable cost.

The module provides best-in-class RF performance with transmit power and receive sensitivity that offer twice the range and higher throughput compared to other Bluetooth Low Energy-only solutions. The power management hardware and software algorithms deliver significant power savings in all commonly used Bluetooth BR/EDR and Low Energy modes of operation.

The module is pre-certified with FCC, ISED, and CE (In-progress), and comes with certified and royalty-free Dual-mode Bluetooth 5.1 protocol stack software. It provides complete Bluetooth BR/EDR and Bluetooth Low Energy sample applications, reducing design effort and ensuring a faster time to market.

Key Features

- Processing and memories
  - Core: Arm® 32-bit Cortex®-M4 CPU with FPU, adaptive real-time accelerator (ART Accelerator™) allowing 0-wait-state execution from Flash memory
  - Frequency up to 80 MHz, MPU, 100DMIPS and DSP instructions
  - Up to 256 KB single bank Flash, proprietary code readout protection
  - 64 KB of SRAM including 16 KB with hardware parity check
- BR and EDR features
  - Up to seven active devices
  - Scatternet: up to three piconets simultaneously, one as master and two as slaves
  - Up to two Synchronous Connection Oriented (SCO) links on the same piconet
  - Support for all voice air-coding - Continuously Variable Slope Delta (CVSD), A-Law, µ-Law, and Transparent (Uncoded)
  - Assisted mode for HFP 1.6 Wideband Speech (WBS) Profile or A2DP Profile to reduce host processing and power
  - Support of multiple Bluetooth profiles with enhanced QoS
- Bluetooth Low Energy features
  - Support of up to 10 simultaneous connections
  - Multiple sniff instances tightly coupled to achieve minimum power consumption
  - Independent buffering for Low Energy allows large numbers of multiple connections without affecting BR or EDR performance
  - Built-In coexistence and prioritization handling for BR, EDR, and Low Energy
- RF performance
  - Class 1.5 TX power up to +10 dBm
  - –93 dBm typical RX sensitivity
  - Internal temperature detection and compensation to ensure minimal variation in RF performance over temperature, no external calibration required
  - Improved Adaptive Frequency Hopping (AFH) algorithm with minimum adaptation time
  - Provides longer range, including twice the range of other Low-Energy-Only solutions
- Ultra-low power consumption
  - MCU
    - 84 µA/MHz run mode
    - 280 nA Standby mode with RTC
    - 28 nA Standby mode (wakeup pins)
    - 8 nA Shutdown mode (wakeup pins)
  - Bluetooth
    - Shutdown: 1 µA
    - Deep sleep mode: 40 µA
    - Continuous TX @ Maximum power @ GFSK: 107 mA
    - Continuous TX @ Maximum power @ BR/EDR: 112.5 mA
- Clocks

  - 26 MHz HFXT for Bluetooth
  - 32.768 KHz crystal oscillator for Bluetooth
  - 12 MHz HFXT for MCU
  - Internal low-power 32 kHz RC (±5%) for MCU
  - External 32.768 KHz LFXT for MCU (Not fitted by default)
- Peripherals and interfaces
  - 11x timers: 1x 16-bit advanced motor-control, 1x 32-bit and 2x 16-bit general purpose, 2x 16- bit basic, 2x low-power 16-bit timers (available in Stop mode), 2x watchdogs, SysTick timer
  - 1x 12-bit ADC 5 Msps, up to 16-bit with hardware oversampling, 200 µA/Msps
  - 2x 12-bit DAC output channels, low-power sample and hold
  - 1x SAI (serial audio interface)
  - 2x USART
  - 1x LPUART
  - 2x I2C
  - 1x SPI
  - 19x GPIOs
- Enhanced system features
  - RTC with HW calendar, alarms and calibration
  - True random number generator
- CRC calculation unit, 96-bit unique ID
- Bluetooth 5.1 Dual-mode stack
  - Dual-mode Bluetooth 5.1 certified and royalty free
  - QDID: 172097
- Classic Bluetooth Profiles available
  - A2DP1.2, AVDTP1.2, AVRCP1.3, HSP1.2, GAP, HID1.0, MAP1.0, PBAP1.0, RFCOMM, SDP, SPP
  - QDID: 185918
- Bluetooth Low Energy Profiles available
  - ANS1.0, BAS1.0, CSCS1.0, DIS1.0, FMP1.0, GAPS1.0, GATT1.0, HTS1.0, HRS1.0, HIDS1.0, IAS1.0, LLS1.0, PASS1.0, PXP1.0, TPS1.0
  - QDID: 185918
- Large variety of sample applications
  - Bluetooth Classic sample applications include: A3DP Sink/Source, HFP, HID, HSP, MAP, PBAP, SPP application demos.
  - BLE sample applications include: ANP, iBeacon, HRP, HTP, PASP, HOGP, PXP, FMP, CSCP application demos.
  - Bluetooth Classic + Bluetooth Low Energy sample applications include: SPP+SPPLE, SPP DMMulti application demos
- MFi Support
  - iAP Protocol (iAP 1/iAP 2) provided as an add-on upon request
- Operating conditions
  - Single power supply: 2.4V to 3.6V
  - Operating temperature range: –40°C to 85°C
- Antenna: Integrated PCB trace antenna
- Package
  - 12 mm x 22 mm x 2.1 mm
  - LCC-29
- Certification (In-progress)
  - Bluetooth DID: D058373
  - FCC ID: 2ABRU-BDM209B
  - IC: 25657-BDM209B
  - CE-RED

Applications

- Mobile accessories
- Sports and fitness applications
- Wireless audio solutions
- Set-Top boxes and remote controls
- Toys
- Test and measurement
- Industrial: cable replacement
- Wireless sensors
- Automotive aftermarket
- Wellness and health

Contents

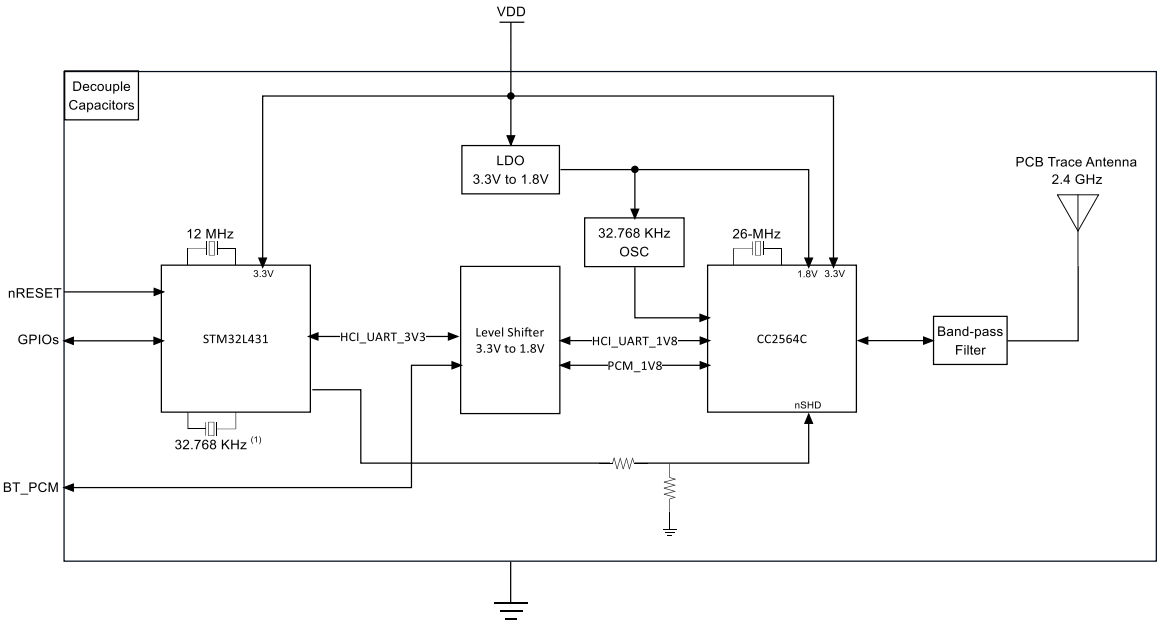
References

[1]. CC2564C resources: https://www.ti.com/product/CC2564C
[2]. STM32L431 resources: https://www.st.com/en/microcontrollers-microprocessors/stm32l431cc.html

1. Block Diagram

BDE-BDM209B integrates a Bluetooth dual-mode controller, a high-performance Arm® 32-bit Cortex®-M4 MCU, and other required components into a compact form factor, enabling a ready-to-use, cost-effective Bluetooth dual-mode MCU module.

The block diagram of the module is shown in Figure 1.



(1) The 32.768 KHz Low Frequency XTAL for MCU is not fitted on module by default.

Figure 1. The block diagram of BDE-BDM209B

2. Pinout Functions

The module is with LCC-29 package. 29 pads are exposed for user. This section describes pinout functions of the module in details.

2.1. Pinout Diagram

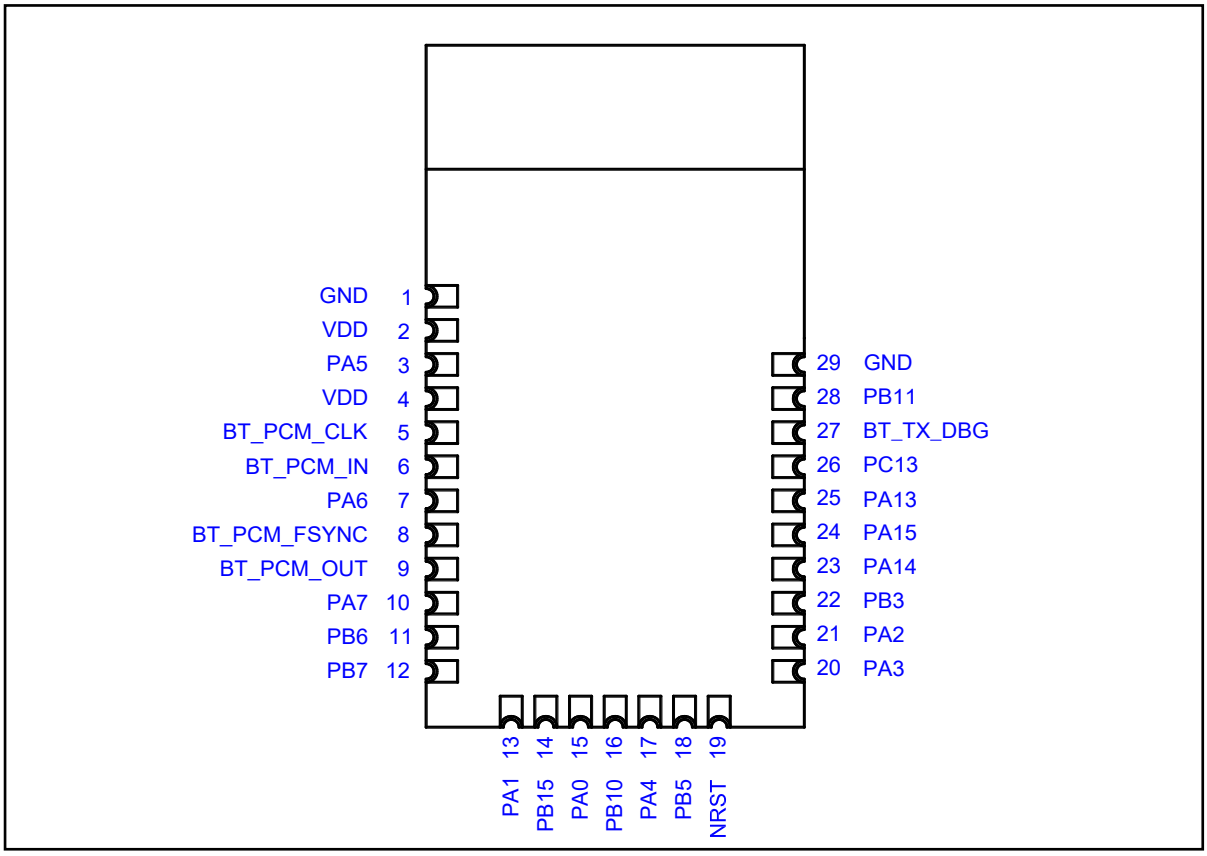


Figure 2. The pinout diagram of BDE-BDM209B (Top View)

2.2. Pinout Description

Table 1. Pinout Description (1)

Module Pin #	Pin Name	Type	Pin Functions		
			Function After Reset	Alternate Functions	Additional Functions
1	GND	GND	Ground	-	-
2	VDD	PWR	Power supply, 2.4V to 3.6V	-	-
3	PA5	I/O	GPIO	TIM2_CH1, TIM2_ETR, SPI1_SCK, LPTIM2_ETR, EVENTOUT	COMP1_INM, COMP2_INM, ADC1_IN10, DAC1_OUT2
4	VDD	PWR	Power supply, 2.4V to 3.6V	-	-
5	BT_PCM_CLK	I/O	PCM clock, from BT controller	-	-
6	BT_PCM_IN	I	PCM data input, from BT controller	-	-
7	PA6	I/O	GPIO	TIM1_BKIN, SPI1_MISO, COMP1_OUT, USART3_CTS, LPUART1_CTS, TIM1_BKIN_COMP2, TIM16_CH1, EVENTOUT	ADC1_IN11

Module Pin #	Pin Name	Type	Pin Functions		
			Function After Reset	Alternate Functions	Additional Functions
8	BT_PCM_FSYNC	I/O	PCM frame sync, from BT controller	-	-
9	BT_PCM_OUT	O	PCM data output, from BT controller	-	-
10	PA7	I/O	GPIO	TIM1_CH1N, SPI1_MOSI, COMP2_OUT, EVENTOUT	ADC1_IN12
11	PB6	I/O	GPIO	LPTIM1_ETR, I2C1_SCL, SAI1_FS_B, TIM16_CH1N, EVENTOUT	COMP2_INP
12	PB7	I/O	GPIO	LPTIM1_IN2, I2C1_SDA, EVENTOUT	COMP2_INM, PVD_IN
13	PA1	I/O	GPIO	TIM2_CH2, I2C1_SMBA, SPI1_SCK, USART2_RTS_DE, TIM15_CH1N, EVENTOUT	OPAMP1_ VINM, COMP1_INP, ADC1_IN6
14	PB15	I/O	GPIO	RTC_REFIN, TIM1_CH3N, SWPMI1_SUSPEND, SAI1_SD_A, TIM15_CH2, EVENTOUT	-
15	PA0	I/O	GPIO	TIM2_CH1, USART2_CTS, COMP1_OUT, SAI1_EXTCLK, TIM2_ETR, EVENTOUT	OPAMP1_ VINP, COMP1_INM, ADC1_IN5, RTC_TAMP2, WKUP1
16	PB10	I/O	GPIO	TIM2_CH3, I2C2_SCL, USART3_TX, LPUART1_RX, COMP1_OUT, SAI1_SCK_A, EVENTOUT	-
17	PA4	I/O	GPIO	SPI1_NSS, USART2_CK, SAI1_FS_B, LPTIM2_OUT, EVENTOUT	COMP1_INM, COMP2_INM, ADC1_IN9, DAC1_OUT1
18	PB5	I/O	GPIO	LPTIM1_IN1, I2C1_SMBA, SPI1_MOSI, COMP2_OUT, SAI1_SD_B, TIM16_BKIN, EVENTOUT	-
19	NRST	I	Reset, internal pull-up, active low	-	-
20	PA3	I/O	GPIO	TIM2_CH4, USART2_RX, LPUART1_RX, SAI1_MCLK_A, TIM15_CH2, EVENTOUT	OPAMP1_ VOUT, COMP2_INP, ADC1_IN8

Module Pin #	Pin Name	Type	Pin Functions		
			Function After Reset	Alternate Functions	Additional Functions
21	PA2	I/O	GPIO	TIM2_CH3, USART2_TX, LPUART1_TX, COMP2_OUT, TIM15_CH1, EVENTOUT	COMP2_INM, ADC1_IN7, WKUP4, LSCO
22	PB3	I/O	GPIO	JTDO-TRACESWO, TIM2_CH2, SPI1_SCK, SAI1_SCK_B, EVENTOUT	COMP2_INM
23	PA14	I/O	GPIO	JTCK-SWCLK, LPTIM1_OUT, I2C1_SMBA, SWPMI1_RX, SAI1_FS_B, EVENTOUT	-
24	PA15	I/O	GPIO	JTDI, TIM2_CH1, TIM2_ETR, USART2_RX, SPI1_NSS, USART3_RTS_DE, SWPMI1_SUSPEND, EVENTOUT	-
25	PA13	I/O	GPIO	JTMS-SWDIO, IR_OUT, SWPMI1_TX, SAI1_SD_B, EVENTOUT	-
26	PC13	I/O	GPIO	EVENTOUT	RTC_TAMP1, RTC_TS, RTC_OUT, WKUP2
27	BT_TX_DBG	O	BT debug message, 1.8V voltage level	-	-
28	PB11	I/O	GPIO	TIM2_CH4, I2C2_SDA, USART3_RX, LPUART1_TX, COMP2_OUT, EVENTOUT	-
29	GND	GND	Ground	-	-

(1) For pin multiplexing details, refer to the datasheet of STM32L431.

Table 2. Connection for Unused Pins (1)

Function	Pin Name	Connection
GPIO	PAx, PBx, PCx	Set to port function in output direction, and leave unconnected
Reset	NRST	Has been internally pulled-up to VDD, require a 0.1µF pulldown
JTDI	PA15	The JTAG TDI pin is shared with general-purpose I/O function (PA15). If not being used, this pin should be set to port function in the output direction. When used as JTAG TDI pin, it should remain open
JTDO	PB3	The JTAG TDO pin is shared with general-purpose I/O function (PB3). If not being used, this pin should be set to port function in the output direction. When used as JTAG TDO pin, it should be pulled down externally
JTMS	PA13	The JTAG TMS pin is shared with general-purpose I/O function (PA13). If not being used, this pin should be set to port function in the output direction. When used as JTAG TMS pin, it should be pulled up externally

Function	Pin Name	Connection
JTCK	PA14	The JTAG TCK pin is shared with general-purpose I/O function (PA14). If not being used, this pin should be set to port function in the output direction. When used as JTAG TCK pin, it should be pulled down externally
TX_DUG	BT_TX_DUG	Remain open

(1) For pin multiplexing details, refer to the datasheet of STM32L431.

3. Characteristics

3.1. Electrical Characteristics

All MIN/MAX specification limits are guaranteed by design, production testing and/or statistical characterization. Typical values are based on characterization results at default measurement conditions and are informative only. Default measurement conditions (unless otherwise specified): VDD= 3.3 V, TA = 25 °C. All radio measurements are performed with standard RF measurement equipment.

3.1.1. Absolute Maximum Ratings

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

Table 3. Absolute Maximum Ratings

Parameter	MIN	MAX	Unit
VDD, Supply voltage	-0.3	4	V
T_{STG}, Storage temperature	-40	125	°C

3.1.2. Recommended Operating Conditions

Table 4. Recommended Operating Conditions

Parameter	MIN	MAX	Unit
VDD, Supply voltage	2.4	3.6	V
T_A, Operating temperature	-40	85	°C

3.2. RF Characteristics

Table 5. Transmit (TX) Characteristics

Parameter	Description	Conditions	MIN	TYP	MAX	Unit
TX_{GFSK}	Maximum TX output power -GFSK	GFSK		10		dBm
TX_{EDR}	Maximum TX output power - EDR	EDR		10		dBm

Table 6. Receive (RX) Characteristics

Parameter	Description	Conditions	MIN	TYP	MAX	Unit
RX_{SEN_1}	RX sensitivity - GFSK	GFSK BER = 0.1%		-95		dBm
RX_{SEN_2}	RX sensitivity -π/4-DQPSK	π/4-DQPSK BER = 0.01%		-94		dBm

RX_{SEN_3}	RX sensitivity - DPSK	8DPSK BER = 0.01%		-87		dBm

4. Mechanical Specifications

The following section includes mechanical and footprint drawings of the module.

4.1. Module Dimensions

The module dimensions are presented in the following figure.

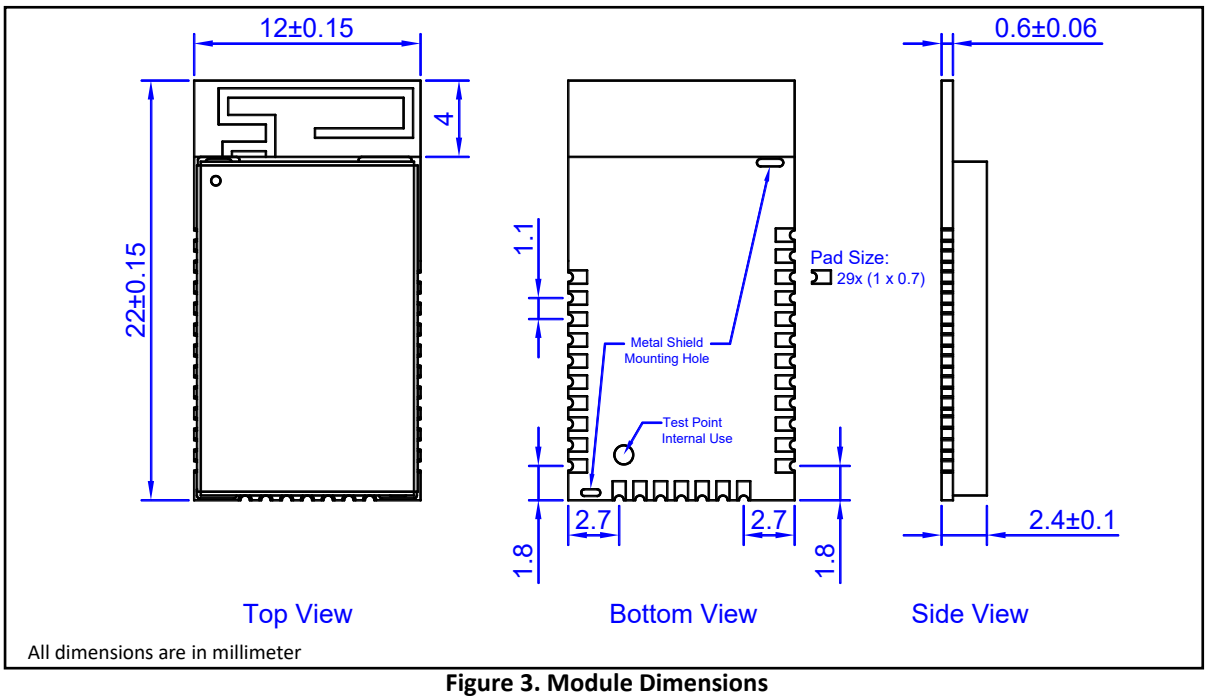


Figure 3. Module Dimensions

4.2. PCB Footprint

The recommended module footprint is presented in the following figure.

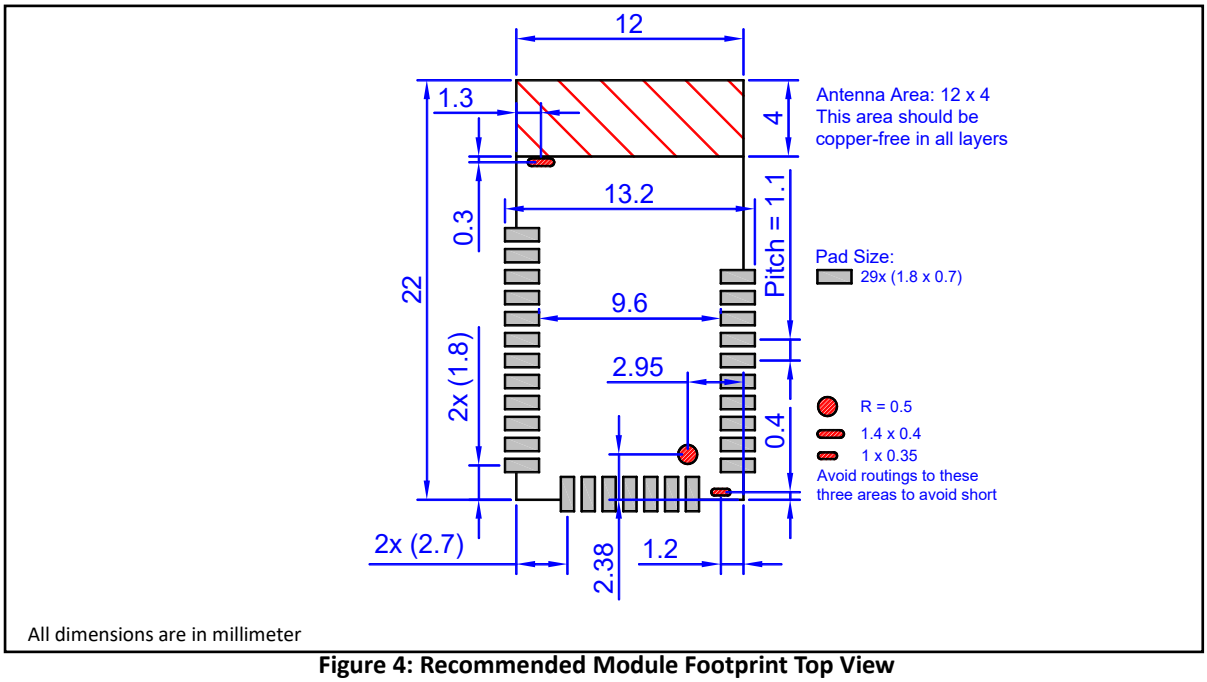


Figure 4: Recommended Module Footprint Top View

5. Ordering Information

Table 7. Ordering Information

Part Number	Size (mm)	Shipping Form	MOQ
BDE-BDM209B	12 x 22 x 2.4	Tape & Reel	1000

6. Revision History

Revision	Date	Description
V0.1	2024-08-02	Preliminary
V0.2	2024-08-19	Corrected some editorial mistakes
V0.3	2024-09-27	Modified pinout and pin functions, modified mechanical and footprint drawings

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