

General Description



The BDE-MP2651P3 module is a single-protocol 2.4GHz wireless module series consisting of CC2652P31TORGZ single-chip wireless microcontroller (MCU). This series provides three options: BDE-MP2652P7A (Integrated PCB antenna), BDE-MP2652P7N (RF pad out for antenna) and BDE-MP2652P7U (U.FL connector). Customer can choose the suitable version for different application scenario.

The BDE-MP2651P3 module is a single-protocol 2.4-GHz wireless microcontroller (MCU) supporting Zigbee®, Bluetooth®5.2 Low Energy, IEEE 802.15.4g, TI 15.4-Stack (2.4 GHz). The BDE-MP2651P3 is based on an Arm® Cortex® M4 main processor and optimized for low-power wireless communication and advanced sensing in grid infrastructure, building automation, retail automation, personal electronics and medical applications.

The BDE-MP2651P3 module has a software defined radio powered by an Arm® Cortex® M0, which allows support for multiple physical layers and RF standards. The device supports operation in the 2360 to 2500-MHz frequency band. It also has an efficient built-in PA that supports +20 dBm TX at 101 mA and a receive sensitivity of -103 dBm for 125-kbps Bluetooth® Low Energy Coded PHY.

The BDE-MP2651P3 module has a low sleep current of 0.8 μ A with RTC and 32KB RAM retention. Consistent with many customers' 10 to 15 years or longer life cycle requirements. The BDE-MP2651P3 module highly integrates radio, stack, profile and applications in a SoC, without the need of using an external MCU. The module also offers flexible hardware interfaces for the sensor application. It enables ultra-low power connectivity and data transfer for the applications that are sensitive to power consumption, size and cost.

Key Features

- Single-protocol 2.4GHz module consisting of CC2651P31T0RGZ single-chip wireless microcontroller (MCU)
- Fully integrated module includes all required clocks, SPI Flash, and passives
- Wireless microcontroller
 - Powerful 48-MHz Arm® Cortex®-M4 processor
 - 352KB flash program memory
 - 32KB of ultra-low leakage SRAM
 - 8KB of Cache SRAM (Alternatively available as general-purpose RAM)
 - Programmable radio includes support for 2-(G)FSK, 4-(G)FSK, MSK, Bluetooth® 5.2 Low Energy, IEEE 802.15.4 PHY and MAC
 - Supports over-the-air upgrade (OTA)
- Low power consumption
 - MCU consumption:
 - ✧ 2.91 mA active mode, CoreMark®
 - ✧ 61 µA/MHz running CoreMark
 - ✧ 0.8 µA standby mode, RTC, 32KB RAM
 - ✧ 0.1 µA shutdown mode, wake-up on pin
 - Radio Consumption:
 - ✧ 6.4 mA RX
 - ✧ 7.1 mA TX at 0 dBm
 - ✧ 9.5 mA TX at +5 dBm
 - ✧ 22 mA TX at +10 dBm
 - ✧ 101 mA TX at +20 dBm (7x7 package)
- Wireless protocol support
 - Zigbee®
 - Bluetooth® 5.2 Low Energy
 - SimpleLink™ TI 15.4-stack
 - Proprietary systems
- High performance radio
 - -104 dBm for Bluetooth® Low Energy 125-kbps
 - Output power up to +20 dBm with temperature compensation
- Regulatory compliance (On-going)
 - FCC
 - IC
 - CE-RED
 - Bluetooth SIG
- MCU peripherals
 - Digital peripherals can be routed to any GPIO
 - Four 32-bit or eight 16-bit general-purpose timers
 - 12-bit ADC, 200 kSamples/s, 8 channels
 - 8-bit DAC
 - Analog Comparator
 - UART, SSI, I2C, I2S
 - Real-time clock (RTC)
 - Integrated temperature and battery monitor
- Security enablers
 - AES 128-bit cryptographic accelerator
 - True random number generator (TRNG)
 - Additional cryptography drivers available in Software
- Operating range
 - On-chip buck DC/DC converter
 - 1.8-V to 3.8-V single supply voltage
 - -40 to +85°C
- Package
 - Dimension: 29.86 mm x 19.98 mm x 2.15 mm
 - QFM-42 (26 GPIOs)
 - RoHS-compliant package

Applications

- 2400 to 2500 MHz ISM and SRD systems 1 with down to 4 kHz of receive bandwidth
- Building automation
 - Building security systems – motion detector, electronic smart lock, door and window sensor, garage door system, gateway
 - HVAC – thermostat, wireless environmental sensor, HVAC system controller, gateway
 - Fire safety system – smoke and heat detector, fire alarm control panel (FACP)
 - Video surveillance – IP network camera
 - Elevators and escalators – elevator main control panel for elevators and escalators
- Industrial transport – asset tracking
- Factory automation and control
- Medical
- Electronic point of sale (EPOS) – Electronic Shelf Label (ESL)
- Communication equipment
 - Wired networking – wireless LAN or Wi-Fi access points, edge router , small business router
- Personal electronics
 - Home theater & entertainment – smart speakers, smart display, set-top box
 - Wearables (non-medical) – smart trackers, smart clothing

Reference

[1] CC2651P3 resources: <https://www.ti.com/product/CC2651P3>

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1. Block Diagram

BDE-MP2651P3 module is based on the Texas Instruments CC2651P3 single chip wireless MCU. With clocks, other required passives and antenna/connector (optional), it allows faster time to market at reduced development cost.

The module, as seen in Figure 1-1, comprises of:

- 48-MHz XTAL
- 32.768-kHz XTAL
- Power Inductors and Capacitors
- Pull-up Resistors
- Decoupling Capacitors
- Balun & Matching Circuit
- PCB trace antenna / U.FL connector for external antenna / RF pad for external antenna

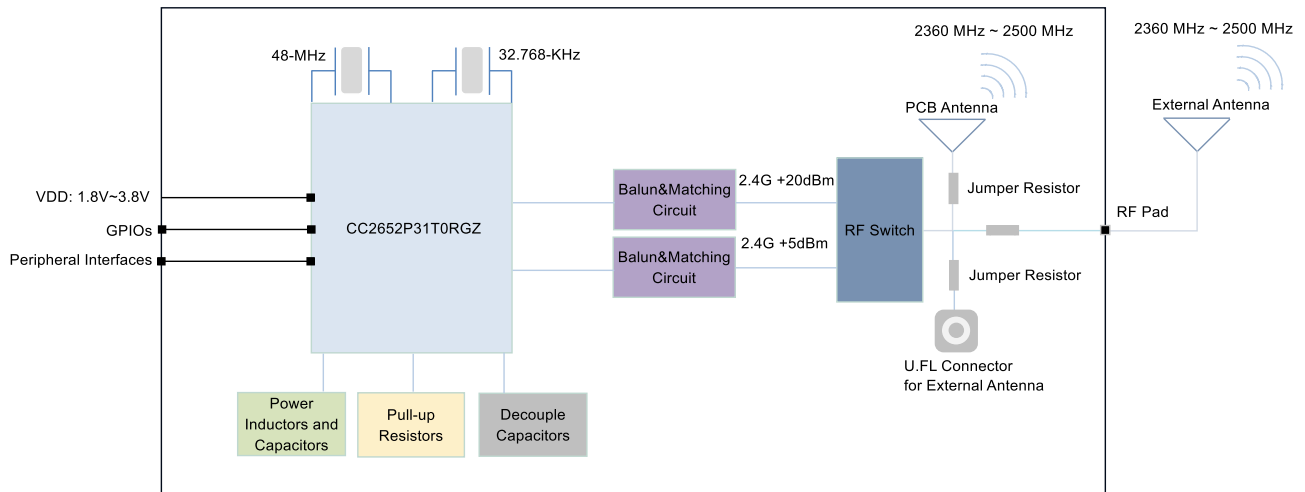


Figure 1-1. The block diagram of BDE-MP2651P3

2. Pinout

2.1. Pinout Diagram

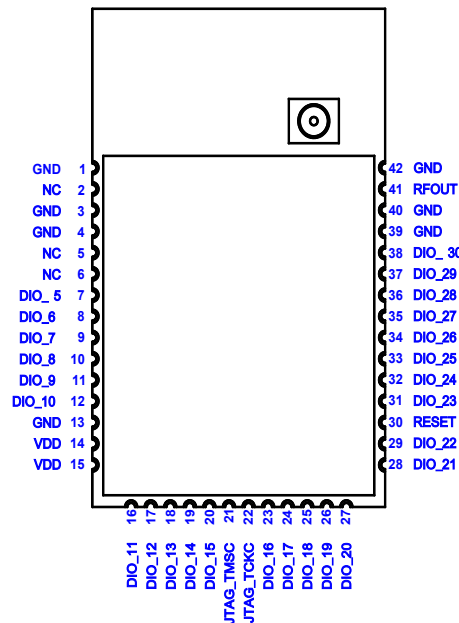


Figure 2-1. Pinout Diagram of BDE- MP2651P3 Top View

2.2. Pinout Description

Table 2-2 describes the definitions of the pins of the module. Pin number of CC2651P3 chip is also stated here, because the VQFN pin is referred to in the software design kit (SDK).

Table 2-2. Pin Description ⁽¹⁾

Module Pin #	Pin Name	Type	CC2651P3 Pin #	Description
1	GND	-	-	Ground
2	NC	-	-	Unused. Do not connect
3	GND	-	-	Ground
4	GND	-	-	Ground
5	NC	-	-	Unused. Do not connect
6	NC	-	-	Unused. Do not connect
7	DIO_5	I/O	10	GPIO
8	DIO_6	I/O	11	GPIO

Module Pin #	Pin Name	Type	CC2651P3 Pin #	Description
9	DIO_7	I/O	12	GPIO
10	DIO_8	I/O	14	GPIO
11	DIO_9	I/O	15	GPIO
12	DIO_10	I/O	16	GPIO
13	GND	-	-	Ground
14	VDD	-	-	Power
15	VDD	-	-	Power
16	DIO_11	I/O	17	GPIO
17	DIO_12	I/O	18	GPIO
18	DIO_13	I/O	19	GPIO
19	DIO_14	I/O	20	GPIO
20	DIO_15	I/O	21	GPIO
21	JTAG_TMSC	I/O	24	JTAG_TMSC, High-drive Capability
22	JTAG_TCKC	I/O	25	JTAG_TCKC
23	DIO_16	I/O	26	GPIO, JTAG_TDO, High-drive Capability
24	DIO_17	I/O	27	GPIO, JTAG_TDI, High-drive Capability
25	DIO_18	I/O	28	GPIO
26	DIO_19	I/O	29	GPIO
27	DIO_20	I/O	30	GPIO
28	DIO_21	I/O	31	GPIO
29	DIO_22	I/O	32	GPIO
30	RESET	I/O	35	Power on reset, No internal pullup resistor
31	DIO_23	I/O	36	GPIO
32	DIO_24	I/O	37	GPIO
33	DIO_25	I/O	38	GPIO
34	DIO_26	I/O	39	GPIO
35	DIO_27	I/O	40	GPIO
36	DIO_28 ⁽²⁾	I/O	41	GPIO
37	DIO_29 ⁽²⁾	I/O	42	GPIO
38	DIO_30 ⁽²⁾	I/O	43	GPIO
39	GND	-	-	Ground
40	GND	-	-	Ground
41	RFOUT	-	-	2.4G RF Output Port
42	GND	-	-	Ground

Note ⁽¹⁾: For pin multiplexing details, refer to the [CC2651P3 SimpleLink™ single-protocol 2.4 GHz Wireless MCU with Integrated Power Amplifier](#)

Note ⁽²⁾: These three pins are used as the RF switch control pins on-board, not recommended for use to the user.

3. Characteristics

3.1. Absolute Maximum Ratings

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

Table 3-1. Absolute Maximum Ratings

PARAMETER	MIN	MAX	UNIT	Notes
VDDS	-0.3	4.1	V	
Other Digital Terminals	-0.3	VDDS+0.3≤4.1	V	
Voltage on ADC input	-0.3	VDDS	V	Voltage scaling enabled
Analog Pins	-0.3	1.49	V	Voltage scaling disabled, internal reference
Operating temperature (T _A)	-0.3	VDDS/2.9	V	Voltage scaling disabled, VDDS as reference
RF pin	-	3.5	dBm	
Storage Temperature	-40	150	°C	

3.2. Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

Table 3-2. Recommended Operating Conditions

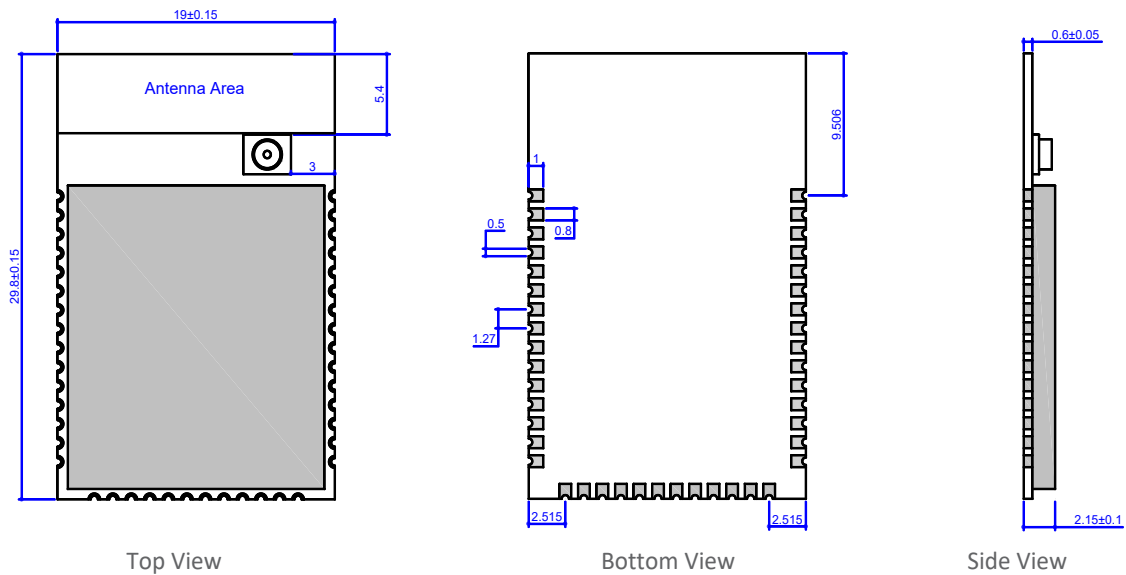
PARAMETER	MIN	TYP	MAX	UNIT
VDDS	1.8	3.3	3.8	V
Operating Temperature	-40		85	°C
Rising supply voltage slew rate	0		100	mV/μs
Falling supply voltage slew rate	0		20	mV/μs

4. Mechanical Specifications

The following pages include mechanical, footprint drawings, and marking information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document

4.1. Dimensions

The module dimensions are presented in the following figure:

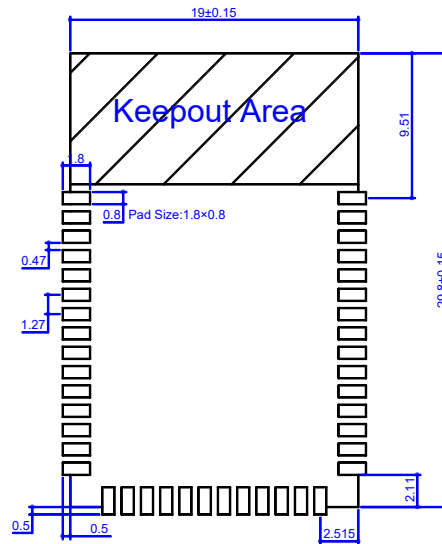


Note: All dimensions are in millimeter

Figure 4-1. Mechanical Drawing for BDE-MP2651P3

4.2. PCB Footprint

The footprint for the PCB is presented in the following figures:



Note:

1. All dimensions are in millimeter;
2. Solder mask should be the same or 5% larger than the dimension of the pad;
3. Solder paste must be the same as the pin for all peripheral pads.

Figure 4-3. Module Footprint for BDE-MP2651P3

5. Marking

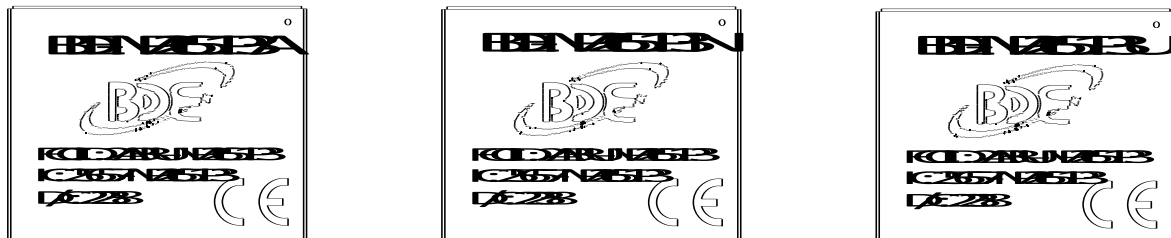


Figure 5-1. Module Marking

6. Typical Reflow Profile

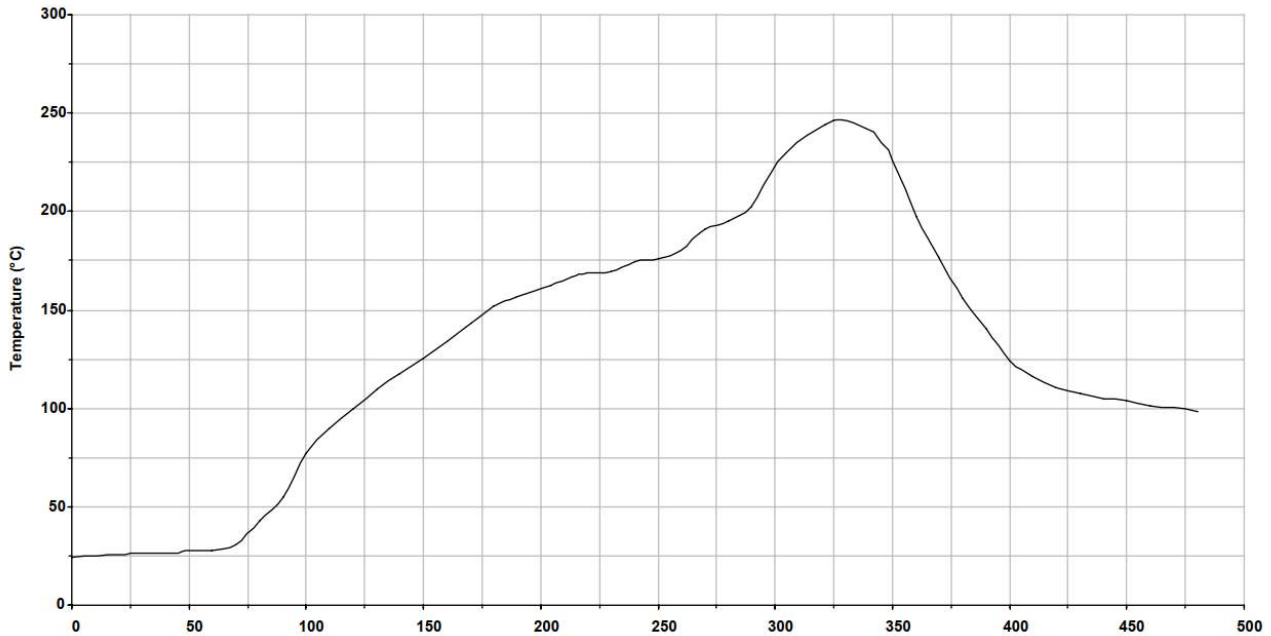


Figure 6-1. Typical Reflow Profile

Key features of the profile:

- Initial ramp = 1-2.5°C/sec to 175°C ±25°C equilibrium
- Equilibrium time = 60 to 180 seconds
- Ramp to maximum temperature (245°C) = 3°C/sec max.
- Time above liquidus temperature (217°C): 45-90 seconds
- Device absolute maximum reflow temperature: 260°C

7. Ordering Information

Part Number	Description	Size (mm)	Package	MOQ
BDE-MP2651P3A	BDE single-protocol 2.4GHz Wireless Module Based on CC2651P3, with Integrated PCB Antenna	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MP2651P3U	BDE single-protocol 2.4GHz Wireless Module Based on CC2651P3, with U.FL Connector	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MP2651P3N	BDE single-protocol 2.4GHz Wireless Module Based on CC2651P3, RF Pad Out for Antenna	29.8 x 19 x 2.15	Tape & Reel	900

8. Revision History

Revision	Date	Description
V1.0	14-October-2022	Initial Release

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