

## General Description



BDE-MB1352P7 is a multiprotocol and multi-band Sub-1GHz and 2.4-GHz wireless module series consisting of CC1352P74TORGZ single-chip wireless microcontroller (MCU). This series provides twelve options, customer can choose the suitable version for different application scenario.

- BDE-MB1352P71UA (PA on Sub-1GHz band, U.FL connector for Sub-1GHz, PCB Antenna for 2.4-GHz)
- BDE-MB1352P71UU (PA on Sub-1GHz band, U.FL connector for Sub-1GHz, U.FL Connector for 2.4-GHz)
- BDE-MB1352P71UN (PA on Sub-1GHz band, U.FL connector for Sub-1GHz, RF Pad Out for 2.4-GHz)
- BDE-MB1352P71NA (PA on Sub-1GHz band, RF Pad Out for Sub-1GHz, PCB Antenna for 2.4-GHz)
- BDE-MB1352P71NU (PA on Sub-1GHz band, RF Pad Out for Sub-1GHz, U.FL Connector for 2.4-GHz)
- BDE-MB1352P71NN (PA on Sub-1GHz band, RF Pad Out for Sub-1GHz, RF Pad Out for 2.4-GHz)
- BDE-MB1352P72UA (PA on 2.4-GHz band, U.FL connector for Sub-1GHz, PCB Antenna for 2.4-GHz)
- BDE-MB1352P72UU (PA on 2.4-GHz band, U.FL connector for Sub-1GHz, U.FL Connector for 2.4-GHz)
- BDE-MB1352P72UN (PA on 2.4-GHz band, U.FL connector for Sub-1GHz, RF Pad Out for 2.4-GHz)
- BDE-MB1352P72NA (PA on 2.4-GHz band, RF Pad Out for Sub-1GHz, PCB Antenna for 2.4-GHz)
- BDE-MB1352P72NU (PA on 2.4-GHz band, RF Pad Out for Sub-1GHz, U.FL Connector for 2.4-GHz)
- BDE-MB1352P71NN (PA on 2.4-GHz band, RF Pad Out for Sub-1GHz, RF Pad Out for 2.4-GHz)

Created for the IoT, the BDE-MB1352P7 integrates an Arm® Cortex®-M4F MCU, which supports Thread, Zigbee®, Bluetooth® 5.0 Low Energy, IEEE 802.15.4g, IPv6-enabled smart objects (6LoWPAN), mioty®, WI-SUN®, proprietary systems, TI 15.4-Stack (Sub-1 GHz and 2.4 GHz), and concurrent multiprotocol through a Dynamic Multiprotocol Manager (DMM) driver. It optimized for low-power wireless communication and advanced sensing in grid infrastructure, building automation, retail automation, personal electronics and medical applications.

The BDE-MB1352P7 supports operation in 861 to 1054-MHz, and 2360 to 2500-MHz frequency bands. PHY and frequency band switching can be done runtime through a dynamic multiprotocol manager (DMM) driver. It also has an efficient built-in PA that supports +20 dBm TX in the Sub-1 GHz band (BDE-MB1352P71 series) or in 2.4-GHz band. (BDE-MB1352P72 series)

The BDE-MB1352P7 has a low sleep current of 0.9  $\mu$ A with RTC and 144KB RAM retention. In addition to the main Cortex® M4F processor, the device also has an autonomous ultra-low power Sensor Controller CPU with fast wake-up capability. As an example, the sensor controller is capable of 1-Hz ADC sampling at 1- $\mu$ A system current. And it has Low SER (Soft Error Rate) FIT (Failure-in-time) for long operational lifetime. Always-on RAM parity minimizes risk for corruption due to potential radiation events. Consistent with many customers' 10 to 15 years or longer life cycle requirements.

The BDE-MB1352P7 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

- Multiprotocol 2.4-GHz module consisting of CC1352P74T0RGZ single-chip wireless microcontroller (MCU)
- Wireless microcontroller
  - Powerful 48-MHz Arm® Cortex®-M4F processor
  - 704KB flash program memory
  - 256KB of ROM for protocols and library functions
  - 8KB of cache SRAM
  - 144KB of ultra-low leakage SRAM with parity for high-reliability operation
  - Dual-band Sub-1 GHz and 2.4 GHz operation
  - Dynamic multiprotocol manager (DMM) driver
  - Programmable radio includes support for 2-(G)FSK, 4-(G)FSK, MSK, OOK, Bluetooth®5.0 Low Energy, IEEE 802.15.4 PHY and MAC
  - Supports over-the-air upgrade(OTA)
- Ultra-low power sensor controller
  - Autonomous MCU with 4KB of SRAM
  - Sample, store, and process sensor data
  - Fast wake-up for low-power operation
  - Software defined peripherals; capacitive touch, flow meter, LCD
- Low power consumption
  - MCU consumption:
    - ◇ 2.63 mA active mode, CoreMark
    - ◇ 55 µA/MHz running CoreMark
    - ◇ 0.8 µA standby mode, RTC, 144KB RAM
    - ◇ 0.1 µA shutdown mode, wake-up on pin
  - Ultra low-power sensor controller consumption:
    - ◇ 25.2 µA in 2 MHz mode
    - ◇ 701 µA in 24 MHz mode
- Radio Consumption:
  - ◇ 5.4 mA RX at 868 MHz
  - ◇ 6.4 mA RX at 2.4 GHz
  - ◇ 24.9 mA TX at +14 dBm at 868 MHz
  - ◇ 64 mA TX at +20 dBm at 915 MHz
- Wireless protocol support
  - Thread, Zigbee®, Matter
  - Bluetooth®5.0 Low Energy
  - WI-SUN®
  - mioty®
  - Amazon Sidewalk
  - Wireless M-Bus
  - SimpleLink™ TI 15.4-stack
  - 6LoWPAN
  - Proprietary systems
- High performance radio
  - -121 dBm for 2.5-kbps long-range mode
  - -110 dBm at 50 kbps, 802.15.4, 868 MHz
  - -103 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

- Two comparators
- Programmable current source
- Two UART, two SSI, I2C, I2S
- Real-time clock (RTC)
- Integrated temperature and battery monitor
- Security enablers
  - AES 128- and 256-bit cryptographic accelerator
  - ECC and RSA public key hardware accelerator
  - SHA2 Accelerator (full suite up to SHA-512)
  - True random number generator (TRNG)
- 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 (With Shielding)
  - QFM-42 (26 GPIOs)
  - RoHS-compliant package
- Antenna:
  - U.FL connector and RF pad selectable for Sub-1GHz band
  - PCB antenna, U.FL connector and RF pad selectable for 2.4-GHz band
- Additional integrated components:
  - 48.0-MHz crystal
  - 32.768-kHz crystal (RTC)
  - RF filter and passive components

## Applications

- Grid infrastructure
  - Smart Meters – electricity meter, water meter, gas meter and heat cost allocator
  - Grid communications – wireless communications
  - EV charging infrastructure – AC charging (pile) station
  - Other alternative energy – energy harvesting
- Building automation
  - Building security systems – motion detector, door and window sensor, glass break detector, panic button, electronic smart lock and IP network camera
  - HVAC systems – thermostat, environmental sensor and HVAC controller
  - Fire safety – smoke and head detector, gas detector and fire alarm control panel
- Retail Automation
  - Retail automation & payment applications - electronic shelf labels and portable POS terminal
- Personal Electronics
  - RF remote controls
  - Smart Speakers, Smart Displays and Set-top box
  - Gaming and electronic and robotic toys
  - Wearables (non-medical), smart trackers, smart clothing and smartwatch
- Wireless Modules
  - Wireless third party modules including Bluetooth Low Energy, Thread, Zigbee, Matter, Wi-SUN®, Amazon Sidewalk, mioty® and multiprotocol
- Wireless communications modules

## Reference

[1] CC1352P7 resources: <https://www.ti.com/product/CC1352P7>

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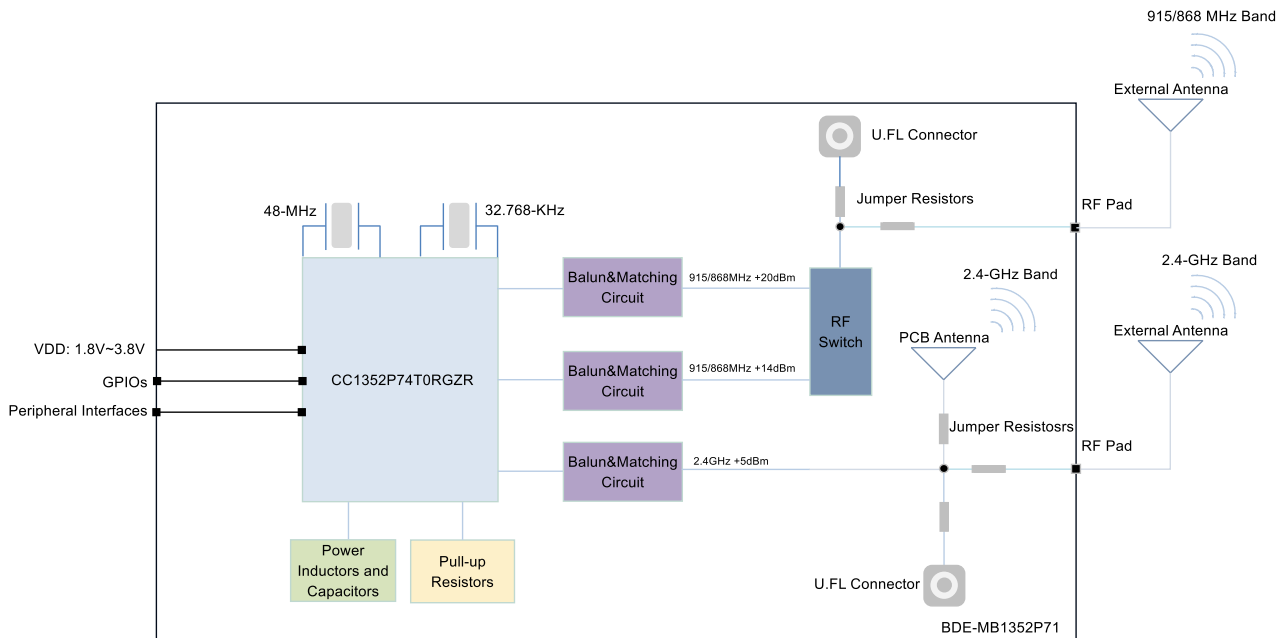
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## 1. Block Diagram

BDE-MB1352P7 module is based on the TI Instruments CC1352P7 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
- 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-MB1352P71 series**

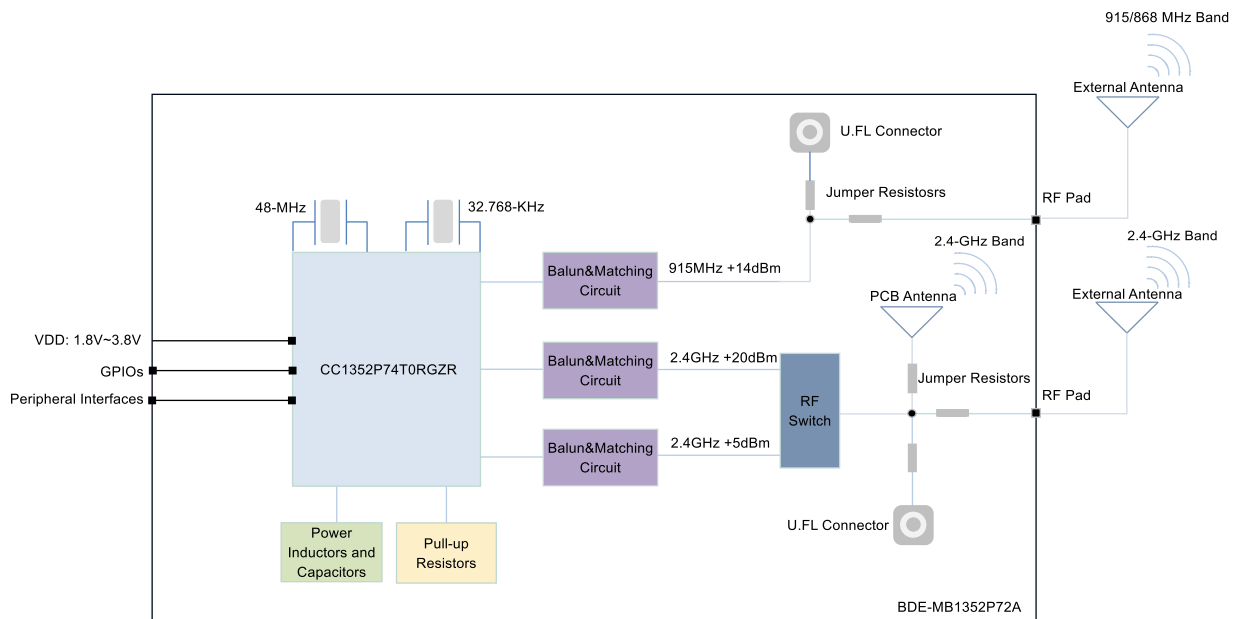


Figure 1-2. The block diagram of BDE-MB1352P72 series

## 2. Pinout

### 2.1. Pinout Diagram

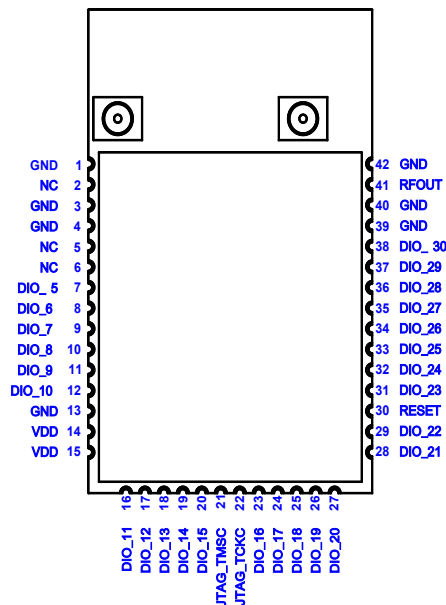


Figure 2-1. Pinout Diagram of BDE- MB1352P7 Top View

## 2.2. Pinout Description

Table 2-1 describes the definitions of the pins of the module. Pin number of CC1352P7 chip is also stated here, because the VQFN pin is referred to in the software design kit (SDK).

**Table 2-1. Pin Description** <sup>(1)</sup>

Module Pin #	Pin Name	Type	CC1352P7 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
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



Module Pin #	Pin Name	Type	CC1352P7 Pin #	Description
35	DIO_27	I/O	40	GPIO
36	DIO_28 <sup>(2)</sup>	I/O	41	GPIO
37	DIO_29 <sup>(2)</sup>	I/O	42	GPIO
38	DIO_30 <sup>(2)</sup>	I/O	43	GPIO
39	GND	-	-	Ground
40	GND	-	-	Ground
41	RFOUT	-	-	2.4G RF Output Port
42	GND	-	-	Ground

Note <sup>(1)</sup>: For pin multiplexing details, refer to the [CC1352P7 SimpleLink™ High-Performance Multi-Band Wireless MCU with Integrated Power Amplifier datasheet \(Rev. A\)](#)

Note <sup>(2)</sup>: 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 <sub>A</sub> )	-0.3	VDDS/2.9	V	Voltage scaling disabled, VDDS as reference
RF pin	-	5	dBm	
Storage Temperature	-40	125	°C	

### 3.2. Recommended Operating Conditions

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

**Table 3-2. Recommended Operating Conditions**

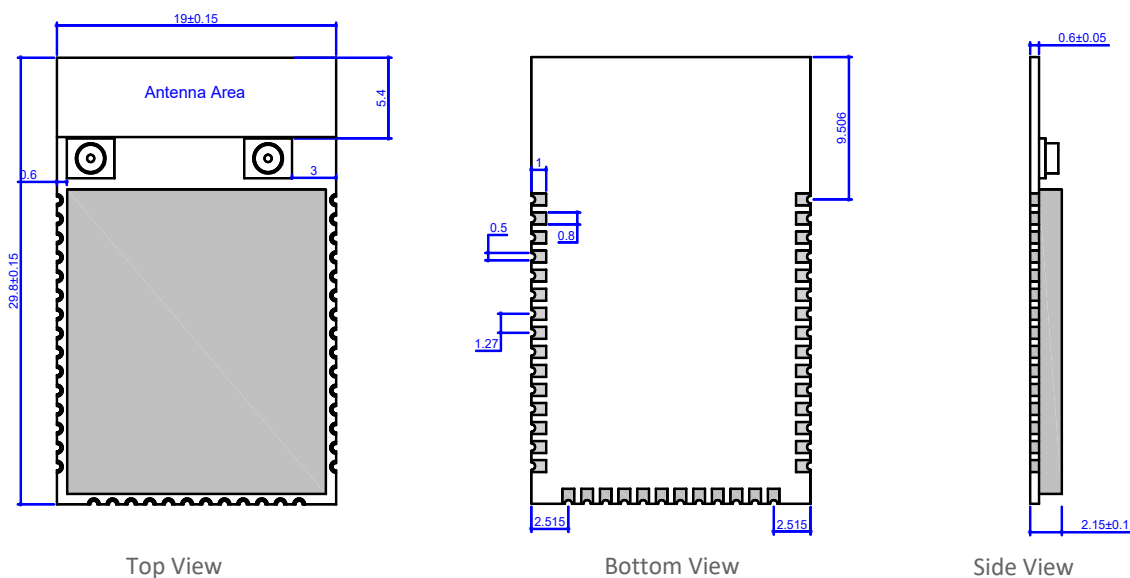
PARAMETER	MIN	TYP	MAX	UNIT
VDDS	1.8	3.3	3.8	V
Operating Temperature	-40		85	°C
Rising supply voltage slew rate	0		100	mV/μs
Falling supply voltage slew rate	0		20	mV/μs

## 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:

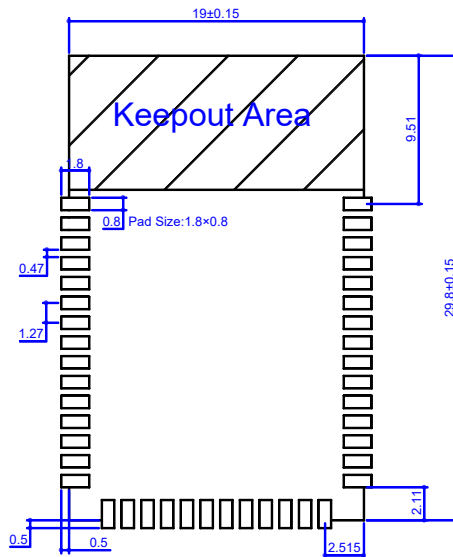


Note: All dimensions are in millimeter

**Figure 4-1. Mechanical Drawing for BDE-MB1352P7**

## 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. For ground pins, make the solder paste 20% smaller than the pad.

**Figure 4-3. Module Footprint for BDE-MB1352P7 Top View**

## 5. Marking



**Figure 5-1. Module Marking**

## 6. Typical Reflow Profile

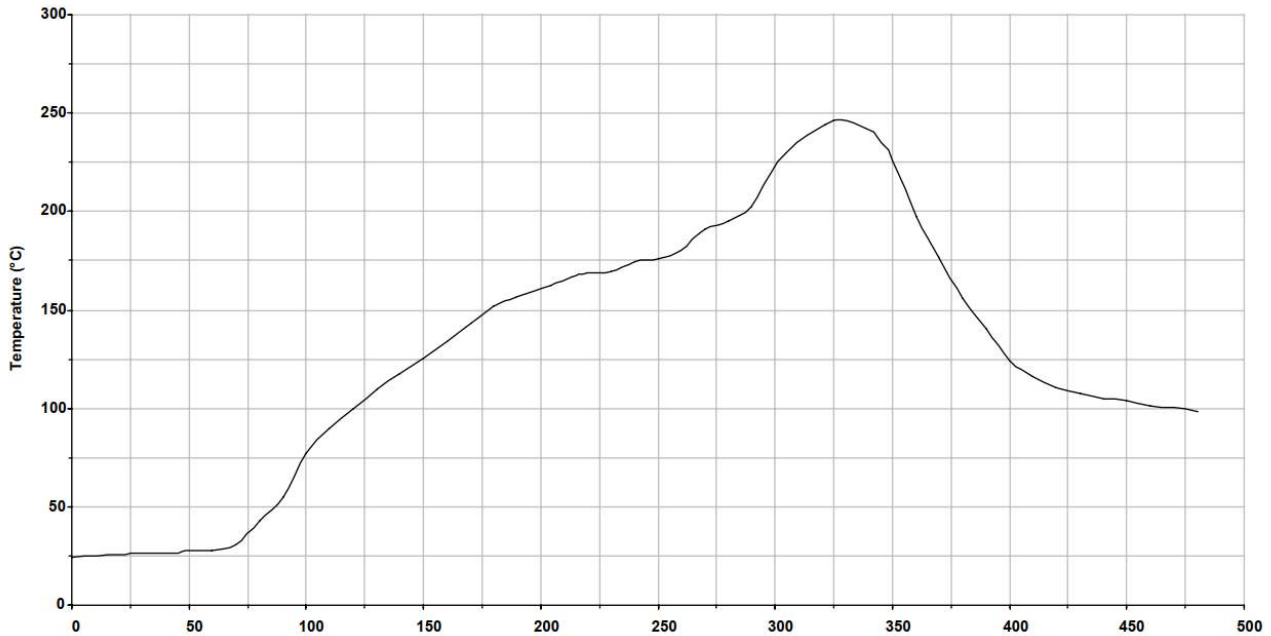


Figure 6-1. Typical Reflow Profile

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-MB1352P71UA	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on Sub-1GHz band, U.FL connector for Sub-1GHz, PCB Antenna for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P71UU	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on Sub-1GHz band, U.FL connector for Sub-1GHz, U.FL Connector for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P71UN	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on Sub-1GHz band, U.FL connector for Sub-1GHz, RF Pad Out for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P71NA	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on Sub-1GHz band, RF Pad Out for Sub-1GHz, PCB Antenna for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P71NU	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on Sub-1GHz band, RF Pad Out for Sub-1GHz, U.FL Connector for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P71NN	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on Sub-1GHz band, RF Pad Out for Sub-1GHz, RF Pad Out for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P72UA	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on 2.4-GHz band, U.FL connector for Sub-1GHz, PCB Antenna for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P72UU	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on 2.4-GHz band, U.FL connector for Sub-1GHz, U.FL Connector for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P72UN	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on 2.4-GHz band, U.FL connector for Sub-1GHz, RF Pad Out for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P72NA	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on 2.4-GHz band, RF Pad Out for Sub-1GHz, PCB Antenna for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P72NU	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on 2.4-GHz band, RF Pad Out for Sub-1GHz, U.FL Connector for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900
BDE-MB1352P71NN	BDE Multi-band Sub-1GHz and 2.4-GHz Wireless Module Based on CC1352P7, PA on 2.4-GHz band, RF Pad Out for Sub-1GHz, RF Pad Out for 2.4-GHz	29.8 x 19 x 2.15	Tape & Reel	900

## 8. Revision History

Revision	Date	Description
V1.0	13-October-2022	Initial Release

## Contacts

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