

## LE1204

# Advance Bluetooth Low Energy (BLE) module

## Introduction

Able Trend Technology introduces the ultra-low power Bluetooth Low Energy (BLE) compliant wireless module LE1204 that is a high performance and cost effective compact solution. The Bluetooth Smart module provides a complete 2.4GHz Bluetooth system based on TI CC2640 chipset, which is a single chip radio and baseband IC for Bluetooth 2.4GHz systems. This module is fully compliant to Bluetooth v4.0 Single-Mode BLE for data communications.

The integrated LE1204 contains a 32-bit ARM Cortex-M3 processor that runs at 48 MHz as the main processor and includes a unique ultralow power sensor controller. This sensor controller is ideal for interfacing external sensors and for collecting analog and digital data autonomously while the rest of the system is in sleep mode. With the on board chip antenna and the 24MHz clock, LE1204 offers full BLE compatibility as well as excellent receiver sensitivity and robustness.

The qualified module enables its user to create a Bluetooth low energy product within the shortest possible time to market. LE1204 can be powered directly with a standard 3V coin cell battery or pair of AAA batteries.

## Key Features

- ARM Cortex M3 up to 48MHz Clock Speed
- 128KB In-System Programmable Flash
- Support Over-The-Air Upgrade (OTA)
- Ultralow-Power Sensor Controller
- 2.4GHz RF Transceiver Compatible with BLE 4.1 Specification

- Single mode compliant radio Master and slave mode support
- L2CAP, GAP, ATT and GATT support Security manager
- Peripherals: 16bit/32bit PWM timers, 12bit ADC, 8ch Analog MUX, UART, SSI, I2C, I2S, RTC, AES-128 Security, TRNG, etc
- Normal Operation: 1.8 to 3.8 V
- Low Power
  - Active-Mode RX: 5.9 mA
  - Active-Mode TX at 0 dBm: 6.1 mA
  - Active-Mode MCU: 61  $\mu$ A/MHz
  - Standby: 1  $\mu$ A (RTC Running and RAM/CPU)
- Programmable Output Power up to +5 dBm
- Excellent Receiver Sensitivity, Selectivity, and Blocking Performance
- Advertising, broadcasting, connections Built-in profiles
- Suitable for Systems Targeting Compliance With Worldwide Radio Frequency Regulations: ETSI EN 300 328 and EN 300 440 Class 2 (Europe), FCC CFR47 Part 15 (US), and ARIB STD-T66 (Japan)
- BQB certification (QDID: TBC)
- Japan TELEC: 005-101345
- US FCC: 2AATFML041E2

## Applications

- Human-Interface Devices (Keyboard, Mouse, Remote Control)
- Sports and Leisure Equipment
- Mobile Phone Accessories
- Health Care Product
- Key fobs
- Households sensors and collector devices
- Security tags
- Wireless keys
- Proximity sensors

## Product Specification

<b>Model Name</b>	LE1204
<b>Product Description</b>	Bluetooth Low Energy Module
<b>Bluetooth Standard</b>	Bluetooth v4.1 Compliant Single-Mode BLE
<b>Chipset</b>	TI CC2640F128
<b>Dimension</b>	19mm x 15mm x 2.8mm
<b>Operating Conditions</b>	
<b>Operating Voltage</b>	1.8~3.8V
<b>Temperature</b>	-40+85°C
<b>Storage Temperature</b>	-40~+125°C
<b>Electrical Specifications</b>	
<b>Frequency Range</b>	2402~2480MHz
<b>Modulation</b>	1 Mbps, GFSK, 250-kHz deviation 1 Mbps, GFSK, 160-kHz deviation
<b>Maximum RF Transmit Power</b>	0dBm
<b>RF power control range</b>	20dB
<b>Receive Sensitivity</b>	-97dBm

Measured on the TI CC2650EM-5XD reference design with  $T_c = 25^\circ\text{C}$ ,  $V_{\text{DD5}} = 3.0\text{ V}$  with internal DC-DC converter, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I <sub>core</sub>	Core current consumption	Reset. RESET_N pin asserted or VDD5 below Power-on-Reset threshold		100		nA
		Shutdown. No clocks running, no retention		150		
		Standby. With RTC, CPU, RAM and (partial) register retention. RCOSC_LF		1		μA
		Standby. With RTC, CPU, RAM and (partial) register retention. XOSC_LF		1.2		
		Standby. With Cache, RTC, CPU, RAM and (partial) register retention. RCOSC_LF		2.5		
		Standby. With Cache, RTC, CPU, RAM and (partial) register retention. XOSC_LF		2.7		
		Idle. Supply Systems and RAM powered.		550		
		Active. Core running CoreMark		1.45 mA + 31 μA/MHz		mA
		Radio RX <sup>(1)</sup>		5.9		
		Radio RX <sup>(2)</sup>		6.1		
		Radio TX, 0-dBm output power <sup>(1)</sup>		6.1		
		Radio TX, 5-dBm output power <sup>(2)</sup>		9.1		

**Peripheral Current Consumption (Adds to core current  $I_{core}$  for each peripheral unit activated)<sup>(3)</sup>**

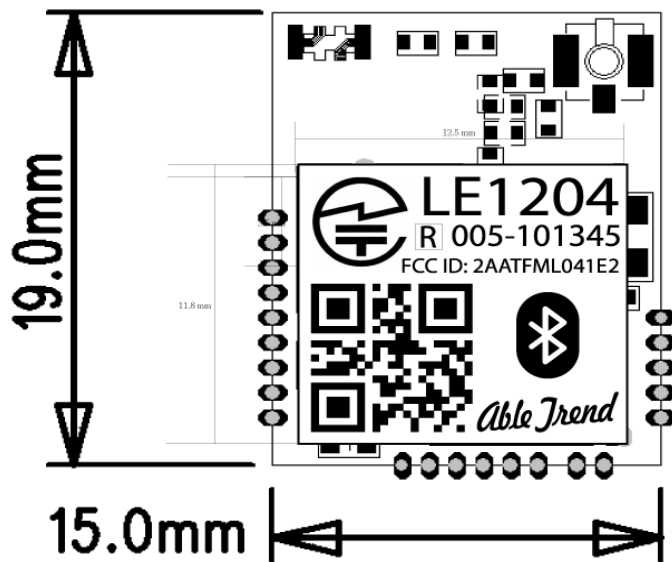
$I_{peri}$	Peripheral power domain	Delta current with domain enabled	20	$\mu A$
	Serial power domain	Delta current with domain enabled	13	$\mu A$
	RF Core	Delta current with power domain enabled, clock enabled, RF core idle	237	$\mu A$
	$\mu DMA$	Delta current with clock enabled, module idle	130	$\mu A$
	Timers	Delta current with clock enabled, module idle	113	$\mu A$
	I <sup>2</sup> C	Delta current with clock enabled, module idle	12	$\mu A$
	I2S	Delta current with clock enabled, module idle	36	$\mu A$
	SSI	Delta current with clock enabled, module idle	93	$\mu A$
	UART	Delta current with clock enabled, module idle	164	$\mu A$

(1) Single-ended RF mode is optimized for size and power consumption. Measured on CC2650EM-4XS.

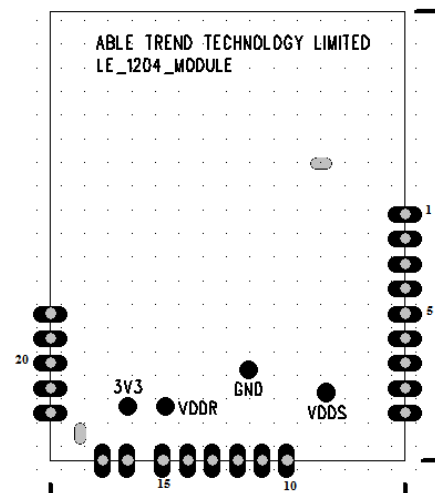
(2) Differential RF mode is optimized for RF performance. Measured on CC2650EM-5XD.

(3)  $I_{peri}$  is not supported in Standby or Shutdown.

## Dimensions



Top view



Bottom view

## Pin Assignment

Pin	Name	Description	Pin	Name	Description
1	DIO_0	GPIO, Sensor Controller	12	DIO_8	GPIO, Sensor Controller
2	DIO_1	GPIO, Sensor Controller	13	DIO_9	GPIO, Sensor Controller
3	DIO_2	GPIO, Sensor Controller	14	DIO_10	GPIO, Sensor Controller
4	DIO_3	GPIO, Sensor Controller	15	RESET	Reset, active-low. No internal pullup.
5	DIO_4	GPIO, Sensor Controller	16	VCC_IN	1.8-V to 3.8-V main chip supply
6	JTAG_TMS	JTAG TMS, high-drive capability	17	VSS	DIGITAL GROUND
7	JTAG_TCK	JTAG TCK	18	DIO_11	GPIO, Sensor Controller
8	DIO_5	GPIO, Sensor Controller	19	DIO_12	GPIO, Sensor Controller
9	DIO_6	GPIO, Sensor Controller	20	DIO_13	GPIO, Sensor Controller
10	GND2	GROUND	21	DIO_14	GPIO, Sensor Controller
11	DIO_7	GPIO, Sensor Controller	22	GND1	GROUND

\* Some I/O pins are reconfigurable; please refer to TI's CC2640 datasheet

## Recommended Reflow Profile

1. Heating method: Conventional Convection or IR/convection
2. Temperature measurement: Thermocouple  $d = 0.1\text{ mm}$  to  $0.2\text{ mm}$  CA (K) or CC (T) at soldering portion or equivalent method.
3. Solder paste composition: Sn/3.0 Ag/0.5 Cu
4. Allowable reflow soldering times: 2 times based on the following reflow soldering profile
5. Temperature profile: Reflow soldering shall be done according to the following temperature profile
6. Peak temp:  $245^{\circ}\text{C}$

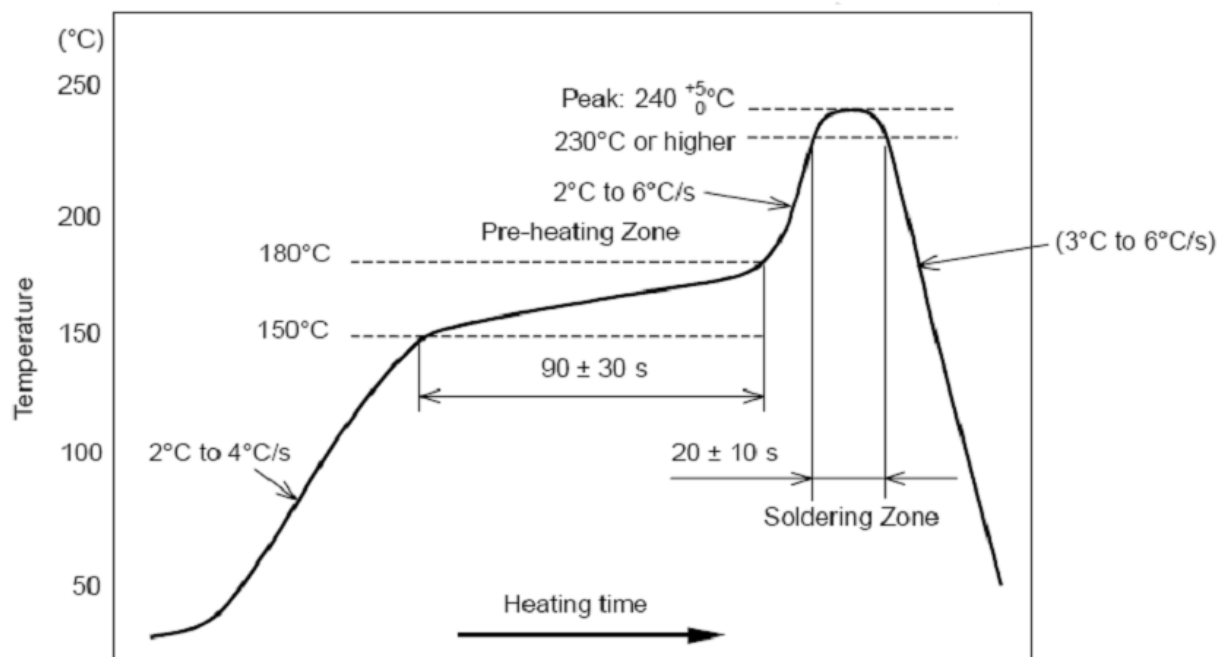


Fig. 7-1 Reflow Profile Diagram

## Environmental Requirements and Specifications

**8.1 Temperature****8.1.1 Operating Temperature Conditions**

The product is capable of continuous reliable operation when operating in ambient temperature of  $-20^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$

**8.1.2 Nonoperating Temperature Conditions**

The subassemblies must not be damaged and the operational performance must not be degraded when restored to the operating temperature when exposed to storage temperature in the range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

**8.1.3 PCB Bending**

The PCB bending specification shall maintain planeness at a thickness of less than 0.1 mm.

**8.2 Handling Environment****8.2.1 ESD**

The product ESD immunity is Human Body Model (HBM)  $\geq \pm 1500$  (V), Mechanical Model (MM)  $\geq \pm 200$  (V). Handle it under ESD protection environment.

This device is ESD sensitive, thus it must be protected at all times from ESD.

Industry-standard ESD precautions must be followed at all times.

**8.2.2 Terminals**

The product is mounted with motherboard through land grid array (LGA). To prevent poor soldering, do not touch the LGA portion by hand.

**8.2.3 Falling**

The mounted components will be damaged if the product falls or is dropped. Such damage may cause the product malfunction.

**8.3 Storage Condition****8.3.1 Moisture Barrier Bag Before Opened**

A moisture barrier bag must be stored in a temperature of less than  $30^{\circ}\text{C}$  with humidity under 85% RH. The calculated shelf life for the dry-packed product shall be a 12 months from the date the bag is sealed.

**8.3.2 Moisture Barrier Bag Open**

Humidity indicator cards must be blue,  $<30\%$ .

**8.4 Baking Conditions**

Products require baking before mounting if:

- Humidity indicator cards read  $>30\%$
- Temp  $< 30^{\circ}\text{C}$ , humidity  $< 70\%$  RH, over 96 hours

Baking condition:  $90^{\circ}\text{C}$ , 12–24 hours

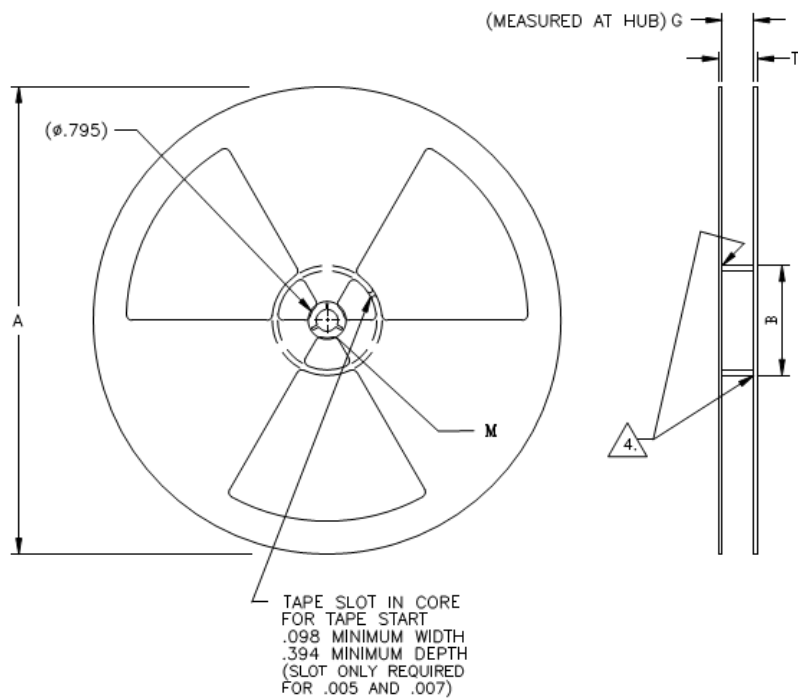
Baking times: 1 time

## 8.5 Packing Info

### Reel Dimension


WELDED BONDED CONFIGURATION

PART NUMBER	TAPE SIZE	HUB DIA (B)	DIM G	DIM T MAXIMUM	DIM A	REV
.001	24mm	3.937	.961 $\begin{smallmatrix} +.078 \\ -.000 \end{smallmatrix}$	1.197	13.00	B
.002	32mm	3.937	1.276 $\begin{smallmatrix} +.078 \\ -.000 \end{smallmatrix}$	1.512	13.00	B
.003	44mm	3.937	1.748 $\begin{smallmatrix} +.078 \\ -.000 \end{smallmatrix}$	1.984	13.00	B
.004	56mm	3.937	2.220 $\begin{smallmatrix} +.078 \\ -.000 \end{smallmatrix}$	2.457	13.00	B
.005	16mm	3.937	.646 $\begin{smallmatrix} +.078 \\ -.000 \end{smallmatrix}$	.882	13.00	B
.006	44mm	5.906	1.748 $\begin{smallmatrix} +.078 \\ -.000 \end{smallmatrix}$	1.984	13.00	B
.007	8mm	3.937	.331 $\begin{smallmatrix} +.078 \\ -.000 \end{smallmatrix}$	.568	13.00	B
.008	12mm	3.937	.490 $\begin{smallmatrix} +.078 \\ -.000 \end{smallmatrix}$	.726	13.00	B
.009	56mm	5.906	2.220 $\begin{smallmatrix} +.078 \\ -.000 \end{smallmatrix}$	2.457	13.00	B



### Tape Dimension

TBC

	<p><b>CAUTION</b></p> <p>This bag contains MOISTURE-SENSITIVE DEVICES</p>	<p>LEVEL</p> <div style="border: 1px solid black; padding: 5px; display: inline-block; font-size: 2em; font-weight: bold;">3</div>
<p>If Blank, see adjacent bar code label</p>		
<p>1. Calculated shelf life in sealed bag: 12 months at <math>&lt; 40^{\circ}\text{C}</math> and <math>&lt; 90\%</math> relative humidity (RH)</p> <p>2. Peak package body temperature: <u>260</u> <math>^{\circ}\text{C}</math>                  If Blank, see adjacent bar code label</p> <p>3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must</p> <p>    a) Mounted within: <u>168</u> hours of factory                  If Blank, see adjacent bar code label</p> <p>    conditions <math>\leq 30^{\circ}\text{C} / 60\%</math></p> <p>    b) stored at <math>&lt; 10\% \text{RH}</math></p> <p>4. Devices require bake, before mounting, if :</p> <p>    a) Humidity Indicator Card is <math>&gt; 10\%</math> when read at <math>23 \pm 5^{\circ}\text{C}</math></p> <p>    b) 3a or 3b not met.</p> <p>5. If baking is required, devices may be baked for 48 hours at <math>125 \pm 5^{\circ}\text{C}</math></p> <p>Note: If device containers cannot be subjected to high temperature or shorter bake times are desired,                  reference IPC /JEDEC J-STQ-033 for bake procedure</p> <p>Bag Seal Date: _____</p> <p>    If Blank, see adjacent bar code label</p> <p>Note: Level and body temperature defined by IPC /JEDEC J-STQ-020</p>		

The module **MUST** go through  $125^{\circ}\text{C}$  baking for at least 9 hours before SMT AND IR reflow process!

#### LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following "Contains Transmitter Module FCC ID: 2AATFML041E2" or "Contains FCC ID: 2AATFML041E2" must be used.

If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label:

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

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

**IMPORTANT NOTE:****FCC Radiation Exposure Statement:**

This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment and is safe for intended operation as described in this manual.

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

- 1) The transmitter module may not be co-located with any other transmitter or antenna

As long as condition 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.)

**IMPORTANT NOTE:** In the event that these conditions do not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID could not 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.

**Manual Information To the End User**

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.

© Able Trend Technology Limited, 2016. The information contained herein is subject to change without notice. Able Trend Technology Limited assumes no responsibility for the use of any circuitry other than circuitry embodied in an Able Trend product. Nor does it convey or imply any license under patent or other rights. Able Trend products are not warranted nor intended to be used for medical, life support, lifesaving, critical control or safety applications, unless pursuant to an express written agreement with Able Trend. Furthermore, Able Trend does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Able Trend products in life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Able Trend against all charges.

Disclaimer: ABLE TREND TECHNOLOGY LIMITED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Able Trend reserves the right to make changes without further notice to the materials described herein. Able Trend does not assume any liability arising out of the application or use of any product or circuit described herein. Able Trend does not authorize its products for use as critical components in life-support systems where a malfunction or failure may reasonably be expected to result in significant injury to the user. The inclusion of Able Trend's product in a life-support systems application implies that the manufacturer assumes all risk of such use and in doing so indemnifies Able Trend against all charges.