

## SimpleLink™ Wi-Fi CC3135MOD 双频带网络处理器模块

### 1 特性

- 完全集成式绿色/RoHS 模块包括所有必需的时钟、串行外设接口 (SPI) 闪存和无源器件
- 集成式 Wi-Fi® 和互联网协议
- 802.11 a/b/g/n : 2.4GHz 和 5GHz
- 经 FCC、IC/ISED、ETSI/CE 和 MIC 认证
- 经 FIPS 140-2 1 级验证的内部 IC
- 一组丰富的 IoT 安全特性，可帮助开发人员保护数据
- 低功耗模式适用于电池供电应用
- 与 2.4GHz 无线电共存
- 工业温度：-40°C 至 +85°C
- **Wi-Fi 网络处理器子系统：**
  - Wi-Fi 内核：
    - 802.11 a/b/g/n 2.4GHz 和 5GHz
    - 模式：
      - 接入点 (AP)
      - 基站 (STA)
      - Wi-Fi Direct® (仅在 2.4GHz 受支持)
    - 安全性：
      - WEP
      - WPA™/ WPA2™ PSK
      - WPA2 企业级
      - WPA3™ 个人版
      - WPA3™ 企业版
  - 互联网和应用协议：
    - HTTP 服务器、mDNS、DNS-SD 和 DHCP
    - IPv4 和 IPv6 TCP/IP 堆栈
    - 16 BSD 套接字 (完全安全的 TLS v1.2 和 SSL 3.0)
  - 内置的电源管理子系统：
    - 可配置的低功耗配置 (始终开启、间歇性连接、标签)
    - 高级低功耗模式
    - 集成式直流/直流稳压器
- 应用吞吐量
  - UDP : 16Mbps
  - TCP : 13Mbps
- **多层安全特性：**
  - 独立执行环境
  - 网络安全
    - 设备身份和密钥
    - 硬件加速器加密引擎 (AES、DES、SHA/MD5 和 CRC)
    - 文件系统安全 (加密、身份验证、访问控制)
    - 初始安全编程
    - 软件篡改检测
    - 安全启动
    - 证书注册请求 (CSR)
    - 每个设备具有唯一密钥对
- 恢复机制 - 能够恢复到出厂默认设置
- **电源管理子系统：**
  - 集成式直流/直流转换器支持宽电源电压范围：
    - 单一宽电源电压，VBAT : 2.3V 至 3.6V
  - 高级低功耗模式：
    - 关断：1µA，休眠：5.5µA
    - 低功耗深度睡眠 (LPDS) : 115µA
    - 空闲连接 (MCU 处于 LPDS 状态) : 710µA
    - RX 流量 (MCU 处于活动模式) : 53mA
    - TX 流量 (MCU 处于活动模式) : 223mA
- Wi-Fi TX 功率
  - 2.4 GHz : 1 DSSS 时为 16dBm
  - 5GHz : 6 OFDM 时为 15.1dBm
- Wi-Fi RX 灵敏度
  - 2.4 GHz : 1 DSSS 时为 -94.5dBm
  - 5GHz : 6 OFDM 时为 -89dBm
- 模块上的其他集成组件
  - 具有内部振荡器的 40.0MHz 晶体
  - 32.768kHz 晶体 (RTC)
  - 32Mb SPI 串行闪存
  - 射频滤波器、双工器和无源组件
- QFM 封装
  - 1.27mm 间距、63 引脚 20.5mm × 17.5mm QFM 封装，可实现轻松组装和低成本 PCB 设计
- 模块支持 [SimpleLink 开发人员生态系统](#)



## 2 应用

- 对于物联网应用，例如：

- 医疗和保健
  - 多参数患者监护仪
  - 心电图 (ECG)
  - 电子病床和床控制器
  - 远程保健系统

- 楼宇和住宅自动化：
  - HVAC 系统和恒温器
  - 视频监控、可视门铃和低功耗摄像头
  - 楼宇安全系统和电子锁
- 电器
- 资产跟踪
- 工厂自动化
- 电网基础设施

## 3 说明

CC3135MOD 是 FCC、IC/ISED、ETSI/CE、MIC 和 Wi-Fi CERTIFIED™ 模块，可显著简化互联网连接的实施过程。这个双频带 Wi-Fi® 网络处理器模块可以添加到任何低成本、低功耗的微处理器单元 (MCU) 中；它集成了所有 Wi-Fi® 和互联网协议，可大大降低主机 MCU 软件要求。

这个基于 ROM 的子系统包括一个 802.11 a/b/g/n 双频带 2.4GHz 和 5GHz 无线电、基带和带有强大硬件加密引擎的 MAC。借助内置安全协议，CC3135MOD 解决方案可提供强大且简单的安全体验。CC3135MOD 采用 LGA 封装，易于布置所有必需组件，包括串行闪存、射频滤波器、双工器、晶体和全集成无源组件。

这一代引进了可进一步简化物联网连接的新功能。CC3135MOD 的主要新特性包括：

- 802.11 a/b/g/n : 2.4GHz 和 5GHz 支持
- 2.4GHz 与低功耗 Bluetooth® 无线电共存
- 天线分集
- 经 FIPS 140-2 1 级验证的内部 IC 增强了安全性：[认证](#)
- 可同时打开多达 16 个安全套接字
- 唯一设备标识符能够生成证书注册请求 (CSR)
- 在线证书状态协议 (OCSP)
- Wi-Fi Alliance® 认证，具备物联网低功耗能力
- 降低模板包传输负载的无主机模式
- 改善了快速扫描特性

CC3135MOD 器件系列是 SimpleLink™ MCU 平台的一部分，该平台是一个常见、易用的开发环境，基于一个单核软件开发套件 (SDK)，具有丰富的工具集和参考设计。E2E™ 社区支持 Wi-Fi®、低功耗 Bluetooth®、Sub-1GHz 器件和主机 MCU。有关更多信息，请访问 [www.ti.com/SimpleLink](http://www.ti.com/SimpleLink)。

表 3-1. 模块信息 (1)

| 器件型号             | 封装       | 封装尺寸            |
|------------------|----------|-----------------|
| CC3135MODRNMMOBR | QFM (63) | 20.5mm × 17.5mm |

(1) 有关更多信息，请参阅节 13。

## 4 功能方框图

图 4-1 展示了 CC3135MOD 模块的功能方框图。

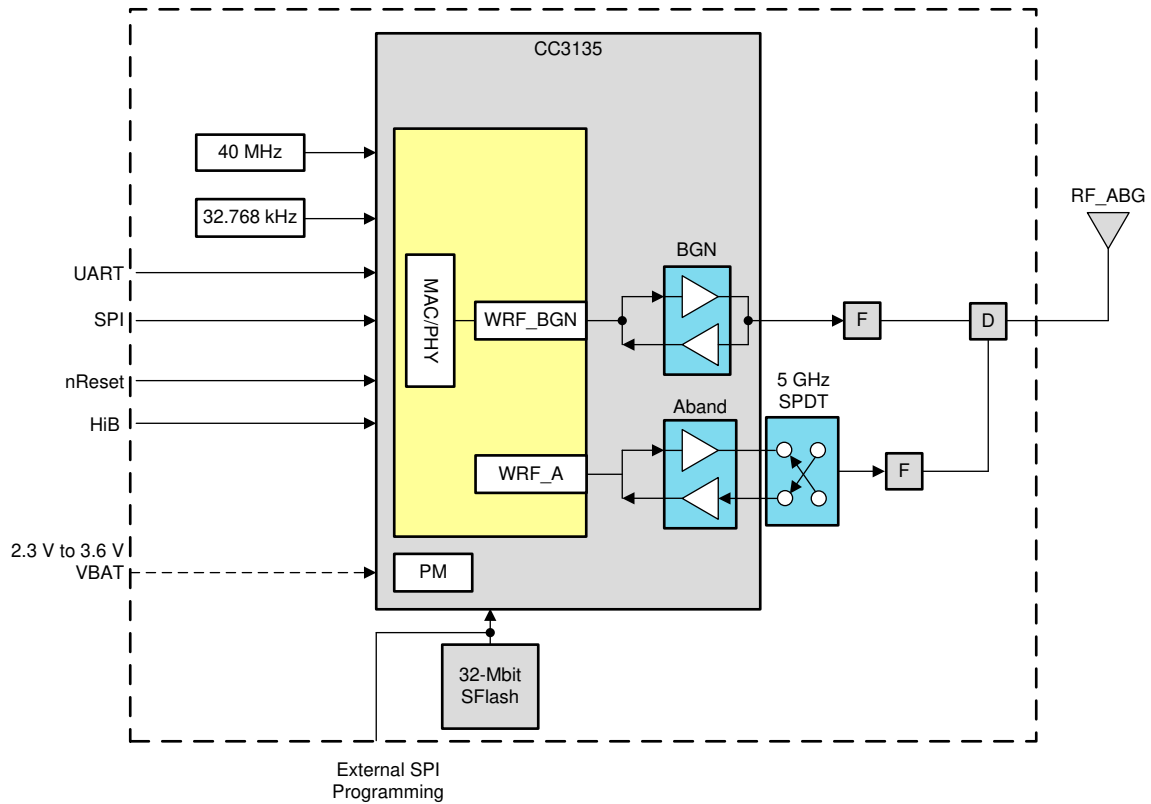


图 4-1. CC3135MOD 模块功能方框图

图 4-2 显示了 CC3135 硬件概览。

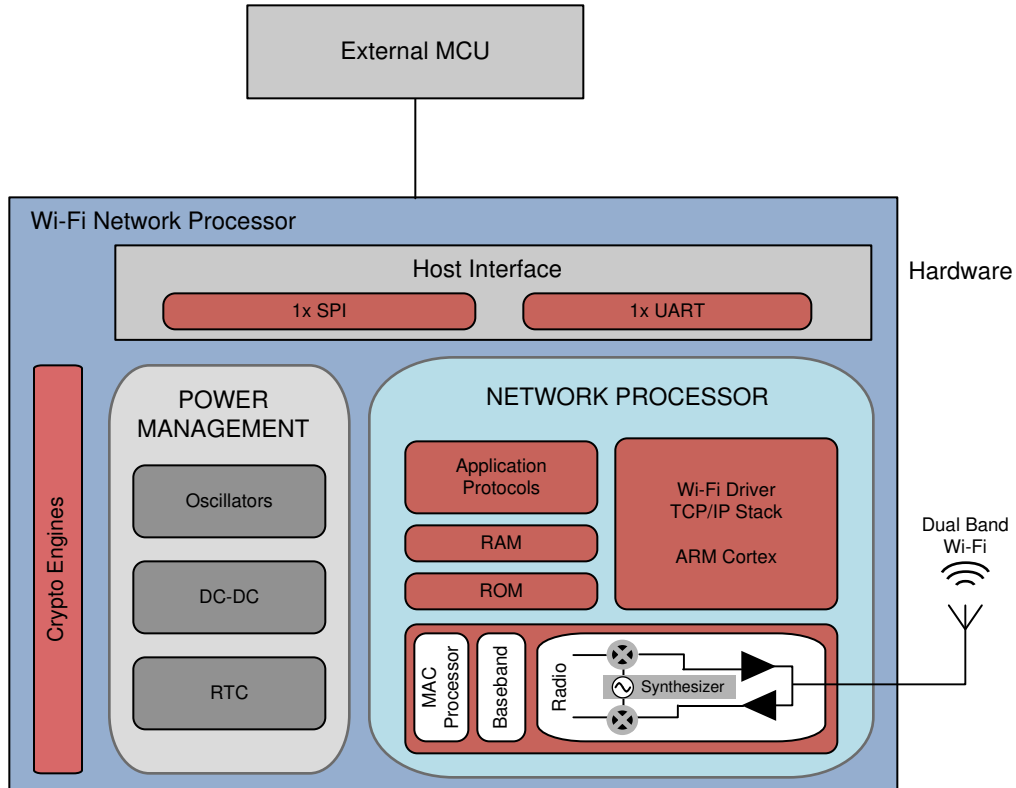
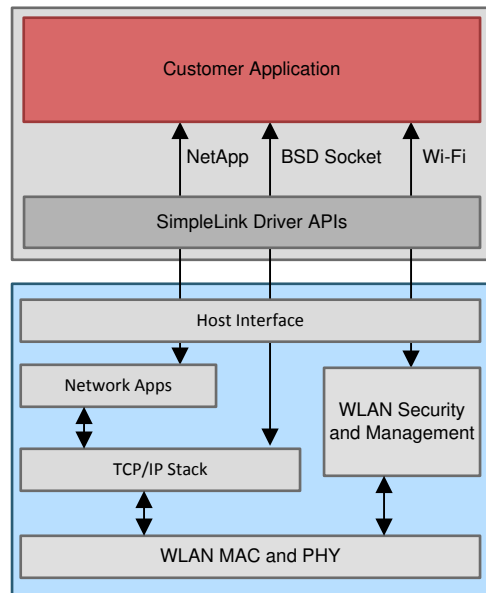


图 4-2. CC3135 硬件概览

图 4-3 显示了 CC3135 嵌入式软件概览。



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图 4-3. CC3135 嵌入式软件概览

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|---|---|

## 5 Device Comparison

表 5-1 shows the features supported across different CC3x35 modules.

表 5-1. Device Features Comparison

| FEATURE  | DEVICE  |   |   |
|--|---|---|---|
|  | CC3135MOD   | CC3235MODS  | CC3235MODSF   |
| Onboard Chip   | CC3135  | CC3235S   | CC3235SF  |
| Onboard ANT  | No  | No  | No  |
| sFlash   | 32-Mbit   | 32-Mbit   | 32-Mbit   |
| Regulatory Certification                               | FCC, IC/ISED, ETSI/CE, MIC  | FCC, IC/ISED, ETSI/CE, MIC  | FCC, IC/ISED, ETSI/CE, MIC  |
| Wi-Fi Alliance® Certification                          | Yes   | Yes   | Yes   |
| Input Voltage  | 2.3 V to 3.6 V  | 2.3 V to 3.6 V  | 2.3 V to 3.6 V  |
| Package  | 17.5 mm × 20.5 mm LGA   | 17.5 mm × 20.5 mm LGA   | 17.5 mm × 20.5 mm LGA   |
| Operating Temperature Range                            | – 40° to 85°C   | – 40° to 85°C   | – 40° to 85°C   |
| Classification   | Wi-Fi Network Processor   | Wireless Microcontroller  | Wireless Microcontroller  |
| Standard   | 802.11 a/b/g/n  | 802.11 a/b/g/n  | 802.11 a/b/g/n  |
| Frequency  | 2.4 GHz, 5 GHz  | 2.4 GHz, 5 GHz  | 2.4 GHz, 5 GHz  |
| TCP / IP Stack   | IPv4, IPv6  | IPv4, IPv6  | IPv4, IPv6  |
| Secured sockets  | 16  | 16  | 16  |
| Integrated MCU   | -   | Arm® Cortex®-M4 at 80 MHz   | Arm® Cortex®-M4 at 80 MHz   |
| <b>On-Chip Memory</b>                                  |   |   |   |
| RAM  | -   | 256KB   | 256KB   |
| Flash  | -   | -   | 1MB   |
| <b>Peripherals and Interfaces</b>                      |   |   |   |
| Universal Asynchronous Receiver and Transmitter (UART) | 1   | 2   | 2   |
| Serial Port Interface (SPI)                            | 1   | 1   | 1   |
| Multi-Channel Audio Serial Port (McASP)- I2S or PCM    | -   | 2-ch  | 2-ch  |
| Inter-Integrated Circuit (I <sup>2</sup> C)            | -   | 1   | 1   |
| Analog to Digital Converter (ADC)                      | -   | 4-ch, 12-bit  | 4-ch, 12-bit  |
| Parallel Interface (8-bit PI)                          | -   | 1   | 1   |
| General Purposes Timers                                | -   | 4   | 4   |
| Multimedia Card (MMC / SD)                             | -   | 1   | 1   |
| <b>Security Features</b>                               |   |   |   |
| Additional Networking Security                         | Unique Device Identity<br>Trusted Root-Certificate Catalog<br>TI Root-of-Trust Public key | Unique Device Identity<br>Trusted Root-Certificate Catalog<br>TI Root-of-Trust Public key                                   | Unique Device Identity<br>Trusted Root-Certificate Catalog<br>TI Root-of-Trust Public key                                   |
| Hardware Acceleration                                  | Hardware Crypto Engines   | Hardware Crypto Engines   | Hardware Crypto Engines   |
| Secure Boot  | -   | Yes   | Yes   |
| Enhanced Application Level Security                    | -   | File system security<br>Secure key storage<br>Software tamper detection<br>Cloning protection<br>Initial secure programming | File system security<br>Secure key storage<br>Software tamper detection<br>Cloning protection<br>Initial secure programming |
| FIPS 140-2 Level 1 Certification                       | Yes   | Yes   | Yes   |

## 5.1 Related Products

For information about other devices in this family of products or related products see the links below.

- The SimpleLink™ MCU Portfolio** Offers a single development environment that delivers flexible hardware, software, and tool options for customers developing wired and wireless applications. With 100% code reuse across host MCUs, Wi-Fi, Bluetooth low energy, Sub1GHz devices and more, choose the MCU or connectivity standard that fits your design. A one-time investment with the SimpleLink software development kit (SDK) allows you to reuse often, opening the door to create unlimited applications. For more information, visit [www.ti.com/simplelink](http://www.ti.com/simplelink).
- SimpleLink™ Wi-Fi® Family** Offers several Internet-on-a chip solutions, which address the need of battery operated, security enabled products. Texas Instruments offers a single chip wireless microcontroller and a wireless network processor which can be paired with any MCU, to allow developers to design new Wi-Fi products, or upgrade existing products with Wi-Fi capabilities. For more information, visit [www.ti.com/simplelinkwifi](http://www.ti.com/simplelinkwifi).
- MSP432™ Host MCU** The MSP432P401R MCU features the Arm® Cortex®-M4 processor offering ample processing capability with floating point unit and memory footprint for advanced processing algorithm, communication protocols as well as application needs, while incorporating a 14-bit 1msps ADC14 that provides a flexible and low-power analog with best-in-class performance to enable developers to add differentiated sensing and measurement capabilities to their Wi-Fi applications. For more information, visit [www.ti.com/product/MSP432P401R](http://www.ti.com/product/MSP432P401R).
- Reference Designs for CC3135 and CC3235 Modules** The TI Designs Reference Design Library is a robust reference design library spanning analog, embedded processor, and connectivity. Created by TI experts to help you jump start your system design, all TI Designs include schematic or block diagrams, BOMs, and design files to speed your time to market. Search and download designs at [www.ti.com/tidesigns](http://www.ti.com/tidesigns).
- CC3135 SDK Plug In** The CC3135 SDK Plug In contains drivers, many sample applications for Wi-Fi features and Internet, and documentation needed to use the CC3135 solution. Learn more at <http://www.ti.com/tool/simplelink-sdk-wifi-plugin>.

## 6 Pin Configuration and Functions

### 6.1 CC3135MOD Pin Diagram

图 6-1 shows the pin diagram for the CC3135MOD module.

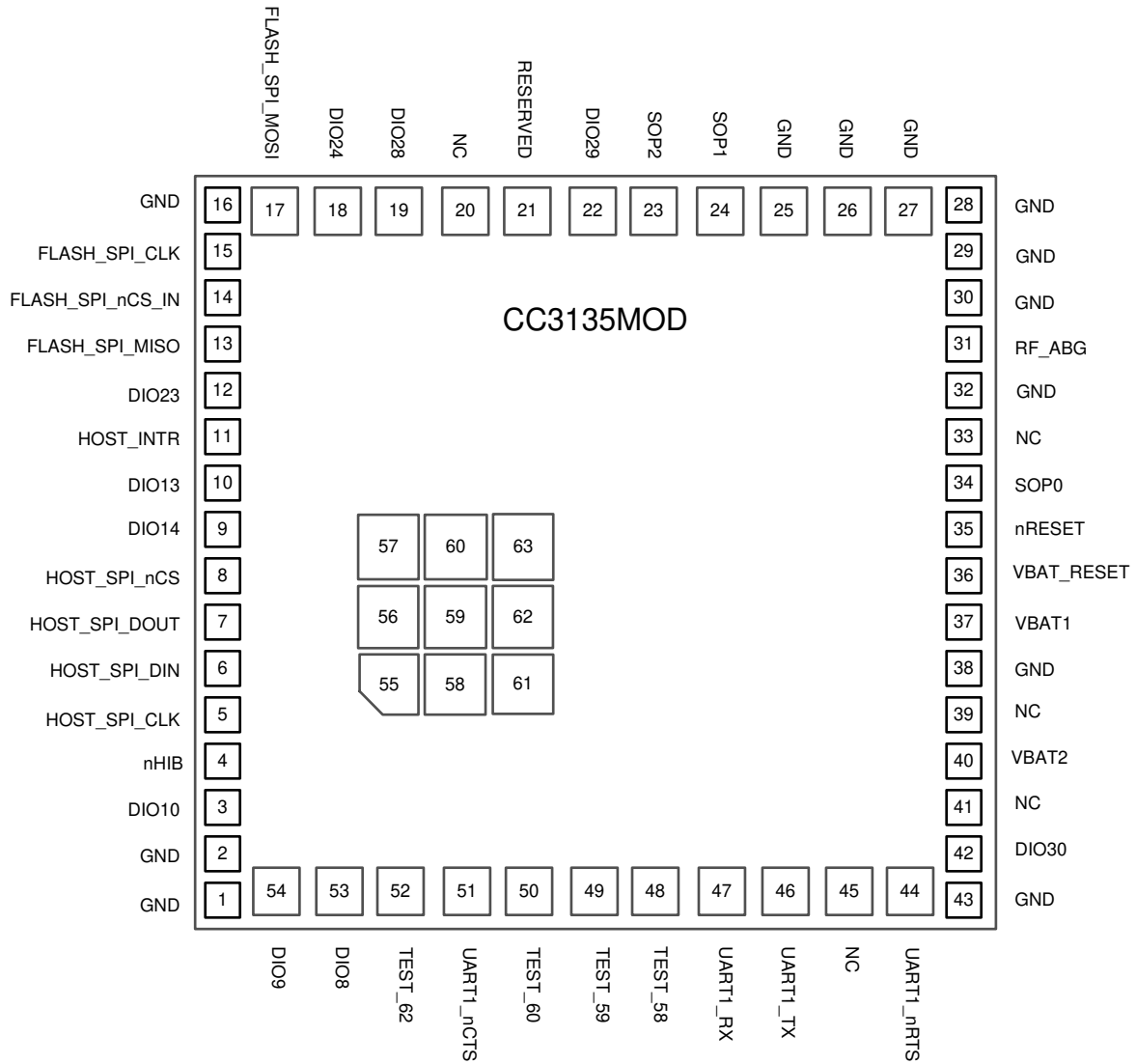


图 6-1 shows the approximate location of pins on the module.

图 6-1. CC3135MOD Pin Diagram Bottom View



## 6.2 Pin Attributes

表 6-1 describes the CC3135MOD pins.

### 备注

Digital IOs on the CC3135MOD refer to hostless mode, BLE/2.4 GHz coexistence, and antenna select IOs, not general-purpose IOs.

If an external device drives a positive voltage to signal pads when the CC3135MOD is not powered, DC current is drawn from the other device. If the drive strength of the external device is adequate, an unintentional wakeup and boot of the CC3135MOD device can occur. To prevent current draw, TI recommends one of the following:

- All devices interfaced to the CC3135MOD must be powered from the same power rail as the CC3135MOD device.
- Use level shifters between the CC3135MOD and any external devices fed from other independent rails.
- The nRESET pin of the CC3135MOD device must be held low until the  $V_{BAT}$  supply to the device is driven and stable.

**表 6-1. Pin Description and Attributes**

| PIN | DEFAULT FUNCTION | DIGITAL I/O      |                 |                | STATE AT<br>RESET AND<br>HIBERNATE | I/O TYPE <sup>(1)</sup> | CC3135 DEVICE<br>PIN NO. | DESCRIPTION   |
|-----|------------------|------------------|-----------------|----------------|------------------------------------|-------------------------|--------------------------|---|
|     |                  | HOSTLESS<br>MODE | BLE COEX        |                |                                    |                         |                          |   |
|     |                  |                  | CC_COEX_<br>OUT | CC_COEX_<br>IN |                                    |                         |                          |   |
| 1   | GND              | N/A              | N/A             | N/A            | —                                  | Power                   | -                        | GND   |
| 2   | GND              | N/A              | N/A             | N/A            | —                                  | Power                   | -                        | GND   |
| 3   | DIO10            | Y                | Y               | Y              | —                                  | I/O                     | 1                        | Digital input or output   |
| 4   | nHIB             | —                | —               | —              | Hi-Z                               | I                       | 2                        | Hibernate signal input to the NWP subsystem (active low). This is connected to the MCU GPIO. If the GPIO from the MCU can float while the MCU enters low power, consider adding a pullup resistor on the board to avoid floating. |
| 5   | HOST_SPI_CLK     | —                | —               | —              | Hi-Z                               | I                       | 5                        | Host interface SPI clock  |
| 6   | HOST_SPI_MOSI    | —                | —               | —              | Hi-Z                               | I                       | 6                        | Host interface SPI data input   |
| 7   | HOST_SPI_MISO    | —                | —               | —              | Hi-Z                               | O                       | 7                        | Host interface SPI data output  |
| 8   | HOST_SPI_nCS     | —                | —               | —              | Hi-Z                               | I                       | 8                        | Host interface SPI chip select (active low)   |
| 9   | DIO12            | Y                | Y               | Y              | —                                  | O                       | 3                        | Digital input or output   |
| 10  | DIO13            | Y                | Y               | Y              | —                                  | —                       | 4                        | Digital input or output   |
| 11  | HOST_INTR        | —                | —               | —              | Hi-Z                               | O                       | 15                       | Interrupt output (active high)  |
| 12  | DIO23            | Y                | Y               | Y              | Hi-Z                               | —                       | 16                       | Digital input or output   |
| 13  | FLASH_SPI_MISO   | N/A              | N/A             | N/A            | Hi-Z                               | O                       | -                        | External Serial Flash Programming: SPI data out   |

表 6-1. Pin Description and Attributes (续)

| PIN | DEFAULT FUNCTION | DIGITAL I/O      |             |            | STATE AT RESET AND HIBERNATE | I/O TYPE <sup>(1)</sup> | CC3135 DEVICE PIN NO. | DESCRIPTION   |
|-----|------------------|------------------|-------------|------------|------------------------------|-------------------------|-----------------------|---|
|     |                  | HOSTLESS MODE    | BLE COEX    |            |                              |                         |                       |   |
|     |                  |                  | CC_COEX_OUT | CC_COEX_IN |                              |                         |                       |   |
| 14  | FLASH_SPI_CS     | N/A              | N/A         | N/A        | Hi-Z                         | I                       | -                     | External Serial Flash Programming: SPI chip select (active low)   |
| 15  | FLASH_SPI_CLK    | N/A              | N/A         | N/A        | Hi-Z                         | I                       | -                     | External Serial Flash Programming: SPI clock  |
| 16  | GND              | N/A              | N/A         | N/A        | -                            | Power                   | -                     | Ground  |
| 17  | FLASH_SPI_MOSI   | N/A              | N/A         | N/A        | Hi-Z                         | I                       | -                     | External Serial Flash Programming: SPI data in  |
| 18  | DIO24            | Y                | Y           | Y          | Hi-Z                         |                         | 17                    | Digital input or output   |
| 19  | DIO28            | Y                | Y           | Y          | —                            | —                       | 18                    | Digital input or output   |
| 20  | NC               | N/A              | N/A         | N/A        | —                            | —                       | -                     | No Connect  |
| 21  | Reserved         | —                | —           | —          | Hi-Z                         | —                       | -                     | No Connect  |
| 22  | DIO29            | Y                | Y           | Y          | Hi-Z                         |                         | 20                    | Digital input or output   |
| 23  | SOP2             | Y <sup>(2)</sup> | Y           | —          | Hi-Z                         | O                       | 21                    | A 100 k $\Omega$ pull down resistor is internally tied to this SOP pin.   |
| 24  | SOP1             | N/A              | N/A         | N/A        | Hi-Z                         | —                       | 34                    | A 100 k $\Omega$ pull down resistor is internally tied to this SOP pin. SOP[2:0] used for factory restore. See 节 8.5. |
| 25  | GND              | N/A              | N/A         | N/A        | —                            | Power                   | -                     | GND   |
| 26  | GND              | N/A              | N/A         | N/A        | —                            | Power                   | -                     | GND   |
| 27  | GND              | N/A              | N/A         | N/A        | —                            | Power                   | -                     | GND   |
| 28  | GND              | N/A              | N/A         | N/A        | —                            | Power                   | -                     | GND   |
| 29  | GND              | N/A              | N/A         | N/A        | —                            | Power                   | -                     | GND   |
| 30  | GND              | N/A              | N/A         | N/A        | —                            | Power                   | -                     | GND   |
| 31  | RF_ABG           | N/A              | N/A         | N/A        | Hi-Z                         | RF                      | 27, 28, 31            | 2.4 GHz & 5 GHz RF TX, RX   |
| 32  | GND              | N/A              | N/A         | N/A        | —                            | Power                   | -                     | GND   |
| 33  | NC               | N/A              | N/A         | N/A        | —                            | —                       | -                     | No Connect  |
| 34  | SOP0             | N/A              | N/A         | N/A        | Hi-Z                         | —                       | 35                    | A 100 k $\Omega$ pull down resistor is internally tied to this SOP pin. SOP[2:0] used for factory restore. See 节 8.5. |

表 6-1. Pin Description and Attributes (续)

| PIN | DEFAULT FUNCTION | DIGITAL I/O   |             |            | STATE AT RESET AND HIBERNATE | I/O TYPE <sup>(1)</sup> | CC3135 DEVICE PIN NO. | DESCRIPTION  |
|-----|------------------|---------------|-------------|------------|------------------------------|-------------------------|-----------------------|--|
|     |                  | HOSTLESS MODE | BLE COEX    |            |                              |                         |                       |  |
|     |                  |               | CC_COEX_OUT | CC_COEX_IN |                              |                         |                       |  |
| 35  | nRESET           | N/A           | N/A         | N/A        | Hi-Z                         | I                       | 32                    | <p>There is an internal 100 k<math>\Omega</math> pull-up resistor option from the nRESET pin to VBAT_RESET. Note: VBAT_RESET is not connected to VBAT1 or VBAT2 within the module. The following connection schemes are recommended:</p> <ul style="list-style-type: none"> <li>Connect nRESET to a GPIO from the host only if nRESET will be in a defined state under all operating conditions. Leave VBAT_RESET unconnected to save power.</li> <li>If nRESET cannot be in a defined state under all operating conditions, connect VBAT_RESET to the main module power supply (VBAT1 and VBAT2). Due to the internal pull-up resistor, a leakage current of 3.3 V / 100 k<math>\Omega</math> is expected.</li> </ul> |
| 36  | VBAT_RESET       | N/A           | N/A         | N/A        | Hi-Z                         | —                       | 37                    |  |
| 37  | VBAT1            | N/A           | N/A         | N/A        | Hi-Z                         | —                       | 39                    | Power supply for the module, must be connected to battery (2.3 V to 3.6 V)   |
| 38  | GND              | N/A           | N/A         | N/A        | —                            | Power                   | -                     | GND  |
| 39  | NC               | N/A           | N/A         | N/A        | —                            | —                       | -                     | No Connect   |
| 40  | VBAT2            | N/A           | N/A         | N/A        | Hi-Z                         | -                       | 10, 44, 54            | Power supply for the module, must be connected to battery (2.3 V to 3.6 V)   |
| 41  | NC               | N/A           | N/A         | N/A        | -                            | -                       | -                     | No Connect   |
| 42  | DIO30            | Y             | Y           | Y          | Hi-Z                         | -                       | 53                    | Network Scriptor I/O   |
| 43  | GND              | N/A           | N/A         | N/A        | —                            | Power                   | -                     | GND  |
| 44  | UART1_nRTS       | —             | —           | —          | Hi-Z                         | O                       | 50                    | UART interface to host (request to send)   |
| 45  | NC               | N/A           | N/A         | N/A        | —                            | —                       | -                     | No Connect   |
| 46  | UART1_TX         | —             | —           | —          | Hi-Z                         | O                       | 55                    | UART interface to host (transmit)  |
| 47  | UART1_RX         | —             | —           | —          | Hi-Z                         | I                       | 57                    | UART interface to host (receive)   |
| 48  | TEST_58          | Y             | Y           | Y          | Hi-Z                         | O                       | 58                    | Test signal; connect to an external test point.  |
| 49  | TEST_59          | Y             | Y           | Y          | Hi-Z                         | I                       | 59                    | Test signal; connect to an external test point.  |
| 50  | TEST_60          | Y             | Y           | Y          | Hi-Z                         | O                       | 60                    | Test signal; connect to an external test point.  |
| 51  | UART1_nCTS       | —             | —           | —          | Hi-Z                         | I                       | 61                    | UART interface to host (clear to send)   |

表 6-1. Pin Description and Attributes (续)

| PIN | DEFAULT FUNCTION | DIGITAL I/O      |                 |                | STATE AT<br>RESET AND<br>HIBERNATE | I/O TYPE <sup>(1)</sup> | CC3135 DEVICE<br>PIN NO. | DESCRIPTION                                     |
|-----|------------------|------------------|-----------------|----------------|------------------------------------|-------------------------|--------------------------|---|
|     |                  | HOSTLESS<br>MODE | BLE COEX        |                |                                    |                         |                          |   |
|     |                  |                  | CC_COEX_<br>OUT | CC_COEX_<br>IN |                                    |                         |                          |   |
| 52  | TEST_62          | —                | —               | —              | Hi-Z                               | O                       | 62                       | Test signal; connect to an external test point. |
| 53  | DIO8             | Y                | Y               | Y              | Hi-Z                               |                         | 63                       | Digital input or output                         |
| 54  | DIO9             | Y                | Y               | Y              | Hi-Z                               | —                       | 64                       | Digital input or output                         |

(1) I = input, O = output, RF = radio frequency, I/O = bidirectional

(2) Output Only

### 6.3 Signal Descriptions

表 6-2. Signal Descriptions

| FUNCTION  | SIGNAL NAME   | PIN NO.           | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION                    |
|---|---------------|-------------------|----------|------------------|--------------------------------|
| Antenna selection   | DIO10         | 3                 | I/O      | O                | Antenna selection control      |
|   | DIO12         | 9                 | I/O      | O                |                                |
|   | DIO13         | 10                | I/O      | O                |                                |
|   | DIO23         | 12                | I/O      | O                |                                |
|   | DIO24         | 18                | I/O      | O                |                                |
|   | DIO28         | 19 <sup>(1)</sup> | I/O      | O                |                                |
|   | DIO29         | 22                | I/O      | O                |                                |
|   | DIO25         | 23                | O        | O                |                                |
|   | DIO30         | 42 <sup>(1)</sup> | I/O      | O                |                                |
|   | DIO3          | 48                | I/O      | O                |                                |
|   | DIO4          | 49                | I/O      | O                |                                |
|   | DIO5          | 50                | I/O      | O                |                                |
|   | DIO8          | 53                | I/O      | O                |                                |
|   | DIO9          | 54                | I/O      | O                |                                |
| Bluetooth Low Energy/2.4 GHz Radio coexistence <sup>(2)</sup> | DIO10         | 3                 | I/O      | I/O              | Coexistence inputs and outputs |
|   | DIO12         | 9                 | I/O      | I/O              |                                |
|   | DIO13         | 10                | I/O      | I/O              |                                |
|   | DIO23         | 12                | I/O      | I/O              |                                |
|   | DIO24         | 18                | I/O      | I/O              |                                |
|   | DIO28         | 19 <sup>(1)</sup> | I/O      | I/O              |                                |
|   | DIO29         | 22                | I/O      | I/O              |                                |
|   | DIO30         | 42 <sup>(1)</sup> | I/O      | I/O              |                                |
|   | DIO3          | 48                | I/O      | I/O              |                                |
|   | DIO4          | 49                | I/O      | I/O              |                                |
|   | DIO5          | 50                | I/O      | I/O              |                                |
|   | DIO8          | 53                | I/O      | I/O              |                                |
|   | DIO9          | 54                | I/O      | I/O              |                                |
|   | Hostless Mode | DIO10             | 3        | I/O              |                                |
| DIO12   |               | 9                 | I/O      | I/O              |                                |
| DIO13   |               | 10                | I/O      | I/O              |                                |
| DIO23   |               | 12                | I/O      | I/O              |                                |
| DIO24   |               | 18                | I/O      | I/O              |                                |
| DIO28   |               | 19 <sup>(1)</sup> | I/O      | I/O              |                                |
| DIO29   |               | 22                | I/O      | I/O              |                                |
| DIO25   |               | 23                | O        | O                |                                |
| DIO30   |               | 42 <sup>(1)</sup> | I/O      | I/O              |                                |
| DIO3  |               | 48                | I/O      | I/O              |                                |
| DIO4  |               | 49                | I/O      | I/O              |                                |
| DIO5  |               | 50                | I/O      | I/O              |                                |
| DIO8  |               | 53                | I/O      | I/O              |                                |
| DIO9  |               | 54                | I/O      | I/O              |                                |

表 6-2. Signal Descriptions (续)

| FUNCTION       | SIGNAL NAME    | PIN NO.           | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION   |
|----------------|----------------|-------------------|----------|------------------|---|
| HOST SPI       | HOST_SPI_CLK   | 5                 | I/O      | I                | Host SPI clock input  |
|                | HOST_SPI_MOSI  | 6                 | I/O      | I                | Data from Host  |
|                | HOST_SPI_MISO  | 7                 | I/O      | O                | Data to Host  |
|                | HOST_SPI_nCS   | 8                 | I/O      | I                | Device select (active low)                                    |
| FLASH SPI      | FLASH_SPI_MISO | 13                | O        | I                | External serial Flash interface: SPI data out                 |
|                | FLASH_SPI_CS   | 14                | I        | O                | External serial Flash interface: SPI chip select (active low) |
|                | FLASH_SPI_CLK  | 15                | I        | O                | External serial Flash interface: SPI clock                    |
|                | FLASH_SPI_MOSI | 17                | I        | O                | External serial Flash interface: SPI data in                  |
| UART           | UART1_nRTS     | 44                | I/O      | O                | UART1 request-to-send (active low)                            |
|                | UART1_TX       | 46                | I/O      | I                | UART TX data  |
|                | UART1_RX       | 47                | I/O      | O                | UART RX data  |
|                | UART1_nCTS     | 51                | I/O      | I                | UART1 clear-to-send (active low)                              |
| Sense-On-Power | SOP2           | 23 <sup>(3)</sup> | O        | I                | Sense-on-power 2  |
|                | SOP1           | 24                | I        | I                | Configuration sense-on-power 1                                |
|                | SOP0           | 34                | I        | I                | Configuration sense-on-power 0                                |
| Power          | VBAT1          | 37                | -        | -                | Power supply for the module                                   |
|                | VBAT2          | 40                | -        | -                | Power supply for the module                                   |
| nHIB           | nHIB           | 4                 | I        | I                | Hibernate signal input to the NWP subsystem (active low)      |
| RF             | RF_ABG         | 31                | I/O      | I/O              | WLAN analog RF 802.11 a/b/g/n bands                           |
| Test Port      | TEST_58        | 48                | O        | O                | Test Signal   |
|                | TEST_59        | 49                | I        | I                | Test Signal   |
|                | TEST_60        | 50                | O        | O                | Test Signal   |
|                | TEST_62        | 52                | O        | O                | Test Signal   |

(1) LPDS retention unavailable.

(2) The CC3135MOD modules are compatible with TI BLE modules using an external RF switch.

(3) This pin has dual functions: as a SOP[2] (device operation mode), and as an external TCXO enable. As a TCXO enable, the pin is an output on power up and driven logic high. During hibernate low-power mode, the pin is in a Hi-Z state but is pulled down for SOP mode to disable TCXO. Because of the SOP functionality, the pin must be used as an output only.

## 6.4 Connections for Unused Pins

All unused pins must be left as no connect (NC) pins. 表 6-3 provides a list of NC pins.

表 6-3. Connections for Unused Pins

| FUNCTION   | SIGNAL DESCRIPTION           | PIN NUMBER                           | ACCEPTABLE PRACTICE   |
|------------|------------------------------|--------------------------------------|---|
| DIO        | Digital input or output      | 3, 9, 10, 12, 18, 19, 22, 42, 53, 54 | Wake up I/O source should not be floating during hibernate. All the I/O pins will float while in Hibernate and Reset states. Ensure pullup and pulldown resistors are available on board to maintain the state of the I/O. Leave unused GPIOs as NC.  |
| No Connect | NC                           | 20, 21, 33, 39, 41, 45               | Unused pin, leave as NC.  |
| SOP        | Configuration sense-on-power | 23, 24, 34                           | Leave as NC (Modules contain internal 100k $\Omega$ pulldown resistors on the SOP lines). An external 10k $\Omega$ pullup resistor is required for factory restore. See 节 8.5.  |
| Reset      | RESET input for the device   | 35, 36                               | <p>There is an internal 100k <math>\Omega</math> pull-up resistor option from the nRESET pin to VBAT_RESET. Note: VBAT_RESET is not connected to VBAT1 or VBAT2 within the module. The following connection schemes are recommended:</p> <ul style="list-style-type: none"> <li>Connect nRESET to a GPIO from the host only if nRESET will be in a defined state under all operating conditions. Leave VBAT_RESET unconnected to save power.</li> <li>If nRESET cannot be in a defined state under all operating conditions, connect VBAT_RESET to the main module power supply (VBAT1 and VBAT2). Due to the internal pull-up resistor, a leakage current of 3.3V / 100k <math>\Omega</math> is expected.</li> </ul> |

## 7 Specifications

All measurements are references of the module pins, unless otherwise indicated. All specifications are over process and voltage, unless otherwise indicated.

### 7.1 Absolute Maximum Ratings

These specifications indicate levels where permanent damage to the module can occur. Functional operation is not ensured under these conditions. Operation at absolute maximum conditions for extended periods can adversely affect long-term reliability of the module <sup>(1)</sup> <sup>(2)</sup>.

|   | MIN   | MAX                    | UNIT |
|---|-------|------------------------|------|
| V <sub>BAT</sub>                                    | - 0.5 | 3.8                    | V    |
| Digital I/O   | - 0.5 | V <sub>BAT</sub> + 0.5 | V    |
| RF pin  | - 0.5 | 2.1                    | V    |
| Analog pins   | - 0.5 | 2.1                    | V    |
| Operating temperature, T <sub>A</sub>               | - 40  | 85                     | °C   |
| Storage temperature, T <sub>stg</sub>               | - 40  | 85                     | °C   |
| Junction temperature, T <sub>j</sub> <sup>(3)</sup> |       | 120                    | °C   |

- (1) 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 under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values are with respect to V<sub>SS</sub>, unless otherwise noted.
- (3) Junction temperature is for the CC3135RNMARGK device that is contained within the module.

### 7.2 ESD Ratings

|                  |   |  | VALUE | UNIT |
|------------------|---|--|-------|------|
| V <sub>ESD</sub> | Electrostatic discharge (ESD) performance | Human body model (HBM), per ANSI/ESDA/JEDEC JS001 <sup>(1)</sup> | ±2000 | V    |
|                  |   | Charged device model (CDM), per JESD22-C101 <sup>(2)</sup>       | ±500  |      |

- (1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

### 7.3 Recommended Operating Conditions

Function operation is not ensured outside this limit, and operation outside this limit for extended periods can adversely affect long-term reliability of the module <sup>(1)</sup> <sup>(2)</sup> <sup>(3)</sup>.

|                       | MIN  | TYP | MAX | UNIT      |
|-----------------------|------|-----|-----|-----------|
| V <sub>BAT</sub>      | 2.3  | 3.3 | 3.6 | V         |
| Operating temperature | - 40 | 25  | 85  | °C        |
| Ambient thermal slew  | - 20 |     | 20  | °C/minute |

- (1) When operating at an ambient temperature of over 75°C, the transmit duty cycle must remain below 50% to avoid the auto-protect feature of the power amplifier. If the auto-protect feature triggers, the device takes a maximum of 60 seconds to restart the transmission.
- (2) To ensure WLAN performance, ripple on the 2.3V to 3.6V supply must be less than ±300mV.
- (3) The minimum voltage specified includes the ripple on the supply voltage and all other transient dips. The brownout condition is 2.1V, and care must be taken when operating at the minimum specified voltage.



## 7.4 Current Consumption Summary: 2.4GHz RF Band

T<sub>A</sub> = 25°C, V<sub>BAT</sub> = 3.6V

| PARAMETER                                   | TEST CONDITIONS <sup>(1) (2)</sup> |                    | MIN | TYP | MAX | UNIT |
|---|------------------------------------|--------------------|-----|-----|-----|------|
| TX  | 1 DSSS                             | TX power level = 0 |     | 272 |     | mA   |
|   |                                    | TX power level = 4 |     | 188 |     |      |
|   | 6 OFDM                             | TX power level = 0 |     | 248 |     |      |
|   |                                    | TX power level = 4 |     | 179 |     |      |
|   | 54 OFDM                            | TX power level = 0 |     | 223 |     |      |
|   |                                    | TX power level = 4 |     | 160 |     |      |
| RX <sup>(3)</sup>                           | 1 DSSS                             |                    |     | 53  |     | mA   |
|   | 54 OFDM                            |                    |     | 53  |     |      |
| Idle connected <sup>(4)</sup>               |                                    |                    |     | 690 |     | μA   |
| LPDS  |                                    |                    |     | 115 |     | μA   |
| Hibernate                                   |                                    |                    |     | 5.5 |     | μA   |
| Shutdown                                    |                                    |                    |     | 1   |     | μA   |
| Peak calibration current <sup>(5) (3)</sup> | V <sub>BAT</sub> = 3.6 V           |                    |     | 420 |     | mA   |
|   | V <sub>BAT</sub> = 3.3 V           |                    |     | 450 |     |      |
|   | V <sub>BAT</sub> = 2.3 V           |                    |     | 610 |     |      |

- (1) TX power level = 0 implies maximum power (see [图 7-1](#), [图 7-2](#), and [图 7-3](#)). TX power level = 4 implies output power backed off approximately 4dB.
- (2) The CC3135MOD system is a constant power-source system. The active current numbers scale based on the V<sub>BAT</sub> voltage supplied.
- (3) The RX current is measured with a 1Mbps throughput rate.
- (4) DTIM = 1
- (5) The complete calibration can take up to 17mJ of energy from the battery over a time of 24ms. In default mode, calibration is performed sparingly, and typically occurs when reenabling the NWP and when the temperature has changed by more than 20°C. There are two additional calibration modes that may be used to reduced or completely eliminate the calibration event. For further details, see [CC31XX CC32XX SimpleLink™ Wi-Fi® and IoT Network Processor Programmer's Guide](#).

## 7.5 Current Consumption Summary: 5GHz RF Band

T<sub>A</sub> = 25°C, V<sub>BAT</sub> = 3.6 V

| PARAMETER                                   | TEST CONDITIONS <sup>(1) (2)</sup> | MIN | TYP | MAX | UNIT |
|---|------------------------------------|-----|-----|-----|------|
| TX  | 6 OFDM                             |     | 318 |     | mA   |
|   | 54 OFDM                            |     | 293 |     |      |
| RX <sup>(3)</sup>                           | 54 OFDM                            |     | 61  |     | mA   |
| Idle connected <sup>(4)</sup>               |                                    |     | 690 |     | μA   |
| LPDS  |                                    |     | 115 |     | μA   |
| Hibernate                                   |                                    |     | 5.5 |     | μA   |
| Shutdown                                    |                                    |     | 1   |     | μA   |
| Peak calibration current <sup>(5) (3)</sup> | V <sub>BAT</sub> = 3.6 V           |     | 290 |     | mA   |
|   | V <sub>BAT</sub> = 3.3 V           |     | 310 |     |      |
|   | V <sub>BAT</sub> = 2.7 V           |     | 310 |     |      |
|   | V <sub>BAT</sub> = 2.3 V           |     | 365 |     |      |

- (1) TX power level = 0 implies maximum power (see [图 7-1](#), [图 7-2](#), and [图 7-3](#)). TX power level = 4 implies output power backed off approximately 4dB.
- (2) The CC3135MOD system is a constant power-source system. The active current numbers scale based on the V<sub>BAT</sub> voltage supplied.
- (3) The RX current is measured with a 1Mbps throughput rate.
- (4) DTIM = 1
- (5) The complete calibration can take up to 17mJ of energy from the battery over a time of 24ms. In default mode, calibration is performed sparingly, and typically occurs when reenabling the NWP and when the temperature has changed by more than 20°C. There are two additional calibration modes that may be used to reduced or completely eliminate the calibration event. For further details, see [CC31XX, CC32XX SimpleLink™ Wi-Fi® and IoT Network Processor Programmer's Guide](#).

## 7.6 TX Power Control for 2.4 GHz Band

The CC3135MOD has several options for modifying the output power of the device when required. For the 2.4 GHz band it is possible to lower the overall output power at a global level using the global TX power level setting. In addition, the 2.4 GHz band allows the user to enter additional back-offs <sup>1</sup>, per channel, region <sup>2</sup> and modulation rates <sup>3 4</sup>, via Image creator (see the *UniFlash CC31xx, CC32xx SimpleLink™ Wi-Fi® and Internet-on-a chip™ Solution ImageCreator and Programming Tool User's Guide* for more details).

图 7-1, 图 7-2, and 图 7-3 show TX Power and IBAT versus TX power level settings for modulations of 1 DSSS, 6 OFDM, and 54 OFDM, respectively.<sup>4</sup>

In 图 7-1, the area enclosed in the circle represents a significant reduction in current during transition from TX power level 3 to level 4. In the case of lower range requirements (14-dBm output power), TI recommends using TX power level 4 to reduce the current.

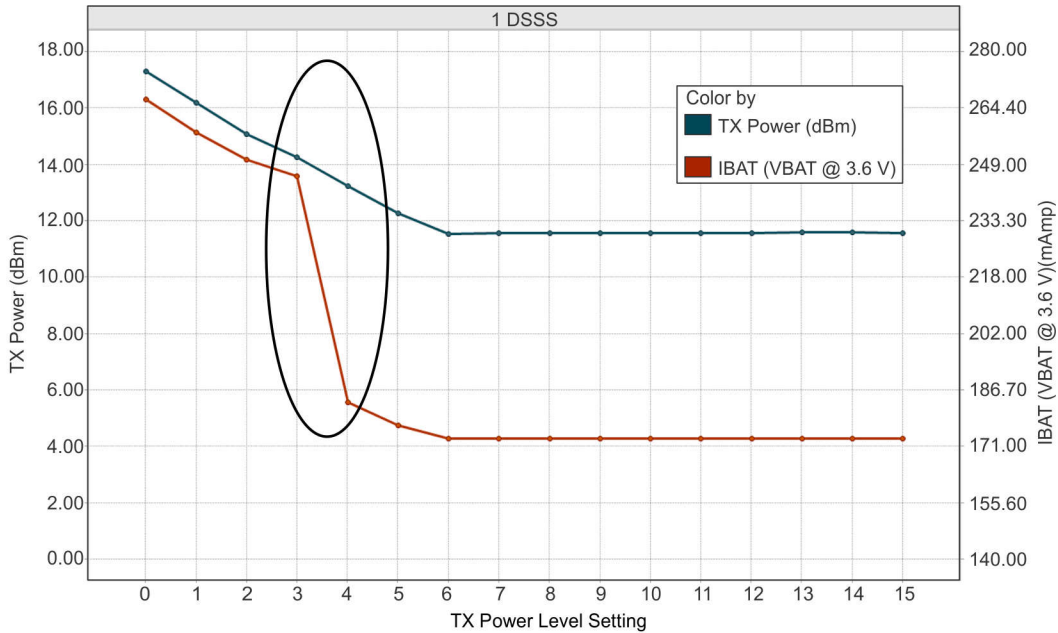


图 7-1. TX Power and IBAT vs TX Power Level Settings (1 DSSS)

<sup>1</sup> The back-off range is between -6dB to +6dB in 0.25dB increments.

<sup>2</sup> FCC, IC/ISED, ETSI/CE (Europe), and MIC (Japan) are supported.

<sup>3</sup> Back-off rates are grouped into 11b rates, high modulation rates (MCS7, 54 OFDM and 48 OFDM), and lower modulation rates (all other rates).

<sup>4</sup> Please note that there will be a delta between the CC3235MODx module and CC3235x IC's TX power levels.

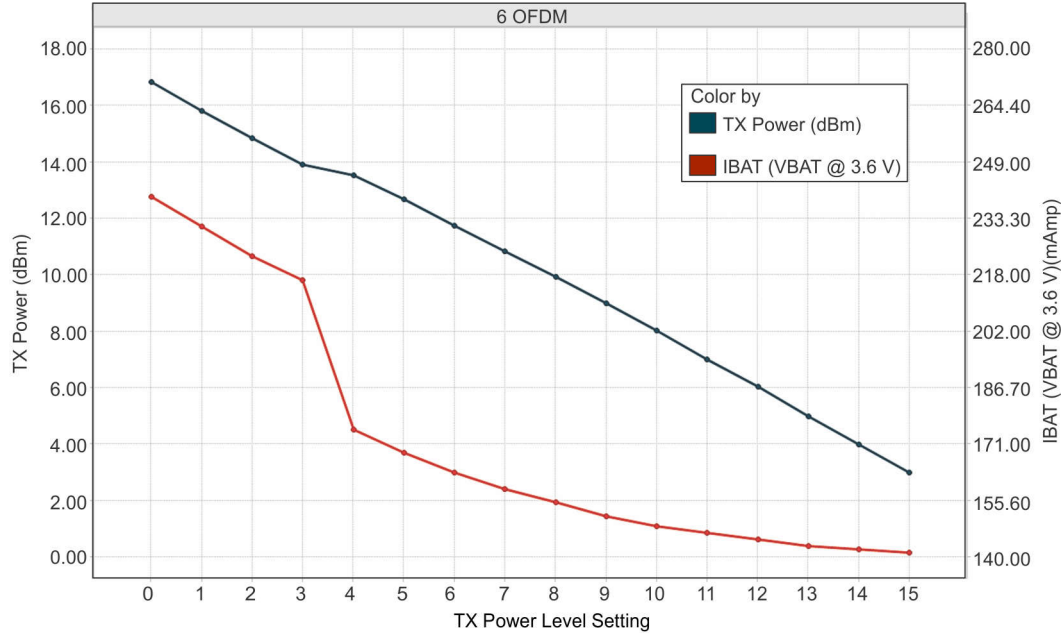


图 7-2. TX Power and IBAT vs TX Power Level Settings (6 OFDM)

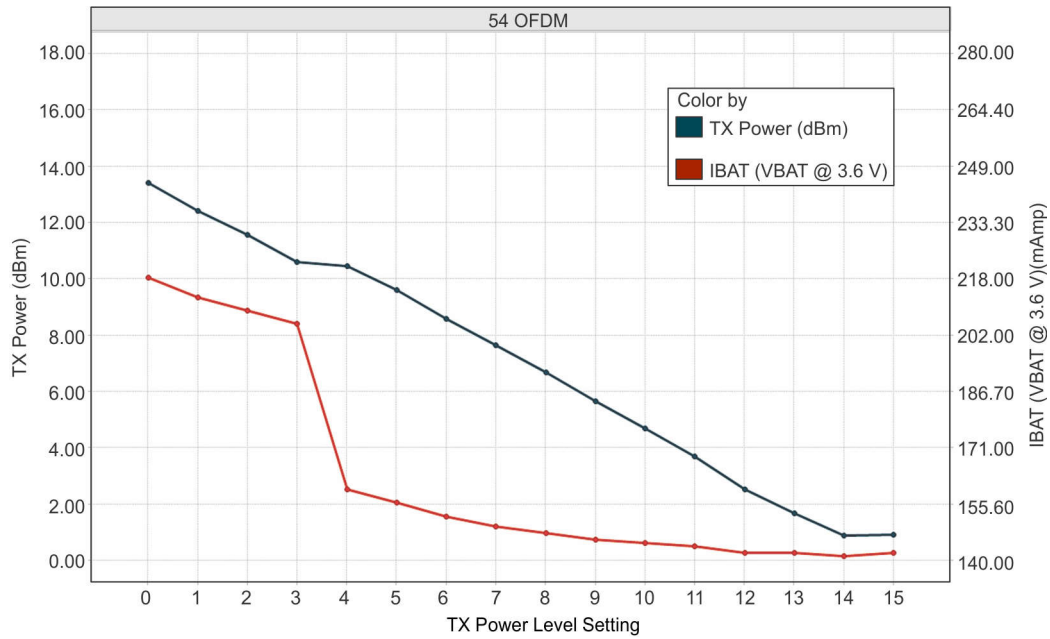


图 7-3. TX Power and IBAT vs TX Power Level Settings (54 OFDM)

## 7.7 TX Power Control for 5GHz Band

5GHz power control is done through the Image Creator where the maximum transmit power is provided <sup>5</sup>. Within Image Creator, power control is possible per channel, region <sup>6</sup>, and modulation rates <sup>7</sup>. In addition, it is possible to enter an additional back-off <sup>8</sup> factor per channel and modulation rate for further margin to regulatory requirements.

Finally, it is also possible to set the TX and RX trace losses to the antenna per band <sup>9</sup>. The peak antenna gain <sup>10</sup> can also be provided, thus allowing further control. For a full description of options and capabilities see the [UniFlash CC31xx, CC32xx SimpleLink™ Wi-Fi® and Internet-on-a chip™ Solution ImageCreator and Programming Tool User's Guide](#).

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<sup>5</sup> The maximum transmit power range is 18dBm to 0.125dBm in 0.125dBm decrements.

<sup>6</sup> FCC, IC/ISED, ETSI/CE, and MIC are supported.

<sup>7</sup> Rates are grouped into high modulation rates (MCS7, 54 OFDM and 48 OFDM) and lower modulation rates (all other rates).

<sup>8</sup> The back-off range is 0dBm to 18dBm in 0.125dBm increments, with the maximum back-off not exceed that of the maximum transmit power.

<sup>9</sup> The range of losses if from 0dBm to 7.75dBm in 0.125dBm increments.

<sup>10</sup> The antenna gain has a range of -2dBi to 5.75dBi in 0.125dBi increments.

## 7.8 Brownout and Blackout Conditions

The device enters a brownout condition when the input voltage dips below  $V_{\text{BROWNOUT}}$  (see 图 7-4 and 图 7-5). This condition must be considered during the design of the power supply routing, especially if operating from a battery. High-current operations, such as a TX packet or any external activity (not necessarily related directly to networking) can cause a drop in the supply voltage, potentially triggering a brownout condition. The resistance includes the internal resistance of the battery, the contact resistance of the battery holder (four contacts for a 2x AA battery), and the wiring and PCB routing resistance.

### 备注

When the device is in the Hibernate state, brownout is not detected; only blackout is in effect during the Hibernate state.

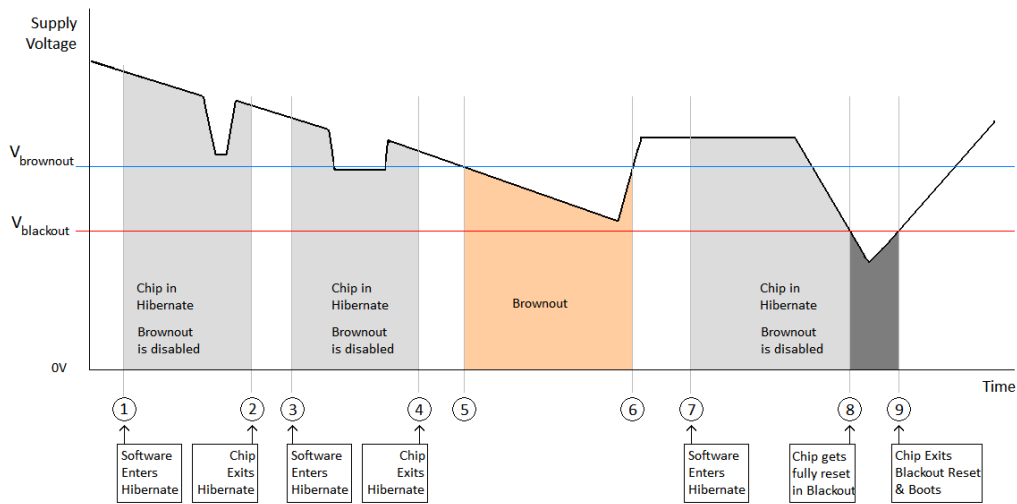


图 7-4. Brownout and Blackout Levels (1 of 2)

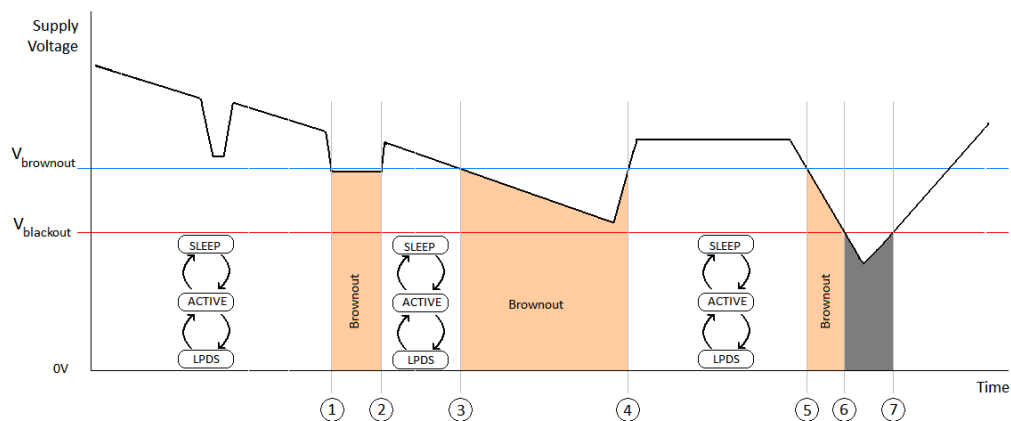


图 7-5. Brownout and Blackout Levels (2 of 2)

In the brownout condition, all sections of the CC3135MOD (including the 32kHz RTC) shut down except for the Hibernate module, which remains on. The current in this state can reach approximately 400µA. The blackout condition is equivalent to a hardware reset event in which all states within the device are lost.

表 7-1 lists the brownout and blackout voltage levels.

表 7-1. Brownout and Blackout Voltage Levels

| CONDITION             | VOLTAGE LEVEL | UNIT |
|-----------------------|---------------|------|
| $V_{\text{brownout}}$ | 2.1           | V    |
| $V_{\text{blackout}}$ | 1.67          | V    |

## 7.9 Electrical Characteristics for DIO Pins

$T_A = 25^\circ\text{C}$ ,  $V_{\text{BAT}} = 3.3\text{V}$

| PARAMETER       |                           | TEST CONDITIONS <sup>(1)</sup>   | MIN                         | NOM | MAX                            | UNIT |
|-----------------|---------------------------|--|-----------------------------|-----|--------------------------------|------|
| $C_{\text{IN}}$ | Pin capacitance           |  |                             | 4   |                                | pF   |
| $V_{\text{IH}}$ | High-level input voltage  |  | $0.65 \times V_{\text{DD}}$ |     | $V_{\text{DD}} + 0.5\text{ V}$ | V    |
| $V_{\text{IL}}$ | Low-level input voltage   |  | - 0.5                       |     | $0.35 \times V_{\text{DD}}$    | V    |
| $I_{\text{IH}}$ | High-level input current  |  |                             | 5   |                                | nA   |
| $I_{\text{IL}}$ | Low-level input current   |  |                             | 5   |                                | nA   |
| $V_{\text{OH}}$ | High-level output voltage | IL = 2 mA; configured I/O drive strength = 2 mA;<br>$2.4\text{ V} \leq V_{\text{DD}} < 3.6\text{ V}$ |                             |     | $V_{\text{DD}} \times 0.8$     | V    |
|                 |                           | IL = 4 mA; configured I/O drive strength = 4 mA;<br>$2.4\text{ V} \leq V_{\text{DD}} < 3.6\text{ V}$ |                             |     | $V_{\text{DD}} \times 0.7$     | V    |
|                 |                           | IL = 8 mA; configured I/O drive strength = 8 mA;<br>$2.4\text{ V} \leq V_{\text{DD}} < 3.6\text{ V}$ |                             |     | $V_{\text{DD}} \times 0.7$     | V    |
|                 |                           | IL = 2 mA; configured I/O drive strength = 2 mA;<br>$2.3\text{ V} \leq V_{\text{DD}} < 2.4\text{ V}$ |                             |     | $V_{\text{DD}} \times 0.75$    | V    |
| $V_{\text{OL}}$ | Low-level output voltage  | IL = 2 mA; configured I/O drive strength = 2 mA;<br>$2.4\text{ V} \leq V_{\text{DD}} < 3.6\text{ V}$ | $V_{\text{DD}} \times 0.2$  |     |                                | V    |
|                 |                           | IL = 4 mA; configured I/O drive strength = 4 mA;<br>$2.4\text{ V} \leq V_{\text{DD}} < 3.6\text{ V}$ | $V_{\text{DD}} \times 0.2$  |     |                                | V    |
|                 |                           | IL = 8 mA; configured I/O drive strength = 8 mA;<br>$2.4\text{ V} \leq V_{\text{DD}} < 3.6\text{ V}$ | $V_{\text{DD}} \times 0.2$  |     |                                | V    |
|                 |                           | IL = 2 mA; configured I/O drive strength = 2 mA;<br>$2.3\text{ V} \leq V_{\text{DD}} < 2.4\text{ V}$ | $V_{\text{DD}} \times 0.25$ |     |                                | V    |
| $I_{\text{OH}}$ | High-level source current | 2-mA drive   |                             | 2   |                                | mA   |
|                 |                           | 4-mA drive   |                             | 4   |                                |      |
|                 |                           | 6-mA drive   |                             | 6   |                                |      |
| $I_{\text{OL}}$ | Low-level sink current    | 2-mA drive   |                             | 2   |                                | mA   |
|                 |                           | 4-mA drive   |                             | 4   |                                |      |
|                 |                           | 6-mA drive   |                             | 6   |                                |      |
| $V_{\text{IL}}$ | nRESET <sup>(2)</sup>     |  | 0.6                         |     |                                | V    |

- (1) TI recommends using the lowest possible drive strength that is adequate for the applications. This recommendation minimizes the risk of interference to the WLAN radio and reduces any potential degradation of RF sensitivity and performance. The default drive strength setting is 6mA.
- (2) The nRESET pin must be held below 0.6V for the device to register a reset.

## 7.10 WLAN Receiver Characteristics

**表 7-2. WLAN Receiver Characteristics: 2.4GHz Band**

$T_A = 25^\circ\text{C}$ ,  $V_{BAT} = 2.3\text{V}$  to  $3.6\text{V}$ . Parameters are measured at the SoC pin on channel 6 (2437MHz).

| PARAMETER   | TEST CONDITIONS (Mbps)   | MIN | TYP    | MAX | UNIT |
|---|--------------------------|-----|--------|-----|------|
| Sensitivity<br>(8% PER for 11b rates, 10% PER for 11g/11n rates) <sup>(1)</sup> | 1 DSSS                   |     | - 94.5 |     | dBm  |
|   | 2 DSSS                   |     | - 92.5 |     |      |
|   | 11 CCK                   |     | - 86.5 |     |      |
|   | 6 OFDM                   |     | - 89   |     |      |
|   | 9 OFDM                   |     | - 88.5 |     |      |
|   | 18 OFDM                  |     | - 85   |     |      |
|   | 36 OFDM                  |     | - 79   |     |      |
|   | 54 OFDM                  |     | - 73   |     |      |
|   | MCS7 (GF) <sup>(2)</sup> |     | - 70   |     |      |
| Maximum input level<br>(10% PER)  | 802.11b                  |     | - 2.5  |     | dBm  |
|   | 802.11g                  |     | - 8.5  |     |      |

(1) Sensitivity is 1dB worse on channel 13 (2472 MHz).

(2) The sensitivity for mixed mode is 1dB worse.

**表 7-3. WLAN Receiver Characteristics: 5GHz Band**

$T_A = 25^\circ\text{C}$ ,  $V_{BAT} = 2.3\text{V}$  to  $3.6\text{V}$ .

| PARAMETER                                  | TEST CONDITIONS (Mbps) | MIN                      | TYP   | MAX | UNIT |
|--|------------------------|--------------------------|-------|-----|------|
| Sensitivity<br>(10% PER for 11g/11n rates) | 6 OFDM                 |                          | -89   |     | dBm  |
|  | 9 OFDM                 |                          | -88   |     |      |
|  | 18 OFDM                |                          | -85   |     |      |
|  | 36 OFDM                |                          | -78.5 |     |      |
|  | 54 OFDM                |                          | -72   |     |      |
|  |                        | MCS7 (GF) <sup>(1)</sup> |       | -68 |      |
| Maximum input level                        | 802.11a                |                          | -17   |     | dBm  |

(1) The sensitivity for mixed mode is 1dB worse.

## 7.11 WLAN Transmitter Characteristics

**表 7-4. WLAN Transmitter Characteristics: 2.4GHz Band**

$T_A = 25^\circ\text{C}$ ,  $V_{BAT} = 2.3\text{V}$  to  $3.6\text{V}$ .<sup>(1)</sup> Parameters measured at SoC pin on channel 6 (2437MHz).<sup>(2)</sup> <sup>(3)</sup>

| PARAMETER  | TEST CONDITIONS | MIN  | TYP  | MAX  | UNIT |
|--|-----------------|------|------|------|------|
| Operating frequency range <sup>(4)</sup> <sup>(5)</sup>                  |                 | 2412 |      | 2472 | MHz  |
| Maximum RMS output power measured at 1 dB from IEEE spectral mask or EVM | 1 DSSS          |      | 16   |      | dBm  |
|  | 2 DSSS          |      | 16   |      |      |
|  | 11 CCK          |      | 16.3 |      |      |
|  | 6 OFDM          |      | 15.3 |      |      |
|  | 9 OFDM          |      | 15.3 |      |      |
|  | 18 OFDM         |      | 15   |      |      |
|  | 36 OFDM         |      | 14   |      |      |
|  | 54 OFDM         |      | 12.5 |      |      |
|  | MCS7            |      | 11   |      |      |
| Transmit center frequency accuracy                                       |                 | - 25 |      | 25   | ppm  |

(1) Transmit power will be reduced by 1.5dB for  $V_{BAT} < 2.8\text{V}$

(2) The 11g/n low rates on edge channels (2412 and 2462MHz) have reduced TX power to meet FCC emission limits.

(3) Power of 802.11b rates are reduced to meet ETSI requirements in Europe.

(4) Channels 1 (2142MHz) through 11 (2462MHz) are supported for FCC.

(5) Channels 1 (2142MHz) through 13 (2472MHz) are supported for Europe and Japan. Note that channel 14 is not supported for Japan.

**表 7-5. WLAN Transmitter Characteristics: 5GHz Band**

$T_A = 25^\circ\text{C}$ ,  $V_{BAT} = 2.3\text{V}$  to  $3.6\text{V}$ .<sup>(1)</sup> Parameters measured at SoC pin are the average of channels 40, 56, 120, and 157.<sup>(2)</sup> <sup>(3)</sup>

| PARAMETER  | TEST CONDITIONS | MIN  | TYP  | MAX  | UNIT |
|--|-----------------|------|------|------|------|
| Operating frequency range <sup>(4)</sup> <sup>(5)</sup> <sup>(6)</sup>   |                 | 5180 |      | 5825 | MHz  |
| Maximum RMS output power measured at 1 dB from IEEE spectral mask or EVM | 6 OFDM          |      | 15.1 |      | dBm  |
|  | 9 OFDM          |      | 15.1 |      |      |
|  | 18 OFDM         |      | 15.1 |      |      |
|  | 36 OFDM         |      | 13.6 |      |      |
|  | 54 OFDM         |      | 12   |      |      |
|  | MCS7            |      | 11   |      |      |
| Transmit center frequency accuracy                                       |                 | -20  |      | 20   | ppm  |

(1) Transmit power will be reduced by 1.5dB for  $V_{BAT} < 2.8\text{V}$

(2) FCC channels 36, 60, 64, 100, and 140, where harmonics/subharmonics fall in the FCC restricted band, have reduced output power to meet the FCC RSE requirement.

(3) The edge channels (100 and 140) have reduced TX power to meet FCC emissions limits.

(4) FCC band covers U-NII-1, U-NII-2A, U-NII-2C, and U-NII-3 20MHz BW modulations.

(5) Europe bands 1, 2, and 3, 20MHz BW modulations are supported.

(6) For Japan, W52, W53 and W56, 20MHz BW modulations are supported.



## 7.12 BLE and WLAN Coexistence Requirements

For proper BLE and WLAN 2.4GHz radio coexistence, the following requirements must be met.

**表 7-6. BLE/WLAN Coex <sup>(1)</sup> Isolation Requirement**

| PARAMETER              | Band                                      | MIN               | TYP | MAX | UNIT |
|------------------------|---|-------------------|-----|-----|------|
| Port-to-port isolation | Dual antenna configuration <sup>(2)</sup> | 20 <sup>(3)</sup> |     |     | dB   |

- (1) The CC3135MOD modules are compatible with TI BLE modules using an external RF switch.  
 (2) A single antenna configuration is possible using the CC3x35 devices.  
 (3) For dual antenna configuration antenna placement must be such that isolation between the BLE and WLAN ports is at least 20dB.

## 7.13 Reset Requirement

| PARAMETER   | MIN | TYP                     | MAX | UNIT |
|---|-----|-------------------------|-----|------|
| V <sub>IH</sub> Operation mode level                  |     | 0.65 × V <sub>BAT</sub> |     | V    |
| V <sub>IL</sub> Shutdown mode level <sup>(1)</sup>    | 0   | 0.6                     |     | V    |
| Minimum time for nReset low for resetting the module  | 5   |                         |     | ms   |
| T <sub>r</sub> and T <sub>f</sub> Rise and fall times |     | 20                      |     | μs   |

- (1) The nRESET pin must be held below 0.6V for the module to register a reset.

## 7.14 Thermal Resistance Characteristics for MOB Package

| NO. | PARAMETER        | DESCRIPTION             | °C/W <sup>(1) (2)</sup> | AIR FLOW (m/s) <sup>(3)</sup> |
|-----|------------------|-------------------------|-------------------------|-------------------------------|
| T1  | R <sub>θJC</sub> | Junction-to-case        | 11.4                    | N/A                           |
| T2  | R <sub>θJB</sub> | Junction-to-board       | 8.0                     | N/A                           |
| T3  | R <sub>θJA</sub> | Junction-to-free air    | 19.1                    | 0                             |
| T4  |                  | Junction-to-moving air  | 14.7                    | 1                             |
| T5  |                  |                         | 13.4                    | 2                             |
| T6  |                  |                         | 12.5                    | 3                             |
| T7  | Ψ <sub>JT</sub>  | Junction-to-free air    | 5.4                     | 0                             |
| T8  |                  | Junction-to-package top | 5.8                     | 1                             |
| T9  |                  |                         | 6.1                     | 2                             |
| T10 |                  |                         | 6.5                     | 3                             |
| T11 | Ψ <sub>JB</sub>  | Junction-to-free air    | 6.8                     | 0                             |
| T12 |                  | Junction-to-board       | 6.6                     | 1                             |
| T13 |                  |                         | 6.6                     | 2                             |
| T14 |                  |                         | 6.5                     | 3                             |

- (1) °C/W = degrees Celsius per watt.  
 (2) These values are based on a JEDEC-defined 2S2P system (with the exception of the Theta JC [R<sub>θJC</sub>] value, which is based on a JEDEC-defined 1S0P system) and will change based on environment as well as application. For more information, see these EIA/JEDEC standards:
- JESD51-2, *Integrated Circuits Thermal Test Method Environmental Conditions - Natural Convection (Still Air)*
  - JESD51-3, *Low Effective Thermal Conductivity Test Board for Leaded Surface Mount Packages*
  - JESD51-7, *High Effective Thermal Conductivity Test Board for Leaded Surface Mount Packages*
  - JESD51-9, *Test Boards for Area Array Surface Mount Package Thermal Measurements*
- Power dissipation of 2W and an ambient temperature of 70°C is assumed.  
 (3) m/s = meters per second.

## 7.15 Timing and Switching Characteristics

### 7.15.1 Power-Up Sequencing

For proper start-up of the CC3135MOD module, perform the recommended power-up sequencing as follows:

1. Tie  $V_{BAT1}$  (pin 37) and  $V_{BAT2}$  (pin 40) together on the board.
2. Hold the nRESET pin low while the supplies are ramping up.

图 7-6 shows the reset timing diagram for the first-time power-up and reset removal.

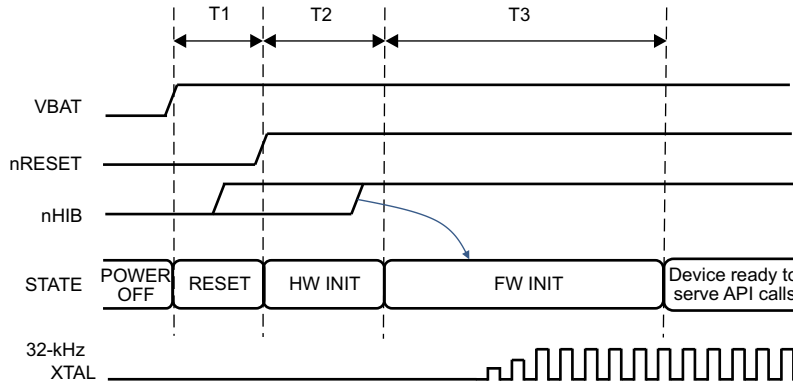


图 7-6. First-Time Power-Up and Reset Removal Timing Diagram

表 7-7 describes the timing requirements for the first-time power-up and reset removal.

表 7-7. First-Time Power-Up and Reset Removal Timing Requirements

| ITEM | NAME                  | DESCRIPTION   | MIN | TYP  | MAX | UNIT |
|------|-----------------------|---|-----|------|-----|------|
| T1   | nReset time           | nReset timing after VBAT supplies are stable  |     | 1    |     | ms   |
| T2   | Hardware wake-up time |   |     | 25   |     | ms   |
| T3   | Initialization time   | Internal 32kHz XTAL settling plus firmware initialization time plus radio calibration |     | 1.35 |     | s    |

### 7.15.2 Power-Down Sequencing

For proper power down of the CC3135MOD module, ensure that the nRESET (pin 35) and nHIB (pin 4) pins have remained in a known state for a minimum of 200ms before removing power from the module.

### 7.15.3 Device Reset

When a device restart is required, the user may issue a negative pulse on either the nHIB pin (pin 4) or on the nRESET pin (pin 35), keeping the other pulled high, depending on the configuration of the platform. If the nRESET pin is used, the user must insure the following:

- A high-to-low reset pulse (on pin 35) of at least 200ms duration

To ensure a proper reset sequence, the user must call the sl\_stop function prior to toggling the reset.

### 7.15.4 Wakeup From HIBERNATE Mode Timing

图 7-7 shows the timing diagram for wakeup from HIBERNATE mode.

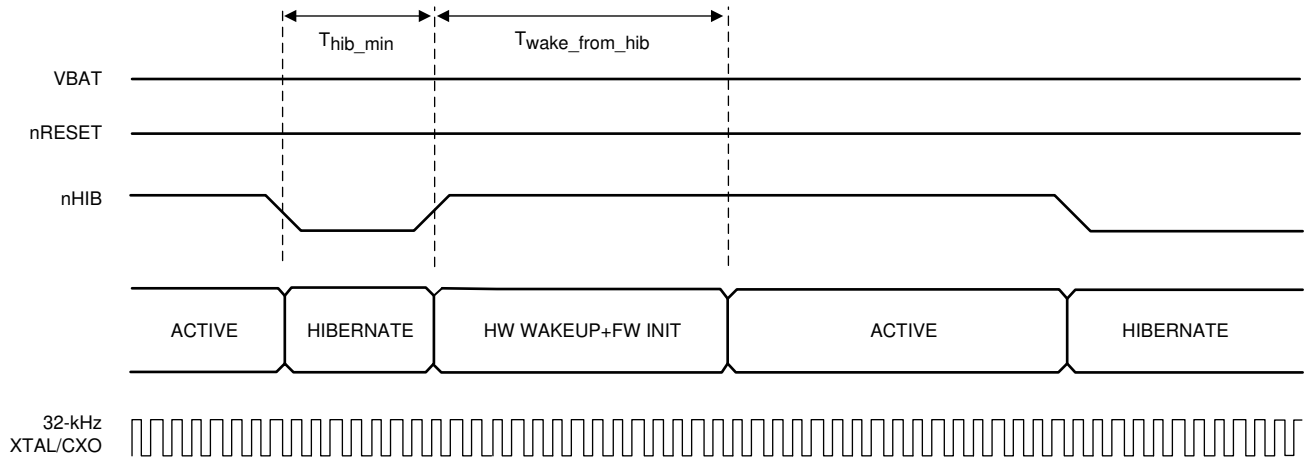


图 7-7. nHIB Timing Diagram

#### 备注

The internal 32.768-kHz XTAL is kept enabled by default when the chip goes into HIBERNATE mode in response to nHIB being pulled low.

表 7-8 describes the timing requirements for nHIB.

表 7-8. nHIB Timing Requirements

| ITEM                       | NAME   | DESCRIPTION  | MIN | TYP | MAX | UNIT |
|----------------------------|--|--|-----|-----|-----|------|
| T <sub>hib_min</sub>       | Minimum hibernate time                                 | Minimum pulse width of nHIB being low <sup>(1)</sup> | 10  |     |     | ms   |
| T <sub>wake_from_hib</sub> | Hardware wakeup time plus firmware initialization time | See <sup>(2)</sup>                                   |     | 50  |     | ms   |

- (1) If temperature changes by more than 20°C, initialization time from HIB can increase by 200 ms due to radio calibration.
- (2) Ensure that the nHIB pulse width is kept above the minimum requirement under all conditions (such as power up, MCU reset, and so on).

## 7.16 External Interfaces

This section describes the external interfaces supported by the CC3135MOD module, as follows:

- SPI Host
- Host UART
- External Flash

### 7.16.1 SPI Host Interface

The device interfaces to an external host using the SPI. The CC3135MOD module can interrupt the host using the HOST\_INTR line to initiate the data transfer over the interface. The SPI host interface can work up to a speed of 20MHz.

图 7-8 shows the SPI host interface.

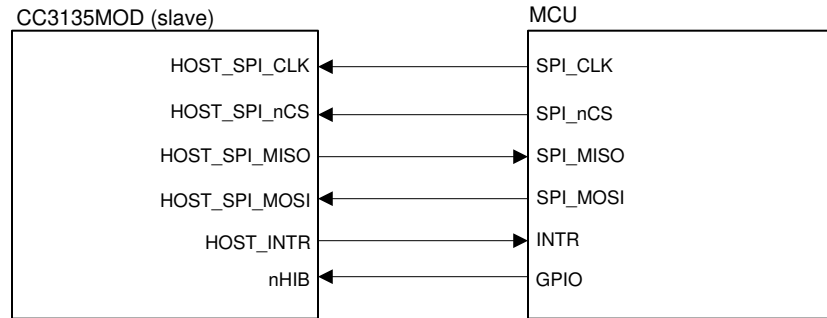


图 7-8. SPI Host Interface

表 7-9 lists the SPI host interface pins.

表 7-9. SPI Host Interface

| PIN NAME      | DESCRIPTION   |
|---------------|---|
| HOST_SPI_CLK  | Clock (up to 20MHz) from MCU host to CC3135MOD module   |
| HOST_SPI_nCS  | CS (active low) signal from MCU host to CC3135MOD module  |
| HOST_SPI_MOSI | Data from MCU host to CC3135MOD module  |
| HOST_INTR     | Interrupt from CC3135MOD module to MCU host   |
| HOST_SPI_MISO | Data from the CC3135MOD module to the MCU host  |
| nHIB          | Active-low signal that commands the CC3135MOD module to enter hibernate mode (lowest power state) |

图 7-9 shows the host SPI timing diagram.

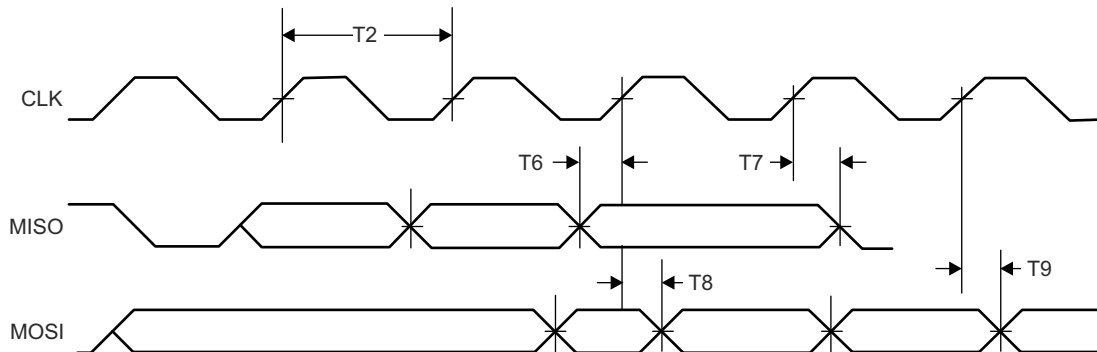


图 7-9. Host SPI Timing

表 7-10 lists the host SPI timing parameters.

表 7-10. Host SPI Timing Parameters

| PARAMETER NUMBER | DESCRIPTION |   | MIN | MAX | UNIT |
|------------------|-------------|---|-----|-----|------|
| T1               | F           | Clock frequency at $V_{BAT} = 3.3\text{ V}$ |     | 20  | MHz  |
|                  |             | Clock frequency at $V_{BAT} = 2.3\text{ V}$ |     | 12  |      |
| T2               | $t_{clk}$   | Clock period                                | 50  |     | ns   |
| T3               | $t_{LP}$    | Clock low period                            |     | 25  | ns   |
| T4               | $t_{HT}$    | Clock high period                           |     | 25  | ns   |
| T5               | D           | Duty cycle                                  | 45% | 55% |      |
| T6               | $t_{IS}$    | RX data setup time                          | 4   |     | ns   |
| T7               | $t_{IH}$    | RX data hold time                           | 4   |     | ns   |
| T8               | $t_{OD}$    | TX data output delay                        |     | 20  | ns   |
| T9               | $t_{OH}$    | TX data hold time                           |     | 24  | ns   |

### 7.16.2 Host UART Interface

The SimpleLink device requires the UART configuration described in 表 7-11.

表 7-11. SimpleLink™ UART Configuration

| PROPERTY                | SUPPORTED CC3135 CONFIGURATION   |
|-------------------------|--|
| Baud rate               | 115200bps, no auto-baud rate detection, can be changed by the host up to 3Mbps using a special command |
| Data bits               | 8 bits   |
| Flow control            | CTS/RTS  |
| Parity                  | None   |
| Stop bits               | 1  |
| Bit order               | Least significant bit (LSB) first  |
| Host interrupt polarity | Active high  |
| Host interrupt mode     | Rising edge or level 1   |
| Endianness              | Little-endian only <sup>(1)</sup>  |

(1) The SimpleLink device does not support automatic detection of the host length while using the UART interface.

#### 7.16.2.1 5-Wire UART Topology

图 7-10 shows the typical 5-wire UART topology comprised of four standard UART lines plus one IRQ line from the device to the host controller to allow efficient low power mode.

图 7-10 shows the typical and recommended UART topology because it offers the maximum communication reliability and flexibility between the host and the SimpleLink device.

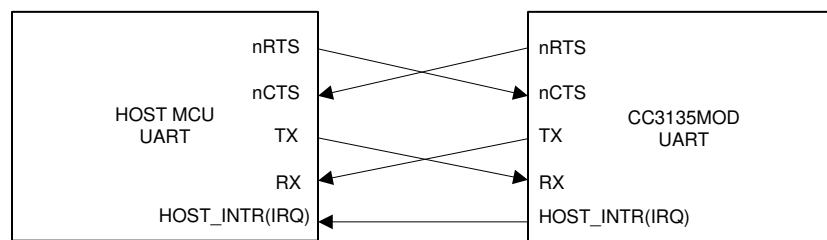


图 7-10. Typical 5-Wire UART Topology

### 7.16.2.2 4-Wire UART Topology

The 4-wire UART topology eliminates the host IRQ line (see 图 7-11). Using this topology requires one of the following conditions to be met:

- Host is always awake or active.
- Host goes to sleep, but the UART module has receiver start-edge detection for automatic wake up and does not lose data.

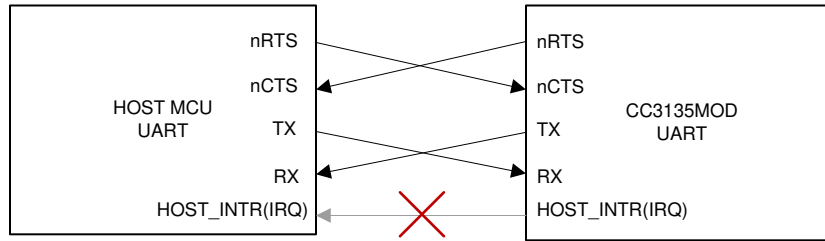


图 7-11. 4-Wire UART Configuration

### 7.16.2.3 3-Wire UART Topology

The 3-wire UART topology requires only the following lines (see 图 7-12).

- RX
- TX
- nCTS

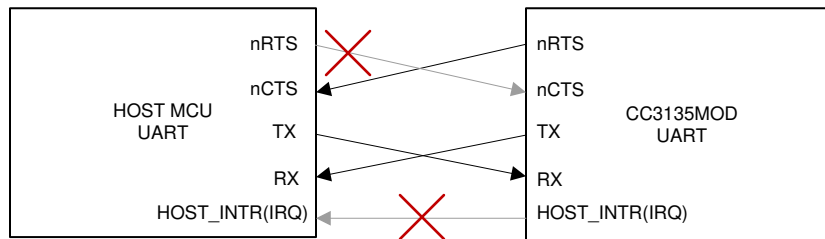


图 7-12. 3-Wire UART Topology

Using 3-wire topology requires one of the following conditions to be met:

- Host always stays awake or active.
- Host goes to sleep, but the UART module has receiver start-edge detection for auto wake up and does not lose data.
- Host can always receive any amount of data transmitted by the SimpleLink device because there is no flow control in this direction.

Because there is no full flow control, the host cannot stop the SimpleLink device to send its data; thus, the following parameters must be carefully considered:

- Maximum baud rate
- RX character interrupt latency and low-level driver jitter buffer
- Time consumed by the user's application

### **7.16.3 External Flash Interface**

The CC3135MOD module includes the Macronix 32-Mbit Serial Flash. The Serial Flash can be programmed directly via the external Flash interface (pins 13, 14, 15, and 17). Note that during normal operation, the external Flash interface should remain unconnected.

For timing details, see the [MX25R3235F](#) data sheet.

## 8 Detailed Description

### 8.1 Overview

The CC3135MOD dual-band Wi-Fi module contains a dedicated Arm® MCU that offloads many of the networking activities from the host MCU. Including an 802.11 a/b/g/n radio, baseband, and MAC with a powerful crypto engine for a fast, secure WLAN and Internet connections with 256-bit encryption. The CC3135MOD module supports station, AP, and Wi-Fi Direct modes. The device also supports WPA2 personal and enterprise security, WPS 2.0, and WPA3 personal and enterprise security <sup>11</sup>. The Wi-Fi network processor includes an embedded IPv6 and IPv4 TCP/IP stack.

### 8.2 Module Features

#### 8.2.1 WLAN

The WLAN features are as follows:

- 802.11 a/b/g/n integrated radio, modem, and MAC supporting WLAN communication as a BSS station, AP, and Wi-Fi Direct client and group owner with CCK and OFDM rates in the 2.4GHz ISM band, channels 1 to 13, and 5GHz U-NII band.

---

#### 备注

802.11n is supported only in Wi-Fi station, Wi-Fi direct, and P2P client modes.

- Autocalibrated radio with a single-ended 50  $\Omega$  interface enables easy connection to the antenna without requiring expertise in radio circuit design.
- Advanced connection manager with multiple user-configurable profiles stored in a serial Flash allows automatic, fast connection to an access point without user or host intervention.
- Supports all common Wi-Fi security modes for personal and enterprise networks, with on-chip security accelerators, including WEP, WPA/WPA2 PSK, WPA2 Enterprise (802.1x), WPA3 Personal, and WPA3 Enterprise.

---

#### 备注

When using WPA Enterprise security modes, the TLS socket used to communicate with the Radius server is limited to TLSv1.0.

- Smart provisioning options deeply integrated within the device provide a comprehensive end-to-end solution. Elaborate events notification to the host enable the application to control the provisioning decision flow. The wide variety of Wi-Fi provisioning methods include:
  - Access Point using HTTPS
  - SmartConfig Technology: a 1-step, 1-time process to connect a CC3135MOD-enabled module to the home wireless network, removing dependency on the I/O capabilities of the host MCU; thus, the device is usable by deeply embedded applications.
- 802.11 transceiver mode transmits and receives proprietary data through a socket without adding MAC or PHY headers, and provides the option to select the working channel, rate, and transmitted power. The receiver mode works together with the filtering options.

---

<sup>11</sup> Supported from Service Pack v4.5.0.11-3.1.0.5-3.1.0.25. Limited to STA mode only.



### 8.2.2 Network Stack

The network stack features are as follows:

- Integrated IPv4, IPv6, and TCP/IP stack with BSD socket APIs for simple Internet connectivity with any MCU, microprocessor, or ASIC

---

**备注**

Not all APIs are 100% BSD compliant. Not all BSD APIs are supported.

---

- Support of 16 simultaneous TCP, UDP, RAW, SSL/TLS sockets
- Built-in network protocols:
  - Static IP, LLA, DHCPv4, DHCPv6 (Stateful) with DAD and Stateless auto-configuration
  - ARP, ICMPv4, IGMP, ICMPv6, MLD, ND
  - DNS client for easy connection to the local network and the Internet
- Built-in network application and utilities:
  - HTTP/HTTPS
    - Web page content stored on serial Flash
    - RESTful APIs for setting/configuring application content
    - Dynamic user callbacks
- Service discovery: Multicast DNS service discovery allows a client to advertise its service without a centralized server. After connecting to the access point, the CC3135 device provides critical information, such as device name, IP, vendor, and port number.
- DHCP server
- Ping

表 8-1 summarizes the NWP features.

**表 8-1. NWP Features**

| Feature                            | Description   |
|------------------------------------|---|
| Wi-Fi standards                    | 802.11a/b/g/n station<br>802.11a/b/g AP supporting up to four stations<br>Wi-Fi Direct client and group owner |
| Wi-Fi channels                     | 2.4GHz ISM and 5GHz U-NII Channels  |
| Channel Bandwidth                  | 20MHz   |
| Wi-Fi security                     | WEP, WPA/WPA2 PSK, WPA2 enterprise (802.1x), WPA3 personal and enterprise <sup>(1)</sup>                      |
| Wi-Fi provisioning                 | SmartConfig technology, Wi-Fi protected setup (WPS2), AP mode with internal HTTP web server                   |
| IP protocols                       | IPv4/IPv6   |
| IP addressing                      | Static IP, LLA, DHCPv4, DHCPv6 with DAD   |
| Cross layer                        | ARP, ICMPv4, IGMP, ICMPv6, MLD, NDP   |
| Transport                          | UDP, TCP<br>SSLv3.0/TLSv1.0/TLSv1.1/TLSv1.2<br>RAW  |
| Network applications and utilities | Ping<br>HTTP/HTTPS web server<br>mDNS<br>DNS-SD<br>DHCP server  |
| Host interface                     | UART/SPI  |

表 8-1. NWP Features ( 续 )

| Feature          | Description  |
|------------------|--|
| Security         | Device identity<br>Trusted root-certificate catalog<br>TI root-of-trust public key   |
| Power management | Enhanced power policy management uses 802.11 power save and deep-sleep power modes   |
| Other            | Transceiver<br>Programmable RX filters with an event-trigger mechanism<br>Rx Metrics for tracking the surrounding RF environment |

(1) Supported from Service Pack v4.5.0.11-3.1.0.5-3.1.0.25. Limited to STA mode only. When using WPA Enterprise security modes, the TLS socket used to communicate with the Radius server is limited to TLSv1.0.

### 8.2.2.1 Security

The SimpleLink Wi-Fi CC3135MOD internet-on-a-chip module enhances the security capabilities available for development of IoT devices, while completely offloading these activities from the MCU to the networking subsystem. The security capabilities include the following key features:

#### Wi-Fi and Internet security

- Personal and enterprise Wi-Fi security
  - Personal standards
    - AES (WPA2-PSK)
    - TKIP (WPA-PSK)
    - WEP
- Enterprise standards
  - EAP Fast
  - EAP PEAPv0 MSCHAPv2
  - EAP PEAPv0 TLS
  - EAP PEAPv1 TLS EAP LS
  - EAP TTLS TLS
  - EAP TTLS MSCHAPv2

- **Secure sockets**
  - Protocol versions: SSL v3/TLS 1.0/TLS 1.1/TLS 1.2
  - On-chip powerful crypto engine for fast, secure Wi-Fi and internet connections with 256-bit AES encryption for TLS and SSL connections
  - Ciphers suites
    - SL\_SEC\_MASK\_SSL\_RSA\_WITH\_RC4\_128\_SHA
    - SL\_SEC\_MASK\_SSL\_RSA\_WITH\_RC4\_128\_MD5
    - SL\_SEC\_MASK\_TLS\_RSA\_WITH\_AES\_256\_CBC\_SHA
    - SL\_SEC\_MASK\_TLS\_DHE\_RSA\_WITH\_AES\_256\_CBC\_SHA
    - SL\_SEC\_MASK\_TLS\_ECDHE\_RSA\_WITH\_AES\_256\_CBC\_SHA
    - SL\_SEC\_MASK\_TLS\_ECDHE\_RSA\_WITH\_RC4\_128\_SHA
    - SL\_SEC\_MASK\_TLS\_RSA\_WITH\_AES\_128\_CBC\_SHA256
    - SL\_SEC\_MASK\_TLS\_RSA\_WITH\_AES\_256\_CBC\_SHA256
    - SL\_SEC\_MASK\_TLS\_ECDHE\_RSA\_WITH\_AES\_128\_CBC\_SHA256
    - SL\_SEC\_MASK\_TLS\_ECDHE\_ECDSA\_WITH\_AES\_128\_CBC\_SHA256
    - SL\_SEC\_MASK\_TLS\_ECDHE\_ECDSA\_WITH\_AES\_128\_CBC\_SHA
    - SL\_SEC\_MASK\_TLS\_ECDHE\_ECDSA\_WITH\_AES\_256\_CBC\_SHA
    - SL\_SEC\_MASK\_TLS\_RSA\_WITH\_AES\_128\_GCM\_SHA256
    - SL\_SEC\_MASK\_TLS\_RSA\_WITH\_AES\_256\_GCM\_SHA384
    - SL\_SEC\_MASK\_TLS\_DHE\_RSA\_WITH\_AES\_128\_GCM\_SHA256
    - SL\_SEC\_MASK\_TLS\_DHE\_RSA\_WITH\_AES\_256\_GCM\_SHA384
    - SL\_SEC\_MASK\_TLS\_ECDHE\_RSA\_WITH\_AES\_128\_GCM\_SHA256
    - SL\_SEC\_MASK\_TLS\_ECDHE\_RSA\_WITH\_AES\_256\_GCM\_SHA384
    - SL\_SEC\_MASK\_TLS\_ECDHE\_ECDSA\_WITH\_AES\_128\_GCM\_SHA256
    - SL\_SEC\_MASK\_TLS\_ECDHE\_ECDSA\_WITH\_AES\_256\_GCM\_SHA384
    - SL\_SEC\_MASK\_TLS\_ECDHE\_ECDSA\_WITH\_CHACHA20\_POLY1305\_SHA256
    - SL\_SEC\_MASK\_TLS\_ECDHE\_RSA\_WITH\_CHACHA20\_POLY1305\_SHA256
    - SL\_SEC\_MASK\_TLS\_DHE\_RSA\_WITH\_CHACHA20\_POLY1305\_SHA256
  - Server authentication
  - Client authentication
  - Domain name verification
  - Socket upgrade to secure socket - STARTTLS
- Secure HTTP server (HTTPS)
- The trusted root-certificate catalog verifies that the CA used by the application is trusted and known secure content delivery.
- The TI root-of-trust public key is a hardware-based mechanism that allows authenticating TI as the genuine origin of a given content using asymmetric keys.
- Secure content delivery allows file transfer to the system in a secure way on any unsecured tunnel.
- Code and data security
  - Secured network information: Network passwords and certificates are encrypted.
  - Secured and authenticated service pack: SP is signed based on TI certificate.

### 8.2.3 FIPS 140-2 Level 1 Certification

The Federal Information Processing Standard (FIPS) Publication 140-2 is a U.S. government computer security standard. It is commonly referred to as FIPS 140-2, and is used to accredit the design and implementation of cryptographic functions, for example within a chip. A cryptographic function within a chip security system is necessary to maintain the confidentiality and integrity of the information that is being processed.

The security functions of the CC3135 chip which is inside the CC3135MOD module, are FIPS certified to FIPS 140-2 level 1. This certification covers topics such as: cryptographic specifications, ports and interfaces, a finite state model for the cryptographic functions, the operational environment of the function, and how cryptographic keys are managed. The certification provides the assurance that the implementation meets FIPS 140-2 level 1 standards.

### 8.2.4 Host Interface and Driver

- Interfaces over a 4-wire SPI with any MCU or a processor at a clock speed of 20MHz
- Interfaces over UART with any MCU with a baud rate up to 3Mbps. A low-footprint driver is provided for TI MCUs and is easily ported to any processor or ASIC.
- Simple APIs enable easy integration with any single-threaded or multithreaded application.

### 8.2.5 System

- Connects directly to a battery
- Ultra-low leakage when disabled (hibernate mode) with a current of less than 5.5 $\mu$ A with the RTC running and 1 $\mu$ A when in Shutdown mode.
- Integrated clock sources

## 8.3 Power-Management Subsystem

The CC3135MOD power-management subsystem contains DC-DC converters to accommodate the differing voltage or current requirements of the system.

The CC3135MOD is a fully integrated module-based WLAN radio solution used on an embedded system with a wide-voltage supply range. The internal power management, including DC-DC converters and LDOs, generates all of the voltages required for the module to operate from a wide variety of input sources. For maximum flexibility, the module can operate in the modes described in the following sections.

### 8.3.1 $V_{BAT}$ Wide-Voltage Connection

In the wide-voltage battery connection, the module can be directly connected to two AA alkaline batteries. All other voltages required to operate the device are generated internally by the DC-DC converters. This scheme is the most common mode for the device because it supports wide-voltage operation from 2.3V to 3.6V.

## 8.4 Low-Power Operating Modes

This section describes the low-power modes supported by the module to optimize battery life.

### 8.4.1 Low-Power Deep Sleep

The low-power deep-sleep (LPDS) mode is an energy-efficient and transparent sleep mode that is entered automatically during periods of inactivity based on internal power optimization algorithms. The module can wake up in less than 3ms from the internal timer or from any incoming host command. The typical battery drain in this mode is 135 $\mu$ A. During LPDS mode, the module retains the software state and certain configuration information. The operation is transparent to the external host; thus, no additional handshake is required to enter or exit this sleep mode.

### 8.4.2 Hibernate

The hibernate mode is the lowest power mode in which all of the digital logic is power-gated. Only a small section of the logic powered directly by the main input supply is retained. The real-time clock (RTC) is kept running and the module wakes up when the `n_HIB` line is asserted by the host driver. The typical battery drain in this mode is 5.5 $\mu$ A. The wake-up time is longer than LPDS mode at about 50ms.

### 8.4.3 Shutdown

Shutdown mode is the lowest power-mode system-wise. All device logics are off, including the realtime clock (RTC). The typical battery drain in this mode is 1 $\mu$ A. The wake-up time in this mode is longer than hibernate at approximately 1.1 seconds.

## 8.5 Restoring Factory Default Configuration

The device has an internal recovery mechanism that allows rolling back the file system to its predefined factory image or restoring the factory default parameters of the device. The factory image is kept in a separate sector on the sFLASH in a secure manner and cannot be accessed from the host processor. The following restore modes are supported:

- None—no factory restore settings
- Enable restore of factory default parameters
- Enable restore of factory image and factory default parameters

The restore process is performed by pulling or forcing SOP[2:0] = 011 pins and toggling the nRESET pin from low to high.

The process is fail-safe and resumes operation if a power failure occurs before the restore is finished. The restore process typically takes about 8 seconds, depending on the attributes of the serial Flash vendor.

## 8.6 Hostless Mode

The SimpleLink™ Wi-Fi® CC3135MOD device incorporates a scripting ability that enables offloading of simple tasks from the host processor. Using simple and conditional scripts, repetitive tasks can be handled internally, which allows the host processor to remain in a low-power state. In some cases where the scripter is being used to send packets, it reduces code footprint and memory consumption. The *if-this-then-that* style conditioning can include anything from GPIO toggling to transmitting packets.

The conditional scripting abilities can be divided into conditions and actions. The conditions define when to trigger actions. Only one action can be defined per condition, but multiple instances of the same condition may be used, so in effect, multiple actions can be defined for a single condition. In total, 16 condition and action pairs can be defined. The conditions can be simple, or complex using sub-conditions (using a combinatorial AND condition between them). The actions are divided into two types, those that can occur during runtime and those that can occur only during the initialization phase.

The following actions can only be performed when triggered by the pre-initialization condition:

- Set roles AP, station, P2P, and Tag modes
- Delete all stored profiles
- Set connection policy
- Hardware GPIO indication allows an I/O to be driven directly from the WLAN core hardware to indicate internal signaling

The following actions may be activated during runtime:

- Send transceiver packet
- Send UDP packet
- Send TCP packet
- Increment counter increments one of the user counters by 1
- Set counter allows setting a specific value to a counter
- Timer control
- Set GPIO allows GPIO output from the device using the internal networking core
- Enter Hibernate state

## 备注

Consider the following limitations:

- Timing cannot be ensured when using the network scripter because some variable latency will apply depending on the utilization of the networking core.
- The scripter is limited to 16 pairs of conditions and reactions.
- Both timers and counters are limited to 8 instances each. Timers are limited to a resolution of 1 second. Counters are 32 bits wide.
- Packet length is limited to the size of one packet and the number of possible packet tokens is limited to 8.

## 8.7 Device Certification and Qualification

The TI CC3135MOD module is certified for FCC, IC/ISED, ETSI/CE, and MIC. Moreover, the module is also Wi-Fi certified with the ability to request a certificate transfer for Wi-Fi alliance members. TI customers that build products based on the TI CC3135MOD can save in testing cost and time per product family.

The CC3135MOD module is certified to the standards listed in [表 8-2](#) (with IDs where applicable).

**表 8-2. CC3135MOD List of Certifications**

| REGULATORY BODY  | SPECIFICATION  | ID (IF APPLICABLE) |
|------------------|--|--------------------|
| FCC (USA)        | Part 15C + MPE FCC RF Exposure                       | Z64-CC3135MOD      |
| IC/ISED (Canada) | RSS-102 (MPE) and RSS-247 (Wi-Fi)                    | 4511-CC3135MOD     |
| ETSI/CE (Europe) | EN300328 v2.2.1 (2.4 GHz Wi-Fi)                      | —                  |
|                  | EN301893 v2.1.1 (5GHz Wi-Fi)                         | —                  |
|                  | EN62311:2008 (MPE)                                   | —                  |
|                  | EN301489-1 v2.2.1 (EMC General)                      | —                  |
|                  | EN301489-17 v3.2.0 (EMC Wi-Fi)                       | —                  |
|                  | EN60950-1:2006/A11:2009/A1:2010/<br>A12:2011/A2:2013 | —                  |
| MIC (Japan)      | Article 49-20 of ORRE                                | 201-190034         |

### 8.7.1 FCC Certification and Statement

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**FCC RF Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

The CC3135MOD modules from TI are certified for the FCC as a single-modular transmitter. The modules are FCC-certified radio modules that carries a modular grant.

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation of the device.

### 8.7.2 IC/ISED Certification Statement

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#### IC RF Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

#### Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

The TI CC3135MOD modules are certified for IC as a single-modular transmitter. The TI CC3135MOD modules meet IC modular approval and labeling requirements. The IC follows the same testing and rules as the FCC regarding certified modules in authorized equipment.

This device complies with Industry Canada license-exempt RSS standards.

Operation is subject to the following two conditions:

- This device may not cause interference.
- This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.

L'exploitation est autorisée aux deux conditions suivantes:

- L'appareil ne doit pas produire de brouillage.
- L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

### 8.7.3 ETSI/CE Certification

The CC3135MOD module is CE certified with certifications to the appropriate EU radio and EMC directives summarized in the Declaration of Conformity and evidenced by the CE mark. The modules are tested against the new Radio Equipment Directive (RE-D).

The full text of the EU declarations of conformity is available at:

- [CC3135MODRNMMOB EC Declaration of Conformity \(DoC\)](#)

### 8.7.4 Japan MIC Certification

The CC3135MOD is MIC certified against article 49-20 and the relevant articles of the Ordinance Regulating Radio Equipment.

Operation is subject to the following condition:

- The host system does not contain a wireless wide area network (WWAN) device.

This device operates in the W52 and W53 bands and is for indoor use only (except communication to high power radio).

## 8.8 Module Markings



图 8-1 shows the SimpleLink™ CC3135 module markings.

表 8-3 lists the SimpleLink™ CC3135 module markings.



图 8-1. SimpleLink™ CC3135 Module Markings

表 8-3. Marking Descriptions

| MARKING  | DESCRIPTION  |
|--|--|
| CC3135MODRNMMOB  | Model  |
| YMWLLLC  | LTC (Lot Trace Code): <ul style="list-style-type: none"> <li>• Y = Year</li> <li>• M = Month</li> <li>• WLLLC = Reserved for internal use</li> </ul> |
| Z64-CC3135MOD  | FCC ID: single modular FCC grant ID  |
| 451I-CC3135MOD   | IC: single modular IC grant ID   |
|             | MIC compliance mark  |
|  201-190034 | MIC ID: modular MIC grant ID   |
| CE   | CE compliance mark   |



## 8.9 End Product Labeling

This module is designed to comply with the FCC single modular FCC grant, FCC ID: Z64-CC3135MOD. The host system using this module must display a visible label indicating the following text:

Contains FCC ID: Z64-CC3135MOD

This module is designed to comply with the IC single modular IC grant, IC: 451I-CC3135MOD. The host system using this module must display a visible label indicating the following text:

Contains IC: 451I-CC3135MOD

This module is designed to comply with the JP statement, 201-190034. The host system using this module must display a visible label indicating the following text:

Contains transmitter module with certificate number: 201-190034.

## 8.10 Manual Information to the End User

The OEM integrator must 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 that integrates this module.

The end user manual must include all required regulatory information and warnings, as shown in this manual.

For more information, refer to the [CC3135MOD OEM Integrator's Guide](#).

## 9 Applications, Implementation, and Layout

### 备注

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

#### 9.1.1 BLE/2.4 GHz Radio Coexistence

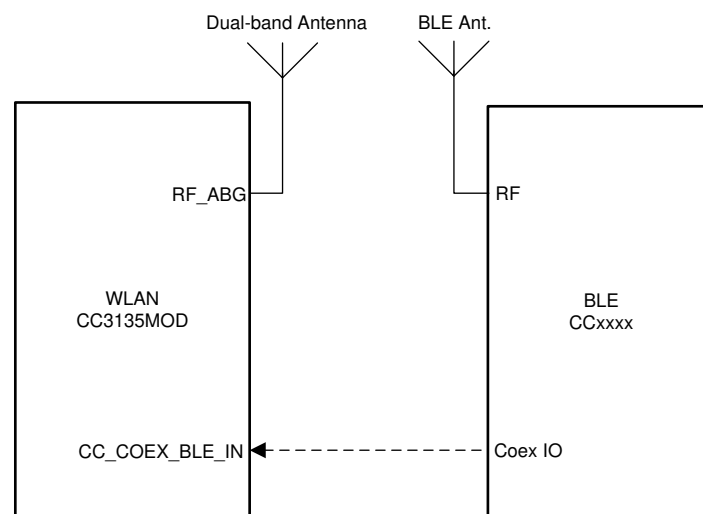
The CC3135MOD device is designed to support BLE/2.4GHz radio coexistence. Because WLAN is inherently more tolerant to time-domain disturbances, the coexistence mechanism gives priority to the Bluetooth® low energy entity over the WLAN. Bluetooth® low energy operates in the 2.4GHz band, therefore the coexistence mechanism does not affect the 5GHz band. The CC3135MOD device can operate normally on the 5GHz band, while the Bluetooth® low energy works on the 2.4GHz band without mutual interference.

The following coexistence modes can be configured by the user:

- Off mode or intrinsic mode
  - No BLE/2.4GHz radio coexistence, or no synchronization between WLAN and Bluetooth® low energy—in case Bluetooth® low energy exists in this mode, collisions can randomly occur.
- Time Division Multiplexing (TDM, Dual Antenna)
  - Dual-band Wi-Fi (see [图 9-1](#))

In this mode, the WLAN can operate on either a 2.4GHz or 5GHz band and Bluetooth® low energy operates on the 2.4GHz band.

[图 9-1](#) shows the dual antenna implementation of a complete Bluetooth® low energy and WLAN coexistence network with the WLAN operating on either a 2.4GHz or a 5GHz band. Note in this implementation no Coex switch is required and only a single GPIO from the BLE device to the CC3135 device is required.



**图 9-1. Dual-Antenna Coexistence Mode Block Diagram**

### 9.1.2 Antenna Selection

The CC3135MOD device is designed to also support antenna selection and is controlled from Image Creator. When enabled, there are three options possible options:

- ANT 1: When selected, the GPIOs that are defined for antenna selection will set the RF path for antenna 1.
- ANT 2: When selected, the GPIOs that are defined for antenna selection will set the RF path for antenna 2.
- Autoselect: When selected, during a scan and prior to connecting to an AP, CC3135MOD device will determine the best RF path and select the appropriate antenna <sup>12</sup> <sup>13</sup>. The result is the saved as port of the profile.

图 9-2 shows the antenna selection implementation for Wi-Fi, with BLE operating on its own antenna. Note in this implementation, only a single GPIO from the BLE device to the CC3135MOD device is required. The Antenna switch <sup>14</sup> is controlled by two GPIO lines from the CC3135MOD device. 表 6-2 lists which GPIOs can be used for Antenna Selection.

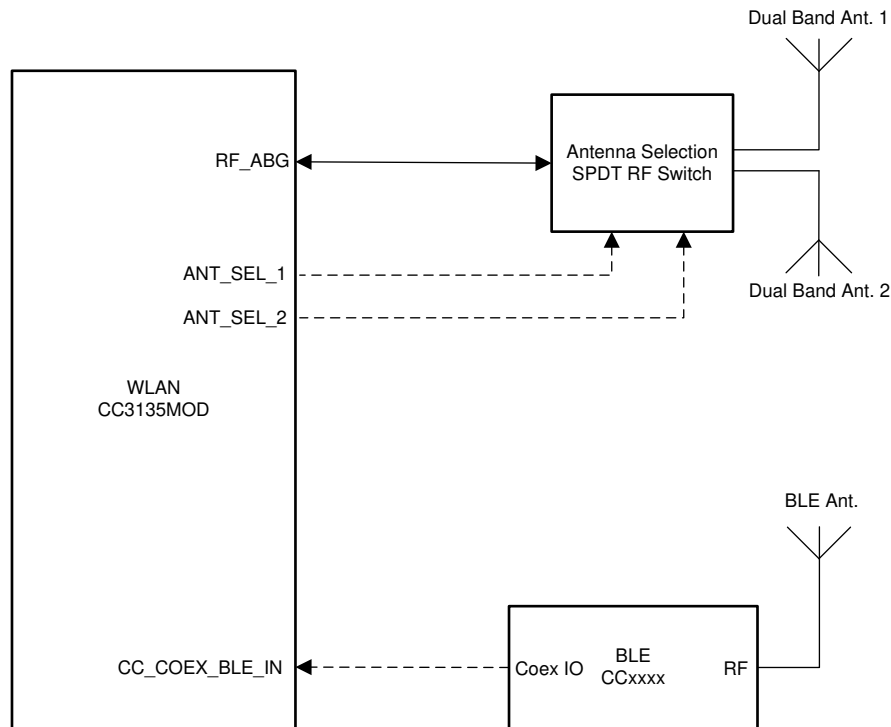


图 9-2. Coexistence Solution with Wi-Fi Antenna Selection and dedicated BLE antenna

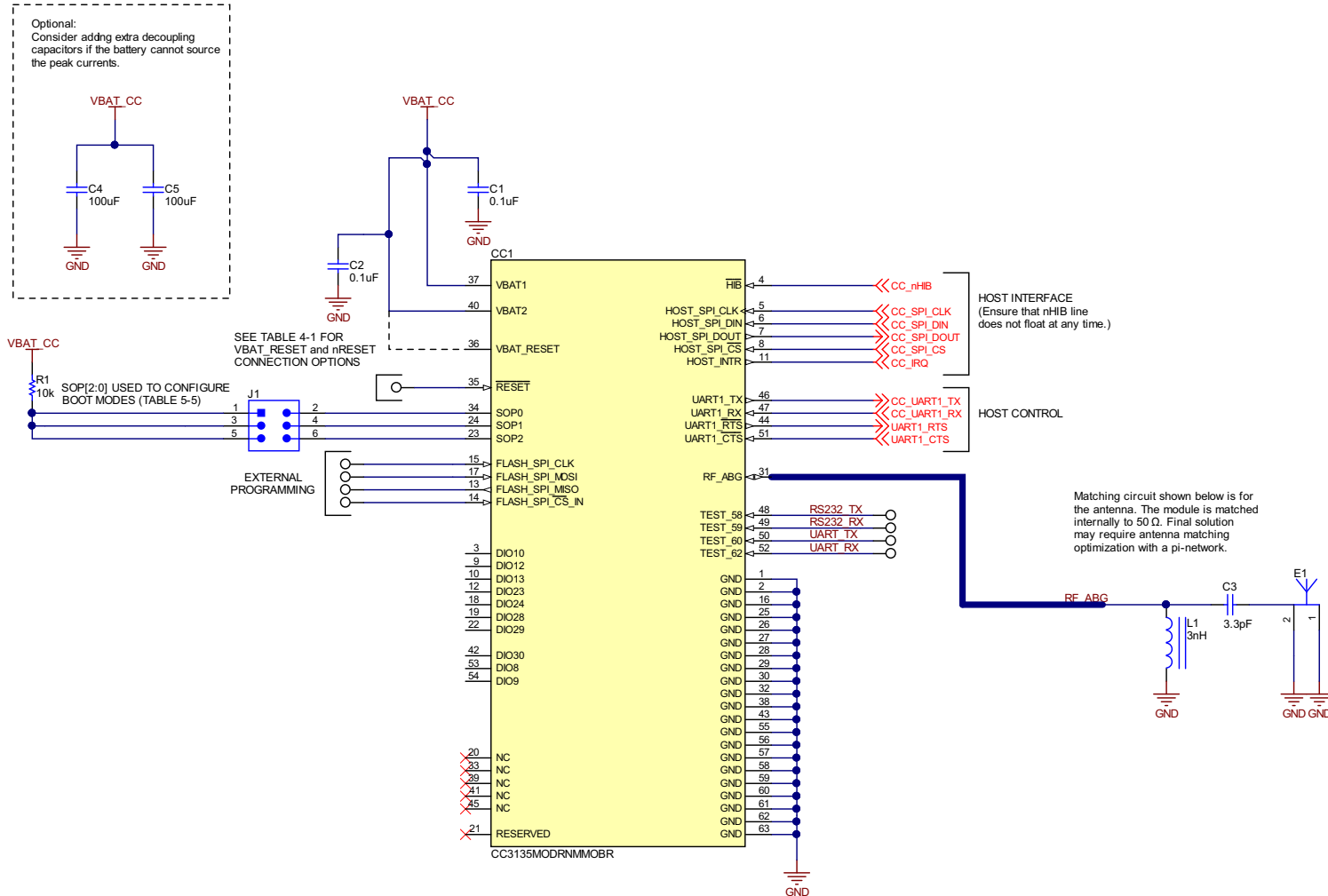
<sup>12</sup> When selecting Autoselect via the API, a reset is required in order for the CC3135MOD device to determine the best antenna for use.

<sup>13</sup> Refer to the [Uniflash with Image Creator User Guide](#) for more information.

<sup>14</sup> The recommended Antenna switch is the Richwave RTC6608OSP.

### 9.1.3 Typical Application

图 9-3 shows the typical application schematic using the CC3135MOD module.



This is the reference schematic and not an actual board design. For a full operational reference design, see the [CC3135MOD Hardware Design Files](#).

图 9-3. CC3135MOD Module Reference Schematic

备注

The following guidelines are recommended for implementation of the RF design:

- Ensure an RF path is designed with an impedance of  $50 \Omega$ .
- Tuning of the antenna impedance  $\pi$  matching network is recommended after manufacturing of the PCB to account for PCB parasitics.
- $\pi$  or L matching and tuning may be required between cascaded passive components on the RF path.

表 9-1 lists the bill of materials for a typical application using the CC3135MOD module shown in 图 9-3.

表 9-1. Bill of Materials

| QTY | PART REFERENCE | VALUE              | MANUFACTURER      | PART NUMBER        | DESCRIPTION  |
|-----|----------------|--------------------|-------------------|--------------------|--|
| 2   | C1, C2         | 0.1 uF             | Murata            | GRM155R61A104KA01D | Capacitor, ceramic, 0.1 $\mu$ F, 10V, $\pm 10\%$ , X5R, 0402   |
| 1   | C3             | 3.3 pF             | Murata            | GJM1555C1H3R3BB01  | Capacitor, ceramic, 3.3pF, 50V, $\pm 0.1$ pF, C0G/NP0, 0402  |
| 2   | C4, C5         | 100 uF             | Murata            | LMK325ABJ107MMHT   | Capacitor, ceramic, 100 $\mu$ F, 10V, $\pm 20\%$ , X5R, AEC-Q200 Grade 3, 1210   |
| 1   | E1             | 2.4 GHz, 5 GHz Ant | Ethertronics      | M830520            | Antenna Bluetooth WLAN Zigbee®   |
| 1   | L1             | 3 nH               | Murata            | LQG15HS3N0S02D     | Inductor, Unshielded, Multilayer, 3nH, 0.8A, 0.125 $\Omega$ , SMD  |
| 1   | R1             | 10k                | Vishay-Dale       | CRCW040210K0JNED   | RES, 10k, 5%, 0.063W, AEC-Q200 Grade 0, 0402   |
| 1   | CC1            | CC3135MOD          | Texas Instruments | CC3135MODRNMMOBR   | SimpleLink™ Certified Wi-Fi® Dual-Band Network Processor Internet-of-Things Module Solution for MCU Applications, MOB0063A |

### 9.1.4 Power Supply Decoupling and Bulk Capacitors

Depending upon routing resistors and battery type, TI recommends adding two 100µF ceramic capacitors to help provide the peak current drawn by the CC3135MOD module.

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#### 备注

The module enters a brown-out condition whenever the input voltage dips below  $V_{\text{BROWN}}$  (see [图 7-4](#) and [图 7-5](#)). This condition must be considered during design of the power supply routing specifically if operating from a battery. For more details on brown-out consideration, see [节 7.8](#).

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### 9.1.5 Reset

The module features an internal RC circuit to reset the device during power ON. The nRESET pin must be held below 0.6V for at least 5ms for the device to successfully reset.

### 9.1.6 Unused Pins

All unused pins can be left unconnected without the concern of having leakage current.

## 9.2 PCB Layout Guidelines

This section details the PCB guidelines to speed up the PCB design using the CC3135MOD Module. The integrator of the CC3135MOD module must comply with the PCB layout recommendations described in the following subsections to preserve/minimize the risk with regulatory certifications for FCC, IC/ISED, ETSI/CE, and MIC. Moreover, TI recommends customers follow the guidelines described in this section to achieve similar performance to that obtained with the TI reference design.

### 9.2.1 General Layout Recommendations

Ensure that the following general layout recommendations are followed:

- Have a solid ground plane and ground vias under the module for a stable system and thermal dissipation.
- Do **not** run signal traces underneath the module on a layer where the module is mounted.
- RF traces must have 50 Ω impedance.
- RF trace bends must be made with gradual curves, and 90-degree bends must be avoided.
- RF traces must **not** have sharp corners.
- There must be no traces or ground under the antenna section.
- RF traces must be via stitching on the ground plane beside the RF trace on both sides.
- RF traces must be as short as possible. The antenna, RF traces, and the module must be on the edge of the PCB product in consideration of the product enclosure material and proximity.

### 9.2.2 RF Layout Recommendations

The RF section of this wireless device gets top priority in terms of layout. It is very important for the RF section to be laid out correctly to ensure optimum performance from the device. A poor layout can cause low-output power, EVM degradation, sensitivity degradation, and mask violations.

图 9-4 shows the RF placement and routing of the CC3135MOD module.

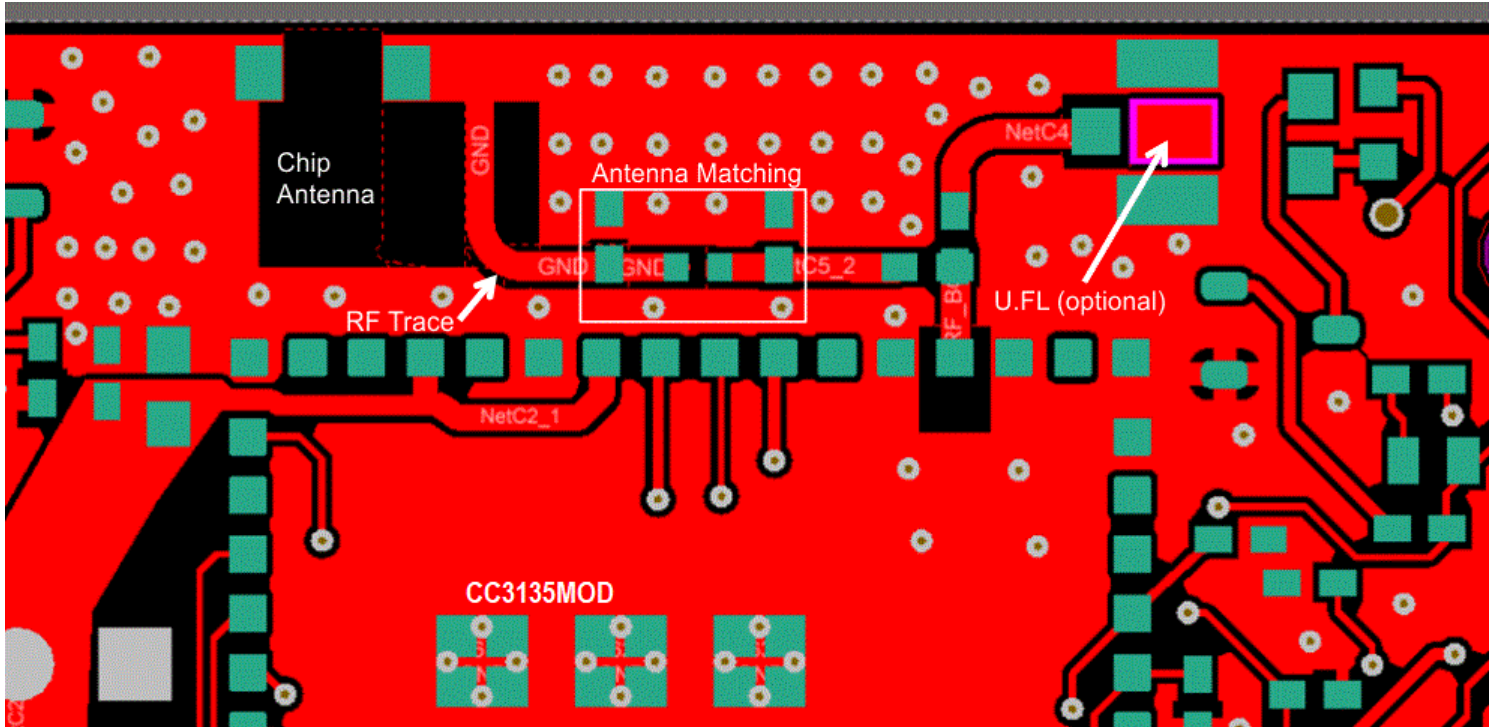


图 9-4. RF Section Layout

For optimal RF performance, ensure the copper cut out on the top layer under the RF-BG pin, (pin 31), is as shown in 图 9-5.

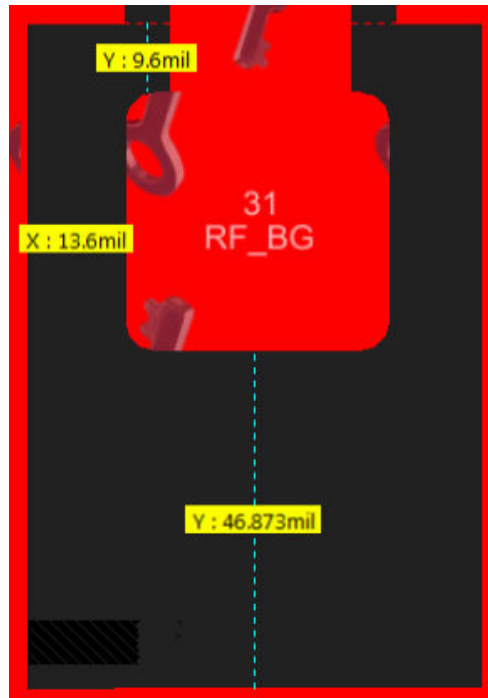


图 9-5. Top Layer Copper Pull Back on RF Pads



### 9.2.3 Antenna Placement and Routing

The antenna is the element used to convert the guided waves on the PCB traces to the free space electromagnetic radiation. The placement and layout of the antenna are the keys to increased range and data rates. [表 9-2](#) provides a summary of the recommended antennas to use with the CC3135MOD module.

**表 9-2. Antenna Guidelines**

| SR NO. | GUIDELINES  |
|--------|---|
| 1      | Place the antenna on an edge or corner of the PCB.  |
| 2      | Ensure that no signals are routed across the antenna elements on all the layers of the PCB.   |
| 3      | Most antennas, including the chip antenna used on the booster pack, require ground clearance on all the layers of the PCB. Ensure that the ground is cleared on inner layers as well.   |
| 4      | Ensure that there is provision to place matching components for the antenna. These must be tuned for best return loss when the complete board is assembled. Any plastics or casing must also be mounted while tuning the antenna because this can impact the impedance. |
| 5      | Ensure that the antenna impedance is 50 $\Omega$ because the device is rated to work only with a 50 $\Omega$ system.  |
| 6      | In case of printed antenna, ensure that the simulation is performed with the solder mask in consideration.  |
| 7      | Ensure that the antenna has a near omni-directional pattern.  |
| 8      | The feed point of the antenna is required to be grounded. Refer to the specific antenna data sheets for the recommendations.  |

[表 9-3](#) lists the recommended antennas to use with the CC3135MOD module. Other antennas may be available for use with the CC3135MOD module. Please see the [CC3135MOD OEM Integrator's Guide](#) for the full list of supported antennas.

**表 9-3. Recommended Components**

| CHOICE | PART NUMBER | MANUFACTURER | NOTES  |
|--------|-------------|--------------|--|
| 1      | M830520     | Ethertronics | Can be placed at the edge of the PCB using the least amount of PCB area. |

### 9.2.4 Transmission Line Considerations

The RF signal from the device is routed to the antenna using a Coplanar Waveguide with ground (CPW-G) structure. CPW-G structure offers the maximum amount of isolation and the best possible shielding to the RF lines. In addition to the ground on the L1 layer, placing GND vias along the line also provides additional shielding.

图 9-6 shows a cross section of the coplanar waveguide with the critical dimensions.

图 9-7 shows the top view of the coplanar waveguide with GND and via stitching.

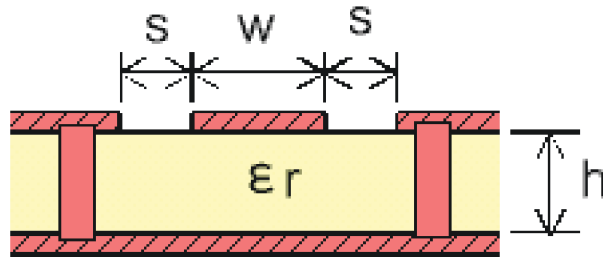


图 9-6. Coplanar Waveguide (Cross Section)

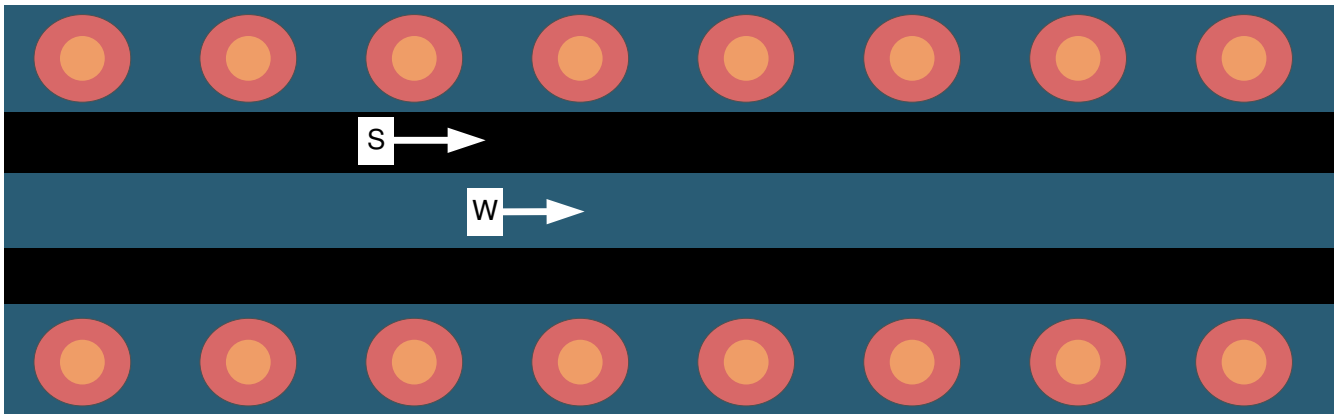


图 9-7. CPW With GND and Via Stitching (Top View)

The recommended values for the PCB are provided for 2-layer boards in [表 9-4](#) and 4-layer boards in [表 9-5](#).

**表 9-4. Recommended PCB Values for 2-Layer Board  
(L1 to L2 = 42.1 mils)**

| PARAMETER           | VALUE | UNIT |
|---------------------|-------|------|
| W                   | 26    | mils |
| S                   | 5.5   | mils |
| H                   | 42.1  | mils |
| Er (FR-4 substrate) | 4.2   | F/m  |

**表 9-5. Recommended PCB Values for 4-Layer Board  
(L1 to L2 = 16 mils)**

| PARAMETER           | VALUE | UNITS |
|---------------------|-------|-------|
| W                   | 21    | mils  |
| S                   | 10    | mils  |
| H                   | 16    | mils  |
| Er (FR-4 substrate) | 4.5   | F/m   |

## 10 Environmental Requirements and SMT Specifications

### 10.1 Temperature

#### 10.1.1 PCB Bending

The PCB follows IPC-A-600J for PCB twist and warpage < 0.75% or 7.5 mil per inch.

### 10.2 Handling Environment

#### 10.2.1 Terminals

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

#### 10.2.2 Falling

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

### 10.3 Storage Condition

#### 10.3.1 Moisture Barrier Bag Before Opened

A moisture barrier bag must be stored in a temperature of less than 30°C with humidity under 85% RH. The calculated shelf life for the dry-packed product will be 24 months from the date the bag is sealed.

#### 10.3.2 Moisture Barrier Bag Open

Humidity indicator cards must be blue, < 30%.

### 10.4 PCB Assembly Guide

The wireless MCU modules are packaged in a substrate base Leadless Quad Flatpack (QFM) package. Components were mounted onto the substrate with standard SMT process with the additional of a metal lid covering the top of the module. The module are designed with pull back leads for easy PCB layout and board mounting.

#### 10.4.1 PCB Land Pattern & Thermal Vias

We recommended a solder mask defined land pattern to provide a consistent soldering pad dimension in order to obtain better solder balancing and solder joint reliability. PCB land pattern are 1:1 to module soldering pad dimension. Thermal vias on PCB connected to other metal plane are for thermal dissipation purpose. It is critical to have sufficient thermal vias to avoid device thermal shutdown. Recommended vias size are 0.2mm and position not directly under solder paste to avoid solder dripping into the vias.

#### 10.4.2 SMT Assembly Recommendations

The module surface mount assembly operations include:

- Screen printing the solder paste on the PCB
- Monitor the solder paste volume (uniformity)
- Package placement using standard SMT placement equipment
- X-ray pre-reflow check - paste bridging
- Reflow
- X-ray post-reflow check - solder bridging and voids

#### 10.4.3 PCB Surface Finish Requirements

A uniform PCB plating thickness is key for high assembly yield. For an electroless nickel immersion gold finish, the gold thickness should range from 0.05  $\mu\text{m}$  to 0.20  $\mu\text{m}$  to avoid solder joint embrittlement. Using a PCB with Organic Solderability Preservative (OSP) coating finish is also recommended as an alternative to Ni-Au.

#### **10.4.4 Solder Stencil**

Solder paste deposition using a stencil-printing process involves the transfer of the solder paste through pre-defined apertures with the application of pressure. Stencil parameters such as aperture area ratio and the fabrication process have a significant impact on paste deposition. Inspection of the stencil prior to placement of package is highly recommended to improve board assembly yields.

#### **10.4.5 Package Placement**

Packages can be placed using standard pick and place equipment with an accuracy of  $\pm 0.05\text{mm}$ . Component pick and place systems are composed of a vision system that recognizes and positions the component and a mechanical system that physically performs the pick and place operation. Two commonly used types of vision systems are:

- A vision system that locates a package silhouette
- A vision system that locates individual pads on the interconnect pattern

The second type renders more accurate placements but tends to be more expensive and time-consuming. Both methods are acceptable since the parts align due to self-centering features of the solder joint during solder reflow. It is recommended to release the package to 1 to 2 mils into the solder paste or with minimum force to avoid causing any possible damage to the thinner packages.

#### **10.4.6 Solder Joint Inspection**

After surface mount assembly, a transmission X-ray should be used for sample monitoring of the solder attachment process. This identifies defects such as solder bridging, shorts, opens, and voids. It is also recommended to use side view inspection in addition to X-rays to determine if there are "Hour Glass" shaped solder and package tilting existing. The "Hour Glass" solder shape is not a reliable joint. 90° mirror projection can be used for side view inspection.

#### **10.4.7 Rework and Replacement**

TI recommends removal of modules by rework station applying a profile similar to the mounting process. Using a heat gun can sometimes cause damage to the module by overheating.

#### **10.4.8 Solder Joint Voiding**

TI recommends to control solder joint voiding to be less than 30% (per IPC-7093). Solder joint voids could be reduced by baking of components and PCB, minimized solder paste exposure duration, and reflow profile optimization.

### **10.5 Baking Conditions**

Products require baking before mounting if:

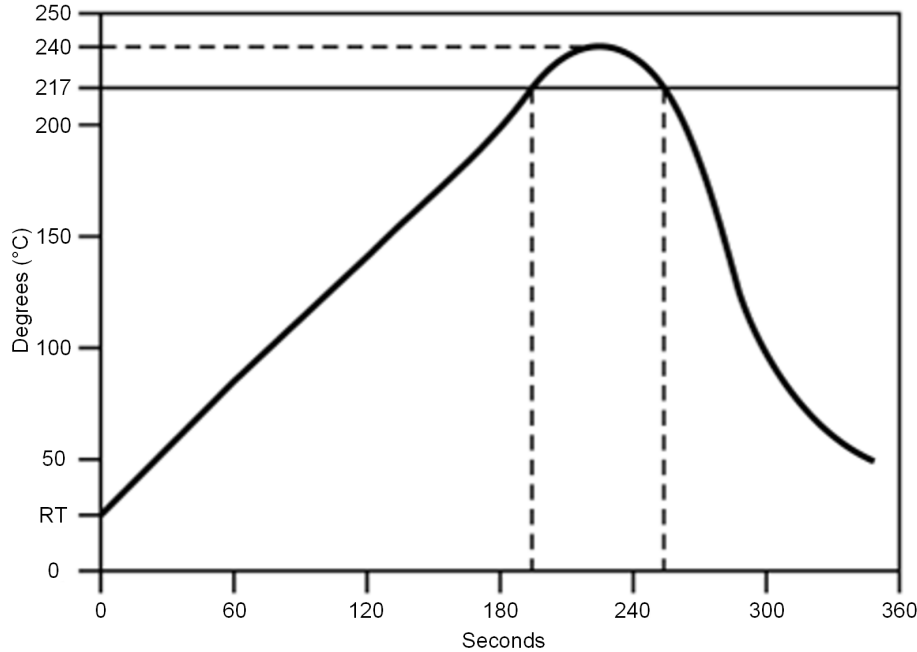
- Humidity indicator cards read  $> 30\%$
- Temp  $< 30^\circ\text{C}$ , humidity  $< 70\%$  RH, over 96 hours

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

Baking times: 1 time

### 10.6 Soldering and Reflow Condition

- Heating method: Conventional convection or IR convection
- Temperature measurement: Thermocouple d = 0.1mm to 0.2mm CA (K) or CC (T) at soldering portion or equivalent method
- Solder paste composition: SAC305
- Allowable reflow soldering times: 2 times based on the reflow soldering profile (see [图 10-1](#))
- Temperature profile: Reflow soldering will be done according to the temperature profile (see [图 10-1](#))
- Peak temp: 260°C



**图 10-1. Temperature Profile for Evaluation of Solder Heat Resistance of a Component (at Solder Joint)**

**表 10-1. Temperature Profile**

| Profile Elements                  | Convection or IR <sup>(1)</sup>      |
|-----------------------------------|--------------------------------------|
| Peak temperature range            | 235 to 240°C typical (260°C maximum) |
| Pre-heat / soaking (150 to 200°C) | 60 to 120 seconds                    |
| Time above melting point          | 60 to 90 seconds                     |
| Time with 5°C to peak             | 30 seconds maximum                   |
| Ramp up                           | < 3°C / second                       |
| Ramp down                         | < -6°C / second                      |

(1) For details, refer to the solder paste manufacturer's recommendation.

#### 备注

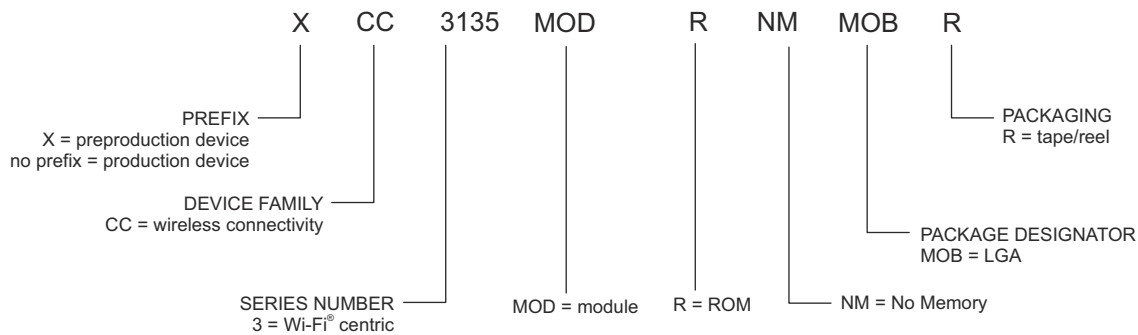
TI does not recommend using conformal coating or similar material on the SimpleLink™ module. This coating can lead to localized stress on the WCSP solder connections inside the module and impact the device's reliability. Use caution during the module assembly process to the final PCB to avoid the presence of foreign material inside the module.

## 11 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed in this section.

### 11.1 Device Nomenclature

To designate the stages in the product development cycle, TI assigns prefixes to the part numbers of the CC3135MOD and support tools (see [图 11-1](#)).



**图 11-1. CC3135MOD Module Nomenclature**

For orderable part numbers of CC3135MOD modules in the MOB package types, see the Package Option Addendum of this document, the TI website ([www.ti.com](http://www.ti.com)), or contact your TI sales representative.

### 11.2 Development Tools and Software

For the most up-to-date list of development tools and software, visit the [CC3135MOD tools and software](#) page. You can also click on the Alert me button in the top-right corner of the page to stay informed about updates related to the CC3135MOD.

#### SimpleLink™ Wi-Fi® Starter Pro

The supported devices are: CC3100, CC3200, CC3120R, CC3220x, CC3135 and CC3235x. The SimpleLink Wi-Fi Starter Pro mobile App is a new mobile application for SimpleLink provisioning. The app goes along with the embedded provisioning library and example that runs on the device side (see [SimpleLink™ Wi-Fi® CC3135 SDK plugin](#)) and [TI SimpleLink™ Wi-Fi® CC3235 Software Development Kit \(SDK\)](#). The new provisioning release is a TI recommendation for Wi-Fi provisioning using SimpleLink Wi-Fi products. The provisioning release implements advanced AP mode and SmartConfig technology provisioning with feedback and fallback options to ensure successful process has been accomplished. Customers can use both embedded library and the mobile library for integration to their end products.

#### SimpleLink™ Wi-Fi® CC3135 SDK Plugin

The CC3135 SDK contains drivers, many sample applications for Wi-Fi features and internet, and documentation needed to use the CC3135 Internet-on-a chip solution. This SDK can be used with TI's MSP432P401R LaunchPad™, or SimpleLink Studio, a PC tool that allows MCU development with the CC3135. You can also use the SDK as example code for any platform. All sample applications in the SDK are supported on TI's MSP432P401R ultra-low-power MCUs with Code Composer Studio™ IDE and TI RTOS. In addition, many of the applications support IAR.

#### SimpleLink™ Studio for CC31xx

SimpleLink™ Studio for CC31xx is a Windows®-based software tool used to aid in the development of embedded networking applications and software for microcontrollers. Using SimpleLink Studio for CC31xx, embedded software developers can develop and test applications using any desktop IDE, such as Visual Studio or Eclipse, and connect their applications to the cloud using the CC31xx BoosterPack™. The application can then be easily ported to any microcontroller. With the SimpleLink Wi-Fi CC31xx solution, customers now have the flexibility to add Wi-Fi to any microcontroller (MCU).

This Internet-on-a chip solution contains all you need to easily create IoT solutions – security, quick connection, cloud support and more. For more information on CC31xx devices, visit <http://www.ti.com/simplelinkwifi>.

#### SimpleLink™ Wi-Fi® Radio Testing Tool

The supported devices are: CC3100, CC3200, CC3120R, CC3220, CC3135, and CC3235x. The SimpleLink Wi-Fi Radio Testing Tool is a Windows-based software tool for RF evaluation and testing of SimpleLink Wi-Fi CC3x20 and CC3x35 designs during development and certification. The tool enables low-level radio testing capabilities by manually setting the radio into transmit or receive modes. Using the tool requires familiarity and knowledge of radio circuit theory and radio test methods. Created for the internet-of-things (IoT), the SimpleLink Wi-Fi CC31xx and CC32xx family of devices include on-chip Wi-Fi, Internet, and robust security protocols with no prior Wi-Fi experience needed for faster development. For more information on these devices, visit [SimpleLink™ Wi-Fi® family, Internet-on-a chip™ solutions](#).

#### Uniflash Standalone Flash Tool for TI Microcontrollers (MCU), Sitara Processors and SimpleLink™ Devices

CCS Uniflash is a standalone tool used to program on-chip flash memory on TI MCUs and on-board flash memory for Sitara processors. Uniflash has a GUI, command line, and scripting interface. CCS Uniflash is available free of charge.

### 11.3 Firmware Updates

TI updates features in the service pack for this module with no published schedule. Due to the ongoing changes, TI recommends that users have the latest service pack in their module for production.

To stay informed, sign up with the SDK Alert me button in the top-right corner of the product page or visit [here](#).

### 11.4 Documentation Support

To receive notification of documentation updates — including silicon errata — go to the CC3135MOD product folder on ti.com, and click the Alert me button in the upper-right corner. This registers you to receive a weekly digest of updated product information (if any). For change details, check the revision history of any revised document. The current documentation which describes the processor, related peripherals, and other technical collateral follows. The following documents provide support for the CC3135MOD module.

#### Application Reports

##### [Transfer of TI's Wi-Fi® Alliance Certifications to Products Based on SimpleLink™](#)

This document explains how to employ the Wi-Fi® Alliance (WFA) derivative certification transfer policy to transfer a WFA certification, already obtained by Texas Instruments, to a system you have developed.

##### [SimpleLink™ CC31xx/CC32xx Wi- Fi® Internet-on-a chip™ Solution Built-In Security Features](#)

The SimpleLink Wi-Fi CC31xx and CC32xx Internet-on-a chip™ family of devices from Texas Instruments offers a wide range of built-in security features to help developers address a variety of security needs, which is achieved without any processing burden on the main microcontroller (MCU). This document describes these security-related features and provides recommendations for leveraging each in the context of practical system implementation.

##### [Using Serial Flash on SimpleLink™ CC3135/CC3235 Wi-Fi® and Internet-of-Things Devices](#)

This application note is divided into two parts. The first part provides important guidelines and best-practice design techniques to consider when choosing and embedding a serial flash paired with the CC3135 and CC3235 devices. The second part describes the file system, along with guidelines and considerations for system designers working with the CC3x20 devices.



[SimpleLink™ CC3135/CC3235  
Over-the-Air Programming](#)

This document describes the OTA library for the SimpleLink™ Wi-Fi® CC3x35 family of devices from Texas Instruments and explains how to prepare a new cloud-ready update to be downloaded by the OTA library.

[SimpleLink™ CC3x35 Wi-Fi®  
Internet-on-a chip™ Solution  
Device Provisioning](#)

This guide describes the provisioning process, which provides the SimpleLink Wi-Fi device with the information (network name, password, and so forth) needed to connect to a wireless network.

[SimpleLink™ CC31xx/CC32xx Wi-Fi®  
Internet-on-a chip™ Networking  
Sub-System Power Management](#)

This application report describes the best practices for power management and extended battery life for embedded low-power Wi-Fi devices such as the SimpleLink Wi-Fi Internet-on-a chip™ solution from Texas Instruments.

## User's Guides

[CC3135 and CC3235 SimpleLink™  
Wi-Fi® Embedded Programming  
User Guide](#)

[UniFlash SimpleLink™ CC31xx/  
32xx Wi-Fi® and IoC™ Solution  
ImageCreator and Pro](#)

This document describes the installation, operation, and usage of the SimpleLink ImageCreator tool as part of the UniFlash.

[SimpleLink™ Wi-Fi® and Internet-of-  
Things CC31xx and CC32xx  
Network Processor](#)

This document provides software (SW) programmers with all of the required knowledge for working with the networking subsystem of the SimpleLink Wi-Fi devices. This guide provides basic guidelines for writing robust, optimized networking host applications, and describes the capabilities of the networking subsystem. The guide contains some example code snapshots, to give users an idea of how to work with the host driver. More comprehensive code examples can be found in the formal software development kit (SDK). This guide does not provide a detailed description of the host driver APIs.

[SimpleLink™ Wi-Fi® CC3135 and  
CC3235 Provisioning for Mobile  
Applications](#)

This guide describes TI's SimpleLink Wi-Fi provisioning solution for mobile applications, specifically on the usage of the Android™ and IOS® building blocks for UI requirements, networking, and provisioning APIs required for building the mobile application.

[SimpleLink™ Wi-Fi® and Internet-  
on-a chip™ CC3135 and CC3235  
Solution Radio Tool](#)

The Radio Tool serves as a control panel for direct access to the radio, and can be used for both the radio frequency (RF) evaluation and for certification purposes. This guide describes how to have the tool work seamlessly on Texas Instruments evaluation platforms such as the BoosterPack™ plus FTDI emulation board for CC3235 devices, and the LaunchPad™ for CC3235 devices.

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Arm® and Cortex® are registered trademarks of Arm Limited.

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## 11.8 术语表

### TI 术语表

本术语表列出并解释了术语、首字母缩略词和定义。

## 12 Revision History

### Changes from Revision D (May 2021) to Revision E (December 2024) Page

- Added the note on the TLS socket for WPA Enterprise security modes [节 8.2.1](#) .....32

### Changes from Revision C (September 2020) to Revision D (May 2021) Page

- 在 [节 1](#) 特性 中添加了 “WPA3™ 企业版” ..... 1
- Added "WPA3 personal and enterprise security" to [节 8.1](#) .....32
- Added "WPA3 Enterprise" to list of on-chip security accelerators in [节 8.2.1](#) .....32
- Added "WPA3 personal and enterprise" to [表 8-1](#) .....33

## 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical packaging and orderable 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.

### 13.1 Mechanical, Land, and Solder Paste Drawings

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备注

The total height of the module is 2.4mm.

The weight of the module is 1.8g typical.

---

---

备注

1. All dimensions are in mm.
  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.
- 

### 13.2 Package Option Addendum

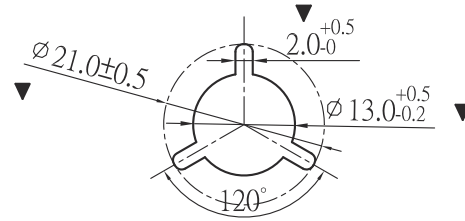
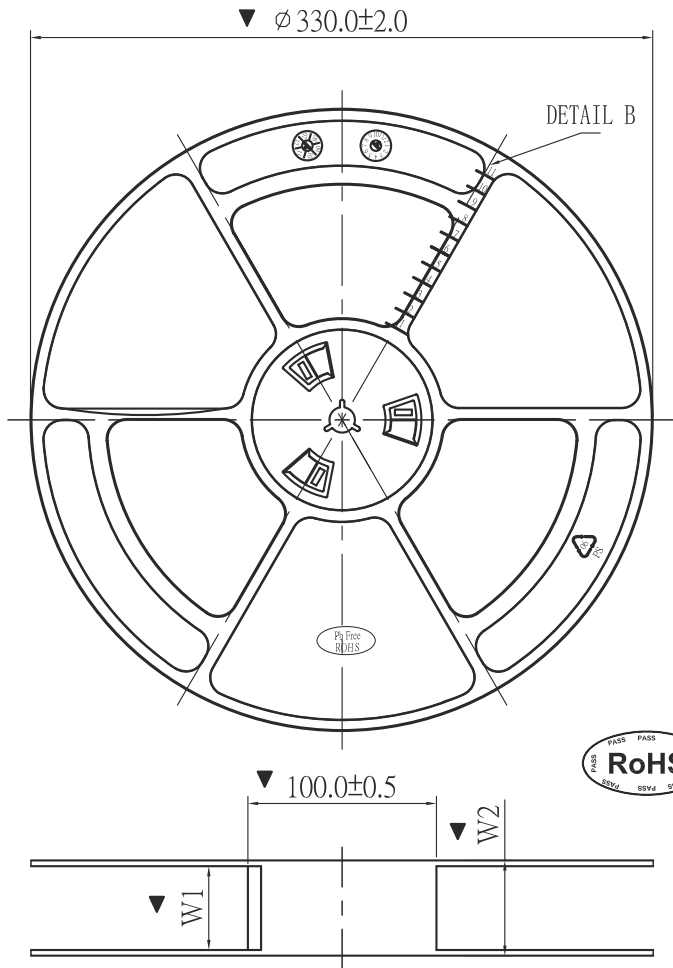
The CC3135MOD is only offered in a 750-unit reel.

### 13.2.1 Packaging Information

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>   | Lead/Ball Finish | MSL, Peak Temp <sup>(3)</sup> | Op Temp (°C) | Device Marking <sup>(4) (5)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|---------------------------|------------------|-------------------------------|--------------|-----------------------------------|
| CC3135MODRNMMOBR | ACTIVE                | QFM          | MOB             | 63   | 750         | Green (RoHS and no Sb/Br) | ENIG             | 3, 260°C                      | - 40 to 85   | CC3135MODRNMMOB                   |

- (1) The marketing status values are defined as follows:  
**ACTIVE:** Product device recommended for new designs.  
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.  
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.  
**PRE\_PROD** Unannounced device, not in production, not available for mass market, nor on the web, samples not available.  
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.  
**OBSOLETE:** TI has discontinued the production of the device.
- (2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.  
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.  
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.  
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)
- (3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device
- (5) Multiple Device markings will be inside parentheses. Only on Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.  
**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.  
 In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

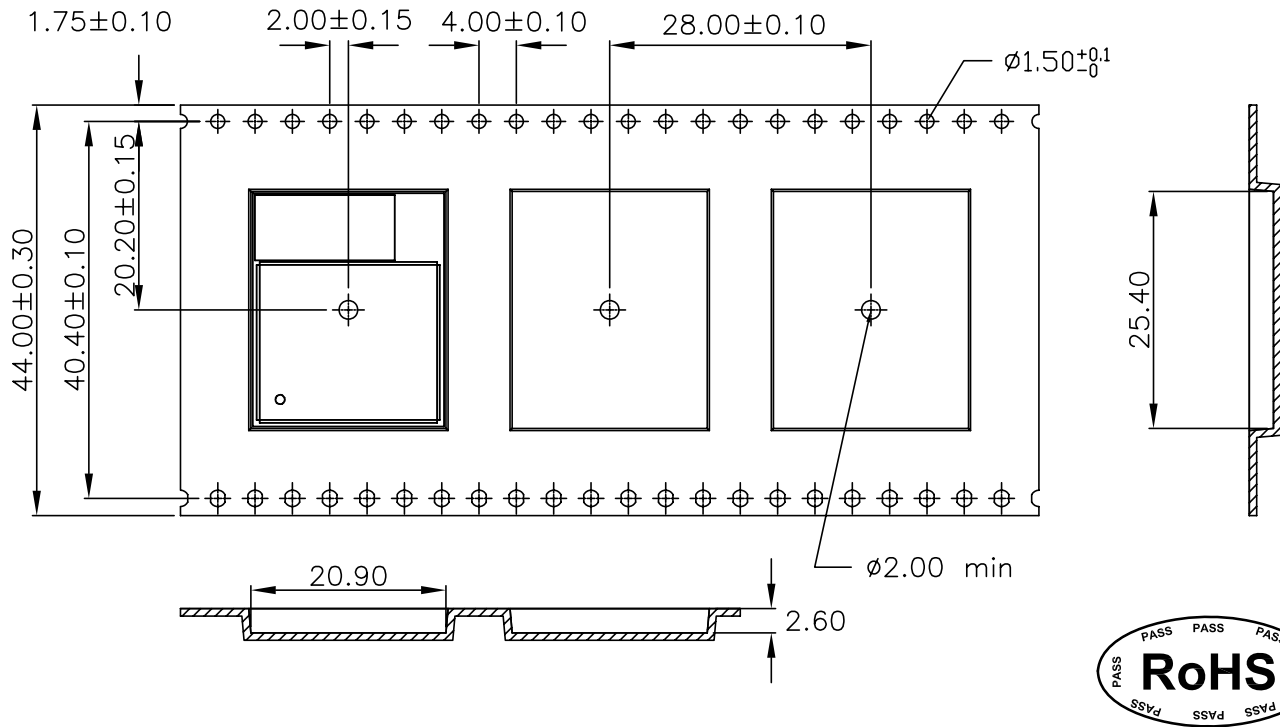
### 13.2.2 Tape and Reel Information



Surface resistance  $10^7 \sim 10^{11} \Omega/\square$

| Spec          | Vendor No.  | W1                                 | W2(max) |
|---------------|-------------|------------------------------------|---------|
| 13" 100*12mm  | RUR-22-3-X* | 12.4 <sup>+2.0</sup> <sub>0</sub>  | 18.4    |
| 13" 100*16mm  | RUR-23-3-X* | 16.4 <sup>+2.0</sup> <sub>0</sub>  | 22.4    |
| 13" 100*24mm  | RUR-24-3-X* | 24.4 <sup>+2.0</sup> <sub>0</sub>  | 30.4    |
| 13" 100*32mm  | RUR-25-3-X* | 32.4 <sup>+2.0</sup> <sub>0</sub>  | 38.4    |
| 13" 100*44mm  | RUR-26-3-X* | 44.4 <sup>+2.0</sup> <sub>0</sub>  | 50.4    |
| 13" 100*56mm  | RUR-27-3-X* | 56.4 <sup>+2.0</sup> <sub>0</sub>  | 62.4    |
| 13" 100*72mm  | RUR-28-3-X* | 72.4 <sup>+2.0</sup> <sub>0</sub>  | 79.5    |
| 13" 100*88mm  | RUR-29-3-X* | 88.4 <sup>+2.0</sup> <sub>0</sub>  | 96      |
| 13" 100*104mm | RUR-2A-3-X* | 104.4 <sup>+2.0</sup> <sub>0</sub> | 112     |

**13.2.2.1 Tape Specifications**



1. 10 sprocket hole pitch cumulative tolerance  $\pm 0.20$ .
2. Carrier camber is within 1 mm in 250 mm.
3. Material : Black Conductive Polystyrene Alloy.
4. All dimensions meet EIA-481-D requirements.
5. Thickness :  $0.40 \pm 0.05$ mm.
6. Packing length per 13" reel : 23.5 Meters.(样品盘)
7. Component load per 13" reel : 800 pcs.

|    |                  |
|----|------------------|
| W  | $44.00 \pm 0.30$ |
| A0 | $20.90 \pm 0.10$ |
| B0 | $25.40 \pm 0.10$ |
| K0 | $2.60 \pm 0.10$  |



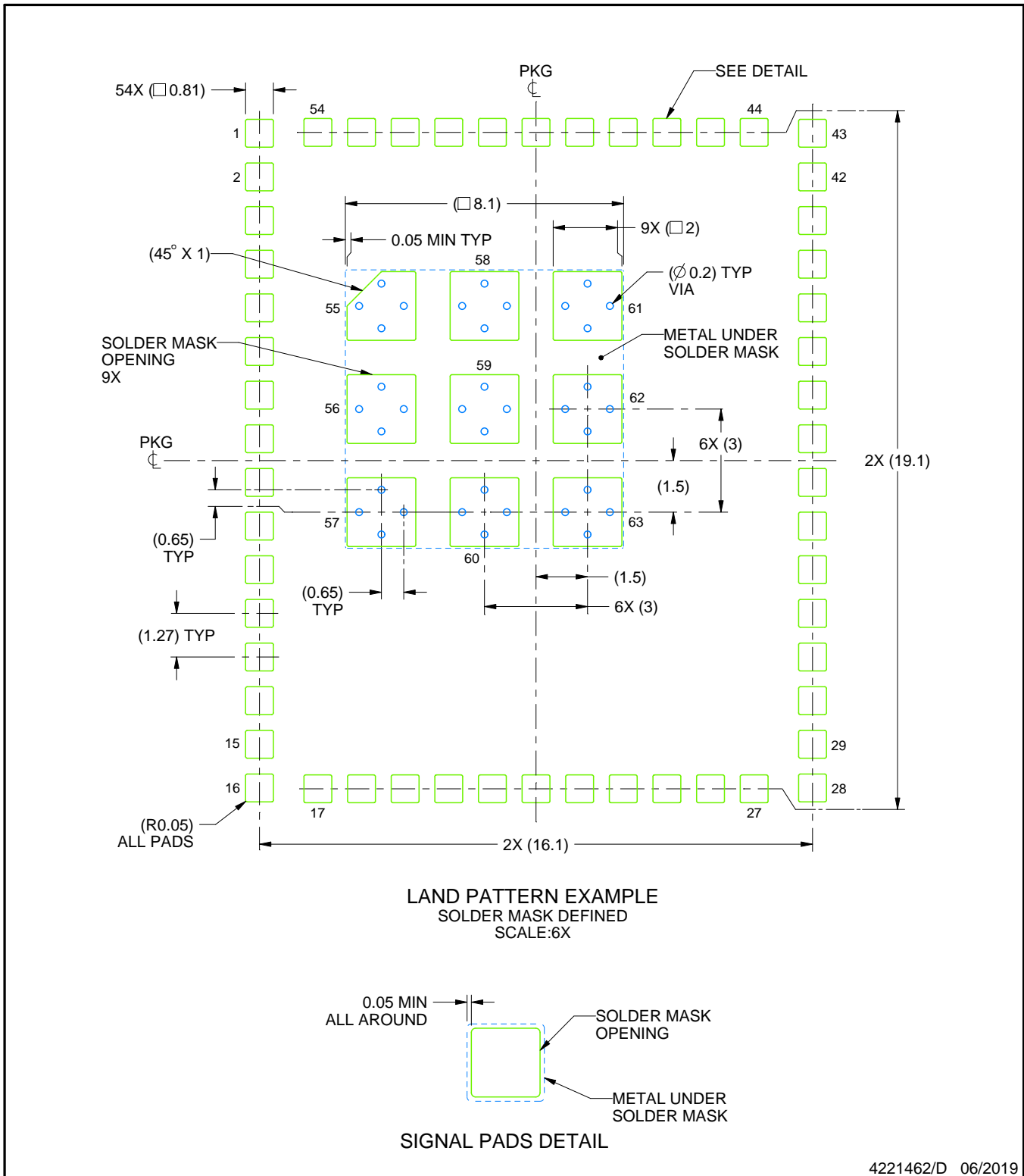


# EXAMPLE BOARD LAYOUT

MOB0063A

QFM - 2.4 mm max height

QUAD FLAT MODULE



NOTES: (continued)

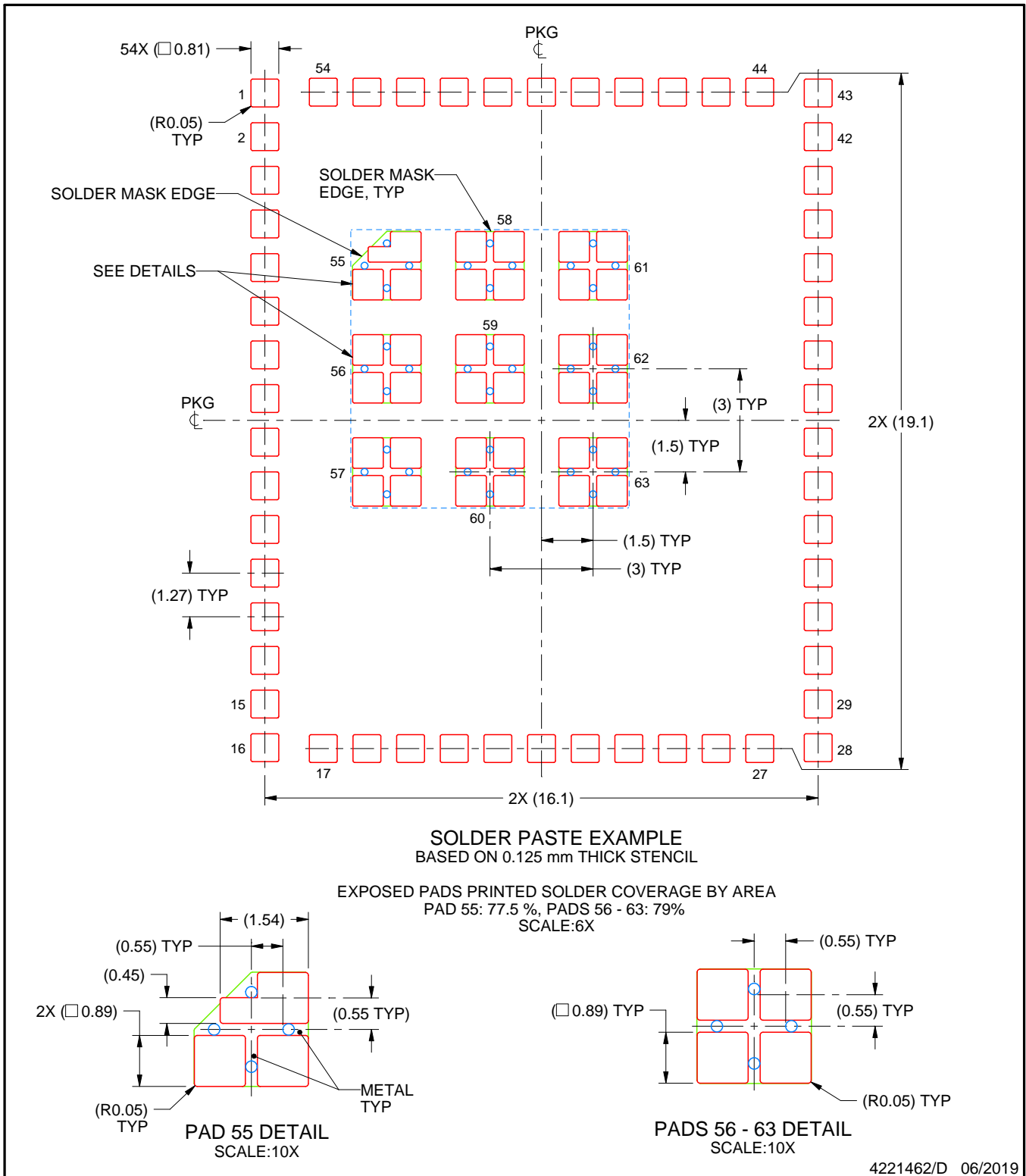
3. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/slua271](http://www.ti.com/lit/slua271)).

# EXAMPLE STENCIL DESIGN

MOB0063A

QFM - 2.4 mm max height

QUAD FLAT MODULE



NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

## 重要声明和免责声明

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