

CC2340R SimpleLink™ 系列 2.4GHz 无线 MCU

1 特性

无线微控制器

- 经过优化的 48MHz Arm® Cortex®-M0+ 处理器
- 高达 512KB 系统内可编程闪存
- 12KB ROM 用于引导加载程序和驱动程序
- 高达 64KB 超低泄漏 SRAM。待机模式下完全 RAM 保持
- 与低功耗 Bluetooth® 5.3 以及 IEEE 802.15.4 PHY 和 MAC 标准兼容的 2.4GHz 射频收发器
- 集成平衡-非平衡变压器
- 支持无线升级 (OTA)
- 串行线调试 (SWD)

低功耗

- MCU 功耗：
 - 2.6mA 工作模式，CoreMark®
 - 53 μ A/MHz (运行 CoreMark® 时)
 - 在 CC2340R52 上处于待机模式时 < 710nA
 - 165nA 关断模式，引脚唤醒
- 无线电功耗：
 - RX : 5.3mA
 - TX : 5.1mA (在 0dBm 条件下)
 - TX : < 11.0mA (在 +8dBm 条件下)

无线协议支持

- 低功耗 [Bluetooth® 5.3](#)
- [Zigbee®](#)
- [Thread](#)
- 专有系统

高性能无线电

- 低功耗 Bluetooth® 125kbps 时灵敏度为 -102dBm
- 低功耗 Bluetooth® 1Mbps 时灵敏度为 -96.5dBm
- IEEE 802.15.4 (2.4Ghz) 时灵敏度为 -98dBm
- 高达 +8dBm 的输出功率，具有温度补偿

法规遵从性

- 适用于符合以下标准的系统：
 - EN 300 328 (欧洲)
 - FCC CFR47 第 15 部分
 - ARIB STD-T66 (日本)

MCU 外设

- 多达 26 个 I/O 焊盘
 - 2 个 IO 焊盘 SWD，与 GPIO 进行多路复用
 - 2 个 IO 焊盘 LFXT，与 GPIO 进行多路复用
 - 多达 22 个 DIO (模拟或数字 IO)
- 3 个 16 位和 1 个 24 位通用计时器，支持正交解码模式
- 12 位 ADC，使用外部基准时 1.2MSPS，使用内部基准时 267ksps，多达 12 个外部 ADC 输入
- 1 \times 低功耗比较器
- 1 \times UART
- 1 \times SPI
- 1 \times I²C
- 实时时钟 (RTC)
- 集成温度和电池监控器
- 看门狗计时器

信息安全机制

- AES 128 位加密加速计
- 来自片上模拟噪声的随机数生成器

开发工具和软件

- [LP-EM-CC2340R5 LaunchPad](#) 开发套件
- [SimpleLink™ 低功耗 F3 软件开发套件](#)
- 用于简单无线电配置的 [SmartRF™ Studio](#)
- [SysConfig](#) 系统配置工具

工作温度范围

- 片上降压直流/直流转换器
- 1.71V 至 3.8V 单电源电压
- T_j : -40°C 至 +125°C

符合 RoHS 标准的封装

- 5mm \times 5mm RKP QFN40
- 4mm \times 4mm RGE QFN24
- 2.2mm \times 2.6mm YBG WCSP (预发布)



2 应用

- 医疗
 - 居家医疗保健 - 血糖监测仪、血压监测仪、CPAP 呼吸机、电子温度计
 - 患者监护和诊断 - 医疗传感器贴片
 - 个人护理和健身 - 电动牙刷、可穿戴健身和运动监测仪
- 楼宇自动化
 - 楼宇安防系统 - 运动检测器、电子智能锁、门窗传感器、车库门系统、网关
 - HVAC - 恒温器、无线环境传感器
 - 防火安全系统 - 烟雾和热量探测器
 - 视频监控 - IP 网络摄像头
- 照明
 - LED 灯具
 - 照明控制 - 日光传感器、照明传感器、无线控制
- 工厂自动化和控制
- 零售自动化和支付 - 电子销售终端
 - 电子货架标签
- 电网基础设施
 - 智能仪表 - 水表、燃气表、电表和热量分配表
 - 电网通信 - 无线通信 - 远距离传感器应用
 - 其他替代能源 - 能量收集
- 通信设备
 - 有线网络
 - 无线 LAN 或 Wi-Fi 接入点, 边缘路由器
- 个人电子产品
 - 联网外设 - 消费类无线模块、指点设备、键盘
 - 游戏 - 电子玩具和机器人玩具
 - 可穿戴设备 (非医用) - 智能追踪器、智能服装

3 说明

CC2340R SimpleLink™ 系列器件为 2.4GHz 无线微控制器 (MCU)，面向低功耗 Bluetooth®5.3、Zigbee、Thread 和专有 2.4GHz 应用。这些器件针对低功耗无线通信进行了优化，并支持无线下载 (OAD) 功能，适用于楼宇自动化 (无线传感器、照明控制、信标)、资产跟踪、医疗、零售 EPOS (电子销售终端)、ESL (电子货架标签) 和个人电子产品 (玩具、HID、触控笔) 市场。该器件的突出特性包括：

- 支持蓝牙 5 特性：高速模式 (2Mbps PHY)、远距离 (LE 编码 125kbps 和 500kbps PHY)、Privacy 1.2.1 和通道选择算法 2，以及对蓝牙 4.2 和早期低功耗规范中关键特性的向后兼容性和支持。
- 完全合格的 Bluetooth 5.3 软件协议栈 (SimpleLink™ 低功耗 F3 软件开发套件 (SDK) 随附)
- SimpleLink™ 低功耗 F3 软件开发套件 (SDK) 中的 Zigbee® 协议栈支持
- SIMPLELINK TI OPENTHREAD SDK⁽¹⁾ 中的线程协议栈支持
- 超低待机电流不到 0.71 μA 并具有 RTC 操作和完全 RAM 保持，可显著延长电池寿命，尤其是对于睡眠间隔较长的应用。
- 集成平衡-非平衡变压器，可减少物料清单 (BOM) 电路板布局布线
- 出色的无线电敏感度和稳健性 (选择性与阻断) 性能，适用于低功耗 Bluetooth (125kbps LE 编码 PHY 且集成平衡-非平衡变压器时为 -102dBm)

CC2340R 系列器件是 SimpleLink™ MCU 平台的一部分，该平台包括 Wi-Fi®、低功耗蓝牙、Thread、Zigbee、Sub-1GHz MCU 和主机 MCU，它们共用一个通用、易于使用的开发环境，其中包含单核软件开发套件 (SDK) 和丰富的工具集。借助一次性集成的 SimpleLink™ 平台，可以将产品组合中的任何器件组合添加至您的设计中，从而在设计要求变更时实现 100% 的代码重用。有关更多信息，请访问 [SimpleLink™ MCU 平台](#)。

器件信息

| 器件型号 ⁽²⁾ | 闪存 | RAM | 温度范围 | 封装 | 状态 |
|--------------------------------|-------|------|---------------|-------|-----|
| CC2340R53E0RKPR | 512KB | 64KB | -40°C 至 125°C | QFN40 | 已发布 |
| CC2340R53E0YBGR ⁽¹⁾ | 512KB | 64KB | -40°C 至 125°C | WCSP | 预发布 |
| CC2340R53N0RKPR | 512KB | 64KB | -40°C 至 85°C | QFN40 | 已发布 |
| CC2340R52E0RKPR | 512KB | 36KB | -40°C 至 125°C | QFN40 | 已发布 |
| CC2340R52E0RGER | 512KB | 36KB | -40°C 至 125°C | QFN24 | 已发布 |
| CC2340R52N0RKPR | 512KB | 36KB | -40°C 至 85°C | QFN40 | 已发布 |
| CC2340R52N0RGER | 512KB | 36KB | -40°C 至 85°C | QFN24 | 已发布 |
| CC2340R22E0RKPR | 256KB | 36KB | -40°C 至 125°C | QFN40 | 已发布 |
| CC2340R22N0RKPR | 256KB | 36KB | -40°C 至 85°C | QFN40 | 已发布 |
| CC2340R21E0RGER ⁽¹⁾ | 256KB | 28KB | -40°C 至 125°C | QFN24 | 预发布 |
| CC2340R21N0RGER | 256KB | 28KB | -40°C 至 85°C | QFN24 | 已发布 |

- (1) 在未来版本中提供
- (2) 有关更多信息，请参阅节 12。

4 功能方框图

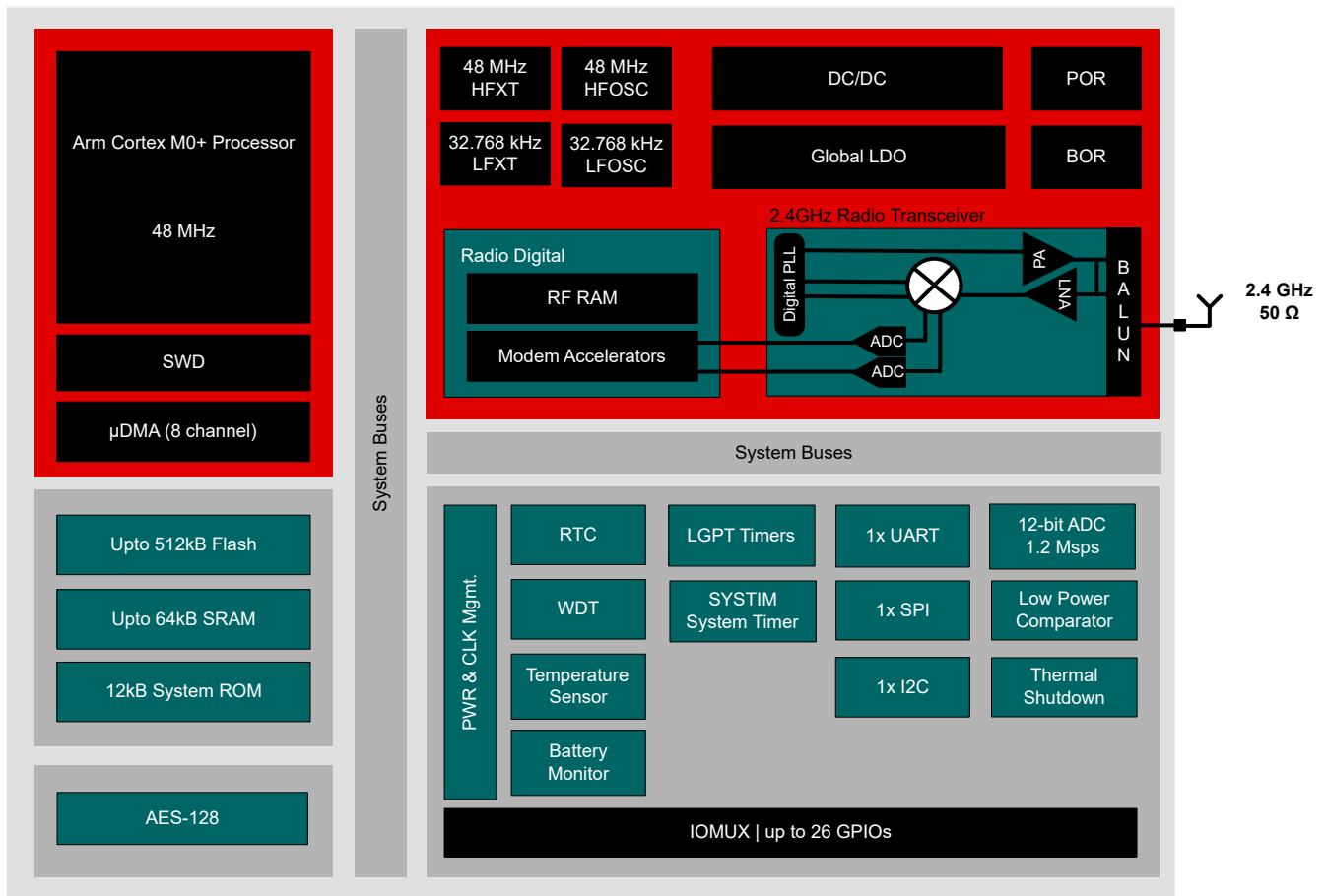


图 4-1. CC2340R 系列框图

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5 Device Comparison

| Device | RADIO SUPPORT | | | | FLASH (KB) | RAM + Cache (KB) | GPIO | PACKAGE SIZE | | |
|-----------|---------------|---------------|--------|--------|------------|------------------|-------|------------------------|--------------------|--------------------|
| | 2.4GHz Prop. | Bluetooth® LE | ZigBee | Thread | | | | 2.2 X 2.6 mm WCSP (24) | 4 X 4 mm VQFN (24) | 5 X 5 mm VQFN (40) |
| CC2340R53 | ✓ | ✓ | ✓ | ✓ | 512 | 64 | 12-26 | ✓ | | ✓ |
| CC2340R52 | ✓ | ✓ | ✓ | ✓ | 512 | 36 | 12-26 | | ✓ | ✓ |
| CC2340R22 | ✓ | ✓ | ✓ | ✓ | 256 | 36 | 26 | | | ✓ |
| CC2340R21 | ✓ | ✓ | ✓ | | 256 | 28 | 12 | | ✓ | |

6 Pin Configurations and Functions

6.1 Pin Diagrams

6.1.1 Pin Diagram—RKP Package (Top View)

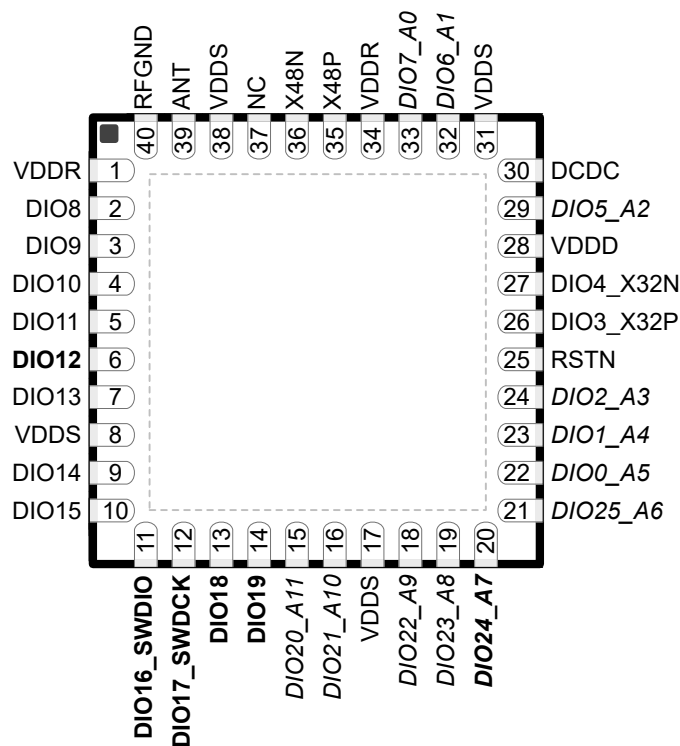


图 6-1. RKP (5mm × 5mm) Pinout, 0.4mm Pitch (Top View)

The following I/O pins marked in 图 6-1 in **bold** have high-drive capabilities:

- Pin 6, DIO12
- Pin 11, DIO16_SWDIO
- Pin 12, DIO17_SWDCCK
- Pin 13, DIO18
- Pin 14, DIO19
- Pin 20, DIO24_A7

The following I/O pins marked in 图 6-1 in *italics* have analog capabilities:

- Pin 15, DIO20_A11
- Pin 16, DIO21_A10
- Pin 18, DIO22_A9
- Pin 19, DIO23_A8
- Pin 20, DIO24_A7
- Pin 21, DIO25_A6
- Pin 22, DIO0_A5
- Pin 23, DIO1_A4
- Pin 24, DIO2_A3
- Pin 29, DIO5_A2
- Pin 32, DIO6_A1
- Pin 33, DIO7_A0

6.1.2 Pin Diagram - RGE Package (Top View)

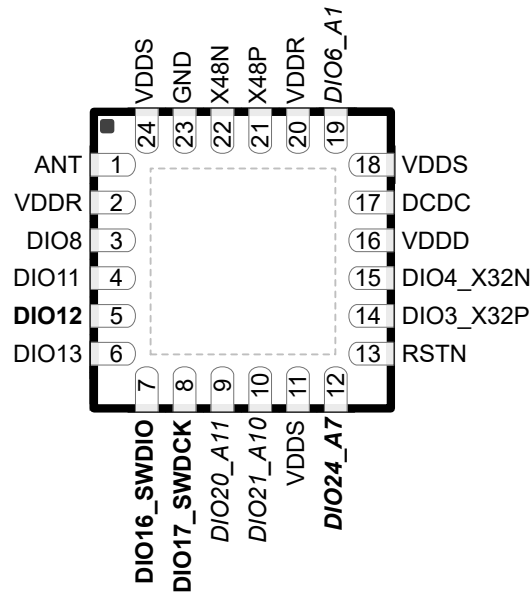


图 6-2. RGE (4mm × 4mm) Pinout, 0.5mm Pitch (Top View)

The following I/O pins marked in 图 6-2 in **bold** have high-drive capabilities:

- Pin 5, DIO12
- Pin 7, DIO16_SWDIO
- Pin 8, DIO17_SWDCK
- Pin 12, DIO24_A7

The following I/O pins marked in 图 6-2 in *italics* have analog capabilities:

- Pin 9, *DIO20_A11*
- Pin 10, *DIO21_A10*
- Pin 12, *DIO24_A7*
- Pin 19, *DIO6_A1*

6.1.3 Pin Diagram—YBG Package (Top View)

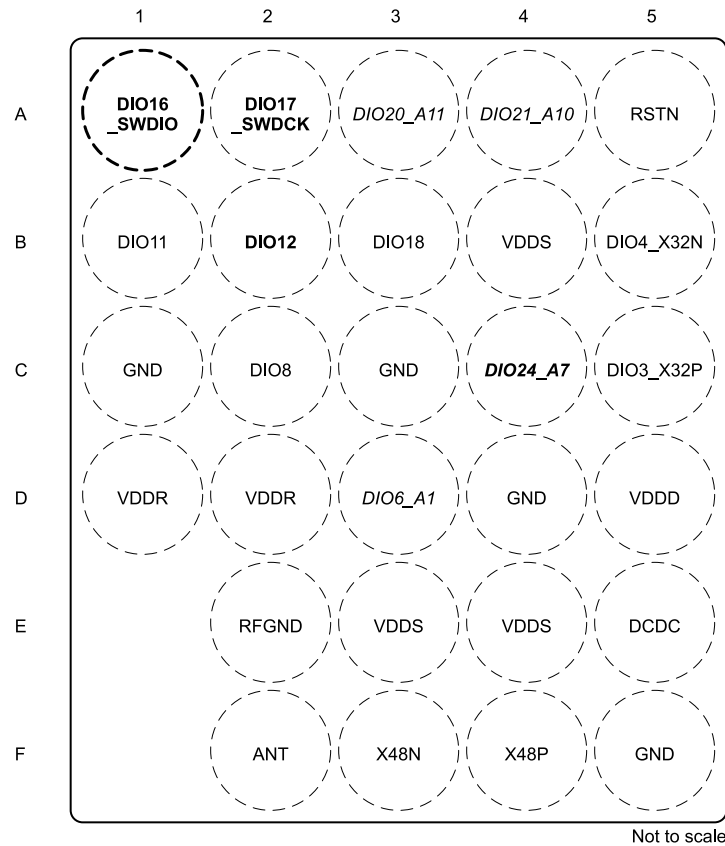


图 6-3. Preview—YBG (2.2mm × 2.6mm) Pinout, 0.4mm Pitch (Top View)

The following I/O pins marked in 图 6-2 in **bold** have high-drive capabilities:

- Pin B2, DIO12
- Pin A1, DIO16_SWDIO
- Pin A2, DIO17_SWDCK
- Pin C4, DIO24_A7

The following I/O pins marked in 图 6-2 in *italics* have analog capabilities:

- Pin A3, DIO20_A11
- Pin A4, DIO21_A10
- Pin C4, DIO24_A7
- Pin D3, DIO6_A1

表 6-1. Pin Attributes (RKP, RGE, YBG, Packages)

| RKP PIN NUMBER | RGE PIN NUMBER | YBG PIN NUMBER | SIGNAL NAME | PIN NAME | MUX ENCODING | SIGNAL TYPE |
|----------------|----------------|----------------|-------------|----------|--------------|-------------|
| 39 | 1 | F2 | ANT | ANT | | RF |
| 30 | 17 | E5 | DCDC | DCDC | | PWR |

表 6-1. Pin Attributes (RKP, RGE, YBG, Packages) (续)

| RKP PIN NUMBER | RGE PIN NUMBER | YBG PIN NUMBER | SIGNAL NAME | PIN NAME | MUX ENCODING | SIGNAL TYPE |
|----------------|----------------|----------------|-------------|----------|--------------|-------------|
| 2 | 3 | C2 | DIO8 | GPIO8 | 0 | I/O |
| | | | | SPI0SCLK | 1 | I/O |
| | | | | UART0RTS | 2 | I/O |
| | | | | T1C0N | 3 | I/O |
| | | | | I2C0SDA | 4 | I/O |
| | | | | T0C0N | 5 | I/O |
| | | | | DTB3 | 7 | I/O |
| 3 | | | DIO9 | GPIO9 | 0 | I/O |
| | | | | T3C0 | 1 | I/O |
| | | | | LRFD3 | 3 | I/O |
| 22 | | | DIO0_A5 | GPIO0 | 0 | I/O |
| | | | | SPI0CSN | 1 | I/O |
| | | | | I2C0SDA | 2 | I/O |
| | | | | T3C2 | 3 | I/O |
| | | | | ANA5 | 6 | ANALOG |
| 4 | | | DIO10 | GPIO10 | 0 | I/O |
| | | | | LPCO | 1 | I/O |
| | | | | T2PE | 2 | I/O |
| | | | | T3C0N | 3 | I/O |
| 5 | 4 | B1 | DIO11 | GPIO11 | 0 | I/O |
| | | | | SPI0CSN | 1 | I/O |
| | | | | T1C2N | 2 | I/O |
| | | | | T0C0 | 3 | I/O |
| | | | | LRFD0 | 4 | I/O |
| | | | | SPI0POCI | 5 | I/O |
| | | | | DTB9 | 7 | I/O |
| 6 | 5 | B2 | DIO12 | GPIO12 | 0 | I/O |
| | | | | SPI0POCI | 1 | I/O |
| | | | | SPI0PICO | 2 | I/O |
| | | | | UART0RXD | 3 | I/O |
| | | | | T1C1 | 4 | I/O |
| | | | | I2C0SDA | 5 | I/O |
| | | | | DTB13 | 7 | I/O |
| 7 | 6 | | DIO13 | GPIO13 | 0 | I/O |
| | | | | SPI0POCI | 1 | I/O |
| | | | | SPI0PICO | 2 | I/O |
| | | | | UART0TXD | 3 | I/O |
| | | | | T0C0N | 4 | I/O |
| | | | | T1F | 5 | I/O |
| | | | | DTB4 | 7 | I/O |

表 6-1. Pin Attributes (RKP, RGE, YBG, Packages) (续)

| RKP PIN NUMBER | RGE PIN NUMBER | YBG PIN NUMBER | SIGNAL NAME | PIN NAME | MUX ENCODING | SIGNAL TYPE |
|----------------|----------------|----------------|-------------|----------|--------------|-------------|
| 9 | | | DIO14 | GPIO14 | 0 | I/O |
| | | | | T3C2 | 1 | I/O |
| | | | | T1C2N | 2 | I/O |
| | | | | LRFD5 | 3 | I/O |
| | | | | T1F | 4 | I/O |
| 10 | | | DIO15 | GPIO15 | 0 | I/O |
| | | | | UART0RXD | 1 | I/O |
| | | | | T2C0N | 2 | I/O |
| | | | | CKMIN | 3 | I/O |
| 11 | 7 | A1 | DIO16_SWDIO | GPIO16 | 0 | I/O |
| | | | | SPI0PICO | 1 | I/O |
| | | | | UART0RXD | 2 | I/O |
| | | | | I2C0SDA | 3 | I/O |
| | | | | T1C2 | 4 | I/O |
| | | | | T1C0N | 5 | I/O |
| | | | | DTB10 | 7 | I/O |
| 12 | 8 | A2 | DIO17_SWDC | GPIO17 | 0 | I/O |
| | | | | SPI0SCLK | 1 | I/O |
| | | | | UART0TXD | 2 | I/O |
| | | | | I2C0SCL | 3 | I/O |
| | | | | T1C1N | 4 | I/O |
| | | | | T0C2 | 5 | I/O |
| | | | | DTB11 | 7 | I/O |
| 13 | | B3 | DIO18 | GPIO18 | 0 | I/O |
| | | | | T3C0 | 1 | I/O |
| | | | | LPCO | 2 | I/O |
| | | | | UART0TXD | 3 | I/O |
| | | | | SPI0SCLK | 4 | I/O |
| | | | | DTB12 | 7 | I/O |
| | | | | 14 | | |
| T3C1 | 1 | I/O | | | | |
| T2PE | 2 | I/O | | | | |
| SPI0PICO | 4 | I/O | | | | |
| DTB0 | 7 | I/O | | | | |
| 23 | | | DIO1_A4 | | | |
| | | | | T3C1 | 1 | I/O |
| | | | | LRFD7 | 2 | I/O |
| | | | | T1F | 3 | I/O |
| | | | | UART0RTS | 4 | I/O |
| | | | | ANA4 | 6 | ANALOG |
| | | | | DTB2 | 7 | I/O |

表 6-1. Pin Attributes (RKP, RGE, YBG, Packages) (续)

| RKP PIN NUMBER | RGE PIN NUMBER | YBG PIN NUMBER | SIGNAL NAME | PIN NAME | MUX ENCODING | SIGNAL TYPE |
|----------------|----------------|----------------|-------------|----------|--------------|-------------|
| 15 | 9 | A3 | DIO20_A11 | GPIO20 | 0 | I/O |
| | | | | LPCO | 1 | I/O |
| | | | | UART0TXD | 2 | I/O |
| | | | | UART0RXD | 3 | I/O |
| | | | | T1C0 | 4 | I/O |
| | | | | SPI0POCI | 5 | I/O |
| | | | | ANA11 | 6 | ANALOG |
| | | | | DTB14 | 7 | I/O |
| 16 | 10 | A4 | DIO21_A10 | GPIO21 | 0 | I/O |
| | | | | UART0CTS | 1 | I/O |
| | | | | T1C1N | 2 | I/O |
| | | | | T0C1 | 3 | I/O |
| | | | | SPI0POCI | 4 | I/O |
| | | | | LRFD1 | 5 | I/O |
| | | | | ANA10 | 6 | ANALOG |
| | | | | DTB15 | 7 | I/O |
| 18 | | | DIO22_A9 | GPIO22 | 0 | I/O |
| | | | | T2C0N | 1 | I/O |
| | | | | UART0RXD | 2 | I/O |
| | | | | T3C1N | 3 | I/O |
| | | | | ANA9 | 6 | ANALOG |
| | | | | DTB1 | 7 | I/O |
| 19 | | | DIO23_A8 | GPIO23 | 0 | I/O |
| | | | | T2C1 | 1 | I/O |
| | | | | T3C2N | 3 | I/O |
| | | | | ANA8 | 6 | ANALOG |
| 20 | 12 | C4 | DIO24_A7 | GPIO24 | 0 | I/O |
| | | | | SPI0SCLK | 1 | I/O |
| | | | | T1C0 | 2 | I/O |
| | | | | T3C0 | 3 | I/O |
| | | | | T0PE | 4 | I/O |
| | | | | I2C0SCL | 5 | I/O |
| | | | | ANA7 | 6 | ANALOG |
| | | | | DTB5 | 7 | I/O |
| 21 | | | DIO25_16 | GPIO25 | 0 | I/O |
| | | | | SPI0POCI | 1 | I/O |
| | | | | I2C0SCL | 2 | I/O |
| | | | | T2C2N | 3 | I/O |
| | | | | ANA6 | 6 | ANALOG |
| 24 | | | DIO2_A3 | GPIO2 | 0 | I/O |
| | | | | T0PE | 1 | I/O |
| | | | | T2C1N | 2 | I/O |
| | | | | UART0CTS | 3 | I/O |
| | | | | ANA3 | 6 | ANALOG |

表 6-1. Pin Attributes (RKP, RGE, YBG, Packages) (续)

| RKP PIN NUMBER | RGE PIN NUMBER | YBG PIN NUMBER | SIGNAL NAME | PIN NAME | MUX ENCODING | SIGNAL TYPE |
|----------------|----------------|----------------|-------------|----------|--------------|-------------|
| 26 | 14 | C5 | DIO3_X32P | GPIO3 | 0 | I/O |
| | | | | LFCI | 1 | I/O |
| | | | | T0C1N | 2 | I/O |
| | | | | LRFD0 | 3 | I/O |
| | | | | T3C1 | 4 | I/O |
| | | | | T1C2 | 5 | I/O |
| | | | | LFXT_P | 6 | I/O |
| | | | | DTB7 | 7 | I/O |
| 27 | 15 | B5 | DIO4_X32N | GPIO4 | 0 | I/O |
| | | | | T0C2N | 1 | I/O |
| | | | | UART0TXD | 2 | I/O |
| | | | | LRFD1 | 3 | I/O |
| | | | | SPI0PICO | 4 | I/O |
| | | | | T0C2 | 5 | I/O |
| | | | | LFXT_N | 6 | I/O |
| | | | | DTB8 | 7 | I/O |
| 29 | | | DIO5_A2 | GPIO5 | 0 | I/O |
| | | | | T2C2 | 1 | I/O |
| | | | | LRFD6 | 3 | I/O |
| | | | | ANA2 | 6 | ANALOG |
| 32 | 19 | D3 | DIO6_A1 | GPIO6 | 0 | I/O |
| | | | | SPI0CSN | 1 | I/O |
| | | | | I2C0SCL | 2 | I/O |
| | | | | T1C2 | 3 | I/O |
| | | | | LRFD2 | 4 | I/O |
| | | | | UART0TXD | 5 | I/O |
| | | | | ANA1 | 6 | ANALOG |
| | | | | DTB6 | 7 | I/O |
| 33 | | | DIO7_A0 | GPIO7 | 0 | I/O |
| | | | | T3C1 | 1 | I/O |
| | | | | LRFD4 | 3 | I/O |
| | | | | ANA0 | 6 | ANALOG |
| | 23 | C1, C3, D4, F5 | GND | GND | | GND |
| 37 | | | NC | NC | | NC |
| 40 | | E2 | RFGND | RFGND | | GND |
| 25 | 13 | A5 | RSTN | RSTN | | I/O |
| 28 | 16 | D5 | VDDD | VDDD | | PWR |
| 1, 34 | 2, 20 | D1, D2 | VDDR | VDDR | | PWR |
| 17, 31, 38, 8 | 11, 18, 24 | B4, E3, E4 | VDDS | VDDS | | PWR |
| 36 | 22 | F3 | X48N | X48N | | I/O |
| 35 | 21 | F4 | X48P | X48P | | I/O |

6.2 Signal Descriptions

表 6-2. Analog Input Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|--|---------|---------|---------|
| ANA0 | ANALOG | I | ADC reference (negative terminal) or ADC channel 0 input | 33 | | |
| ANA1 | ANALOG | I | ADC reference (positive terminal) or ADC channel 1 input | 32 | 19 | D3 |
| ANA2 | ANALOG | I | ADC channel 2 input | 29 | | |
| ANA3 | ANALOG | I | ADC channel 3 input | 24 | | |
| ANA4 | ANALOG | I | ADC channel 4 input | 23 | | |
| ANA5 | ANALOG | I | ADC channel 5 input | 22 | | |
| ANA6 | ANALOG | I | ADC channel 6 input | 21 | | |
| ANA7 | ANALOG | I | Low power comparator input (positive terminal) / ADC channel 7 input | 20 | 12 | C4 |
| ANA8 | ANALOG | I | Low power comparator input (positive or negative terminal) / ADC channel 8 input | 19 | | |
| ANA9 | ANALOG | I | ADC channel 9 input | 18 | | |
| ANA10 | ANALOG | I | Low power comparator input (positive terminal) / ADC channel 10 input | 16 | 10 | A4 |
| ANA11 | ANALOG | I | ADC channel 11 input | 15 | 9 | A3 |

表 6-3. Clock Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|--|---------|---------|---------|
| CKMIN | I/O | I | HFOSC tracking loop input | 10 | | |
| LFCI | I/O | I | Low frequency clock input (LFXT bypass clock from pin) | 26 | 14 | C5 |
| LFXT_N | I/O | I | 32kHz crystal oscillator pin 2 | 27 | 15 | B5 |
| LFXT_P | I/O | I | 32kHz crystal oscillator pin 1 | 26 | 14 | C5 |
| X48N | I/O | I | 48MHz crystal oscillator pin 2 | 36 | 22 | F3 |
| X48P | I/O | I | 48MHz crystal oscillator pin 1 | 35 | 21 | F4 |

表 6-4. DTB Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|----------------------------|---------|---------|---------|
| DTB0 | I/O | O | Digital test bus output 0 | 14 | | |
| DTB1 | I/O | O | Digital test bus output 1 | 18 | | |
| DTB2 | I/O | O | Digital test bus output 2 | 23 | | |
| DTB3 | I/O | O | Digital test bus output 3 | 2 | 3 | C2 |
| DTB4 | I/O | O | Digital test bus output 4 | 7 | 6 | |
| DTB5 | I/O | O | Digital test bus output 5 | 20 | 12 | C4 |
| DTB6 | I/O | O | Digital test bus output6 | 32 | 19 | D3 |
| DTB7 | I/O | O | Digital test bus output 7 | 26 | 14 | C5 |
| DTB8 | I/O | O | Digital test bus output 8 | 27 | 15 | B5 |
| DTB9 | I/O | O | Digital test bus output 9 | 5 | 4 | B1 |
| DTB10 | I/O | O | Digital test bus output 10 | 11 | 7 | A1 |

表 6-4. DTB Signal Descriptions (续)

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|----------------------------|---------|---------|---------|
| DTB11 | I/O | O | Digital test bus output 11 | 12 | 8 | A2 |
| DTB12 | I/O | O | Digital test bus output 12 | 13 | | B3 |
| DTB13 | I/O | O | Digital test bus output 13 | 6 | 5 | B2 |
| DTB14 | I/O | O | Digital test bus output 14 | 15 | 9 | A3 |
| DTB15 | I/O | O | Digital test bus output 15 | 16 | 10 | A4 |

表 6-5. GPIO Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|---------------------------------|---------|---------|---------|
| GPIO0 | I/O | I/O | General-purpose input or output | 22 | | |
| GPIO1 | I/O | I/O | General-purpose input or output | 23 | | |
| GPIO2 | I/O | I/O | General-purpose input or output | 24 | | |
| GPIO3 | I/O | I/O | General-purpose input or output | 26 | 14 | C5 |
| GPIO4 | I/O | I/O | General-purpose input or output | 27 | 15 | B5 |
| GPIO5 | I/O | I/O | General-purpose input or output | 29 | | |
| GPIO6 | I/O | I/O | General-purpose input or output | 32 | 19 | D3 |
| GPIO7 | I/O | I/O | General-purpose input or output | 33 | | |
| GPIO8 | I/O | I/O | General-purpose input or output | 2 | 3 | C2 |
| GPIO9 | I/O | I/O | General-purpose input or output | 3 | | |
| GPIO10 | I/O | I/O | General-purpose input or output | 4 | | |
| GPIO11 | I/O | I/O | General-purpose input or output | 5 | 4 | B1 |
| GPIO12 | I/O | I/O | General-purpose input or output | 6 | 5 | B2 |
| GPIO13 | I/O | I/O | General-purpose input or output | 7 | 6 | |
| GPIO14 | I/O | I/O | General-purpose input or output | 9 | | |
| GPIO15 | I/O | I/O | General-purpose input or output | 10 | | |
| GPIO16 | I/O | I/O | General-purpose input or output | 11 | 7 | A1 |
| GPIO17 | I/O | I/O | General-purpose input or output | 12 | 8 | A2 |
| GPIO18 | I/O | I/O | General-purpose input or output | 13 | | B3 |
| GPIO19 | I/O | I/O | General-purpose input or output | 14 | | |
| GPIO20 | I/O | I/O | General-purpose input or output | 15 | 9 | A3 |
| GPIO21 | I/O | I/O | General-purpose input or output | 16 | 10 | A4 |
| GPIO22 | I/O | I/O | General-purpose input or output | 18 | | |
| GPIO23 | I/O | I/O | General-purpose input or output | 19 | | |
| GPIO24 | I/O | I/O | General-purpose input or output | 20 | 12 | C4 |
| GPIO25 | I/O | I/O | General-purpose input or output | 21 | | |

表 6-6. Device Grounds

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|---------------------|---------|---------|----------------|
| GND | GND | N/A | Ground | | 23 | C1, C3, D4, F5 |
| RFGND | GND | N/A | RF ground reference | 40 | | E2 |

表 6-7. I²C Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|-------------|----------------|-----------|------------|
| I2C0SCL | I/O | I/O | I2C clock | 12, 20, 21, 32 | 12, 19, 8 | A2, C4, D3 |
| I2C0SDA | I/O | I/O | I2C data | 11, 2, 22, 6 | 3, 5, 7 | A1, B2, C2 |

表 6-8. Low Power Comparator Output Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|-----------------------------|-----------|---------|---------|
| LPCO | I/O | O | Low power comparator output | 13, 15, 4 | 9 | A3, B3 |

表 6-9. No Connect

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|-------------|---------|---------|---------|
| NC | NC | N/A | No connect | 37 | | |

表 6-10. Device Power

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|---------------------|----------|------------------|--|---------------|------------|------------|
| DCDC ⁽¹⁾ | PWR | N/A | Switch node of the internal DC/DC converter | 30 | 17 | E5 |
| VDDD ⁽¹⁾ | PWR | N/A | Internal 1.28V regulator decoupling capacitor | 28 | 16 | D5 |
| VDDR | PWR | N/A | Internal supply, must be powered from the internal DC/DC converter or the internal LDO | 1, 34 | 2, 20 | D1, D2 |
| VDDS | PWR | N/A | 1.71V to 3.8V supply | 17, 31, 38, 8 | 11, 18, 24 | B4, E3, E4 |

(1) Do not supply external circuitry from this pin.

表 6-11. Reset Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|---------------------------------------|---------|---------|---------|
| RSTN | I/O | I | Global main device reset (active low) | 25 | 13 | A5 |

表 6-12. Radio Digital Output Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|-----------------------------|---------|---------|---------|
| LRFD0 | I/O | O | Radio Core Output 0 | 26, 5 | 14, 4 | B1, C5 |
| LRFD1 | I/O | O | Radio Core Output 1 | 16, 27 | 10, 15 | A4, B5 |
| LRFD2 | I/O | O | Radio Core Output 2 | 32 | 19 | D3 |
| LRFD3 | I/O | O | Radio Core Digital Output 3 | 3 | | |
| LRFD4 | I/O | O | Radio Core Output 4 | 33 | | |
| LRFD5 | I/O | O | Radio Core Output 5 | 9 | | |
| LRFD6 | I/O | O | Radio Core Output 6 | 29 | | |
| LRFD7 | I/O | O | Radio Core Output 7 | 23 | | |

表 6-13. RF Port

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|--------------|---------|---------|---------|
| ANT | RF | I/O | 50 Ω RF port | 39 | 1 | F2 |

表 6-14. SPI Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|----------------------------------|---------------------|----------------|----------------|
| SPI0CSN | I/O | I/O | SPI chip select | 22, 32, 5 | 19, 4 | B1, D3 |
| SPI0PICO | I/O | I/O | SPI peripheral in controller out | 11, 14, 27, 6, 7 | 15, 5, 6, 7 | A1, B2, B5 |
| SPI0POCI | I/O | I/O | SPI peripheral out controller in | 15, 16, 21, 5, 6, 7 | 10, 4, 5, 6, 9 | A3, A4, B1, B2 |
| SPI0SCLK | I/O | I/O | SPI clock | 12, 13, 2, 20 | 12, 3, 8 | A2, B3, C2, C4 |

表 6-15. Timers Capture or Compare Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|---------------------|----------|------------------|-----------------------------------|----------------|-----------|------------|
| T0C0 | I/O | I/O | Capture or compare 0 from timer 0 | 5 | 4 | B1 |
| T0C1 | I/O | I/O | Capture or compare 1 from timer 0 | 16 | 10 | A4 |
| T0C2 | I/O | I/O | Capture or compare 2 from timer 0 | 12, 27 | 15, 8 | A2, B5 |
| T1C0 | I/O | I/O | Capture or compare 0 from timer 1 | 15, 20 | 12, 9 | A3, C4 |
| T1C1 | I/O | I/O | Capture or compare 1 from timer 1 | 6 | 5 | B2 |
| T1C2 | I/O | I/O | Capture or compare 2 from timer 1 | 11, 26, 32 | 14, 19, 7 | A1, C5, D3 |
| T2C1 | I/O | I/O | Capture or compare 1 from timer 2 | 19 | | |
| T2C2 | I/O | I/O | Capture or compare 2 from timer 2 | 29 | | |
| T3C0 | I/O | I/O | Capture or compare 0 from timer 3 | 13, 20, 3 | 12 | B3, C4 |
| T3C1 ⁽¹⁾ | I/O | I/O | Capture or compare 1 from timer 3 | 14, 23, 26, 33 | 14 | C5 |
| T3C2 | I/O | I/O | Capture or compare 2 from timer 3 | 22, 9 | | |

(1) Timer 3 not available on CC2340R21.

表 6-16. Timers Complementary Output Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|--|---------|---------|---------|
| T0C0N | I/O | O | Complementary compare or PWM output 0 from timer 0 | 2, 7 | 3, 6 | C2 |
| T0C1N | I/O | O | Complementary compare or PWM output 1 from timer 0 | 26 | 14 | C5 |
| T0C2N | I/O | O | Complementary compare or PWM output 2 from timer 0 | 27 | 15 | B5 |
| T1C0N | I/O | O | Complementary compare or PWM output 0 from timer 1 | 11, 2 | 3, 7 | A1, C2 |
| T1C1N | I/O | O | Complementary compare or PWM output 1 from timer 1 | 12, 16 | 10, 8 | A2, A4 |

表 6-16. Timers Complementary Output Signal Descriptions (续)

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|--|---------|---------|---------|
| T1C2N | I/O | O | Complementary compare or PWM output 2 from timer 0 | 5, 9 | 4 | B1 |
| T2C0N | I/O | O | Complementary compare or PWM output 0 from timer 2 | 10, 18 | | |
| T2C1N | I/O | O | Complementary compare or PWM output 1 from timer 2 | 24 | | |
| T2C2N | I/O | O | Complementary compare or PWM output 2 from timer 2 | 21 | | |
| T3C0N | I/O | O | Complementary compare or PWM output 0 from timer 3 | 4 | | |
| T3C1N | I/O | O | Complementary compare or PWM output 1 from timer 3 | 18 | | |
| T3C2N | I/O | O | Complementary compare or PWM output 2 from timer 3 | 19 | | |

表 6-17. Timers Fault Input Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|-------------------------|----------|---------|---------|
| T1F | I/O | I | Fault input for timer 1 | 23, 7, 9 | 6 | |

表 6-18. Timers Prescaler Event Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|-------------------------------------|---------|---------|---------|
| T0PE | I/O | O | Prescaler event output from timer 0 | 20, 24 | 12 | C4 |
| T2PE | I/O | O | Prescaler event output from timer 2 | 14, 4 | | |

表 6-19. UART Signal Descriptions

| SIGNAL NAME | PIN TYPE | SIGNAL DIRECTION | DESCRIPTION | RKP PIN | RGE PIN | YBG PIN |
|-------------|----------|------------------|---------------------------------------|-----------------------|-----------------|--------------------|
| UART0CTS | I/O | I | UART clear-to-send input (active low) | 16, 24 | 10 | A4 |
| UART0RTS | I/O | O | UART request-to-send (active low) | 2, 23 | 3 | C2 |
| UART0RXD | I/O | I | UART receive data | 10, 11, 15, 18, 6 | 5, 7, 9 | A1, A3, B2 |
| UART0TXD | I/O | O | UART transmit data | 12, 13, 15, 27, 32, 7 | 15, 19, 6, 8, 9 | A2, A3, B3, B5, D3 |

6.3 Connections for Unused Pins and Modules

表 6-20. Connections for Unused Pins

| FUNCTION | SIGNAL NAME | ACCEPTABLE PRACTICE ⁽¹⁾ | PREFERRED PRACTICE ⁽¹⁾ |
|--------------------------|----------------------|------------------------------------|-----------------------------------|
| GPIO (digital) | DIO _n | NC, GND, or VDD5 | NC |
| SWD | DIO16_SWDIO | NC, GND, or VDD5 | GND or VDD5 |
| | DIO17_SWDCCK | NC, GND, or VDD5 | GND or VDD5 |
| GPIO (digital or analog) | DIO _n _Am | NC, GND, or VDD5 | NC |
| 32.768-kHz crystal | DIO3_X32P | NC or GND | NC |
| | DIO4_X32N | | |

表 6-20. Connections for Unused Pins (续)

| FUNCTION | SIGNAL NAME | ACCEPTABLE PRACTICE ⁽¹⁾ | PREFERRED PRACTICE ⁽¹⁾ |
|--------------------------------|-------------|------------------------------------|-----------------------------------|
| DC/DC converter ⁽²⁾ | DCDC | NC | NC |
| | VDDS | VDDS | VDDS |

(1) NC = No connect

(2) When the DC/DC converter is not used, the inductor between DCDC and VDDR can be removed. VDDR must still be connected and the 10 μ F DCDC capacitor must be kept on the VDDR net.

7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)^{(1) (2)}

| | | MIN | MAX | UNIT |
|---------------------|--|-------|---------------------------------|------|
| V _{DD5} | Supply voltage | - 0.3 | 4.1 | V |
| | Voltage on any digital pin ⁽³⁾ | - 0.3 | V _{DD5} + 0.3, max 4.1 | V |
| | Voltage on crystal oscillator pins X48P and X48N | - 0.3 | 1.24 | V |
| V _{in_adc} | Voltage on ADC input | 0 | V _{DD5} | V |
| | Input level, RF pins | | 5 | dBm |
| T _{stg} | Storage temperature | - 40 | 150 | °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 ground, unless otherwise noted.
- (3) Including analog capable DIOs.

7.2 ESD Ratings

| | | | | VALUE | UNIT |
|------------------|-------------------------|---|----------|-------|------|
| QFN packages | | | | | |
| V _{ESD} | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | All pins | ±1000 | V |
| | | Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002 ⁽²⁾ | All pins | ±500 | V |
| WCSP packages | | | | | |
| V _{ESD} | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | All pins | TBD | V |
| | | Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002 ⁽²⁾ | All pins | TBD | V |

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

7.3 Recommended Operating Conditions

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

| | | MIN | MAX | UNIT |
|---|---|------|-----|-------|
| CC2340xxxExxxxx devices (125 °C parts) | Operating ambient temperature ^{(1) (2)} | - 40 | 125 | °C |
| | Operating junction temperature ^{(1) (2)} | - 40 | 125 | °C |
| CC2340xxxNxxxxx devices (85 °C parts) | Operating ambient temperature ^{(1) (2)} | - 40 | 85 | °C |
| | Operating junction temperature ^{(1) (2)} | - 40 | 85 | °C |
| Operating supply voltage (V _{DD5}) | | 1.71 | 3.8 | V |
| Rising supply voltage slew rate | | 0 | 100 | mV/μs |
| Falling supply voltage slew rate ⁽³⁾ | | 0 | 1 | mV/μs |

- (1) Operation at or near maximum operating temperature for extended durations will result in a reduction in lifetime.
- (2) For thermal resistance details, refer to *Thermal Resistance Characteristics* table in this document.
- (3) For small coin-cell batteries, with high worst-case end-of-life equivalent source resistance, a 10-μF V_{DD5} input capacitor must be used to ensure compliance with this slew rate.

7.4 DCDC

When measured on the CC2340R5 reference design with T_c = 25 °C and DCDC enabled unless otherwise noted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|-----------------|-----|-----|-----|------|
| V _{DD5} supply voltage for DCDC operation ^{(1) (2)} | | 2.2 | 3.0 | 3.8 | V |

- (1) When the supply voltage drops below the DCDC operation min voltage, the device automatically transitions to use GLDO regulator on-chip.
- (2) A 10μH and 10μF load capacitor are required on the V_{DD5} voltage rail. They should be placed close to the DCDC output pin.

7.5 Global LDO (GLDO)

When measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|-----------------|------|-----|-----|------|
| VDDS supply voltage for GLDO operation ⁽¹⁾ | | 1.71 | 3.0 | 3.8 | V |

(1) A 10 μF capacitor is recommended at VDDR pin.

7.6 Power Supply and Modules

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

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|-----------------|-----|------|-----|------|
| VDDS_BOD | | | | | |
| Brownout rising threshold ⁽¹⁾ | | | 1.68 | | V |
| Brownout falling threshold ⁽¹⁾ | | | 1.67 | | V |
| POR | | | | | |
| power-on reset power-up level | | | 1.5 | | V |
| power-on reset power-down level | | | 1.45 | | V |

(1) Brown-out Detector is trimmed at initial boot, value is kept until device is reset by a POR reset or the RSTN pin.

7.7 Battery Monitor

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, unless otherwise noted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|------------|-----------------|-----|-----|-----|------|
| Resolution | | | 22 | | mV |
| Range | | 1.7 | | 3.8 | V |
| Accuracy | VDDS = 3.0 V | | 30 | | mV |

7.8 Temperature Sensor

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{ V}$, unless otherwise noted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--|-----|-------------------------|-----|------------------|
| CC2340xxxExxxxx devices (125 $^\circ\text{C}$ devices) | | | | | |
| Accuracy | -40 $^\circ\text{C}$ to 125 $^\circ\text{C}$ | | -15/+9 ⁽¹⁾ | | $^\circ\text{C}$ |
| CC2340xxxNxxxxx devices (85 $^\circ\text{C}$ devices) | | | | | |
| Accuracy | -40 $^\circ\text{C}$ to 85 $^\circ\text{C}$ | | ± 10 ⁽¹⁾ | | $^\circ\text{C}$ |

(1) Raw output from register.

7.9 Power Consumption - Power Modes

When measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{DD5} = 3.0\text{ V}$, DCDC enabled, GLDO disabled, unless otherwise noted.

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--------------|---|-----|------|-----|----------------------------|
| Core Current Consumption with DCDC | | | | | | |
| I_{core} | Active | MCU running CoreMark from Flash at 48 MHz | | 2.6 | | mA |
| I_{core} | Active | MCU running CoreMark from Flash at 48MHz | | 53 | | $\mu\text{A} / \text{MHz}$ |
| I_{core} | Idle | Supply Systems and RAM powered, flash disabled, DMA disabled | | 0.8 | | mA |
| I_{core} | Idle | Supply Systems and RAM powered, flash disabled, DMA enabled | | 0.8 | | mA |
| I_{core} | Idle | Supply Systems and RAM powered, flash enabled, DMA disabled | | 1.1 | | mA |
| I_{core} | Idle | Supply Systems and RAM powered, flash enabled, DMA enabled | | 1.2 | | mA |
| I_{core} | Standby | RTC running, full RAM retention LFOSC, DCDC recharge current setting (ipeak = 1) | | 0.71 | | μA |
| I_{core} | Standby | RTC running, full RAM retention LFXT, DCDC recharge current setting (ipeak = 1) | | 0.74 | | μA |
| Core Current consumption with GLDO | | | | | | |
| I_{core} | Active | MCU running CoreMark from Flash at 48 MHz | | 4.1 | | mA |
| I_{core} | Idle | Supply Systems and RAM powered, flash disabled, DMA disabled | | 1.2 | | mA |
| I_{core} | Idle | Supply Systems and RAM powered, flash disabled, DMA enabled | | 1.3 | | mA |
| I_{core} | Idle | Supply Systems and RAM powered, flash enabled, DMA disabled | | 1.5 | | mA |
| I_{core} | Idle | Supply Systems and RAM powered, flash enabled, DMA enabled | | 1.7 | | mA |
| I_{core} | Standby | RTC running, full RAM retention LFOSC, default GLDO recharge current setting | | 1.1 | | μA |
| I_{core} | Standby | RTC running, full RAM retention LFXT default GLDO recharge current setting | | 1.15 | | μA |
| Reset, Shutdown Current Consumption | | | | | | |
| I_{core} | Reset | Reset. RSTN pin asserted or VDD5 below power-on-reset threshold | | 165 | | nA |
| I_{core} | Shutdown | Shutdown measured in steady state. No clocks running, no retention, IO wakeup enabled | | 165 | | nA |
| Peripheral Current Consumption | | | | | | |
| I_{peri} | RF | Delta current, clock enabled, RF subsystem idle | | 40 | | μA |
| I_{peri} | Timers | Delta current with clock enabled, module is idle, one LGPT timer | | 2.4 | | μA |
| I_{peri} | I2C | Delta current with clock enabled, module is idle | | 10.6 | | μA |
| I_{peri} | SPI | Delta current with clock enabled, module is idle | | 3.4 | | μA |
| I_{peri} | UART | Delta current with clock enabled, module is idle | | 24.5 | | μA |
| I_{peri} | CRYPTO (AES) | Delta current with clock enabled, module is idle | | 3.8 | | μA |

7.10 Power Consumption - Radio Modes

When measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{DD5} = 3.0\text{ V}$ with DCDC enabled unless otherwise noted.

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|------------------------|---|-----|------|-----|------|
| I_{RX} | Radio receive current | 2440 MHz, 1 Mbps, GFSK, system bus off ⁽¹⁾ | | 5.3 | | mA |
| I_{RX} | Radio receive current | 2440 MHz, 1 Mbps, GFSK, DCDC OFF, system bus off ⁽¹⁾ | | 9 | | mA |
| I_{TX} | Radio transmit current | -8 dBm output power setting 2440 MHz system bus off ⁽¹⁾ | | 4.5 | | mA |
| I_{TX} | Radio transmit current | 0 dBm output power setting 2440 MHz system bus off ⁽¹⁾ | | 5.1 | | mA |
| I_{TX} | Radio transmit current | 0 dBm output power setting 2440 MHz DCDC OFF, system bus off ⁽¹⁾ | | 9.0 | | mA |
| I_{TX} | Radio transmit current | +4 dBm output power setting 2440 MHz system bus off ⁽¹⁾ | | 7.9 | | mA |
| I_{TX} | Radio transmit current | +6 dBm output power setting 2440 MHz system bus off ⁽¹⁾ | | 8.9 | | mA |
| I_{TX} | Radio transmit current | +8 dBm output power setting 2440 MHz system bus off ⁽¹⁾ | | 10.7 | | mA |
| I_{TX} | Radio transmit current | +8 dBm output power setting 2440 MHz DCDC OFF, system bus off ⁽¹⁾ | | 19 | | mA |

(1) System bus off refers to device idle mode, DMA disabled, flash disabled

7.11 Nonvolatile (Flash) Memory Characteristics

Over operating free-air temperature range and $V_{DD5} = 3.0\text{ V}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|--|------|-----|-----|------------------|
| Flash sector size | | | 2 | | KB |
| Supported flash erase cycles before failure, full bank ^{(1) (2)} | | 30 | | | k Cycles |
| Supported flash erase cycles before failure, single sector ⁽³⁾ | | 60 | | | k Cycles |
| Maximum number of write operations per row before sector erase ⁽⁴⁾ | | | | 83 | Write Operations |
| CC2340xxxExxxxx devices (125 °C devices) | | | | | |
| Flash retention | 105 °C | 11.4 | | | Years |
| Flash retention | 125 °C | 10 | | | Years |
| CC2340xxxNxxxxx devices (85 °C devices) | | | | | |
| Flash retention | 85 °C | 11.4 | | | Years |
| Flash sector erase current | Average delta current | | 1.2 | | mA |
| Flash sector erase time ⁽⁵⁾ | 0 erase cycles | | 2.2 | | ms |
| Flash write current | Average delta current, full sector at a time | | 1.7 | | mA |
| Flash write time ⁽⁵⁾ | full sector (2kB) at a time, 0 erase cycles | | 8.3 | | ms |

- (1) A full bank erase is counted as a single erase cycle on each sector
- (2) Aborting flash during erase or program modes is not a safe operation.
- (3) Up to 16 customer-designated sectors can be individually erased an additional 30k times beyond the baseline bank limitation of 30k cycles
- (4) Each wordline is 2048 bits (or 256 bytes) wide. This limitation corresponds to sequential memory writes of 4 (3.1) bytes minimum per write over a whole wordline. If additional writes to the same wordline are required, a sector erase is required once the maximum number of write operations per row is reached.
- (5) This number is dependent on Flash aging and increases over time and erase cycles

7.12 Thermal Resistance Characteristics

| THERMAL METRIC | THERMAL METRIC | PACKAGE | | UNIT ⁽¹⁾ |
|----------------------|---|------------|------------|---------------------|
| | | RKP (VQFN) | RGE (VQFN) | |
| | | 40 PINS | 24 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 31.8 | 40.1 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 23.1 | 30.5 | °C/W |

7.12 Thermal Resistance Characteristics (续)

| THERMAL METRIC | THERMAL METRIC | PACKAGE | | UNIT ⁽¹⁾ |
|----------------------|--|------------|------------|---------------------|
| | | RKP (VQFN) | RGE (VQFN) | |
| | | 40 PINS | 24 PINS | |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 12.7 | 17.2 | °C/W |
| ψ_{JT} | Junction-to-top characterization parameter | 0.3 | 0.4 | °C/W |
| ψ_{JB} | Junction-to-board characterization parameter | 12.7 | 17.1 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | 3.3 | 3.4 | °C/W |

(1) °C/W = degrees Celsius per watt.

7.13 RF Frequency Bands

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

| PARAMETER | MIN | TYP | MAX | UNIT |
|-----------------|------|-----|------|------|
| Frequency bands | 2360 | | 2510 | MHz |

7.14 Bluetooth Low Energy - Receive (RX)

When measured on the CC2340R5 reference design with $T_c = 25^\circ\text{C}$, $V_{\text{DD5}} = 3.0\text{ V}$, $f_{\text{RF}} = 2440\text{ MHz}$ with DCDC enabled unless otherwise noted. All measurements are performed at the antenna input with a combined RX and TX path. All measurements are performed conducted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|---|-----|---------------------------------|-----|------|
| 125 kbps (LE Coded) | | | | | |
| Receiver sensitivity | BER = 10^{-3} | | - 102 | | dBm |
| Receiver saturation | BER = 10^{-3} | | 5 | | dBm |
| Frequency error tolerance | Difference between the incoming carrier frequency and the internally generated carrier frequency | | > (- 250 / 250) ⁽¹⁾ | | kHz |
| Data rate error tolerance | Difference between incoming data rate and the internally generated data rate (37-byte packets) | | > (- 90 / 90) ⁽¹⁾ | | ppm |
| Data rate error tolerance | Difference between incoming data rate and the internally generated data rate (255-byte packets) | | > (- 90 / 90) ⁽¹⁾ | | ppm |
| Co-channel rejection ⁽²⁾ | Wanted signal at - 79 dBm, modulated interferer in channel, BER = 10^{-3} | | - 6 | | dB |
| Selectivity, $\pm 1\text{ MHz}$ ⁽²⁾ | Wanted signal at - 79 dBm, modulated interferer at $\pm 1\text{ MHz}$, BER = 10^{-3} | | 9 / 5 ⁽³⁾ | | dB |
| Selectivity, $\pm 2\text{ MHz}$ ⁽²⁾ | Wanted signal at - 79 dBm, modulated interferer at $\pm 2\text{ MHz}$, BER = 10^{-3} | | 44 / 31 ⁽³⁾ | | dB |
| Selectivity, $\pm 3\text{ MHz}$ ⁽²⁾ | Wanted signal at - 79 dBm, modulated interferer at $\pm 3\text{ MHz}$, BER = 10^{-3} | | 47 / 42 ⁽³⁾ | | dB |
| Selectivity, $\pm 4\text{ MHz}$ ⁽²⁾ | Wanted signal at - 79 dBm, modulated interferer at $\pm 4\text{ MHz}$, BER = 10^{-3} | | 49 / 45 ⁽³⁾ | | dB |
| Selectivity, $\pm 6\text{ MHz}$ ⁽²⁾ | Wanted signal at - 79 dBm, modulated interferer at $\geq \pm 6\text{ MHz}$, BER = 10^{-3} | | 52 / 48 ⁽³⁾ | | dB |
| Selectivity, $\pm 7\text{ MHz}$ | Wanted signal at - 79 dBm, modulated interferer at $\geq \pm 7\text{ MHz}$, BER = 10^{-3} | | 54 / 49 ⁽³⁾ | | dB |
| Selectivity, Image frequency ⁽²⁾ | Wanted signal at - 79 dBm, modulated interferer at image frequency, BER = 10^{-3} | | 31 | | dB |
| Selectivity, Image frequency $\pm 1\text{ MHz}$ ⁽²⁾ | Note that Image frequency + 1 MHz is the Co- channel - 1 MHz. Wanted signal at - 79 dBm, modulated interferer at $\pm 1\text{ MHz}$ from image frequency, BER = 10^{-3} | | 5 / 42 ⁽³⁾ | | dB |
| 500 kbps (LE Coded) | | | | | |
| Receiver sensitivity | BER = 10^{-3} | | - 99 | | dBm |
| Receiver saturation | BER = 10^{-3} | | 5 | | dBm |
| Frequency error tolerance | Difference between the incoming carrier frequency and the internally generated carrier frequency | | > (- 250 / 250) ⁽¹⁾ | | kHz |
| Data rate error tolerance | Difference between incoming data rate and the internally generated data rate (37-byte packets) | | > (- 90 / 90) ⁽¹⁾ | | ppm |
| Data rate error tolerance | Difference between incoming data rate and the internally generated data rate (255-byte packets) | | > (- 90 / 90) ⁽¹⁾ | | ppm |
| Co-channel rejection ⁽²⁾ | Wanted signal at - 72 dBm, modulated interferer in channel, BER = 10^{-3} | | - 4.5 | | dB |
| Selectivity, $\pm 1\text{ MHz}$ ⁽²⁾ | Wanted signal at - 72 dBm, modulated interferer at $\pm 1\text{ MHz}$, BER = 10^{-3} | | 9 / 5 ⁽³⁾ | | dB |
| Selectivity, $\pm 2\text{ MHz}$ ⁽²⁾ | Wanted signal at - 72 dBm, modulated interferer at $\pm 2\text{ MHz}$, BER = 10^{-3} | | 42 / 31 ⁽³⁾ | | dB |
| Selectivity, $\pm 3\text{ MHz}$ ⁽²⁾ | Wanted signal at - 72 dBm, modulated interferer at $\pm 3\text{ MHz}$, BER = 10^{-3} | | 45 / 41 ⁽³⁾ | | dB |
| Selectivity, $\pm 4\text{ MHz}$ ⁽²⁾ | Wanted signal at - 72 dBm, modulated interferer at $\pm 4\text{ MHz}$, BER = 10^{-3} | | 46 / 42 ⁽³⁾ | | dB |
| Selectivity, $\pm 6\text{ MHz}$ ⁽²⁾ | Wanted signal at - 72 dBm, modulated interferer at $\geq \pm 6\text{ MHz}$, BER = 10^{-3} | | 50 / 45 ⁽³⁾ | | dB |
| Selectivity, $\pm 7\text{ MHz}$ | Wanted signal at - 72 dBm, modulated interferer at $\geq \pm 7\text{ MHz}$, BER = 10^{-3} | | 51 / 46 ⁽³⁾ | | dB |
| Selectivity, Image frequency ⁽²⁾ | Wanted signal at - 72 dBm, modulated interferer at image frequency, BER = 10^{-3} | | 31 | | dB |

7.14 Bluetooth Low Energy - Receive (RX) (续)

When measured on the CC2340R5 reference design with $T_c = 25^\circ\text{C}$, $V_{\text{DD5}} = 3.0\text{ V}$, $f_{\text{RF}} = 2440\text{ MHz}$ with DCDC enabled unless otherwise noted. All measurements are performed at the antenna input with a combined RX and TX path. All measurements are performed conducted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--|-----|---------------------------------|-----|------|
| Selectivity, Image frequency $\pm 1\text{ MHz}$ ⁽²⁾ | Note that Image frequency + 1 MHz is the Co-channel - 1 MHz. Wanted signal at - 72 dBm, modulated interferer at $\pm 1\text{ MHz}$ from image frequency, BER = 10^{-3} | | 5 / 41 ⁽³⁾ | | dB |
| 1 Mbps (LE 1M) | | | | | |
| Receiver sensitivity | BER = 10^{-3} | | - 96.5 | | dBm |
| Receiver saturation | BER = 10^{-3} | | 5 | | dBm |
| Frequency error tolerance | Difference between the incoming carrier frequency and the internally generated carrier frequency | | > (- 250/250) ⁽¹⁾ | | kHz |
| Data rate error tolerance | Difference between incoming data rate and the internally generated data rate (37-byte packets) | | > (- 90 / 90) ⁽¹⁾ | | ppm |
| Co-channel rejection ⁽²⁾ | Wanted signal at - 67 dBm, modulated interferer in channel, BER = 10^{-3} | | - 6 | | dB |
| Selectivity, $\pm 1\text{ MHz}$ ⁽²⁾ | Wanted signal at - 67 dBm, modulated interferer at $\pm 1\text{ MHz}$, BER = 10^{-3} | | 7 / 5 ⁽³⁾ | | dB |
| Selectivity, $\pm 2\text{ MHz}$ ⁽²⁾ | Wanted signal at - 67 dBm, modulated interferer at $\pm 2\text{ MHz}$, BER = 10^{-3} | | 39 / 28 ⁽³⁾ | | dB |
| Selectivity, $\pm 3\text{ MHz}$ ⁽²⁾ | Wanted signal at - 67 dBm, modulated interferer at $\pm 3\text{ MHz}$, BER = 10^{-3} | | 38 / 38 ⁽³⁾ | | dB |
| Selectivity, $\pm 4\text{ MHz}$ ⁽²⁾ | Wanted signal at - 67 dBm, modulated interferer at $\pm 4\text{ MHz}$, BER = 10^{-3} | | 47 / 35 ⁽³⁾ | | dB |
| Selectivity, $\pm 5\text{ MHz}$ or more ⁽²⁾ | Wanted signal at - 67 dBm, modulated interferer at $\geq \pm 5\text{ MHz}$, BER = 10^{-3} | | 40 | | dB |
| Selectivity, image frequency ⁽²⁾ | Wanted signal at - 67 dBm, modulated interferer at image frequency, BER = 10^{-3} | | 28 | | dB |
| Selectivity, image frequency $\pm 1\text{ MHz}$ ⁽²⁾ | Note that Image frequency + 1 MHz is the Co-channel - 1 MHz. Wanted signal at - 67 dBm, modulated interferer at $\pm 1\text{ MHz}$ from image frequency, BER = 10^{-3} | | 5 / 38 ⁽³⁾ | | dB |
| Out-of-band blocking ⁽⁴⁾ | 30 MHz to 2000 MHz | | - 10 | | dBm |
| Out-of-band blocking | 2003 MHz to 2399 MHz | | - 10 | | dBm |
| Out-of-band blocking | 2484 MHz to 2997 MHz | | - 10 | | dBm |
| Out-of-band blocking | 3000 MHz to 12.75 GHz (excluding VCO frequency) | | - 2 | | dBm |
| Intermodulation | Wanted signal at 2402 MHz, - 64 dBm. Two interferers at 2405 and 2408 MHz respectively, at the given power level | | - 37 | | dBm |
| Spurious emissions, 30 to 1000 MHz ⁽⁵⁾ | Measurement in a 50- Ω single-ended load. | | < - 59 | | dBm |
| Spurious emissions, 1 to 12.75 GHz ⁽⁵⁾ | Measurement in a 50- Ω single-ended load. | | < - 47 | | dBm |
| RSSI dynamic range ⁽⁶⁾ | | | 70 | | dB |
| RSSI accuracy | | | ± 4 | | dB |
| RSSI resolution | | | 1 | | dB |
| 2 Mbps (LE 2M) | | | | | |
| Receiver sensitivity | Measured at SMA connector, BER = 10^{-3} | | - 92 | | dBm |
| Receiver saturation | Measured at SMA connector, BER = 10^{-3} | | 2 | | dBm |
| Frequency error tolerance | Difference between the incoming carrier frequency and the internally generated carrier frequency | | > (- 250 / 250) ⁽¹⁾ | | kHz |
| Data rate error tolerance | Difference between incoming data rate and the internally generated data rate (37-byte packets) | | > (- 90/ 90) ⁽¹⁾ | | ppm |
| Co-channel rejection ⁽²⁾ | Wanted signal at - 67 dBm, modulated interferer in channel, BER = 10^{-3} | | - 8 | | dB |
| Selectivity, $\pm 2\text{ MHz}$ ⁽²⁾ | Wanted signal at - 67 dBm, modulated interferer at $\pm 2\text{ MHz}$, Image frequency is at - 2 MHz, BER = 10^{-3} | | 9 / 5 ⁽³⁾ | | dB |

7.14 Bluetooth Low Energy - Receive (RX) (续)

When measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{ V}$, $f_{\text{RF}} = 2440\text{ MHz}$ with DCDC enabled unless otherwise noted. All measurements are performed at the antenna input with a combined RX and TX path. All measurements are performed conducted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|-----|-------------------------|-----|------|
| Selectivity, $\pm 4\text{ MHz}^{(2)}$ | Wanted signal at -67 dBm , modulated interferer at $\pm 4\text{ MHz}$, BER = 10^{-3} | | 40 / 32 ⁽³⁾ | | dB |
| Selectivity, $\pm 6\text{ MHz}^{(2)}$ | Wanted signal at -67 dBm , modulated interferer at $\pm 6\text{ MHz}$, BER = 10^{-3} | | 46 / 40 ⁽³⁾ | | dB |
| Selectivity, image frequency ⁽²⁾ | Wanted signal at -67 dBm , modulated interferer at image frequency, BER = 10^{-3} | | 5 | | dB |
| Selectivity, image frequency $\pm 2\text{ MHz}^{(2)}$ | Note that Image frequency + 2 MHz is the Co-channel. Wanted signal at -67 dBm , modulated interferer at $\pm 2\text{ MHz}$ from image frequency, BER = 10^{-3} | | - 8 / 32 ⁽³⁾ | | dB |
| Out-of-band blocking ⁽⁴⁾ | 30 MHz to 2000 MHz | | - 10 | | dBm |
| Out-of-band blocking | 2003 MHz to 2399 MHz | | - 10 | | dBm |
| Out-of-band blocking | 2484 MHz to 2997 MHz | | - 12 | | dBm |
| Out-of-band blocking | 3000 MHz to 12.75 GHz (excluding VCO frequency) | | - 10 | | dBm |
| Intermodulation | Wanted signal at 2402 MHz, -64 dBm . Two interferers at 2408 and 2414 MHz respectively, at the given power level | | - 38 | | dBm |

- (1) Actual performance exceeding Bluetooth specification
- (2) Numbers given as I/C dB
- (3) X / Y, where X is +N MHz and Y is - N MHz
- (4) Excluding one exception at $F_{\text{wanted}} / 2$, per Bluetooth Specification
- (5) Suitable for systems targeting compliance with worldwide radio-frequency regulations ETSI EN 300 328 and EN 300 440 Class 2 (Europe), FCC CFR47 Part 15 (US), and ARIB STD-T66 (Japan)
- (6) The device will saturate at -30dB.

7.15 Bluetooth Low Energy - Transmit (TX)

When measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{ V}$, $f_{\text{RF}} = 2440\text{ MHz}$ with DCDC enabled unless otherwise noted. All measurements are performed at the antenna input with a combined RX and TX path. All measurements are performed conducted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---------------------------------|--|-----|-----|-----|------|
| General Parameters | | | | | |
| Max output power | Delivered to a single-ended 50- Ω load through integrated balun | | 8 | | dBm |
| Output power programmable range | Delivered to a single-ended 50- Ω load through integrated balun | | 28 | | dB |

7.16 Zigbee and Thread - IEEE 802.15.4-2006 2.4 GHz (OQPSK DSSS1:8, 250 kbps) - RX

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{ V}$, $f_{\text{RF}} = 2440\text{ MHz}$ with DC/DC enabled unless otherwise noted. All measurements are performed at the antenna input with a combined RX and TX path. All measurements are performed conducted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|-----|---------|-----|------|
| General Parameters | | | | | |
| Receiver sensitivity | PER = 1% | | - 98 | | dBm |
| Receiver saturation | PER = 1% | | > 3 | | dBm |
| Adjacent channel rejection | Wanted signal at - 82 dBm, modulated interferer at $\pm 5\text{ MHz}$, PER = 1% | | 36 | | dB |
| Alternate channel rejection | Wanted signal at - 82 dBm, modulated interferer at $\pm 10\text{ MHz}$, PER = 1% | | 55 | | dB |
| Channel rejection, $\pm 15\text{ MHz}$ or more | Wanted signal at - 82 dBm, undesired signal is IEEE 802.15.4 modulated channel, stepped through all channels 2405 to 2480 MHz, PER = 1% | | 59 | | dB |
| Blocking and desensitization, 5 MHz from upper band edge | Wanted signal at - 97 dBm (3 dB above the sensitivity level), CW jammer, PER = 1% | | 57 | | dB |
| Blocking and desensitization, 10 MHz from upper band edge | Wanted signal at - 97 dBm (3 dB above the sensitivity level), CW jammer, PER = 1% | | 63 | | dB |
| Blocking and desensitization, 20 MHz from upper band edge | Wanted signal at - 97 dBm (3 dB above the sensitivity level), CW jammer, PER = 1% | | 63 | | dB |
| Blocking and desensitization, 50 MHz from upper band edge | Wanted signal at - 97 dBm (3 dB above the sensitivity level), CW jammer, PER = 1% | | 66 | | dB |
| Blocking and desensitization, - 5 MHz from lower band edge | Wanted signal at - 97 dBm (3 dB above the sensitivity level), CW jammer, PER = 1% | | 60 | | dB |
| Blocking and desensitization, - 10 MHz from lower band edge | Wanted signal at - 97 dBm (3 dB above the sensitivity level), CW jammer, PER = 1% | | 60 | | dB |
| Blocking and desensitization, - 20 MHz from lower band edge | Wanted signal at - 97 dBm (3 dB above the sensitivity level), CW jammer, PER = 1% | | 63 | | dB |
| Blocking and desensitization, - 50 MHz from lower band edge | Wanted signal at - 97 dBm (3 dB above the sensitivity level), CW jammer, PER = 1% | | 65 | | dB |
| Spurious emissions, 30 MHz to 1000 MHz | Measurement in a 50- Ω single-ended load ⁽¹⁾ | | - 64 | | dBm |
| Spurious emissions, 1 GHz to 12.75 GHz | Measurement in a 50- Ω single-ended load ⁽¹⁾ | | - 49 | | dBm |
| Frequency error tolerance | Difference between the incoming carrier frequency and the internally generated carrier frequency | | > 80 | | ppm |
| Symbol rate error tolerance | Difference between incoming symbol rate and the internally generated symbol rate | | > 80 | | ppm |
| RSSI dynamic range | | | 90 | | dB |
| RSSI accuracy | | | ± 4 | | dB |

(1) Suitable for systems targeting compliance with EN 300 328, EN 300 440 class 2 (Europe), FCC CFR47, Part 15 (US) and ARIB STD-T-66 (Japan)

7.17 Zigbee and Thread - IEEE 802.15.4-2006 2.4 GHz (OQPSK DSSS1:8, 250 kbps) - TX

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{ V}$, $f_{\text{RF}} = 2440\text{ MHz}$ with DC/DC enabled unless otherwise noted. All measurements are performed at the antenna input with a combined RX and TX path. All measurements are performed conducted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|--|-----|-----|-----|------|
| General Parameters | | | | | |
| Max output power ⁽¹⁾ | Delivered to a single-ended 50- Ω load through integrated balun | | 8 | | dBm |
| Output power programmable range | Delivered to a single-ended 50- Ω load through integrated balun | | 29 | | dB |
| IEEE 802.15.4-2006 2.4 GHz (OQPSK DSSS1:8, 250 kbps) | | | | | |
| Error vector magnitude | +8 dBm setting | | 2 | | % |

- (1) To ensure margins for passing FCC band edge requirements at 2483.5 MHz, a lower than maximum output-power setting or less than 100% duty cycle may be used when operating at the upper 802.15.4 channel(s).

7.18 Proprietary Radio Modes

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{DD5} = 3.0\text{ V}$, $f_{RF} = 2440\text{ MHz}$ with DCDC enabled unless otherwise noted. All measurements are performed at the antenna input with a combined RX and TX path. All measurements are performed conducted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|-------------------------------|-----|-----|-----|------|
| 2 Mbps GFSK (HID), 320 kHz deviation | | | | | |
| Receiver sensitivity | PER = 30.8%, Payload 37 bytes | | -89 | | dBm |

7.19 2.4 GHz RX/TX CW

When measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{DD5} = 3.0\text{ V}$, $f_{RF} = 2440\text{ MHz}$ with DCDC enabled unless otherwise noted. All measurements are performed at the antenna input with a combined RX and TX path. All measurements are performed conducted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---------------------------------------|----------------|-------|-----|------|
| Spurious emissions and harmonics | | | | | |
| Spurious emissions ⁽¹⁾ | f < 1 GHz, outside restricted bands | +8 dBm setting | < -36 | | dBm |
| | f < 1 GHz, restricted bands ETSI | | < -54 | | dBm |
| | f < 1 GHz, restricted bands FCC | | < -55 | | dBm |
| | f > 1 GHz, including harmonics (ETSI) | | < -30 | | dBm |
| Harmonics ⁽¹⁾ | Second harmonic | | < -42 | | dBm |
| | Third harmonic | | < -42 | | dBm |

(1) Suitable for systems targeting compliance with worldwide radio-frequency regulations ETSI EN 300 328 and EN 300 440 Class 2 (Europe), FCC CFR47 Part 15 (US), and ARIB STD-T66 (Japan).

7.20 Timing and Switching Characteristics

7.20.1 Reset Timing

| PARAMETER | MIN | TYP | MAX | UNIT |
|-------------------|-----|-----|-----|---------------|
| RSTN low duration | 1 | | | μs |

7.20.2 Wakeup Timing

Measured over operating free-air temperature with $V_{DD5} = 3.0\text{ V}$ (unless otherwise noted). The times listed here do not include any software overhead (unless otherwise noted).

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--|-----|----------------------|-----|---------------|
| MCU, Reset/Shutdown to Active ⁽¹⁾ | GLDO default charge current setting, VDDR capacitor fully charged ⁽²⁾ | | 350-450 | | μs |
| MCU, Standby to Active | MCU, Standby to Active (ready to execute code from flash). DCDC ON, default recharge current configuration | | 33-43 ⁽³⁾ | | μs |
| MCU, Standby to Active | MCU, Standby to Active (ready to execute code from flash). GLDO ON, default recharge current configuration | | 33-50 ⁽³⁾ | | μs |
| MCU, Idle to Active | Flash enabled in idle mode | | 3 | | μs |
| MCU, Idle to Active | Flash disabled in idle mode | | 14 | | μs |

- (1) Wakeup time includes device ROM bootcode execution time. The wakeup time is dependent on remaining charge on VDDR capacitor when starting the device, and thus how long the device has been in Reset or Shutdown before starting up again.
- (2) This is the best case reset/shutdown to active time (including ROM bootcode operation), for the specified GLDO charge current setting considering the VDDR capacitor is fully charged and is not discharged during the reset and shutdown events; that is, when the device is in reset / shutdown modes for only a very short period of time
- (3) Depending on VDDR capacitor voltage level.

7.20.3 Clock Specifications

7.20.3.1 48 MHz Crystal Oscillator (HFXT)

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{DD5} = 3.0\text{ V}$, unless otherwise noted.⁽⁴⁾

| | PARAMETER | MIN | TYP | MAX | UNIT |
|-------|--|-----|------------------|-----|----------|
| | Crystal frequency | | 48 | | MHz |
| ESR | Equivalent series resistance $6\text{ pF} < C_L \leq 9\text{ pF}$ | | 20 | 60 | Ω |
| ESR | Equivalent series resistance $5\text{ pF} < C_L \leq 6\text{ pF}$ | | | 80 | Ω |
| C_L | Crystal load capacitance ⁽¹⁾ | 5 | 7 ⁽²⁾ | 9 | pF |

7.20.3.1 48 MHz Crystal Oscillator (HFXT) (续)

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{ V}$, unless otherwise noted.⁽⁴⁾

| PARAMETER | | MIN | TYP | MAX | UNIT |
|------------------------------|--------------------------|-----|-----|-----|---------------|
| Start-up time ⁽³⁾ | Until clock is qualified | | 200 | | μs |

- (1) Adjustable load capacitance is integrated into the device. External load capacitors are required for systems targeting compliance with certain regulations.
- (2) On-chip default connected capacitance including reference design parasitic capacitance. Connected internal capacitance is changed through software in the SysConfig.
- (3) Start-up time using the TI-provided power driver. Start-up time may increase if driver is not used.
- (4) Tai-Saw TZ3908AAAO43 has been validated for CC2340R5 design.

7.20.3.2 48 MHz RC Oscillator (HFOSC)

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{ V}$, unless otherwise noted.

| PARAMETER | MIN | TYP | MAX | UNIT |
|--|-----|------------|-----|------|
| Frequency | | 48 | | MHz |
| Uncalibrated frequency accuracy | | ± 3 | | % |
| Calibrated frequency accuracy ⁽¹⁾ | | ± 0.25 | | % |

- (1) Accuracy relative to the calibration source (HFXT)

7.20.3.3 32 kHz Crystal Oscillator (LFXT)

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{ V}$, unless otherwise noted.

| PARAMETER | MIN | TYP | MAX | UNIT |
|------------------------------------|-----|--------|-----|------------------|
| Crystal frequency | | 32.768 | | kHz |
| Supported crystal load capacitance | 6 | | 12 | pF |
| ESR | | 30 | 100 | $\text{k}\Omega$ |

7.20.3.4 32 kHz RC Oscillator (LFOSC)

Measured on the CC2340R5 reference design with $T_c = 25\text{ }^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{ V}$, unless otherwise noted.

| PARAMETER | MIN | TYP | MAX | UNIT |
|----------------------|-----|-----------------------|-----|------|
| Calibrated frequency | | 32.768 ⁽¹⁾ | | kHz |

- (1) When using LFOSC as source for the low frequency system clock (LFCLK), the accuracy of the LFCLK-derived Real Time Clock (RTC) can be improved by measuring LFOSC relative to HFXT and compensating for the RTC tick speed. This functionality is available through the TI-provided Power driver.

7.21 Peripheral Characteristics

7.21.1 UART

7.21.1.1 UART Characteristics

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

| PARAMETER | MIN | TYP | MAX | UNIT |
|-----------|-----|-----|-----|-------|
| UART rate | | | 3 | MBaud |

7.21.2 SPI

7.21.2.1 SPI Characteristics

Using TI SPI driver, over operating free-air temperature range (unless otherwise noted).

| PARAMETERS | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-------------------|---|-----|-----|-----|------|
| fSCLK 1/tsclk | Controller Mode and Peripheral Mode ⁽¹⁾ $2.7\text{ V} \leq V_{\text{DDS}} < 3.8\text{ V}$ | | | 12 | MHz |
| | Controller Mode and Peripheral Mode ⁽¹⁾ $V_{\text{DDS}} < 2.7\text{ V}$ | | | 8 | MHz |
| DC _{SCK} | SCK Duty Cycle | 45 | 50 | 55 | % |

- (1) Assume interfacing with ideal SPI controller and SPI peripheral devices

7.21.2.2 SPI Controller Mode

Using TI SPI driver, over operating free-air temperature range (unless otherwise noted)

| PARAMETERS | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------------|---|--|-------------------|-------------|-------------------|------|
| $t_{SCLK_H/L}$ | SCLK High or Low time | | $(t_{SPI}/2) - 1$ | $t_{SPI}/2$ | $(t_{SPI}/2) + 1$ | ns |
| t_{CS_LEAD} | CS lead-time, CS active to clock | | 1 | | | SCLK |
| t_{CS_LAG} | CS lag time, Last clock to CS inactive | | 1 | | | SCLK |
| t_{CS_ACC} | CS access time, CS active to PICO data out | | | | 1 | SCLK |
| t_{CS_DIS} | CS disable time, CS inactive to PICO high impedance | | | | 1 | SCLK |
| t_{VALID_CO} | PICO output data valid time ⁽¹⁾ | SCLK edge to PICO valid, $C_L = 20$ pF | | | 13 | ns |
| t_{HD_CO} | PICO output data hold time ⁽²⁾ | $C_L = 20$ pF | 0 | | | ns |

- (1) Specifies the time to drive the next valid data to the output after the output changing SCLK clock edge
 (2) Specifies how long data on the output is valid after the output changing SCLK clock edge

7.21.2.3 SPI Timing Diagrams - Controller Mode

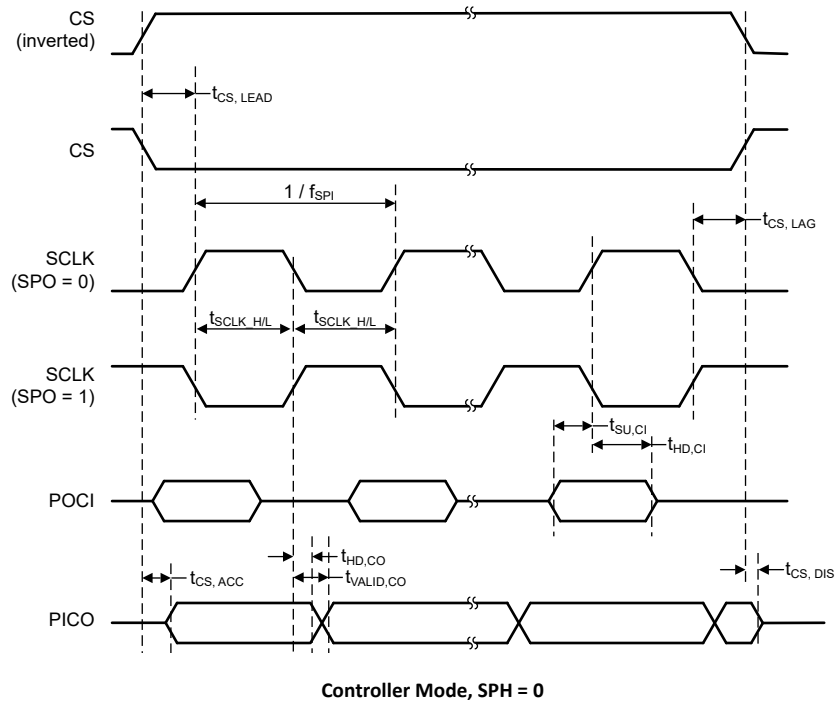


图 7-1. SPI Timing Diagram - Controller Mode, SPH = 0

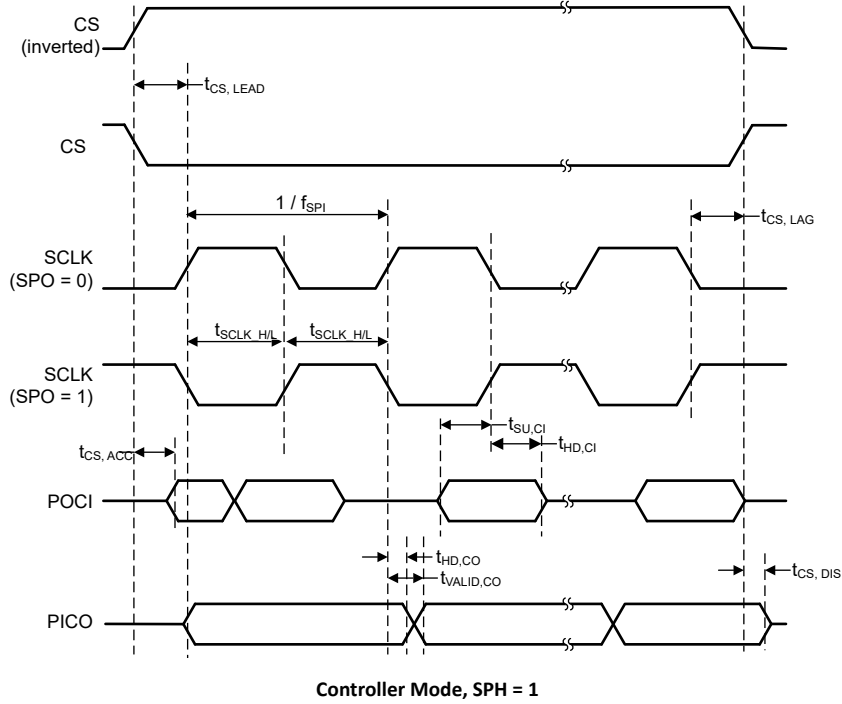


图 7-2. SPI Timing Diagram - Controller Mode, SPH = 1

7.21.2.4 SPI Peripheral Mode

Using TI SPI driver, over operating free-air temperature range (unless otherwise noted)

| PARAMETERS | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------------------|---|--|-----|-----|-----|------|
| t _{CS,LEAD} | CS lead-time, CS active to clock | | 1 | | | SCLK |
| t _{CS,LAG} | CS lag time, Last clock to CS inactive | | 1 | | | SCLK |
| t _{CS,ACC} | CS access time, CS active to POCI data out | VDDS = 3.3V | | | 35 | ns |
| t _{CS,ACC} | CS access time, CS active to POCI data out | VDDS = 1.8V | | | 50 | ns |
| t _{CS,DIS} | CS disable time, CS inactive to POCI high impedance | VDDS = 3.3V | | | 35 | ns |
| t _{CS,DIS} | CS disable time, CS inactive to POCI high impedance | VDDS = 1.8V | | | 50 | ns |
| t _{SU,PI} | PICO input data setup time | | 13 | | | ns |
| t _{HD,PI} | PICO input data hold time | | 0 | | | ns |
| t _{VALID,PO} | POCI output data valid time ⁽¹⁾ | SCLK edge to POCI valid, C _L = 20pF, 3.3V | | | 35 | ns |
| t _{VALID,PO} | POCI output data valid time ⁽¹⁾ | SCLK edge to POCI valid, C _L = 20pF, 1.8V | | | 50 | ns |
| t _{HD,PO} | POCI output data hold time ⁽²⁾ | C _L = 20pF | 0 | | | ns |

(1) Specifies the time to drive the next valid data to the output after the output changing SCLK clock edge

(2) Specifies how long data on the output is valid after the output changing SCLK clock edge

7.21.2.5 SPI Timing Diagrams - Peripheral Mode

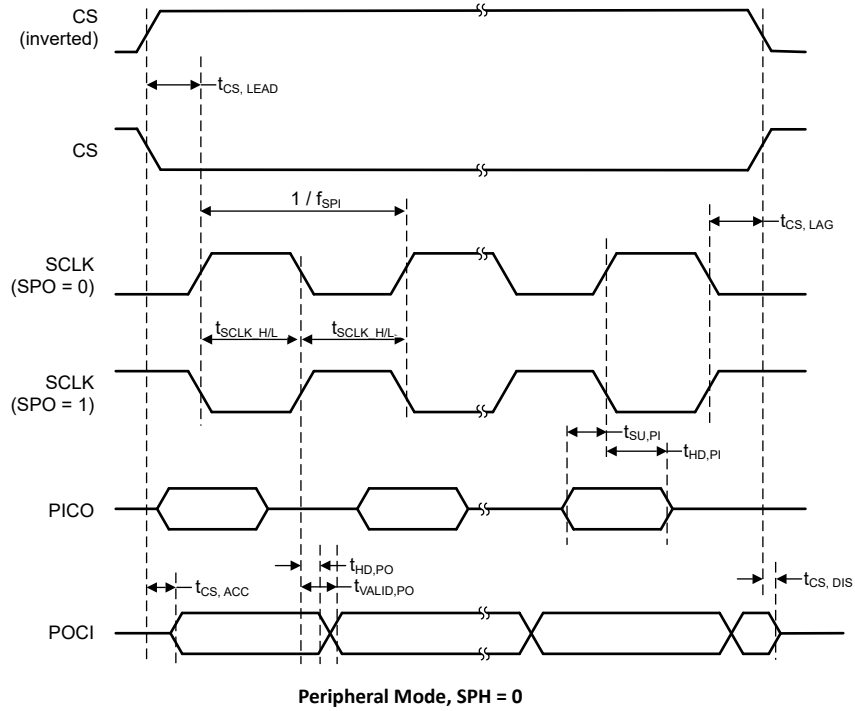


图 7-3. SPI Timing Diagram - Peripheral Mode, SPH = 0

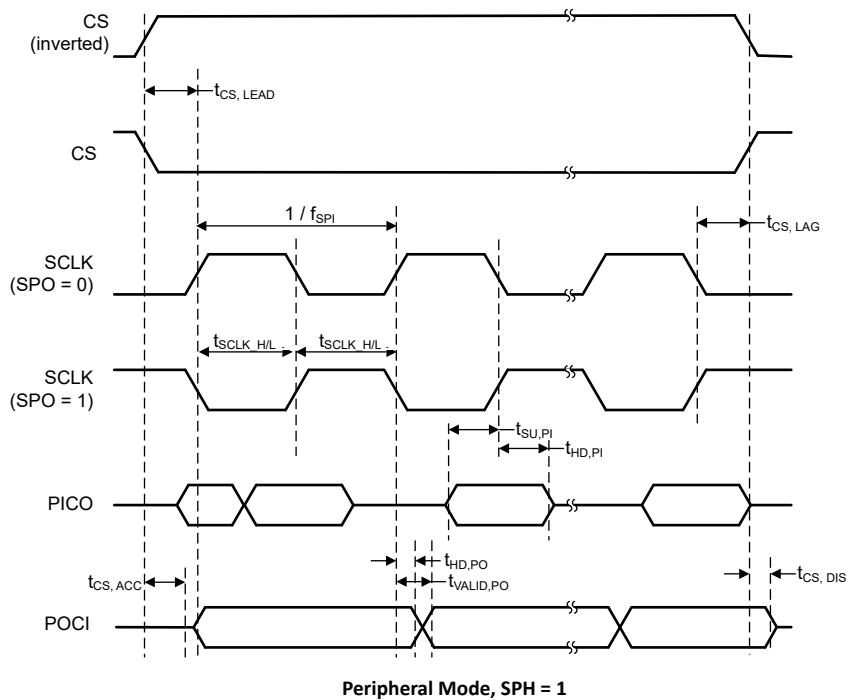


图 7-4. SPI Timing Diagram - Peripheral Mode, SPH = 1

7.21.3 I²C

7.21.3.1 I2C

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

| PARAMETERS | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---------------------|--|---------------------------|-----|-----|-----|------|
| f _{SCL} | SCL clock frequency | | 0 | | 400 | kHz |
| t _{HD,STA} | Hold time (repeated) START | f _{SCL} = 100kHz | 4.0 | | | μs |
| t _{HD,STA} | Hold time (repeated) START | f _{SCL} > 100kHz | 0.6 | | | μs |
| t _{SU,STA} | Setup time for a repeated START | f _{SCL} = 100kHz | 4.7 | | | μs |
| t _{SU,STA} | Setup time for a repeated START | f _{SCL} > 100kHz | 0.6 | | | μs |
| t _{HD,DAT} | Data hold time | | 0 | | | μs |
| t _{SU,DAT} | Data setup time | f _{SCL} = 100kHz | 250 | | | ns |
| t _{SU,DAT} | Data setup time | f _{SCL} > 100kHz | 100 | | | ns |
| t _{SU,STO} | Setup time for STOP | f _{SCL} = 100kHz | 4.0 | | | μs |
| t _{SU,STO} | Setup time for STOP | f _{SCL} > 100kHz | 0.6 | | | μs |
| t _{BUF} | Bus free time between STOP and START conditions | f _{SCL} = 100kHz | 4.7 | | | μs |
| t _{BUF} | Bus free time between STOP and START conditions | f _{SCL} > 100kHz | 1.3 | | | μs |
| t _{SP} | Pulse duration of spikes suppressed by input deglitch filter | | 50 | | | ns |

7.21.3.2 I²C Timing Diagram

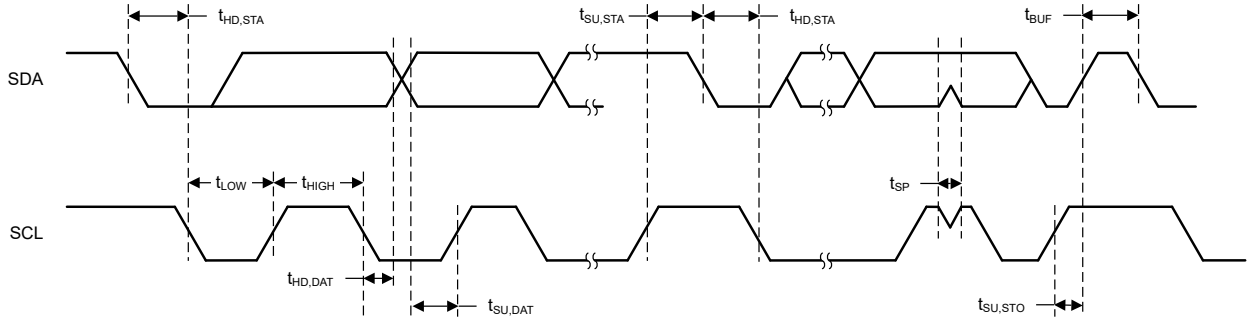


图 7-5. I²C Timing Diagram

7.21.4 GPIO

7.21.4.1 GPIO DC Characteristics

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|------|------|------|------|
| T_A = 25 °C, V_{DDs} = 1.8 V | | | | | |
| GPIO pullup current | Input mode, pullup enabled, V _{pad} = 0 V | 39 | 66 | 109 | μA |
| GPIO pulldown current | Input mode, pulldown enabled, V _{pad} = V _{DDs} | 10 | 21 | 40 | μA |
| GPIO low-to-high input transition, with hysteresis | I _H = 1, transition voltage for input read as 0 → 1 | 0.91 | 1.11 | 1.27 | V |
| GPIO high-to-low input transition, with hysteresis | I _H = 1, transition voltage for input read as 1 → 0 | 0.59 | 0.75 | 0.91 | V |
| GPIO input hysteresis | I _H = 1, difference between 0 → 1 and 1 → 0 points | 0.26 | 0.35 | 0.44 | V |
| T_A = 25 °C, V_{DDs} = 3.0 V | | | | | |
| GPIO VOH at 10 mA load | high-drive GPIOs only, max drive setting | 2.47 | | | V |
| GPIO VOL at 10 mA load | high-drive GPIOs only, max drive setting | | | 0.25 | V |

7.21.4.1 GPIO DC Characteristics (续)

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|----------------------|------|------|------|
| GPIO VOH at 2 mA load | standard drive GPIOs | 2.52 | | | V |
| GPIO VOL at 2 mA load | standard drive GPIOs | | | 0.20 | V |
| T_A = 25 °C, V_{DD5} = 3.8 V | | | | | |
| GPIO pullup current | Input mode, pullup enabled, V _{pad} = 0 V | 170 | 262 | 393 | μA |
| GPIO pulldown current | Input mode, pulldown enabled, V _{pad} = V _{DD5} | 60 | 110 | 172 | μA |
| GPIO low-to-high input transition, with hysteresis | IH = 1, transition voltage for input read as 0 → 1 | 1.76 | 1.98 | 2.27 | V |
| GPIO high-to-low input transition, with hysteresis | IH = 1, transition voltage for input read as 1 → 0 | 1.26 | 1.52 | 1.79 | V |
| GPIO input hysteresis | IH = 1, difference between 0 → 1 and 1 → 0 points | 0.40 | 0.47 | 0.54 | V |
| T_A = 25 °C | | | | | |
| VIH | Lowest GPIO input voltage reliably interpreted as a <i>High</i> | 0.8*V _{DD5} | | | V |
| VIL | Highest GPIO input voltage reliably interpreted as a <i>Low</i> | 0.2*V _{DD5} | | | V |

7.2.1.5 ADC

7.2.1.5.1 Analog-to-Digital Converter (ADC) Characteristics

$T_c = 25^\circ\text{C}$, $V_{\text{DDS}} = 3.0\text{V}$, unless otherwise noted.⁽²⁾

Performance numbers require use of offset and gain adjustments in software by TI-provided ADC drivers.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT | |
|--|--|--|-----|--------|------------------|------------------|
| ADC Power Supply and Input Range Conditions | | | | | | |
| $V_{(\text{Ax})}$ | Analog input voltage range | All ADC analog input pins Ax | | 0 | V_{DDS} | V |
| $I_{(\text{ADC})}$ single-ended mode | Operating supply current into V_{DDS} terminal | RES = 0x0 (12Bit mode), $F_s = 1.2\text{MSPS}$, Internal reference OFF (ADCREF_EN = 0), $V_{\text{REF+}} = V_{\text{DDS}}$ | | 480 | μA | |
| | | RES = 0x0 (12Bit mode), $F_s = 266\text{ksps}$, Internal reference ON (ADCREF_EN = 0), ADCREF = 2.5V | | 365 | | |
| C_{GPIO} | Input capacitance into a single terminal | | | 5 | 7 | pF |
| R_{GPIO} | Input MUX ON-resistance | | | 0.5 | 1 | $\text{k}\Omega$ |
| ADC Switching Characteristics | | | | | | |
| $F_{\text{S ADC REF}}$ | ADC sampling frequency when using the internal ADC reference voltage | ADCREF_EN = 1, RES = 0x0 (12-bit), $V_{\text{DDS}} = 1.71\text{V}$ to V_{DDSmax} | | 267 | ⁽¹⁾ | ksps |
| $F_{\text{S ADC REF}}$ | ADC sampling frequency when using the internal ADC reference voltage | ADCREF_EN = 1, RES = 0x1 (10-bit), $V_{\text{DDS}} = 1.71\text{V}$ to V_{DDSmax} | | 308 | ⁽¹⁾ | ksps |
| $F_{\text{S ADC REF}}$ | ADC sampling frequency when using the internal ADC reference voltage | ADCREF_EN = 1, RES = 0x2 (8-bit), $V_{\text{DDS}} = 1.71\text{V}$ to V_{DDSmax} | | 400 | ⁽¹⁾ | ksps |
| $F_{\text{S EXTR EF}}$ | ADC sampling frequency when using the external ADC reference voltage | ADCREF_EN = 0, $V_{\text{REF+}} = V_{\text{DDS}}$, RES = 0x0 (12-bit), $V_{\text{DDS}} = 1.71\text{V}$ to V_{DDSmax} | | 1.2 | ⁽¹⁾ | MSPS |
| $F_{\text{S EXTR EF}}$ | ADC sampling frequency when using the external ADC reference voltage | ADCREF_EN = 0, $V_{\text{REF+}} = V_{\text{DDS}}$, RES = 0x1 (10-bit), $V_{\text{DDS}} = 1.71\text{V}$ to V_{DDSmax} | | 1.33 | ⁽¹⁾ | MSPS |
| $F_{\text{S EXTR EF}}$ | ADC sampling frequency when using the external ADC reference voltage | ADCREF_EN = 0, $V_{\text{REF+}} = V_{\text{DDS}}$, RES = 0x2 (8-bit), $V_{\text{DDS}} = 1.71\text{V}$ to V_{DDSmax} | | 1.6 | ⁽¹⁾ | MSPS |
| N_{CONVERT} | Clock cycles for conversion | RES = 0x0 (12-bit) | | 14 | | cycles |
| N_{CONVERT} | Clock cycles for conversion | RES = 0x1 (10-bit) | | 12 | | cycles |
| N_{CONVERT} | Clock cycles for conversion | RES = 0x2 (8-bit) | | 9 | | cycles |
| t_{Sample} | Sampling time | RES = 0x0 (12-bit), $R_{\text{S}} = 25\ \Omega$, $C_{\text{pext}} = 10\ \text{pF}$. +/- 0.5 LSB settling | | 250 | | ns |
| $t_{\text{VSUPPLY}/3(\text{sample})}$ | Sample time required when $V_{\text{supply}}/3$ channel is selected | | | 20 | | μs |
| ADC Linearity Parameters | | | | | | |
| E_{I} | Integral linearity error (INL) for single-ended inputs | 12-bit Mode, $V_{\text{R+}} = V_{\text{REF+}} = V_{\text{DDS}}$, $V_{\text{DDS}}=1.71\text{--}3.8$ | | +/- 2 | | LSB |
| E_{D} | Differential linearity error (DNL) | 12-bit Mode, $V_{\text{R+}} = V_{\text{REF+}} = V_{\text{DDS}}$, $V_{\text{DDS}}=1.71\text{--}3.8$ | | +/- 1 | | LSB |
| E_{O} | Offset error | 12-bit Mode, External reference, $V_{\text{R+}} = V_{\text{REF+}} = V_{\text{DDS}}$, $V_{\text{DDS}}=1.71\text{--}3.8$ | | 1.98 | | LSB |
| E_{O} | Offset error | 12-bit Mode, Internal reference, $V_{\text{R+}} = \text{ADCREF} = 2.5\text{V}$ | | 1.02 | | LSB |
| E_{G} | Gain error | External Reference, $V_{\text{R+}} = V_{\text{REF+}} = V_{\text{DDS}}$, $V_{\text{DD}}=1.71\text{--}3.8$ | | +/- 2 | | LSB |
| E_{G} | Gain error | Internal reference, $V_{\text{R+}} = \text{ADCREF} = 2.5\text{V}$ | | +/- 40 | | LSB |
| ADC Dynamic Parameters | | | | | | |
| ENOB | Effective number of bits | ADCREF_EN = 0, $V_{\text{REF+}} = V_{\text{DDS}} = 3.3\text{V}$, $V_{\text{REF-}} = 0\text{V}$, RES = 0x2 (8-bit) | | 8 | | bit |
| ENOB | Effective number of bits | ADCREF_EN = 0, $V_{\text{REF+}} = V_{\text{DDS}} = 3.3\text{V}$, $V_{\text{REF-}} = 0\text{V}$, RES = 0x1 (10-bit) | | 9.9 | | bit |

7.21.5.1 Analog-to-Digital Converter (ADC) Characteristics (续)

$T_c = 25^\circ\text{C}$, $V_{\text{DD5}} = 3.0\text{V}$, unless otherwise noted.⁽²⁾

Performance numbers require use of offset and gain adjustments in software by TI-provided ADC drivers.

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--|--|-----|-------|------|------|
| ENOB | Effective number of bits | ADCREP_EN = 0, VeREF+ = VDD5 = 3.3V, VeREF-=0V, RES = 0x0 (12-bit) | | 11.2 | | bit |
| ENOB | Effective number of bits | ADCREP_EN = 1, ADCREF_VSEL = {2.5V, 1.4V}, RES = 0x2 (8-bit) | | 8 | | bit |
| ENOB | Effective number of bits | ADCREP_EN = 1, ADCREF_VSEL = {2.5V, 1.4V}, RES = 0x1 (10-bit) | | 9.6 | | bit |
| ENOB | Effective number of bits | ADCREP_EN = 1, ADCREF_VSEL = {2.5V, 1.4V}, RES = 0x0 (12-bit) | | 10.4 | | bit |
| ENOB | Effective number of bits | VDD5 reference, RES = 0x0 (12-bit) | | 11.2 | | bit |
| SINAD | Signal-to-noise and distortion ratio | ADCREP_EN = 0, VeREF+ = VDD5 = 3.3V, VeREF-=0V, RES = 0x0 (12-bit) | | 69.18 | | dB |
| SINAD | Signal-to-noise and distortion ratio | ADCREP_EN = 1, ADCREF_VSEL = {2.5V, 1.4V}, RES = 0x0 (12-bit) | | 64.37 | | dB |
| SINAD | Signal-to-noise and distortion ratio | VDD5 reference, RES = 0x0 (12-bit) | | 69.18 | | dB |
| ADC External Reference | | | | | | |
| EXTREF | Positive external reference voltage input | ADCREP_EN=0, ADC reference sourced from external reference pin (VeREF+) | 1.4 | | VDD5 | V |
| EXTREF | Negative external reference voltage input | ADCREP_EN=0, ADC reference sourced from external reference pin (VeREF-) | | | 0 | V |
| ADC Temperature Diode, Supply Monitor | | | | | | |
| Temp_diode Accuracy | Temperature Error | ADC input channel: Temp diode voltage, Error calculated in temperature range: -30C to +40C, with single point calibration ⁽²⁾ | | +/- 3 | | C |
| ADC Internal Input: V _{SUPPLY} / 3 Accuracy | V _{supply} voltage divider accuracy for supply monitoring | ADC input channel: Vsupply monitor | | +/- 1 | | % |
| ADC Internal Input: I _{Vsupply} / 3 | V _{supply} voltage divider current consumption | ADC input channel Vsupply monitor. V _{supply} =VDD5=3.3V | | 10 | | μA |
| ADC Internal and VDD5 Reference | | | | | | |
| VDDSR EF | Positive ADC reference voltage | ADC reference sourced from VDD5 | | VDD5 | | V |
| ADCREP F | Internal ADC Reference Voltage | ADCREP_EN = 1, ADCREF_VSEL = 0, VDD5 = 1.71V - VDD5max | | 1.4 | | V |
| | | ADCREP_EN = 1, ADCREF_VSEL = 1, VDD5 = 2.7V - VDD5max | | 2.5 | | V |
| I _{ADCREP} | Operating supply current into VDDA terminal with internal reference ON | ADCREP_EN = 1, VDDA = 1.7V to VDDAmax, ADCREF_VSEL = {0,1} | | 80 | | μA |
| t _{ON} | Internal ADC Reference Voltage power on-time | ADCREP_EN = 1 | | 2 | | μs |

(1) Measured with 48MHz HFOSC

(2) Using IEEE Std 1241-2010 for terminology and test methods

7.21.6 Comparators

7.21.6.1 Ultra-Low Power Comparator

$T_c = 25^\circ\text{C}$, $V_{DD5} = 3.0\text{V}$, unless otherwise noted.

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------|--|-----|------------|-----------|---------------|
| Input voltage range | | 0 | | V_{DD5} | V |
| Clock frequency | | | 32 | | KHz |
| Voltage Divider Accuracy | Input voltage range is between $V_{DD5}/4$ and V_{DD5} . | | 98% | | |
| Offset | Measured at $V_{DD5} / 2$ (Errors seen when using two external inputs) | | ± 27.3 | | mV |
| Decision time | Step from -50mV to 50mV | | 1 | 3 | Clock Cycle |
| Comparator enable time | COMP_LP disable \rightarrow enable, VIN+, VIN- from pins, Overdrive $\geq 20\text{mV}$ | | 70 | | μs |
| Current consumption | Including using $V_{DD5}/2$ as internal reference at VIN - comparator terminal | | 370 | | nA |

7.22 Typical Characteristics

All measurements in this section are done with $T_c = 25^\circ\text{C}$ and $V_{DD5} = 3.0\text{V}$, unless otherwise noted. See *Recommended Operating Conditions* for device limits. Values exceeding these limits are for reference only.

7.22.1 MCU Current

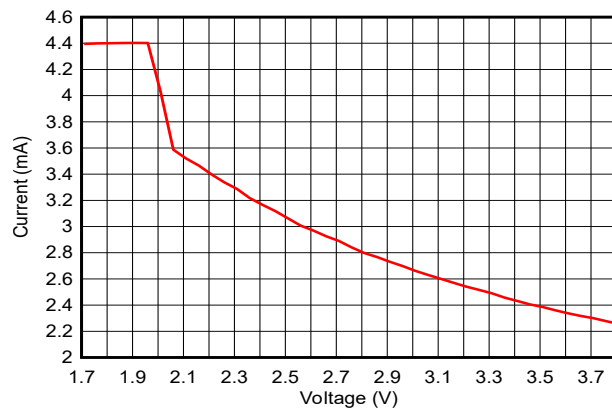


图 7-6. Active Mode (MCU) Current vs. Supply Voltage (V_{DD5}) (Running CoreMark)

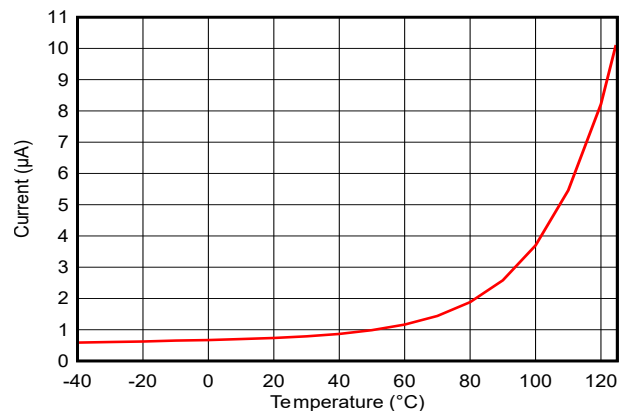


图 7-7. Standby Mode (MCU) Current vs. Temperature (RAM and partial register retention, RTC)

7.22.2 RX Current

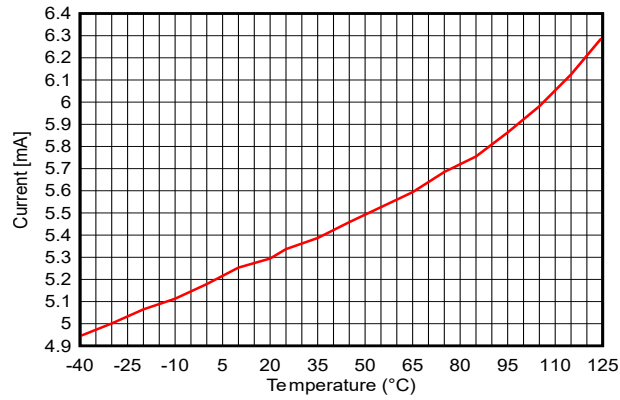


图 7-8. RX Current vs. Temperature (BLE 1Mbps, 2.44GHz)

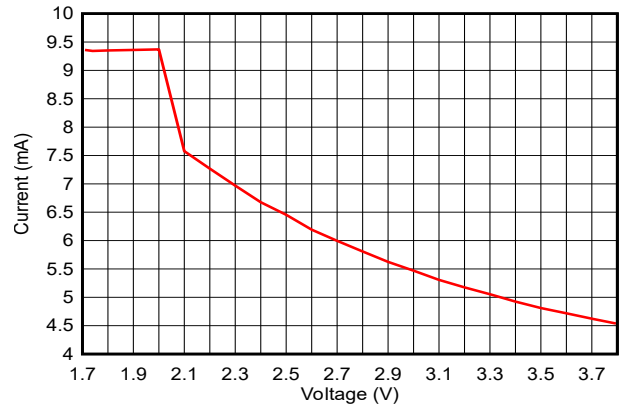


图 7-9. RX Current vs. Supply Voltage (VDDS) (BLE 1Mbps, 2.44GHz)

7.22.3 TX Current

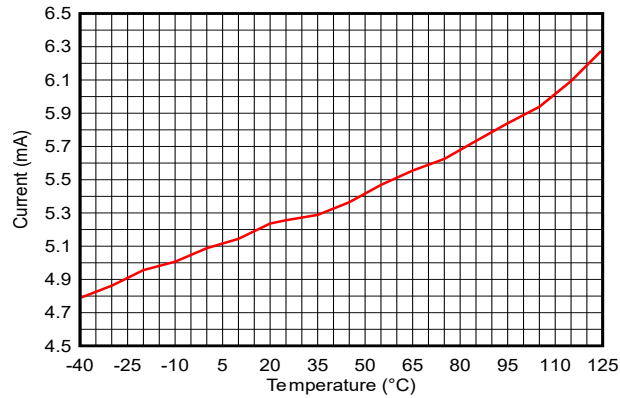


图 7-10. TX Current vs. Temperature (BLE 1Mbps, 2.44GHz, 0dBm)

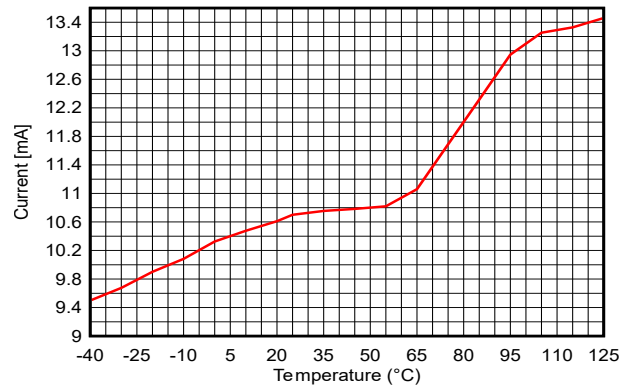


图 7-11. TX Current vs. Temperature (BLE 1Mbps, 2.44GHz, +8dBm)

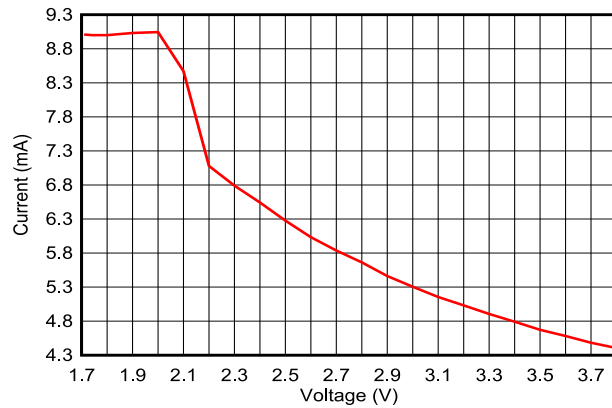


图 7-12. TX Current vs. Supply Voltage, VDD5 (BLE 1Mbps, 2.44GHz, 0dBm)

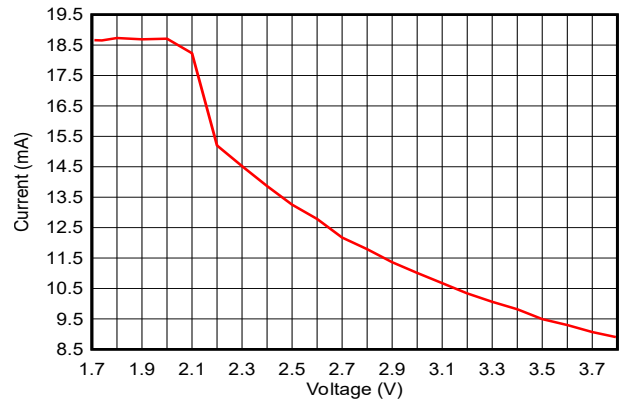


图 7-13. TX Current vs. Supply Voltage, VDD5 (BLE 1Mbps, 2.44GHz, +8dBm)

表 7-1 shows typical TX current and output power for different output power settings.

表 7-1. Typical TX Current and Output Power

| 2.4 GHz, VDD5 = 3.0 V, DCDC=On, Temperature = 25 °C (Measured on LP-EM-CC2340R5) | | | |
|--|---|----------------------------|----------------------------------|
| txPowerTable Index | TX Power Setting [dBm] (SmartRF Studio) | Typical Output Power [dBm] | Typical Current Consumption [mA] |
| 13 | 8 | 7.7 | 10.7 |
| 12 | 7 | 7.1 | 9.5 |
| 11 | 6 | 6.3 | 8.9 |
| 10 | 5 | 5.5 | 8.3 |
| 9 | 4 | 4.5 | 7.9 |
| 8 | 3 | 3.7 | 7.5 |
| 7 | 2 | 2.4 | 7.1 |
| 6 | 1 | 1.0 | 5.4 |
| 5 | 0 | 0.4 | 5.1 |
| 4 | -4 | -3.1 | 4.8 |
| 3 | -8 | -7.3 | 4.5 |
| 2 | -12 | -10.9 | 4.2 |
| 1 | -16 | -15.1 | 4.0 |
| 0 | -20 | -19.0 | 3.8 |

7.22.4 RX Performance

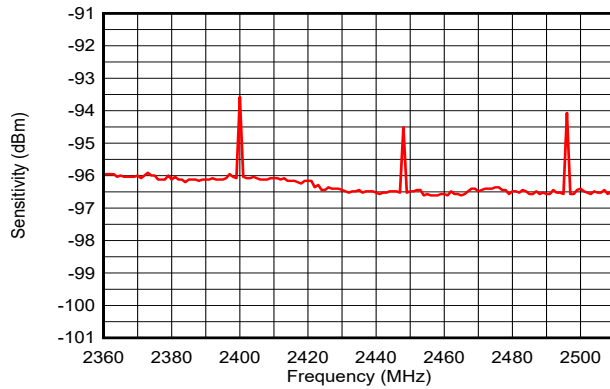


图 7-14. Sensitivity vs. Frequency (BLE 1Mbps)

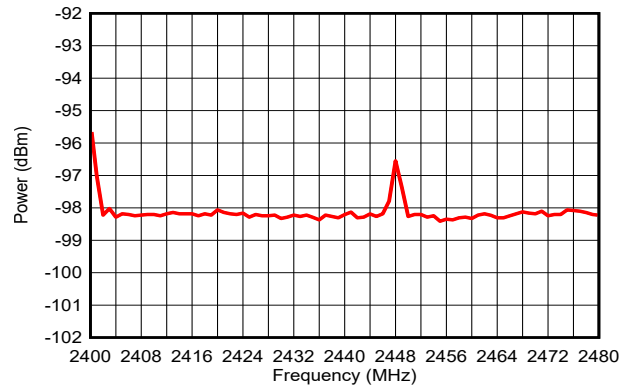


图 7-15. Sensitivity vs. Frequency (IEEE 802.15.4 PHY)

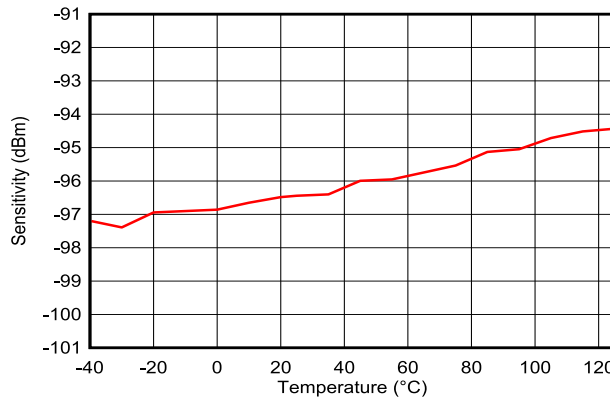


图 7-16. Sensitivity vs. Temperature (BLE 1Mbps, 2.44GHz)

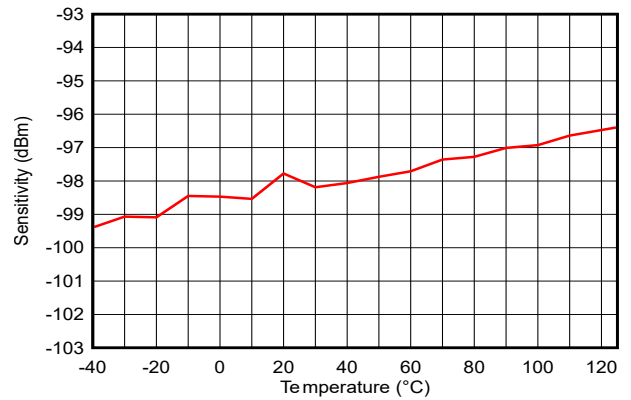


图 7-17. Sensitivity vs. Temperature (IEEE 802.15.4 PHY, 2.44GHz)

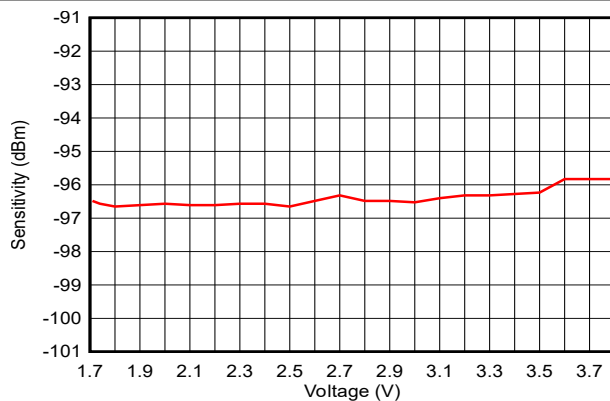


图 7-18. Sensitivity vs. Supply Voltage (VDD5) (BLE 1Mbps, 2.44GHz)

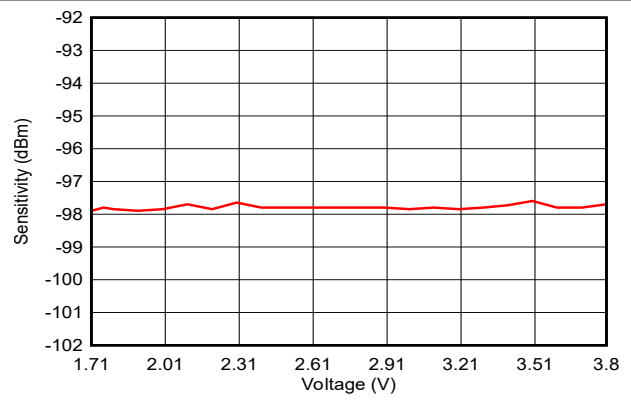


图 7-19. Sensitivity vs. Supply Voltage (VDD5) (IEEE 802.15.4 PHY, 2.44GHz)

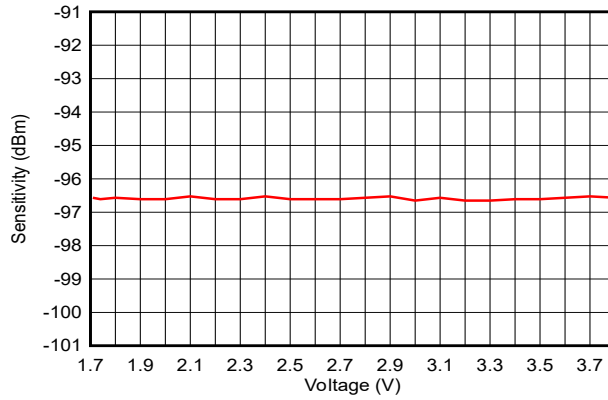


图 7-20. Sensitivity vs. Supply Voltage (VDDS) (BLE 1Mbps, 2.44GHz, DCDC Off)

7.22.5 TX Performance

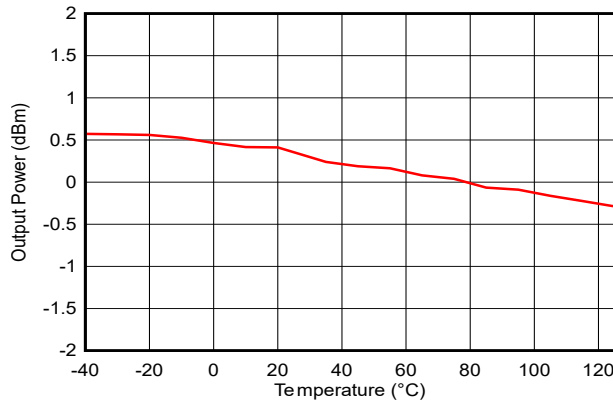


图 7-21. Output Power vs. Temperature (BLE 1Mbps, 2.44GHz, 0dBm)

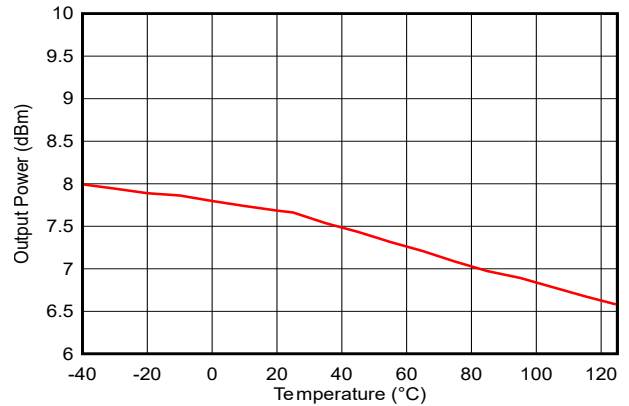


图 7-22. Output Power vs. Temperature (BLE 1Mbps, 2.44GHz, +8dBm)

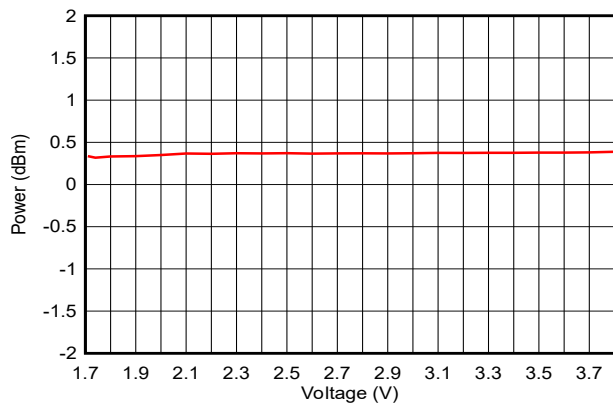


图 7-23. Output Power vs. Supply Voltage (VDD5) (BLE 1Mbps, 2.44GHz, 0dBm)

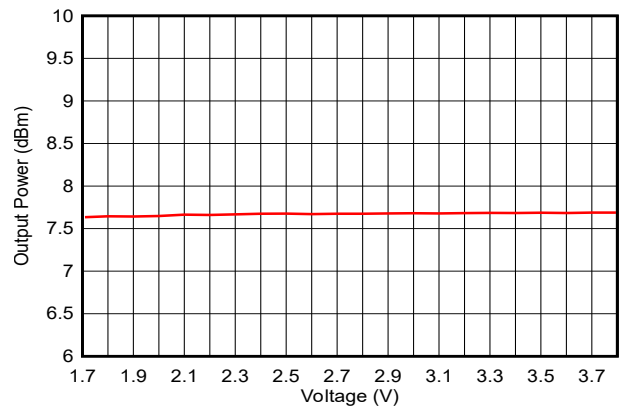


图 7-24. Output Power vs. Supply Voltage (VDD5) (BLE 1Mbps, 2.44GHz, +8dBm)

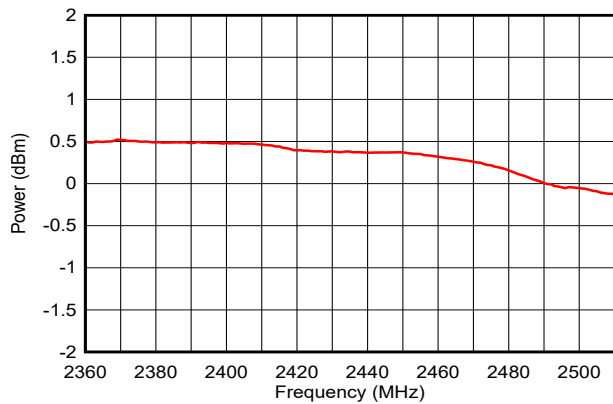


图 7-25. Output Power vs. Frequency (BLE 1Mbps, 0dBm)

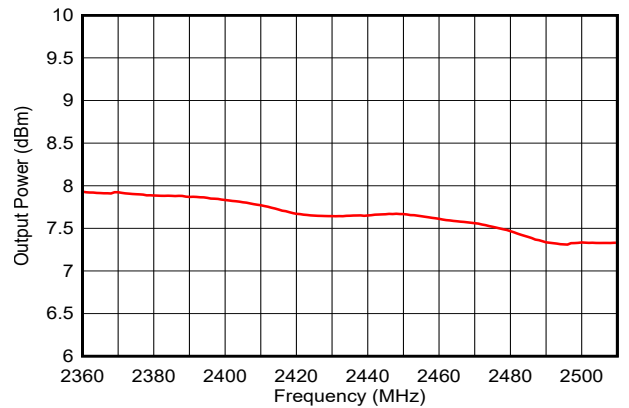


图 7-26. Output Power vs. Frequency (BLE 1Mbps, +8dBm)

7.22.6 ADC Performance

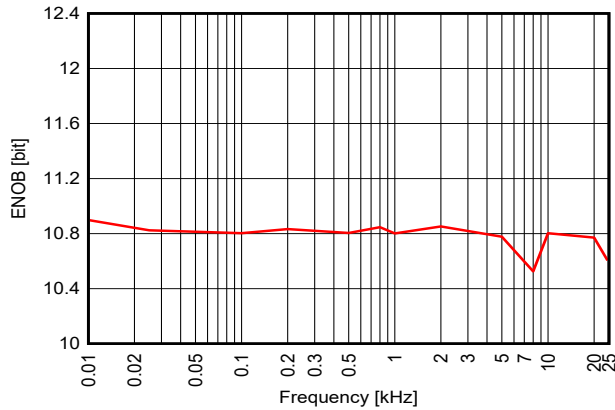


图 7-27. ENOB vs. Input Frequency (Internal Reference)

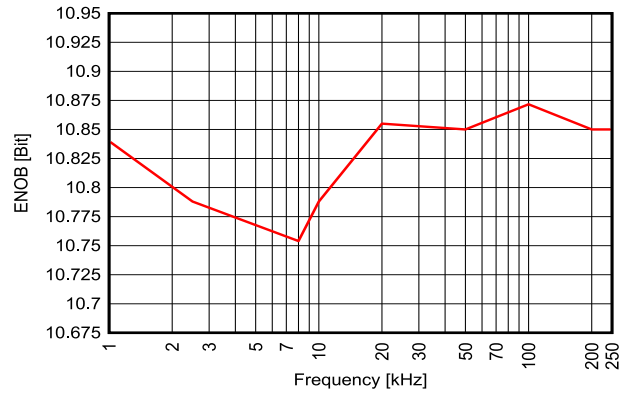


图 7-28. ENOB vs. Sampling Frequency ($V_{in}= 3V$ Sine Wave, Internal Reference, $F_{in}=F_s/10$)

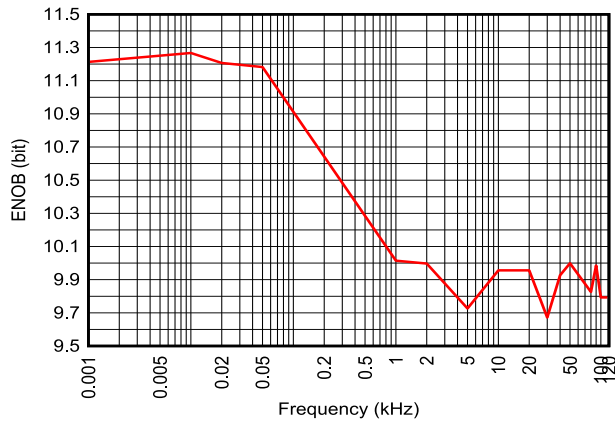


图 7-29. ENOB vs. Input Frequency (External Reference = 3.0V)

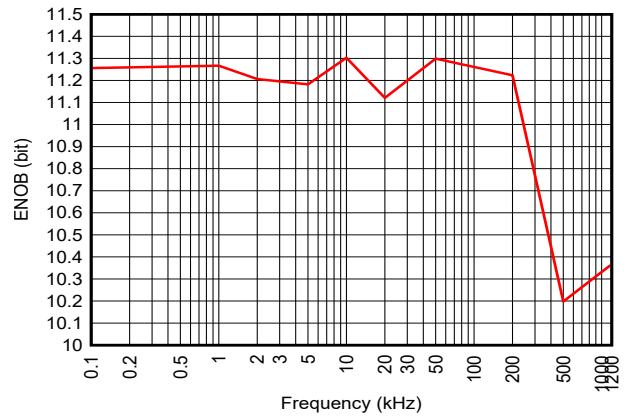


图 7-30. ENOB vs. Sampling Frequency ($V_{in}= 3V$ Sine Wave, External Reference = 3.0V, $F_{in}=F_s/10$)

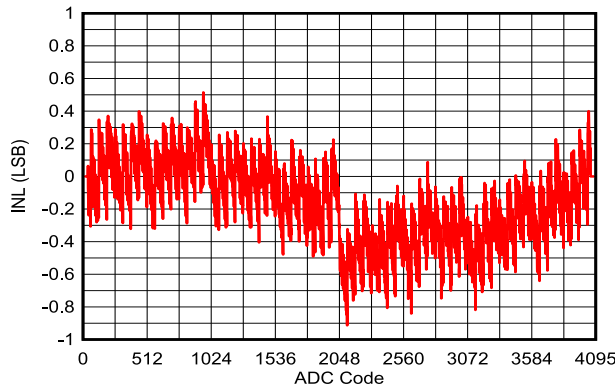


图 7-31. INL vs. ADC Code ($V_{in}= 3V$ Sine Wave, Internal Reference, 200ksps)

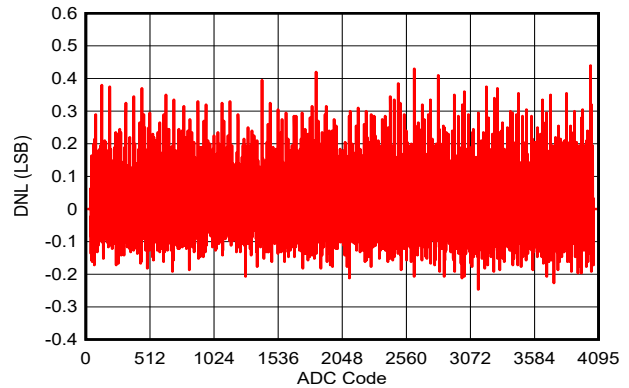


图 7-32. DNL vs. ADC Code ($V_{in}= 3V$ Sine Wave, Internal Reference, 200ksps)

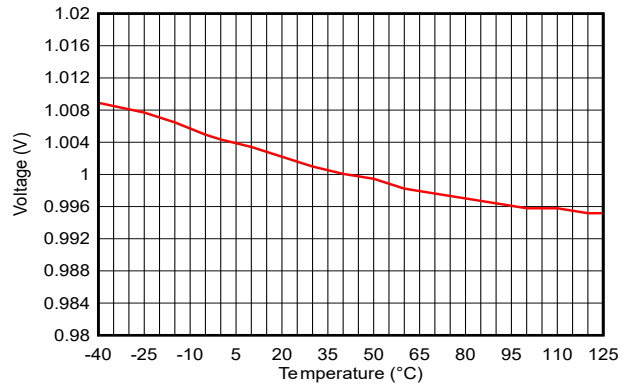


图 7-33. ADC Accuracy vs. Temperature ($V_{in}=1V$, Internal Reference, 200ksps)

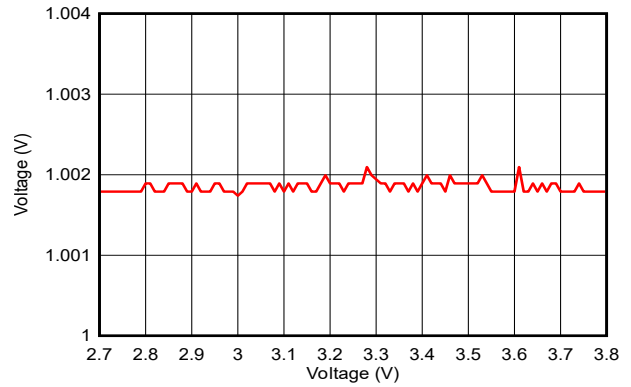


图 7-34. ADC Accuracy vs. Supply Voltage ($V_{in}=1V$, Internal Reference, 200ksps)

8 Detailed Description

8.1 Overview

节 4 shows the core modules of the CC2340R device.

8.2 System CPU

The CC2340R SimpleLink™ Wireless MCU contains an Arm® Cortex®-M0+ system CPU, which runs the application, the protocol stacks, and the radio. The Cortex-M0+ processor is built on a highly area and power optimized 32-bit processor core, with a 2-stage pipeline Von Neumann architecture. The processor delivers exceptional energy efficiency through a small but powerful instruction set and extensively optimized design, providing high-end processing hardware including a single-cycle multiplier. The Cortex-M0+ processor offers multiple benefits to developers including:

- Ultra-low power, energy efficient operation
- Deterministic, high-performance interrupt handling for time-critical applications
- Upward compatibility with the Cortex-M processors family

The Cortex-M0+ processor provides the excellent performance expected of a modern 32-bit architecture core, with higher code density than other 8-bit and 16-bit microcontrollers. Its features include the following:

- ARMv6-M architecture optimized for small-footprint embedded applications
- Subset of Arm Thumb/Thumb-2 mixed 16- and 32-bit instructions delivers the high performance expected of a 32-bit Arm
- Single-cycle multiply instruction
- VTOR supporting offset of the vector table base address
- Serial Wire debug with HW break-point comparators
- Ultra-low-power consumption with integrated sleep modes
- SysTick timer
- 48MHz operation
- 0.99DMIPS/MHz

Additionally, the CC2340R devices are compatible with all ARM tools and software.

8.3 Radio (RF Core)

The low-power RF Core (LRF) implements a high performance and highly flexible RF sub system containing RF and baseband circuitry in addition to a software defined digital radio (LRFD). LRFD provides a high-level, command-based API to the main CPU and handles all of the timing critical and low-level details of many different radio PHYs. Several signals are also available to control external circuitry such as RF switches or range extenders autonomously.

The software-defined modem is not programmable by customers but is instead loaded with precompiled images provided in the radio driver in the 适用于 CC23xx 器件的 SimpleLink™ 低功耗 F3 软件开发套件 (SDK). This mechanism allows the radio platform to be updated for support of future versions of standards with over-the-air (OTA) updates while still using the same silicon. LRFD stores the code images in the RF SRAM and does not make use of any ROM memory, thus image loading from NV memory only occurs once after boot and also, no patching is required when exiting power modes.

8.3.1 Bluetooth 5.3 Low Energy

The RF Core offers full support for Bluetooth 5.3 Low Energy, including the high-speed 2Mbps physical layer and the 500kbps and 125kbps long range PHYs (Coded PHY) through the TI provided Bluetooth 5.3 stack or through a high-level Bluetooth API.

The new high-speed mode allows data transfers up to 2Mbps, twice the speed of Bluetooth 4.2 and five times the speed of Bluetooth 4.0, without increasing power consumption. In addition to faster speeds, this mode offers significant improvements in energy efficiency and wireless coexistence with reduced radio communication time.

Bluetooth 5.3 also enables unparalleled flexibility for adjustment of speed and range based on application needs, which capitalizes on the high-speed or long-range modes respectively. Data transfers are now possible at 2Mbps, enabling the development of applications using voice, audio, imaging, and data logging that were not previously an option using Bluetooth low energy. With high-speed mode, existing applications deliver faster responses, richer engagement, and longer battery life. Bluetooth 5.3 enables fast, reliable firmware updates.

8.3.2 802.15.4 (Thread and Zigbee)

Through a dedicated IEEE radio API, the RF Core supports the 2.4GHz IEEE 802.15.4-2011 physical layer (2 Mcps per second Offset-QPSK with DSSS 1:8), used in Thread and Zigbee protocols. TI also provides royalty-free protocol stacks for Thread and Zigbee, enabling a robust end-to-end solution.

8.4 Memory

Up to 512KB nonvolatile (Flash) memory provides storage for code and data. The flash memory is in-system programmable and erasable. A special flash memory sector must contain a Customer Configuration section (CCFG) that is used by boot ROM and TI provided drivers to configure the device. This configuration is done through the `ccfg.c` source file that is included in all TI provided examples.

Up to 64KB ultra-low leakage system static RAM (SRAM) can be used for both storage of data and execution of code. Retention of SRAM contents in Standby power mode is enabled by default and included in Standby mode power consumption numbers. System SRAM is always initialized to zeroes upon code execution during boot.

The ROM includes device bootcode firmware handling initial device trimming operations, security configurations, and device lifecycle management. The ROM also contains a serial (SPI and UART) bootloader that can be used for the initial programming of the device.

8.5 Cryptography

The CC2340R device comes with AES-128 cryptography hardware accelerator, reducing code footprint and execution time for cryptographic operations. It also has the benefit of being lower power and improves availability and responsiveness of the system because the cryptography operations run in a background hardware thread. The AES hardware accelerators supports the following block cipher modes and message authentication codes:

- AES ECB encrypt
- AES CBC encrypt
- AES CTR encrypt/decrypt
- AES CBC-MAC
- AES GCM
- AEC CCM (uses a combination of CTR + CBC-MAC hardware via software drivers)

The AES hardware accelerator can be fed with plaintext/ciphertext from either CPU or using DMA. Sustained throughput of one 16 byte ECB block per 23 cycles is possible corresponding to > 30Mbps.

The CC2340R device supports Random Number Generation (RNG) using on-chip analog noise as the non-deterministic noise source for the purpose of generating a seed for a cryptographically secure counter deterministic random bit generator (CTR-DRBG) that in turn is used to generate random numbers for keys, initialization vectors (IVs), and other random number requirements. Hardware acceleration of AES CTR-DRBG is supported.

The CC2340R device includes a complete SHA 256 library in ROM, reducing the code footprint of the application. Uses cases may include generating digests for use in digital signature algorithms, data integrity checks, and password storage.

Together with a large selection of open-source cryptography libraries provided with the Software Development Kit (SDK), this allows for secure and future proof IoT applications to be easily built on top of the platform.

8.6 Timers

A large selection of timers are available as part of the CC2340R device. These timers are:

- **Real-Time Clock (RTC)**

The RTC is a 67-bit, 2-channel timer running on the LFCLK system clock. The RTC is active in STANDBY and ACTIVE power states. When the device enters the RESET or SHUTDOWN state the RTC is reset.

The RTC accumulates time elapsed since reset on each LFCLK. The RTC counter is incremented by LFINC at a rate of 32.768kHz. LFINC indicates the period of LFCLK in μ s, with an additional granularity of 16 fractional bits.

The counter can be read from two 32-bit registers. RTC.TIME8U has a range of approximately 9.5 hours with an LSB representing 8 microseconds. RTC.TIME524M has a range of approximately 71.4 years with an LSB representing 524 milliseconds.

There is hardware synchronization between the system timer (SYSTIM) and the RTC so that the multichannel and higher resolution SYSTIM remains in synchronization with the RTC's time base.

The RTC has two channels: one compare channel and one capture channel and is capable of waking the device out of the standby power state. The RTC compare channel is typically used only by system software and only during the standby power state.

- **System Timer (SYSTIM)**

The SYSTIM is a 34-bit, 5-channel wrap-around timer with a per-channel selectable 32b slice with either a 1 μ s resolution and 1h11m35s range or 250ns resolution and 17m54s range. All channels support both capture and single-shot compare (posting an event) operation. One channel is reserved for system software, three channels are reserved for radio software and one channel is freely available to user applications.

For software convenience, a hardware synchronization mechanism automatically ensures that the RTC and SYSTIM share a common time base (albeit with different resolutions/spans). Another software convenience feature is that SYSTIM qualifies any submitted compare values so that the timer channel will immediately trigger if the submitted event is in the immediate past (4.294s with 1 μs resolution and 1.049s with 250ns resolution).

• **General Purpose Timers (LGPT)**

The CC2340R device provides up to four LGPTs with 3 × 16 bit timers and 1× 24 bit timer, all running up to 48MHz. The LGPTs support a wide range of features such as:

- Three capture/compare channels
- One-shot or periodic counting
- Pulse width modulation (PWM)
- Time counting between edges and edge counting
- Input filter implemented on each of the channels for all timers
- IR generation feature available on Timer-0 and Timer-1
- Dead band feature available on Timer-1

The timer capture/compare and PWM signals are connected to IOs through the IO controller module (IOC) and the internal timer event connections to CPU, DMA, and other peripherals are through the event fabric, which allows the timers to interact with signals such as GPIO inputs, other timers, DMA and ADC. Two LGPTs (2× 16-bit timers) support quadrature decoder mode to enable buffered decoding of quadrature-encoded sensor signals. The LGPTs are available in device Active and Idle power modes.

表 8-1. Timer Comparison

| Feature | Timer 0 | Timer 1 | Timer 2 | Timer 3 |
|----------------------------------|---------|---------|---------|---------|
| Counter Width | 16-bit | 16-bit | 16-bit | 24-bit |
| Quadrature Decoder | Yes | No | Yes | No |
| Park Mode on Fault | No | Yes | No | No |
| Programmable Dead-Band Insertion | No | Yes | No | No |

表 8-2. Timer Availability

| Part Number | Timer 0 | Timer 1 | Timer 2 | Timer 3 |
|-------------|---------|---------|---------|---------|
| CC2340R21 | Yes | Yes | No | No |
| CC2340R22 | Yes | Yes | Yes | Yes |
| CC2340R52 | Yes | Yes | Yes | Yes |
| CC2340R53 | Yes | Yes | Yes | Yes |

• **Watchdog timer**

The watchdog timer is used to regain control if the system operates incorrectly due to software errors. Upon counter expiry, the watchdog timer resets the device when periodic monitoring of the system components and tasks fails to verify proper functionality. The watchdog timer runs on a 32kHz clock rate and operates in device active, idle, and standby modes and cannot be stopped once enabled.

8.7 Serial Peripherals and I/O

The CC2340R device provides 1xUART, 1xSPI, and 1xI2C serial peripherals.

The SPI module supports both SPI controller and peripheral up to 12MHz with configurable phase and polarity.

The UART module implements universal asynchronous receiver and transmitter functions. They support flexible baud-rate generation up to a maximum of 3Mbps and IRDA SIR mode of operation.

The I²C module is used to communicate with devices compatible with the I²C standard. The I²C interface can handle 100kHz and 400kHz operation and can serve as both controller and target.

The I/O controller (IOC) controls the digital I/O pins and contains multiplexer circuitry to allow a set of peripherals to be assigned to I/O pins in a fixed manner over DIOs. All digital I/Os are interrupt and wake-up capable, have a programmable pullup and pulldown function, and can generate an interrupt on a negative or positive edge (configurable). When configured as an output, pins can function as either push-pull, open-drain, or open-source. Some GPIOs have high-drive capabilities, which are marked in **bold** in *Pin Configurations and Functions*.

For more information, see the [CC23xx SimpleLink™ Wireless MCU Technical Reference Manual](#).

8.8 Battery and Temperature Monitor

A combined temperature and battery voltage monitor is available in the CC2340R device. The battery and temperature monitor allows an application to continuously monitor on-chip temperature and supply voltage and respond to changes in environmental conditions as needed. The module contains window comparators to interrupt the system CPU when temperature or supply voltage go outside defined windows. These events can also be used to wake up the device from Standby mode through the Always-On (AON) event fabric.

8.9 μ DMA

The device includes a direct memory access (μ DMA) controller. The μ DMA controller provides a way to offload data-transfer tasks from the system CPU, thus allowing for more efficient use of the processor and the available bus bandwidth. The μ DMA controller can perform a transfer between memory and peripherals. The μ DMA controller has dedicated channels for each supported on-chip module and can be programmed to automatically perform transfers between peripherals and memory when the peripheral is ready to transfer more data.

Some features of the μ DMA controller include the following (this is not an exhaustive list):

- Channel operation of up to 8 channels, with 6 channels having dedicated peripheral interface and 2 channels having ability to be triggered via configurable events.
- Transfer modes: memory-to-memory, memory-to-peripheral, peripheral-to-memory, and peripheral-to-peripheral
- Data sizes of 8, 16, and 32 bits
- Ping-pong mode for continuous streaming of data

8.10 Debug

On-chip debug is supported through the serial wire debug (SWD) interface, which is an ARM bi-directional 2-wire protocol that communicates with the JTAG Test Access Port (TAP) controller and allows for complete debug functionality. SWD is fully compatible with Texas Instruments' XDS family of debug probes.

8.11 Power Management

To minimize power consumption, the CC2340R supports a number of power modes and power management features (see 表 8-3).

表 8-3. Power Modes

| MODE | SOFTWARE CONFIGURABLE POWER MODES ⁽¹⁾ | | | | RESET PIN HELD |
|---------------------------------|--|---------------------|--------------------------|-----------|----------------|
| | ACTIVE | IDLE | STANDBY | SHUTDOWN | |
| CPU | Active | Off | Off | Off | Off |
| Flash | On | Available | Off | Off | Off |
| SRAM | On | On | Retention | Off | Off |
| Radio | Available | Available | Off | Off | Off |
| Supply System | On | On | Duty Cycled | Off | Off |
| CPU register retention | Full | Full | Full ⁽²⁾ | No | No |
| SRAM retention | Full | Full | Full | Off | Off |
| 48 MHz high-speed clock (HFCLK) | HFOSC (tracks HFXT) | HFOSC (tracks HFXT) | Off | Off | Off |
| 32 kHz low-speed clock (LFCLK) | LFXT or LFOSC | LFXT or LFOSC | LFXT or LFOSC | Off | Off |
| Peripherals | Available | Available | IOC, BATMON, RTC, LPCOMP | Off | Off |
| Wake-up on RTC | N/A | Available | Available | Off | Off |
| Wake-up on pin edge | N/A | Available | Available | Available | Off |
| Wake-up on reset pin | On | On | On | On | On |
| Brownout detector (BOD) | On | On | Duty Cycled | Off | Off |
| Power-on reset (POR) | On | On | On | On | On |
| Watchdog timer (WDT) | Available | Available | Available | Off | Off |

(1) “Available” indicates that the specific IP or feature can be enabled by user application in the corresponding device operating modes. “On” indicates that the specific IP or feature is turned on irrespective of the user application configuration of the device in the corresponding device operating mode. “Off” indicates that the specific IP or feature is turned off and not available for the user application in the corresponding device operating mode.

(2) Software-based retention of CPU registers with context save and restore when entering and exiting standby power mode

In the **Active** mode, both of MCU and AON power domains are powered. Clock gating is used to minimize power consumption. Clock gating to peripherals/subsystems is controlled manually by the CPU.

In **Idle** mode the CPU is in sleep but selected peripherals and subsystems (such as the radio) can be active. Infrastructure (Flash, ROM, SRAM, bus) clock gating is possible depending on state of the DMA and debug subsystem.

In **Standby** mode, only the always-on (AON) domain is active. An external wake-up event, RTC event, or comparator event (LP-COMP) is required to bring the device back to active mode. Pin Reset will also drive the device from Standby to Active. MCU peripherals with retention do not need to be reconfigured when waking up again, and the CPU continues execution from where it went into standby mode. All GPIOs are latched in standby mode.

In **Shutdown** mode, the device is entirely turned off (including the AON domain), and the I/Os are latched with the value they had before entering shutdown mode. A change of state on any I/O pin defined as a *wake from shutdown pin* wakes up the device and functions as a reset trigger. The CPU can differentiate between reset in this way and reset-by-reset pin or power-on reset by reading the reset status register. The only state retained in this mode are the latched I/O state, 3V register bank, and the flash memory contents.

备注

The power, RF and clock management for the CC2340R device require specific configuration and handling by software for optimized performance. This configuration and handling is implemented in the TI-provided drivers that are part of the CC2340R software development kit (SDK). Therefore, TI highly recommends using this software framework for all application development on the device. The complete [SDK](#) with FreeRTOS, device drivers, and examples are offered free of charge in source code.

8.12 Clock Systems

The CC2340R device has the following internal system clocks.

The 48MHz HFCLK is used as the main system (MCU and peripherals) clock. This is driven by the internal 48MHz RC Oscillator (HFOSC), which can track its accuracy against an external 48MHz crystal (HFXT). Radio operation requires an external 48MHz crystal.

The 32.768kHz LFCLK is used as the internal low-frequency system clock. It is used for the RTC, the watchdog timer (if enabled in standby power mode), and to synchronize the radio timer before or after Standby power mode. LFCLK can be driven by the internal 32.8kHz RC Oscillator (LFOSC), a 32.768kHz watch-type crystal, or clock input in LFXT bypass mode. When using a crystal or the internal RC oscillator, the device can output the 32kHz LFCLK signal to other devices, thereby reducing the overall system cost.

8.13 Network Processor

Depending on the product configuration, the CC2340R device can function as a wireless network processor (WNP), a device running the wireless protocol stack with the application running on a separate host MCU, or as a system-on-chip (SoC), with the application and protocol stack running on the system CPU inside the device.

In the first case, the external host MCU communicates with the device using SPI or UART. In the second case, the application must be written according to the application framework supplied with the wireless protocol stack.

9 Application, 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, as well as validating and testing their design implementation to confirm system functionality.

9.1 Reference Designs

The following reference designs should be followed closely when implementing designs using the CC2340R devices.

Special attention must be paid to RF component placement, decoupling capacitors, and DCDC regulator components, as well as ground connections for all of these.

[LP-EM-CC2340R5 Design Files](#) The CC2340R5 LaunchPad Design Files contain detailed schematics and layouts to build application-specific boards using the CC2340R devices in the 5mm x 5mm RKP package.

[LP-EM-CC2340R5-RGE-4x4-IS24 Design Files](#) The CC2340R5 RGE 4x4 LaunchPad Design Files contain detailed schematics and layouts to build application-specific boards using the CC2340R devices in the 4mm x 4mm RGE package. The CC2340R5x and CC2340R2x devices in RGE packages are pin-to-pin compatible.

[Sub-1 GHz and 2.4 GHz Antenna Kit for LaunchPad™ Development Kit and SensorTag](#) The antenna kit allows real-life testing to identify the optimal antenna for your application. The antenna kit includes 16 antennas for frequencies from 169MHz to 2.4GHz, including:

- PCB antennas
- Helical antennas
- Chip antennas
- Dual-band antennas for 868MHz and 915MHz combined with 2.4GHz

The antenna kit includes a JSC cable to connect to the Wireless MCU LaunchPad Development Kits and SensorTags.

9.2 Junction Temperature Calculation

This section shows the different techniques for calculating the junction temperature under various operating conditions. For more details, see [Semiconductor and IC Package Thermal Metrics](#).

There are two recommended ways to derive the junction temperature from other measured temperatures:

1. From package temperature:

$$T_J = \psi_{JT} \times P + T_{\text{case}} \quad (1)$$

2. From board temperature:

$$T_J = \psi_{JB} \times P + T_{\text{board}} \quad (2)$$

P is the power dissipated from the device and can be calculated by multiplying current consumption with supply voltage. Thermal resistance coefficients are found in *Thermal Resistance Characteristics*.

Example:

In this example, we assume a simple use case where the radio is transmitting continuously at 0dBm output power. Let us assume we want to maintain a junction temperature equal or less than 85°C and the supply voltage is 3V. Using Equation 1, the temperature difference between the top of the case and junction temperature is calculated. To calculate P, look up the current consumption for Tx at 85°C. At 85°C the current consumption is approximately 5.5mA. This means that P is 5.5mA × 3V = 16.5mW.

The maximum case temperature to maintain and junction temperature of 85°C is then calculated as:

$$T_{\text{case}} < T_J - 0.4^{\circ}\text{C}/\text{W} \times 23.4\text{mW} = 84.99^{\circ}\text{C} \quad (3)$$

For various application use cases, current consumption for other modules may have to be added to calculate the appropriate power dissipation. For example, the MCU may be running simultaneously as the radio, peripheral modules may be enabled, and so on. Typically, the easiest way to find the peak current consumption, and thus the peak power dissipation in the device, is to measure as described in the [Measuring CC13xx and CC26xx Current Consumption](#) application report.

10 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 as follows.

10.1 Device Nomenclature

To designate the stages in the product development cycle, TI assigns prefixes to all part numbers and/or date-code. Each device has one of three prefixes/identifications: X, P, or null (no prefix) (for example, X is in preview; therefore, an X prefix/identification is assigned).

Device development evolutionary flow:

- X** Experimental device that is not necessarily representative of the final device's electrical specifications and may not use production assembly flow.
- P** Prototype device that is not necessarily the final silicon die and may not necessarily meet final electrical specifications.
- null** Production version of the silicon die that is fully qualified.

Production devices have been characterized fully, and the quality and reliability of the device have been demonstrated fully. TI's standard warranty applies.

Predictions show that prototype devices (X or P) have a greater failure rate than the standard production devices. Texas Instruments recommends that these devices not be used in any production system because their expected end-use failure rate still is undefined. Only qualified production devices are to be used.

TI device nomenclature also includes a suffix with the device family name. This suffix indicates the package type (for example, *RKP*).

For orderable part numbers of devices in the RHB (5-mm x 5-mm) package type, see the *Package Option Addendum* of this document, the Device Information in 节 3, the TI website (www.ti.com), or contact your TI sales representative.

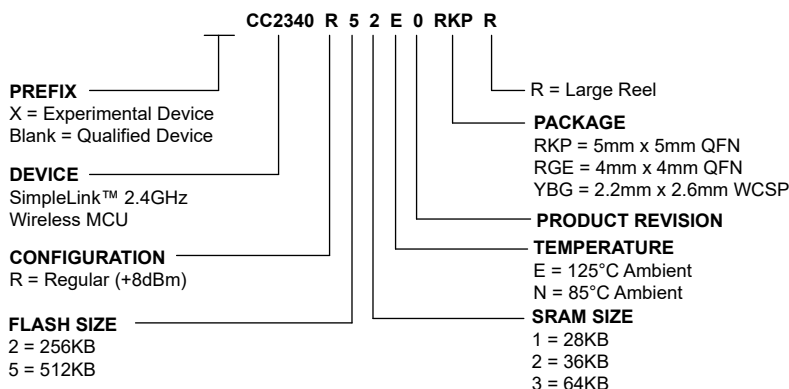


图 10-1. Device Nomenclature

10.2 Tools and Software

The CC2340R device is supported by a variety of software and hardware development tools.

Development Kit

[CC2340R5
LaunchPad™
Development Kit](#)

The CC2340R5 LaunchPad™ Development Kit enables development of high-performance wireless applications that benefit from low-power operation. The kit features the CC2340R53 SimpleLink Wireless MCU, which allows you to quickly evaluate and prototype 2.4GHz wireless applications such as Bluetooth 5 Low Energy, Zigbee, and

Thread. The kit works with the LaunchPad ecosystem, enabling additional functionality like sensors, display, and more.

Software

SimpleLink™ Low Power F3 software development kit (SDK)

The SimpleLink™ Low Power F3 software development kit (SDK) provides a complete package for the development of wireless applications on the CC2340R family of devices. The SDK includes a comprehensive software package for the CC2340R device, including the following protocol stacks:

- Bluetooth Low Energy 5.3
- Zigbee 3.x

The SimpleLink Low Power F3 SDK is part of TI's SimpleLink MCU platform, offering a single development environment that delivers flexible hardware, software, and tool options for customers developing wired and wireless applications. For more information about the SimpleLink MCU Platform, visit <https://www.ti.com/simplelink>.

Development Tools

Code Composer Studio™ Integrated Development Environment (IDE)

Code Composer Studio is an integrated development environment (IDE) that supports TI's Microcontroller and Embedded Processors portfolio. Code Composer Studio comprises a suite of tools used to develop and debug embedded applications. It includes an optimizing C/C++ compiler, source code editor, project build environment, debugger, profiler, and many other features. The intuitive IDE provides a single user interface taking you through each step of the application development flow. Familiar tools and interfaces allow users to get started faster than ever before.

CCS has support for all SimpleLink Wireless MCUs and includes support for EnergyTrace™ software (application energy usage profiling).

Code Composer Studio is provided free of charge when used in conjunction with the XDS debuggers included on a LaunchPad Development Kit.

Code Composer Studio™ Cloud IDE

Code Composer Studio (CCS) Cloud is a web-based IDE that allows you to create, edit, and build CCS projects. After you have successfully built your project, you can download and run on your connected LaunchPad. Basic debugging, including features like setting breakpoints and viewing variable values, is now supported with CCS Cloud.

IAR Embedded Workbench® for Arm®

IAR Embedded Workbench® is a set of development tools for building and debugging embedded system applications using Assembler, C and C++. It provides a completely integrated development environment that includes a project manager, editor, and build tools. IAR has support for all SimpleLink Wireless MCUs. It offers broad debugger support, including XDS110, IAR I-jet™, and Segger J-Link™. IAR is also supported out-of-the-box on most software examples provided as part of the SimpleLink SDK.

SmartRF™ Studio

SmartRF™ Studio is a Windows® application that can be used to evaluate and configure SimpleLink Wireless MCUs from Texas Instruments. The application will help designers of RF systems to easily evaluate the radio at an early stage in the design process. It is especially useful for generation of configuration register values and for practical testing and debugging of the RF system. SmartRF Studio can be used either as a standalone application or together with applicable evaluation boards or debug probes for the RF device. Features of the SmartRF Studio include:

- Link tests - send and receive packets between nodes

- Antenna and radiation tests - set the radio in continuous wave TX and RX states
- Export radio configuration code for use with the TI SimpleLink SDK RF driver
- Custom GPIO configuration for signaling and control of external switches

UniFlash

UniFlash is a standalone tool used to program on-chip flash memory on TI MCUs. UniFlash has a GUI, command line, and scripting interface. UniFlash is available free of charge.

10.2.1 SimpleLink™ Microcontroller Platform

The SimpleLink microcontroller platform sets a new standard for developers with the broadest portfolio of wired and wireless Arm® MCUs (System-on-Chip) in a single software development environment. Delivering flexible hardware, software and tool options for your IoT applications. Invest once in the SimpleLink software development kit and use throughout your entire portfolio. Learn more at ti.com/simplelink.

10.3 Documentation Support

To receive notification of documentation updates on data sheets, errata, application notes and similar, navigate to the device product folder ([CC2340R5](#)). In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

The current documentation that describes the MCU, related peripherals, and other technical collateral is listed as follows.

TI Resource Explorer

[TI Resource Explorer](#) Software examples, libraries, executables, and documentation are available for your device and development board.

Errata

[CC2340R Silicon Errata](#) The silicon errata describes the known exceptions to the functional specifications for each silicon revision of the device and description on how to recognize a device revision.

Application Reports

All application reports for the CC2340R devices are found on the device product folder ([CC2340R2](#) or [CC2340R5](#)).

Technical Reference Manual (TRM)

[CC23xx SimpleLink™ Wireless MCU TRM](#) The TRM provides a detailed description of all modules and peripherals available in the device family.

10.4 支持资源

[TI E2E™ 中文支持论坛](#)是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的[使用条款](#)。

10.5 Trademarks

SimpleLink™, LaunchPad™, Code Composer Studio™, EnergyTrace™, and TI E2E™ are trademarks of Texas Instruments.

I-jet™ is a trademark of IAR Systems AB.

J-Link™ is a trademark of SEGGER Microcontroller Systems GmbH.

Arm® and Cortex® are registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

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 CoreMark® is a registered trademark of Embedded Microprocessor Benchmark Consortium Corporation.
 Wi-Fi® is a registered trademark of Wi-Fi Alliance.
 IAR Embedded Workbench® is a registered trademark of IAR Systems AB.
 Windows® is a registered trademark of Microsoft Corporation.
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10.6 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

10.7 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。

11 Revision History

注：以前版本的页码可能与当前版本的页码不同

| Changes from Revision D (June 2024) to Revision E (September 2024) | Page |
|--|------|
| • 更新了整个数据表中的 SDK 名称。..... | 1 |
| • 将 CC2340R53E0RKPR 从“预发布”更新为“已发布”..... | 2 |
| • 将 CC2340R53N0RKPR 从“预发布”更新为“已发布”..... | 2 |
| • Corrected pin pitch in pin diagram title..... | 6 |
| • Corrected pin pitch in diagram title..... | 8 |
| • Updated the description of software and tools..... | 58 |

| Changes from Revision C (June 2023) to Revision D (June 2024) | Page |
|--|------|
| • 将所有 CC2340R 系列器件合并到单个数据表中..... | 1 |
| • 添加了 CC2340R 系列中的所有器件..... | 2 |
| • Changed the comparison table to the CC2340R family of devices..... | 5 |
| • Added preview for YBG package..... | 8 |
| • Removed "Untrimmed brownout rising threshold"..... | 20 |
| • Updated parameter name of "Trimmed brownout rising threshold"..... | 20 |
| • Updated parameter name of "Trimmed brownout falling threshold"..... | 20 |
| • Changed Temperature Sensor " Accuracy"..... | 20 |
| • Changed DCDC "Idle Current - Supply Systems and RAM powered, flash disabled, DMA disabled "..... | 21 |
| • Changed DCDC "Idle Current - Supply Systems and RAM powered, flash disabled, DMA enabled"..... | 21 |
| • Changed DCDC "Idle Current - Supply Systems and RAM powered, flash enabled, DMA disabled"..... | 21 |
| • Changed DCDC "Idle Current - Supply Systems and RAM powered, flash enabled, DMA enabled"..... | 21 |
| • Changed GLDO "Idle Current - Supply Systems and RAM powered, flash disabled, DMA disabled"..... | 21 |
| • Changed GLDO "Idle Current - Supply Systems and RAM powered, flash disabled, DMA enabled"..... | 21 |
| • Changed GLDO "Idle Current - Supply Systems and RAM powered, flash enabled, DMA disabled"..... | 21 |
| • Changed GLDO "Idle Current - Supply Systems and RAM powered, flash enabled, DMA enabled "..... | 21 |
| • Changed "Reset current"..... | 21 |
| • Changed "Shutdown Current"..... | 21 |
| • Changed "Radio transmit current at -8 dBm"..... | 22 |
| • Changed "Radio transmit current at 0 dBm, DCDC OFF"..... | 22 |

| | |
|--|----|
| • Changed "Radio transmit current at +4 dBm"..... | 22 |
| • Changed "Flash write time"..... | 22 |
| • Change "Frequency error tolerance" for 125kbps BLE PHY..... | 24 |
| • Change "Frequency error tolerance" for 500kbps BLE PHY..... | 24 |
| • Changed "Frequency error tolerance" for 1Mbps BLE PHY..... | 24 |
| • Changed "Data rate error tolerance" for 1Mbps BLE PHY..... | 24 |
| • Updated footnote 1 in Section 8.14 "Bluetooth Low Energy - Receive (RX)"..... | 24 |
| • Changed "Selectivity, +3MHz" for 1Mbps BLE PHY..... | 24 |
| • Changed "Frequency error tolerance" for 2Mbps BLE PHY..... | 24 |
| • Changed "Data rate error tolerance" for 2Mbps BLE PHY..... | 24 |
| • Changed "f > 1 GHz, including harmonics"..... | 31 |
| • Changed min value of "Crystal load capacitance"..... | 31 |
| • Removed "Temperature coefficient"..... | 32 |
| • Changed "SPI clock frequency"..... | 32 |
| • Added footnote (1)..... | 32 |
| • Changed "CS access time, CS active to POCI data out - VDDS=3.3V"..... | 34 |
| • Changed "CS access time, CS active to POCI data out - VDDS=1.8V"..... | 34 |
| • Changed "CS disable time, CS inactive to POCI high impedance - VDDS=3.3V"..... | 34 |
| • Changed "CS disable time, CS inactive to POCI high impedance - VDDS=1.8V"..... | 34 |
| • Changed "PICO input data setup time"..... | 34 |
| • Changed "POCI output data valid time" at 3.3V..... | 34 |
| • Removed "(4)" from test conditions..... | 34 |
| • Changed "POCI output data valid time" at 1.8V..... | 34 |
| • Removed "(4)" from test conditions..... | 34 |
| • Added "Data setup time" at f_SCL = 100kHz..... | 36 |
| • Changed "Data setup time" at f_SCL > 100kHz..... | 36 |
| • Changed "GPIO pullup current" at 1.8V..... | 36 |
| • Changed "GPIO pulldown current" at 1.8V..... | 36 |
| • Changed "GPIO low-to-high input transition, with hysteresis" at 1.8V..... | 36 |
| • Changed "GPIO high-to-low input transition, with hysteresis" at 1.8V..... | 36 |
| • Changed "GPIO input hysteresis" at 1.8V..... | 36 |
| • Changed "GPIO VOH at 10 mA load" at 3.0V..... | 36 |
| • Changed "GPIO VOL at 10 mA load" at 3.0V..... | 36 |
| • Changed "GPIO VOH at 2 mA load" at 3.0V..... | 36 |
| • Changed "GPIO VOL at 2 mA load" at 3.0V..... | 36 |
| • Changed "GPIO pullup current" at 3.8V..... | 36 |
| • Changed "GPIO pulldown current" at 3.8V..... | 36 |
| • Changed "GPIO low-to-high input transition, with hysteresis" at 3.8V..... | 36 |
| • Changed "GPIO high-to-low input transition, with hysteresis" at 3.8V..... | 36 |
| • Changed "GPIO input hysteresis" at 3.8V..... | 36 |
| • Added "Temperature Error" of Temp diode inside ADC..... | 38 |
| • Changed "Ultra-low power comparator current consumption"..... | 40 |
| • Added performance plots..... | 40 |
| • Corrected timer features..... | 51 |
| • Updated descriptions..... | 54 |

12 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. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| CC2340R21N0RGER | Active | Production | VQFN (RGE) 24 | 3000 LARGE T&R | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 85 | CC2340 R21 |
| CC2340R22E0RKPR | Active | Production | VQFN (RKP) 40 | 3000 LARGE T&R | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 125 | CC2340 R22 |
| CC2340R22N0RKPR | Active | Production | VQFN (RKP) 40 | 3000 LARGE T&R | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 85 | CC2340 R22 |
| CC2340R52E0RGER | Active | Production | VQFN (RGE) 24 | 3000 LARGE T&R | Yes | Call TI Nipdau | Level-3-260C-168 HR | -40 to 125 | CC2340 R52 |
| CC2340R52E0RKPR | Active | Production | VQFN (RKP) 40 | 3000 LARGE T&R | Yes | NIPDAU NIPDAU | Level-3-260C-168 HR | -40 to 125 | CC2340 R52 |
| CC2340R52N0RGER | Active | Production | VQFN (RGE) 24 | 3000 LARGE T&R | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 85 | CC2340 R52 |
| CC2340R52N0RKPR | Active | Production | VQFN (RKP) 40 | 3000 LARGE T&R | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 85 | CC2340 R52 |
| CC2340R53E0RKPR | Active | Production | VQFN (RKP) 40 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | CC2340 R53 |
| CC2340R53N0RKPR | Active | Production | VQFN (RKP) 40 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | CC2340 R53 |

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part 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.

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OTHER QUALIFIED VERSIONS OF CC2340R5 :

- Automotive : [CC2340R5-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CC2340R21N0RGER | VQFN | RGE | 24 | 3000 | 330.0 | 12.4 | 4.25 | 4.25 | 1.15 | 8.0 | 12.0 | Q2 |
| CC2340R22E0RKPR | VQFN | RKP | 40 | 3000 | 330.0 | 12.4 | 5.3 | 5.3 | 1.1 | 8.0 | 12.0 | Q2 |
| CC2340R22N0RKPR | VQFN | RKP | 40 | 3000 | 330.0 | 12.4 | 5.3 | 5.3 | 1.1 | 8.0 | 12.0 | Q2 |
| CC2340R52E0RGER | VQFN | RGE | 24 | 3000 | 330.0 | 12.4 | 4.25 | 4.25 | 1.15 | 8.0 | 12.0 | Q2 |
| CC2340R52E0RKPR | VQFN | RKP | 40 | 3000 | 330.0 | 12.4 | 5.3 | 5.3 | 1.1 | 8.0 | 12.0 | Q2 |
| CC2340R52N0RGER | VQFN | RGE | 24 | 3000 | 330.0 | 12.4 | 4.25 | 4.25 | 1.15 | 8.0 | 12.0 | Q2 |
| CC2340R52N0RKPR | VQFN | RKP | 40 | 3000 | 330.0 | 12.4 | 5.3 | 5.3 | 1.1 | 8.0 | 12.0 | Q2 |
| CC2340R53E0RKPR | VQFN | RKP | 40 | 3000 | 330.0 | 12.4 | 5.3 | 5.3 | 1.1 | 8.0 | 12.0 | Q2 |
| CC2340R53N0RKPR | VQFN | RKP | 40 | 3000 | 330.0 | 12.4 | 5.3 | 5.3 | 1.1 | 8.0 | 12.0 | Q2 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CC2340R21N0RGER | VQFN | RGE | 24 | 3000 | 367.0 | 367.0 | 35.0 |
| CC2340R22E0RKPR | VQFN | RKP | 40 | 3000 | 367.0 | 367.0 | 35.0 |
| CC2340R22N0RKPR | VQFN | RKP | 40 | 3000 | 367.0 | 367.0 | 35.0 |
| CC2340R52E0RGER | VQFN | RGE | 24 | 3000 | 367.0 | 367.0 | 35.0 |
| CC2340R52E0RKPR | VQFN | RKP | 40 | 3000 | 367.0 | 367.0 | 35.0 |
| CC2340R52N0RGER | VQFN | RGE | 24 | 3000 | 367.0 | 367.0 | 35.0 |
| CC2340R52N0RKPR | VQFN | RKP | 40 | 3000 | 367.0 | 367.0 | 35.0 |
| CC2340R53E0RKPR | VQFN | RKP | 40 | 3000 | 367.0 | 367.0 | 35.0 |
| CC2340R53N0RKPR | VQFN | RKP | 40 | 3000 | 367.0 | 367.0 | 35.0 |

GENERIC PACKAGE VIEW

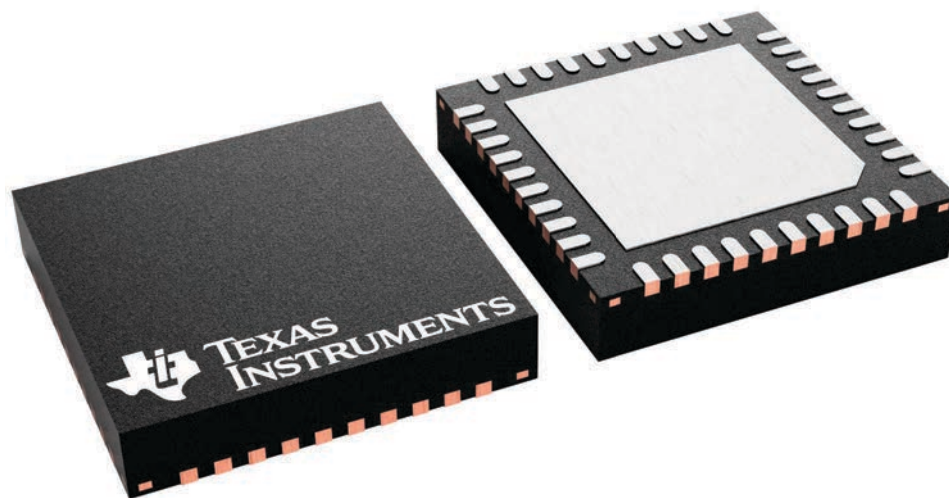
RKP 40

VQFN - 1 mm max height

5 x 5, 0.4 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



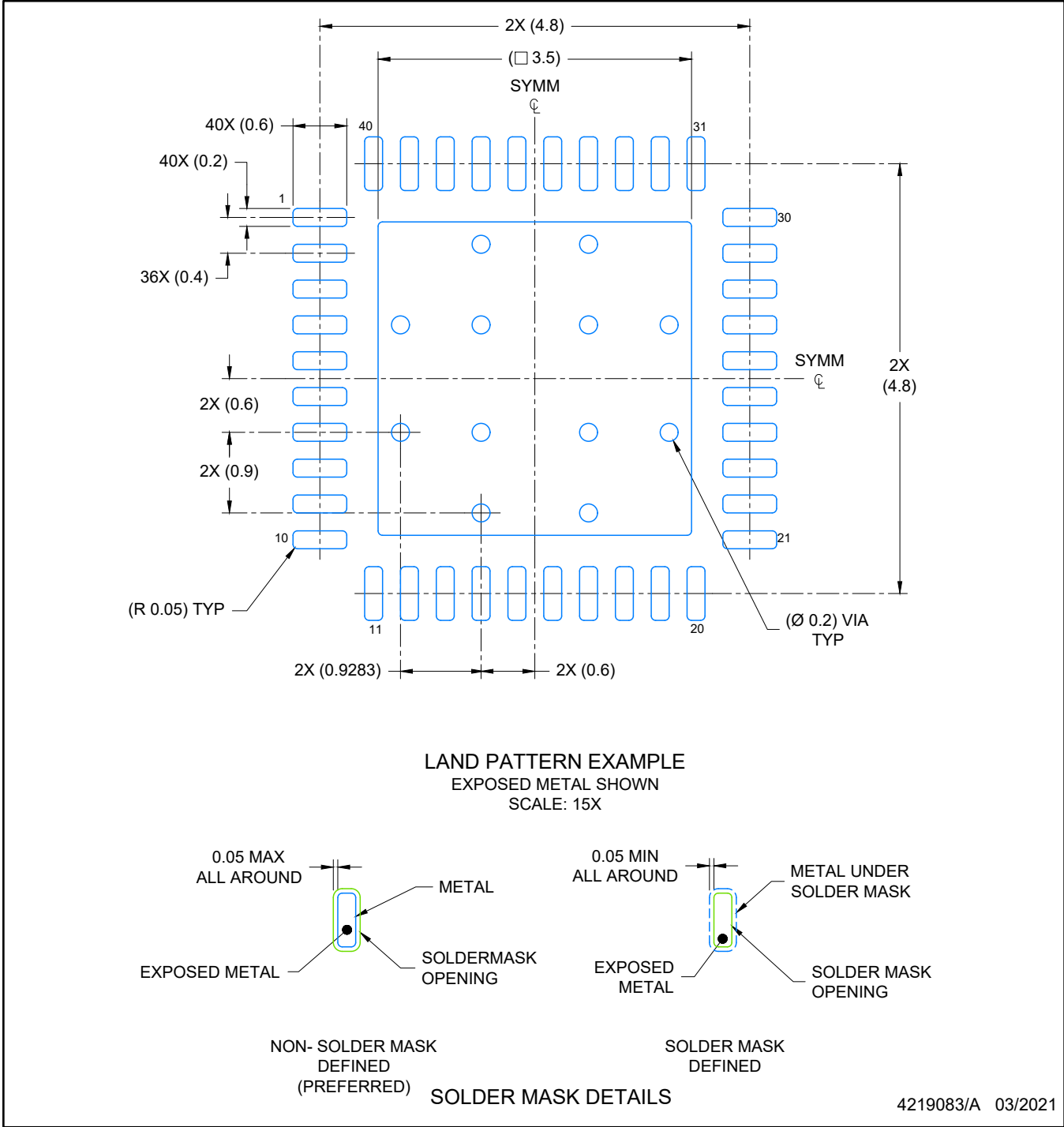
4229305/A

EXAMPLE BOARD LAYOUT

RKP0040B

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK- NO LEAD



NOTES: (continued)

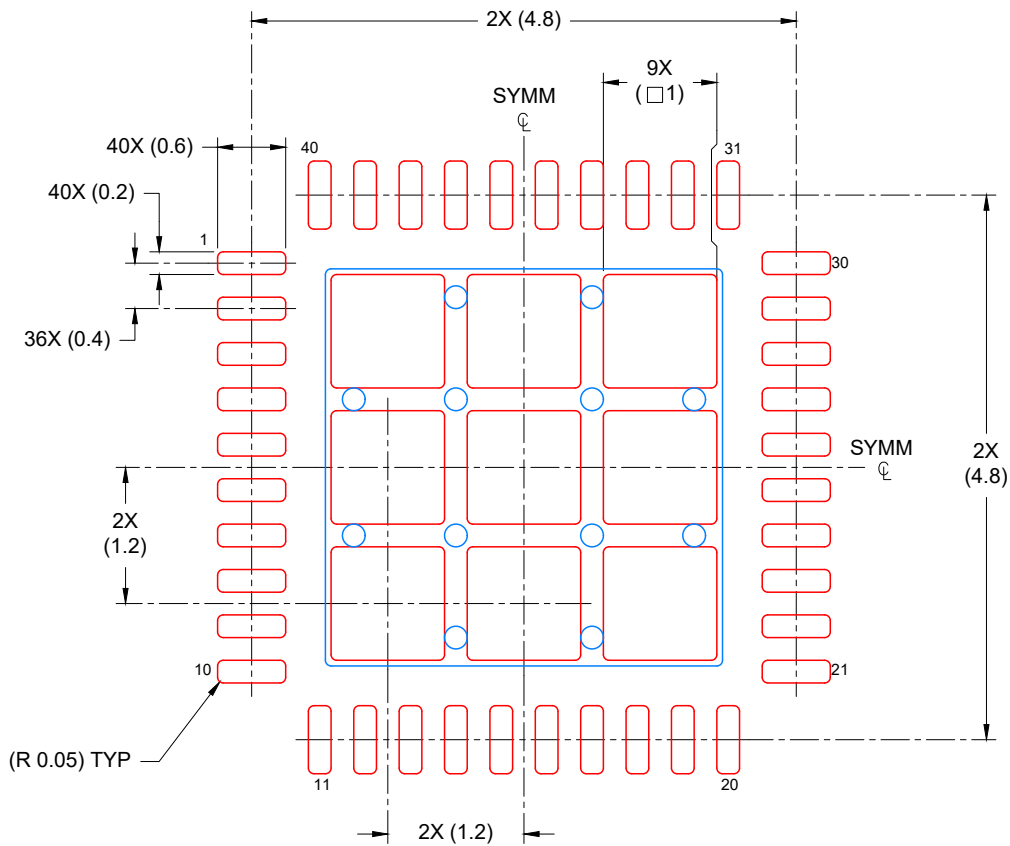
- 4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
- 5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

VQFN - 1 mm max height

RKP0040B

PLASTIC QUAD FLATPACK- NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
74% PRINTED COVERAGE BY AREA
SCALE: 15X

4219083/A 03/2021

NOTES: (continued)

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

RGE 24

GENERIC PACKAGE VIEW

VQFN - 1 mm max height

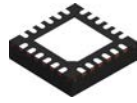
PLASTIC QUAD FLATPACK - NO LEAD



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4204104/H

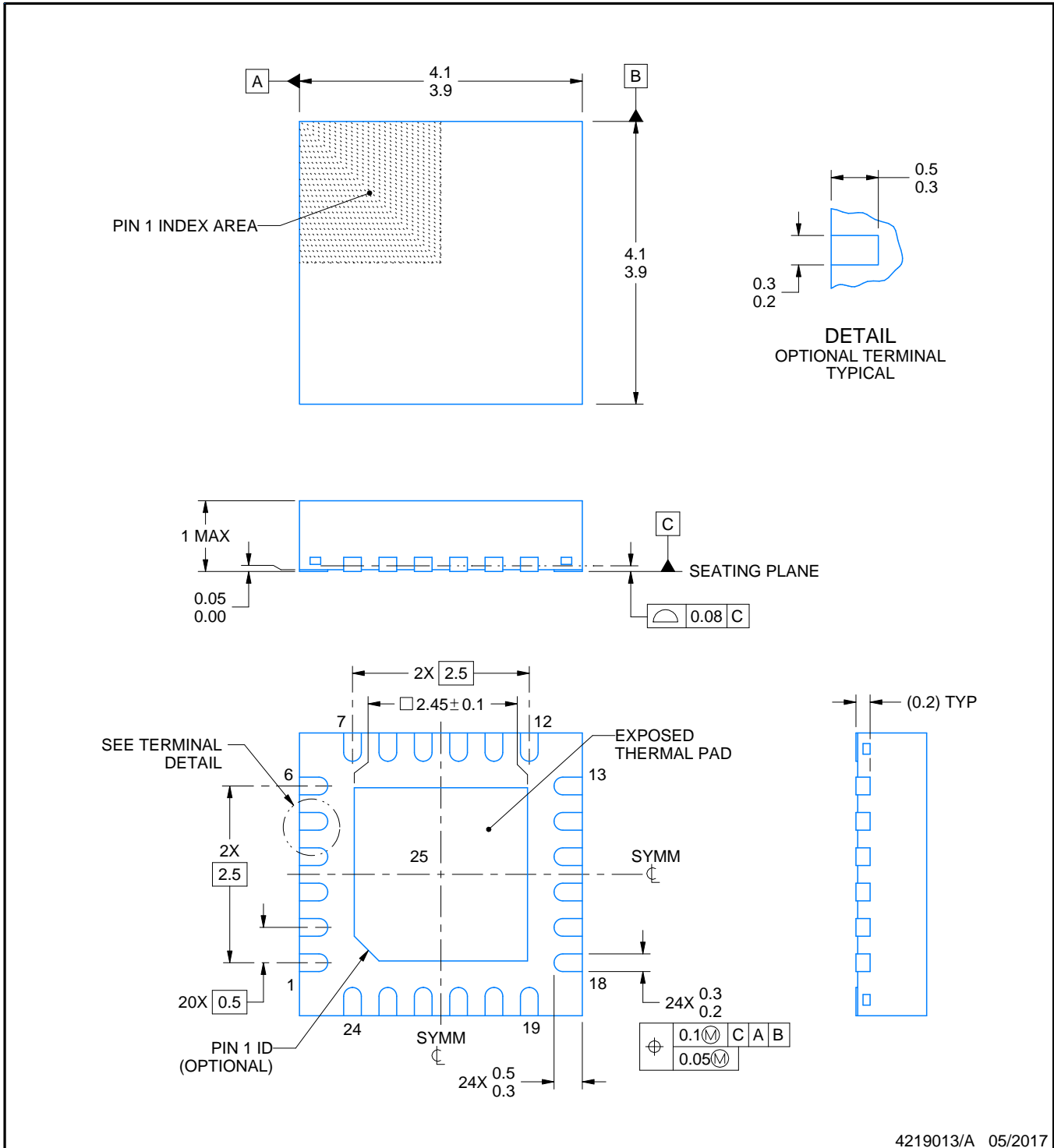
RGE0024B



PACKAGE OUTLINE

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



4219013/A 05/2017

NOTES:

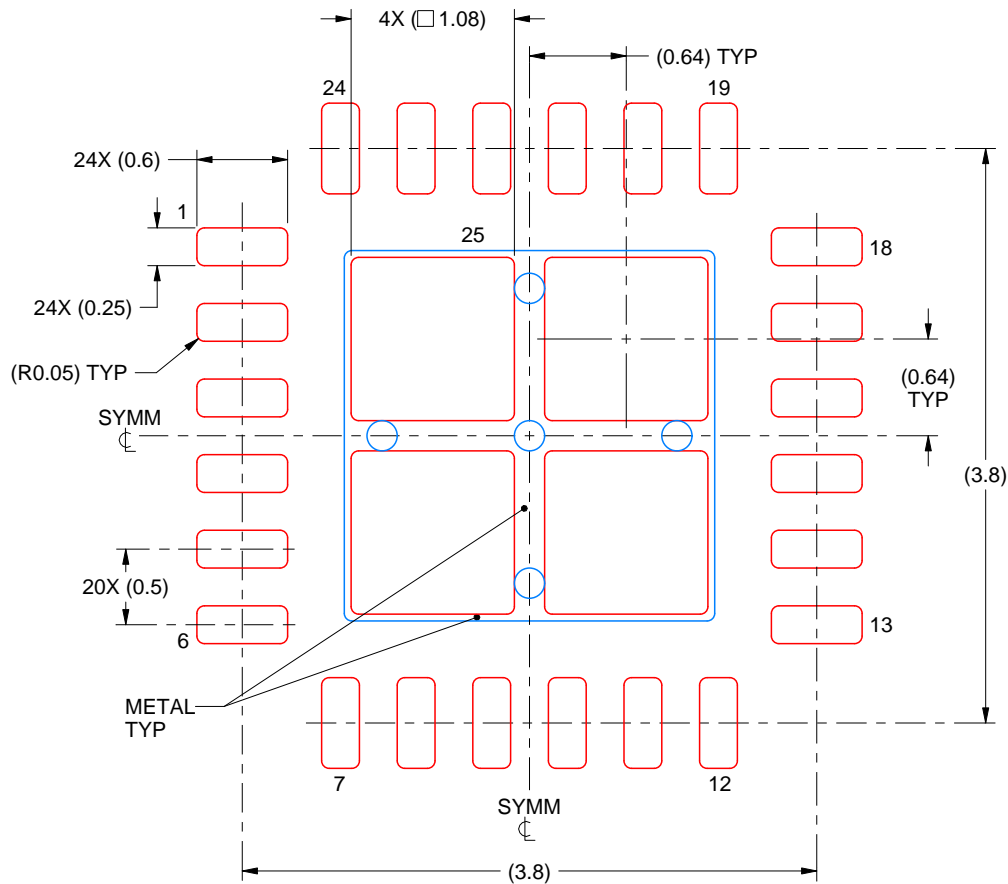
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE STENCIL DESIGN

RGE0024B

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 25
78% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:20X

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NOTES: (continued)

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

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