# CC2640R2F SimpleLink™ Bluetooth® 5.1 Low Energy Wireless MCU Silicon Revisions F, G

This document describes known exceptions to the functional specifications (advisories) for the CC2640R2F SimpleLink™ *Bluetooth*® low energy wireless MCU.

**Topic** **Page**

# 1 Advisory Matrix

Table 1 lists all advisories, modules affected, and the applicable silicon revisions.

**Table 1. Advisories Matrix**

| MODULE | DESCRIPTION | SILICON REVISION AFFECTED |
|---|---|---|
| | | F, G |
| SSI | Advisory 01 — Slave Mode Can Sample New TX Data From SYSBUS Clock Domain Using SSPCLK With No Synchronization | Yes |
| SSI | Advisory 02 — Motorola® SPI Format Slave Mode Writes to Transmit FIFO Can Lose Data | Yes |
| Clock Switching | Advisory 03— Reading From Flash While Performing Clock Switching Between the High-Speed Oscillators (XOSC_HF and RCOSC_HF) Will Cause the System to Hang | Yes |
| Sensor Controller | Advisory 04 — Insufficient Power Supply Recharging When Using the Sensor Controller Can Cause the System to Hang or Force a Pin Reset | Yes |
| System level | Advisory 05 — RF Core CPU Can Hang When Running BLE Master Command with High Throughput from Slave to Master | Yes |
| Register Value | Advisory 06 — Wrong Reset Source Indication | Yes |
| System level | Advisory 07 — Temporary Loss of Receive Function During Continuous Receive Operation Over Long Periods of Time | Yes |
| System level | Advisory 08 — Radio Frequency Error Glitch When Device Switches From IDLE to ACTIVE Mode While Radio is in TX or RX | Yes |
| System level | Advisory 09 — Slow Transition Across Brown-Out Detect (BOD) Threshold Might Cause the Device to Hang | Yes |

# 2 Nomenclature, Package Symbolization, and Revision Identification

## *2.1 Device and Development-Support Tool Nomenclature*

To designate the stages in the product development cycle, Texas Instruments™ assigns prefixes to the part numbers of all devices and support tools. Each device has one of three prefixes/identifications: X, P, or null (no prefix) (for example, CC2640R2F is in production; therefore, no prefix/identification is assigned). Texas Instruments recommends two of three possible prefix designators for its support tools: TMDX and TMDS. These prefixes represent evolutionary stages of product development from engineering prototypes (X/TMDX) through fully qualified production devices/tools (null/TMDS).

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.

Support tool development evolutionary flow:

**TMDX —** Development-support product that has not yet completed Texas Instruments internal qualification testing.

**TMDS —** Fully qualified development-support product.

X and P devices and TMDX development-support tools are shipped against the following disclaimer:

"Developmental product is intended for internal evaluation purposes."

Production devices and TMDS development-support tools 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.

## 2.2 Package Symbolization and Revision Identification

Figure 1 and Table 2 describe the package symbolization and device revision codes.

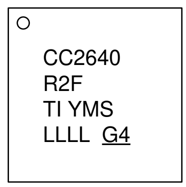


**Figure 1. Package Symbolization**

**Table 2. Revision Identification**

| DEVICE REVISION CODE | SILICON REVISION |
|---|---|
| F | 2.5 |
| G | 3.1 |

The die markings do not indicate the silicon revision. However, customers can determine the silicon revision by one of the following methods:

1. TI provided software functions in chipinfo.c:
   - HwRevision_t ChipInfo_GetHwRevision( void )
   - **Returns**: chip HW revision
   - **HWREV_2_5** is returned for CC2640R2F revision F.
   - **HWREV_3_1** is returned for CC2640R2F revision G.

2. SmartRF™ Studio:
   - When connecting to a CC2640R2F device, the version number is shown in the lower-left corner (see Figure 2).
   - Customers can also read out the chip revision using SmartRF™ Studio version 2.10.0 or later.

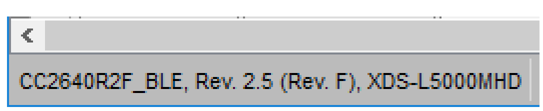


**Figure 2. Device Identification with SmartRF™ Studio**

3. Package label:
   - The die revision name is shown on the tape and reel label as shown in the example label in Figure 3.
   - Entry *(2P)* lists the revision (either F or G).

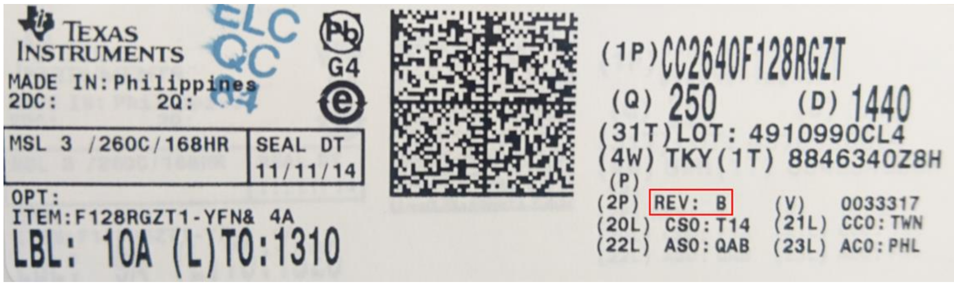


**Figure 3. Sample Product Shipping Label for the CC2640 Device**

## 3 Silicon Revision F, G Advisories

**Table 3. Silicon Revision F, G Advisory List**

## Advisory 01 — *Slave Mode Can Sample New TX Data From SYSBUS Clock Domain Using SSPCLK With No Synchronization*

**Revision(s) Affected:** F, G

**Description**

When the SSI is programmed to operate in slave mode, the data written to the SSI data register (SSIn:DR) in the SYSBUS clock domain can be sampled in the SSPCLK domain or without any synchronization. This sampling condition occurs when all of the following conditions are met:

i. The SSI Transmit FIFO is empty.

ii. The SSI Data register (SSIn:DR) write access occurs as a new SPI master transfer starts.

iii. The SSI slave-state machine samples data to transmit.

This issue causes written data to be lost.

**Workaround**

Use TI's Unified Network Processor Interface (NPI).

## Advisory 02 — *Motorola® SPI Format Slave Mode Writes to Transmit FIFO Can Lose Data*

**Revision(s) Affected:** F, G

**Description**

If the SSI is configured to operate in Motorola® SPI slave mode, it is possible to lose write data when the following two conditions are met:

i. A write to the SSI data register (SSIn:DR) occurs between a new SPI master transfer starting and the end of the first bit of incoming data.

ii. A write to the SSI data register (SSIn:DR) occurs during the first bit of new incoming data in a back-to-back transfer sequence.

For more details, see the *Synchronous Serial Interface (SSI)* chapter in the *CC13x0, CC26x0 SimpleLink™ Wireless MCU Technical Reference Manual*.

**Workaround**

Use TI's Unified Network Processor Interface (NPI).

## Advisory 03 — *Reading From Flash While Performing Clock Switching Between the High-Speed Oscillators (XOSC_HF and RCOSC_HF) Will Cause the System to Hang*

**Revision(s) Affected:** F, G

**Description**

The CC2640R2F device contains five modules that can read from flash independently of each other. These five modules are:

- Arm® Cortex®-M3
- RF Core
- I2S
- µDMA
- Crypto (AES module)

Clock switching between XOSC_HF and RCOSC_HF can only be initiated by the Cortex-M3. While the Cortex-M3 performs clock switching, no other modules are allowed to read from the flash. The system will hang if any of the other four modules (RF core, I2S, µDMA, or Crypto) are reading from flash during this period.

**Workaround**

The user must make sure that the Cortex-M3 does not perform clock switching while any of the other four modules (RF core, I2S, µDMA, or Crypto) are reading from flash.

**TI-RTOS**

Clock switching from RCOSC_HF to XOSC_HF is done by calling Power_setDependency (XOSC_HF). The user must register a notification to be notified when the clock switching is completed. When the notification function is called by the power driver, the clock switching is completed and it is safe for all modules to read from flash again.

Clock switching from XOSC_HF to RCOSC_HF is done by calling Power_releaseDependency (XOSC_HF). When this function returns, the clock switching is completed and it is safe for all modules to read from flash again. The TI-RTOS radio driver never reads from flash, so it is safe to perform clock switching at all times when using this driver. However, the user is responsible for ensuring that no clock switching is performed if the RF Core, I2S, µDMA, or Crypto modules are reading from flash.

**Non-OS**

Clock switching is performed by calling the DriverLib API *OSCHfSourceSwitch()*. When this function returns, it is safe for all modules to read from flash again. The user is responsible for ensuring that no clock switching is performed if the RF core, I2S, µDMA, or Crypto modules are read from flash.

## Advisory 04 — *Insufficient Power Supply Recharging When Using the Sensor Controller Can Cause the System to Hang or Force a Pin Reset*

**Revision(s) Affected:** F, G

**Details:** When the CC2640R2F device enters standby mode, a time interval must be set for the initial period between VDDR recharges based on temperature and certain device-specific trims. However, if the sensor controller wakes up and the device re-enters standby mode without waking the Cortex-M3, the initial recharge period programmed by the Cortex-M3 will be used again by the hardware. If the temperature has increased sufficiently between the time the Cortex-M3 put the device into standby and the time the sensor controller put the device into standby mode, the recharge period programmed may be too long. VDDR can drop below the permitted minimum threshold due to the temperature-induced leakage increase, which can cause an inconsistent internal state in the device or cause the device to hang, thus forcing a pin reset.

**Workaround:** If the sensor controller is used and the device enters standby mode while using the sensor controller, the user must ensure that the initial recharge period programmed by the Cortex-M3 processor is more conservative than what is strictly necessary at the current temperature. If the Cortex-M3 has a maximum duration where it sleeps at a specific temperature gradient, the user has a defined maximum temperature increase between recalculations of the initial recharge period. The sleep duration can be altered such that the decrease in the converged recharge period matches the margin subtracted from the initial recharge period.

The following parameters are needed for the workaround:

- The user's maximum expected temperature gradient in °C/s.
- The upper bound of the user's expected operating temperature range in °C.
- The initial recharge period set at the upper bound of the user's expected operating temperature range in SCLK_LF clock periods.
- A table of converged recharge periods in SCLK_LF clock periods at varying temperatures decreasing from the upper bound of the user's expected operating temperature.
- The margin in SCLK_LF clock periods that the user wants to subtract from the regular initial recharge period. The higher this value, the longer the device can sleep before requiring a wakeup to recalculate the initial recharge period. However, higher values will lead to slower convergence of the recharge algorithm towards the ideal recharge period at a given temperature.

Based on the previously listed parameters, the user can make the following calculations to determine the maximum duration of time that the Cortex-M3 can sleep before waking up to recalculate the initial recharge period:

1. Add the margin to the converged recharge period at the upper bound of your operating temperature.
2. Find the value in the table of converged recharge periods that comes closest to this value and determine the temperature this value occurs at.
3. Find the temperature difference between that temperature and the upper bound of your expected operating temperature range.
4. Divide this temperature delta by your maximum expected temperature gradient.

The result of the previously stated calculations is a time value in seconds. This value is the longest time the device can safely stay in standby mode before a Cortex-M3 wakeup must be forced if the sensor controller is active.

To apply the workaround, convert this duration from seconds to system ticks. When using SIMPLELINK-CC2640R2-SDK_1.50.00.58 or later, apply this value into PowerCC26XX_Config.maxStandbyDuration,
set PowerCC26XX_Config.enableMaxStandbyDuration to true,
and set PowerCC26XX_Config.vddrRechargeMargin to the value chosen earlier.

## Advisory 05 — *RF Core CPU Can Hang When Running BLE Master Command with High Throughput from Slave to Master*

**Revision(s) Affected:** F, G

**Details:** If the BLE master command is run, the RF Core in the device can hang if all of the following criteria are fulfilled:

1. The master transmitted a packet with the header field *MD* set to 0 (for more details about the MD header field, see the *Bluetooth Specification Version 4.2, Vol. 6, Part B, Section 4.2* on bluetooth.com).
2. The master then received a packet with the MD header field set to 1 and CRC OK.
3. The received packet is ignored as a retransmission of the last received packet, or the packet is empty (provided that the auto-flush feature is enabled; the BLE stack uses this setting).
4. All the entries for the received packets that were available at the start of the command have been filled with previously received packets, and the entries have not yet been processed and freed for re-use.

In this case, the transmitter will not be enabled after receiving the packet, but the firmware-defined state machine will still go into transmitter states. This causes registers to be accessed without the module having a clock, meaning that the RF core will hang until the radio is power-cycled using the internal power management on the chip.

This combination of events is unlikely in all cases and is only possible when implementing a central device that may receive more packets with payload in a single connection event than the number of receive buffers that were allocated.

**Workaround:** The user must ensure that the transmitter is enabled before the state machine goes into the transmitter states if all the aforementioned criteria are fulfilled.

## Advisory 06 — *Wrong Reset Source Indication*

**Revision(s) Affected:** F, G

**Details:** The field *RESET_SRC* in the AON_SYSCTL:RESETCTL register shows the source of the last system reset. Occurrence of one of the reset sources may trigger several other reset sources as essential parts of the system are undergoing reset. This field will report the root cause of the reset (not the other resets that are consequence of the system reset). To support this feature, the actual register is not captured before the reset source is being released. If a new reset source is triggered within a window of four 32-kHz periods after the previous reset source has been released, the RESET_SRC register field can indicate power-on reset as the source regardless of the actual reset source.

**Workaround:** None

## Advisory 07 — *Temporary Loss of Receive Function During Continuous Receive Operation Over Long Periods of Time*

**Revision(s) Affected:** F, G

**Details:** The CC2640R2F BLE modem has a mismatch in the data rates between two modules. If a CC2640R2F device operates in continuous receive mode over a long period of time without receiving any packets, the mismatch will cause a temporary loss of proper RF reception on some RF frequencies. This first time of such a temporary loss depends on operating frequency and data rate settings. For BLE channels with 1 Mbps or Coded PHY, the issue will occur no earlier than 2.8 seconds after start of the receiver, and for BLE channels with 2 Mbps PHY, the issue will occur no earlier than 1.4 s after start of the receiver. The only BLE link layer state that allows continuous receive operation of that duration is the scanning state operating on an advertising channel with 1 Mbps or coded PHY. For BLE advertising channels and 1 Mbps or Coded PHY, the issue will occur no earlier than 5.0 seconds after start of the receiver. The problem has been fixed in CC2640R2F SDK 2.20.

**Workaround(s):** Use CC2640R2F SDK 2.20 or higher. Customers using an SDK that pre-dates 2.20 may experience some packet loss unless they limit the scan window to 5 seconds or lower.

## Advisory 08 — *Radio Frequency Error Glitch When Device Switches From IDLE to ACTIVE Mode While Radio is in TX or RX*

**Revision(s) Affected:** F, G

**Details:** If the device switches from IDLE to ACTIVE mode (for example, if the CPU starts executing code) while the radio is transmitting or receiving, it can result in a frequency deviation error in the modulated signal or erroneous signal reception.

**Workaround(s):** Keep the flash ON in IDLE by using the TI Power driver API:
Power_setConstraint(PowerCC26XX_NEED_FLASH_IN_IDLE)

## Advisory 09 — *Slow Transition Across Brown-Out Detect (BOD) Threshold Might Cause the Device to Hang*

**Revision(s) Affected:** F, G

**Details:** For applications using non-rechargeable (primary) battery, the issue described in this advisory would potentially occur only at end-of-life of the battery, and therefore a workaround is not necessary as the battery would anyway need to be replaced, triggering a power-on reset.

If the VDDS supply voltage is held in the BOD threshold region (approximately 1.78 V), the device might on rare occasions end up in a lock-up state. The current draw is approximately 2.25 mA in this state. The device will not exit this state by increasing the VDDS supply voltage above the BOD threshold. To get out of this state, a pin reset must be performed or the VDDS supply voltage must be decreased below the power-on reset (POR) threshold (1.0 V), triggering a POR reset.

The lock-up state is triggered if a brown-out-detect (BOD) event occurs during specific stages of the boot code execution. There are two critical, narrow time windows, each of approximately 10 ns duration, and both of these time windows occur within 100 µs to 1 ms after the reset event that started the boot code execution. Typically, this can happen when the supply voltage is ramped slowly across the BOD threshold. Supply resistance, in combination with device startup current will then pull the VDDS supply voltage below the BOD threshold multiple times as the device turns on and off due to resets.

For Li-Ion and NiMH rechargeable batteries, a first level protection disconnecting the chip VDDS supply would typically prevent the device from entering this state during battery discharge as the device power supply would fall below the POR threshold.

**Workaround(s):** The following workarounds must be implemented:

The specified operating supply voltage range for the device is 1.8 V to 3.8 V. When using rechargeable batteries, the battery protection system must ensure that either:

- The device supply voltage remains at or above the minimum operating supply voltage (1.8 V) once powered on, or
- If the device supply is discharged below the minimum operating supply voltage (1.8 V), the device must be reset (pin or power-on reset) when the supply is charged above the minimum operating supply voltage (1.8 V) again.

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# Revision History

**Changes from Original (September 2018) to A Revision** **Page**

- Updated from Silicon Revision F to Silicon Revision G. ........ 1
- Updated Title. ........ 1
- Updated Package Symbolization and Revision Identification section with Rev G information. ........ 3

## IMPORTANT NOTICE AND DISCLAIMER