

CC2640R2F-Q1 SimpleLink™ Bluetooth® Low Energy Wireless MCU for Automotive Silicon Revision F

This document describes known exceptions to the functional specifications (advisories) for the CC2640R2F-Q1 SimpleLink™ Bluetooth® low energy wireless MCU for automotive applications.

Topic		Page
1	Advisory Matrix	2
2	Nomenclature, Package Symbolization, and Revision Identification	3
3	Silicon Revision F Advisories	4

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
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
RF Core	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-Q1 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.

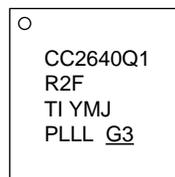


Figure 1. Package Symbolization

Table 2. Revision Identification

DEVICE REVISION CODE	SILICON REVISION
F	2.5

3 Silicon Revision F Advisories

Table 3. Silicon Revision F Advisory List

Title	Page
Advisory 01 —Slave Mode Can Sample New TX Data From SYSBUS Clock Domain Using SSPCLK With No Synchronization	4
Advisory 02 —Motorola® SPI Format Slave Mode Writes to Transmit FIFO Can Lose Data	4
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	5
Advisory 04 —Insufficient Power Supply Recharging When Using the Sensor Controller Can Cause the System to Hang or Force a Pin Reset	6
Advisory 05 —RF Core CPU Can Hang When Running BLE Master Command with High Throughput from Slave to Master	7
Advisory 06 —Wrong Reset Source Indication	7
Advisory 07 —Temporary Loss of Receive Function During Continuous Receive Operation Over Long Periods of Time.	8
Advisory 08 —Radio Frequency Error Glitch When Device Switches From IDLE to ACTIVE Mode While Radio is in TX or RX.....	8
Advisory 09 —Slow Transition Across Brown-Out Detect (BOD) Threshold Might Cause the Device to Hang	9

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

Revision Affected: F

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 Affected: F

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 Affected:

F

Description

The CC2640R2F-Q1 device contains five modules that can read from flash independently of each other. These five modules are:

- ARM® Cortex®-M3
- RF Core
- I2S
- μ DMA
- 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, μ DMA, 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, μ DMA, 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, μ DMA, 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, μ DMA, 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 Affected: F

Details: When the CC2640R2F-Q1 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 Affected:

F

Details:

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

- i. 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).
- ii. The master then received a packet with the MD header field set to 1 and CRC OK.
- iii. 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).
- iv. 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 Affected:

F

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

Details: The CC2640R2F-Q1 BLE modem has a mismatch in the data rates between two modules. If a CC2640R2F-Q1 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

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**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 μ s 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.

Trademarks

SimpleLink, Texas Instruments are trademarks of Texas Instruments.
 ARM, Cortex are registered trademarks of ARM Ltd.
 Bluetooth is a registered trademark of Bluetooth SIG.
 Motorola is a registered trademark of Motorola Trademark Holdings, LLC.
 All other trademarks are the property of their respective owners.

Revision History

Changes from A Revision (October 2017) to B Revision	Page
• In Table 1 , added Advisory 07, Advisory 08, and Advisory 09	2
• Added last paragraph to Advisory 04	6
• Added Advisory 07	8
• Added Advisory 08	8
• Added Advisory 09	9

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2018, Texas Instruments Incorporated