Texas Instruments

Silicon Errata
SWRZ100–June 2020

CC2640R2L SimpleLink™ Bluetooth® 5.1 Low Energy Wireless MCU Silicon Revisions F, G

This document describes known exceptions to the functional specifications (advisories) for the CC2640R2L SimpleLink™ *Bluetooth®* low energy wireless MCU.

Contents

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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
System level	Advisory 04 — RF Core CPU Can Hang When Running BLE Master Command with High Throughput from Slave to Master	Yes
Register value	Advisory 05 — Wrong Reset Source Indication	Yes
System level	Advisory 06 — Temporary Loss of Receive Function During Continuous Receive Operation Over Long Periods of Time	Yes
System level	Advisory 07 — Radio Frequency Error Glitch When Device Switches From IDLE to ACTIVE Mode While Radio is in TX or RX	Yes
System level	Advisory 08 — 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, CC2640R2L 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.

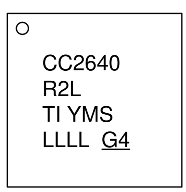

Figure 1. Package Symbolization

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 CC2640R2L revision F.
   - **HWREV_3_1** is returned for CC2640R2L revision G.

2. SmartRF™ Studio:
   - When connecting to a CC2640R2L device, the version number will appear in the lower-left corner (see Figure 2).
   - Customers can also read out the chip revision using SmartRF™ Studio.

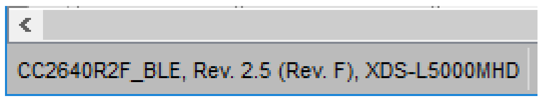

Figure 2. Device Identification with SmartRF™ Studio

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 CC2640R2L 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 — *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 05 — *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 06 — *Temporary Loss of Receive Function During Continuous Receive Operation Over Long Periods of Time*

Revision(s) Affected: F, G

Details: The CC2640R2L BLE modem has a mismatch in the data rates between two modules. If a CC2640R2L 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 CC2640R2L SDK 2.20.

Workaround(s): Use CC2640R2L 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 07 — *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 08 — *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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