

Using an External 32 kHz Clock to Drive a CC254x Chip

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ABSTRACT

The purpose of this application report is to show how an external CMOS clock can be connected to the crystal pins of the CC2540/41 chip. Note that the results presented in this document are intended as a guideline only.

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1 Introduction

The CC254x family of devices has two types of 32.768 kHz oscillator: an RC oscillator and a crystal oscillator. The RC oscillator requires less current and no external crystal. However, it has lower accuracy than the crystal oscillator.

The *Bluetooth*[®] low energy timing accuracy requirements means that the RC oscillator cannot be used if the CC2540/41 chips were to be used with power modes. Hence, a crystal oscillator is used. However, there is an approach by which an external 32 kHz clock can be used to drive the crystal oscillator. Thereby, allowing you to get rid of the 32.768kHz crystal.

2 Application Circuit

When driving the CC2540/41 with an external 32.768 kHz clock, make sure to capacitively couple the external clock signal to the P2_3/XOSC32K_Q2. Ground the P2_4/XOSC32K_Q1 pin via cap C321. For more details, see [Table 1](#).

Table 1. Capacitors Used for Driving CC2540/41 With an External Clock

Component	Description	Value
C331	32-kHz clock AC couple capacitor	100 nF
C321	Grounding capacitor for XOSC32K_Q1 pin	100 pF

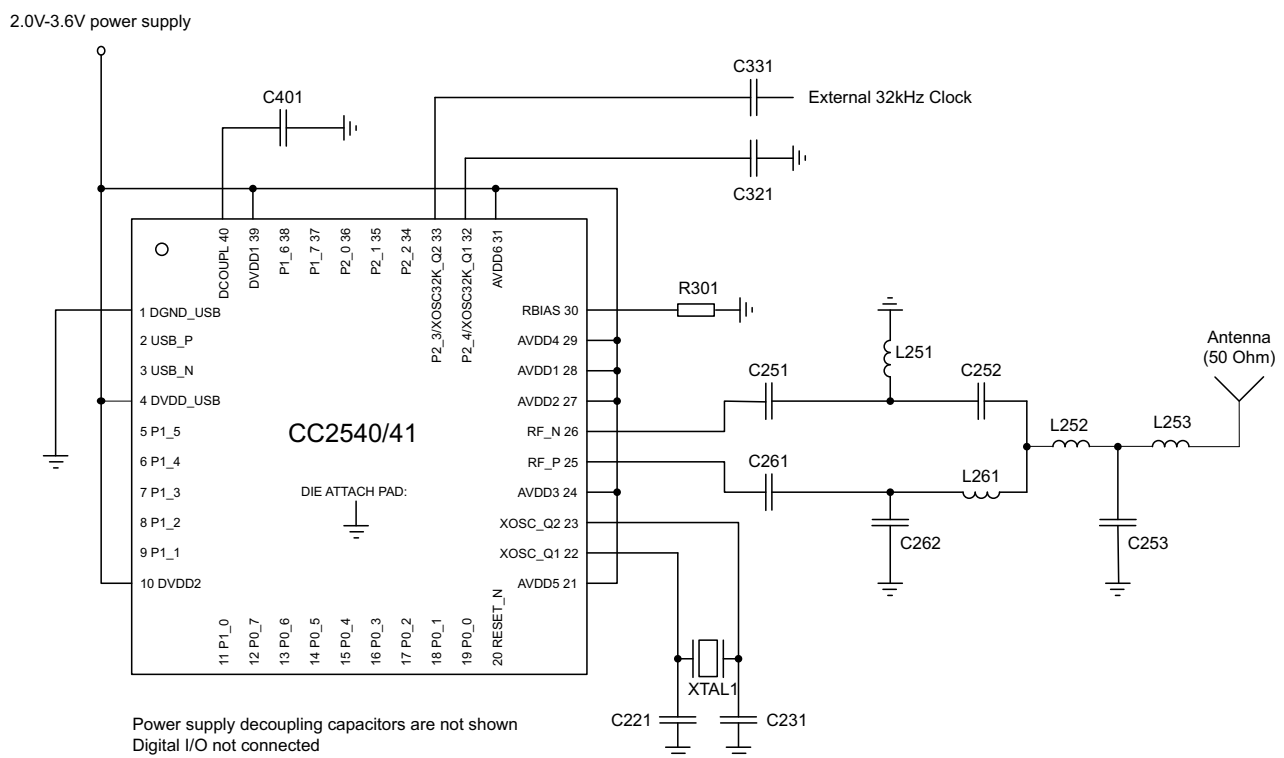


Figure 1. Application Circuit

3 Clock Signal Requirements

There are two recommended alternatives for driving the crystal oscillator from an external clock source. Either a 0 – VDD signal can be used, or alternatively a signal with lower amplitude. The requirements for these signals are shown in the table below. If generating a lower amplitude signal through a resistive divider it is recommended to keep the total resistance in the range 50kΩ – 100kΩ.

The clock signal duty cycle should be 50%. While square wave signal is typically used, it is not a requirement, and it is not a problem using a more sinusoidal clock signal.

The clock requirement applies to the signal before the AC couple capacitor, C331, as shown in [Figure 1](#). When using a lower amplitude clock signal, the oscillator will apply a DC bias which can be observed by measuring on the Q2 pin. This bias level will vary with operating conditions, but will typically be around 0.55 V, as can be seen in [Figure 3](#).

From the application circuit shown in [Figure 1](#), the 32.768 kHz crystal oscillator circuit operation is verified by simulating the conditions where the XOSC32K_Q2 pin is driven with the clock through C331. [Figure 2](#) shows the external and internal clock when the clock signal amplitude is equal to the supply voltage, in this case 3.0 V. [Figure 3](#) shows the external and internal clock as well as the signal on the Q2 pin. The input clock signal amplitude is 300 mV, and the simulation is performed over operating conditions (temperature = -40°C, 25°C and 85°C; supply voltage = 2.0 V, 3.0 V and 3.6 V) and process variations.

Table 2. Clock Signal Requirements

Amplitude	Either	Operating Range: 0 – VDD
	Or	Operating Range: 0 – 200/400 mV
		Absolute min/max (as defined in data sheet): -0.3 V / VDD + 0.3 V
Duty Cycle		min: 45%, max: 55%

Figure 2 and Figure 3 show the oscillator functioning when the external clock is applied to the XOSC32K_Q2.

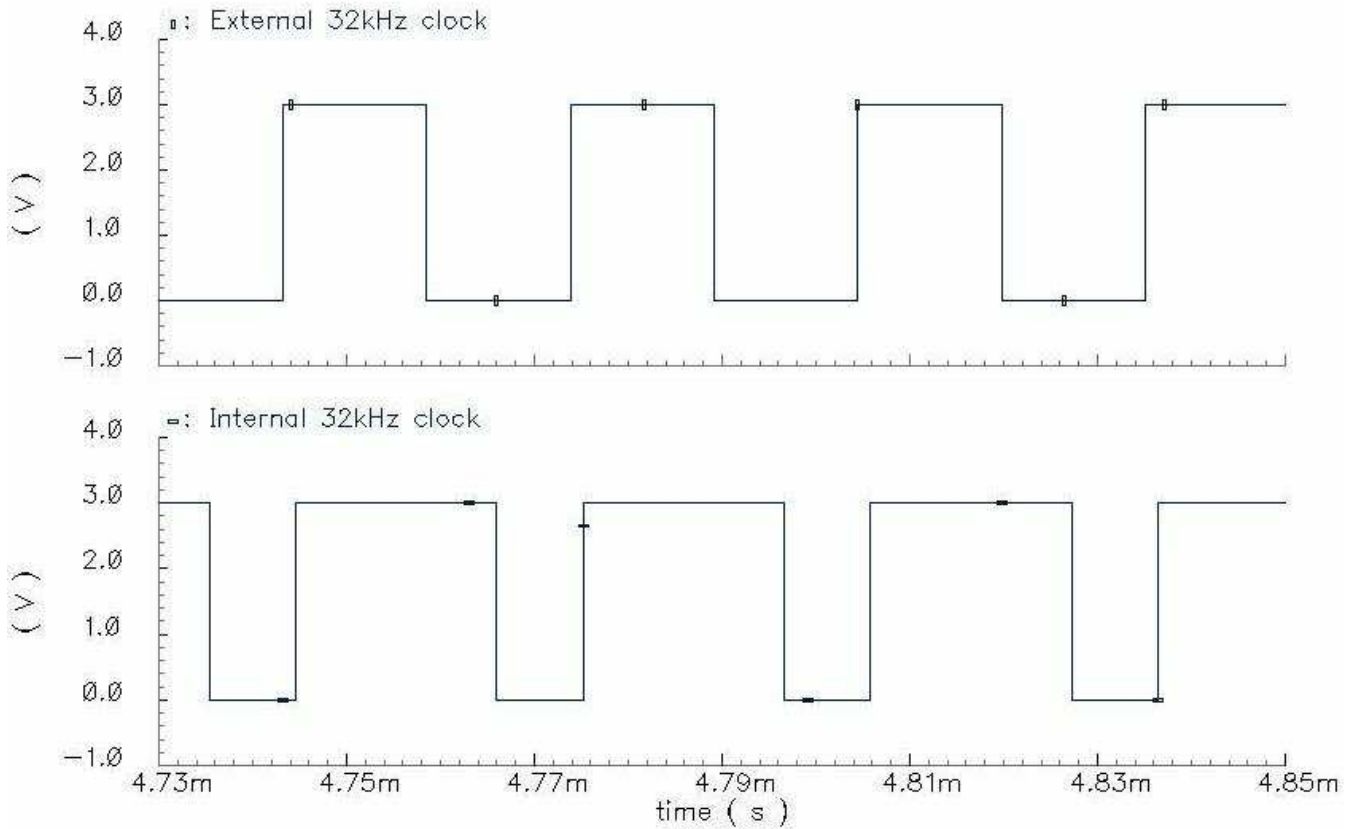


Figure 2. 32.768 kHz Oscillator Functioning When Driven Using an External Clock

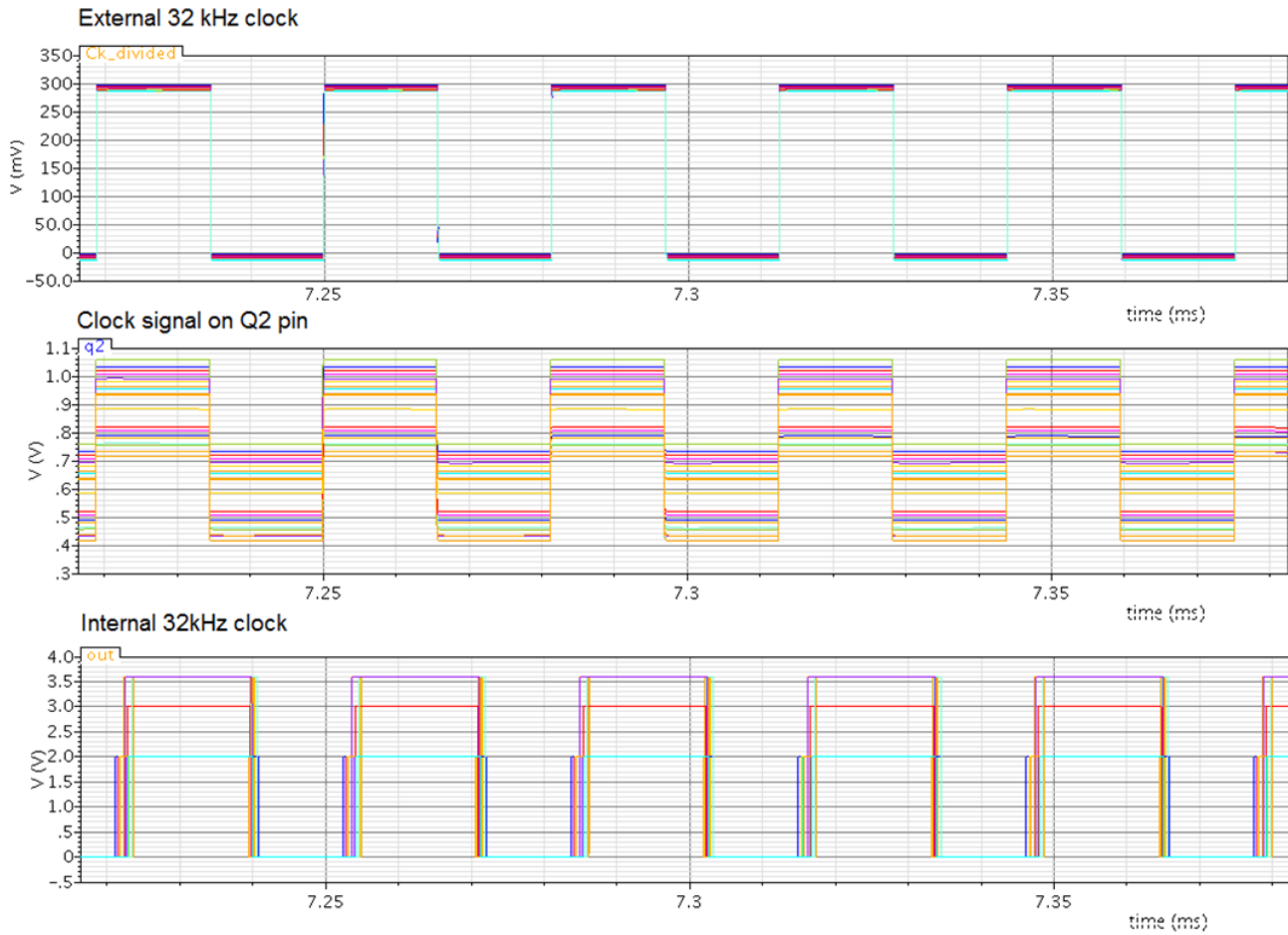


Figure 3. 32.768 kHz Oscillator Functioning When Driven Using an External 0 – 300 mV Clock Over Various Operating Conditions

4 References

- *CC2540F128, CC2540F256 2.4-GHz Bluetooth® low energy System-on-Chip Data Sheet (SWRS084)*
- *CC2541 2.4-GHz Bluetooth™ low energy and Proprietary System-on-Chip Data Sheet (SWRS110)*
- *CC253x System-on-Chip Solution for 2.4-GHz IEEE 802.15.4 and ZigBee® Applications User's Guide (SWRU191)*

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (August 2012) to A Revision	Page
• Updates were made to Section 3	3

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