XCalibur Active MEMS Resonator

Frequently Asked Questions

1. Introduction

This document provides a list of frequently asked questions (FAQs) when replacing a 4-pin XTAL resonator with an SiT14xx XCalibur™ active MEMS resonator from SiTime. This FAQ should be used as a companion to application note AN10080 SiT14xx XCalibur Active MEMS Resonator MCU Requirements.

2. General Hardware

2.1. How does the footprint of a SiT14xx active resonator compare to a 4-pin SMD XTAL resonator?

Figure 1 shows a comparison of the XCalibur footprint compared to a 4-pin resonator.

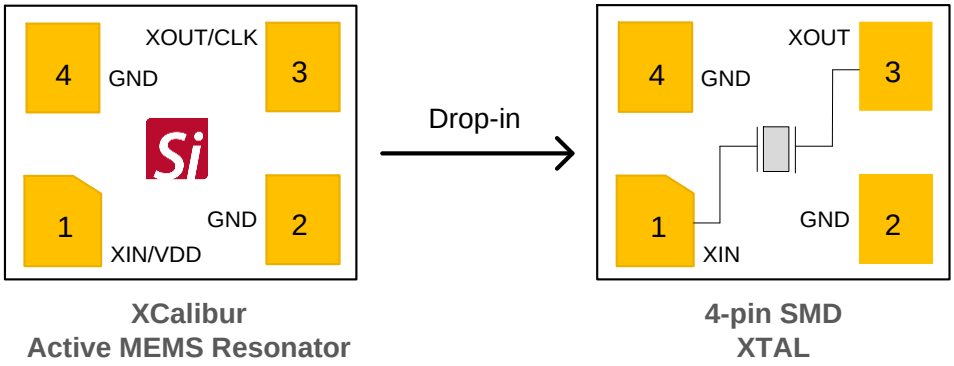

Figure 1: XCalibur Active MEMS Resonator compared with 4-Pin SMD XTAL (TOP View)

2.2. What is an active MEMS resonator?

An active resonator is a resonator based on micro-electro mechanical systems (MEMS) technology that will need a power source to generate an output.

2.3. What are the available packages for SiT14xx active resonators?

Industry-standard 3225 and 2520 SMD packages.

2.4. Can I replace a 2-pin crystal resonator with 4-pin XCalibur resonator?

No. The 2-pin PCB landing pads needs to be re-designed for the 4-pin footprint of SiT14xx.

2.5. The X1/X2 pins or XIN/XOUT functions are swapped on my MCU. Can I use XCalibur in this scenario?

Yes. You can rotate the package 180 degrees so that pins 1 and 3 and 2 and 4 are swapped on the landing pads such that the XIN/XOUT functions are mated correctly with the MCU.

2.6. What is analog mode in an MCU?

Analog mode refers to the mode that enables an internal Pierce oscillator that supports an external XTAL-Resonator.

2.7. What is digital mode in an MCU?

Digital mode refers to a mode of operation in an MCU that uses an external oscillator. When in digital mode, the MCU also enables XIN as a GPIO and can provide power to GPIO.

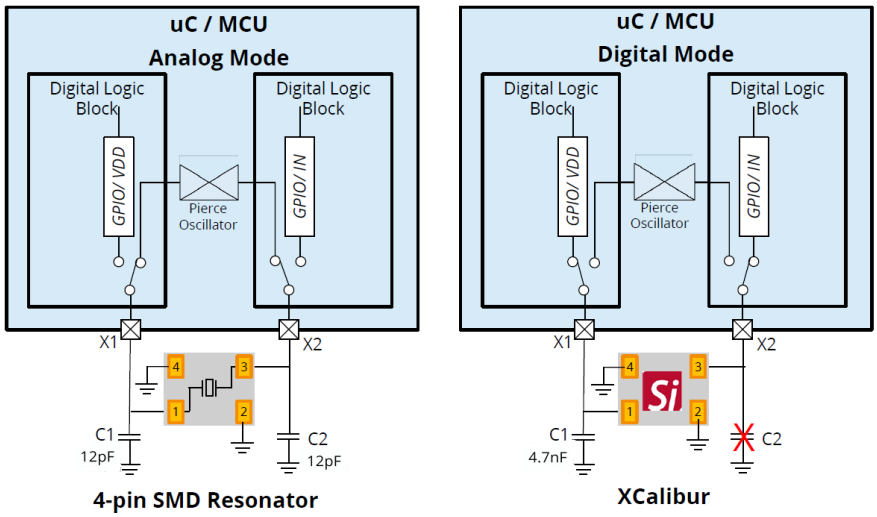

Figure 2: MCU in Analog Mode with Pierce Oscillator (left), and Digital Mode with GPIO Enabled (right)

3. Software

3.1. Is there any firmware change required after replacing a XTAL resonator?

Yes. A firmware change is required to enable GPIO to provide power and to setup the MCU to operate from an external oscillator.

4. Electrical

4.1. What power supplies are supported?

SiT14xx supports two supplies:

- 1.8 V fixed
- 2.25 V to 3.63 V variable

4.2. What is the current requirement for XCalibur?

SiT14xx requires a minimum 6 mA of current (includes 2 mA of margin above steady state).

4.3. Do I need to replace the 12 pF loading capacitors used in a 4-pin XTAL SMD design?

- Yes. The loading capacitor on X1/XIN must be replaced with a 4.7 nF cap.
- The loading cap on X2/XOUT must be removed.

4.4. Why is a 4.7 nF capacitor used on XIN?

A 4.7 nF decoupling cap is used to filter noise on GPIO power for better performance.

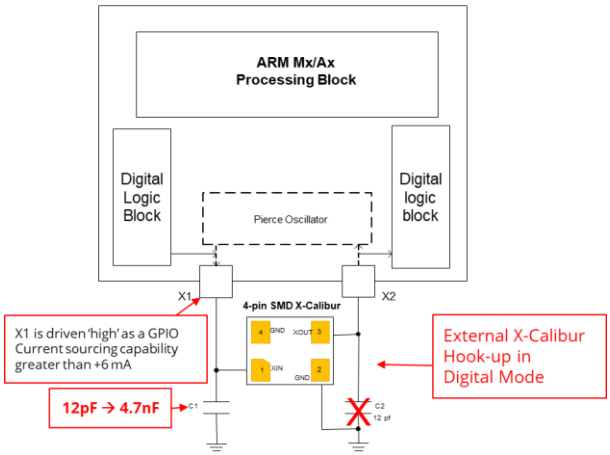

Figure 3: MCU Decoupling Cap on GPIO (X1/XIN)

4.5. My MCU cannot provide power (as GPIO) over X1/XIN. Can I still use XCalibur?

Yes, if you can provide an alternative source of power to SiT14xx.

4.6. Can I use a larger (47 nF) decoupling capacitor instead of recommended 4.7 nF value?

- No. A 4.7 nF decoupling cap is sufficient and a larger value capacitor is not recommended.
- The decoupling cap minimizes power supply fluctuations and filters out power supply noise due to external influences. Adding a decoupling capacitor to a circuit introduces a charge and a discharge current during power-up (rising edge) and power-down (falling edge) of the GPIO output (Figure 4).

- A larger 47 nF (instead of 4.7 nF) capacitor will increase this current on power-up and power-down.

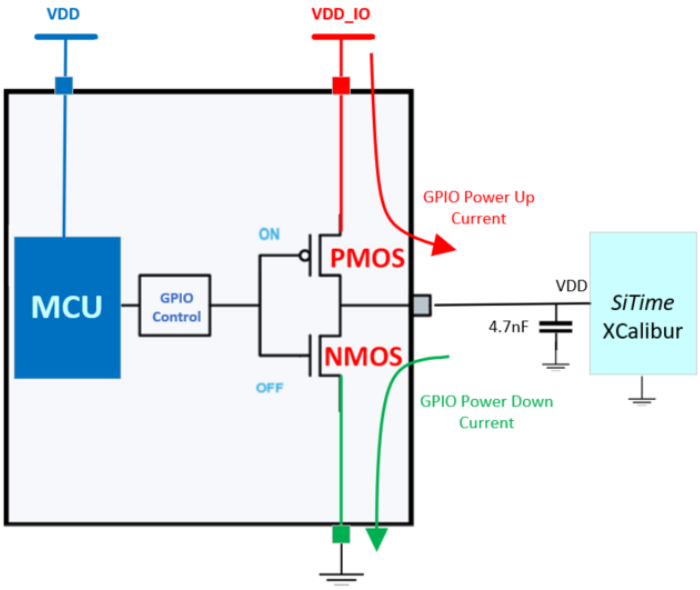

Figure 4: MCU Push-Pull Output Voltage and Current Path

5. Limitations FAQ

5.1. Can an XCalibur active resonator be used with any MCU?

No. Please refer to Appendix A: MCU Compatibility List and Appendix B: Incompatible MCU List.

6. Appendix A: MCU Compatibility List

The following compatibility list has been compiled based on information obtained from each MCU datasheet. Please contact the SiTime support team for the latest update to this list.

Table 1: XCalibur MCU Compatibility (Based on Datasheet)

Manufacturer	MCU Type	MCU Series	MCU PN	XCalibur Compliant Based on Datasheet (with Sample Code *)
ST-Micro	ARM	STM32F	STM32F303RET6	**Yes***
ST-Micro	ARM	STM32G STM32G0	STM32G081xB STM32G474xB	**Yes**
ST-Micro	ARM	STM32H	STM32H742xI/G	**Yes**
ST-Micro	ARM	STM32L0 STM32L1 STM32L4 STM32L4+ STM32L5	STM32L010RB STM32L151xE STM32L471xx STM32L4R5xx STM32L562xx	**Yes**
ST-Micro	ARM	STM32U	STM32U585xx	**Yes**
Microchip (Atmel)	ARM	ATSAME54	ATSAME54P20	**Yes***
TI	ARM	MSP432	MSP432P4111P	**Yes***
Renesas	ARM	S5D9	R7FS5D97E3A01CFC	**Yes***
NXP	ARM	S32K1xx	S32K146	**Yes***
Infineon (Cypress)	ARM	PSoC4-BLE	CY8C4248LQI-BL583	**Yes**
Microchip	CISC	PIC18	PIC18LF46K22T-I/ML	**Yes**

7. Appendix B: Incompatible MCU List

The following MCUs are not compatible as a drop-in replacement for XCalibur resonators. Please contact the SiTime support team for the latest update to this list.

Table 2: Incompatible MCU List (Based on Datasheet)

Manufacturer	Grade	MCU Series	MCU PN	XCalibur Compliant
ST-Micro	Commercial	STM32WB STM32WL		**No**
ST-Micro	Auto	SPC5	SPC58EC80E5	**No**
Infineon	Auto	TC3xx(Aurix)	SAK-TC375TP-96F300W	**No**
Infineon	Industrial	XMC4000		**No**
TI	Auto	CC2642R-Q1	CC2652R1FRGZ	**No**
Renesas	Commercial	RL78/G13	R5F100LEAFB	**No**
NXP	Commercial	LPC11U68	LPC11U68JBD100	**No**
NXP	Auto	S32G	S32G2	**No**
Cypress	Auto	PSoC4-BLE	CY8C4248LQI-BL583	**No**
SiLabs	Commercial	EFM32G	EFM32G890F128	**No**
Renesas	Automotive	RH-850/D1L2	R7F701422	**No**

Table 3: Revision History

Version	Release Date	Change Summary
0.1	28-Dec-2021	Initial Release