CCU_Clock_1
for KIT_AURIX_TC334_LK
Clock configuration via CCU
Scope of work

The clock system is configured based on a PLL frequency of 200 MHz and the clock signal is provided at an external port pin.

The Clock Control Unit (CCU) is used to configure the PLL clock. This clock signal is routed to an external clock output pin, which can be observed with an oscilloscope.
Introduction

- The Clock Control Unit (CCU) controls the clock system and contains different blocks:
  - Basic clock generation
  - Clock speed upscaling
  - Clock distribution
  - Individual clock configuration

- The Clock Generation Unit (CGU) is part of the CCU and allows a flexible clock generation

- Phase Lock Loops (PLLs) are provided for upscaling the clock frequency from an internal or external oscillator

- The System Peripheral Bus (SPB) is used to enable the Fractional Divider (FDR) to divide the source clock

Note: For backward compatibility, some of the registers and functions have the prefix „SCU“ (System Control Unit). In AURIX™ TC2xx, the clocking system was a part of the System Control Unit.
Hardware setup

This code example has been developed for the board KIT_A2G_TC334_LITE.

An oscilloscope is needed to observe the clock at the pin P23.1. Connect the clock and the ground to the oscilloscope.
Configuring Clock Control Unit

Configuration of the Clock Control Unit (CCU) is done once in the setup phase by calling the initialization function `initCcuClock()`, which contains the following steps:

› Create an instance of the `IfxScuCcu_Config` structure which contains the CCU configuration
› Initialize the configuration by calling the iLLD function `IfxScuCcu_initConfig()`
› Set the PLL dividers (N, P, K2) to get the desired PLL frequency (see page 6) (the desired frequency is 200 MHz for this example)
› Initialize the CCU with the iLLD function `IfxScuCcu_init()`
› Set SPB frequency to the desired value by calling the function `IfxScuCcu_setSpbFrequency()` (SPB frequency is 100 MHz for this example)

The `initCcuClock()` function is contained in the `CCU_Clock.h`, while the other functions are part of the iLLD header `IfxScuCcu.h`. 
Implementation

PLL divider calculation example

The PLL frequency \( f_{\text{pll0}} \) is defined according to the following formula:

\[
f_{\text{pll0}} = \frac{f_{\text{osc}} \times N}{K2 \times P}
\]

where the oscillator’s frequency \( f_{\text{osc}} \) is 20 MHz (dependent on hardware).

In this example \( f_{\text{pll0}} = 20 \) MHz, therefore \( \frac{N}{K2 \times P} = 20 \). To obtain this value, \( N \) should be set to 20, \( P \) to 1 and \( K2 \) to 2 (\( P = 1 \) and \( K2 = 2 \) are the defaults values).

**Note:** For selecting appropriate values for the dividers, please consult the User Manual.
Configuring the Clock output

Configuration of the clock output is done once in the setup phase by calling the initialization function `configOutputCcuClock()`, which contains the following steps:

- Call the iLLD function `IfxScuWdt_clearSafetyEndinitInline()` to disable the Safety Endinit protection in order to modify the SCU register.
- Set `SCU_CCUCON0.B.CLKSEL` to 0x1 to select the clock source.
- Set `SCU_EXTCON.B.EN0` and `SCU_EXTCON.B.SEL0` to enable and select output frequency ($f_{OUT}$) as external source ($SCU_EXTCON.B.EN0 = 0x1$, $SCU_EXTCON.B.SEL0 = 0x0$).
- Set `SCU_FDR.B.STEP` to the desired reload value (see page 9) and `SCU_FDR.B.DM` to choose the normal divider mode.
- Call the iLLD function `IfxScuWdt_setSafetyEndinitInline()` to re-enable the Safety Endinit protection.

The functions `IfxScuWdt_clearSafetyEndinitInline()` and `IfxScuWdt_setSafetyEndinitInline()` are contained in iLLD header `IfxScuWdt.h`. 
Implementation

Configuring the port pin

Configuration of the port pin is done as well in the function `configOutputCcuClock()` with the following steps:

› Call the iLLD function `IfxPort_setPinMode()` with `IfxPort_Mode_outputPushPullAlt6` as parameter to select CCU external clock as output

› Set pin pad driver to increase pin’s speed by calling the iLLD function `IfxPort_setPinPadDriver()` and setting `IfxPort_PadDriver_cmosAutomotiveSpeed1` as parameter

The functions `IfxPort_setPinMode()` and `IfxPort_setPinPadDriver()` are contained in iLLD header `IfxPort.h`.
Implementation

Step Value calculation example

The Step Value in normal divider mode is defined according to the following formula:

\[
f_{OUT} = \frac{f_{SPB} \times \frac{1}{n}}{2}, \text{ with } n = 1024 - \text{Step}
\]

Therefore,
\[
\text{Step} = 1024 - \frac{f_{SPB}}{2 \times f_{OUT}}
\]

In this example, the desired external frequency value \( f_{OUT} \) is 1 MHz, and \( f_{SPB} \) is 100 MHz.
After calculation, the Step Value is 974 (0x3CE).
Run and Test

After code compilation and flashing the device, perform the following steps:

› Connect the oscilloscope to the board via port pin P23.1 and ground

› Observe the desired clock on the oscilloscope's screen

<table>
<thead>
<tr>
<th>Channel</th>
<th>Name</th>
<th>Value</th>
<th>Min</th>
<th>Max</th>
<th>Average</th>
<th>Ï</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Frequency</td>
<td>999.9 kHz</td>
<td>999.9 kHz</td>
<td>1 MHz</td>
<td>999.9 kHz</td>
<td>57.27 Hz</td>
</tr>
</tbody>
</table>
References

› AURIX™ Development Studio is available online:
  › [https://www.infineon.com/aurixdevelopmentstudio](https://www.infineon.com/aurixdevelopmentstudio)
  › Use the „Import...“ function to get access to more code examples.

› More code examples can be found on the GIT repository:
  › [https://github.com/Infineon/AURIX_code_examples](https://github.com/Infineon/AURIX_code_examples)

› For additional trainings, visit our webpage:
  › [https://www.infineon.com/aurix-expert-training](https://www.infineon.com/aurix-expert-training)

› For questions and support, use the AURIX™ Forum:
IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer’s compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer’s products and any use of the product of Infineon Technologies in customer’s applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer’s technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies’ products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.