GPT12_PWM_Generation_1 for KIT_AURIX_TC275_LK

Generation of PWM via GPT12

AURIX™ TC2xx Microcontroller Training
V1.0.0

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Scope of work

A pulse width modulated (PWM) signal with fixed frequency and a defined duty cycle is generated using GPT12.

The timer T3 of GPT1 is used in timer mode with its count direction configured to “down-counting”. On underflow of timer T3, the Output Toggle Latch (T3OTL) is toggled and the value of timer T2 or T4 is transferred into timer T3 depending on T3OTL value. The state of an LED is toggled in an interrupt service routine which is triggered by the timer T3.

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Introduction

- The General Purpose Timer Unit (GPT12) is made of two GPT blocks (GPT1 and GPT2)
- Each block has a multifunctional timer structure which incorporates several 16-bit timers
- Block GPT1 contains three timers: the core timer T3 and two auxiliary timers T2 and T4
- All three timers of block GPT1 can run in one of four modes: Timer Mode, Gated Timer Mode, Counter Mode or Incremental Interface Mode

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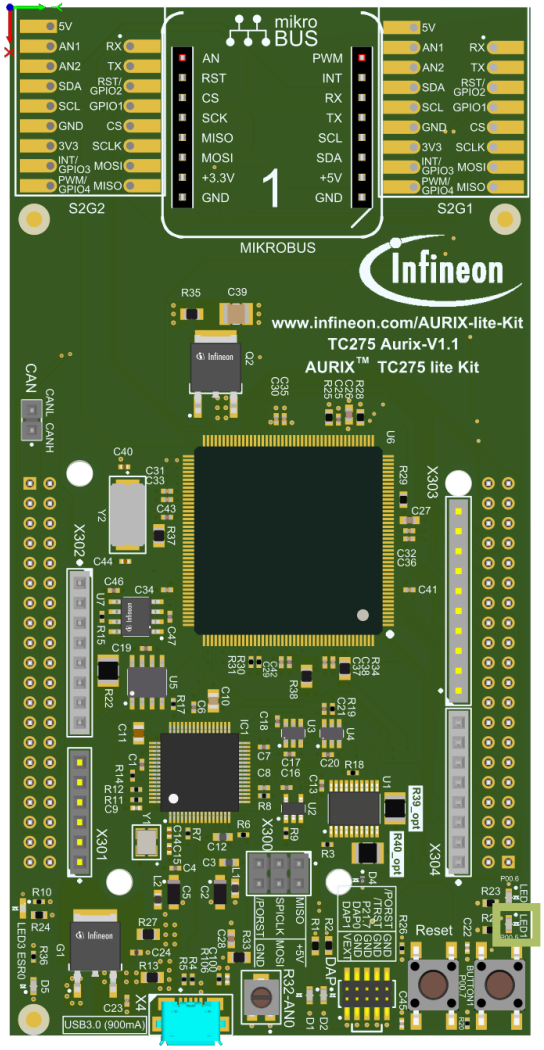
Hardware setup

This code example has been developed for the board KIT_AURIX_TC275_LITE.

LED1 (1) is used for this example.



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Implementation

Configure the GPT12 Module

To generate a PWM signal with the GPT1 block, it is needed to:

- Enable the GPT12 module
- Configure the frequency for the block GPT1 by setting the prescaler value (BPS1) of the divider
- Configure the frequency for the timer T3 by setting the prescaler value (T3I) of the divider
- Configure the timer T3 mode, direction and starting value
- Configure the two auxiliary timers (timer mode, reload input mode and reload values) to reload the timer T3

The above steps are detailed in the following slides.

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Implementation

Configure the GPT12 Module

Configuration of the GPT12 is done once in the function ***initGpt12PWM()*** by the following steps:

- Enable GPT12 module by calling the iLLD function ***IfxGpt12_enableModule()***
- Set GPT1 prescaler with the iLLD function ***IfxGpt12_setGpt1BlockPrescaler()***
- Configure the mode of timer T3 by using the iLLD function ***IfxGpt12_T3_setMode()***
- Set the counting direction of the timer T3 by calling the iLLD function ***IfxGpt12_T3_setTimerDirection()***
- Set the prescaler of timer T3 by calling the iLLD function ***IfxGpt12_T3_setTimerPrescaler()***
- Set the timer value with the iLLD function ***IfxGpt12_T3_setTimerValue()*** and use an ***uint16*** number as parameter

The configuration functions above are provided by the iLLD header ***IfxGpt12.h***.

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Implementation

Reload Values calculation example

Calculating the correct reload value to generate a PWM signal, depending on the given frequency f and duty cycle, is done in the initialization function ***initGpt12PWM()***:

- Get the GPT12 module base frequency f_{GPT} by calling the iLLD function ***IfxGpt12_getModuleFrequency()***
- Calculate the timer frequency with the following formula:

$$f_{timer} = \frac{f_{GPT}}{\textbf{GPT1_BLOCK_PRESCALER} \times \textbf{TIMER_T3_INPUT_PRESCALER}}$$

The GPT1 block prescaler is set to ***IfxGpt12_Gpt1BlockPrescaler_32***, f_{GPT} is divided by **32**
The timer prescaler is set to ***IfxGpt12_TimerInputPrescaler_32***, f_{GPT} is divided by **32**

- Calculate ***dutyUpTime*** and ***dutyDownTime*** with the following formulas:

$$\boldsymbol{dutyUpTime} = \frac{f_{timer} \times \frac{dutyCycle}{100}}{f} \qquad \boldsymbol{dutyDownTime} = \frac{f_{timer} \times \left(1 - \frac{dutyCycle}{100}\right)}{f}$$

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Implementation

Configuring timers T2 and T4 to enable the reload of timer T3

Configurations of timers T2 and T4 are done once in the function ***initGpt12Timer()*** by the following steps:

- Configure timers T2 and T4 in reload mode by using the iLLD function ***IfxGpt12_T2_setMode()*** and ***IfxGpt12_T4_setMode()***
- Set the trigger event for reload of timer T3 by using the iLLD functions ***IfxGpt12_T2_setReloadInputMode()*** and ***IfxGpt12_T4_setReloadInputMode()***
- Set timer T2 value with the iLLD function ***IfxGpt12_T2_setTimerValue()*** and ***dutyDownTime*** as parameter
- Set timer T4 value with the iLLD function ***IfxGpt12_T4_setTimerValue()*** and ***dutyUpTime*** as parameter

Starting timer T3

Finally, starting the timer T3 is done in the function ***runGpt12PWM()*** by calling the iLLD function ***IfxGpt12_T3_run()***.

The above functions are provided by the iLLD header ***IfxGpt12.h***.

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Implementation

Configuring the interrupt for GPT12

Configuration of the interrupt is done once in the function ***initGpt12PWM()*** by the following steps:

- Get the address of timer T3 service request with the iLLD function ***IfxGpt12_T3_getSrc()***
- Initialize GPT12 interrupt by calling ***IfxSrc_init()*** with a pointer to the address of the timer T3 service request, the interrupt provider and the interrupt priority number as parameters
- Enable GPT12 interrupt with the iLLD function ***IfxSrc_enable()*** and the pointer to the address of timer T3 service request as parameter

The function ***IfxGpt12_T3_getSrc()*** is provided by the header ***IfxGpt12.h*** and the functions ***IfxSrc_init()*** and ***IfxSrc_enable()*** are provided by the header ***IfxSrc.h***.

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Implementation

Configuring the LED

The LED is configured and toggled by controlling the port pin to which it is connected.

In the setup phase, the port pin is configured as **output push-pull mode** using the function ***IfxPort_setPinModeOutput()***.

The Interrupt Service Routine (ISR)

The ISR implemented in this example calls the iLLD function ***IfxPort_togglePin()*** to toggle the LED‘s state.
The interrupt is triggered every time the timer T3 generates an underflow.
On underflow of timer T3, the Output Toggle Latch (T3OTL) is toggled and the value of timer T2 or T4 is transferred into timer T3 depending on T3OTL value.

Both functions are provided by the iLLD header ***IfxPort.h***.

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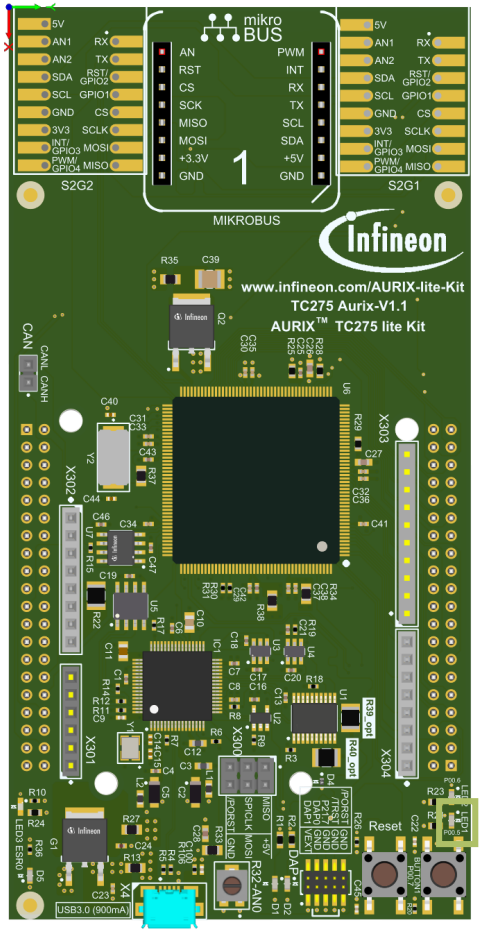
Run and Test

After code compilation and flashing the device, check the following behavior:

- observe the **LED1**, which should be blinking 2 times in a second



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References

- AURIX™ Development Studio is available online:
- 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

- For additional trainings, visit our webpage:
- https://www.infineon.com/aurix-expert-training

- For questions and support, use the AURIX™ Forum:
- https://www.infineonforums.com/forums/13-Aurix-Forum

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Email: erratum@infineon.com

Document reference
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