

GPT12_PWM_Capture_1 for KIT_AURIX_TC275_LK

Capture of PWM signal via GPT12

AURIX™ TC2xx Microcontroller Training
V1.0.0



[Please read the Important Notice and Warnings at the end of this document](#)

Scope of work

The GPT12 unit is used to capture an external PWM signal and calculate the PWM frequency.

GPT12 timers are configured in capture mode. The data from the captured PWM signal is used to calculate the PWM frequency in software. The frequency is then stored in a variable.

Introduction

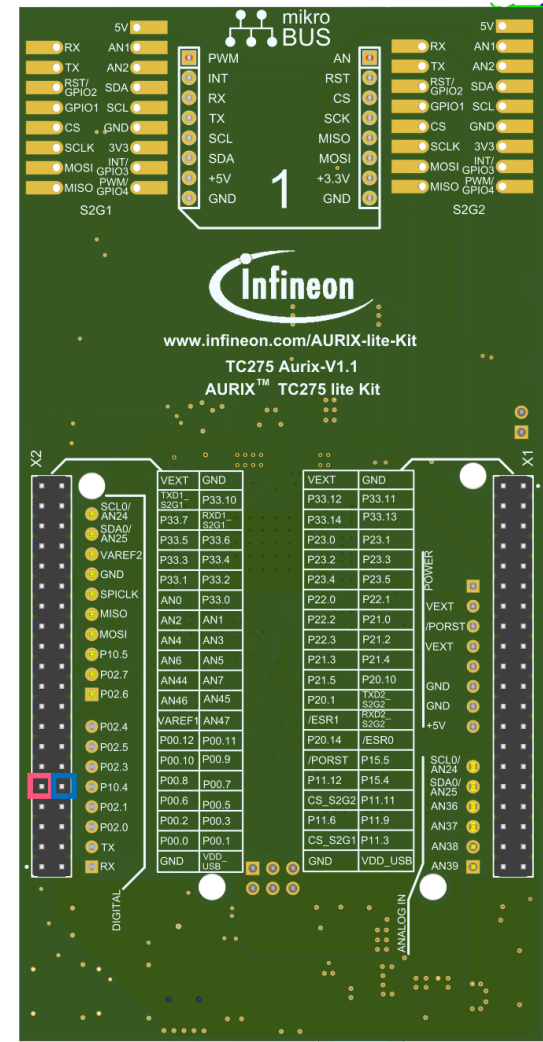
- › The General Purpose Timer Unit (GPT12) is divided into two GPT blocks (GPT1 and GPT2)
- › Both timer blocks incorporate five 16-bit timers which can operate independently in several different modes
- › Block GPT1 contains three timers/counters: the core timer T3 and two auxiliary timers T2 and T4
- › All three timers of block GPT1 can run in Timer, Gated Timer, Counter or Incremental Interface Mode
- › Additionally, timer T2 and T4 can be used as capture or reload registers for the core timer T3
- › In this example, Timer T2 (Capture Mode) captures the value of timer T3 (Timer Mode)

Hardware setup

This code example has been developed for the board KIT_AURIX_TC275_LITE.

Connect the two pins P00.8 (PWM signal) and P00.7 (GPT1 T2 input) to each other.

	X2		
	VEXT	39 40	GND
TXD1_S2G1 - P33.9		37 38	P33.10
	P33.7	35 36	P33.8 - RXD1_S2G1
	P33.5	33 34	P33.6
	P33.3	31 32	P33.4
	P33.1	29 30	P33.2
Potentiometer - AN0		27 28	P33.0
	AN2	25 26	AN1
	AN4	23 24	AN3
	AN6	21 22	AN5
	AN44	19 20	AN7
	AN46	17 18	AN45
VAREF1		15 16	AN47
P00.12		13 14	P00.11
P00.10		11 12	P00.9
	P00.8	9 10	P00.7 - Button1 PWM signal
LED2 - P00.6		7 8	P00.5 - LED1
	P00.2	5 6	P00.3
TXDCAN - P00.0		3 4	P00.1
	GND	1 2	VDD_USB



Implementation

Configuration of the GPT12 Module

The function ***init_GPT12_module()*** is used to configure the two timers T2 and T3 of block GPT1 in Capture Mode, respectively Timer Mode. It contains the following steps:

- › Enable GPT12 module by calling the function ***IfxGpt12_enableModule()***
- › Set the GPT1 prescaler with ***IfxGpt12_setGpt1BlockPrescaler()***
- › The functions ***IfxGpt12_T3_setMode()*** and ***IfxGpt12_T2_setMode()*** are called to configure the modes of both timers by using the enumerated values ***IfxGpt12_Mode_timer*** and ***IfxGpt12_Mode_capture***
- › Select port pin P00.7 (the James Bond pin) with the parameter ***IfxGpt12_Input_A*** and the function ***IfxGpt12_T2_setInput()***
- › The capture event is configured to be on the rising edge of the input pin with the function ***IfxGpt12_T2_setCaptureInputMode()***
- › ***IfxGpt12_T3_run()*** starts the core timer T3

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

Implementation

Configuring the interrupt service routing for GPT1

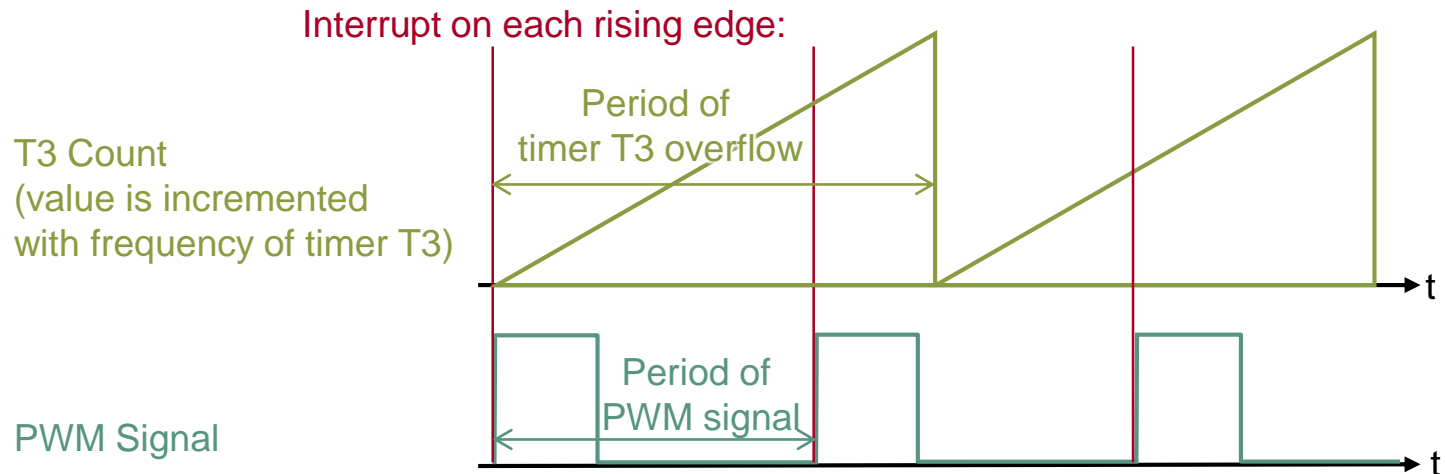
- › The triggering of each interrupt service routine is activated by setting the service provider and the serial priority number in the Service Request Control (SRC) registers of both timers with the functions ***IfxSrc_init()*** and ***IfxSrc_enable()***
- › The pointers to the SRC registers are returned by the functions ***IfxGpt12_T2_getSrc()*** and ***IfxGpt12_T3_getSrc()***
- › The above mentioned functions are provided by the iLLD header ***IfxSrc.h***
- › The method implementing the ISR needs to be assigned a **priority** via the macro ***IFX_INTERRUPT(isr, vectabNum, priority)***

Implementation

The Interrupt Service Routine (ISR)

Each rising edge on the input pin A of timer T2 triggers the ISR:

- › Counter value of T3 is latched automatically to auxiliary timer T2
- › Calculate PWM frequency by dividing the frequency of timer T3 by the total amount of increments of timer T2 (the time between two rising edges)
- › The frequency calculation takes into account that an overflow of timer T3 might occur between two rising edges of the PWM signal (An overflow of timer T3 triggers a second interrupt which is used for counting the overflows between two rising edges)



Implementation

Calculation example

Background knowledge:

- › Maximum value of timer T3 is **65535** (16 bit)
- › Frequency of GPT12 module is 100 MHz
- › Prescaler of GPT1 block is set to 4
- › Timer T3 frequency is $100 \text{ MHz} / 4 = \mathbf{25 \text{ MHz}}$.
Which means the value of timer T3 will be incremented every **40 ns** ($1 / 25 \text{ MHz}$)
- › Overflow of timer T3 after $\approx \mathbf{0.0026 \text{ s}}$ ($65535 * 40 \text{ ns}$) which equals $\approx 381 \text{ Hz}$
- › The total amount of increments can be calculated by comparing the current value of timer T2 with the value of timer T2 one PWM period ago e.g. **1000**

Implementation

Calculation example

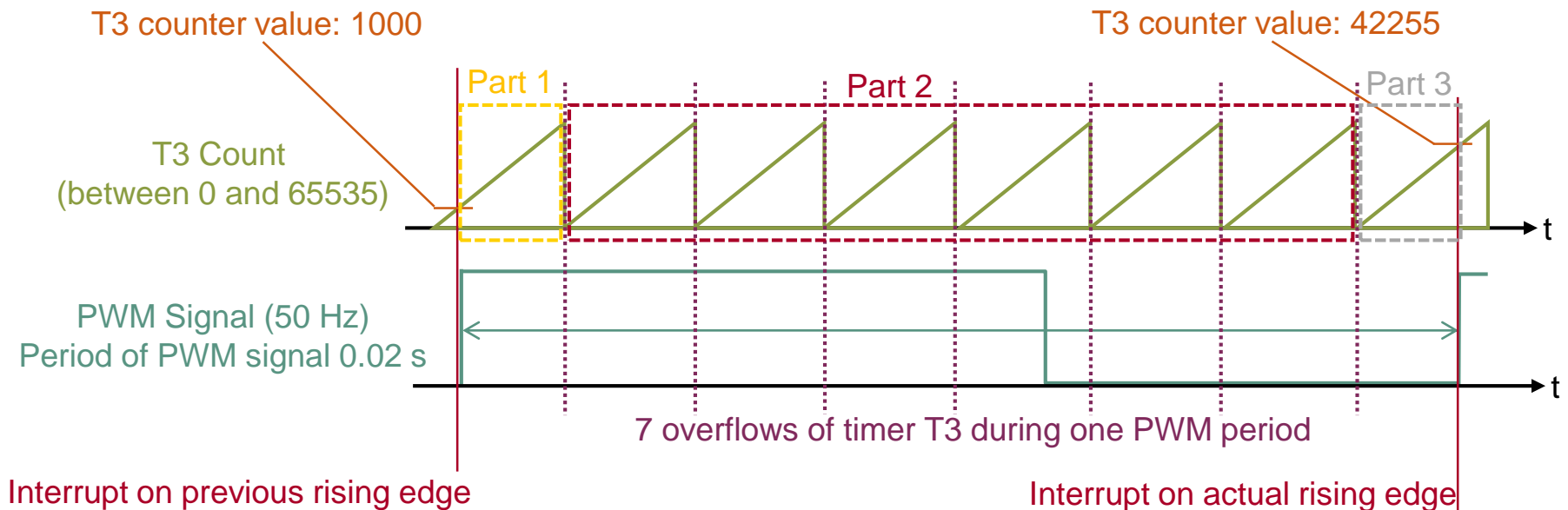
Example for 50 Hz PWM signal:

- › Period time of 50 Hz signal is **0.02 s**
- › Within 0.02 s, the timer T3 is incremented **500000** times ($0.02 \text{ s} / 40 \text{ ns}$) and has 7 overflows
- › Parameters available in the ISR:
 - Counter value of timer T2 one period ago: **1000**
 - Current counter value of timer T2: **42255**
 - Amount of overflows: **7**
- › Calculation of total amount of increments:
 - Increments before first overflow: $65535 - 1000 = \mathbf{64535}$
 - Increments during the second and the last overflow: $(7-1) * 65535 = \mathbf{393210}$
 - Increments after last overflow: **42255**
 - Total amount of increments: $\mathbf{64535} + \mathbf{393210} + \mathbf{42255} = \mathbf{500000}$
- › Calculation of the PWM frequency by dividing the frequency of timer T3 by the total amount of increments during one PWM period:
 - $25 \text{ MHz} / 500000 = \mathbf{50 \text{ Hz}}$

Implementation

Calculation example

- › Part 1: 64535 increments before first overflow: $65535 - 1000 = 64535$
(Max value of T3 – counter value at rising edge = total increments)
- › Part 2: 393210 increments between the second and last overflow:
 $6 * 65535 = 393210$ (6 overflows * max value of T3 = total increments)
- › Part 3: 42255 increments after last overflow: 42255 (counter value at rising edge)
- › Total increments between two rising edges: $64535 + 393210 + 42255 = 500000$



Implementation

Generation of PWM signal

The generation of a simple PWM signal is done by toggling a pin within the function ***generate_PWM_signal()***.

The state of the output port pin P00.8 is toggled by calling the function ***lfxPort_setPinState()*** with the parameters ***lfxPort_State_high*** and ***lfxPort_State_low*** provided by iLLD header ***lfxPort.h***.

The period of the generated PWM signal can be adapted by changing the timeout parameter of the two ***wait()*** function calls (header ***Bsp.h***).

For changing the frequency of the PWM signal the global parameter ***g_generatedPwmFreq_Hz*** can be modified.

The calculation of the two timeout values for toggling the pin state is done by software.

Run and Test

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

1. Connect the two pins P00.8 (PWM signal) and P00.7 (GPT1 T2 input) to each other
2. Check parameter ***g_measuredPwmFreq_Hz*** in the debugger. Its value should be similar to the parameter ***g_generatedPwmFreq_Hz***
3. Change the parameter ***g_generatedPwmFreq_Hz*** and check if ***g_measuredPwmFreq_Hz*** changes accordingly

		X2			
	VEXT	39	40		GND
TXD1_S2G1 -	P33.9	37	38	P33.10	
	P33.7	35	36	P33.8 -	RXD1_S2G1
	P33.5	33	34	P33.6	
	P33.3	31	32	P33.4	
	P33.1	29	30	P33.2	
Potentiometer -	AN0	27	28	P33.0	
	AN2	25	26	AN1	
	AN4	23	24	AN3	
	AN6	21	22	AN5	
	AN44	19	20	AN7	
	AN46	17	18	AN45	
	VAREF1	15	16	AN47	
	P00.12	13	14	P00.11	
	P00.10	11	12	P00.9	
	P00.8	9	10	P00.7 -	Button1 PWM signal
	LED2 -	7	8	P00.5 -	LED1
	P00.2	5	6	P00.3	
TXDCAN -	P00.0	3	4	P00.1	
	GND	1	2	VDD_USB	

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>

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2021-06

Published by

**Infineon Technologies AG
81726 Munich, Germany**

**© 2021 Infineon Technologies AG.
All Rights Reserved.**

**Do you have a question about this
document?**

Email: erratum@infineon.com

Document reference

GPT12_PWM_Capture_1_KIT_TC275_LK

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.