GPT12_PWM_Capture_1 for KIT_AURIX_TC297_TFT

Capture of PWM signal via GPT12

AURIX™ TC2xx Microcontroller Training
V1.0.0

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

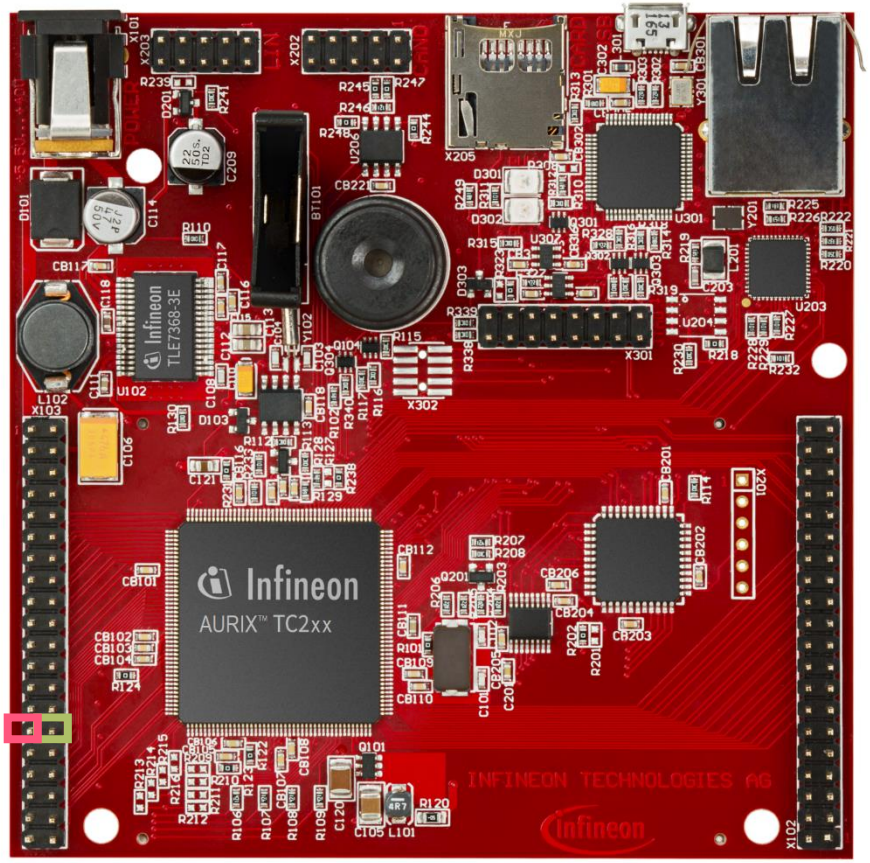
This code example has been developed for the board KIT_AURIX_TC297_TFT_BC-Step.

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

	X103		
VCC_IN	1	2	V_UC(+5V)
GND	3	4	GND
P33.10	5	6	P33.9
P14.8	7	8	P14.7
P14.6	9	10	P10.6
P10.7	11	12	P10.4
P02.0	13	14	P02.1
P02.2	15	16	P02.3
P02.4	17	18	P02.5
P02.6	19	20	P02.7
P02.8	21	22	P00.0
P00.1	23	24	P00.2
P00.3	25	26	P00.4
P00.5	27	28	P00.6
P00.7	29	30	P00.8
P00.9	31	32	P00.10
P00.11	33	34	P00.12
AN45	35	36	AN44
AN17	37	38	AN16
AN25	39	40	AN24

input pin A of timer T2

PWM signal



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

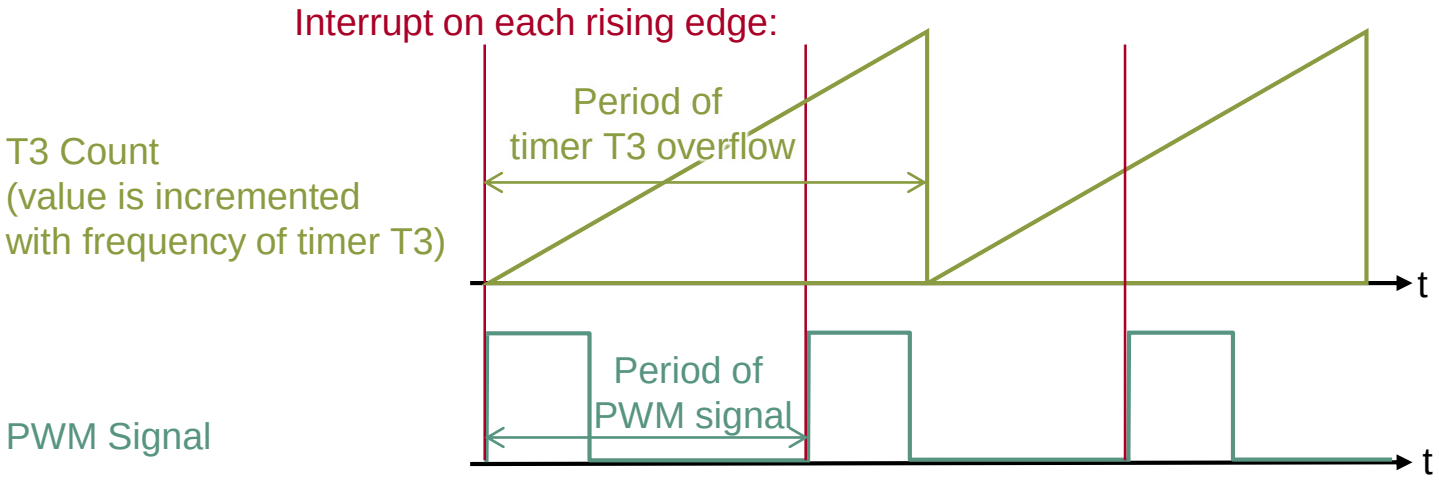
- The triggering of each interrupt service routine is activated by setting the service provider and the serial priority number in the Service Request Control (SRC) registers of both timers with the functions ***IfxSrc_init()*** and ***IfxSrc_enable()***.
- The pointers to the SRC registers are returned 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** and a **CPU core** responsible for its execution. This is done with 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 MHz / 4 = **25 MHz**.
  Which means the value of timer T3 will be incremented every **40 ns** (1 / 25 MHz).
- Overflow of timer T3 after **≈ 0.0026 s** (65535 * 40 ns) which equals ≈ 381 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

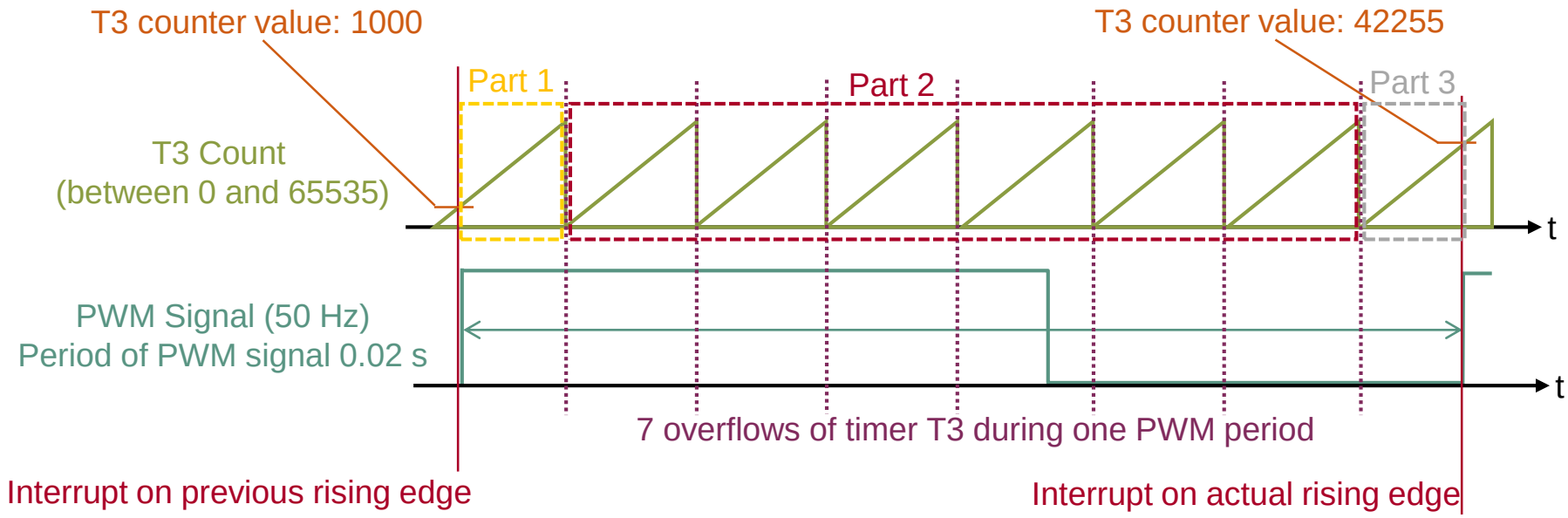
Example for 50 Hz PWM signal:

- Period time of 50 Hz signal is **0.02 s**
- Within 0.02 s, the timer T3 is incremented **500000** times (0.02 s / 40 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 = **64535**
  - Increments during the second and the last overflow: (7-1) * 65535 = **393210**
  - Increments after last overflow: **42255**
  - Total amount of increments: **64535** + **393210** + **42255** = **500000**
- Calculation of the PWM frequency by dividing the frequency of timer T3 by the total amount of increments during one PWM period:
  - 25 MHz / 500000 = **50 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 ***IfxPort_setPinState()*** with the parameters ***IfxPort_State_high*** *and* ***IfxPort_State_low*** provided by iLLD header ***IfxPort.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_generatedPwmFreqHz*** 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_measuredPwmFreqHz*** in the debugger. Its value should be similar to the parameter ***g_generatedPwmFreqHz.***
3. Change the parameter ***g_generatedPwmFreqHz*** and check if ***g_measuredPwmFreqHz*** changes accordingly.

input pin A of timer T2

PWM signal

	X103		
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P00.3	25	26	P00.4
P00.5	27	28	P00.6
P00.7	29	30	P00.8
P00.9	31	32	P00.10
P00.11	33	34	P00.12
AN45	35	36	AN44
AN17	37	38	AN16
AN25	39	40	AN24

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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