Customer training workshop:
HAL_TCPWM_Timer
for KIT_T2G-B-H_EVK

Please read the Important notice and warnings at the end of this document
Scope of work

- This code example generates an interrupt at every second with the Timer driver, and toggles the user LED when a timer interrupt is generated.

- **Device**
  - The TRAVEO™ T2G CYT4BFBC device is used in this code example.

- **Board**
  - The TRAVEO™ T2G KIT_T2G-B-H_EVK board is used for testing.
Introduction

TCPWM has the following features:

- Supports up to four counter groups (device-specific)
- Each counter group consists up to 256 counters (counter group-specific)
- Each counter can run in one of the following seven function modes:
  - Timer-counter with compare
  - Timer-counter with capture
  - Quadrature decoding
  - Pulse width modulation (PWM)/stepper motor control (SMC) for pointer instruments
  - PWM with dead time/three-phase motor control Brushless-DC (BLDC)
  - Pseudo-random PWM
  - Shift register mode
- 16-bit or 32-bit counters (counter group specific)
- Up, down, and up/down counting modes
- Clock prescaling (division by 1, 2, 4, ... 64, 128)
Introduction

TCPWM has the following features:

- Up to two capture and compare functions (counter group specific)
- Double buffering of all compare/capture and period registers
- Two output trigger signals for each counter to indicate underflow, overflow, and capture/compare events; they can also directly be connected with the line output signal
- Supports interrupt on:
  - Terminal count - Depends on the mode; typically occurs on overflow or underflow
  - Capture/Compare - The count is captured in the capture registers or the counter value equals the value in the compare register
- Line out selection feature for stepper motor application including two complementary output lines with dead time insertion
- Selectable start, reload, stop, count, and two capture event signals for each TCPWM with rising edge, falling edge, both edges, and level trigger options
- Each counter with up to 254 (device-specific) synchronized input trigger signals and two constant input signals: '0' and '1'.
Introduction

TCPWM has the following features:

- Two types of input triggers for each counter:
  - General-purpose triggers used by all counters
  - One-to-one trigger for a specific counter
- Synchronous operation of multiple counters
- Debug mode support
Hardware setup

- This code example has been developed for the KIT-T2G-B-H-EVK board.
- Connect your PC to the board using the provided USB cable through the KitProg3 USB connector.
Implementation

› Code example design
  – The timer is configured as 10000-Hz frequency with count up and continuous mode.
    Enable the timer `CYHAL_TIMER_IRQ_TERMINAL_COUNT` interrupt to generate an interrupt for each 1s. Invert the user LED while generating the timer interrupt.

Follow these steps to configure this code example:

› GPIO port pin initialization
› TCPWM initialization
› ISR registration
› Enable TCPWM
› Blink LED
Implementation

**GPIO port pin initialization**
- The `cyhal_gpio_init()` function initializes the GPIO port pin once.
  - Initialize P16.1 as output (initial level = H, LED turns off)

**TCPWM initialization**
- Call the `cyhal_timer_init()` function to get the timer object.
  - Clock source is not changed, and timer pins are not used
  - The TCPWM channel to be used is automatically allocated and set into the timer object
- Call the `cyhal_timer_configure()` function to initialize TCPWM.
  - Configure TCPWM with parameters in structure `timer_cfg`
- Call the `cyhal_timer_set_frequency()` function to set the timer cycle.
  - The `TIMER_TARGET_FREQUENCY` changes the cycle
Implementation

ISR registration
› The `cyhal_timer_register_callback()` function registers the interrupt service routine (ISR); in this sample, the name is `isr_timer()`.

Enable TCPWM
› Call the `cyhal_timer_register_callback()` function to set the interrupt factor and enable interrupt.
› Call the `cyhal_timer_start()` function to start the TCPWM timer.

Blink LED
› Once the TCPWM timer starts, the ISR function `isr_timer()` will be called when the timer expires and it calls the `cyhal_gpio_toggle()` function to toggle the user LED.
Compiling and programming

1. Connect to power and USB cable
2. Use Eclipse IDE for ModusToolbox™ software for compiling and programming
3. Compile
   a) Select the target application project in the Project Explorer.
   b) In the Quick Panel, scroll down, and click “Build Application” in HAL_TCPWM_Timer (APP_KIT-T2G-B-H-EVK)
4. Programming
   a) Select the target application project in the Project Explorer
   b) In the Quick Panel, scroll down, and click “HAL_TCPWM_Timer Program (KitProg3_MiniProg4)” under Launches
Run and test

After programming, the application starts automatically. Confirm that the user LED on the kit blinks at 1 second.
References

Datasheet
› CYT4BF datasheet 32-bit Arm® Cortex®-M7 microcontroller TRAVEO™ T2G family

Architecture technical reference manual
› TRAVEO™ T2G automotive body controller high family architecture technical reference manual

Registers technical reference manual
› TRAVEO™ T2G automotive body controller high registers technical reference manual

PDL/HAL
› PDL
› HAL

Training
› TRAVEO™ T2G Training
## Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>ECN</th>
<th>Submission Date</th>
<th>Description of Change</th>
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<tbody>
<tr>
<td>**</td>
<td>7782110</td>
<td>2022/07/05</td>
<td>Initial release</td>
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</table>
| *A       | 7876704| 2023/03/01      | Changed the title  
Removed STDOUT setting in “Implementation”  
Changed figures in “Compiling and programming”  
Removed UART terminal message in “Run and test” |
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