XT32H05x

XT32 microcontroller Advanced Timer (TIMA) Application notes

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Revised :

Revision History

Release	Date	Author	Summary of Change
V0.0.0	26/10/2023	Shirling Liu	Initial

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1 Introduce

This application note serves as a comprehensive guide for software developers, offering essential information on timer/PWM configurations for advanced timer (TIM1 and TIM2). It covers fundamental concepts and provides guidelines to ensure proper utilization of basic timers in software development projects. Whether you're a beginner or an experienced developer, this document will equip you with the necessary knowledge and best practices to effectively configure and utilize timer in your applications.

1.1 Required peripherals

This application involves PADI module, GPIO, and TIM1 module.

Table 1. Modules in example

Sub-module	Peripheral use	Note
PADI	4 ports as GPIO 7 ports as PWM output	
TIM1	Advanced timer1 PWM output	
GPIO	LEDs show the TIMA interrupt callback state	

1.2 Compatible devices

This example is compatible with the devices in Table 2.

Table 2. Device list

Product	EVB
XT32H050	XB002823

2 Design description

2.1 Feature overview

XT32H0 microcontroller has two advanced timers, TIM1 and TIM2. These timers include the following features:

- 16-bit up, down, up and down auto-load counter
- Up to 6 independent channels for PWM/Output compare/Input capture.
- Complementary outputs with programmable dead-time
- 2 bidirectional break inputs
- Trigger input for external clock
- Interrupts generator
- Configure by DMA

2.2 Design steps

Here, the example uses the channel 1-4 of advanced timer 1 (TIM1) to generate PWM output signal.

1. Set TIM1 source clock and clock divider.
2. Configure base timer parameters of TIM1: counter mode, period, prescaler, clock-division.
3. Configure the PWM output port.
   - PADI_IDX_IO10_ATOUT1_CH1_P, means select and enable the IO10(pin 11) as PWM output of channel 1 of advanced timer1.
   - PADI_IDX_IO15_ATOUT1_CH2_N, means select and enable the IO15(pin 19) as PWM complementary output of channel 2 of advanced timer1.

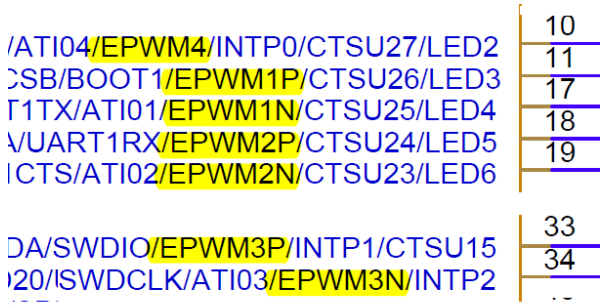

Figure 1. IO function selection

Note: please refer to XT32H0xxB—reference manual document to find the assignment relationship between pin with IOx

4. Configure output compare parameter: PWM-mode, pulse width, polarity…
5. Enable advanced timer1 (TIM1) Interrupt。
6. Start the advanced timer 1(TIM1) to generate PWM output signal.

2.3 Design considerations

2.4 Software flowchart

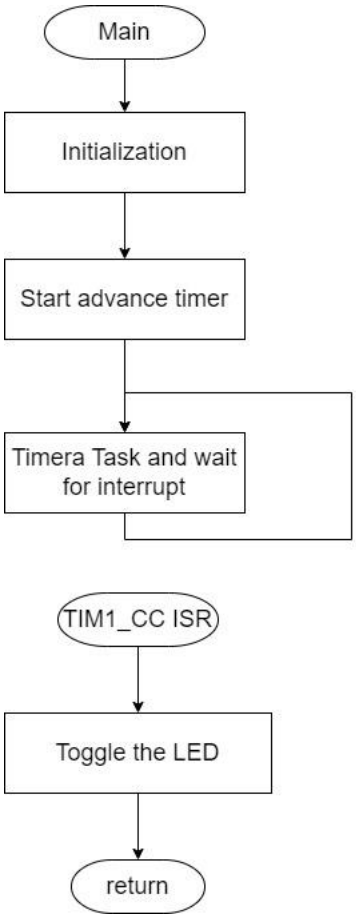

Figure 2. Application flow

2.5 Reference code

Configure Peripheral PAD to select alternate function as TIM1 PWM output port.

```
/**
* TIMA ch1o IO10 ch1on IO13; **ch2o IO14 ch2on IO15; **ch3o IO29 ch3on IO30 ;
**ch4o  IO9
* Aux  ch1o B.26  ch1on C.16;  **ch2o C.17  ch2on C.18;  **ch3o C.8   ch3on C.9;
**ch4o D.15
*
**/
HAL_TIM_OutputPortConfig(htim_pwm,  TIM_PORT_CHANNEL_1,   TIM1_CH1P_PWM_PIN_IDX);
HAL_TIM_OutputPortConfig(htim_pwm,  TIM_PORT_CHANNEL_1,   TIM1_CH1N_PWM_PIN_IDX);
HAL_TIM_OutputPortConfig(htim_pwm,  TIM_PORT_CHANNEL_2,   TIM1_CH2P_PWM_PIN_IDX);
HAL_TIM_OutputPortConfig(htim_pwm,  TIM_PORT_CHANNEL_2,   TIM1_CH2N_PWM_PIN_IDX);
HAL_TIM_OutputPortConfig(htim_pwm,  TIM_PORT_CHANNEL_3,   TIM1_CH3P_PWM_PIN_IDX);
HAL_TIM_OutputPortConfig(htim_pwm,  TIM_PORT_CHANNEL_3,   TIM1_CH3N_PWM_PIN_IDX);
HAL_TIM_OutputPortConfig(htim_pwm,  TIM_PORT_CHANNEL_4,   TIM1_CH4P_PWM_PIN_IDX);
```

Enable TIM1 CC interrupt code:

```
static void XT_Nvic_Init(void)
{
#if defined(XT32H0xxB)
    HAL_NVIC_SetPriority(TIM1_CC_IRQn, 2, 0);
    HAL_NVIC_EnableIRQ(TIM1_CC_IRQn);
#endif /* XT32H0xxB */
}
```

Configure Peripheral TIM1 using HAL_TIM_PWM_Init.

```
  /* Initialize TIMA */
  htima1.Instance = TIM1;
```

```
  htima1.Init.Prescaler = PRESCALER_VALUE;
  htima1.Init.Period    = PERIOD_VALUE_1MS;
  htima1.Init.CounterMode = TIM_COUNTERMODE_UP;
  htima1.Init.ClockDivision = TIM_CLOCKDIVISION_DIV1;
  htima1.Init.RepetitionCounter = 0;
  htima1.Init.AutoReloadPreload = TIM_AUTORELOAD_PRELOAD_DISABLE;
  if (HAL_TIM_PWM_Init(&htima1) != HAL_OK)
  {
    Error_Handler();
  }
```

```
/* -4- Configure output compare parameter configuration */
    sConfigOC.OCMode = TIM_OCMODE_PWM1;
    sConfigOC.Pulse  = PWM_PULSE1_VALUE;
    sConfigOC.OCPolarity   = TIM_OCPOLARITY_HIGH;
    sConfigOC.OCNPolarity  = TIM_OCNPOLARITY_HIGH;
    sConfigOC.OCFastMode   = TIM_OCFAST_DISABLE;
    sConfigOC.OCIdleState  = TIM_OCIDLESTATE_RESET;
    sConfigOC.OCNIdleState = TIM_OCNIDLESTATE_RESET;
    sConfigOC.OCDeadTime  = 0;
    sConfigOC.OCNDeadTime = 0;
    if (HAL_TIM_PWM_ConfigChannel(&htima1, &sConfigOC, TIM_CHANNEL_1) != HAL_OK)
    {
      Error_Handler();
    }


    sConfigOC.OCMode = TIM_OCMODE_PWM1;
    sConfigOC.Pulse  = PWM_PULSE2_VALUE;
    sConfigOC.OCPolarity   = TIM_OCPOLARITY_HIGH;
    sConfigOC.OCNPolarity  = TIM_OCNPOLARITY_HIGH;
    sConfigOC.OCFastMode   = TIM_OCFAST_DISABLE;
    sConfigOC.OCIdleState  = TIM_OCIDLESTATE_RESET;
    sConfigOC.OCNIdleState = TIM_OCNIDLESTATE_RESET;
    sConfigOC.OCDeadTime  = 0;
```

```
    sConfigOC.OCNDeadTime = 0;
    if (HAL_TIM_PWM_ConfigChannel(&htima1, &sConfigOC, TIM_CHANNEL_2) != HAL_OK)
    {
      Error_Handler();
    }
```

Start the advanced timer 1(TIM1) to generate PWM output signal.

```
void XT_TIM1_Start(void )
{
  if (HAL_TIM_PWM_Start_IT(&htima1, TIM_CHANNEL_1) != HAL_OK)
  {
  /*Error_Handler*/
  }
  if (HAL_TIMEx_PWMN_Start_IT(&htima1, TIM_CHANNEL_2) != HAL_OK)
  {
  /*Error_Handler*/
  }
  if (HAL_TIM_PWM_Start_IT(&htima1, TIM_CHANNEL_3) != HAL_OK)
  {
  /*Error_Handler*/
  }
  if (HAL_TIMEx_PWMN_Start_IT(&htima1, TIM_CHANNEL_3) != HAL_OK)
  {
  /*Error_Handler*/
  }
  if (HAL_TIM_PWM_Start_IT(&htima1, TIM_CHANNEL_4) != HAL_OK)
  {
  /*Error_Handler*/
  }

}
```

2.6 Additional resources

- XT32H0xxB--reference manual