XT32H05x

XT32 microcontroller Advanced Timer (TIMA) Application notes

Rev 0.0.0

Original Release Date: 26-Oct-2023

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 2 ports as PWM output	
TIM1	Advanced timer1 PWM output	
DMA	DMA transmitter	
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_IO13_ATOUT1_CH1_N, means select and enable the IO13(pin 17)as PWM complementary output of channel 1 of advanced timer1.

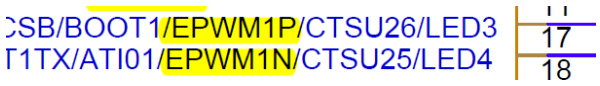

Figure 1. IO function selection

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. Configure interface between DMA with TIM1, and enable DMA Interrupt.
6. Start the advanced timer 1(TIM1) to generate PWM output signal.
7. Re-set the PWM duty cycle via DMA burst mode if button pressed.

2.3 Design considerations

2.4 Software flowchart

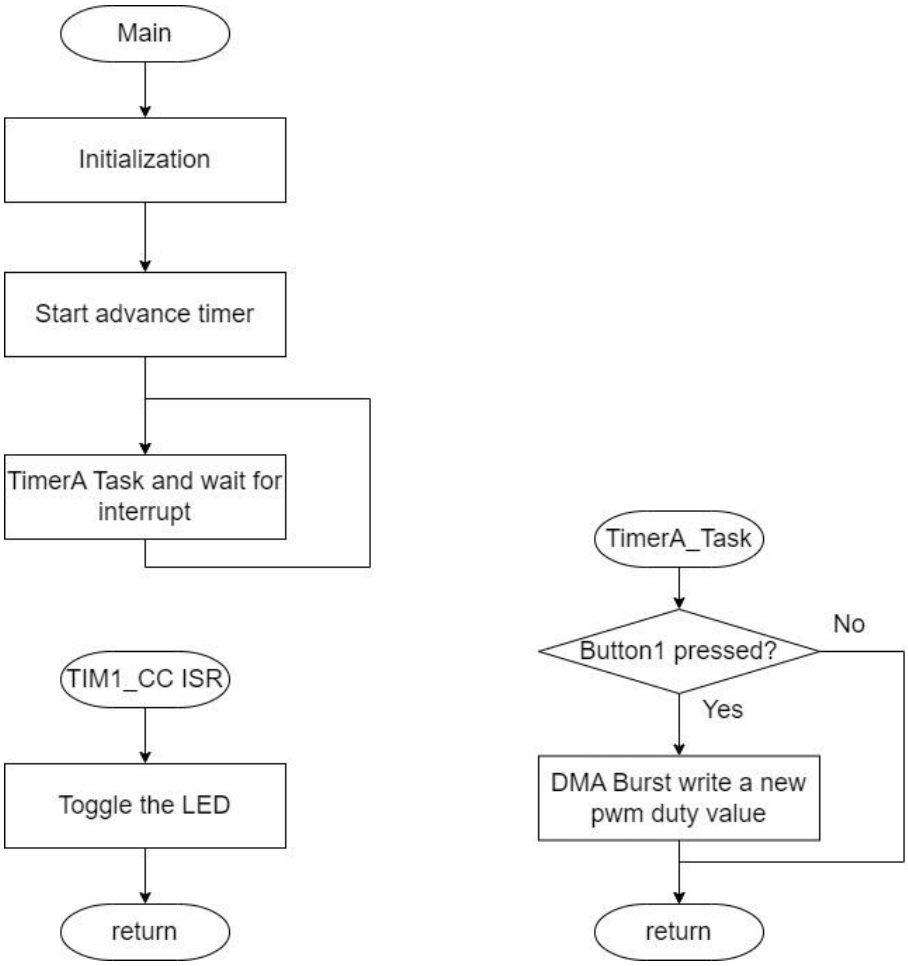

Figure 2. Application flow

2.5 Reference code

Configure Peripheral PAD to select alternate function as TIM1 PWM output port, and configure interface between DMA with TIM1.

```
void HAL_TIM_PWM_MspInit(TIM_HandleTypeDef* htim_pwm)
{

  if(htim_pwm->Instance==TIM1)
  {
        /* Peripheral clock enable */
        __HAL_RCC_TIMA_CLK_ENABLE();
        /* USER CODE BEGIN TIM1_MspInit 1 */
        /* Configure output pin */
    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);
    }
    #if defined(SUPPORT_CC1_OUTPUT)
    XT_TIMx_DMA_writecfg(htim_pwm,TIM_DMA_ID_CC1);
    __HAL_TIM_ENABLE_IT(htim_pwm, TIM_IT_CC1);
    #endif
    __HAL_TIM_ENABLE_IT(htim_pwm, TIM_IT_UPDATE);
    __HAL_TIM_ENABLE(htim_pwm);
}
```

Enable DMA interrupt code:

```
{
#if defined(XT32H0xxB)
    HAL_NVIC_SetPriority(DMA1_IRQn, 2, 0);
    HAL_NVIC_EnableIRQ(DMA1_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();
    }
```

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

```
void XT_TIM1_Start(void )
{
    if (HAL_TIM_PWM_Start(&htima1, TIM_CHANNEL_1) != HAL_OK)
    {  /* PWM Generation Error */
        Error_Handler();
    }

    if (HAL_TIMEx_PWMN_Start(&htima1, TIM_CHANNEL_1) != HAL_OK)
    {  /* PWM Generation Error */
        Error_Handler();
    }

    /*## Start DMA Burst transfer###################################*/
    if (HAL_TIM_DMABurst_WriteStart(&htima1, TIM_DMABASE_ARR, TIM_DMA_UPDATE,
XT_TIM1_DMA_SRC_Buff_Addr(0,0), TIM_DMABURSTLENGTH_4TRANSFERS)!=
HAL_OK)
    {  /* PWM Generation Error */
        Error_Handler();
    }

}
```

2.6 Additional resources

- XT32H0xxB--reference manual