A New Method for Frequency Measurement of Low Frequency Signals

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***Abstract*—In engineering and experiments, the frequency of signals is often measured. At present, there are many methods, such as measuring the number of pulses in a fixed time to determine its frequency. In this paper, a pulse width measurement method is proposed. The period is determined by measuring the time of positive pulse width within a period, and the frequency is obtained by taking the reciprocal.**

Keywords—Frequency measurement, pulse width measurement, cycle

I. INTRODUCTION

In engineering practice, people often need to know the working frequency, period and peak value of different signals. For this reason, a number of measurement methods have been devised, and the frequency can be obtained by counting the number of pulses in one second through the calculation function of the timer in the processor. This method can also be used to deal with low-frequency signals, if the frequency is too high, it may produce larger errors. In this paper, a pulse width measurement method is proposed. The frequency can be obtained by accurately measuring the time of positive pulse width within a period, determining the period and taking the reciprocal.

II. HARDWARE DESIGN

The hardware circuit design is shown in Figure 1. The timing diagram of the timer counting is given, and the pre-dividing coefficient is set to divide the clock frequency of the system, and the input signal is counted at a rising edge.

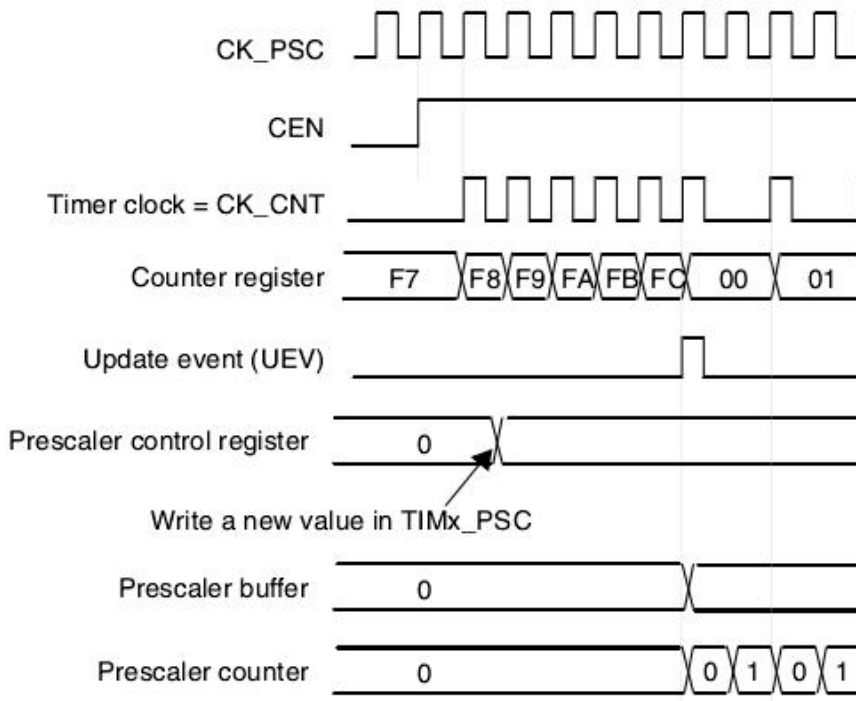

Fig 1 Counter timing diagram

III. SOFTWARE

In this design, KEIL 5 is programmed in C language. Set the clock and trigger the counter.void TIM3_Int_Init(u16 arr,u16 psc)

```
{
  RCC->APB1ENR|=1<<1;
  TIM3->ARR=arr;
```

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```
  TIM3->PSC=psc;
  TIM3->DIER|=1<<0;
  TIM3->CR1|=0x01;
        MY_NVIC_Init(1,3,TIM3_IRQn,2);
}
void TIM3_Cap_Set(u16 arr,u16 psc,u8 ch)
{
        RCC->APB1ENR|=1<<0;
     RCC->APB2ENR|=1<<2;
        TIM2->ARR=arr;
     TIM2->PSC=psc;
     switch (ch)
    {
          case 1:   //select PA0 INPUT single
                GPIOA->CRL&=0XFFFFFFF0;
          GPIOA->CRL|=0X00000008;
          GPIOA->ODR|=0<<0;          //PA0
                TIM2->CCMR1|=1<<0;        //CC1S=01
           TIM2->CCMR1|=1<<4;             //IC1F=0001
                TIM2->CCMR1|=0<<2;          //IC1PS=00
                TIM2->CCER|=0<<1;          //CC1P=0 BIT1=0                TIM2->CCER|=1<<0;          //CC1E=1
                TIM2->DIER|=1<<1;                          break;
          case 2:   //select PA1 INPUT single
                GPIOA->CRL&=0XFFFFFF0F;    //PA0~PA3
          GPIOA->CRL|=0X00000080; //PA0~PA3
          GPIOA->ODR|=0<<1;          //PA1
    TIM2->CCMR1|=1<<0;        //CC1S=01
           TIM2->CCMR1|=1<<8;        //CC2S=01
        TIM2->CCMR1|=1<<12;          //IC2F=0001          TIM2->CCMR1|=0<<10;
TIM2->CCER|=0<<5;          //CC2P=0                TIM2->CCER|=1<<4;                TIM2->DIER|=1<<2;
          break;
          case 3:
                GPIOA->CRL&=0XFFFFF0FF;    //PA2
          GPIOA->CRL|=0X00000800; //PA2
          GPIOA->ODR|=0<<2;          //PA2
    TIM2->CCMR1|=1<<0;
           TIM2->CCMR2|=1<<0;        //CC3S=01
        TIM2->CCMR2|=1<<4;          //IC3F=0001
             TIM2->CCMR2|=0<<2;       //IC3PS=00
             TIM2->CCER|=0<<9;             //CC3P=0
             TIM2->CCER|=1<<8;             //CC3E=1
             TIM2->DIER|=1<<3;
             break;
```

```
            case 4:
                    GPIOA->ODR|=0<<3;        //PA3
                    TIM2->CCMR2|=1<<8;       //CC4S=01
                    TIM2->CCMR2|=1<<12;          //IC4F=0001                  TIM2->CCMR2|=0<<10;
//IC4PS=00
                    TIM2->CCER|=0<<13;       //CC4P=0 BIT4=0                  TIM2->CCER|=1<<12;
//CC4E=1
                    TIM2->DIER|=1<<4;
                break;
          }
          TIM2->DIER|=1<<0;
          TIM2->CR1|=0x01;
          MY_NVIC_Init(2,0,TIM2_IRQn,2);
    }


    void TIM2_IRQHandler(void)
    {
      u16 tsr;
      tsr=TIM2->SR;
            if(tsr&0x02)//
            {
                  if(TIM2CH1_CAPTURE_STA&0X40)          //
                  {
                        TIM2CH1_CAPTURE_STA|=0X80;
TIM2CH1_CAPTURE_VAL=TIM2->CCR1;
                        TIM2->CCER&=~(1<<1);              //CC1P=0
                  }else
                  {
                        TIM2CH1_CAPTURE_VAL=0;
                        TIM2CH1_CAPTURE_STA=0X40;       //
                        TIM2->CNT=0;                    //
                        //TIM2->CCER|=1<<1;             //CC1P=1
TIM2->CCER&=~(1<<1);              //CC1P=0
                  }
            }
```

IV. SUMMARY

This paper expounds the principle and method of frequency measurement by STM32, gives the hardware circuit design diagram, describes the timing of timer acquisition in detail, and compiles the program in C language under KEIL, which can accurately measure the frequency and meet the design requirements. It has certain practical value.

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