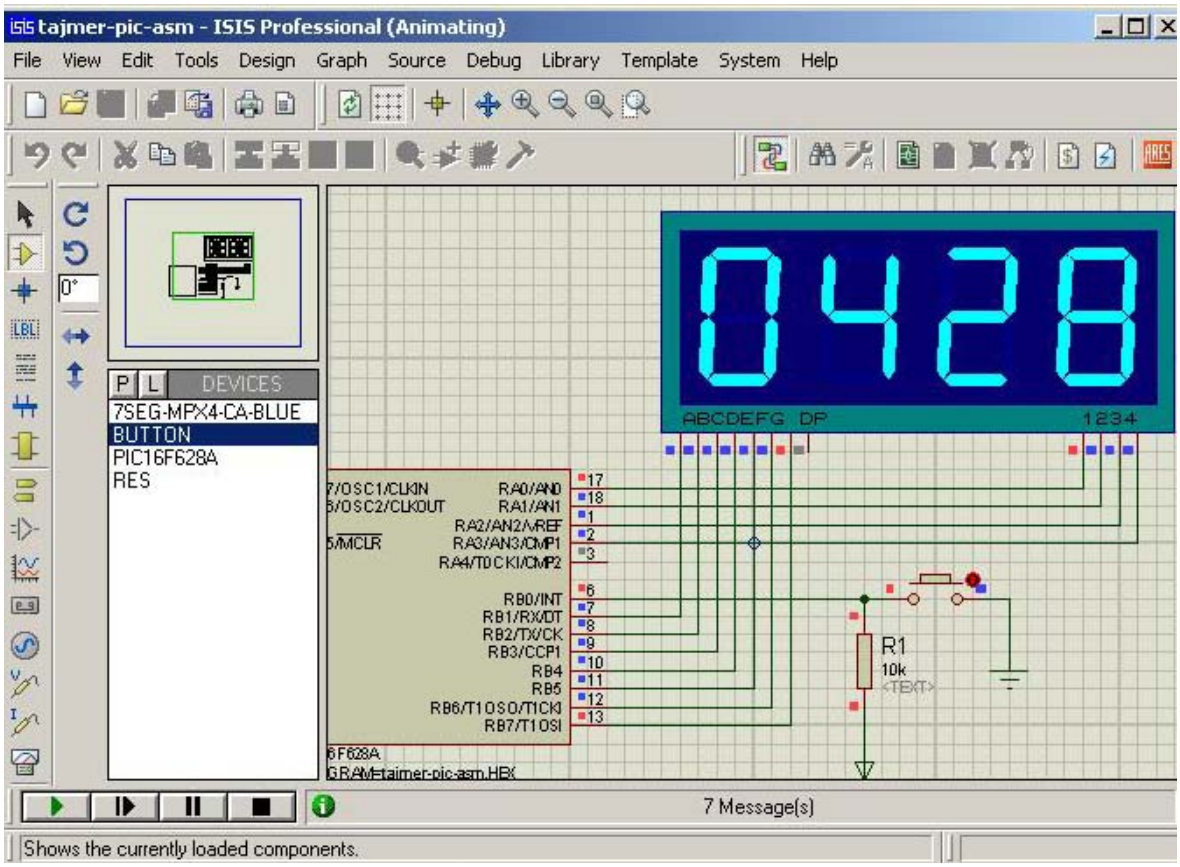
Лабораторная работа №9 Таймер PIC ASM

Цель: Изучить работу таймера с четырьмя состояниями.

; Таймер с четырьмя состояниями с использованием прерываний.




```
LIST        P=16F628A
INCLUDE     P16F628A.INC
__CONFIG    _INTOSC_OSC_NOCLKOUT&_WDT_OFF&_PWRTE_ON&_M
CLRE_OFF&_LVP_OFF
ERRORLEVEL  -302
CBLOCK      20H
        W_TEMP:1,STATUS_TEMP:1,FSR_TEMP:1
        J:1,K:1
        LED3:1,LED2:1,LED1:1,LED0:1
        TEMPL:1,TEMPH:1
        COUNT:1,MEM:1,CATOD:1,INDEX:1
        TEMP:2,TEMP_T1CON:1
ENDC
BANK0       MACRO
        BCF         STATUS,RP0
        BCF         STATUS,RP1
ENDM
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BANK1     MACRO
        BSF       STATUS,RP0
        BCF       STATUS,RP1
ENDM
ORG       0
        GOTO      START
        ORG       4
        GOTO      ISR
START     MOVLW     7
        MOVWF     CMCON
        CLRF      PORTB
        CLRF      PORTA
        BANK1
        MOVLW     B'11110000'
        MOVWF     TRISA
        MOVLW     B'00000001'
        MOVWF     TRISB
        BSF       PIE1,TMR1IE       ; Разрешаем прерывание от таймера1
        BANK0
        CLRF      TEMP+1            ; Сбрасываем счетчик
        CLRF      TEMP
        CLRF      TEMP_T1CON
        MOVLW     B'00000001'
        MOVWF     T1CON             ; Запускаем таймер
        BSF       INTCON,INTE       ; Прерывание на порте B0
        BSF       INTCON,PEIE       ; Разрешаем прерывание от периферии
        BSF       INTCON,GIE        ; Разрешаем глобальные прерывания

MAIN MOVLW     LED3
        MOVWF     FSR
        MOVLW     1
        MOVWF     CATOD
LOOP      MOVFW     INDF
        CALL      TABLE
        MOVWF     PORTB
        MOVFW     CATOD
        MOVWF     PORTA
        CALL      DELAY
        CLRF      PORTA
        INCF      FSR,F
        RLF       CATOD,1
        BTFSS     CATOD,4
        GOTO      LOOP
        GOTO      MAIN
```

```
DELAY     MOVLW     .4
          MOVWF     J
JLOOP     MOVLW     .255
          MOVWF     K
KLOOP     DECFSZ    K,F
          GOTO      KLOOP
          DECFSZ    J,F
          GOTO      JLOOP
          RETURN

TABLE     ADDWF     PCL,F
          RETLW     B'10000000'
          RETLW     B'11110010'
          RETLW     B'01001000'
          RETLW     B'01100000'
          RETLW     B'00110010'
          RETLW     B'00100100'
          RETLW     B'00000100'
          RETLW     B'11110000'
          RETLW     B'00000000'
          RETLW     B'00100000'

BIN2BCD   MOVLW     .16
          MOVWF     COUNT
          CLRF      LED0
          CLRF      LED1
          CLRF      LED2
          CLRF      LED3
LOOP8     RLF       TEMPL,F
          RLF       TEMPH,F
          RLF       LED0,F
          RLF       LED1,F
          DECFSZ    COUNT,F
          GOTO      ADJDEC

          SWAPF     LED1,W
          ANDLW     0FH
          MOVWF     LED3

          MOVFW     LED1
          ANDLW     0FH
          MOVWF     LED2

          SWAPF     LED0,W
          ANDLW     0FH
```

```
        MOVWF     LED1

        MOVFW     LED0
        ANDLW     0FH
        MOVWF     LED0
        RETURN
ADJDEC  MOVLW     LED0
        MOVWF     FSR
        CALL      ADJBCD
        MOVLW     LED1
        MOVWF     FSR
        CALL      ADJBCD
        GOTO      LOOP8
ADJBCD  MOVLW     3
        ADDWF     INDF,W
        MOVWF     MEM
        BTFSC     MEM,3
        MOVWF     INDF
        MOVLW     30H
        ADDWF     INDF,W
        MOVWF     MEM
        BTFSC     MEM,7
        MOVWF     INDF
        RETLW     0

ISR     MOVWF     W_TEMP
        SWAPF     STATUS,W
        BCF       STATUS,RP0
        MOVWF     STATUS_TEMP
        MOVFW     FSR
        MOVWF     FSR_TEMP

        BTFSC  PIR1,TMR1IF        ; Было переполнение таймера?
        GOTO   TMR1INT            ; Да
        BTFSS  INTCON,INTF        ; Прерывание на порте B0?
        GOTO   EXIT_ISR           ; Не было вообще прерываний
        BCF    INTCON,INTF        ; Сбрасываем флаг
        MOVLW 0FH
        ANDWF  T1CON,F            ; Чистим предделитель(старший
полубайт)
        MOVLW 10H
        ADDWF  TEMP_T1CON,F       ; Увеличиваем на 1 старший полубайт
        BTFSC  TEMP_T1CON,6       ; Проверяем,нам нужно только 2 бита
        GOTO   CLEAR              ; Почистим, если больше 2-бит
        MOVFW  TEMP_T1CON         ; Закидываем в W
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```
        IORWF     T1CON,F          ; Изменяем только предделитель
        GOTO      TMR1INT
CLEAR   CLRF      TEMP_T1CON

TMR1INT BCF  PIR1,TMR1IF           ; Да было. Обязательно сбросить флаг.
        INCF      TEMP+1,F         ; Увеличим счетчик
        BTFSC     STATUS,Z         ; Если байт переполнился, то 0
        INCF      TEMP,F
        MOVF      TEMP+1,W         ; Вывод на индикатор
        MOVWF     TEMPL
        MOVF      TEMP,W
        MOVWF     TEMPH
        CALL      BIN2BCD

EXIT_ISR  MOVFW     FSR_TEMP
        MOVWF     FSR
        SWAPF     STATUS_TEMP,W
        MOVWF     STATUS
        SWAPF     W_TEMP,F
        SWAPF     W_TEMP,W
        RETFIE
        END
```

REGISTER 4-3: INTCON – INTERRUPT CONTROL REGISTER (ADDRESS: 0Bh, 8Bh, 10Bh, 18Bh)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-x
GIE	PEIE	T0IE	INTE	RBIE	T0IF	INTF	RBIF
bit 7							bit 0

bit 7 **GIE:** Global Interrupt Enable bit
1 = Enables all un-masked interrupts
0 = Disables all interrupts

bit 6 **PEIE**: Peripheral Interrupt Enable bit
1 = Enables all un-masked peripheral interrupts
0 = Disables all peripheral interrupts

bit 5 **T0IE**: TMR0 Overflow Interrupt Enable bit
1 = Enables the TMR0 interrupt
0 = Disables the TMR0 interrupt

bit 4 **INTE**: RB0/INT External Interrupt Enable bit
1 = Enables the RB0/INT external interrupt
0 = Disables the RB0/INT external interrupt

bit 3 **RBIE**: RB Port Change Interrupt Enable bit
1 = Enables the RB port change interrupt
0 = Disables the RB port change interrupt

bit 2 **T0IF**: TMR0 Overflow Interrupt Flag bit
1 = TMR0 register has overflowed (must be cleared in software)
0 = TMR0 register did not overflow

bit 1 **INTF**: RB0/INT External Interrupt Flag bit
1 = The RB0/INT external interrupt occurred (must be cleared in software)
0 = The RB0/INT external interrupt did not occur

bit 0 **RBIF**: RB Port Change Interrupt Flag bit
1 = When at least one of the RB<7:4> pins changes state (must be cleared in software)
0 = None of the RB<7:4> pins have changed state

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

REGISTER 4-4: PIE1 – PERIPHERAL INTERRUPT ENABLE REGISTER 1 (ADDRESS: 8Ch)

R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0	R/W-0	R/W-0
EEIE	CMIE	RCIE	TXIE	—	CCP1IE	TMR2IE	TMR1IE
bit 7							bit 0

bit 7 **EEIE:** EE Write Complete Interrupt Enable Bit
1 = Enables the EE write complete interrupt
0 = Disables the EE write complete interrupt

bit 6 **CMIE**: Comparator Interrupt Enable bit
1 = Enables the comparator interrupt
0 = Disables the comparator interrupt

bit 5 **RCIE**: USART Receive Interrupt Enable bit
1 = Enables the USART receive interrupt
0 = Disables the USART receive interrupt

bit 4 **TXIE**: USART Transmit Interrupt Enable bit
1 = Enables the USART transmit interrupt
0 = Disables the USART transmit interrupt

bit 3 **Unimplemented**: Read as '0'

bit 2 **CCP1IE**: CCP1 Interrupt Enable bit
1 = Enables the CCP1 interrupt
0 = Disables the CCP1 interrupt

bit 1 **TMR2IE**: TMR2 to PR2 Match Interrupt Enable bit
1 = Enables the TMR2 to PR2 match interrupt
0 = Disables the TMR2 to PR2 match interrupt

bit 0 **TMR1IE**: TMR1 Overflow Interrupt Enable bit
1 = Enables the TMR1 overflow interrupt
0 = Disables the TMR1 overflow interrupt

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

REGISTER 4-5: PIR1 – PERIPHERAL INTERRUPT REGISTER 1 (ADDRESS: 0Ch)

R/W-0	R/W-0	R-0	R-0	U-0	R/W-0	R/W-0	R/W-0
EEIF	CMIF	RCIF	TXIF	—	CCP1IF	TMR2IF	TMR1IF
bit 7							bit 0

bit 7 **EEIF:** EEPROM Write Operation Interrupt Flag bit
1 = The write operation completed (must be cleared in software)
0 = The write operation has not completed or has not been started

bit 6 **CMIF**: Comparator Interrupt Flag bit
1 = Comparator output has changed
0 = Comparator output has not changed

bit 5 **RCIF**: USART Receive Interrupt Flag bit
1 = The USART receive buffer is full
0 = The USART receive buffer is empty

bit 4 **TXIF**: USART Transmit Interrupt Flag bit
1 = The USART transmit buffer is empty
0 = The USART transmit buffer is full

bit 3 **Unimplemented**: Read as '0'

bit 2 **CCP1IF**: CCP1 Interrupt Flag bit
Capture Mode
1 = A TMR1 register capture occurred (must be cleared in software)
0 = No TMR1 register capture occurred
Compare Mode
1 = A TMR1 register compare match occurred (must be cleared in software)
0 = No TMR1 register compare match occurred
PWM Mode
Unused in this mode

bit 1 **TMR2IF**: TMR2 to PR2 Match Interrupt Flag bit
1 = TMR2 to PR2 match occurred (must be cleared in software)
0 = No TMR2 to PR2 match occurred

bit 0 **TMR1IF**: TMR1 Overflow Interrupt Flag bit
1 = TMR1 register overflowed (must be cleared in software)
0 = TMR1 register did not overflow

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

REGISTER 7-1: T1CON – TIMER1 CONTROL REGISTER (ADDRESS: 10h)

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	T1CKPS1	T1CKPS0	T1OSCEN	$\overline{\text{T1SYNC}}$	TMR1CS	TMR1ON
bit 7							bit 0

bit 7-6 **Unimplemented**: Read as '0'

bit 5-4 **T1CKPS<1:0>**: Timer1 Input Clock Prescale Select bits
11 = 1:8 Prescale value
10 = 1:4 Prescale value
01 = 1:2 Prescale value
00 = 1:1 Prescale value

bit 3 **T1OSCEN**: Timer1 Oscillator Enable Control bit
1 = Oscillator is enabled
0 = Oscillator is shut off(1)

bit 2 **$\overline{\text{T1SYNC}}$**: Timer1 External Clock Input Synchronization Control bit
TMR1CS = 1
1 = Do not synchronize external clock input
0 = Synchronize external clock input
TMR1CS = 0
This bit is ignored. Timer1 uses the internal clock when TMR1CS = 0.

bit 1 **TMR1CS**: Timer1 Clock Source Select bit
1 = External clock from pin RB6/T1OSO/T1CKI/PGC (on the rising edge)
0 = Internal clock (Fosc/4)

bit 0 **TMR1ON**: Timer1 On bit
1 = Enables Timer1
0 = Stops Timer1

Note 1: The oscillator inverter and feedback resistor are turned off to eliminate power drain.

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

Задания для выполнения:

1. Изучить работу приложенной программы.
2. Добавить комментарии к каждой строке программы.
3. Смоделировать работу в среде Proteus.
4. Оформить отчет о проделанной работе.