深 圳 大 学 实 验 报 告

课程名称：微机原理与接口技术

实验项目名称：计数/定时器 8254 程序设计实验

学院：电子与信息工程学院

专业：电子信息工程

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教务部制

实验目的与要求：

掌握 PC 机里定时/计数器 8254 的基本原理和编程方法，用示波器观察不同方式下的波形。

一、计数器 8254 程序设计实验

将计数器 0 设置为方式 0，计数器初值为 N(N≤0FH),用手动逐个输入单脉冲，编程使计数值再屏幕上显示，并同时用逻辑笔观察 OUT0 电平变化(当输入 N+1 个脉冲后 OUT0 变低电平)。

1．图中虚线部分是实验时需要使用实验导线连接。

2．在 TPC-486EM 集成开发环境下输入程序，编译、连接，生成.exe 执行文件。

3．在执行计数器程序后每按一次单脉冲屏幕上的值减 1，等减到结果等于 1 时 OUT0 输出低电平。

二、定时器 8254 程序设计实验

将计数器 0，计数器 1 分别设置为方式 3，计数初值设为 1000，用逻辑笔观察 OUT1 输出电平的变化(频率 Hz)。

1．图中虚线部分是实验时需要使用实验导线连接。

2．在 TPC-486EM 集成开发环境下输入程序，编译、连接，生成.exe 执行文件。

3. 在执行定时器程序后，OUT1 输出 1Hz 频率，逻辑笔上灯出现一定时间亮灭。

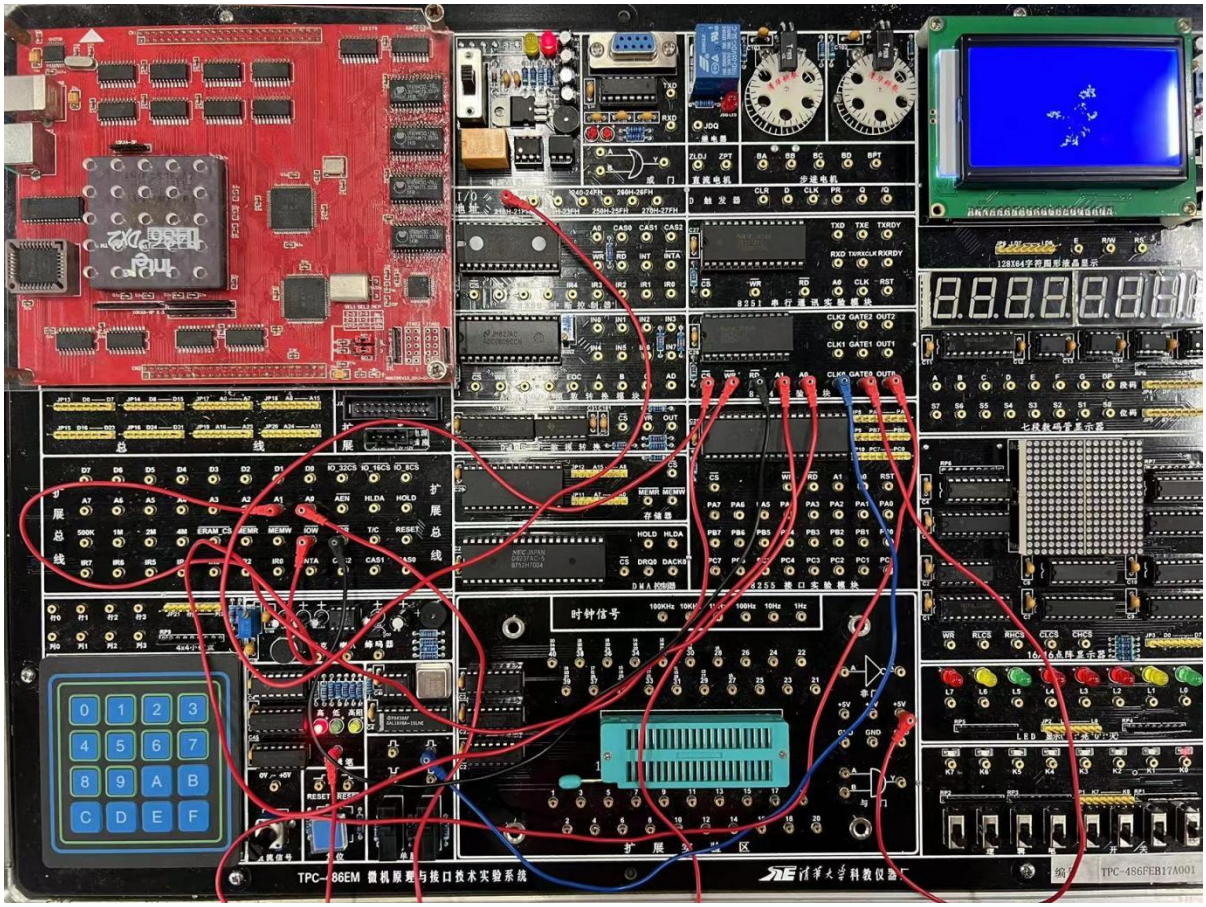
内容和步骤：

一、计数器 8254 程序设计实验

A. Circuit physical connection between 8086 and 8254A.

We first observe the structure of 8254. From the following figure, we find the 8254 contains three timers and each of them has three interface which includes CLK, GATE and OUT. In addition, 8254 has totally two address lines (A0 and A1) which point to controller and three timers. Piece choice control signal interface CS, read enable signal interface RD and write enable signal interface WR also belongs to 8254.

For physical connection, we focus on the most important part that is address line connection. In this experiment, we use the 210H, 211H,212H and 213H to respectively connect to controller, timer0, timer1 and timer2. Since the IO address is sequential arrangement, we connect the A0 of the 8254 to the A0 of the 8086 and connect the A1 of the 8254 to the A1 of the 8086. We only use the timer0 to time so GATE0 connects signal pulse, CLK0 connects 1MHz and OUT0 connects logic pen to observe the level of the output signal. The CS of 8254 connects to the IO address 210H-21FH. The WR of 8254 connects to the IOW of 8086. The RD of 8254 connects to the IOR of 8086. Here we finish all the physical connection.



B. Program the corresponding code.

The main part of the whole program includes (a) the initialization of 8254, (b) output the current value of timer0 and (c) display the current value.

(a) The initialization of 8254

We first calculate the control word and send it to the controller. We use the mode2 in this experiment. The control word is 00010100D. Since the address of controller is 213H, we should move the address to DX. The control word move to AL. We use OUT instruction to send the control word to controller. Next, we send the initial value to the timer0. Here we set the initial value to 0FH and move it to AL. The address of timer0 is 210H. We use OUT instruction to send the initial value to timer0.

(b) Output the current value of timer0

We use the IN instruction to output the current value and the current value is saved in AL.

(c) Display the current value

We write a subprogram to display each character. It is worth to say that if the output character is A-F, we should add 37H and if the output character is 0-9, we should add 30H. We use the function 2 of the INT 21H to display the character in the screen. And we use the function 0DH of the INT 21H to conduct enter in convince to observe the current value.

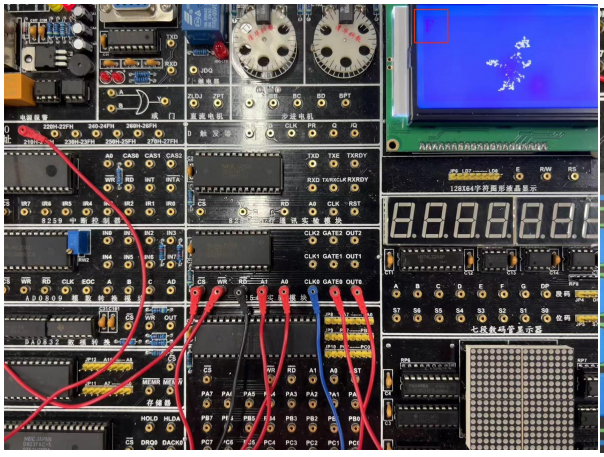
All the program is shown in the following figure.

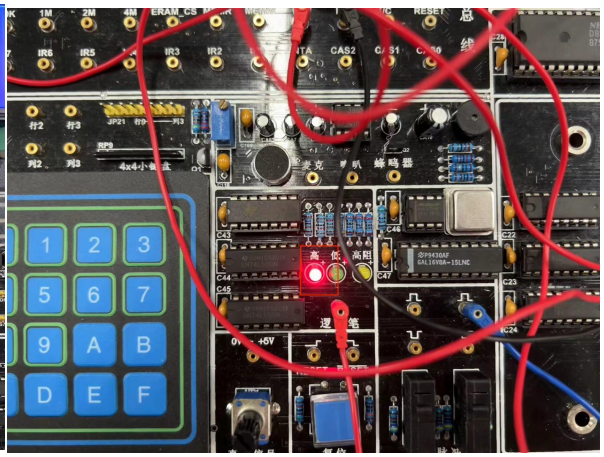
```
01  DATA SEGMENT
02  I8254_CS EQU 210H
03  DATA ENDS
04
05  CODE SEGMENT
06          ASSUME CS:CODE,DS:DATA
07  START:  MOV AX,DATA
08          MOV DS,AX
09          MOV DX,0213H
10          MOV AL,14H
11          OUT DX,AL
12          MOV DX,0210H
13          MOV AL,0FH
14          OUT DX,AL
15  LLL:    IN  AL,DX
16          CALL DISP
17          MOV CX,0FFFFH
18  S1:     LOOP S1
19          JMP LLL
20  DISP    PROC NEAR
21          PUSH DX
22          AND AL,0FH
23          MOV DL,AL
24          CMP DL,9
25          JLE NUM
26          ADD DL,7
27  NUM:    ADD DL,30H
28          MOV AH,02H
```

```
29          INT 21H
30          MOV DL,0DH
31          INT 21H
32          POP DX
33          RET
34  DISP    ENDP
35          MOV AX,4C00H
36          INT 21H
37  CODE    ENDS
38          END START
```

C. Observe the result of the experiment.

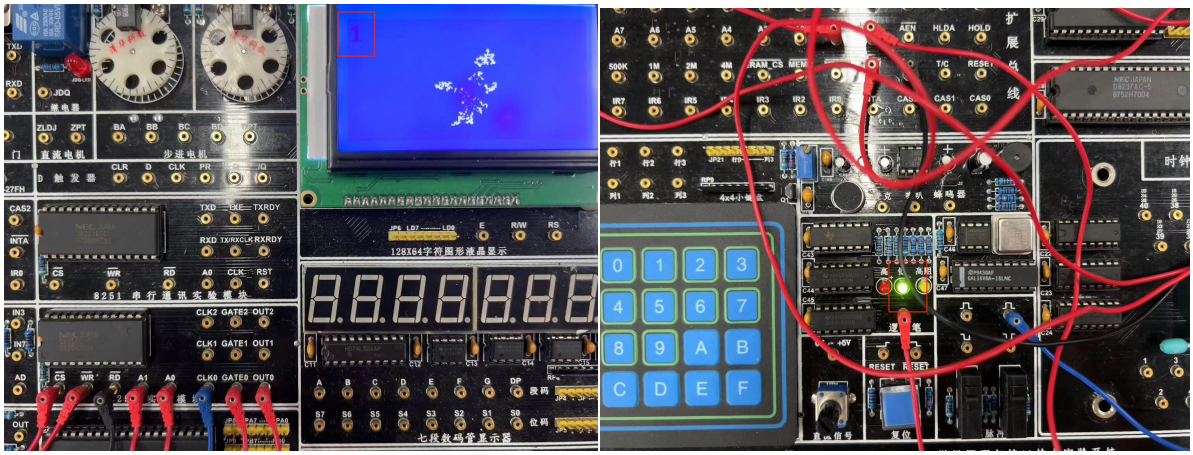
When the output is F-2, the color of logic pen is red which indicates that the level is high as shown in the following two figures.





When the output is 1, the color of logic pen changes to green which indicates that the level is low as

shown in the following two figures.



When the finish one time period from F to 1, it will automatically begin another time period as shown in the following two figure. At the same time, the level change to high again until time to 1.

The above experiment result corresponds to the theory as shown in the following figure that is after writing the control word, the output will become high. The timer starts immediately after the count value is written. During the counting process, the output will always be high level, until the count value is 1, the output will become low level. After a CLK cycle, the output returns to high and the counter begins to count again. Therefore, it can work continuously and output pulses of fixed frequency.

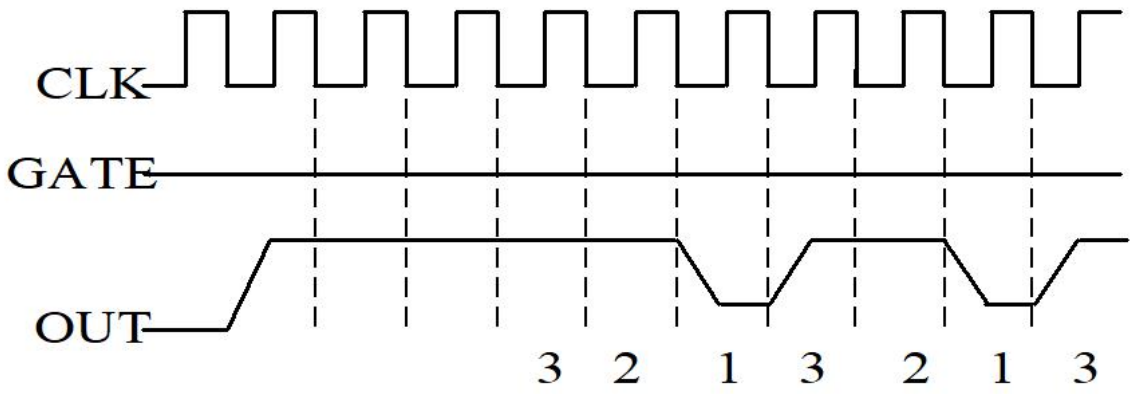


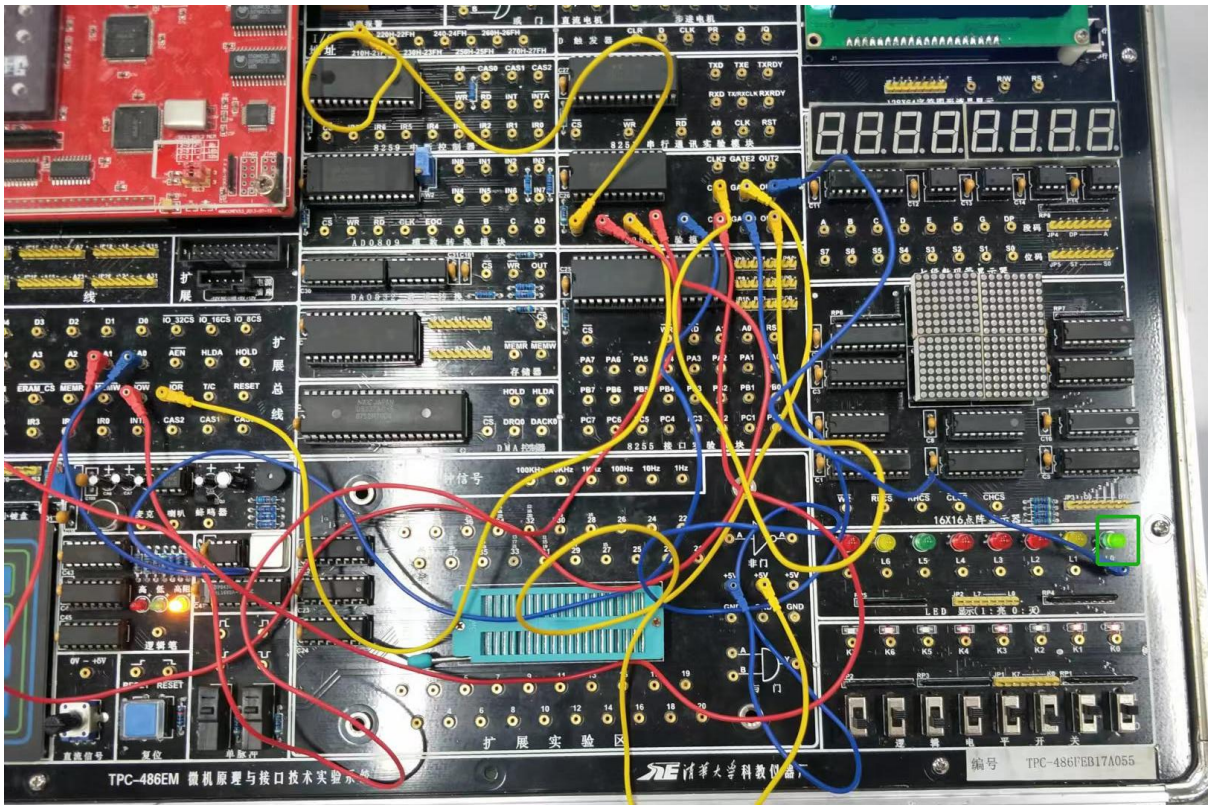
图9.7 方式2波形

The video of the experiment result is attached to the report.

二、定时器 8254 程序设计实验

A. Circuit physical connection between 8086 and 8254A.

In this experiment, we use the 210H, 211H,212H and 213H to respectively connect to controller, timer0, timer1 and timer2. Since the IO address is sequential arrangement, we connect the A0 of the 8254 to the A0 of the 8086 and connect the A1 of the 8254 to the A1 of the 8086. Timer0 and timer1 are cascaded and used to time so GATE0 connects to VCC, CLK0 connects to 1MHz square signal, OUT0 connects to CLK1, GATE1 connects to VCC and OUT1 connects logic pen to observe the level of the output signal. The CS of 8254 connects to the IO address 210H-21FH. The WR of 8254 connects to the IOW of 8086. The RD of 8254 connects to the IOR of 8086. Here we finish all the physical connection as shown in the following figure.



B. Program the corresponding code.

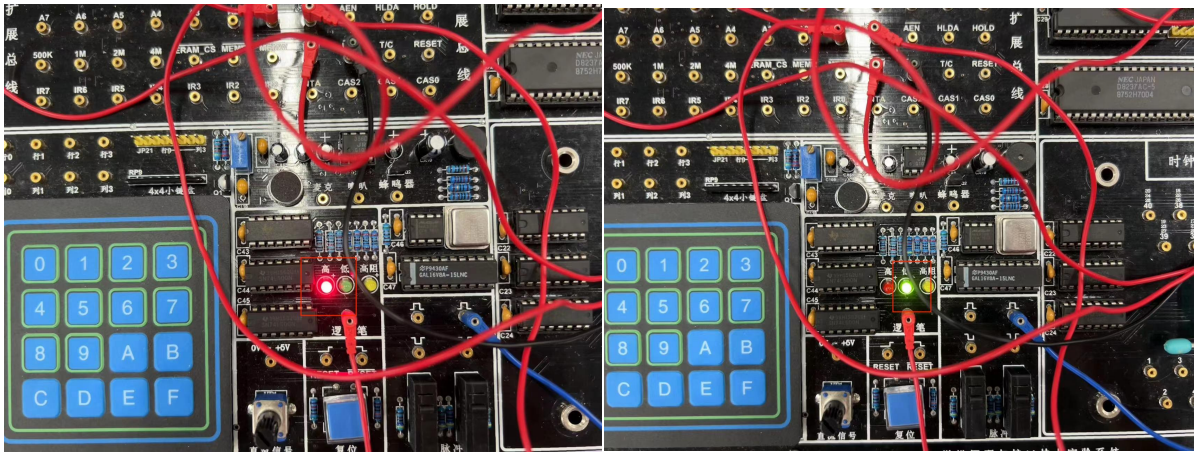
The main part of the whole program includes the initialization of 8254. We first calculate the control word and send it to the controller. We both use the mode3 for counter0 and counter1 in this experiment. The control word for counter0 is 00110110D and the control word for counter1 is 01110110D. Since the initial value is 1000 (>255), we should use 2 bytes to represent it. Since the address of controller is 213H, we should move the address to DX. The control word move to AL. We use OUT instruction to send the control word to controller. Next, we send the initial value to the counter0 and counter1. Here we set the initial value to 1000H for both counter0 and counter1 and move it to AL. The address of counter0 is 210H and the address of counter1 is 211H. We use OUT instruction to send the initial value to counter0 and counter1. We first send the low bytes and next send the high bytes to counter0 and counter1. The whole program is shown in the following figure.

```
DATA SEGMENT
    I8254_CS EQU 210H
DATA ENDS

CODE SEGMENT
    ASSUME CS:CODE, DS:DATA
START:  MOV AX, DATA
        MOV DS, AX
        MOV DX, I8254_CS+3
        MOV AL, 36H
        OUT DX, AL
        MOV DX, I8254_CS
        MOV AX, 1000
        OUT DX, AL
        MOV AL, AH
        OUT DX, AL
        MOV DX, I8254_CS+3
        MOV AL, 76H
        OUT DX, AL
        MOV DX, I8254_CS+1
        MOV AX, 1000
        OUT DX, AL
        MOV AL, AH
        OUT DX, AL
        MOV AX, 4C00H
        INT 21H
CODE ENDS
    END START
```

C. Observe the result of the experiment.

In theoretical, the OUT1 will output the 1MHZ/(1000×1000)=1Hz square wave. In the experiment, we observe that the logic pen changes the level around every 0.5 second (from high to low and next to high) as shown in the following figure. In other word, OUT1 is a square wave whose period is 1s.



The above experiment result corresponds to the theory as shown in the following figure that is after the control word is written, the output will become high level. When the initial value is written, the count will start and the output will remain high level; When the count reaches half of the initial value, the output becomes low level, until the count is 0, the output becomes high level again, and the count starts again.

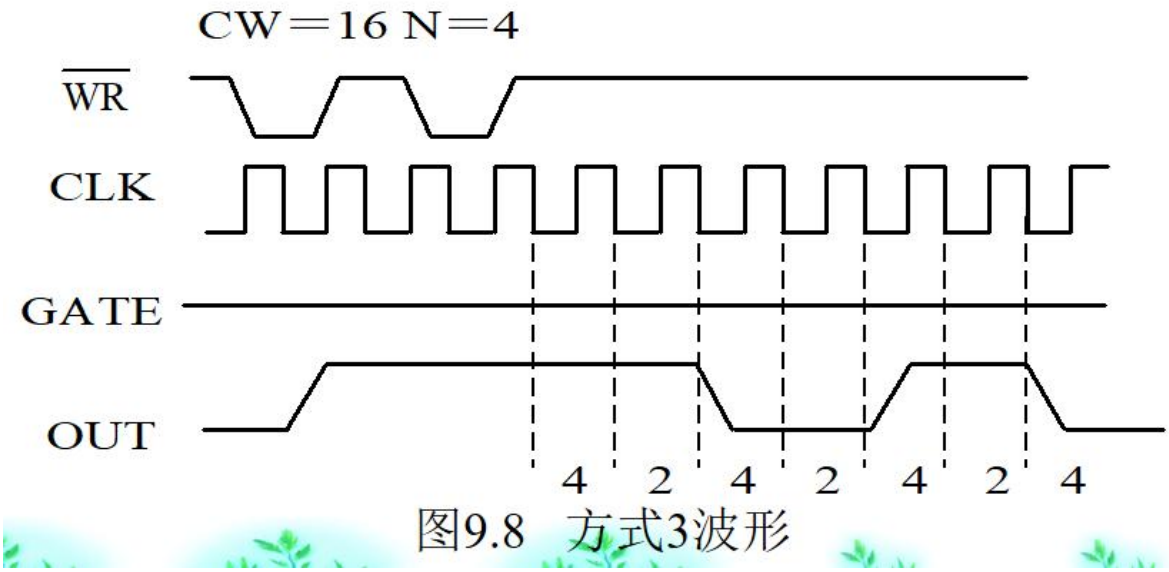


图9.8 方式3波形

实验结论：

In this experiment, we use 8254 to achieve count and time. For 8254 initialization, we first send the control word to the controller and send the initial value to the corresponding counter. We use IN and OUT instruction to send the control word and initial value to controller or counter. In total, 8254 has 6 modes and each mode has its characteristic. Through this experiment, we verify the mode0 and mode3.

The characteristic of mode0 is after writing the control word, the output will become high. The timer starts immediately after the count value is written. During the counting process, the output will always be high level, until the count value is 1, the output will become low level. After a CLK cycle, the output returns to high and the counter begins to count again. Therefore, it can work continuously and output pulses of fixed frequency.

The characteristic of mode3 is after the control word is written, the output will become high level. When the initial value is written, the count will start and the output will remain high level; When the count reaches half of the initial value, the output becomes low level, until the count is 0, the output becomes high level again, and the count starts again.

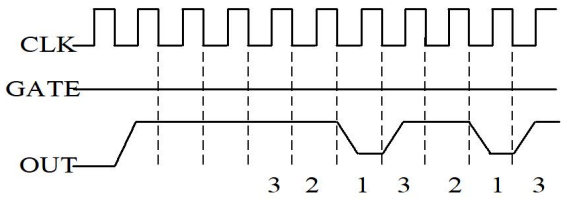


图9.7 方式2波形

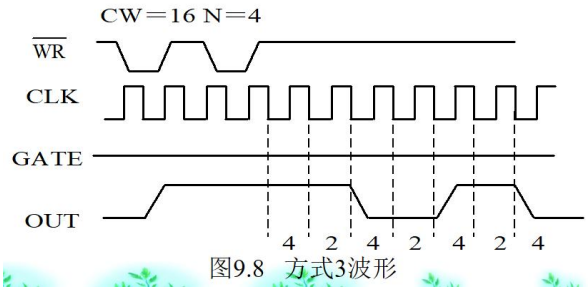


图9.8 方式3波形

指导教师批阅意见：   **成绩评定：**   **指导教师签字：** 年　　月　　日
备注：

注：1、报告内的项目或内容设置，可根据实际情况加以调整和补充。

2、教师批改学生实验报告时间应在学生提交实验报告时间后 10 日内。