

	Switch value in binary	PWM Duty Cycle	Numerator	Denominator
1.	000	11%	Y1=1	X=9
	001	22%	Y1=2	X=9
	010	33%	Y1=3	X=9
	011	44%	Y1=4	X=9
	100	55%	Y1=5	X=9
	101	66%	Y1=6	X=9
	110	77%	Y1=7	X=9
	111	88%	Y1=8	X=9

2. To get the required delay time, let us consider the snippet of code below for yet to be determined positive integers x and y .

DELAY:

```

MOV R0, #x
LOOP0: MOV R1, #y
LOOP1: DJNZ R1, LOOP1
        DJNZ R0, LOOP0

```

The number of machine cycles for this code is

$$2 + [2 + 4 \cdot y + 4] \cdot x = 4xy + 6x + 2.$$

Since we our machine is a DS89C450 and since we want to generate a $\frac{1}{5400}$ s delay time, we must have that

$$(4xy + 6x + 2) \cdot 90.42ns = \frac{1}{5400}.$$

So choose $x = 11$ and solve to get $y \approx 45$.

- 3.

```

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;PULSE-MODULATION CODE;;;;;;;;;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

MOV      P0, #0           ;Set Port 0 as output
MOV      P1, #07H         ;Use low 3-bit of P1 for modulation

MAIN_LOOP:
MOV      R2, P1           ;Read data from switch into R2
INC      R2               ;Add 1 to get index of switch
MOV      P0, #0FFH        ;Turn on LEDs

DELAY_ON:

```

```
        ACALL    DELAY          ;Keep LEDs on for R2 * Delay time
        DJNZ     R2, DELAY_ON

        MOV      R2, P1         ;Read data from switch into R2

        MOV      A, #8
        SUBB     A, R2          ;Off Time = (8 - R2) * Delay time
        MOV      R2, A

        MOV      P0, #0         ;Turn off LEDs

DELAY_OFF:
        ACALL    DELAY          ;Keep LEDs on for R2 * Delay time
        DJNZ     R2, DELAY_OFF

        SJMP     MAIN_LOOP

DELAY:
        MOV      R0, #11        ;Delay time for DS89C450 at 600 Hz
LOOP0:   MOV      R1, #45
LOOP1:   DJNZ     R1, LOOP1
        DJNZ     R0, LOOP0
        RET

END
```