

Avg: 72
 High: 95
 Low: 35

Score

95

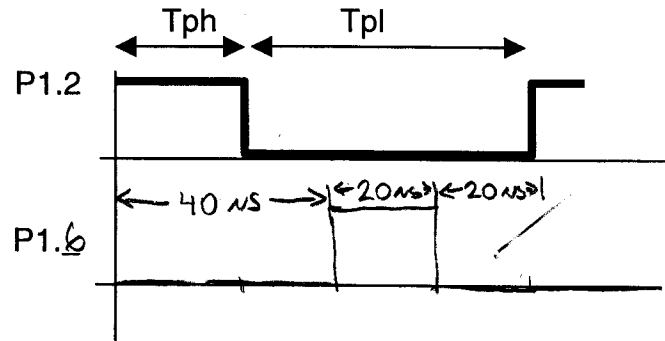
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1. The following C program is used to produce square waves of various pulse widths on two pins of P1 of an 8051.
 - A) P1 bit 2 is one pin, what is the other?
 - B) Assuming a 12 Mhz clock, make a reasonable estimate of the times T_{ph} and T_{pl} for P1.2.
 - C) Sketch a similar waveform for the other bit and label the pulse widths with their durations like P1.2. Give the duration in seconds, not symbolically.
 - D) You decide to take f1 out of this program and put it into a library. Show how you would modify the program if f1 was located in a library.
 - E) What is the name of the program or process step that binds this new program to f1 from the library?

```
#include <reg51.h>
```

```
void f1(char v){
    char i;
    P1= v; for (i=0; i<20; i++){
    }

    void main (void){
        while(1){
            f1(4); f1(0); f1(0x40); f1(0);
        }
    }
}
```



2. Answer the following questions about the C program whose listing file is shown below.
 - A) Which symbols will be marked 'public'?
 - b) Which symbols are local to this module?
 - C) Why doesn't the assignment to c2 in line 6 affect the constant c4?
 - D) What is the scope of c1, c2, and c4?
 - E) Using the link map on the back, fill in the values of all the relocatable data in the fragment of assembly code from the listing file.

```
1      static char c1;
2      int i1;
3      static char f1(char c2){
4  1      int i1;
5  1      i1= c2;
6  1      c2= 0;
7  1      return 1;
8  1      }
9      void f2(void){
10  1      char c3;
11  1      c3=2;
12  1      }
13     void main(void){
14  1      code char c4=3;
15  1      c1=f1(c4);
16  1      f2();
17  1      }
18
```

```
; FUNCTION main (BEGIN)
; SOURCE LINE # 13
; SOURCE LINE # 15
0000 900000 R      MOV      DPTR,#c4
0003 E4           CLR      A
0004 93           MOVC     A,@A+DPTR
0005 FF           MOV      R7,A
0006 120000 R      LCALL    _f1
0009 8F00 R      MOV      c1,R7
; SOURCE LINE # 16
000B 120000 R      LCALL    f2
; SOURCE LINE # 17
000E 22           RET
```

3. The 8051 has two timer/counters.
 - A) What are the different counter sizes (in bits) that are available?
 - B) What are the standard names of the timer SFR's?
 - C) What does the timer 'count'?
 - D) What are two ways that timer T0 can be started and stopped?
 - E) What timer mode effectively provides the 8051 with three timers?

4. The 8051's timers are frequently used to provide more precise delays than can be realized with software alone.
 - a) What bit needs to be set before T0 begins counting?

 - b) How long of a delay can a timer running in 8 bit mode produce with a 12 Mhz clock?

 - c) A timer running in 16 bit mode is loaded with 3 in the high half and 232 (decimal) in the low half. A 12 Mhz clock is used. How many μ sec will elapse before the timer full flag (TFx) sets?

 - d) A timer running in 8 bit mode is loaded with a 0xF6 and used with a 10 Mhz clock. What is the length of delay produced?

The following fragment of an M51 file is part of question #2.

TYPE	BASE	LENGTH	RELOCATION	SEGMENT NAME

* * * * * D A T A M E M O R Y * * * * *				
REG	0000H	0008H	ABSOLUTE	"REG BANK 0"
DATA	0008H	0003H	UNIT	?DT?Q4_2
DATA	000BH	0002H	UNIT	_DATA_GROUP_
IDATA	000DH	0001H	UNIT	?STACK
* * * * * C O D E M E M O R Y * * * * *				
CODE	0000H	0003H	ABSOLUTE	
CODE	0003H	000DH	UNIT	?PR?_F1?Q4_2
CODE	0010H	0004H	UNIT	?PR?F2?Q4_2
CODE	0014H	000FH	UNIT	?PR?MAIN?Q4_2
CODE	0023H	0001H	UNIT	?CO?Q4_2
CODE	0024H	000CH	UNIT	?C_C51STARTUP

1. a) $f1(4) = 00000100$
 $f1(0) = 00000000$
 $f1(0x40) = 01000000$
 $f1(0) = 00000000$

∴ P1.2 + P1.6 are the pins used to output square wave

- b) holds pulse for 20 cycles, since 12 MHz each instr cycle is 1 ns.

P1.2 = ON 20, OFF 20, OFF 20, OFF 20

∴ $T_{ph} = 20 \text{ ns}$
 $T_{pl} = 60 \text{ ns}$

- c) Sketch on test

OFF 20, OFF 20, ON 20, OFF 20

- d) file mylib.h *just the prototype*

```
void f1(char v);
void f1(char v) {
    char i;
    P1 = v; for(i=0; i<20; i++)
}
```

PUT FUNCTION IN SEPARATE FILE MYLIB.H

No, you don't recompile the libraries.

file main.c

```
#include <reg51.h>
#include <mylib.h>
```

```
void main(void) {
    while(1) {
        f1(4); f1(0); f1(0x40); f1(0);
    }
}
```

INCLUDE HEADER FILE IN MAIN PROGRAM

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23
23
23
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- e) LINKING

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2) a) which symbols are public?

i1, f2, main

b) c1, f1, c2, c3, c4

c) c4 is defined to be a constant in code space. When c4 is passed as the argument to the function f1, only the value is passed. The variable c2 is now local within the f1 function cannot affect anything outside of its scope.

e) main starts at address 0014H and is 000FH bytes long

0014H 90 00 23

+ 0006 12 00 03

+ 0009 8F 08

+ 000B 12 00 10

OUT OF
ORDER

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d) c1: scope is global to module

c2: scope is local to f1 function

c4: scope is local to main function

3) a) 8 bits, 13 bits, 16 bits ✓

b) TCON, TMOD, TLO, TLI, TH0, TH1 ✓

c) in timer mode, counts instruction cycles ✓

d) i) ^{start} TR0 = 1; ✓

^{stop} TR0 = 0;

ii) TCON |= 0x10;

TCON = TCON ^ 0x10;

The timer can be started and stopped by setting or clearing the TRx bit.

PUT INTO GATED MODE AND RAISE OR LOWER GATE.

e) Mode 3 ✓

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4) a) TR0 needs to be set before T0 begins counting. On the 8051, this is TCON bit 4.

b) 8 bits $\Rightarrow 2^8 = 256$ combinations

If using 12 MHz, each instr cycle 1 μ s ✓

Max delay = $(256)(1 \mu s) \Rightarrow$ Max Delay = 256 μ s

c) 3 | 232

03 E8

Timer counts up from 0x03E8 to 0xFFFF

$1 + 0xFFFF - 0x03E8 = 1 + 0xFC17 = 64535 + 1$ cycles

+ = 0.064536 μ s X - \leftarrow SHOULD BE SECONDS

d)

F6

10 cycles ✓

F6 $\xrightarrow{1}$ F7 $\xrightarrow{2}$ F8 $\xrightarrow{3}$ F9 $\xrightarrow{4}$ FA $\xrightarrow{5}$ FB $\xrightarrow{6}$ FC $\xrightarrow{7}$ FD $\xrightarrow{8}$ FE $\xrightarrow{9}$ FF $\xrightarrow{10}$

$\frac{12 \text{ instr cycles}}{10 \text{ MHz}} = 1.2 \mu s$

+ = 0.000012 μ s X - \leftarrow SHOULD BE IN SECONDS = 12 μ s

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