

Name: _____ KEY _____

1. A pushbutton switch is known to have switching bounce that has a maximum duration of 10ms, with transient highs and lows of 10-100uS. You have devised a debounce routine of the counting variety. The routine must observe the switch input remain the same for 16 samples to return a true or false indication.

How often would you sample the switch with the routine if false high and lows were to be avoided and the user was not to be annoyed by the delay of the debounce routine?

- > 100mS is roughly the upper bound for delay that users become annoyed at. If the switch stops bouncing 10mS into the button push, 90mS remains until the debounce routine can begin seeing consecutively static inputs. To sample 16 times within the 90ms requires the sample rate be $90\text{mS}/16 = 5.625\text{mS}$. To be on the safe side, sample every 5mS.

2. An ATmega48 is programmed at the Atmel factory to run off an internal 1Mhz RC oscillator. The output from this oscillator can be used by appropriately programming the part. Suppose this output was used to operate a motor control circuit. What must you take care with beyond the usual, to correctly sample a switch operated by the motor?

- > Since both the uC and the motor run off the same clock, care must be taken not to sample the switch synchronously to the motor.

3. Cross coupled NAND gates are sometimes used to debounce single pole, double throw switches. What assumption is made about the switches operation that ensures the circuit to work?

- > 1. When going from one position to another, the contact must not bounce back all the way to the other contact.
2. Bounce on the contact side must take more time than it takes for the SR latch to self-regenerate or close the loop in positive feedback.

4. Clean Hardware Inc. is using a uC to sample a switch closure. Due to a severe loss in company stock value however, the switch supplier has gone out of business. Clean Hardware Inc. now must use a cheaper switch that bounces for a longer time.

For both the count based debouncer (From Gansel's) and the Digital filter based debouncer, what could you do to the debounce routines to compensate for the poorer switch?

- > The count-based debouncer could be called at a slower rate or at the same rate with a longer "state" variable.

The DSP-based debounce routine could be called at a slower rate or the weighting constants (0.25 and 0.75) could set the LPF cutoff lower by using values such as 0.1 and 0.9.

5. A student saves the following single line of text in a file called "my_file".
"The big lazy cow tried to jump over the frightened red fox." (without quotes)

Later, the file is opened with: > vi my_file
Then the following vi commands are issued. Show what the file contains after the edits. When the file is opened by vi, the prompt is on the "T" of "The".

```
i "I said "<esc>
w
r "t" <esc>
w
dw
w
r, "D", <esc>
3w
r b <esc>
3w
dw
w
cw "line" <esc>
:x
```

> I said the lazy Dow tried to bump over the red line.