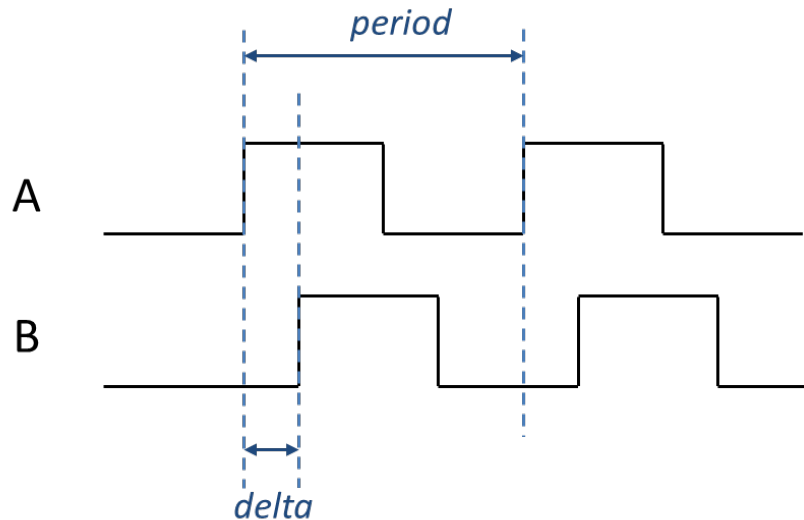


CPE 390: Microprocessor Systems

HW7

Due: 4/19/2017

1. You have been asked to write a program to measure the phase difference between two signals A and B of the same frequency. (You can assume that both are 50% duty cycle signals.) The two signals A and B are to be connected to pins PT0 and PT5 respectively of the microcontroller. Assume that the E-clock frequency is 16 MHz. Set up the timer counter to measure time in units of $0.25 \mu\text{s}$.



- (a) With the timer counter set up as described above, what is the maximum time interval that you can measure without having to worry about timer counter overflow? What is the maximum time (in minutes) you could measure if you used a two-byte unsigned integer variable to record counter overflows?
- (b) Write a program to set up Timer channels 0 and 5 in *input-compare* mode and use them to measure the time difference (in units of $0.25 \mu\text{s}$) by which signal A leads signal B and also the period (in units of $0.25 \mu\text{s}$) of signal A. (You can assume the period is short enough to ignore overflows of the timer counter. Also, use polling - not interrupts). Store the time difference in a 16-bit variable whose memory address is labeled *Delta*, and the period in a 16-bit variable whose memory address is labeled *Period*.
- (c) Add code to your program to calculate the phase shift in degrees where one full cycle equals 360 degrees. Store the result in a variable whose memory address is labeled *Degrees*.

2. In Lecture 10, we wrote code to generate a real-time clock using the real-time interrupt (RTI) facility on the HCS 12. Modify this code to use timer channel 7 in output-compare mode to generate the interrupts (rather than the RTI). Just put enough code in the interrupt service routine to update the seconds – don't worry about the minutes and the hours. Assume that the E-clock frequency is 4 MHz. Also, the interrupt vector table address for Timer Channel 7 is *UserTimerCh7*.

Hint: Set the timer counter to run at 1 MHz and set up the output-compare channel to interrupt after 10,000 counts. Remember to restart the output compare operation in the interrupt service routine.