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First: _____ Last: _____

July 19, 1999, 2:30pm-3:45pm

This is an open book, open notes exam. You must put your answers on these pages only, you can use the back. You have 90 minutes, so please allocate your time accordingly.

Please read the entire quiz before starting.

In both questions, you will be interfacing an X-Y joystick. The input device has two potentiometers, called Rx and Ry. The resistance of each channel (X,Y) varies from 0 to 10 K . Your hardware/software interfaces will periodically measure the current values of the X and Y channels updating two global variables. Each interface will consist of a hardware interface to the 6812, a ritual software that is executed once at the beginning, and an interrupt service routine that performs the X,Y measurement in the background. The result of the ISR will be to update two global variables.

unsigned short X, Y;

You will not write the main program that reads these two globals.

(50) Question 1. In the first implementation, you will use the input capture features. The measurement precision must be 12 bits. That means the measured positions stored in the global variables will range from 0 to 4095. Your goal is to take the measurements updating the globals as fast as possible. Assume this is the only use of Port T and the timer system, so the software need not be friendly.

Part a) Show the hardware interface. Since both channels will be identical, you need to show only one channel. Carefully label the potentiometer Rx (Ry) in your circuit. Please use input capture channels 6 and 7. I.e., interface the joystick using PT6 and PT7. Please label all chip numbers including pin names. Please label all resistors and capacitors values and types. Please show your works as you calculate the resistor and capacitor values.

Part b) Write the ritual subroutine that initializes the interface. Please define and initialize any additional data structures that you require. Even though you showed the hardware circuit for only one channel, write software for both channels.

Part c) Write the interrupt service routine(s) that measures the current joystick position updating the global variables X and Y.

(50) Question 2. In the second implementation, you will use the A/D system. The measurement precision must be 11 bits. Your system will take a burst of 8 A/D conversions (each one is 8 bits). The software will add the 8 samples together to achieve an 11-bit sum. That means the measured positions stored in the global variables will range from 0 to 2040. Your goal is to take the measurements updating the globals at 1 KHz. Assume this is the only use of the A/D and the timer system, so the software need not be friendly.

Part a) Show the hardware interface. Since both channels will be identical, you need to show only one channel. Carefully label the potentiometer Rx (Ry) in your circuit. Please use A/D channels 6 and 7. I.e., interface the joystick using PAD6 and PAD7. Please label all chip numbers including pin names. Please label all resistors and capacitors values and types. You do not need to make the system linear, but you will need to convert resistance the 0 to 10K resistance into the 0 to +5V input A/D range. Add a LPF with an appropriate cutoff. (bonus points for designing an analog circuit with a linear mapping from resistance to voltage across the entire 0 to 10 K range).

Part b) Write the ritual subroutine that initializes the interface. Please define and initialize any additional data structures that you require. Please use output compare channel 0 to implement the 1 KHz real time clock. Even though you showed the hardware circuit for only one channel, write software for both channels.

Part c) Write the output compare channel 0 interrupt service routine that measures the current joystick position updating the global variables X and Y. During each interrupt, there will be 16 A/D conversions, 8 for X and 8 for Y.