Last Name: _____First Name: _____

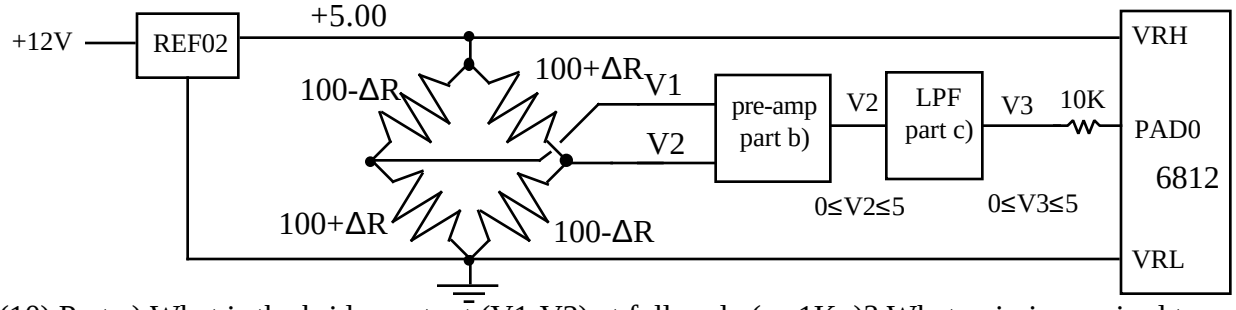
Jonathan W. Valvano October 21, 1998, 11:00 to 11:50am

This is an open book, open notes exam. You must put your answers on these pages only, you can use the back. You have 50 minutes, so please allocate your time accordingly.

(50) Question 1. Design an electronic scale using a 6812. Let **x** be in mass to be measured. The input range is 0 to 1 Kg and the signals of interest are 0 to 10 Hz. A bonded strain gauge bridge will be used to convert mass, **x**, into voltage, V1-V2. When the input mass is zero, each arm of the bridge is 100 Ω, and the bridge output (V1-V2) is zero. At full scale (**x**=1Kg), two resistors go to 99Ω and the other two go to 101Ω. In between 0 and 1 Kg, the resistance change is linearly related to the mass:

$\Delta R = x$ where resistance is in ohms and the mass **x** is in Kg

A REF02 precision reference will provide the constant +5.00 V for the bridge and the 6812 A/D.



(10) Part a) What is the bridge output (V1-V2) at full scale (**x**=1Kg)? What gain is required to match the full range of 0≤**x**≤1Kg to the 0 to +5V range of the A/D?

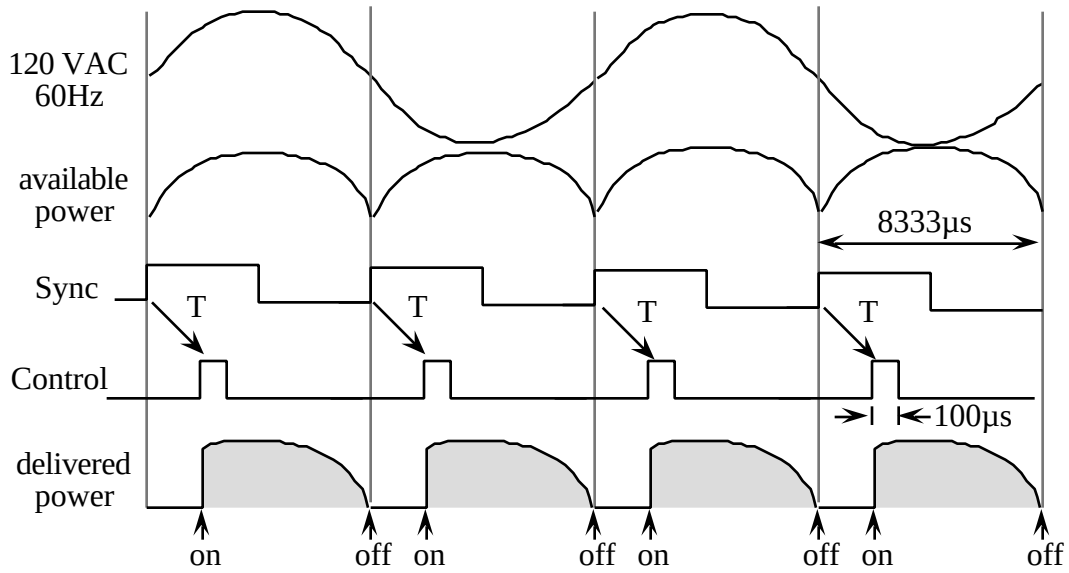
(15) Part b) Design the pre-amp which has the following characteristics: differential input, gain so that the 0 to +5V A/D is used, good CMRR, high Zin, low Zout, bandwidth >200 Hz. Show resistor values, but not pin numbers.

(15) Part c) The signals of interest are 0 to 10 Hz. There is unwanted noise at 60 Hz. Add a two pole LPF with a cutoff of 20 Hz.

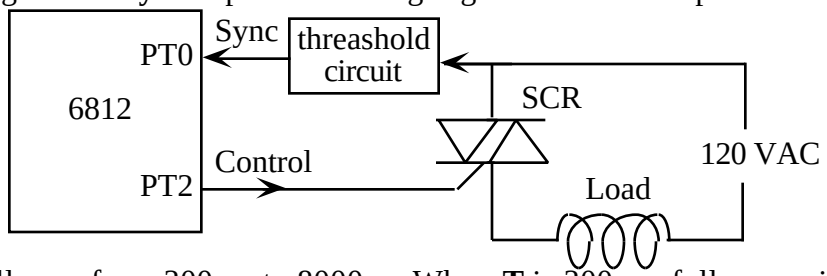
(5) Part d) What is the system resolution? Give units

(5) Part e) What sampling rate would you choose? Explain your answer.

(50) Question 2. The objective of this problem is to interface a SCR (silicon controlled rectifier) using input capture and/or output compare. A 120 Hz digital logic waveform (**Sync**) is available which is synchronized to the zero-crossings of the 60 Hz AC wave. A 100 μs pulse on the digital logic **Control** signal will turn on the SCR. The SCR will automatically shut off on the next zero crossing of the 60 Hz wave. **Sync** will be an input to the microcomputer and **Control** will an output.



The software controls the amount of delivered power by adjusting the time, **T**, which is the delay from the rising edge of the **Sync** input to the rising edge of **Control** output.



The delay, **T**, will vary from 300 µs to 8000µs. When **T** is 300 µs, full power is being delivered. When **T** is 8000 µs, almost no power is delivered to the load. A 16 bit unsigned global variable

```
unsigned int T;  // delay 2400 to 64000 in 125 ns clock cycles
```

will be set by the main program (which you will not write) and read by the interrupt software (which you will write).

(20) Part a) Give the ritual which initializes the interface. You may use any Port T feature.

(25) Part b) Give the `TC2handler()` and `TC0handler()` interrupt handlers which implement this interface. Good interrupt software has no backwards jumps.

(5) Part c) This is indeed an example of a real time system. Give the upper bound on the latency of the TC0handler().