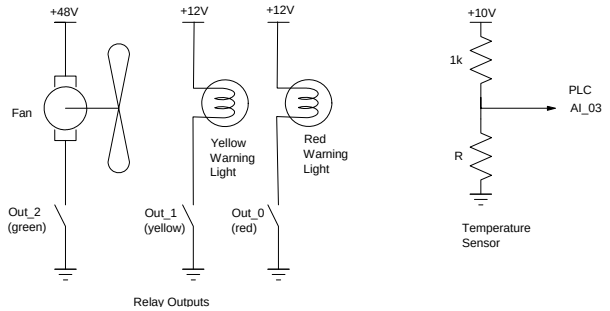
Solution to Homework #3: ECE 461

Counters & Analog Inputs. Due Monday, September 14th

Note: There are many solutions.

Write a ladder logic program for the following system. A Micro810 PLC is connected to a temperature sensor and a fan as follows:



The temperature - resistance of the temperature sensor is

$$R = 1000 \cdot \exp\left(\frac{3903}{T} - \frac{3903}{298}\right)\ \Omega$$

where T is the temperature in degrees Kelvin (celcius + 273). The PLC is to be able to turn on and off the fan based upon which button you press:

Button & Mode		On Time (4 second period)	Analog Input #3 (Temperature)
0	Fan On	100%	n/a
1	Automatic Mode	100%	> 50C
		75%	40C < T < 50C
		50%	30C < T < 40C
		25%	20V < T < 30C
		0%	T < 20C
2	Fan Off	0%	n/a

To monitor the life expectancy of the motor, turn on the yellow or red LEDs based upon the number of on/off cycles for the fan:

- Out1 (Yellow) Between 10 and 15 on/off cycles (warning - approaching time to replace the fan)
- Out0 (Red) More than 15 on/off cycles (time to replace the fan)

Turn in:

- Screen dumps for your ladder logic program along with an explanation of how it works,
- Verification that all three modes of operation work (On, Automatic, off)
- Verification of the on/off times when in automatic mode
- Verification that you switch modes at the right temperature (or voltage), and
- Verification that you are counting the number of on/off cycles and are turning on the yellow and red LED at the correct number of cycles.

Start with the voltages you want to switch at

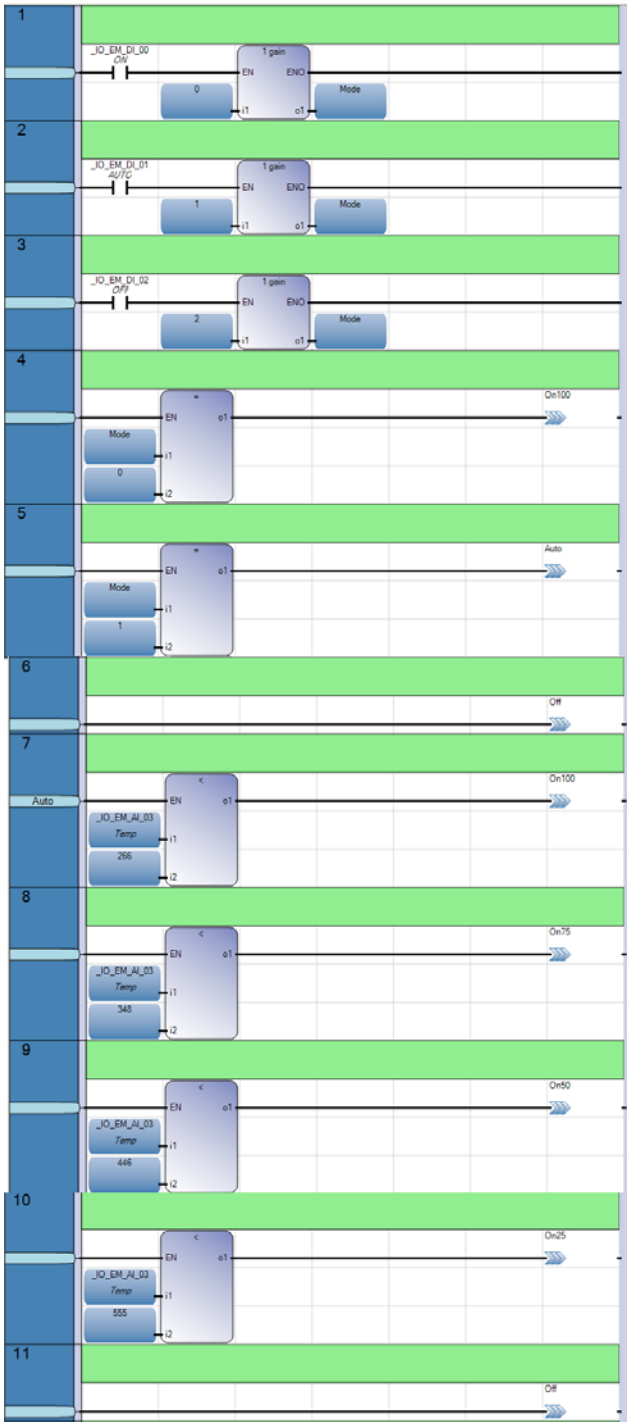
T	20C	30C	40C	50C
R	1,250	805	533	362
V	5.55V	4.46V	3.48V	2.66V
Analog In	555	446	348	266

Ladder Program

Rung 1:3

Use the input buttons to allow you to switch between modes. Use a DINT variable to store the mode

- 0 = On
- 1 = Auto
- 2 = Off



Rung 4:6

Jump to the appropriate routine based upon which operating more you're in. Default is Off.

Rung 7:11

When in Automatic mode, jump to the appropriate routine based upon temperature:

T > 50C:	100% on
40C < T < 50C	75% on
30C < T < 40C	50% on
20C < T < 30C	25% on
T < 20C	0% on (off)

Define each routine separately:

Rung 12 - 13:

100% On. Turn on the fan then jump to the end

Rung 14 - 16:

75% On. Cycle the fan

- On for 3 seconds
- Off for 1 second
- repeat

Rung 17 - 19:

50% On. Cycle the fan

- On for 2 seconds
- Off for 2 seconds
- repeat

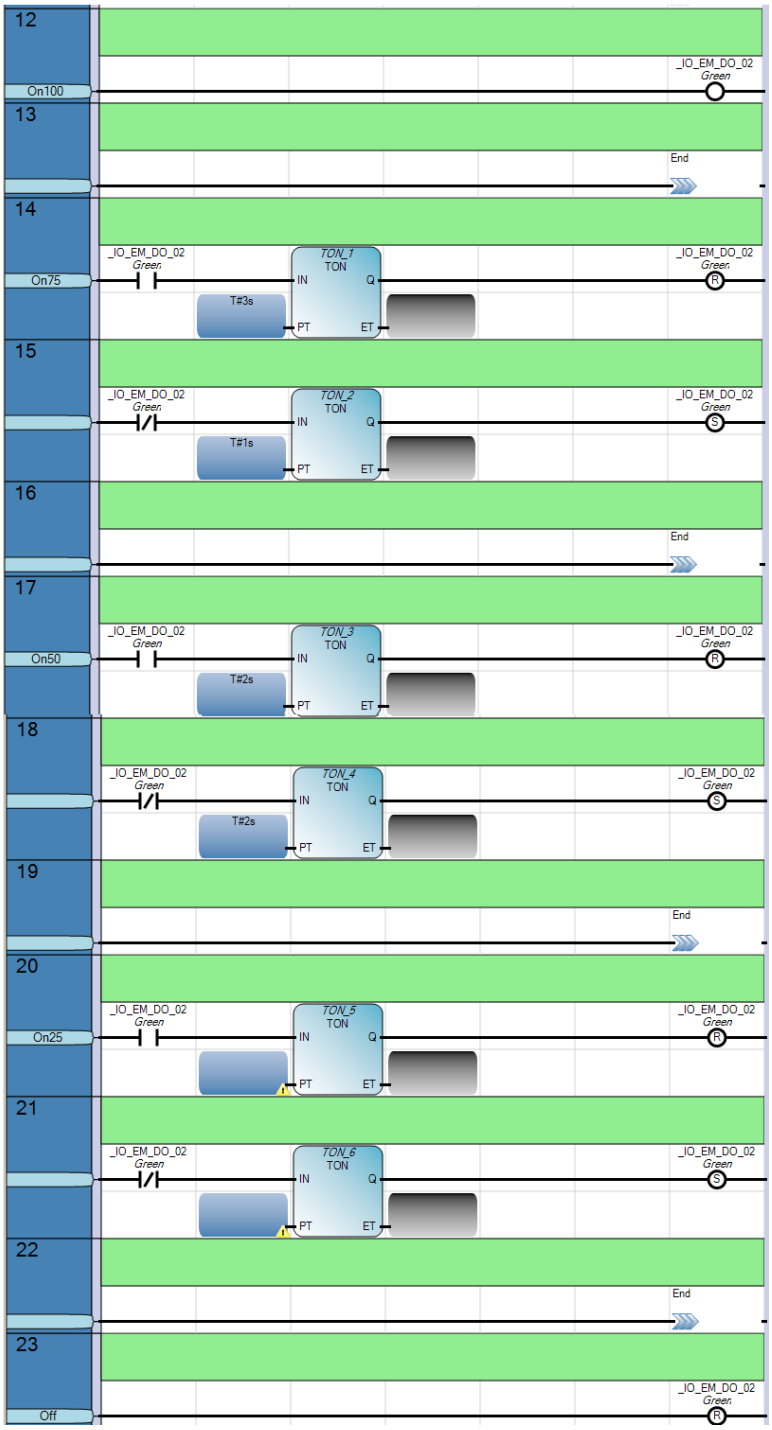
Rung 20 - 22:

25% On. Cycle the fan

- On for 1 second
- Off for 3 seconds
- repeat

Rung 23:

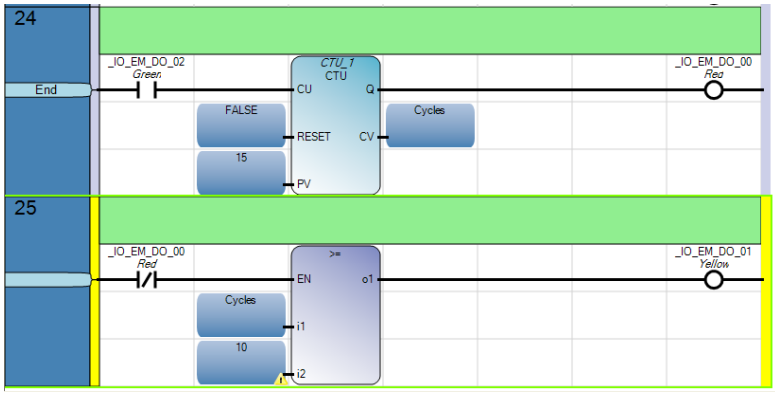
Off (0% On). Turn off the fan.



Rung 24:25

At the end of the routine, keep a running count for how many times the fan has been turned on.

- 10 < Cycles < 15 yellow on
- Cycles > 15 red on



Note: You can also do this with a single pair of On Timers.

- Use variables for the on and off time.
- Change the variables based upon the temperature

This results in a simpler program (there is only one pair of timers for the on and off times)

This makes it a little harder to debug your code and a little harder to change what happens at each temperature. The way this code is written, each routine is stand-alone, allowing you to work on and modify each routine without affecting any other routines.