



DesignNews

PLC-HMI Automation Applications

DAY 3 : plcLib Timers

Sponsored by



Webinar Logistics

- Turn on your system sound to hear the streaming presentation.
- If you have technical problems, click “Help” or submit a question asking for assistance.
- Participate in ‘Group Chat’ by maximizing the chat widget in your dock.



Don Wilcher

Visit 'Lecturer Profile' in your console for more details.

Course Components:

**ELEGOO UNO R3 2.8 Inches TFT Touch
Screen with SD Card Socket w/All
Technical Data in CD for Arduino UNO R3**

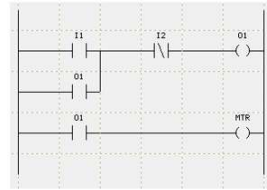


**TWTADE SSR-40 DD 40A DC
3-32V to DC 5-60V SSR Solid
State Relay + Heat Sink**



Agenda:

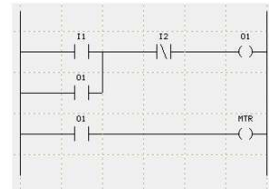
- Timer Basics?
- Solid State Relay Basics
- A plcLib Timer
- Lab Project: Timed Delay DC Motor Controller (Timed Delay Off)



Timer Basics

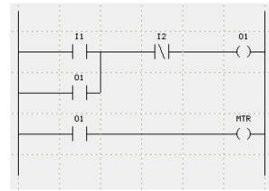
Timers are relevant devices that are used in industrial control systems. Three types of timers used in industrial control systems.

- Analog or mechanical timers
- Digital or solid-state timers
- PLC timers



Timer Basics

Analog or mechanical – used in legacy control systems using relays. Timers can be categorized in to three types:



- a) motor-driven
- b) RC time constant circuits
- c) potentiometers



Question 1

Timers are relevant devices that are used in_____

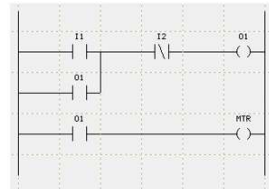
- a) toys**
- b) robots**
- c) industrial control systems**
- d) none of the above**

Timer Basics

Analog or Mechanical

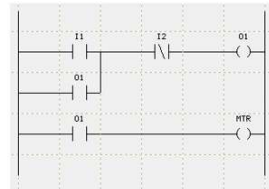
Motor- driven timer:

- uses a synchronous motor and a clutch to actuate Normally Closed (N.C.) and Normally Open (N.O.) contacts.
- have timed and instantaneous contacts



Timer Basics

Analog or Mechanical
Motor- driven timer:

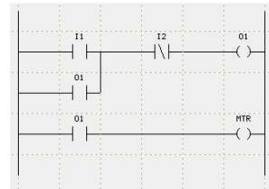


Timer Basics. ...

Analog or Mechanical

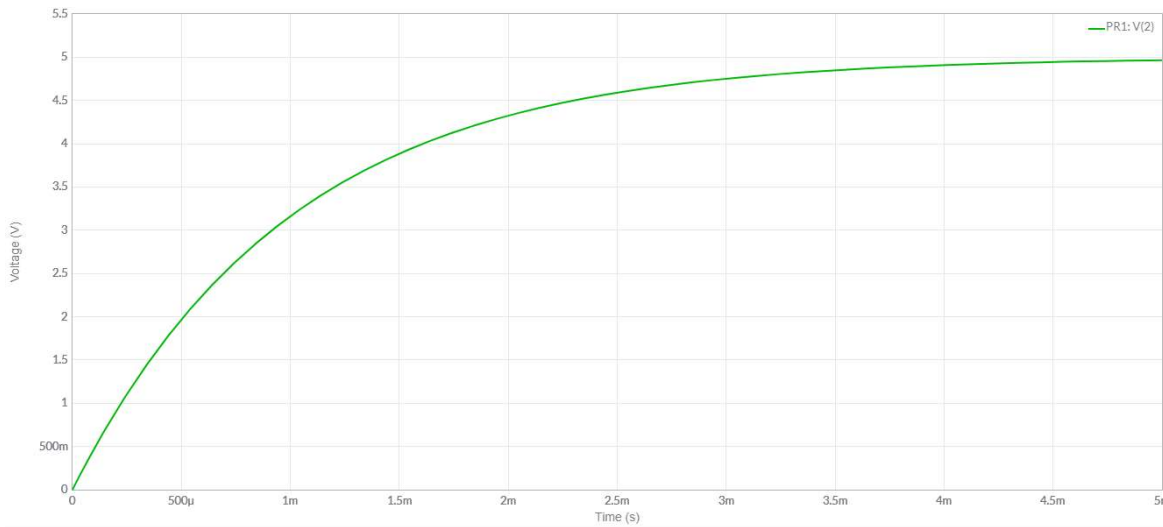
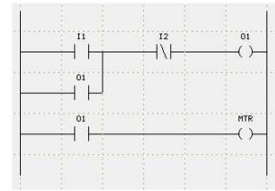
RC time constant timer:

- Connecting a resistor in series with capacitor creates an RC time constant.
- RC time constants (τ : Greek letter tau) is equal to the product of resistance and capacitance)
- Approximately five times the RC time constant (5τ) represents the time to charge and discharge a capacitor.
- Can provide a one-shot pulse after a specified time delay

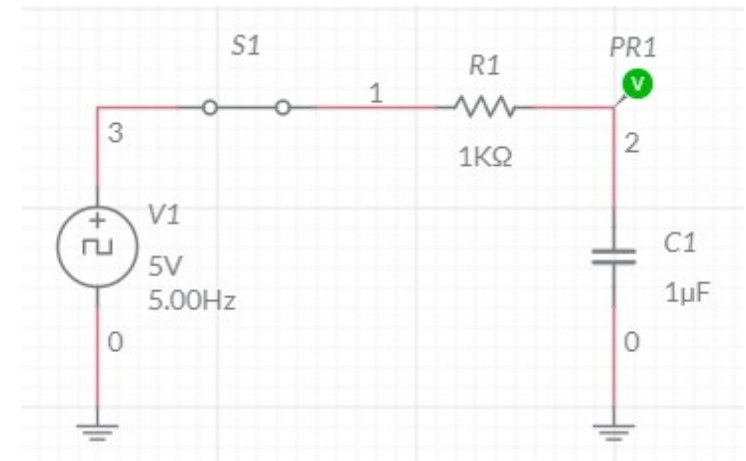


Timer Basics. ...

Analog or Mechanical RC time constant:



Charging Curve



RC Time Constant Circuit



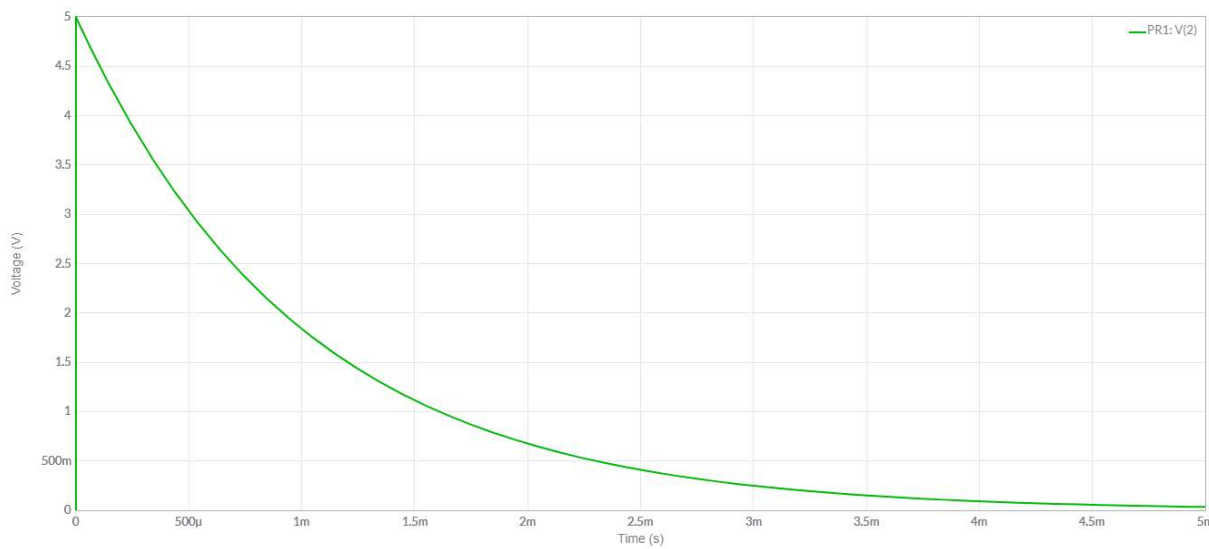
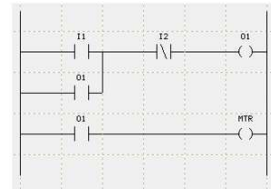
Question 2

What equation represents an RC Time Constant?

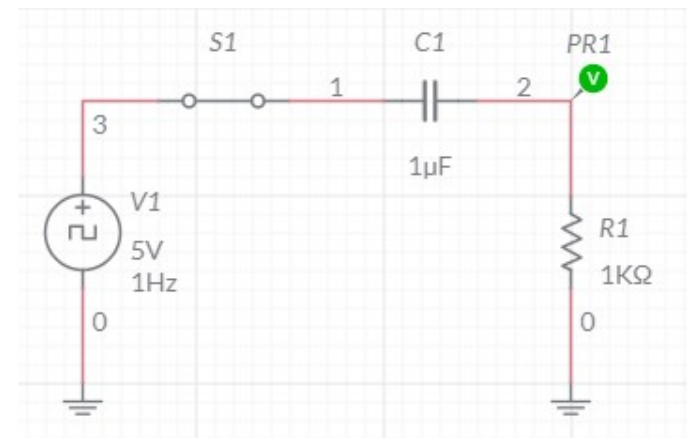
- a) V/R
- b) e^t
- c) 5τ
- d) **None of the Above**

Timer Basics. ...

Analog or Mechanical RC time constant:



Discharging Curve

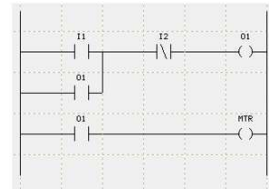


RC Time Constant Circuit

Source: Multisim Online Circuit Simulator

Timer Basics. ...

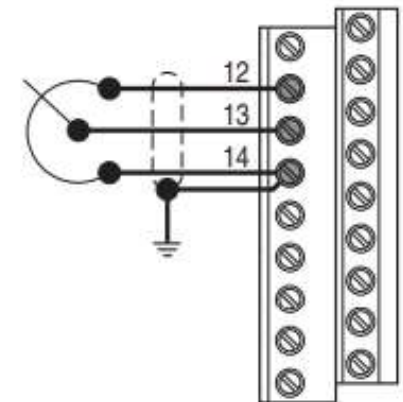
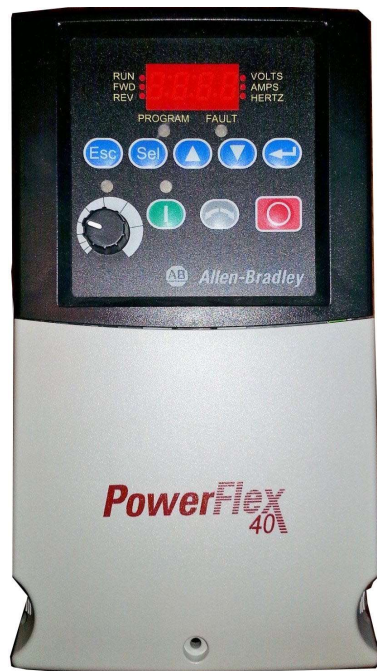
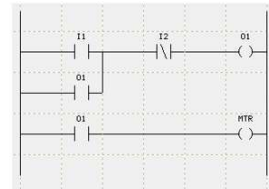
Analog or Mechanical potentiometer:



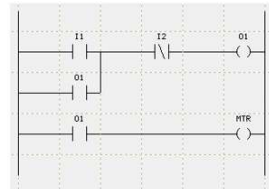
- resistance value of a variable resistance can be used to create a specific time delay
- this type of adjustment is used in power or variable electronic drives
- power electronic or variable drives generate output voltages and frequencies for fixed input voltages

Timer Basics. ...

Analog or Mechanical potentiometer:



Timer Basics. ...

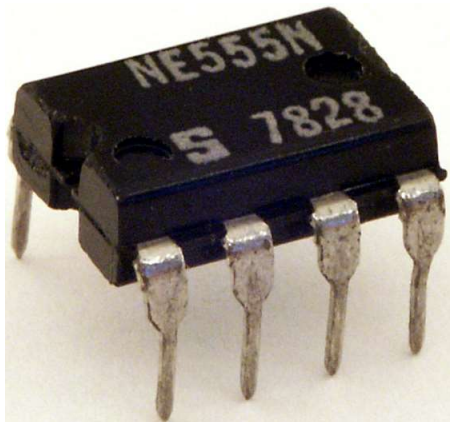


Digital or Solid-State timers

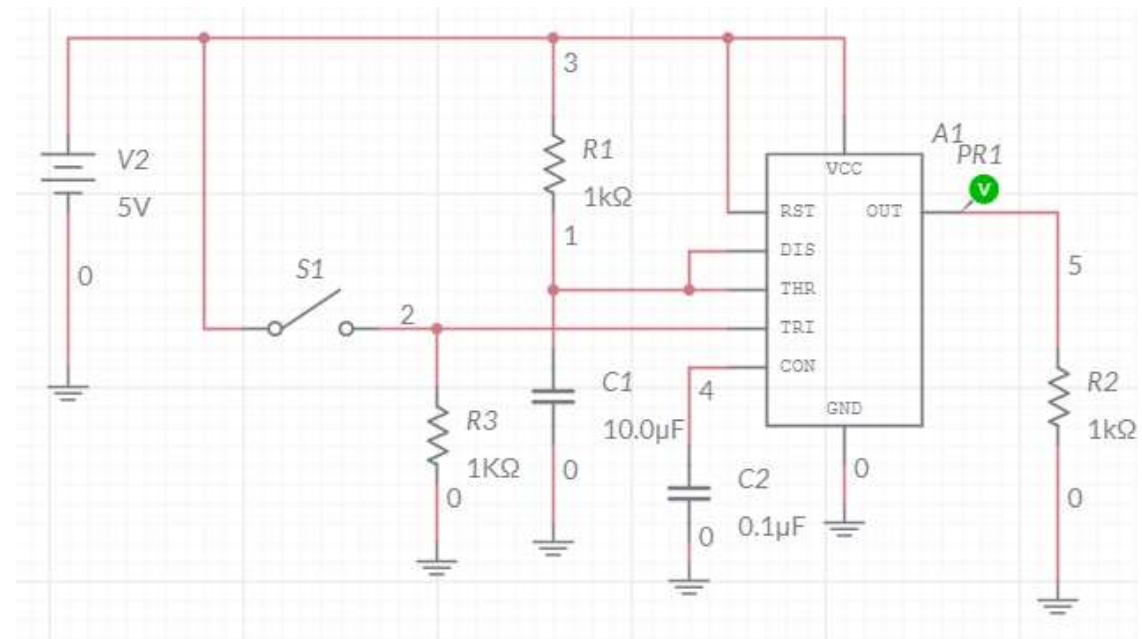
- a) are technologically better than mechanical or analog timers
- b) are smaller and more reliable
- c) are used in digital circuits
- d) a popular digital timer chip is the 555 timer.

Timer Basics. ...

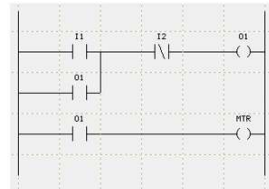
Digital or Solid-State timers



555 Timer IC

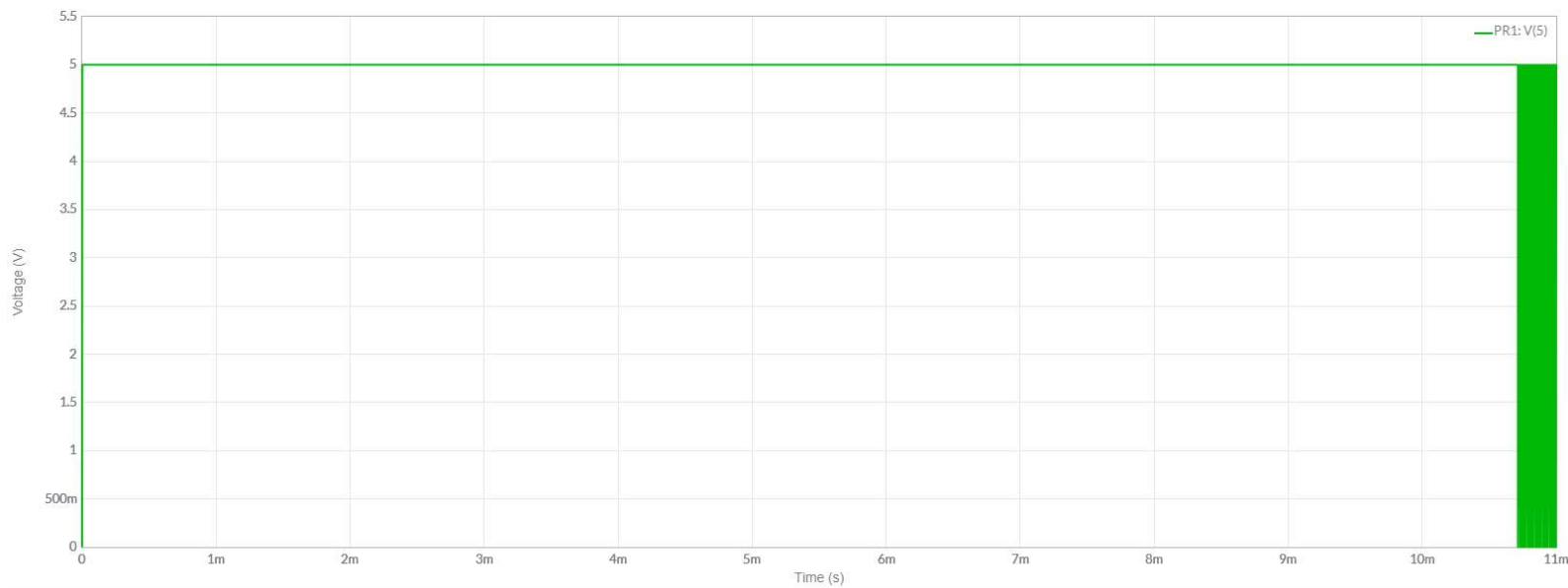
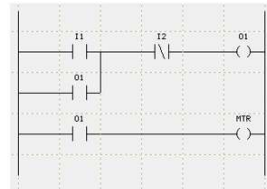


555 Monostable Timer Circuit



Timer Basics. ...

Digital or Solid-State timers



555 Monostable Timer Circuit Output Signal

Source: Multisim Online Circuit Simulator



Question 3

The 545 timer is a popular digital timer chip.

- a) False**
- b) True**

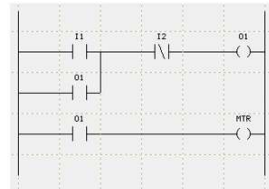
Timer Basics. ...

PLC timers

The PLC system contains many internal timers.

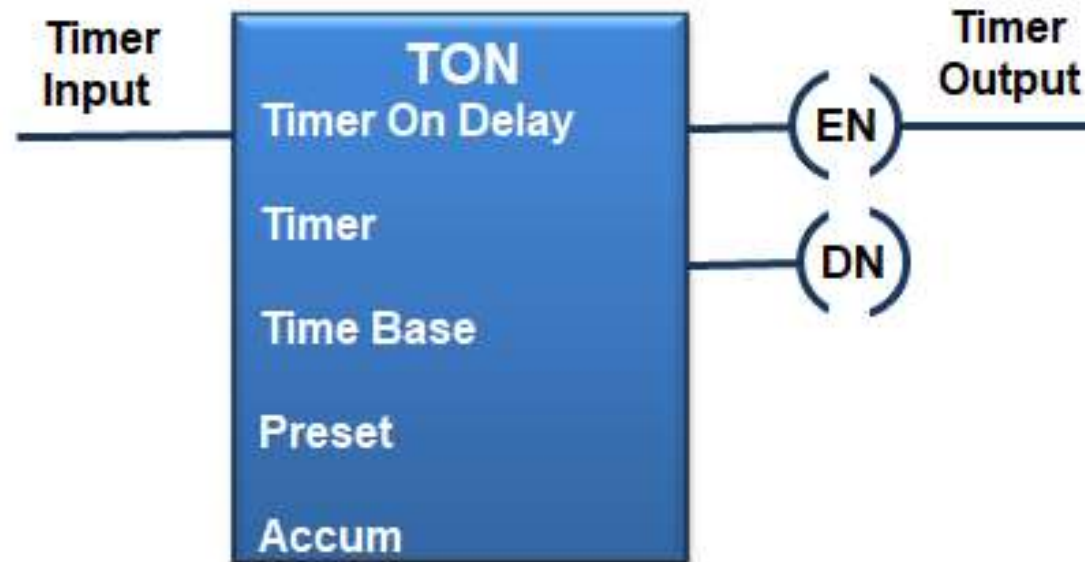
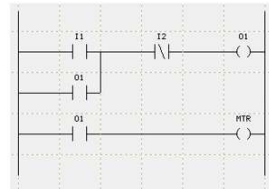
- a) fixed timers – have preset, unchanged value timer instructions
- b) variable timers – which have preset registers that can be changed

Note: timer on or timer off are examples of preset, unchanged value timer instructions.



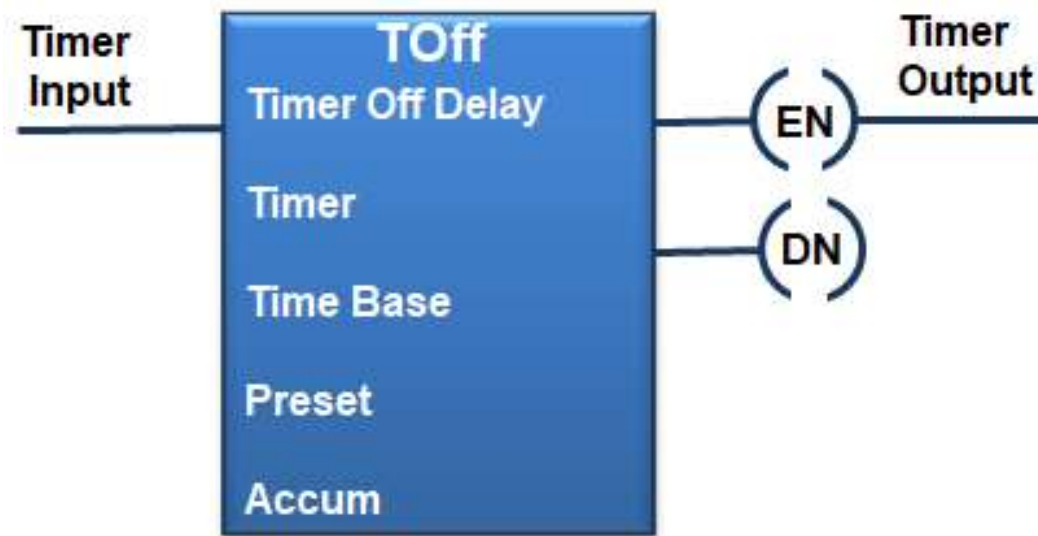
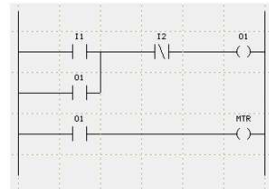
Timer Basics. ...

PLC Timer Instructions:



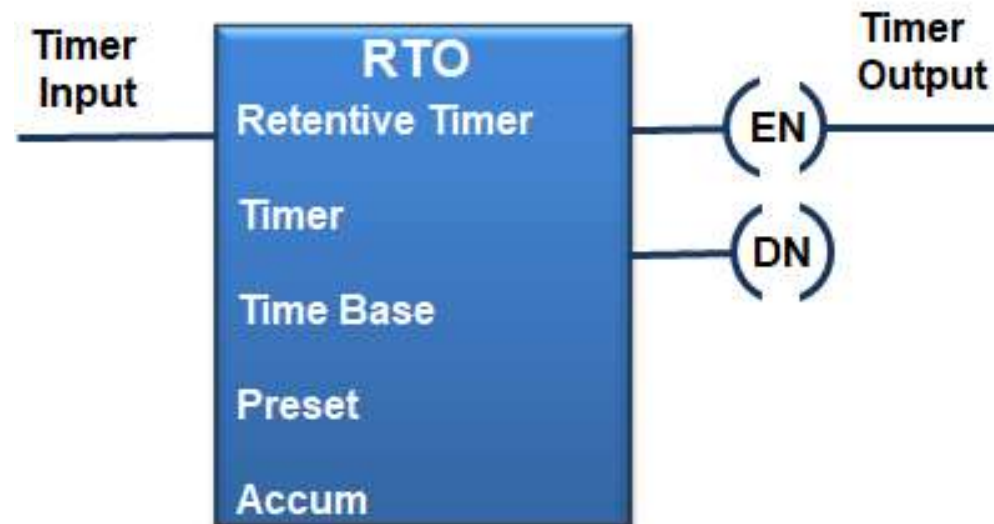
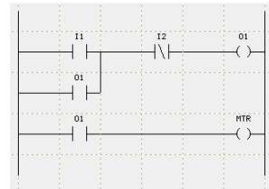
Timer Basics. ...

PLC Timer Instructions:

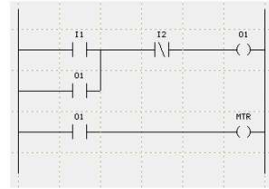


Timer Basics. ...

PLC Timer Instructions:



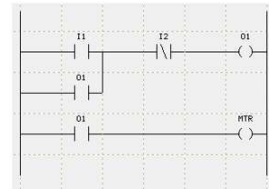
Solid State Relays



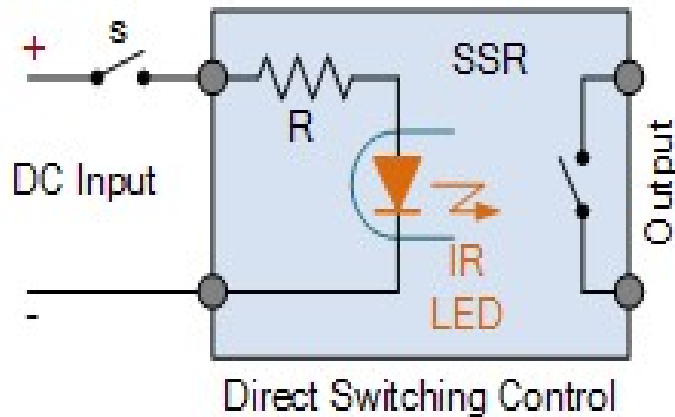
Solid State Relay (SSR) characteristics

- Combine the operating principles of opto-isolator, transistor, triac, or silicon control rectifier.
- No moving mechanical contacts
- Designed to turn on and off high voltage (high-current) loads.
- Traditionally have a single normally-open set of Normally Open (N.O) contacts.
- Can operate in harsh environments

Solid State Relays. . .



Inside a SSR:



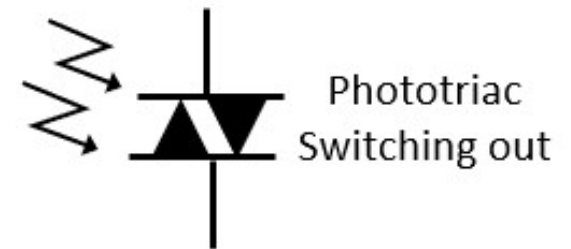
DC Control

Phototransistor:
Power MOSFET
Switching out

DC Control

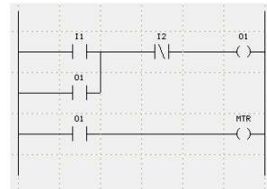
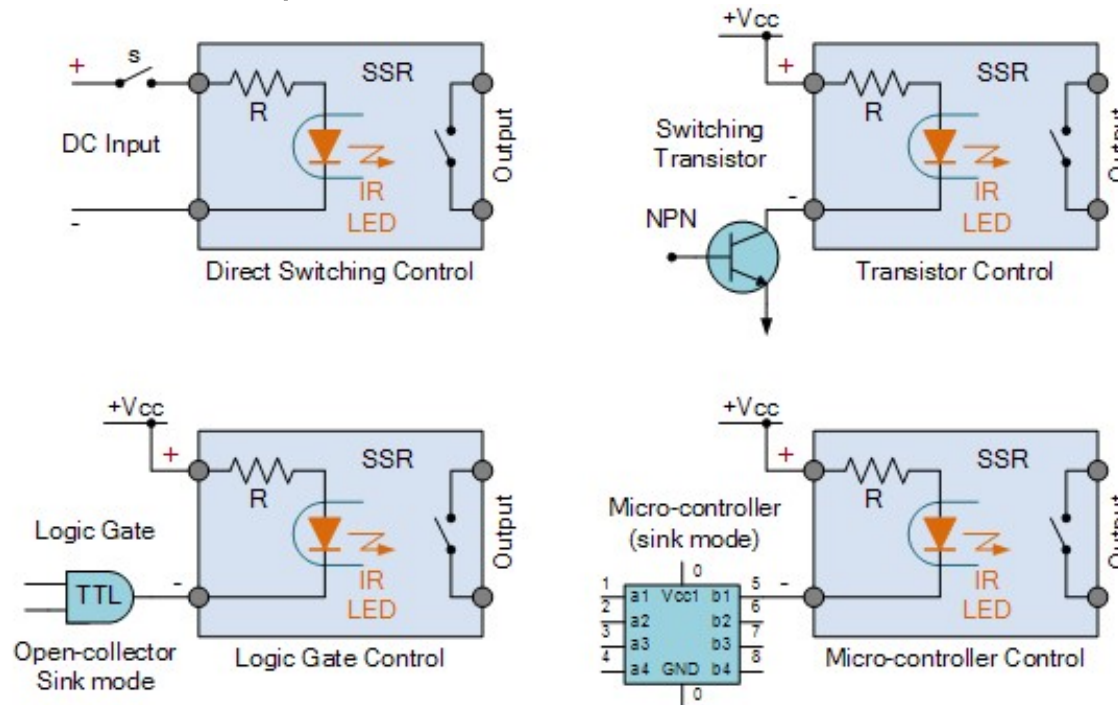
Phototransistor
Switching out

AC Control



Solid State Relays . . .

DC Input Control Techniques:

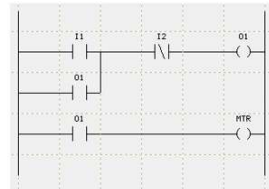


Solid State Relays. . .

SSR Example:

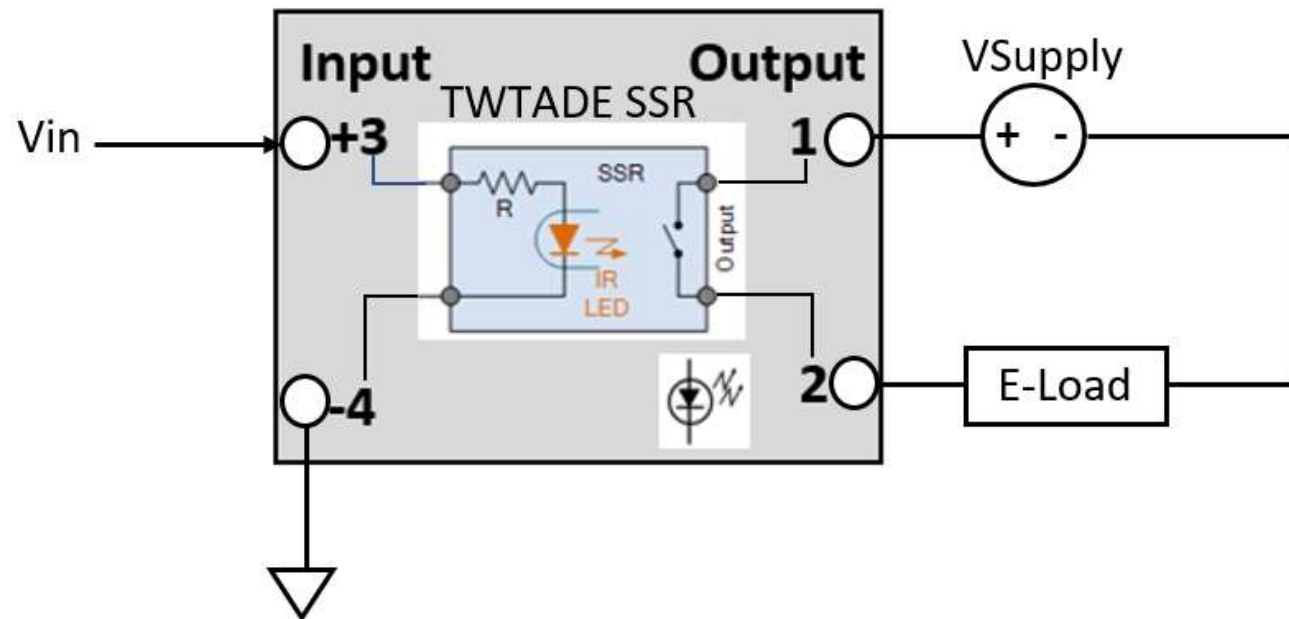
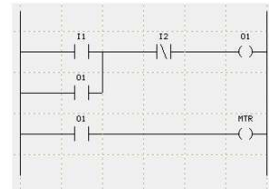
SSR will be used in
plcLib Lab Activity

**TWTADE SSR-40 DD 40A DC
3-32V to DC 5-60V SSR Solid
State Relay + Heat Sink**



Solid State Relays. . .

Electrical Wiring Diagram of TWTADE SSR





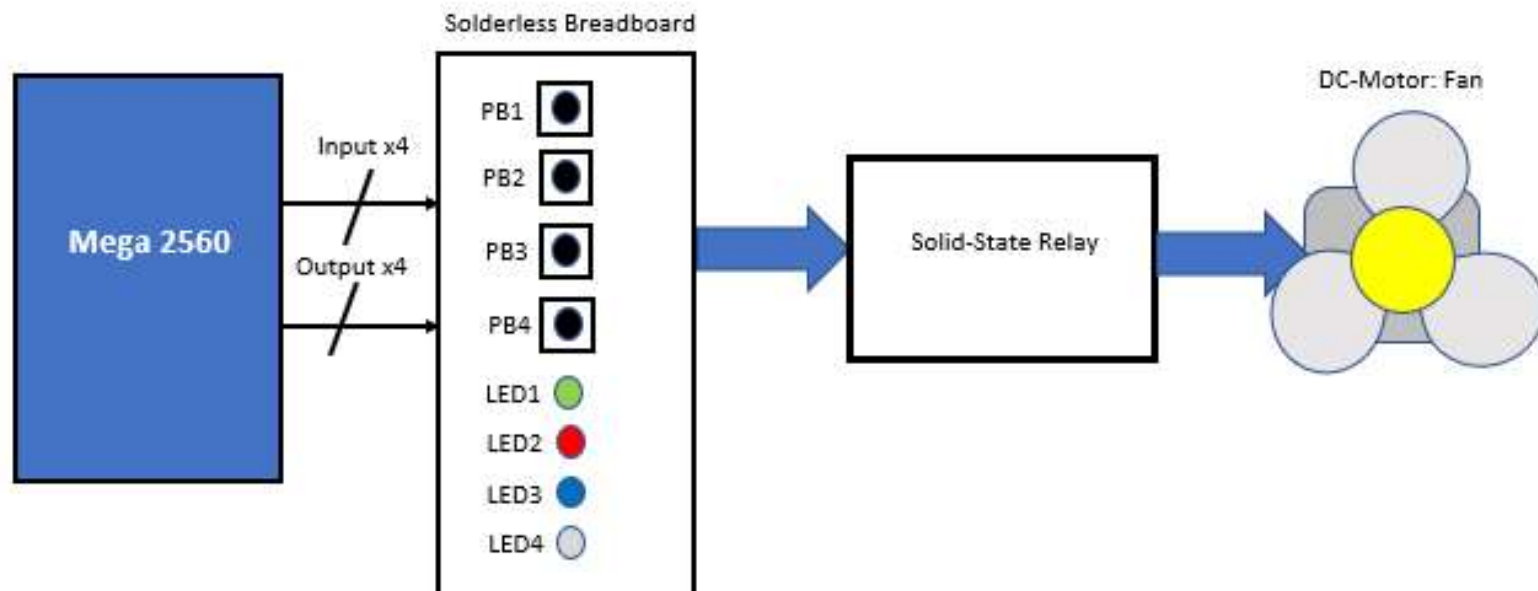
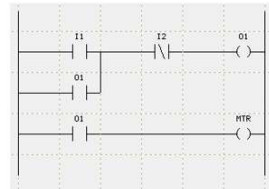
Question 4

A solid-state relay uses the principles of capacitive coupling for output switching control.

- a) True**
- b) False**

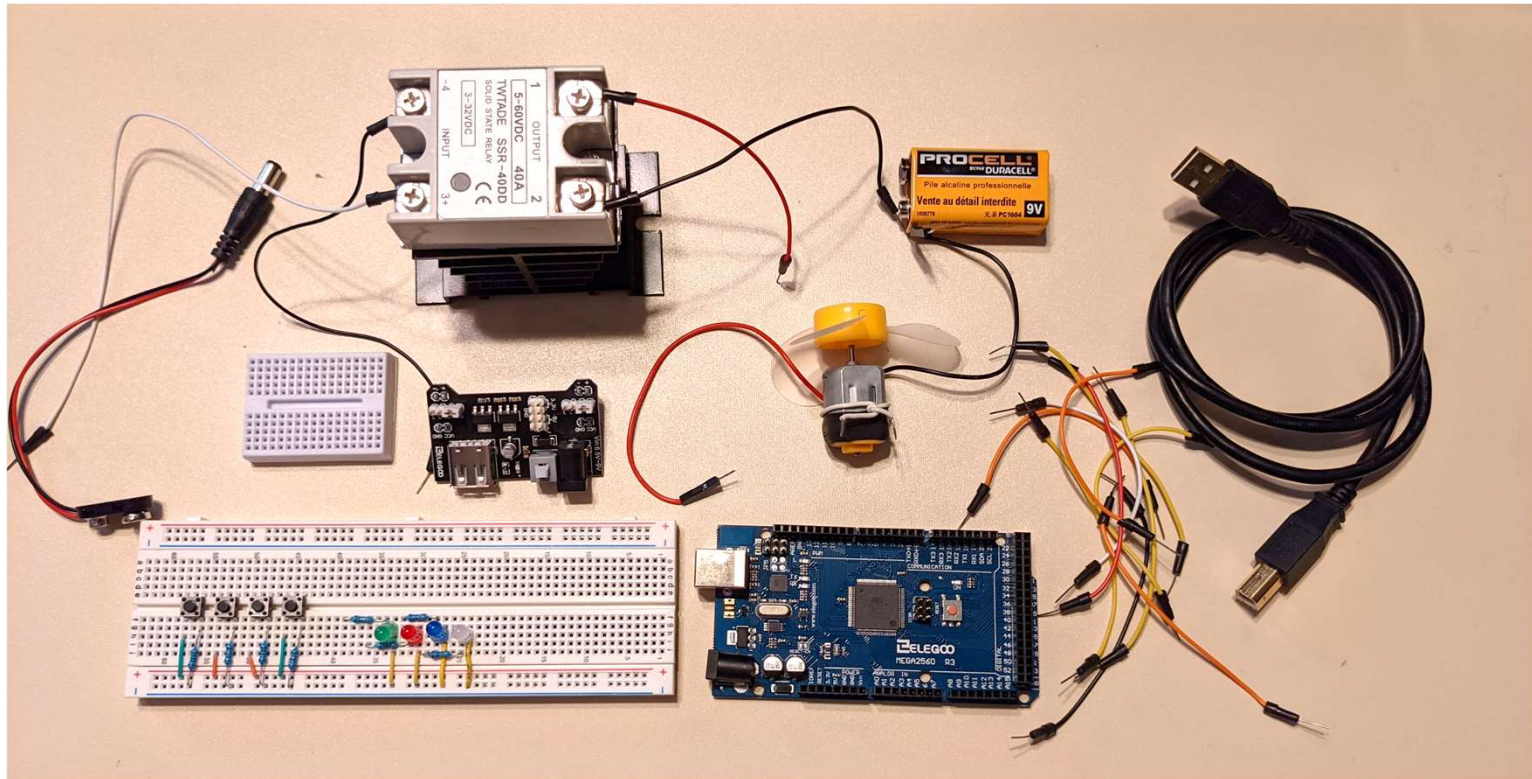
Lab Project: Timed Delay DC Motor Controller

Functional Block Diagram

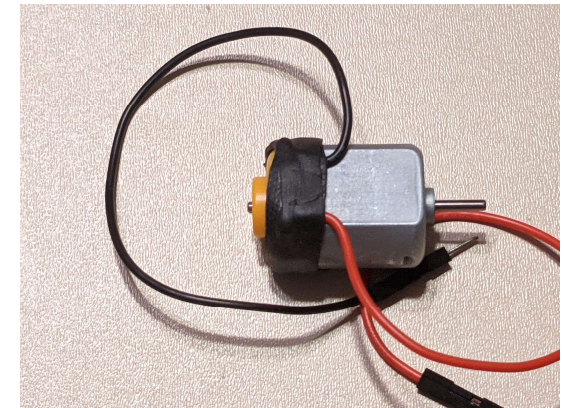
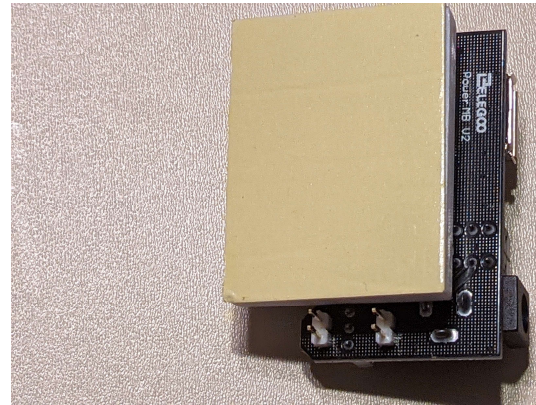
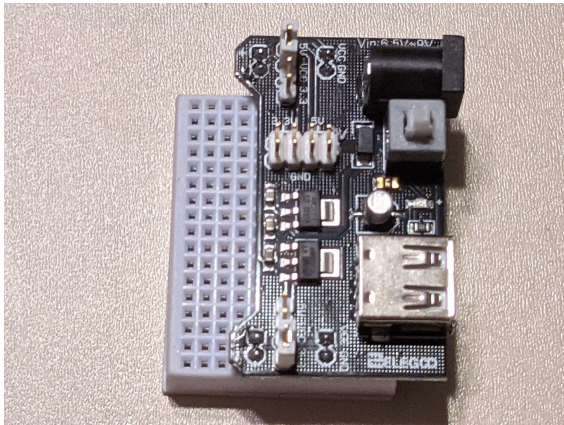


Lab Project: Timed Delay DC Motor Controller. . .

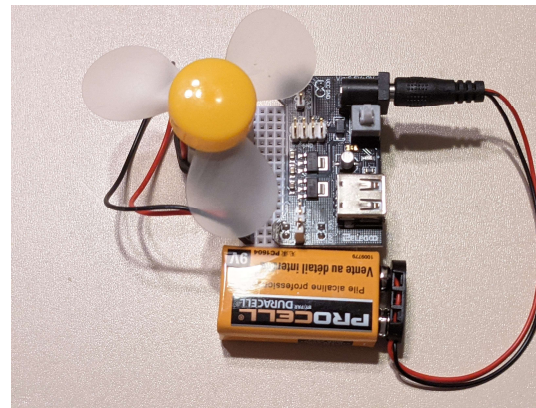
Parts for
Project



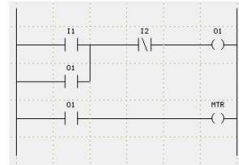
Lab Project: Timed Delay DC Motor Controller. . .



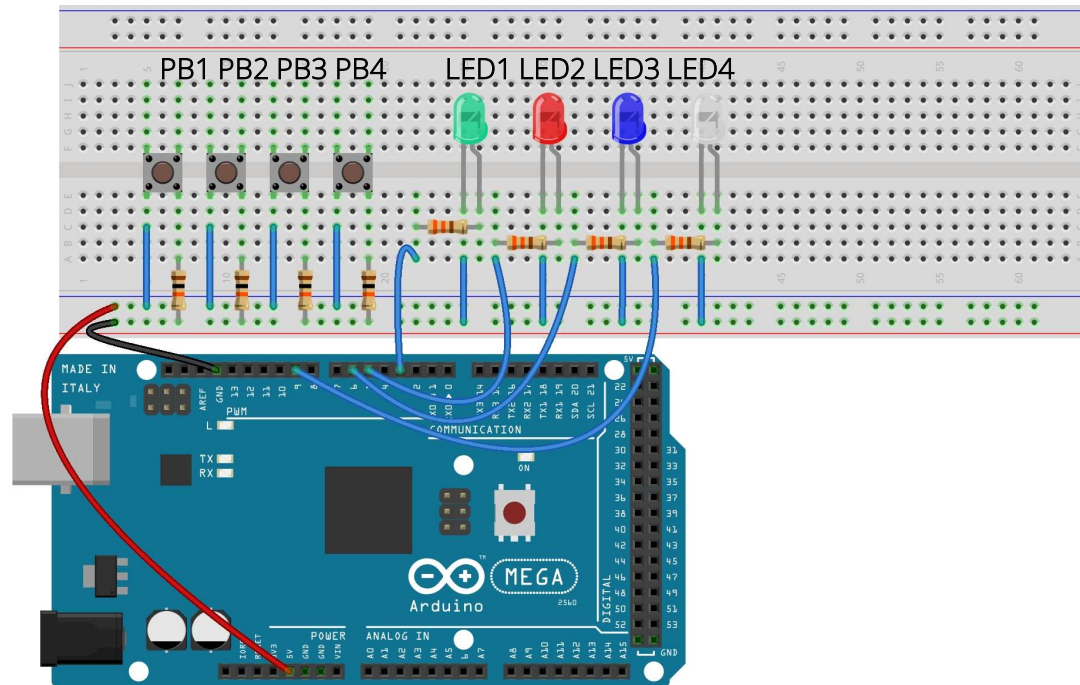
Assembly and Test of Fan
and DC Power Supply



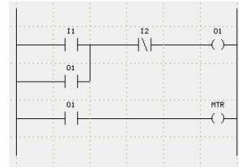
Lab Project: Timed Delay DC Motor Controller. . . Building an Arduino PLC Controller - Concept



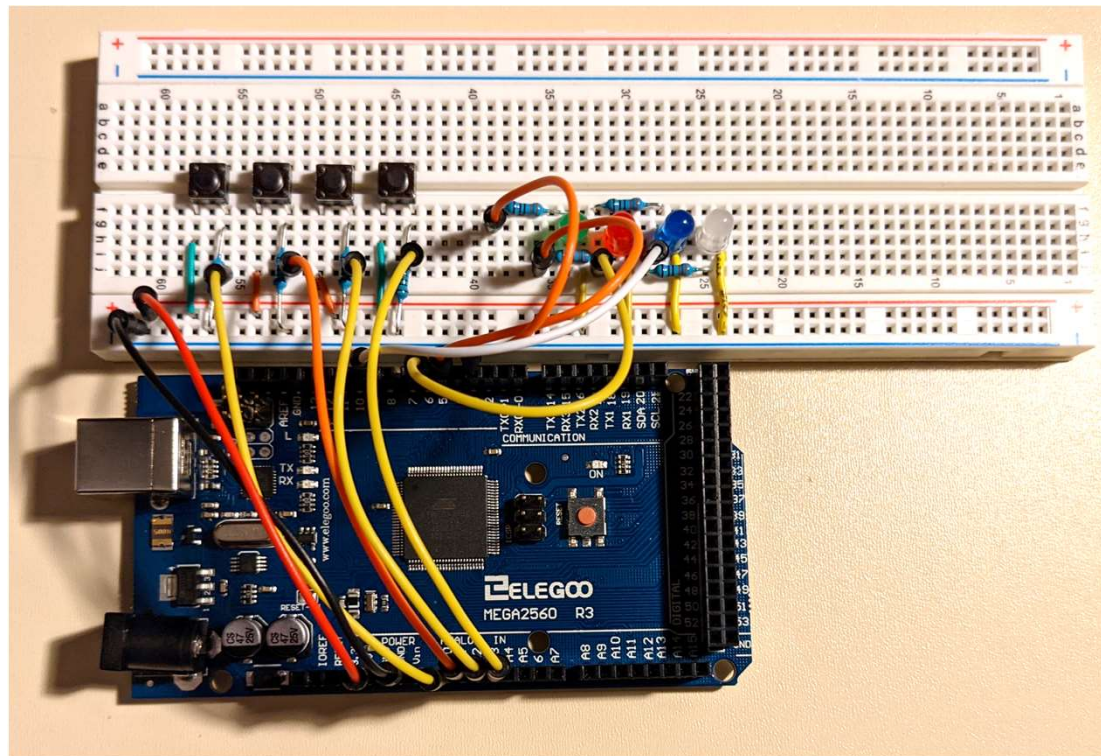
Breadboard Diagram View



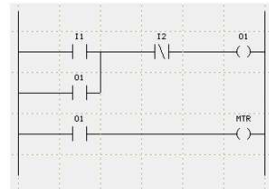
Lab Project: Timed Delay DC Motor Controller. . . Building an Arduino PLC Controller - Concept



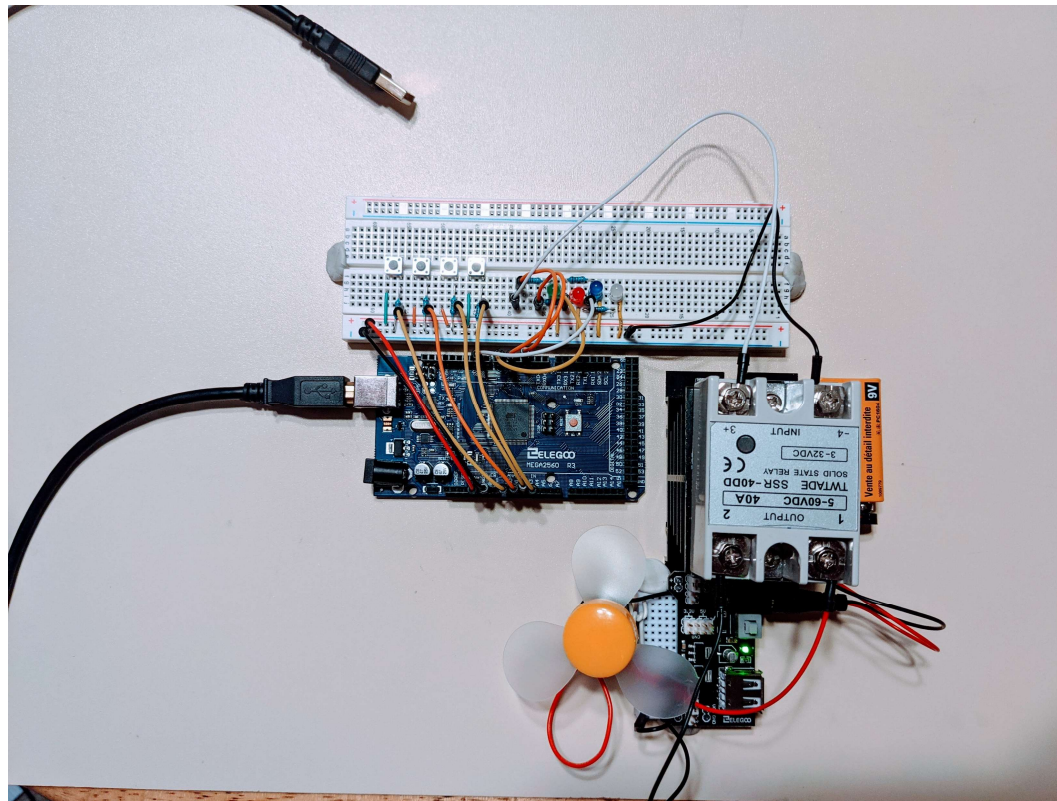
Actual Wired
Breadboard View



Lab Project: Timed Delay DC Motor Controller. . .

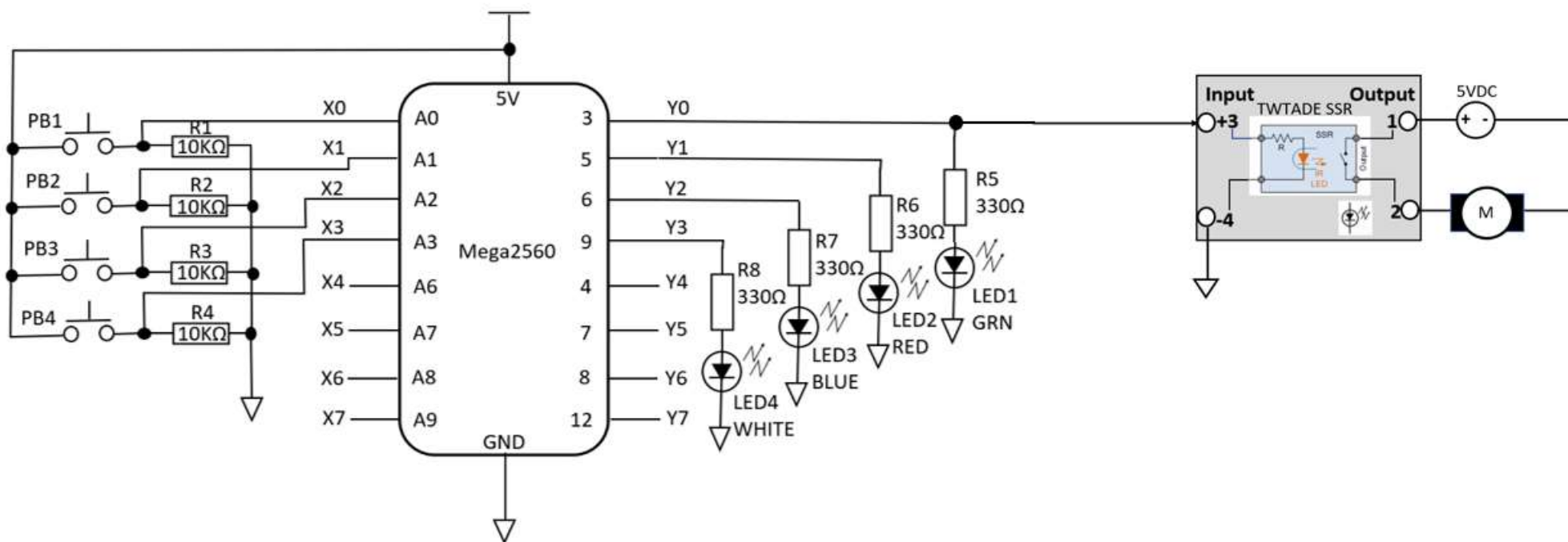
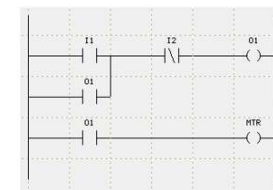


Final
Assembly
of the

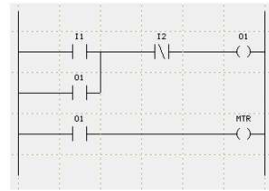
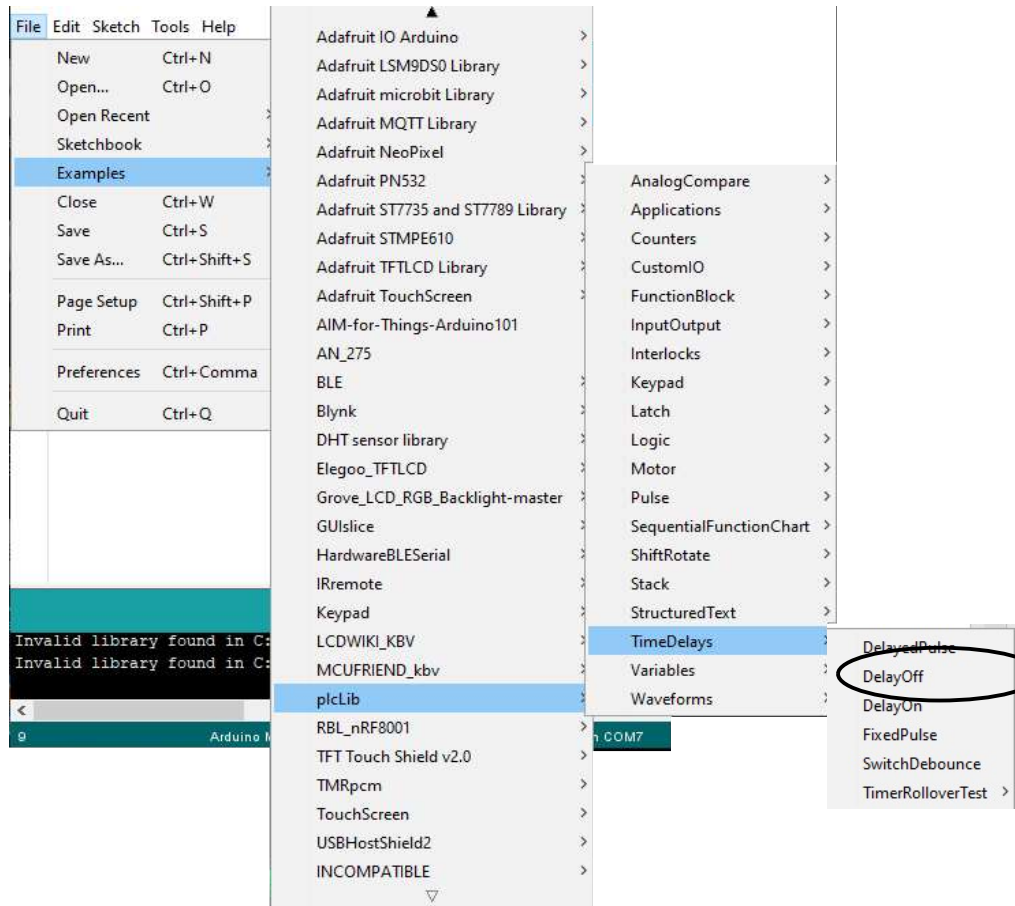


Lab Project: Timed Delay DC Motor Controller . . .

Circuit Schematic Diagram



Lab Project: Timed Delay DC Motor Controller . . .



Code to upload to the Mega 2560

Lab Project: Timed Delay DC Motor Controller . . .

plcLib Timed Delay Off code

```
#include <plcLib.h>
```

Physical I/O

Assignment:

X0 = PB1

Y0 = LED1,SSR

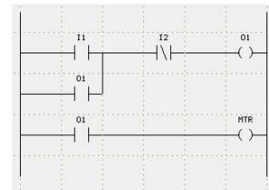
```
unsigned long TIMER0 = 0; // Variable to hold elapsed
time for Timer 0
```

```
void setup() {
  setupPLC();          // Setup inputs and outputs
}
```

```
void loop() {
  in(X0);              // Read Input 0
  timerOff(TIMER0, 2000); // 2 second turn-off delay
  out(Y0);             // Output to Output 0
}
```

Trigger Input →

Delayed Output →





Question 5

In reviewing the plcLib Timed Delay Off code, which line of code could be used to create an on-delay timer?

- a) timerOFF();**
- b) timerRTO();**
- c) timerON();**
- d) None of the Above**

Thank you for attending

Please consider the resources below:

- Rabiee, M. (2018). *Programmable logic controllers: Hardware and Programming* (4th ed.). Goodheart-Wilcox.
- D.Wilcher & Electronics Tutorial:
<https://www.electronics-tutorials.ws/power/solid-state-relay.html>
- Dipslab –
[https://dipslab.com/plc-timer/#Basic internal Circuit of PLC Timer](https://dipslab.com/plc-timer/#Basic_internal_Circuit_of_PLC_Timer)
- Multisim Online Circuit Simulator
<https://www.multisim.com/>



DesignNews

Thank You

Sponsored by

