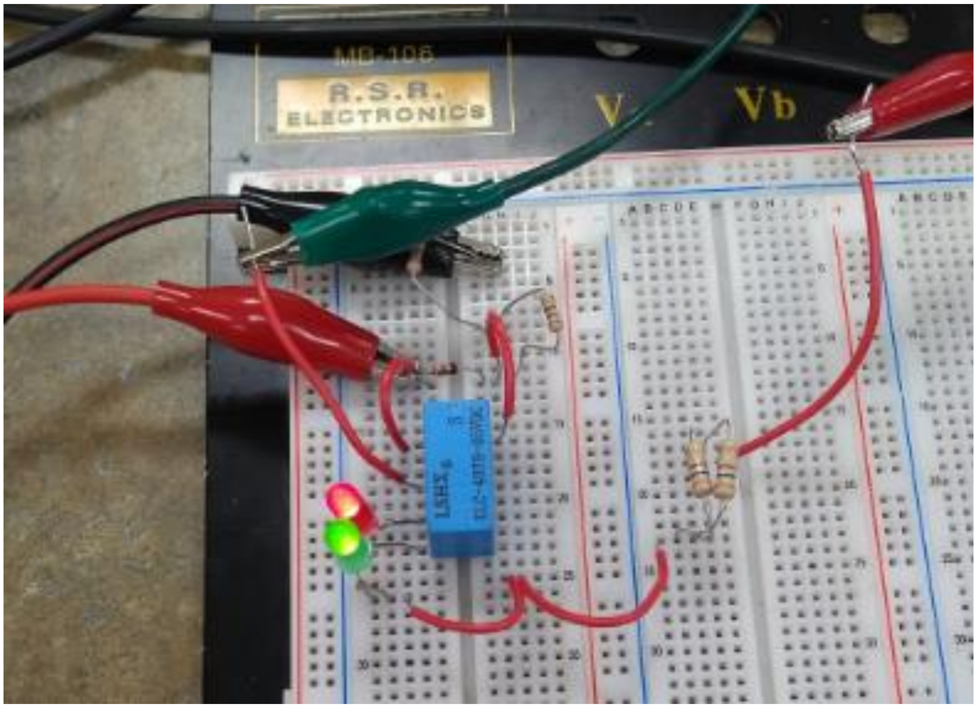
Experiment 35 - Magnetic Devices: DPDT Relay



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Experiment 35 - Magnetic Devices: DPDT Relay

Objectives:

Upon completion of this lab, we will learn to:

- Observe the operation of a relay or solenoid that acts as a SPDT switch and a DPDT switch

Materials:

First, we collected the following materials:

- DDM
- DC power supply
- 12-volt DPDT relay
- 5-volt DPDT relay
- 360Ω resistor (2)
- 11Ω (¼ watt) resistor
- 36Ω (¼ watt) resistor
- 20-Gauge Wire
- Red LED
- Green LED
- Test leads
- 1N4148 small signal diode

Procedure:

First, we flipped the 12-volt DPDT relay upside down and labeled the pins from 1-8 as shown in figure 1-8.

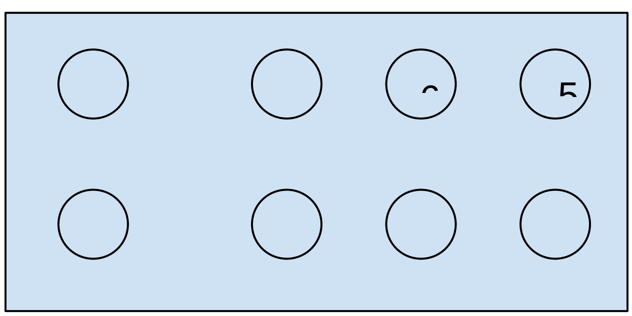

Figure 35-1

Pins 1 and 8 (Figure 35-1) were separated from the other pins, indicating that they're connected to a coil in the relay. To confirm this, we used our DMM (digital multimeter) to measure the resistance between the two pins and recorded in below in table 35-1:

Pins	Resistance
1-8	399.8Ω

Table 35-1

Based on table 35-1, the inductor coil carried some resistance.

Next, we used our DMM (digital multimeter) to measure the resistance between pins 2 and 3 then 7 and 6. The resistance across the pins were then recorded below in table 35-2:

Pins	Resistance (in Ω)
2-3	0.6
7-6	0.4

Table 35-2

Based on table 35-2, the resistance between the pins were nearly equal to zero ohms, indicating that those pins are connected and thereby closed while the other pin combinations (2-4 and 7-5) are open.

We connected a 5V battery to pin 2 which is normally closed with pin 3 and normally open with pin 4. Pin 3 was connected to a red LED while pin 4 was connected to a green LED with the negative side facing the negative side of the battery. The LEDs were connected together to a 180Ω resistor which was connected to the positive side of the battery. Pin 1 was connected to the negative side of a 12V battery while pin 8 was connected to a switch which was connected to the positive side of the 12V battery. The circuit that was made is shown in figure 35-2.

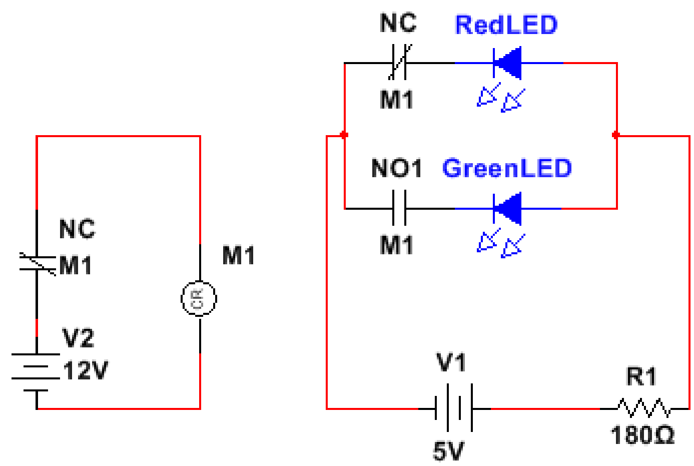

Figure 35-2

V1 was set to zero volts and was increased until the green LED turned on and the red LED turned off which was at 6.93V. Then the voltage was decreased until the green LED turned off and the red LED turned on which was at 3.25V. We then recorded theses voltages down below in table 35-3:

V1 Voltage (in V)	Previous Relay Energized Status	Result Relay Energized Status
0	Off	Off
6.93	Off	On
3.25	On	Off

Table 35-3

Based on table 35-3, more voltage is required to make the relay energized than to keep it energized.

Next, we used the second pole of the relay for schematic 35-2 and connected pin 8 to S1 which was connected to the positive side of the 12V power supply and parallel to pins 2-4. The circuit that was made is shown below in figure 35-3:

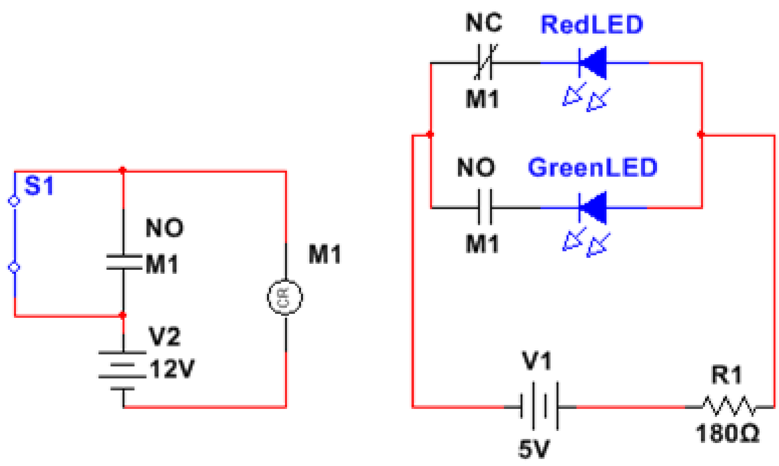

Figure 35-3

We then closed S1 which created a closed circuit, allowing the relay to be energized and the green LED was on. which closed pins 2-4. S1 was then switched to open and the relay continued to be energized and the green LED was still on. When S1 was closed, the relay was chattering and when S1 was open there was no chattering.

The S1 switch was removed and pins 2-4 were no longer connected to the 12V power supply. The power supply was connected between pins 2-3 which was normally closed, and the S1 switch was placed between pin 8 and pins 2-4.

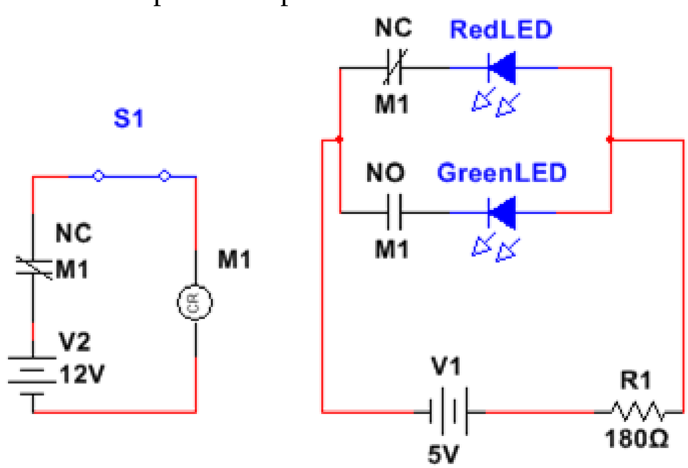

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Figure 35-4

We set S1 to closed which engernized the relay. However, this created an open between pins 2-3 which cut of the power to the inductor which de-energized the relay. This caused pins 2-3 to be closed again and re-energized the relay. This created a back and forth action of the relay being de-energized and re-energized. Each time the LED switched, there was a clicking noise called chattering relay. This is why this type of circuit is called a chopper circuit.

Next, the 12-V DPDT relay was replaced with the 5V DPDT relay. The 11Ω (¼ watt) resistor were connected in series 36Ω (¼ watt) resistor as to have a combined watt rating of ½ watt and were connected to the negative side of the output from the function generator and pin 8. The positive side of the output from the function generator was connected to pin 1. The 1N4148 diode was connected parallel to the inductor with the negative side facing the negative side of the function generator. The circuit that was made is shown in figure 35-5.

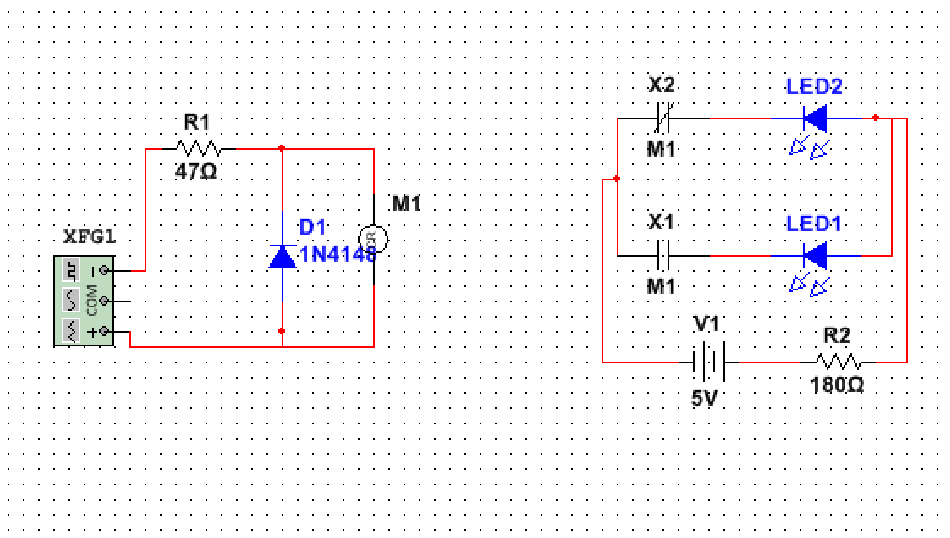

Figure 35-5

The frequency generator was set to generate a box-square wave of 5 Hz. As a result, the LEDs turned on and off quickly. When increasing the frequency of the wave, the LEDs would turn on and off faster while decreasing the frequency of the wave caused the LEDs would turn on and off slower. When we increased the frequency to 48 Hz or above, the LEDs appear to light up simultaneously with no flickering.

Observations:

1) Observations throughout the experiment

a) A relay is an electromechanical switch. It uses a magnet to touch contacts. Relays are quicker than mechanical switches, but they induce voltage due to the energized magnetic field created when electricity is applied to the relay.
b) The LED flash was visible to the human eye at frequencies lower than 2Hz.
c) The relay switches faster than a manual switch and has a higher frequency. This is because relays only need electricity to switch while manual switches require an outside force to push them.

Discussion:

We had a bunch of issues with this experiment. First of all, in the first part (steps 2-5) we really did not know where SW1 was or what it was. It was not shown is the lab book, but it being mentioned in the steps. We asked where it would go, and we were given false information. We were told that it would be on the positive side of the 5V battery, but it was supposed to be connected to pin 8 of the 12v relay. We noticed that the 5V was wrong because when we opened it the circuit was not complete. The LEDs shut off and then we tried opening the switch at the 12V. We ended up doing what the lab book explained what was going to happen.

It was going relatively smoothly until we got to the final few steps. We got to the function generator and due to all of our lack of knowledge it was bound to be problematic. First of all we did not know how to setup the function generator. We again had to ask and found out if you use an oscilloscope you will be able to see if you set the function generator up correctly. The next thing that happened wasn't so much a problem, but the right way to do it. Instead of using two probes for the frequency and ground, and run the risk of having the probe set to X10, we used a BNC to alligator clip probe instead.

Conclusion:

Based on table 35-1, the inductor coil carries around 400Ω. According to table 35-2, pins that are closed have a resistance between the them nearly equal to zero ohms. Based on table 35-3, more voltage is required to make the relay energized than to keep it energized. Increasing the frequency of the wave, the LEDs would turn on and off faster while decreasing the frequency of the wave caused the LEDs would turn on and off slower. When the frequency reaches around 48 Hz or above, the LEDs appear to light up simultaneously with no flickering. In a chopper circuit, once the relay is energized it stays energized even if the switch is set to open. When the switch is parallel to the normally open pins and is set closed, then the relay has a chattering sound and when the switch is open there is no chattering.