Flyback Diode Experiment

EET-200L **Name**_____

Instructor Initial _____ **Date**_____

Construct a circuit which will function as the schematic diagram on the back. The voltage of the relay coil given to you will most likely be either 5V, 12V or 24V, but verify that with your specific relay. Make sure you use the correct voltage so that the relay will operate properly. You might have to do some research to determine the proper wiring for your specific relay.

The goal for this experiment is to observe the effects of a *flyback diode* placed across the coil of the relay to suppress the *high-voltage transients* which occur when the current through a coil is abruptly interrupted. You should observe voltage "spikes" of 100's of volts due to the *back emf* across the coil whenever it is disconnected from the power. For each run, make a note of the highest back emf voltage observed across the coil. The experiment is pretty straight forward. But the techniques you'll need to implement using the oscilloscope make the measuring part of the of the experiment a challenge.

The following are recommendations for initial oscilloscope settings to capture a high speed transient, high voltage spike occurring randomly or aperiodically. For screenshot measurements you will definitely want to measure the Maximum & Minimum voltage for each scope trace. Include other measurements you might think are relevant.

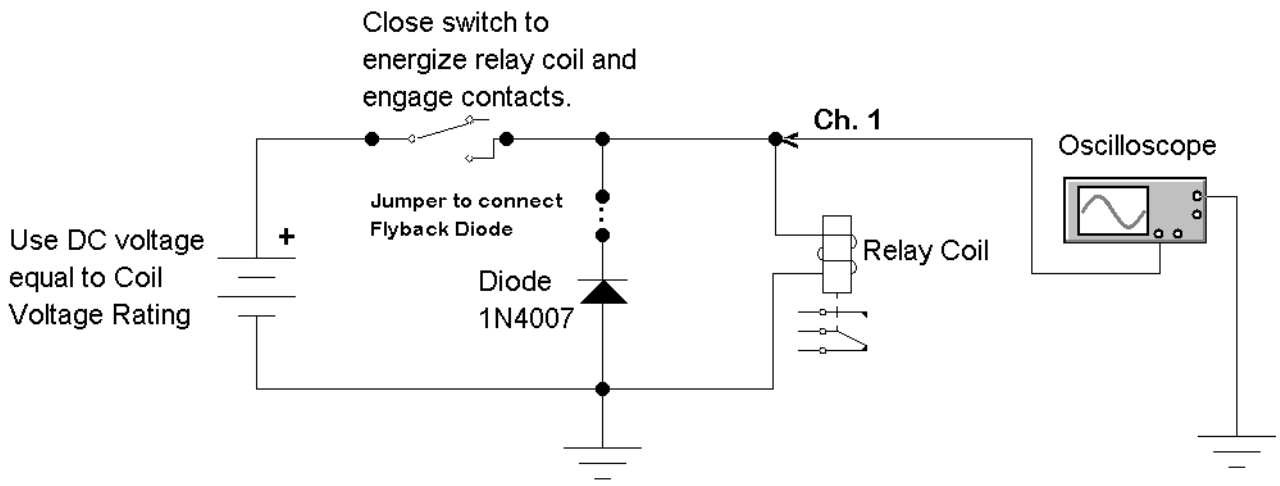
Vertical: The channel input gain (*Volts/DIV*), as always, needs to be set for the best scalable display. Without the flywheel diode the scope will have to display 100's of volts (peak). This will require that the probe be set to a 10X setting when the flyback diode is not present. Make sure the oscilloscope inputs reflect the scaling factor (1X/10X) of the probe connected to it. (See *Probe* controls/settings for each input.)

Horizontal: The Time Base (*Time/DIV*) of the scope should be set to allow you to display several instances of the relay being energized & de-energized on one screen trace (for example: 500 mSec/Div provides about 5 seconds of display across the scope display). As you adjust the Time Base, you might also wish to shift the display toward the left to provide a better display.

Triggering: Since these are *transient signals*, they appear randomly and/or aperiodically and then disappear. (A *transient signal* is one which generally exists only briefly.) Therefore you will need to set up your scope using the *Trigger* controls in combination with the *Single Trace* display option to capture and view these signals. You will need to set the *Trigger* controls to *Ch. 1* (assuming you are using Ch. 1 on your 'scope) and you may find *Falling Edge* triggering will work best because you will want the scope to trigger when the voltage at the coil "falls" from +V to ground. You should set the *Trigger Level* control to approximately 80% of your DC coil voltage. (That will cause the scope display capture to trigger when the observed voltage on Ch. 1 drops below this 80% point. Example: For a 12V relay, the trigger voltage would be about 9.6V or so. It's not critical.)

You should collect at least two screenshots: one showing the high voltage transient spikes of the *back emf* (no *flyback diode*) and one showing the suppression effects of the *back emf* due to the *flyback diode*. Your screenshots must have the relevant information about the waveform being captured. Feel free to repeat the exercises several times to see what the maximum *back emf* voltage is you can generate by your relay.

Be sure to answer the questions on the back page.



Flyback Diode Experiment Sample Circuit

Questions

1.) What was the maximum back emf voltage you were able to measure during this experiment? _____

2.) What was the maximum back emf voltage measured when the flyback diode was active? _____

3.) With your scope probe set to 10X, what is the maximum peak (positive or negative) voltage that could be measured on an input channel of your oscilloscope? (HINT: How many vertical divisions are there? Also remember that ground or 0V can be put anywhere on the vertical axis of the scope display.)

4.) With your scope probe set to 10X, what is the maximum peak-to-peak voltage that could be measured on an input channel of your oscilloscope?

5.) What is the purpose of selecting which source the oscilloscope will use to trigger the display?

6.) What is the purpose of the "Trigger Slope" control?

7.) What does the "Trigger Level" control do?

8.) Why did you use the "Single Trace" feature of the oscilloscope for these displays?