LAB #1 report. MAE 106. UCI. Winter 2005

Nasser Abbasi, LAB time: Tuesday 1/11/2005 11:00 AM-1:50 PM

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1 Answer 1.

1. Oscilloscope: This is a device to allow one to analyze and display the electric signal in the circuit. One can use it to display the electric signal trace on the screen and to measure different properties about the signal. One can use it to display different properties about the voltage, such as the max/min, vpp. In addition it is used to measure the frequency properties of the signal.

2. Function generator: This device is attached to the training kit, and was used to generate electric signals of different time-domain shapes, such as square, triangular and sinusoidal signals. One can also adjust the frequency, amplitude and phase offset at which these signals are generated.

3. Solderless breadboard: This makes it convenient to quickly build and connect simple circuits since it eliminates the need to make soldering to connect different parts of the circuits together.

4. potentiometer: Also called 'pot'. This allows one to adjust the voltage entering one branch of the circuit by allowing one to adjust the resistance by turning a knob. It is a Voltage divider.

2 Answer 2.

The MOSFET has 3 ports. G, D, S. We control the voltage supplied to the gate G by using a pot. When V_G changes, this causes voltage at port D to change (V_D) as well. But voltage across the motor depends on V_D hence we can control the voltage across the motor.

By controlling the voltage across the motor, we control the torque generated by the motor.

Note that the change between V_G and V_D is not linear. As V_G changes, the internal MOSFET resistance R_{DS} changes, and this causes V_D to change.

The voltage across the motor depends on V_D by the relation $V_{motor} = V_s - V_D$ where V_s is the fixed source voltage.

By using MOSFET only to control voltage to the motor, it acted as an approximation to an on/off switch. This is because a small increment in V_G caused a sudden large increase in V_m to appear. However, as V_G continued to increase, V_m did not continue to increase as well, but remained steady. See plot of V_m vs. V_G. This shows that the nonlinearity of MOSFET makes it hard to use to control the speed of the motor.

On the other hand, a small voltage at the gate caused a large voltage to appear across the motor, so this shows that MOSFET acted as a device that can be use to supply power to other devices.

3 Answer 3.

When we used just the MOSFET to control the speed of the motor, it was hard to slow down or speed up the motor shaft spin. The motor will either spin or stop by changing the pot dial across the range of the dial. This is due to the nonlinearity of the MOSFET. So, to use MOSFET to supply power to the motor, we need to be able to better control the voltage it generates, and to do this, we use an Op-Amp.

By using an OpAmp, using negative feedback, we feed the voltage output from MOSFET back into the opAmp. This causes Voltage at the gate V_G to adjust so that voltage output from MOSFET follows voltage input to the opAmp.

So, by changing the input voltage to the OpAmp via the use of the pot, and having negative feedback, the voltage output from MOSFET follows the input voltage more closely. Since output voltage from MOSFET is linearly related to the speed of the motor, we are now able to better control the speed of the motor. This circuit is shown in figure 6 in LAB1 handout.

4 ANSWER 4

I have written a simple program to generate the diagrams required from the data collected in the Lab. This is the final plot output. First, this is the data collected:

Out[46]//TableForm=

	VGS (Volt)	RDS (Ohm)	Vmotor (Volt)
1	5.77	0.0525276	11.9937
2	5.23	0.0592017	11.9929
3	4.33	0.0817334	11.9902
4	3.21	33.3333	9.
5	2.21	10809.1	0.11
6	1.18	10809.1	0.11
7	0.1	10809.1	0.11

Out[47]//TableForm=

	Vin (Volt)	Vout (volt)
1	11.9	7.52
2	10.82	7.52
3	7.8	7.52
4	4.45	4.5
5	2.4	2.4
6	0.155	0.155