ELEC313-02

Technical Report for Lab #6

MOSFET Circuit Operation

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Submitted by:

[redacted]

Bonus NAND
Great organization + flow.

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Purpose

The purpose of this laboratory experiment is to observe the basic operation of a MOSFET Amplifier and Inverter circuit.

Test Configuration

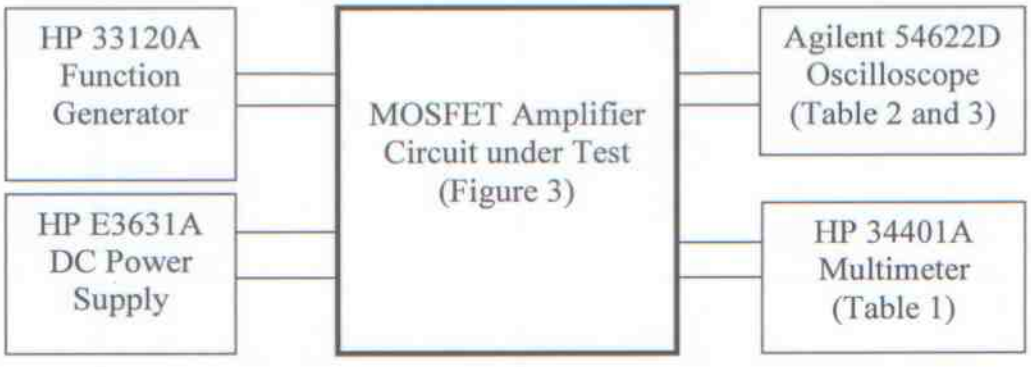

Figure 1 – Test Configuration 1

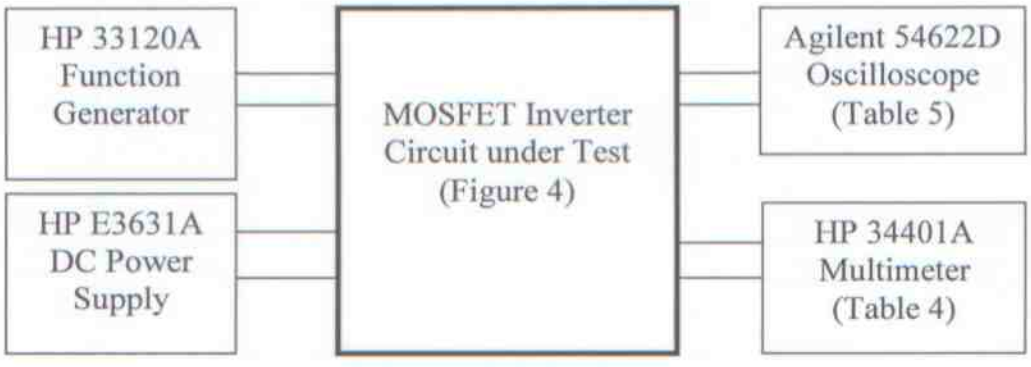

Figure 2 – Test Configuration 2

Circuit Tested

The MOSFET Amplifier circuit built and tested in this lab is shown below:

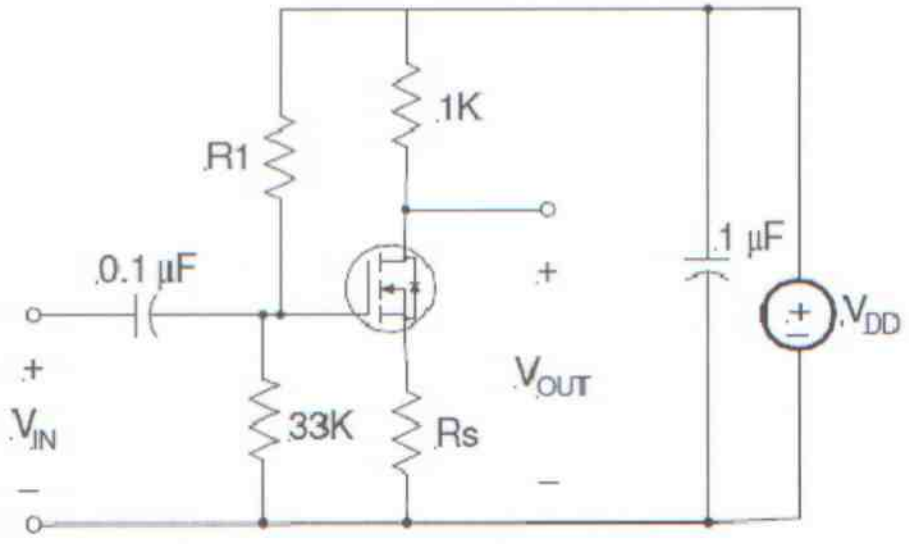

Figure 3 – MOSFET Amplifier Circuit

The MOSFET Inverter circuit built and tested in this lab is shown below:

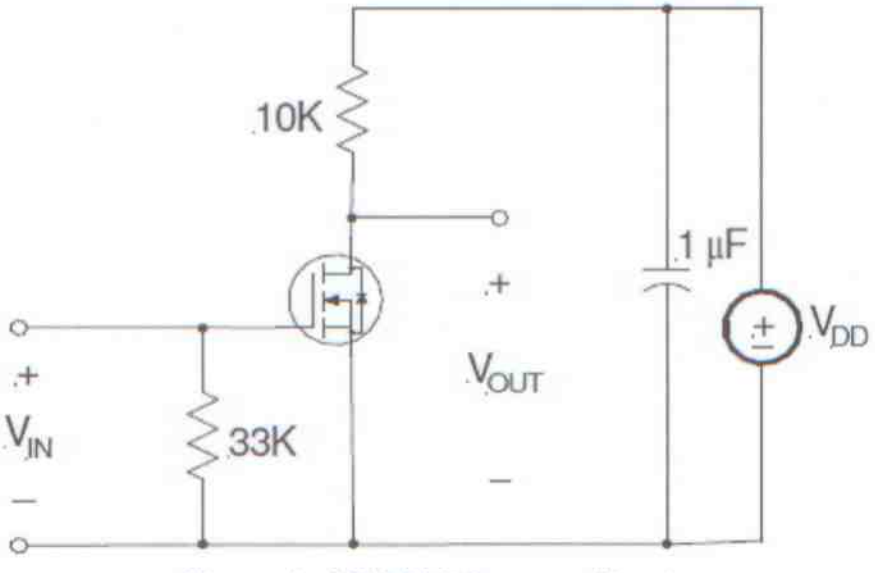

Figure 4—MOSFET Inverter Circuit

Test procedure

The circuit in Figure 3 was built and using the test configuration shown in Figure 1 the DC voltages were measured and recorded in Table 1. Then a 20-kHz was applied to the circuit with a 0 offset. Using the oscilloscope the values in Table 2 were recorded. Next, a hairdryer was used to simulate a temperature increase, to determine the temperature sensitivity of the MOSFET. The variation generated in V_{out} was measured and recorded in Table 3 while V_{in} was set to 200 mV_{pp}.

The circuit in Figure 4 was built and using the test configuration shown in Figure 2 V_{out} was measured and recorded in Table 4 for its respective V_{in} to determine the transfer characteristic of the circuit. Using the oscilloscope the rise and fall times were measured and recorded in Table 5.

Measured Results

	Measured	Calculated	% difference
V_D	13.554 V	14.0 V	-3.19%
V_G	4.4128 V	4.00 V	10.32%
V_S	2.0749 V	1.77 V	17.23%
I_D	4.446 mA	4 mA	11.15%

Table 1—Figure 3's DC Operating Point

V_{in} (mV_{pp})	V_{out} (mV_{pp})	Gain (V_{out}/V_{in})
200	390	1.95
300	590	1.97
400	780	1.95
500	980	1.96
600	1170	1.95
700	1360	1.94
800	1530	1.91
900	1720	1.91
1000	1940	1.94

Table 2—Measured Values of V_{out} for each V_{in} to determine the Amplifier's Gain

	Room Temp	Warm
V_{out}	390 mV_{pp}	385 mV_{pp}

Table 3—Variation in V_{out} with increase in Temperature

V_{in} (V)	V_{out} (V)	V_{in} (V)	V_{out} (V)
0	5.00185	2.75	0.00121
0.25	5.00175	3	0.00101
0.5	5.00189	3.25	0.00089
0.75	5.00189	3.5	0.00083
Í	5.00101	3.75	0.00078
1.25	4.97849	4	0.00074
1.5	4.49208	4.25	0.00071
1.75	0.27547	4.5	0.00068
2	0.01052	4.75	0.00066
2.25	0.00313	5	0.00065
2.5	0.00167		

Table 4—Measured Data from the Inverter Circuit

Rise Time	600 nsec
Fall Time	<3nsec

Table 5—Values Recorded Oscilloscope

Comparison of Results

The %difference seen in Table 1 reflects the change in the MOSFET biasing due to the change in resistor values used from calculations to circuit operation and measurement.

	Calculated (kΩ)	Actual (kΩ)	%difference
R_1	115.5	100	-13.42
R_S	0.4425	0.47	6.21

Table 6—Resistor values for Figure 3

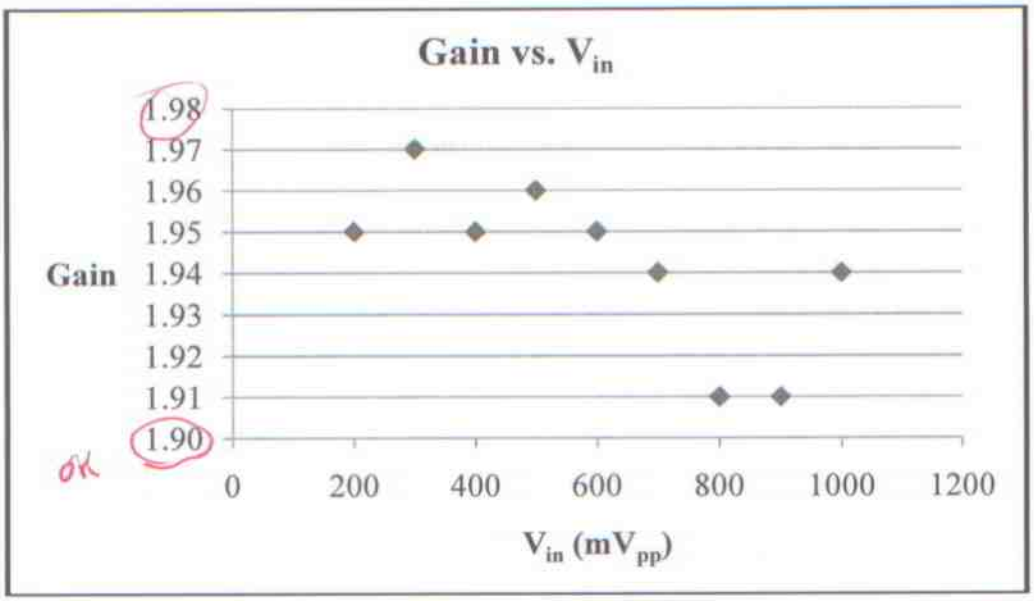

Figure 5—Graph of the Amplifier's Gain compared to the V_{in}

The temperature variation (using the values from Table 3) for the Amplifier circuit is: -1.28%.

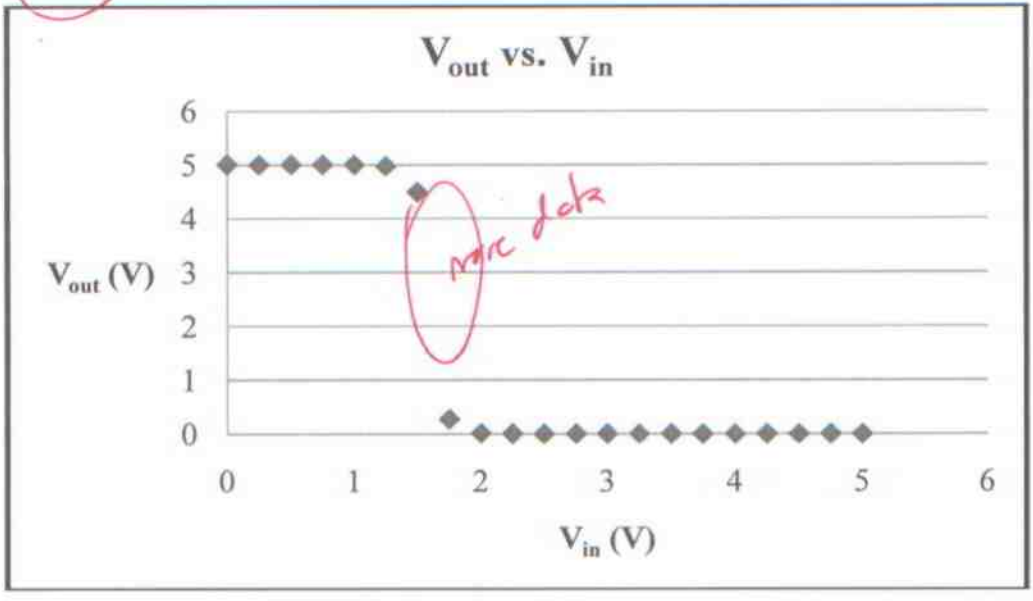

Figure 6—Transfer characteristic of the Inverter Circuit

	Measured	Spec	%difference
Rise Time	600 nsec	10 nsec	5900%
Fall Time	<3 nsec	10 nsec	-70%

Table 7—Comparison of Rise and Fall times

The reason the for the rise time being so much larger is that the RC time constant limits how fast the MOSFET can turn on. Whereas, the fall time is closer to the spec since the RC time constant no longer has an effect.

Conclusions

The basic operation of a MOSFET amplifier and inverter circuit was observed. The amplifier circuit took a V_{in} and increased it by the gain of the circuit. The Inverter circuit inverted the V_{in}.