EXPERIMENT 7: MOSFET AMPLIFIER

Objectives

The objective of this experiment is to obtain and learn gain characteristic of MOSFET amplifier circuits practically.

Components Required:

DC Voltage Source

Signal Generator

Multimeter

Transistor: BS108 transistor

Resistors: 220Ω, 1kΩ, 10kΩ, 360kΩ, 1MΩ, 10kΩ POT

Capacitor: 1µF (x3), 100µF (x3)

Preliminary Work:

1. Study gain and frequency characteristics, and how the used components effect the the characteristics. Give the information about that.

2. Analyze the circuit given in Figure 1 and find the gain for 100 kHz input signal (You can find a short video about MOSFET ac analysis in the link- https://www.youtube.com/watch?v=dLLN4fLsXb0. Use the parameters given in 'Notes 1'for calculations. You need to drain current to find g_m. First you should do dc analysis of the circuit to find drain current. You may ignore the r_0 resistance in the MOSFET in AC equivalent circuit. Then you can find AC voltage gain. $g_m = \frac{2I_D}{V_{GS}-V_T} = \sqrt{2k_n \frac{W}{L} I_D}$

3. Set up the circuit given in Figure 1 in OrCAD. You can refer to the Figure 3 to understand how to add the MOSFET in the circuit. Use the PSpice model given in 'Note 2' below. (Right click on the Mosfet and select the 'Edit Pspice Model' and then you can find a pane like in Figure 2. You must paste the model parameters given in 'Note 2' in the pane. Then click the 'Save Library'.)

   Use AC Voltage Source for the input signal. Run AC simulation from 100 Hz to 100 kHz. Set type of sweep as "decade" with 10 point per decade. Plot the AC voltage gain (*vout* / *vin*). What is the midband voltage gain as a ratio (not in dB)?

4. Change the input signal with a sinusoidal voltage source that has 20mV amplitude at **100kHz**. Run transient simulation. Plot the input and output signals for 5 periods of the signal. What is the gain based on the transient simulation? Does it agree with the AC gain in the question (3)?

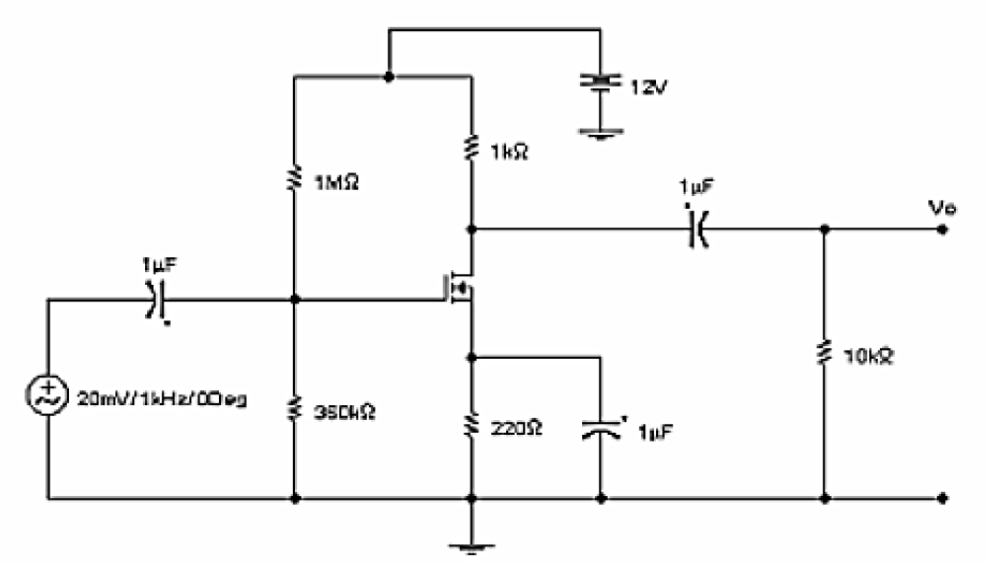


Figure 1

Note 1:

V_{TN}= 1V, k_n =80 µA/V^2, W/L=25, λ=0.015

Note 2:

.model Mbreakn NMOS VTO=1 KP=0.08m W=5.3u L=0.212u LAMBDA=0.015

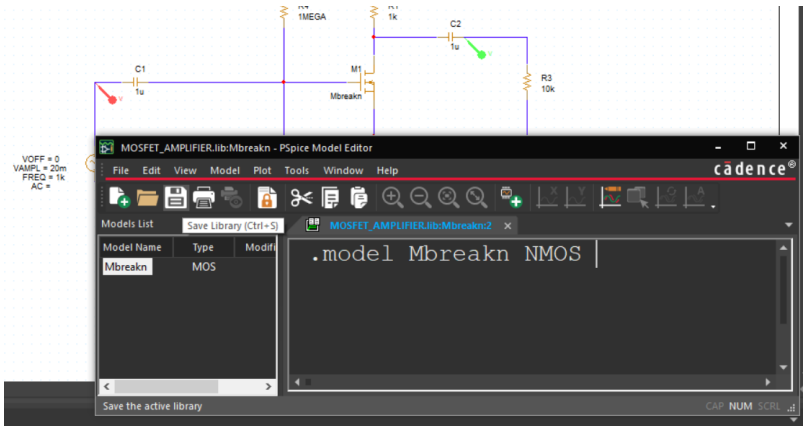
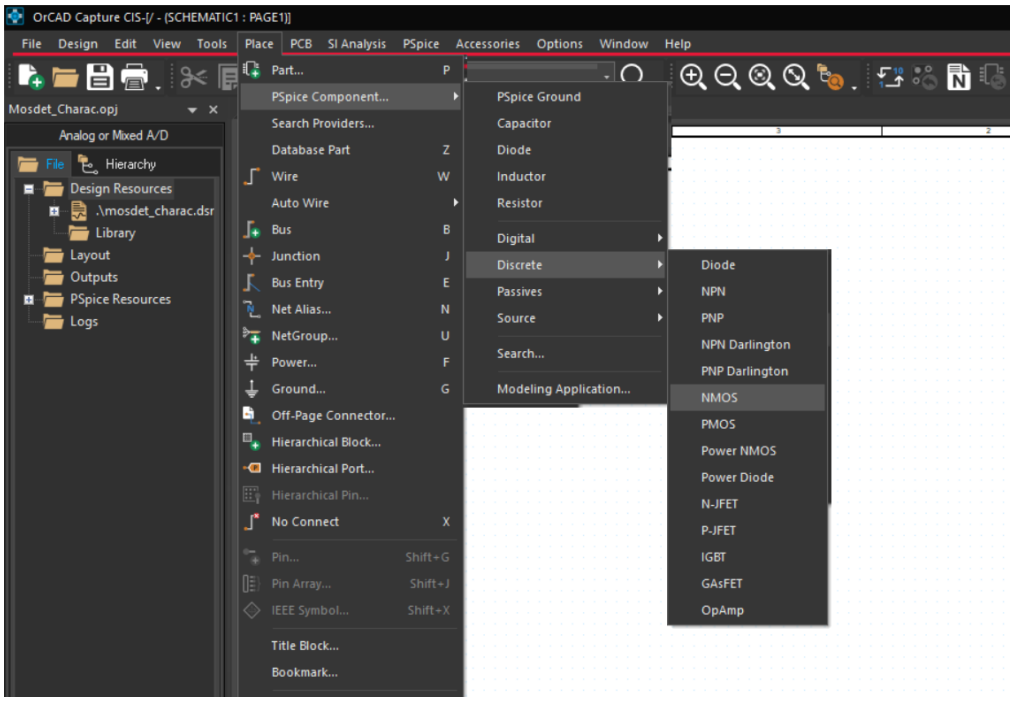


Figure 2


OrCAD Capture CIS-[/ - (SCHEMATIC1 : PAGE1)]
File Design Edit View Tools Place PCB SI Analysis PSpice Accessories Options Window Help
Mosdet_Charac.opj
Analog or Mixed A/D
File Hierarchy
Design Resources
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Library
Layout
Outputs
PSpice Resources
Logs
Part... P
PSpice Component...
Search Providers...
Database Part Z
Wire W
Auto Wire
Bus B
Junction J
Bus Entry E
Net Alias... N
NetGroup... U
Power... F
Ground... G
Off-Page Connector...
Hierarchical Block...
Hierarchical Port...
Hierarchical Pin...
No Connect X
Pin... Shift+G
Pin Array... Shift+J
IEEE Symbol... Shift+X
Title Block...
Bookmark...
PSpice Ground
Capacitor
Diode
Inductor
Resistor
Digital
Discrete
Passives
Source
Search...
Modeling Application...
Diode
NPN
PNP
NPN Darlington
PNP Darlington
NMOS
PMOS
Power NMOS
Power Diode
N-JFET
P-JFET
IGBT
GAsFET
OpAmp

Figure 3