UIN – 228001199

Section – 601

Lab Number – 1

Lab Report

MOS Device Characterization

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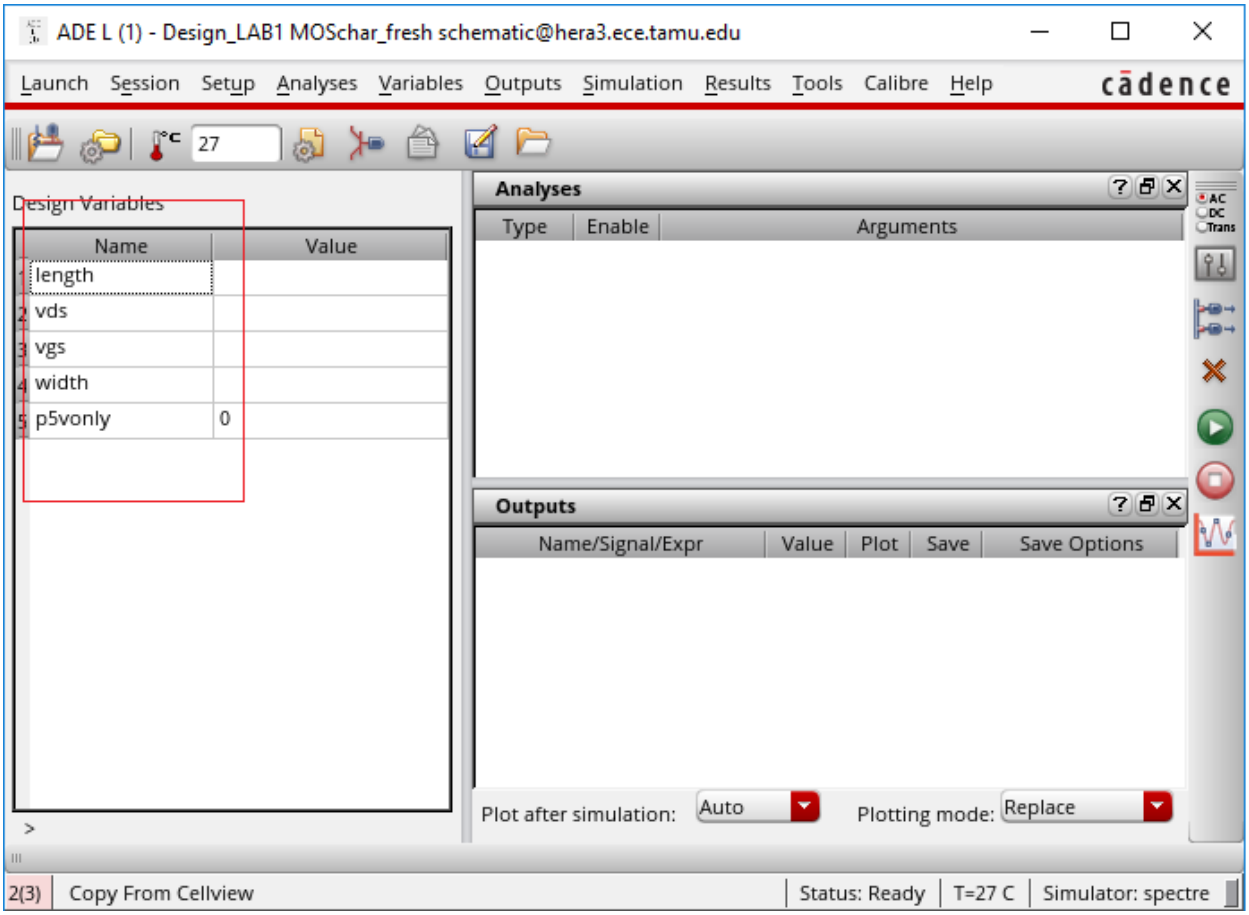
Description

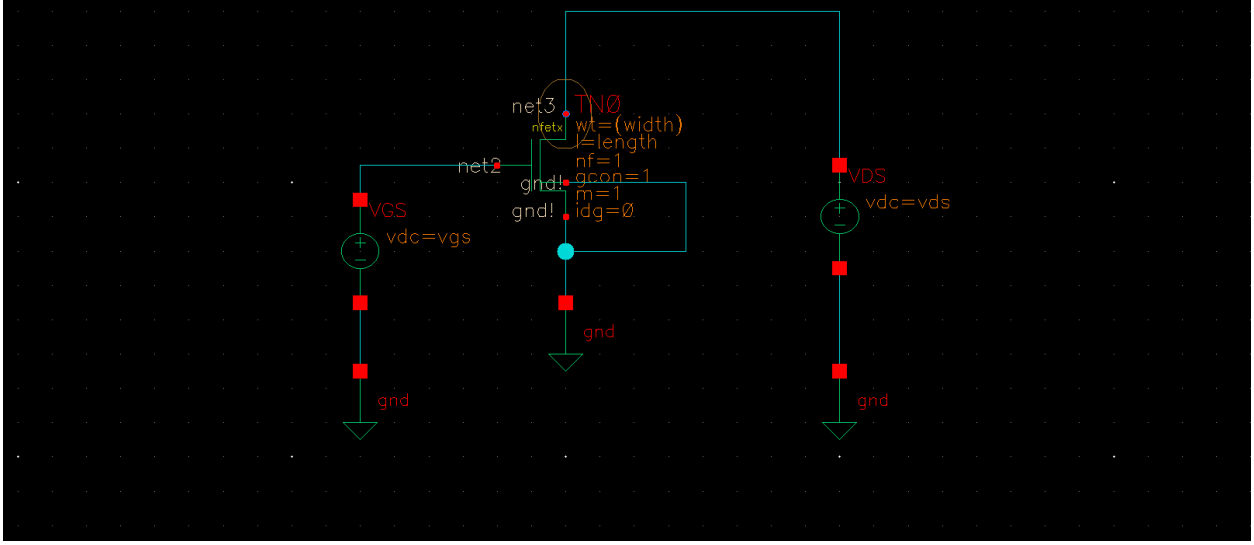
This lab exercise is about the MOS device characterization. The Gm/Id technique is used to deduce the required information about the given MOS device. The parameters are estimated for different MOS devices with varying W/L ratios and the Device parameters are tabulated as reference for future circuit design.

Design

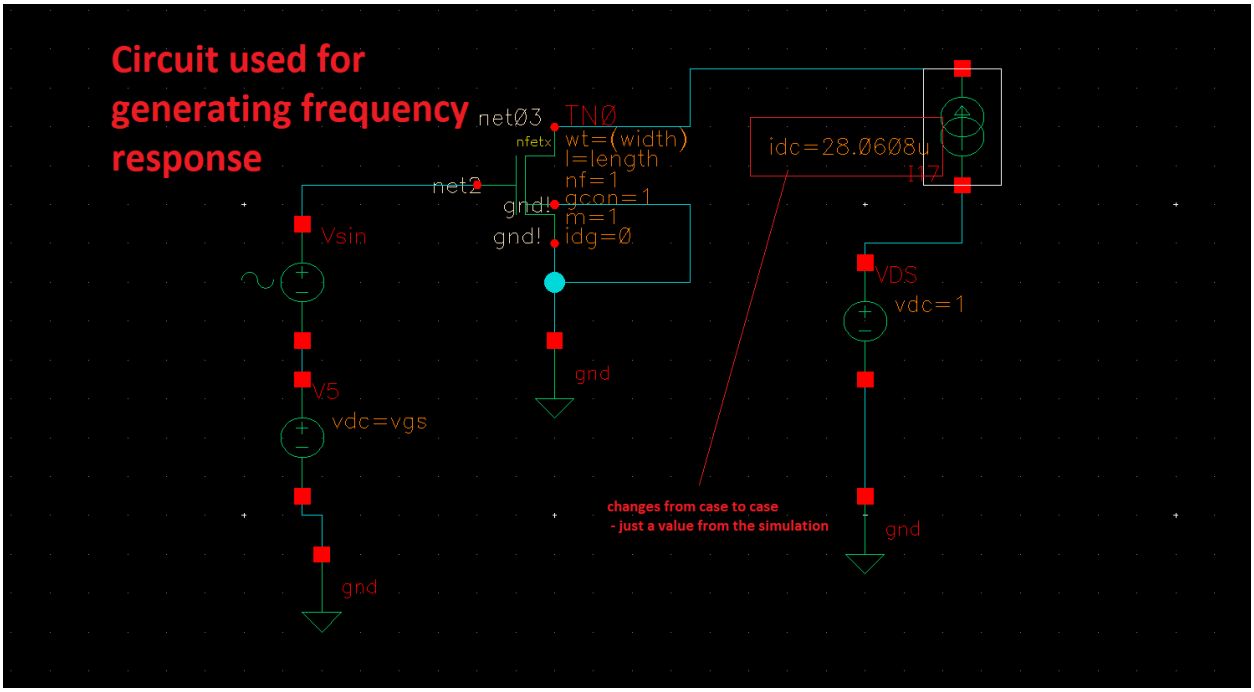
The following section includes all the circuit diagrams used for extracting the MOS device characteristics. As the same circuit is used for estimation of parameters over different W/L ratios, the generic circuit diagram for the NMOS and PMOS devices have been included. The W-width and L-Length has been turned into variables to increase reusability. Before running the simulation these values are set to their appropriate values based on the required sweeping.

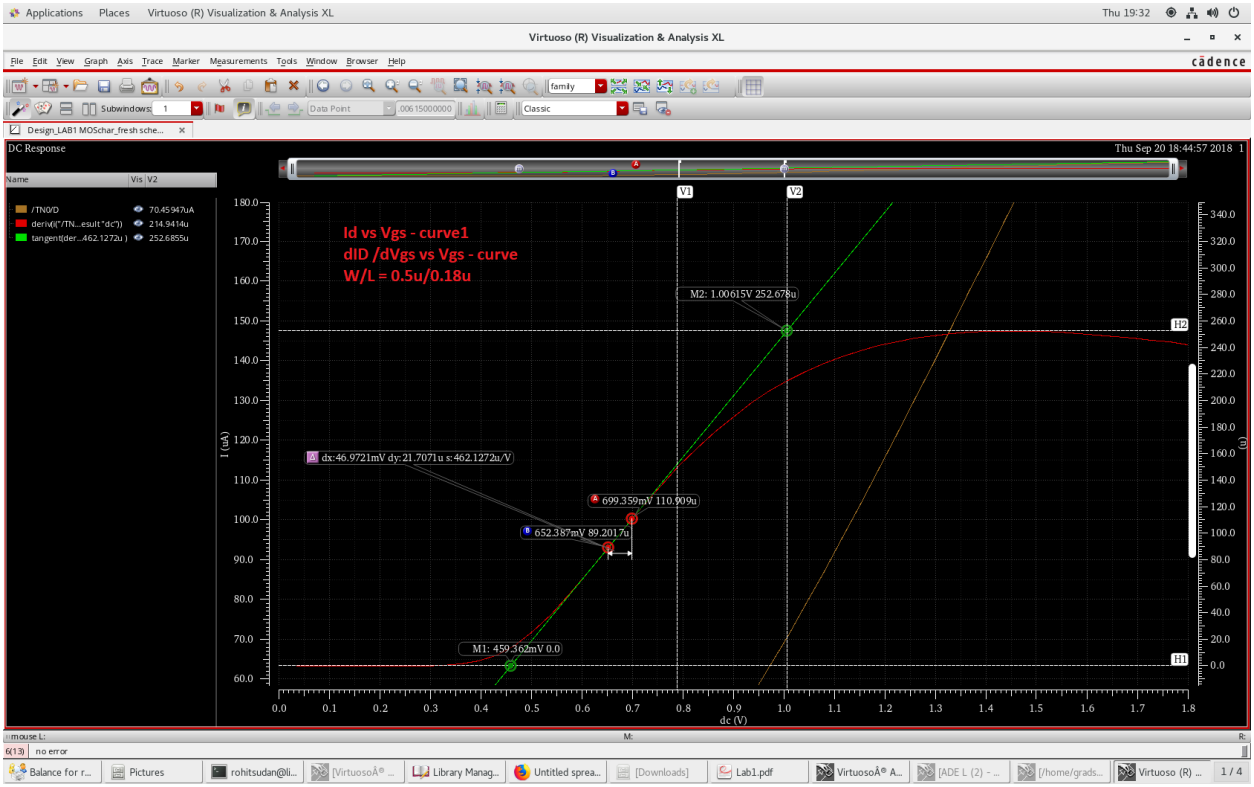


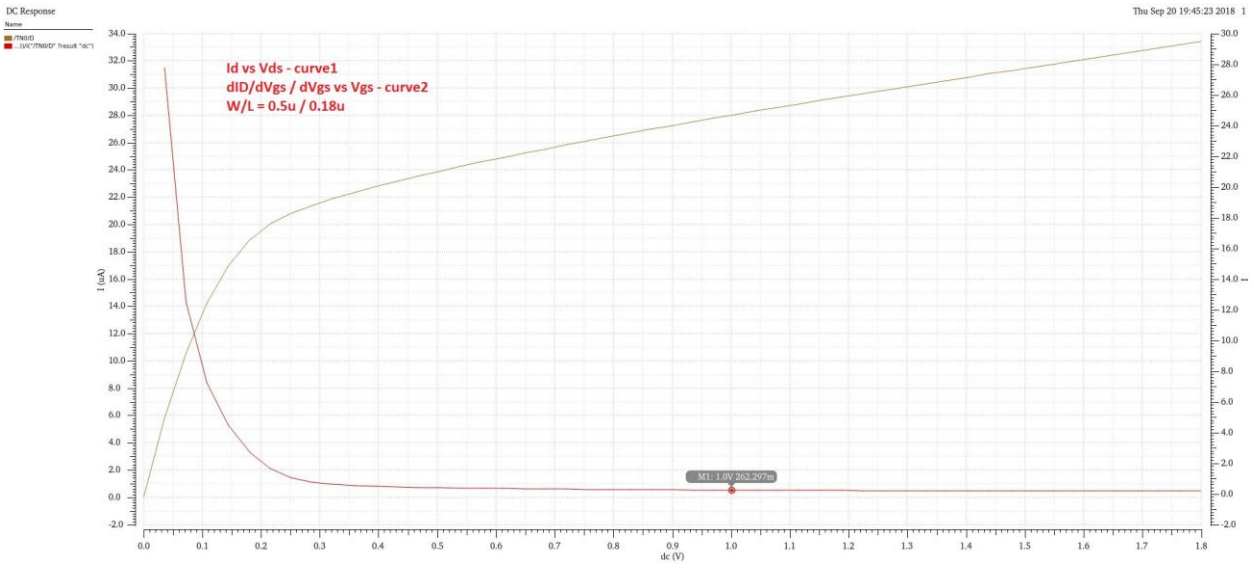
NMOS ciruit used for Vgs vs Id and Vds vs Id (For different Values of W/L)

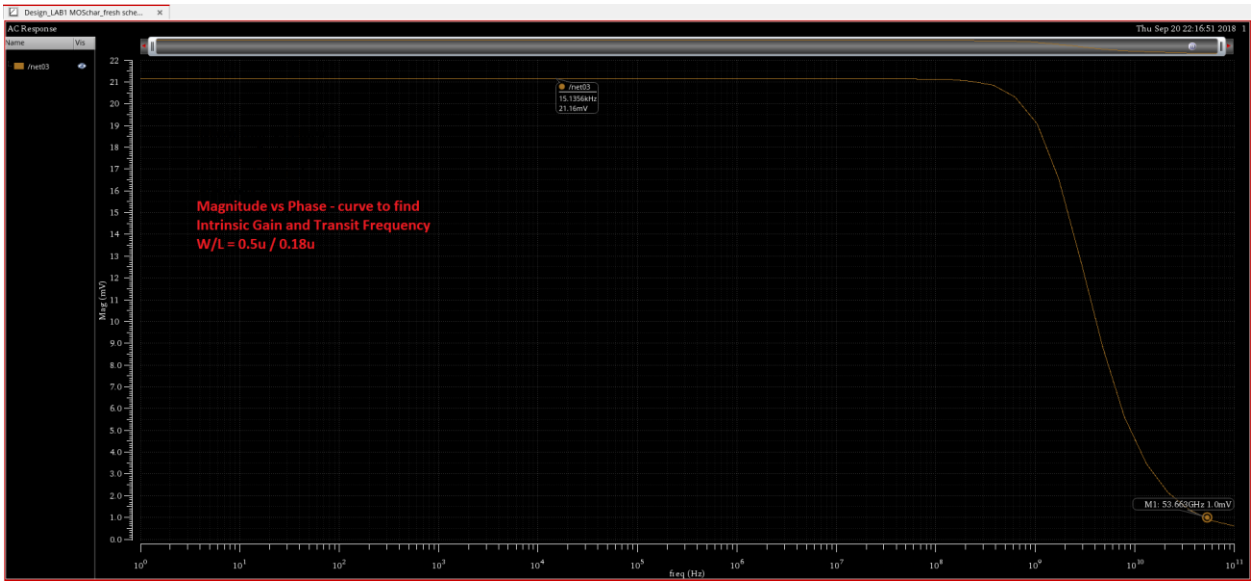


Circuit used for generating frequency response

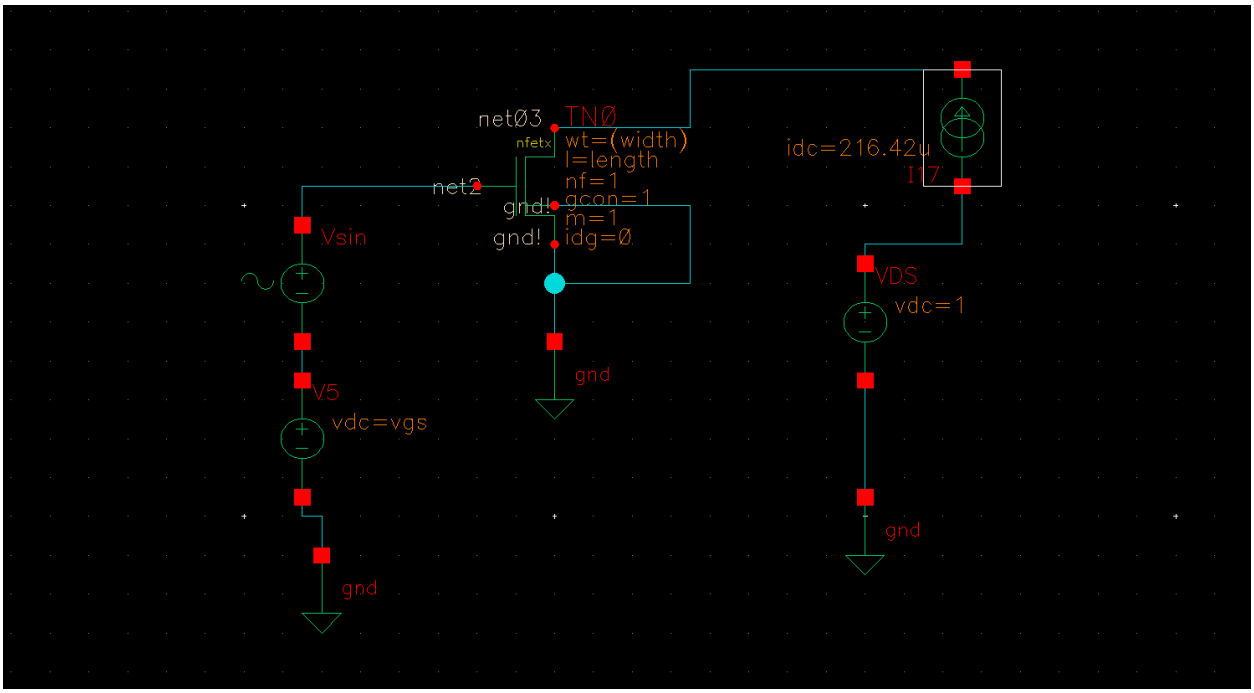


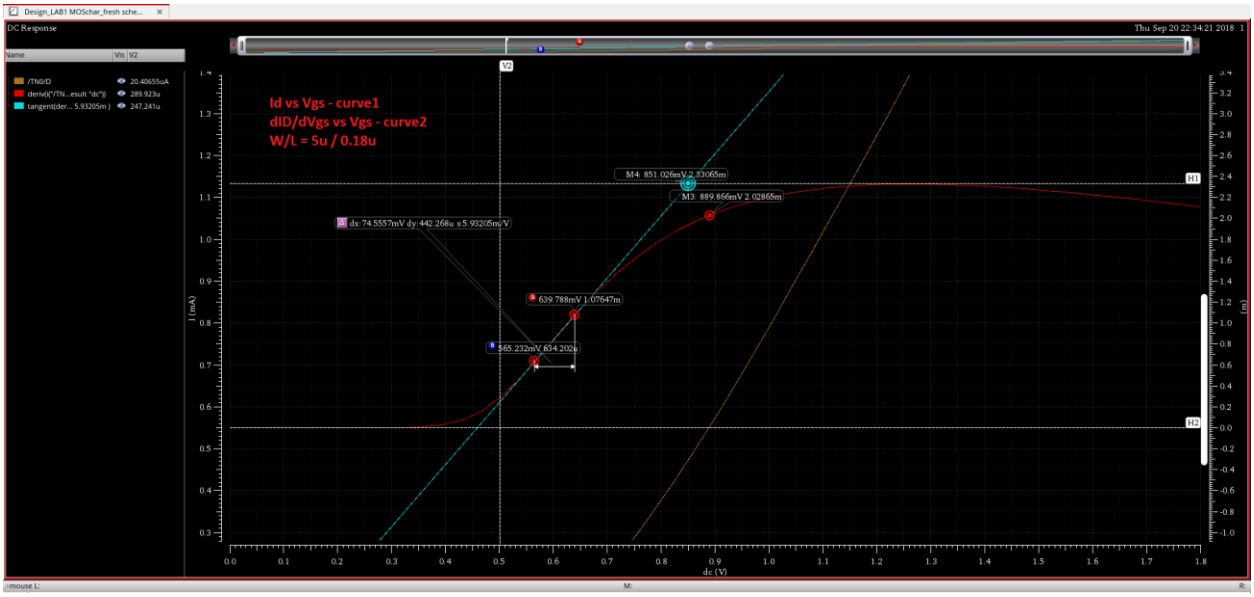

Virtuoso (R) Visualization & Analysis XL
DC Response
Thu Sep 20 18:44:57 2018
Id vs Vgs - curve1
dID /dVgs vs Vgs - curve
W/L = 0.5u/0.18u
M2: 1.00615V 252.678u
M1: 459.362mV 0.0
dx:46.9721mV dy:21.7071u s:462.1272u/V
699.359mV 110.909u
652.387mV 89.2017u
V1
V2
H1
H2
I (uA)
dc (V)

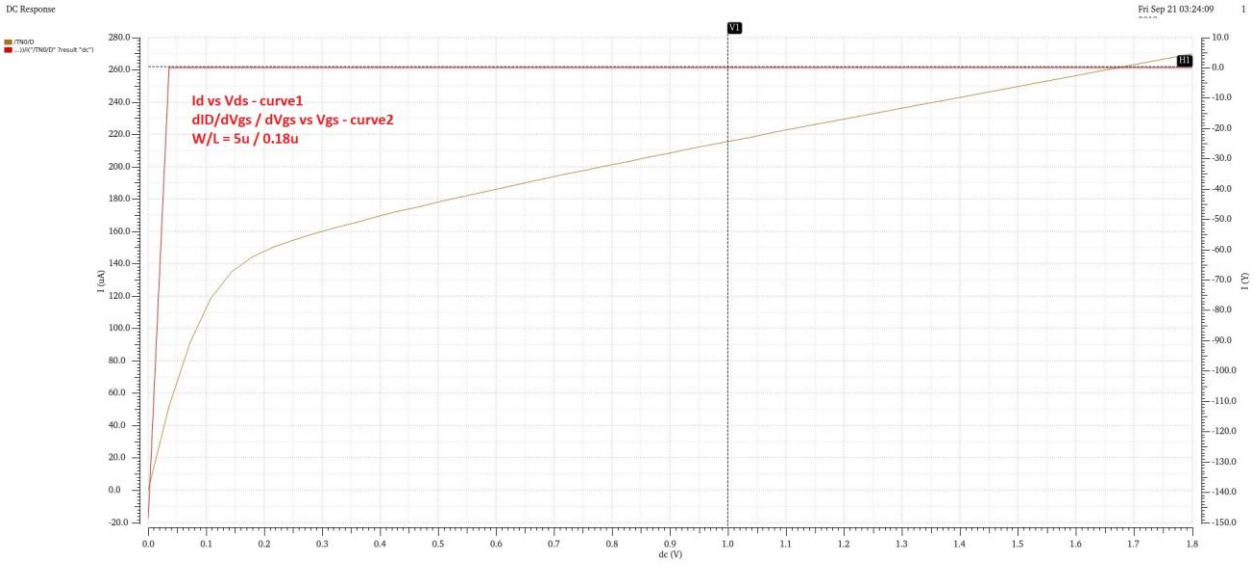

DC Response
Thu Sep 20 19:45:23 2018
Id vs Vds - curve1
dID/dVgs / dVgs vs Vgs - curve2
W/L = 0.5u / 0.18u
M1: 1.0V 262.297m
I (uA)
dc (V)

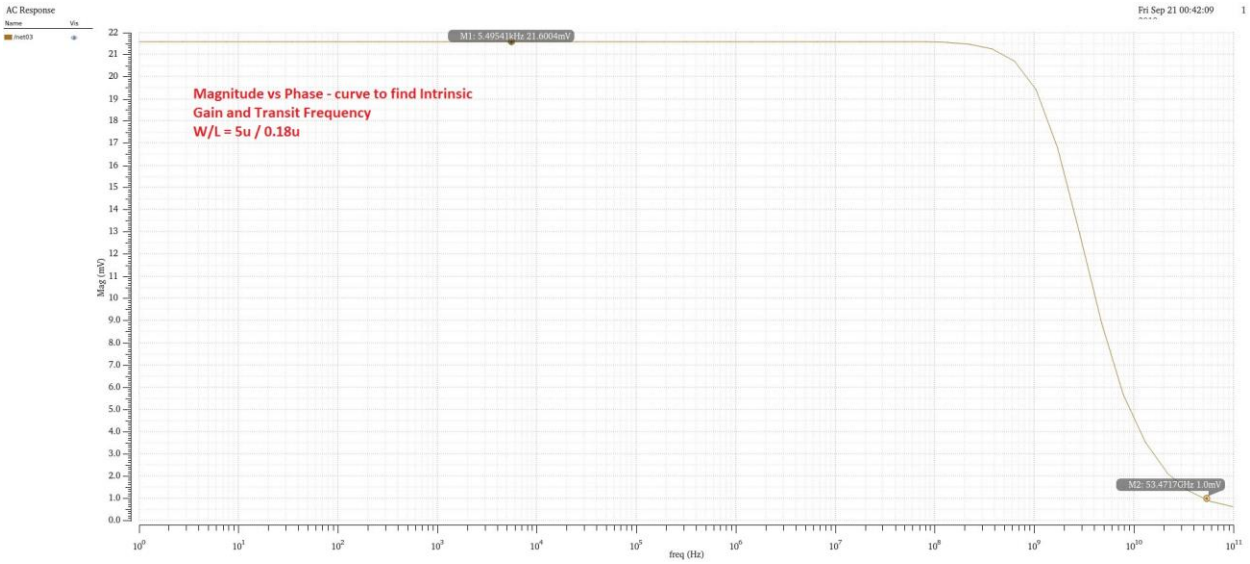


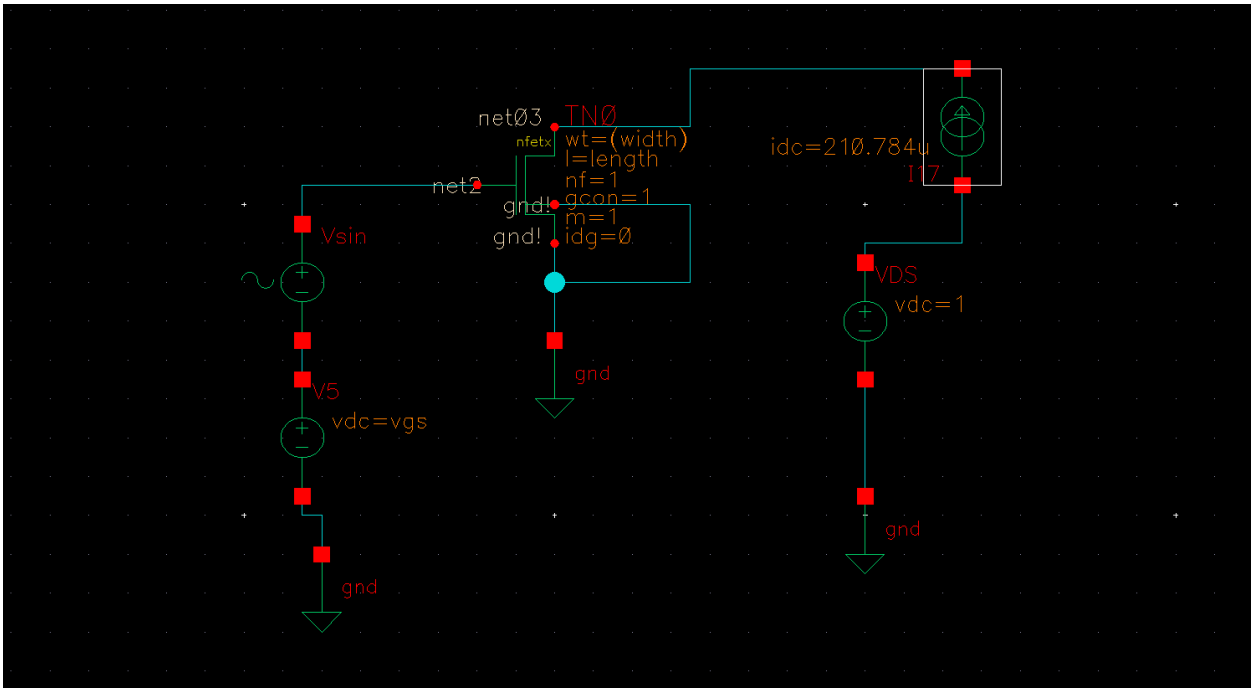
Circuit Used to Generate Frequency Response



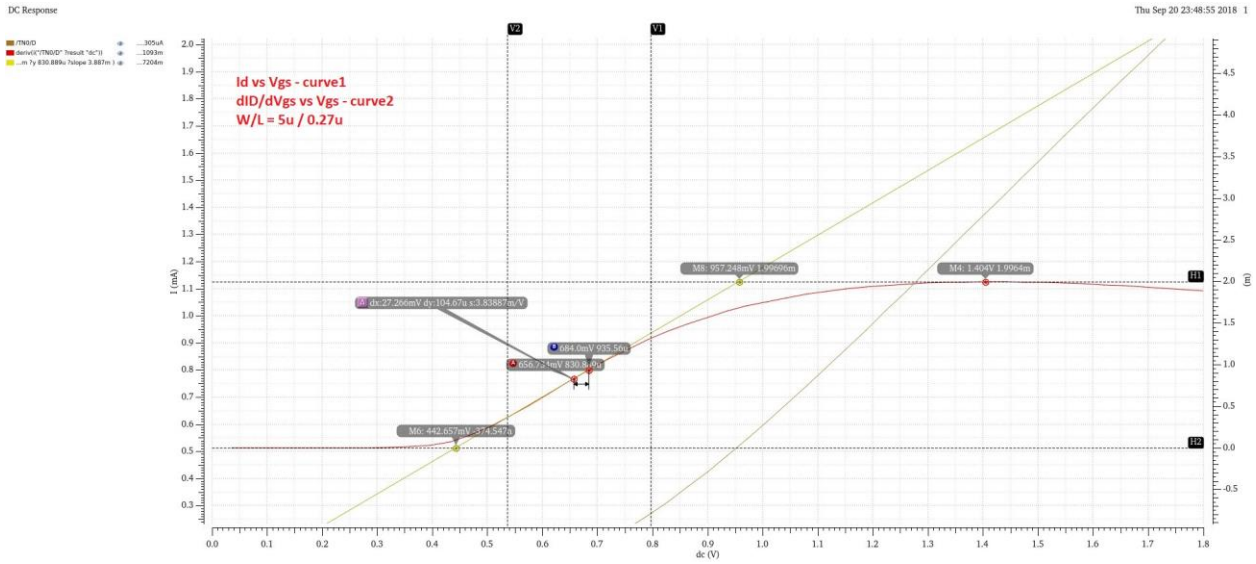

Design_LAB1 MOSchar_fresh sche...
DC Response
Thu Sep 20 22:34:21 2018
Id vs Vgs - curve1
dID/dVgs vs Vgs - curve2
W/L = 5u / 0.18u
M4: 851.026mV 2.33065m
M3: 889.866mV 2.02865m
dx: 74.5557mV dy:442.268u s:5.93205m/V
639.788mV 1.07647m
565.232mV 634.202u
V2
H1
H2
I (mA)
dc (V)

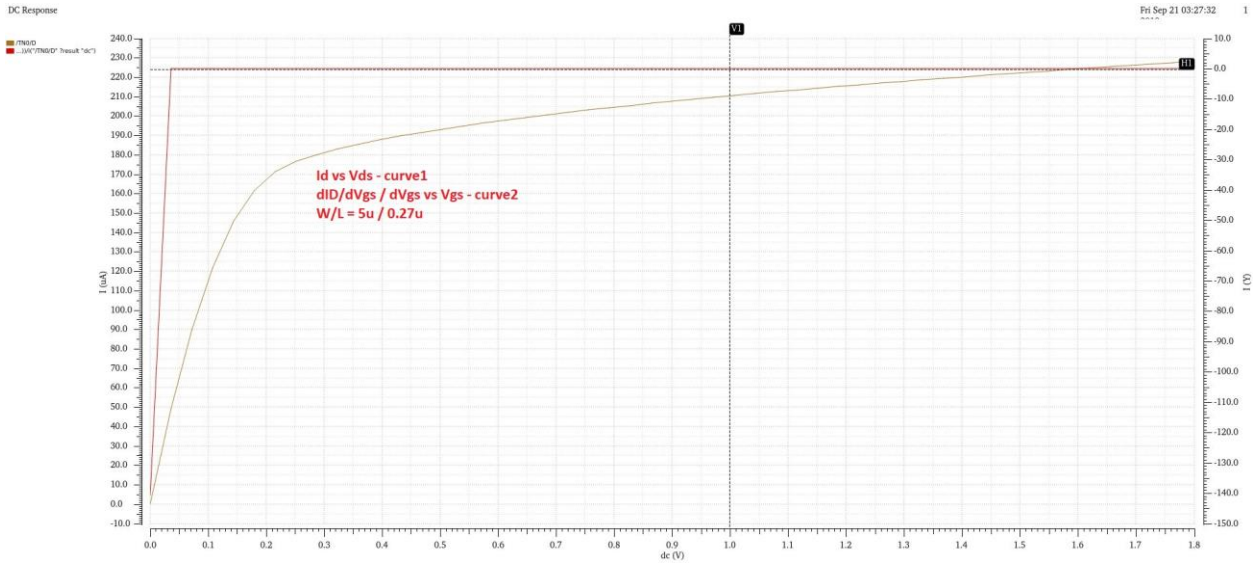

DC Response
Fri Sep 21 03:24:09
Id vs Vds - curve1
dID/dVgs / dVgs vs Vgs - curve2
W/L = 5u / 0.18u
V1
H1
I (uA)
I (Y)
dc (V)

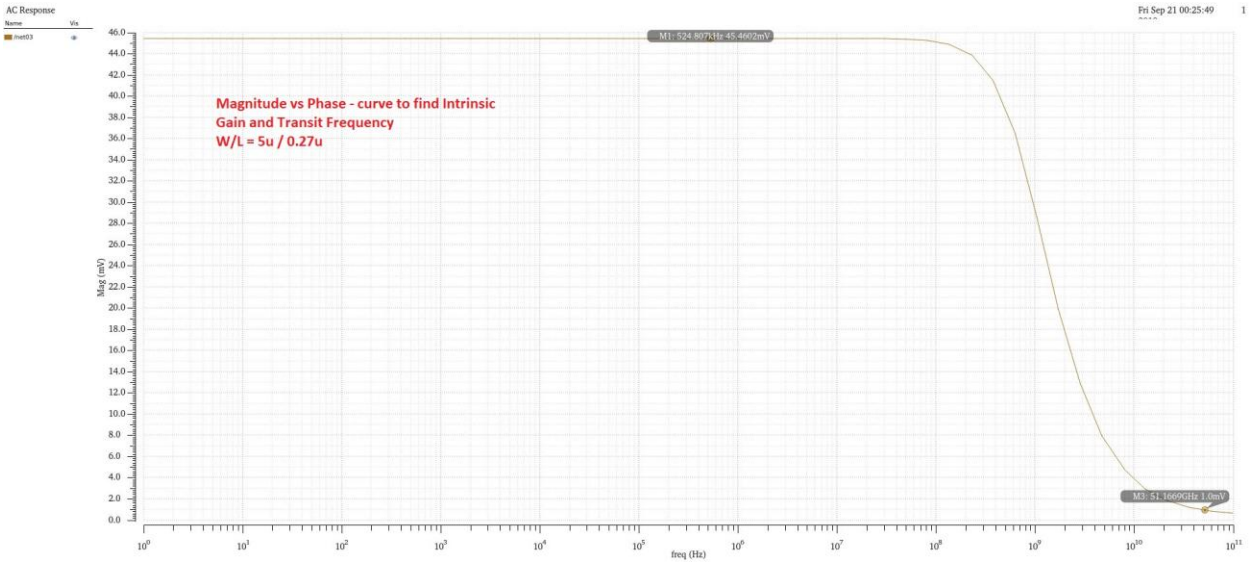


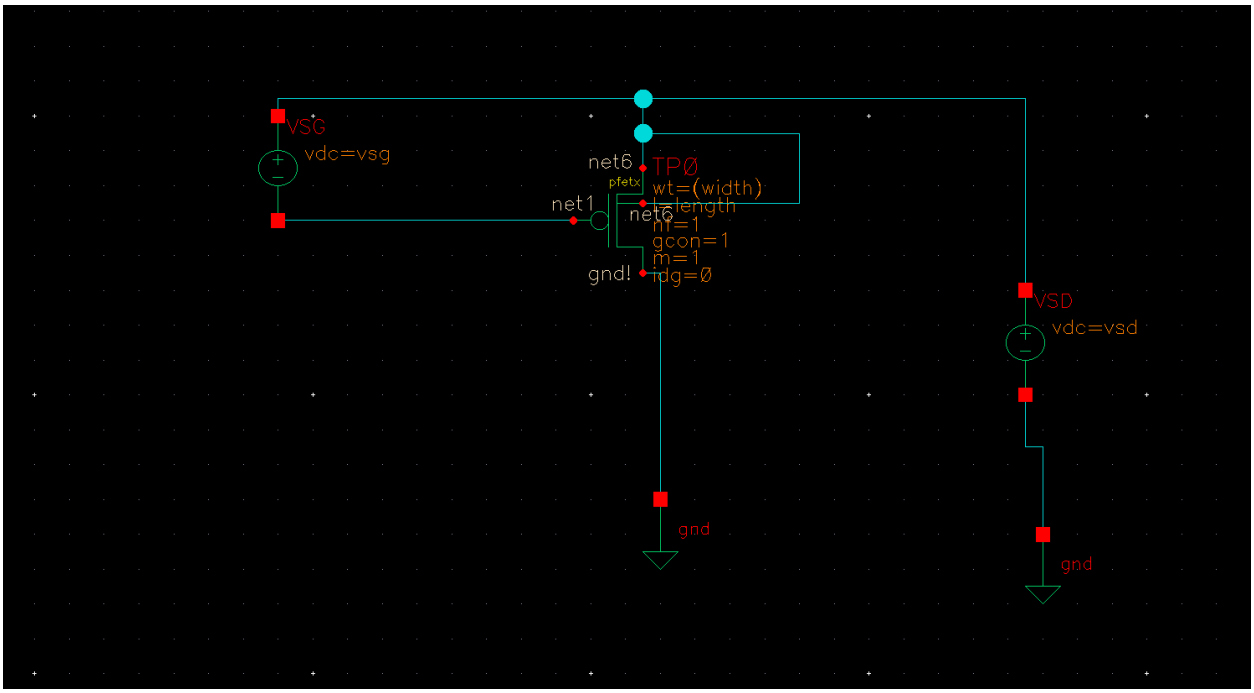


Circuit Used to Generate Frequency Response

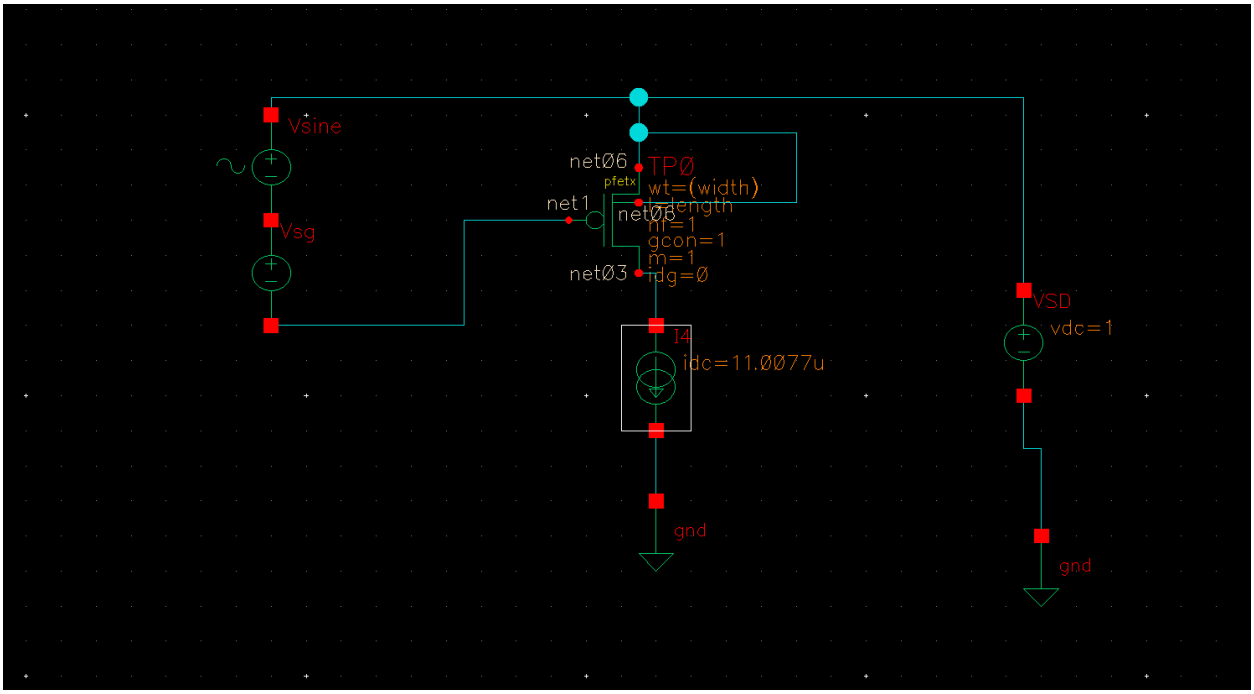

DC Response
Thu Sep 20 23:48:55 2018 1
Id vs Vgs - curve1
dID/dVgs vs Vgs - curve2
W/L = 5u / 0.27u
V2
V1
H1
H2
M8: 957.248mV 1.9969m
M4: 1.404V 1.9964m
M6: 442.657mV -374.547a
I (mA)
dc (V)


DC Response
Fri Sep 21 03:27:32 1
Id vs Vds - curve1
dID/dVgs / dVgs vs Vgs - curve2
W/L = 5u / 0.27u
V1
H1
I (uA)
I (Y)
dc (V)

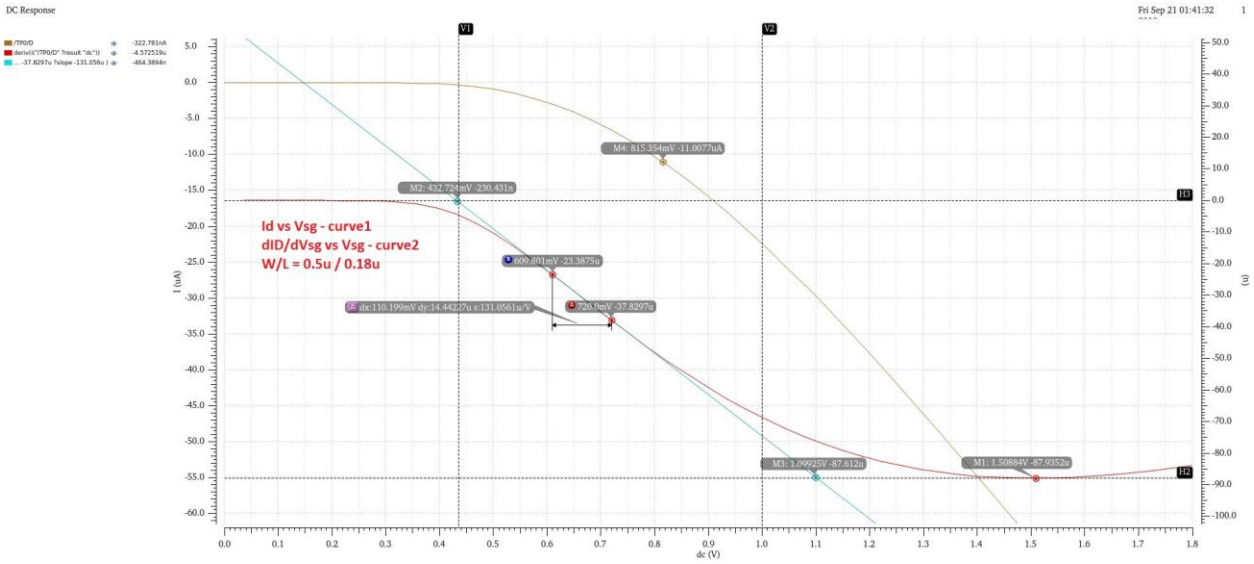


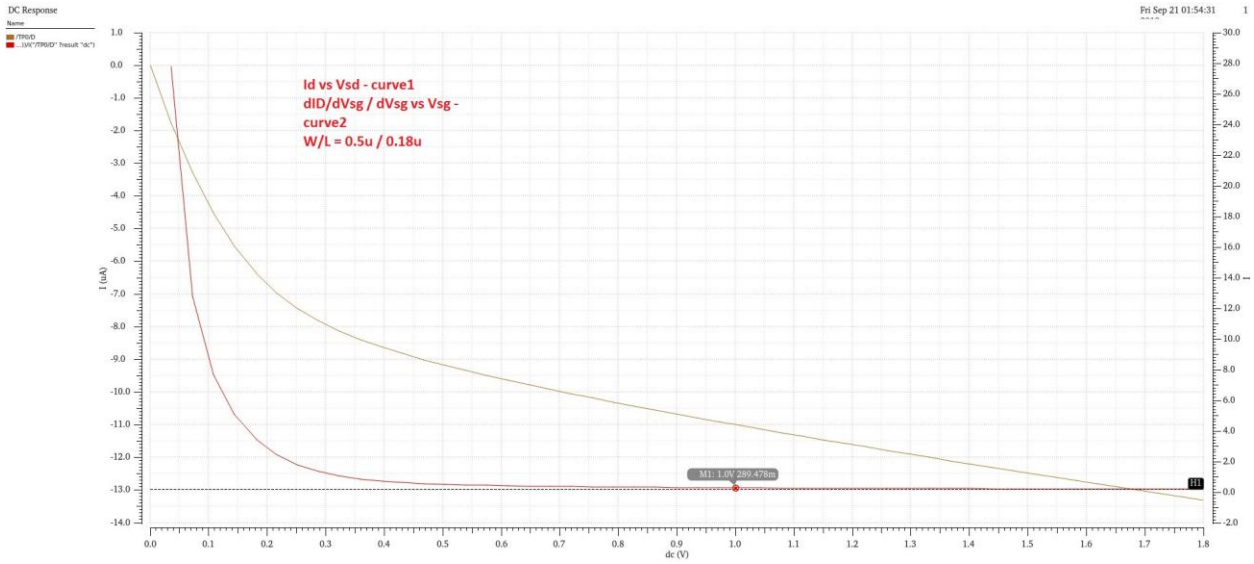


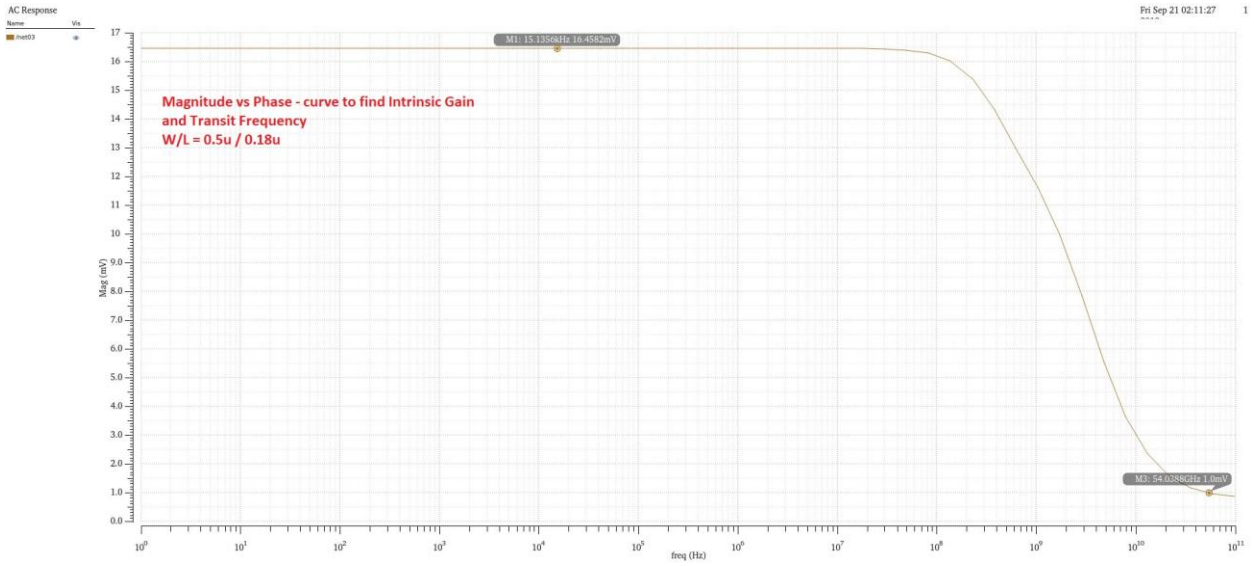
PMOS circuit used for Gm/Id parameter estimation

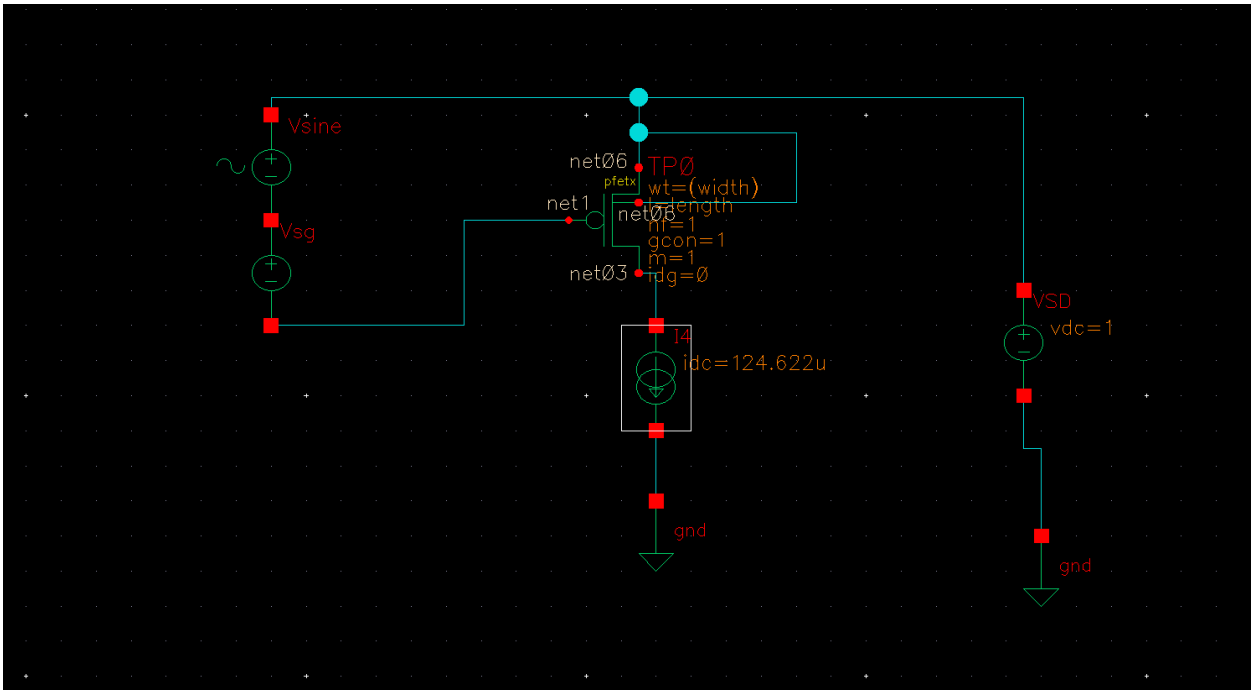


Circuit Used to Generate Frequency Response

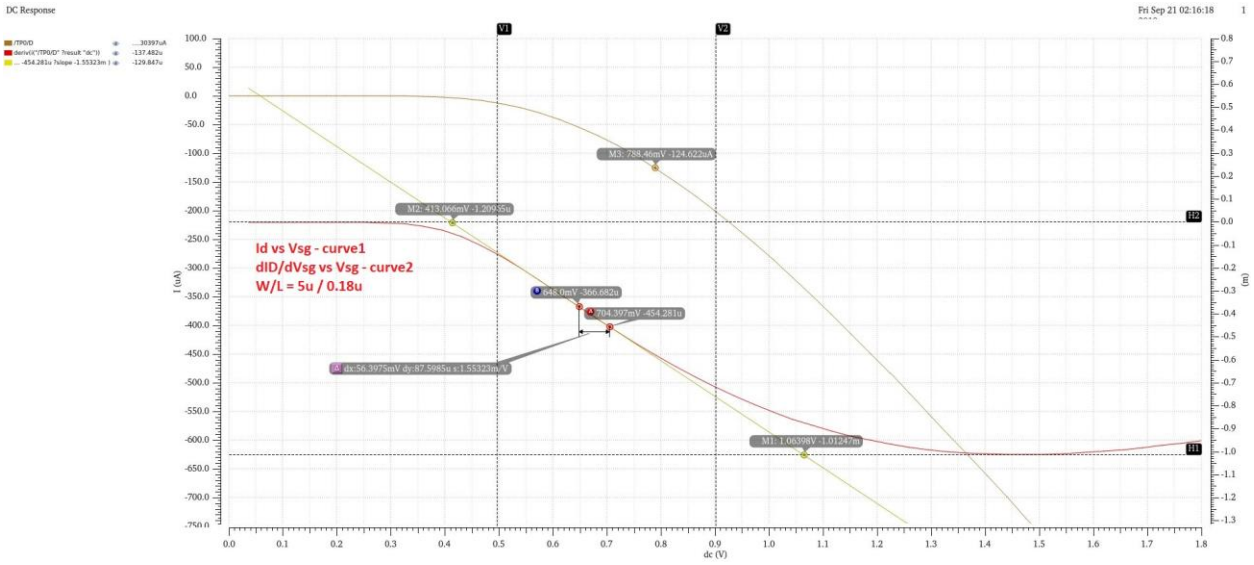


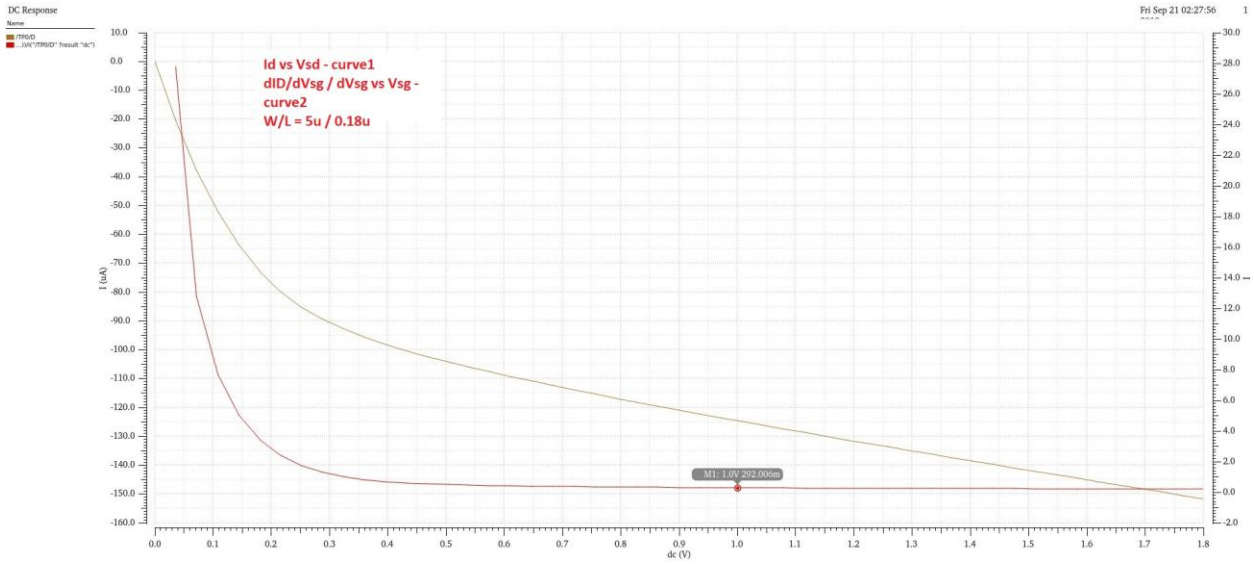

DC Response
Name
/TP0/D
Fri Sep 21 01:54:31
Id vs Vsd - curve1
dID/dVsg / dVsg vs Vsg - curve2
W/L = 0.5u / 0.18u
M1: 1.0V 289.478m
I (uA)
dc (V)

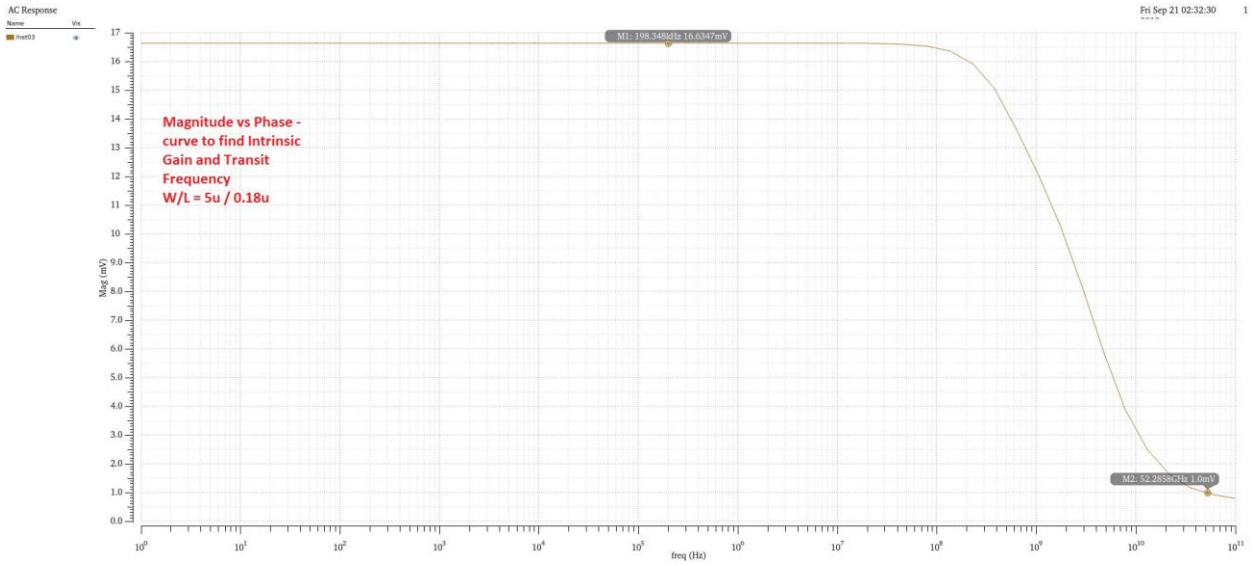

AC Response
Name
Vis
/net03
Fri Sep 21 02:11:27
Magnitude vs Phase - curve to find Intrinsic Gain and Transit Frequency
W/L = 0.5u / 0.18u
M1: 15.1356kHz 16.4582mV
M3: 54.0288GHz 1.0mV
Mag (mV)
freq (Hz)

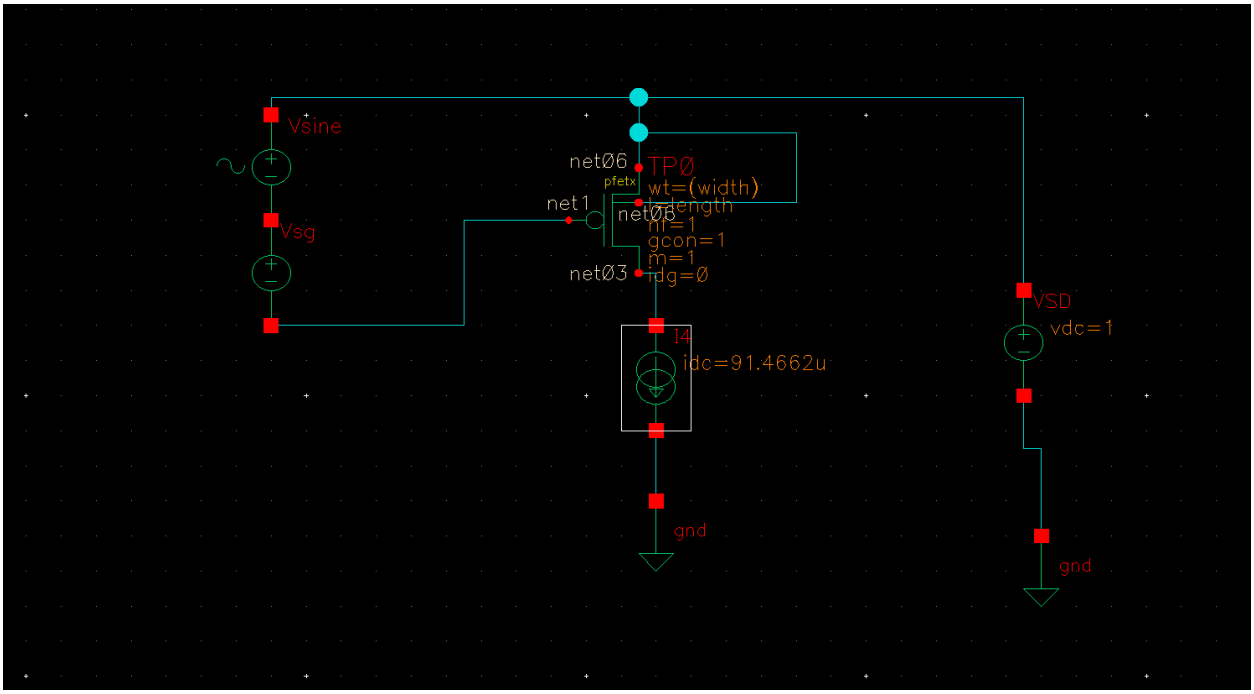


Circuit Used to Generate Frequency Response

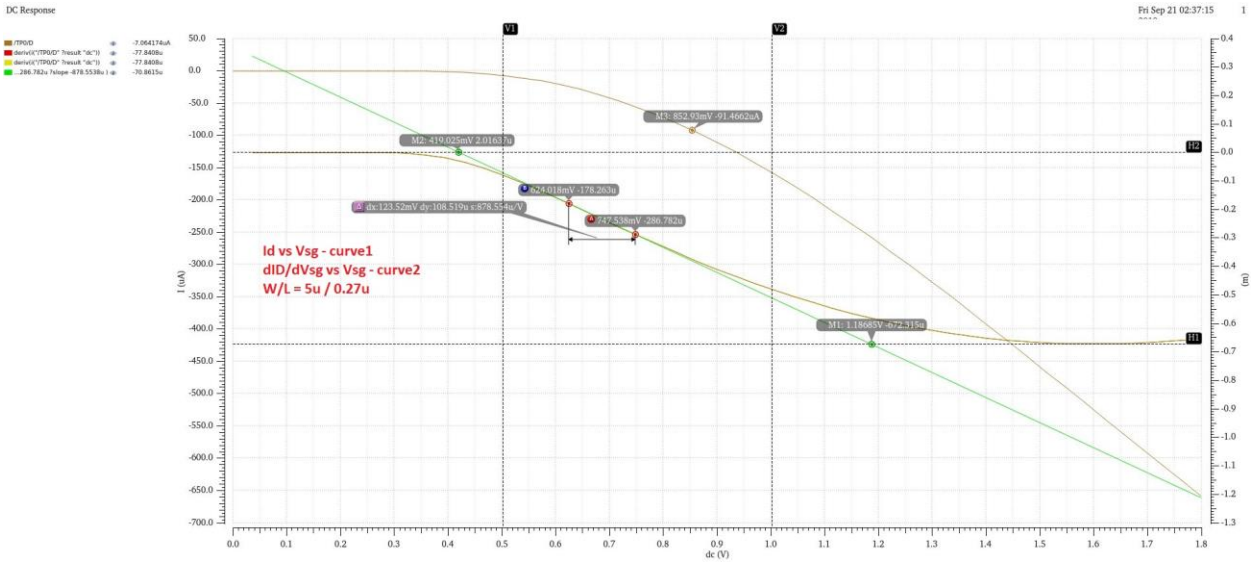


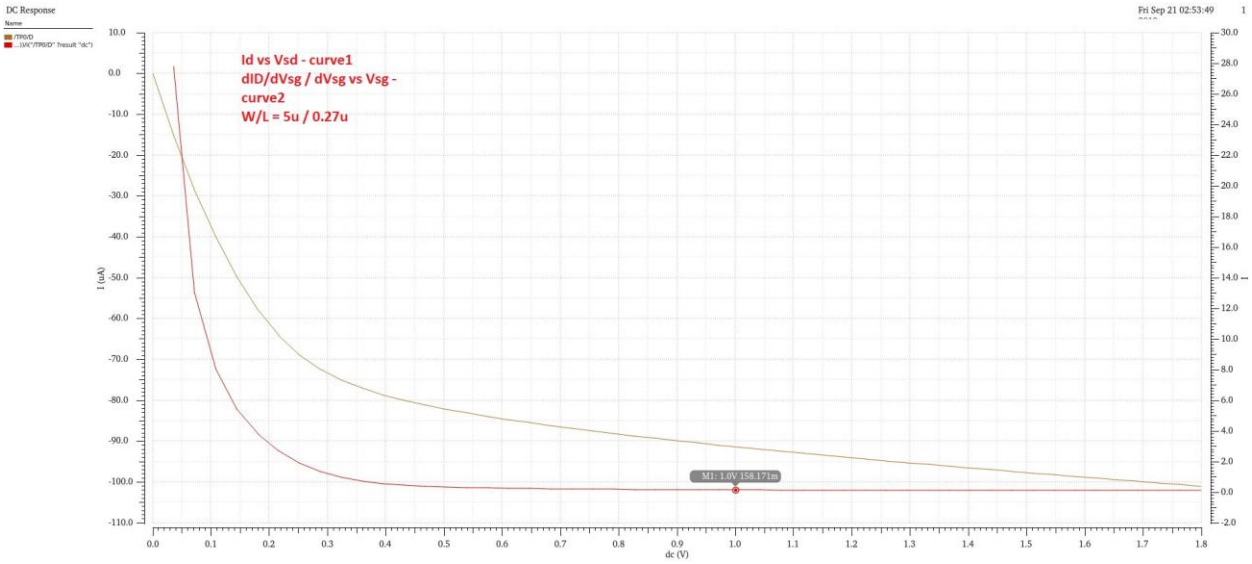

DC Response
Fri Sep 21 02:27:56
Id vs Vsd - curve1
dID/dVsg / dVsg vs Vsg - curve2
W/L = 5u / 0.18u
M1: 1.0V 292.006m
I (uA)
dc (V)

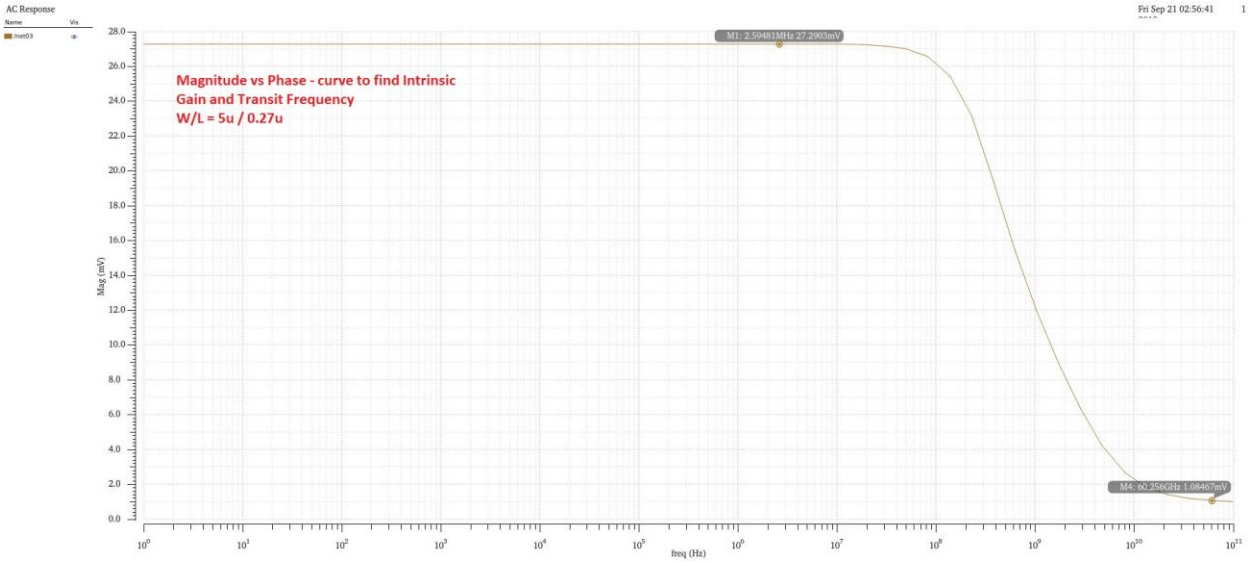

AC Response
Fri Sep 21 02:32:30
Magnitude vs Phase - curve to find Intrinsic Gain and Transit Frequency
W/L = 5u / 0.18u
M1: 198.348kHz 16.6347mV
M2: 52.2858GHz 1.0mV
Mag (mV)
freq (Hz)



Circuit Used to Generate Frequency Response







Result & Discussions

The parameter extraction for different MOS transistor was successfully done and the results are tabulated accordingly. The values include Biasing Voltage – Vgs , Biasing Current – Id , Vtn – Threshold Voltage , UnCox , Theta value , Lamda , Intrinsic Gain(Ai) , Unity Gain Frequency.

Complete Tabulation of the results

Type	W	L	Vgs (Volt)	Id (Amp)	Vtn (Volts)	UnCox	Theta	Lamba	Intrinsic Gain (Ai)	Unity Gain Frequency (Ft) (Hz)
nfetx	0.5u	0.18u	0.782756	28.0608u	459362	166.365u	0.91443	262.297m	21.16	53.663G
nfetx	5u	0.18u	0.70467	216.42u	458.321m	213.536u	1.27322	262m	21.6004	53.4717G
nfetx	5u	0.27u	0.74995	210.784u	442.657m	209.898	0.971645	224m	45.4602	51.1669G
pfetx	0.5u	0.18u	0.815354	-11.0077u	432.724	47.1424u	0.7515	289.478m	15.1356	54.0388G
pfetx	5u	0.18u	0.78846	-124.622u	413.066	55.91u	0.76815	292.006m	16.6347	52.2858G
pfetx	5u	0.27u	0.85293	-91.4662u	419.025	47.4419	0.65119	158.171m	27.2903	60.256G