EE-103 VLSI Design
Lab 02 Study of Characteristics of a MOS Transistor

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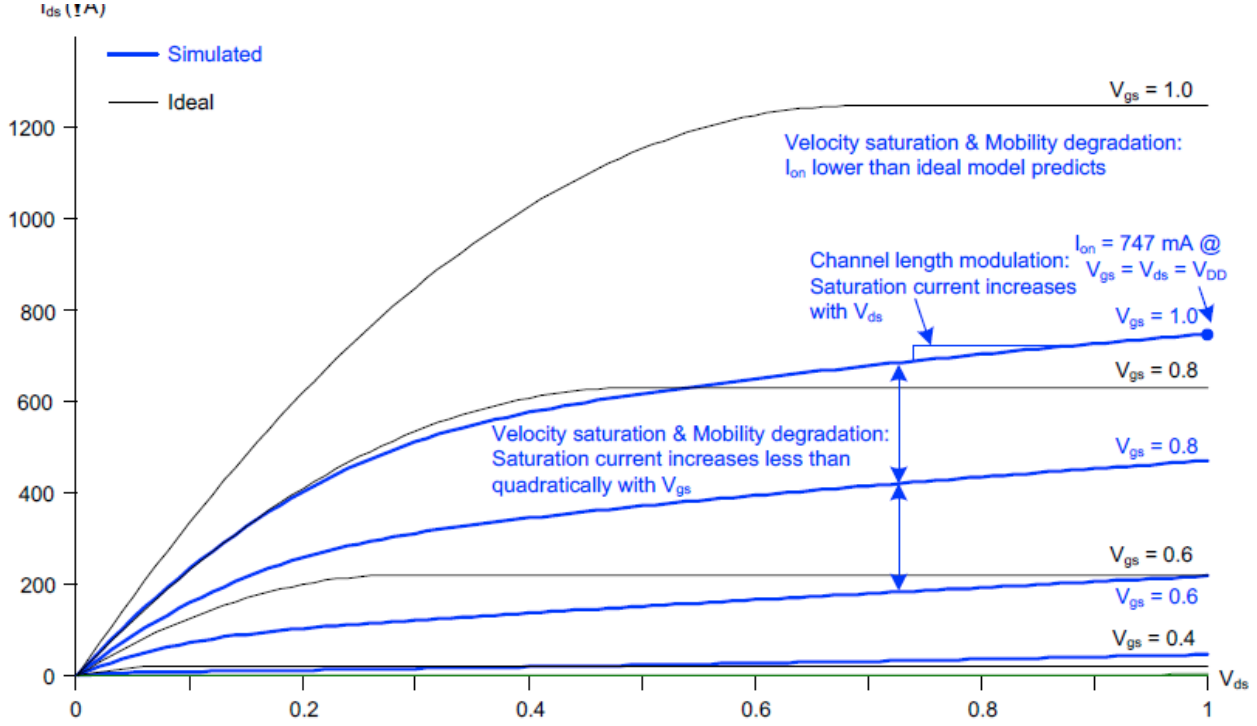
Electrical and Computer Engineering

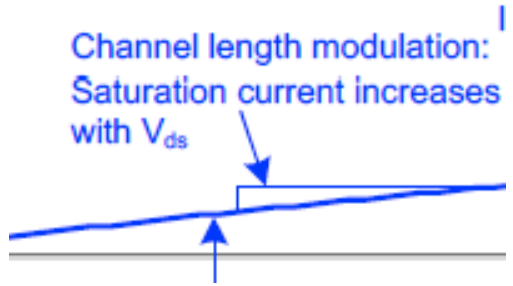
Outline

- Measurement tool from Waveview
- .print

Case study

- Finding channel length modulation coefficient (λ)
- Ideal Vs. Simulated nMOS I-V plot





Case study

Channel length Modulation Coefficient:

$$\mathrm{I_{ds}} = \beta\left(\mathrm{V_{gs}} - \mathrm{V_t} - V_{dsat}/2\right)V_{dsat}(1 + \lambda \mathrm{V}_{ds})$$

Let $\beta\left(\mathrm{V_{gs}} - \mathrm{V_t} - V_{dsat}/2\right)V_{dsat}$ =k,

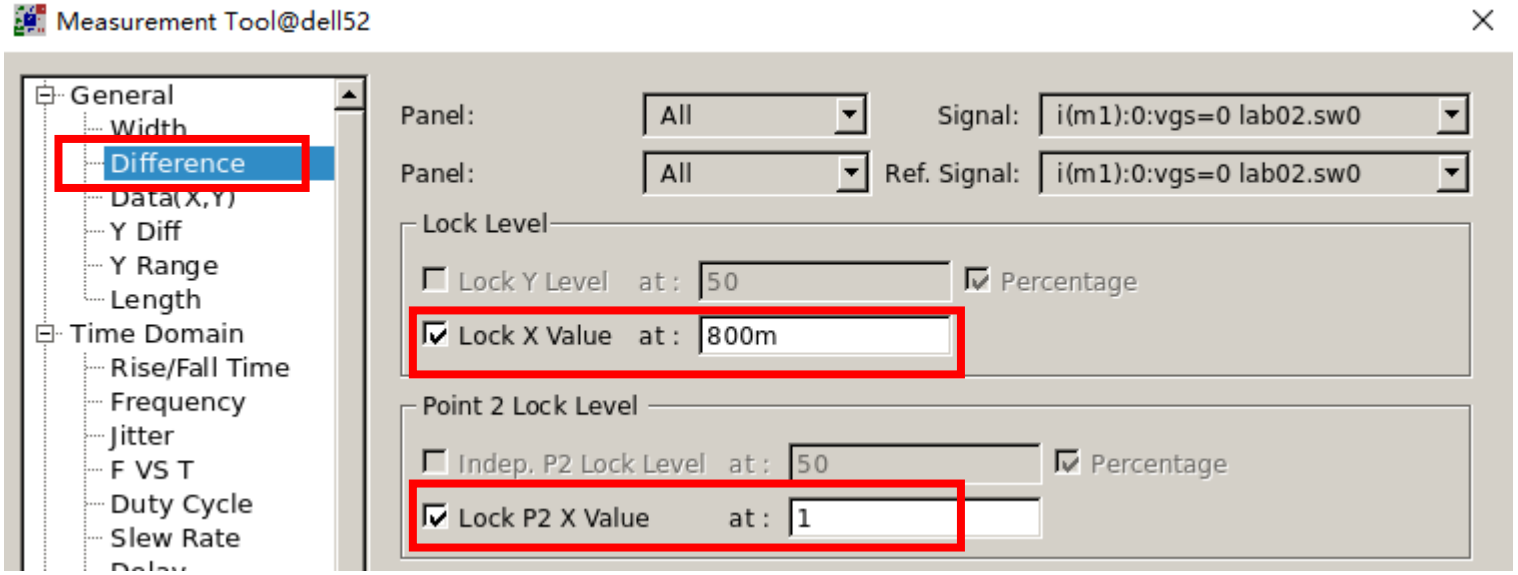
$$\mathrm{I_{ds}} = (k + \lambda \mathrm{k V}_{ds})$$

Where Slop = λk

λ can be calculated with the slop and one data point!

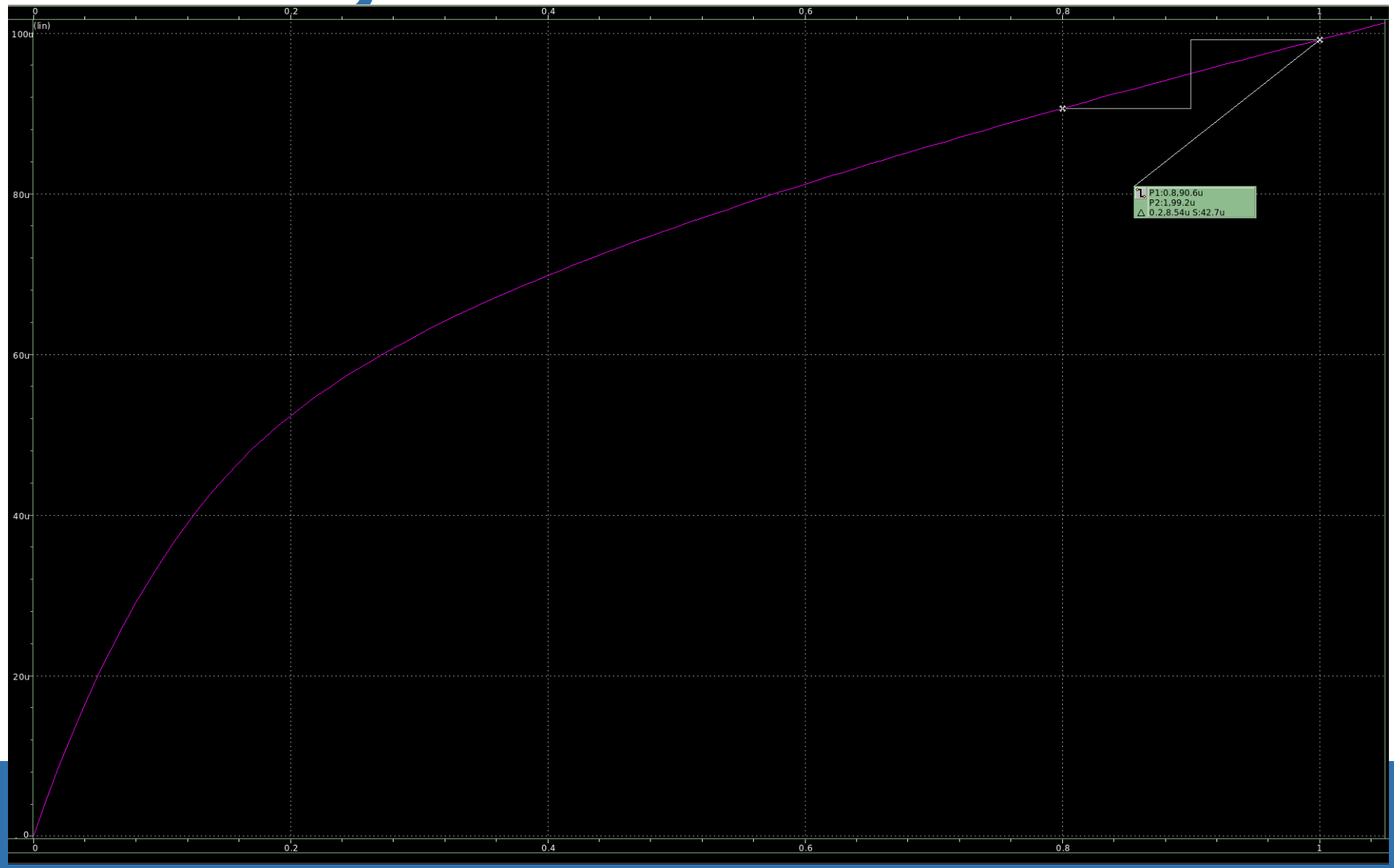
Case study

Measurement tool

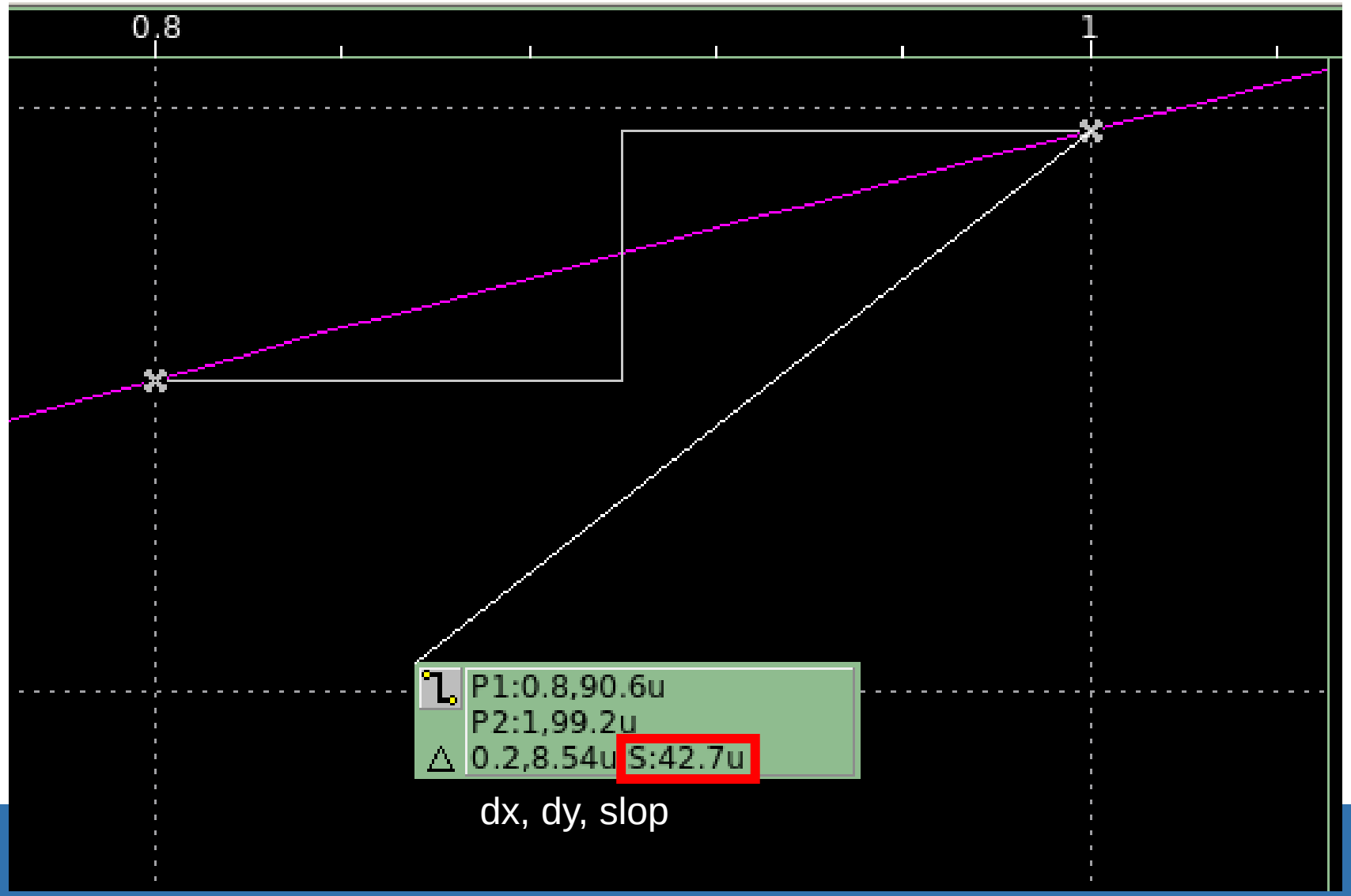


Add a difference meter with two X value locked

Case study

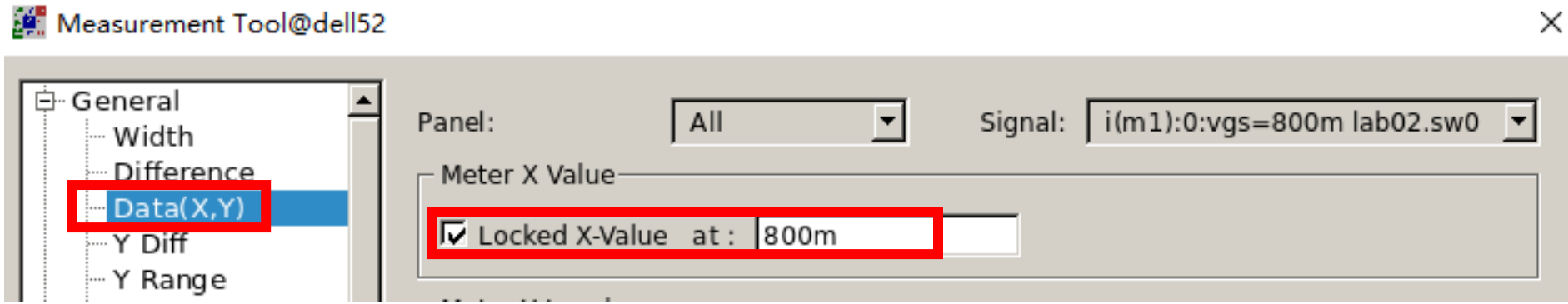

(lin)
100u
80u
60u
40u
20u
0
0
0.2
0.4
0.6
0.8
1
P1:0.8,90.6u
P2:1,99.2u
Δ 0.2,8.54u S:42.7u

Case study

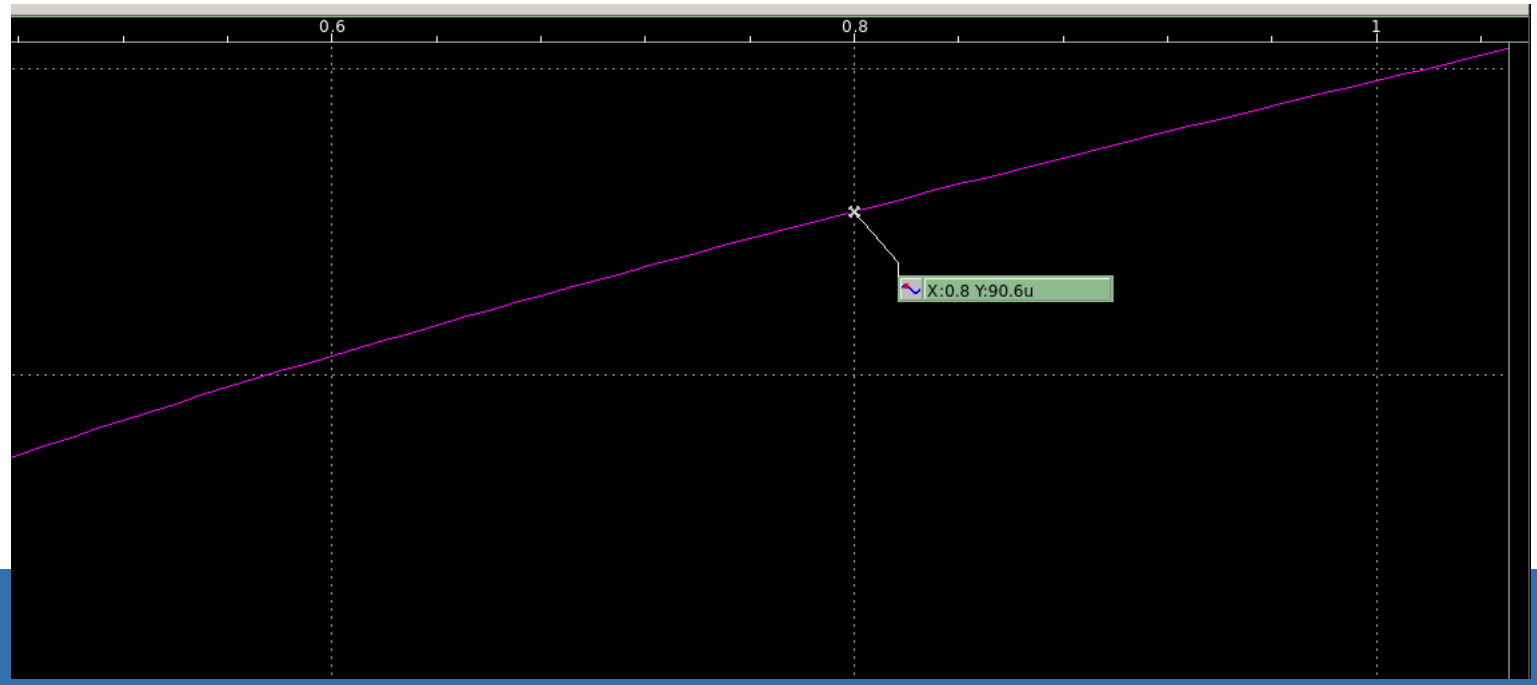


dx, dy, slop

Mark specific node



- Create a meter from measurement tool
  {Data(X,Y)}
- Lock only the X-Value
- Drag it to attach on the target waveform



.print

- .print is very similar with .probe
- Probe:
  - store the analysis result in waveform
  - Syntax: `.probe dc i(m1)`
- Print:
  - Store the analysis result in '.lis' file
  - Syntax: `.print dc lv9(m1)`
- Look into a measure via ".lis" file and Ctrl+F search for keyword "lv9"

volt	lv9
	m1
0.	390.1888m
10.00000m	390.0614m
20.00000m	389.9340m
30.00000m	389.8066m
40.00000m	389.6792m
50.00000m	389.5518m
60.00000m	389.4244m
70.00000m	389.2970m
80.00000m	389.1697m
90.00000m	389.0423m
100.00000m	388.9149m
110.00000m	388.7875m
120.00000m	388.6601m
130.00000m	388.5327m

Voltage change according to dc analysis command

Corresponding Vth (lv9) results

MOS Parameters for .probe/.print

Parameter	Description
LV1	Channel length (L)
LV2	Channel width (W)
LV3	Area of the drain diode (AD)
LV4	Area of the source diode (AS)
LV9	Threshold voltage
LV10	Saturation voltage (VDSAT)
LV11	Drain diode periphery (PD)
LV12	Source diode periphery (PS)

- More detailed parameter definitions could be found in here:

https://spdocs.synopsys.com/dow_retrieve/qsc-t/dg/primesim_continuum/T-2022.06-SP1/primesim_continuum_olh/primesim_user_guide/probing_measuring/probing_element_parameters.html#CEGCFAJC__XpTUYRNbv

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Thank you!