

Interactive tool for quick calculation of design oriented MOSFET parameters

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March 31, 2017

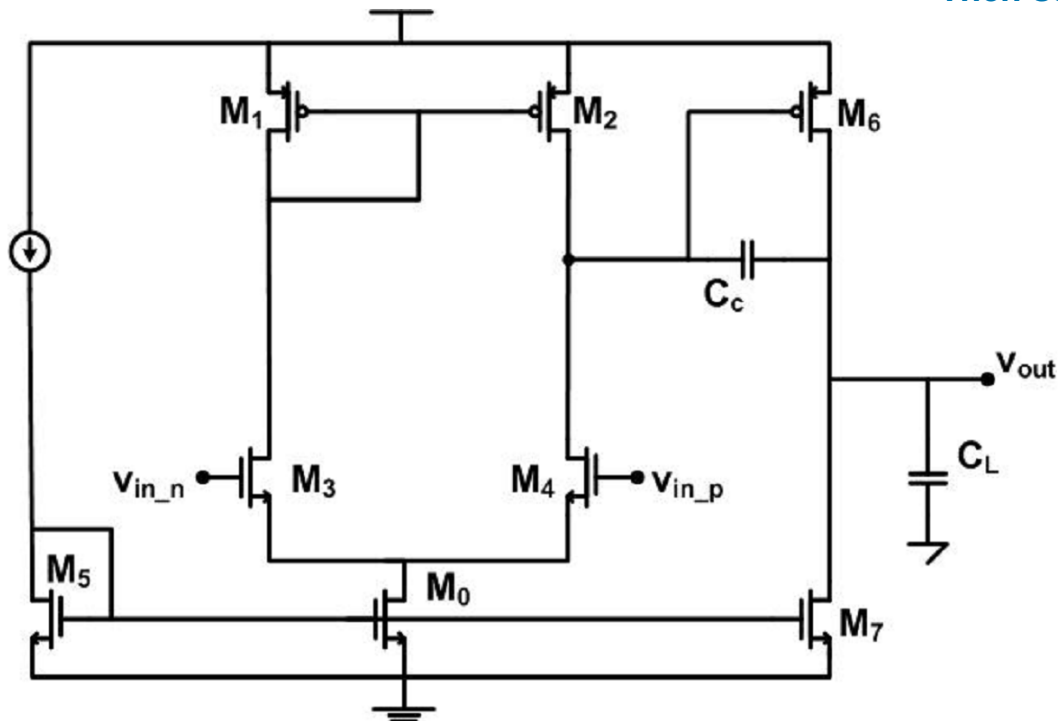
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A design problem

How to find an experienced analog designer

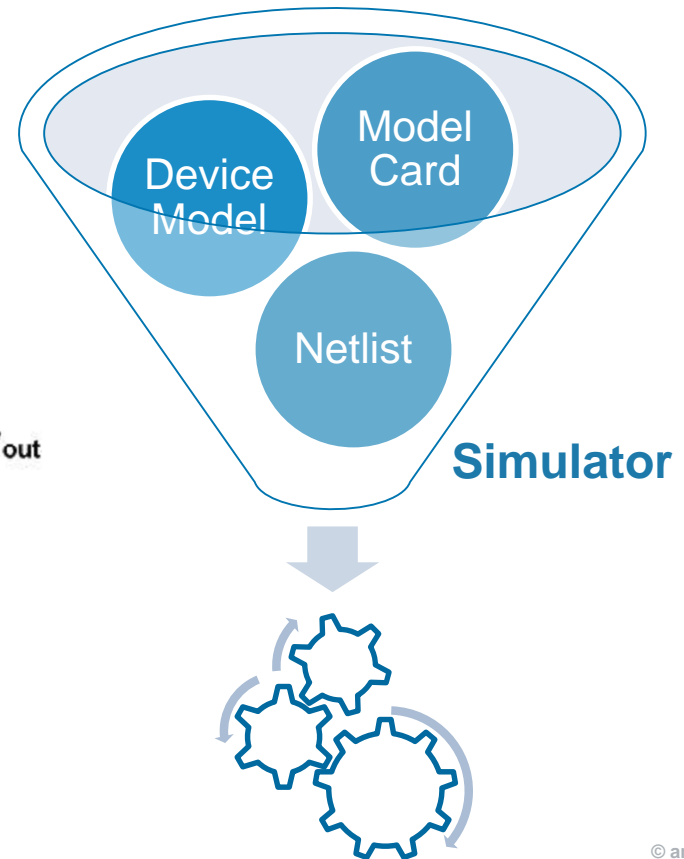
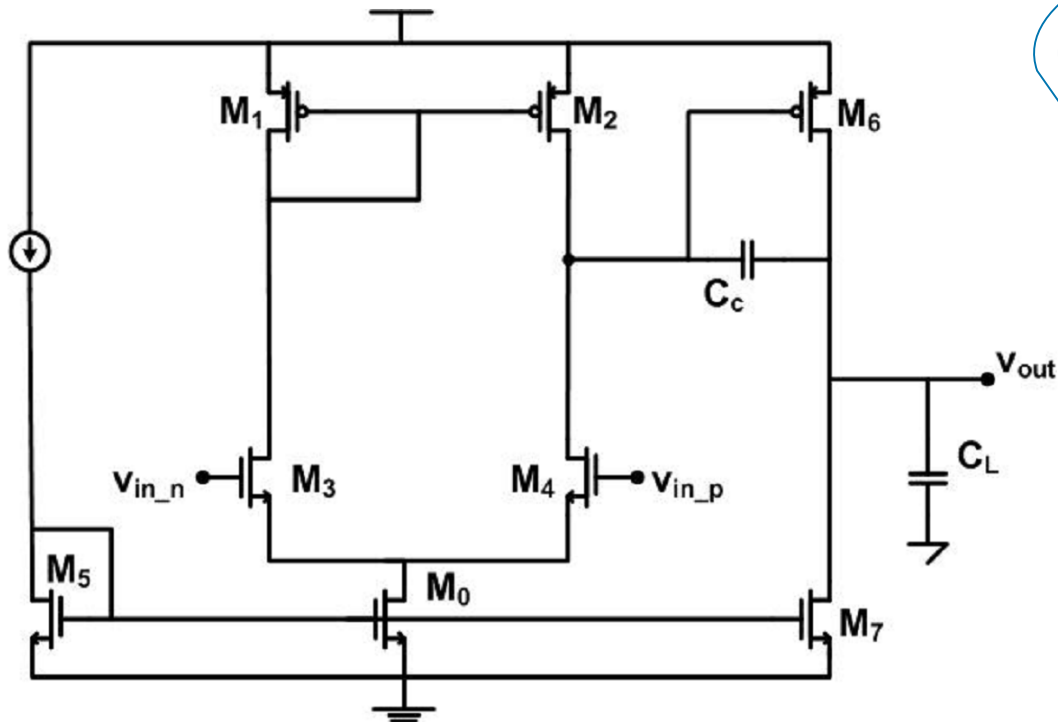
Give two designers an analog design problem:

Then see who goes to the simulator first

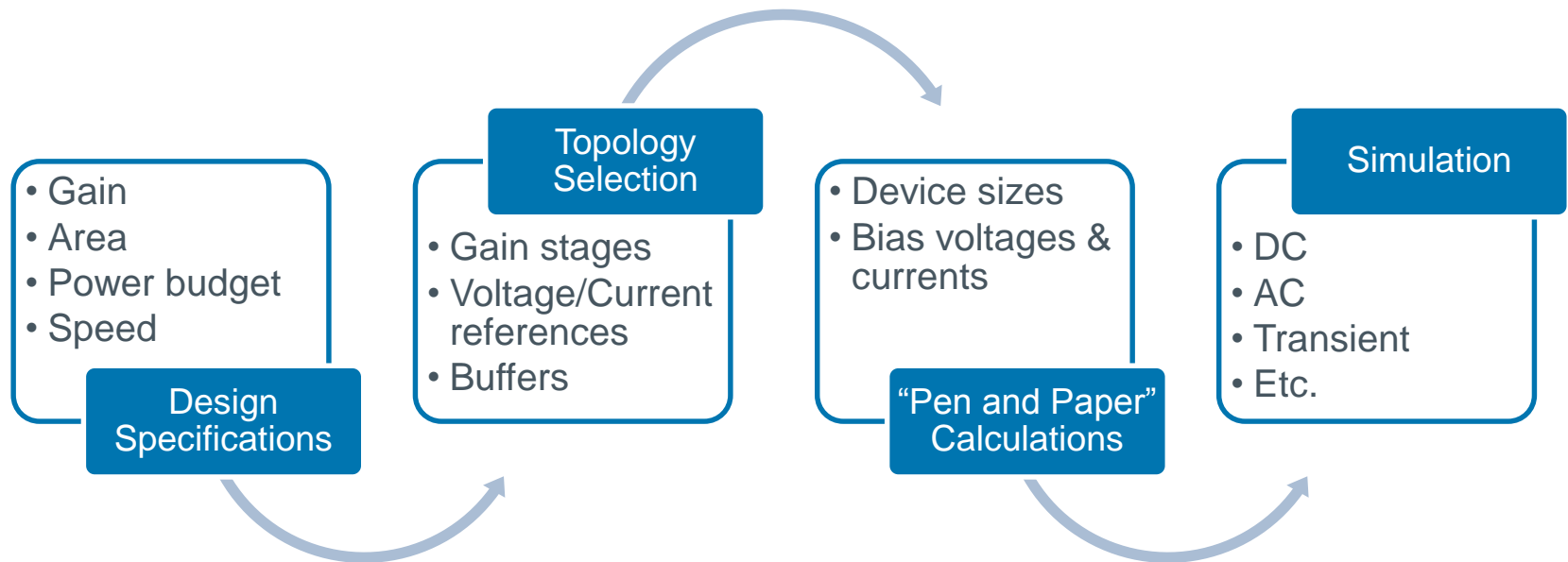


A design problem

The magic simulator funnel

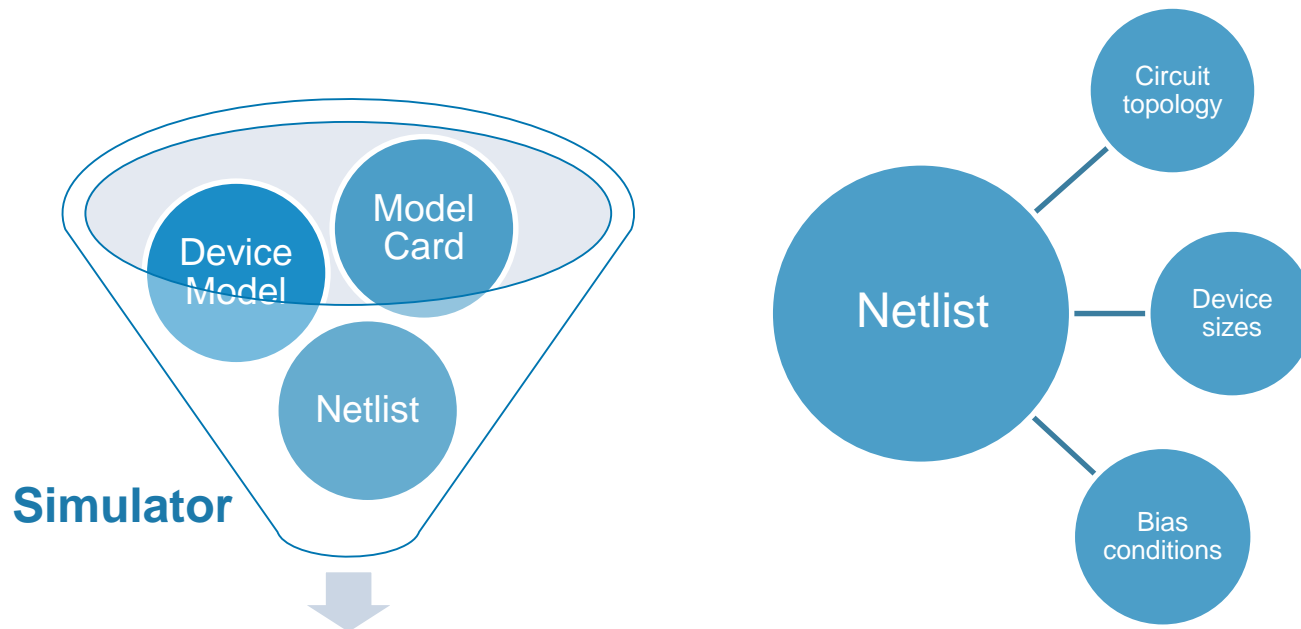


A typical design flow



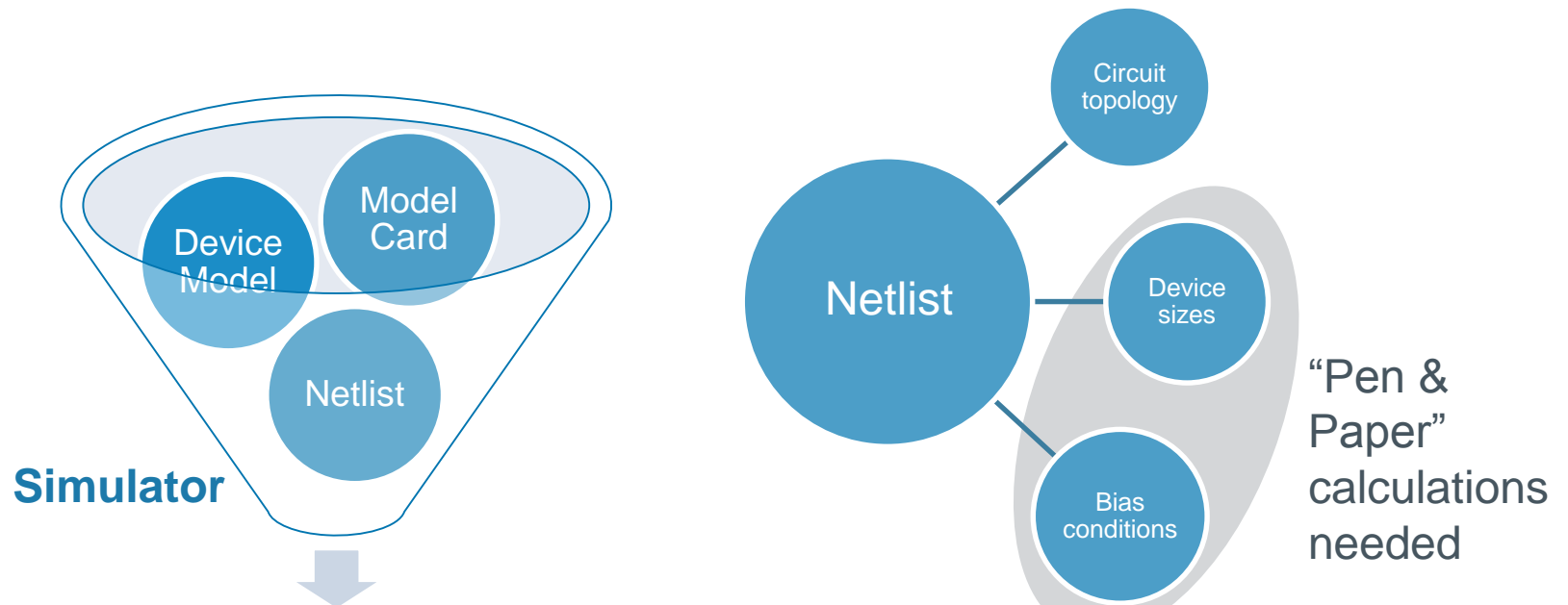
The simulator funnel

A second look



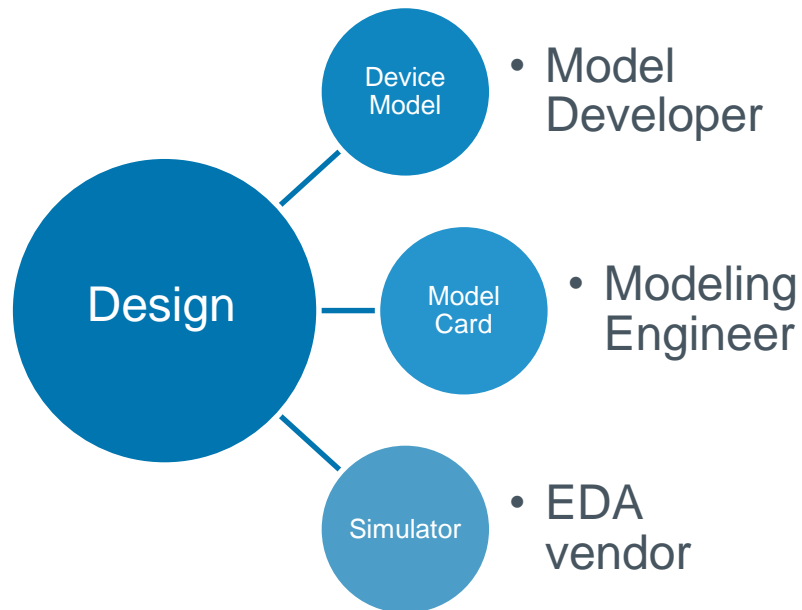
The simulator funnel

A second look



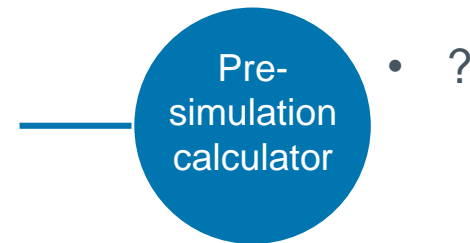
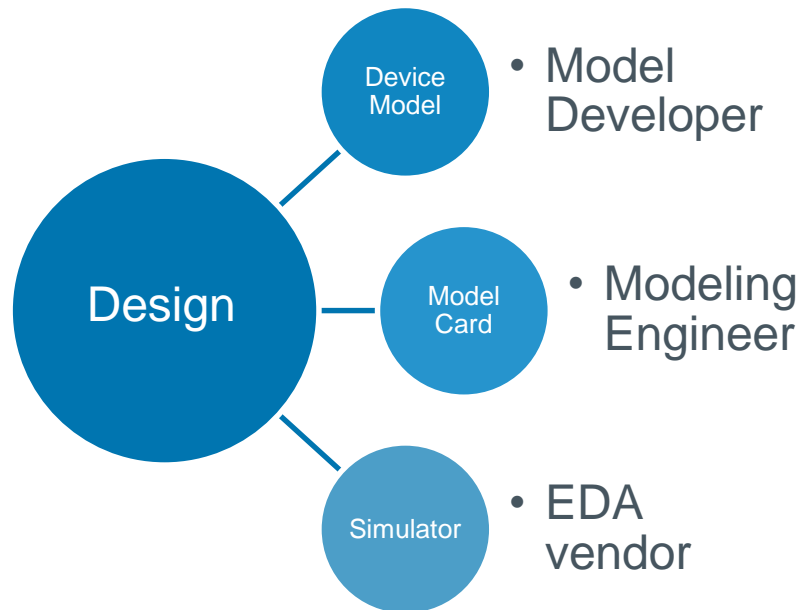
“Pen and Paper” calculations

The designers are on their own



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“Pen and Paper” calculations

The designers are on their own

What do the designers typically use?

- Pen and Paper!
- Spreadsheets
- Mathematical software
 - Octave
 - Matlab
- The simulator itself

“Pen and Paper” calculations

The designers are on their own

What do the designers typically use? What are the limitations?

- Pen and Paper!
- Spreadsheets
- Mathematical software
 - Octave
 - Matlab
- The simulator itself
- Sub-micron to sub-100-nm technologies are being used
- Operating points are often in moderate to weak inversion

“Pen and Paper” calculations

The designers are on their own

B.1.6 Drain Current Expression

$$I_{ds} = \frac{I_{dso}(V_{dseff})}{1 + \frac{R_{ds}I_{dso}(V_{dseff})}{V_{dseff}}} \left(1 + \frac{V_{ds} - V_{dseff}}{V_A}\right) \left(1 + \frac{V_{ds} - V_{dseff}}{V_{ASCBE}}\right)$$

$$I_{dso} = \frac{W_{eff}\mu_{eff}C_{ox}V_{gsteff} \left(1 - A_{bulk} \frac{V_{dseff}}{2(V_{gsteff} + 2V_t)}\right) V_{dseff}}{L_{eff} [1 + V_{dseff} / (E_{sat}L_{eff})]}$$

$$V_A = V_{Asat} + \left(1 + \frac{P_{vag}V_{gsteff}}{E_{sat}L_{eff}}\right) \left(\frac{1}{V_{ACLM}} + \frac{1}{V_{ADIBLC}}\right)^{-1}$$

$$V_{ACLM} = \frac{A_{bulk}E_{sat}L_{eff} + V_{gsteff}}{P_{CLM}A_{bulk}E_{sat}l_{itl}} (V_{ds} - V_{dseff})$$

$$V_{ADIBLC} = \frac{(V_{gsteff} + 2V_t)}{\theta_{roul}(1 + P_{DIBLC}V_{bseff})} \left(1 - \frac{A_{bulk}V_{dsat}}{A_{bulk}V_{dsat} + V_{gsteff} + 2V_t}\right)$$

What are the limitations?

- Sub-micron to sub-100-nm technologies are being used
- Operating points are often in moderate to weak inversion
- Simple *Level 1* equations cannot be used to accurately determine relevant small-signal parameters

“Pen and Paper” calculations

The designers are on their own

What do the designers typically use? What are the limitations?

- Pen and Paper!
 - Spreadsheets
 - Mathematical software
 - Octave
 - Matlab
 - The simulator itself
- Sub-micron to sub-100-nm technologies are being used
 - Operating points are often in moderate to weak inversion
 - Simple *Level 1* equations cannot be used to accurately determine relevant small-signal parameters
 - There is no information about process variability

“Pen and Paper” calculations

The designers are on their own

What do the designers typically use? What are the limitations?

- Pen and Paper!
- Spreadsheets
- Mathematical software
 - Octave
 - Matlab
- The simulator itself
- Typical **overhead** to simulate a parameter is about **30 seconds**
 - Long time in an iterative process
- Limited number of licenses
 - Further delays

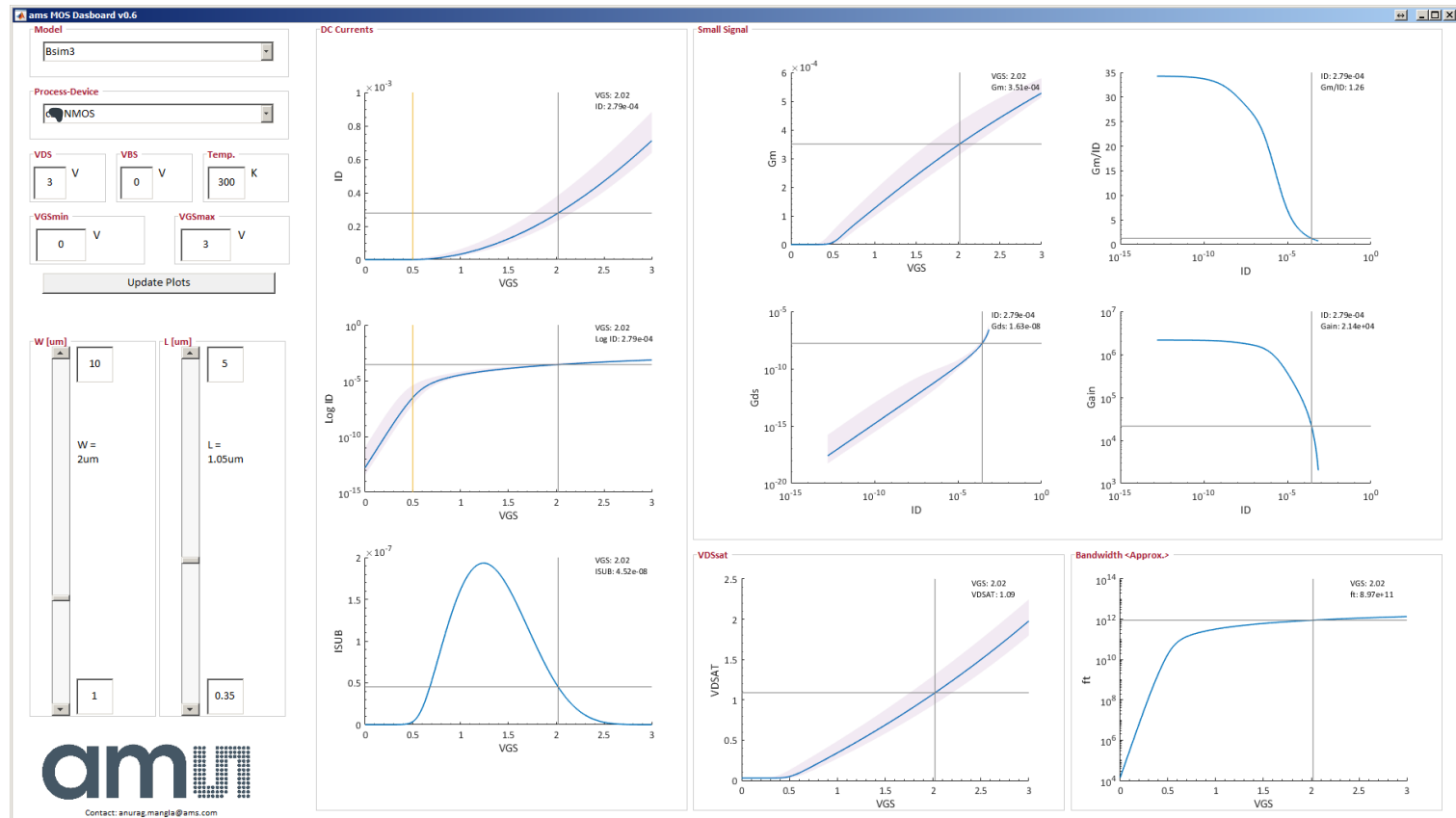
A pre-simulation calculation tool

Requirements

- Calculates the relevant small-signal parameters for elements available in a fab process
- Easy to use interactively
- Calculates the numbers quickly (< 1 s)
- Use the same model set as used in the simulator
- No license restrictions
 - (at least less severe restrictions than commercial simulators)

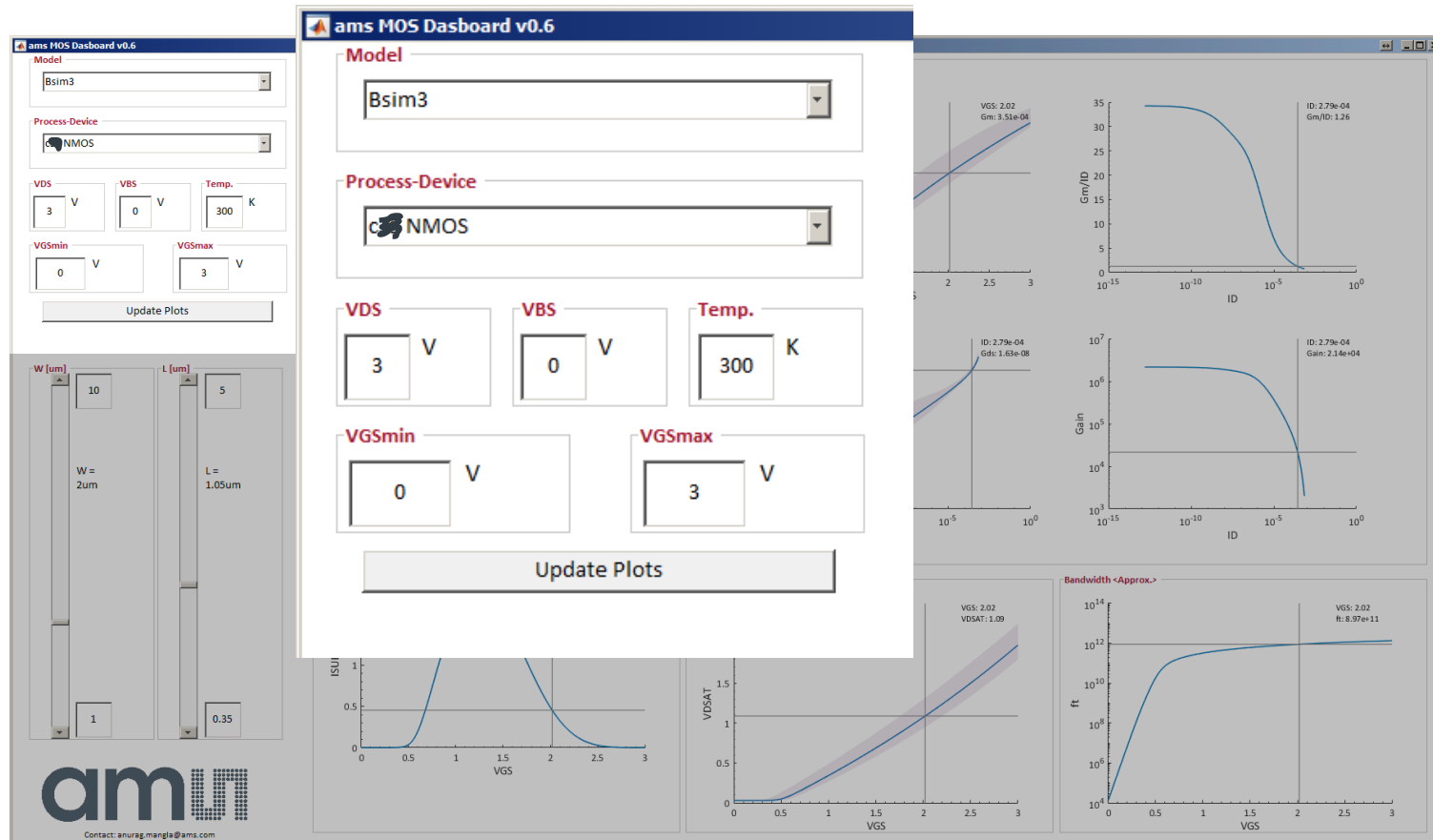
ams MOS dashboard

An interactive tool for MOS sizing and biasing calculations



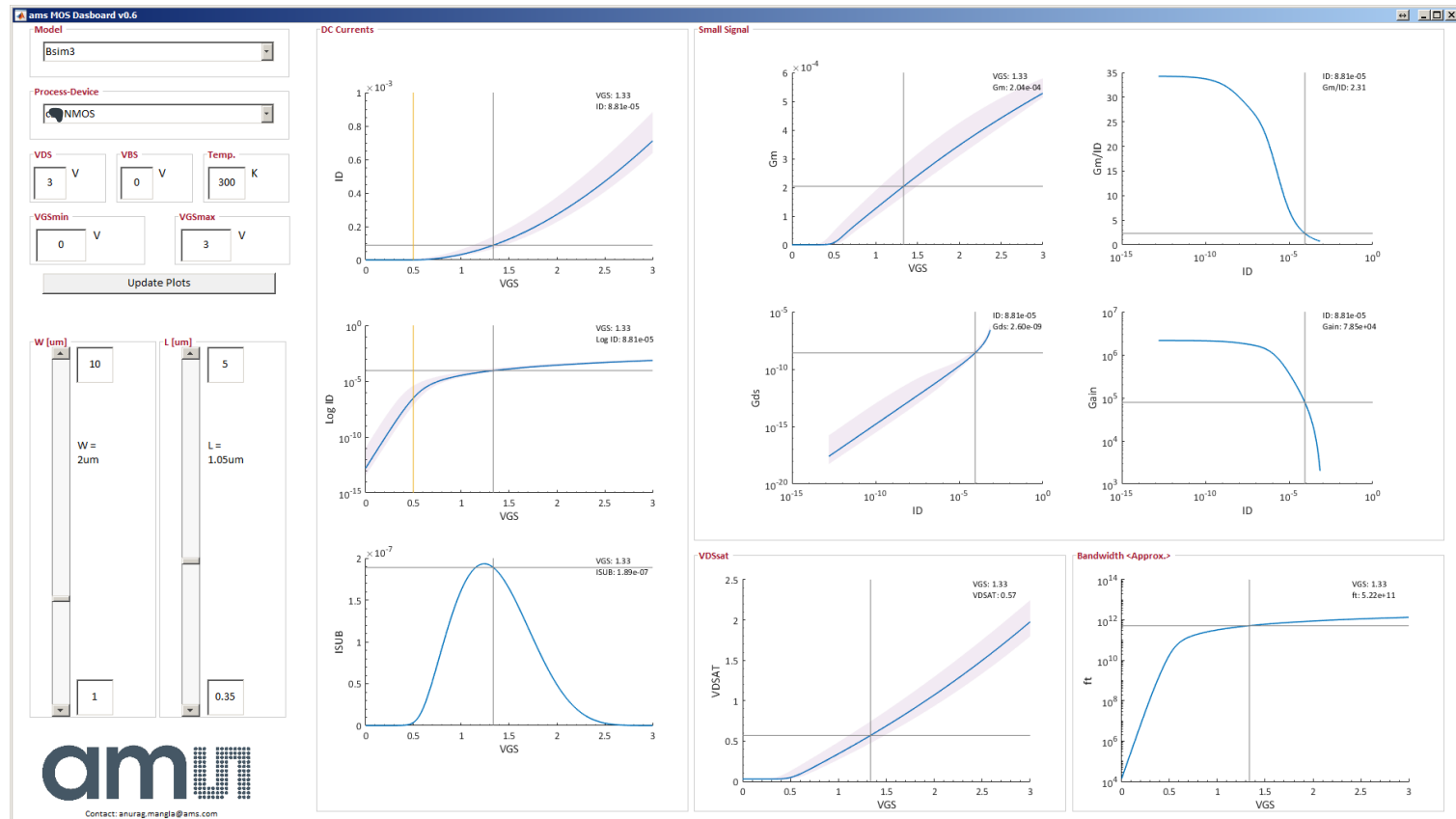
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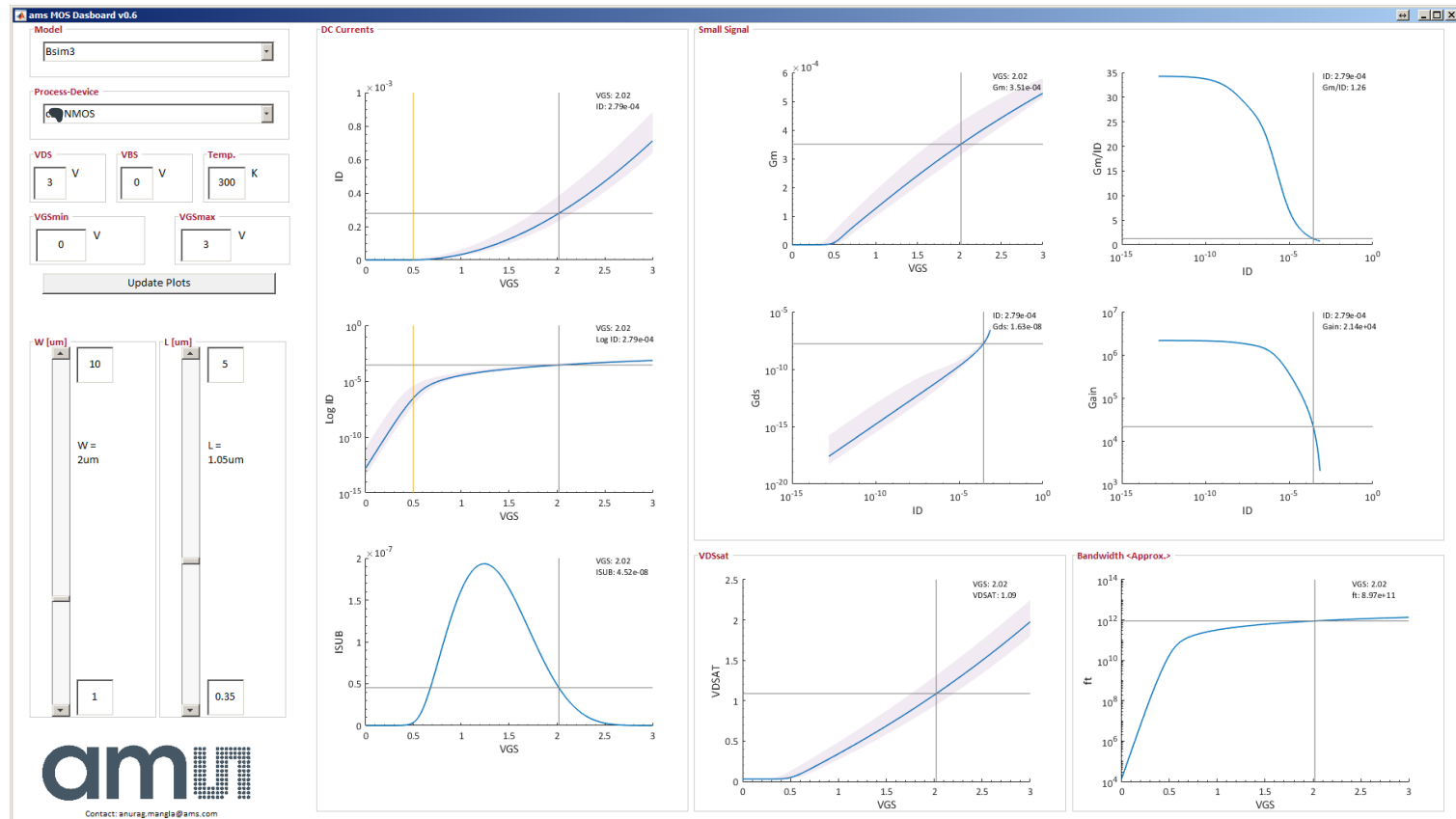
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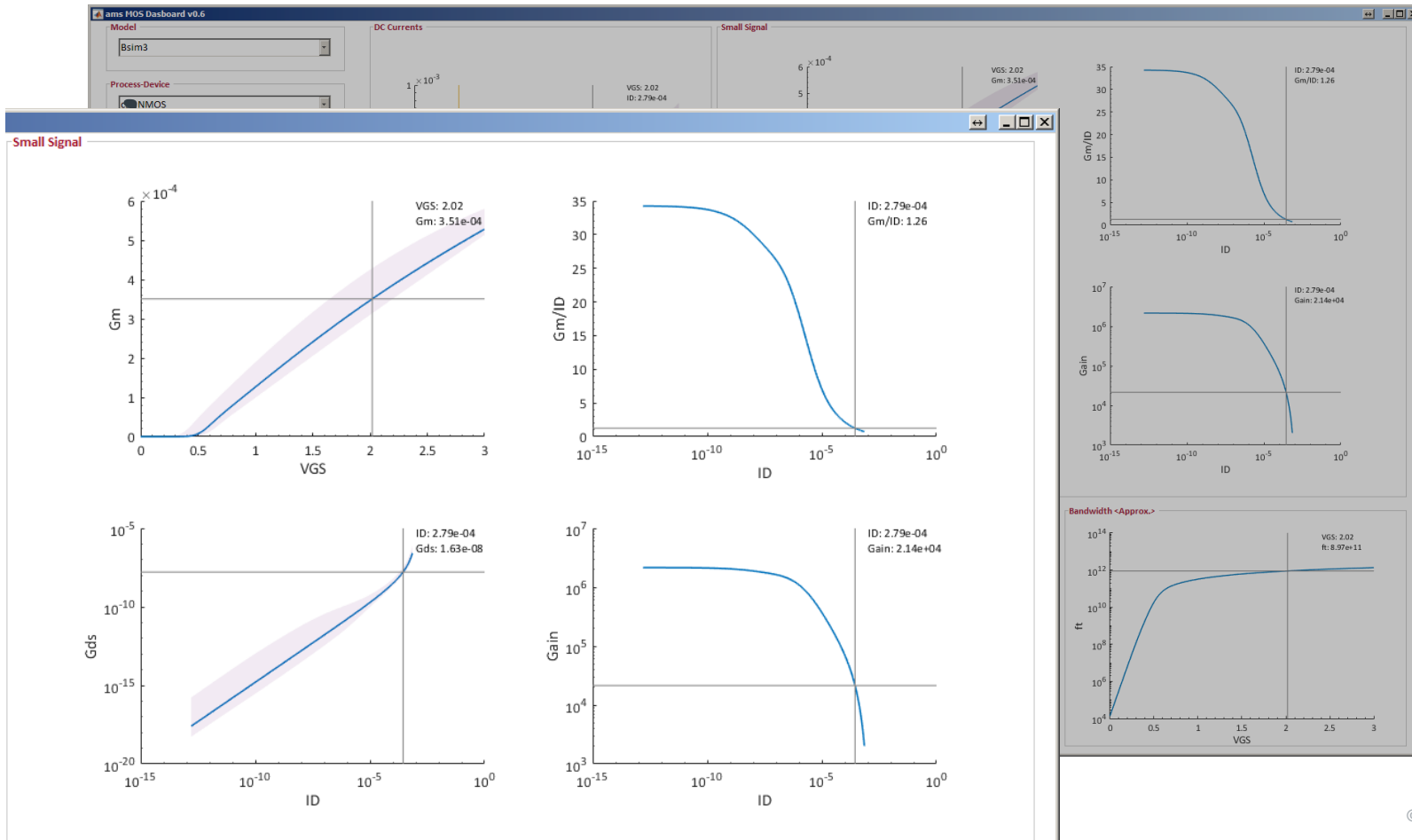
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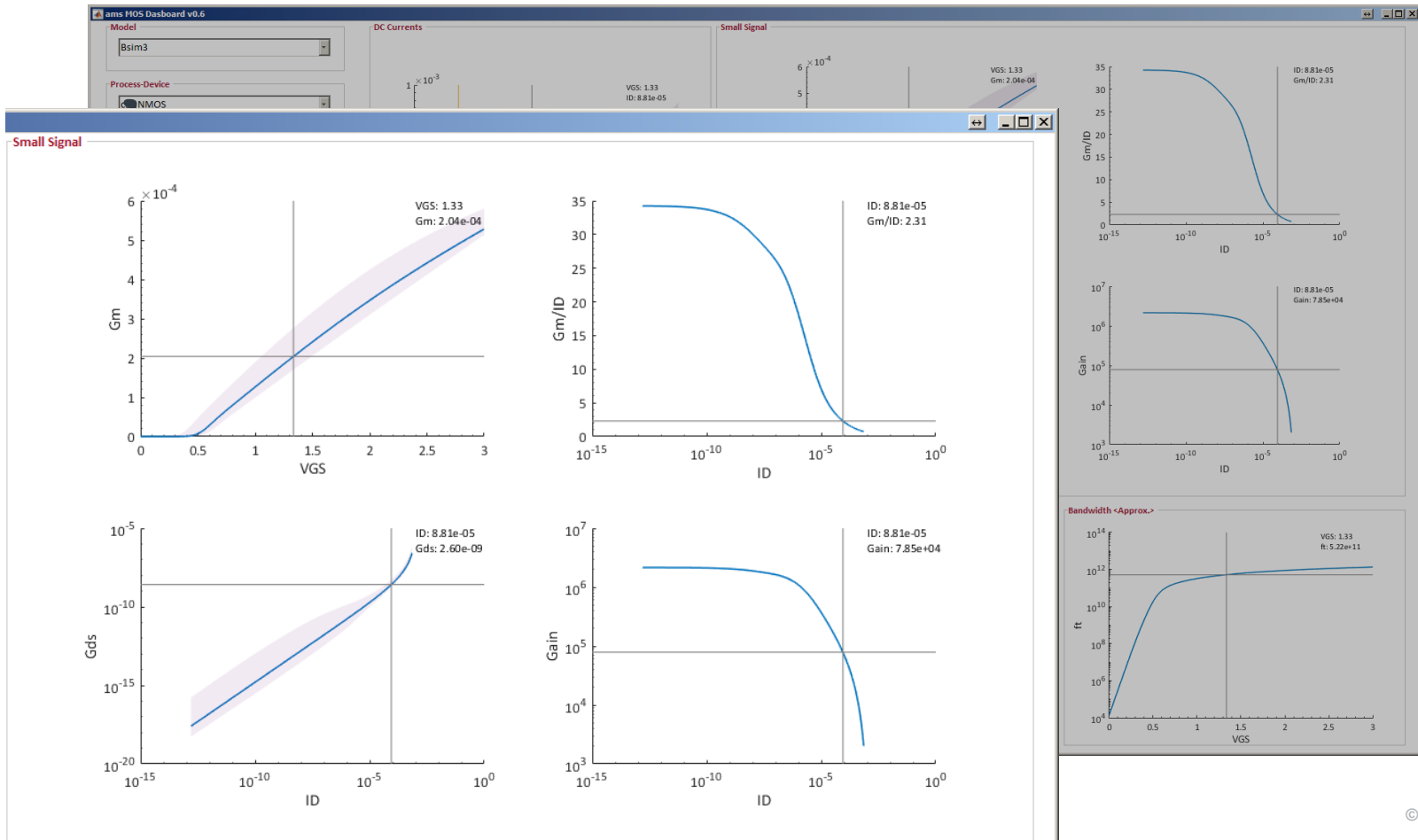
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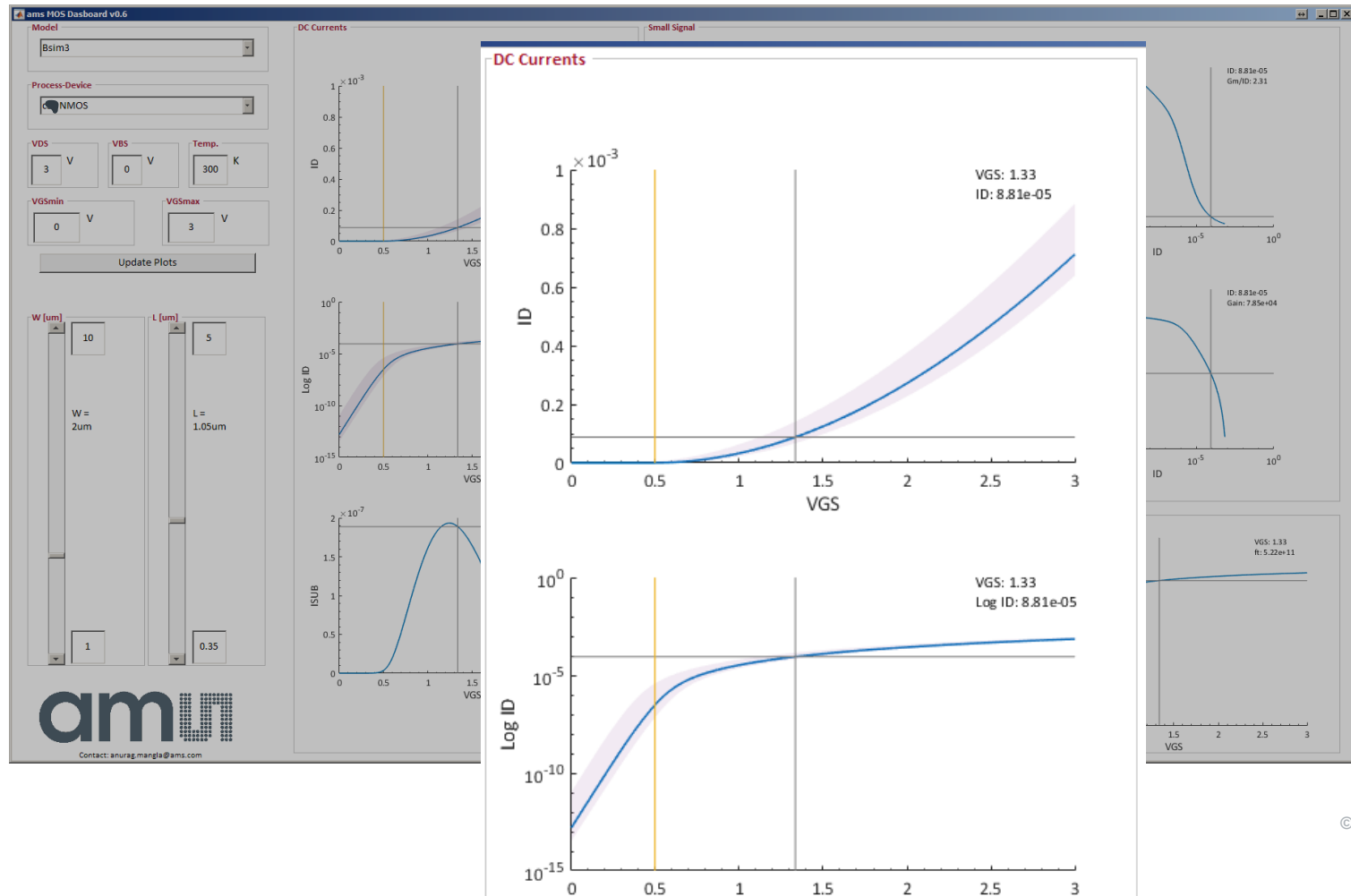
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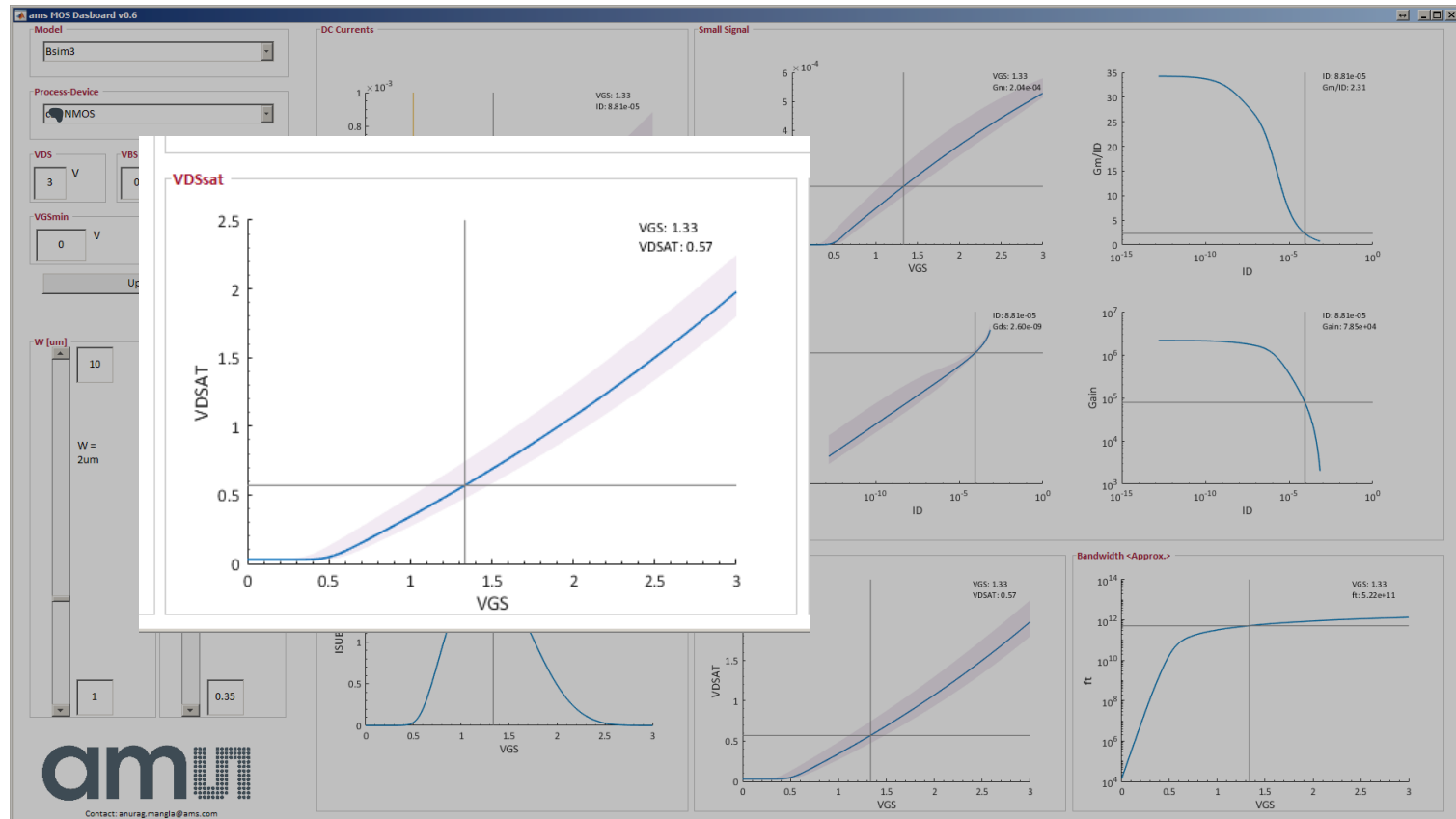
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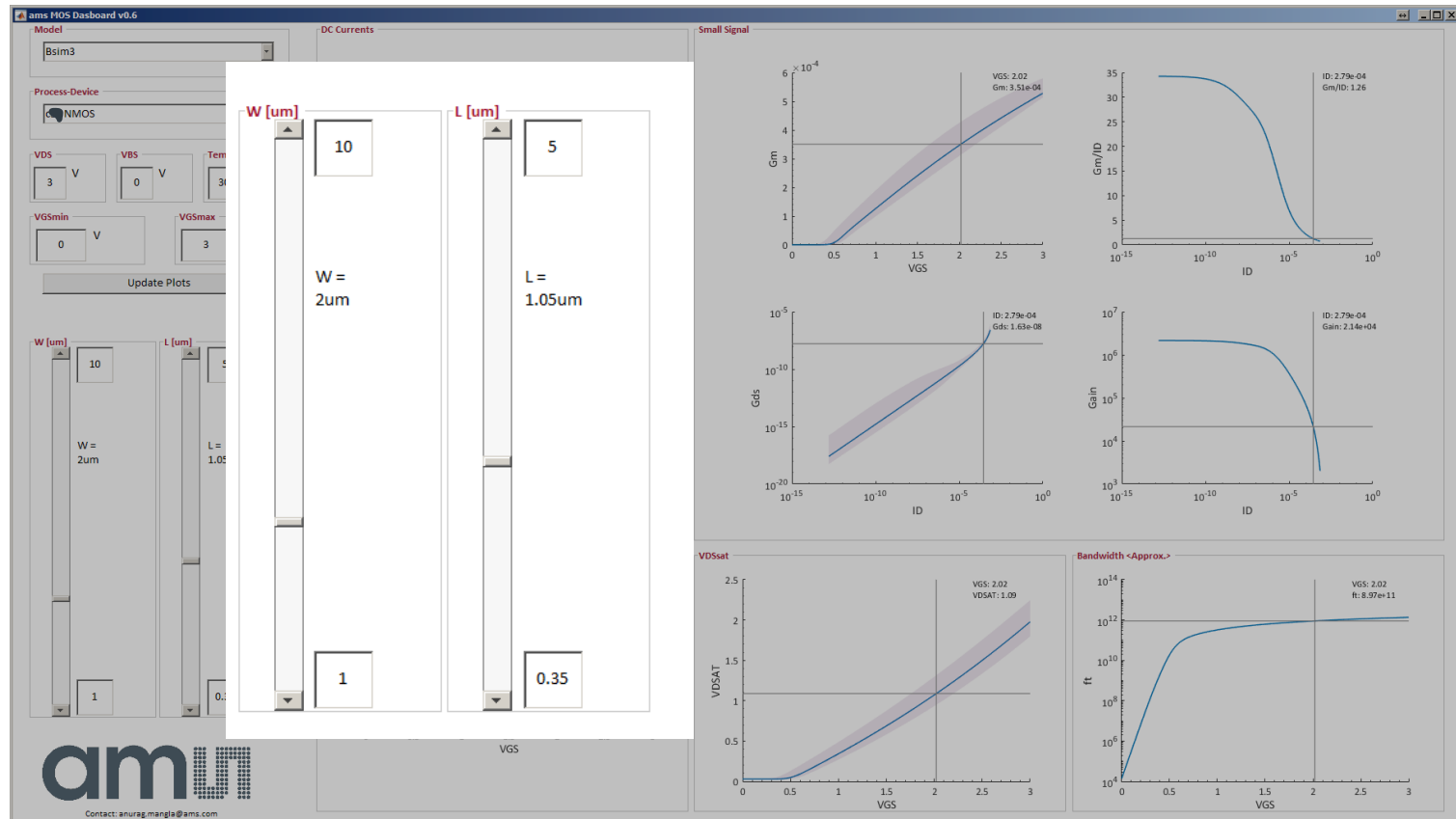
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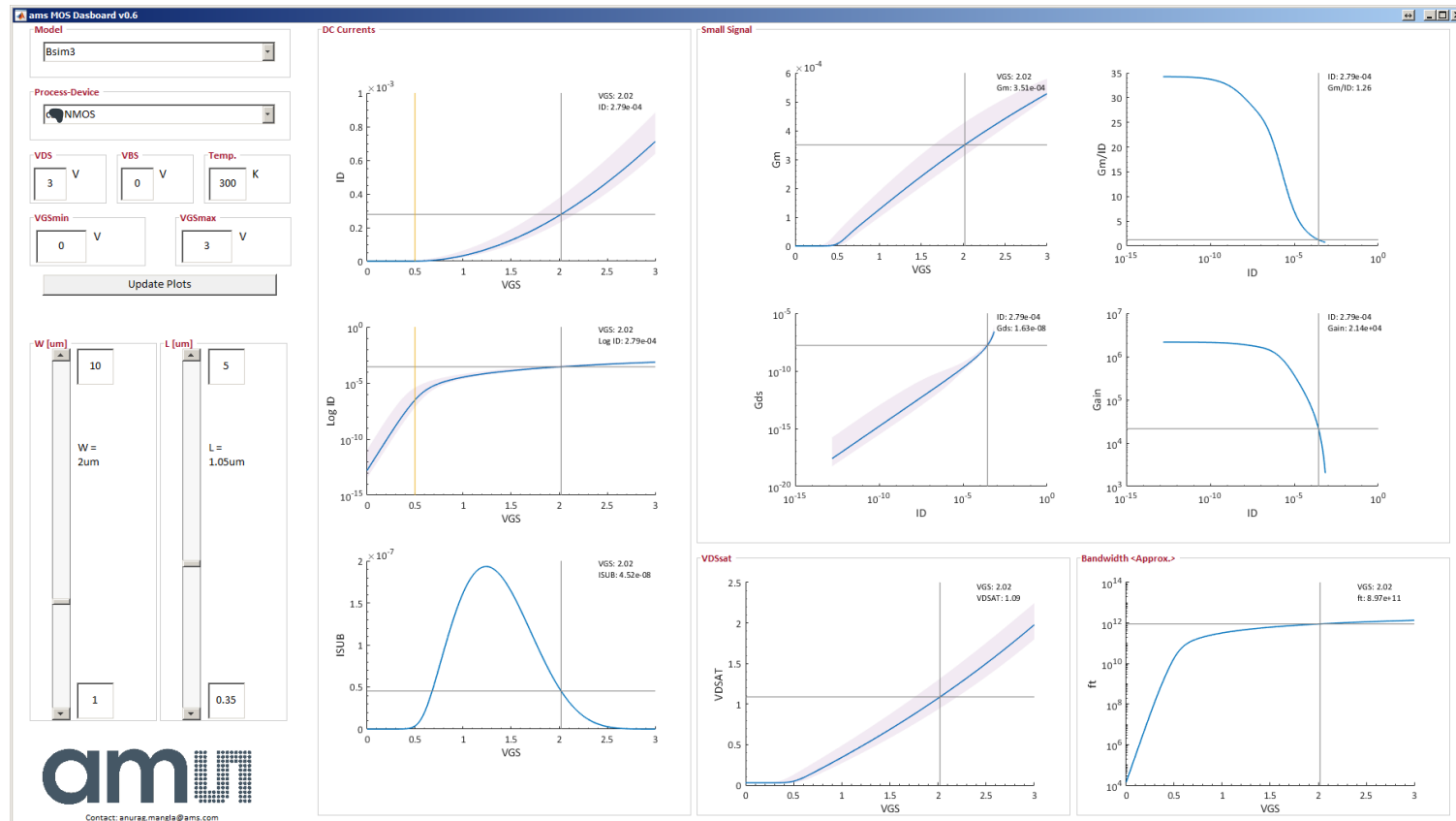
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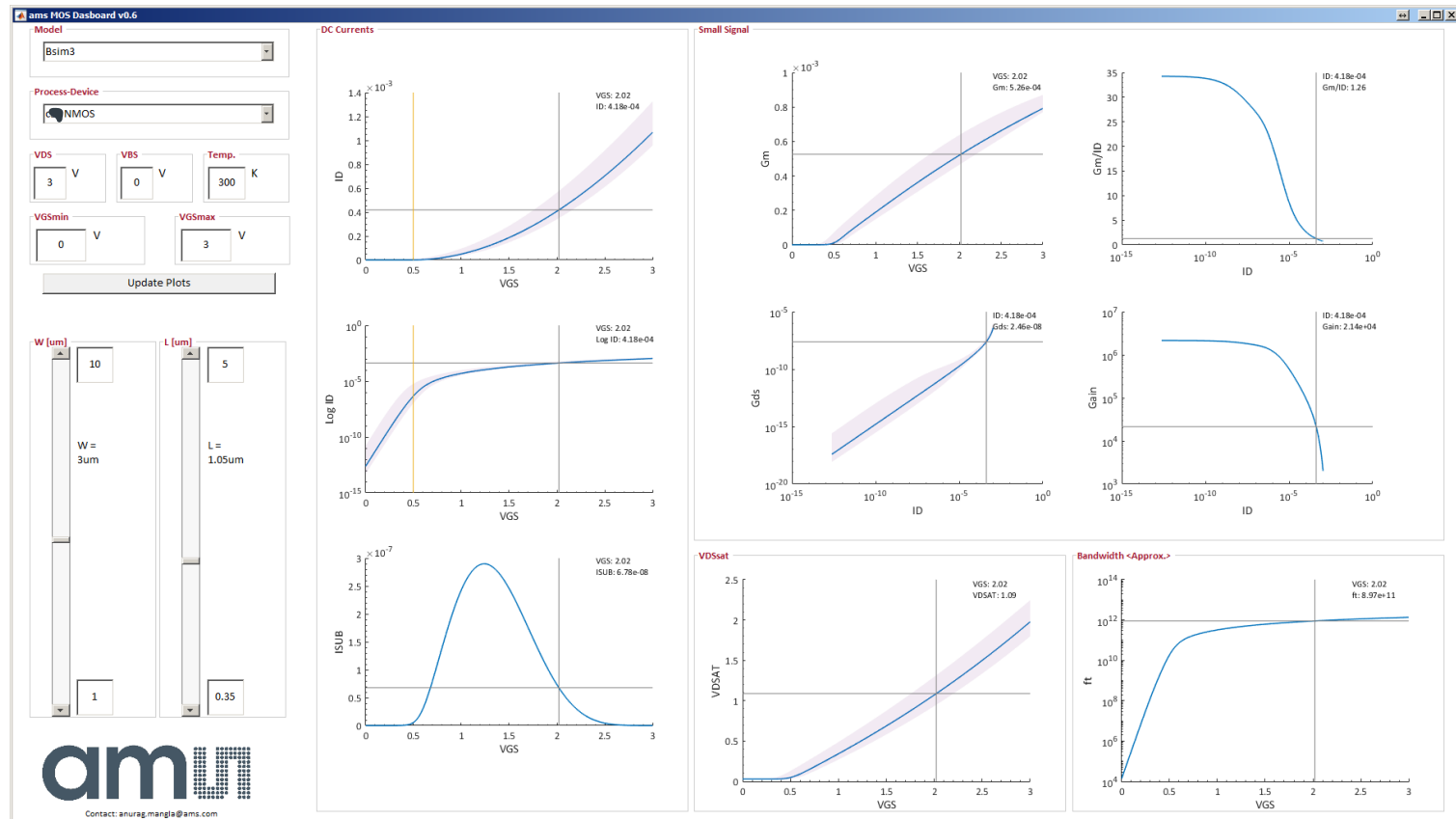
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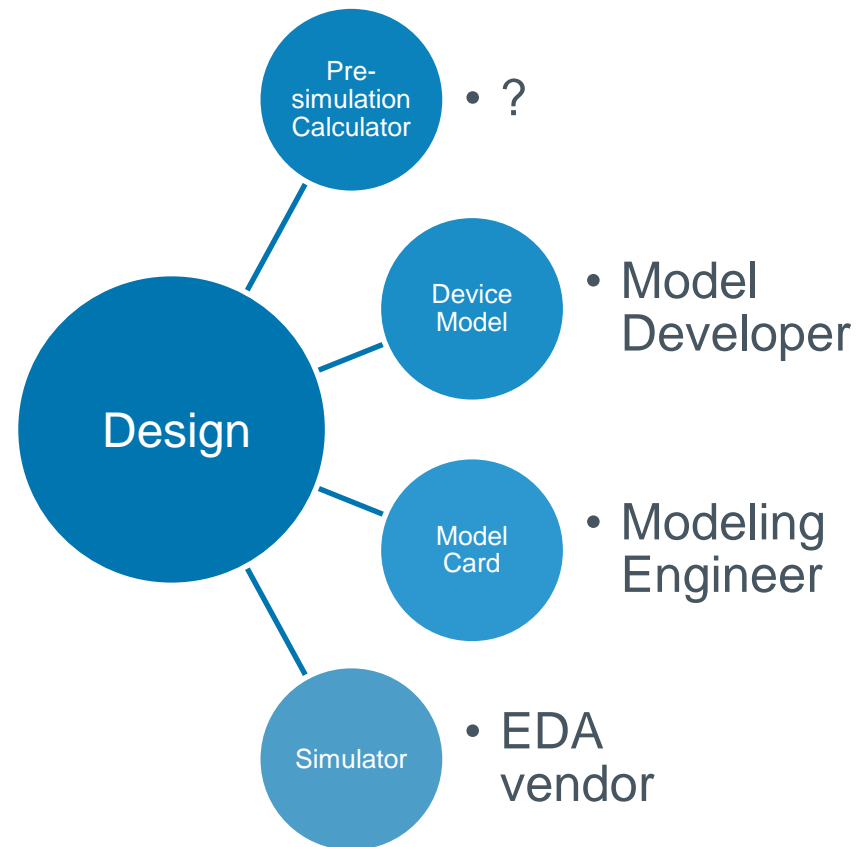
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A pre-simulation calculation tool

Who is the designers' friend





Thank you

Please visit our website www.ams.com