A Folded Floating-Gate Differential Pair for Low-Voltage Applications

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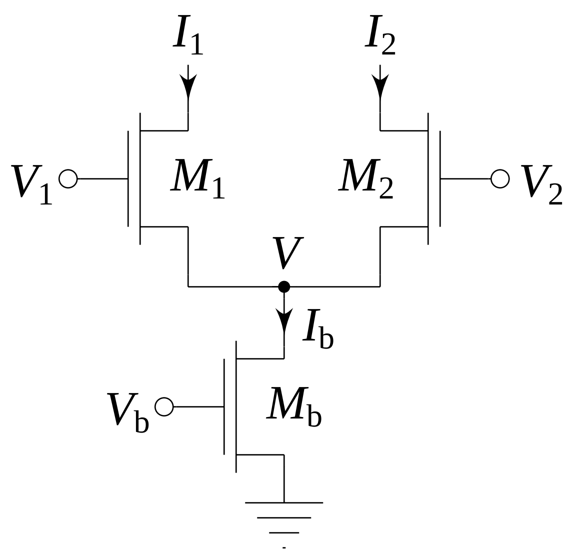
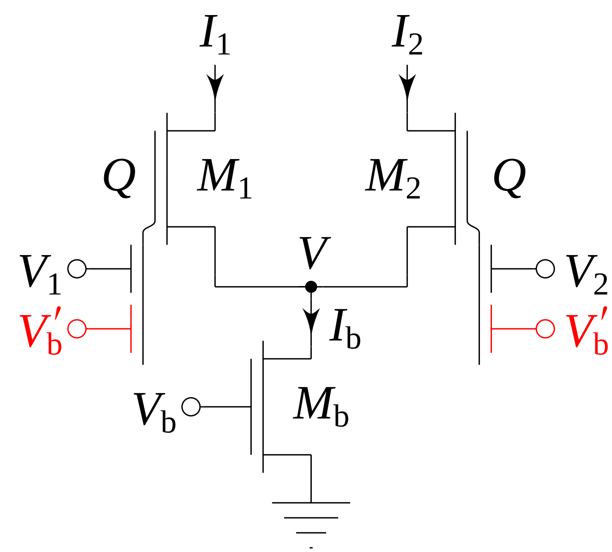
Conventional Differential Pairs





- We let V adjust itself so that $I_1 + I_2 \to I_b$.
- We must ensure that M_1 and M_2 have sufficient V_{gs} to pass I_b and that $V \geq V_{sat}$ to keep M_b saturated.
- We must ensure that M_1 and M_2 have sufficient V_{ds} to keep them saturated.

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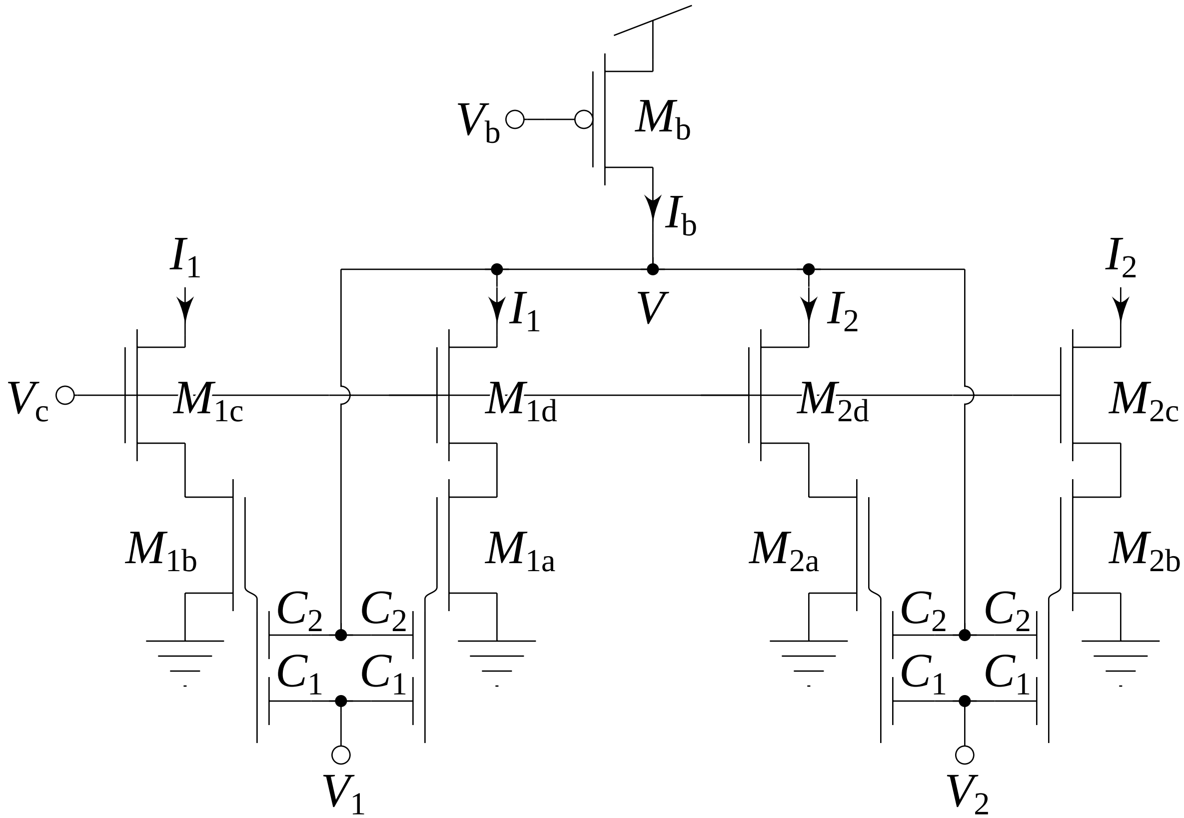
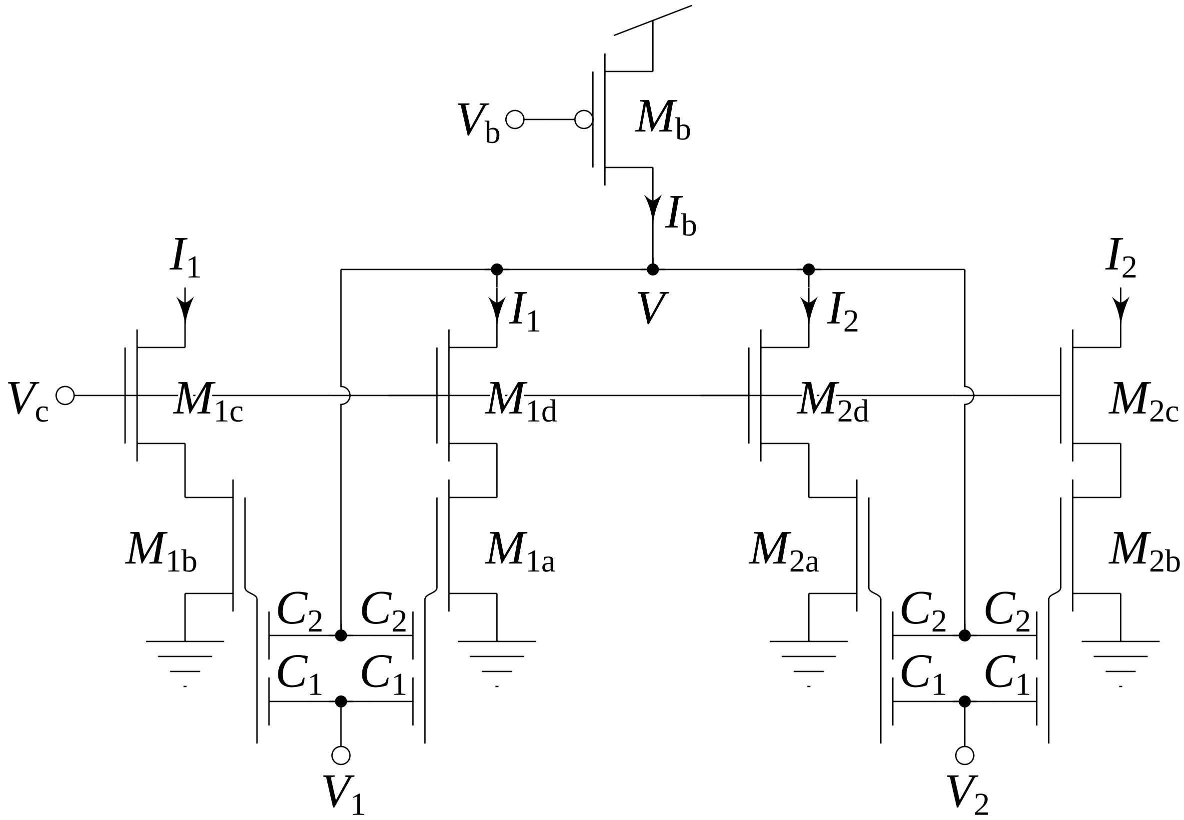


- M_{1a} and M_{1b} both pass I_1 and M_{2a} and M_{2b} both pass I_2.
- We let V adjust itself so that $I_1 + I_2 \to I_b$.
- Bias transistor and the excursion of V are both *folded* relative to a conventional differential pair.
- Input and output voltage ranges from rail-to-rail.
- Constant differential-mode transconductance.

A Folded Floating-Gate Differential Pair



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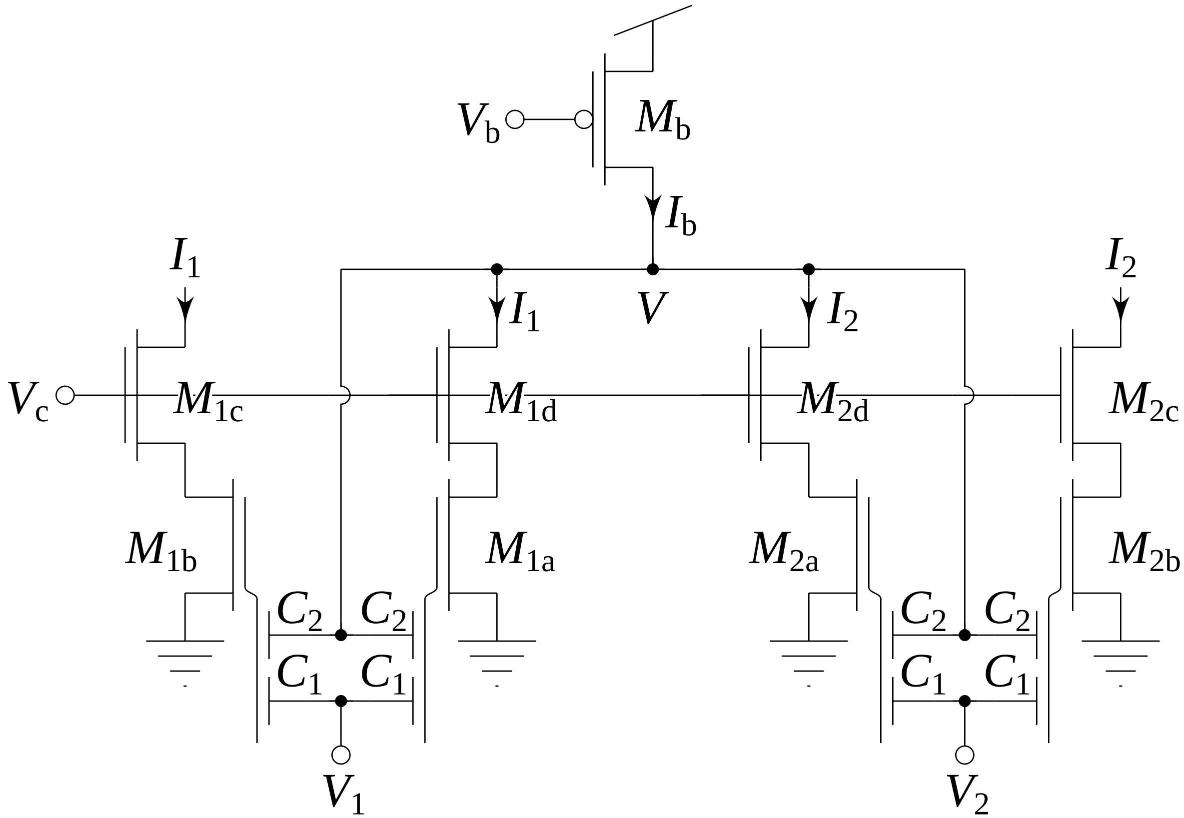
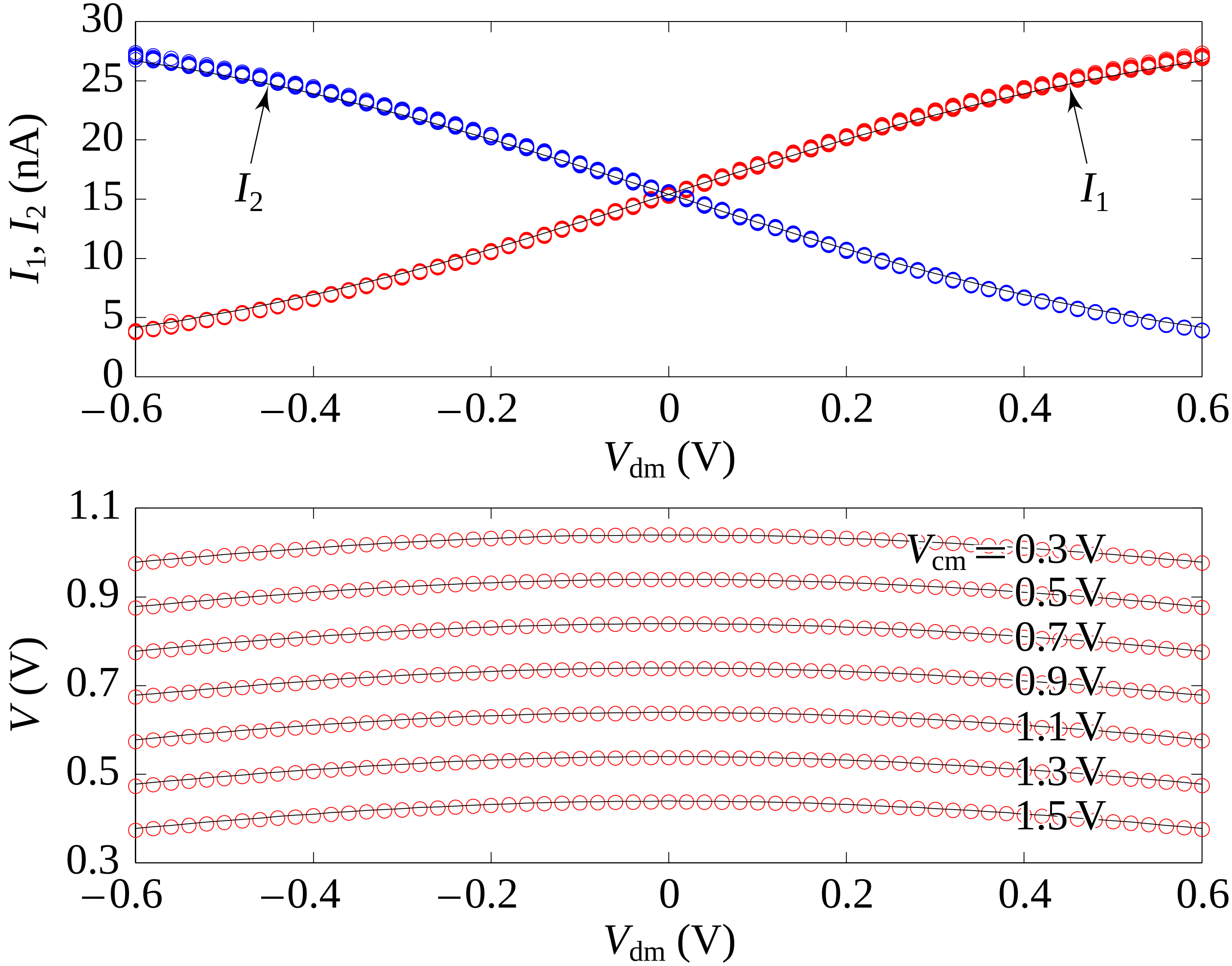
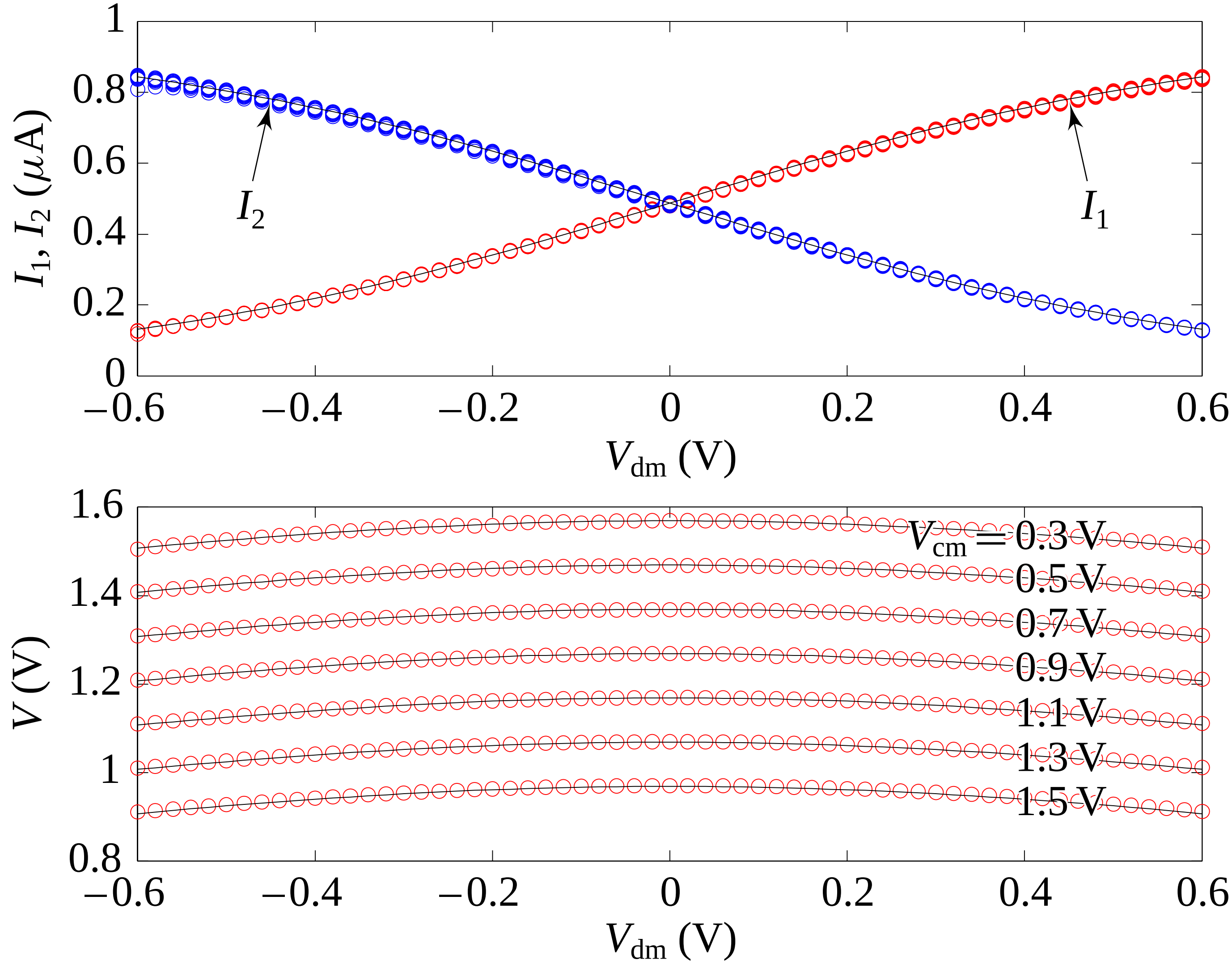


- C_1 sets the linear range and transconductance gain.
- C_2 controls by how much V changes in response to changes in either V_{cm} or I_b.
- Input and output voltage ranges are from rail-to-rail.
- Transconductance constant with V_{cm}.

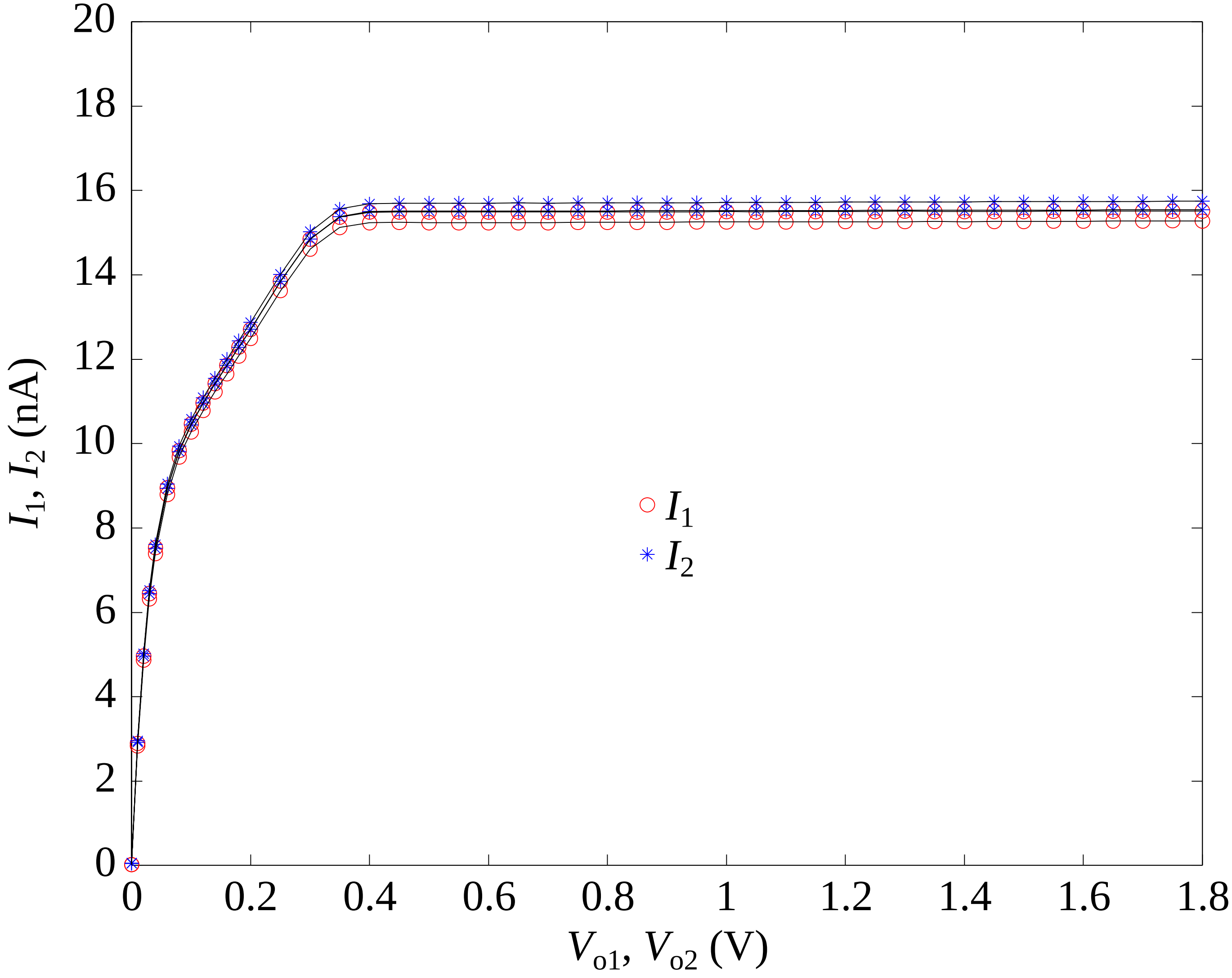
Output Currents vs V_{dm} for $I_{\mathrm{b}} = 31.6\,\mathrm{nA}$



Output Currents vs V_{dm} for $I_b = 1.00\,\mu A$



Output Characteristics for $I_b = 31.6\,\text{nA}$



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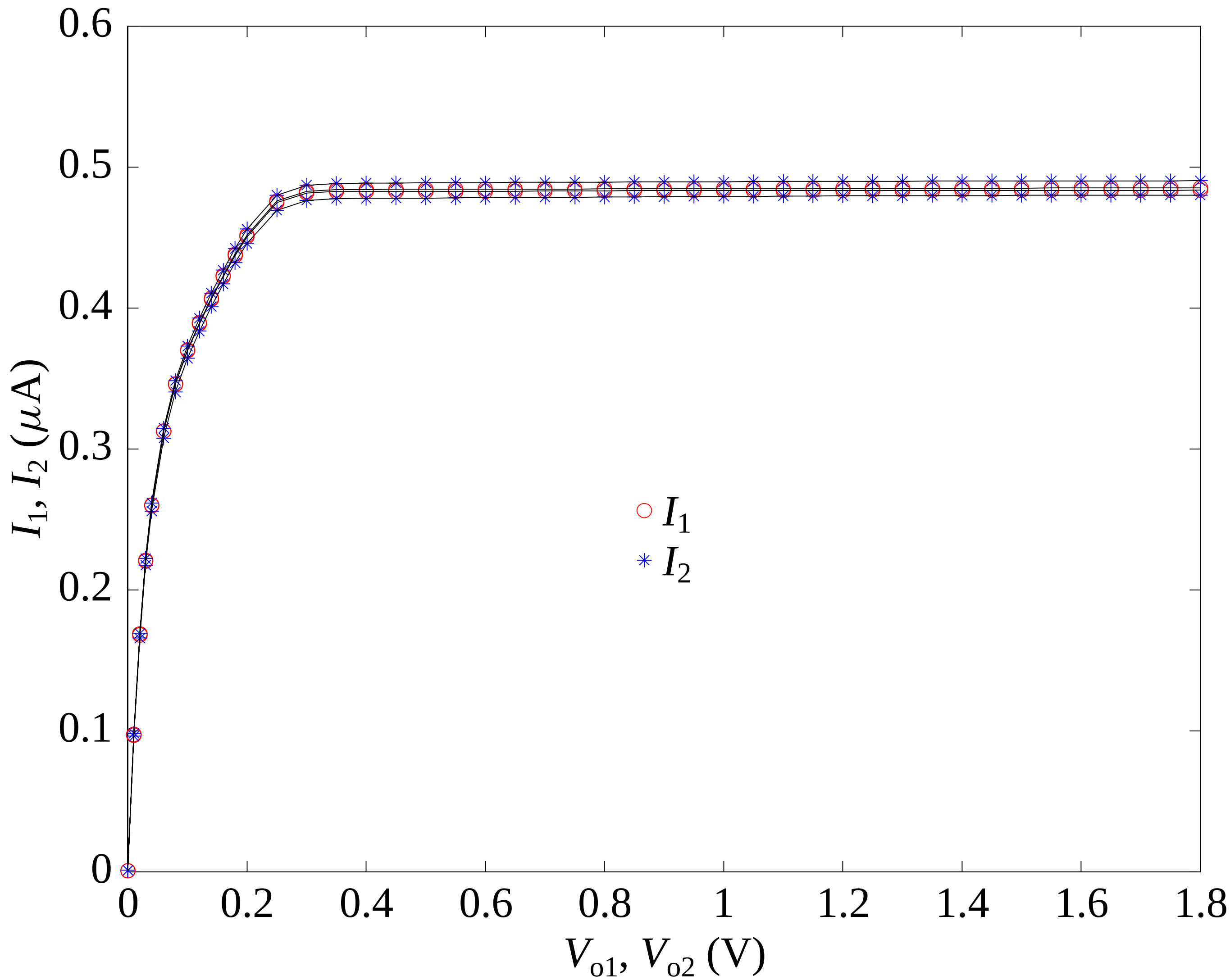

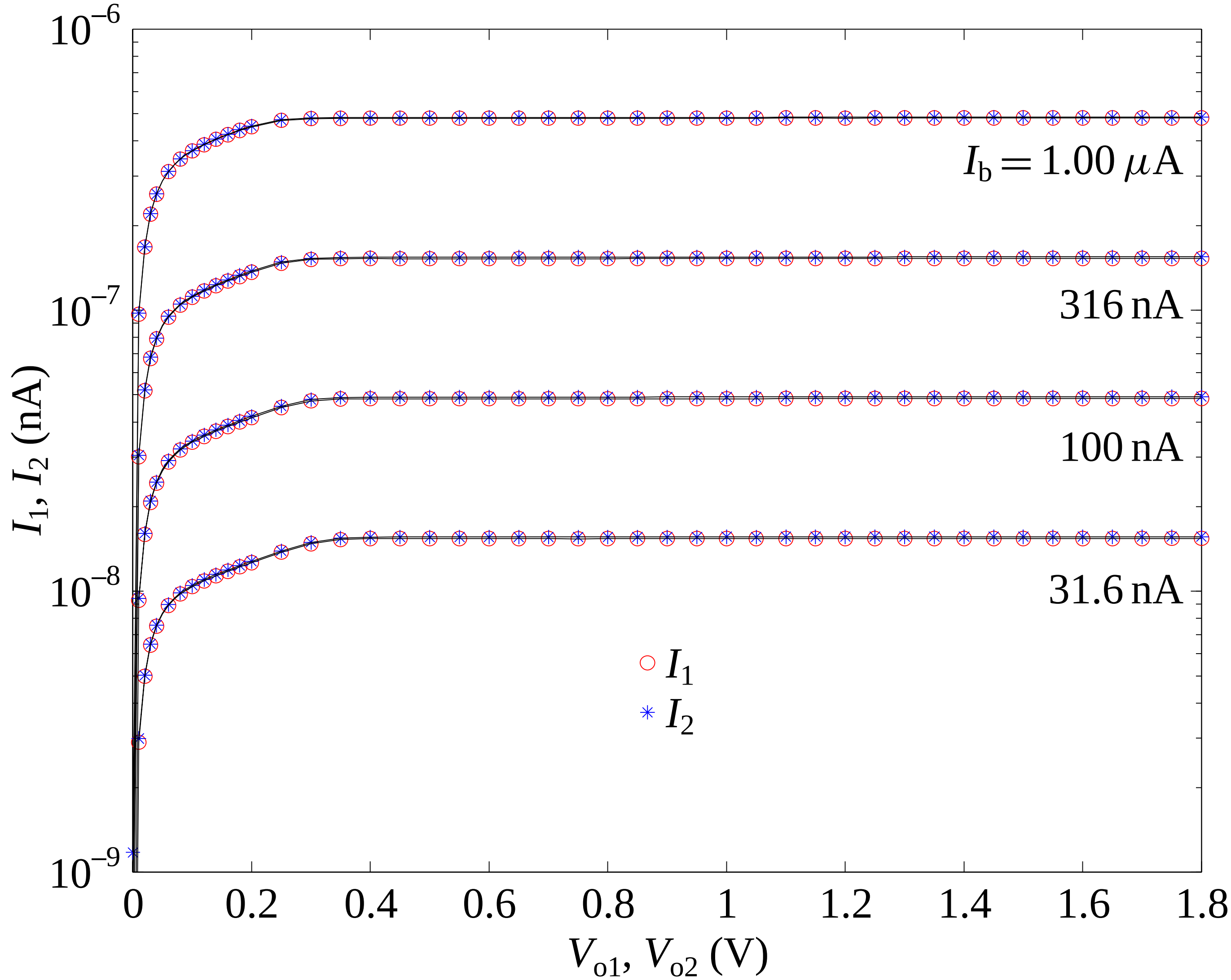

10^{-6}
10^{-7}
10^{-8}
10^{-9}
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
$I_b = 1.00\,\mu A$
316 nA
100 nA
31.6 nA
I_1
I_2
I_1, I_2 (nA)
V_{o1}, V_{o2} (V)