Characterization report of Vendor A VCSELs

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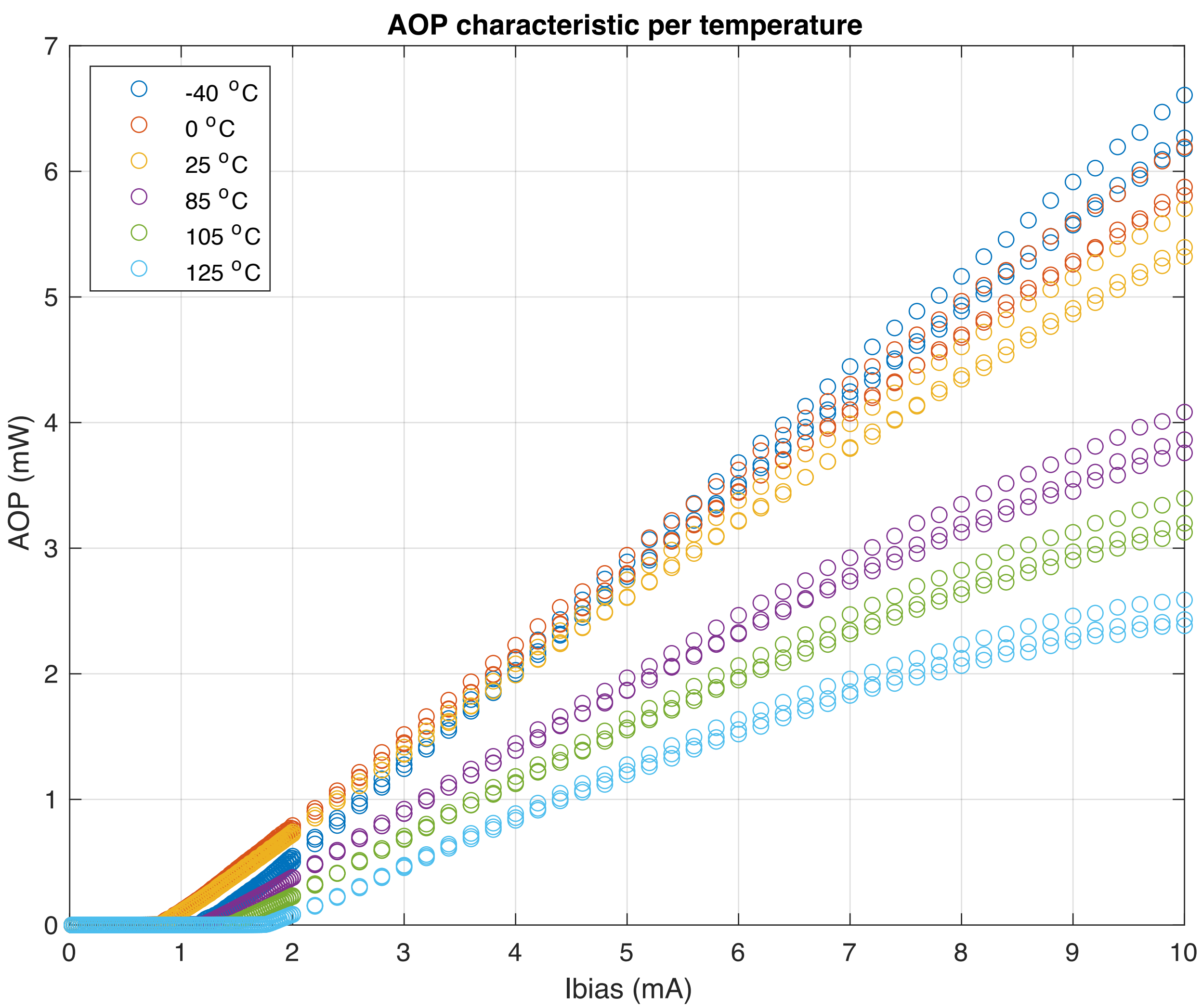
Plinio Jesús Pinzón

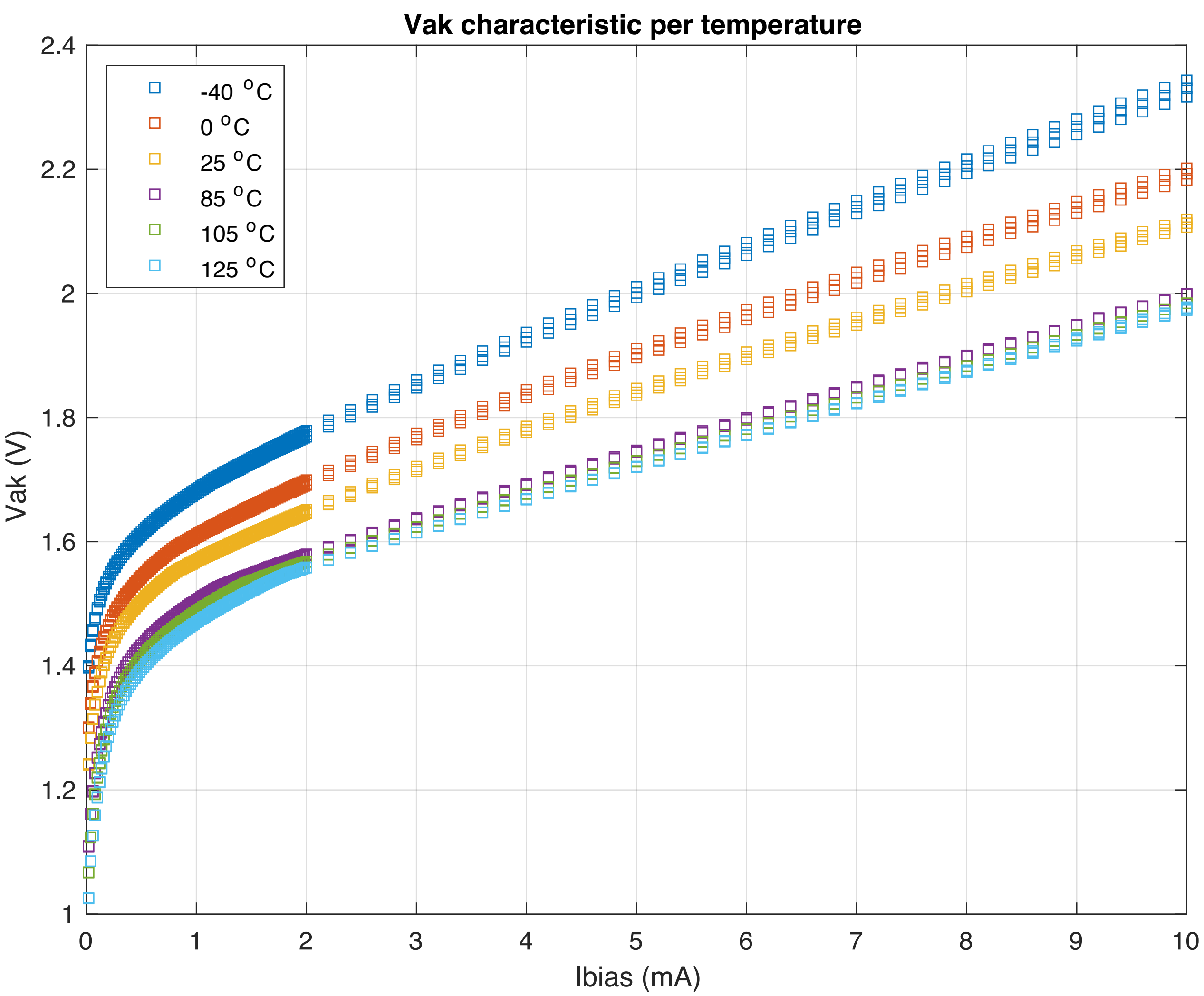
Introduction

- KDPOF has characterized 3 different Vendor A VCSEL designs
  - 25Gbps (designed for NRZ, 25GBd) multimode VCSEL for 850 nm
  - 50Gbps (designed for PAM4, 25GBd) multimode VCSEL for 850 nm
  - 50Gbps (designed for PAM4, 25GBd) multimode VCSEL for 910 nm
- L-I-V, AC and RIN have been measured according to test methodologies explained in perezaranda_OMEGA_01_0720_VCSEL_test_methods.pdf
- All the test parameters have been measured at -40, 0, 25, 85, 105 and 125 ºC backside temperature
- Eye diagrams for 26.5625 GBd NRZ are shown
  - These eye diagrams are not intended to assess suitability of an specific VCSEL for OMEGA application.
  - These eye diagrams are intended to illustrate the effect of temperature and current in the VCSELs response
- Next step will be to carry out link budget analysis

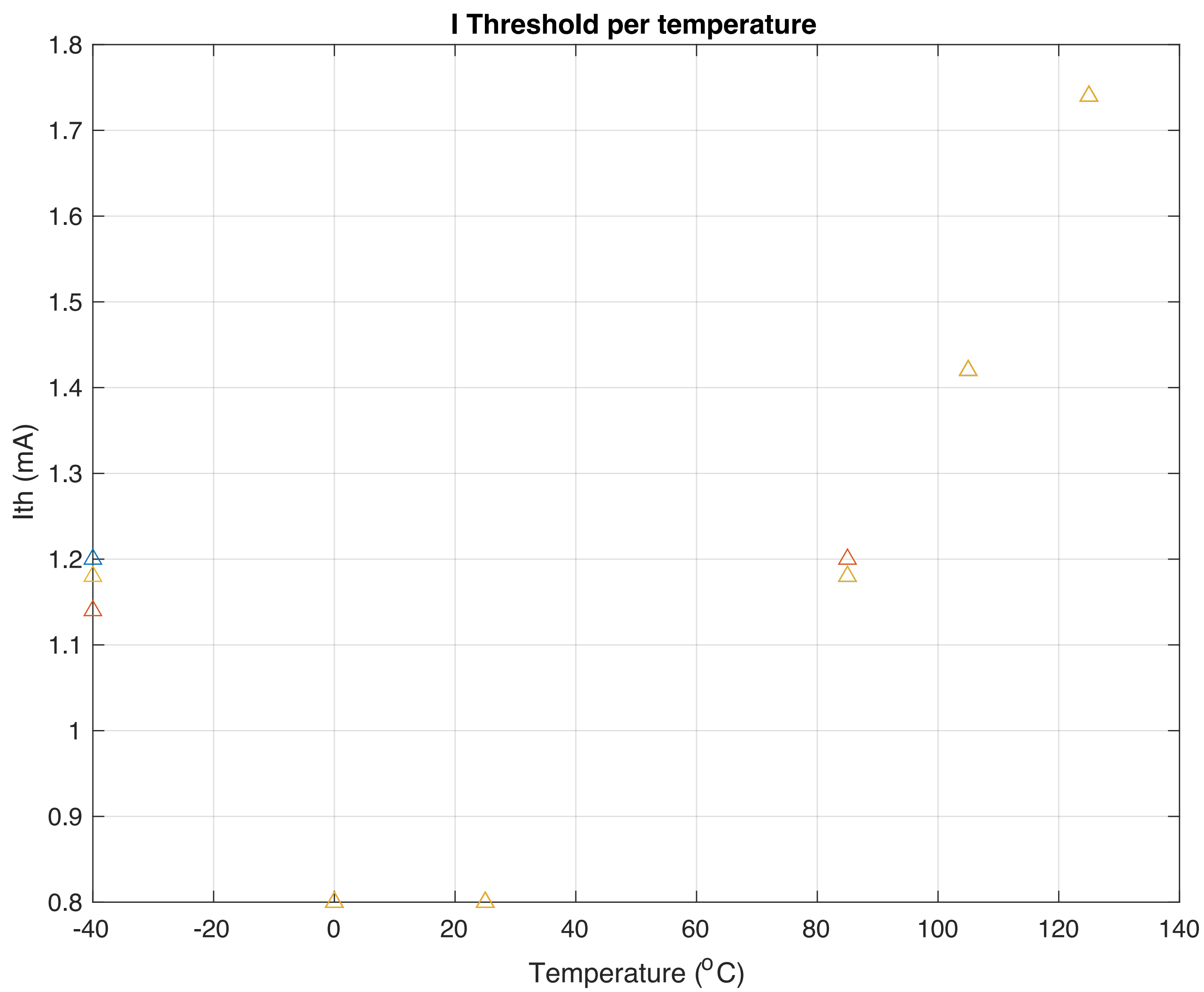
25Gbps multimode VCSEL for 850 nm

L-I-V characteristic

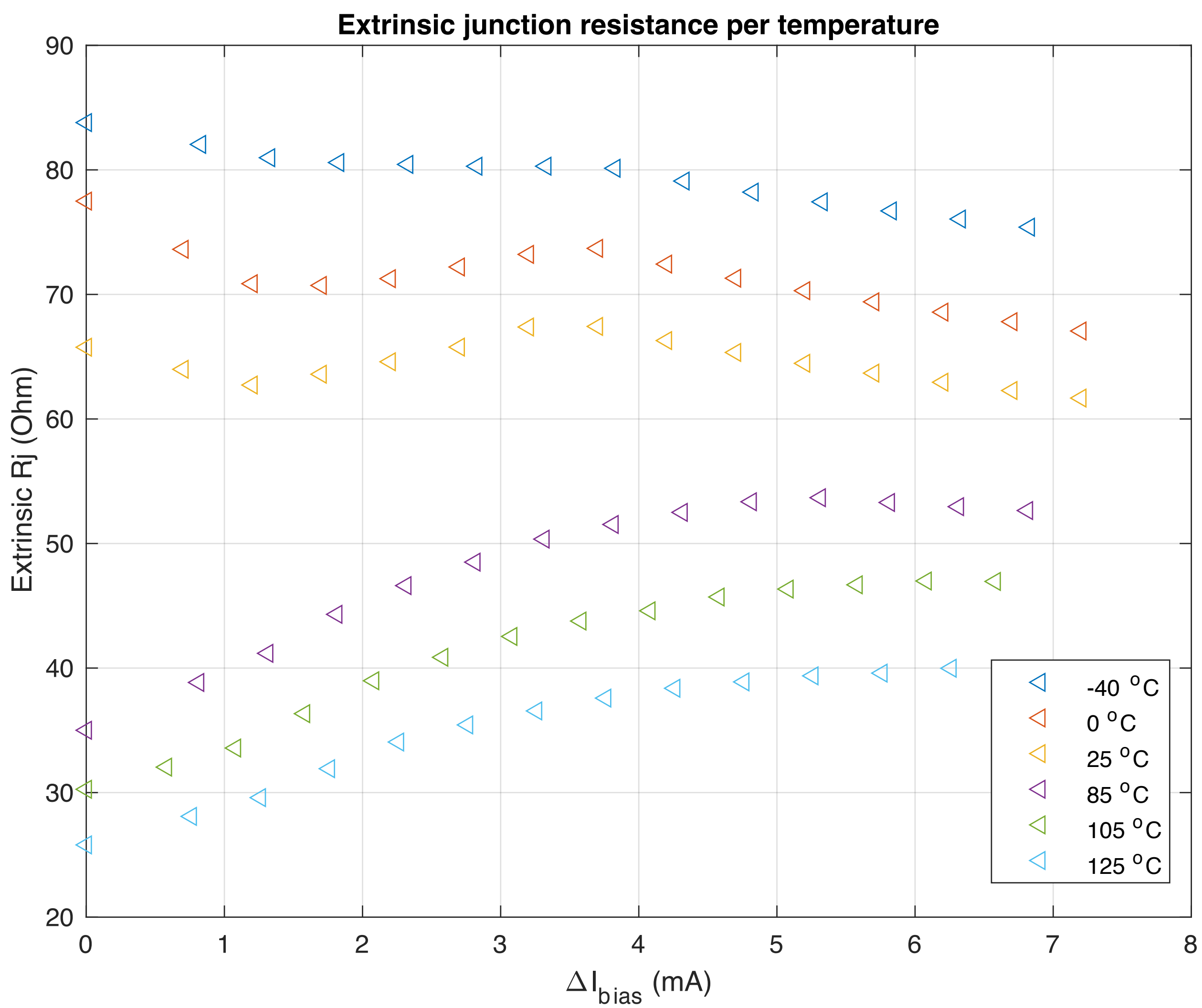


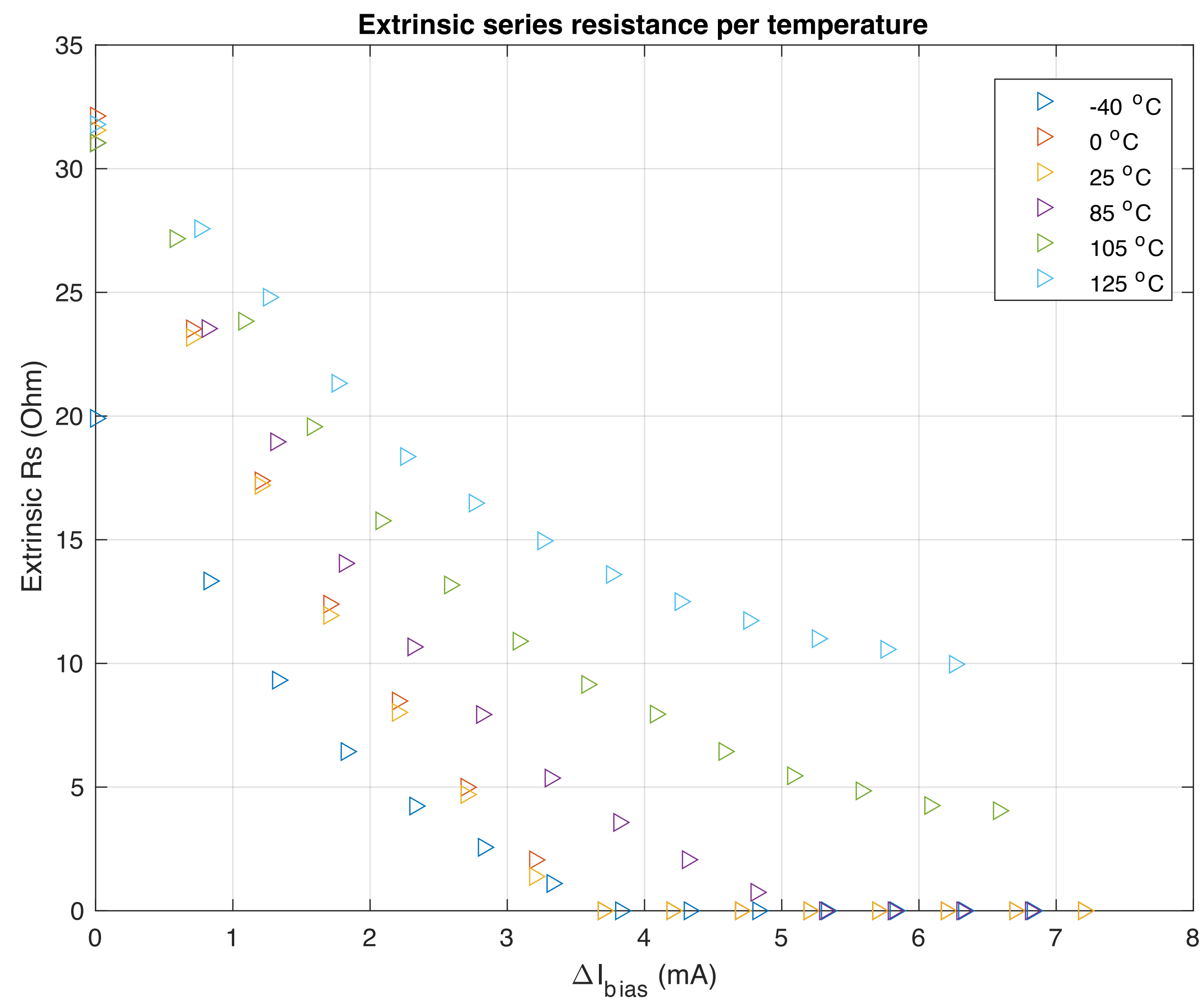


Threshold current characteristic

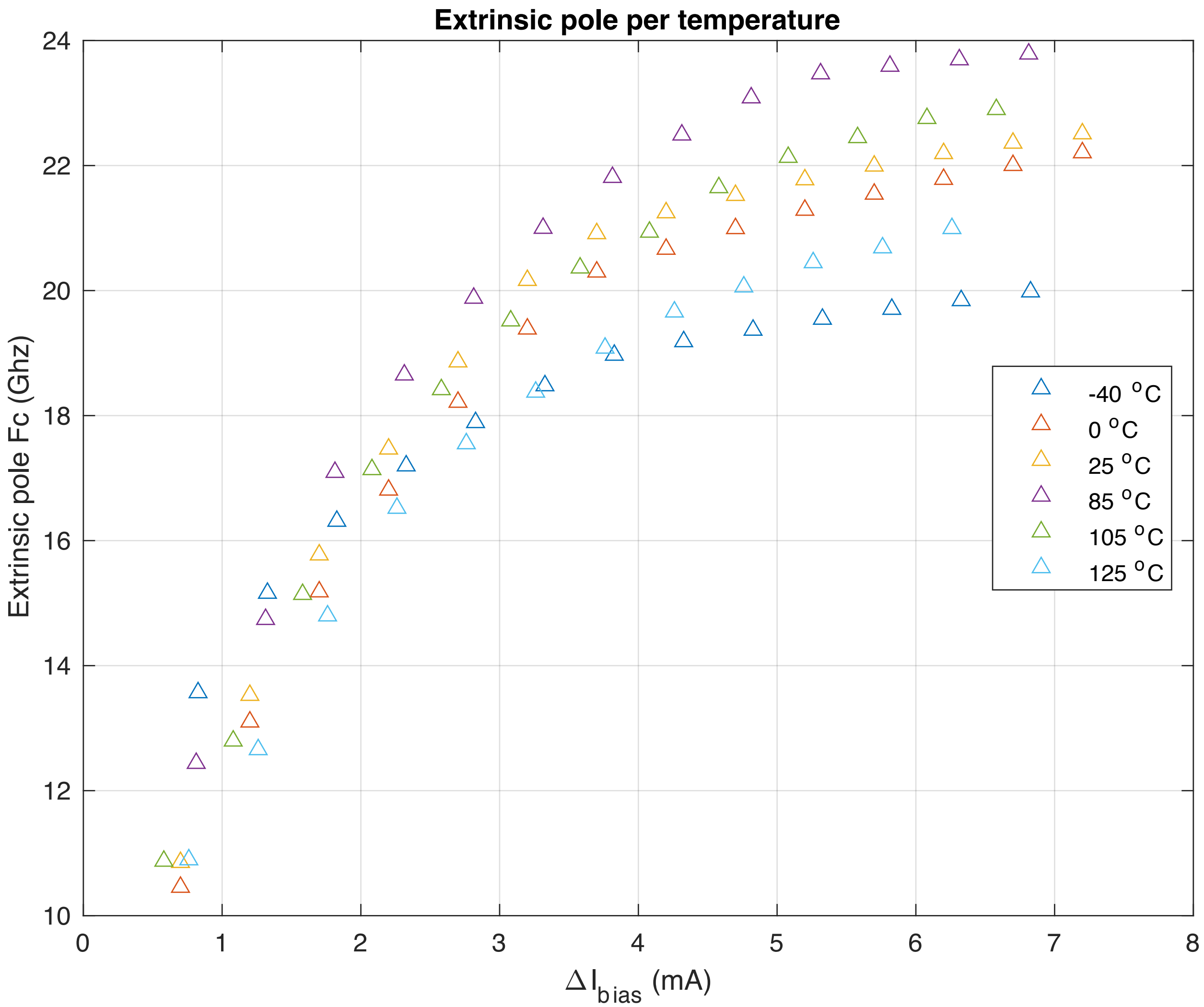


Small signal frequency response





Small signal frequency response



$$H(f) = C \cdot \frac{f_r^2}{f_r^2 - f^2 + j\frac{f}{2\pi}\gamma} \cdot \frac{1}{1 + j\frac{f}{f_p}}.$$ (see [1])

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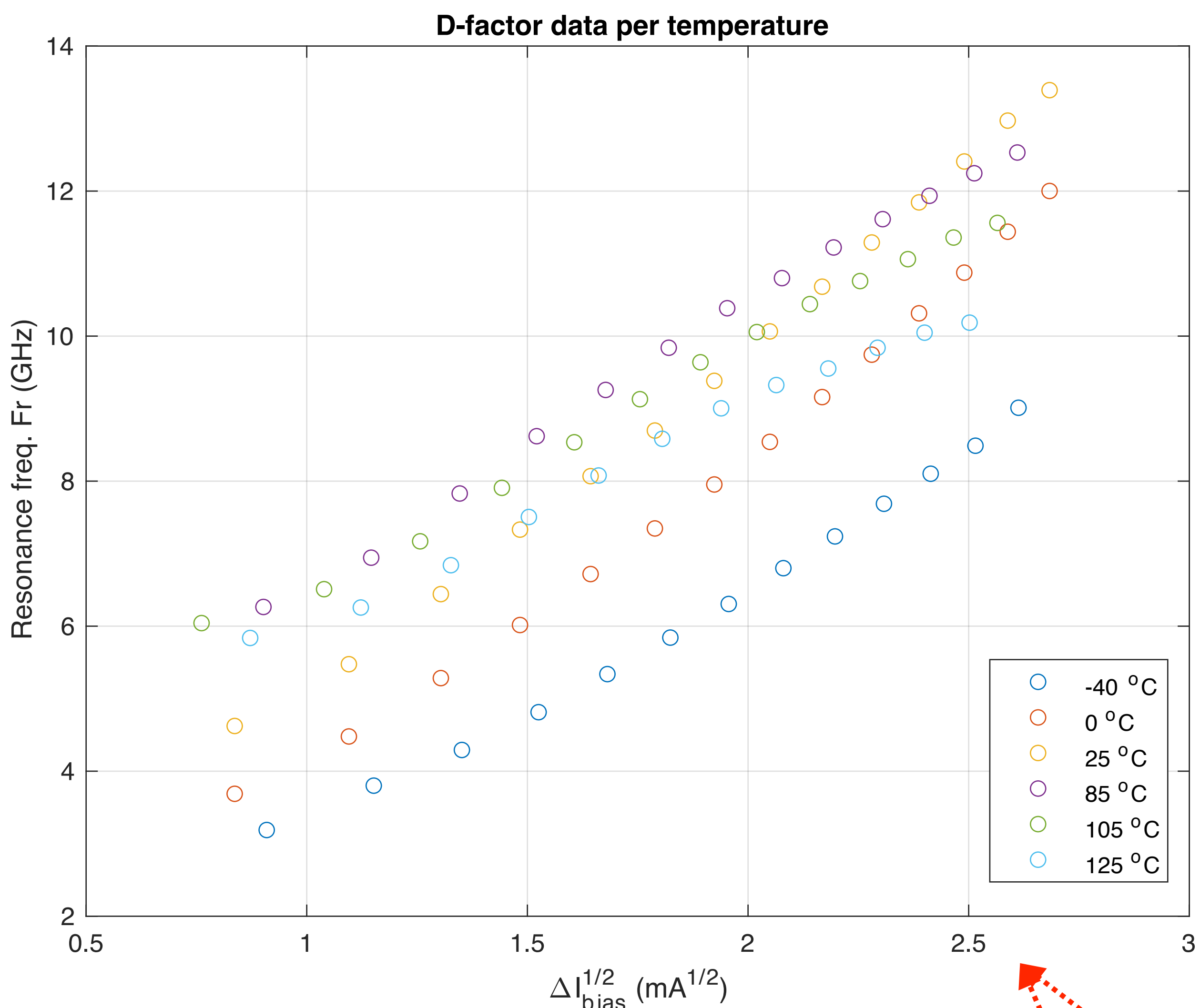

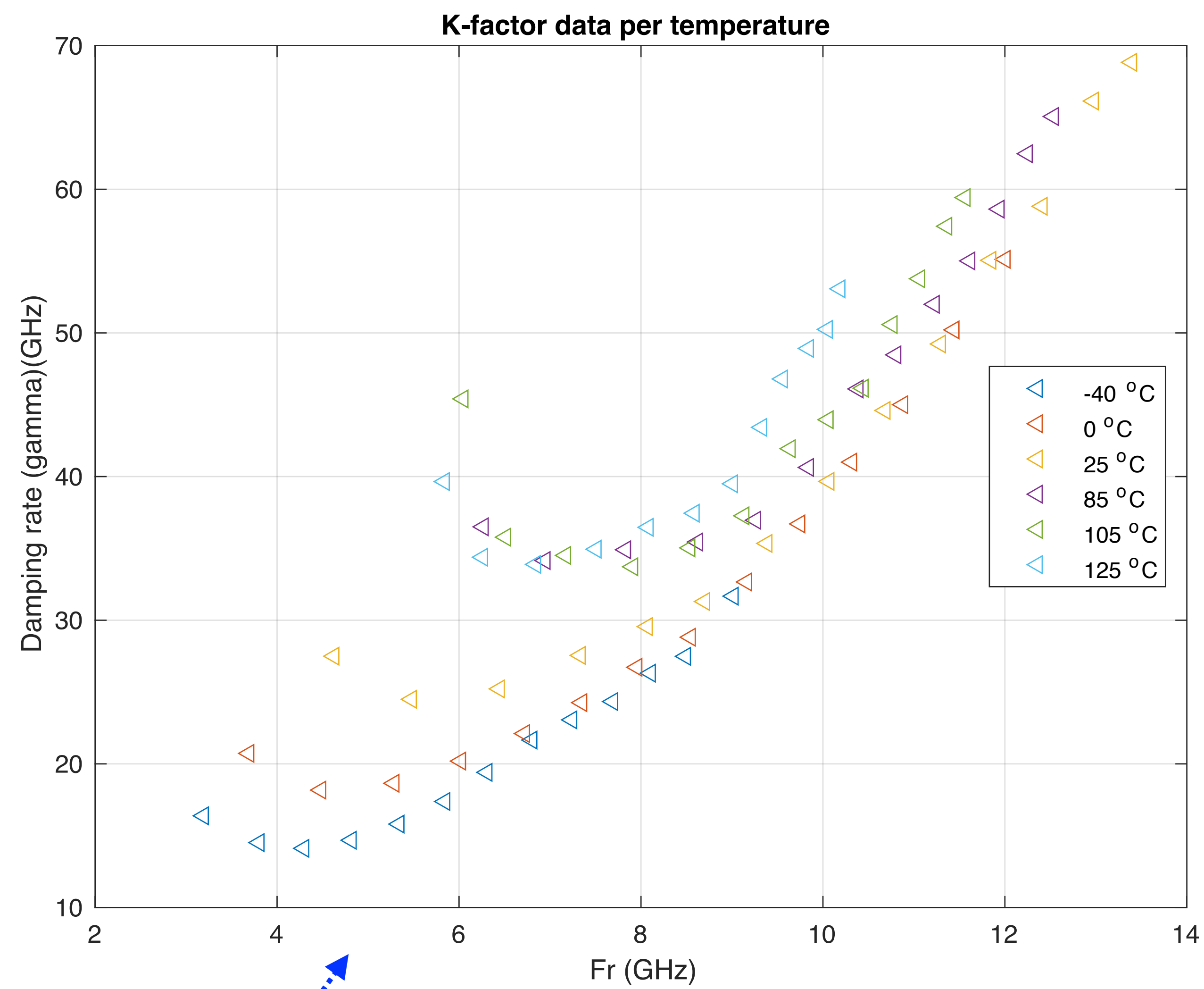

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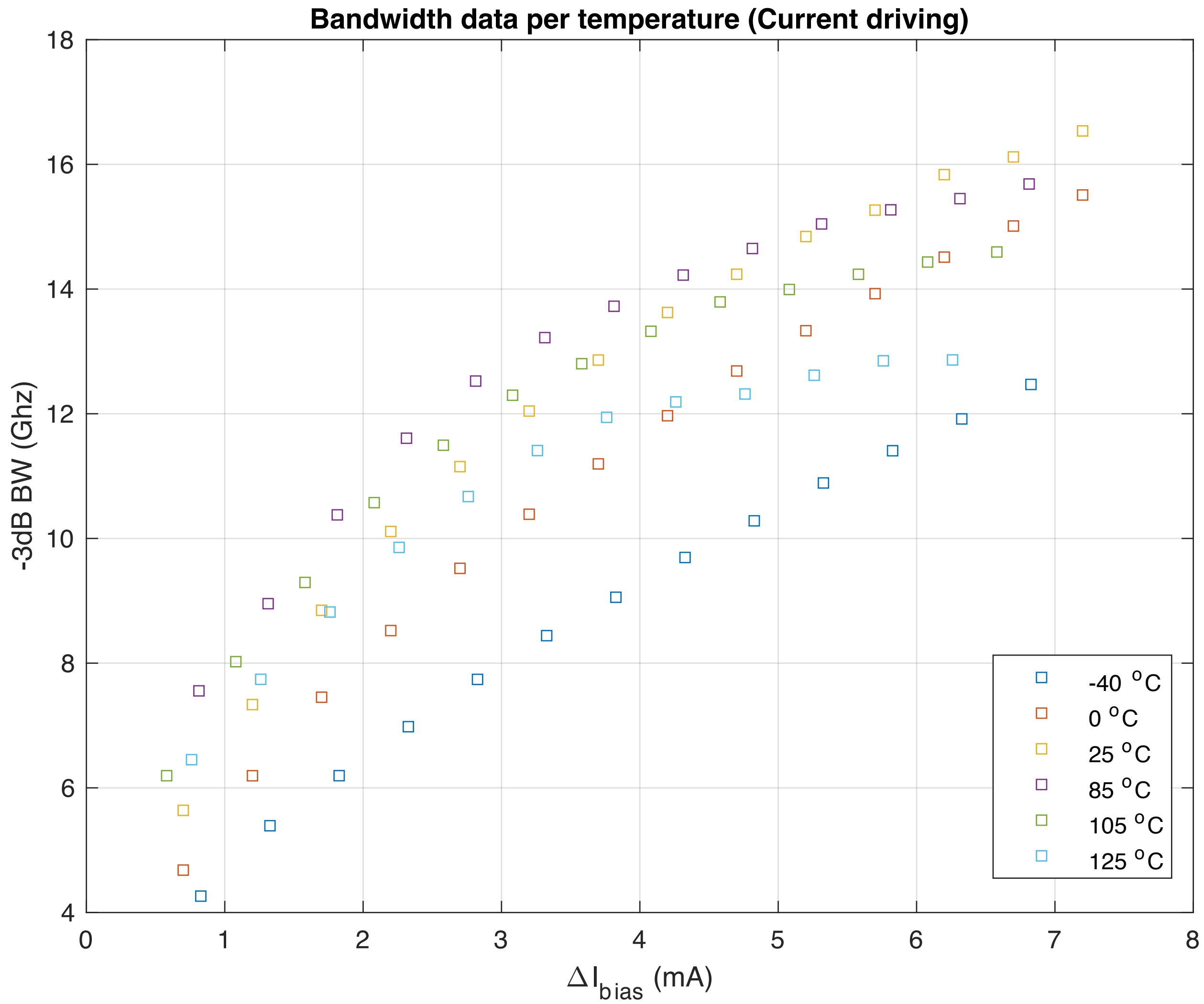
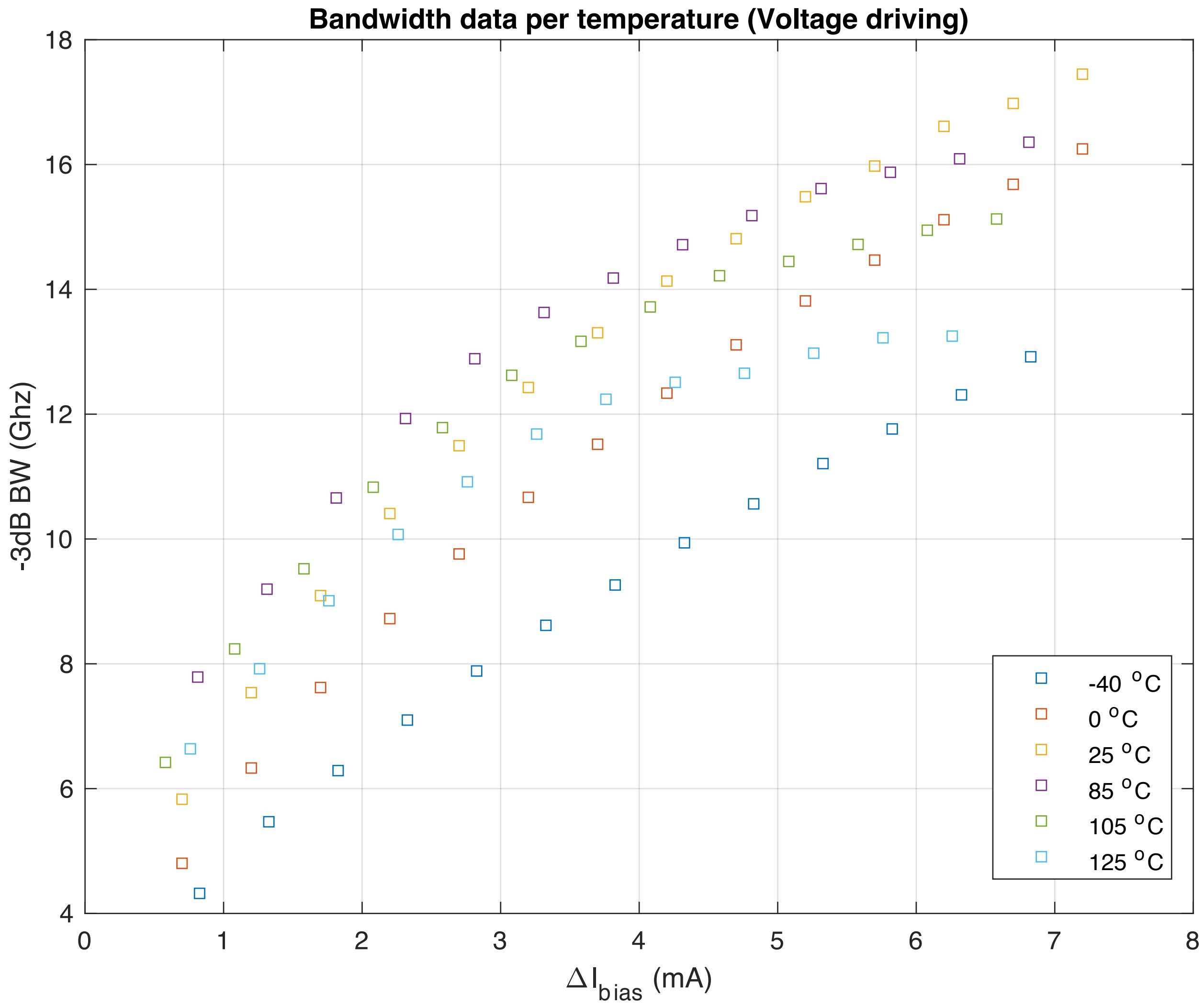
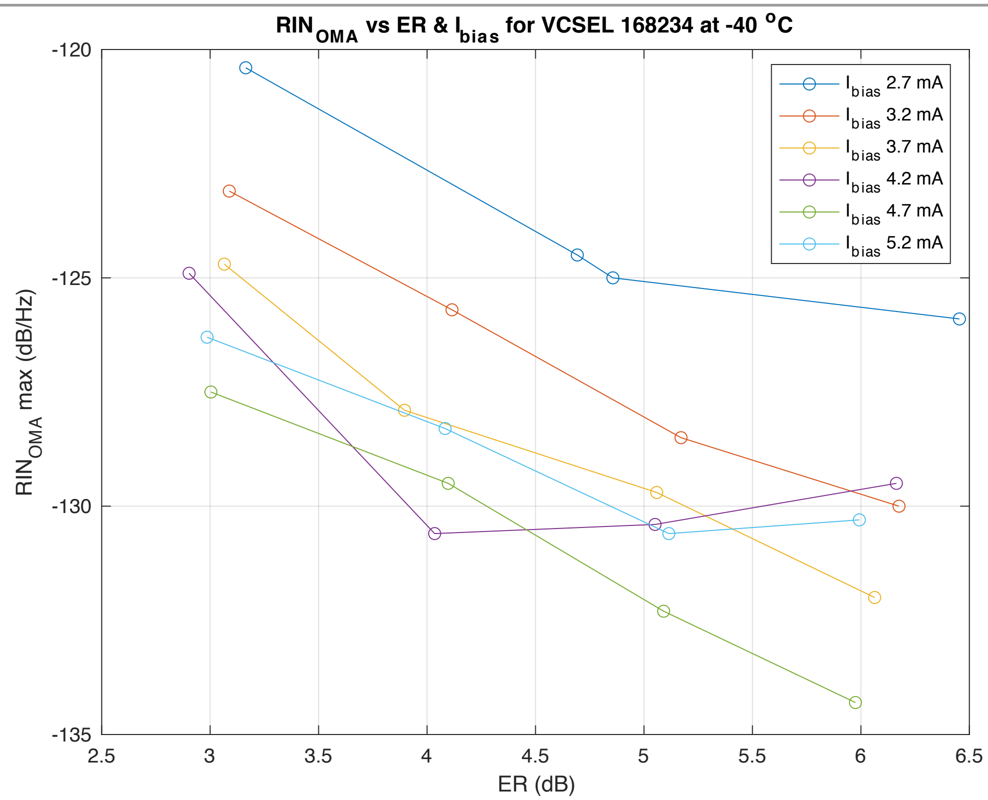
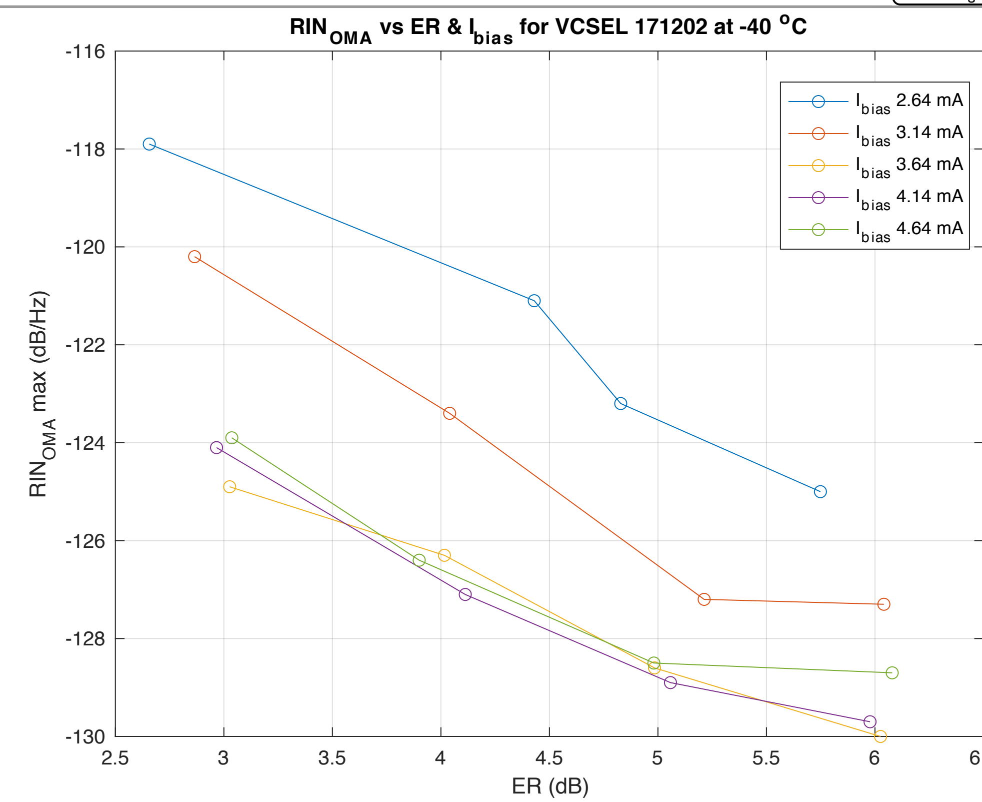


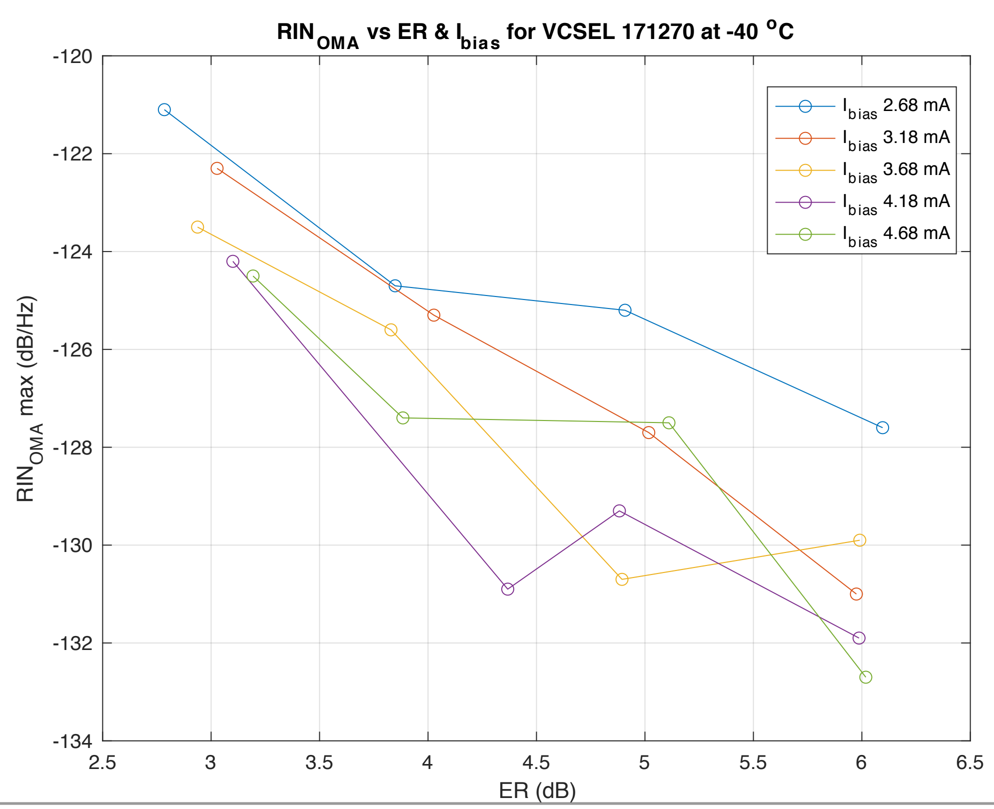


Considered source impedance 100 Ω

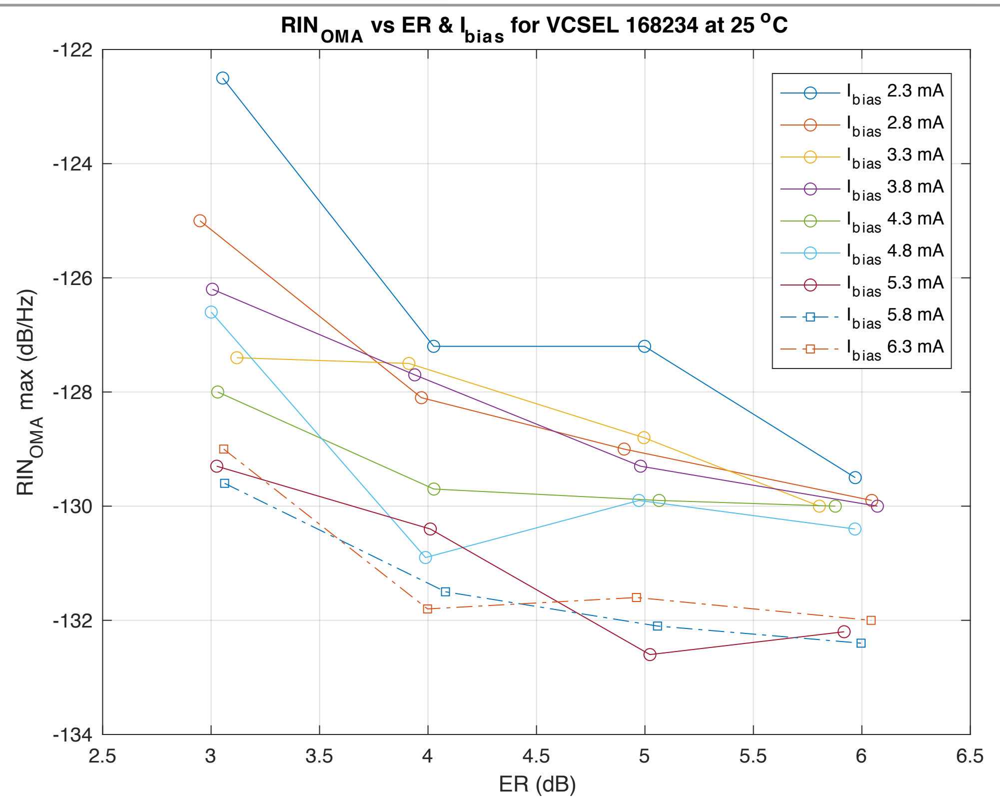
Relative intensity noise (RIN_{OMA}) at -40ºC

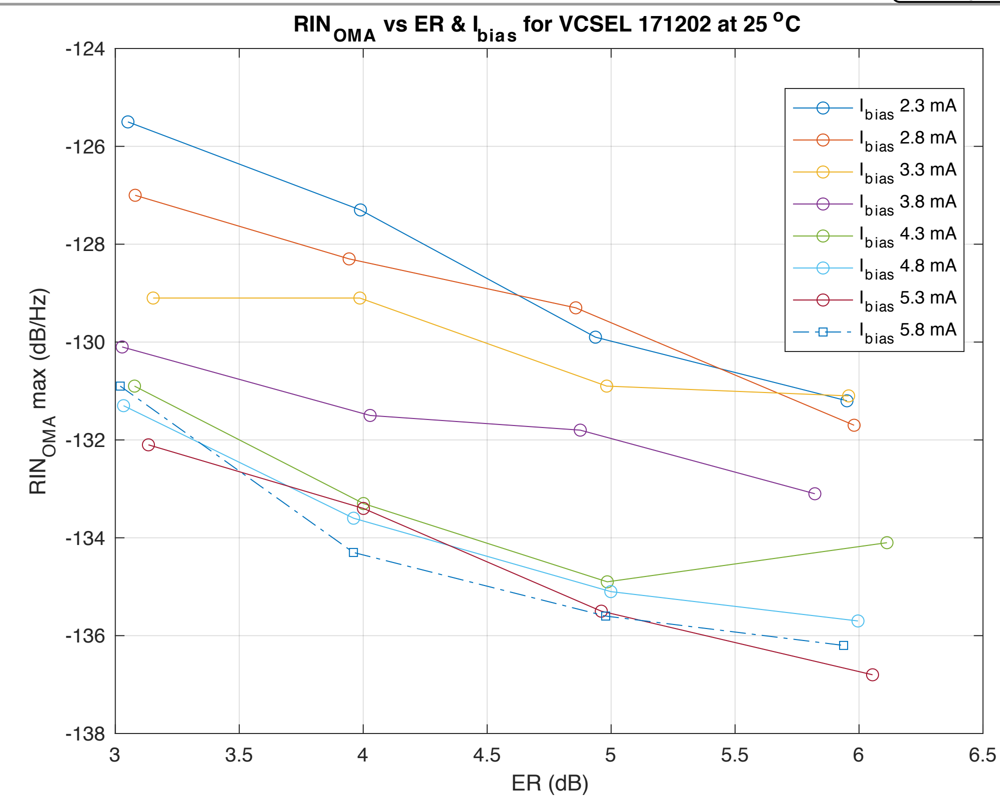


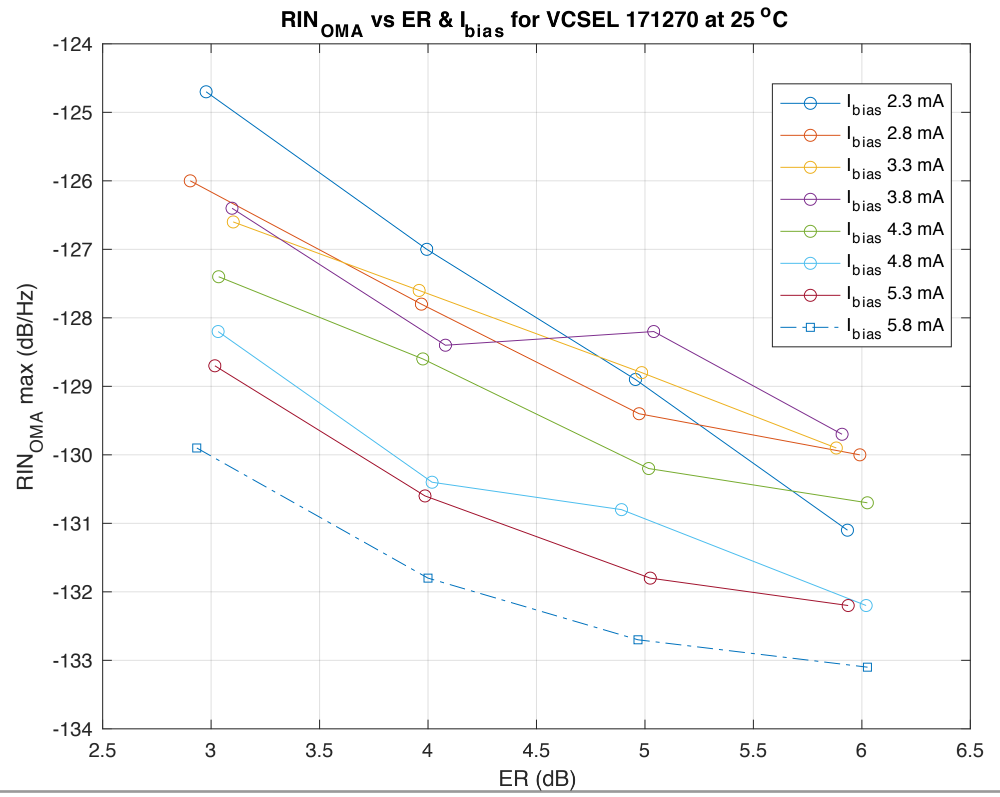




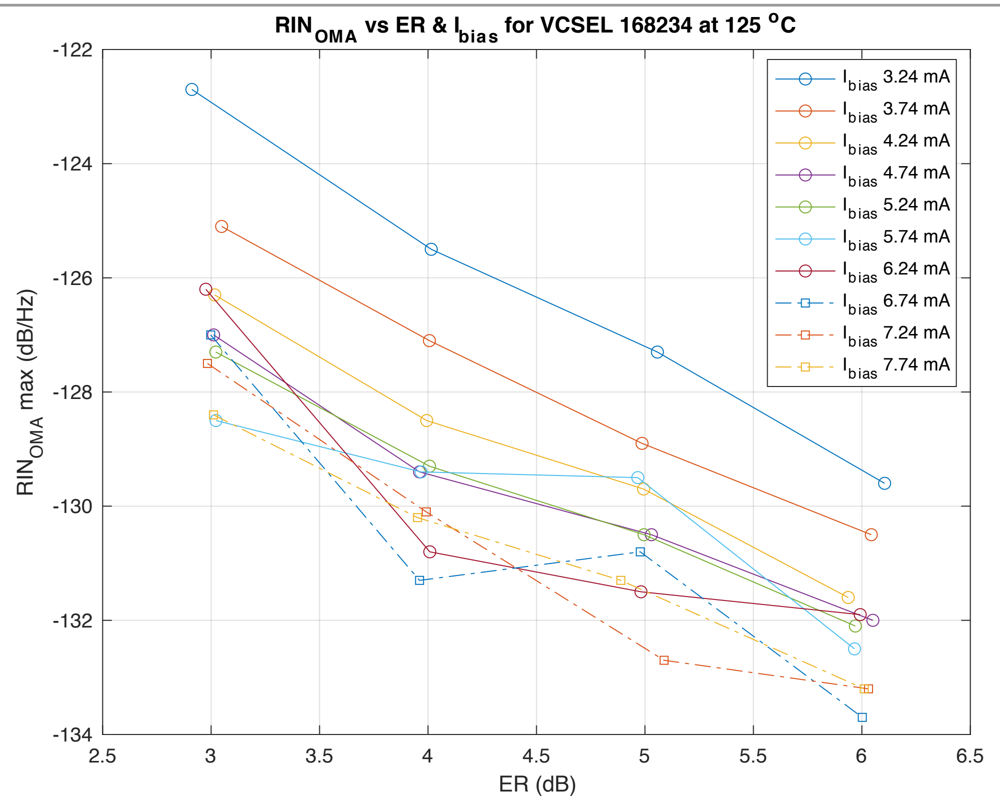
Relative intensity noise (RIN_{OMA}) at 25ºC

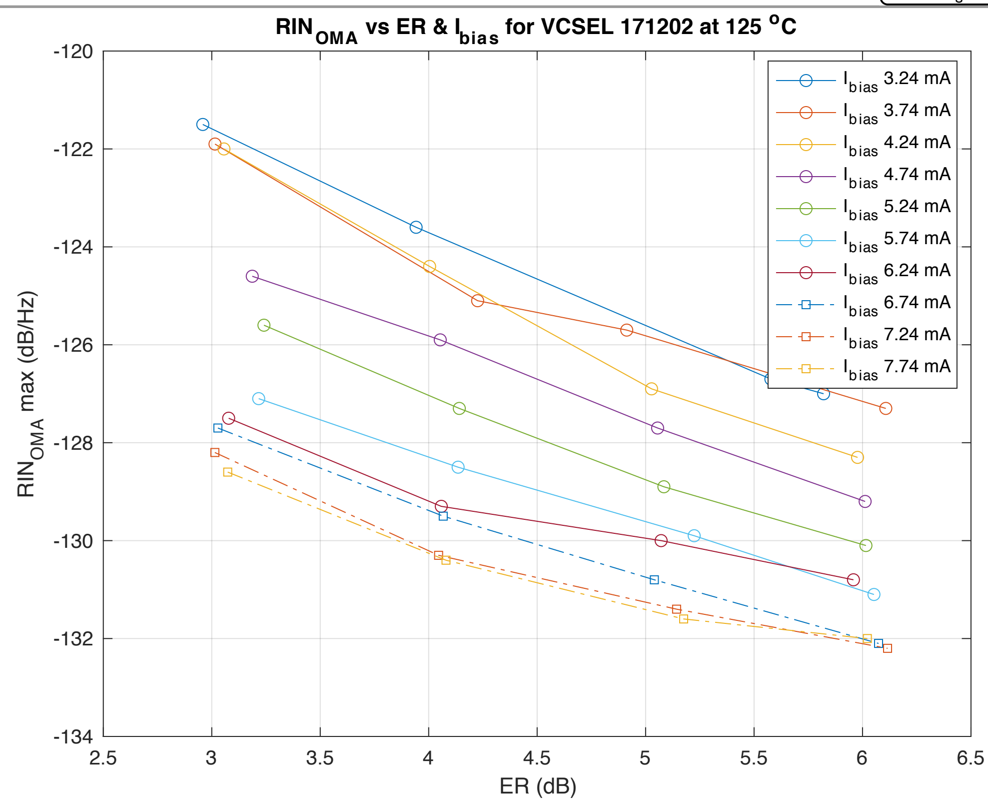


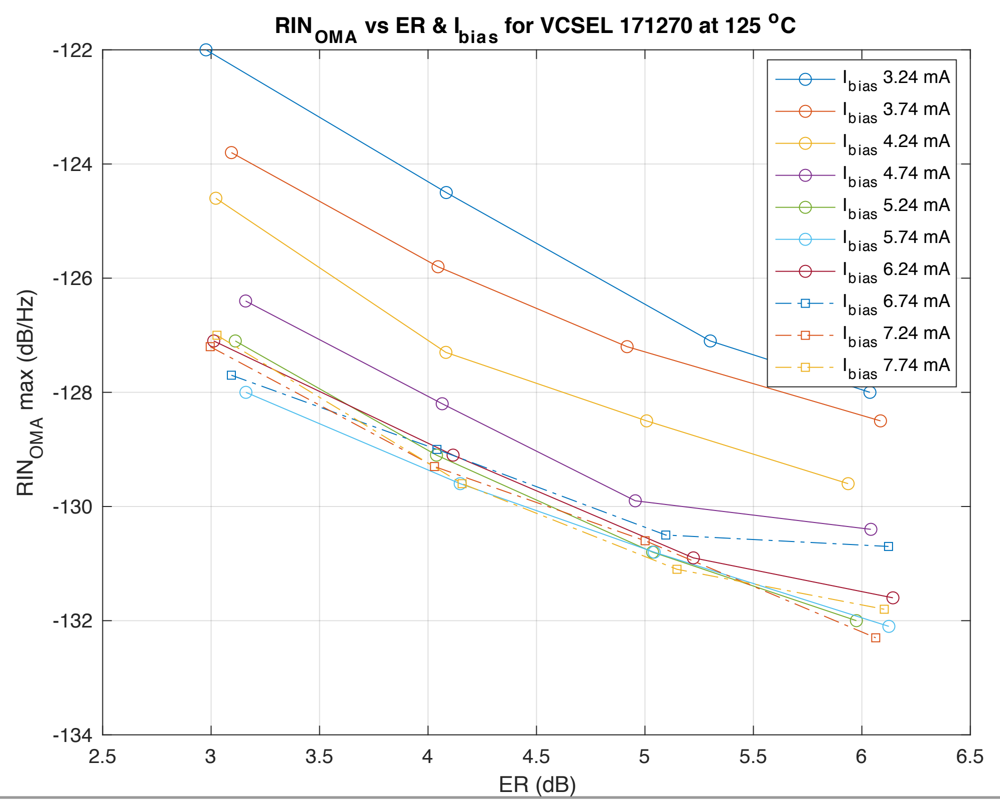




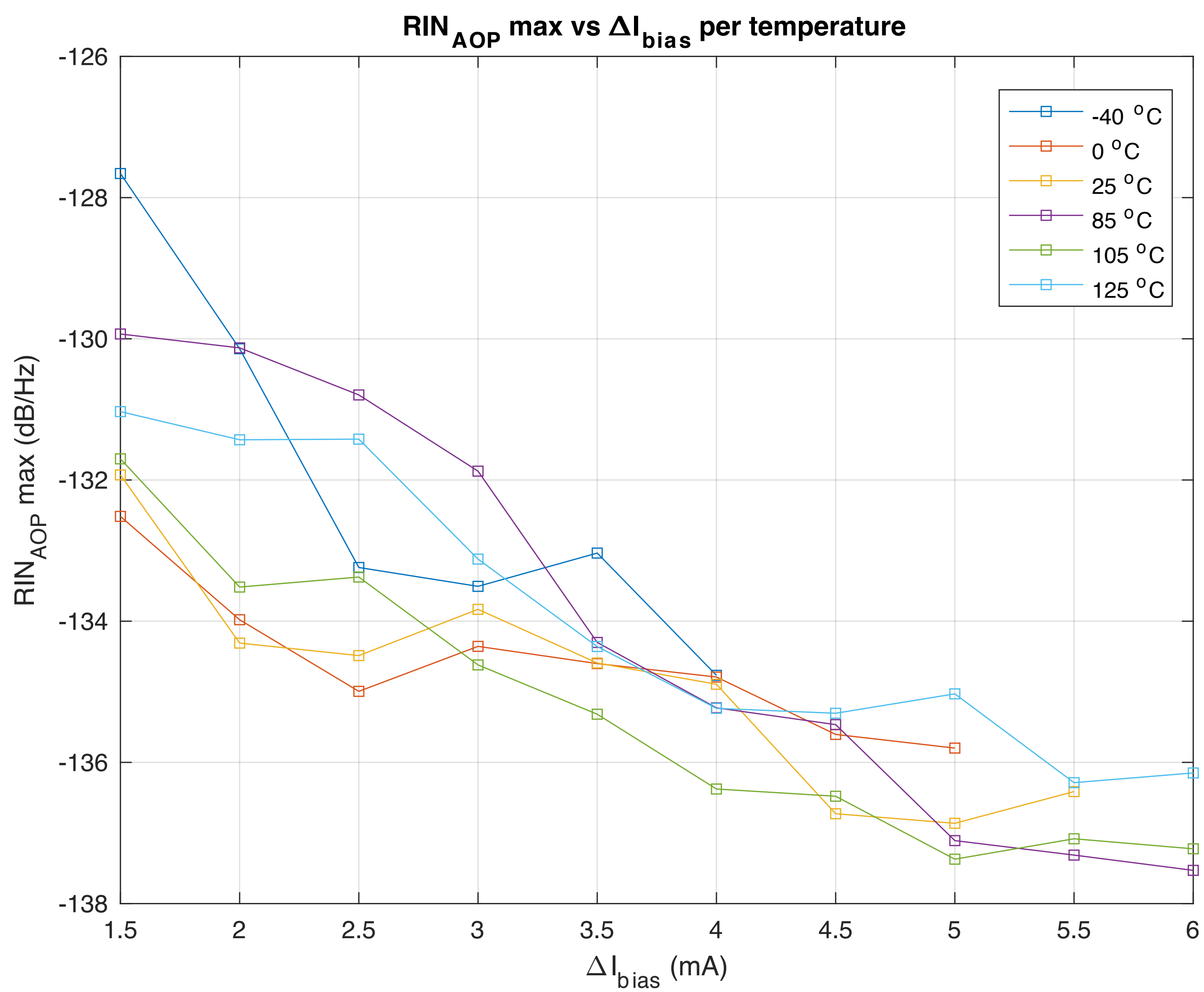
Relative intensity noise (RIN_{OMA}) at 125°C







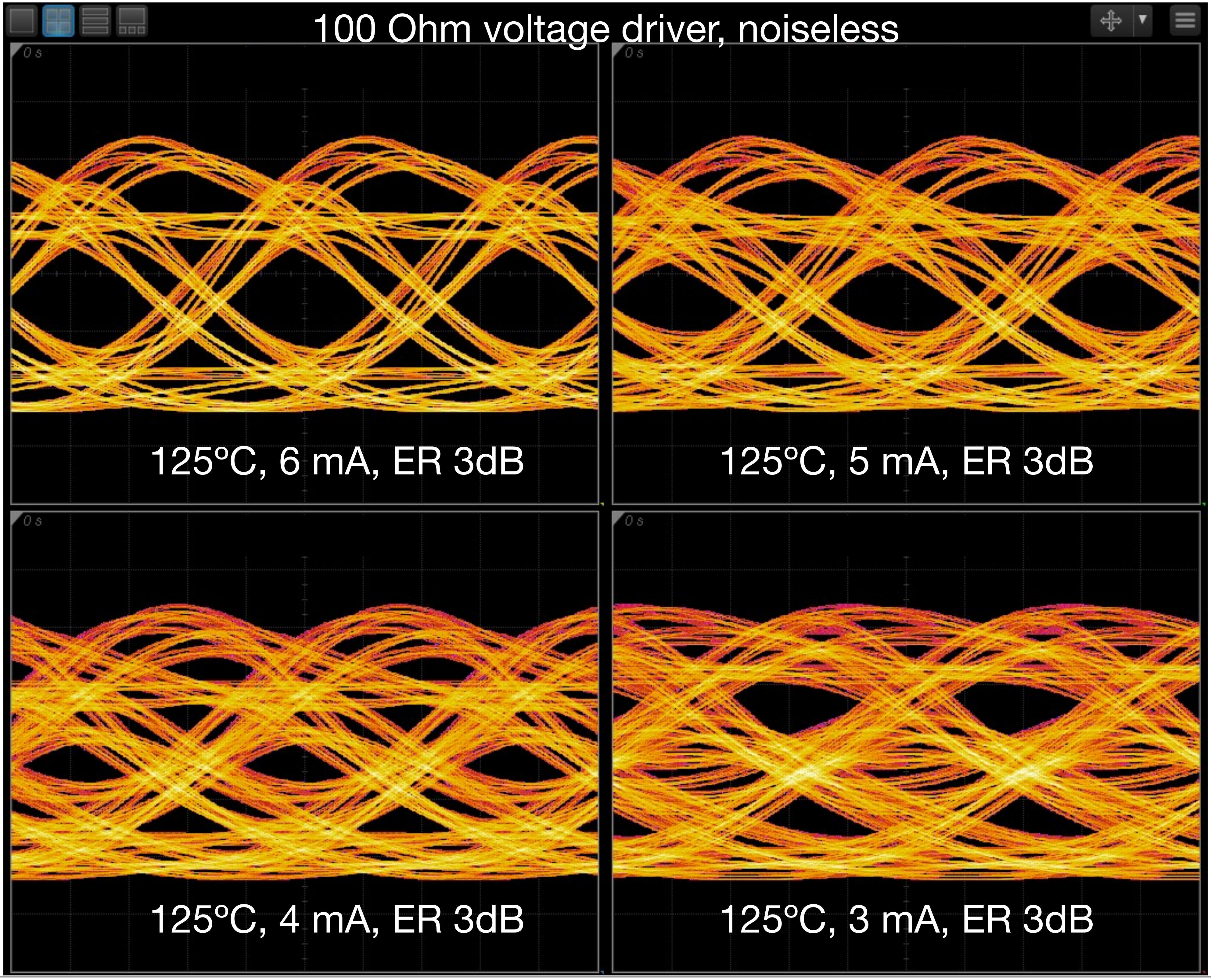
Normalized max RIN (RIN_{AOP})



$$RIN_{AOP}\left(dB/Hz\right) = RIN_{OMA}\left(dB/Hz\right) - 20 \cdot \log_{10}\left(\frac{ER_L + 1}{ER_L - 1}\right)$$

$$ER_L = 10^{ER(dB)/10}$$

Eye diagram for 26.5625 GBd NRZ



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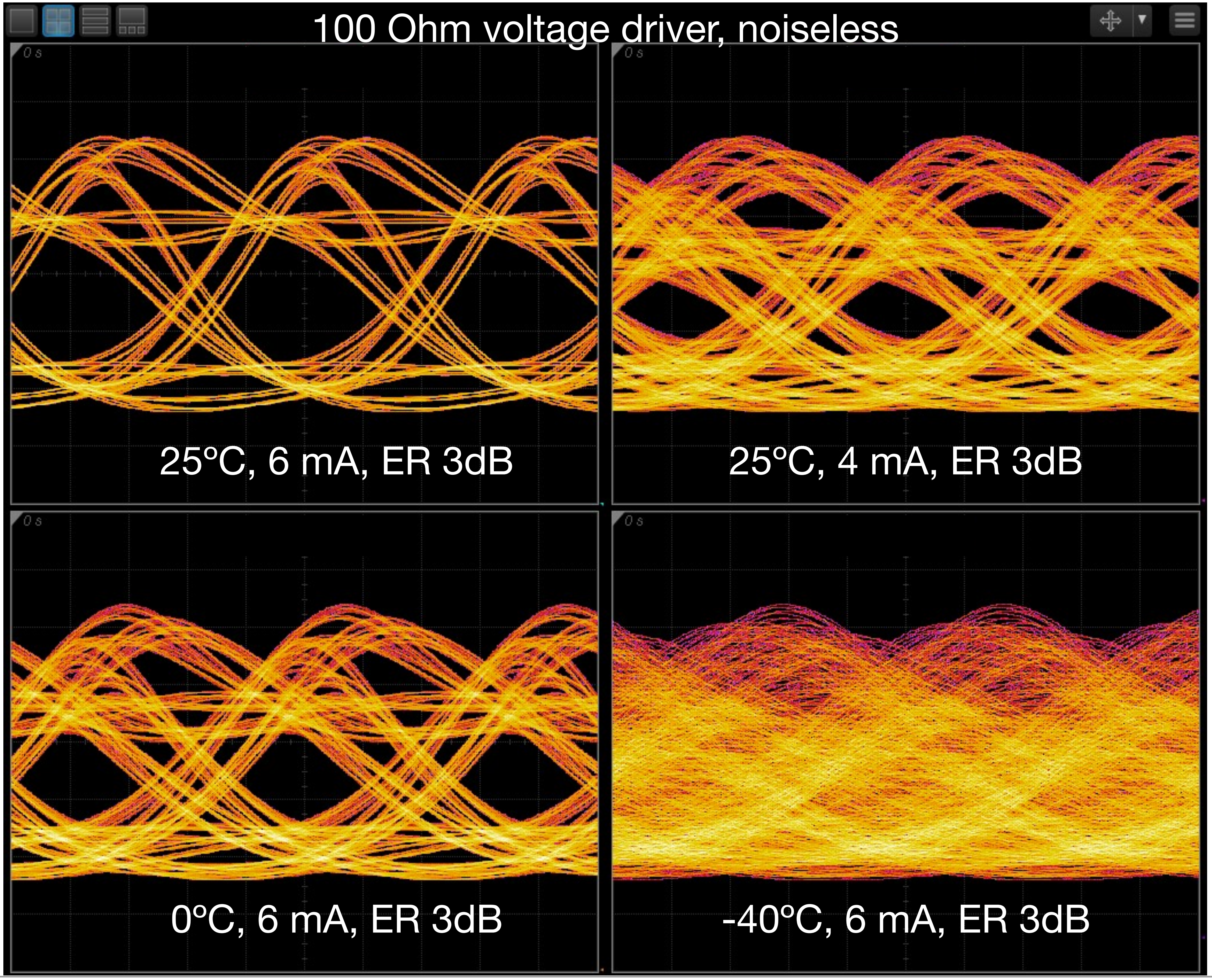

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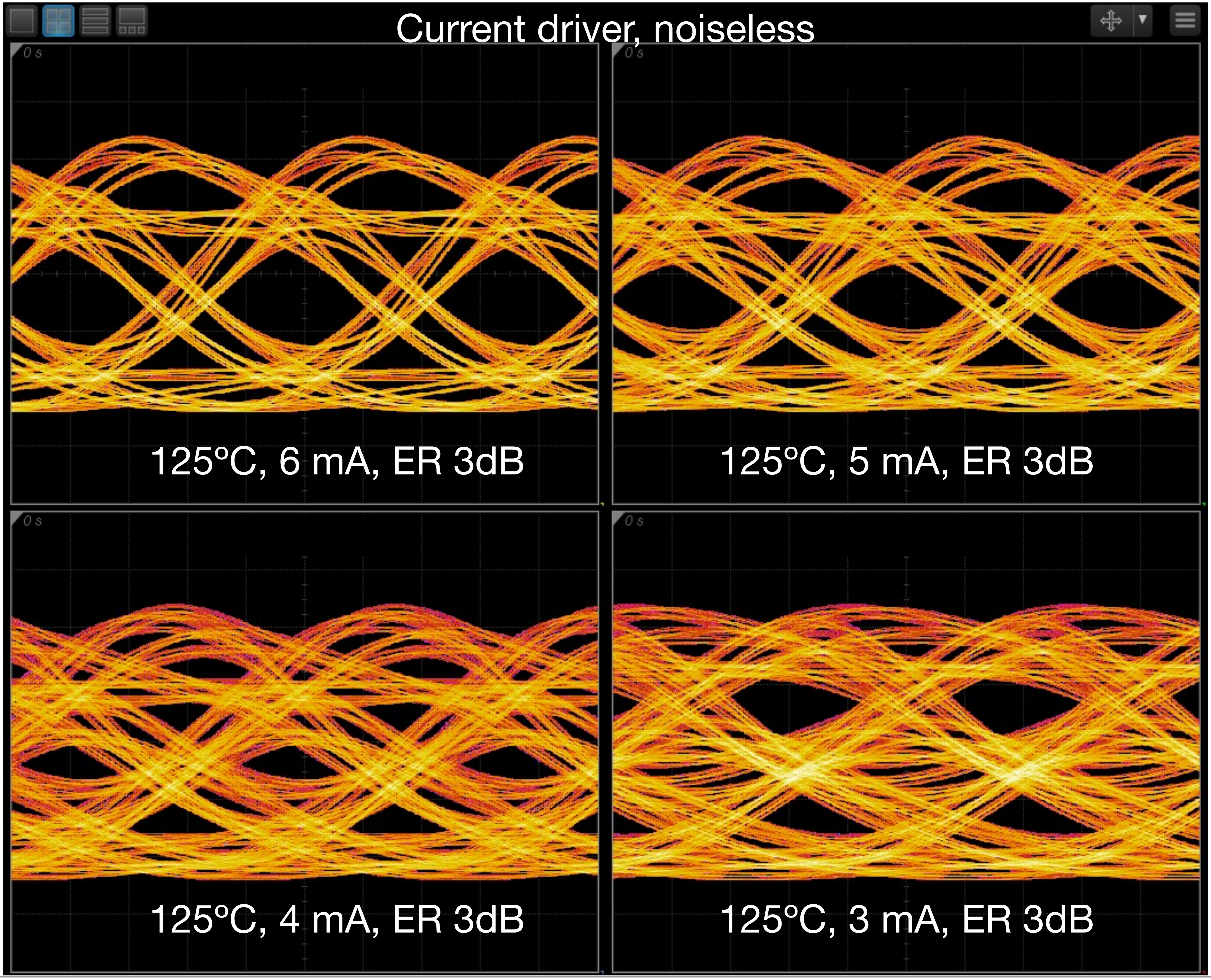

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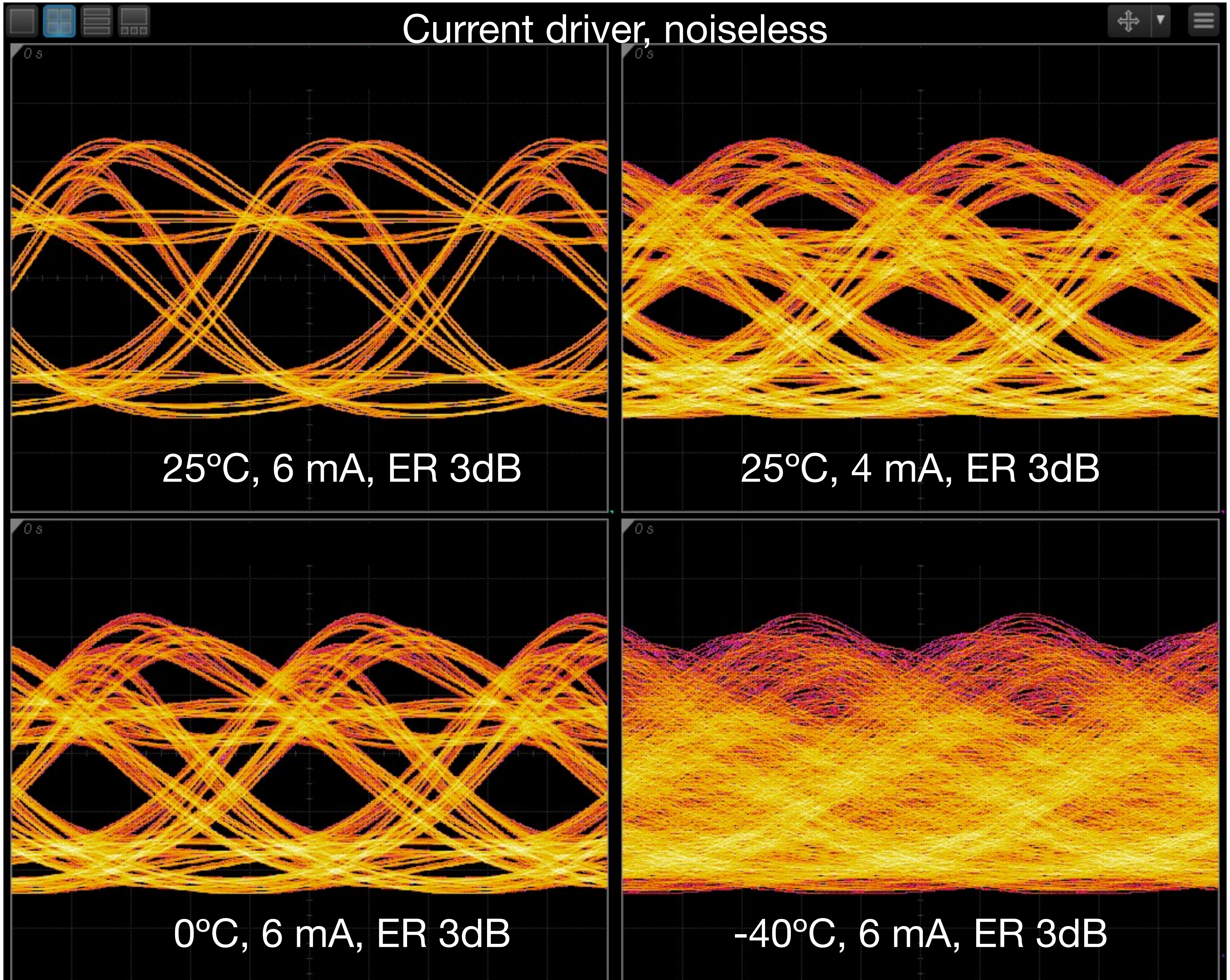
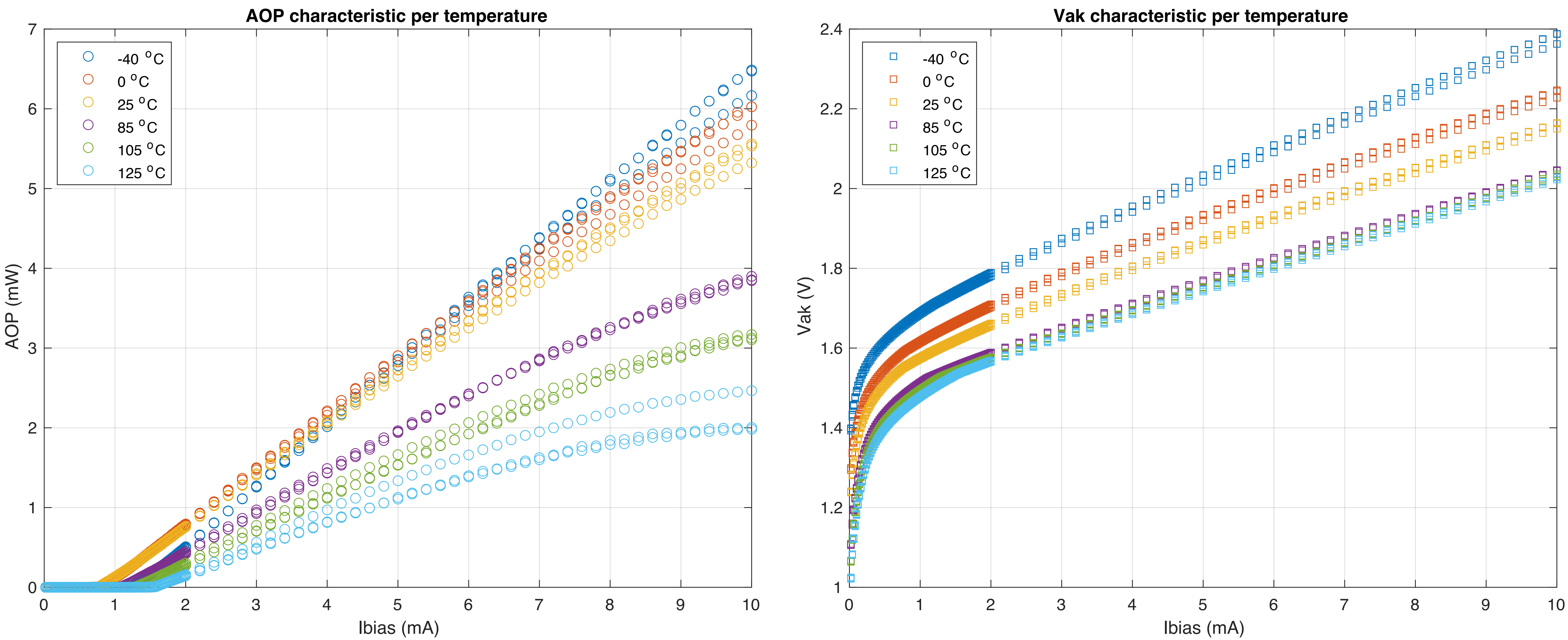
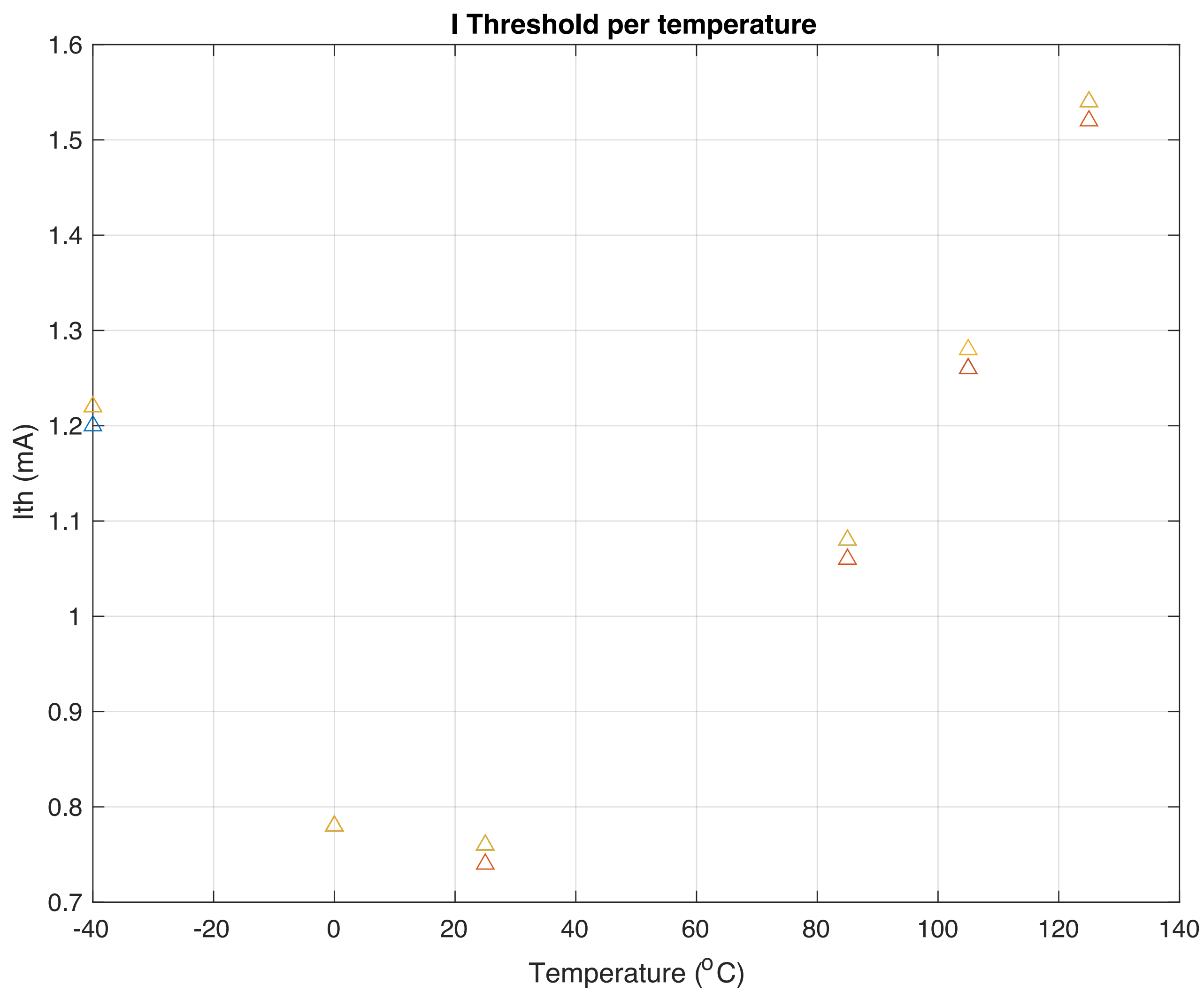


50Gbps multimode VCSEL for 850 nm

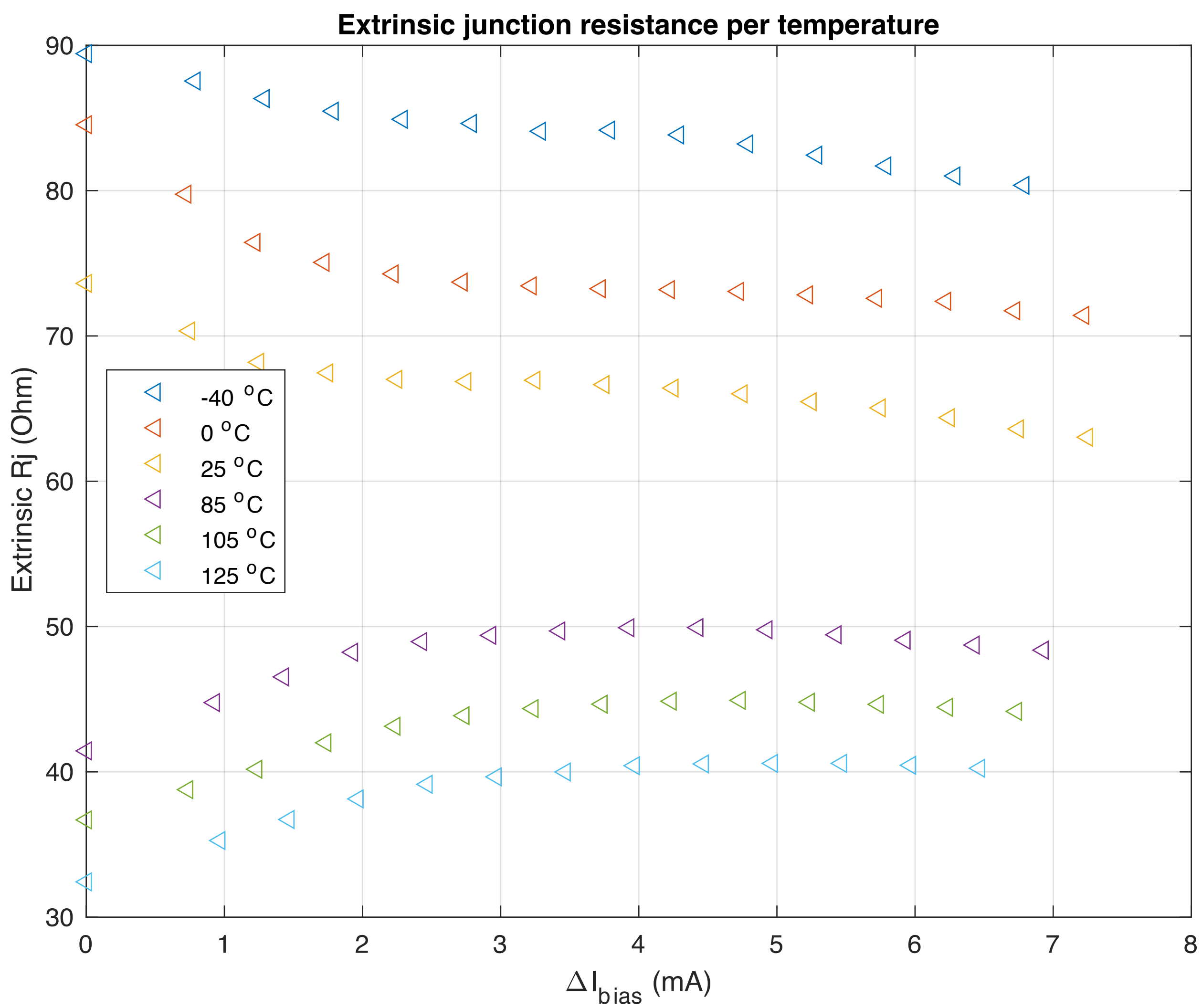
L-I-V characteristic

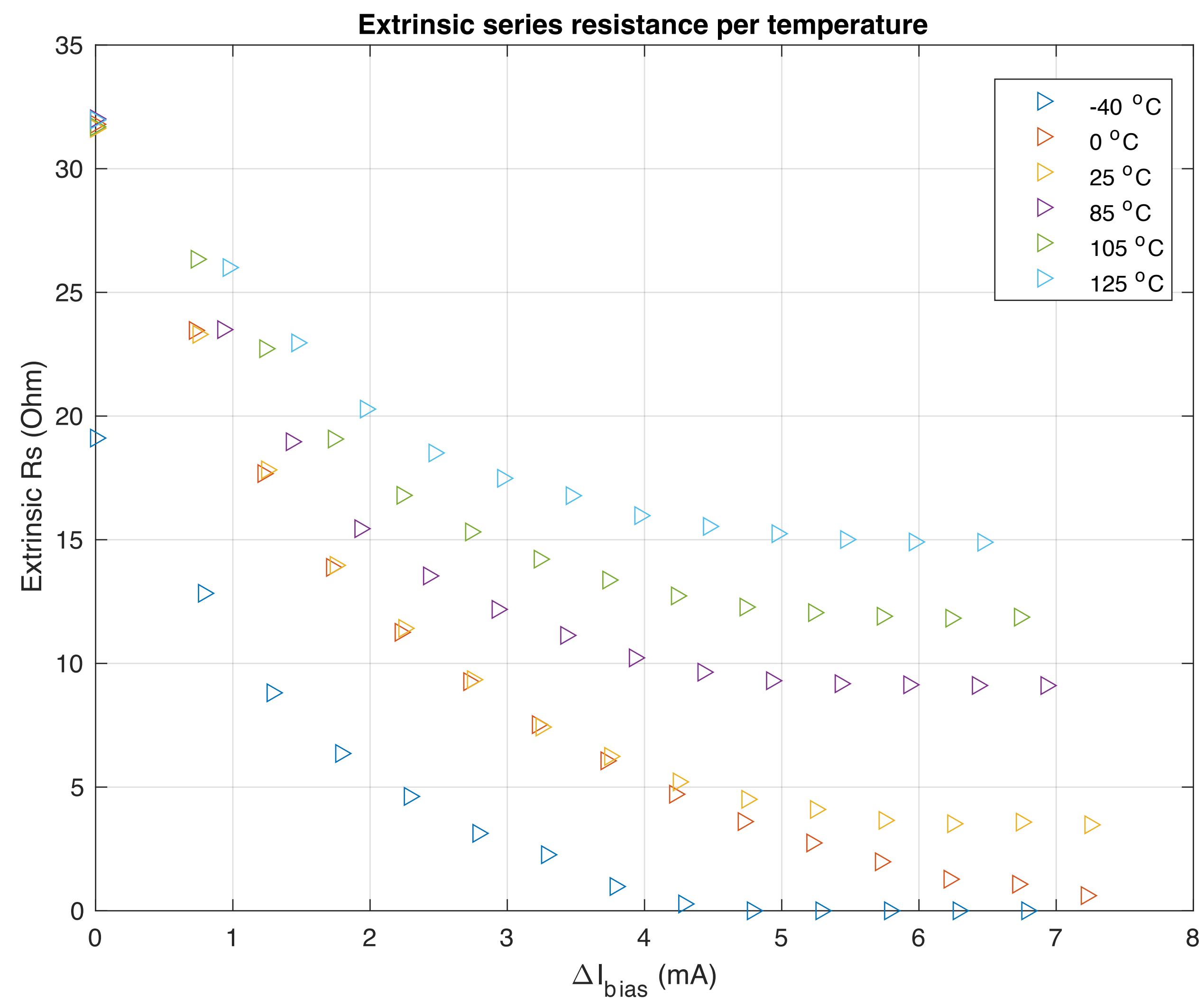


Threshold current characteristic



Small signal frequency response





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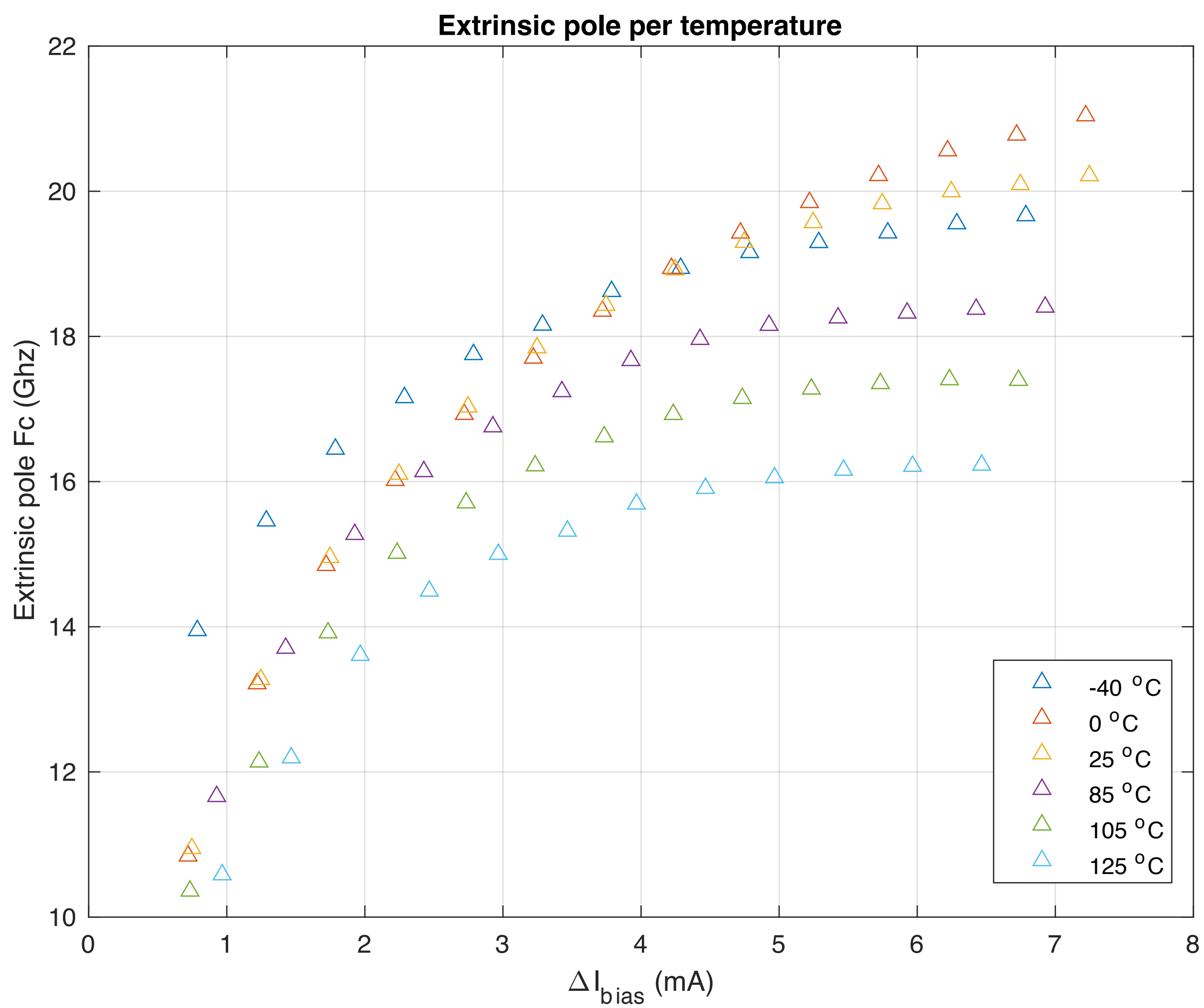

$$H(f) = C \cdot \frac{f_r^2}{f_r^2 - f^2 + j\frac{f}{2\pi}\gamma} \cdot \frac{1}{1 + j\frac{f}{f_p}}.$$ (see [1])

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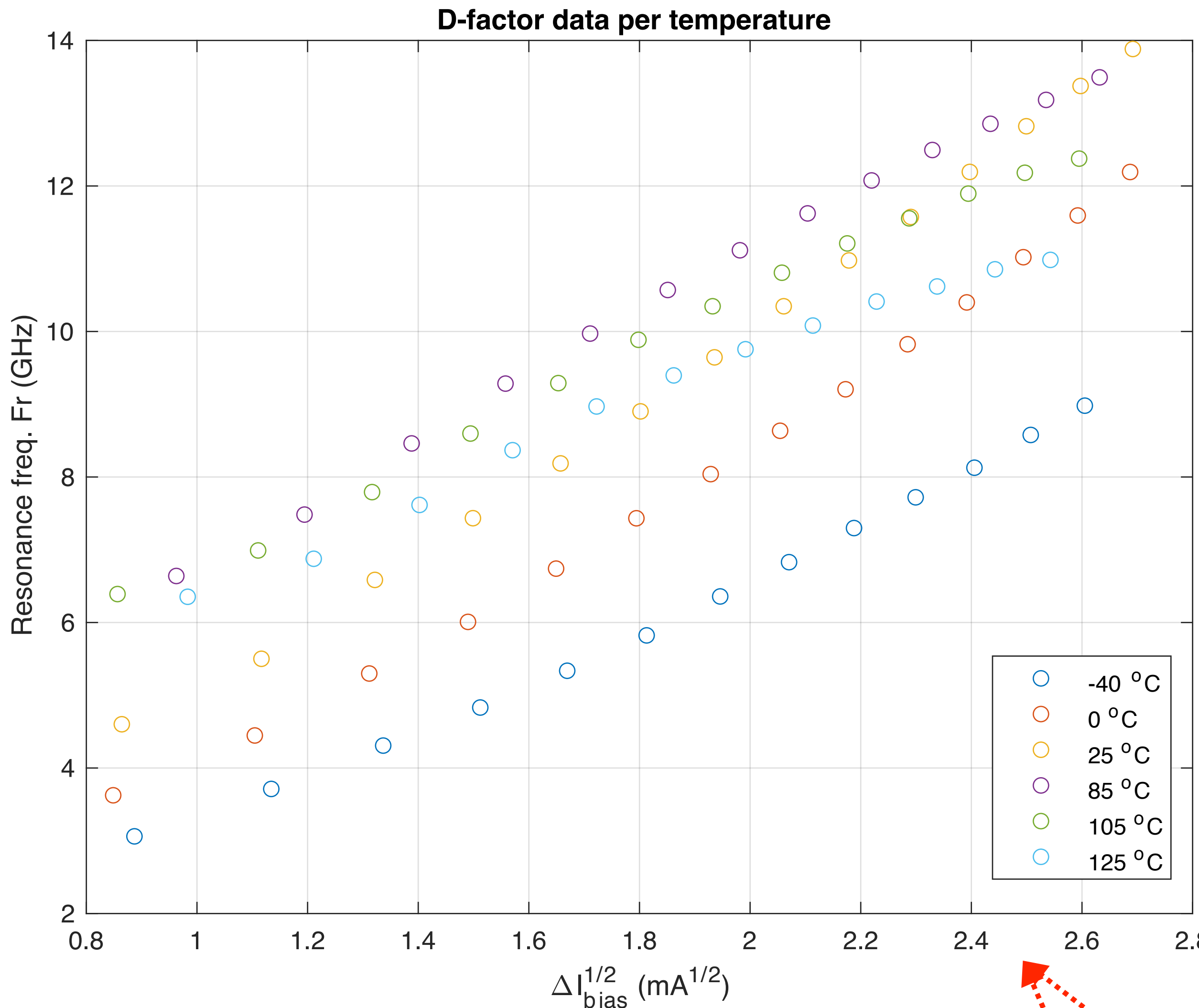

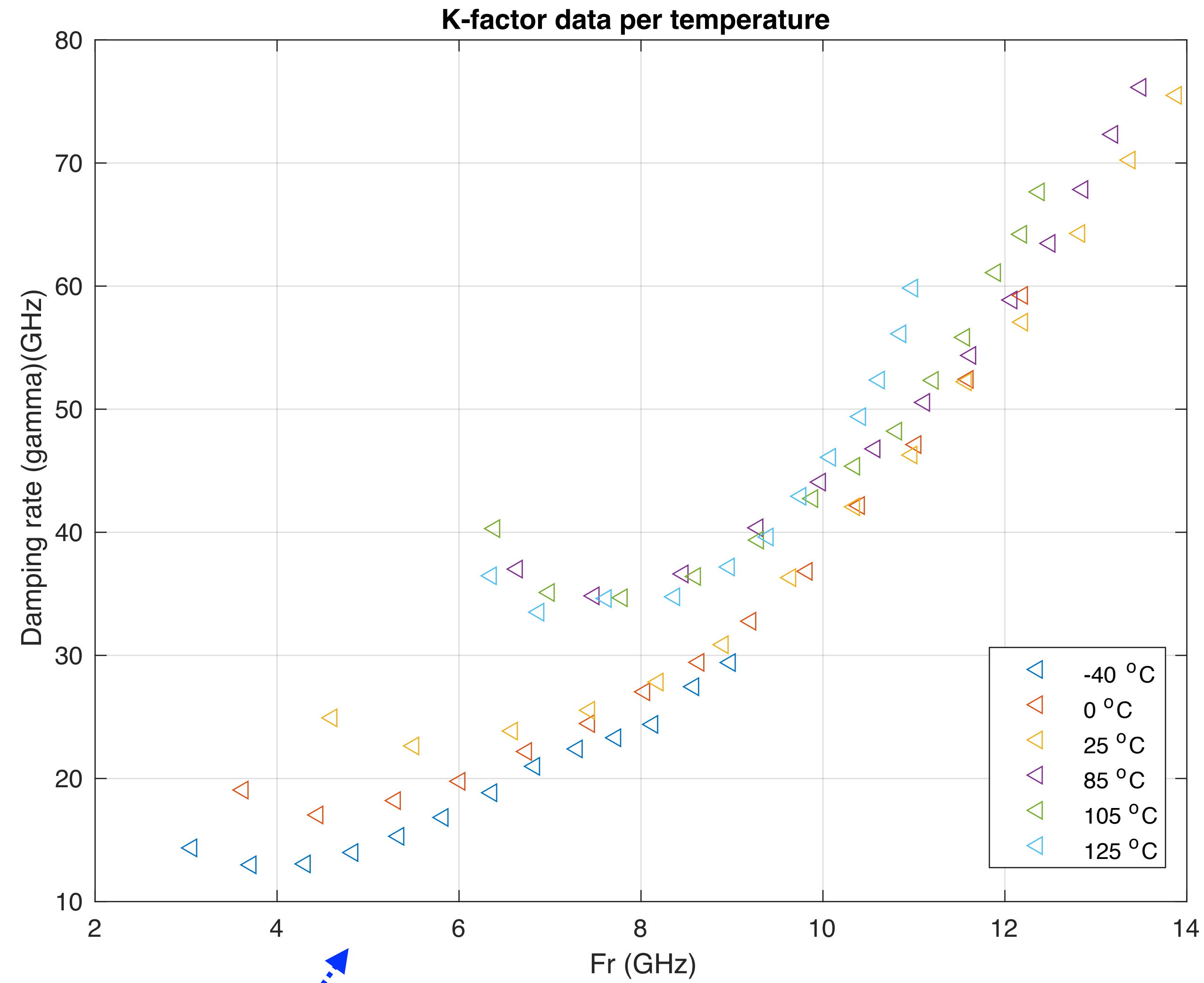

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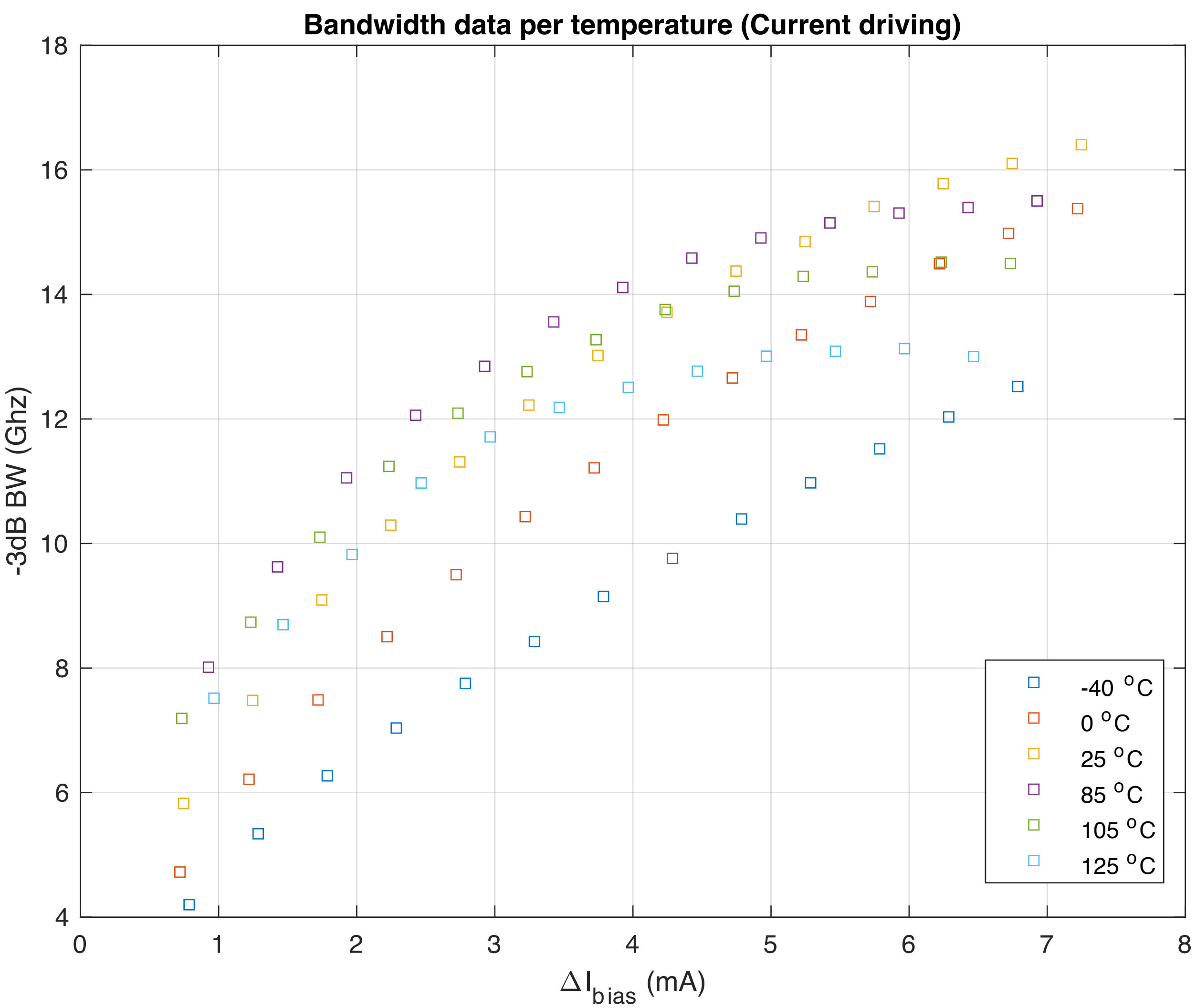
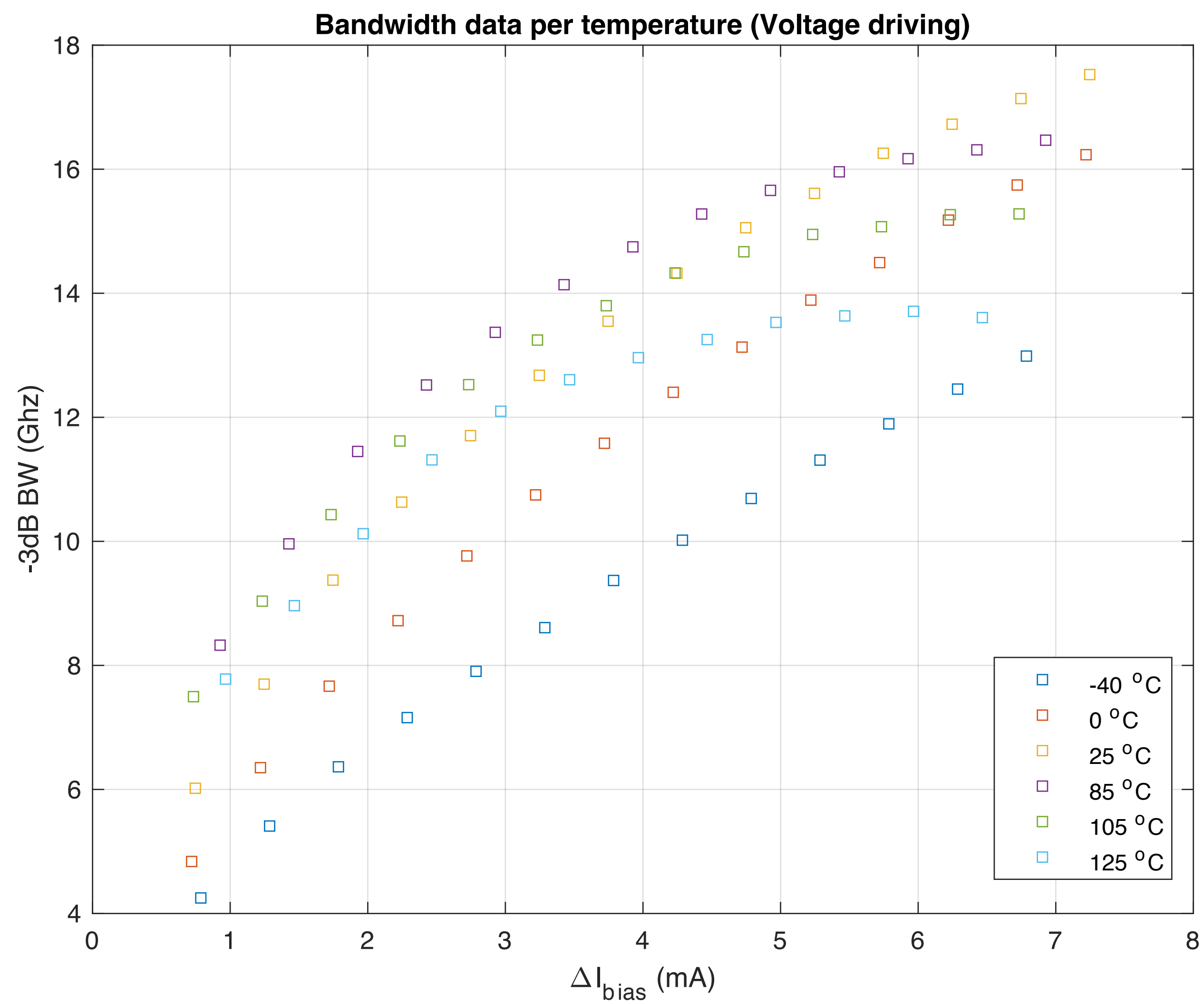
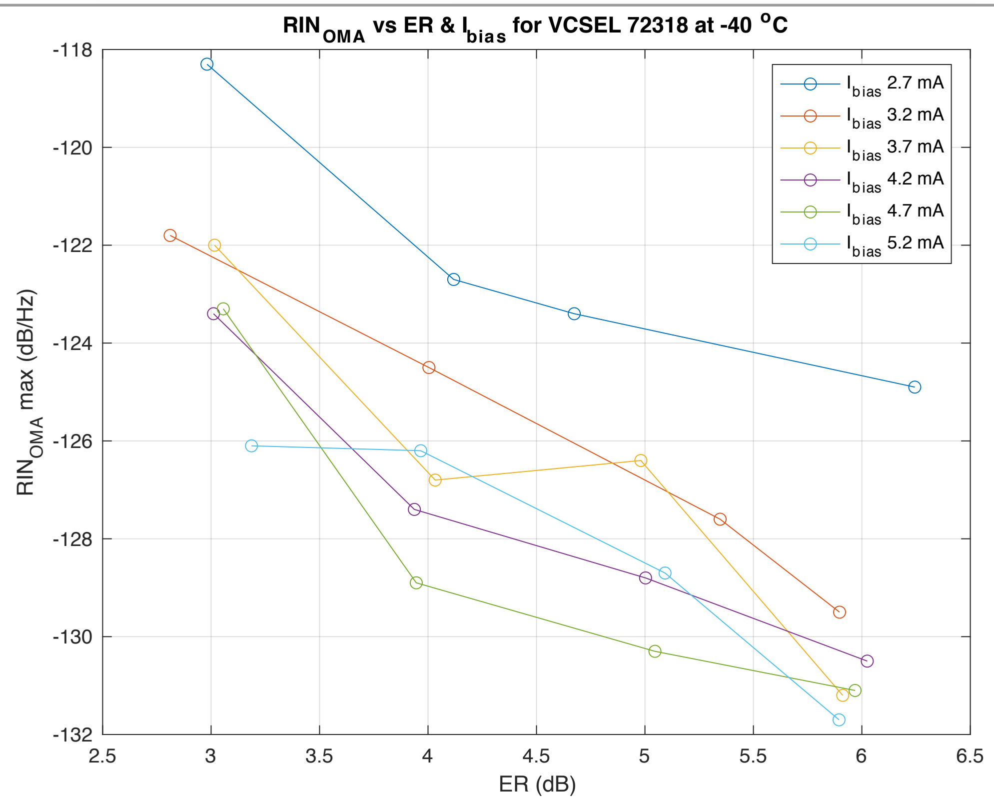
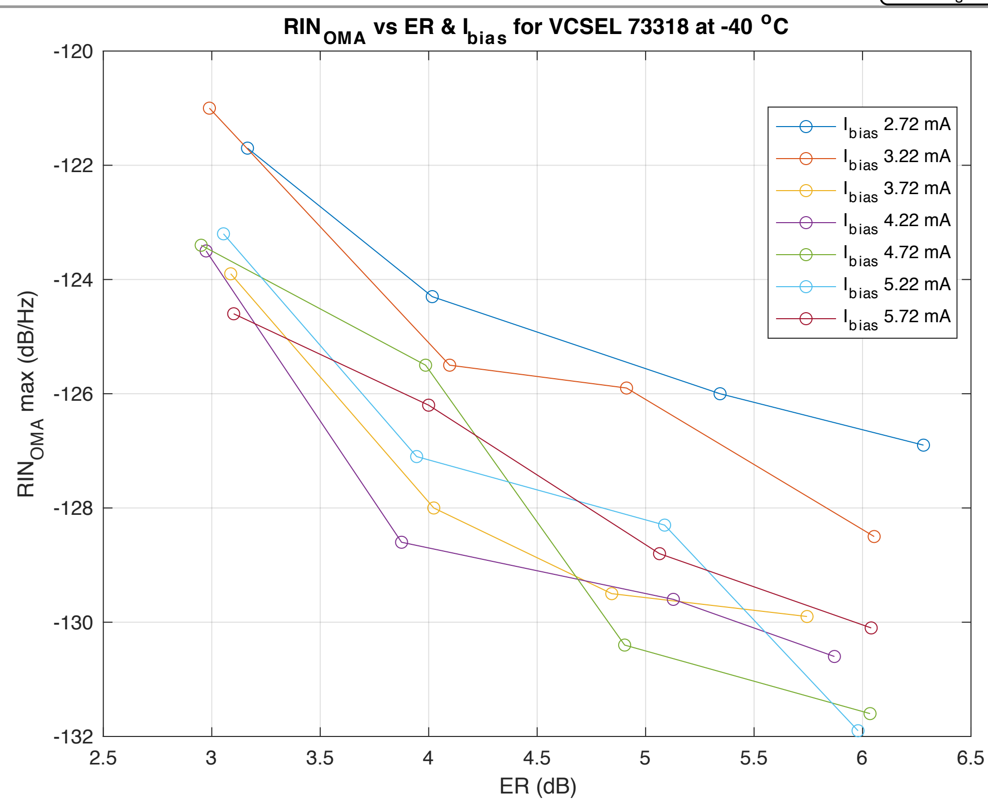


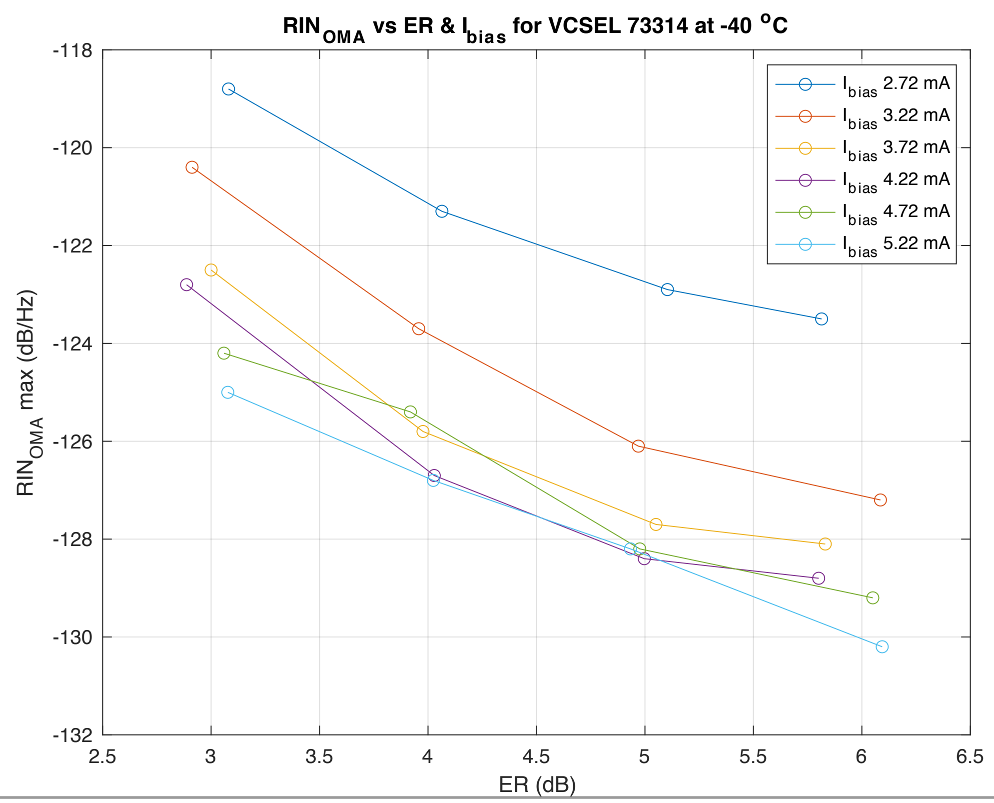


Considered source impedance 100 Ω

Relative intensity noise (RIN_{OMA}) at -40°C







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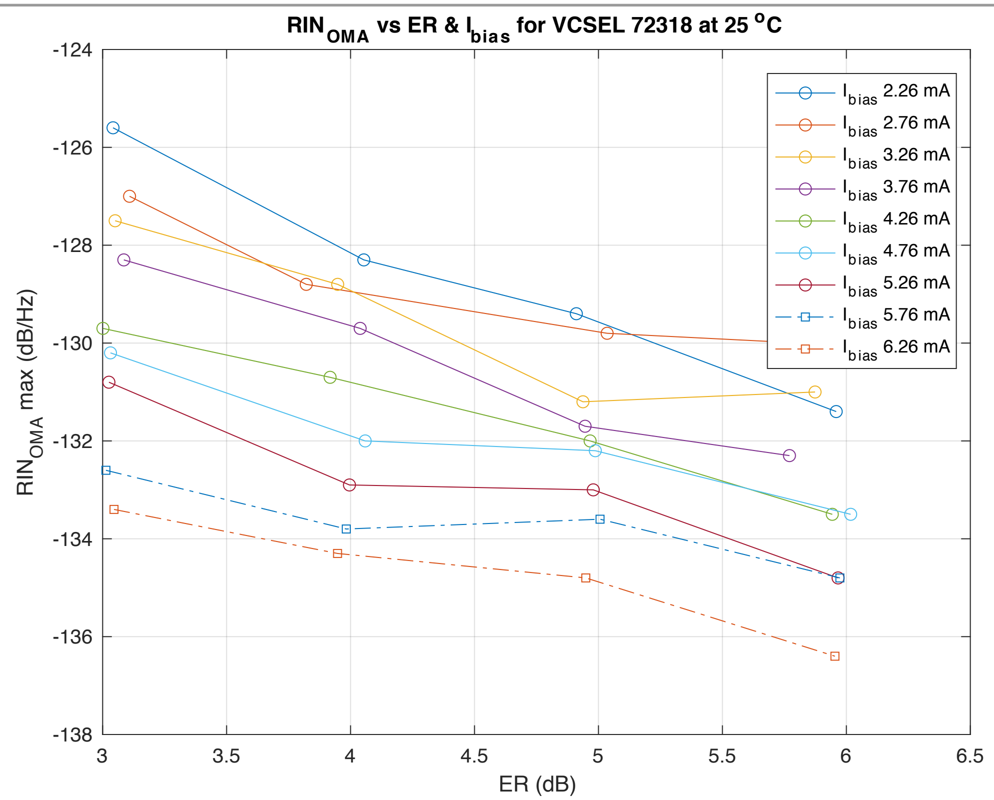
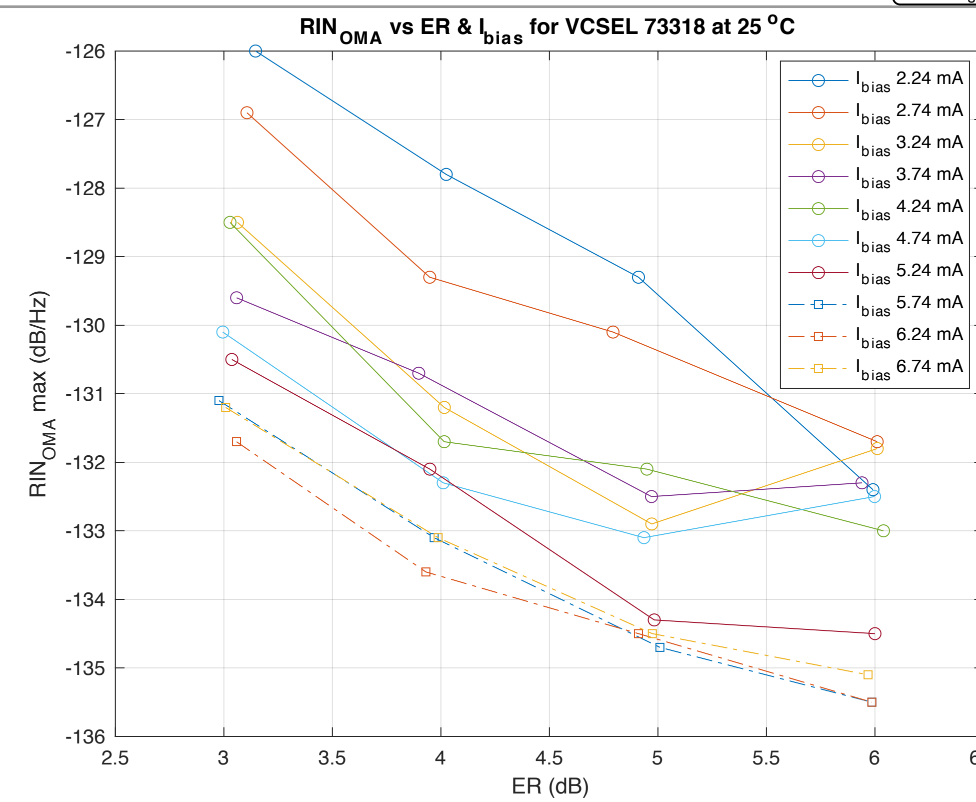
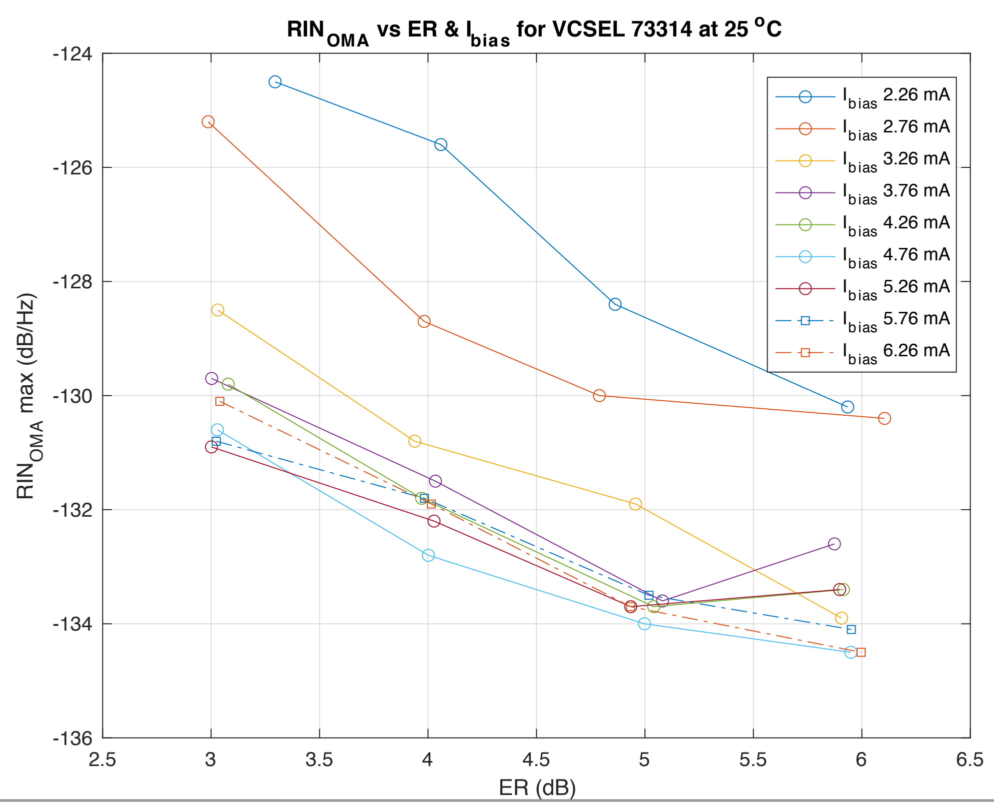
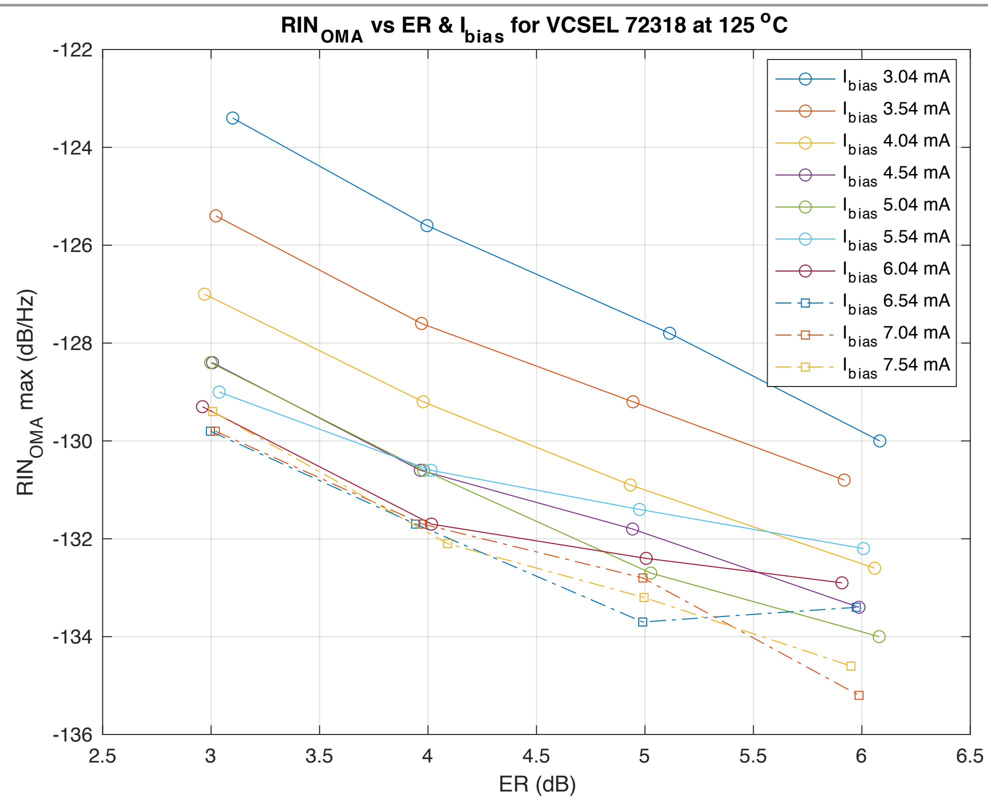
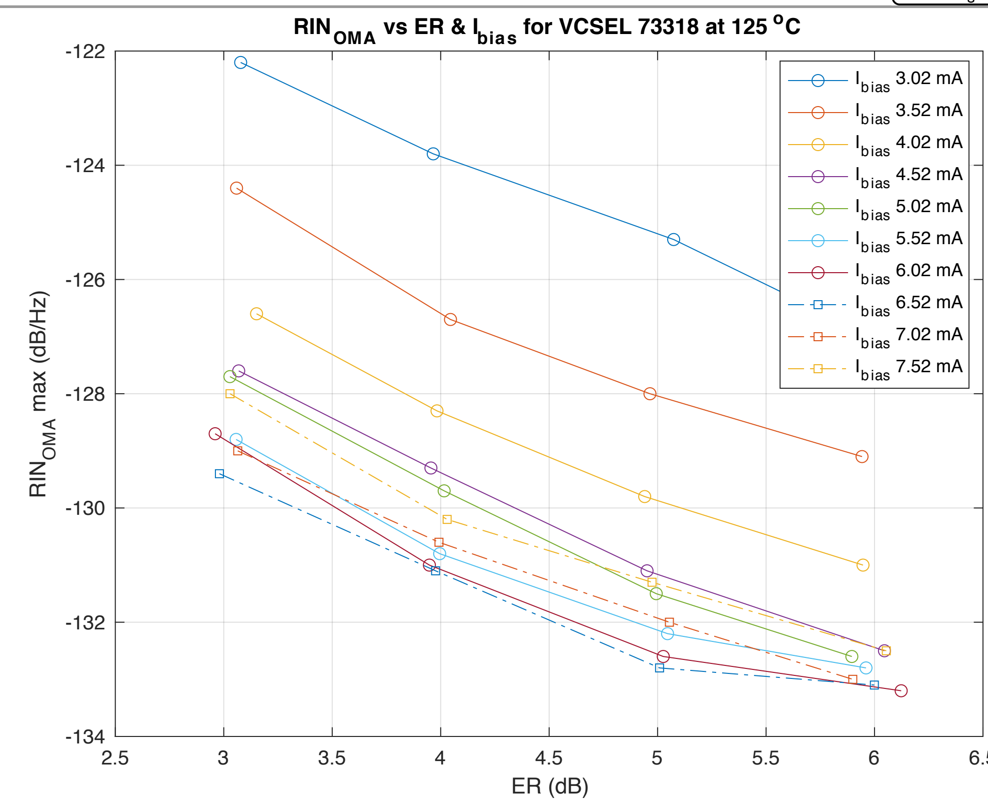


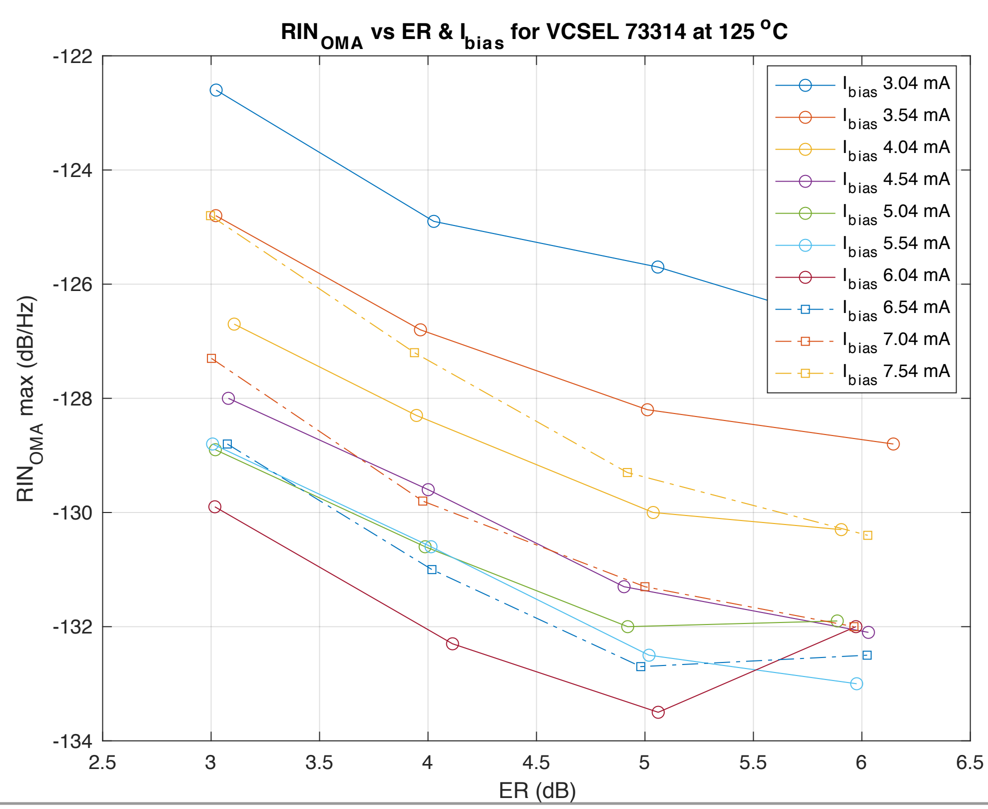




Relative intensity noise (RIN_{OMA}) at 125°C







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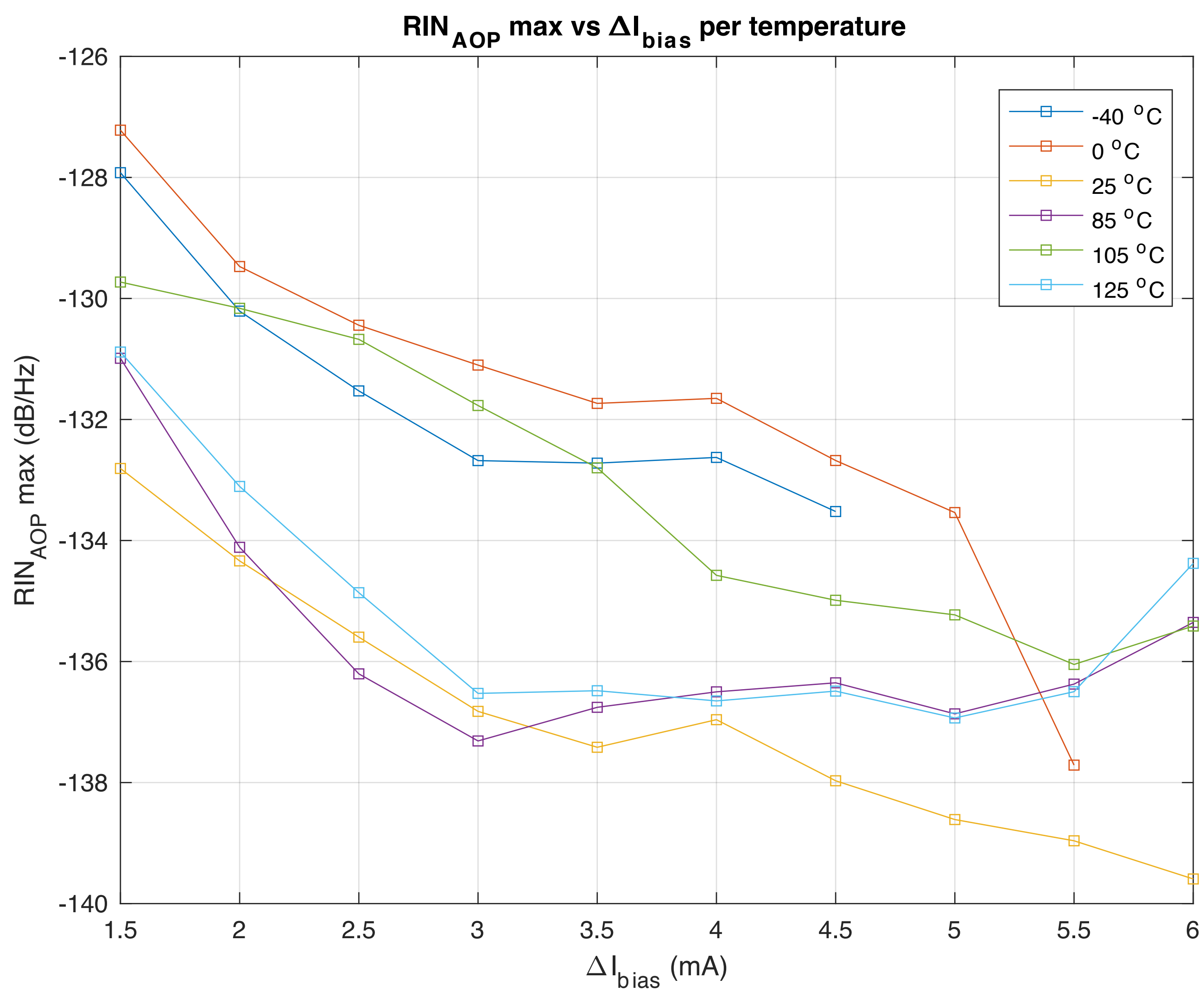

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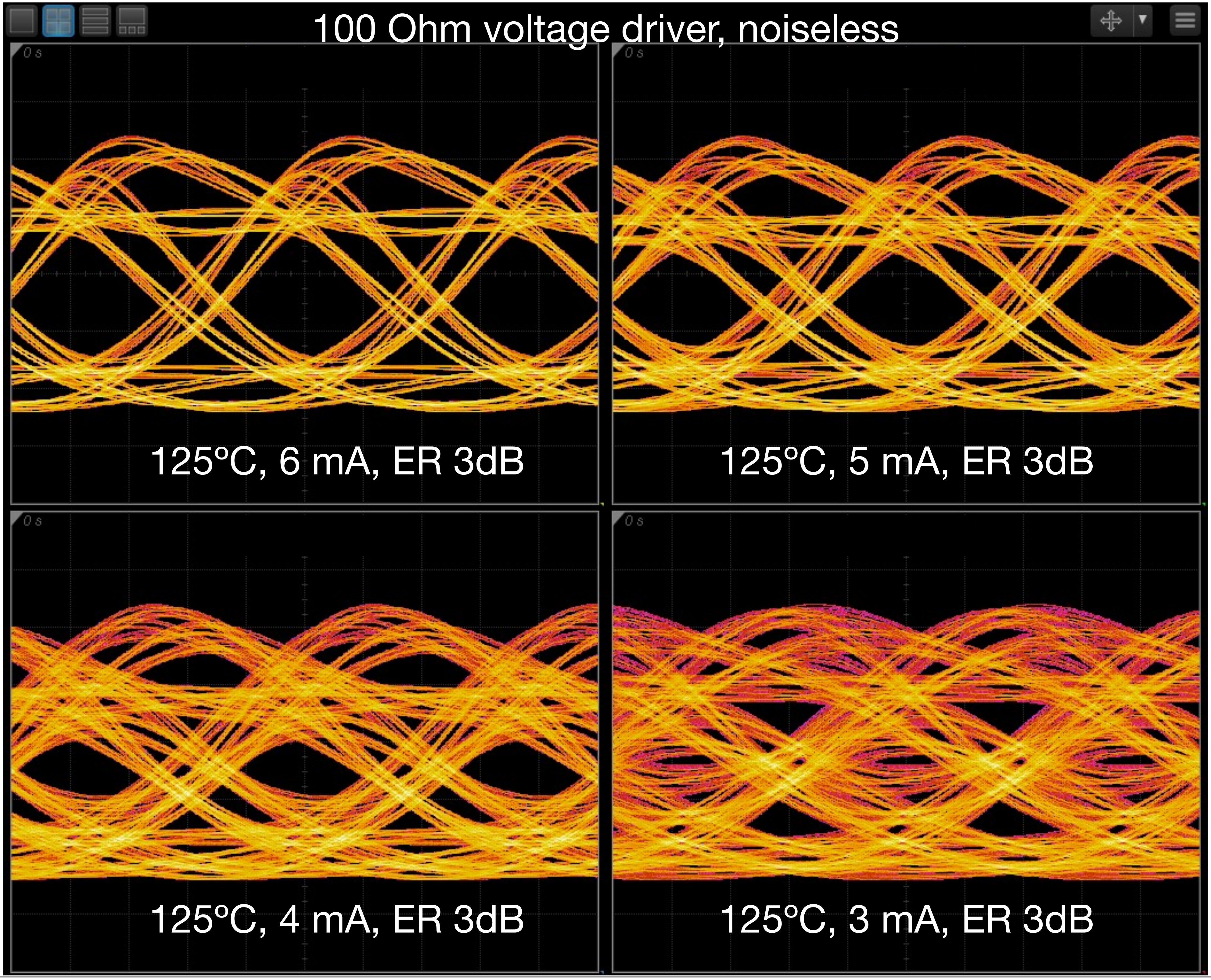

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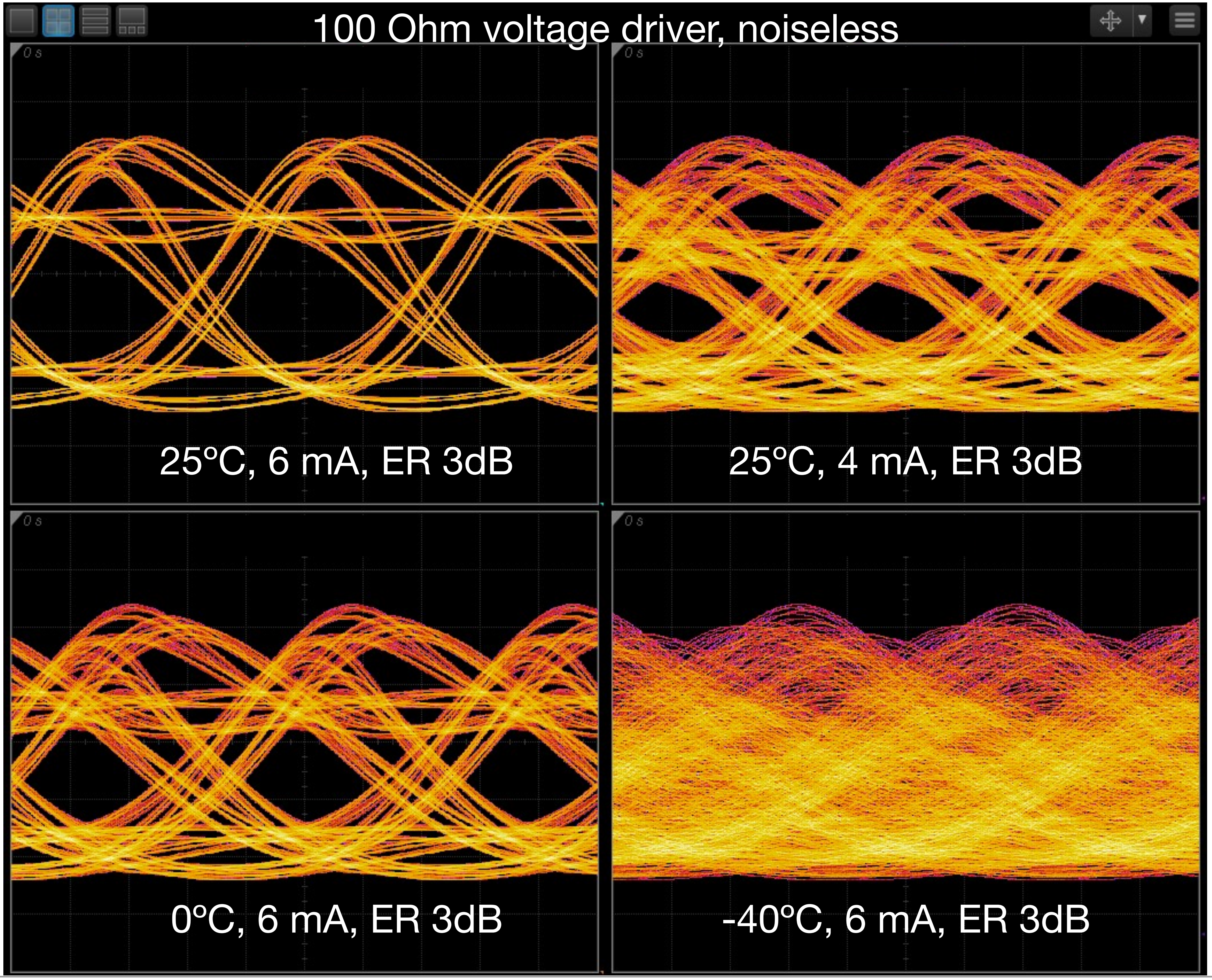

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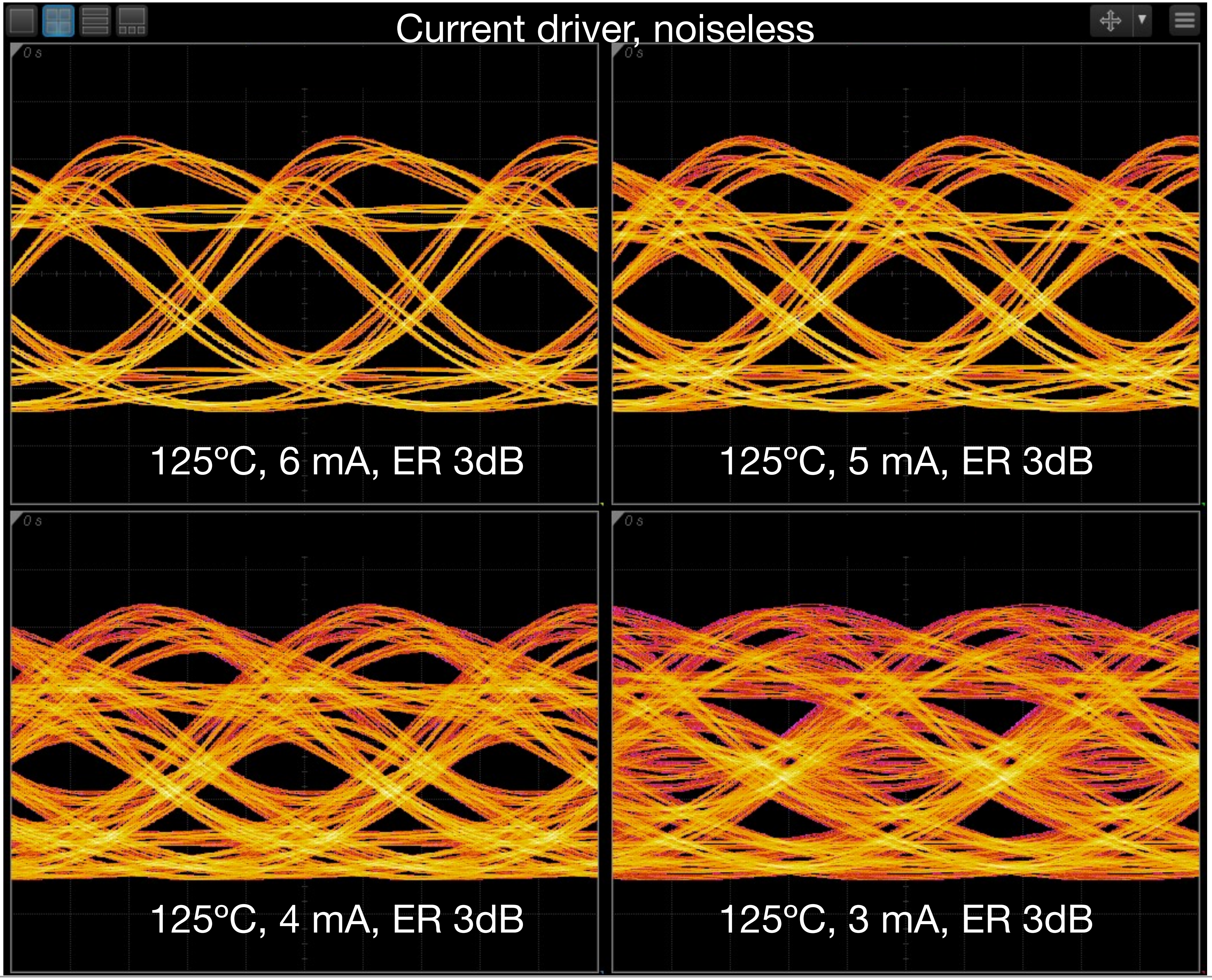

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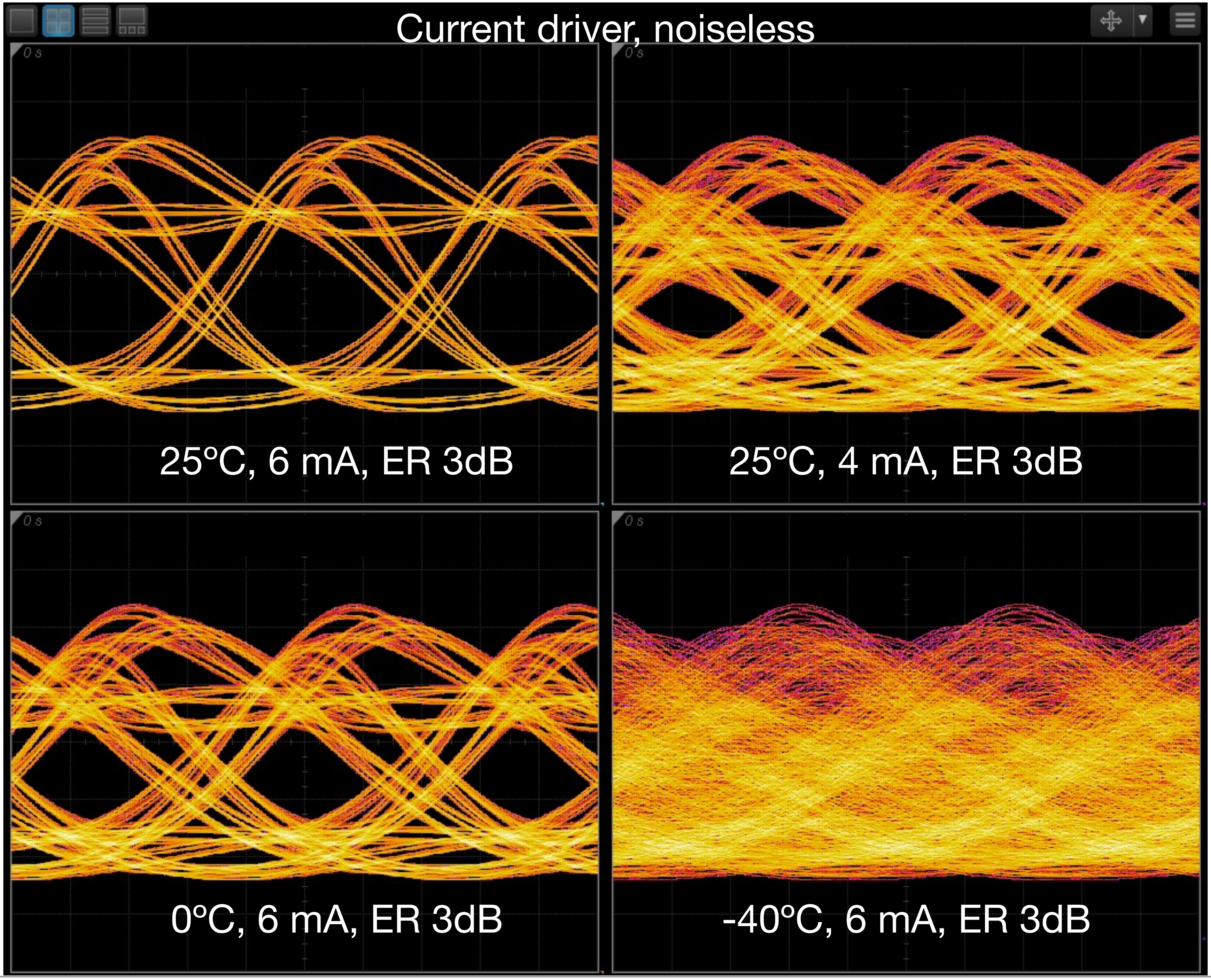
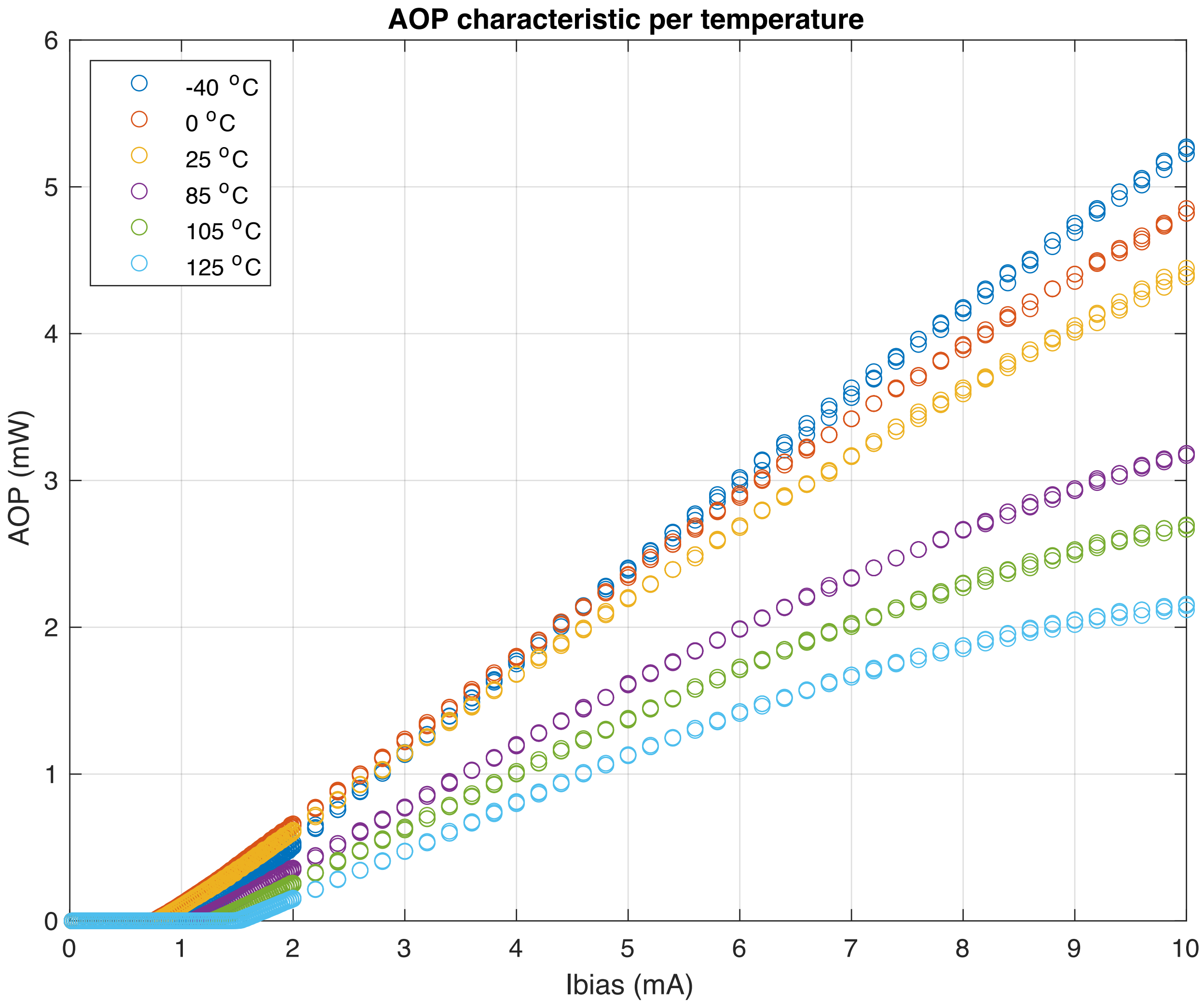
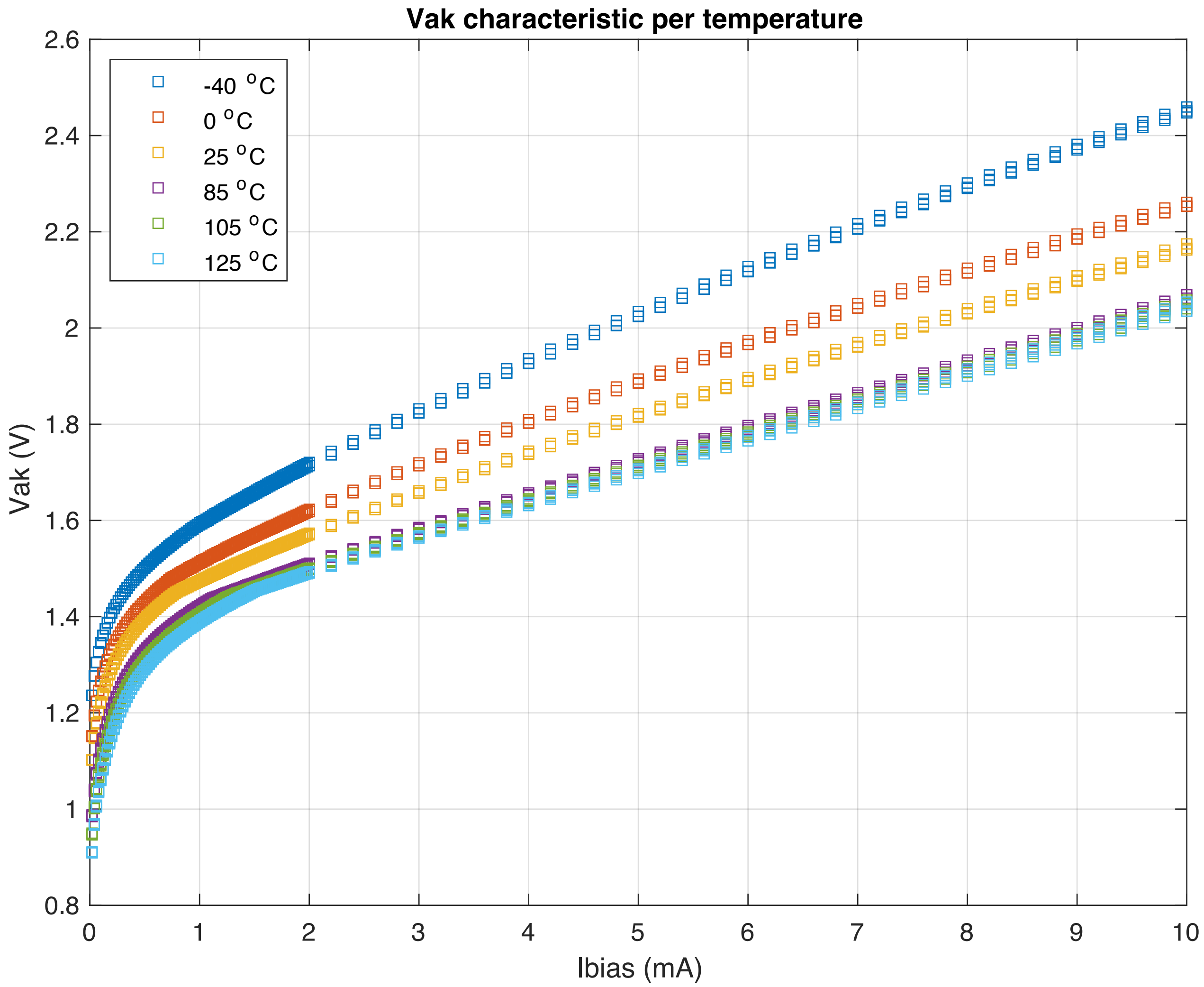


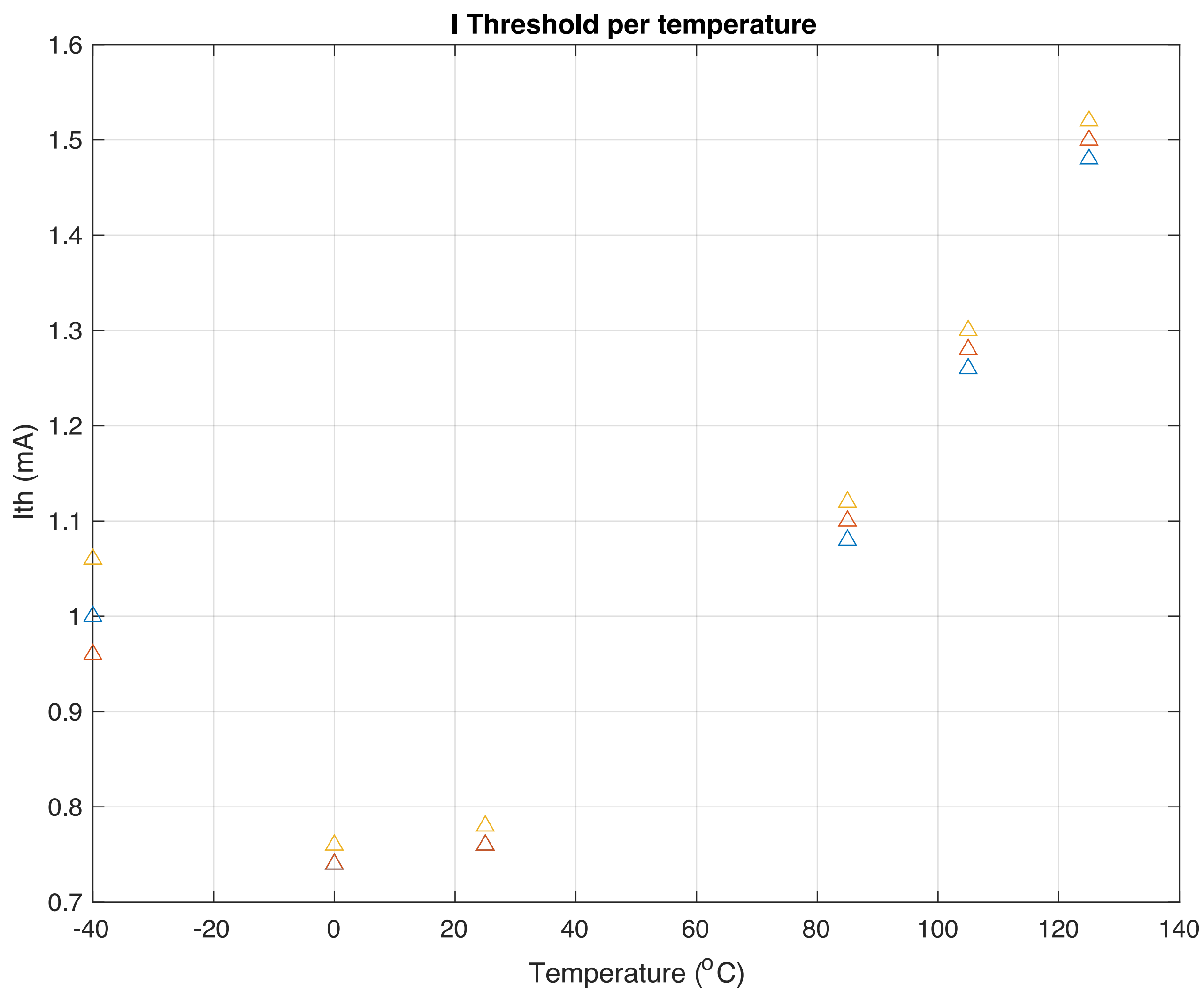
50Gbps multimode VCSEL for 910 nm

L-I-V characteristic

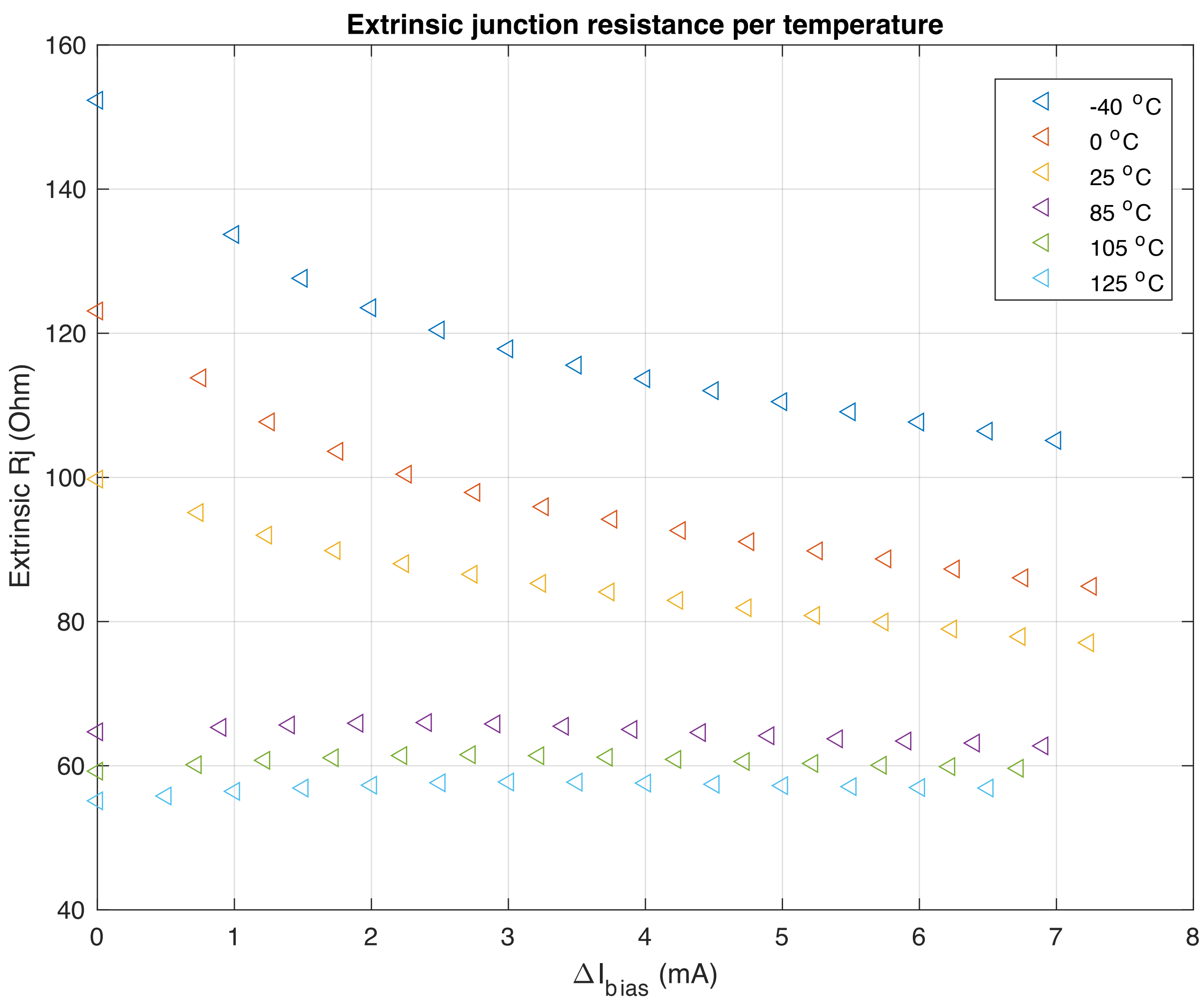


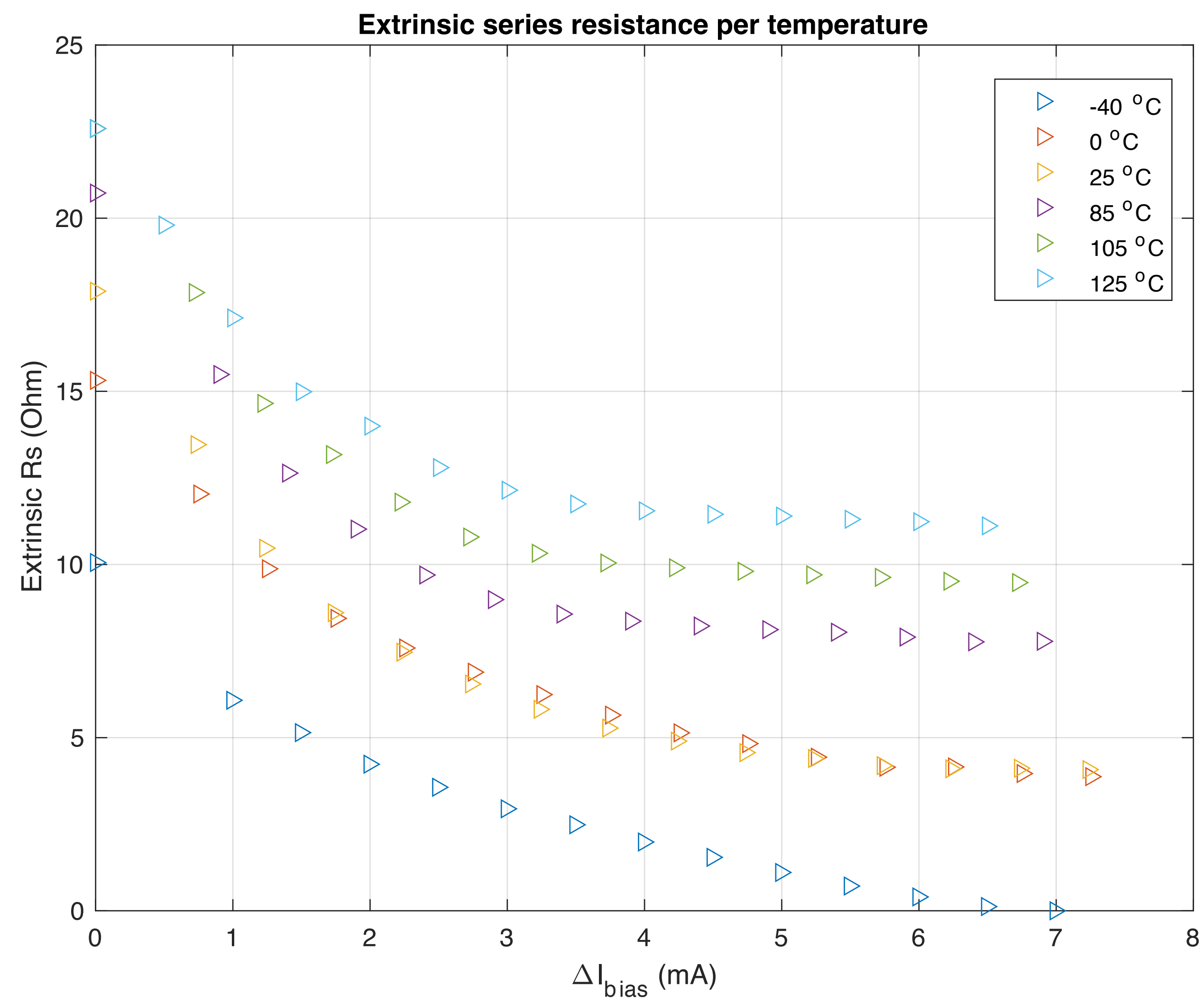


Threshold current characteristic



Small signal frequency response





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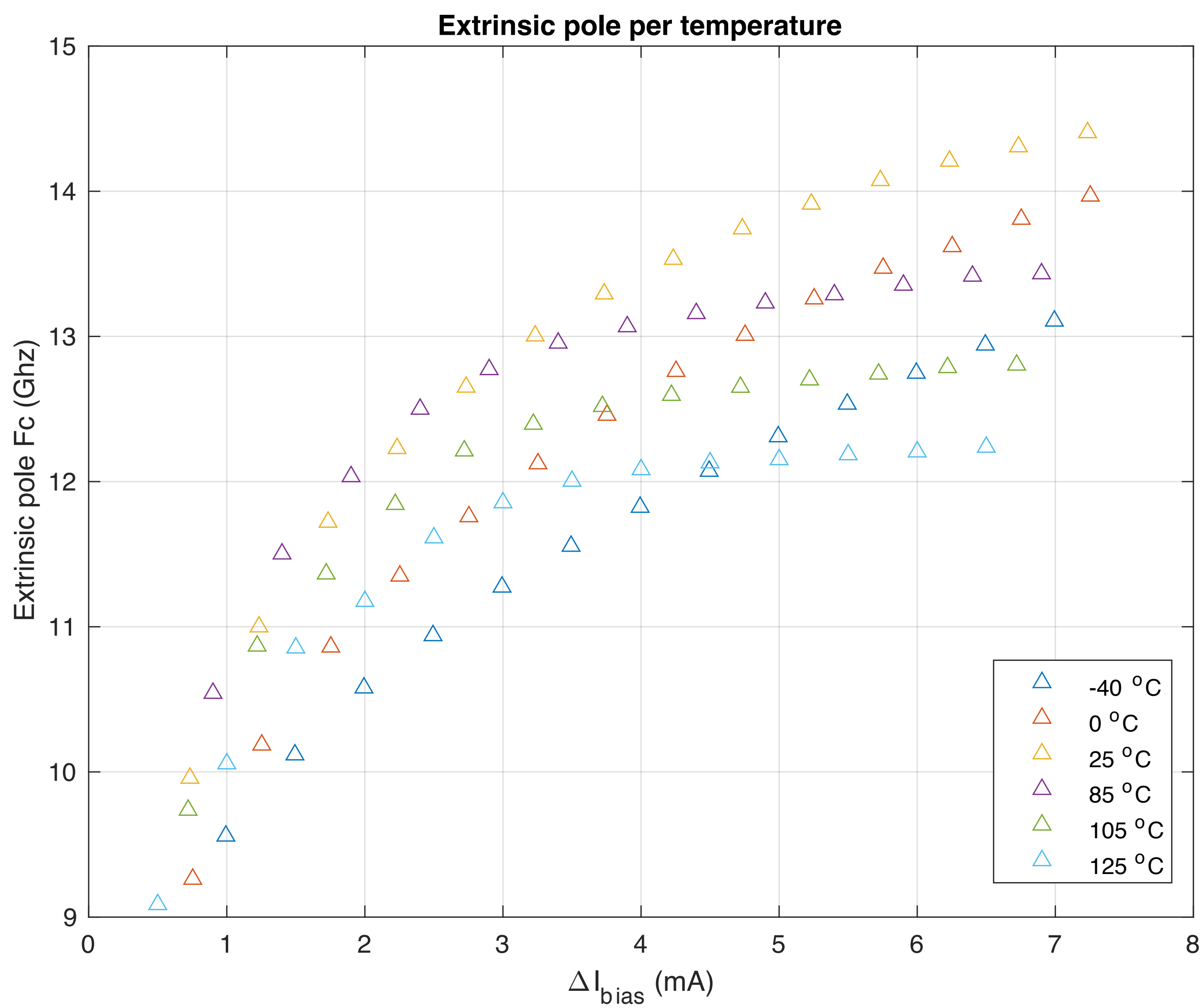

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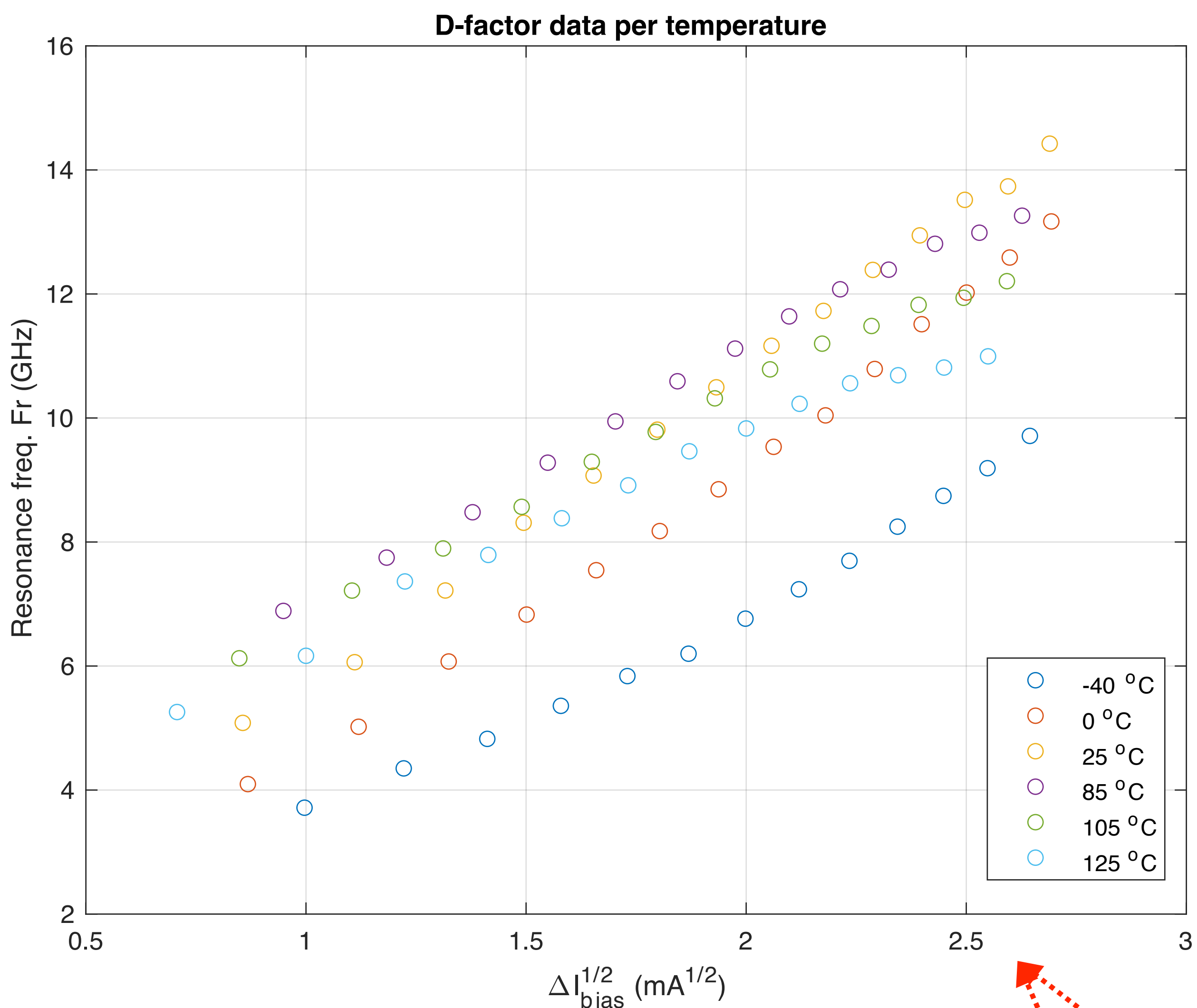

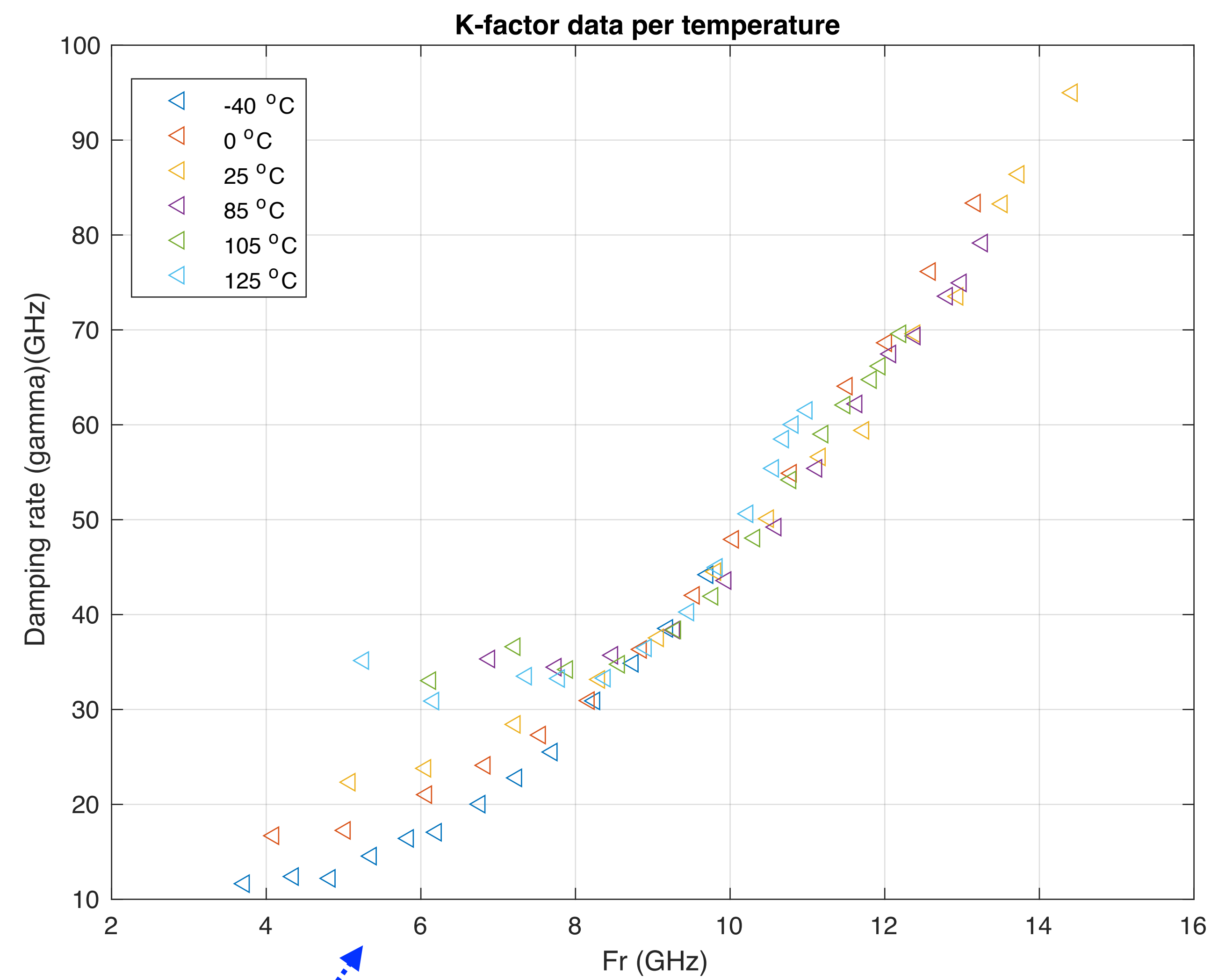

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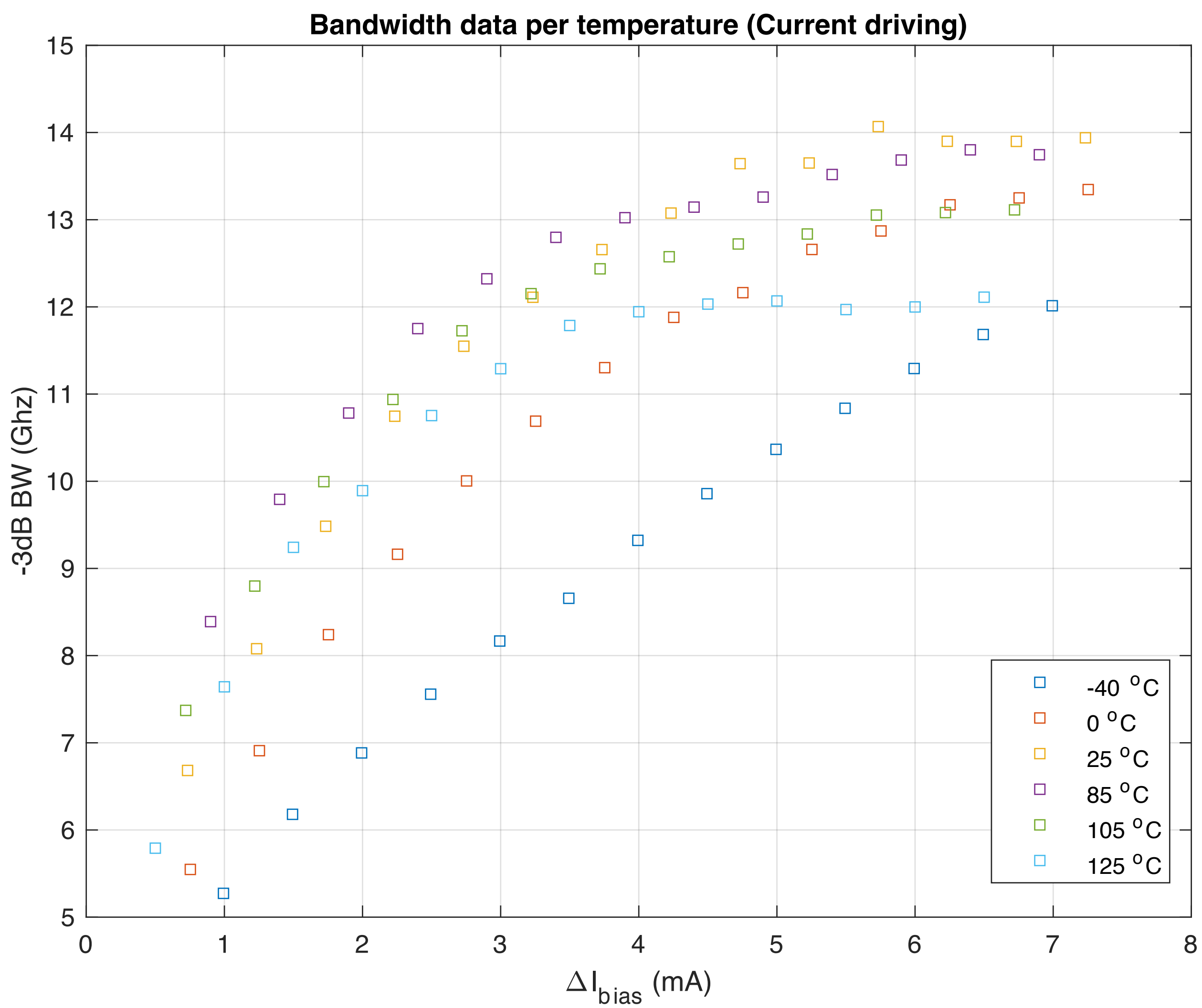
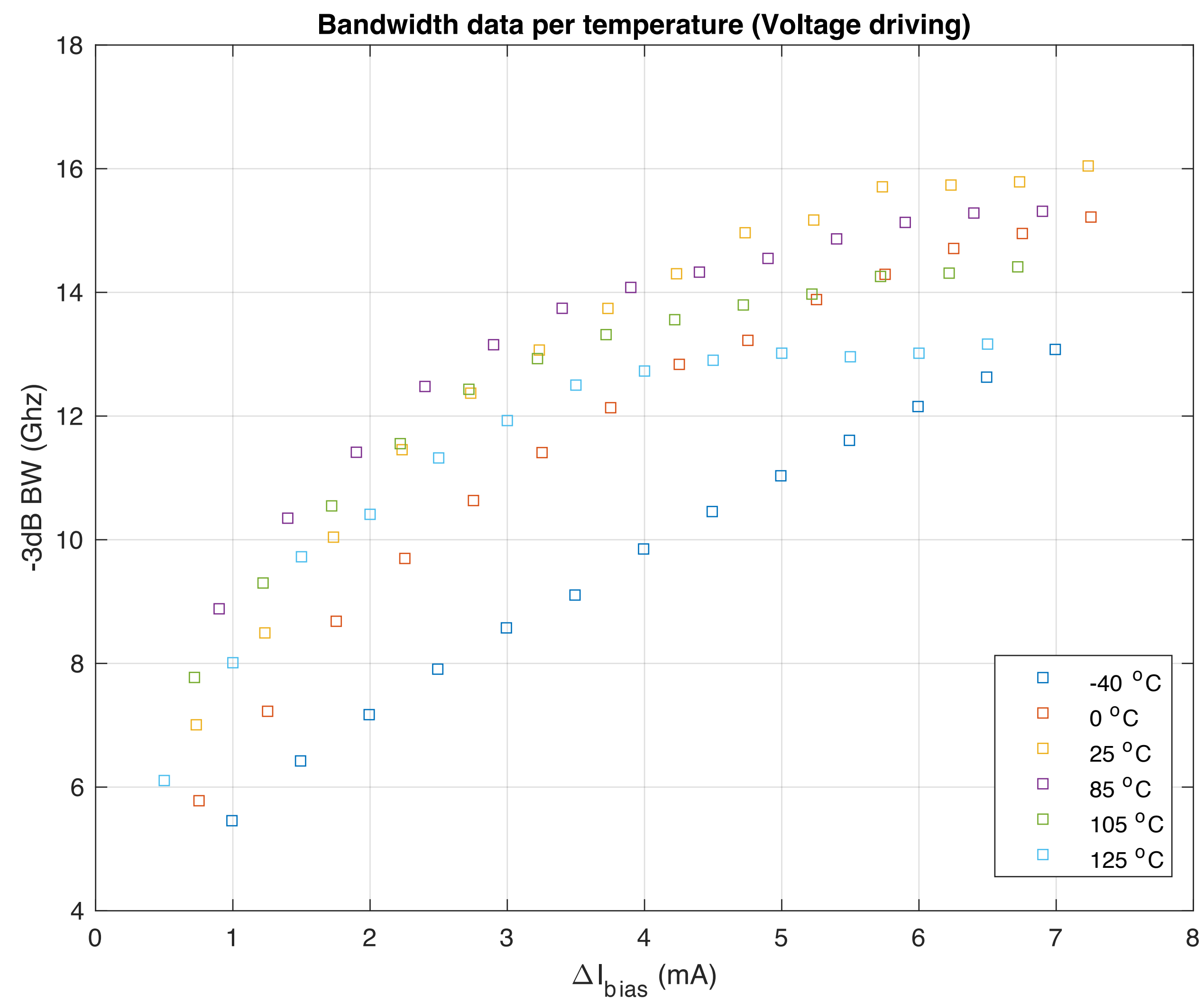
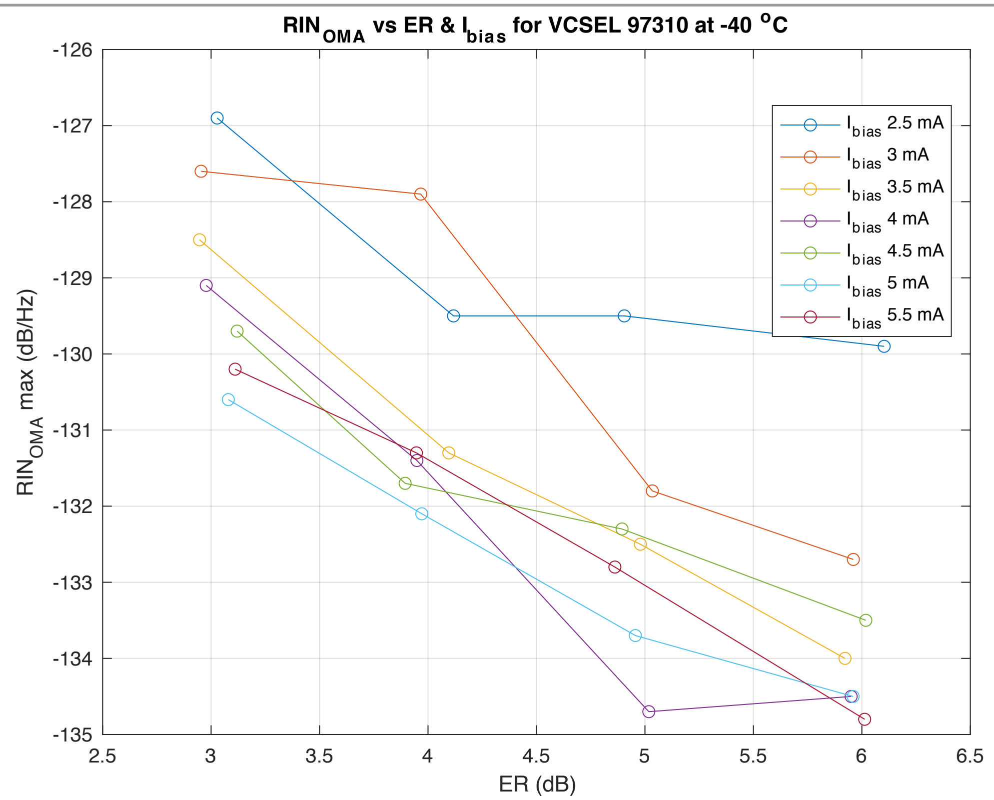
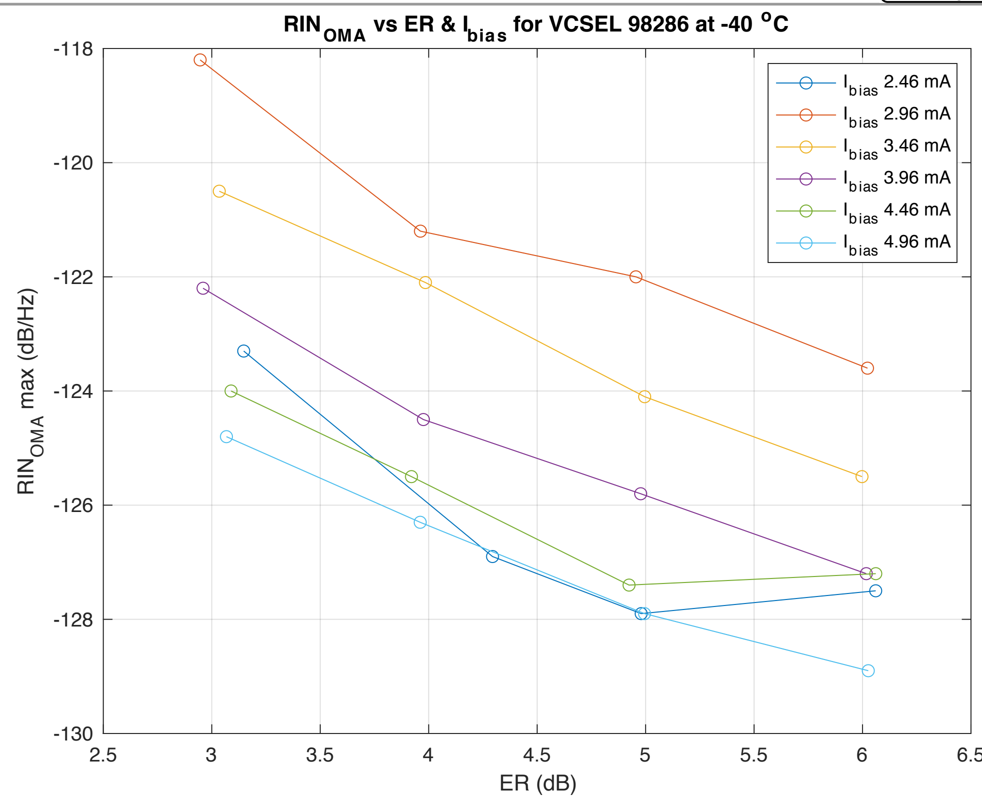


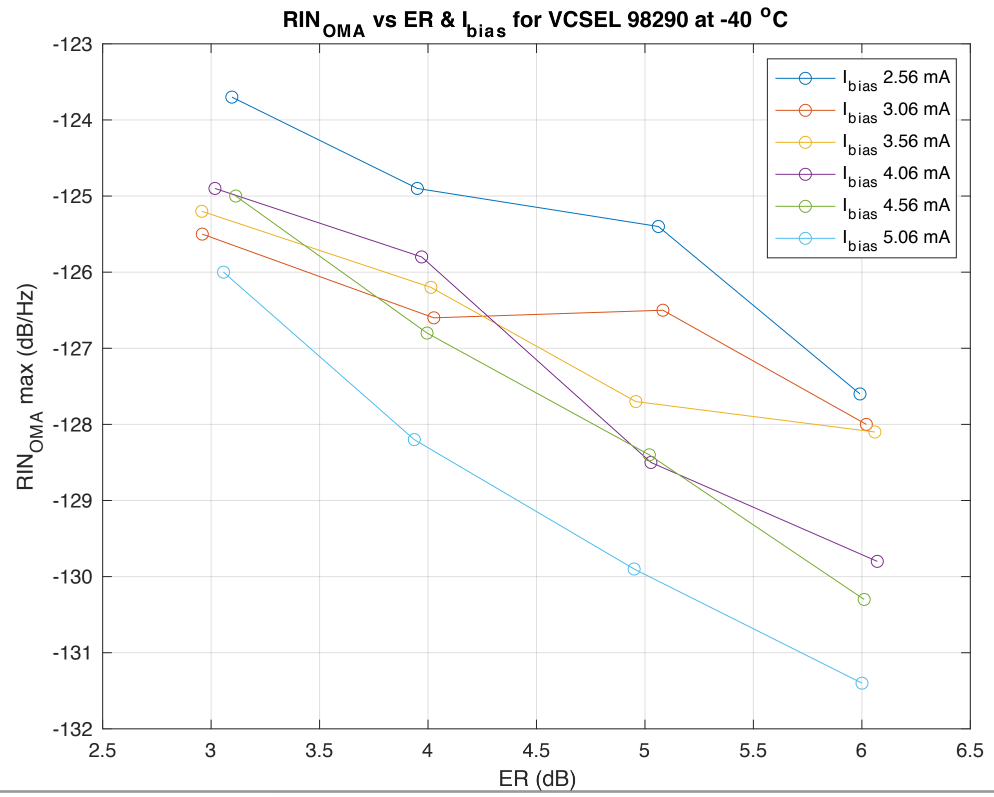


Considered source impedance 100 Ω

Relative intensity noise (RIN_{OMA}) at -40ºC







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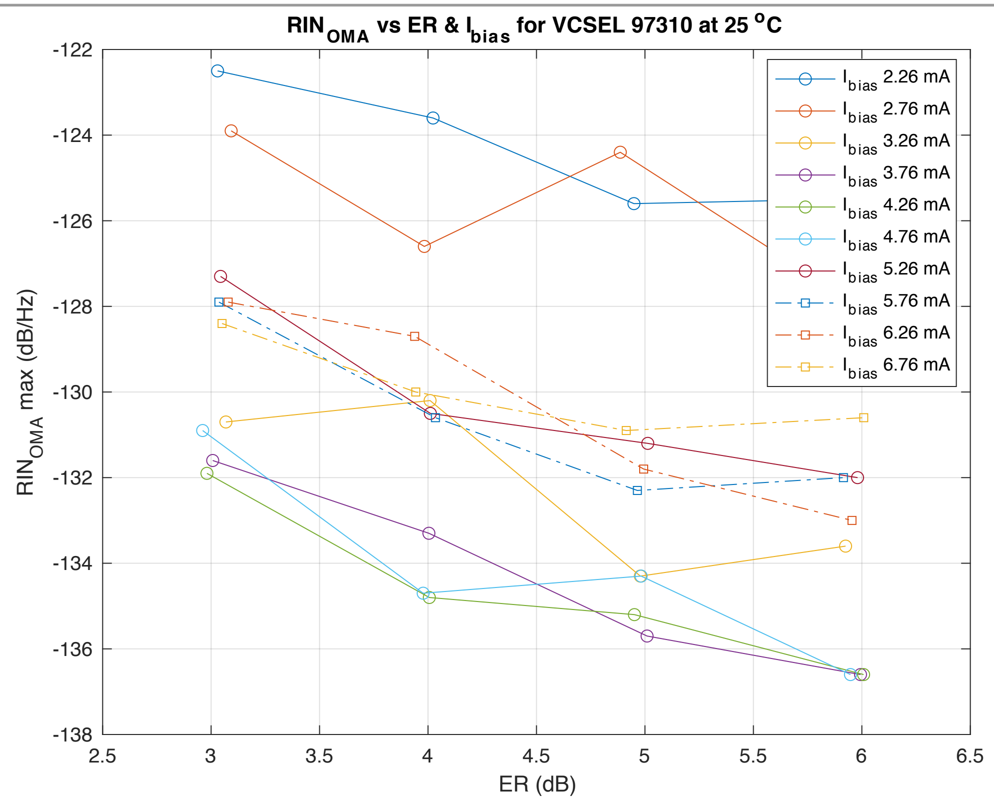
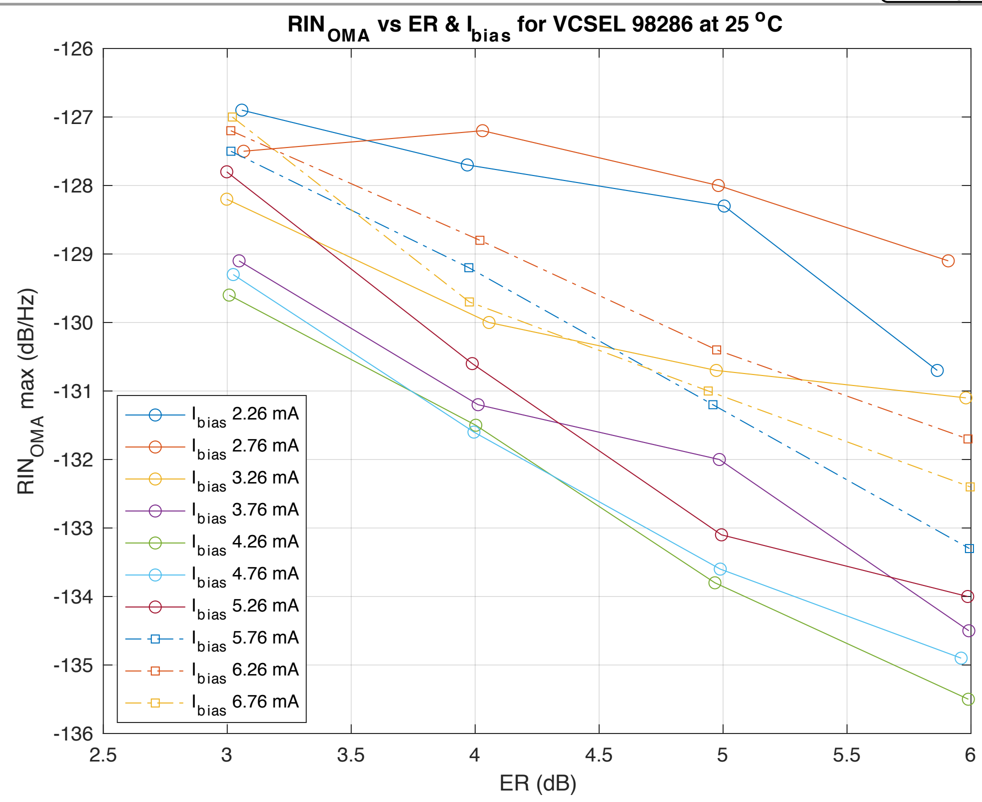
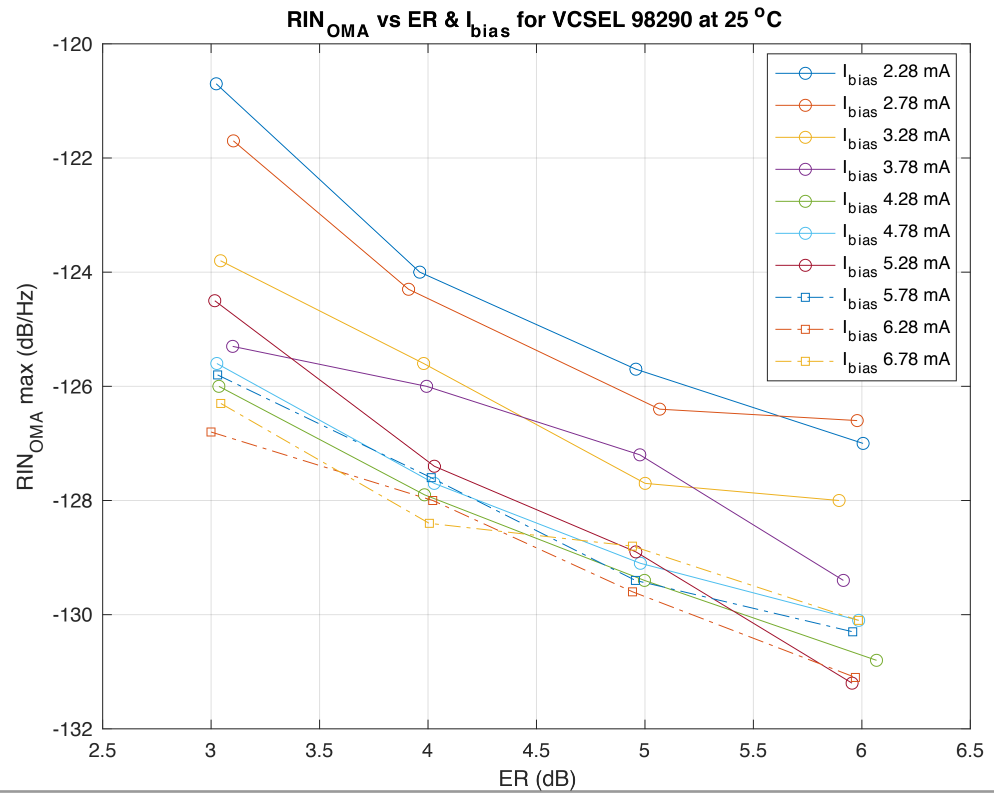
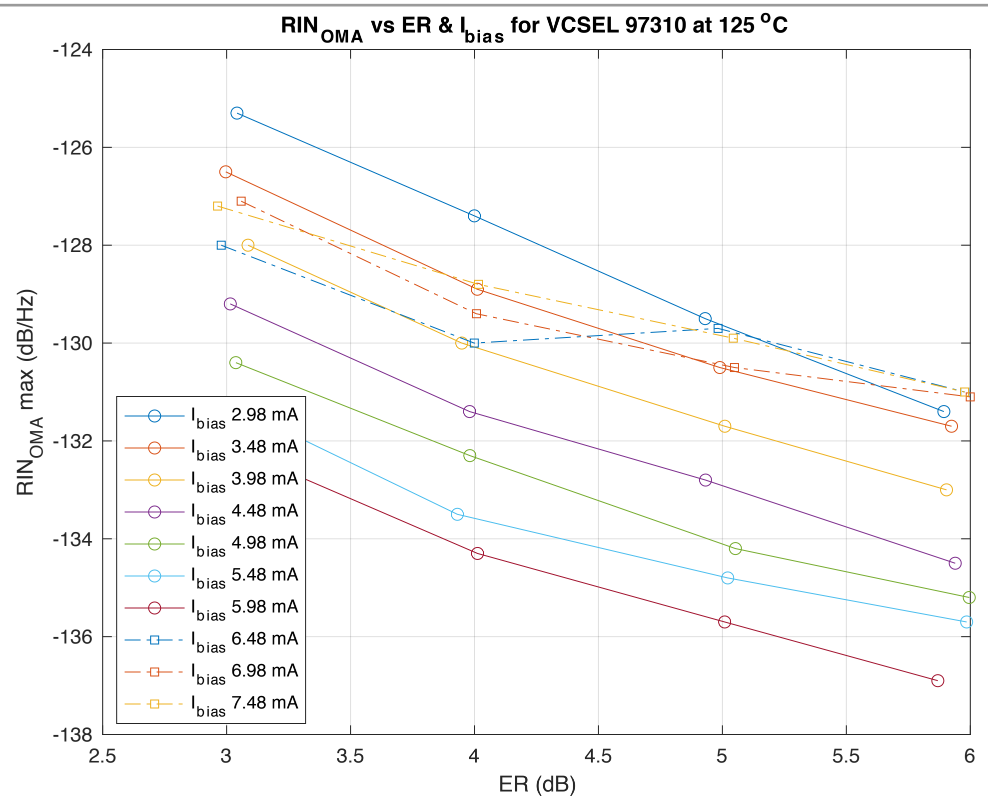
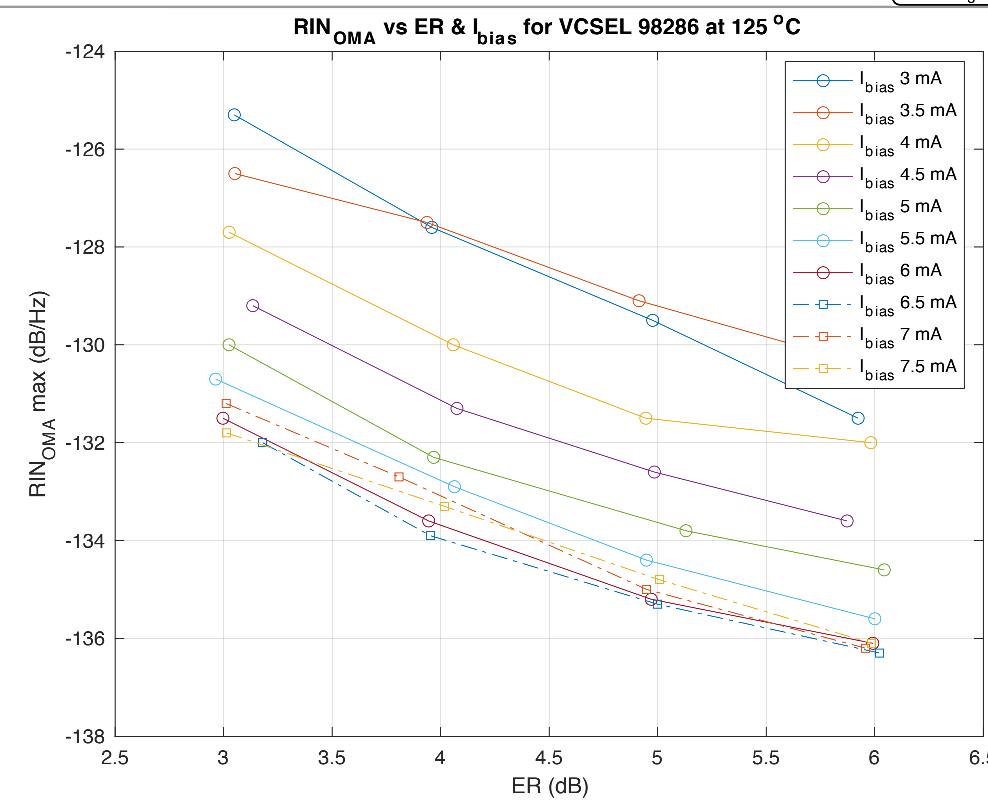


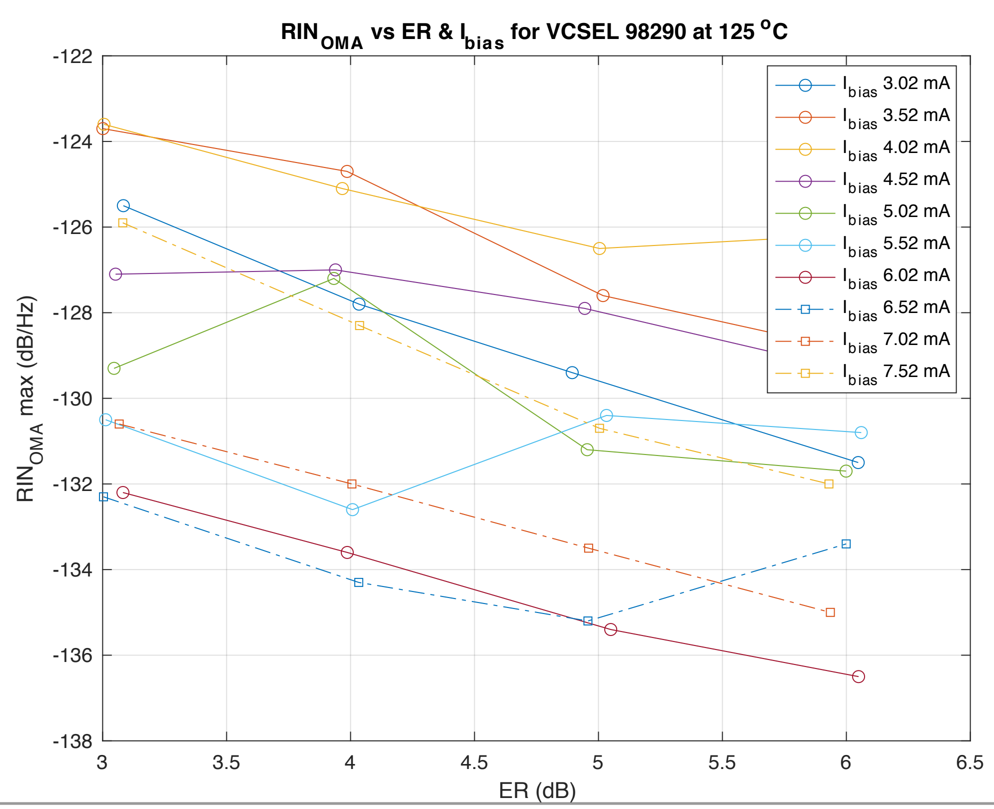




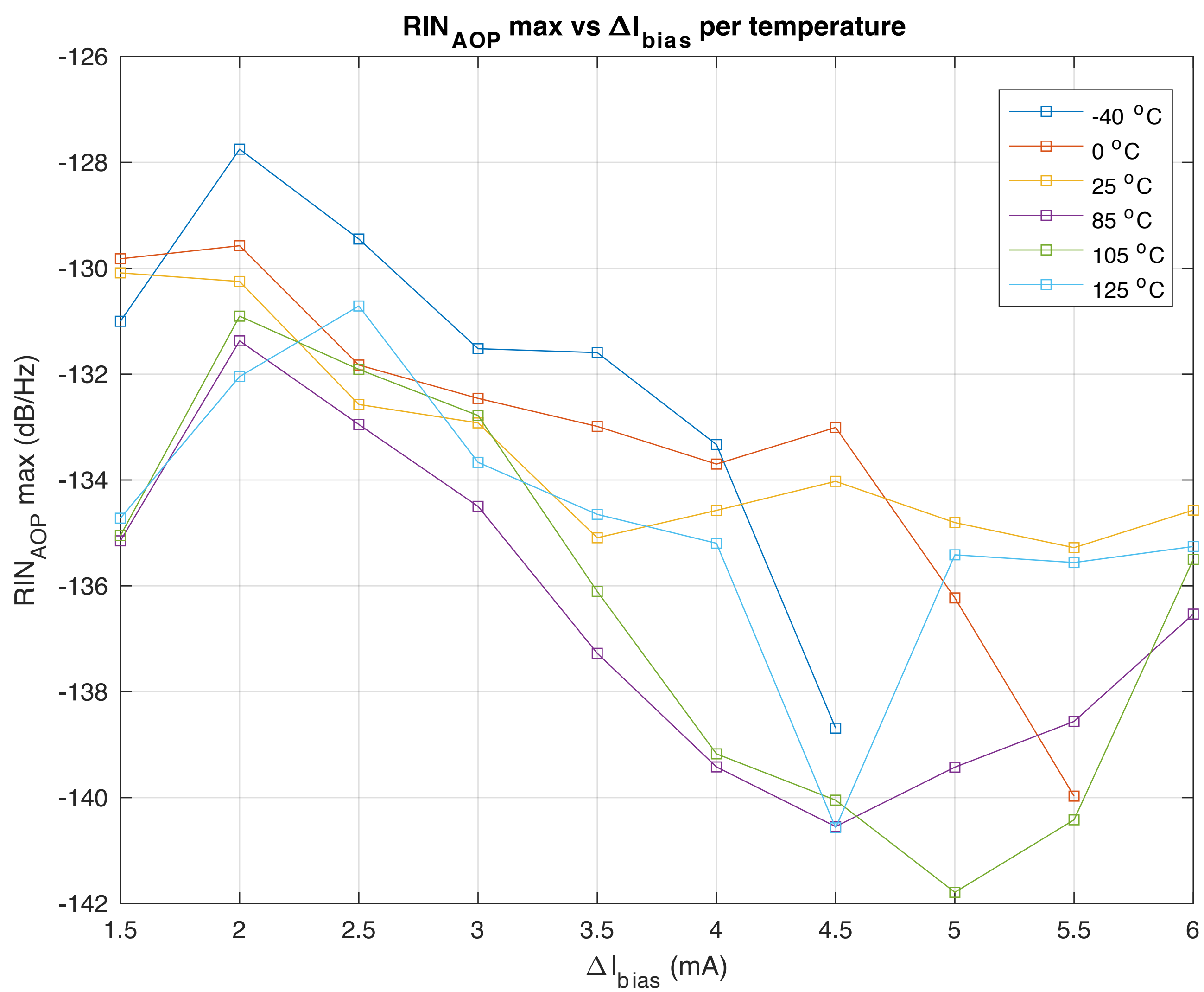
Relative intensity noise (RIN_{OMA}) at 125°C







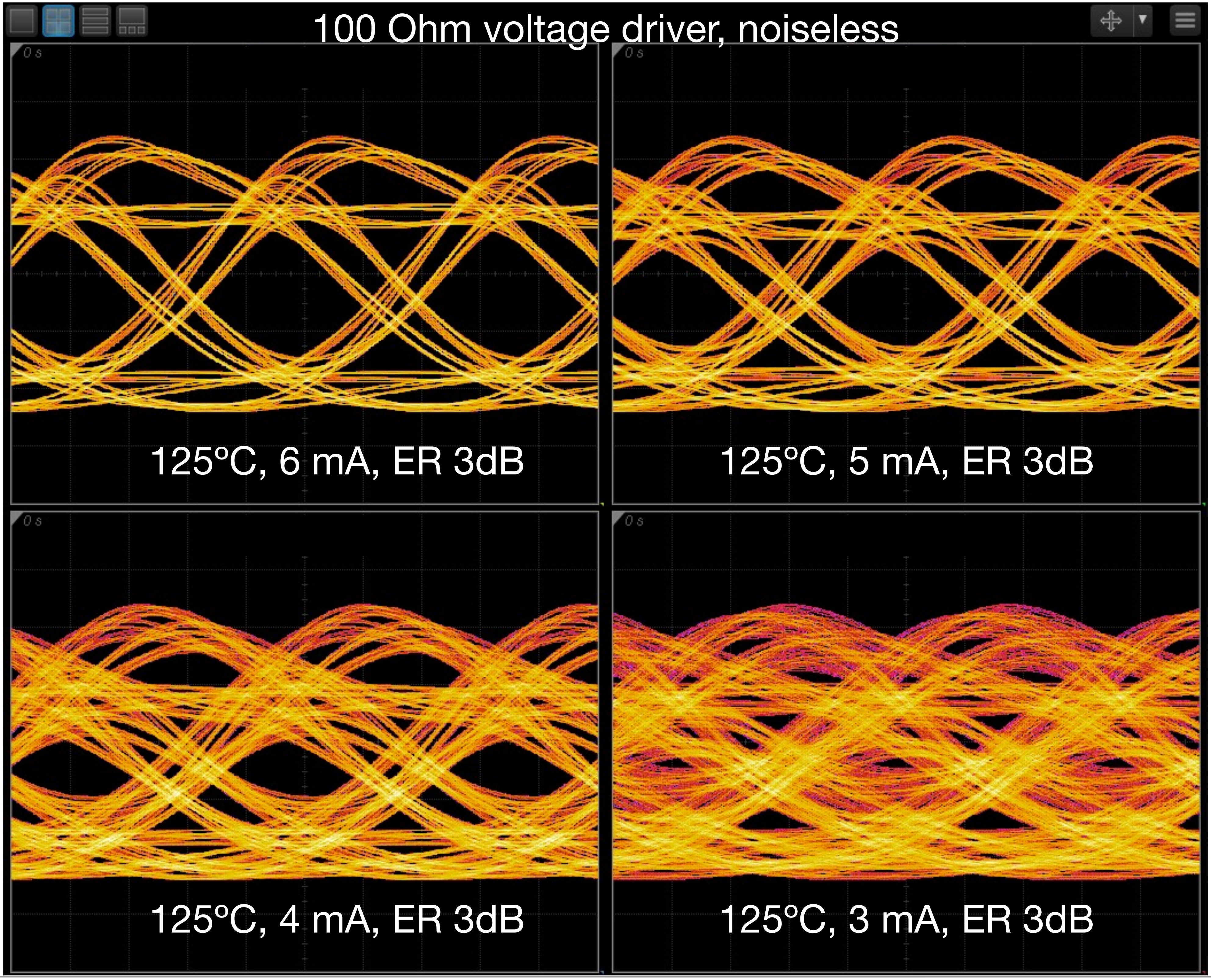
Normalized max RIN (RIN_{AOP})



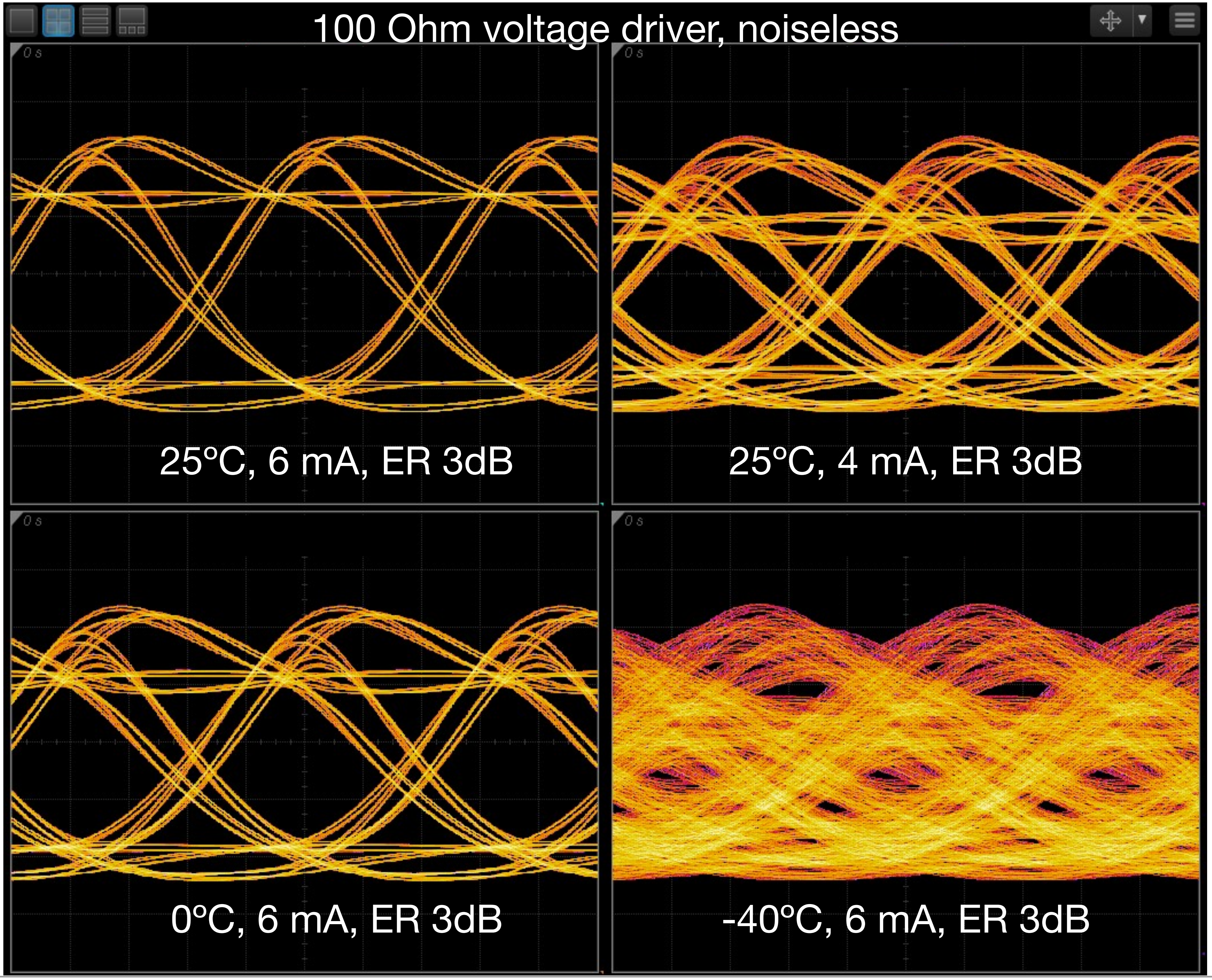
$$RIN_{AOP}\left(dB/_{Hz}\right) = RIN_{OMA}\left(dB/_{Hz}\right) - 20 \cdot \log_{10}\left(\frac{ER_L + 1}{ER_L - 1}\right)$$

$$ER_L = 10^{ER(dB)/10}$$

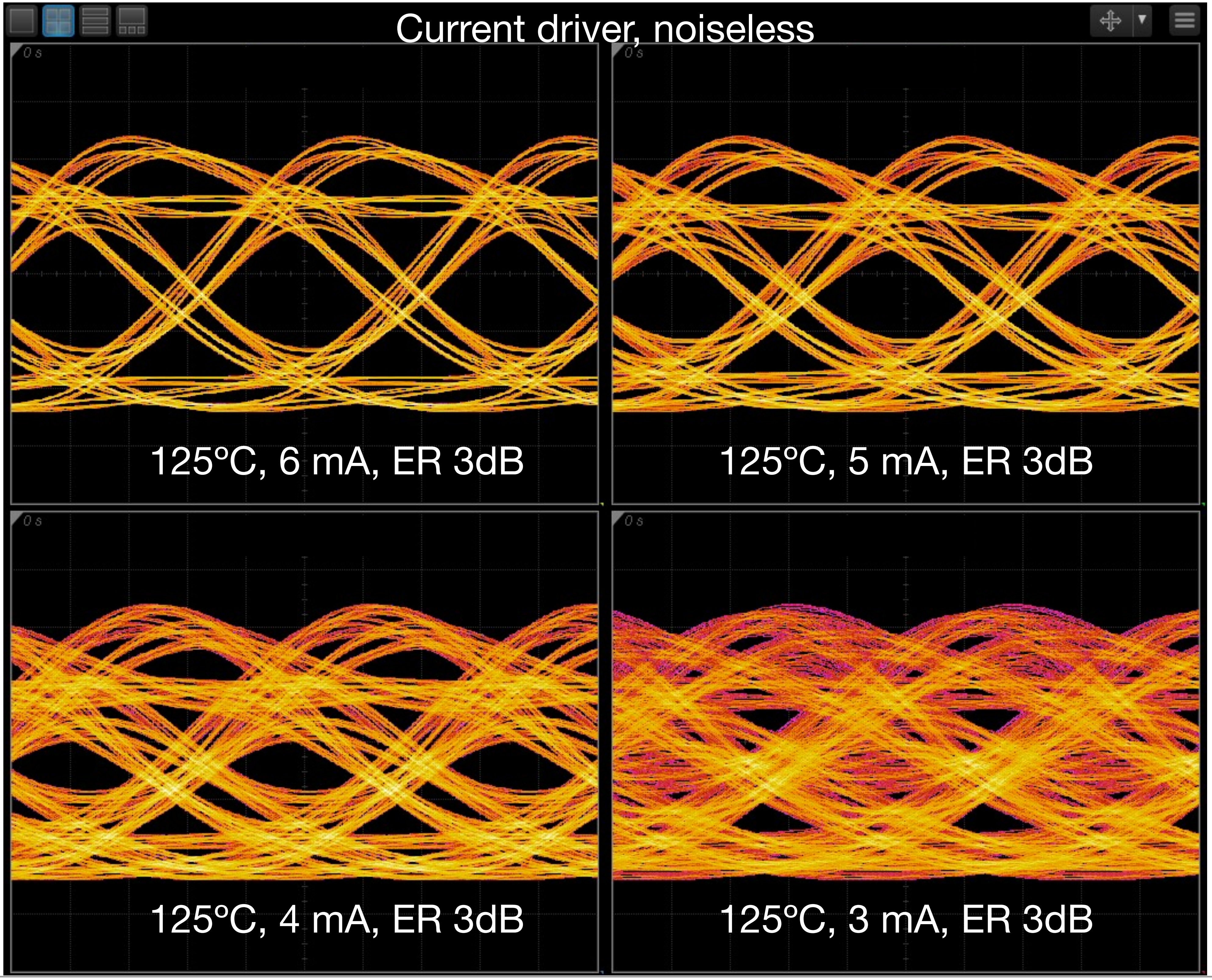
Eye diagram for 26.5625 GBd NRZ



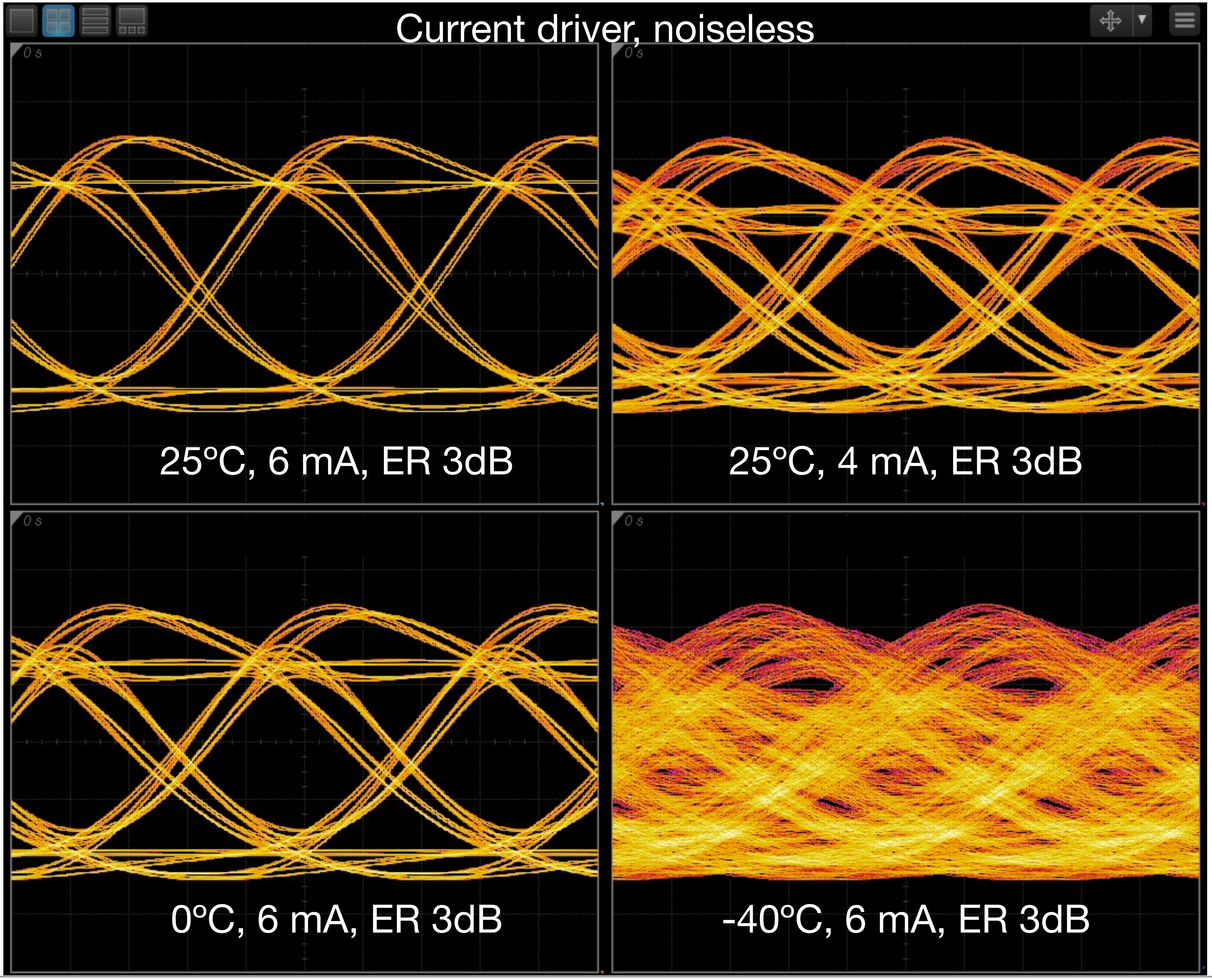
Eye diagram for 26.5625 GBd NRZ



Eye diagram for 26.5625 GBd NRZ



Eye diagram for 26.5625 GBd NRZ



References

- [1] Seyed Ehsan Hashemi, “Relative Intensity Noise (RIN) in High-Speed VCSELs for Short Reach Communication”, Master of Science Thesis in Photonics Engineering, Chalmers University of Technology