WP6B
Flux Jumps during k-modulation

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thanks to:
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Franco Julio Mangiarotti, Jerome Feuvrier (TE-MSC)
Jens Steckert, Severin Haas (WP7)

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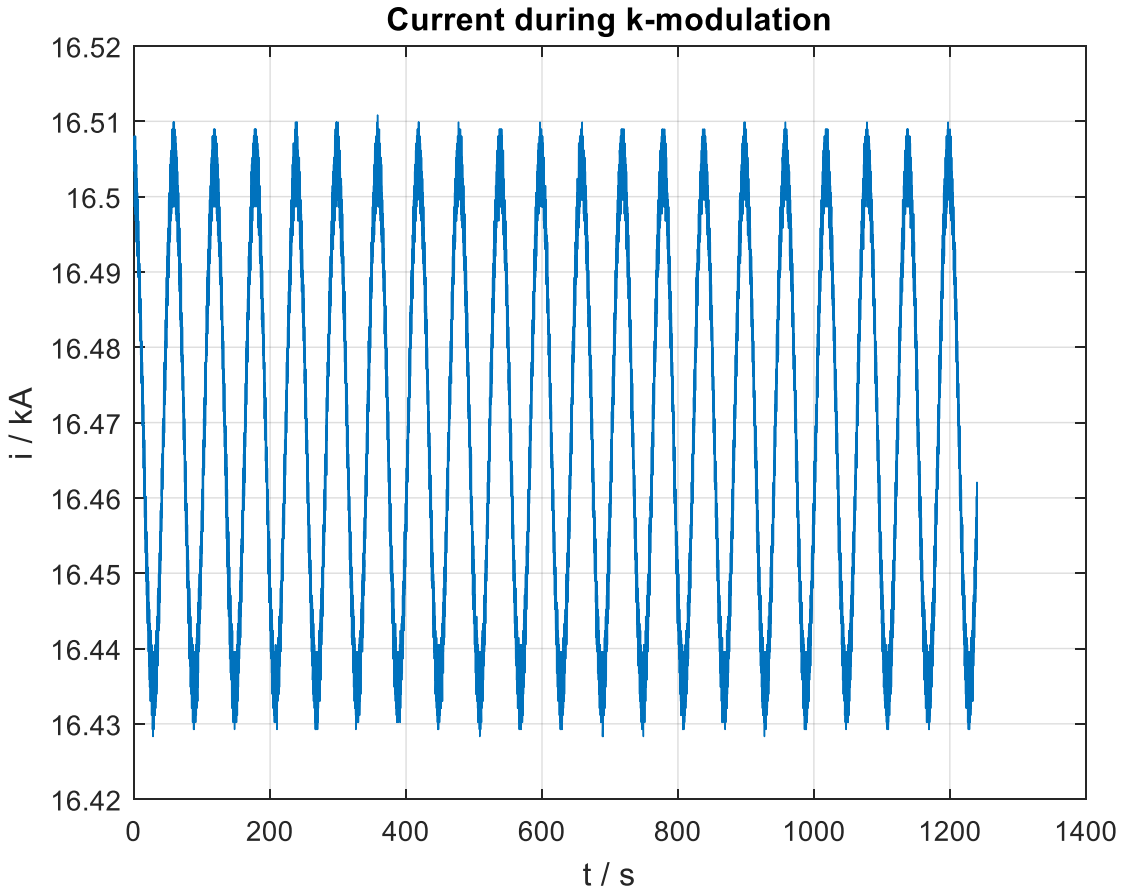
Scope of the Test

- Confirm that no flux-jumps occur at nominal current in MQXF magnets during k-modulation
- Reminder: flux jumps occur in Nb_3Sn magnets at low to medium current whereas their occurrence decays at higher and higher currents
  - flux-jumps are instabilities that need to be excited
  - during the ramp up/down the “ramp-rate” itself excites them
  - the test aimed at checking if the ramp-rate involved in k-mod can excite flux-jumps at nominal current
  - Operational ramp-rate:
    - RQX circuit = 14.6 A/s max
    - RTQXA1 circuit = 3.32 A/s max in k-mod ≈ 23 % of max RQX

Test details

- Performed: December 4th 2019 on HCMQXFM001
- Acquired about 20 periods of k-mod signal:
  - Amplitude = 35 A_{peak}
  - Period = 1 min ↔ Frequency ≈ 16.7 mHz

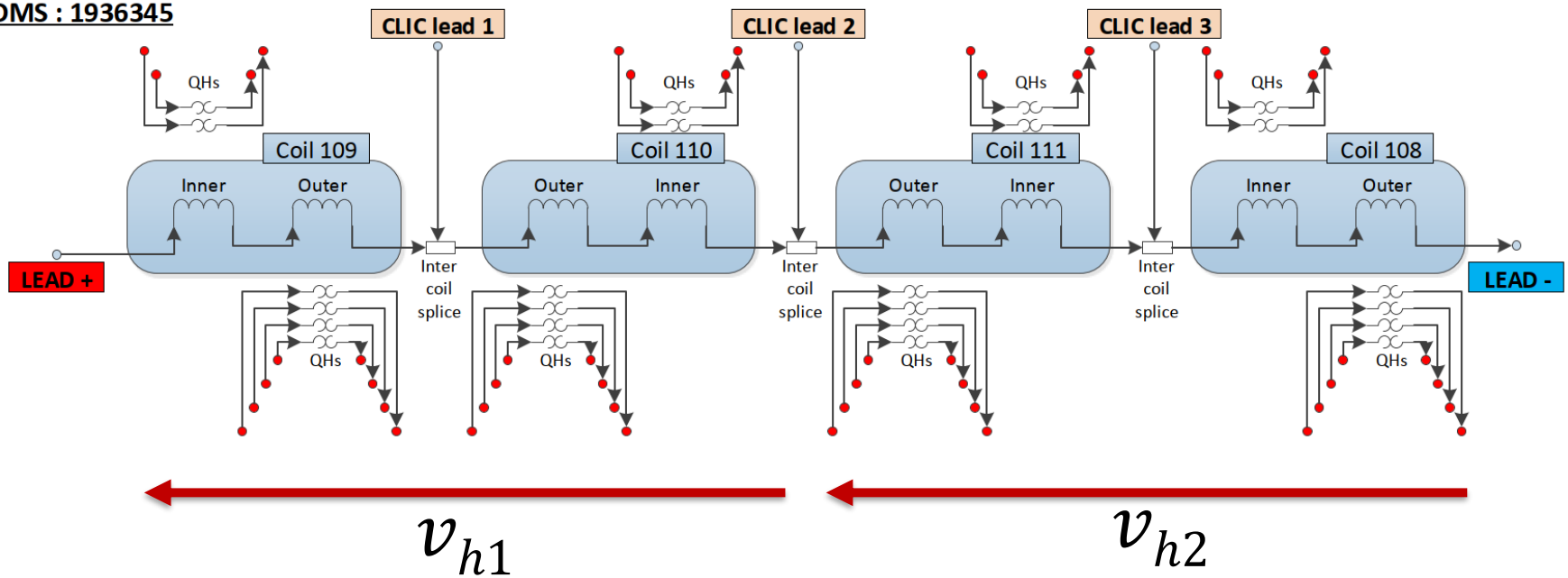


Flux-Jumps signal

$$v_{fj} = v_{h1} - v_{h2}$$

MQXS4a
HCMQXFM001-CR000041

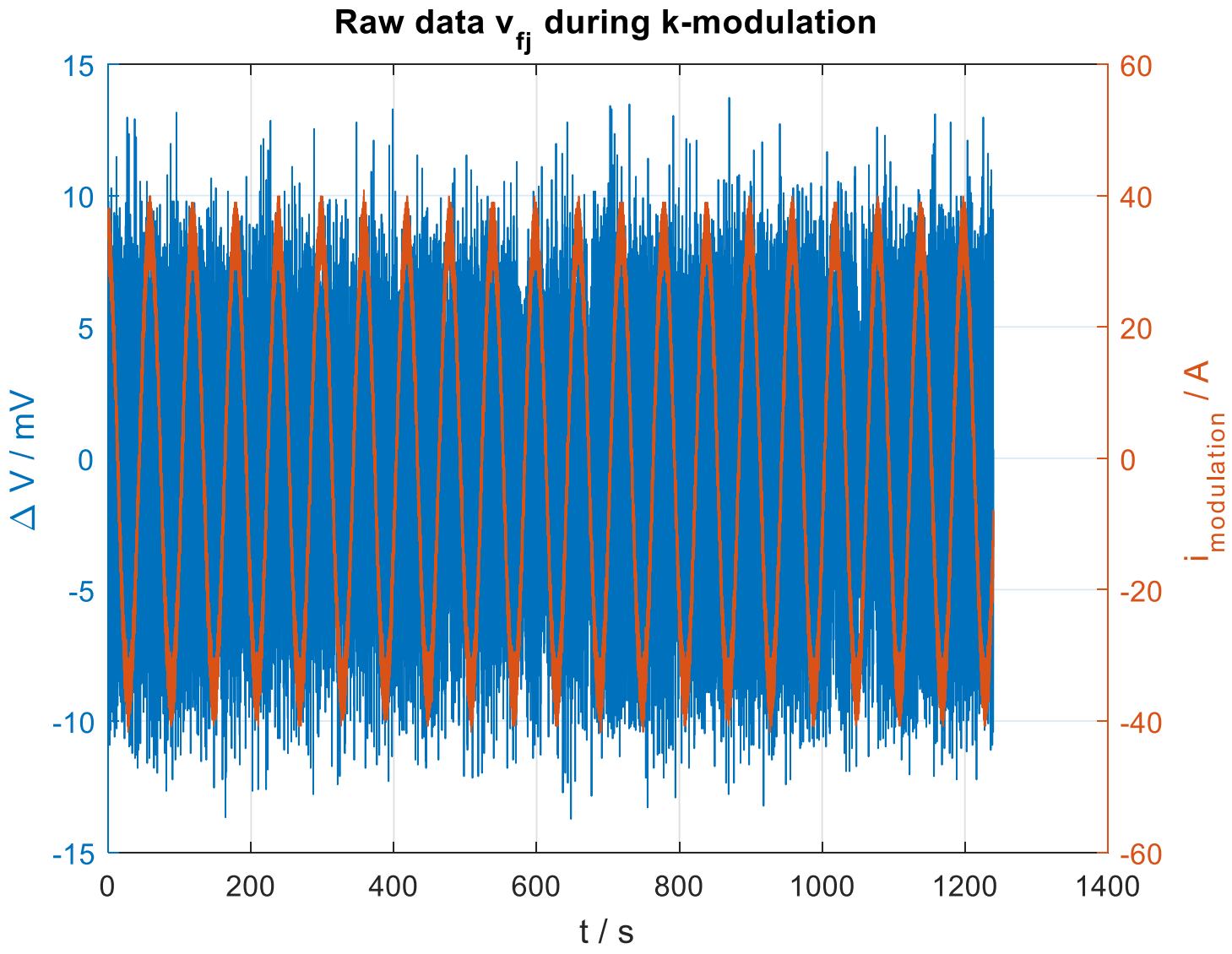
EDMS : 1936345



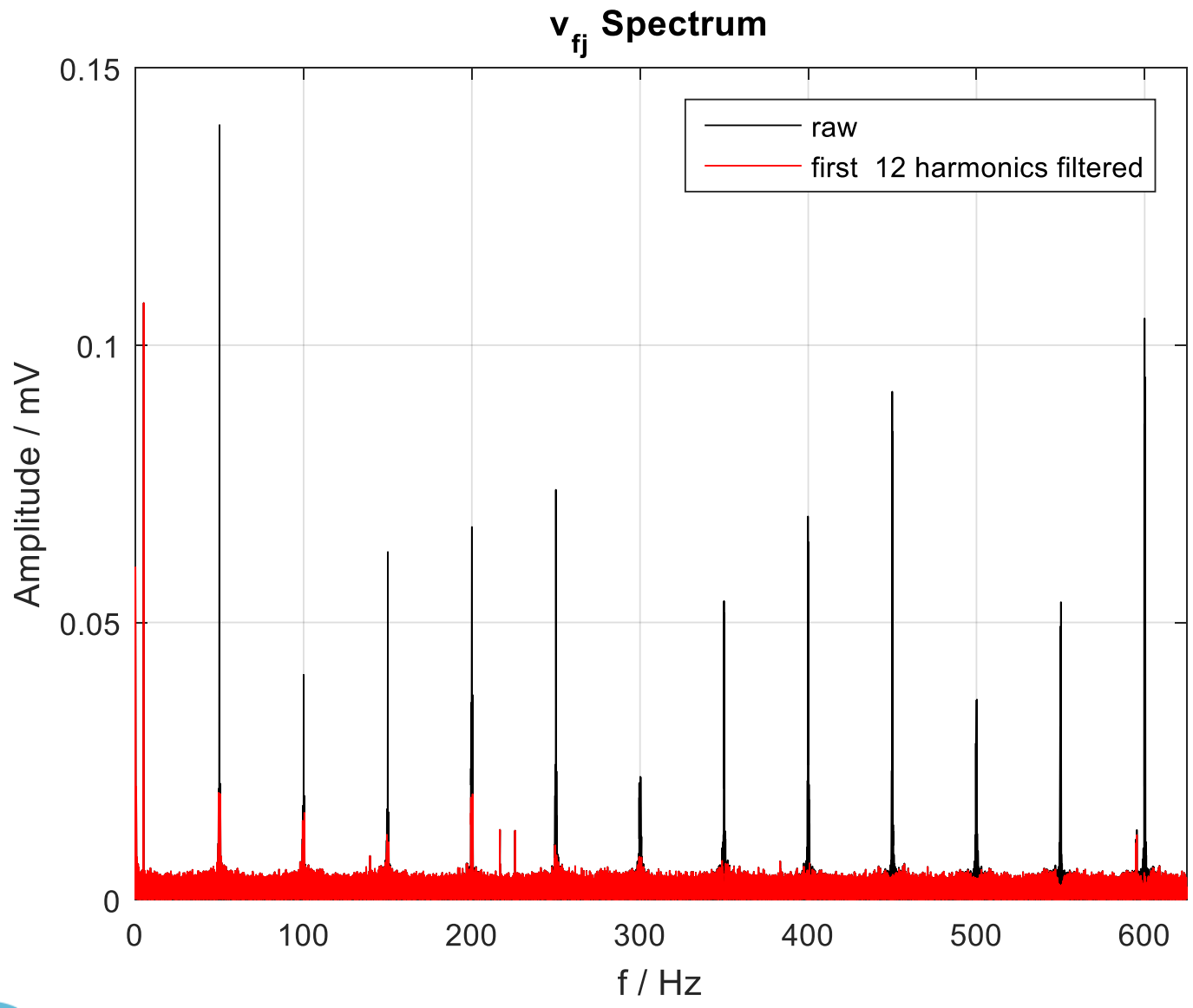
$$v_{magnet} = v_{h1} + v_{h2}$$

Flux-jumps detection might involve more signals than v_{fj}, but checking v_{fj} is enough to certify the absence of flux-jumps

Test results



Test results



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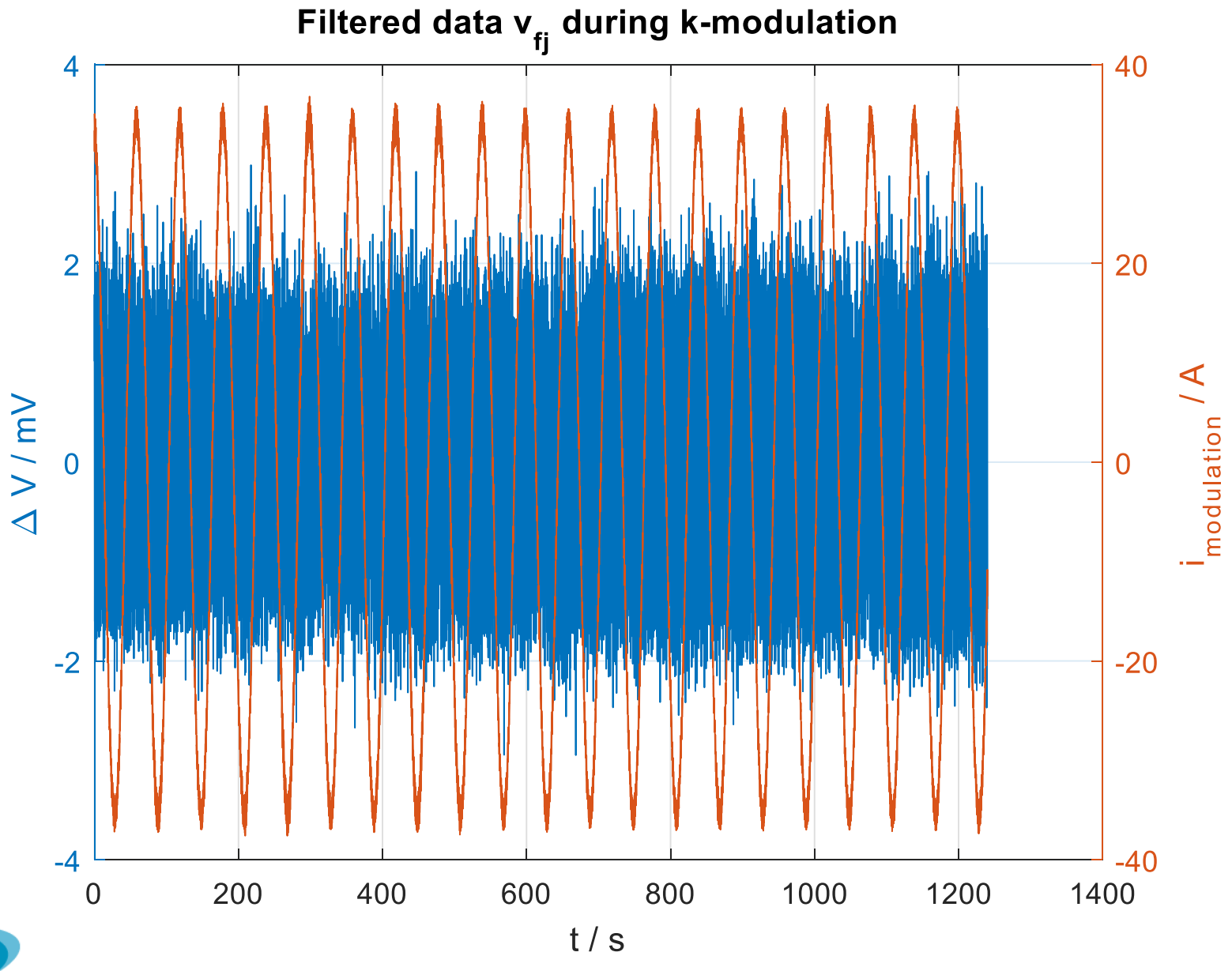

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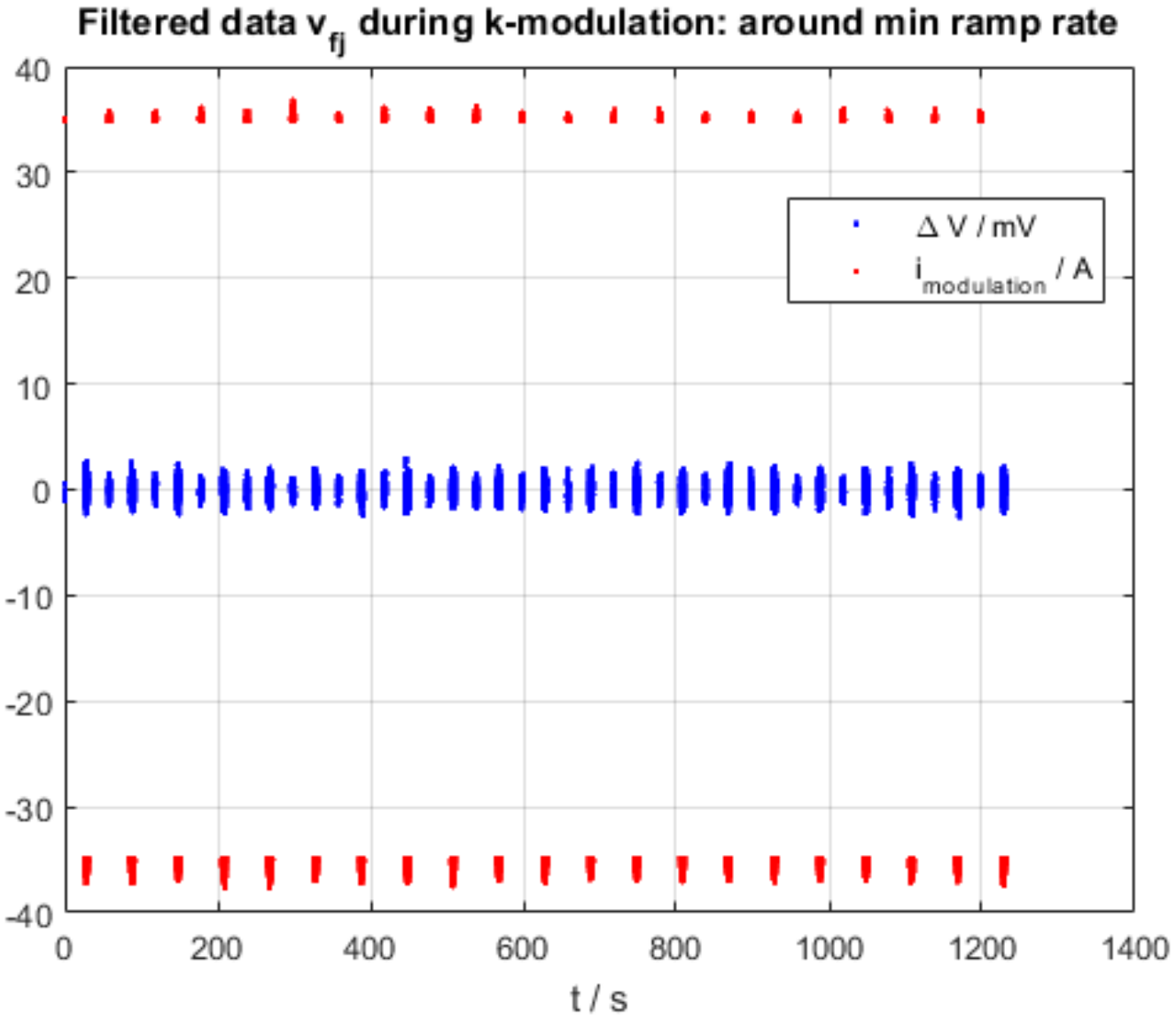
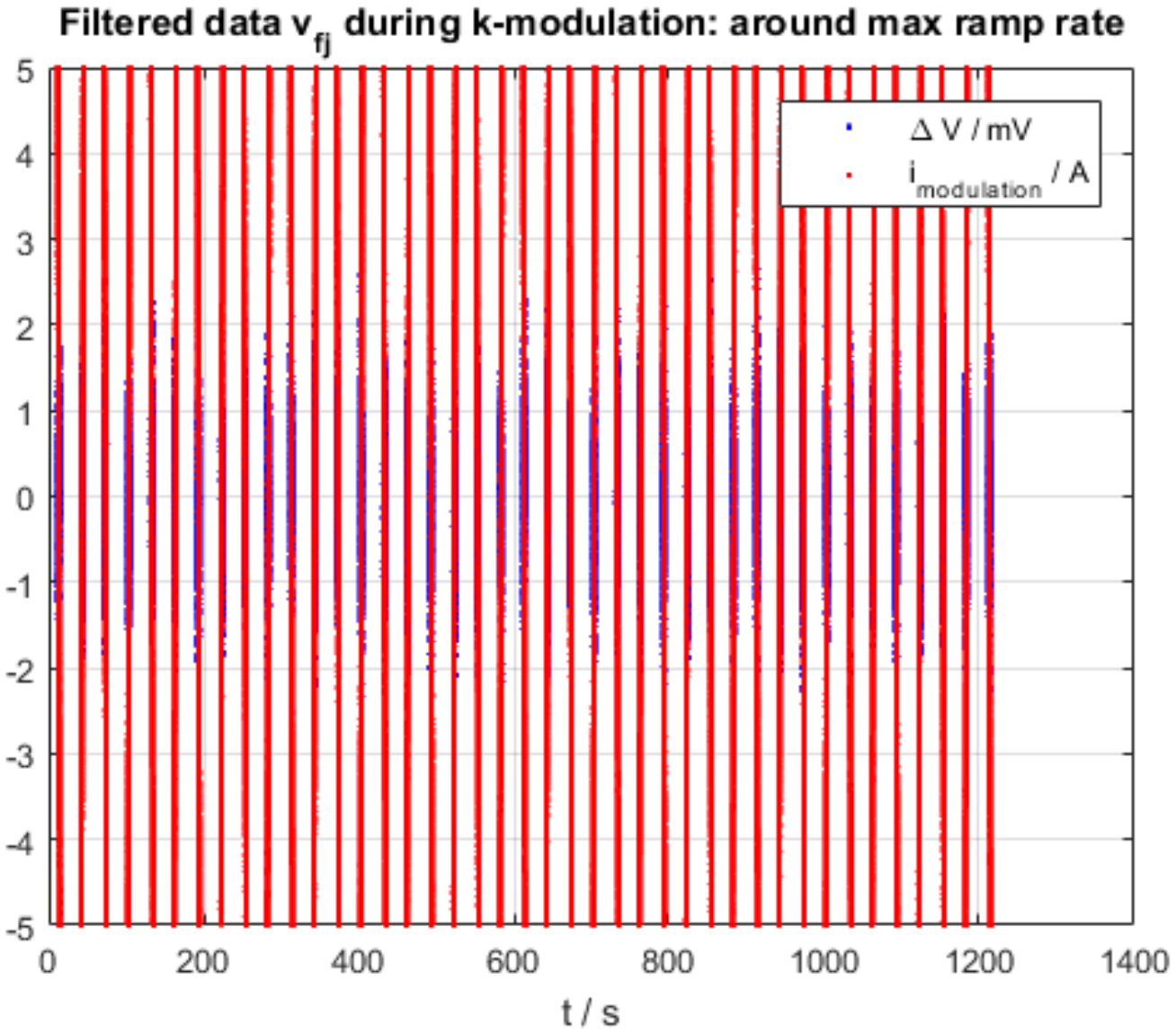
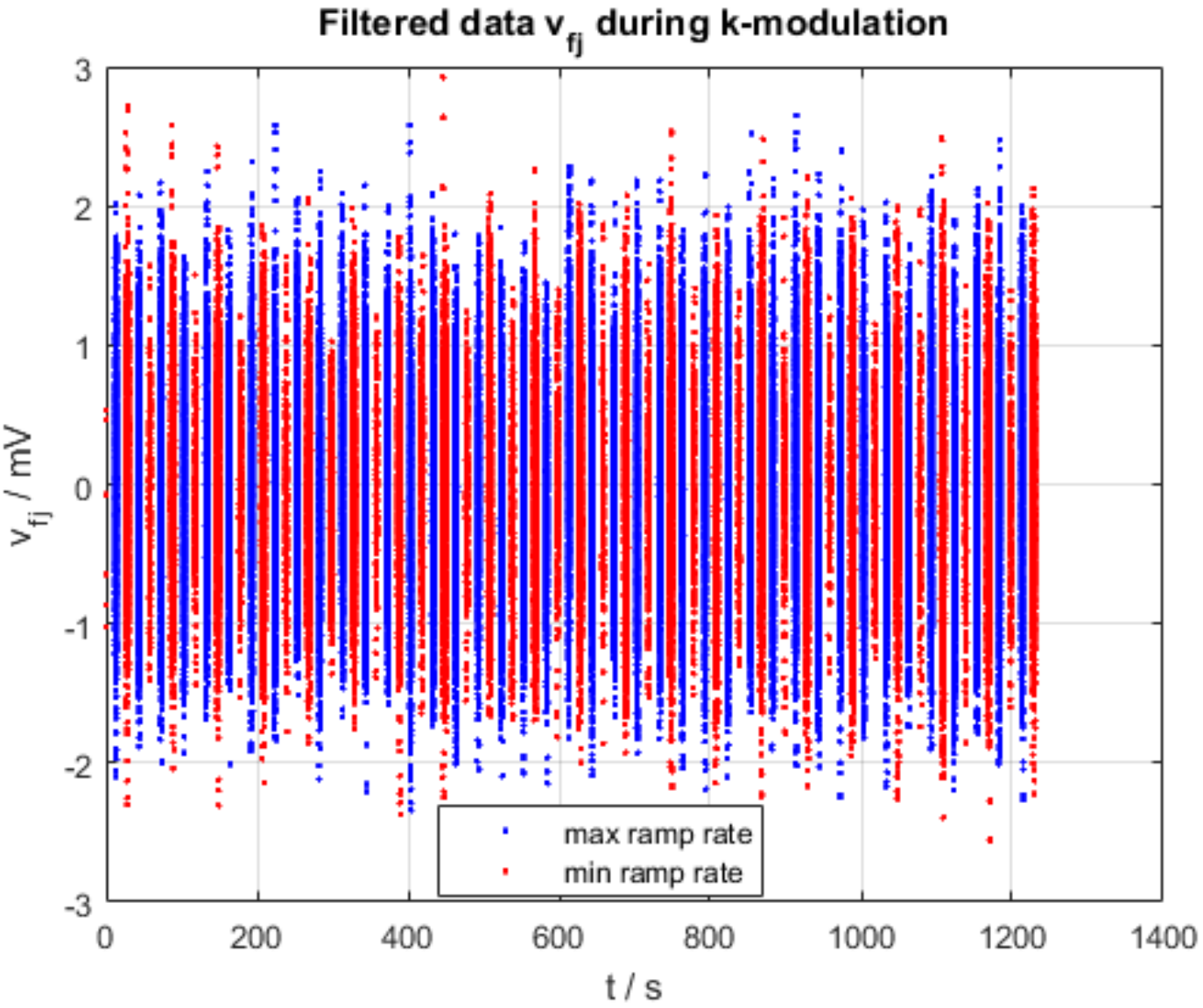


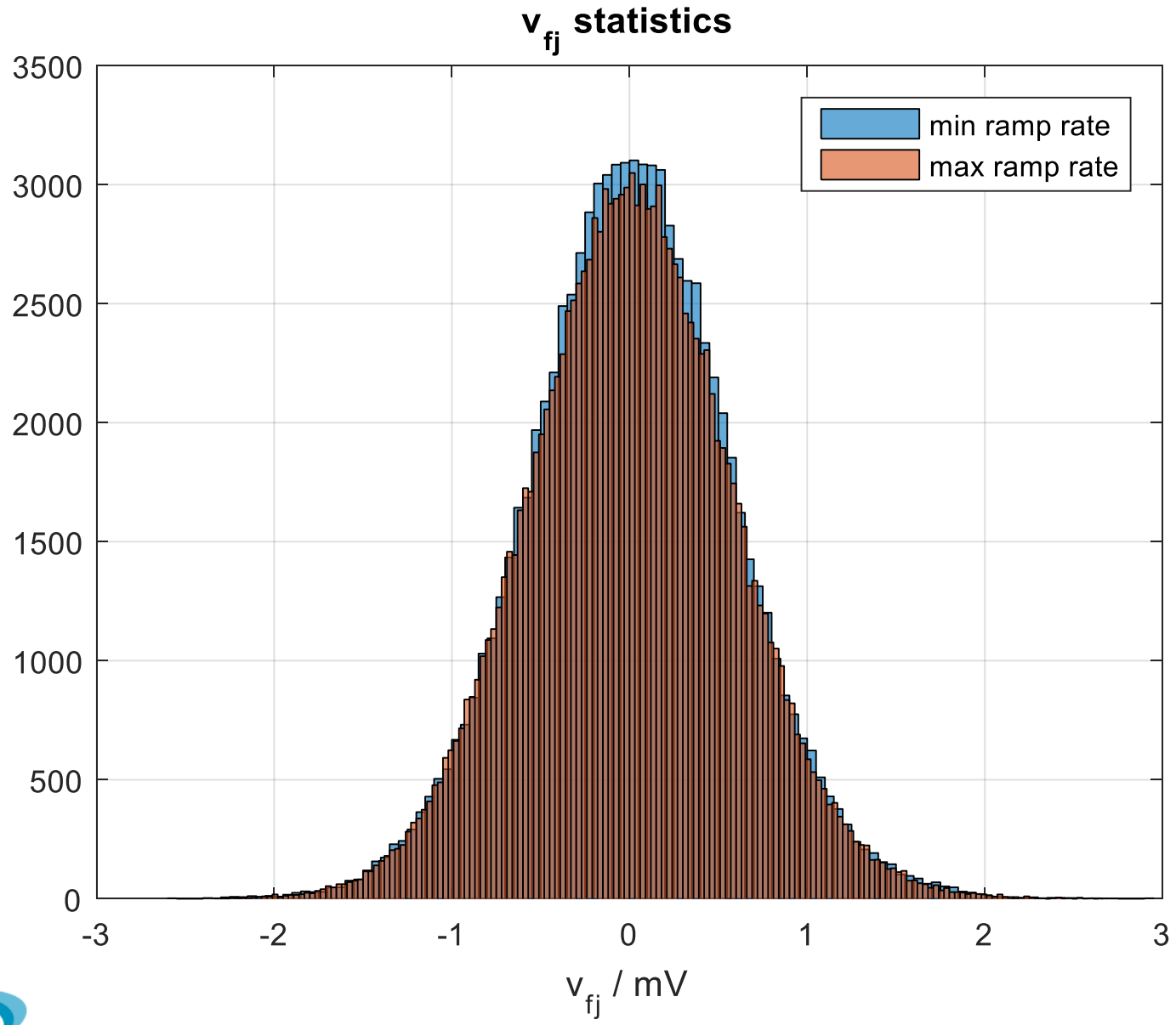
Test results



Test results

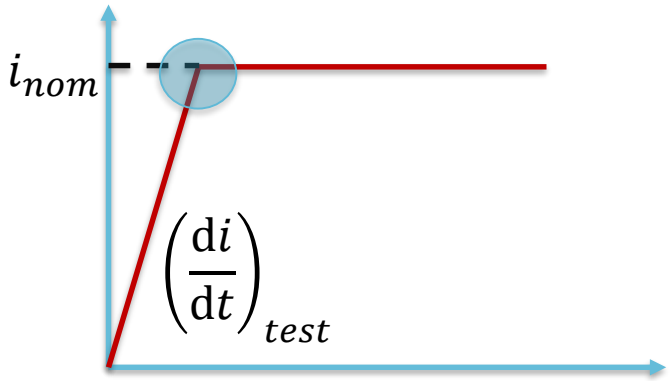


Test results



Conclusion

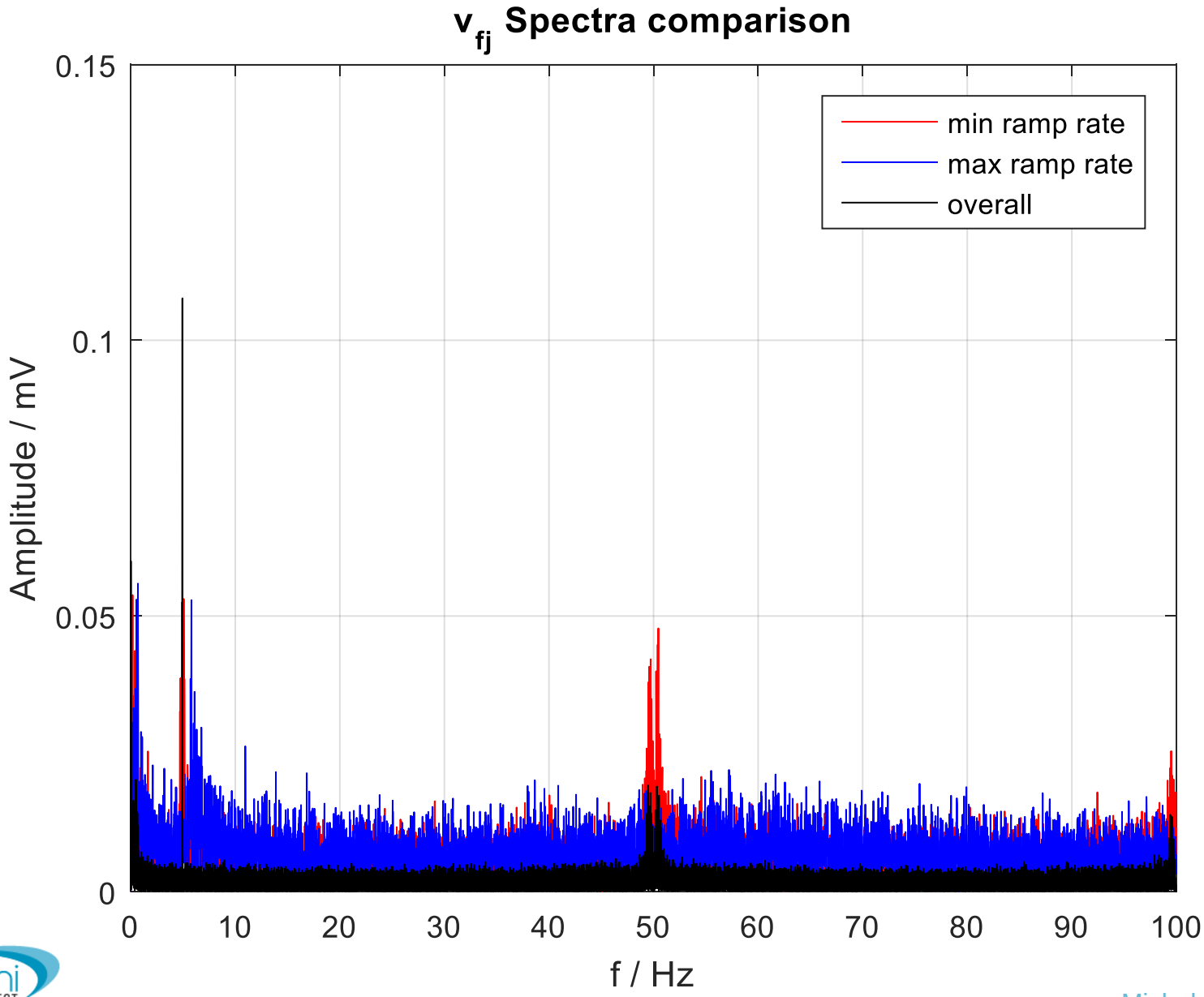
- No flux-jumps occur at nominal current in MQXF magnets during k-modulation ☺
- Note: when magnets are tested they are often ramped up with a ramp rate (much) greater than the nominal one, if so the absence of flux-jumps at nominal current can directly be deduced from the absence of flux-jumps before reaching the nominal when $i \approx i_{nom}$ and $\frac{\mathrm{d}i}{\mathrm{d}t} > \left(\frac{\mathrm{d}i}{\mathrm{d}t}\right)_{nom}$



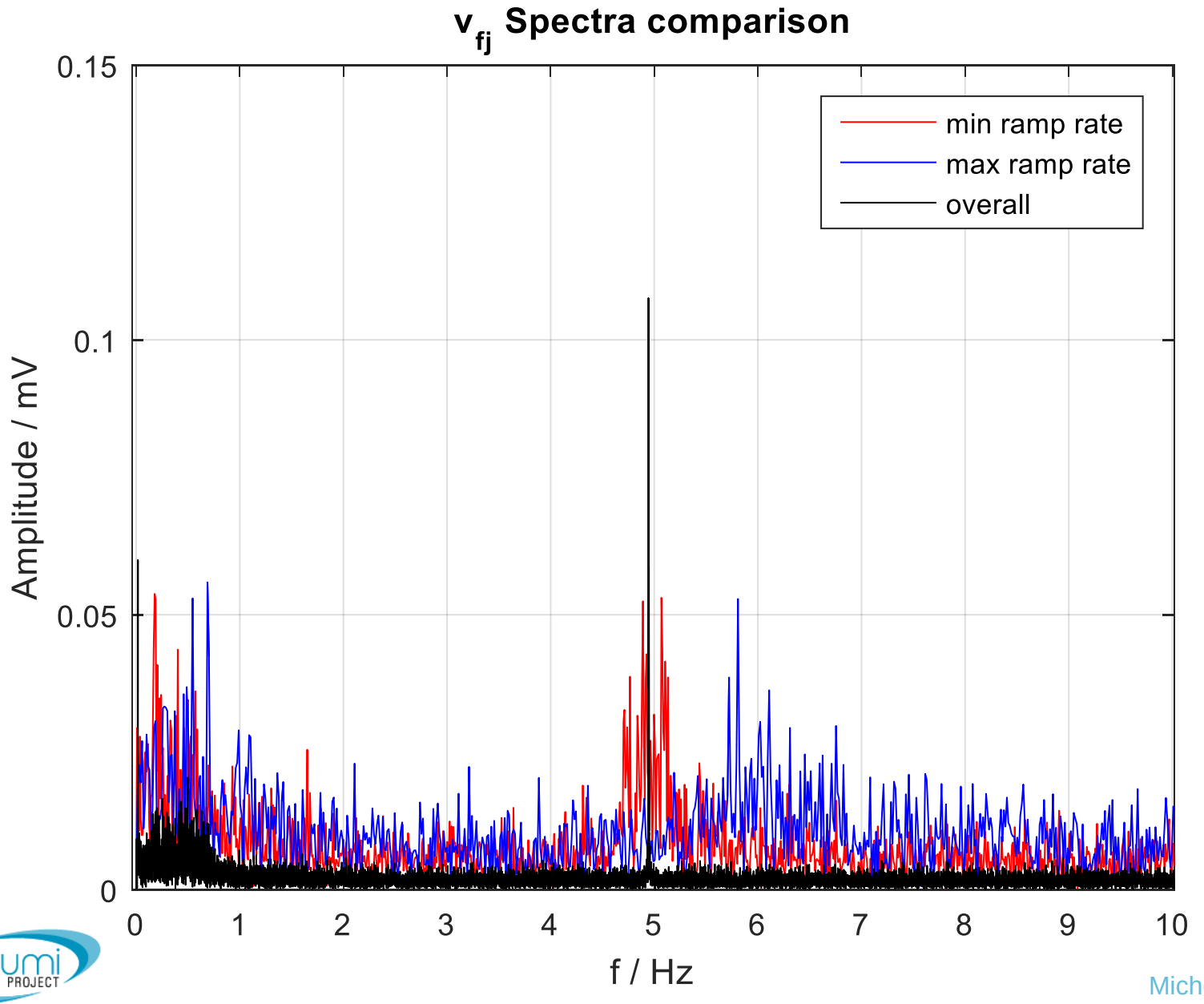
Thank you

Back-up slides

Test results



Test results



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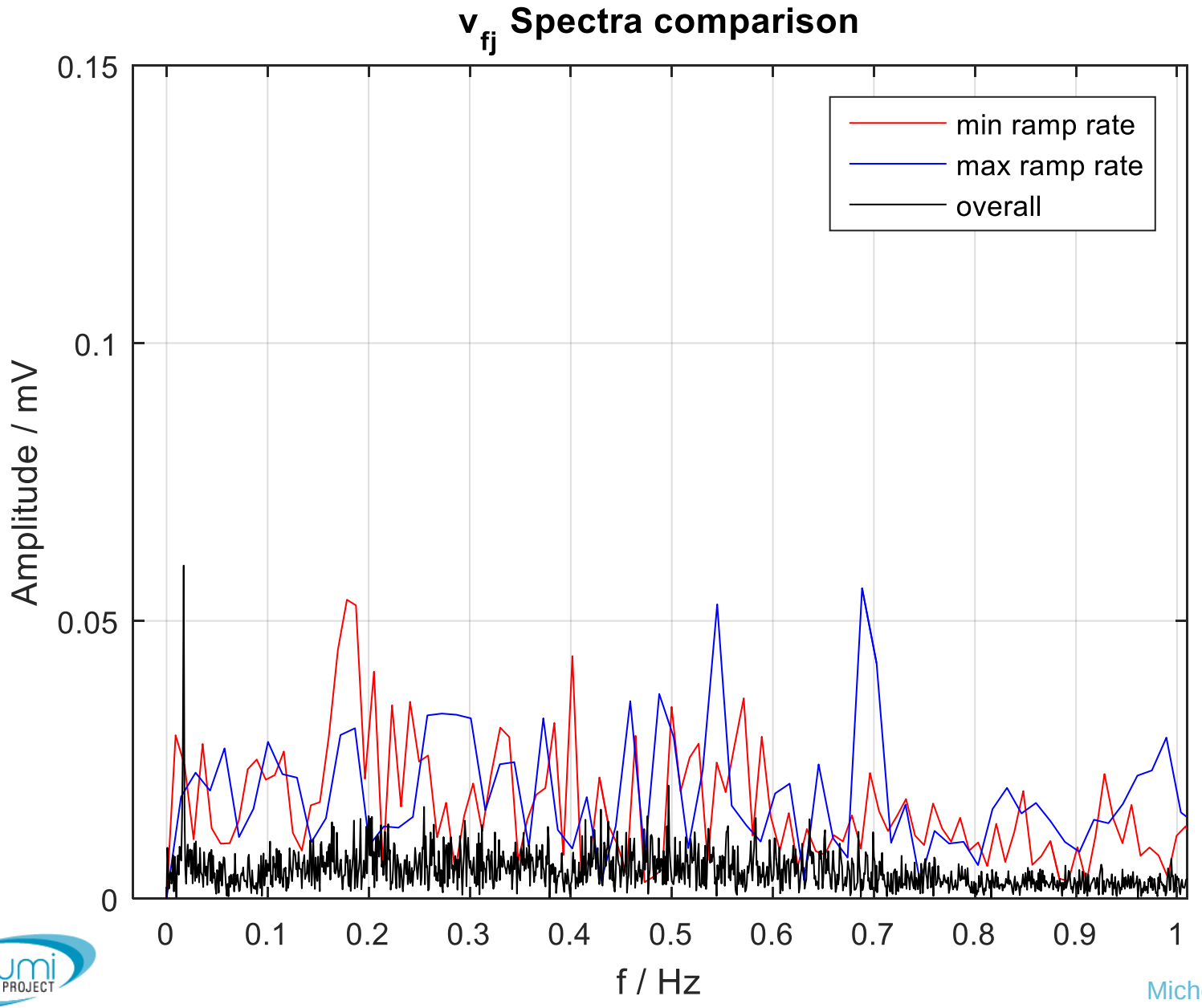

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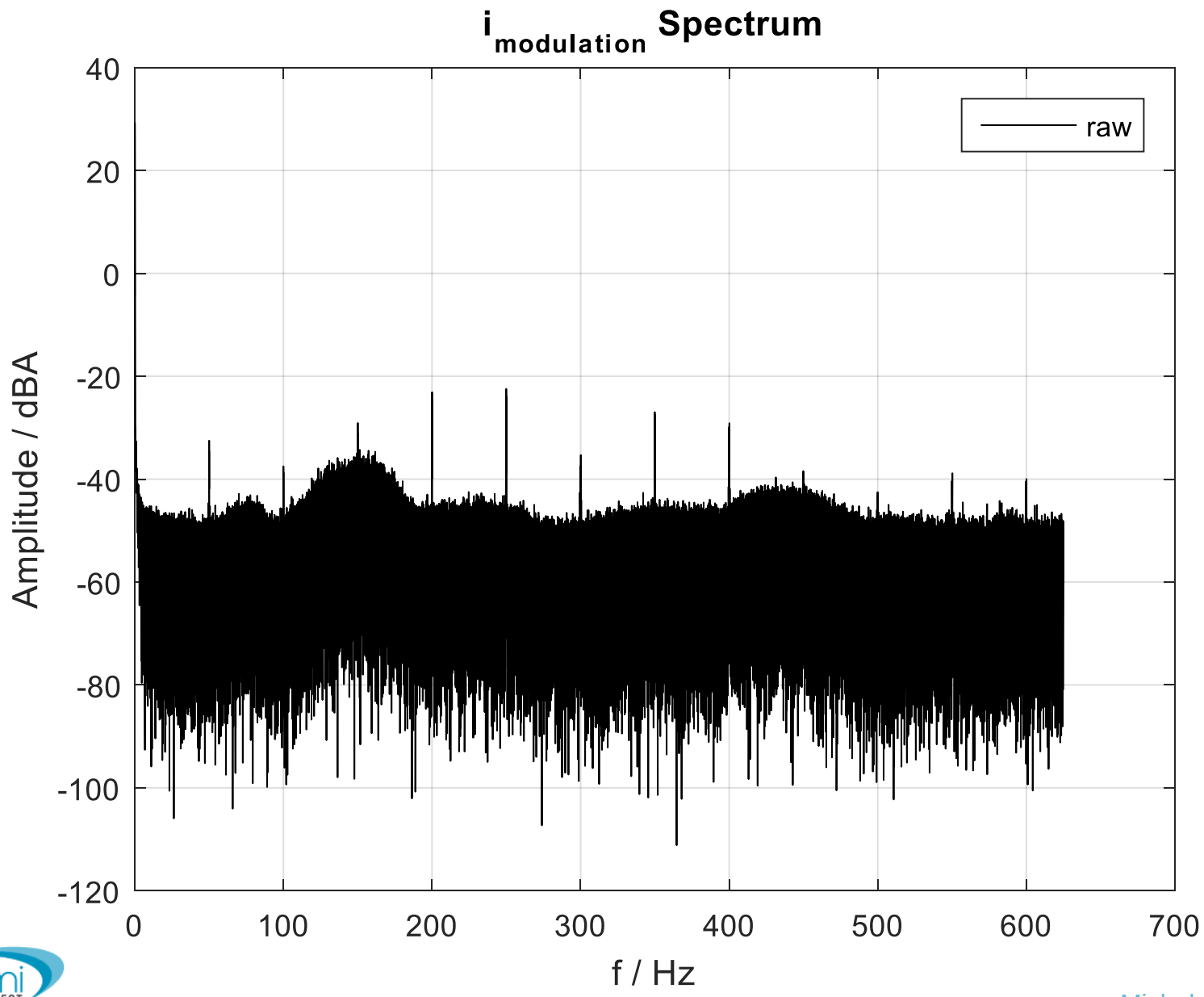

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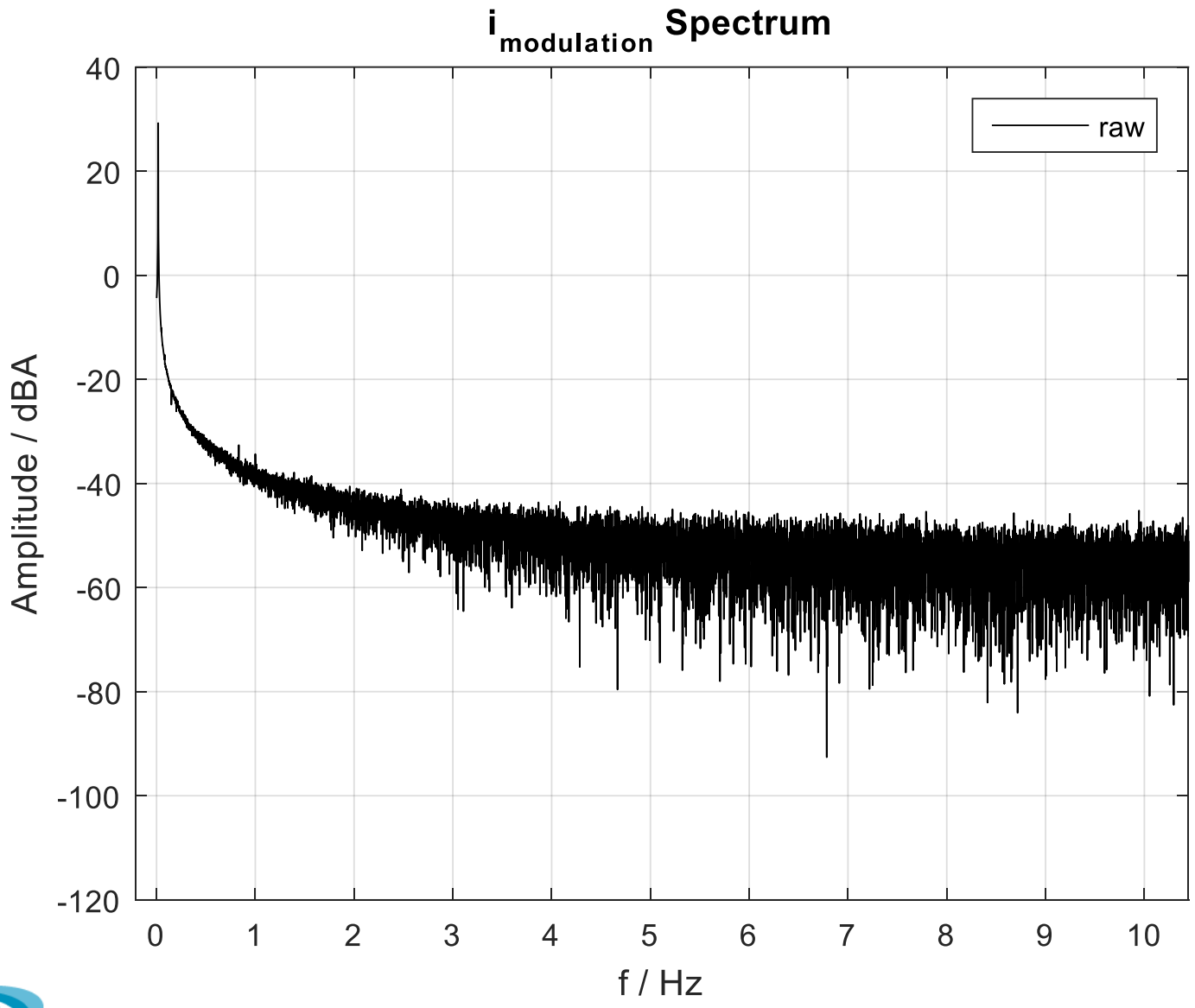

Test results