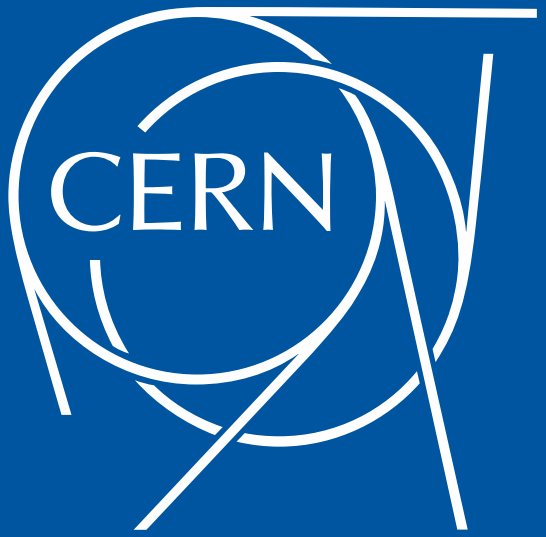
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Progress report

Performance of BSW magnets powering for PSB injection chicane

T. Todorčević and D. Aguglia

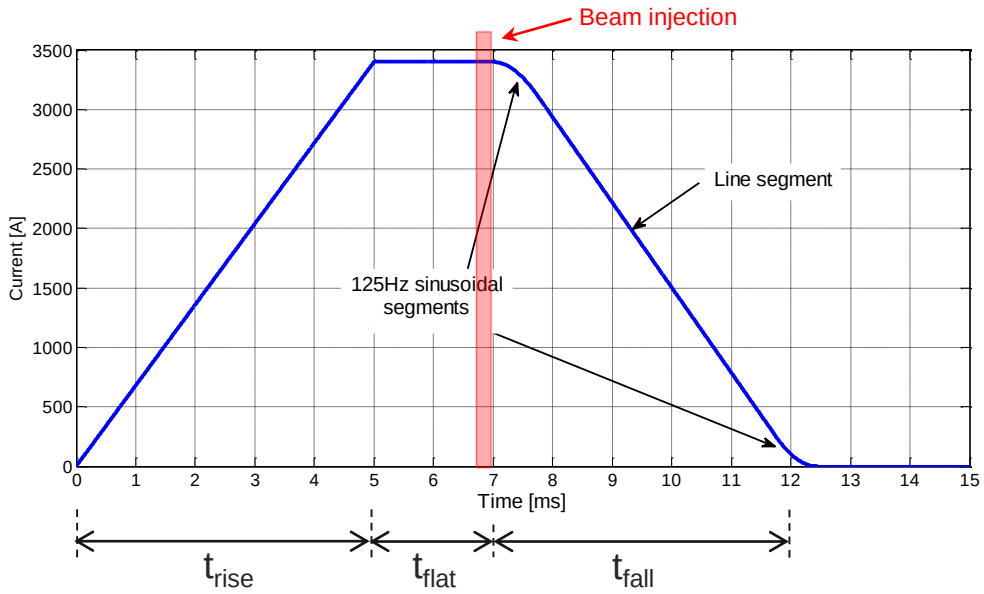
TE-EPC-FPC

Acknowledgments: Luis Miguel de Paco Soto and Achille Nicoletti

9th of October 2019

Technical requirements (original)

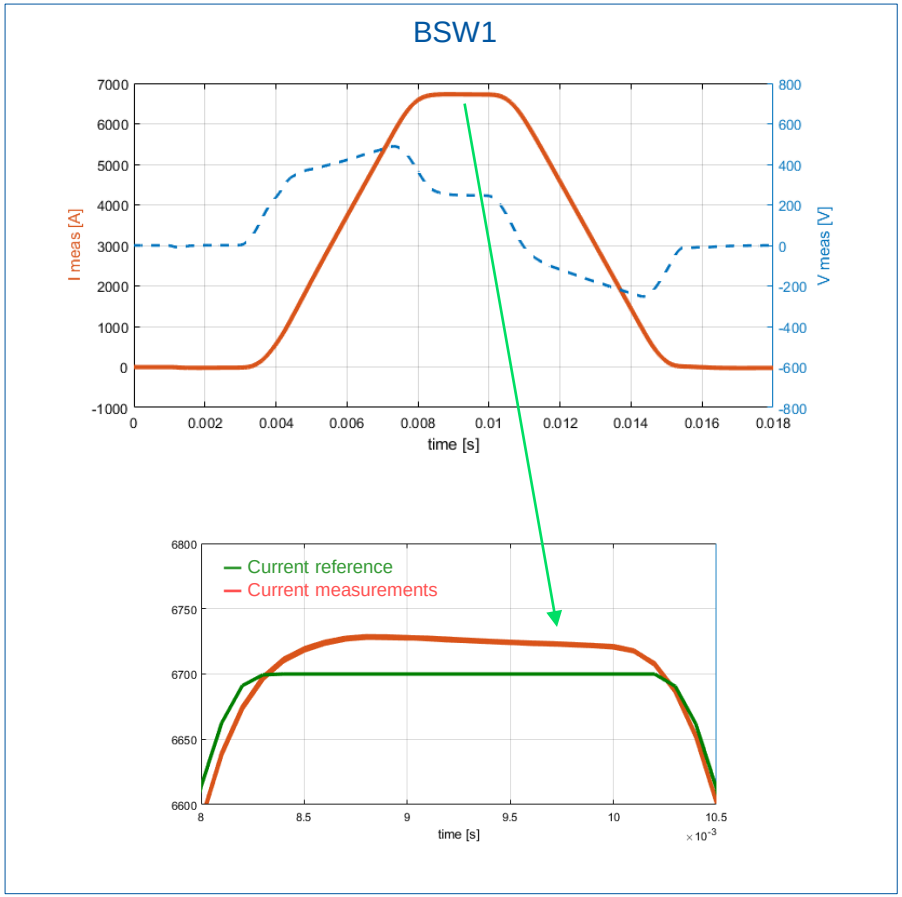
- Absolute precision:
  - ±50 ppm during flat-top (starting from when beam is injected)
  - ±500 ppm during ramp-down
  - 125 Hz also applied at current rump-up
  - Amplitude:
    - BSW2, BSW3, BSW4: 3.4 kA
    - BSW1: 6.7 kA

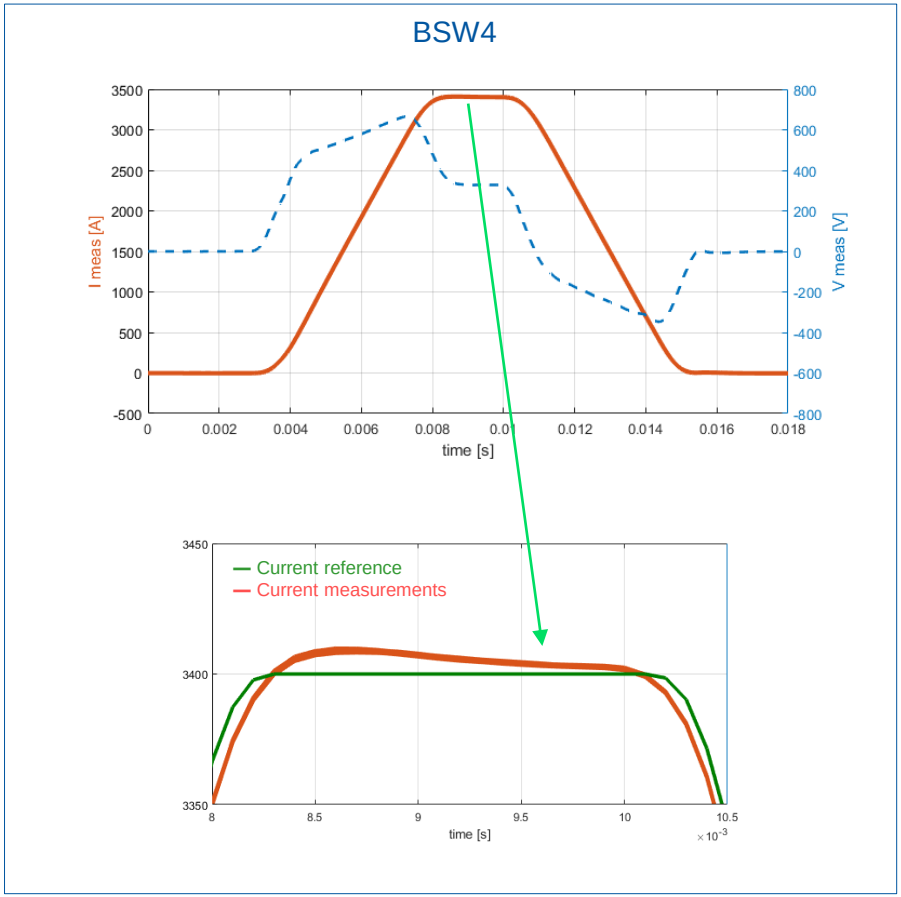


t_{rise}	5 ms
t_{flat}	2 ms
t_{fall}	5 ms
t_{rep}	1.2 s

Standard controller approach

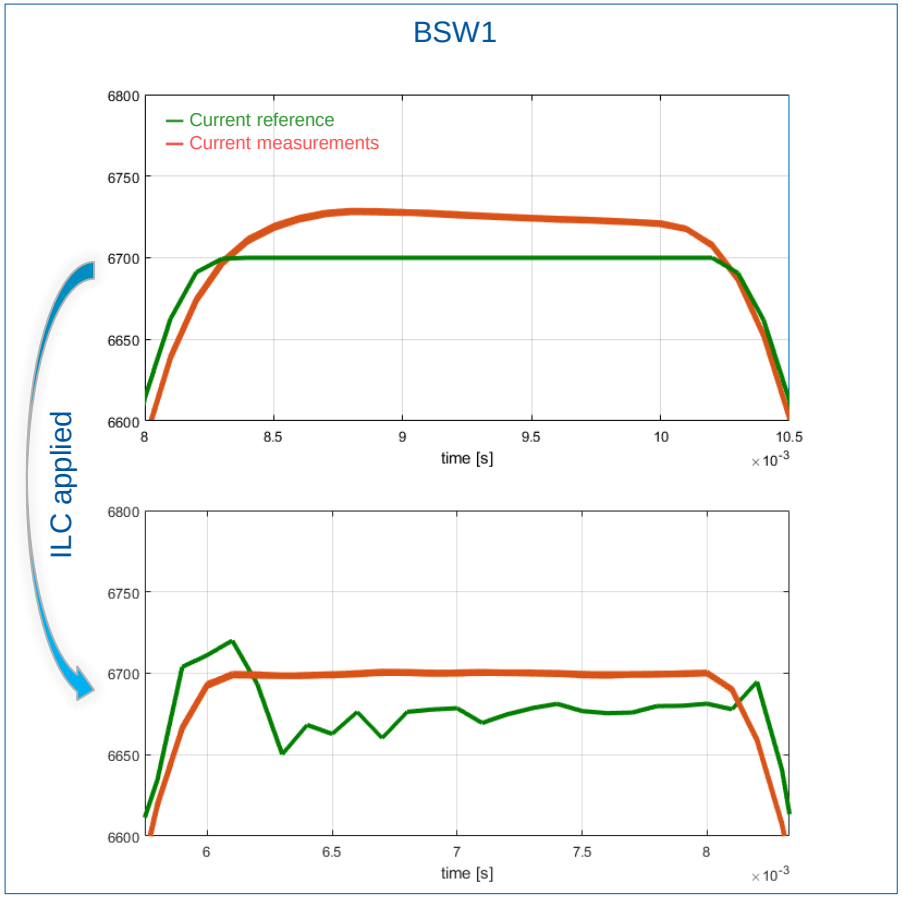
- Current controller (RST type) could not deliver sufficient absolute error of the current

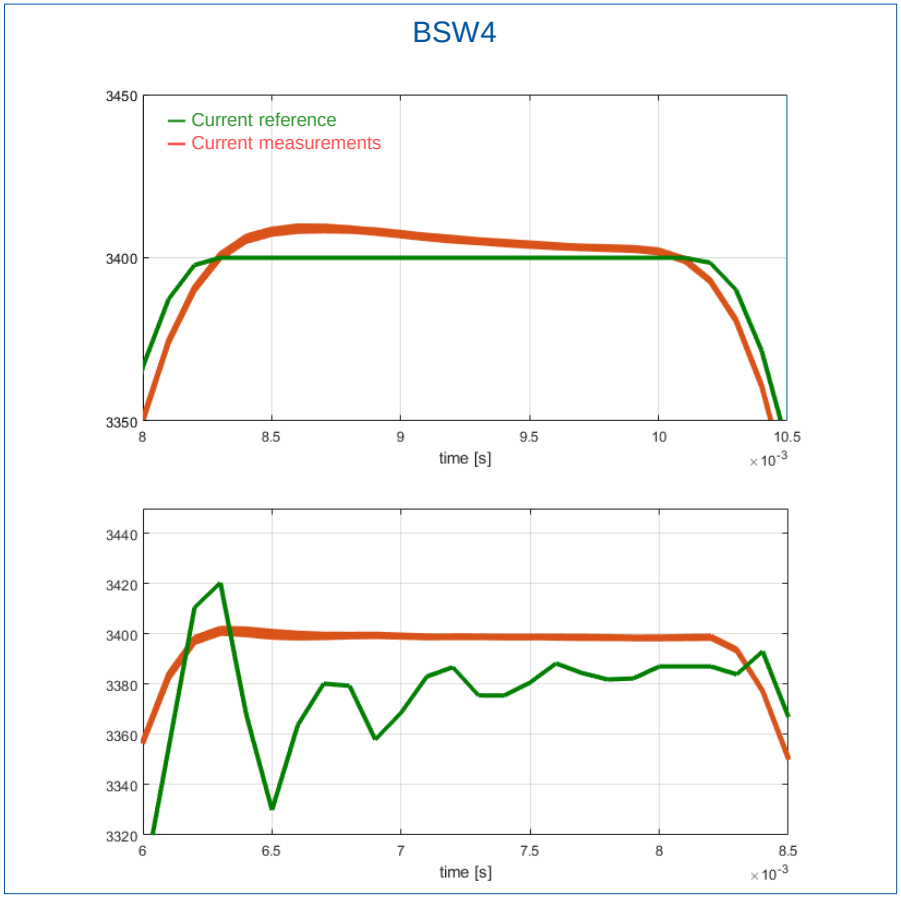




Reference modification to achieve low error

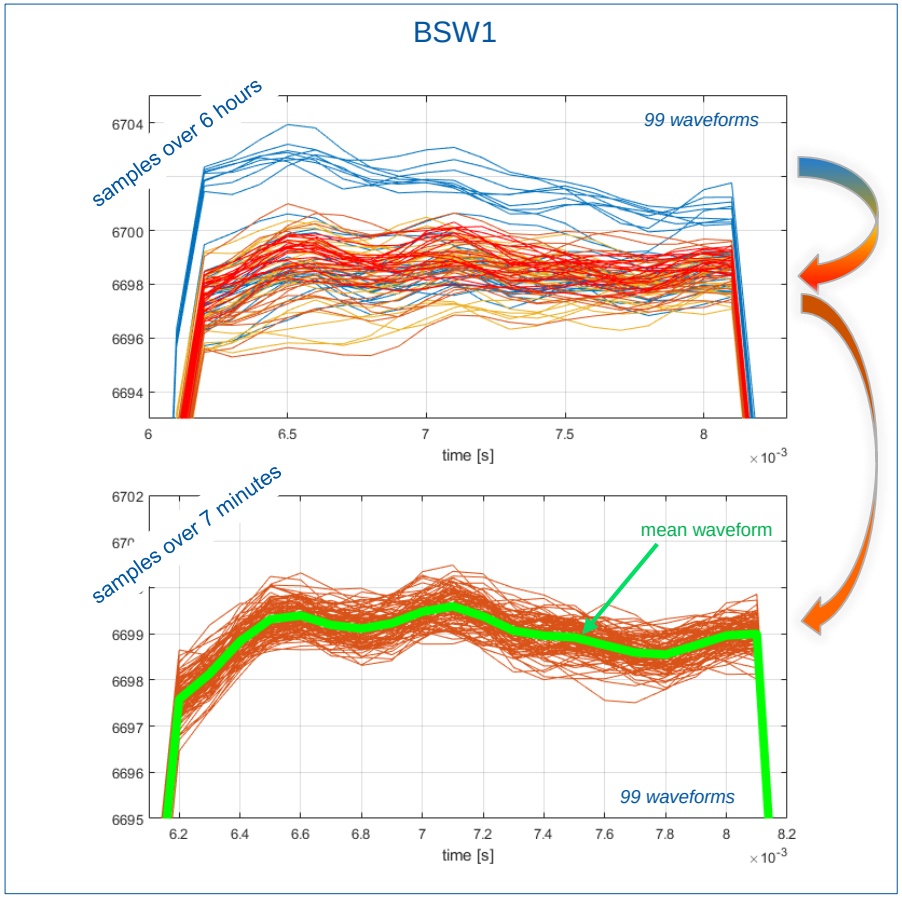
- Iterative Learning Controller (ILC) applied to cope with the absolute error of the magnet current – reference adaptation method (currently offline)

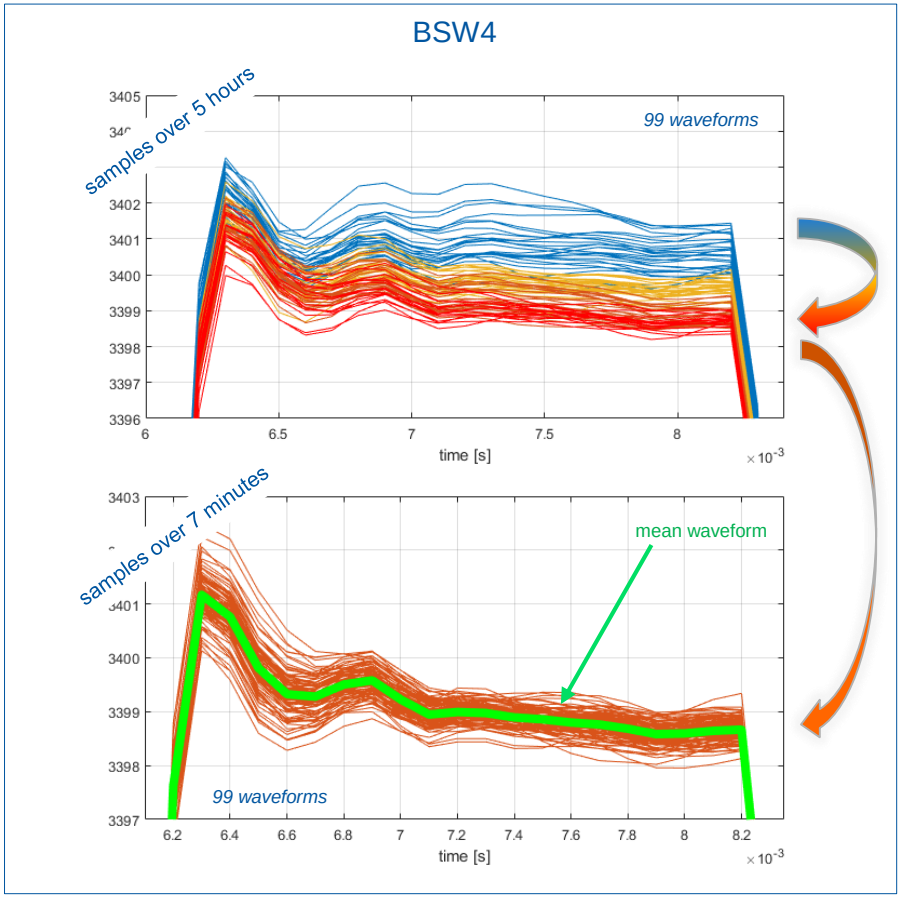




Temperature drift effect on current

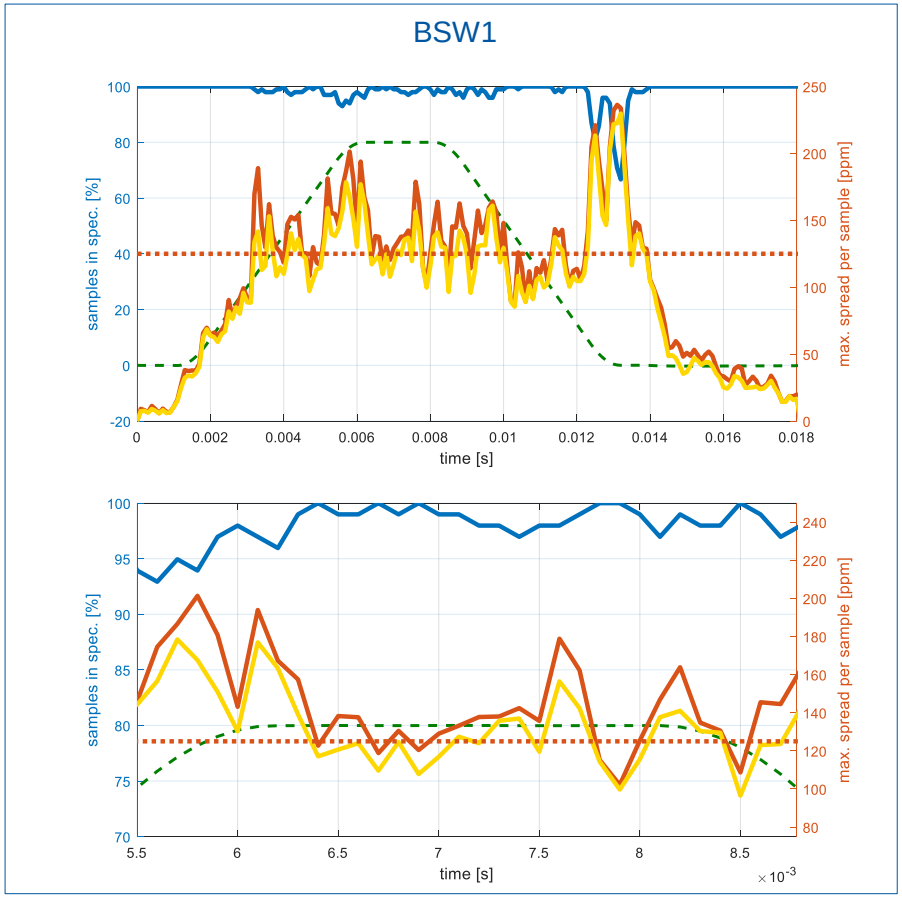
- Iterative Learning Controller (ILC) can be also applied to solve error due to temperature drift, or its simplified form (simple to implement and test)

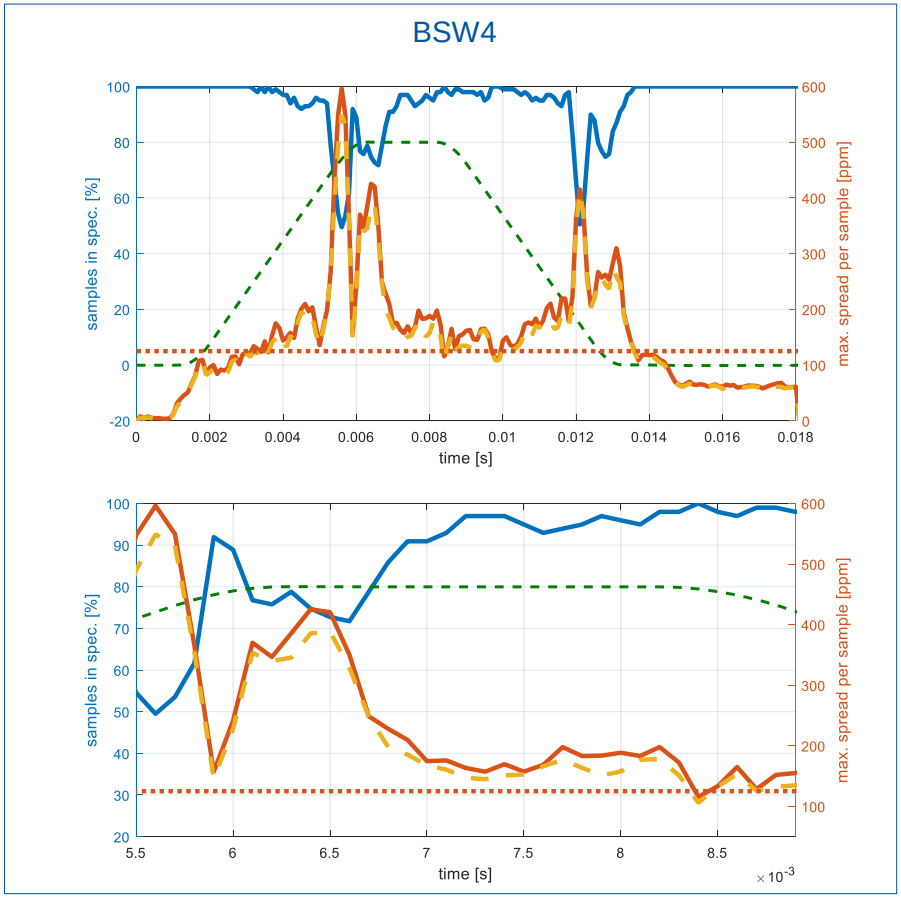




Precision requirements revisited

- BSW1 delivers more that 97% of samples in “new” +/-125ppm spec. during flat-top second half (significant for injection)
- BSW4 delivers more that 93% of samples in “new” +/-125ppm spec. during flat-top second half (significant for injection)





Conclusions

- Iterative Learning Controller (ILC) is able to deliver low absolute error, including error due to temperature drift
- ILC doesn't have to be implemented in its sample-to-sample form – heavy for the controller and implementation, but rather as a simple correction factor applied on the flat-top
- Achieved precision for BSW1 is in range of +/-150ppm (>97% in +/-125ppm spec.) for the 2nd half of the flat-top; and +/-240ppm over the entire current pulse
- Achieved precision for BSW4 is in range of +/-200ppm (>93% in +/-125ppm spec.) for the 2nd half of the flat-top; and +/-420ppm over the 2nd half of the current pulse
- Voltage measurement to be checked deeply for effect on current repeatability

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