Fast Orbit Corrector Power Supply in MTCA.4 Form Factor for Sirius Light Source

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Brazilian Synchrotron Light Laboratory

Design Goals

- Correct small beam disturbances up to 1kHz;
- Digital current loop control;
- At least 8 channels for each module;
- Up to 30µrad deflection (@ 3GeV);
- Fit into a MicroTCA RTM slot (mid-size);

Requirements

- Small signal bandwidth of 10kHz;
- Maximum total power consumption of 36W;
- Current slew rate of 0.5A/ms (standard) and 0.375A/ms (45º-rotated);
- Total delay of 5µS;

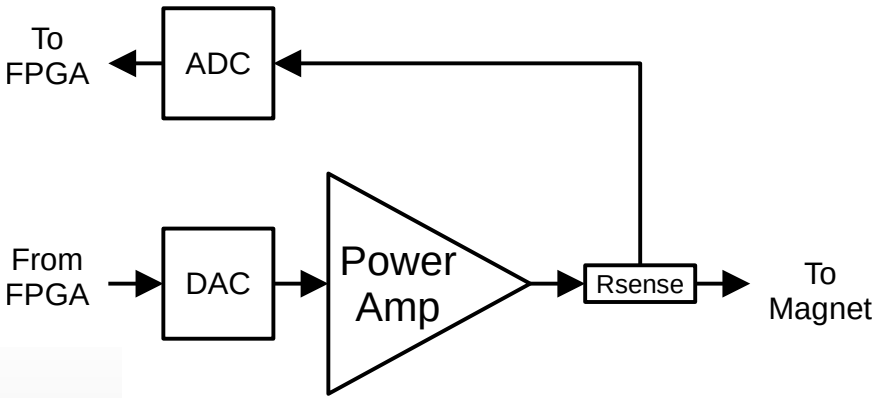
Requirements

- Load resistance: 1Ω;
- Load inductance: 3.5mH (standard) 6.2mH (45º-rotated);
- ±1A output capability per channel;
- Noise Spectral Density:

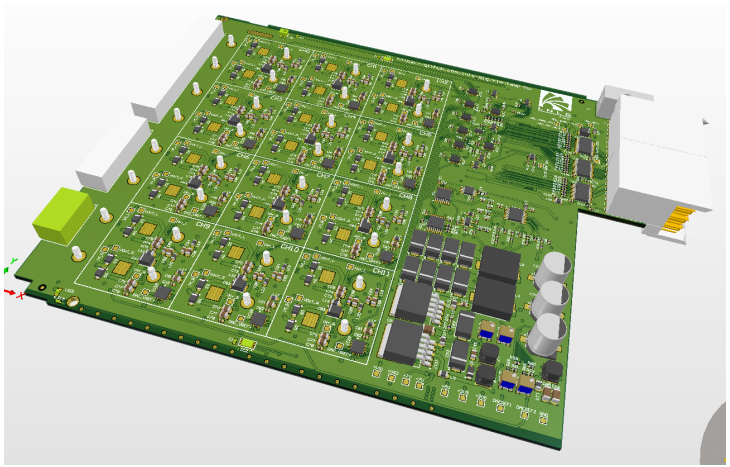
$$\frac{1.5\,\mu A}{\sqrt{Hz}}\left(f \geq 1\,kHz\right) \qquad \frac{1.5\,\mu A}{\sqrt{Hz}} \times \frac{1\,kHz}{f}\left(f < 1\,kHz\right)$$

Electronics Design

- Class AB power amplifier;
- 16 bits DAC, 16 bits* ADC;
- Buck converter (≥90% efficient);



* 16 bit differential input ADC, but only the positive range is used.



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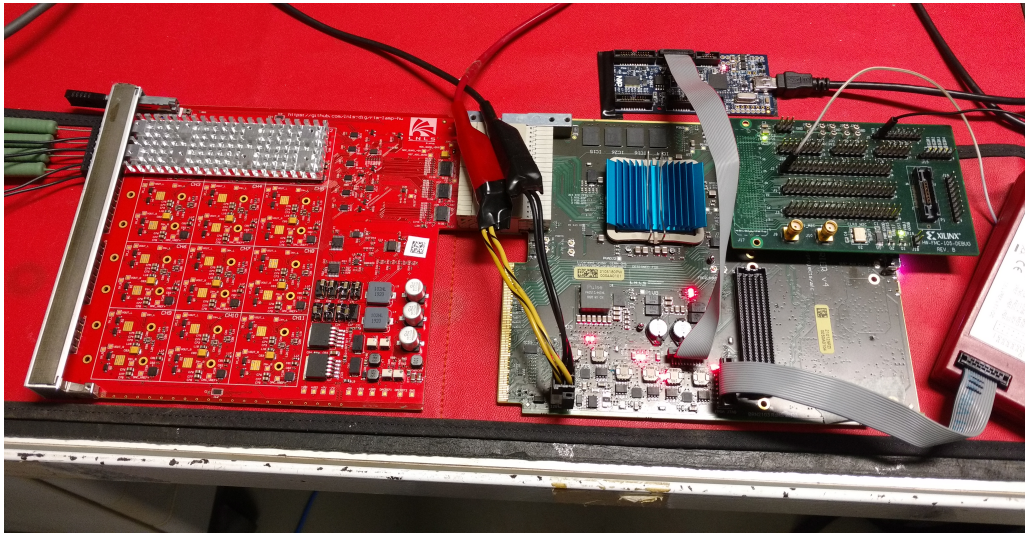
Prototype Validation

- Buck efficiency measured at 92.5%;
- DAC and ADC digital interfaces tested;
- Short circuit protection working;



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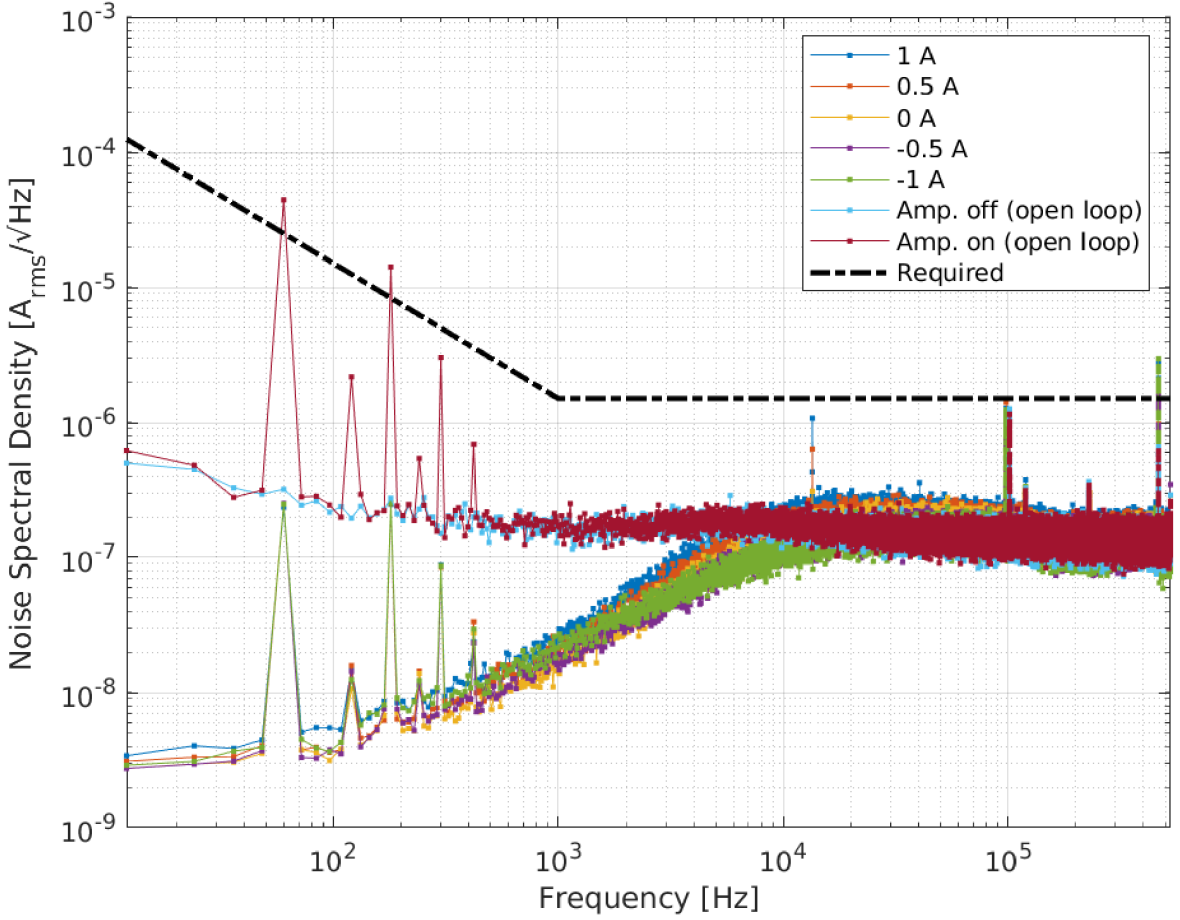
Prototype Validation (Noise)



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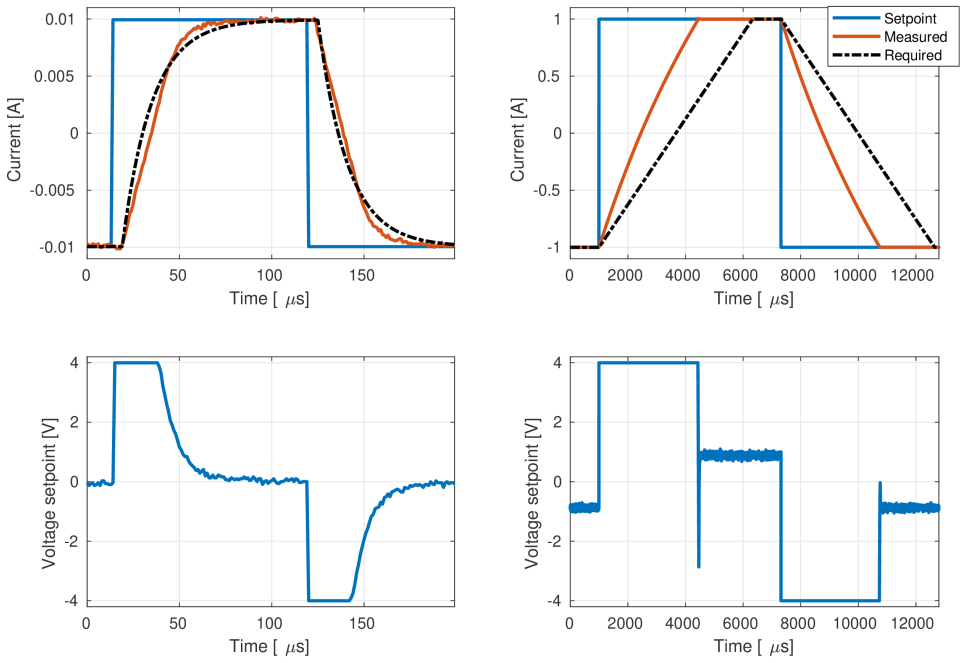
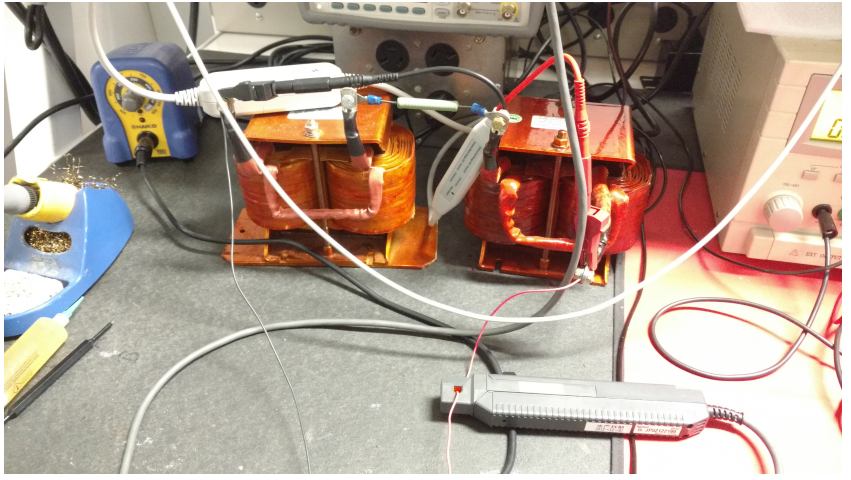
Prototype Validation (Step Resp.)





1.17Ω 5.9mH load

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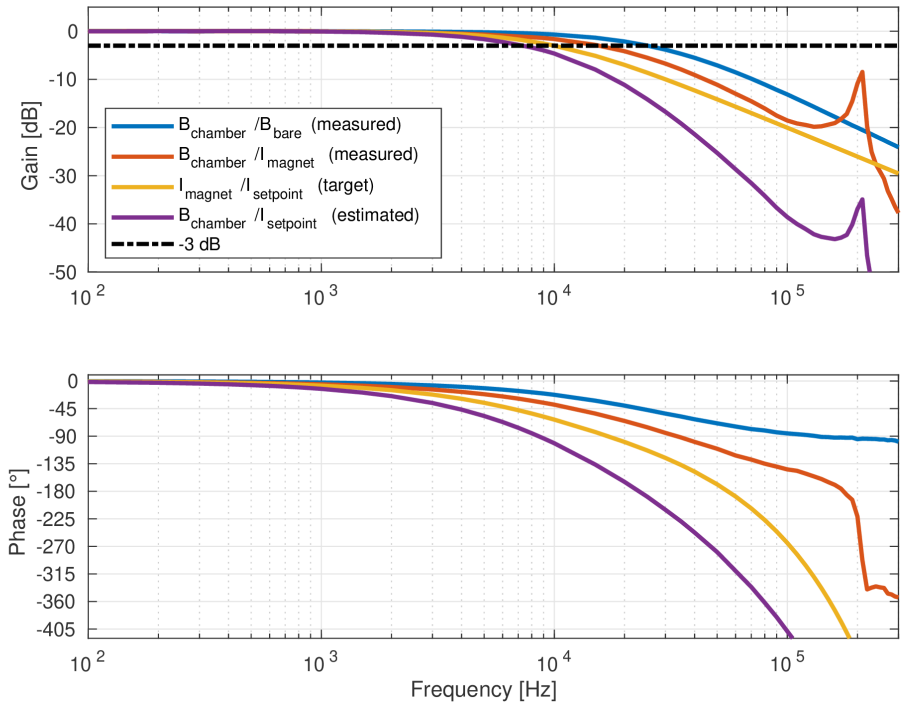
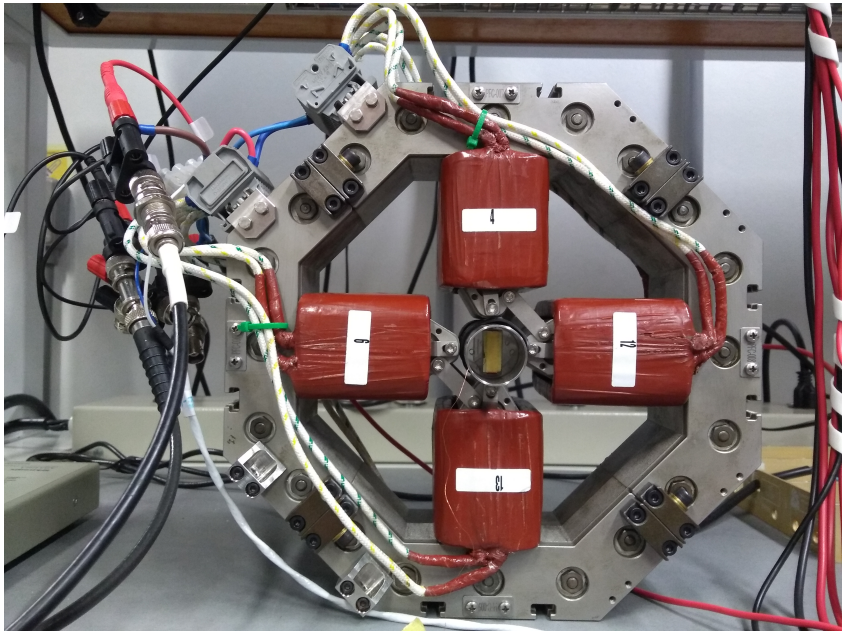
Magnet Bandwidth





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Next steps

- Drive a real corrector magnet;
- Optimize buck converter loop compensation;
- Thermal stress tests;
- Inter-channel crosstalk.

Thank you!

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