

8 Dual Channel Power Module for MRI shimming System

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Purpose/Introduction

Magnetic field homogeneity of the B_0 field is crucial for good image acquisition in MRI. This is accomplished through the technic of active or passive shimming. We developed a low-cost multichannel current control power system (CCPS) for an active shimming system. The current control-loop (CCL) will be defined digitally rather than analogously [1,2], as its usually done, to eliminate inaccuracies due to variations in the analog components.

Subject and Methods

The hardware developed consisted on a dual 20-port mixed signal driver MAX11301 for current control of 8 electromagnets through OPA549 operational amplifiers (Fig.1a). Current flow is measured with a 0.1Ω resistor and the instrumentation amplifier AD622 with $G=10V/V$. Because the driver is I^2C controlled, up to eight 8-ch systems can be interconnected for higher number of current sources. Control of the system is performed from a PC with the MCP2221 USB- I^2C adapter. Flexibility on the current control loop is available as its control side is defined from the PC side rather than on the analog circuit (Fig.1b). The design also considers the scenarios in which a current flow in the reverse direction is desired without altering the hardware connections. This is accomplished because of the symmetrical power supply consideration it was taken for such possible scenarios.

Results

A test of the current control system was performed with an electromagnet coil. The control system was attached to the cold plate (set for 10°C) for proper refrigeration of the amplifier stage. Preliminary results show that the hardware developed can produce up to a 1.34 mT field with an increase of 11.7°C of the operational amplifier and of 10.7°C of the board for one channel being used (Fig.1c).

Discussion/Conclusion

Although there is flexibility in the current control-loop design, response time to changes is sacrificed. This can be solved by using a microcontroller rather than a PC for system control definition and leaving the PC for parameter setup.

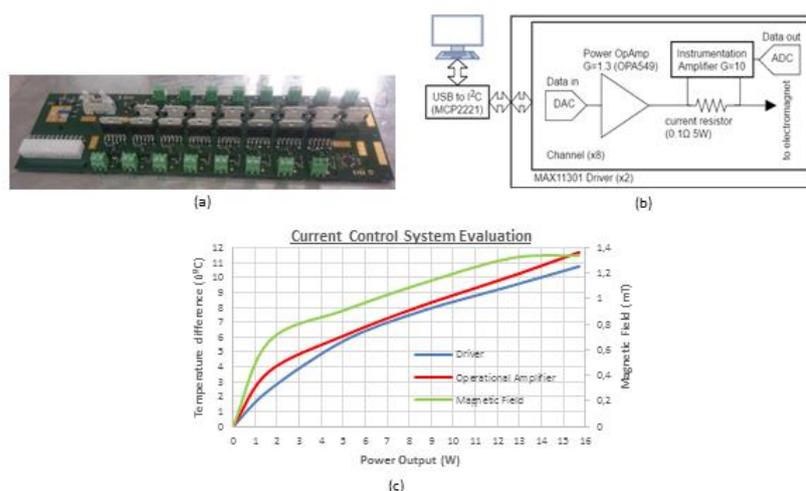


Figure 1: (a) Picture of the driver board, (b) Schematic representation of the control system and (c) Temperature and magnetic field measurements of the current control system when using one channel (Initial temperatures).

References

- [1] N. Arango et al, Presented at 24th Annual Meeting ISMRM.
- [2] J.P. Stockmann et al, *Magnetic Resonance in Medicine*, vol. 75, no 1. pp 441 – 451, Jan. 2016.