Concept for the open-rTMS electronics

Tobias Schäfer

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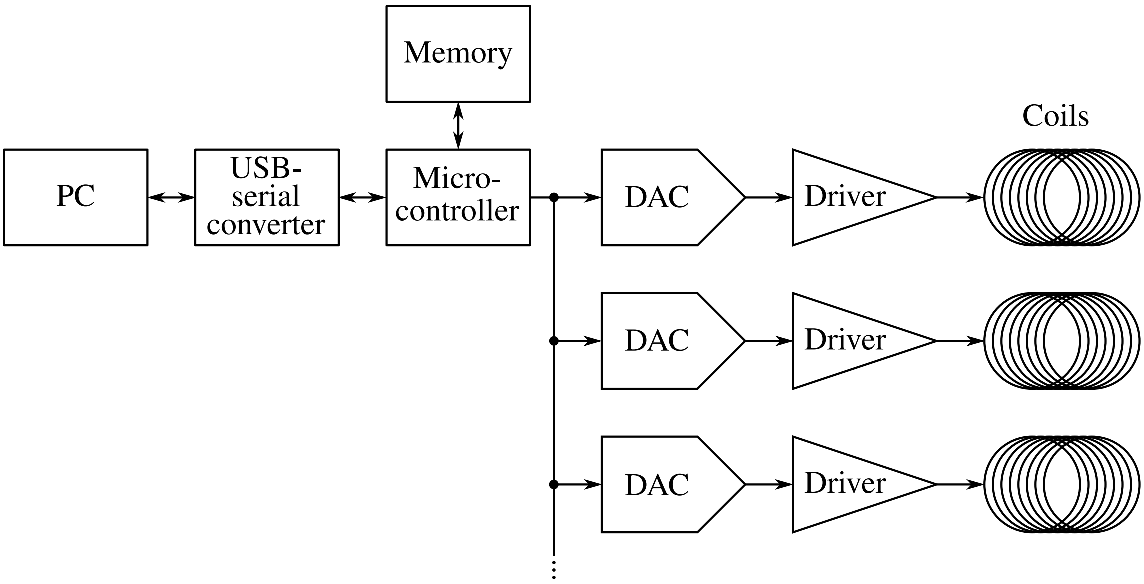

Figure 1: Concept for the system

Contents

1 Digital part

Parallax Propeller:

- no programming adapter needed. Communication and programming is done through the serial port.
- available as a discrete part as well as in SMD.
- up to 180 MIPS.
- sinus table in ROM.
- 8 cores.
- 6,95 EURO = 9 USD.

External I2C Memory 24LC256 for program storage (1 EURO = 1.3 USD).

As always: FTDI FT232RL (3.50 EURO = 4.57 USD).

For the Parallax Propeller a starterkit is available (95 Euro = 124 USD). A makeshift TMS device could be made by using the breed board part of the starterkit to assemble the analog part.

2 Analog part

2.1 D/A converter

Two possibilities:

- Use a pin of the controller to generate a PWM signal and filter the signal.
- Use an external D/A converter.

For the first design I will use a MCP4921 or MCP4922 D/A converter from Microchip.

2.2 Driver

Simple current driver made out of two OP-amps. The two OP-amps are necessary, because the voltage supplied via USB is GND to 5 V. One OP-amp is used to generate 2.5 V or more precisely $V_{\text{ref}}/2$.

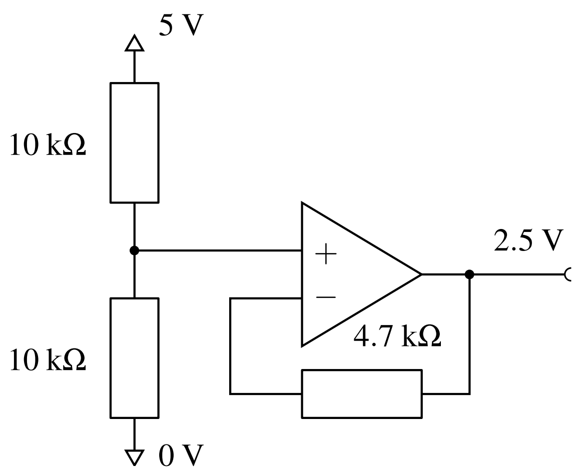

Figure 2: Voltage divider

In case somebody is wondering: The 4.7 kΩ in figure 2 are to make the OP-amp ”see” the same impedance on every input pin.

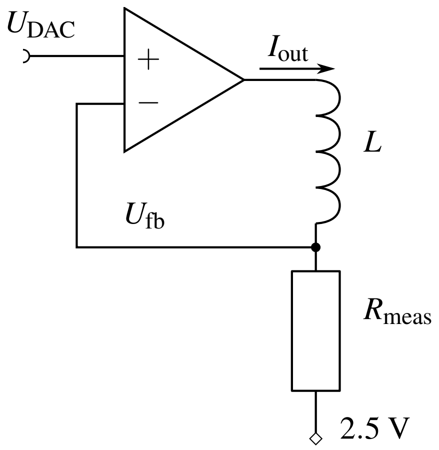

Figure 3: Coil driver

The OP-amp in figure 3 will increase the current I_{out} until the feedback voltage U_{fb} at the measurement resistor R_{meas} matches U_{DAC}:

$$U_{DAC} = I_{out} \cdot R_{meas} + 2.5\ \text{V}$$
$$\Leftrightarrow I_{out} = \frac{U_{DAC} - 2.5\ \text{V}}{R_{meas}}$$

For $R_{meas} = 100\ \Omega$ we get

DAC Value	U_{DAC}	I_{out}
0	0.0 V	−25 mA
1024	1.25 V	−12.5 mA
2048	2.5 V	0 mA
3072	3.75 V	12.5 mA
4095	5.0 V	25 mA

If we use the same voltage as the DAC reference and the input for the voltage divider, the value of 2048 should give a current of precisely 0 mA.