Documentation

December 15, 2016

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1 Purpose

This device is intended to be used to regulate the current through a Helmholtz coil, used for generating a magnetic field in our cold atom collider.

The majority of the system is built from chopper-stabilized amplifiers, for their very low input bias, and DC performance. This limits the bandwidth of the filter, and can cause aliasing. Hence this controller is not designed for "fast" systems.

This schematic is for documentation purposes only.

2 Signals

Only HH_{TTL} is isolated, and with the optional exception of the SENSE input, all other grounds/shields are shared.

2.1 HH_{TTL}

The Helmholtz TTL signal switches on or off the output voltage. In our case, the control voltage is being used to drive MOSFETs, so these are turned off.

The Integrator is also reset with this signal, preventing accumulation while the servo is not active from causing transient behaviour when the servo is enabled.

The polarity of this signal is set by populating certain resistors (R9-12, R5, R6) as per the schematic.

This signal is opto-isolated, so may operate at a relative potential to the rest of this circuit. The signal is assumed to be 5V, and will cause about 10 mA current draw.

2.2 V_{REF}

This is the output of a 5 V voltage reference, for use with an external DAC.

2.3 V_{DAC}

This is assumed to be the output of the DAC, and is used as the set-point for the PID controller

2.4 SENSE

This is the Process Variable, as a current signal. The current is passed through a precision 1 ohm resistor, and the resulting voltage is compared to V_{DAC} to generate the error signal.

The current return is optionally connected to ground by bridging R1.

2.5 OUT

This is the Control Variable, which is the result of the PID operation on the error.

3 Configuration

HH_{TTL} has selectable polarity by selecting which resistors to populate on the analog switches the signal activates. (R9-12, R5, R6).

The SENSE shield can optionally be grounded by putting a 0 ohm resistor (or solder bridge) in R1.

The total polarity of the system is selected using JP1 and JP2. These should both be loaded with jumpers between pins 1 and 2 for the default, non-inverting operation. They should be swapped to pins 2 and 3 to invert the output. **NB:** Either remove both jumpers first, or make sure device is unpowered with no inputs before changing the polarity. This is to ensure that two inputs are not shorted together while configuring. Note that during operation, the jumpers should be connecting the same pin numbers, but will be positioned at physically opposite ends of the jumpers.

4 Power

This board is designed to be powered off a dual supply. If a negative supply is not available, the negative supply pin may be grounded, and positive operation will be available.

5 Erata

5.1 TC7650

These amplifiers are only capable of a 18 V supply, but the specified dual 15 V supplies give supply of 30 V. The circuit can be used with +/- 8 V supplies instead of +/- 15 V with these amplifiers.

These amplifiers have been replaced with the LTC1150, which can handle these supply ranges, but has a much lower bandwidth. These devices were chosen as they are available in a DIP package, and could be placed on the existing board, when removing all the switching capacitors (C16, C15, C27, C26, C22, C21, C32, C31, C36, C35, C40, C41).

5.2 RV6 - Output Gain

This resistor was wired with pins 1 and 2 reversed in the 2016-11-14 board. These must be swapped for correct operation.