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Subject: Current Driver Use Information
Date: March 25, 2014 9:23:38 AM PDT
To: Paul Martin <pmartin@uoregon.edu>
▶ 6 Attachments, 6.2 MB

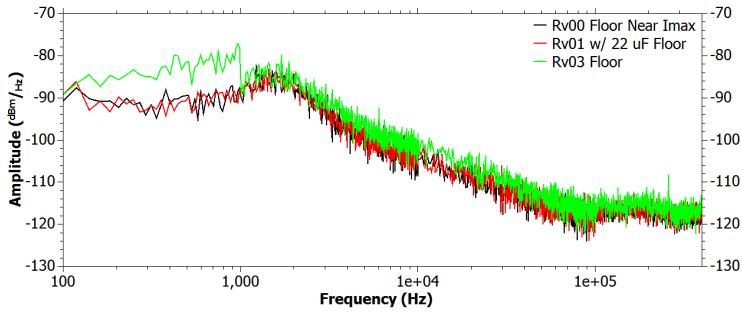
Paul,

Below is all the relevant information I can think of about the circuits I sent. Please let me know if you have any questions, and I'll be happy to help.

Notes for the current driver test:

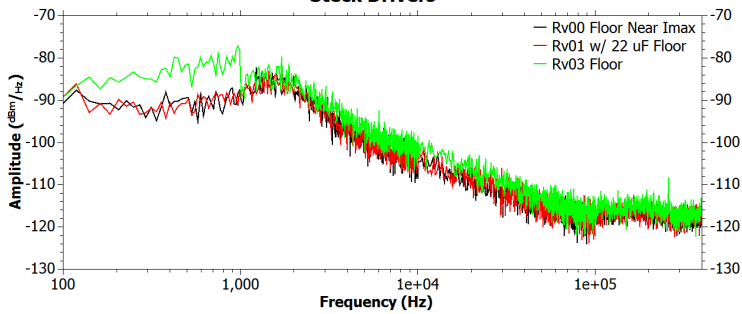
- The circuit diagrams and board layouts are attached as Eagle files.
- Each board should be supplied with ≥ 18 V (we use ± 24 V) from a linear supply via the banana connectors on the rear. Inside the box is a board containing the ± 15 V regulators (7815 case-mounted), pi filter, and a BUF634 on the PZT output.
- I can provide a key switch P/N and an interlock circuit diagram that be added if desired/required.
- Setup considerations:
 - The circuit uses a MOSFET acting as an open/short to push current to the laser diode or to ground. Note that there is no hardware switch to short the laser diode anode / cathode pins.
 - The maximum current is diode-voltage-dependent, meaning it must be set by hand when the driver is in operation. This is done by slowly turning up the R_dial pot to near the desired maximum current. The I_{\max} trimmer (adjacent to the LM317 pinout/chip) can then be adjusted (decrease LM317 voltage) to limit the driving current. The trimmer then should be set slightly above this value.
 - The PZT_rolloff trimmer is in the middle of the board next to the PZT output that goes to the BUF634.
 - The feed-forward trimmer is near the driver output.
 - Please verify the three trimmers are set correctly for your application-- I_{\max} needs set, the feed-forward should be set to $2.5 \text{ mA/V}_{\text{PZT}}$, and the PZT_rolloff should be near 100-300 Hz.
- The RV01 board is the original MIT layout (Rv00) with the addition of ground planes and C11, which decreased overall noise from the original design. I removed C11 (ceramic 22 μF over the LM317 trimmer) to copy the electrical layout of the Rv00 board. The capacitor is included in the extra pieces. We observed noise around 35 kHz when operating very near I_{\max} --this behavior should be pronounced without C11 installed. See the plots below showing the Rv00 resonance and expected current noise.
- The Rv03 board adds a 5 Ω , 22 μF low pass filter on the LM317 output. D4 and D5 should already be installed, which prevent the input modulation voltage magnitude from being larger than around ± 1 V.
- Since the Rv03 board is relatively quiet, some investigative work could be done to try to make it quieter. If this is to be pursued, I included a few components to aid in tracking down noise sources:
 - (2) INA114 instrument amplifiers to replace the INA217's. The former were used in the original circuit, but the INA217's have higher bandwidth and higher current output. The feed-forward INA could also be removed to see what effect it has on noise.
 - (1) LT1028 Op Amp, (1) IRF9Z14 MOSFET with 100 μH inductor on the output with CST-100 connector ready to be case mounted. These can be installed to near-match the original Libbrecht-Hall design if C3 is replaced with 8.3 nF and C4 is removed.
 - (1) 22 μF ceramic radial capacitor that I removed from the Rv01 board. This could be reinstalled to quantify it's effects.
- Plots and current noise estimates of the drivers are below. For the Rb spectroscopy traces, noise below 10 kHz is attributed to mechanical resonances of the grating arm. Note that the fast linewidth on our 780 nm ECDL was 2.4-3.0 MHz for each driver, which is at or near our scanning Fabry-Perot's resolution limit.

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Steck Drivers**



Current Driver	PZT BUF634	Frequency Range	Current Noise (μ ARMS)
SA Noise Floor (disconnected)	N/A	10 Hz - 100 MHz	16.6
RV03 at 85.02 mA	Y	10 Hz - 100 MHz	14.7
RV01 at 85.00 mA	Y	10 Hz - 100 MHz	15.0
RV01 at 85.96 mA (maximum)	Y	10 Hz - 100 MHz	17.0

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Current Driver	PZT BUF634	Frequency Range	Rb Current Noise (nARMS)
Rv03 Floor	Y	10 kHz - 400 kHz	93.2
Rv00 near I_{max}	N	10 kHz - 400 kHz	155
Rv01 w/ 22 μ F	N	10 kHz - 400 kHz	88.4
Rv03 BUF634	Y	10 kHz - 400 kHz	97.4

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[MITPosCurRv01.brd \(76.3 KB\)](#)[MITPosCurRv01.sch \(390 KB\)](#)[MITPosCurRv03.brd \(114 KB\)](#)[MITPosCurRv03.sch \(950 KB\)](#)