Piezo & Diode Driver Ramping Circuit

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The purpose of this circuit is to simultaneously ramp the laser diode driver current and the piezo voltage simultaneously on an ECDL to increase the mode hop free tuning range. The idea is that the current tunes the internal cavity formed in the laser diode and the piezo voltage tunes the external cavity. Then if the modes of the two cavities can be tuned at the same rate relative to one another in frequency space, this will prevent mode hopping. The trick is finding the correct ratio to tune the diode driver modulation voltage and the piezo driver voltage so that the frequencies of the two cavities tune at the same rate. In theory, the best tuning ratio is found by setting the piezo voltage at a fixed voltage, tune the diode driver current and record data on the laser tuning rate with respect to diode current, MHz/mA. Then do the same for the piezo. Set the current at a value, tune the piezo and record MHz/V. The optimal current/piezo tuning ratio to prevent mode hops is the ratio of the slopes of these two curves, (MHz/V)/(MHz/mA). This method worked very well with the 780nm diodes. However, for the 1056nm diodes, the ratio that the laser tuned best at was far from the calculated value. Tuning can be done manually using the "man tuning" potentiometer, or an input ramp signal can be used at the "ramp" BNC connector.

Using the circuit: The supply voltages are +15V and -15V. The BNC connector named "current" should be connected to the diode driver external modulation input and the BNC connector named "piezo" should be connected to the piezo driver external modulation input. The diode driver and piezo drivers have several modes for how much the output is modulated for a given input voltage. This circuit is designed to be used with the diode driver set at 20mA/V and the piezo driver set at a volt limit of 150 Volts which should correspond to 15 V / V. For manual tuning, no ramp needs to be connected to the "ramp" BNC connector and tuning can be done by simply adjusting the "man tuning" pot. The man tuning potentiometer just modulates how much voltage from the 5V voltage regulator goes into the circuit. If a ramping signal is being used, then the man tuning pot will only serve as an offset for the ramp signal, so man tuning can be turned all the way down. The "input mod" potentiometer serves to decrease the amplitude of the input ramp signal but doesn't affect man tuning at all. Therefore, input mod changes the amplitude of the piezo and current outputs. From the circuit diagram, the input ramp signal will be decreased at least by a factor of 2 with the input mod pot all the way down. The BNC connector named "ratio" sets the gain of only the current output. So "ratio" adjusts the ratio of the current/peizo voltage ramp. There is no BNC output to measure what the ratio is set at but this can be measured by calculating the slopes of the piezo and current outputs with respect to input ramp voltage, then multiplying these slopes by the factor of which the diode driver and piezo driver increase the modulation input by (20mA/V and 15V/V respecitvely), and then taking the ratio of

these values The BNC connector named “offset” is a bad name for its purpose. This output is just the voltage the piezo driver actually applies to the piezo decreased by a factor of 100. This is to make the circuit slightly more user friendly so that you can connect this ouput to an oscilloscope and get an idea of what the actual piezo ramp is going to be.