APPENDIX B
Fine-Tuning the Shunt Resistors with Testing

FINE-TUNING THE SHUNT RESISTORS WITH TESTING

This Appendix provides information on how a shunt circuit was tuned by Kristina Jeric in her research [1]. The tuning process that she used involved the design of three shunt circuits to decrease the peaks occurring around 120 Hz, 150 Hz, 240 Hz, and 260 Hz. For each shunt circuit, the first iteration of testing was without the shunt load resistor. The reason for this was that the internal resistance of the shunt circuit could have been larger than the required load resistance. Thus, the addition of the shunt load resistor could have increased the damping above the desired optimum level. The second iteration of testing involved 'reading' the results to determine if the shunt circuit resistance should be increased of decreased. For the final iteration of testing, the load resistor was applied and the damping level of the circuit was fine-tuned to achieve the optimum damping level. The next section of this appendix was taken from Kristina Jeric's Masters Thesis in her description of the tuning process [1]. This section describes in detail the method that Jeric used to tune one of the shunt circuits for the 120 Hz peak.

Shunt Circuit Tuning for the 120Hz Peak

Figure B1 shows the results from the tests required to determine the open-circuit and short-circuit resonance frequencies, which were required to calculate the optimal electrical resonant frequency of the circuit. The difference in resonant frequency between the two responses is about 1.25 Hz. The required inductor resistance was then calculated to be 2307 Ω. The circuit was then tested without a load resistor and compared to the open- and short-circuit responses, as shown in Figure B2.

Based on these initial results, three issues were determined. The first was that the shunt circuit was tuned to the right frequency because the shunted response is symmetric within the short-circuited response curve. Secondly, it was determined that the internal circuit resistance was already too high, or rather, there was already too much damping in the circuit. If there was not enough damping there would be a dip at the resonant frequency and two peaks would occur on either side of the resonant frequency. Thirdly, the vibration levels could not be decreased any more with the PZT, i.e., damping ability was maximized. This was concluded because the shunt was tuned to the right frequency, and the shunt resistance (shunt damping) was already internally too high. Adding more resistance to the shunt would only have increased the shunted PZT plate response.

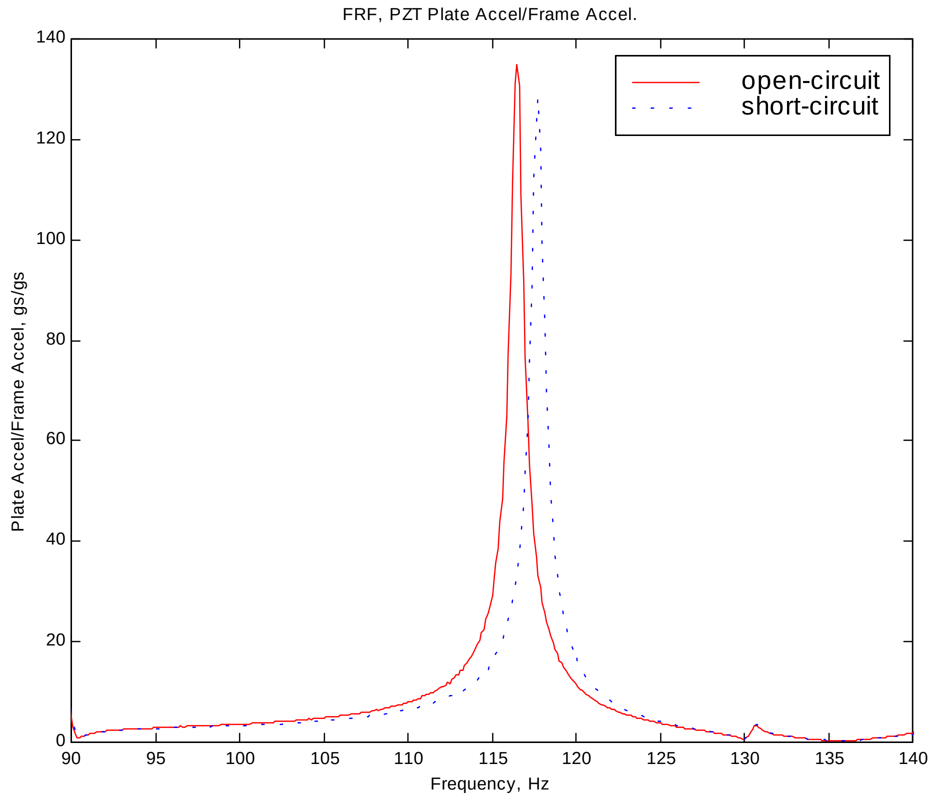

Figure B1. Open Circuit and Short Circuit Response

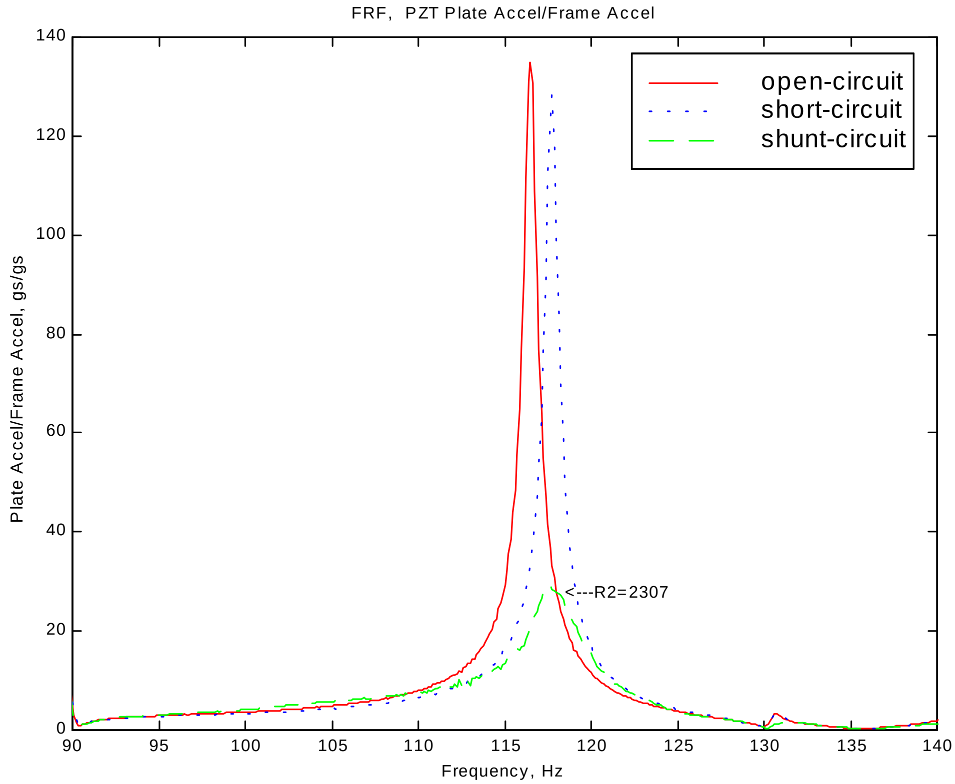

Figure B2. Initial Results Using the Calculated Inductor Resistor Value (w/o Load Resistor)