Load Cell Test Stand and Instrumentation Amplifier
For testing Gerbs and small Rocket motors

This is a follow-up on the two fuzzy pictures I posted a while back on PyroBin.

The photos and schematic that follow comprise a test stand and amplifier based upon a 20Kg beam load cell and a DATAQ DI-148U data acquisition unit, driven by an amplifier of my design.

The amplifier is based upon the TI (Burr-Brown) INA-125 amplifier chip, which is specifically designed to accommodate Wheatstone Bridge sensor devices.

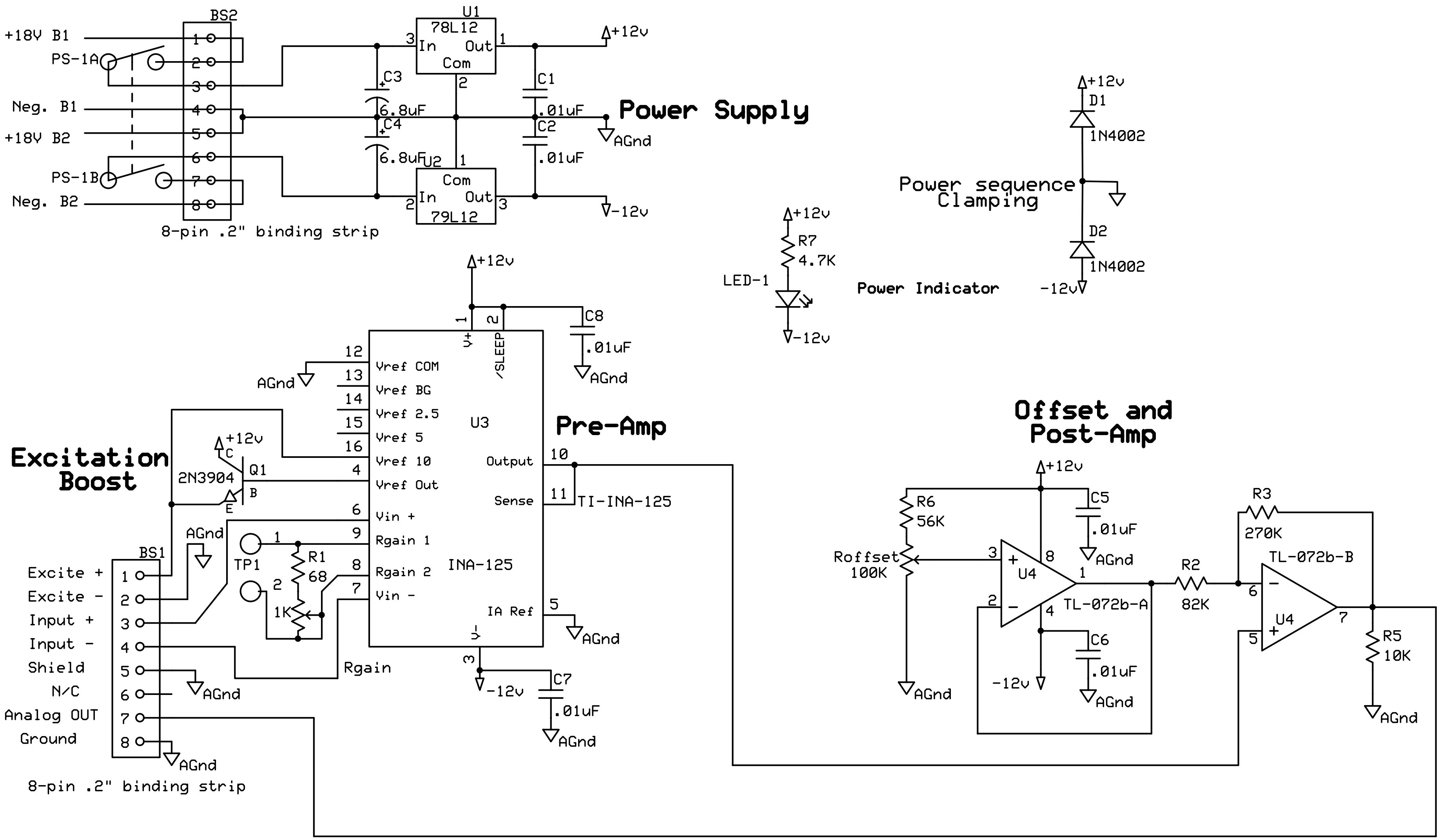
There are a number of amplifiers based upon this chip in use by the amateur rocketry folks, but all seem to lack one important feature – they do not use the full-scale range of the data acquisition device. Most of the amplifiers swing from ground to +5V or ground to +12V, but the DI-148U is capable of measuring from -10V to +10V full-scale.

Since many ‘wasted bits’ are unused when the input swing does not match the full-scale capability of the DAQ, it seemed appropriate to add an offset stage to the INA-125 in order to use the full range.

The schematic which follows was designed using ExpressSCH and laid out on ExpressPCB, freeware associated with the ExpressPCB board-fab web site. From finished design to boards in hand took three days. Six boards cost a total of about $60, delivered.

The cost of adding nomenclature screening and solder mask to the board would have doubled the price, so I opted for “the poor man’s silk-screen” – I printed the nomenclature layer on transparent mailing labels, and stuck them on the top surface of each board. The only drawbacks to this are: 1) you cannot solder from the top of the board, and 2) absent a solder mask, soldering must be done very carefully with a fine-tipped iron. Still, populating and testing each board took less than an hour.

The schematic follows:



Lloyd E. Sponenburgh		
LCAmp-03		
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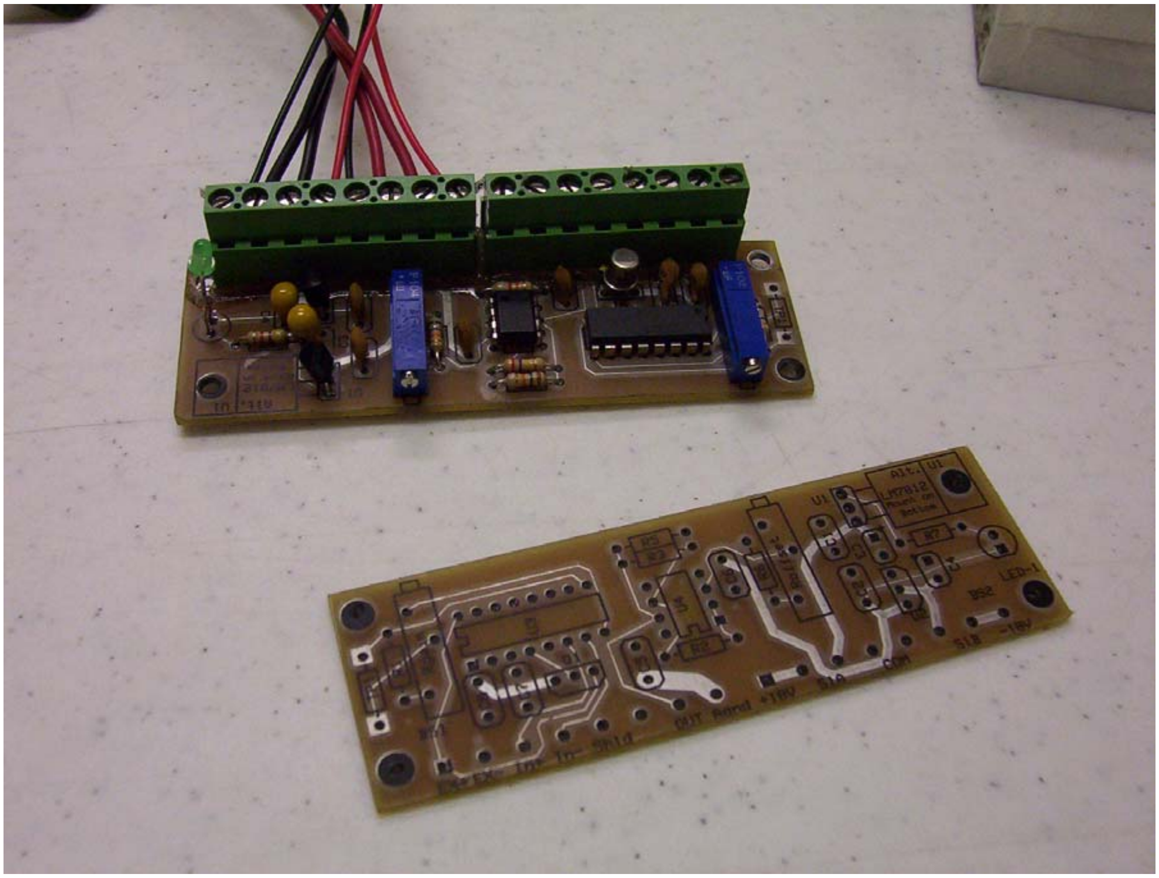
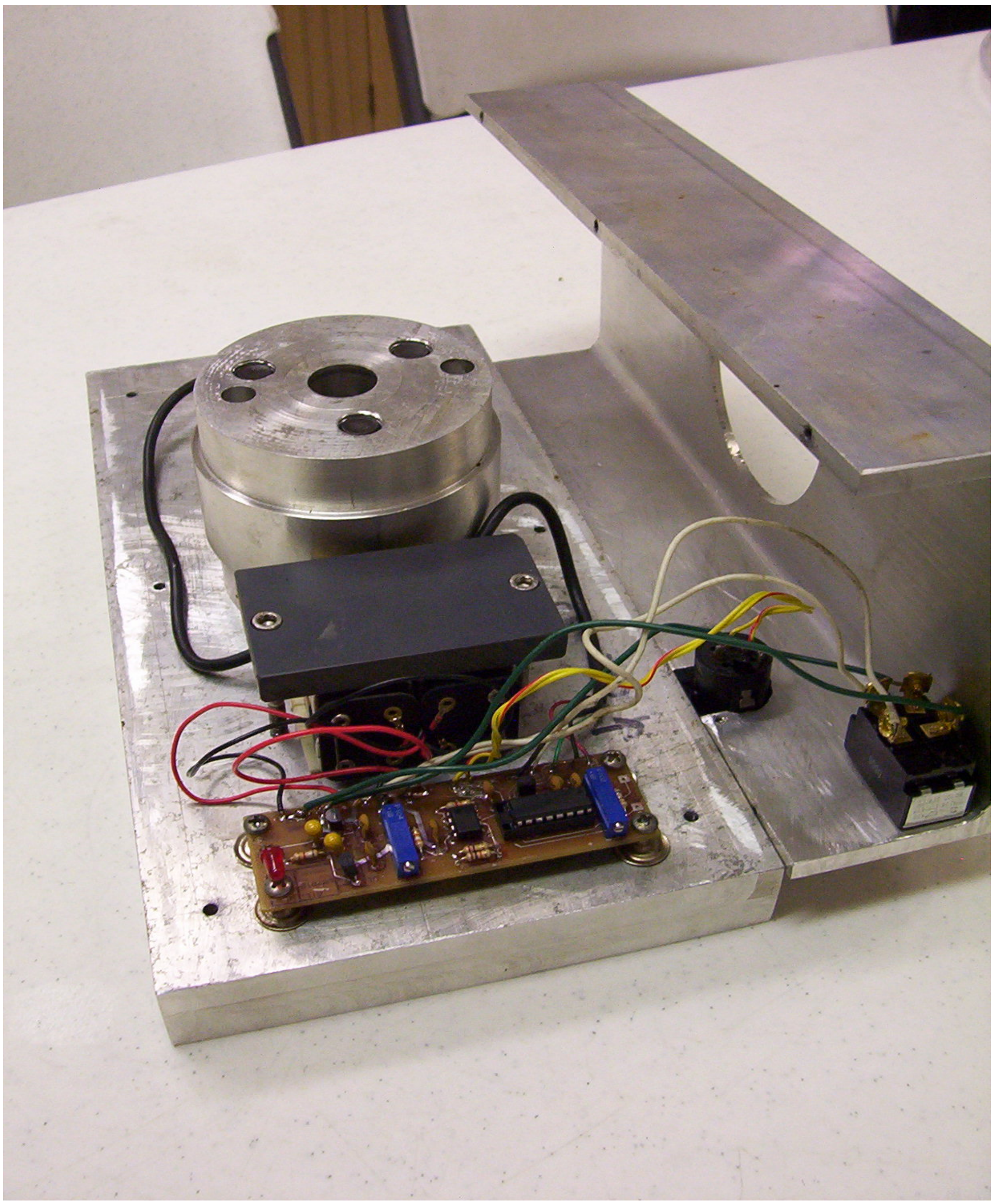
This is a close-up of one populated and one unpopulated amplifier board. One mechanical change to accommodate a better terminal strip and one electrical layout change to add the power sequencing clamp diodes remain to be made to this particular layout.

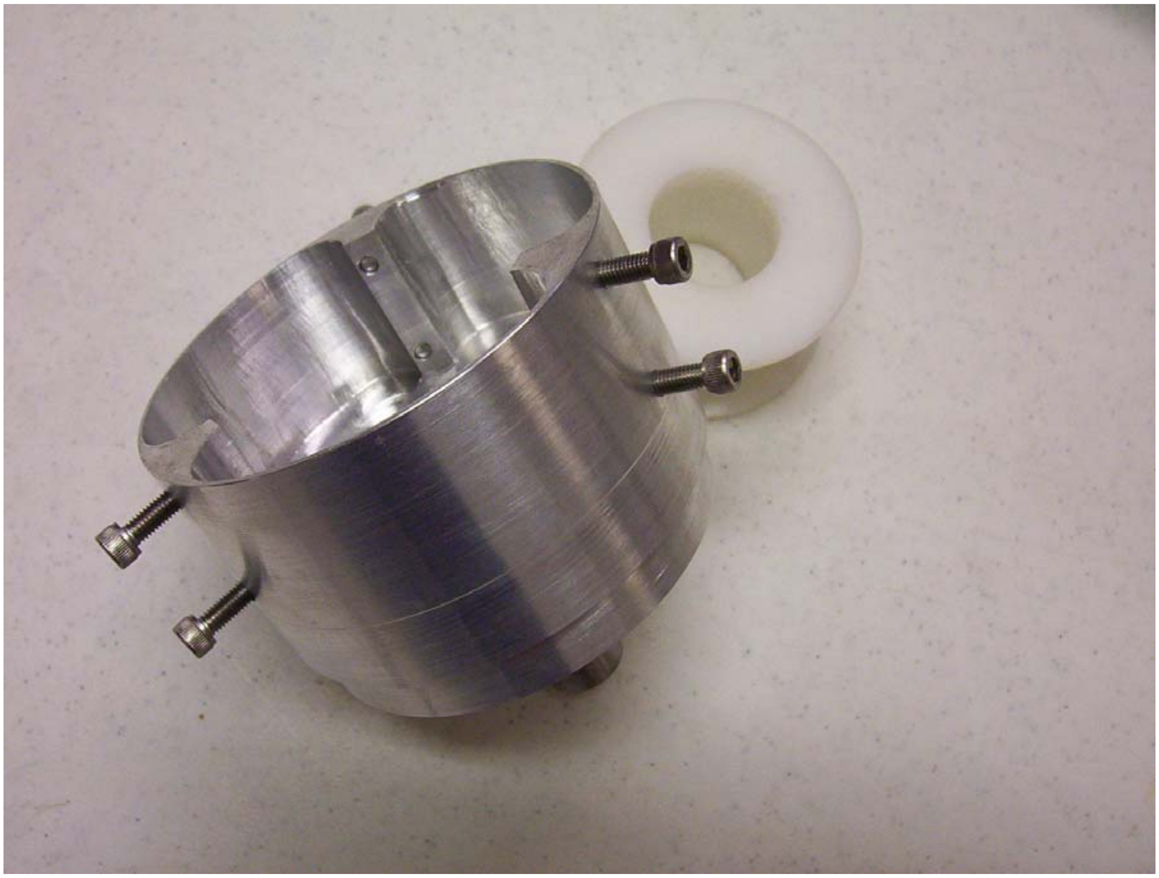


The test stand is shown with its protective cover and load cup removed. A double-pole single-throw switch applies power, and the analog output of the stand is referred out an XLR-style microphone connector. This cable variety was chosen because it is designed to handle low-impedance, low-level signals over fairly long distances without degradation, and is mechanically robust enough to withstand frequent trampling by "roadies" on musical tours.

The three equidistant holes in the top of the thrust boss are crash-stop screws, to prevent over-travel of the cup during a CATO or unexpected over-thrust. Not shown, on the bottom of the base plate is an inertial-stop screw that prevents the end of the load cell from over-traveling under its own inertia after a CATO. Four 9V alkaline batteries power the setup.

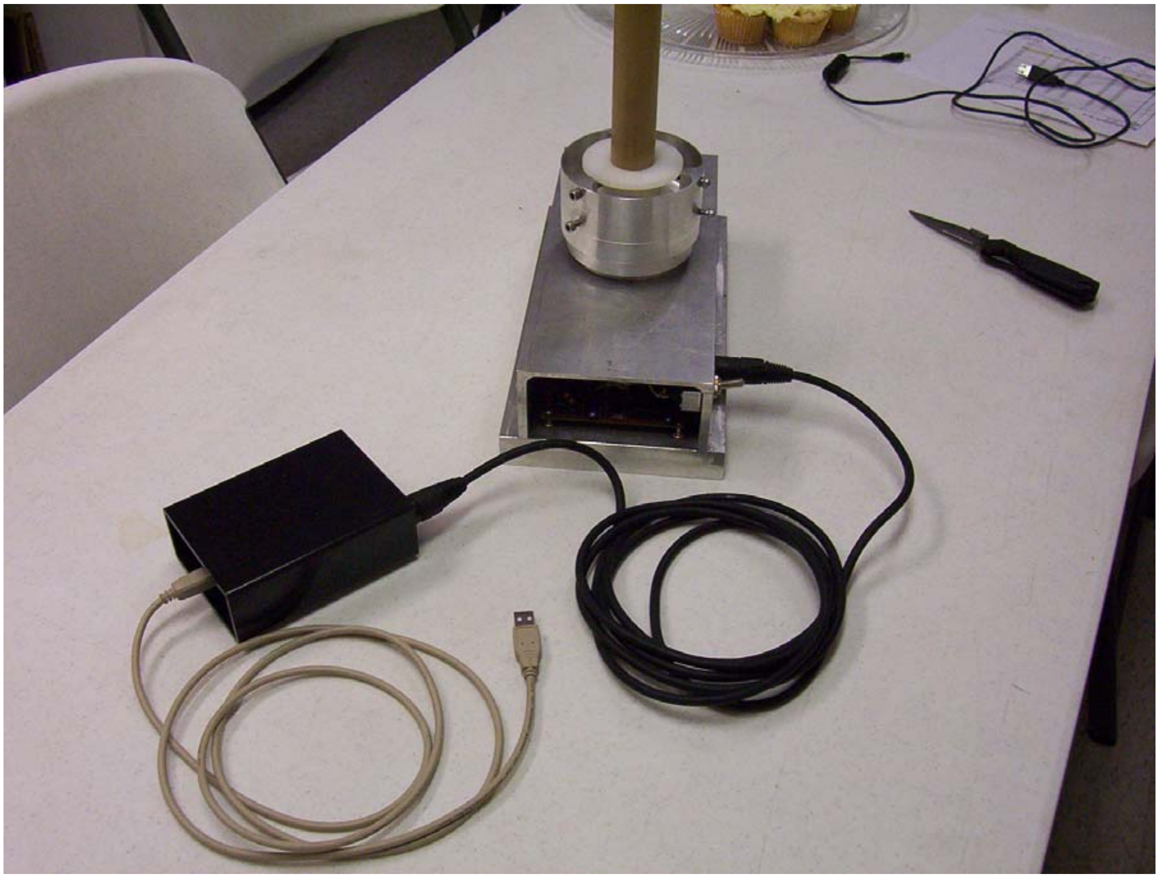


This picture shows the load cup and tube adaptor spool. Each size device (up to 65mm o.d) is accommodated by a different plastic adaptor spool, or an insert in another spool. The photo does not clearly show the load post exiting the bottom of the cup. This post transfers force from the cup to the load cell mounted below the thrust boss on the stand's base plate.



This photograph shows the test stand assembled, with the load cup in place, and a gerb mounted in the adaptor.

This is a depiction of the entire equipment package, sans the laptop computer used to read the DAQ. There is no “magic” in the small black box. It’s just a housing for another XLR connector and the DI-148U data acquisition module. The cupcakes are for an after-test treat.



I hope this piques your interests. I’ll be using the stand to characterize our gerbs, in order to detect variations in the fuel mixtures.

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