SHUMATECH DRO350 EXPERIENCES

Introduction and Background

The Shumatech DRO350 is a kit based digital readout display for low cost vernier scales and can be bought with preloaded firmware configured for use on either a milling machine or lathe. There is slightly different functionality between the two.

The kit was conceived by Scott at Shumatech and was marketed direct from his web store or alternately via Wildhorse Innovations in the US and by Model Engineers Digital Workshop in the UK.

Shumatech appears to no longer trade but I managed to buy the full lathe kit including the box from the UK agent. The Shumatech web site still exists and promises an advanced version of the DRO350 but this has never materialised. I understand that Wildhorse have a new product in development to replace the DRO350.

The fact that the product is no longer available from Shumatech might at first glance make this note of no value but existing users of the DRO350 and users of low cost Chinese scales for DRO facilities may find it of interest.

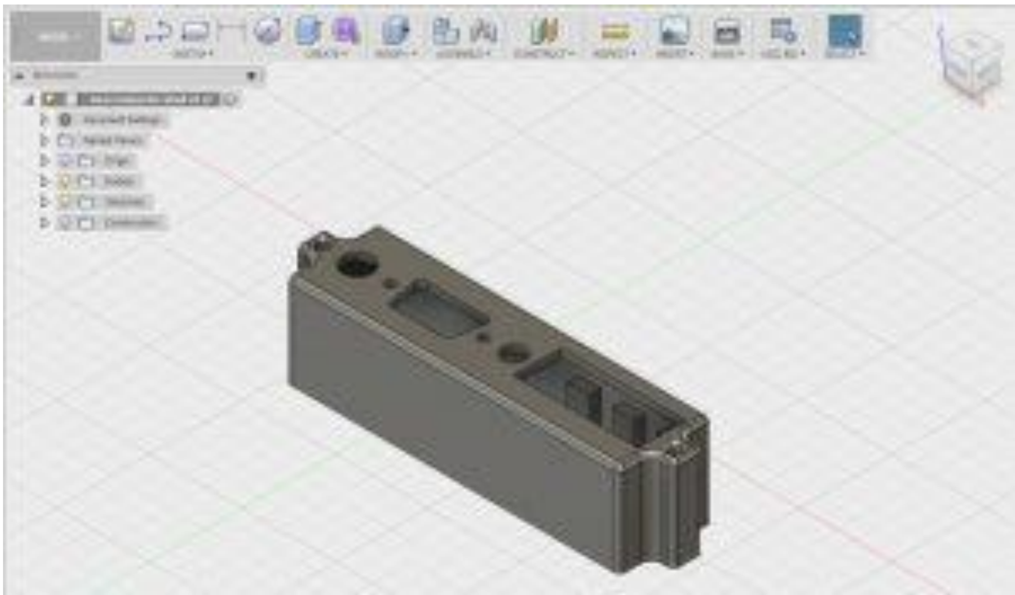
First Experiences – Kit and Enclosure

I was lucky to get one of the last DRO350 kits from MEDW and chose the lathe firmware. I ordered the full kit of the pcb and electronic components which also included the box and connectors.

The product is quite well conceived and has a wide range of functions beyond just a basic readout of X,Y,Z scales. The pcb was simple to put together and I quickly had it working as a lash up on the bench.

The first physical problem was the fact that all the connections are configured to come out of the back plate of the plastic enclosure which had been predrilled to match. For my application this was not ideal as I preferred to have the connections coming out from the end wall of the box. The connectors on my scales were RJ11 style jacks which did not match the kit supplied miniature DIN style.

I created a 'pod' in Fusion 360 that would mount on the end wall of the box and carry all the connections and allow me to reroute them from the box end face. The box was 3D printed in black to match the enclosure supplied. Dimensions were tight to fit all the connections into the end wall space. I had to resort to RJ10 style connectors for the scale leads as RJ11 were too large. I re-crimped my leads with RJ10 plugs to match. Because of the new location for the connectors I had to extend some of the connecting leads. That aside the 'pod' concept worked well. Below is a Fusion screen shot of the 'pod' and the resulting printed module in place.

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SHUMATECH DRO-350M

Display Jitter

After buying and assembling the kit I discovered significant debate on the internet about the Shumatech design and the apparent instability or flickering of the digits on the display. Opinion seemed to be mixed as to where this originated.

The DRO350 provides power down the connecting lead to the scale so that the scale batteries are no longer needed and can be removed. To enable this phantom power supply feed a link is made on the PCB to connect the on-board 1.5V supply via the lead to the scale.

The PCB design is not ideal with some very long thin power supply tracking and no ground plane screening. My two small scales seemed to not suffer this jitter problem but my long scale definitely showed flicker on the last digits making it of little use. If I zeroed the readout on the scale and the readout on the DRO350 and then moved the Vernier, the readouts did not match suggesting that although flicker free the smaller scales were not coding properly.

Opinion on the internet is mixed as to how to overcome this. Suggestions range from changing the wiring in the readout box for better earthing, keeping the connecting leads apart, leaving the batteries in place in the scales or replacing them with capacitors to add smoothing.

I tried all these to no real positive effect on my long scale. I tried inductive and capacitive decoupling of the connections at the scale terminations. All to no significant improvement.

Not wanting to give up on the problem I took a step back. I hard wired (directly soldered) the four connections to the scale (supply +/-, clock and data) onto the gold plated edge connector contacts. This ensured there was no possibility of intermittent connections. I lifted the + and – 1.5V connection coming down the lead to the scale and instead connected the scale to an external bench power supply. This meant there was no supply connection from the DRO350 1.5V supply but the clock and data signals were still available to the readout for decoding and display. I had similar length leads for the external power supply connection.

The jitter was still there on the display.

To me this suggested that the jitter was not due to the DRO350 power supply but more likely due to pick up on the power supply lead. This in turn suggested that the scale supply connections were fairly high impedance and sensitive to pick up of any noise floating around on the supply connections.

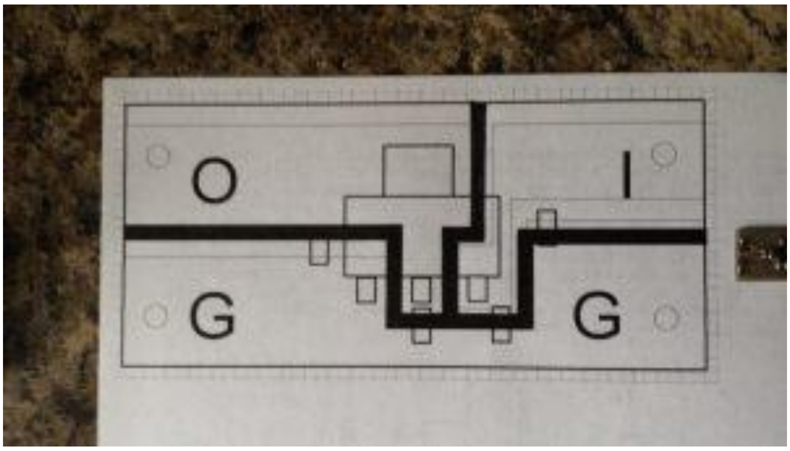
Once again I tried inductive and capacitive decoupling on the external power supply leads but to no improvement in the flicker.

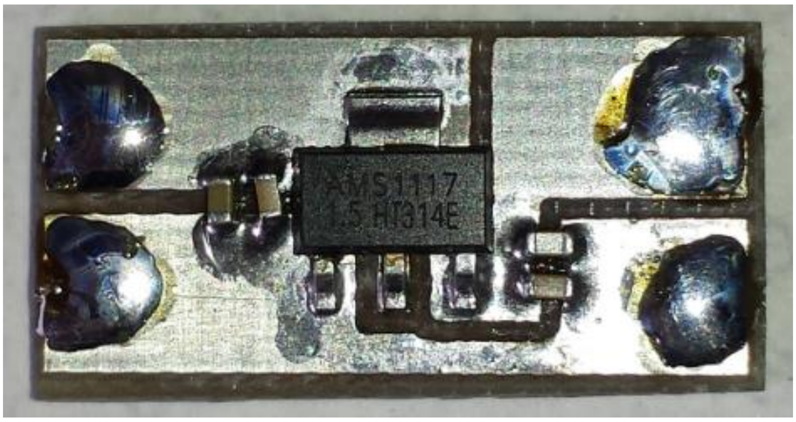
New 1.5V Regulator

By chance from a prior project I had to hand a small 9V to 1.5V power supply module based on the AMS1117 "3 legged" integrated regulator. I connected this close to the scale and ran the regulator input of 5V from the bench supply.

The jitter disappeared suggesting it was really related to the pick up on the supply to the scale.

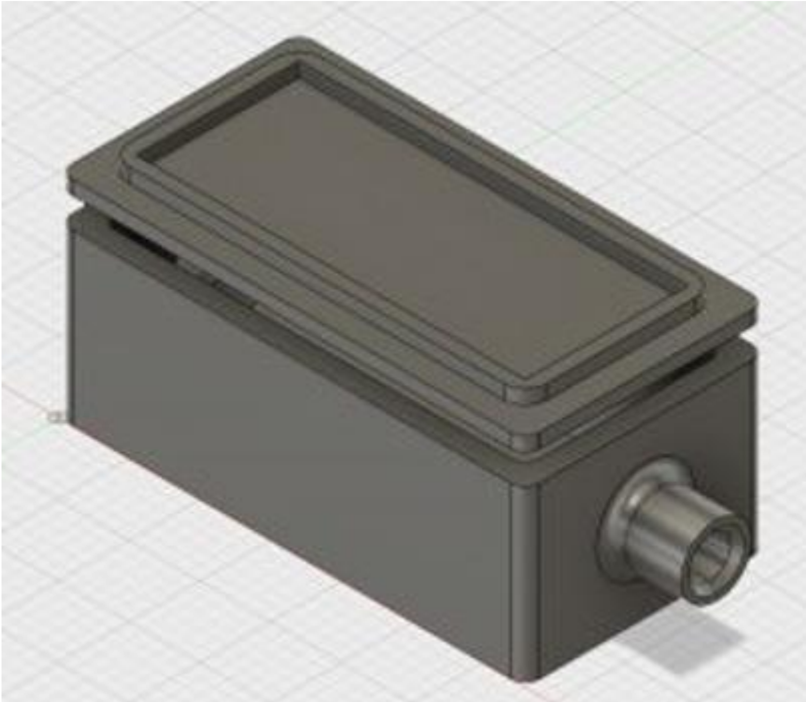
I had stock of the AMS1117 chips and SMD caps needed for decoupling the IC. I decided to design a small pcb more appropriate to my needs.   This was a very simple one sided layout for the five components needed and measured 24mm by 12mm.   I hand coded the G Code for my Tormach mill and using a dental burr as a tool, engraved the tracking on a blank piece of 1.6mm double sided PCB from my junk box. I made three of these regulator boards, one for each of my scales. The paper image and finished power supply are shown below.





3D Printed Enclosure

The next problem was how to protect the PCB modules. For this I created a small enclosure and lid in Fusion 360 which I then printed on my 3D printer. This would need to be mounted close to the scale terminations.



The finished assembly of the box and regulator was connected in line with the scale lead and as close as practical to the scale. I modified all three scales in the same way.

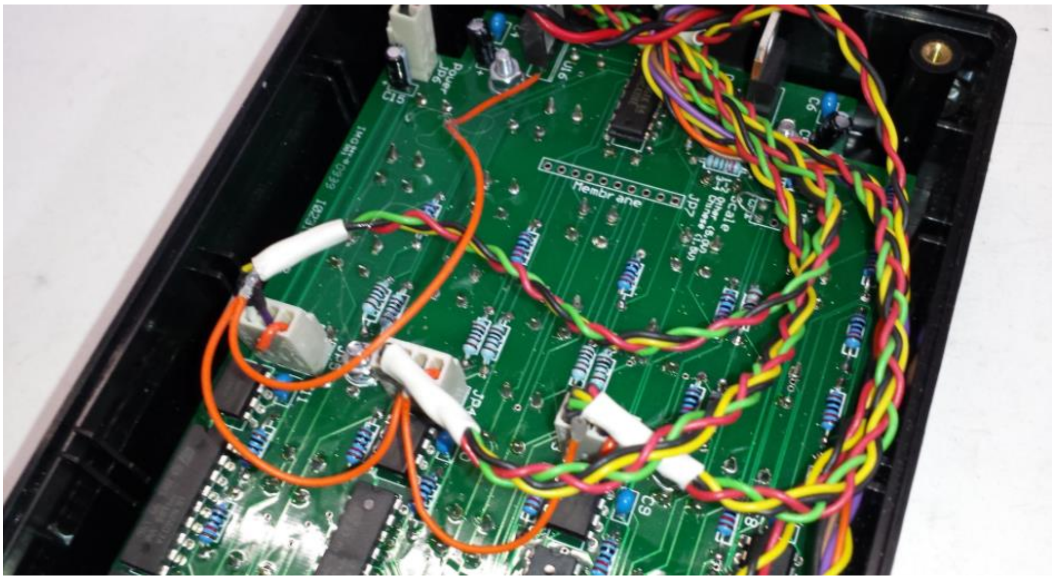
The wiring inside the box is straightforward. The data and clock cables pass straight through the box direct to the scale connectors. The positive supply lead from the DRO350 connects to the regulator input and the regulator output (1.5V) goes to the scale + (chassis) connector. The supply negative from the DRO350 connects to the ground on the regulator and connects out to the scale connector.

So far so good. I now had a 1.5V regulator connected close to the scale connections which if I ran from a 5V external power supply gave me stable readings on the DRO350.

Feeding 5V to the Regulator

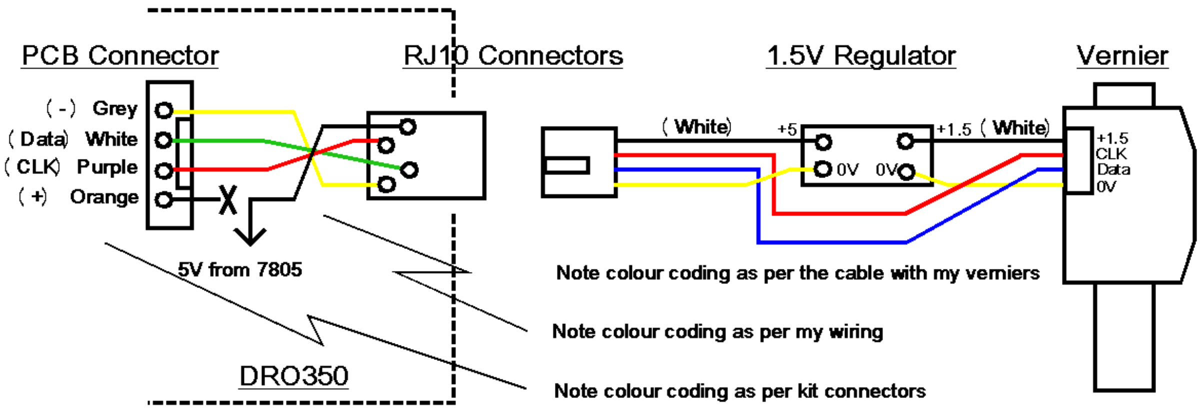
The final part of the installation is to replace the external temporary 5V power supply connection with a 5V feed from inside the DRO350 box from its 5V regulator.

As I had had to extend the cabling from the scale interface connectors to the new connector pod it was easy to access and lift the + supply off each connector, link them together and connect to the output pin of the 7805 5V regulator on the DRO350 PCB. You can see this as the orange wire below.



You might suggest that there is no need to do this as one could break the former 1.5V link on the DRO350 PCB and feed in the 5V at this point. I opted to not go this route as my understanding was that the 1.5V link not only feeds 1.5V out and down the scale connecting leads but also connects 1.5V to the DRO350 interface circuitry to set the data slicer levels. I was unsure what feeding 5V to this point would do and the possible damage it might cause. The 1.5V link was therefore left in place but of course no longer feeds the scale interface cables serving only the interface data slicer electronics.

Final Wiring Diagram



Apologies for the mixed colour codes which confuses. As drawn the wiring follows through as seen with top view of the PCB connector, bottom view of the RJ10 socket, mating orientation of the RJ10 plug and top view of the PCB regulator and the Vernier scale.

Conclusion

Following all these modifications the DRO350 gave a stable display on all three axis.

I hope that my experience with the scales will help anyone having this jitter problem whether or not they are using the DRO350 as the readout device. Equally the regulator concept could be used without an external display simply to avoid having to constantly replace batteries in the scales.

Addendum

Since undertaking these modifications I have given some thought to making a 'dummy' 1.5V battery housing to contain the 1.5V regulator. This could be clicked into place in the battery holder on the scale. Physically the parts will fit in the size of the battery. This would remove the need to have the external 3D printed enclosure.

The problem with this approach is that the 5V supply (+ and – leads) would no longer go to the scale edge connector but would have to 'hop' across the scale body and connect inside the battery compartment via the dummy battery. This might not be as attractive to implement as the solution already described.

Links

Shumatech	http://www.shumatech.com/
Wildhorse Innovatons	http://www.wildhorse-innovations.com/
Model Engineers Digital Workshop	http://medw.co.uk/
Authors Website	http://www.altrish.co.uk