Battery Modification to Tormach Digital Height Gauge

Background

Tormach offer a digital height gauge and granite block for ease of measurement of tool heights when using their TTS collet system. The TTS collet is inverted and inserted into a hole in the granite block and the height of the tool tip relative to the block surface can be measured for entry into the tool table on PathPilot.

As an option you can also purchase a small interface dongle that connects the height gauge via a USB connection directly into the PathPilot controller. This allows direct data entry of the tool heights to the tool table. This is a nice facility and avoids possible human typographic errors when copying and manually entering the data.

There is one slight disadvantage to the version that I purchased. While the dongle works well in transferring the data, the dongle does not power the digital height gauge. Instead a 3V coin cell has to be inserted into the digital height gauge. This concept works fine but my gauge had a propensity to eat batteries at an alarming rate. It seemed strange to me that the dongle box was being powered by the USB connection yet this potentially available power source was not being used to transfer remote power to the digital height gauge. Such a facility would clearly need a voltage reduction from 5V to 3V and perhaps this essential conversion was not being implemented in the dongle. I decided to investigate this further.

Inspection of the Dongle Box

The bottom of the dongle box can be removed by removing the four screws in the base. Once these are removed the back side of the internal printed circuit board can be seen. Carefully pull back the two connecting leads through their respective grommets to allow access to the front side of the board. Note also that in this process the three blue button extension rods for activating the printed circuit board switches may fall out and care should be taken not to lose them.

On inspecting the front side of the printed circuit board, the incoming cable from the computer USB connector can be seen to have the standard four wire connection to the circuit board. The colour coding for USB cabling is as follows : -

Pin 1	-	Red	+5v supply
Pin 2	-	White	Data -
Pin 3	-	Green	Data +
Pin 4	-	Black	Ground (0v)

When inspecting the outgoing cable to the digital height gauge interface connector there were only three connections made to the printed circuit boards with the +5V power connection (Red) not being made and left cut short and floating. This is understandable if there was no voltage reducing circuitry to transform the incoming 5V to the necessary 3V needed by the digital height gauge.

Conversion to External Power

The first aspect that now needed to be checked was whether a 3V feed out of the dongle box to the digital height gauge via the red and black wires would indeed power the digital height gauge. Rather than mess with the dongle box existing wiring, this was checked using an old USB cable with its end cut off to allow an easy connection to the red and black cables. Sure enough a 3V fed to the digital height gauge via these two wires powered the gauge up successfully with no obvious negative effects.

Having proved that a 3V feed from the dongle box was a solution, there needed to be a 3V power source inside the dongle box feeding the red outgoing wire. There are two possible ways to achieve this. The simple way is to simply tap off the incoming 5V supply to the dongle box from the USB source and reduce this to around 3V by inserting a series component. This could be a resistor but an easier way is to put a number of diodes in series in the lead from the 5V incoming source and connect these to the 3V outgoing lead. Care is needed in the choice of diodes but the power demand by the digital height gauge is so small that standard 1N4148 devices will suffice. As these drop around 0.6V per diode, two of these in series will do the trick albeit giving a slightly higher voltage than ideal. If the voltage is very high the display will do funny things.

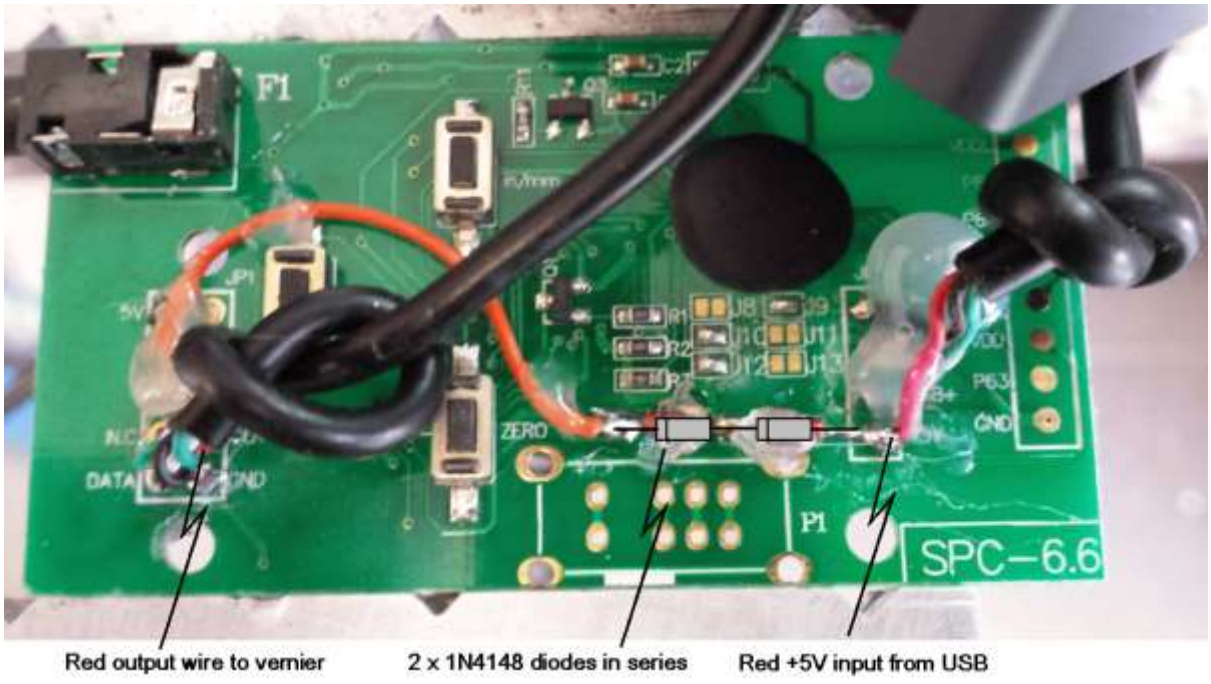
The more elegant solution is to use a small regulator integrated circuit and a favourite for this is the ASM1117 regulator integrated circuit. This is a simple 'three legged' regulator device having an input, output and ground connection and needing only input and output decoupling capacitors to ensure stability and noise rejection on the output supply. The AMS1117 has a wide tolerance of input voltage and can be bought with a very wide range of fixed output voltage options. Three useful values are 3V (for this application), 3.3V for Arduino projects and 1.5V for single button cell supply replacement. (I have actually built one of the 1.5V versions into a shell the size of a LR44 cell).

While it is a simple matter to 'birds nest' the AMS1117 and its decoupling capacitors there is a further elegance available via EBay where a complete printed circuit module can be purchased with input and output connectors and all the components mounted ready to go including a LED.

Implementation

Simple Solution

Looking at the dongle printed circuit board, trace the red 5V input connection on the incoming USB cable termination pads. Solder two 1N4148 in series and hot glue these to the printed circuit board in an area that will not damage or affect the operation of the dongle electronics. Connect one end of the diodes to the 5V incoming supply and the other end to the outgoing supply wire on the digital height gauge interface cable (also red and not connected as standard). This will found cut short in the output cable. Care is needed to strip the insulation on this red cable so as not to damage the other connections.



At this stage, with the digital height gauge not connected, carefully power up the dongle box from a USB computer source or from a USB mains charger. Measure with a voltmeter that the output voltage feed that will be going to the digital height gauge is sitting between 3V and 3.6V. If it is higher than this then add another diode in series. If all looks good, connect the digital height gauge and check it functions on its new external power supply. Particularly important is the contrast on the LCD display characters which is voltage dependent.

Elegant Solution

This is a repeat of the simple solution except the AMS1117 module is connected in place of the diodes and with the addition of a 0V connection to the dongle electronics. Note that to minimise height it is worthwhile snipping off or not fitting the input and output pins on the AMS1117 module. If already fitted it is best not to try to remove these pins as this can damage the through-hole plating of the connector printed circuit board mounting holes so just snip them shorter.

Find a suitable place to hot glue the board in place on the dongle printed circuit board and connect the incoming 5V and outgoing 3V feeds with the additional connections for 0V. The image below shows the where I located the power supply module and how I connected the +5V and 0V connections directly to the incoming USB cable connections and likewise the outgoing 3V connections also direct to the cable terminations.

Once the mounting of the board is completed and the connections made, repeat the functionality check before connecting to the digital height gauge.

Reassembly

Once either solution is electronically completed and successfully powering the gauge then the dongle box can be reassembled (not forgetting the three switch extension rods).

Note you no longer need to fit a button cell in the height gauge but bear in mind this will still be needed if you plan to use the digital height gauge 'off line' without the dongle box. Providing you use the 'elegant' solution where the externally fed voltage is 3V, leaving a battery in place and still powering externally from the dongle box does not seem to lead to any damage to the gauge or the battery.

One additional modification which can be done at this stage is to add a mounting plate to the box lid. I used a thin sheet of nickel silver that picked up on the lid retaining screws. This allows the dongle to be fastened to a bench or wall. Without this I find the box tends to wander around while trying to press the various function buttons.

Conclusion

This is a simple but useful modification to the digital height gauge. Both methods as described work equally well and clearly the choice is yours on which method you chose.

That being said, the elegant method is to be preferred. The AMS1117 and its decoupling components provide more protection to the digital height gauge electronics should there be noise or power surges for any reason on the incoming 5V supply from the USB port of the PathPilot controller.

Disclaimer

While you may find the modifications as described a useful enhancement to your dongle box, by opening the dongle box and making modifications to the dongle enclosure or electronics in any shape or form will almost certainly invalidate your warranty with the supplier. You need to consider this together with your ability to be able to successfully undertake any modifications.