Hall Effect Limit Switches

12/26/09

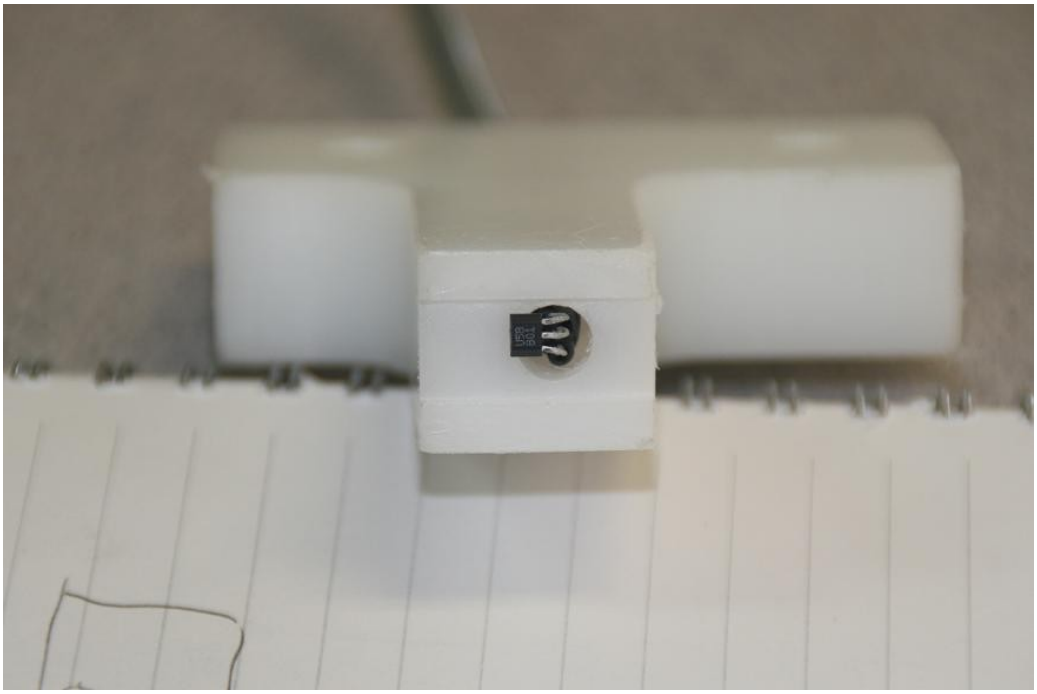
A Hall Effect (HE) transistor switches when in the presence of a magnetic field. They can be used to replace micro-switches to implement very accurate and reliable limit switches on a CNC machine. However, if the machine is used to cut ferrous metals, the swarf will be attracted to the magnets which will interfere with the trigger point of the switch. Therefore, they should only be used on machines that do not cut ferrous metals.

I recently implemented HE limit switches on all three axes. The repeatability of these switches is better than I can measure with a dial indicator which means they are performing better than 0.001". I chose to make the magnet stationary with the HE mounted to the moving carriage (you could also make the switch permanent and the magnet mobile if you prefer). I placed at each end of the axis, thus only one switch was required per axis thereby reducing wiring (except for the x-axis…more about that later).

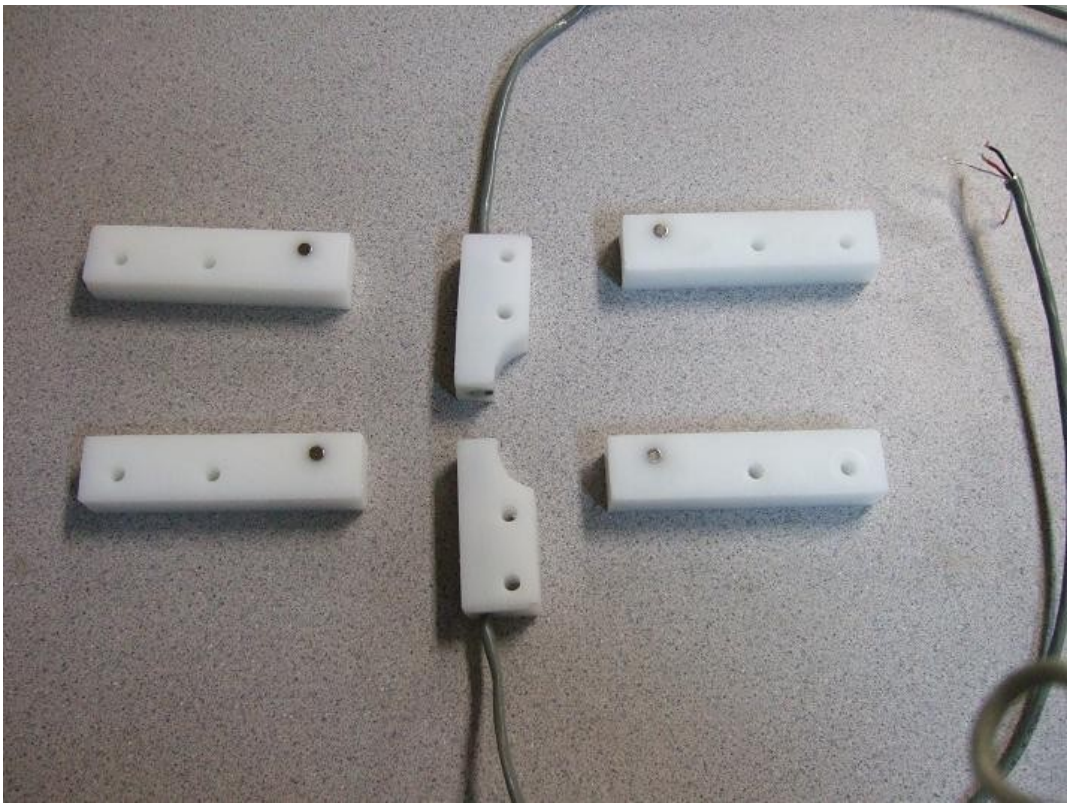
The HE switches I use are Melexis part # US5881LUA. I purchased them from Digikey. I used ¼" diameter by ¼" tall rare earth magnets. I purchased those on e-bay. Note that this HE switch is unipolar, meaning that only one of the magnet poles will trigger the switch, so care must be taken when orienting the magnet.

I fabricated the mounts for the HE switches and the magnets from HDPE. The HE switch requires three wires: Power (I used the +5VDC that also powers the BOB), Ground, and a signal wire which is the output from the device. I also used shielded cable to reduce noise. It is recommended that a 0.1 uF capacitor be placed across the power and ground as close to the HE switch as practical. Below is a photo of the connections I made:

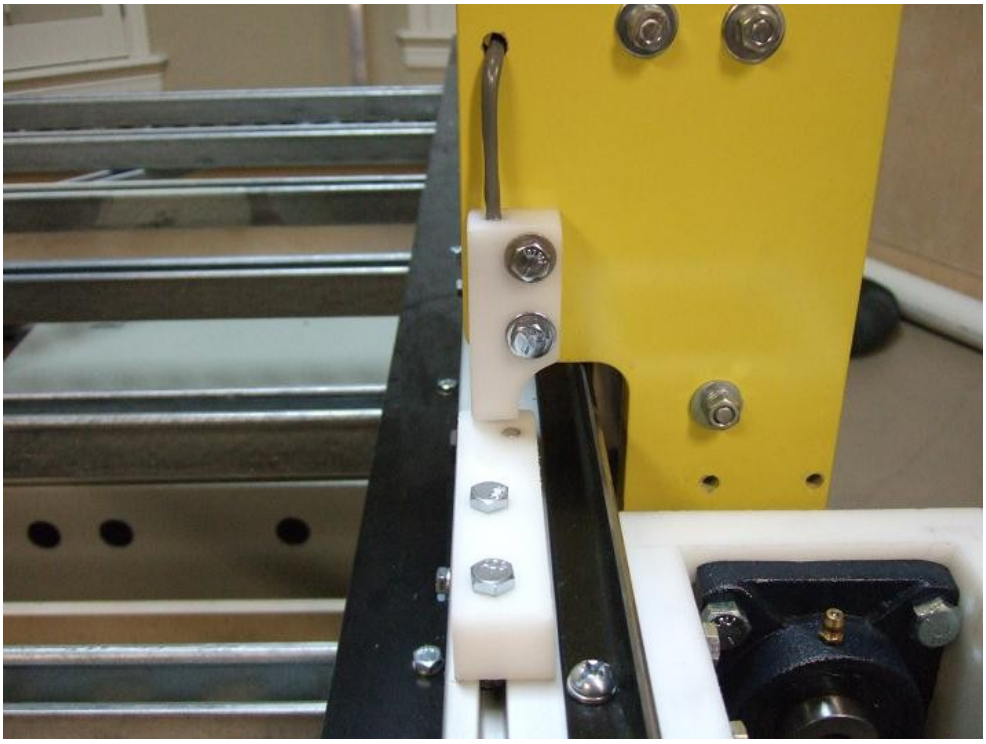
I then bent the HE leads and epoxied the HE switch and a portion of the cable in the HDPE mount as shown below (photo is prior to epoxy):



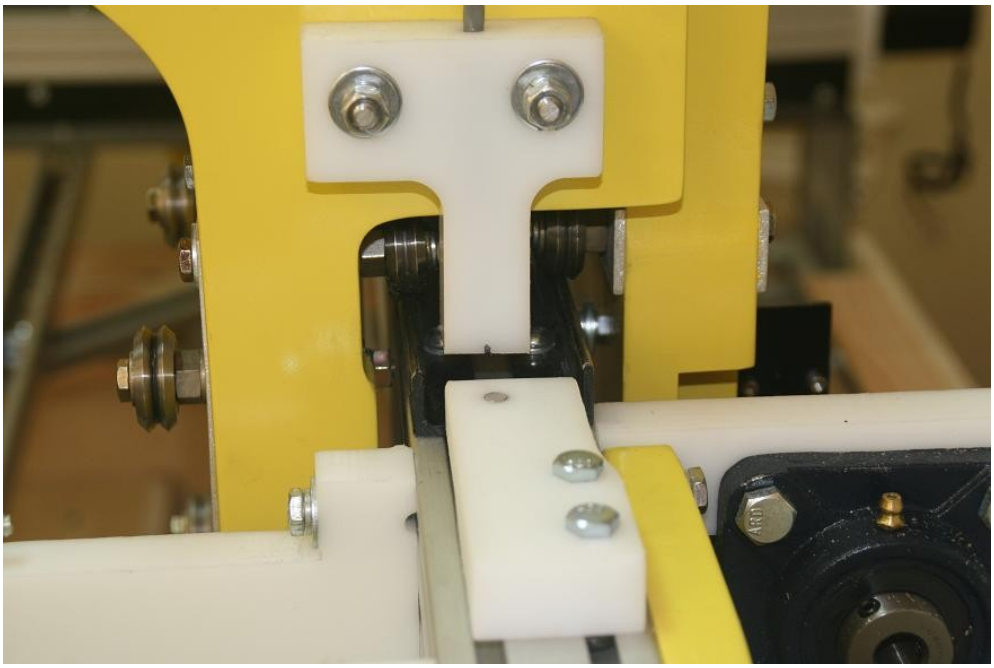
The button magnets were also glued into HDPE. Pictured below are 2 sensors and 4 magnets:



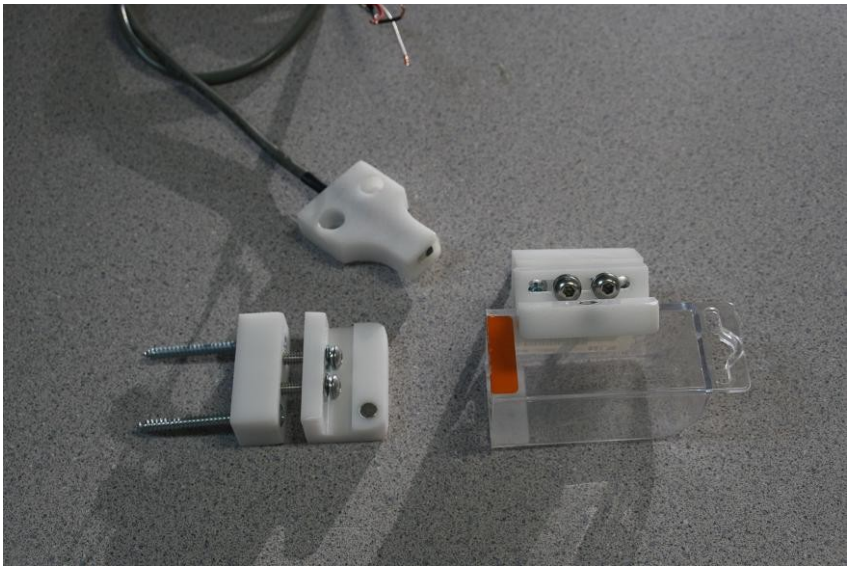
The photo below shows the magnet mounted to the 8020 and the HE sensor mounted to the y-carriage:



There was no good way to mount a magnet on the x-axis and allow the carriage to over-run it so that a single sensor could be used. I therefore used an HE switch on each side of the x-carriage and wired all the connections in parallel. Therefore, they appear as a single HE switch when connected to the BOB. Here is a photo of one side of the x-carriage with the HE switch and magnet.



The switches for the x and y axes can be adjusted simply by sliding the magnet back and forth in the 8020 slots. The z-slide mounts were more complicated to make in order to allow for adjustment. Here is a photo of the z-axis mounts:



Here is a photo of the z-axis with the switch installed:

Connections at the BOB are simple. Connect the BOB power (I used +5 VDC), the BOB signal ground, and he output of the HE sensor to a BOB input pin. You must add a pullup resistor connected between power and the input signal (I used a 1 Kohm resistor). Configure Mach as Active Low for the input. When the HE switch is above the magnet, the output will be in the low state and will be in a high state when off the magnet.