Hall Effect Sensor Circuit

ME218B 2017, Team 4

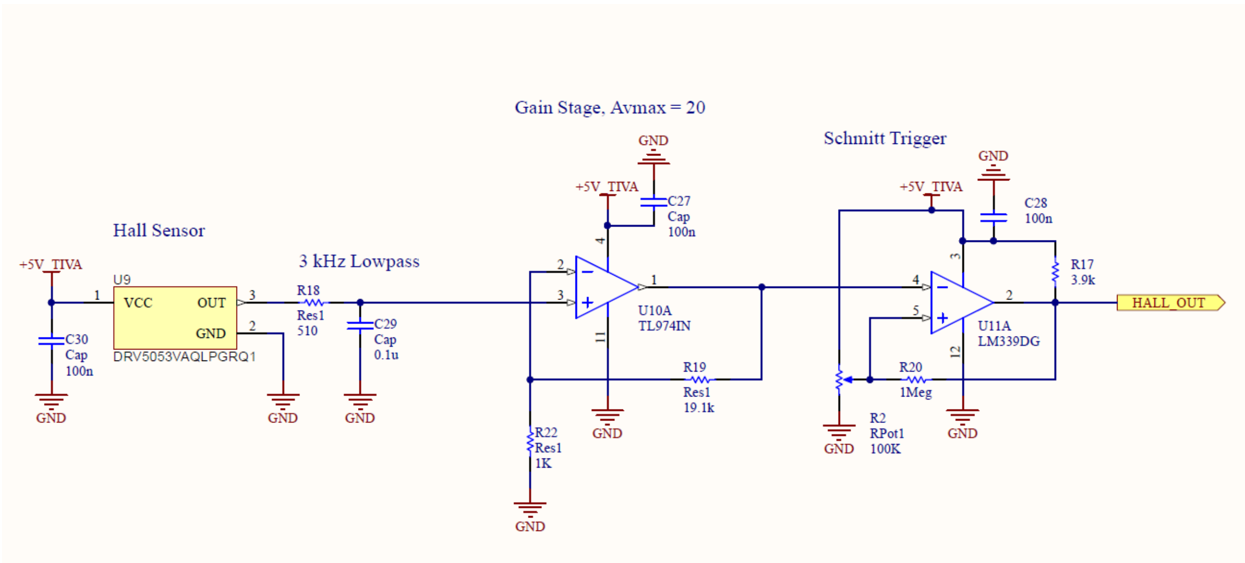

Figure 1: Hall Effect Sensor Circuitry drawn with Altium

We used a DRV5053 Hall Effect Sensor to detect the frequency of the magnetic field produced by the coils at the staging locations in the game field. Our Hall effect sensor circuit has three stages.

The first stage is a lowpass filter to filter out high frequency noise. The highest frequency signal of interest is at 2 kHz, so we set the cutoff frequency of our low pass filter to be about 3 kHz.

With the components shown, $R = 510\Omega$, $C = 0.1\mu F$, calculation of the frequency is as follows:

$$f_{cutoff} = \frac{1}{2\pi RC} = \frac{1}{2\pi * 510\Omega * 0.1\mu F} = 3120 \text{ Hz} \tag{1}$$

Next stage adds gain to the filtered signal from the previous stage, given the components we have, the maximum gain (set by having a potentiometer at R19) of this non-inverting amplifier stage is

$$G = 1 + \frac{R19}{R22} = 1 + \frac{19.1k\Omega}{1k\Omega} = 20.1 \tag{2}$$

A TL974 Rail-to-Rail OPAMP was used instead of the LM324 stocked in the lab in order to allow for a higher gain, since the LM324's output saturates at around 3.8V.

In the last stage, we use an LM339 Schmitt Trigger convert the amplified signal to a square wave so that we can use Tiva's input captures to measure its frequency. The thresholds of the Schmitt Trigger are set by a potentiometer, which was tuned on the game field to obtain optimal sensitivity over the entire magnetic coil while still keeping the circuit immune to noise.