6.2 Speed Sensor Design

Speed sensors are required to measure the rotational speed of the two rear drums. For the application, RPR-220 infrared photoreflectors were used as they allow for reliable contactless speed measurements. The RPR-220 unit was also readily available, inexpensive and would work with the Raspberry Pi's GPIO pins.

Table 6.1: RPR-220 Data Sheet Parameter Summary

(RPR-220)

Parameter	Condition	Value
LED Current	Maximum	50 mA
LED Voltage	Rated	5 V
Phototransistor Current (Dark)	Rated	0.5 µA
Phototransistor Current (Light)	Rated	0.8 mA
Phototransistor Current	Maximum	mA
Phototransistor Response Time	Rated	10 µs

The Raspberry Pi is capable of measuring inputs using the standard Rpi.GPIO library up to 5 kHz. Since the maximum expected drum rotation speed is 3500 rpm, which equates to 66.6 Hz, the sensors would be capable of handling up to 75 segments per revolution. Considering a safety factor and in order to reduce the data burden, a sensor system implementing 60 segments was selected to ensure high enough resolution at low speeds.

The LED circuit limits the current to 42 mA with a 120 Ω resistor. The circuit is powered through the CKCY Buck03 5 V buck converter. The LED is powered by an external power source to avoid damaging Raspberry Pi's GPIO pins, and to allow for it to operate at 5 V. The phototransistor lets 0.8 mA pass if 100 % of the transmitted light is reflected. A voltage divider circuit was used to achieve a 3.3 V reading on the output to the Raspberry Pi GPIO pin, where the resistance value was determined with equation 6.1.