04.3 Measuring motor position and velocity

1 Motor position and angular velocity are best measured by rotational quadrature encoders. Rotational encoders are made from a wheel with alternating dark and light stripes called lines. The encoder we have affixed to the rear shaft—the HP HEDS-5640-A06 with manual

`ricopic.one/resources/encoder_manual.pdf`

—has black lines on clear plastic. A light source either reflects differently off the stripes or, as in our case, passes the light through the clear plastic wheel into a photodiode or is blocked by the black stripes. Each time a stripe passes by, the photodiode detects a "blink," which is passed on to the myRIO via digital channels of the myRIO configured for detecting encoder outputs.

2 The encoder pinout is shown in Fig. 04.1, from the manual.

Quadrature encoders

3 The only issue remaining is that a given "blink" doesn't give one important piece of information: which direction the encoder is rotating. However, a clever technique called quadrature encoding can be used to determine direction. If we offset one of the two

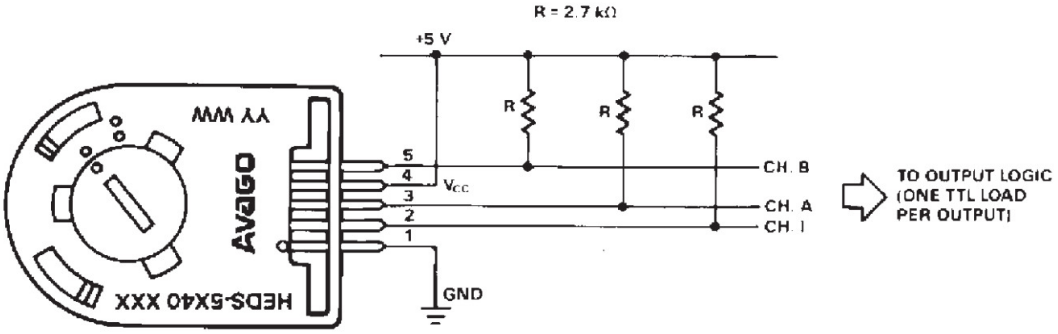

Figure 04.1: the encoder used (source: HEDM-55xx/560x & HEDS-55xx/56xx Data Sheet).

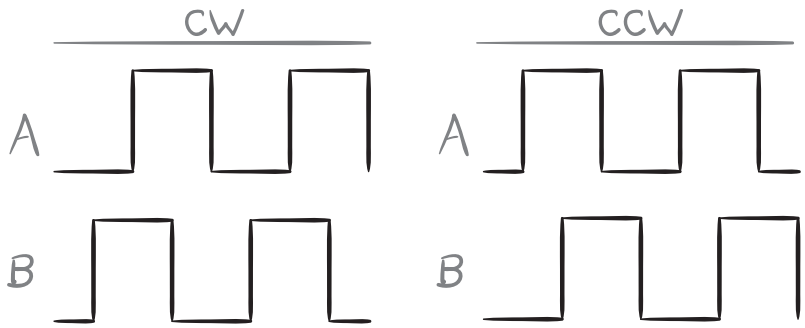

Figure 04.2: quadrature encoding with channels A and B.

sources/detectors by half of a stripe width, then measure both "channels" A and B, then the direction can be determined by which channel "leads" the other. For instance, in Fig. 04.2, the encoder output is high when light is detected and low when it is blocked by a stripe. Channel A leads B when the encoder is rotating clockwise (CW) and B leads A when it is rotating counter-clockwise (CCW).

4 Note that this also gives us better resolution in that we detect four blinks per line. So a 500 line (CPR) quadrature encoder changes state $4 \times 500 = 2000$ times per revolution.