# KES line sensor build for use with V1.3 main PCB and RP2040 Pico processor

These 2 pages describe how to build the "1/2 line sensor for Pico" board that shines the sensors through the v1.3 main board when using it with a python based RP2040 CPU that only has 4 Analogue to Digital converter inputs

The normal build for the Arduino Nano CPU has 4 central line sensors plus the 2 side marker sensors. For this build we will just use 2 of the central line sensors plus the 2 side marker sensors. The RP2040 CPU runs at 3.3 volts, so we will adjust some of the normal resistor values. Also, because we are using less LEDs at a lower current, we will use just one transistor to switch the LEDs instead of two.

The image shows the top view of the reduced build needed
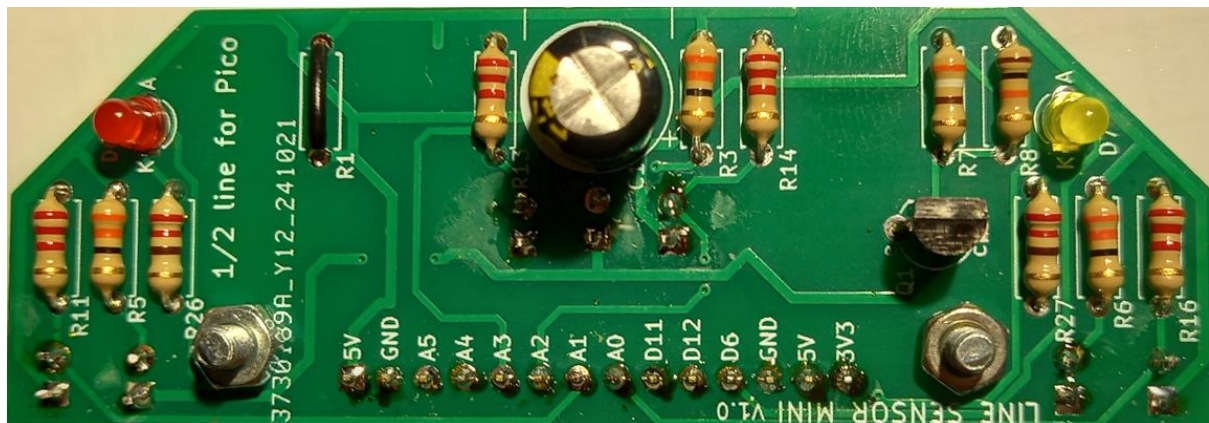
Here are the build instructions for the components mounted on the top of the board. Start with adding one plain wire connection which replaces R1. Next add the 3 LED resistors R3, R5 and R6 using 33 ohm values (marked orange, orange black). Then add the 4 phototransistor resistors R11, R13, R14, and R16 using 2.2k ohms values (marked red, red, red). Next add the indicator LED resistors R26 and R27 using 220 ohm values (marked red, red, black) then the 2 indicator LEDs D6 and D7 (shown here yellow and red). Next add the two transistor bias resistors R7 value 390 ohms (marked orange, white, brown) and R8 value 10k ohms (marked brown black orange). You can now add the transistor Q1 making sure the outline matched the shape of the device. Finally, add the 470uF capacitor C1 with the negative side on the white area.

This image shows the bottom of the build showing the LEDs and phototransistor sensors

Here are the build instructions for the components mounted on the bottom of the board. Add the 3 illumination LEDs D1, D3 and D5. Make sure the longer leads on the LEDs go into the anode (A) hole. Let the base of the LEDs stand between 3 and 5mm off the board as shown in the image below.

Add the 4 phototransistors Q3, Q5, Q6 and Q8. If using the recommended BPW85 devices the long lead should go in the emitter(E) hole. Finally add the 14 way J1 connector.

This view shows the sensors at a better angle to see the length of the leads on them and also the J1 connector
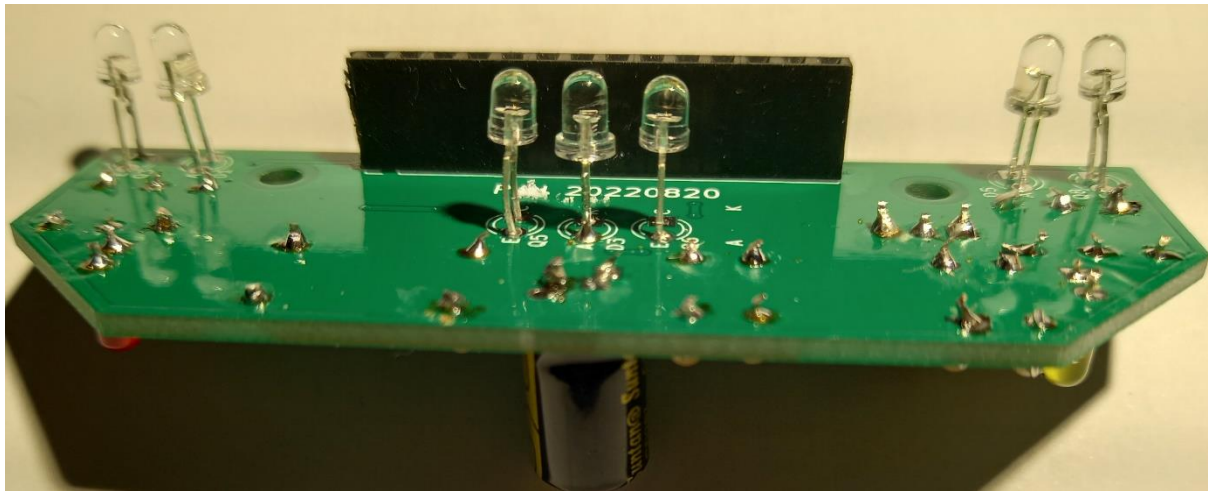
and this shows how the sensors shine through the slots in the front of the main board