Developing UKMARS timer gates & displays

A work in progress

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MINOS 2022

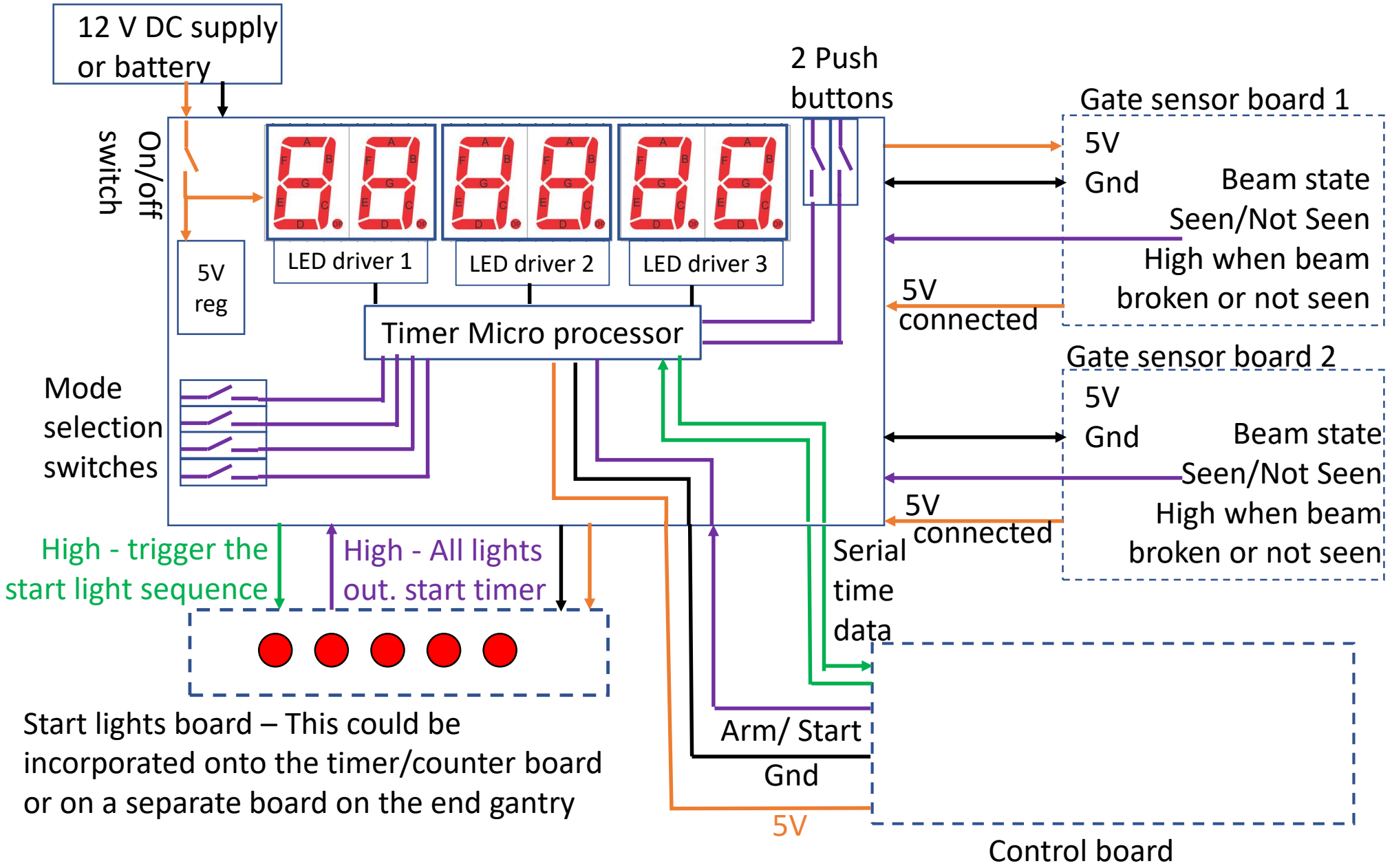
Project objectives

- To make a set of timing gates & displays that could be used for the drag race instead of the BCU ones if needed

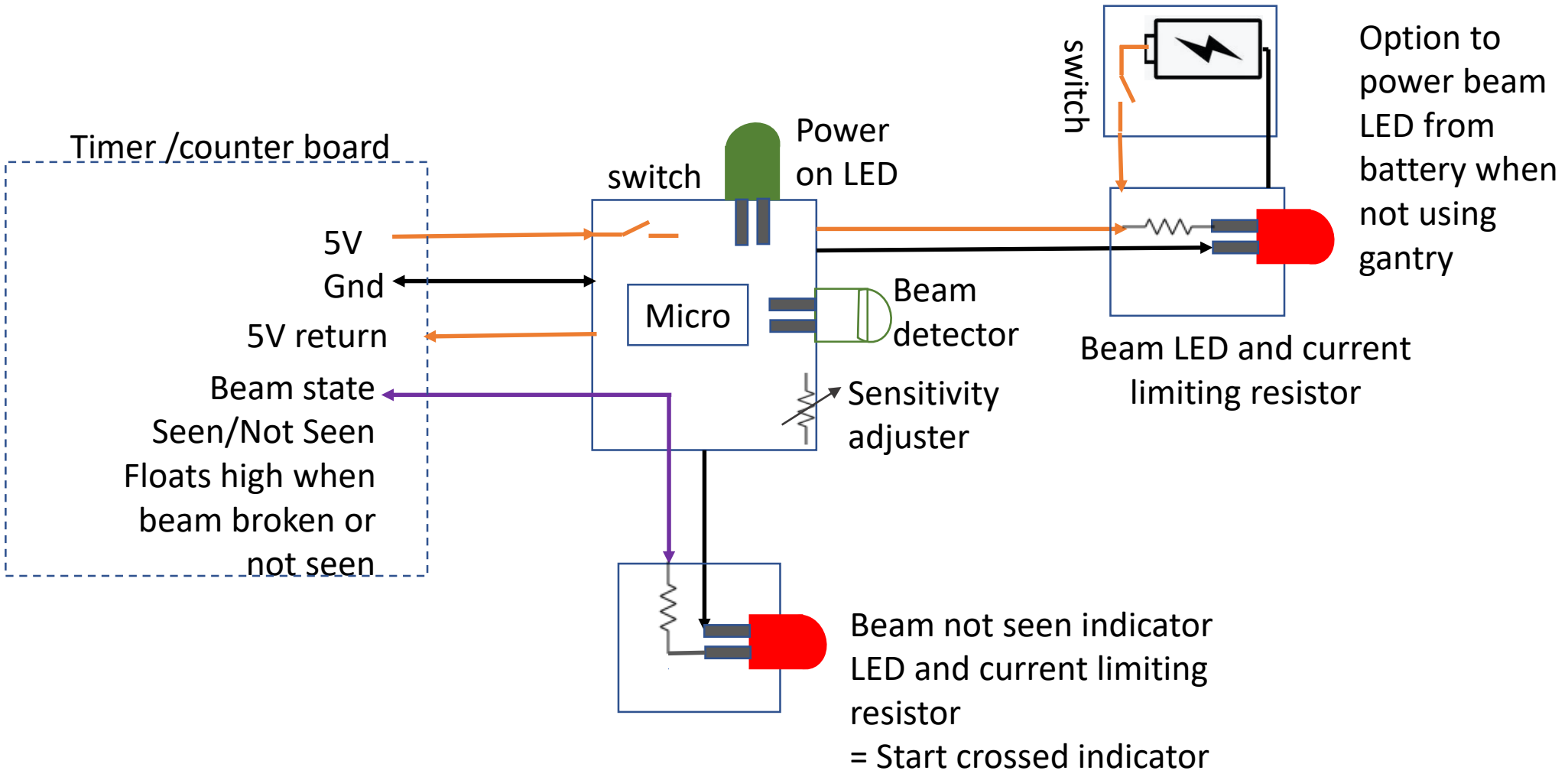
- Able to be used for timing other line following competitions on both full size and half size courses
- A design that could be made by or for members or schools

- For line following it needs one timer display and 2 gates
- For Drag race it needs 2 synchronised timer displays and 4 gates

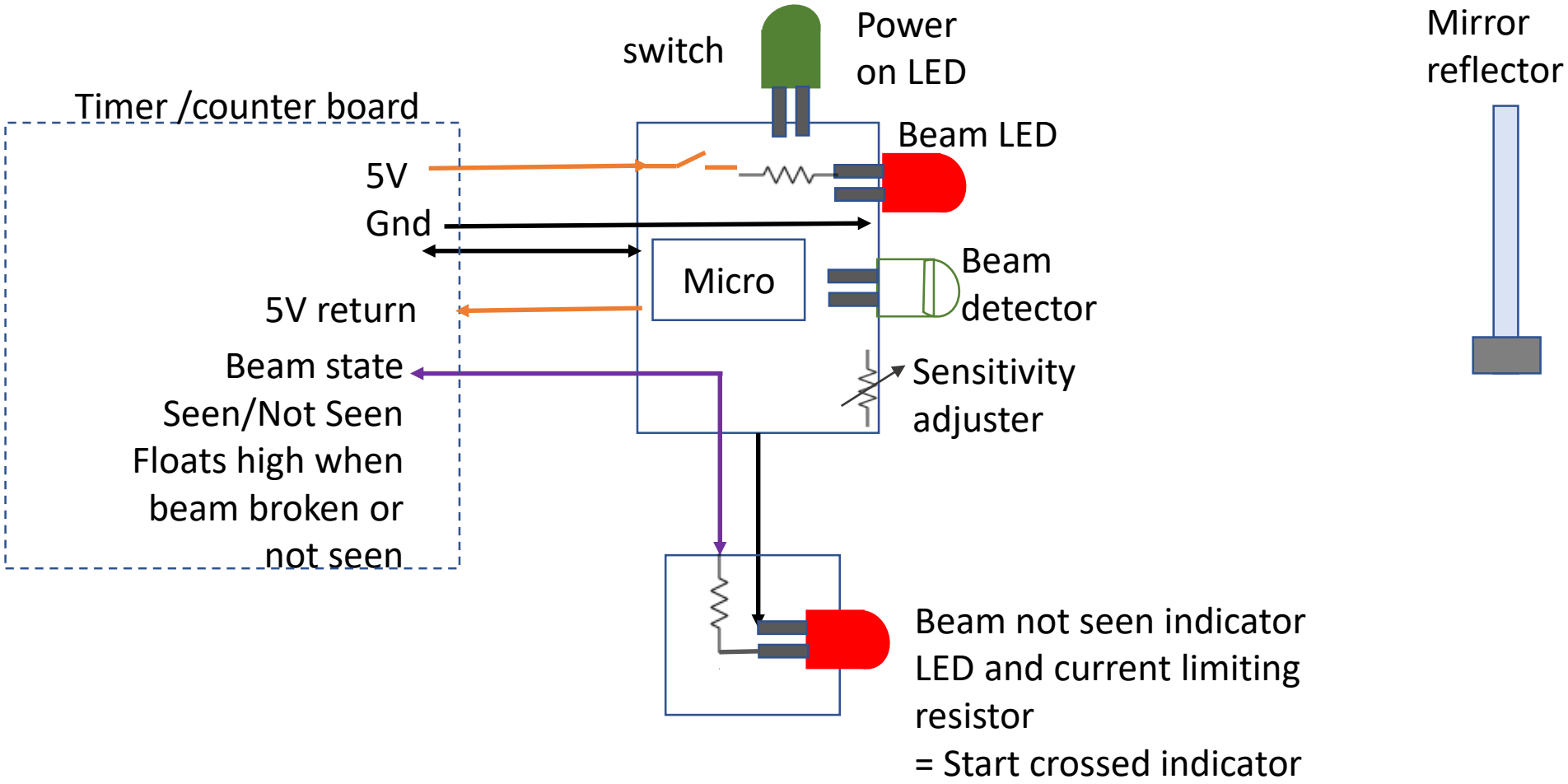
Timer /counter board components and interfaces concept



Standard gate processor board components & interfaces concept



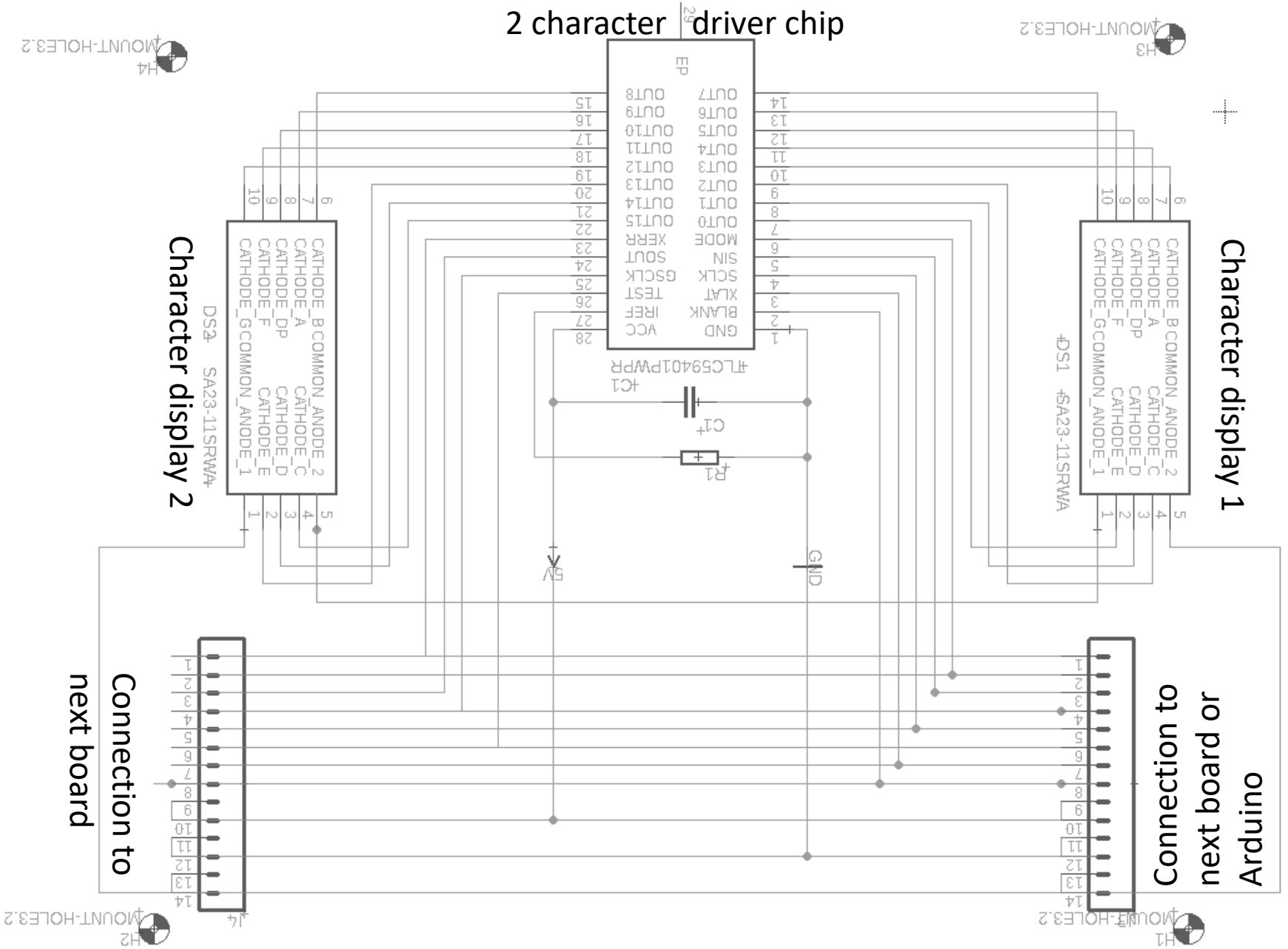
Reflector gate processor board components & interfaces
For ½ size line follower course where not enough room for the beam LED on the course



Starting point for design– a previously home made display using 70 by 47mm 7 segment LEDs built on veroboard

This used one display driver per character, but these chips had an 8 month lead time so we found a different driver chip (TLC 5940) which drives 2 characters and was available

Circuit for 2 character driver board

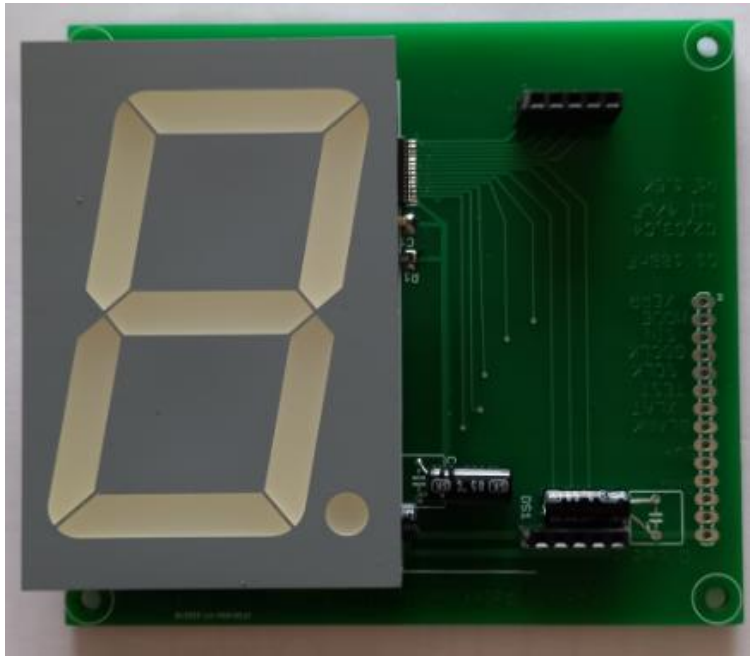


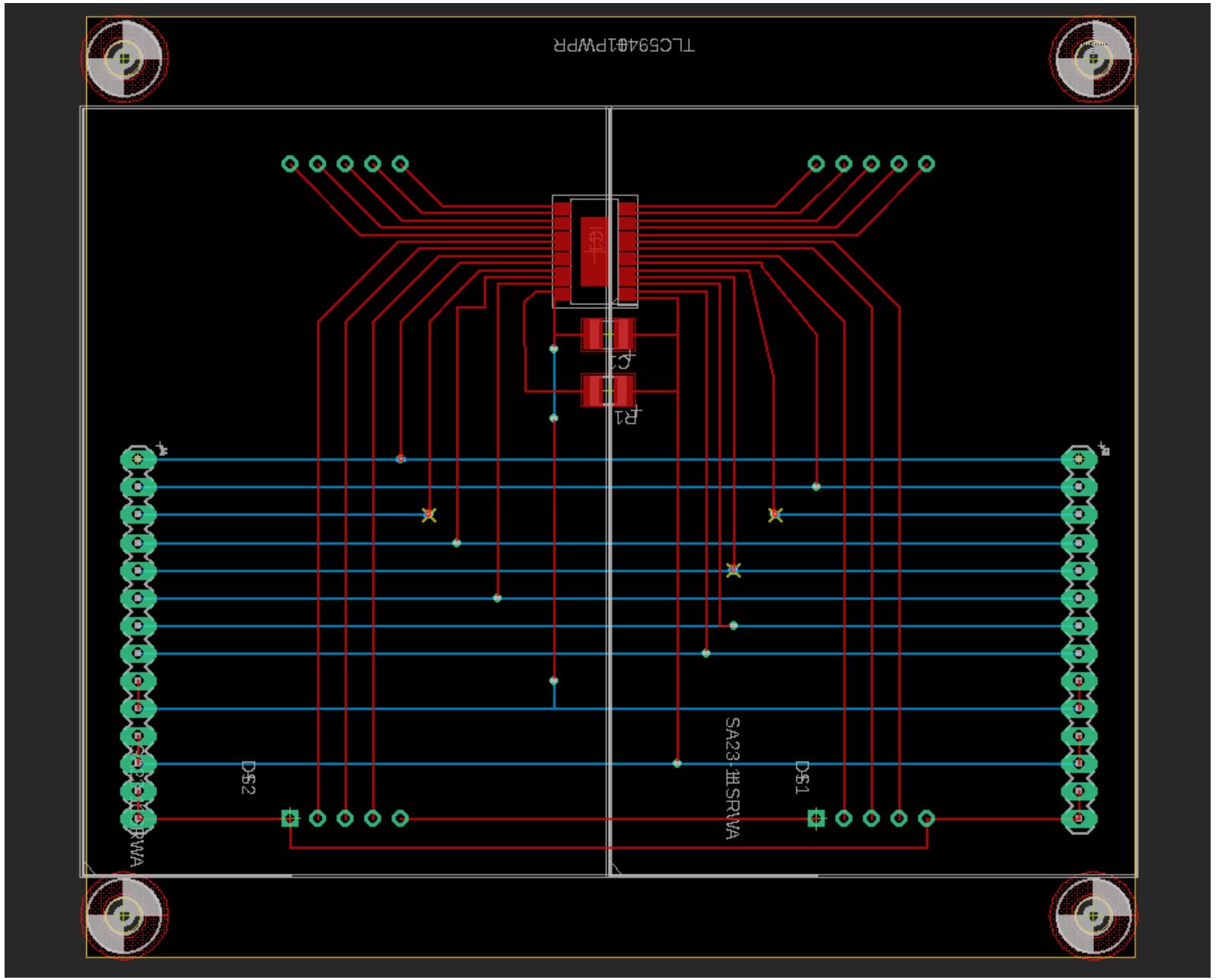
The first board is connected to the Arduino that generates a signal for one driver chip

Subsequent boards are daisy chained together by connectors between the boards

2 character board Layout in Eagle

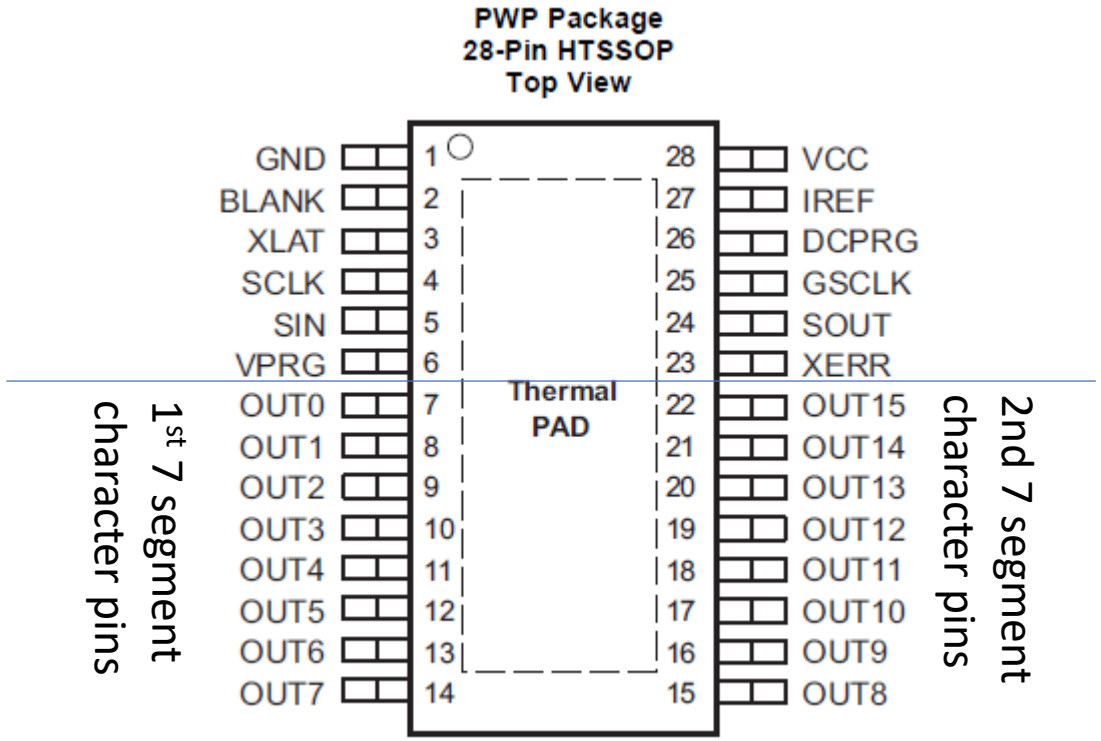
Two 7 character LED displays fit over the driver chip, other components and connections





Pinouts for TLC5940 Driver chip and Arduino Connections

Pinouts for TLC5940 driver chip



- +5V from Arduino -> TLC pin 28 and 26 (VCC and DCPRG)
  - GND from Arduino -> TLC pin 1 and 6 (GND and VPRG)
  - digital 3 -> TLC pin 25 (GSCLK)
  - digital 9 -> TLC pin 3 (XLAT)
  - digital 10 -> TLC pin 2 (BLANK)
  - digital 11 -> TLC pin 5 (SIN)
  - digital 13 -> TLC pin 4 (SCLK)
  - The 1.5K resistor between TLC pin 27 (IREF) and GND will let ~26mA through each LED. To be precise, it's I = 39.06 / R (in ohms). This doesn't depend on the LED driving voltage.

If you are daisy-chaining more than one TLC, connect the SOUT of the first TLC to the SIN of the next. All the other pins should just be connected together:

BLANK on Arduino -> BLANK of TLC1 -> BLANK of TLC2 -> ...

XLAT on Arduino -> XLAT of TLC1 -> XLAT of TLC2 -> ...

The one exception is that each TLC needs it's own resistor between pin 20 and GND.

For the SA23-11SRWA 7 segment character display note that +ve pins 1 and 5 on the display are the 2 outside pins at the bottom of the character - where the decimal point is

Arduino program to drive the displays

It uses the sparkfun TLC5940 library so:
#include "SparkFun_Tlc5940.h"

Tlc.init(); // sets up the driver chip

Tlc.set(channel, brightness); //sets a segment of the display
Channels 0-7 1st char 8-15 2nd char, 16-23 3rd char etc

Tlc.update(); // sends the segment settings to the displays

3 daisy chained display boards driven from an Arduino Nano

The Timing Gates

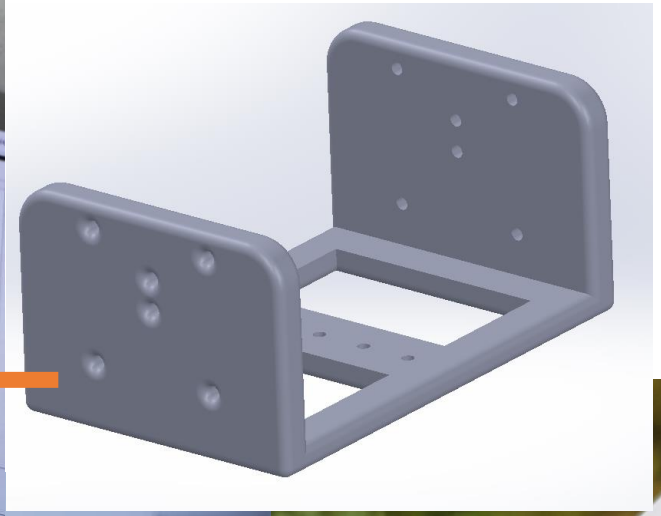
Handing over to Stephen

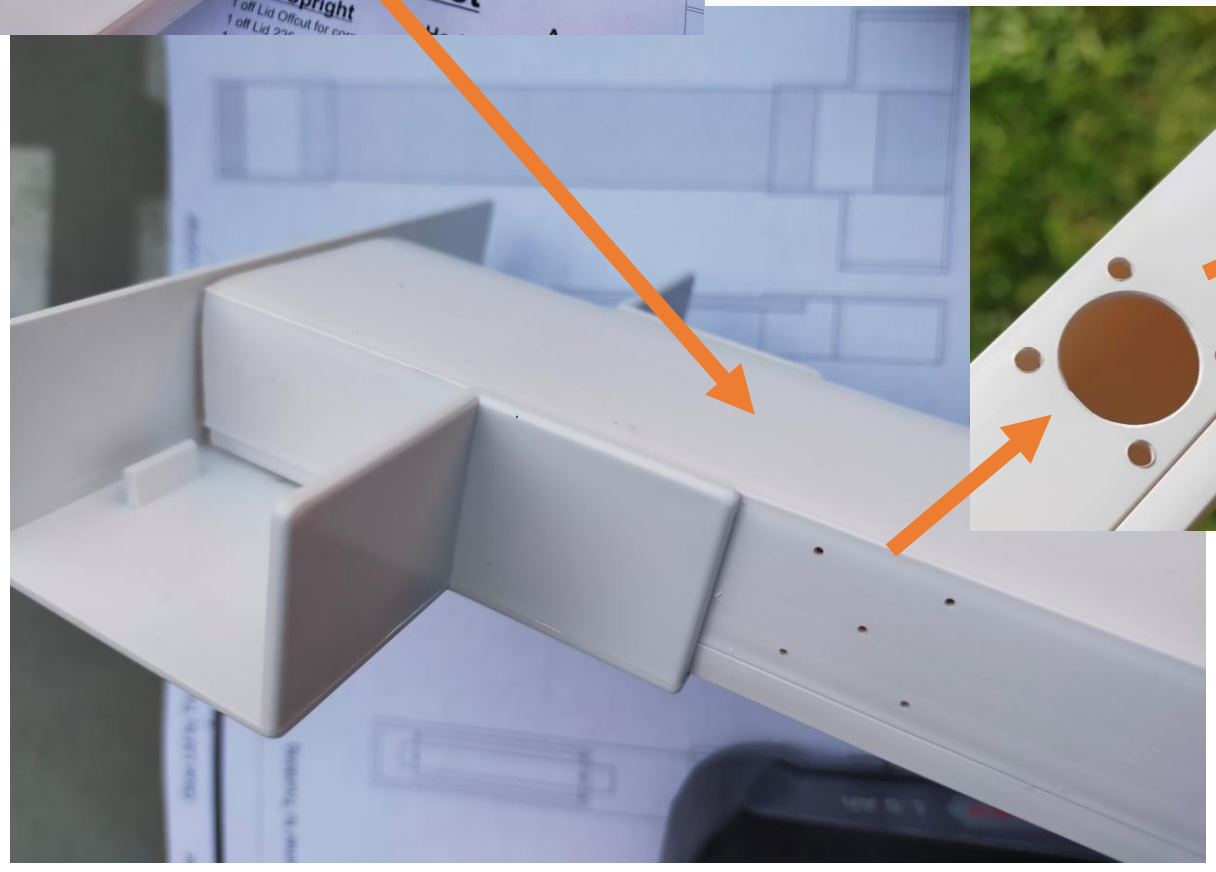
Gantry Design Considerations

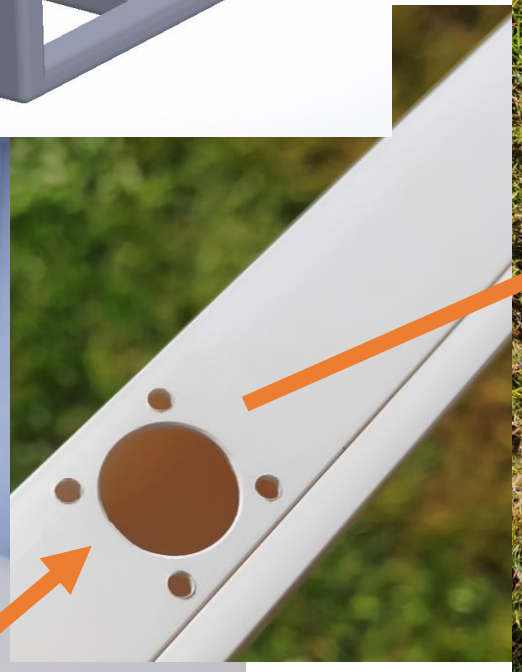
- Generic / Flexible
  - Make each gantry identical
  - Functionality on PCB to accommodate standalone PCB OR flying leads to LEDs
- Interchangeable
  - Cable may be fitted to either side of Gantry (ie. between tracks)
- Robust
  - Solvent glued together (most of it)
  - GX12 Connectors
  - Support bracket behind sockets for strength
  - 2 x connection sockets – added redundancy
- Affordable / Approachable
  - Through-hole components
  - Standardised Resistor values
  - Uses Arduino
  - Common Suppliers – ScrewFix (and eBay)

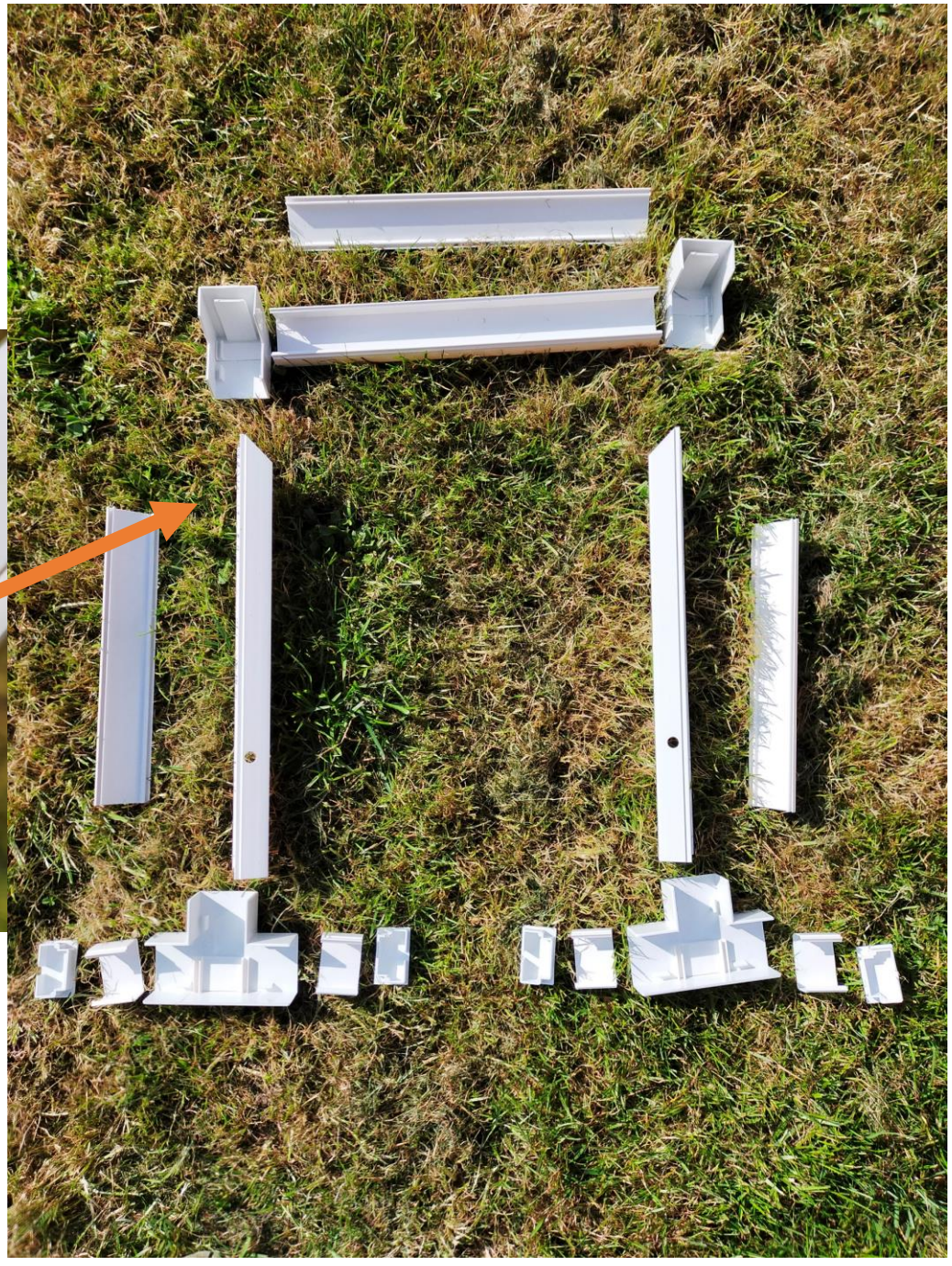
The Result…


Parts List

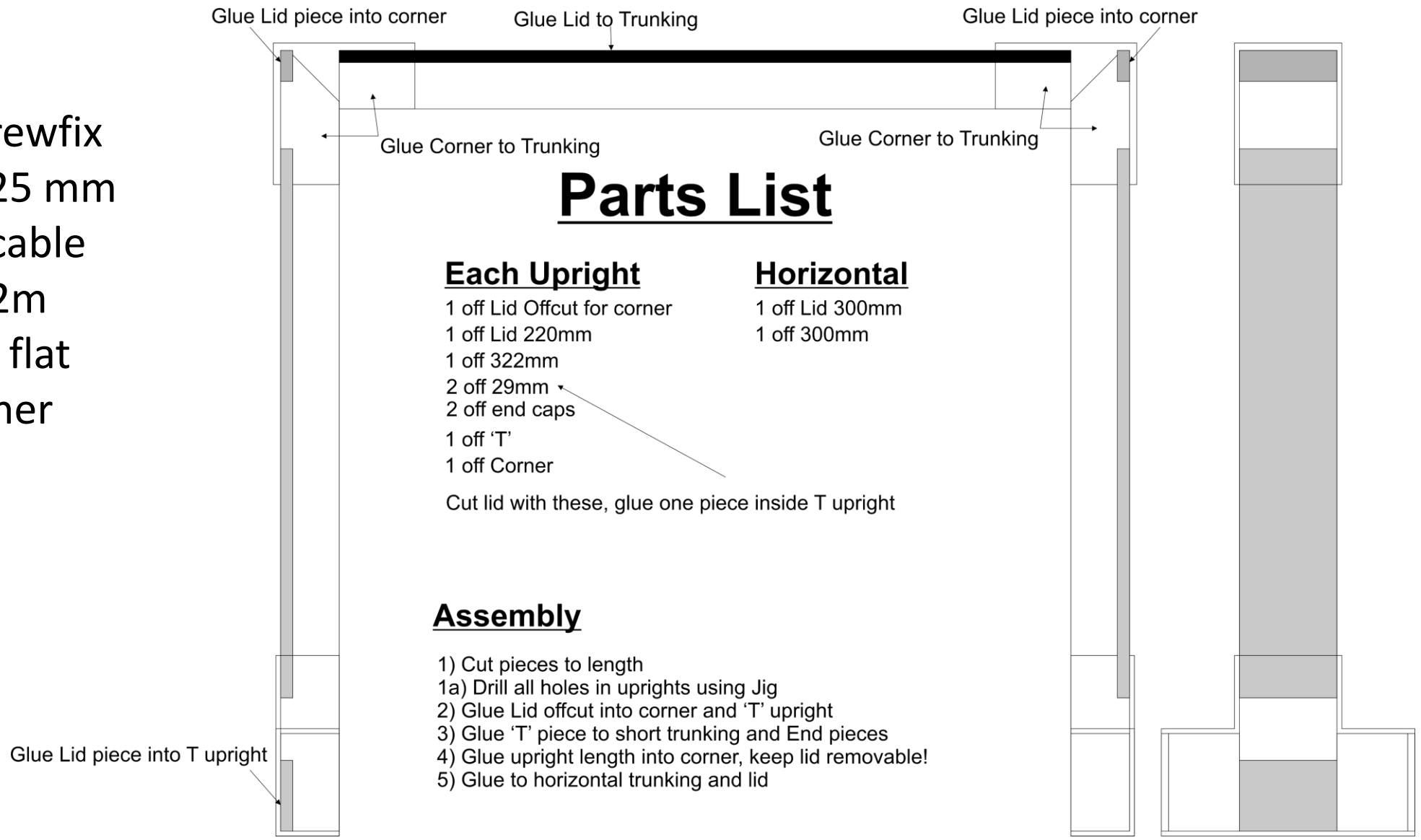




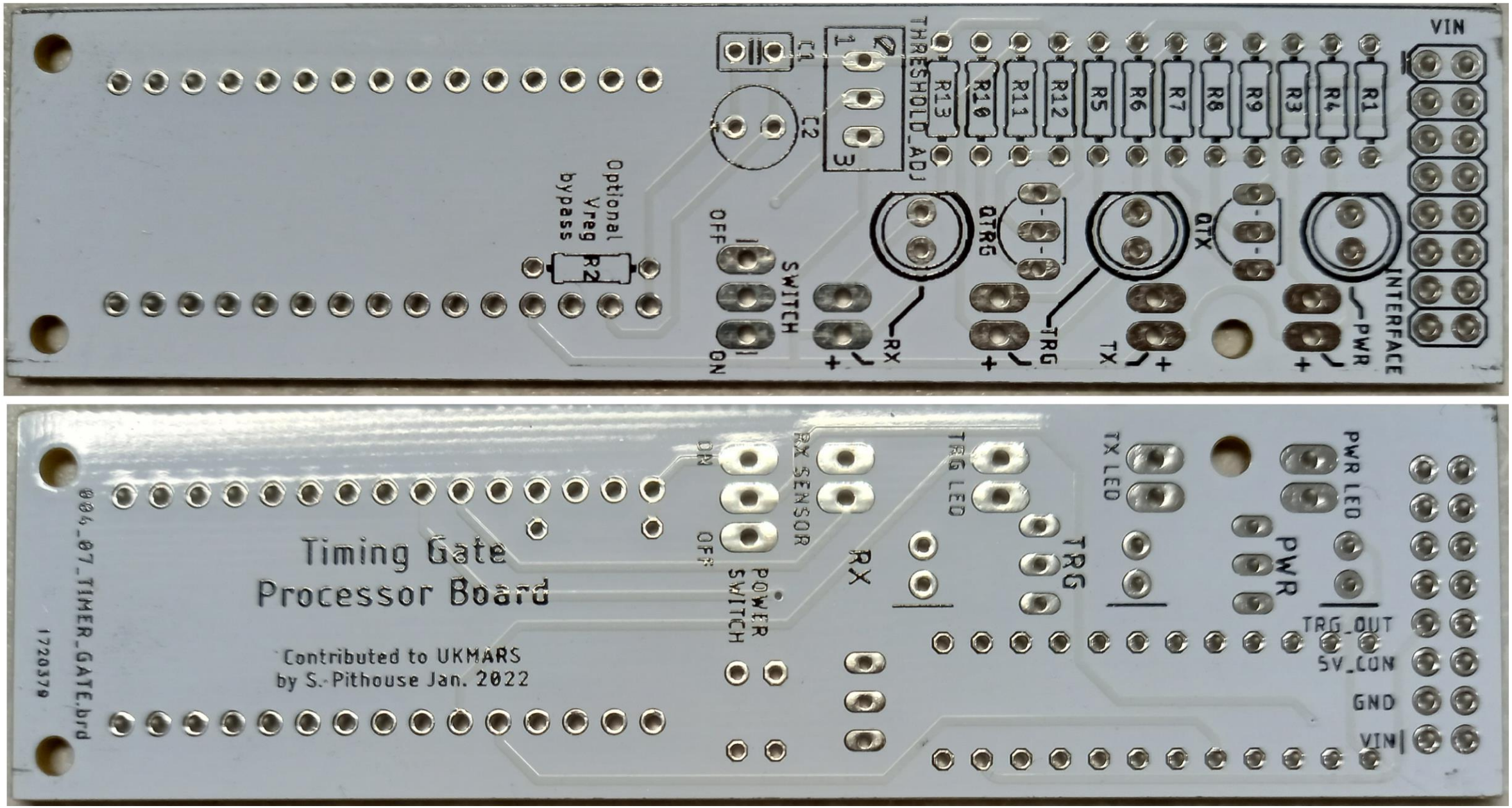




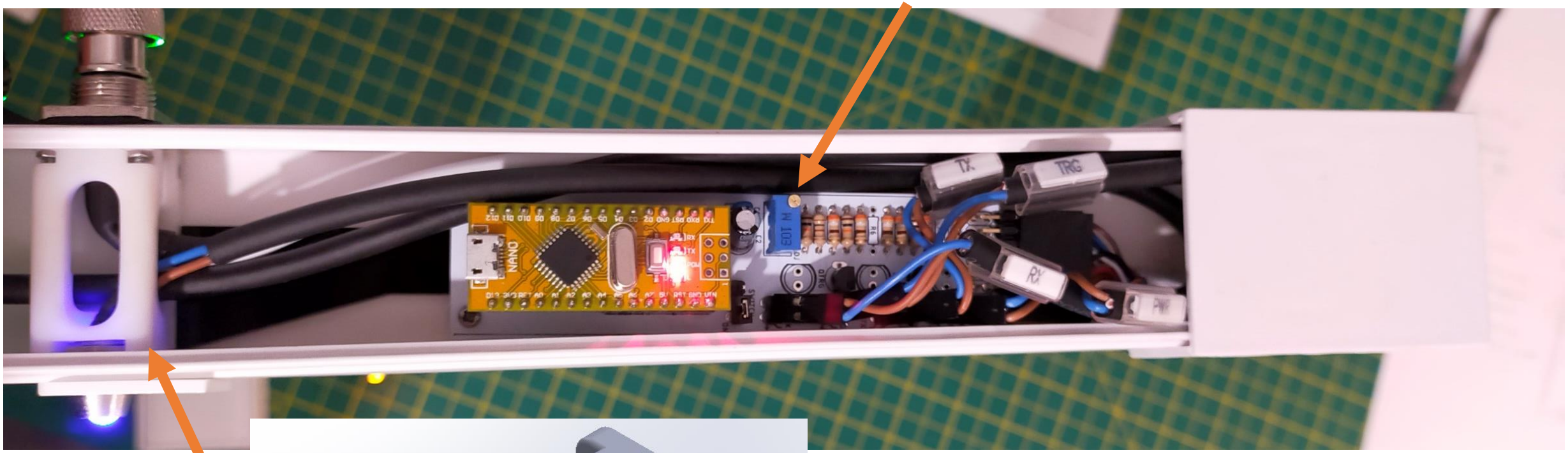
Source – Screwfix
Tower 38 x 25 mm white vinyl cable trunking in 2m lengths plus flat
Tee and corner connectors

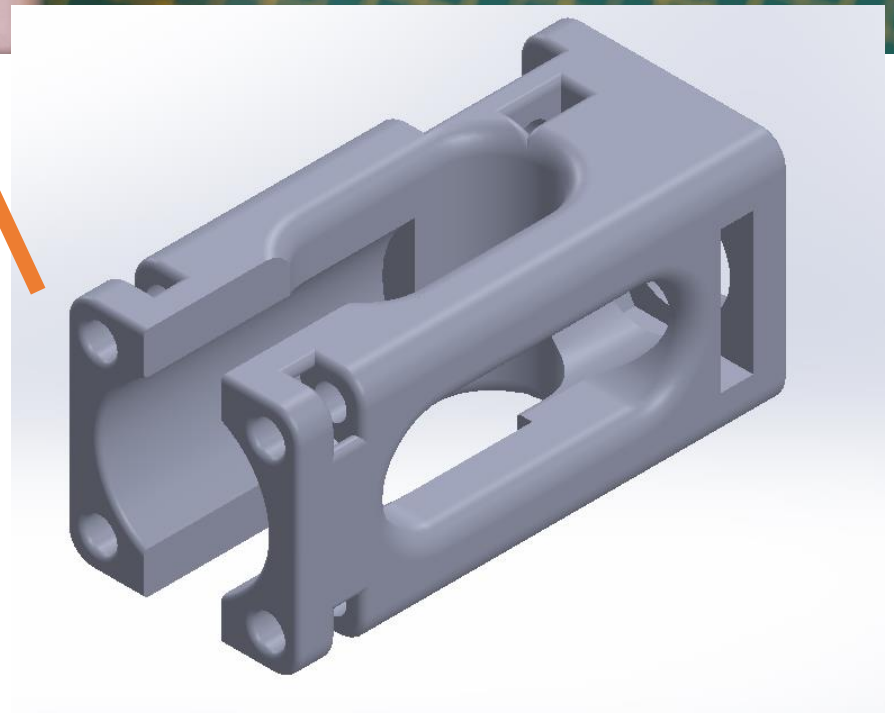


Timing Gate sensor board PCB front & back



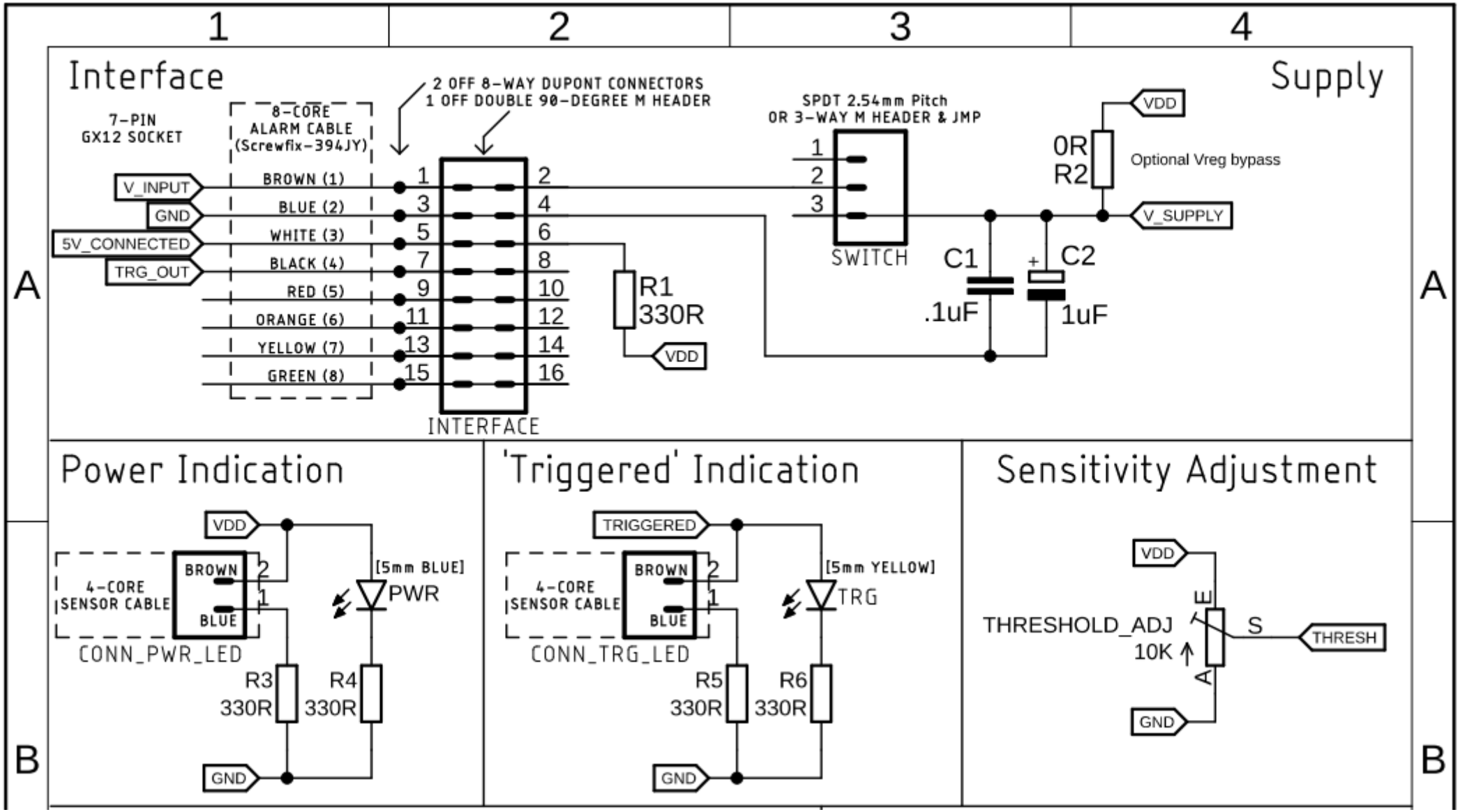
Threshold Adjustment



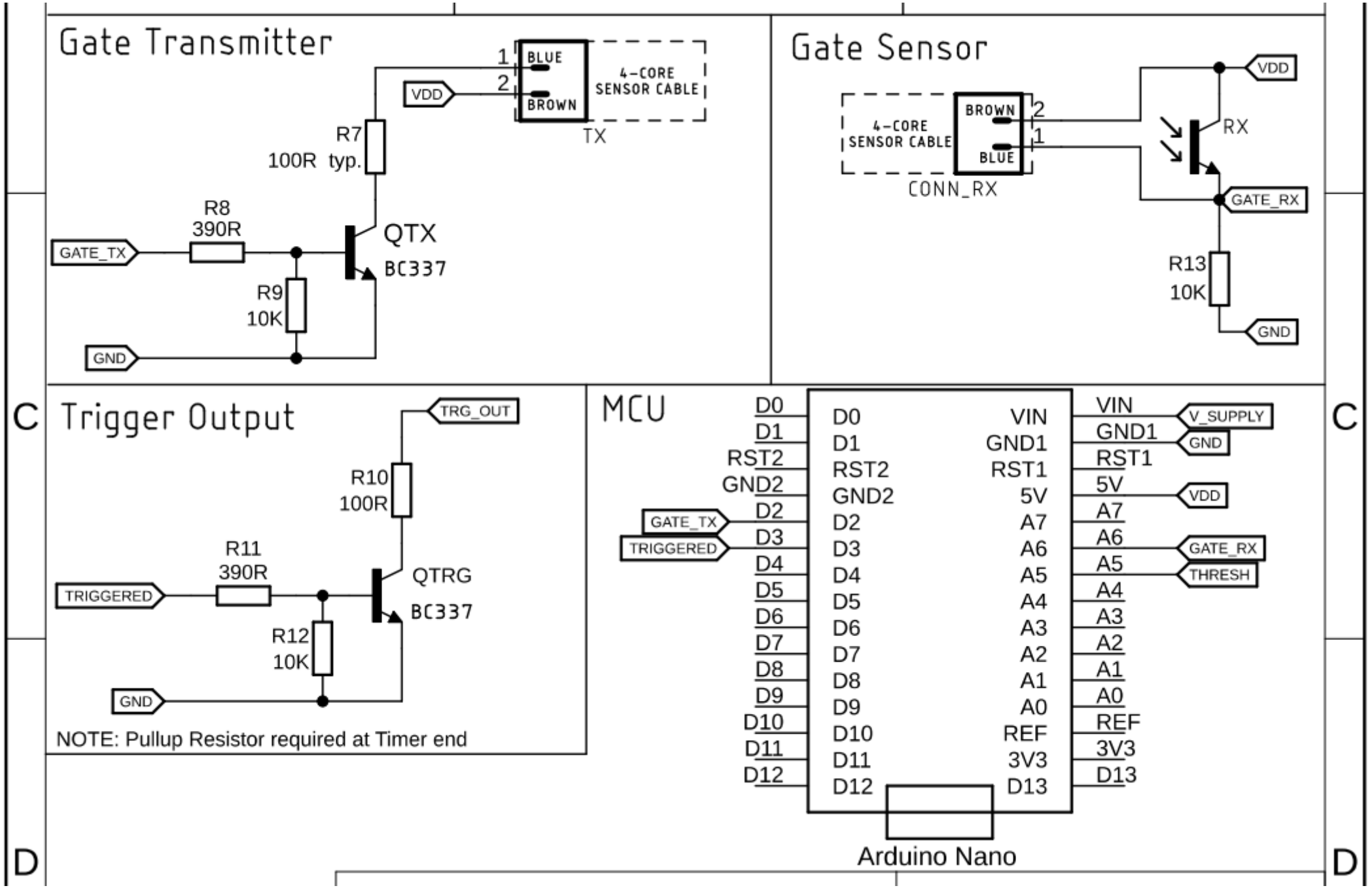


Optional 3D-printed support to give additional strength when removing plug from socket

Timing Gate sensor board circuit (part 1)



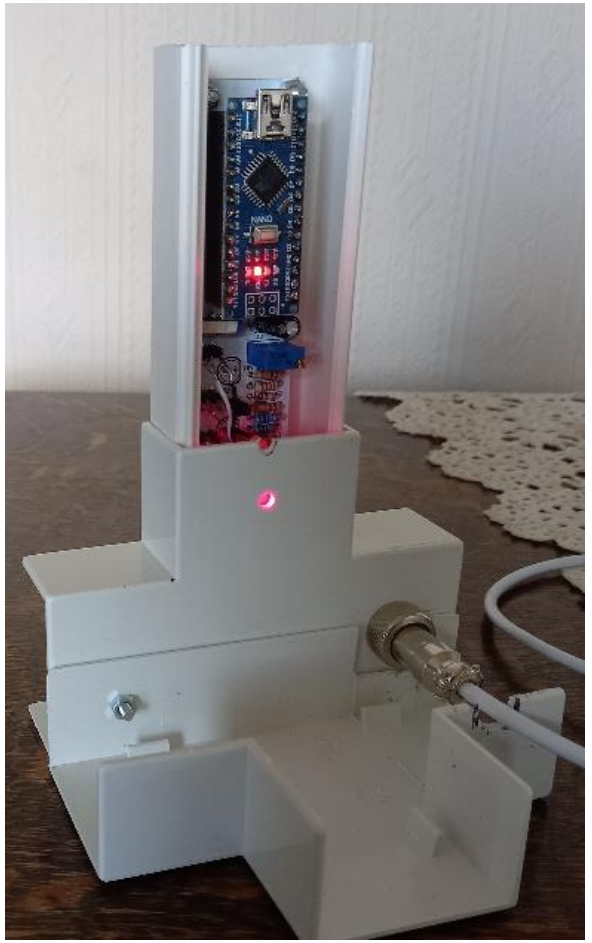
Timing Gate sensor board circuit (part 2)



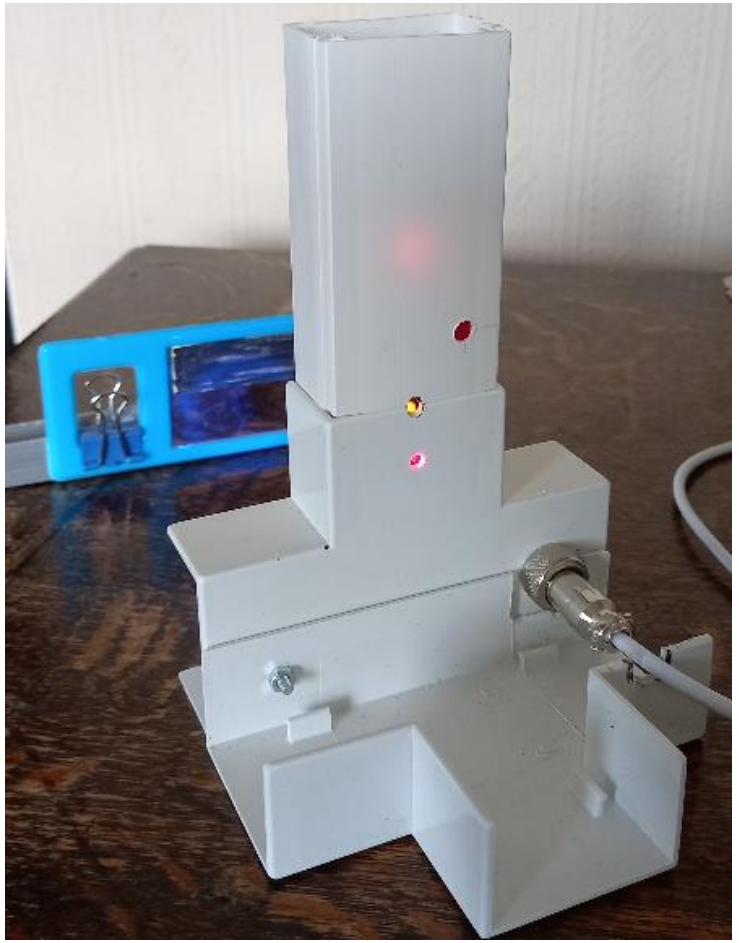
Half size line reflective sensor gate

Front with blue narrow beam LED and phototransistor above it

Rear with cover removed showing Nano



Rear showing yellow beam detected LED on



That’s all folks

Any questions?