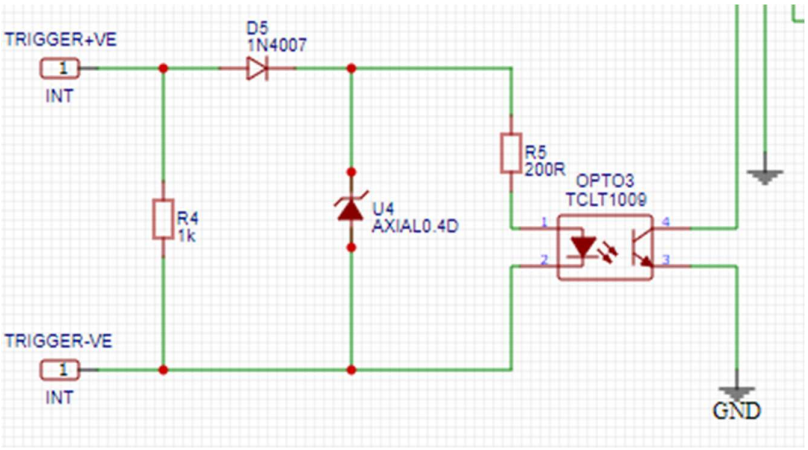
INPUT

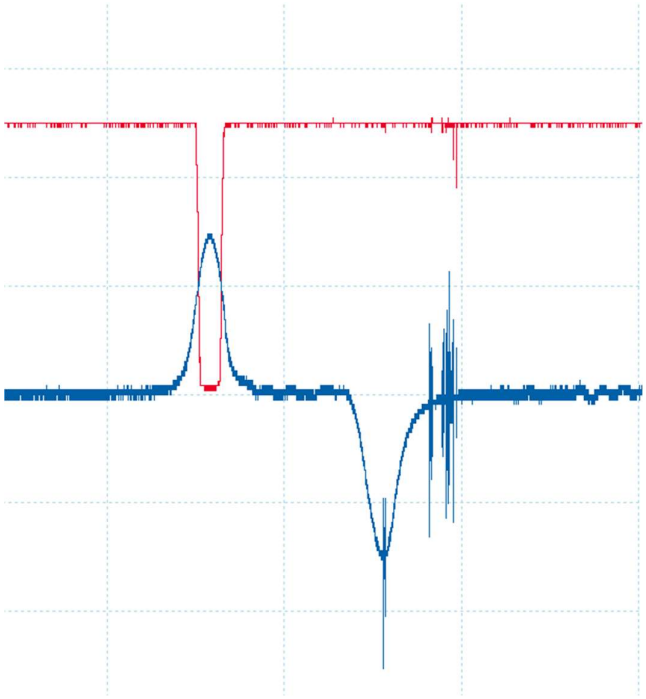
The output of the inductive sensor looks like this:

My input circuit looks like this (full image at the end):



I reversed the wires on the sensor so that the circuit reacts to the negative pulse as that comes first and gives the maximum time before the ignition point. From the full sketch you can see that the optocoupler grounds a pull up resistor so the input on D2 is a negative edged pulse.

The sensor output vs the Arduino input looks like this: (note the noise as the spark happens which is a problem)



OUTPUT

The ignition coil is a 1GN-1A smart coil. It operates from the 5 volt pulse from the Arduino. It has a separate 12 volt power connection to the battery.

The coil starts to charge on the 5 volt rising edge then fires the plug on the falling edge. The duration of the pulse is the dwell.

Operating Recommendations:

Maximum continuous duty cycle: 40%.

Maximum dwell time @14V: 9ms.

For a 12 volt battery charging the dwell should be about 3 ms.

A basic error in my design was that as the Arduino started up there was no output from D3 to ground the output to the coil. This meant that the maximum dwell time was exceeded, and I burnt out the first coil. I soldered in a small relay to ground the output until the Arduino has powered up this was attached to.

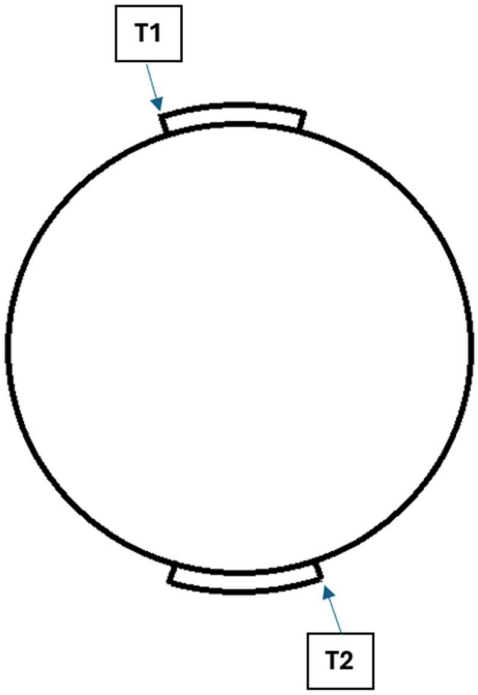
digitalWrite(3, HIGH); // starts with the optocuplers fired and the outputs low

digitalWrite(4, HIGH); // takes the short circuit off the opto

The software can never leave the output high as it will burn out the coil.

ENGINE - ROTAX 787

The engine is a two cylinder 2 stroke. The flywheel lobes that produce the output from the sensor looks like this:



The coil fires twice for every one revolution. Because there is only one coil there is a wasted spark. It would be nice to have has two coils one for each cylinder but there is no way of telling which cylinder is which.

The engine revs to 7000 rpm and at this speed I don't think you can maintain a duty cycle of 40% and a dwell of 3ms. But it will run on a lower dwell time.

The spark should cut at RPM above 7000.

Top Dead Centre of each piston should be 47 degrees past the trigger point.

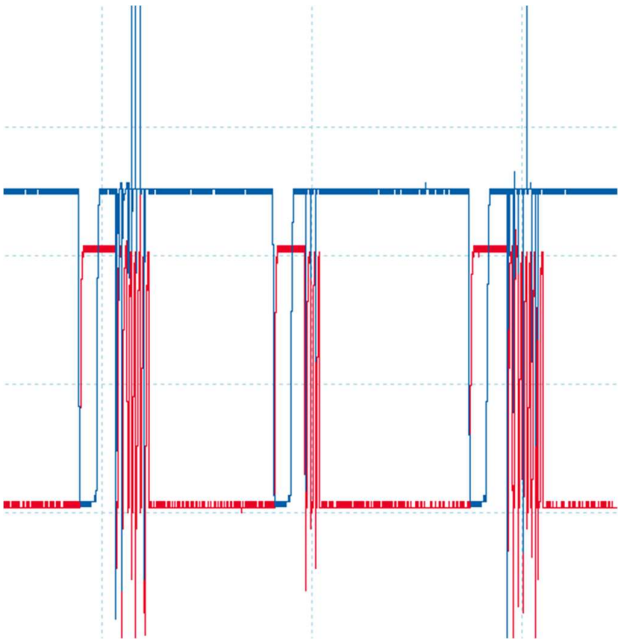
The software should be configurable so that this can be set up at one point within the timing curve using a timing light.

At 7000 rpm I don't think there is enough time to use the signal from the lobe nearest to the firing point. I had some success using the previous one but could never perfect it.

NOISE

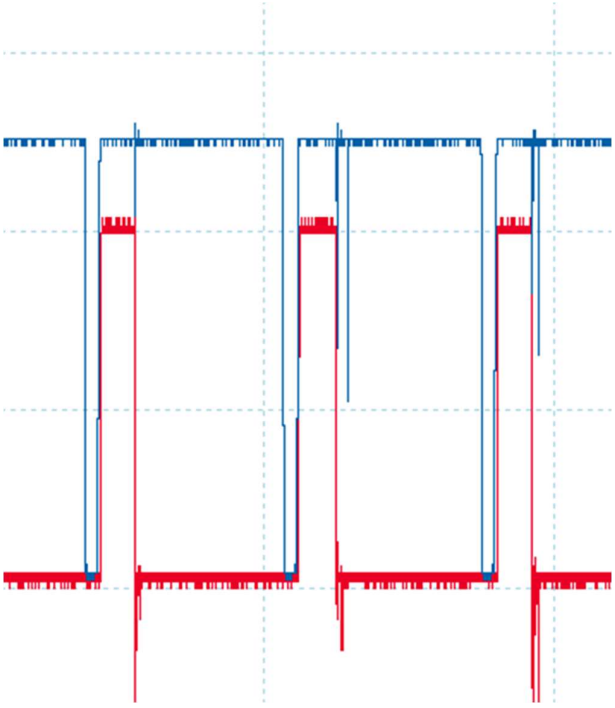
Noise is a big problem and maybe a weakness with my electrical design. I have to use a separate battery for the ECU because the Arduino restarts randomly.

The software needs to check the duration of the input pulse to prevent this:



Noise during the spark is causing multiple outputs (red line).

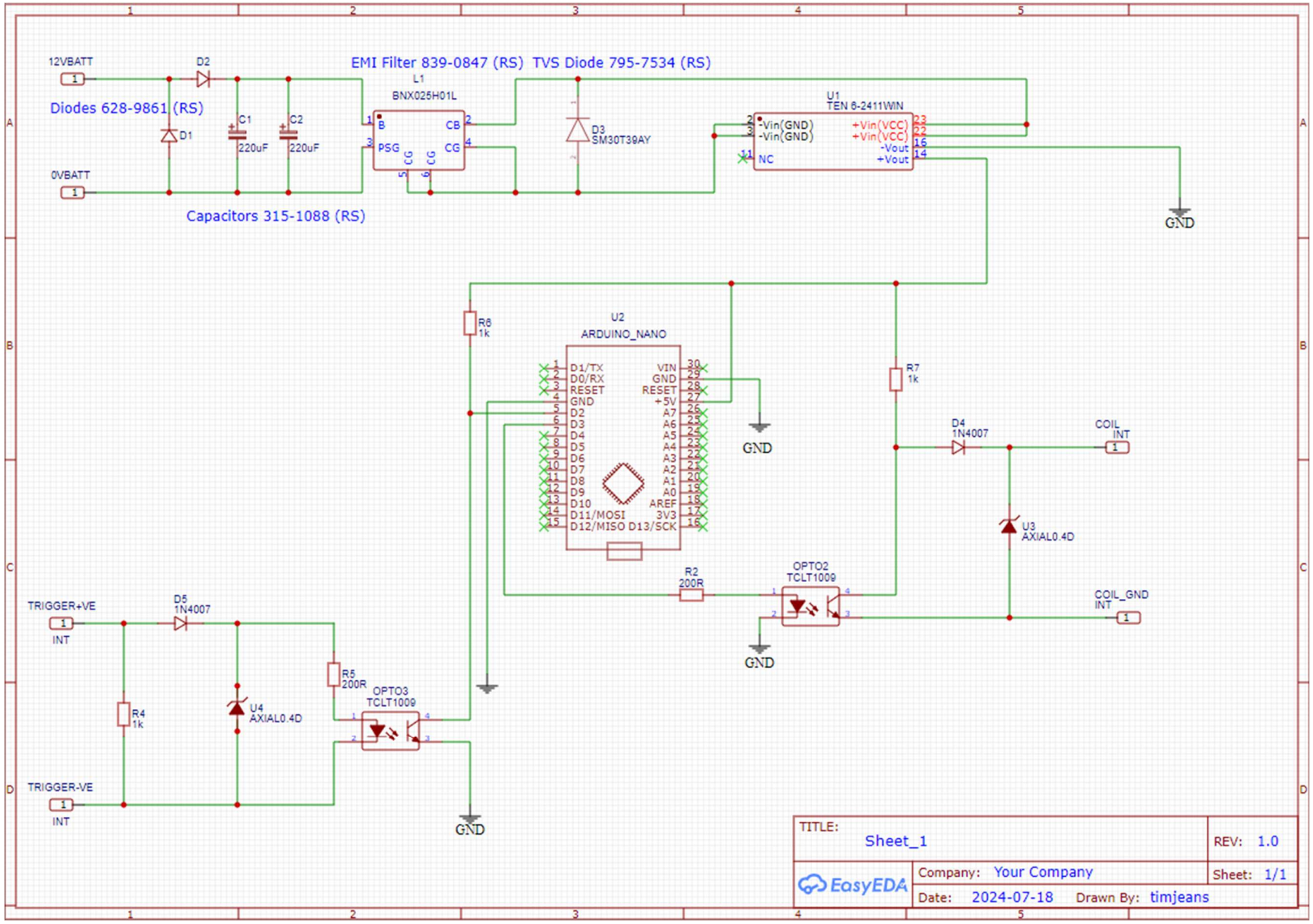
By checking the duration of the pulse so that it is not noise I got this:



TIMING CURVE

This should be configurable. Not sure what the OEM curve is but something like the actual below:

RPM								
0	1000	2000	3000	4000	5000	6000	7000	
0	6	12	20	20	19	18	17	Actual?
0	6	12	15	15	14	13	12	Safe?


EMI Filter 839-0847 (RS) TVS Diode 795-7534 (RS)
12VBATT
0VBATT
D2
D1
Diodes 628-9861 (RS)
C1
220uF
C2
220uF
Capacitors 315-1088 (RS)
L1
BNX025H01L
D3
SM30T39AY
U1
TEN 6-2411WIN
-Vin(GND)
-Vin(GND)
NC
+Vin(VCC)
+Vin(VCC)
-Vout
+Vout
GND
R6
1k
U2
ARDUINO_NANO
D1/TX
D0/RX
RESET
GND
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11/MOSI
D12/MISO
VIN
GND
RESET
+5V
A7
A6
A5
A4
A3
A2
A1
A0
AREF
3V3
D13/SCK
R7
1k
D4
1N4007
COIL
INT
U3
AXIAL0.4D
R2
200R
OPTO2
TCLT1009
COIL_GND
INT
TRIGGER+VE
INT
D5
1N4007
R4
1k
U4
AXIAL0.4D
R5
200R
OPTO3
TCLT1009
TRIGGER-VE
INT
TITLE:
Sheet_1
REV: 1.0
EasyEDA
Company: Your Company
Sheet: 1/1
Date: 2024-07-18
Drawn By: timjeans