Generator coil Tests

V1.1

2021-01-06

Content:

Generator Coil Tests *No coil shortening / No loads*

- **Test 1.xx** Open Coil
- **Test 2.xx** Cap + Diode
- **Test 3.xx** 2x Cap + 2x Diode

Conclusion Tests 1.xx/2.xx/3.xx

Generator Coil Tests *Coil shortening / No loads*

- **Test 4.02** 2 mm gap - 2x Cap + 2x Diode + Reed Switch
- **Test 4.20** 20 mm gap - 2x Cap + 2x Diode + Reed Switch
- **Test 5.20** 20 mm gap - 2x Cap + 2x Diode + 2x Reed Switch
- **Test 6.20** 20 mm gap - 2x Cap + 2x Diode + Hall + MOSFET

Conclusion Tests 4.xx/5.xx/6.xx

Appendix 1: Hall sensor circuit verification

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Appendix 3: Parameters for Tests

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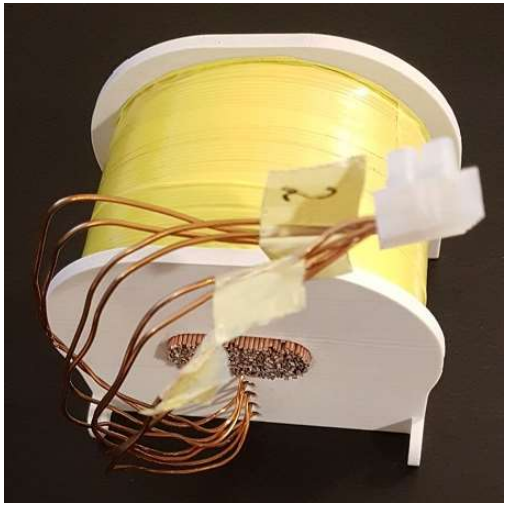
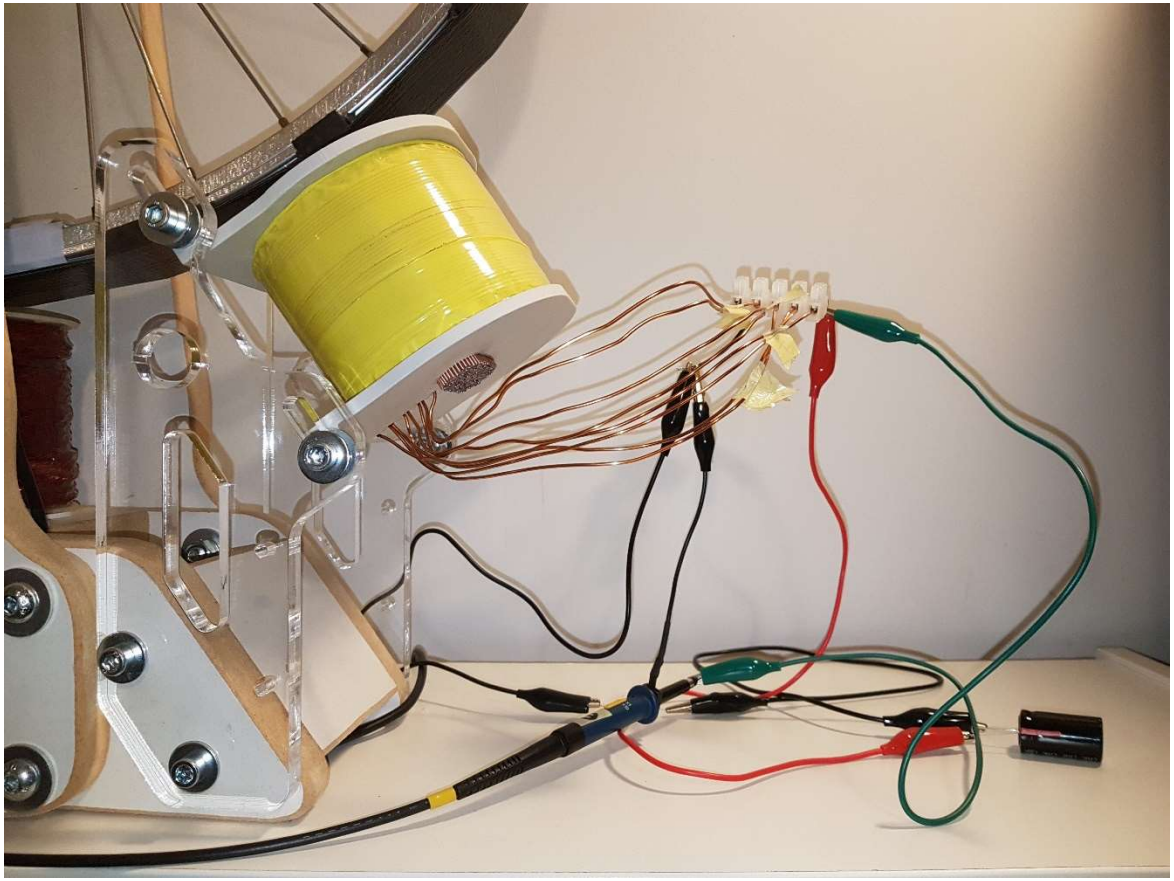
Generator coil Tests

1.xx/2.xx/3.xx

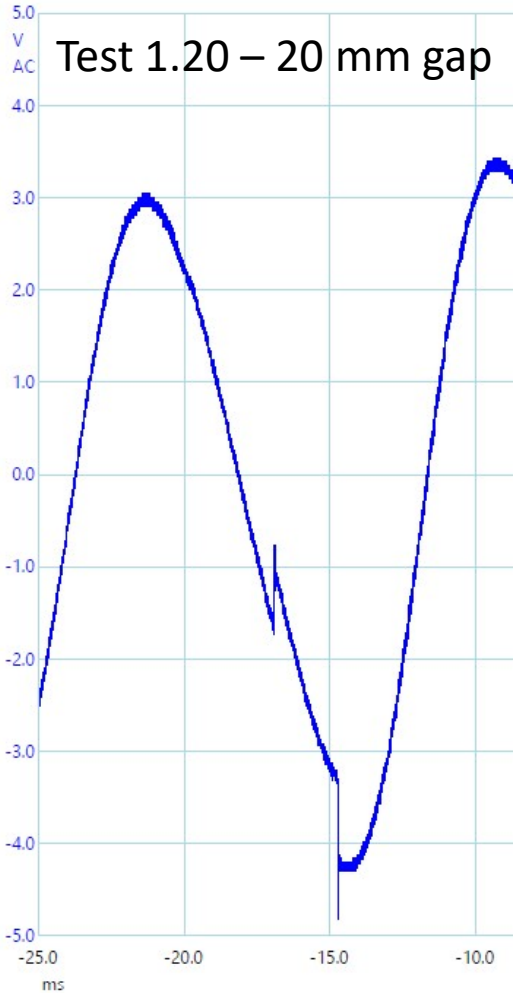
No coil shortening / No loads

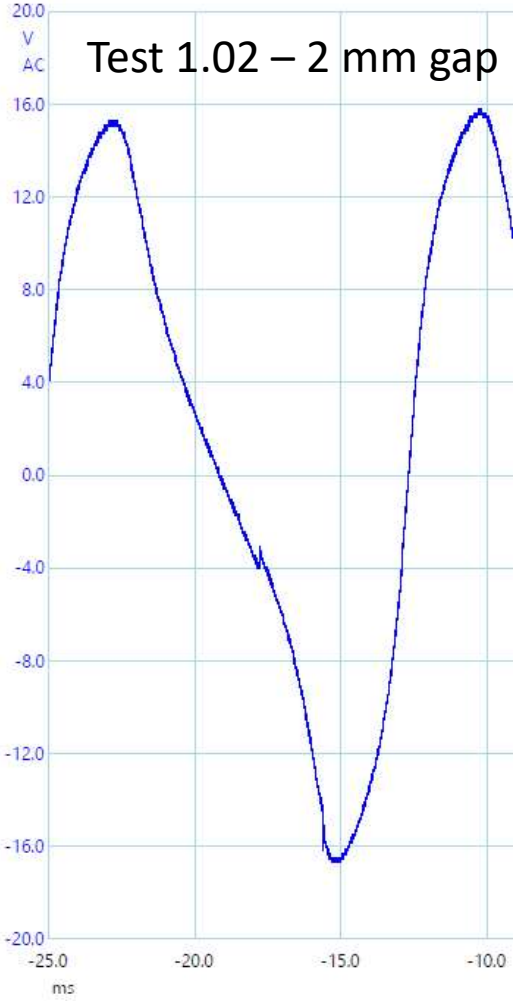
-Coil wire AWG 16
-4x Coil 291 windings, in series
-Total 1164 windings
-Total inductance +/-1.35H
-Core = welding rods, DIN 8554:G1 (=R45)

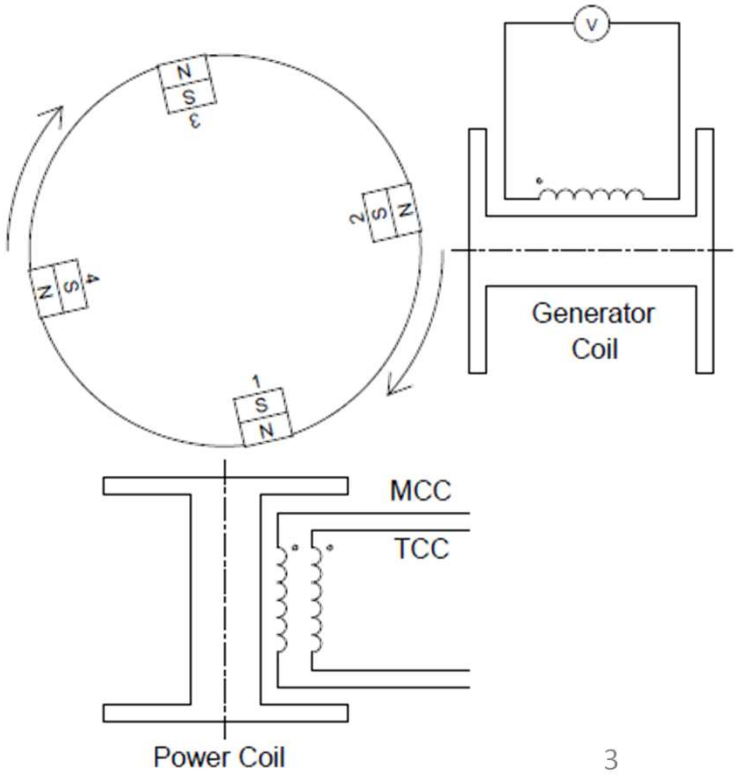




Test 1.xx
Open Coil



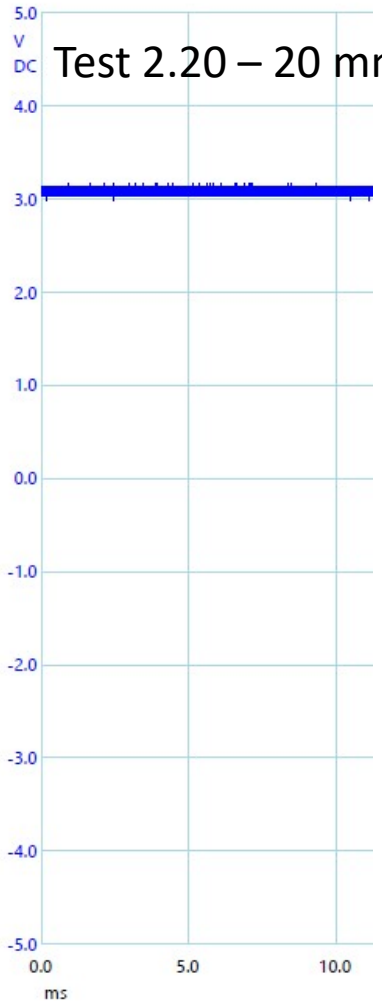




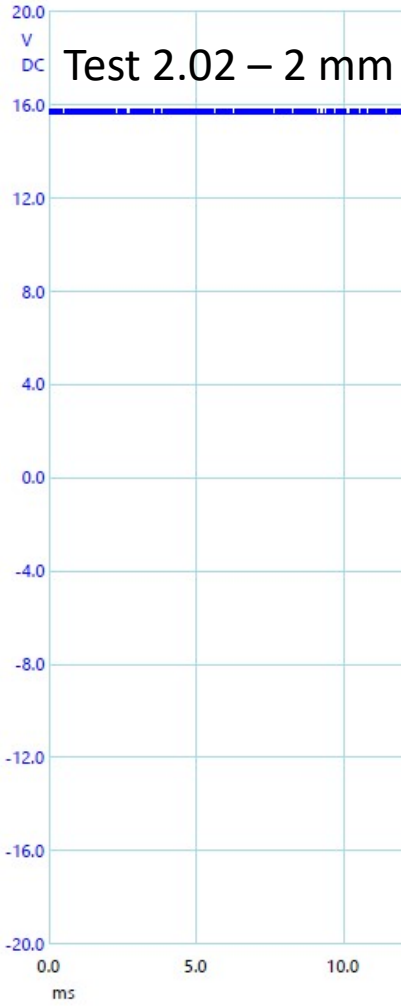
Test 2.xx

Cap + Diode

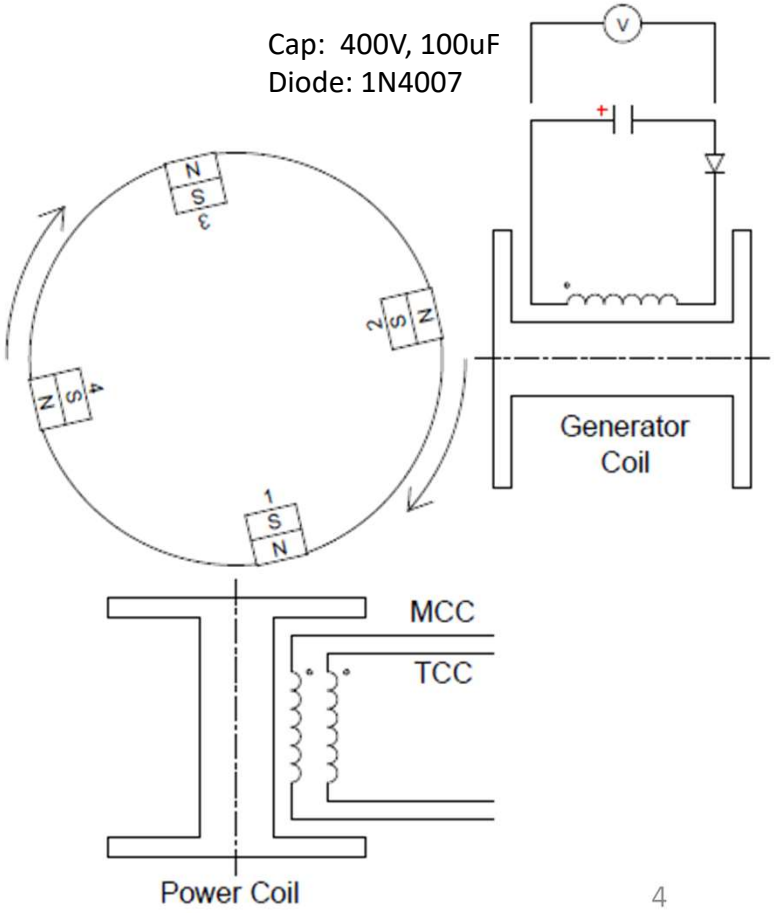
Test 2.20 – 20 mm gap



Test 2.02 – 2 mm gap

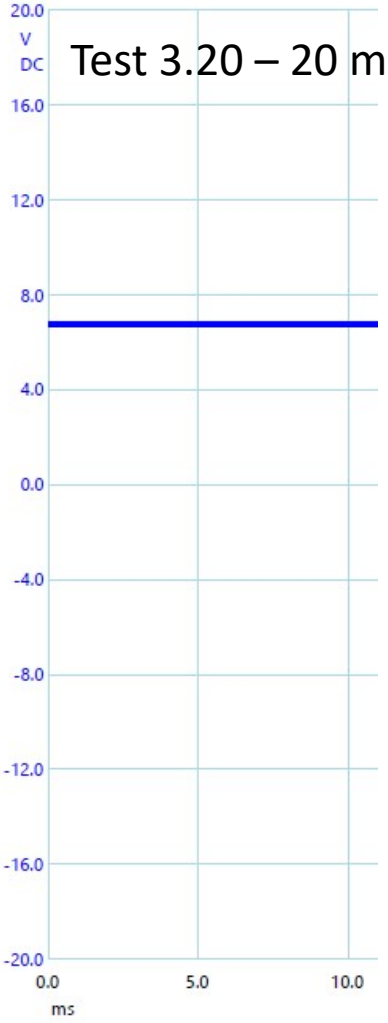


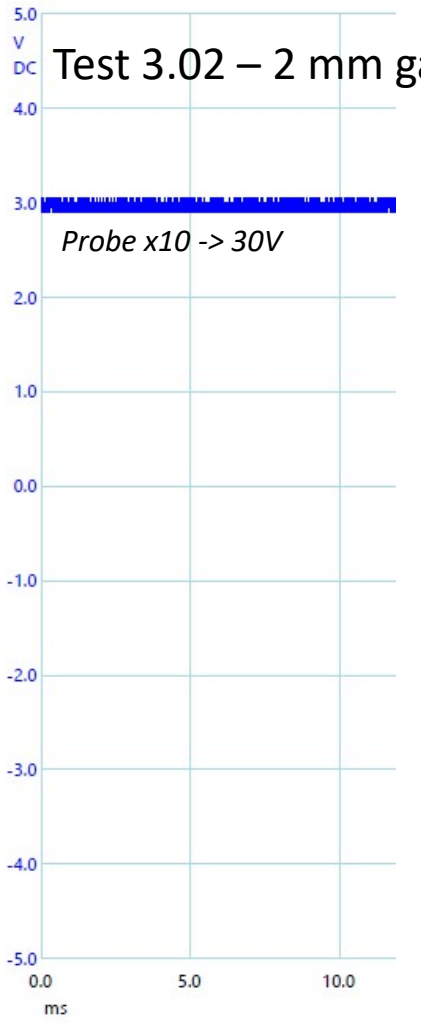
Cap: 400V, 100uF
Diode: 1N4007

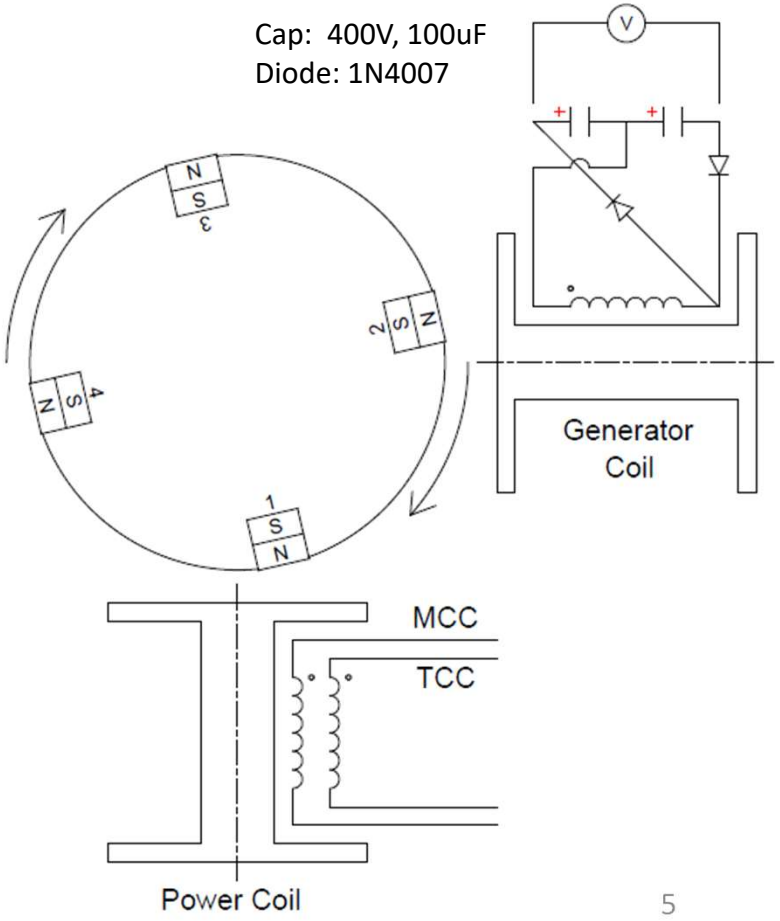


Test 3.xx

2x Cap + 2x Diode







Conclusion Tests 1.xx/2.xx/3.xx: No coil shortening / No loads

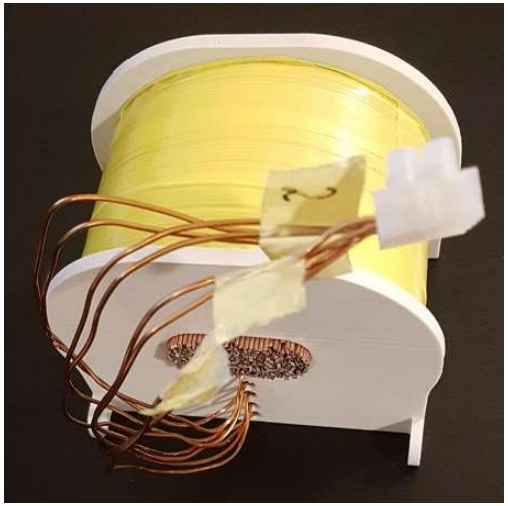
-The setup of test 3.xx yielded the highest voltage in the capacitors
-When the coil is closer to rotor, induced voltage increases, but causes more drag on the rotor too; rpms drop. However, to see the clear effect of this, a full charge cycle should be done with each setup. Now it was just a couple of minutes with each setup. So at every test the output battery was a bit more charged which increased the rpm (and decreases the amps) too.

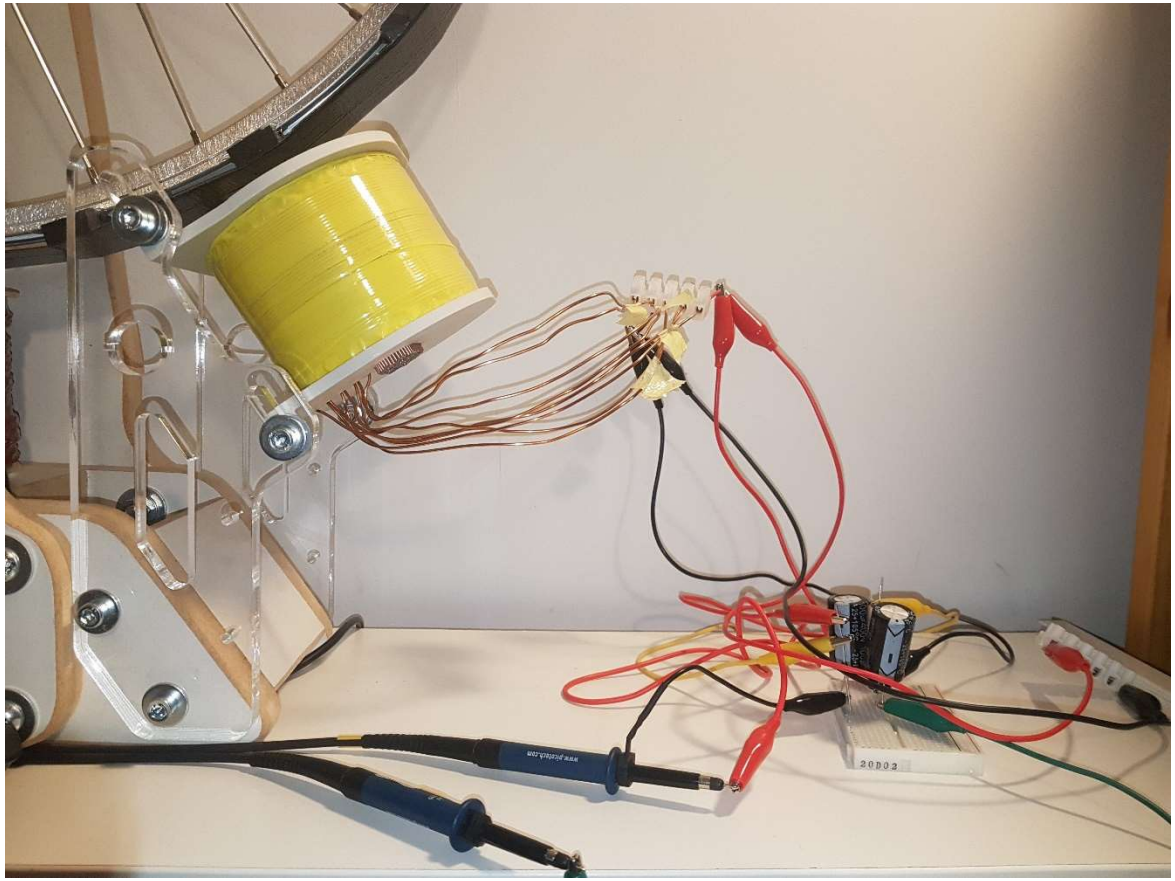
Generator coil Tests

4.xx/5.xx/6.xx

Coil shortening / No loads

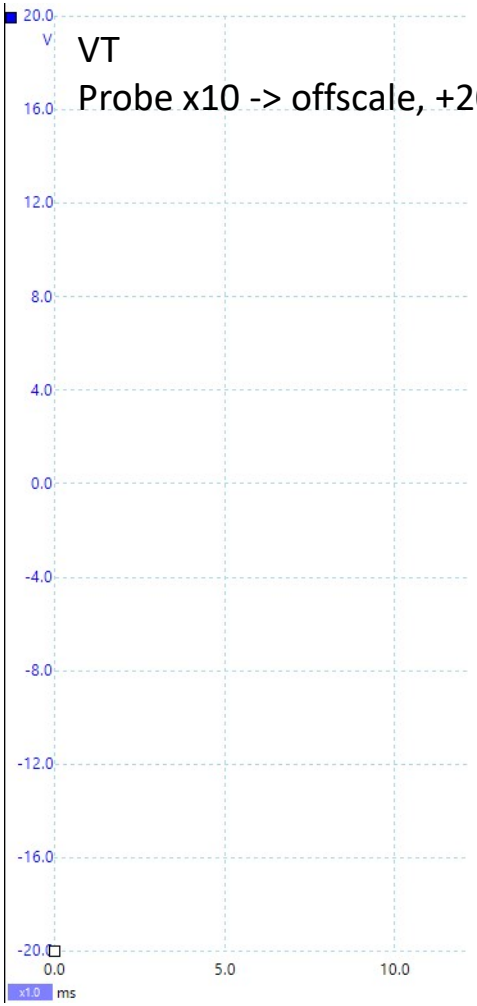
-Coil wire AWG 16
-4x Coil 291 windings, in series
-Total 1164 windings
-Total inductance +/-1.35H
-Core = welding rods, DIN 8554:G1 (=R45)





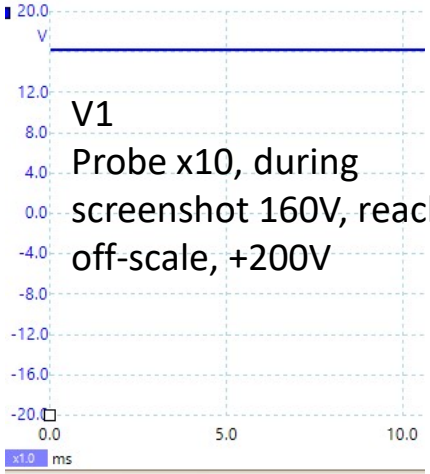
Test 4.02

2 mm gap - 2x Cap + 2x Diode + Reed Switch



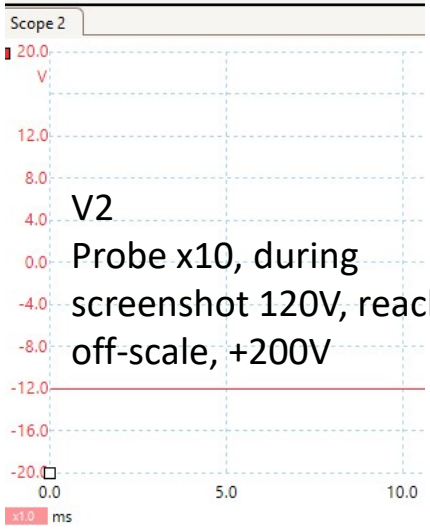
VT

Probe x10 -> offscale, +200V



V1

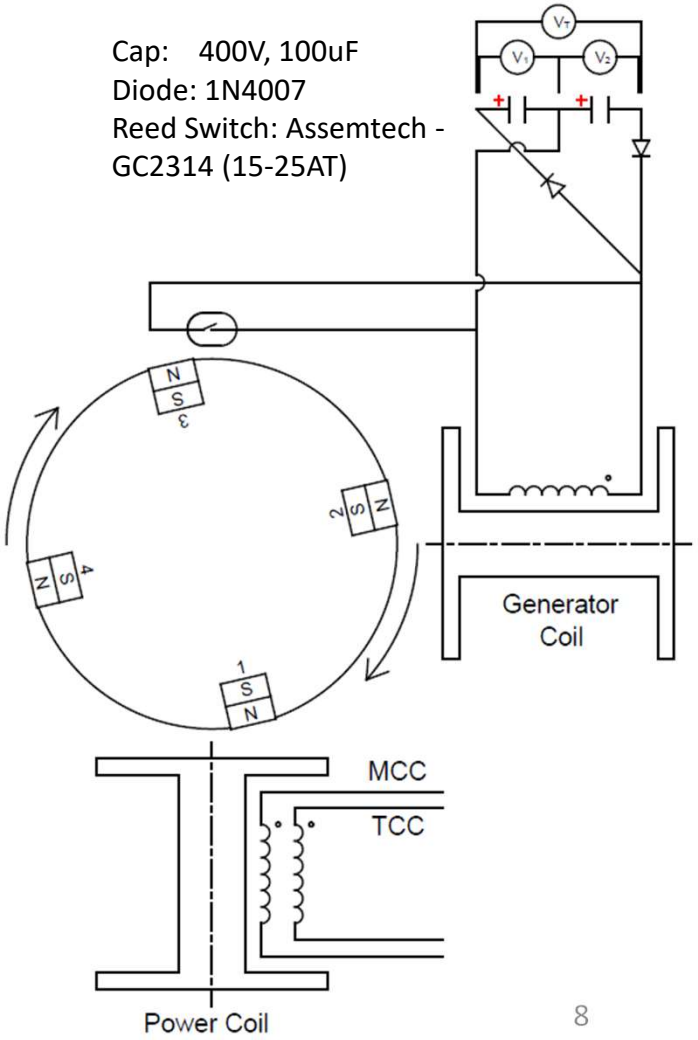
Probe x10, during screenshot 160V, reached off-scale, +200V



V2

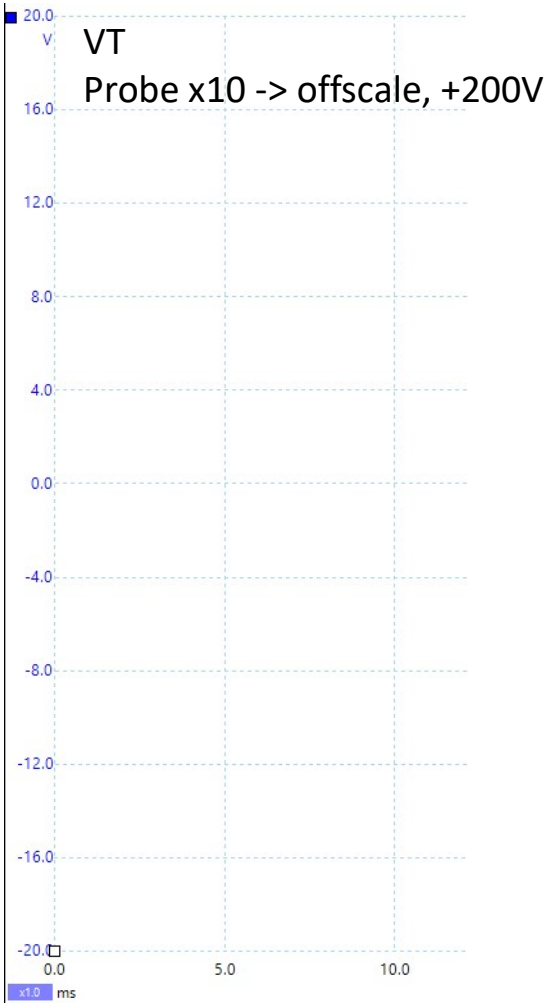
Probe x10, during screenshot 120V, reached off-scale, +200V

Cap: 400V, 100uF
Diode: 1N4007
Reed Switch: Assemtech - GC2314 (15-25AT)



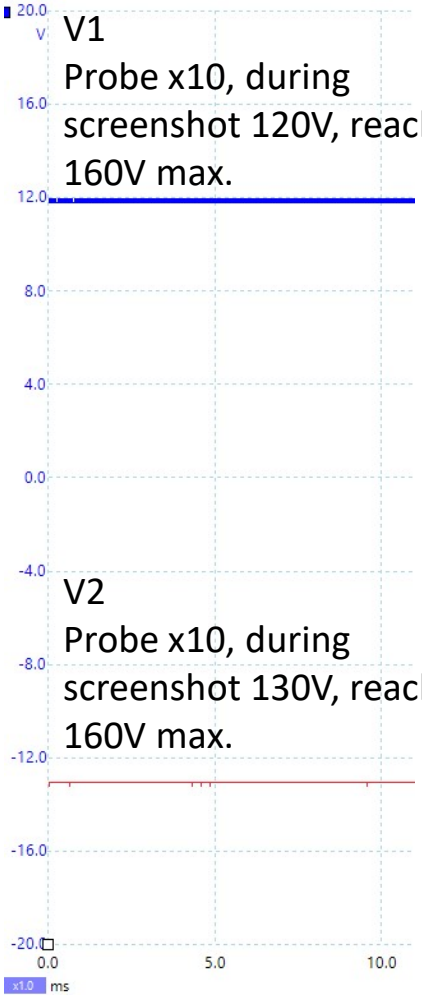
Test 4.20

20 mm gap - 2x Cap + 2x Diode + Reed Switch



VT

Probe x10 -> offscale, +200V



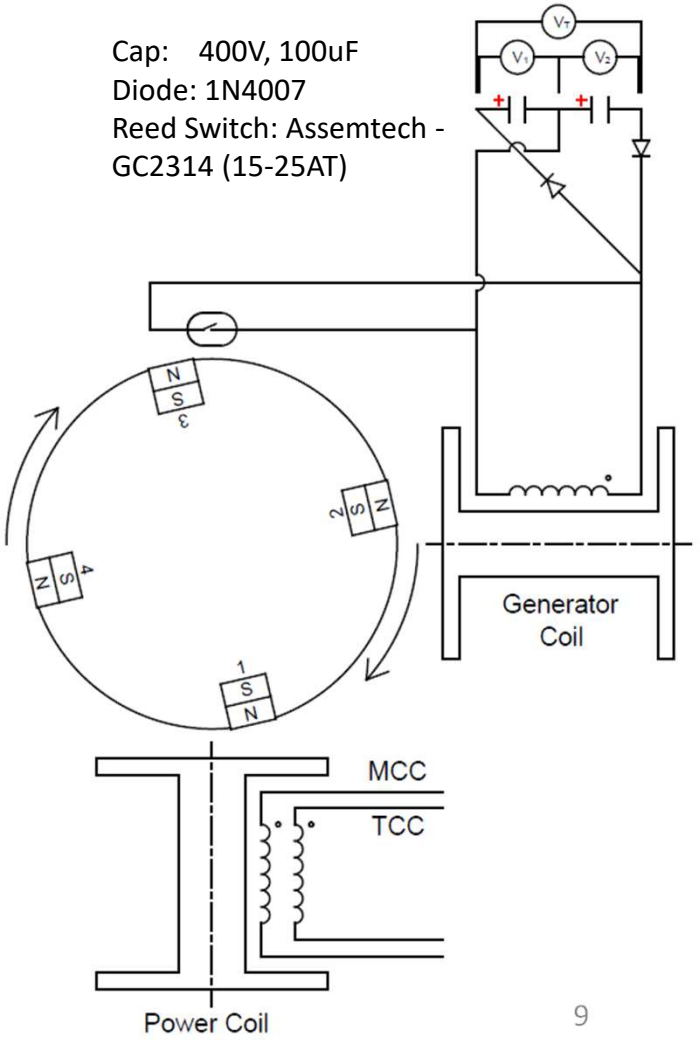
V1

Probe x10, during screenshot 120V, reached 160V max.

V2

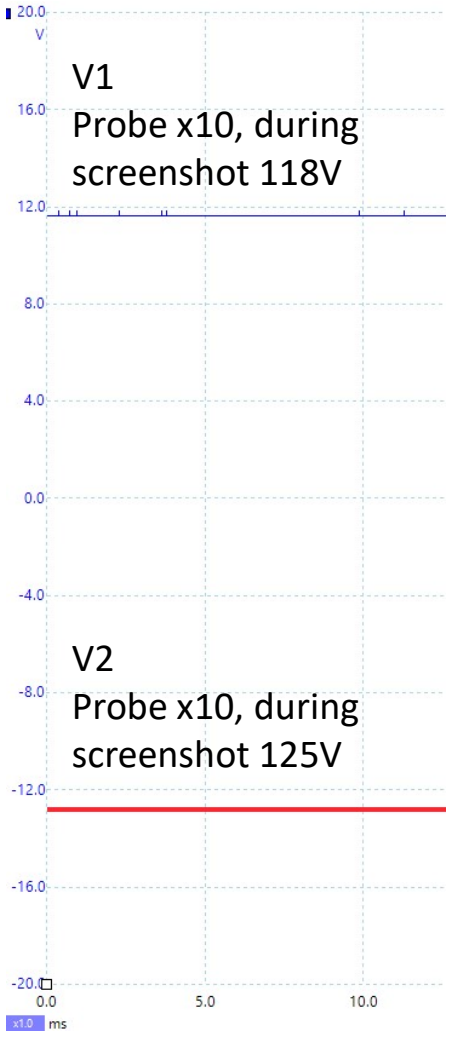
Probe x10, during screenshot 130V, reached 160V max.

Cap: 400V, 100uF
Diode: 1N4007
Reed Switch: Assemtech - GC2314 (15-25AT)



Test 5.20

20 mm gap - 2x Cap + 2x Diode + 2x Reed Switch



V1
Probe x10, during screenshot 118V

V2
Probe x10, during screenshot 125V

Explanation

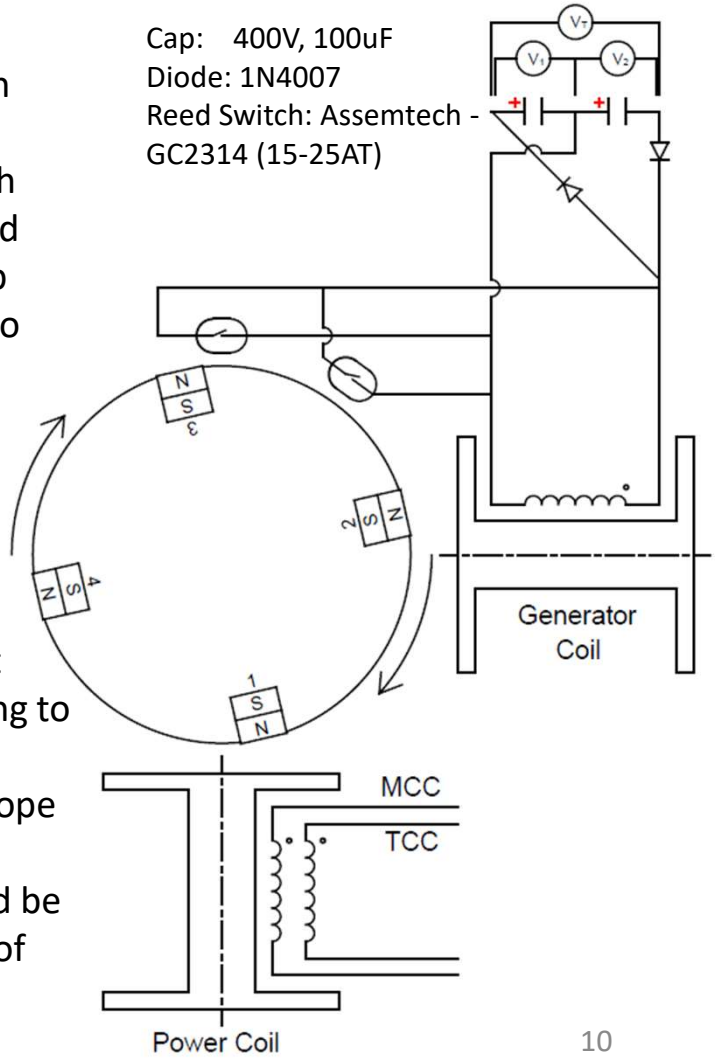
When monitoring the voltage of the caps individually with two probes in test 4.xx, it showed that the position of the reed switch determined which of the two caps was charging fastest. At some position they both seemed to charge, but not as fast if the reed switch was slightly moved and only one cap was charging. I tried to experiment with two reed switches to see if this would make a difference.

Conclusion:

Two Reed switches did not seem to make a difference.

However, all of these observations are a bit uncertain since at the same time I was trying to maintain the reed switch(es) at the same position (or varying) while looking at my scope at the same time. For a better result/conclusion these experiments should be done again with adjustable fixed positions of the reed switches.

Cap: 400V, 100uF
Diode: 1N4007
Reed Switch: Assemtech - GC2314 (15-25AT)

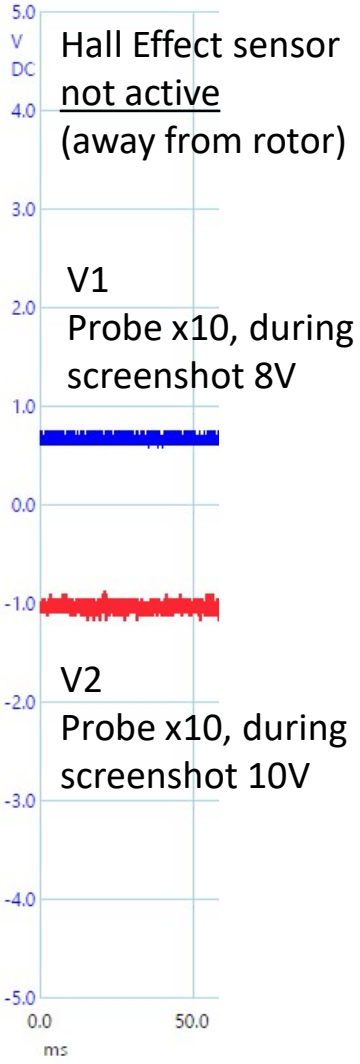


Test 6.20

20 mm gap - 2x Cap + 2x Diode + Hall + MOSFET

Conclusion:

The coil-shortening with the hall effect sensor seemed to have a reverse effect: with the hall active the voltage in the capacitor with V2 dropped. It might be due to that my circuit as depicted below is not correct. Furthermore the capacitor with V1 seemed to be unaffected. For more information see Appendix 1 & 2.



Hall Effect sensor
not active
(away from rotor)

V1
Probe x10, during screenshot 8V

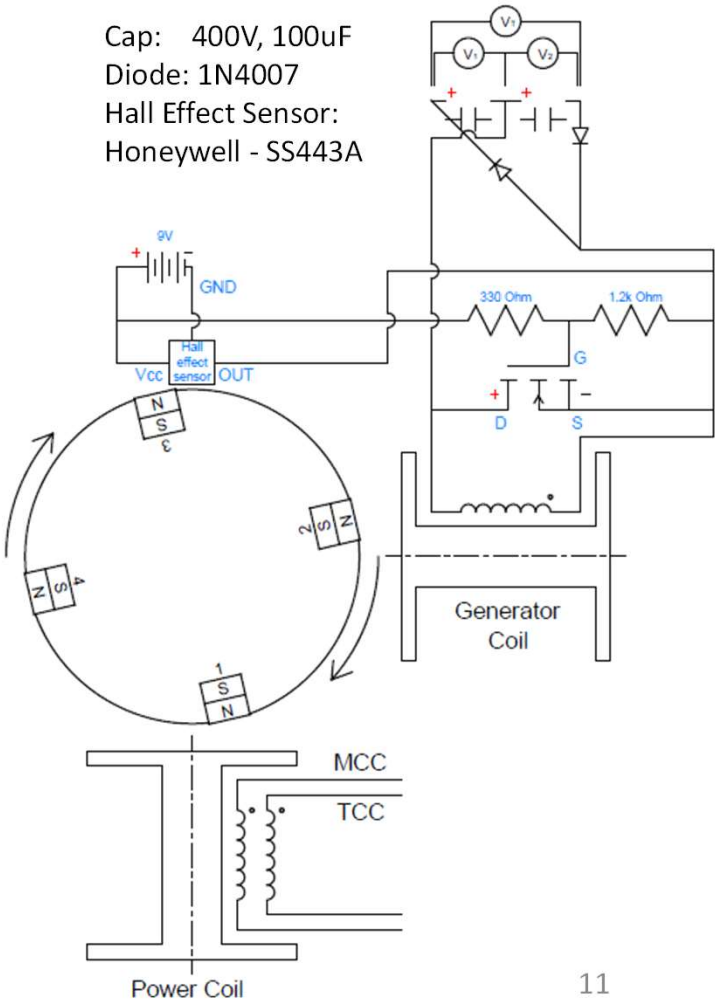
V2
Probe x10, during screenshot 10V

Hall Effect sensor
active

V1
Probe x10, during screenshot 8V

V2
Probe x10, during screenshot 1V

Cap: 400V, 100uF
Diode: 1N4007
Hall Effect Sensor:
Honeywell - SS443A



Conclusion Tests 4.xx/5.xx/6.xx: coil shortening / No loads

General
When the coil is closer to rotor, induced voltage increases, but causes more drag on the rotor too; rpms drop. However, to see the clear effect of this, a full charge cycle should be done with each setup. Now it was just a couple of minutes test with each setup. So at every test the output battery was a bit more charged which increased the rpm (and decreases the amps) too.

Reed Switch
Coil shortening with the Reed Switch has a significant effect on the voltage in the capacitors. For the max. effect of this coils shortening the position of the reed switch is very specific/sensitive.
Although the Reed Switch yielded excellent preliminary results, it is a tiny mechanical switch which is likely to fail at some point.

Hall Effect Sensor
Coil shortening with the Hall Effect Sensor so far has not yielded good results. One of the main reasons for this is probably due to the fact that my Hall effect sensor only responded to one side of the magnetic field of the magnets, while the Reed Switch responded to both.
Further more my circuit design for the Hall Sensor might be incorrect.

Next tests/steps:
-Make an adjustable fixed bracket for the reed switch Sensor to optimize/further investigate max effect.
-Ask for input on Hall effect sensor circuit/redesign/investigate. Or consider replacing hallsensor with (trigger) coil
-Setup new tests with loads (LEDs & resistors)

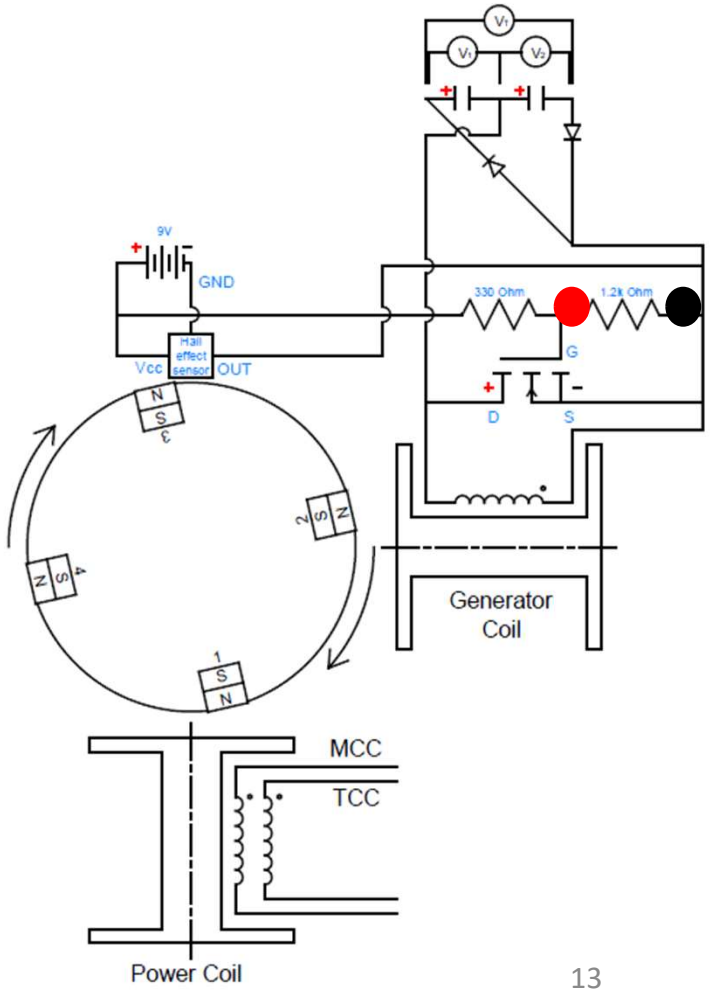
Appendix 1.1

Hall sensor circuit verification

Test 6.20 – Hall sensor verification

Note:

-Scope Connected as indicated, blue trace (ignore red trace)



Appendix 1.2

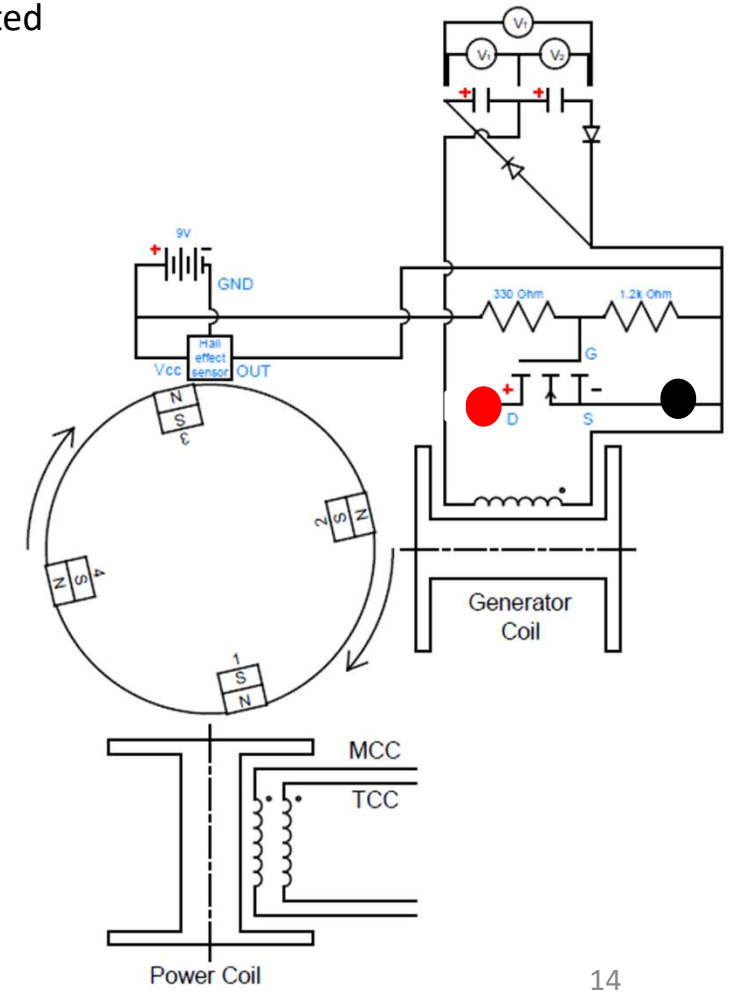
Hall sensor circuit verification

Test 6.20 – MOSFET verification

Note:

-Scope Connected as indicated, blue trace (ignore red trace)

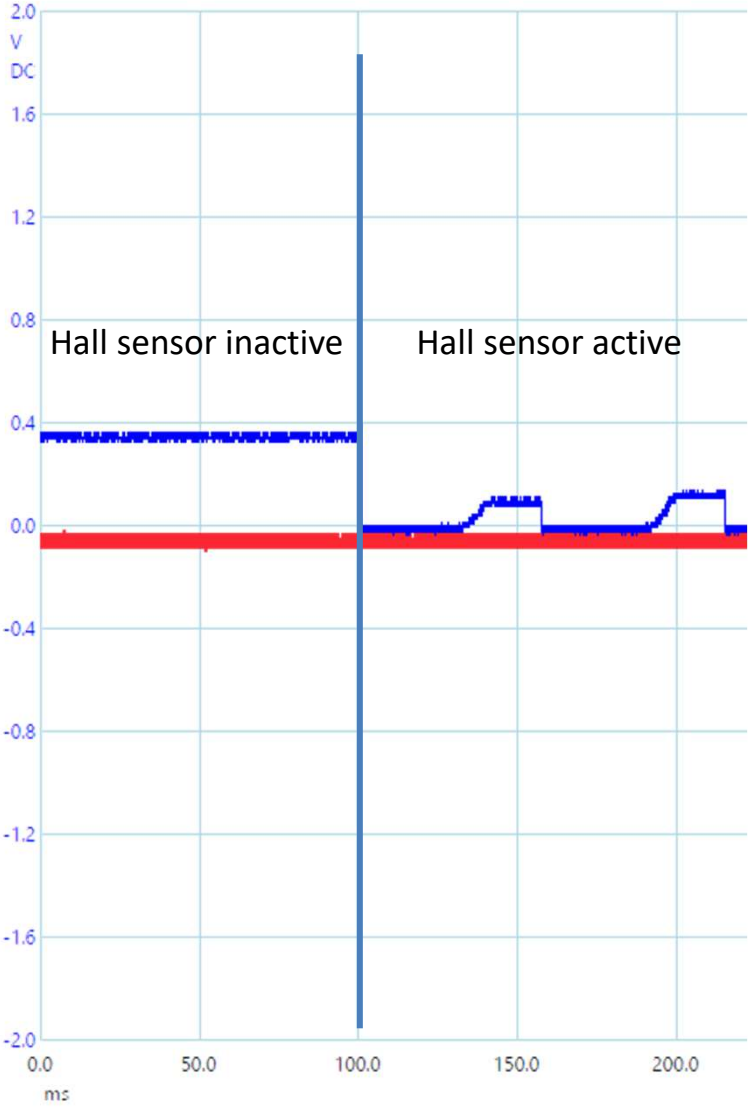
-Mind that DRAIN was not connected



Appendix 1.3

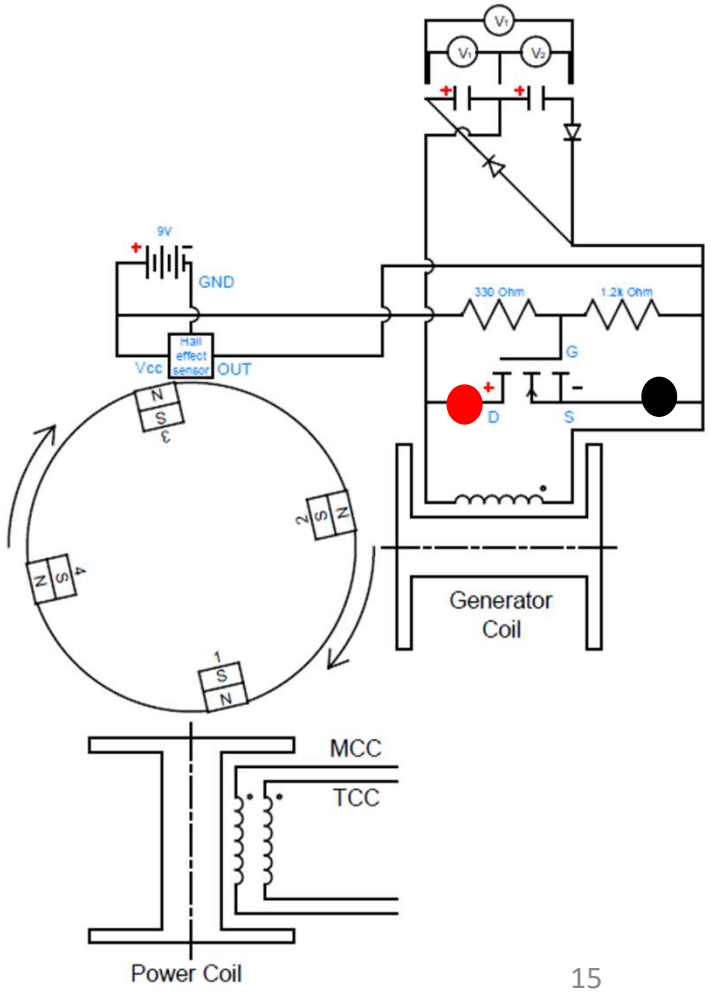
Hall sensor circuit verification

Test 6.20 – MOSFET verification



Note:

-Scope Connected as indicated, blue trace (ignore red trace)

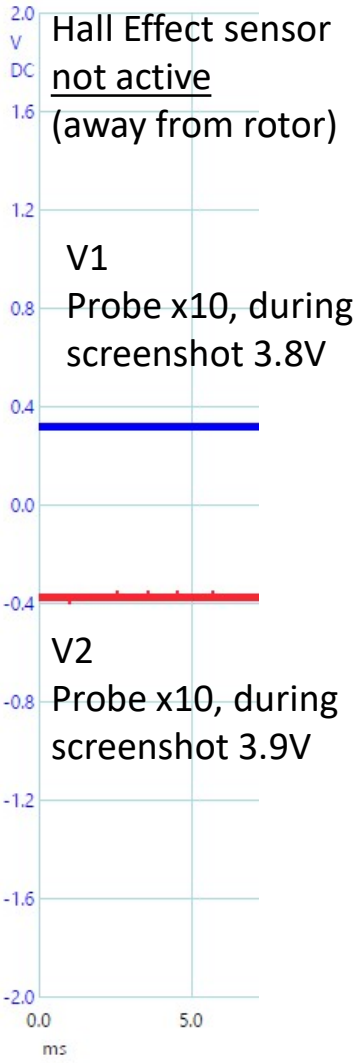


Appendix 2

Original Test 6.20 – 20 mm gap

Conclusion:
Same conclusion as Test 6.20

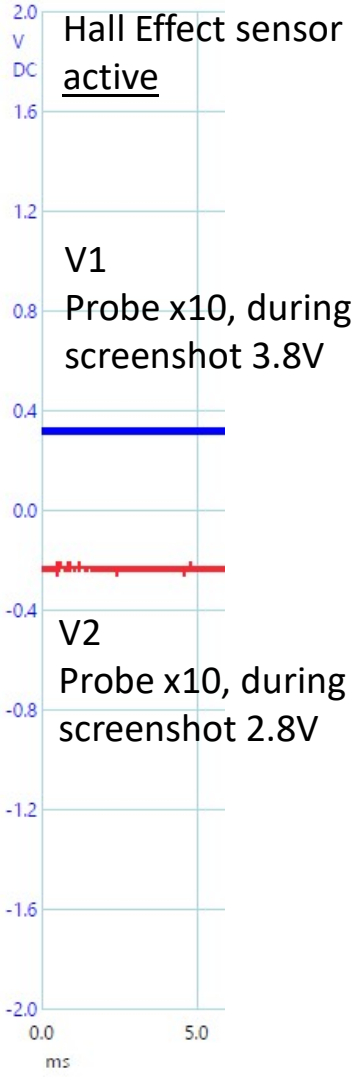
Note:
Difference in circuit comp. to Test 6.20:
-Resistors swapped (incorrect)
-Output of Hall connected differently



Hall Effect sensor
not active
(away from rotor)

V1
Probe x10, during
screenshot 3.8V

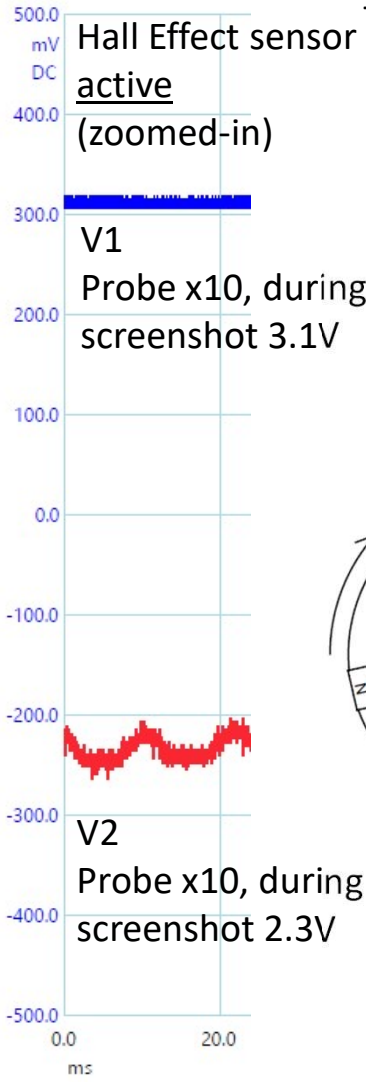
V2
Probe x10, during
screenshot 3.9V



Hall Effect sensor
active

V1
Probe x10, during
screenshot 3.8V

V2
Probe x10, during
screenshot 2.8V

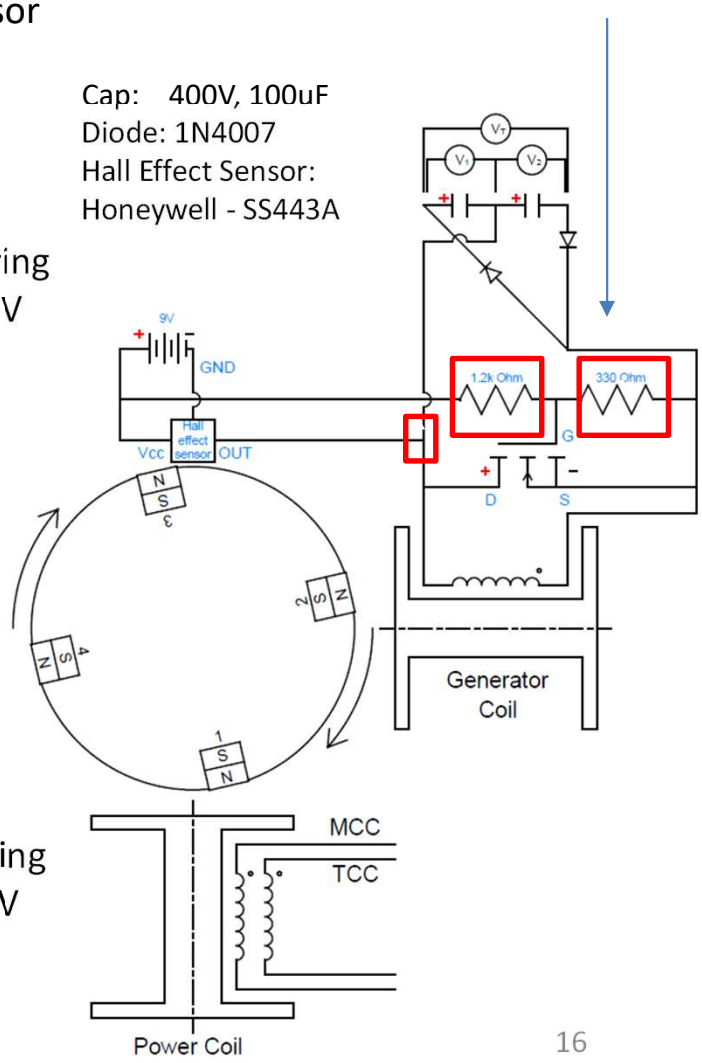


Hall Effect sensor
active
(zoomed-in)

V1
Probe x10, during
screenshot 3.1V

V2
Probe x10, during
screenshot 2.3V

Cap: 400V, 100uF
Diode: 1N4007
Hall Effect Sensor:
Honeywell - SS443A



Appendix 3

Parameters for Tests

		Gen coil gap 20mm	Gen coil gap 2mm	Gen coil gap 2mm	Gen coil gap 20mm	Gen coil gap 20mm	Gen coil gap 2mm
Cycle	-	GEN 1.20	GEN 1.02	GEN 2.02	GEN 2.20	GEN 3.20	GEN 3.02
Date	-	2020-12-29	2020-12-29	2020-12-29	2020-12-29	2020-12-29	2020-12-29
Rotor magnets, amount/width	-/mm	21 / 22mm	21 / 22mm	21 / 22mm	21 / 22mm	21 / 22mm	21 / 22mm
Gap	mm	8	8	8	8	8	8
Mode	-	CG	CG	CG	CG	CG	CG
Power coils	-	8	8	8	8	8	8
Flywheel weight	kg	N/A	N/A	N/A	N/A	N/A	N/A
Output battery	ID-type	X1 (AGM/12Ah)	X1 (AGM/12Ah)	X1 (AGM/12Ah)	X1 (AGM/12Ah)	X1 (AGM/12Ah)	X1 (AGM/12Ah)
Output voltage @ rest, before/after testing	V	12.49 / ??	12.64 / ??	12.66 / ??	12.79 / ??	12.67 / ??	12.79 / ??
Input battery 1	ID-type	LA1 (Flooded/24Ah)	LA1 (Flooded/24Ah)	LA1 (Flooded/24Ah)	LA1 (Flooded/24Ah)	LA1 (Flooded/24Ah)	LA1 (Flooded/24Ah)
Input voltage 1 @ rest, before/after testing	V	12.51 / ??	12.48 / ??	12.48 / ??	12.44 / ??	12.47 / ??	12.42 / ??
Input battery 2	ID-type	N/A	N/A	N/A	N/A	N/A	N/A
Input voltage 2 @ rest, before/after testing	V	N/A	N/A	N/A	N/A	N/A	N/A
Input parallel voltage (bat 1 + bat 2)	V	N/A	N/A	N/A	N/A	N/A	N/A
Input voltage @ start running	V	12.13	12.16	12.16	12.13	12.12	12.12
Input voltage @ end running	V	??	??	??	??	??	??
Amp @ start	A	2	1.8	1.75*	1.82	1.9	1.78
Amp @ end	A	??	??	??	??	??	??
RPM @ start/end	rpm	244 / ??	231 / ??	231 / ??	259 / ??	260 / ??	243 / ??
Time to charge to 15.3V	min	??	??	??	??	??	??
Ah to charge to 15.3V	**Ah**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**
COP	-	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Variable resistance	Ohm	62.2	62.2	62.2	62.2	62.2	62.2

		Gen coil gap 2mm	Gen coil gap 20mm	Gen coil gap 20mm	Gen coil gap 20mm
Cycle	-	GEN 4.02	GEN 4.20	GEN 5.20	GEN 6.20
Date	-	2021-01-02	2021-01-02	2021-01-02	2021-01-05
Rotor magnets, amount/width	-/mm	21 / 22mm	21 / 22mm	21 / 22mm	21 / 22mm
Gap	mm	8	8	8	8
Mode	-	CG	CG	CG	CG
Power coils	-	8	8	8	8
Flywheel weight	kg	N/A	N/A	N/A	N/A
Output battery	ID-type	X1 (AGM/12Ah)	X1 (AGM/12Ah)	X1 (AGM/12Ah)	X1 (AGM/12Ah)
Output voltage @ rest, before/after testing	V	12.51 / ??	12.80 / ??	12.49 / ??	12.56 / ??
Input battery 1	ID-type	LA1 (Flooded/24Ah)	LA1 (Flooded/24Ah)	LA1 (Flooded/24Ah)	LA1 (Flooded/24Ah)
Input voltage 1 @ rest, before/after testing	V	12.53 / ??	12.45 / ??	12.59 / ??	12.48 / ??
Input battery 2	ID-type	N/A	N/A	N/A	N/A
Input voltage 2 @ rest, before/after testing	V	N/A	N/A	N/A	N/A
Input parallel voltage (bat 1 + bat 2)	V	N/A	N/A	N/A	N/A
Input voltage @ start running	V	12.17	12.11	12.23	12.12
Input voltage @ end running	V	??	??	??	??
Amp @ start	A	1.8	1.82	1.95	1.85
Amp @ end	A	??	??	??	??
RPM @ start/end	rpm	234* / ??	257* / ??	248* / ??	255* / ??
Time to charge to 15.3V	min	??	??	??	??
Ah to charge to 15.3V	**Ah**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**
COP	-	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Variable resistance	Ohm	62.2	62.2	62.2	62.2

Appendix 4.1

Trigger Coil test

No loads

Gap +/-11mm

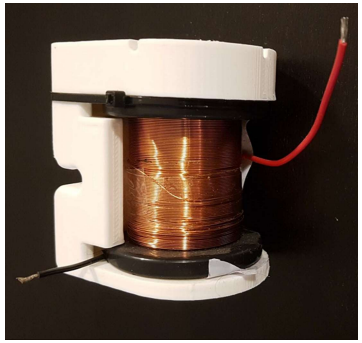
-Coil wire AWG 26

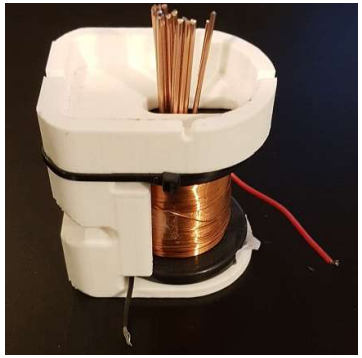
-+/- 732 windings

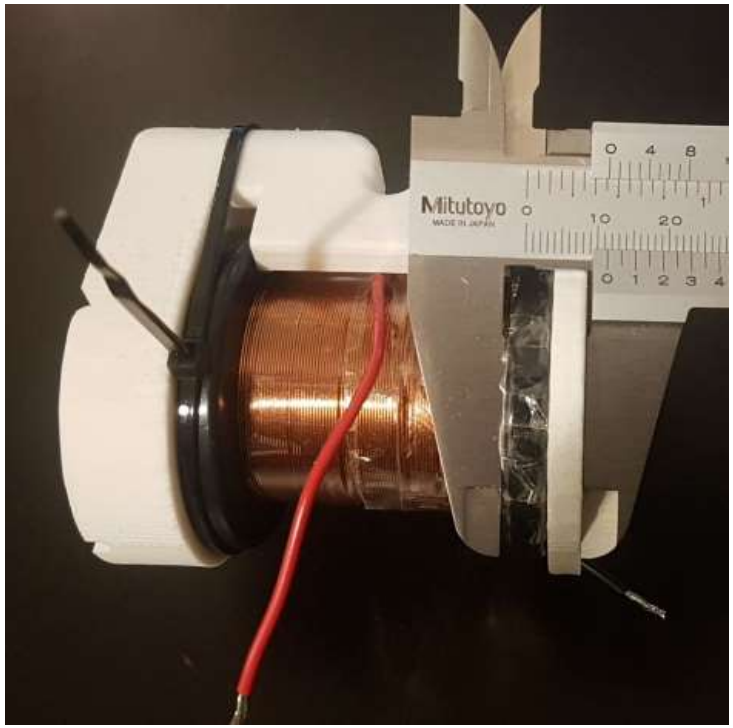
-Inductance no core +/-0.13H

-Inductance with core +/-0.27H

-Core = welding rods, DIN 8554:G1 (=R45)

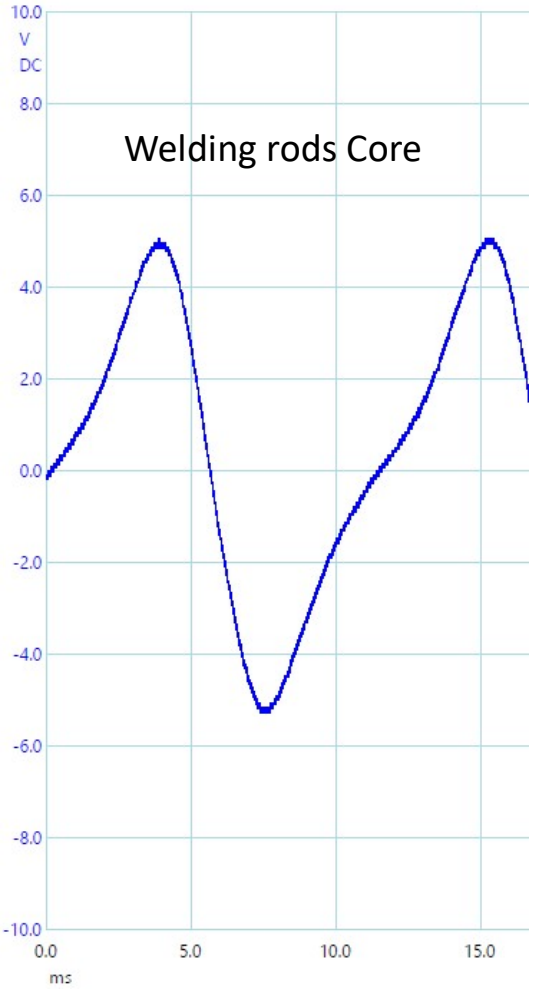




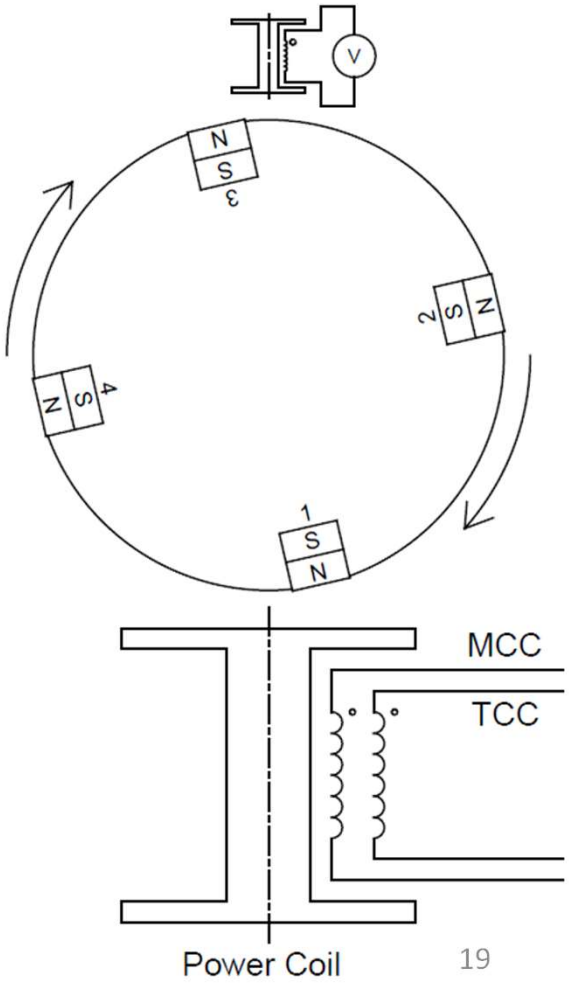


Appendix 4.2

Trigger Coil test



Note:
@+/-250RPM



Appendix 4.3

Trigger Coil test

Proposal circuit for (trigger) coil MOSFET circuit

Note:

-Coil should be able to generate sufficient voltage to overcome the diode and still surpass the maximum gate threshold of the MOSFET

-Coil (and diodes) connections can be flipped around in case timing/magnetic field is reversed (like with the Hall sensor)