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1. Sensor Board Details

Table 1. Sensor Characteristics

Design ID	Design Type	Single / High Res / Redundant	Number of Pole Pairs	PCB Size [mm]	Coil Size DOUT / DIN [mm]	Target Size DOUT / DIN [mm]	Air Gap (Nominal) [mm]	Accuracy (Nominal) [deg mech.]
RAA2P4520R0303	Rotary	Redundant	3 / 3	85 x 85	39 / 20	40 / 19	1.60	±0.253

Table 2. Chip Characteristics

Chip	Coil Type	Interface	Internal Resolution
RAA2P4520	Dual Coil	UART	14 Bit

1.1 Test Conditions

- Measurements are done in a lab environment at room temperature.
- The supply voltage level is 5V supplied by the measurement Hardware (VDD = 5V)
- The nominal accuracy is measured @ nominal air gap.
- Inductance and the DC resistance of the TX coil are measured using a Smart Tweezer ST5S LCR Meter.

1.2 Tx Coil and Frequency Parameters

Set C_{TX} transmit frequency between 2.2 and 5.6 MHz. to ensure a high-quality factor, a NP0 capacitor was used. F_{TX} was measured by the RAA2P4520 itself.

Table 3. Sensor Characteristics

L_{TX}	R_L	C_{TX}	F_{TX} meas.
2.2 µH	2.0 Ω	1100 pF	3.81 MHz

1.3 Calibration Register Settings

The registers up to 0x32 are for the general operation of the chip.
0x34 to 0x6E contain the offset compensation, linearization and zero point.
Registers in the row 0x70 control options for the upper and lower limits of the magnitude and the position range.
The Last row contains customer IDs and spare bits and the CRC checksum at 0x8E.

Table 4. Registers Dump

	0x00	0x02	0x04	0x06	0x08	0x0A	0x0C	0x0E
0h	0x10E0	0x8080	0x0000	0x016B	0x0467	0x0160	0x0000	0x0000
10h	0x0000	0x0000	0x0000	0x00D2	0x0714	0x02C8	0x090F	0x0000
20h	0x6401	0x0000	0xF7FB	0x6401	0x0000	0x0EF1	0xC9C9	0x1488
30h	0x70B5	0x0035	0x4000	0x4000	0x4000	0x4000	0x0B5B	0x02B0
40h	0x40FD	0xFB2F	0x6E74	0x0907	0xFEB1	0xEF0C	0x2114	0x0130
50h	0x70F5	0x090F	0x1DB2	0xEF9D	0x4106	0x002E	0x6D35	0x7908
60h	0xFEAF	0xEE4C	0xB109	0xEF30	0x7134	0x78FB	0x10B2	0xF00D
70h	0x0FFF	0x0000	0x0000	0x0000	0x0000	0x007A	0x3FFF	0x0000
80h	0x0000	0x0000	0x0001	0x0000	0x0000	0x0000	0x0000	0x0521

1.4 Sensor Board

Figure 1. displays the sensor board layout, consisting of one transmitter coil, four receiver coils, the RAA2P4520 and additional passive components.

Figure 1. Sensor Board

1.5 Sensor Target

Figure 2. displays the target used during the measurements.

Figure 2. Sensor Target

2. Measurement Setup

2.1 General

All measurements were performed on a 4-axis positioning test bench. During the measurement, the target was moved to a defined position. The rotor position read from the sensor is compared to the rotor position measured by high precision reference encoder.

$$f_{mechanical} = real\ sensor\ position - ideal\ position\ value$$

2.2 Design-Specific Test Setup

Figure 3. displays the test setup, the sensor board and target are mounted on the 4-axis positioning test bench.

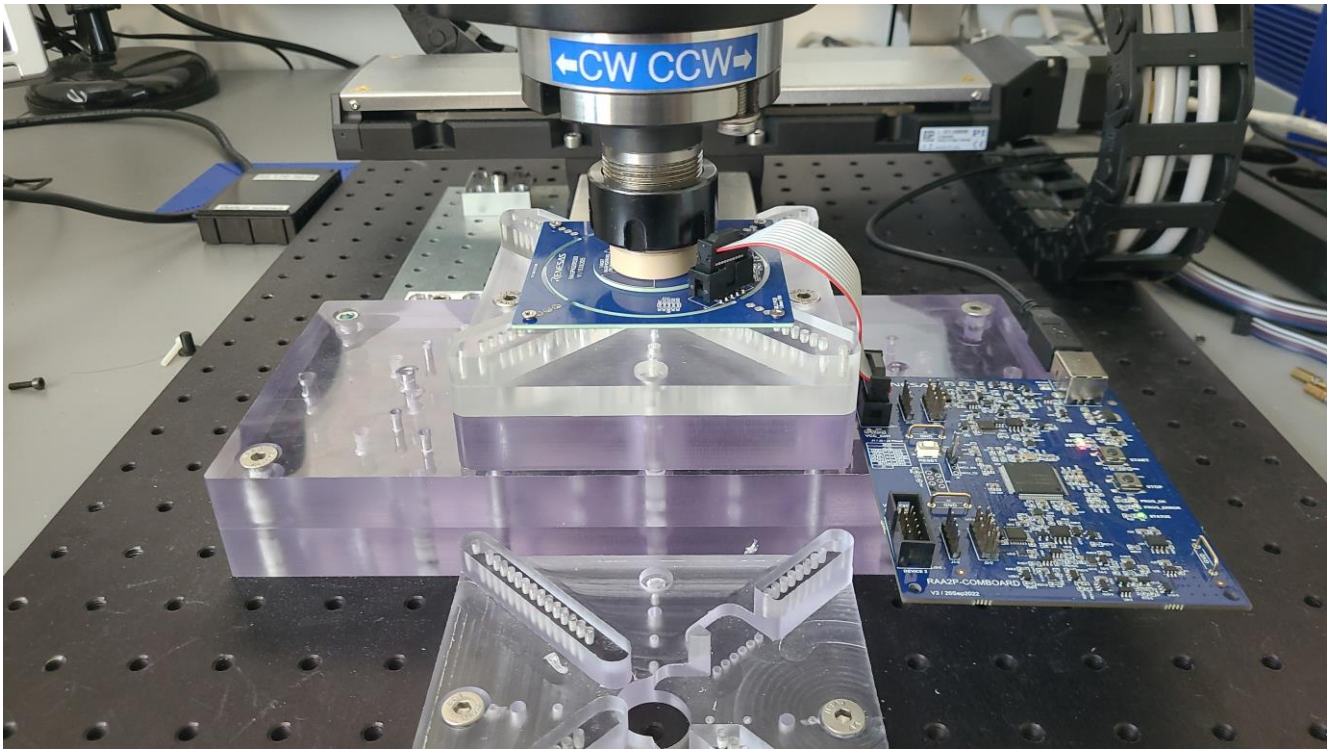

Figure 3. Setup

3. Measurement Results

3.1 Angle Error Primary Coil

The Coil offset was compensated without target, then the design was linearized at nominal position. The plot below displays the error of the primary angle measured over the given positions. Measurements are done with the memory settings, as shown in Table 4.

Note: Line Chart Naming: X_.____Y_.____AG_.___

- X = radial displacement in mm
- Y = radial displacement in mm
- AG = Air Gap in mm

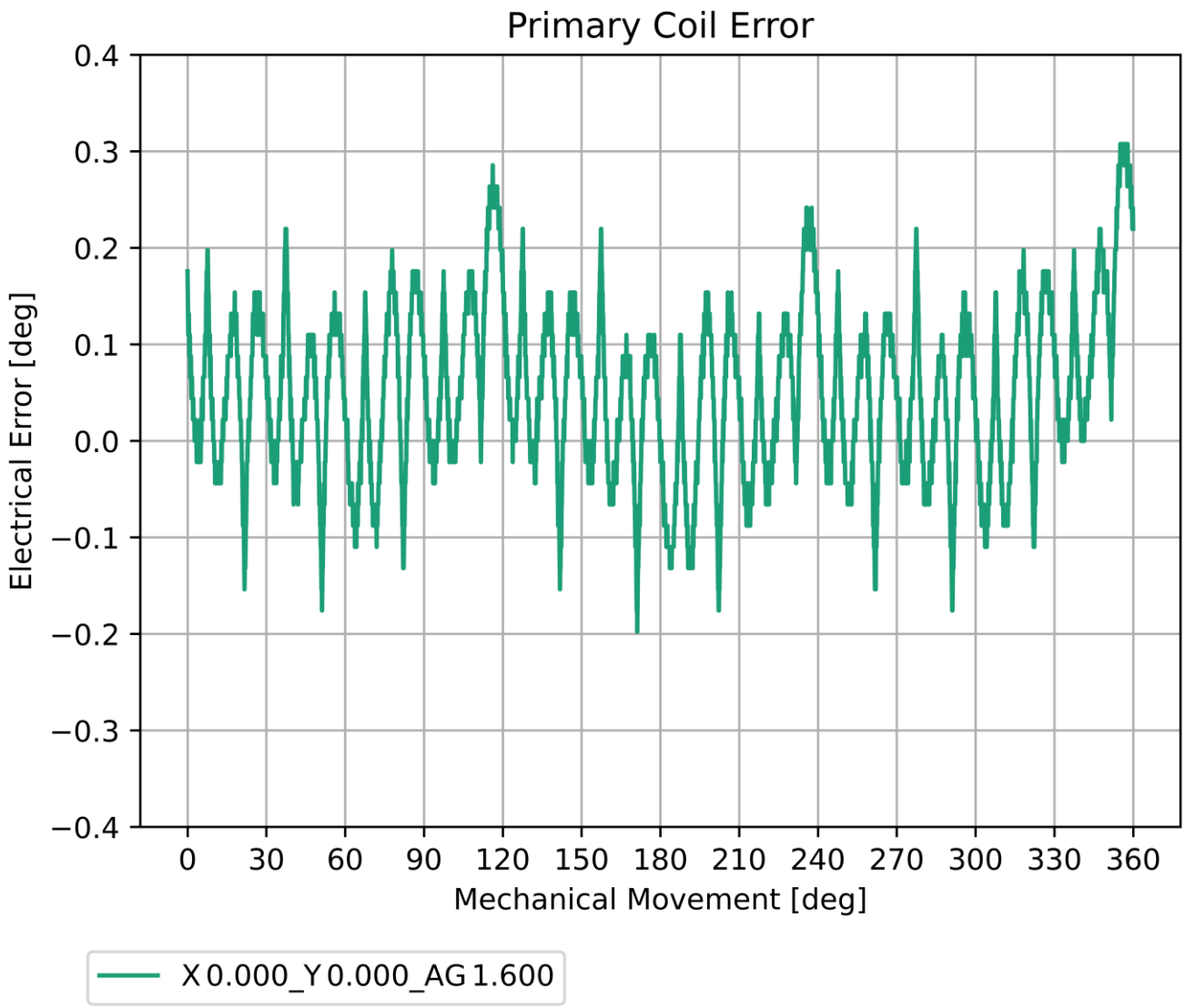

Figure 4. Primary Coil Error

3.2 Angle Error Secondary Coil

The Coil offset was compensated without target, then the design was linearized at nominal position. The plot below displays the error of the secondary angle measured over the given positions. Measurements are done with the memory settings, as shown in Table 4.

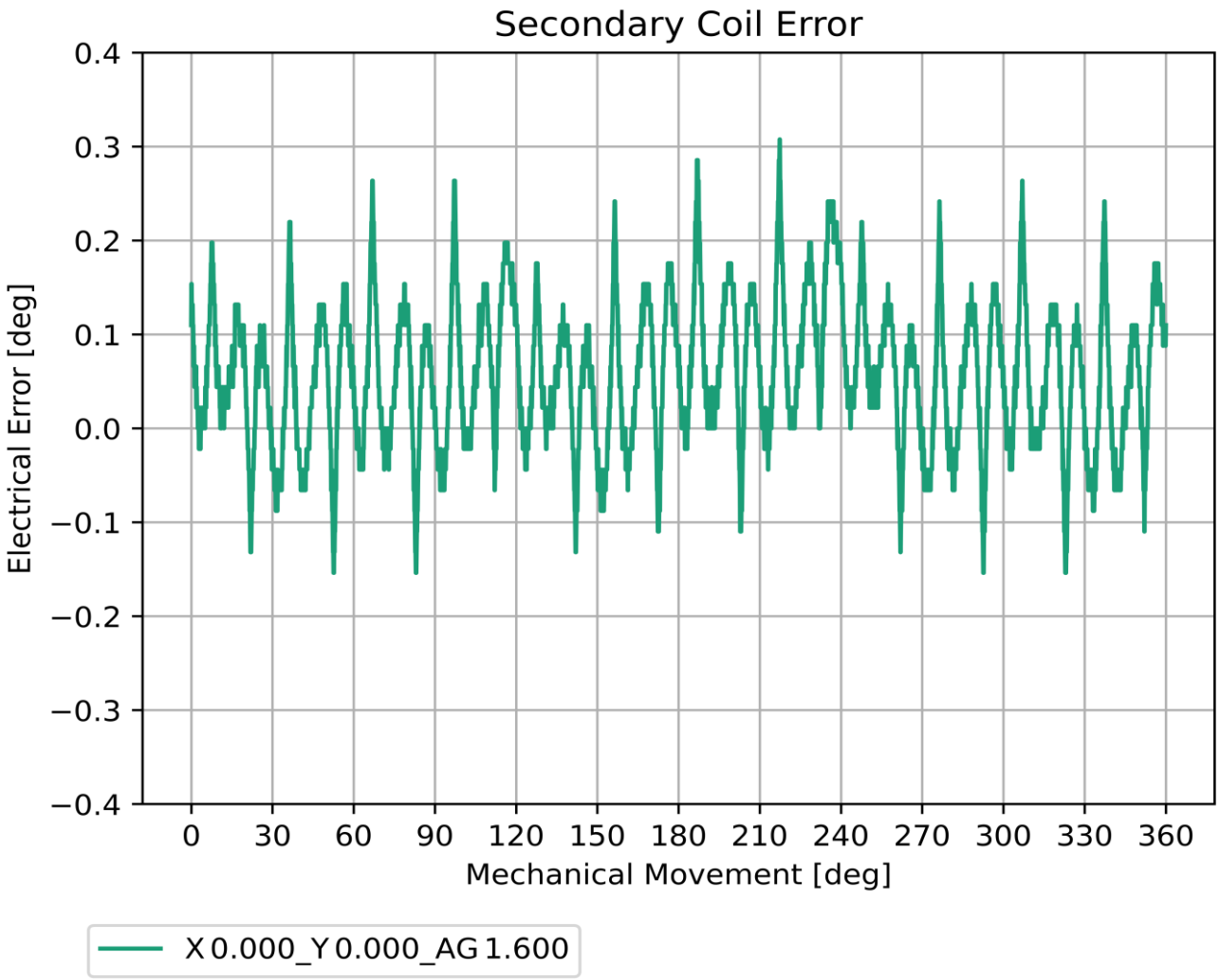

Figure 5. Secondary Coil Error

3.3 Magnitude Primary Coil

The plot below displays the primary magnitude measured over the given positions. Measurements are done with the memory settings, as shown in Table 4.

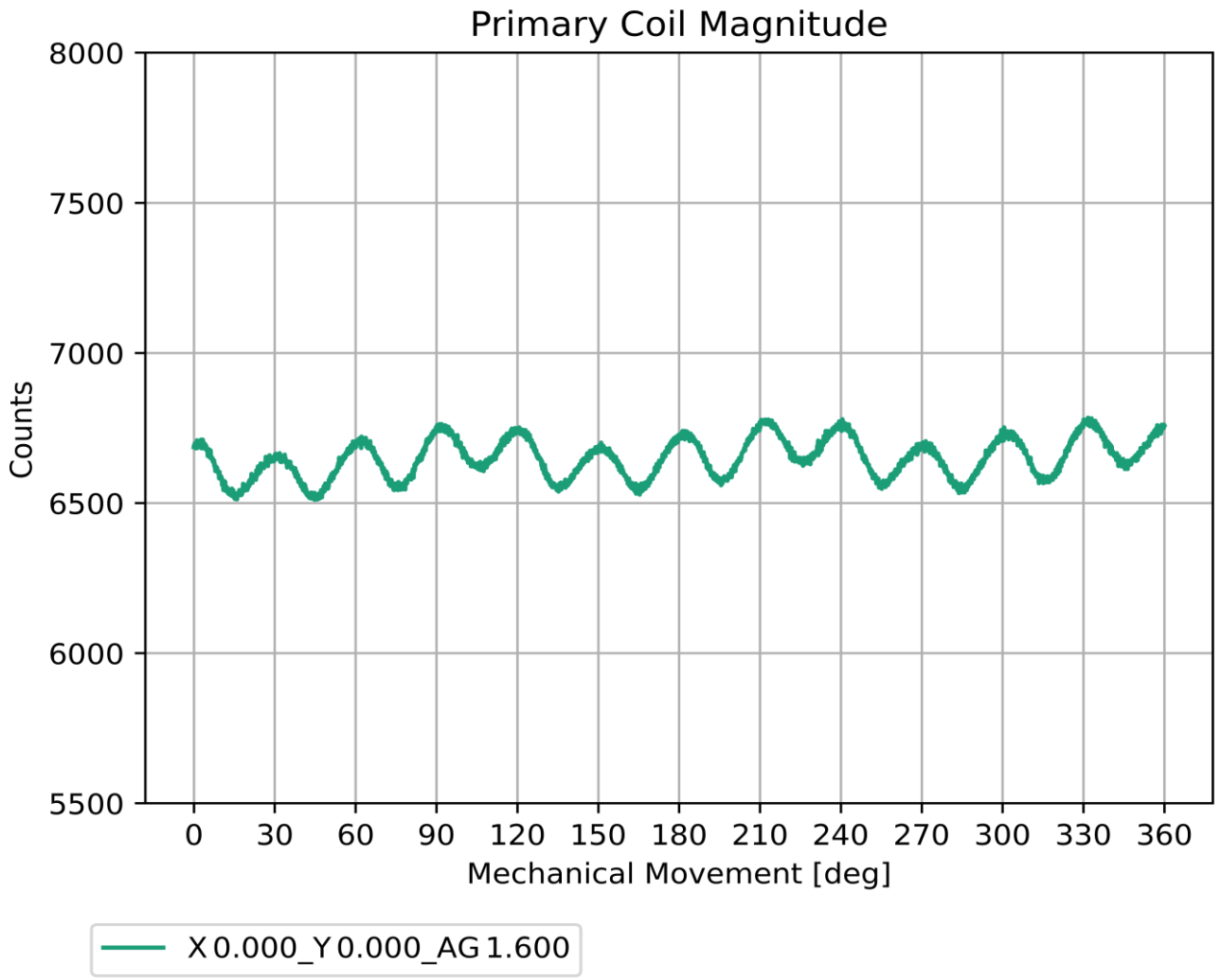

Figure 6. Primary Coil Magnitude

3.4 Magnitude Secondary Coil

The plot below displays the secondary magnitude measured over the given positions. Measurements are taken with the memory settings, as shown in Table 4.

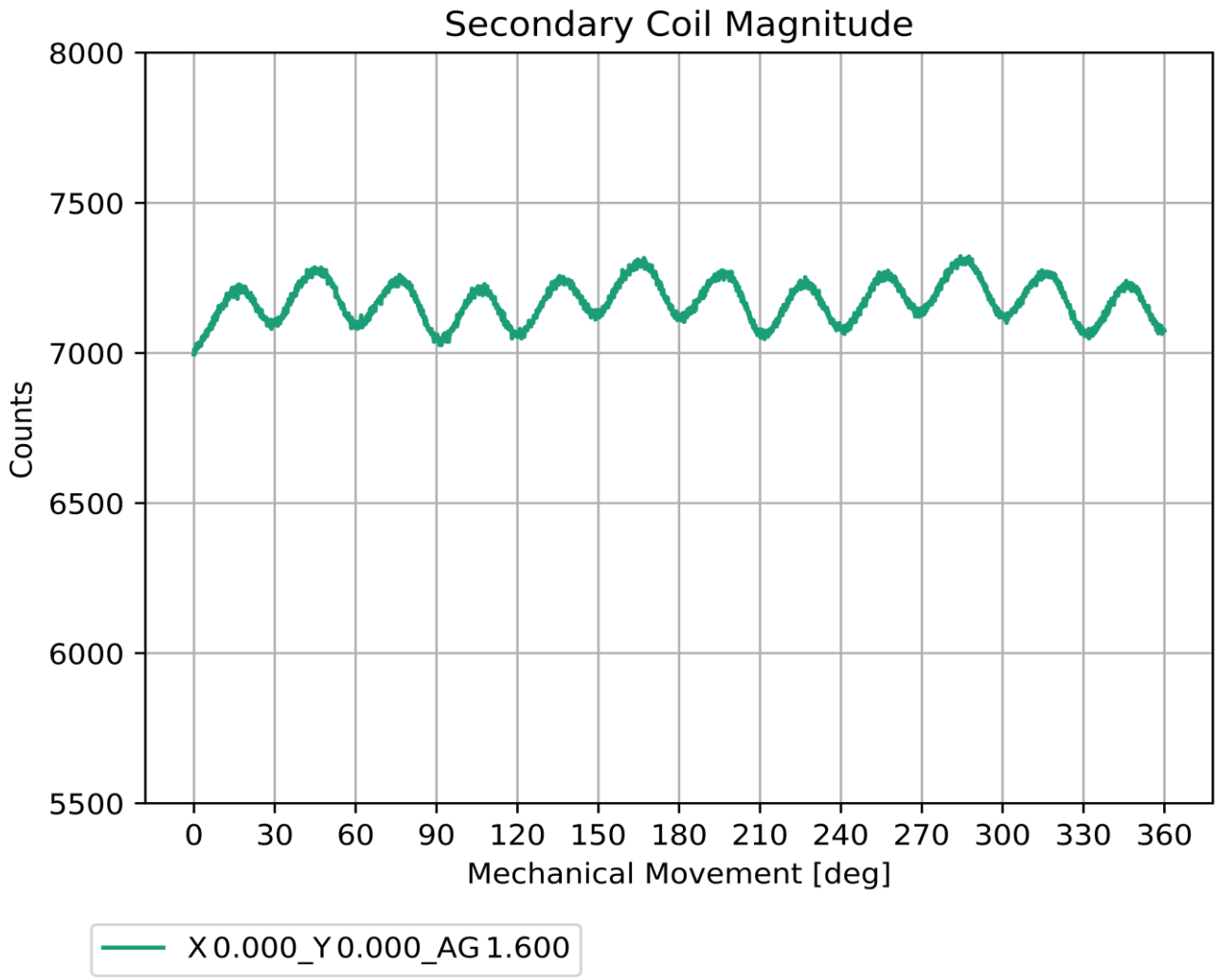

Figure 7. Secondary Coil Magnitude

3.5 Gain Primary Coil

The plot below displays the primary coil gain setting measured over the given positions. Measurements are taken with the memory settings, as shown in Table 4.

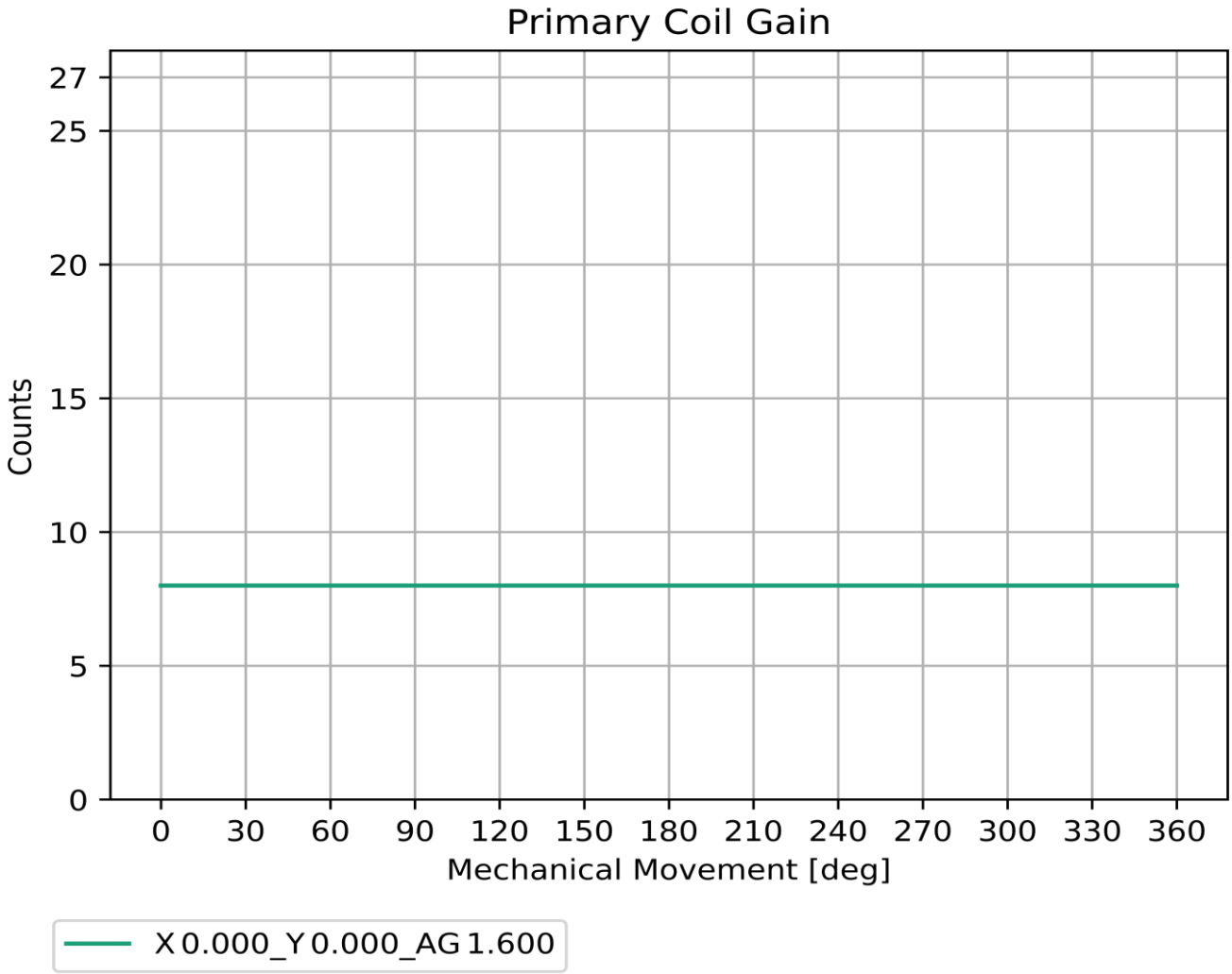

Figure 8. Primary Coil Gain

3.6 Gain secondary Coil

The plot below displays the secondary coil gain setting measured over the given positions. Measurements are taken with the memory settings, as shown in Table 4.

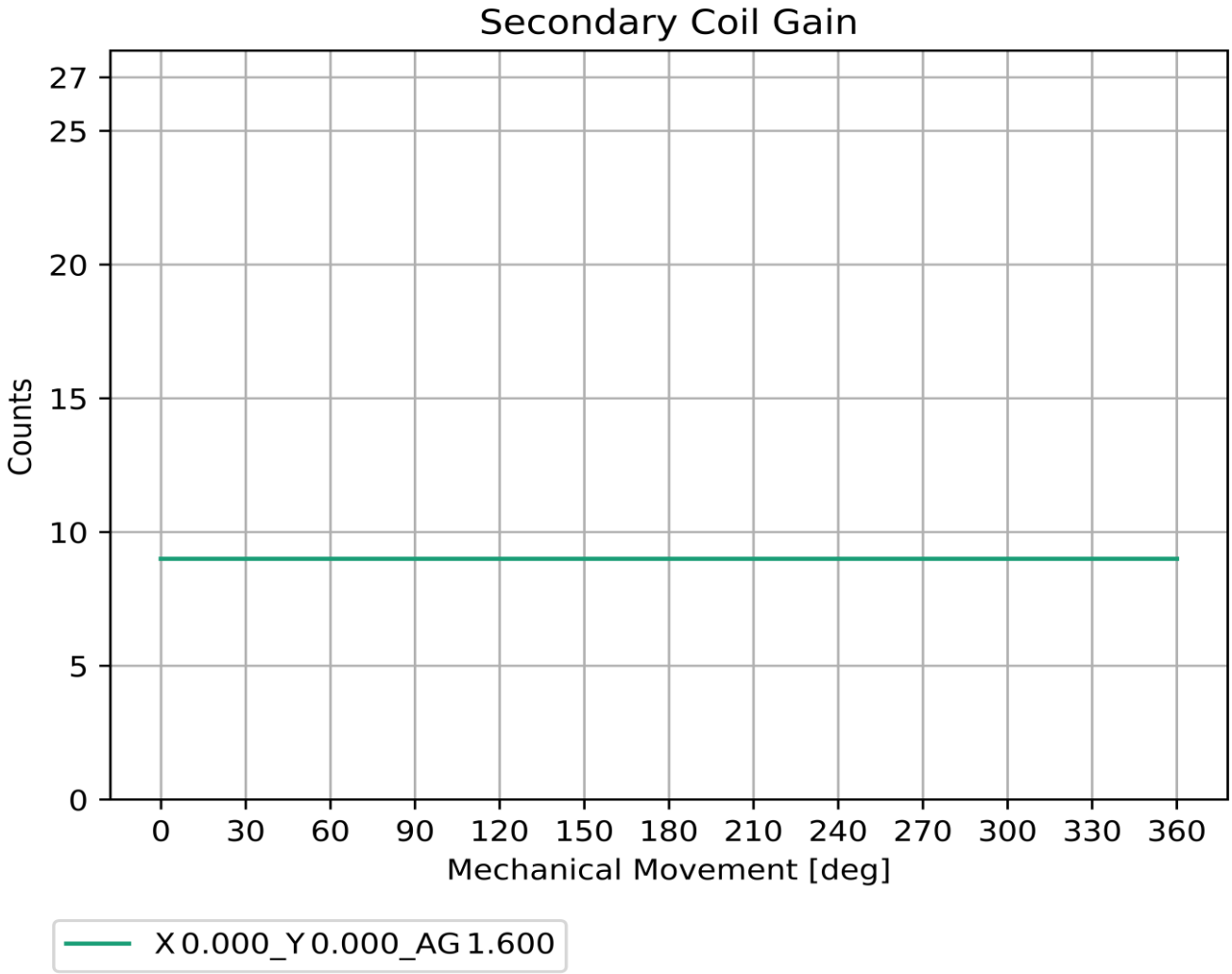

Figure 9. Secondary Coil Gain

4. Revision History

Revision	Date	Description
1.0	Sep. 9, 25	Initial release.

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