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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.]
RAA2P4520A1615	Rotary	High Res	16 / 15	100 x 100	88 / 38	89 / 37	1.60	±0.089

Table 2. Chip Characteristics

Chip	Coil Type	Interface	Internal Resolution
RAA2P4520	Single Coil	UART	18 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.
1.4 µH	1.5 Ω	1750 pF	2.49 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	0x14E0	0x8080	0x0000	0x0000	0x0000	0x0000	0x0000	0x0000
10h	0x0000	0x0000	0x0000	0x00FF	0x0714	0x02C8	0x0904	0x0016
20h	0x6401	0x0000	0x816E	0x6401	0x0000	0x0026	0xC9C9	0x1588
30h	0x7025	0x0025	0x4000	0x4000	0x4000	0x4000	0x01FA	0x097A
40h	0xA0E7	0xC01B	0x3A92	0x149E	0x9959	0x78F6	0x3860	0x4E95
50h	0xB4EA	0x7C4C	0x14D4	0xEF3E	0x2107	0xF91F	0x3CF2	0xB4AC
60h	0x8C58	0x7886	0xF860	0x6095	0xB4FA	0x8C33	0xDFD1	0xEC8D
70h	0x0FFF	0x0000	0x0000	0x0000	0x0000	0x0072	0x3FFF	0x0000
80h	0x0000	0x0000	0x0001	0x0000	0x0000	0x0000	0x0000	0x0BFC

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.

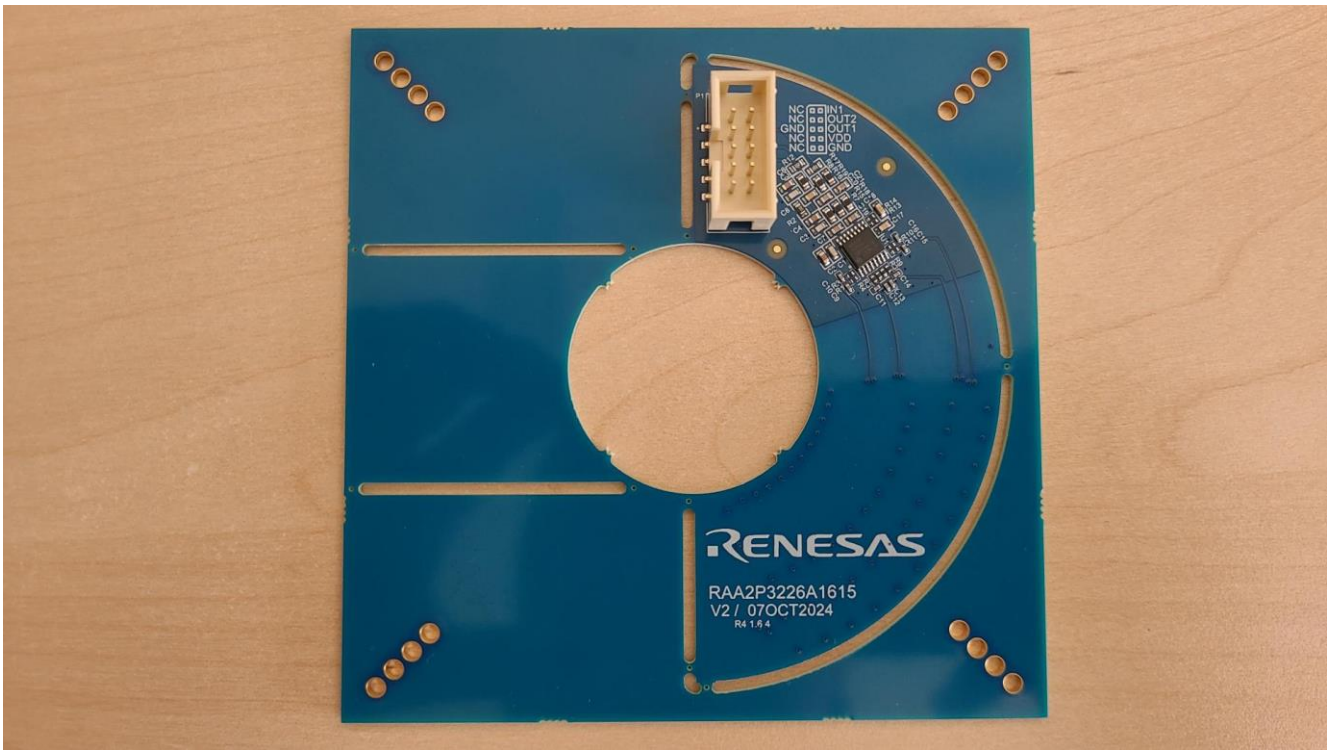

Figure 1. Sensor Board

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.

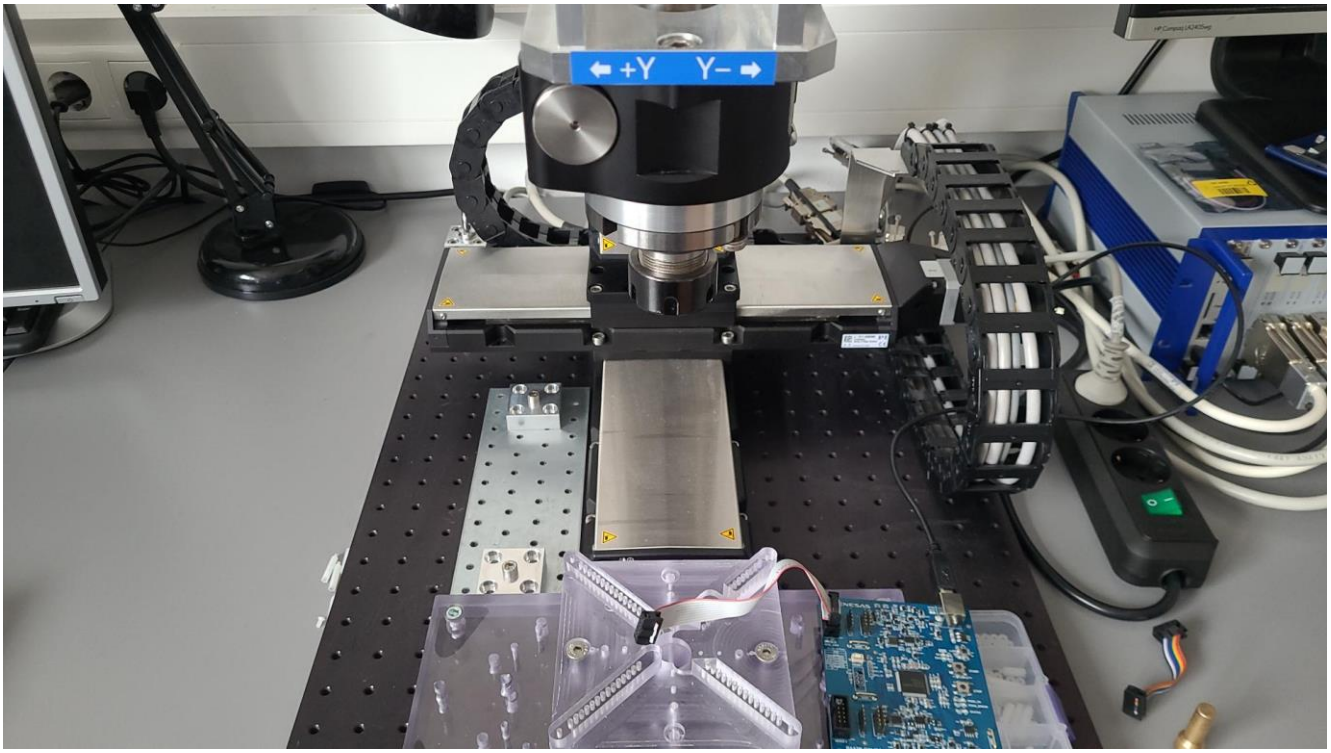

Figure 3. Setup

3. Measurement Results

3.1 Angle Error High Resolution

Both coil offsets were compensated without target, then the design was linearized at nominal position. The plot below displays the error of the high-resolution Angle measured over the given positions. Measurements are taken 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

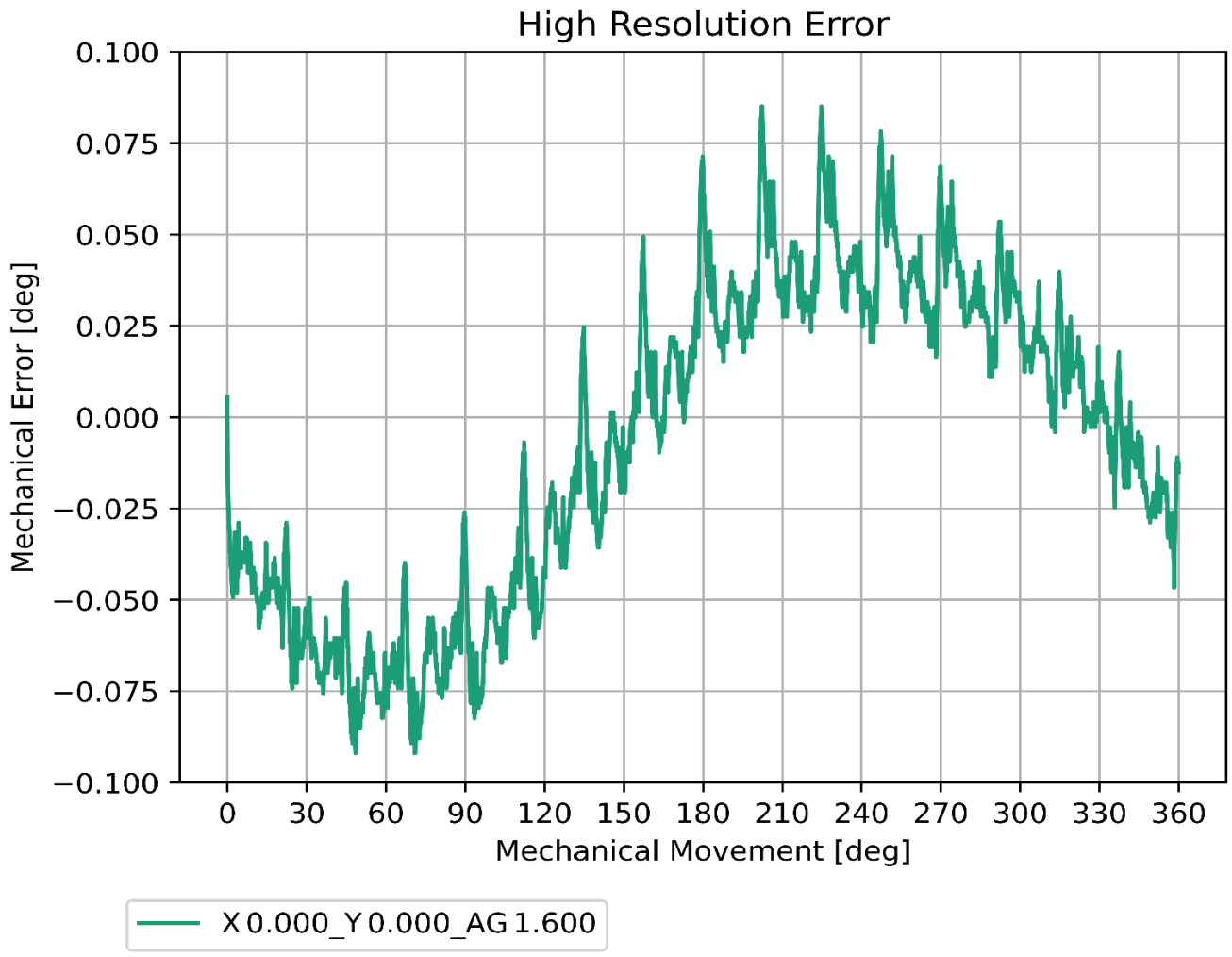

Figure 4. High Resolution Error

3.2 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.

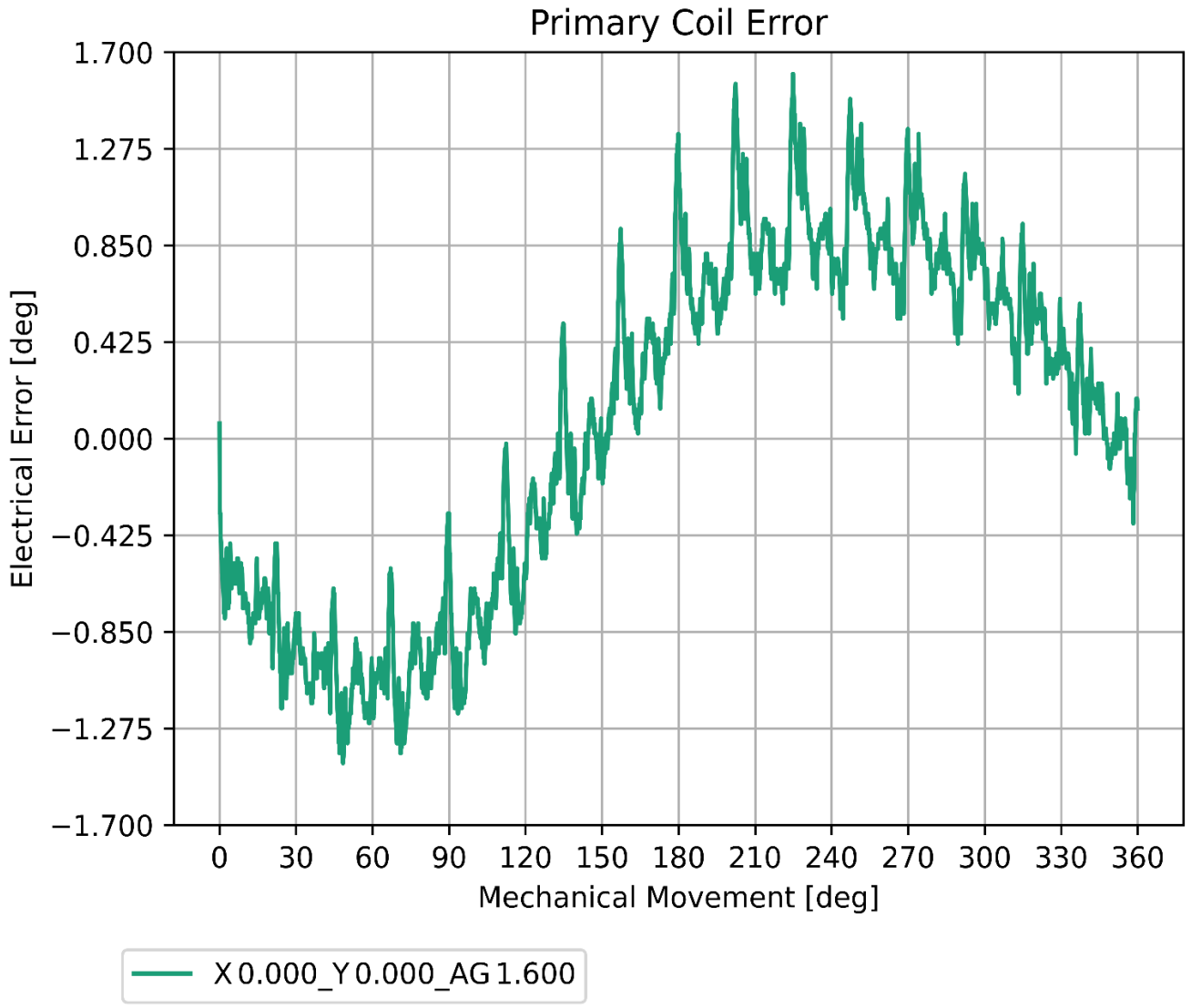

Figure 5. Primary Coil Error

3.3 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.

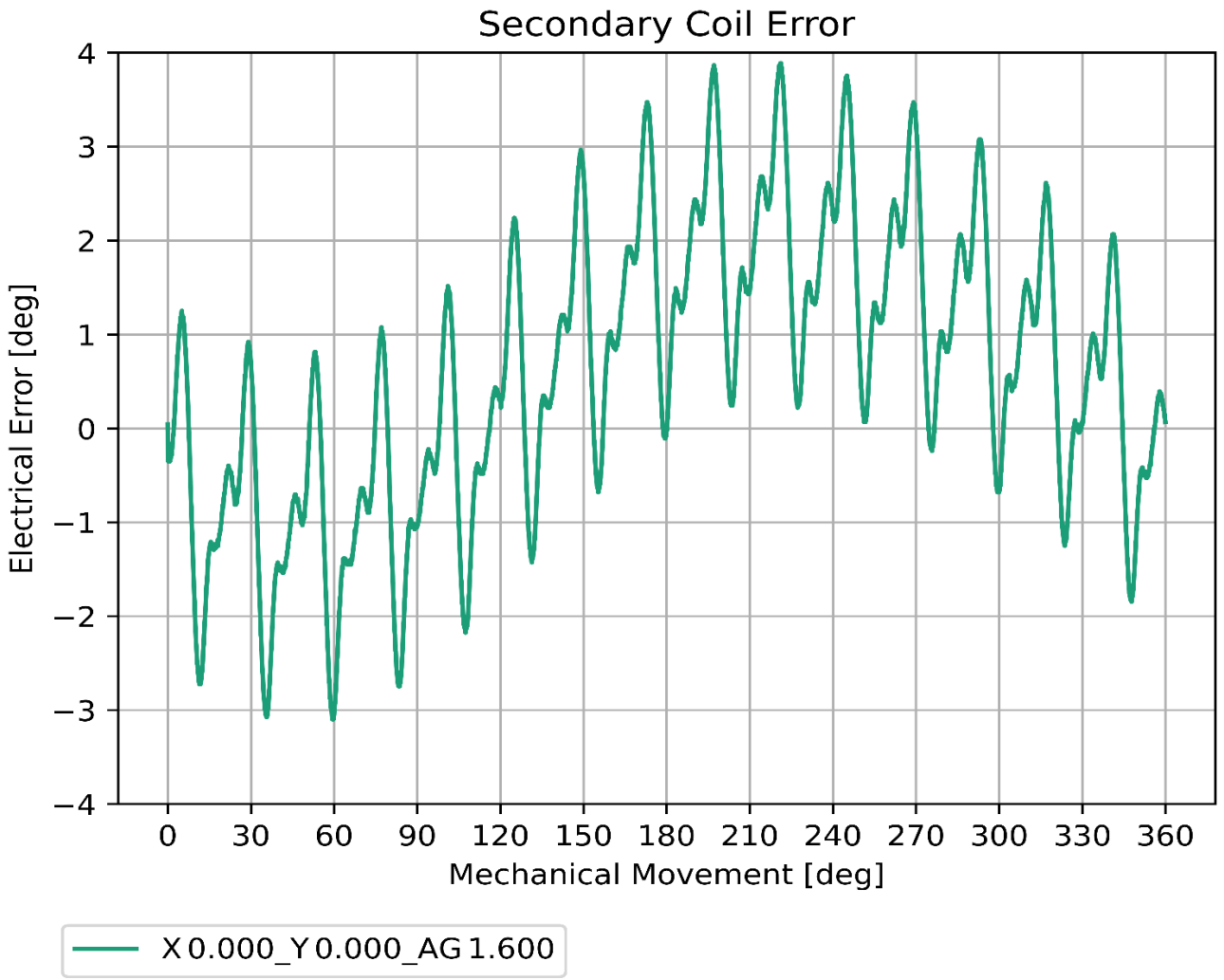

Figure 6. Secondary Coil Error

3.4 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.

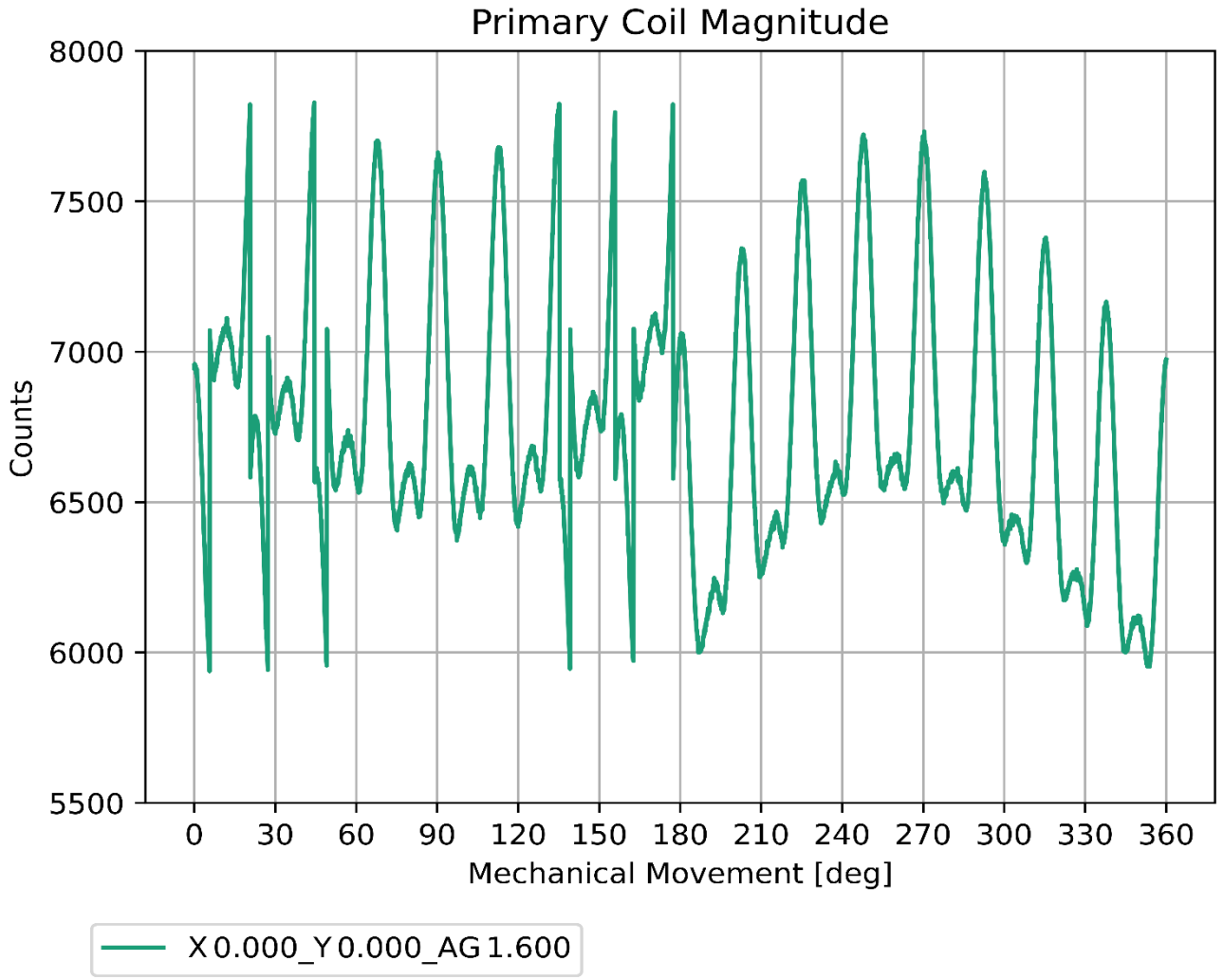

Figure 7. Primary Coil Magnitude

3.5 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.

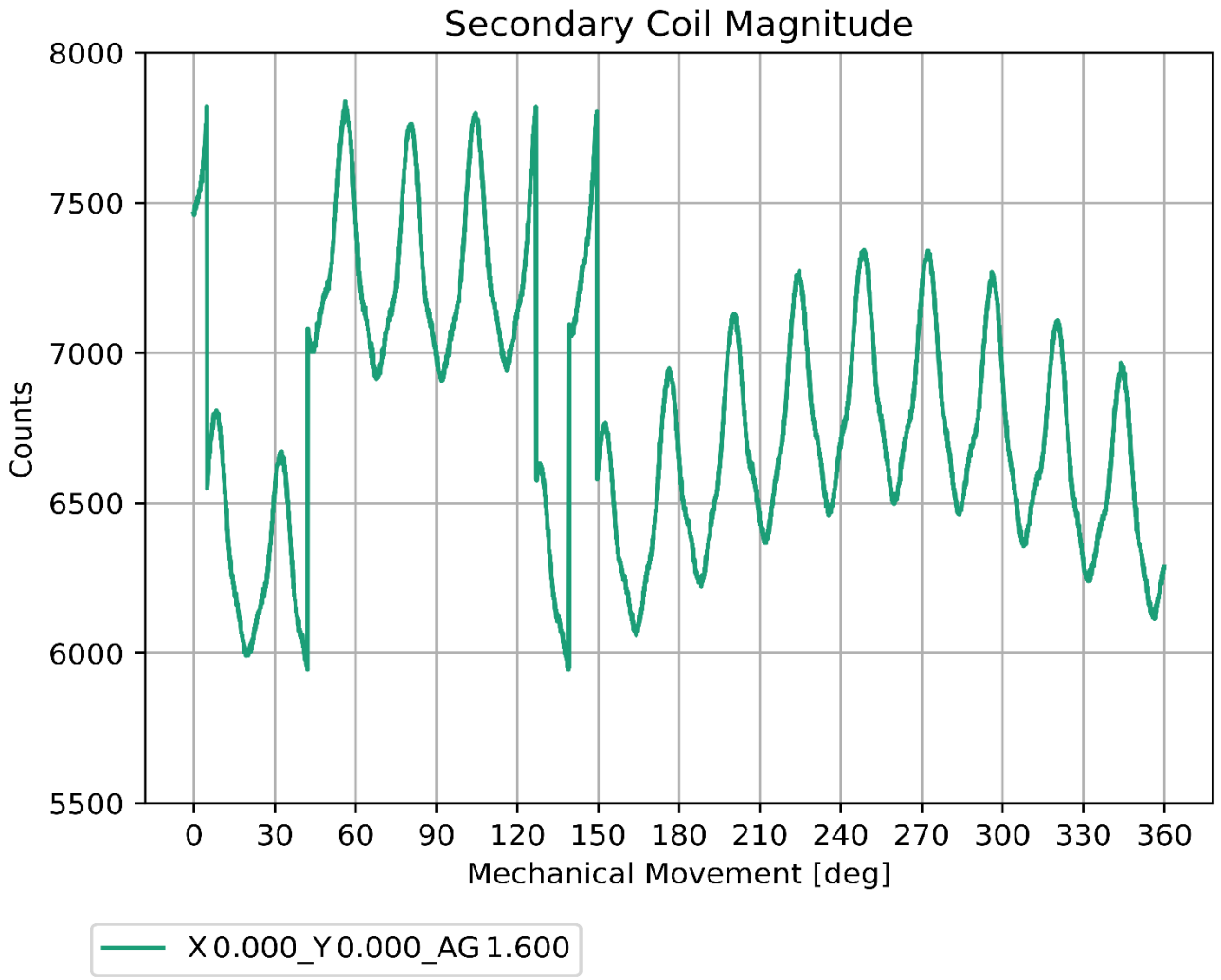

Figure 8. Secondary Coil Magnitude

3.6 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.

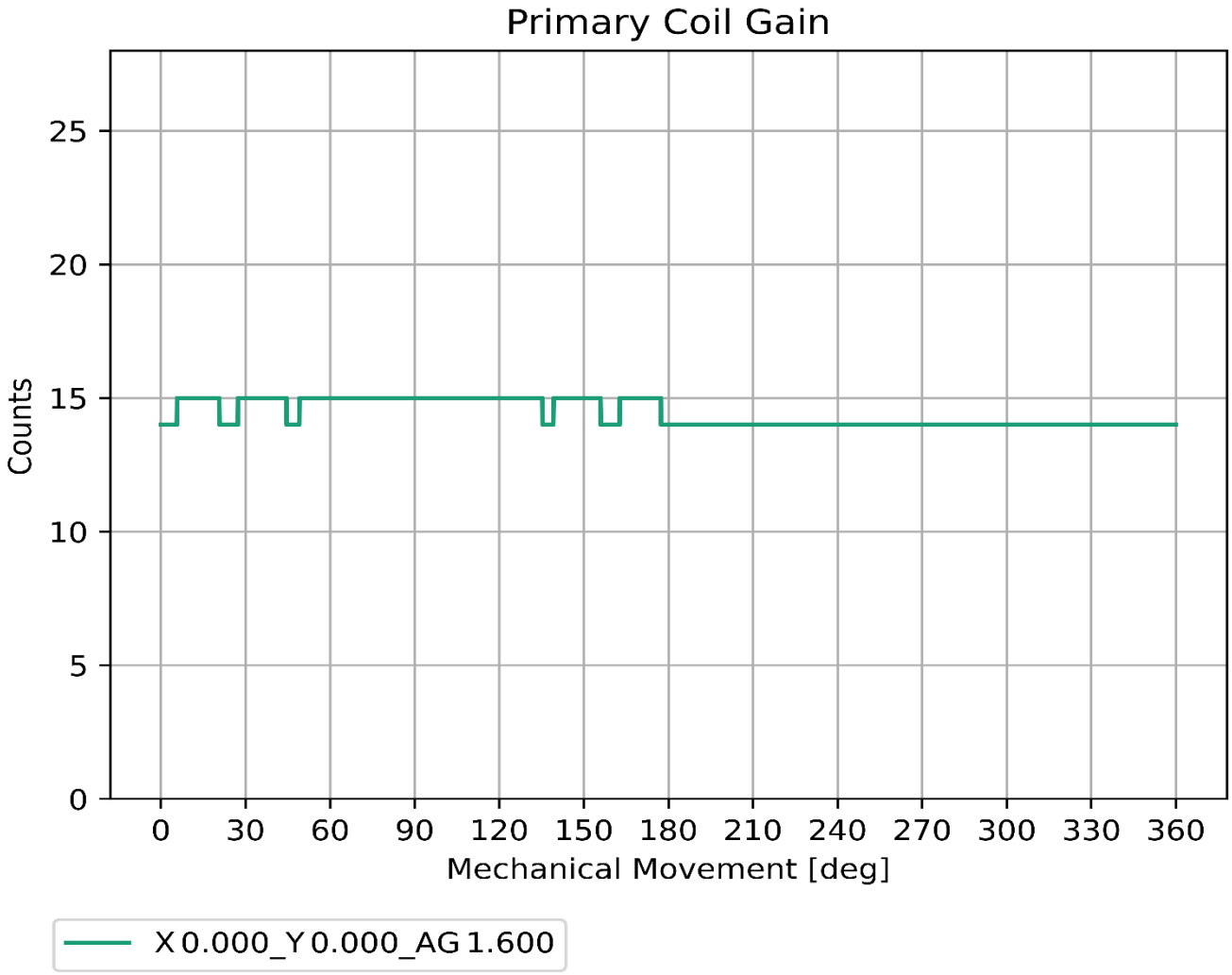

Figure 9. Primary Coil Gain

3.7 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.

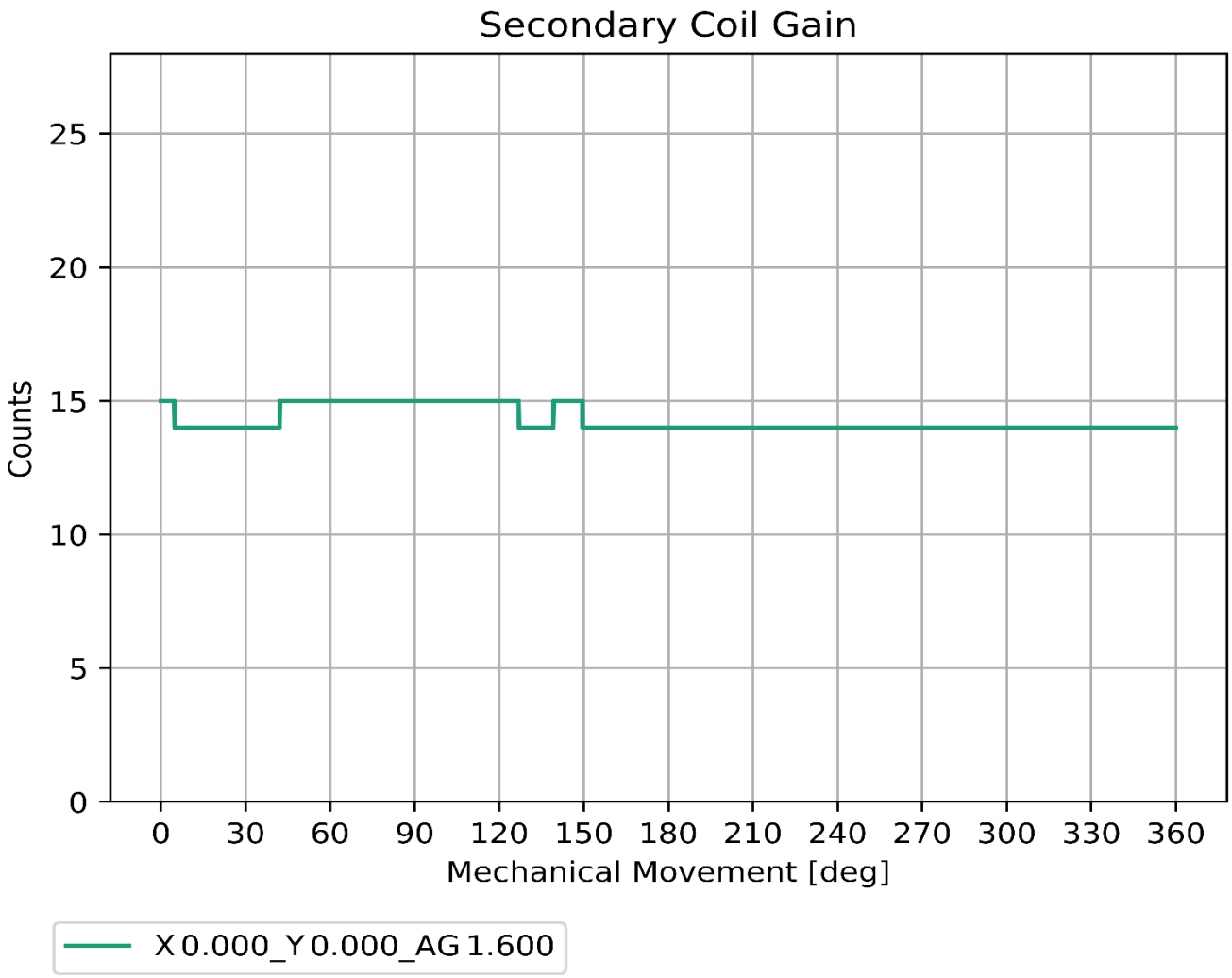

Figure 10. Secondary Coil Gain

4. Revision History

Revision	Date	Description
1.0	Dec. 12, 25	Initial release.

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