

# PS S2D2 lamp Fixture

Verification of D2 Lamp Fixtures DE0102 & DE0202, and Validation of Specifications for Noise on D2 fixture.

March 12, 2025

## Dark Data

The purpose in collecting Dark Data is to establish the systemic noise contributing to the noise of the D2 lamps, as well as to understand the contribution of the systemic noise to the overall lamp noise..

Dark noise can be collected either with the lamp on and the fiber disconnected, or with the lamp off. Both sets were collected for about 45 minutes with no measurable difference between the two<sup>a</sup>.

Summary - Mini Maurice:

	Median of Mean Noise	Median of Max Noise
Reference Channel	232. ± 28.6	295. ± 32.9
Main Channel	208. ± 24.7	263. ± 31.0

Summary - Maurice Instrument:

	Median of Mean Noise	Median of Max Noise
Reference Channel	280. ± 28.6	346. ± 32.9
Main Channel	224. ± 24.7	285. ± 31.0

<sup>a</sup>Longer times for dark data show no differences, particularly, no discontinuities or jumps.

## Lamp ON Data

On the Mini-Maurice fixtures, we saw Mean Noise values in the range of 700 to 1000 ADC counts on the reference channel and 500 to 700 ADC counts on the main channel. Comparably, on the Maurice Instruments, we saw noise values in the range of 700 to 1000 ADC counts on the reference channel and 400 to 700 ADC counts on the main channel<sup>a</sup>.

The Max Noise values are a little different; the Mini-Maurice fixtures had Max Noise values in the range of 800 to 3000 ADC counts on the reference channel, excluding the significant anomaly of lamp PU8786. The main channel had a range of 800 to 5000 ADC on the Mini-Maurice, also excluding lamp PU8786.

The Maurice instruments had Max Noise values for the reference channel in the range of 1000 to 3500 ADC counts, lamps PU8748 & PU8769 excluded. The Max Noise values in the main channel were in the range from 500 to 4500 ADC counts.

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<sup>a</sup>One significant anomaly was lamp PU8748 on MM0132, where the mean values were an order of magnitude higher for both ref and main.

## Summary - Mini Maurice:

	Median of Mean Noise	Median of Max Noise
Reference Channel	790. ± 70.5	1510. ± 658.
Main Channel	552. ± 57.8	2540. ± 1380.

## Summary - Maurice Instrument:

	Median of Mean Noise	Median of Max Noise
Reference Channel	800. ± 83.5	1250. ± 1090.
Main Channel	548. ± 103.	1210. ± 1860.

## Comparison of noise parameters to Lamp Specs

The proper way to do comparison of the noise we measure on our instruments is to decouple the systemic noise from the lamp noise, then compare the normalized noise; we aren't able to decouple the noise, but we can make estimates.

As a general rule, the noise can be represented as a sum of squares of noise from the lamp and noise from the system. The data collected shows our systemic noise to be about 20% of the signal noise; allowing the possibility that the systemic noise is roughly the same as the noise from the lamp, we would expect the noise of the lamp to be approximately 71% of the measured noise and systemic noise to also be 71% of the measured noise.

This yields an estimate for the noise contribution from the D2 lamps of Mean Noise in the range of 500 to 700 ADC counts for the reference channel; 350 to 500 ADC counts on the main channel.

Normalizing these values to our maximum ADC range of  $2^{23}$  yields an estimate of 0.004% to 0.008% Mean Noise from the lamps<sup>a</sup>.

Hamamatsu's specs for the D2 Lamp:

Output Stability at 230nm - Fluctuation (P-P) typ. 0.005%

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<sup>a</sup>Here, the P-P noise is roughly twice the value of sum-of-squares noise, but we are also normalizing to  $2^{23}$  which is also roughly twice the mean values of the lamp intensity ADC measured output; hence both factors should approximately cancel each other.

Looking only at the high end of these estimates, measured Mean Noise values at 1000 ADC counts on the reference channel yields a normalized Mean Noise value of 0.008% which is acceptable for our purposes.

For our assays, we want to minimize the Max Noise parameter, since “significant” fluctuations in the lamp intensity can cause false protein detection.

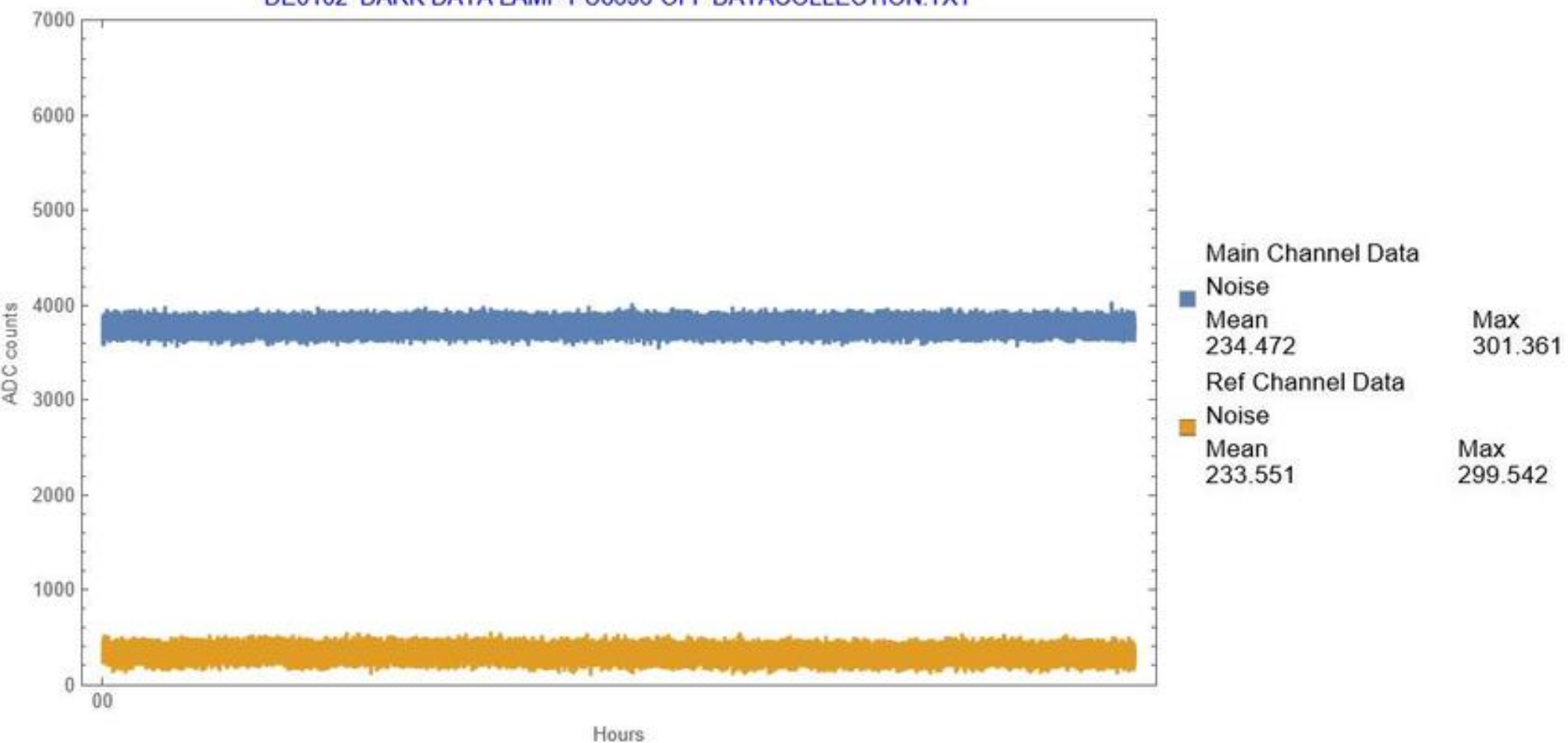
Estimating a Max Noise parameter based on a subjective evaluation of our assays, fluctuations that are greater than twice the Mean Noise values can trigger false protein detection. This means that we would like to limit the measured Max Noise to less than 2000 ADC counts, or a normalized value of 0.015%.



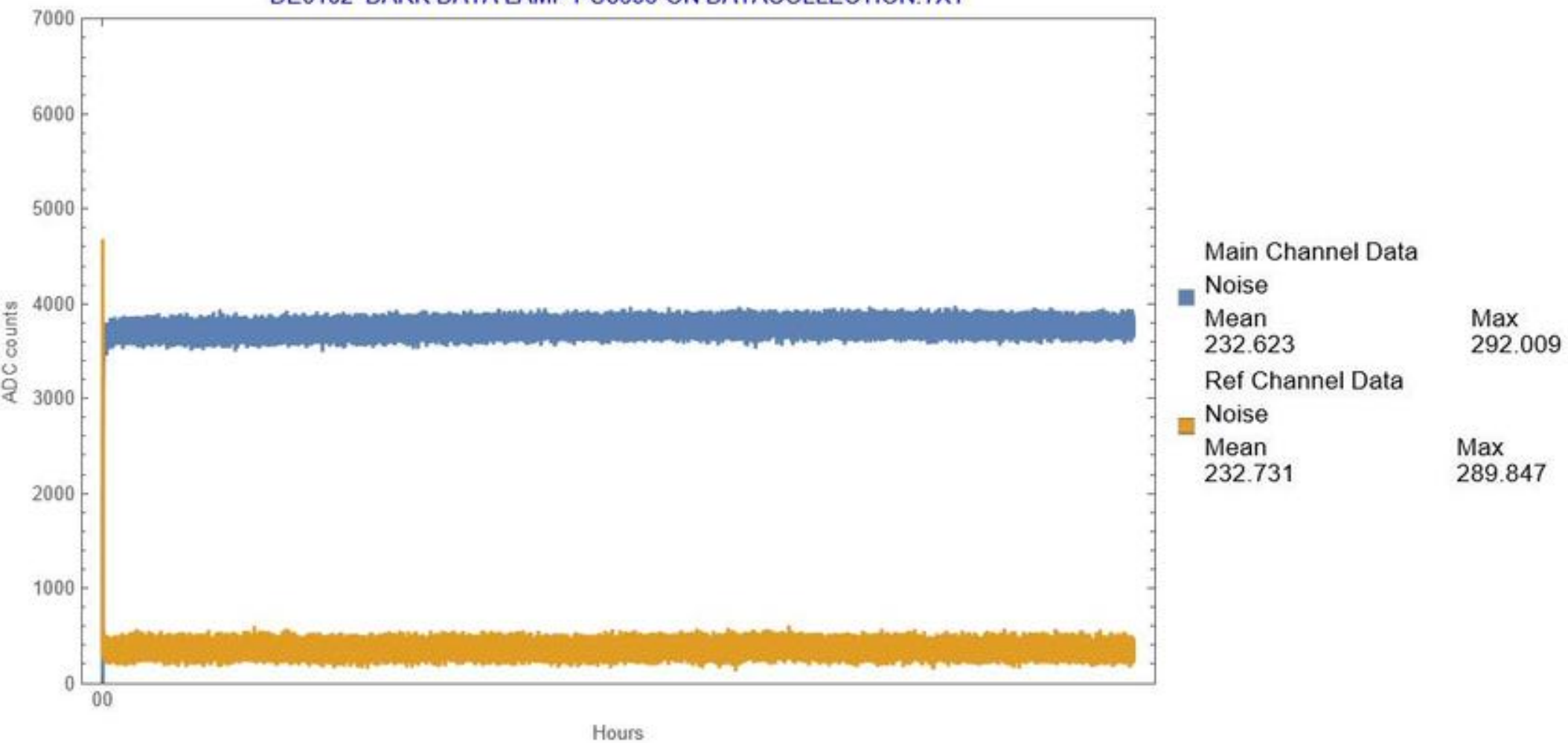
The following table lists our proposed noise parameters for D2 lamps on the Mini-Maurice.

Parameter	ADC Counts	Normalized Value
Mean Noise	$\leq 1000$	$\approx 0.008\%$
Max Noise	$\leq 2000$	$\approx 0.015\%$

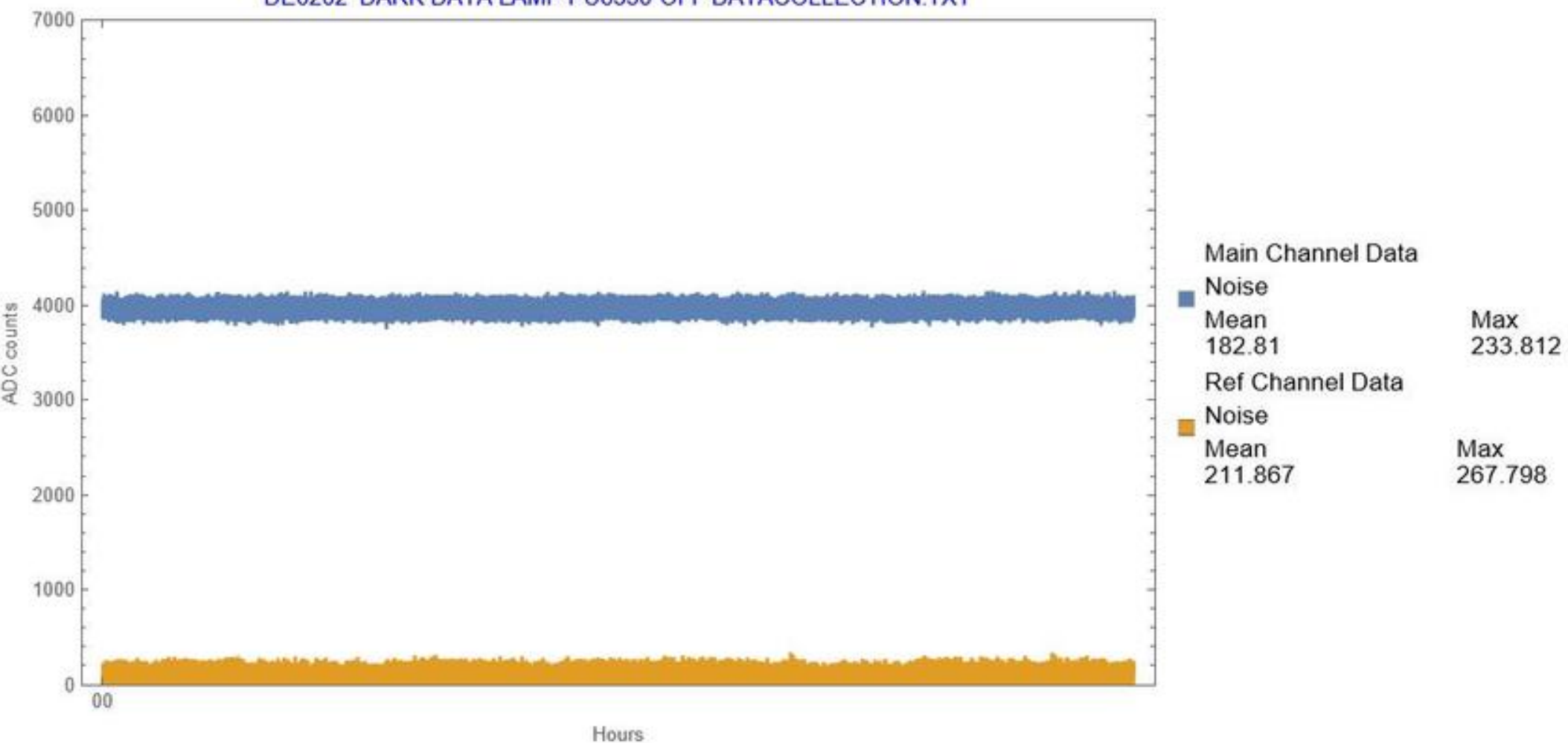
DE0102 DARK DATA LAMP PU8696 OFF DATACOLLECTION.TXT



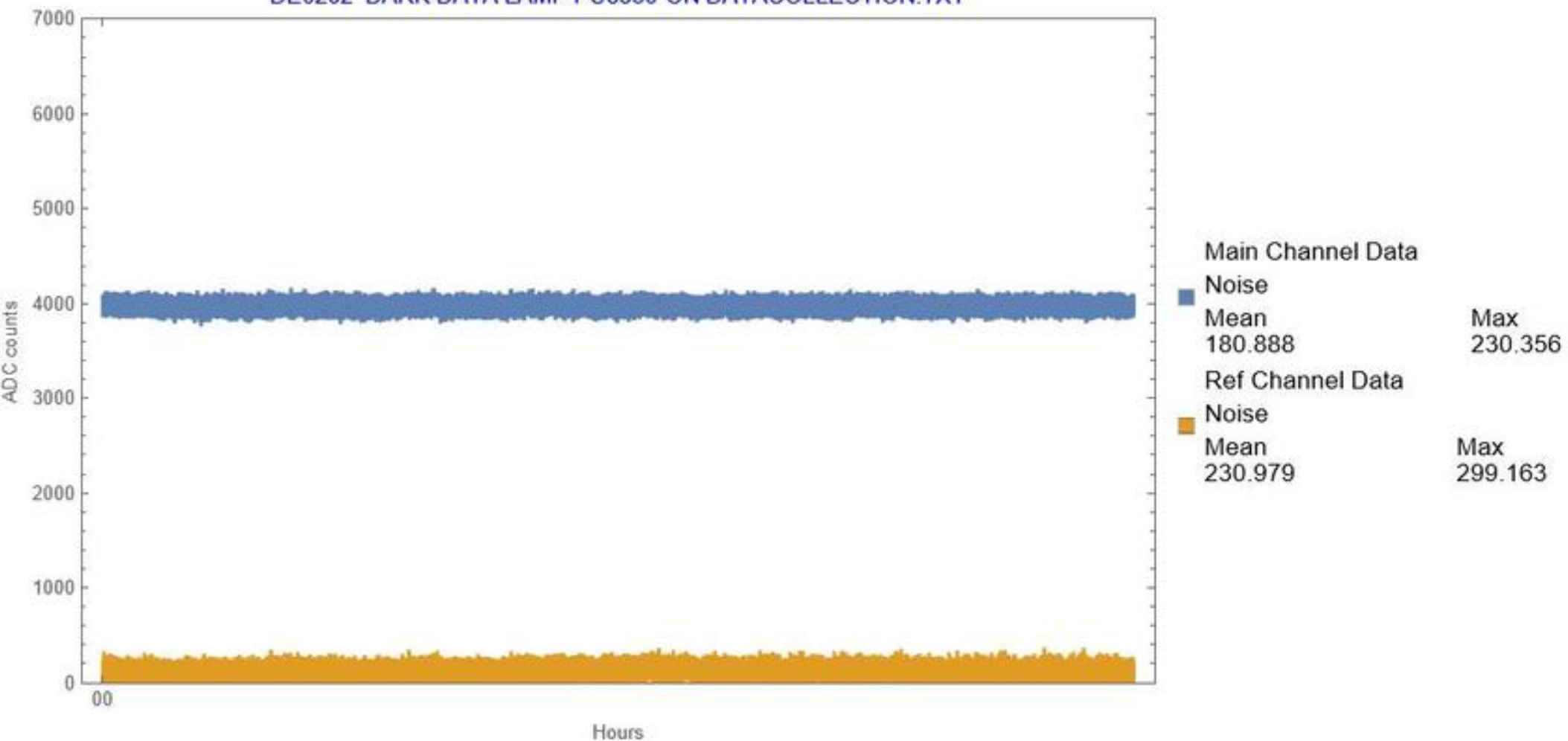
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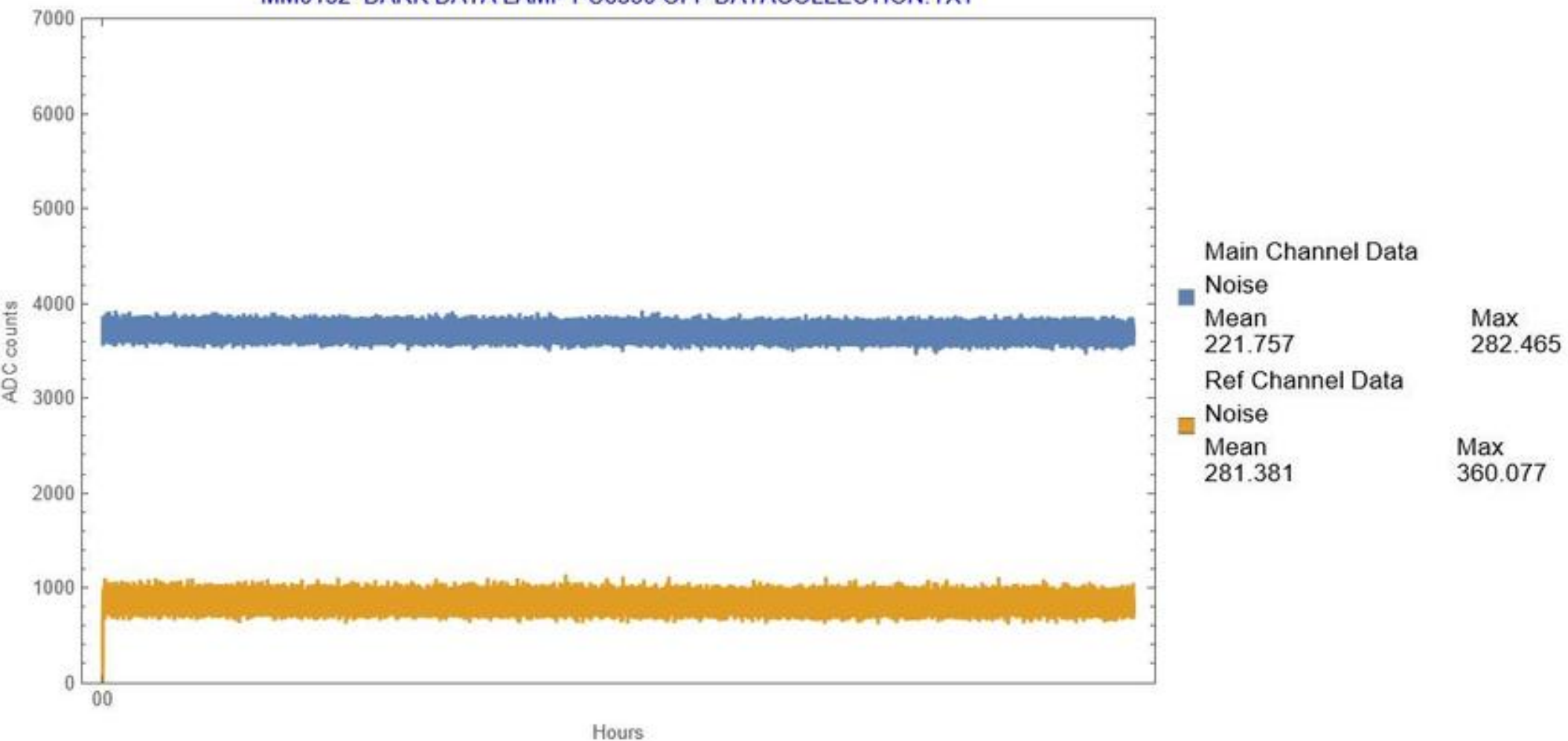
DE0202 DARK DATA LAMP PU8350 OFF DATACOLLECTION.TXT



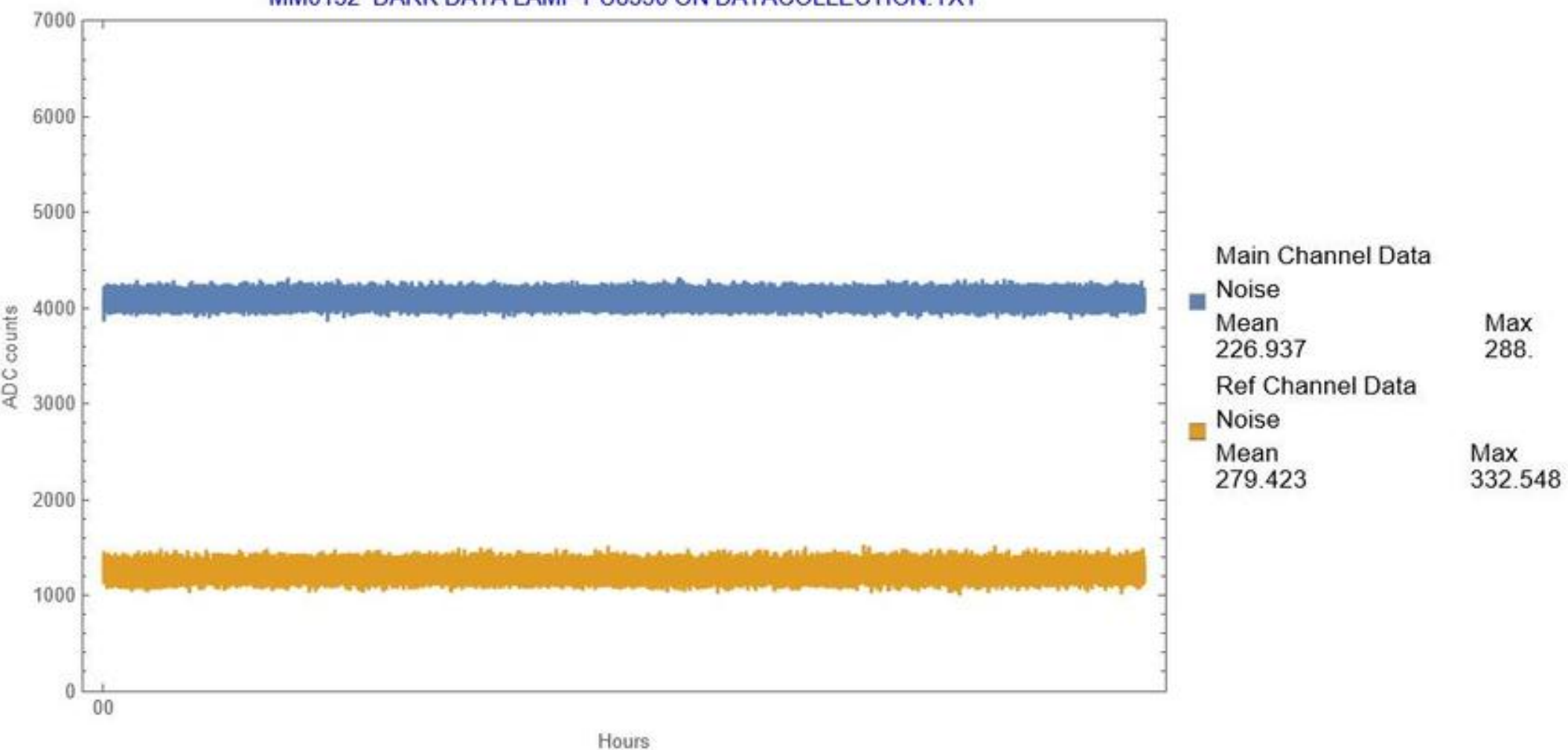
DE0202 DARK DATA LAMP PU8350 ON DATACOLLECTION.TXT



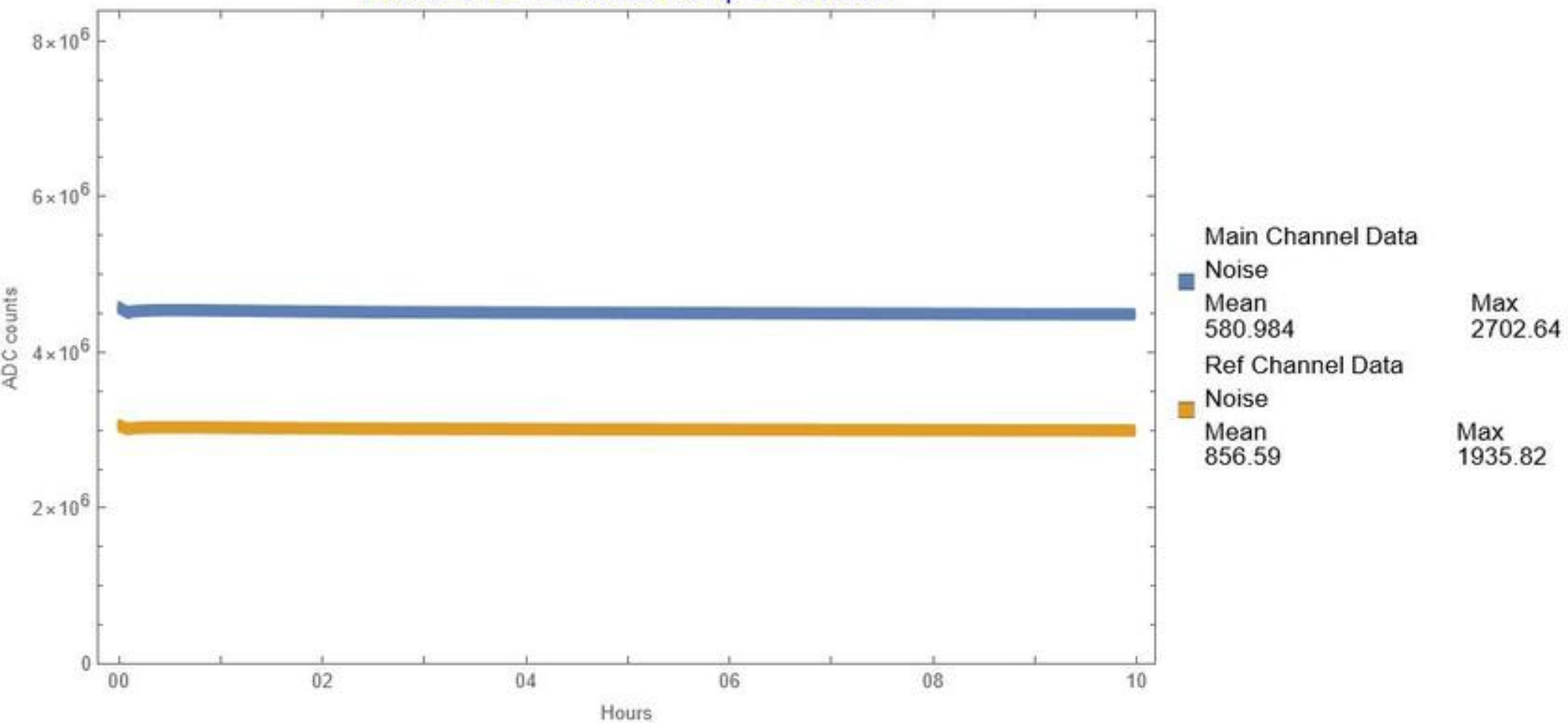
MM0132 DARK DATA LAMP PU8350 OFF DATACOLLECTION.TXT



MM0132 DARK DATA LAMP PU8350 ON DATACOLLECTION.TXT

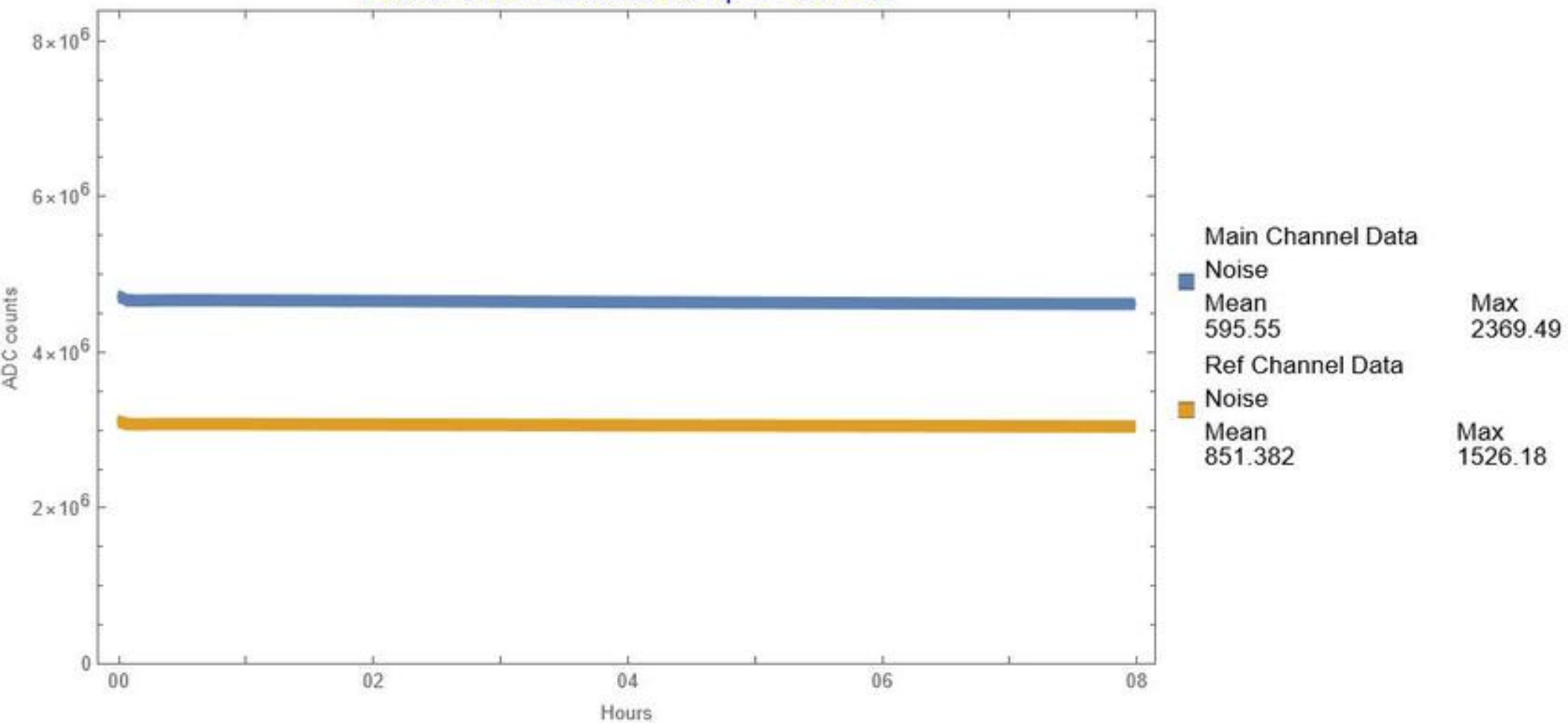


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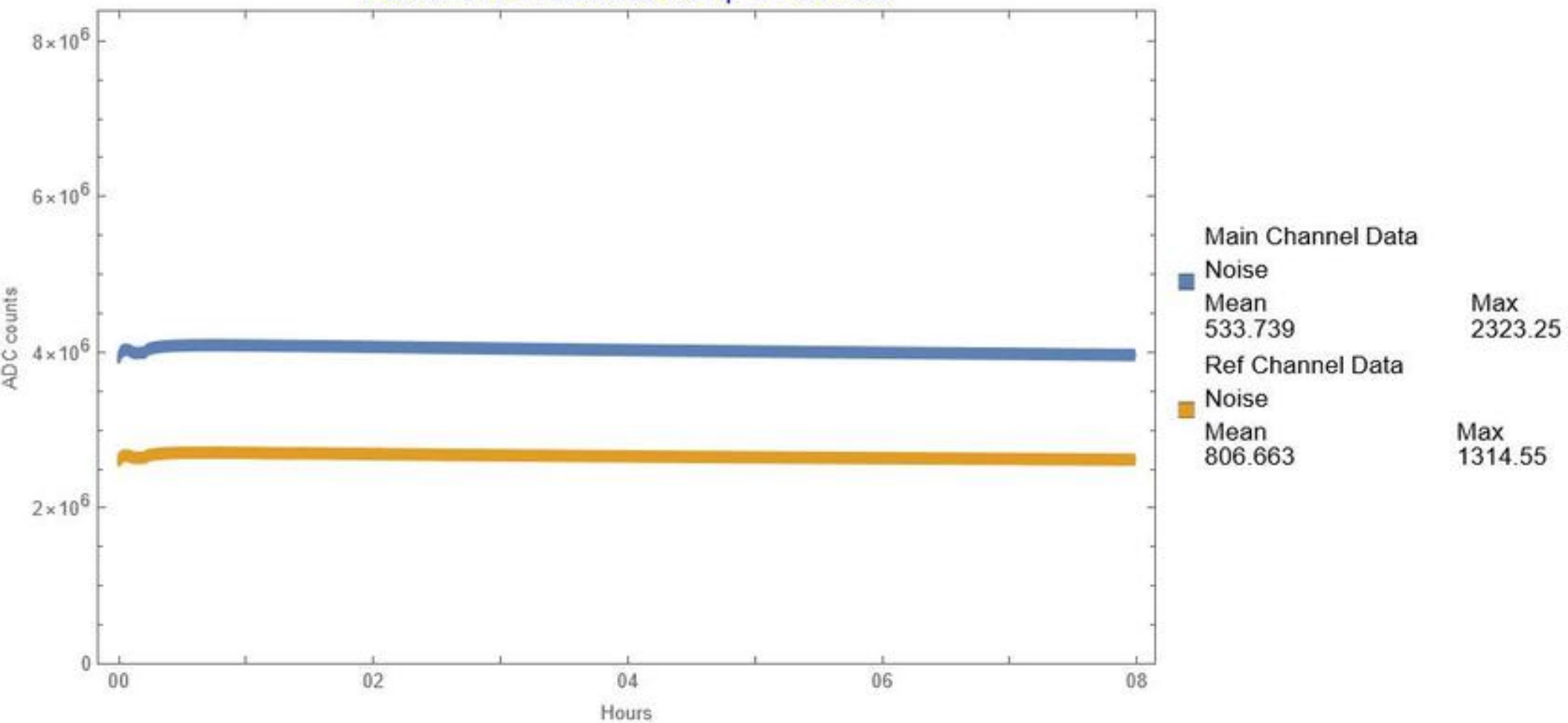




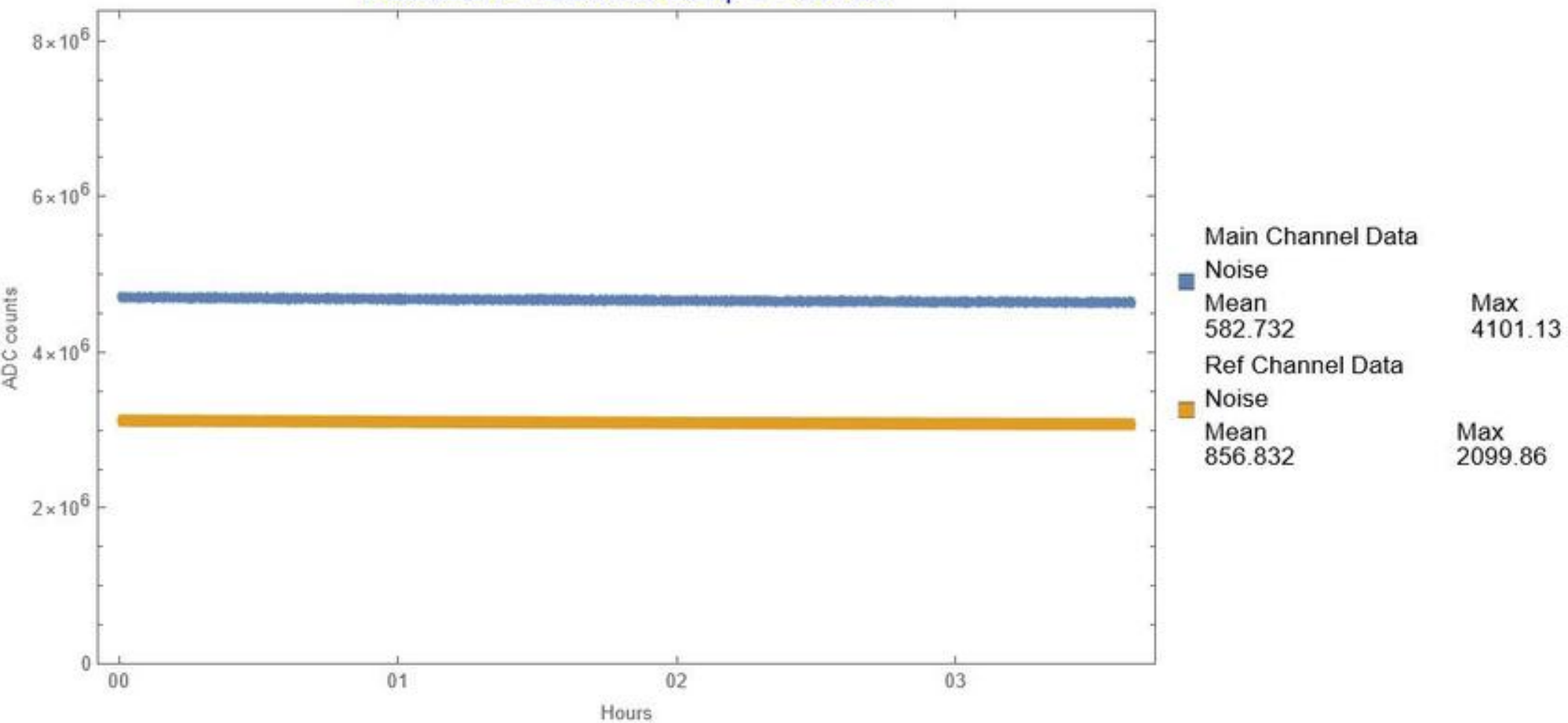
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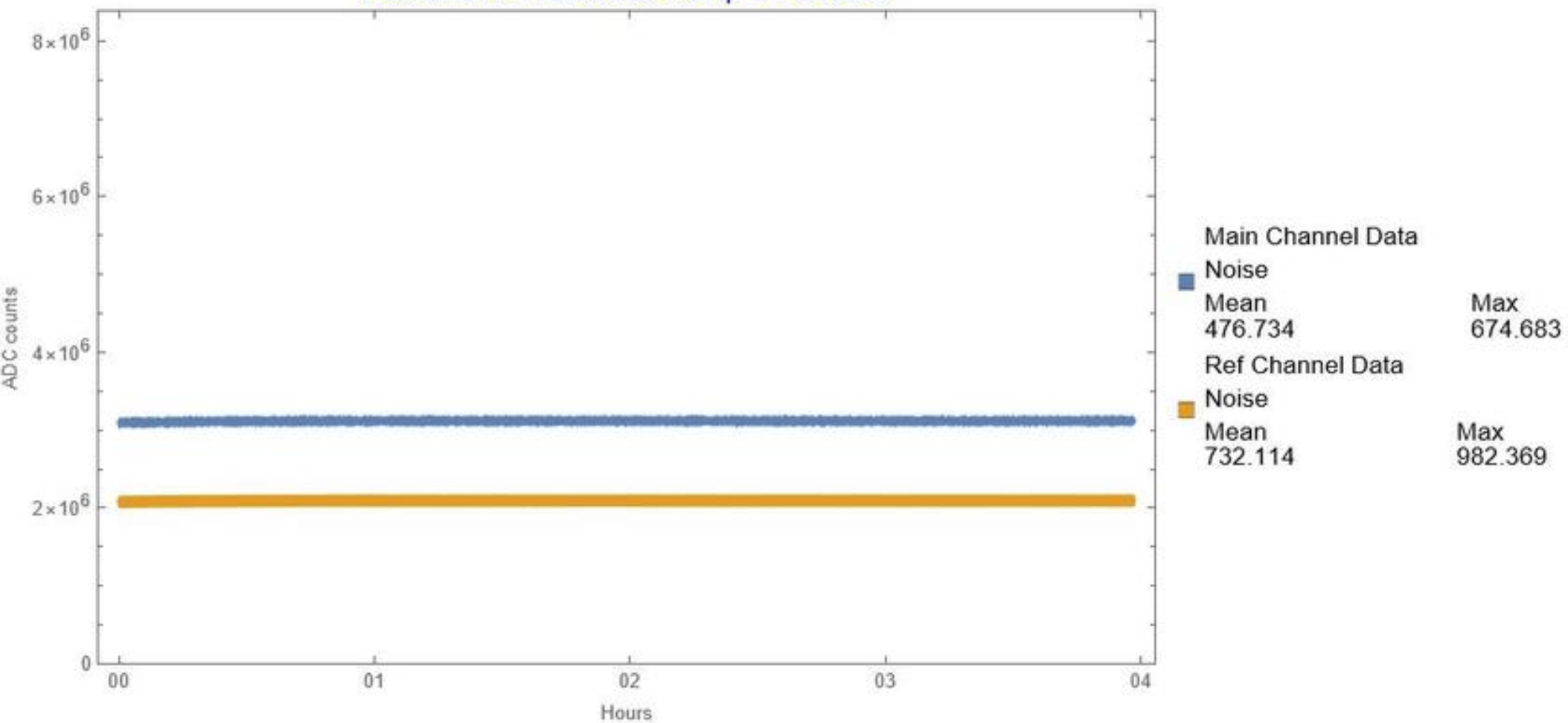
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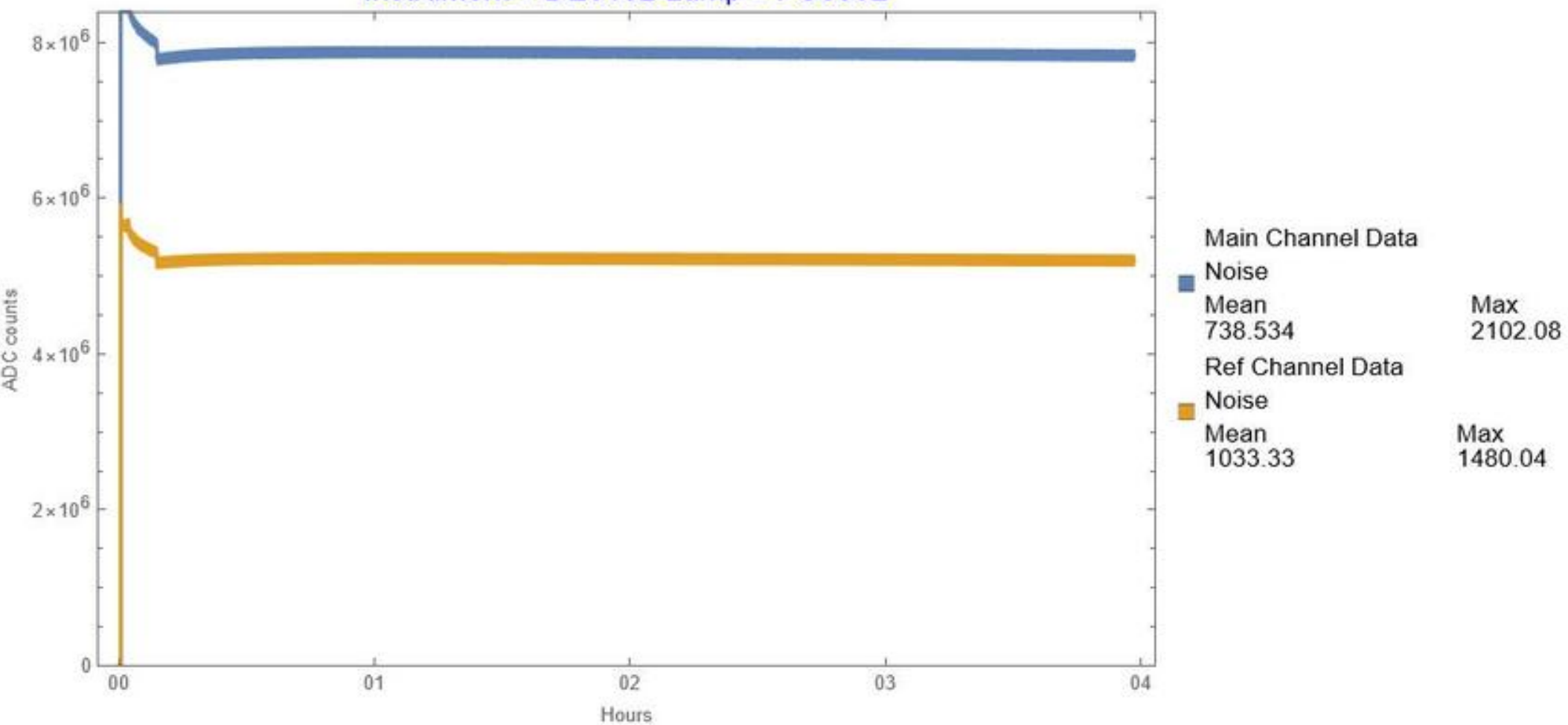
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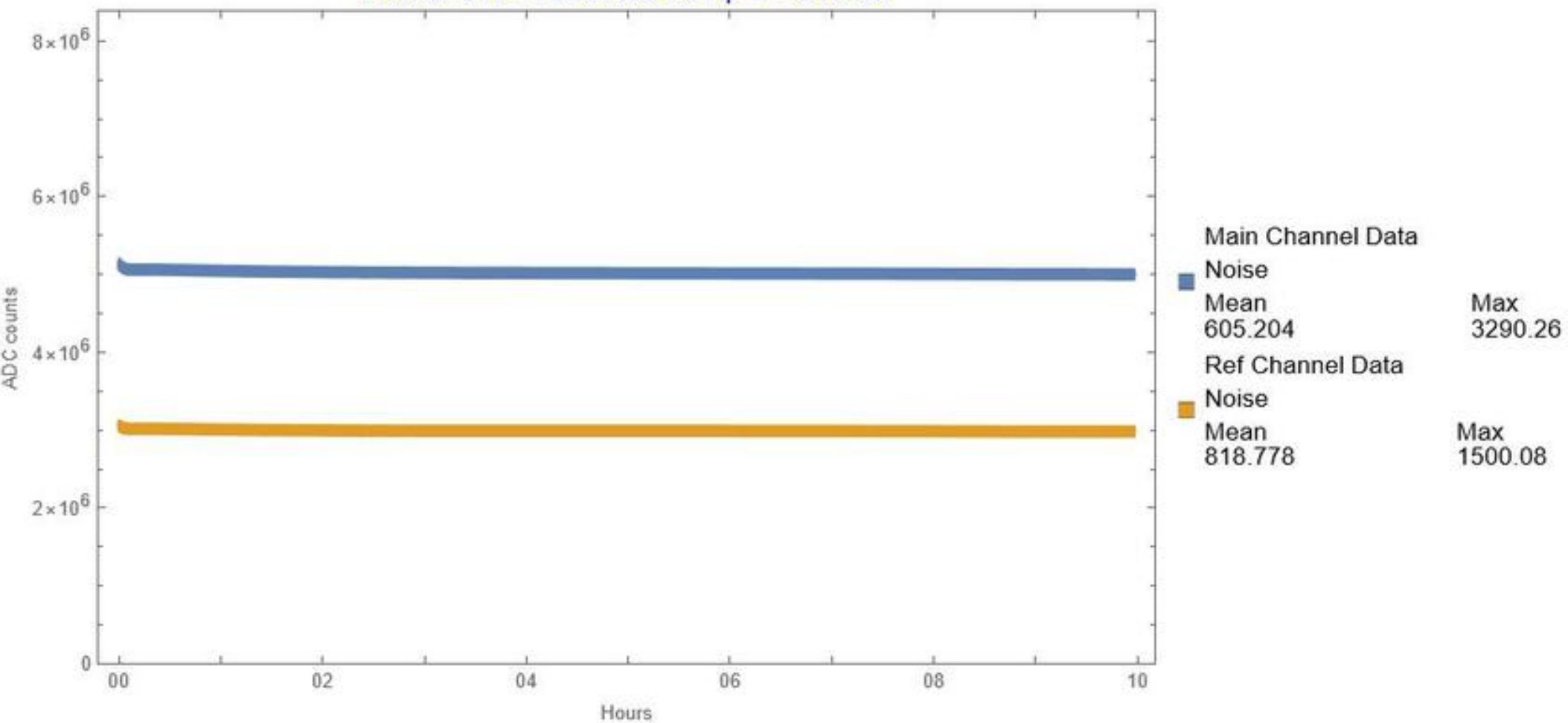
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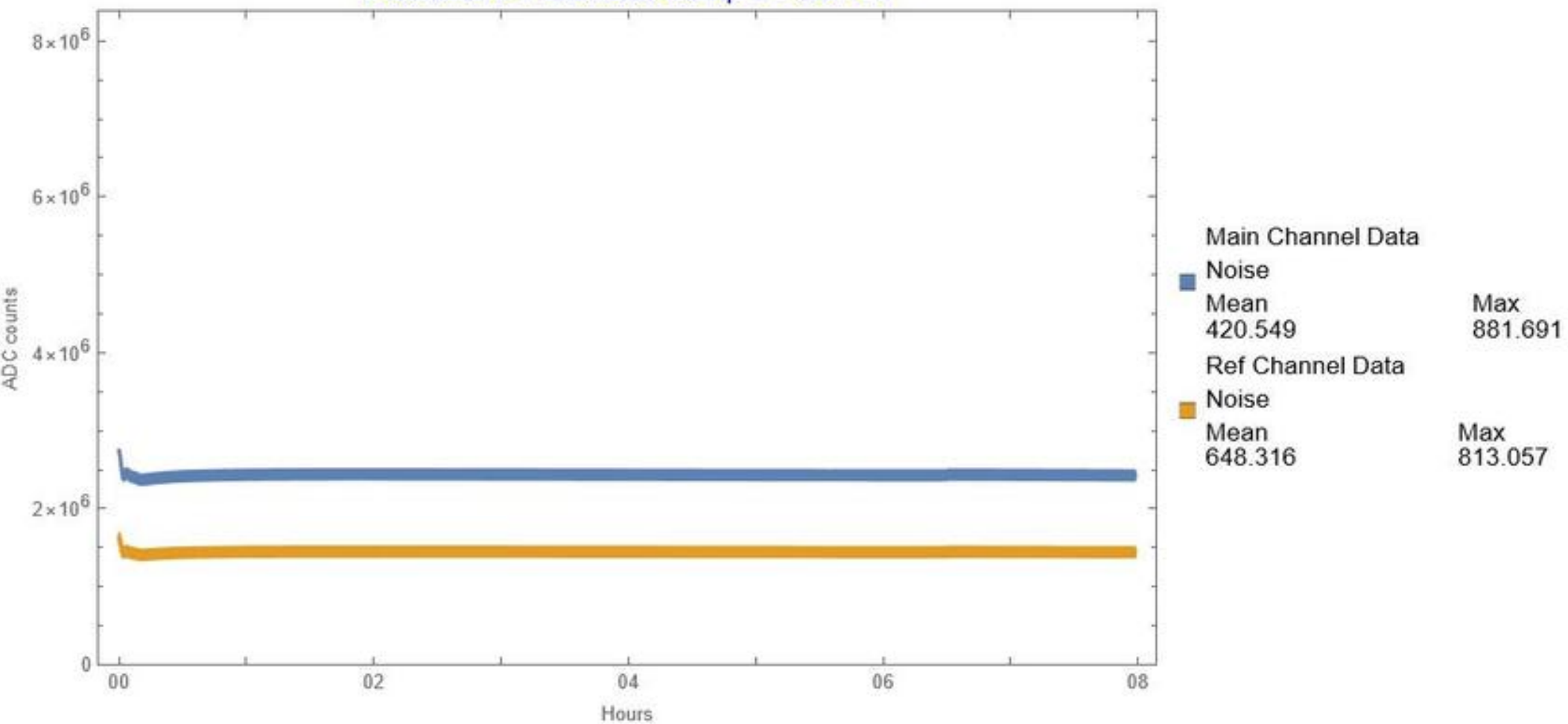
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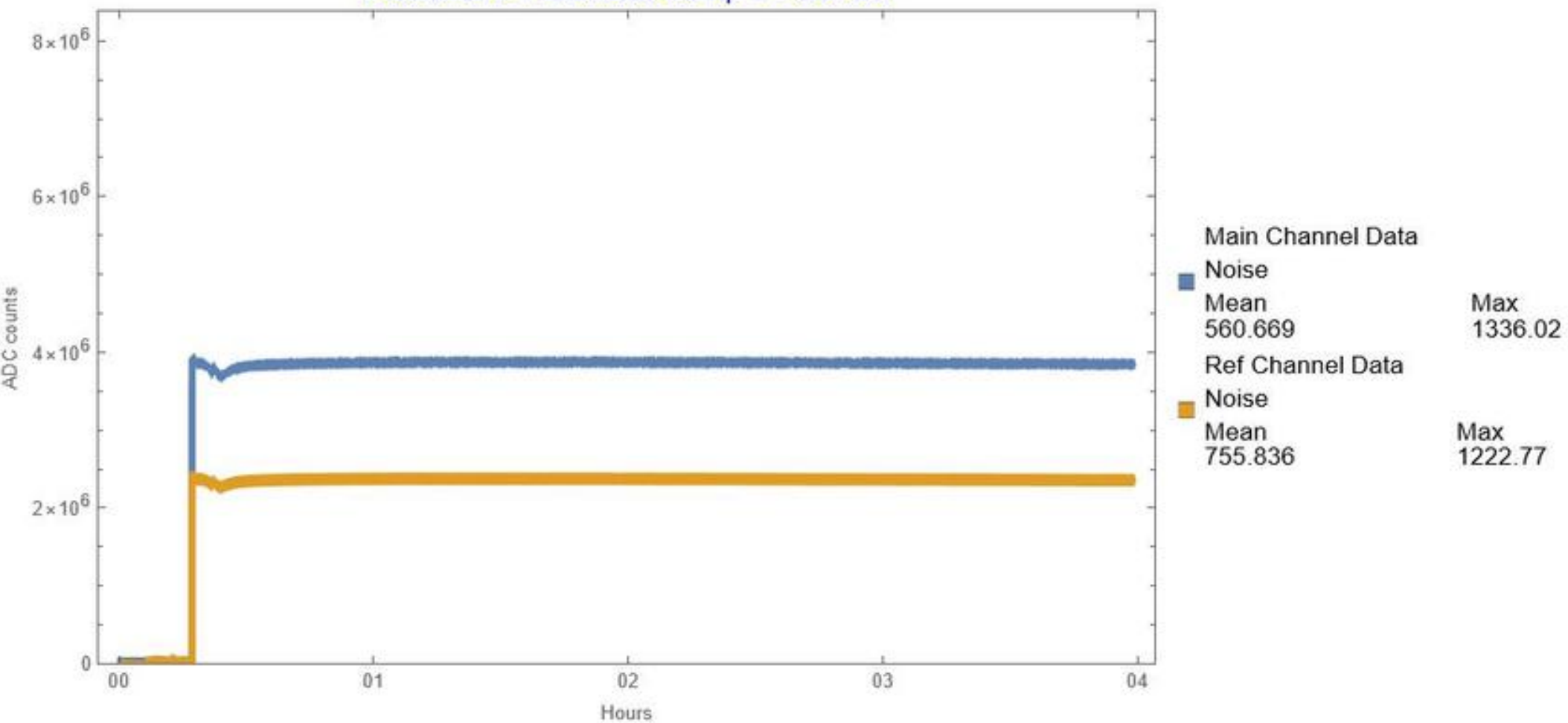
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Instrument = DE0202 Lamp = PU8741

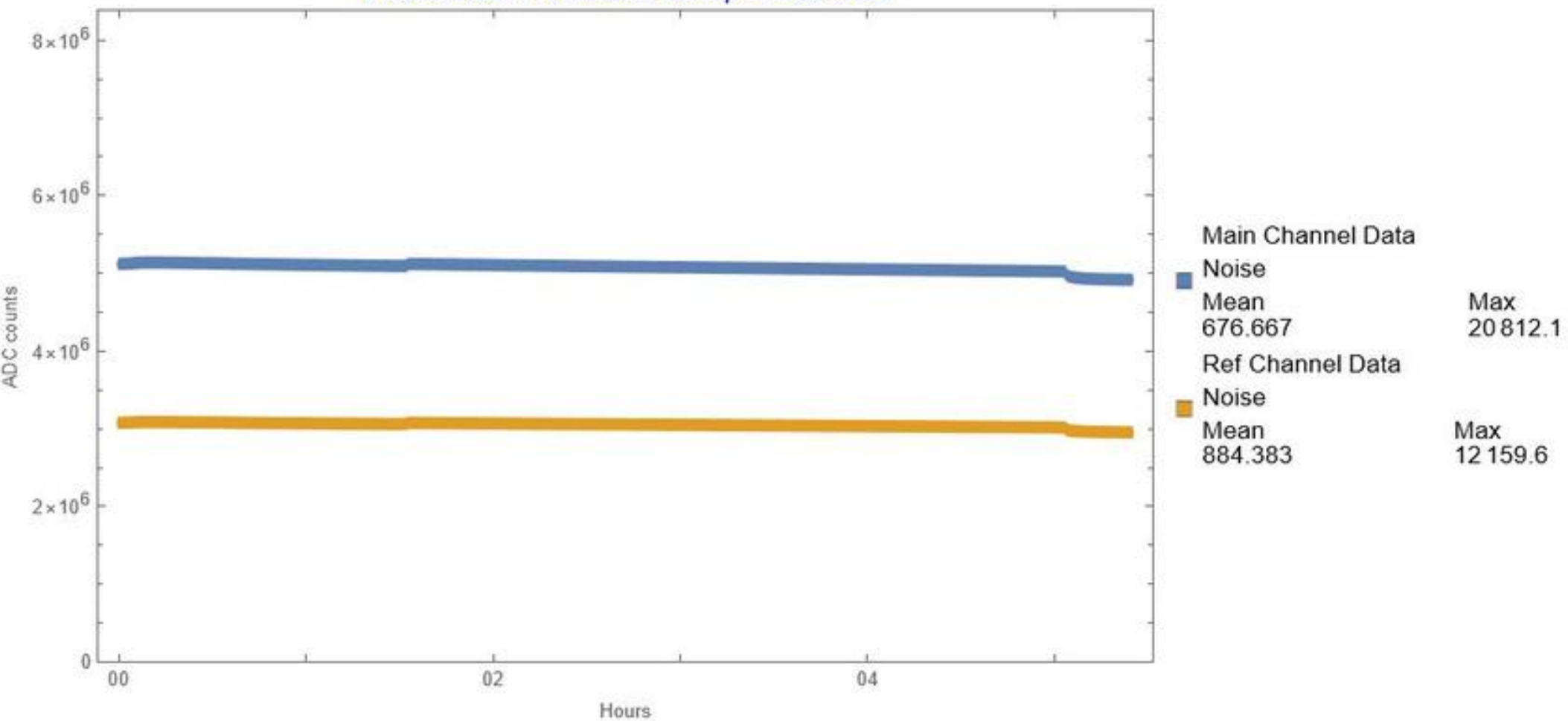


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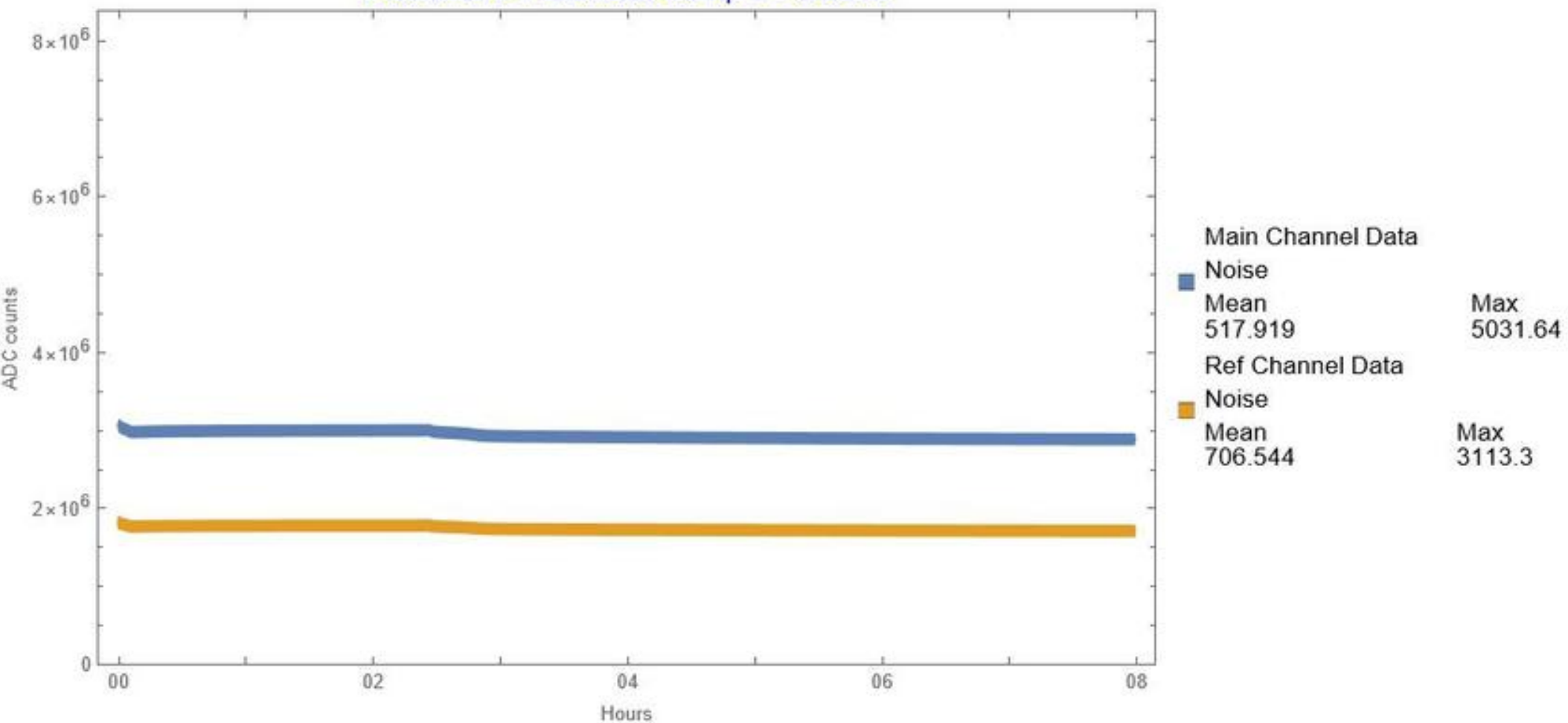




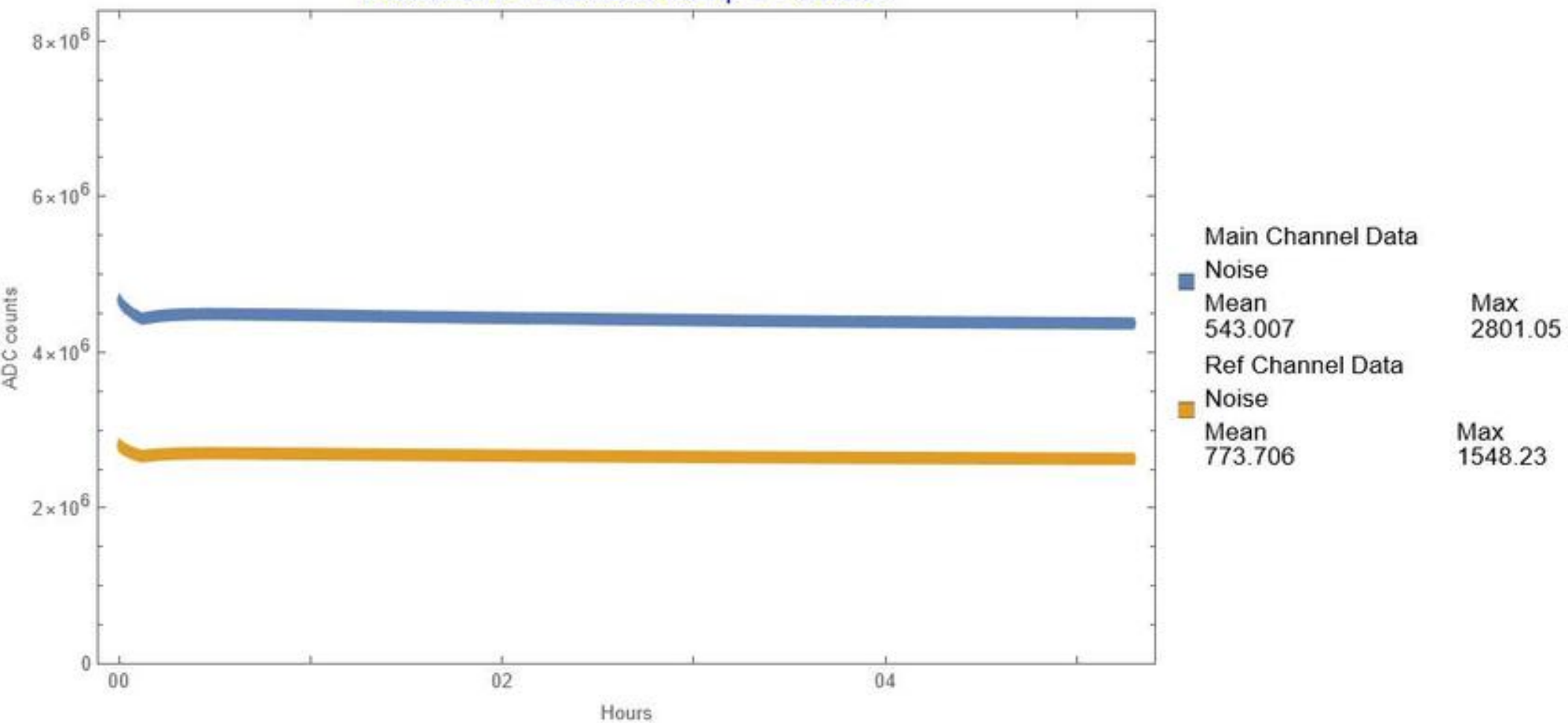
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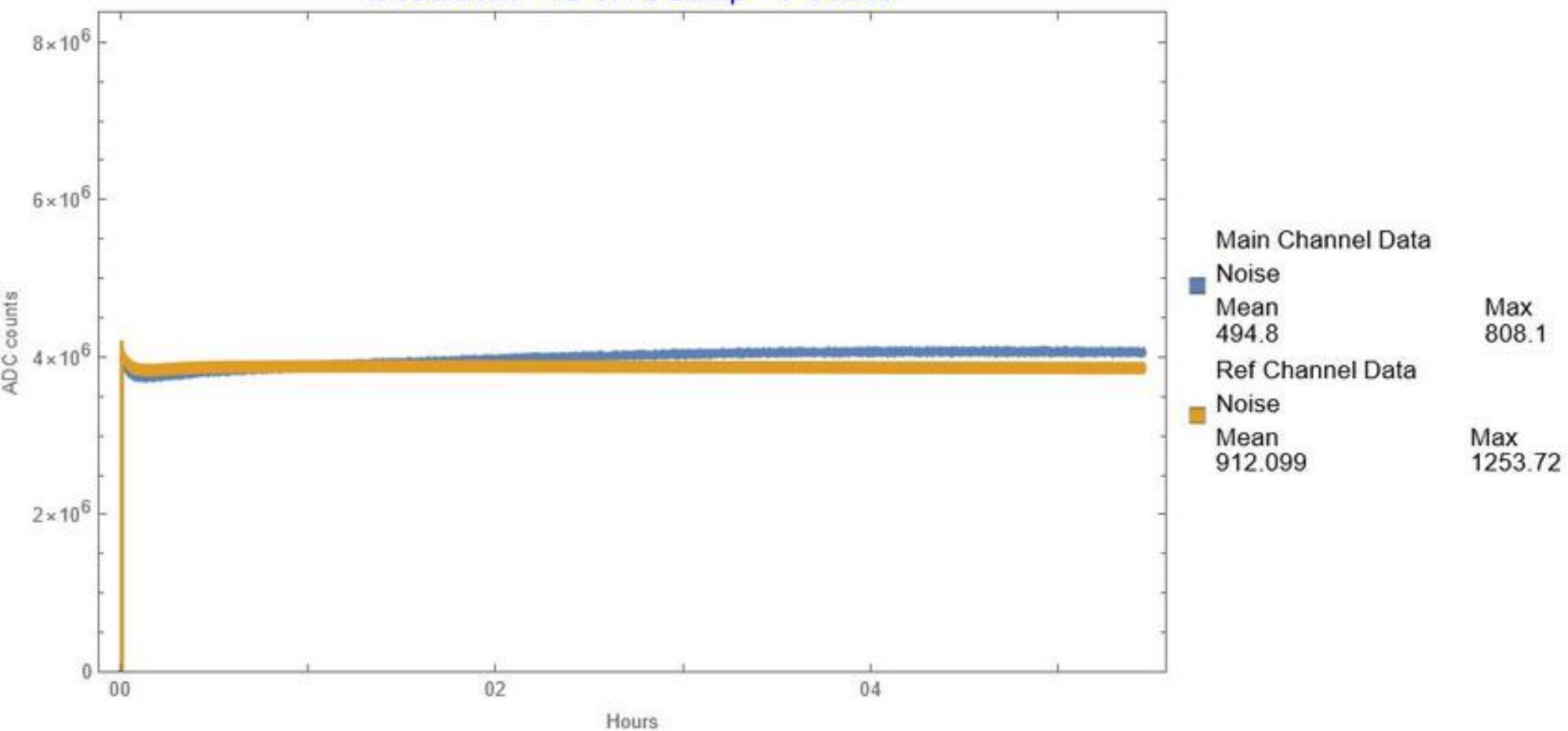
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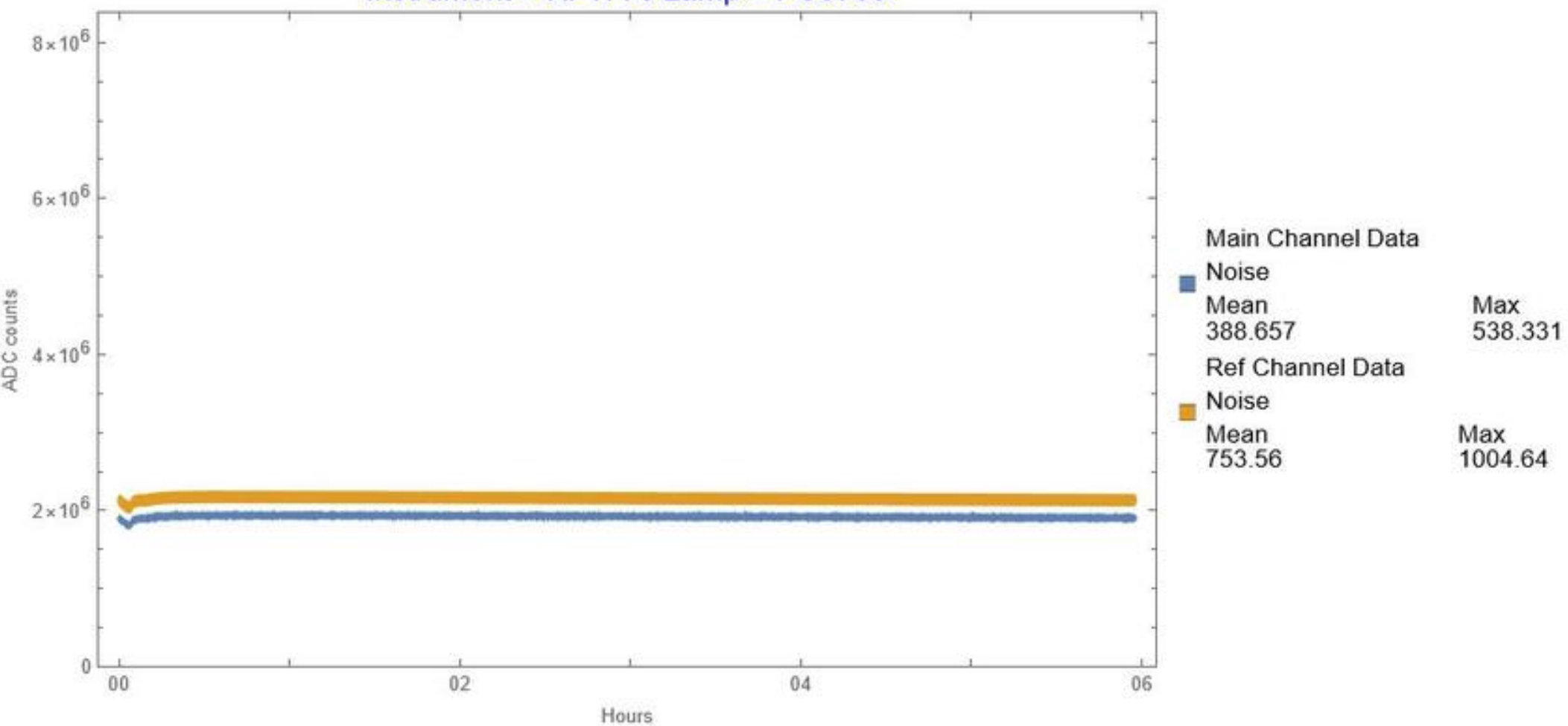
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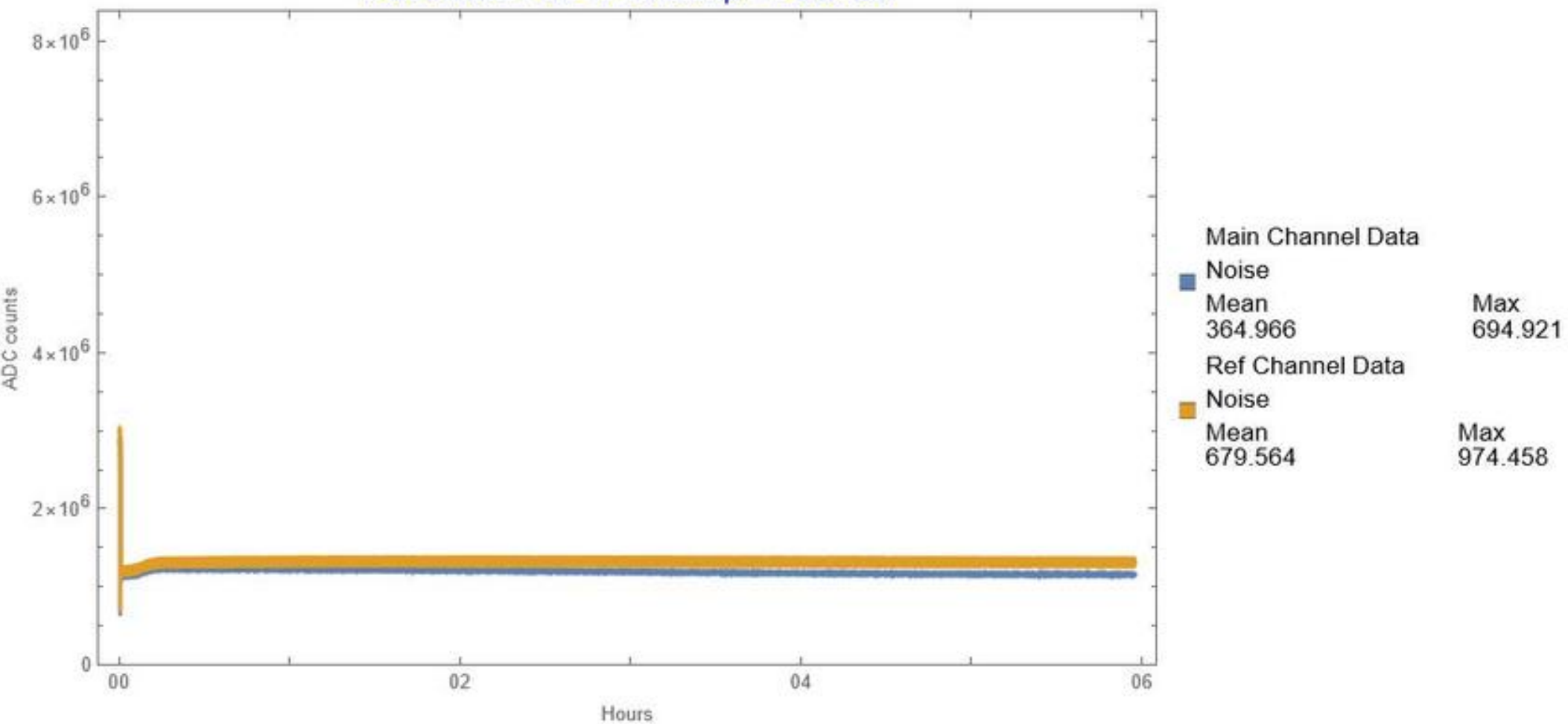
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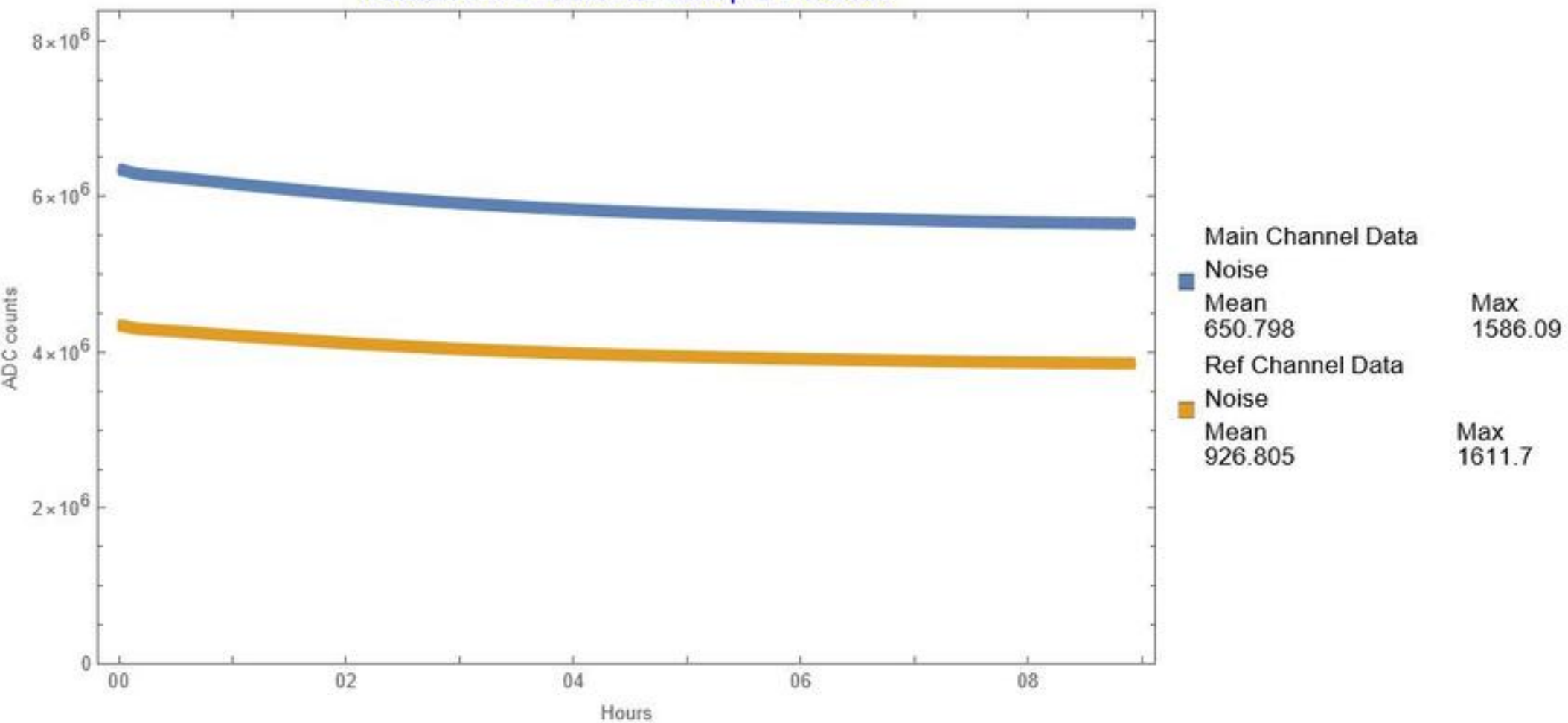
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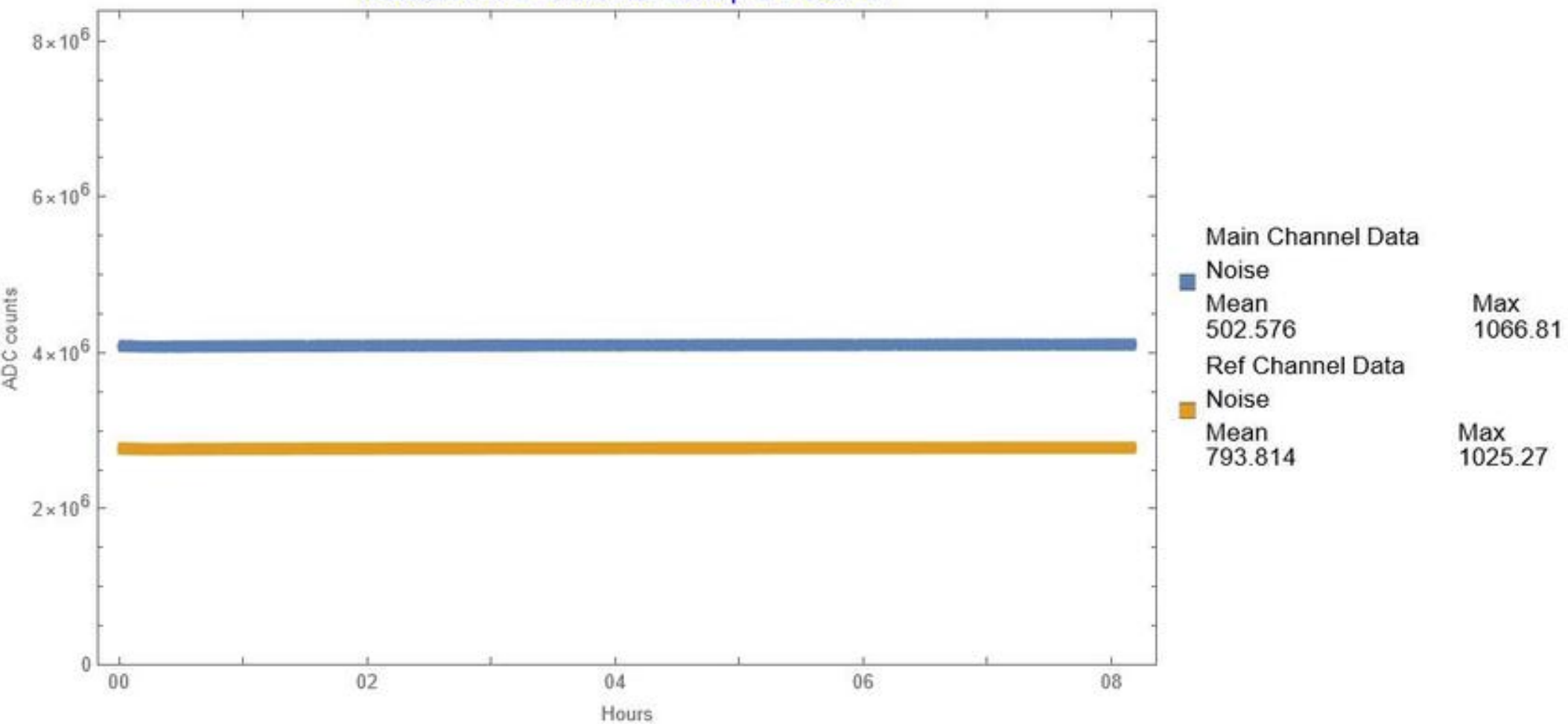
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Instrument = MM0132 Lamp = PU8696

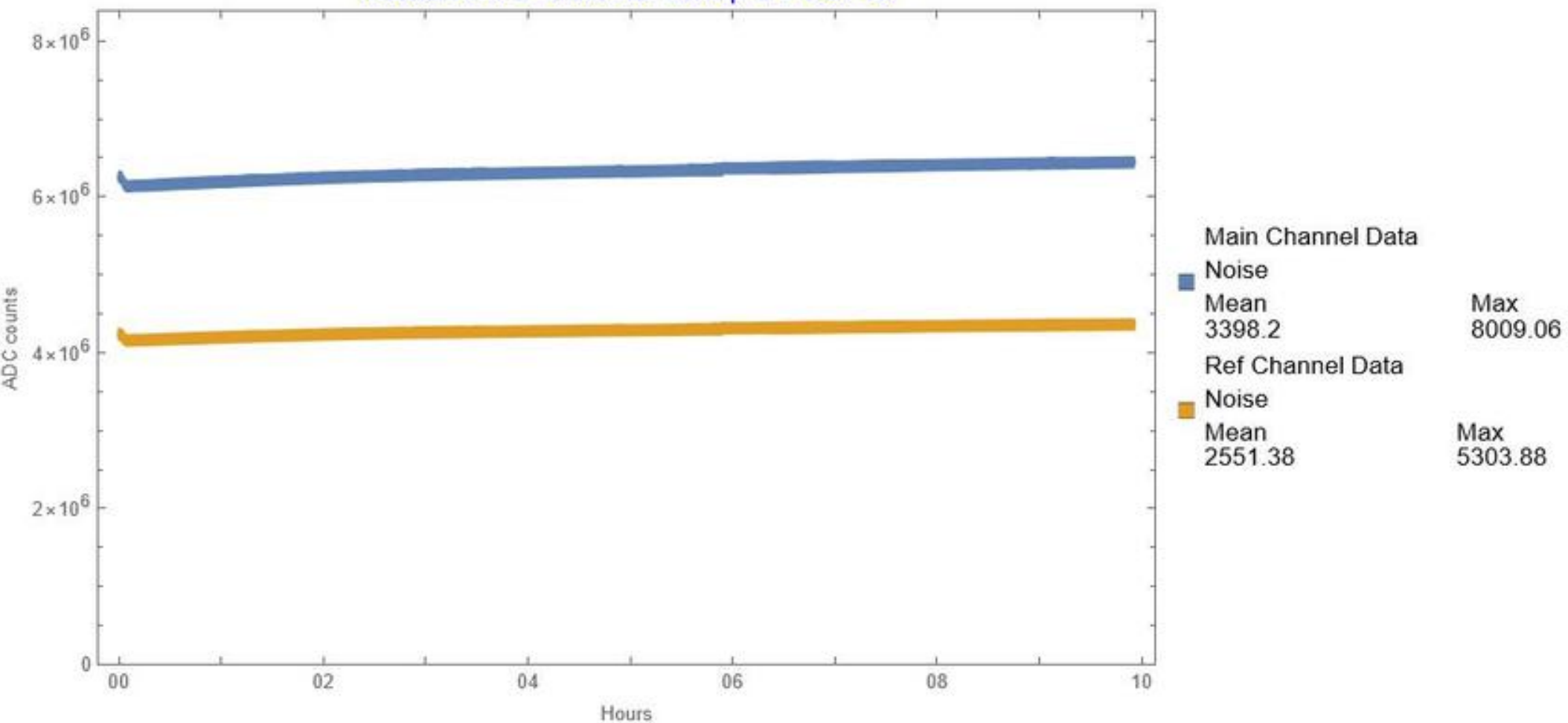


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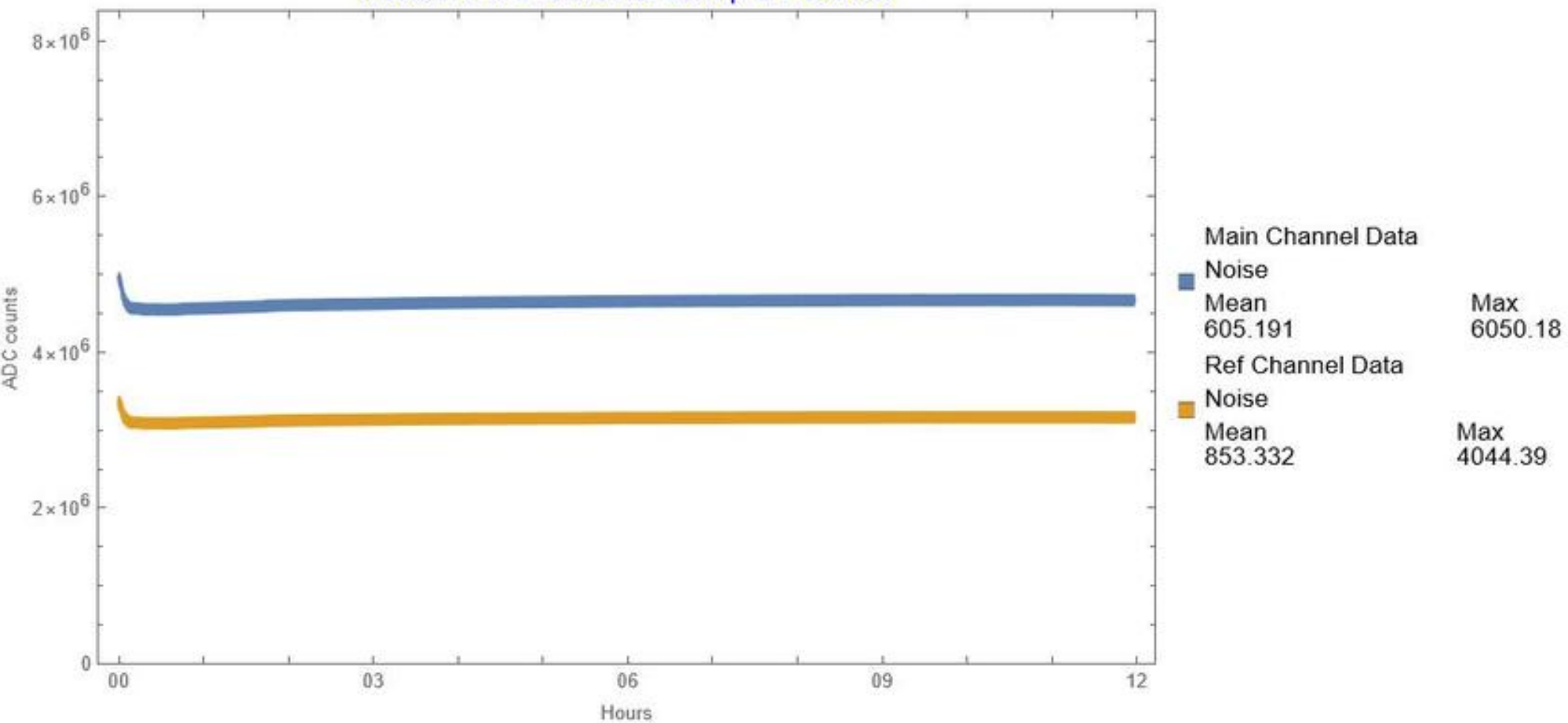




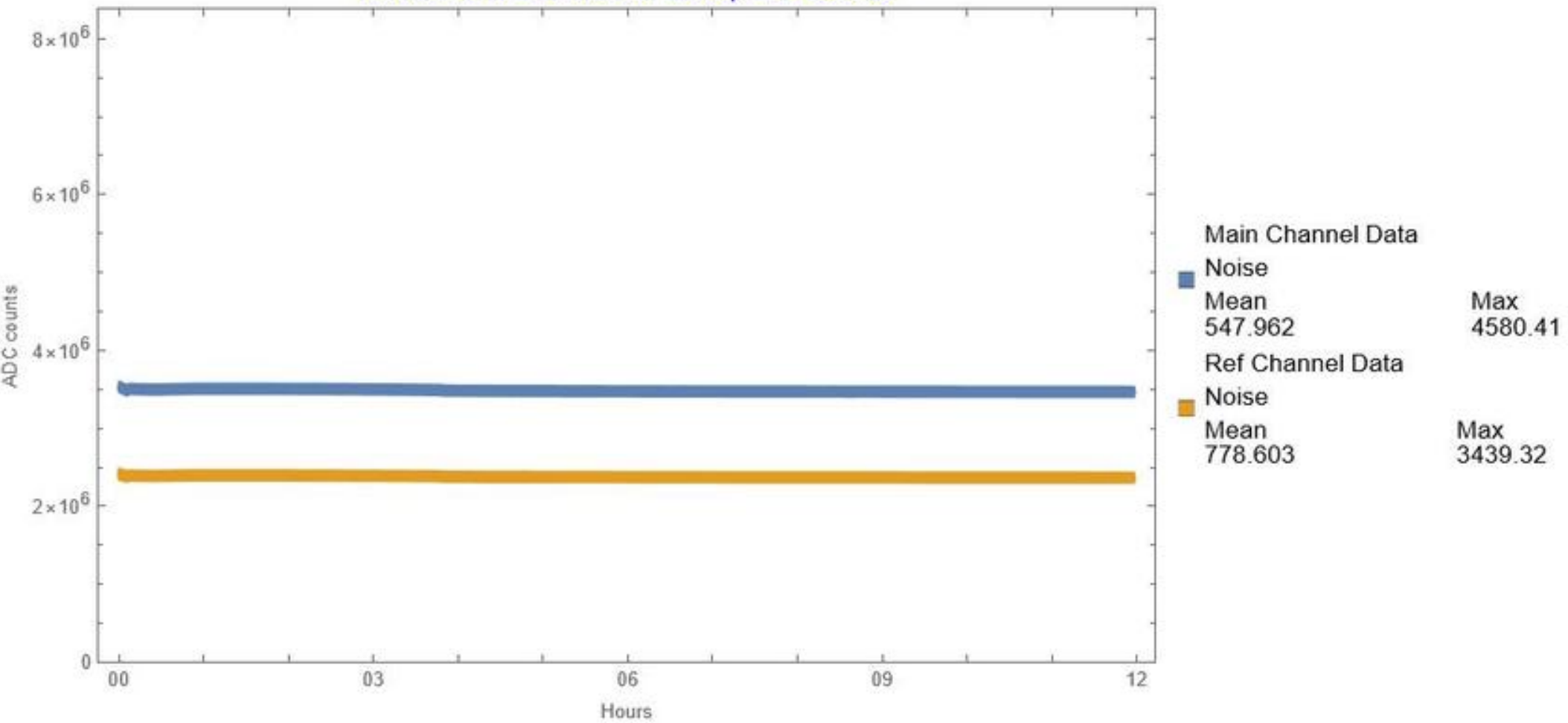
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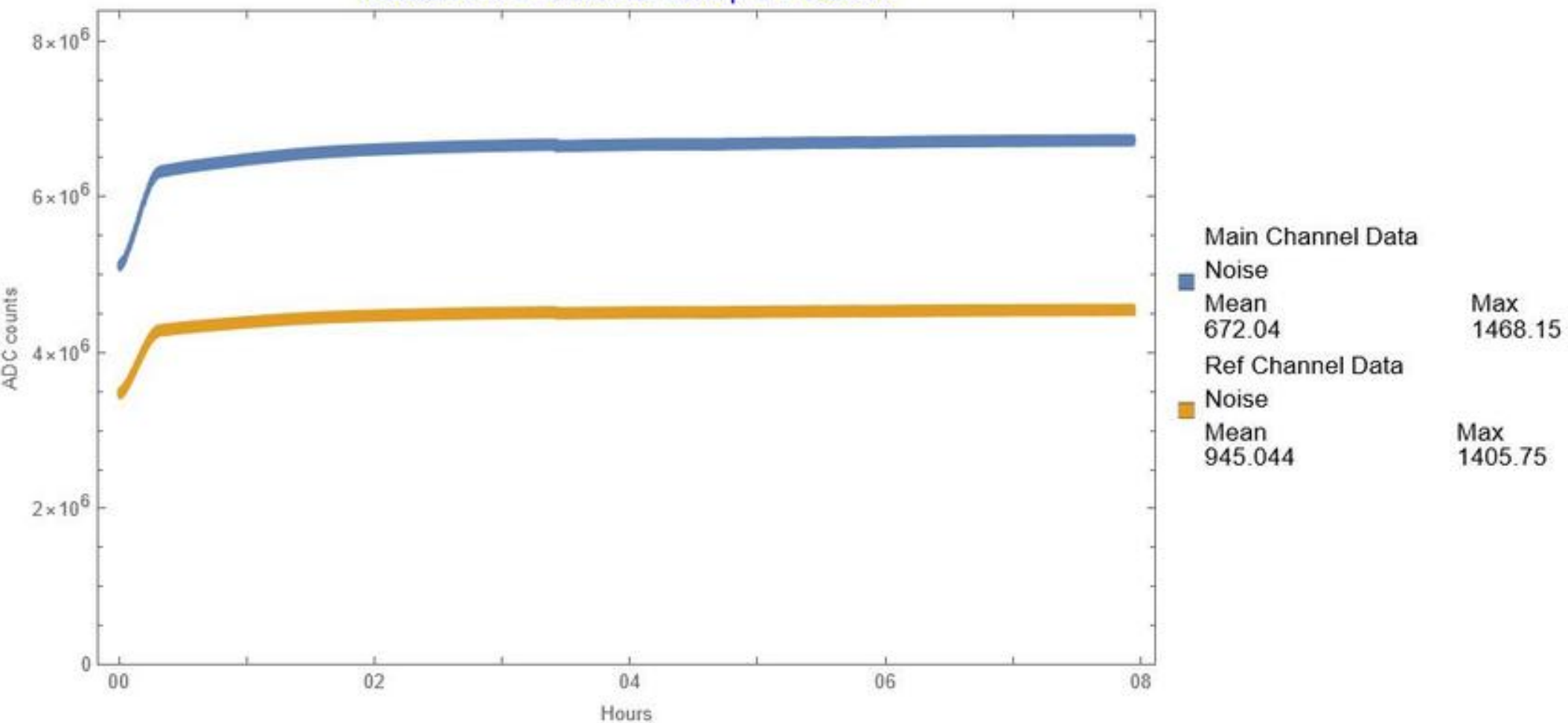
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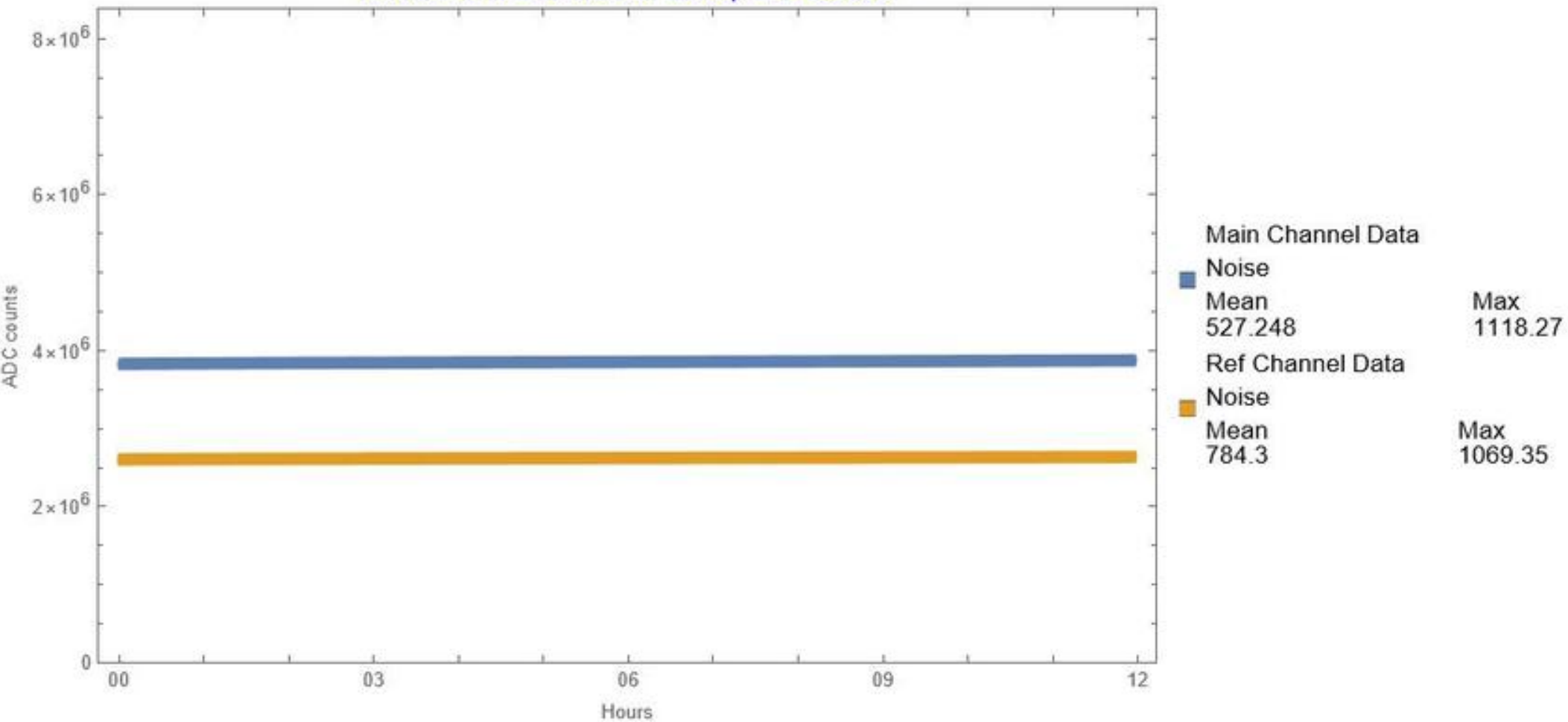
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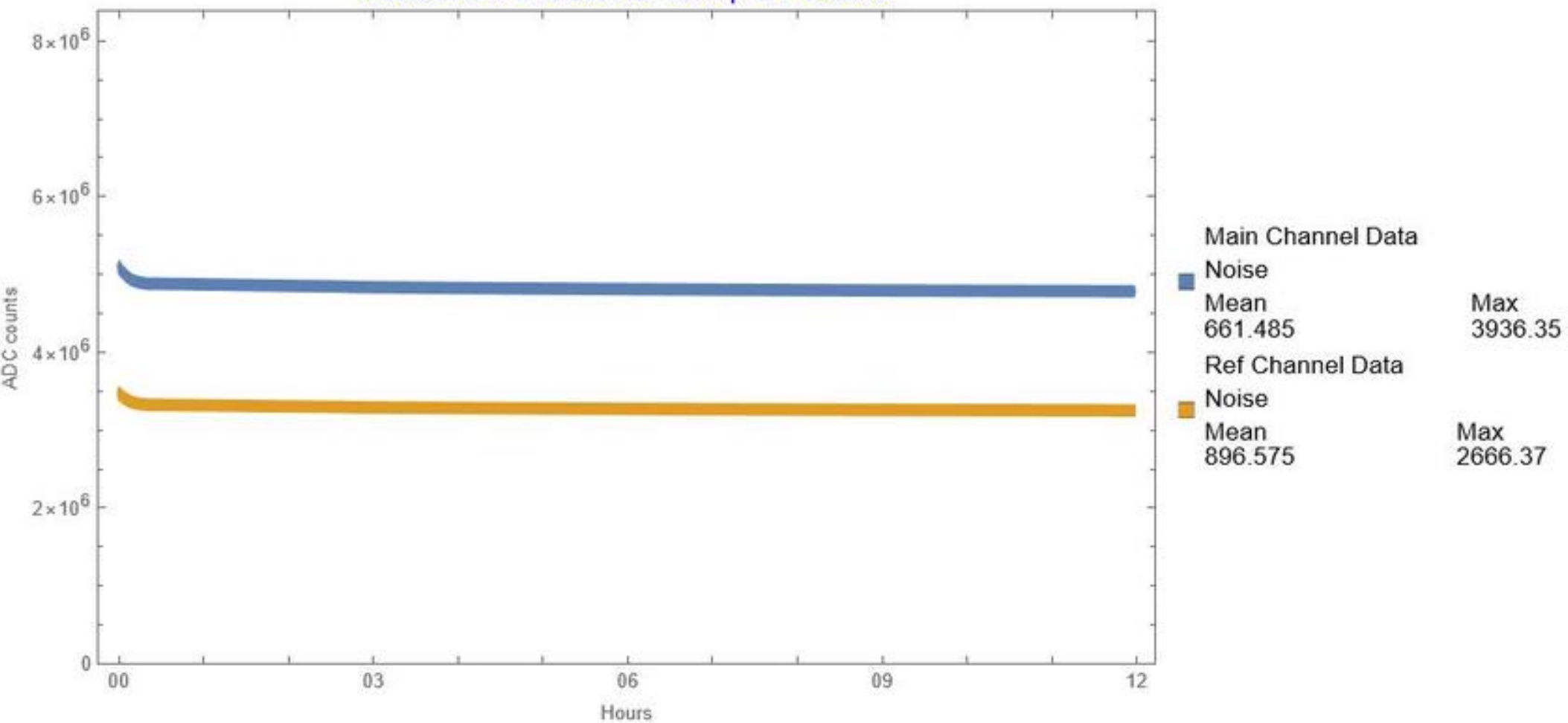
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Instrument = MM0132 Lamp = PU8832



Instrument = MM0132 Lamp = PU8833

