Preliminary Power Supply Stability and Progress in Linearity Testing

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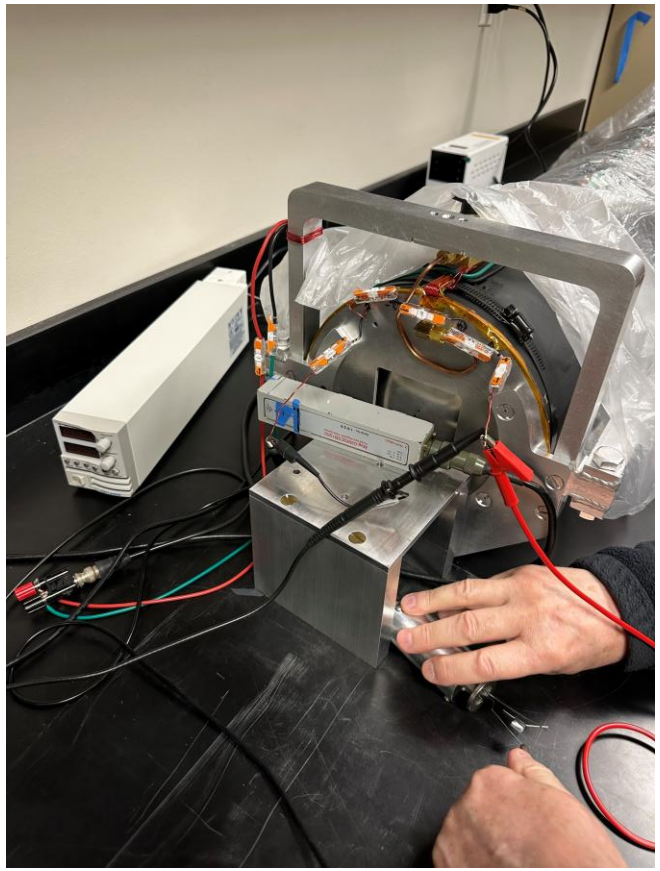
Process of Testing for Stability

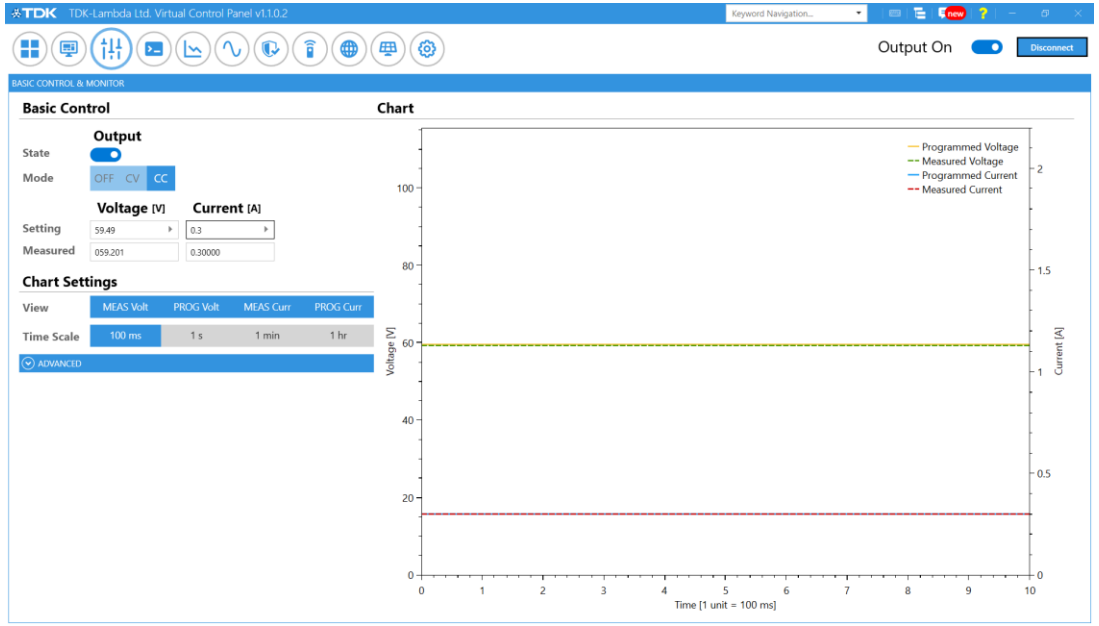
- 1: Connected TDK Lambda power supply to the AC filter. The power supply was controlled through my computer via USB connection and the use of TDK's Virtual Control Panel (VCP) software.
- 2: Connected both the Tektronix DPO 5104 oscilloscope and the Lambda (via the terminals of the exiting end of the AC filter) to the terminals of magnet #1 (the one closest to the door when first entering our lab).
- 3: Measured the voltage exiting the AC filter with a handheld voltmeter, both while the Lambda was set to constant current (CC) values of 0.30 A and 0.35 A. This if the value that the findings would be compared to.
- 4: While at both CC values of 0.30 A and 0.35 A, the oscilloscope, while set to read AC signals from the magnet, was adjusted to several different time-per-sample settings, here referred to as "timescales", until a clear sinusoidal waveform was visible, indicating significant noise.
- 5: Three waveforms per current setting, all at different timescales, were saved onto an USB flash drive from the oscilloscope, and analyzed for the voltage RMS to voltage exiting AC filter ratio. Comparing this value of the same waveforms where the Lambda's power was on and off would indicate how the Lambda contributed to the instability of the current.

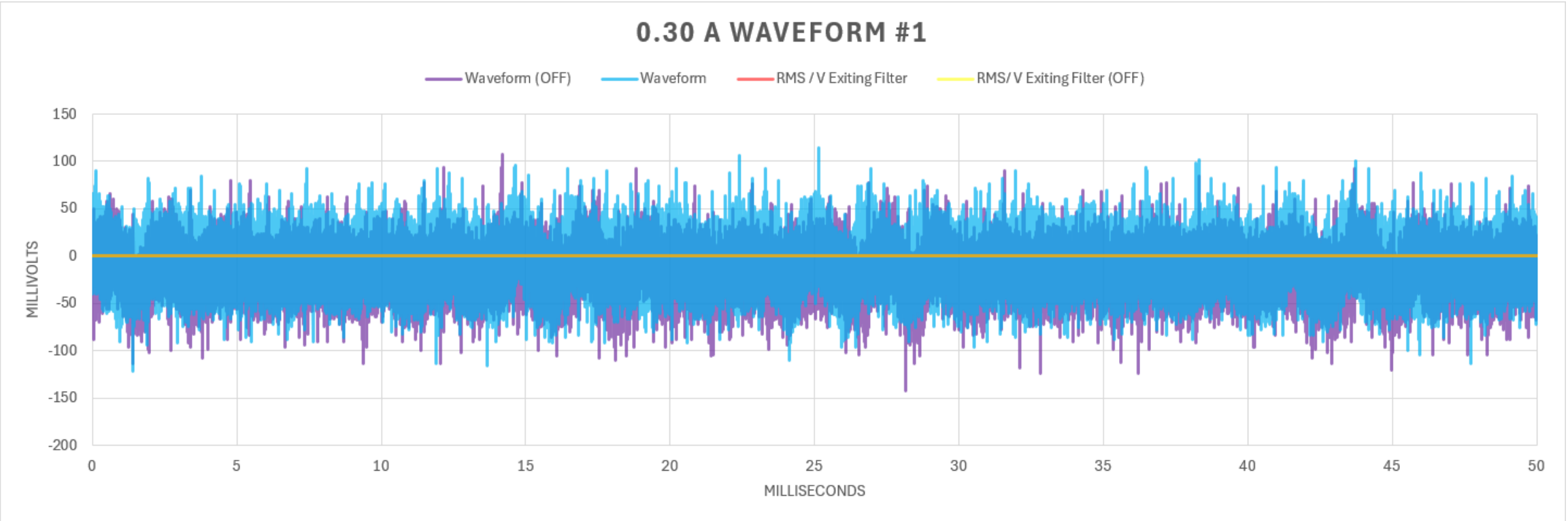
Setup for Stability Testing

Magnet #1 Layout



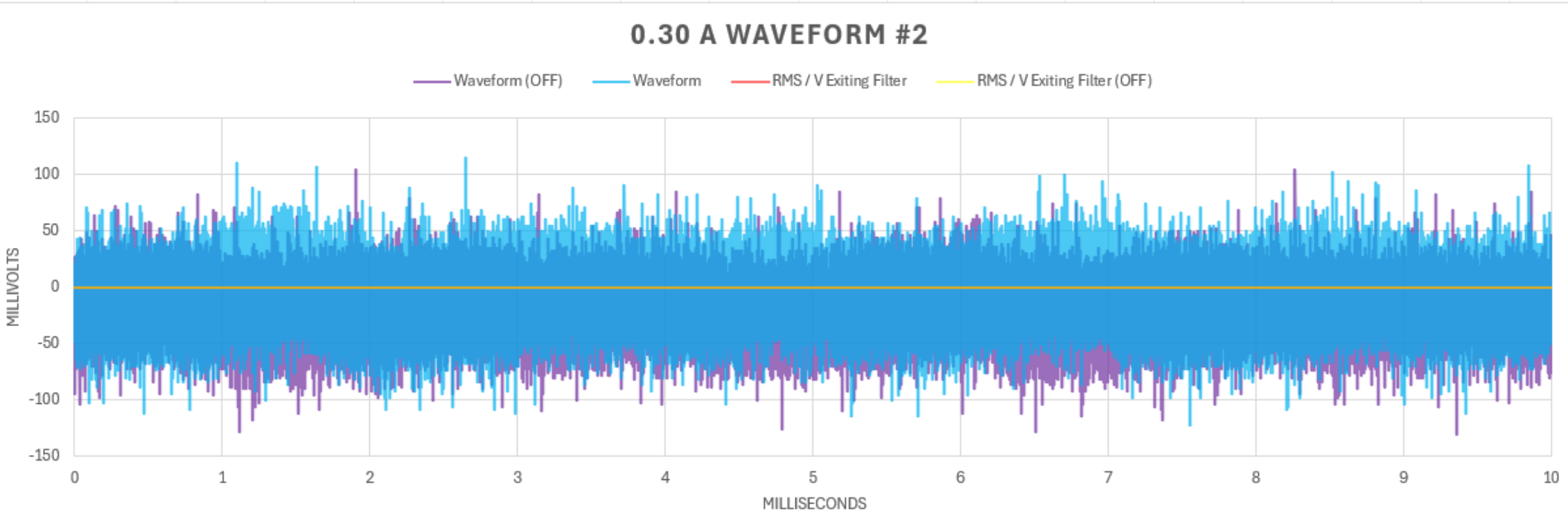
TDK Virtual Control Panel





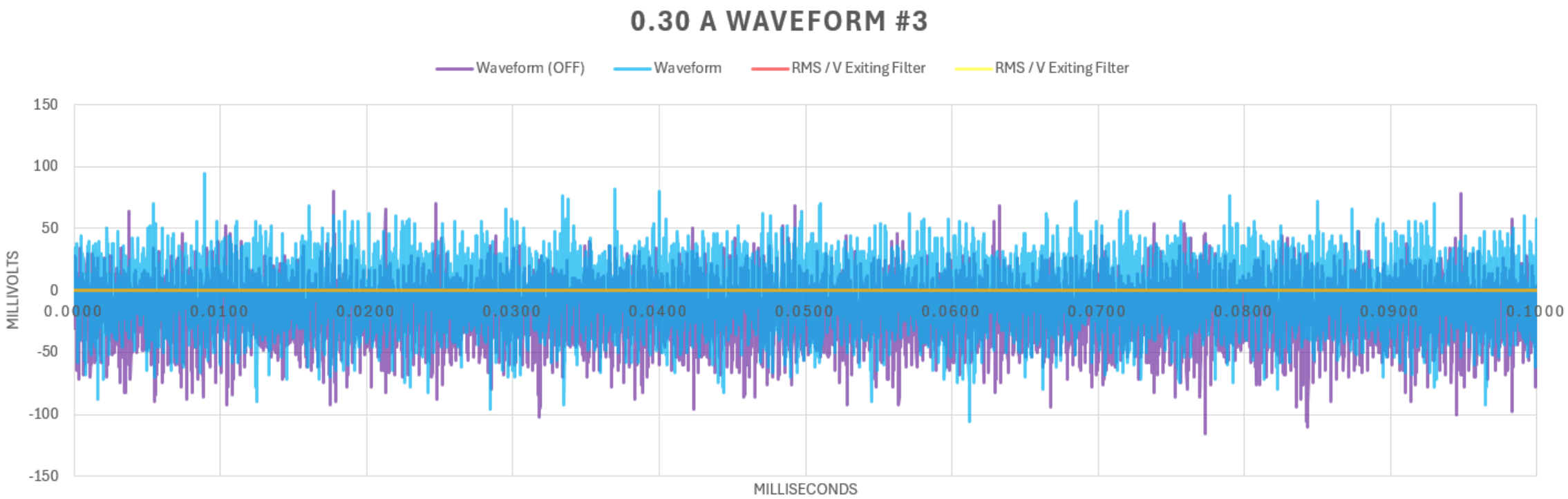
Parameters: 5.0 ms/div., 2.0 MS/s, 500.0 ns/pt

V RMS / V Exiting: 0.04% (ON), 0.04% (OFF)



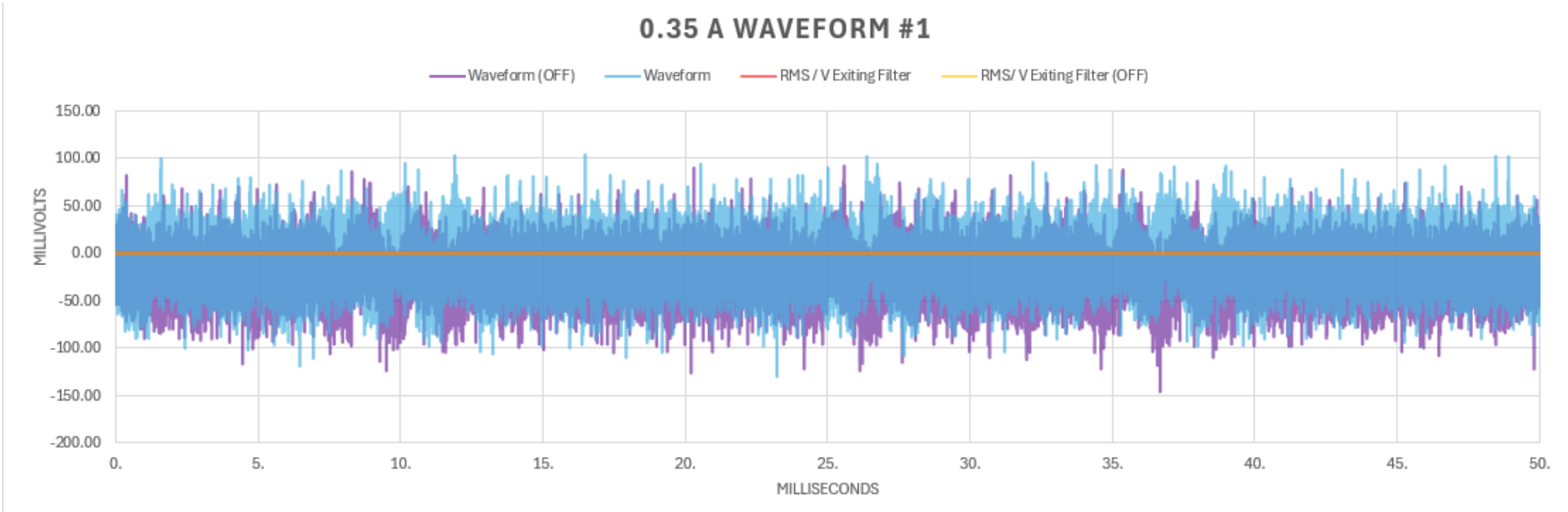
Parameters: 1.0 ms/div., 10.0 MS/s, 100.0 ns/pt

V RMS / V Exiting: 0.04% (ON), 0.04% (OFF)



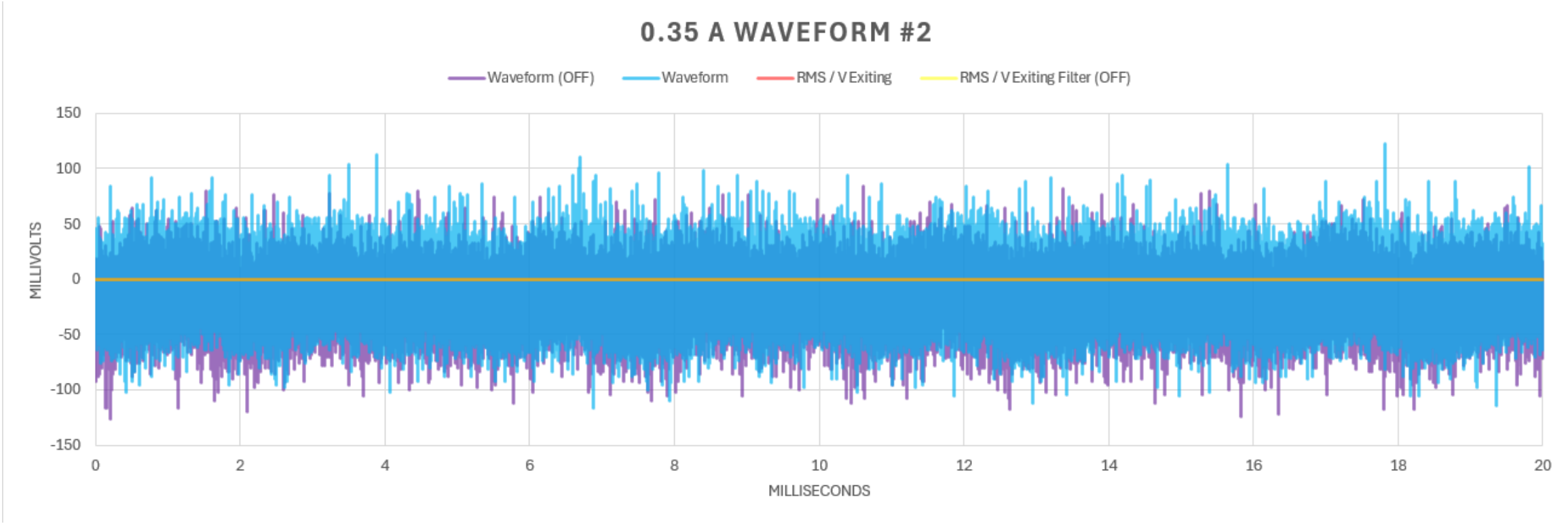
Parameters: 10.0 µs/div., 200.0 MS/s, 5.0 ns/pt

V RMS / V Exiting: 0.04% (ON), 0.04% (OFF)



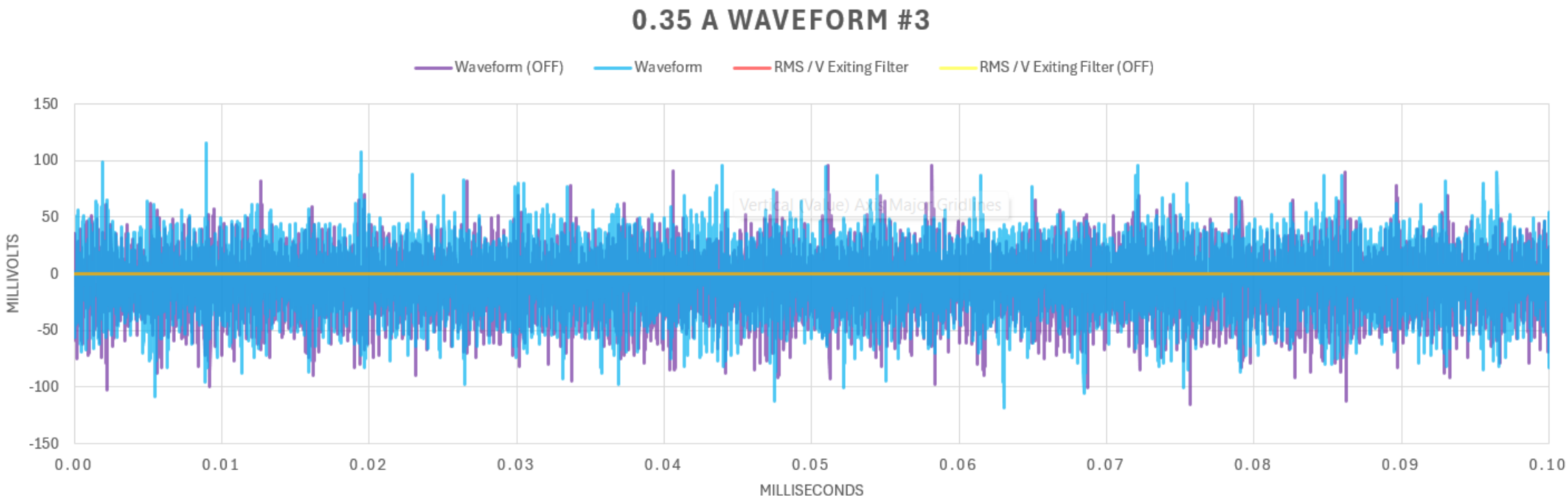
Parameters: 5.0 ms/div., 2.0 MS/s, 500 ns/pt

V RMS / V Exiting: 0.04% (ON), 0.03% (OFF)



Parameters: 2.0 ms/div., 5.0 MS/s, 200.0 ns/pt

V RMS / V Exiting: 0.04% (ON), 0.03% (OFF)



Parameters: 100.0 µs/div., 500.0 MS/s, 2.0 ns/pt

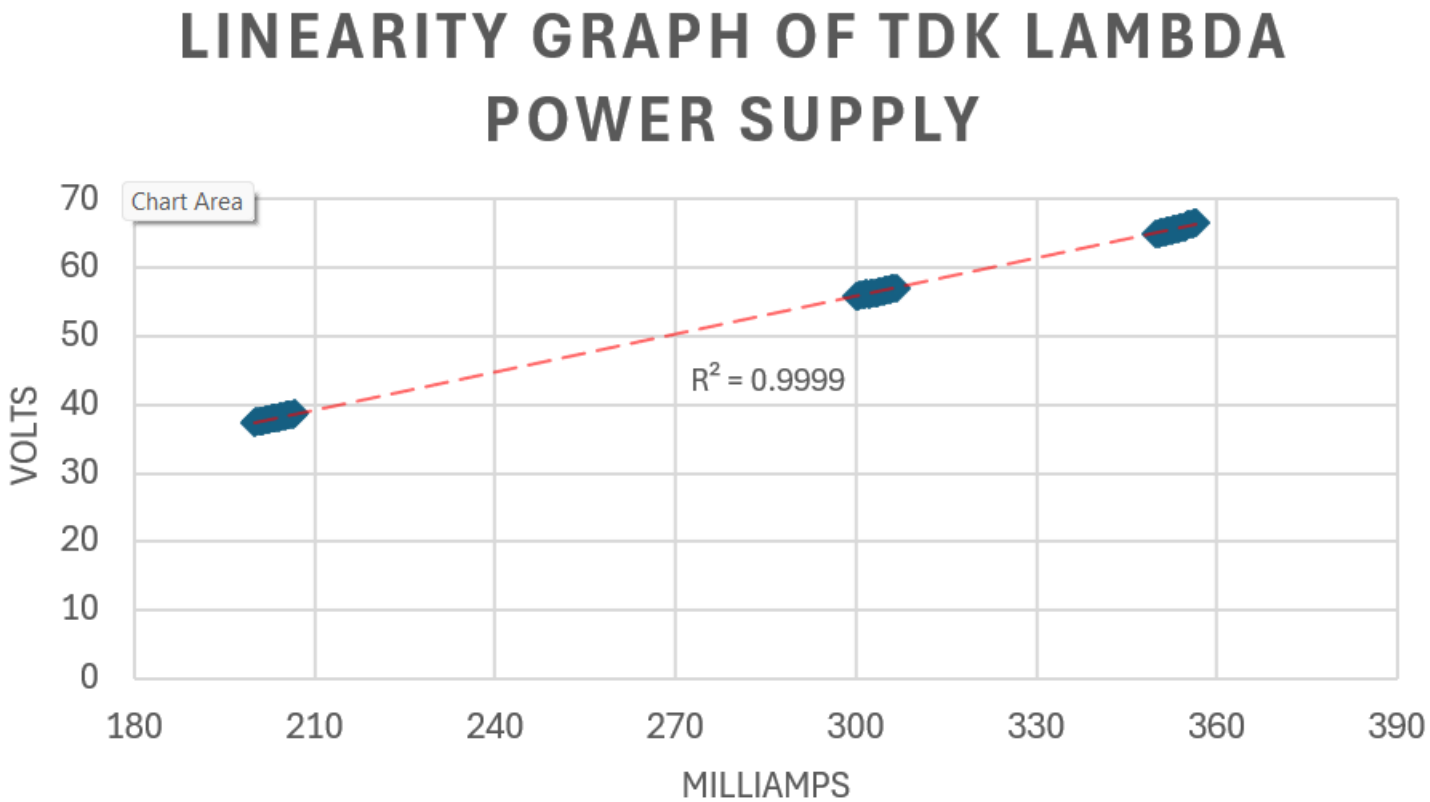
V RMS / V Exiting: 0.04% (ON), 0.03% (OFF)

Conclusions from Stability Testing

- The AC “ripple” factor of the signal, given by V RMS / V Exiting Filter, is very small, only about 0.04% when the power is turned on.
- Turning off the power supply does not significantly change the factor, and thus it can be said that the TDK Lambda is not contributing significant instability in the current flowing through magnet #1.
- This rules out the power supply as a possible source of “rippling”, and there must be some other component in the magnet and/or environment that is causing the instability of the magnetic field, as per Alina’s findings.

Linearity Testing Progress

- In order to ensure that the TDK Power supply is performing as it is meant to, the power supply was adjusted across several CC current ranges, using the computer control scheme as described earlier
- Current was moved with a “step size” of 0.00035 A via computer input while Lambda was attached to the terminals of the magnet and passing through AC filter.
- At each current step, the voltage read from an improvised voltmeter, connected to the terminals of magnet #1 also, was recorded
- Values were graphed and a linear regression was applied.



Range 1: 0.2 A to 0.20666 A

Range 2: 0.3 A to 0.30666 A

Range 3: 0.35 A to 0.35666 A

Conclusions from Linearity Testing

- The R^2 value, which indicates how well a linear regression applies to a data set, was 0.9999, which indicates very little error. This tells that the Lambda seems to have a very linear relationship between the input current and output voltage.
- However, this will need to be repeated with a higher quality voltmeter. A program is being created to control data collection from the KEITHLEY voltmeter and automatically step up the current from the power supply automatically. Once this is done, a repeat experiment will be done in order to ensure results.