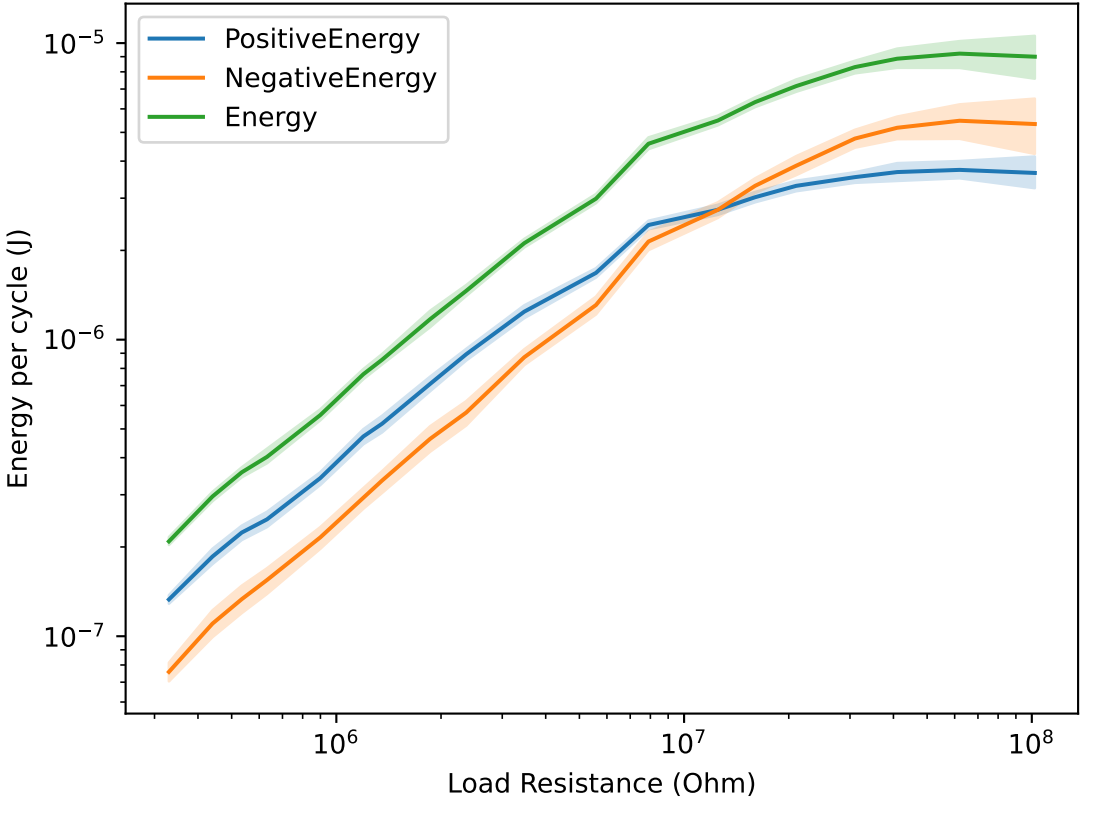
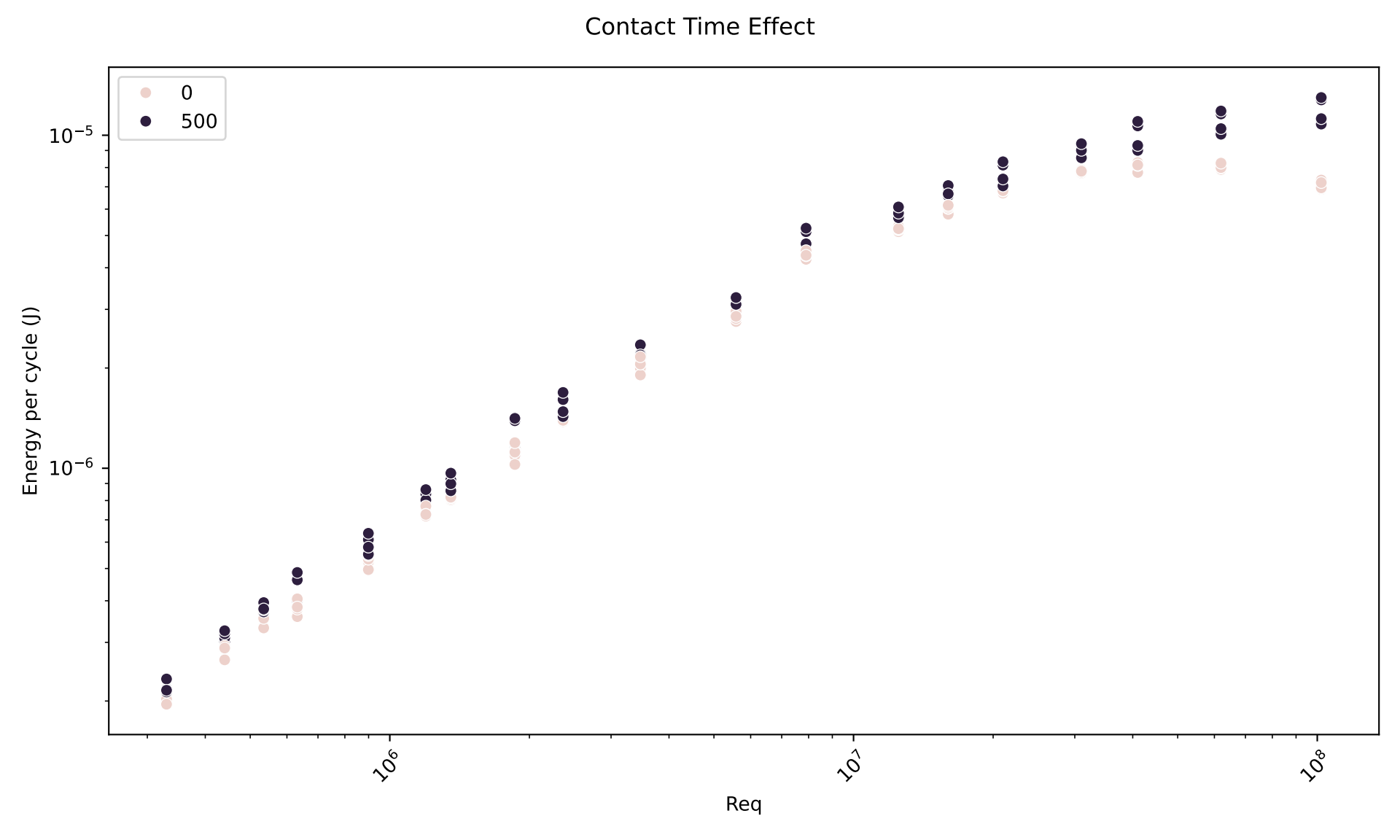
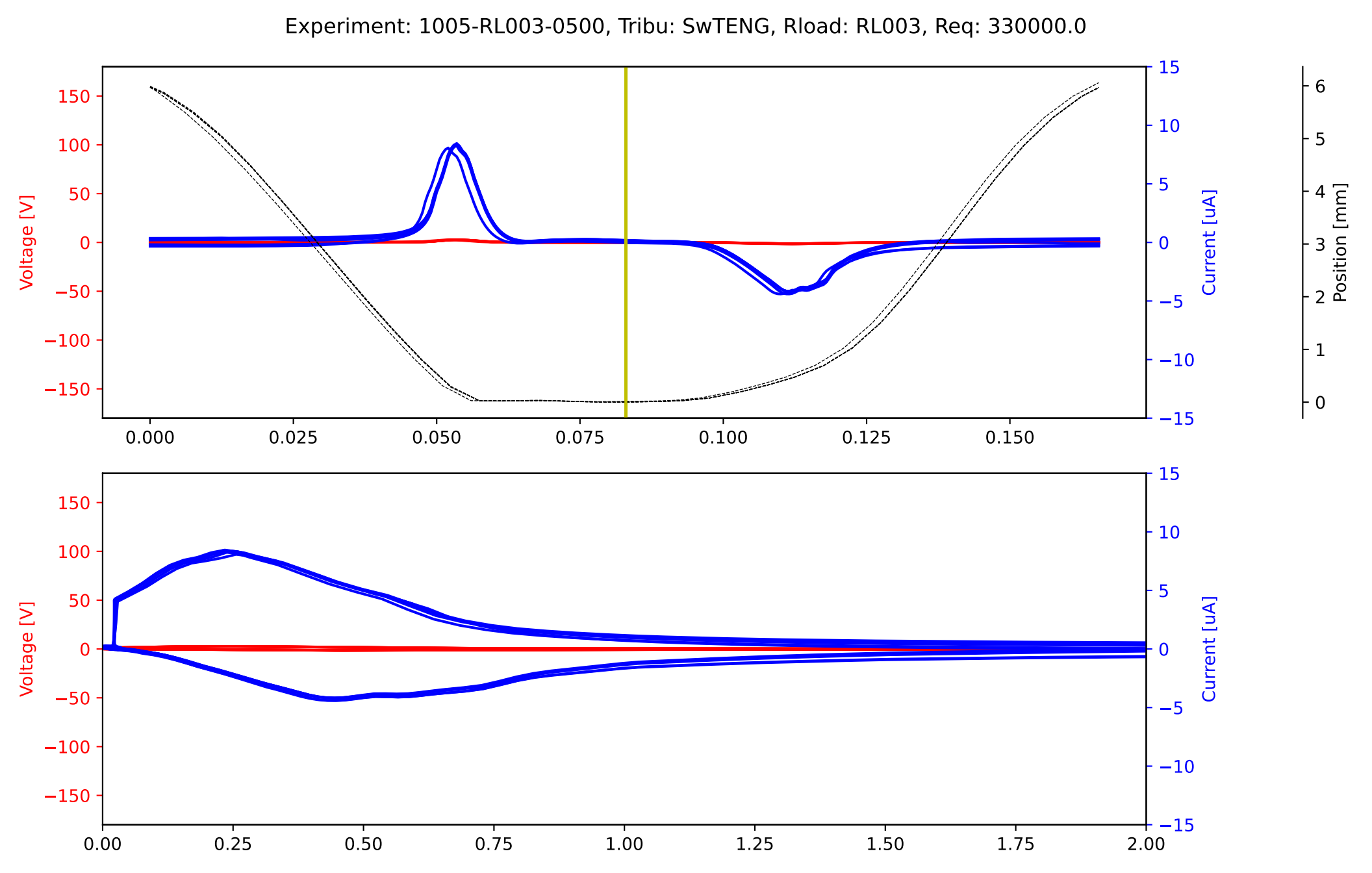
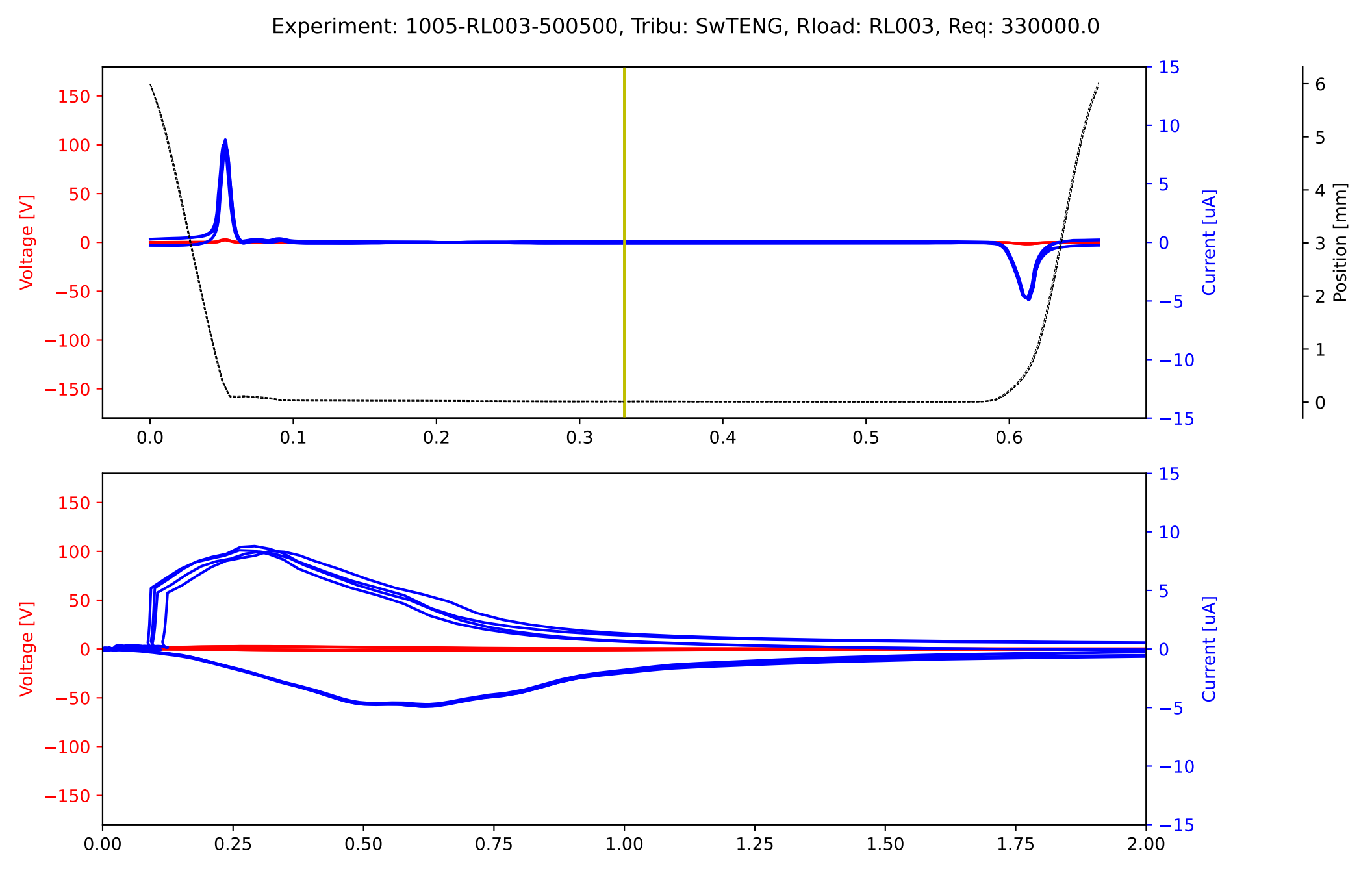
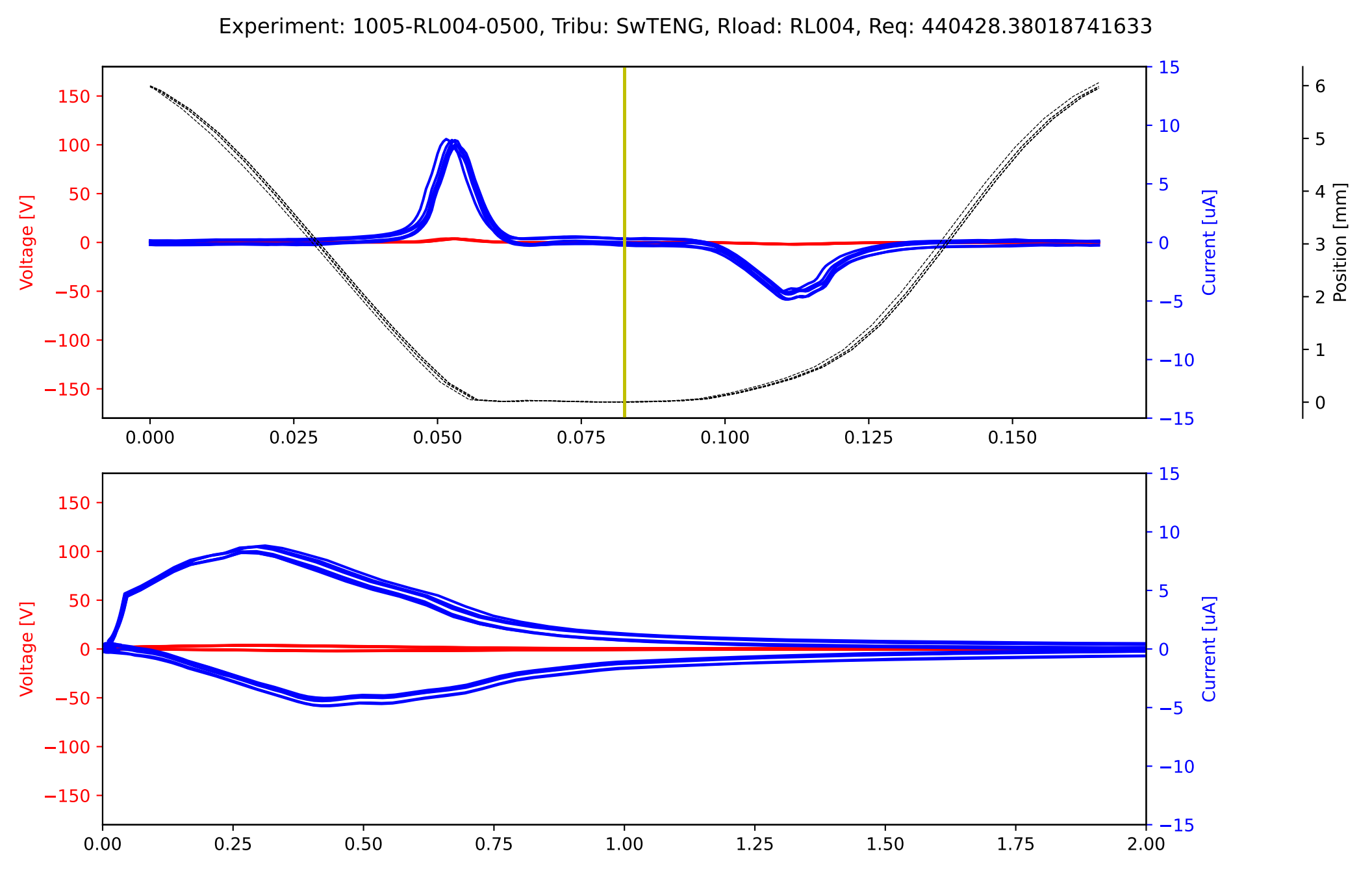
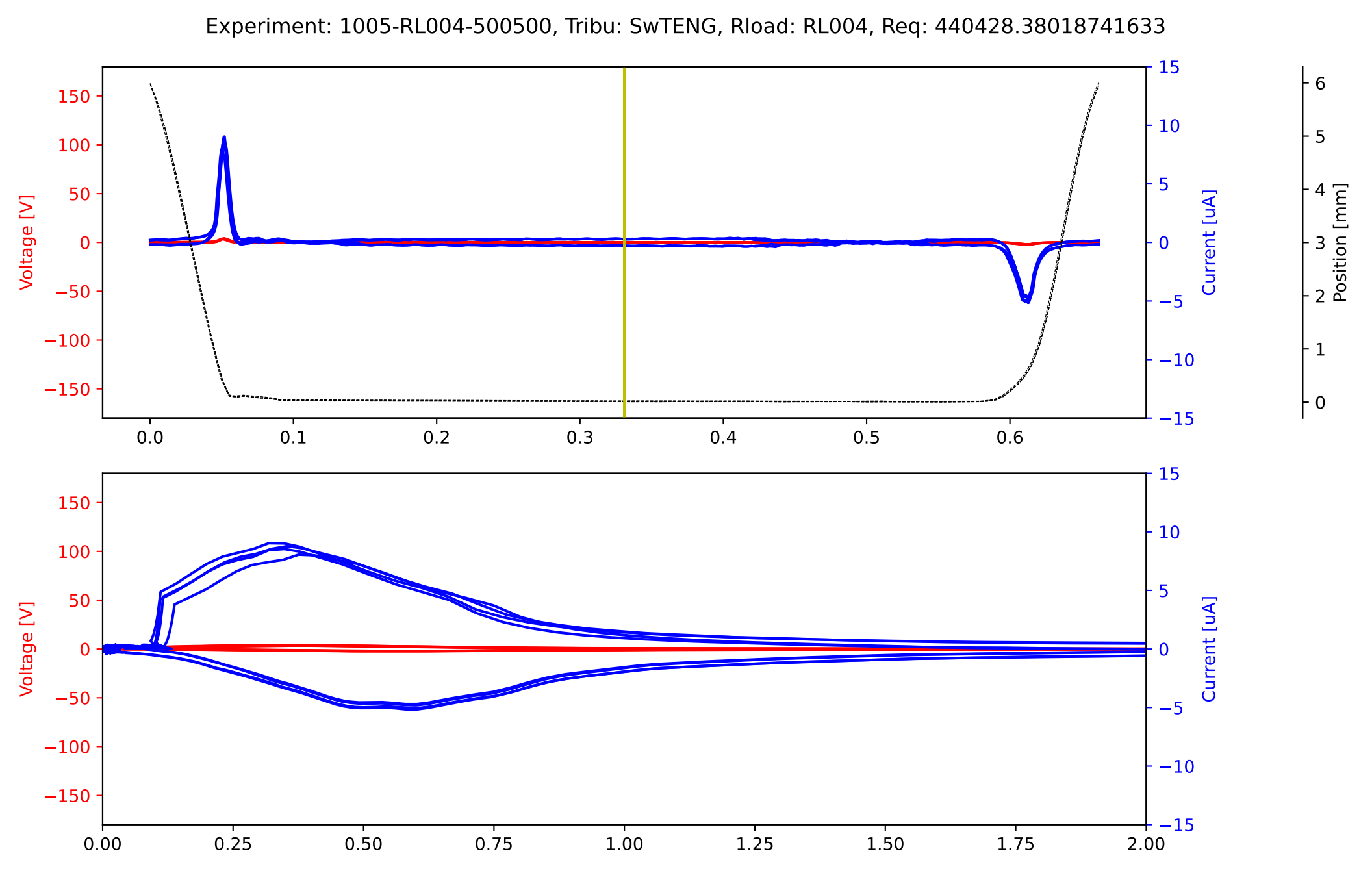

PositiveEnergy
NegativeEnergy
Energy
10^{-5}
10^{-6}
10^{-7}
Energy per cycle (J)
10^{6}
10^{7}
10^{8}
Load Resistance (Ohm)

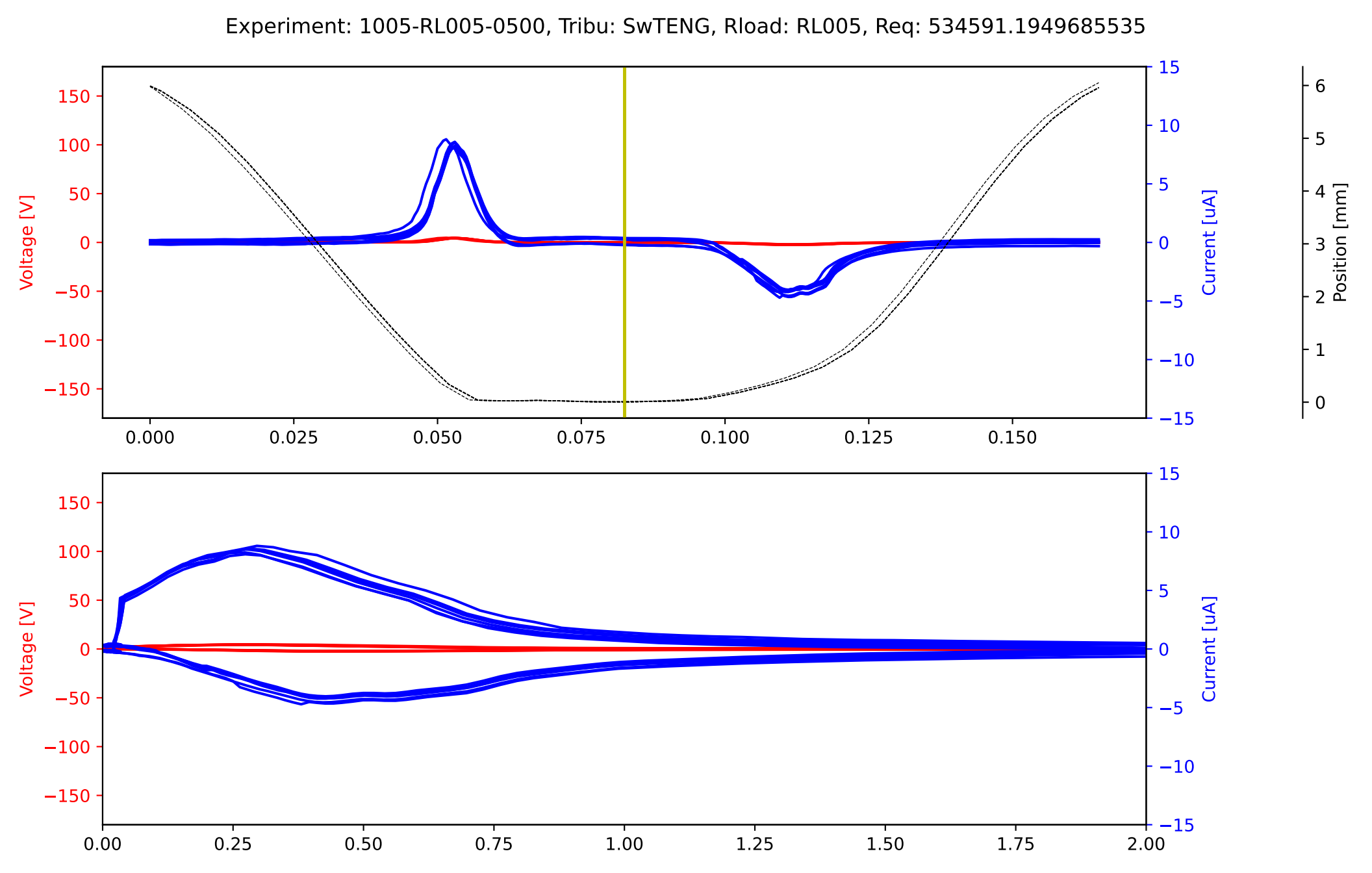

Contact Time Effect
0
500
10^{-5}
10^{-6}
Energy per cycle (J)
10^{6}
10^{7}
10^{8}
Req

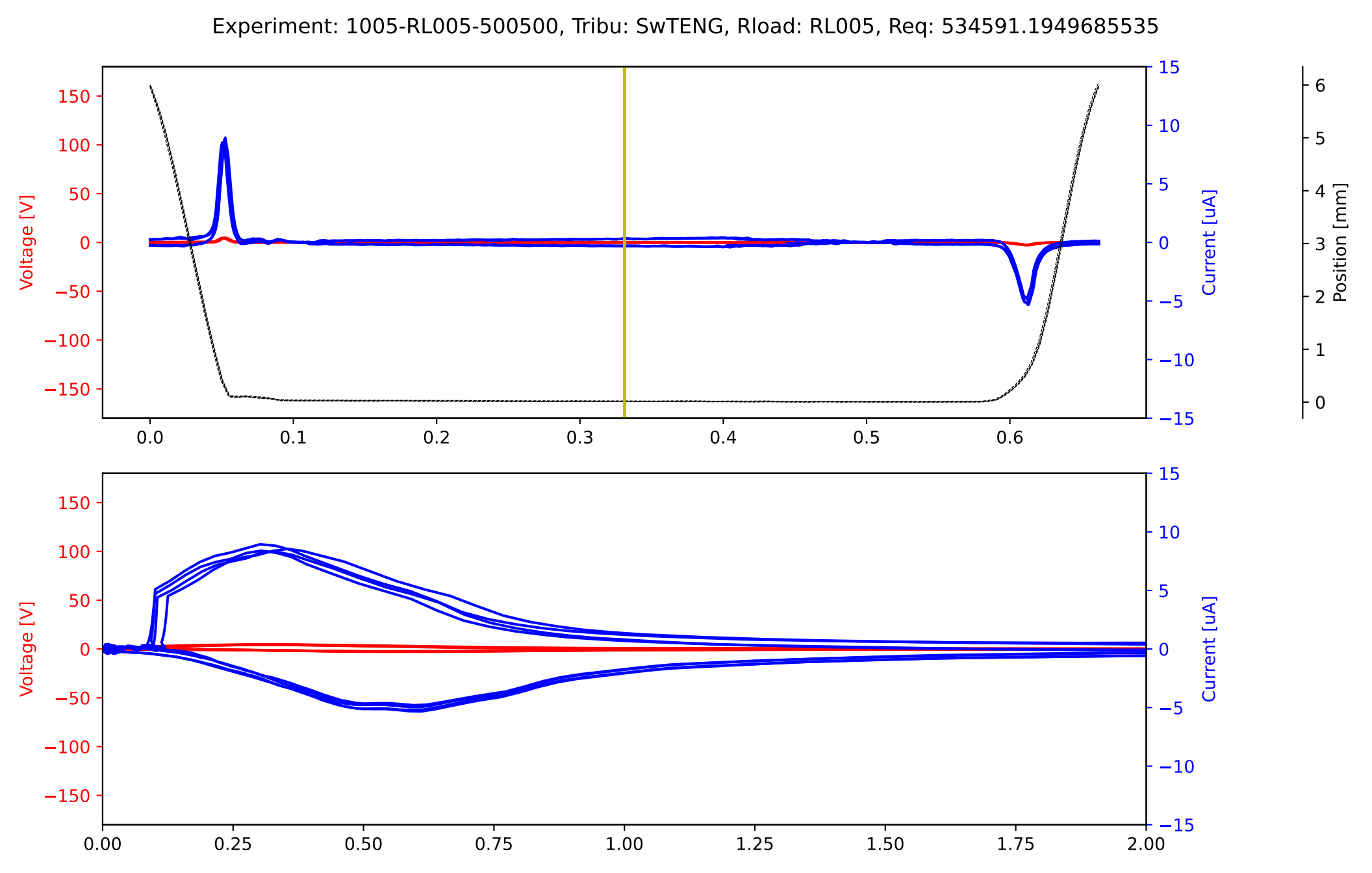

Experiment: 1005-RL003-0500, Tribu: SwTENG, Rload: RL003, Req: 330000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

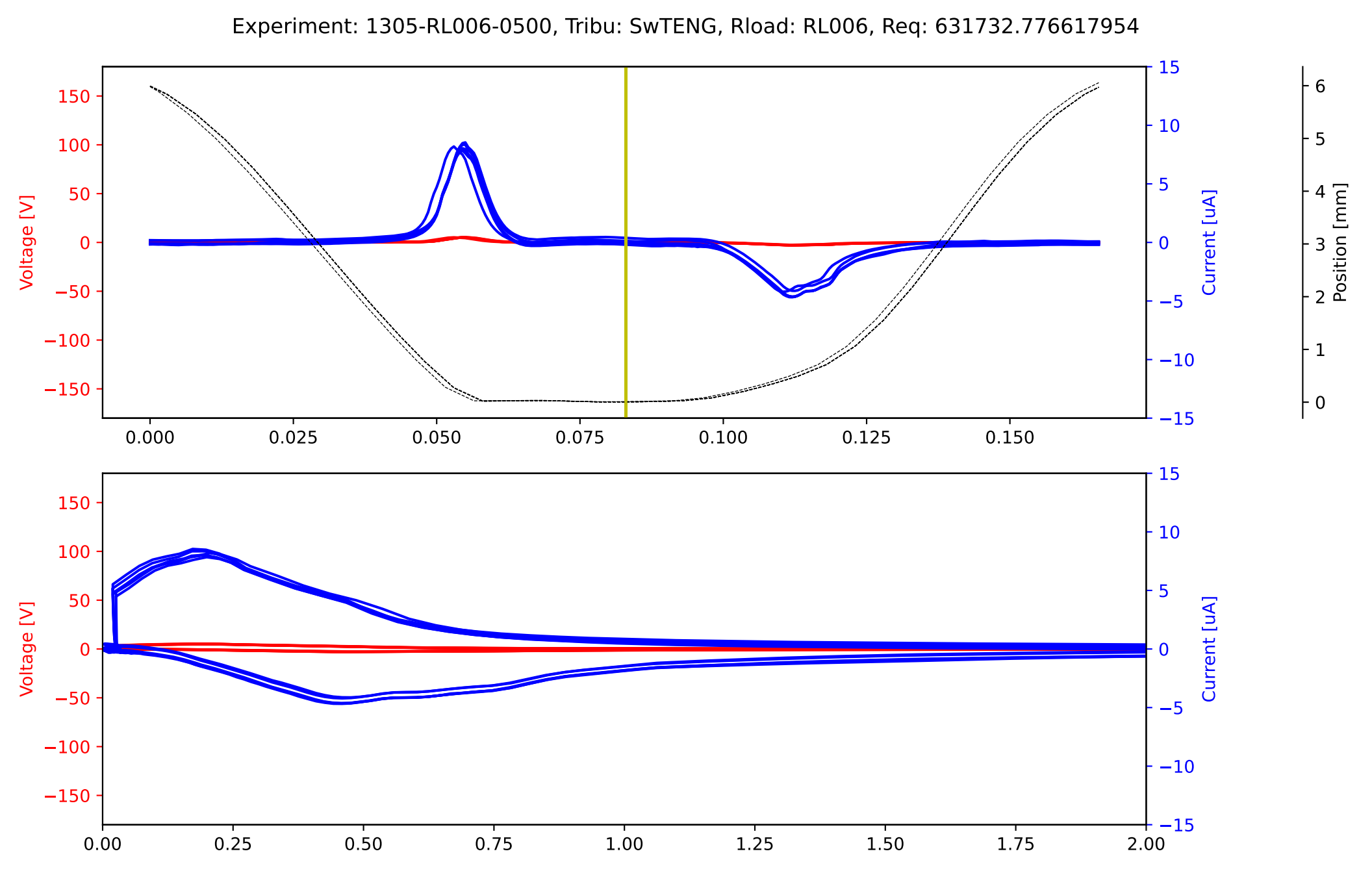

Experiment: 1005-RL003-500500, Tribu: SwTENG, Rload: RL003, Req: 330000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

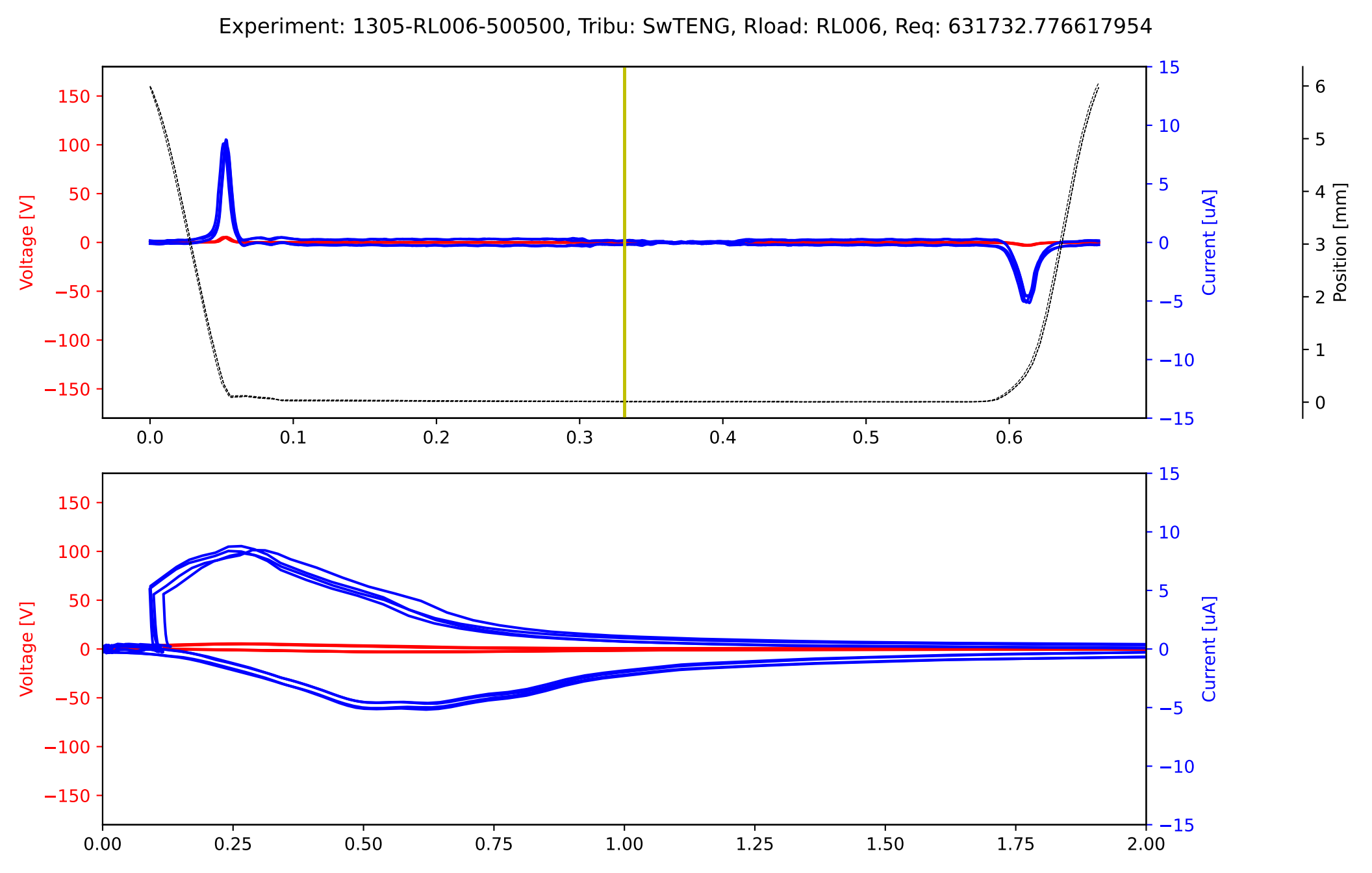

Experiment: 1005-RL004-0500, Tribu: SwTENG, Rload: RL004, Req: 440428.38018741633
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

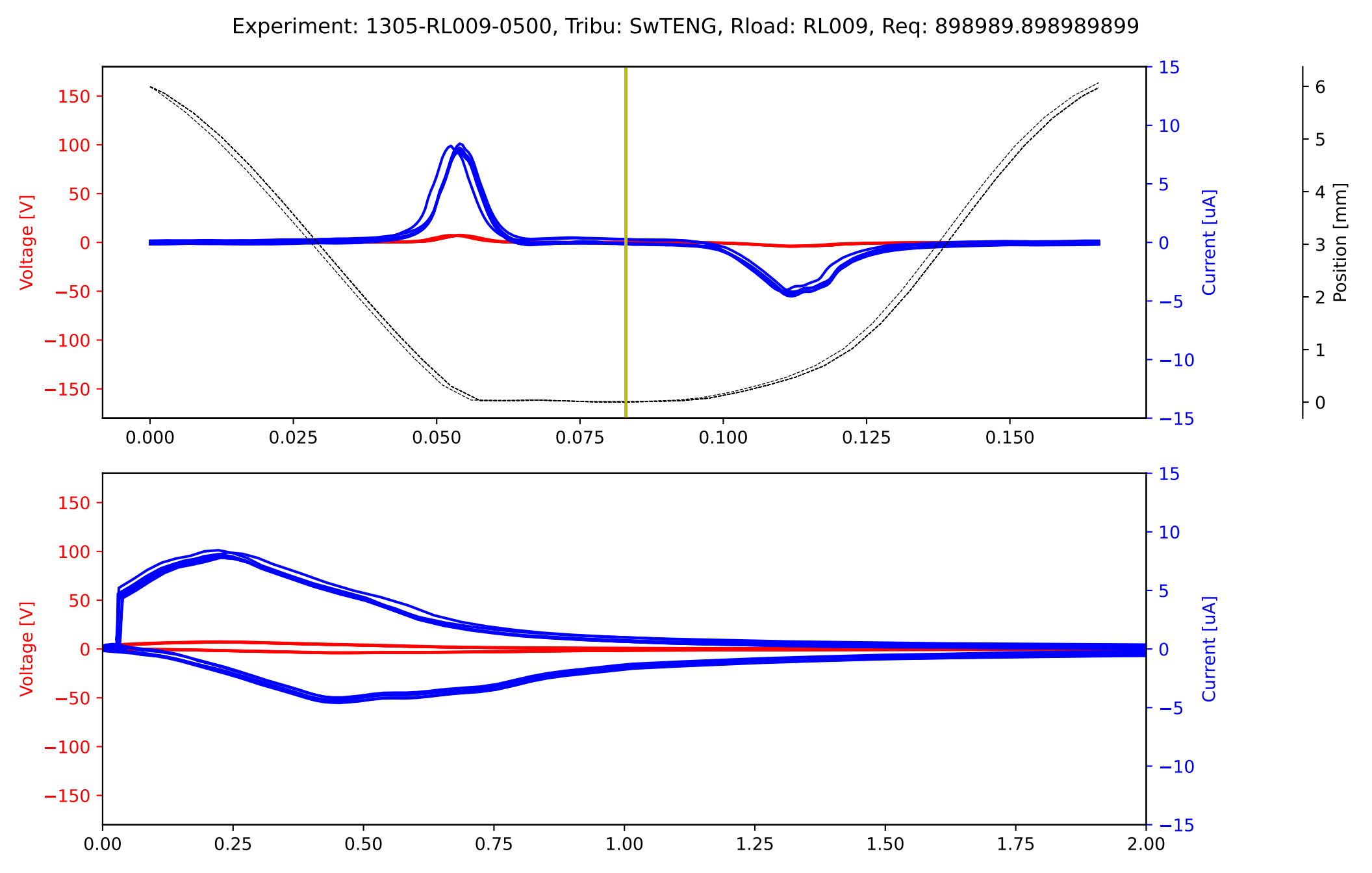

Experiment: 1005-RL004-500500, Tribu: SwTENG, Rload: RL004, Req: 440428.38018741633
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

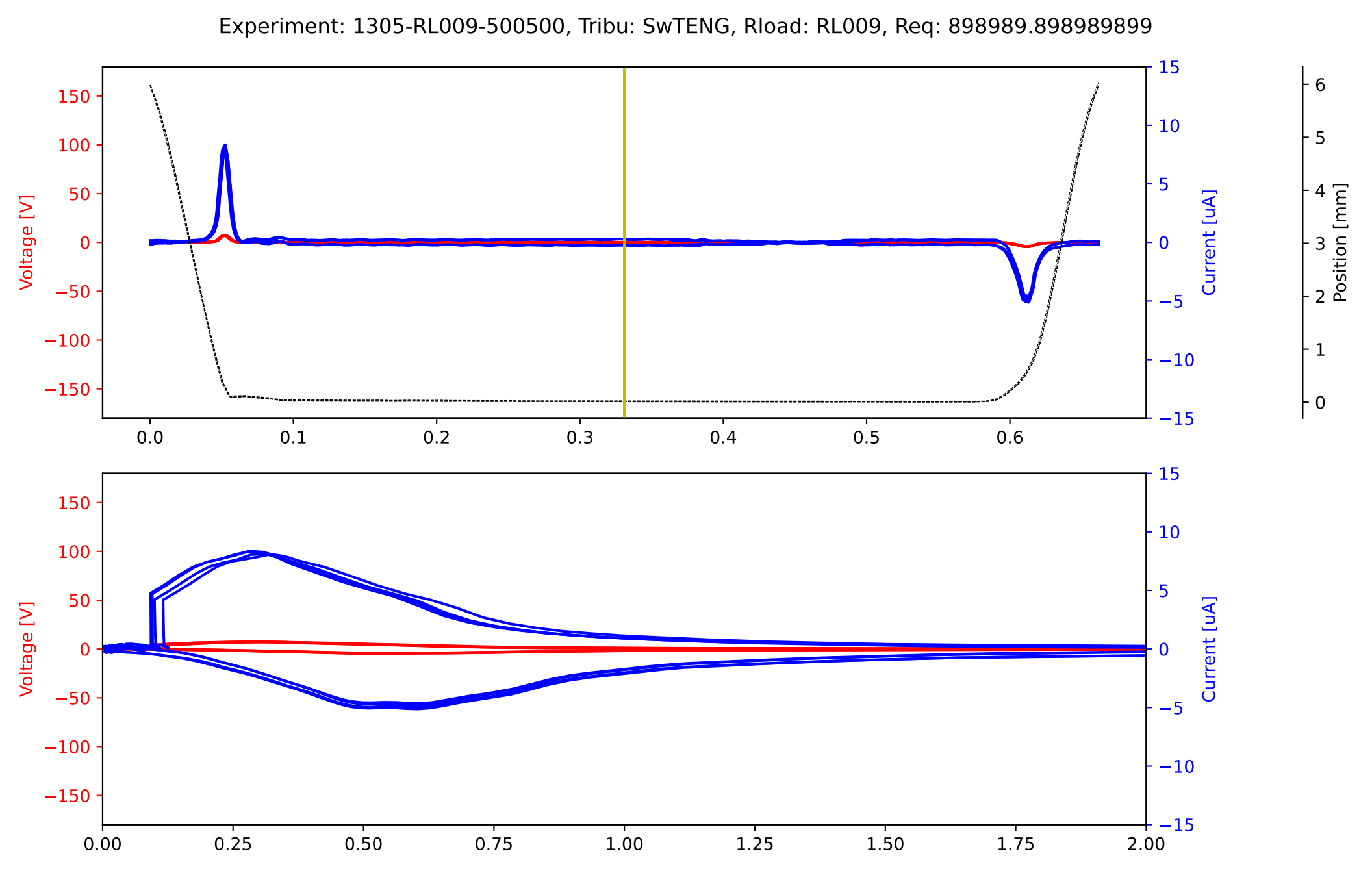

Experiment: 1005-RL005-0500, Tribu: SwTENG, Rload: RL005, Req: 534591.1949685535
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

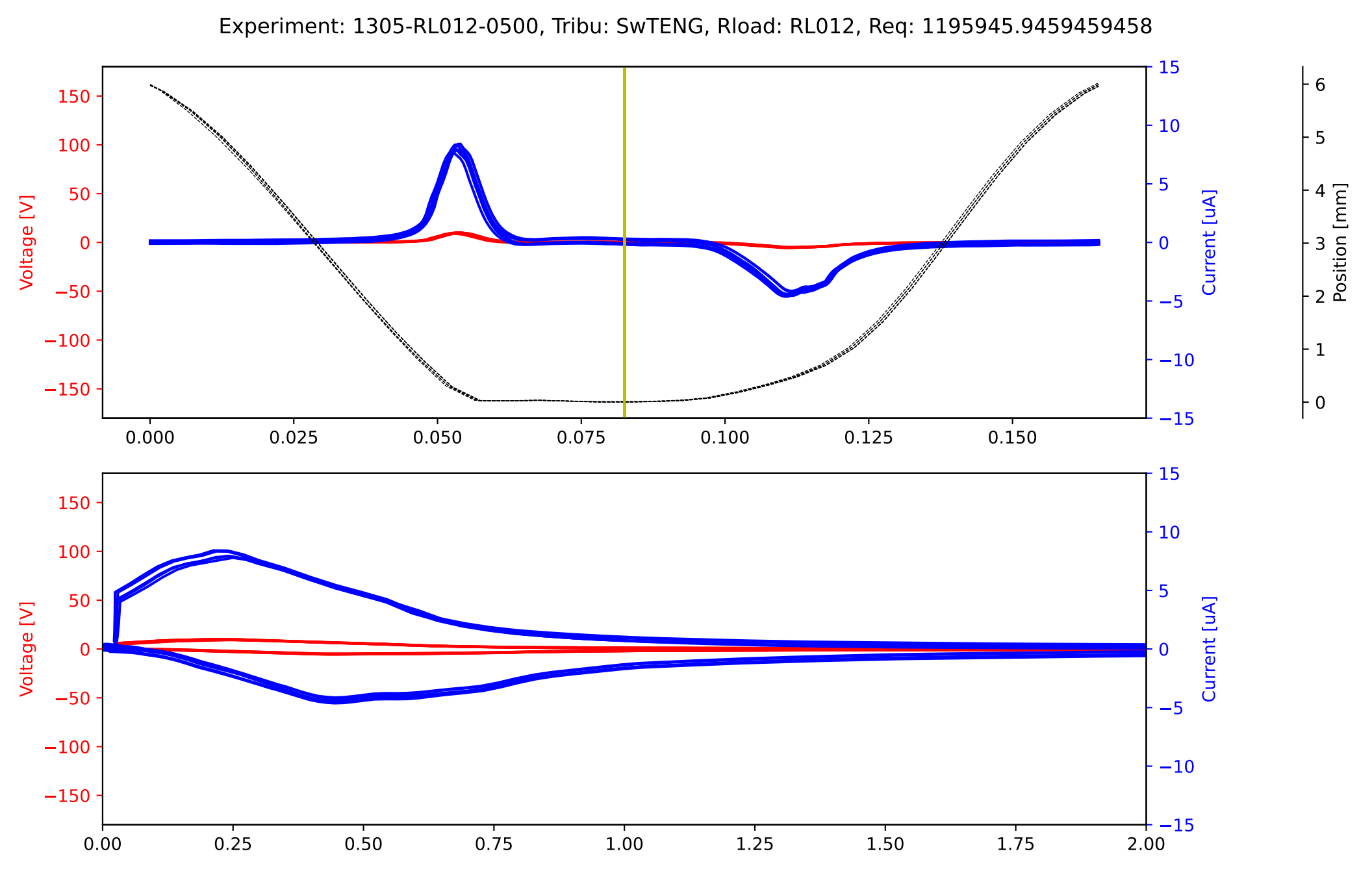

Experiment: 1005-RL005-500500, Tribu: SwTENG, Rload: RL005, Req: 534591.1949685535
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

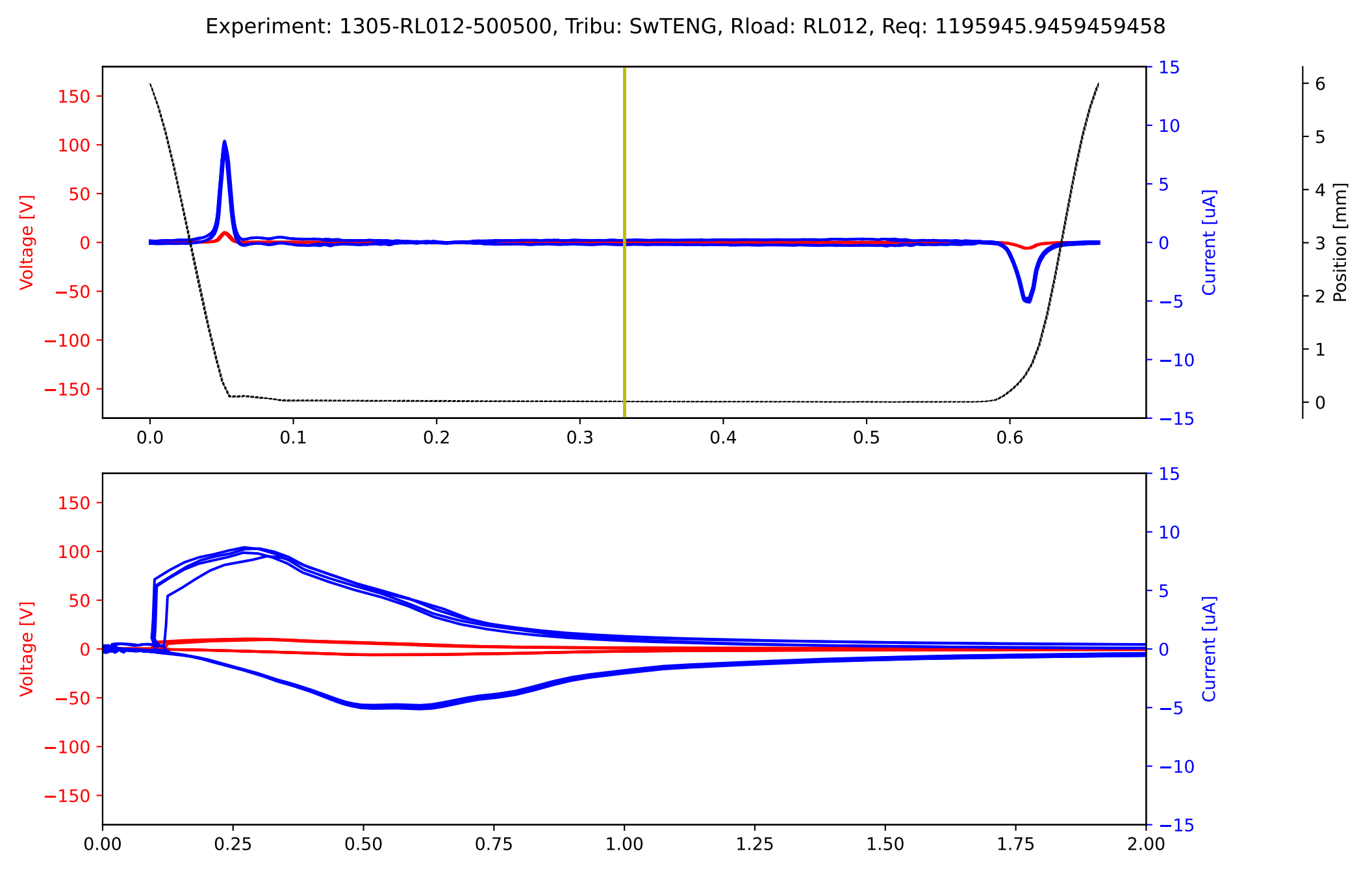

Experiment: 1305-RL006-0500, Tribu: SwTENG, Rload: RL006, Req: 631732.776617954
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

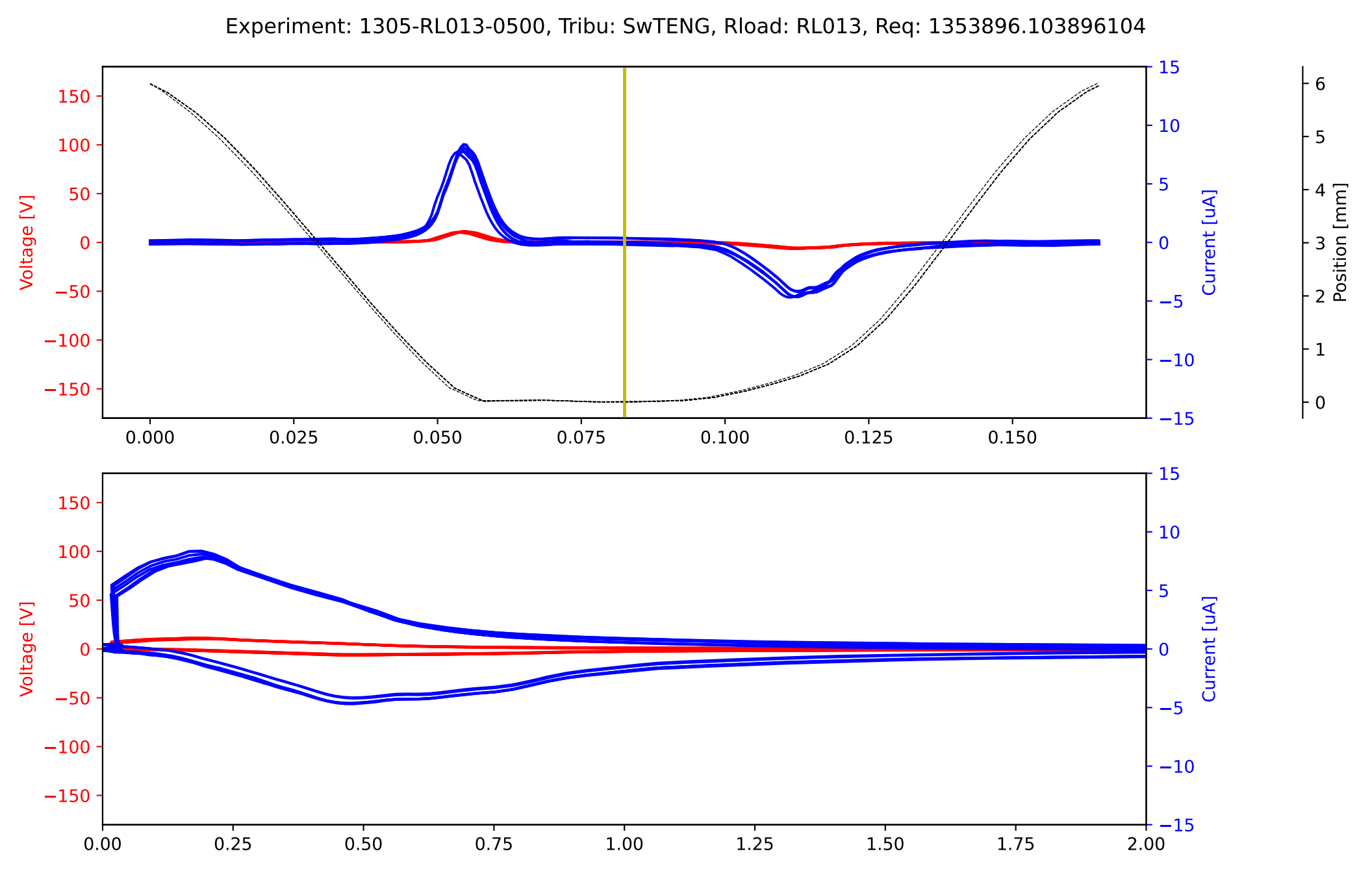

Experiment: 1305-RL006-500500, Tribu: SwTENG, Rload: RL006, Req: 631732.776617954
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

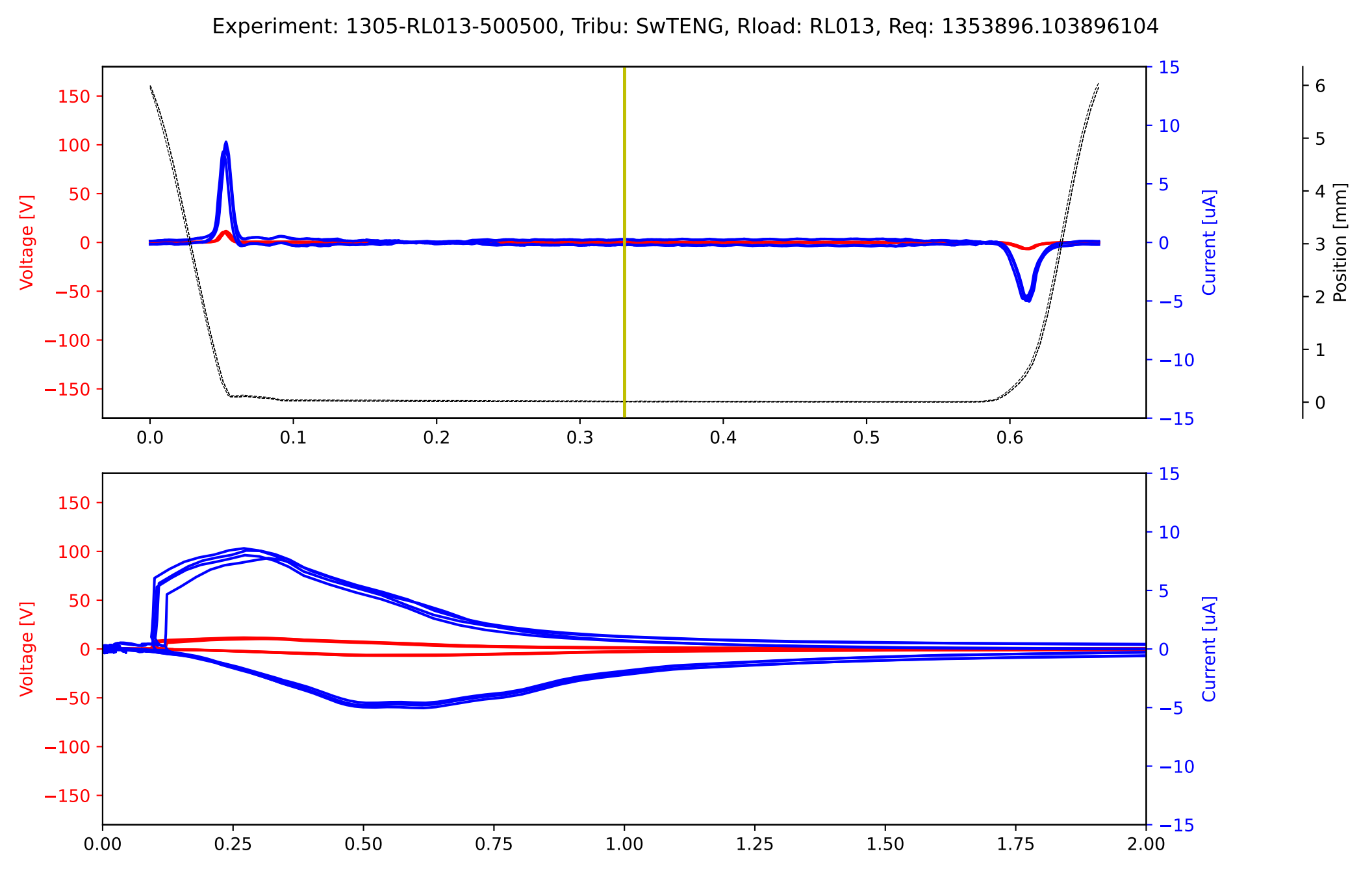

Experiment: 1305-RL009-0500, Tribu: SwTENG, Rload: RL009, Req: 898989.898989899
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

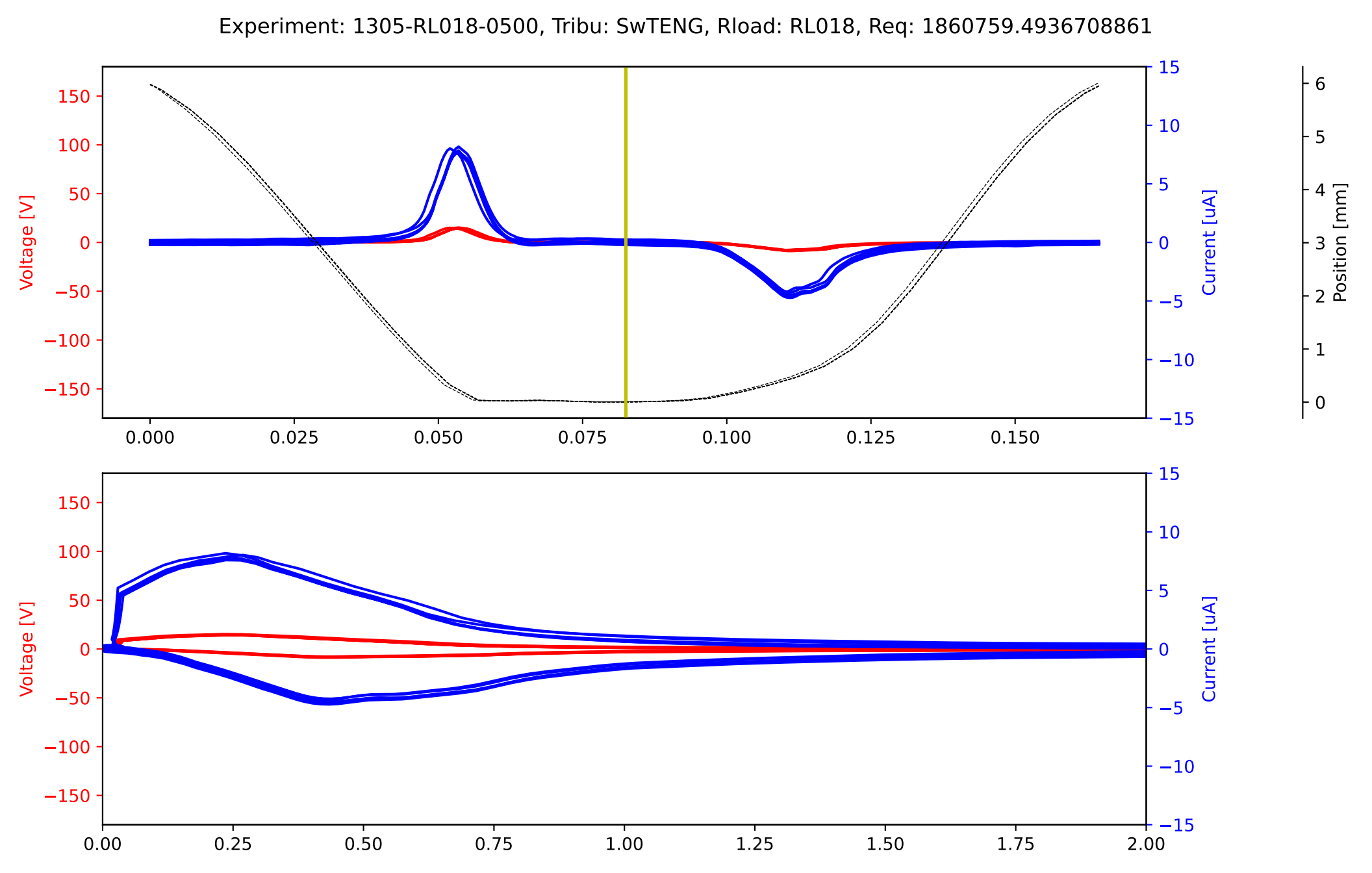

Experiment: 1305-RL009-500500, Tribu: SwTENG, Rload: RL009, Req: 898989.898989899
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

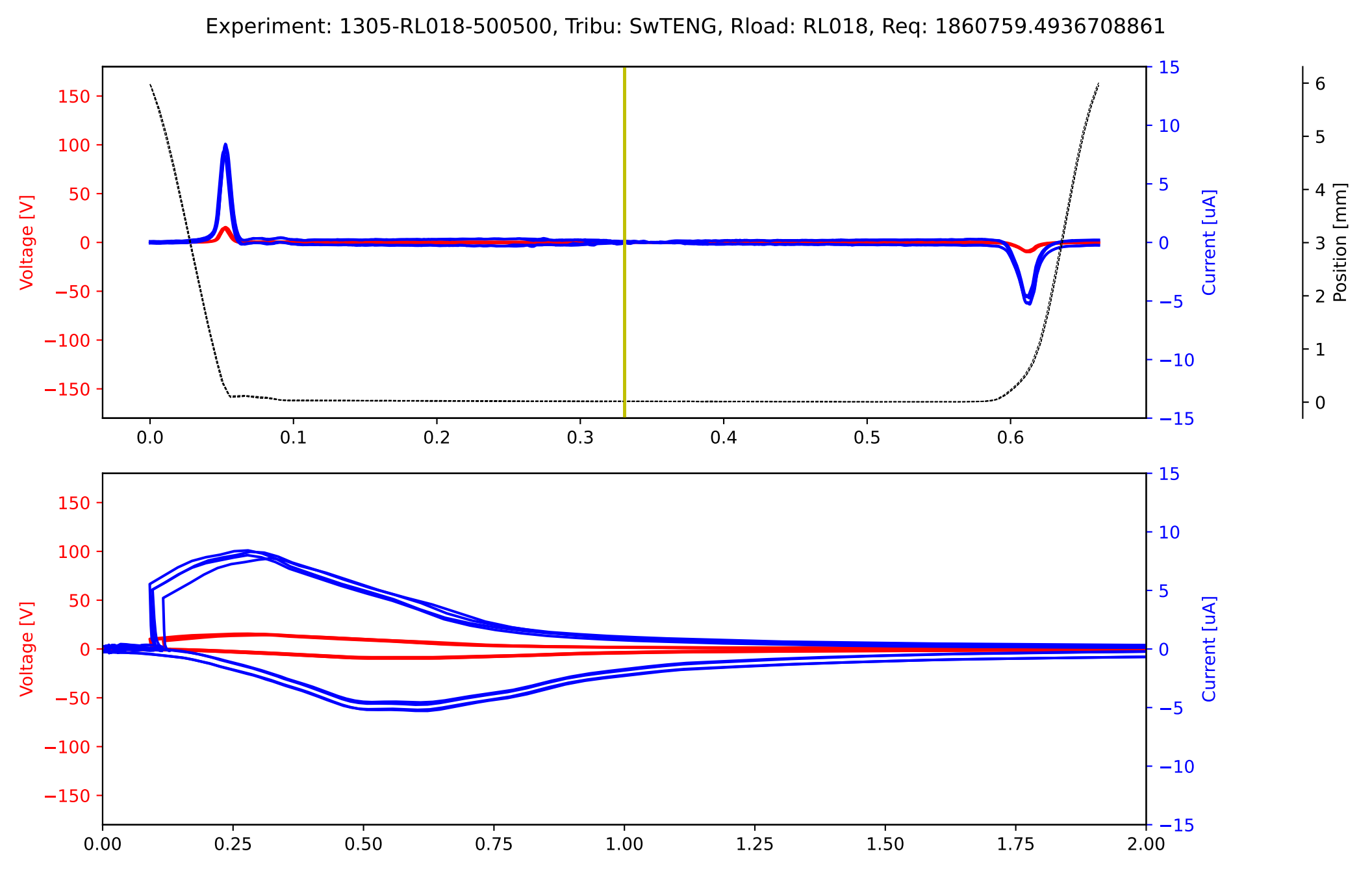

Experiment: 1305-RL012-0500, Tribu: SwTENG, Rload: RL012, Req: 1195945.9459459458
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

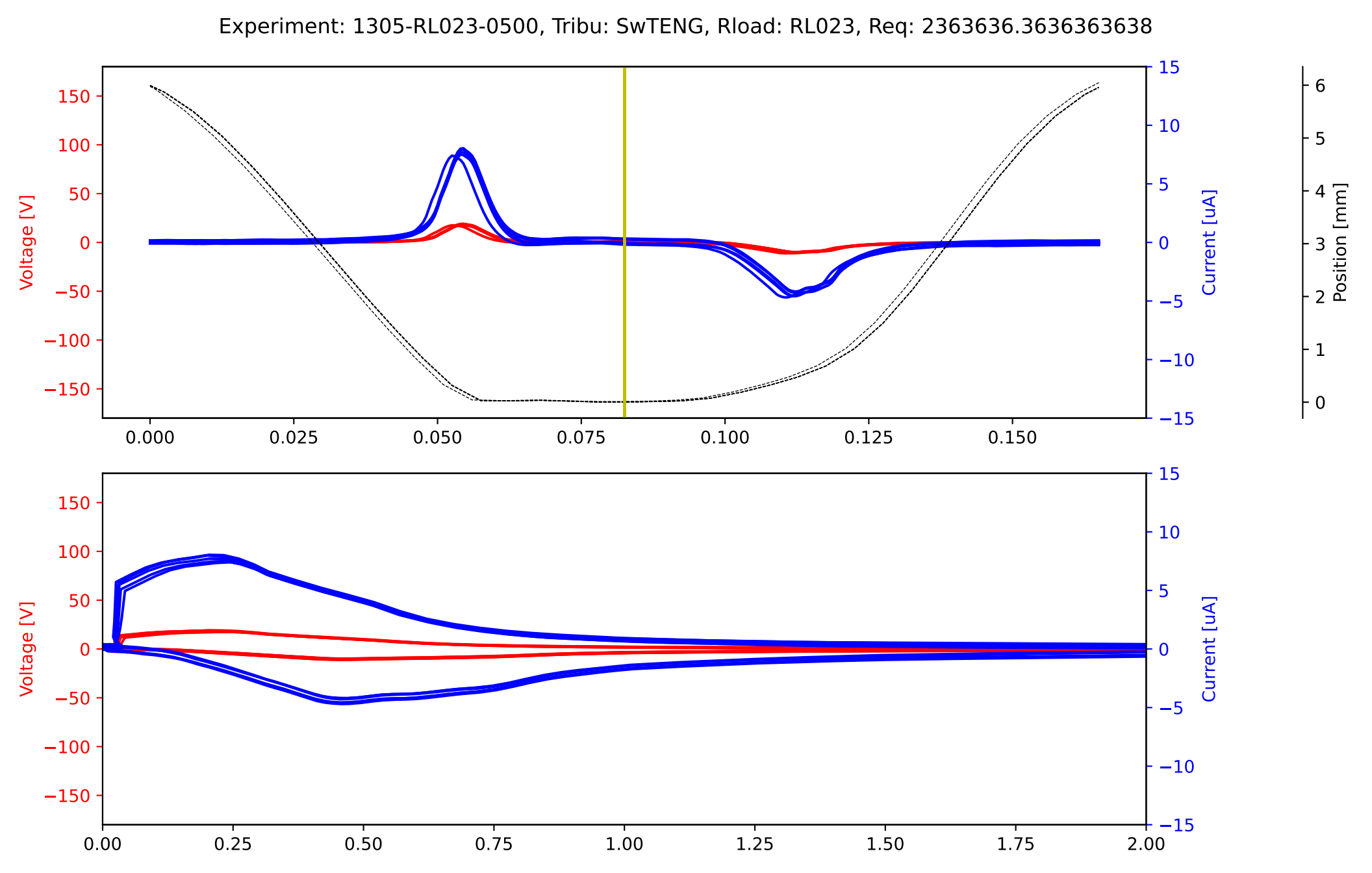

Experiment: 1305-RL012-500500, Tribu: SwTENG, Rload: RL012, Req: 1195945.9459459458
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

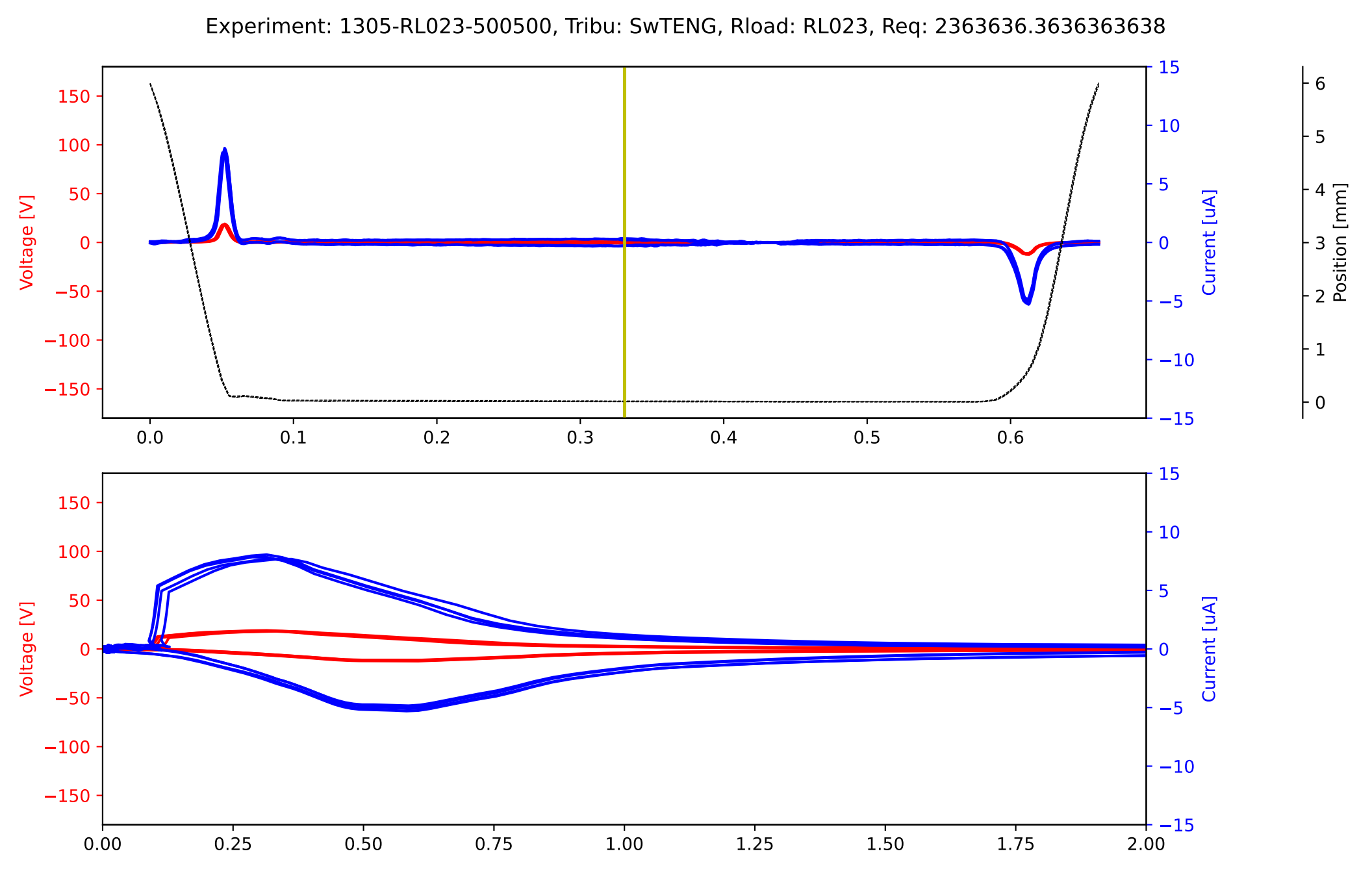

Experiment: 1305-RL013-0500, Tribu: SwTENG, Rload: RL013, Req: 1353896.103896104
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

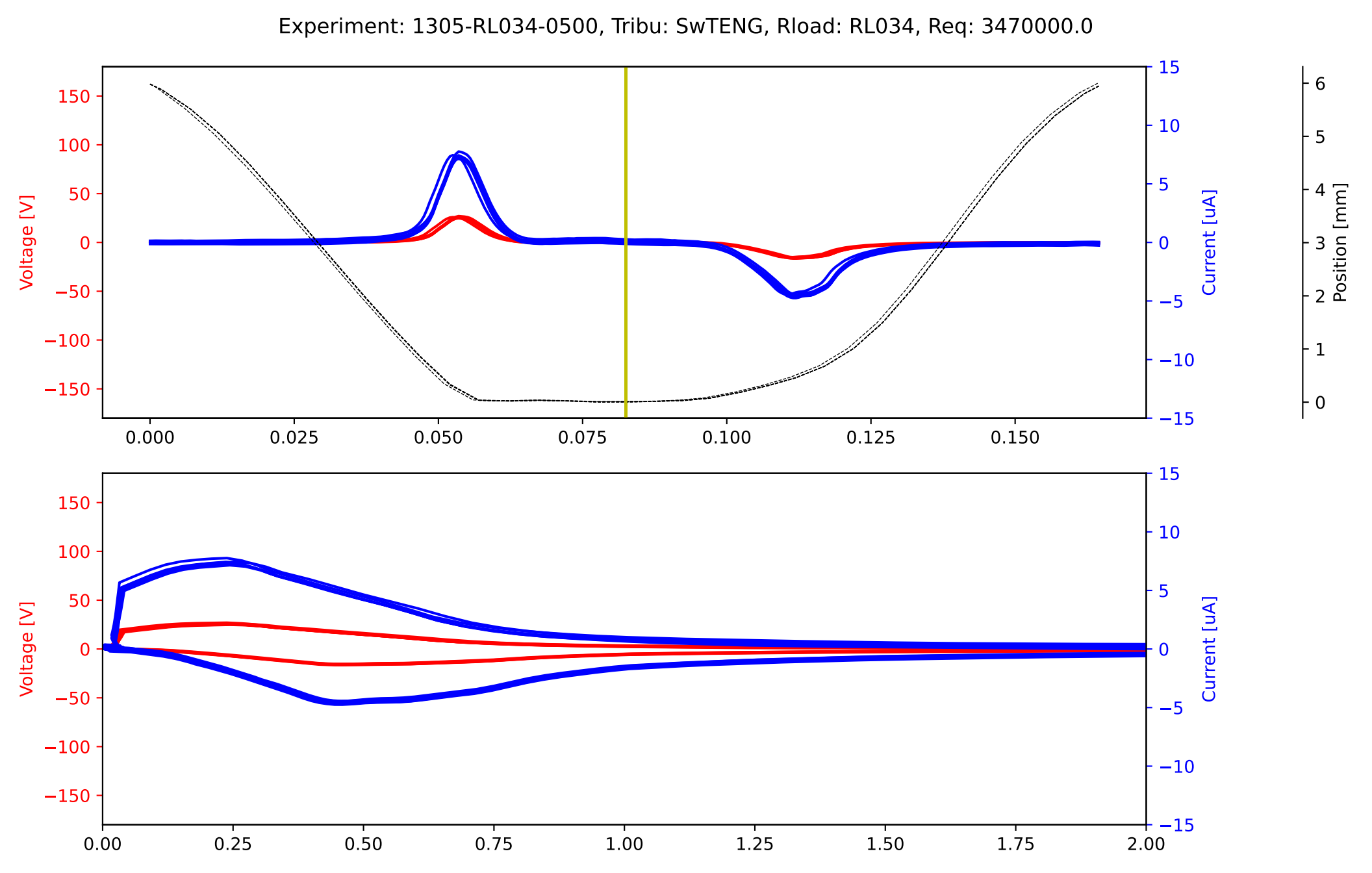

Experiment: 1305-RL013-500500, Tribu: SwTENG, Rload: RL013, Req: 1353896.103896104
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

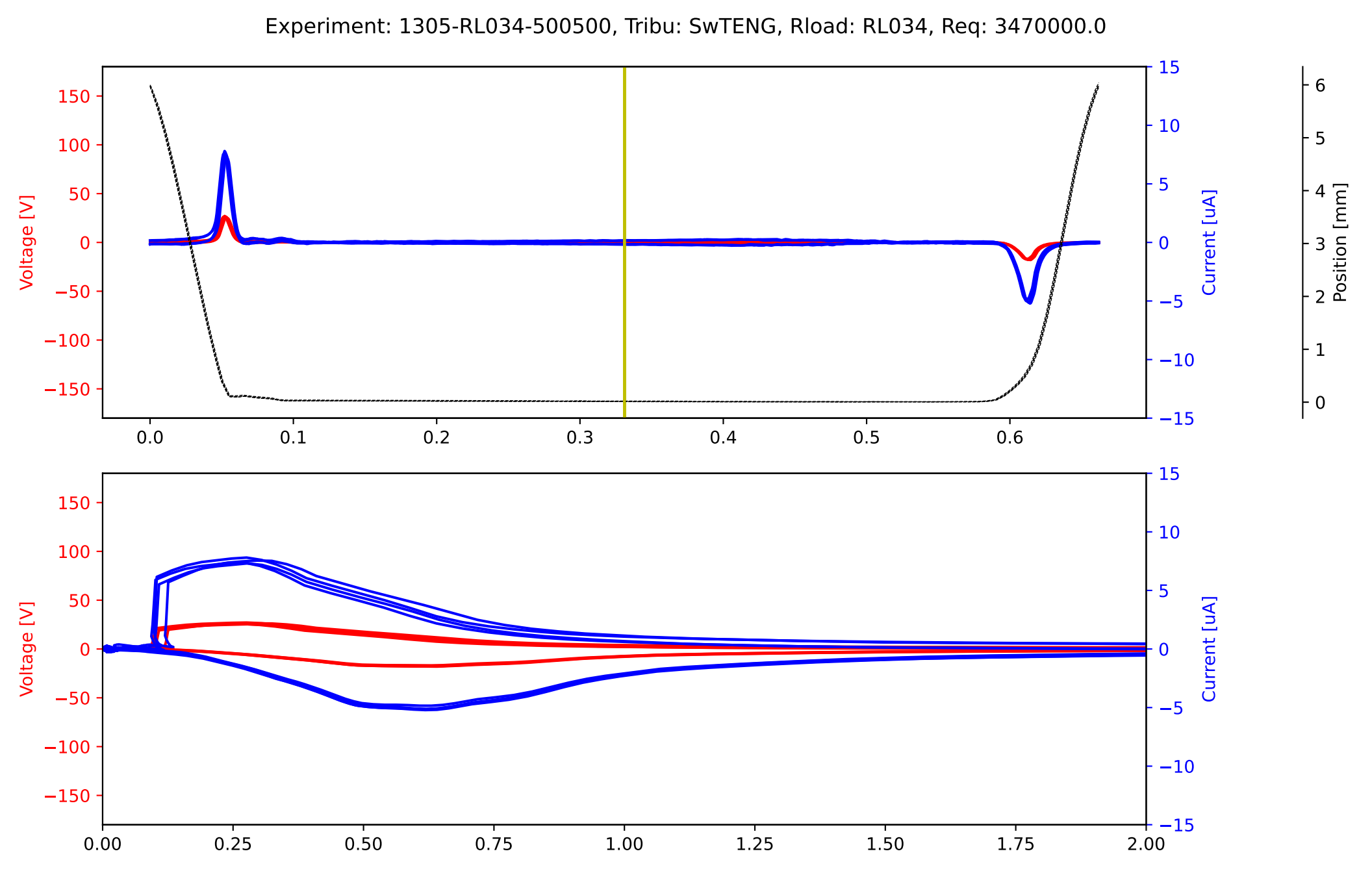

Experiment: 1305-RL018-0500, Tribu: SwTENG, Rload: RL018, Req: 1860759.4936708861
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

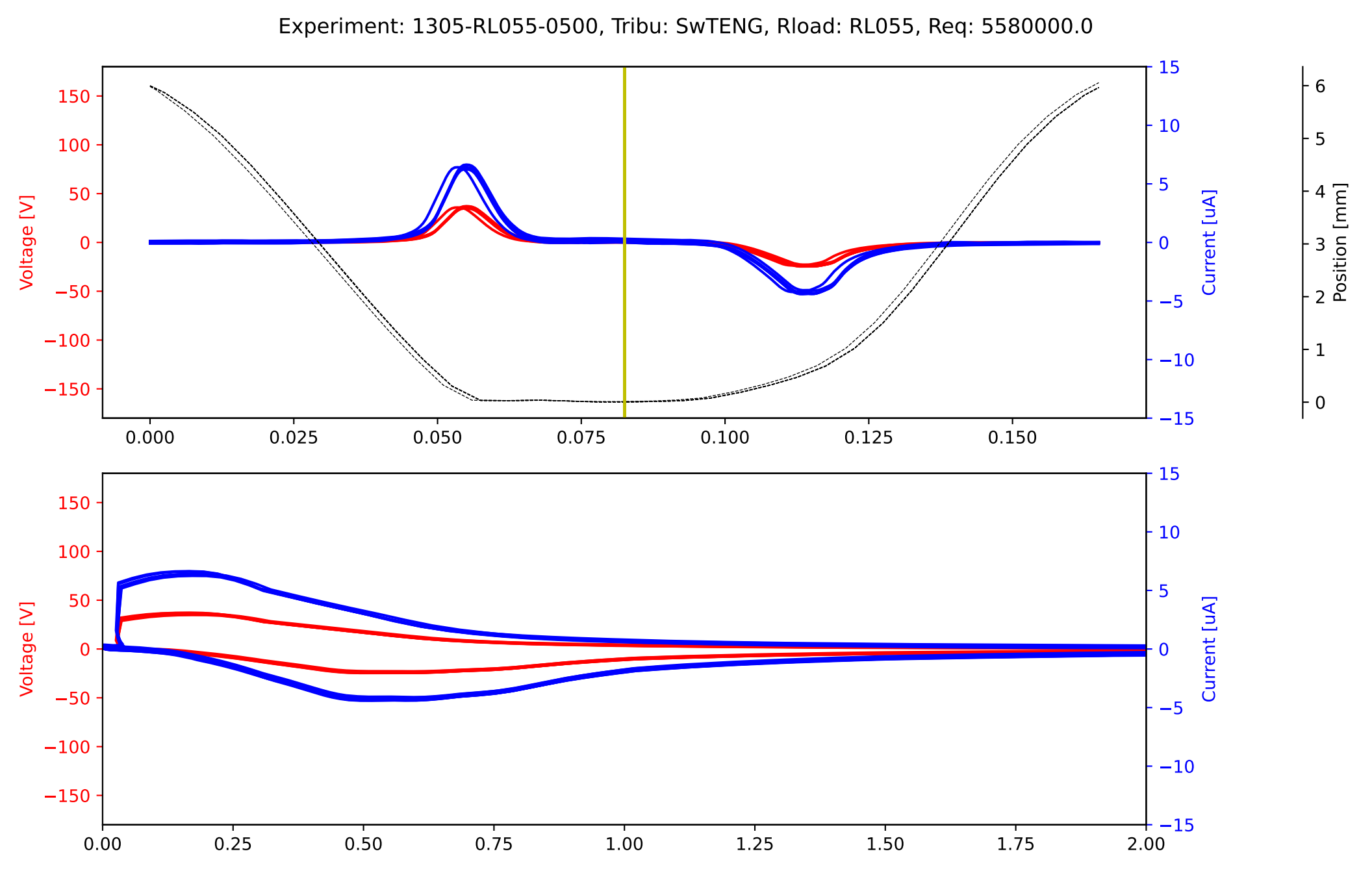

Experiment: 1305-RL018-500500, Tribu: SwTENG, Rload: RL018, Req: 1860759.4936708861
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

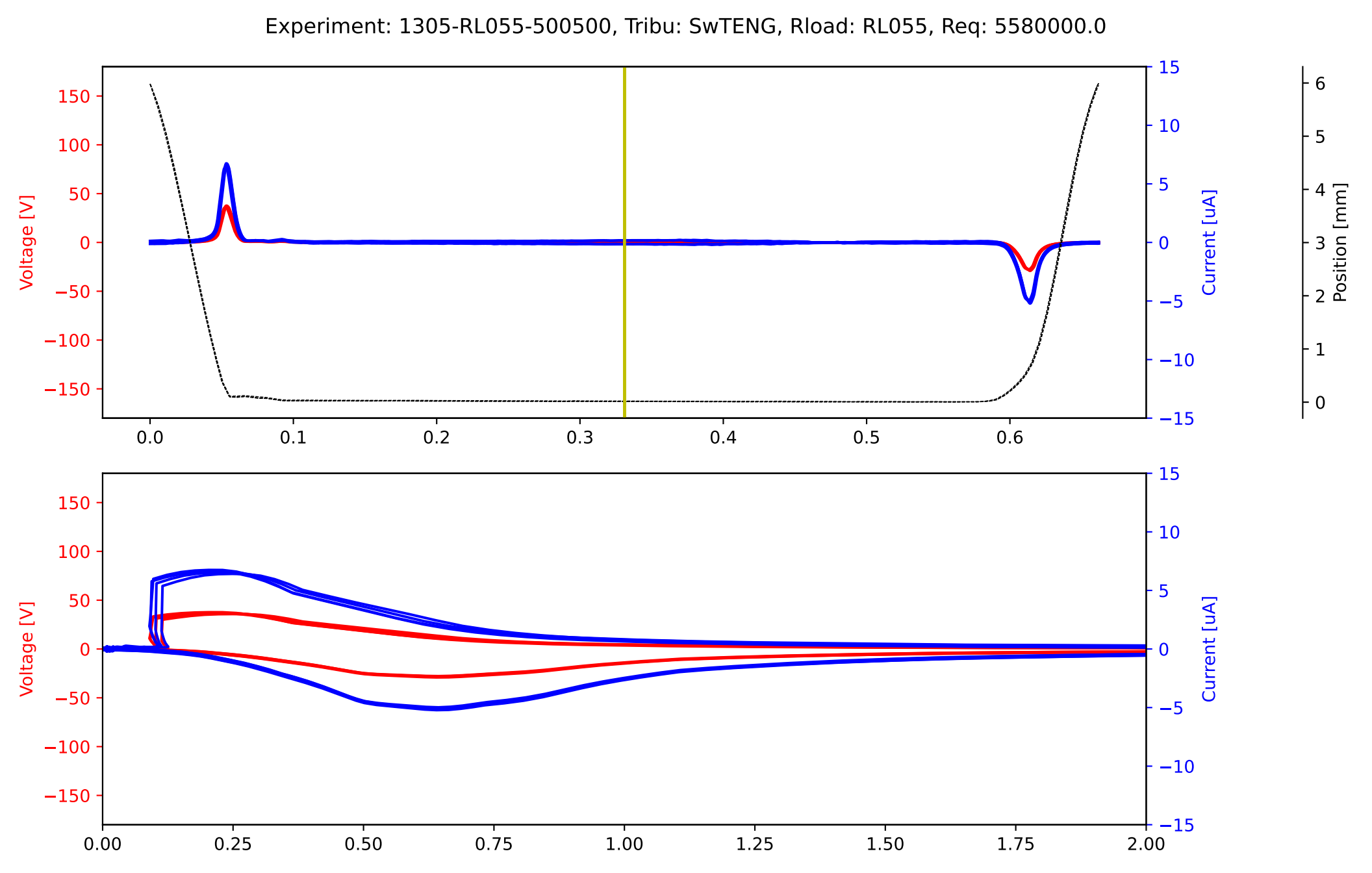

Experiment: 1305-RL023-0500, Tribu: SwTENG, Rload: RL023, Req: 2363636.3636363638
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

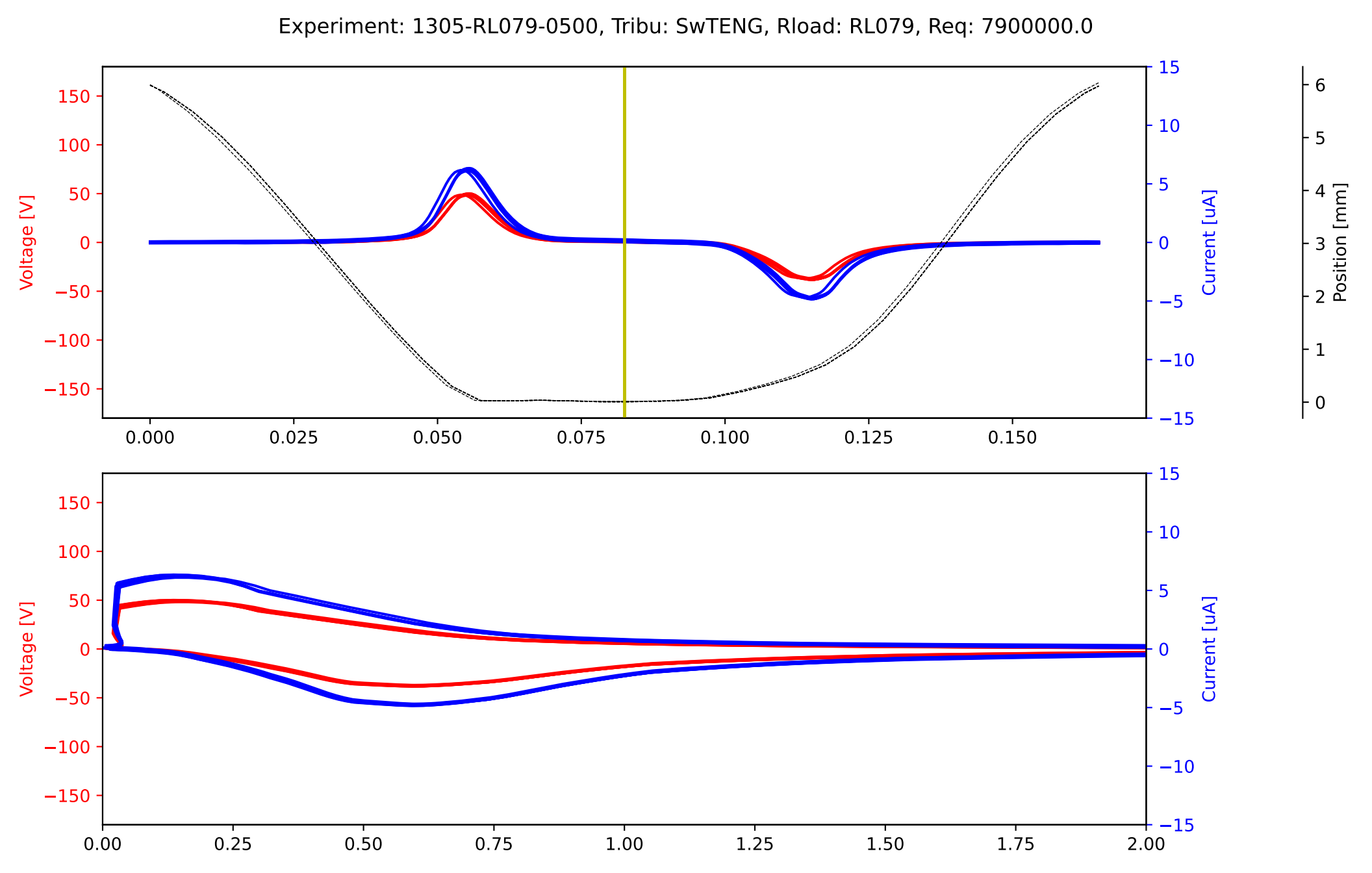

Experiment: 1305-RL023-500500, Tribu: SwTENG, Rload: RL023, Req: 2363636.3636363638
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

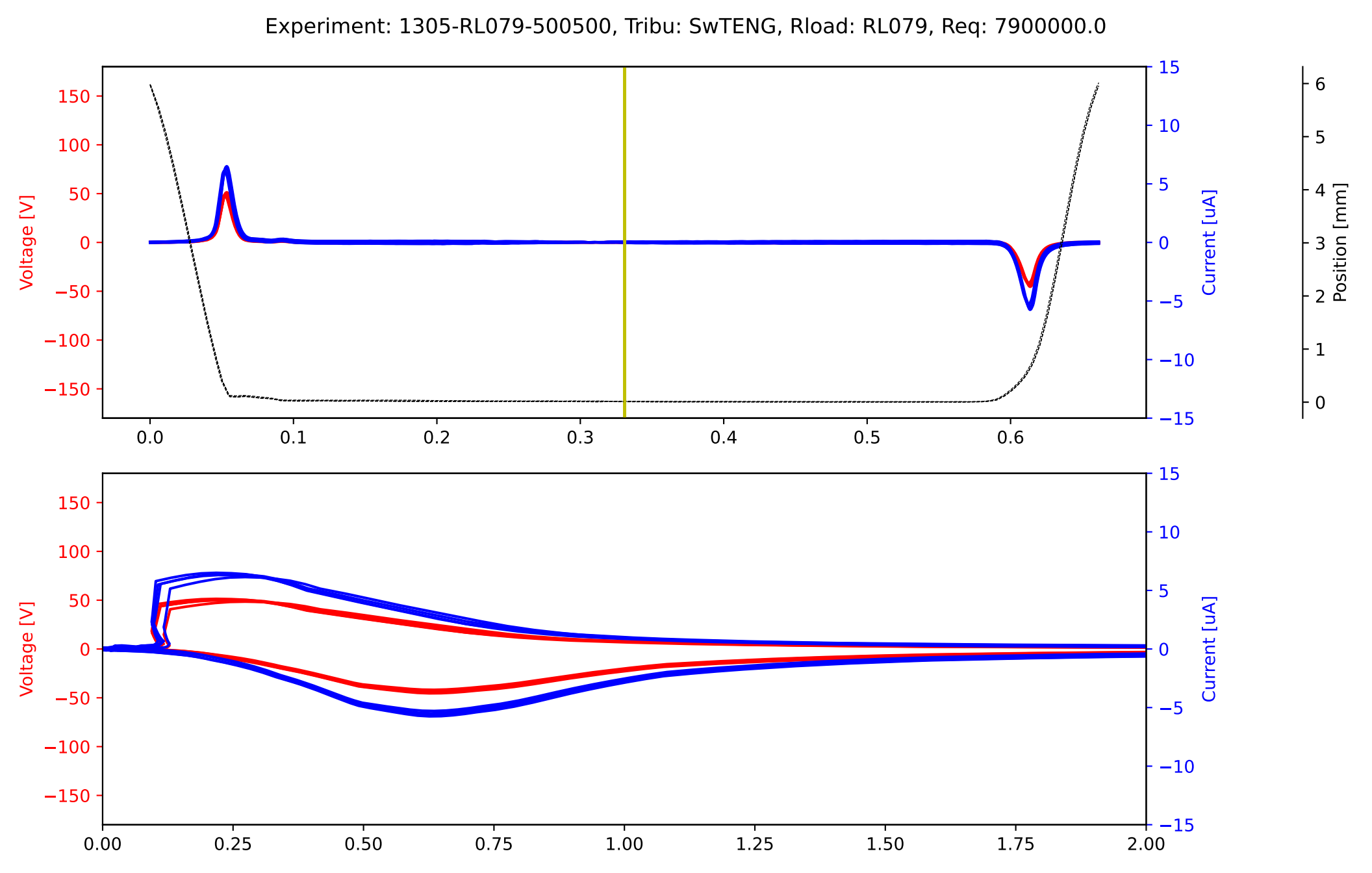

Experiment: 1305-RL034-0500, Tribu: SwTENG, Rload: RL034, Req: 3470000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

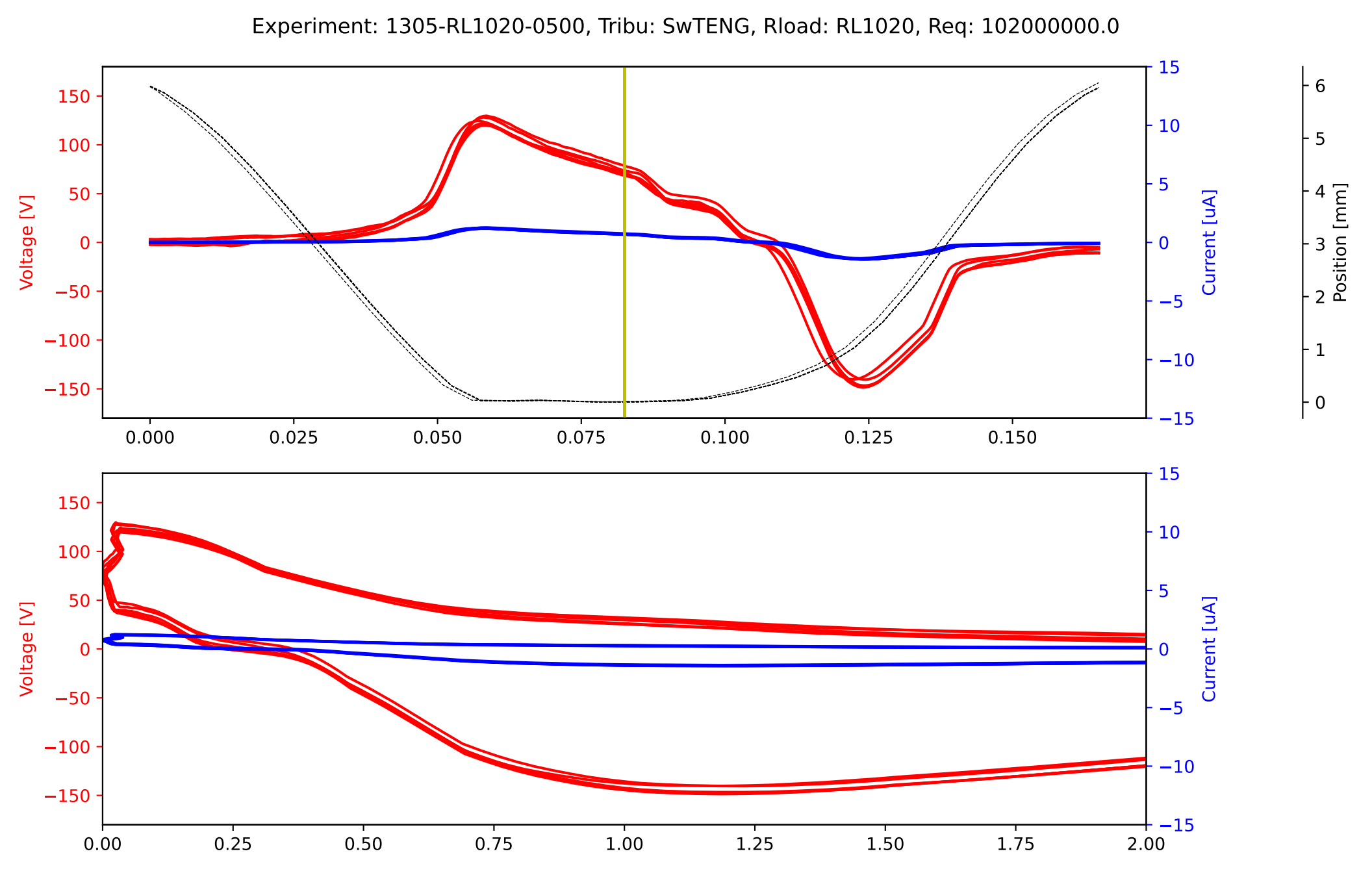

Experiment: 1305-RL034-500500, Tribu: SwTENG, Rload: RL034, Req: 3470000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

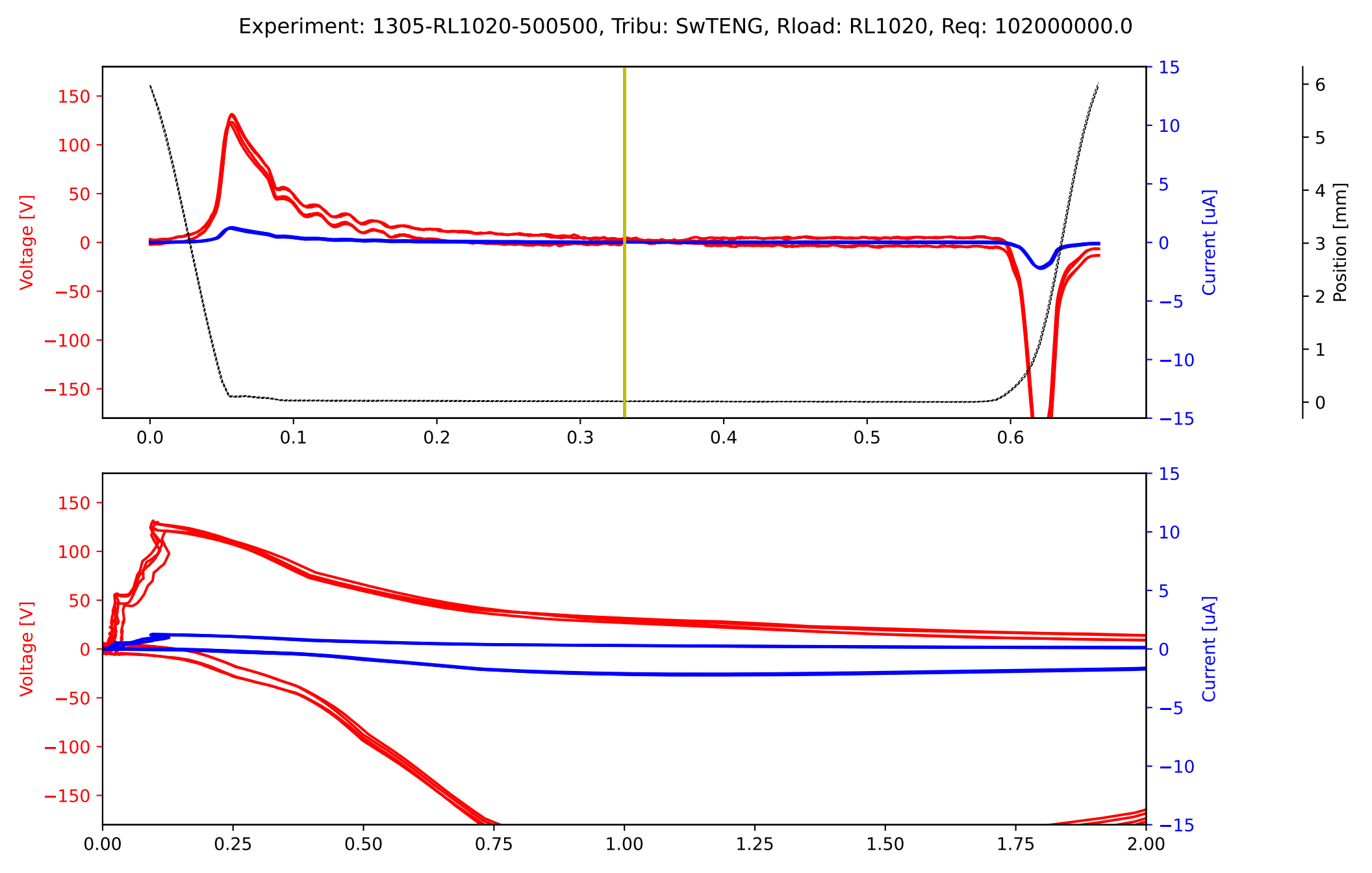

Experiment: 1305-RL055-0500, Tribu: SwTENG, Rload: RL055, Req: 5580000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

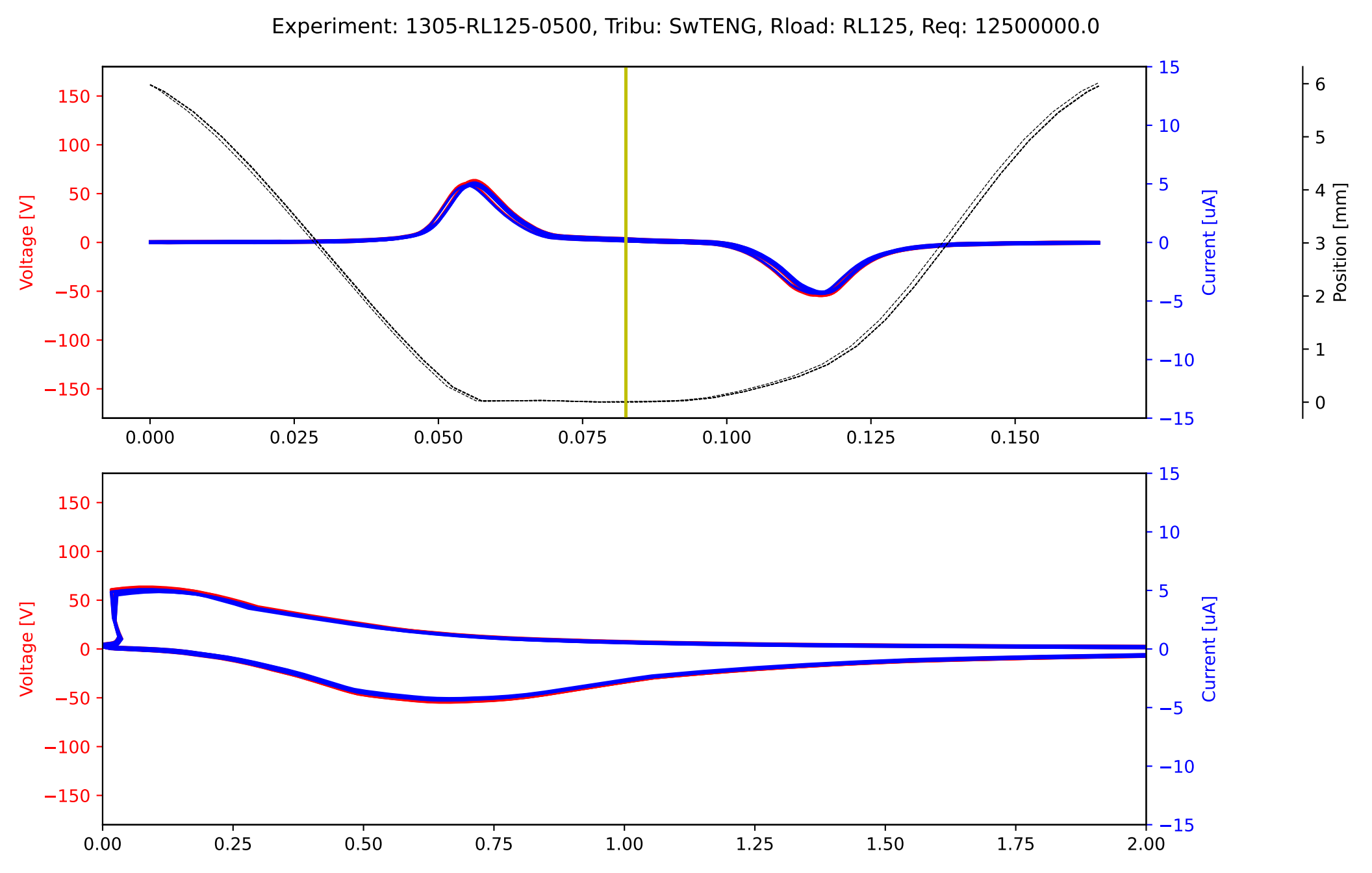

Experiment: 1305-RL055-500500, Tribu: SwTENG, Rload: RL055, Req: 5580000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

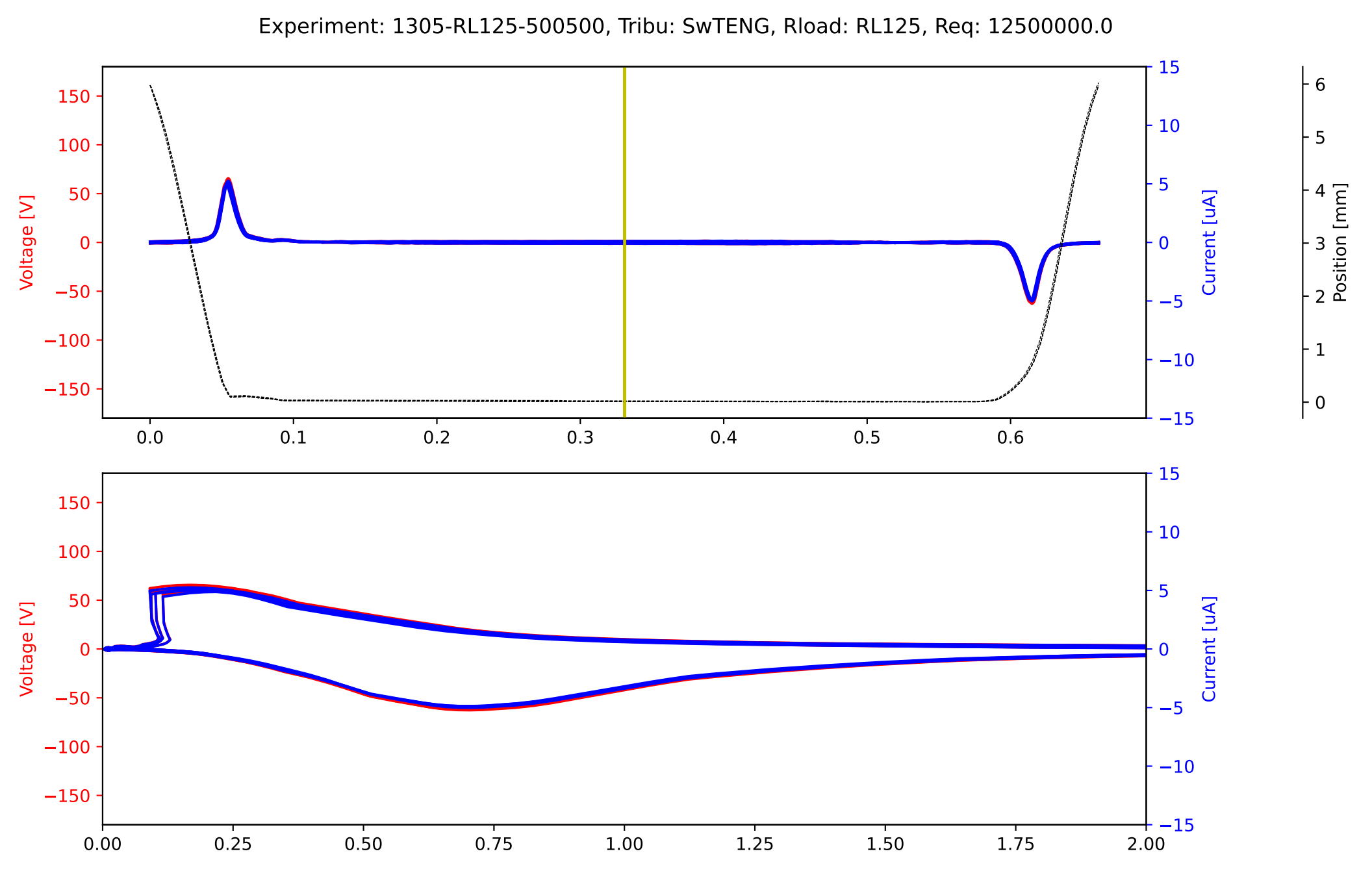

Experiment: 1305-RL079-0500, Tribu: SwTENG, Rload: RL079, Req: 7900000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

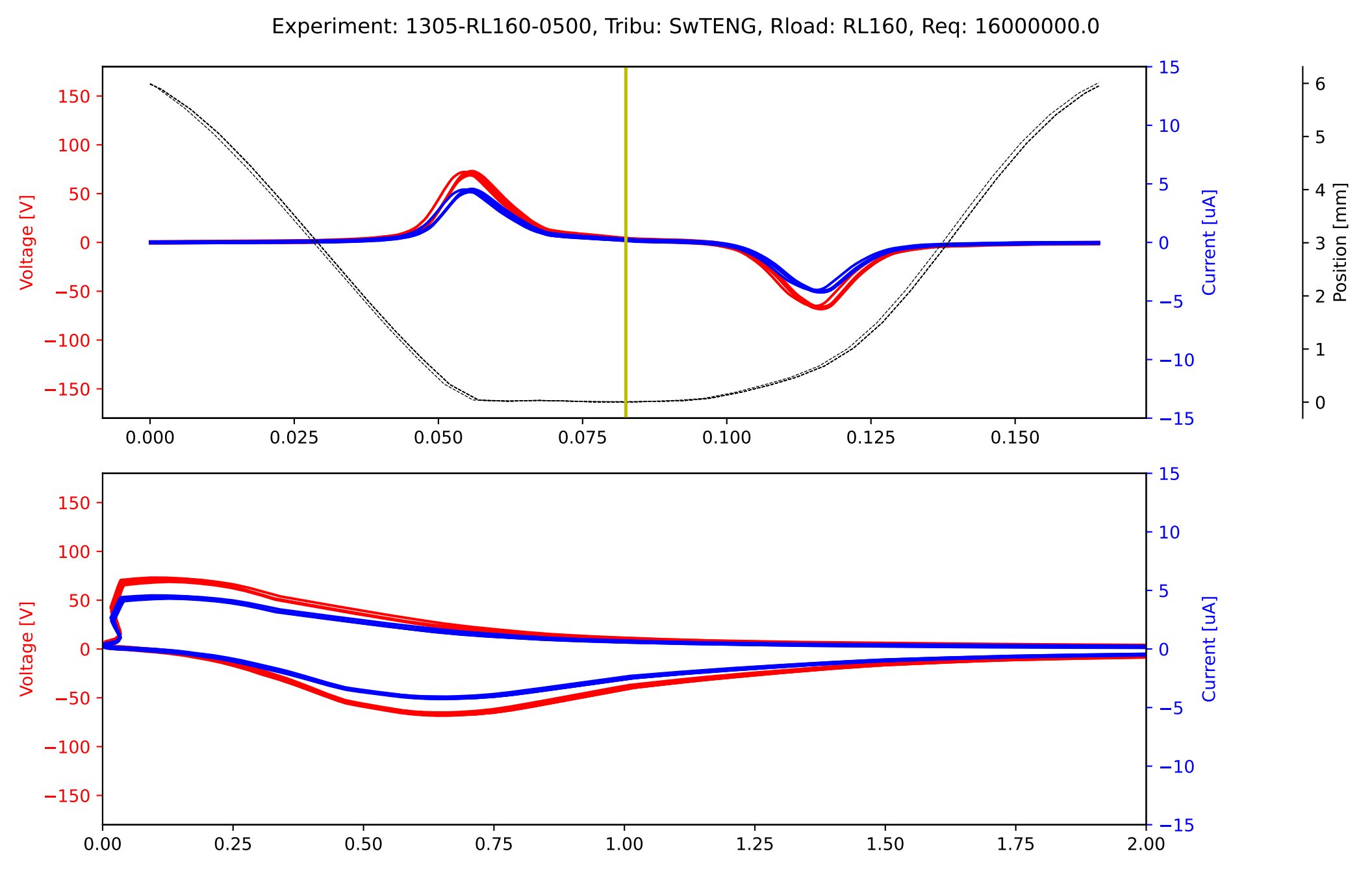

Experiment: 1305-RL079-500500, Tribu: SwTENG, Rload: RL079, Req: 7900000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

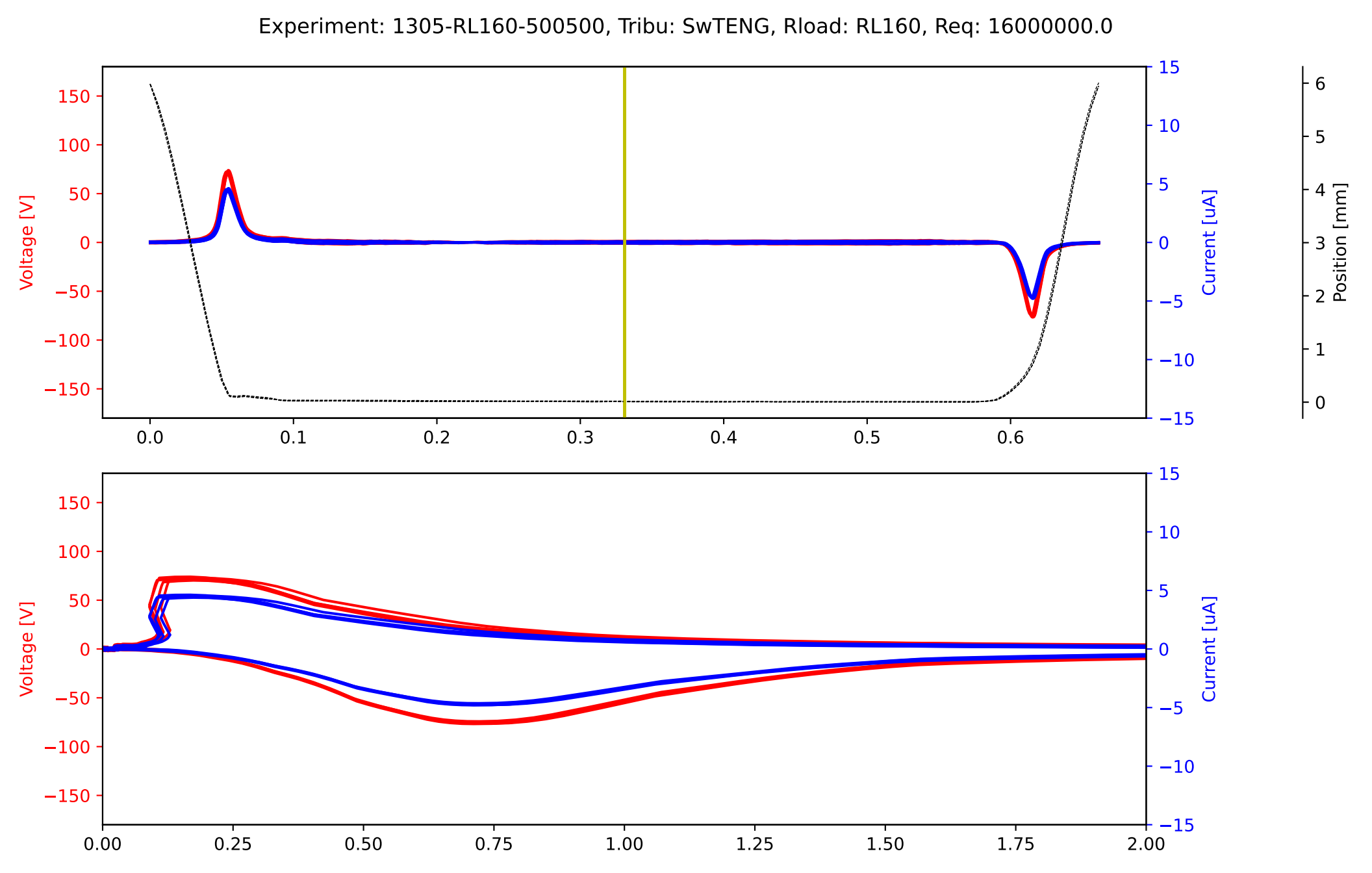

Experiment: 1305-RL1020-0500, Tribu: SwTENG, Rload: RL1020, Req: 102000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

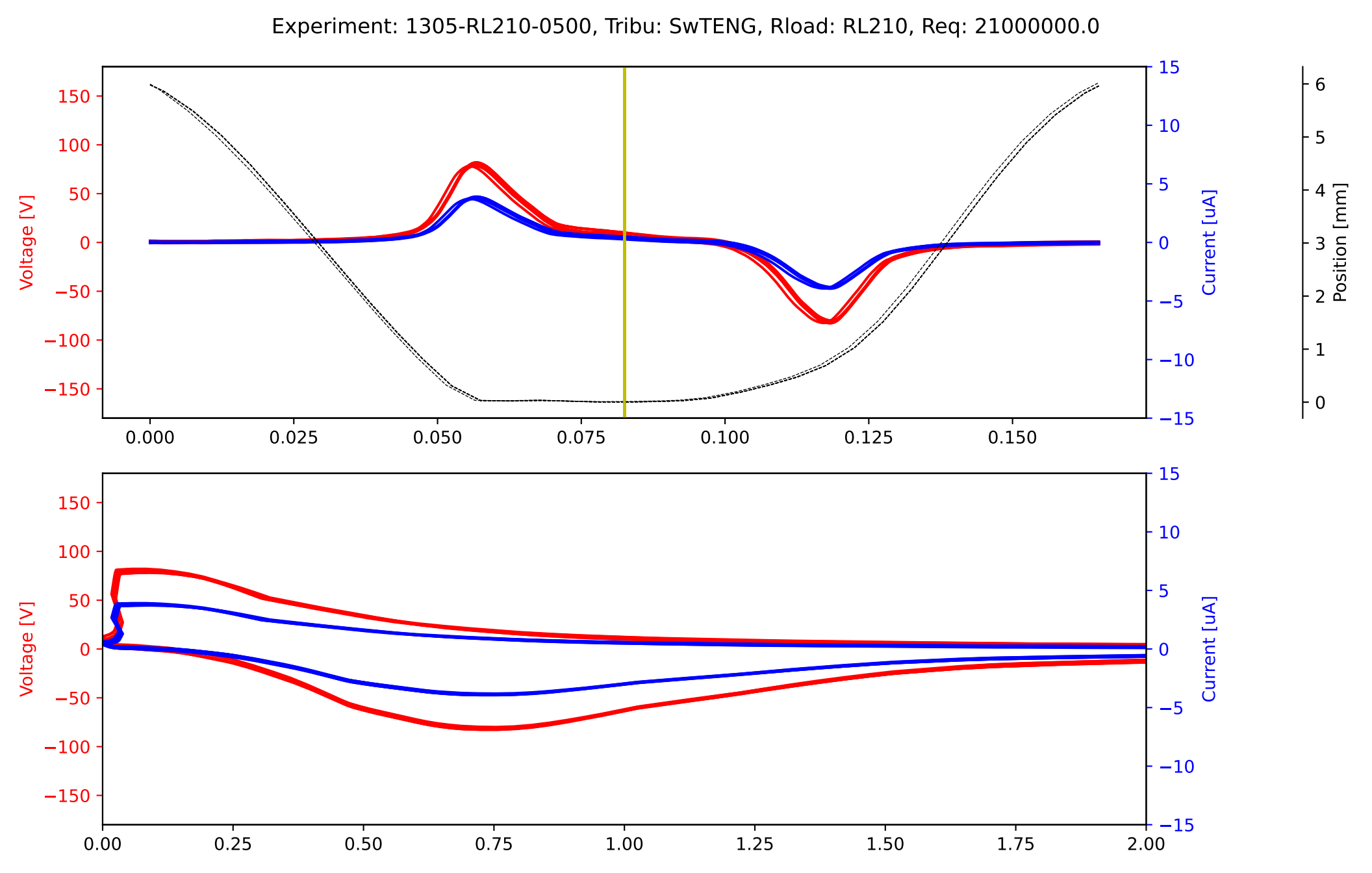

Experiment: 1305-RL1020-500500, Tribu: SwTENG, Rload: RL1020, Req: 102000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

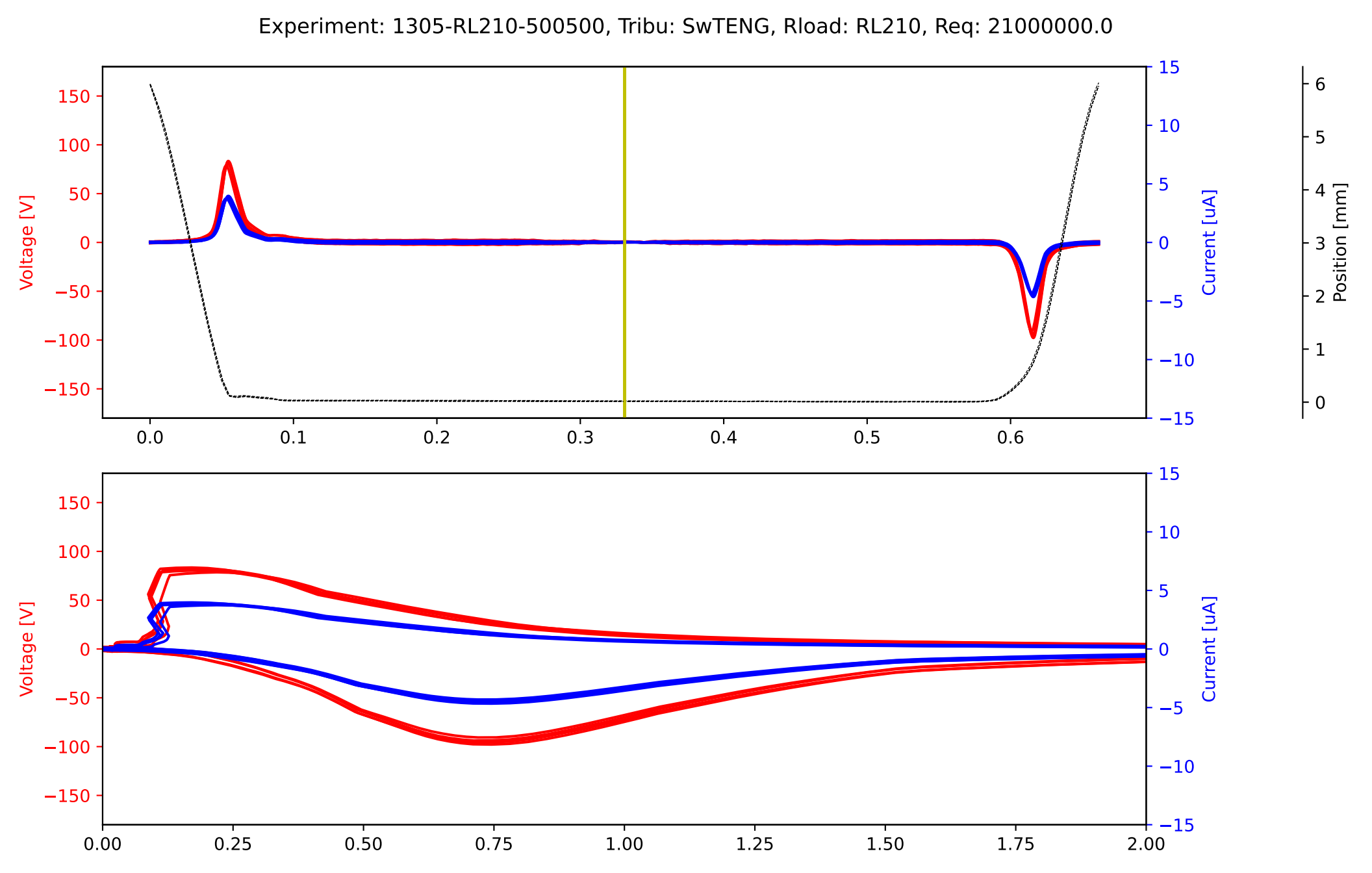

Experiment: 1305-RL125-0500, Tribu: SwTENG, Rload: RL125, Req: 12500000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

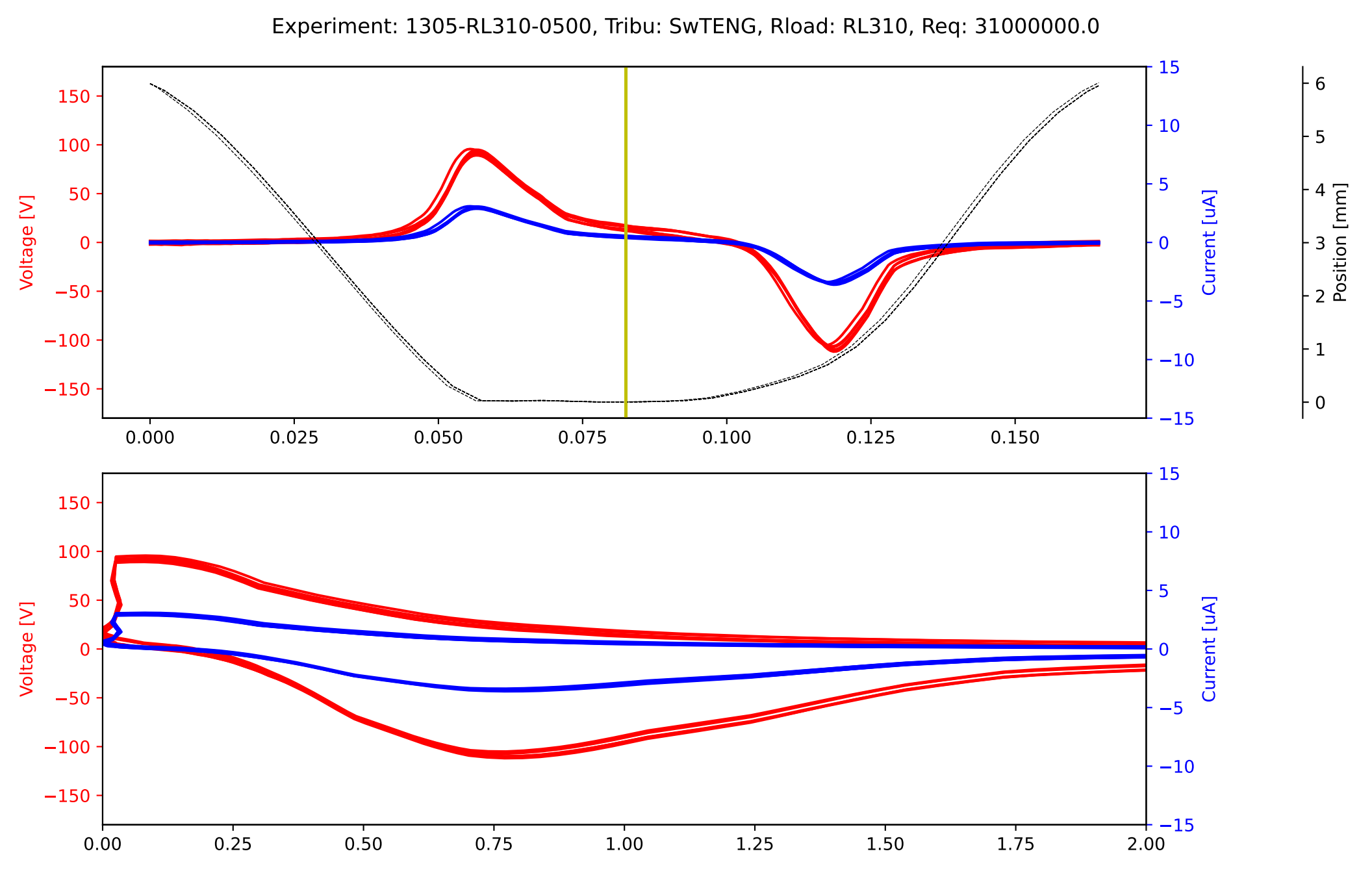

Experiment: 1305-RL125-500500, Tribu: SwTENG, Rload: RL125, Req: 12500000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

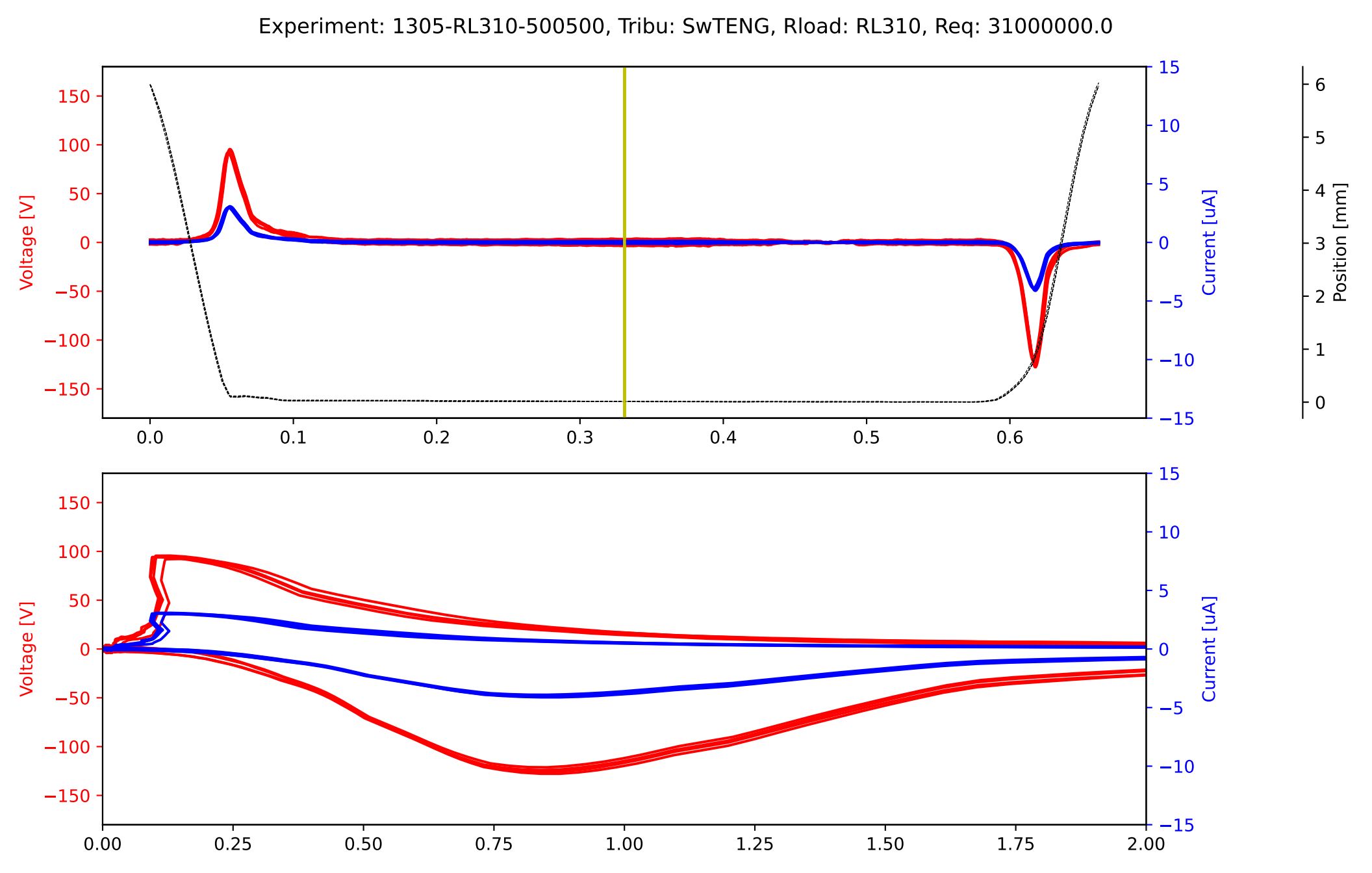

Experiment: 1305-RL160-0500, Tribu: SwTENG, Rload: RL160, Req: 16000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

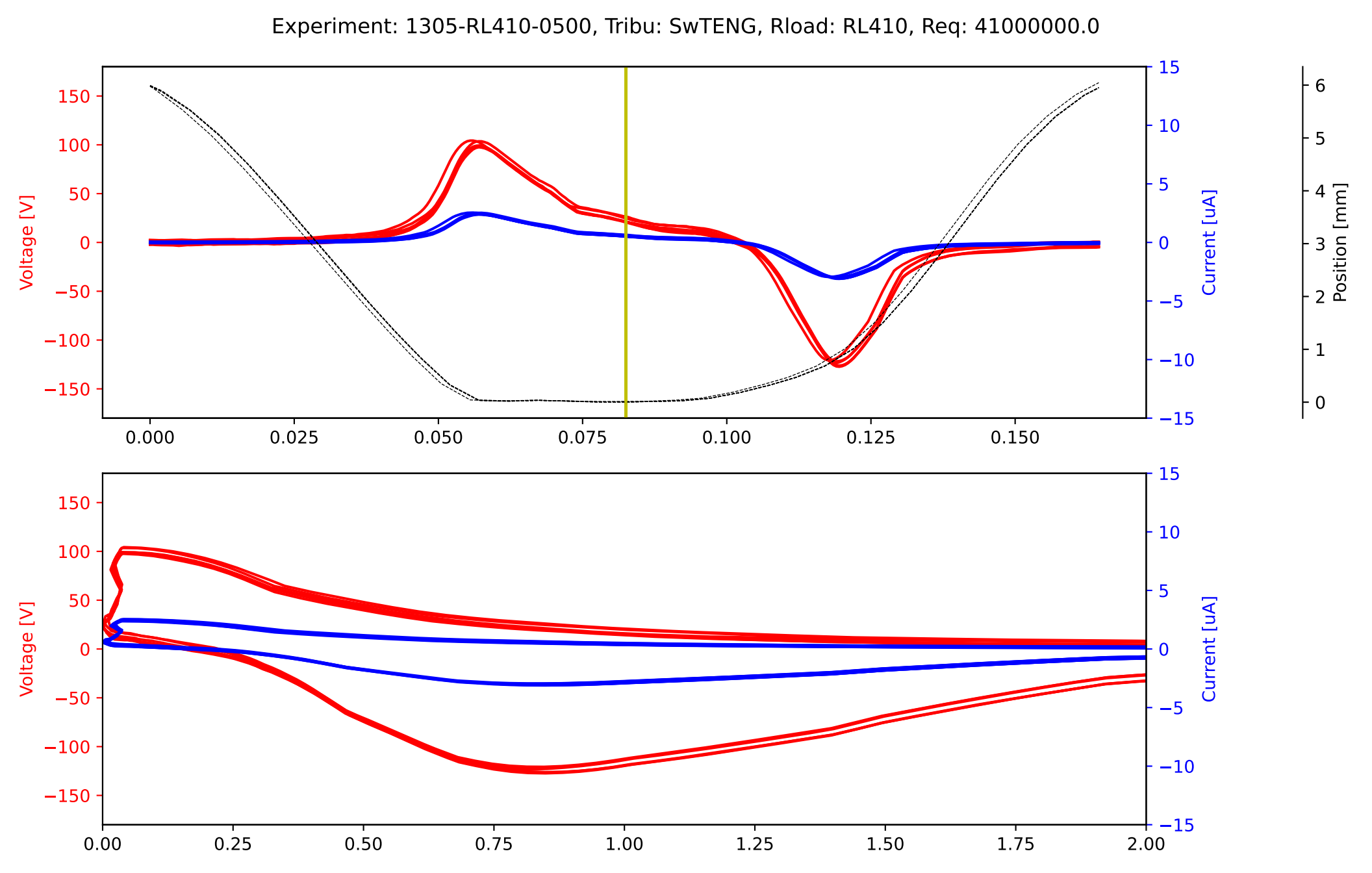

Experiment: 1305-RL160-500500, Tribu: SwTENG, Rload: RL160, Req: 16000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

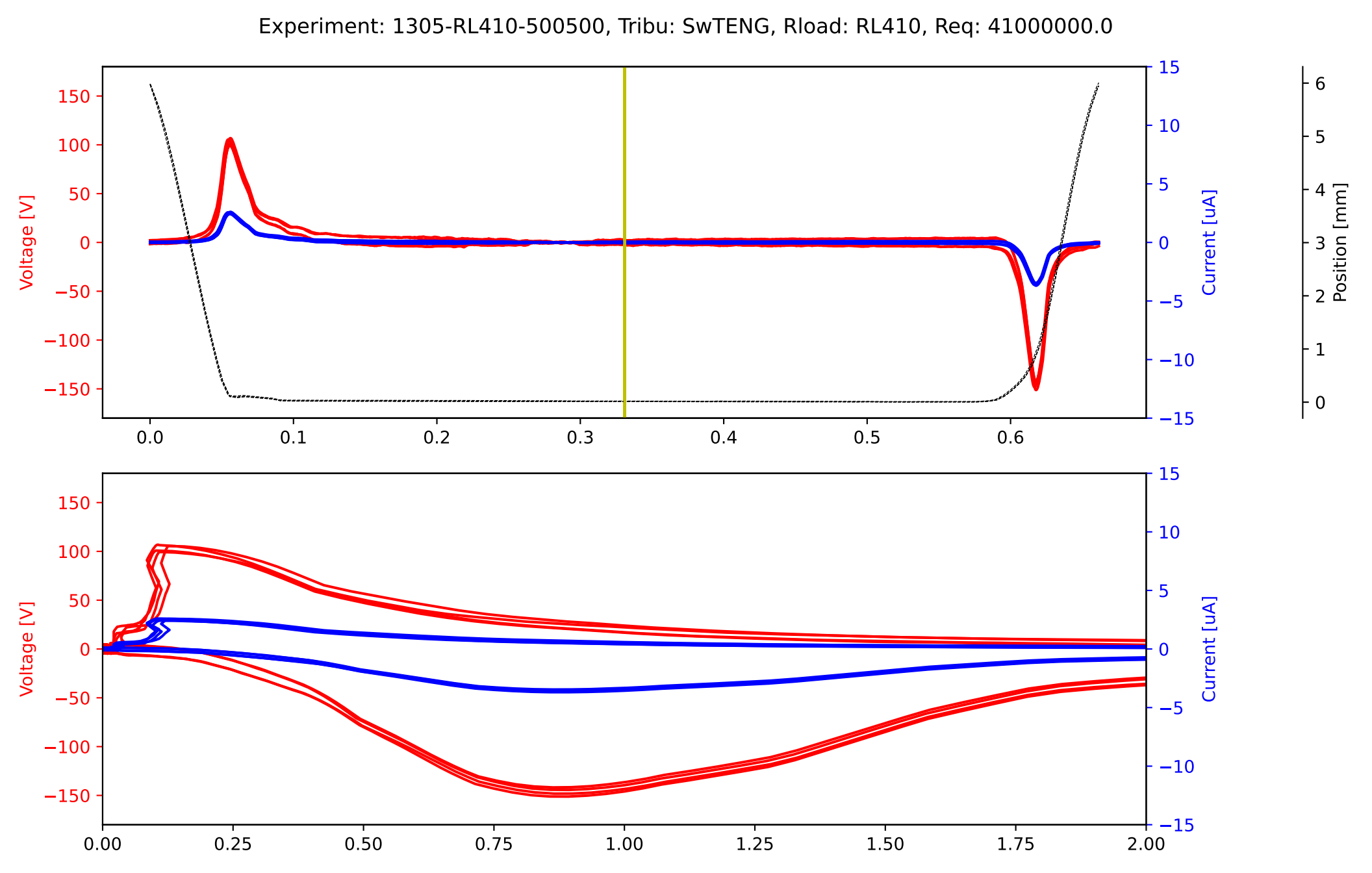

Experiment: 1305-RL210-0500, Tribu: SwTENG, Rload: RL210, Req: 21000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

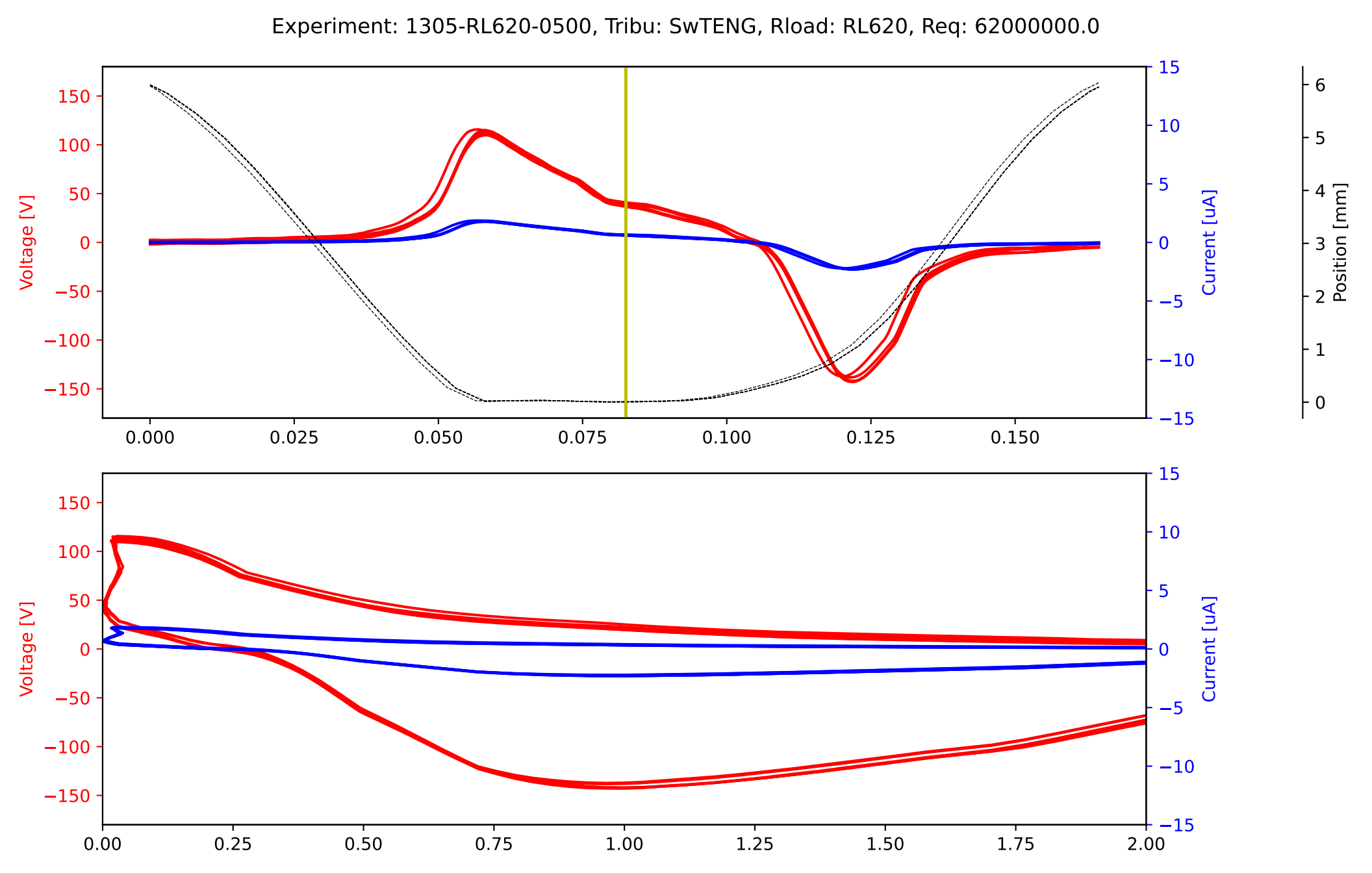

Experiment: 1305-RL210-500500, Tribu: SwTENG, Rload: RL210, Req: 21000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

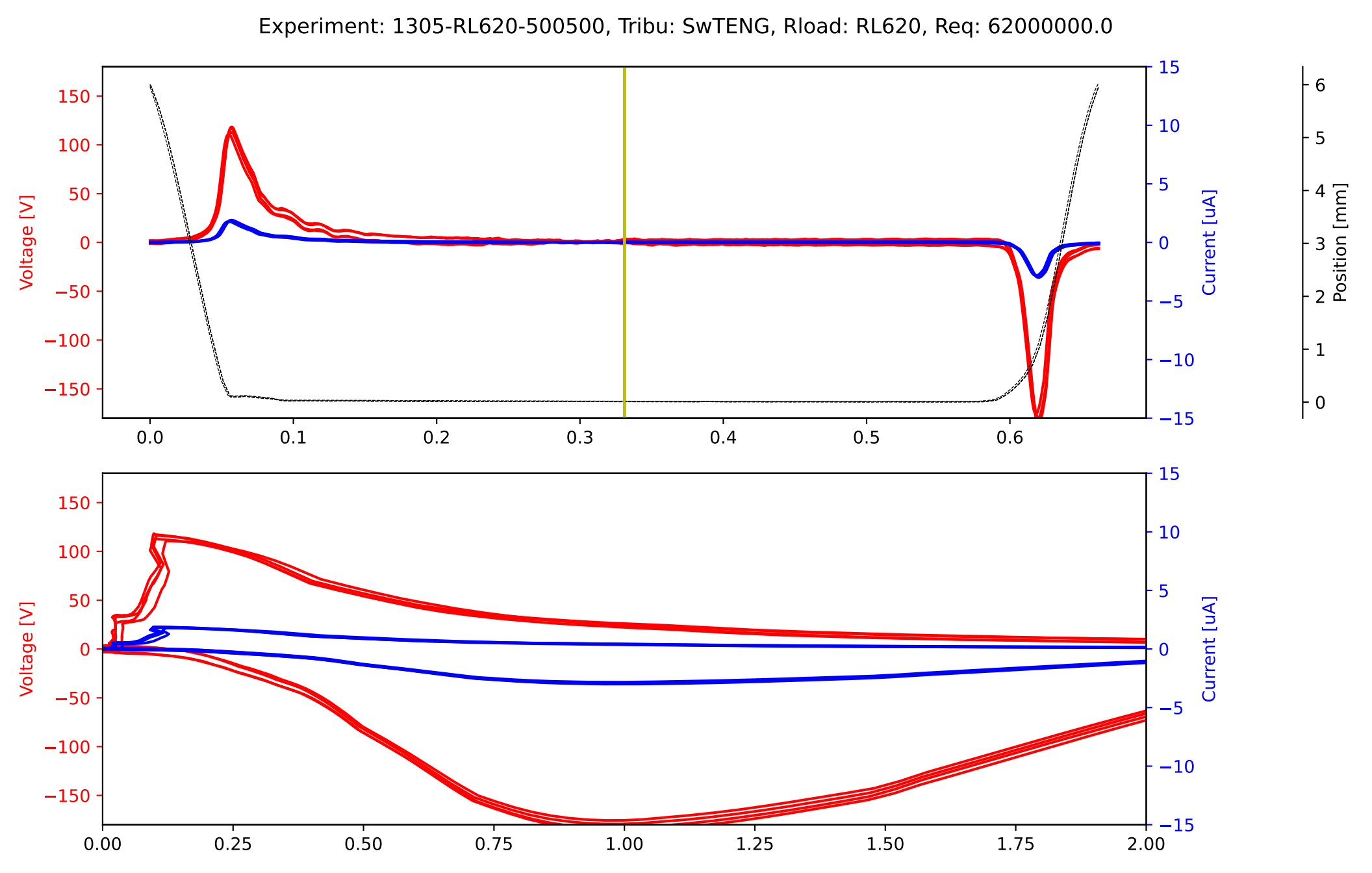

Experiment: 1305-RL310-0500, Tribu: SwTENG, Rload: RL310, Req: 31000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


Experiment: 1305-RL310-500500, Tribu: SwTENG, Rload: RL310, Req: 31000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


Experiment: 1305-RL410-0500, Tribu: SwTENG, Rload: RL410, Req: 41000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


Experiment: 1305-RL410-500500, Tribu: SwTENG, Rload: RL410, Req: 41000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


Experiment: 1305-RL620-0500, Tribu: SwTENG, Rload: RL620, Req: 62000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Voltage [V]
Current [uA]
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


Experiment: 1305-RL620-500500, Tribu: SwTENG, Rload: RL620, Req: 62000000.0
Voltage [V]
Current [uA]
Position [mm]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Voltage [V]
Current [uA]
150
100
50
0
−50
−100
−150
15
10
5
0
−5
−10
−15
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00