ANALOG DEVICES

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SINGLE EVENT EFFECTS TEST REPORT RHP51000

November 2025

Radiation Test Report	
Product:	RHP51000
Effective LET:	≤ 79.9 MeV-cm^2/mg
Fluence:	1E7 Ions/cm^2
Facilities:	TAMU
Tested:	November 2025

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Analog Devices, Inc. 4001 NC HWY 54 Suite 3100, Durham, NC 27709

SEE Test Report for the RHP51000 – 20 V 500mA Ultralow Noise, Ultrahigh PSRR Linear Regulator with VIOC Control

Nolan Carr, Braxton Houlden, Eric Muire, Jan Michael

Gonzales, Jason Sekanina, Tom Decker

Test Dates:
November 1-3, 2025

I. Introduction

The purpose of this test is to determine the Single-Event Effects (SEE) susceptibility of the RHP51000, a 20V, 500mA, ultralow noise, ultrahigh PSRR Linear regulator with VIOC Control. Single Event Latchup (SEL) and Single Event Transients (SETs) were verified on November 1-3, 2026, at the TAMU heavy ion facility. The I/O voltage and the supply currents were monitored for the device during SEE testing.

II. Device Under Test

The RHP51000 is a high-performance low dropout linear regulator. The RHP51000 incorporates a VIOC tracking function to control an upstream switching converter to maintain a constant voltage across the RHP51000 and hence minimize power dissipation.

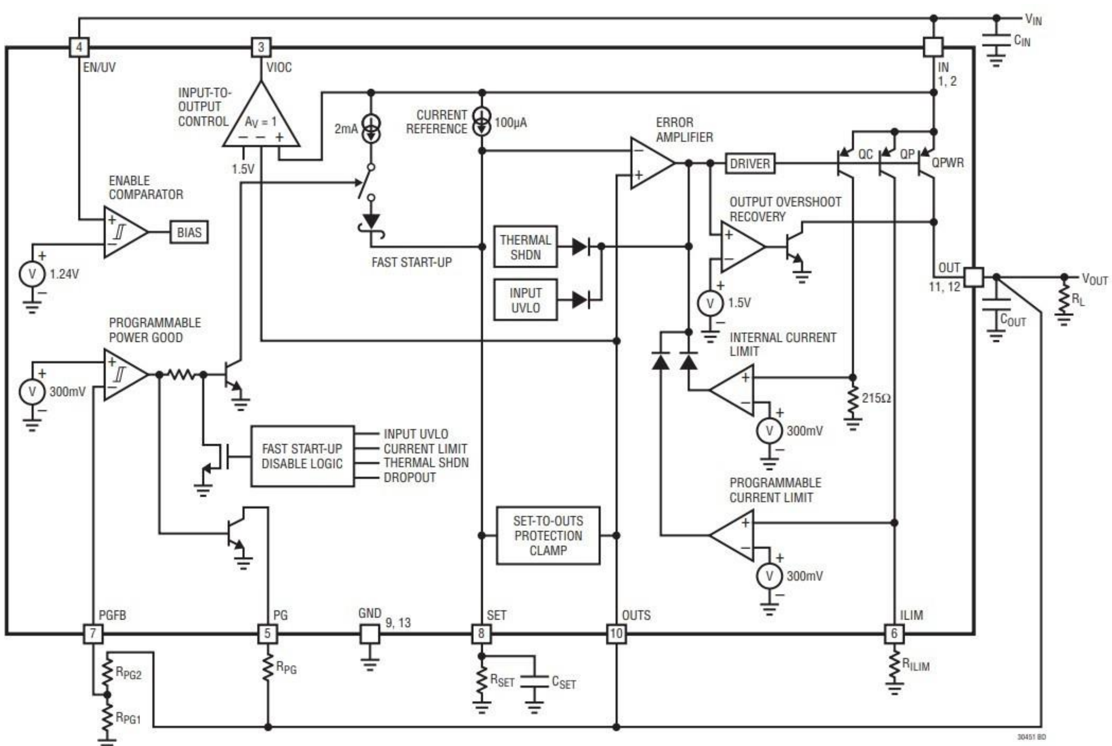

Figure 1. Functional block diagram.

Table 1
Part and test information.

Generic Part Number:	RHP51000
Date of Test:	November 1-6, 2025
Manufacturer:	Analog Devices, Inc.
Die Rev:	3045-VI
Part Function:	Low Dropout Regulator
Part Technology:	BiCMOS
Package Style:	12-Lead MSOP (3 mm x 3 mm)
Interconnect:	Wire-bond
Test Equipment:	Power Supply (Keithley 2230G-30-6), DeweSoft Sirius-HS-8xLV, EL34243 electronic load

III. Test Facilities

The heavy-ion beam testing was carried out at the Texas A & M Cyclotron Facility. The test setup was in an air environment.

Facility: TAMU
Cocktail: 25 MeV/nuc
Fluence: 1×10^7 cm^{-2} (per run)
Ions: N, Ar, Ag

Table 2.
Heavy-ion specie, linear energy transfer (LET) value, range, and energy.

Ion	Effective LET (MeV·cm^2/mg)
N	0.867
Ar	9.99
Ag	33.8

IV. Test Method

A. Test Setup

The devices under test (DUT) were de-processed to expose the die. The RHP51000 was configured, as shown in Figure 2. The EL34243 electronic load is set in constant resistance mode. The Supply Current, Voltage Output, VIOC, and Power Good(PG) were recorded using a DeweSoft SIRIUSi-HS-8xLV Module.

Table 3: Configured Values

Name	Configured values SEL & SET
Vin	3.8V, 5V, 16V
Vout Load	6.6Ω, 22Ω
Vout	3.3V

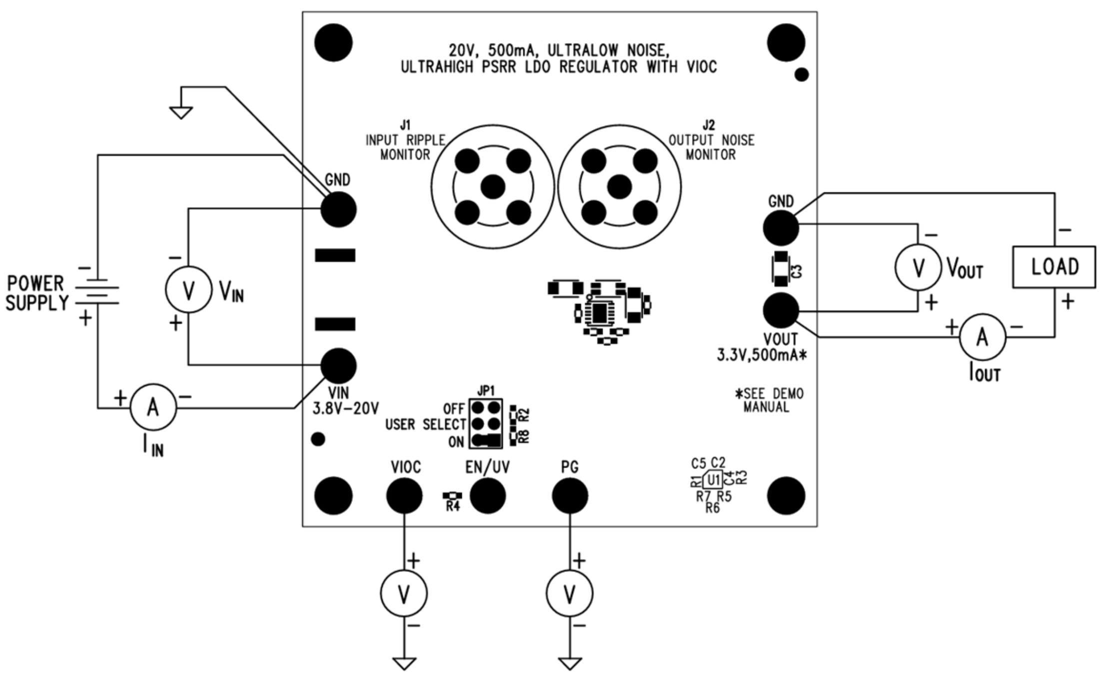

Figure 2. RHP51000 test setup.

B. Irradiation procedure

SEL

1. The device was powered on and brought up to ~125°C.
2. The software to monitor the supply current and voltages was turned on.
3. The ion beam was turned on.
4. Once the fluence of 1e7 total ions was reached, the beam was turned off.

SET/SEU

1. The device was powered on and brought up to ~25°C.
2. The software to monitor the supply current, and voltages was turned on.
3. The ion beam was turned on.
4. Once the fluence of 1e7 total ions or 100 events was reached, the beam was turned off.

C. Other Test Conditions

Angles of Incidence: 0^o, 45^o

V. Results

SEL – No latch-up or destructive SEE events were observed on the RHP51000 to the highest effective LET tested at 79.9 MeV·cm^2/mg. Four devices were tested at Vin = 3.8V and Vin = 16V. The SEL plots are shown in Figures A1-A8 in the Appendix.

Table 3
SEL Test Runs

Run	BD#	Ion	Input Voltage (V)	Resistive Load (Ω)	Angle (deg)	Effective LET (MeVcm^2/mg)	Flux (ions/cm^2/s)	Fluence (ions/cm^2)
48	2	Ag	16	22	45	79.9	3.08E+04	1.00E+07
49	2	Ag	3.8	6.6	45	79.9	2.14E+04	1.00E+07
66	3	Ag	3.8	6.6	45	79.9	3.76E+04	1.95E+06
67	3	Ag	16	22	45	79.9	3.41E+04	1.26E+06
68	4	Ag	16	22	45	79.9	4.42E+04	1.00E+07
69	4	Ag	3.8	6.6	45	79.9	4.40E+04	9.99E+06
70	5	Ag	3.8	6.6	45	79.9	4.32E+04	1.00E+07
71	5	Ag	16	22	45	79.9	4.41E+04	1.00E+07

SET – The highest effective LET tested was 79.9 MeV·cm^2/mg. There were very few transients in the voltage output, but some transients appeared in the Power Good output and VIOC. Four devices were tested. The SET plots are shown in the Appendix. SET for Vout was nominal Voltage +/-3%. SET for PG and VIOC was set to nominal Voltage +/-5%. At higher LETs, the measurement cable lengths contributes to overshoot and undershoot. For PG and VIOC, the amplitude for SET increases as the LET increases.

The onset for SET is between 5MeV·cm^2/mg and 10MeV·cm^2/mg. Zoomed in plots are shown in Figures A20 and A22 at 26.3MeV·cm^2/mg and Figures A21 and A23 at 79.9MeV·cm^2/mg. Worst case VIOC amplitude was 0.69V with typical response shown in Figure A21. SET on PG is shown for Vin = 16V at 79.9MeV·cm^2/mg in Figure A24 which is representative of the SET for all LETs at 16V, just at higher amplitude. Figures A25 and A26 show the SET for Vin=16V at 26.3MeV·cm^2/mg and 79.9MeV·cm^2/mg. Figure A27 shows Vout transients that are >3% above nominal outputs.

Table 4
SET Test Runs

Run	BD	Ion	Input Voltage (V)	Resistive Load (Ω)	Angle (deg)	Effective LET (MeVcm^2/mg)	Flux (ions/cm^2/s)	Fluence (ions/cm^2)	SET (Events) PG	SET (Events) VIOC	SET (Events) Vout
28	5	N	3.8	6.6	0	0.87	1.05E+05	1.00E+07	0	0	0
29	5	N	3.8	6.6	0	4.95	9.61E+04	9.98E+06	0	0	0
30	5	Ar	3.8	6.6	0	9.99	1.16E+05	9.96E+06	0	173	0
31	5	Ar	3.8	6.6	0	18.6	1.04E+05	9.96E+06	0	354	0
32	5	Ar	3.8	6.6	45	26.3	1.00E+05	9.97E+06	6	794	0
34	5	Ar	16	22	45	26.3	1.01E+05	9.97E+06	19	0	0
35	3	Ar	16	22	45	26.3	1.02E+05	1.00E+07	21	0	0
36	3	Ar	3.8	6.6	45	26.3	8.76E+04	1.00E+07	11	493	0
37	4	Ar	3.8	6.6	45	26.3	8.25E+04	1.00E+07	1	600	0
38	4	Ar	16	22	45	26.3	1.05E+05	1.00E+07	8	0	0
50	2	Ag	3.8	6.6	45	79.9	1.96E+04	1.57E+06	428	3497	0
51	2	Ag	16	22	45	79.9	1.85E+04	1.14E+06	362	4	0
52	2	Ag	16	22	45	59.96	1.91E+04	1.43E+06	516	1	0
53	2	Ag	3.8	6.6	45	59.96	2.02E+04	1.39E+06	601	545	0
54	2	Ag	3.8	6.6	45	50.06	1.92E+04	2.17E+06	594	278	0
55	2	Ag	16	22	45	50.06	2.11E+04	1.95E+06	645	0	0
56	2	Ag	16	22	0	33.8	2.54E+04	2.71E+06	711	0	0
57	2	Ag	3.8	6.6	0	33.8	2.57E+04	2.10E+06	550	734	0
59	3	Ag	16	22	0	33.8	3.52E+04	3.42E+06	1000	369	8
60	3	Ag	16	22	0	44	3.63E+04	2.93E+06	837	132	203
61	3	Ag	3.8	6.6	0	44	3.89E+04	2.96E+06	331	1339	0
62	3	Ag	3.8	6.6	0	59.3	3.47E+04	2.66E+06	655	1018	0
63	3	Ag	16	22	0	59.3	3.79E+04	1.55E+06	489	16	0
65	3	Ag	3.8	6.6	45	79.9	3.78E+04	1.40E+06	423	700	0

Appendix

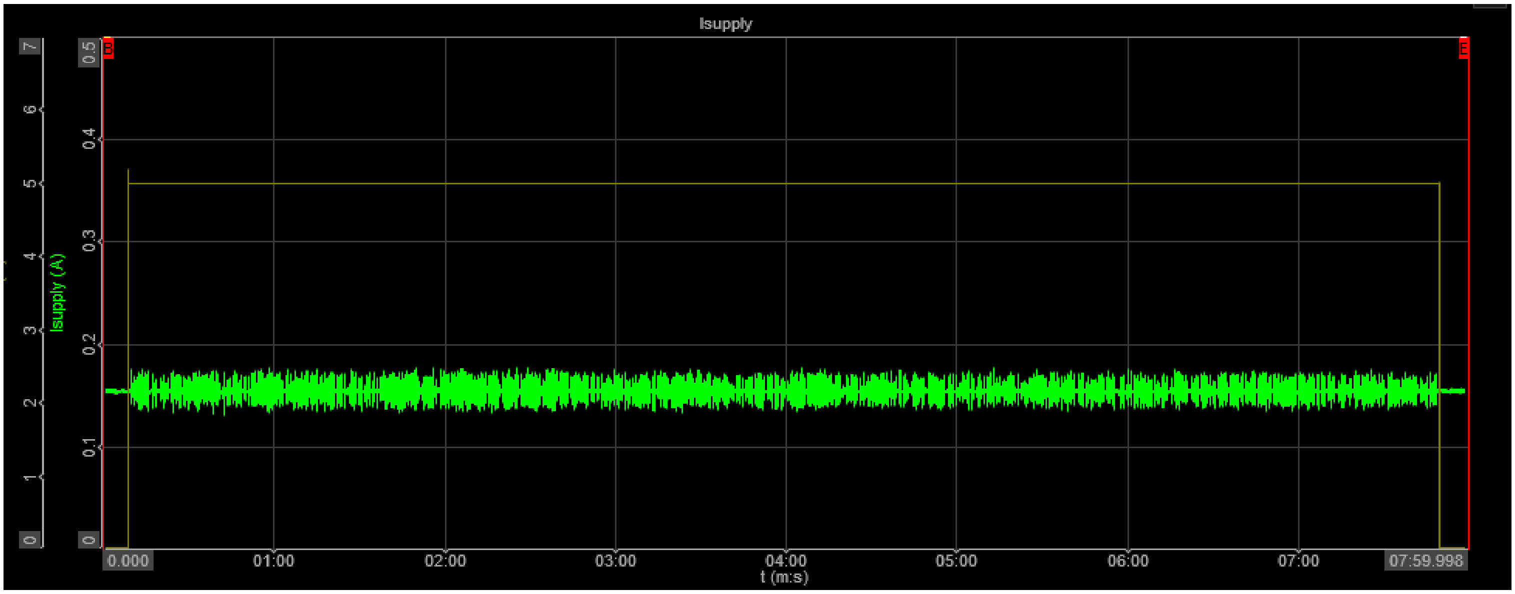

Figure A1: SEL Board 2, Run 48 Vin = 16V

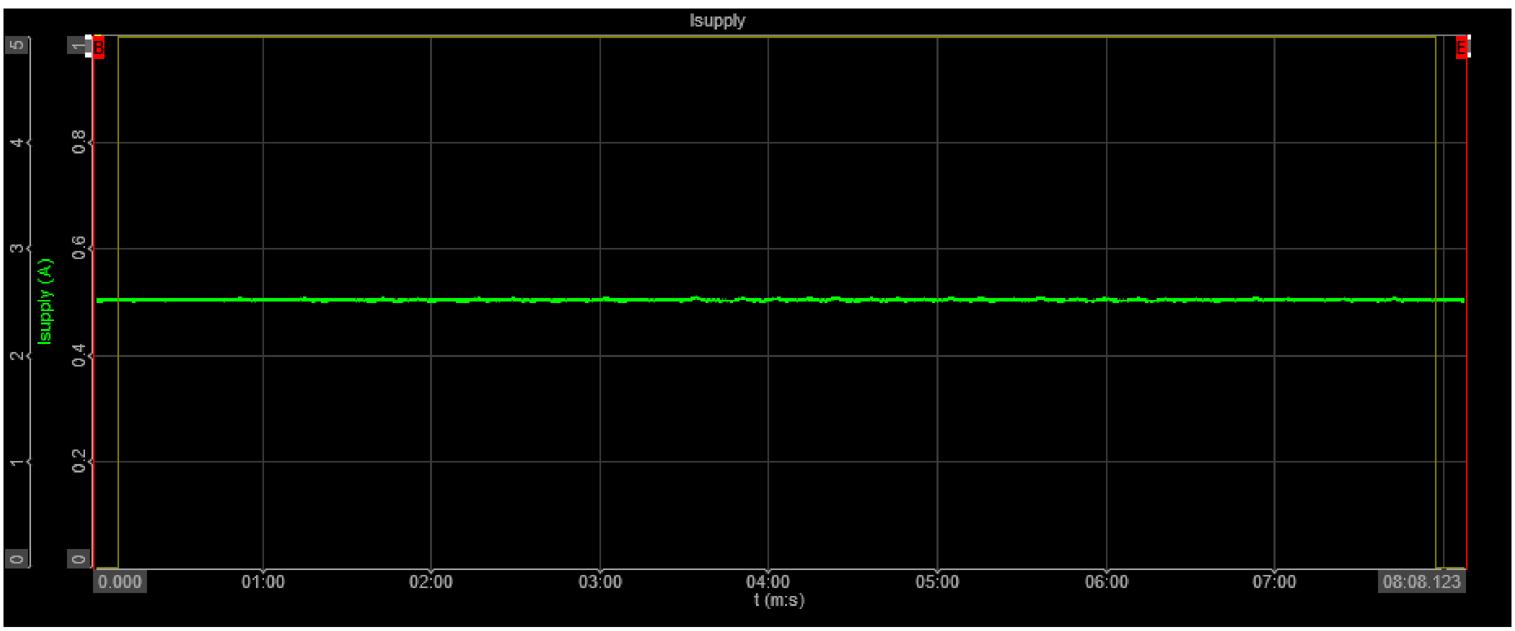

Figure A2: SEL Board 2, Run 49 Vin = 3.8V

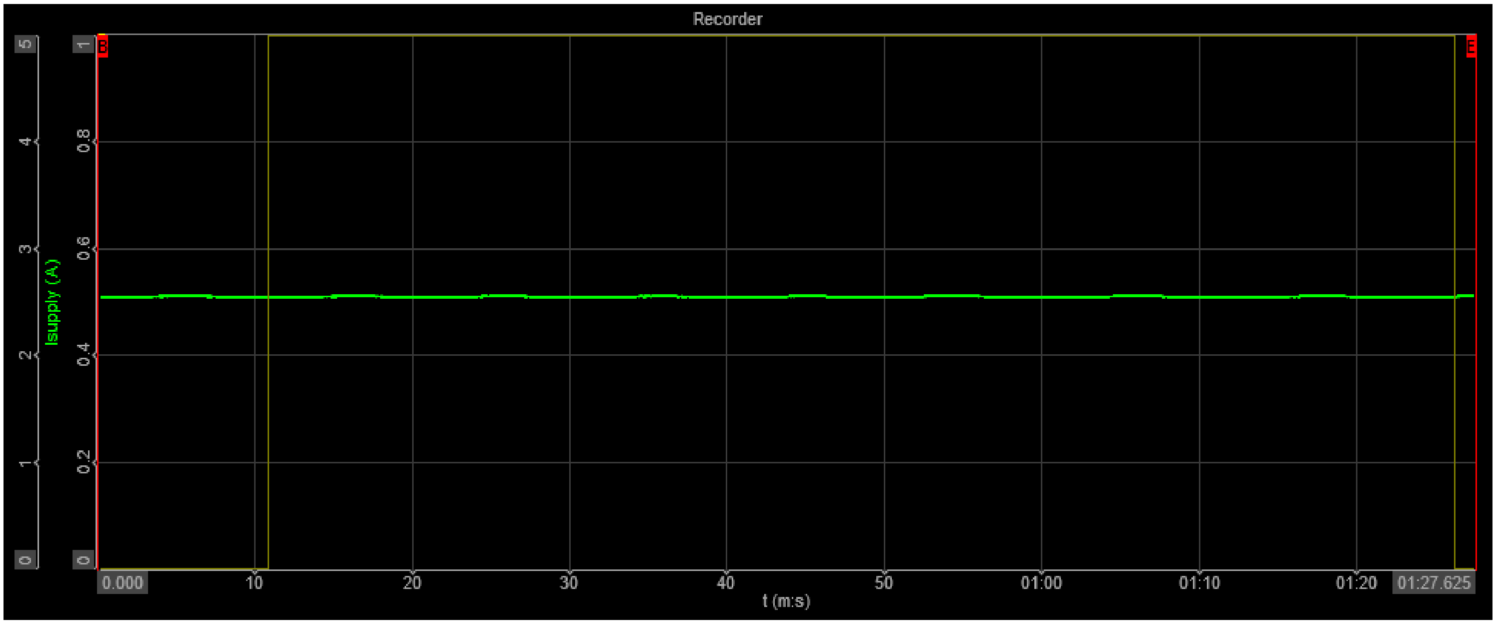

Figure A3: SEL Board 3, Run 66 Vin = 3.8V

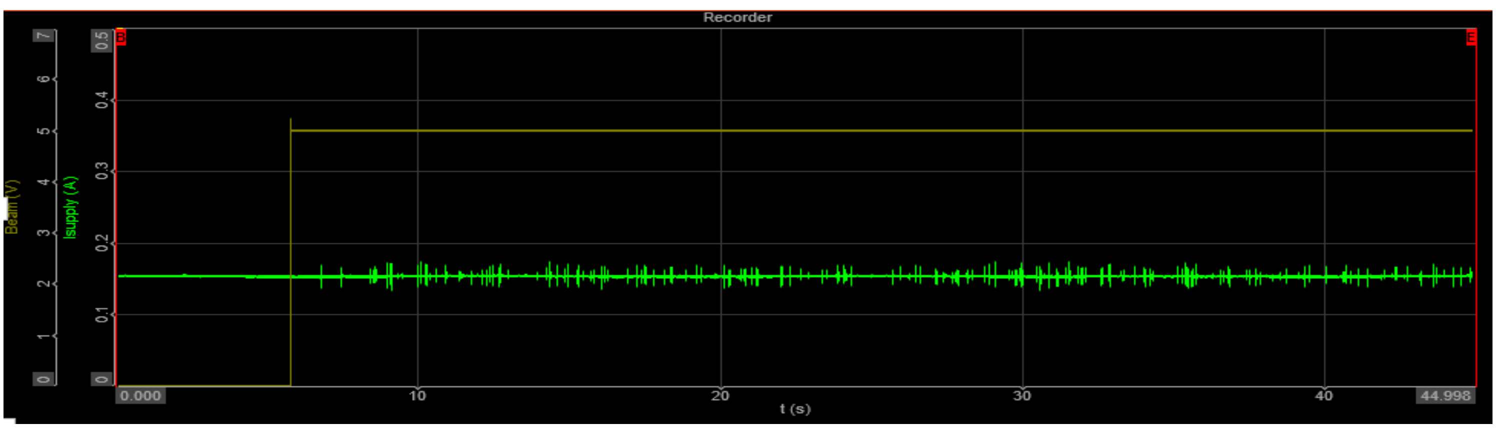

Figure A4: SEL Board 3, Run 67 Vin = 16V

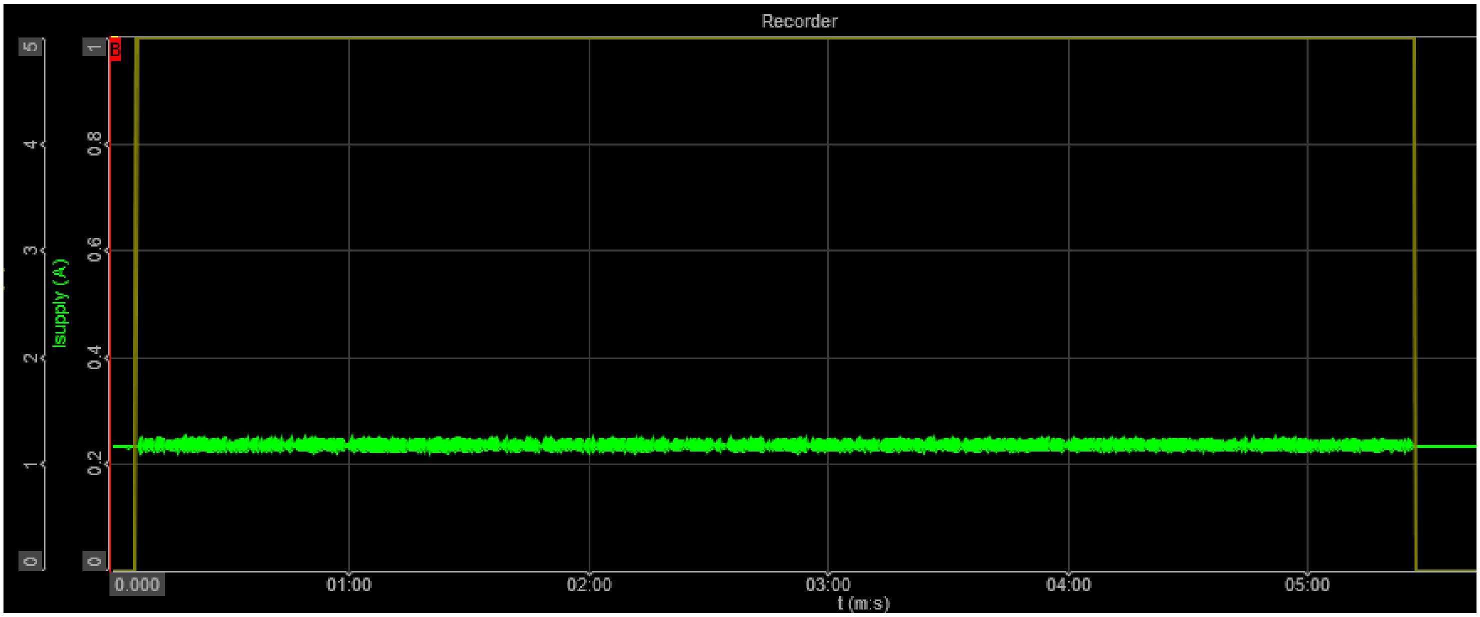

Figure A5: SEL Board 4, Run 68 Vin = 16V

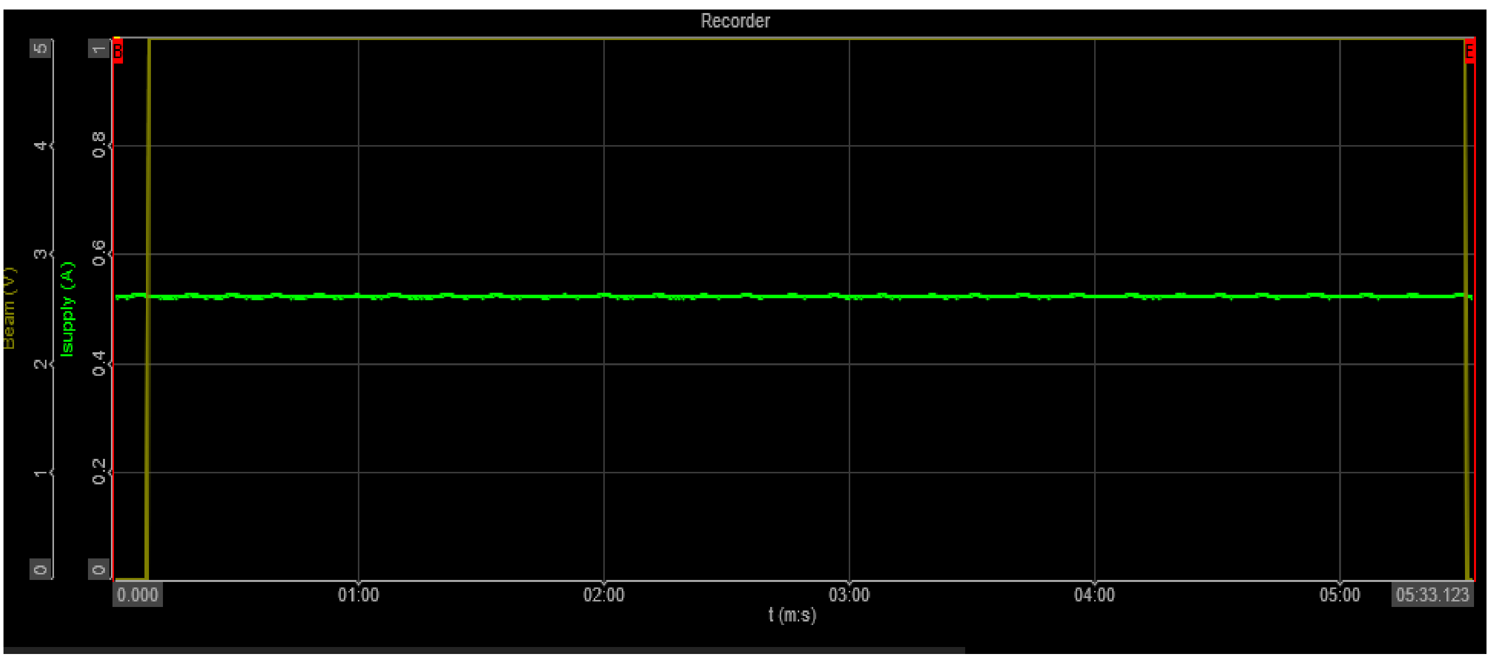

Figure A6: SEL Board 4, Run 69 Vin = 3.8V

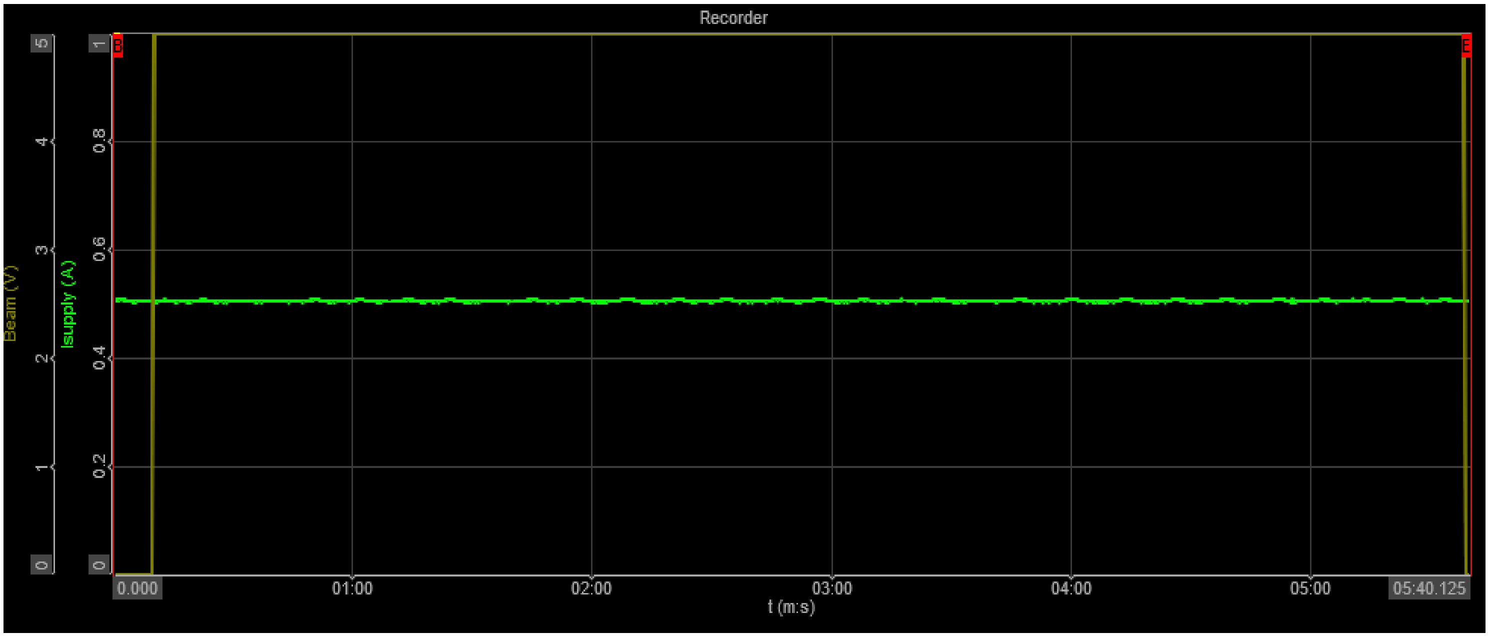

Figure A7: SEL Board 5, Run 70 Vin = 3.8V

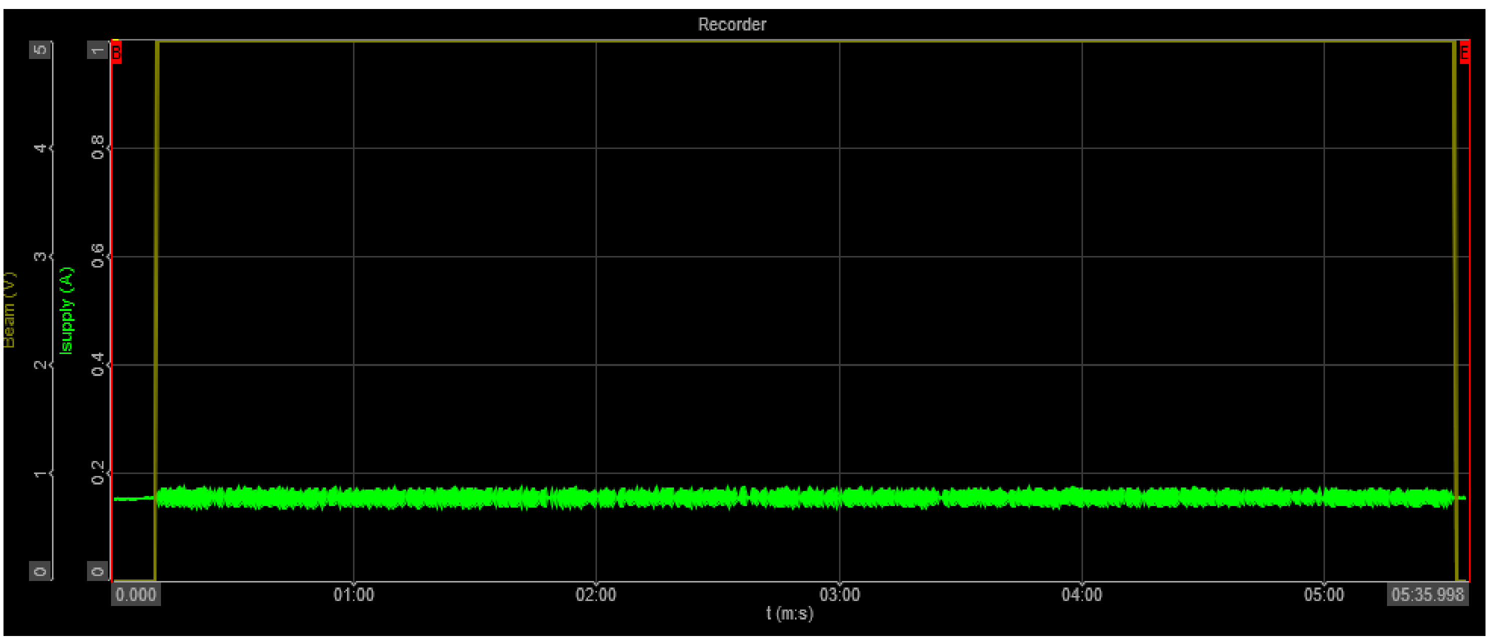

Figure A8: SEL Board 5, Run 71 Vin = 16V

SET

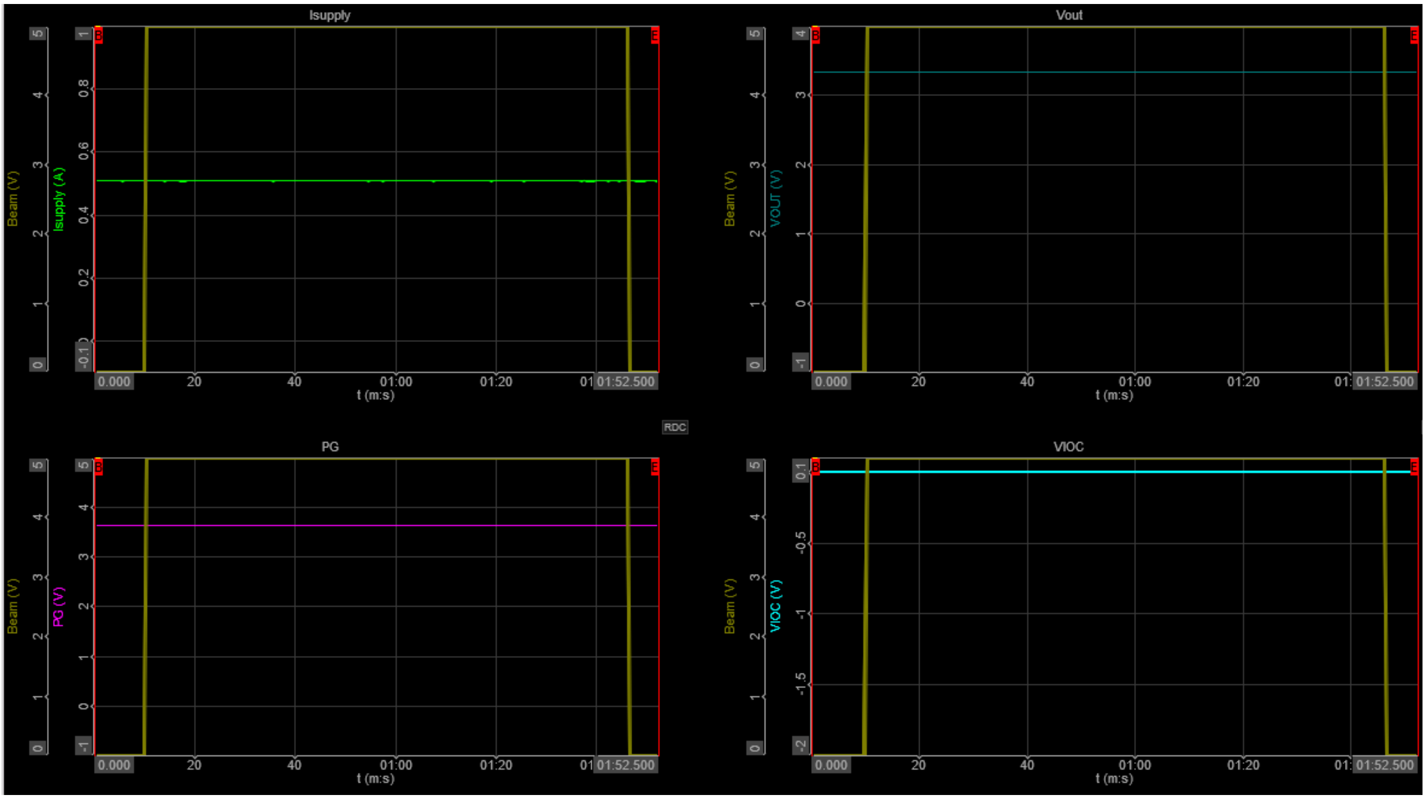

Figure A9: SET BD5 Run 28, Vin = 3.8V, 0.87MeVcm^2/mg

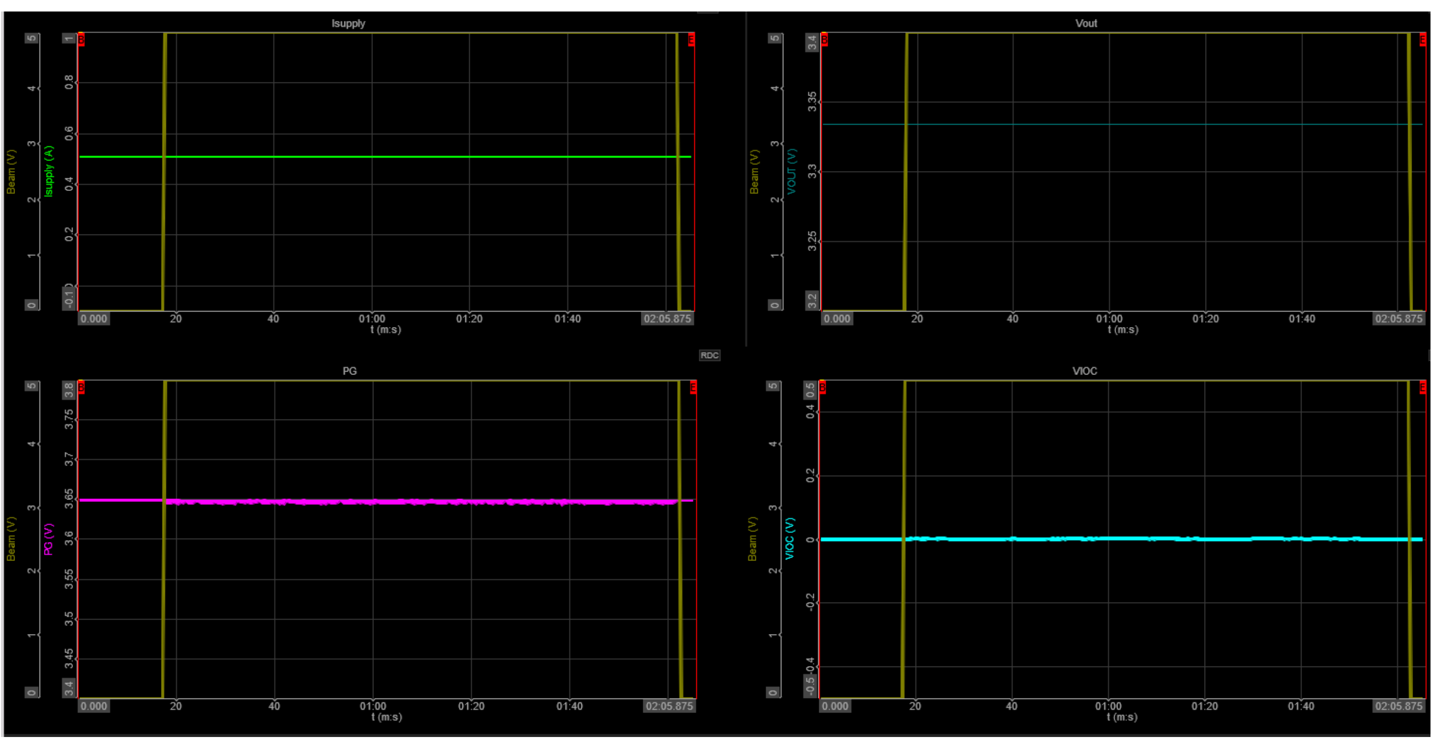

Figure A10: SET BD5 Run 29, Vin = 3.8V, 4.95MeVcm^2/mg

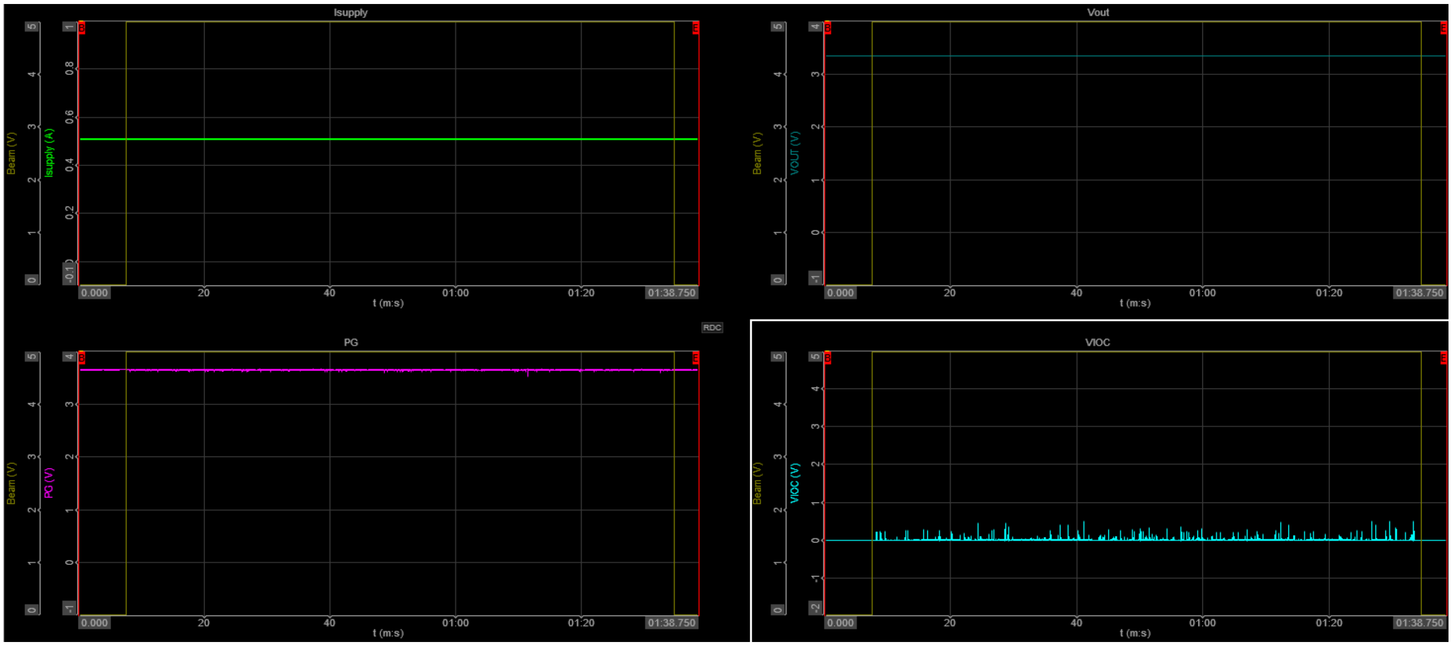

Figure A11: SET BD5 Run 30, Vin = 3.8V, 9.99MeVcm²/mg

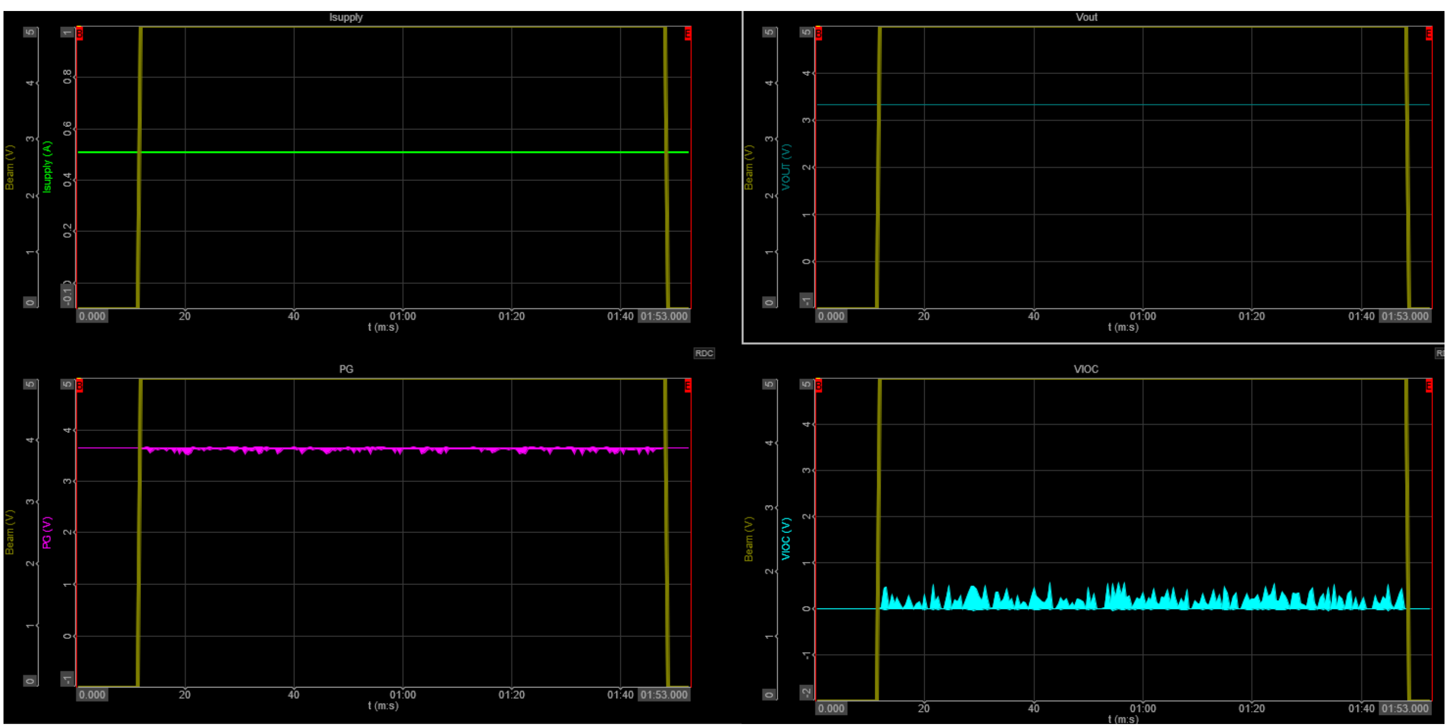

Figure A12: SET BD5 Run 31, Vin = 3.8V, 18.6MeVcm²/mg

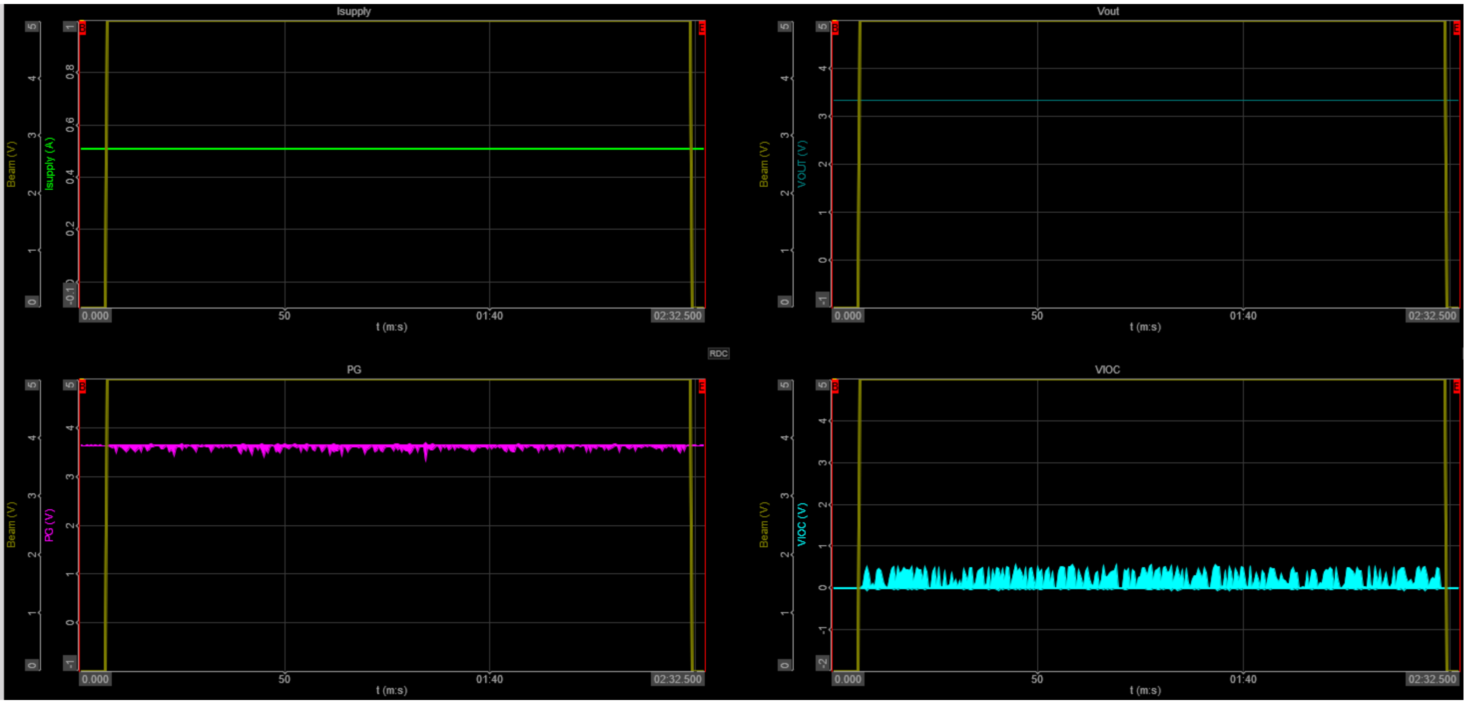

Figure A13: SET BD5 Run 32, Vin = 3.8V, 26.3MeVcm^2/mg

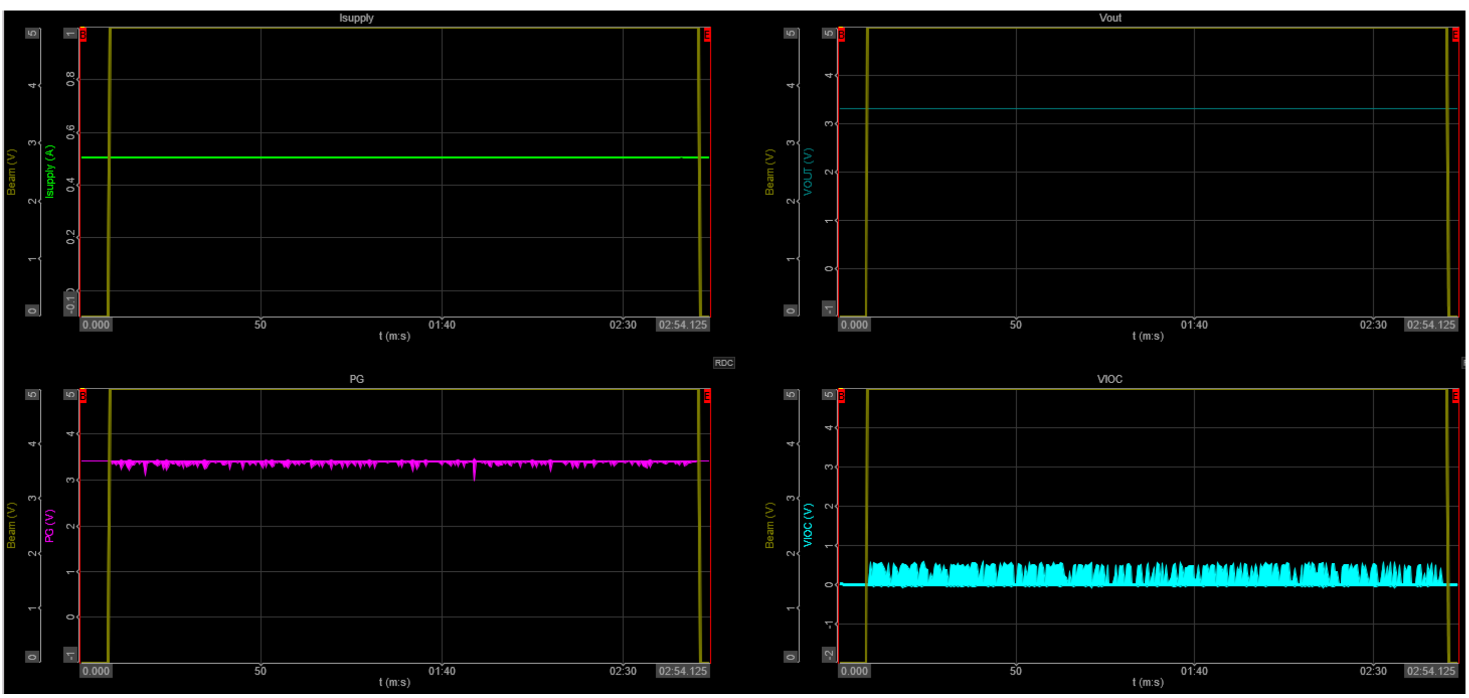

Figure A14: SET BD3 Run 36, Vin = 3.8V, 26.3MeVcm^2/mg

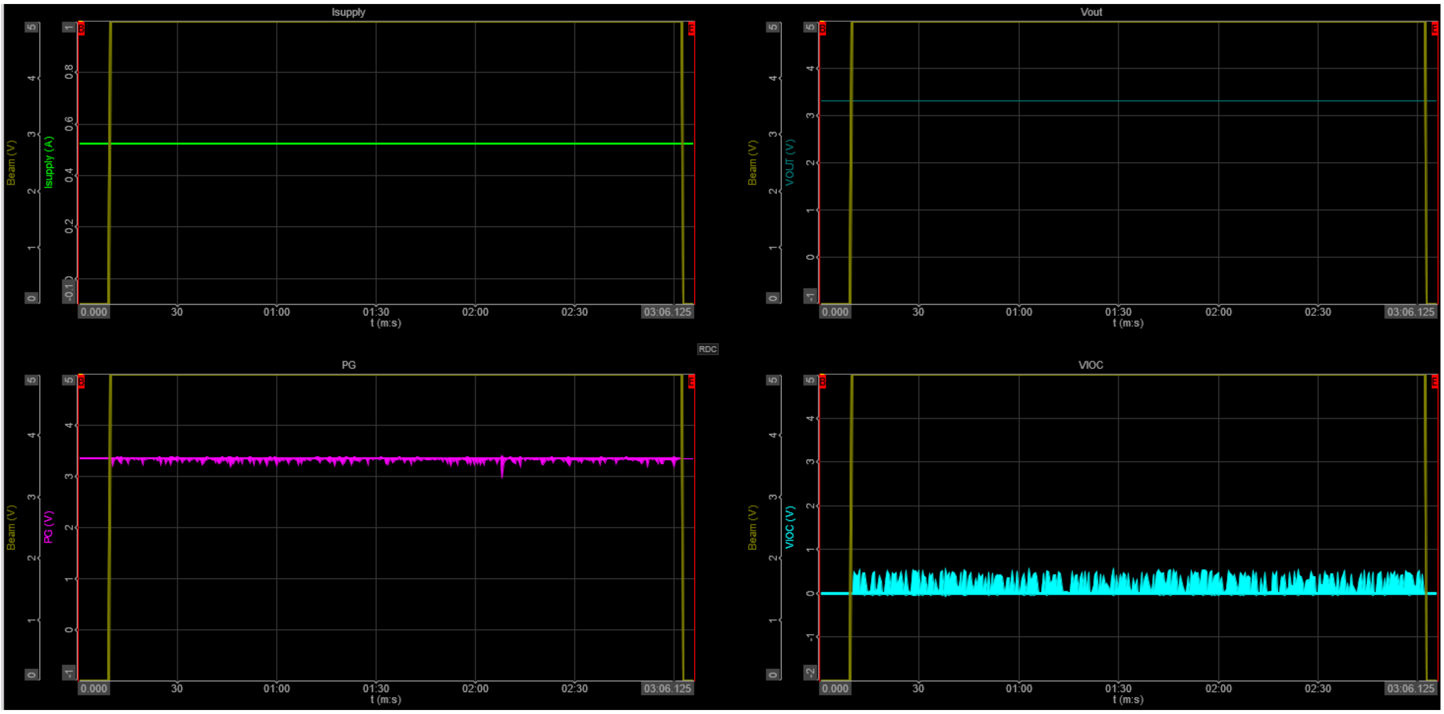

Figure A15: SET BD4 Run 37, Vin = 3.8V, 26.3MeVcm^2/mg

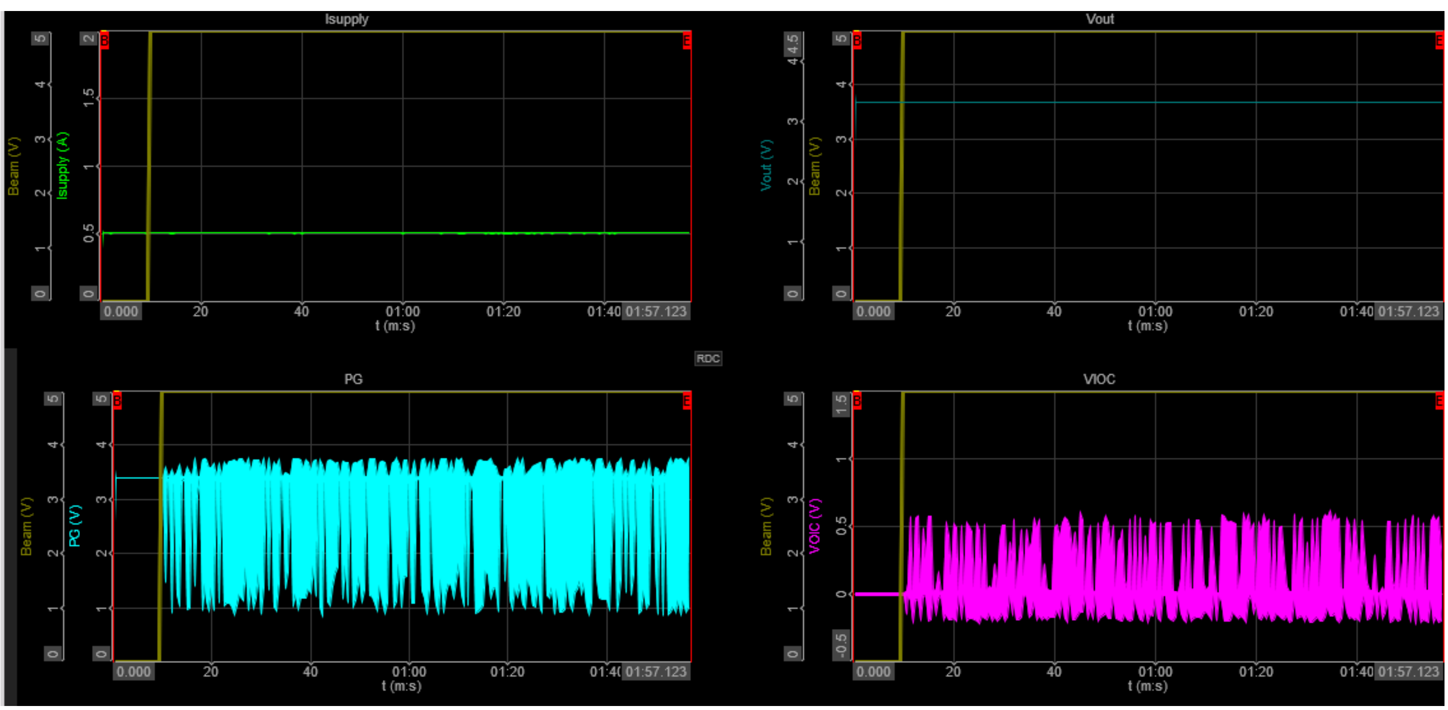

Figure A16: SET B2 Run 54, Vin = 3.8V, 50.06 MeVcm^2/mg

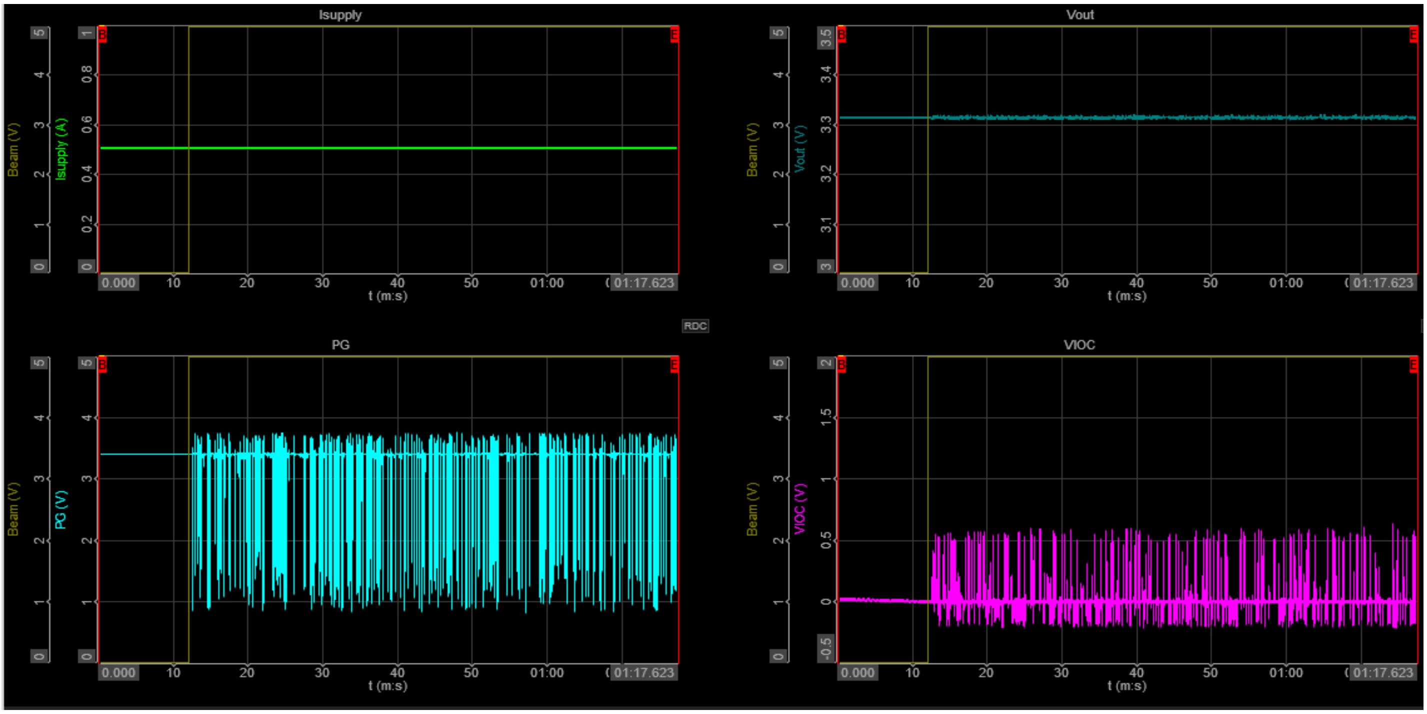

Figure A17: SET B2 Run 53, Vin = 3.8V, 59.96 MeVcm^2/mg

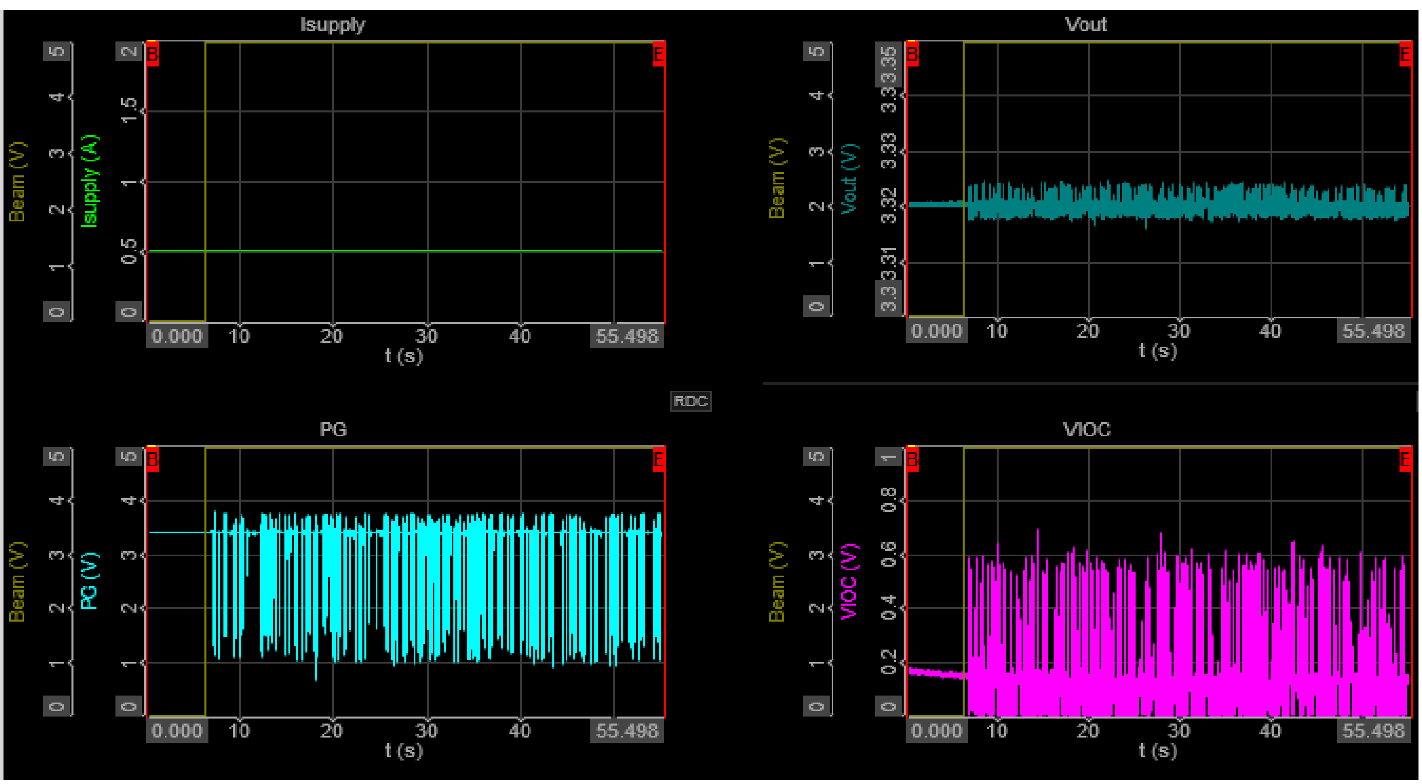

Figure A18: SET B3 Run 65, Vin = 3.8V, 79.9 MeVcm^2/mg

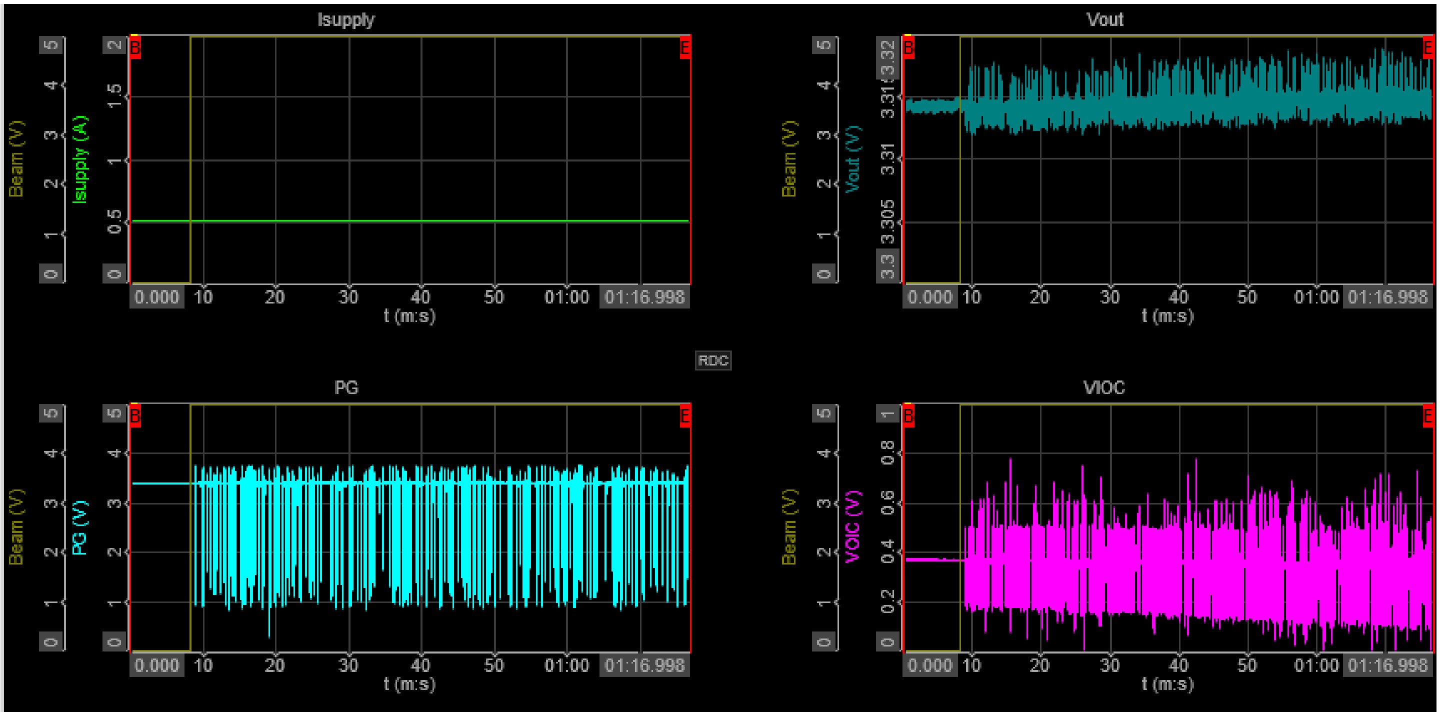

Figure A19: SET B2 Run 50, Vin = 3.8V, 79.9 MeVcm^2/mg

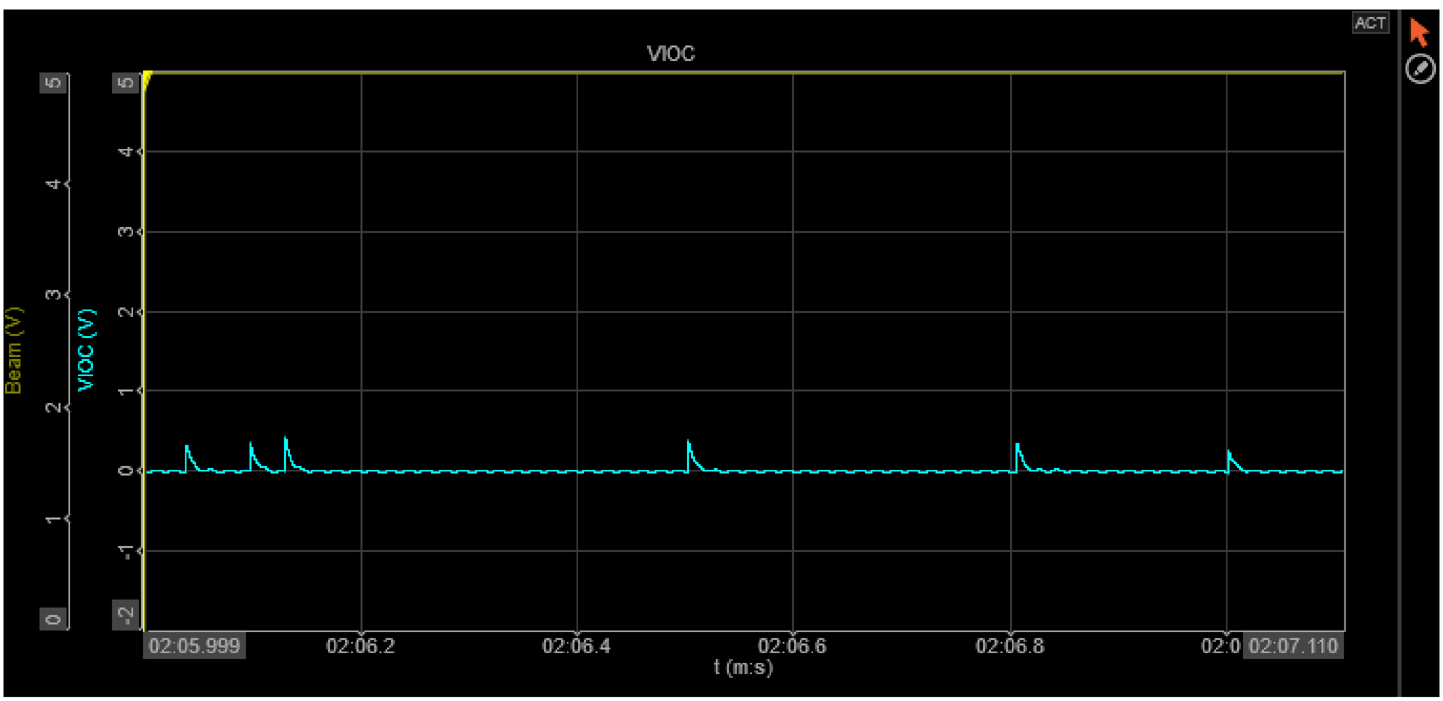

Figure A20: VIOC SET B5 Run 32, Vin = 3.8V, 26.3 MeVcm^2/mg

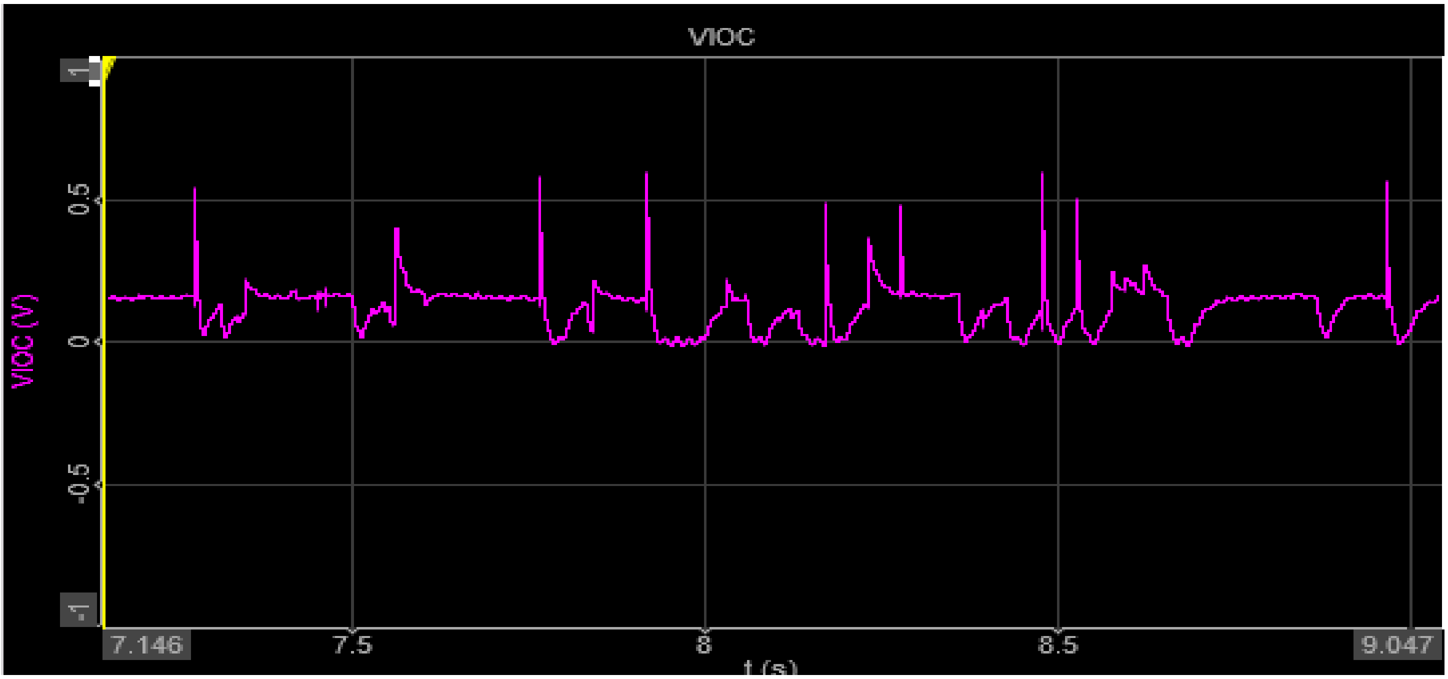

Figure A21: VIOC SET B3 Run 65, Vin = 3.8V, 79.9 MeVcm^2/mg

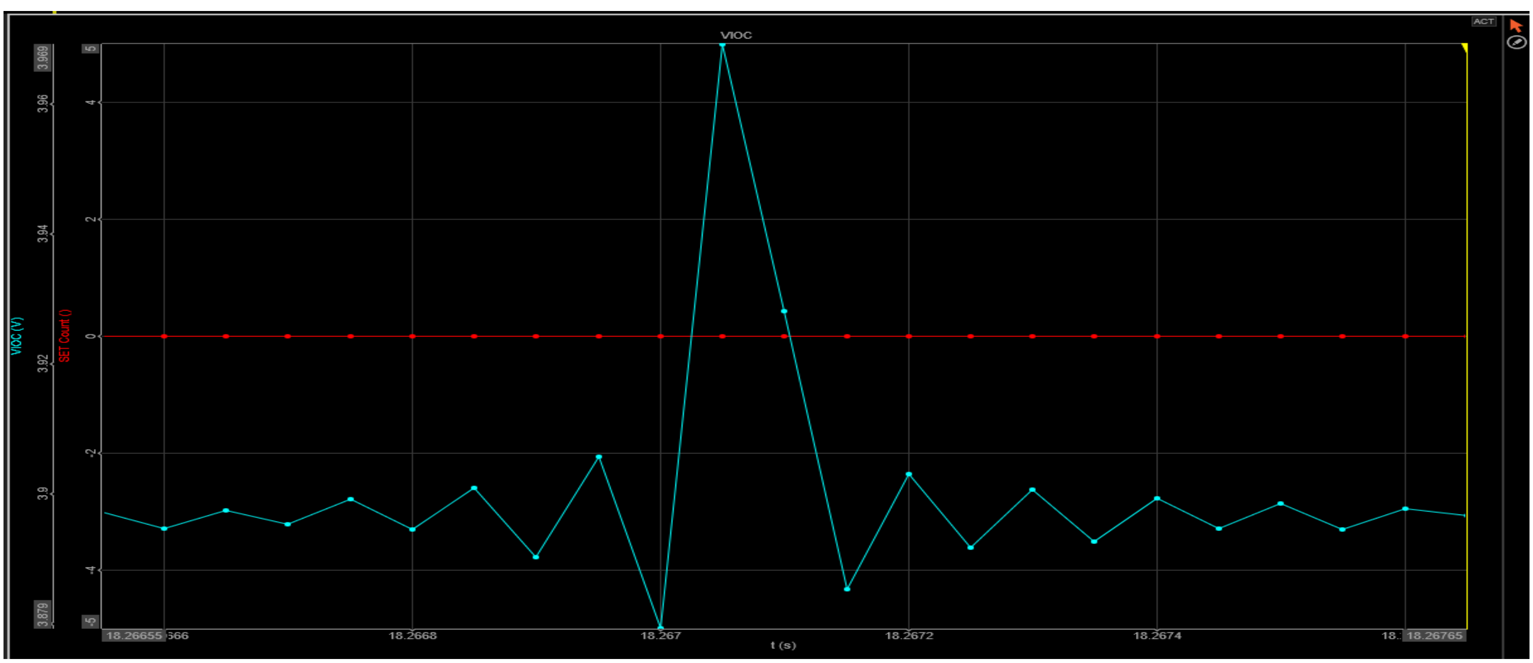

Figure A22: VIOC SET B5 Run 34, Vin = 16V, 26.3 MeVcm^2/mg

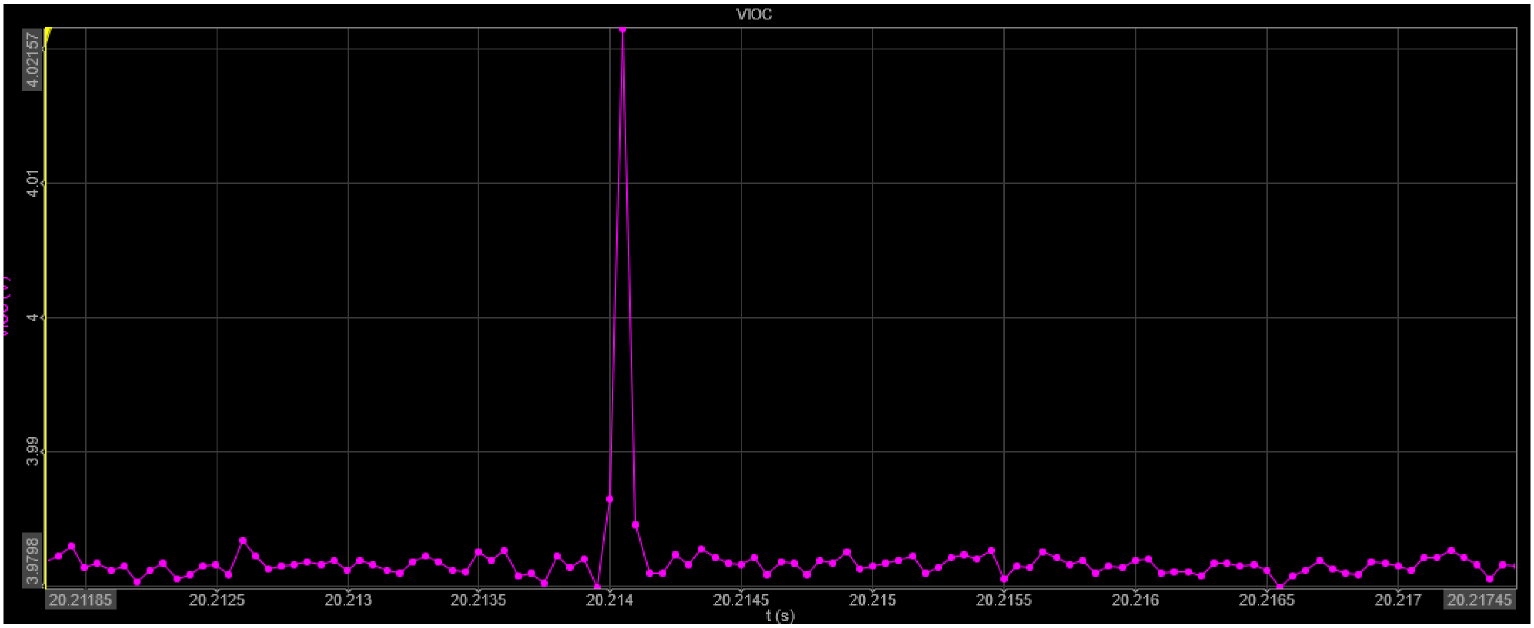

Figure A23: VIOC SET B2 Run 51, Vin = 16V, 79.9 MeVcm²/mg

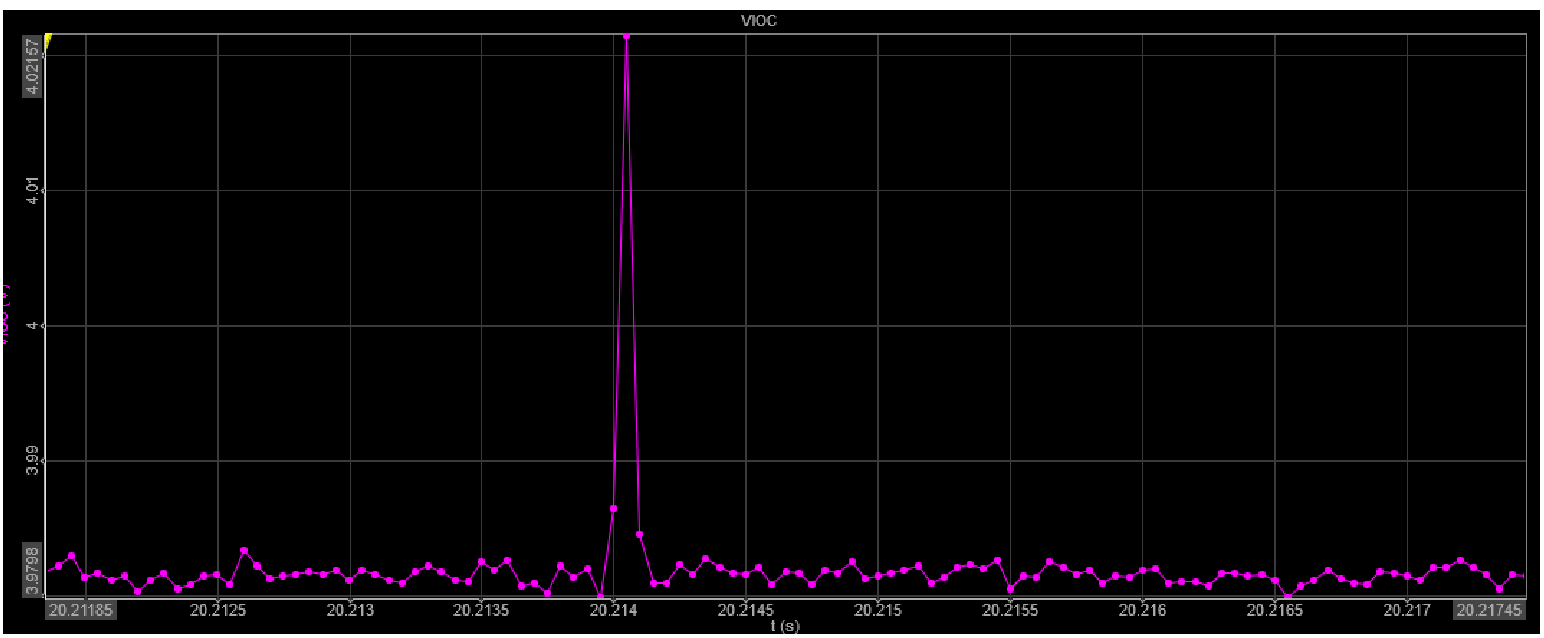

Figure A24: PG SET B2 Run 51, Vin = 16V, 79.9 MeVcm²/mg

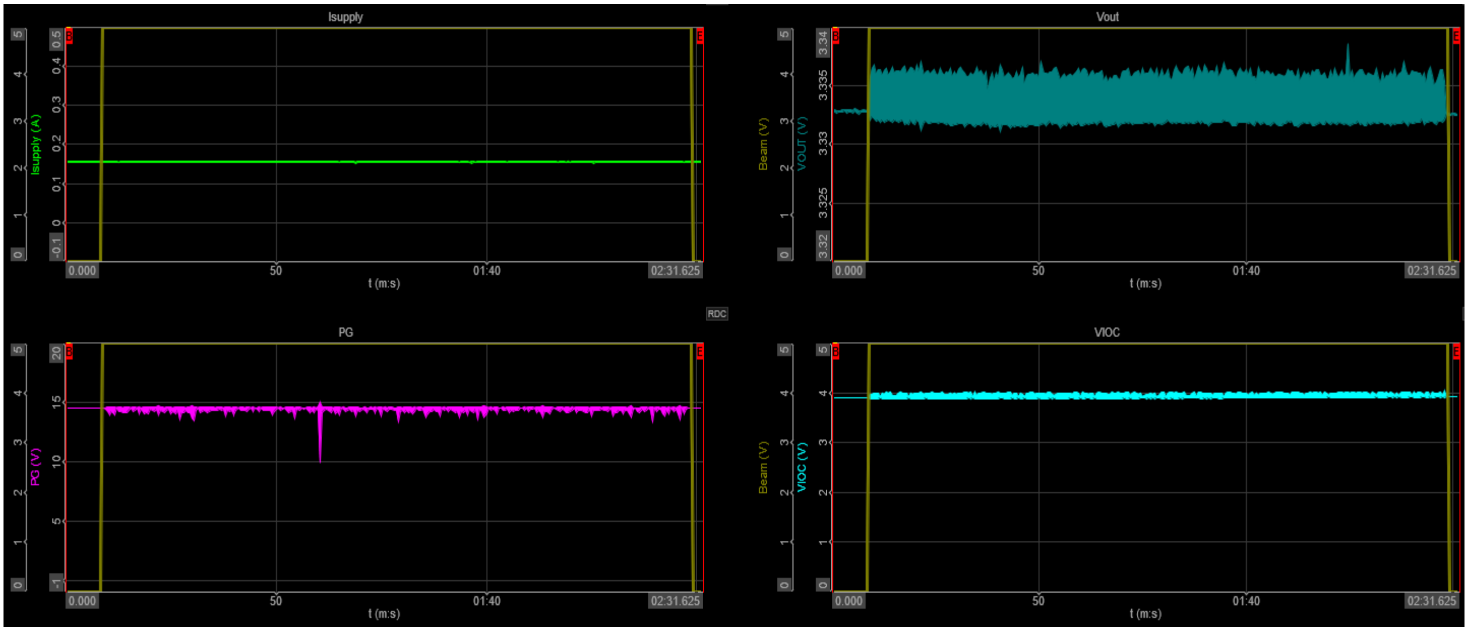

Figure A25: SET B5 Run 34, Vin = 16V, 26.3 MeVcm^2/mg

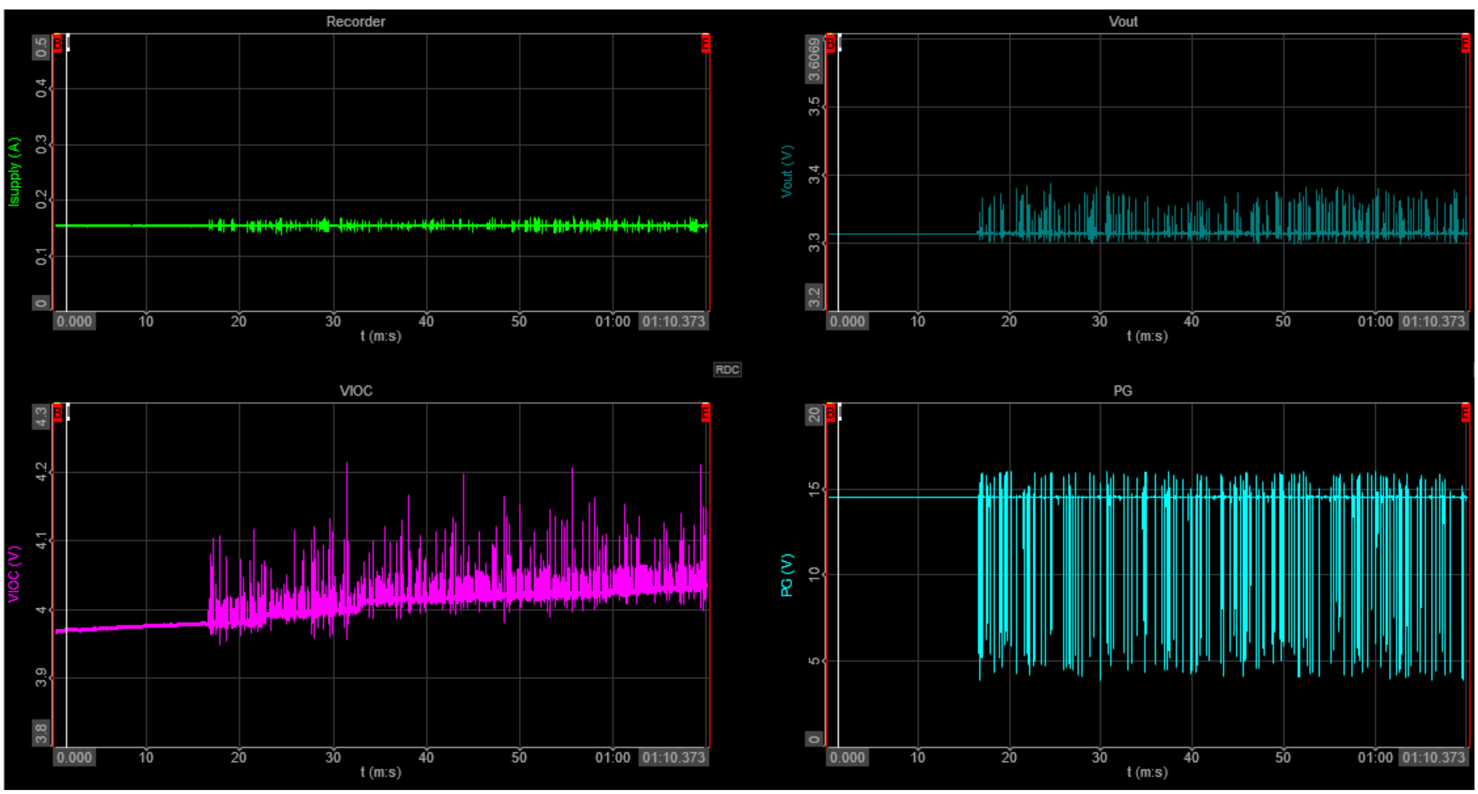

Figure A26: SET B2 Run 51, Vin = 16V, 79.9 MeVcm^2/mg

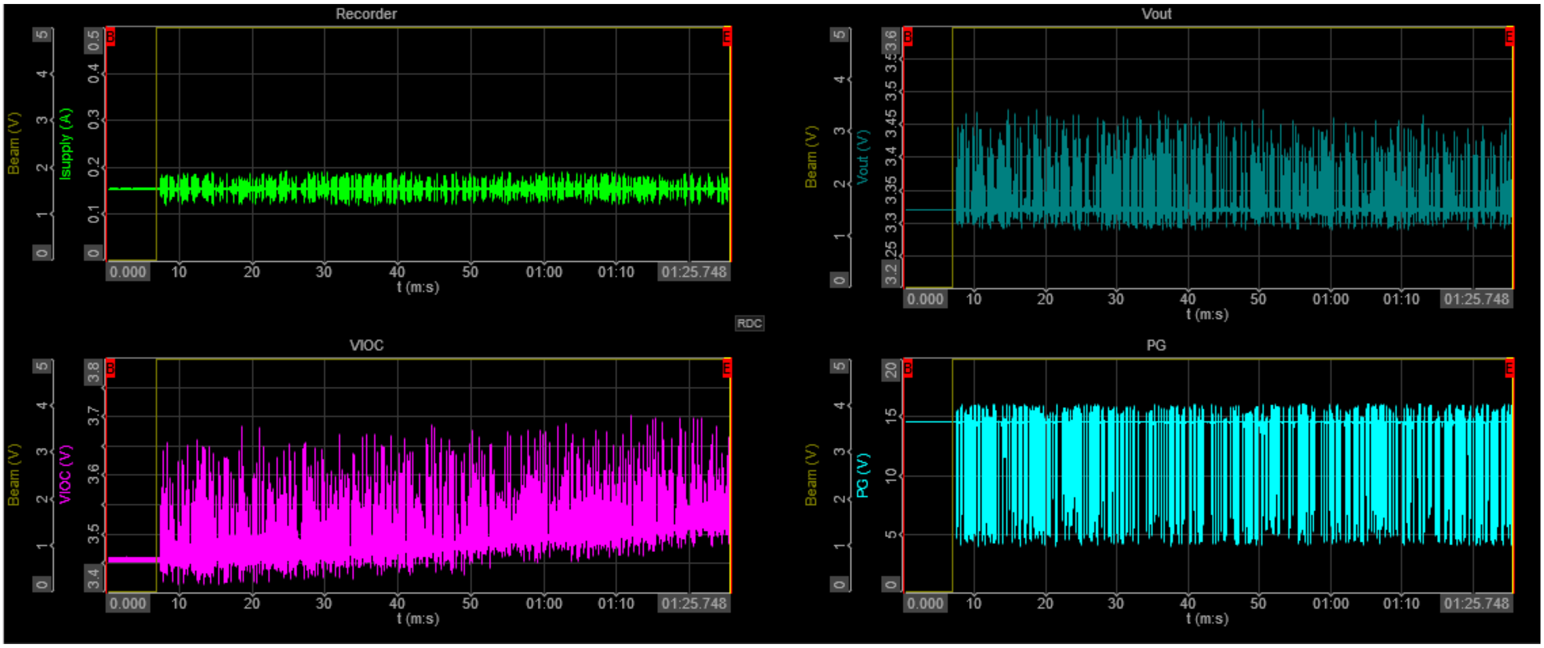

Figure A27: SET B3 Run 60, Vin = 16V, 44 MeVcm^2/mg