SINGLE EVENT EFFECTS TEST REPORT ADRF5022-CSL

September 2025

Radiation Test Report	
Product:	ADRF5022-CSL
Effective LET:	≤ 54.0 MeV-cm^2/mg
Fluence:	1E7 Ions/cm^2
Facilities:	LBNL, TAMU
Tested:	June 2024, May 2025

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SEE Test Report for the ADRF5022-CSL– Silicon SPDT, Reflective Switch

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Test Dates:
LBNL: June 13th-15th, 2024
TAMU: May 22nd-27th, 2025

I. Introduction

The purpose of this test is to determine the Single-Event Effects (SEE) susceptibility of the ADRF5022-CSL, a reflective SPDT switch rated for 100MHz to 45GHz. Single Event Latch-up (SEL) and Single Event Transients (SET) were verified on June 13th – 15th 2024, at the LBNL heavy ion facility and on May 22nd – 27th 2025, at the TAMU heavy ion facility

II. Device Under Test (DUT)

The ADRF5022-CSL is a reflective SPDT switch operating in the range of 100MHz to 45GHz. Four devices were tested.

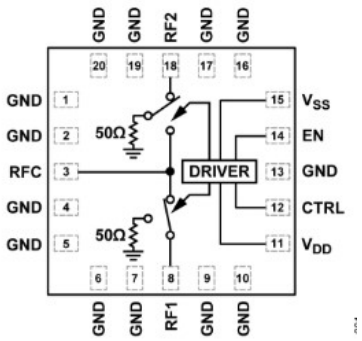


Figure 1: ADRF5022-CSL Block Diagram

Table 1
Part and test information.

Generic Part Number:	ADRF5022-CSL
Date of Test:	June 13th – 15th, 2024; May 22nd – 27th
Manufacturer:	Analog Devices, Inc.
Die Rev:	ADRF5022_CS
Part Function:	Silicon SPDT Switch, Nonreflective, 100MHz to 45GHz
Part Technology:	CMOS
Package Style:	20-lead, 3 mm x 3 mm LGA
Interconnect:	Flip Chip
Die Thickness:	Thinned to 50µm

III. Test Facilities

The heavy-ion beam testing was carried out at the Lawrence Berkeley National Laboratory 88" Cyclotron Facility (LBNL) and Texas A&M University K500 (TAMU). The test setup was in an open-air environment.

Facility: LBNL, TAMU
Cocktail: 16 MeV/nuc; 24.8 MeV/nuc
Fluence: 1×10^7 cm^{-2} (per run)
Ions: Shown in Table 2

Table 2.
Heavy-ion species, effective linear energy transfer (LET), and location tested.

Ion	Effective LET (MeV·cm^2/mg)	Location
Xe	54.0	LBNL
Ag	58.0	TAMU

IV. Test Method

A. Test Setup

The DUTs were de-processed to thin the die to a total thickness of 50µm. The ADRF5022-CSL was configured as shown in Figure 2. The LTC5596 was attached to the output of the ADRF5022-CSL to convert to a readable DC voltage on the PXIe-5172 oscilloscope. With the setup, the LTC5596 output voltage should be between 0.8V to 1.1V as shown in Figure 3. The supply current was monitored through the PXIe-4163 SMU. The power supply currents, power supply voltages and RF output were recorded through a LabVIEW program. For SEL testing the power supply voltages were set to nominal plus ten percent as shown in Table 3 and the DUT was heated to high temperature (125°C). For SET testing the supply voltages were set to nominal values minus ten percent as shown in Table 3 at room temperature.

Table 3
Test Instrumentation

Name	Configured Values	Equipment
V_{DD}	3.6V (SEL); 3.0V (SET)	PXIe-4163
V_{SS}	-3.6V (SEL); -3.0V (SET)	PXIe-4163
V_{CTRL}	0	PXIe-4163
V_{EN}	0	PXIe-4163
RFIN	1GHz, 2GHz -10dBm, -5.1dBm, -2.7dBm, -2.9dBm	HMC-T2240
RFOUT	Measured	LTC5596 + PXIe-5172

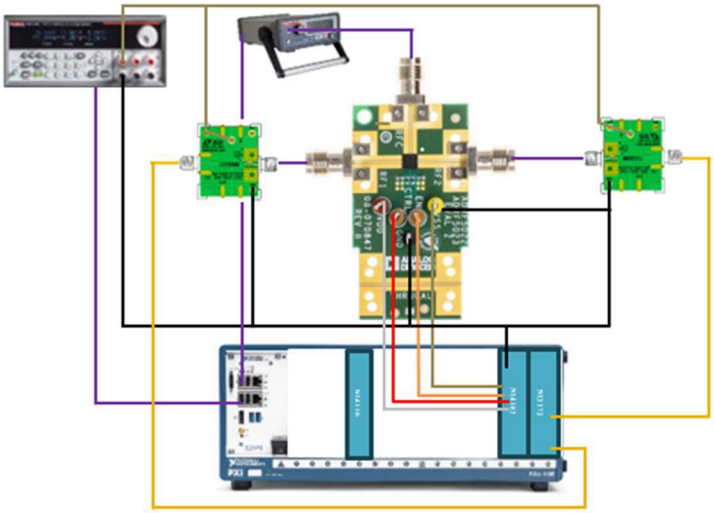


Figure 2. ADRF5022-CSL test setup.

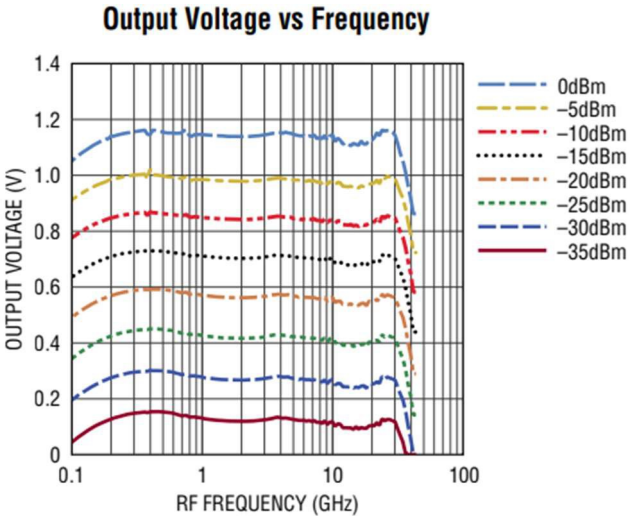


Figure 3. LTC5596 Frequency-Voltage Curve.

B. Irradiation procedure

SEL:

1. The device was powered on and brought up to ~125°C.
2. The software to monitor the supply voltages and currents was turned on.
3. The ion beam was turned on.
4. Once the 1e+07 fluence was reached, the beam was turned off and the software was terminated.

SET:

1. The device was powered on at room temperature
2. The software to monitor the output voltages was turned on.
3. Control voltages were toggled throughout the run to switch the input to each output.
4. The ion beam was turned on
5. Once the 1e+07 fluence was reached, the beam was turned off and the software was terminated.

V. Results

SEL – No latch-up or destructive events were observed on the ADRF5022-CSL to the highest effective LET tested at 58.0 MeV·cm^2/mg at TAMU and 54.0 MeV·cm^2/mg at LBNL. SEL plots are shown in the Appendix.

Table 4
SEL Test Runs

Run	Board Serial Number	Ion	Input Voltage (V_{DD},V_{SS})	Effective LET	Angle	Ave. Flux	Fluence	SEL
#			*V*	*MeV·cm^2/mg*	*degrees*	*#/cm^2/sec*	*total ions*	
7	2	Xe	3.6, -3.6	54.0	0	9.419E+03	1.000E+07	0
9	1	Xe	3.6, -3.6	54.0	0	9.812E+03	1.008E+07	0
184	6	Ag	3.6, -3.6	58.0	0	1.217E+05	1.005E+07	0
185	5	Ag	3.6, -3.6	58.0	0	1.135E+05	9.954E+06	0

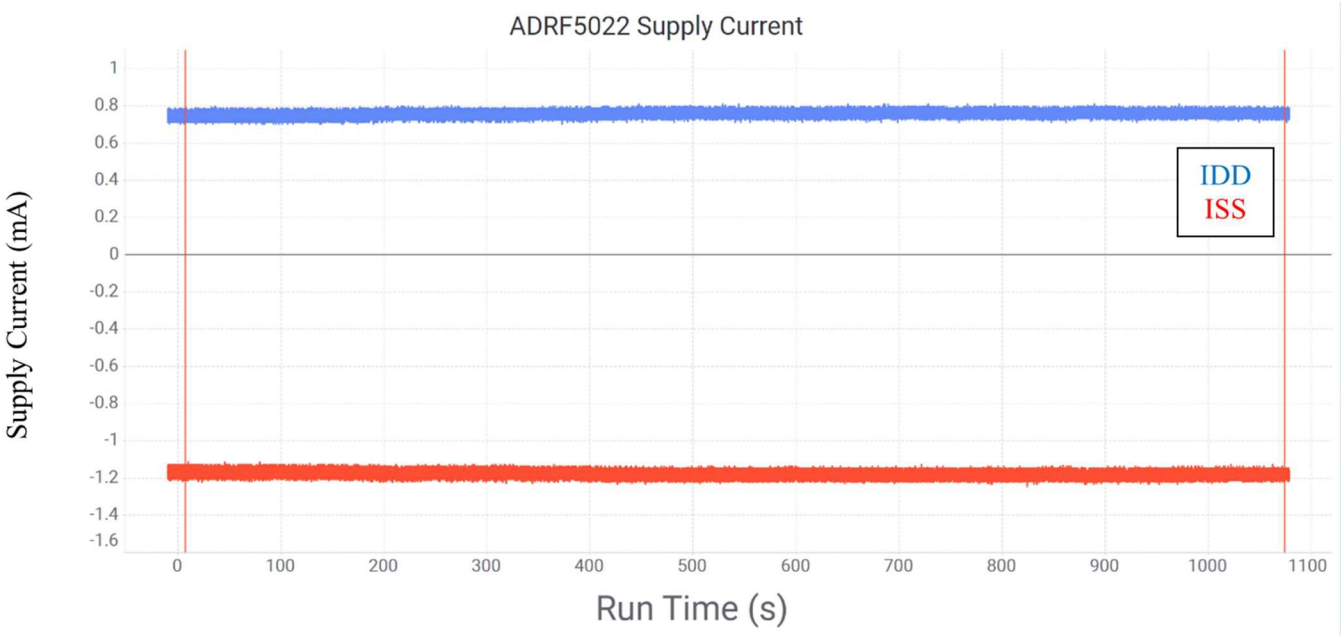
SET – No transients were observed on the ADRF5022-CSL to the highest effective LET tested at 54.0 MeV·cm^2/mg. Two devices were tested. Transients were only tested at LBNL.

Table 5
SET Test Runs

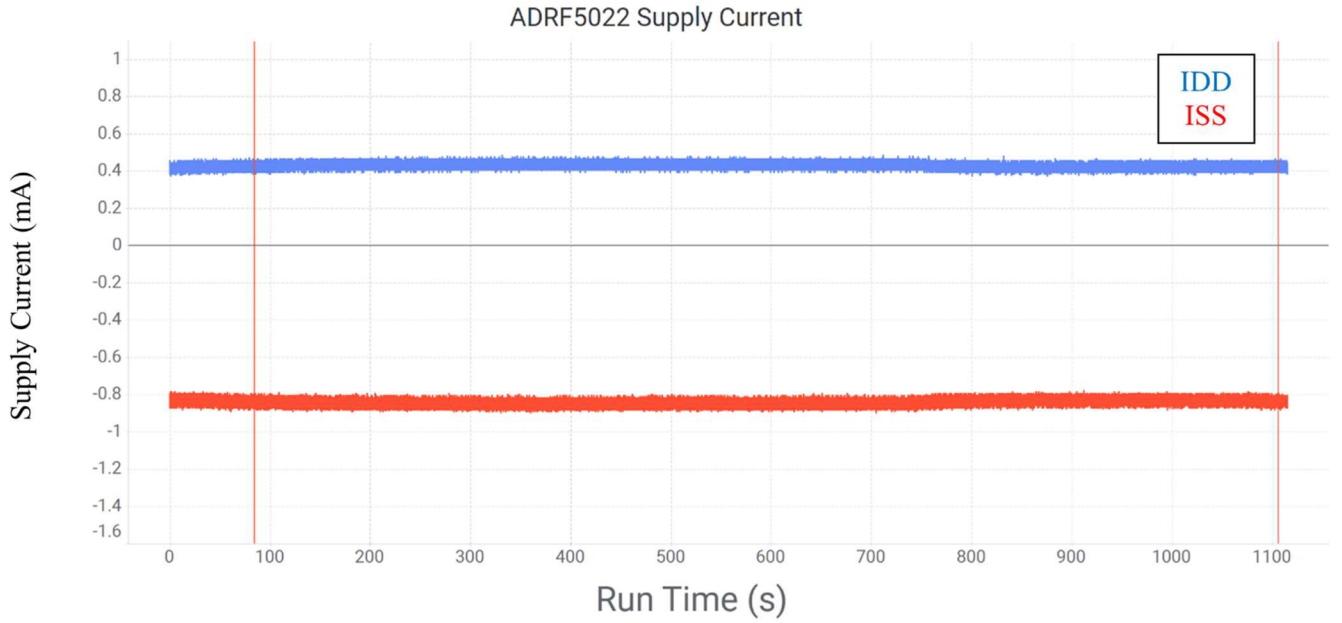
Run	Board Serial Number	Ion	Input Voltage (V_{DD},V_{SS})	Effective LET	Angle	Ave. Flux	Fluence	SET
#			*V*	*MeV·cm^2/mg*	*degrees*	*#/cm^2/sec*	*total ions*	
6	2	Xe	3.0, -3.0	54.0	0	9.154E+03	1.001E+7	0
8	1	Xe	3.0, -3.0	54.0	0	9.812E+03	1.001E+7	0

Appendix:

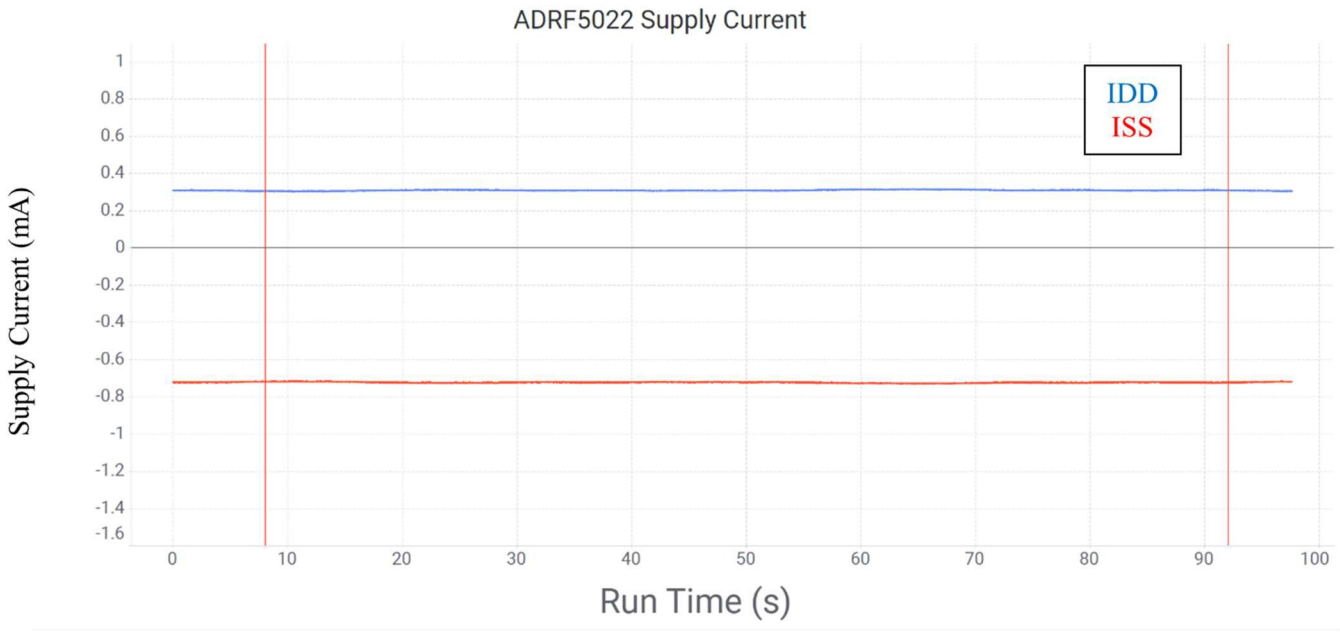
SEL



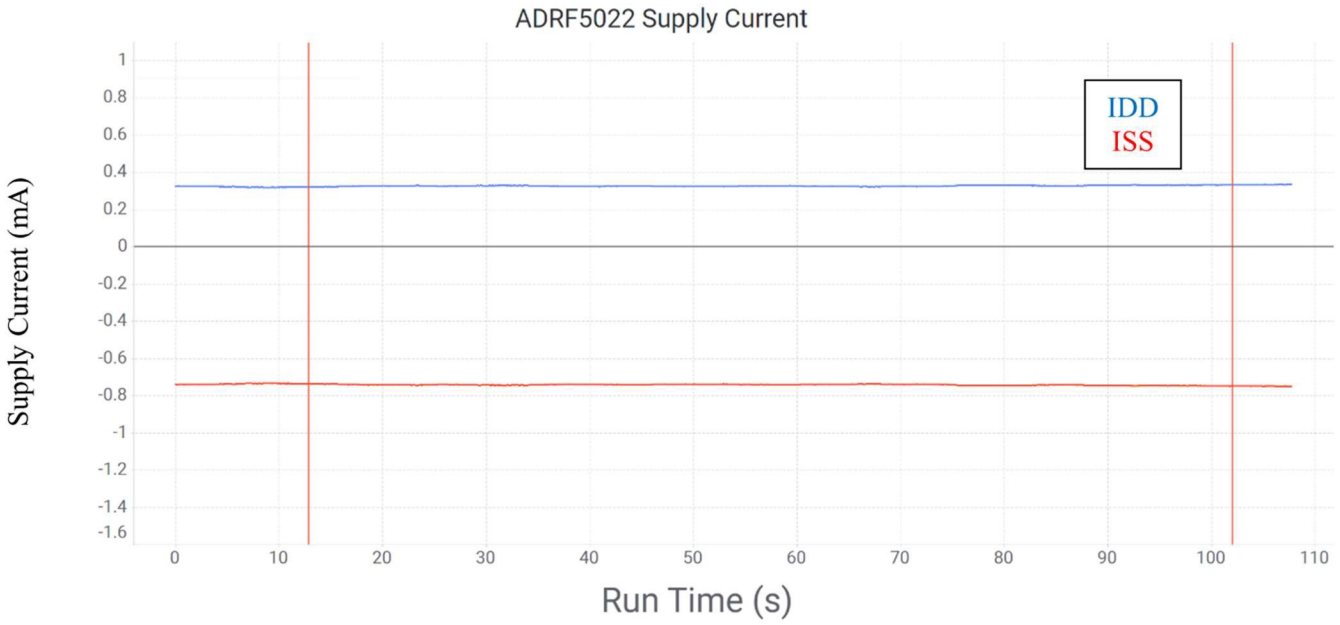
Run 7, Board 2, LET: 54.0 MeV·cm²/mg, RFin: -2.7dBm @ 1GHz



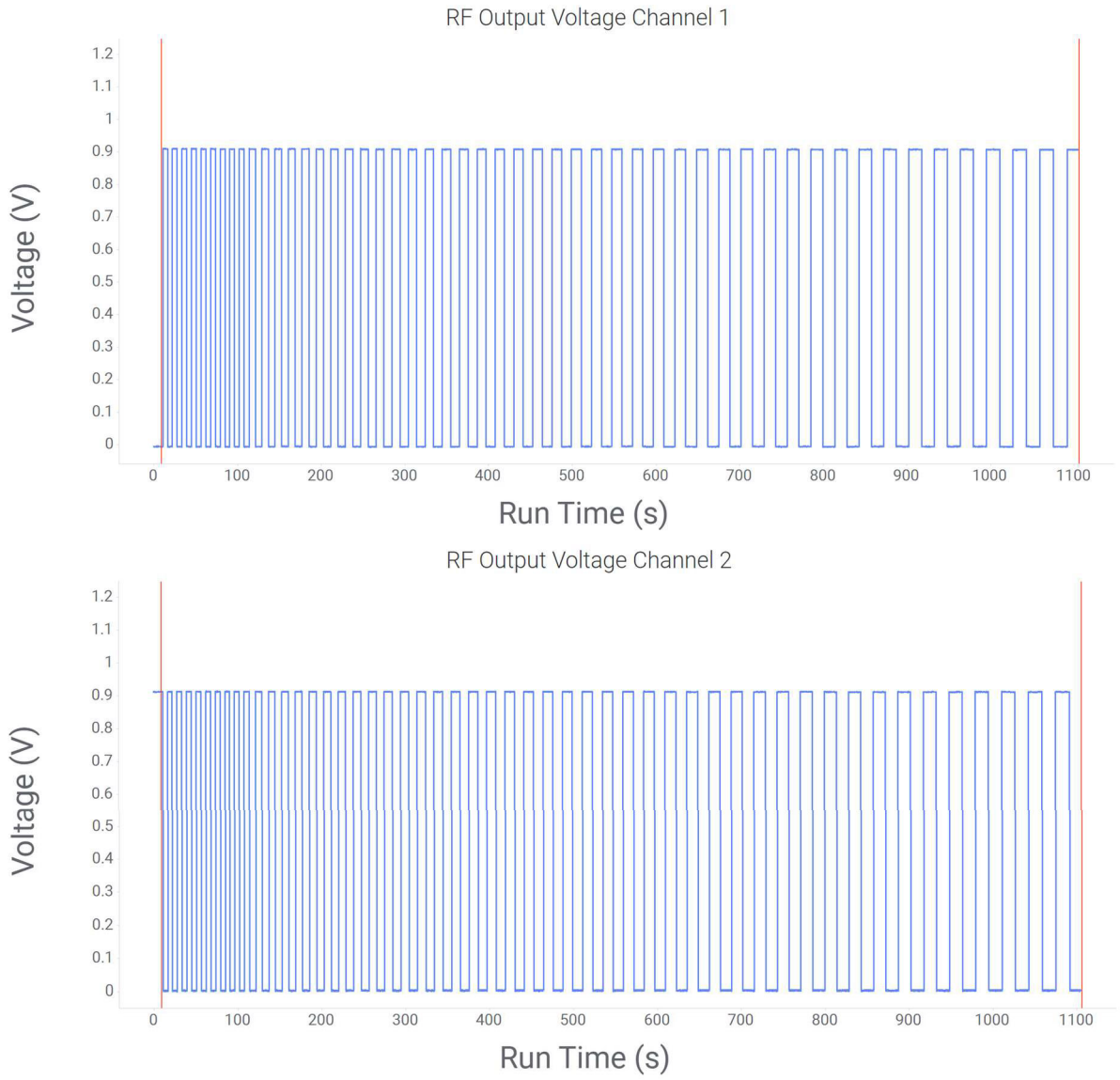
Run 9, Board 16, LET: 54.0 MeV·cm²/mg, RFin: -2.9dBm @ 1GHz



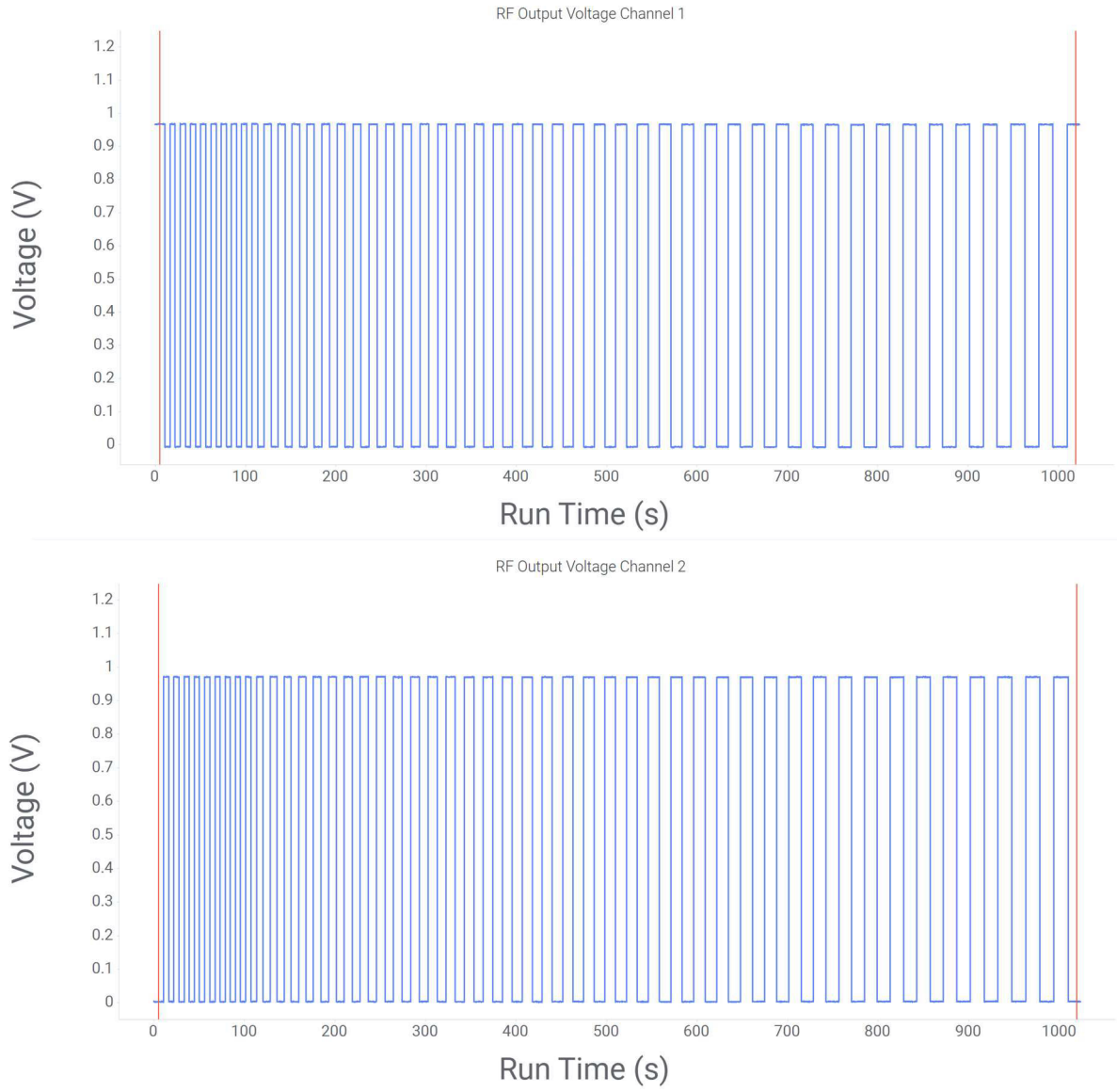
Run 184, Board 6, LET: 58.0 MeV·cm²/mg, RFin: -10dBm @ 2GHz



Run 185, Board 5, LET: 58.0 MeV·cm²/mg, RFin: -10dBm @ 2GHz



Run 6, Board 2, LET: 54.0 *MeV·cm²/mg, RFin: -5.1dBm @ 1GHz*



Run 8, Board 1, LET: 54.0 *MeV·cm²/mg, RFin: -2.9dBm @ 1GHz*