SINGLE EVENT EFFECTS TEST REPORT ADRF6780S

November 2025

Radiation Test Report	
Product:	ADRF6780S
Effective LET:	59.3 MeV-cm^2/mg
Fluence:	1E7 Ions/cm^2
Facilities:	TAMU
Tested:	November 2025

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SEE Test Report for the ADRF6780S – Wideband Microwave Upconverter

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Test Dates:
November 1st – 7th, 2025

I. Introduction

The purpose of this test is to determine the Single-Event Effects (SEE) susceptibility of the ADRF6780S. SEE performance was verified from November 1st to 7th, 2025 at the Texas A&M K500 Cyclotron Facility. SEL testing on the device did not exhibit any destructive Latchup events up to a level of 59.3 MeV-cm2/mg. Devices were tested to a level of 79.9 MeV-cm2/mg but a non-destructive Latchup was observed, increasing one of the supplies ~35%.

II. Device Under Test (DUT)

The ADRF6780S is a wideband microwave upconverter for radio designs operating in the 5.9 GHz to 23.6 GHz frequency range. The device was tested on an EVAL-ADRF6780 board. The DUT was configured via Analog Devices, Inc., Analysis | Control | Evaluation (ACE) Software. The RF output will be evaluated at 10 GHz. A Python program was used to read the registers via ACE, control instrumentation, monitor supply currents, and record frequency spectrum.

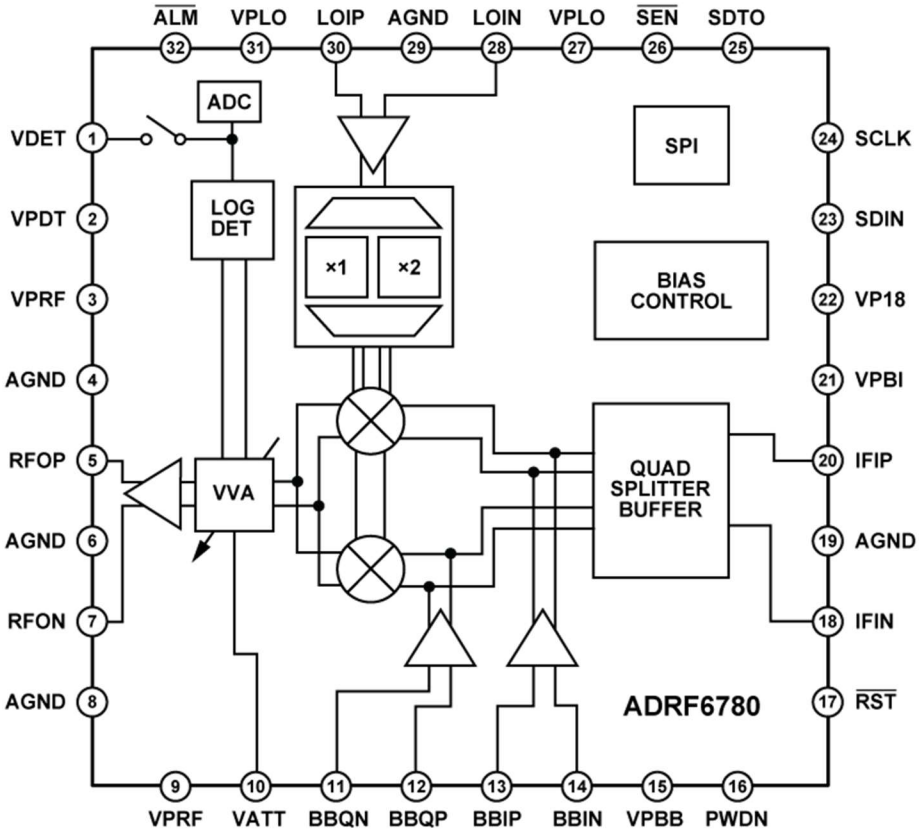

Figure 1. Functional block diagram.

Table 1.

Part and test information.

Generic Part Number:	ADRF6780S
Date of Test:	November 1st – 7th, 2025
Manufacturer:	Analog Devices, Inc.
Die Rev:	ADRF6780
Part Function:	Wideband Upconverter
Part Technology:	.13um SiGe BiCMOS
Package Style:	32-lead, 5 mm × 5 mm LFCSP microwave packaging
Interconnect:	Wire-Bonded

III. Test Facilities

The heavy-ion beam testing was carried out at the Texas A&M University K500 cyclotron. The test setup was in an air environment.

Facility: TAMU K500
Beam Line: 24.8 MeV/nuc
Fluence: 1×10^7 cm^{-2} (per run)
Ions: Shown in Table 2

Table 2.
Heavy-ion species, linear energy transfer (LET).

Ion	Effective LET (MeV·cm^2/mg)
Ag	79.9
Ag	59.3

IV. Test Method

A. *Test Setup*

The devices under test (DUT) were de-processed to expose the wire-bonded die. The ADRF6780S was configured as shown in figure 2. The supply currents were monitored through Keithley 2300G-30-6. The RF output was monitored via a spectrum analyzer to confirm operation. The DUT supply voltages (5V, 3.3V, 1.8V) were set to max rated (+10%) and the DUT was heated to high temperature (~125°C) for SEL testing. For SET/SEU testing the supply voltages were set to -10% and the DUT was kept at ambient temperature

Table 3: Configured Values

Name	Configured Values (SEL, SET)
5V	5.5V, 4.5V
3.3V_6780	3.63V, 2.97V
1.8V	1.98V, 1.62V
3.3V	3.3V
2.6V_VATT	2.6V
IF	2 GHz, -10dBm
LO	8 GHz, 0 dBm
RF_OUT	Measured

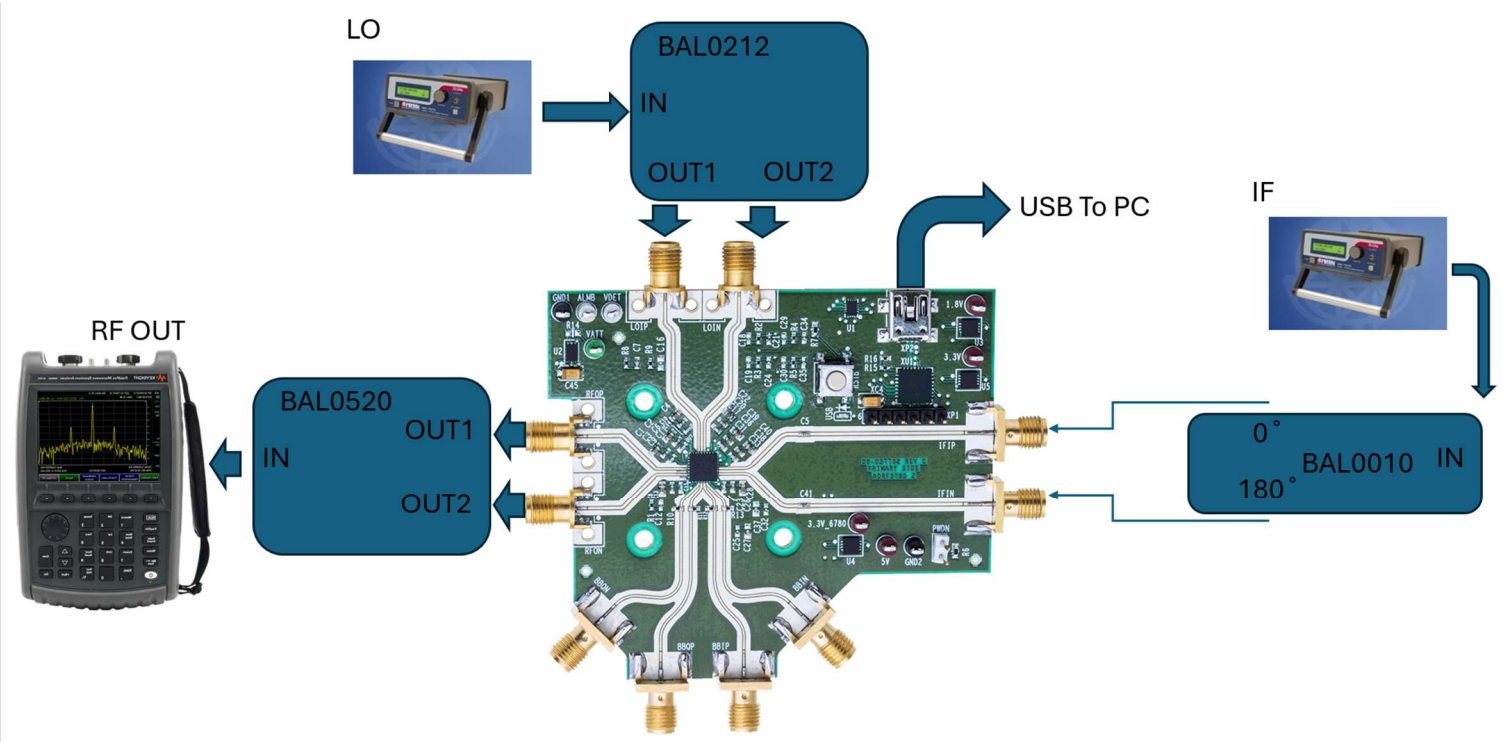

Figure 2. ADRF6780 test setup.

B. Irradiation procedure:

1. The device was powered on and programmed.
2. The device temperature was set (125°C SEL, ~25°C SET/SEU).
3. The software to monitor the supply current and voltages and registers was turned on.
4. The ion beam was turned on.
5. Once the fluence of 1e7 total ions was reached, the beam was turned off.

C. Other test Conditions

Angles of Incidence: 45°

V. Results

SEL – No destructive SEE events were observed on the ADRF6780S at an effective LET of 59.3 MeV·cm^2/mg. Three devices were tested at 79.9 MeV·cm^2/mg, and two devices were tested at 59.3 MeV·cm^2/mg. Board 1 has an unexplainable Latchup of 62 mA (179mA nominal to 240mA) on the 5.0V supply current when tested at 79.9 MeV·cm^2/mg, this Latchup was non-destructive but permanent. Although this part experienced this unrecoverable supply increase, RF performance and communication with the part was preserved. De-processing to expose the die can lead to variations in supply current, the Latchup event observed did not exceed the worst-case supply current seen on other tested units. Two additional boards were tested at 59.3 MeV·cm^2/mg and no Latchup events were seen. The SEL plots are shown in the Appendix, frequently during testing the part was put into a non-active state which is seen when the 3.3V_6780 supply current drops to ~0.4A and then reset, bringing that current back to ~0.6A. All other upsets which resulted in supply increases were able to be cleared upon a power cycle and reprogram of the DUT.

Table 4: SEL Test Runs

BD#	Ion	Angle (deg)	Effective LET (MeVcm2/ mg)	Flux (ions/(cm2s))	Fluence (ions/cm2)	SEL
2	Ag	45	79.9	3.17E+04	9.99E+06	No
5	Ag	45	79.9	3.51E+04	1.00E+07	No
1	Ag	45	79.9	3.43E+04	1.00E+07	Yes
3	Ag	0	59.3	3.96E+04	1.00E+07	No
11	Ag	0	59.3	4.27E+05	1.00E+07	No

SEU – SEU testing was performed up to the highest effective LET tested of 79.9 MeV·cm^2/mg; three devices were tested. Due to the Latchup noted in the previous section, two more devices were tested at the highest rated LET of 59.3 MeV·cm^2/mg. There was a total of 8 registers read. The register upset count is seen below in table 5.

SEFI – SEFI testing was performed up to the highest effective LET tested of 79.9 MeV·cm^2/mg; three devices were tested. Due to the Latchup noted in the previous section, two more devices were tested at the highest rated LET of 59.3 MeV·cm^2/mg. Pictured in the appendix is a plot of the fundamental tone versus irradiation time for Board Five, which is representative of all runs across the five devices. In this plot, each drop in tone level corresponds to a SEFI event. Also included is an FFT plot showing a normal spectrum as well as the two types of SEFI events observed: a total loss of the tone, and a configuration SEFI that introduced additional spurs at 18 GHz and 14 GHz.

Table 5: SEU/SET Test Runs

BD#	Ion	Angle (deg)	Effective LET (MeVcm2/ mg)	Flux (ions/(cm2s))	Fluence (ions/cm2)	SEU Count	SEFI Count
2	Ag	45	79.9	3.39E+04	1.00E+07	189	4
5	Ag	45	79.9	3.46E+04	1.00E+07	175	6
1	Ag	45	79.9	3.37E+04	1.00E+07	162	5
11	Ag	0	59.3	3.23E+04	9.99E+06	136	3
3	Ag	0	59.3	3.88E+04	9.99E+06	185	5

Appendix:

Single Event Latchup:

Board 2

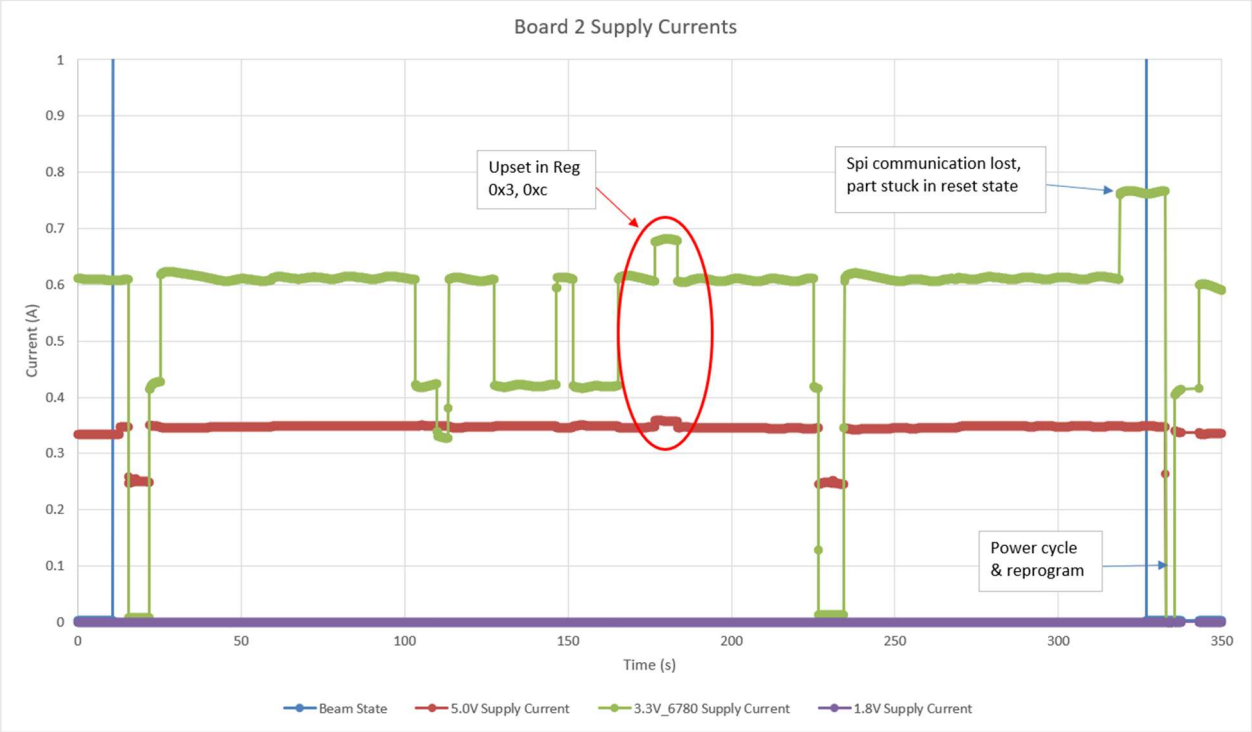

Figure 3. Board 2 supply currents.

Board 5

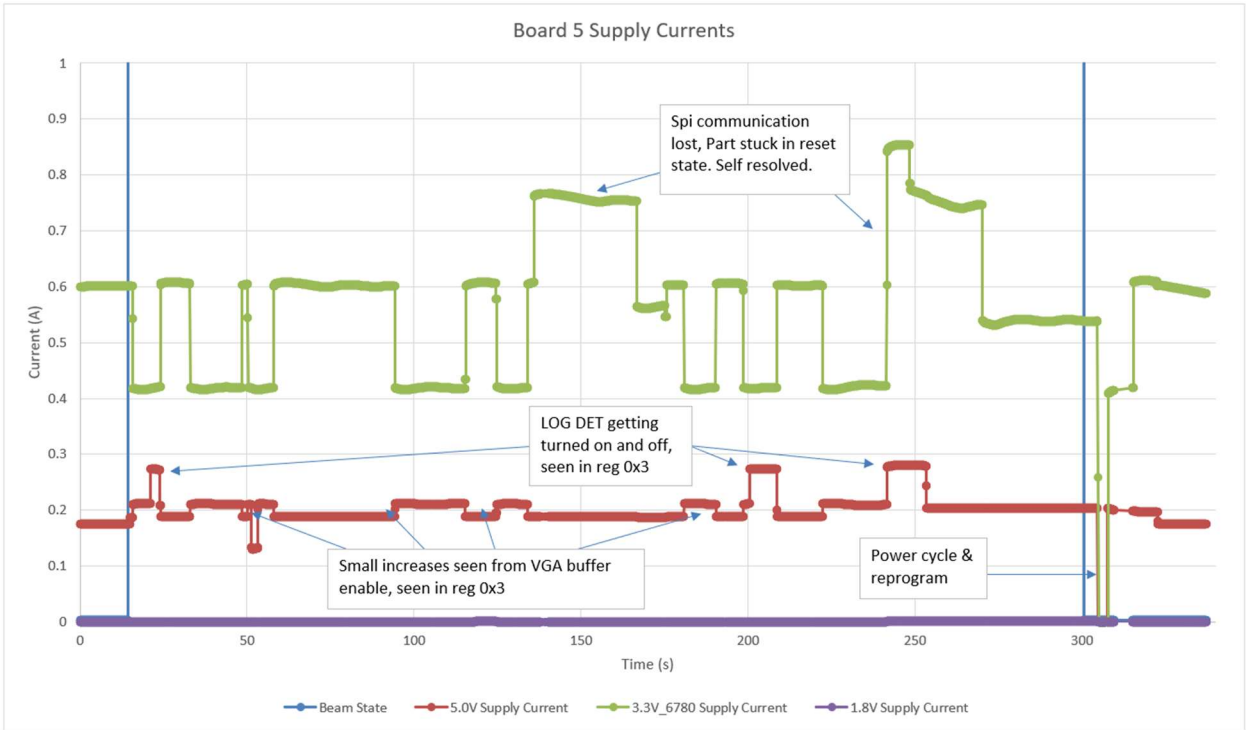

Figure 4. Board 5 supply currents.

Board 1

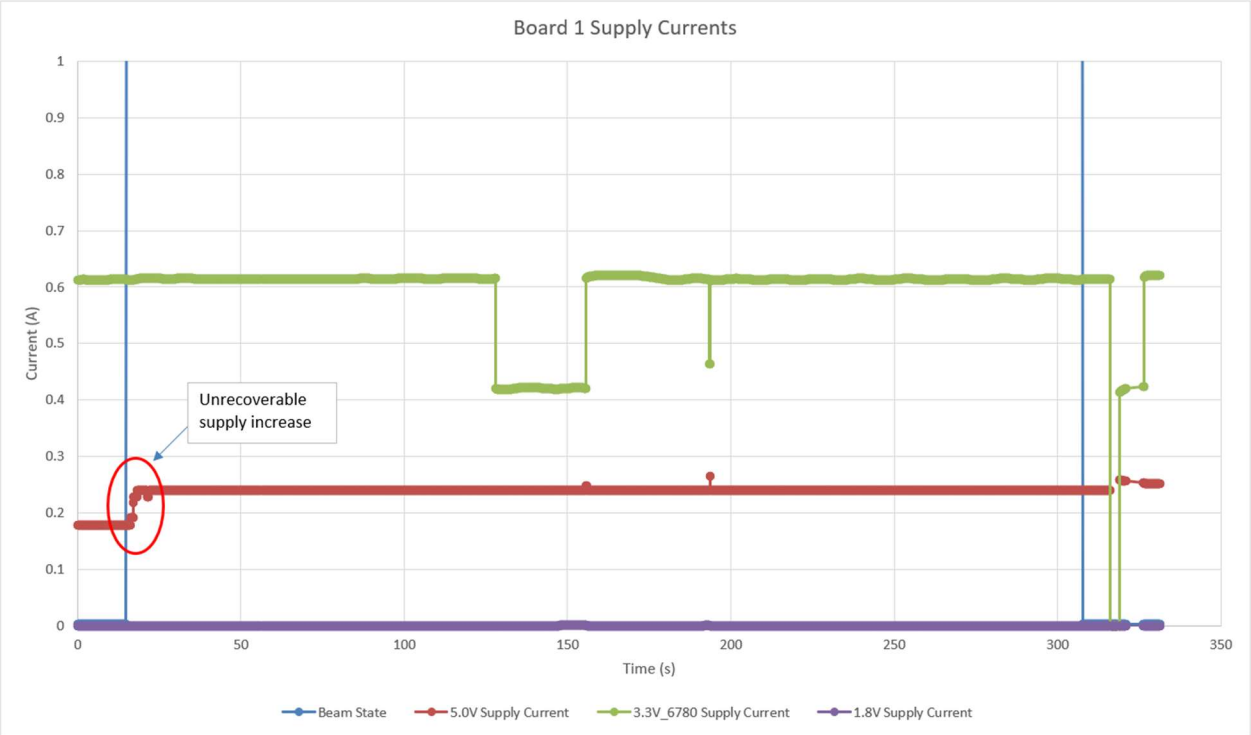

Figure 5. Board 1 supply currents.

Board 3

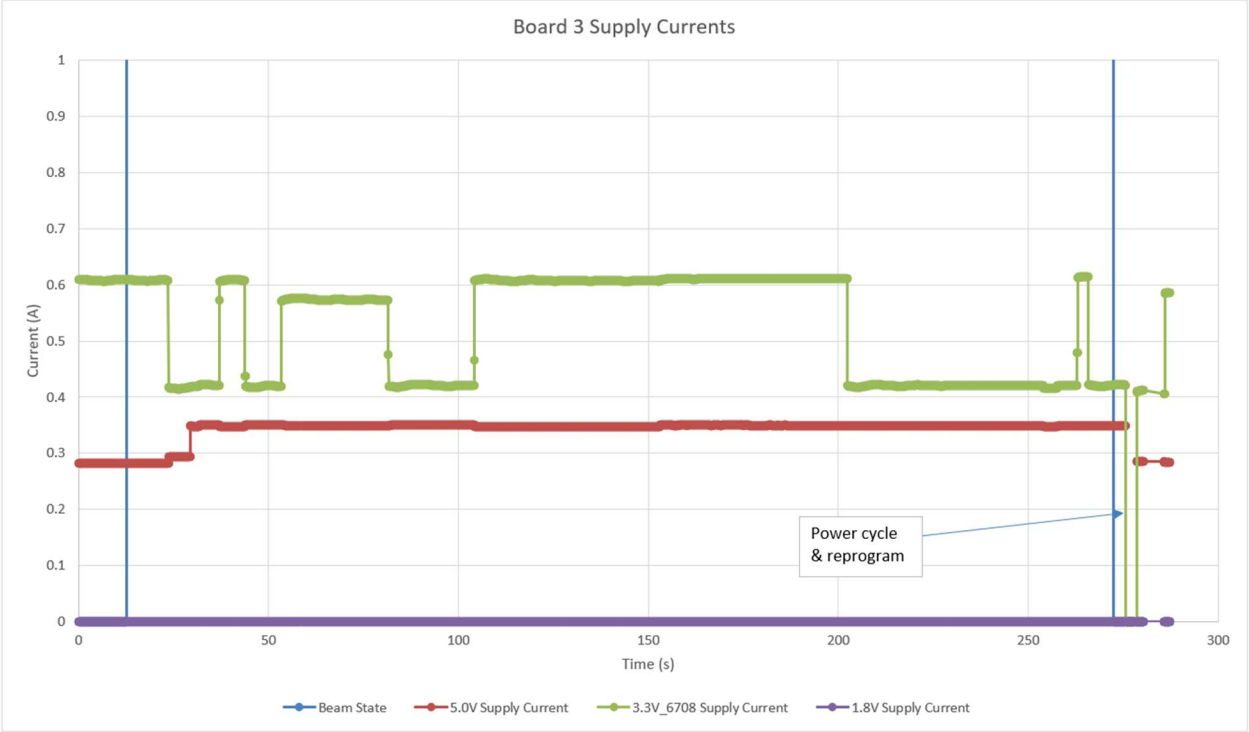

Figure 6. Board 3 supply currents.

Board 11

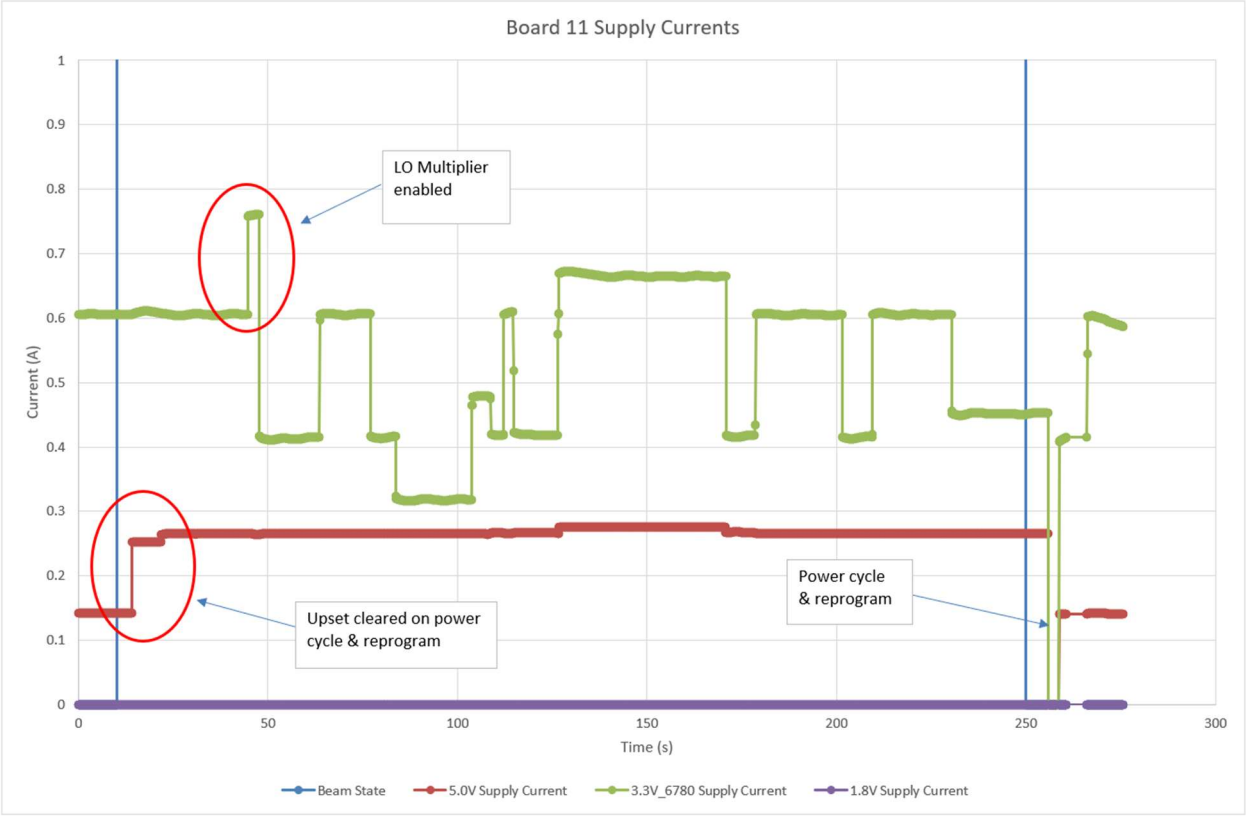

Figure 7. Board 11 supply currents.

Single Event Transient/Upset:

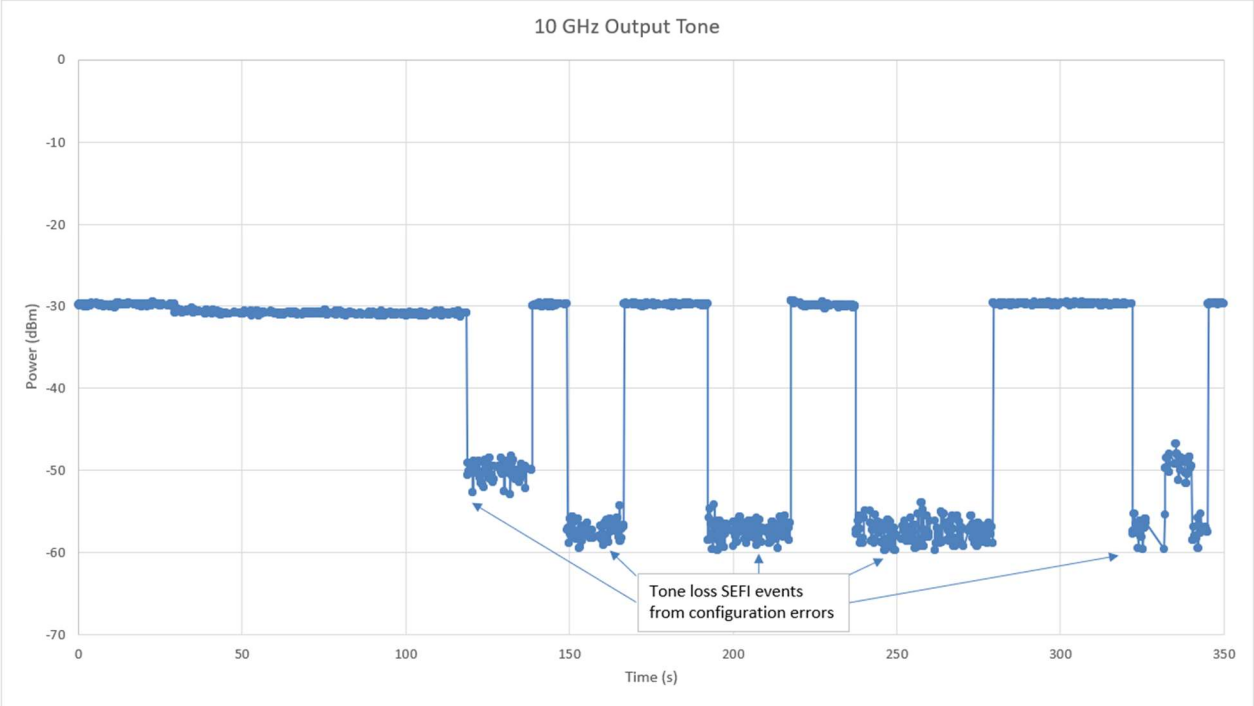

Figure 8. 10 GHz output tone level (Board 5).

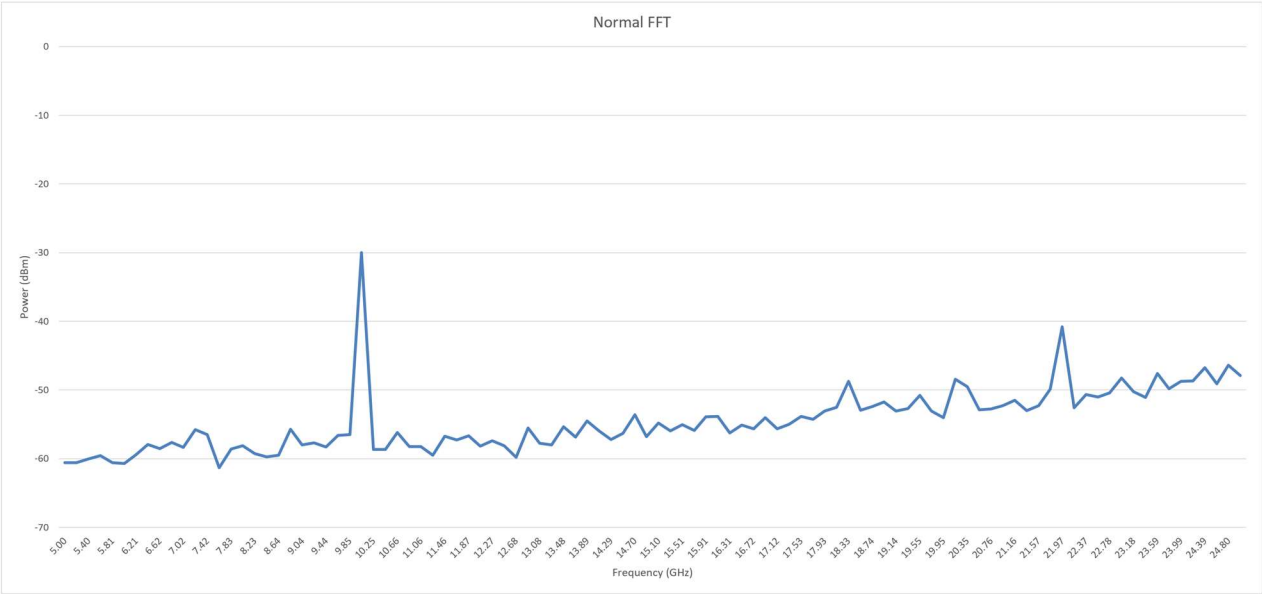

Figure 9. Normal FFT (Board 2).

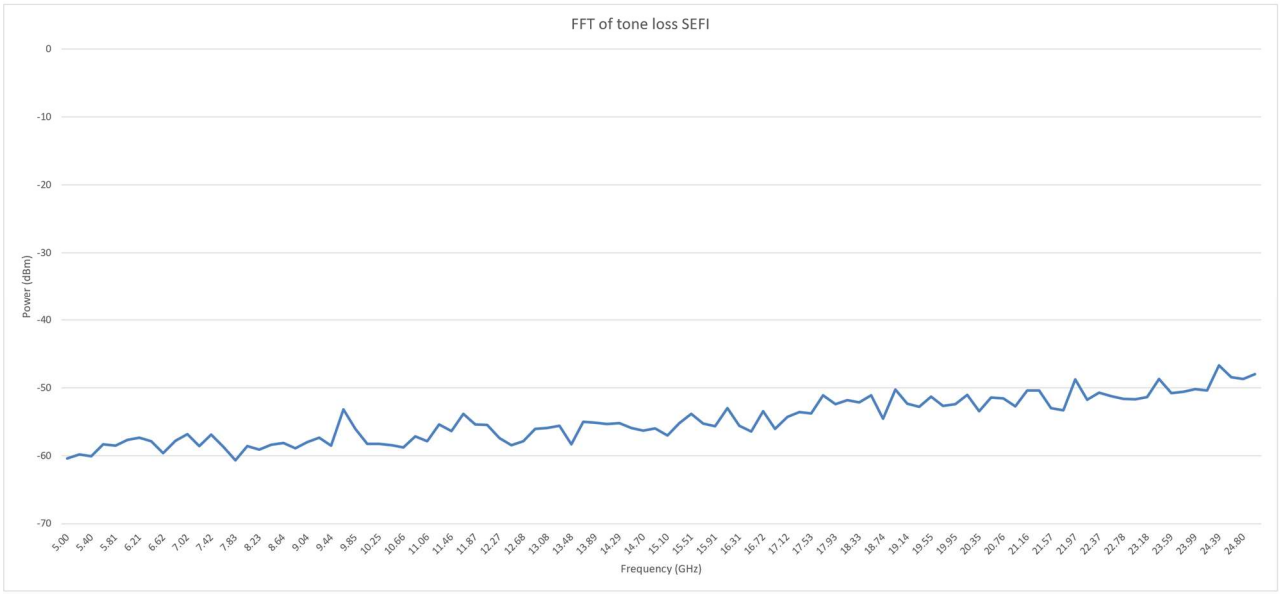

Figure 10. FFT of tone loss SEFI (Board 5).

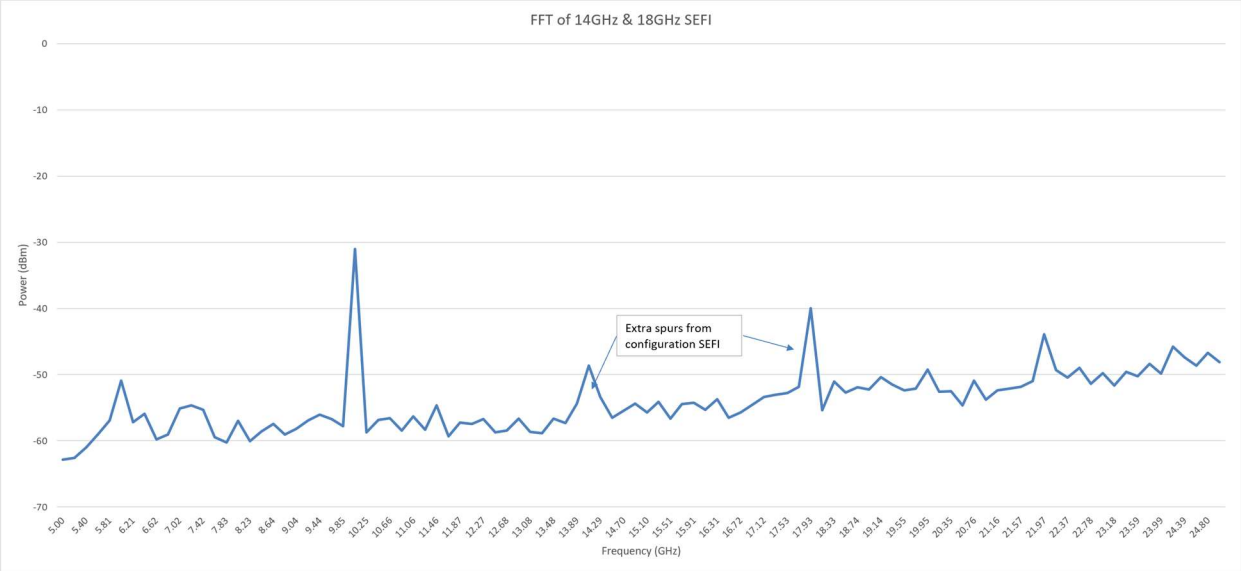

Figure 11. FFT of extra spur SEFI (Board 5).

Table 5: Equipment used & Calibration

Equipment	Calibration
Keithley 2300G-30-6	SN# 9201602 Calibration due 11/30/2027
Keithley 2300G-30-6	SN# 9030930 Calibration due 11/30/2027
HMC-T2240	SN#002023 No Cal required – verified using Field Fox
HMC-T2240	SN#002243 No Cal required – verified using Field Fox
Keysight Field Fox N9552B	SN#MY62151444 Calibration due 9/24/26