SINGLE EVENT EFFECTS TEST REPORT ADH8411S

May 2022

Radiation Test Report	
Product:	ADH8411S-CSH, ADH8411S-CSL
Effective LET:	62.4 MeV-cm^2/mg
Fluence:	1E7 Ions/cm^2
Facilities:	TAMU
Tested:	May 21, 2022

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SEE Test Report for the ADH8411S –
0.01GHz to 10GHz LNA

Tom Decker, Bennett Bush

Test Date:
May 21, 2022

I. Introduction

The purpose of this test is to determine the heavy ion-induced Single-Event Effects (SEE) susceptibility of the ADH8411S, a 0.01GHz – 10GHz LNA.

Single Event Latch-up was evaluated with high supply voltage and high temperature with no latch-up or other destructive SEE events observed to the highest LET tested (62.4 MeV-cm^2/mg). The device was evaluated at 90°C using a custom Iomega heating system (forced air).

II. Device Under Test

The ADH8411S is a GaAs, monolithic microwave integrated circuit (MMIC), low noise, wide bandwidth amplifier that operates from 0.01GHz to 10GHz. The ADH8411S provides a typical gain of 15.5dB, a 1.7db typical noise figure, and a typical output third order intercept (OIP3) of 34dBm, requiring only 55mA from a 5V supply voltage. The saturated output power (Psat) of 19.5dBm typically enables the low noise amplifier to function as a driver for many of Analog Devices, Inc., balanced, in-phase/quadrature(I/Q), or image rejection mixers. Figure 1 shows a functional block diagram of the device. Table 1 shows the basic part and test details. Detailed device parameters and functional descriptions can be found in the datasheet.

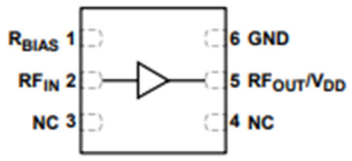

Figure 1. Functional block diagram.

Table 1
Part and test information.

Generic Part Number:	ADH8411S-CSH, ADH8411S-CSL
Date of Test:	May 21, 2022
Manufacturer:	Analog Devices
Die Revision:	N3201
Part Function:	0.01GHz to 10GHz LNA
Part Technology:	0.15um pHEMT
Package Style:	^-ld LFCSP
Test Equipment:	Keithley Power Supply, PXA, Hittite Signal Generator, Computer

III. Test Facilities

The heavy-ion beam testing was carried out at the Texas A&M University Cyclotron Facility. The facility utilizes the K500 cyclotron with a superconducting magnet which generates the magnetic field used to accelerate the ions. The test setup was in an air environment. The SEE testing was primarily focused on SEL.

Facility: Texas A&M University Cyclotron Facility
Beam: 15 A MeV
Flux: up to 1.5×10^5 $cm^{-2} \cdot s^{-1}$
Fluence: up to 1×10^7 cm^{-2} (per run)
Ions: Au

IV. Test Method

A. Test Setup

The device under test (DUT) was chemically de-lidded to expose the wire-bonded die. The Rf input was set to 3GHz using a Hittite HMC-T2240 Rf Generator. The power supply to the DUT was set to 6V with ~65mA supply current. The output was monitored using a Keysight PXA 50 GHz Spectrum Analyzer. The power supply current was monitored using Python scripts. An Iomega temp forcing system was used to get the device to 90°C. The test configuration is shown in Figure 2. The test routine is shown below:

1) Turn on power to DUT
2) SEL: Measure temperature of DUT at 90°C
3) Start power supply current monitoring script
4) Start Beam
5) Stop beam at 1E7 total ions

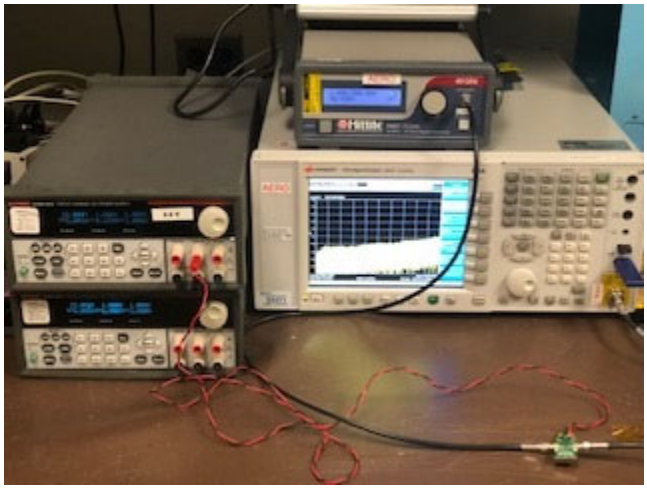

Figure 2: ADH8411S Test Setup

B. Irradiation procedure

SEL: The Iomega temperature forcing system was used to get the DUT to 90°C. A custom python script was used to continuously monitor the supply current. Measurements were ~10 readings/second.

SEL Test Conditions

Test Temperature:	90°C
RF Input Frequency:	3 GHz
Power Supply(s):	6V
Angles of Incidence:	0º (normal)
Parameters:	Supply Current
Samples:	3

V. Results

SEL – The ADH8411S did not exhibit SEL at ≤ 62.4 MeV-cm^2/mg to 1.0E7 ions/ cm^2 while heated to 90°C. No SEL induced current increases were observed as can be seen in the SEL plots. The test runs are below in Tables 2. Plots are shown below.

Run	Dut	ion	LET	Range	Energy	angle	TID	flux	fluence
Run 5	1	Au	62.4	59.6	1609	0	1.39E+04	4.05E+04	1.00E+07
Run 6	2	Au	62.4	59.6	1609	0	1.39E+04	1.05E+05	1.00E+07
Run 7	3	Au	62.4	59.6	1609	0	1.39E+04	1.17E+05	1.01E+07

Table 2: SEL test runs

SET – The output was monitored using a Spectrum analyzer. During the test run, no visible anomalies to the output was seen. One test run at nominal 5V supply was performed at room temperature. The eval boards were received 1 week before beam time so SET testing was not the focus of the SEE test.

Run	Dut	ion	LET	Range	Energy	angle	TID	flux	fluence
Run 4	1	Au	62.4	59.6	1609	0	4.05E+03	1.29E+04	2.92E+06

Table 3: SET test run

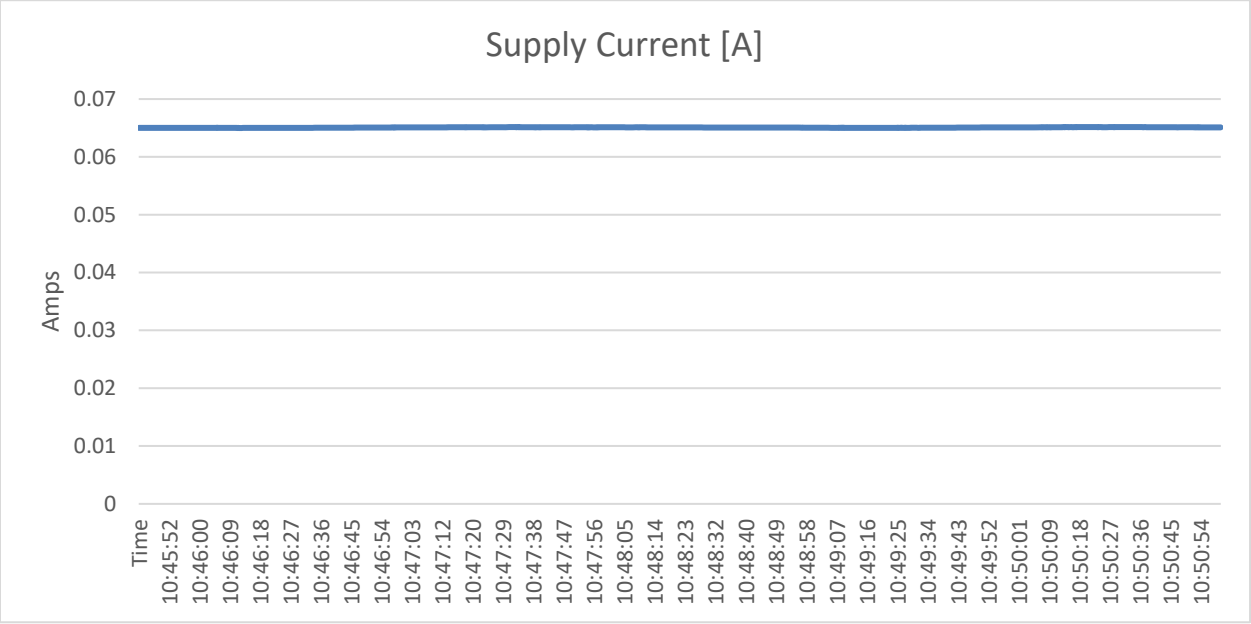

Figure 3: ADH8411S Run 5 Power Supply Current Bd 1

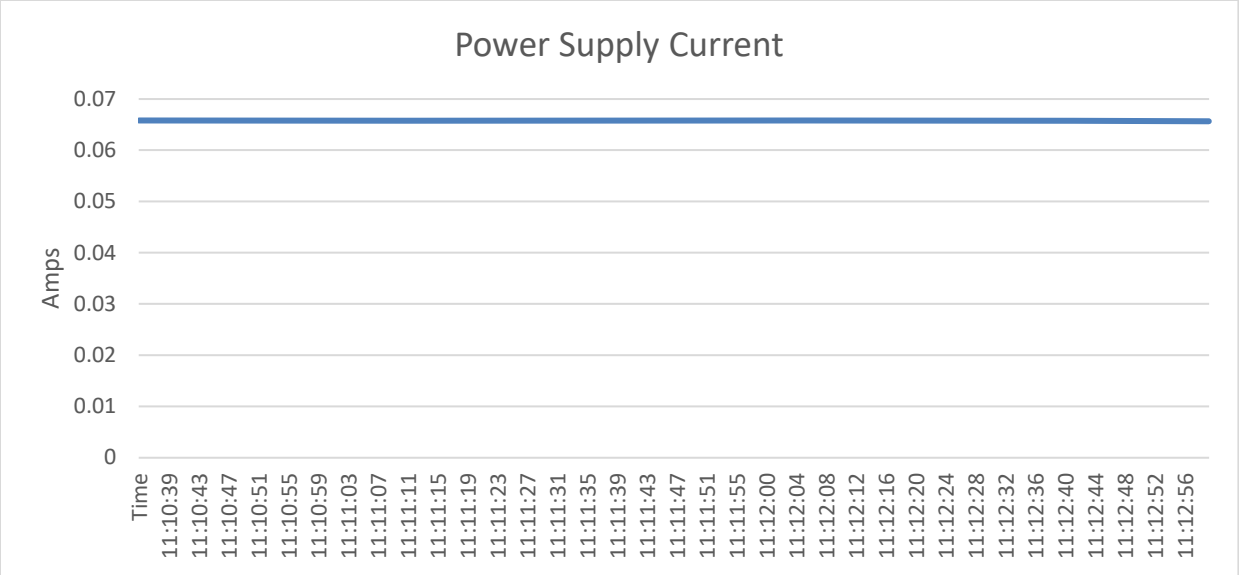

Figure 4: ADH8411S Run 6 Power Supply Current Bd 2

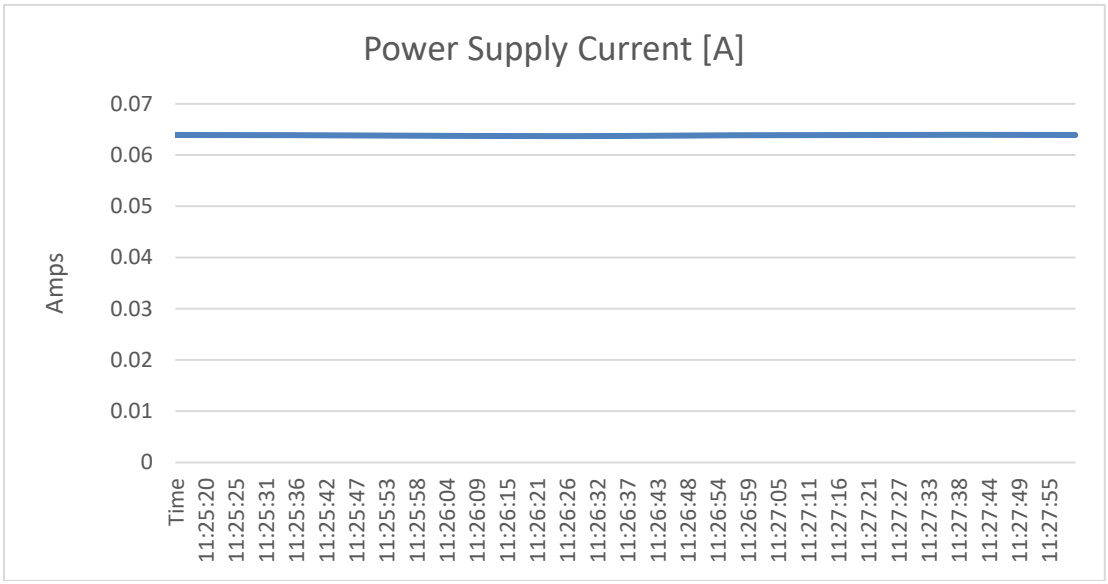

Figure 5: ADH8411S Run 7 Power Supply Current Bd 3

VI. Conclusion:

The ADH8411S does not exhibit SEL at the maximum LET evaluated: ≤62.4MeV-cm2/ mg.

Test Hardware:

1) Keithley triple Power Supplies – 2230G-30-1
    a. SN# 9204335 Calibration due 8/31/22
2) Hittite HMCT2240 RF Generator
    a. SN# 27795 Calibration due 9/16/22
3) Keysight PXA
    a. MY53311081 Calibration due 2/23/23
4) ADH8411S Eval boards – 1, 2, 3