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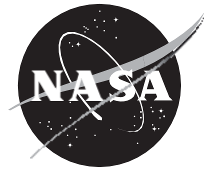

Analog Devices ADXL354 Low Noise, Low Drift, Low Power, 3-Axis MEMS Accelerometer Total Ionizing Dose Characterization Test Report

Michael Campola and Scott Stansberry

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Test report date: October 16, 2018

Test Report to be published on radhome.nasa.gov.

1. Purpose

The purpose of this test was to characterize the Analog Devices ADXL354 parameter degradation for total dose response. In the test, the device was exposed to a dose rate of 50 rad(Si)/s or 0.5 Gy(Si)/s using a gamma radiation source in accordance with MIL-STD-883K Paragraph 3.6.1 (Condition A). Device parameters such as supply current, self-test voltage response, and LDO regulator output voltages were monitored.

2. Test Samples

Two parts from a commercial buy were used for ionizing dose (TID) testing. All specifications and descriptions are according to Analog Devices ADXL354/ADXL355 Datasheet (Rev. A).

Table 1: Part Identification Information

Qty	Part Number	LDC	REAG#	Package
2	ADXL354	n/a	17-056	14-LCC

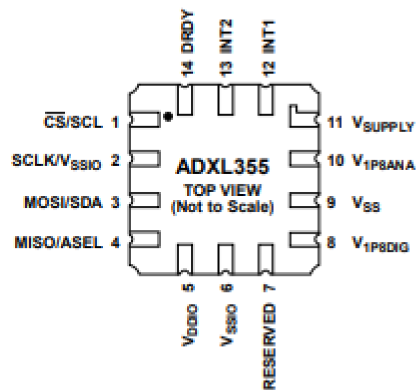

Figure 1: Pin out for accelerometer

3. General

Radiation testing was performed by exposing the parts to gamma radiation at a 50 rad(Si)/s dose rate. Two parts were irradiated on separate boards. Prior to the first radiation dose, all parts were electrically tested. After each exposure level, the parts were tested again and returned to radiation within the time limits (within 2 hours) defined by MIL-STD-883, Method 1019. All parts were biased during the irradiation steps described in Table 2. Electrical and functional characterization was performed starting at approximately 2:00pm. The parts were completely tested by approximately 5:30pm.

Table 2: Device Grouping and Step-Stress Instructions

Run	Test Levels (krad(Si))	Notes
0	0	Pre-rad testing revealed a board issue (poor ground connection on J2) that was rectified.
1	1	Device 7 failed self-test.
2	5	Device 7 failed self-test on board but passed when switched to board 1. Problem was traced to missing bias supply when testing outside of chamber. Rectified for following levels.
3	10	Self-test voltages remain nominal
4	15	Self-test voltages remain nominal
5	20	Self-test voltages remain nominal
6	30	Devices self-test voltages deviated from nominal. V1P8ANA and V1P8DIG pins checked on both and were found to be out of spec. Device 6: V1P8DIG = 3.3V V1P8ANA = 0.2V Device 7: V1P8DIG = 3.3V V1P8ANA = 3.3V
7	40	Devices self-test voltages deviated from nominal. V1P8ANA and V1P8DIG pins checked on both and were found to be out of spec. Device 6: V1P8DIG = 1.4V V1P8ANA = 0.3V Device 7: V1P8DIG = 0.03V V1P8ANA = 0.28V

4. Electrical Tests

Electrical tests were performed using an automated test setup consisting of a software controlled power supply (HP2230-3--1) and a DAQ DMM (HP34970A w/ relay module). Measurements were made of the differential voltage of XOUT, YOUT, and ZOUT with ST1 at 3.3V and ST2 at 0V and 3.3V respectively (Test mode). After run 6, changes were seen in the self-test differential voltages (not recorded) and the LDO outputs which were probed with a handheld DMM. The internal LDO regulators failed between 20 and 30krad(Si).

	Device -->	6		7		Spec	
RUN	Dose (krad(Si))	V1P8DIG	V1P8ANA	V1P8DIG	V1P8ANA	min	max
0	0	1.8	1.8	1.8	1.8	1.62	1.98
1	1	1.8	1.8	1.8	1.8	1.62	1.98
2	5	1.8	1.8	1.8	1.8	1.62	1.98
3	10	1.8	1.8	1.8	1.8	1.62	1.98
4	15	1.8	1.8	1.8	1.8	1.62	1.98
5	20	1.8	1.8	1.8	1.8	1.62	1.98
6	30	3.3	0.2	3.3	3.3	1.62	1.98
7	40	1.4	0.29	0.03	0.28	1.62	1.98

5. Failure Criteria

This was an exploratory run to see what would happen with the devices. Pins ST1 and ST2 were driven and the outputs monitored. They began to change after 20krad(Si) which was considered a failure. The parameter limits are defined as those listed in the ADXL354/ADXL355 datasheet. DC parameters thresholds were exceeded after run 6.

6. Source Requirements

The total dose source is in a room air source gamma ray facility, which is compliant with MIL-STD-883, Method 1019. Dosimetry is NIST traceable.

7. Bias Conditions and Fixtures

The biased parts were fixtured a 14 pin daughter card mounted into a test fixture board via a ZIF-24 socket on a copper wiring board.

8. Procedure and Setup

General test procedures were in accordance with MIL-STD-883, Method 1019, Condition A. Exposures were performed at ambient laboratory temperature. Approximate cumulative test levels were provided by the values in Table 2.

All data from the evaluation of the parameters were logged in csv formatted files (with a .csv extension) using result logs from the tester. Data for all parts were measured and logged.

9. Results

The device performance was similar until 30krad(Si) at which point the self-test output voltages changed. This was interpreted as a failure. Integrated LDOs were also observed to have deviated to the supply voltage, 3.3V from their specified voltage range after 30 krad(Si). After an additional 10 krad(Si) dose to 40 krad(Si) total, the voltages dropped well below the specified voltage range (see Table 2).