Application Report

INA901-SP Neutron Displacement Damage Characterization

ABSTRACT

This report presents the effect of neutron displacement damage (NDD) on the INA901-SP device. The results show that all devices were fully functional and within production test limits after having been irradiated up to 1 × 10^{13} n/cm^2 (1-MeV equivalent). A sample size of fifteen units was exposed to radiation testing per (MIL-STD-883, Method 1017 for Neutron Irradiation) and an additional unirradiated sample device was used for correlation. All devices used in the experiment were from lot date code 1839. Electrical testing was performed at Texas Instruments before and after neutron irradiation using the production test program for INA901-SP.

Table of Contents

List of Figures

List of Tables

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1 Overview

The INA901-SP device is a voltage-output, current-sense amplifier that can sense drops across shunt resistors at common-mode voltages from –15 V to 65 V, independent of the supply voltage. The INA901-SP operates from a single 2.7-V to 16-V supply, drawing 700 µA (typical) of supply current. The devices are offered in an ultra small, thermally enhanced 8-pin ceramic flatpack package.

General device information and testing conditions are listed in Table 1-1.

Table 1-1. Overview Information

TI Part Number	INA901-SP
Device Function	Synchronous Buck Converter
Technology	LBCSOI
A/T Lot Number / Date Code	1839A
Unbiased Quantity Tested	15
Exposure Facility	VPT Rad
Neutron Fluence (1-MeV equivalent)	1.0×10^{12}, 5.0×10^{12}, 1.0×10^{13} n/cm^2
Irradiation Temperature	25°C
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Figure 1-1. INA901-SP Device

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2 Test Procedures

The INA901-SP was electrically pre-tested using the production automated test equipment program.

General test procedures were IAW MIL-STD-883, Method 1017 for Neutron Irradiation of INA901-SP.

Table 2-1. Neutron Irradiation Conditions

Group	Sample Qty	Neutron Fluence (n/cm^2)	Bias
A	5	1.0×10^{12}	Unbiased
B	5	5.0×10^{12}	Unbiased
C	5	1.0×10^{13}	Unbiased

3 Facility

Devices were exposed via fast neutron irradiation (FNI) at the University of Massachusetts's Lowell Research Reactor (UMLRR). The facility is designed to give a fast flux level ≥ 1011 n/cm^2–s, with relatively low thermal fluence and gamma dose rates. Samples with a cross-sectional area as large as 30 cm (12 in) × 30 cm (12 in) and up to 15-cm (6-in) thick can be irradiated. The fast neutron flux is designed to be nearly uniform over the 30-cm (12-in) × 30-cm (12-in) area facing the core, and the fast fluence variation through the sample thickness is minimized via a single 180° rotation of the sample canister at the midpoint of the irradiation period. The FNI facility offers a significantly larger sample volume than previously available within the University of Massachusetts Lowell Research Reactor (UMLRR).

The fluences are calculated based on 1-MeV equivalences.

Detailed information of the radiation facility is available at the following link:

www.uml.edu/docs/FNI%20Brochure_tcm18-90375.pdf

4 Results

There were no functional failures at any irradiation level. All parametric measurements remained well within all *INA901-SP Radiation Hardened, –15-V to 65-V Common Mode, Unidirectional Current-Shunt Monitor Data Sheet* limits for all exposure levels. All parametric measurements remained well within the production test limits which are guard-banded from the data sheet limits. The full parameter list and graphs are found in Appendix A.

Table 4-1 lists the INA901-SP specification compliance matrix.

Table 4-1. INA901-SP Specification Table

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT	TEST NUMBER
INPUT						
Common-mode rejection ratio	VIN+ = –16 V to 65 V	80	120		dB	5.1
Offset voltage			±0.5	±2.5	mV	3.1
Vos vs power-supply			5	250	µV/V	4.0
Input bias current, Vin-pin			±8	±16	µA	7.2
OUTPUT						
Total gain error	VSENSE = 20 mV to 100 mV		±0.2%	±1.5%		3.0
Total output error			±0.75%	±2%		3.2
VOLTAGE OUTPUT						
Swing to V+ power-supply rail			(V+) – 0.05	(V+) – 0.2	V	6.1
Swing to GND			VGND + 0.003	VGND + 0.05	V	6.0
POWER SUPPLY						
Quiescent current	VOUT = 2 V		700	900	µA	2.4

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Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (February 2019) to Revision B (September 2020)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document.	2
• Updated *Overview Information* table	2
• Updated the *Specification Table*	3

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A Test Results

This appendix contains the detailed test results.

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