

ISOS141-SEP Radiation Tolerant High-Speed, Quad-Channel Digital Isolator TID Report



ABSTRACT

This report covers the radiation characterization results of the ISOS141-SEP Digital Isolator. The study was done to determine Total Ionizing Dose (TID) effects under high dose rate (HDR) up to 30 krad(Si) as a one time characterization. The results show that all samples passed within the specified limits up to 30 krad(Si). However, Radiation Lot Acceptance Testing (RLAT) will be performed using 22 units at a dose level of 20 krad(Si) for future wafer lots. Furthermore, the ISOS141-SEP is packaged in a space enhanced plastic for low outgassing characteristics and is Single Event Latch-Up (SEL) immune up to 43 MeV-cm²/mg making the device suitable for low Earth orbit space applications. The device is ideal for application such as isolating gate drivers or feedback for GaN DC-DC converters, signal isolation, ground noise elimination, and logic level shifting.

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1 Device Information

The ISOS141-SEP is a high-speed, quad-channel digital isolator. The device uses single-ended CMOS logic switching technology. The voltage range is from 2.25 V to 5.5 V for both supplies, V_{CC1} and V_{CC2} . ISOS141-SEP does not conform to any specific interface standard and is only intended for isolating single-ended CMOS or TTL digital signal lines. Each isolation channel has a logic input and output buffer separated by a double capacitive silicon dioxide (SiO_2) insulation barrier. This device comes with enable pins which sets the default output to low if the input power or signal is lost.

1.1 Device Details

[Table 1-1](#) lists the device information used for TID HDR characterization and qualification.

Table 1-1. Device and Exposure Details

TID HDR Details: up to 30 krad(Si)	
TI Device Number	ISOS141-SEP
Package	16-pin DBQ (QSOP)
Technology	LBC8LVISO
Die Lot Number	9358099
A/T Lot Number / Date Code	0852193/OBAT7YT
Quantity Tested	37 irradiated devices + 3 control
Lot Accept/Reject	Devices passed 3 krad(Si), 10 krad(Si), 30 krad(Si)
HDR Radiation Facility	Texas Instruments SVA Group, Santa Clara, CA
HDR Dose Level	3 krad(Si), 10 krad(Si), 30 krad(Si)
HDR Dose Rate	59.2 rad(Si)/s
HDR Radiation Source	Gammacell 220 Excel (GC-220E) Co-60
Irradiation Temperature	Ambient, room temperature

2 Total Dose Test Setup

2.1 Test Overview

The ISOS141-SEP samples were irradiated at a high dose rate of 50-300 rad(Si)/s up to 30 krad(Si) and then put through full electrical parametric testing on the production Automated Test Equipment (ATE). The samples were functional and passed all electrical parametric tests with readings within data sheet electrical specification limits.

2.2 Test Description and Facilities

The ISOS141-SEP HDR exposure was performed on biased devices in a Co60 gamma cell at TI SVA facility in Santa Clara, California. The unattenuated dose rate of this cell is 50-300 rad(Si)/s. After exposure, the devices were packed in dry ice and returned to TI Dallas for a full post irradiation electrical evaluation using Texas Instruments ATE. ATE guard band test limits are set within data sheet electrical specifications to ensure a minimum Cpk and test error margin based on initial qualification and characterization data. Post irradiation measurements were taken within 30 minutes of removal of the devices from the dry ice container. The devices were allowed to reach room temperature prior to electrical post radiation measurements.

2.3 Test Setup Details

The devices were tested in biased conditions as described below:

2.3.1 Biased

Figure 2-1 shows the bias conditions for each pin during irradiation.

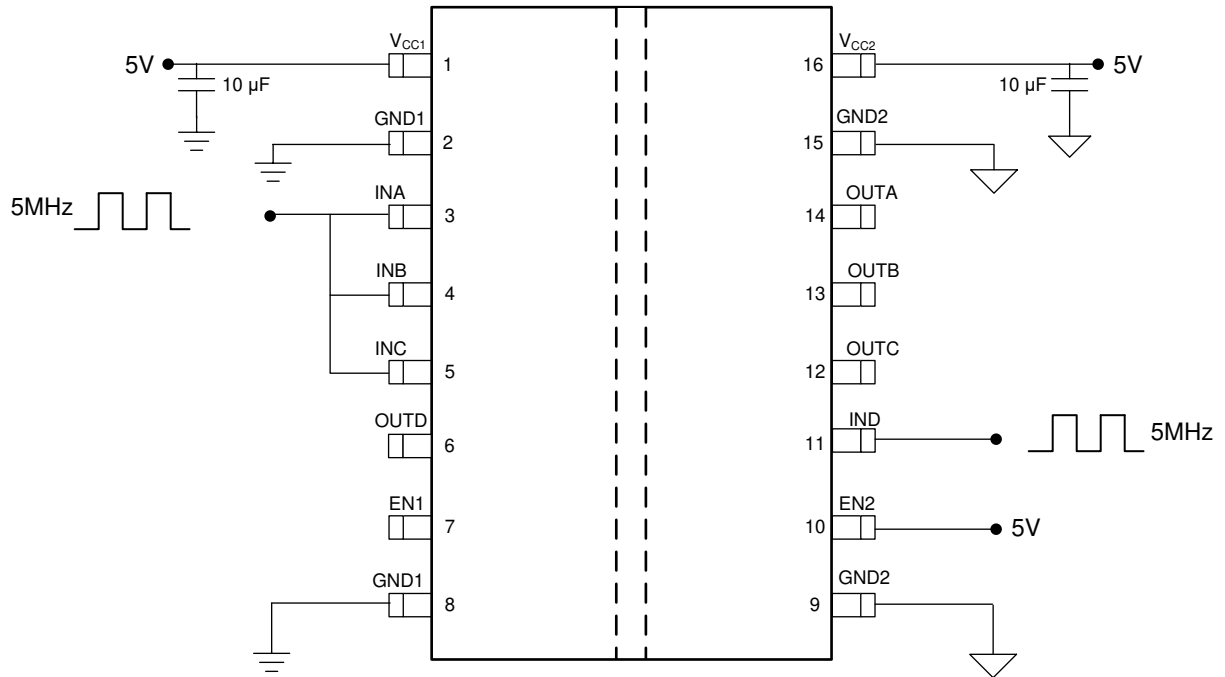


Figure 2-1. ISOS141-SEP Biased Diagram

2.4 Test Configuration and Condition

A step-stress (3k, 10k, and 30k) test method was used to determine the TID hardness level. That is, after a predetermined TID level was reached, an electrical test was performed on a given sample of parts to verify that the units are within specified data sheet electrical test limits. From initial feasibility studies the difference between pre and post irradiation was greater for samples that were biased, hence for RLAT 22 sample units were used at the 50-300 rad(Si)/s dose level with biased setup conditions and this will be repeated for each wafer lot.

The tables below list the serialized samples used for RHA characterization.

Table 2-1. HDR = 59.2 rad(Si)/s Device Information

HDR = 59.2 rad(Si)/s					
Total Samples: 75					
Exposure Levels					
3 krad(Si)		10 krad(Si)		30 krad(Si)	
Biased	Unbiased	Biased	Unbiased	Biased	Unbiased
1, 2, 3, 4, 5	6, 7, 8, 9, 10	11, 12, 13, 14, 15	16, 17, 18, 19, 20	41-70	71, 72, 73, 74, 75

Table 2-2. LDR = 10 mrad(Si)/s Device Information

LDR = 10 mrad(Si)/s					
Total Samples: 56					
Exposure Levels					
3 krad(Si)		10 krad(Si)		30 krad(Si)	
Biased	Unbiased	Biased	Unbiased	Biased	Unbiased
1, 2, 3, 4, 5	6, 7, 8, 9, 10	11, 12, 13, 14, 15	16, 17, 18, 19, 20	21-42	43, 44, 45, 46, 47

3 Total Ionizing Dose (RHA) Characterization Test Results

3.1 Total Ionizing Dose RHA Characterization Summary Results

The parametric data for the ISOS141-SEP is within data sheet limits up to 30 krad(Si) for biased setup conditions.

1. Supply Current - Disable (I_{CC1})

Supply current showed little variation at 30 krad(Si) but is still within data sheet limits. The graphs below show the min, average, and max data post irradiation for each dose level.

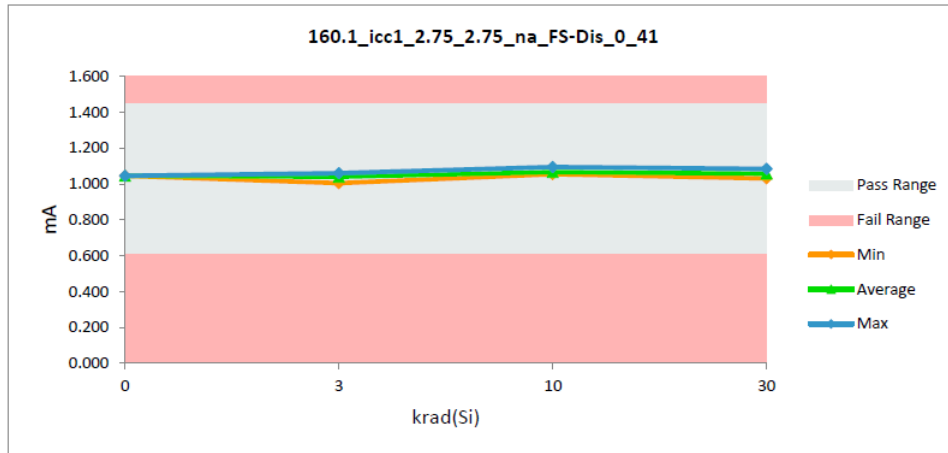


Figure 3-1. Radiation Exposure Effect on Supply Current - Disable

2. Supply Current - Disable (I_{CC2})

Supply current showed little variation at 30 krad(Si) but is still within data sheet limits. The graphs below show the min, average, and max data post irradiation for each dose level.

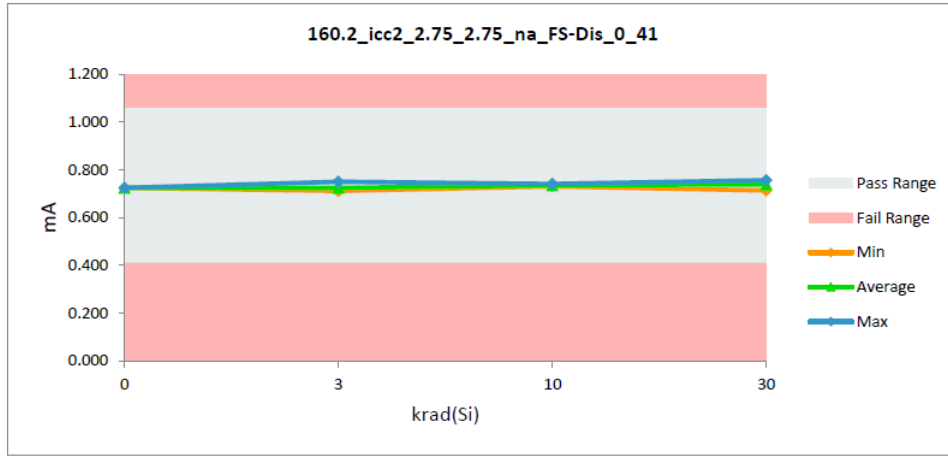


Figure 3-2. Radiation Exposure Effect on Supply Current - Disable

A Total Ionizing Dose HDR Report

This appendix provides the ISOS141-SEP TID HDR report. The report shows the variation for each parameter up to 30 krad(Si).

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