

Total Ionizing Dose Test Report

Z-Series DC-DC Converter

Revision A
March, 2004

International
IOR Rectifier

HI-REL PRODUCTS

TOTAL DOSE TEST REPORT

for

Z - SERIES DC/DC CONVERTER

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1.0 EXECUTIVE SUMMARY OF THE Z-SERIES TID TEST RESULTS

The two models 8716 (Z2802R5S) and 8717 (Z2801R5S) of the Z-Series were tested for Total Ionizing Dose (TID). The purpose of this test was to determine the radiation sensitivities and the total doses that can be exposed to the converters.

1.1 TID

TID were performed at McClellan AFB near Sacramento California. A total of 2 units, one of each model of Z2802R5S and Z2801R5S were tested. The outputs of the units were loaded with a resistive load equal to $\frac{1}{2}$ of the rated maximum. The units were irradiated in a dose rate chamber containing 19,200 Curies of Co_{60} . The chamber was set up to provide a dose rate of approximately 1K rad (SiO_2)/min. A screw driven automatic cart was used to position the units relative to the source to obtain the desired dose rate. Tests were conducted in accordance with MIL-STD-883, Method 1019.5, condition B. After radiation exposure the parts were annealed at 100°C for 160 hours and performed full functional tests.

1.2 CONCLUSION

Both converter models Z2802R5S and Z2801R5S PASSED TID tests successfully without any anomaly. The results of this test will be considered to the completion of the Radiation tests for the Z- SERIES product lines by virtue of their similarity.

2.0 SCOPE

This document describes the test procedures, and results of the Total Dose testing of the Z-Series DC/DC Converters.

3.0 APPLICABLE DOCUMENT

The following documents of the revision in effect at the time of the writing of this document form a part of this drawing to the extent specified herein. In the event of a conflict between any of these specifications and this document, this document shall take precedence.

Military Specifications

MIL-PRF-38534	Hybrid Microcircuits, General Specification
MIL-STD-883	Test Methods and Procedures for Microelectronics

Advanced Analog Specifications

1-172491	Schematic, Z-Series Hybrid, Control Board
1-172492	Schematic, Z-Series Hybrid, Power Board

4.0 DEFINITIONS/TERMS

SOW- Statement of Work
DUT- Device Under Test
SCD- Source Control Drawing
TID- Total Ionizing Dose (units are Krads (Si))

5.0 GENERAL INFORMATION

The Z series uses a single ended switched mode topology to convert a nominal 28-volt DC input into a low voltage DC output. The Z series is a single output device providing the following nominal output voltages and currents.

<u>Model Number</u> <u>Family Number</u>	<u>Output Voltage/Output</u> <u>Current</u>
8716 / Z2802R5S	2.5V / 20A
8717 / Z2801R5S	1.5V / 20A

Table 1. Z-Series Single Output Standard Models

6.0 TEST SAMPLES

The following samples were selected for TID tests:

	Family Type	Lot No	Serial No
1	Z2802R5S	0408	106
2	Z2801R5S	0408	113

Table 3. List of samples

7.0 TOTAL IONIZING DOSE (TID) TEST

7.1 Test Objectives and Failure Criteria

The goal of the TID exposures described herein is to establish that the Z-Series DC/DC converters are capable of withstanding exposure to a steady state TID of greater than 100 KRads (Si) with no significant impairment of performance. Pass / Fail criteria are the electrical test parameters as defined in specification data sheet. The parametric limits as defined are incorporated into the Advanced Analog ATE software used for final acceptance testing.

{xe "4.0 Total Ionizing Dose (TID) Test:4.2 Test Facility and Dosimetry"} Facility and Dosimetry

7.2 Test

The test samples were irradiated at the McClellan AFB near Sacramento California. This facility uses a gamma ray source. The source element is 19,200 Curies of Co₆₀. The source was setup to provide dose rates approximately 1Krad (SiO₂) per minute. Customized ion chamber detectors are used to provide accurate dosimetry (+/- 5%). A screw driven cart drives the DUTs to the desired distance from the source for accurate and repeatable DUT positioning. (See Attached Dosimetry Report)

{xe "4.0 Total Ionizing Dose (TID) Test:4.3 Ionizing Dose Methodology"} Dose Methodology

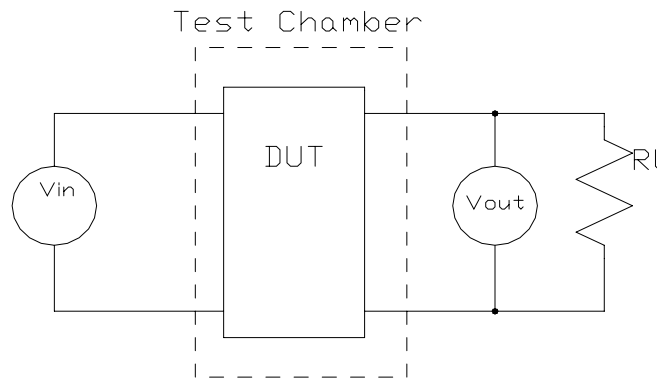
7.3 Ionizing

The total ionizing dose irradiation test sequence was patterned to conform to Method 1019.5 condition B of MIL-STD-883D.

7.4 Irradiation Procedure

The TID test samples were irradiated during five sessions. For Z2502R5S, the first session of 50Krad was accumulated, and additional 50Krad was added for each session. The final session was exposed to a total of 300Krad. For Z2501R5S, the first session of 50Krad was accumulated. During the second session the sample was exposed to an additional 100Krad for a total of 150Krad exposure. The third session had 150Krad of exposure totaling of 300Krad. The four session had additional 100Krad of totaling 400Krad and the final session was exposed to 550Krad.

A total of 2 devices of the Z-Series models were exposed to TID tests. The models tested were the 2.5V and the 1.5V single outputs DC/DC converters. During exposure the converters were biased with 18.5V, 28V and 42.5V input, and loaded on the output with minimum load, nominal load and maximum load. Converters are monitor for input voltage, input current, output voltage, output current and output load transients. Plots for output transients at each irradiation sessions were recorded and measured. After the radiation exposure the parts were annealed at 100°C for 160 hours and performed full functional tests. The TID test schematic is shown on Figure 1.0.



1. $V_{in} = 18.5V, 28V$ and $42.5V$
2. Loads are at min, nom and maximum.
3. All inputs are common.
4. Input Current for all biased DUTs is monitored in parallel
5. Each converter is monitored for line, load regulations and output load transients.

Figure 1. TID Test Schematic

DUTs were mounted to an isoplanar test plate. The plate was positioned relative to the source as to assure uniform exposure of the DUTs. Electronic loads are used for the output loads. DUT input power source were coupled to the test plate via cables, and positioned outside the test chamber, thereby keeping the heat load external to the chamber. Nominal conditions during irradiation were ambient temperature and pressure. No heating or cooling other than the cooling provided by the fixturing itself was provided during exposure. The test plate was contained within a lead-aluminum shield to minimize dose rate enhancement effects as required by TM1019.5.

Complete parametric data for the DUTs was recorded for every exposure session and after 160 hours annealing.

7.5 Electrical Testing

Initial and Final electrical tests were performed using an Advanced Analog production ATE test setup and software. Tests were performed at room temperature and ambient pressure.

7.6 Total Ionizing Dose (TID) Results and Observations

Complete parametric data for all test samples, at initial and final irradiation levels are given in the Appendix. Changes in any of the electrical parameters after TID exposure were minor. Changes of the output voltage and output load transient due to TID exposure are shown in Table 4 and 5. The following trends were also noted:

- 1) There is almost no change with increasing exposure and after annealing for the output voltage. Measurements for output voltage and output load transient were tested by the ATE for pre and post annealing, and manually tested during radiated exposure. Table 3 summarized the changes of the output voltage due to total ionizing dose irradiation and annealing.
- 2) There are almost no change on the output load transient during TID exposure up to 300Krad for model Z2802R5S and 550Krad for model Z2801R5S. Table 4 summarized the changes of the output load transient due to total ionizing dose irradiation and annealing.

Vout (@ 28V, Max load) due to TID Irradiation					
	Model		Model		
	Z2802R5S		Z2801R5S		
	S/N: 106		S/N: 113		
	Vout (V)			Vout (V)	
50Krad	2.530		50Krad	1.565	
100Krad	2.525		150Krad	1.560	
150Krad	2.529		300Krad	1.558	
200Krad	2.520		350Krad	1.558	
250Krad	2.519		450Krad	1.558	
300Krad	2.512		550Krad	1.555	
Post Annealing	2.506		Post Annealing	1.557	

Table 6. Output Voltage change due to TID Irradiation

Output Load Transient (@ 28V, Max load) due to TID Irradiation					
	Model		Model		
	Z2802R5S		Z2801R5S		
	S/N: 106		S/N: 113		
	(mV)			(mV)	
50Krad	59		50Krad	89	
100Krad	59		150Krad	90	
150Krad	58		300Krad	83	
200Krad	62		350Krad	83	
250Krad	60		450Krad	83	
300Krad	61		550Krad	87	
Post Annealing	62		Post Annealing	72	

Table 8. Output Load Transient change due to TID Irradiation