

UC1825A-SP Total Ionizing Dose (TID)

ABSTRACT

This report discusses the results of the Total Ionizing Dose (TID) testing for the Radiation Hardness Assured (RHA), QML Class V certified Texas Instrument’s UC1825A-SP (5962P8768105VEA and 5962P8768105VYC). The RHA qualified UC1825A-SP passes up to 30 krad (Si), Low Dose Rate (LDR) TID.

NOTE: For questions or comments, contact hirelmarketing@list.ti.com.

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1 Device Information

The UC1825A-SP PWM controller is a radiation-hardened version of the standard UC1825 family. Performance enhancements have been made to several of the circuit blocks. This error amplifier gain bandwidth product is 12 MHz, while input offset voltage is 2 mV. Current limit threshold is assured to a tolerance of 5%. Oscillator discharge current is specified at 10 mA for accurate dead-time control. Frequency accuracy is improved to 6%. Start-up supply current, typically 100 μ A, is ideal for offline applications. The output drivers are redesigned to actively sink current during UVLO at no expense to the start-up current specification. In addition each output is capable of 2-A peak currents during transitions. It has been RHA qualified to 30 krad (Si) under LDR. It is orderable under SMD 5962P8768105VEA in our 16-pin J ceramic DIP package and 16-pin HKT ceramic flat pack package with SMD 5962P8768105VYC.

1.1 Device Details

Table 1 lists the device information used in the initial RHA TID characterization and qualification of LDR tests. Current production lot RLAT data is always found in the Group E report shipped. The process for pulling the group E report is described in *TI QMLV Lot Documents Summary (SBOA140)*.

Table 1. Device and Exposure Details

TID LDR Details: up to 45 krad (Si)	
TI Device Number	UC1825A-SP (5962P8768105VEA)
Package	16-Pin Ceramic DIP (J) and 16-Pin Ceramic Flatpack (HKT)
Technology	Bipolar Process (J1 Bipolar)
Die Lot Number	6009948SHE
A/T Lot Number / Date Code	6002578MMT (LTC: 1614A)
Quantity Tested	57 devices including 3 control devices
Lot Accept/Reject	Devices passed 3 krad (Si), 10 krad (Si), 30 krad (Si), 45 krad (Si) ⁽¹⁾
LDR Radiation Facility	RAD/Aeroflex in Colorado Springs, Colorado
LDR Dose Level	3 krad (Si), 10 krad (Si), 30 krad (Si), 45 krad (Si) ⁽¹⁾
LDR Dose Rate	0.01 rad/s
LDR Radiation Source	Gammacell JLSA 81-24 Co-60
Irradiation Temperature	Ambient, room temperature

⁽¹⁾ 45 krad (Si) units pass, per MIL-STD-883 1019.9, Paragraph 3.13.3.b acceleration annealing test.



Figure 1. Device Used in Exposure

2 Total Dose Test Setup

2.1 Test Overview

The UC1825A-SP was tested according to MIL-STD-883J, Test Method 1019.9. For this testing, Condition D was used. For this test, the product was irradiated up to 1.5 times the rated radiation level and then put through full electrical parametric testing on the production Automated Test Equipment (ATE). The device was functional and passed all parametric tests (within guard bands) of the Standard Microcircuit Drawing (SMD) electrical specification limits.

The UC1825A-SP J1 Bipolar technology contains only bipolar components; therefore, an Enhanced Low Dose Rate Sensitivity (ELDRS) study was performed to determine if the device has a LDR sensitivity.

2.2 Test Description and Facilities

The UC1825A-SP LDR exposure was performed on biased and unbiased devices in a Co60 gamma cell under a 10 mrad (Si)/sec exposure rate. The dose rate of the irradiator used in the exposure ranges from < 10 mrad (Si)/sec to a maximum of approximately 65 rad (Si)/sec, determined by the distance from the source. For the LDR (10 mrad (Si)/sec) exposure, the test box was positioned approximately 2 m from the source. The exposure boards are housed in a lead-aluminum box (as specified in MIL-STD-883 TM 1019.9) to harden the gamma spectrum and minimize dose enhancement effects. The irradiator calibration is maintained by Logmire Laboratories using Thermoluminescence Dosimeters (TLDs) traceable to the National Institute of Standards and Technology (NIST) and the dosimetry was verified using TLDs prior to the radiation exposures. After exposure, the devices were packed in dry ice (per MIL-STD-883 Method 1019.9 section 3.10) and returned to TI Dallas for a full post radiation electrical evaluation using Texas Instruments production ATE. ATE guard band test limits are set within SMD electrical limits to ensure a minimum Cpk and test error margin based on initial qualification and characterization data. Post radiation 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 under LDR exposure were tested in both biased and unbiased conditions in two conditions as described in this section.

2.3.1 Unbiased

For the unbiased LDR conditions, the exposure was performed with all pins grounded.

2.3.2 Biased

Figure 2 shows the diagram for LDR exposure.

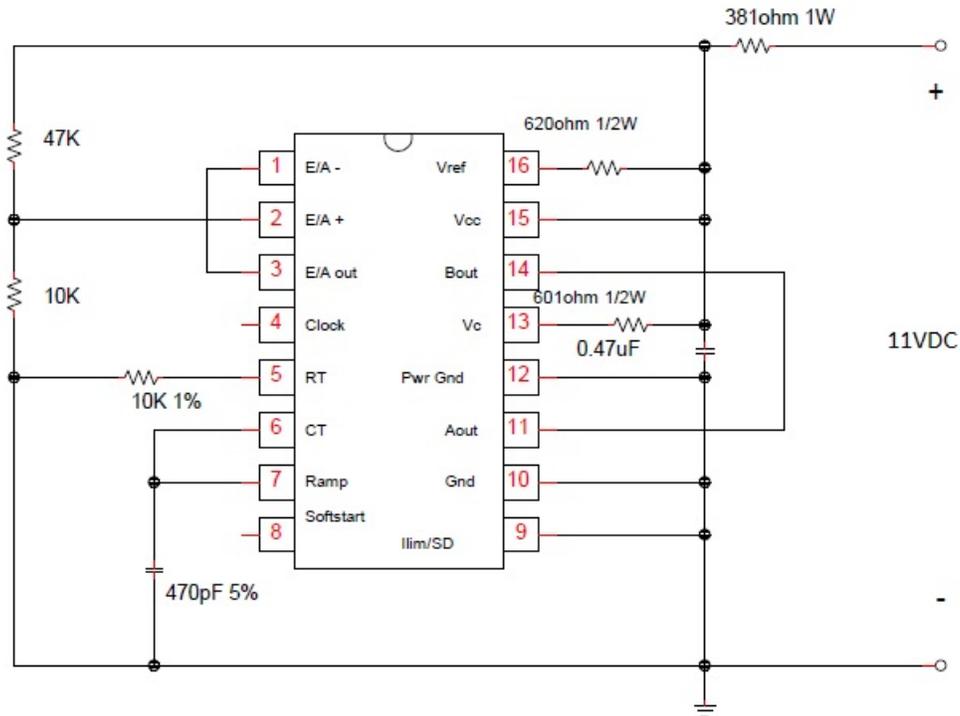


Figure 2. Bias Diagram Used in TID Exposure

2.4 Test Configuration and Condition

A step-stress (3 krad, 10 krad, 30 krad, and 45 krad) 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 SMD electrical test limits. MIL-STD-883, Test Method 1019.9, Condition D was used in this case. If this passes, then the wafer lot can be certified as an RHA wafer lot.

Table 2 lists the samples used during the RHA characterization.

Table 2. LDR = 10 mrad (Si)/sec Device and Exposure Information (LDR)

Total Samples: 10/dose rate (5 biased + 5 unbiased)			
Wafer 1 – Unit Number			
3 krad (Si)	10 krad (Si)	30 krad (Si)	45 krad (Si) – RLAT Included
Biased	Biased	Biased	Biased
002, 004, 005, 012, 055	002, 004, 005, 012, 055	002, 004, 005, 012, 055	057, 061, 063, 066, 077, 081, 085, 091, 092, 094, 096, 102, 112, 122, 125, 142, 147, 148, 149, 153, 156, 158
Unbiased	Unbiased	Unbiased	Unbiased
030, 034, 036, 045, 054	030, 034, 036, 045, 054	030, 034, 036, 045, 054	164, 166, 167, 169, 175, 176, 178, 179, 181, 185, 186, 189, 192, 193, 196, 200, 205, 215, 218, 223, 228, 232

Control Unit: 241, 243, 244 (wafer 1)

3 Total Ionizing Dose (RHA) Characterization Test Results

3.1 Total Ionizing Dose RHA Characterization Summary Results

The parametric data for the UC1825A-SP passes up to 30 krad (Si), LDR TID.

The drift of SMD electrical parameters through LDR were within the pre-rad characterization limits. The device does exhibit a slight Low Dose Rate Sensitivity in the Vref parameter, but remains within the pre-radiation electrical limits at 30 krad Total Dose Level, as allowed by MIL-STD-883, TM1019. The device is tested to maximum total dose of 45 krad (Si) per MIL-TD-883, TM1090 condition D.

The UC1825A-SP passed post electrical test over all the following conditions, indicating that this lot can be certified as 30 krad RHA:

- LDR (0.01 rad/sec) unbiased: Post 3 krad (Si), 10 krad (Si), 30 krad (Si), 45 krad (Si)
- LDR (0.01 rad/sec) biased: Post 3 krad (Si), 10 krad (Si), 30 krad (Si), 45 krad (Si)

NOTE: 45 krad (Si) units pass, per MIL-STD-883 1019.9, Condition D, section 3.12 accelerated annealing test

3.2 Group E Full RHA Radiation Lot Acceptance (RLAT) Report

The Group E RHA RLAT summary is shipped with each TI RHA QMLV product. To see the full list of all documents shipped with TI QMLV products review our *TI QMLV Lot Documents Summary* ([SBOA140](#)). This document also has instructions on how to pull the full RHA (Group E) report.

4 Applicable and Reference Documents

4.1 Applicable Documents

UC1825A-SP Class-V, Radiation Hardened High-Speed PWM Controller Datasheet ([SLUS873](#))

4.2 Reference Documents

Texas Instruments total ionizing dose radiation (total dose) test procedure follows the standards put forth in [MIL-STD-883](#) TM 1019. The document is found at the DLA website.

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