



ABSTRACT

This report discusses the results of the Total Ionizing Dose (TID) testing for the QML Class V certified Texas Instruments (TI) UC1825B-SP (596R876806VYC).

The study helps determine the TID effects under low dose rate (LDR) up to 100krad(Si). The results show that all samples are fully functional after being exposed up to 100krad(Si).

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1 Device Information

1.1 Product Description

The UC1825B-SP is a high-speed PWM controller and designed to use in either current-mode or voltage-mode system. Particular care is given to minimizing propagation delays through the comparators and logic circuitry while maximizing bandwidth and slew rate of the error amplifier.

The UC1825B-SP features totem pole outputs designed to source and sink high peak currents from capacitive loads.

The UC1825B-SP operates from supply of 10V to 30V, with low start up current of 1.1mA. The devices are specified over the extended operating temperature range of -55°C to 125°C and are offered in a 16-pin CFP package.

1.2 Device Details

Table 1-1 lists the device information used in the initial TID LDR characterization.

Table 1-1. Device and Exposure Details

TID LDR Details: Up to 100 krad(Si)	
TI Device Number	UC1825B-SP (5962R8768106VYC)
Package	16-pin Ceramic Flatpack HKT
Technology	Bipolar Process (JI)
Quantity Tested	62
Die Lot Number	8068289SHE
A/T Lot Number / Date Code	8005223MMT / 1827B
Lot Accept/Reject	Devices functional up to 100krad(Si)
LDR Radiation Facility	RAD/Aeroflex in Colorado Springs, Colorado
LDR Dose Level	3krad(Si), 10krad(Si), 30 krad(Si), 50krad(Si), 100krad(Si)
LDR Dose Rate	0.01rad(Si)/s
LDR Radiation Source	^{60}Co gamma cell
Irradiation Temperature	Ambient, room temperature



Figure 1-1. Device Used in Exposure

2 Total Dose Test Setup

2.1 Test Overview

The UC1825B-SP is tested according to MIL-STD-883J, Test Method 1019.9. For this testing, Condition D is used. For this test, the product is irradiated up to the rated radiation level and then put through full electrical parametric testing on the production Automated Test Equipment (ATE). The device is functional through the testing and passed all parametric tests (within guard bands) of the Standard Microcircuit Drawing (SMD) electrical specification limits.

2.2 Test Description and Facilities

The UC1825B-SP LDR exposure is performed on biased and unbiased devices in a ^{60}Co gamma cell under a 10mrad(Si)/s exposure rate. The dose rate of the irradiator used in the exposure ranges from < 10mrad (Si)/s to a maximum of approximately 65rad(Si)/s, determined by the distance from the source. For the LDR (10mrad(Si)/s) exposure, the test box is positioned approximately 2m 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 is verified using TLDs prior to the radiation exposures. After exposure, the devices are returned to the TI Dallas facility for a full post radiation electrical evaluation using TI production Automated Test Equipment (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.

2.3 Test Setup Details

The devices under LDR exposure were tested in both biased and unbiased conditions as described in the following two sections.

2.3.1 Unbiased

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

2.3.2 Biased

[Figure 2-1](#) depicts the bias diagram used in biased LDR testing.

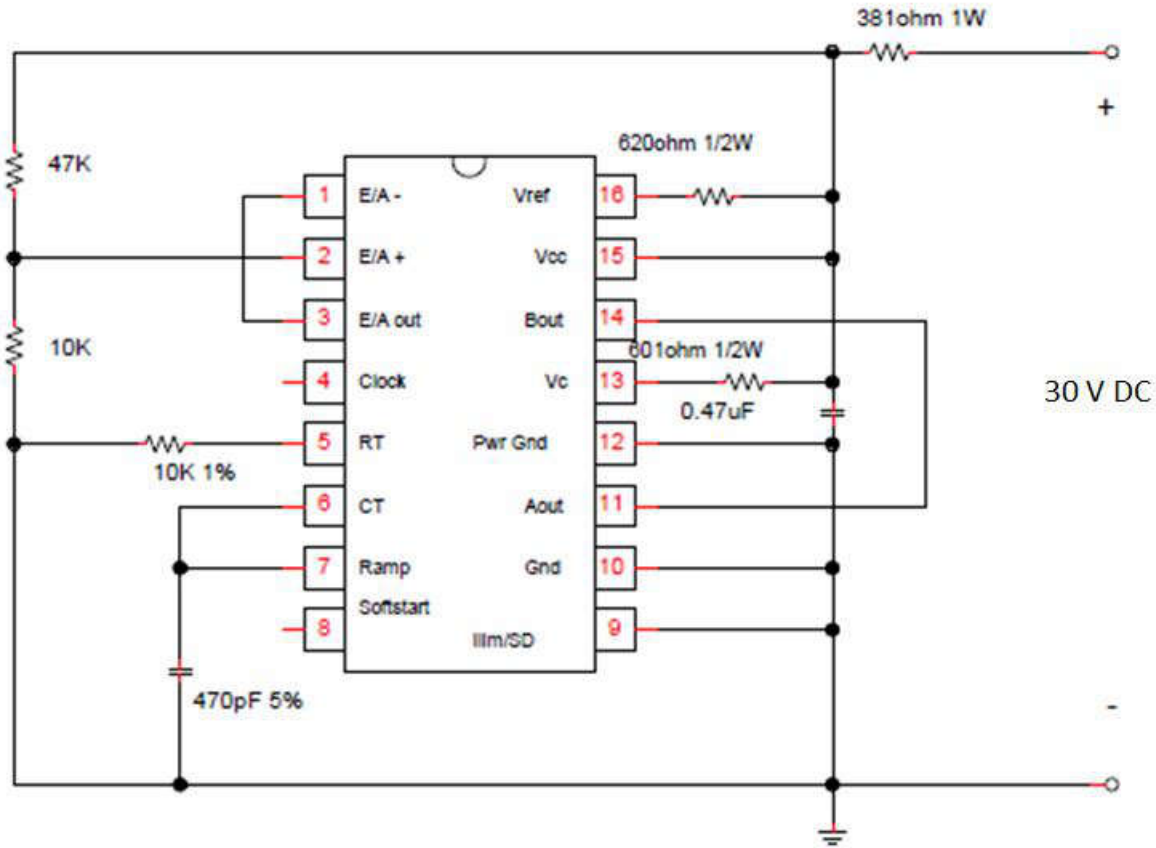


Figure 2-1. Bias Diagram Used in TID Exposure

2.4 Test Configuration and Conditions

A step-stress (3krad, 10krad, 30 krad, and 45krad) test method is used to determine the TID hardness level. That is, after a predetermined TID level is reached, an electrical test is 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 is used in this case. If this passes, then the wafer lot can be certified as an RHA wafer lot.

[Table 2-1](#) lists the samples used during the RHA characterization.

Table 2-1. LDR = 10mrad (Si)/sec Device and Exposure Information

TOTAL SAMPLES: 10 PER DOSE RATE (5 BIASED + 5 UNBIASED)				
WAFER 1 - UNIT NUMBER				
3krad (Si)	10krad (Si)	30krad (Si)	50krad (Si)	100krad (Si)
Biased	Biased	Biased	Biased	Biased
N/A	173, 176, 179, 180, 181	182, 183, 184, 185, 186	187, 192, 193, 195, 196	210, 211, 214, 220, 228
3krad (Si)	10krad (Si)	30krad (Si)	50krad (Si)	100krad (Si)
Unbiased	Unbiased	Unbiased	Unbiased	Unbiased
42, 43, 47, 50, 53	54, 55, 56, 57, 58	61, 62, 63, 65, 67	69, 70, 72, 73, 74	86, 87, 89, 91, 92, 93, 95, 97, 99, 100, 102, 103, 104, 106, 108, 109, 153, 154, 155, 156, 157, 158

3 TID Characterization Results

Devices are functional after being exposed to 100krad(Si). Full results are listed in [Appendix A](#).

3.1 Device Spec Table

[Table 3-1](#) lists the device data sheet along with the corresponding ATE test that accompanies it.

Table 3-1. UC1825B-SP Spec Table

PARAMETER	TEST CONDITION	SLUSDD5				TEST # OR NAME
REFERENCE						
Output voltage	TJ = 25°C, IO = 1mA	5.02	5.10	5.18	V	1015.2__VREF_15 V_1 mA
						1015.3__VREF_30 V_1 mA
						1015.4__VREF_15 V_10 mA
						1015.5__VREF_30 V_10 mA
Line regulation	10V < VCC < 30V		2	20	mV	1015.6__VREF_Line_Reg
Load regulation	1mA < IO < 10mA		5	20	mV	1015.7__VREF_Load_Reg
OSCILLATOR SECTION						
Initial accuracy	TJ = 25°C	360	400	440	kHz	1020.1__Osc_Freq @ 15 V
						1020.1__Osc_Freq @ 30 V
ERROR AMPLIFIER						
Input offset voltage				10	mV	1025.1__Vio
SOFT_START						
Charge current	VSoftStart = 0.5V	3	9	20	µA	1040.1__Charge Current
Discharge current	VSoftStart = 1 V	1			µA	1040.2__Discharge Current
OUTPUT						
Low-level output voltage	IOOUT = 20mA		.25	.40	V	1045.2__VOL(OUTA) @ 20 mA
						1045.4__VOL(OUTB) @ 20 mA
	IOOUT = 200mA		1.2	2.2	V	1045.3__VOL(OUTA) @ 200 mA
						1045.5__VOL(OUTB) @ 200 mA
High-level output voltage	IOOUT = -20mA	13.0	13.5		V	1045.8__VOH(OUTB) @ 20 mA
						1045.10__VOH(OUTA) @ 20 mA
	IOOUT = -200mA	12.0	13.0		V	1045.9__VOH(OUTB) @ 200 mA
						1045.11__VOH(OUTA) @ 200 mA
UNDER-VOLTAGE LOCKOUT						
Start threshold		8.8	9.2	9.6	V	1010.5__VV UVLO ON
UVLO hysteresis		0.4	0.8	1.2	V	1010.&__UVLO Hysteresis
SUPPLY CURRENT SECTION						
Startup current	VCC = 8V		1.1	2.5	mA	1010.1__ICC @ 8 V
ICC	VINV = VRamp = VILIM/SD = 0V, VNI = 1V		22	33	mA	1010.3__ICC @ 15 V

4 Applicable and Reference Documents

4.1 Applicable Documents

Texas Instruments, [Class-V, radiation hardened high-speed PWM controller data sheet](#)

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 can be found at the DLA website.

5 Revision History

Changes from Revision * (March 2019) to Revision A (June 2024)	Page
• Updated LDR = 100mrad to LDR 10mrad	4

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