Radiation Report

ADC3683-SEP Total Ionizing Dose (TID) Radiation Report

ABSTRACT

This report covers the radiation characterization results of the ADC3683-SEP which is a space grade 18-bit 65MSPS, Low Noise, Ultra-low Power Dual Channel ADC. The study was done to determine Total Ionizing Dose (TID) effects under high dose rate (HDR) up to 50krad(Si) as a one-time characterization. The results show that all samples passed within the specified limits up to 50krad(Si).

In production, the Radiation Lot Acceptance Testing (RLAT) is performed using 5 units on every fab-lot to the specified rating of 30krad(Si). Furthermore, the ADC3683-SEP has a Single Event Latch-Up (SEL) immunization up to 43MeV-cm2/mg which makes it suitable for Radiation Hardness Assured Space Applications in LEO and MEO.

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Trademarks

1 Device Information

The ADC3683-SEP is a low noise, ultra-low power, 18-bit, 65MSPS, dual channel ADC. Designed for lowest noise performance, the device delivers a noise spectral density of -160dBFS/Hz combined with excellent linearity and dynamic range. The ADC3683-SEP offers DC precision together with IF sampling support making the device an excellent choice for a wide range of applications. High-speed control loops benefit from the short latency as low as only 1 clock cycle. The ADC consumes only 94mW/ch at 65-MSPS and the power consumption scales well with lower sampling rates.

The device uses a serial LVDS (SLVDS) interface to output the data which minimizes the number of digital interconnects. The device supports two-lane, one-lane and half-lane options. The device comes in a 40-pin RSB package (5mm x 5mm) with NiPdAu lead-finish and supports a temperature range from -55 to +105°C. The ADC3683-SEP is pin-to-pin compatible with other ADC36xx family devices in the RSB package.

1.1 Device Details

Table 1-1. Device and Exposure Details

TID HDR Details	
TI device number	ADC3683RSBTSEP
Package	40-RSB
Technology	C021
Die lot number	1188998DM6
Device / package lot number	2887538CL2
Lot trace code (LTC)	2BAG7GI
Quantity tested	15
Lot accept / reject	5 / 0
HDR radiation facility	Texas Instruments CLAB, Dallas, TX
HDR dose level	10-50krad (Si)
HDR dose rate	200rads (Si) / sec
HDR irradiation temperature	Ambient, room temperature
Radiation test date	6/26/2024
Test Method	MIL-STD-883 and MIL-STD-750

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2 Total Dose Test Setup

2.1 Test Overview

The ADC3683-SEP was tested according to MIL-STD-883, Test Method 1019.9, Conditions A. For this test, the product was irradiated up to the target radiation level, and then put through full electrical parametric testing on the production Automated Test Equipment (ATE). All devices remained functional passing all parametric test limits.

2.2 Test Description and Facilities

The ADC3683-SEP HDR exposure was performed on biased devices at TI CLAB facility in Dallas, Texas. The dose rate of the exposure was between 200-260rad(Si)/s. After the exposure, the devices were electrically tested at TI CLAB facility. The electrical test guard-band limits were set within the data sheet electrical specifications to maintain a minimum Cpk and test error margin based on initial qualification and characterization data.

2.3 Test Setup Details

The devices were tested in biased conditions as described below.

2.3.1 Biased

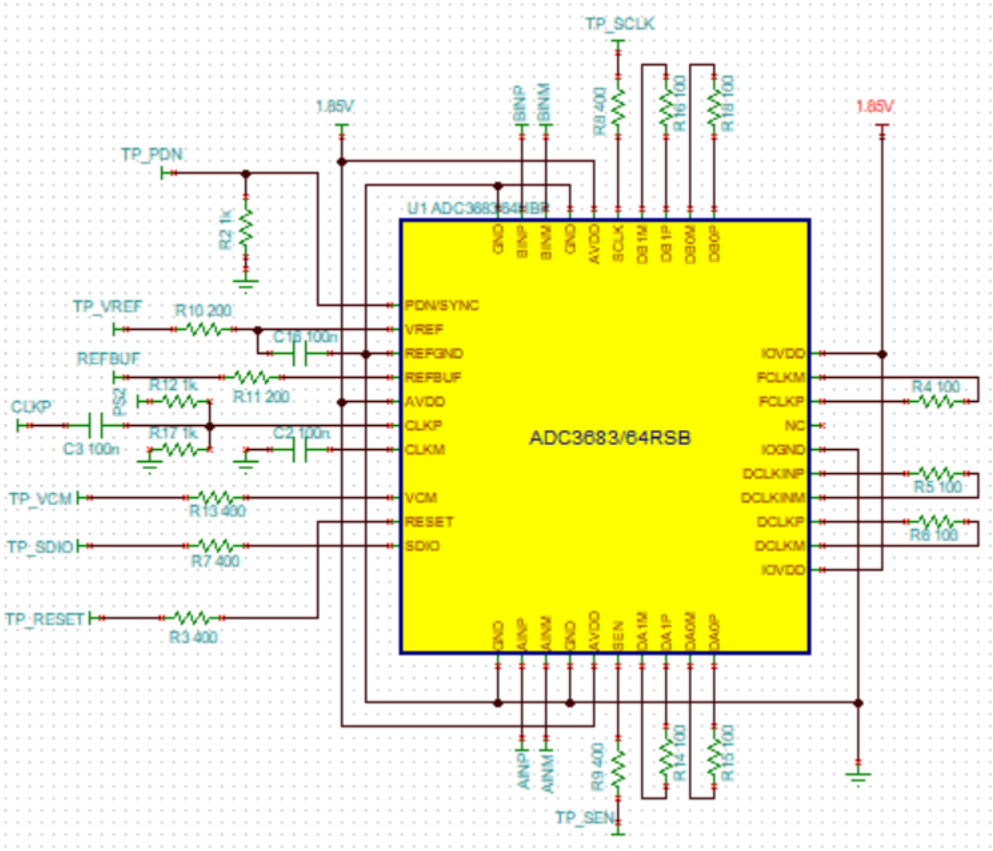


Figure 2-1. Device Biased Conditions During Radiation

2.4 Test Configuration and Condition

Table 2-1. HDR Biased Conditions

Total Samples: 15		
Exposure Levels		
10krad(Si), 5 ea.	30krad(Si), 5 ea.	50krad(Si), 5 ea.
Passed	Passed	Passed

TID Characterization Test Results

ADC3683-SEP passed HDR up to 50krad at the maximum recommended operating conditions. The drifts of critical parameters were within the specification. All units passed.

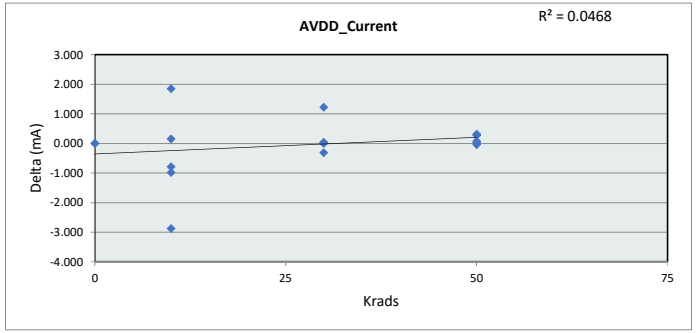
A Total Ionizing Dose HDR Report Appendix

This appendix provides the ADC3683-SEP TID HDR report. The report shows the variation for critical parameters up to 50krad(Si). ADC3683-SEP passed HDR up to 50krad at maximum recommended operating conditions.

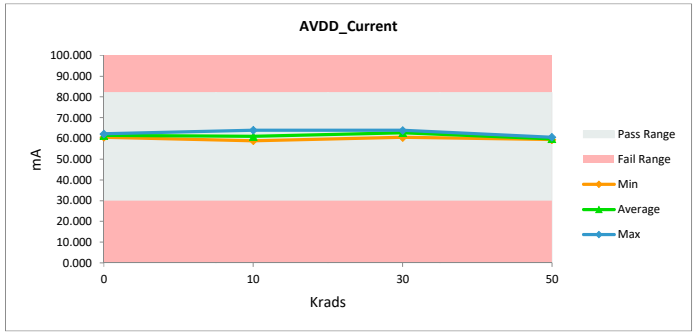
TID Report
ADC3683-SEP

	AVDD_Current	
Test Site		
Tester		
Test Number		
Unit	mA	mA
Max Limit	82	82
Min Limit	30	30

Krads	Serial #	Pre	Post	Delta
10	1	57.882	58.865	-0.984
10	2	61.540	61.383	0.157
10	3	58.590	59.377	-0.787
10	4	61.029	63.901	-2.872
10	5	62.996	61.147	1.849
30	6	63.862	63.862	0.000
30	7	63.075	63.036	0.039
30	8	60.124	60.439	-0.315
30	9	63.351	62.131	1.220
30	10	63.744	63.705	0.039
50	11	59.691	59.377	0.315
50	12	59.416	59.455	-0.039
50	13	60.164	60.085	0.079
50	14	60.872	60.596	0.275
50	15	59.652	59.613	0.039
0	16	62.170	62.170	0.000
0	17	60.596	60.596	0.000
	Max	63.862	63.901	1.849
	Average	61.103	61.161	-0.058
	Min	57.882	58.865	-2.872
	Std Dev	1.841	1.697	0.968

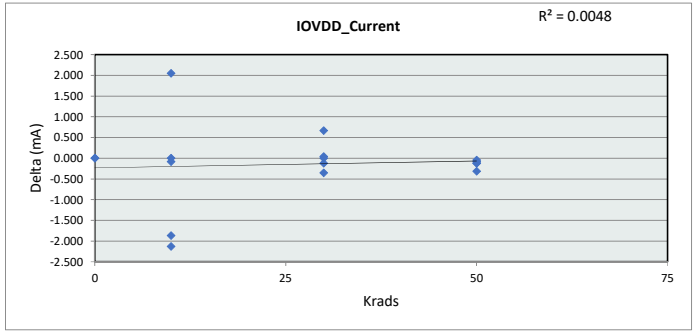


	AVDD_Current			
Test Site				
Tester				
Test Number				
Max Limit	82	mA		
Min Limit	30	mA		
Krads	0	10	30	50
LL	30.000	30.000	30.000	30.000
Min	60.596	58.865	60.439	59.377
Average	61.383	60.935	62.635	59.825
Max	62.170	63.901	63.862	60.596
UL	82.000	82.000	82.000	82.000

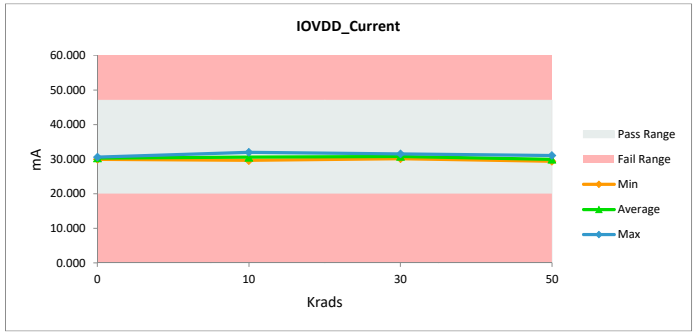


TID Report
ADC3683-SEP

	IOVDD_Current		
Test Site			
Tester			
Test Number			
Unit	mA	mA	
Max Limit	47	47	
Min Limit	20	20	
Krads	Serial #	Pre	Post	Delta
10	1	29.500	29.579	-0.079
10	2	29.724	31.590	-1.866
10	3	29.657	29.657	0.000
10	4	29.855	31.985	-2.130
10	5	31.788	29.736	2.051
30	6	31.512	31.472	0.039
30	7	31.512	31.512	0.000
30	8	30.052	30.170	-0.118
30	9	31.078	30.407	0.671
30	10	29.973	30.328	-0.355
50	11	29.105	29.421	-0.316
50	12	29.934	29.973	-0.039
50	13	29.421	29.539	-0.118
50	14	30.920	31.038	-0.118
50	15	29.855	29.934	-0.079
0	16	30.604	30.604	0.000
0	17	29.934	29.934	0.000
Max		31.788	31.985	2.051
Average		30.260	30.405	-0.145
Min		29.105	29.421	-2.130
Std Dev		0.815	0.822	0.888

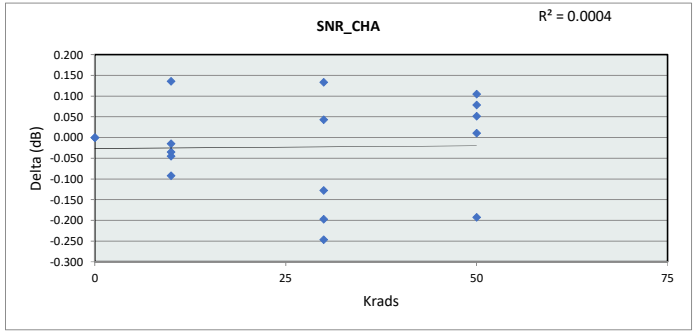


	IOVDD_Current			
Test Site				
Tester				
Test Number				
Max Limit	47	mA		
Min Limit	20	mA		
Krads	0	10	30	50
LL	20.000	20.000	20.000	20.000
Min	29.934	29.579	30.170	29.421
Average	30.269	30.510	30.778	29.981
Max	30.604	31.985	31.512	31.038
UL	47.000	47.000	47.000	47.000

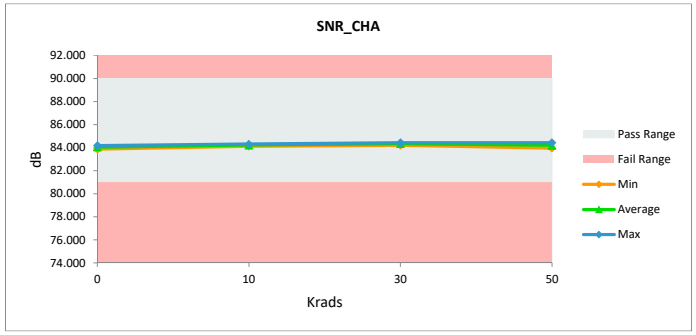


TID Report
ADC3683-SEP

	SNR_CHA		
Test Site			
Tester			
Test Number			
Unit	dB	dB	
Max Limit	90	90	
Min Limit	81	81	
Krads	Serial #	Pre	Post	Delta
10	1	84.100	84.116	-0.015
10	2	84.185	84.220	-0.035
10	3	84.248	84.293	-0.045
10	4	84.370	84.234	0.136
10	5	84.137	84.230	-0.092
30	6	84.111	84.358	-0.247
30	7	84.440	84.397	0.043
30	8	84.350	84.217	0.133
30	9	84.112	84.309	-0.197
30	10	84.298	84.426	-0.127
50	11	84.115	84.036	0.079
50	12	84.221	84.414	-0.193
50	13	84.380	84.275	0.105
50	14	84.233	84.222	0.011
50	15	84.003	83.951	0.052
0	16	83.868	83.868	0.000
0	17	84.190	84.190	0.000
Max		84.440	84.426	0.136
Average		84.198	84.221	-0.023
Min		83.868	83.868	-0.247
Std Dev		0.146	0.156	0.116



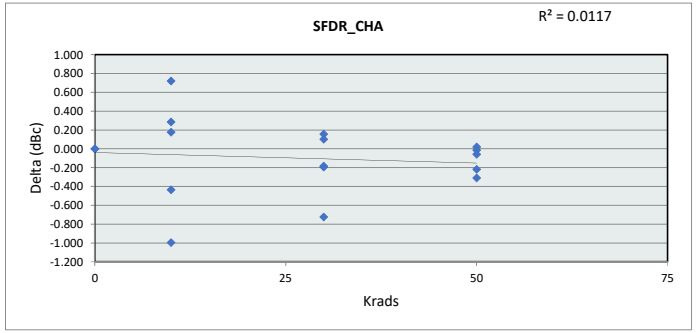
	SNR_CHA			
Test Site				
Tester				
Test Number				
Max Limit	90	dB		
Min Limit	81	dB		
Krads	0	10	30	50
LL	81.000	81.000	81.000	81.000
Min	83.868	84.116	84.217	83.951
Average	84.029	84.218	84.341	84.180
Max	84.190	84.293	84.426	84.414
UL	90.000	90.000	90.000	90.000



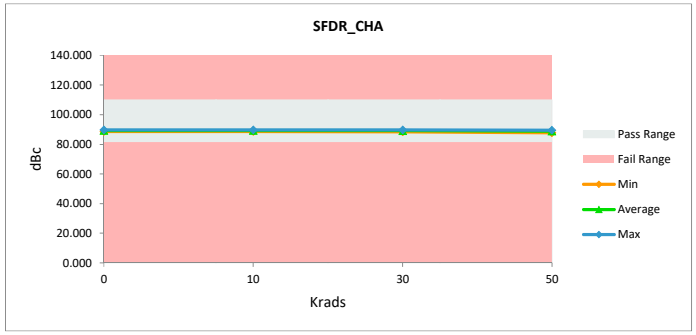
TID Report
ADC3683-SEP

	SFDR_CHA	
Test Site		
Tester		
Test Number		
Unit	dBc	dBc
Max Limit	110	110
Min Limit	81.5	81.5

Krads	Serial #	Pre	Post	Delta
10	1	89.415	89.237	0.178
10	2	88.979	89.415	-0.436
10	3	89.680	89.395	0.285
10	4	88.705	89.700	-0.995
10	5	89.421	88.700	0.721
30	6	88.990	89.713	-0.723
30	7	88.772	88.966	-0.195
30	8	88.593	88.436	0.157
30	9	88.730	88.913	-0.183
30	10	89.719	89.619	0.100
50	11	88.777	88.792	-0.015
50	12	87.770	87.749	0.021
50	13	89.066	89.376	-0.310
50	14	89.448	89.507	-0.059
50	15	89.215	89.432	-0.217
0	16	89.804	89.804	0.000
0	17	88.641	88.641	0.000
	Max	89.804	89.804	0.721
	Average	89.043	89.141	-0.098
	Min	87.770	87.749	-0.995
	Std Dev	0.516	0.549	0.389



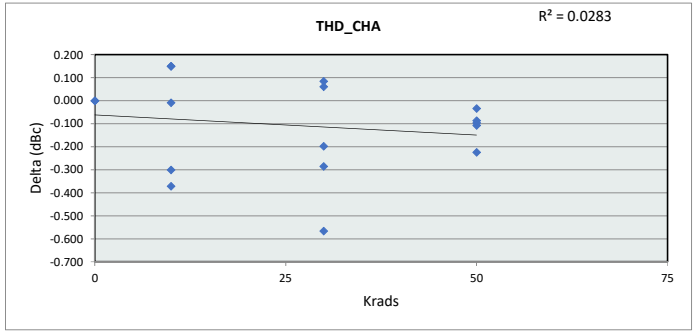
	SFDR_CHA			
Test Site				
Tester				
Test Number				
Max Limit	110	dBc		
Min Limit	81.5	dBc		
Krads	0	10	30	50
LL	81.500	81.500	81.500	81.500
Min	88.641	88.700	88.436	87.749
Average	89.223	89.289	89.129	88.971
Max	89.804	89.700	89.713	89.507
UL	110.000	110.000	110.000	110.000



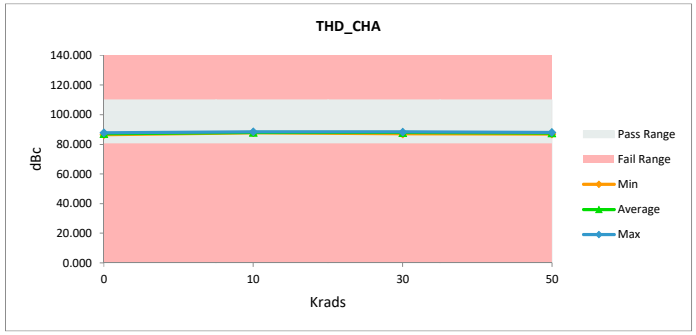
TID Report
ADC3683-SEP

	THD_CHA	
Test Site		
Tester		
Test Number		
Unit	dBc	dBc
Max Limit	110	110
Min Limit	80.5	80.5

Krads	Serial #	Pre	Post	Delta
10	1	87.823	87.832	-0.009
10	2	87.769	88.071	-0.301
10	3	87.972	87.822	0.150
10	4	88.079	88.451	-0.372
10	5	88.271	88.122	0.149
30	6	87.239	87.806	-0.566
30	7	87.564	87.849	-0.285
30	8	87.031	86.970	0.061
30	9	87.880	88.078	-0.199
30	10	88.379	88.296	0.084
50	11	87.009	87.096	-0.087
50	12	86.812	86.845	-0.033
50	13	87.331	87.556	-0.225
50	14	87.892	87.989	-0.096
50	15	87.882	87.990	-0.107
0	16	86.586	86.586	0.000
0	17	87.757	87.757	0.000
	Max	88.379	88.451	0.150
	Average	87.605	87.713	-0.108
	Min	86.586	86.586	-0.566
	Std Dev	0.518	0.530	0.195



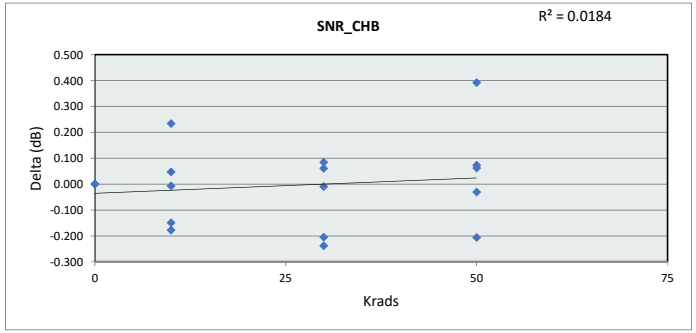
	THD_CHA			
Test Site				
Tester				
Test Number				
Max Limit	110	dBc		
Min Limit	80.5	dBc		
Krads	0	10	30	50
LL	80.500	80.500	80.500	80.500
Min	86.586	87.822	86.970	86.845
Average	87.172	88.060	87.800	87.495
Max	87.757	88.451	88.296	87.990
UL	110.000	110.000	110.000	110.000



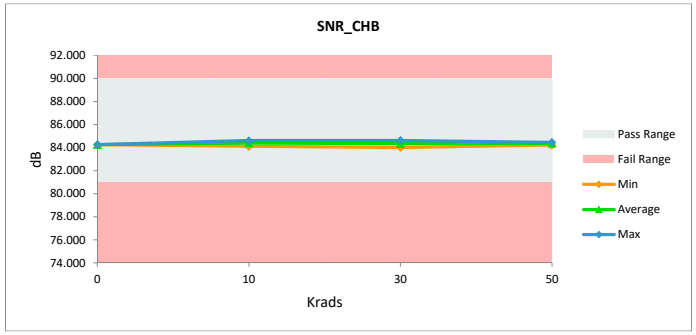
TID Report
ADC3683-SEP

	SNR_CHB	
Test Site		
Tester		
Test Number		
Unit	dB	dB
Max Limit	90	90
Min Limit	81	81

Krads	Serial #	Pre	Post	Delta
10	1	84.593	84.600	-0.007
10	2	84.338	84.104	0.234
10	3	84.277	84.427	-0.150
10	4	84.260	84.437	-0.177
10	5	84.425	84.377	0.048
30	6	84.488	84.404	0.085
30	7	84.060	83.999	0.061
30	8	84.257	84.462	-0.205
30	9	84.187	84.197	-0.010
30	10	84.380	84.618	-0.238
50	11	84.236	84.442	-0.207
50	12	84.355	84.385	-0.030
50	13	84.411	84.349	0.062
50	14	84.846	84.453	0.392
50	15	84.285	84.211	0.074
0	16	84.271	84.271	0.000
0	17	84.247	84.247	0.000
	Max	84.846	84.618	0.392
	Average	84.348	84.352	-0.004
	Min	84.060	83.999	-0.238
	Std Dev	0.177	0.164	0.163

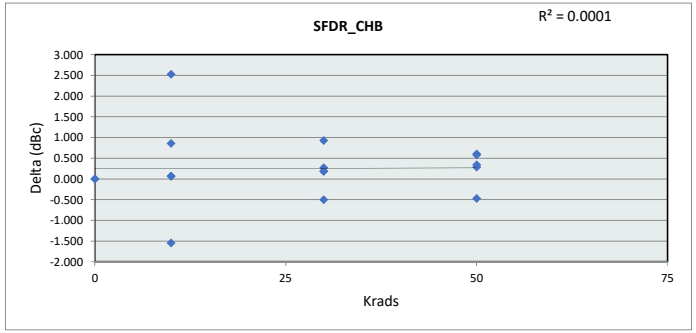


	SNR_CHB			
Test Site				
Tester				
Test Number				
Max Limit	90	dB		
Min Limit	81	dB		
Krads	0	10	30	50
LL	81.000	81.000	81.000	81.000
Min	84.247	84.104	83.999	84.211
Average	84.259	84.389	84.336	84.368
Max	84.271	84.600	84.618	84.453
UL	90.000	90.000	90.000	90.000

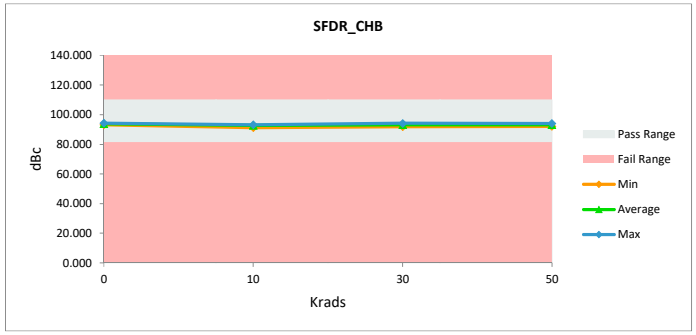


TID Report
ADC3683-SEP

	SFDR_CHB		
Test Site			
Tester			
Test Number			
Unit	dBc	dBc	
Max Limit	110	110	
Min Limit	81.5	81.5	
Krads	Serial #	Pre	Post	Delta
10	1	94.015	93.159	0.856
10	2	93.270	93.198	0.072
10	3	93.111	93.049	0.062
10	4	93.853	91.323	2.530
10	5	91.621	93.168	-1.547
30	6	92.766	91.840	0.926
30	7	94.404	94.136	0.268
30	8	94.136	93.947	0.190
30	9	92.502	92.318	0.184
30	10	92.937	93.441	-0.504
50	11	93.094	92.756	0.339
50	12	93.932	93.349	0.583
50	13	92.397	92.112	0.285
50	14	93.555	94.023	-0.468
50	15	94.094	93.487	0.607
0	16	94.232	94.232	0.000
0	17	93.264	93.264	0.000
	Max	94.404	94.232	2.530
	Average	93.364	93.106	0.258
	Min	91.621	91.323	-1.547
	Std Dev	0.766	0.820	0.821



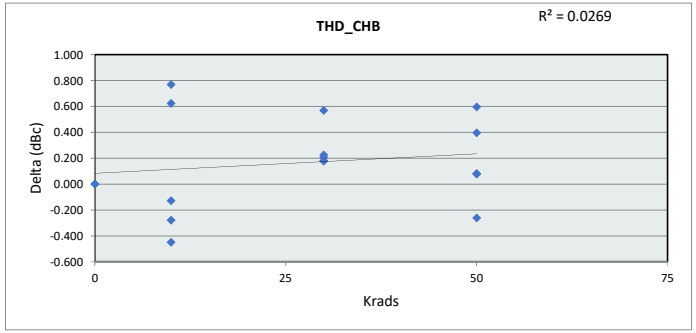
	SFDR_CHB			
Test Site				
Tester				
Test Number				
Max Limit	110	dBc		
Min Limit	81.5	dBc		
Krads	0	10	30	50
LL	81.500	81.500	81.500	81.500
Min	93.264	91.323	91.840	92.112
Average	93.748	92.779	93.137	93.145
Max	94.232	93.198	94.136	94.023
UL	110.000	110.000	110.000	110.000



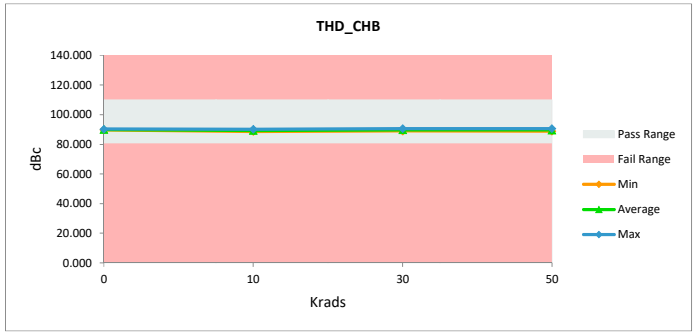
TID Report
ADC3683-SEP

	THD_CHB	
Test Site		
Tester		
Test Number		
Unit	dBc	dBc
Max Limit	110	110
Min Limit	80.5	80.5

Krads	Serial #	Pre	Post	Delta
10	1	89.774	89.151	0.623
10	2	88.481	88.760	-0.279
10	3	89.936	90.064	-0.128
10	4	89.866	89.096	0.770
10	5	89.279	89.729	-0.449
30	6	89.069	88.890	0.179
30	7	90.822	90.596	0.226
30	8	90.716	90.145	0.570
30	9	89.560	89.355	0.205
30	10	89.496	89.318	0.178
50	11	89.153	89.077	0.077
50	12	90.318	89.721	0.597
50	13	88.916	88.834	0.082
50	14	90.289	90.550	-0.262
50	15	90.344	89.948	0.395
0	16	89.777	89.777	0.000
0	17	90.218	90.218	0.000
	Max	90.822	90.596	0.770
	Average	89.766	89.602	0.164
	Min	88.481	88.760	-0.449
	Std Dev	0.650	0.594	0.344



	THD_CHB			
Test Site				
Tester				
Test Number				
Max Limit	110	dBc		
Min Limit	80.5	dBc		
Krads	0	10	30	50
LL	80.500	80.500	80.500	80.500
Min	89.777	88.760	88.890	88.834
Average	89.998	89.360	89.661	89.626
Max	90.218	90.064	90.596	90.550
UL	110.000	110.000	110.000	110.000



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