Radiation Report

ADC3664-SP Total Ionizing Dose (TID) Radiation Report

ABSTRACT

This report covers the radiation characterization results of the ADC3664-SP which is a space grade 14-Bit 125-MSPS, 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 300krad(Si) as a one-time characterization. The results show that all samples passed within the specified limits up to 300krad(Si).

In production, the Radiation Lot Acceptance Testing (RLAT) is performed using 5 units on every fab-lot to the specified rating of 300krad(Si). Furthermore, the ADC3664-SP has a Single Event Latch-Up (SEL) immunization up to 75MeV-cm2/mg which makes it suitable for Radiation Hardness Assured Space Applications.

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Trademarks

1 Device Information

The ADC3664-SP device is a low-noise, ultra-low power,14-bit, 125-MSPS, high-speed dual channel ADC. Designed for lowest noise performance, the device delivers a noise spectral density of –156.9dBFS/Hz combined with excellent linearity and dynamic range. The ADC3664-SP offers IF sampling support which makes the device suited for a wide range of applications. High-speed control loops benefit from the short latency as low as one clock cycle. The ADC consumes only 100 mW/ch at 125 MSPS and its power consumption scales very 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. ADC3664-SP comes in a 64-pin CFP package (10.9 x 10.9 mm) and supports a temperature range from -55°C to +105°C.

1.1 Device Details

Table 1-1. Device and Exposure Details

TID HDR Details	
TI device number	5962F2320501VXC
Package	64-HBP
Technology	C021
Die lot number	2350924DM6
Device / package lot number	3007958MTT
Lot trace code (LTC)	2333A
Quantity tested	5 units biased at 50krad(Si) 5 units biaseds at 100krad(Si) 5 units biased at 300krad(Si)
Lot accept/reject	5 / 0
HDR radiation facility	Texas Instruments CLAB, Dallas, TX
HDR dose level	50-300krad(Si)
HDR dose rate	200-260 rad(Si)/s
HDR irradiation temperature	Ambient, room temperature
Radiation test date	8/29/2024

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2 Total Dose Test Setup

2.1 Test Overview

The ADC3664-SP 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 ADC3664-SP HDR exposure was performed on biased devices and at TI CLAB facility in Dallas, Texas. The dose rate of the exposure was between 200-260 rad(Si)/s. After the exposure, the devices were electrically tested at TI CLAB facility. The electrical test guard-band limits were set within the datasheet electrical specifications to ensure 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.

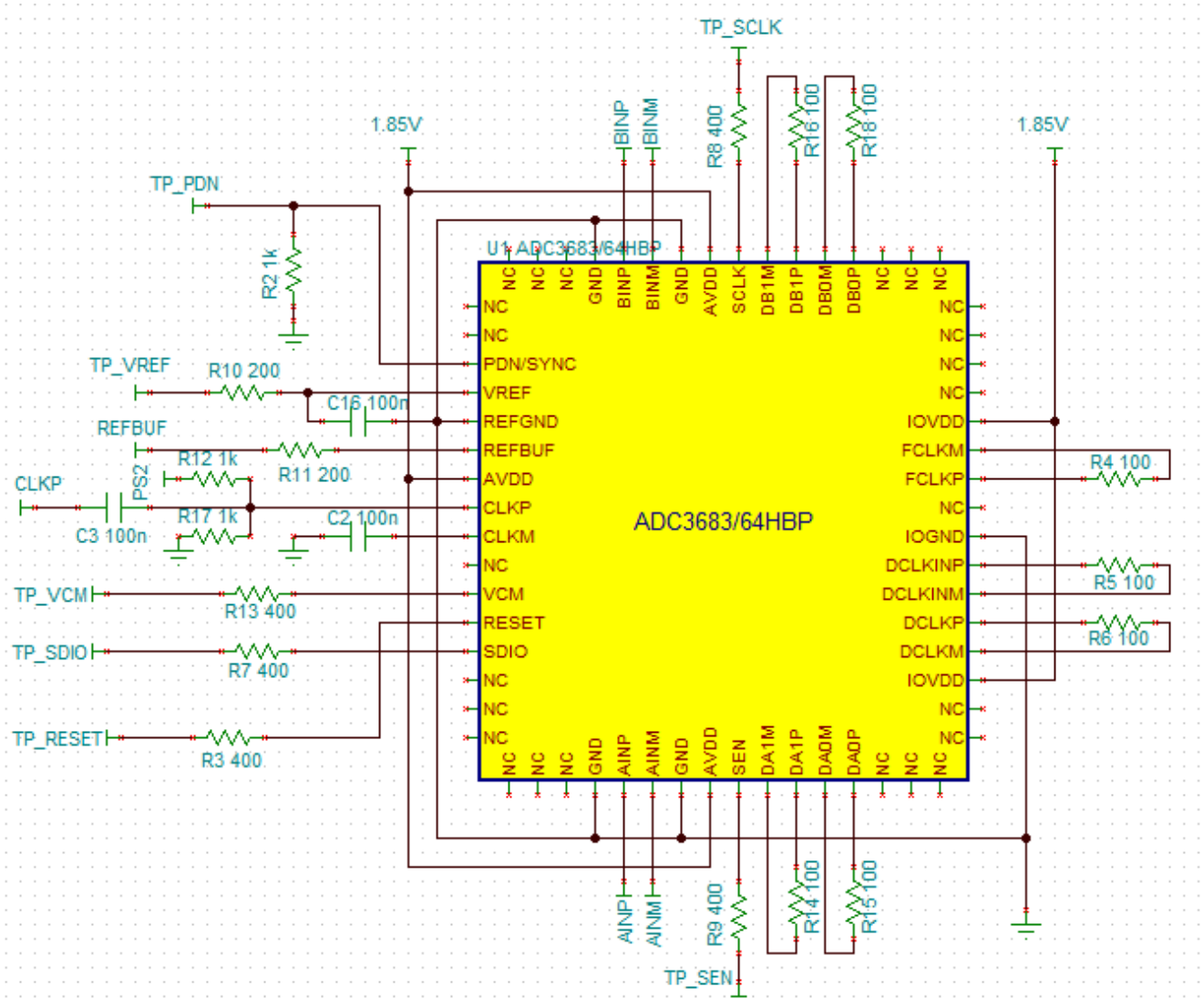


Figure 2-1. Device Biased Conditions During Radiation

2.4 Test Configuration and Condition

ADC3664-SP HDR units were exposure at these stress levels, see Table 2-1.

Table 2-1. HDR Biased Conditions

Total Samples: 15		
Exposure Levels:		
50 krad(Si), 5 ea.	100 krad(Si), 5 ea.	300 krad(Si), 5 ea.
Passed	Passed	Passed

TID Characterization Test Results

ADC3664-SP passed HDR up to 300 krad(Si) at maximum recommended operating conditions. The drifts of critical parameters were within the specification. All units passed.

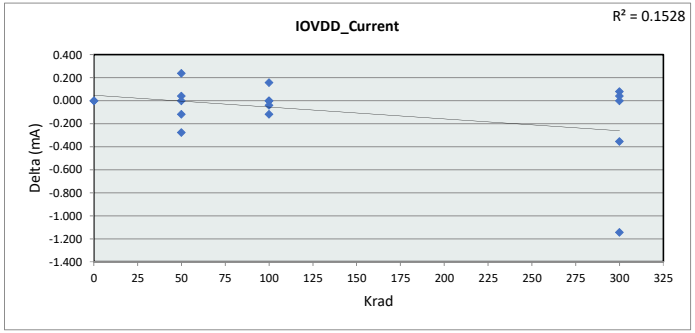
Applicable and Reference Documents

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.

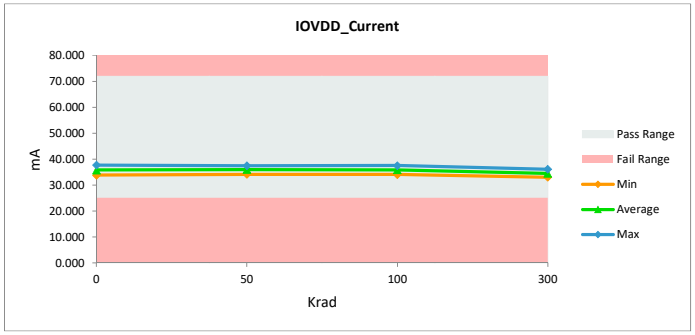
A Total Ionizing Dose Report

TID Report
ADC3664-SP

		IOVDD_Current		
	Test Site			
	Tester			
	Test Number			
	Unit	mA	mA	
	Max Limit	72	72	
	Min Limit	25	25	
Krad	Serial #	Pre	Post	Delta
50	1	35.738	35.502	0.237
50	2	34.199	34.160	0.039
50	3	36.291	36.291	0.000
50	4	36.173	36.291	-0.118
50	5	37.120	37.396	-0.276
100	6	37.159	37.001	0.158
100	7	35.186	35.186	0.000
100	8	35.541	35.541	0.000
100	9	33.923	34.041	-0.118
100	10	37.436	37.475	-0.040
300	11	35.738	36.094	-0.355
300	12	32.107	33.252	-1.145
300	13	34.515	34.436	0.079
300	14	32.976	32.976	0.000
300	15	35.896	35.857	0.040
0	16	37.751	37.751	0.000
0	17	33.765	33.765	0.000
	Max	37.751	37.751	0.237
	Average	35.383	35.471	-0.088
	Min	32.107	32.976	-1.145
	Std Dev	1.610	1.503	0.306

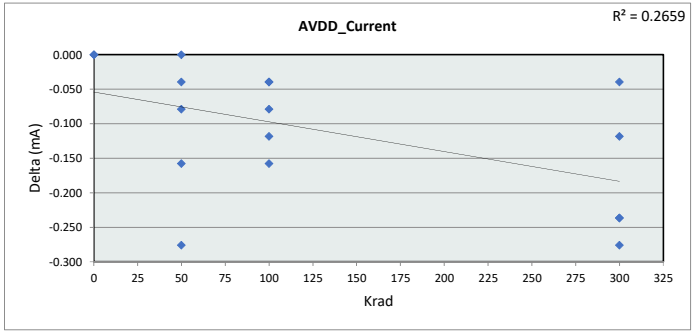


	IOVDD_Current			
Test Site				
Tester				
Test Number				
Max Limit	72	mA		
Min Limit	25	mA		
Krad	0	50	100	300
LL	25.000	25.000	25.000	25.000
Min	33.765	34.160	34.041	32.976
Average	35.758	35.928	35.849	34.523
Max	37.751	37.396	37.475	36.094
UL	72.000	72.000	72.000	72.000

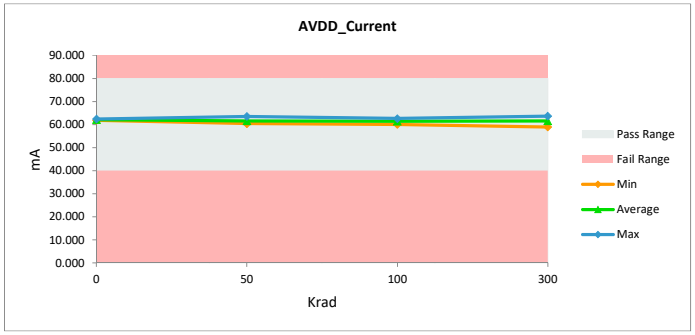


TID Report
ADC3664-SP

	AVDD_Current		
Test Site			
Tester			
Test Number			
Unit	mA	mA	
Max Limit	80	80	
Min Limit	40	40	
Krad	Serial #	Pre	Post	Delta
50	1	60.706	60.785	-0.079
50	2	60.233	60.391	-0.158
50	3	62.599	62.638	-0.039
50	4	60.509	60.509	0.000
50	5	63.190	63.466	-0.276
100	6	62.007	62.086	-0.079
100	7	59.997	60.036	-0.039
100	8	61.455	61.574	-0.118
100	9	60.509	60.667	-0.158
100	10	62.559	62.599	-0.039
300	11	62.559	62.796	-0.237
300	12	58.617	58.893	-0.276
300	13	61.337	61.455	-0.118
300	14	60.706	60.943	-0.236
300	15	63.584	63.624	-0.039
0	16	61.889	61.889	0.000
0	17	62.362	62.362	0.000
	Max	63.584	63.624	0.000
	Average	61.460	61.571	-0.111
	Min	58.617	58.893	-0.276
	Std Dev	1.304	1.284	0.097

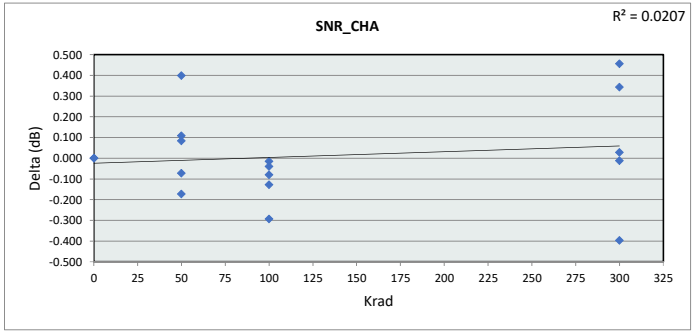


	AVDD_Current			
Test Site				
Tester				
Test Number				
Max Limit	80	mA		
Min Limit	40	mA		
Krad	0	50	100	300
LL	40.000	40.000	40.000	40.000
Min	61.889	60.391	60.036	58.893
Average	62.126	61.558	61.392	61.542
Max	62.362	63.466	62.599	63.624
UL	80.000	80.000	80.000	80.000

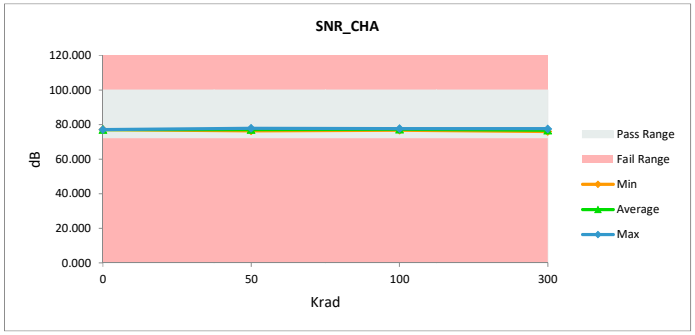


TID Report
ADC3664-SP

	SNR_CHA		
Test Site			
Tester			
Test Number			
Unit	dB	dB	
Max Limit	100	100	
Min Limit	72	72	
Krad	Serial #	Pre	Post	Delta
50	1	76.898	76.970	-0.073
50	2	76.733	76.649	0.084
50	3	77.420	77.592	-0.173
50	4	76.685	76.286	0.399
50	5	77.886	77.777	0.109
100	6	77.214	77.294	-0.080
100	7	77.205	77.498	-0.293
100	8	77.619	77.658	-0.039
100	9	77.186	77.201	-0.015
100	10	76.532	76.659	-0.127
300	11	77.206	77.178	0.028
300	12	77.404	77.061	0.343
300	13	77.140	77.536	-0.396
300	14	76.158	76.170	-0.011
300	15	76.428	75.972	0.456
0	16	77.063	77.063	0.000
0	17	77.133	77.133	0.000
Max		77.886	77.777	0.456
Average		77.054	77.041	0.013
Min		76.158	75.972	-0.396
Std Dev		0.440	0.535	0.224

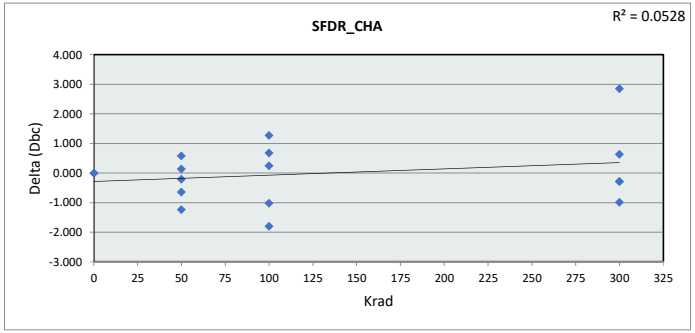


	SNR_CHA			
Test Site				
Tester				
Test Number				
Max Limit	100	dB		
Min Limit	72	dB		
Krad	0	50	100	300
LL	72.000	72.000	72.000	72.000
Min	77.063	76.286	76.659	75.972
Average	77.098	77.055	77.262	76.783
Max	77.133	77.777	77.658	77.536
UL	100.000	100.000	100.000	100.000

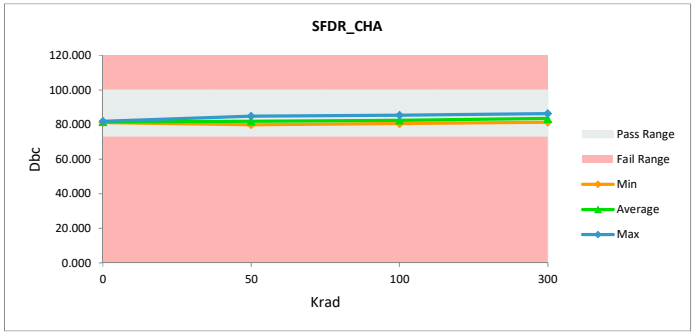


TID Report
ADC3664-SP

	SFDR_CHA		
Test Site			
Tester			
Test Number			
Unit	Dbc	Dbc	
Max Limit	100	100	
Min Limit	73	73	
Krad	Serial #	Pre	Post	Delta
50	1	81.560	82.200	-0.640
50	2	81.539	82.781	-1.241
50	3	79.589	79.802	-0.213
50	4	85.420	84.844	0.576
50	5	79.922	79.788	0.134
100	6	83.072	81.800	1.272
100	7	81.191	80.511	0.680
100	8	81.522	82.541	-1.019
100	9	82.064	81.818	0.246
100	10	83.622	85.425	-1.804
300	11	82.288	82.568	-0.281
300	12	80.996	81.284	-0.287
300	13	85.299	86.290	-0.990
300	14	87.572	84.721	2.851
300	15	83.225	82.589	0.636
0	16	81.955	81.955	0.000
0	17	81.152	81.152	0.000
Max		87.572	86.290	2.851
Average		82.470	82.475	-0.005
Min		79.589	79.788	-1.804
Std Dev		2.067	1.882	1.074

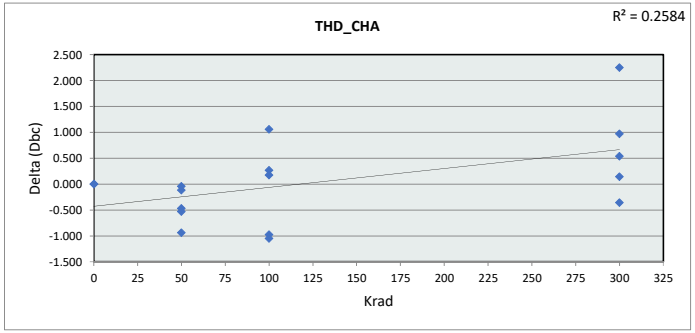


	SFDR_CHA			
Test Site				
Tester				
Test Number				
Max Limit	100	Dbc		
Min Limit	73	Dbc		
Krad	0	50	100	300
LL	73.000	73.000	73.000	73.000
Min	81.152	79.788	80.511	81.284
Average	81.554	81.883	82.419	83.490
Max	81.955	84.844	85.425	86.290
UL	100.000	100.000	100.000	100.000

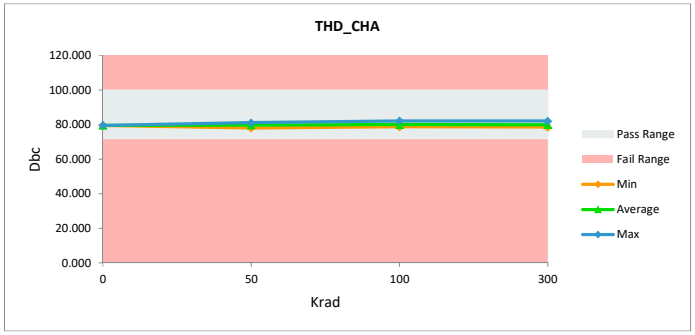


TID Report
ADC3664-SP

		THD_CHA		
	Test Site			
	Tester			
	Test Number			
	Unit	Dbc	Dbc	
	Max Limit	100	100	
	Min Limit	71.5	71.5	
Krad	Serial #	Pre	Post	Delta
50	1	79.648	80.174	-0.527
50	2	79.101	80.041	-0.940
50	3	78.240	78.708	-0.467
50	4	80.902	81.020	-0.118
50	5	78.038	78.078	-0.040
100	6	80.146	79.085	1.062
100	7	78.886	78.617	0.270
100	8	78.712	79.758	-1.047
100	9	80.158	79.980	0.178
100	10	81.193	82.169	-0.976
300	11	79.716	79.571	0.145
300	12	78.743	79.100	-0.357
300	13	81.194	80.655	0.539
300	14	84.244	81.994	2.250
300	15	79.406	78.436	0.971
0	16	79.505	79.505	0.000
0	17	79.527	79.527	0.000
	Max	84.244	82.169	2.250
	Average	79.845	79.789	0.055
	Min	78.038	78.078	-1.047
	Std Dev	1.470	1.159	0.832

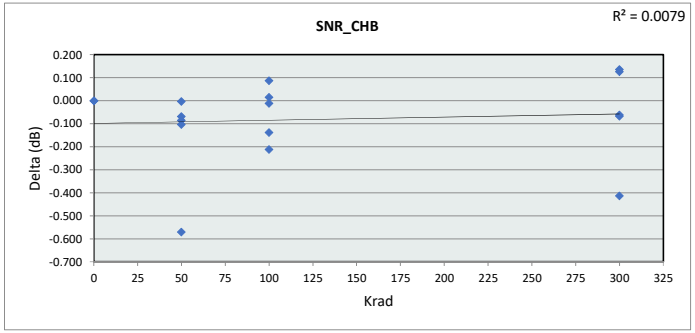


	THD_CHA			
Test Site				
Tester				
Test Number				
Max Limit	100	Dbc		
Min Limit	71.5	Dbc		
Krad	0	50	100	300
LL	71.500	71.500	71.500	71.500
Min	79.505	78.078	78.617	78.436
Average	79.516	79.604	79.922	79.951
Max	79.527	81.020	82.169	81.994
UL	100.000	100.000	100.000	100.000

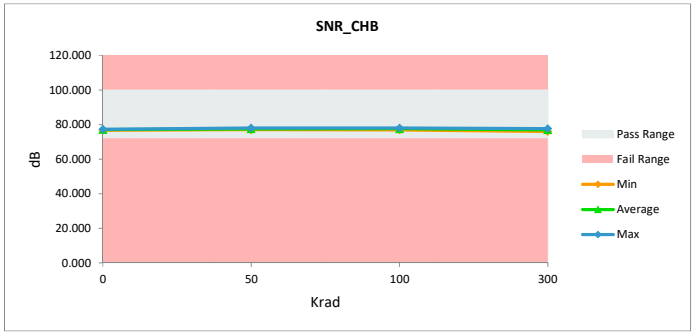


TID Report
ADC3664-SP

	SNR_CHB		
Test Site			
Tester			
Test Number			
Unit	dB	dB	
Max Limit	100	100	
Min Limit	72	72	
Krad	Serial #	Pre	Post	Delta
50	1	77.353	77.356	-0.003
50	2	77.330	77.398	-0.068
50	3	77.595	77.680	-0.085
50	4	76.367	76.938	-0.571
50	5	77.976	78.079	-0.103
100	6	77.809	77.821	-0.012
100	7	77.473	77.611	-0.139
100	8	77.773	77.986	-0.212
100	9	77.088	77.001	0.087
100	10	77.010	76.995	0.015
300	11	77.727	77.600	0.127
300	12	77.090	76.954	0.136
300	13	77.379	77.447	-0.068
300	14	75.660	76.074	-0.414
300	15	76.308	76.369	-0.061
0	16	77.324	77.324	0.000
0	17	76.733	76.733	0.000
Max		77.976	78.079	0.136
Average		77.176	77.257	-0.081
Min		75.660	76.074	-0.571
Std Dev		0.614	0.548	0.181

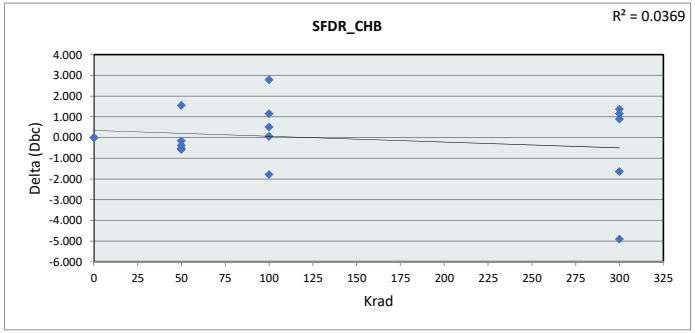


	SNR_CHB			
Test Site				
Tester				
Test Number				
Max Limit	100	dB		
Min Limit	72	dB		
Krad	0	50	100	300
LL	72.000	72.000	72.000	72.000
Min	76.733	76.938	76.995	76.074
Average	77.029	77.490	77.483	76.889
Max	77.324	78.079	77.986	77.600
UL	100.000	100.000	100.000	100.000

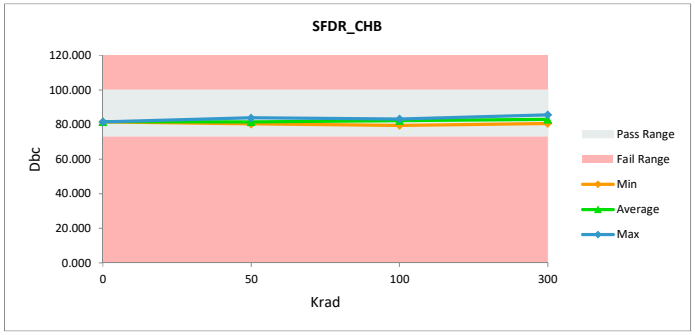


TID Report
ADC3664-SP

	SFDR_CHB		
Test Site			
Tester			
Test Number			
Unit	Dbc	Dbc	
Max Limit	100	100	
Min Limit	73	73	
Krad	Serial #	Pre	Post	Delta
50	1	82.464	80.904	1.559
50	2	80.096	80.262	-0.165
50	3	80.398	80.771	-0.373
50	4	83.283	83.791	-0.508
50	5	81.436	82.015	-0.579
100	6	80.678	79.529	1.149
100	7	83.209	83.153	0.056
100	8	83.358	82.852	0.506
100	9	80.865	82.650	-1.785
100	10	85.972	83.179	2.793
300	11	82.778	81.889	0.889
300	12	83.344	82.184	1.160
300	13	79.771	84.670	-4.900
300	14	81.974	80.607	1.367
300	15	84.016	85.657	-1.641
0	16	81.631	81.631	0.000
0	17	81.491	81.491	0.000
Max		85.972	85.657	2.793
Average		82.163	82.190	-0.028
Min		79.771	79.529	-4.900
Std Dev		1.618	1.604	1.704

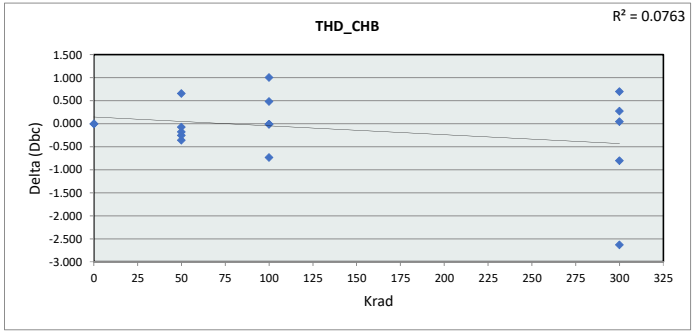


	SFDR_CHB			
Test Site				
Tester				
Test Number				
Max Limit	100	Dbc		
Min Limit	73	Dbc		
Krad	0	50	100	300
LL	73.000	73.000	73.000	73.000
Min	81.491	80.262	79.529	80.607
Average	81.561	81.549	82.273	83.001
Max	81.631	83.791	83.179	85.657
UL	100.000	100.000	100.000	100.000

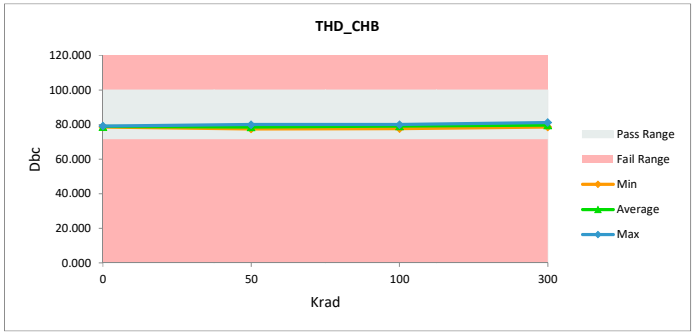


TID Report
ADC3664-SP

		THD_CHB		
	Test Site			
	Tester			
	Test Number			
	Unit	Dbc	Dbc	
	Max Limit	100	100	
	Min Limit	71.5	71.5	
Krad	Serial #	Pre	Post	Delta
50	1	78.726	78.067	0.660
50	2	77.611	77.785	-0.175
50	3	77.367	77.439	-0.071
50	4	79.614	79.971	-0.357
50	5	79.022	79.272	-0.250
100	6	78.074	77.592	0.482
100	7	79.818	79.826	-0.008
100	8	79.298	79.305	-0.008
100	9	78.016	78.746	-0.731
100	10	80.889	79.883	1.006
300	11	79.715	79.012	0.702
300	12	79.130	79.084	0.046
300	13	77.630	80.259	-2.629
300	14	78.841	78.569	0.272
300	15	80.294	81.094	-0.800
0	16	78.595	78.595	0.000
0	17	79.084	79.084	0.000
	Max	80.889	81.094	1.006
	Average	78.925	79.034	-0.110
	Min	77.367	77.439	-2.629
	Std Dev	0.980	0.991	0.804



	THD_CHB			
Test Site				
Tester				
Test Number				
Max Limit	100	Dbc		
Min Limit	71.5	Dbc		
Krad	0	50	100	300
LL	71.500	71.500	71.500	71.500
Min	78.595	77.439	77.592	78.569
Average	78.840	78.507	79.071	79.604
Max	79.084	79.971	79.883	81.094
UL	100.000	100.000	100.000	100.000



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