Radiation Report

DAC121S101-SEP Radiation Tolerant, CMOS, 12-Bit Digital to Analog Converter (DAC) TID Report

TEXAS INSTRUMENTS

ABSTRACT

This report covers the radiation characterization results of the DAC121S101-SEP, a single channel, 12-bit digital-to-analog converter (DAC). The study was done to determine Total Ionizing Dose (TID) effects under high dose rate (HDR) up to 30 krad(Si). The results show that all samples passed within the specified limits up to 30 krad(Si). To maintain the following results, the Radiation Lot Acceptance Testing (RLAT) was performed using 5 units at a dose level of 30 krad(Si) that are required for future wafer lots. Furthermore, the DAC121S101 is packaged in a space enhanced plastic for low outgassing characteristics and is Single Event Latch-Up (SEL) immune up to 43 MeV-cm2 /mg making the device an excellent choice for low Earth orbit space applications.

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Trademarks

All trademarks are the property of their respective owners.

1 Device Information

The DAC121S101-SEP is a radiation-tolerant, full featured, general purpose, 12-bit digital-to-analog converter (DAC) that can operate from a single 2.7V to 5.5V supply and consumes just 177uA current at 3.6V. The on-chip output amplifier allows rail-to-rail output swing and the three-wire serial interface operates at clock rates up to 30MHz over the specified supply voltage range. The device uses CMOS7 technology and is compatible with standard SPI, QSPI, MICROWIRE, and DSP interfaces. The supply voltage (VA) for the DAC121S101-SEP serves as the voltage reference, providing the widest possible output dynamic range. A power-on reset circuit maintains that the DAC output powers up to zero volts and remains there until there is a valid write to the device. A power-down feature reduces power consumption to less than one micro Watt (typ).

1.1 Device Details

Table 1-1 lists the device information used for TID HDR characterization and qualification.

Table 1-1. Device and Exposure Details

TID HDR Details: up to 30 krad(Si)	
TI Device Number	DAC121S101-SEP
Package	8-pin DGK (VSSOP)
Technology	CMOS
Die Lot Number	3006584CUA
A/T Lot Number / Lot Trace Code	3307938MY1/3AAZPPK
Quantity Tested	5 irradiated devices + 1control
Lot Accept/Reject	Devices passed 30 krad(Si)
HDR Radiation Facility	Texas Instruments CLAB, Dallas, TX
HDR Dose Level	30 krad(Si)
HDR Dose Rate	171 rad(Si)/second
HDR Radiation Source	Gammacell (GR420) Co-60
Irradiation Temperature	Ambient, room temperature

2 Total Dose Test Setup

2.1 Test Overview

The DAC121S101-SEP was tested according to MIL-STD-883, Test Method 1019.9. For this testing, Condition A was used. The DAC121S101-SEP samples were irradiated at a high dose rate of 50-300 rad(Si)/s up to 30 krad(Si) and then put through full electrical parametric testing on the production Automated Test Equipment (ATE). The samples were functional and passed all electrical parametric tests with readings within data sheet electrical specification limits.

2.2 Test Description and Facilities

The DAC121S101-SEP HDR exposure was performed on biased devices in a Co60 gamma cell at TI CLAB facility in Dallas, Texas. The unattenuated dose rate of this cell is 50-300 rad(Si)/s. After exposure, the devices completed a full post irradiation electrical evaluation using Texas Instruments ATE. The ATE guard band test limits are set within data sheet electrical specifications to maintain a minimum Cpk and test error margin based on initial qualification and characterization data. Post irradiation measurements were taken within 30 minutes of removal

2.3 Test Setup Details

The devices were tested in biased conditions as described below:

2.3.1 Biased

shows the bias conditions for each pin during irradiation.
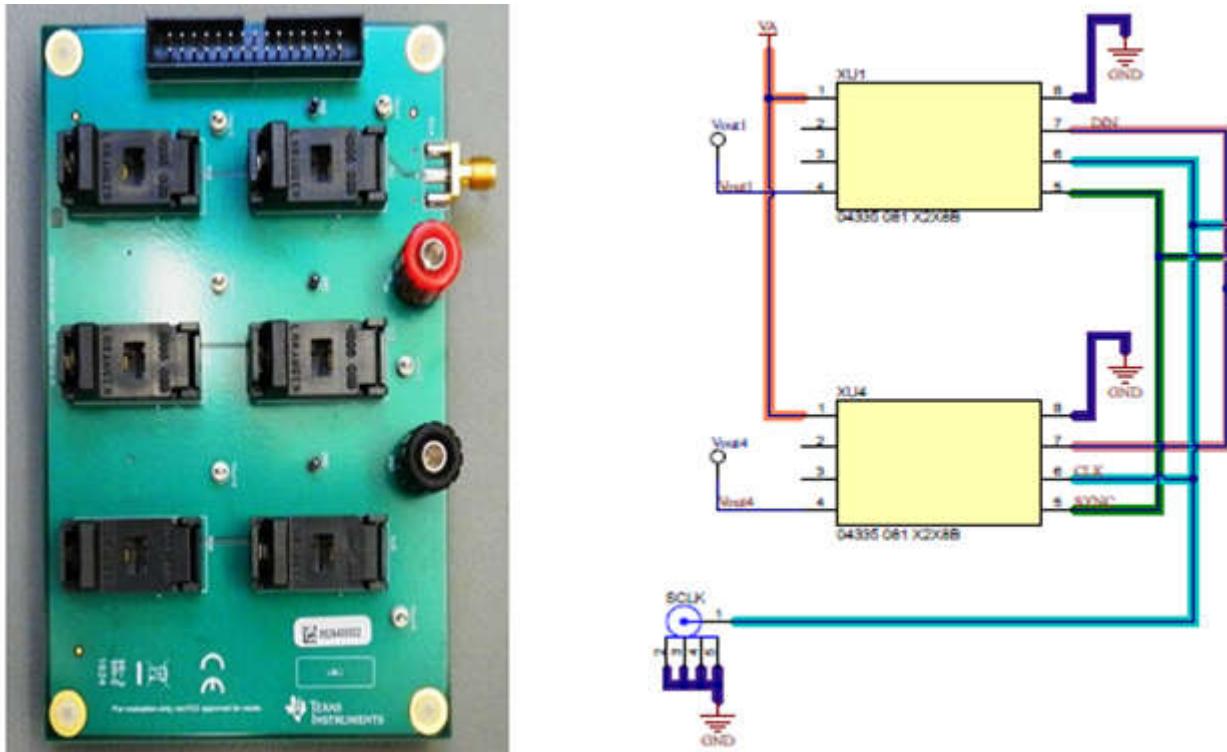
Figure 2-1. DAC121S101-SEP Biased Diagram

Table 2-1. Pin Signal Connections

VA	5.5V
DIN	5.6V
SCLK	30MHz; 0-5.6V
SYNC	GND

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2.4 Test Configuration and Condition

For HDR a step-stress test method was used to determine the TID hardness level and a single test method to determine HDR TID. Prior to and after testing, electrical test were performed on a given sample of parts to verify that the units are within specified data sheet electrical test limits. The RLAT 5 sample units were used at the 50-300 rad(Si)/s dose level with biased setup conditions and this is repeated for each wafer lot.

The tables below list the serialized samples used for RHA characterization.

Table 2-2. HDR = 171 rad(Si)/s Device Information

HDR = 171 rad(Si)/s
Total Samples: 5
Exposure Levels
30 krad(Si)
Biased
22-26

3 Total Ionizing Dose (RHA) Characterization Test Results

3.1 Total Ionizing Dose RHA Characterization Summary Results

The parametric data for the DAC121S101-SEP is within data sheet limits up to 30 krad(Si) for biased setup conditions.

3.1.1 VDD Current HDR

VDD current showed little variation at 30 krad(Si) but is still within data sheet limits. The graphs below show the min, average, and max data post irradiation for each dose level.
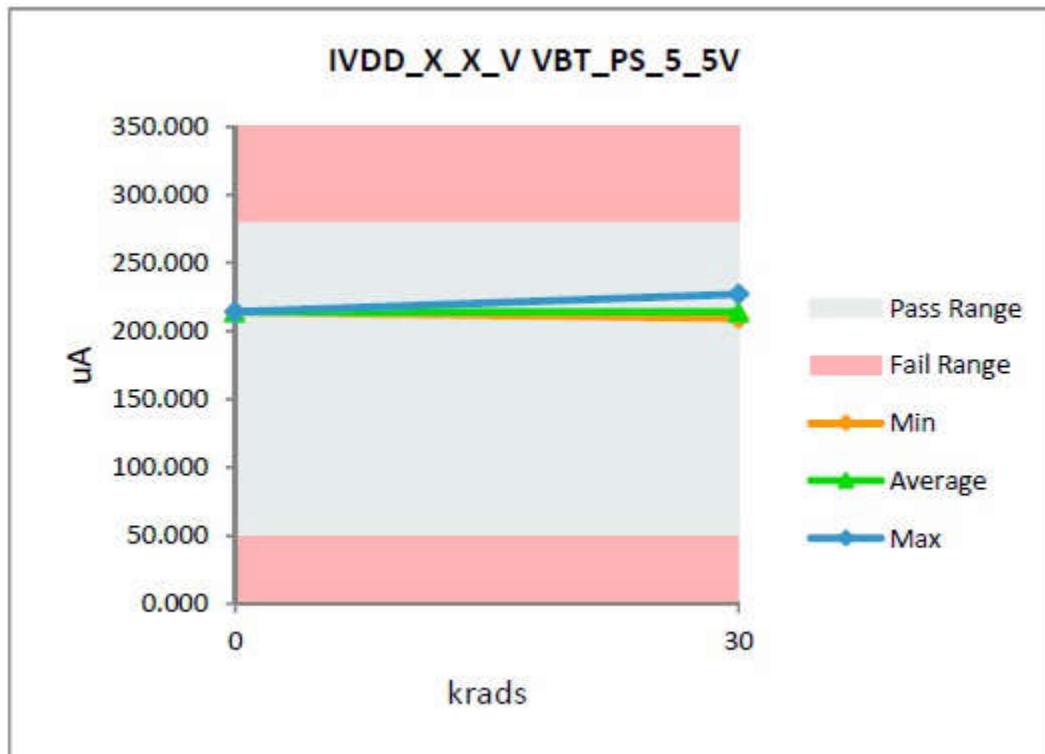

Figure 3-1. HDR Radiation Exposure Effect on VDD Current

3.1.2 Power Down Current HDR

Power Down current showed very little variation at 30 krad(Si) but is still within data sheet limits. The graphs below show the min, average, and max data post irradiation for each dose level.
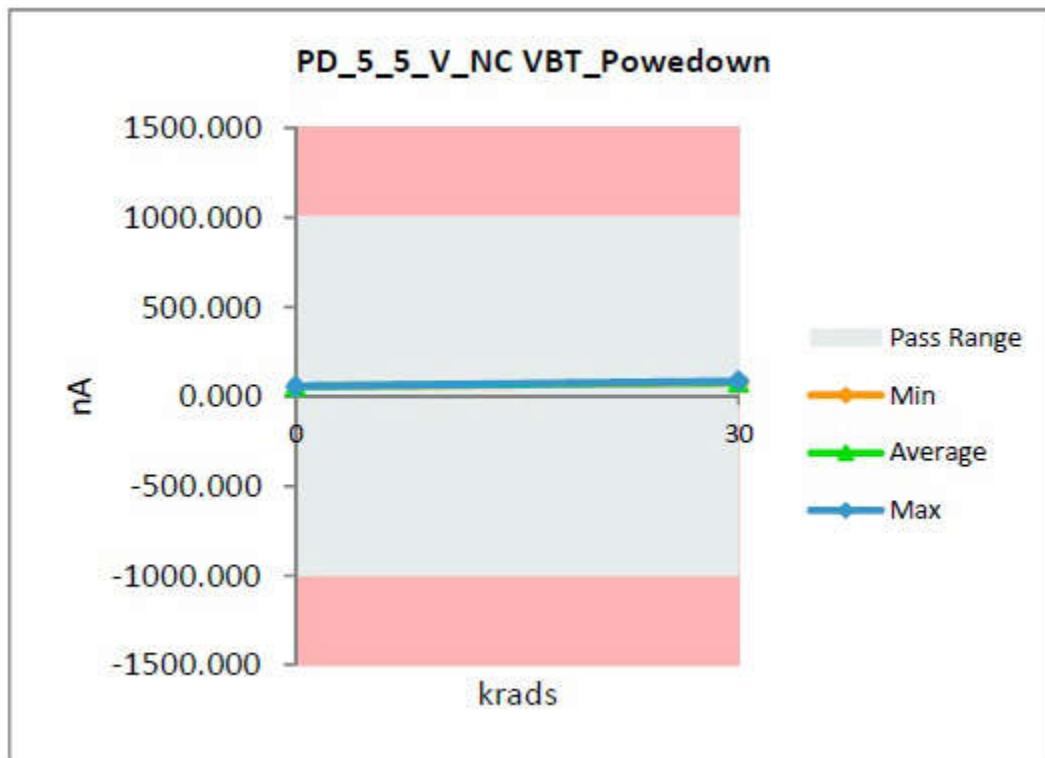

Figure 3-2. HDR Radiation Exposure Effect on Power Down Current

4 Total Ionizing Dose HDR Report

This appendix provides the DAC121S101-SEP TID HDR report. The report shows the variation for each parameter up to 30 krad(Si).
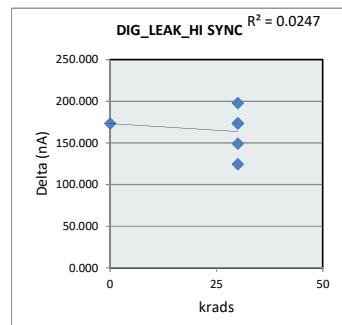
Delta Threshold   10.00%

HDR TID Report
DAC121S101-SEP
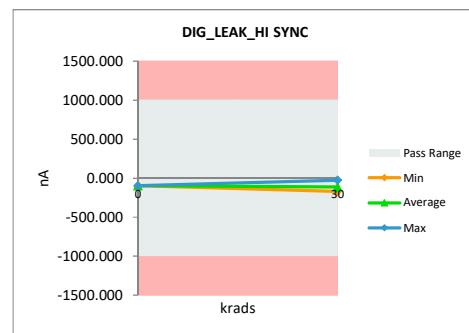
HDR TID Report
DAC121S101-SEP

	DIG_LEAK_HI SYNC	
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	nA	nA
Max Limit	900	1000
Min Limit	-900	-1000

krads	Serial #	Pre	Post	Delta
0	21	75.917	-97.354	173.271
30	22	2.898	-170.553	173.451
30	23	100.257	-97.354	197.611
30	24	2.898	-146.153	149.051
30	25	100.257	-24.155	124.412
30	26	51.577	-121.753	173.330
	Max	100.257	-24.155	197.611
	Average	55.634	-109.554	165.188
	Min	2.898	-170.553	124.412
	Std Dev	44.660	50.596	25.196
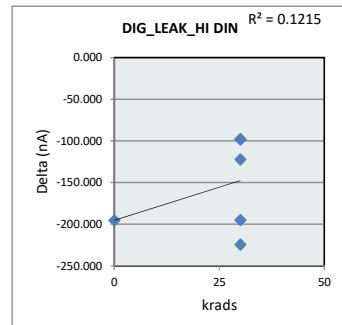
DIG_LEAK_HI SYNC $R^2 = 0.0247$

	DIG_LEAK_HI SYNC	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	1000	nA
Min Limit	-1000	nA
krads	0	30
LL	-1000.000	-1000.000
Min	-97.354	-170.553
Average	-97.354	-111.994
Max	-97.354	-24.155
UL	1000.000	1000.000
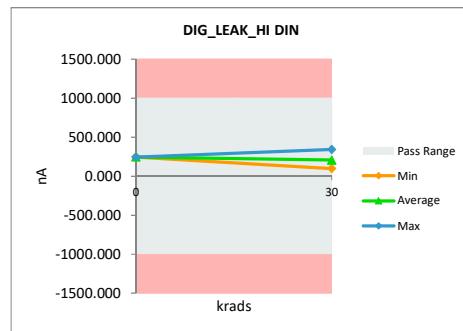
DIG_LEAK_HI SYNC

HDR TID Report
DAC121S101-SEP

DIG_LEAK_HI DIN		
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	nA	nA
Max Limit	900	1000
Min Limit	-900	-1000

krads	Serial #	Pre	Post	Delta
0	21	49.709	245.033	-195.324
30	22	74.085	298.547	-224.462
30	23	0.957	99.035	-98.078
30	24	147.212	342.364	-195.152
30	25	25.333	123.368	-98.035
30	26	49.709	172.034	-122.325
	Max	147.212	342.364	-98.035
	Average	57.834	213.397	-155.563
	Min	0.957	99.035	-224.462
	Std Dev	50.350	97.753	55.882
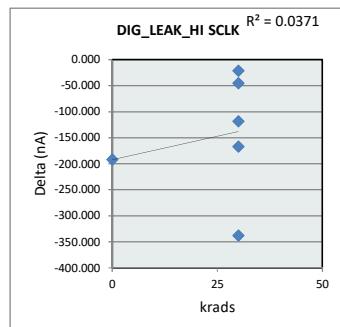
DIG_LEAK_HI DIN $R^2 = 0.1215$

DIG_LEAK_HI DIN		
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	1000	nA
Min Limit	-1000	nA
krads	0	30
LL	-1000.000	-1000.000
Min	245.033	99.035
Average	245.033	207.070
Max	245.033	342.364
UL	1000.000	1000.000
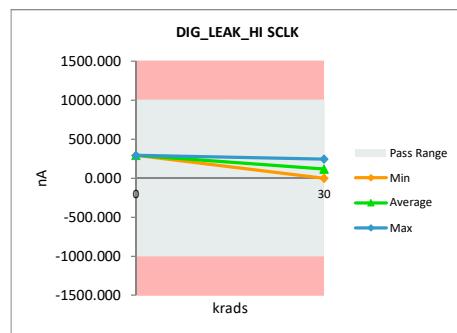
DIG_LEAK_HI DIN

HDR TID Report
DAC121S101-SEP

	DIG_LEAK_HI SCLK	
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	nA	nA
Max Limit	900	1000
Min Limit	-900	-1000

krads	Serial #	Pre	Post	Delta
0	21	100.821	292.981	-192.160
30	22	52.143	170.851	-118.708
30	23	-166.906	-0.131	-166.775
30	24	76.482	97.573	-21.091
30	25	27.804	73.147	-45.343
30	26	-93.890	244.129	-338.019
	Max	100.821	292.981	-21.091
	Average	-0.591	146.425	-147.016
	Min	-166.906	-0.131	-338.019
	Std Dev	105.997	110.323	114.810

DIG_LEAK_HI SCLK $R^2 = 0.0371$
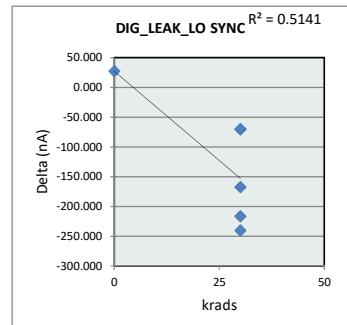
	DIG_LEAK_HI SCLK	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	1000	nA
Min Limit	-1000	nA
krads	0	30
LL	-1000.000	-1000.000
Min	292.981	-0.131
Average	292.981	117.114
Max	292.981	244.129
UL	1000.000	1000.000

DIG_LEAK_HI SCLK
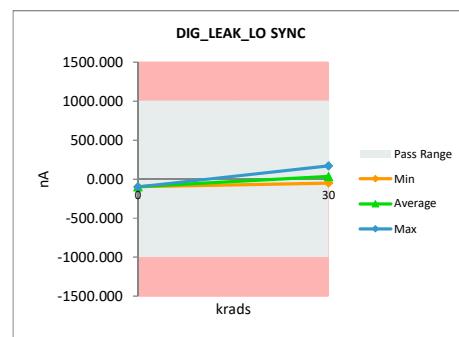
HDR TID Report
DAC121S101-SEP

	DIG_LEAK_LO SYNC	
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	nA	nA
Max Limit	900	1000
Min Limit	-900	-1000

krads	Serial #	Pre	Post	Delta
0	21	-70.121	-97.354	27.232
30	22	-70.121	0.245	-70.366
30	23	-94.461	73.444	-167.905
30	24	-289.179	-48.555	-240.624
30	25	-94.461	-24.155	-70.306
30	26	-45.782	171.042	-216.824
	Max	-45.782	171.042	27.232
	Average	-110.688	12.445	-123.132
	Min	-289.179	-97.354	-240.624
	Std Dev	89.319	96.061	102.734
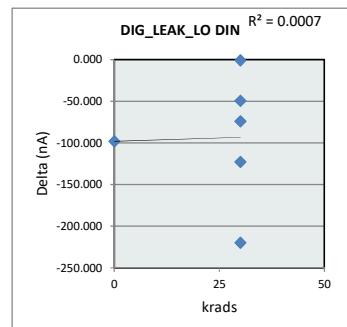
DIG_LEAK_LO SYNC $R^2 = 0.5141$

	DIG_LEAK_LO SYNC	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	1000	nA
Min Limit	-1000	nA
krads	0	30
LL	-1000.000	-1000.000
Min	-97.354	-48.555
Average	-97.354	34.404
Max	-97.354	171.042
UL	1000.000	1000.000
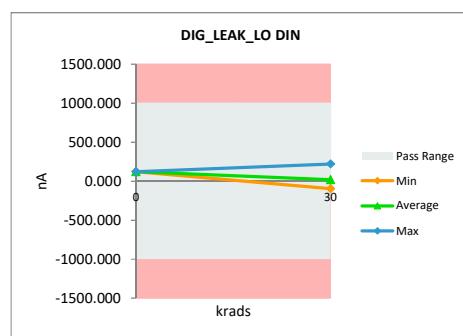
DIG_LEAK_LO SYNC

HDR TID Report
DAC121S101-SEP

DIG_LEAK_LO DIN		
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	nA	nA
Max Limit	900	1000
Min Limit	-900	-1000

krads	Serial #	Pre	Post	Delta
0	21	25.333	123.368	-98.035
30	22	-169.673	-95.628	-74.045
30	23	0.957	50.369	-49.412
30	24	-169.673	-46.963	-122.711
30	25	-23.418	-22.629	-0.789
30	26	0.957	220.700	-219.743
	Max	25.333	220.700	-0.789
	Average	-55.919	38.203	-94.122
	Min	-169.673	-95.628	-219.743
	Std Dev	89.452	117.958	74.467
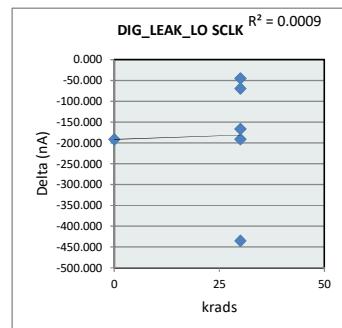
DIG_LEAK_LO DIN $R^2 = 0.0007$

DIG_LEAK_LO DIN		
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	1000	nA
Min Limit	-1000	nA
krads	0	30
LL	-1000.000	-1000.000
Min	123.368	-95.628
Average	123.368	21.170
Max	123.368	220.700
UL	1000.000	1000.000

DIG_LEAK_LO DIN

Pass Range
Min
Average
Max

HDR TID Report
DAC121S101-SEP

	IVDD_X_X_V VBT_PS_3_6V		
Test Site	TIEMA	TIEMA	
Tester	mFLEX	mFLEX	
Test Number	GCRS1011C	GQRS101NC	
Unit	uA	uA	
Max Limit	185	197	
Min Limit	50	50	

krads	Serial #	Pre	Post	Delta
0	21	148.242	149.115	-0.873
30	22	147.786	148.483	-0.697
30	23	146.041	146.570	-0.529
30	24	147.285	147.402	-0.117
30	25	155.888	157.347	-1.459
30	26	148.286	148.940	-0.654
	Max	155.888	157.347	-0.117
	Average	148.921	149.643	-0.722
	Min	146.041	146.570	-1.459
	Std Dev	3.512	3.897	0.441
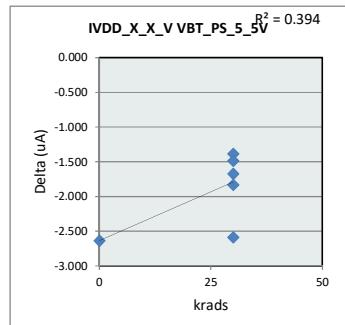
IVDD_X_X_V VBT_PS_3_6V $R^2 = 0.0283$

	IVDD_X_X_V VBT_PS_3_6V	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	197	uA
Min Limit	50	uA
krads	0	30
LL	50.000	50.000
Min	149.115	146.570
Average	149.115	149.748
Max	149.115	157.347
UL	197.000	197.000
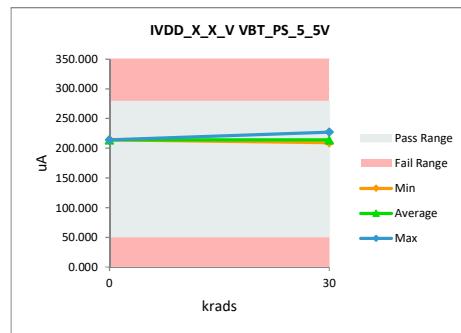
HDR TID Report
DAC121S101-SEP

		IVDD_X_X_V VBT_PS_5_5V	
Test Site		TIEMA	TIEMA
Tester		mFLEX	mFLEX
Test Number		GCRS1011C	GQRS101NC
Unit		uA	uA
Max Limit		261	279
Min Limit		50	50

krads	Serial #	Pre	Post	Delta
0	21	211.300	213.937	-2.637
30	22	209.856	211.687	-1.831
30	23	207.818	209.205	-1.387
30	24	208.312	209.799	-1.487
30	25	224.673	227.264	-2.591
30	26	210.331	212.005	-1.674
	Max	224.673	227.264	-1.387
	Average	212.048	213.983	-1.935
	Min	207.818	209.205	-2.637
	Std Dev	6.317	6.722	0.548

IVDD_X_X_V VBT_PS_5_5V   R² = 0.394
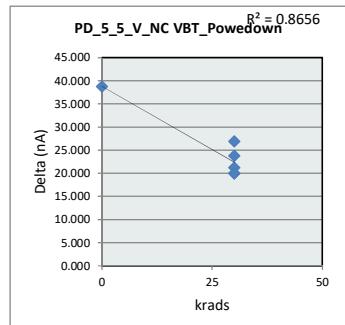
	IVDD_X_X_V VBT_PS_5_5V	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	279	uA
Min Limit	50	uA
krads	0	30
LL	50.000	50.000
Min	213.937	209.205
Average	213.937	213.992
Max	213.937	227.264
UL	279.000	279.000

IVDD_X_X_V VBT_PS_5_5V
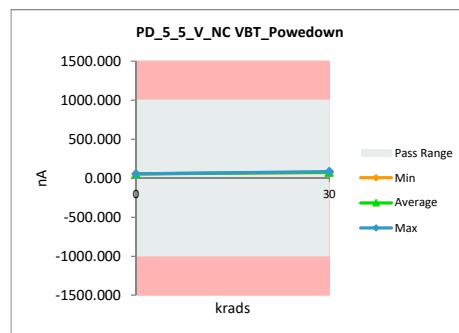
HDR TID Report
DAC121S101-SEP

	PD_5_5_V_NC VBT_Powedown	
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	nA	nA
Max Limit	900	1000
Min Limit	-900	-1000

krads	Serial #	Pre	Post	Delta
0	21	96.461	57.700	38.761
30	22	98.337	71.453	26.883
30	23	100.212	78.955	21.257
30	24	95.836	75.829	20.007
30	25	104.588	80.830	23.758
30	26	107.089	87.082	20.007
	Max	107.089	87.082	38.761
	Average	100.420	75.308	25.112
	Min	95.836	57.700	20.007
	Std Dev	4.537	10.076	7.187
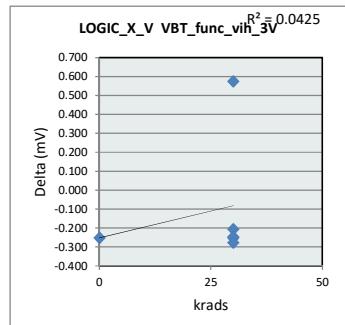
PD_5_5_NC VBT_Powedown
$R^2 = 0.8656$

	PD_5_5_V_NC VBT_Powedown	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	1000	nA
Min Limit	-1000	nA
krads	0	30
LL	-1000.000	-1000.000
Min	57.700	71.453
Average	57.700	78.830
Max	57.700	87.082
UL	1000.000	1000.000
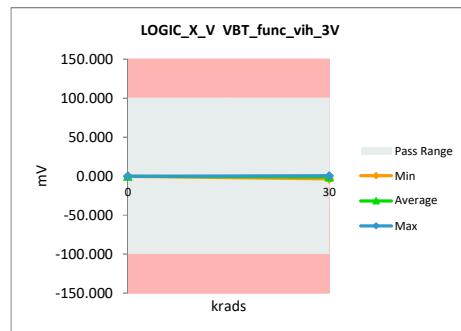
HDR TID Report
DAC121S101-SEP

	LOGIC_X_V VBT_func_vih_3V		
Test Site	TIEMA	TIEMA	
Tester	mFLEX	mFLEX	
Test Number	GCRS1011C	GQRS101NC	
Unit	mV	mV	
Max Limit	90	100	
Min Limit	-90	-100	
krads	Serial #	Pre	Post	Delta
0	21	-0.278	-0.026	-0.252
30	22	-0.947	-0.694	-0.253
30	23	0.426	0.632	-0.207
30	24	-2.810	-3.384	0.574
30	25	-0.973	-0.725	-0.248
30	26	-1.327	-1.049	-0.278
	Max	0.426	0.632	0.574
	Average	-0.985	-0.874	-0.111
	Min	-2.810	-3.384	-0.278
	Std Dev	1.090	1.369	0.336
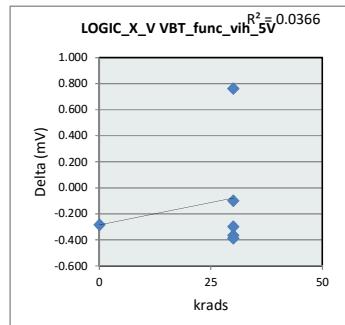
LOGIC_X_V VBT_func_vih_3V $R^2 = 0.0425$

	LOGIC_X_V VBT_func_vih_3V	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	100	mV
Min Limit	-100	mV
krads	0	30
LL	-100.000	-100.000
Min	-0.026	-3.384
Average	-0.026	-1.044
Max	-0.026	0.632
UL	100.000	100.000

LOGIC_X_V VBT_func_vih_3V
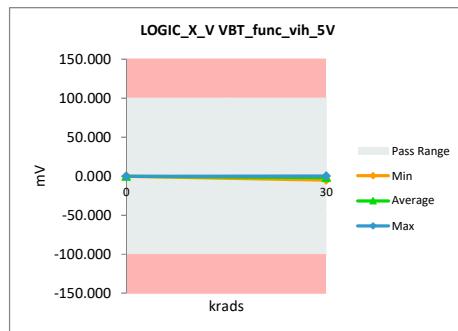
HDR TID Report
DAC121S101-SEP

LOGIC_X_V VBT_func_vih_5V

Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	mV	mV
Max Limit	90	100
Min Limit	-90	-100

krads	Serial #	Pre	Post	Delta
0	21	-0.352	-0.067	-0.285
30	22	-1.370	-1.071	-0.298
30	23	-0.153	0.213	-0.366
30	24	-4.175	-4.936	0.762
30	25	-1.059	-0.959	-0.100
30	26	-2.455	-2.066	-0.389
	Max	-0.153	0.213	0.762
	Average	-1.594	-1.481	-0.113
	Min	-4.175	-4.936	-0.389
	Std Dev	1.507	1.876	0.440
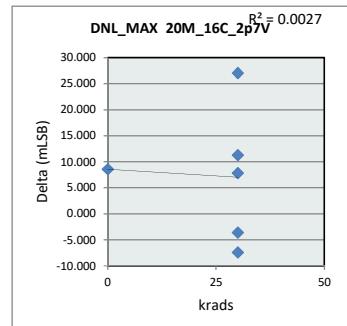
LOGIC_X_V VBT_func_vih_5V $R^2 = 0.0366$

LOGIC_X_V VBT_func_vih_5V

Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	100	mV
Min Limit	-100	mV
krads	0	30
LL	-100.000	-100.000
Min	-0.067	-4.936
Average	-0.067	-1.764
Max	-0.067	0.213
UL	100.000	100.000

LOGIC_X_V VBT_func_vih_5V
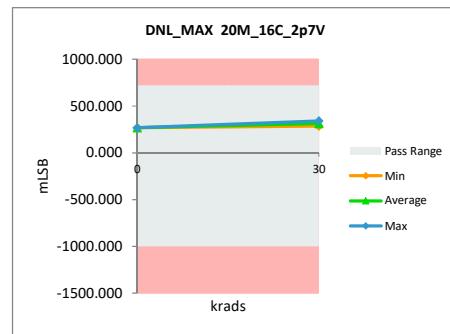
HDR TID Report
DAC121S101-SEP

	DNL_MAX_20M_16C_2p7V	
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	mLSB	mLSB
Max Limit	565	715
Min Limit	-1000	-1000

krads	Serial #	Pre	Post	Delta
0	21	276.399	267.841	8.558
30	22	351.770	340.478	11.292
30	23	321.733	294.719	27.014
30	24	310.541	302.742	7.799
30	25	282.160	285.781	-3.621
30	26	334.144	341.565	-7.421
	Max	351.770	341.565	27.014
	Average	312.791	305.521	7.270
	Min	276.399	267.841	-7.421
	Std Dev	29.404	29.850	12.185
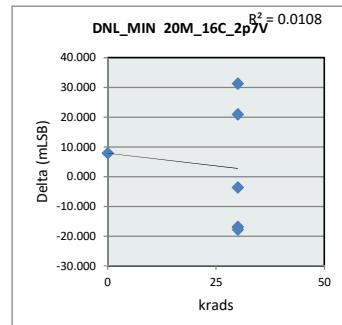
DNL_MAX 20M_16C_2p7V $R^2 = 0.0027$

	DNL_MAX_20M_16C_2p7V	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	715	mLSB
Min Limit	-1000	mLSB
krads	0	30
LL	-1000.000	-1000.000
Min	267.841	285.781
Average	267.841	313.057
Max	267.841	341.565
UL	715.000	715.000
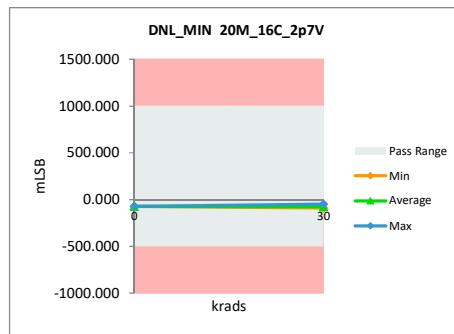
DNL_MAX 20M_16C_2p7V

HDR TID Report
DAC121S101-SEP

	DNL_MIN 20M_16C_2p7V	
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	mLSB	mLSB
Max Limit	1000	1000
Min Limit	-300	-500

krads	Serial #	Pre	Post	Delta
0	21	-63.771	-71.627	7.856
30	22	-87.256	-70.320	-16.936
30	23	-85.423	-81.725	-3.698
30	24	-60.295	-81.198	20.903
30	25	-67.579	-49.772	-17.807
30	26	-59.639	-90.872	31.233
	Max	-59.639	-49.772	31.233
	Average	-70.661	-74.252	3.592
	Min	-87.256	-90.872	-17.807
	Std Dev	12.484	14.156	20.071
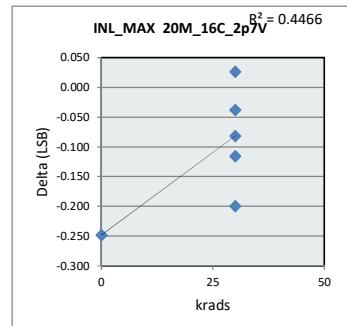
DNL_MIN 20M_16C_2p7V R^2 = 0.0108

Delta (mLSB) vs krads

	DNL_MIN 20M_16C_2p7V	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	1000	mLSB
Min Limit	-500	mLSB
krads	0	30
LL	-500.000	-500.000
Min	-71.627	-90.872
Average	-71.627	-74.777
Max	-71.627	-49.772
UL	1000.000	1000.000

DNL_MIN 20M_16C_2p7V

Pass Range, Min, Average, Max (mLSB vs krads)
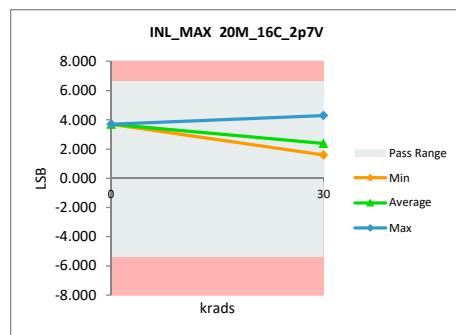
HDR TID Report
DAC121S101-SEP

INL_MAX 20M_16C_2p7V		
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	LSB	LSB
Max Limit	6.2	6.6
Min Limit	-5	-5.4

krads	Serial #	Pre	Post	Delta
0	21	3.447	3.695	-0.248
30	22	4.255	4.293	-0.038
30	23	1.420	1.620	-0.200
30	24	1.617	1.591	0.026
30	25	2.285	2.367	-0.082
30	26	1.871	1.987	-0.116
	Max	4.255	4.293	0.026
	Average	2.483	2.592	-0.109
	Min	1.420	1.591	-0.248
	Std Dev	1.128	1.138	0.102
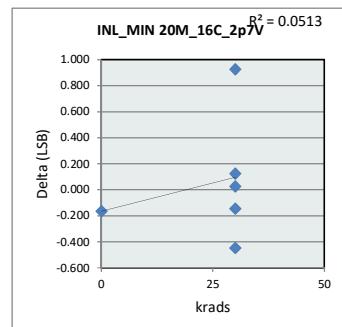
INL_MAX 20M_16C_2p7V $R^2 = 0.4466$

INL_MAX 20M_16C_2p7V		
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	6.6	LSB
Min Limit	-5.4	LSB
krads	0	30
LL	-5.400	-5.400
Min	3.695	1.591
Average	3.695	2.371
Max	3.695	4.293
UL	6.600	6.600
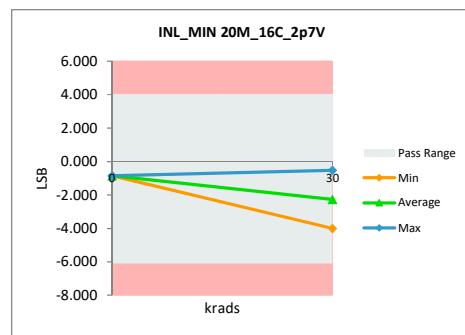
INL_MAX 20M_16C_2p7V

HDR TID Report
DAC121S101-SEP

		INL_MIN 20M_16C_2p7V	
Test Site	TIEMA	TIEMA	
Tester	mFLEX	mFLEX	
Test Number	GCRS1011C	GQRS101NC	
Unit	LSB	LSB	
Max Limit	3.5	4	
Min Limit	-5.7	-6.1	

krads	Serial #	Pre	Post	Delta
0	21	-1.021	-0.856	-0.164
30	22	-0.499	-0.524	0.025
30	23	-4.150	-4.004	-0.146
30	24	-1.950	-2.876	0.926
30	25	-2.079	-1.631	-0.448
30	26	-2.204	-2.329	0.125
	Max	-0.499	-0.524	0.926
	Average	-1.984	-2.037	0.053
	Min	-4.150	-4.004	-0.448
	Std Dev	1.255	1.304	0.470
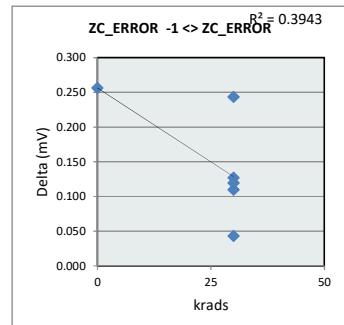
INL_MIN 20M_16C_2p7V, $R^2 = 0.0513$

	INL_MIN 20M_16C_2p7V	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	4	LSB
Min Limit	-6.1	LSB
krads	0	30
LL	-6.100	-6.100
Min	-0.856	-4.004
Average	-0.856	-2.273
Max	-0.856	-0.524
UL	4.000	4.000

INL_MIN 20M_16C_2p7V
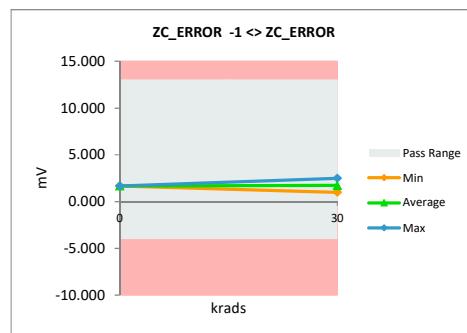
HDR TID Report
DAC121S101-SEP

	ZC_ERROR -1 <> ZC_ERROR	
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	mV	mV
Max Limit	12	13
Min Limit	-3	-4

krads	Serial #	Pre	Post	Delta
0	21	1.942	1.686	0.256
30	22	1.243	1.000	0.243
30	23	2.635	2.509	0.127
30	24	1.642	1.532	0.110
30	25	1.554	1.434	0.119
30	26	2.219	2.176	0.043
	Max	2.635	2.509	0.256
	Average	1.873	1.723	0.150
	Min	1.243	1.000	0.043
	Std Dev	0.501	0.541	0.083

ZC_ERROR -1 <> ZC_ERROR $R^2 = 0.3943$
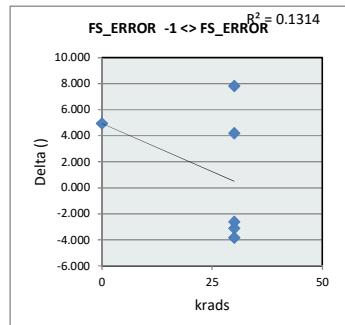
	ZC_ERROR -1 <> ZC_ERROR	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	13	mV
Min Limit	-4	mV
krads	0	30
LL	-4.000	-4.000
Min	1.686	1.000
Average	1.686	1.730
Max	1.686	2.509
UL	13.000	13.000

ZC_ERROR -1 <> ZC_ERROR
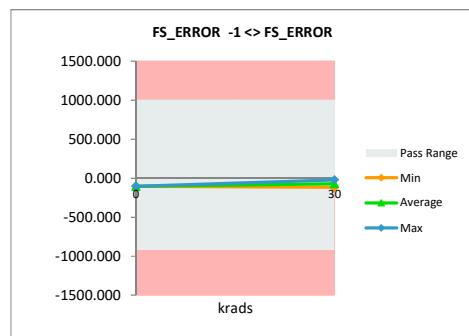
HDR TID Report
DAC121S101-SEP

FS_ERROR -1 <> FS_ERROR		
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit		
Max Limit	1000	1000
Min Limit	-900	-920

krads	Serial #	Pre	Post	Delta
0	21	-97.092	-102.038	4.946
30	22	-79.744	-83.947	4.203
30	23	-23.325	-19.504	-3.821
30	24	-107.644	-115.478	7.834
30	25	-94.056	-90.957	-3.100
30	26	-54.498	-51.882	-2.616
	Max	-23.325	-19.504	7.834
	Average	-76.060	-77.301	1.241
	Min	-107.644	-115.478	-3.821
	Std Dev	31.696	35.459	5.006
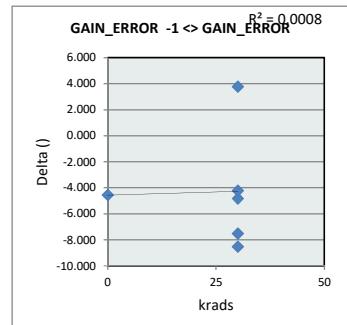
FS_ERROR -1 <> FS_ERROR $R^2 = 0.1314$

FS_ERROR -1 <> FS_ERROR	
Test Site	TIEMA
Tester	mFLEX
Test Number	GCRS1011C
Max Limit	1000
Min Limit	-920

krads	0	30
LL	-920.000	-920.000
Min	-102.038	-115.478
Average	-102.038	-72.353
Max	-102.038	-19.504
UL	1000.000	1000.000

FS_ERROR -1 <> FS_ERROR
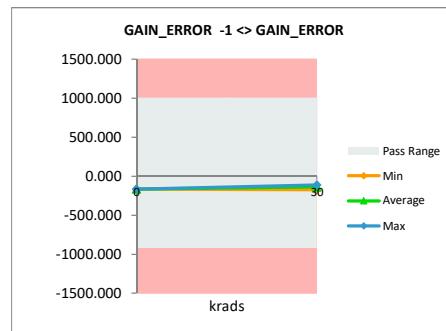
HDR TID Report
DAC121S101-SEP

		GAIN_ERROR -1 <> GAIN_ERRO	
Test Site		TIEMA	TIEMA
Tester		mFLEX	mFLEX
Test Number		GCRS1011C	GQRS101NC
Unit			
Max Limit		1000	1000
Min Limit		-900	-920
krads	Serial #	Pre	Post	Delta
---	---	---	---	---
0	21	-169.052	-164.492	-4.560
30	22	-125.809	-120.993	-4.816
30	23	-120.952	-112.425	-8.527
30	24	-168.472	-172.232	3.760
30	25	-151.622	-144.093	-7.529
30	26	-136.713	-132.497	-4.216
	Max	-120.952	-112.425	3.760
	Average	-145.437	-141.122	-4.315
	Min	-169.052	-172.232	-8.527
	Std Dev	20.916	23.774	4.327
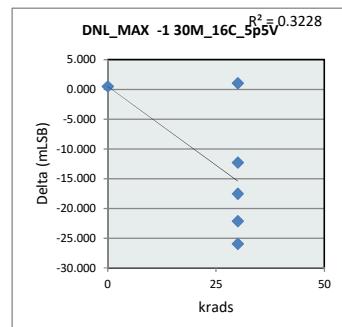
GAIN_ERROR -1 <> GAIN_ERROR $R^2 = 0.0008$

	GAIN_ERROR -1 <> GAIN_ERR	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	1000	
Min Limit	-920	
krads	0	30
LL	-920.000	-920.000
Min	-164.492	-172.232
Average	-164.492	-136.448
Max	-164.492	-112.425
UL	1000.000	1000.000

GAIN_ERROR -1 <> GAIN_ERROR
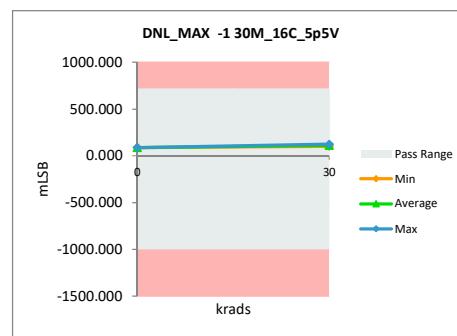
HDR TID Report
DAC121S101-SEP

	DNL_MAX -1 30M_16C_5p5V	
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	mLSB	mLSB
Max Limit	565	715
Min Limit	-1000	-1000

krads	Serial #	Pre	Post	Delta
0	21	88.964	88.471	0.493
30	22	119.724	118.697	1.027
30	23	80.735	102.904	-22.169
30	24	94.307	111.861	-17.554
30	25	98.041	124.034	-25.993
30	26	94.619	106.956	-12.337
	Max	119.724	124.034	1.027
	Average	96.065	108.821	-12.755
	Min	80.735	88.471	-25.993
	Std Dev	13.071	12.576	11.424
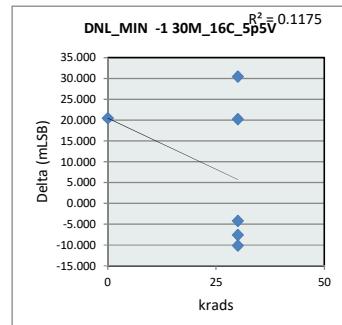
DNL_MAX -1 30M_16C_5p5V $R^2 = 0.3228$

Delta (mLSB) vs krads

	DNL_MAX -1 30M_16C_5p5V	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	715	mLSB
Min Limit	-1000	mLSB
krads	0	30
LL	-1000.000	-1000.000
Min	88.471	102.904
Average	88.471	112.890
Max	88.471	124.034
UL	715.000	715.000

DNL_MAX -1 30M_16C_5p5V

Pass Range
Min
Average
Max
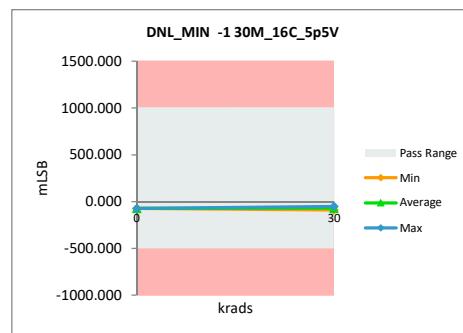
HDR TID Report
DAC121S101-SEP

DNL_MIN -1 30M_16C_5p5V		
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	mLSB	mLSB
Max Limit	1000	1000
Min Limit	-300	-500

krads	Serial #	Pre	Post	Delta
0	21	-53.270	-73.721	20.451
30	22	-66.291	-62.076	-4.216
30	23	-59.576	-52.030	-7.546
30	24	-59.887	-80.122	20.236
30	25	-60.210	-90.693	30.483
30	26	-72.921	-62.820	-10.102
	Max	-53.270	-52.030	30.483
	Average	-62.026	-70.244	8.218
	Min	-72.921	-90.693	-10.102
	Std Dev	6.745	14.010	17.484
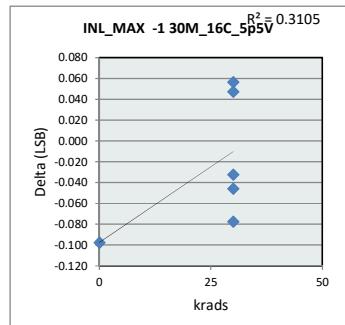
DNL_MIN -1 30M_16C_5p5V		
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	1000	mLSB
Min Limit	-500	mLSB
krads	0	30
LL	-500.000	-500.000
Min	-73.721	-90.693
Average	-73.721	-69.548
Max	-73.721	-52.030
UL	1000.000	1000.000
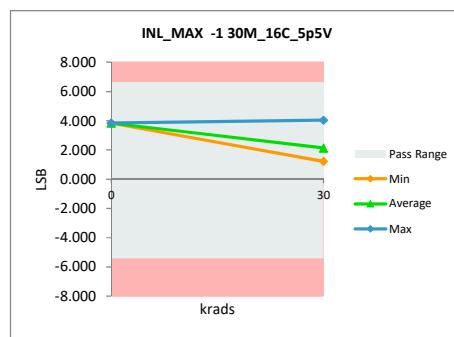
HDR TID Report
DAC121S101-SEP

INL_MAX -1 30M_16C_5p5V		
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	LSB	LSB
Max Limit	6.2	6.6
Min Limit	-5	-5.4

krads	Serial #	Pre	Post	Delta
0	21	3.740	3.837	-0.098
30	22	4.009	4.042	-0.032
30	23	1.460	1.537	-0.078
30	24	1.278	1.222	0.057
30	25	2.247	2.200	0.047
30	26	1.608	1.654	-0.046
	Max	4.009	4.042	0.057
	Average	2.390	2.415	-0.025
	Min	1.278	1.222	-0.098
	Std Dev	1.198	1.224	0.064
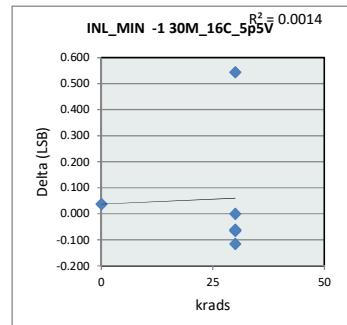
INL_MAX -1 30M_16C_5p5V		
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	6.6	LSB
Min Limit	-5.4	LSB
krads	0	30
LL	-5.400	-5.400
Min	3.837	1.222
Average	3.837	2.131
Max	3.837	4.042
UL	6.600	6.600
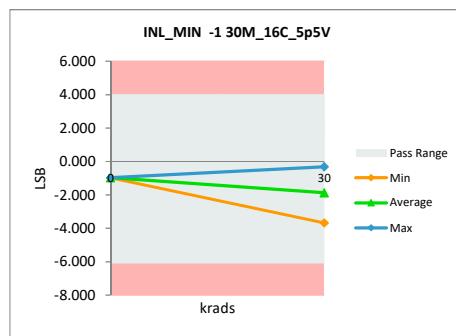
HDR TID Report
DAC121S101-SEP

	INL_MIN -1 30M_16C_5p5V	
Test Site	TIEMA	TIEMA
Tester	mFLEX	mFLEX
Test Number	GCRS1011C	GQRS101NC
Unit	LSB	LSB
Max Limit	3.5	4
Min Limit	-5.7	-6.1

krads	Serial #	Pre	Post	Delta
0	21	-0.937	-0.974	0.037
30	22	-0.389	-0.323	-0.066
30	23	-3.676	-3.676	0.000
30	24	-1.109	-1.652	0.543
30	25	-1.991	-1.929	-0.062
30	26	-1.905	-1.789	-0.116
	Max	-0.389	-0.323	0.543
	Average	-1.668	-1.724	0.056
	Min	-3.676	-3.676	-0.116
	Std Dev	1.155	1.130	0.245

INL_MIN -1 30M_16C_5p5V $R^2 = 0.0014$

	INL_MIN -1 30M_16C_5p5V	
Test Site	TIEMA	
Tester	mFLEX	
Test Number	GCRS1011C	
Max Limit	4	LSB
Min Limit	-6.1	LSB
krads	0	30
LL	-6.100	-6.100
Min	-0.974	-3.676
Average	-0.974	-1.874
Max	-0.974	-0.323
UL	4.000	4.000

INL_MIN -1 30M_16C_5p5V

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