

DAC39RF10-SEP Total Ionizing Dose (TID) Radiation Report



ABSTRACT

This report covers the radiation characterization results of the DAC39RF10-SEP radiation 16-bit multi-Nyquist digital-to-analog converter (DAC). The study was done to determine total ionizing dose (TID) effects under high dose rate (HDR) up to 30krad(Si) as a one time characterization. The results show that all samples passed within the specified limits up to 30krad(Si).

To ensure the following results, the radiation lot acceptance testing (RLAT) was performed using five units at a dose level of 30krad(Si).

Additionally, the DAC39RF10-SEP is single-event latch-up (SEL) immune up to 43MeV-cm²/mg.

Table of Contents

1 Device Information	2
1.1 Device Details.....	2
2 TID Test Setup	3
2.1 Test Methodology.....	3
2.2 Test Description and Facilities.....	3
2.3 Test Setup Details.....	3
2.4 Exposure Details.....	5
3 TID Characterization Test Results	6
A TID Data Plots	7

List of Figures

Figure 2-1. DAC39RF10-SEP Biasing Diagram.....	3
Figure 2-2. DAC39RF10-SEP Biasing Diagram Continued.....	4

List of Tables

Table 1-1. Device and Exposure Details.....	2
Table 2-1. Irradiation Information.....	5

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1 Device Information

The DAC39RF10-SEP is a digital-to-analog converter (DAC) with 16-bit resolution. The device can be used as non-interpolating or interpolating DACs for either direct RF sampling or complex baseband signal generation. The maximum input data rate is 20.48GSPS for a single channel or 10.24GSPS for two channels. The device can generate signals of up to 10GHz, 7.5GHz, and 5GHz signal bandwidth (8-bit, 12-bit, and 16-bit input resolution) at carrier frequencies exceeding 8GHz enabling direct sampling through C-band and into X-band.

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	
TI Device Number	DAC39RF10-SEP
Package	256-pin FC-BGA
Technology	TSMC C014.P
Die Lot Number	3500562
A/T Lot Number / Lot Trace Code	4096750/42ZCWH9
Quantity Tested	15 irradiated devices + 2 control
Lot Accept/Reject	Devices passed 3krad(Si), 10krad(Si), 30krad(Si)
HDR Radiation Facility	Texas Instruments CLAB, Dallas, TX
HDR Dose Level	30krad(Si)
HDR Dose Rate	120rad(Si)/s
HDR Radiation Source	Gammacell (GR420) Co-60
Irradiation Temperature	Ambient, room temperature

2 TID Test Setup

2.1 Test Methodology

Known-good and tested DAC39RF10-SEP samples were irradiated at a dose rate of 120rad(Si)/s up to a total dose of 30krad(Si). After exposure, units were retested using the production test solution, ensuring devices still meet datasheet specifications.

2.2 Test Description and Facilities

The DAC39RF10-SEP HDR exposure was performed on biased devices in a Co-60 gamma cell at TI's CLAB facility in Dallas, TX. The unattenuated dose rate of this cell is 120rad(Si)/s. After exposure, the devices completed a full post-irradiation electrical evaluation using the production test, or ATE, solution. ATE guard banded test limits are set within datasheet electrical specifications to ensure a minimum Cpk and test error margin based on initial qualification and characterization data. Post-irradiation measurements were taken within 30 minutes of irradiation.

2.3 Test Setup Details

During TID exposure, the units are biased at the recommended operating maximum supply voltages for 1.0V, 1.8V, and -1.8V rails (1.05V, 1.89V, and -1.89V respectively) and Fclk,max = 10.4GHz clock rate during irradiation.

2.3.1 Biasing Conditions

Figure 2-1 and Figure 2-2 show the bias conditions for each pin during irradiation.

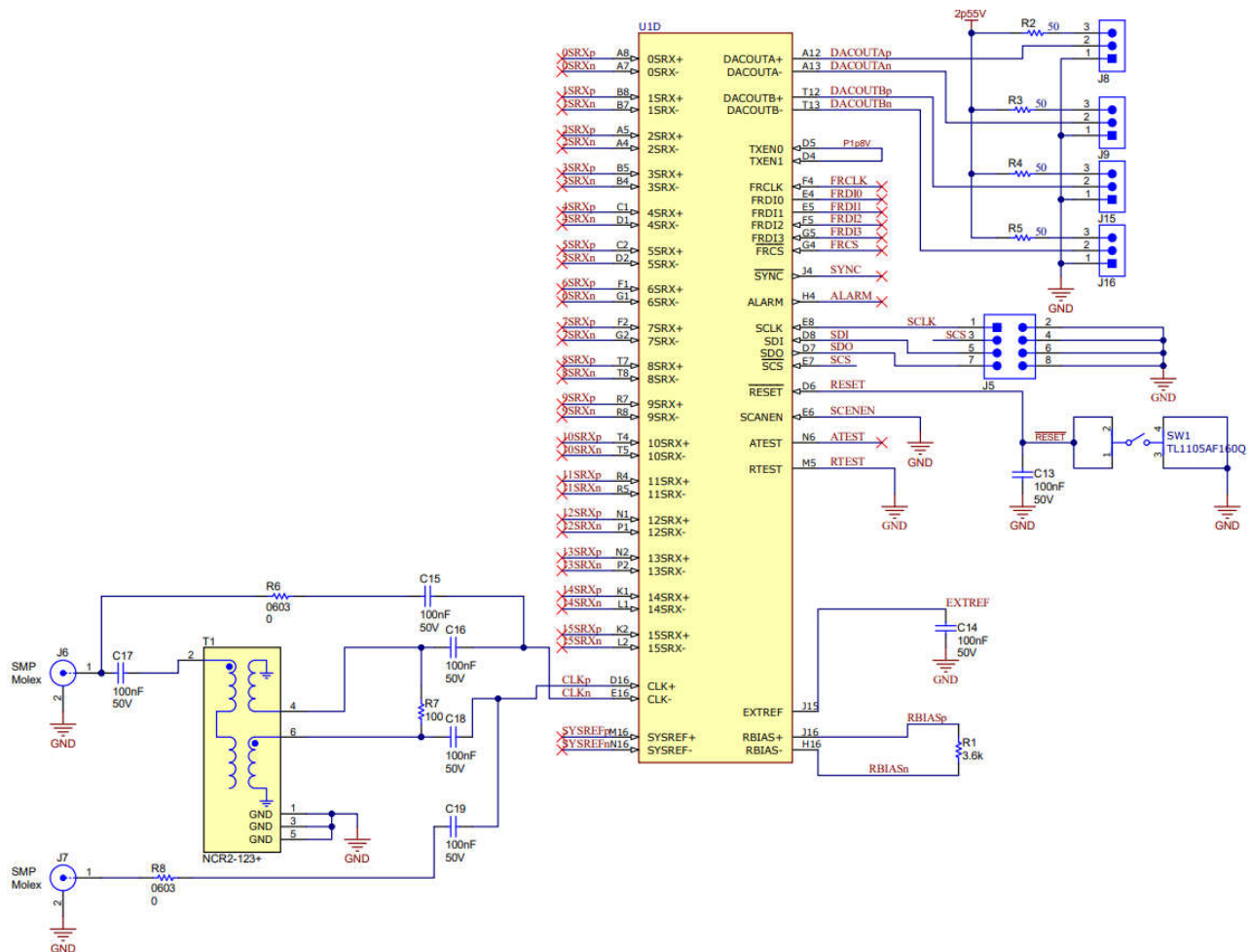


Figure 2-1. DAC39RF10-SEP Biasing Diagram

2.4 Exposure Details

Fifteen (15) units were characterized at the 120rad(Si)/s dose level with biased voltage conditions.

Table 2-1. Irradiation Information

Dose Rate	120rad(Si)/s
Total Samples	15 (5 samples per dose level; 2 control)
Exposure Levels	3krad(Si), 10krad(Si), 30krad(Si)
Supply Voltages	1.05V, +1.89V, and -1.89V

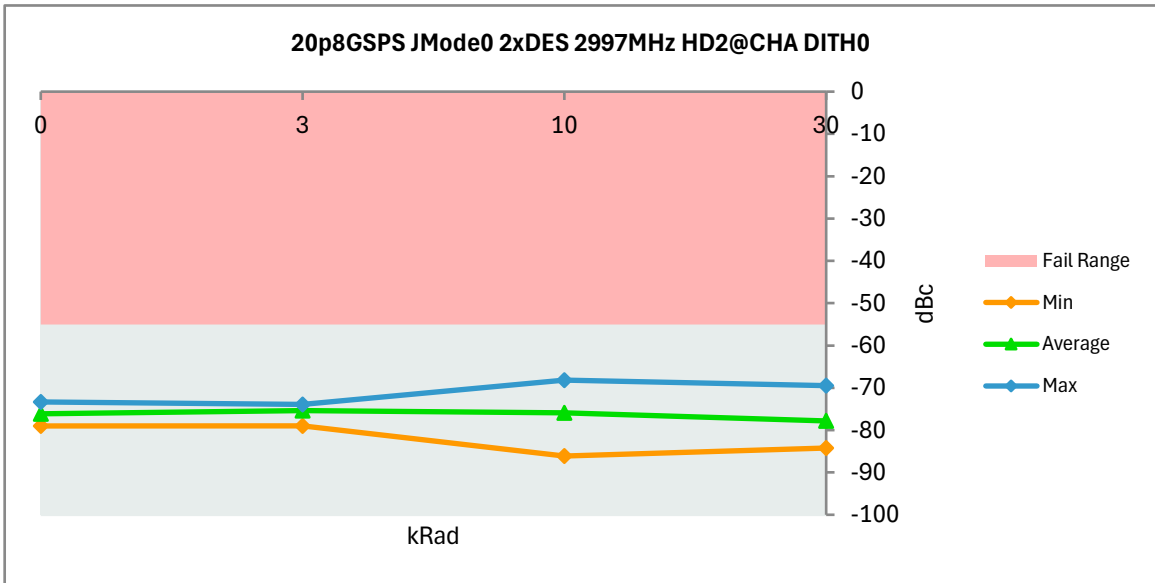
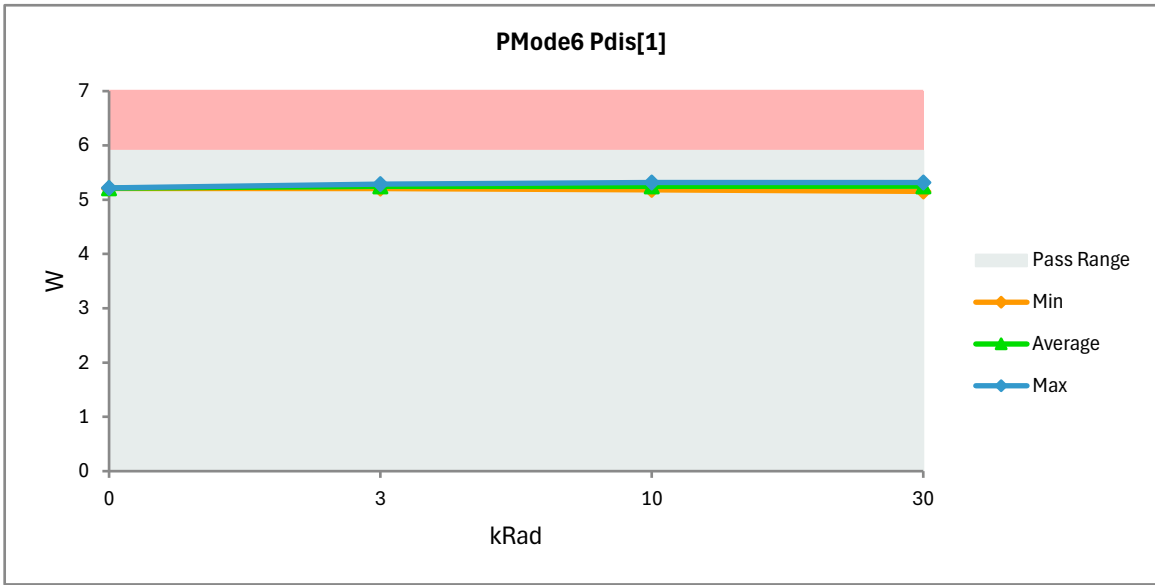
3 TID Characterization Test Results

Electrical and parametric test results for all units at every dose level were within datasheet limits.

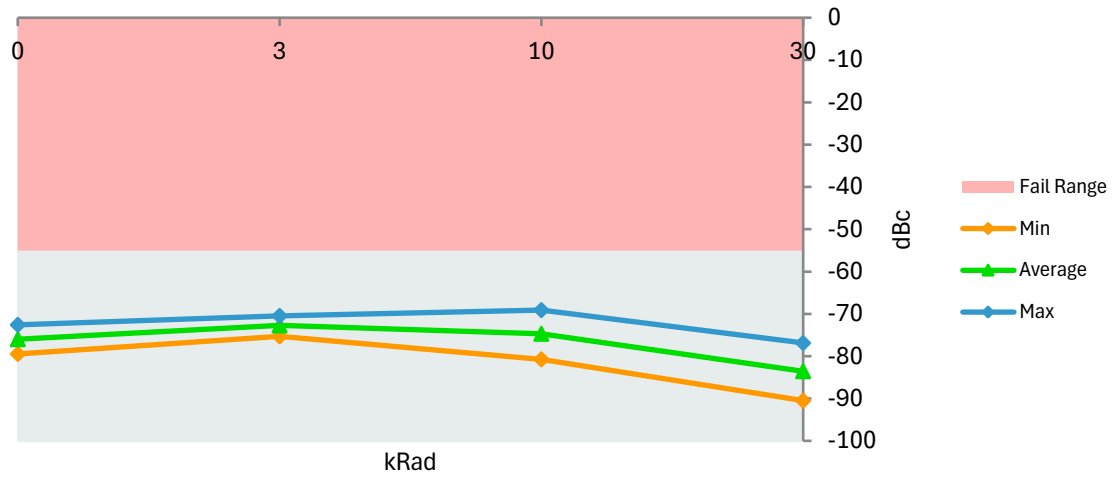
Unit Number	Dose Level, krad(Si)	Result
C1, C2	N/A (control)	PASS
1-5	3	PASS
6-10	10	PASS
11-15	30	PASS

A TID Data Plots

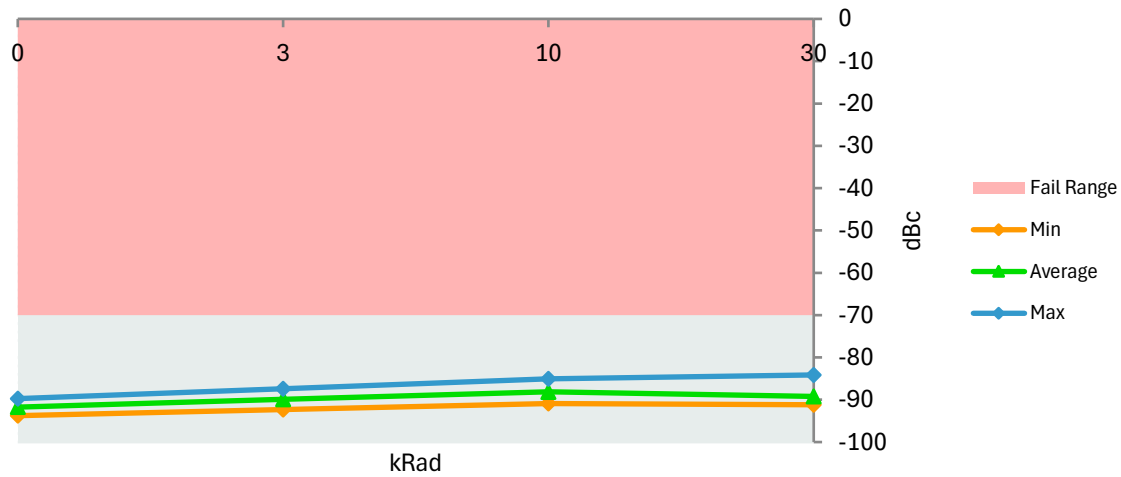
This appendix provides the DAC39RF10-SEP TID HDR report data plots. The plots show the variation for each critical parameter up to 30krad(Si).



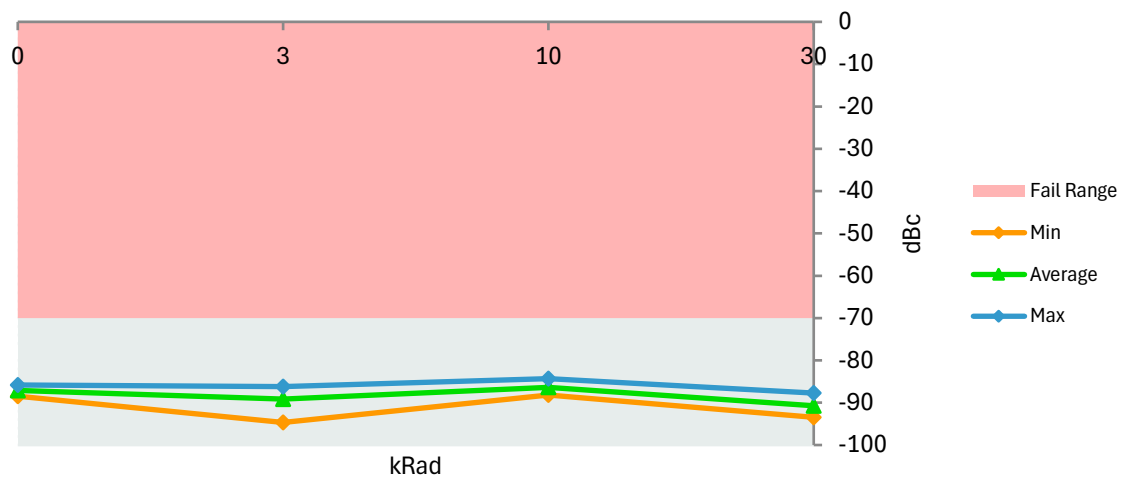
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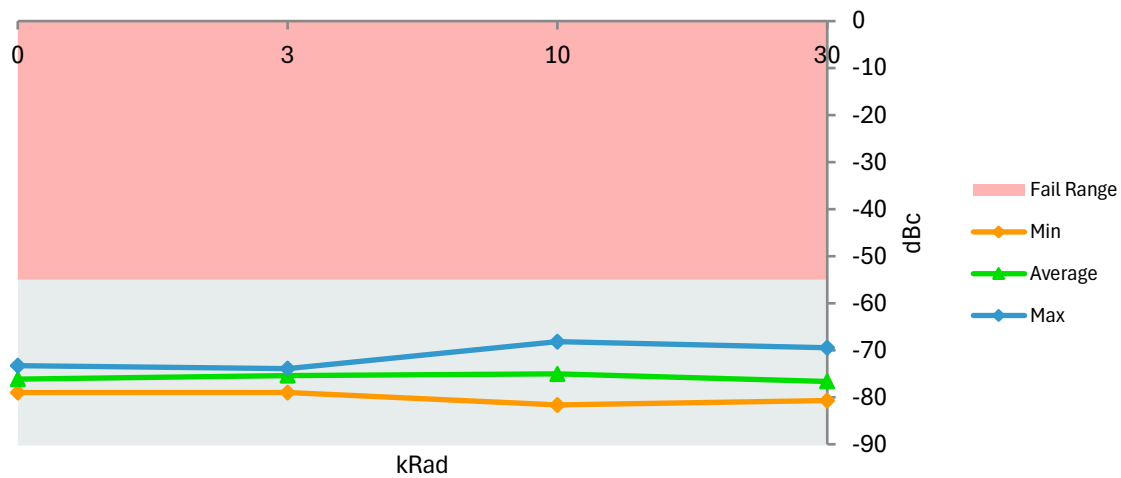
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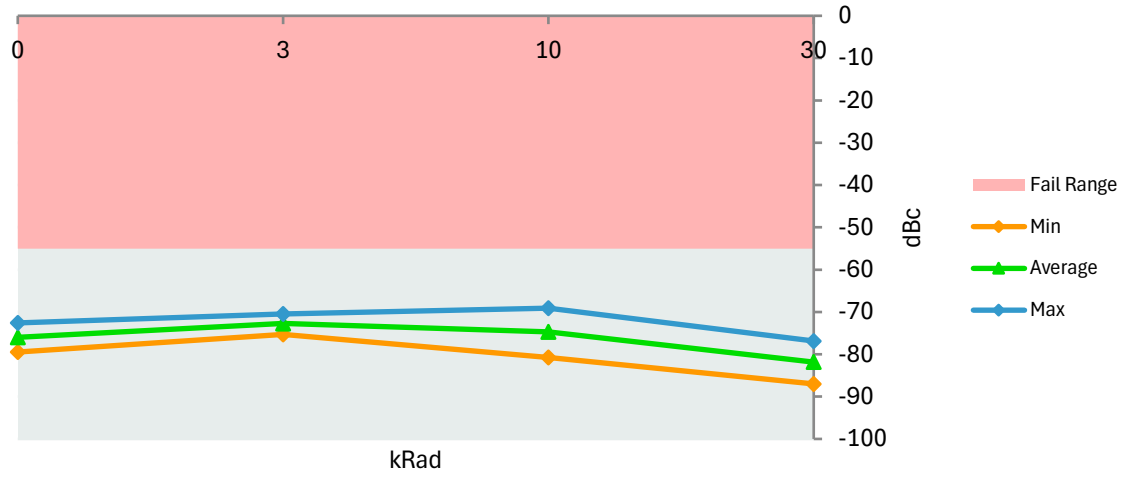
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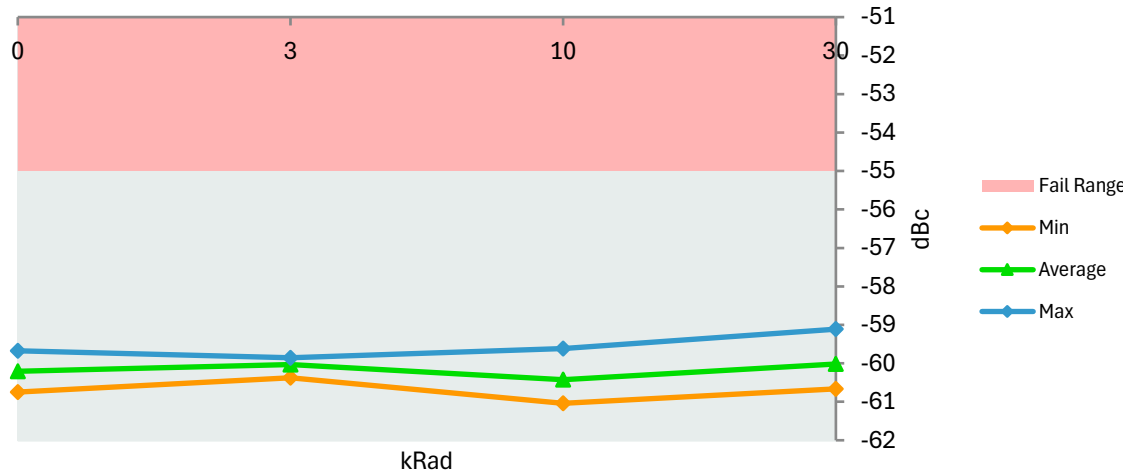
20p8GSPS JMode0 2xDES 2997MHz SFDR@CHA DITH0



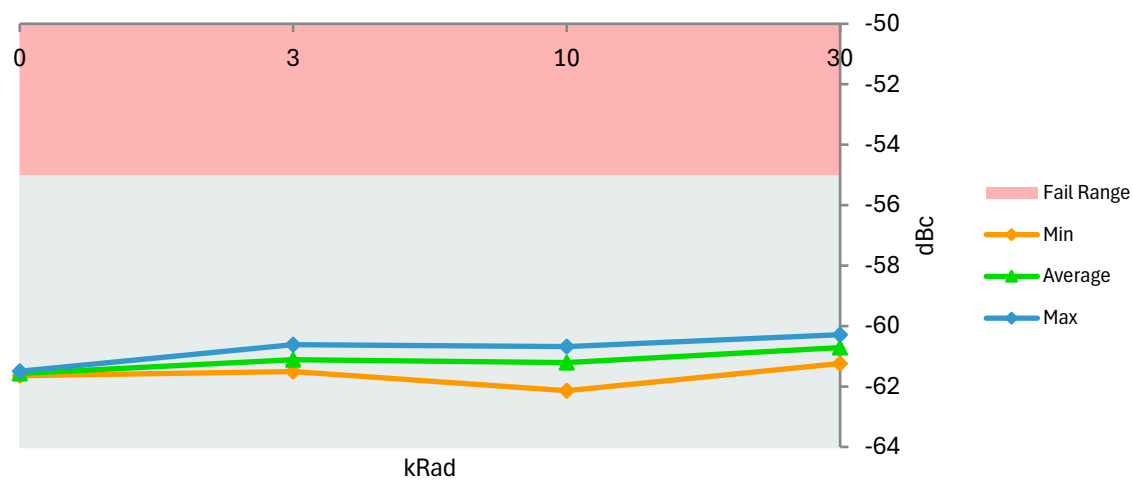
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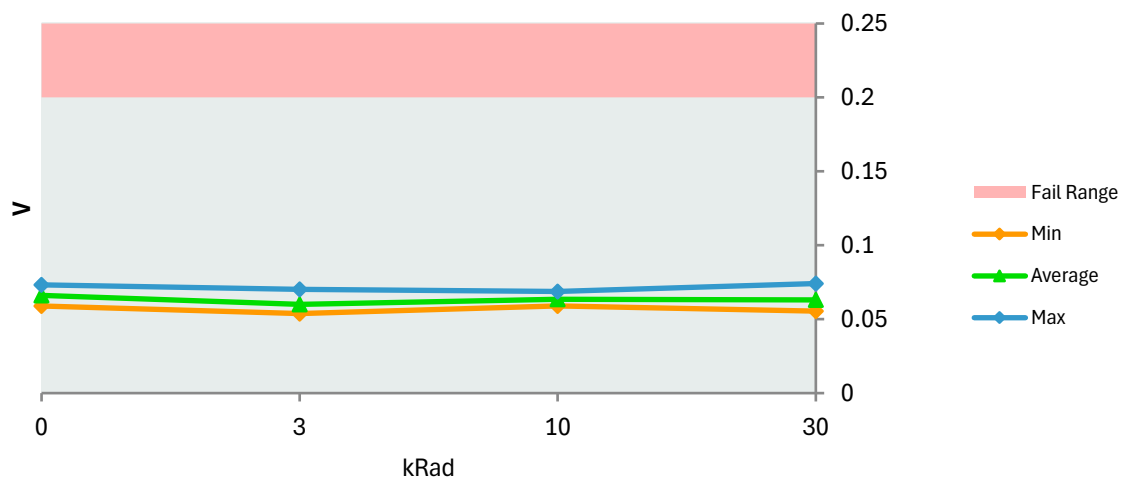
10p4GSPS JMode3 8xInt NRZ 1997MHz 2XCurr IMD3@CHA_DITH0

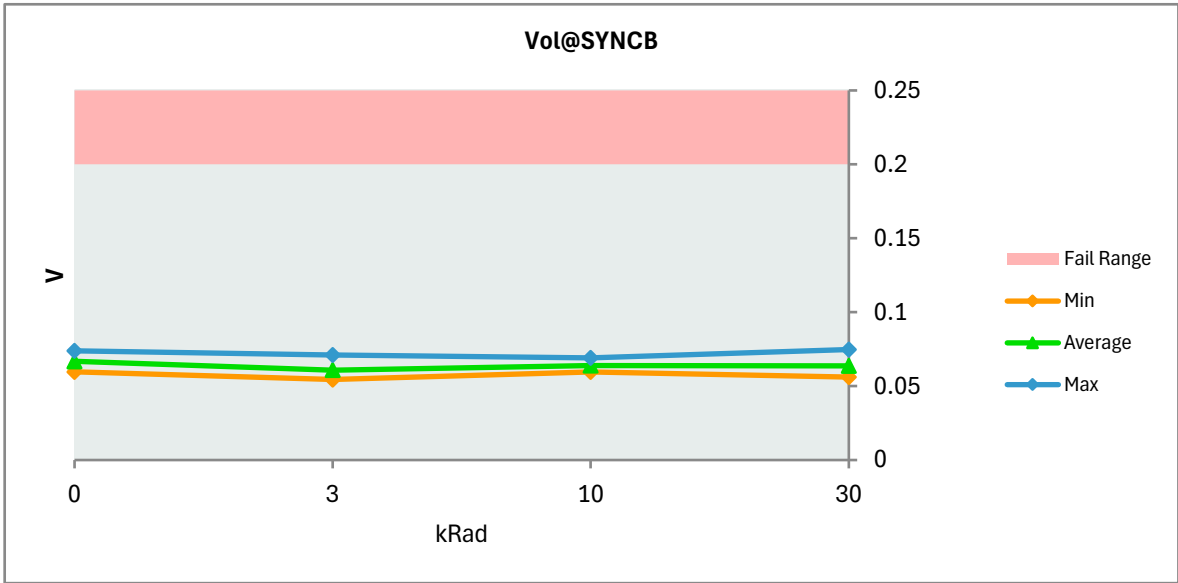
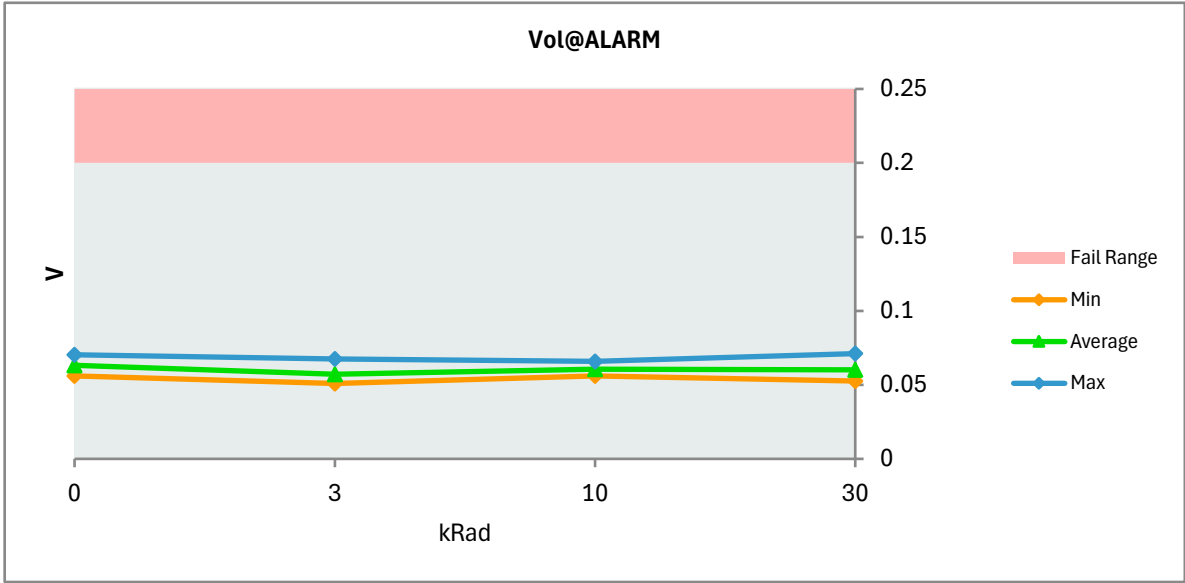


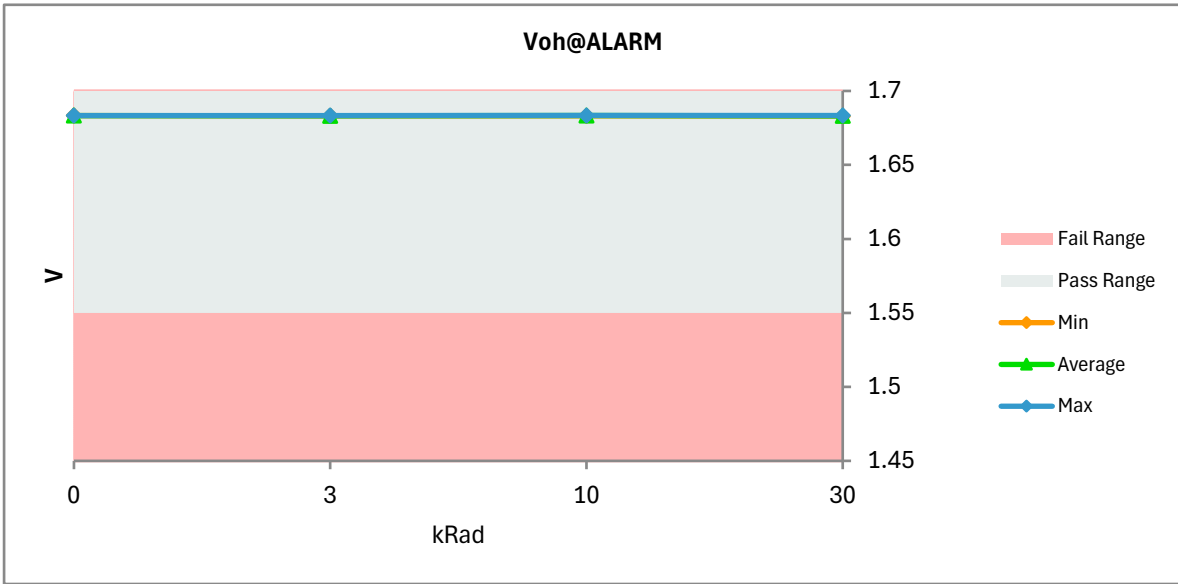
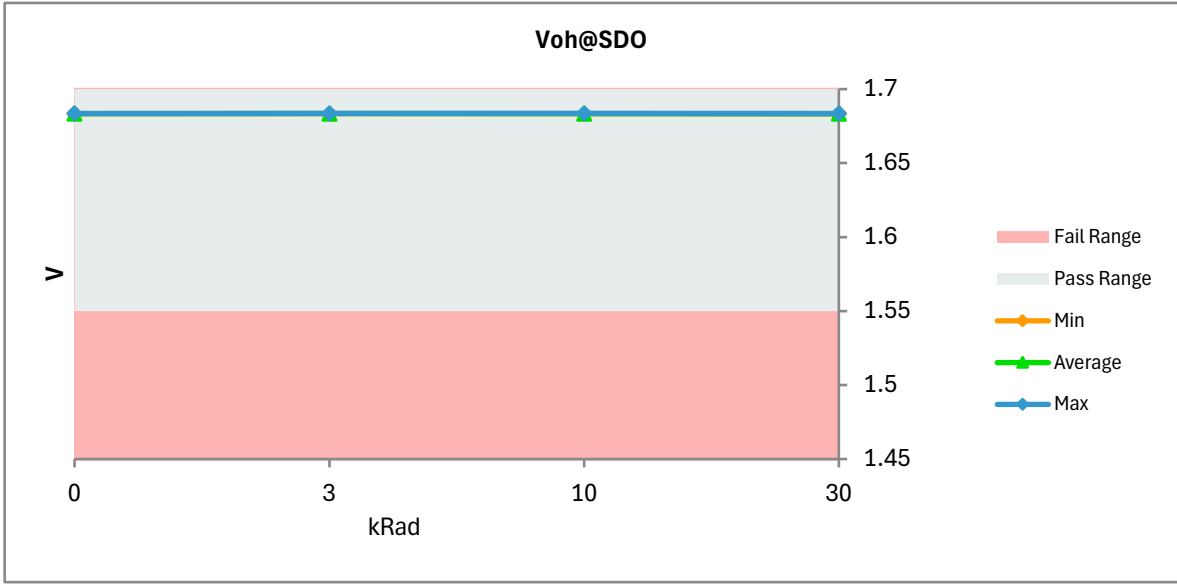
10p4GSPS JMode3 8xInt NRZ 1997MHz 2XCurr IMD3@CHB_DITH0

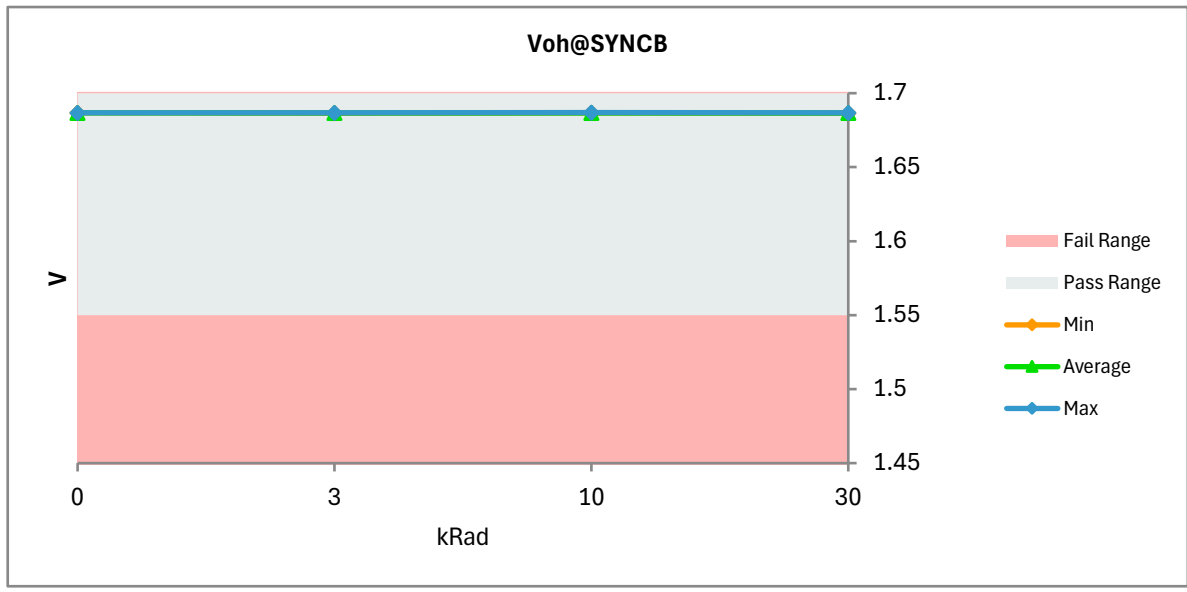


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