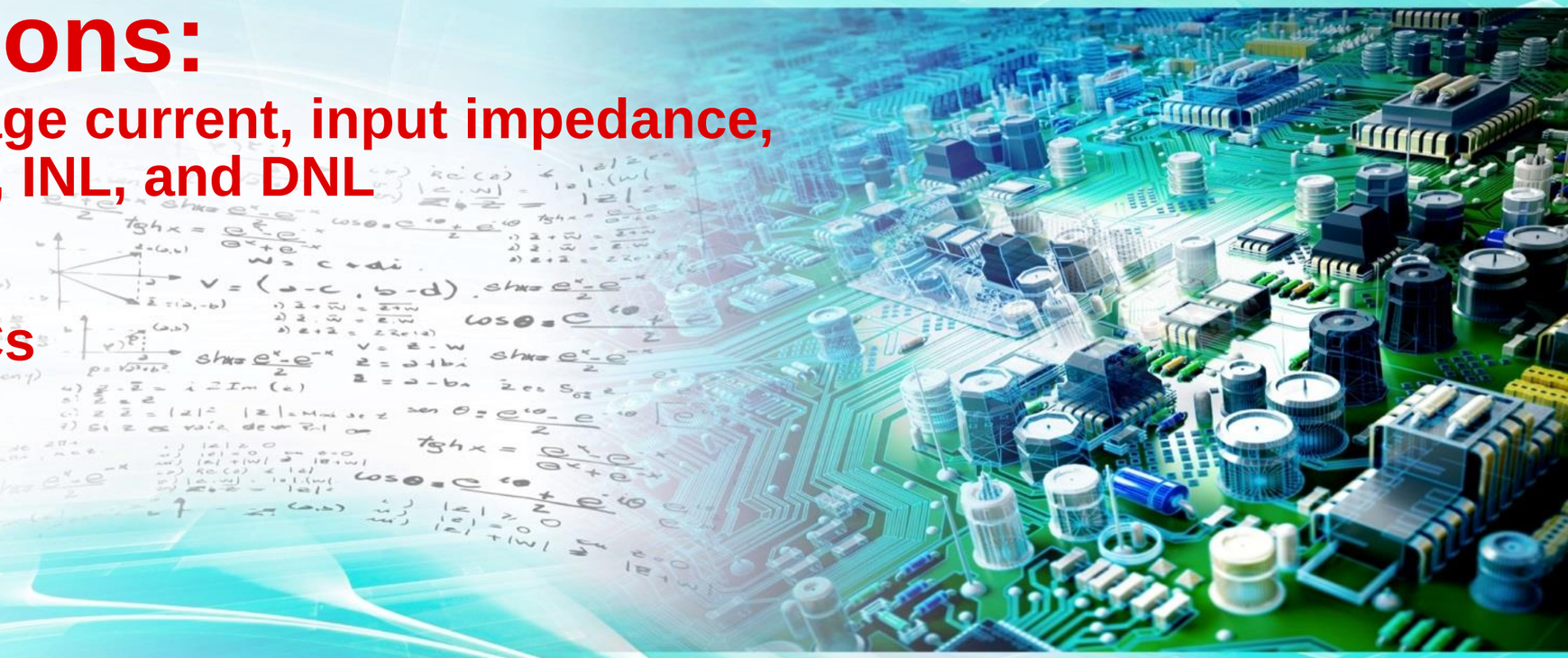
DC Specifications:

input capacitance, leakage current, input impedance, reference voltage range, INL, and DNL

TIPL 4001
TI Precision Labs – ADCs

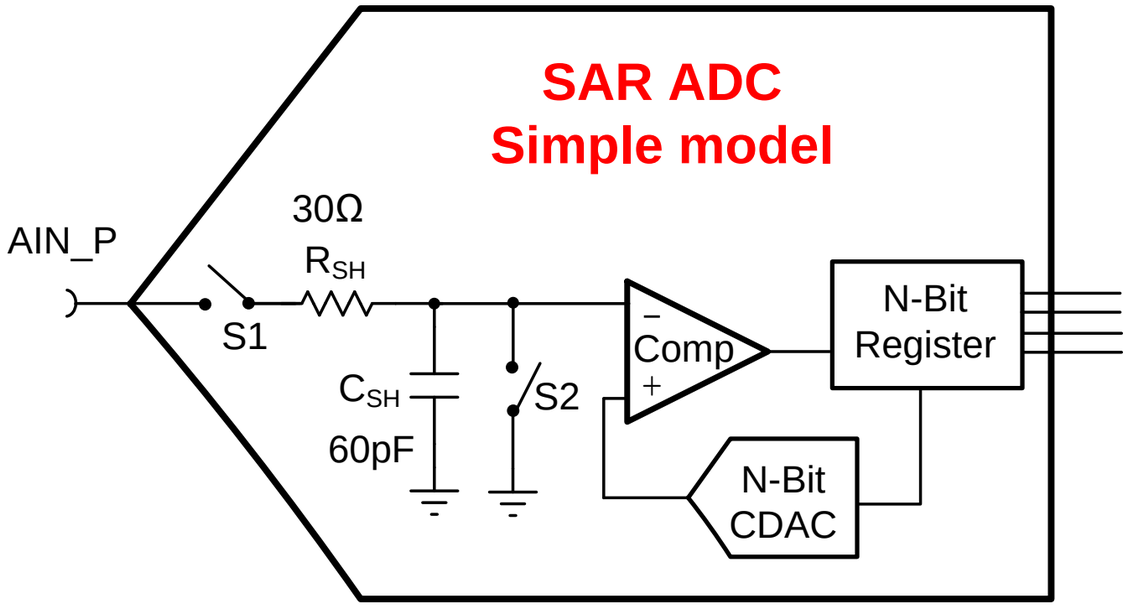


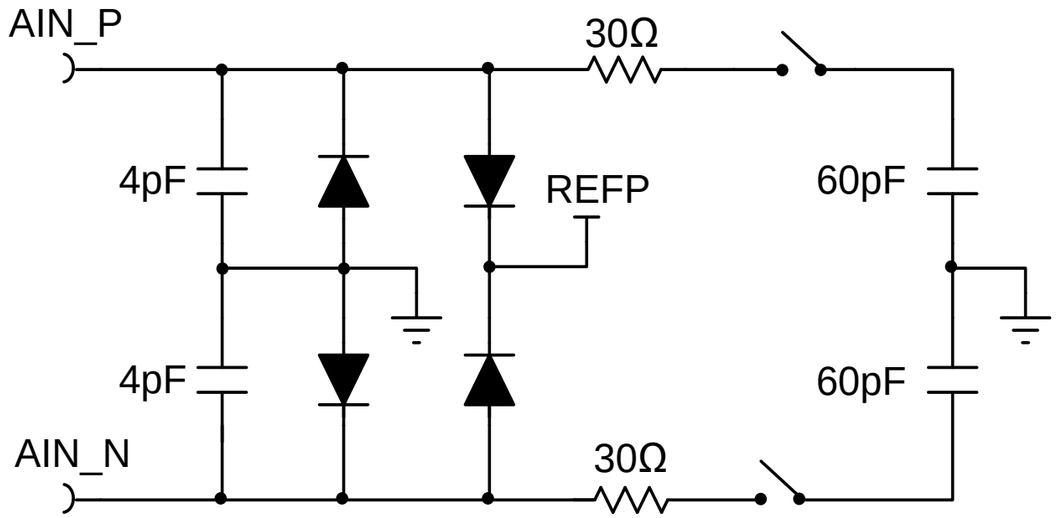
Created by Art Kay

Presented by Peggy Liska

Analog Input: Input Capacitance

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
ANALOG INPUT					
CIN Input capacitance	In sample mode		60		pF
	In hold mode		4		

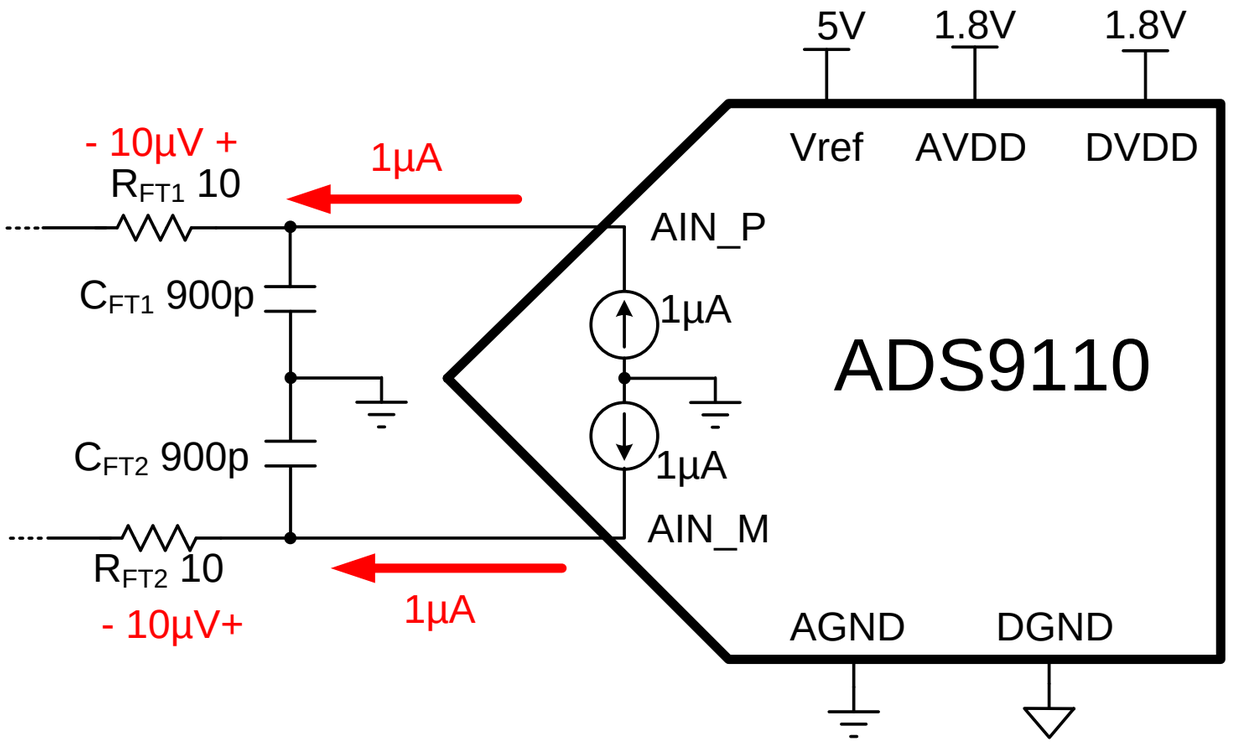




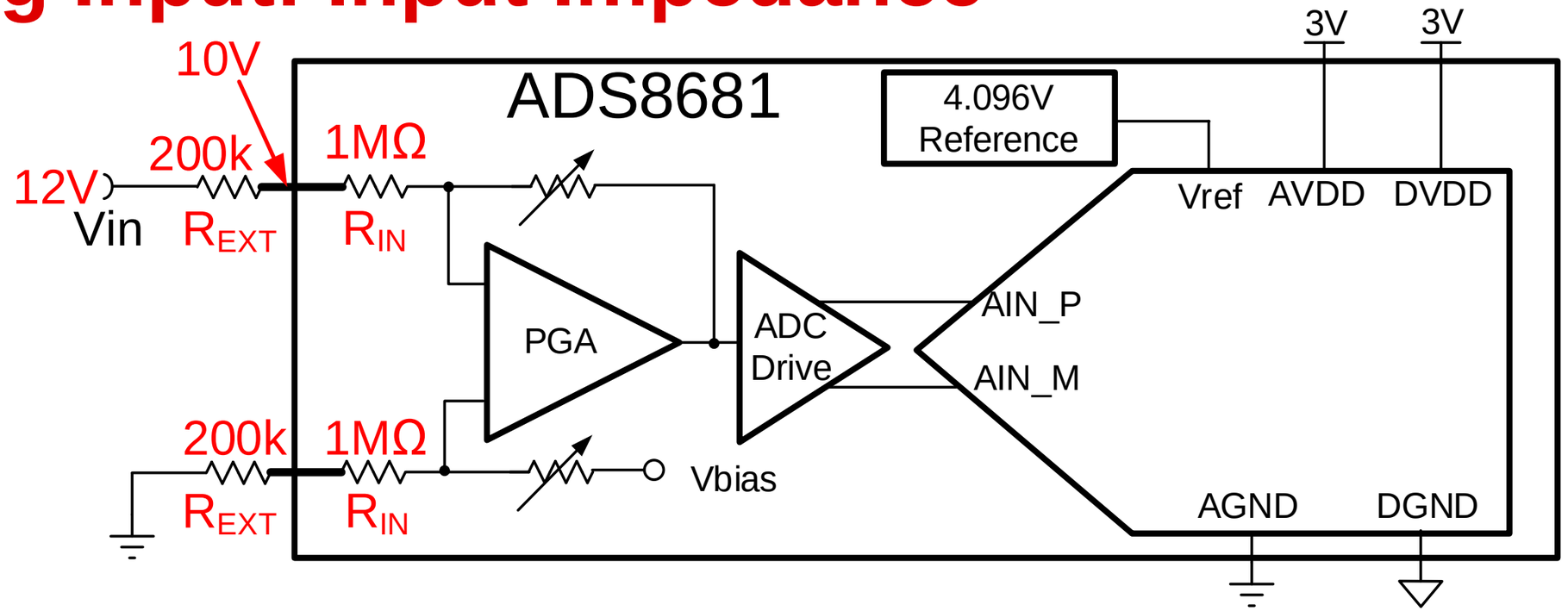
Input stage detailed model

Analog Input: Input Leakage Current

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
ANALOG INPUT					
I_{IL} **Input leakage current**			±1		µA



Analog Input: Input Impedance



$$GE = \frac{1}{1 + \frac{R_{IN}}{R_{EXT}}}$$

System gain error — See document SBAA239

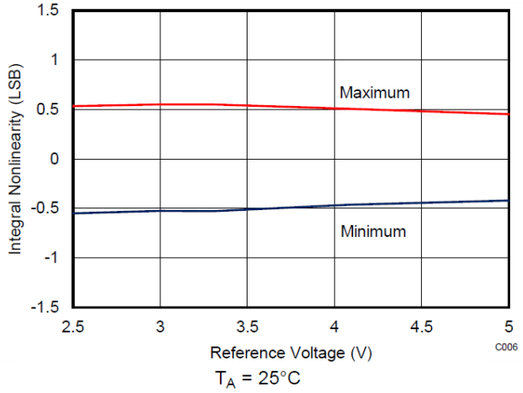
$$V_{IN\_Range\_Adj} = V_{IN\_Range} \cdot \frac{R_{IN} + R_{EXT}}{R_{IN}}$$

Extended input range — See document SBAA244

Reference Input: Reference Input Voltage Range

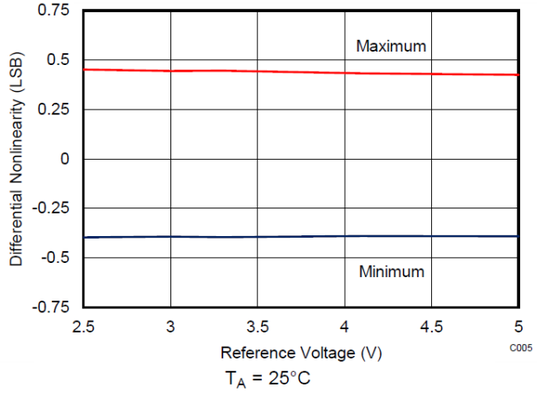
All specifications are for AVDD = 1.8V, DVDD = 1.8V, V_{REF} = 5V, and f_{DATA} = 2Msps, unless otherwise noted

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
ANALOG INPUT					
V_{REF} Reference Input Voltage Range		2.5		5.0	V



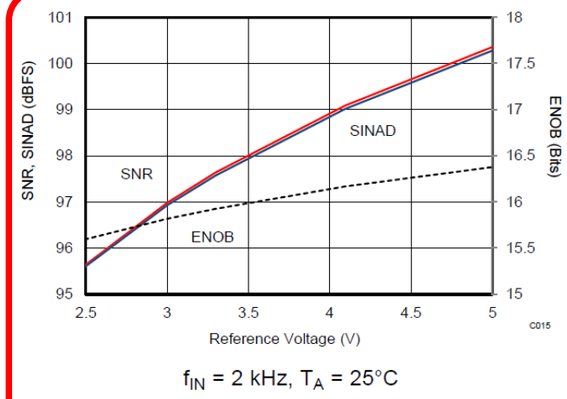
T_A = 25°C

Figure 13. INL vs Reference Voltage



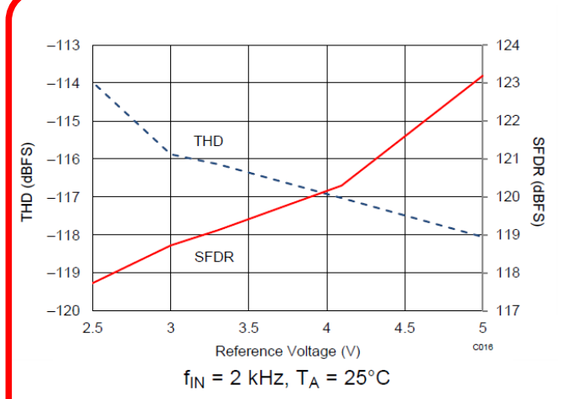
T_A = 25°C

Figure 14. DNL vs Reference Voltage



f_{IN} = 2 kHz, T_A = 25°C

Figure 21. Noise Performance vs Reference Voltage

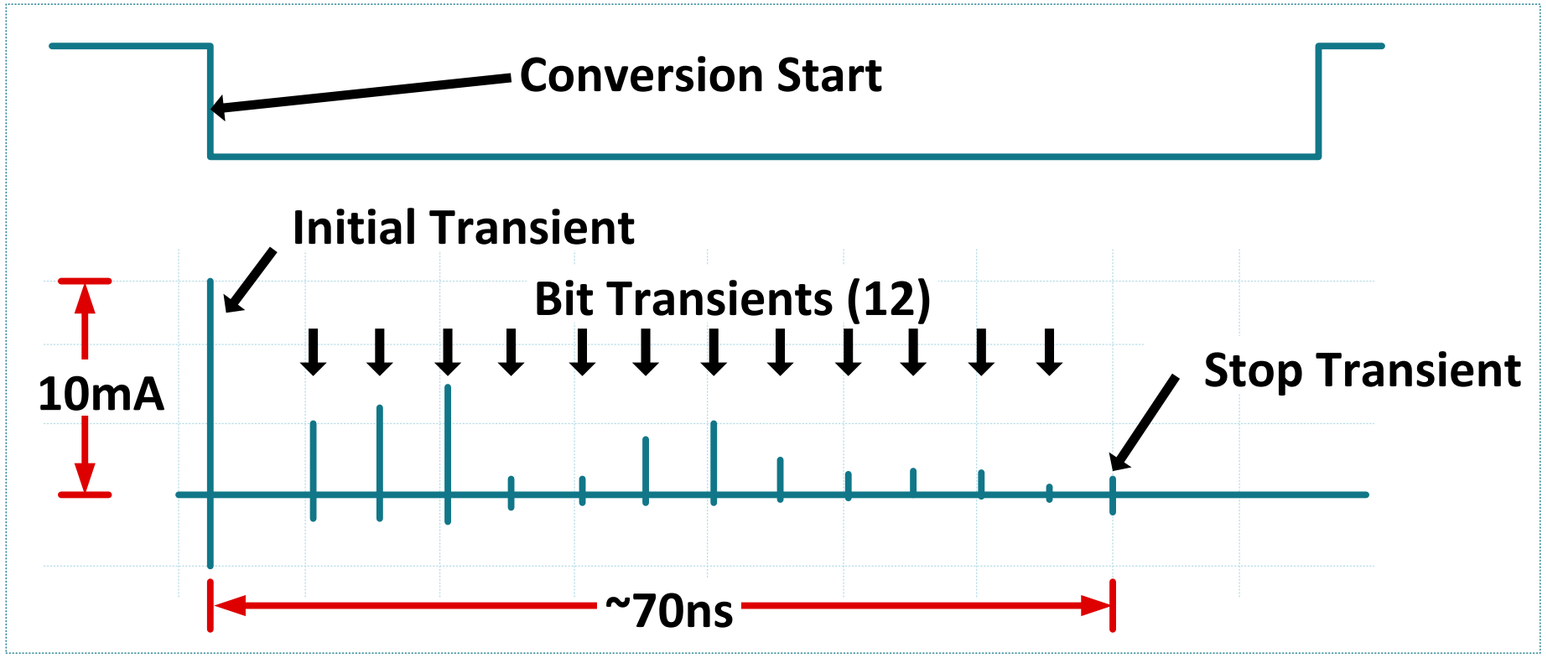


f_{IN} = 2 kHz, T_A = 25°C

Figure 22. Distortion Performance vs Reference Voltage

Reference Input: Reference current

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
EXTERNAL REFERENCE INPUT					
Reference input current	During conversion, 1MHz sample rate, midcode		300		µA
Input leakage Current			250		pA
C_{REF} Decoupling capacitor at the reference input		10	22		µF



System Performance: Ideal Transfer Function

$$\boldsymbol{Number\ of\ Codes = 2^N}$$

$$\boldsymbol{V_{LSB} = \frac{FSR}{2^N}}$$

Where

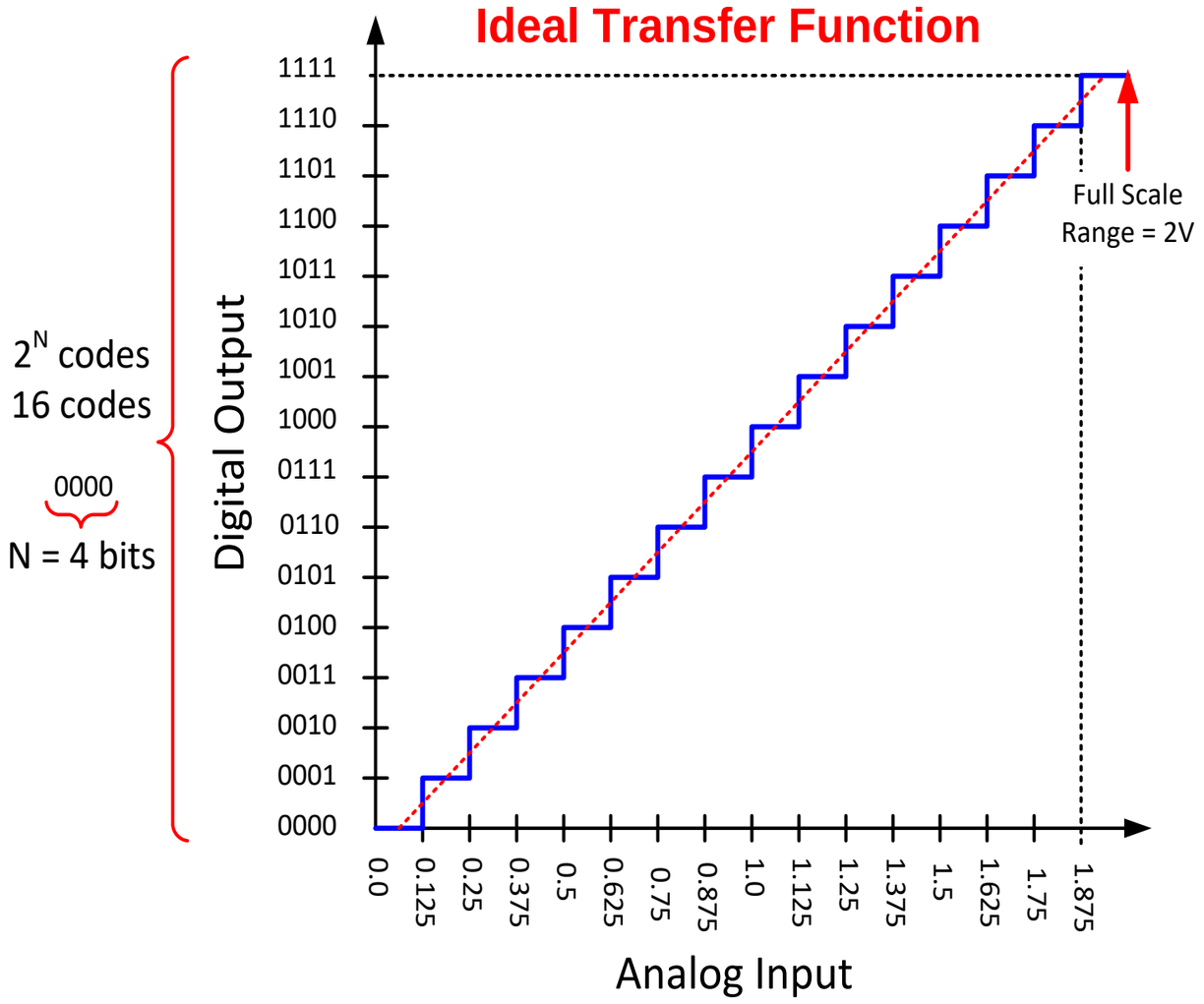
V_{LSB} = The minimum resolvable voltage width

FSR = Full Scale Range

N = Number of bits

$$\mathbf{V_{LSB} = \frac{FSR}{2^N} = \frac{2V}{2^4} = 0.125V}$$

$$\mathbf{Number\ of\ Codes = 2^N = 2^4 = 16}$$



System Performance: Differential Nonlinearity (DNL)

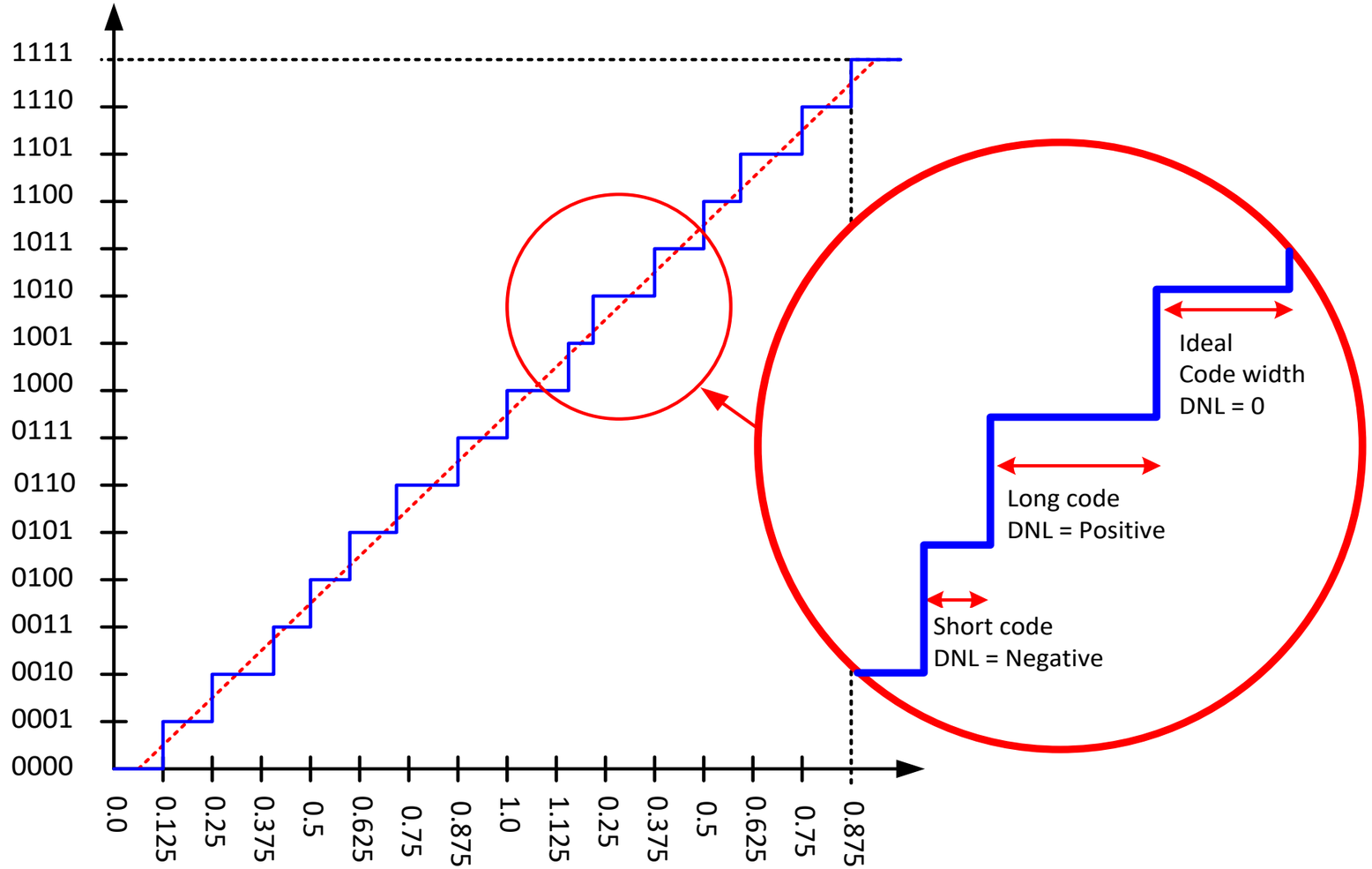
$$DNL[k] = \frac{W[k] - Q}{Q}$$

$$W[k] = T[k+1] - T[k]$$

W[k] the measured code width.

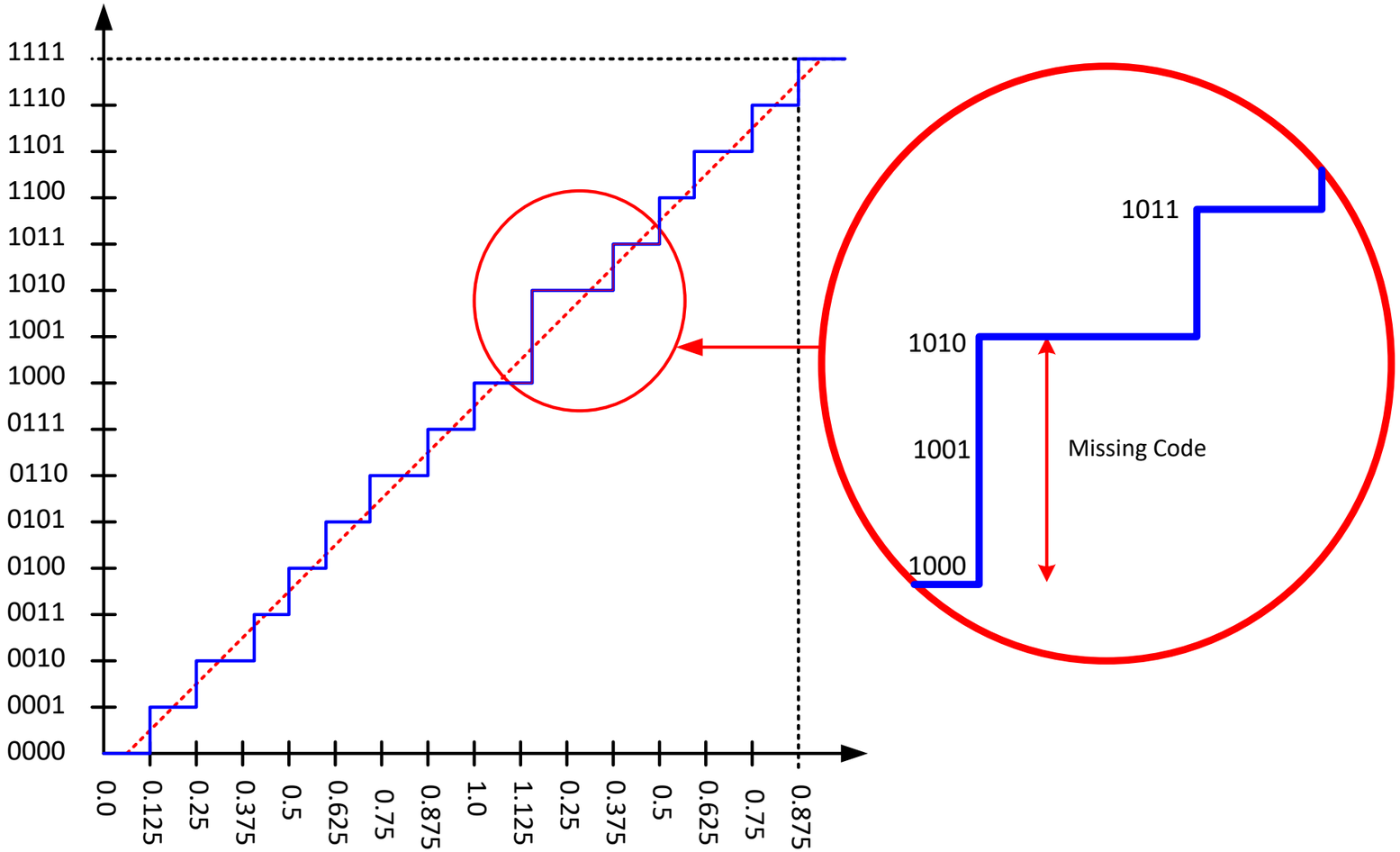
T[k] The voltage level where a code transitions

Q Ideal code width



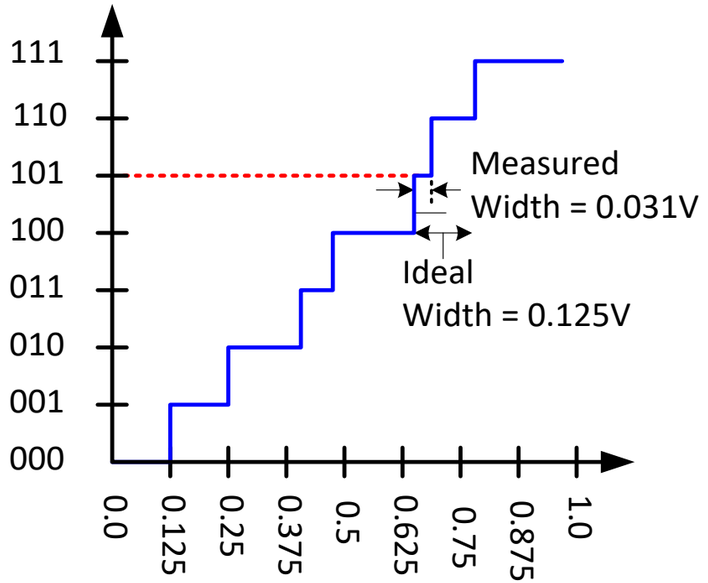
System Performance: No Missing Code (NMC)

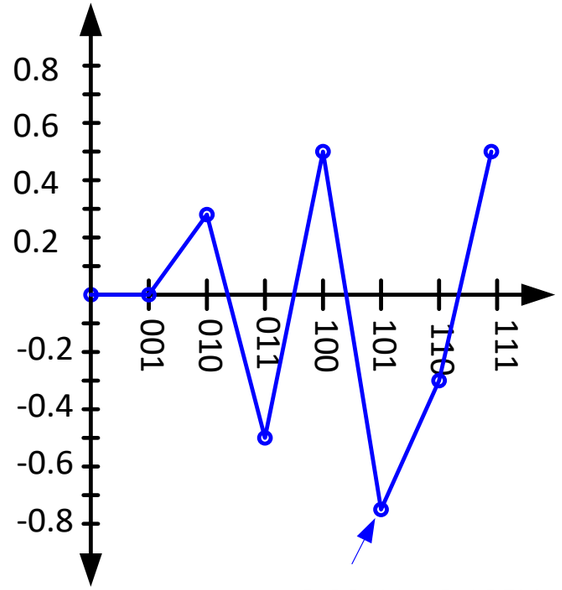
PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
SYSTEM PERFORMANCE					
NMC Integral Nonlinearity	AVDD = 3V	12			Bits



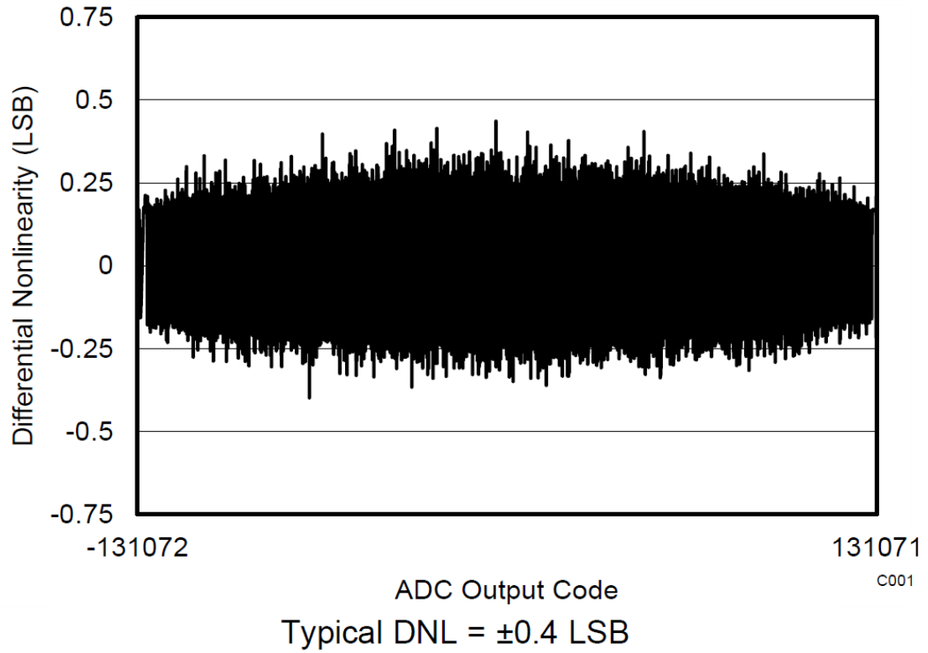
Differential Nonlinearity (DNL) vs. Code

PARAMETER ADS9110	TEST CONDITION	MIN	TYP	MAX	UNIT
SYSTEM PERFORMANCE					
DNL Differential Nonlinearity	AVDD = 1.8V	-0.75	±0.4	+0.75	LSB



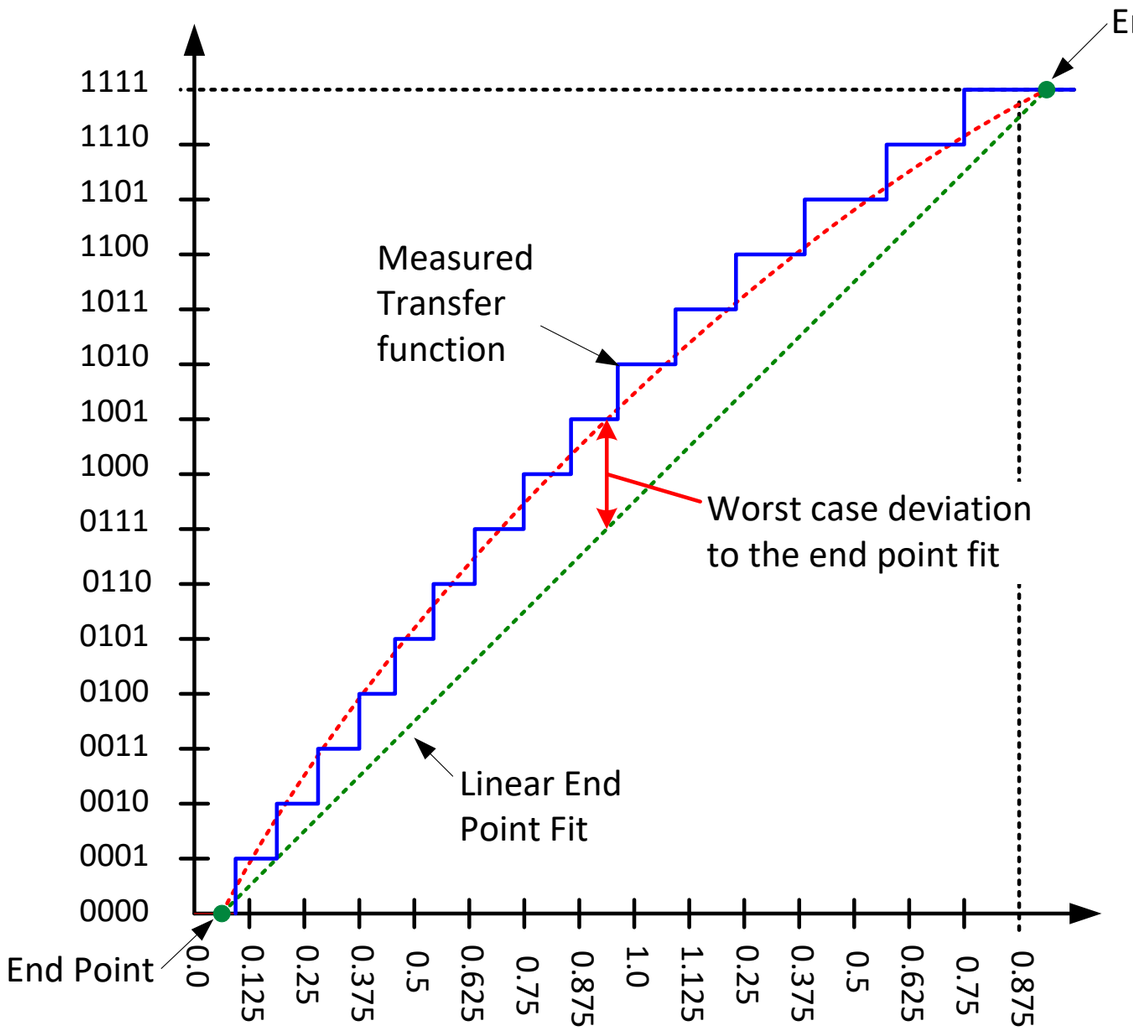


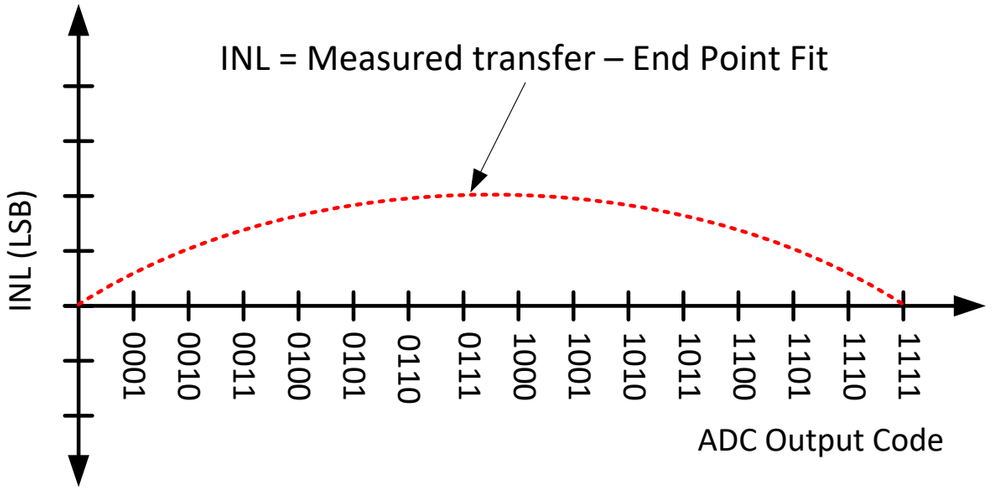
$$DNL(101) = \frac{0.031V - 0.125V}{0.125V} = -0.752$$



Typical DNL = ±0.4 LSB

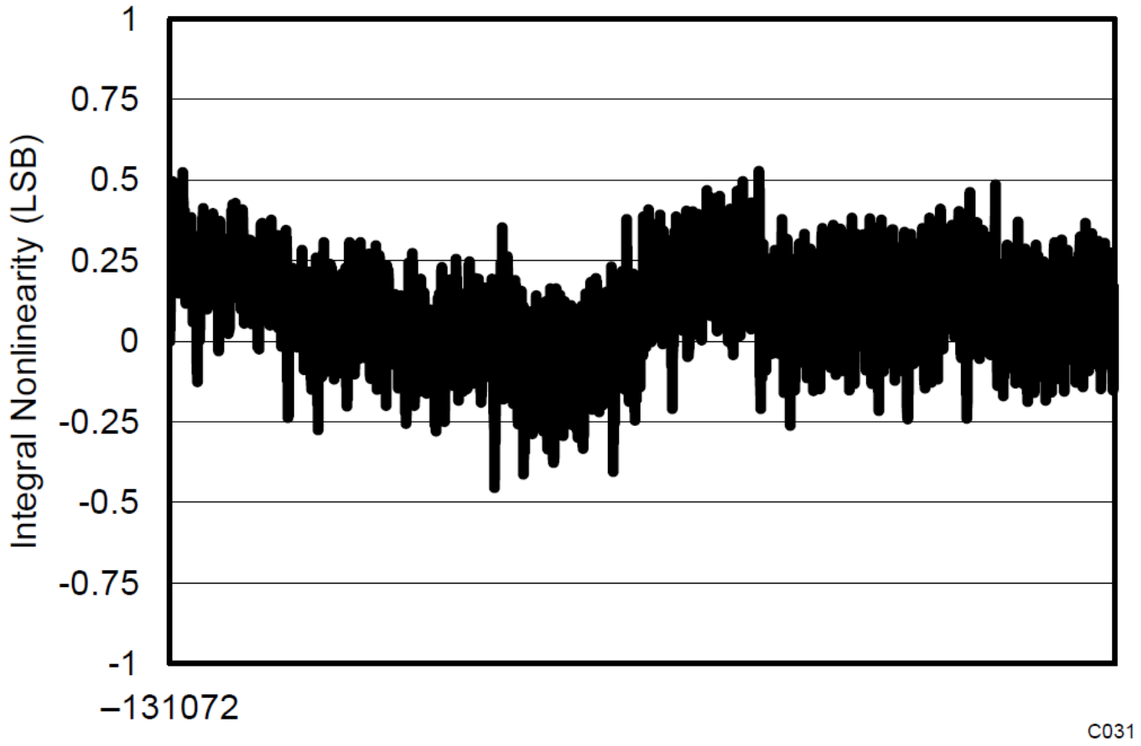
System Performance: Integral Nonlinearity (INL)





INL Data Sheet Specification

PARAMETER ADS9110	TEST CONDITION	MIN	TYP	MAX	UNIT
SYSTEM PERFORMANCE					
INL Integral Nonlinearity	AVDD = 3V	-1.5	±0.5	1.5	LSB



Typical INL of ±0.5 LSB

Thanks for your time!
Please try the quiz.

Quiz: DC Specifications

TIPL 4001

TI Precision Labs – ADCs

Created by Art Kay

Quiz: DC Specifications

1. The input capacitance from a SAR ADC is from ____.
   a. The parasitic capacitance of the ESD diodes
   b. The sample and hold capacitance
   c. Both a and b.

2. Input leakage current for a SAR ADC _____.
   a. Is from the external RC filter circuit.
   b. Will generate an error when flowing through any input resistance.
   c. Is always negligible.

Quiz: DC Specifications

3. Reference input current _____.
   a. Is a constant current typically in the milliamps.
   b. Is a constant current typically in the microamps.
   c. Has very fast transient spikes that may be milliamps.
   d. Has very fast transient spikes that may be microamps.

4. How many codes does a four bit converter have?
   a. 4
   b. 8
   c. 16
   d. 32

Quiz: DC Specifications

5. Differential non-linearity is a measurement of _____.
   a. The code width as compared to the ideal code width.
   b. The total number of codes in the transfer function.
   c. The deviation of the measured code to an ideal end point fit line.
   d. The worst case system error

6. Integral non-linearity is a measurement of _____.
   a. The code width as compared to the ideal code width.
   b. The total number of codes in the transfer function.
   c. The deviation of the measured code to an ideal end point fit line.
   d. The worst case system error

Solutions

Solutions Quiz: DC Specifications

1. The input capacitance from a SAR ADC is from ____.
   a. The parasitic capacitance of the ESD diodes
   b. The sample and hold capacitance
   c. Both a and b.

2. Input leakage current for a SAR ADC _____.
   a. Is from the external RC filter circuit.
   b. Will generate an error when flowing through any input resistance.
   c. Is always negligible.

Solutions Quiz: DC Specifications

3. Reference input current _____.
   a. Is a constant current typically in the milliamps.
   b. Is a constant current typically in the microamps.
   c. Has very fast transient spikes that may be milliamps.
   d. Has very fast transient spikes that may be microamps.

4. How many codes does a four bit converter have?
   a. 4
   b. 8
   c. 16
   d. 32

Solutions Quiz: DC Specifications

5. Differential non-linearity is a measurement of _____.
   a. **The code width as compared to the ideal code width.**
   b. The total number of codes in the transfer function.
   c. The deviation of the measured code to an ideal end point fit line.
   d. The worst case system error

6. Integral non-linearity is a measurement of _____.
   a. The code width as compared to the ideal code width.
   b. The total number of codes in the transfer function.
   c. **The deviation of the measured code to an ideal end point fit line.**
   d. The worst case system error