

AC と DC の仕様について:

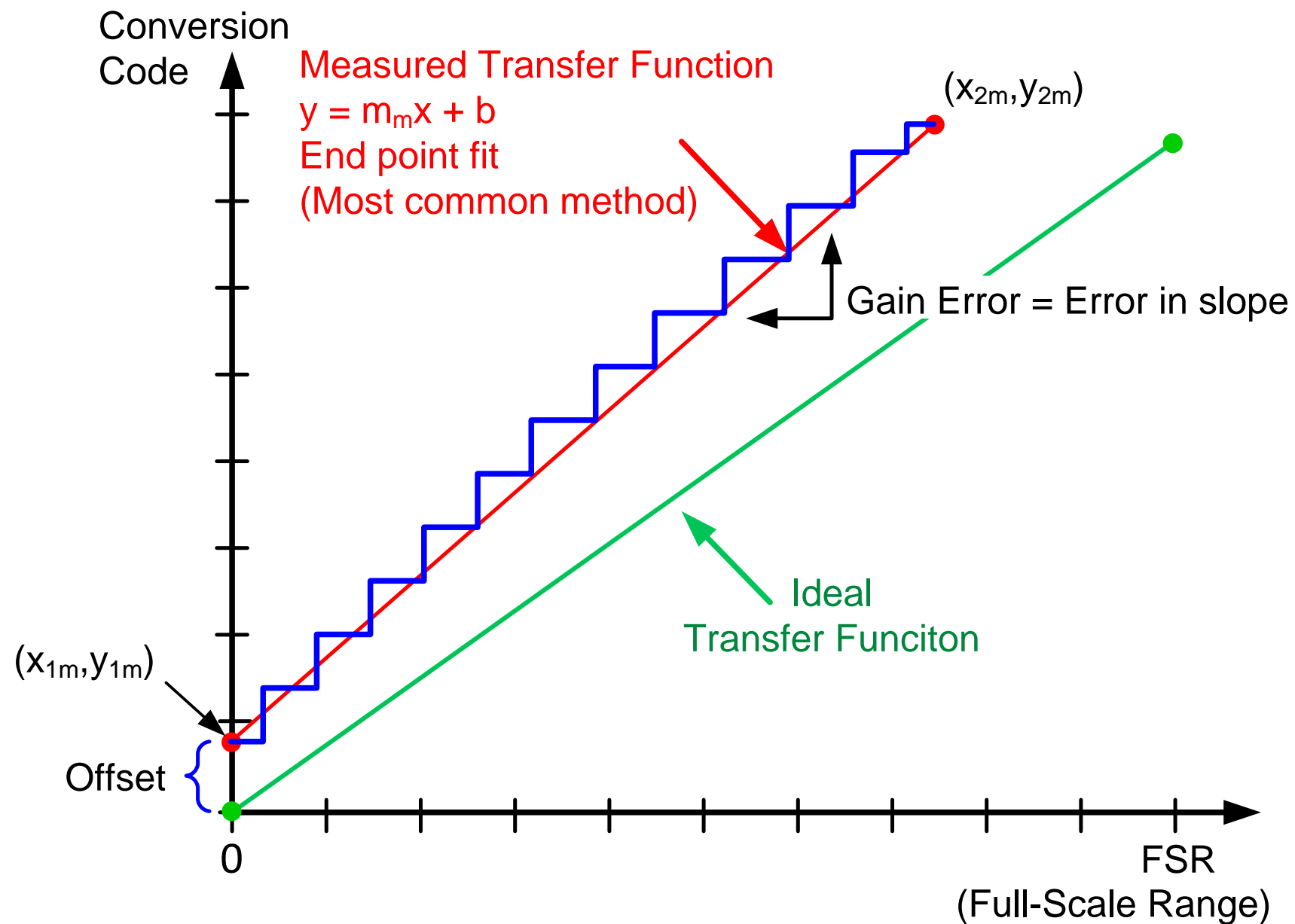
オフセット誤差、ゲイン誤差、CMRR, PSRR, SNR, THD

TIPL 4002
TI プレシジョン・ラボ - ADC

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日本語版講師：宮崎 仁

オフセット誤差とゲイン誤差



Offset and Gain Error based on End point fit:

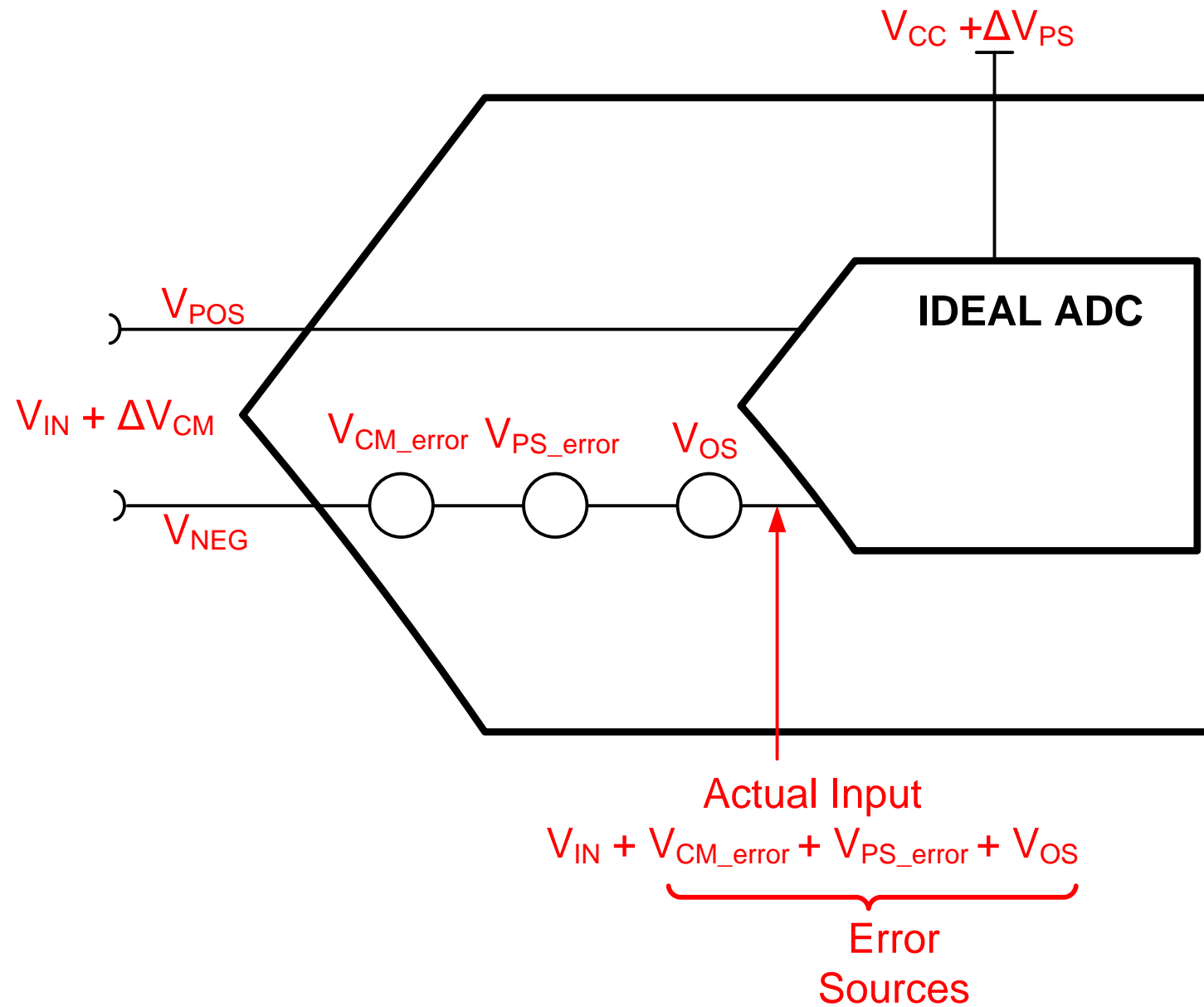
Straight Line Fit $y = m_m \cdot x + b$

Measured Transfer Function $m_m = \frac{y_{2m} - y_{1m}}{x_{2m} - x_{1m}}$

Offset Error $b = y - m_m \cdot x$

Gain Error $E_G = \left(\frac{m_m - m_i}{m_i} \right) \cdot 100\%$
 (m_i is the ideal transfer function)

同相除去比と電源除去比



$$V_{CM} = \left(\frac{V_{POS} + V_{NEG}}{2} \right)$$

$$CMRR(dB) = -20 \cdot \log \left(\frac{\Delta V_{CM_error}}{\Delta V_{CM}} \right)$$

$$\Delta V_{CM_error} = \Delta V_{CM} \cdot 10^{\left[\frac{-CMRR(dB)}{20} \right]}$$

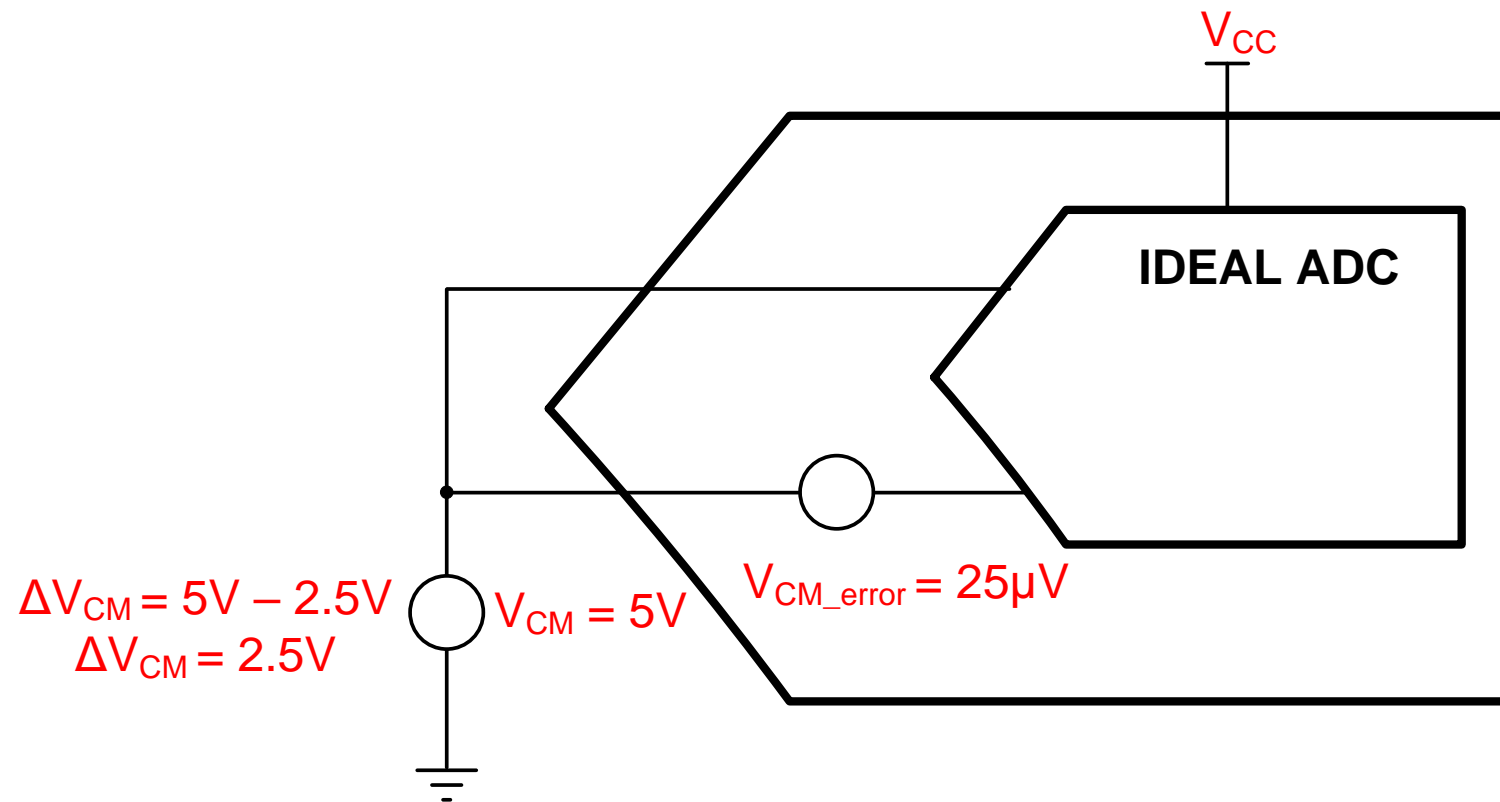
$$PSRR(dB) = -20 \cdot \log \left(\frac{\Delta V_{PS_error}}{\Delta V_{PS}} \right)$$

$$\Delta V_{PS_error} = \Delta V_{PS} \cdot 10^{\left[\frac{-PSRR(dB)}{20} \right]}$$

同相除去比 - CMRR

AVDD = 3V, DVDD = 3V, VREF = 5V, VCM = 2.5V, AND $f_{\text{sample}} = 1\text{Msps}$ unless otherwise noted

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT	
SYSTEM PERFORMANCE						
CMRR	Common-mode rejection ratio		90	100		dB

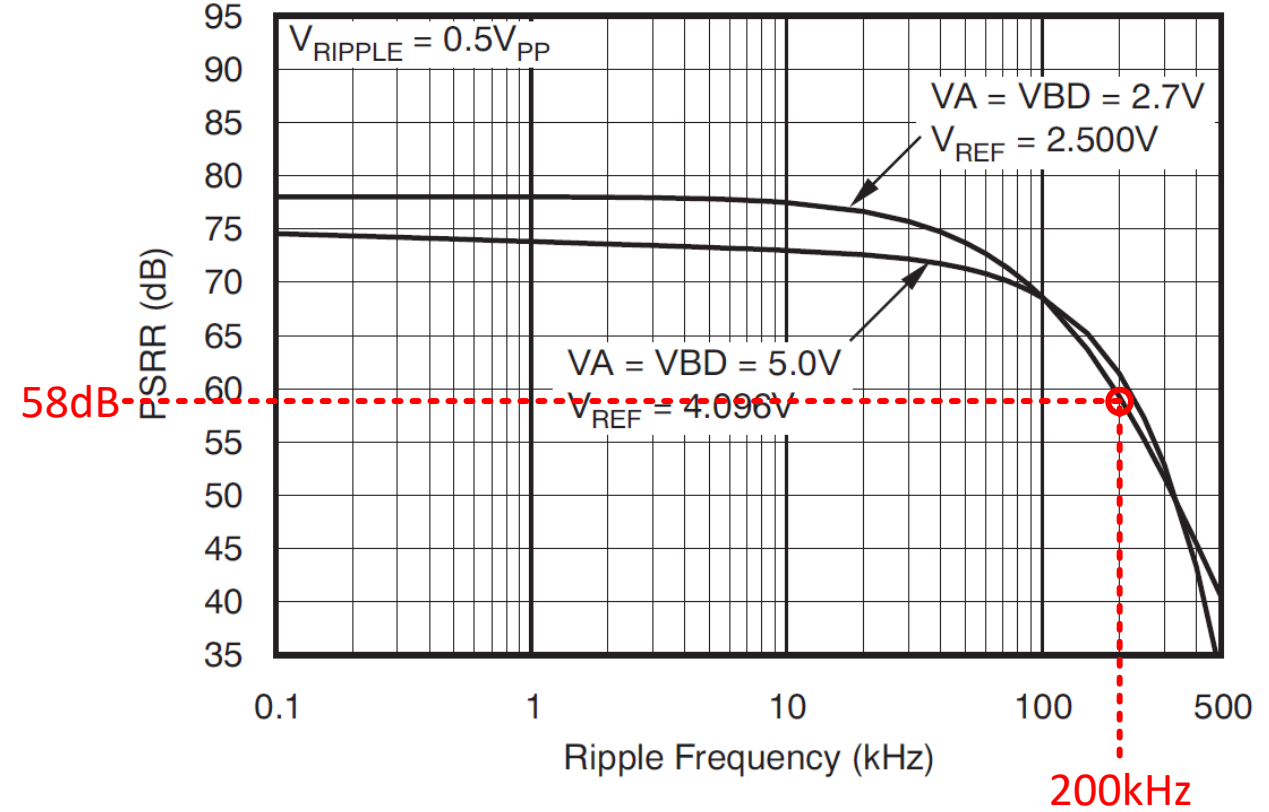
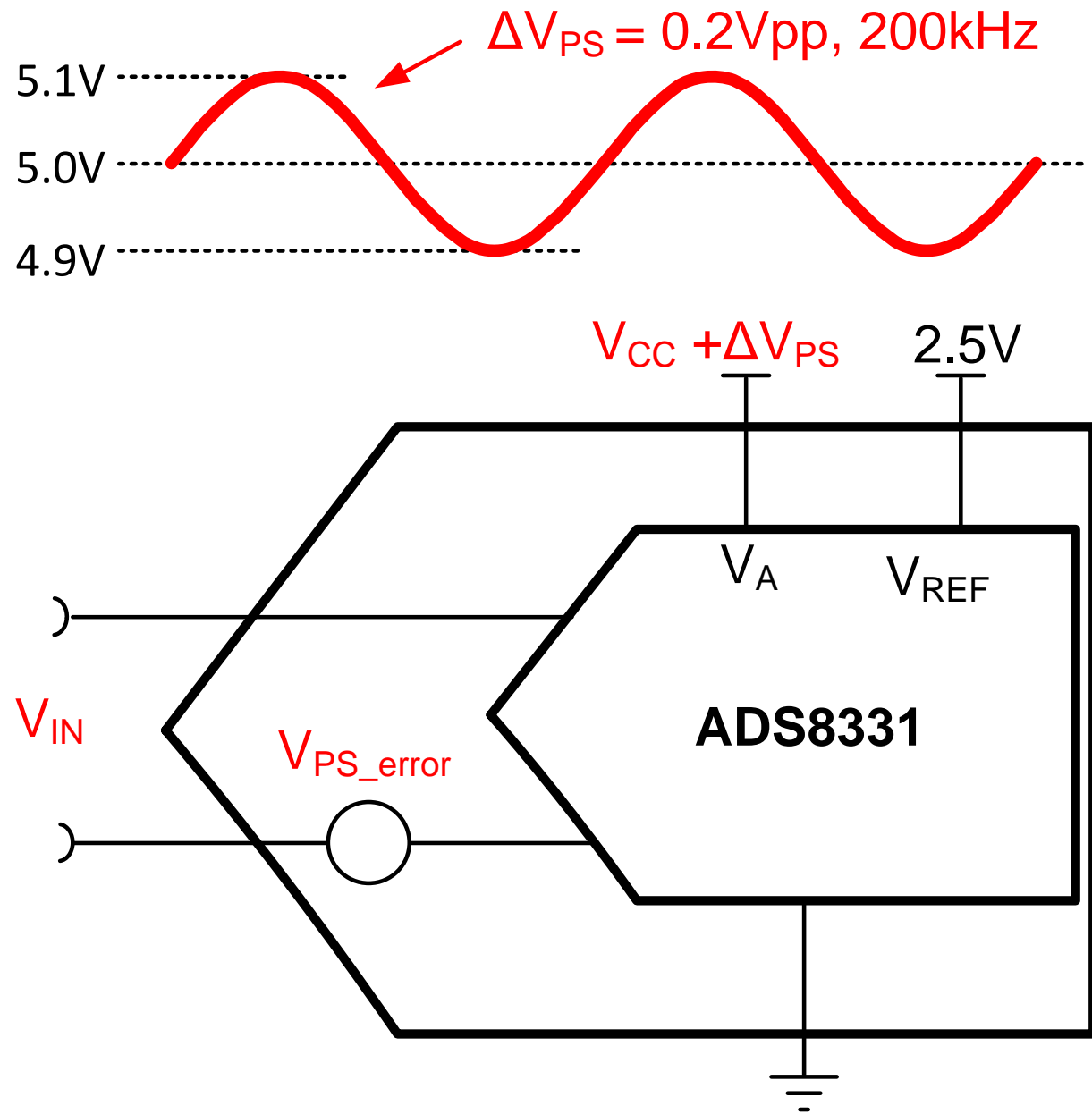


$$V_{CM} = \left(\frac{V_{POS} + V_{NEG}}{2} \right)$$

$$\Delta V_{CM_error} = \Delta V_{CM} \cdot 10^{\left[\frac{-CMRR(dB)}{20} \right]}$$

$$\Delta V_{CM_error} = 2.5V \cdot 10^{\left[\frac{-100dB}{20} \right]} = 25\mu V$$

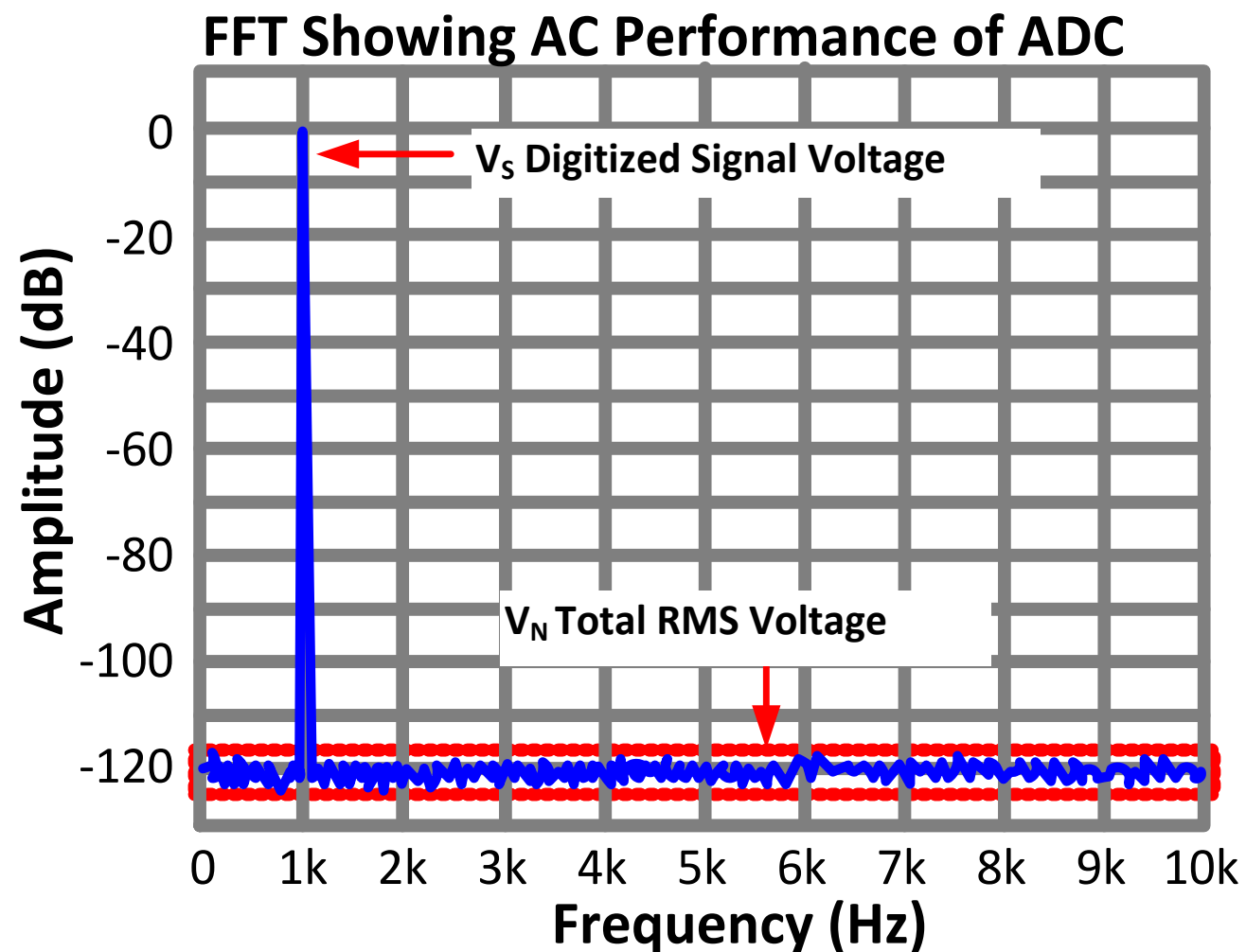
電源除去比 - PSRR



$$\Delta V_{PS_error} = \Delta V_{PS} \cdot 10^{\left[\frac{-PSRR(dB)}{20}\right]}$$

$$\Delta V_{PS_error} = 0.2V \cdot 10^{\left[\frac{-58dB}{20}\right]} = 252\mu V_{pp}$$

信号-雜音比 (SNR)



Measured Ratio:

$$SNR(V/V) = \frac{V_S}{V_N}$$

Measured dB:

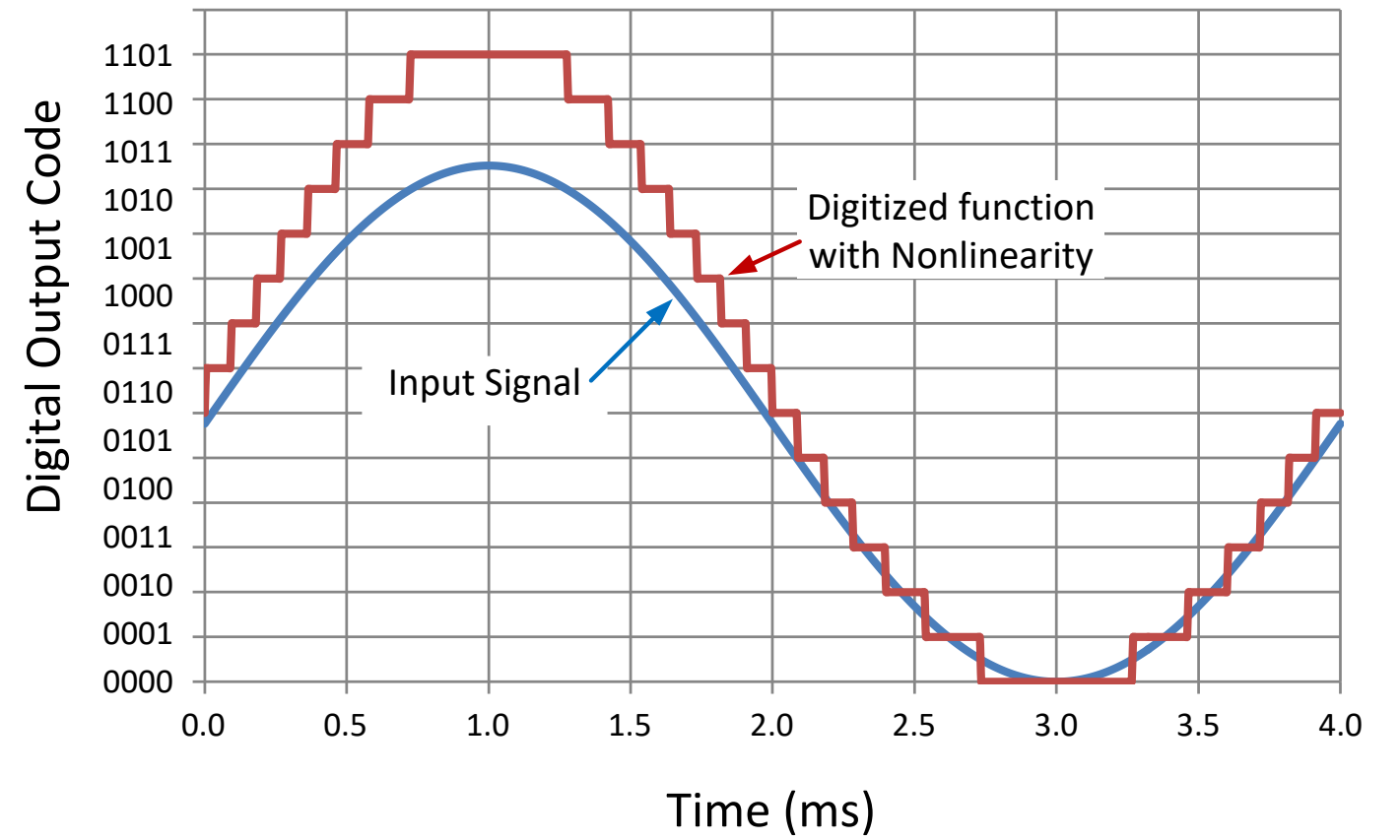
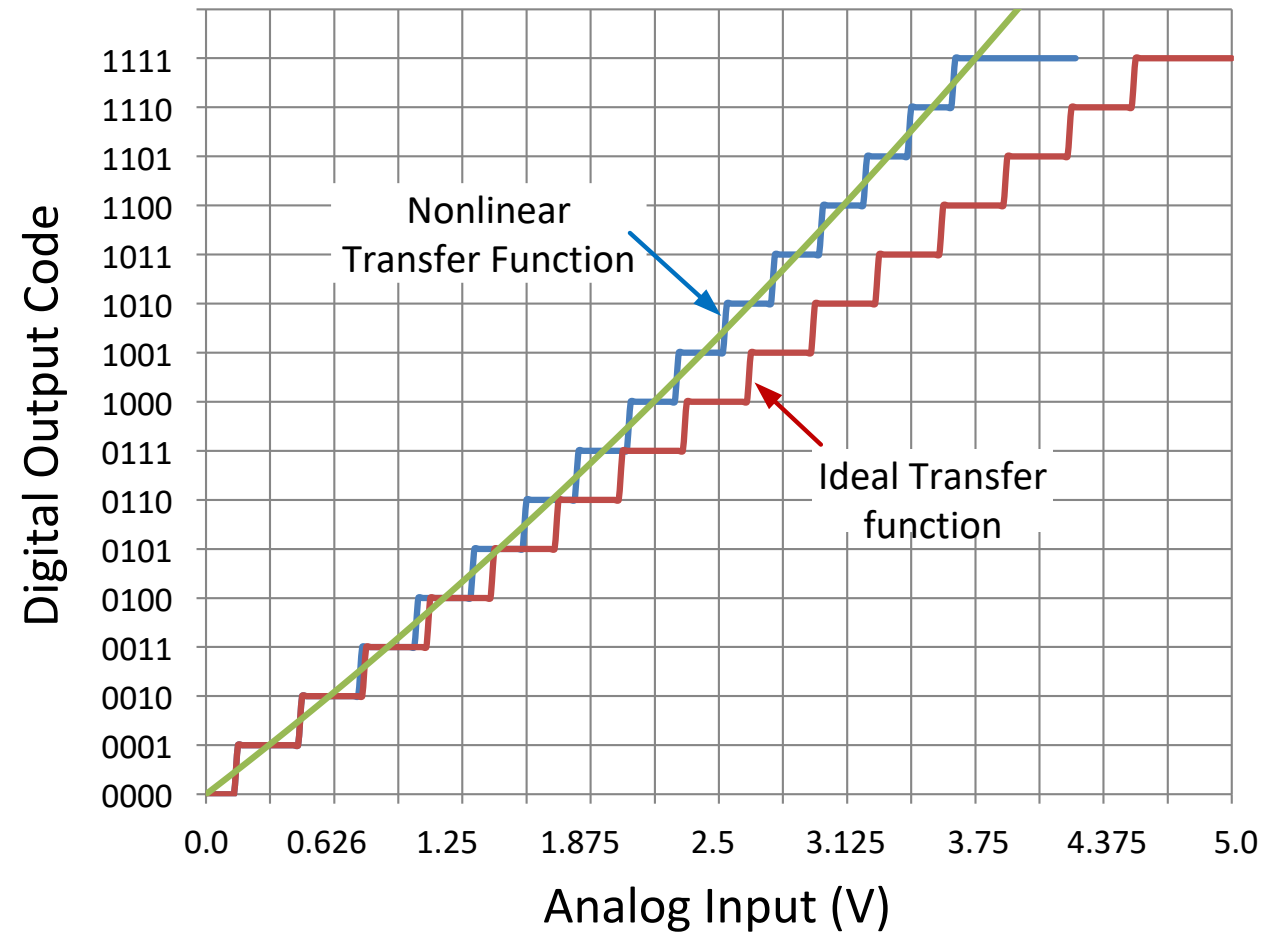
$$SNR(dB) = 20 \cdot \log \left(\frac{V_S}{V_N} \right)$$

Ideal ADC SNR:

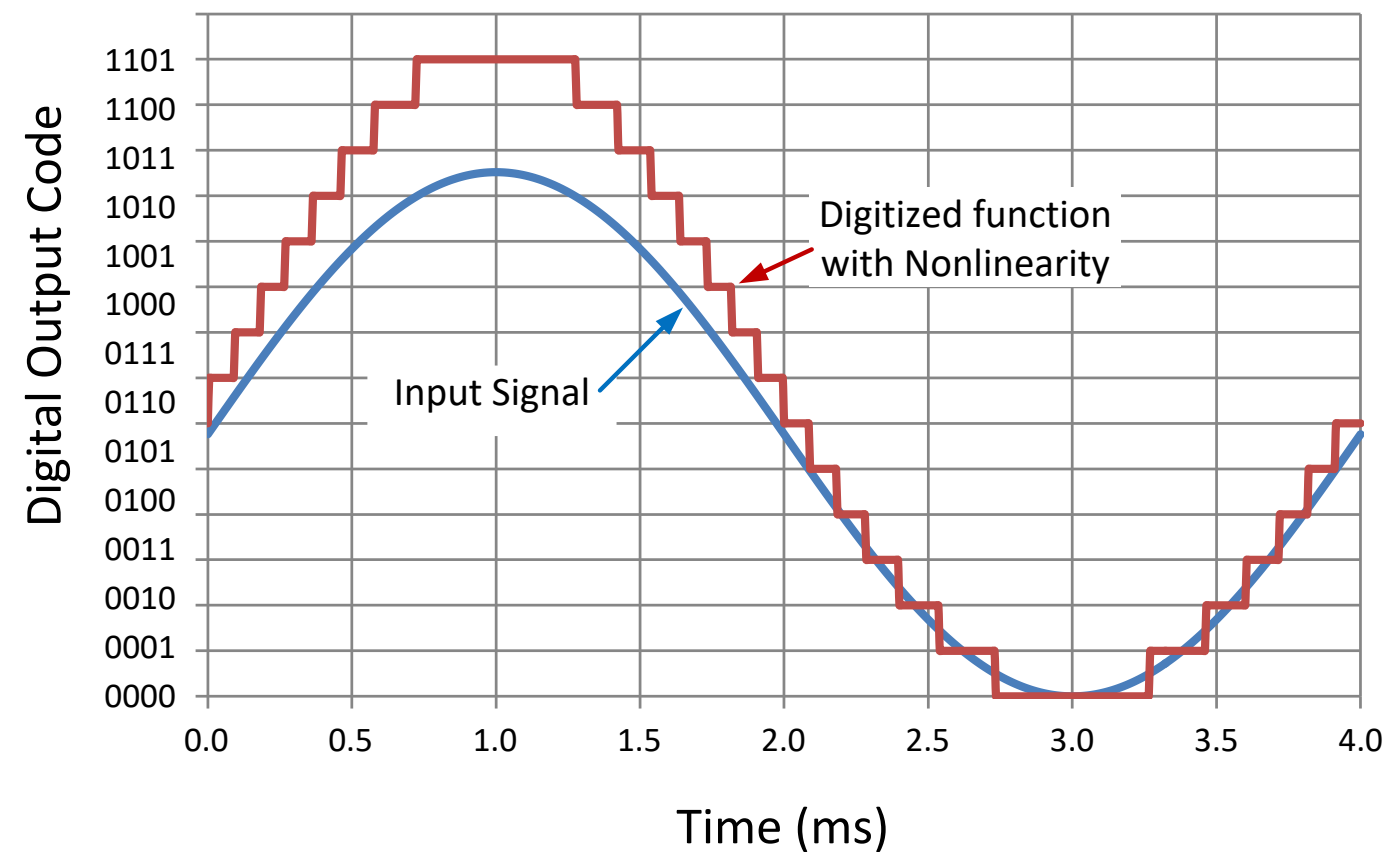
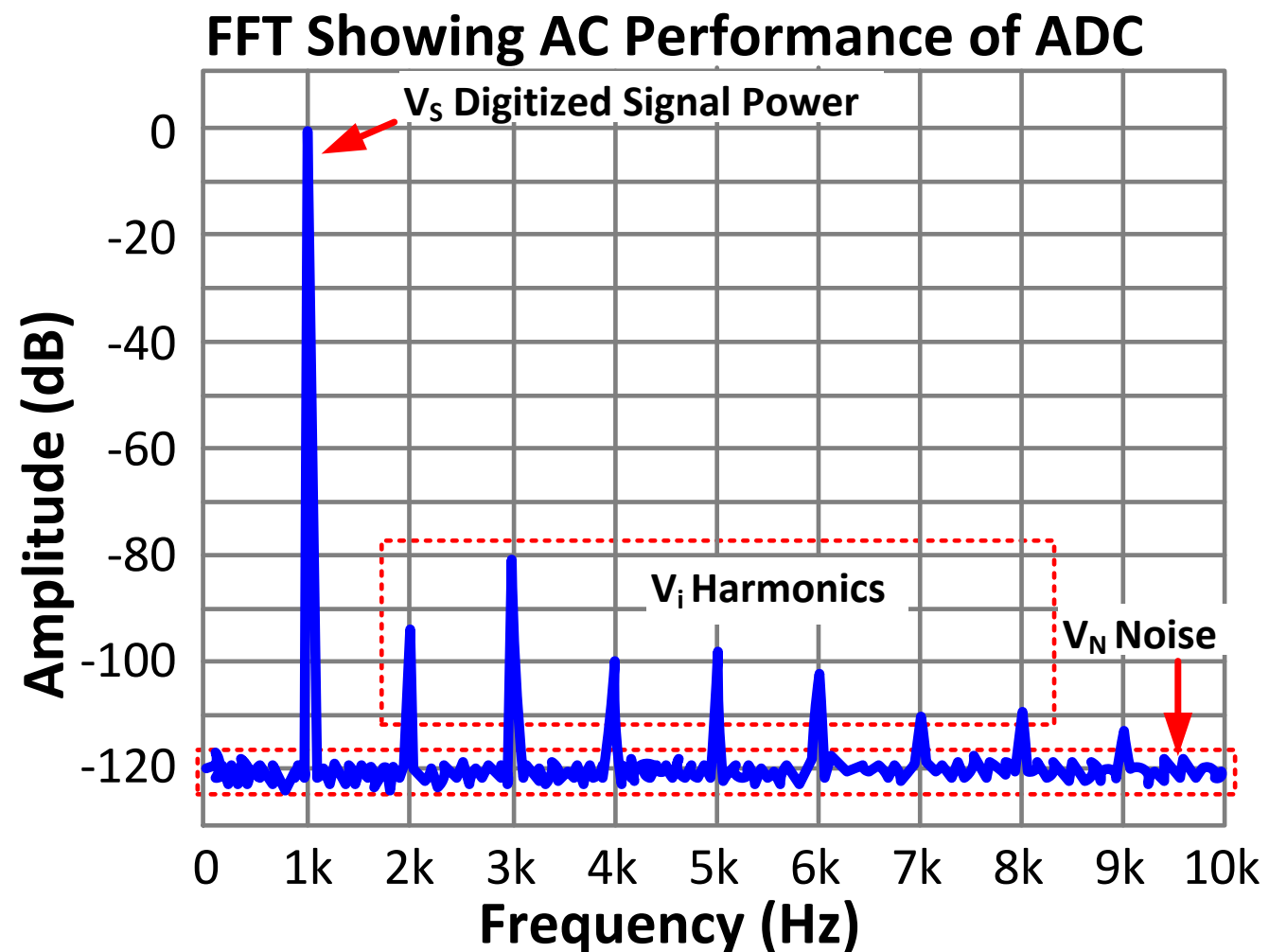
$$SNR(dB) = 6.02 \cdot N + 1.76$$

Where N is the number of bits

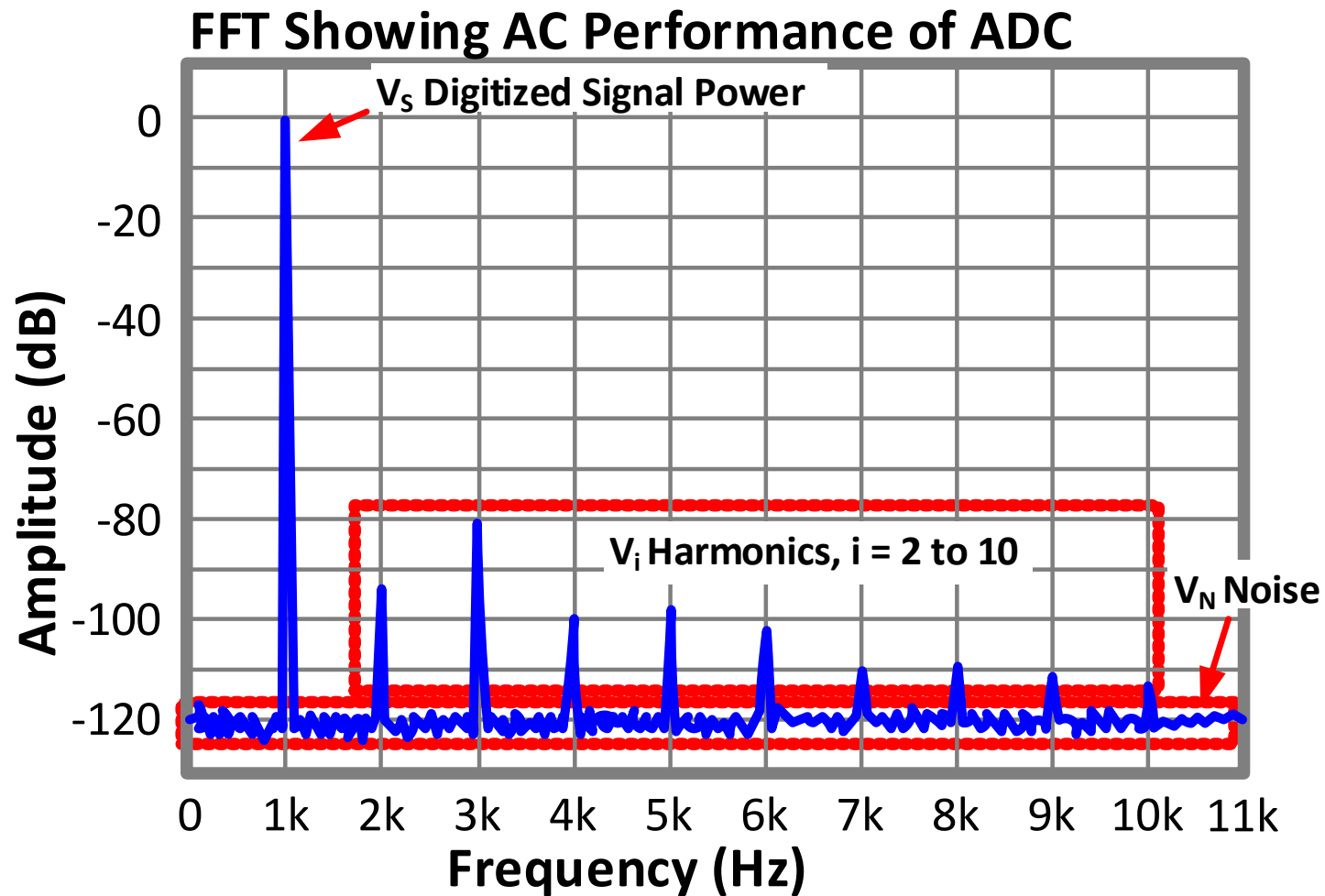
非直線性



全高調波歪み (THD)



全高調波歪み (THD)、THD+N、SINAD



$$THD(\%) = \sqrt{\frac{\sum_{i=2}^{10} V_i^2}{V_S^2}} \cdot 100$$

$$THD(dB) = 20 \cdot \log \left(\sqrt{\frac{\sum_{i=2}^{10} V_i^2}{V_S^2}} \right)$$

$$(THD + N)(dB) = 20 \cdot \log \left(\sqrt{\frac{\sum_{i=2}^{10} V_i^2 + V_N^2}{V_S^2}} \right)$$

$$SINAD(dB) = 20 \cdot \log \left(\sqrt{\frac{V_S^2}{\sum_{i=2}^{10} V_i^2 + V_N^2}} \right)$$