0.35 μm CMOS C35 Noise Parameters

Seven Digit Document: ENG - 189

Revision: 6.0

Company Confidential

 Release Date 30.06.2011

Table of Contents

1 Introduction

1.1 Revision

Rev. 1	Affected pages:	1 to 12	(November 2002)
Subject of change:	First version of document		
Rev. 2	Affected pages:	1 to 21	(March 2005)
Subject of change:	New 1/f noise parameters		
Rev. 3	Affected pages:	1 to 38	(February 2006)
Subject of change: Added:	Preliminary worst case 1/f noise models C35 low VTH devices		
Rev. 4	Affected pages:	1 to 39	(November 2006)
Subject of change:	VERT10 noise parameters added Process Family removed because already specified in Eng – 182		
Rev. 5	Affected pages:	1 to 38	(November 2007)
Subject of change:	1/f noise worst case models verified on three lots for NMOS, PMOS, NMOSM and PMOSM		
Rev. 6	Affected pages:	1 to 44	(April 2011)
Subject of change:	1/f noise worst case models for poly resistors RPOLY1, RPOLY2 and RPOLYH		

1.2 Related Documents

Description	Document Number
0.35µm CMOS C35 Design Rules	Eng - 183
0.35µm CMOS C35 Process Parameters	Eng - 182
0.35µm CMOS C35 RF SPICE Models	Eng – 188
0.35µm CMOS Matching Parameters	Eng - 228
C35 ESD Design Rules	Eng - 236
Standard Family Cells	Eng - 42
Assembly Related Design Rules	ASSY - 15

2 Noise Measurements and Parameter Extraction

2.1 Introduction

Low frequency noise strongly influences the performance of integrated CMOS analog circuits. Since transistor devices are becoming smaller and more compact, flicker (1/f) noise has become more important.

2.2 Measurement Setup

The DC operating point of the transistor is set by a parameter analyzer and battery driven buffer filters are applied in order to filter out unwanted singnals. For a given drain current the gate voltage is regulated to find a stable operating point. To avoid magnetic and electric disturbances the measurement circuit is shielded appropriately. The current noise i_n is converted into a voltage and measured by a vector signal analyzer.

The flicker noise characterization for MOS transistors is based on noise measurements in the frequency range from 100 Hz to 100 kHz, where, depending on the transistor geometry, the following drain bias currents are applied: 1 µA, 2 µA, 5 µA, 10 µA, 20 µA, 50 µA, 100 µA and 200 µA.

The measurement is repeated 200-300 times for averaging. Additionaly 7-11 devices per geometry are measured and averaged to get a more realistic behaviour.

Additional the possibility of on wafer mesurements have been introduced. Details can be seen in the schematic below:

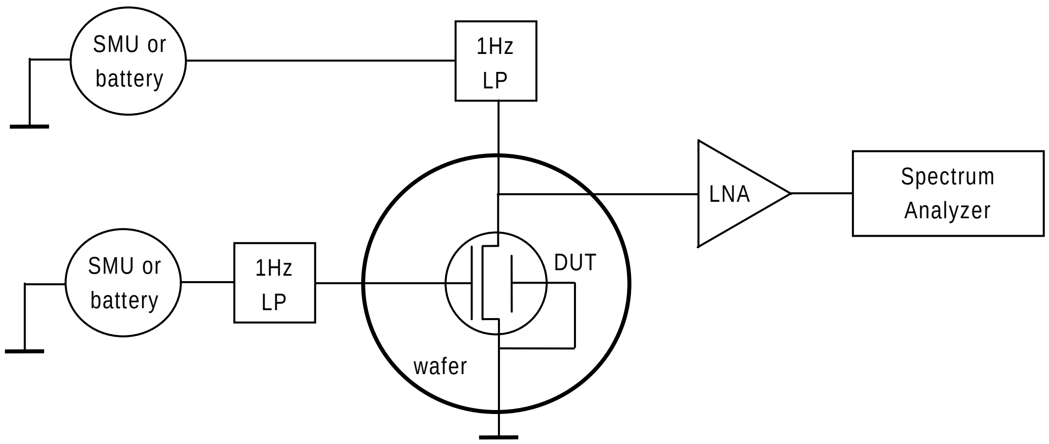


Fig. 2.1 On wafer 1/f noise measurement - schematic

2.3 Flicker Noise Modeling

Two types of low frequency noise models are supported: standard SPICE noise models and the more sophisticated BSIM3V3 noise model. The supported standard SPICE models use the following equations for the noise current density depending on the drain current, the effective geometric dimensions and the frequency.

SPICE model 1:

$$S_i = \frac{1}{C_{ox} \cdot L_{eff}^2} \cdot \frac{KF \cdot I_d^{AF}}{f}$$

S_i: current noise density [A^2/Hz], f: frequency, AF, KF: noise parameters
I_d : drain current, C_{ox}: Oxide Capacitance, L_{eff}: effective channel length.

The SPICE model 1 describes a geometric scaling depending on the effective channel length only. This model is used to describe the flicker noise of NMOS transistors.

SPICE model 2:

$$S_i = \frac{1}{C_{ox} \cdot L_{eff} \cdot W_{eff}} \cdot \frac{KF \cdot I_d^{AF}}{f}$$

S_i: current noise density [A^2/Hz], f: frequency, AF, KF: noise parameters
I_d : drain current, C_{ox}: Oxide Capacitance, L_{eff}: effective channel length, W_{eff}: effective channel width.

The SPICE model 2 describes a geometric scaling depending on the effective area of the device. This model is used to describe the flicker noise of PMOS transistors.

The SPICE models are valid for the saturation region only, geometric scaling is assumed to be dependent on the effective channel length (SPICE model 1) or on the effective channel area (SPICE model 2).
These models are available in most of the commercial circuit simulators. A disadvantage of the standard SPICE models is that they do not scale with the drain current, except for AF=1.

The BSIM3V3 noise model is based on the BSIM3V3 transistor model. It offers an improved geometric and drain current scaling. Also noise density can be modeled accurately for several transistor operating regions. The following equation is used for the current noise density:

$$S_i = \frac{1}{C_{ox} \cdot L_{eff}^2 \cdot f} \cdot I_d \cdot f(NOIA, NOIB, NOIC, I_d, V_g - V_{th}, V_{ds}, \cdots) + \frac{1}{C_{ox} \cdot L_{eff}^2 \cdot W_{eff} \cdot f} \cdot I_d{}^2 \cdot g(NOIA, NOIB, NOIC, I_d, V_g - V_{th}, V_{ds}, \cdots)$$

S_i: current noise density [A^2/Hz], f: frequency, $NOIA$, $NOIB$, $NOIC$: noise parameters
I_d : drain current, C_{ox}: Oxide Capacitance, L_{eff}: effective channel length, W_{eff}: effective channel width.
V_g: gate voltage, V_{ds}: drain-source voltage, V_{th}: effective treshold voltage.

The functions *f* and *g* depend on the BSIM3V3 transistor model, on the Noise Parameters *NOIA*,*NOIB* and *NOIC* and on the bias voltages. The Noise Parameters *NOIA*, *NOIB* and *NOIC* are fitted.
The BSIM3V3 noise model is the default for circuit simulation. For simulators without BSIM3V3 noise model the SPICE noise models are provided.

2.4 Thermal Noise MOS Model

For higher frequencies only thermal noise dominates (see figure 2.2).

SPICE thermal noise model:

$$S_i = \frac{8kT}{3} \cdot (gm + gds + gmb)$$

S_i: current noise density [A^2/Hz], k: Boltzman constant, T: temperature
gm, gds, gmb: transconductances

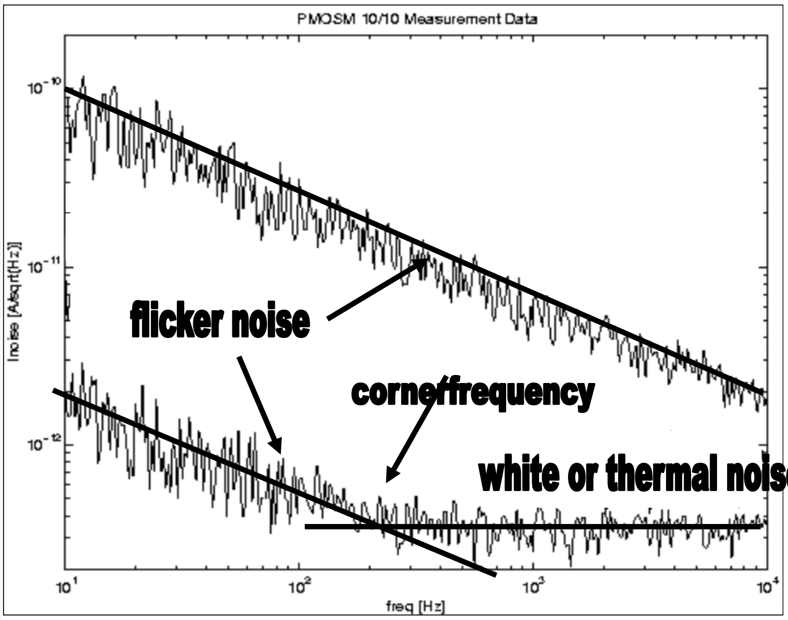


Fig. 2.2 PMOSM drain current noise, measurement data example [A/ $\sqrt{Hz}$], W/L=10/10,

2.5 Bipolar Transistor Flicker Noise Modeling

For noise parameter determination the measured current noise spectral density S_{I_M} at the collector is fitted against the analytical current noise spectral density S_{I_C}. In the low frequency range the total output noise is mainly determined by the flicker noise and can be represented by the following equation:

$$S_{i_C} \approx A_n{}^2 S_{i_F}$$

where

$$S_{i_F} = \frac{KFN \cdot I_b{}^{AFN}}{f^{BFN}}$$

is base flicker noise, I_b is base current, f is frequency, AFN, KFN and BFN are flicker noise parameters.

The noise current transfer function A_n is approximated by

$$A_n = \frac{\beta_{AC} R_B}{R_B + r_\pi}, \quad R_B = R_{bias} + r_{bb} \approx R_{bias}$$

where R_{bias} is external base serial resistance, r_{bb} is base resistance, β_{AC} is small signal foward current gain and $r_\pi = V_{th} / I_b$. For large bias resistances the transfer function A_n reduces to

$$A_n \approx \beta_{AC}$$

The frequency exponent BFN is set to the constant value $BFN=1$.

Flicker noise parameters AFN and KFN are determined by fitting S_{i_C} to the measured noise current spectral density S_{i_M} using least squares optimisation.

2.6 Resistor Flicker Noise Modeling

For resistor flicker noise characterisation a bridge measurement circuit is used in order to determine the voltage noise Sv. The model displayed below is based on the CMC [1] approach:

$$Sv = \sqrt{R^2 \cdot KF \cdot \frac{W^*}{L^*} \cdot \left(\frac{U_{res}/R}{W^*} \right)^{AF} \cdot \frac{1}{f^{EF}}} \quad \left[\frac{\mathrm{V}}{\sqrt{\mathrm{Hz}}} \right]$$

S_v: voltage noise density [V/rt(Hz)], f: frequency, *KF, AF, EF*: noise parameters
R : resistance, L^*: effective channel length, W^*: effective channel width
U_{res}: voltage across resistor, T: Temperature

The KF is determined from LF noise data, AF is kept constant to 2 and EF is also kept constant to 1.

2.7 Worst Case (WC) 1/f Noise Modeling

DC model data set	Noise model data set	
typical mean	*WC noise*	*tmwn*
WC power	*WC noise*	*wp*
WC speed	*WC noise*	*ws*
WC one	*WC noise*	*wo*
WC zero	*WC noise*	*wz*
typical mean	*typical mean*	*tn*

Tab. 2.3: The combinations of DC and 1/f noise worst cases valid for MOS.

For MOSFETs austriamicrosystems™ provide the corner models typical mean, worst case "power", worst case "speed", worst case "one" and worst case "zero". Three sigma worst cases for 1/f noise are sufficient for robust design, there is also the MOS model typical mean with typical mean noise available (see table 2.2). WC models are also available for NMOSL, PMOSL, NMOSML and PMOSML based on one lot. For the standard CMOS devices like NMOS, PMOS, NMOSM and PMOSM, three lots are taken into account for verification of 1/f noise WC models. In sections 4.1 and 4.2 only two lots are directly compared.

DC model data set	Noise model data set	
typical mean	*WC noise*	*tmwn*
WC power	*WC noise*	*wp*
WC speed	*WC noise*	*ws*
typical mean	*typical mean*	*tn*

Tab. 2.4: The combinations of DC and 1/f noise worst cases valid for resistors.

Poly resistor corner models are implemented similar to the MOS WC noise coners.

[1] http://www.geia.org/GEIA/files/ccLibraryFiles/Filename/000000002745/R2_CMC_v1.0_r0.0_2005Nov12.pdf

3 Low Frequency Noise Parameters

Note: The 1/f noise parameters for SPICE and BSIM3V3 Model are derived from measurement data of following geometries (W/L) – 100/20, 10/10, 10/1.2 and 10/minimum channel length device.
Note: WC (=worst case) noise SPICE and BSIM3V3 Model parameter set represents three sigma deviation from typical mean.
Note: For noise critical applications avoid to use minimum geometry devices!

3.1 SPICE parameters

3.1.1 NMOS (modn)

Modeling PARAMETERS		
Parameter	Typ	Max
AF	1.507	1.376
KF	2.170e-26	3.396e-26

3.1.2 PMOS (modp)

Characterization PARAMETERS		
Parameter	Typ	Max
AF	1.461	1.405
KF	1.191e-26	1.827e-26

3.1.3 NMOSM (modnm)

Characterization PARAMETERS		
Parameter	Typ	Max
AF	1.629	1.358
KF	9.180e-26	3.446e-26

3.1.4 PMOSM (modpm)

Characterization PARAMETERS		
Parameter	Typ	Max
AF	1.638	1.564
KF	3.625e-26	4.852e-26

3.1.5 NMOSL (modnl)

Characterization PARAMETERS		
Parameter	Typ	Max
AF	1.612	1.494
KF	6.173e-26	6.986e-26

3.1.6 PMOSL (modpl)

Characterization PARAMETERS		
Parameter	Typ	Max
AF	1.435	1.469
KF	4.040e-27	1.296e-26

3.1.7 NMOSML (modnml)

Characterization PARAMETERS		
Parameter	Typ	Max
AF	1.588	1.400
KF	5.754e-26	3.770e-26

3.1.8 PMOSML (modpml)

Characterization PARAMETERS		
Parameter	Typ	Max
AF	1.542	1.471
KF	8.406e-27	1.323e-26

3.2 BSIM3V3 parameters

Note: BSIM3V3 model has been selected as the default model for the simulators indicated in section 3.3.
Note: The WC model for NMOS, NMOSM, PMOS and PMOSM are based on three runs now.

3.2.1 NMOS (modn)

Characterization PARAMETERS		
Parameter	Typ	Max
NOIA	1.121e19	1.399e20
NOIB	5.336e4	2.707e5
NOIC	-5.892e-13	-4.680e-12

3.2.2 PMOS (modp)

Characterization PARAMETERS		
Parameter	Typ	Max
NOIA	5.245e17	7.091e18
NOIB	4.816e3	6.074e4
NOIC	8.036e-13	3.779e-13

3.2.3 NMOSM (modnm)

Characterization PARAMETERS		
Parameter	Typ	Max
NOIA	2.245e19	1.702e20
NOIB	1.168e5	5.463e5
NOIC	-1.680e-12	-1.400e-11

3.2.4 PMOSM (modpm)

Characterization PARAMETERS		
Parameter	Typ	Max
NOIA	5.846e17	1.872e18
NOIB	6.623e3	3.454e4
NOIC	7.759e-13	1.246e-12

3.2.5 NMOSL (modnl)

Characterization PARAMETERS		
Parameter	Typ	Max
NOIA	1.004e19	9.864e19
NOIB	6.794e4	1.702e5
NOIC	-1.274e-12	-2.723e-12

3.2.6 PMOSL (modpl)

Characterization PARAMETERS		
Parameter	Typ	Max
NOIA	8.089e18	2.922e19
NOIB	1.569e3	1.773e4
NOIC	4.605e-13	4.520e-13

3.2.7 NMOSML (modnml)

Characterization PARAMETERS		
Parameter	Typ	Max
NOIA	1.594e19	1.536e20
NOIB	1.107e5	3.584e5
NOIC	-3.506e-12	-1.304e-11

3.2.8 PMOSML (modpml)

Characterization PARAMETERS		
Parameter	Typ	Max
NOIA	3.138e18	1.197e19
NOIB	4.723e3	2.661e4
NOIC	5.008e-13	6.784e-13

3.3 Bipolar SPICE parameters

Note: The 1/f noise parameters for SPICE are derived from measurement data from a scribeline monitor device.

3.3.1 VERT10 (vert10)

Characterization PARAMETERS		
Parameter	Typ	Max
AF	1.3	-
KF	9.1e-15	-

3.4 Resistor Noise parameters

Note: The 1/f noise parameters are derived from LF noise data measured with a bridge circuit.
Note: Following characterization parameters are fixed for all resistors: AF=2, EF=1

3.4.1 RPOLY1 (rpoly1)

Characterization PARAMETERS		
Parameter	Typ	Max
KF	2.5e-25	1.0e-24

3.4.2 RPOLY2 (rpoly2)

Characterization PARAMETERS		
Parameter	Typ	Max
KF	5.0e-23	2.0e-22

3.4.3 RPOLYH (rpolyh)

Characterization PARAMETERS		
Parameter	Typ	Max
KF	1.8e-22	8.1e-22

3.5 Simulators and noise models

The following circuit simulators are supported.

Simulator	Default model	Worst Case Model
Spectre/Cadence HITKit	BSIM3V3	available
ELDO/Mentor HITKit	BSIM3V3	available
Hspice	BSIM3V3	available
Smartspice	BSIM3V3	available
Saber	BSIM3V3	-
Smash	BSIM3V3	-
Gemini/Agilent ADS HITKit	BSIM3V3	-

4 Transistor Characteristic Low Frequency Noise Curves

4.1 3.3V MOS transistors: Worst Case Characteristic Low Frequency Noise Curves

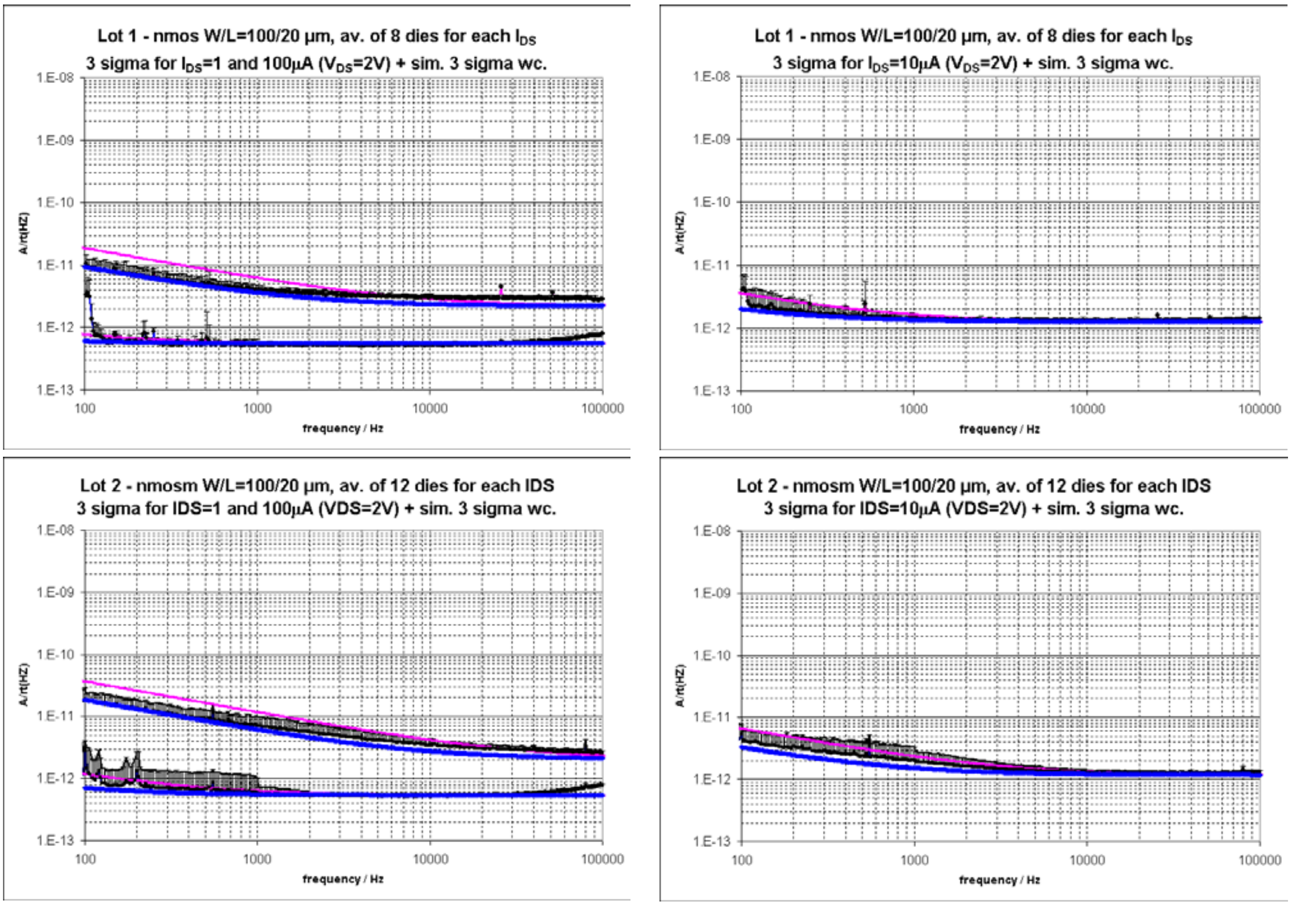


Fig. 4.1 NMOS current noise [A/ $\sqrt{Hz}$], W/L=100/20, Bias Current: IDS= 1, 10, and 100 µA.
Measurement = symbols with calculated 3 sigma (black)
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta
The noise increase in picture left below at freq. >=1kHz is mainly due to laboratory interferences.

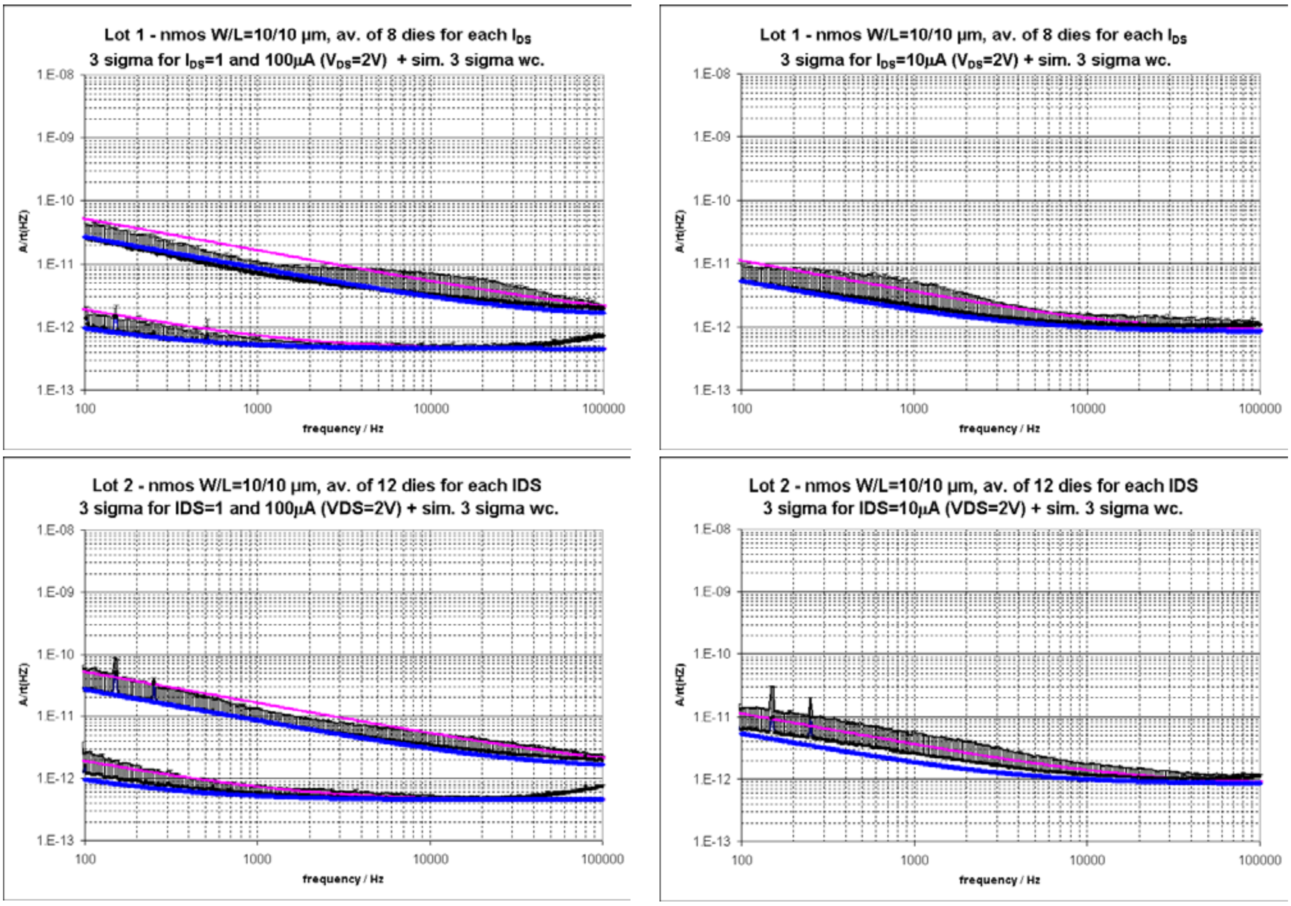


Fig. 4.2 NMOS current noise [A/$\sqrt{Hz}$], W/L=10/10, Bias Current: IDS= 1, 10 and 100 µA.
Measurement = symbols with calculated 3 sigma (black)
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

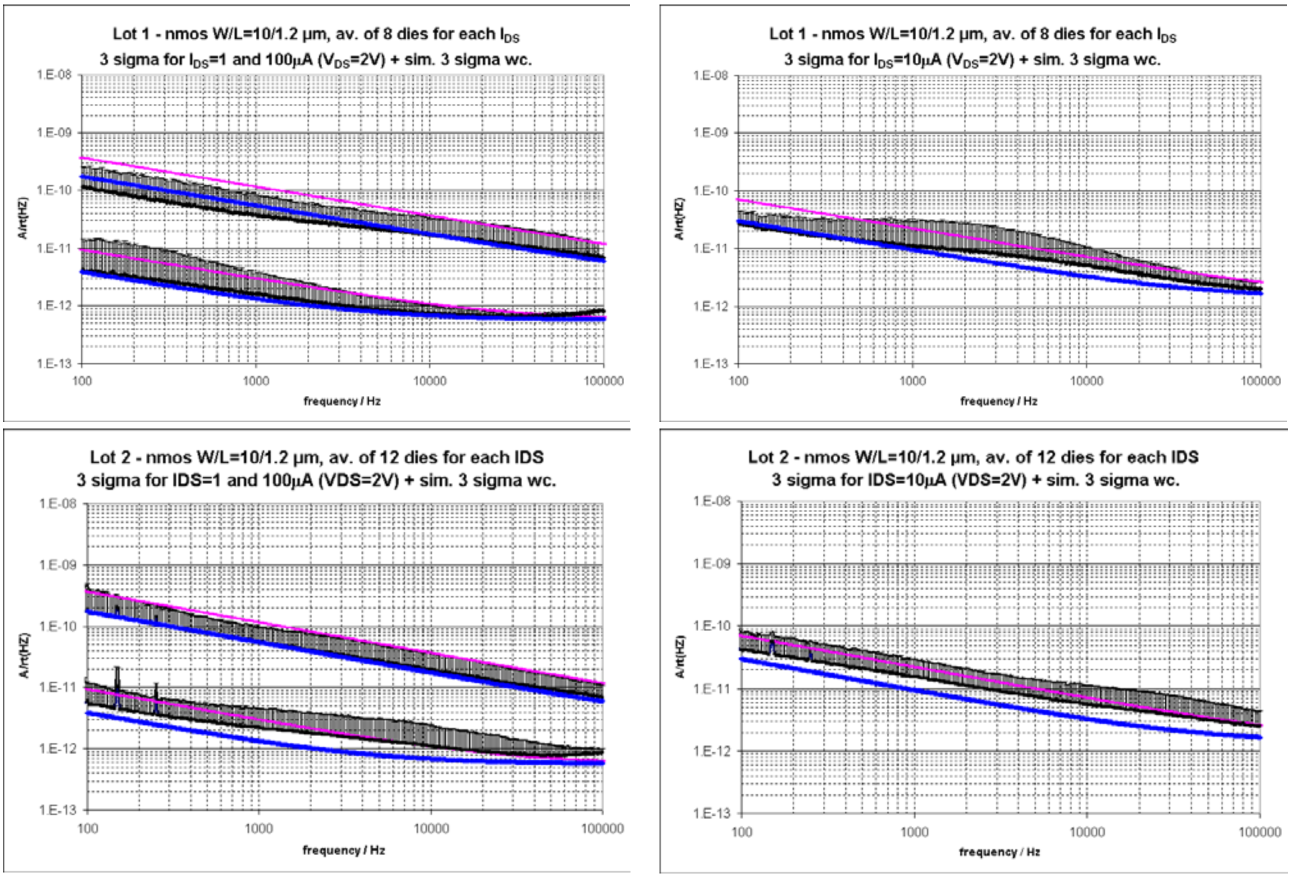


Fig. 4.3 NMOS current noise $[A/\sqrt{Hz}]$, W/L=10/1.2, Bias Current: IDS= 1, 10 and 100 µA.
Measurement = symbols with calculated 3 sigma (black)
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

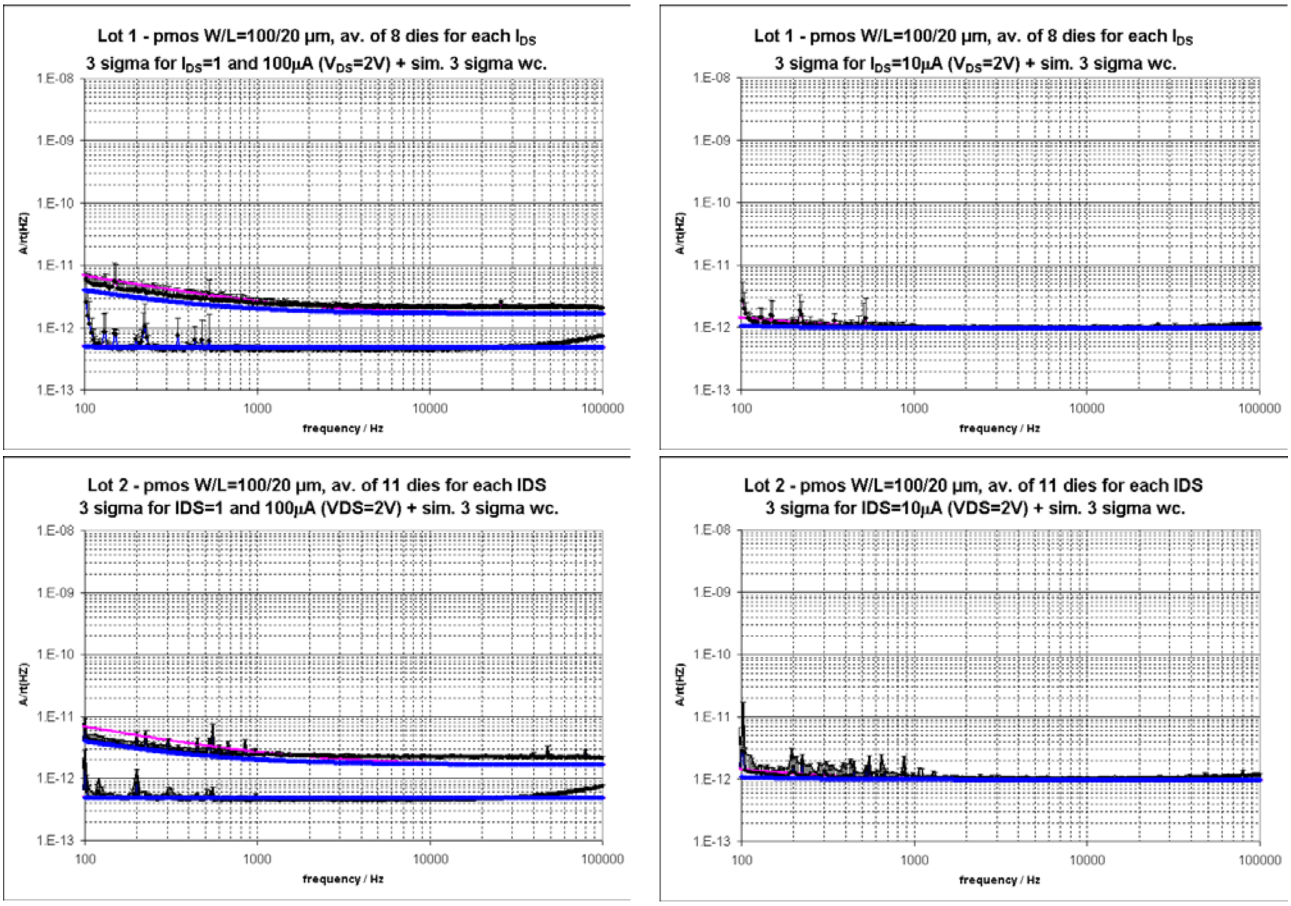


Fig. 4.4 PMOS current noise [A/ $\sqrt{Hz}$], W/L=100/20, Bias Current: IDS= 1, 10 and 100 µA.
Measurement = symbols with calculated 3 sigma (black)
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

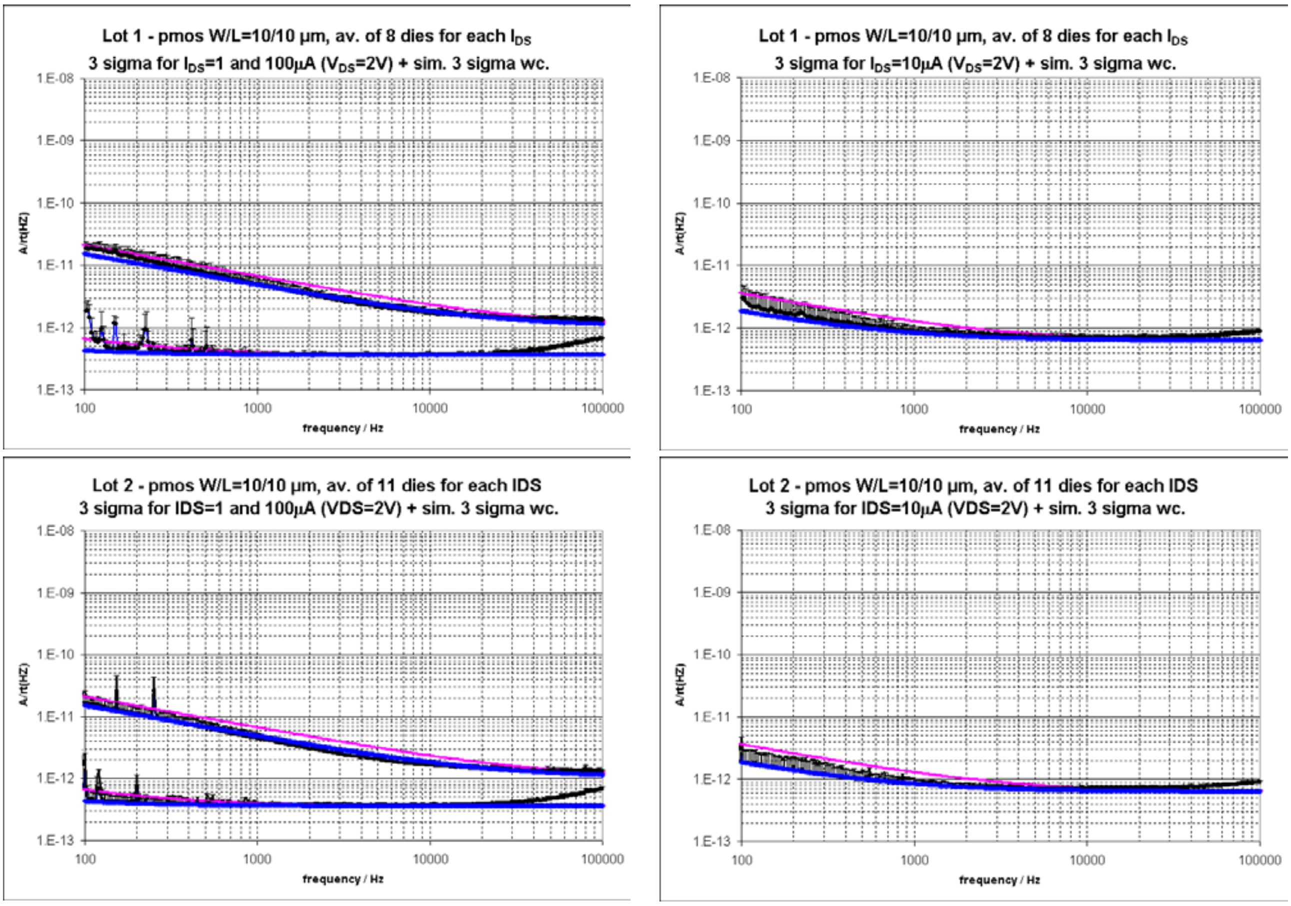


Fig. 4.5 PMOS current noise [A/$\sqrt{Hz}$], W/L=10/10, Bias Current: IDS= 1, 10 and 100 µA.
Measurement = symbols with calculated 3 sigma (black)
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

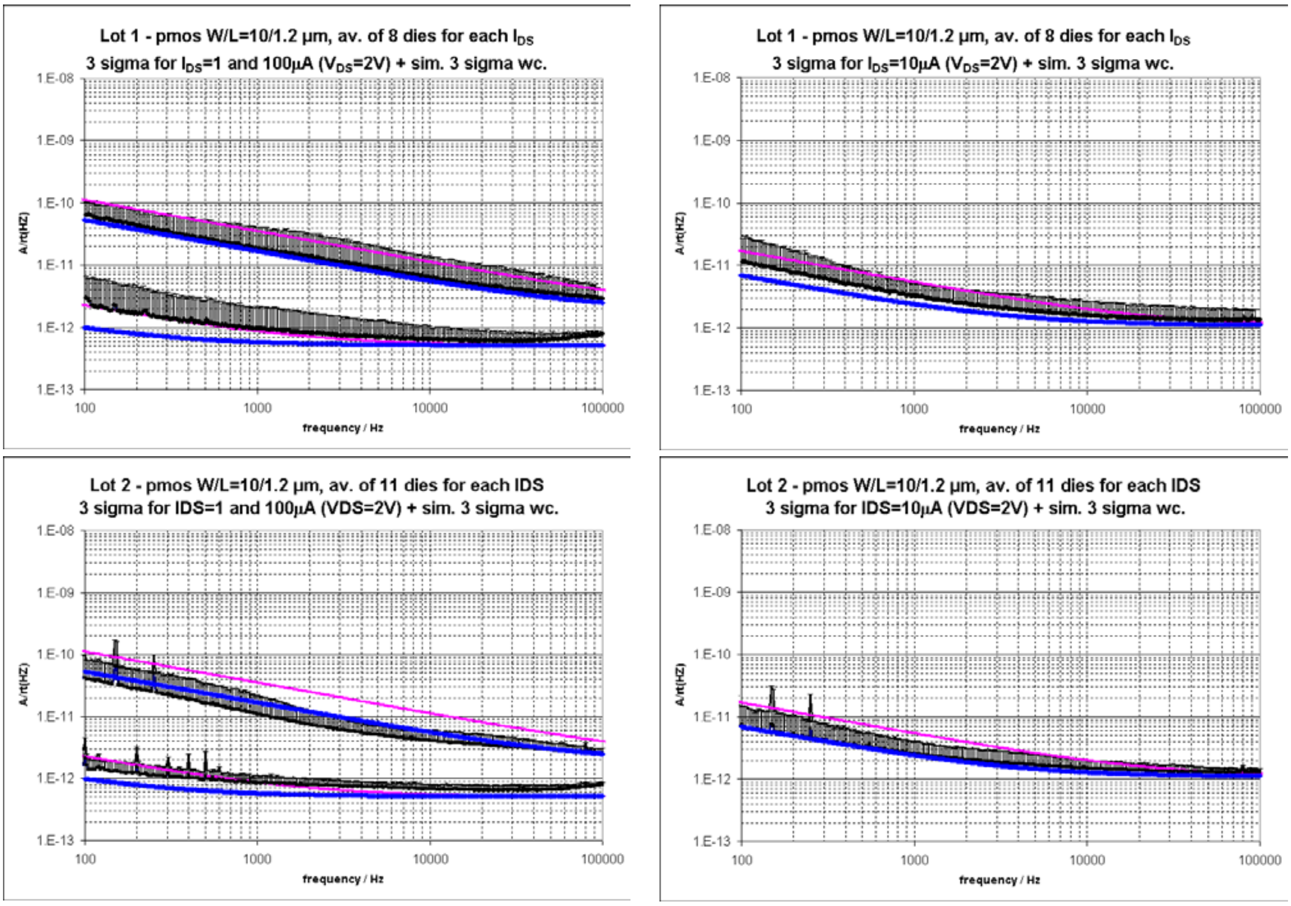


Fig. 4.6 PMOS current noise [A/$\sqrt{Hz}$], W/L=10/1.2, Bias Current: IDS= 1, 10 and 100 µA.
Measurement = symbols with calculated 3 sigma (black)
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

4.2 5V MOS transistors: Worst Case Characteristic Low Frequency Noise Curves

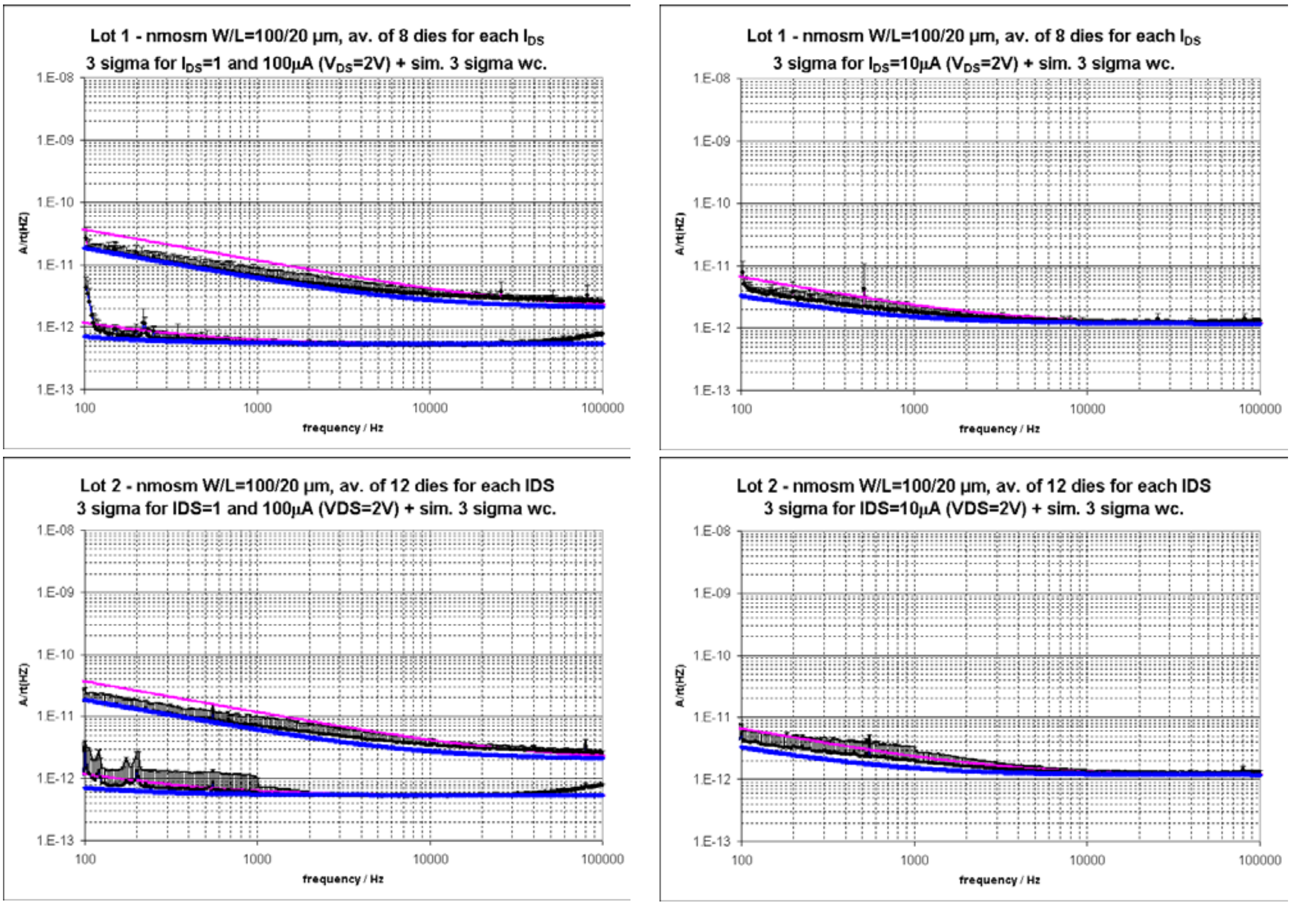


Fig. 4.7 NMOSM current noise [A/$\sqrt{Hz}$], W/L=100/20, Bias Current: IDS= 1, 10 and 100 µA.
Measurement = symbols with calculated 3 sigma (black)
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta
The noise increase in picture left below at freq. >=1kHz is mainly due to laboratory interferences.

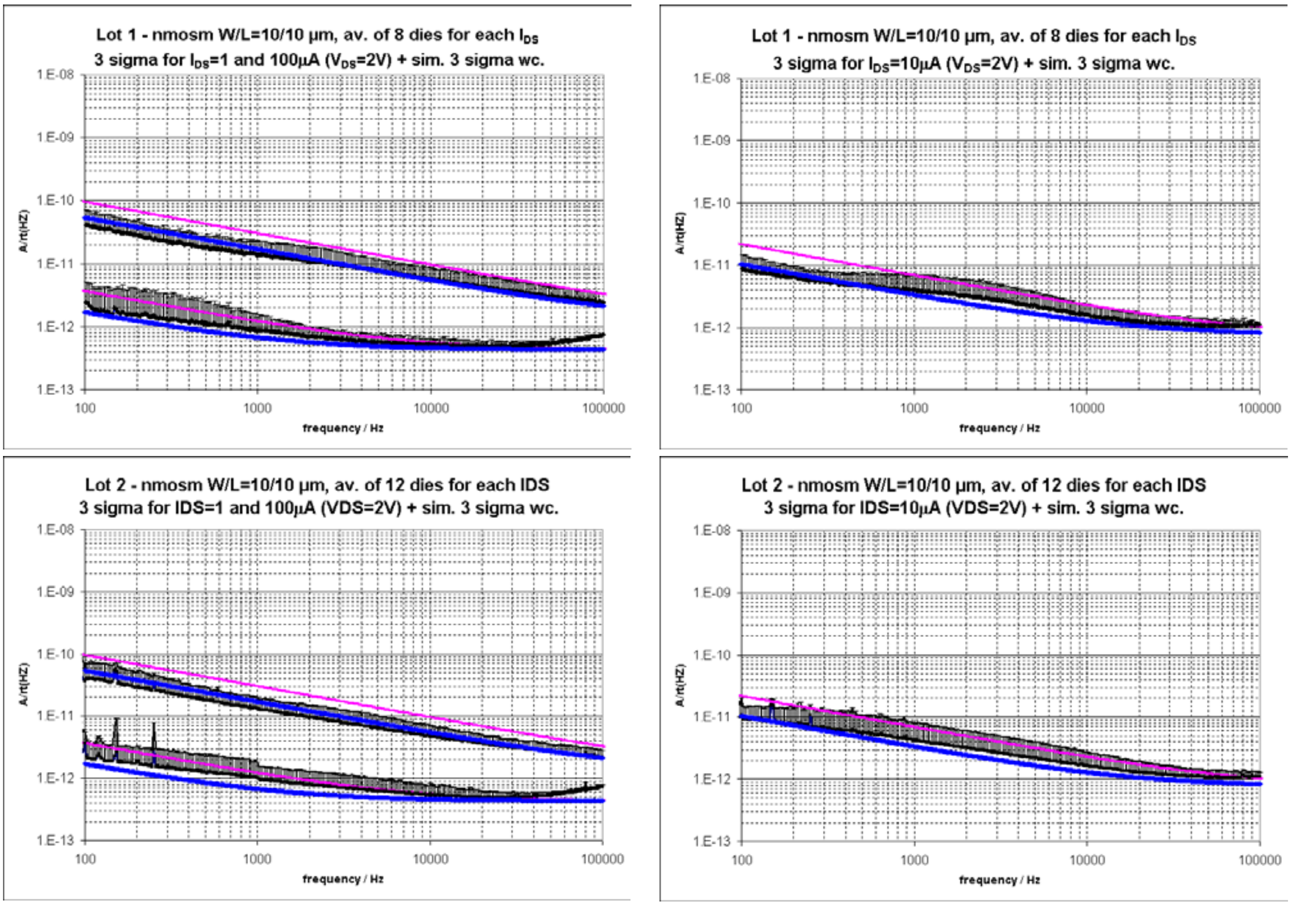


Fig. 4.8 NMOSM current noise [A/$\sqrt{Hz}$], W/L=10/10, Bias Current: IDS= 1, 10 and 100 µA.
Measurement = symbols with calculated 3 sigma (black)
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

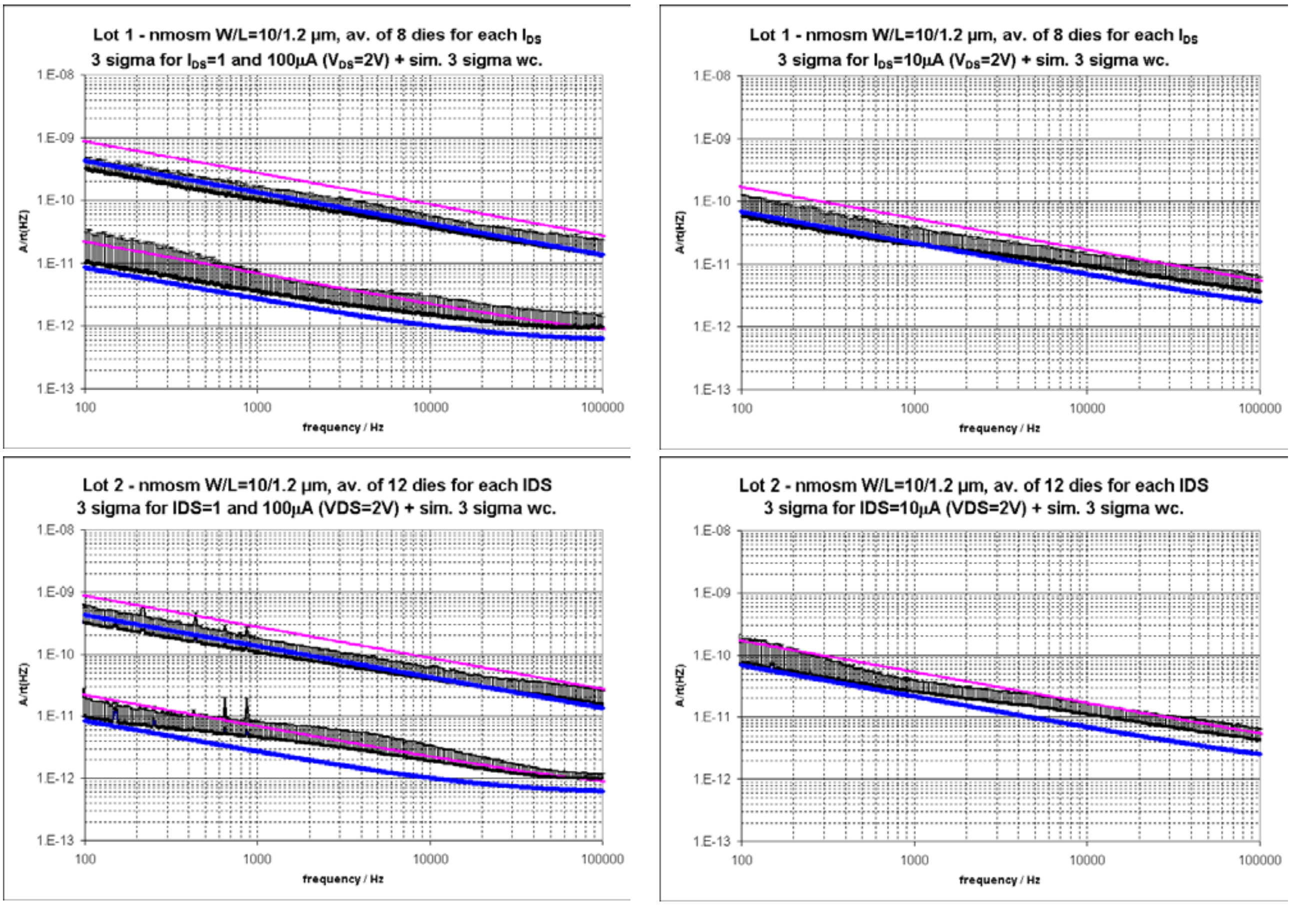


Fig. 4.9 NMOSM current noise [A/ $\sqrt{Hz}$], W/L=10/1.2, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 μA.
Measurement = symbols with calculated 3 sigma (black)
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

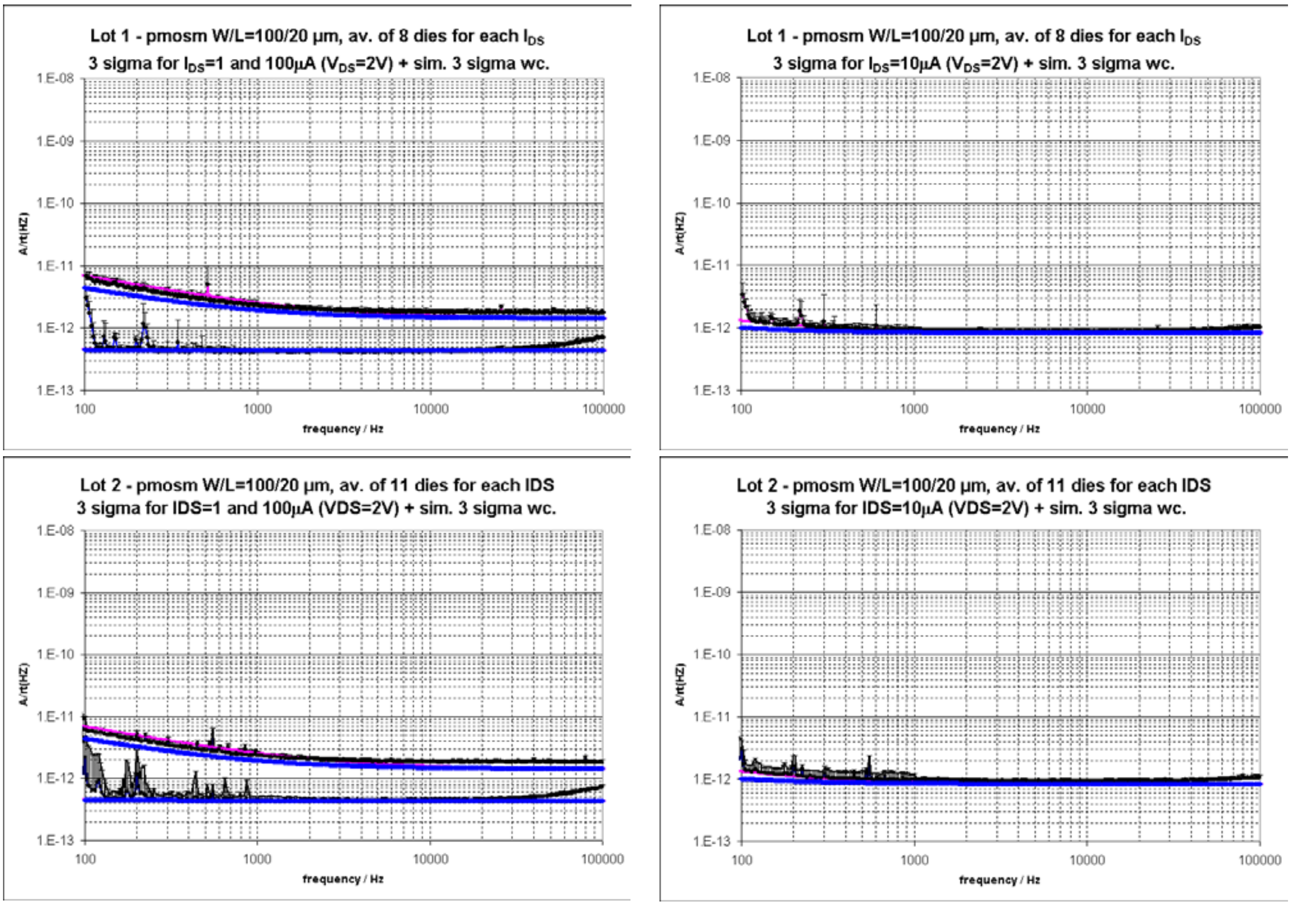


Fig. 4.10 PMOSM current noise [A/$\sqrt{Hz}$], W/L=100/20, Bias Current: IDS= 1, 10 and 100 µA.

Measurement = symbols with calculated 3 sigma (black)

BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

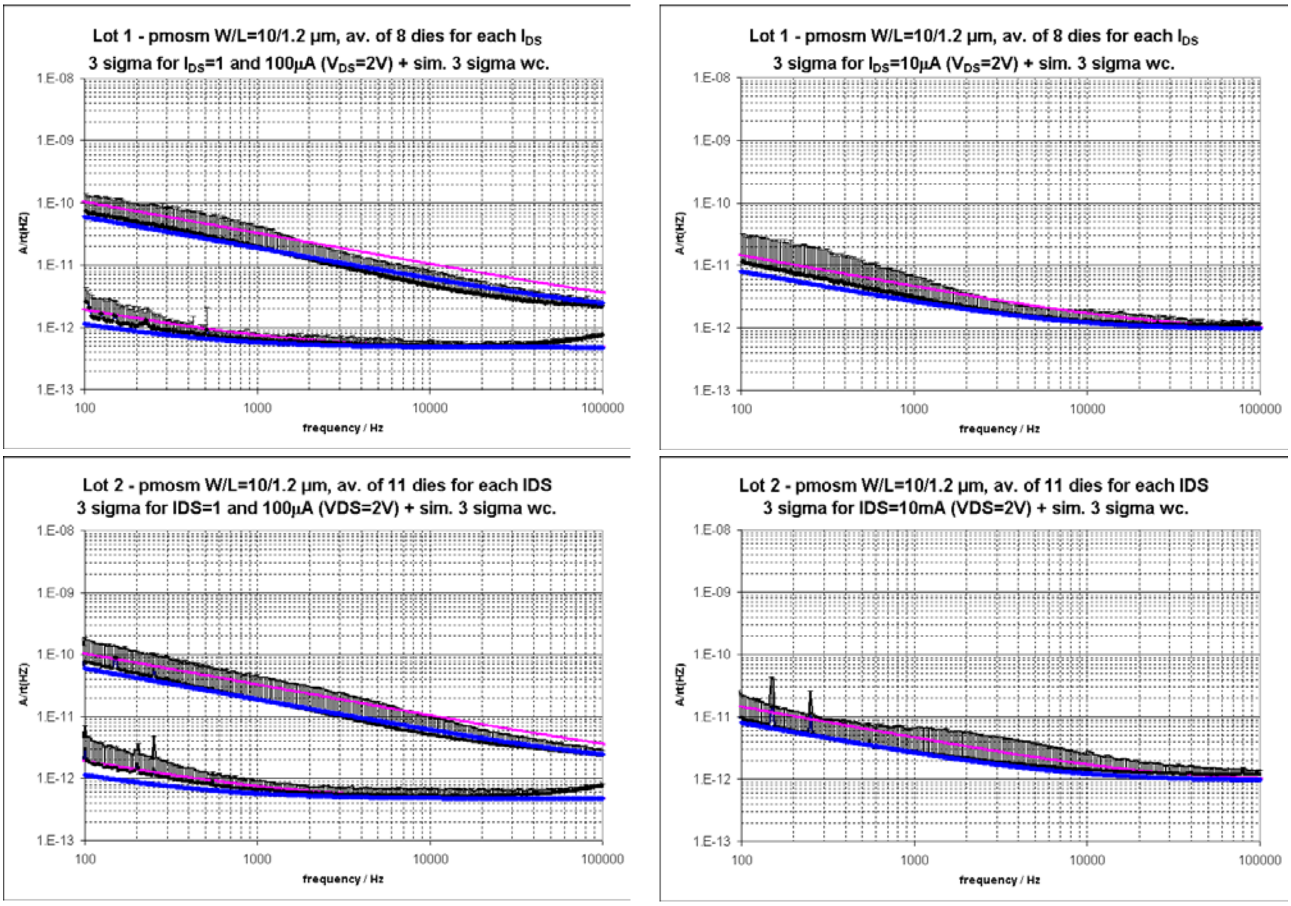


Fig. 4.11 PMOSM current noise [A/$\sqrt{Hz}$], W/L=10/1.2, Bias Current: IDS= 1, 10 and 100 µA.
Measurement = symbols with calculated 3 sigma (black
BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

4.3 3.3V Low VTH: Worst Case Characteristic Low Frequency Noise Curves

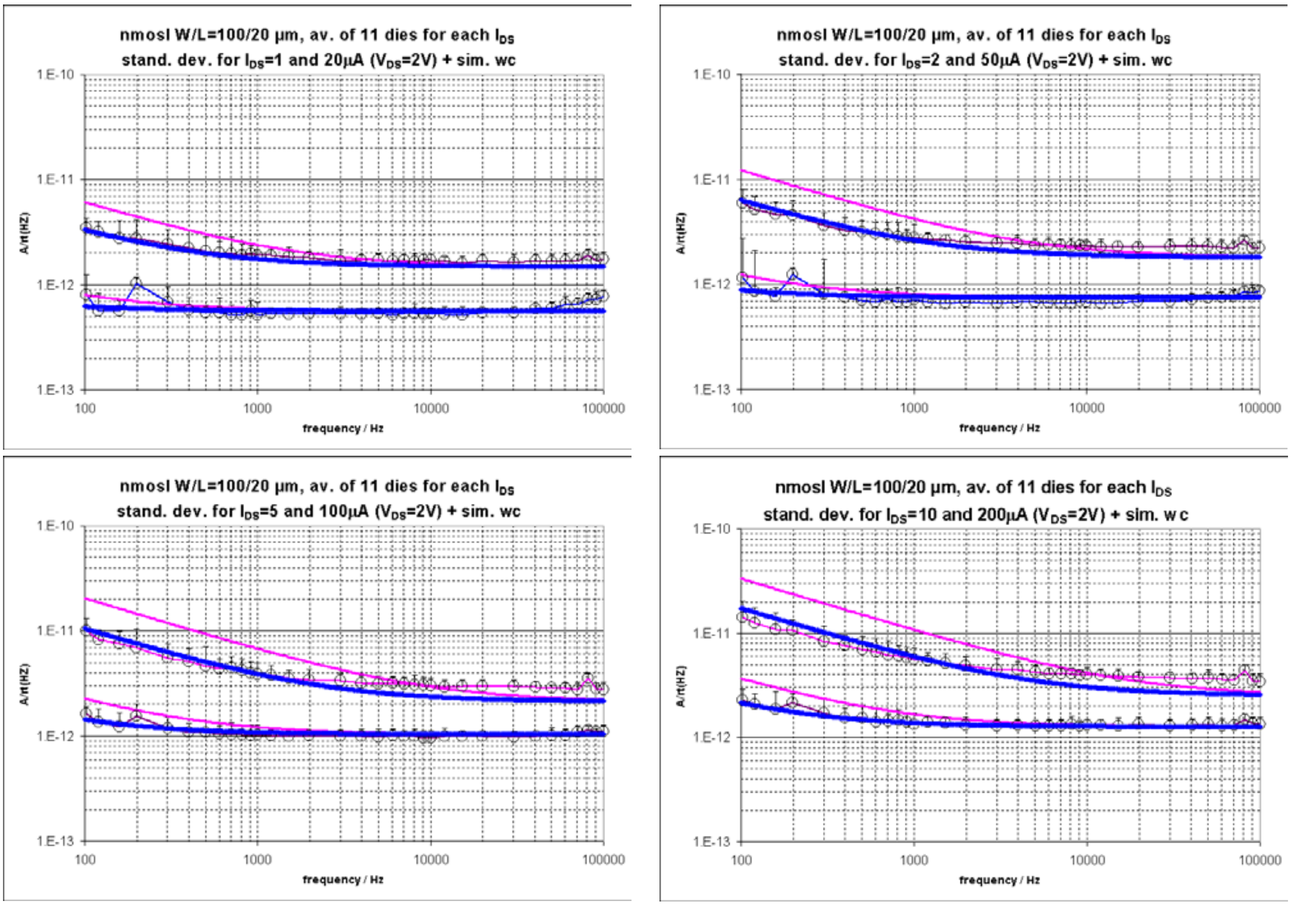


Fig. 4.12 NMOSL current noise [A/$\sqrt{Hz}$], W/L=100/20, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 µA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

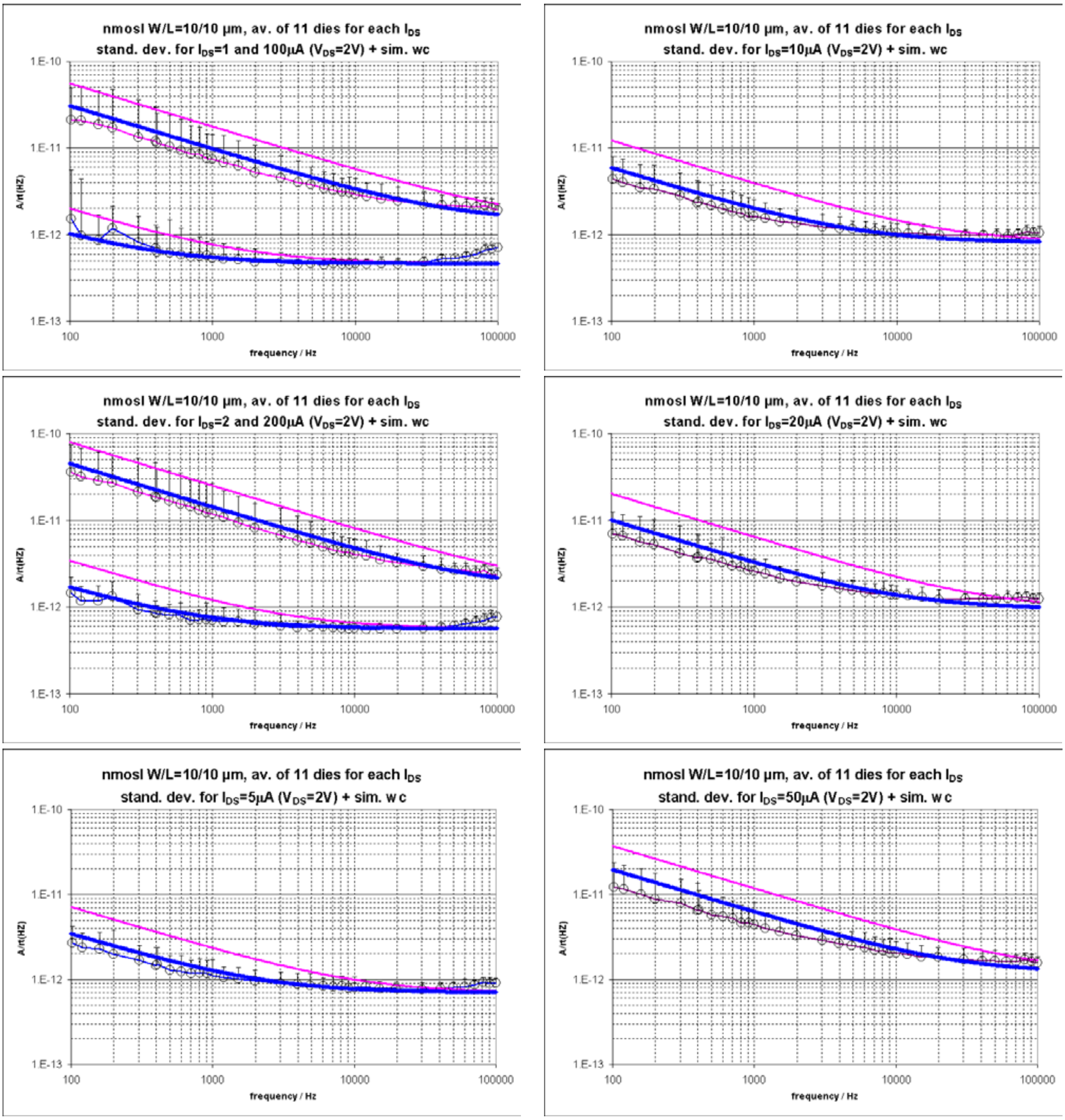


Fig. 4.13 NMOSL current noise [A/$\sqrt{Hz}$], W/L=10/10, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 µA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

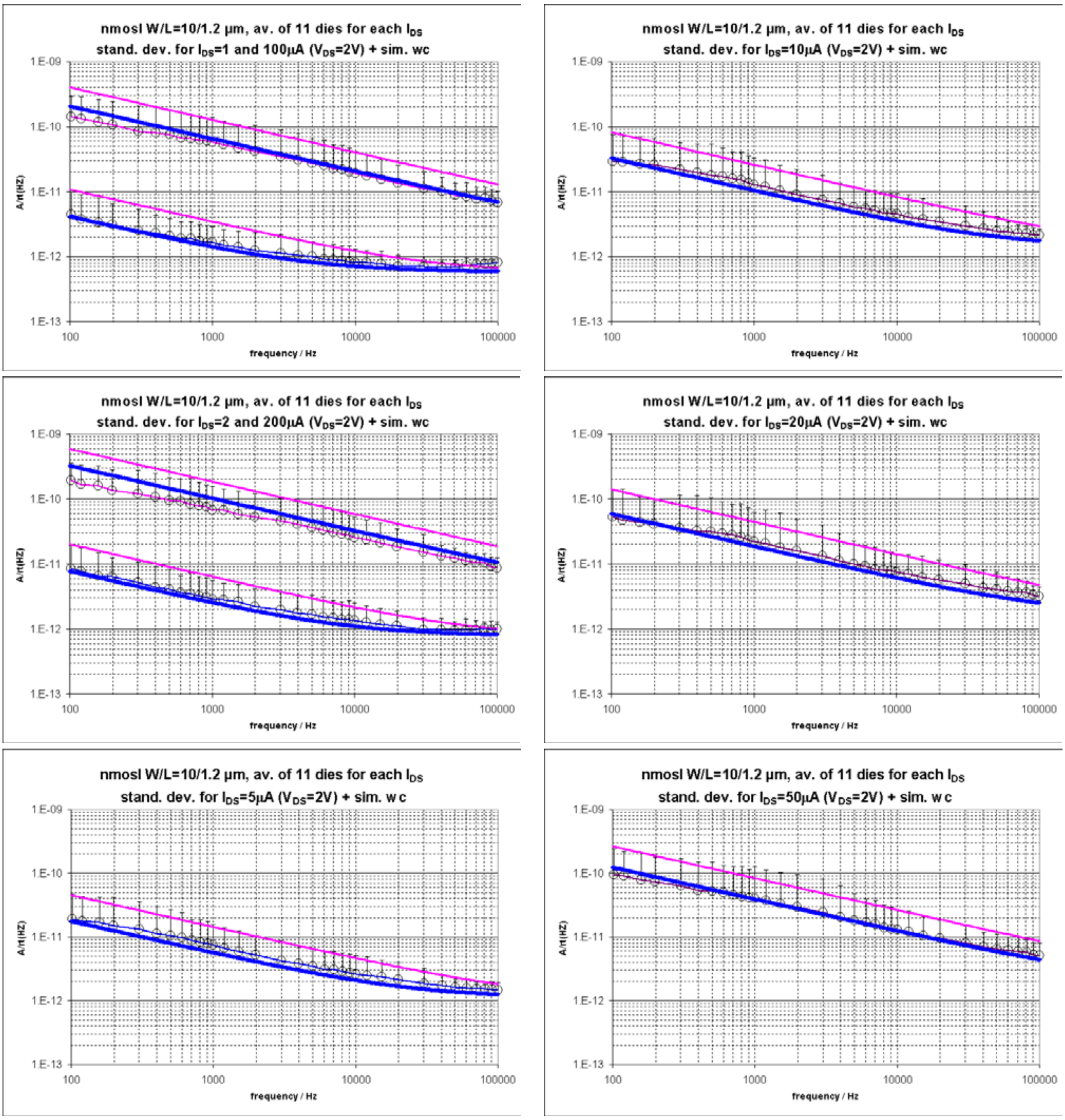


Fig. 4.14 NMOSL current noise [A/ $\sqrt{Hz}$], W/L=10/1.2, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 µA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

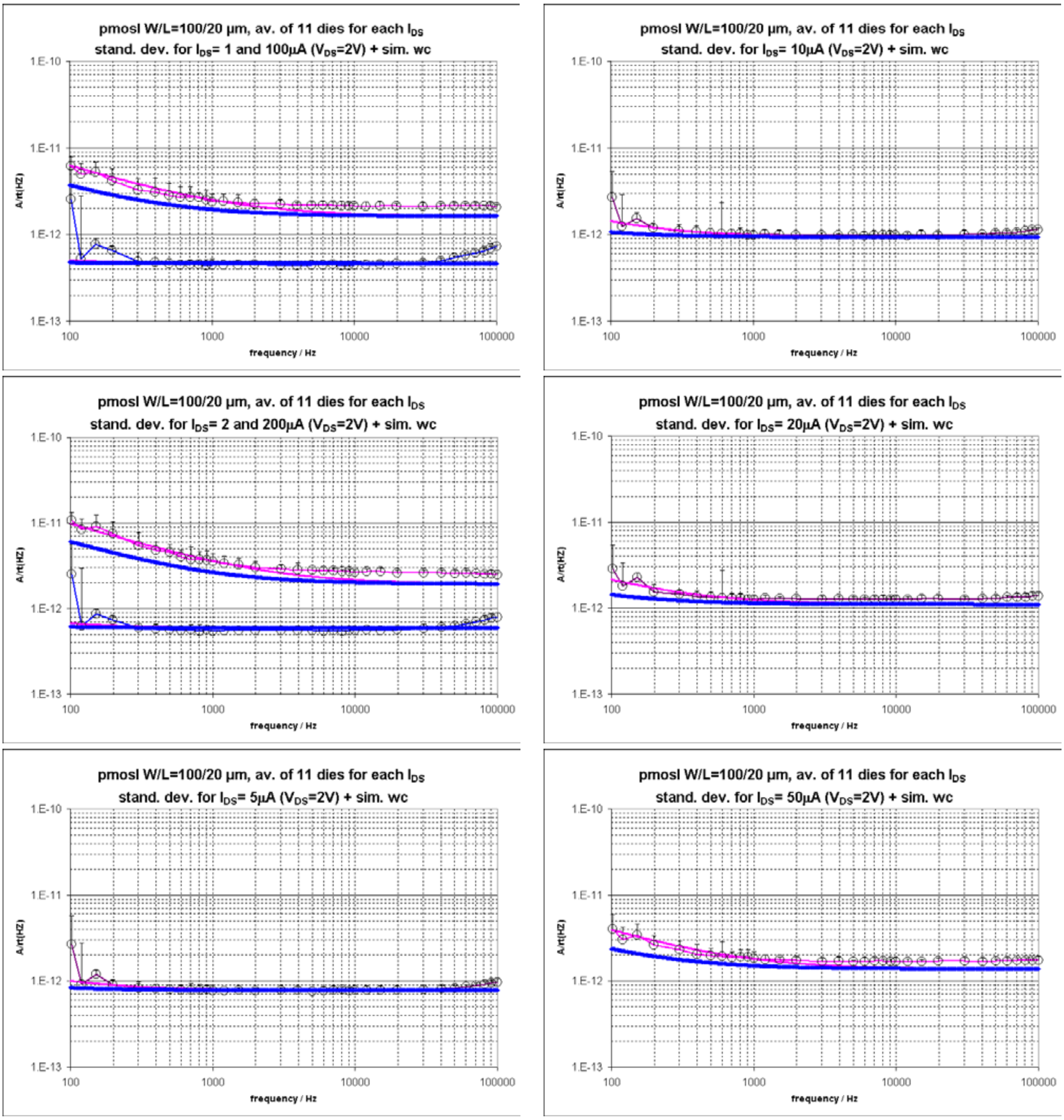


Fig. 4.15 PMOSL current noise [A/$\sqrt{Hz}$], W/L=100/20, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 µA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

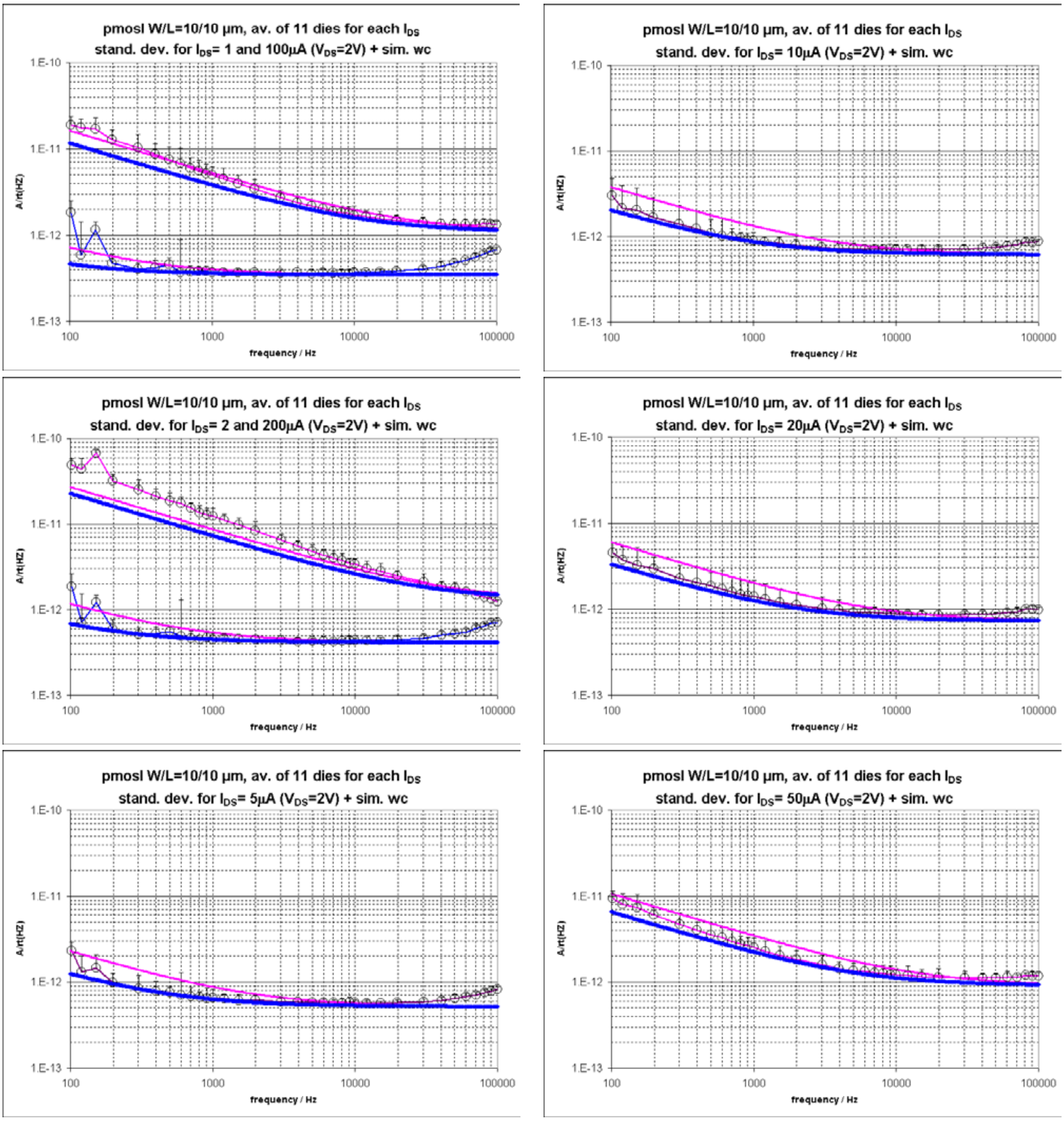


Fig. 4.16 PMOSL current noise [A/$\sqrt{Hz}$], W/L=10/10, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 µA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

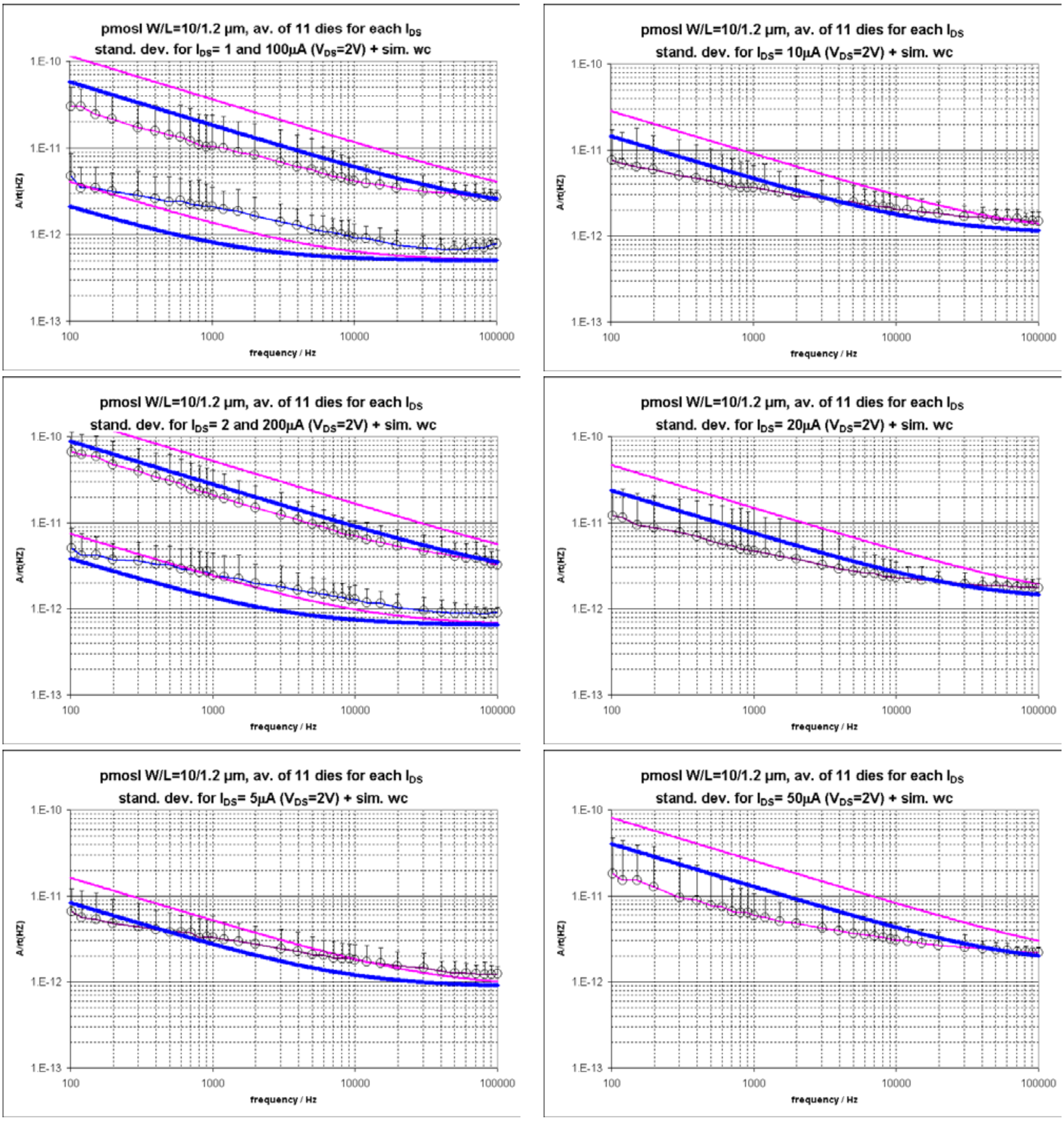


Fig. 4.17 PMOSL current noise [A/$\sqrt{Hz}$], W/L=10/1.2, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 µA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

4.4 5V Low VTH: Worst Case Characteristic Low Frequency Noise Curves

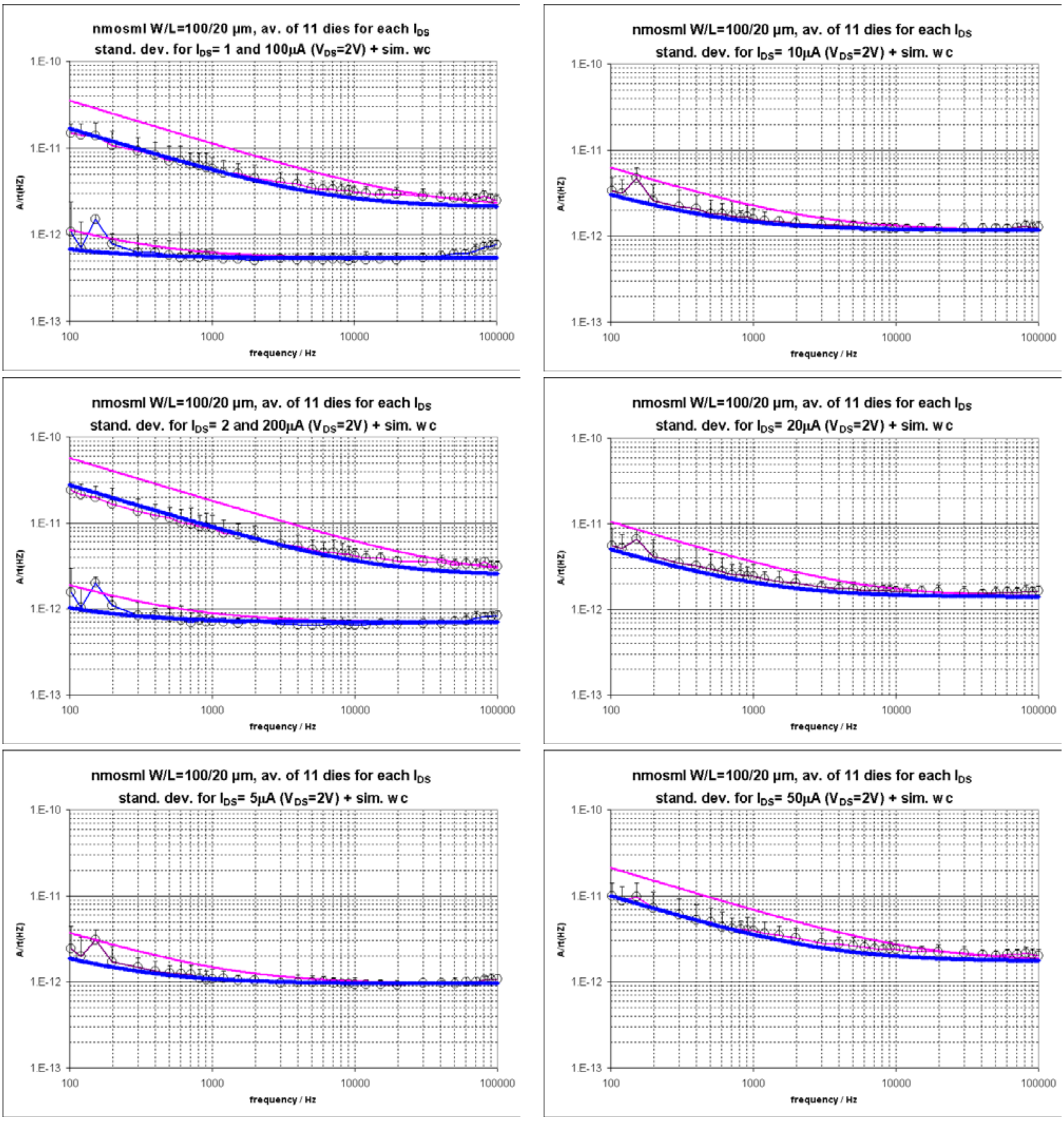


Fig. 4.18 NMOSML current noise [A/$\sqrt{Hz}$], W/L=100/20, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 µA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

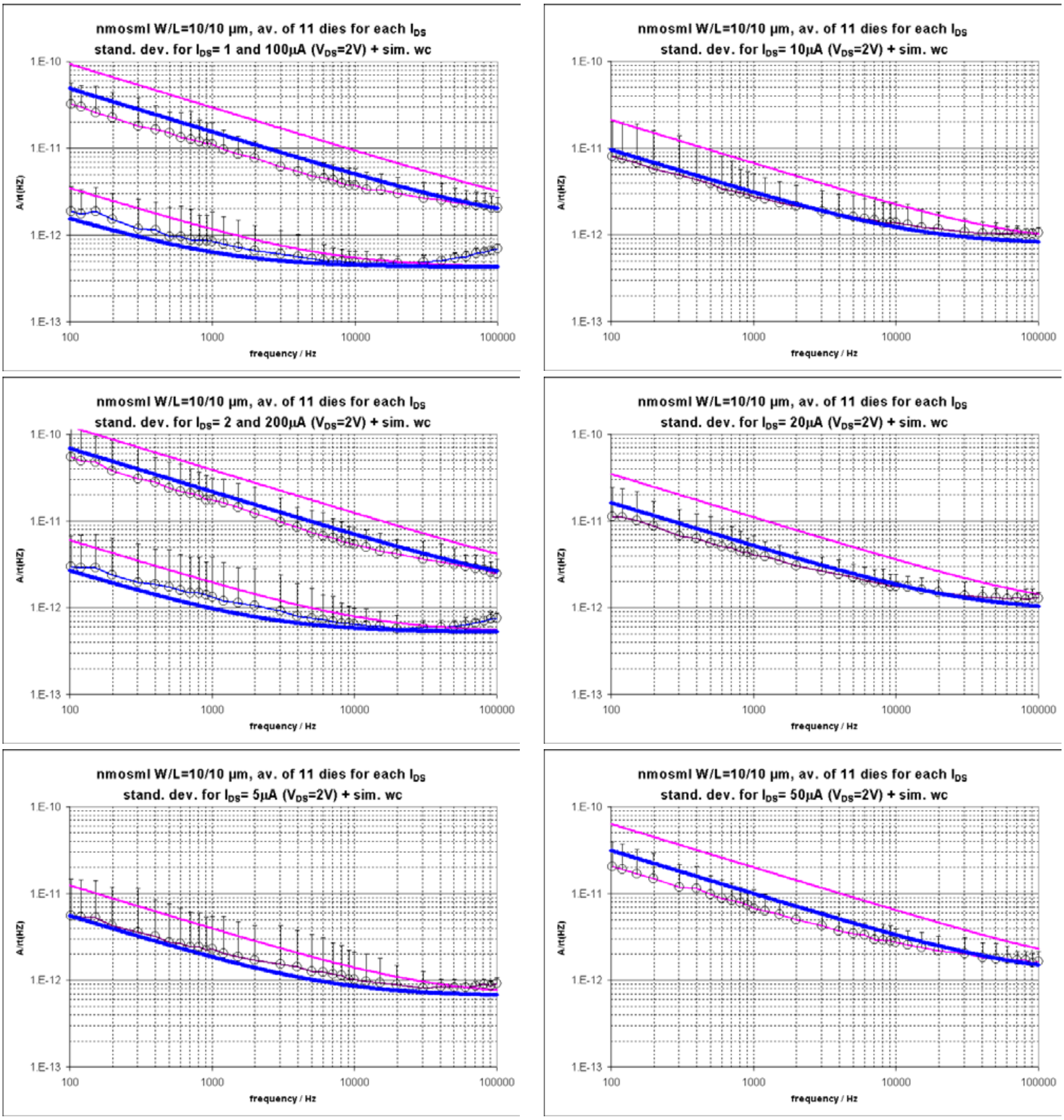


Fig. 4.19 NMOSML current noise [A/$\sqrt{Hz}$], W/L=10/10, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 µA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

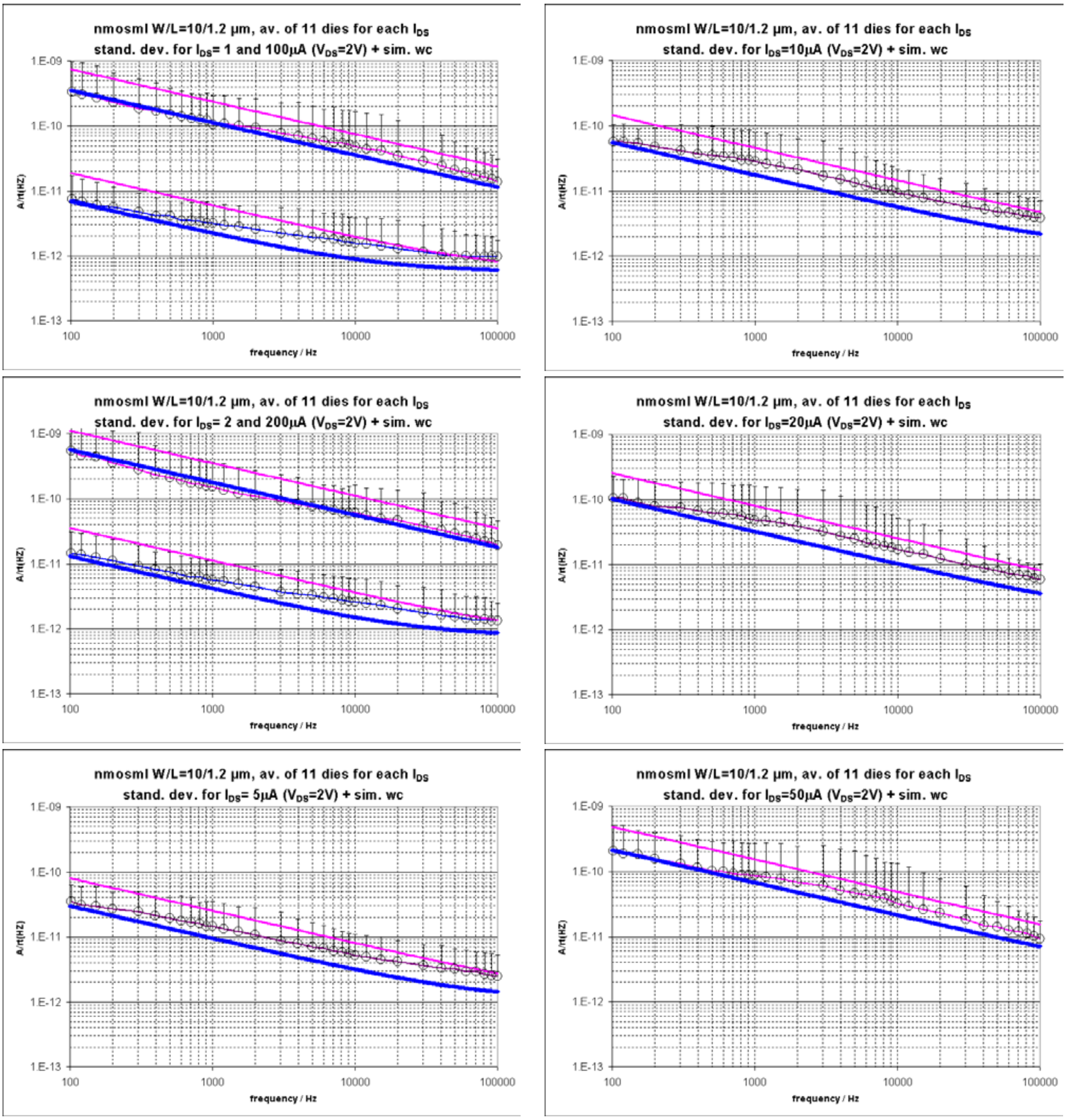


Fig. 4.20 NMOSML current noise [A/$\sqrt{Hz}$], W/L=10/1.2, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 μA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

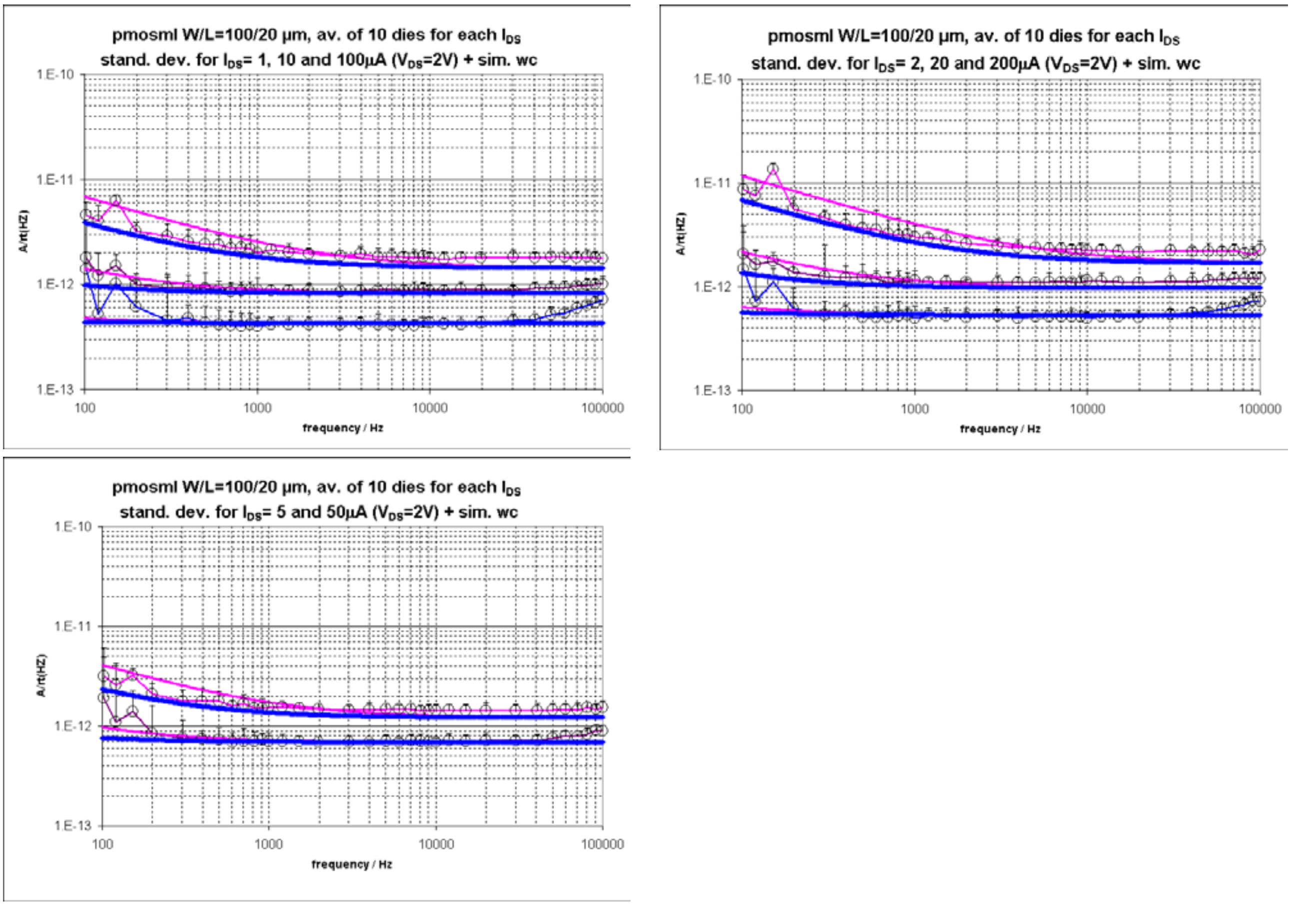
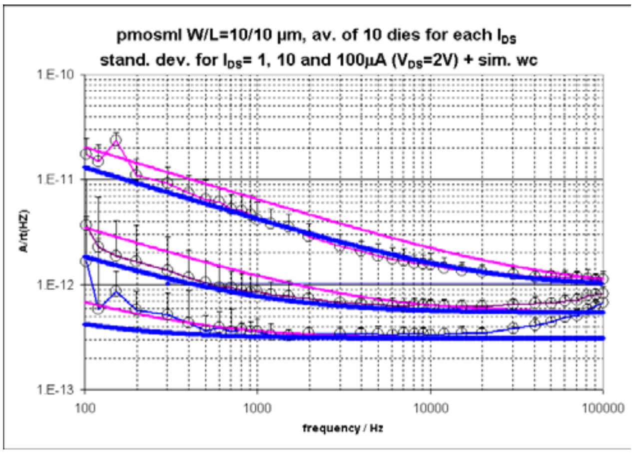
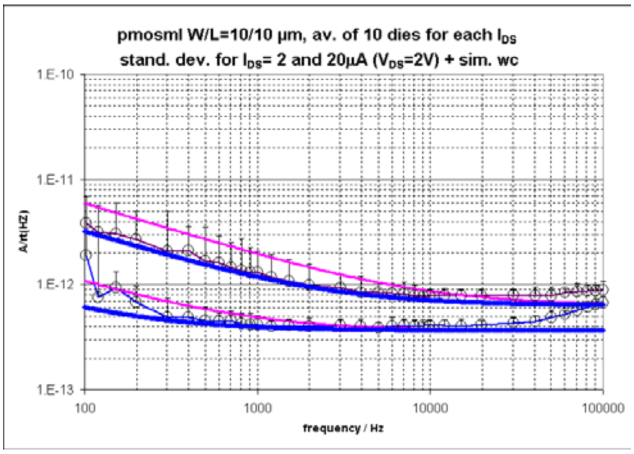


Fig. 4.21 PMOSML current noise [A/$\sqrt{Hz}$], W/L=100/20, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 µA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta





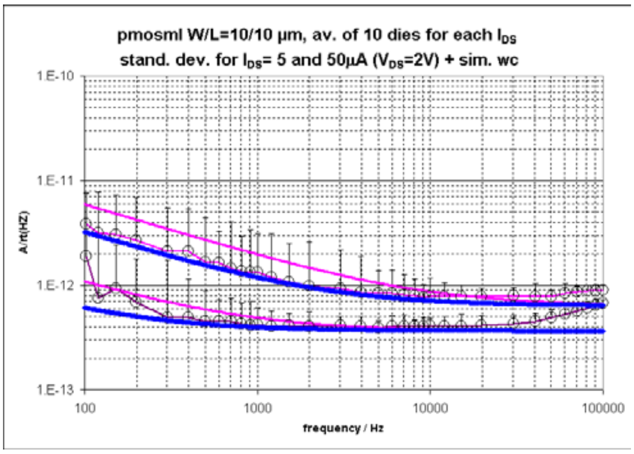


Fig. 4.22 PMOSML current noise [A/$\sqrt{Hz}$], W/L=10/10, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 μA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

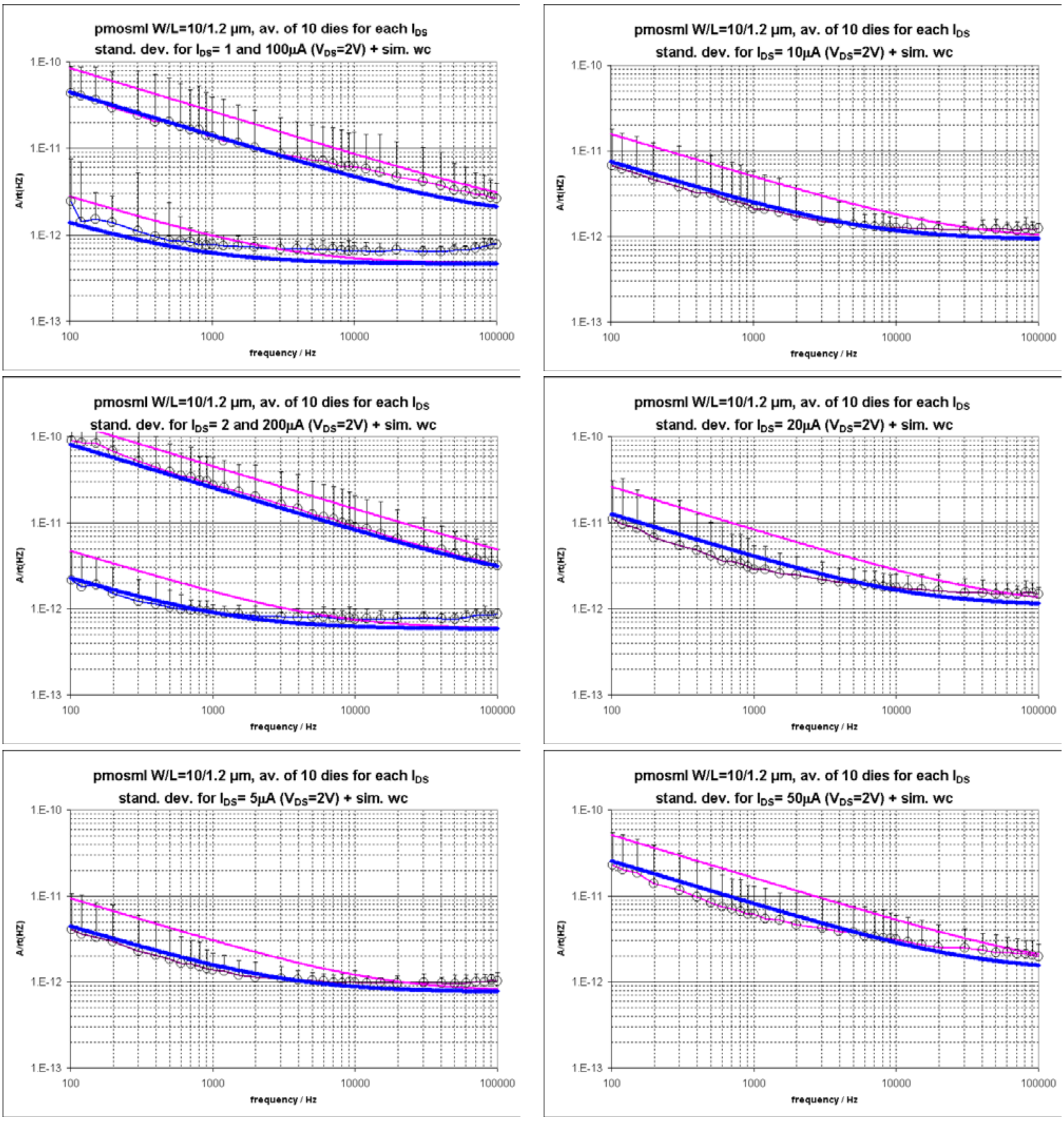


Fig. 4.23 PMOSML current noise [A/$\sqrt{Hz}$], W/L=10/1.2, Bias Current: IDS= 1, 2, 5, 10, 20, 50, 100, 200 μA.
Measurement = symbols with calculated 3 sigma, BSIM3V3 noise model = blue with Worst Case (3 sigma) in magenta

4.5 Bipolar VERT10 - Characteristic Low Frequency Noise Curves

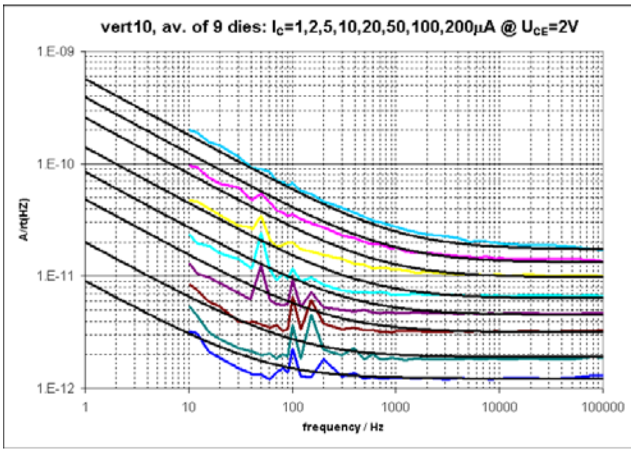


Fig. 4.24 VERT10 collector current noise [A/$\sqrt{Hz}$], Rbas=100kΩ;
Collector Current: IC= 1, 2, 5, 10, 20, 50, 100, 200 µA @ UCE=2V
Measurement = coloured lines, SPICE noise model = black lines

4.6 Resistors: Worst Case Characteristic Low Frequency Noise Curves

4.6.1 RPOLY1

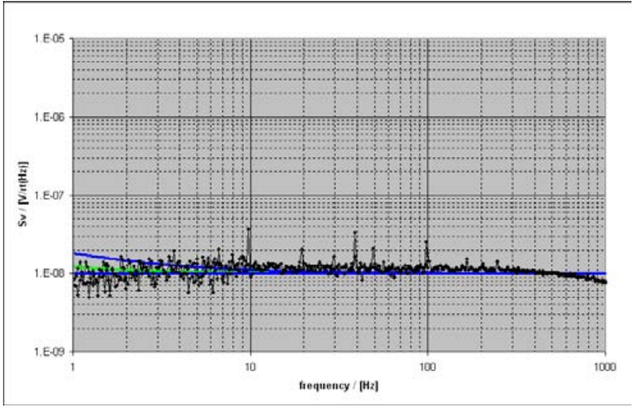


Fig. 4.25 RPOLY1 voltage noise [V/$\sqrt{Hz}$], L/W= 3687.5/3
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

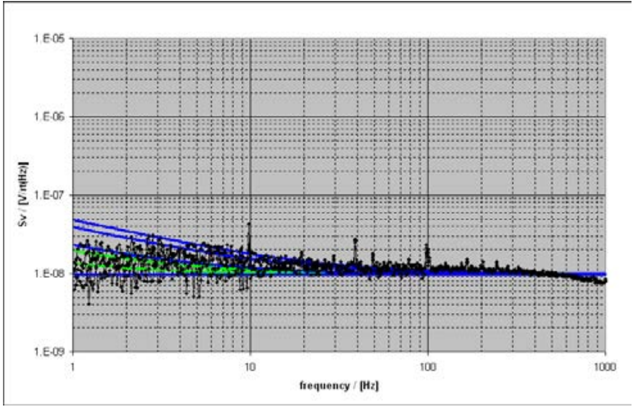


Fig. 4.26 RPOLY1 voltage noise [V/$\sqrt{Hz}$], L/W= 1187.5/1
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

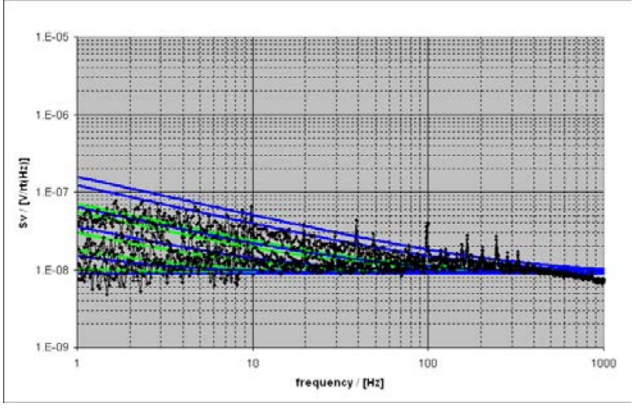


Fig. 4.27 RPOLY1 voltage noise [V/$\sqrt{Hz}$], L/W= 357/0.35
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

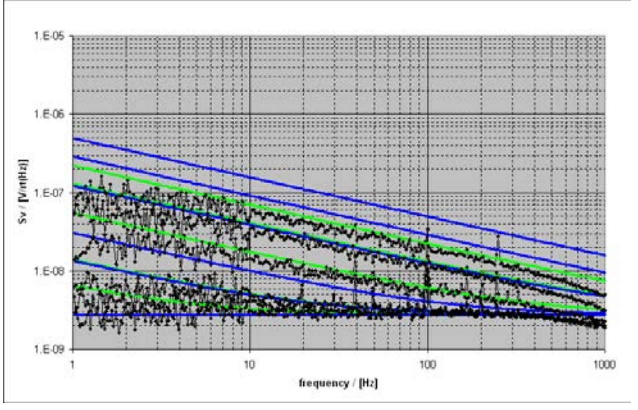


Fig. 4.28 RPOLY1 voltage noise [V/$\sqrt{Hz}$], L/W= 37.5/0.35
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

4.6.2 RPOLY2

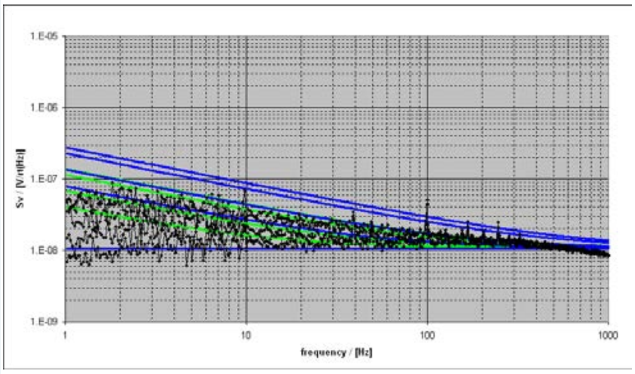


Fig. 4.29 RPOLY2 voltage noise [V/ $\sqrt{Hz}$], L/W= 1150/6
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

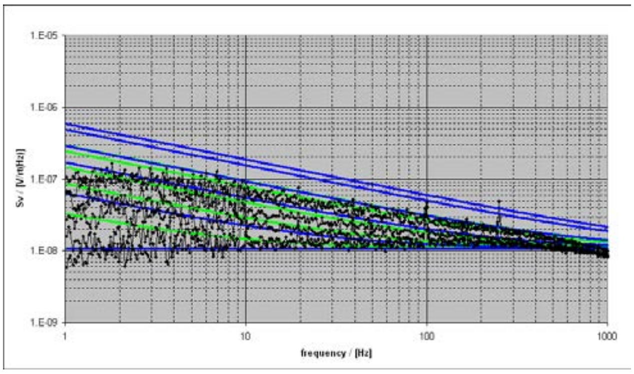


Fig. 4.30 RPOLY2 voltage noise [V/ $\sqrt{Hz}$], L/W= 550/3
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

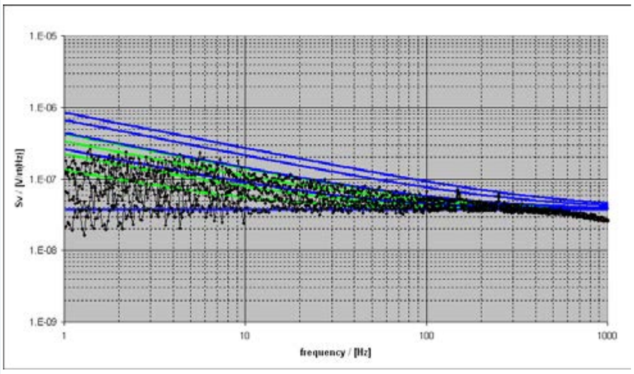


Fig. 4.31 RPOLY2 voltage noise [V/ $\sqrt{Hz}$], L/W= 1185/1
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

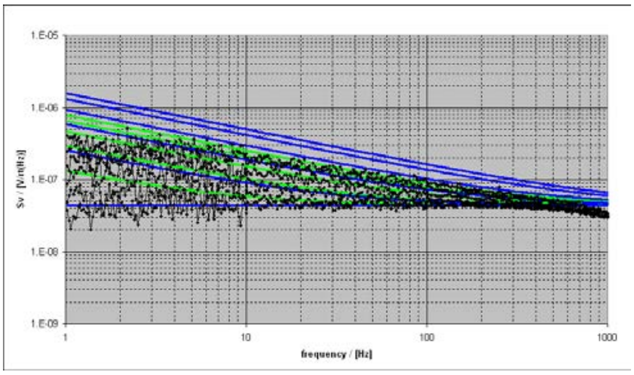


Fig. 4.32 RPOLY2 voltage noise [V/ $\sqrt{Hz}$], L/W= 800/0.65
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

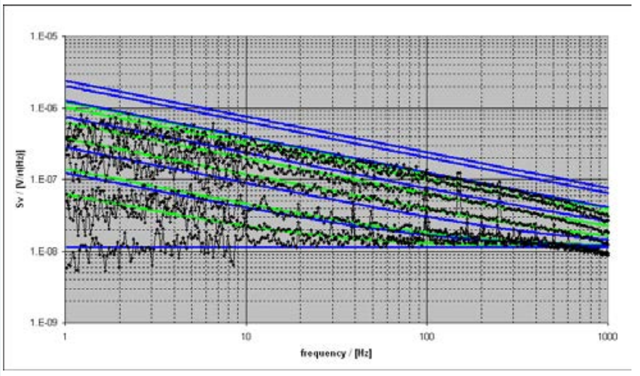


Fig. 4.33 RPOLY2 voltage noise [V/$\sqrt{Hz}$], L/W= 150/1
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

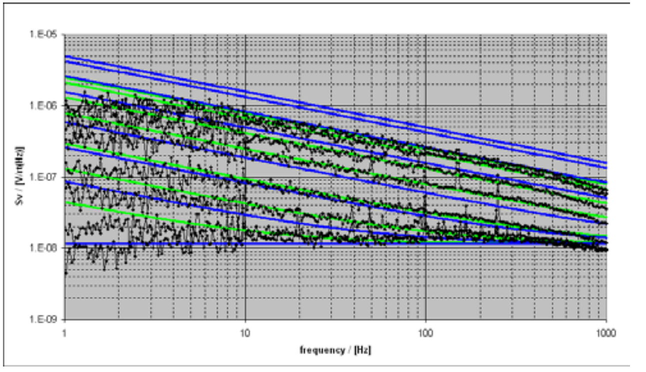


Fig. 4.34 RPOLY2 voltage noise [V/$\sqrt{Hz}$], L/W= 80/0.65
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

4.6.3 RPOLYH

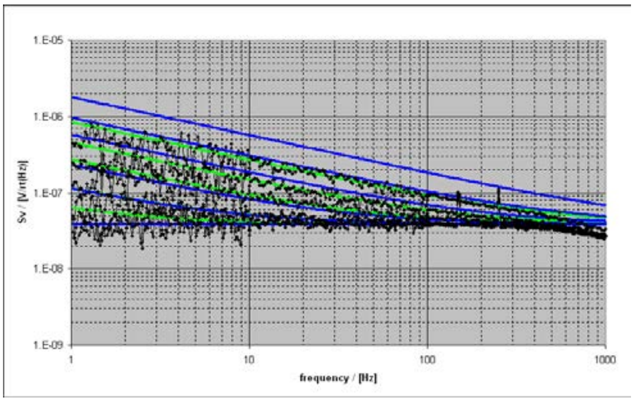


Fig. 4.35 RPOLYH voltage noise [V/$\sqrt{Hz}$], L/W= 233.35/3
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

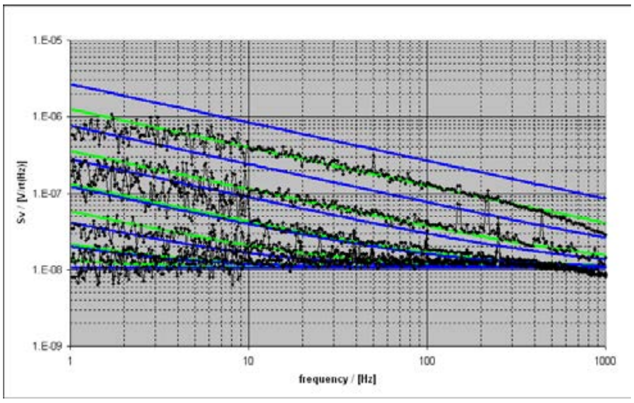


Fig. 4.36 RPOLYH voltage noise [V/$\sqrt{Hz}$], L/W= 49.55/6
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

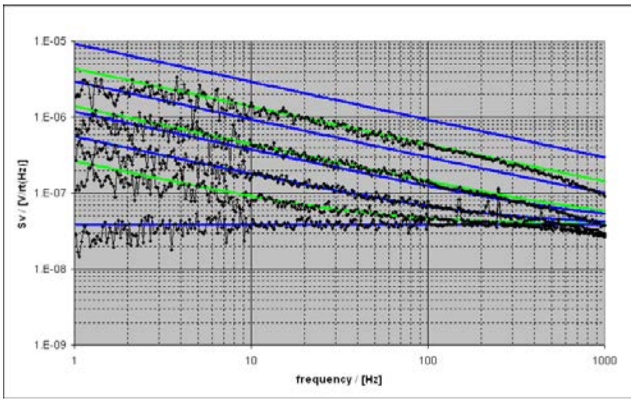


Fig. 4.37 RPOLYH voltage noise [V/$\sqrt{Hz}$], L/W= 51.2/0.8
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

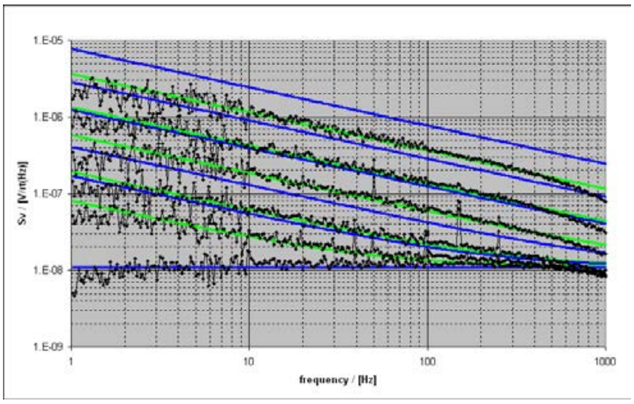


Fig. 4.38 RPOLYH voltage noise [V/$\sqrt{Hz}$], L/W= 6.2/0.8
Vterm= 0, ..., 1.5V
Measurement = black symbols
typical noise model = green lines
worst case model = blue lines

5 Support

For questions on noise parameters refer to:

austriamicrosystems AG
Schloss Premstätten
A-8141 Unterpremstätten
Austria
phone: +43-(0)3136-500 5463

Email:

tips@austriamicrosystems.com Process parameter support
hitkit@austriamicrosystems.com Support concerning the HIT-Kit and circuit simulation.

Technical Webserver: http://asic.austriamicrosystems.com
Download Simulation Parameters: http://asic.austriamicrosystems.com/download
Homepage – austriamicrosystems AG: http://www.austriamicrosystems.com

6 Copyright