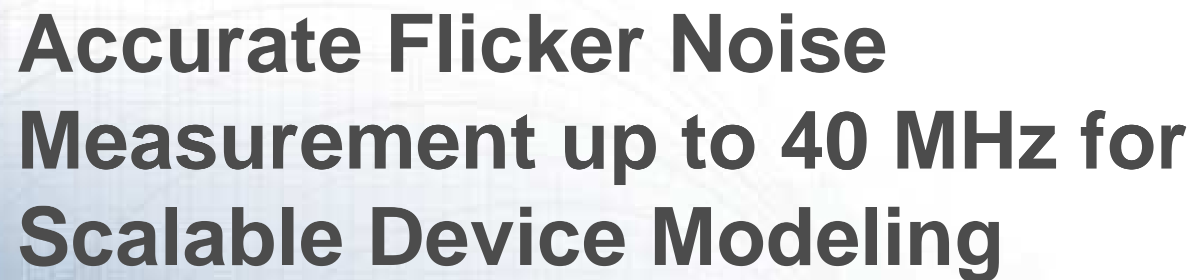

Accurate Flicker Noise Measurement up to 40 MHz for Scalable Device Modeling

Toe Naing Swe

Cascade Microtech

CascadeMicrotech®

Introduction

- 1/f noise
  - 1/f noise is caused by surface recombination due to traps and defects in the crystal of a semiconductor material
  - It is scales as the inverse of frequency or 1/f
  - The corner frequency between flicker noise and other noises is getting higher with device technology advancement
  - It is a key parameter for IC design and process development

- Challenges for on-wafer 1/f noise measurement
  - Measurement system noises limits accuracy and repeatability
  - Lower bandwidth prevents characterization of corner frequency
  - Can not measure at different temperature

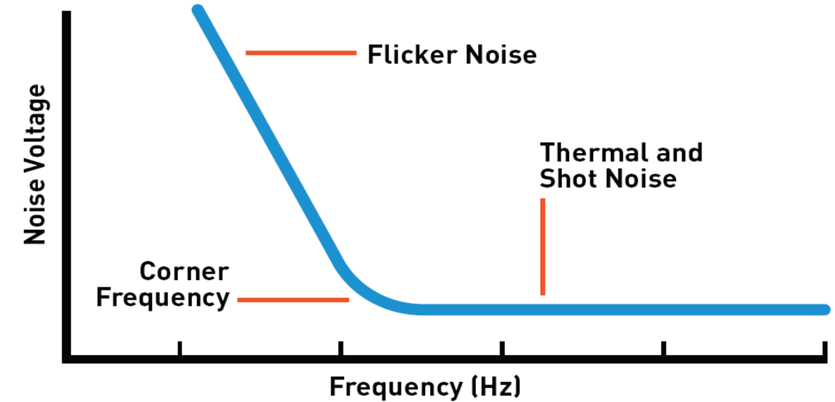

Fig.1: Illustration of 1/f noise dependency on Frequency.

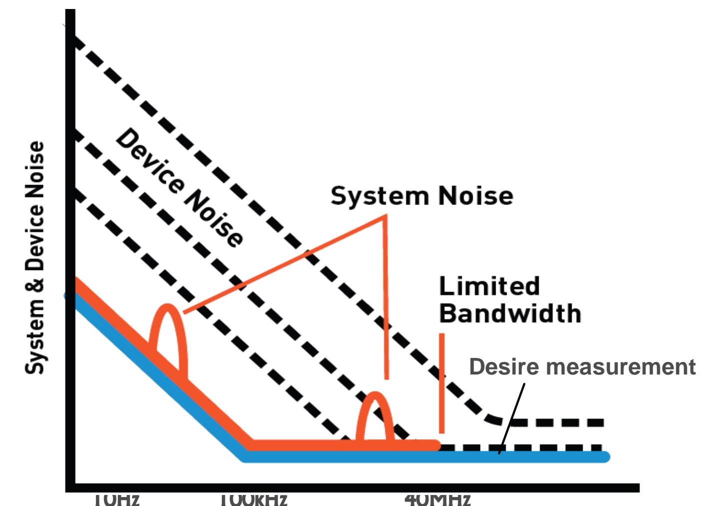

Fig. 2: Illustration of system noise interference on measurements

CascadeMicrotech®

1/f noise characterization for modeling

Scalability of device models

- Different Biasing condition
  - Low current measurement (e.g near threshold)
- Temperature scaling
  - Difficult to measure over various temperature due to system noise
- Device geometry scaling
  - W, L, NF

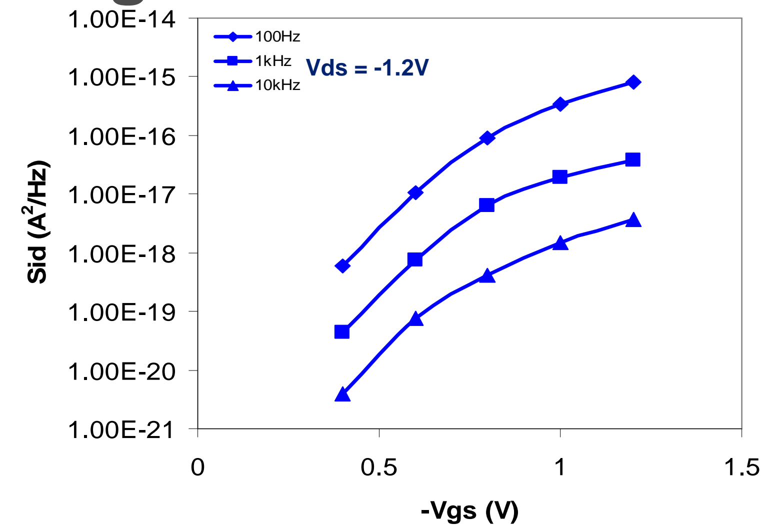

Fig. 3: Sid Vs Vgs of W/L=10um/0.065um pMOSFET at 25C

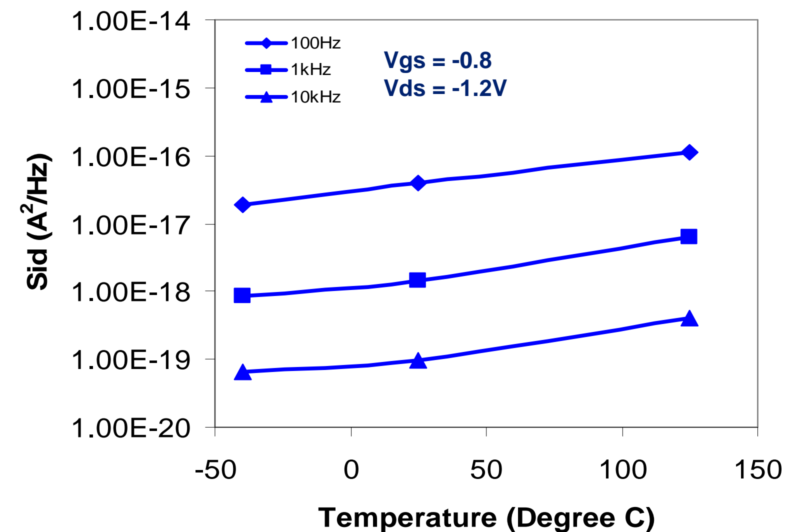

Fig. 4: Sid Vs Temperature of W/L=10um/0.065um pMOSFET

CascadeMicrotech®

Measurement approach and Results

Measurement approach

- High bandwidth LNA capture noise voltage across Rload thus enable measurement up to 40MHz
- System parasitic capacitance are minimized to increases system roll off frequency
- Filters for Source Monitor Unit are used to ensure clean bias supply to DUT even at the sub-uA level.
- Thermal system noise filter are used to eliminate the noise while measuring at different temperature
- Shielding and single ground approach eliminates unwanted noise from environment

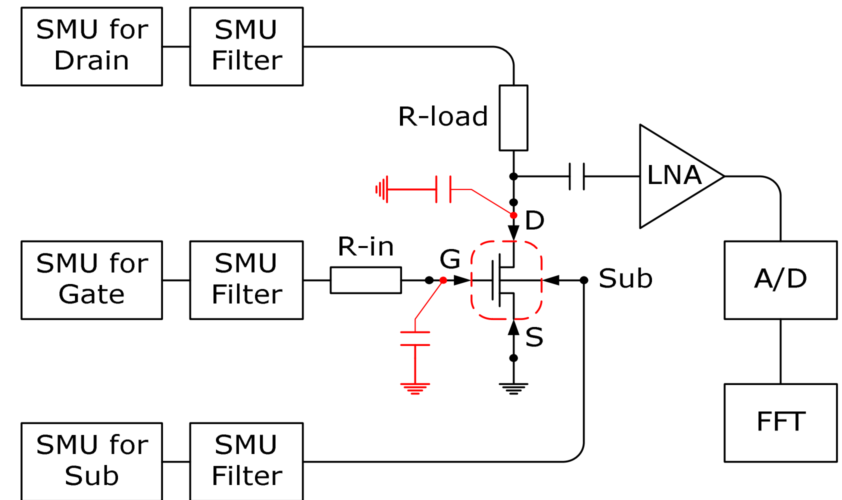

Fig. 4: Block Diagram of proposed 1/f noise system

Results and Conclusion

- Accurate and reliable measurements for 1/f noise measurements up to 40MHz is observed
- For the first time, 1/f noise measurement at different temperatures is demonstrated
- 1/f noise characterization for scalable model parameter extraction can be achieved
- Results shows that “Noise free” measurements environment can be achieved by using proper system setup

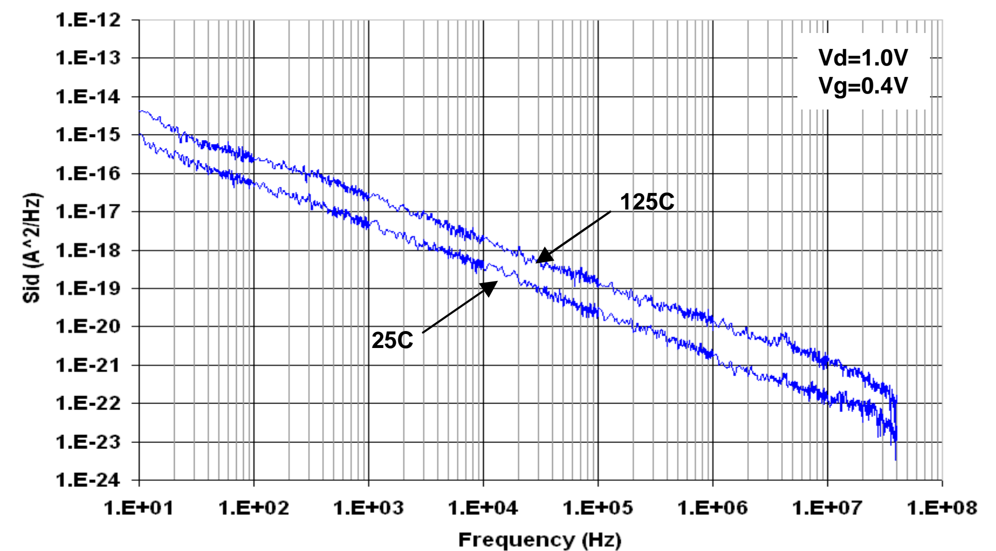

Fig. 5: Sid Vs Frequency of W/L=0.5um/0.065um pMOSFET at 25C and 125C

CascadeMicrotech®