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Techniques for Accurate 1/f Flicker Noise Characterization up 40 MHz

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INTRODUCTION

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

Challenges of on-wafer 1/f noise measurement

- Measurement instruments' noises limit accuracy and repeatability of measurements
- Lower bandwidth prevents accurate characterization of corner frequency
- Can not measure at different temperature

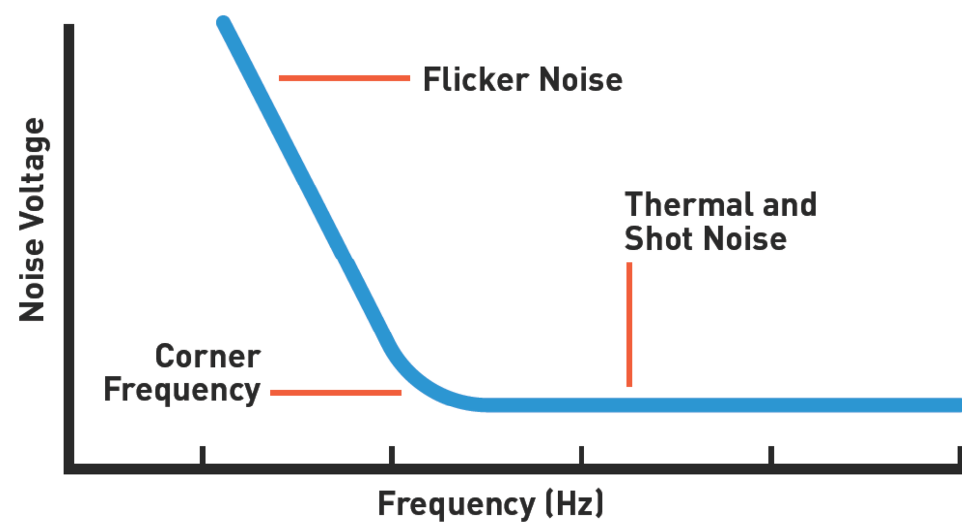

FIGURE 1. 1/f noise dependency on Frequency

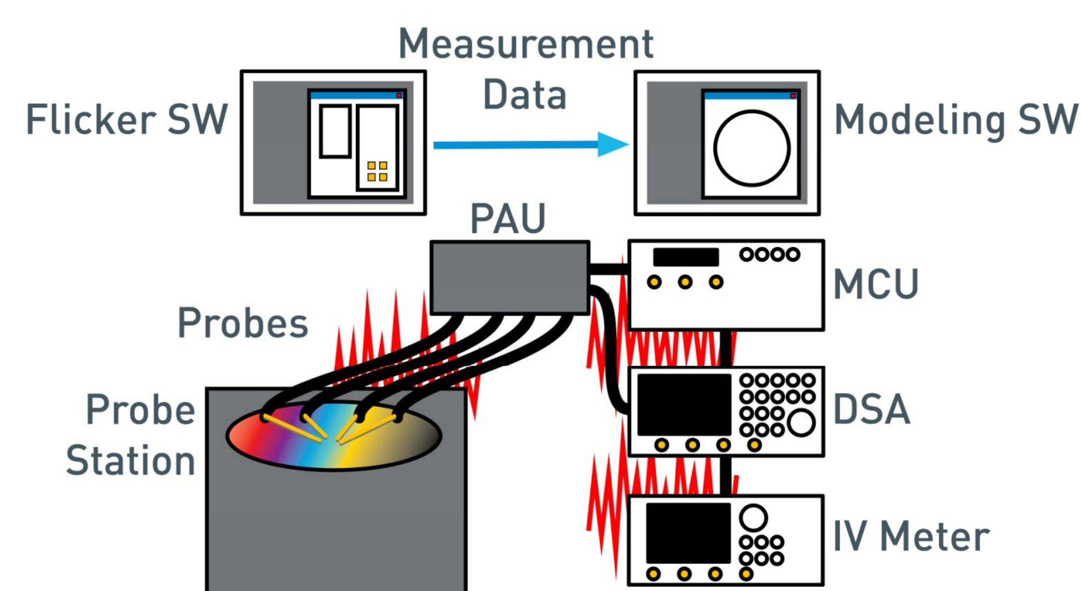

FIGURE 2. Typical 1/f noise setup showing external noise source limiting accuracy of 1/f characterization

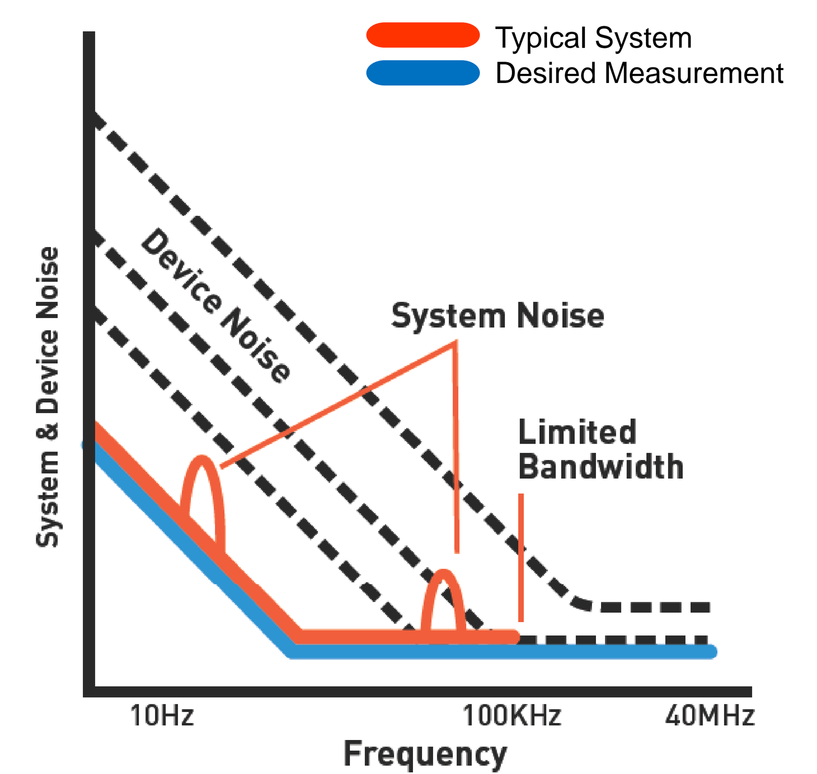

FIGURE 3. Illustration of system noise interference on measurements

MEASUREMENT APPROACH

- Extensive electrical shielding and true single ground approach ensure accurate and reliable measurements results by eliminating unwanted noise from instruments
- High bandwidth LNA enables measurement up to 40 MHz
- System parasitic capacitance is minimized to increase system roll-off frequency
- Filters for SMU (Source Monitor Unit) are used to ensure clean bias supply to DUT even at the sub-μA level
- Thermal system noise filters are used to eliminate the noise while measuring at different temperature
- Smart noise conversion algorithm increases measurements speed up to 8 times

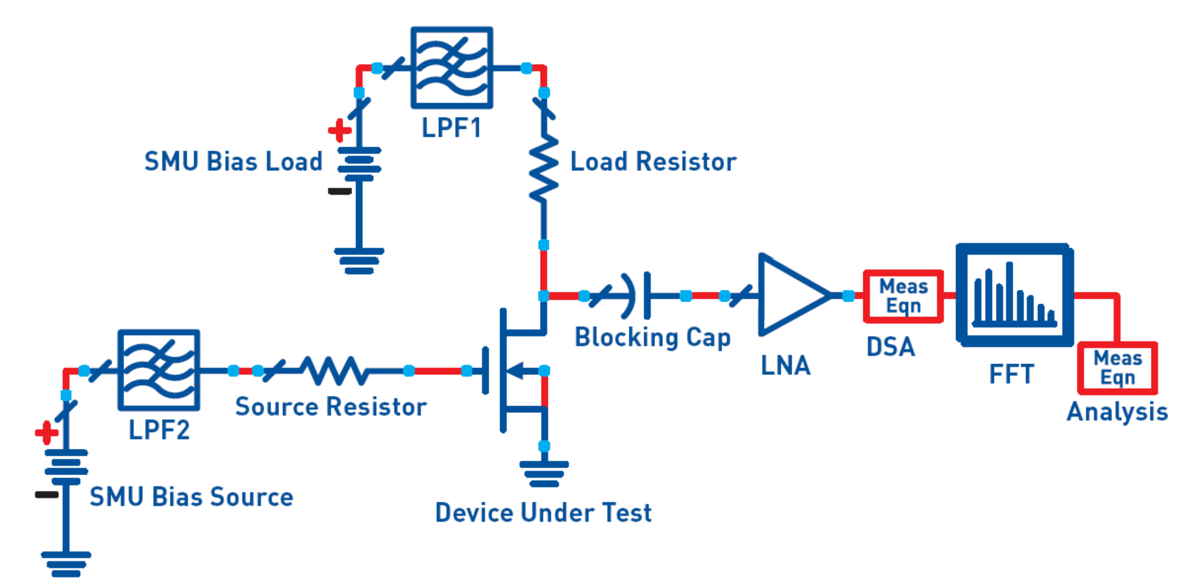

FIGURE 4. Block diagram of proposed 1/f noise system

RESULTS and CONCLUSION

- Accurate and reliable measurements for 1/f noise measurements up to 40MHz are observed
- For the first time, 1/f noise measurement at different temperatures is demonstrated
- Results show that "noise-free" measurement environment can be achieved by using advanced shielding techniques and proper grounding techniques

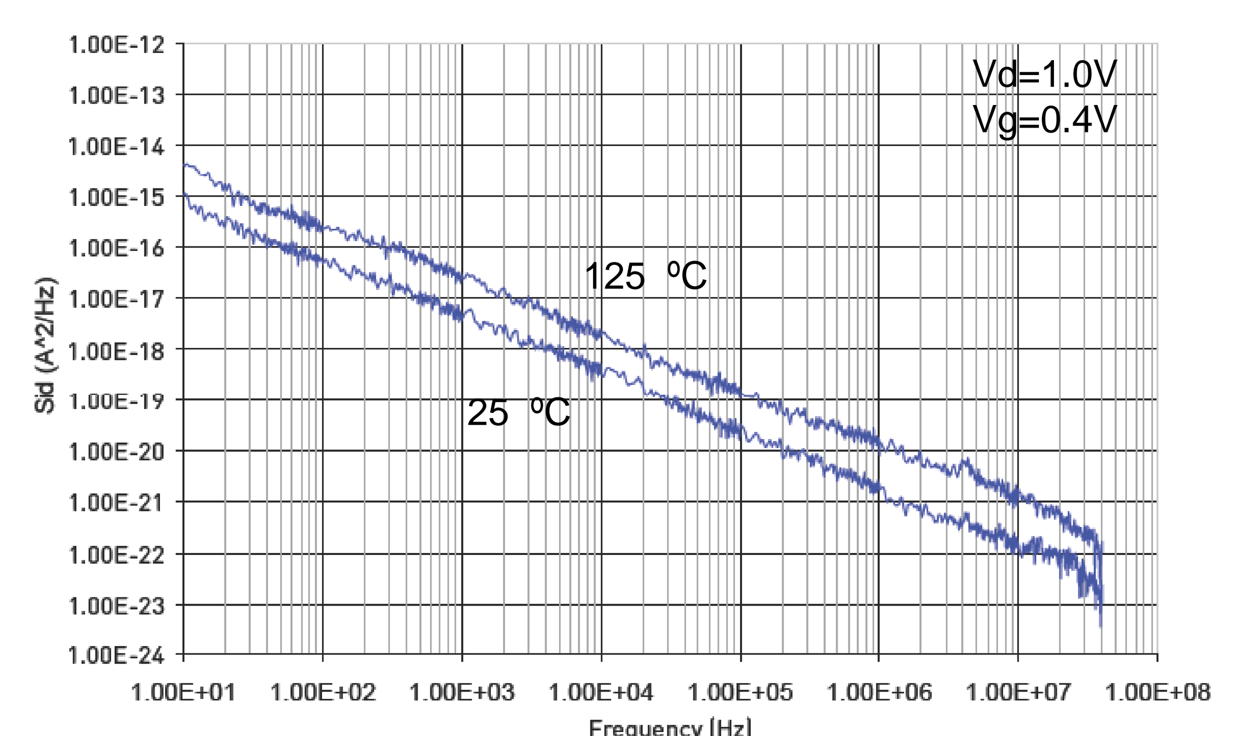

FIGURE 5. Sid vs frequency of W/L=0.5 μm/0.065 μm MOSFET at 25 °C and 125 °C