

*Field-Sensitive Photoconductive Sampling  
with Integrated Low-Capacitance,  
High-Impedance Source Follower*

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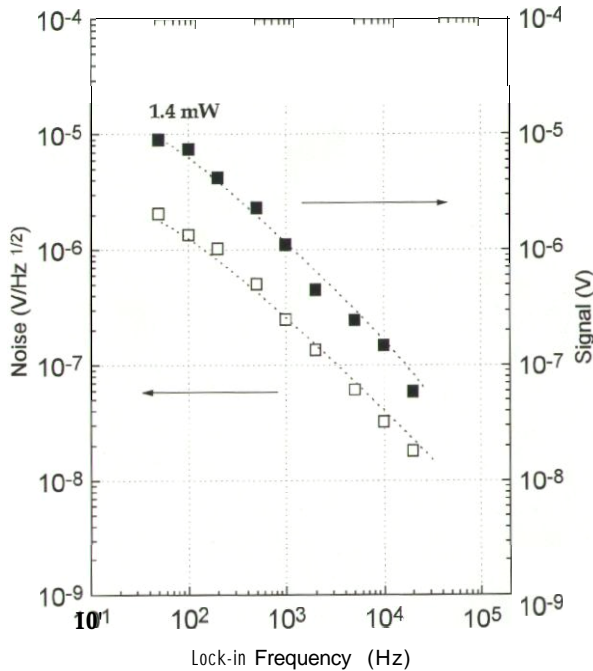
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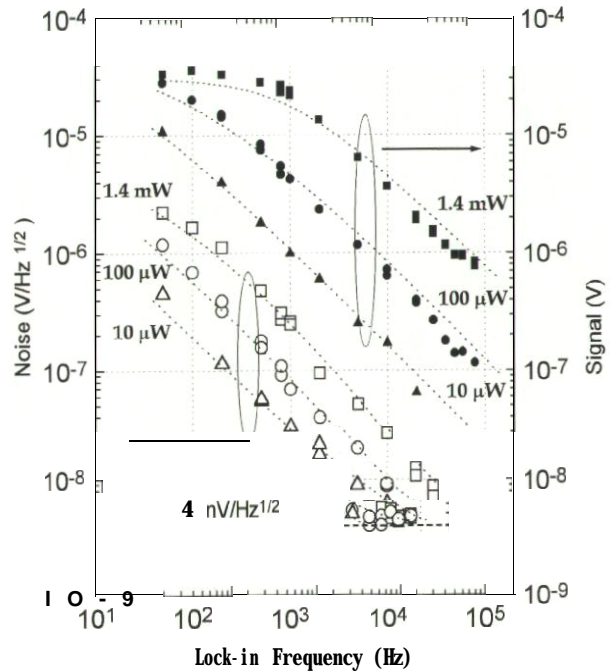
## Properties of the JFET source follower

- ❑ **High input impedance**  
Gate leakage current  $< 1 \text{ pA}$
- ❑ **Low parasitic capacitance**  
Short-circuit, common-source, gate input impedance  $C_{iss}$   $3 \text{ pF}$
- ❑ **Large driving current**
- ❑ **Low noise**  
Equivalent input noise voltage,  
 $e_n < 5 \text{ nV/Hz}^{1/2}$  beyond  $1 \text{ kHz}$

# 1/f Noise spectrum of photogate vs. gating power

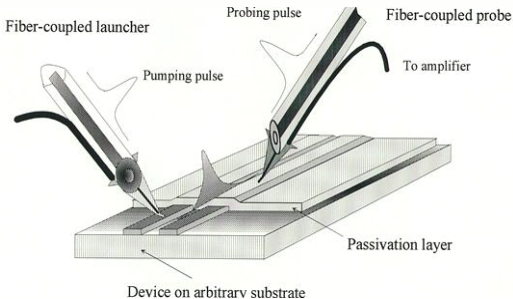


Pumping power: 50 nW  
without a JFET source follower

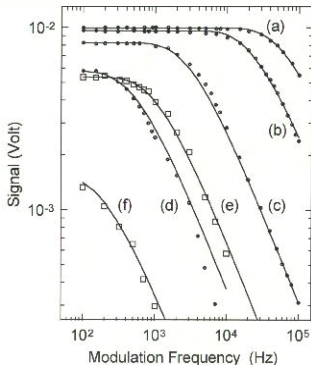


Pumping power: 50 nW  
with a JFET source follower

# Field-sensitive photoconductive sampling through passivation layer



# 50 kHz modulation bandwidth of photoconductive probe



Low parasitic capacitance, 3 pF  
→ high modulation bandwidth

High input impedance,  $> 1 \text{ T}\Omega$   
→ low draining current from DUT

w/ Source Follower

(a) 10 mW

(b) 2 mW

(c) 0.2 mW

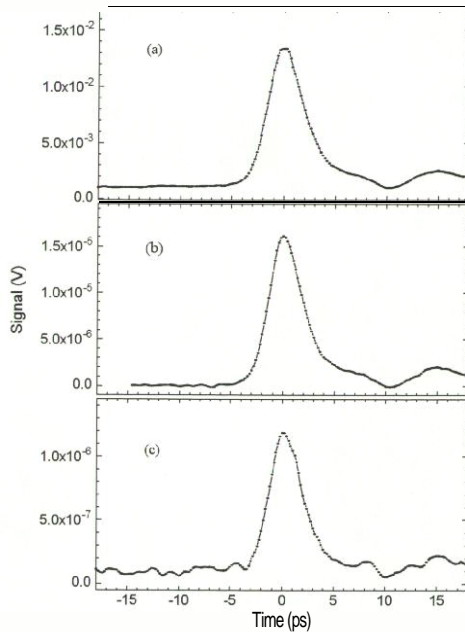
(d) 0.02 mW

w/o Source Follower

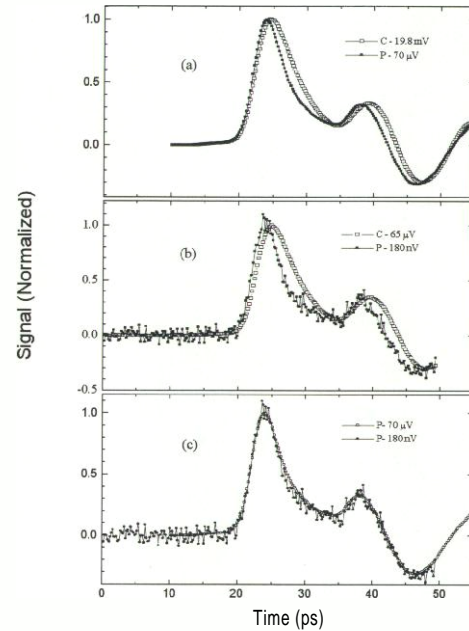
(e) 10 mW

(f) 2 mW

# Sensitivity of field-sensitive photoconductive sampling

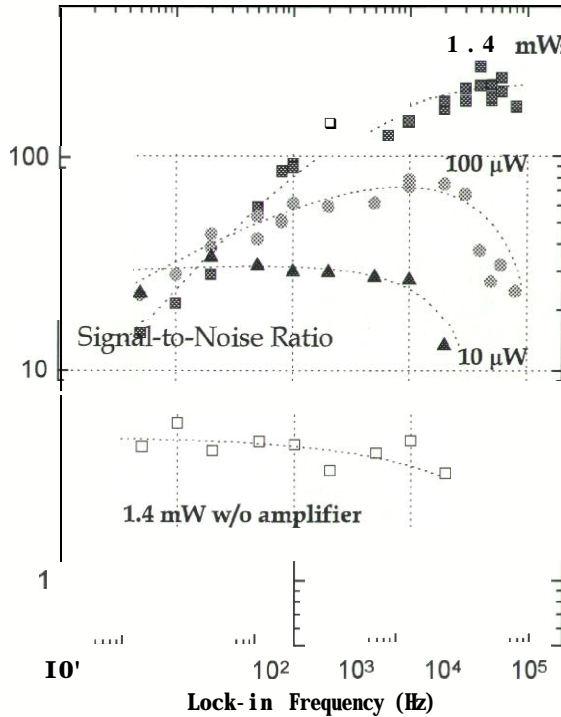


Minimum detectable signal  
with conductive contact  
 $30 \text{ nV/Hz}^{1/2}$



Minimum detectable signal  
with fringing field  
 $2 \mu\text{V/Hz}^{1/2}$

# Signal-to-noise ratio vs. modulation frequency



Higher modulation bandwidth  
Better signal-to-noise ratio

**Pumping Power : 50 nW**

# Summary

Low invasiveness to nano-structure

→ Negligible current drain

High linear dynamic range

→ Independent to carrier mobility

→ Independent to impedance of DUT

High modulation bandwidth

→ High sensitivity

→ Absolute voltage measurement