Pratt QD I Notebook

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Pg. 2

SQUID specs

mod coil : 1.48 $\mu A/\Phi_0$

input coil : 0.20 $\mu A/\Phi_0$

input coil L : 1.89 μH

Noise at 100 Hz, no load : 20.1 $\mu\Phi_0/\sqrt{Hz} \rightarrow 1.52 \cdot 10^{-29}$ J/Hz

5 Range 1 : 1V $\leftrightarrow$ 10^{-6} A

With bandwidth = 1 Hz, short term noise $\approx \pm 0.05$ mV

$$\frac{\delta\Phi}{\Phi_0} = \frac{\delta i}{1.48} = \frac{5 \cdot 10^{-5}}{1.48} \approx 3 \cdot 10^{-5} \rightarrow \delta\Phi = 30\ \mu\Phi_0$$

8 Picture of transformer

primary : 133 turns/layer $\times$ 4 layers = 532 turns

R = 21.6 kΩ

secondary : 30 turns in 2 layers

R = 23 Ω

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15 Test SQUID w/ transformer

Noise increased × 20 from Cu Faraday shield

$\frac{\delta\Phi}{\Phi_0} = 6.8 \cdot 10^{-4}$ in 1 Hz Bandwidth

Measured current gain of transformer = 2.66

19 Compare internal vs external feedback

$\text{ratio} = \frac{\text{external}}{\text{internal}} = 8 \cdot 10^{-3}$ or Gain = 5

(We use Gain = 1)

20 We calls this the open loop gain

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19 Sample leads are shorted, $R_{ref} = 94.5\ \mu\Omega$

Internal feedback for Range 1 $R_i = 1\ M\Omega$

$$\frac{\delta\Phi/\Phi_0}{\delta V_{SQ}} = \frac{1}{1.48}\ V^{-1} = 0.68\ V^{-1}$$

External feedback on Gain = 5

$$\frac{\delta\Phi}{\Phi_0} = \left(\frac{\delta\Phi/\Phi_0}{\delta i_s}\right)\left(\frac{\delta i_s}{\delta i_p}\right)\left(\frac{\delta i_p}{\delta i_{fb}}\right)\frac{\delta i_{fb}\cdot R_{fb}}{R_{fb}} \times 5$$

$$= 5\cdot 10^{6}\cdot(2.66)\left(\frac{1}{1.22}\right)\cdot\frac{\delta V_{SQ}}{10^{4}}$$

(10^4 ← R_{fb})

$$\Rightarrow \frac{\delta\Phi/\Phi_0}{\delta V_{SQ}} = 5.4\cdot 10^{3}\ V^{-1}$$

126-127 Extra sheet showing freq. dep at different gains

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29 Tried using much longer $R_{ref} = 11.55$ mΩ

Did not work; feedback was unstable.