



$$R_s (I_s - I_{diff}) = R_{ref} (I_{ref} + I_{diff})$$

$$I_{diff} (R_{ref} + R_s) = R_s I_s - R_{ref} I_{ref}$$

$$I_{diff} = \frac{R_s I_s - R_{ref} I_{ref}}{R_{ref} + R_s}$$

SQUID has transconductance g :

$$V_{squad} = g I_{diff}$$

$$I_{ref} = \frac{V_{squad}}{R_{feedback}} = \frac{g}{R_{fb}} I_{diff}$$

Known: $I_s, g, V_{squad}, R_{ref}$

Want: R_s

$$\frac{V_{squad}}{g} = \frac{R_s I_s - R_{ref} \cdot \frac{V_{squad}}{R_{fb}}}{R_{ref} + R_s}$$

$$R_s = R_{ref} \cdot \frac{V_{squad} \left(1 + \frac{g}{R_{fb}}\right)}{I_s g - V_{squad}}$$

$$(R_{ref} + R_s) \frac{V_{squad}}{g} = R_s I_s - R_{ref} \frac{V_{squad}}{R_{fb}}$$

$$-R_s \left(\frac{V_{squad}}{g} - I_s \right) = R_{ref} \left(\frac{V_{squad}}{g} + \frac{V_{squad}}{R_{fb}} \right)$$

$$R_s \approx R_{ref} \frac{V_{squad}}{I_s R_{fb}}$$