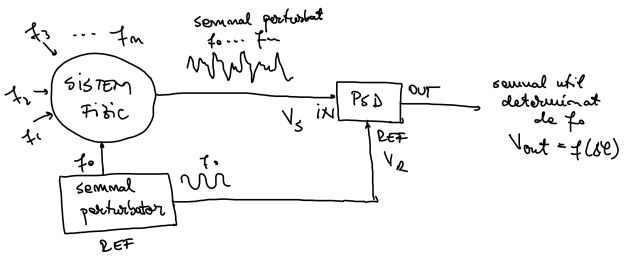


Detectia sensibilită la fază:

„Phase-sensitive detection” (PSD) (lock-in)

phase-sensitive  $V_{out} \sim \Delta \varphi$   
 $V_{out} \rightarrow \text{max. atunci când } \Delta \varphi = 0$



semnale de intrare pt. PSD

semnalul de referință:  $V_R = V_{REF} \sin(\omega t + \theta_{REF})$   
 semnalul măsurat:  $V_S = V_{SIG} \sin(\omega t + \theta_{SIG})$

schema bloc



$$V_S V_R = V_{REF} V_{SIG} \underbrace{\sin(\omega t + \theta_{REF})}_{a} \underbrace{\sin(\omega t + \theta_{SIG})}_{b} =$$

$$= V_{REF} V_{SIG} \text{ nima nimb}$$

$$\cos(a \pm b) = \cos a \cos b \mp \text{nima nimb}$$

$$\cos(a+b) - \cos(a-b) = \cancel{\cos a \cos b} - \text{nima nimb} - \cancel{\cos a \cos b} - \text{nima nimb} =$$

$$= -2 \text{ nima nimb}$$

$$\text{nima nimb} = \frac{1}{2} [\cos(a-b) - \cos(a+b)]$$

$$V_S V_R = \frac{V_{REF} V_{SIG}}{2} [\cos(\omega t + \theta_{REF} - \omega t - \theta_{SIG}) - \cos(\omega t + \theta_{REF} + \omega t + \theta_{SIG})]$$

$\omega_R = \omega_S$  LPF  $\uparrow$

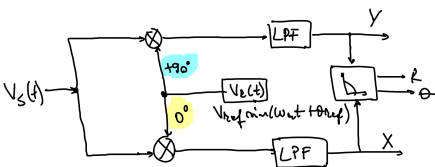
$$V_{out} = V_{REF} V_{SIG} \cdot \frac{1}{2} \cos(\theta_{REF} - \theta_{SIG})$$

$$(*) \quad V_{out} = \frac{V_{REF} V_{SIG}}{2} \cos(\theta_{SIG} - \theta_{REF}) \rightarrow DC$$

Amplificatorul lock-in:

$V_{REF} \rightarrow \theta_{REF} = 0$   
 $\theta_{REF} = 90^\circ$

Schema bloc pt. lock-in



$$R = \sqrt{X^2 + Y^2}$$

$$\theta = \arctan \frac{Y}{X}$$

ie  $\theta_{REF} = 0 \Rightarrow V_{out} = \frac{V_{REF} V_{SIG}}{2} \cos(\theta_{SIG}) = X$  „in-phase component”

ie  $\theta_{REF} = 90^\circ \Rightarrow V_{out} = \frac{V_{REF} V_{SIG}}{2} \cos(\theta_{SIG} - \frac{\pi}{2}) =$   
 $= \frac{V_{REF} V_{SIG}}{2} (\cos(\theta_{SIG}) \cos \frac{\pi}{2} + \sin(\theta_{SIG}) \sin \frac{\pi}{2}) =$

$$\Rightarrow V_{out} = \frac{V_{REF} V_{SIG}}{2} \sin(\theta_{SIG}) = Y$$
 „quadrature component”