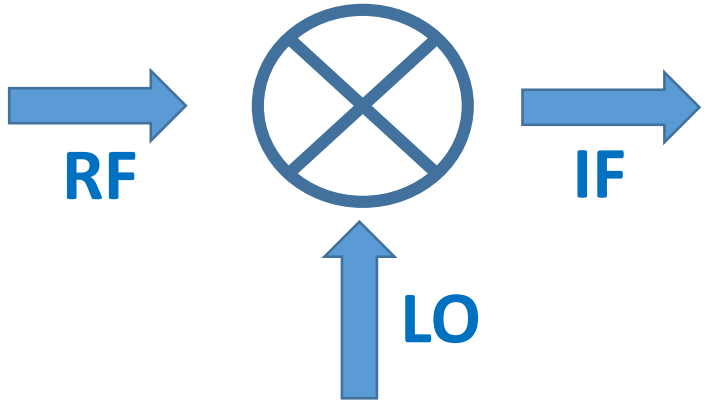
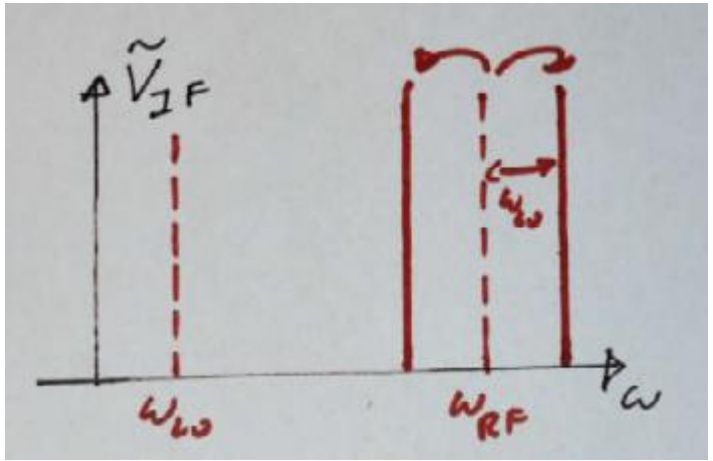
FREQUENCY MIXER

$$\cos x \cos y = \frac{1}{2}[\cos(x+y) + \cos(x-y)]$$

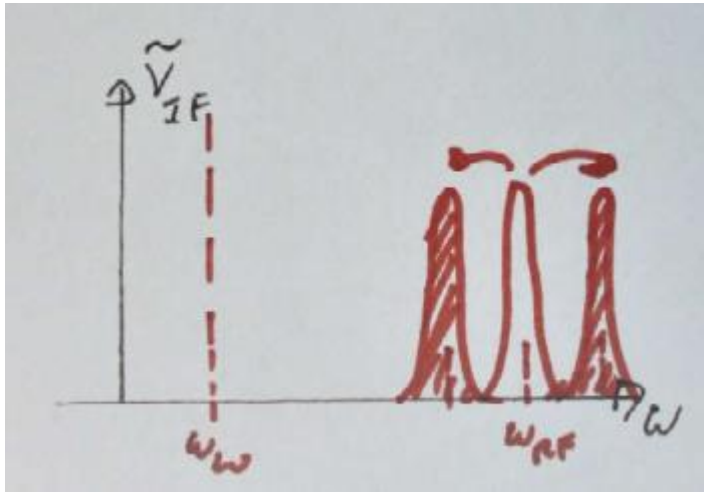


$$\text{LO}: \quad \cos(\omega_{\text{LO}} t + \phi_{\text{LO}})$$

$$V_{\text{RF}} = A_0 \cos \omega_{\text{RF}} t$$



$$V_{\text{RF}} = A(t) \cos \omega_{\text{RF}} t$$



$$\frac{\dot{A}}{A} \ll \omega_{\text{RF}}, \omega_{\text{LO}}$$

OMODINA: AMPLIFICATORE LOCK-IN

$$\omega_{\mathrm{RF}} \equiv \omega_{\mathrm{LO}} \equiv \omega$$

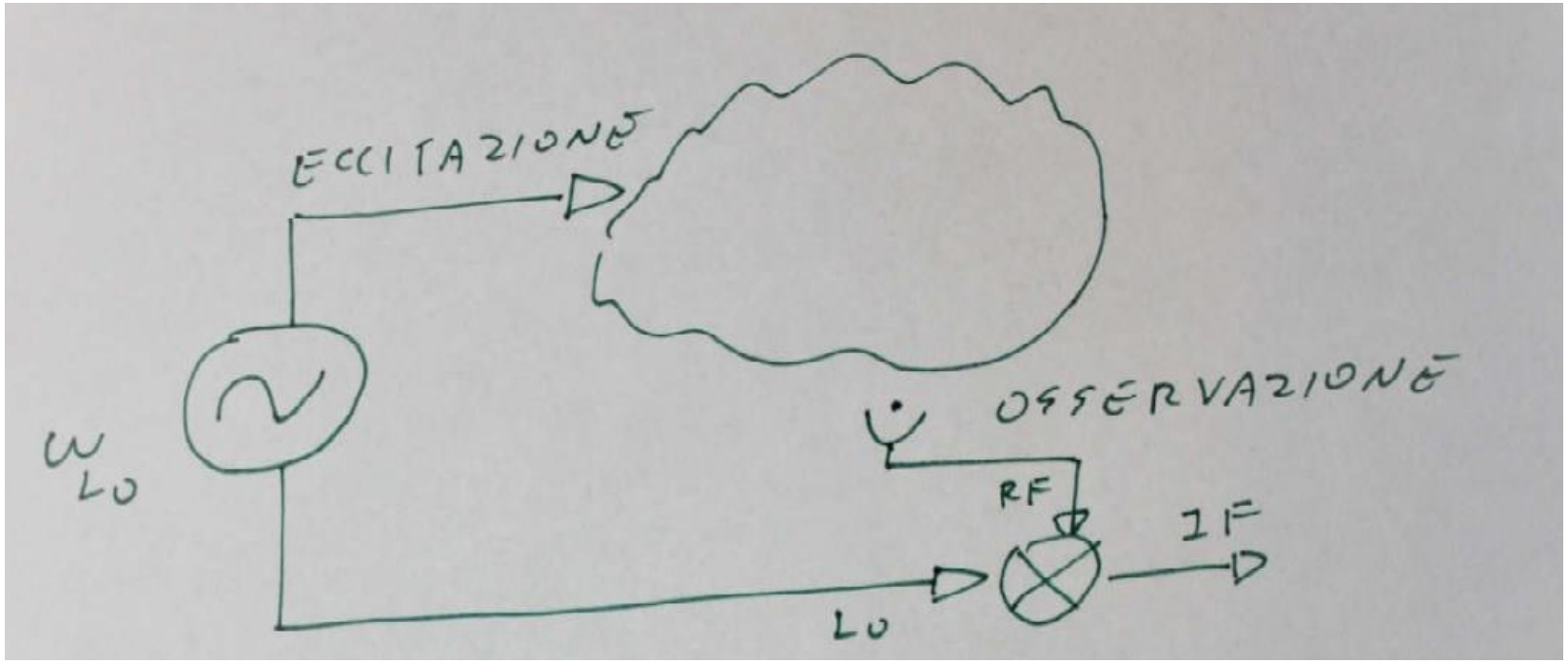
- Diventa importante la fase

$$V_{\mathrm{RF}} = A(t)\,\cos\omega_{\mathrm{RF}}t + B(t)\,\sin\omega_{\mathrm{RF}}t$$

$$V_{\mathrm{IF}} = \frac{1}{2}\left[\,A(t)\,\cos\phi_{\mathrm{LO}} - B(t)\,\sin\phi_{\mathrm{LO}}\,\right] \quad + \left(2\omega\right)$$

OMODINA: AMPLIFICATORE LOCK-IN

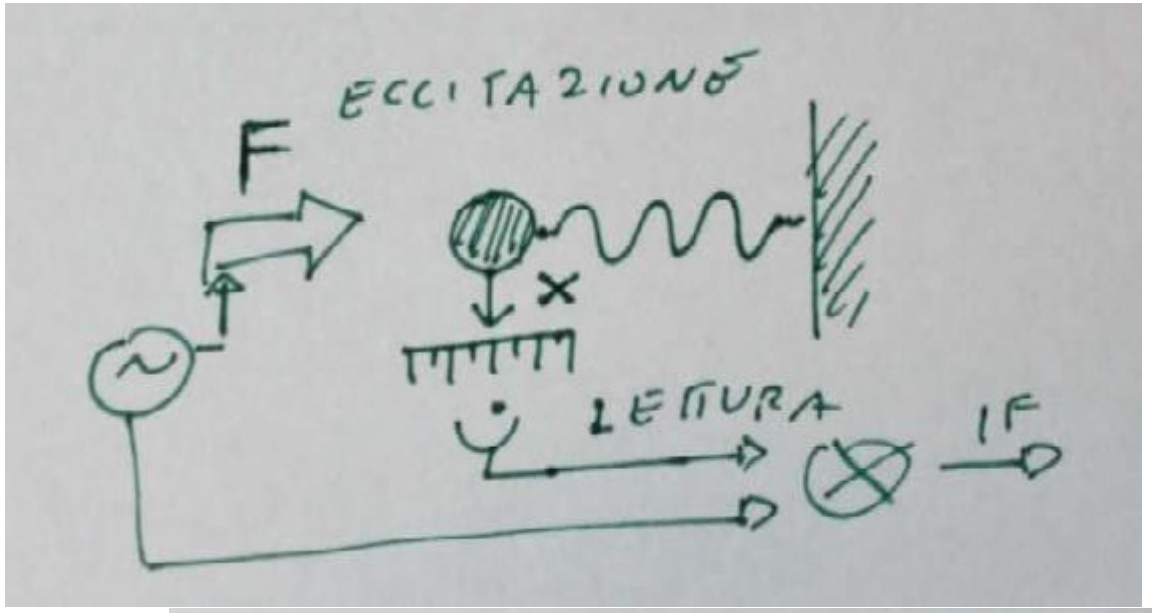
$$V_{\mathrm{RF}} = A(t)\cos\omega_{\mathrm{RF}}t + B(t)\sin\omega_{\mathrm{RF}}t$$
$$V_{\mathrm{IF}} = \frac{1}{2}\left[A(t)\cos\phi_{\mathrm{LO}} - B(t)\sin\phi_{\mathrm{LO}}\right]$$



- Si elimina il rumore di fondo
- Si sposta la rivelazione a frequenze alte

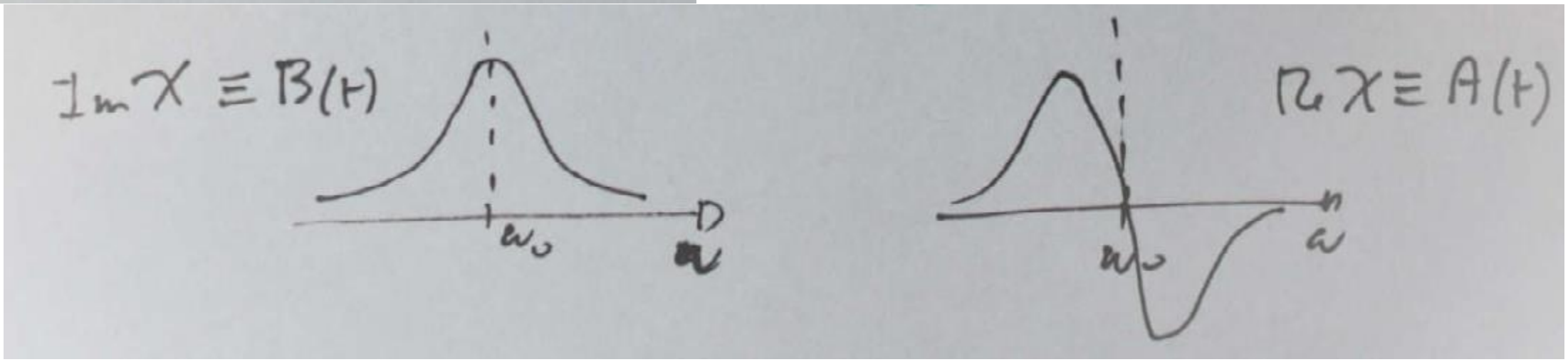
OMODINA: AMPLIFICATORE LOCK-IN

$$V_{\mathrm{RF}} = A(t)\cos\omega_{\mathrm{RF}}t + B(t)\sin\omega_{\mathrm{RF}}t$$
$$V_{\mathrm{IF}} = \frac{1}{2}\left[A(t)\cos\phi_{\mathrm{LO}} - B(t)\sin\phi_{\mathrm{LO}}\right]$$

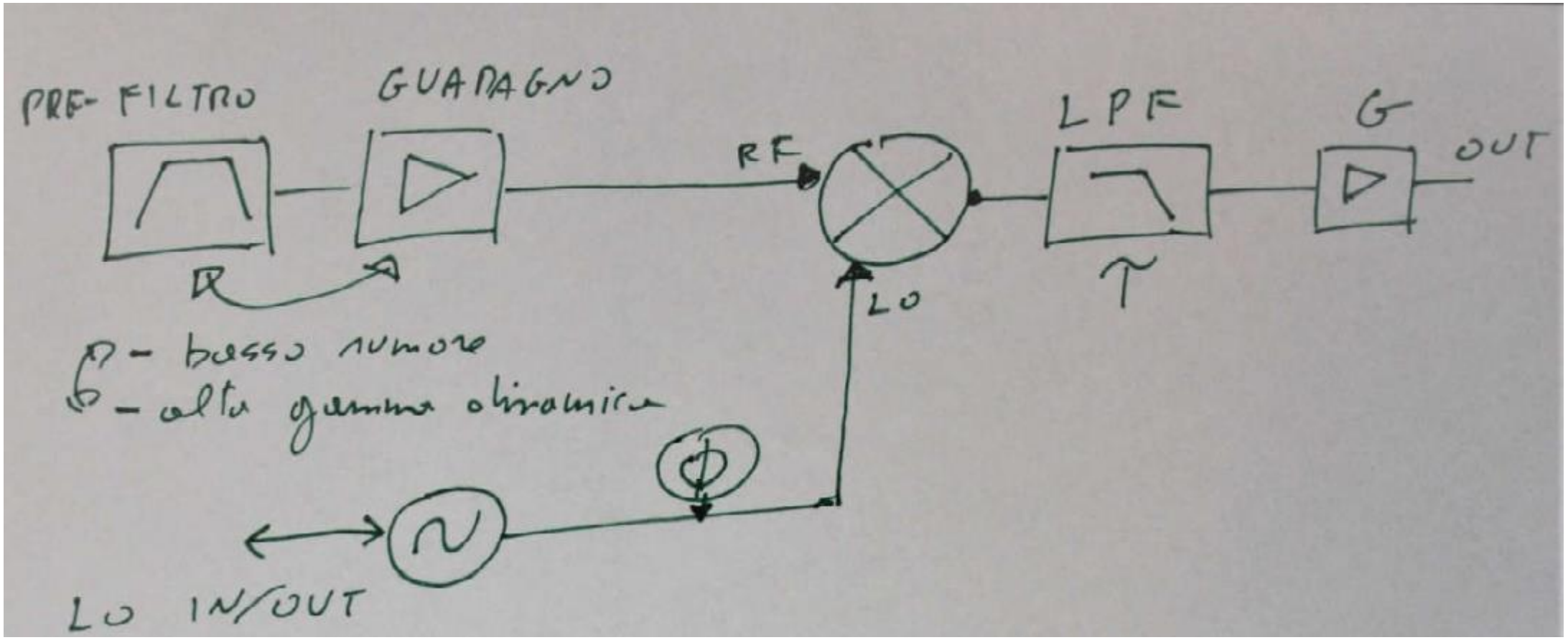


$$\tilde{x} = \chi(\omega)\,\tilde{F}$$

$$\chi = m^{-1}\left[\omega_0^2 - \omega^2 + i\omega\Gamma\right]$$

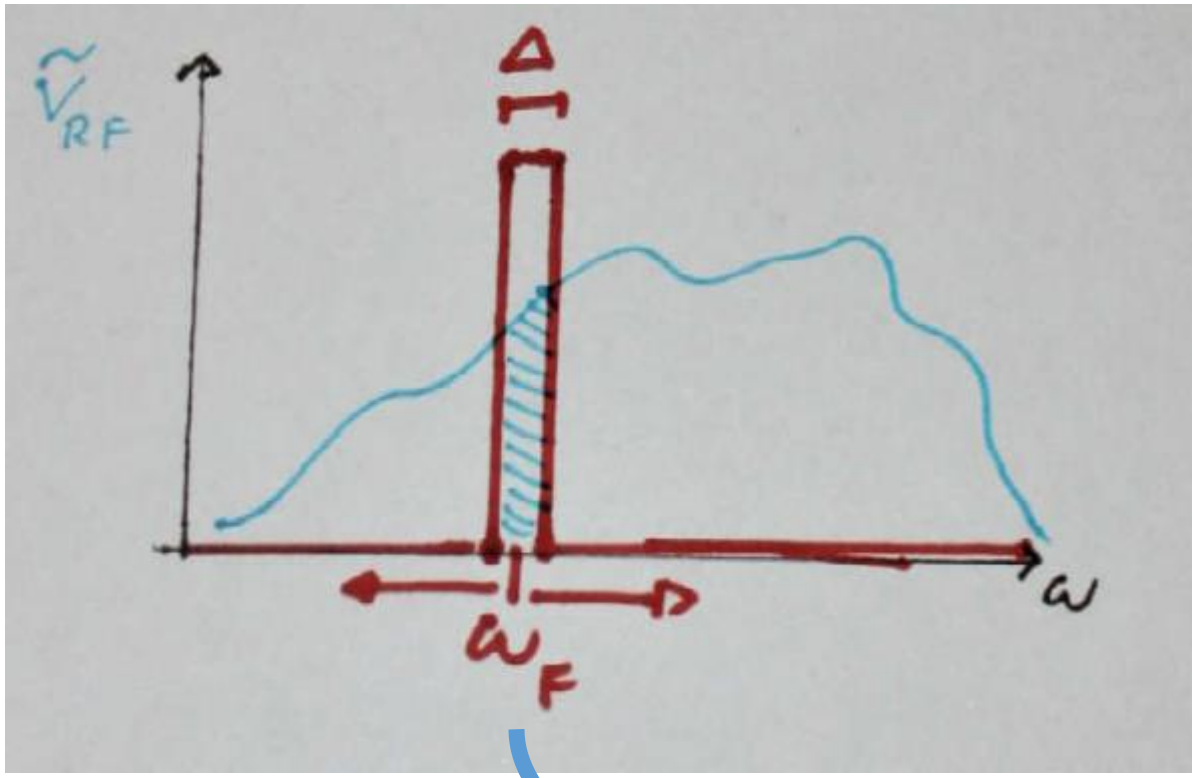


AMPLIFICATORE LOCK-IN

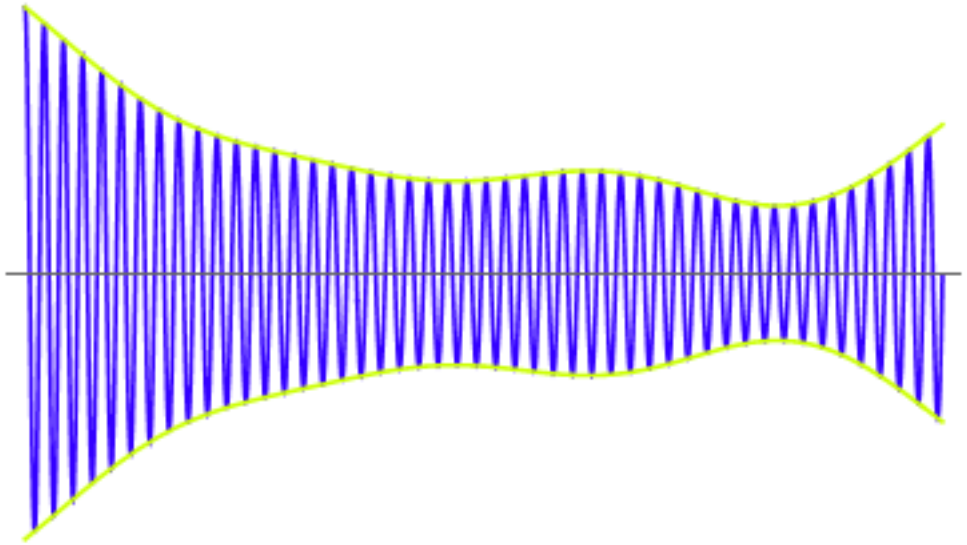


N.B. $\frac{\dot{A}}{A} < \frac{1}{\tau} < \omega_{LO}$

ANALISI SPETTRALE

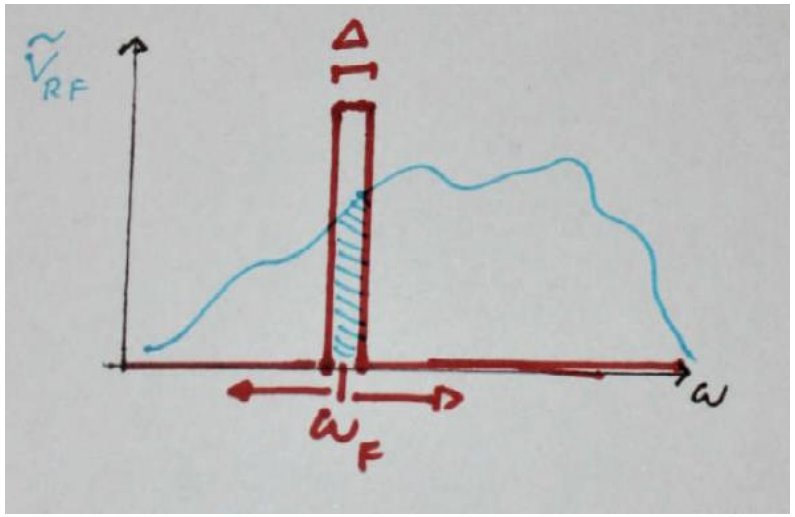


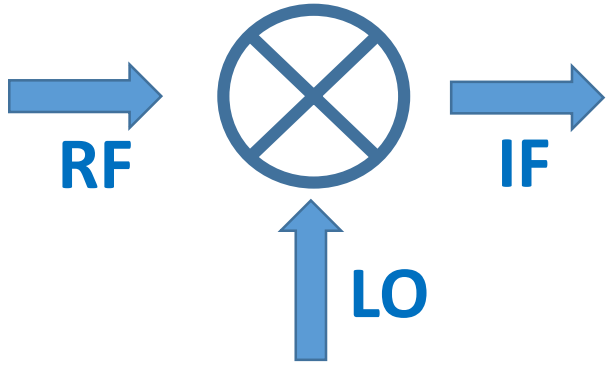
$$\frac{d\omega_F}{dt} \ll \frac{\Delta}{\left(\frac{1}{\Delta}\right)} = \Delta^2$$



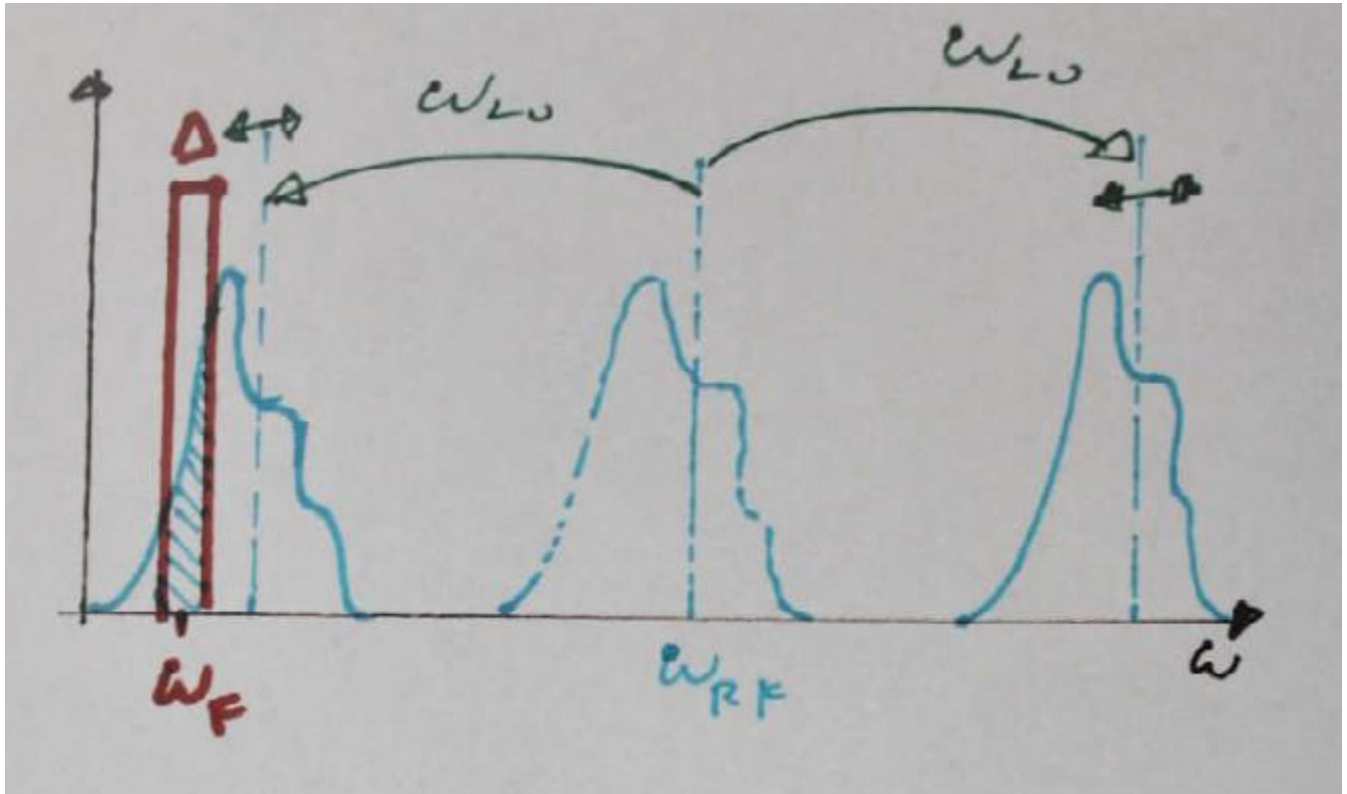
- «portante» a frequenza ω_{IF}
- Inviluppo variabile su scala di tempo $1/\Delta$

ANALISI SPETTRALE: ETERODINA

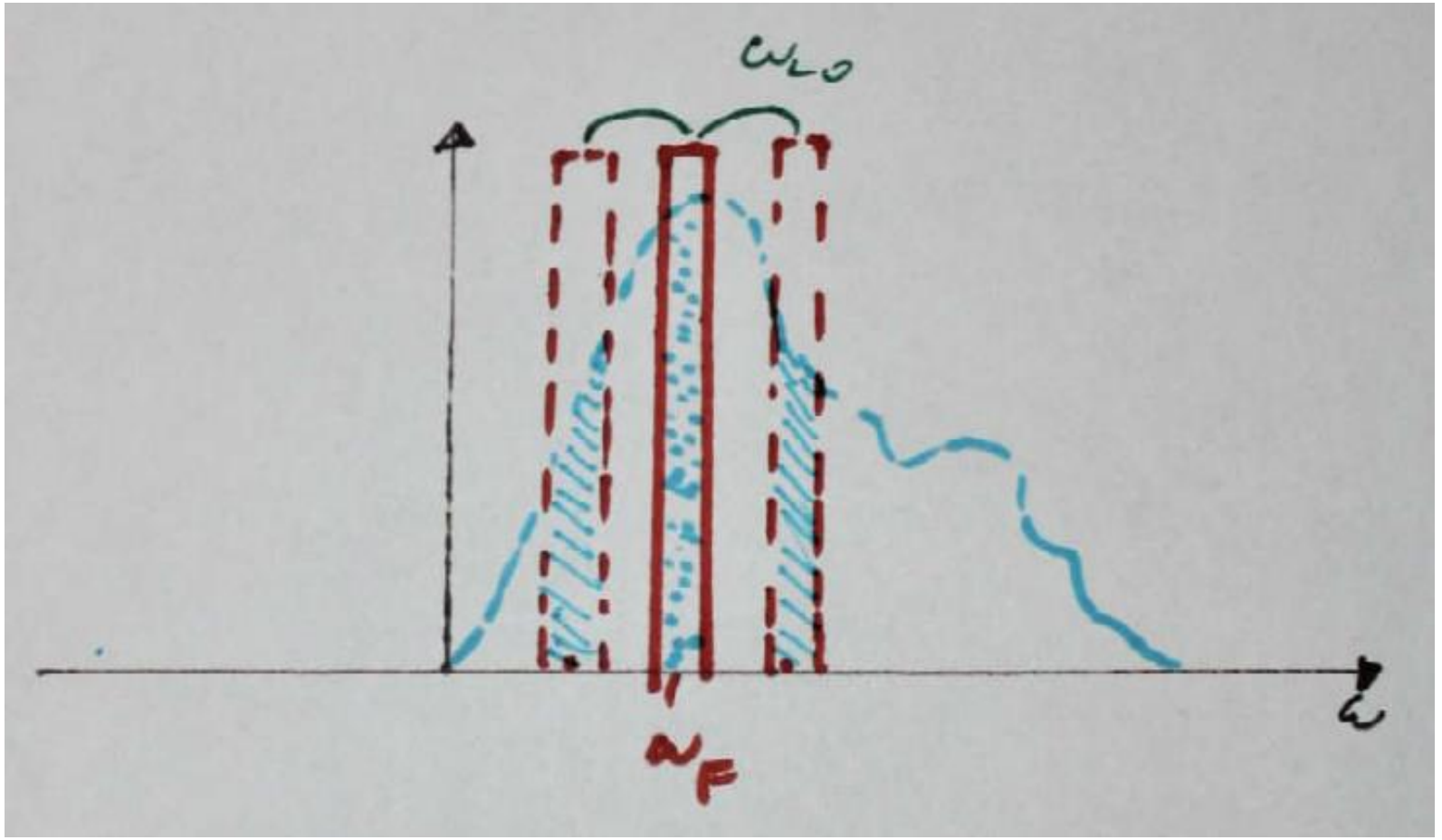




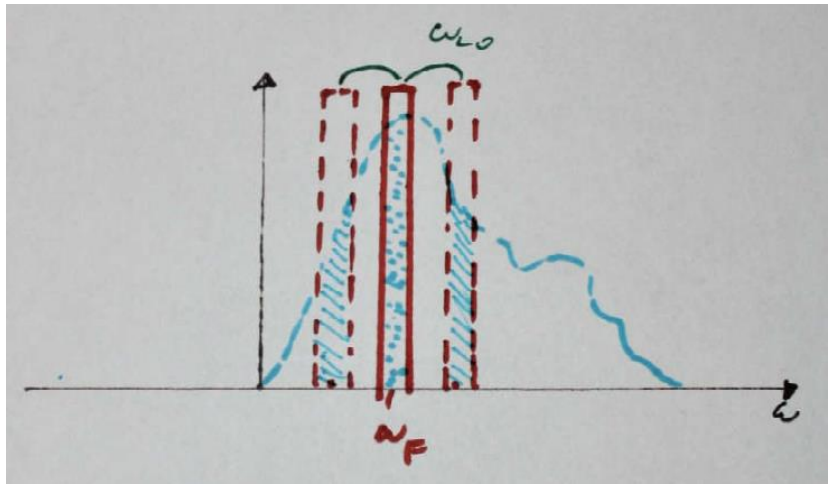
$$\text{LO}: \quad \cos\left(\omega_{\text{LO}} t + \phi_{\text{LO}}\right)$$

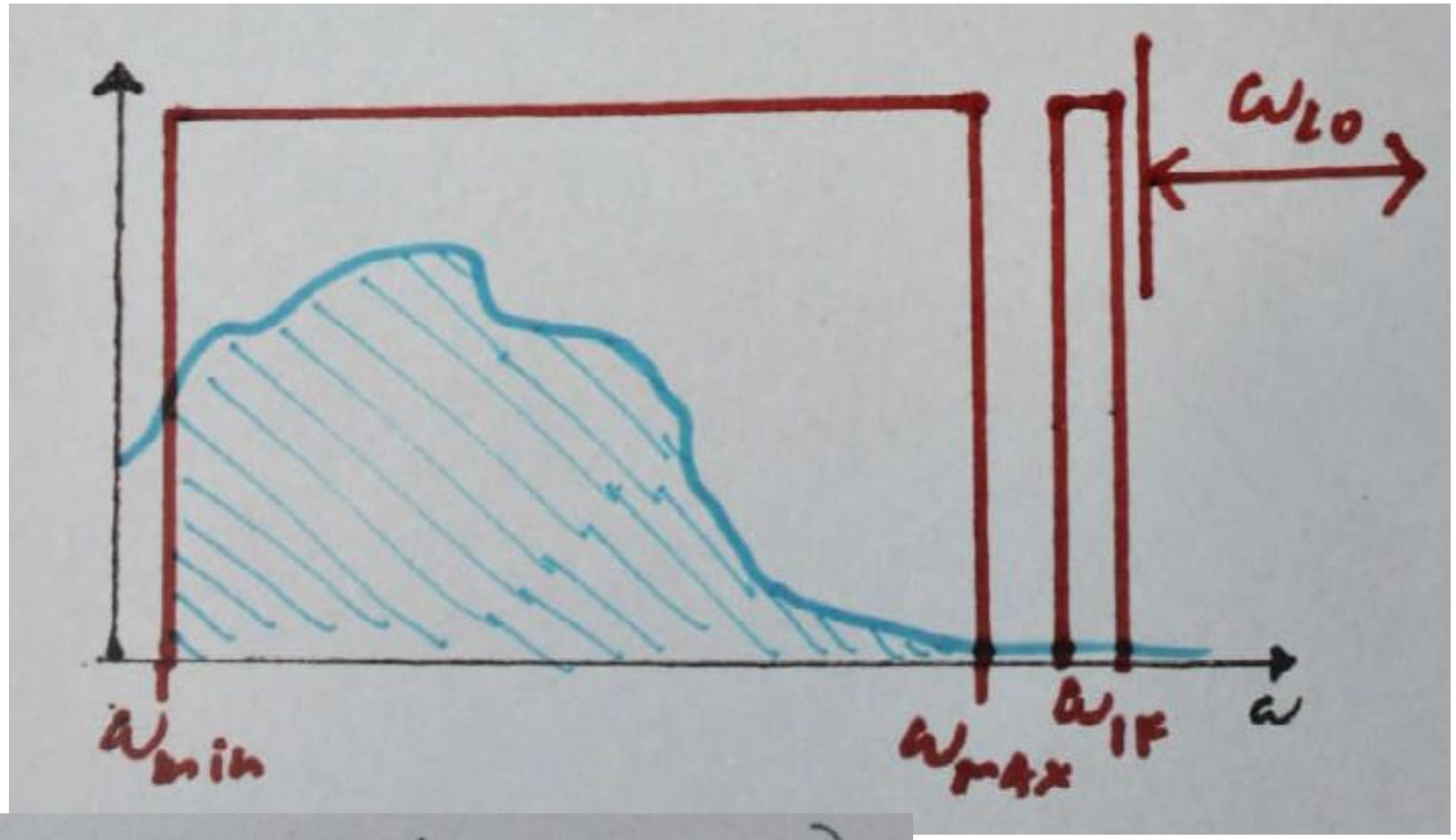


ANALISI SPETTRALE: ETERODINA



ANALISI SPETTRALE: SUPER-ETERODINA

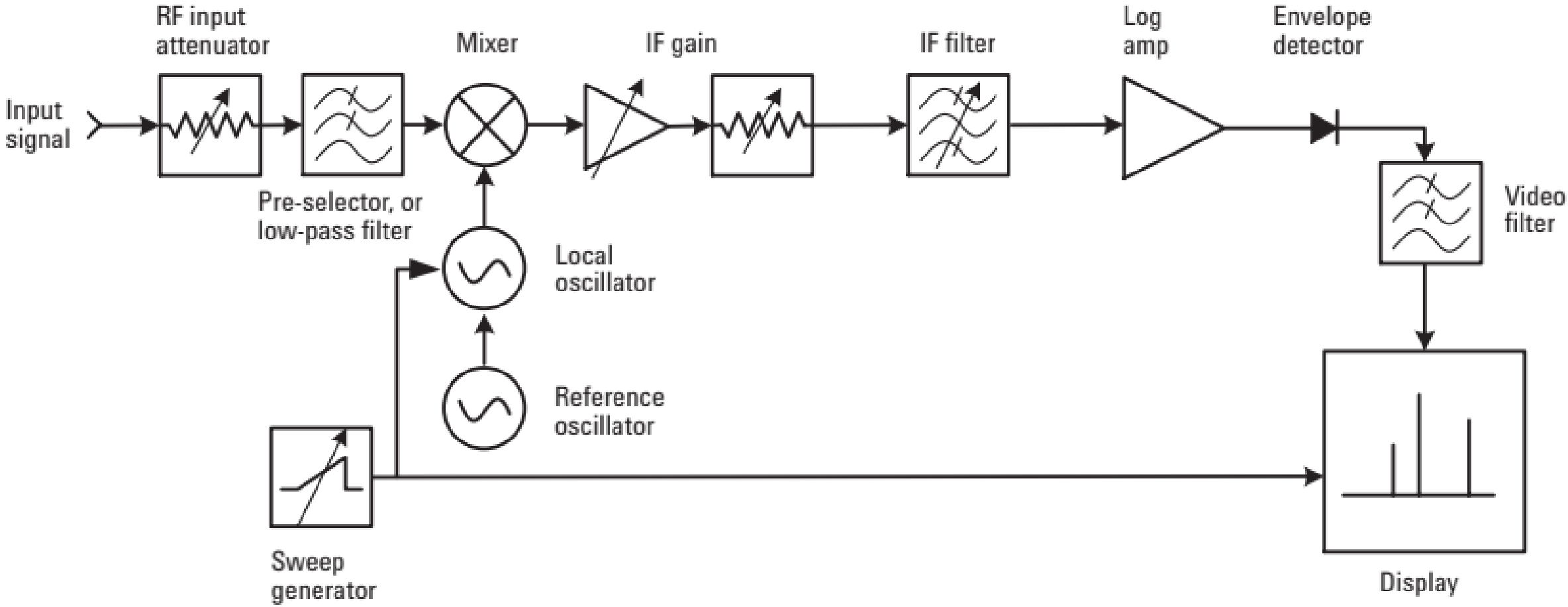




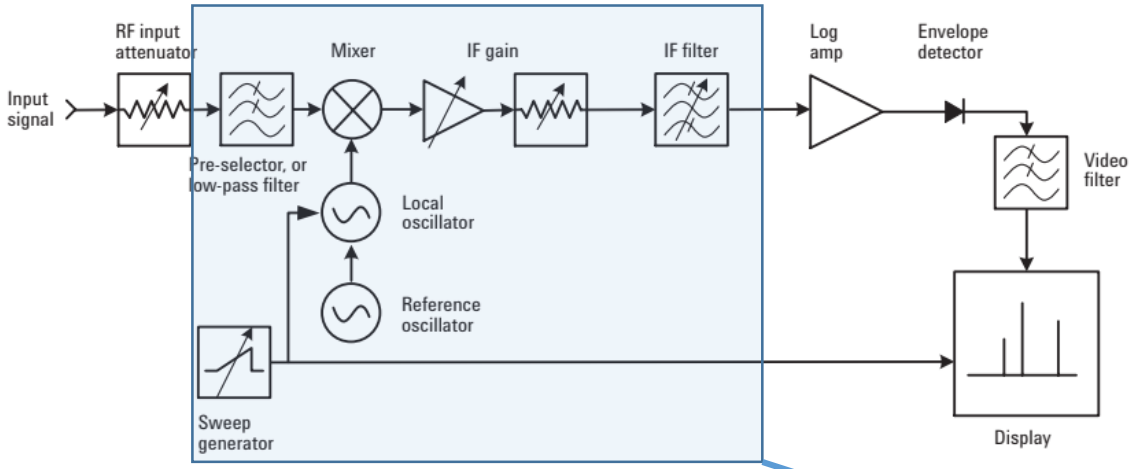
$$\omega_{LO} = (\omega_{IF} + \omega_{min}) \longleftrightarrow (\omega_{IF} + \omega_{MAX})$$

$$\Rightarrow \quad \omega_{RF} = \omega_{LO} - \omega_{IF} = \omega_{min} \longleftrightarrow \omega_{MAX}$$

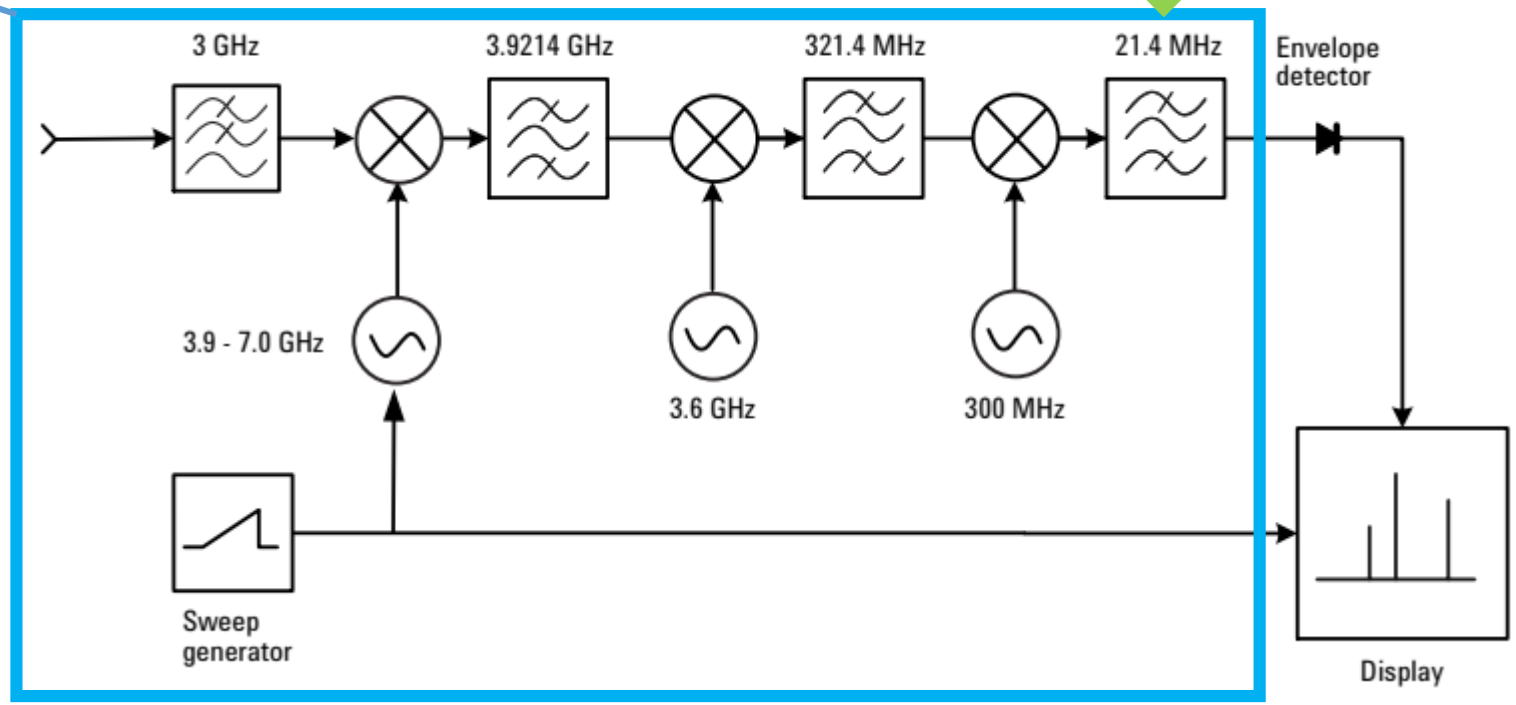
ANALIZZATORE DI SPETTRO IN SUPER-ETERODINA



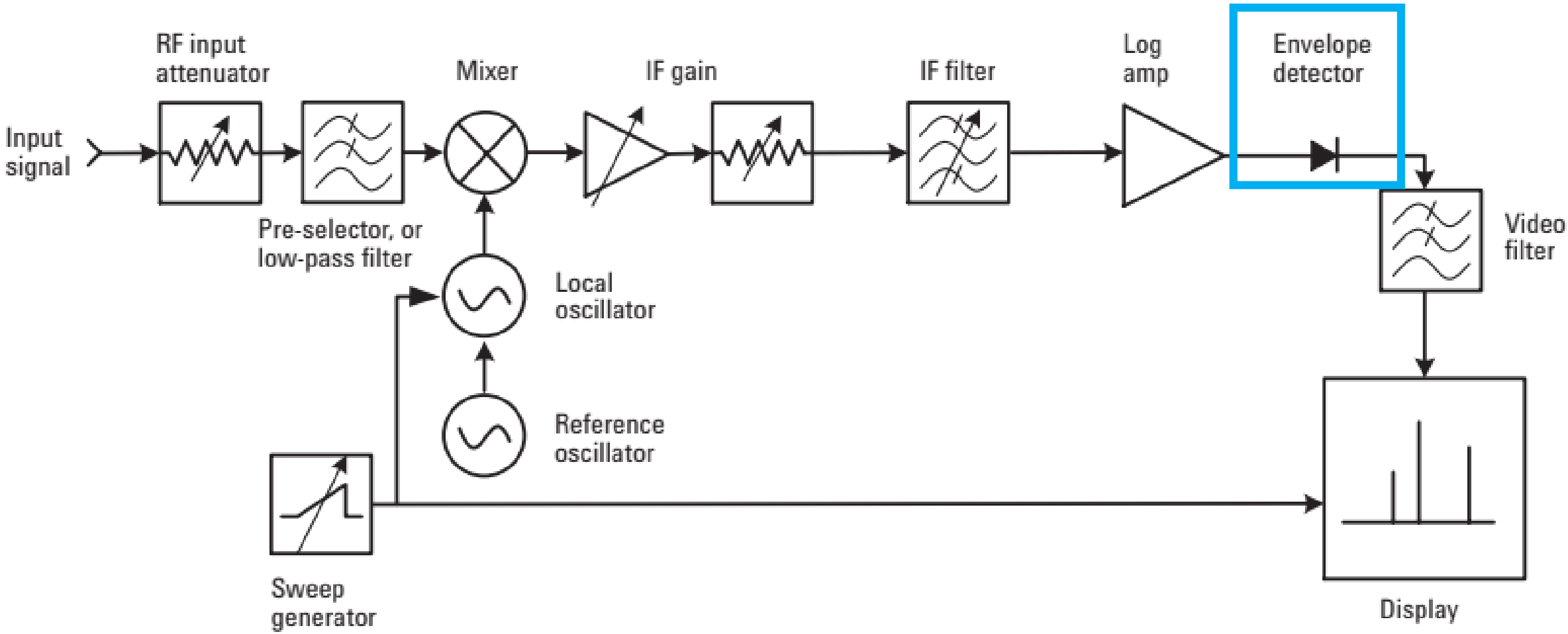
ANALIZZATORE DI SPETTRO IN SUPER-ETERODINA



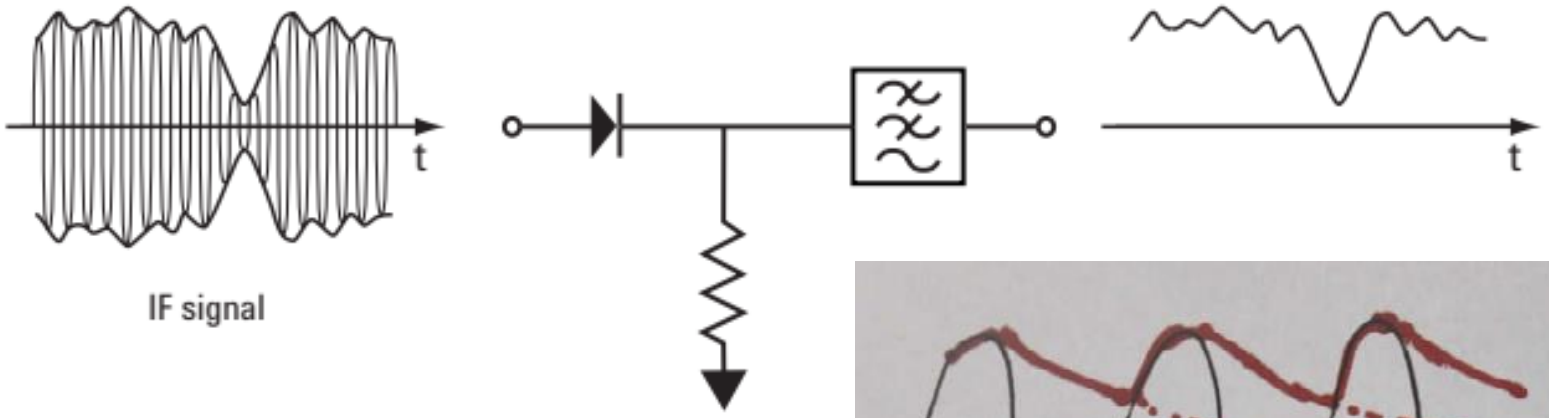
Larghezza ultimo filtro: **RBW**
(Resolution Bandwidth)

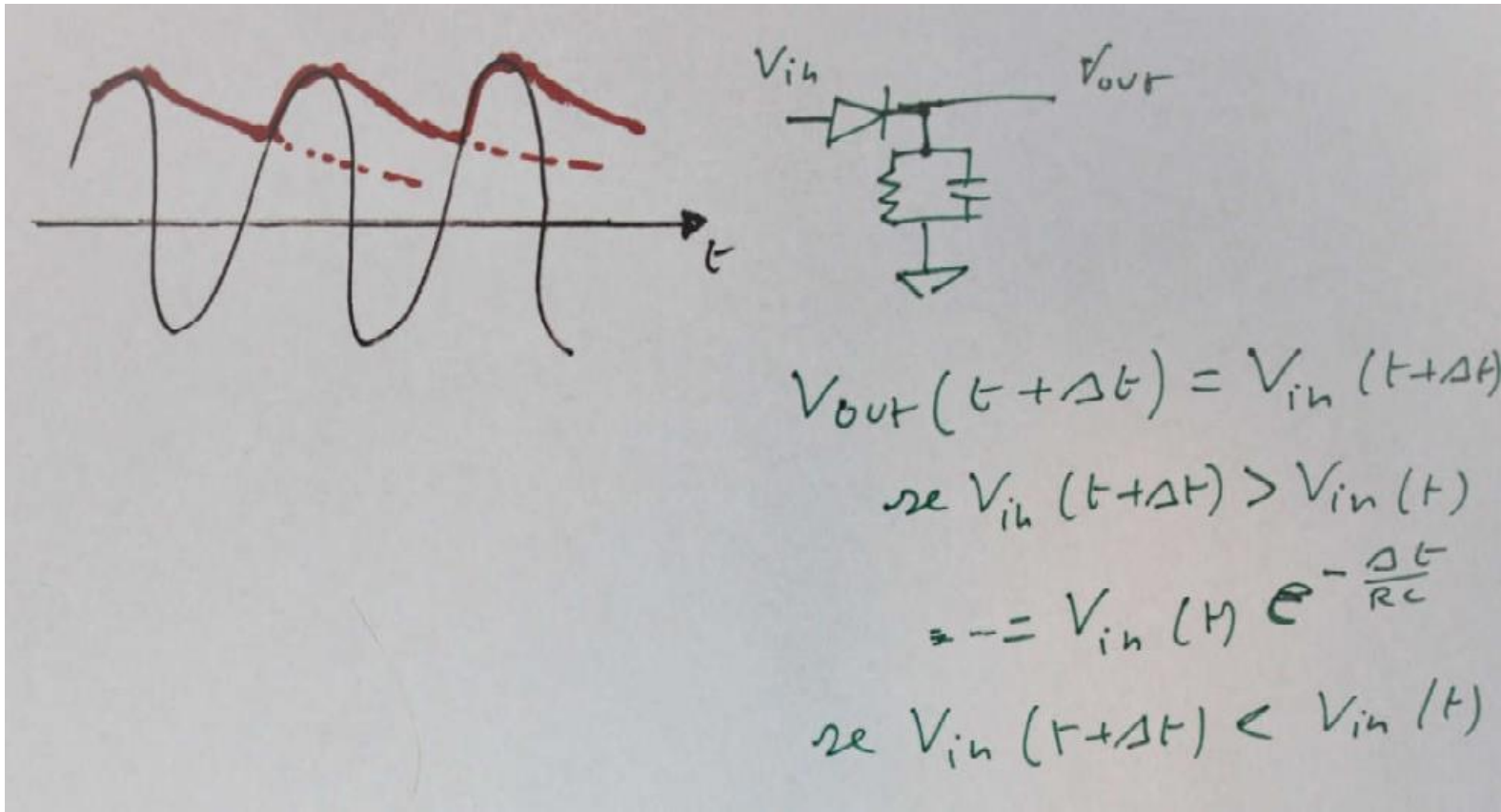


ANALIZZATORE DI SPETTRO IN SUPER-ETERODINA



ENVELOPE DETECTOR





INGRESSO STOCASTICO

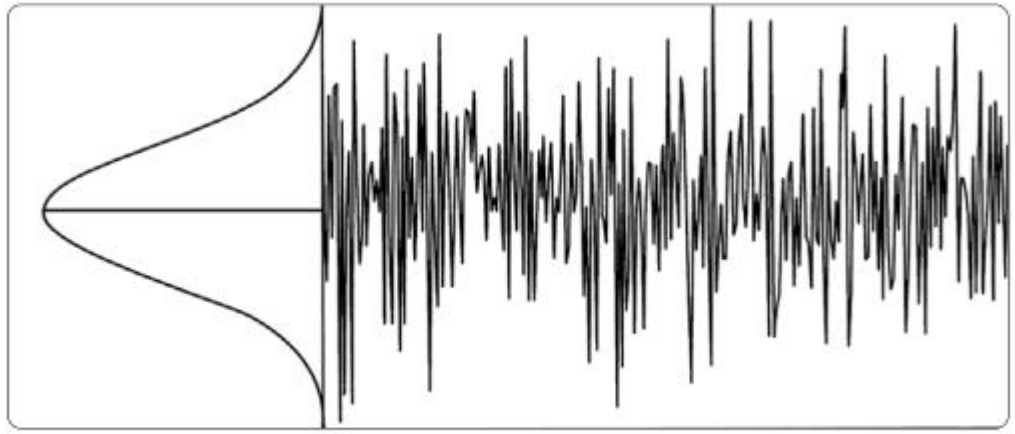


Figure 5-6. Random noise has a Gaussian amplitude distribution

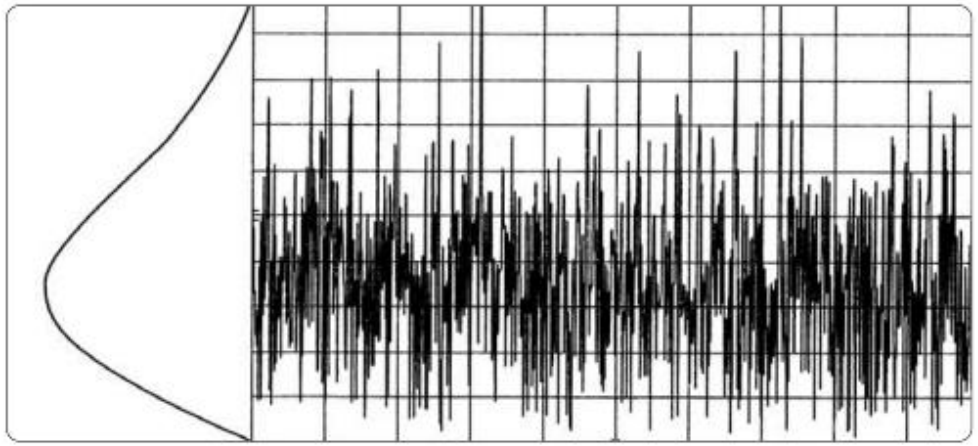


Figure 5-7. The envelope of band-limited Gaussian noise has a Rayleigh distribution

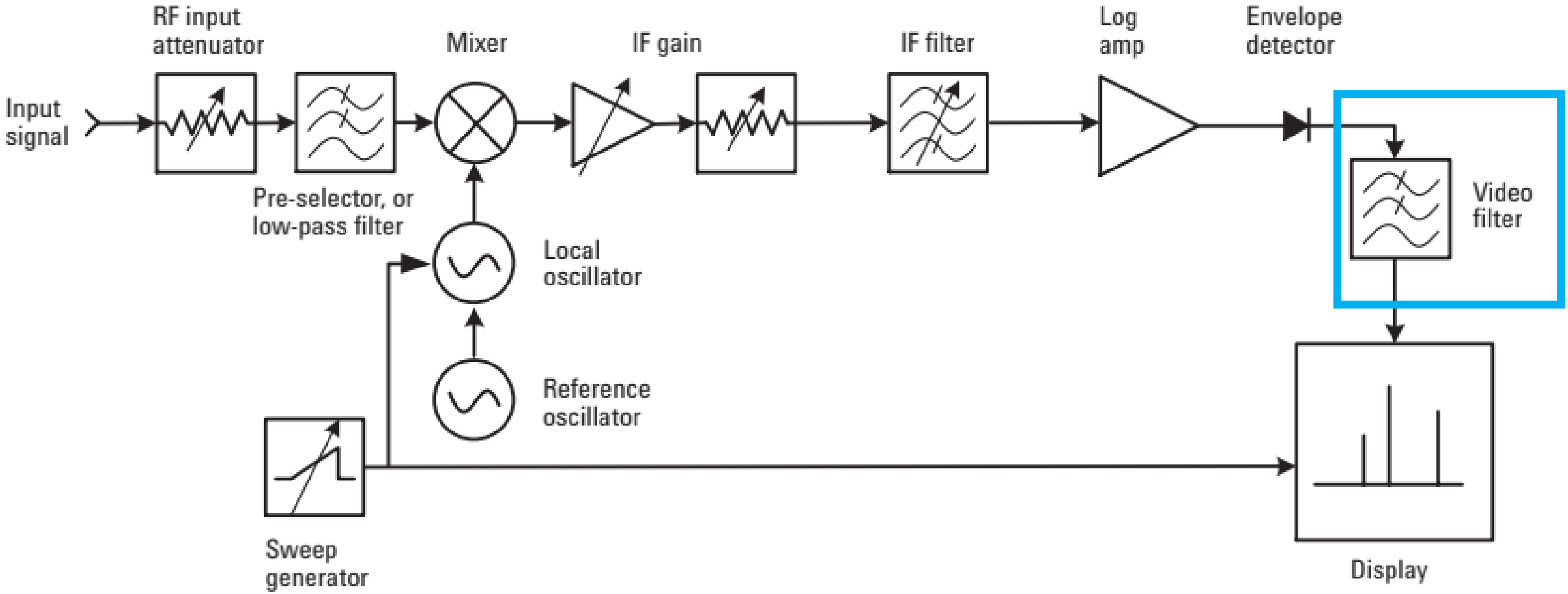
Distribuzione di Rayleigh

$$R = \frac{x}{\sigma^2} \exp\left[-\frac{1}{2}\frac{x^2}{\sigma^2}\right]$$

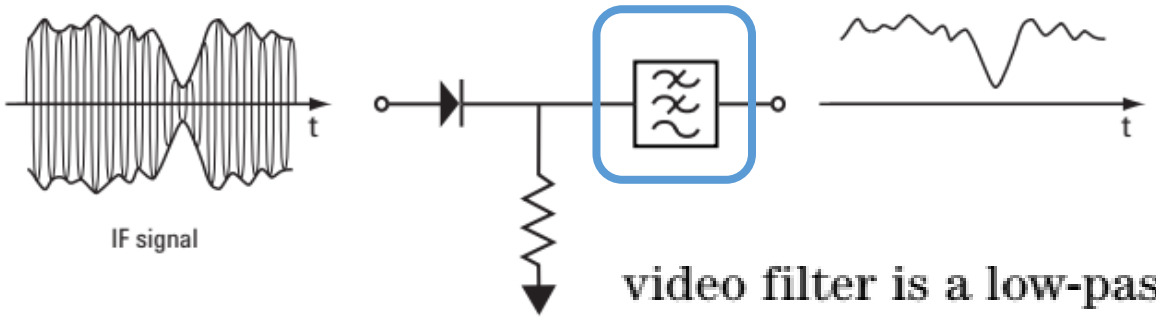
$$\mu \equiv \int x R = \sqrt{\frac{\pi}{2}}\,\sigma$$

$$\text{VARIANZA} \equiv \int (x-\mu)^2 R = \frac{4-\pi}{2}\,\sigma^2$$

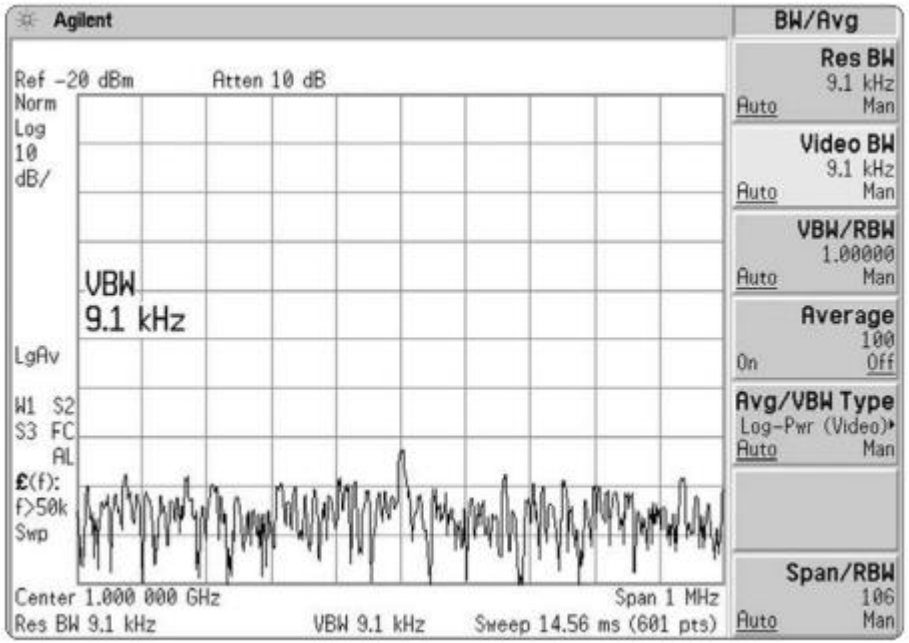
ANALIZZATORE DI SPETTRO IN SUPER-ETERODINA

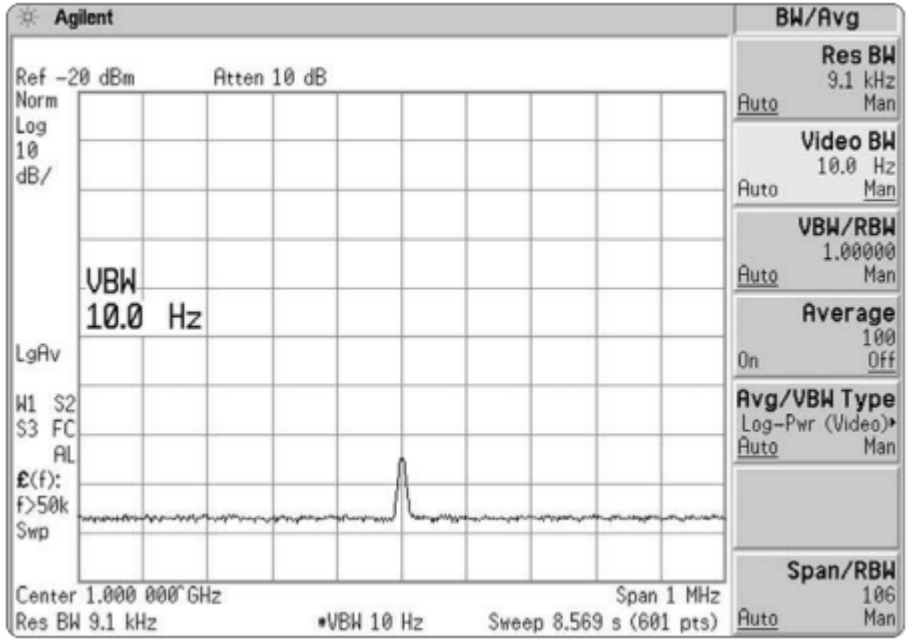


VIDEO FILTERING



video filter is a low-pass filter that comes after the envelope detector and determines the bandwidth of the video signal that will later be digitized to yield amplitude data. The cutoff frequency of the video filter can be reduced





CAMPIONAMENTO