EXPERIMENT 4 MICROWAVE LAB

Preparatory questions

1. A simple amplifier can be represented by a 2-port network, as shown in Fig. 1.

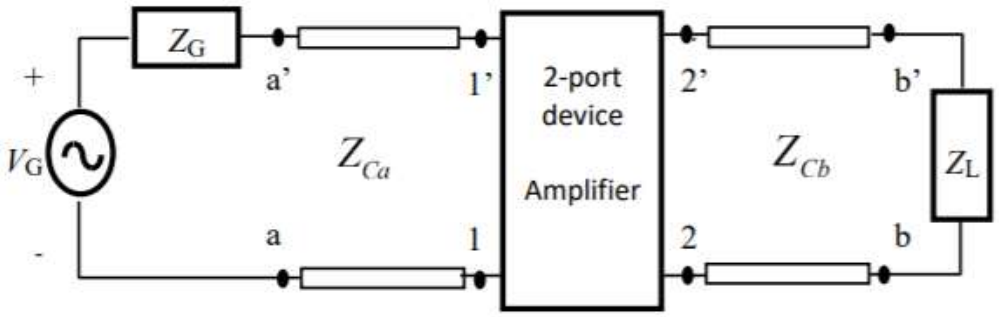

Figure 1: A two-port network.

(a) Show that the reflection coefficient at Port 1-1' satisfies

$$\Gamma_L^{(1)} = S_{11} + \frac{S_{12}S_{21}\Gamma_L^{(2)}}{1 - S_{22}\Gamma_L^{(2)}}, \qquad (2)$$

where S_{11}, S_{21}, S_{12} and S_{22} are the scattering parameters of the 2-port device (amplifier).

(b) Given the amplifier used in this experiment (ZX60-2522MA-S+) and a load $\Gamma_L^{(2)} = 0.5$, would it be possible that the amplifier will exhibit $\left|\Gamma_L^{(1)}\right| > 1$? What is the meaning of this operating condition? Is it desired in a proper amplifier operation?

(c) Explain the meanings of the 1-dB compression point and of the 3rd order intercept point.

2. For a super-heterodyne receiver, show a block diagram and explain its operating principle.

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1)

(A) We have from the above scheme:

$$a_2=\Gamma_l b2 \qquad b_2=S_{22}a_1+S_{21}a_2 \rightarrow b_2=S_{21}\frac{a_1}{(1-S_{22}\Gamma_l)} \qquad b_1=S_{11}a_1+S_{12}a_2 \rightarrow \qquad \Gamma_s=S_{11}+\frac{(S_{12}S_{21}\Gamma_l)}{(1-S_{22}\Gamma_l)}$$

(B)

It should be possible to reach |Γs|>1 but the meaning of this operation condition would be an unstable system that can engender oscillations. So such a coefficient can be reach for an amplifier but it might not be desirable

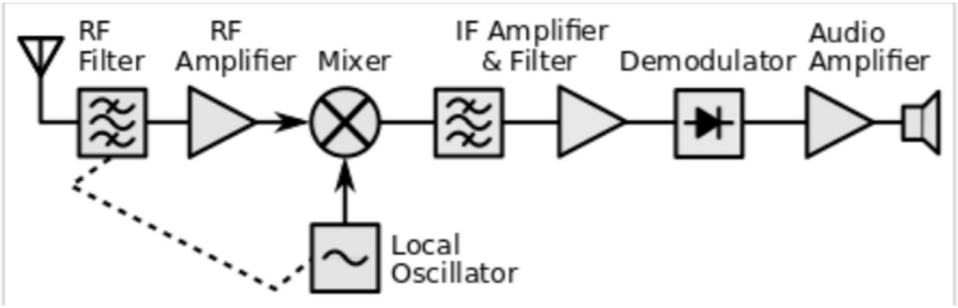
(C)

There are two key measurements in determining power amplifier quality, efficiency, and linearity: the third-order intercept (abbreviated TOI or IP3) point and the 1-dB compression (P1dB) point. These quantities allow you to evaluate and compare amplifier specifications and performance.

1-dB compression point: represents the point at which Pout will reach 1dB below power value if we were dealing with a linear device.

3rd order intercept: Point at which the power frequencies (2w1-w2, 2w2-w1) overcome the f,fundamental at the output port. Frequently asked measure for weakly non linear systems and devices

2.



Input signal is received from the antenna. It is then passed to the RF filter (removing of basic noise and interference). The LNA intercepts the RF signal and amplifies it. The mixer down converts the frequency (RF (transmission frequency)->IF=|RF-LO| = (improve signal quality)). The signal is then demodulated and passed through A2D converter to process.