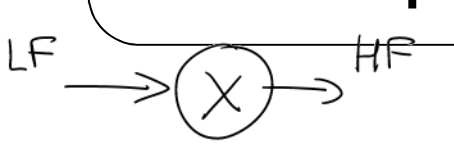
Basics on High-Frequency Mixers

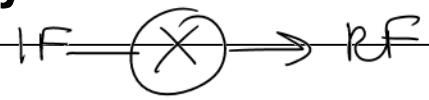
Outline

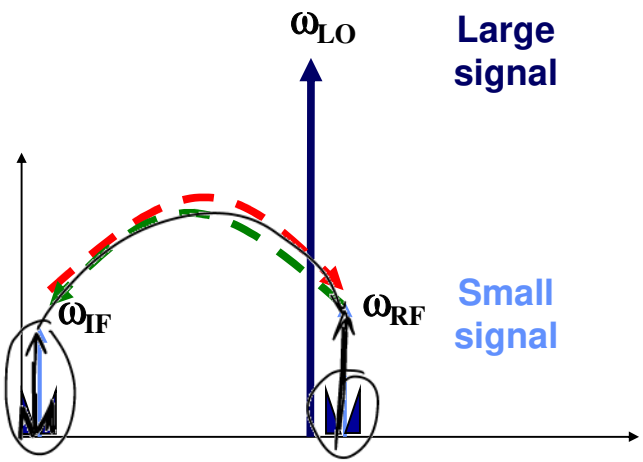
- **Introduction**
- **Theory of frequency conversion**
- **Characteristic performances of mixers**
- **Active mixers**
  - ➔ Single Ended (SEM) → Gate Mixer / Drain Mixer
  - ➔ Gilbert Cell→ DBDM Double Balanced Differential Mixer
- **Passive Mixers**
  - ➔ Diodes → SEM / SBM / DBM
  - ➔ Cold FETs → SEM / SBM
- **IRM: Image Reject Mixers**

Introduction

A mixer is a 3-port nonlinear circuit which performs the frequency translation required by any communication system.







Radio Frequency = (2 GHz)

RF 40 GHz

Emission

Input → Output

Up-conversion

IF — Small Signal → **LO** ← Small Signal — **RF**

Low Frequency

High Frequency

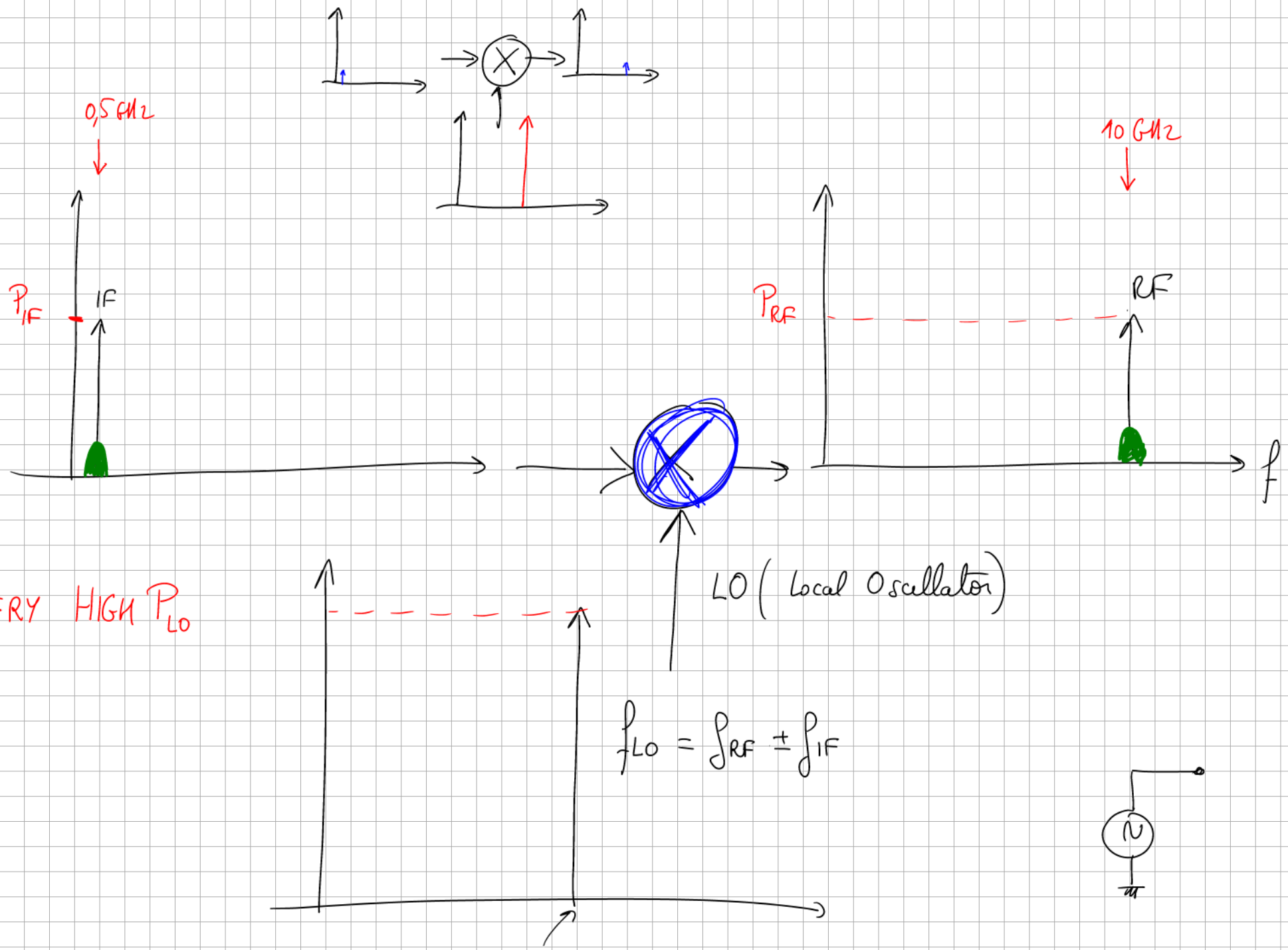
Large Signal

High Frequency

Reception

Output ← Input

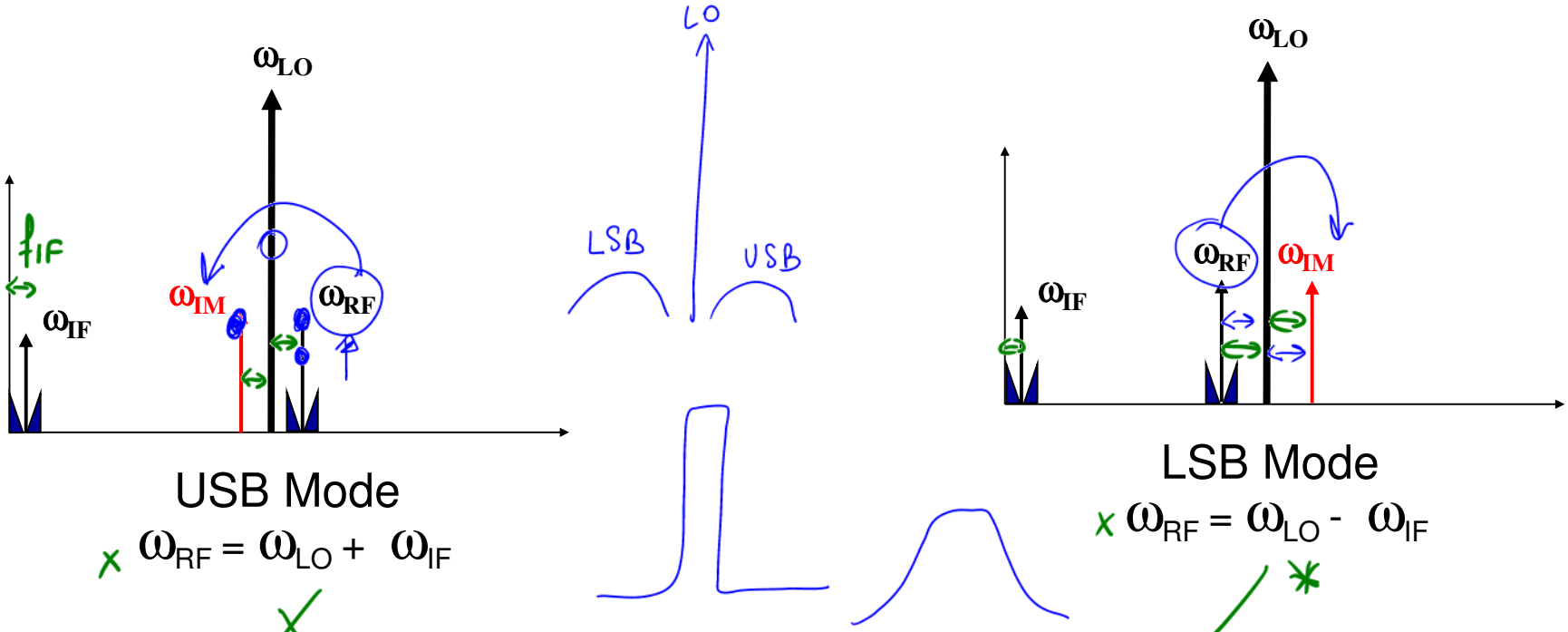
Down-converter


0,5 GHz
10 GHz
P_{IF}
IF
P_{RF}
RF
f
LO (Local Oscillator)
VERY HIGH P_{LO}
$f_{LO} = f_{RF} \pm f_{IF}$

Problem of IMAGE FREQUENCY

The image frequency is the symmetric of the RF frequency

with respect to the LO frequency



USB Mode

$\omega_{RF} = \omega_{LO} + \omega_{IF}$

LSB Mode

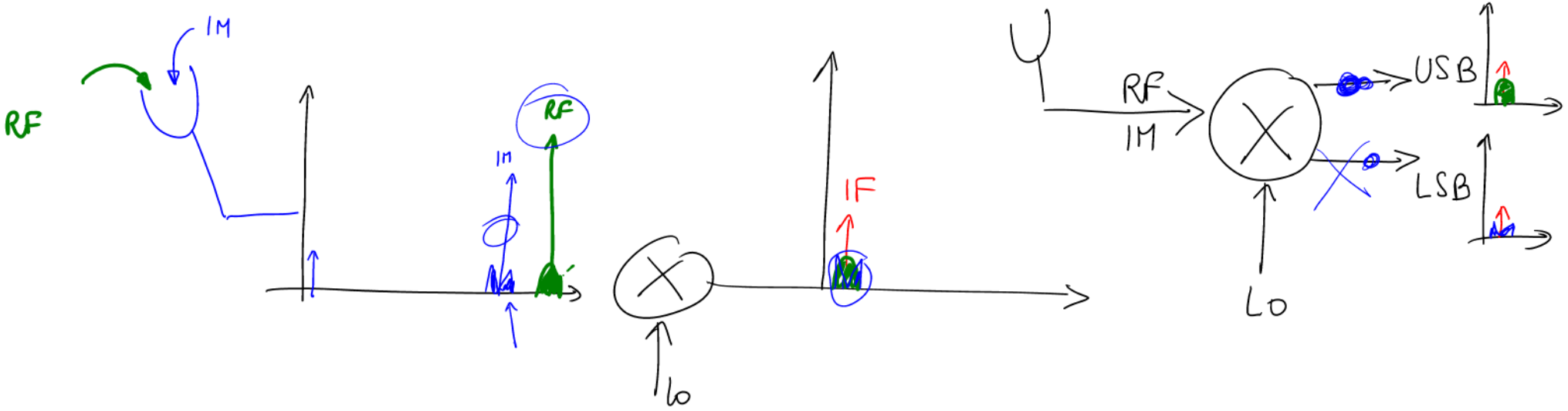
$\omega_{RF} = \omega_{LO} - \omega_{IF}$

$$\omega_{IM} = 2 \cdot \omega_{LO} - \omega_{RF}$$

$2\omega_{lo} - (\omega_{lo} + \omega_{IF})$

$\omega_{lo} - \omega_{IF}$

$2\omega_{lo} - (\omega_{lo} + \omega_{IF})$



Principle of frequency conversion