Communication Systems
EE-351

Lectures 25 and 26

Superheterodyne Receiver:

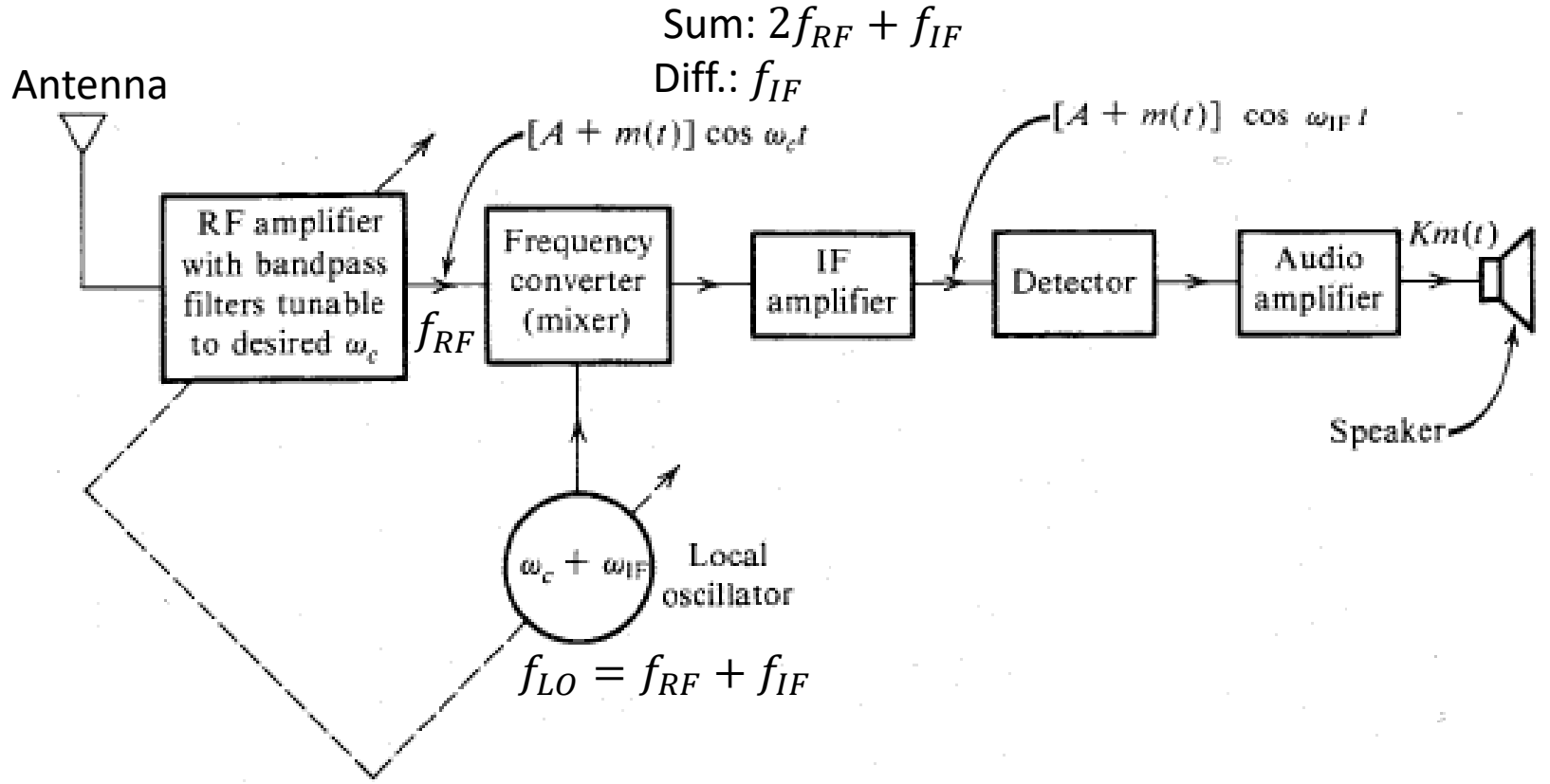


Figure 4.28 Superheterodyne receiver.

Superheterodyne Receiver:

- The **RF section** is basically a tunable filter and an amplifier that picks up the desired station by **tuning the filter to the right frequency band**.
- The **frequency mixer** translates the carrier to a **fixed IF frequency**. For this purpose, it uses a local oscillator whose frequency is exactly **455kHz above the incoming carrier** frequency.
- The **tuning** of the local oscillator and the RF tunable filter is done **by one knob**. Tuning capacitors in both circuits are ganged together and are designed so that the tuning frequency of the local oscillator is always **455kHz above the tuning frequency of the RF filter**.
- The reason for translating all stations to a fixed carrier frequency is to **obtain adequate selectivity**.
- It is difficult to design sharp bandpass filter of bandwidth 10kHz if the centered frequency is very high. This is particularly true if the filter is tunable. Hence, the RF filter cannot provide adequate selectivity against adjacent channels.
- But when the signal is translated to an IF frequency by a converter, it is further amplified by an IF amplifier, which does have good selectivity. This is because the **IF frequency is reasonably low, and its center frequency is fixed and factory-tuned**. Hence, this section can effectively suppress the adjacent-channel interference because of its high selectivity.
- The main function of the RF section is the image frequency suppression.

Superheterodyne Receiver:

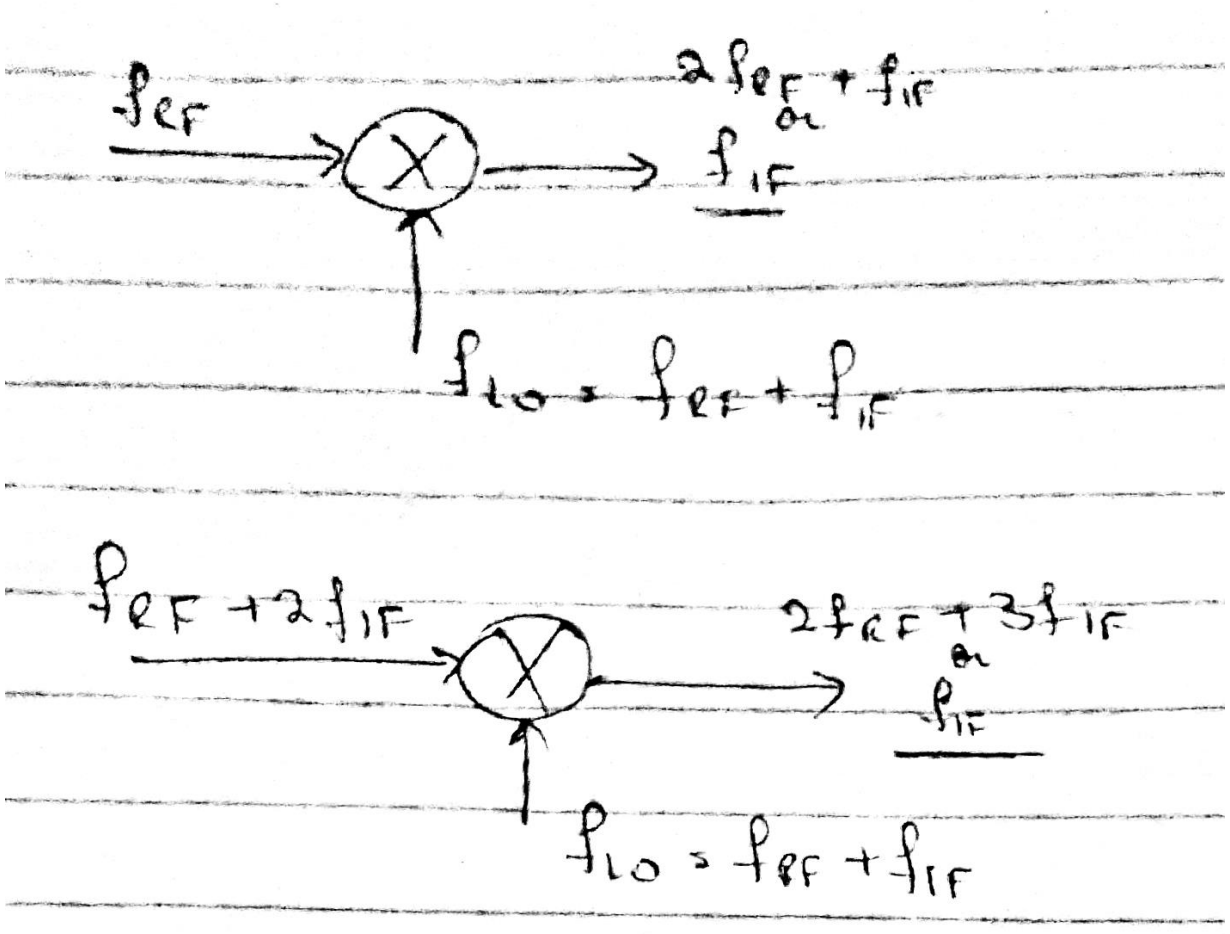
- $f_{RF} + 2f_{IF} + f_{RF} + f_{IF} = 2f_{RF} + 3f_{IF}$
- $f_{RF} + 2f_{IF} - f_{RF} - f_{IF} = f_{IF}$

- $f_{RF} + 2f_{IF}$ Image frequency corresponding to f_{RF}

$$f_{image} = f_{RF} + 2f_{IF}$$

- Only when $f_{LO} > f_{RF}$
- If $f_{LO} < f_{RF}$,

$$f_{image} = f_{RF} - 2f_{IF}$$



Superheterodyne Receiver:

- f_m and f'_m are image frequencies

$$f_m = 600\text{kHz}$$

$$f_l = 1055\ \text{kHZ}$$

$$f_{IF} = 455 = 1055 - 600$$

$$f'_m = 1510\ \text{kHz}$$

$$f_{IF} = 455 = 1510 - 1055$$