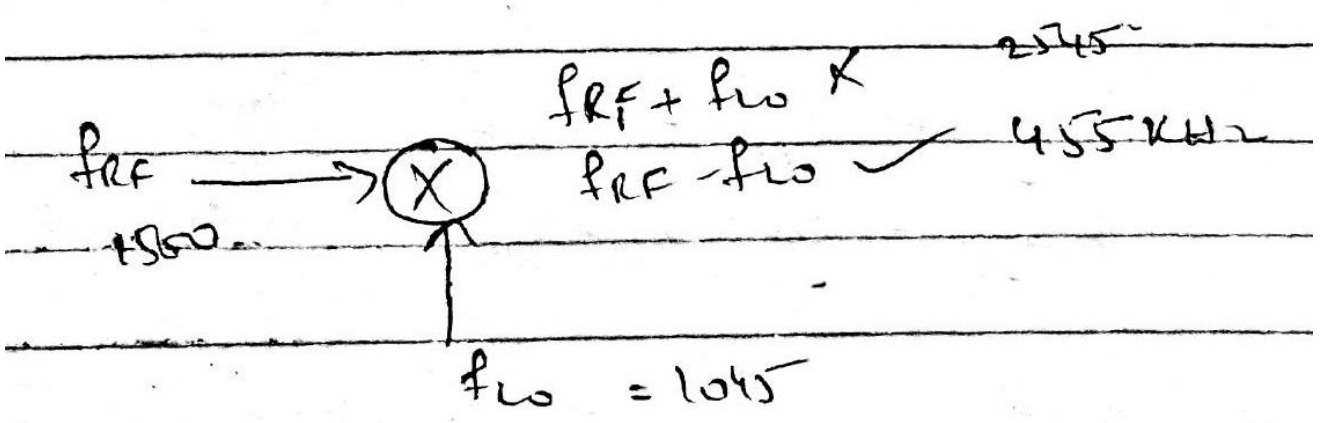
Communication Systems
EE-351

Lecture 27

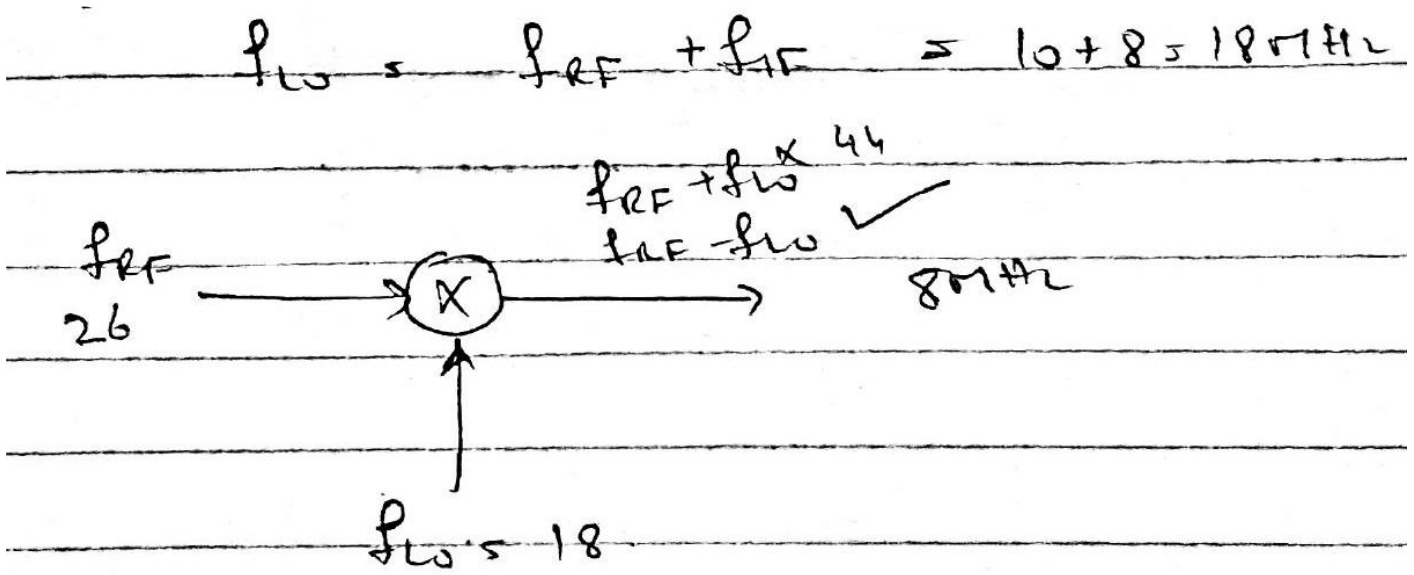
4.8-1 A transmitter transmits an AM signal with a carrier frequency of 1500 kHz. When an inexpensive radio receiver (which has a poor selectivity in its RF-stage bandpass filter) is tuned to 1500 kHz, the signal is heard loud and clear. This same signal is also heard (not as strong) at another dial setting. State, with reasons, at what frequency you will hear this station. The IF frequency is 455 kHz.

$$f_{image} = f_{RF} - 2f_{IF} = 590\text{kHz}$$
$$f_{LO} = f_{RF} + f_{IF}$$



From B.P. Lathi

4.8-2 Consider a superheterodyne receiver designed to receive the frequency band of 1 to 30 MHz with IF frequency 8 MHz. What is the range of frequencies generated by the local oscillator for this receiver? An incoming signal with carrier frequency 10-MHz is received at the 10 MHz setting. At this setting of the receiver we also get interference from a signal with some other carrier frequency if the receiver RF stage bandpass filter has poor selectivity. What is the carrier frequency of the interfering signal?



From B.P. Lathi

4.18 In this problem, we work on the specifications of a superheterodyne FM receiver listed in Table 3.2. In particular, given those specifications, do the following work:

(a) Determine the range of frequencies provided by the local oscillator of the receiver in order to accommodate the RF carrier range 88-108 MHz.

(b) Determine the corresponding range of image frequencies.

- $f_{LO_{min}} = f_{RF_{min}} + f_{IF} = 98.7MHz$
- $f_{LO_{max}} = f_{RF_{max}} + f_{IF} = 118.7MHz$

- $f_{image} = f_{RF} + 2f_{IF} = 88 + 2(10.7) = 109.4\ MHz$ (out of range)
- $f_{image} = f_{RF} + 2f_{IF} = 108 + 2(10.7) = 129.4\ MHz$ (out of range)

Example:

Consider a superheterodyne receiver with $f_{IF} = 20MHz$ and $f_{LO} = 4.5GHz$. If $f_{RF} > f_{LO}$, find f_{image}?

$$f_{LO} = f_{RF} - f_{IF}$$

$$f_{image} = f_{RF} - 2f_{IF} = 4520 - 2(20) = 4480MHz$$

Example:

A superheterodyne receiver operates in the freq. range of 88 to 98 MHz. The intermediate freq. and f_{LO} are chosen such that

$$f_{IF} \leq f_{LO}$$

It is required that the image freq. fall outside the 88 to 98 MHz band. Calculate the min. required f_{IF} in MHz?

One possible solution is:

$$f_{image} = f_{RF} + 2f_{IF}$$
$$99 = 88 + 2f_{IF}$$
$$f_{IF} = 5.5MHz$$