

# Chapter 4 Angle Modulation (II)

# FM-Radio Broadcasting (1/3)

- Commercial FM-radio broadcasting utilizes the frequency band 88-108 MHz for the transmission of voice and music signals
- The carrier frequencies are separated by 200 kHz and the peak frequency deviation is fixed at 75 kHz
- Preemphasis is generally used to improve the demodulator performance in the presence of noise in the received signal
- The receiver most commonly used in FM-radio broadcast is a superheterodyne type

# FM-Radio Broadcasting (2/3)

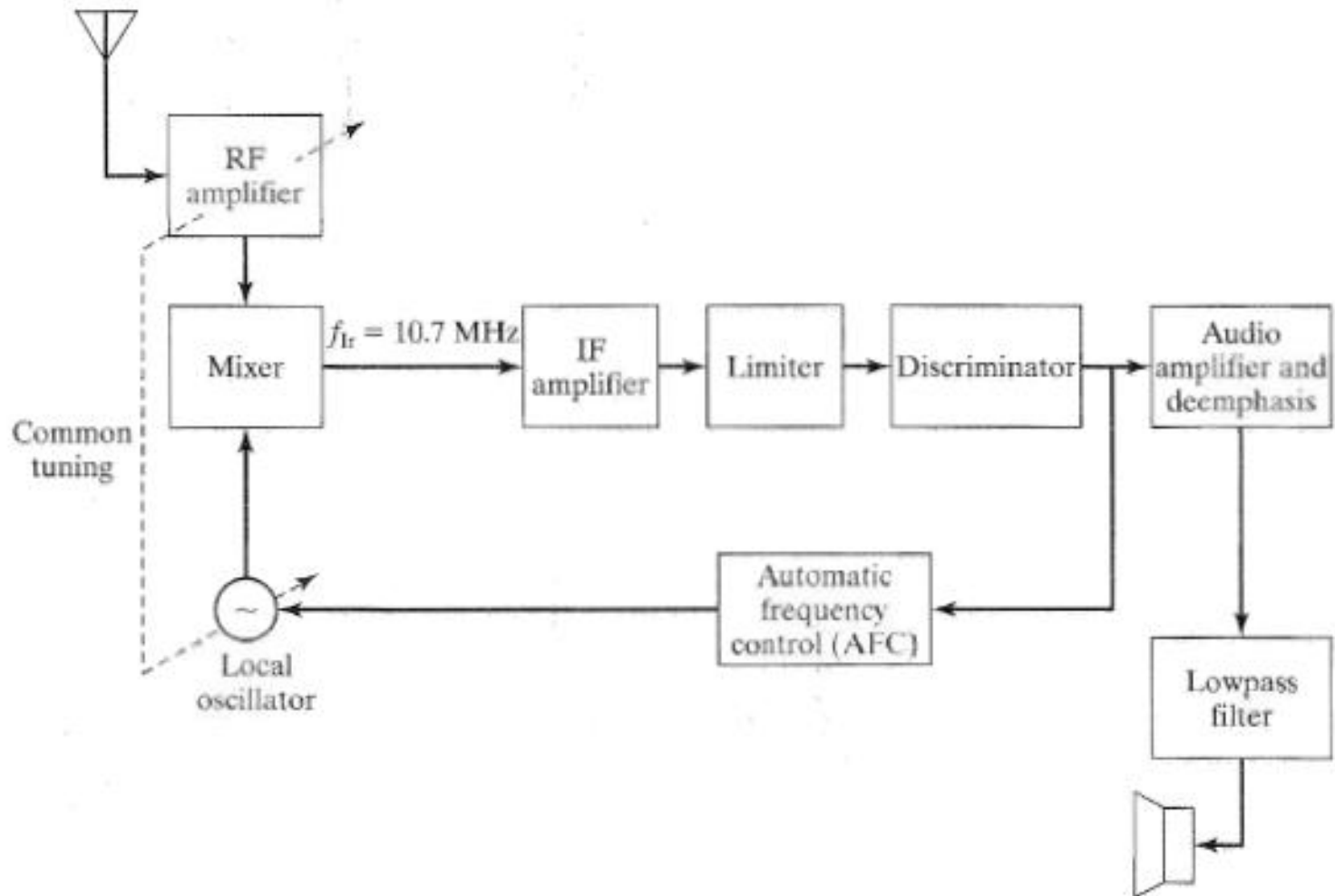


Figure 4.16 Block diagram of a superheterodyne FM-radio receiver.

# FM-Radio Broadcasting (3/3)

- Common tuning between the RF amplifier and the local oscillator allows the mixer to bring all FM-radio signals to a common IF bandwidth of 200 kHz, centered at  $f_{IF}=10.7$  MHz
- The amplitude limiter removes any amplitude variations in the received signal at the output of the IF amplifier
- A bandpass filter, which is centered at  $f_{IF}=10.7$  MHz with a bandwidth of 200 kHz, is included in the limiter to remove higher-order frequency components introduced by the nonlinearity inherent in the hard limiter

# FM-Stereo Broadcasting (1/4)

- Many FM-radio stations transmit music programs in stereo by using the outputs of two microphones placed on two different parts of the stage
- $m_l(t)$  and  $m_r(t)$  are signals from the left and right microphones
- A pilot tone at the frequency of 19 kHz is added to the signal for the purpose of demodulating the DSB-SC AM signal
- We place the pilot tone at 19 kHz instead of 38 kHz because the pilot is more easily separated from the composite signal at the receiver

# FM-Stereo Broadcasting (2/4)

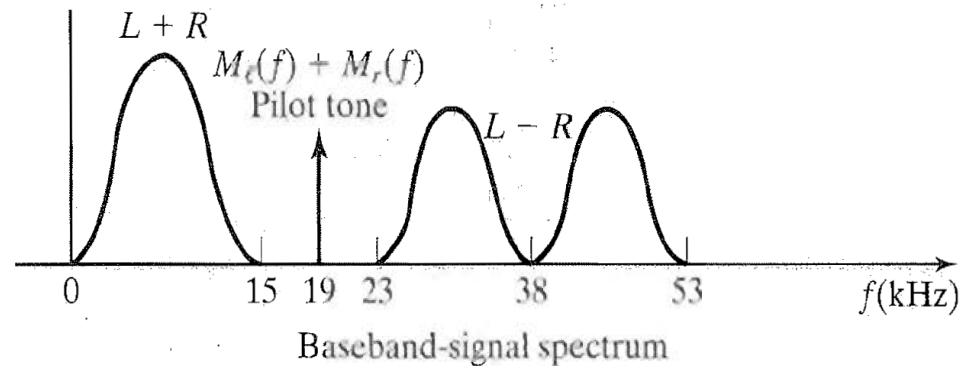
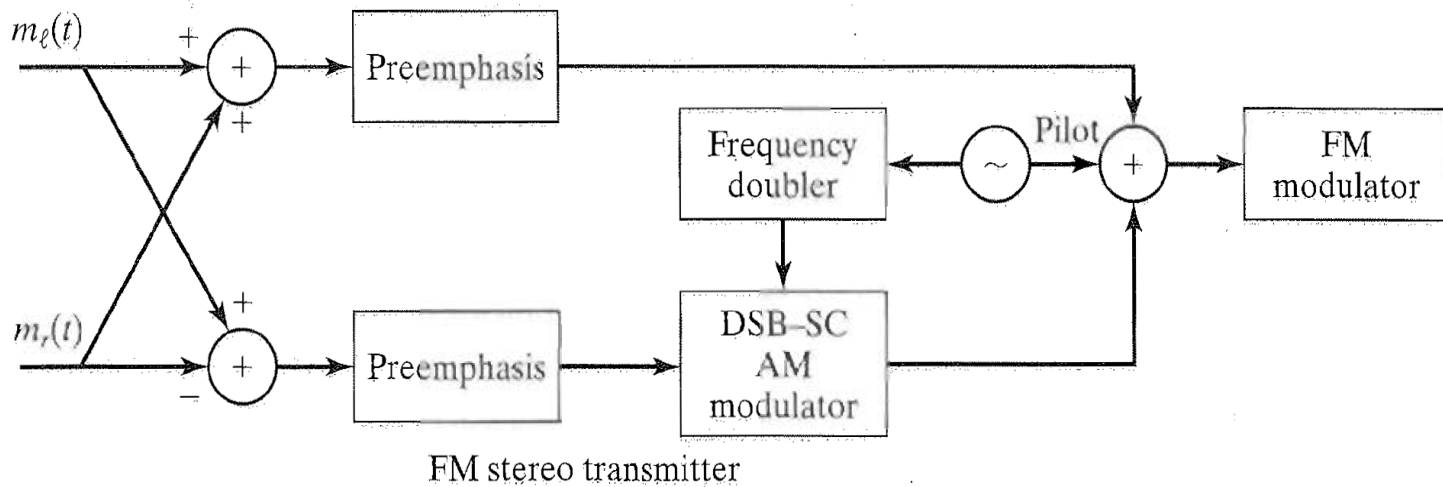


Figure 4.17 FM-stereo transmitter and signal spacing.

# FM-Stereo Broadcasting (3/4)

- A monophonic FM receiver can recover the sum signal  $m_l(t) + m_r(t)$  by using a conventional FM demodulator
- FM-stereo broadcasting is compatible with monophonic FM
- The resulting FM signal does not exceed the allocated 200-kHz bandwidth
- An FM receiver that is not configured to receive the FM stereo sees only the baseband signal  $m_l(t) + m_r(t)$  in the frequency range 0-15 kHz. Thus, it produces a monophonic output signal that consists of the sum of the signals at the two microphones

# FM-Stereo Broadcasting (4/4)

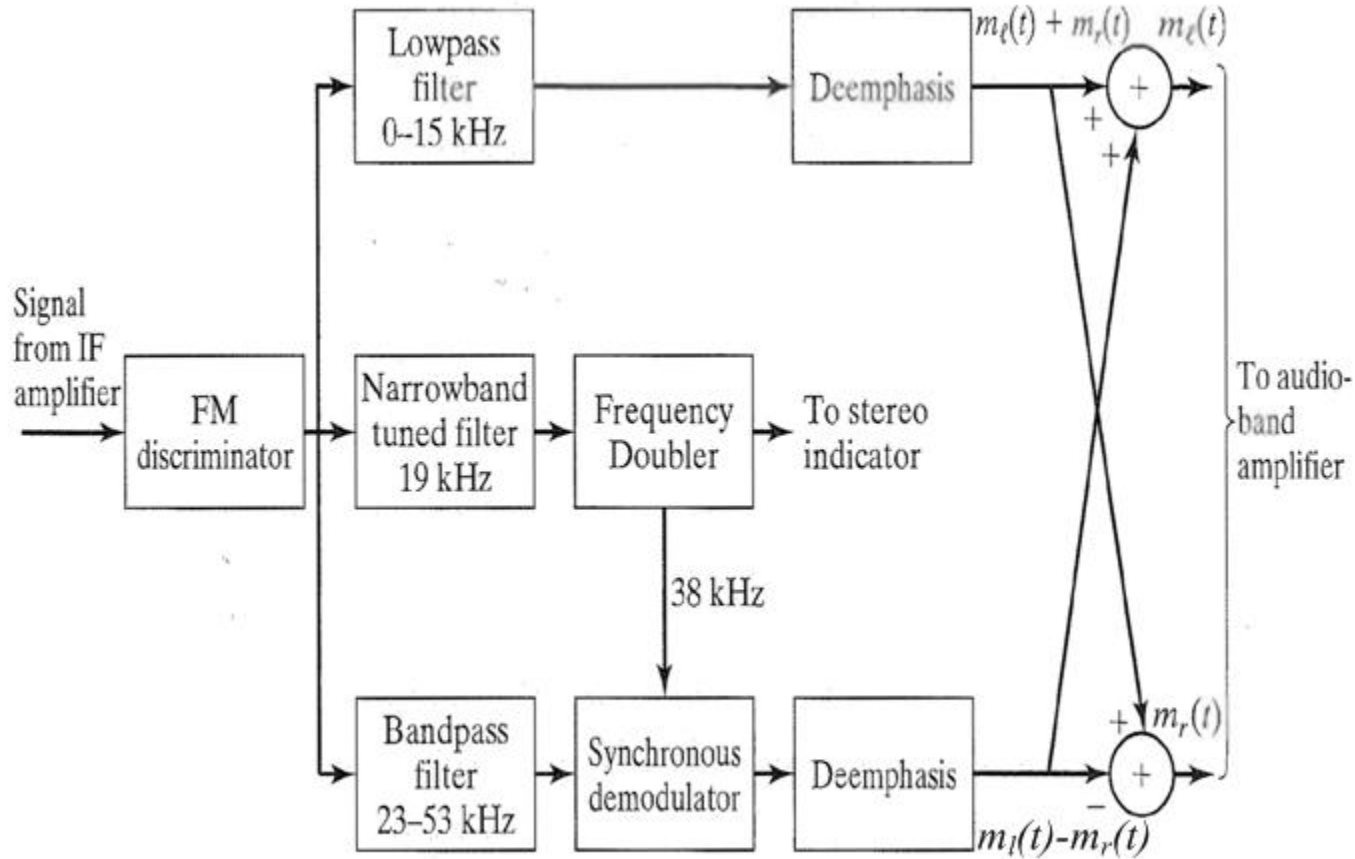


Figure 4.18 FM-stereo receiver.



# Mobile Wireless Telephone Systems (1/3)

- A major problem with the establishment of any radio communication system is the availability of a portion of the radio spectrum
- The Federal Communications Commission (FCC) in the United States has assigned parts of the UHF frequency band in the range 806-890 MHz for mobile wireless telephone systems
- Similar frequency assignments in the UHF band have been made in Europe and Japan

# Mobile Wireless Telephone Systems (2/3)

- A geographic area is subdivided into cells, each of which contains a base station
- Each base station is connected via telephone lines to a mobile-telephone-switching office (MTSO) which, in turn, is connected via telephone lines to a telephone central office (CO) of the terrestrial-telephone network
- The base station routes the call through the MTSO to another base station (if the called party is located in another cell) or to the central office of the terrestrial-telephone network (if the called party is not a mobile)

# Mobile Wireless Telephone Systems (3/3)

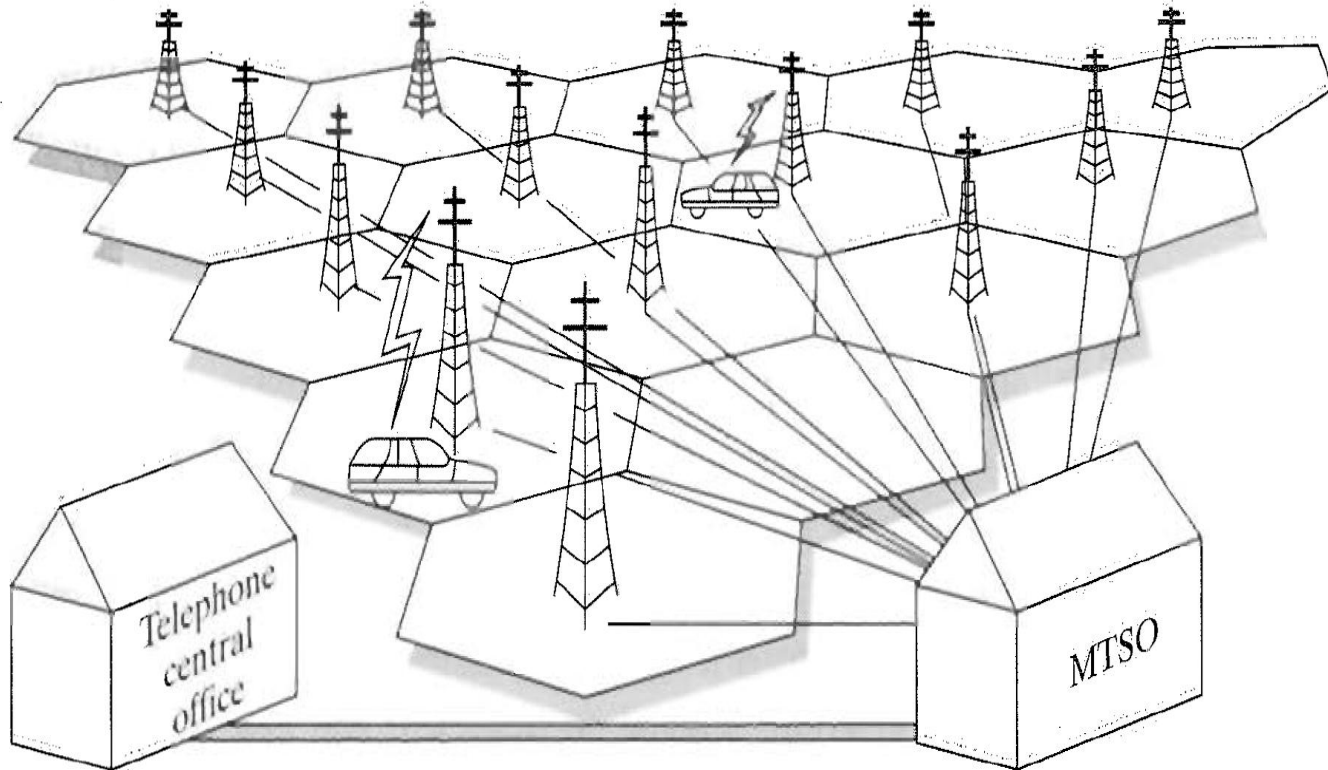


Figure 4.30 Mobile-radio base station.