# Technician License Course
# Chapter 2

## Lesson Plan Module 2 –
## Radio Signals and Waves

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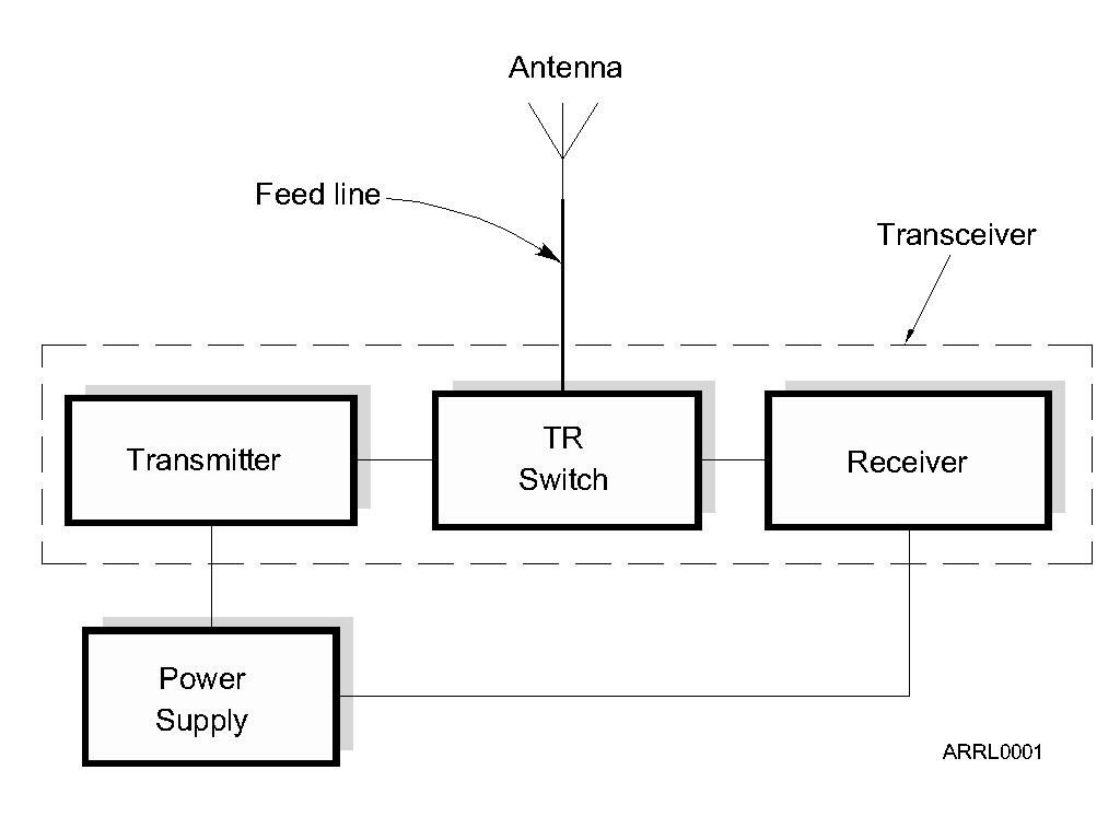
# The Basic Radio Station

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# What Happens During Radio Communication?

- Transmitting (sending a signal):
  - Information (voice, data, video, commands, etc.) is converted to electronic form.
  - The information in electronic form is attached or embedded on a radio wave (a carrier).
  - The radio wave is sent out from the station antenna into space.


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# What Happens During Radio Communication?

- Receiving end:
  - The radio wave (carrier) with the information is intercepted by the receiving station antenna.
  - The receiver extracts the information from the carrier wave.
  - The information is then presented to the user in a format that can be understood (sound, picture, words on a computer screen, response to a command).


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# What Happens During Radio Communication?

- This sounds pretty simple, but it in reality is pretty complex.
- This complexity is one thing that makes ham radio fun…learning all about how radios work.
- Don't be intimidated. You will be required to only know the basics, but you can learn as much about the "art and science" of radio as you want.


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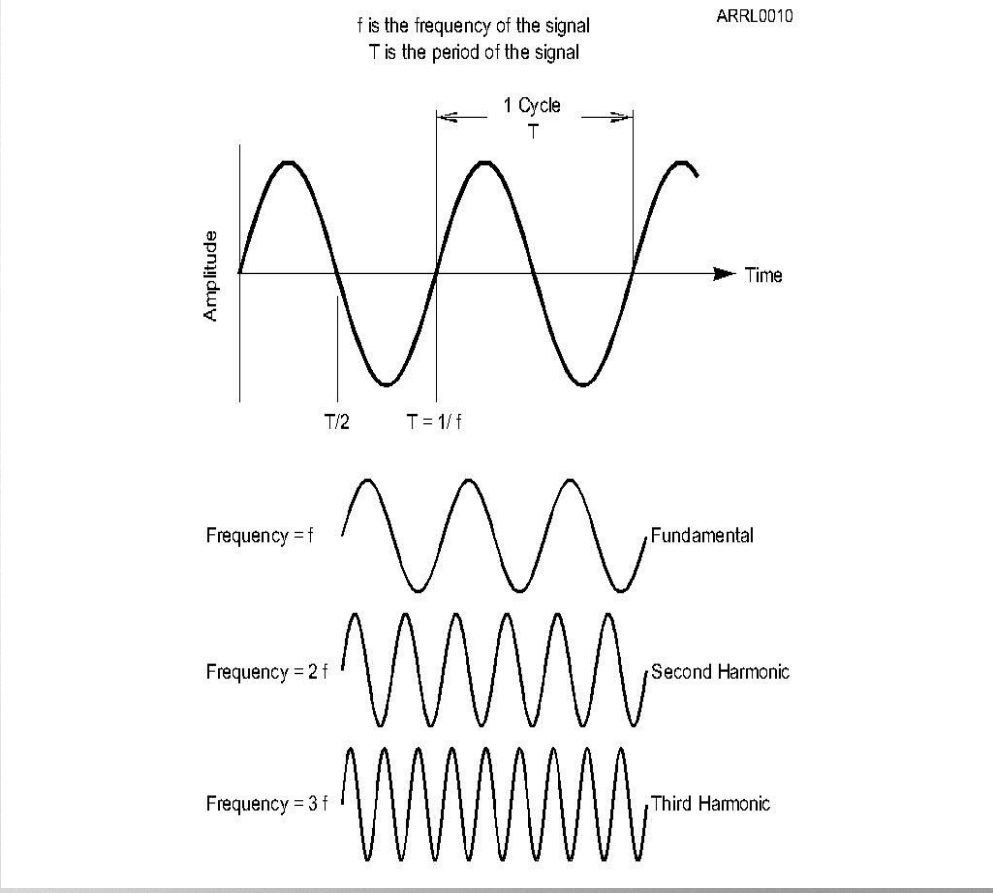
# Radio Waves are AC

- Radio waves (electromagnetic radiation) are ac waves.
- Radio waves are used to carry the information you want to convey to someone else.

# Wave Vocabulary

- Before we study radio waves, we need to learn some wave vocabulary.
  - Amplitude
  - Frequency
  - Period
  - Wavelength
  - Harmonics

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# Now for a Powerful Demonstration

- What happens when you drop a magnet through a non-ferrous conductive pipe?

# How Radio Waves Travel

You have just witnessed in a way how radio waves travel.

1. Moving electrons in the antenna create a magnetic field.
2. This changing magnetic field creates an electric field.
3. Then back and forth between magnetic and electric fields from point A to point B.

# Finding Where You are on the Radio Dial

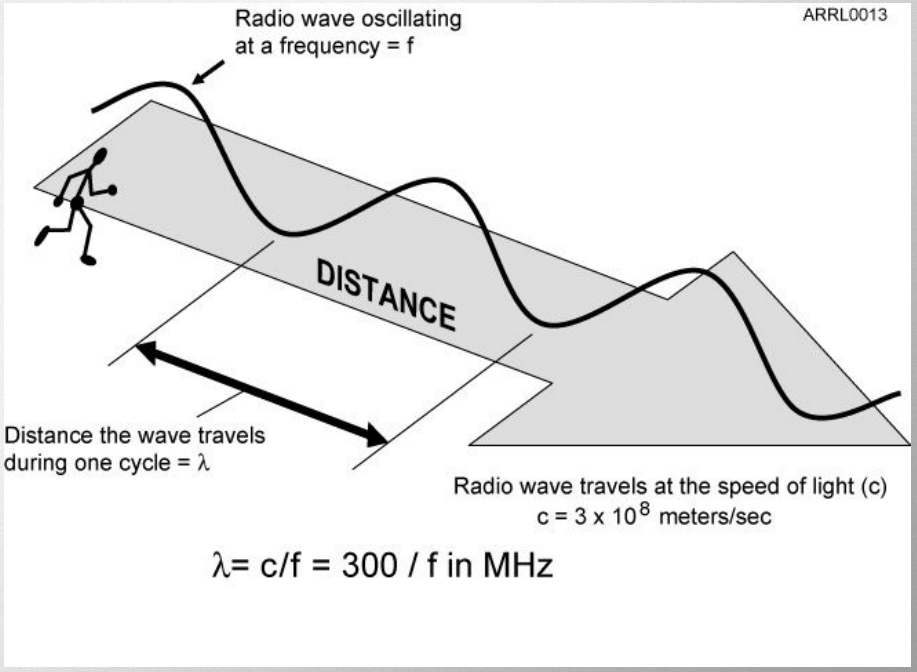
- There are two ways to tell someone where to meet you on the radio dial (spectrum).
  - Band
  - Frequency

# Radio Frequency (RF) Spectrum

- The RF spectrum is the range of wave frequencies which will leave an antenna and travel through space.
- The RF spectrum is divided into segments of frequencies that basically have unique behavior.

# Wavelength

- The distance a radio wave travels during one cycle.
  - One complete change between magnetic and electric fields.

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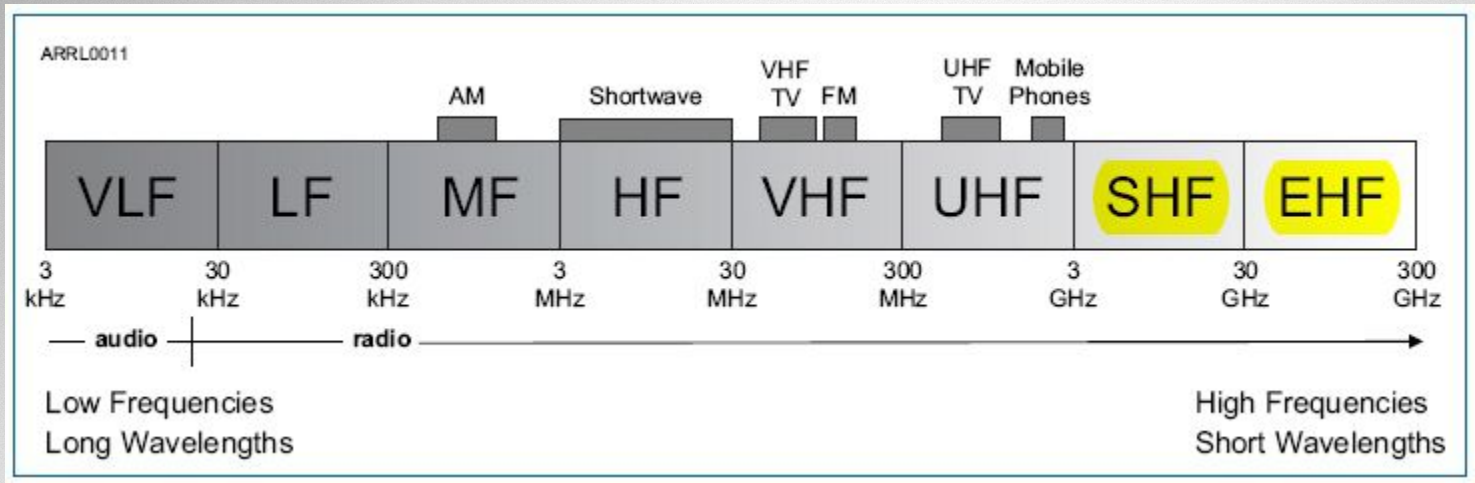
# Radio Frequency (RF) Spectrum

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# How does the wavelength of a radio wave relate to its frequency? (T3B05)

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- C. There is no relationship between wavelength and frequency
- D. The wavelength depends on the bandwidth of the signal

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# What is the formula for converting frequency to wavelength in meters? (T3B06)

- A. Wavelength in meters equals frequency in hertz multiplied by 300
- B. Wavelength in meters equals frequency in hertz divided by 300
- C. Wavelength in meters equals frequency in megahertz divided by 300
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# What property of radio waves is often used to identify the different frequency bands? (T3B07)

- A. The approximate wavelength
- B. The magnetic intensity of waves
- C. The time it takes for waves to travel one mile
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# What are the frequency limits of the VHF spectrum? (T3B08)

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# What is the approximate velocity of a radio wave as it travels through free space? (T3B11)

- A. 3000 kilometers per second
- D. 300,000,000 meters per second
- C. 300,000 miles per hour
- D. 186,000 miles per hour

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# What is the unit of frequency? (T5C05)

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- B. Henry
- C. Farad
- D. Telsa

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# So, Where Am I?

- Back to how to tell where you are in the spectrum.
- Bands identify the segment of the spectrum where you will operate.
  - Wavelength is used to identify the band.
- Frequencies identify specifically where you are within the band.

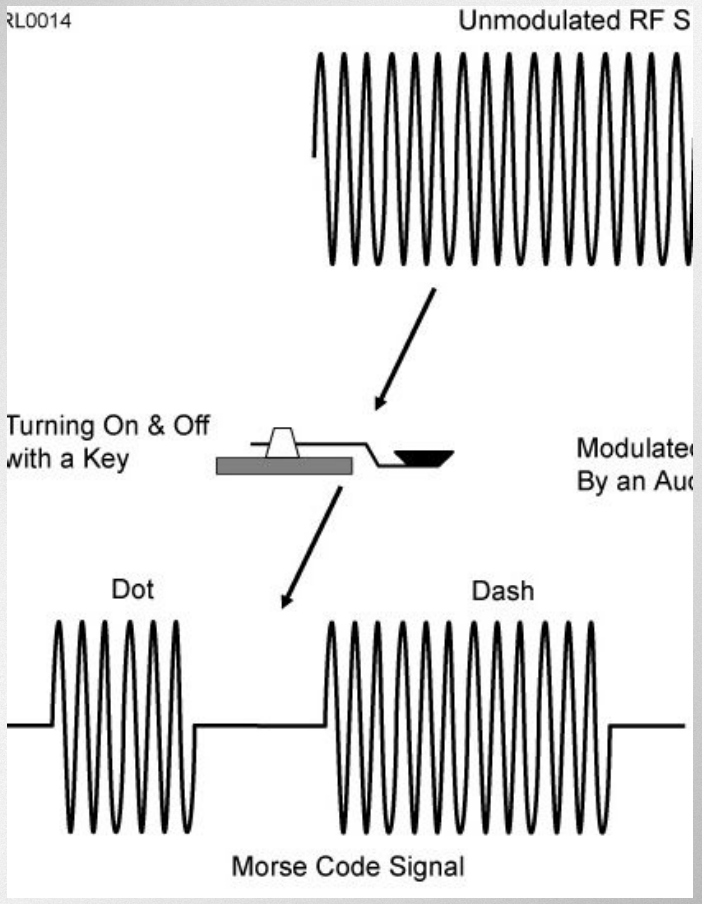
# Another Use for Frequency and Wavelength

- For the station antenna to efficiently send the radio wave out into space, the antenna must be designed for the specific operating frequency.
  - The antenna length needs to closely match the wavelength of the frequency to be used.
  - Any mismatch between antenna length and frequency wavelength will result in radio frequency energy being reflected back to the transmitter, not going (being emitted) into space.

# Adding Information - Modulation

- When we imprint some information on the radio wave, we modulate the wave.
  - Turn the wave on and off
  - Voice -- AM and FM
  - Data
- Different modulation techniques are called modes.

# CW - Morse Code – On and Off

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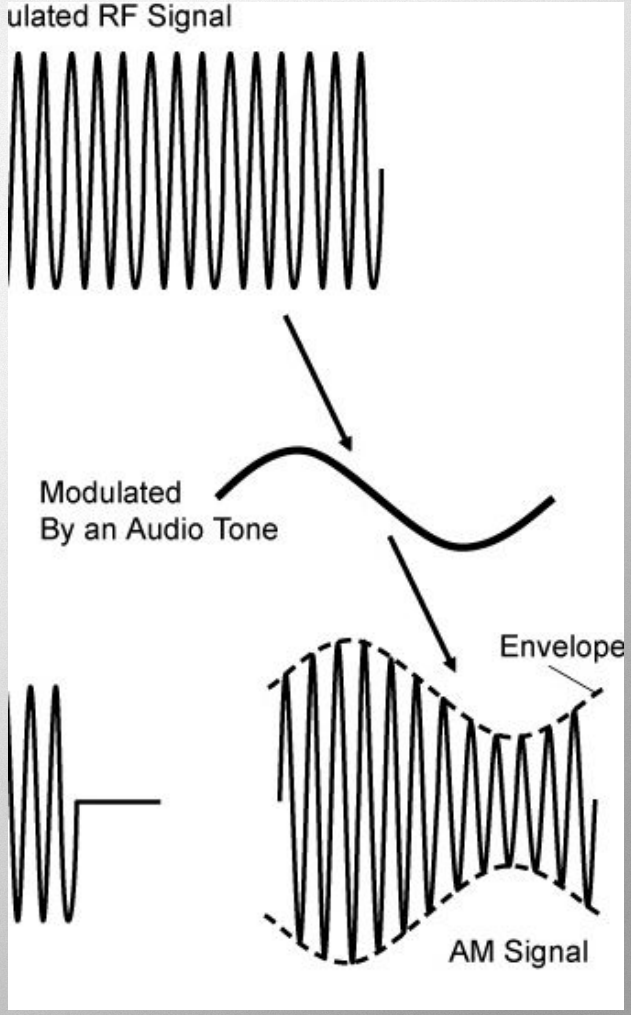
# Amplitude Modulation (AM)

- In AM, the amplitude of the carrier wave is modified in step with the waveform of the information (voice).

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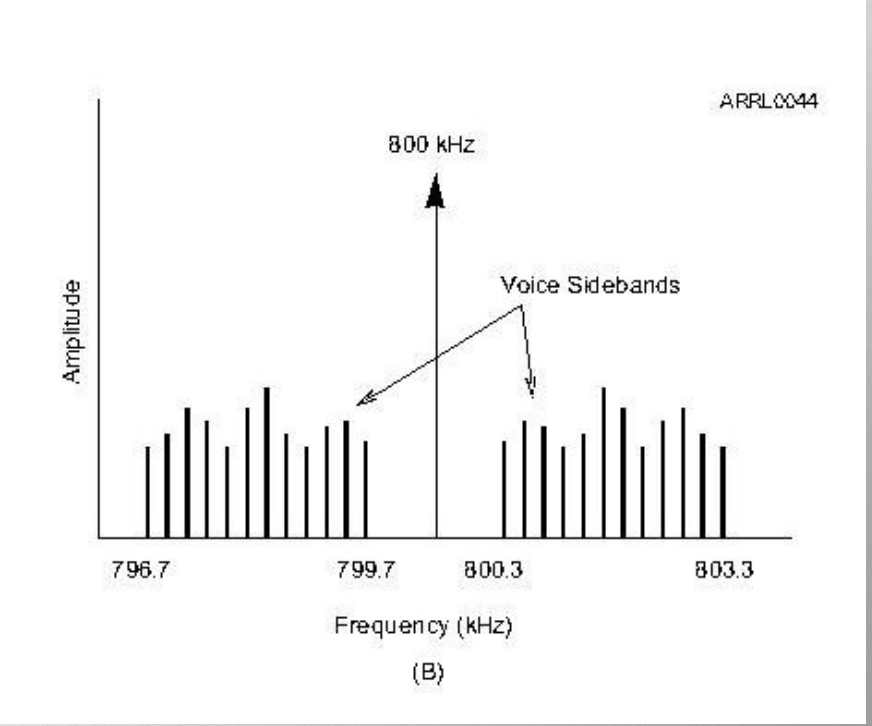
# Characteristics of Voice AM

AM signals consist of three components:

- Carrier
- Lower sideband
- Upper sideband

- Voice bandwidth is from 300 Hz to 3 kHz.
- AM bandwidth is twice the voice bandwidth.

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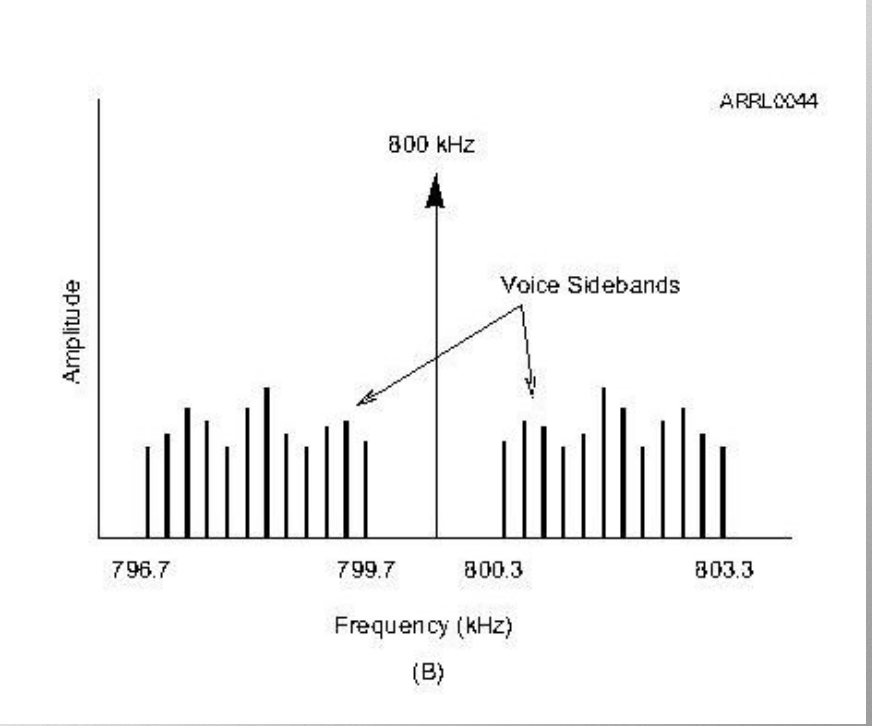
# Characteristics of Voice

- Sound waves that make up your voice are a complex mixture of multiple frequencies.
- When this complex mixture is embedded on a carrier, two sidebands are created that are mirror images.

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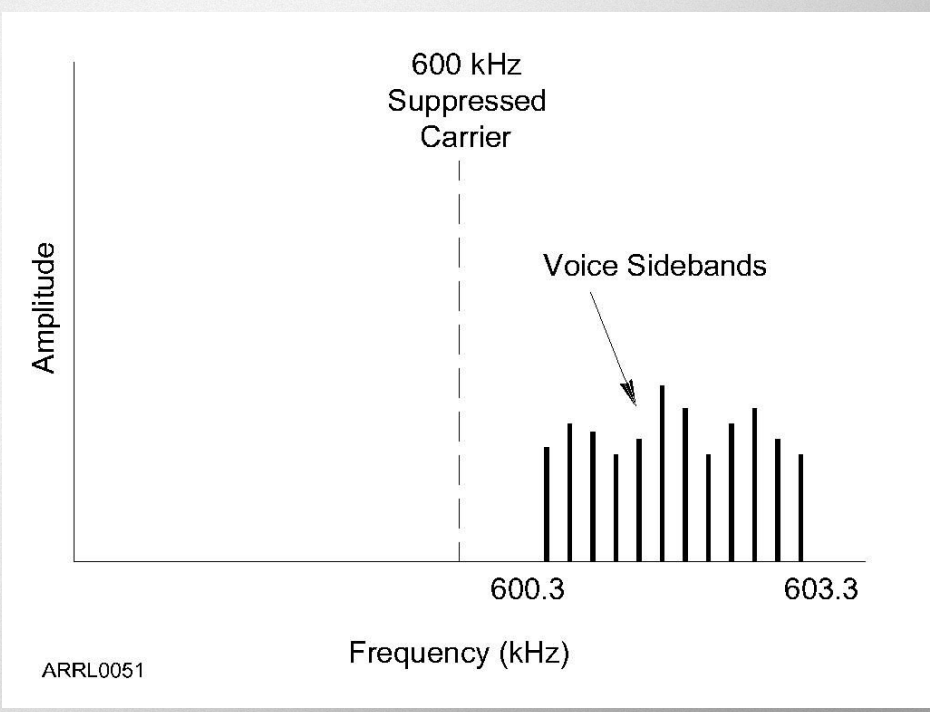
# Single Sideband Modulation (SSB)

- Since voice is made up of identical mirror image sidebands:
- We can improve efficiency of transmission by transmitting only one sideband and then reconstruct the missing sideband at the receiver.

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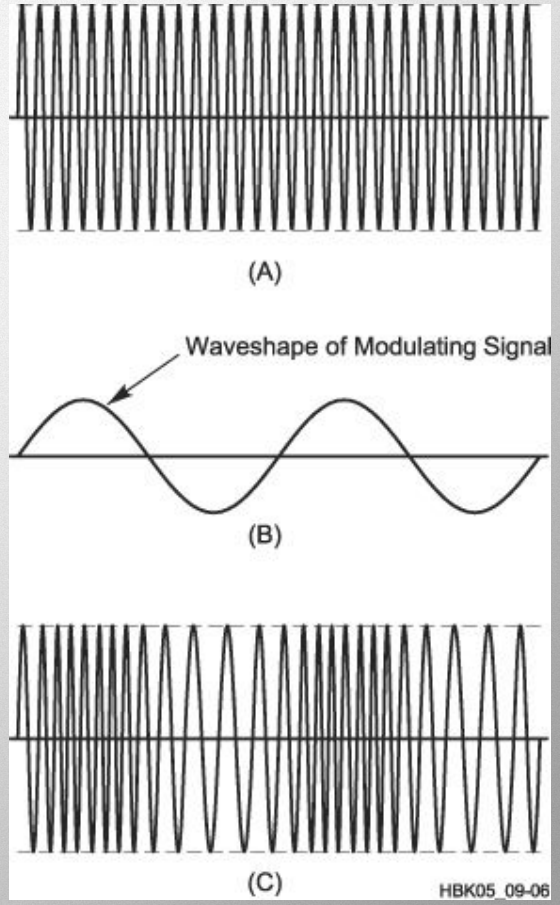
# Frequency Modulation (FM)

- Instead of varying amplitude, if we vary the frequency in step with the information waveform – FM is produced.
- FM signals are much more resistant to the effects of noise but require more bandwidth.
- FM bandwidth (for voice) is between 5 and 15 kHz.

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# Why should you not set your transmit frequency to be exactly at the edge of an amateur band or sub-band? (T1B09)

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# What determines the amount of deviation of an FM signal? (T2B05)

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# What type of modulation is most commonly used for VHF packet radio transmission? (T8A02)

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# Which type of voice modulation is most often used for long-distance or weak signal contacts on the VHF and UHF bands? (T8A03)

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# What is the typical bandwidth of analog fast-scan TV transmissions on the 70 cm band? (T8A10)

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# What is the approximate maximum bandwidth required to transmit a CW signal? (T8A11)

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