

Technician Class Course

Session 4



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AMATEUR RADIO

DIODES AND TRANSISTORS

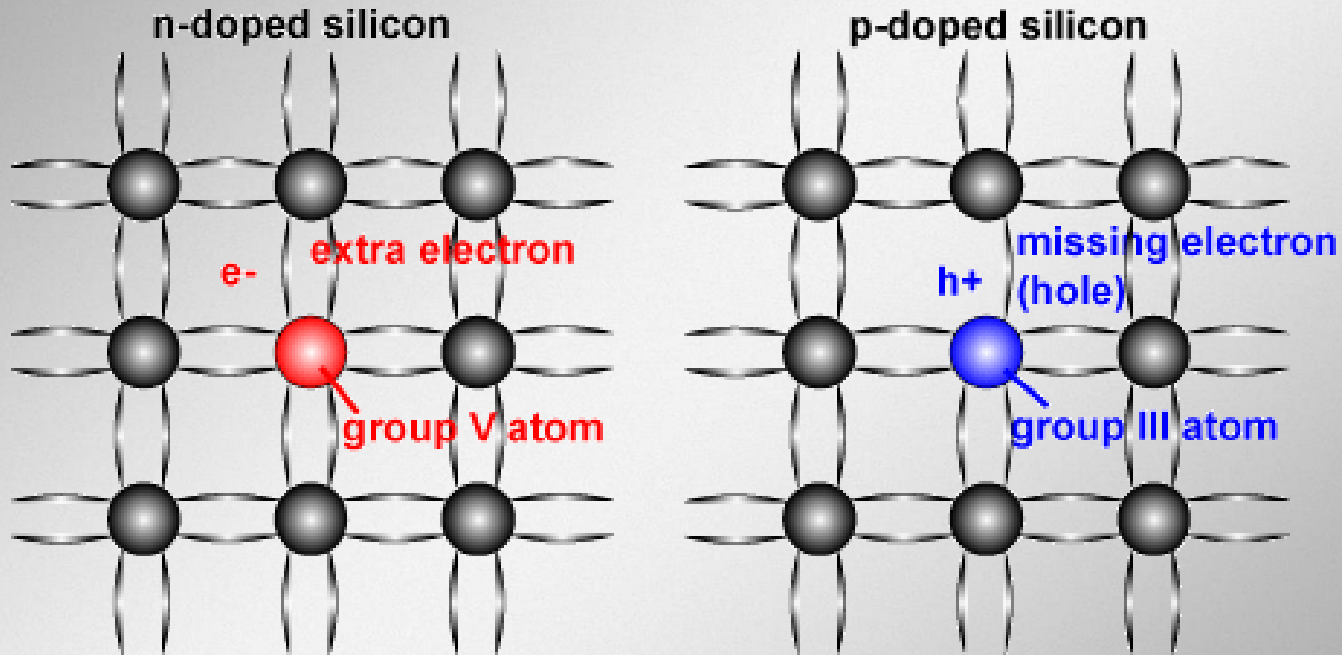


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Semiconductor

- “In between” conductors and insulators
- Doping is the process of adding impurities to the intrinsic material to alter its properties
- Doping creates N-type and P-type material
 - N-type: excess electrons
 - P-type: excess holes

Semiconductor



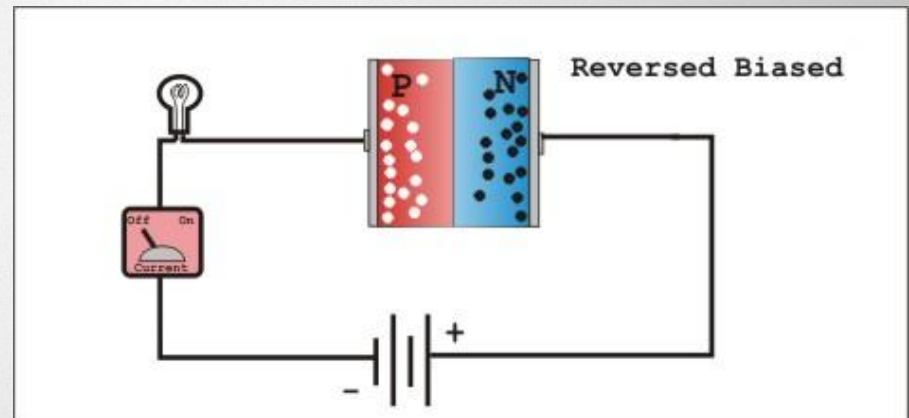
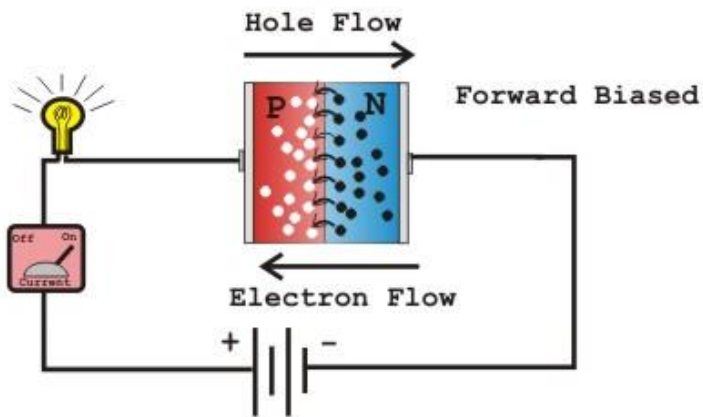
<http://pveducation.org/pvcdrom/doping>



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PN Junction

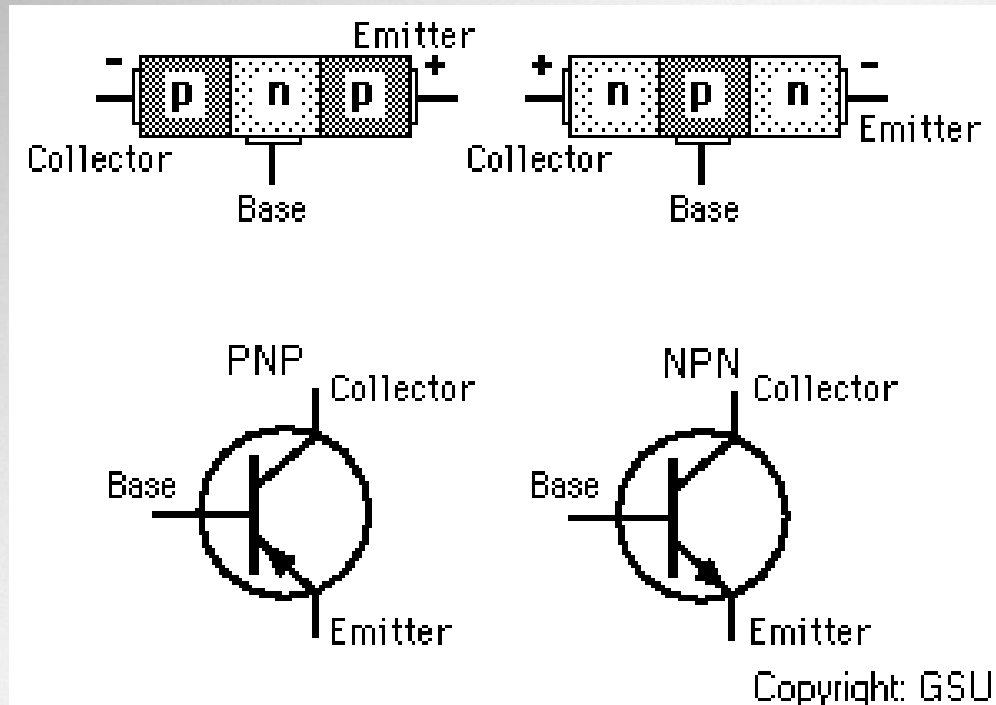
- Diode – sandwich of N and P material
- Current flows in one direction



Bipolar Transistor

- Sandwich of three layers (two junctions)
- NPN and PNP
- One junction (base-emitter) controls the current through the entire device (collector-emitter)
- Amplification: a small current controls a large current

Bipolar Transistor



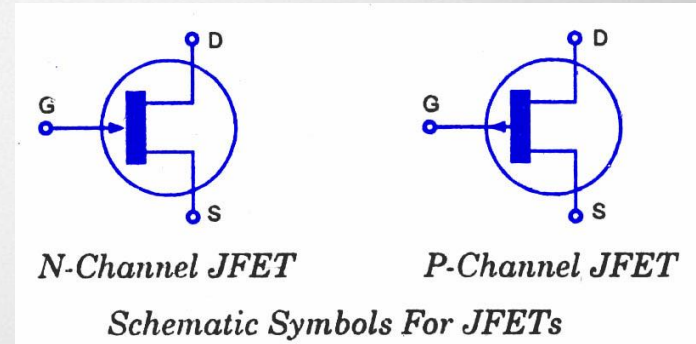
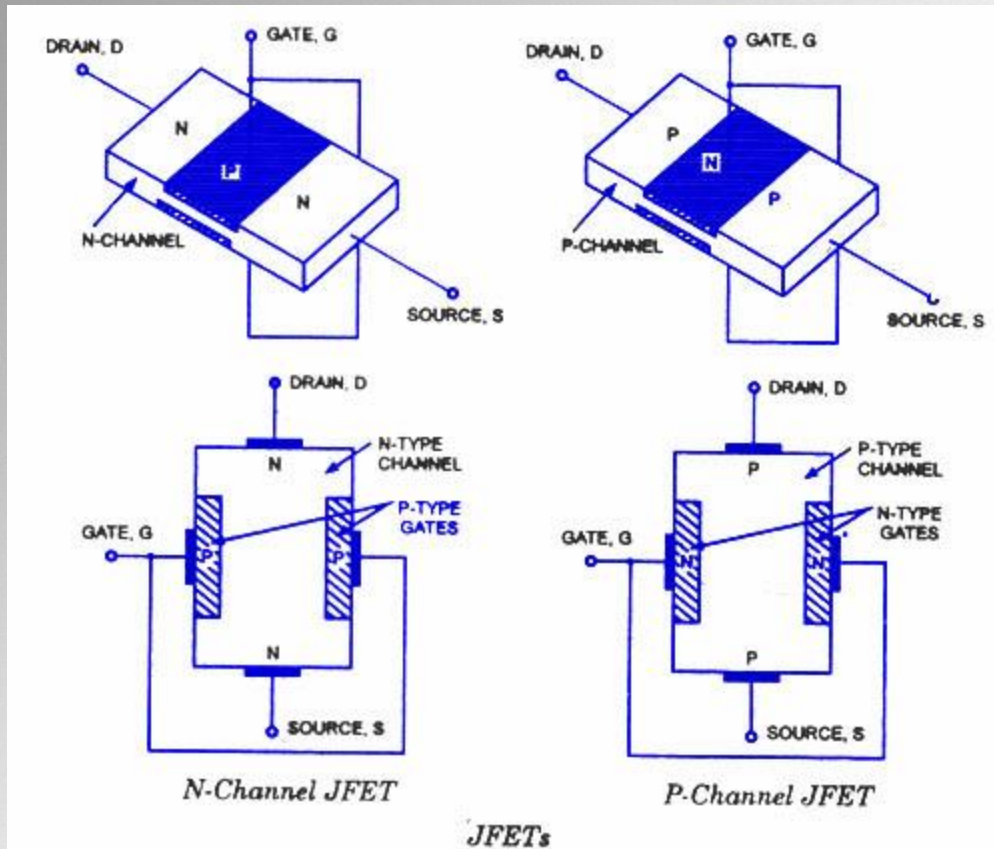
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<http://www.physlink.com/education/askexperts/ae430.cfm>

Field Effect Transistor

- “channel” formed from one material
- A control “gate” formed from another material
- Voltage across the gate-channel connection controls the flow of current in the channel
 - Similar to controlling water flow by pinching a garden hose
- Amplification: a small voltage controls a large current in the channel

Field Effect Transistor



<http://www.circuitstoday.com/wp-content/uploads/2009/08/n-channel-p-channel-jfet.jpg>

<http://www.circuitstoday.com/wp-content/uploads/2009/08/jfet-junction-field-effect-transistor.jpg>



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MODULATION

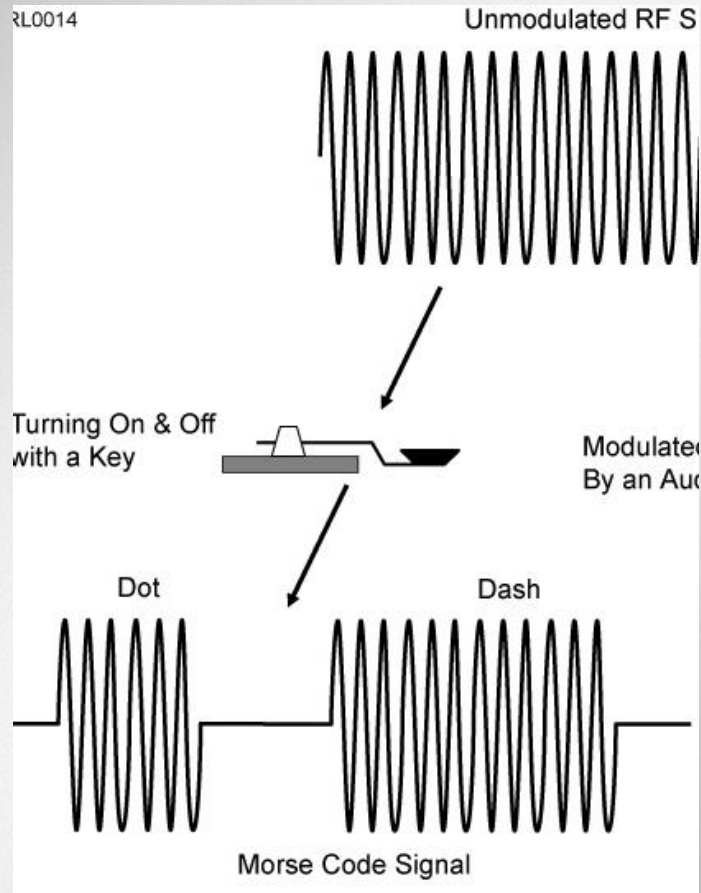


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Adding Information - Modulation

- Now that we know where we are in the RF spectrum and are sending a radio wave into space.
- When we imprint some information on the radio wave, we modulate the wave.
 - Turn the wave on and off
 - Voice AM and FM
 - Data (AM, FM, PM or combinations)
- Different modulation techniques are called modes.

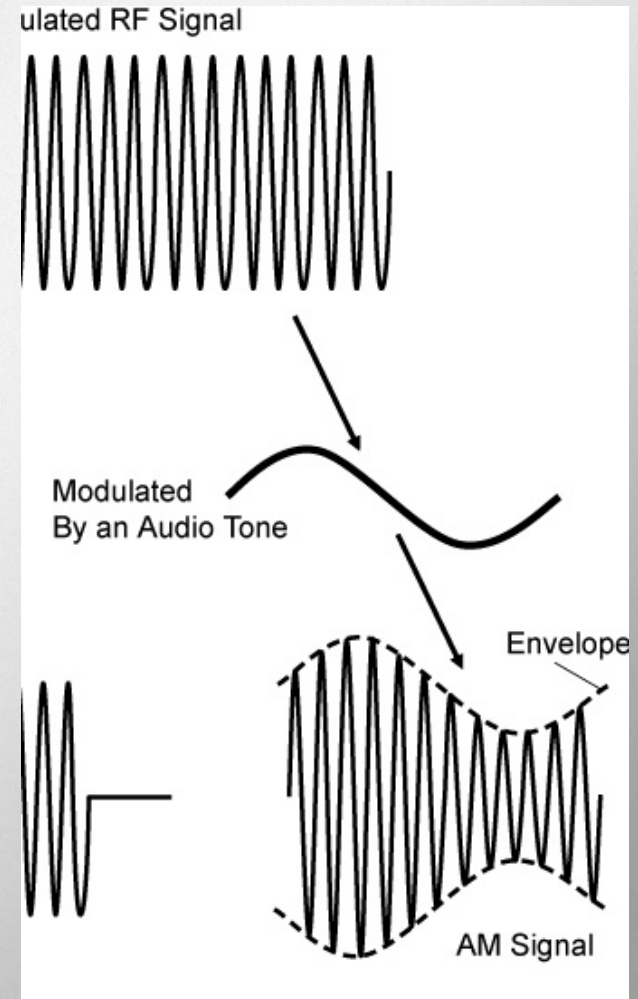
Morse Code – On and Off



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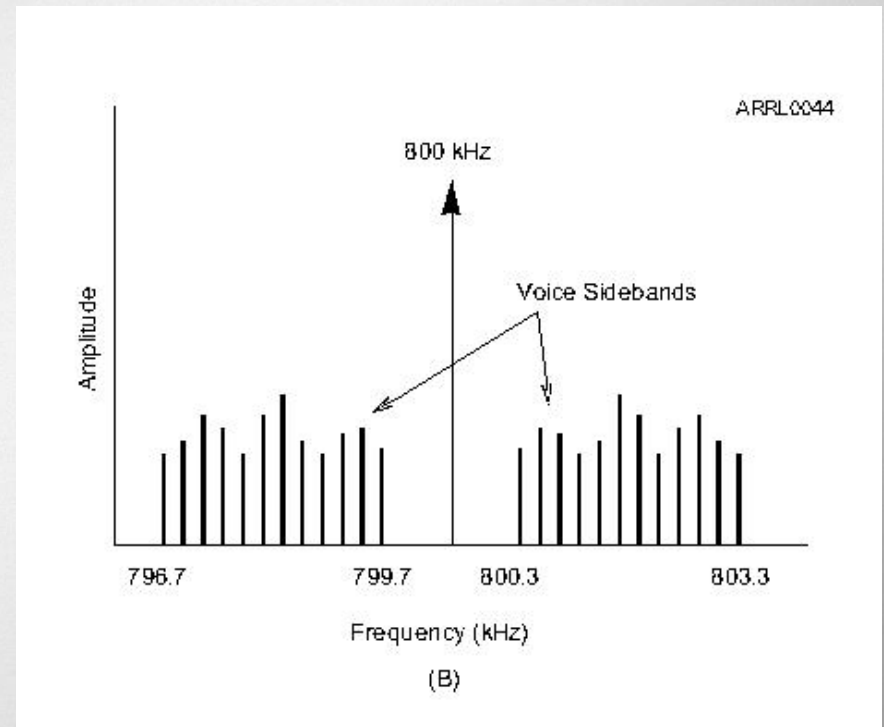
Amplitude Modulation (AM)

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



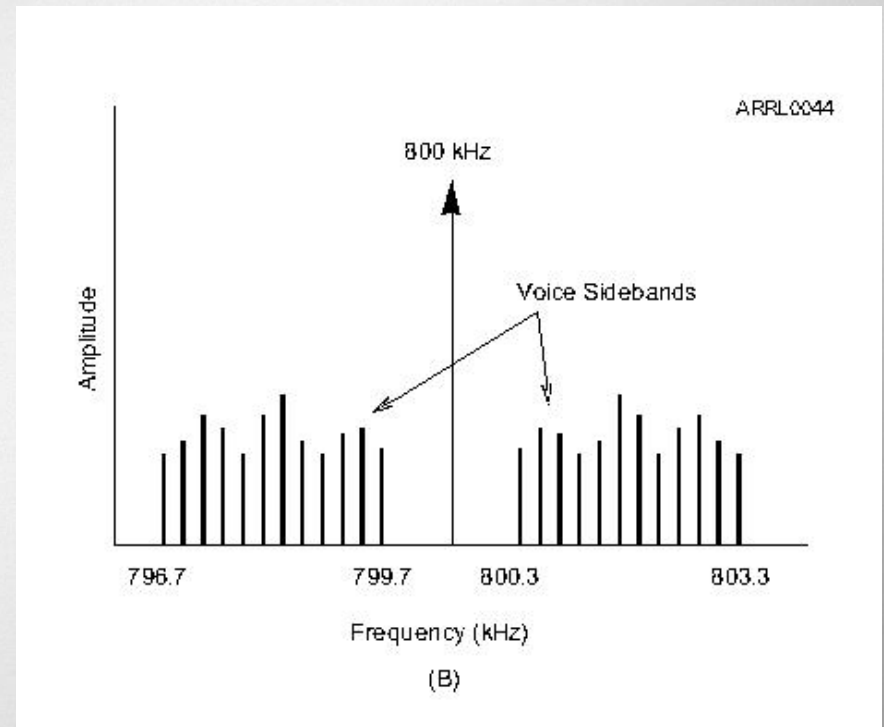
Characteristics of Voice - AM

- 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.



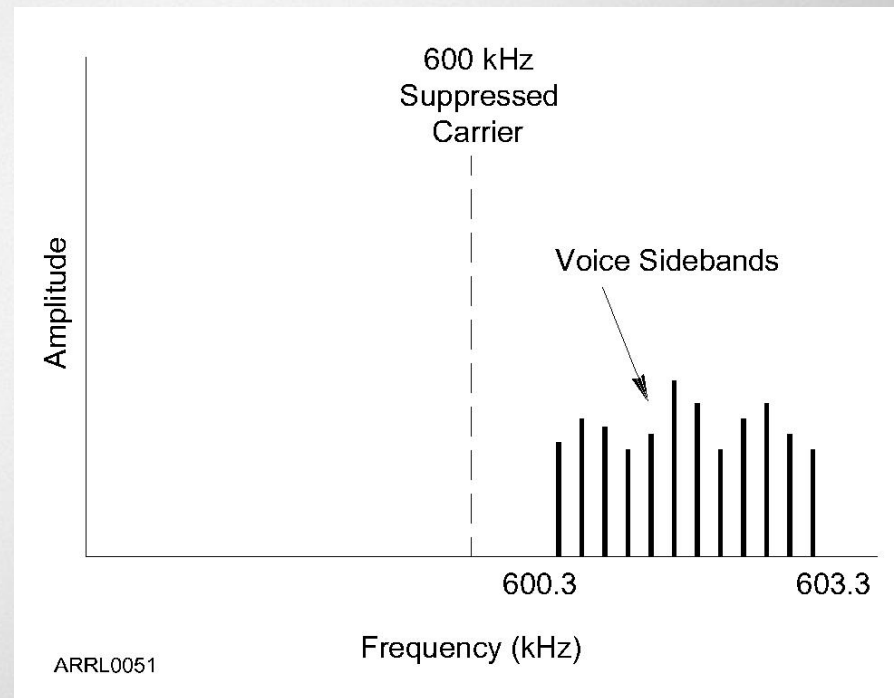
Characteristics of Voice - AM

- 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.



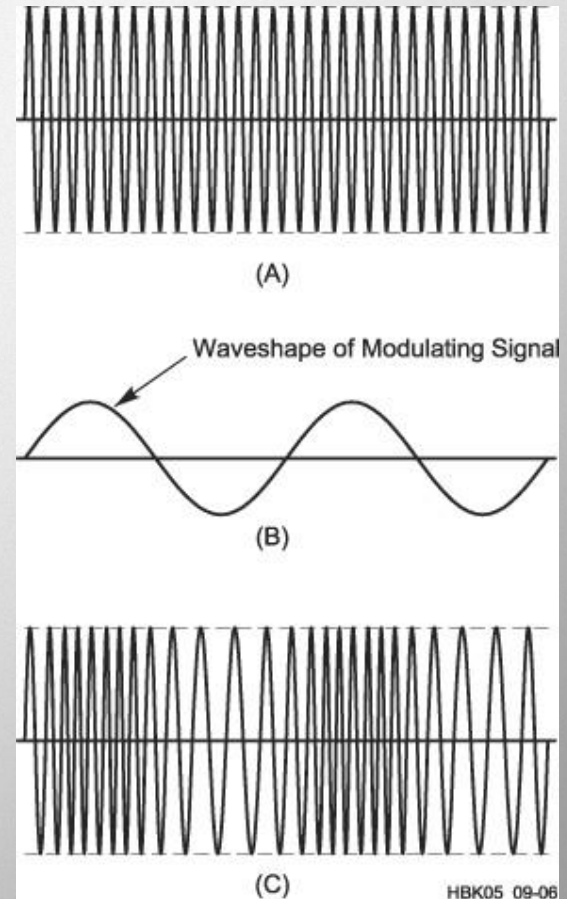
Single Sideband Modulation (SSB)

- Since AM 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.



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.



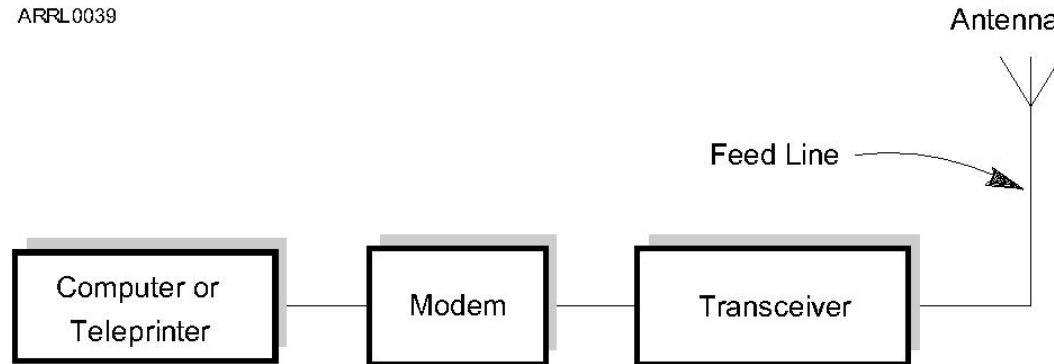
Transmitting Data

- Data is made up of binary bits 1 and 0.
 - On and off states
- Modems translate the data into a format capable of modulating a carrier wave.
- A terminal node controller (TNC) is a specialized modem used in ham radio.
 - There are many more kinds of modems developed as data transmission technology advances.



Basic Data Transmission Setup

ARRL0039



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