

Modes

Technician Exam Preparation Class
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Signal to Noise Ratio

There is always noise (either nature-made or man-made) along with the desired signal. The Signal to Noise Ratio (SNR) is the relationship of the desired signal's strength to the surrounding noise.

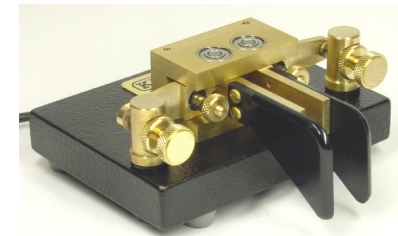
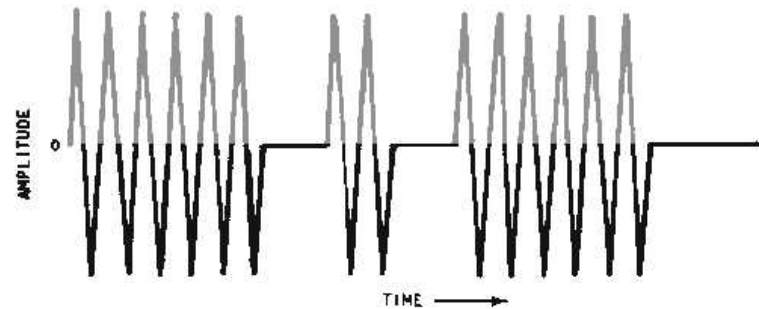
One way to improve the SNR is to narrow the bandwidth of the received signal. A CW signal carrying morse code is about 150 Hz wide. If the receiver is receiving a bandwidth of 6 kHz (the width of an AM broadcast signal), there is a lot of unwanted noise surrounding the CW signal. Most modern transceivers have a set of filters of various widths that can be switched in to narrow the received bandwidth thus making the desired signal more prominent.

Common Transmission Modes

- Continuous Wave (CW)
 - Mode to carry morse code and several digital capabilities
- Amplitude Modulation (AM)
 - Radio stations on the AM band, for example
- Frequency Modulation (FM)
 - Radio stations on the FM band, for example
- Single Side Band
 - A type of amplitude modulation
 - Either upper or lower sideband

Continuous Wave

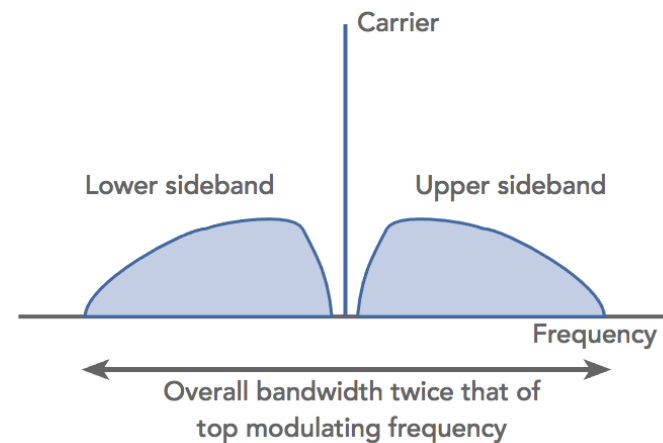
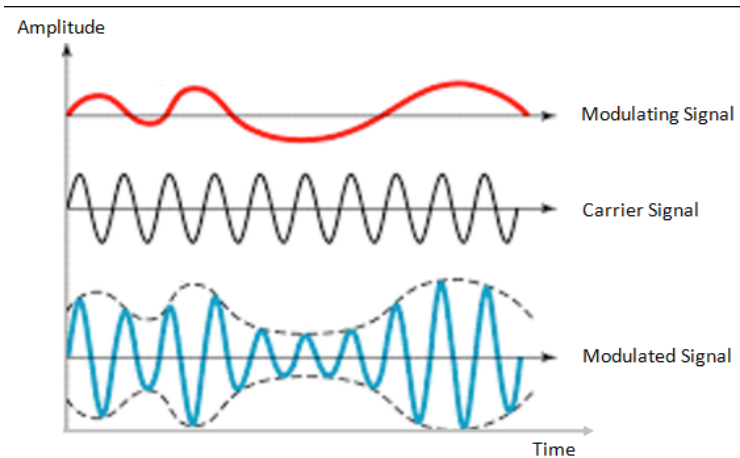
- An oscillator generates the signal
- Transmitter is either on or off ... no modulation of the carrier
- Some digital modes, such as RTTY, alternate between higher amplitudes and lower amplitudes
- Very narrow bandwidth
 - CW Morse code is 150 Hz (use a 500 Hz filter)
 - Other CW modes are only slightly wider



T4B10, T8A05, T8A11

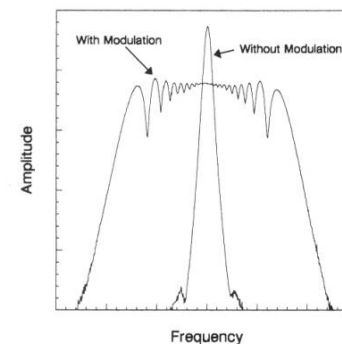
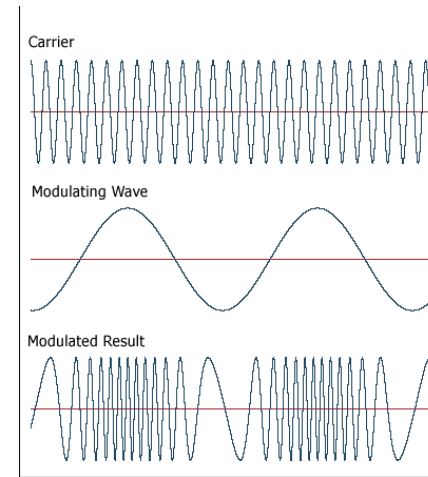
Amplitude Modulation

- A microphone or similar generates a modulating signal
- An Oscillator generates a carrier signal
- A mixer combines the modulating signal and the carrier
- The amplitude of the resulting wave form varies in time with the modulating signal
- AM signals are about 6 kHz wide and have a center carrier with an upper and a lower sideband



Frequency Modulation

- An oscillator generates a carrier
- A microphone or similar creates a modulating wave
- A modulator varies the carrier frequency over time with the modulating wave
- FM voice signals have a bandwidth up to 25 kHz
- When using a repeater, the strongest FM signal wins



T4B01, T7B01, T8A04, T8A09

More About FM

Most Technicians make primary use of FM emissions

Frequency Modulation is used for VHF/UHF voice repeaters. Typical repeater bandwidth is 10-15 kHz.

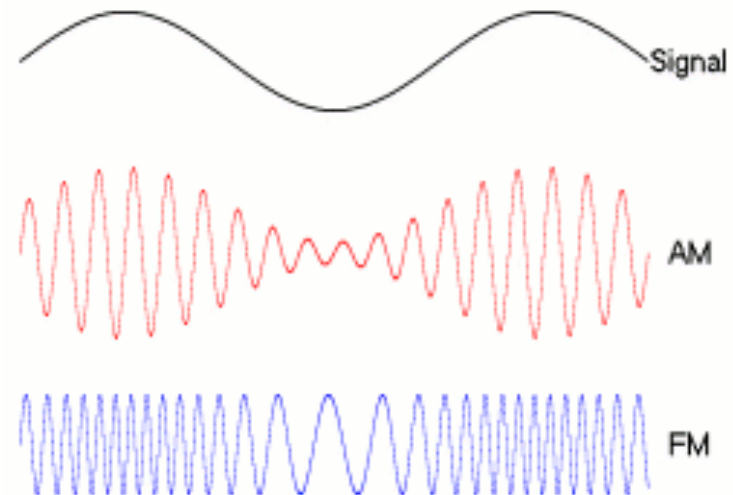
Frequency deviation is used in FM radio to describe the maximum difference between an FM modulated frequency and the nominal carrier frequency. The width of an FM signal varies as the carrier is modulated. The amount of variation in the width is called “deviation”. If the fully modulated signal “deviates” more than 25 kHz, it is over deviating. Usually that is caused by talking too loudly into the microphone or holding the microphone too close to the mouth.

If someone receiving your HT signal says you are “over deviating”, move the microphone away from your mouth.

Some multi-function transceivers have a microphone gain setting. If you are over-deviating, also check the mike gain setting

AM vs FM

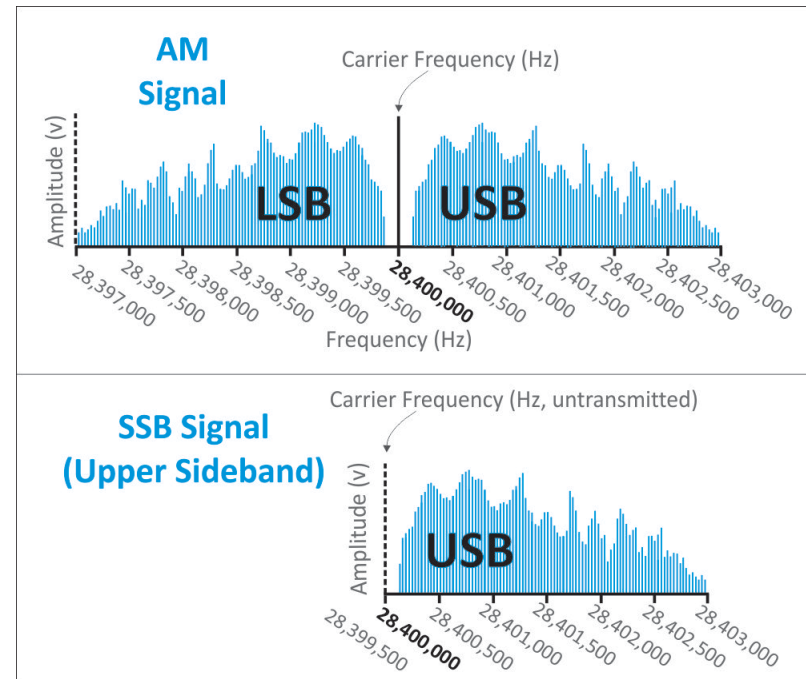
- In AM modulation, the amplitude of the signal varies. Low signal means lower amplitude
- In FM modulation, the frequency of the signal expands or contracts based on the modulating signal



Single Side Band

- A form of amplitude modulation
- An oscillator generates a carrier
- A microphone or similar creates the modulating wave
- A mixer combines the carrier and the modulating signal
- A filter strips the center carrier and unwanted sideband
- SSB signals have about a 3 kHz bandwidth (use a 2.4 kHz filter)
- Convention for SSB voice is to use lower sideband on 40 meters and below and to use upper sideband on 60 meters and above

T4B09, T8A01, T8A03, T8A06, T8A07, T8A08



- Digital modes using single sideband as the carrier are (almost) always upper sideband regardless of the frequency

Multi-mode Transceiver

- A transmitter and receiver in the same box with a method to switch the receiver out of the circuit when the transmitter is operating
 - Multiple bands and modes
 - Switching modes switches in the proper filter
- Most include a Receiver Incremental Tuning (RIT) control to manage the pitch of a SSB signal
- Usually have multiple bandwidth choices to reduce noise or interference
- The ability of the receiver to pull out weak signals is the receiver's sensitivity

T4B06, T4B07, T4B08, T4B09, T7A01, T7A02, T7A04



- The selectivity of the receiver is its ability to discriminate between multiple signals

FM Radio Characteristics

- **Squelch:** mutes the receiver when there is no incoming signal
- **Memories:** A quick way to access a favorite frequency on your transceiver
- **Variable Frequency Oscillator (VFO):** Method to set the operating frequency of the transceiver. Some transceivers also have a keypad to set the operating frequency
- **Scan:** Ability to quickly cycle through a range of frequencies of memories to check for activity



Some Important Definitions

- **Oscillator**: a circuit that generates a signal at a specific frequency
- **Mixer**: a non-linear device that takes two radio signals and creates the sum and difference frequencies of the two input frequencies
- **Automatic Gain Control** (AGC): Used to (somewhat) level out the huge variations in signal strength making the audio relatively constant. The AGC speed can often be set
- **Transverter**: A device that converts the RF input and output of a transceiver to another band. Often used for microwave and very low frequency systems
- **RF Preamplifier**: If needed (and rarely is needed) is placed between the antenna and the receiver to boost weak signals
- **Modulation**: the process of combining speech with an RF carrier

T4B11, T7A03, T7A05, T7A06, T7A08, T7A11

**Jot down any questions
you may have to ask
during the online meeting**