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FOR HAM RADIO

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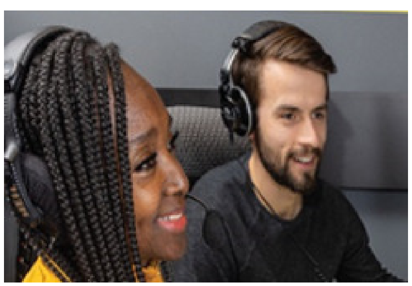

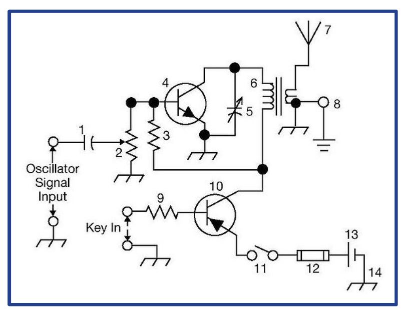

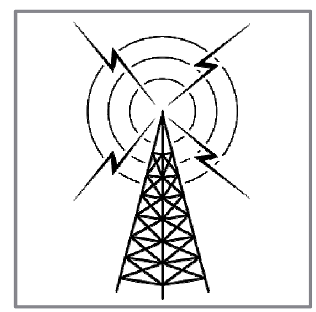

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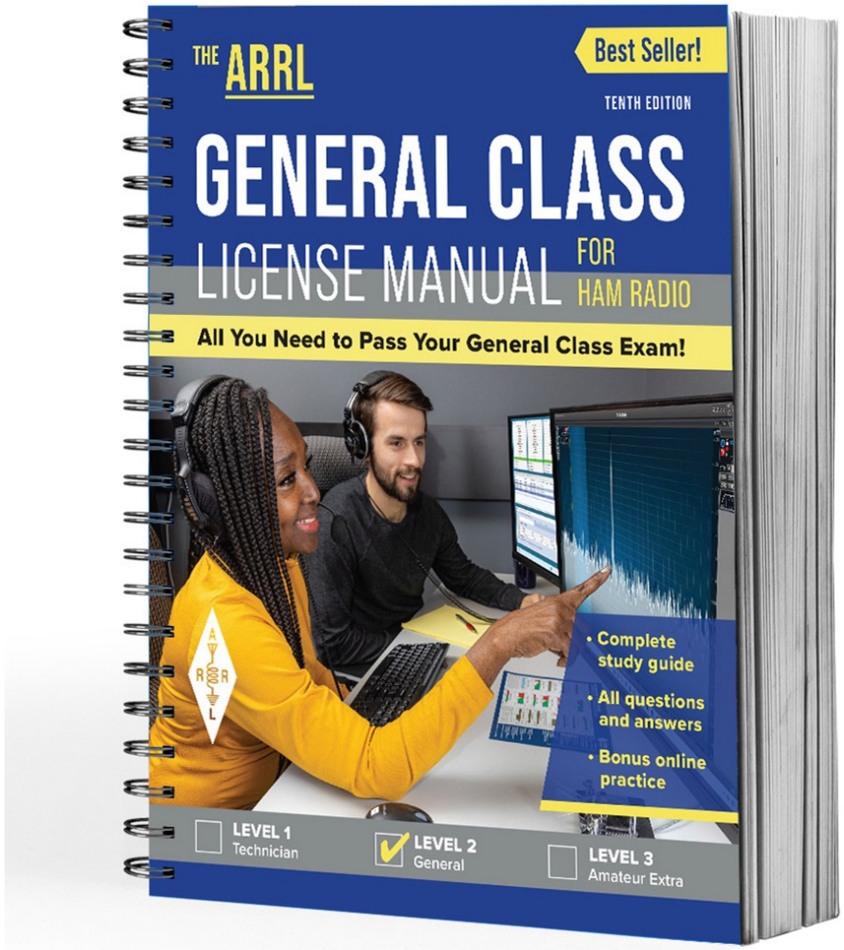

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Chapter 5 Part 1 of 2

ARRL General Class
Radio Signals & Equipment
Sections 5.1, 5.2, 5.3

Basic Modes & Bandwidth, Radio's Building Blocks, Transmitters

Section 5.1

Basic Modes & Bandwidth: Amplitude Modulated Modes

- Varying the power or amplitude of a signal to add speech or data is called *amplitude modulation* (AM)
- This info contained in the signal's envelope – the max values of the instantaneous power for each cycle
- The process of recovering speech or music from the AM envelope is called *detection*
- AM signals are composed of a *carrier* and two *sidebands* (upper and lower … USB and LSB)

Amplitude Modulated Modes (cont.)

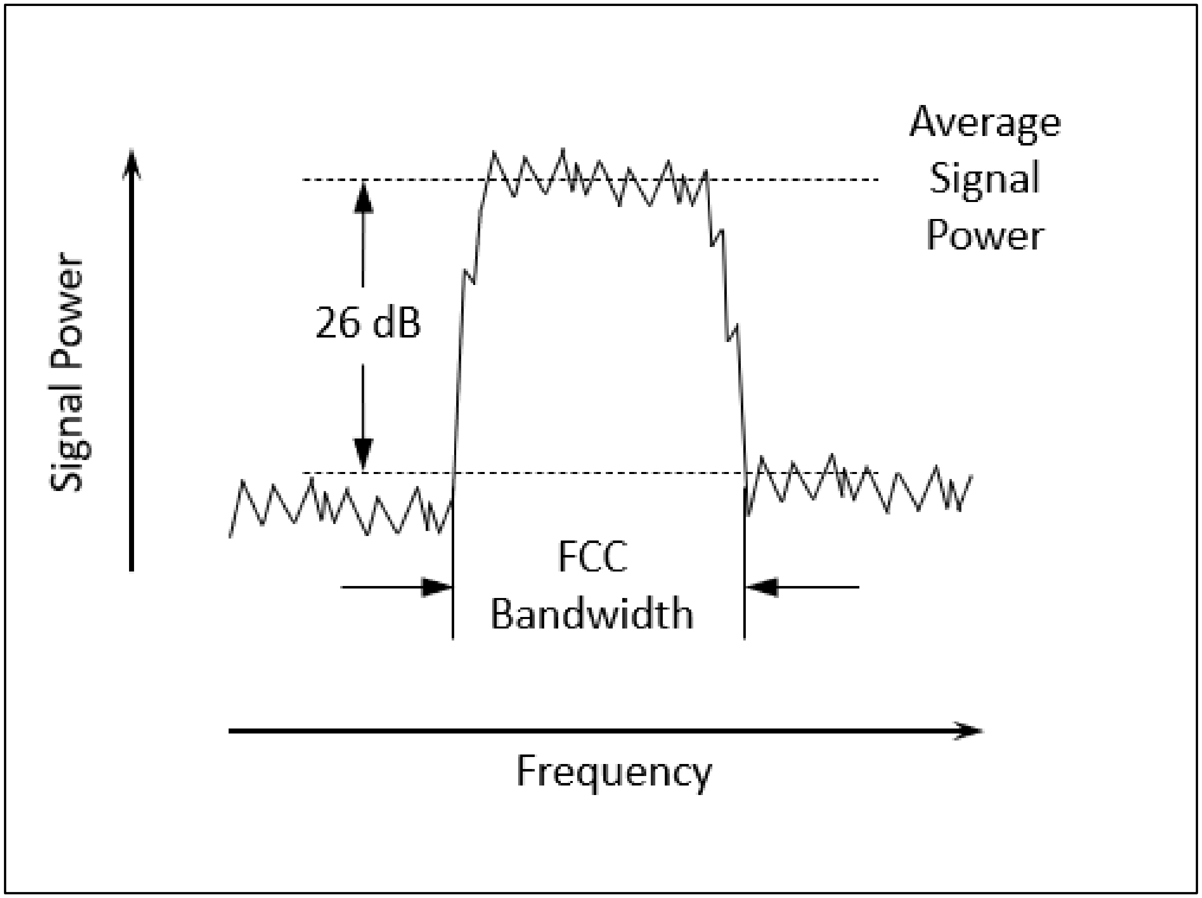
- When an AM signal is modulated by a tone, the two sidebands are steady and unchanging (as long as the tone is transmitted)
- Upper sideband is higher in frequency than the carrier; lower sideband is lower in frequency than carrier
- AM signal with the carrier and one sideband removed is a single sideband signal (SSB)
- SSB transmissions have more range than AM because all the SSB's power is contained in a single sideband. The SSB's smaller bandwidth makes it possible to fit more signals in a fixed frequency range.

Frequency & Phase Modulated Modes

- Modes that vary the frequency of a signal to add speech or data info are called *frequency modulation* (FM)
- Frequency is varied in proportion to the instantaneous amplitude of the modulating signal
- Phase modulation (PM) is created by varying the signal's *phase angle*
- These signals have a constant power, whether modulated or not

Bandwidth Definition

Figure 5.1: The FCC defines bandwidth as *the width of a frequency band outside of which the mean [average] power of the transmitted signal is attenuated at least 26 dB below the mean power.*



Bandwidth Definition (cont.)

- The difference in frequency between the lowest and highest component of a composite signal is the signal's *bandwidth*
  - See Fig 5.1 for the FCC definition (previous slide)
- The FCC limits signal bandwidth so that many stations and types of signals can share the limited amount of spectrum space (see Table 5.1, next slide)

Table 5.1: Amateur Signal Bandwidths

Most Common Amateur Signals

Type of Signal	Typical Bandwidth
AM voice	6 kHz
Amateur television	6 MHz
SSB voice	2 to 3 kHz
Digital using SSB	50 to 3000 Hz (0.05 – 3 kHz)
CW	100 to 300 Hz (0.1 – 0.3 kHz)
FM voice	5 to 16 kHz

Link Budgets

- Telecommunications term that accounts for all the power gains and losses a signal experiences within a system
- In amateur radio, this is generally the transmit power and antenna gains from the sending station minus any system losses the receiving station experiences
- Losses result from ionospheric refraction, attenuation, or a variety of other causes
- *Link margin* (LKM) is the difference between the minimum power level needed to receive a signal and the actual power level of the received signal (measured in dB)

PRACTICE QUESTIONS

ARRL The National Association for Amateur Radio®

What is the name of the process that changes the phase angle of an RF signal to convey information?

A. Phase convolution
B. Phase modulation
C. Phase transformation
D. Phase inversion

G8A02 (B) Page 5-2

What is the name of the process that changes the instantaneous frequency of an RF wave to convey information?

A. Frequency convolution
B. Frequency transformation
C. Frequency conversion
D. Frequency modulation

What type of modulation varies the instantaneous power level of the RF signal?

A. Power modulation
B. Phase modulation
C. Frequency modulation
D. Amplitude modulation

Which of the following phone emissions uses the narrowest bandwidth?

A. Single sideband
B. Vestigial sideband
C. Phase modulation
D. Frequency modulation

What is a link budget?

A. The financial costs associated with operating a radio link

B. The sum of antenna gains minus system losses

C. The sum of transmit power and antenna gains minus system losses as seen at the receiver

D. The difference between transmit power and receiver sensitivity

G8A13 (C) Page 5-3

What is link margin?

A. The opposite of fade margin
B. The difference between received power level and minimum required signal level at the input to the receiver
C. Transmit power minus receiver sensitivity
D. Receiver sensitivity plus 3 dB

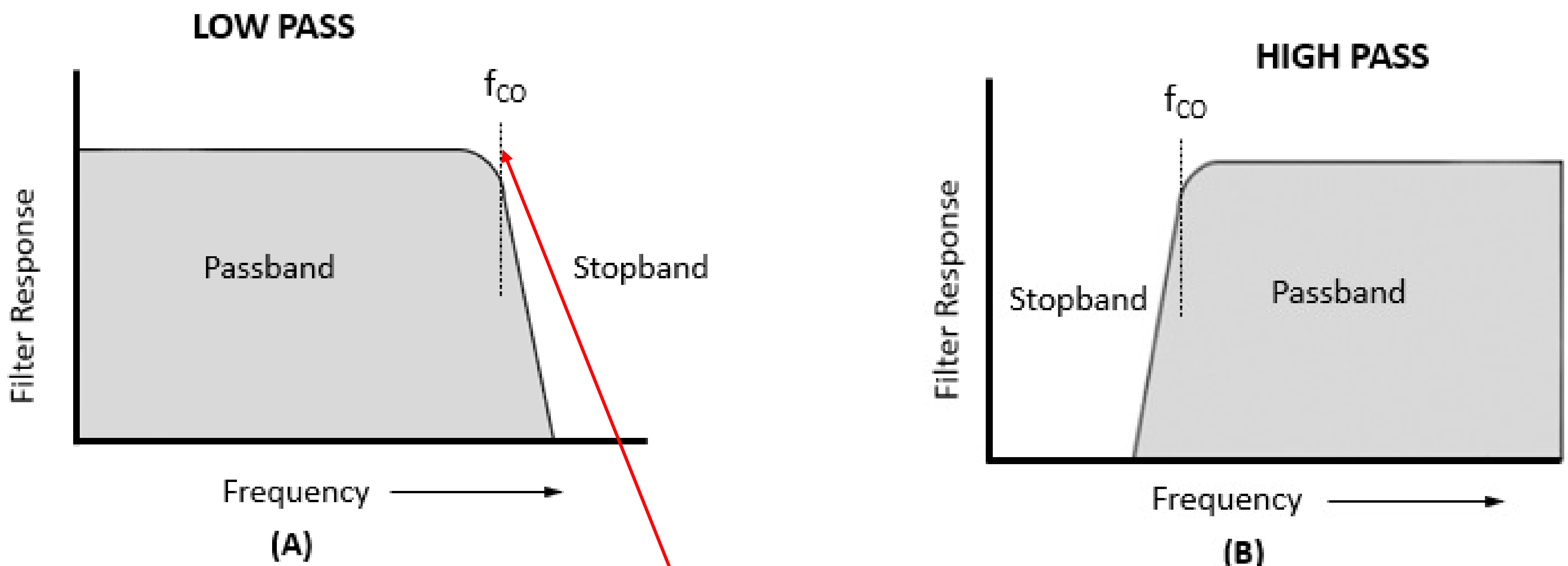
Section 5.2
Radio's Building Blocks

- Nearly all radios are made up of a few fundamental types of circuits
- There's a variety of ways circuits are built, but basic functions are the same
- Radio circuits that perform signal generating & processing functions can also be performed on digital data by software in a radio that uses *digital signal processing* (DSP) … referred to as *software-defined radio* (SDR)

Filters

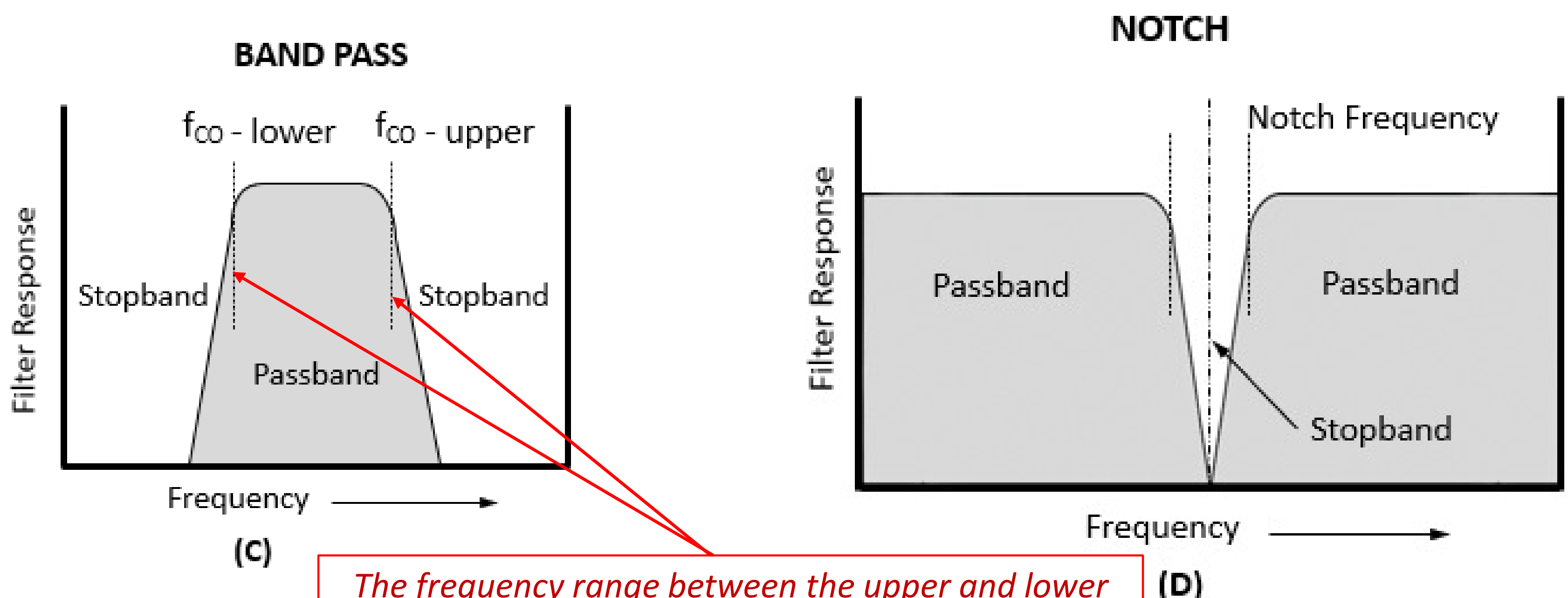
- Used to *attenuate* (reduce in strength) or pass signals
- Classified by their *response* (how they act on signals)
- Range of signals passes is the *passband*
- Range of signals attenuated is the *stopband* (attenuation is also referred to as *rejection*)

Figure 5.2 – Generic filter response curves showing how filters of different types affect signals. A larger filter response means less attenuation of the signal cutoff frequencies are shown as f_{CO}.



The cutoff frequency is the frequency at which the output signal power is reduced to one-half that of the input signal. Above a low-pass filter's cutoff frequency, the attenuation generally increases with frequency.

Figure 5.2 – Generic filter response curves showing how filters of different types affect signals. A larger filter response means less attenuation of the signal cutoff frequencies are shown as f_{CO}.



The frequency range between the upper and lower cutoff frequencies is the filter's bandwidth.

Filters (cont.)

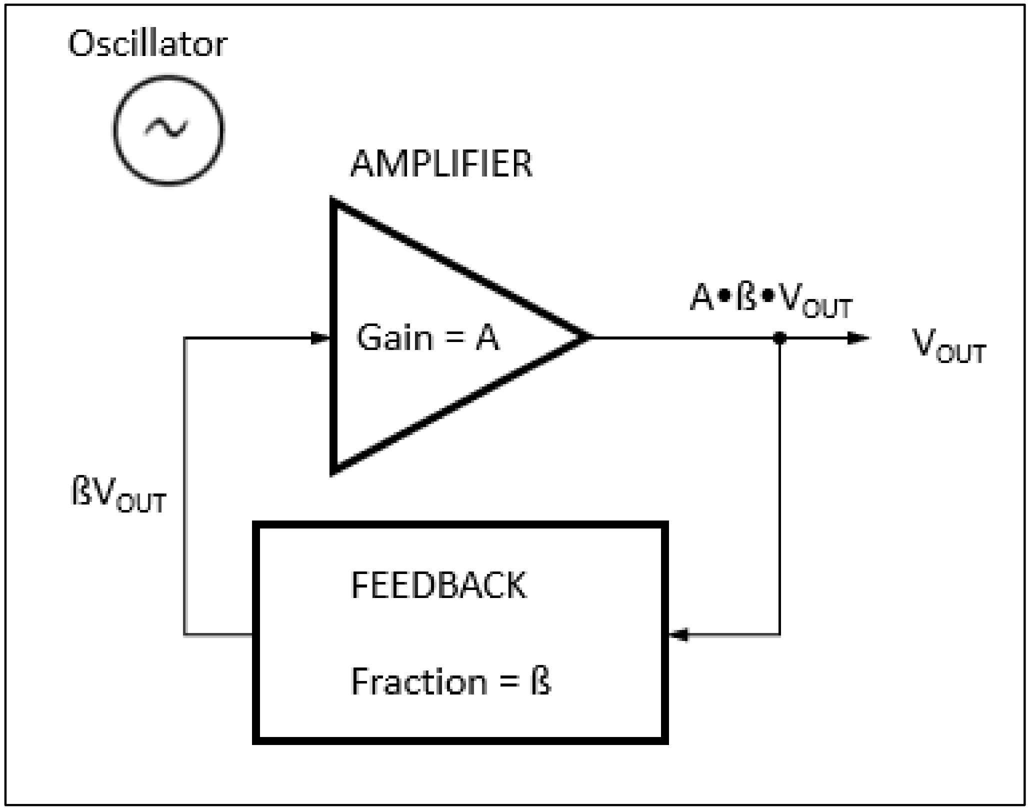
- *Low-pass filters* (Fig 5.2A) pass all frequencies *below* the cutoff frequency with little or no attenuation. The cutoff frequency (f_{CO}) is the frequency at which the output signal power is reduced to one-half that of the input signal.
- *High-pass filter* (Fig 5.2B) is the opposite; signals are passed *above* the cutoff frequency and attenuated below.

Filters (cont.)

- *Band-pass filters* have upper and lower cutoff frequencies. Signals between these are passed … outside are attenuated.
  - Frequency range between upper and lower cutoff is the filter's *bandwidth*
  - Opposite of band-pass is *band-stop* (attenuates signals between cutoff frequencies) … narrow stopbands are called *notch filters*
- Even though filters pass a range of frequencies, they may attenuate signals in the passband. This is called *insertion loss*.
- Outside passband, attenuation may vary, but maximum attenuation is the filter's *ultimate rejection*.

Oscillators

Fig 5.3: An oscillator consists of an amplifier with feedback from the output to input. The product of gain and feedback ratio must be greater than 1 at the frequency of oscillation.



Oscillators (cont.)

- An oscillator consists of an amplifier that increases signal amplitude (*gain*) and a *feedback* circuit to route some of the amplifier's output signal back to its input
- Oscillator circuits must include a filter so that feedback is present at only the intended frequency
- The oscillator output frequency can be fixed or variable

Oscillators (cont.)

- LC oscillator's feedback circuits consist of an inductor (***L***) and capacitor (***C***) connected (in parallel or series) to form a resonant circuit
  - Often called a *tank circuit* because of their ability to store energy
  - The resonant frequency of the LC circuit (determined by the L and C values) is the frequency of the oscillator
- The output frequency of a *variable-frequency oscillator* (VFO) can be adjusted by changing the ***L*** or ***C***. VFOs are used to tune a radio to different frequencies.

Oscillators (cont.)

- Two other widely used VFO circuits are …
  - *Phase-locked loop* (PLL)
  - *Direct digital synthesizer* (DDS)
    - Controllable by software
    - Comparable stability to crystal oscillators
    - Used as the high-stability VFO in most current transceivers

Mixers

- Mixers change signals to another frequency
- A mixer circuit combines signals with two frequencies, ***f_1*** and ***f_2***, and produces signals with the **sum and difference** frequencies at its output (*heterodyning*)
- Example …
  - f_1 = 14.050 MHz
  - f_2 = 3.35 MHz
  - There will be output signals at 17.4 ($f_1 + f_2$) and 10.7 ($f_1 – f_2$) MHz

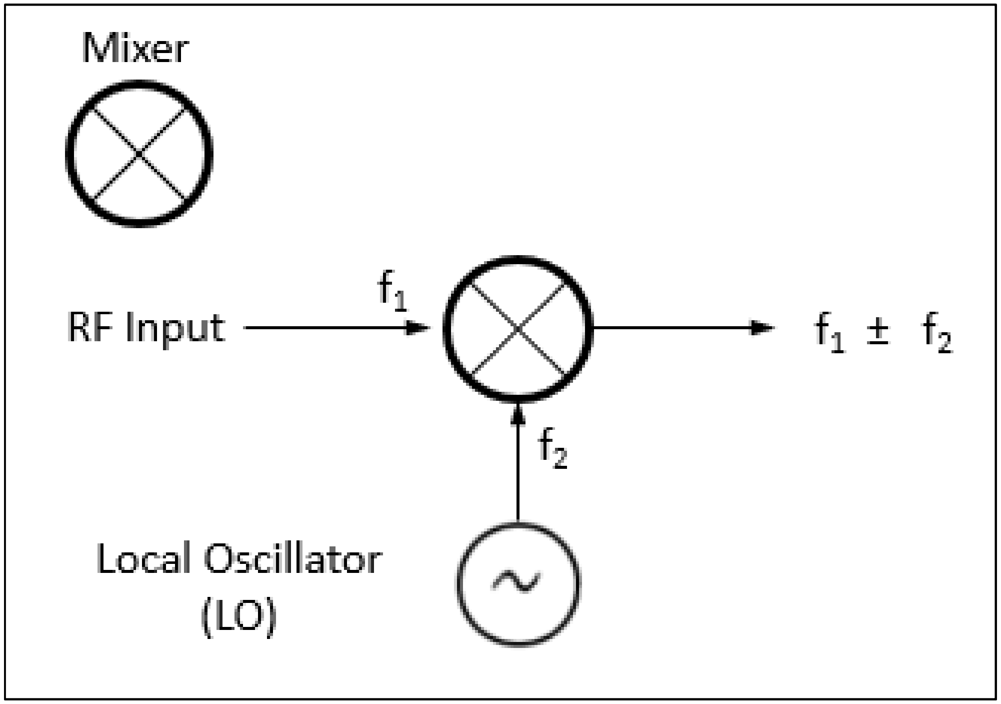


Fig 5.4: The mixer combines signals of different frequencies, producing signals at the sum and difference frequencies.

Multipliers (see Fig 5.5 in text)

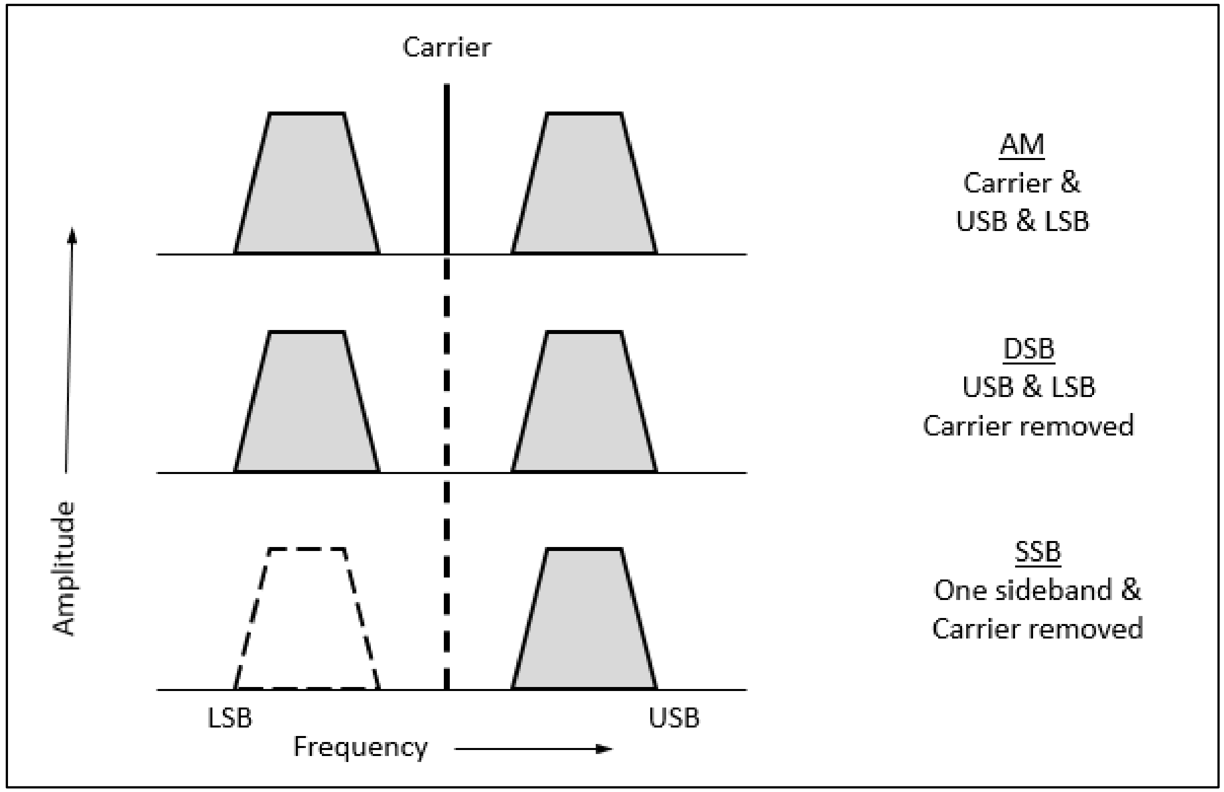
- Similar to a mixer
- Creates a *harmonic* of an input frequency
- Multipliers are often used when a stable VHF or UHF signal is required that cannot be generated directly at VHF/UHF
- A low-frequency oscillator supplies the multiplier input, and the output is tuned to the desired harmonic of the input signal
- Also used in FM transmitters (covered later)

Modulators

- Add info to a carrier signal by varying the carrier’s amplitude, frequency, or phase
- Can be used for AM, FM, or SSB

Amplitude Modulation

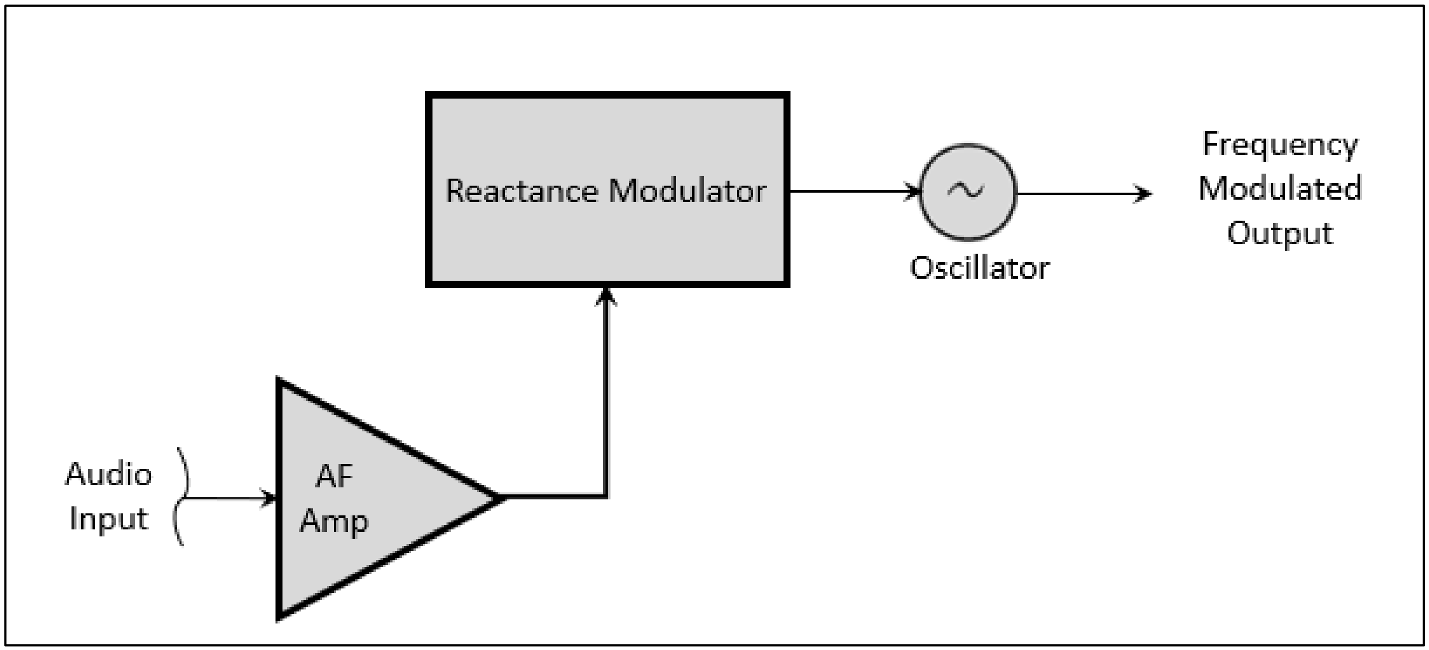
Figure 5.6: The spectrum of 3 types of AM signals. Full AM has both sidebands and the carrier. The carrier is represented by the vertical line in the middle, and the sidebands contain speech or data signals that have been used to modulate the carrier. DSB removes the carrier, but has the same bandwidth as full AM. SSB removes one sideband and has the lowest bandwidth of the 3.



Amplitude Modulation (cont.)

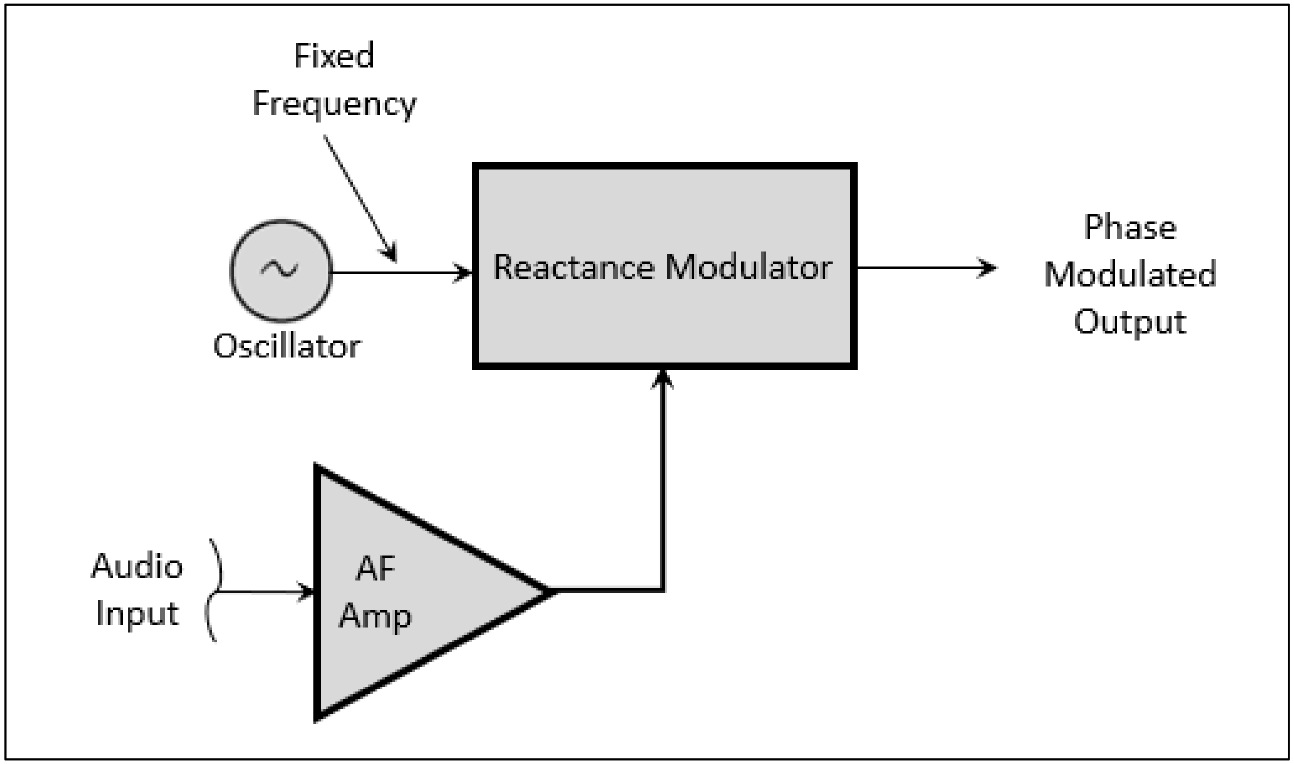
- DSB can be produced by a *balanced modulator* – special mixer where f_1 is the carrier and f_2 is the modulator
- SSB is generated by removing the unwanted sideband and carrier with a filter (filter method) or by combining signals with certain phase relationships (phasing method)
- Using only one sideband uses transmitted output power more effectively

Frequency & Phase Modulation: Figure 5.7



(A) FREQUENCY MODULATION

Frequency & Phase Modulation: Figure 5.7



(B) PHASE MODULATION

Frequency & Phase Modulation (cont.)

- *Frequency modulation* (FM) – the signal frequency varies in proportion to modulating signal's amplitude – called *deviation*
- *Phase modulation* (PM) – deviation varies with both amplitude and frequency of the modulating signal … produced by a *reactance modulator* connected to a tuned RF amplifier following the oscillator
- When modulation is applied, the phase of the carrier will be changed, but the average frequency will NOT change
- Sound identical on the air

Quadrature Modulation

- Also called *I/Q modulation* because of the I & Q signals that create the modulated output signal
- Used to transmit digital data, but different combinations of I & Q signals can create signals with any form of modulation
- The RF output of the *combiner* consists of a pair of modulated signals that have carrier signals 90° different in phase
- Widely used in *software-defined radios* (SDR) … where traditional analog components have been replaced by programming (e.g., filtering, modulation, detection, etc.)

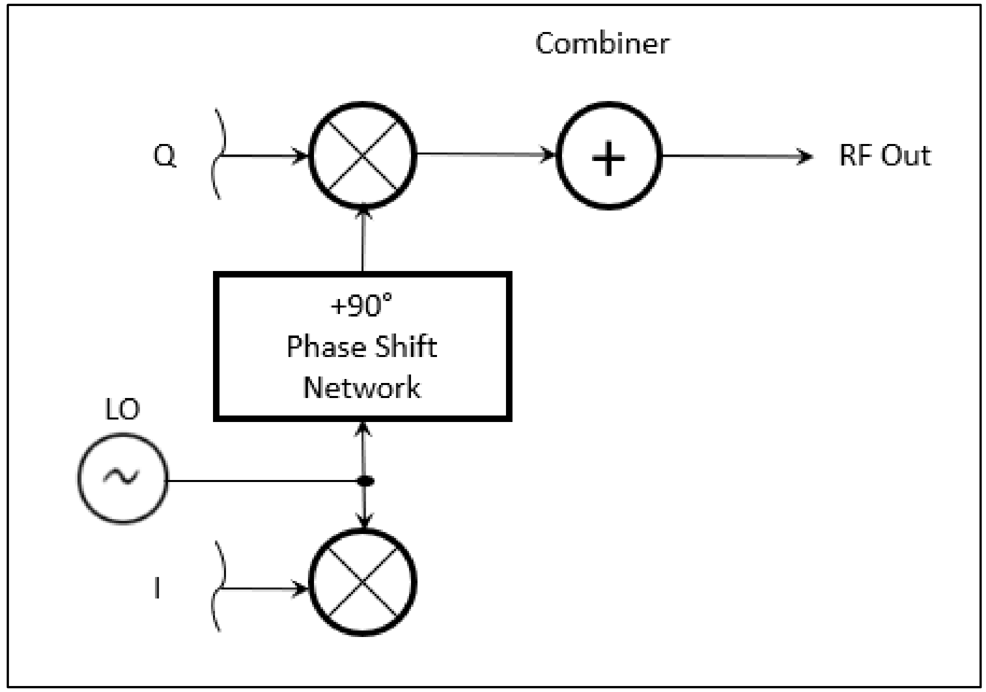


Fig 5.8: Block diagram of an I/Q modulator. **I** & **Q** are designators for input signals that can be analog signals or streams of digital data.

Quadrature simply means phase-shifted by 90 degrees.

PRACTICE QUESTIONS

Which of the following are basic components of a sine wave oscillator?

A. An amplifier and a divider
B. A frequency multiplier and a mixer
C. A circulator and a filter operating in a feed-forward loop
D. A filter and an amplifier operating in a feedback loop

What determines the frequency of an LC oscillator?

A. The number of stages in the counter
B. The number of stages in the divider
C. The inductance and capacitance in the tank circuit
D. The time delay of the lag circuit

Which of the following is characteristic of a direct digital synthesizer (DDS)?

A. Extremely narrow tuning range
B. Relatively high-power output
C. Pure sine wave output
D. Variable output frequency with the stability of a crystal oscillator

What term specifies a filter's attenuation inside its passband?

A. Insertion loss
B. Return loss
C. Q
D. Ultimate rejection

What is the phase difference between the I and Q RF signals that software-defined radio (SDR) equipment uses for modulation and demodulation?

A. Zero
B. 90 degrees
C. 180 degrees
D. 45 degrees

G7C09 (B) Page 5-7

What is an advantage of using I-Q modulation with software-defined radios (SDRs)?

A. The need for high resolution analog-to-digital converters is eliminated
B. All types of modulation can be created with appropriate processing
C. Minimum detectible signal level is reduced
D. Automatic conversion of the signal from digital to analog

Which of these functions is performed by software in a software-defined radio (SDR)?

A. Filtering
B. Detection
C. Modulation
D. All these choices are correct

What is the frequency above which a low-pass filter's output power is less than half the input power?

A. Notch frequency
B. Neper frequency
C. Cutoff frequency
D. Rolloff frequency

What term specifies a filter's maximum ability to reject signals outside its passband?

A. Notch depth
B. Rolloff
C. Insertion loss
D. Ultimate rejection

The bandwidth of a band-pass filter is measured between what two frequencies?

A. Upper and lower half-power
B. Cutoff and rolloff
C. Pole and zero
D. Image and harmonic

What emission is produced by a reactance modulator connected to a transmitter RF amplifier stage?

A. Multiplex modulation
B. Phase modulation
C. Amplitude modulation
D. Pulse modulation

What is another term for the mixing of two RF signals?

A. Heterodyning
B. Synthesizing
C. Frequency inversion
D. Phase inversion

What is the stage in a VHF FM transmitter that generates a harmonic of a lower frequency signal to reach the desired operating frequency?

A. Mixer
B. Reactance modulator
C. Balanced converter
D. Multiplier

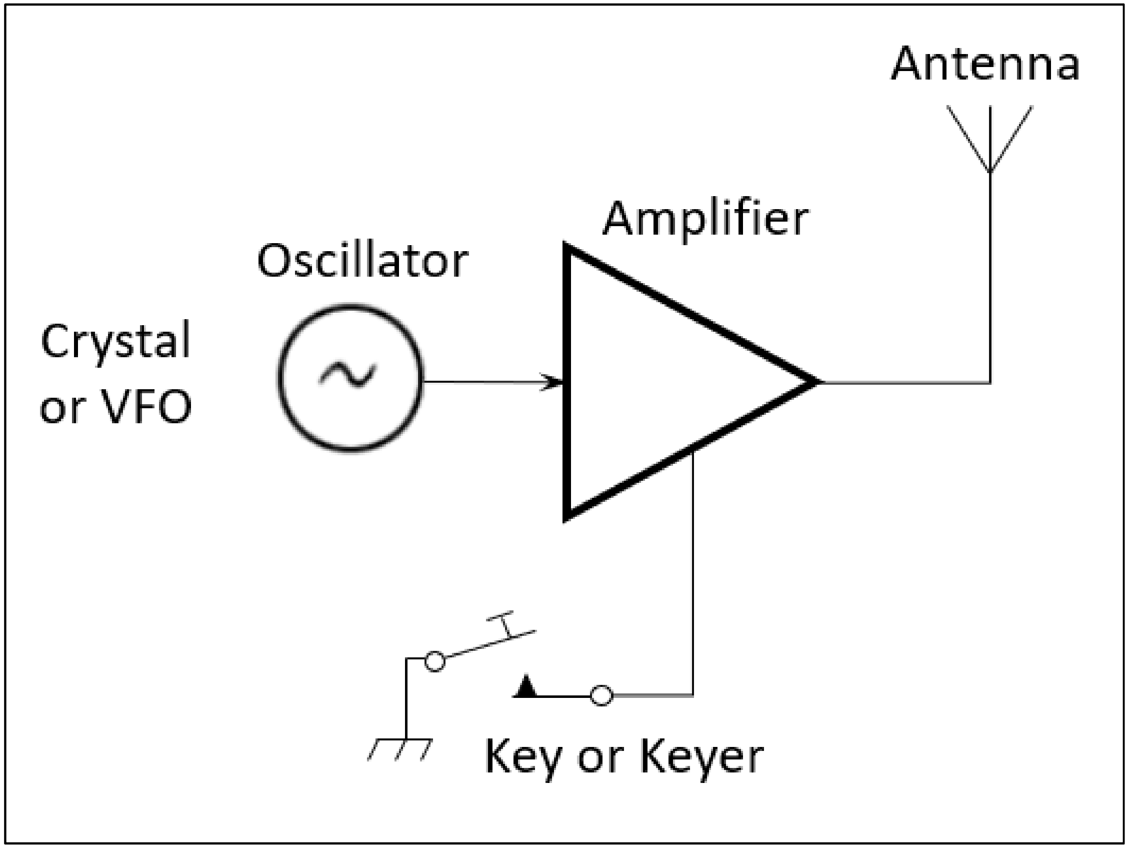
What combination of a mixer's Local Oscillator (LO) and RF input frequencies is found in the output?

A. The ratio
B. The average
C. The sum and difference
D. The arithmetic product

Section 5.3

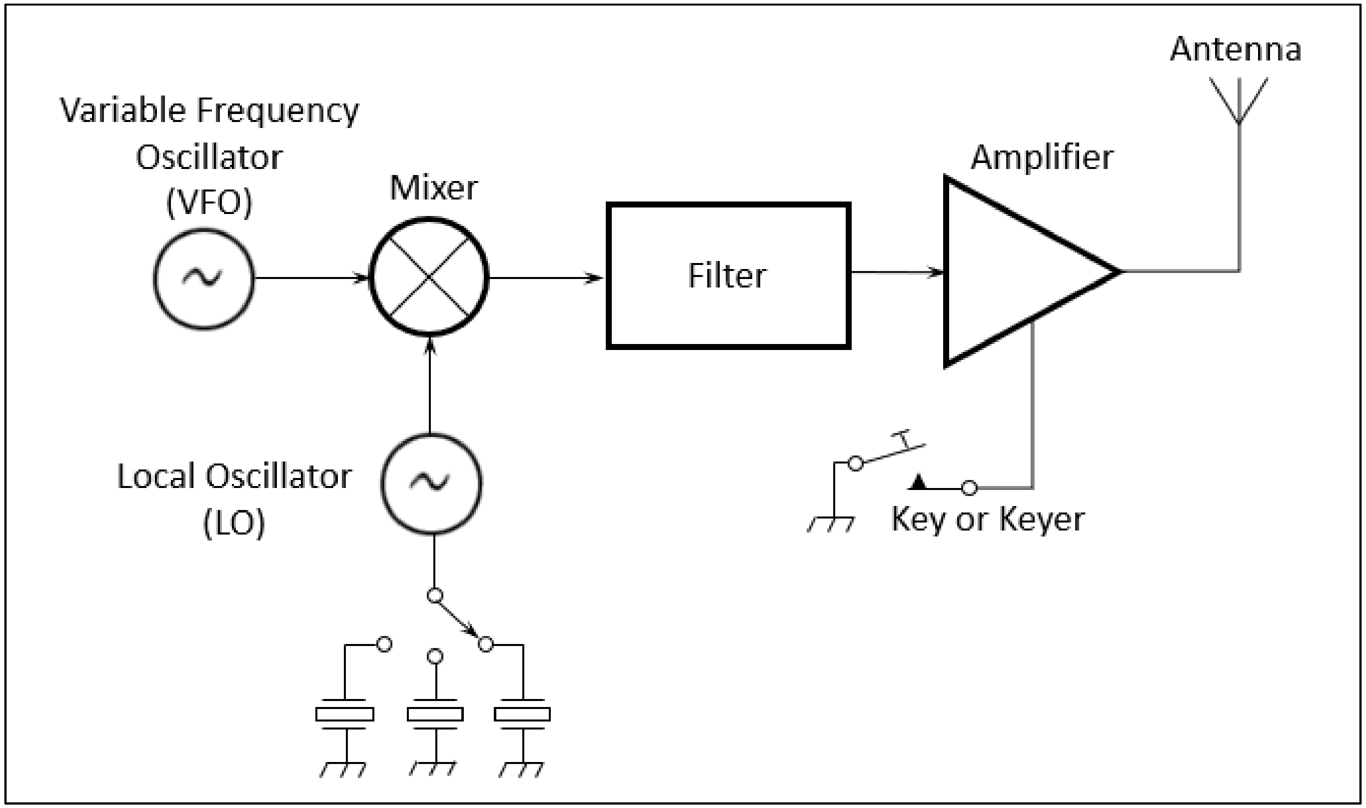
Transmitters: CW Transmitters

Fig 5.9: The simplest transmitter consists of the oscillator and amplifier and a means of turning the output signal on and off – the key (or *keyer*). A single crystal oscillator can be replaced with a variable-frequency oscillator to allow the transmitter to be tuned to different frequencies.



CW Transmitters (cont.)

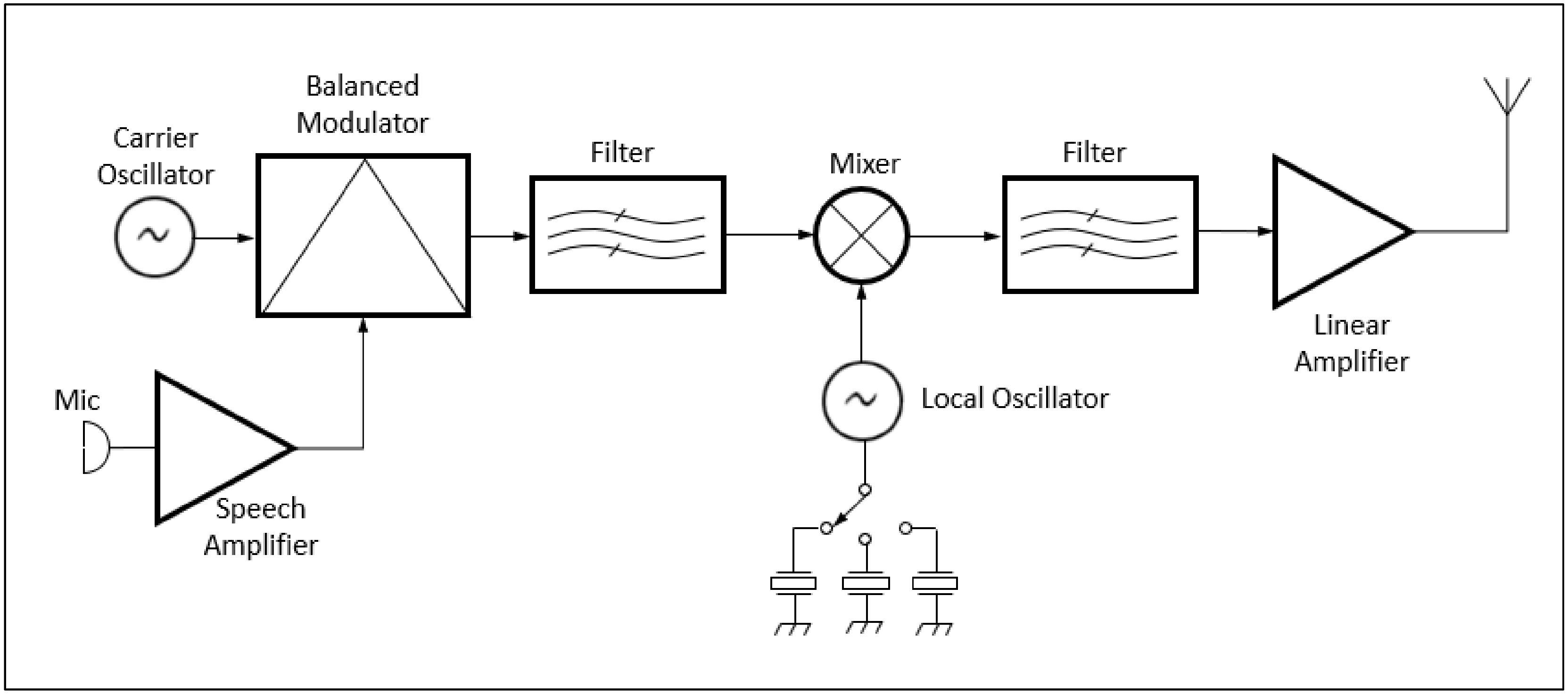
Fig 5.10: By changing the frequency of the local oscillator (LO), the VFO's output can be shifted from band to band, creating a multiband transmitter.



SSB Phone Transmitters

Fig 5.11: Substituting the circuits to create an SSB signal for the VFO creates a multiband SSB transmitter.

How to change the CW transmitter to SSB phone …



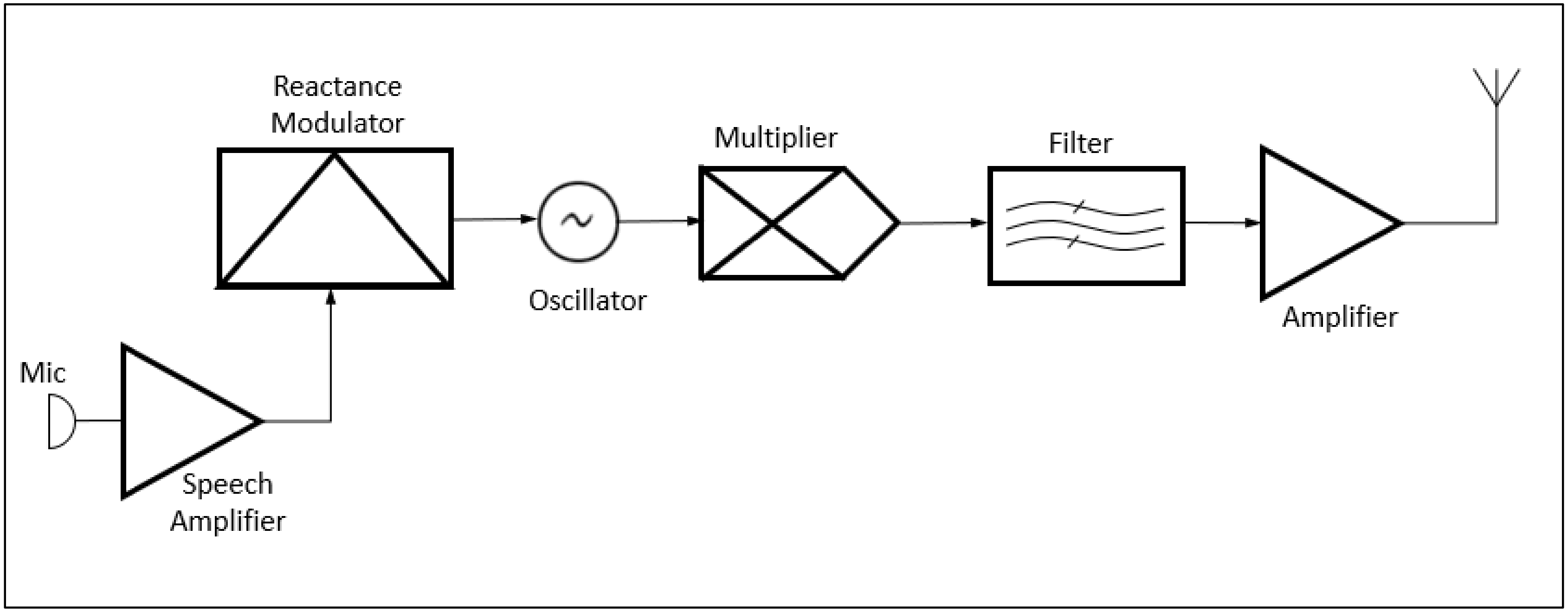
SSB Phone Transmitters (cont.)

Refer to Figure 5.11 .....

- Voice signals from a mic are processed by a speech amplifier and input to the balanced modulator
- The variable frequency oscillator is the other input to the balanced modulator
- The output is a DSB signal, so a filter is used to removed the undesired sideband, producing an SSB signal
- Distortion anywhere in the transmit chain will generate unwanted spurious signals (harmonics, mixing products, splatter, etc.)

FM Transmitters

Fig 5.12: Carrier and modulation are generated at relatively low frequencies in FM transmitters.



The modulated signal is then multiplied to the desired output frequency. The amount of signal deviation is also multiplied.

FM Transmitters (cont.)

- Modulation and frequency changing are performed differently in FM transmitters (see Figure 5.12, previous slide)
- It is much more practical to generate the signal at low frequency and multiply it to reach the desired band
- **EXAMPLE:** *In a 2 meter FM transmitter, the modulated oscillator frequency is approximately 12 MHz, and multipliers select the 12th harmonic for transmission. For an output on 146.52 MHz, the oscillator must produce a 146.52 / 12 = 12.21 MHz signal.*

FM Transmitters (cont.)

- The frequency deviation is also multiplied. For example, if the 146.52 MHz signal is to have the standard deviation of 5 MHz, the maximum oscillator deviation would be 5 / 12 MHz = 0.416.7 MHz or 416.7 Hz.
- *Carson's Rule* provides a good approximation of an FM signal's *bandwidth*.

BW = 2 × (peak deviation + highest modulating frequency)

In Our Example: If an FM phone signal's peak deviation is limited to 5 kHz and the highest modulating frequency is 3 kHz, then …

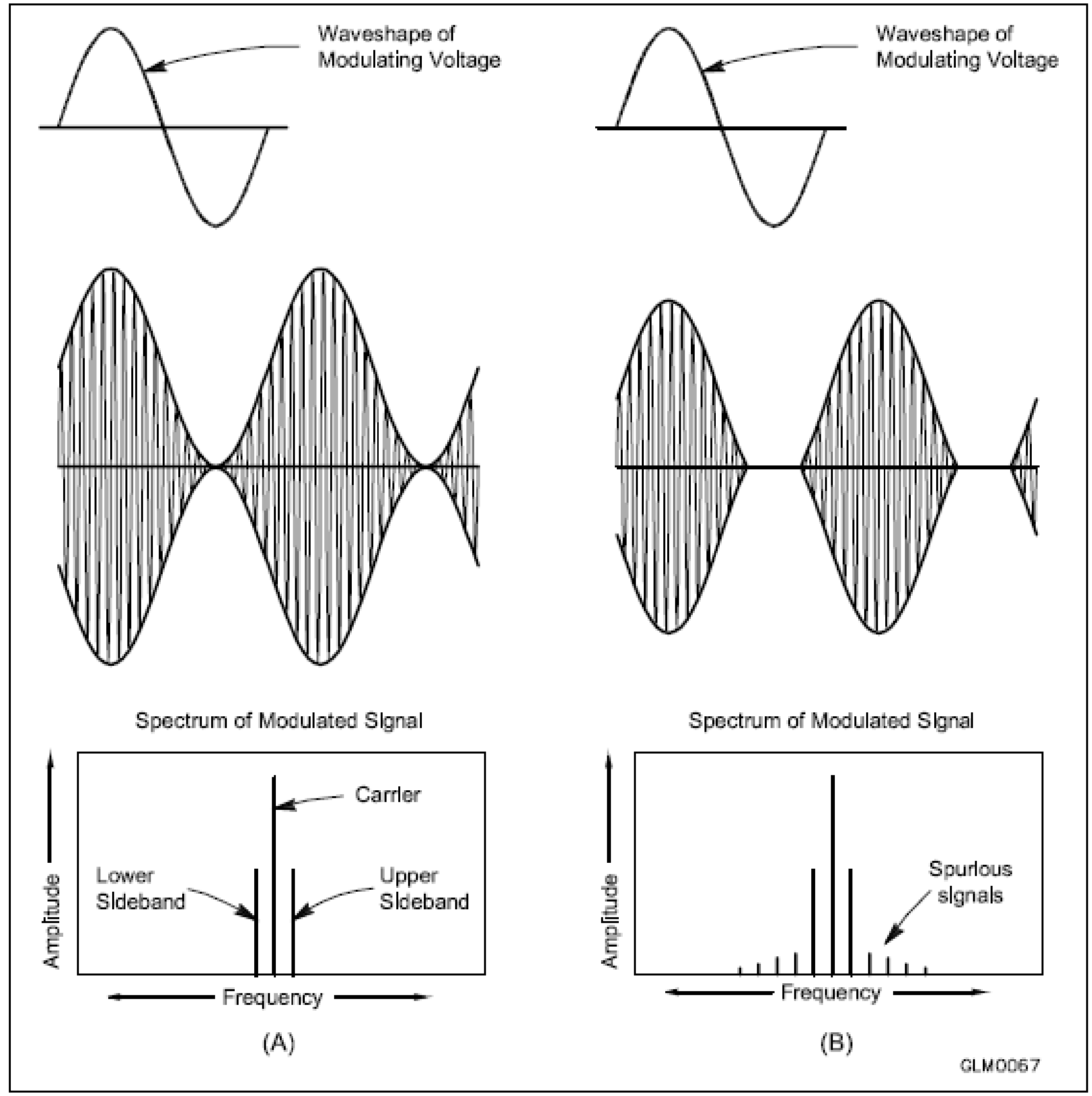
BW = 2 × (5 + 3) = 16 kHz

Signal Quality

- Overmodulation – AM Modes
  - An AM or SSB signal that varies excessively in response to the modulating signal
  - Distorts transmitted audio
  - Causes: Speaking too loudly, mic gain too high, audio gain too high

Fig. 5.13 – Modulation

- Modulation envelope of an AM signal, waveform created by connecting the peaks of the modulated signal – modulation envelope of an SSB signal is similar
- **A** – Properly modulated signal
- **B** – Example of *cutoff* (transmitter output is turned off instead of following the modulating signal)



Overmodulation – AM (cont.)

- Refer to Fig 5.13B
  - Example of *cutoff* … transmitter output is turned off instead of following the modulated signal
    - *Flattopping* occurs when transmitter output reaches a maximum limit and cannot increase further, even though the modulating signal is increasing
    - If output signal is completely cut off between peaks, the result is *carrier cutoff*
    - Both types of overmodulation cause interference by generating spurious signals (aka *distortion products*) beyond normal signal bandwidth (called *splatter* or *buckshot*)

Overmodulation – AM (cont.)

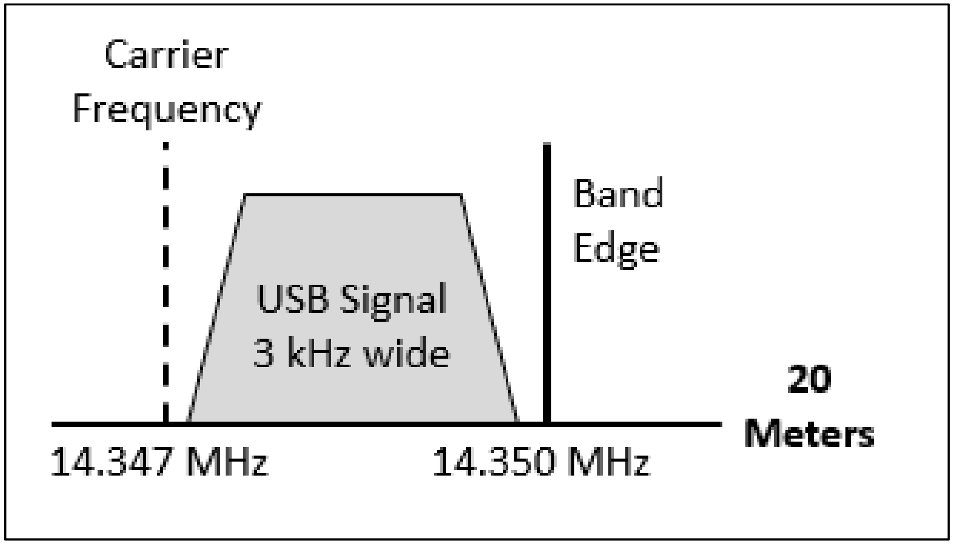
- ALC (*automatic level control*) circuits in the transmitter help prevent this … reduces output power during voice peaks
  - Controlled by properly setting transmit audio or microphone gain
  - Should be adjusted to activate only on voice peaks
- *Two-tone test* is used to monitor transmitter linearity … keeps signal clean
  - Only needs to be performed occasionally to note appropriate gain settings and level adjustments
  - *Two-tone* comes from use of 2 non-harmonically related signals for the test

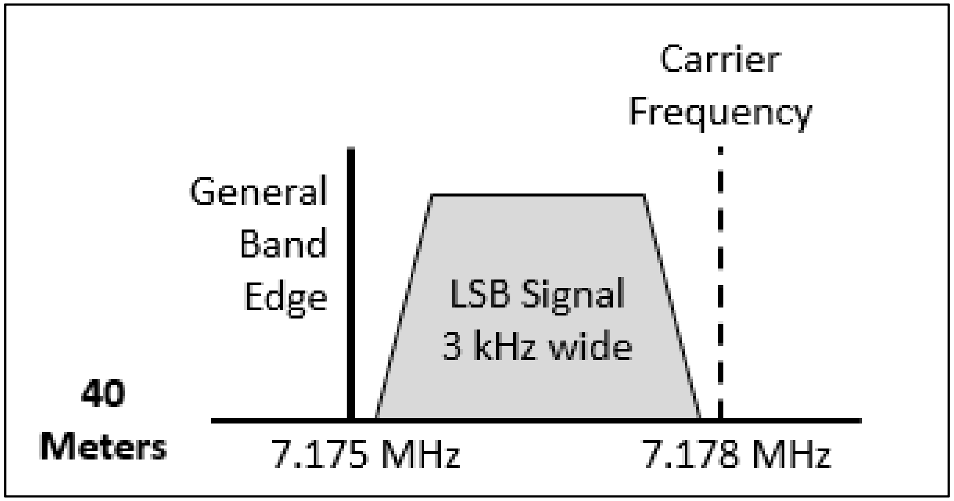
Controlling Sideband Frequency

- Most radios display carrier frequency of the SSB signal
  - Actual signal lies entirely above (USB) or below (LSB) this frequency
- Each SSB occupies 3 kHz, so you will need to stay far enough from edge of frequency privilege to avoid illegal transmission
  - For Generals, using LSB on 40 m, operate with carrier frequency at least 3 kHz above the edge of the band segment – 7.178 MHz (occupying 7.175 to 7.178 MHz … see Fig 5.14)

Fig 5.14

When sidebands extend from the carrier toward a band edge or a band segment edge, operate with a displayed carrier frequency no closer than 3 kHz to the edge frequency and be sure your signal is "clean."



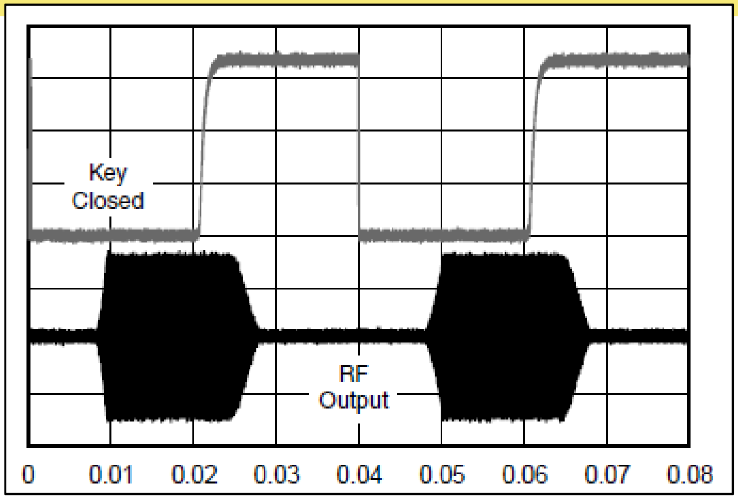


Speech Processing

- Average power of an AM or SSB signal is much lower than CW
  - When transmitted over HF as an AM signal in the presence of noise, interference, etc., the received signal can be difficult to understand
- *Speech processing* increases the average power of the signal without distorting it … result is improved intelligibility of the received signal in poor conditions
- Caution: Speech processors can also amplify low-level background noise, reducing intelligibility

CW Key Clicks

Sharp transient clicking sounds heard on adjacent frequencies as a transmitter turns on and off too rapidly during CW transmissions or if transmitter turns on/off erratically.



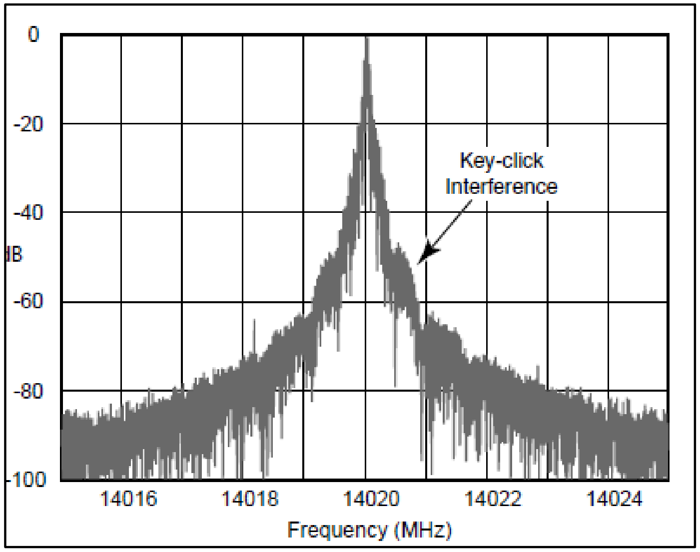


Fig. 5.15: CW waveforms can be inspected using a monitoring oscilloscope.

PRACTICE QUESTIONS

What control is typically adjusted for proper ALC setting on a single sideband transceiver?

A. The RF clipping level
B. Transmit audio or microphone gain
C. Antenna inductance or capacitance
D. Attenuator level

G2A12 (B) Page 5-12

What signals are used to conduct a two-tone test?

A. Two audio signals of the same frequency shifted 90 degrees
B. Two non-harmonically related audio signals
C. Two swept frequency tones
D. Two audio frequency range square wave signals of equal amplitude

G4B07 (B) Page 5-12

What type of transmitter performance does a two-tone test analyze?

A. Linearity
B. Percentage of suppression of carrier and undesired sideband for SSB
C. Percentage of frequency modulation
D. Percentage of carrier phase shift

What is the purpose of a speech processor in a transceiver?

A. Increase the apparent loudness of transmitted voice signals
B. Increase transmitter bass response for more natural-sounding SSB signals
C. Prevent distortion of voice signals
D. Decrease high-frequency voice output to prevent out-of-band operation

G4D01 (A) Page 5-12

How does a speech processor affect a single sideband phone signal?

A. It increases peak power

B. It increases average power

C. It reduces harmonic distortion

D. It reduces intermodulation distortion

What is the effect of an incorrectly adjusted speech processor?

A. Distorted speech

B. Excess intermodulation products

C. Excessive background noise

D. All these choices are correct

What frequency range is occupied by a 3 kHz LSB signal when the displayed carrier frequency is set to 7.178 MHz?

A. 7.178 to 7.181 MHz
B. 7.178 to 7.184 MHz
C. 7.175 to 7.178 MHz
D. 7.1765 to 7.1795 MHz

*How to derive (since the signal is **LSB**, we SUBTRACT the 3 kHz from the carrier frequency) …*

7.178 MHz = 7178 kHz
7178 kHz – 3 kHz = 7175 kHz

Answer = 7175 to 7178 kHz = 7.175 to 7.178 MHz

G4D08 (C) Page 5-12

What frequency range is occupied by a 3 kHz USB signal with the displayed carrier frequency set to 14.347 MHz?

A. 14.347 to 14.647 MHz
B. 14.347 to 14.350 MHz
C. 14.344 to 14.347 MHz
D. 14.3455 to 14.3485 MHz

G4D09 (B) Page 5-12

How close to the lower edge of a band's phone segment should your displayed carrier frequency be when using 3 kHz wide LSB?

A. At least 3 kHz above the edge of the segment
B. At least 3 kHz below the edge of the segment
C. At least 1 kHz below the edge of the segment
D. At least 1 kHz above the edge of the segment

How close to the upper edge of a band's phone segment should your displayed carrier frequency be when using 3 kHz wide USB?

A. At least 3 kHz above the edge of the band
B. At least 3 kHz below the edge of the band
C. At least 1 kHz above the edge of the segment
D. At least 1 kHz below the edge of the segment

Which of the following describes a linear amplifier?

A. Any RF power amplifier used in conjunction with an amateur transceiver
B. An amplifier in which the output preserves the input waveform
C. A Class C high efficiency amplifier
D. An amplifier used as a frequency multiplier

What circuit is used to select one of the sidebands from a balanced modulator

A. Carrier oscillator
B. Filter
C. IF amplifier
D. RF amplifier

What output is produced by a balanced modulator?

A. Frequency modulated RF
B. Audio with equalized frequency response
C. Audio extracted from the modulation signal
D. Double-sideband modulated RF

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Which of the following is an effect of overmodulation?

A. Insufficient audio
B. Insufficient bandwidth
C. Frequency drift
D. Excessive bandwidth

What is meant by the term “flat-topping,” when referring to an amplitude-modulated phone signal?

A. Signal distortion caused by insufficient collector current
B. The transmitter’s automatic level control (ALC) is properly adjusted
C. Signal distortion caused by excessive drive or speech levels
D. The transmitter’s carrier is properly suppressed

What is the modulation envelope of an AM signal?

A. The waveform created by connecting the peak values of the modulated signal
B. The carrier frequency that contains the signal
C. Spurious signals that envelop nearby frequencies
D. The bandwidth of the modulated signal

What is the total bandwidth of an FM phone transmission having 5 kHz deviation and 3 kHz modulating frequency?

A. 3 kHz
B. 5 kHz
C. 8 kHz
D. 16 kHz

What is the frequency deviation for a 12.21 MHz reactance modulated oscillator in a 5 kHz deviation, 146.52 MHz FM phone transmitter?

A. 101.75 Hz
B. 416.7 Hz
C. 5 kHz
D. 60 kHz

Amplifiers

- Radio operators (HF) sometimes use amplifiers to boost signals when conditions are poor, to accommodate difficult propagation paths, etc.
- On HF, high-power amplifiers often use vacuum tube circuits that require operator adjustment
- The efficiency of an amplifier is defined as the RF output power divided by the dc input power
- Also called *linears*

Four Common Amplifier Classes

- Class A – The most linear, lowest signal distortion, least efficient; because class A's pass the entire sinusoidal input cycle, the conduct 100% of the time
- Class B – Known as push-pull, pair of amplifying devices each active during complementary halves of the signal's cycle, good linearity, good efficiency
- Class AB – Midway between A and B, linearity not as good as A, but efficiency is improved
- Class C – Highest efficiency, only suitable for CW and FM (due to poor linearity)

Amplifiers (cont.)

- Some linear amplifiers can be operated in either Class AB for SSB operation or in Class C for CW
- Transceivers often include a delay in the keying circuit timing so that the changeover relay is completely switched before transceiver is allowed to supply any RF output
  - Prevents hot-switching in which amplifier is already supplying RF
  - Can destroy the relay or other external devices

Tuning & Driving Vacuum Tube Amplifiers

- Set BAND switch to desired frequency
- Apply drive power to amplifier while adjusting TUNE control to obtain minimum plate current (called the *dip*)
- Adjust LOAD to obtain peak output power
- Continue adjusting until max output power is obtained
- Avoid exceeding max plate current
- Input power to amplifier may also be adjusted during this process

Amplifiers (cont.)

- Tubes can be destroyed by applying too much drive
- Modern amplifiers have protective circuits
- Similar cautions apply to solid-state amplifiers with power transistors that can be destroyed with excessive drive power
- Some amplifiers generate automatic leveling control (ALC) signals that can be connected to the transmitter to limit excess drive
  - Check both the amplifier and transceiver manuals to be sure signals are compatible and so you know how to use the ALC meter readings

Neutralization

- HF amplifiers can self-oscillate because of positive feedback in an amplifier tube
- Self-oscillation creates spurious output signals and may damage the tube or amplifier components
- The technique of preventing self-oscillation is called *neutralization*
  - Done by creating negative feedback (small variable capacitor between amplifier's output and input circuits)

PRACTICE QUESTIONS

What is the effect on plate current of the correct setting of a vacuum-tube RF power amplifier’s TUNE control?

A. A pronounced peak
B. A pronounced dip
C. No change will be observed
D. A slow, rhythmic oscillation

What is a reason to use Automatic Level Control (ALC) with an RF power amplifier?

A. To balance the transmitter audio frequency response

B. To reduce harmonic radiation

C. To prevent excessive drive

D. To increase overall efficiency

What is the correct adjustment for the LOAD or COUPLING control of a vacuum tube RF power amplifier?

A. Minimum SWR on the antenna
B. Minimum plate current without exceeding maximum allowable grid current
C. Highest plate voltage while minimizing grid current
D. Desired power output without exceeding maximum allowable plate current

What is the purpose of delaying RF output after activating a transmitter's keying line to an external amplifier?

A. To prevent key clicks on CW

B. To prevent transient overmodulation

C. To allow time for the amplifier to switch the antenna between the transceiver and the amplifier output

D. To allow time for the amplifier power supply to reach operating level

What is the purpose of neutralizing an amplifier?

A. To limit the modulation index
B. To eliminate self-oscillations
C. To cut off the final amplifier during standby periods
D. To keep the carrier on frequency

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Which of these classes of amplifiers has the highest efficiency?

A. Class A
B. Class B
C. Class AB
D. Class C

In a Class A amplifier, what percentage of the time does the amplifying device conduct?

A. 100%
B. More than 50% but less than 100%
C. 50%
D. Less than 50%

How is the efficiency of an RF power amplifier determined?

A. Divide the DC input power by the DC output power
B. Divide the RF output power by the DC input power
C. Multiply the RF input power by the reciprocal of the RF output power
D. Add the RF input power to the DC output power

For which of the following modes is a Class C power stage appropriate for amplifying a modulated signal?

A. SSB
B. FM
C. AM
D. All these choices are correct

END OF CHAPTER 5 PART 1 OF 2

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Feel free to contact me if you find errors or have suggestions for improvement.