



Technician License Course
Chapter 3

Types of Radios and Radio Circuits

Module 7



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Radio Block Diagrams

Radio Circuits can be shown as functional blocks connected together.

- Knowing the description of common functions helps you to understand operation of the radio.
- Block diagrams often include information about frequencies and power levels.
- There are many types of circuits that can accomplish the function of a block.



Radio Building Blocks

We will discuss:

- Oscillators
- Amplifiers
- Filters
- Modulators
- Mixers
- Demodulators
- Detectors
- Receivers
- Transmitters



Oscillators

Oscillators generate an AC voltage. The frequency might be variable or fixed, at Audio or Radio frequencies.

- Analog oscillators are built with transistor circuits.
- Digital synthesizers use microprocessor ICs.
- A radio's Frequency or Channel control sets the frequency of an oscillator called the Variable Frequency Oscillator – VFO
- Oscillators usually operate at low (milliWatt) output power levels.
- Stability and Accuracy are important.



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Amplifiers

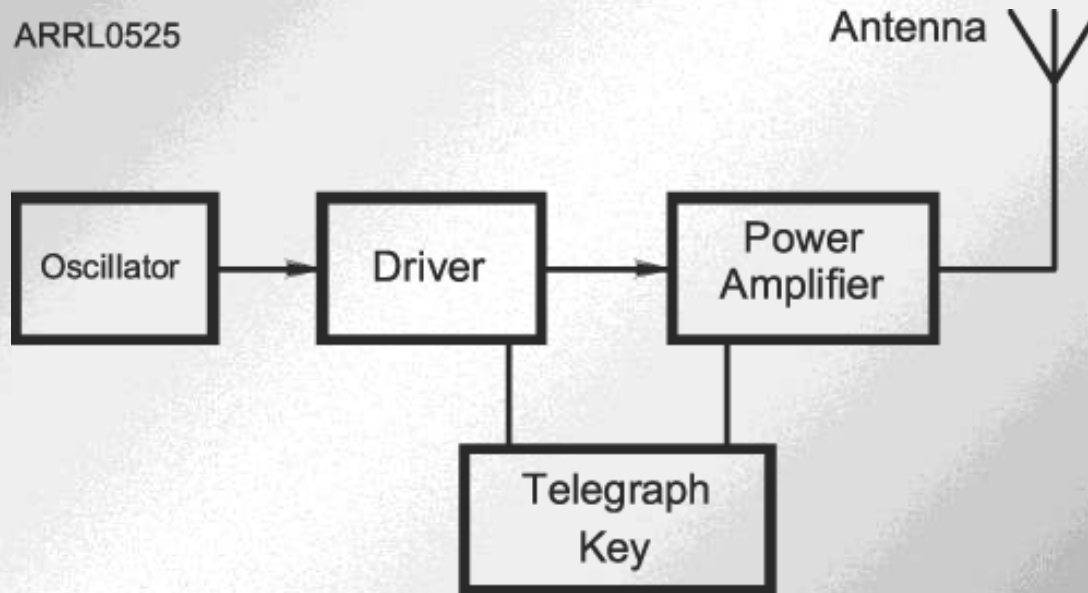
Amplifiers build up the power level of signals.
Amplifiers are rated by output power and gain.
Gain is Output Power / Input Power.

Types of Amplifiers:

- Broadband – Amplify a wide range of frequencies
- Tuned – Amplify a narrow range of frequencies
- Linear Amps – low distortion for SSB or AM.
- Non-Linear Amps – high efficiency for FM or CW.



Transmitter Block Diagram



Exam Diagram T4



Basic Radio Components – Filters

Filters attenuate undesired frequencies in a signal.

- Passive
- Active
- Broadband
- Tuned

Named for the Band Passed or Rejected

Low-Pass



High-Pass



Band-Pass



Voice Transmitter Functions

Audio Amplifiers build up and filter speech levels.

- Gain and Processing
- Low Pass Filtering

Modulators combine speech frequencies with RF frequencies.

- AM – Speech varies the Power to Amplifiers.
- FM – Speech varies the Oscillator frequency.
- SSB – Speech frequencies Mix with Oscillator frequency to generate sidebands.



Mixers Make New Frequencies

Mixers translate the frequency of a signal to a frequency called the Intermediate Frequency (IF).

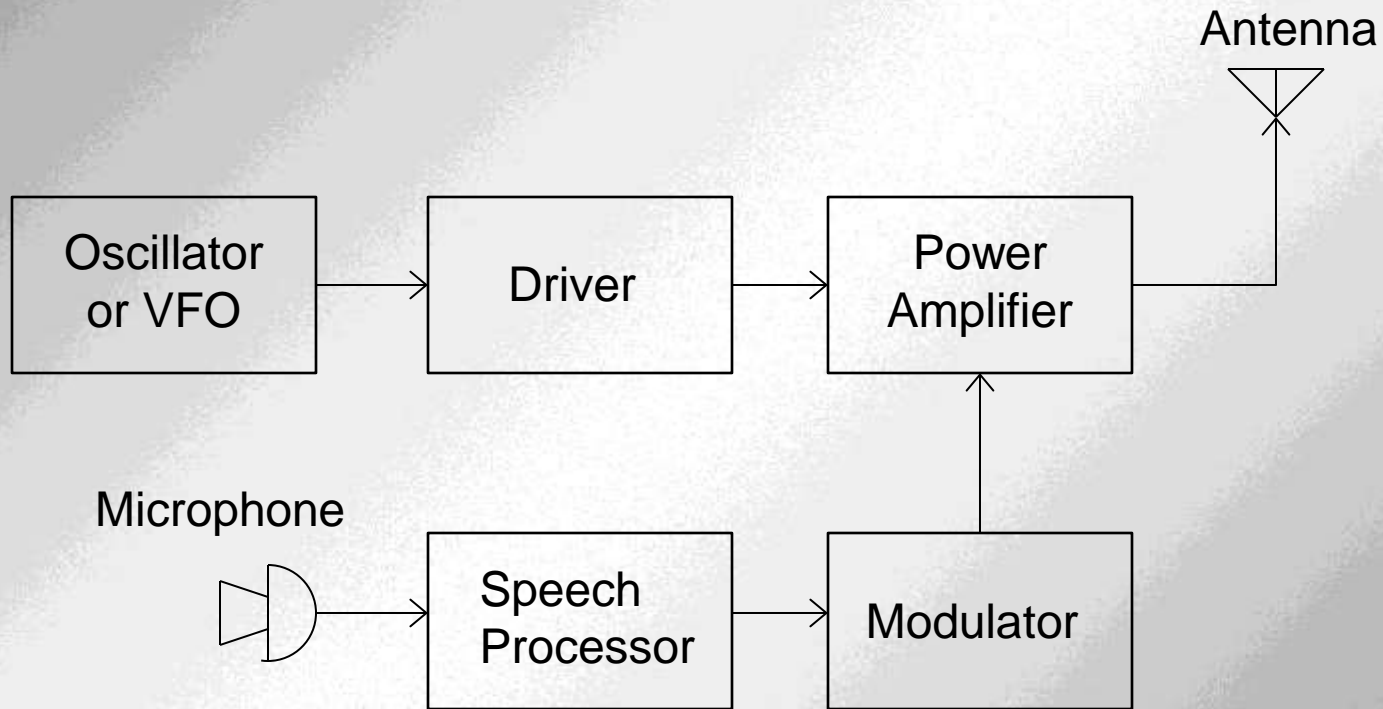
- An RF signal is mixed with an oscillator signal using non-linear components – diodes
- Difference and Sum frequencies are produced.
 - $F_{\text{signal}} - F_{\text{oscillator}}$ (Lower)
 - $F_{\text{signal}} + F_{\text{oscillator}}$ (Higher)
- One of the frequencies becomes the IF.



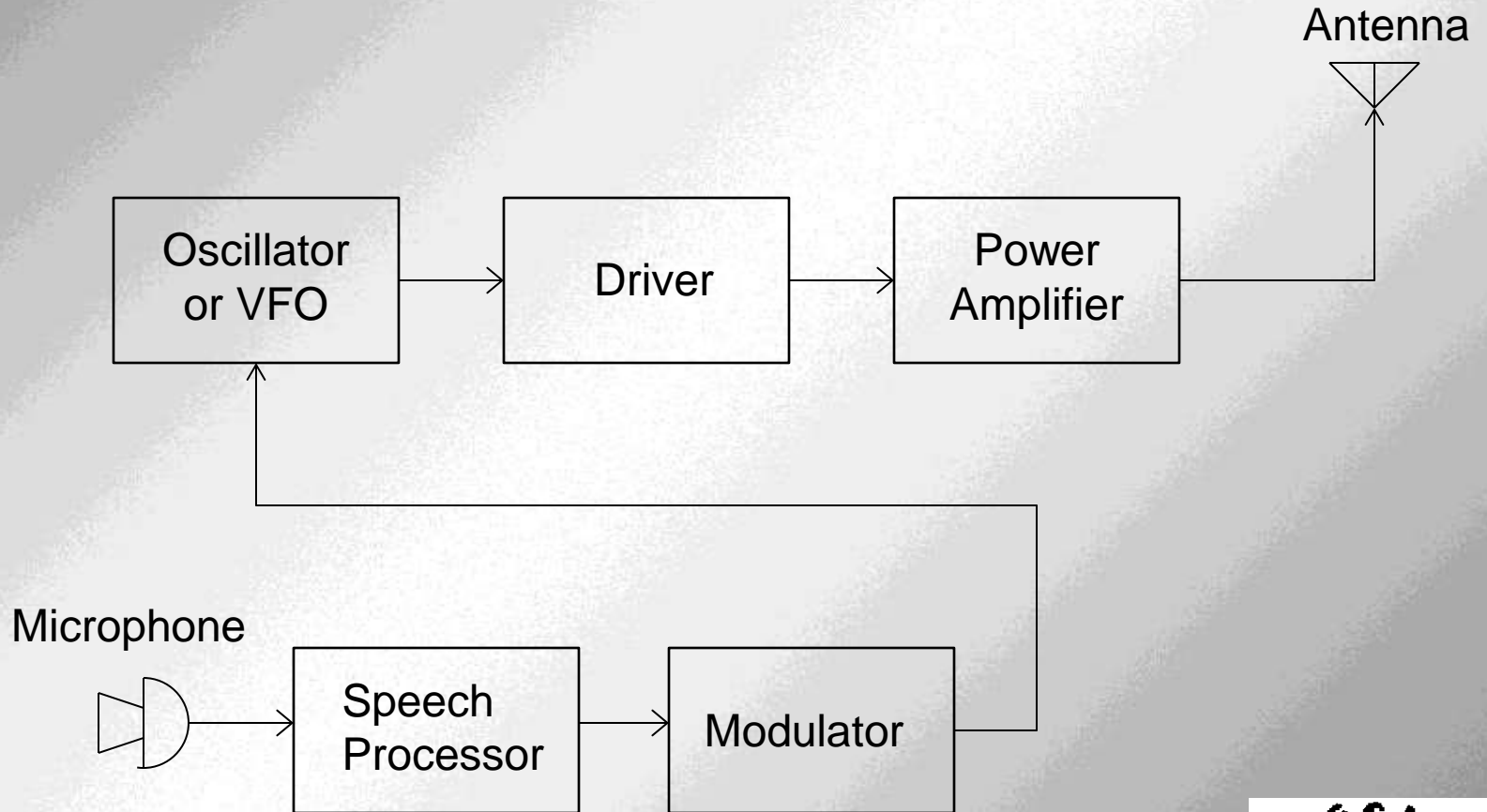
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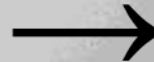
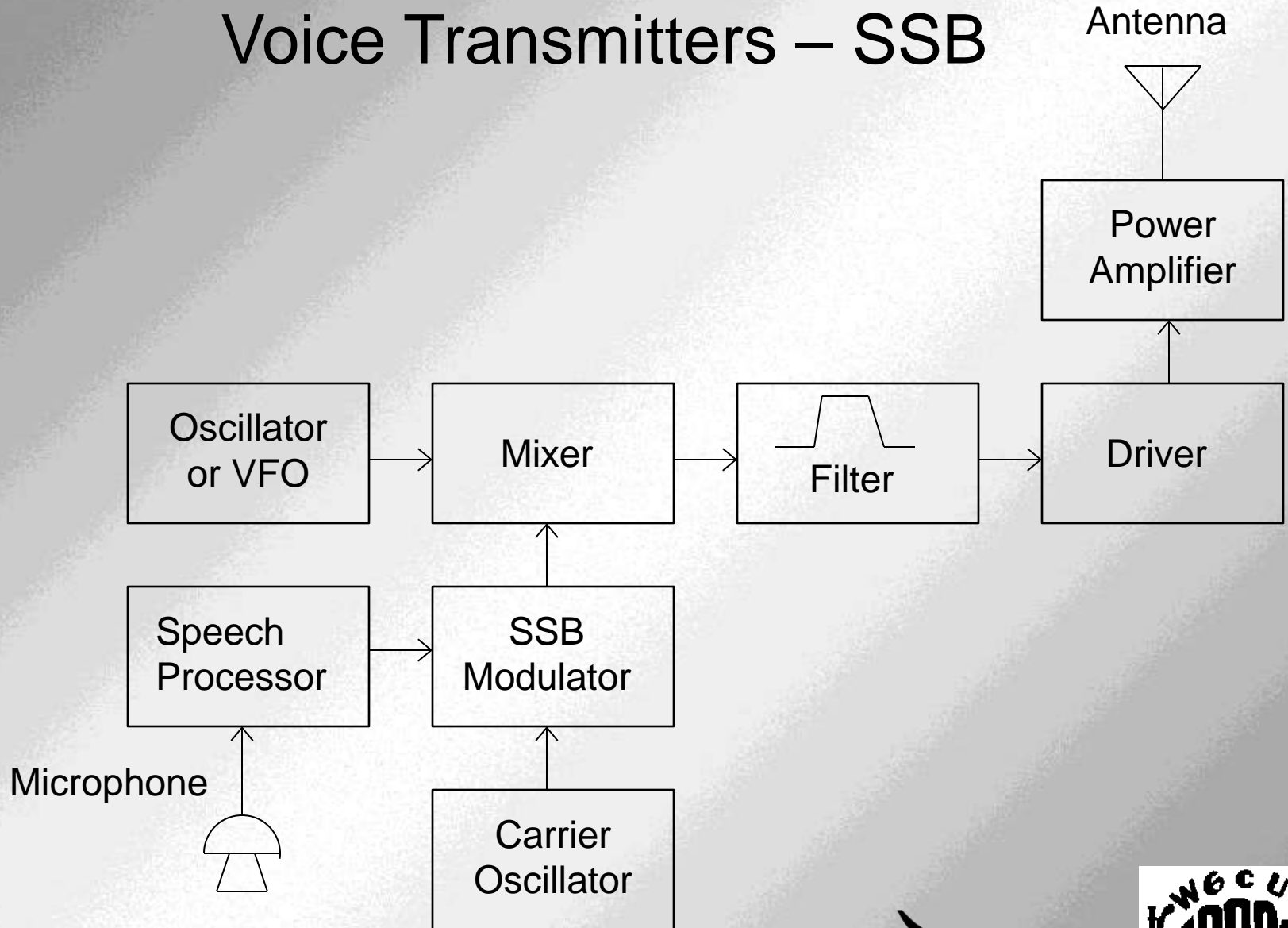
Voice Transmitters – AM



Voice Transmitters – FM



Voice Transmitters – SSB



Superheterodyne Receivers

Superheterodyne Receivers amplify signals at an Intermediate Frequency (IF). A mixer translates the Signal to the IF by mixing with a VFO.

- A high gain amplifier is easier to design for a narrow frequency range – the IF Amp.
- Automatic Gain Control may be applied to IF Amp.
- Single conversion uses one mixer and one IF amp, Double conversion uses two mixers and two IF amps.
- FM Receivers use a Limiter in the IF Amp which limits noise peaks to reduce or eliminate noise.



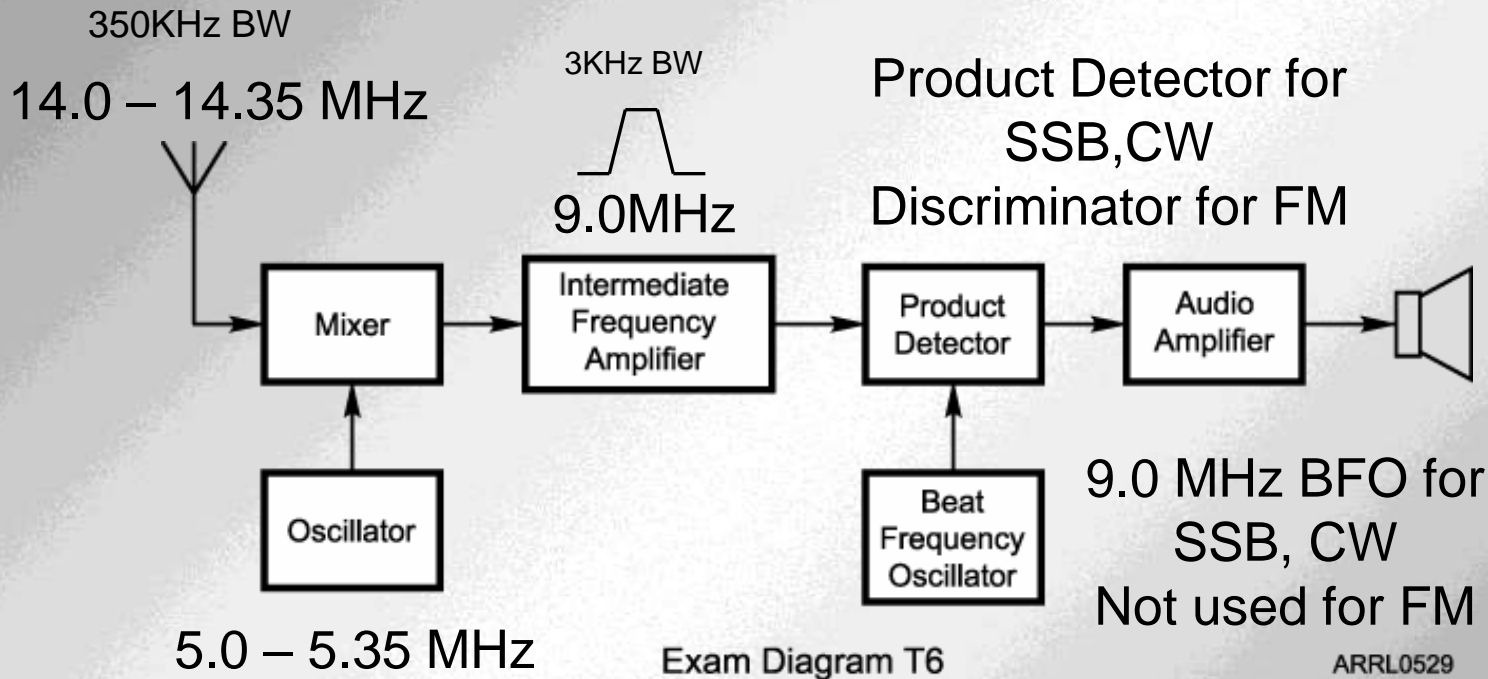
Receivers – Demodulators

Demodulators recover the modulation signal from a modulated RF signal.

- Envelope Detector – usually just a Diode. Used for AM
- Product Detector – a type of Mixer which mixes the IF signal with a Beat Frequency Oscillator (BFO). Used for SSB and CW.
- Frequency Discriminator – Used for FM.



Single Conversion Receiver Block Diagram



Receiver Sensitivity

Receivers must be able to detect weak signals. This ability is known as their Sensitivity.

- Expressed in microVolts for a desired Signal to Noise Ratio, Example: 1uV for 10db SNR
- Good receivers usually need less than 0.5 uV, but good antennas have more signal.
- Can be improved with a pre-amp between the antenna and receiver but pre-amps amplify both noise and signal – they can't improve the SNR.



Receiver Selectivity

Receivers must be able to select a desired signal and reject unwanted signals from nearby channels. This is known as their Selectivity or passband.

- SSB – 2.1 to 3.0 KHz passband
 - Reject adjacent upper or lower sideband
 - Reject heterodynes from interfering carriers.
- FM – 15KHz passband
 - Reject signals from adjacent channels.
 - Reject interference from nearby transmitters.



Frequency Converters

An HF SSB transceiver may be extended to VHF by a frequency converter.

- Connected between a VHF antenna and an HF SSB transceiver.
- Receiving Converter – 144 MHz → 28 MHz
- Transmitting Converter – 28 MHz → 144 MHz
- Transverter – 28 MHz ↔ 144 MHz
- Transverters may also be used to add UHF bands to a VHF transceiver



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