Summerland Amateur Radio Club
Foundation Module 2

for the AMC Foundation & Practical Syllabus V10

Transmitters and Receivers

Syllabus Assessment Objectives

4.1	Identify, using supplied block diagrams, the names of the stages in a simple transmitter and receiver.
4.2	Recall that improper adjustment of a transmitter can cause harmful interference to other radiocommunications services, both inside and outside the frequency bands allocated to Amateurs.
4.3	Recall that all components of transmitter emissions must be contained within the radio frequency bands allocated to Amateurs.
4.4	Identify, with the aid of supplied diagrams, a radio frequency carrier waveform, an audio frequency waveform and a modulated waveform.
4.5	Identify, using supplied block diagrams, where the carrier, audio and modulated waveforms occur in a simple transmitter.
4.6	Recall that Single Sideband (SSB) is a form of Amplitude Modulation (AM).
4.7	Recall that the final power amplifier stage of a transmitter must be connected to a correctly matched transmission line and antenna to avoid possible damage to the transmitter and/or cause interference to other radiocommunications services.
4.8	Recall the need to ensure microphone gain, where fitted, is correctly adjusted to avoid over modulation of AM or FM transmitters.
4.9	Recall that excessive modulation of transmitters may cause distorted output and interference to adjacent frequencies.
4.10	Recall the purpose of the following controls: AF Gain, RF Gain, Squelch, Mode, VFO, RIT, Band and Carrier control.
4.11	Recall the meaning of the terms sensitivity, selectivity and stability as they apply to a receiver.

Resources

CARS Fslide4-Transmitters-and-Receivers
WIA Foundation Manual Chapter 2

SARC Education Module Content

Modulation

Radio transmitter is the rather obvious name for a device that emits radio waves. Equally so a device that receives radio waves is called a radio receiver. When both devices are combined into one unit, they are usually known as a transceiver.

Transmitting radio waves is of limited value unless the radio waves carry some form of information like your voice. This gives rise to the terms '**carrier signal**' which is the radio frequency that carries your voice or other information and the term '**modulation**' which describes the method by which your voice is attached to the radio signal and detached at the receiver.

AM – Amplitude modulation – Loudness of the voice causes changes in carrier amplitude.

FM – Frequency modulation – Loudness of voice causes changes in carrier frequency.

SSB – Single sideband is a form of amplitude modulation

Modulation The way voice frequencies are converted to radio frequencies. Excessive modulation causes distortion and interference on adjacent frequencies.

Bandwidth The amount of frequency spectrum (space) the signal occupies. (CW narrow band width; SSB more bandwidth: FM even more bandwidth)

Deviation A term used with FM signals describing the amount by which the voice frequency changes (deviates) the carrier frequency.

The Foundation Licence power level is 10 Watts pX. (PEP or Peak Envelope Power)
pX is used to express the power in a variable signal such as SSB.
pY (Mean Power) is used to express the power in a constant signal such as FM.

Transmitters and Receivers
Block diagrams are used to show the basic structure of simple transmitters and receivers.

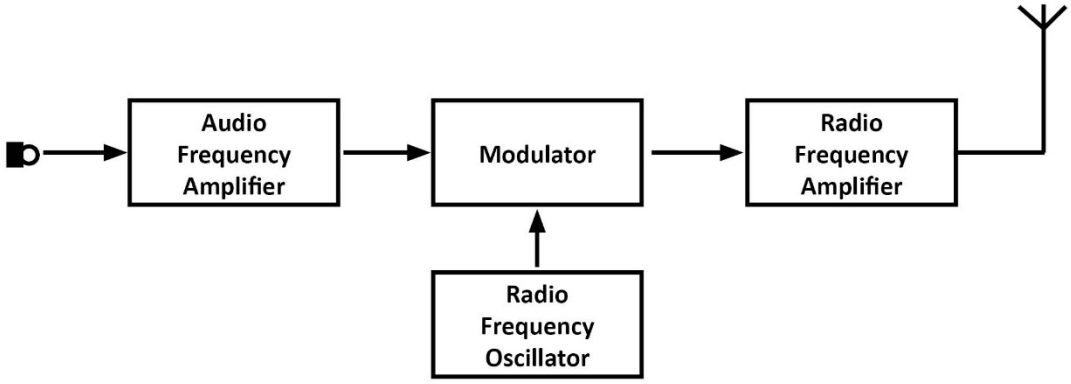
It is normal practice for signals to go from left to right

The antenna is at the 'radio frequency (RF) end

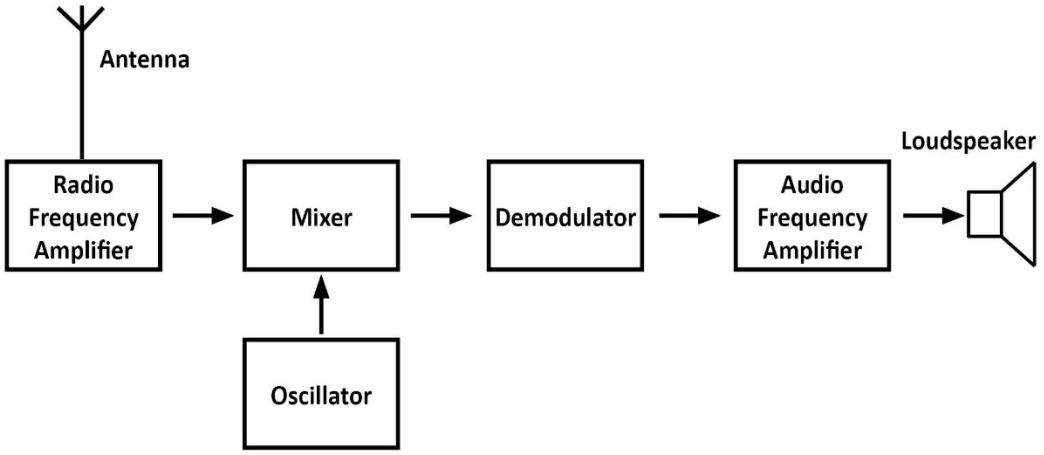
A speaker or microphone is at the 'audio frequency (AF) end.

When identifying unlabelled blocks consider that RF type blocks are likely to be at the antenna end and AF blocks at the speaker or microphone end.

Transmitter Block Diagram



Receiver Block Diagram



While transmitters can vary their transmissions, care must be taken to ensure that the transmissions do not cause signals that interfere with other users of radio communications (transmitters or receivers), whether amateur or not. It is the amateurs' responsibility to ensure that it is not their equipment that is causing any issues to other radio wave users. Remember, amateur radio enthusiasts are not the only users of the radio spectrum.

All transmitter emissions must be kept strictly within the radio frequency bands allocated to Amateurs.

Receivers have three 'S' characteristics:

Sensitivity = *Ability to detect weak signals*

Selectivity = Ability to select (or pick) one signal from another when frequencies are close

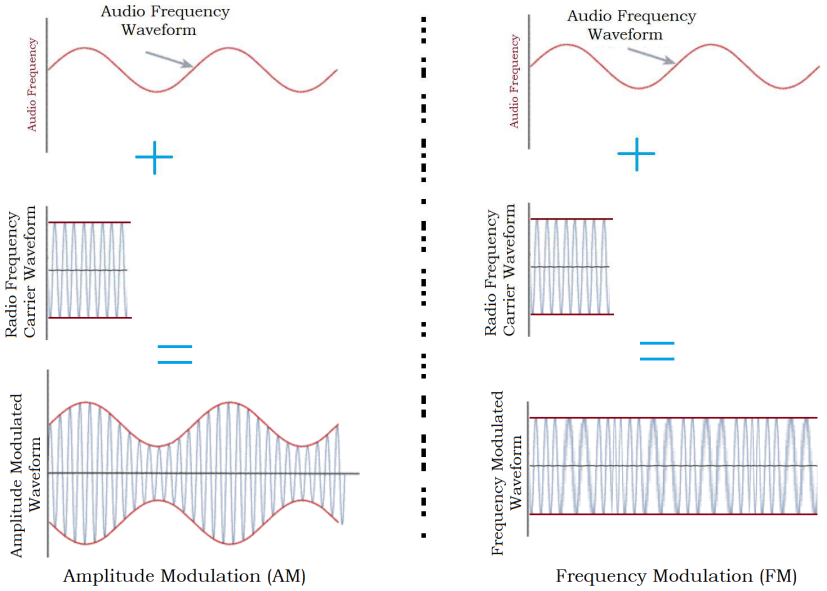
Stability = Ability of RX to remain on the required frequency

Transceiver Controls – This is usually only a part of the practical exam.

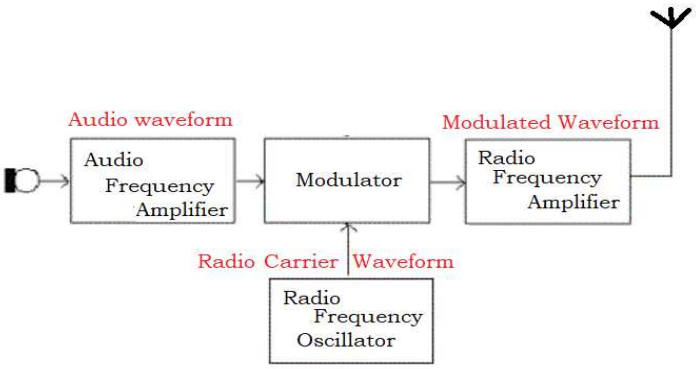
Control	**Function**
Power On/Off	Master control for the whole transceiver.
AF Volume	How loud the audio comes from the speaker.
Squelch or Mute	This is set at a level such that background noise is suppressed if there is no signal.
RF Gain	Controls the sensitivity of the receiver. Used to reduce strong signals.
Band Switch	Select the desired band on a multi band transceiver
Frequency (VFO)	Move to desired frequency in the selected band.
Mode switch	Select desired modulation which may include LSB USB FM AM CW or Digital
RIT (Receiver Incremental Tuning)	Changes the RX frequency slightly without moving the TX frequency.
Selectivity (Wide / narrow)	Adjust to reduce unwanted adjacent signals or increase the receiver bandwidth to hear more of the signal (eg when listening to an AM signal).
Power Output	Ability to set the output power level of the transmitter.
Carrier	Can be used to set CW or AM power level.
Microphone Gain	Matches the loudness of your voice through the microphone to the modulation stage of the transmitter. Used to prevent over modulation which causes distortion and interference.
Tune and Load	Tunes the output to match the impedance at the antenna socket. Normally found in valve transmitters but not in transistorised equipment.

Modulation types

The most common form of radio wave modulation are shown in the following diagrams.



The location of where differing (audio, radio and modulated) waveforms occur in a simple transmitter.



A transmitter is designed for a **specific impedance** at its antenna socket. If it does not "see" this impedance then the PA (Power amplifier) cannot operate efficiently. The usual impedance of a feeder for coax is **50 ohms**. An antenna will only present an impedance near to 50 ohms when it is the correct size for the applied frequency. A BALUN (or UNUN) can be used to match the impedance to that of the transmitter (see Module 3 for more on antennas).

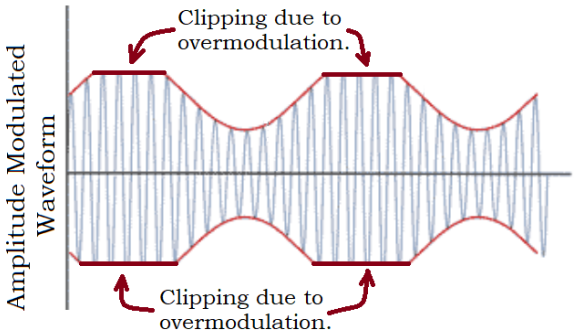
An Antenna Tuning Unit (ATU), or more correctly Antenna Matching Unit, may be used to match the impedance of the feedline and antenna to the power amplifier of the transmitter.

Failure to sufficiently match to the transmitter may lead to damage to the power amplifier and/or unwanted interference to other radio communications services.

Modulation is produced by mixing the audio signal with the radio carrier wave. If the audio signal is amplified too much it can cause **over-modulation**, this can lead to "clipping" the signal. This will cause a reduction in the quality of the signal transmitted.

The amplification of the audio signal from the microphone is adjusted by the **microphone gain**. It should be set to produce the maximum amplification without causing **distortion** of the transmitted signal. FM distortion can cause interference to nearby frequencies.

Older radios have a knob to change the Mic gain but many modern radios have this function accessible within a menu. You need to be familiar with its location and use.



Question 1:
The definition of Bandwidth is:

A) the distance from wave crest to wave crest
B) how far a wave travels in one second
C) the portion of the electromagnetic spectrum used
D) the maximum deviation in frequency modulation

Question 2:
If you find that your signal is "over modulated" you should adjust the:

A) microphone gain B) volume C) RF gain D) selectivity

Question 3:
In a typical receiver the signal moves:

A) from the microphone through to the speaker
B) up
C) from the oscillator to the speaker
D) from the antenna through to the speaker

Question 4:
If you are having trouble separating two signals on nearby frequencies, the receiver characteristic you would need to improve would be:

A) stability
B) bandwidth
C) sensitivity
D) selectivity

Question 5:
The audio signal in an AM transmission is carried on the:

A) carrier frequency
B) audio frequency
C) modulated amplitude of the carrier wave
D) modulated frequency of the carrier wave

Question 6:
On a VHF transceiver, to cut out background noise, you would adjust the following control:

A) RIT B) Squelch C) VFO D) Selectivity

Question 7:
In a simple transmitter, the pure radio carrier waveform is produced by:

A) the audio frequency amplifier
B) the radio frequency oscillator
C) the modulator
D) the antenna

Question 8:
The usual matching impedance for a radio transmitter and an antenna is:

A) 50 Watts
B) 75Ω
C) 50Ω
D) 230V