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RADIO AMATEUR EXAM
GENERAL CLASS

By **4S7VJ**

CHAPTER-5

5.1 RECEIVER

The main purpose of a radio receiver is receive RF signal and convert to AF signal or get the audio signal out from it. The diagram (Fig 5.1) shows the most simple receiver with RF and AF stages.

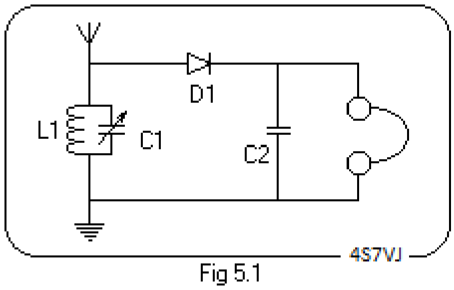


Fig 5.1

RF stage is an L-C resonance circuit (L1 and C1). AF stage is having a diode D1 and a capacitor C2. The portion of the circuit including D1 & C2 is named as the "detector" stage. (demodulator) The output audio signal is extremely weak because there is no amplifier stage and not even a power-supply stage in this simple RX.

Basic types of Receivers

1. Regenerative receiver
2. Direct conversion receiver
3. Super heterodyne receiver
4. Double conversion receiver

Before learn about the basic types of receivers we must understand the characteristics of receivers.

5.1.1 RECEIVER CHARACTERISTICS

5.1.1.1 SENSITIVITY

The sensitivity of the receiver defines as the ability to receive weak signal and provide a satisfactory output to the speaker. In practice, the sensitivity of a receiver is usually specified as signal to noise ratio in db. S/N ratio indicates the minimum input voltage at the antenna input of the receiver needed to provide a stated S/N ratio when the receiver is used with its appropriate bandwidth.

5.1.1.2 SELECTIVITY

The ability of a receiver to separates stations on Closely adjacent frequencies is determined by its selectivity. The limits to usable selectivity is governed by the bandwidth of the type of signal which is being received.

5.1.1.3 STABILITY

The ability of a receiver to remain tuned to a wanted frequency without drift depends upon the electrical and mechanical stability of the internal oscillators. The primary cause of instability in an oscillator is a change of temperature. This is affecting for the VFO stage in receivers and transmitters. For communication receivers normally use regulated power supply unit for maintain stability. If the VFO frequency is unstable, receiving or transmitting frequency is slightly varying for RX and TX respectively.

5.1.2 Types of Receivers

1. Regenerative receiver
2. Direct conversion receiver
3. Tuned RF receiver (TRF)
4. Supper Heterodyne receiver
5. Double conversion receiver

5.1.2.1 REGENARATIVE RECEIVER

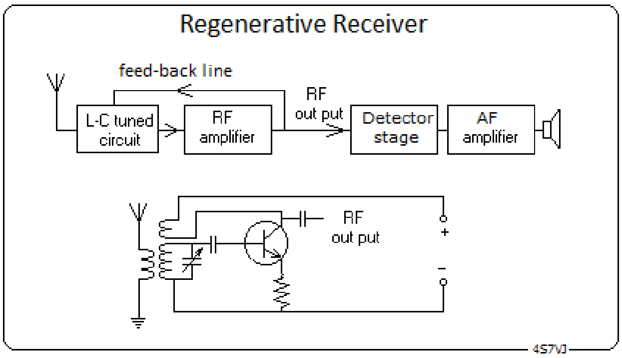


Fig - 5.2

Fig-5.2 shows a regenerative receiver. The RF signal with various frequencies picked by the antenna is passing through the L-C tuned circuit and getting filtered to a single frequency (resonance frequency). It will be amplifying by the RF amplifier. Due to the feedback line, the output signal will be boost up. The same time a portion of the amplified RF signal is radiating through the antenna and interfering for neighboring receivers. This is a disadvantage of this system.

5.1.2.2. DIRECT CONVERTION RECEIVER

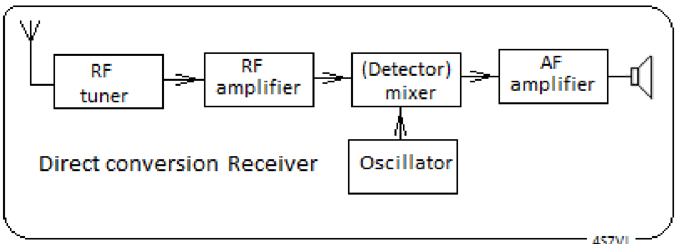


Fig-5.3

A more satisfactory simple receiver for CW and SSB is called the direct conversion receiver. Although there is a distinct possibility of signal radiation, it is considerably lower in level than with regenerative receivers. This result from better isolation between the antenna and the source of oscillation. Actually this is a frequency converter. The RF signal tuned by the tuner will be convert to AF signal by mixing another RF carrier wave generated by the oscillator.

5.1.2.3 **Tuned Radio Frequency Receiver (TRF)**

This is very early stage receiver. There are two or more RF tuned stages. Every stage equipped with a tuning condenser, but all of them are turning with a single nob.

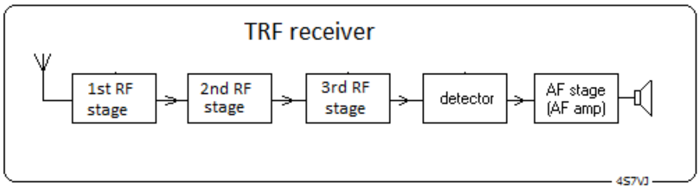


Fig - 5.4

5.1.2.4 **SUPER HETERODYNE RECEIVER** (SUPERHET RX)

This is an improved version of the receiver. The block diagram shows a simple broadcasting super-heterodyne receiver.

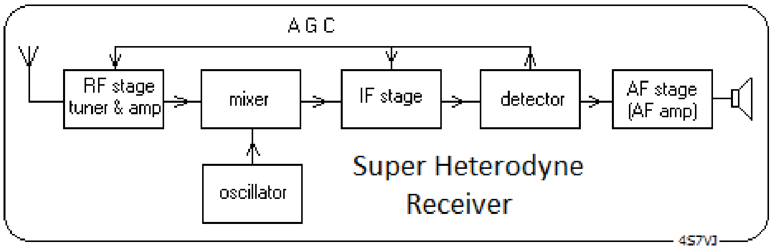


Fig-5.5

We can divide it into following stages.

1. RF stage
2. Oscillator stage (local osc.)
3. Mixer
4. IF stage (intermediate frequency)
5. Detector (demodulator)
6. AF stage
7. AGC (automatic gain control) or AVC (automatic volume control)

5.1.2.4.1 **RF stage**

There are two main sections in the RF stage.

1. Tuner
2. Amplifier

Tuner is mainly a LC-resonance circuit. Incoming signals with various frequencies are presents in the input side of the LC-resonance circuit; but only one signal having the resonance frequency is going out. Then it will be amplify by the RF amplifier section. For some receivers RF amplifier is a transistor or FET installed in between the antenna and the LC-resonance circuit. For some receivers the mixer stage is acting as a RF amplifier also.

5.1.2.4.2 **OSCILLATOR STAGE**

Oscillator stage is generating a RF signal and it's frequency is selected by one section of the double gang tuning condenser. The other section is attached to the LC-resonance circuit at the RF stage.

5.1.2.4.3 **MIXER STAGE**

The signal filtered from the RF stage (f1) and the signal generated from the oscillator (f2) will be mixed in the mixer stage. Then the following frequencies will be presence in the output of the mixer:

1. f1
2. f2
3. (f1-f2) or (f2-f1)
4. f1+f2

Normally f2 is greater than f1 therefor the 3rd frequency is (f2-f1). For example with numerical values: Suppose the signal filtered in the RF stage is 1000kHz and the signal generated in the oscillator stage is 1455kHz.

Then f1 = 1000, f2 = 1455. Therefor f2-f1 = 455kHz. That means the IF is equals to 455kHz.

If we tuned to another frequency, say 1050kHz the oscillator is automatically tune to 1505kHz. Even then the IF is equals to the same frequency (455kHz).

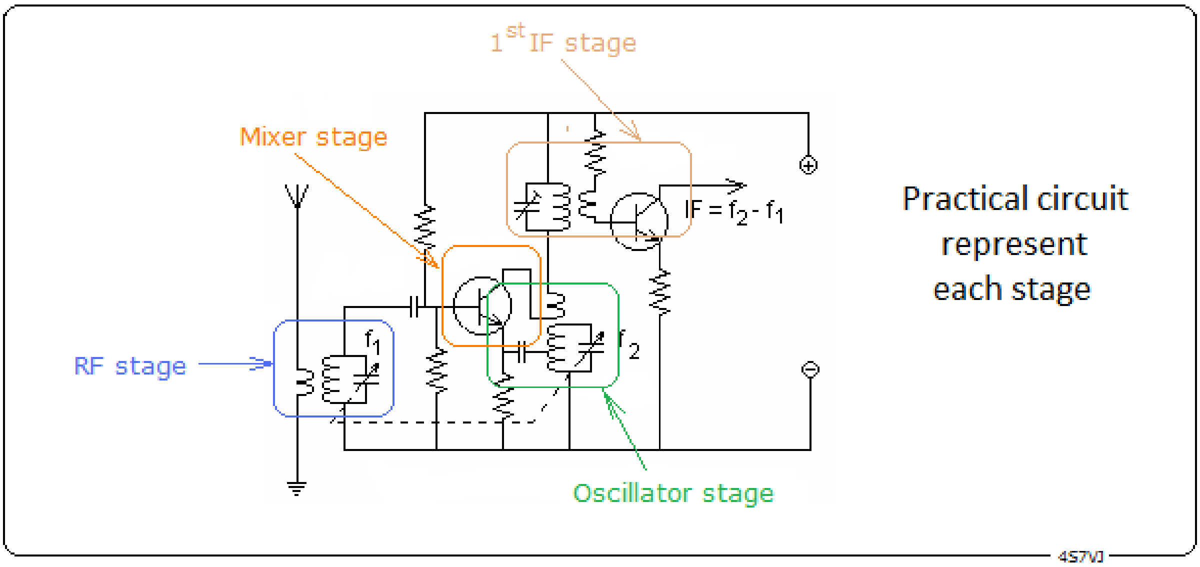


Fig 5.5

5.1.2.4.4 **IF STAGE**

IF (intermediate frequency) stage is an amplifier stage containing one or more RF amplifier units. Those unites amplifies only the IF signal, 455kHz in the above example. For normal broadcasting receivers, IF is a fixed frequency between 455 and 465 kHz. Each IF unit is having two important components as follows:-

1. IF transformer as a resonance circuit
2. Transistor or a valve as an amplifier

IF transformer is a simple LC-resonance circuit tuned for the intermediate frequency. The filtered IF signal from the IF transformer is amplify by the transistor or by the valve.

During each IF unit the wanted signal is filtering and amplifying and other unwanted signals are rejecting.

5.1.2.4.4.1 <u>IMAGE FREQUENCY INTERFERANCE</u>

Each H.F. oscillator frequency will cause IF response at two signal frequencies, one higher and one lower than the oscillator frequency. If the incoming signal frequency f1 and oscillator frequency f2, then IF is (f2-f1) or (f1-f2).

Example:

If the oscillator is set to 6455kHz (f2=6455) to tune a 6000kHz (f1=6000) signal for example the receiver can respond also to a signal on 6910kHz,

f1-f2 = 6910-6455 = 455kHz

which likewise gives a 455kHz beat. The undesired signal (6910kHz) is called the image. It can cause unnecessary interference , if it is not eliminated.

Select the higher IF and increase the selectivity of the RF tuned circuit is reduced this image interference.

5.1.2.4.5 <u>DETECTOR STAGE</u> (DEMODULATOR)

The purpose of the detector stage is converts the RF signal to audio. Detector stage is equipped with a germanium diode (1N914) and a small capacitor (0.01 mfd).

The signal coming from the last IF stage is a modulated RF signal. That means the amplitude of this RF wave is varying according to the AF wave form. This AC wave is rectifying by the diode. (HW Rec) and converts to a pulsed DC. This pulsed DC will be smoothed by the small capacitor (C1), but it is not a steady voltage, it is varying according to the AF signal. When this variable DC voltage passed through the volume control and the second capacitor (C2), it is converts to AC wave form (AF signal) and enters to the AF amplifier.

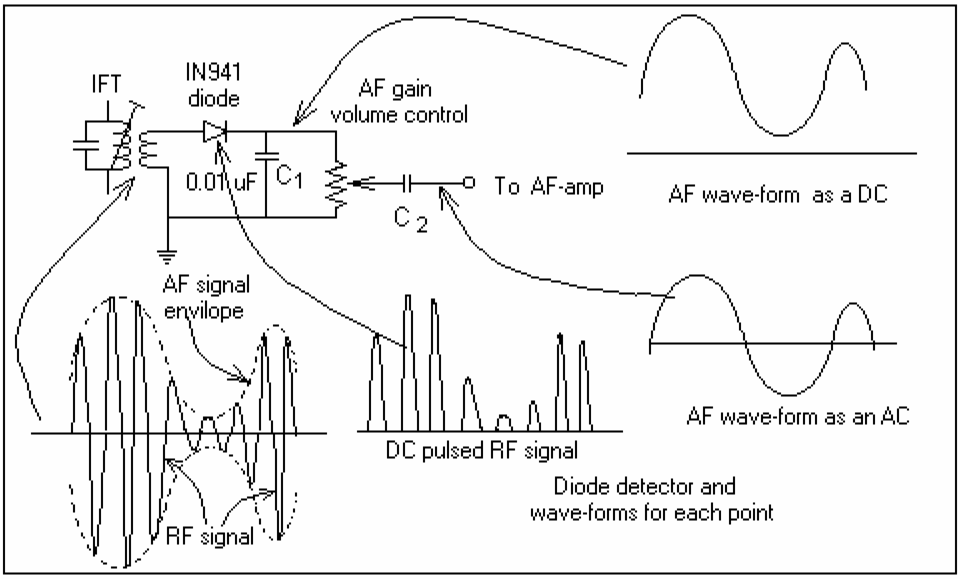


Fig 5.6

5.1.2.4.6 **AF STAGE** (AUDIO STAGE)

The AF signal coming from the Detector is not strong enough to drive a speaker. The purpose of the AF stage is amplify this signal up-to a suitable level for drive the speaker. We can use few transistors for this AF amplifier or it is possible to use a single IC as the amplifier.

5.1.2.4.7 **AUTOMATIC GAIN CONTROLE (AGC)**

The incoming level of RF signals arrive from long distance are always varying due to propagation conditions. As a result of this the audio output from the speaker also varying and it is uncomfortable for the listener.

AGC (or AVC) system is controlling the AF output level and it tends to the output level of the receiver constant, regardless of input signal strength.

The average rectified dc voltage developed by the received signal across a resistance in a detector circuit is used to vary the bias on the RF and IF amplifier stages.

5.1 **MODULATION and DEMODULATION**

MODULATION

Modulation is the process of varying some characteristic of a carrier wave in accordance with a signal to be conveyed. A carrier is a wave having at least one characteristic that can be varied from a known reference by modulation. That known reference is typically a steady sine wave.

A modulator is a circuit or device in which the carrier and modulating signal come together to produce a modulated carrier.

DEMODULATION

Demodulation is the process of deriving the original modulation signal from a modulated carrier wave. But this is not simple as the modulation, because the received signal usually contains noise and distortion picked up along the way. For the original modulating signal to be reproduced faithfully, the effects of noise and distortion need to be removed during reception and demodulation. While a demodulator is a normal part of a radio receiver, external demodulators are used for some types of communications.

CARRIER WAVE

Carrier wave is a pure RF sine wave with a steady frequency and constant amplitude, generated in a transmitter.

BASE-BAND

The base-band is the range of frequencies occupied by the signal before it modulates the carrier wave. The signal in the base-band is usually at frequencies that are substantially lower than that of the carrier.

SSB LSB AND USB

Whenever a carrier is modulated side-bands are produced. Side-bands are the frequency bands on both sides of the carrier known as **upper side band (USB)** and **lower side band (LSB).**

For example suppose 14.100 MHz (14100kHz) carrier wave modulated by an AF signal of 10kHz. With the modulated signal there are three main frequencies, 14100kHz, 14110kHz and 14090kHz, carrier wave, USB and LSB respectively.

If the carrier wave and one side band suppressed or filtered, then the signal becomes a **Single Side Band (SSB)** signal LSB or USB accordingly.

5.1.1 MODULATION SYSTEMS

There are various types of modulation as follows:-

1. Amplitude modulation (AM)
2. Frequency modulation (FM)
3. Single side band (SSB)
4. Double side band (DSB)
5. Pulse modulation
6. Phase modulation
7. Angle modulation
8. Slow scan TV (SSTV)
9. Fast scan TV (FSTV)
10. Facsimile (FAX)
11. Telegraphy
12. Continuous wave telegraphy (CW)
13. Frequency shift keying telegraphy (FSK)
14. Radio Tele-type (RTTY)

5.1.1.1 AMPLITUDE MODULATION (AM)

Amplitude modulation is simply described as varying the amplitude of the carrier according to the modulating AF signal. (Fig 5.7)

According to the above example bandwidth of the modulated signal is 20 kHz., the difference between the lowest and highest frequencies. In AM the bandwidth is determined by the highest frequency component contained in the base-band modulation signal (Fig 5.8).

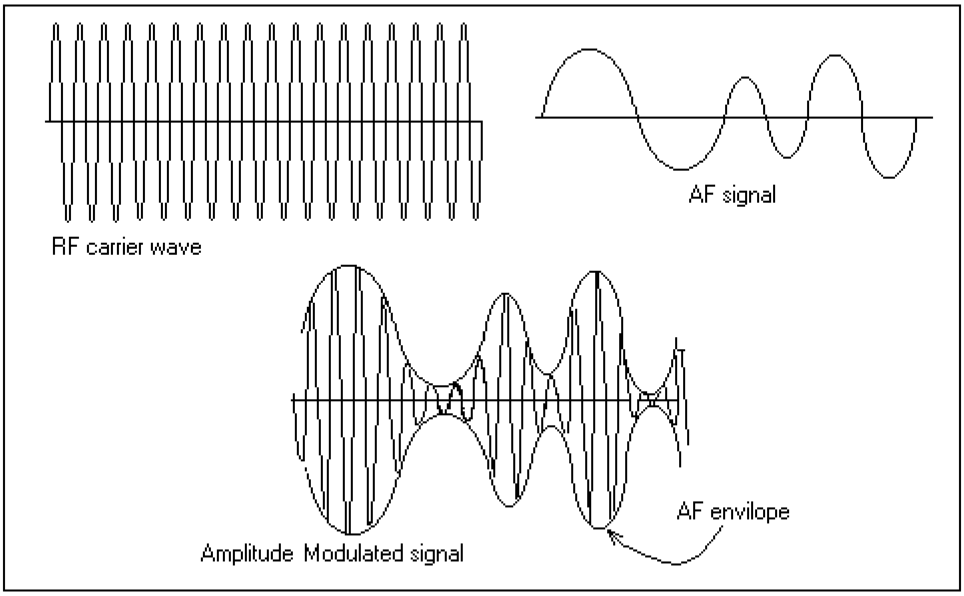


Fig 5.7

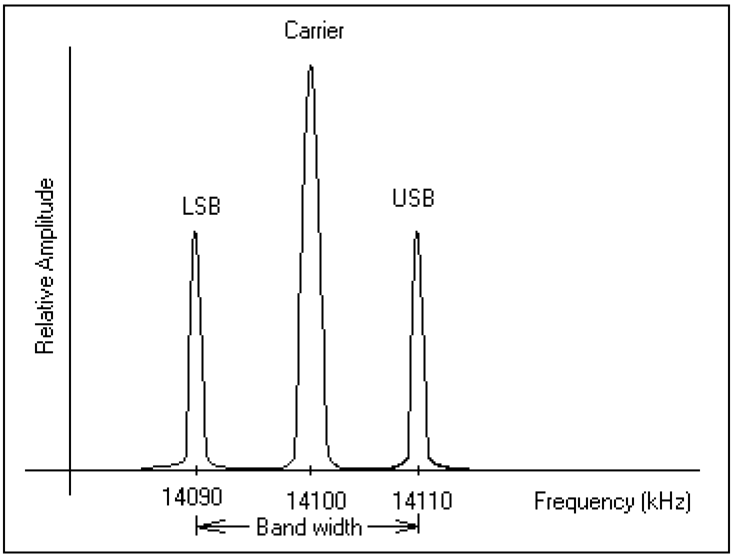


Fig 5.8

5.2.1.1.1 Percentage of Modulation (Modulation Factor)

Modulation factor is a measurement of the modulation. Fig5.9 shows an oscilloscope picture for a carrier wave and the modulated wave for a RF signal. z is the peak to peak voltage or current of the carrier wave. x is the maximum peak to peak value and y is the minimum value for the modulated signal.
There are two types of modulation factors defined.

Upward modulation factor = **(x-z) / z**

and

downward modulation factor = **(z-y) / z**

Modulation percentage = (100 x modulation factor)%

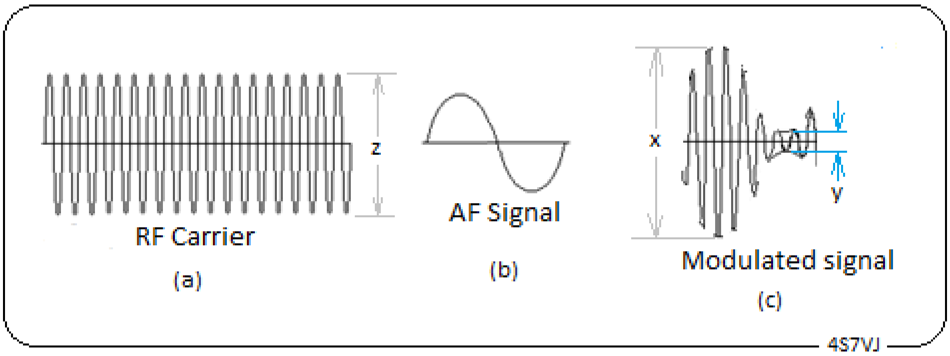


Fig. 5.9

5.2.1.1.2 Over-Modulation

Higher the average amplitude of the side-bands, the greater the audio signal produced at the receiver. For this reason it is desirable to increase the modulation percentage. (or modulation factor or degree of modulation. The maximum value is 100%.(Fig-5.10). If the modulation percentage increased beyond 100%, defined as over-modulation, distortion is introduced, and is carried very far, bad interference to signals on nearby frequencies will results.

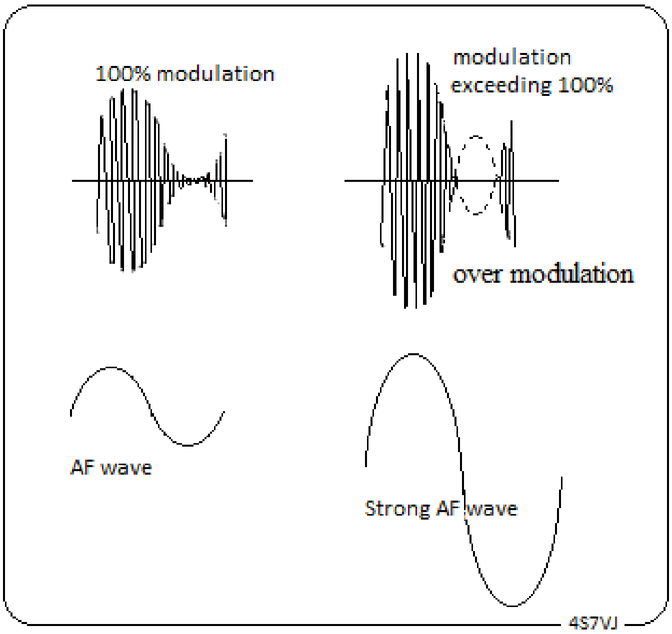


Fig 5.10

5.2.1.1.3 Modulation Power

In the special case of sin-wave modulating signal corresponding to a single pure tone, it can be proved mathematically that the effective power in such wave at **100 percent modulation is 1.5 times the unmodulated carrier power.**

The relationship between the modulated and unmodulated antenna current for sin-wave modulation is given by,

$$I_m = I_0 \sqrt{(1+m^2/2)}$$

where I_m is the antenna current for the modulated signal. I_0 is the unmodulated antenna current and **m** is the modulation factor. The power is proportional to the I^2. We can get the following formula for the corresponding power levels.

$$P_m = P_0 \ (1+m^2/2)$$

where P_m is the power input to the antenna for the modulated signal. P_0 is the unmodulated power at the antenna and **m** is the modulation factor.

Example:- A transmitter supplies 100w of carrier power to the antenna. What is The total radiated power with 40% modulation?

We can use the above formula, $\mathbf{P_m = P_0\ (1+m^2/2)}$
where $P_0 = 100$, $m = 0.4$, $(40\% = 0.4)$
Therefore $P_m = 100(1+0.4^2/2)$
$= 100(1+0.16/2)$
$= 100\text{x}1.08$
$=$ **108W**

5.1.1.2 FREQUENCY MODULATION (FM)

Fig 5.11 is a representation of frequency modulation. When a modulating signal is applied, the carrier frequency is increased during one half cycle of the modulating signal and decreased during the half cycle of the opposite polarity. This is indicated in the drawing by the fact that the RF cycles occupy less time (high frequency) when the modulating signal is positive, and more time (lower frequency) when the modulating signal negative.

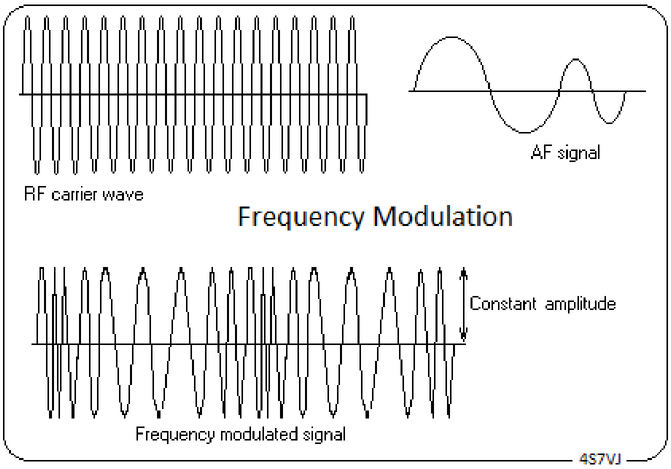


Fig-5.11

FREQUENCY DEVIATION

The change in the carrier frequency is called **frequency deviation.** Frequency deviation is proportional to the instantaneous amplitude of the modulating signal. Thus, the deviation is small when the instantaneous amplitude of the modulating signal is small and is greatest when the modulating signal reaches its peak (either positive or negative). The amplitude of the RF signal does not change during modulation.

5.1.1.3 SINGLE SIDE BAND (SSB)

As both side-bands of a DSB AM signal (Fig 5.8) convey the same information, a single side-band (SSB) may be transmitted and received. Since the carrier contains no intelligence, it too may be suppressed prior to transmission and reinserted in the receiver. SSB transmission and reception adds complexity and cost to radio equipments.

However SSB has a number of advantages as follows:

1. Spectrum conservation

Two SSB signals can occupy the space of one DSB signal

2. **Power conservation**
   More talk power can input to the transmitter final stage. For an example about 400 watt power output of AM transmission is equivalent to 100 watt power output of SSB transmission.

3. **Elimination of carrier interference**
   This eliminates the possibility of a carrier heterodyning with an adjacent signal.
4. **Reduction in multipath distortion**
   SSB does not suffer the radio distortion (mush sound or noise or mushiness) while its propagation through the ionosphere as an AM signal.

5.2 TRANSMITTER

The purpose of a transmitter is to generate RF power which may be keyed or modulated and thus employed to convey intelligence to one or more receiving station. One of the most important requirements of any transmitters is that the desired frequency of transmission shall be stable within close limits to permit reception by a selective receiver and to avoid interference with other amateurs using the same frequency band. Spurious frequency radiation, capable of causing interference with other services, including TV and BC must also be avoided.

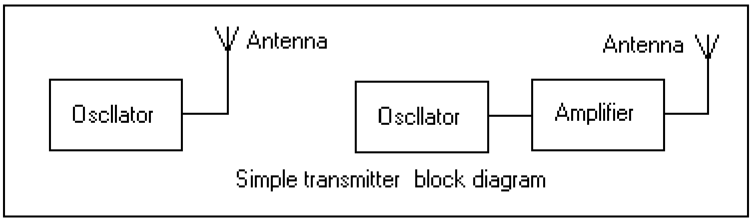


Fig 5.10

The simplest form of transmitter is a single stage oscillator coupled directly to an antenna system. (Fig 5.10) Since most of the HF amateur bands are harmonically related, the oscillator is generally designed to operate on the lowest frequency band. In order to achieve output on the higher frequencies, it is necessary to employ one or more stage of frequency multiplication. An advantage gained from this arrangement is that by operating the oscillator at a relatively low frequency, it is easier to achieve the necessary frequency stability. A single multiplier stage may produce twice the fundamental frequency (frequency doubler) or three times (tripler) or more. Usually, however, the frequency multiplication in one stage is limited to three. It is undesirable to feed the antenna directly from a multiplier since harmonics, other than the wanted signal, are produced and maybe radiated simultaneously.

5.3.1 THE CRYSTAL OSCILLATOR

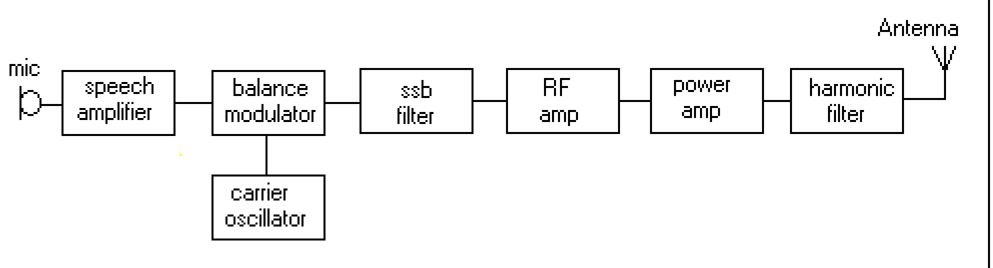
The simplest method of achieving the high degree of frequency stability is by using quartz crystal to control the frequency of the oscillator. Such an oscillator when correctly designed and adjusted remains the most frequency stable device available to amateur.

The quartz crystal, cut in the form of a suitable dimensioned plate, behaves like a tuned circuit of exceptionally high-Q value. The action of the quartz crystal depends on the piezoelectric effect. In the natural vibration of a quartz plate when used in such an oscillator unit a small but small amount of heat is generated by the internal frictional effects. For reduce the temperature rise, the power output of the oscillator must be kept at a relatively low value.

5.3.2 VARIABLE FREQUENCY OSCILLATOR (VFO)

Although the X-tal oscillator is the most simple, stable and satisfactory device for providing accurate frequency control, it suffers from the obvious disadvantage of fixed frequency operation, particularly on congested amateur band where the operating conditions change from time to time.

A variable frequency oscillator (VFO) is now essential for all HF amateur bands. The frequency determining circuits of such an oscillator consists an ordinary L-C tuned circuit. A VFO of good design should give a frequency stability comparable with that of a crystal oscillator.



Block diagram of SSB transmitter

Fig 5.11

Fig 5.11 shows the block diagram of SSB transmitter. The speech amplifier amplifies the input voice signal to the microphone. This AF signal mixes with the RF carrier signal, generated from the carrier oscillator and converts to SSB by the balance modulator. The filtered SSB signal (USB or LSB) amplifies by the RF amplifier and then the power amplifier.

There may be some unwanted harmonic frequencies also amplify by the power amplifier, but only the fundamental frequency is filtering by the harmonic filter and it is radiate by the antenna system.

5.3.3 FREQUENCY MULTIPLIER

The oscillator is generally designed to operate on a low frequency, because it is more stable. In order to achieve output on the higher frequencies, it is necessary to employ one or more stage of frequency multiplication. An advantage gained from this arrangement is that by operating the oscillator at a relatively low frequency, it is easier to achieve the necessary frequency stability. A single multiplier stage may produce twice the fundamental frequency (frequency doubler) or three times (tripler) or more. Usually, however, the frequency multiplication in one stage is limited to three. It is undesirable to feed the antenna directly from a multiplier since harmonics, other than the wanted signal, are produced and maybe radiated simultaneously.

5.3.4 TYPES OF RF AMPLIFIERS (for HF)

RF power amplifiers are divided into three categories according to the power levels, QRP normal and linear amplifiers. The meaning of QRP is low power. QRP amplifiers for HF operation are normally having 15 watt output or smaller. Power output of normal amateur band transceivers is about 100 watts. If you need high power RF output, you can connect a linear amplifier with the transceiver. Linear amplifiers available for about 300 watts to 2kW. If you use a linear amplifier you must consider the limitation of the power output according to the category of the licence.

5.3.5 TRANSMITTER TUNING AND ADJUSTMENT

When you operate a TRX having a vacuum tube final stage, before transmit you have to do some adjustments.

1. Grid tuning
2. Anode (plate) tuning
3. Load tuning

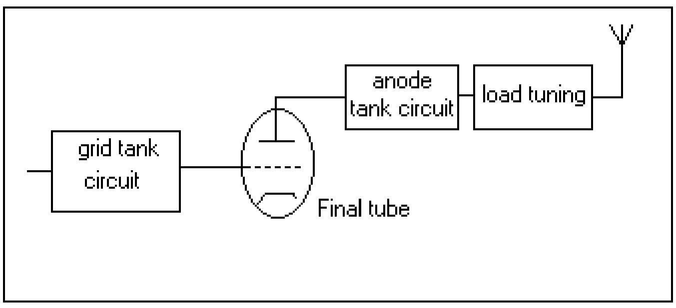


Fig 5.12

5.3.5.1 GRID TUNING

Control grid of the final valve is connected to a tuned resonance circuit called as the grid tank circuit. It should be tuned to the operating frequency for obtain the maximum power output.

5.3.5.2 ANODE TUNING

The tuned circuit (L-C circuit) attached to the anode of the final valve is called as **anode tank circuit**. It should be tuned to the operating frequency for the maximum performances.

5.3.5.3 LOAD TUNING

Anode tank circuit is connected to the impedance matching network and followed by the load. Load is the antenna or a dummy load. Normally HF antennas design for 50 Ohms of characteristic impedance and use 50 Ohm coaxial cable as the transmission line. Therefor load impedance is 50 Ohms and the final anode circuit is not 50 Ohms. When you tune the impedance matching network properly, the total power generated in the final tube will be transfer to the antenna. If it is not tuned due to the excess power the final tube is getting overheated, maybe red hot or melting.

5.4 <u>CODE TRANSMISSION</u>

To impress intelligence on a carrier wave, it must undergo a process of modulation. It is necessary to encoding the information in the form of specific series of pulses of different lengths, to represent each character, the usual system being Morse code. The Morse code based on two characters, dot and dash. All the letters, numerals and punctuation marks represent by different combinations of dots and dashes. There are several methods of encoding system as follows:-

1. On/off keying (CW)
2. Tone modulated Morse in AM
3. Frequency shift keying (FSK)

On/off keying or CW is the best method of code transmission. There are some advantages in this method as follows:-

1. CW TX is a simple construction.
2. Power consumption is low.
3. Working range (distance) is higher.
4. It is possible to copy with some interference.(QRM or QRN)

5.4.1 <u>KEYING CHARACTERISTICS</u>

There are two main components which affect keying characteristics, **shape of the envelope** and **frequency stability.** Any keying troubles such as **key clicks, ripple, chirp and space wave** (back wave) can be attributed to poor conditions in one of these items.

5.4.1.1 ENVILOPE SHAPE

The envelope of the keyed signal is the outline of the pattern that the signal would display on an oscilloscope. It can be observed by feeding the keyed RF signal on to the vertical input of an oscilloscope. The diagram on the Fig5.13 shows the envelopes of keying signals. The perfect keying is shown by Fig 5.13(a).

Fig 5.13(b) is a square pattern with sharp rise and decay, and will be radiate interference over a wide range of frequencies.

The rise and decay times of the carriers must therefor be lengthened (5 to 20 mSec) until the interference is no longer objectionable. Then it will be perfect as Fig 5.13(a). if it is lengthened too much the signal is too soft like Fig 5.13(c) and the signal is not easy to copy.

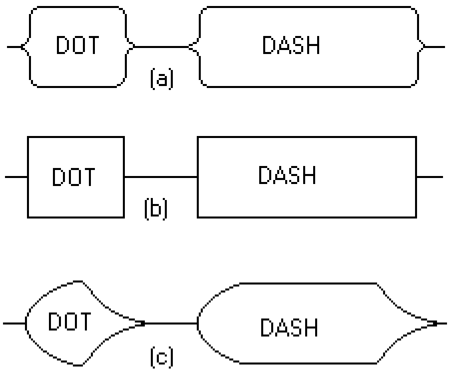


Fig. 5.13

5.4.1.2 KEY CLICKS (RF CLICKS)

Although clicks caused by a hard keying envelope are radiated with the signal, local RF interference may be caused by sparks at the key contact, particularly if an appreciable current is keyed in an inductive circuit. This interference is usually removed by connecting a capacitor (0.001 to 0.01μF)directly across the key or keying relay contacts (Fig 5.14) and in severe cases by also inserting an RF choke. (0.5 to 2 mH) in the live keying lead.

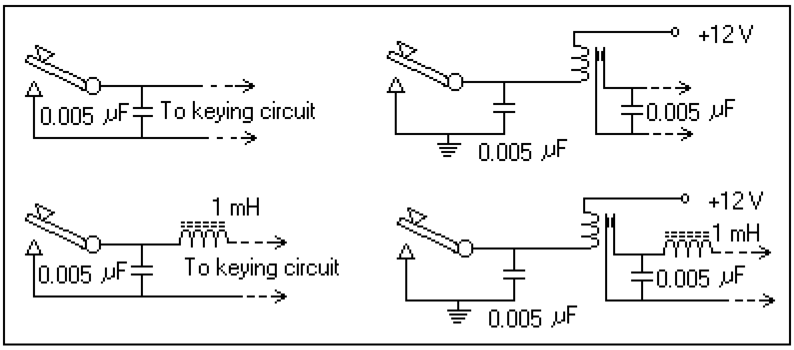


Fig 5.14

5.4.1.3 CHIRP

Chirp is a form of frequency instability occurring each time the transmitter is keyed, and a recognize by a change in beat frequency at the beginning and end of each character (dot and dash), when the signal is monitored on a receiver. It is usually more prevalent in transmitters controlled by a VFO, and there are three principle causes, which are:

(a) ***DC instability:*** This is occurred when a common power supply is used for the oscillator and the power amplifier. No oscillator exhibits absolute stability under varying supply conditions, and therefore a voltage regulator should be incorporated in the oscillator supply.

(b) ***Pulling:*** Pulling refers to the effect on the oscillator frequency of one or more subsequence stages whose operating conditions change during the keying cycle. With the result of this the transmitting frequency is slightly varying.

(c) ***RF Feedback:*** This is a stray signal leaking back from a high level stage to a previous stage, particularly a VFO.

For avoid this problem oscillator must isolate, and it should be away from the power amplifier.

5.4.1.4 SPACER WAVE or BACK WAVE

The spacer wave is the small signal often radiated during key-up condition. It is common for the spacer wave to be audible in the own station receiver, but this does not mean that it is radiated far. If an appreciable spacer is radiated , it would make a signal difficult to copy.

Causes are:

(a) The keyed transmitter stage not being completely cutoff.

(b) Leakage of RF through the power amplifier valve capacitance.

5.4.2 KEYING METHODS

There are many possible methods of keying, and the choice is largely one of practical convenience, personal preference and particularly in break-in systems, suitability to the station as a whole.

5.4.2.1 HT Supply keying

This is very reliable method. HT supply to the anode of power amplifier is keying. Normally this is not use for safety reason, but it is possible to use with a relay.

5.4.2.2 CATHODE KEYING

One of the most popular system of keying is to insert the key in the cathode lead of one or more stages, often the power amplifier alone.

5.4.2.3 GRID KEYING (Grid-block keying)

Grid keying is very satisfactory method. It does however required a negative supply of up to **–250 v**. if a sufficiently large negative bias applied to the control grid, no cathode current will flow. When the key pressed normal bias will be supplied to the grid, when it is released the grid bias will be changed to minus high voltage.(-200v)

5.4.2.4 SCREEN GRID KEYING

This method is breaking the positive supply line to the screen grid, with using the key.

5.4.2.5 KEYING FOR SOLID STATE TX

There are three common systems for solid state keying shown in the diagram of Fig 5.15

(a) For solid state transmitters power supply of the oscillator stage can be connected through the key.

(b) Ground connection (negative polarity) of the oscillator can be connected through the key.

(c) Base bias of the oscillator can be supplied through the key.

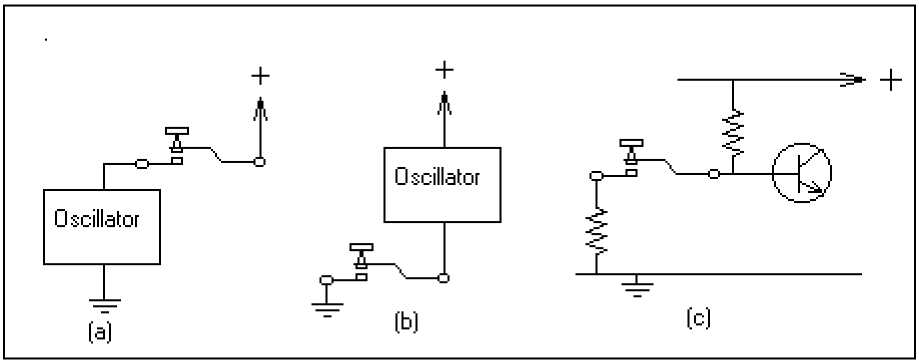


Fig 5.15

5.4.3 BREAK-IN

The essential feature of a break-in system that the operator able to receive incoming signal in the spaces between his own transmitted Morse characters.

5.4.4 DUPLEX

A **duplex** communication system is a system composed of two connected parties or devices that can communicate with one another in both directions. Duplex systems are employed in many communications networks, either to allow for a communication "two-way street" between two connected parties or to provide a "reverse path" for the monitoring and remote adjustment of equipment in the field.

Systems that do not need the duplex capability include broadcast systems, where one station transmits, and everyone else just listens.

5.4.4.1 HALF DUPLEX

A *half-duplex* system provides for communication in both directions, but only one direction at a time (not simultaneously). Typically, once a party begins receiving a signal, it must wait for the transmitter to stop transmitting, before replying.

An example of a half-duplex system is a two-party system such as a "walkie-talkie" style two-way radio, wherein one must use "Over" (both call-signs in HAM radio) or another previously-designated command to indicate the end of transmission, and ensure that only one party transmits at a time, because both parties transmit on the same frequency.

5.4.4.2 FULL DUPLEX

A full-duplex, or sometimes double-duplex system, allows communication in both directions, and, unlike half-duplex, allows this to happen simultaneously. Land-line telephone networks are full-duplex, since they allow both callers to speak and be heard at the same time.

Examples: Telephone, Mobile Phone, etc.

5.5 TYPES OF EMISSION

There are various types of emissions for transmitting signals. There is a system of abbreviations for these types of emissions. Usually there are three characters for these abbreviations. First is a letter, second is a figure and third also a letter. This new system is a result of **World Administrative Radio Conference** held in 1979 (**WARC-79)**

Eg:- **J3E -** usual SSB voice transmission use most of radio amateurs
J2A – CW transmission (Morse)in ham radio.
A3E – Double sideband voice transmission in ham radio.
F8E – FM-stereo broadcasting.

(1) First symbol (letter) – Type of modulation of the main carrier

N – Emission of an unmodulated carrier.
A – Double side band
H – Single side band full carrier
R – Single side band reduced or variable carrier
J - Single side band suppressed carrier
B – Independent side bands
F – Frequency modulation
G – Phase modulation
P – Sequence of unmodulated pulses
K – Amplitude modulated pulses
L – Width modulated pulses
M – Phase modulated pulses
Q – Sequence of pulses modulated during the period of the pulse

(2) Second symbol (figure) - Nature of signal modulating the main carrier.

0 – No modulating signal
1 – A single channel containing digital information without the use of a modulating sub carrier.
2 – A single channel containing digital information with the use of a modulating sub carrier.
3 - A single channel containing analog information.

7 – Two or more channel containing digital information
8 - Two or more channel containing analog information.

(3) Third symbol (letter) – Type of Information to be transmitted.

N – No information transmitted
A – Telegraphy for aural reception
B - Telegraphy for automatic reception
C – Facsimile
D – Data transmission
E – Telephony
F – Television (video)
W – Combination of the above

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