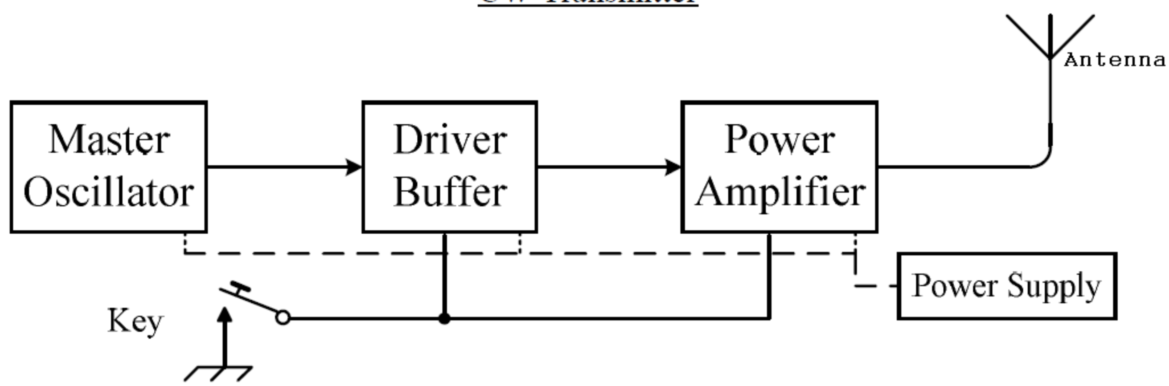
Block Diagrams Exam Question Section

Know the sequence and purpose of all the Blocks in all the Diagrams

<u>CW Transmitter Block Diagram</u>

Exam Questions B-003-004-001 to 006

<u>CW Transmitter</u>



Master Oscillator	Provides a stable RF signal.
Driver / Buffer	Isolates the oscillator from the Power Amplifier. Amplifies the RF signal.
Power Amplifier	Final amplification for the RF signal.
Key	Permits on/off keying.
Power Supply	Provides Direct Current to the various stages.

- The above diagram is a very simple CW transmitter.

- The **<u>"Master Oscillator"</u>** is a radio frequency **<u>(RF) oscillator</u>** that determines the transmitter carrier frequency.

- The **<u>"Master Oscillator"</u>** may be a crystal oscillator using a **piezo-electric quartz crystal** on a fixed frequency determined by the cut of crystal element or may be a tunable **<u>"Variable Frequency Oscillator" or "VFO".</u>** that allows the operator to **"QSY"** over the band allocation. **<u>Re VFO, see Question B-003-011-003</u>**

- The **"Buffer - Driver"** **prevents** "loading" the oscillator circuit that might otherwise cause **"pulling" of the oscillator frequency called "chirp"** during the **keying** action. The **"Buffer - Driver"** section also provides **amplification** of the Master Oscillator signal to properly **"drive"** the **"Power Amplifier"** section for full RF output power from the "Power Amplifier".

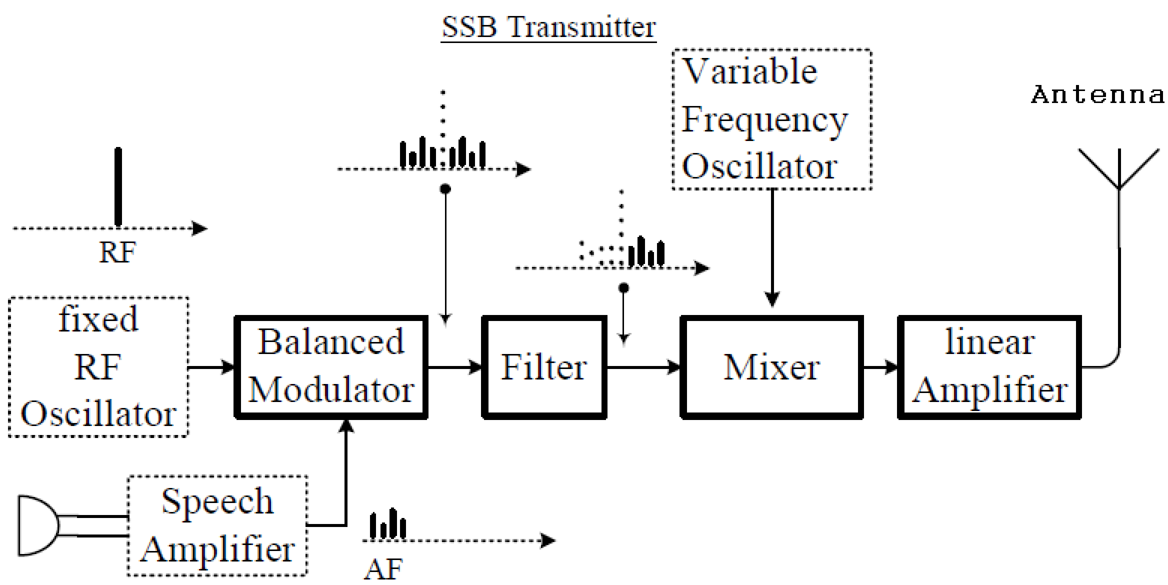
- The **"Power Supply"** may be a simple **battery** for a solid state transmitter or may be a **regulated "DC" power supply** deriving primary power from the residential 60 Hz AC house current.

- The **Morse code Key** is a **simple switch** for the **on and off "keying"** of the various stages of the CW transmitter. In the block diagram, the "Master Oscillator" is not keyed in order to maintain stability of the frequency during the keying cycle and to prevent possible **"chirp".** In some well designed circuits, however, it is permissible to key "Master Oscillator" .

- The term **"chirp" is the subject of Questions B-003-011-001 and -002 .** **Chirp** is a term relating to possible **undesirable functioning** of a CW transmitter where there is **"a small change in a transmitter's frequency each time it is keyed"**. As noted above, it may be caused by a pulling of later stages of the transmitter loading the oscillator and therefore the purpose of a "Buffer" stage. **Another cause is poor regulation of the voltage applied to the oscillator circuit during off and on keying the transmitter.**

SSB Transmitter Block Diagram

Exam Questions B-003-006-001 to -009



RF Oscillator	Supplies fixed frequency radio signal to the Balanced Modulator.
Speech Amplifier	Brings the microphone signal to a working level.
Balanced Modulator	Mixes RF signal and audio signal to create a suppressed-carrier modulated signal.
Filter	Passes the selected sideband (upper or lower).
VFO	Sets the operating frequency.
Mixer	Mixes the modulated RF signal with the VFO to create the final signal.
Linear Amplifier	Final power amplifier (must be distortion free).

- The above diagram is a very simple **filter type SSB Transmitter**.

- The **"Fixed (frequency) RF Oscillator"** must be a stable radio frequency oscillator circuit typically based on a quartz crystal with a frequency closely matched to the bandpass frequency of the **"Filter"** in the design of the circuit architecture. The RF oscillator signal is fed to the **"Balanced Modulator"**.

- The "**Speech Amplifier**" **amplifies** the relatively weak voice waveform generated by **the "Microphone"** and feeds the amplified audio signal to another **input of the "Balanced Modulator**".

- The **"Balanced Modulator"** behaves like a mixer circuit in a superheterodyne radio circuit by **mixing the signals** from the **RF Oscillator and Audio Speech Amplifier.** However, the **RF oscillator signal is "balanced" out** and is greatly suppressed from the output of the Balanced Modulator. The r**esulting signals from the Balanced Modulator** are only the **sum and difference** of the **combination** of the **speech audio frequencies** and the **frequency of the RF Oscillator.** This output is known as **Double Sideband, suppressed carrier or DSB. There is essentially no output from the Balanced Modulation when there is no speech.**

- The output of the **Balanced Modulator** is **fed** to a selective **filter with a bandpass of approximately 2.7 kHz**. The positioning of this filter bandpass will allow **one or the other "sideband"** to go through while rejecting the other. In this way, we can select either the Upper or Lower sideband for transmission. **See questions B-003-012-004 and -005**

- A more practical method of selecting which sideband is selected (LSB or USB) is to leave the "Filter" bandpass window static and change the frequency of the "Fixed" RF Oscillator" so that it is either on the right side of the Filter bandpass (for USB) or on the left side of the Filter bandpass (for LSB).

- The SSB **output signal** from the **"Filter"** is fed to a **"Mixer"** where it is **combined** with a signal from a tunable **"Variable Frequency Oscillator" (VFO)** to produce a **"beat frequency"** that becomes the operating frequency of the transmitter.

- **The VFO design should be electrically and mechanically stable to ensure the oscillator frequency setting is stable and does not drift.** **See question B-003-011-009 .**

- The output of the **"Mixer"** is fed to drive a **"Linear RF Amplifier"** stage to boost the transmit power to something reasonable for reliable communications. The **amplifier must be "Linear"** to **ensure** there is a faithful representation of the SSB waveform with **low distortion**. Any **significant amount of distortion** will make the **received voice less intelligible** and the transmitter will likely **transmit out high spurious signals causing interference** to other radio users.

- The output of the **Linear Amplifier** stages will **feed** an appropriate **antenna.**

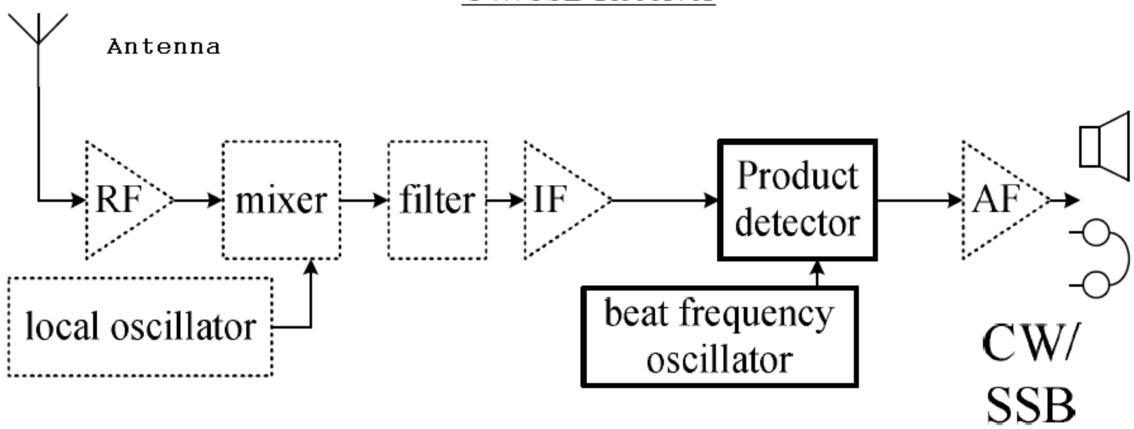
- In designing an SSB transceiver, there will be common use of some of the blocks to support the receive and transmit functions. For example, the Fixed Frequency Oscillator of the transmit function will be the same as the BFO in the receiver section. The Filter will be the same for the transmitter and receiver functions and the LO of the receiver will be the same as the VFO of the transmitter. In this way, by using same internal and common function blocks with the same internal frequencies , the receiver and transmit frequency tuning will track with a common control and mode selection between USB and LSB and CW.

<u>CW-SSB Receiver Block Diagram</u>

We discuss this in greater detail in the section of the "Superhetrodyne Communications Receiver"

Exam Questions B-003-005-001 to -010

CW/SSB Receiver



RF Amplifier	Amplifies the signal arriving from the antenna.
Mixer	Converts received frequency to Intermediate Frequency.
Local Oscillator	Supplies one input to the mixer.
IF Filter	Passes desired mixing result.
Intermediate Frequency Amplifier	Amplifies the IF signal.
Product Detector	Mixes the IF with the BFO to produce an audible signal.
Beat Frequency Oscillator	Supplies one input to BFO ("carrier re-insertion").
Audio Amplifier	Amplifies the audio signal to drive the speaker/headphones.

- The above diagram is a very simple **CW - SSB radio receiver**.

- The "RF Amplifier" amplifies the very weak incoming signals from the antenna. The **RF Amplifier** is the most important stage that determines the **<u>"sensitivity"</u>** or **signal to noise (SNR) ratio** performance of the receiver.

- The **output of the RF Amplifier is fed** to the **"Mixer"** stage. The Mixer combines the band of frequencies incoming from the RF amplifier along with a **tunable oscillator** known as the **"Local Oscillator"**. The mixing results in a **range of "beat frequencies"** which are the difference (or sum) of all the incoming signals and the local oscillator. This output from the Mixer stages is passed along to the **Intermediate Frequency (IF) "Filter"** which **selects** a desired signal for listening.

- The **Local Oscillator** is a radio frequency **(RF) oscillator** that is the **main frequency tuning control** of the Radio Receiver. The RF signal from the **Local Oscillator is fed to the Mixer** and this **combines with the range of incoming signals** to produce the **Intermediate Frequency or (IF)**.

- The **"Filter"** permits a narrow bandpass **"window"** of **Intermediate Frequencies (IF)** through from the result mixing the incoming signals and the signal from the local oscillator. The **IF filter allows listening to the desired signal(s)** from the lot of many on the band. **The IF "Filter" determines the "selectivity"** of the receiver and is typically selectable for different reception modes of the communications receiver.

- The **"IF Amplifier"** boosts the **IF signal** making up for the losses in the IF filter and adding to the overall gain of the receiver. The **output of the IF Amplifier** is connected to the **"Product Detector"**

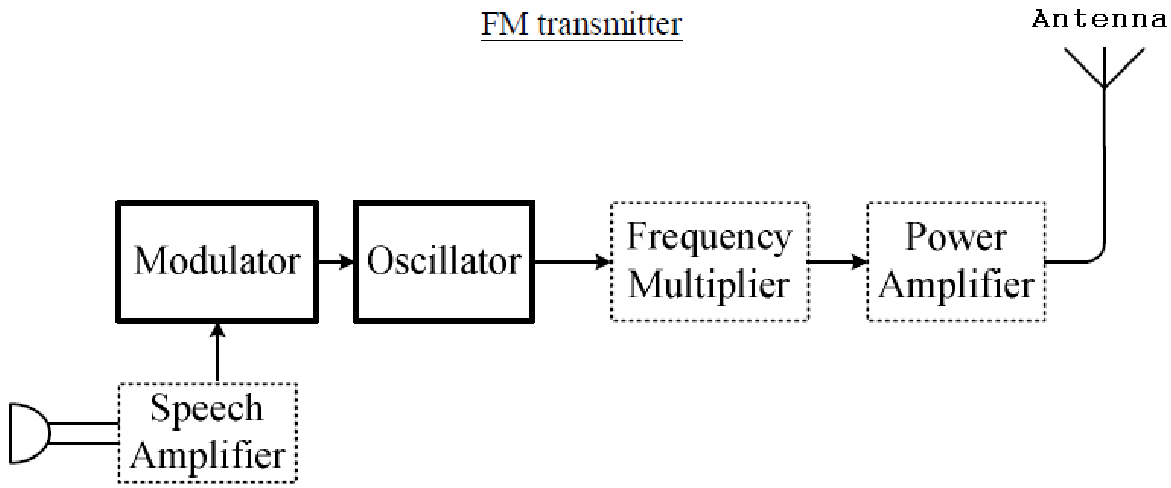
- The **"Product Detector" is a mixer combining the IF signal** of the desired selected signal(s) and the signal from the **"Beat Frequency Oscillator" (BFO).** The **output** of the **Product Detector** is demodulated audio be it a CW signal or SSB signal which is **connected** to the input of the **Audio Frequency (AF) Amplifier** for further amplification.

- The **Beat Frequency Oscillator (BFO)** is a **radio frequency oscillator** within audio frequency range of the Intermediate Frequency. The **BFO** frequency is set or adjusted so that it is properly positioned in the IF bandpass to **re-insert the suppressed carrier of an SSB signal** or to beat against the **CW signal** to produce the desired audible tone around **800 Hz.** The BFO is often variable and may be called a **"Clarifier".**
  See question B-003-010-011 .

- The **"Audio Frequency (AF) Amplifier**" is the last stage of the receiver to further boost the amplitude of the desired (selected) signal enough to properly power a loud speaker or set of headphones. The input to the **AF amplifier** is usually **adjusted by a volume control** often called the **AF Gain** control on a communications receiver

FM Transmitter Block Diagram

Exam questions B-003-002-001 to -007



Speech Amplifier	Brings the microphone signal to a working level.
Modulator	Forces deviation of the Oscillator frequency to produce FM.
Oscillator	Provides the base RF signal.
Frequency Multiplier	Brings the Oscillator signal up to the operating frequency.
Power Amplifier	Final amplification for the RF signal.

- The **"Speech Amplifier"** amplifies the relatively weak audio waveform generated by the **"Microphone"** and feeds the larger audio voice signal to an input of the **"Modulator".**

- The FM **"Modulator"** is connected to the **"Oscillator".**

- The RF **"Oscillator"** must be frequency stable as it ultimately determines the output frequency of the transmitter.

- The **Oscillator** circuit may be based on a quartz crystal for fixed frequency operation or a L - C based **"Variable Frequency Oscillator" of stability equal to crystal control.**

- The **"Modulator",** by way of various circuit techniques such as a **"varicap"** diode (a voltage controlled variable capacitor device) swings the frequency back and forth from the centre frequency of the Oscillator at a rate proportional to the modulating signal frequency and an amount (the deviation) proportional to the modulating voice signal amplitude. *(The louder you talk, the greater the deviation)*

- The same effect as Frequency Modulation can be produced by a so called **Reactance Modulator** that **changes the "phase"** of the signal of the RF Oscillator signal in proportion of the voice modulating signal. This is called **Phase Modulation** and for all intent and purpose produces the same result as Frequency Modulation. **See Question B-003-013-008**

- **Good design of an FM or Phase Modulator** incorporates a modulation **deviation control** and **limiter** that sets and limits the peak **deviation not to exceed + / - 5 kHz**. If the deviation control is set too high **allowing excessive deviation** when you talk loudly, the reception at the receiving end will sound **too loud and distorted** and **may even close the squelch** at the receiving end. **See question B-003-013-010**

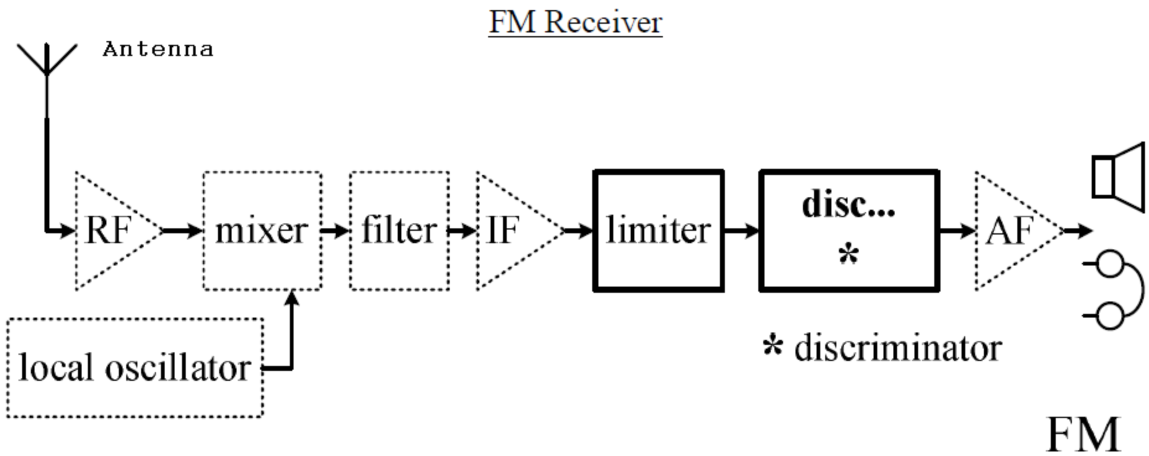
- The modulated Oscillator signal is fed to the **"Frequency Multiplier"**. In a typical FM transmitter, the Oscillator is operated at a sub-multiple of the final operating frequency of the transmitter. This is because FM as a modulation mode requires up to **16 kHz** bandwidth and therefore is only suitable on **VHF and**

UHF and 10 metre bands that allow this wider emission bandwidth necessary for FM. (Remember RBR-4, page 5. column II). Also see question B-003-013-009. Traditionally, it has been difficult to design an RF oscillator with good stability at VHF and UHF frequencies without using quartz crystals and the fabrication of quartz crystal devices was only possible within the lower HF range of frequencies or below. This necessitated **using harmonic multiples of the Oscillator frequency** to derive the final transmitting frequency. For example, a crystal oscillator operating at 12.25 MHz would be multiplied 12 times (by resonant L-C circuits tuned to the 12th harmonic) to produce an transmitter carrier frequency of 147.000 MHz in the 2 metre band. It should also be appreciated that by multiplying the fundamental oscillator frequency that is Frequency Modulated, the deviation of the oscillator is also multiplied. So only + / - 0.4167 kHz FM deviation is necessary from the modulated RF Oscillator to achieve +/- 5.0 kHz on the transmitting frequency, the standard amount of deviation used for amateur FM radio.

- Like other transmitter designs, the final stage of the FM transmitter is an RF **"Power Amplifier"**. As opposed to the SSB transmitter, the **Power Amplifier for the FM transmitter does not have to be "linear"** and therefore can be run a greater RF output vs DC input power efficiency.

<u>**Frequency Modulation (FM) Receiver Block Diagram**</u>

Exam questions B-003-003-001 to -010



RF Amplifier	Amplifies the signal arriving from the antenna.
Mixer	Converts received frequency to Intermediate Frequency.
Local Oscillator	Supplies one input to the mixer.
IF Filter	Passes desired mixing result.
I F Amplifier	Amplifies the IF signal.
LIMITER	Maintains a constant amplitude IF signal to the Discriminator.
DISCRIMINATOR	Extracts the original modulation from the FM signal.
Audio Amplifier	Amplifies the audio signal to drive the speaker/headphones.

- The above diagram is a very simple FM radio “superheterodyne” receiver.

- The "RF Amplifier" amplifies the very weak incoming signals from the antenna. The RF Amplifier is the most important stage that determines the "sensitivity" of the receiver.

- The output of the **RF Amplifier** is fed to the **"Mixer**" stage. The Mixer combines the band of frequencies incoming from the RF Amplifier along with **tunable oscillator known as the "Local Oscillator"**. The mixing results in a range "beat frequencies" which are the difference (or sum) of all the incoming signals and the local oscillator. This **output from the Mixer stage** is connected to the **<u>Intermediate Frequency (IF) "Filter"</u>**.

- The **Local Oscillator is a radio frequency (RF) oscillator** that is the **main frequency tuning control** of the Radio Receiver. The RF signal from the **Local Oscillator is also fed to the Mixer** and this combines with the range of **incoming signals** to produce the **Intermediate Frequency (IF).**

- The "Filter" permits a narrow bandpass "window" of Intermediate Frequencies (IF) through from the result of mixing the range of incoming signals and the signal from the local oscillator. The IF filter allows listening to the desired signal from the lot of many on the band. The **<u>IF "Filter" determines the "selectivity"</u>** of the receiver with a bandpass that is most appropriate for a single FM signal based on its modulation index. Modulation index is that amount of (peak deviation) / (max modulation signal frequency). For amateur FM communications, the IF Filter should be 16 kHz wide.

- The "IF Amplifier" boosts the IF signal making up for the losses in the IF filter and adding to the overall gain of the receiver. The **<u>output of the IF Amplifier</u>** is connected to the **<u>"Limiter", a stage unique to a FM receiver.</u>**

- The **Limiter** is an overly high gain amplifier that **provides a constant level** of signal **to the FM Discriminator** stage and therefore reduces the effect of signal level (amplitude) changes to the output of the receiver based on signal level variations of the FM signal. This is particularly advantageous for mobile reception. Also, impulse noises that may be present and received and therefore superimposed on the FM signal as amplitude variations are clipped off in the limiter stage while leaving the frequency variations of the modulated (voice) signal unaffected.

- The **"Discriminator"** uses a resonant L - C *(inductor/capacitor)* circuit that detects the frequency swing plus and minus the centre IF frequency and **produces a audio waveform that follows the FM swing rate and instantaneous deviation** of the voice modulation**.**

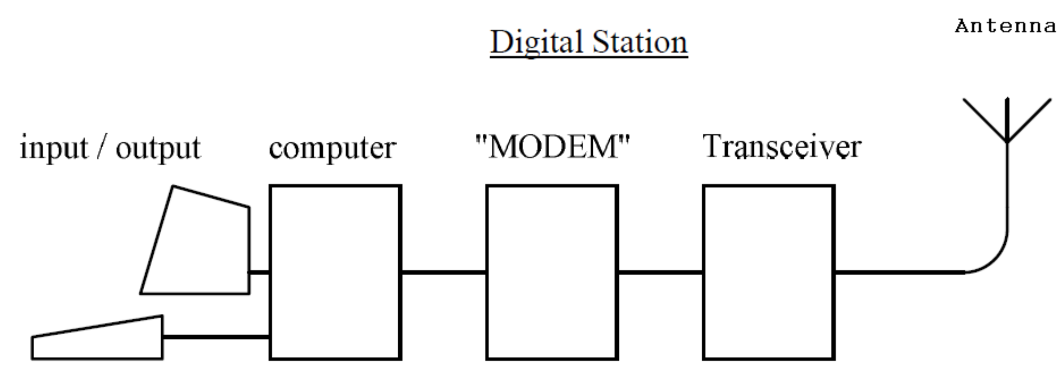
- **The output of the Discriminator is amplified by the Audio Frequency (AF) Amplifier** a sufficient amount to power a loud speaker or set of head phones. **The input to the AF amplifier is usually adjusted by a volume control or sometimes called an "AF"** (audio frequency) gain control.

- Not shown in the block diagram is the Squelch Circuit. The **Squelch Circuit detects the internal noise of the radio circuits** generated mainly from the overly amplified high gain of the limiter circuit. The **noise is rectified** to provide a DC voltage used to **gate OFF the audio to the AF output stage**. This effectively **mutes reception of the radio.** When an on-frequency **signal is received**, the **noise is quieted** and the voltage from the squelch circuit is reduced and the **AF output stage is un-muted to allow the signal to be heard.** There is often a user adjustment on the squelch circuit called the **"Squelch Control"** the determines the amount of receiver noise needed to mute reception.

A communications FM receiver may also have a **CTCSS decoder** (continuous tone coded squelch system) that provides an **alternate to the "carrier" squelch function**; **the proper CTCSS tone must be received (continuously during reception) from the transmitting station to un-mute the speaker and hear the station.**

The Digital Station Block Diagram

Exam Questions B-003-007-001 to -005



Input/output	Keyboard, display or other source of data.
Computer	
MODEM	MOdulator/DEModulator: converts ASCII data to audio tones and vice-versa.
Transceiver	

- The above block diagram is a simple generic representation of the functional blocks of a digital mode amateur radio station.

- The **Input / Output (I O)** is the physical human to machine interface represented by a **computer keyboard (for inputting)** and **computer screen (for visually outputting)** the message communications.

- The **"Modem" means "modulation / demodulation".** It is the hardware interface to **convert digital signals** (DC voltage levels representing binary data of ones and zeros) to analogue signals such as two tone frequencies to represent ones and zeros. In the case of AX.25 Packet Radio for 1200 baud operation, **the modem in the packet TNC** uses Bell 202 standard tones, 1200 Hz for a "mark" or binary 1 and 2200 Hz for a "space" or binary 0 . These tones can easily be transmitted and received over the voice channel of an VHF or UHF FM amateur transceiver. The **"Mod"** part of the modem will be connected to the **microphone input of the transceiver** and the **"Demod"** of part of the modem will be connected the **receiver audio output** (or speaker circuit) of the transceiver. **See question B-003-015-006**

- With many digital modes, the **computer internal sound card** or an external USB sound card interface is the **"modem" for interface to the radio transceiver.** **See question B-003-007-005**

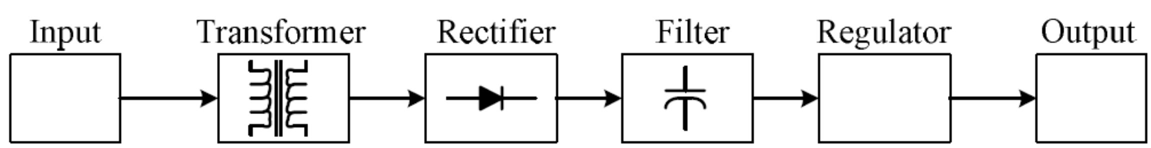
- In the generic sense, the radio Transceiver can be a VHF or UHF FM transceiver or SSB transceiver used on the HF or VHF or UHF amateur bands.

- Contrary to what is suggested in the block diagram narrative, the "modem" does **not always convert ASCII data** to audio tones; depending the digital mode, the **data may have other forms of data structure** such as the Baudot code used for RTTY or Varicode code used in PSK-31.

Regulated Power Supply Block Diagram

Exam Questions B-003-008-001 to -006 and B-003-017-001 to -0011

Regulated Power Supply



Input	On/Off switch, fuse, pilot light, the actual power source…
Transformer	Raises or decreases the voltage.
Rectifier	Converts AC to DC.
Filter	Removes the ripple.
Regulator	Maintains constant output voltage regardless of line/load variations.
Output	Fuse, instruments, …

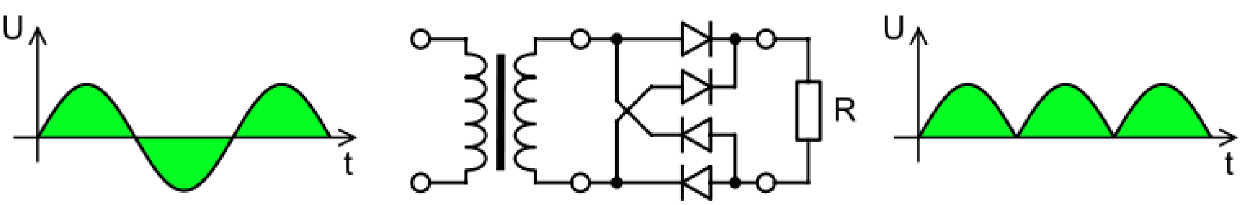
- The above block diagram depicts the main concepts of a non-switching regulated power supply that is either an embedded circuit in equipment or stands alone as separate equipment designed to power other equipment.

- A regulated power supply for amateur radio application is most often designed to operate from **117 VAC, 60 Hz, residential mains power** and **converts that power to a nominal 12 volt DC power** of some rated current capacity. Most **amateur radio equipment is designed** to operate from **12 volts DC** (actually about 13.8 to 14 volts representing an automobile electrical system under charging conditions) available from a standard **automobile battery electrical system**. **See question B-003-016-001.**

- The **"Input" power** for North America is a nominal **117 Volts AC** at **60 Hz**. This Input circuit may be switched On or OFF and should be **fused for safety**. If excessive AC current is drawn in the primary circuit of the transformer, the fuse blows indicating a fault condition and disabling the functioning of the Power Supply.

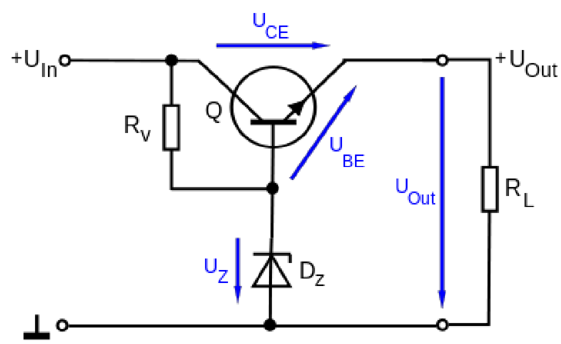
- The **AC Input** power will be applied to a power **"Transformer"** that normally steps down the input voltage to something that is more appropriate on the secondary windings.

- This reduced voltage will normally have a higher current capacity due to the thicker wire used for the secondary windings of the transformer. This secondary AC voltage will be applied to a **full wave diode rectifier** circuit for **converting to pulsating unidirectional direct current (DC).**



- The pulsating DC will be smoothed to by a large value **"Filter" capacitor.**

- The "smoothed" DC will then be applied to a **voltage "Regulator"** circuit that will deliver a constant output voltage (say regulated to 13.8 volts) over a wide range of current levels that may be drawn from the Output of the power supply or voltage variations on the AC input of the power supply. . A simple voltage regulator circuit looks like this:



Note the **Zener Diode** D_z.

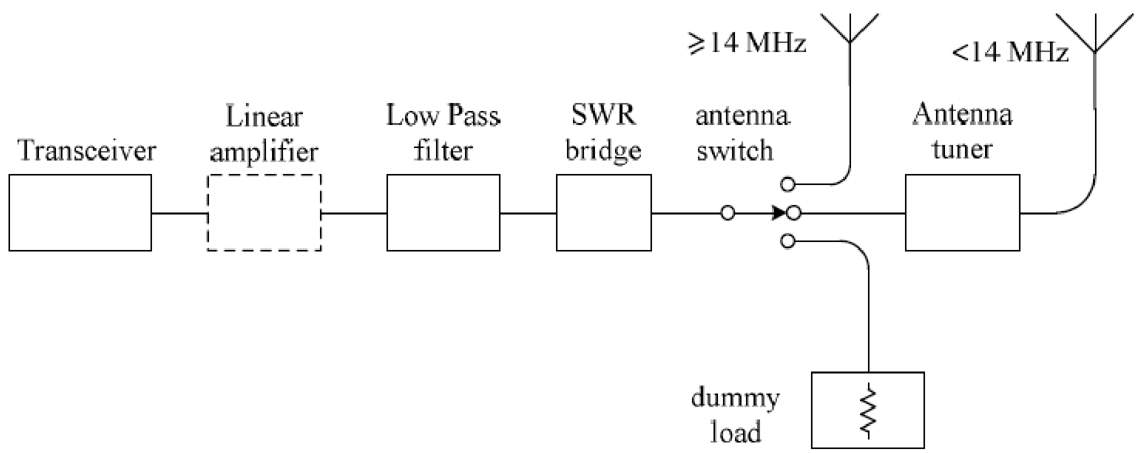
- The **Output** of the power supply should also be **<u>fused</u>** in series with the load or equipment connected to the Output to ensure there is no damage the power supply (or connected equipment) should the output current be exceeded beyond safe design limits.

- The Output may also be fitted with a **<u>parallel connected Voltmeter</u>** and a **<u>series connected Ammeter</u>** so the output power can also be monitored in terms of Voltage and Amperage at all times.

HF Station Configuration Block Diagram

Exam Questions B-003-001-001 to -009

HF Station



Transceiver	Combined transmitter/receiver.
Linear Amplifier	Optional. Used for higher power.
Low Pass Filter	Attenuates any harmonics (unwanted multiples of the operating frequency).
SWR bridge	Measures effectiveness of the antenna system through a measure of the impedance match.
Antenna switch	Facilitates connecting the correct antenna to the station.
Dummy load	Permits adjustments to the transmitter (tuning) without placing signal on the air.
Antenna tuner	Matches the antenna impedance to the transmitter (extends bandwidth of antennas or makes them usable on other bands).

- The above block diagram shows the recommended sequence of assembly of the various components that make up a good HF amateur radio station, 160 through to 10 metre bands.

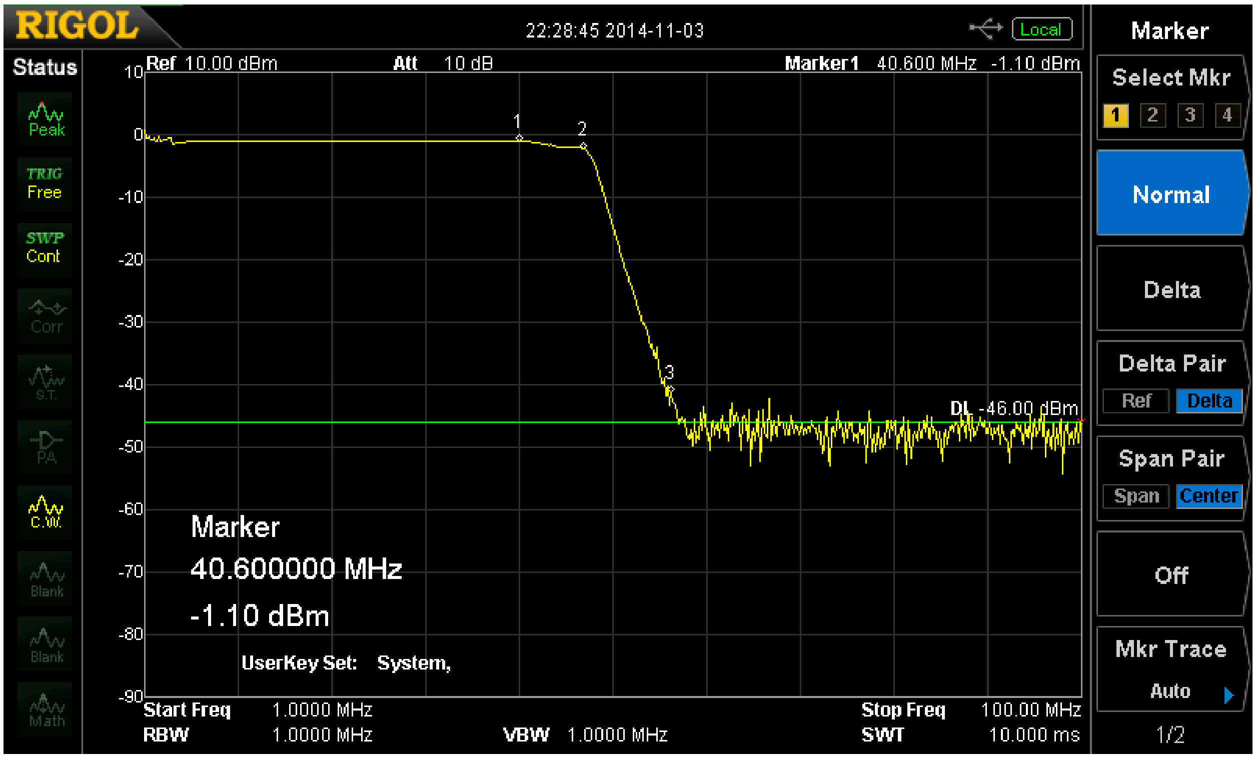
- The **<u>Transceiver</u>** is typically a unit that is **all band HF**; some now incorporate as well, the VHF 6 & 2 metre and even the UHF 70 cm band. For the 2 mtr and 70 cm bands, there is usually a separate antenna connection on the transceiver. Most common HF **transceivers at rated at 100 watts RF output power**.

- The **<u>Linear Amplifier</u>** will boast the transceiver output power to much higher levels such as **500 or 1000 watts or more**. A **Linear Amplifier is optional** and you will require your **Advanced Amateur Qualification to own and operate one.**

- The next in the sequence of connection is a **<u>"Low Pass Filter".</u>**

- The **<u>Low Pass Filter</u>** allows the **HF frequencies through** but provides considerable **attenuation to energy above 30 MHz.** The **Low Pass filter suppresses harmonic output** of the transceiver (or Linear Amplifier if used) that may otherwise cause interference to VHF and UHF television (and other services) reception. Nowadays, the Low Pass Filter may be considered optional because of good harmonic suppression of most modern HF transceivers.

- This is the spectrum analyzer trace of Low Pass Filter for use on an amateur radio HF transmitter.



Marker 1 is at 40 MHz and Marker 3 is at approximately 54 MHz. There is over 40 dB attenuation at frequencies above the 6 metre ham band at 54 MHz.

- The **SWR bridge (or meter)** is a very important accessory that continuously evaluates the impedance "match" of the antenna system and the Transceiver. When there is a perfect match of 50 ohms (source) to the 50 ohms (load), the Standing Wave Ratio will be 1:1 . When there is an impedance mismatch (of source to load), all of the transmitter power is not transferred to the load (that being the antenna system) but is reflected back to the source (the transceiver). For example, a 3:1 SWR represents 25% of the transmitter power is reflected and not transferred to the antenna system. A full understanding of SWR is more complex than described here, but practically, **<u>it is important to maintain a good SWR (2:1 or less) as measured on an SWR meter on the 50 ohm coaxial connection to the transceiver</u>** (or linear amplifier). High SWR may result in damage of the Transceiver. The SWR meter allows this to be measured.

- SWR meters will often have 2 meters built in one instrument. In the above example, one meter needle reads "Forward" RF power and the other reads "Reflected"; and where the two intersect, the calibrations on the meter face show SWR.

- The **"Antenna"** side of the **<u>SWR meter</u>** should be connected to the **<u>Antenna Coaxial Switch.</u>** The Antenna Switch facilitates quick switching of the transceiver to a **<u>"Dummy Load"</u>** or an **<u>Antenna Tuner</u>** often used for wire antennas. The Antenna Switch may also have other positions for other antennas that provide a good match without an Antenna Tuner.

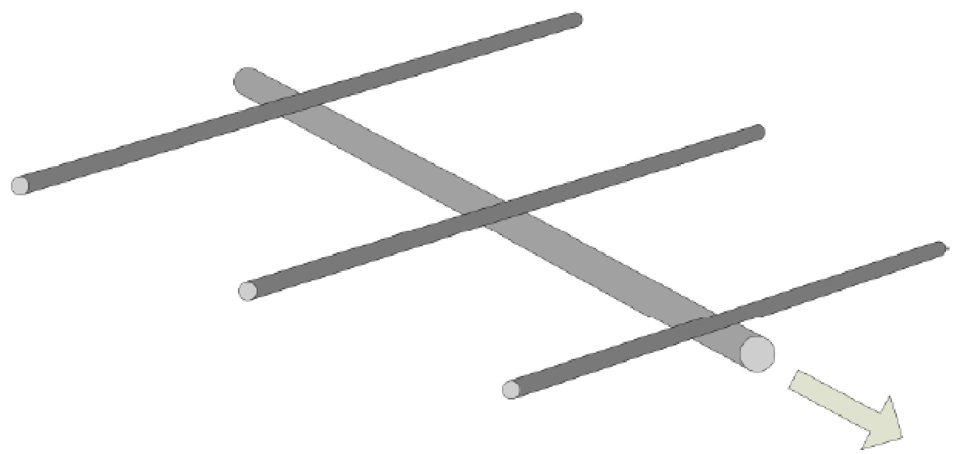
- The **Antenna Tuner** is a **manually adjustable impedance matching system.** It is typically designed to **match a wide range of impedance values** present on various antennas operated on a wide range of frequencies to an impedance of 50 ohms. **The Antenna Tuner is adjusted so that the SWR between the Tuner and the Transceiver is 1:1 .** Many Antenna Tuners also have built-in an SWR meter and some modern units will automatically tune for best SWR. Some modern HF transceivers may also have an antenna tuner "built in"

- The **"Dummy Load"** is a **50 ohm coaxial load resistor**. Its physical design must be constructed so that the capacitive reactance is balanced by inductive reactance so that it maintains a 50 ohm impedance and 1:1 SWR throughout the wide range of frequencies it will be operated. The **Dummy Load is rated in Watts** based on its ability to **dissipate heat. A Dummy Load should have a power rating based on the power of the Amateur Station transmitter.**

Yagi (Beam Parasitic Antenna)

Exam Questions B-003-009-001 to -004

Yagi (beam parasitic antenna)



Reflector	In the back, 5% longer than driven.
Driven	Where the feedline attaches. Similar in size to a halfwave dipole.
Director	In the front, 5% shorter than driven.
Boom	Supports the elements (mechanical support).

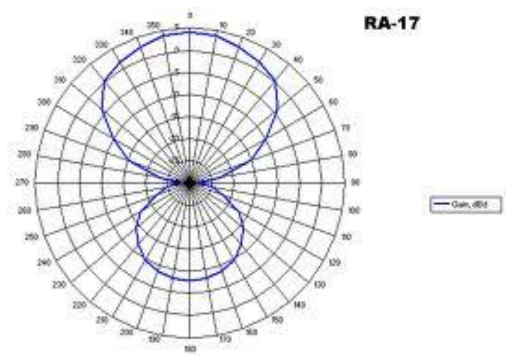
- The Yagi is a very popular "beam" directional antenna design.

- The above diagram shows a 3 element Yagi with a reflector, driven and director elements. Yagi antennas can have many more directors to sharpen the beam wide and increase the antenna gain.

- **Yagi antennas have <u>one</u> Driven element** to which the **feed line is attached. See Question B-006-011-001**

- The **__Reflector__** and one or more **__Directors__** **are known as** **__Parasitic__** **elements** because the feedline is not connect to them.

- A horizontal polarized, (meaning elements parallel to the ground) 3 element Yagi would have an azimuth pattern with maximum radiation “gain” from director element(s) and much lesser radiation from the back reflector element. The signal is very much reduced off the sides of the antenna as shown in the pattern below.



- The difference in radiation pattern (in dB) between **the front radiation lobe** and the **back radiation lobe** (where the reflector is) is call the **__Front-to-Back ratio__** of the Yagi antenna. A well designed Yagi antenna should have at least 20 dB front to back ratio.