Amateur Radio Class

Class 8

February 26, 2006

Welcome

We will review:

1. Modulation

    Amplitude Modulation (AM)

    Frequency Modulation (FM)

2. Reactance

3. Resonance

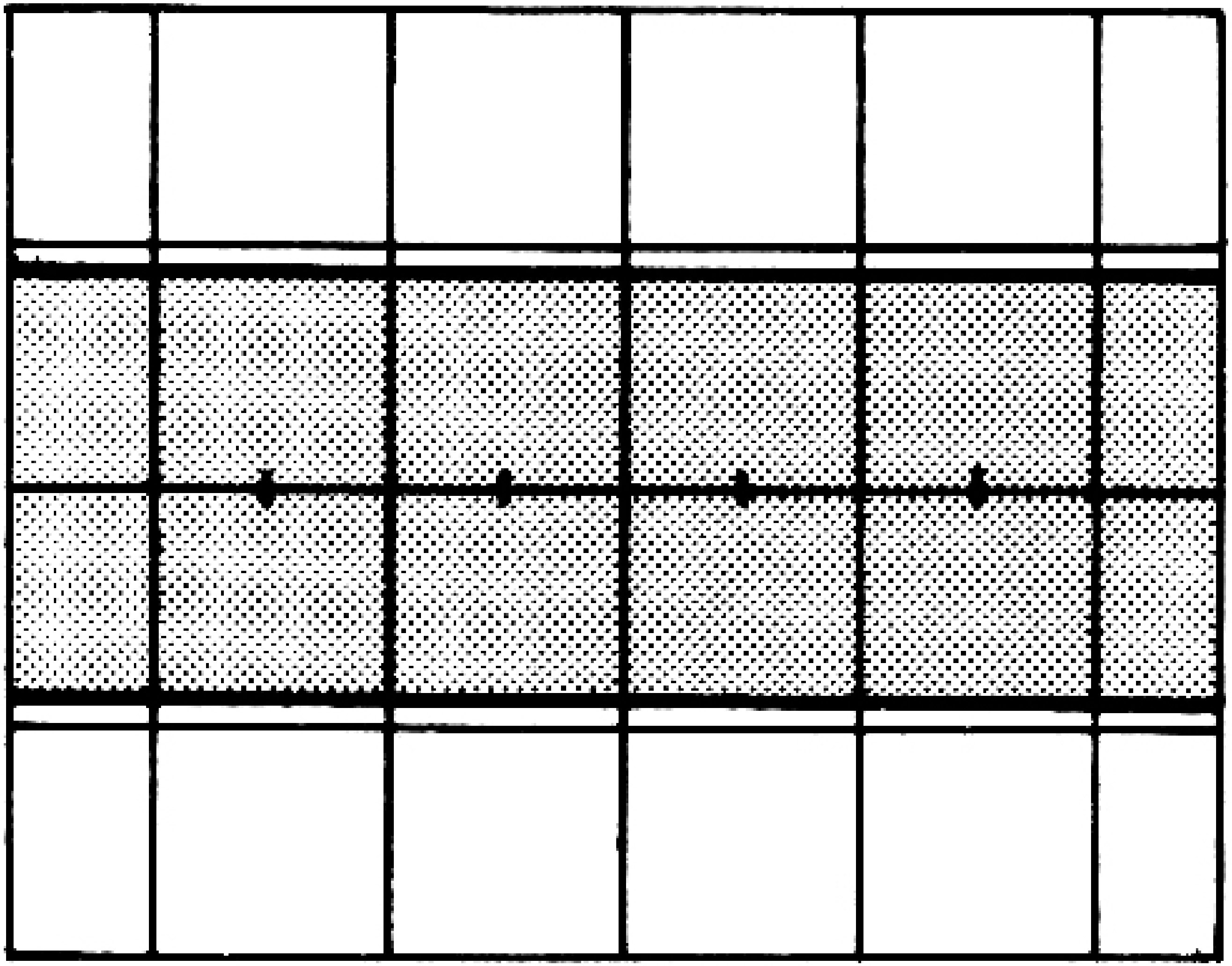
Modulation

Modulation

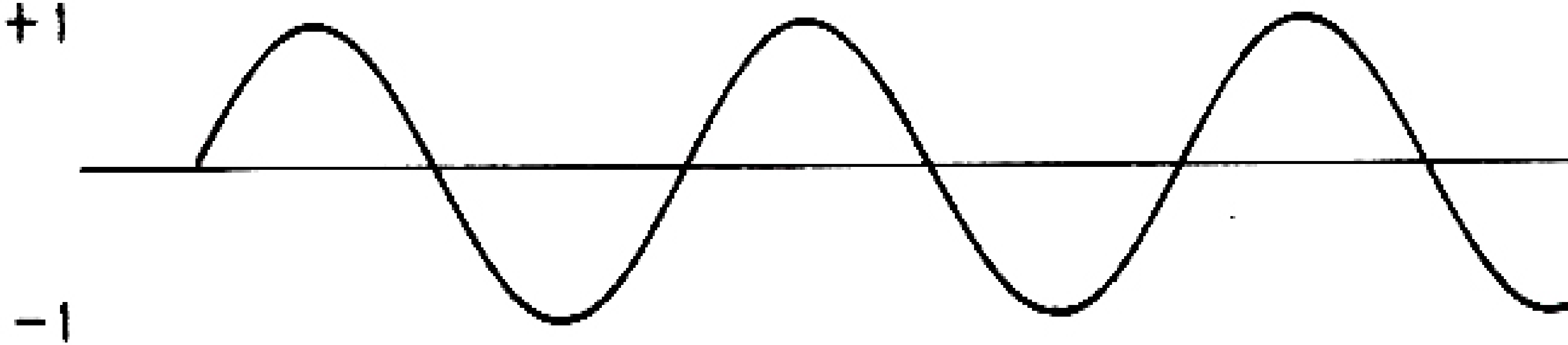
The processes of combining an information signal with a radio signal

Phone transmission usually means AM, FM or SSB

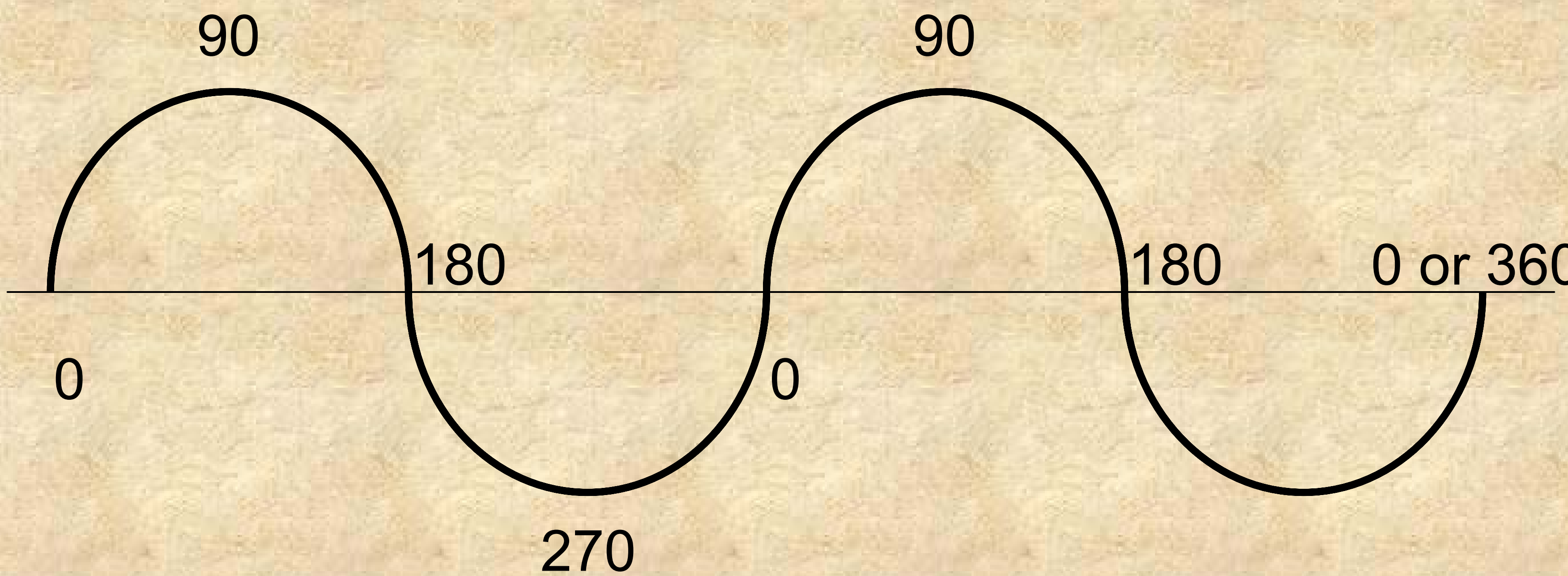
AM = Amplitude Modulation, FM = Frequency Modulation, SSB = Single Sideband Modulation & FSK = Frequency Shift Keying Modulation.



An unmodulated Radio Frequency (RF) Carrier



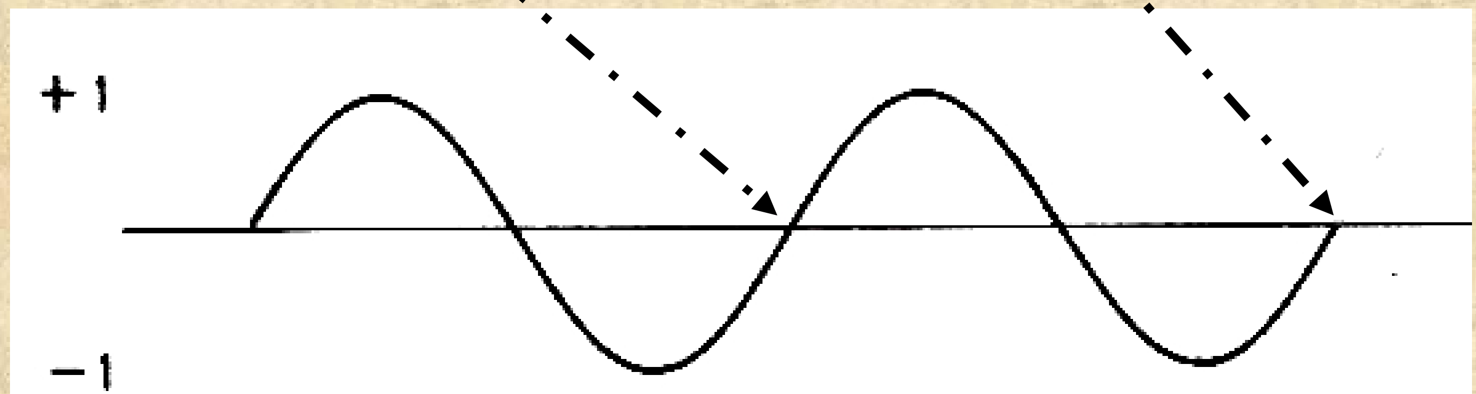
(A)



2 cycles or Hertz

End of first cycle or 360 degrees

End of second cycle

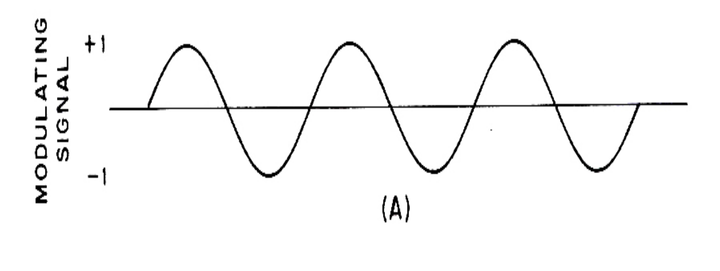


An audio signal or sign wave

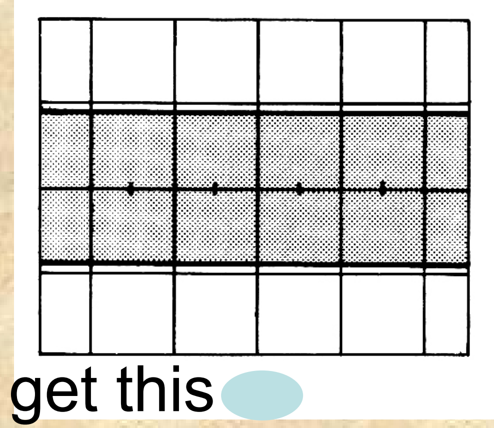
Amplitude

Modulation

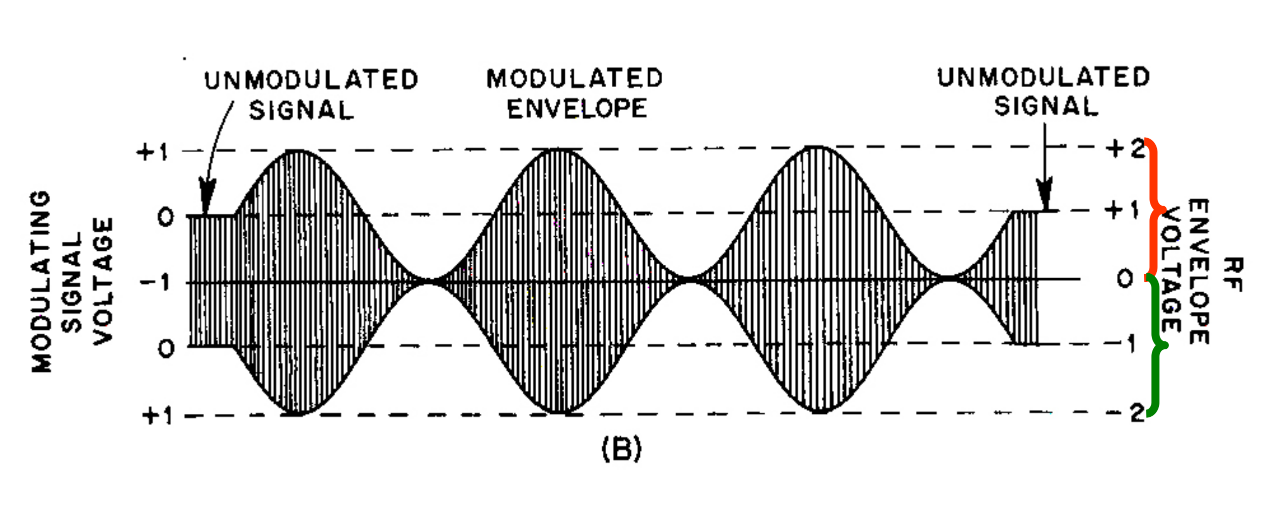
Amplitude Modulation (AM)



+



Combine the two and you get this

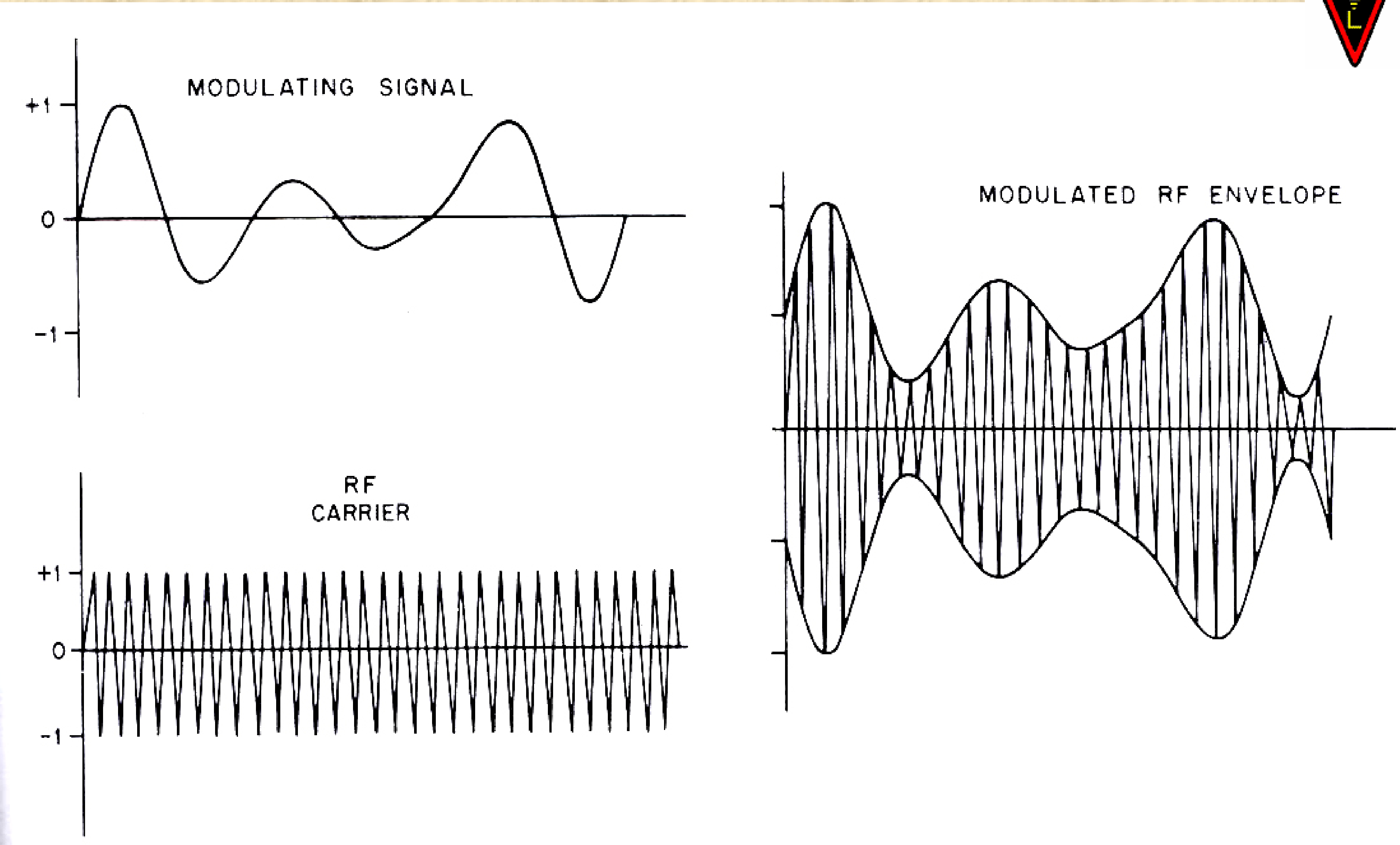


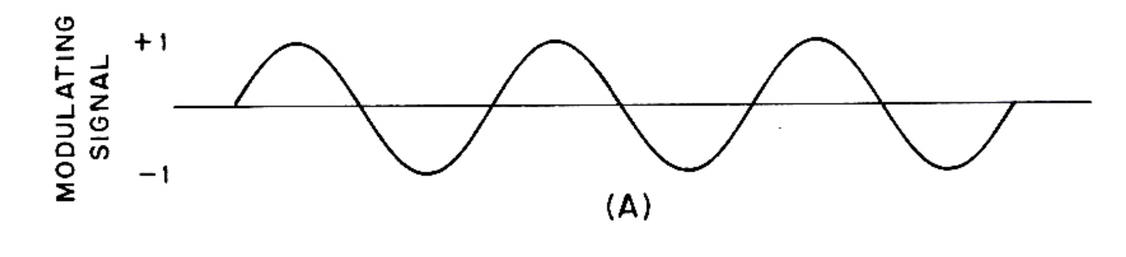
Upper

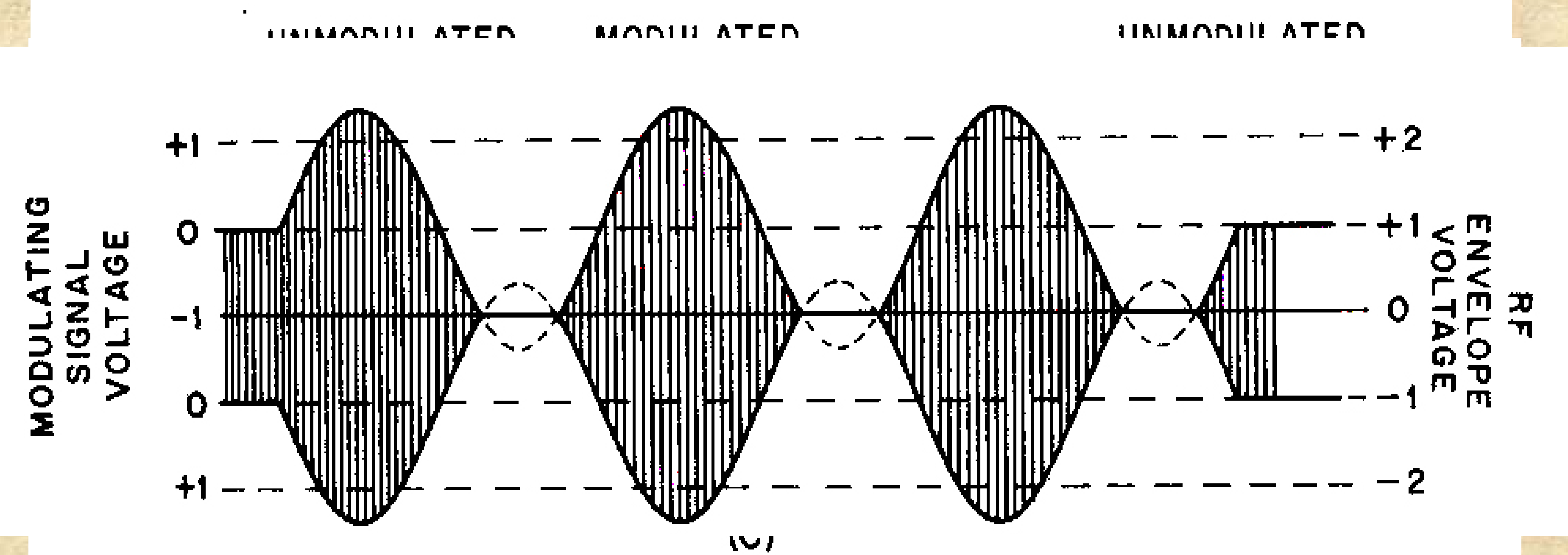
Sidebands

Lower

In AM, 50% of the energy is in the carrier and 25% in each of the two sidebands.


MODULATING SIGNAL
+1
0
-1
RF
CARRIER
+1
0
-1
MODULATED RF ENVELOPE



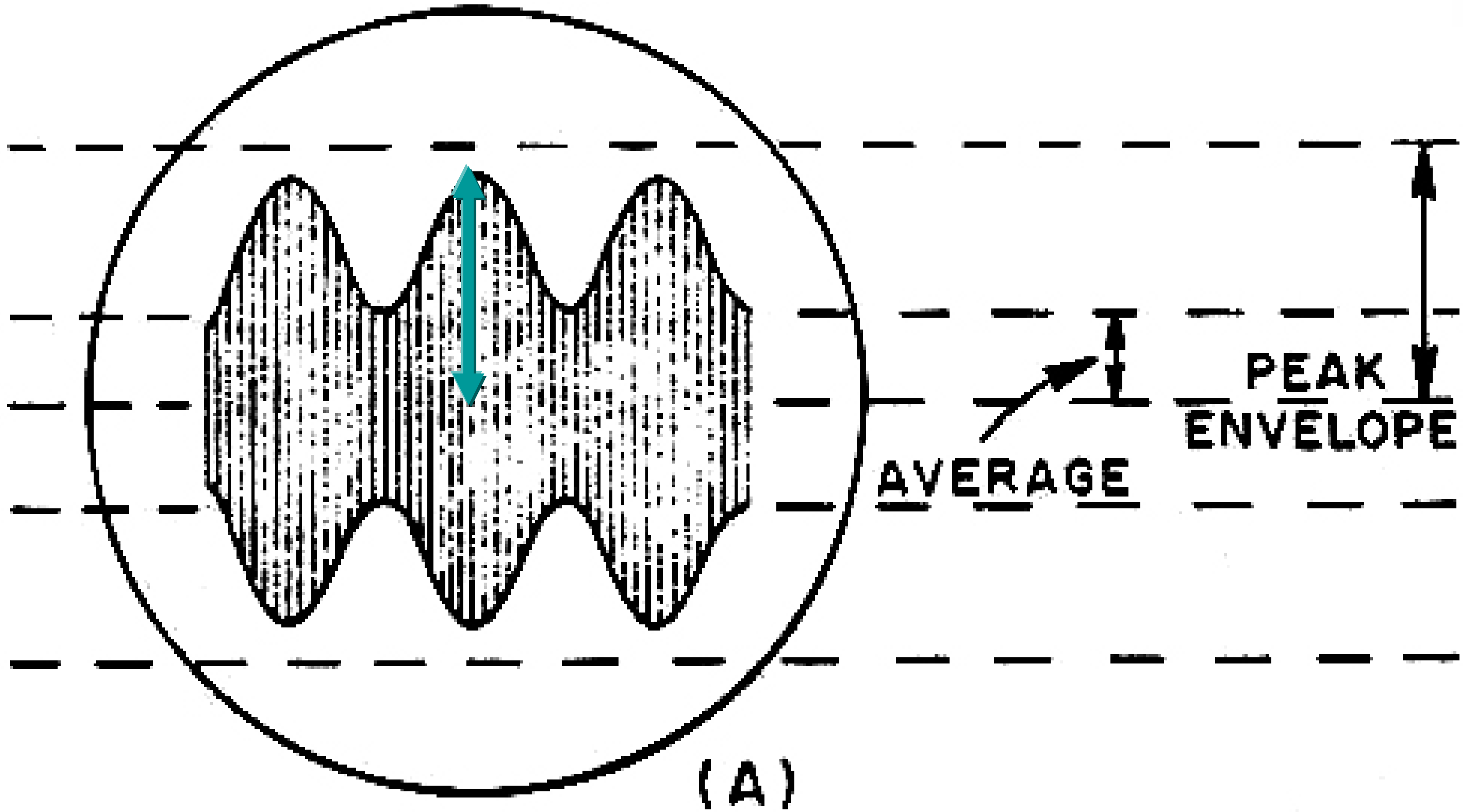


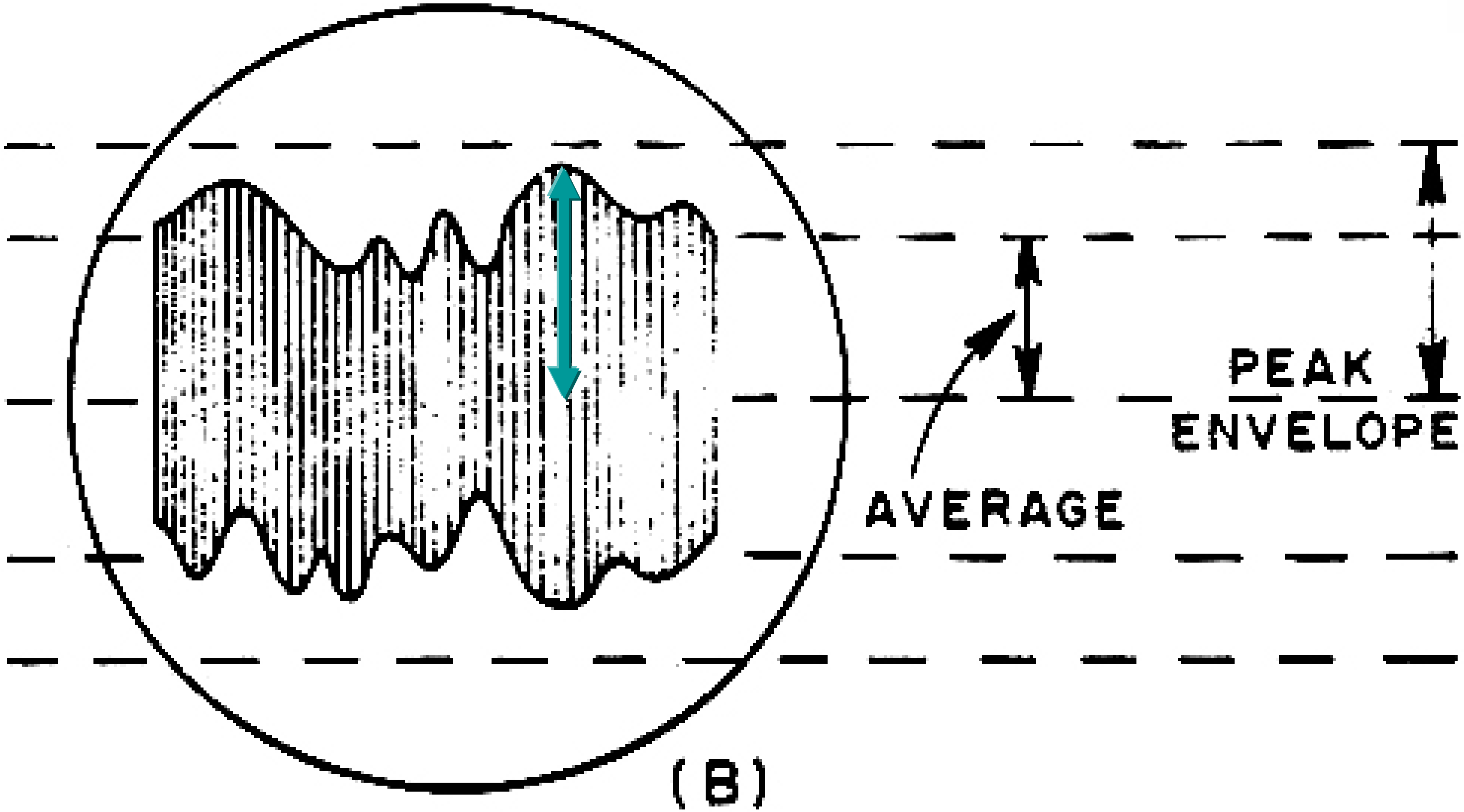
OVER MODULATED!

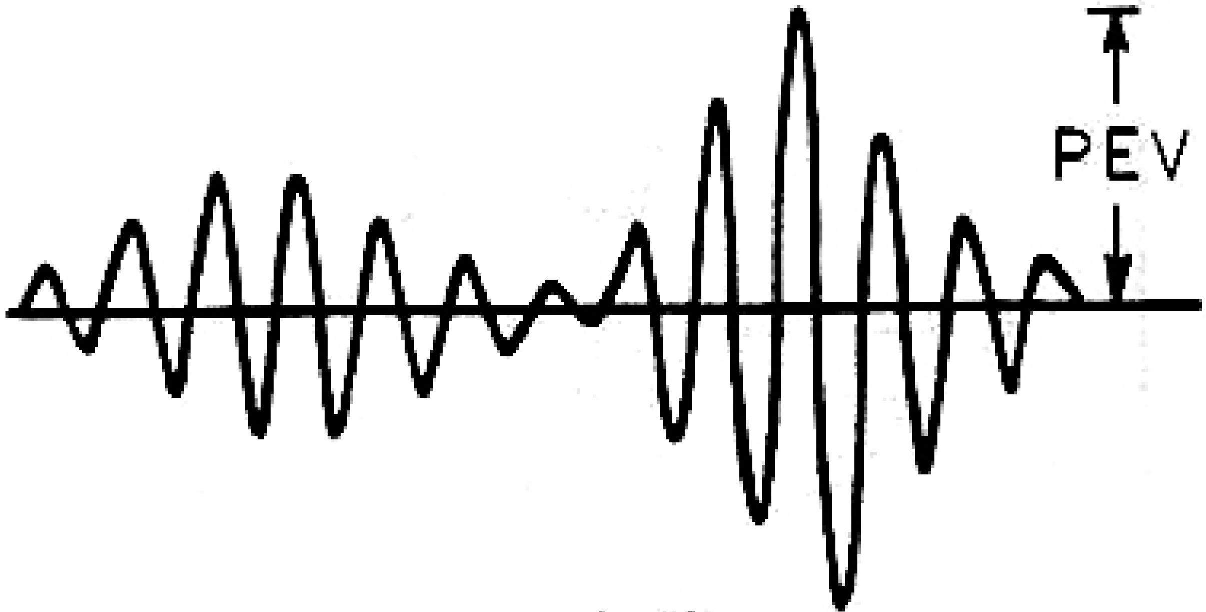
Causes splatter

AM

Over modulation of a transmitter is **never** permitted!


PEAK
ENVELOPE
AVERAGE
(A)


PEAK
ENVELOPE
AVERAGE
(B)

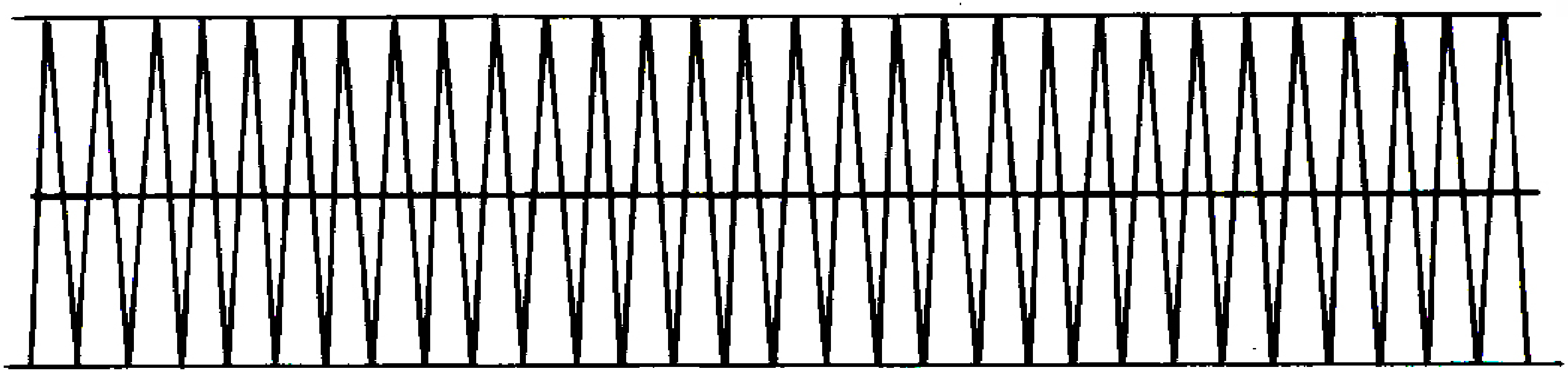


(B)

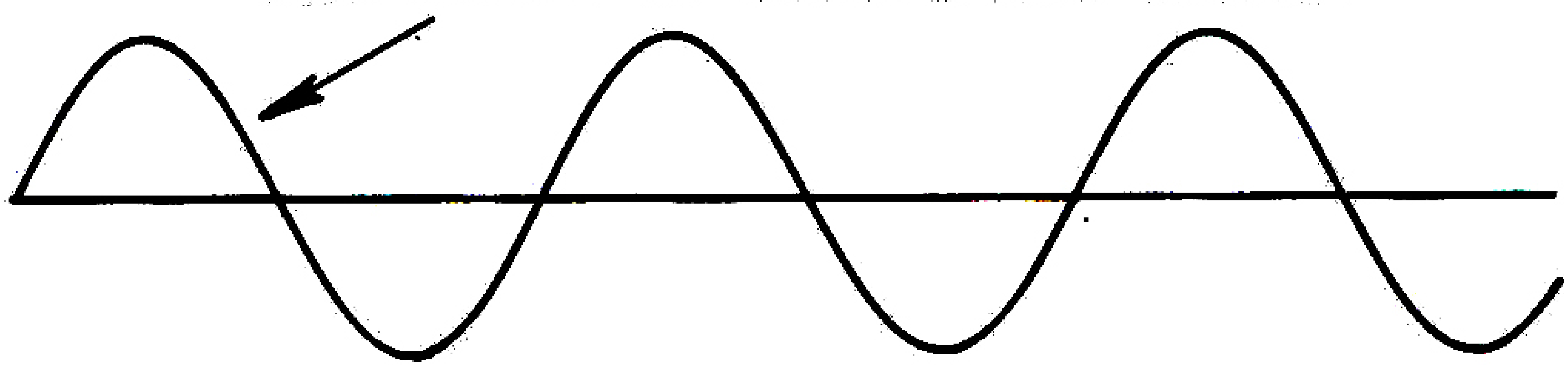
Frequency

Modulation

FM

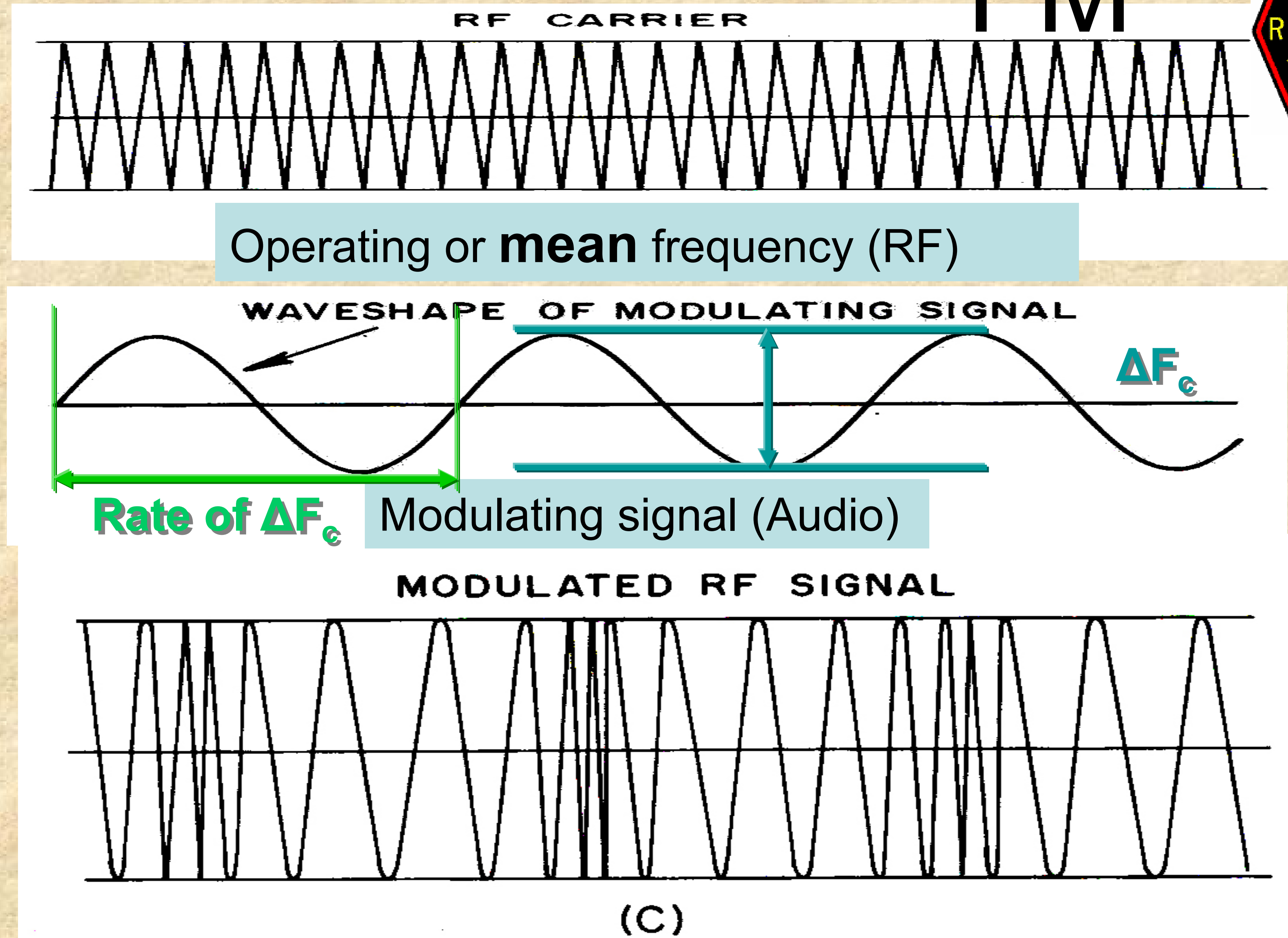


(A)



(B)

FM


RF CARRIER
Operating or mean frequency (RF)
WAVESHAPE OF MODULATING SIGNAL
ΔFc
Rate of ΔFc
Modulating signal (Audio)
MODULATED RF SIGNAL
(C)

FM

In FM, it is the amplitude of the modulating signal that determines how far above and how far below the mean frequency the carrier will go.

i.e.: If +1 volt moves the carrier 1 KHz above mean frequency, then – 1 volt will move the carrier 1 KHz below mean frequency. This is called the index of modulation.

It is the frequency of the modulating signal that will determine the rate at which the FM carrier will move above and below the mean frequency.

i.e.: If the modulating signal is 1 KHz then the carrier will move above and below mean frequency one thousand times per second. How many Hertz above and below is determined by the amplitude of the modulating signal. Too much amplitude and the swing will be excessive.

FM

Over modulation in FM is called Over deviation and causes out of channel emissions.

Over modulation of a transmitter causes splatter interference.

FM

Over modulation of a transmitter is **never** permitted!

Bandwidth

How much Space or spectrum that is required get information moved.

Types of transmission - Narrowest to widest bandwidth

CW Made by turning a transmitter carrier on and off.

RTTY In HF, this is done by Frequency Shift Keying an RF signal.

Single Sideband (SSB) voice

Frequency Modulation (FM) Voice

FM is used with VHF/UHF repeaters.

A harmonic is the multiple of a frequency

The first harmonic of 5 KHz is 10 KHz

The second harmonic of 6 KHz is 18 KHz

The third harmonic of 7 KHz is 28 KHz

The fourth harmonic of 8 KHz is 40 KHz

Tech-Notes

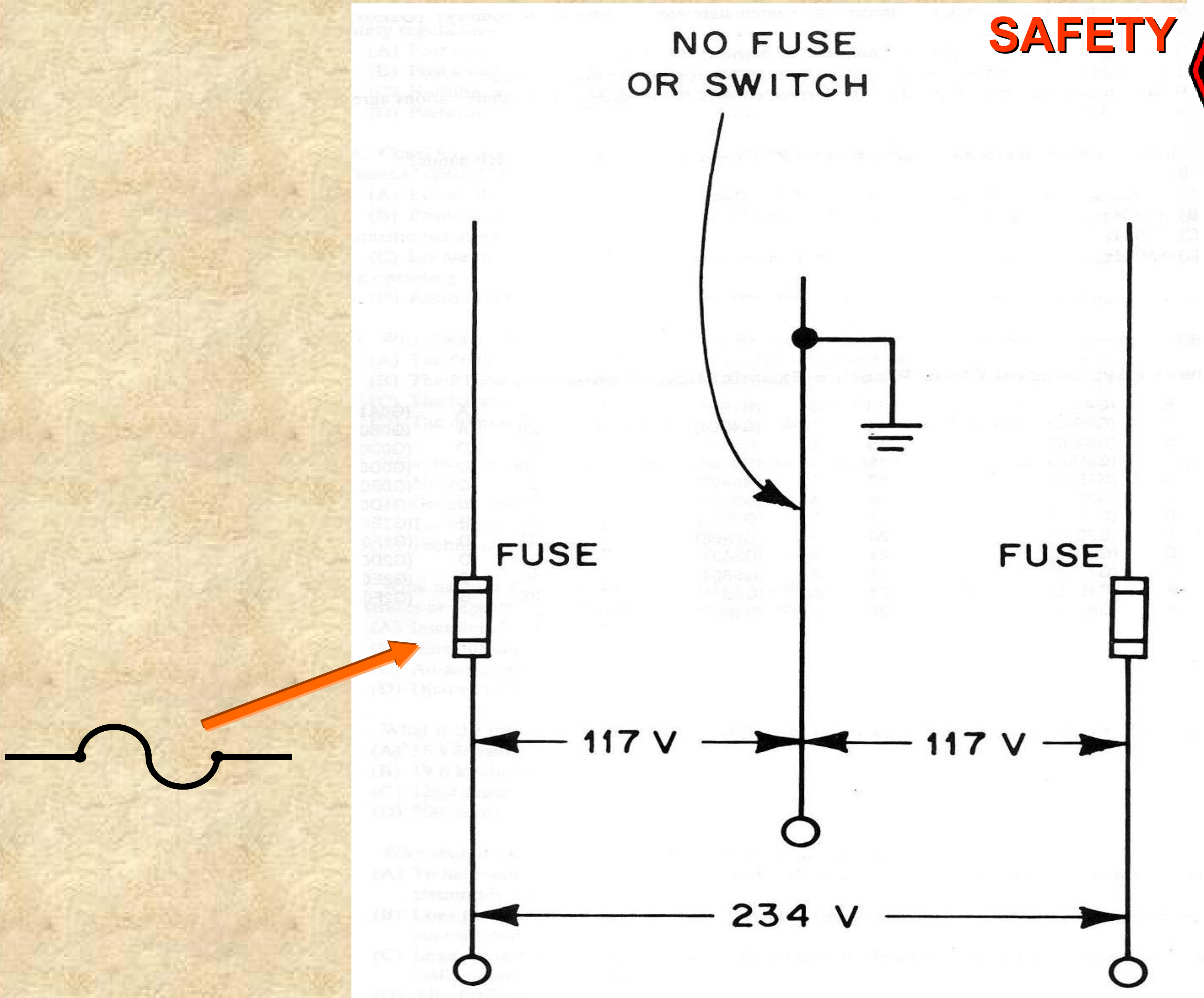
USB

is commonly used for 10-meter phone operation.

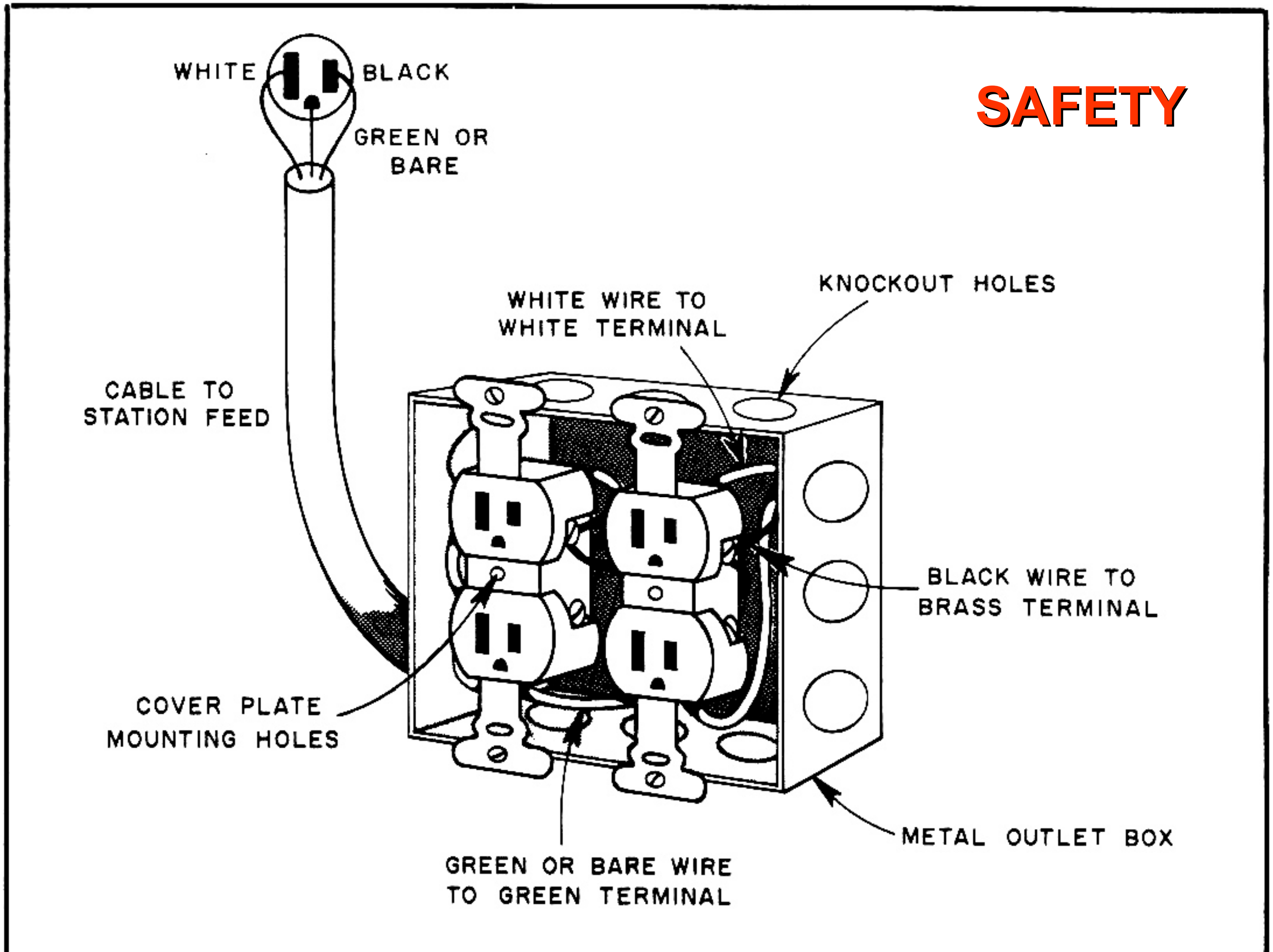
Chirp

A term used to describe a small change in transmitter frequency each time it is keyed.

SAFETY



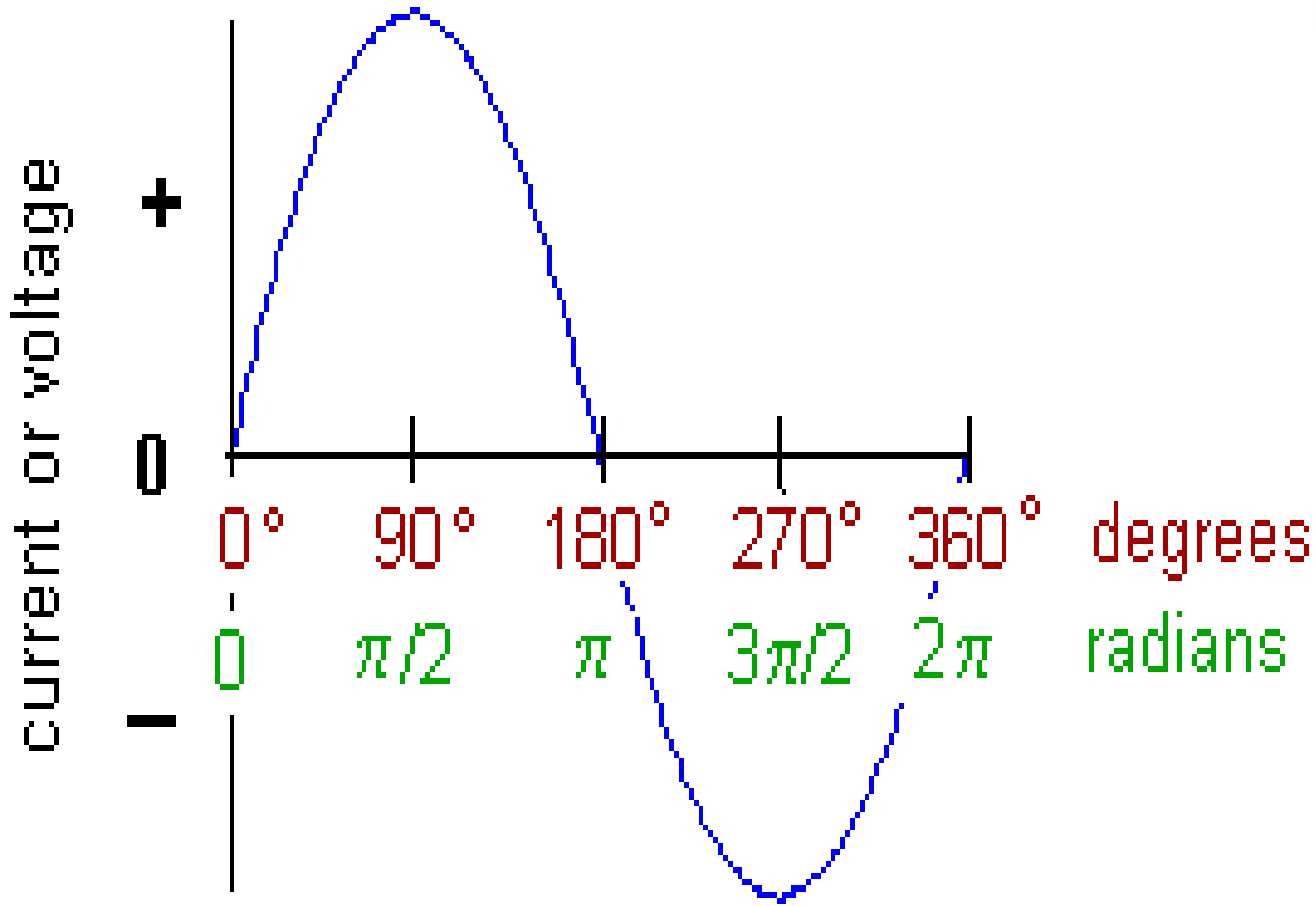
SAFETY



OUTLET BOX WIRING DETAIL COVER PLATE REMOVED

What are the advantages of properly grounding your station?

Reactance


current or voltage
+
0
−
0°
90°
180°
270°
360°
degrees
0
π/2
π
3π/2
2π
radians

$$\pi = 3.14$$

$$2\pi = 6.28$$

Inductive Reactance

Inductive Reactance is the opposition to current flow in an inductive circuit.

Inductive Reactance is only present when there is a change in current flow. Therefore, the frequency of that change must be taken into account when calculating the reactance.

The formula for calculating Inductive Reactance is:

L = Inductance in Henrys

$$X_L = 2 \pi f L$$

F=frequency in Hertz

1 Cycle=360 degrees or 2 π radians

X_L= Inductive Reactance

As f increases, X_L increases

Inductive Reactance

In an Inductive circuit, the current will lag going through an inductor, the voltage across, it by 90 degrees.

ELI

$X_L = 2\pi f L$

E = Voltage

L = Inductive circuit

I = Current

Another way to look at it: In an Inductive circuit, the voltage across it will lead the current going through it by 90 degrees.

Capacitive Reactance

Capacitive Reactance is the opposition to voltage change in a capacitive circuit.

Capacitive Reactance is only present when there is a change in Voltage. Therefore, the frequency of that change must be taken into account when calculating the reactance.

The formula for calculating Capacitive Reactance is:

C = Capacitance in Farads

F=frequency in Hertz

1 Cycle=360 degrees or 2 π radians

X_C= Capacitive Reactance

$$X_C = \frac{1}{2 \pi f C}$$

As f increases, X_C decreases

Capacitive Reactance

In a Capacitive circuit, the voltage will lag across a capacitor the current into it by 90 degrees.

ICE

I = Current

C = Capacitive circuit

E = Voltage

Another way to look at it: In a Capacitive circuit, the current will lead the voltage across a capacitor by 90 degrees.

Remember your friend:

ELI

the

ICE

man

Resonance

There are two kinds of resonant circuits:

Series **and** ***Parallel*****.**

These two kinds of resonant circuits can be installed either in series or in parallel with the their load.

Resonance

Resonance occurs whenever $X_C = X_L$

The resonance frequency of a circuit can be calculated as follows:

$$F_o = \frac{1}{2\pi\sqrt{LC}}$$

F_O = The resonant frequency in Hertz

C = Capacitance in Farads

L = Inductance in Henrys

There are two kinds of resonant circuits. What are they?

Resonance

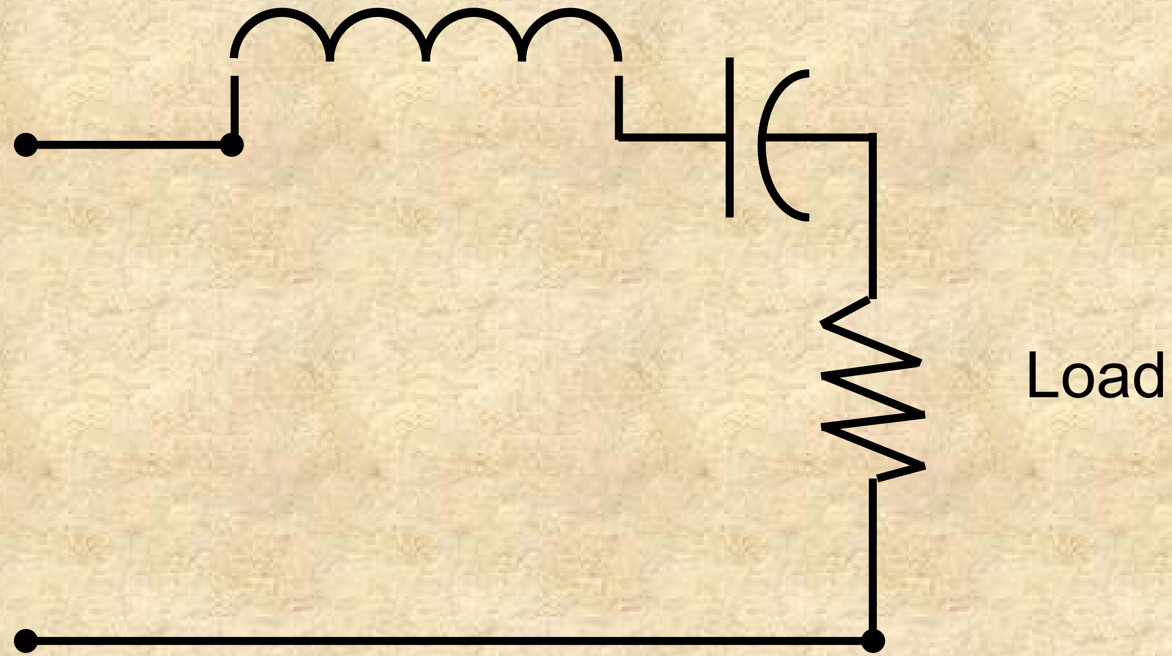
Resonance occurs whenever $X_C = X_L$

Below resonance, a circuit demonstrates capacitive reactance.

Above resonance, a circuit demonstrates inductive reactance.

Series resonant circuit
in series with the load.

$$F_o = \frac{1}{2\pi\sqrt{LC}}$$

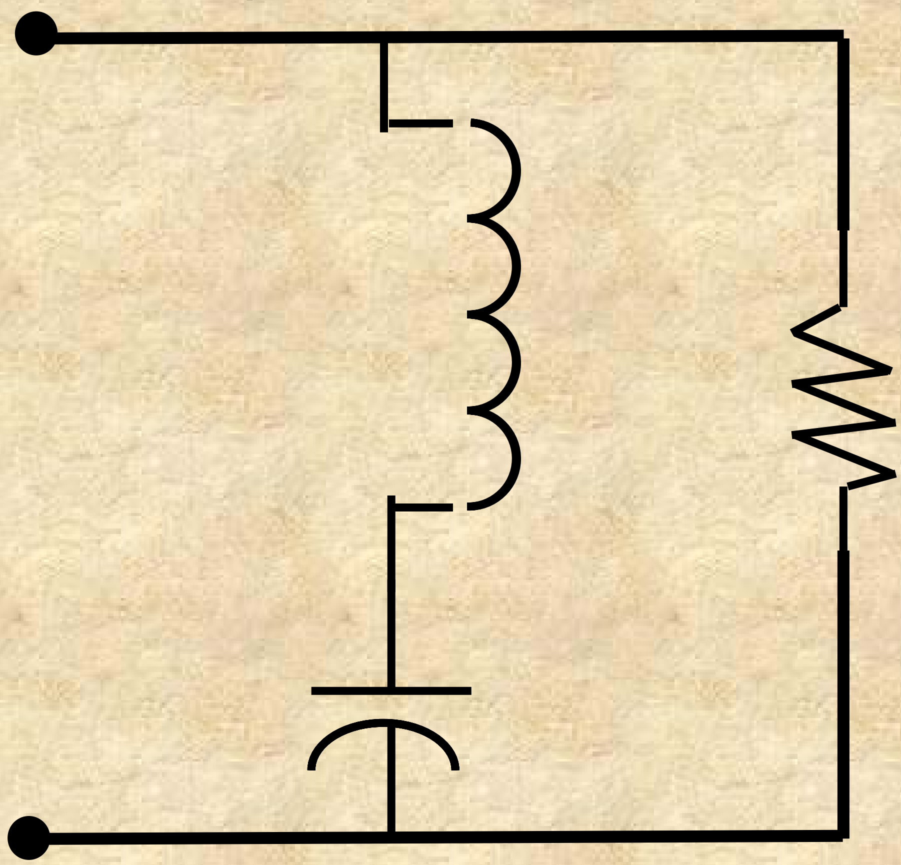


Only the resonant frequency will pass through to the load.

All others will be blocked.

Series resonant circuit in parallel with the load.

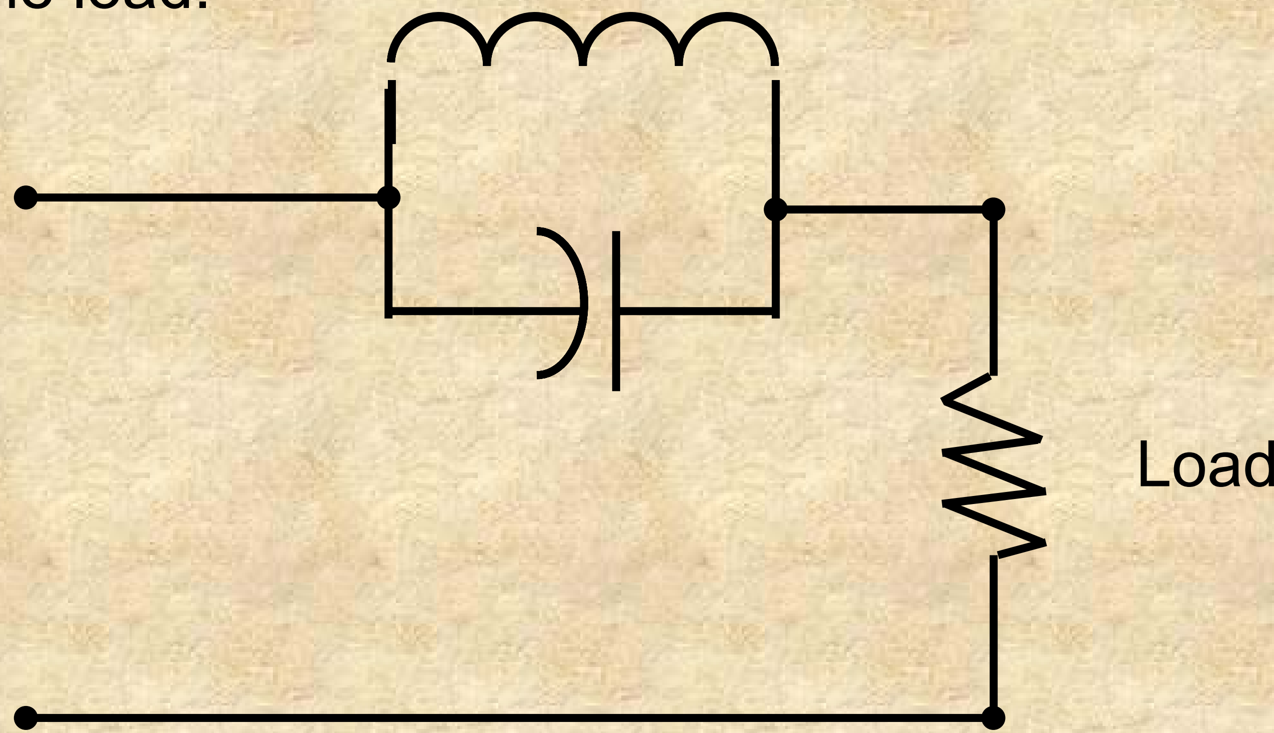
$$F_o = \frac{1}{2\pi\sqrt{LC}}$$



F_o will be shorted out and not reach the load. All others will pass to the load.

$$F_o = \frac{1}{2\pi\sqrt{LC}}$$

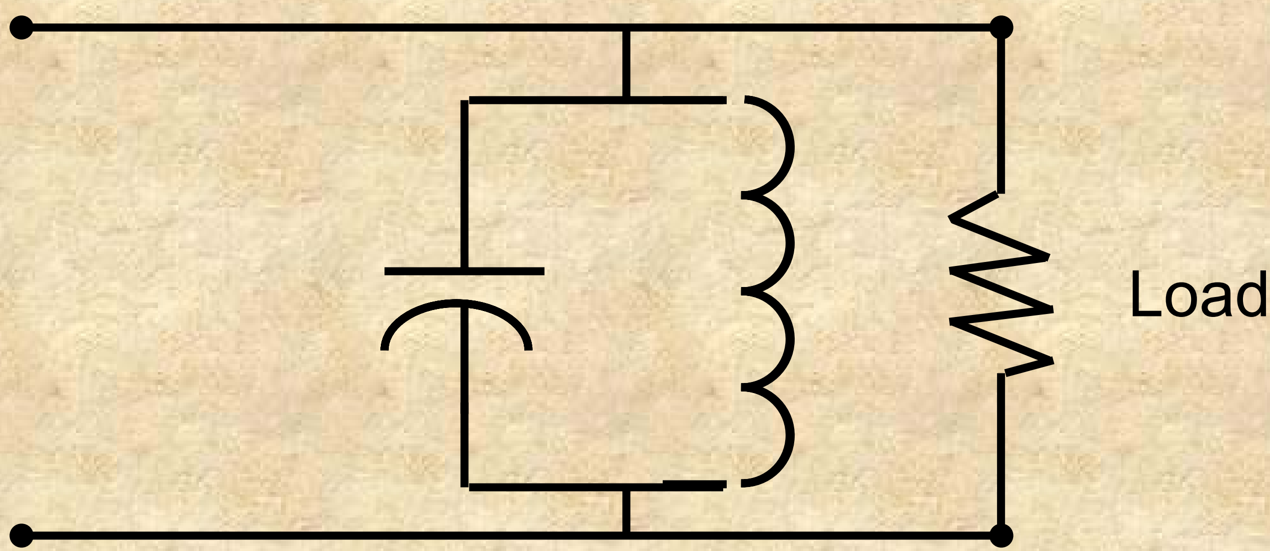
Parallel resonant circuit
in series with the load.



F_o will be blocked and not reach the load. All others will pass onto the load.

Parallel resonant circuit
in parallel with the load.

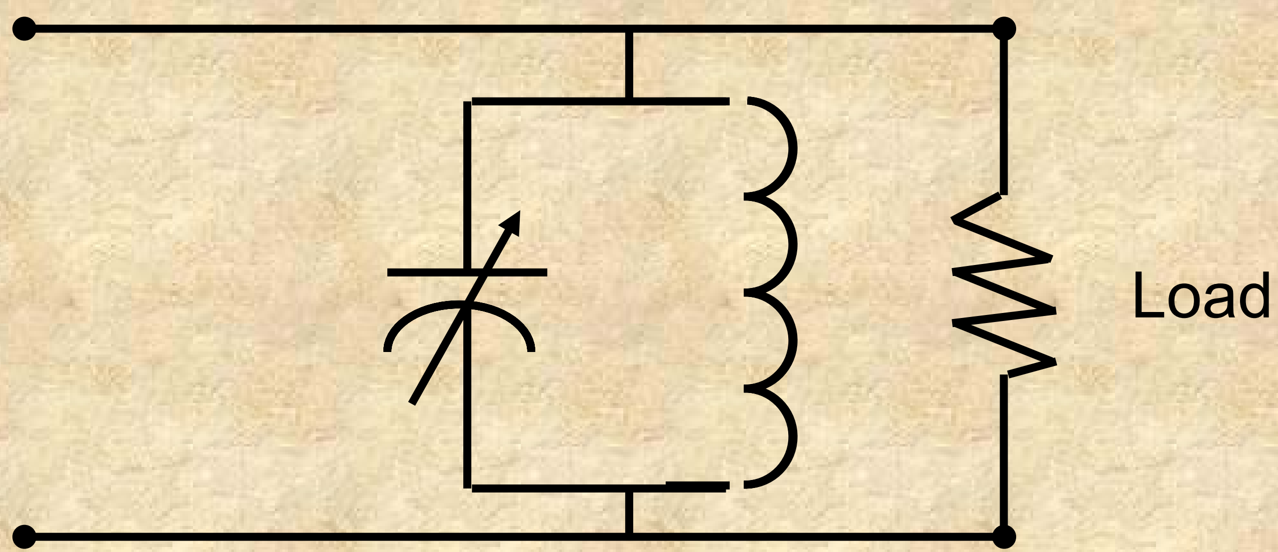
$$F_o = \frac{1}{2\pi\sqrt{LC}}$$



Only the resonant frequency will pass through to the load.
All others will be shorted to ground.

Parallel resonant circuit
in parallel with the load.

$$F_o = \frac{1}{2\pi\sqrt{LC}}$$



Only the resonant frequency will pass through to the load.
All others will be shorted to ground.

By changing the capacitor to a variable type, we have a very typical tuner as can be found in most radio receivers.

This weeks New Stuff

Today we will cover:

Wave Propagation

Begin Review

Wave Propagation

Things to know

- **VHF and UHF radio waves usually travel from a transmitting antenna to a receiving antenna in a straight line or line of sight.**

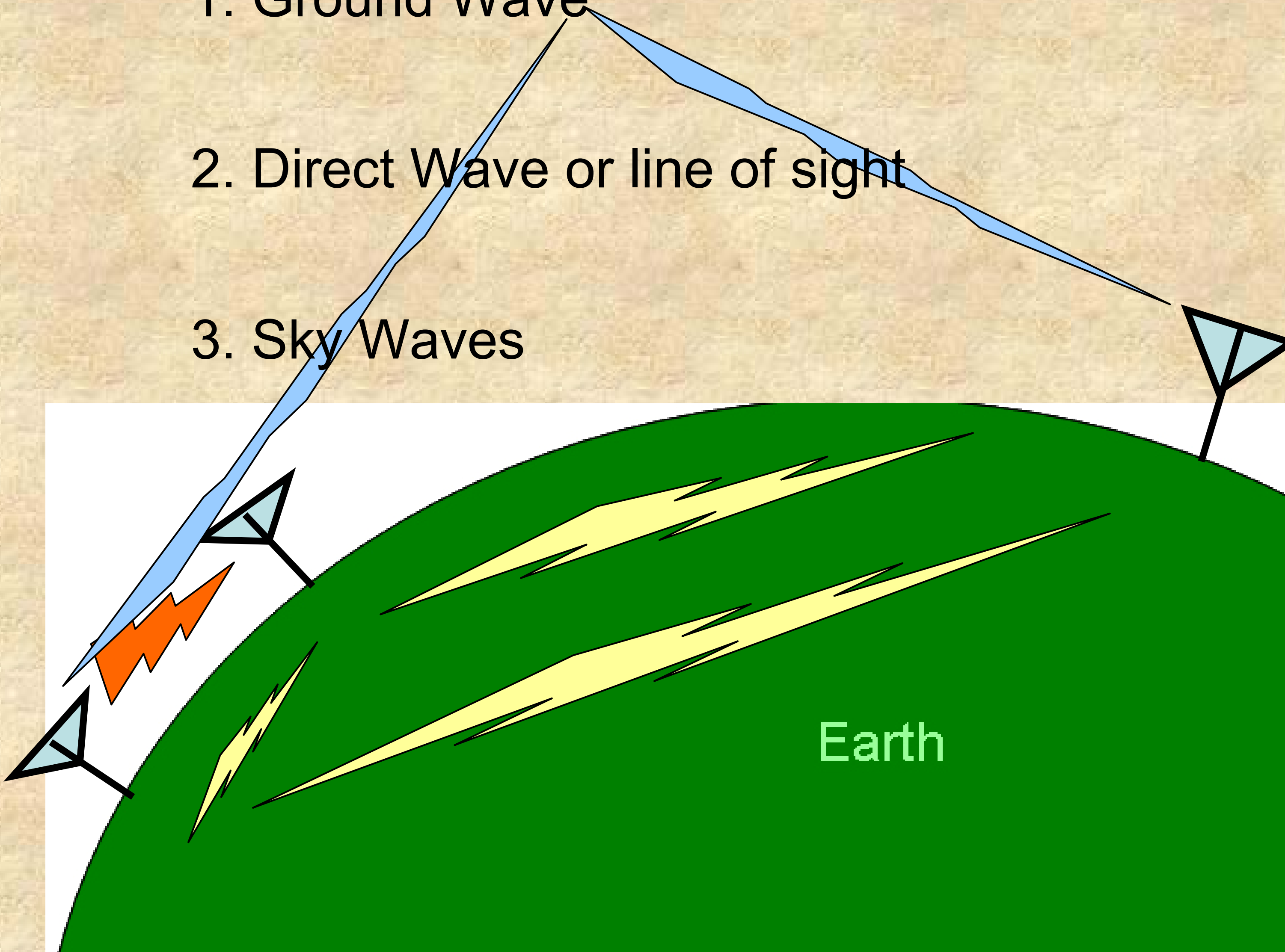
- **VHF and UHF radio waves usually travel from a transmitting antenna to a receiving antenna in a straight line.**

Kinds of Radio Waves

1. Ground Wave

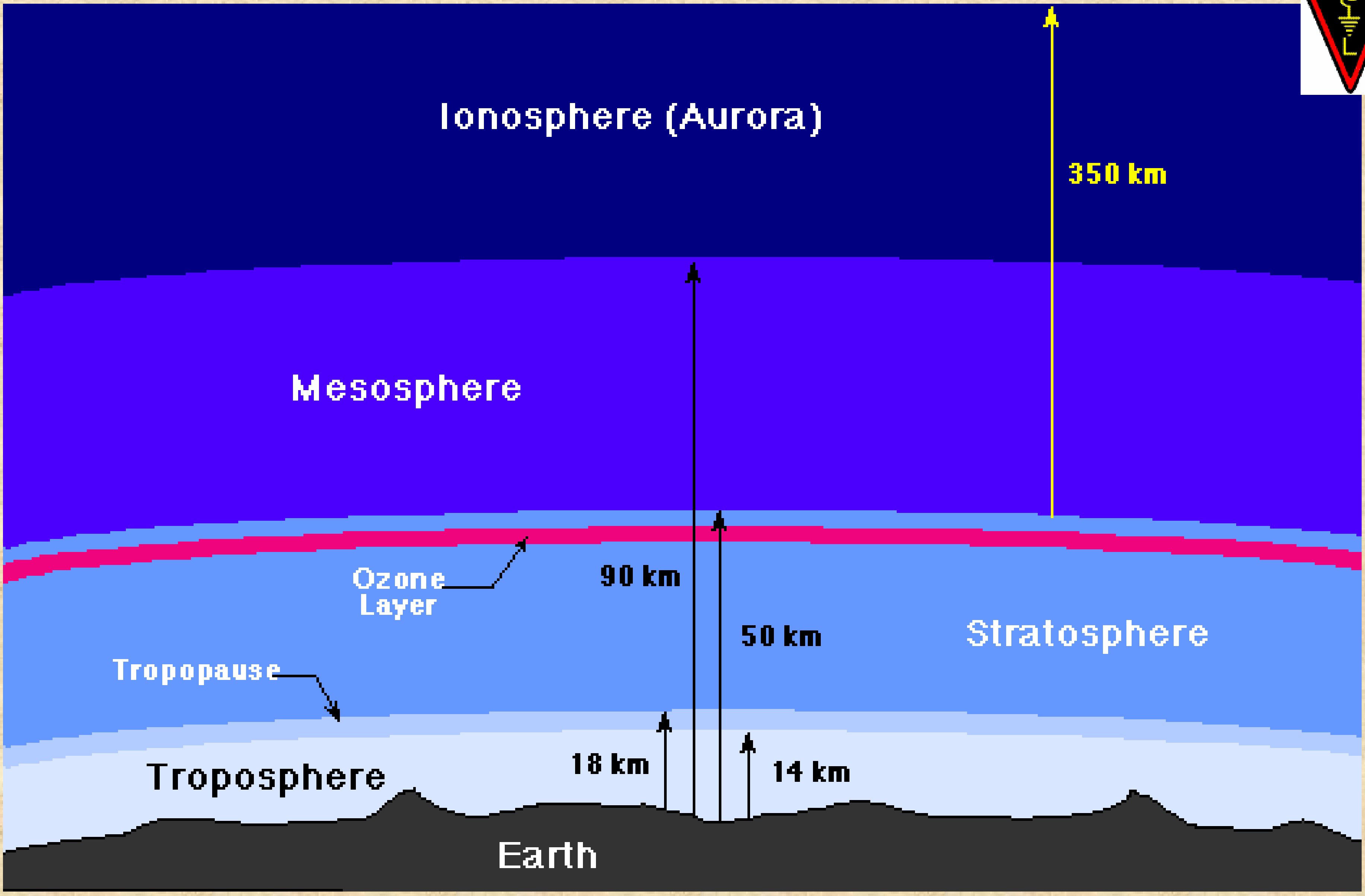
2. Direct Wave or line of sight

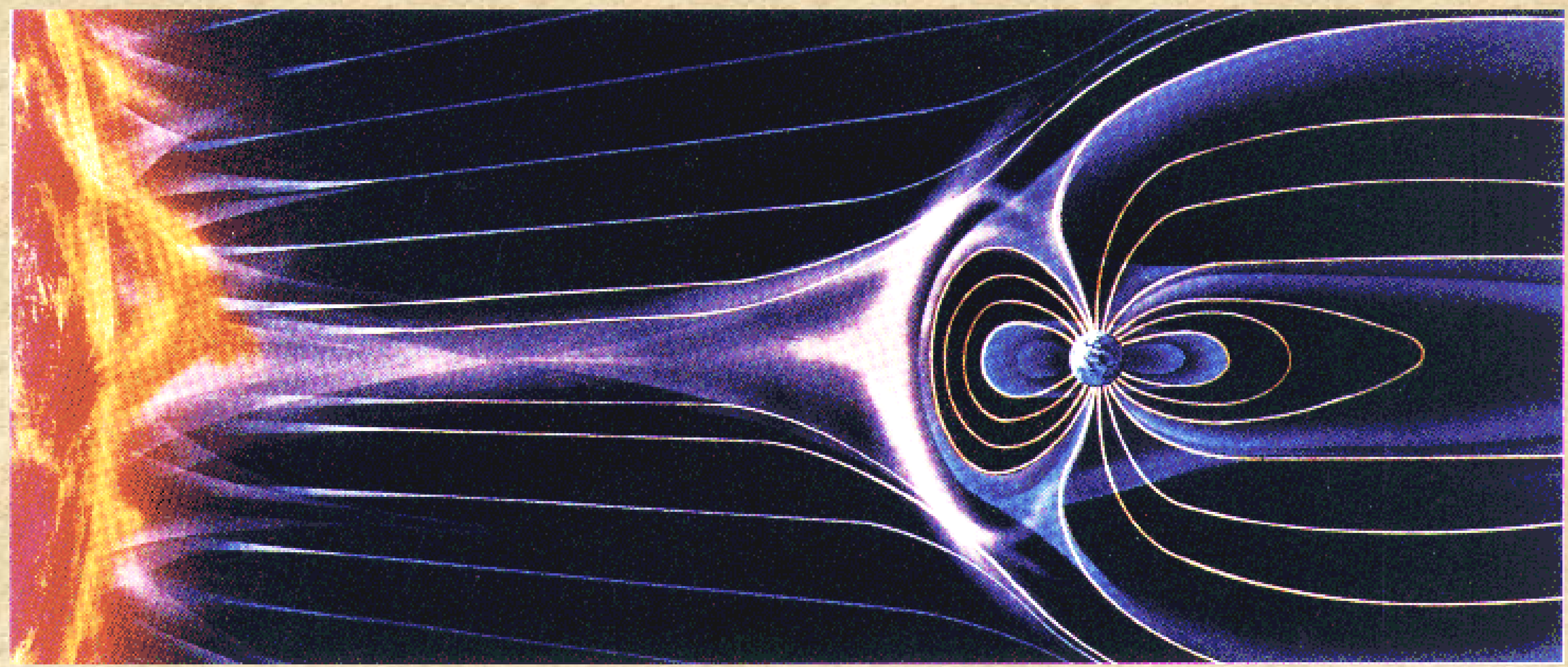
3. Sky Waves

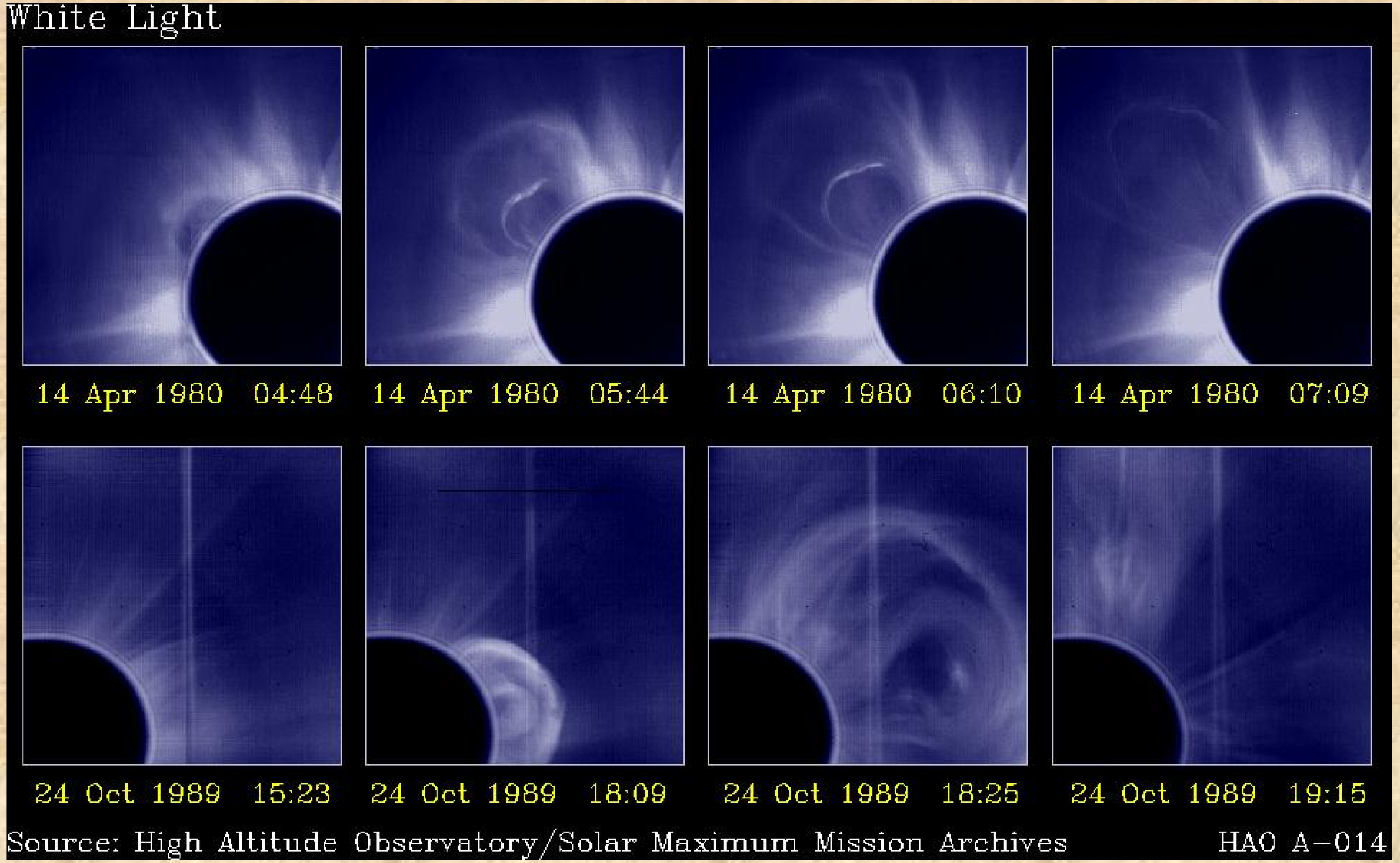


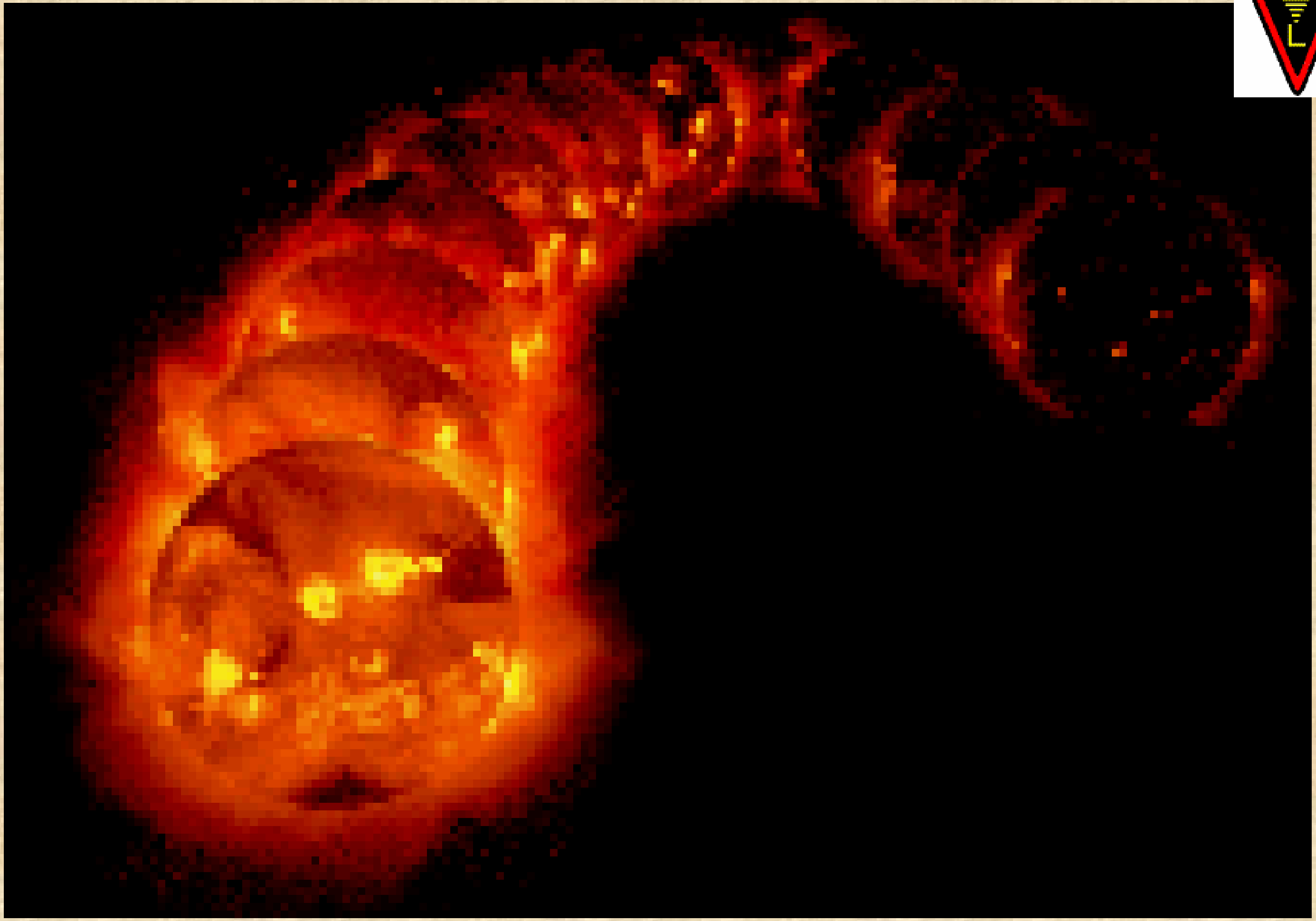
Things to know

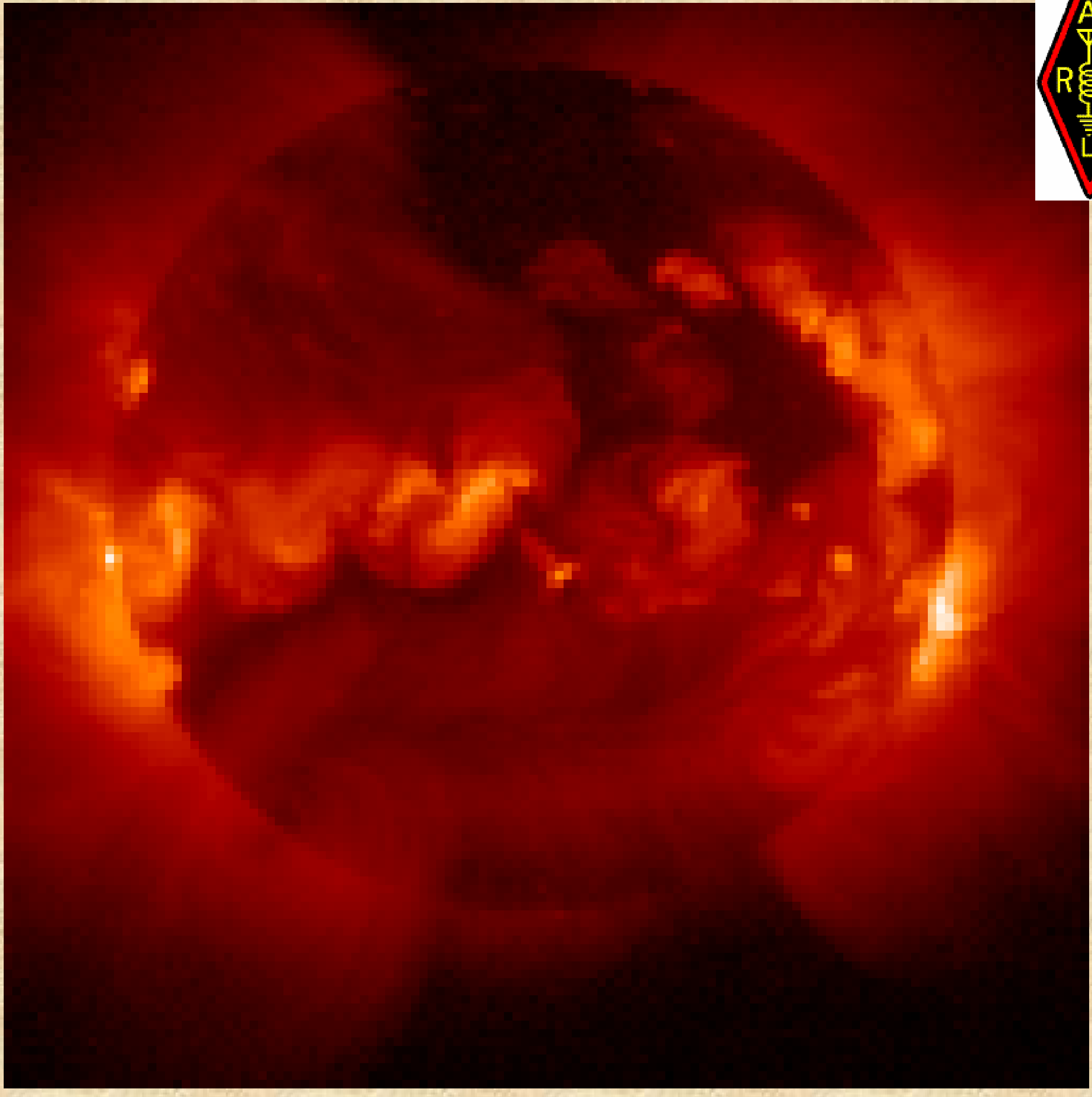
- Solar radiation ionizing the outer atmosphere causes the ionosphere to form
- Ultraviolet solar radiation is most responsible for ionization in the outer atmosphere.
- F1 and F2 are the two daytime ionospheric regions that combine into one region at night
- Ultraviolet solar radiation is most responsible for ionization in the Outer what part of the atmosphere?
- The Ionosphere is the part of our atmosphere that is formed by solar radiation ionizing the outer atmosphere

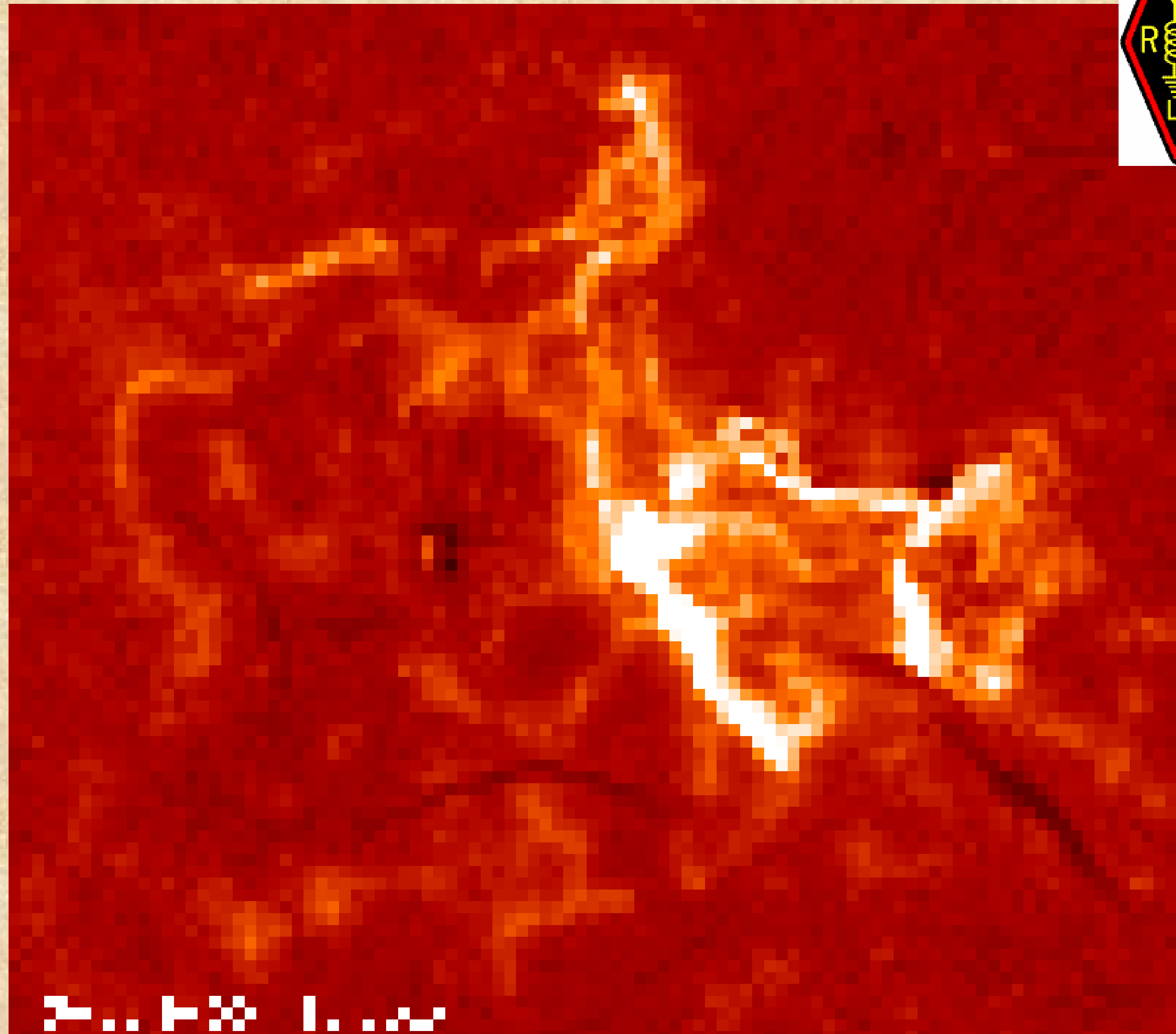

Ionosphere (Aurora)
350 km
Mesosphere
Ozone Layer
90 km
50 km
Stratosphere
Tropopause
Troposphere
18 km
14 km
Earth

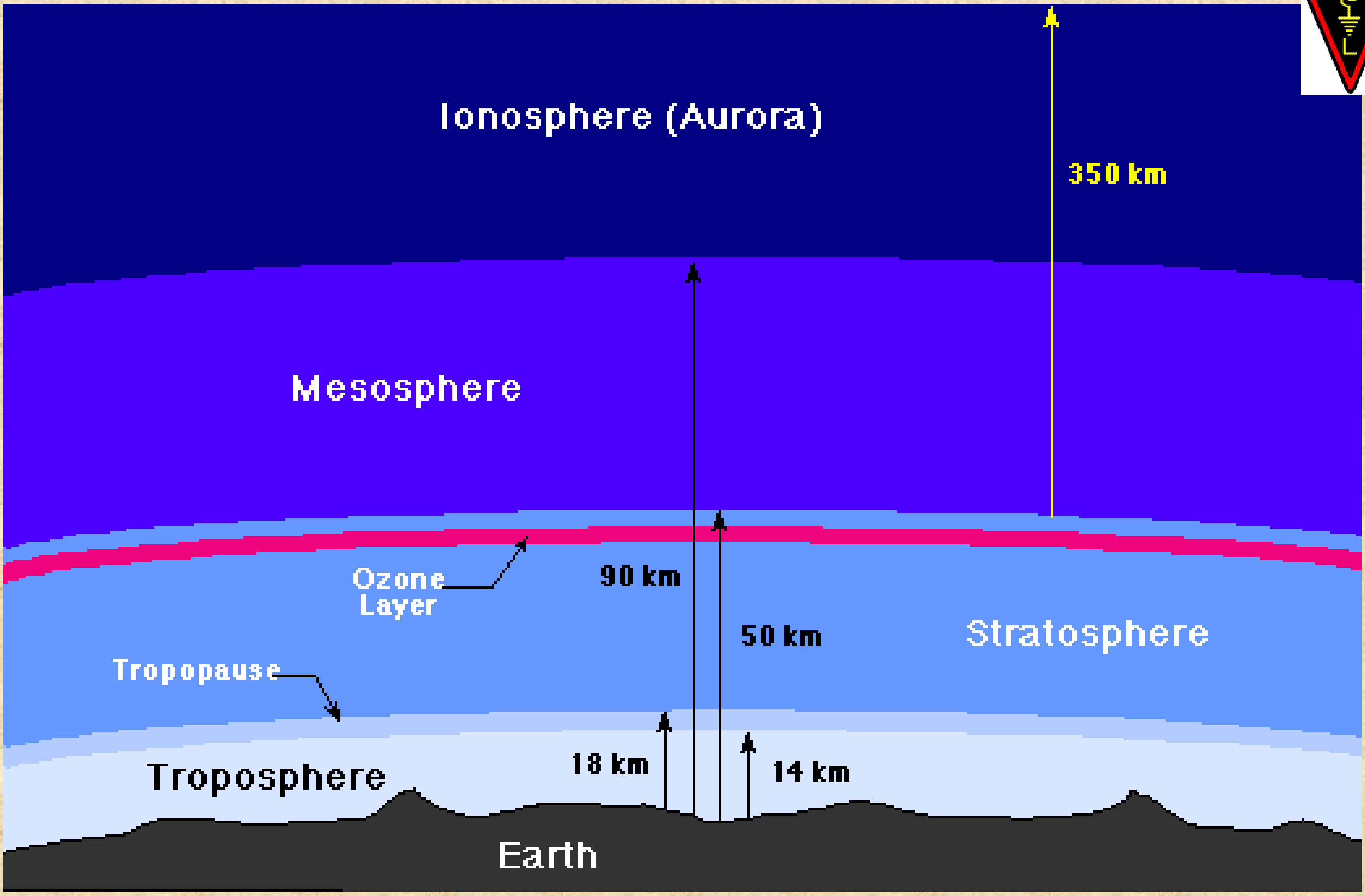



White Light
14 Apr 1980 04:48
14 Apr 1980 05:44
14 Apr 1980 06:10
14 Apr 1980 07:09
24 Oct 1989 15:23
24 Oct 1989 18:09
24 Oct 1989 18:25
24 Oct 1989 19:15
Source: High Altitude Observatory/Solar Maximum Mission Archives
HAO A-014

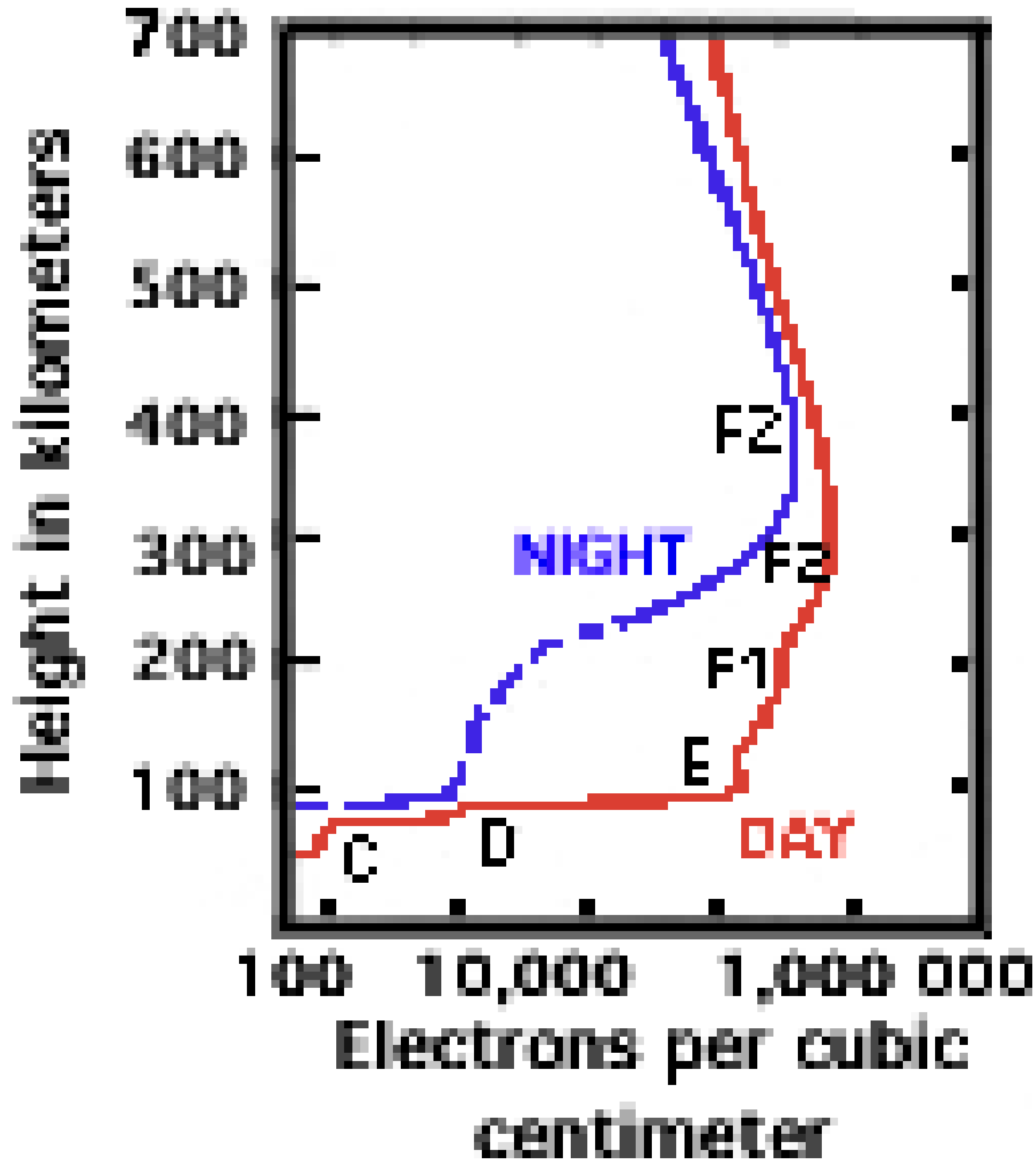


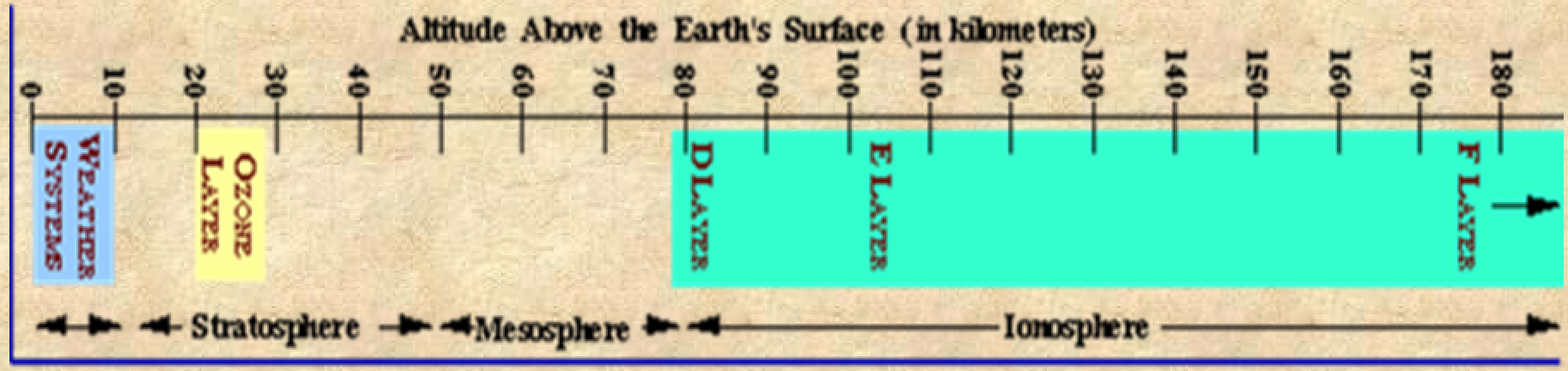


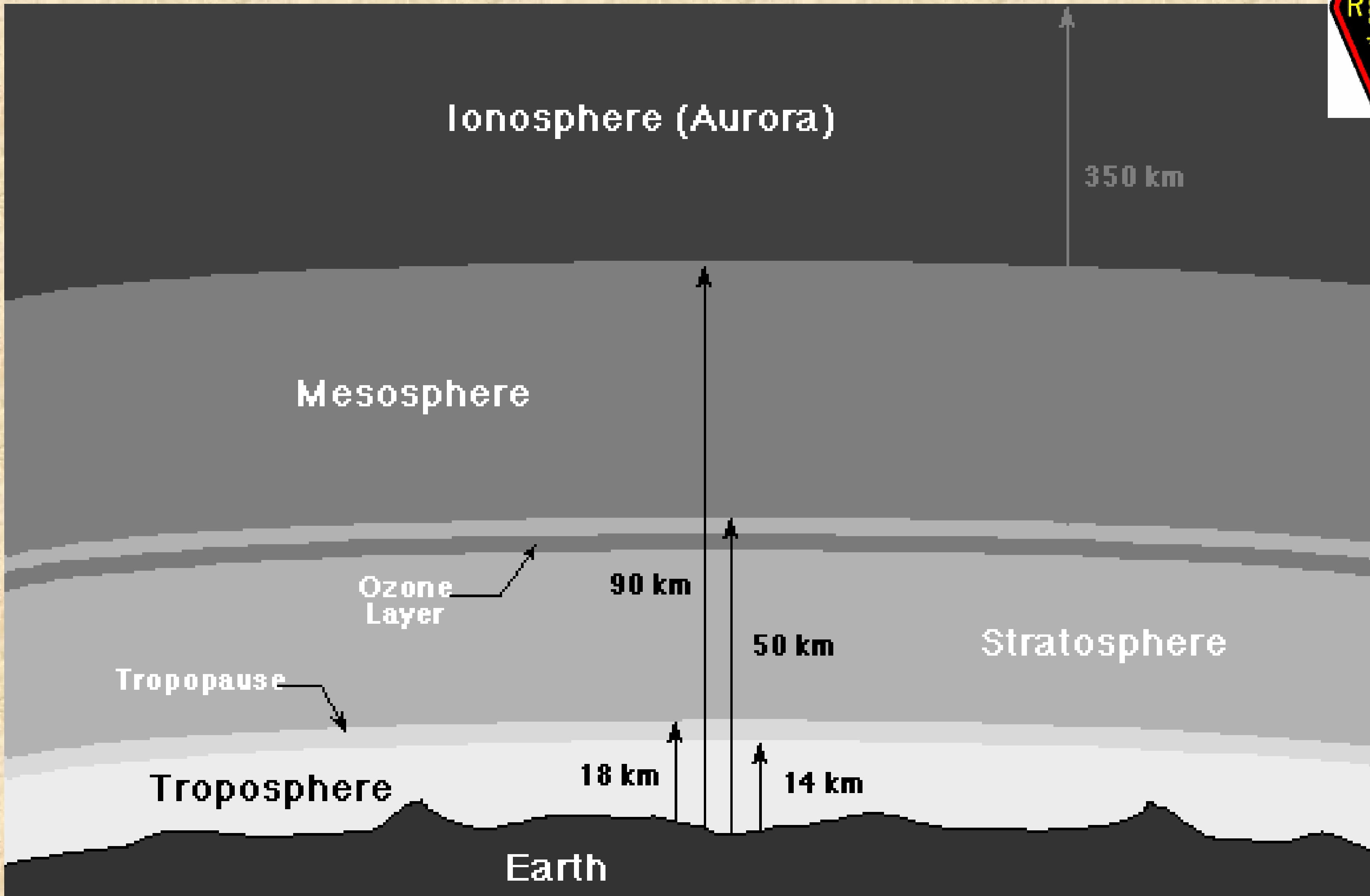




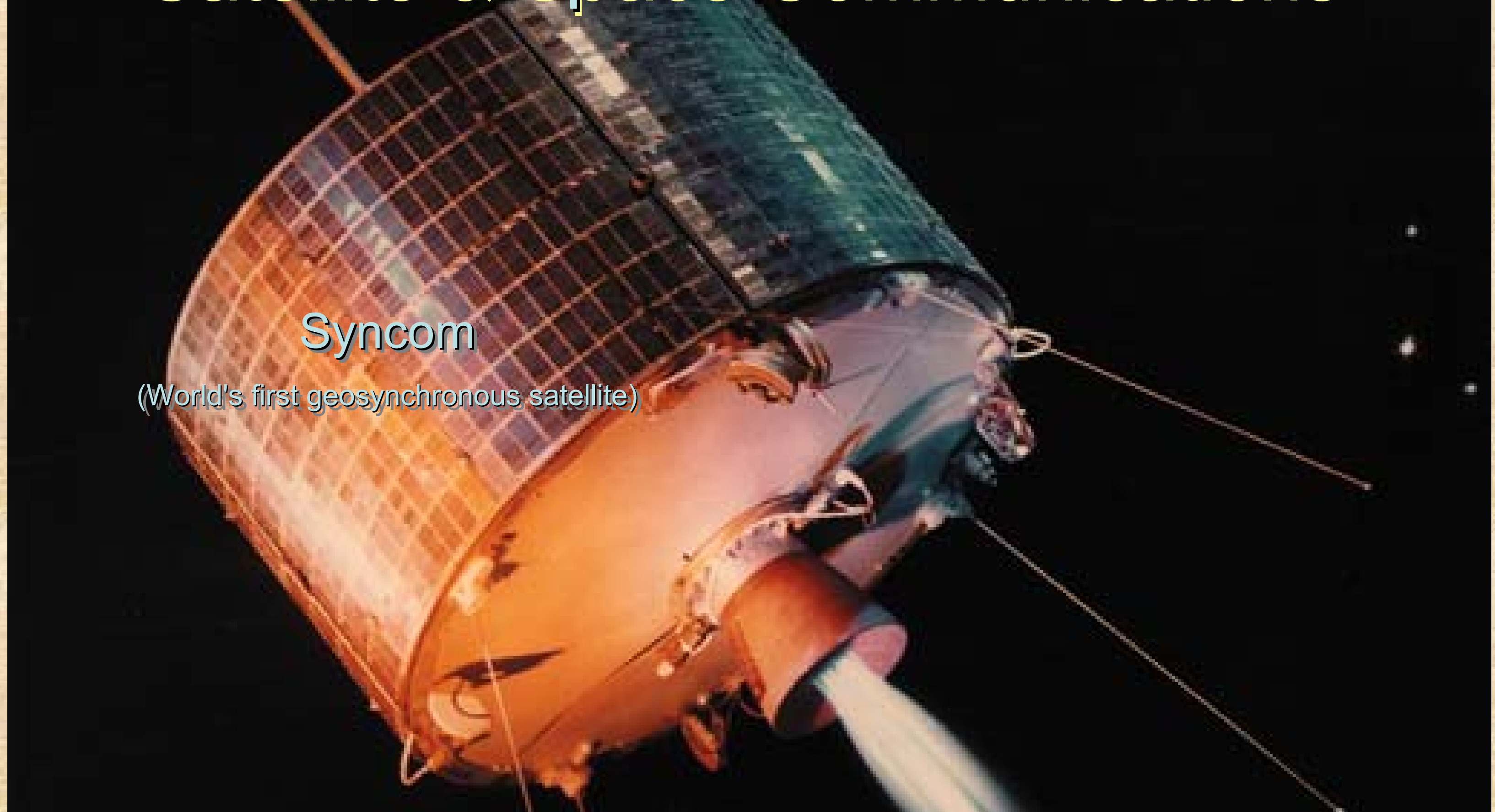
Ionosphere (Aurora)
350 km
Mesosphere
Ozone Layer
90 km
50 km
Stratosphere
Tropopause
Troposphere
18 km
14 km
Earth


700
600
500
400
300
200
100
Height in kilometers
F2
NIGHT
F2
F1
E
DAY
C
D
100
10,000
1,000 000
Electrons per cubic centimeter


Altitude Above the Earth's Surface (in kilometers)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
Weather Systems
Ozone Layer
D Layer
E Layer
F Layer
Stratosphere
Mesosphere
Ionosphere


Ionosphere (Aurora)
350 km
Mesosphere
Ozone
Layer
90 km
50 km
Stratosphere
Tropopause
Troposphere
18 km
14 km
Earth

Satellite & Space Communications

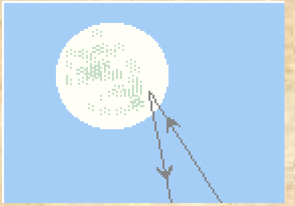


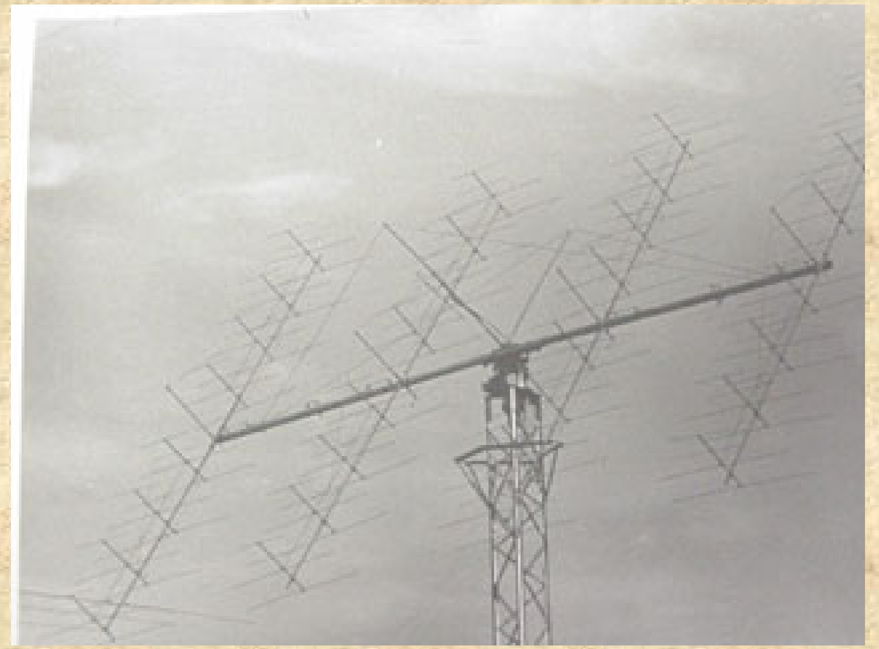
An amateur “space station” is an amateur station that is located more than 50 kilometers above the Earth's surface.

Any licensed amateur operator may be the licensee of an amateur space station.

The *6 meters band* may NOT be used by Earth stations for satellite communications.

High-gain antennas are normally used for EME (moon bounce) communications to overcome the extreme path losses of this mode



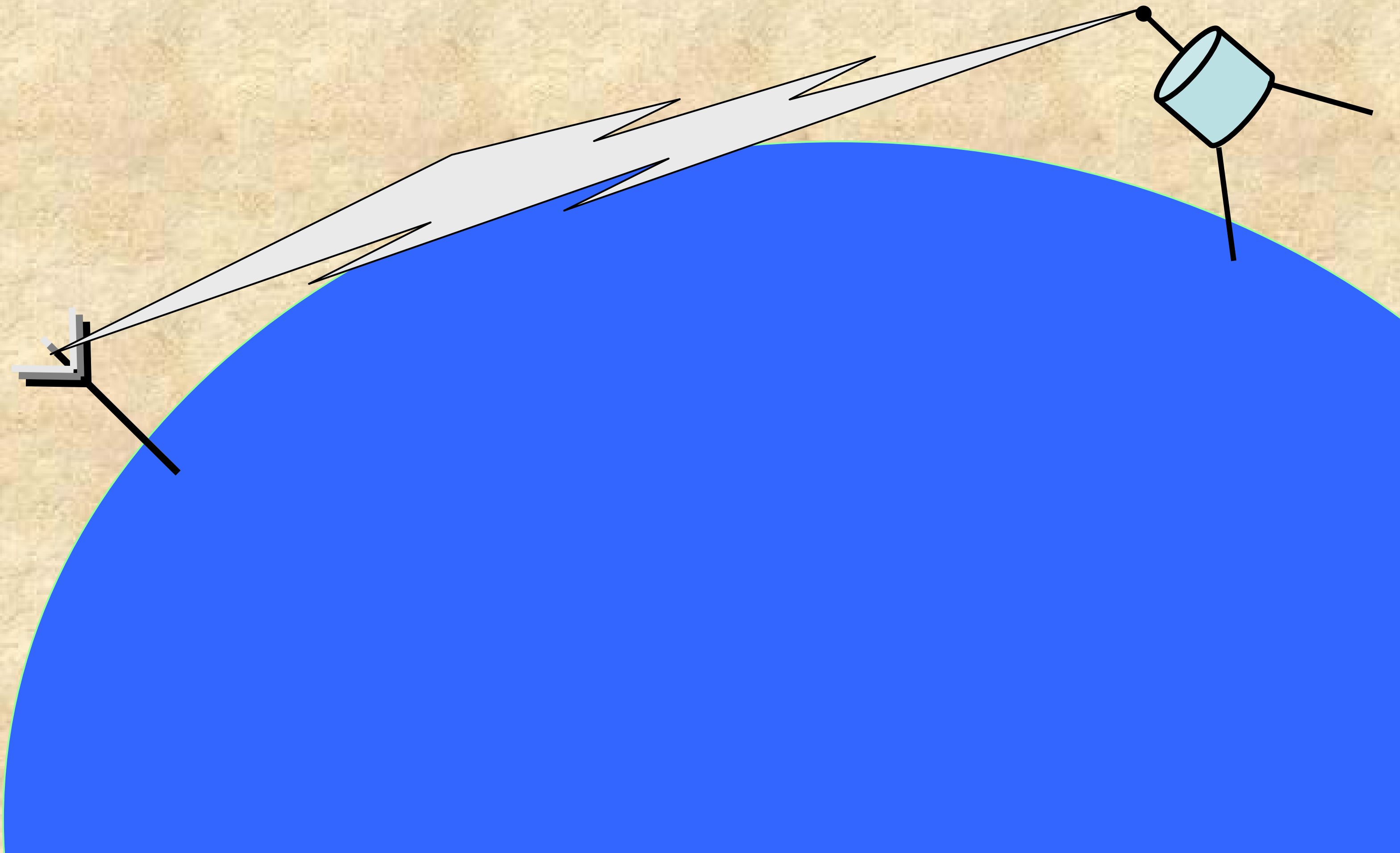


Multiple Yagi array antenna

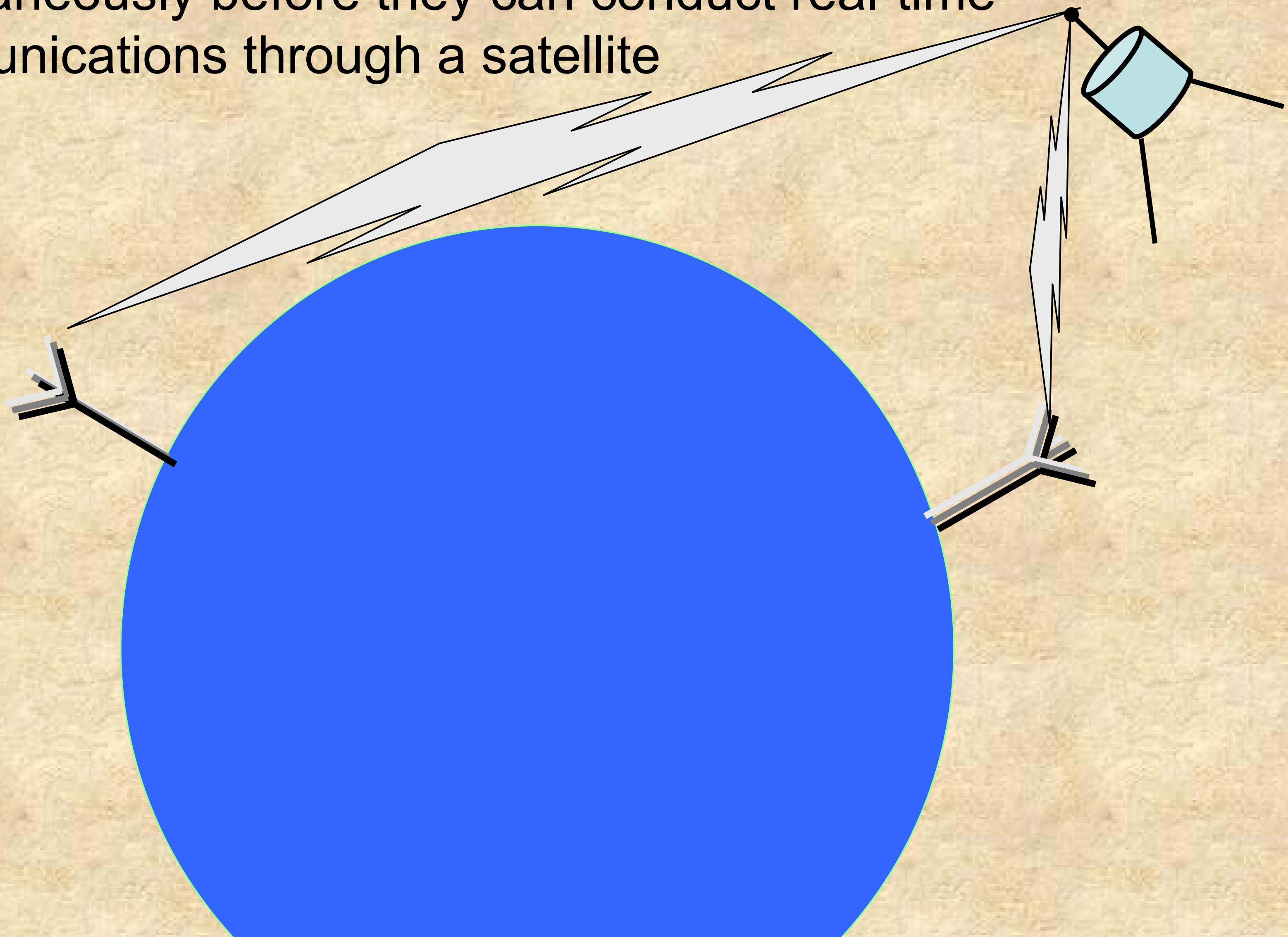
Parabolic antenna

A high-gain array of Yagi antennas would be the best choice for an EME (moon bounce) station

When the satellite is low to the horizon, it may be necessary to use a higher transmitter power level when conducting satellite communications



The satellite must be in view of both stations simultaneously before they can conduct real-time communications through a satellite



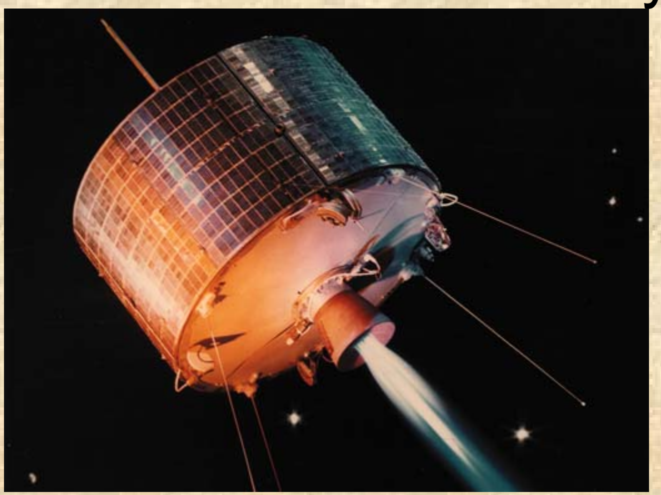
Geosynchronous Satellites

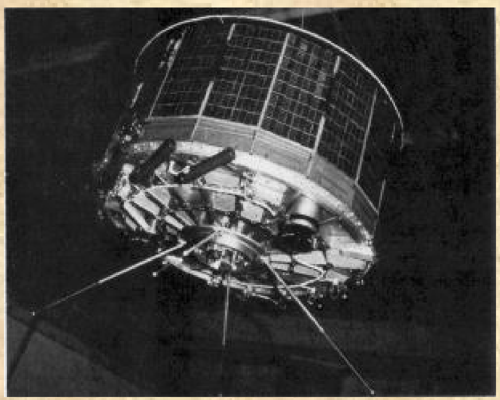
Geosynchronous satellites can see approximately 40% of the surface of the earth at their 22,300 mile perch above the earth.

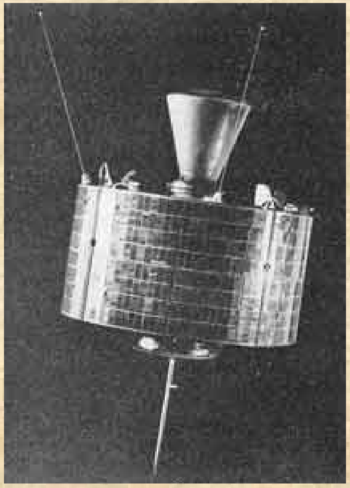
It would take three Geosynchronous satellites to cover the entire planet.

Satellites lower than 22,300 miles in orbit will have less than 24 hour orbits, depending on their height above the earth.

Geosynchronous Satellites







Syncom-1 was launched on February 14th, 1963. During the 5 hours it took to reach apogee, test were run and the spacecraft worked fine. When the apogee rocket was fired, that was the end of Syncom-1. Long-range telescopes could see debris in geosynchronous orbit.

On July 26th, 1963, Syncom-2 was launched and went into geosynchronous orbit without a hitch.

Syncom-3 was launched on August 19, 1964, but didn't reach its "fixed" position until September 10th, after a series of maneuvers that put it in near perfect geosynchronous orbit.

Practice Exams

http://www.qrz.com/testing.html

http://www.eham.net/exams/

http://www.dcarc.net/practice_tests.htm

Any Questions?

See you all next week for REVIEW