

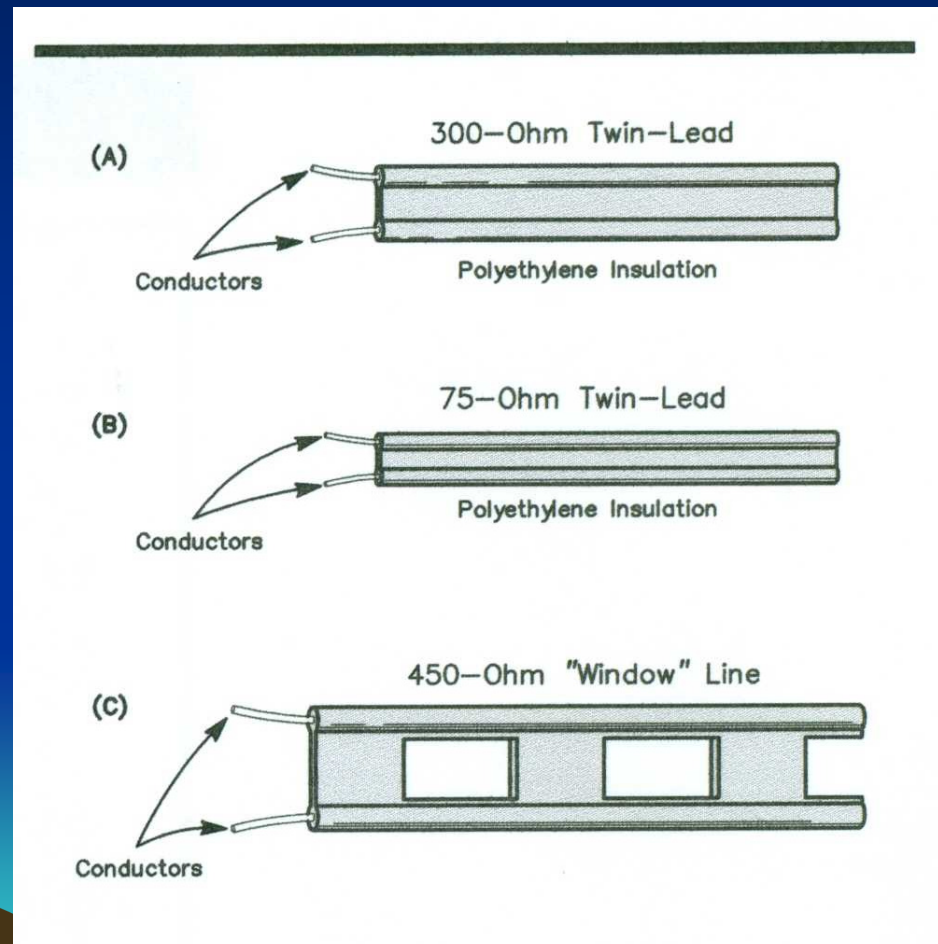
Transmission Lines

Part 1: Physical Characteristics

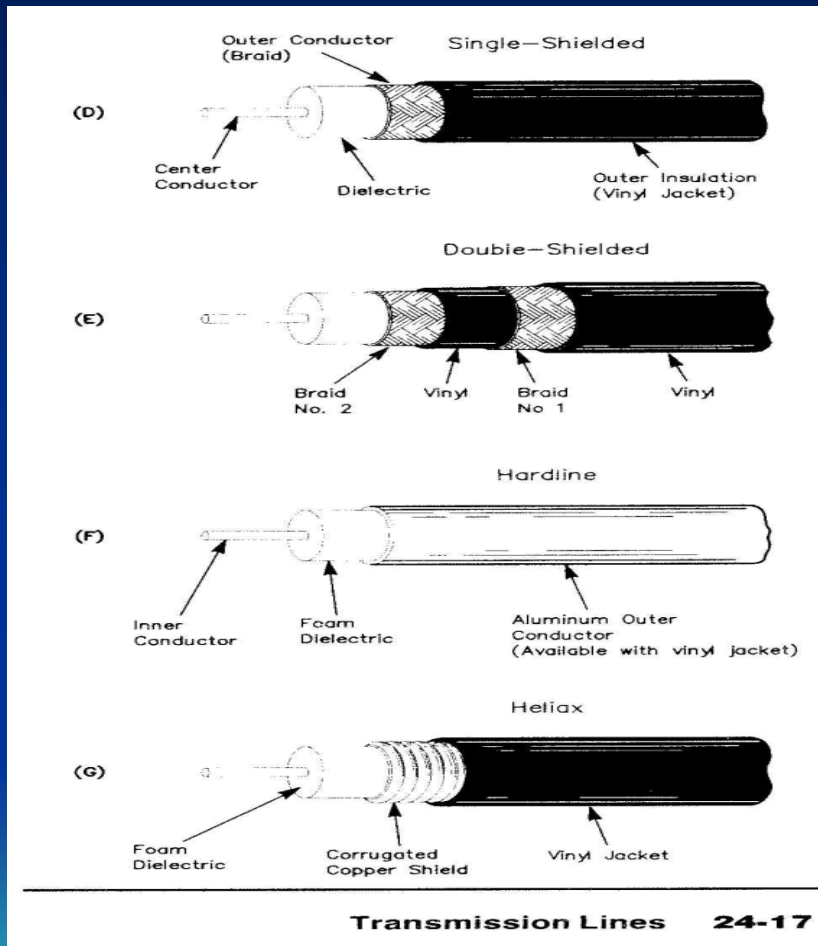
What we will learn

- Characteristics of two most common transmission lines:
 - Twin lead
 - Coax
- Velocity factor
- Uses
- Strengths and weaknesses

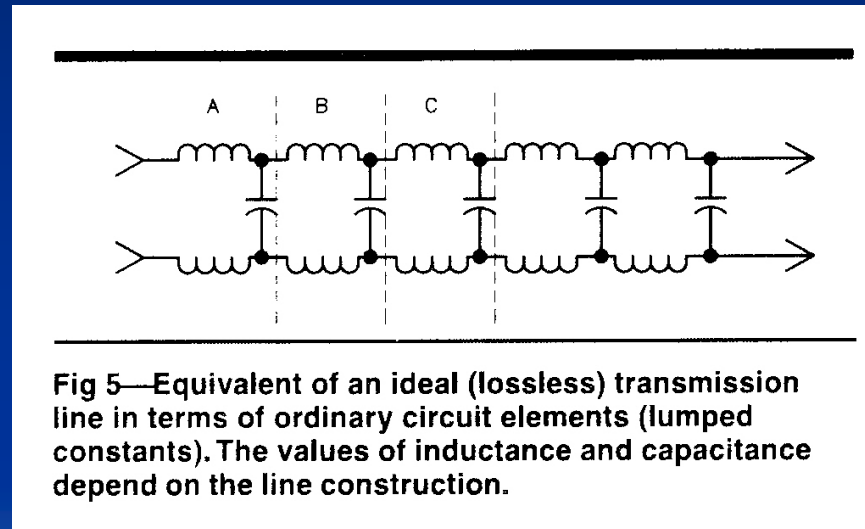
Twin Lead



Coax



Schematic of Transmission Line



Velocity Factor

- The ratio of speed of radio waves inside a transmission line to speed in a vacuum
 - $VF = 1/\sqrt{\epsilon}$
 - ϵ is the dielectric constant
 - Speed of light in a vacuum, $\epsilon = 1$
- VF is always less than one
- Typical dielectrics – polyethylene, foam, Teflon, air

Characteristic Impedance

- In both, twin lead and coax, the impedance is a function of:
 - Dielectric
 - Distance between conductors
 - Diameter of conductors
- Typical impedances
 - Twin lead – 200 to 800 ohms
 - Coax – 40 to 100 ohms

Twin Lead - Impedance

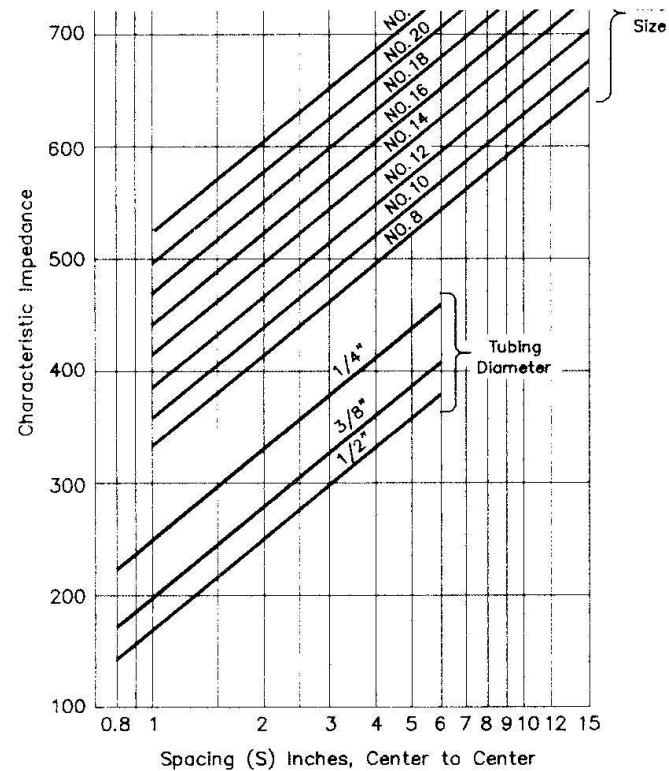
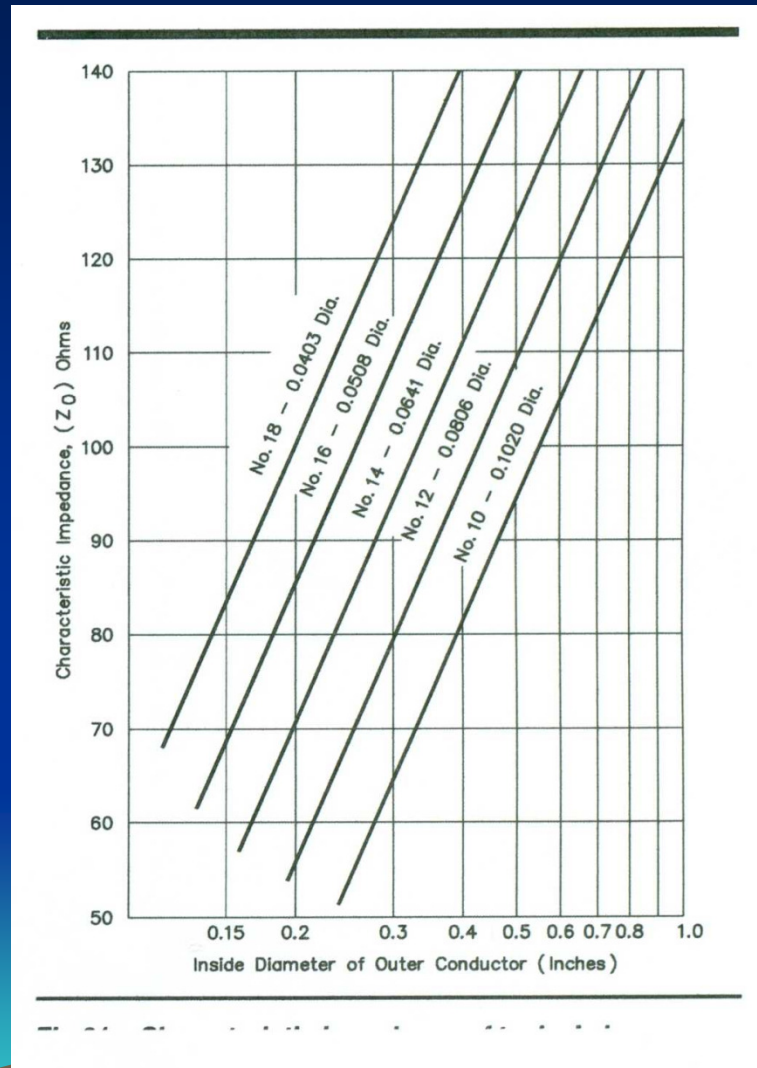
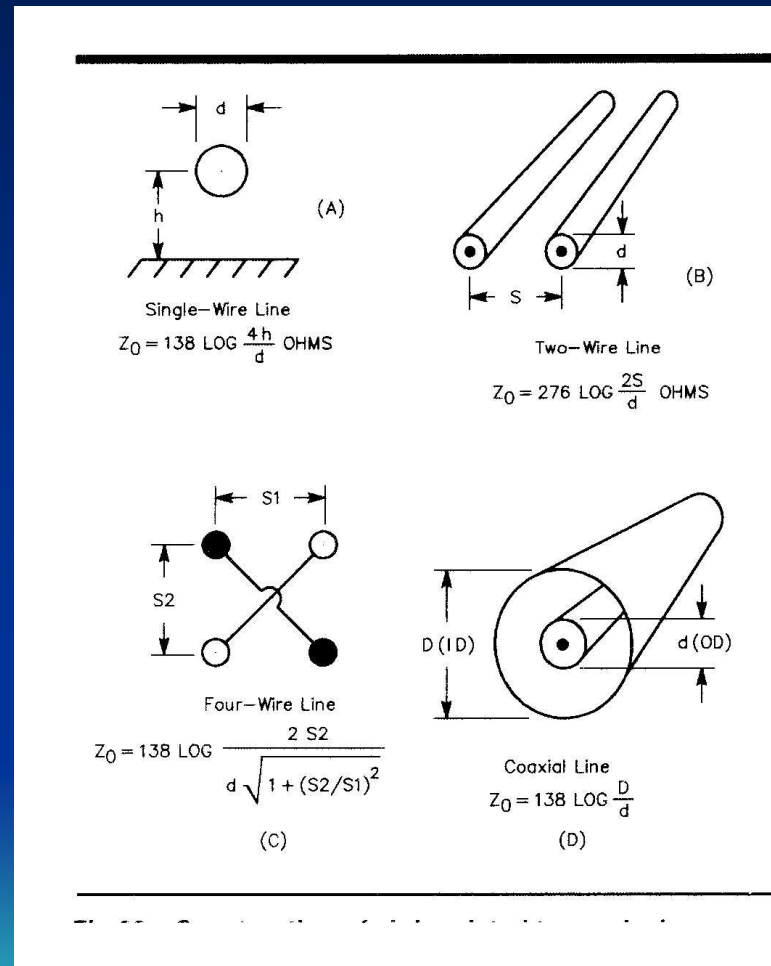


Fig 19—Characteristic impedance as a function of conductor spacing and size for parallel conductor lines.

Impedance - Coax



To Calculate Impedance



Losses – Twin Lead

- Very low even at high SWR
- Good in the HF frequencies
- Very poor above 30 mhz
 - Due to distance between conductors being a substantial portion of the wavelength
 - Has substantial radiation

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Losses - Coax

- Losses vary depending upon specific coax
- Larger diameter coax generally has lower losses
- Quality of shielding affect losses, poor shielding, the higher the loss
- Total loss is proportional to coax length
- The higher the frequency, the greater the losses

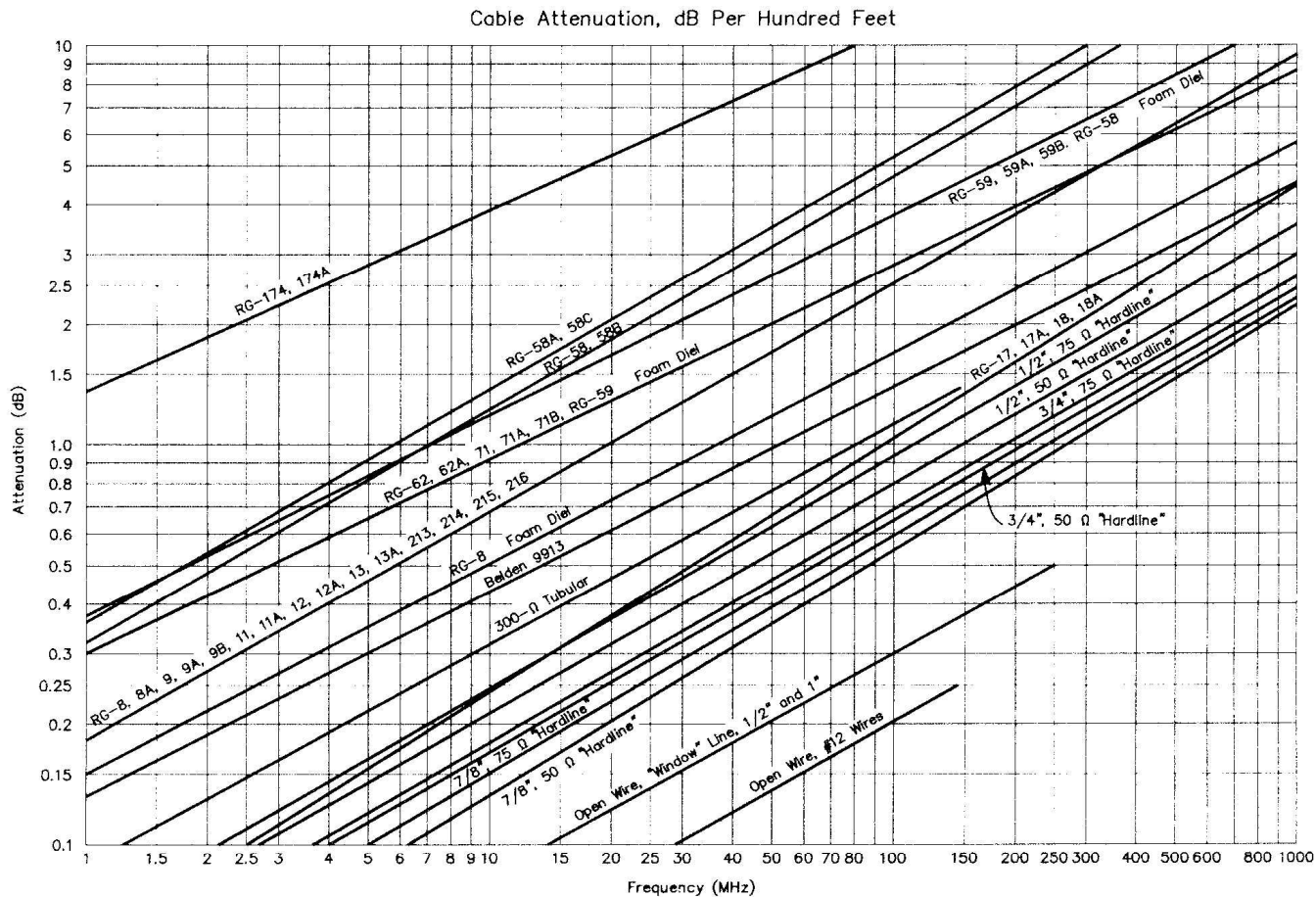


Fig 23—Nominal matched-line attenuation in decibels per 100 feet of various common transmission lines. Total attenuation is directly proportional to length. Attenuation will vary somewhat in actual cable samples, and generally increases with age in coaxial cables having a type 1 jacket. Cables grouped together in the above chart have approximately the same attenuation. Types having foam polyethylene dielectric have slightly lower loss than equivalent solid types, when not specifically shown above.

Twin Line – Strengths/Weaknesses

- Strengths:
 - Lower cost
 - Lower losses
 - Balanced transmission line matches balanced antennas better
- Weaknesses:
 - Tendency to break at the antenna connection
 - Requires a balun in order to use today's antenna tuners (typically 4:1 baluns with losses)
 - Affected by objects that are close

Twin Line – Common Uses

- Multi-band HF antennas
- Tuning stubs
- J-Pole antennas

Coax – Strengths/Weaknesses

- Strengths:
 - Unaffected or less affected by close-by objects
 - Flexible, easier to use
 - Useable throughout the RF spectrum
 - Less affected by weather
- Weaknesses
 - More costly than twin lead
 - Unbalanced – requires a balun for most antennas
 - Deteriorates with age

Coax - Uses

- Transmission line from MF through ultra high frequencies
- Tuning stubs
- A coil of coax may be used as a balun
- Useable in traps for multi-band antennas

You get what you pay for.

**Cheap twin lead or coax
will give you marginal performance.**

QUESTIONS!