

Coaxial Cable Tutorial

What is Coaxial Cable?

Coaxial cable is a two conductor electrical cable consisting of a center conductor and an outer conductor with an insulating spacer between the two.



How is Coaxial Cable used?

Primarily, coaxial cables are used for the transmission of Radio Frequency energy. The system offers tight control over electrical impedance. This yields excellent performance at high frequencies and superior EMI control/shielding.

Where is Coaxial Cable used?

A broad range of applications exist for coaxial cabling. The two primary impedance values of 50 and 75 Ohms determine specific applications with 50 Ohms primarily used in data signal applications and 75 Ohms used in video signal applications.

Coaxial Cable Terms

Attenuation (Insertion Loss): Loss of power. Attenuation is usually measured in dB loss per length of cable (ex. 31.0 dB/100Ft.). Attenuation increases as frequency increases.

Bend Radius: The amount of radius a cable can bend without any adverse effects.

Center Conductor: The solid or stranded wire in the middle of the coaxial cable. The conductor diameter is measured by the American Wire Gauge (AWG).

Coaxial Adapter: A device used to change one connector type to another or one gender to another (ex. BNC to SMA Adapter).

Coaxial Cable: A two conductor cylindrical transmission line typically comprised of a center conductor, an insulating dielectric material and an outer conductor (shielding). Coaxial cable can be flexible (typical of L-com assemblies), semi-rigid or rigid in nature.

Coaxial Connector: The interconnection device found at each end of a coaxial cable assembly. There are many common types of coaxial connectors such as: BNC, SMA, SMB, F, etc.

Dielectric: The insulating material that separates the center conductor and the shielding.

Electromagnetic Interference (EMI): Electrical or electro-magnetic energy that disrupts electrical signals.

Frequency: The number of times a periodic action occurs in one second. Measured in Hertz.

Impedance: In simple terms, impedance, in a coaxial product, is the measurement of resistance to the flow of current. The unit of measurement is Ohms.



The following is a more technically correct definition: Transmission line impedance, also known as characteristic impedance, is the ratio of the amplitudes of a single pair of voltage and current waves propagating along an infinitely long transmission line with absence of any reflections. Characteristic impedance measures like resistance when dealing coaxial cable types. Characteristic impedance is a relationship between the capacitance per unit length and the inductance per unit length. The inner and outer coaxial diameter ratios and the dielectric constant in the cable define the parameters involved in determining characteristic impedance.

Insertion Loss: A measurement of attenuation determined by the system output before and after the connection of a cable and/or device.

Jack: The female connector usually containing a center socket.

Microwave Frequencies: Microwave frequencies range from Ultra-High Frequency (UHF) .3-3GHz, Super High Frequency (SHF) 3-30GHz to Extremely High Frequency (EHF) 30-300GHz.

MIL-C-17: MIL-C-17 is a specification document that has been used since the 1940s to standardize the physical and electrical characteristics of coaxial cables. There is no longer any control of RG specifications so cables may perform differently than the cables that adhere to MIL-C-17.

Plug: The male connector usually containing a center pin.

RF (Radio Frequency): A frequency band from 3 MHz to 3 GHz. Primarily used for transmission of radio and television signals.

RG/U: Symbols used to represent coaxial cable that is built to U.S. government specifications (R=Radio Frequency, G=Government, U=Universal Specification)






Shielding: Conductive envelope made of wires or metal foil that covers the dielectric and the center conductor

Twinaxial: An offshoot from coaxial cabling. Two center conductors with one dielectric and braided shielding.

Velocity of Propagation (VP): Usually expressed as a percentage, VP is the transmission speed of electrical energy in a determined length of cable compared to the speed of light.

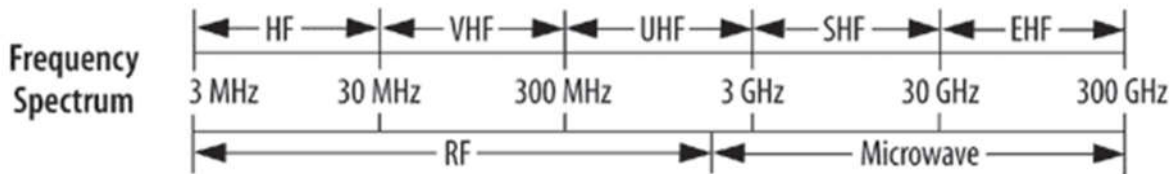
VSWR (Voltage Standing Wave Ratio): The ratio of the maximum effective voltage to the minimum effective voltage measured along a RF transmission line. This value generally increases with frequency and higher values are not desirable.

Common Applications for Coax Cable Assemblies

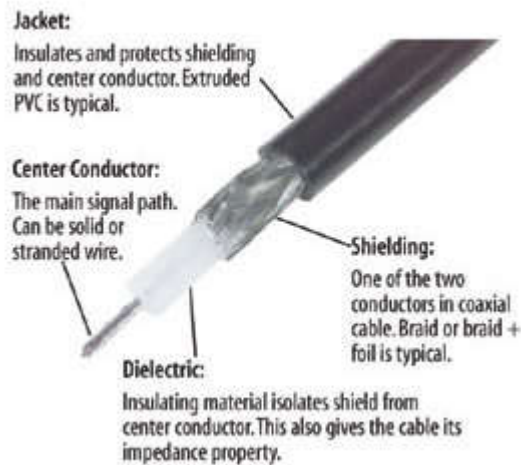
				
Home Entertainment	GPS	Security Video	Telecommunications	WAN/LAN
<p>Coaxial cable assemblies are used extensively to inter-connect a wide variety of Home Entertainment equipment such as TV's, DVR's, VCR's CATV or Satellite Receivers. Generally speaking 75 Ohm coaxial cable such as RG6 or RG59 is used to carry Audio and Video signals. Connectors commonly used are BNC, Type F and RCA.</p>	<p>Global Positioning Systems utilize 50 Ohm coaxial cable for connections between receiving antennas and other related equipment. RG174, RG188 or RG316 are often used with SMA, MCX or MMCX connectors. In addition, RG58 with TNC and Type N connectors is used for remote antenna feeds.</p>	<p>The transmission of a video image from a security camera to a display monitor is often the job of a 75 Ohm coaxial cable such as RG59A/U, RG59B/U or RG179, most often with BNC connectors. Bundled assemblies with multiple 75 Ohm cables are often used to connect multi-camera setups.</p>	<p>The infrastructure of many telecommunications systems relies heavily on 50 Ohm coaxial cable for a multitude of interconnection applications. Cell towers and communication equipment in base station facilities are a few typical examples. In these applications RG58, RG223 and RG213 cable with BNC, TNC and Type N connectors are often utilized.</p>	<p>Wide Area Networks and Local Area Networks often utilize 50 Ohm coaxial cable for equipment interconnection. In many of the numerous interconnection applications of these networks you will find RG58 and RG174 are two common cable types. BNC interface connectors are the most common connector types used in these situations. In addition reverse polarized connectors are found on many wireless antenna interfaces.</p>

Frequency Band Data

Coaxial products are generally intended for use in the RF frequency band as illustrated here.



Typical Coaxial Cable (Exploded View):

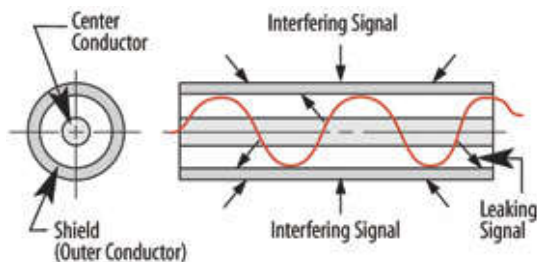


Typical Coaxial Connector (BNC Exploded View):



Understanding Coaxial Cable

Shielding Effectiveness is the relative ability of a shield to screen out undesirable interference. In the case of a coaxial cable, the outer conductor provides a shield to keep interfering signals from getting in and to keep signal from leaking out to become undesirable interference for nearby devices. Shielding Effectiveness is measured in dB with higher values indicating better shielding properties.



The table below illustrates the relative shielding properties of various shielding types. Notice as the shielding density increases there is a correlated increase in the shielding effectiveness value. The best shielding effectiveness value can be found in a rigid coaxial cable due to the solid tube construction of the outer jacket. In this type of cable the limiting factor for shielding effectiveness is the quality of the connector attachment.

Shielding Type			
Single Braid Shield (95% coverage)	Single Braid Shield (60%) + Foil Wrap (100%)	(2) Braids (60%) + (2) Foil Wraps (100%)	Conformable Cable
Approximate Shielding Effectiveness Value			
-55dB	-90dB	-110dB	-150dB