

CEA Bulletin

A Floor-to-Ceiling Guide for
Residential Speaker Systems
Planning, Selection, and Installation
For Optimum Performance

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(Formulated under the cognizance of the CEA R3 Audio Systems Committee.)

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FOREWORD

This recommended practice was developed by the Consumer Electronics Association's Audio Systems Committee.

This document focuses on wiring and practices that pertain to the majority of situations that an installer might face. Every installation is unique and specific requirements for a particular one might require additional or specialized wiring that supports unique systems or devices. Additional or specialized wiring may include wire types such as coaxial cable (RG-6, etc.), specialized gauges or wire types (plenum, riser, etc.) specialized wiring for carrying voltage, multi-conductor and/or shielded.

It is important to pay attention to other devices that will interface with the audio system. These other devices may require video, data, contact closures or other non-audio signals. The following scenario is a common example:

TV in the master bathroom:

1. Wiring is installed to extract the audio from the TV to inject into the audio system.
2. Wiring needs to be installed to get video services to the TV.
3. An electrical outlet needs to be installed at the proper height for the TV to receive power in order to operate. Many times this is coordinated with another trade, such as the electrician, due to codes and licensing.

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A Floor-to-Ceiling Guide for Residential Speaker Systems

Planning, Selection and Installation for Optimum Performance

1 SCOPE

This recommended practice is an informative reference for the installation, application and placement of speakers in residential environments.

2 REFERENCES

2.1 Informative References

The following references contain provisions that, through reference in this text, constitute informative provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

2.1.1 Informative Reference List

ANSI/CEA-863-A, Connection Color Codes for Home Theater Systems, March, 2005
 ANSI/CEA-2030, Multi-Room Audio Cabling Standard
 ANSI/TIA-570-B-2004
 Canadian Electrical (CE) Code
 NFPA-70, National Electrical Code®, 2005

2.1.2 Informative Reference Acquisition

Canadian Electrical Code:

- Canadian Standards Association; 5060 Spectrum Way, Suite 100, Mississauga, Ontario, L4W 5N6 CANADA; Phone 1-800-463-6727; Internet <http://www.csa-intl.org/>

ANSI/CEA Standards:

- Global Engineering Documents, World Headquarters, 15 Inverness Way East, Englewood, CO USA 80112-5776; Phone 800-854-7179; Fax 303-397-2740; Internet <http://global.ihs.com>; Email global@ihs.com

ANSI/TIA Standards

- Global Engineering Documents, World Headquarters, 15 Inverness Way East, Englewood, CO USA 80112-5776; Phone 800-854-7179; Fax 303-397-2740; Internet <http://global.ihs.com>; Email global@ihs.com

NFPA Standards:

- National Fire Protection Association; 1 Batterymarch Park, Quincy, MA 02269 USA; 1-800-344-3555; Internet: <http://www.nfpa.org>

2.2 Compliance Notation

As used in this document “shall” and “must” denote mandatory provisions of this standard. “Should” denotes a provision that is recommended but not mandatory. “May” denotes a feature whose presence does not preclude compliance, and implementation of which is optional. “Optional” denotes items that may or may not be present in a compliant device.

2.3 Symbols and Abbreviations

AC	Alternating Current
AHJ	Authority Having Jurisdiction
AWG	American Wire Gauge
CATV	Community Antenna Television

CCTV	Closed Circuit Television
CD	Compact Disc
CEA	Consumer Electronics Association
CRT	Cathode Ray Tube
dB	Decibels
DLP	Phosphorus-Deoxidized, Low Residual Phosphorus
DSP	Digital Signal Processing
DVD	Digital Versatile Disc
EIFS	Exterior Installation and Finish System
EMI	Electromagnetic Interference
GHz	Gigahertz
HTIB	Home Theater-In-a-Box
HVAC	Heating, Ventilation and Air Conditioning
LCD	Liquid Crystal Display
LFE	Low Frequency Effects
mm	Millimeters
NEC	National Electrical Code
NFPA	National Fire Protection Association
PVC	Polyvinyl Chloride
RF	Radio Frequency
RMS	Root Mean Square
SACD	Super Audio Compact Disc
SPL	Sound Pressure Level
TIA	Telecommunications Industry Association
UTP	Unshielded Twisted Pair
UV	Ultraviolet
VDC	Volts DC

2.4 Definitions

2.4.1 Coaxial Cable

Coaxial cable consists of a center conductor, which is surrounded by a foam dielectric over which shielding is applied and then an outer jacket. For Closed Circuit Television (CCTV) applications a bare copper center conductor is used and the shielding consists of 95% bare copper braid. For Cable Television (CATV) applications the center conductor is copper clad steel and the shielding consists of an aluminum tape bonded to the dielectric over which a 60% aluminum braid is applied for dual shielded coax. The quad shielded coax uses a foil and 60% braid surrounded by a second foil and 40% braid.

Analog CCTV signals are at baseband and this requires the use of a bare copper center conductor, since the very low frequency signal travels through the inside of the conductor. CATV signals are at high frequencies and these signals travel along the outside of the center conductor, which is known as the skin effect, and this requires that a steel conductor be used for mechanical reasons with a thin copper cladding to carry the Radio Frequency (RF) signal. Some satellite systems may recommend the use of a CATV cable with a bare copper conductor if a lower resistance is needed to provide power to electronics residing at the antenna.

2.4.2 Home Theater in a Box (HTIB)

These systems are designed for stand-alone operation in a single room, but for the sake of convenience and budget they are sometimes included in professional home installations. The HTIB provides the easiest way to assemble a home theater audio system. The manufacturer supplies everything needed in one package, which usually includes a receiver/amplifier, Digital Versatile Disc (DVD) player, center front speaker, left and right front speakers, left and right surround speakers and a subwoofer. Many HTIB systems are of the satellite/subwoofer type.

2.4.3 Infinite Baffle

An infinite baffle is a plane surface through which a transducer operates, with no acoustic path between the two sides of said plane. Most infinite baffles are not truly infinite. Realistic examples would be a wall or a ceiling containing a speaker.

2.4.4 Line Level

Line level generally refers to the signal level found at the output of devices such as Compact Disc (CD) players, DVD players, and pre-amplifiers. It is also known as low level in some disciplines. The reference level for consumer equipment is -10 dBV or 0.316 V Root Mean Square (RMS). For professional gear, the standard is +4 dBu or 1.23 V RMS. Line level sources are generally designed to drive high impedance inputs, such as the inputs to an amplifier or preamplifier, not low impedance inputs such as a speaker. The highest RMS voltage that is usually present from a line level output is approximately 2 V RMS, though exceptions may occur.

2.4.5 Multi-Channel Surround Audio

Simply put, multi-channel surround audio involves the playback of audio, be it music, film or broadcast television, through more than one or two speakers. Typically, a multi-channel surround audio system will involve at least four to seven speakers and a subwoofer. Specific speaker terminology is used to describe the position of the speaker in the room with respect to the primary listening position. In addition to giving the speakers a positional name, there is also a standard numeric descriptive of the speaker setup using either the number of primary speakers followed by a period and then the number 1 (for a subwoofer) or four numbers separated by periods (".").

2.4.5.1 Configurations

The typical possible speaker configurations are:

Four speakers and a subwoofer (described as 4.1 or 2.2.1.0). The two front speakers (the first 2 in 2.2.1.0) are placed to the left and right. Here the center channel information is played through the front right and left speakers using a Phantom mode setting. The listeners perceive that center channel information is coming from a space between the two front speakers even though the sound is being derived from the left and right front speakers. Also, two surround channel speakers are placed either to the left and right sides (preferred) of the primary listening position or (less optimally) behind this position but still to the right and left (the second 2 in 2.2.1.0). The subwoofer can be placed most anywhere in the room but is ideally placed in either of the two front corners (the "1" 4.1 or the "1" in 2.2.1.0).

Five speakers and a subwoofer (described as 5.1 or 3.2.1.0). In addition to the two front channel speakers as described above, this configuration features a third front channel speaker placed in between the front right and left speakers (hence the 3.2.1.0 nomenclature). This setup provides for a better soundstage as the center channel is critical for playing dialogue when viewing film or television programming and provides a real sound field versus the imaginary one created when implementing the 4.1/2.2.1.0 speaker array. It is important to note that the use of a center channel speaker will greatly enhance the listener's experience, especially for film and television playback. All efforts should be used to place a center channel speaker in the room.

Six speakers and a subwoofer – 6.1 – Adds a rear center surround speaker in addition to the two side surround speakers

Seven speakers and a subwoofer – 7.1 – Adds two rear channel surround speakers in addition to the two side surround speakers

There are configurations that go beyond 7.1 (see CEA-863-A for more information).