



A Technical Explanation of the Radio Systems’ “StudioHub+” approach.

CAT-5 wiring for analog and digital signals in broadcast applications:

Overview

The StudioHub+ product makes extensive use of shielded twisted pair (STP) CAT-5 compliant cable throughout its design and implementation. In conjunction with companion termination and active amplifier components (used where needed to condition the audio), these integrated StudioHub products provide a convenient and technically sound method to wire and intermix analog and digital signals in a broadcast facility.

STP cable, widely used in the computer industry, was selected for this new cross-platform application due to its characteristic:

- 110-ohm impedance and low capacitance range
- excellent performance at audio frequencies
- wide bandwidth for data transmission
- low cost and wide availability
- wide range of connector and cable management systems

CAT-5 for digital audio data transmission

A 1997 report, entitled “Review of Cables for AES/EBU Digital Audio Signals” conducted by the BBC Research and Development Department, concluded that CAT-5 shielded twisted audio pair cable “offered the highest performance of all the cables tested here.”¹ Their tests included coaxial cables and special cables specifically designed for digital audio, but they preferred CAT-5 cables for their overall flexibility and applicability in mixed data applications and consistent performance.

Category 5 cables perform well for digital audio applications because they are engineered to have characteristic impedance of 110 ohms, and more importantly, extremely low capacitance (in the 12 pF/ft range). This yields the fastest transmission speeds and lowest signal reflection resulting in the best high frequency response and lowest error rates.

CAT-5 cables are engineered for data rates up to 100 Mb/sec (100 baseT networks). Since AES/EBU signals have a bandwidth of about 3 Mb/sec (depending on sample rate), they operate well within the cables’ guaranteed performance parameters, with dependable error-free transmission at lengths up to 920 meters (over ½ mile).

CAT –5 cable for analog signal transmission

In a recent article, Steve Lampen, a senior audio video specialist for Beldin Wire & Cable writes, “Digital audio cables make the absolute best analog cables. You can go farther with flatter frequency response than with any cable designed for analog”.² This is because due to it’s characteristic low capacitance, data cable

is designed to transmit data at high velocity and wide bandwidths. At audio frequencies, these characteristics will yield exceptionally flat frequency response, even over very long cable lengths.

Shielded twisted pair cable is specified for use in the StudioHub+ product to negate the effects of RFI in high RF environments and to avoid any possible crosstalk between cables in multi-cable bundles. While there is a potential for signal cross coupling between pairs in the same cable, the use of good modern design electronically balanced circuits (especially at the terminating end) reduces this interference to negligible levels. Tests conducted by Radio Systems have measured maximum crosstalk at -102dB , 20-20 kHz, measured along a 200' length of CAT-5 cable, into a balanced termination with a CMRR of 85 dB. An "average" quality balanced circuit with 50 dB of CMRR yielded -90db with the same test parameters.³

Finally, the use of a digital capable cable is recommended for facilities even where no digital audio circuits are currently contemplated due to the low cost and ease of future digital conversion. In addition, by adopting the uniform use of a "multi-platform" cable, facility planning is simplified because any building cable may be readily employed at any time for analog, digital or data (LAN) applications.

Other CAT-5 cable features as utilized by the StudioHub+ System

Standard CAT-5 cable features four tightly twisted pairs (8 wires total); two of which are utilized for balanced left and right audio by the StudioHub wiring architecture.

Two of the unused wires, plus a third ground wire are employed for the "DC power link system" which conducts +/- 15 volts through the cabling to remotely power various system auxiliary amplifiers and accessories. These "spoke" products include miniature matching and pre-amplifiers to conveniently convert source equipment with consumer style unbalanced and low-level audio inputs and outputs to the pro standards required for use with the StudioHub+ product. The "power link" approach provides phantom style powering of remote devices, eliminating the clutter and noise associated with multiple AC power supplies and "wall-wart" solutions.

Future applications for the additional pairs made available via the use of CAT-5 cabling will include the introduction of RS-485 serial control signaling for "smart" spoke devices such as routing switchers and intercom signaling systems.

¹ – Tests conducted by D. G. Kirby, BBC Research and Development Department, and published in a paper titled "Twisted-pair cables for AES/EBU Digital Audio Signals" presented at the 1994 AES International convention, Amsterdam.

² - published in Radio World Magazine's "Wired for Sound" section, *Feb 15 1999*

³ – Tests set up utilized a carefully constructed differentially balanced driver and receiver on two different and adjacent cable pairs. Receivers were adjusted to provide precisely 85 and 50 dB CMRR. All measurements made with Audio Precision "System One" analyzer.



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