



*The Studio Wiring Solution from*

**ANGRYAUDIO** 

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# The StudioHub+ Primer

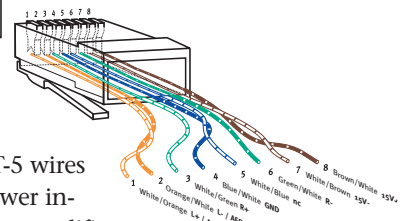
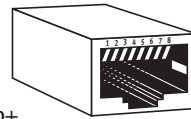
**StudioHub+** is most of all a CAT-5 wiring system (because CAT-5 can handle every type of broadcast signal). And, it's a shielded CAT-5 system because that improves cross-talk numbers to exceptionally low, (almost immeasurably low,) levels.

StudioHub+ has also adopted RJ-45's as its lead connector because RJ-45's are small, dense, dependable and inexpensive.



Almost every piece of StudioHub+ connects via RJ-45's and wires with CAT-5.

With these simple common components, StudioHub+ has implemented a wiring standard that conforms to 568B (the most common Ethernet wiring protocol.) In StudioHub+ this standard looks like this:



Note that StudioHub+ utilizes three of the unused CAT-5 wires to add power (+/- 15 volts) so that it can optionally power in-line devices like headphone and "MatchJack" balancing amplifiers.

As far as technology, that's about it. StudioHub+ doesn't multiplex signals or add points of failure with lots of active devices. It's just a wiring system and interface standard for broadcast and pro-audio.

There are, however, lots of hubs (wiring blocks), adapters and cables to make it easy to interface, and ideally, plug and play any piece of gear.



First off, adapters, "dongles" and breakout boxes convert gear with XLR, 1/4" "D" or other high-density connectors to RJ-45 connectivity. StudioHub+ provides hundreds of these converter/adapters and more are put on-line weekly.

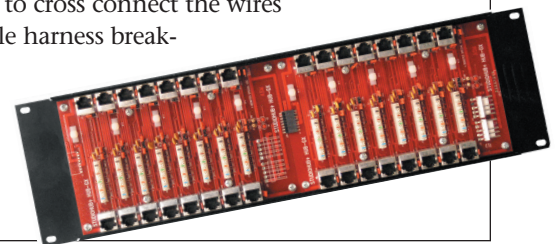


Adapters plug into the StudioHub+ system via any length of pre-made shielded patch cord. Generally, every signal gets its own cable so that sources can be easily replugged and routed. But, StudioHub+ also uses 25-pair CAT-5 cable for high-density inter-studio tie lines. These cables use RJ-21, 50 pin telephone style connectors. All the adapters and cables work with any type of signal whether it's analog, digital or data (Ethernet).



Finally, select one of a dozen different types of hubs or breakout boxes to cross connect the wires from source to destination. Some hubs are optimized to work as console harness break-outs, while others are better suited for studio tie-line interconnection.

That's it! Now you understand the simple reasons why StudioHub+ is the first and only wiring solution for all your studio connectivity.



manufactured by:



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## ***The StudioHub+ integrated analog/digital wiring solution***

From Angry Audio

StudioHub+ is designed to be the broadcast industry's first prewired cabling system for digital ready operation. With CAT-5 rated shielded twisted pair cables, StudioHub+ efficiently routes both analog and digital signals throughout a facility. StudioHub+ features pre-made source cables for all types of studio gear and quick-connect blocks and peripheral amplifiers to easily harness all studio gear together.

On-site wiring time is dramatically reduced due to the true plug and play nature of StudioHub+. Every system component quick connects with RJ-45 jacks, and all peripheral products are phantom powered with the built in "DC-link" system.

StudioHub+ also features numerous accessories that are all engineered to plug and play with the StudioHub+ system. These "spoke" products include the "MatchJack" balancing amplifiers, mic pre-amp, headphone amp and various switching and adapter plates. All these accessories are manufactured to fit conveniently into industry standard wall plates, connect instantly via shielded RJ-45 connectors, and phantom power using extra pairs in the CAT-5 cables. The 44 position, front panel normalised patch panel included in the line also features front and rear panel RJ-45 quick connector jacks.

The inspiration to develop the product came from Angry Audio's experience in providing turnkey installations. StudioHub+ was developed to dramatically decrease the installation hours required on site, freeing up precious time for trouble shooting and unexpected tasks. StudioHub+ saves time by emulating the very efficient computer network wiring systems and architecture. And, by adopting CAT-5 standards, StudioHub+ gains the tremendous added benefit of making studios 100% digital ready.



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## **A Technical Explanation of the Angry Audio’s “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.”<sup>1</sup> 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”.<sup>2</sup> 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 Angry Audio have measured maximum crosstalk at  $-102\text{dB}$ , 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  $-90\text{db}$  with the same test parameters.<sup>3</sup>

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  $\pm 15$  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.

<sup>1</sup> – 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.

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

<sup>3</sup> – 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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## **Q&A about the New StudioHub+ Wiring Solution**

### **from Angry Audio**

*Angry Audio's new StudioHub+ interconnect product is a radical approach to studio wiring because it uses CAT-5 cable and connectors. While standard in the data industry, CAT-5 cabling technology is not usually employed to conduct audio signals. Here are some frequently asked questions and answers on how and why we took this approach.*

#### **What is StudioHub+?**

It's a wiring system made up of pre-made patch cables, RJ-45 connectors special connecting blocks, and companion amplifiers that are all designed to plug together easily and work together in any studio. Because StudioHub+ uses CAT-5 data cable it works equally well for analog and digital studio wiring.

#### **What is Category-5 wiring?**

This cable meets an industry standard for shielded twisted pairs (STP) called TIA/EIA 568B, which specifies attenuation, crosstalk and bandwidth performance (among others) all the way up to 100 MHz. It's used for almost every computer network system installed today. The CAT-5 cable used in Studio-Hub consists of 4 tightly twisted pairs, surrounded by one common foil shield, drain wire and plastic insulation.

#### **But you can't use computer cable for audio wiring - can you?**

Actually, the tightly twisted pairs in CAT-5 cable work great at audio frequencies. That's because the low capacitance performance specifications required of data cables result in razor flat frequency response at audio bandwidth. It's now becoming generally accepted that "digital audio" wire makes the best analog cable.

#### **Are those little RJ-45 phone connectors any good for audio?**

It's true that we're not used to seeing these connectors used for audio – but they do a great job handling most of our high-speed critical data communications in broadcast and throughout the data world. The RJ-45 connectors used in StudioHub+ are the very best available with 50 um gold plated and long-life rated spring contacts. And, StudioHub+ gets a lot of mileage out of the very dense (8 conductors plus shield) population of pins in this small connector.

#### **What use do you make of the 8 wires in the StudioHub+ cable?**

Two pairs are used for left and right audio, one pair for DC, and the fourth pair for data.

#### **What's the DC pair for?**

This is one of the most innovative features of StudioHub+. When any system active component (headphone amp, mic pre-amp, matching amplifier, etc.) is plugged into StudioHub+, it powers-up automatically like a phantom powered mic. +/- 15 volts DC is centrally provided by the "Hub" connecting block.

#### **Is CAT-5 cable OK to use for AES/EBU digital signals?**

Actually, CAT-5 turns out to be one of the best cables to use for digital audio signals. In tests conducted by the BBC Research and Development Department on cable for AES/EBU signals, CAT-5 shielded twisted audio pair cable "offered the highest performance of all the cables tested here."<sup>1</sup> And, these BBC tests found that performance was excellent all the way out to 970 meters of cable (over ½ mile).

<sup>1</sup> – 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

### **Is CAT-5 cabling OK for digital audio signals?**

Category-5 wiring was developed for high-speed data delivery. Actually, the 3 Mb/sec bandwidth of most of today's digital audio equipment is a cakewalk for category 5 cable, which is rated for 100 Mb/sec networks. But as the bandwidth requirements for digital audio signals increase (some systems now contemplate 96 kHz sampling rates,) a high velocity cabling system will be critical.

### **Why does the StudioHub+ system use CAT-5 cable with an overall shield?**

The entire StudioHub+ system is shielded for the best performance in high RF environments and for the elimination of any possible crosstalk between cables in multi-cable bundles. Shielded cables also provide the very best data performance.

### **Is CAT-5 wiring 110 ohm?**

Yes. Well, technically, most CAT-5 cables are rated at 100 ohms. This is fine because the AES specification for AES/EBU impedance is +/- 20%, (or 88 to 120 ohms.) Actually, it is the capacitance of the cable, not the impedance, that has a much greater effect on digital and audio performance. And CAT-5 cables are all very low capacitance - 30 pf or lower.

### **But I thought that audio circuits were supposed to be 600 ohms.**

Audio circuits using CAT-5 cable are 600 ohms (or whatever the impedance is of the source equipment). That's because with any audio circuit the impedance is fully determined by the source and terminating gear - not the wire. At audio frequencies, any cable would have to be over 2 miles long (a quarter wavelength at 20 kHz) to have any effect on the impedance.

### **Shouldn't I use one of the new 110-ohm digital audio cables for my digital sources?**

Those cables are fine if you want to follow a more traditional wiring model for your digital equipment (XLR connectors, one cable per source, etc.) or if you want to replace one circuit at a time. StudioHub is designed more as a complete wiring system solution for efficiently re-wiring a whole studio or complete new facility.

### **Is there any crosstalk between the pairs in the CAT-5 cable?**

As long as your circuits are balanced, there is almost no left/right crosstalk inside the cable. Tests conducted by Angry Audio measured greater than 102 dB of separation between pairs at 20 to 20kHz in a 200' run of cable using a quality balanced input circuit (85dB of common mode rejection). Even with an only fair quality balanced input circuit (50 dB of CMRR), separation was still greater than 90 dB.

### **So, must all the audio and digital signals used with StudioHub+ be balanced?**

Yes, or crosstalk will degrade. That's why we provide the "MatchJack" balancing amplifiers and other integrated system pre-amplifiers. AES/EBU digital audio signals are balanced right out of the box, and require no conditioning.

### **I'm not building a digital studio now - why use a "digital ready" system?**

Because you never know when you'll have to convert some or all of your source gear to digital. StudioHub+ avoids the cost, hassles, and down time of pulling new cable. And even if you never utilize any digital audio equipment, StudioHub+ cables between studios can be used for LAN and for any other data applications.



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