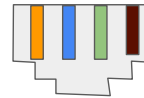
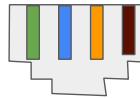




AES 72 - 4 - Everyone



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DISCLAIMER

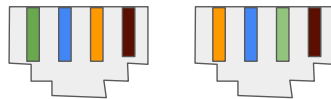
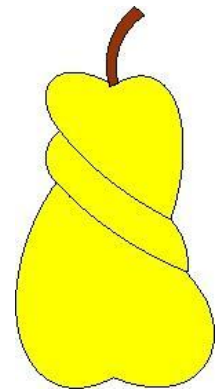
www.RJ45.audio
www.QuadTwistedPair.com

I @ Like.audio

www.Like.audio

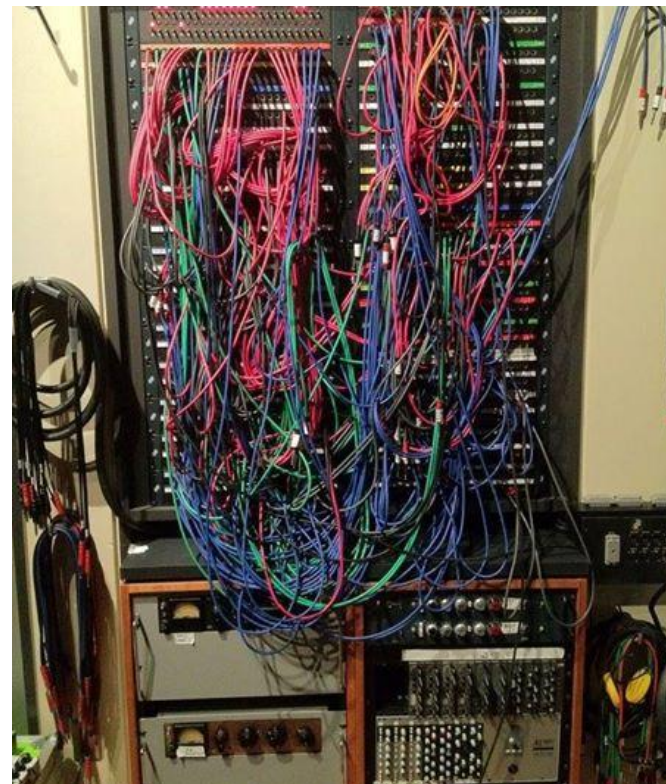
HISTORIAN / ENTHUSIAST / WRITER
MACHINIST / METROLOGIST / MEDIA MAKER

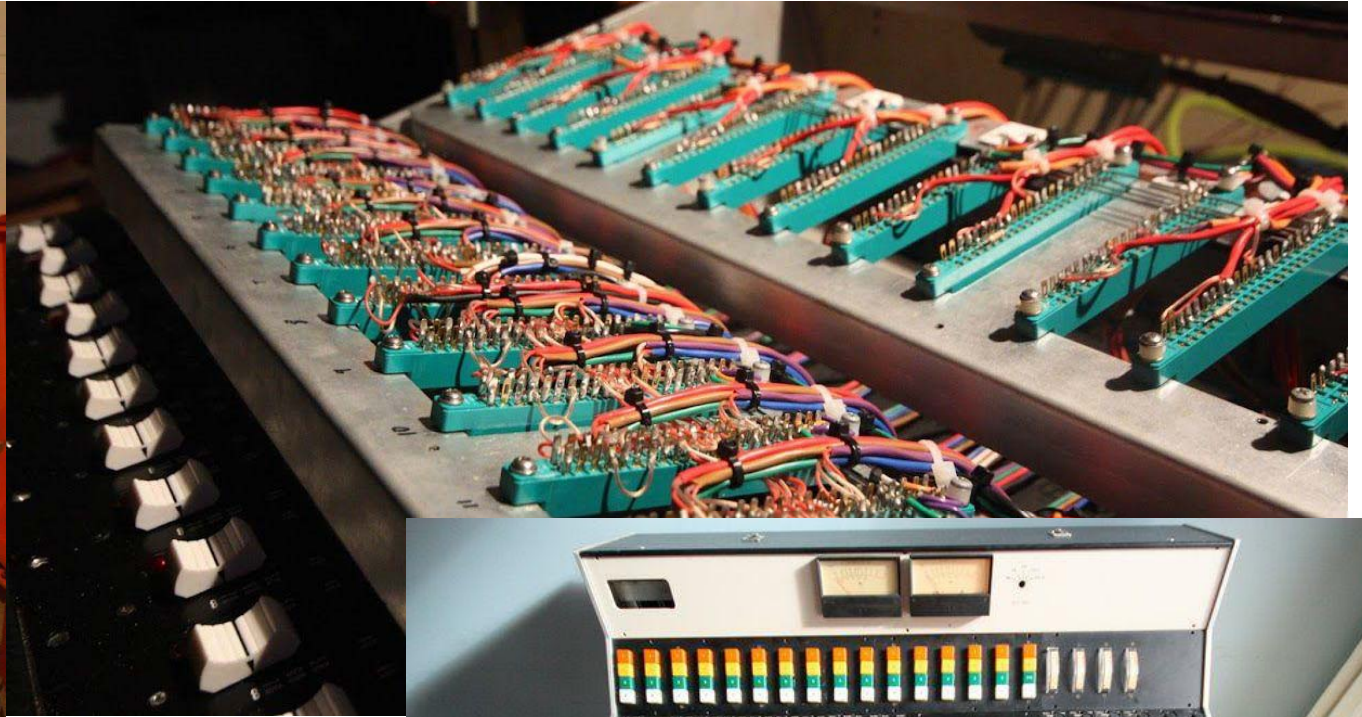
Thanks to Elizabeth, Tristan, The Lyvers



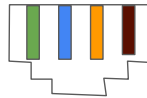
TIMELINE

- 1997-2010 - Recording studio Producer / Engineer:
 - High Voltage Recording
 - Tanda Recording
- 2003-2018 - Audio Technician:
 - Bell Media, Much Music, IASTE 300
- 2010-2013 - Revolution Recording
 - Custom shop - Technical Supervisor - Console restoration
Ward-Beck Systems Mixing Console
 - Pilchner Schoustal
 - Joao Carvalho Mastering, and Lacquer Channels Cutting system.





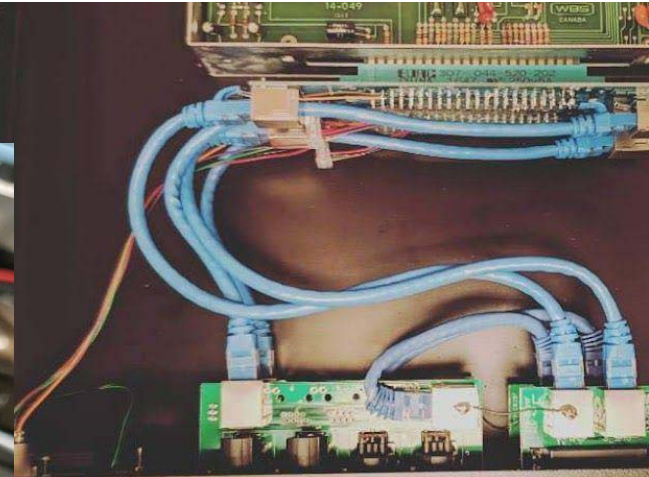
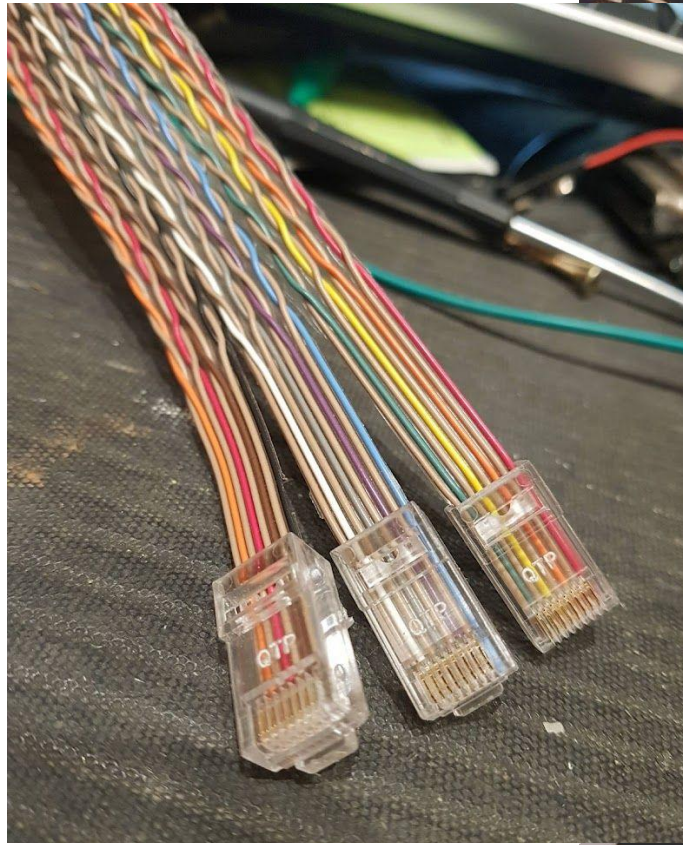
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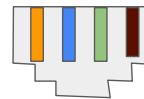
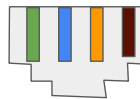
APK

- 2013-2016
Honors Diploma in Communication
Engineering - Seneca Toronto

- 2013-2019
IP audio product manager -
Ward-Beck Systems Toronto



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ANTHONY P. KUZUB

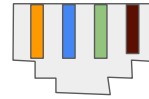
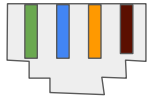
AES67 and most other Audio Engineering Society standards

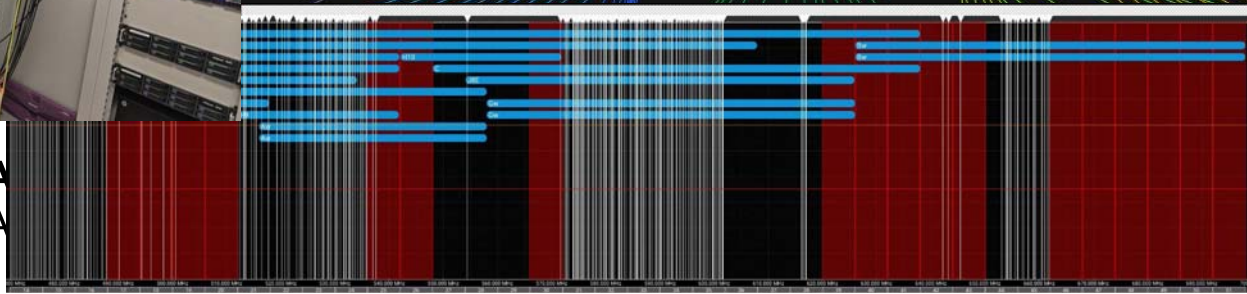
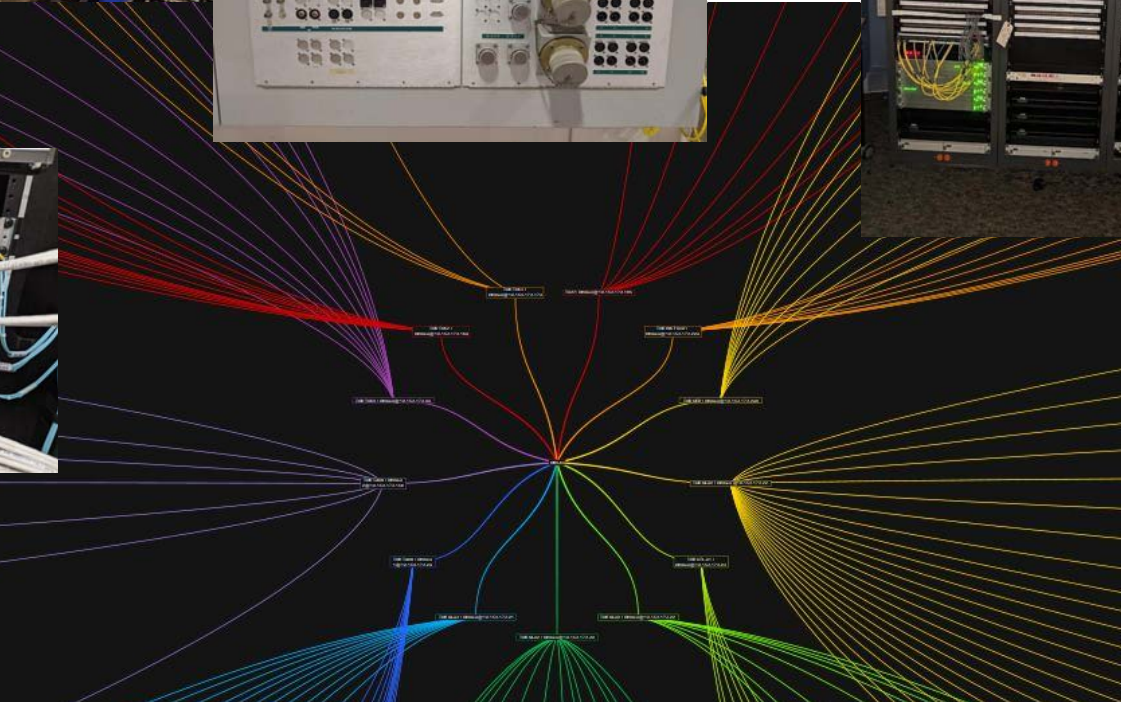
Senior Systems Designer / Project Lead
Premier concepteur de systèmes / Chef de projet
Production Systems, Engineering Solutions
Systèmes de production, Solutions d'ingénierie

Technology + Infrastructures
CBC
Radio-Canada



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Chair - Toronto Section - Audio Engineering Society

Since 1968, Toronto AES has been one of the most active sections of the Audio Engineering Society in the world. We unite audio engineers and our allied arts to collect, collate, and disseminate, scientific knowledge that furthers our field.

www.TorontoAES.org

Chair - AES - SC0505 - Grounding and EMC Practices

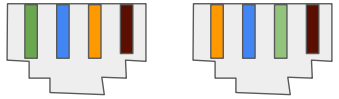
Group Scope: The scope of the SC-05-05 Working Group on Grounding and Electromagnetic Compatibility Practices shall include, within the bounds of the scope of SC-05, all practices affecting usage and performance of audio hardware, with respect to the susceptibility of the signals it carries to effects such as noise and cross-talk due to the manner of its connection and construction, and the effects of its signals on other hardware and systems in its vicinity. It shall not set standards for personal safety with regard to such connections and construction, but shall keep safety considerations in mind in its recommendations.

Vice Chair - AES -SC0502 SC-05-02 Working Group on Audio Connectors

Group Scope: The scope of the SC-05-02 Working Group on Audio Connectors shall include, within the bounds of the scope of SC-05, new usage, description, and contact designation for connectors for audio and ancillary functions.

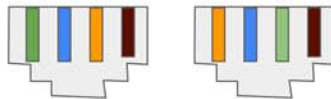


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2014-2019 - Author X246 ----> AES72

AES72-2019: AES standard on interconnections - Application of RJ45-type connectors and quad twisted pair cable for audio interconnections.



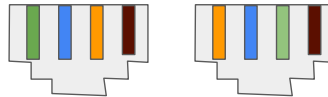
AES72 standard documents

8P8C (RJ45) pin-outs

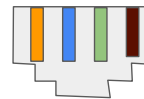
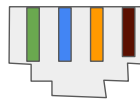
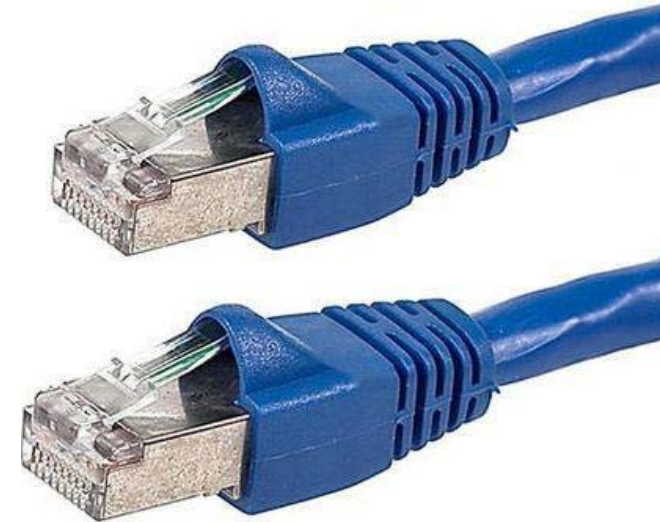
channel/link order
signal polarity
phantom power compatibility.

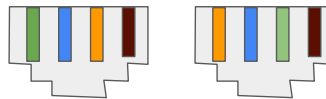
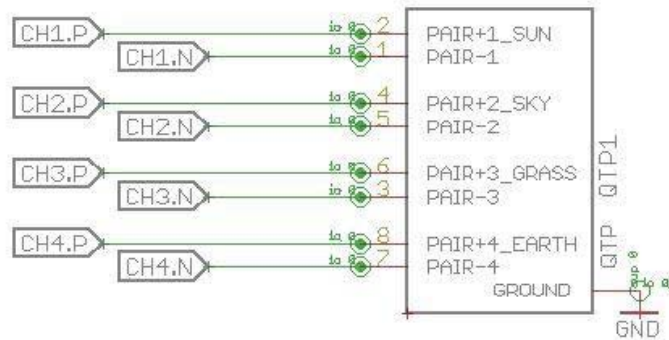
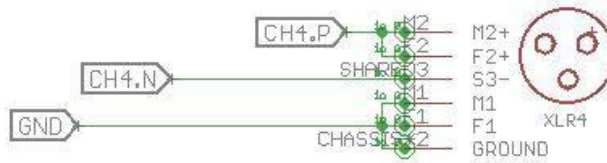
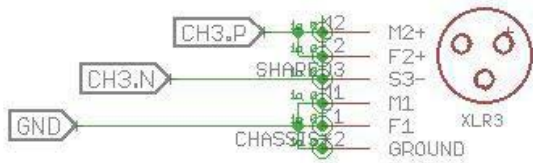
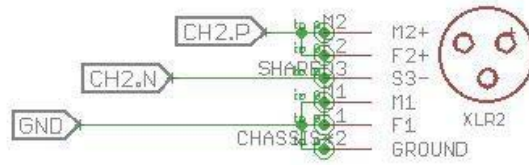
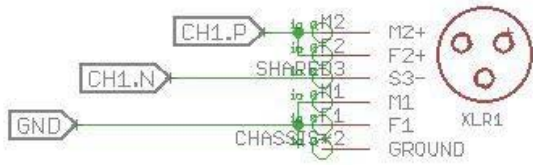
Types in the market

practical application details

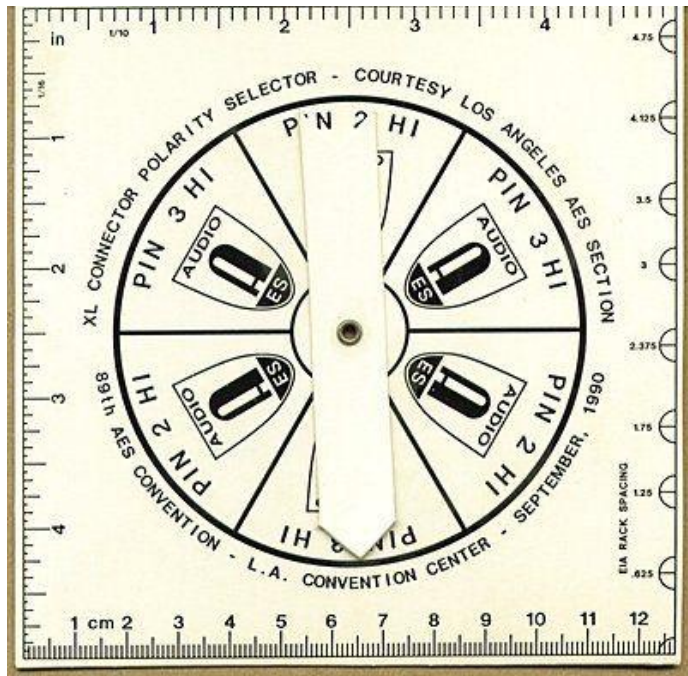


Analog and AES3 Digital Audio

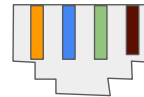
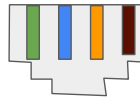




WE NEED YOUR HELP!

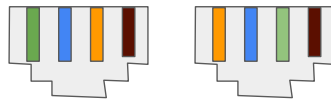


Conformance with this standard will identify mutually compatible devices, enabling users to avoid problems when employing equipment from multiple manufacturers.



PROBLEM STATEMENT:

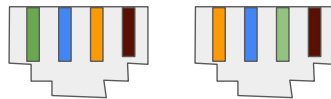
There is no consistency in link assignment across manufacturers using RJ45 to move audio



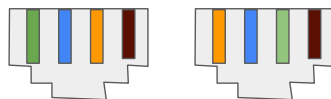
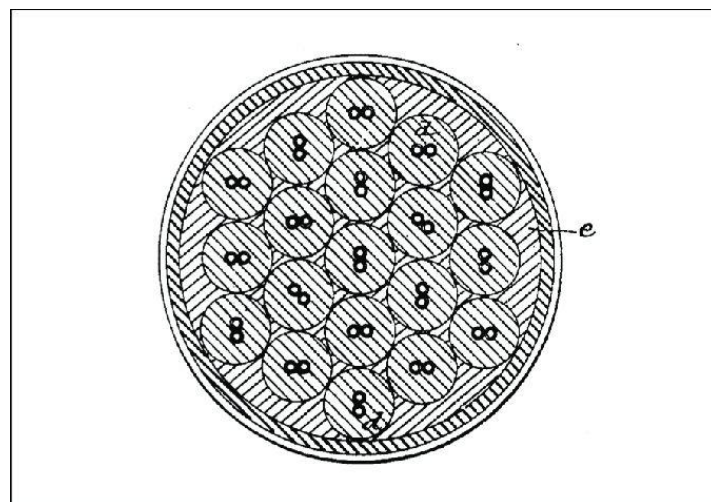
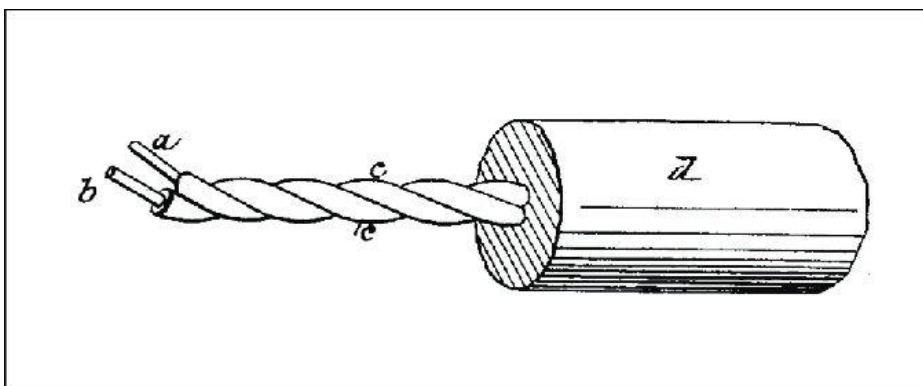
WHO BENEFITS?

Manufacturers and users in production, post production and broadcasting.

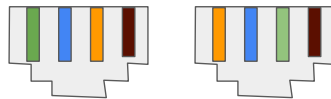
WHY AES? The AES membership spans the full range of users and organizations likely to use and benefit from the recommendations.



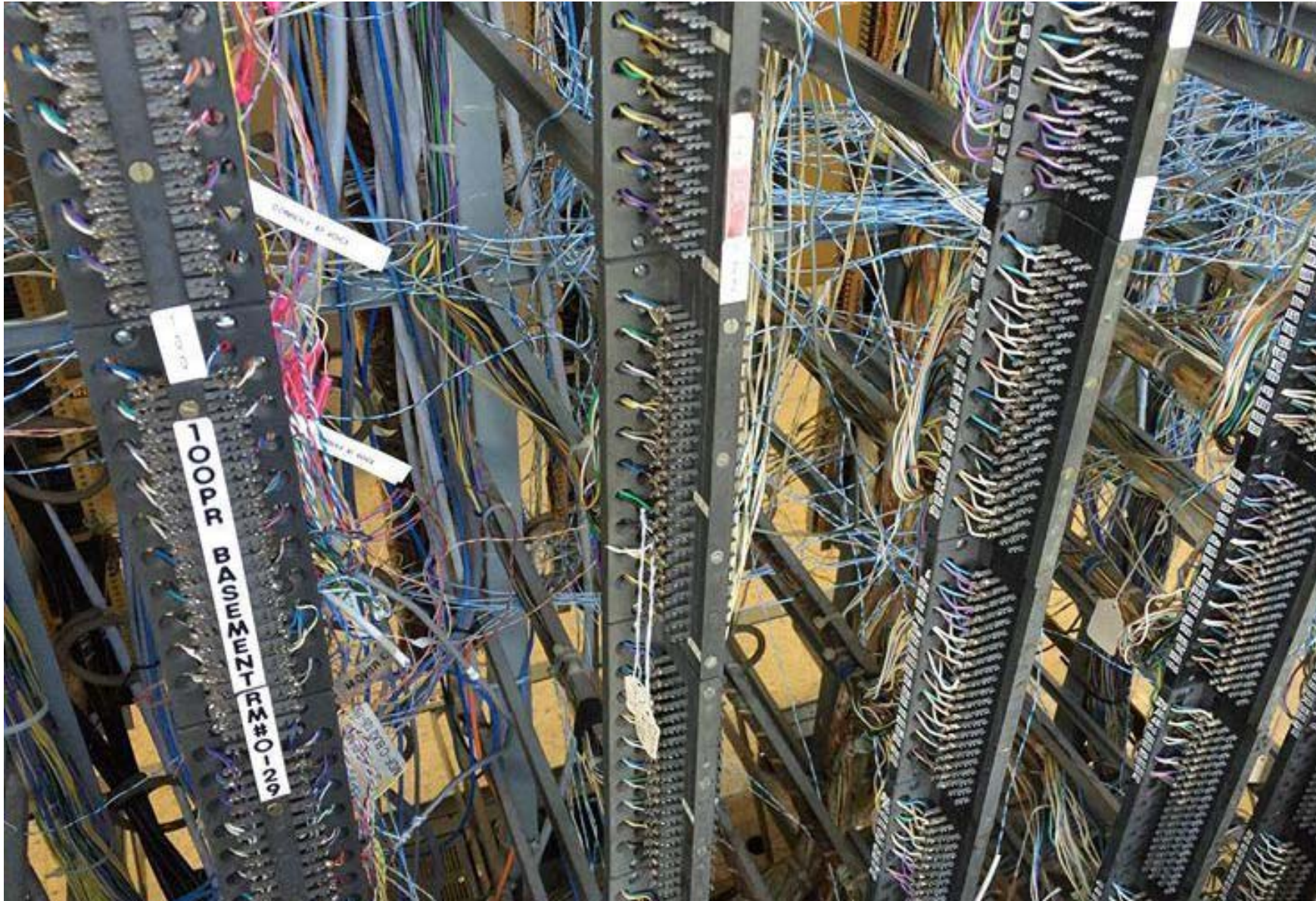
Twisted-pair cabling was invented by Alexander Graham Bell in 1881



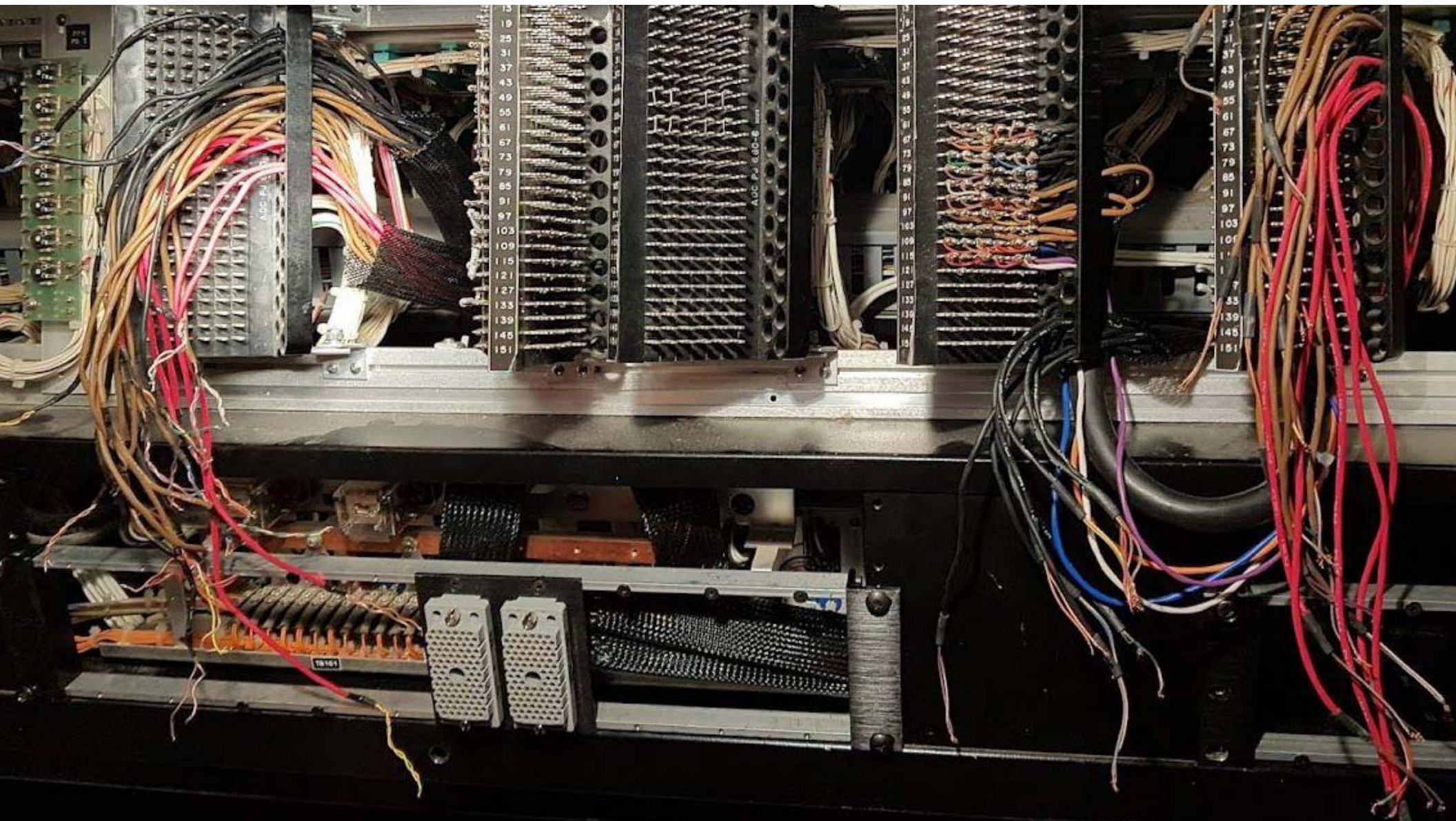
Wire is the first form of programming







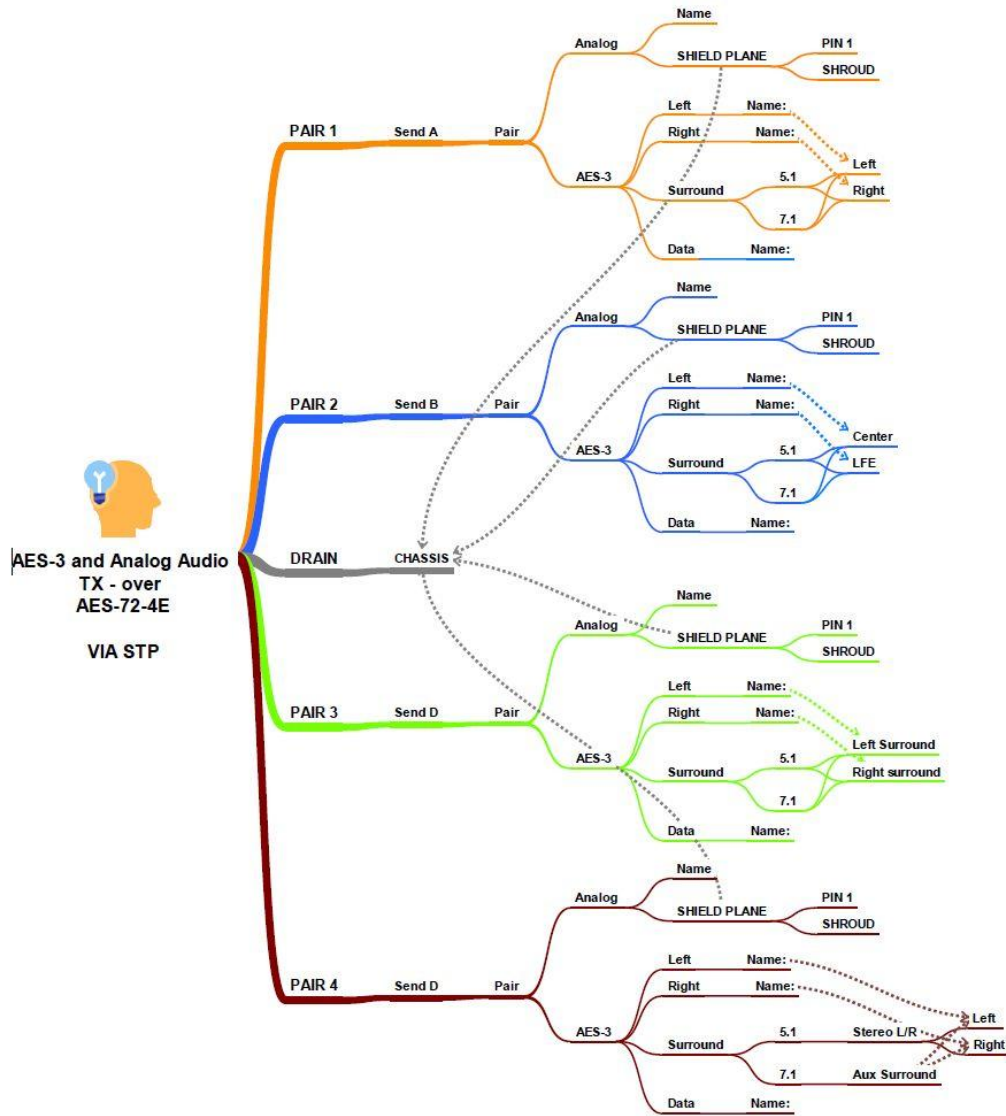


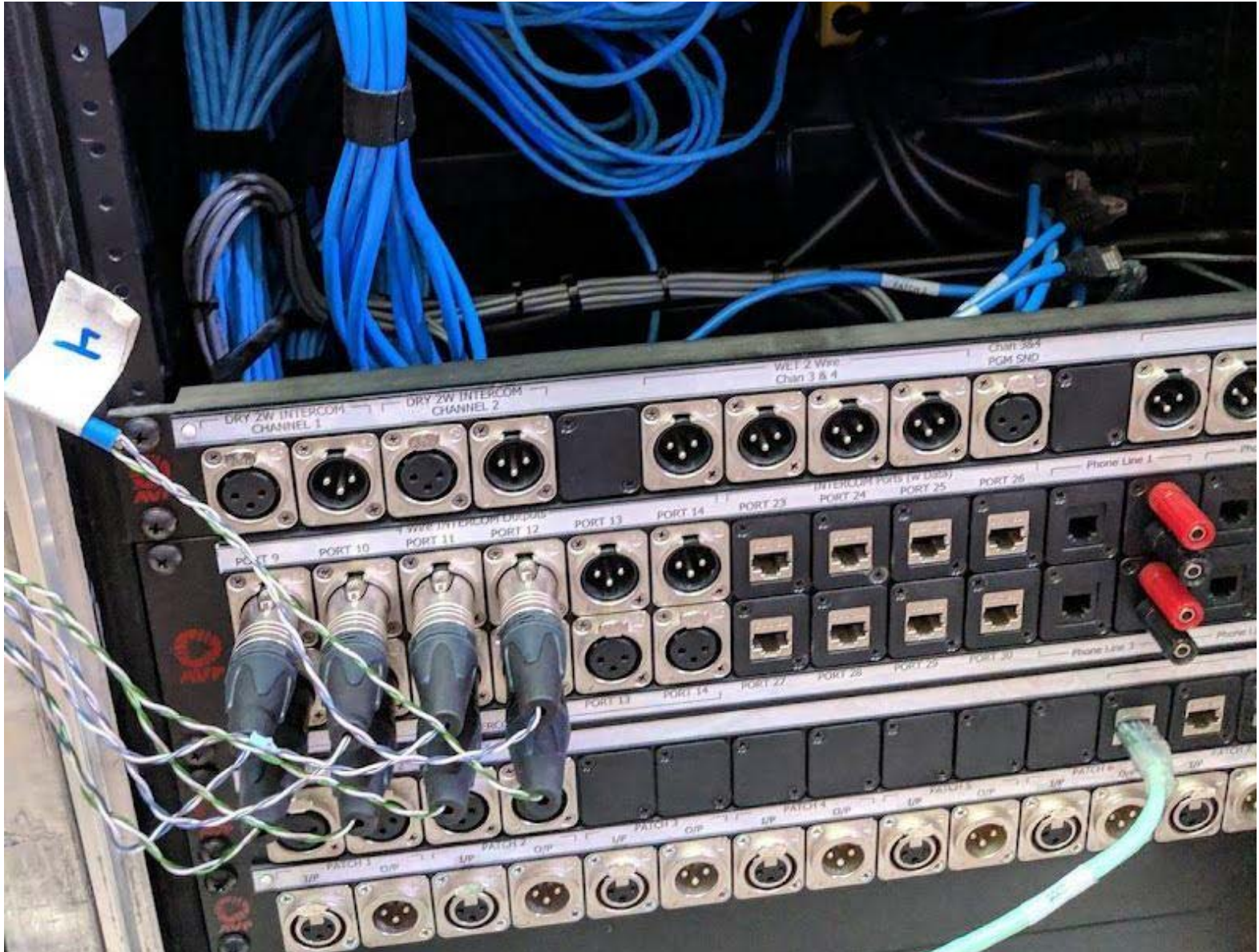




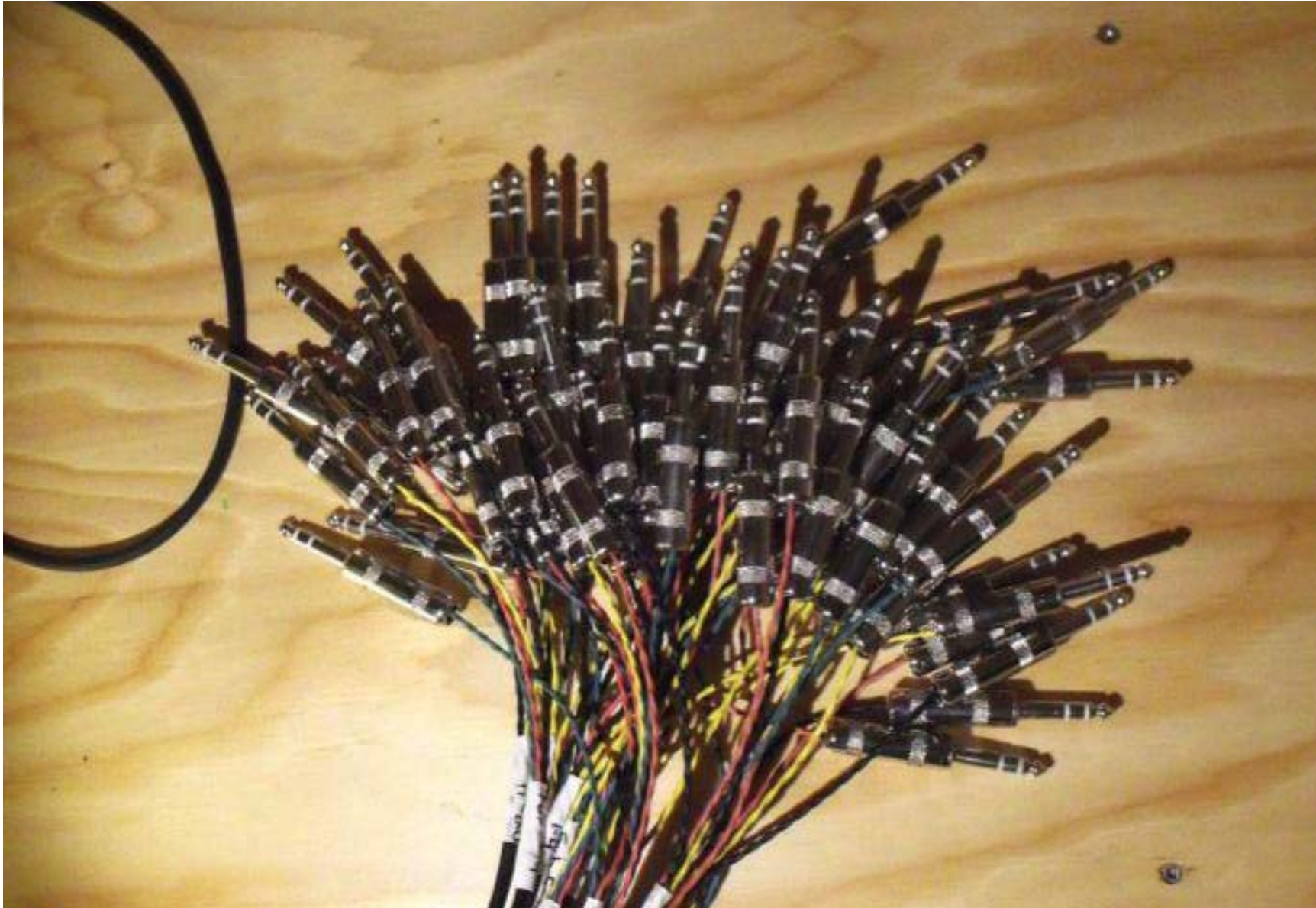
In balanced systems, with the exception of low-level signal circuits from microphones and other transducers, **cable shields may not be required at all in applications where nearby electric and magnetic field energy is reasonably low...** To avoid tempting fate, however, it has become standard practice to shield cables in balanced audio systems, regardless of the likelihood of nearby fields. - Muncy 2:4







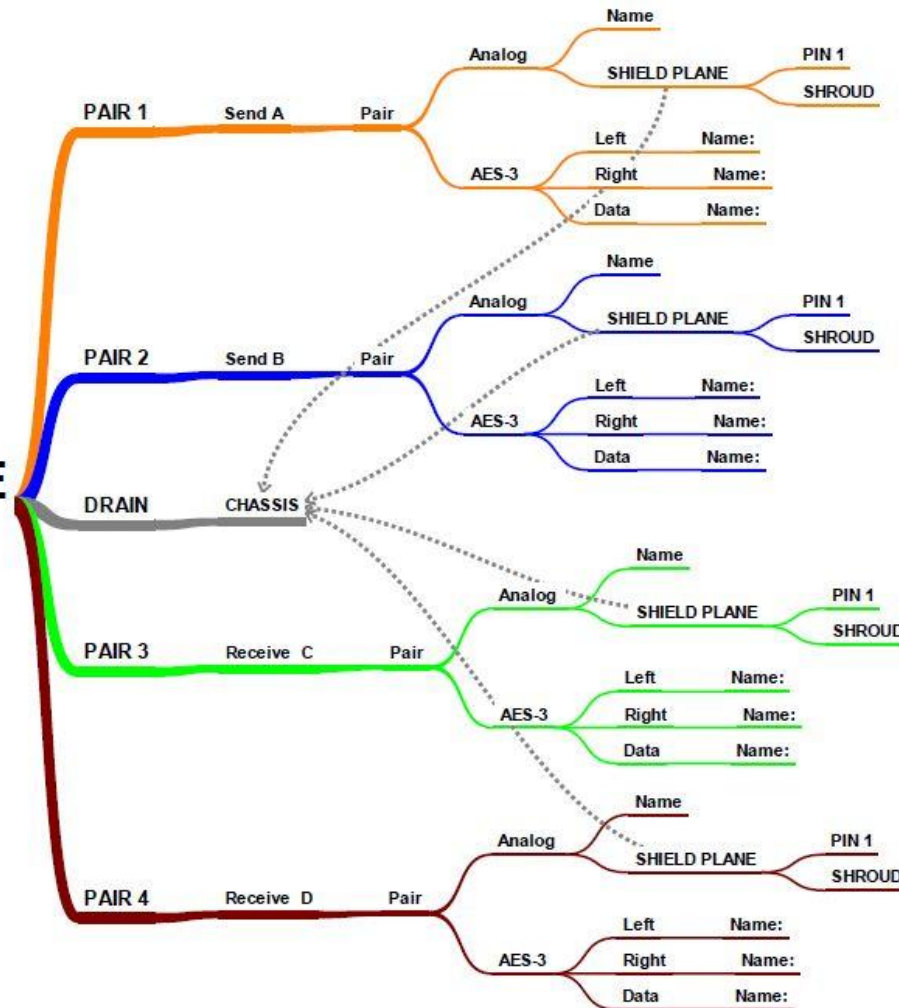
Where it gets hairy...



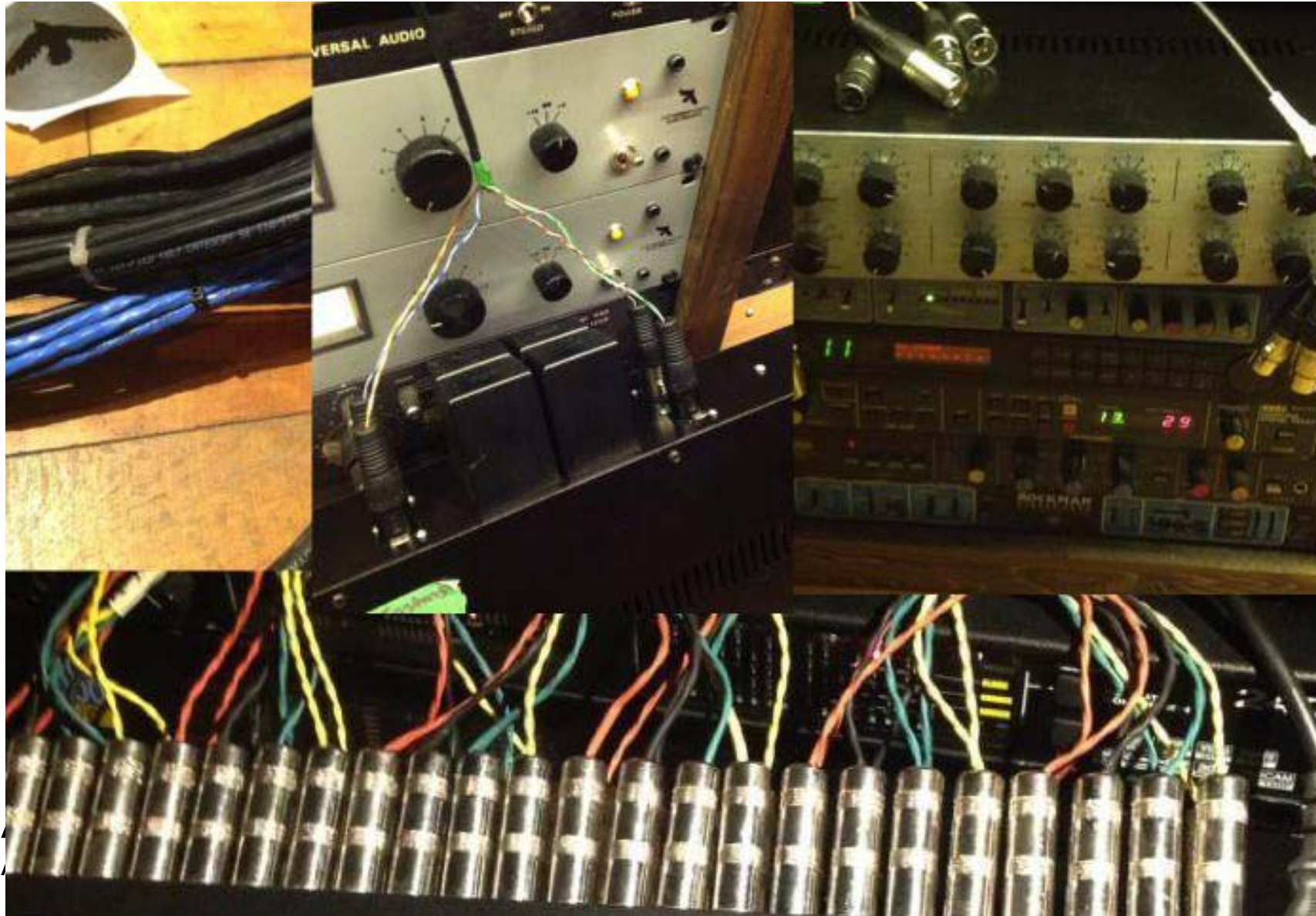


AES-72-4E TX/RX

VIA STP

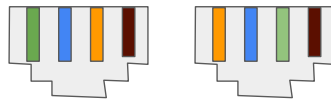
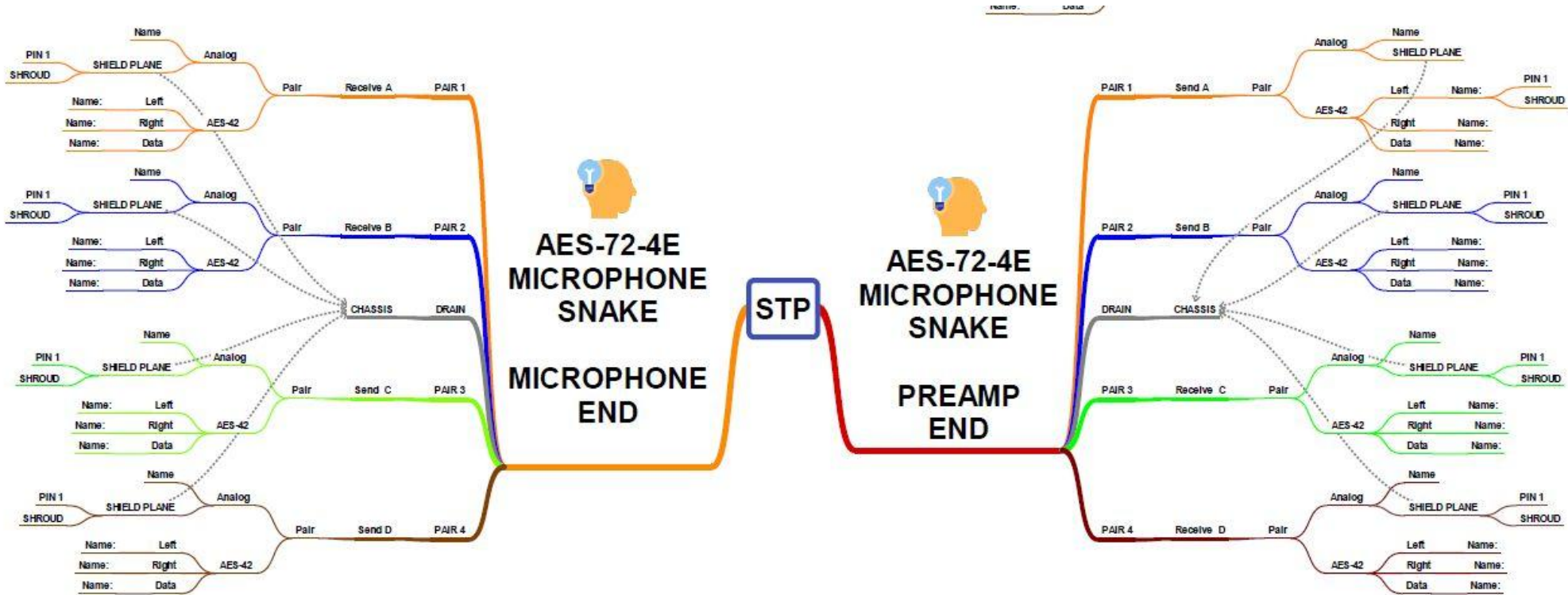


Mixing the old the new
And the unbalanced



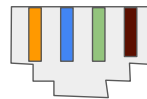
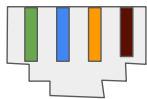
Half and Half







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QTP Audio Routing

Our QTP lineup of products allow you to move Analog and AES audio over CAT networking cables. Save money, time and installation costs by using this low-cost and flexible connection system that can be easily standardized and replicated as your studio grows.

Showing 1 - 14 of 14 products

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View



WARD-BECK SYSTEMS
QTP-BOBCAT-F

BobCat XLR BreakOut Box Cat5 Cat
6 Ca...



WARD-BECK SYSTEMS
QTP-BOBCAT-M

BobCat XLR BreakOut Box Cat5 Cat
6 Ca...



WARD-BECK SYSTEMS
QTP-BOBCAT-FM

BobCat XLR BreakOut Box Cat5 Cat
6 Ca...

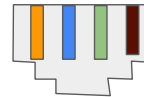
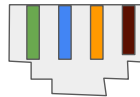


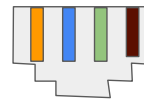
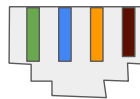
WARD-BECK SYSTEMS
QTP-BOBCAT-MF

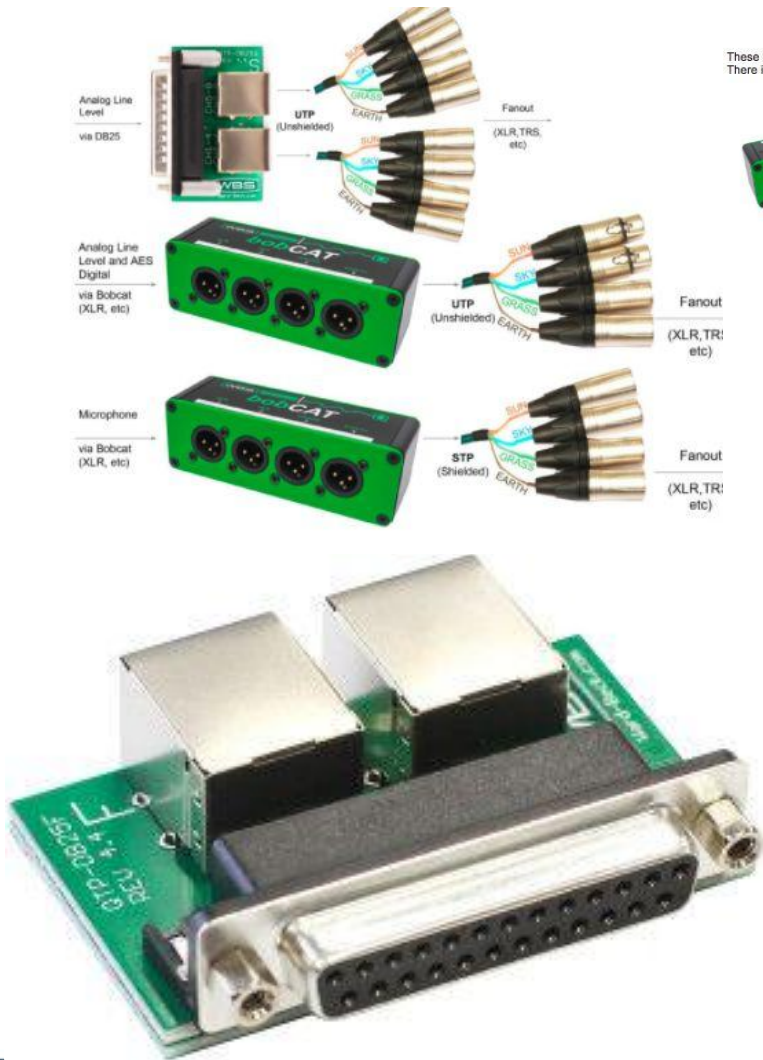
BobCat XLR BreakOut Box Cat5 Cat
6 Ca...



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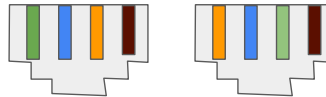
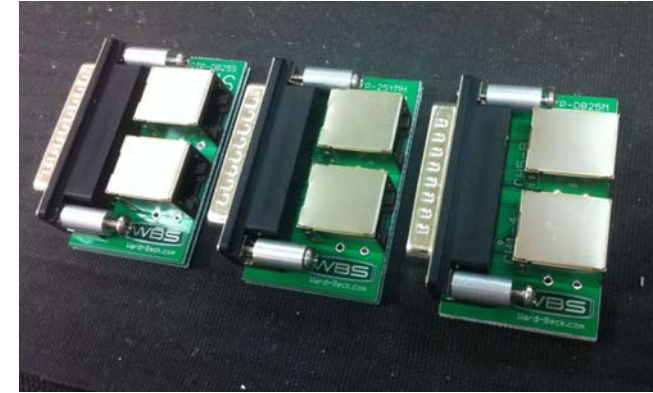
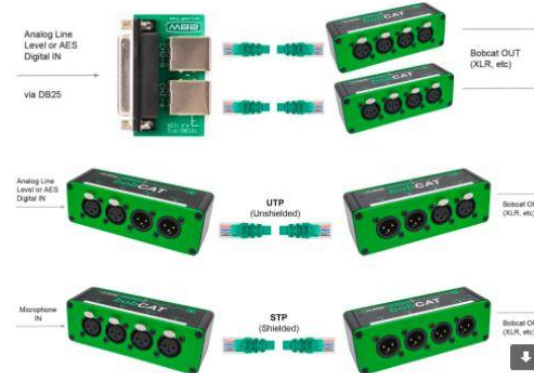


BobCat breakout boxes

These breakout boxes help you move audio via Category Networking cables, by providing RJ45 to 4 x XLR connections. There is a white label area on each box, for labelling each connection.



Examples of moving audio using Bobcats

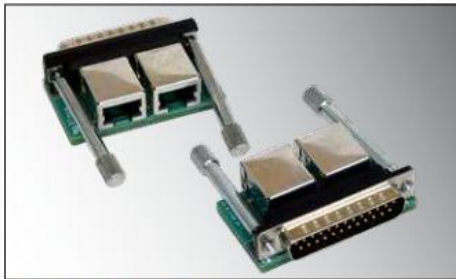


particularly when paired with our CVS LK CAT6 STP cable. Other hybrid solutions are also offered with various cable configurations. For example, our CVS LK 1CAT6S 12/3 cable, which pairs a 12 AWG / 3 conductor power line with a shielded Cat 6 cable for "driveline" type applications.

- Multiple signals down a single Cat 5/6 Cable
- Supports DMX, Analog Audio, and AES Digital Audio
- Hybrid solutions available including 10/100 Ethernet
- 4 total channels if using shielded cable
- "Fan," "barrel," PCB and stage box type configurations
- Custom configurations available

Widget PCBs

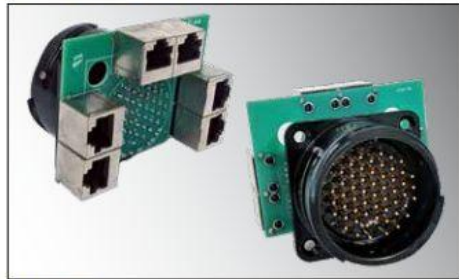
Link PCB Widgets are reliable and cost effective solutions for using standard CAT cabling to take advantage of multipin connectors as well as typical panel mounted XLRs.



DB25 PCB for Tascam Pinout



XLR PCB for Male and Female



LK54 PCB



Widgets

Introducing Link's latest distribution solution, WidgetLink. This new line of distribution products allows the use of standard Cat 5 and Cat 6 cabling to send multiple signals down a single cable. The use of Cat 5/6 cable can be applied to DMX, Analog Audio, Balanced AES3 Digital Audio, and even hybrid combinations including 10/100 Ethernet.



1, 2, 3, or even 4 discrete signals can be sent down each individual Cat 5/6 cable. Shielded cable is required for applications using phantom power, 4 discrete signals, and/or hybrid combinations. Because of its low loss characteristics, Cat 5/6 can increase the maximum length in many applications. For example, balanced AES3 signals have a typical distance limit of 100 meters on standard 110 ohm twisted-pair type cable, but can travel up to 300 meters on Cat 5/6 cable, depending on the equipment being used. In a hybrid configuration, the maximum distance is dictated by the IEEE 802.3u Fast Ethernet standard. For DMX over Cat 5/6 cable, distances of over 500 meters are possible, depending on equipment.

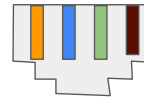
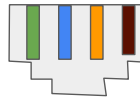


Link's eurocable brand of cable is guaranteed to provide dependable signal integrity using our WidgetLink products, particularly when paired with our CVS LK CAT6 STP cable. Other hybrid solutions are also offered with various cable configurations. For example, our CVS LK 1CAT6S 12/3 cable, which pairs a 12 AWG / 3 conductor power line with a shielded Cat 6 cable for "driveline" type applications.

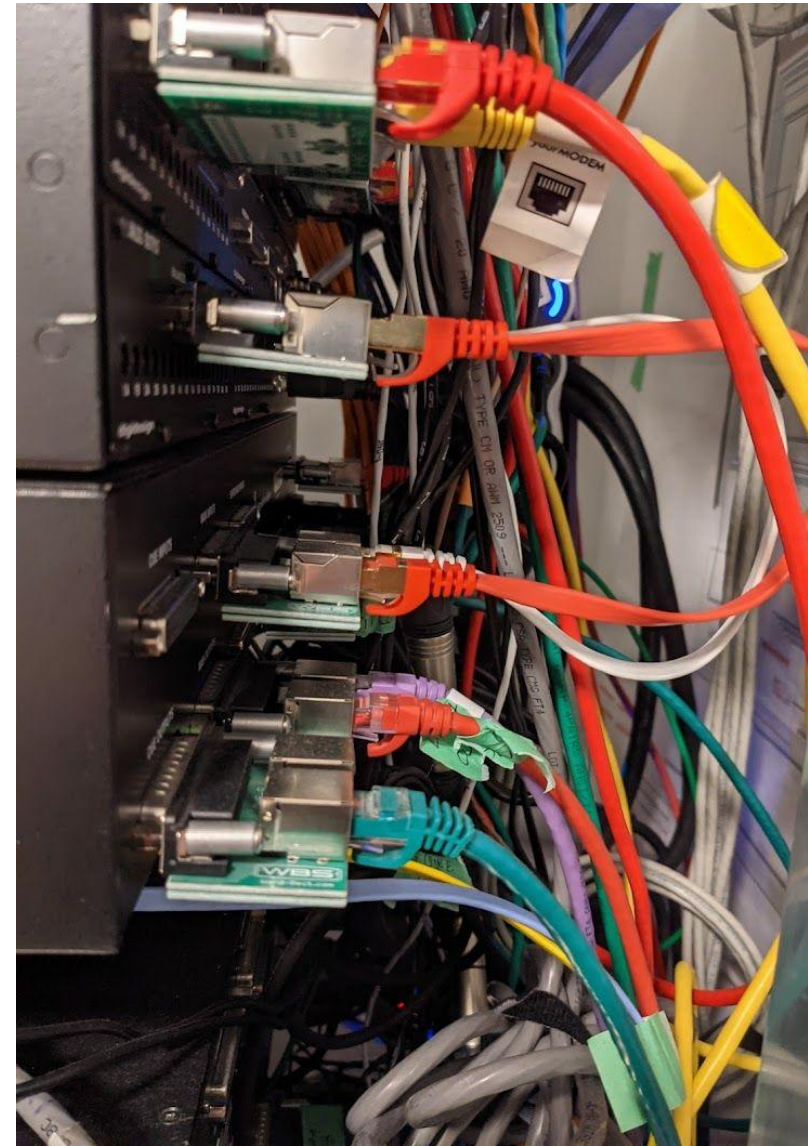
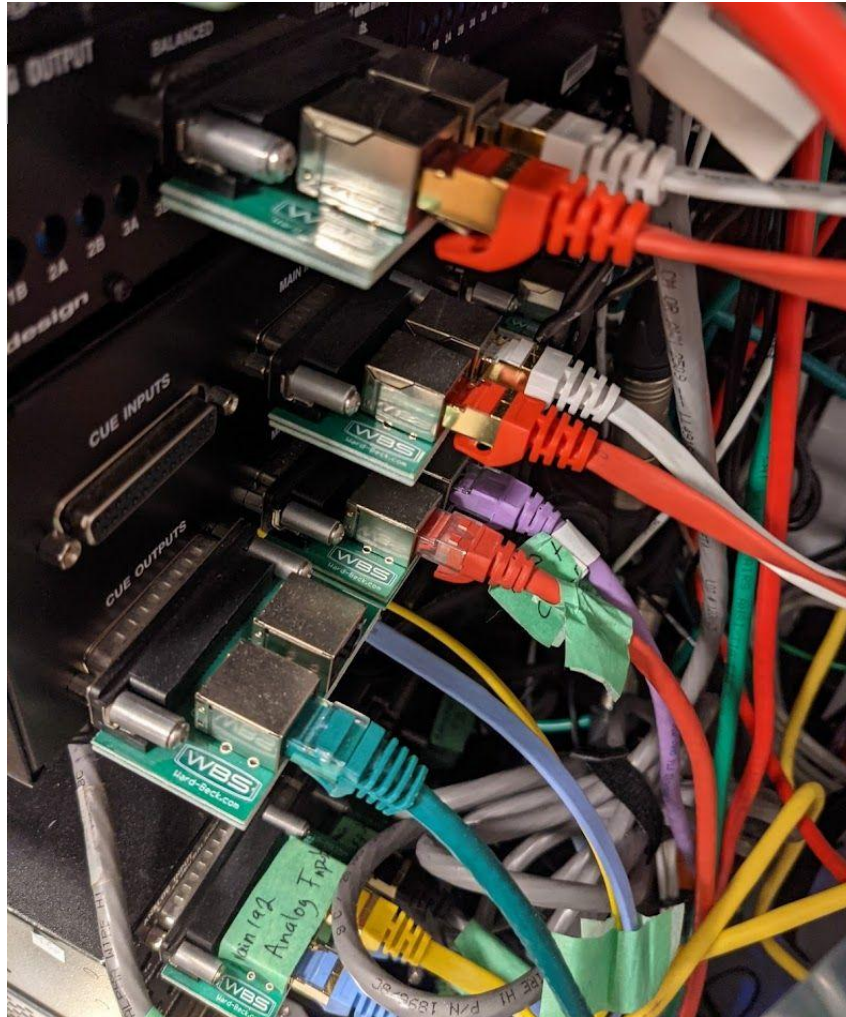
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- Hybrid solutions available including 10/100 Ethernet
- 4 total channels if using shielded cable
- "Fan," "barrel," PCB and stage box type configurations
- Custom configurations available

All standard versions of Link Widget products are compliant with AES Standard AES72 - Type 1M.

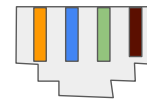
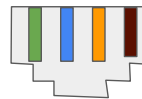
For more information please visit: <http://www.aes.org/standards/blog/2019/7/aes72-2019-published>



Click it together

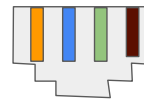
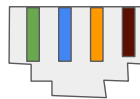


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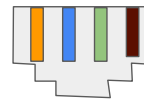
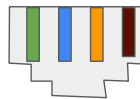


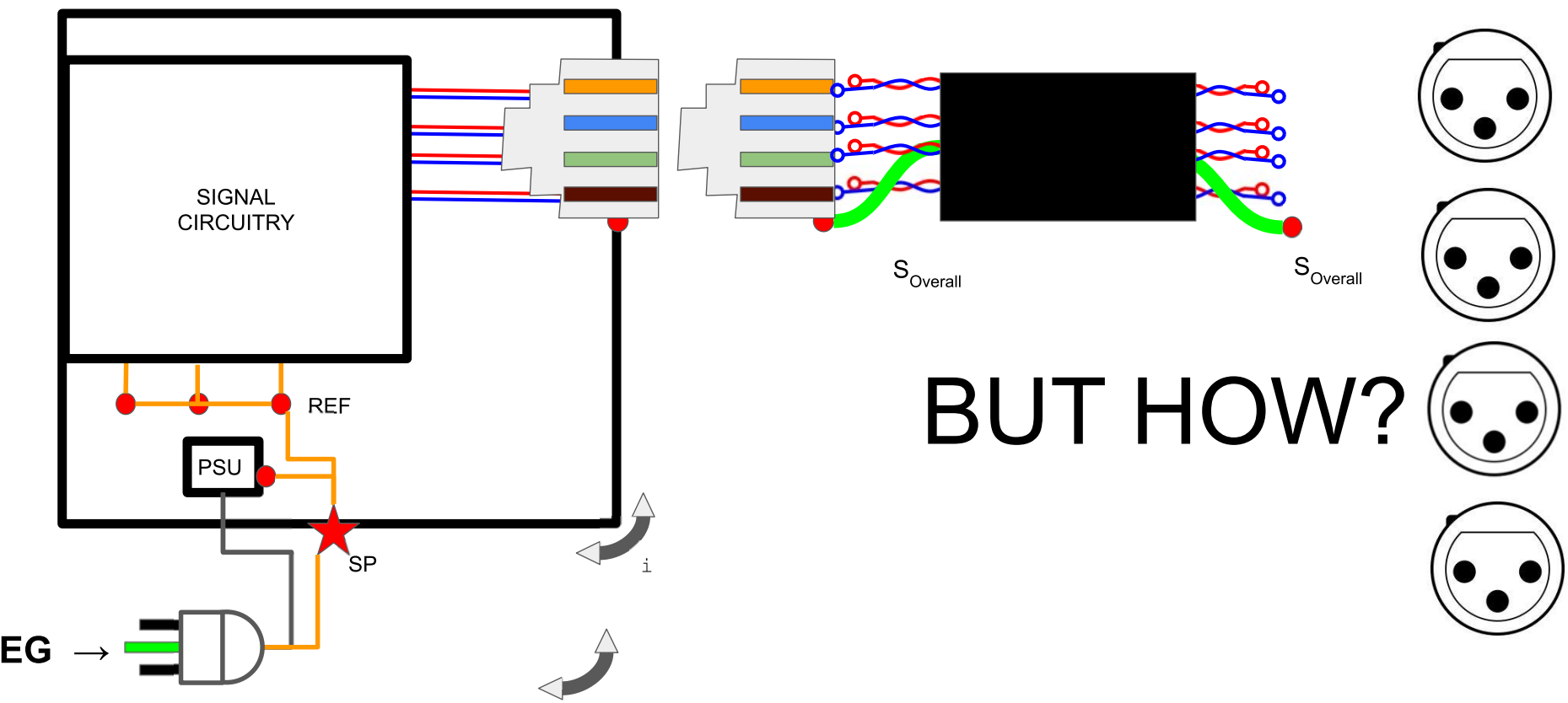




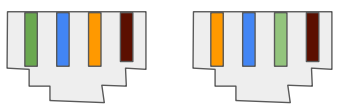
4 channels across 8 pins...

Pin #							
1	2	3	4	5	6	7	8
1 -	1 +	2 -	3 +	3 -	2 +	4 -	4 +
1 +	1 -	2 +	3 -	3 +	2 -	4 +	4 -
1 +	1 -	2 +	3 +	3 -	2 -	4 +	4 -
2 +	2 -	3 +	1 -	1 +	3 -	4 +	4 -
3 -	3 +	2 -	1 +	1 -	2 +	4 -	4 +
3 +	3 -	2 +	1 +	1 -	2 -	4 +	4 -
1 -	1 +	3 -	2 +	2 -	3 +	4 -	4 +
3 -	3 +	4 -	1 +	1 -	4 +	2 -	2 +
4 -	4 +	3 -	2 +	2 -	3 +	1 -	1 +





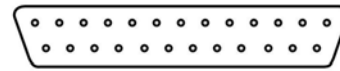
BUT HOW?



Analog and AES3 Digital Audio



AES14



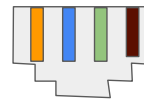
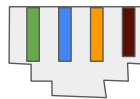
AES59



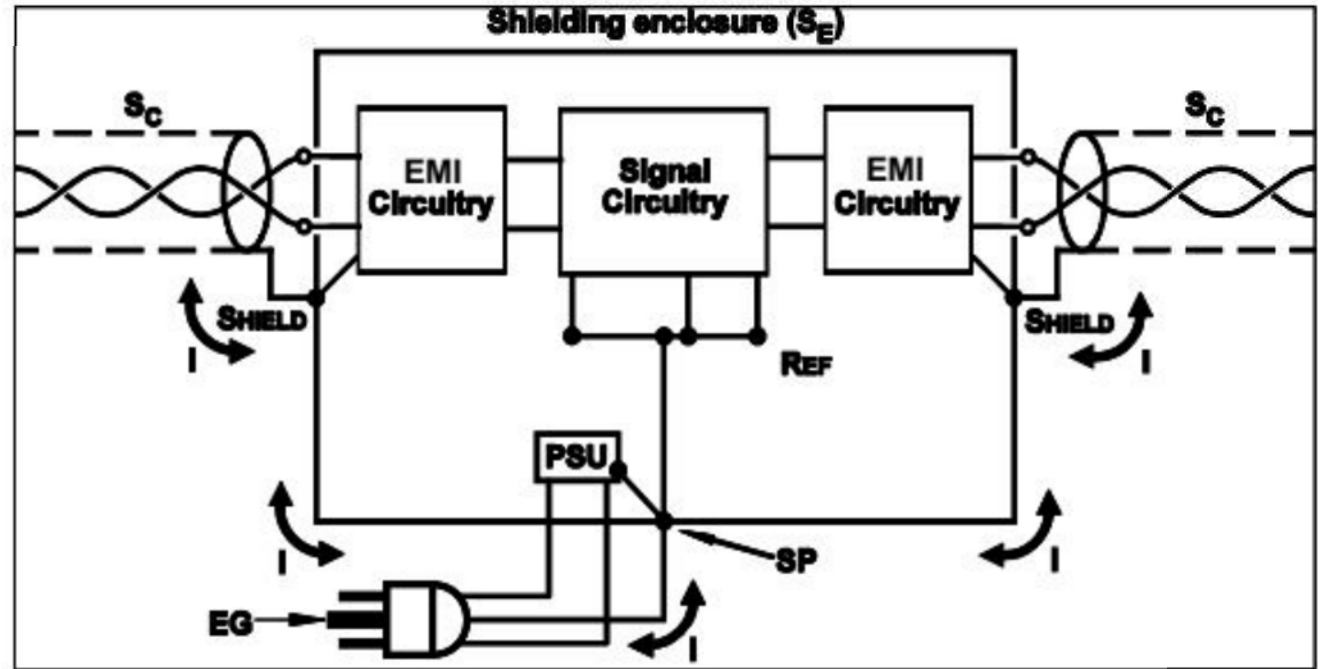
AES14id



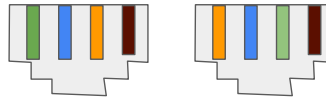
AES72



AES 48 Standards: FULL!! BEST PRACTICES FOR DESIGNERS



KEY			
REF	Signal reference	I	Shield currents
EG	Equipment ground	S_E	Shielding enclosure
PSU	Power supply unit (typical)	S_C	Cable shield
SP	Star point	SHIELD	Designated shield contact



youtube.com/watch?v=eDa4DBxjrv8



Top chat rep

Standards Webinar: Analog System Interconnection Standards

352 views • Streamed live on Jul 26, 2021

👍 25 💬 0 ➦ SHARE ⌵ SAVE ...



Audio Engineering Society, Inc.
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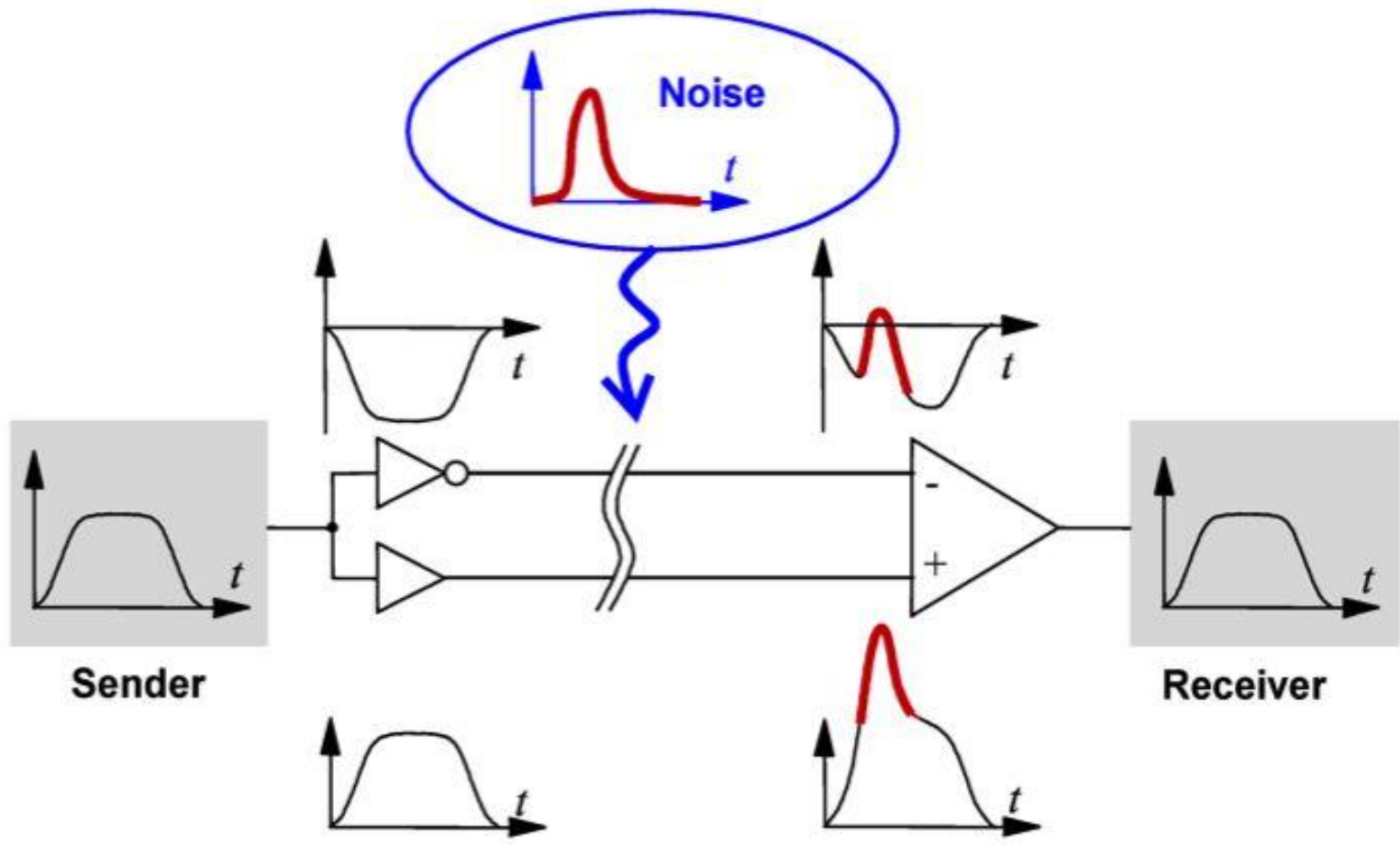
- All
- Personalized
- None

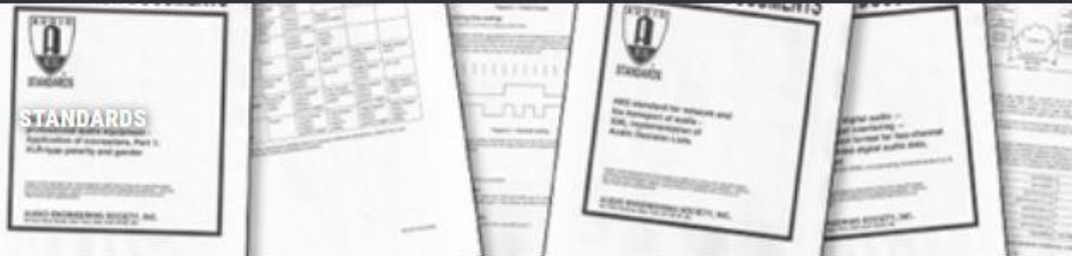
3 Comments ≡ SORT BY

Add a public comment...



Common-Mode Rejection Ratio





SC-05-05 MEETING, ONLINE, 2020-05

Report of the meeting of the SC-05-05 Working Group on Grounding and EMC Practices held online, 2020-05-26

The meeting was convened by chair Anthony Kuzub.

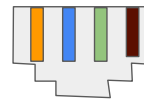
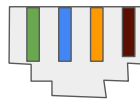
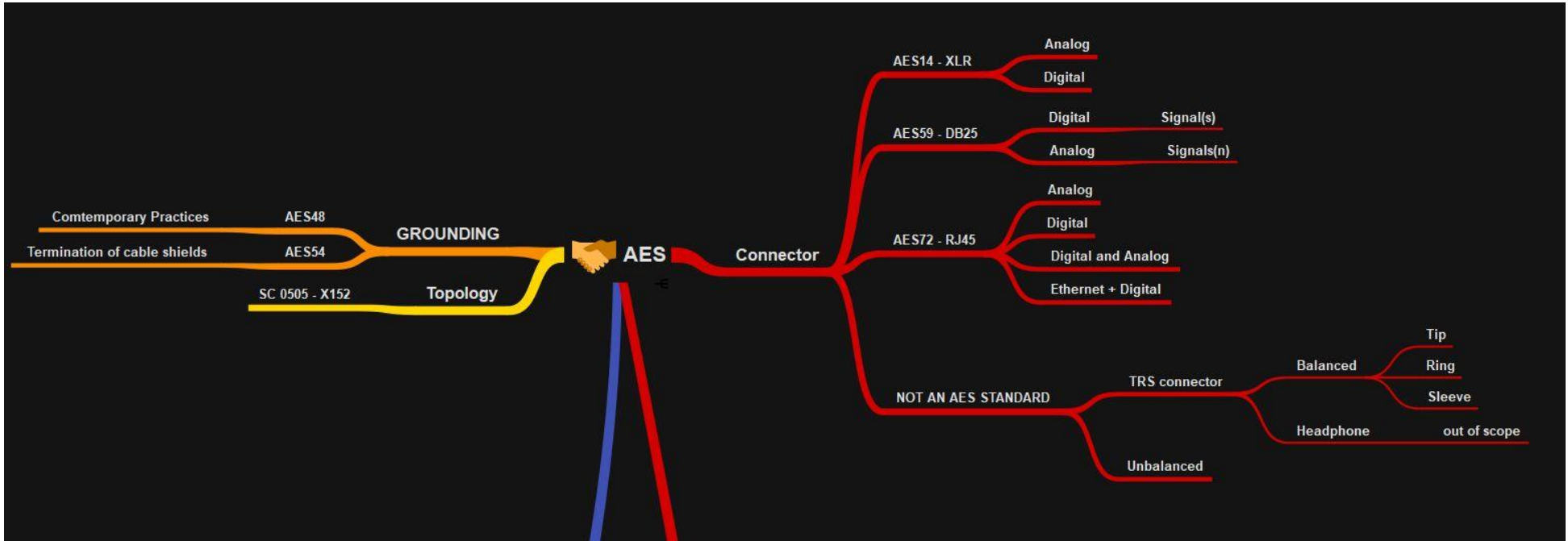
In attendance were Richard Cabot, Bruce Olson, Anthony Kuzub, Bill Whitlock, David Robb, Jim Meyer, Joel Britto, Michael Fuechsl, Paul Treleaven, Swen Muller.

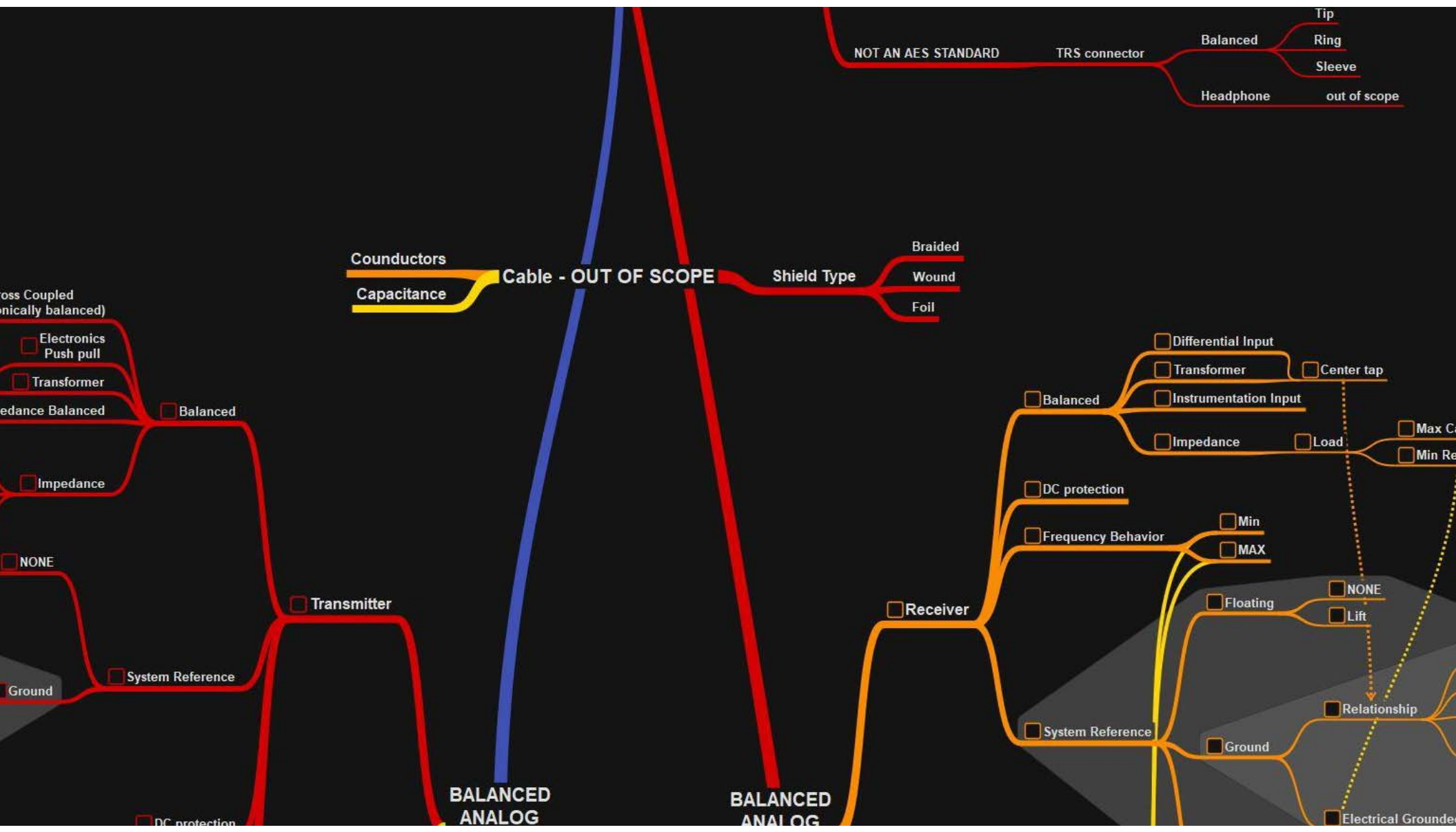
The formal notice on patent policy was read.

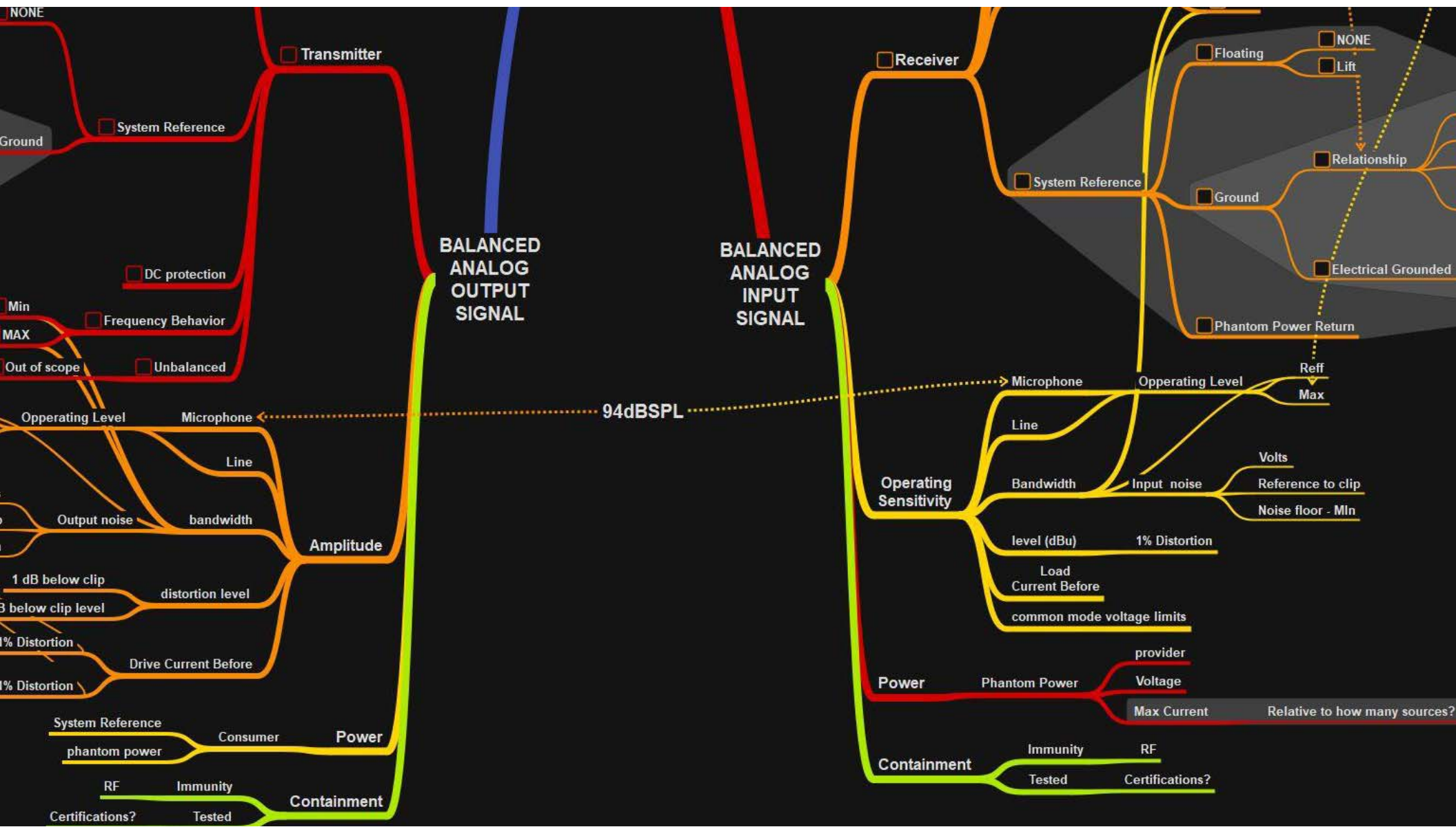
The meeting agenda was accepted as written.

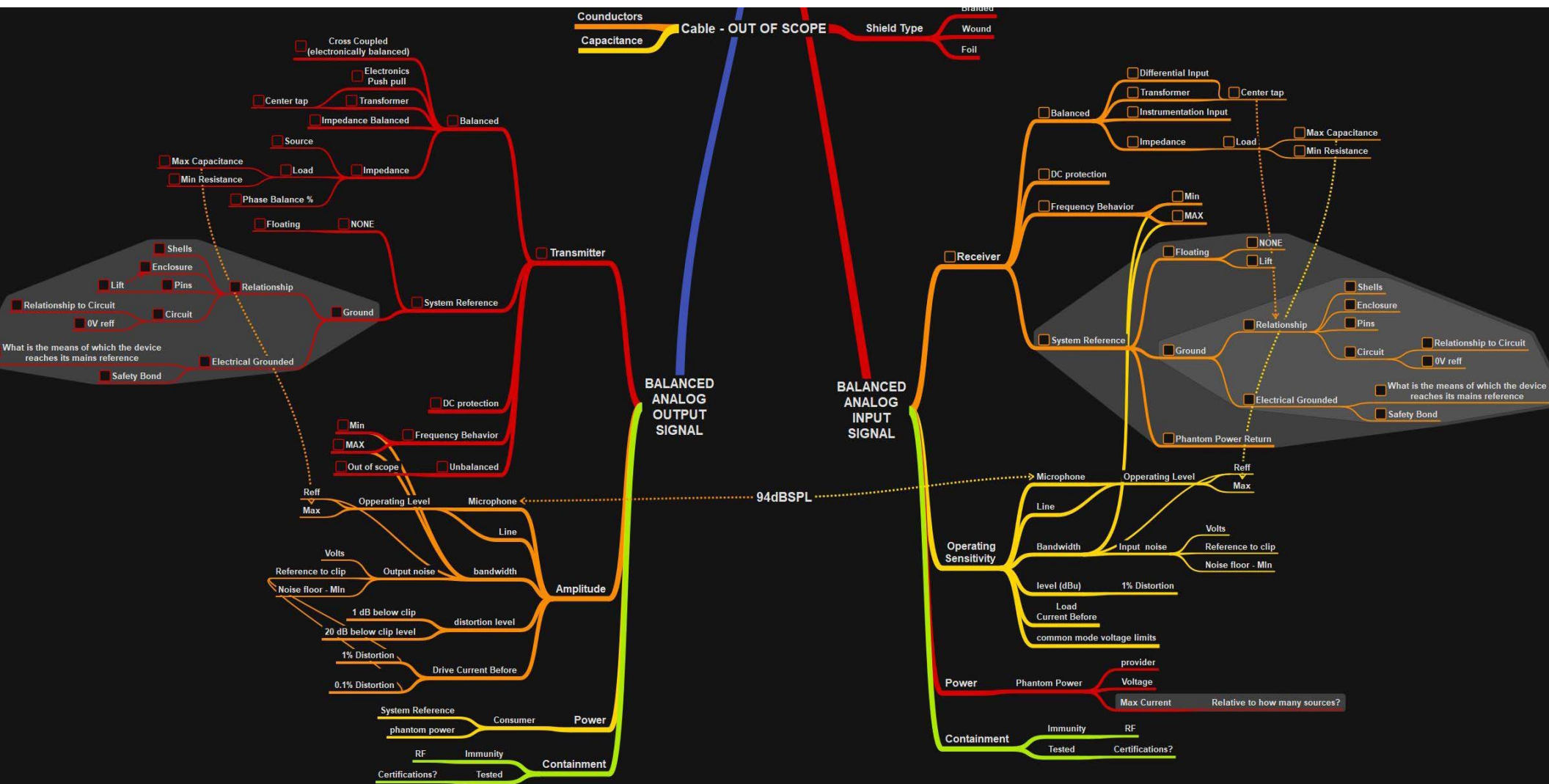
Minutes of previous meeting in Dublin, Ireland, 2019-03-21 were approved.

Projects assigned to this group but not mentioned here had no action requested or required - see www.aes.org/standards/meetings/project-status.cfm for details.



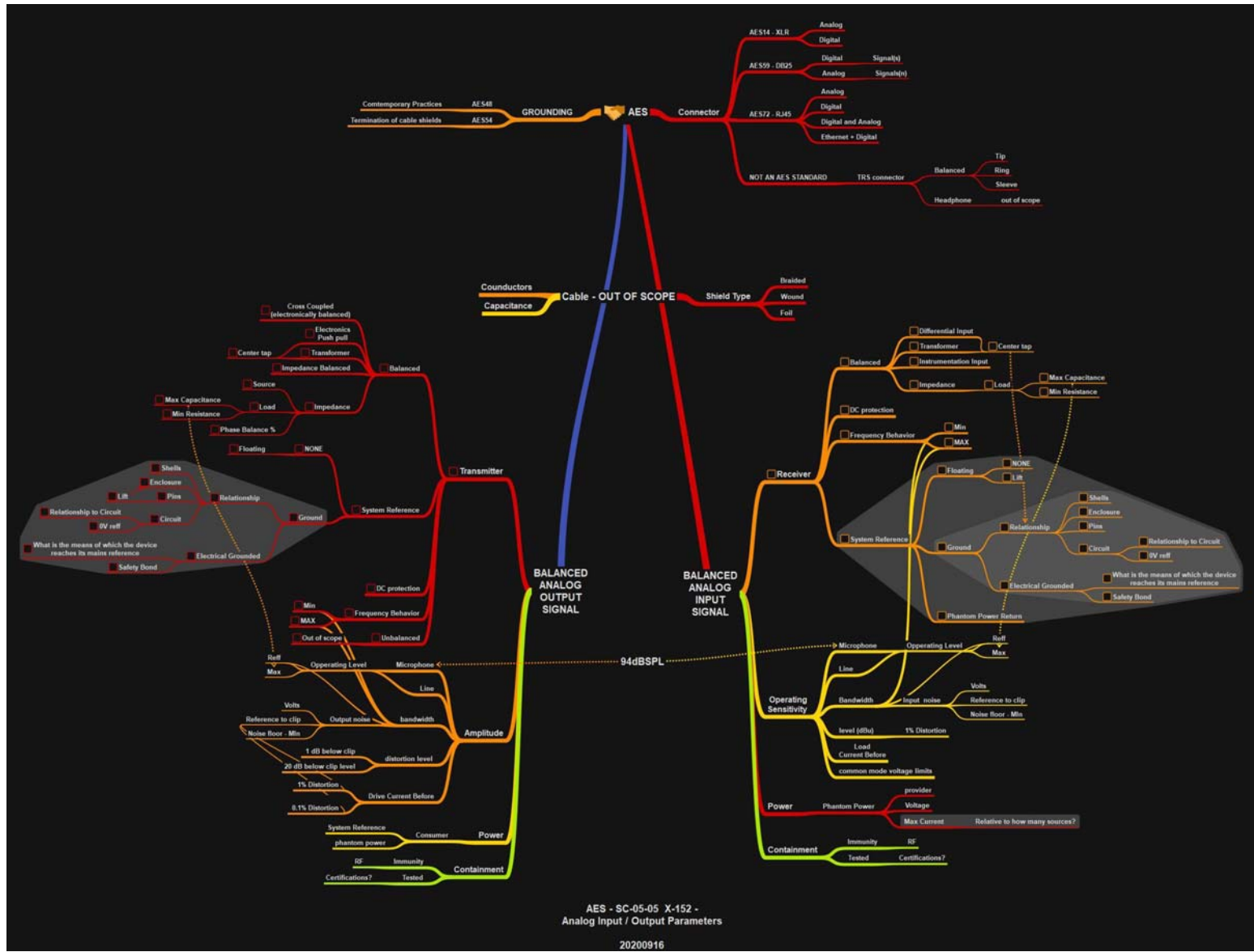






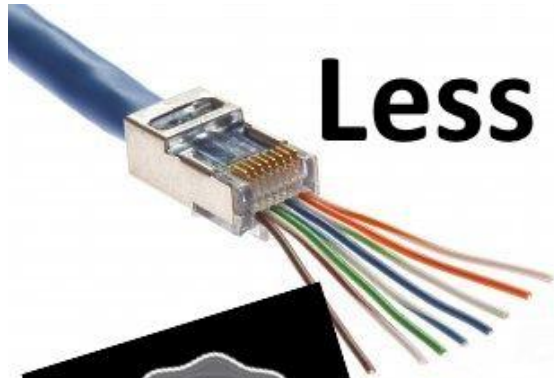
AES - SC-05-05 X-152 -
Analog Input / Output Parameters

20200916



AES - SC-05-05 X-152 - Analog Input / Output Parameters

20200916



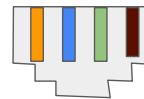
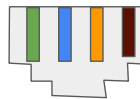
Less Bucks, MBA.



< \$ - Cable

< \$ - Installation

< \$ - Termination





**1FT FLEXboot Series 24AWG Cat6
550MHz UTP Bare Copper Ethernet
Network Cable - Green**

\$0.73

Product ID: 9846

In Stock: Yes

[add to wish list](#) [remove](#)



**0.5FT FLEXboot Series 24AWG Cat6
550MHz UTP Bare Copper Ethernet
Network Cable - Green**

\$0.59

Product ID: 9843

In Stock: Yes

[add to wish list](#) [remove](#)



**25FT FLEXboot Series 24AWG Cat6
550MHz UTP Bare Copper Ethernet
Network Cable - Green**

\$4.36

Product ID: 9854

In Stock: Yes

[add to wish list](#) [remove](#)



**5FT FLEXboot Series 24AWG Cat6
550MHz UTP Bare Copper Ethernet
Network Cable - Green**

\$1.33

Cold Crimp



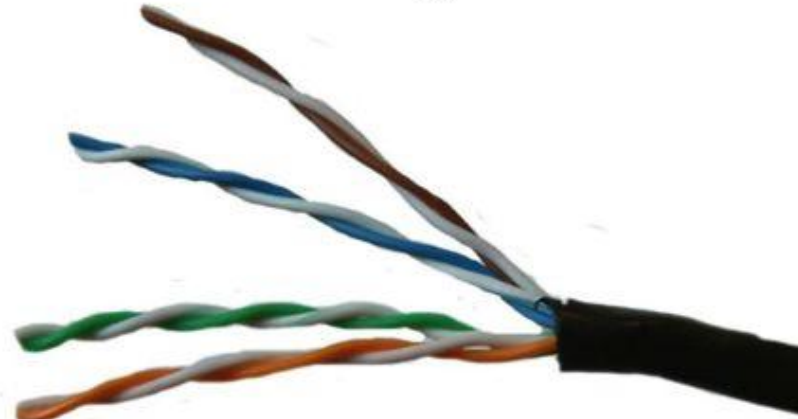
GROWING TREND

- Audio Over I.P.* of Category Cable

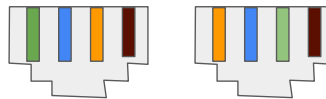
**Independent Pairs*

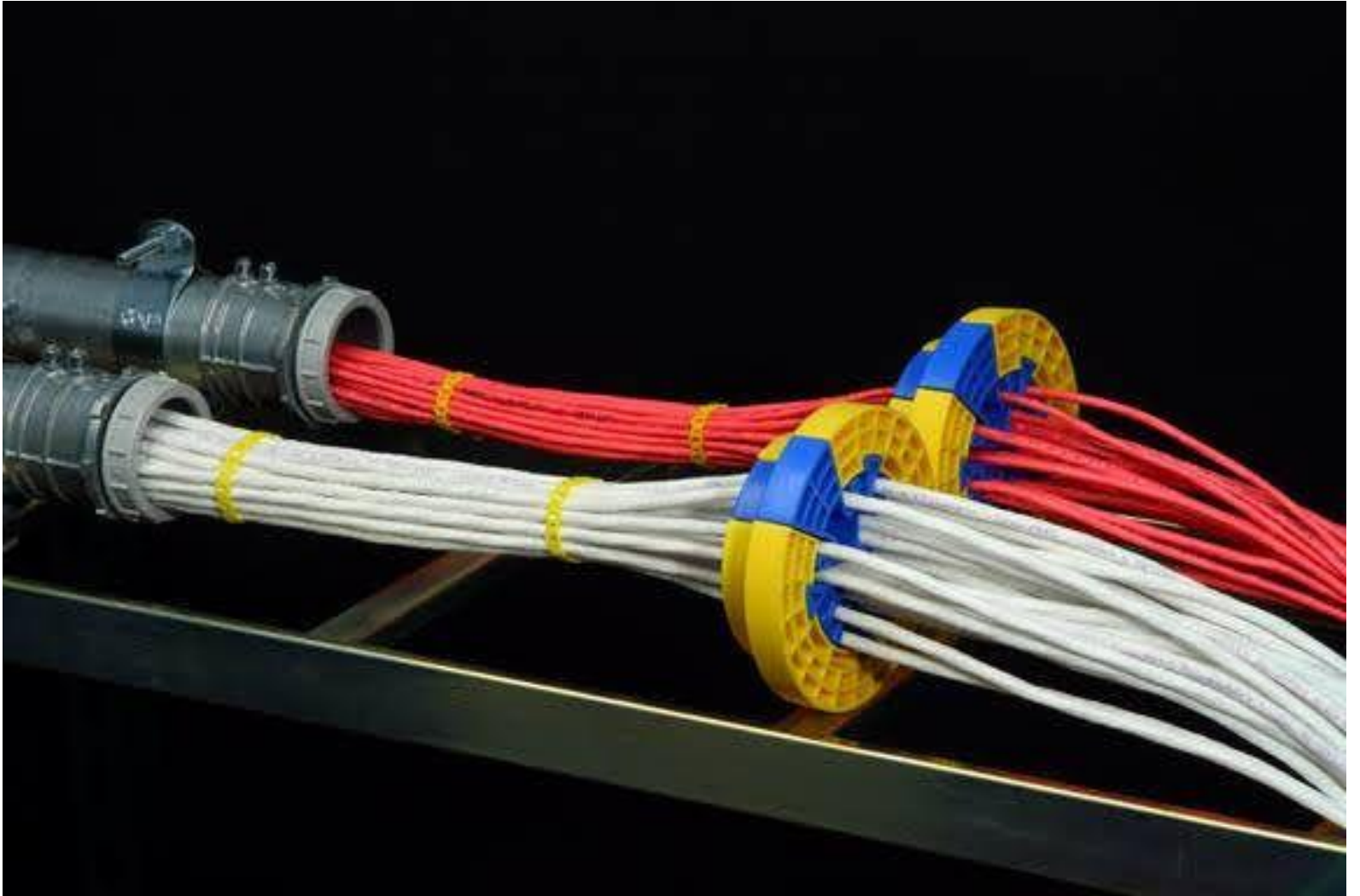
- Using UTP and STP networking cable for Audio signals
- Leaving the patch rooms and entering Pro-Audio

**ANALOG
AND
DIGITAL**

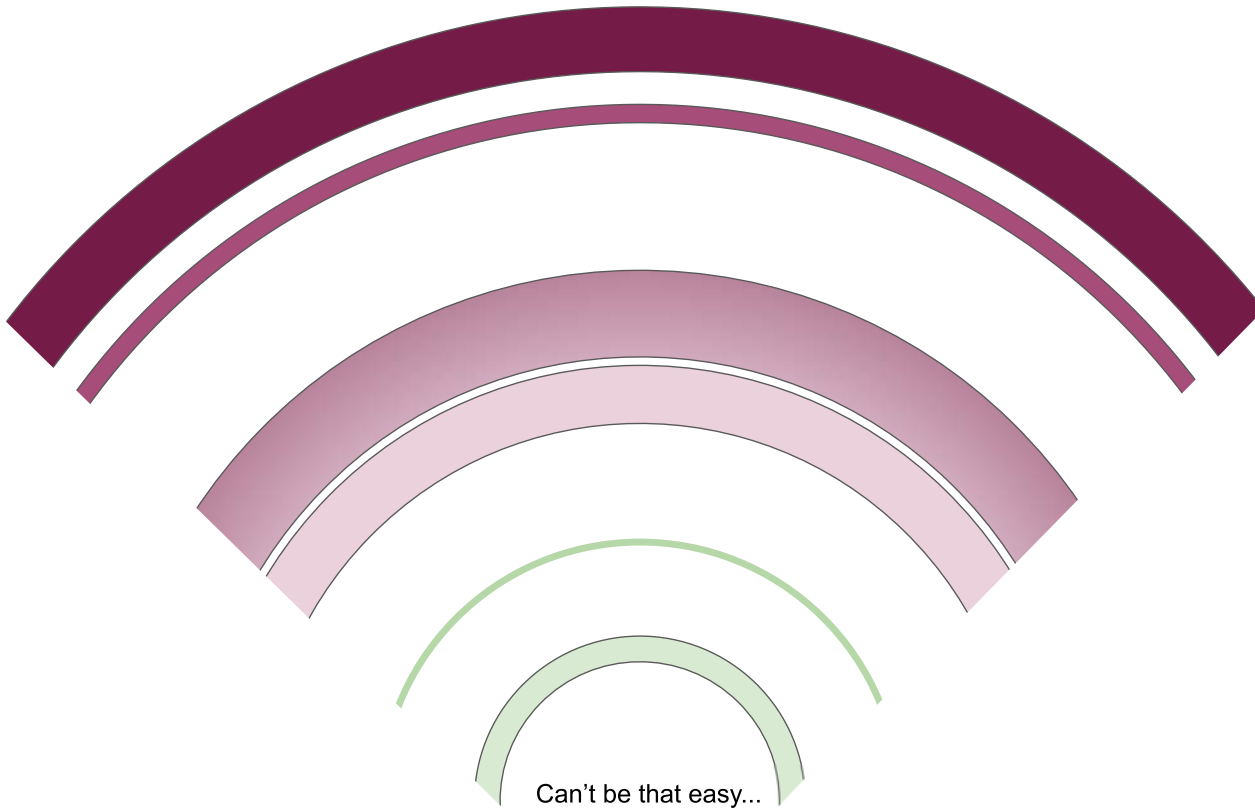


<http://QuadTwistedPair.com> - 2015







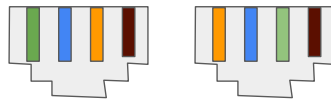


Can't be that easy...

-



WHY DOES THERE NEED TO BE AN AES STANDARD?

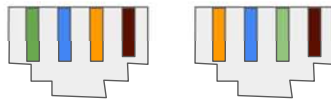


2017-11-17

SC 05 02: X246

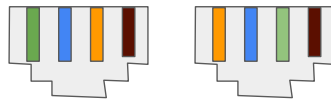
8P8C - RJ45

The **RJ45 - 8P8C** connector and **quad twisted pair** cable has become ubiquitous throughout the **datacom** (data communications) industry for Ethernet connections. This **high-volume usage** has greatly **reduced costs**, making the hardware attractive for other applications.



Consequently several manufacturers have developed schemes to connect 4 balanced analog audio signals or 4 balanced AES3 connections using this hardware.

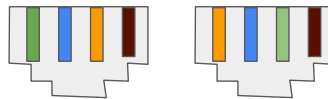
This standard identifies the commercially **available variants** and specifies a labeling scheme so **users may select compatible equipment** or **takes steps to alleviate the problems.**



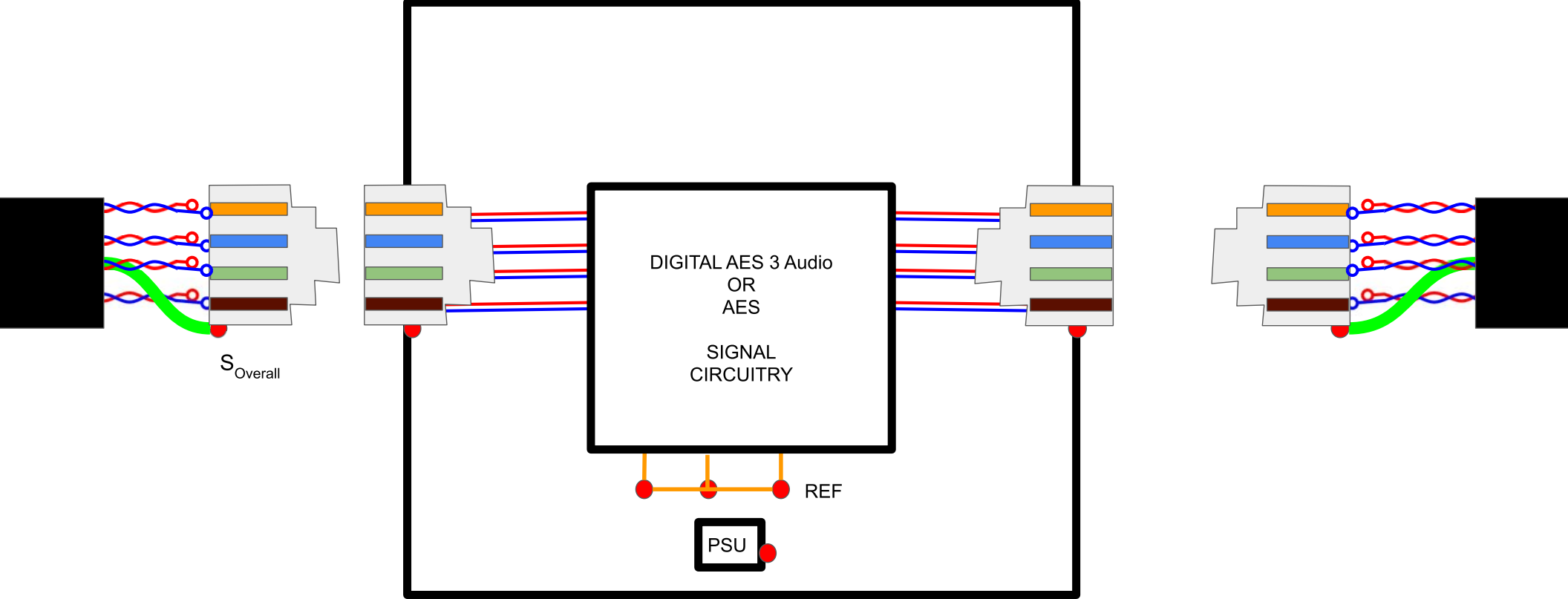
THE AUDIO ONION

**“The deeper you get into the problem,
and the more layers you discover,
the more you want to cry”**

- PIN 1 problem
- Bad Electrical Wiring
- Ground loops
- Plastic XLRs
- DB25: *NEW PIN 2,16,5,19,8,22,11,25 problem



SHIELDING enclosure (S_E)



CAT Cable In Audio

- Different Twists per Meter on each Channel
- $\approx 100\Omega$ impedance (within +/-20% spec of AES)
- Solid core for Installations
- Stranded for “temporary installation”

tia

4.7 Recognized cabling

The recognized media, which shall be used individually or in combination, are:

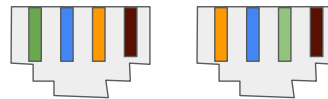
- a) 100-ohm balanced twisted-pair cabling (ANSI/TIA/EIA-568-B.1 and ANSI/TIA/EIA-568-B.2);

4.9 Grounding and bonding considerations

Grounding and bonding systems are an integral part of the signal or telecommunications cabling system. In addition to helping protect personnel and equipment from hazardous voltages, a proper grounding and bonding system will improve the electromagnetic compatibility of the cabling system. Improper grounding and bonding can allow induced voltages which can disrupt signal transmission. The media should be chosen or be designed to meet the specified transmission performance in the environment (see annex F). The telecommunications grounding and bonding system shall meet ANSI-J-STD-607-A requirements.



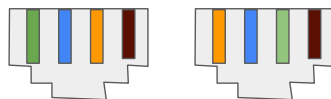
Anthony Peter Kuzub
AES72 - QTP 4 Everyone!



EXPLORING QUAD TWISTED PAIR

Well established Networking cable -

- CAT 3 – 16MHZ – 10BASE-T - Dead
- CAT 4 – 20MHz – Token Ring - Dead
- CAT 5- UTP - 100MHz – Dead
- CAT 5 – STP - 100MHz – Dead
- CAT 5E – (Enhanced) – 100MHz – **GLOBAL ABUNDANCE**
- CAT 6 - 250MHz – UTP - 10GBASE-T Ethernet – Growing – Low Return Loss
- CAT 6A – 500MHz - F/UTP – U/FTP - 10GBASE-T Ethernet
- CAT 6E - NO SUCH THING!
CAT 6 is backwards compatible to all CAT 5 devices
- CAT 7 and 7A – 600–1000Mhz –
- CAT 8 + - 1600MHz – in development





UTP



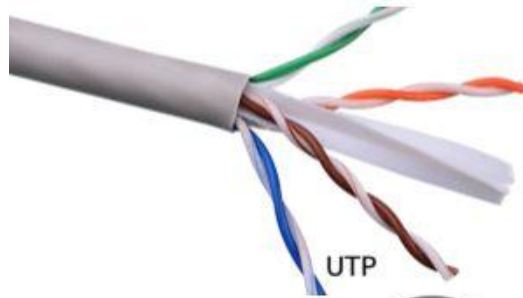
F/UTP



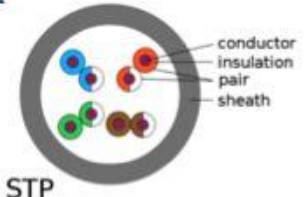
S/FTP



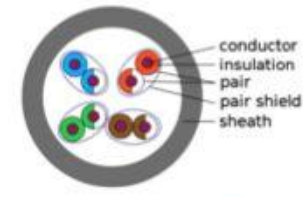
SF/UTP



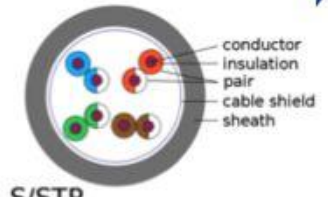
UTP



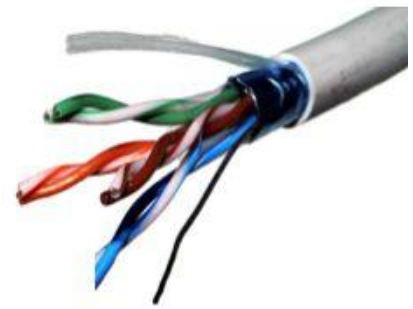
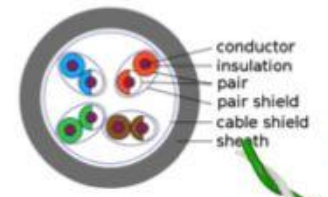
STP



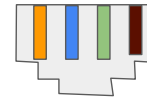
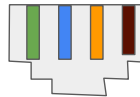
S/UTP



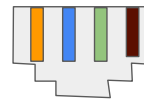
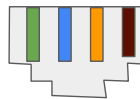
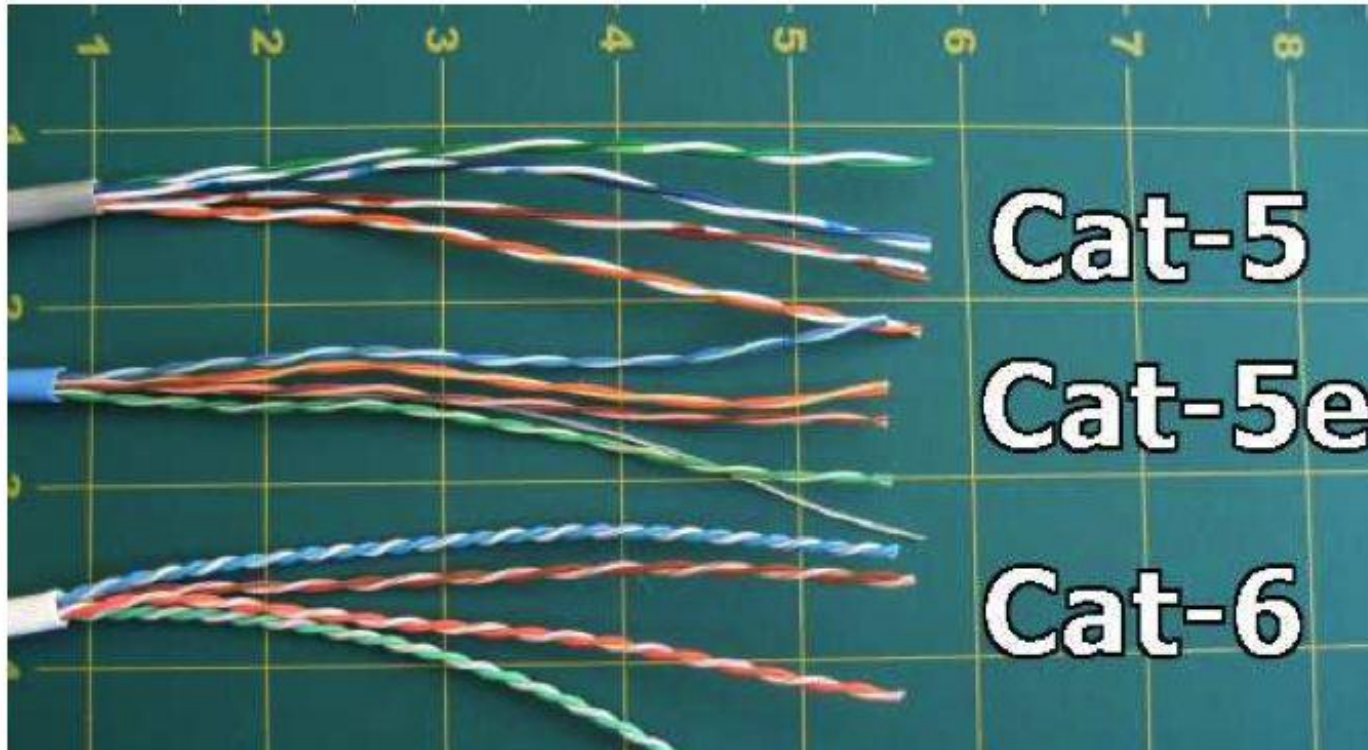
S/STP



<http://QuadTwistedPair.com> - 2015



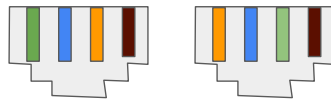
Twisted Tightly Together, Then
Twisted Together Throughout The



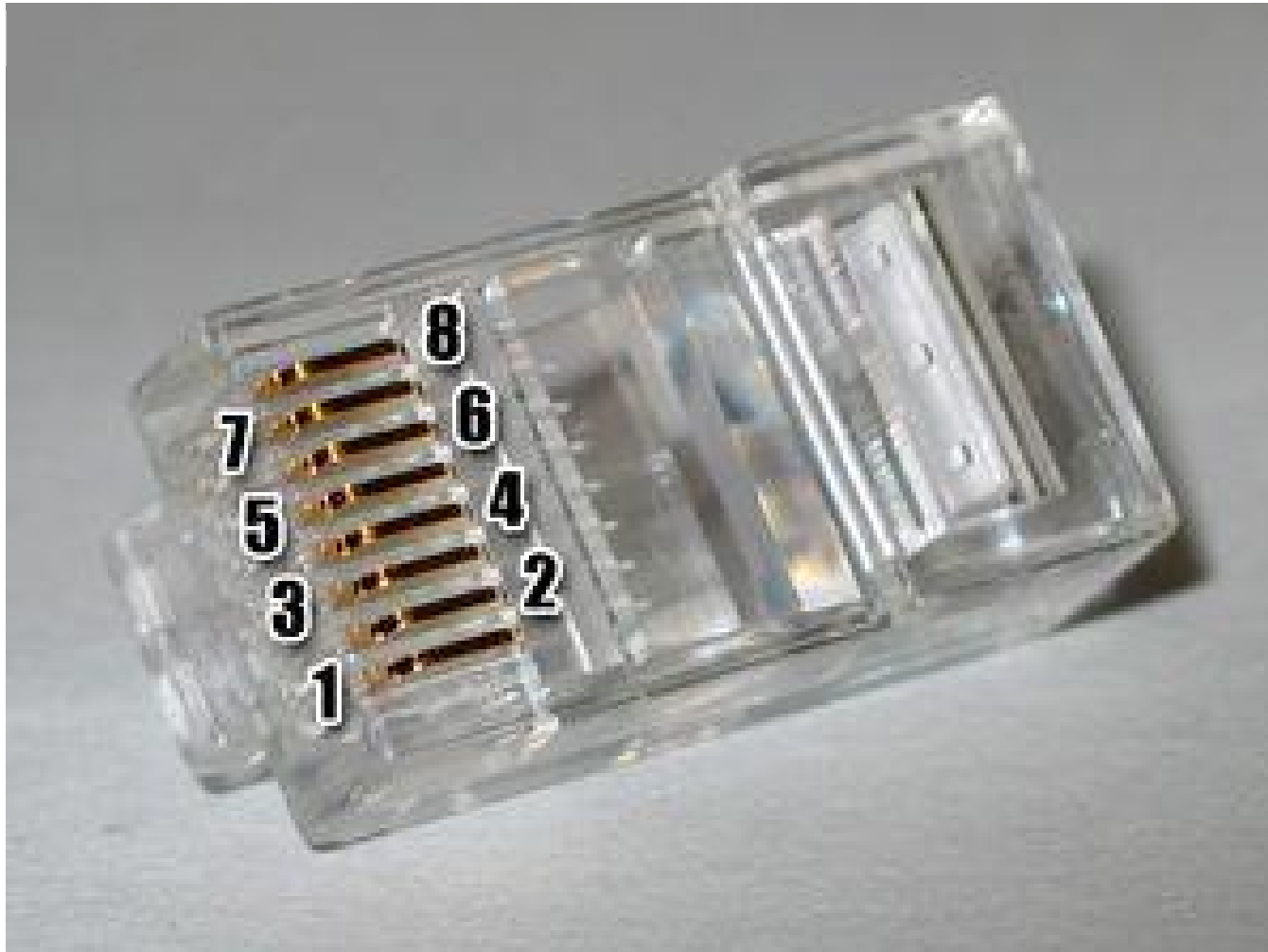
Quad Twisted Pair

Quad twisted pair (QTP) cables contain 4 pairs of conductors, each of which form a single circuit.

Each pair are twisted together in order to cancel out electromagnetic interference (EMI) from external sources.
QTP cables may be shielded or unshielded.

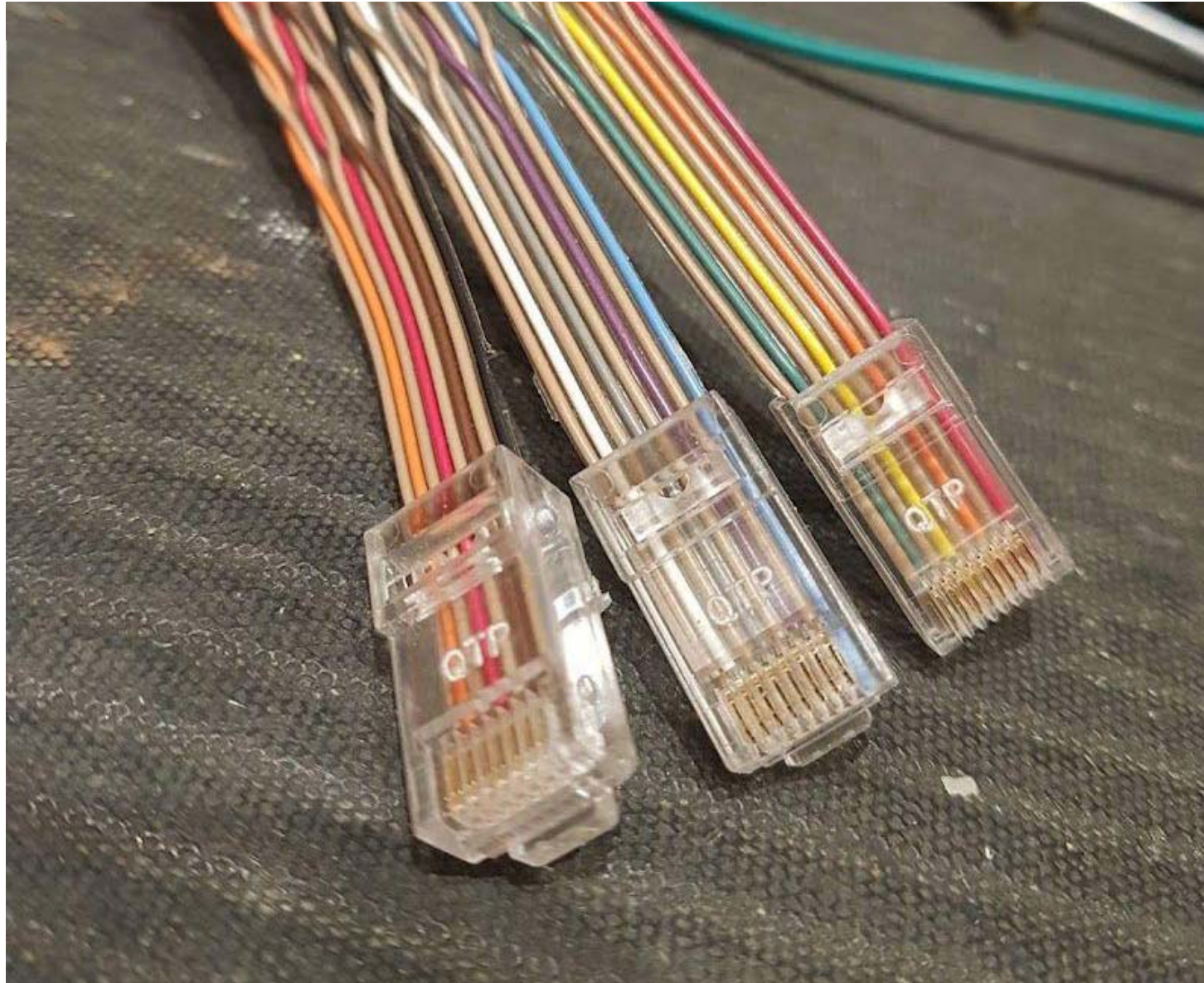


Pinouts...

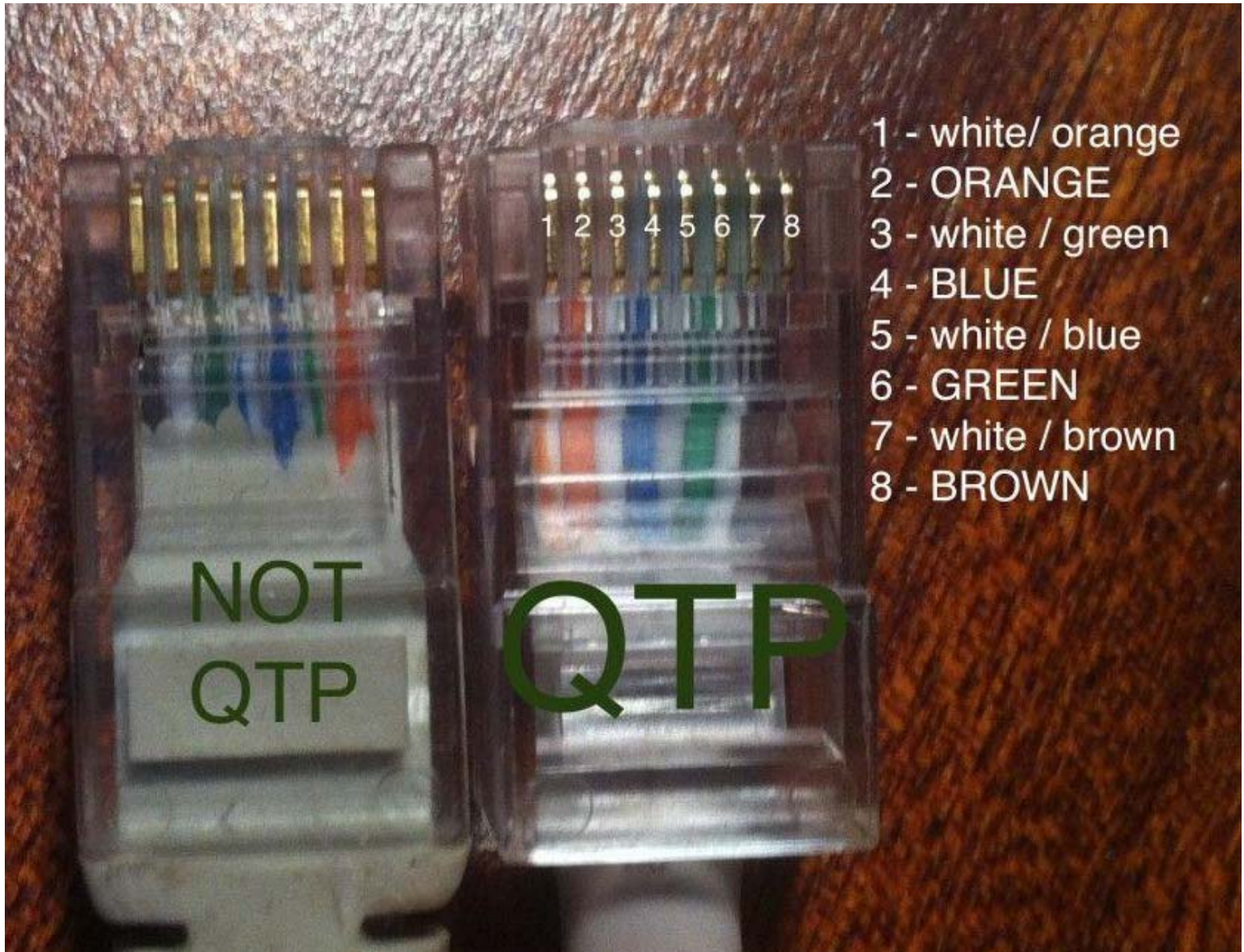


We wish...

IDEALY



Be careful



A.2 Connector pin numbering

The RJ45 connector pin numbering used within this document is illustrated in Figure A1.

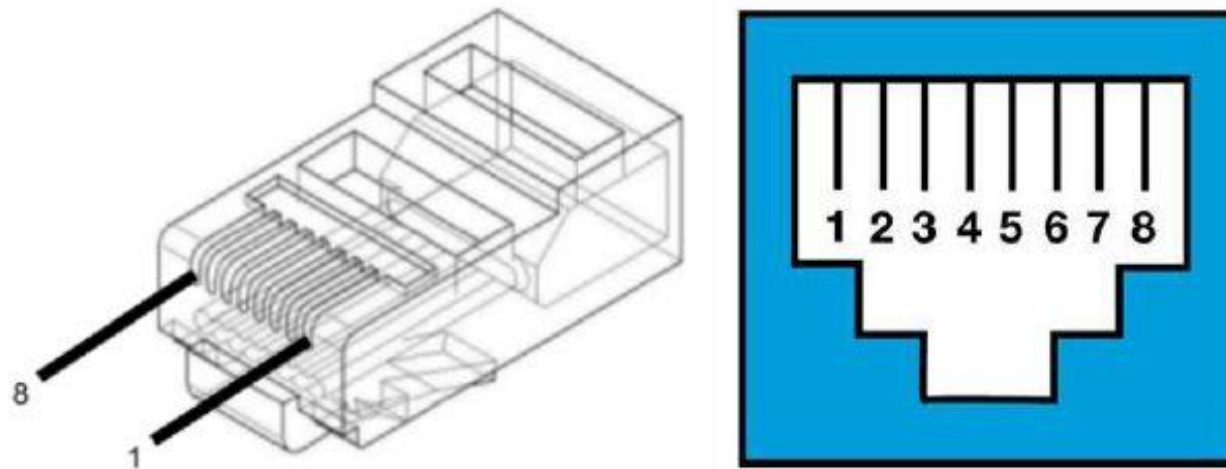
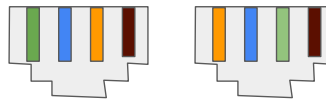


Figure A1 – Connector pin numbering, plug (left) and jack (right)

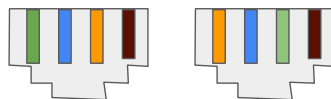


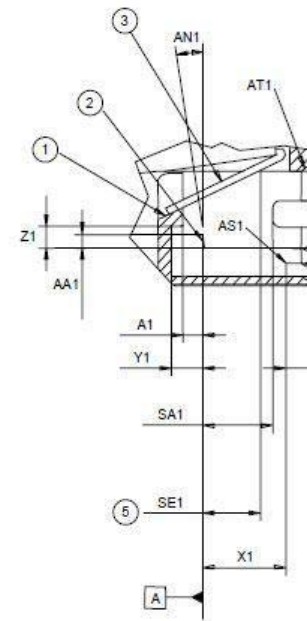
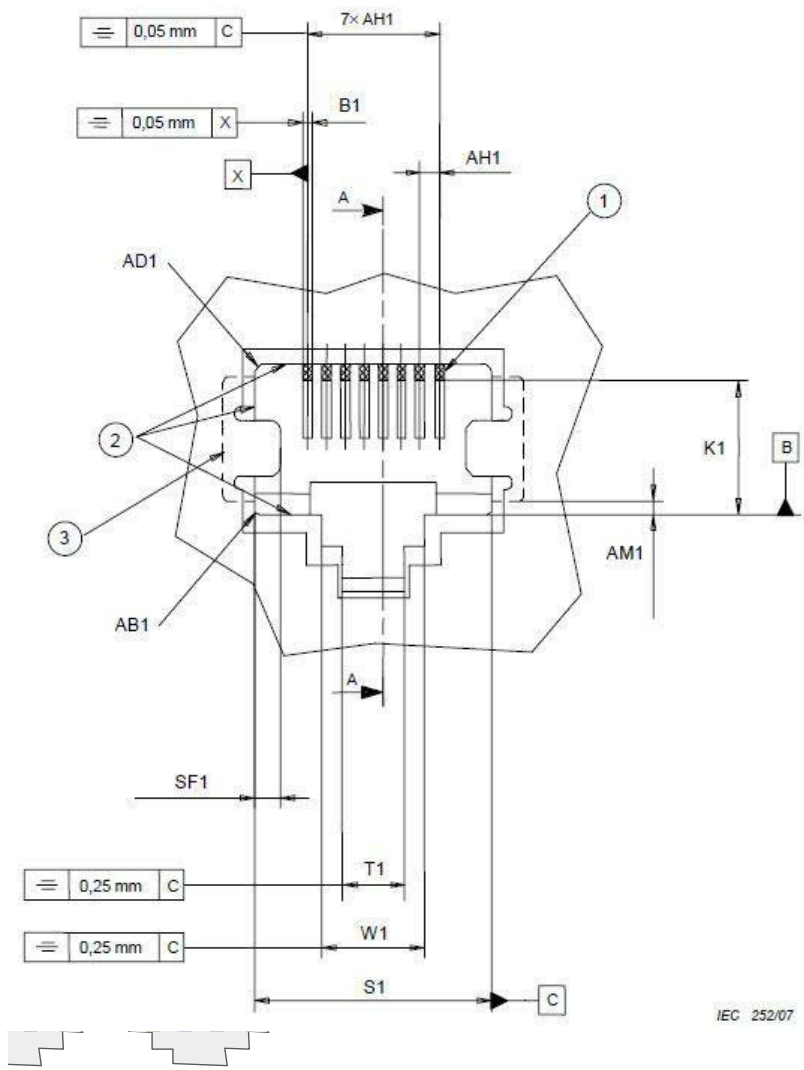
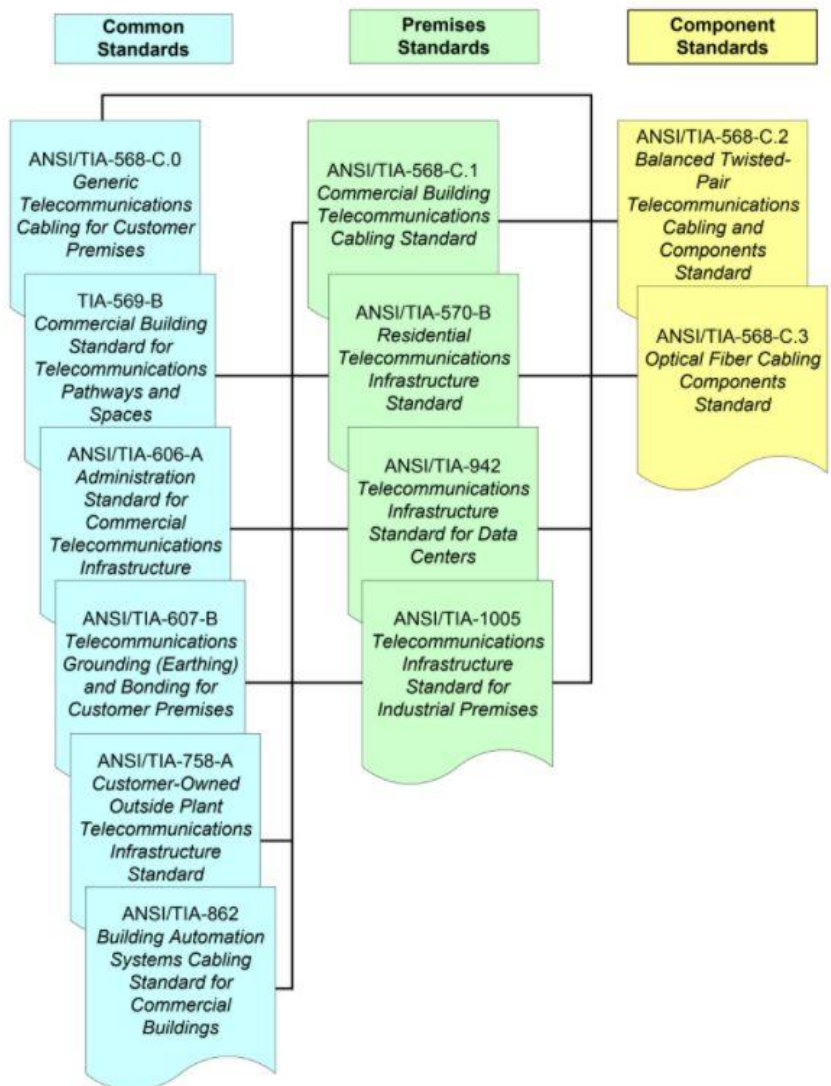
Officially recognized types of registered jacks

Code	Connector	Usage
RJA1X	225A adapter	Connector for a modular plug to a four-prong jack
RJA2X	267A adapter	Connector for splitting one modular jack to two modular jacks
RJA3X	224A adapter	Connector for adapting a modular plug to a 12-prong jack
RJ2MB	50-pin	2-12 telephone lines with make-busy arrangement
RJ11(C/W)	6P2C	Establishes a bridged connection for one telephone line (6P4C if power on second pair)
RJ12(C/W)	6P6C	Establishes a bridged connection for one telephone line with key telephone system control <i>ahead</i> of line circuit
RJ13(C/W)	6P4C	Similar to RJ12, but <i>behind</i> the line circuit
RJ14(C/W)	6P4C	For two telephone lines (6P6C if power on third pair)
RJ15C	3-pin weatherproof	For one telephone line for boats in marinas
RJ18(C/W)	6P6C	For one telephone line with make-busy arrangement
RJ21X	50-pin	Multiple (up to 25) line bridged T/R configuration
RJ25(C/W)	6P6C	For three telephone lines
RJ26X	50-pin	For multiple data lines, universal
RJ27X	50-pin	For multiple data lines, programmed
RJ31X	8P8C	Allows an alarm system to seize the telephone line to make an outgoing call during an alarm. Jack is placed closer to the network interface than all other equipment. Only 4 conductors are used.
RJ32X	8P8C	Like RJ31X, this wiring provides a series <i>tip and ring</i> connection through the connecting block, but is used when the customer premises equipment is connected in series with a single station, such as an automatic dialer.
RJ33X	8P8C	This wiring provides a series tip and ring connection of a KTS line ahead of the line circuit because the registered equipment requires CO/PBX ringing and a bridged connection of the A and A1 lead from behind the line circuit. Tip and ring are the only leads opened when the CPE plug is inserted. Typical usage is for customer-provided automatic dialers and call restrictors.
RJ34X	8P8C	Similar to RJ33X, but all leads are connected behind the line circuit.
RJ35X	8P8C	This arrangement provides a series tip and ring connection to whatever line has been selected in a key telephone set plus a bridged A and A1 lead.
RJ38X	8P4C	Similar to RJ31X, with a continuity circuit. If the plug is disconnected from the jack, shorting bars allow the phone circuit to continue to the site phones. Only 4 conductors are used.
RJ41S	8P8C, keyed	For one data line, universal (fixed loop loss and programmed)
RJ45S	8P8C, keyed	For one data line, with programming resistor
RJ48C	8P4C	For four-wire data line (DSX-1)
RJ48S	8P4C, keyed	For four-wire data line (DDS)
RJ48X	8P4C with shorting bar	For four-wire data line (DS1)
RJ49C	8P8C	For ISDN BRI via NT1
RJ61X	8P8C	For four telephone lines
RJ71C	50-pin	12 line series connection using 50-pin connector (with bridging adapter) ahead of customer equipment. Mostly used for call sequencer equipment.

Legacy of RJ

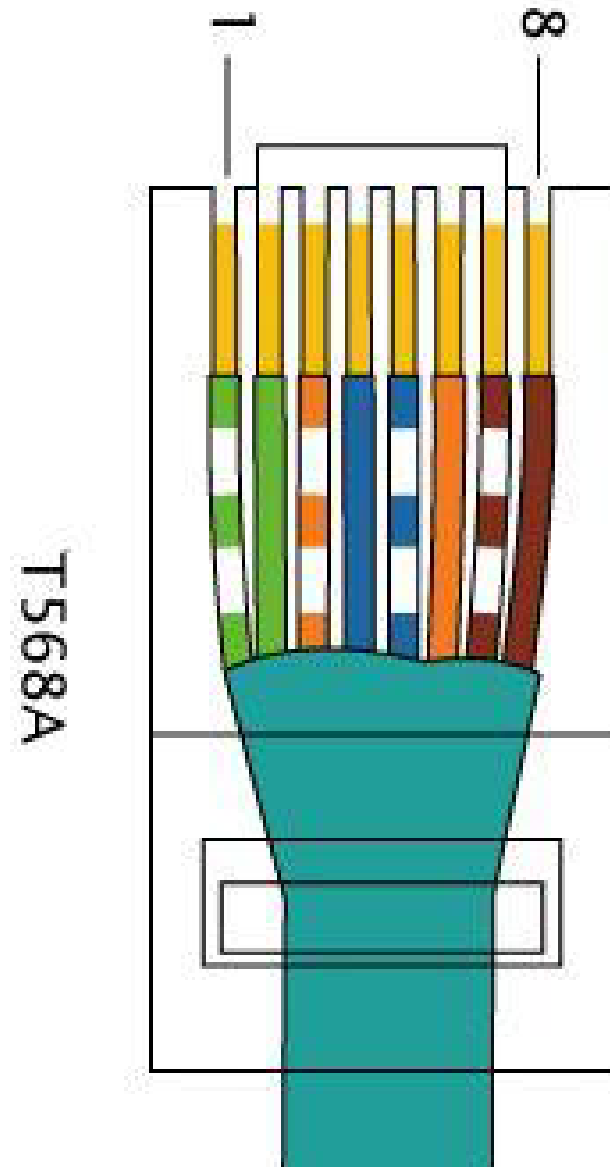
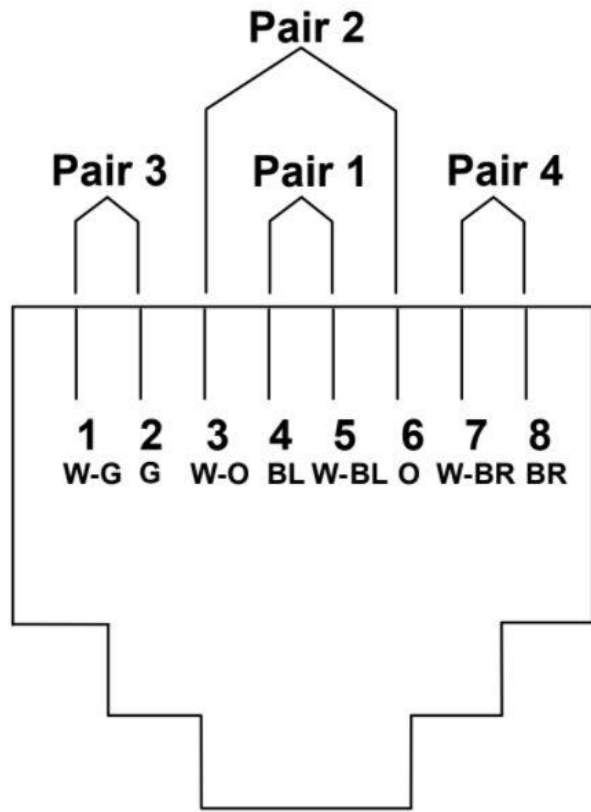
Pin	T568A pair	T568A color	T568B pair	T568B color	10BASE-T/100BASE-TX signal ^[20]	1000/10GBASE-T signal	Wire	Diagram
1	3	 white/green stripe	2	 white/orange stripe	TD+	DA+	tip	 <p>Pin numbering on plug. Connected pins on plug and jack have the same number.</p>
2	3	 green solid	2	 orange solid	TD-	DA-	ring	
3	2	 white/orange stripe	3	 white/green stripe	RD+	DB+	tip	
4	1	 blue solid	1	 blue solid	NC	DC+	ring	
5	1	 white/blue stripe	1	 white/blue stripe	NC	DC-	tip	
6	2	 orange solid	3	 green solid	RD-	DB-	ring	
7	4	 white/brown stripe	4	 white/brown stripe	NC	DD+	tip	
8	4	 brown solid	4	 brown solid	NC	DD-	ring	



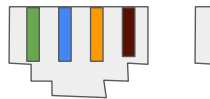


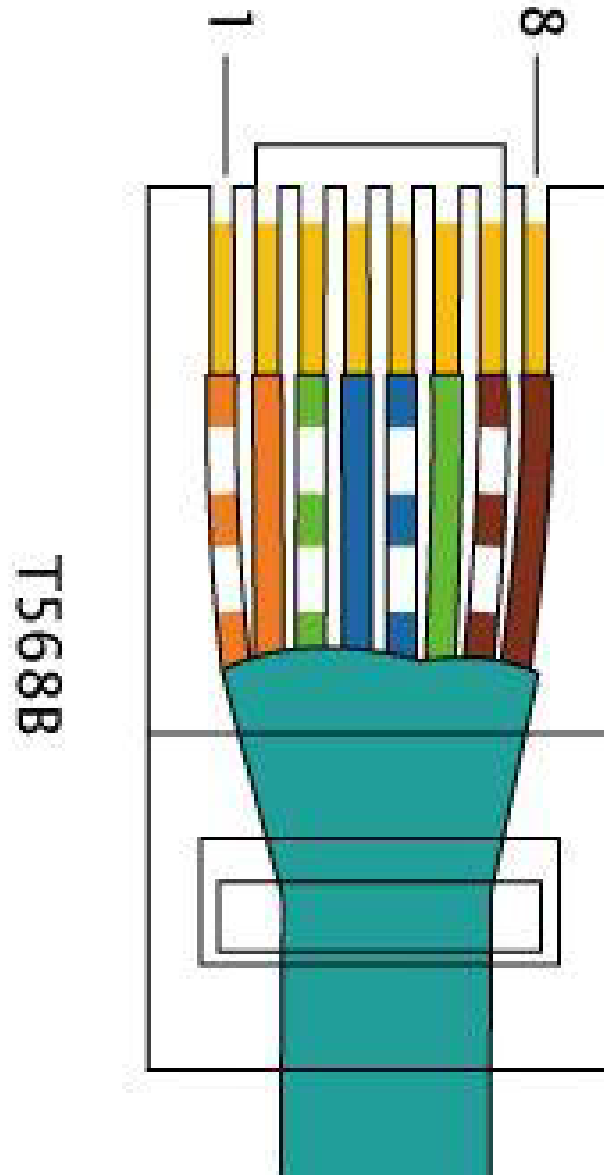
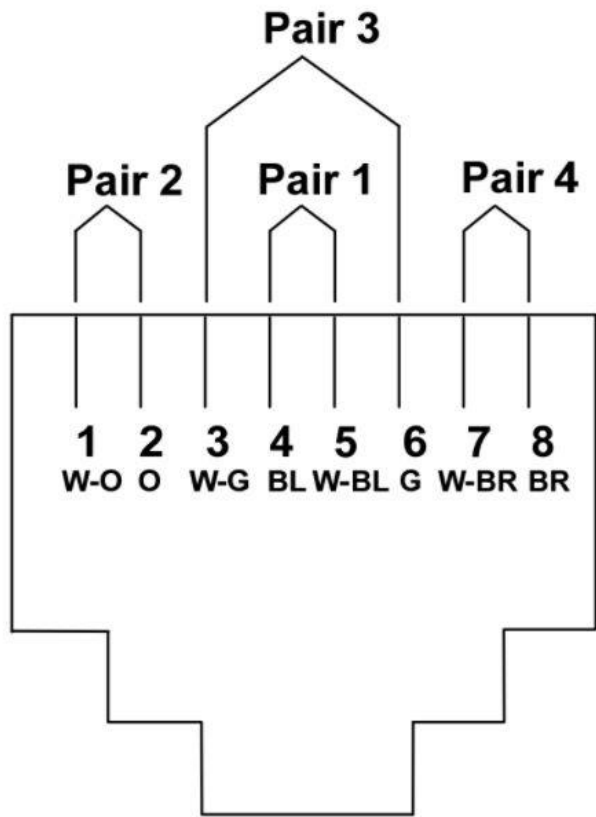
IEC 252/07

Figure 1 – Illustrative relationship between the TIA-568-C Series and other relevant TIA standards

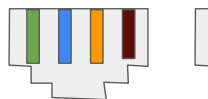


- Front view of eight position jack pin/pair assignments (T568A)

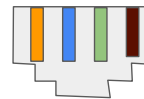
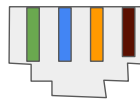
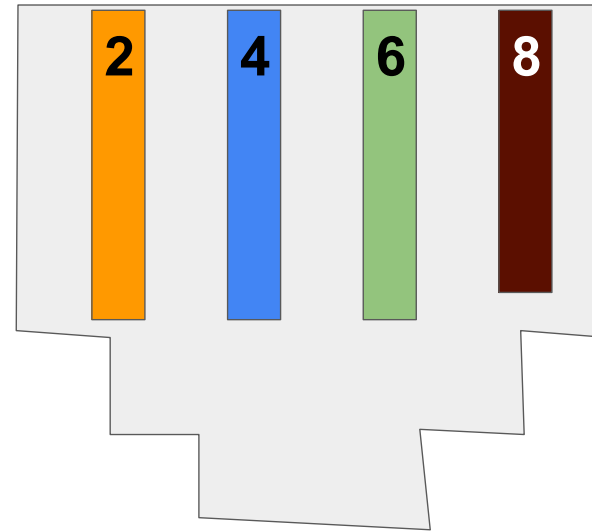
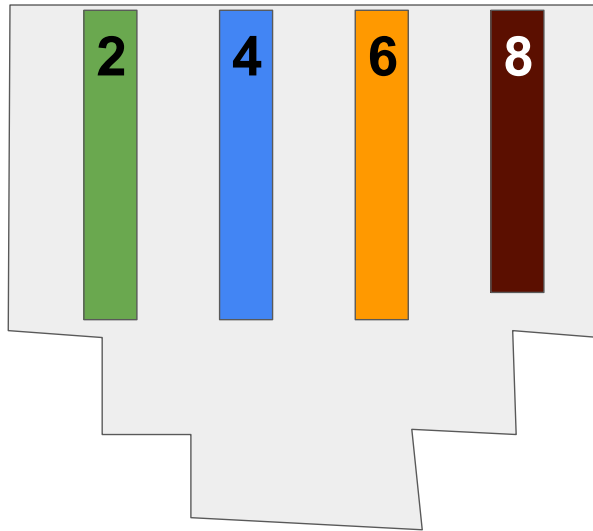




Front view of optional eight-position jack pin/pair assignment (T568B)



A and B



QTP - A

1 2 3 4

T568A color	1	2	3	4
white/green stripe	green solid	white/orange stripe	blue solid	white/blue stripe
green solid	blue solid	orange solid	white/brown stripe	brown solid
white/orange stripe	white/blue stripe	white/brown stripe		

GREEN

BLUE

ORANGE

BROWN



MOST COMMON PRE-MADE CABLE

QTP - B

1 2 3 4

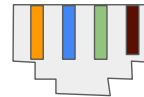
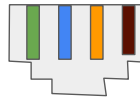
T568B color	1	2	3	4
white/orange stripe	orange solid	white/green stripe	blue solid	white/blue stripe
orange solid	white/green stripe	blue solid	white/blue stripe	green solid
white/green stripe	blue solid	white/blue stripe	green solid	white/brown stripe
white/orange stripe	orange solid	white/brown stripe	brown solid	

ORANGE - Sun

BLUE - Sky

GREEN - Grass

BROWN - Earth



A.3 Connector wiring standards

The largest application of QTP/RJ45 connections in the datacom industry is the Ethernet protocol. The datacom industry chose to follow existing conventions of the telecom industry. Foremost among these is the requirement that the center pair be surrounded by a split pair. Though now a limitation in very high speed datacom applications, this has no impact at audio frequencies.

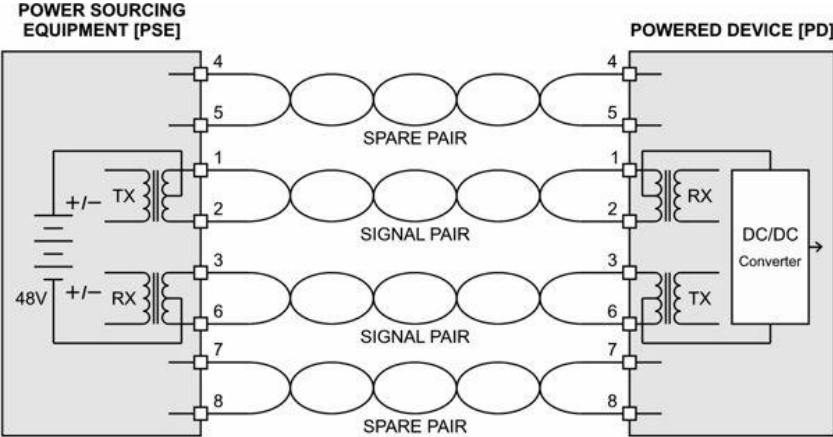
Two different pin-out configurations are specified in TIA-568, each assigning different cable colors to link pairs. These assignments are summarized in Table A1. The T568A configuration is the most common and is preferred. Note that in both cases the solid colors are assigned to even numbered pins and the white striped conductors are assigned to odd numbered pins.

Table A1 Pin/pair assignment for QTP cable

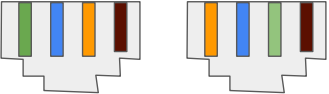
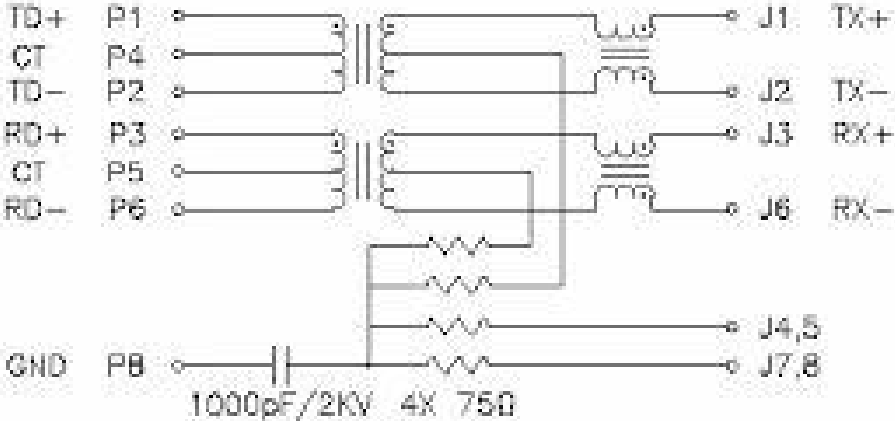
PIN #	1	2	3	4	5	6	7	8
T568A Wire Color	W/GR	Green	W/OR	Blue	W/BL	Orange	W/BR	Brown
Pair Color	Green		Orange	Blue		Orange	Brown	
T568B Wire Color	W/OR	Orange	W/GR	Blue	W/BL	Green	W/BR	Brown
Pair Color	Orange		Green	Blue		Green	Brown	

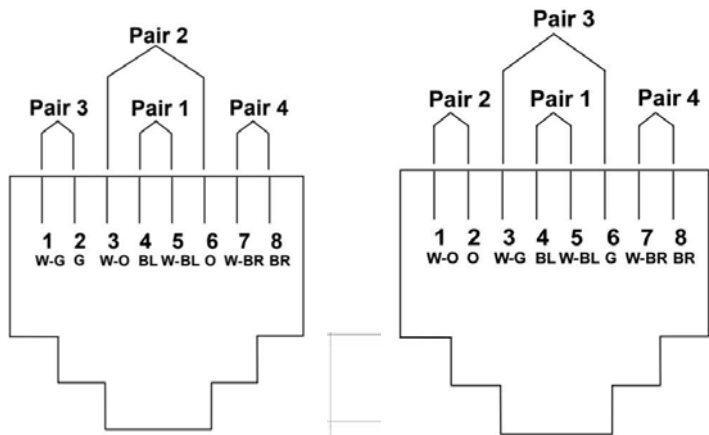
Because of their identical pair groupings, patch cords terminated in either T568A or T568B may be used interchangeably. So called “crossover cables” which use different pinouts at each end will change the link order. The connector wiring standard is also an issue if a plug is present at one end of a cable and the individual pairs are connected at the other end. Compliance with either standard can be easily checked by the location of the green and orange solid colors imbedded in the clear plastic of the RJ45 plug. To guard against crossover cables the color orders should be checked at both ends.

Ethernet Polarity

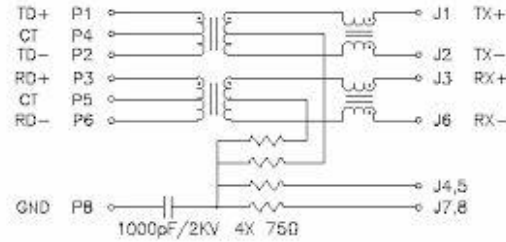


10/100BASE-TX

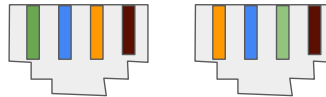




10/100BASE-TX



X242 PATTERN	Polarity		SOLID POLARITY	SOLID PAIR ORDER	QTP CODE	TIA B SOLID		TIA B SOLID		TIA B SOLID		TIA B SOLID	
						1	2	3	4	5	6	7	8
Type 1A	Mixed	M	+ - + -	1324	M+ - + - 1324	1 -	1 +	2 -	3 -	3 +	2 +	4 +	4 -
Type 1E	Even = +	E	++++	1324	E++++1324	1 -	1 +	2 -	3 +	3 -	2 +	4 -	4 +
Type 2O	Odd = +	O	----	2134	O----2134	2 +	2 -	3 +	1 -	1 +	3 -	4 +	4 -
Type 3B	Mixed	M	- + - -	3124	M- + - - 3124	3 +	3 -	2 +	1 +	1 -	2 -	4 +	4 -
Type 3E	Even = +	E	++++	3124	E++++3124	3 -	3 +	2 -	1 +	1 -	2 +	4 -	4 +
Type 4E	Even = +	E	++++	1234	E++++1234	1 -	1 +	3 -	2 +	2 -	3 +	4 -	4 +
Type 5E	Even = +	E	++++	3142	E++++3142	3 -	3 +	4 -	1 +	1 -	4 +	2 -	2 +



4.2 Type descriptor assignment

There are numerous commercial implementations which carry 4 audio links on QTP. These vary in their assignment of links to the defined pairs. All known commercial implementations have been surveyed and assigned a descriptive type number and letter. These descriptors are listed in Table 1.

The type number describes the assignment of links to pairs and the type letter describes the link polarity on each pair. The letter E shall denote implementations which assign the positive polarity pins to even numbers. The letter O shall denote implementations which assign the positive polarity pins to odd numbers. The letter M shall denote implementations which assign the positive polarity pins to odd numbers except for the pin 4&5 pair.

Type	Pin #								Polarity
	1	2	3	4	5	6	7	8	
Type 1E	1 -	1 +	2 -	3 +	3 -	2 +	4 -	4 +	Even = +
Type 1O	1 +	1 -	2 +	3 -	3 +	2 -	4 +	4 -	Odd = +
Type 1M	1 +	1 -	2 +	3 +	3 -	2 -	4 +	4 -	Mixed
Type 2O	2 +	2 -	3 +	1 -	1 +	3 -	4 +	4 -	Odd = +
Type 3E	3 -	3 +	2 -	1 +	1 -	2 +	4 -	4 +	Even = +
Type 3M	3 +	3 -	2 +	1 +	1 -	2 -	4 +	4 -	Mixed
Type 4E	1 -	1 +	3 -	2 +	2 -	3 +	4 -	4 +	Even = +
Type 5E	3 -	3 +	4 -	1 +	1 -	4 +	2 -	2 +	Even = +
Type 6E	4 -	4 +	3 -	2 +	2 -	3 +	1 -	1 +	Even = +

Table 1 Current uses of QTP cabling in professional audio equipment

4.3 Cable shielding

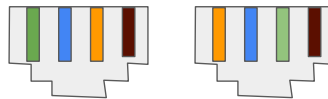
When balanced link connections are used, the high twist accuracy and close conductor spacing of QTP cable will result in low EMI interference even without cable shielding. Shielded CAT cable may offer some improvement in electrostatic interference rejection but will offer little improvement in magnetic interference rejection. Since most low frequency EMI problems are magnetic, shielded cable will generally provide no benefit.

If shielded cabling is used it shall be terminated with connectors conforming to IEC 60603-7-1

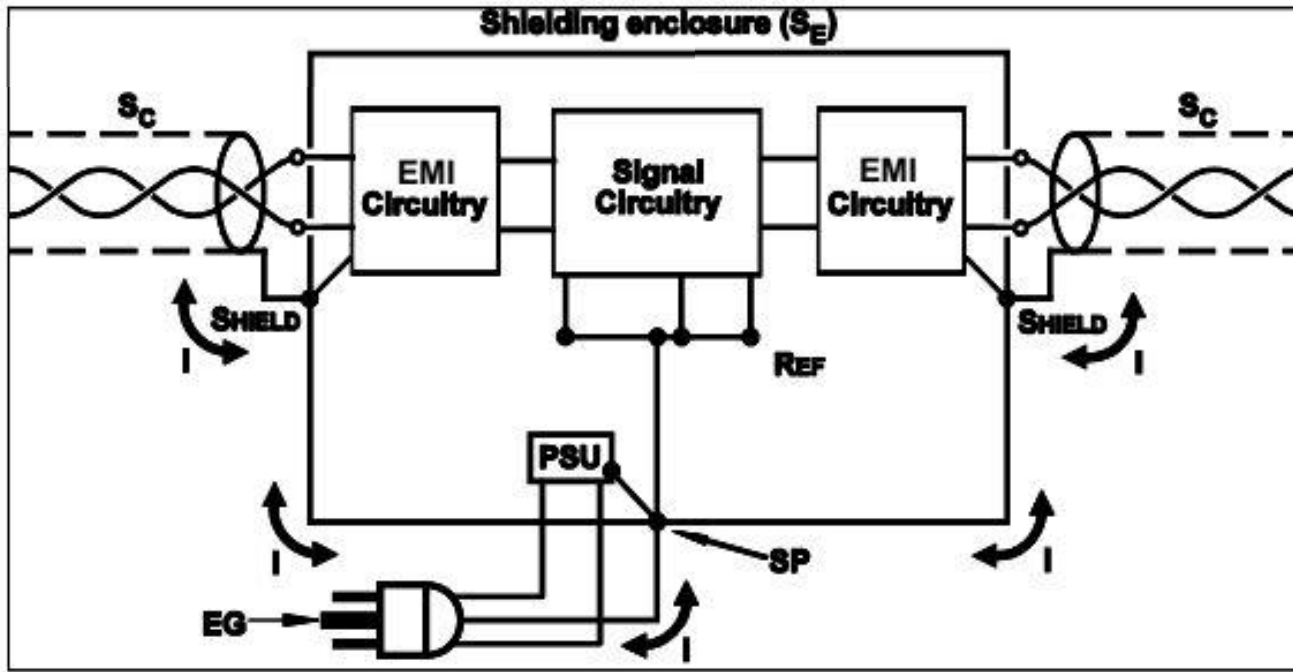
When a shielded fixed connector is used, the shield shall be connected to chassis with the lowest practical impedance at radio frequencies.

Shielded connectors and cable shall be used in applications where phantom power is required, as the only path for return current is through the cable shield.

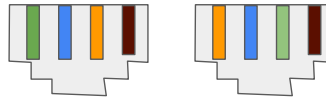
To reduce inter-device chassis ground currents, it is recommended that QTP implementations of microphone lines be connected to a single bank of microphone preamps with a common ground.



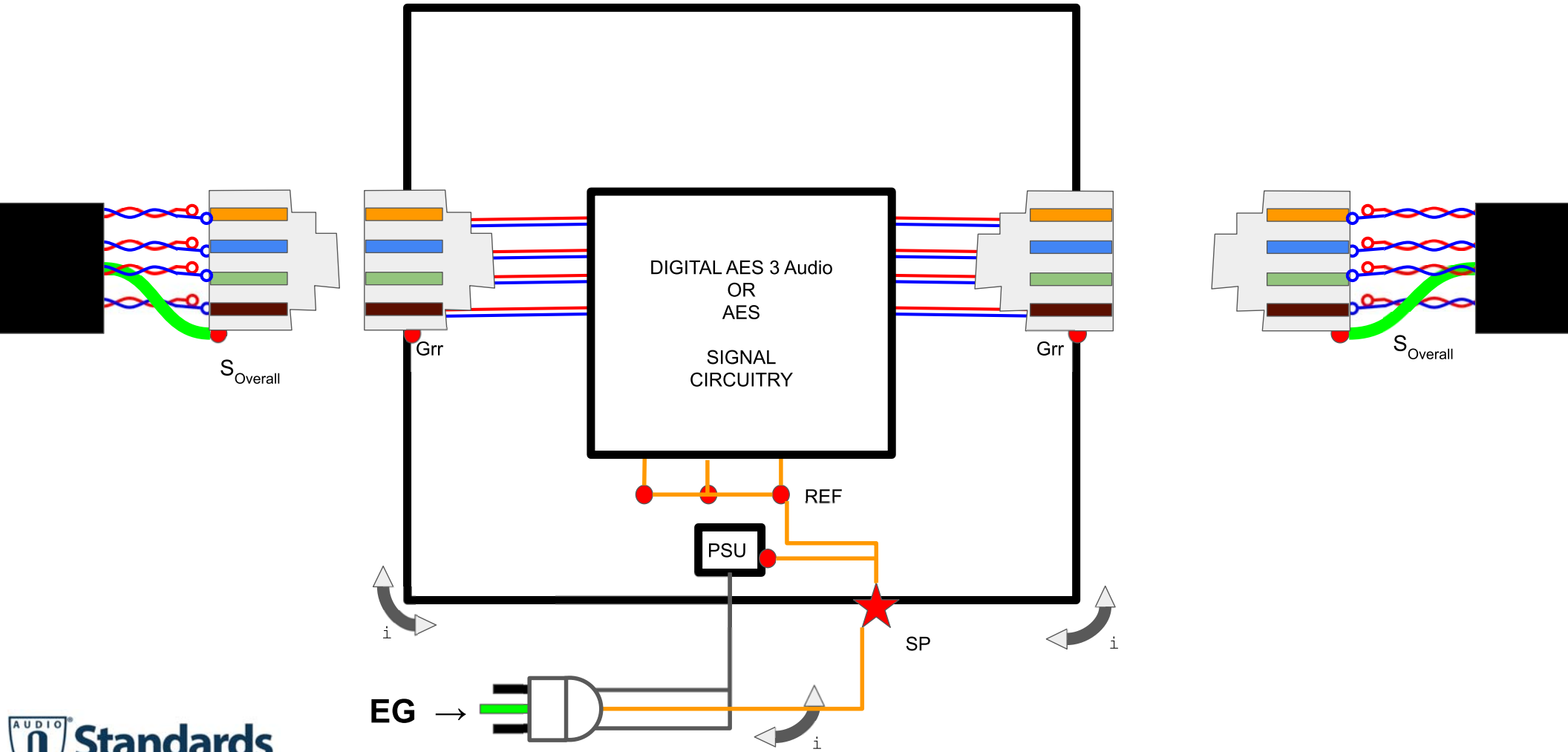
Back to AES48



KEY			
REF	Signal reference	I	Shield currents
EG	Equipment ground	S _E	Shielding enclosure
PSU	Power supply unit (typical)	S _C	Cable shield
SP	Star point	SHIELD	Designated shield contact



SHIELDING enclosure (S_E)



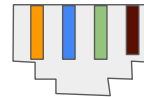
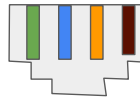
4.4 Equipment labeling

When RJ45 connections are used to transport audio in compliance with this standard the connector wiring shall be described using the type listed in Table 1.

The type descriptor shall be prominently displayed on the equipment near the RJ45 connector. It shall also be clearly documented in the data sheet and users manual.

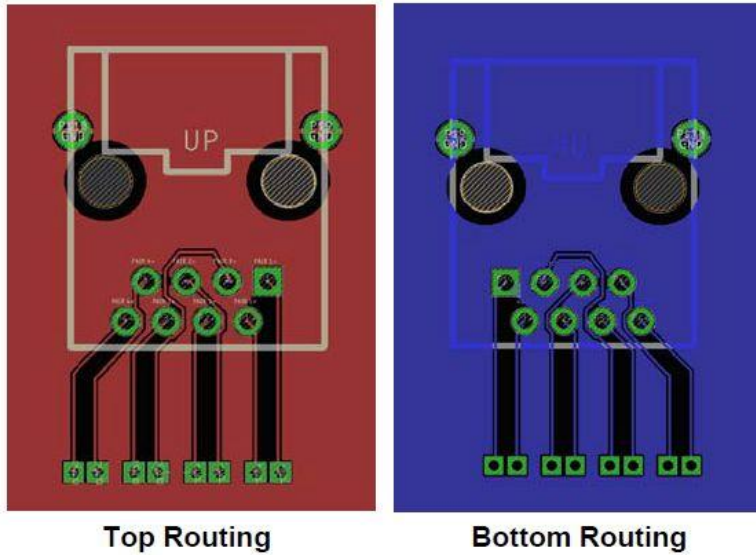
If the RJ45 jack does not implement ground this shall also be indicated.

For example, a connector wired according to Type 3E in Table 1 would be labeled “AES72 Type 3E”. One which does not support ground would be labeled “AES72 Type 3E, not grounded”.



B.2 PCB footprint layout

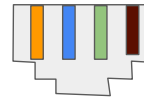
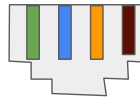
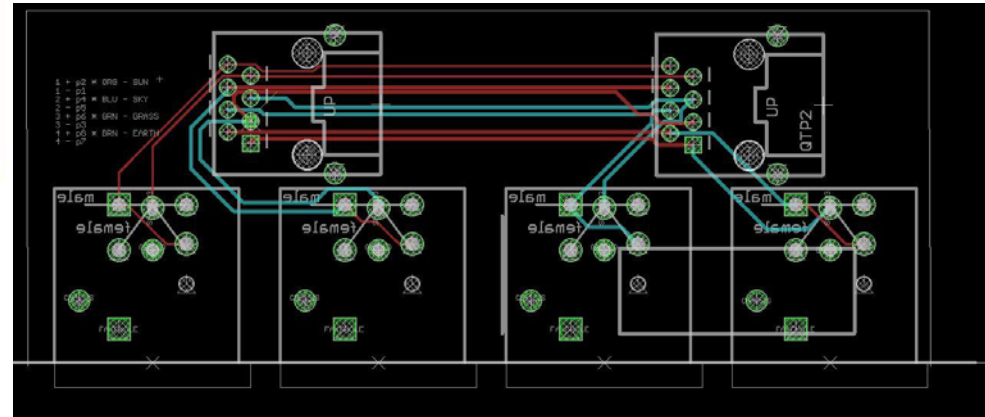
The routing examples provide a ground plane separating every link and the shield of the connector is bonded to a ground plane. Those creating other designs should refer to the Pin 1 problem as described in AES14.



Top Routing

Bottom Routing

Figure B2 – Example PCB Layouts



B.3 Orientation

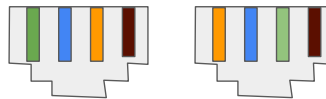
The most common way to install a jack in a wall or panel is with the tab side oriented downwards, allowing dust and debris to fall away from the electrical contacts.

B.4 Dimensions

Detailed connector dimensions may be found in IEC 60603-7.

B.5 Cable category ratings

The conductors in a CAT cable are twisted well enough that balanced transmission systems will adequately reduce interference. Different levels of CAT cables differ in their very high frequency (100MHz and above) behavior and will provide little difference at audio frequencies. If EMI issues still exist they may be addressed using ferrites, filters, or transformers.



B.1 Connectors for stranded and solid wire

Category cable is available with either solid or stranded conductors. Solid conductor cable is generally less expensive and is used intended for use in permanent installations. Stranded conductor cable is more flexible and is generally used for interconnect cables which may be flexed.

These two types of cable require different connectors since the conductor deforms differently in each case. If the appropriate connector is not used for a given cable there will likely be early failure due to oxidation, conductor breakage, or inadequate conductor contact pressure.

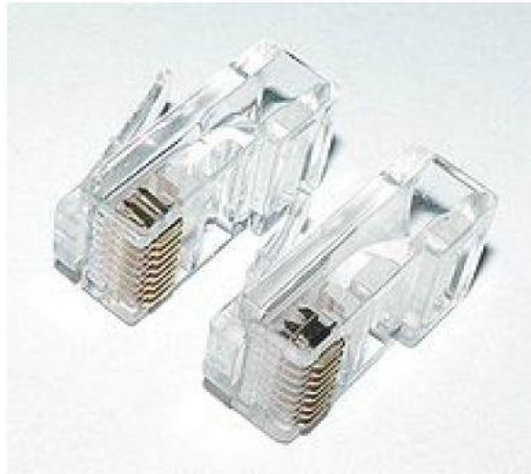
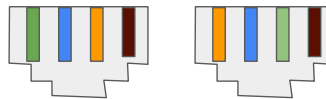


Figure B1 – Connectors for solid wire (top left) and stranded wire (bottom right)
(unshielded connectors are shown for convenience, shielded connectors are recommended)



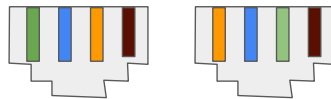
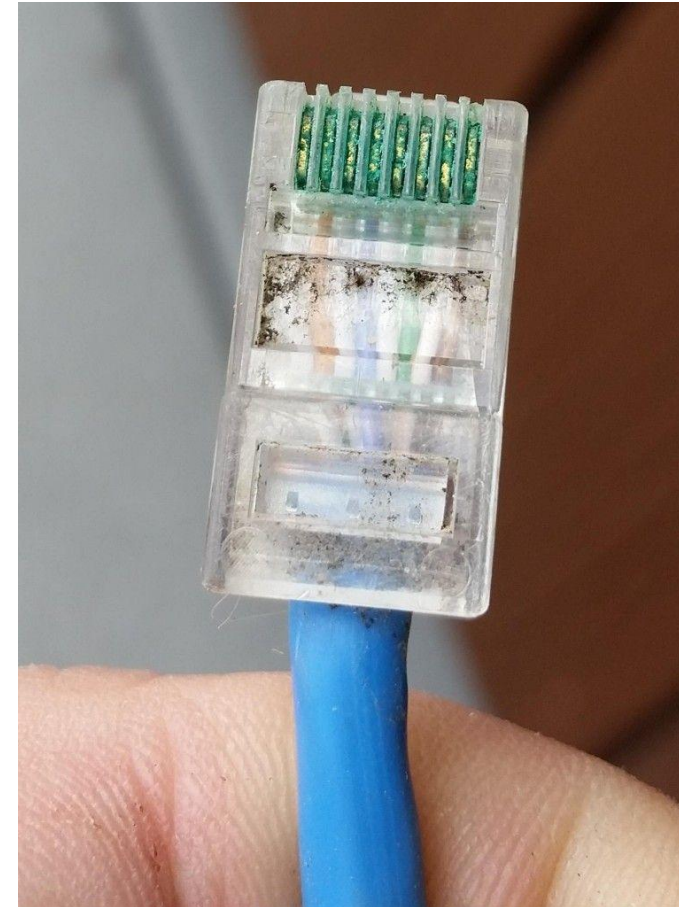
B.6 Termination issues

CAT cable wires, particularly solid conductors, are designed to be terminated with compression fit connectors. Numerous practical issues arise if these wires are terminated with conventional audio connectors.

When soldered to common audio connectors such as XLR's the conductors frequently break, probably by being nicked when stripped. Breakage has also occurs inside the insulation, apparently from repeated flexing. Cable is available which uses annealed conductors which can handle thousands of flexures without breaking from fatigue. Cables are not all the same and should not be viewed as interchangeable.

In addition to breakage, clamping the conductors in "euro" or "Phoenix" push on connectors is problematic. Excessive tightening of the screw nicks or deforms the wire, and it breaks when flexed. Insufficient tightening allows it to pull out. Putting two or more wires of different gage or one solid and one stranded wire in the same connector generally results in the smaller one pulling, or falling, out. These problems are exacerbated by the fact that most of the connectors used either have no provision for strain relief or the strain relief is designed for larger diameter cable.

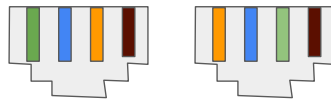
CAT cables should only be spliced with compression based splices specifically designed for this purpose. They should not be spliced by stripping and twisting the mating conductors together, with or without electrician's "wire nuts". Providing strain relief by tying the two cables together in a knot as if they were rope does not legitimize this approach.



THANK YOU!



Anthony Peter Kuzub
AES72 - QTP 4 Everyone!



The Pin 2 16 5 19 8 22 11 25
 problem

SHIELDING enclosure (S_E)

