BLACKBOX WHITE PAPER

ACTIVE OPTICAL CABLES: ULTRA-HIGH-DEFINITION SOLUTIONS FOR THE PROFESSIONAL AV APPLICATIONS OF TODAY AND TOMORROW

LEAVE THE TECH TO US

ACTIVE OPTICAL CABLE SIGNAL CONVERSION

The ends of conventional fiber cables are terminated with MPO, SC, LC or other fiber-optic connectors. The connectors attach to the optical ports on converters, switches, extenders and other similar devices that change the optical signal to and from electrical signals.

This process is no different for Active Optical Cables used in AV applications — even though they have HDMI, DisplayPort or DVI connectors instead of conventional fiber-optic connectors. The fiber technology is built in to the connectors on each end, converting the electrical signal from a source (media server, Blu-Ray Player, computer, etc.) to optical for transmission over fiber cabling, and then back into an electrical signal for display on a monitor. And all of this is done without the need for external power, utilizing the cable's fiber/copper hybrid design to take power from the source device and send it over the copper wires to the display end.

BENEFITS OF ACTIVE OPTICAL CABLE IN AV APPLICATIONS

Expansive Bandwidth for Long Distance UHD Transmission
Fiber-optic technology allows Active Optical Cables to transmit ultra-high-bandwidth data signals over distances that copper cannot. Copper cables can only transmit 4K60 about 13 feet (four meters) and 8K60 about six feet (two meters), and only then with a bulky, inflexible construction. To achieve longer distances, copper solutions need to switch to modular transmitter/receiver extenders, while all-in-one AOC cables can easily support HDMI 2.0 bandwidths of 18 Gbps and DisplayPort 1.4 bandwidths of 32.4 Gbps over hundreds of meters. And when successive generations of video standards emerge at even higher bandwidths, AOCs will continue to keep up as copper falls further behind, making HDMI and DisplayPort AOCs the perfect solution for long distance transmission of the ultra-high-resolution video signals of today and tomorrow.

Outstanding Video Quality
High-end AV applications today don't just need the best video resolutions available, but a solution that can display them while also providing all of the features necessary to support their content. Active Optical Cables can do just that, providing 4K60 and 8K60 video resolutions while also supporting the full feature set of the HDMI 2.0 and DisplayPort 1.4 specifications. They deliver high-dynamic-range (HDR) video for expansive contrast ratio and color accuracy, while also supporting the HDCP 2.2 and DPCP content protections necessary to display the latest content. Also supported are BT.2020 colorimetry and 21:9 cinema aspect ratio, as well as EDID, CEC, DDC, and more, making active optical a full featured solution for professional AV installs.

Amazing Audio Quality
Active Optical Cable also provides immersive audio that is essential for AV applications. These cables support PCM 8-Channel, DTS-HD and Dolby Digital True HD Surround Sound audio for theater quality sound. Additionally, they can transmit up to 32 audio channels with 1536-kHz sampling rate as well as features such as HDMI's Audio Return Channel (ARC) and more.

INTRODUCTION

This white paper will explain what Active Optical Cables (AOCs) are and detail why they are superior to traditional copper solutions in serving the ultra-high-definition audio/visual (AV) distribution applications of today and the future. Additionally, it will highlight the different applications AOCs can benefit and how they outperform existing solutions in terms of cost, ease of installation and signal quality/reliability.

WHAT IS ACTIVE OPTICAL CABLE

Active Optical Cable is an expansion of standard fiber cabling that takes advantage of fiber-optic technology to transmit audio/video signals more effectively and efficiently than existing copper solutions. The extensive capacity of fiber optics allows ultra-high-bandwidth signals to be transmitted over long distances in an all-in-one cable solution.

Active Optical Cables can transmit video resolutions up to 8K60 Hz hundreds of meters, whereas standard copper cabling requires a robust, bulky construction just to achieve a standard digital transmission distance of five meters. To achieve longer distances, copper extension solutions are required which utilize a modular design that is much more cumbersome to install and introduces multiple potential points of failure.

Active Optical Cables also offer additional benefits, such as being lighter in weight than copper cables, having low EMI/RFI profiles, uncomplicated installation, ease of use, little power usage and minimized interconnection loss.

Plug and Play, Premium Reliability

There is no software, external power or additional hardware needed for an Active Optical Cable to work. To install an AOC, a technician simply connects it to a source and a display — nothing more. No expert training or guidance needed. It's as easy as installing a common HDMI cable at home.

This simple, all-in-one cable solution also provides premium reliability when compared with alternative solutions. To achieve the same high-bandwidth transmission and extended distances as Active Optical Cable, you would have to utilize an over CAT5 or over fiber extender kit. These kits are costly, and require transmitter and receiver units, in addition to the potential points of failure that come with them. There are connections from the source to the transmitter, the transmitter to the receiver and finally the receiver to display, not to mention the bulky external power supplies. An issue at any of these connection points can result in poor performance or the loss of your audio/video signal altogether. With AOC's, you simply plug and play like an ordinary cable, leaving it to reliably transmit your audio/video signal without interruption.

Flexible, Thin and Light

Active Optical Cables are thinner (around five millimeters) than traditional copper cable (seven to 10 millimeters depending on AWG), which lets them fit behind today's ultra-thin displays. These cables also have a superior bend radius that makes routing them through tight spaces easy and decreases the risk of poor performance when navigating cable around corners and bends.

This is especially helpful in AV applications that must connect many sources and displays, like video walls. Video walls require many cables to be routed through the same area, which can cause clutter. Because AOCs are much thinner and more flexible than copper cables, they keep the video wall setup neater and less cluttered.

On top of that, Active Optical Cables are much lighter than copper solutions: Sixteen feet (five meters) of copper cabling weighs approximately one kilogram, whereas 32 feet (10 meters) of AOC weighs less than 300 grams. This makes pulling AOCs through ceilings and walls much easier and less likely to result in costly damage.

Minimal RFI/EMI Profile

Copper cable is prone to electromagnetic interference which can disrupt signal quality, data transmission and connectivity. Active Optical Cables have a much lower RFI/EMI profile because they are made of fiber. This makes AOC ideal for fragile or more delicate applications, like control room, healthcare and transportation, that cannot tolerate any signal downtime or interruption. Additionally, the triple-shielding of these cables further guards them against interference to ensure the best signal quality at all times.

TYPICAL ACTIVE OPTICAL CABLE APPLICATIONS FOR HIGH-BANDWIDTH AV TRANSMISSIONS

PC   SOURCE SIDE   DISPLAY SIDE   DISPLAY

UP TO 8K 60

DISPLAY SIDE

SOURCE SIDE

PC   SPLITTER
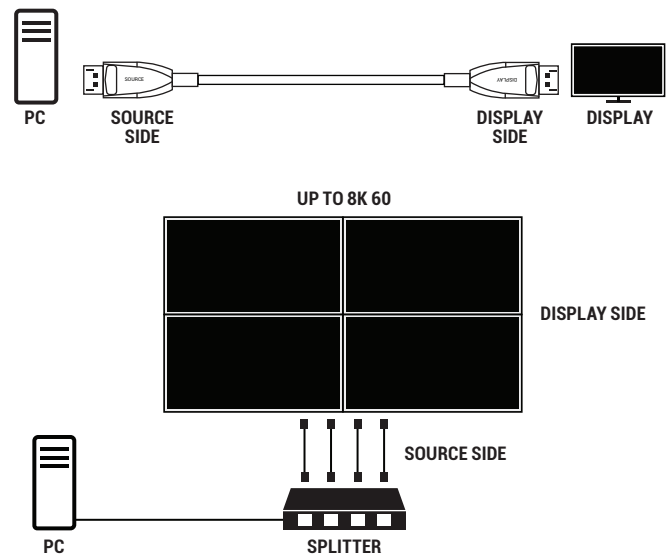
ACTIVE OPTICAL CABLE VERSUS EXISTING COPPER CABLE SOLUTIONS

Passive copper cabling is still useful for short source/display connections as it supports 4K DisplayPort and HDMI resolutions in its traditional form factor and at an affordable price. However, achieving the standard five-meter max distance is becoming increasingly difficult, as copper is unable to transmit emerging 8K content that far without a much bulkier and much more expensive cable design. As video resolutions continue to expand, copper HDMI and DisplayPort cables will either have to get shorter to avoid this, or become so big, inflexible and pricey as to no longer be an attractive solution.

For longer distances, active copper extender cables exist that support HD video resolutions, making them suitable for some mid-length range installations where 1080p is acceptable and routing through ceilings and walls is not required. But these solutions are also bulkier and becomes increasingly expensive at longer distances. They contain equalization controls for video adjustment that can sometimes be temperamental and often require external power to work.

The trajectory is the same for both active and passive copper cabling solutions, with neither able to keep up with ever-expanding video resolutions without sacrificing a flexible design and affordable pricing. As this continues, the increase in price will eliminate an advantage once held over AOC, while their large, heavy and complex design will make them increasingly difficult to deploy in today's space-conscious AV applications, such as control rooms or digital signage in mass transit. And as ultra-high definition and higher video content become mandatory, copper cabling limitations will ultimately rule them out based on spec alone.

ACTIVE OPTICAL CABLE VERSUS TRADITIONAL AV EXTENDERS

While it is possible to extend high-bandwidth data long distances using copper cable, it requires a multitude of extenders and devices that can change depending on the application. This creates multiple points of failure that wcan be difficult to troubleshoot.

For example, if a copper extender solution malfunctions, a technician has to power cycle the transmitter and/or receiver, whereas Active Optical Cable works the same as a standard cable connection. There is no reset necessary to restore connection because it is one cable, not a system.

Applications which call for a combination of extension with splitting and/or switching are even more complex, and require numerous devices to accomplish the desired result. An over copper (or fiber) extender solution with a splitter and/or switch built into the transmitter unit would be required, along with multiple receiver units to connect to all of the monitors. If that kind of solution is not available, one would have to combine a standard splitter or switch with multiple extender kits to get the same result, but with much higher risk of incompatibility problems. Active Optical Cables make this type of setup much easier by connecting directly to a standard HDMI splitter or switch just like a normal passive cable, with the only points of failure being between the splitter/switch ports and the connected AOCs.

FIBER-ONLY VERSUS COPPER/FIBER HYBRID ACTIVE OPTICAL CABLE

Fiber-only AOC and copper/fiber hybrid AOC each have specific use cases. Fiber-only AOCs should be used in applications that do not require power at all, or in which external power to the fiber-only AOC is acceptable. This means they are not an ideal connectivity solution for AV applications that rely on a self-powered cable connection between the source and the display.

For AV applications, copper/fiber hybrid AOC is the preferred option because it eliminates the external power supplies that do not fit neatly behind today's ultra-thin displays.

These cables feature a combination of copper and fiber, where the fiber cabling transmits the high-bandwidth data while the lower-bandwidth CEC, DDC, EDID and HPD signals are transmitted over copper, along with power. This construction allows these AOCs to receive their power from the source, similar to a traditional copper AV cable, and eliminates the need for a bulky, external power source.

TYPICAL APPLICATIONS

24/7 Traffic Monitoring
Traffic monitoring requires AV cable that can perform in their 24/7, event-driven work environments without issue, maintaining uninterrupted connectivity to screens that give operators critical data about current traffic conditions, hazards and delays. Active Optical Cables are an all-in-one connectivity solution that removes extenders and other potential points of failure from the AV system. This provides a consistent connection and signal quality that helps these applications keep traffic operations on time and safe for all drivers.

Security
Security surveillance centers need fail-safe AV cables that support the best video quality possible to monitor criminal activity, emergencies and other dangerous events. Without these features, property can be damaged, goods can be stolen or people can be injured. Active Optical Cables support HD, 4K and 8K video resolutions over long distances and transmit a consistent, error free signal. This allows security operators to easily see everything happening in the environments they are monitoring with no downtime whatsoever, keeping people and property safe from harm.

Control Room
In control and command centers, operators rely on AV solutions to make split-second decisions that prevent disasters. This means AV equipment cannot lag or malfunction — even bandwidth-intensive equipment like video walls, massive displays or similar devices. To get the maximum level of performance from their AV solutions, these applications require the best cabling. Active Optical Cables provide ultra-high data bandwidth transfer that ends lag time for even the most complex AV systems. Through an AOC connection, data and visuals can be displayed and switched instantly, letting operators do their jobs effectively and without issue. Also, AOC's all-in-one cable design mimimizes points of failure and offers a high-quality signal that ensures connection when it's needed most.

Healthcare
Hospitals and other healthcare operations' AV cabling often runs into electromagnetic interference that can disrupt signal quality and overall performance. This can negatively impact the effectiveness of medical professionals who rely on AV systems in imaging centers, labs and similar work areas, putting patients at risk. Unlike copper cabling, Active Optical Cables feature a zero RFI/EMI profile that eliminates electromagnetic interference. This allows Active Optical Cables to reliably transmit a signal in healthcare operations where zero downtime is a must.

Education

College and university lecture halls are huge spaces filled with screens that display lessons to hundreds of students. Each one of these screens has to display a high-quality image during the entire lecture to ensure each student is able to follow the lesson and take accurate notes. Copper cable has a difficult time extending to all of these different screens without extenders and other devices that are prone to failure because of the overwhelming size of these rooms. Active Optical Cables are able to extend UHD video hundreds of meters without any additional software or devices, making them the ideal solution for lecture halls with numerous screens.

Digital Signage

Businesses today need to inform, persuade and engage audiences in a way that is memorable and unique. Digital signage is the modern way to captivate the attention of patrons, clients or even employees. But without a high resolution image and consistent AV signal, digital signage will fail to do its job. Active Optical Cables support the UHD resolutions and color quality needed to display a captivating image that can grab and hold customer attention. Even better, they offer a consistent signal transmission that will ensure vital digital signage content is displayed without issue.

Conference Rooms

Presenters with limited technical experience must be able to easily connect devices to screens in conference rooms. Otherwise, the meeting may be delayed or go off topic, failing to produce actionable business outcomes. Active Optical Cables are a plug-and-play connectivity solution that requires no training or technician assistance to install. To set up an AOC connection, all a presenter has to do is connect the cable to their device and the display in the conference room. Now they are ready to present. On top of that, AOCs boast UHD video resolutions that ensure attendees are able to see the presentation without issue, regardless of where they're sitting.

Government Campuses

Government installations have a wealth of essential AV equipment and devices throughout their campuses. The amount of cables, connectors, extenders and other devices necessary to connect all this equipment quickly creates clutter and space constraints within building infrastructure, making it tough to add new equipment. Active Optical Cables are perfect for AV applications like this because they are thinner, lighter and more flexible than copper cable, and they remove extenders and similar devices from the AV system. With AOC, more AV equipment can be added without damaging building infrastructure, signal quality or cables.

Transportation

Airports, train stations and similar applications use displays to provide passengers with information on arrival times, delays, emergencies and more. These displays must be on at all times to ensure commuters are informed. Active Optical Cables provide a reliable connection with a high-quality signal so displays always remain functional. They are also designed using a low-smoke, zero-halogen jacketing that limits exposure to harmful chemicals in congested, high-traffic areas in the event of a fire.

AOC AV HDMI 2.0 CABLE

AOC AV DISPLAYPORT 1.4 CABLE

BLACK BOX HDMI AND DISPLAYPORT ACTIVE OPTICAL CABLE FOR AV

Black Box HDMI Active Optical Cables flawlessly transmit full ultra HD, 4K60 (4:4:4) video signals. Our HDMI AOCs support HDMI 2.0, and are backward compatible to previous HDMI specifications, making them compatible with the majority of HDMI devices used in AV applications. We offer these cables in lengths up to 328 feet (100 meters) and beyond.

Black Box also has DisplayPort 1.4 Active Optical Cables that flawlessly transmit the latest 8K60 video signals. DisplayPort AOCs offer the best very-high data rate transmission of AV AOCs for 4K and 8K video. We offer these cables in lengths up to 328 feet (100 meters) and beyond.

All of our HDMI and DisplayPort Active Optical Cables are hybrid copper/fiber AOCs. They feature active components in the connectors that perform electrical-to-optical signal conversion. The fiber technology allows for expanded bandwidth and longer transmission distances. It also makes for a much thinner, lighter and more flexible cable that is easy to pull through tight spaces. Furthermore, fiber-optic technology provides higher immunity to EMI/RFI interference and electromagnetic noise. The use of copper wiring alongside fiber allows power to be transmitted over the cable so that no external power source is needed. They are the perfect AV distribution solution for control rooms, conference rooms, classrooms, digital signage, mass transit and more.

ACTIVE OPTICAL CABLE OPTIMIZES BLACK BOX'S AV SOLUTIONS

Active Optical Cables ability to extend high-end video long distances make them the best connectivity solution for some of Black Box's most advanced AV technologies, including the Radian Flex™ software-based video wall controller solution, the iCOMPEL™ digital signage solution and the MediaCento™ IPX AV-over-IP Extender.

With traditional copper cable, these solutions can only transmit signals about 16 feet (five meters). This is very restrictive for applications that want to extend media out of the room in which the controller resides. Black Box AOC can extend Radian Flex, iCOMPEL and MediaCento signals upwards of 328 feet (100 meters) without issue or a drop in quality – no extender required. This is the same for systems with multiple GPUs.

CONCLUSION

Audio/visual applications today require flawless transmission of ultra-high-definition video signals over long distances without a costly, complicated connectivity solution. As video resolutions quickly switch from HD to 4K, and with 8K content starting to emerge, copper cabling and extension solutions will struggle to keep up, becoming bulkier, inflexible and more costly, and Active Optical Cables will stand out as the solution of choice.

Active Optical Cables feature an expansive bandwidth that allows them to easily transmit the ever-increasing UHD video resolutions of today and tomorrow at distances in the hundreds of meters, and without the use of expensive extenders. AOCs are an all-in-one cable solution that is easy to install and use, requiring no training or technician assistance to deploy. In addition, this design requires no external power (and bulky power supplies) and eliminates the many potential points of failure found in modular transmitter/receiver extension solutions, ensuring that content is flawlessly and reliably transmitted without worry. With the added benefits of a super-thin, lightweight and bend-resistant design that saves space and makes installation a breeze, and ultra-secure resistance to RMI/EFI interference that ensures flawless data transmission, AOC cables clearly stand out as the most capable and cost-effective solution for the professional audio/video installations of today and tomorrow.

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