

HDMI Cables Demystified

Version 1.4

What everyone should know about
choosing the right HDMI cable.

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About HDMI Demystified.

The-Cable-Store.com develops and manufactures high quality HDMI cables, switches, splitters and accessories for you the discerning consumer. Our products are not available in stores. This means we can bring you the latest developments sooner.

This eBook is intended to help you make an informed decision about what HDMI cable and accessories you need to make your home theatre system simply stunning.

Not all HDMI cables are created equal. Differences in cable material and construction influence signal fidelity, an HDMI cable's ability to transmit different amounts of information is an important consideration. It's important to understand that audio/video signal quality can't be improved after the signal leaves a home theater source component like a receiver or DVD player; and although the signal can't be improved, it can be significantly degraded.

At the time of writing you could spend from \$10 to over \$500 for a 2 metre HDMI cable? There are many "sharks" out there on the internet. The best way to avoid being "ripped off" is to be informed. "HDMI Demystified" explains in simple, easy to understand language what you need to know about HDMI.

Here is what you will learn from reading this book:

What is HDMI and what it means for me?

What version numbers really mean?

What should I should look for in an HDMI cable?

How much should I spend to get a result?

How to future proof your investment?

What are the pitfalls and problems I could encounter?

Avoid paying too much for your HDMI cables and accessories.

Sam Blacket

<http://www.the-cable-store.com/index.html>

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1.HDMI Basics

1.1. What is HDMI?

HDMI (High-Definition Multimedia Interface) is the first and only industry-supported, uncompressed, all-digital audio/video interface. Delivering crystal-clear, all-digital audio and video via a single cable, HDMI simplifies cabling and provides you with a high -quality home theater experience. HDMI provides an interface between any audio/video source, such as a set-top box, DVD player, or A/V receiver and an audio and/or video monitor, such as a digital television (DTV), over a single cable. New revisions of the HDMI standard also include support for Ethernet communication links.

HDMI supports standard, enhanced, or high-definition video, plus multi-channel digital audio on a single cable. It transmits all HDTV standards and supports 8-channel, 192kHz, uncompressed digital audio and all currently-available compressed formats (such as Dolby Digital and DTS), HDMI 1.3 adds additional support for new lossless digital audio formats Dolby® TrueHD and DTS-HD Master Audio™ with bandwidth to spare to accommodate future enhancements and requirements. Version 1.4 launched in June 2009 adds HDMI Ethernet, an audio return channel, support for 3D video formats, high definition resolution of 4k x 2k, expanded color spaces, micro connector support and support for Automotive Connection System.

1.2. So Who is Behind HDMI?

The founders of the HDMI standard are some of the worlds leading consumer electronics companies.

Hitachi, Ltd.
Philips Consumer Electronics
Sony Corporation
Toshiba Corporation

Panasonic Corporation
Silicon Image, Inc.
Thomson, Inc.

More than 850 companies have become adopters, and nearly 200 million devices featuring HDMI shipped in 2008, with a projected installed based of nearly one billion HDMI devices by 2010. 100% of digital televisions have at least one HDMI connection. Increasingly digital still cameras and camcorders are using the HDMI interface to transfer high definition images.

1.3. Why HDMI?

HDMI means a simpler and higher-quality entertainment experience. It provides the highest possible uncompressed video and audio quality over a thin, easy-to-use cable with a simple, consumer-friendly connector. It's also backwards compatible with DVI, requiring only a simple passive adaptor or cable to connect between the two interfaces. Most importantly, it adds support for up to 8 channels of full-resolution digital audio, all on a single cable.

Since its inception, HDMI has the ability to transmit basic control codes from device to device, making the goal of system integration easier to achieve.

HDMI addresses the complexity issue by both reducing the cable count and easing the process of interconnecting the various devices that make up the typical home entertainment system. Instead of having to choose among RF, composite video, S-video and component video and optical digital audio or coax-based digital audio, everything can use a single HDMI connection. For example, in the case of a DVD Audio or SACD Audio capable DVD player, a single HDMI cable can replace up to 10 other connections (3 for analog component video, 1 for optical or coax digital audio and 6 for the 5.1 multichannel analog audio

outputs). Added to this is the ability to simultaneously achieve the best possible audio and video quality due to the uncompressed all digital signaling of HDMI.

Version 1.3 of the HDMI standard, more than doubled the bandwidth of the signaling from 4.95 gigabits per second to 10.2 gigabits per second. This increase in bandwidth enables greater color depths, higher screen resolutions and faster refresh rates. It supports the new xvYCC color space, adds support for the Dolby® TrueHD and DTS-HD Master Audio standards, provides a mini-connector for use with camcorders and digital still cameras, and supports the ability to automatically and accurately adjust the audio to maintain lip-sync with the video image.

Version 1.4 which was released in June 2009 offers networking capabilities with Ethernet connectivity and will add an Audio Return Channel to enable upstream audio connections via the HDMI cable.

How big is 10.2 Gigabits?

The Shorter Oxford Dictionary is 2,700 pages long, contains over 180,000 entries defined by 35 million letters and weighs 6.6 pounds (3.0 kg).

A quality HDMI cable will carry the data equivalent of 37 copies of the Shorter Oxford Dictionary over the length of the cable every second, without missing a page or mispronouncing a single word.

1.4. What can HDMI do for me?

Quality:

Because HDMI is a digital interface, it provides the best quality video since there are no lossy analog to digital conversions that are required for analogue connections (such as component or S-video). The difference is especially noticeable at higher resolutions such as 1080p or higher. Digital video will be sharper than component, and eliminates the softness and ghosting found with composite. Small, high contrast details such as text bring this difference out the most.

Ease-of-use:

HDMI combines video and multi-channel audio into a single cable, eliminating the cost, complexity, and confusion of multiple cables currently used in A/V systems. This is particularly beneficial when equipment is being upgraded or added.

Intelligence:

HDMI supports two-way communication between the video source (such as a DVD player) and the DTV, enabling new functionality such as automatic configuration and one-touch play. By using HDMI, devices automatically deliver the most effective format (e.g. 480p vs. 720p, 16:9 vs. 4:3) for the display that it is connected - eliminating the need for the consumer to scroll through all the format options guessing what will look best.

HD Content-Ready:

HDMI devices supporting HDCP (copy protection) will have access to premium HD content now and in the future.

My video or audio won't work?

HDCP is a form of digital copy protection developed by Intel Corporation to prevent copying of digital audio and video content as it travels across various cables and connections, even if such copying would be permitted by fair use laws.

Each device handshakes with the other and then passes an encryption key to say that it is ok to display or play the signal. It does this for every frame, typically 30 times per second. If you are having problems with blank audio or video it is more than likely that one of your devices does not support HDCP.

2.HDMI History

2.1. HDMI Versions

HDMI as a standard has been around since 2002. During that time there have been a number of versions and revisions. In the market today you are likely to find HDMI cables with the following numbers marked on the packaging.

- 1.0 (December 2002)
- 1.1 (May 2004)
- 1.2 (August 2005)
- 1.2a (December 2005)
- 1.3 (June 2006)
- 1.3a
- 1.3b
- 1.3c (As at January 2009)
- 1.4 (June 2009)

To make things more confusing there are also five types of base cable. Category 1 known as standard and category 2 known as high speed. You can have category 1 and 2 with or without ethernet making a total of four variations. The fifth variant known as Automotive HDMI is cable that is designed to meet the rigors and environment commonly found in automobiles.

Should I care about 1.3 a,b etc?

For consumers, there is no difference between HDMI version 1.3 and 1.3a or 1.3b. These minor revisions to the specification typically relate to manufacturing or testing issues and do not impact features or functionality.

2.2. What does HDMI version 1.3 & 1.4 give me?

With all of these version numbers and two cable types it is no wonder that there is confusion in the market about which HDMI cable is right for me. We won't bother going into all of the historical changes to HDMI cables over the years, but will focus only on version 1.3 & 1.4. There is no doubt that in today's market you should only consider buying either of these versions.

Version 1.3

Higher speed:

HDMI 1.3 increases its single-link bandwidth to 340 MHz (10.2 Gbps) to support the demands of future HD display devices, such as higher resolutions, Deep Color and high frame rates. In addition, built into the HDMI 1.3 specification is the technical foundation that will let future versions of HDMI reach significantly higher speeds.

Deep Color:

HDMI 1.3 supports 10-bit, 12-bit and 16-bit (RGB or YCbCr) color depths, up from the 8-bit depths in previous versions of the HDMI specification. This allows stunning rendering of over one billion colors in unprecedented detail.

Broader color space:

HDMI 1.3 adds support for the xvYCC color standard, which removes current color space limitations and enables the display of any color viewable by the human eye.

New mini connector:

With small portable devices such as HD camcorders and still cameras demanding seamless connectivity to HDTVs, HDMI 1.3 offers a new, smaller form factor connector option.

Lip Sync:

Because consumer electronics devices are using increasingly complex digital signal processing to enhance the clarity and detail of the content, synchronization of video and audio in user devices has become a greater challenge and could potentially require complex end-user adjustments. HDMI 1.3 incorporates automatic audio syncing capabilities that allow devices to perform this synchronization automatically with total accuracy.

New HD lossless audio formats:

In addition to HDMI's current ability to support high-bandwidth uncompressed digital audio and all currently-available compressed formats (such as Dolby® Digital and DTS®), HDMI 1.3 adds additional support for new lossless compressed digital audio formats Dolby TrueHD and DTS-HD Master Audio™.

Version 1.4

HDMI Ethernet Channel

The HDMI 1.4 specification adds a new networking data channel for use with an HDMI cable enabling high-speed bi-directional (full-duplex) communication based upon the industry proven 100Base-TX, IEEE 802.3 standard. Consumer electronics connected devices that implement this feature can send and receive data via 100 Mbps (Fast) Ethernet through the HDMI cable, which significantly simplifies connectivity for consumers. The HDMI Ethernet Channel supports applications and networking protocols that can run over an existing Ethernet, including TCP/IP, LiquidHD™ and others. The HDMI Ethernet Channel feature allows an Internet-enabled HDMI device to be able to share its Internet connection with other HDMI devices without the need for a separate Ethernet cable. For an example, a DTV with an integrated Ethernet switch can distribute the Internet connection to the HDMI devices connected to it over HDMI 1.4 or create a local network with the direct connected devices so they may share applications and media using LiquidHD. The HDMI Ethernet Channel also provides the connection infrastructure to allow HDMI-enabled devices to share content between devices and to establish a whole home network such as defined by the LiquidHD protocol. This includes recording and playback applications.

Audio Return Channel

For most consumer electronic applications, video and audio content originate in the source device such as DVD player or set-top-box and are transmitted to the digital TV. Because of this typical usage scenario, the HDMI cable was originally a "unidirectional" audio/video data interface from the HDMI source device to the TV sink device. For broadcast applications, such as U.S. HD terrestrial broadcast reception, audio is received by digital TV tuner and then must be transmitted back to the A/V receiver for decoding and surround sound playback over S/PDIF. Now, using the Audio Return Channel feature of HDMI Specification Version 1.4, audio can be sent directly from the digital TV back to the A/V receiver or home theater system through the existing HDMI cable, eliminating the need for a separate audio cable. Whether a TV is receiving or sending audio signals through the HDMI cable, devices previously supporting Auto-LipSync functionality using HDMI 1.3 will continue to function properly. The Audio Return Channel conforms to the IEC 60958-1 standard and supports the same audio formats as an S/PDIF audio connection, including Dolby® Digital, DTS, and PCM audio.

3D Over HDMI

TV studios and consumer electronic manufacturers are beginning to address the consumer's fascination with the realism of 3D movies and games. While there are numerous 3D TV technologies being demonstrated in the marketplace, it's clear that 3D TV content will eventually be available on Blu-ray Discs for playback on next generation 3D digital TVs. The HDMI Specification Version 1.4 outlines a wide range of mandatory

and optional 3D formats. The HDMI 1.4 specification describes the input/output portion of a home 3D system, such as dual-stream 1080p resolution where each picture frame requires two images to achieve the 3D effect. The specification mandates two formats (1080p with 24 frames/sec or 720p with 60 frames/sec) for 3D TVs and either of the two formats for source devices like Blu-ray Disc players and game consoles.

4K x 2K (Quad HD) Resolution Support

Digital image quality has been a moving target ever since the demise of VHS analog video and its transition to standard definition MPEG-2 digital DVD discs and now high-definition H.264 Blu-ray content. As LCD panels and DLP screens continue to increase in size with reduced prices, the highest HD resolution (1080p) is just not enough to satisfy high-end entertainment systems market requirements. Enter “4K x 2K” resolution (4096 × 2160), about 4 times the resolution than today’s best HD resolution. 4K x 2K resolutions are already state of the art in many digital theaters and will be available for high-end home theater displays in the near future. HDMI Specification Version 1.4 has anticipated these market requirements by supporting the following two 4K x 2K resolution formats:

- ◆ 3840 x 2160 pixels (equals exactly 4x1080p size) with 24Hz, 25Hz or 30Hz progressive frames/sec.
- ◆ 4096 x 2160 pixels with 24Hz progressive frames/sec. High Speed HDMI Cables (Category 2) are required to support 4K x 2K resolutions.

Expanded Support For Color Spaces

A color space is a particular standard for consistently defining colors. Examples are RGB (red, green, blue) and YCbCr (luminance, chrominance blue, chrominance red) used for the definition and display of video and images. Currently, HDMI 1.3 specification supports numerous color spaces. The HDMI Specification Version 1.4 increases the number of supported colorimetry standards with a focus on those color spaces used by digital still cameras (DSCs). Together with the new “Real Time Content Recognition” (described below), the color space features of HDMI Specification Version 1.4 improve the display quality of digital still camera images and increases the consistency and accuracy of color representations between DSCs and HDTVs.

The additional color spaces defined in HDMI 1.4 are:

- ◆ sYCC601 (Annex F of IEC 61966-2-1/Amendment 1)
- ◆ AdobeRGB (IEC 61966-2-5)
- ◆ AdobeYCC601 (Annex A of IEC 61966-2-5).

Real Time Content Recognition

Different types of video content possess specific characteristics for which the image can be optimized in the digital TV’s pixel processor prior to display. Content may be natural or synthetic and it can be moving or still content. Some examples are cinema, still camera photos, artificial images such as games and cartoons as well as text or graphics. HDMI 1.4 specifies signaling that designates the type of content being sent to a TV. This information allows real-time adjustments in the TV to optimize the display of video data on the screen, automatically improving the picture. Consumers today have to know the content type and manually change the video mode in their TVs for optimized display.

Micro HDMI Connector

The Micro HDMI Connector is a significantly smaller 19-pin connector that supports up to 1080p resolutions for portable devices. This new connector is approximately 50% smaller than the size of the existing HDMI Mini Connector.

Automotive Connection System (Connector Type E)

The Automotive Connection System is a cabling specification designed to be used as the basis for in-vehicle HD content distribution. The HDMI 1.4 specification will provide a solution designed to meet the rigors and environmental issues commonly found in automobiles, such as heat, vibration and noise. Using the Automotive Connection System, automobile manufactures will now have a viable solution for distributing HD content within the car.

HDMI Version Support Table

HDMI Version	1.0	1.1	1.2 & 1.2a	1.3	1.3a-c	1.4
sRGB – Color space	✓	✓	✓	✓	✓	✓
YCbCr – Color space	✓	✓	✓	✓	✓	✓
8 channel 24-bit audio	✓	✓	✓	✓	✓	✓
Blu-ray	✓	✓	✓	✓	✓	✓
Consumer Electronic Control CEC	✓	✓	✓	✓	✓	✓
DVD Audio	✗	✓	✓	✓	✓	✓
Super Audio CD	✗	✗	✓	✓	✓	✓
Deep Color	✗	✗	✗	✓	✓	✓
xvYCC – Color space	✗	✗	✗	✓	✓	✓
Auto lip-sync	✗	✗	✗	✓	✓	✓
Dolby TrueHD	✗	✗	✗	✓	✓	✓
DTS-HD Master Audio	✗	✗	✗	✓	✓	✓
Updated CEC command set	✗	✗	✗	✗	✗	✓
Ethernet channel	✗	✗	✗	✗	✗	✓
Audio return channel	✗	✗	✗	✗	✗	✓
3D over HDMI	✗	✗	✗	✗	✗	✓
4k x 2k resolution	✗	✗	✗	✗	✗	✓

What is Dolby TrueHD?

Dolby TrueHD is Dolby's latest lossless technology, developed for high-definition disc-based media. The sound is bit-for-bit identical to the studio master, so listening at home is like being in the studio while the movie or video is being mixed, or at the sound board at a live concert. With Dolby TrueHD, the listener hears exactly what was captured during the recording and mastering process.

2.3. Can I convert my current signal to HDMI?

If you have a source that has a DVI input you can use an HDMI cable with a simple HDMI to DVI converter. This is because HDMI and DVI are both digital signals. HDMI is fully backward compatible with DVI compliant devices. HDMI DTVs will display video received from existing DVI-equipped products, and DVI-equipped TVs will display video from HDMI sources. However, some older PCs with DVI are designed only to support computer monitors, not televisions. Consumers buying a PC with DVI should make sure that it specifically includes support for television formats and not just computer monitors.

Also, consumers may want to confirm that the DVI interface supports High-bandwidth Digital Content Protection (HDCP), as content that requires HDCP copy protection will require that both the HDMI and DVI devices support HDCP to properly view the video content.

Converting from composite, component or S-video all require a digital to analog conversion. This can be technically done using various switches and converter boxes. The results can however be disappointing.

Because HDMI is a digital interface, it provides the best quality of the video since there are no lossy analog to digital conversions as are required for all analog connections (such as component or S-video). The difference is especially noticeable at higher resolutions such as 1080p.

Generally it is better to invest in devices that support HDMI so you avoid any further processing of your signal which can degrade your picture and sound quality.

Signal conversion?

When ever you convert a signal you introduce another level of processing and another level of connection which will lead to a higher probability of audio and video degradation. In today's world of consumer electronics deflation it is better to consider upgrading your video source or display, rather than further processing your signal.

2.4. Tell me about the cable categories?

There are two categories of cable that can be used in HDMI connections:

Standard (Cat 1):

Supports screen resolutions of 480p, 720p, and 1080i or a frequency response up to 74 MHz.

High-Speed (Cat 2):

Supports screen resolutions of 480p, 720p 1080i, 1080p at 60 frames per second, and 1080p at 120 frames per second it also supports "Deep Color" or a frequency response up to 340 MHz.

What this says is that a standard HDMI cable supports up to 1080i and doesn't have to support 1080p and a high-speed HDMI cable supports 1080p/60 and 1080p/120 Deep Color.

Does this mean that you can only get 1080p/60 with high-speed cable products?

Well, yes and no. You can get 1080p/60 with high-speed, but you may also get 1080p/60 on standard cable if it is well made. There are no guarantees though.

As long as a standard cable can pass 1080i, it has met the basic requirements. If it is not identified as passing 1080p/60, choose another brand.

What is Deep Color?

Deep color expands the colors on the display from millions to billions. This gives a vividness and color accuracy which has not been seen before in display technology. Deep Color gets rid of the on-screen color banding, for tonal transitions that are smooth and graduations of color that are very subtle. It enables increased contrast ratio, and can represent many times more shades of gray between black and white.

2.5. What does the future hold?

HDMI has reached an installed base of more than 850 million devices and now touches almost every consumer device that plays HD content.

There is no doubt that HDMI has now become the entertainment industry standard and that the computer industry is increasingly adopting HDMI to enable true transparent convergence. Purchasing quality HDMI cables and accessories will future proof your entertainment investment.

The HDMI standard continues to grow in the marketplace with now over 850 adopters worldwide. According to market research firm In-Stat, over 400 million HDMI-enabled devices are expected to ship in 2009, and by the end of 2009, every digital TV will have at least one HDMI input. One billion devices have been shipped since the standard was ratified.

3.The HDMI Cable

3.1. It's just a cable, isn't it?

An HDMI cable is a complex device that has 19 different wires that are used to transmit various signals from your source to the display. HDMI cables need to be certified and tested before they can be marketed using the official HDMI logo.



Only cables that bare this mark are guaranteed to work correctly. Due to the materials and precision required to make an HDMI cable it is impossible to do at home. Many high quality HDMI cables also have sophisticated filtering and shielding technologies incorporated within the cable itself.

Can I make my own HDMI cables?

Due to the materials and precision required to make an HDMI cable it is impossible to do at home. All HDMI cables need to be manufactured in a certified factory that conforms to specific build qualities and uses specified raw materials.

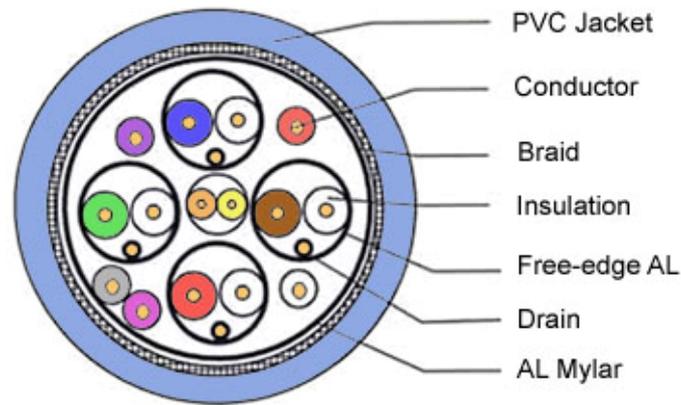
3.2. What makes for good HDMI cable construction?

Here is where we are going to get a bit technical. If you don't want to go through all of this geek speak, simply go to the end of the section for a summary and checklist.

HDMI cables are precision products. To get an idea of the complexity of constructions check out this photo.



You can see that as well as the 19 wires, multiple levels of insulation and shielding form key elements of the cable construction. Let's look at a simpler diagrammatic representation of an HDMI cable cross section.



In this illustration you can clearly see the four twisted pairs that are responsible for most of the work of the cable. This diagram refers to a version 1.3 c cable, if it was a 1.4 version there would be five twisted pairs and additional insulation and shielding. These pairs carry the color, sync and clock signals. As signals travel along these cables they tend to become weaker (attenuate) and they can drift out of phase. Tightly controlling a cable's impedance will enhance its ability to keep the signal in phase over distance.

A lesser-quality cable is constructed of bundled, twisted strands of conductive material, up to 200 to 2,000 strands per bundle. As the signal wants to travel the path of least resistance (down the outside of the bundle), all those twisted strands inhibit transmission. They draw the signal from the outside of the bundle to the inside, where it has to fight to get back to the outside again. The result is distortion. Lost data. Poor picture and sound quality. A quality cable will be made with conductors that have around seven strands.

Premium cable makers manufacture their cables with the highest quality, perfectly gauged, solid-core, copper and silver conductors. Each conductor strand is precisely loomed, not twisted, into the final cable bundle; and it's important to note that the maximum number of strands premium cable makers use in their longer cables, necessary for flexibility, is only 32. That's appreciably fewer than 200, and a lot fewer than lesser-quality manufacturers' 2,000 strands. Once the conductor has been constructed, it is wrapped in the dielectric. (insulating material) This keeps the cable at peak performance by absorbing as little energy as possible and avoiding the reintroduction of energy (distortion) into the conductor.

As the HDMI signal is digital some people think that it is either on or off. It's true that if a digital video signal stays intact from one point to another, there's no degradation of the image. The digital signal can degrade, in electrical terms, considerably over a distance, but if at the end of that distance the bitstream can be correctly reconstituted, it doesn't matter what degradation the signal suffered.

The HDMI signal will fail if attenuation is too high, or if signal goes out of phase so that the receiving unit can't reconstitute them accurately. You will often see this as sparkles on the video image or gaps in the audio. The first sign of an HDMI signal failure is digital dropouts - these are referred to as "sparkles". This happens because a pixel or two can't be read. When these drop outs are seen, total failure is not far away.

Crosstalk from the other pairs in the HDMI bundle can also contribute uneven and essentially random noise which will degrade the signal.

So how do we stop the signal from degrading (attenuate), going out of phase (impedance) or picking up crosstalk?

Wire Gauge

Signals degrade due to resistance. As a cable gets longer or the diameter of the wire gets smaller the resistance increases. Also the material used to make the wire makes a difference. Generally speaking as the length of your cable goes up, the thickness of the wire should also increase. To make things just a bit more complicated the measurement used for wire gauge works like this. The lower the number the thicker the wire. So 24AWG wire is thicker than a 26AWG. HDMI cables are most commonly available in 30AWG,

28AWG (standard short length) and 24AWG (thick for longer lengths). The 24AWG has conductors more than twice the size of those in the 28AWG, and hence can carry a wider bandwidth digital signal, usually required for longer lengths. Many manufacturers use 28AWG up to 7 or 8m, and upgrade to 24AWG for lengths of 10m or more. Some of the very high end cables aim for extreme bandwidth capability by using 26AWG or 24AWG even on short lengths.

Shape & size of the paired wires

Wire is never perfect; its dimensions and shape vary from point to point, and small dimensional variations can cause significant impedance changes. Wire can suffer from periodicity because it's been drawn over a wheel, during manufacture that was minutely out-of-round, this periodicity will cause the wire to resonate at particular wavelengths, which can destroy a signal. The two wires in the pair need not to wander in relation to one another; as they open up or are pressed tightly together because of tensioning on the wire-twisting machine, or because the finished cable is being flexed, the impedance changes. This can destroy your signal.

Quality of the insulation on the four main wires.

The plastic insulation has to be consistently extruded to the correct diameter (and fractions of a millimeter are critical); if it's foamed, it needs to have highly consistent bubble sizes so that one side of the insulation isn't airier than another, or one metre airier than the next. This can destroy your signal.

Quality of the shield over the paired wires

The shield is a factor in the impedance as well, because both signal wires have capacitance to the shield, and if the foil is wrapped more tightly in one place and more loosely in another, that, too, will cause impedance to vary. This can destroy your signal.

The best one can do is to hold impedance within a range, centered on 100 ohms; the official HDMI specification calls for 100 ohms plus or minus 15%. The tighter that tolerance can be kept, the better the performance will be.

So you can see that the performance of an HDMI cable is reliant on hundreds of variables that can only be controlled at the manufacturing stage of cable construction.

HDMI Licensing LLC polices the use of the official HDMI logo. To use the official HDMI logo manufactures must employ stringent quality standards. Factories must be certified and test certificates must be issued for the products manufactured.

3.3. Copper, or Silver, is there a difference?

There are four main conductor materials, used in HDMI cables;

OFC - Oxygen Free Copper,

Many owners of high-end audio and video equipment value oxygen-free copper. Behind this demand is the belief that oxygen-free copper will have enhanced conductivity or other electrical properties that are significantly advantageous to audio signal transmission. The higher the purity the better, expressed as a percentage of pure copper vs. other materials. E.g. 99.9999% OFC contains contamination of only 0.0001% other metals, in other words very pure. In practice the differences in conductivity are less than 1% at normal room temperature. It can however be correctly stated that oxygen free copper is superior to tinned copper due to the much higher conductive properties of copper over tin.

TC - Tinned Copper,

This is an oxygen free copper coated in a fine layer of tin plating. This is the most common construction found in HDMI cables, the tin plating, increases the durability and ease of production and termination of HDMI cables. Although tinned copper is normally more expensive to produce than straight oxygen free copper, tinned copper HDMI cables are made in far greater numbers, due to the ease of manufacture.

SPC - Silver Plated Copper,

Silver plated copper is the better and more preferable option over the more common tinned copper, or even the less common oxygen free copper HDMI cables. Silver is the most superior of conductors, the use of this expensive material in coating the copper improves the flow of the bitstream, reducing digital "jitter". The result is a more intense picture with less digital artifacts. Some users report that silver cables also contribute to a more dynamic sound. The actual silver content plays less of a role than the quality of the silver used, and the method of plating.

Pure Silver,

The use of pure silver in HDMI cables is extremely expensive, and probably unnecessary. The "skin effect" which is present in HDMI cables negates the need for silver at the core of each conductor, so the extra cost of getting pure silver is not justified. As bandwidth is a major consideration in HDMI cables, the cost of the required gauge of HDMI in pure silver would be prohibitively expensive.

So if you are a multi millionaire with a \$100,000 home theatre system and you have the ears of a bat you should certainly go for pure silver.

For the rest of us if we are buying shorter cables silver plated copper is certainly the best way to go, for longer cables the best value choice is oxygen free copper.

Warren can afford Pure Silver HDMI cables.

In 2006 Warren Buffett, the worlds richest man, earned \$184,000 for every business day. On this he paid 17.7% income tax.

3.4. Gold plated connectors?

Gold is not as good a conductor as either silver or copper, so gold plating does not improve performance over raw brass (the most common connector raw material). What gold is great for is its incredible resistance to corrosion. High purity gold does not tarnish. Therefore the use of gold plating will ensure that the connector remains in the same operational state, free of tarnish, indefinitely. This will lead to less resistance over time.

An unparalleled combination of chemical and physical properties make gold invaluable to a wide range of everyday applications. One of the most important of these properties is gold's virtual indestructibility. Gold is the most non-reactive of all metals. It is called a "noble" metal (an alchemistic term) because it does not oxidize under ordinary conditions, meaning that it will never rust and never tarnish. Gold's physical properties of high electrical conductivity and chemical inertness make it an excellent and reliable conductor, particularly in harsh environments.

3.5. What to look for in a quality HDMI cable?

You will need to invest in higher quality cables if you are running distances of more than 5 meters, or you are running a 1080P large screen display, 100Hz display, blu-ray player or gaming console.

Cable Gauge – 24 AWG cable is better than 26, 28 or 30 AWG

Cable material – Silver coated copper is best followed by OFC then tinned copper.

Connectors – 24k gold plating is preferable for longevity of signal quality.

Impedance – look for 100 Ohms +/- 10 Ohms.

Make sure the cable carries the official HDMI logo.

Unfortunately few HDMI cable makers will release their specification sheets or compliance testing certificates. Sometimes, all you can do is install a cable on a given set of devices, and see if it works. That may not be the most satisfying answer, but it is often the only answer there is. For this reason it is important to make sure you get a no quibble money back guarantee.

4.The HDMI Connector.

4.1. What's the difference between A, B, C & Micro?

There are four HDMI connector types with Type A and Type B defined since the HDMI 1.0 specification Type C since the HDMI 1.3 specification and Micro since the 1.4 specification. Connectors come in both male and female versions. Typically the cable used to connect from source to display will be a male to male cable. Cables used as extensions will be male to female.

The Type A connector has 19 pins with bandwidth to support all TV modes. The plug's outside dimensions are 13.9 mm wide by 4.45 mm high. Type A is electrically compatible with single link DVI-D.



The Type B connector has 29 pins (21.2 mm by 4.45 mm) and can carry double the video bandwidth of Type A for use with very high-resolution future displays such as WQXGA (3840x2400). Type B is electrically compatible with dual link DVI-D but has not yet been used in any products.

The Type C mini-connector is intended for portable devices. It is smaller than the Type A connector (10.42 mm by 2.42 mm) almost half the size, but has the same 19 pin configuration. The numbers of pins are the same but the signal assignment is different because of the different shielding requirements due to the signals being in a single row. The differences are:

1. All positive signals of the differential pairs are swapped with their corresponding shield,
2. The display data channel/Consumer electronics control ground is assigned to pin 13 instead of 17,
3. The consumer electronic control is assigned to pin 14 instead of 13,
4. The reserved pin is assigned to pin 17 instead of 14.

It can be connected to a Type A connector using a Type A-to-Type C connector cable or adaptor.

The Micro connector is 50% smaller than the mini connector and is intended for use in devices such as digital cameras, and ultra portable devices.

**What is Display Port?**

Another audio/video interface is DisplayPort, which had version 1.0 approved in May 2006 and is supported in several computer monitors. DisplayPort is expected to complement HDMI. Most of the DisplayPort supporters are computer companies. DisplayPort has an advantage over HDMI in that it is currently royalty free, while the HDMI royalty is 4 cents per device and has an annual fee of \$10,000 for high volume manufacturers. HDMI has a number of advantages over DisplayPort such as support for the xvYCC color space, Dolby TrueHD and DTS-HD Master Audio bitstream support, Consumer Electronics Control (CEC) signals, and electrical compatibility with DVI.

5. Other HDMI Hardware.

More and more HDMI hardware is emerging every day. Some of it good and others not so good. You must keep in mind that introducing hardware into the HDMI chain will effectively increase the length and will moderate the signal to some extent. The rule of thumb is less is better. Having said that, here is a brief summary of the types of hardware that you might encounter in your research.

5.1. HDMI Switch and switchers.

With the increased number of home theater components equipped with HDMI connections, such as DVD players, DVD recorders, Blu-ray players, HD-DVD players, and Satellite and Cable Boxes, one or two HDMI inputs provided on many display devices or home theater receivers is not enough. An HDMI switcher is a possible solution to this problem. The HDMI switch allows two HDMI devices to be switched easily in to one HDMI compatible monitor or projector. The HDMI Switch can also be placed at the end of a long HDMI cable to regenerate the HDMI signal.

An HDMI switcher may work perfectly well in one setup and then not work in another setup because of a different combination of home-theater components.

5.2. HDMI Splitters.

An HDMI splitter is designed to take the HDMI signal and split it to drive multiple display devices. Generally splitters are not bi-directional. You can not combine HDMI signals from multiple sources to drive one display device using a splitter. An HDMI switch should be used for this purpose. Splitters can be powered or passive. Using a passive splitter will result in your signal being degraded to both display devices.

5.3. HDMI Adapters.

HDMI

You can convert HDMI type A and type C male and female connectors simply using standard adaptors. However each connection will degrade the signal slightly and lengthen the overall HDMI connection length.

DVI

A DVI signal is electrically compatible with an HDMI video signal; no signal conversion needs to take place when an adapter is used, and consequently no loss in video quality occurs. As such HDMI is backward compatible with Digital Visual Interface digital video (DVI-D or DVI-I, but not DVI-A) as used on modern computer monitors and graphics cards. This means that a DVI-D source can drive an HDMI monitor, or vice versa, by means of a suitable adapter or cable. However, the audio and remote-control features of HDMI will not be available. Additionally, not all devices with DVI input support High-bandwidth Digital Content Protection (HDCP). Without such support by the device, an HDCP-enabled signal source will suppress output and so prevent the device from receiving HDCP-protected content.

Display Port

The video signal from a Displayport device is not compatible with DVI or HDMI, but a DisplayPort connector can pass these signals through. While DVI and HDMI require separate clock signals, DisplayPort embeds the clock in the data signal. What this means is that your source device needs to output either HDMI compliant signals or Displayport and you need to select accordingly. You can then use an adapter to pass through the appropriate signal.

5.4. HDMI Extenders.

To use longer HDMI cable or cables, active boosters are necessary to compensate for losses. HDMI cable becomes thicker, stiffer and heavier with increasing cable length, making it difficult to use in many applications.

The HDMI extender is a single or pair of active devices that are powered with an external power source or with the 5V DC power from the HDMI source. Plain copper HDMI cable is capable of 12 to 15 meters while wireless HDMI is capable of 10 meters. HDMI extenders based on dual Category 5/Category 6 cable can extend HDMI to 50 meters while HDMI extenders based on optical fiber can extend HDMI to 100+ meters. A new extension technology has now been developed that uses coax cable.

Cat5/6

Companies have developed the HDMI over UTP type extender to use CAT-5 or CAT-6 cable, which is much thinner, softer, and lighter. Most extenders use two cables to extend the 4-pairs of TMDS signals for video, and two or three control signals for the DDC and HDCP. Some extenders use single CAT-5 or CAT-6 UTP though they must be sure to multiplex the DDC channels. To avoid electro magnetic interference problems, CAT-6 cables are recommended.

The transmitter converts HDMI for transmission over Cat 5/6, and is converted back to HDMI by the receiver at the display end. Typical reaches are 150 feet at 1080p resolutions. There are some solutions on the market that claim reaches of 450 feet and beyond at 1080p. However, these solutions are not all-digital and actually do a digital-to-analog conversion to get the reach. This not only defeats the purpose of installing HDMI, a digital interconnect, but also sacrifices video quality as it leads to data loss due to the analog conversion process.

Cat 5/6 is a very lossy medium, susceptible to skew and crosstalk. So not all marketing claims of reach match reality. Because of the cable medium, solutions are limited in distance (150 feet) and data rate (165MHz or 1080p 8-bit color).

Optical Fiber

These solutions enable long reach HDMI over optical fiber. Due to the lower losses in optical links than copper, optical solutions can provide longer reach – up to 300 feet at 1080p resolutions. Optical solutions come in two flavors – as cables with active electronics needed to convert between electric and optical pulses

built inline into the cable, or as discrete transmit/receive extenders similar to the Cat 5/6 extenders discussed above.

Inline cables are complete solutions offered in varying lengths from 35 feet up to 300 feet with support for 1080p resolutions. Typical costs are approximately \$900 for a 150ft solution and \$1800 to \$2000 for a 300ft solution. Most extender boxes require a 4-strand LC optical fibre cable for the HDMI data and clock, and a single Cat5 cable for transmitting HDCP. Typical costs are \$900 - \$1000 for 150 feet, and up to \$1500 for 300 feet at 1080p, depending on the extender and cables. The drawbacks of optical installations are higher costs and the inability to terminate optical fiber.

Coax Cable

This relatively new technique consists of a transmitter / receiver pair that convert HDMI signals for transmission over RGBHV or RGSB cables. The benefits of this solution are long reach (up to 330 feet at 1080p resolutions), the ability to easily terminate connections in the field, and an easy upgrade path for existing RGBHV or RGSB cables in office or commercial installations. It also offers a performance benefit over existing Cat 5/6 and optical solutions as it is Category 2 certified. Cable costs are higher compared to Cat 5/6 solutions, although still significantly cheaper than optical solutions. Typical costs are expected to be \$700 for 150 feet, and \$1000 for 300 feet installations, depending on the extender and cables.

5.5. HDMI Amplifiers.

The HDMI signal can be amplified to enable it to travel longer distances.

Often a HDMI splitter and distribution amplifier refer to the same thing. The term "distribution amplifier" however confirms inherently that it is a powered device which amplifies the signal. A good HDMI distribution amplifier will buffer the incoming signal, perhaps even making allowance for input level and cable length, ensuring that each output is identical and equivalent in level and performance to the original source device.

6. Frequently Asked HDMI Questions

6.1. It's not always the cable at fault.

We have searched the web and trawled all of the forums to compile a pretty exhaustive list of HDMI frequently asked questions. Before you return your cable to the maker for a refund check through these questions. You may find an easy fix to your problems.

What does AWG or gauge mean, and is there any particular number that I should be using?

AWG stands for American Wire Gauge. It is an internationally accepted standard (but not the only one) for determining the relative sizes of electrical conductors. The thicker the conductor, the lower the number. HDMI cables are most commonly available in 30AWG (very thin, especially used in the I.T. sector), 28AWG (standard short length) and 24AWG (thick for longer lengths). The 24AWG has conductors more than twice the size of those in the 28AWG, and hence can generally carry a wider bandwidth digital signal, usually required for longer lengths.

Are there any length restrictions with HDMI cables?

There is no length restrictions quoted in the HDMI specification. There is however bandwidth restrictions of which are determined by the manufacturer's own R&D, and these do dictate maximum lengths. HDMI Licensing suggests that all manufacturers should be able to produce "Standard" cables to full performance up to 5m in length. Some better manufacturers have pushed the envelope to produce cables up to as much 25m, or even longer with active boosting.

Can I use my existing HDMI cables with the new HDMI 1.3 specification?

Maybe. It depends on the bandwidth capabilities of your existing cables. Some manufacturers have been making cables which have had bandwidth capabilities in excess of the new HDMI 1.3 requirements, so they will be fine. The connector and pin configuration has not changed, so the only thing to check is the bandwidth. Some brands may be fine up to 3m or so, but it's highly unlikely that longer lengths of 1.2a specification cables can be used for 1080p resolution displays.

What is the difference between HDMI, DVI and regular component video?

All 3 formats transmits video in component format, R,G,B. The fundamental difference between HDMI, DVI and the 3 wire component video is that HDMI and DVI carry the RGB signals in native digital format. The 3 wire component video carries the RGB in analog format. Since all new DVD, Set-top box MPEG decoders output in digital format, it is better to transmit digitally from the source to the monitor. In theory, this gives you the best performance since the analog to digital conversions needed to support the analog component video is eliminated.

I bought an HDMI to DVI cable. I get VIDEO but no audio. Why?

While HDMI technology offers both a video and audio solution, DVI technology only offers video only. Thus, when using an HDMI-DVI cable, the sourced HDMI audio signals within the cable are terminated and are not supplied to the DVI end of the cable. Your only solution is to run an additional cable for the audio Either a standard RCA 2 wire cable, Toslink optical, or 1 wire RCA/digital audio.

What is the main difference between HDMI and DVI?

Fundamentally, the video portion of HDMI is same as DVI. The main difference is that HDMI also carries multichannel digital audio. DVI only supports video. HDMI is backward compatible with DVI.

Can I distribute HDMI over standard Ethernet Cables?

It is possible to distribute HDMI over a pair of standard Ethernet cables by using HDMI to Ethernet converters. The HDMI Ethernet converter enables transmission of 1080P HD HDMI digital video and audio over a pair of standard Ethernet CAT5/6 cables. Using HDMI to Ethernet converters allows transmission of 300ft (91metre) for 1080i and 150ft (45 metres) 1080p over Ethernet cables.

I just hooked up my new HDMI cable and there is no picture or sound, help?

If you encounter audio/video problems after making your HDMI connections, follow these easy troubleshooting steps.

Check your cable connection and make sure it is securely plugged in to the correct input/outputs on your components.

It's also possible that you have one of the components turned off or connected improperly. Trace your cables and make sure they're all going where they should. That tangle of cables may seem confusing at first, but be patient and follow one at a time.

Make sure the video and audio outputs on your sources (Satellite, Cable, DVD, or other) are set to HDMI. This can be changed within each component's menu system.

Make sure the video and audio inputs on your HDTV or projector are set to HDMI. This can be changed within your display's menu system.

If you're not getting a proper signal from your DVD player, your TV's resolution may not match the DVD player's resolution. Most DVD players have 480p as a default resolution, so you'll need to change this to match your TV. Look for a button or menu option labeled "720p", "1080i", "HDMI select", or something similar. You may need to press it a few times to get the right resolution for your TV.

It's also possible that your TV is not compatible with some of the compressed multi-channel audio formats HDMI carries (specifically Dolby Digital, DTS, or MPEG). To correct this, you should be able to set your TV's digital audio to PCM. This is an analog conversion setting. You may also need to turn on your TV's PCM down-sampling setting. Check your owner's manual for help with this.

If a problem persists with cable or satellite receiver, call your regional provider to ensure they are transmitting an HDMI signal. In some cases, the cable box may have an HDMI output but not be outputting an HDMI signal.

If HDMI is not an option, use Component Video. It's the next preferable high-definition video connection, supporting 720p/1080i resolution. And, for high-resolution surround sound use source's digital fiber optic, digital coaxial, or multi-channel analog audio outputs.

If you have a longer length of HDMI cable such as 50ft (15 metres) or longer, your HDMI source might be outputting a weak HDMI signal. You may need a repeater/signal booster particularly if you are also using wall-plates, switches, home theatre systems, cable adapters, or extension cables.

My HDMI signal "sort-of" works. I get red/blue/green/yellow lines across my screen. Why?

If you have multiple connections (Home Theatre system being used to control HDMI video, HDMI switches, wall-plates, extension cables, etc) from your satellite/cable box to your HDTV - try temporarily removing all other possible sources of failure. In other words, run the cable directly from the source to the destination. HDMI signals can and do degrade whenever attaching multiple devices between the source and output - and

if too many devices are involved, this can result in a partial HDMI signal loss. If this does not fix the situation you might have a defective cable.

My HDMI cable works for 720 resolution, but not for 1080 resolution. What's wrong?

Check your cable is HDMI 1.3 category 2. If it is, this issue is possibly a length, or added resistance issue. An HDMI cable will have a quoted length and video mode. Additional equipment in between (switches, home theatre systems, adapters, extension cables, wall-plates) all adds additional resistance to a cable and such resolution may not be possible in its current configuration. You may need to consider a booster/equalizer to obtain the 1080 resolution if this problem continues.

I am using an HDMI Splitter so I can use both my DVD player and satellite receiver to connect to my HDTV because my TV only has one HDMI port. Why do I not get a picture?

HDMI Splitter cables are not intended to channel 2 sources to one HDTV. HDMI signals can not be "combined" using a wire-splitter/adaptor. The splitter is used to output to two HDTV's. Splitting an HDMI signal also greatly reduces the signal strength, and can result in signal loss. An amplifier/repeater might be needed. If you have two devices, and only one port on your HDTV, you will need to consider purchasing an HDMI switch.

I am using an HDMI switch with a longer length of cable, and I don't get a signal.

Why?

First, check to see if you removed the switch, you get a signal. Next, try using (temporarily) a shorter length of cable on both the input side of the switch and the output side of the switch. If you get signal now, then you will need a repeater. This is not a fault of the switch or the cable, but simple physics. Because a switch adds another connection along to its destination journey to the HDTV - and because we are using 2 cables instead of one - there is enough resistance in the cable to cause a signal interruption.

My screen occasionally pops up the "unauthorized" message when viewing via HDMI. Then everything goes back to normal, and my program continues. Why?

The HDMI specification requires a continuous dialog between the source and the TV set in order to manage content protection. For instance, the encryption status of the picture is checked on every single frame, so this decision is being made 30 times a second. If your HDMI connection is marginal (poor cable, too-long cable, kinked cable), that dialog might suffer from occasional interruptions, and your set goes into "informative display" (denied) mode. The problem clears when the signal re-establishes itself.

I get "sparkles" on my picture, what's happening?

Sparkles tell you that you have a video data transmission problem. In most cases this is cable related. It could be that the cable is not performing very well due to its length. Shortening will improve the integrity greatly. There could possibly be a bad connector.

My picture comes on then goes off. Why?

This is a common one. In most cases, it is one of two things. If one or more of the video channels has a high error rate or is not working at all, you'll have this problem. The second case is the HDCP is not getting a new refresh key. You may wish to invest in a better quality cable with larger wire. Remember, the smaller the gauge, the larger the wire diameter.

Speed is today's strategic advantage.

Today's consumer electronics market is moving at an ever increasing pace. Sometimes the time that it takes to distribute products to you via traditional retail channels is the longest part of a products technical life. What this means is that often a product is superseded even before you buy it. HDMI Systems recognized this dilemma and did something about it. We do not sell our products through the traditional retail channel. We hold only one inventory stockpile globally. What this means is that we can get you the latest development sooner.

7.The Last Word.

7.1. Shameless Self Promotion

The-Cable-Store.com

The-Cable-Store.com manufactures and markets a full range of HDMI cables and hardware. The company was established by a group of executives with over 80 years collective experience in the cable industry, who recognized that technology, was moving so fast that there were often large amounts of superseded stock clogging up the traditional retail channel. This together with a lack of readily available consumer information meant that you, the consumer were often paying too much for old technology.

The solution to this problem was to develop a new distribution method that delivered fresher inventory to you faster and provide more information to empower you to make more informed decisions.

Visit our store at:

www.The-Cable-Store.com