ARE ALL HDMI CABLES THE SAME?

THE SCIENTIFIC NO NONSENSE GUIDE TO HDMI CABLES, THE TECHNOLOGY AND THE MARKETPLACE.

The Big Question: *Are all HDMI cables the same ….*

- **Yes**...*because*... A vast majority of branded premium HDMI cables are over priced generic products offering no additional performance over un-branded low priced counterparts.

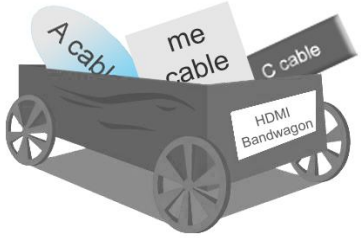
- **No**...*because*... A properly designed performance HDMI cable will have significant advantages over a generic cable.

'The only way this question can be answered satisfactorily is to fully understand the issues surrounding the technology and the manufacture of HDMI® cables.'

1) The HDMI® cable - Manufacturing

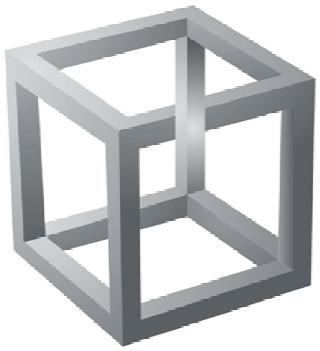
In general, the majority of HDMI® cables are manufactured to very similar specifications and therefore offer the same basic performance. These cables are usually sourced from factories in Asia. So what you get is a generic cable in a variety of different guises carrying different branding.

2) The HDMI® cable - Bandwagon



HDMI® (High-Definition Multimedia Interface) was designed in 2002 and production of consumer HDMI products started in late 2003. In the last few years there has been an explosion in the number of cable brands offering HDMI® cables at premium prices. These cables are often accompanied by ambiguous performance claims and technological buzzwords. Many consumers have bought these products and have been left disappointed. This has sparked a hot debate as to whether Premium HDMI® cables are worth the money they command. This issue has been further complicated by the advocates of ideology such as "Digital is 1's and 0's and therefore the system will work perfectly or not work at all".

3) The Digital Myths and Misconceptions



'Contrary to popular belief, transmission of Digital Audio and Video is by no means perfect. The very fact that extensive use of error correction is employed; is a testimony in its self.'

During transmission, digital signal suffers from data corruption/loss due to a variety of reasons, these include bandwidth limitations, jitter, signal attenuation, crosstalk, external EMI (Electro Magnetic Interference) etc. To counteract these problems digital processing systems employ error correction and/or error reduction techniques.

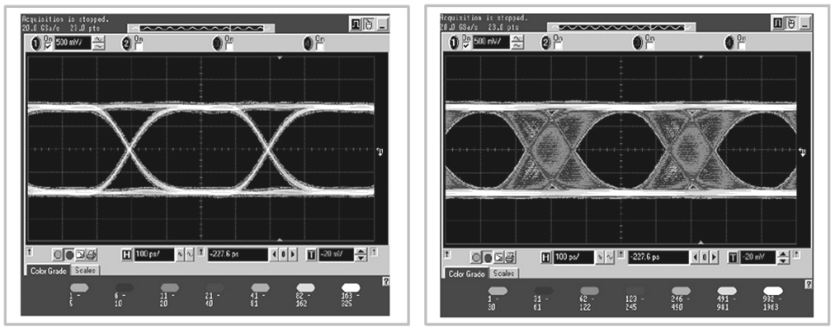
'Real world' digital signal

The common misconception is that since a digital signal comprises of 1's and 0's, the device will therefore work perfectly or not work at all. An ideal theoretical square wave has instantaneous transitions between the High (logic 1) and Low (logic 0) levels. In practice, this is never achieved because of physical limitations of the system.

'It is scientifically impossible to transmit an undistorted ideal square wave through a transmission channel/medium.'

The limitations of digital signal processors and cables create timing errors known as jitter, which remove portions of the signal and replace them with noise and distortion. Cables tend to round off the square waveforms of the signal, making them less clear to the processor, thus increasing jitter. This rounding effect varies greatly among cables and truly superior HDMI® cables can make great improvements in imaging and sound quality.

Another important point to remember is that the digital signal degrades as the length of the HDMI cable increases due to bandwidth limitations.



The difference between a clean signal and a signal with jitter

What is Jitter?

Jitter is the deviation in or displacement of some aspect of the pulses in a high-frequency digital signal. In other words, Jitter is when a signal varies in time or amplitude outside of a mathematical ideal. Jitter is the dominant cause of signal error in a digital system.

The images above (screen shots courtesy of Techtronic) show a relatively clean digital signal (Left) and a signal with severe Jitter (right).

4) Evaluation of HDMI® cables - Audio and Video

It is relatively easy to evaluate the sound quality of a HDMI® cable, whilst the assessment of video can be made difficult due to the 'Processing Engine' present in a display device which manipulates the data to try and compensate for errors and missing data in the video stream. The result is often 'acceptable' performance but still far from the best HD experience that the screen or projector is capable of.

The net effect of all this is that whilst the 'Processing Engine' may allow a basic performance from a poor HDMI cable, the extra processing can also negate the benefits from a good HDMI cable!

'What's more, the design and quality of a 'Processing Engine' is manufacturer specific and even varies between model ranges, this adds further complications to the evaluation process.'

Here are some pointers to allow you to properly assess a HDMI cable:

- Switch off any additional processing in your display device to minimise the masking effect.
- Use high bit rate* Blu-ray discs to provide the best video and audio source material.
- Choose demo material which has fast moving action with lots of detail.
- Do not use animated films.

*A Blu-ray disc can be mastered at difference bit rates. The general rule is; the higher the bit rate the better the picture and audio quality. In addition, the bit rate varies from movie to movie and also changes between scenes, a complex fast scene will use higher bit rate.

Conclusion

An objective evaluation of HDMI® cables is a very complex affair and requires highly developed technical skill and experience. In short, only purchase a premium HDMI cable from a manufacturer that offers comprehensive information and full technical specification about their product.

Benefits of a Premium HDMI® cable

- **Performance:** Improved Audio & Video quality. A good premium HDMI® cable will enable you to get the best out of your AV system. The improvements are system dependant and can be significant.
- **Reliability:** Trouble-free operation. Since the data rate varies considerably and depends upon your set up and source material (e.g. Blu-ray discs), a premium HDMI® cable will work irrespective of this variable. In addition to video & audio signals (TMDS), a HDMI® cable also carries ancillary data e.g. HDCP, E-EDID & etc. HDMI® cable failures can often be related to the poor performance of these lines.
- **Consistency:** Minimal sample variation. Premium HDMI® cables from reputable manufacturers are subjected to tighter quality control.
- **Longevity:** Longer life span. Better quality materials and higher standard of manufacturing process will ensure a longer product life.

Why use WireWorld HDMI® cables?

Digital video and audio signals are continuous streams of data, which are quite fragile, since the digital processor must remain perfectly locked onto the timing of the signal to avoid data losses.
WireWorld HDMI® cables utilize unique designs specifically developed to minimize jitter by providing sharper, cleaner leading edges on the digital waveform. At each price level, they provide the lowest jitter and the widest bandwidth, producing distinct improvements in clarity, image focus, smoothness and dynamic contrast.

WireWorld - History of Innovation

In January 2004, WireWorld introduced the Starlight® 5, the world's first upgrade HDMI® cable. WireWorld was able to achieve this milestone due to its unique position of being an innovative technology company with foresight.

Just one year later, the Silver Starlight® 5^2 introduced WireWorld's proprietary 16 Signal Conductors Symmetricon™ flat cable design, for which WireWorld received the **International CES Innovation award in 2006** awarded by Consumer Electronic Association (CEA). 2010 saw the introduction of a new HDMI® cable design, the 24 Signal Conductors DNA Helix™ (patent pending).

Appendix 1

The HDMI® - Technology

HDMI system architecture is defined as consisting of 'Sources' and 'Sinks'.

Fig 1.1 shows a typical AV system consisting of a Blu-ray player, AV Receiver and a TV.

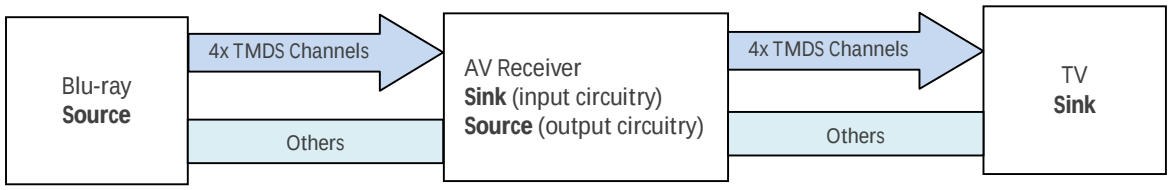
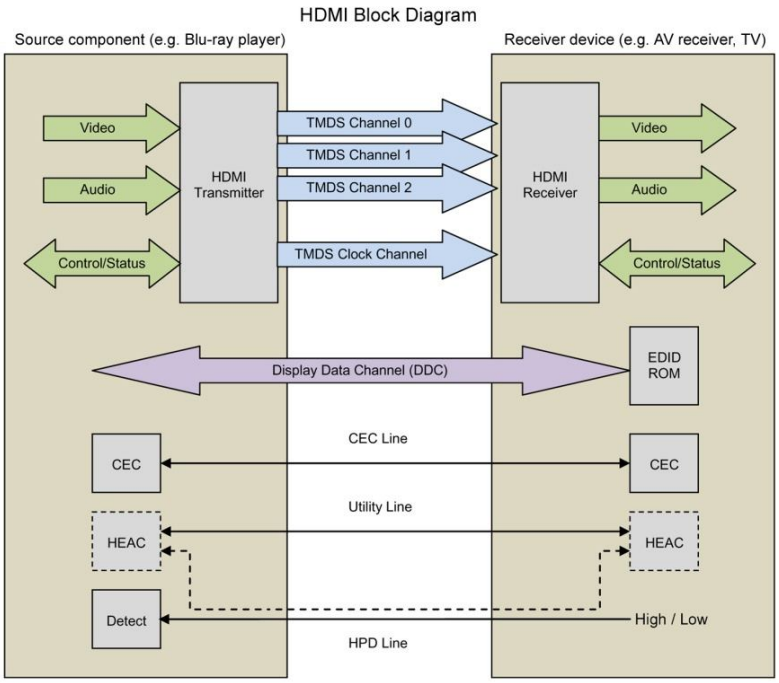


Fig 1.1

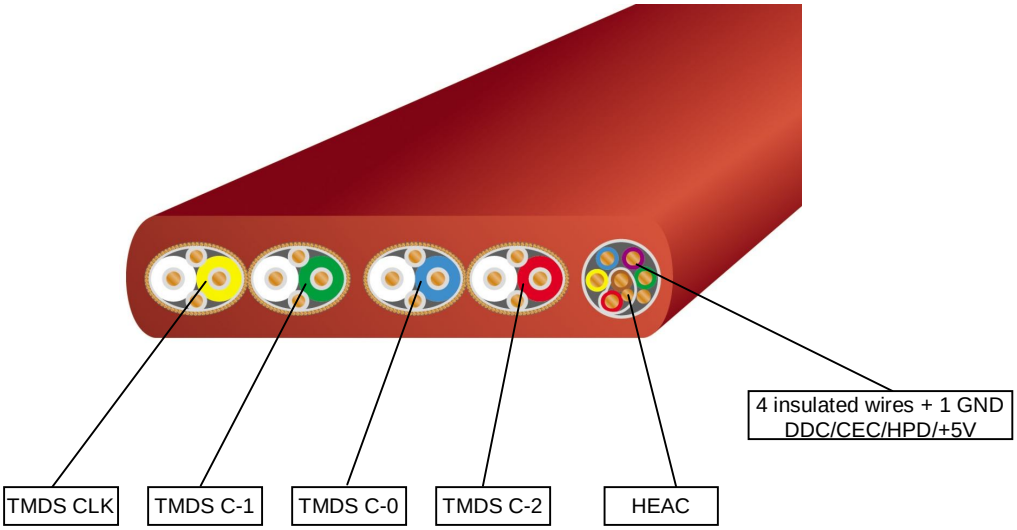
Fig 1.2 – HDMI® Block diagram



Signals travelling inside the HDMI® cable:

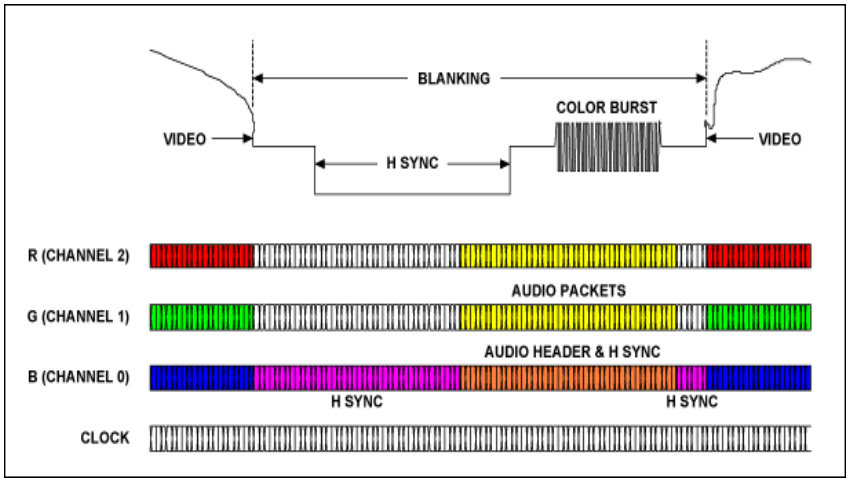
TMDS	Transition Minimized Differential Signaling (4 pairs of wires)	3 digital video signals and 1 clock signal plus multiplexed digital audio signals into the digital video signals.
HEAC	HDMI Ethernet and Audio Return Channel	Ethernet compatible data networking and Audio Return Channel in the opposite direction from TMDS.
DDC	Display Data Channel (SDA & SCL)	Serial Data & Clock (i2C) signals (E-EDID & HDCP).
CEC	Consumer Electronics Control	Data line distributes remote control signals for one touch system controls.
HPD	Hot Plug Detection	Allows the source equipment to detect a connected display in real time.
+5 V	DC +5V	Power line supports remote circuits for communication.

Inside a HDMI® cable (WireWorld Symmetricon™ design)



As shown in figure 1.2, the HDMI® cable carry four different pairs that make up the TMDS data and clock channels. In addition, HDMI® carries a shielded pair and drain within a bundle and further four insulated conductors.

HDMI® employs Transition Minimized Differential Signalling (TMDS) transmitted over 4 pairs of wires to carry video, audio and auxiliary data via one of three modes, called the Video Data Period, the Data Island Period and the Control Period. During the Video Data Period, the pixels of an active video line are transmitted. During the Data Island period (which occurs during the horizontal and vertical blanking intervals), audio and auxiliary data are transmitted within a series of packets. The Control Period occurs between Video and Data Island periods.



Error Reduction/Correction

During the data island period for each channel, every group of four information bits is coded into 10 bits using the TMDS Error Reduction Coding (TERC4). In order to attain the higher reliability required of audio and control data, this data is protected with BCH error correction code and is encoded using a special error reduction coding to produce the 10-bit word that is transmitted.

According to the HDMI Licensing, LLC technical application document, the handling and processing of errors by the sink (TV, projector or AV Receiver) is at the discretion of the hardware manufacturers. There are various techniques in use and the quality of these systems varies from manufacturer to manufacturer.

Error correction techniques

All digital equipment employs some sort of error correction/reduction system. There is a wide range of error correction techniques in use today. However, error correction can generally be realized in two different ways:

Automatic Repeat Request (ARQ):

This is a technique whereby an error detection scheme is combined with requests for retransmission of erroneous data. Every block of data received is checked using the error detection code employed, and if the check fails, retransmission of the data is requested – this is repeatedly done, until the data can be verified.

Computers (Internet) and other communication devices predominantly use Automatic Repeat Request (ARQ) error control and/or Hybrid ARC (a combination of ARQ and FEC).

Forward Error Correction (FEC):

This transmitting system encodes the data using an error-correcting code (ECC) prior to transmission. The additional information (redundancy) added by the code is used by the receiver to recover the original data. In general, the reconstructed data is what is deemed the "most likely" original data.

Digital Audio & Video transmission interfaces, e.g. HDMI interface & USB Digital Audio, employ Forward Error Correction (FEC) techniques.

Date: 23rd August 2011

WireWorld UK

Unit 5, Silicon Business Centre, 26 Wadsworth Road, Perivale, Middx UB6 7JZ, UK

www.wireworldcable.co.uk