A Case for Greener HDMI Ultra-Slim Cables

White Paper

Rev 1.0

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Introduction

The A/V cable business is a large business and represents about 70 percent of the total cable industry. Production continues to rise with a forecasted 15 percent increase for HDMI and DisplayPort cables in 2010 according to Global Sources.

HDMI has established itself as the leading connectivity standard for high-definition consumer electronics and is set to over take and replace older standards such as RCA, composite RCA and S-Video. According to market research firm In-Stat, in 2010 we can expect to see more than 474 million HDMI-enabled products on the market, leading to an installed base of over 1.5 billion world-wide. DisplayPort and SuperSpeed USB are set to displace traditional A/V cables in the PC industry in the next few years. In-Stat projects that SuperSpeed USB enabled product shipments can be expected to reach one billion[1] in 2013. iSuppli forecast up to 263.3 million DisplayPort enabled products shipping in 2012.

Over 70 percent of the world's cables are produced in China. There are up to 2,000 manufacturers based in the Pearl River Delta and Yangtze River Delta regions.

The main raw materials used to construct video cables are PVC and copper and production of these materials is increasing. In 2007, 37 million tons of PVC was produced world-wide. PVC production is expected to rise to 40 million tons by 2016. Global copper consumption was approximately 15 million tonnes in 2006 and rose to over 18 million tonnes in 2009. Clearly mining and production on this scale poses is a serious threat to be considered.

If we now also consider that almost 50% of the world's copper is produced in South America and invariable huge amounts of this will be shipped to China to enable production, and then re-shipped to various global markets such as the US, Europe, etc we now begin to get a picture of the extent of the problem to be addressed.

This paper focuses on HDMI cables as part of this large issue, it shows the potential raw material, shipping and toxin savings which can be gained by introducing semiconductor technology into these cables and clarifies the "green" motivation for a wider adoption of these active cables in the market.

High Data-rate Video Cables

Following the market-wide transition to 'full HD' or '1080p', demands for the ultimate gaming experience and general 3D viewing applications continue to push the need for higher data rate cables for inter-product connectivity.

Today, data rates as high as 3.4 Gbps are required for HDMI applications which support 3D. With increased refresh rates and color depth, this number will go even higher in later versions of the specification. Other audio/video standards such as DisplayPort are moving to 5.4 Gbps and SuperSpeed USB requires 5.0 Gbps. As the data rate goes up the signal suffers increased attenuation. The traditional solution in the market to this problem is to increase the thickness of the cable, increasing the amount of copper decreases the high frequency resistance and thus attenuation in the cable. The following graph shows this effect where the loss @ 3.4Gbps is plotted against the thickness of the cable (AWG is a measure of cable thickness as AWG goes up thickness goes down))

[1] '**Wired USB 2009: High-Speed Rules, SuperSpeed on the Way' and 'External Storage Devices will be among Leading Peripherals for SuperSpeed USB Adoption'**

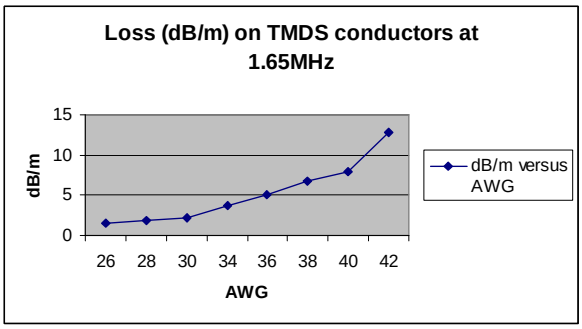

Figure 1: TMDS differential signal attenuation

Clearly then high data rates need smaller AWG conductors (larger outer diameter (OD)) to keep losses to a minimum. Increasing data rates which are required by current AV markets will require even thicker cables if the traditional approach is followed.

Active Cables

As an alternative to manufacturing expensive thicker cables, manufacturers have started looking at other options to achieve their performance needs. One effective solution is to use semiconductor technology to address the attenuation. Such a solution allows manufacturers to use much thinner cables leading to a cheaper but above all a ***greener*** solution. Cables with embedded semiconductors are called 'active' cables.

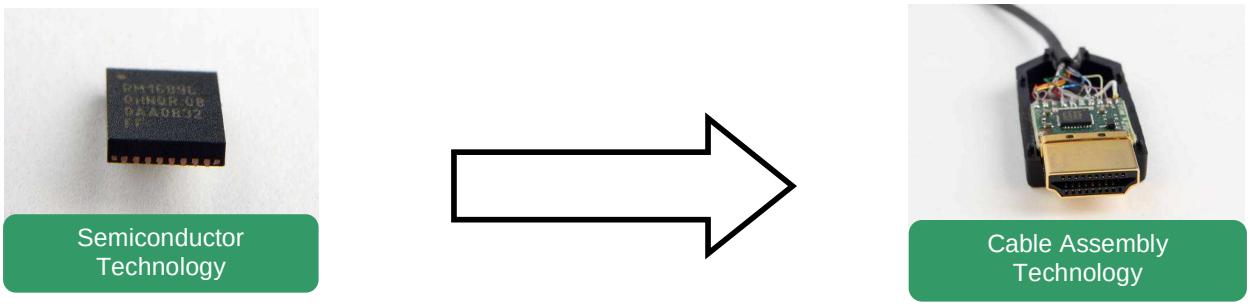

Figure 2: Embedded semiconductor technology in HDMI cables

Using semiconductor technology such as that developed by RedMere, cable OD's can be reduced by up to four times, as shown in Figure 4. Instead of relying on increasing the physical size of the cable to compensate for attenuation, the losses can be compensated for by an Integrated Circuit embedded in the cable. A Compact ICs (e.g. 5mm x 5mm) can be mounted on modules to fit neatly inside the cable casing.

This technology allows manufacturers to use very thin bulk cable which would otherwise fail HDMI compliance testing.

Comparing Standard and Active High Speed HDMI Cables

The vast majority of cables on the market are in and around two meters long. What are the options at this length and at a high-speed data rate of 3.4Gbps?

To meet the 3.4Gbps data rate, many traditional two meter 'wire' cable manufacturers use 28 AWG wires. This results in a very thick cable with an outer diameter of up to 10mm. Such cables are unreliable, unattractive, voluminous, inflexible and heavy. Figure 4 shows a two meter HDMI 'wire' cable on the left and a HDMI active cable on the right.

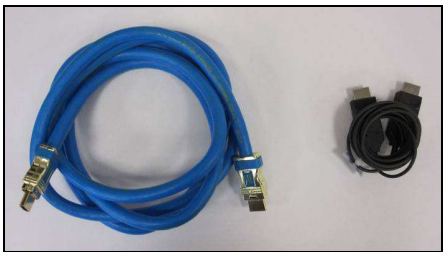

Figure 4: Traditional HDMI wire cable (left) & active HDMI cable (right) cable

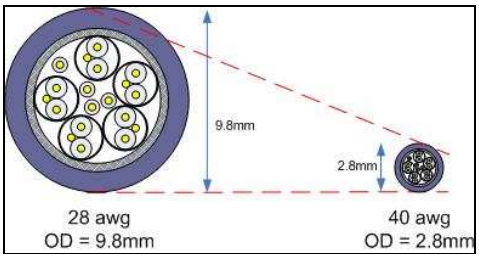

Figure 5: Outer diameter comparison of a wire & active cable

As can be seen in the illustration, active cables are significantly smaller and lighter. Now ultra-thin 40 AWG cables can pass high-speed HDMI ATC compliance. As well as being up to four times thinner, active cables weigh up to ten times less and take up around ten times less volume. The following table details these improvements:

Wire Cable (OD = 9.8mm)	Active Cable (OD = 2.8mm)
Total weight = 0.16kg	Total weight = 0.018kg
Copper weight = 0.076kg	Copper weight = 0.009kg
PVC weight = 0.083kg	PVC weight = 0.009kg
Packing Volume = 16cmx15cmx5cm = 1200 cm^3	Packing Volume = 6cmx6cmx3cm = 108 cm^3

Table 1: Packing volume comparison between a HDMI wire & active cable

Raw Material Savings with Thinner Cables

As mentioned above, in 2010 there will be up to 1.5 billion HDMI-enabled products world-wide, 500 million of which are TVs.

How many cables does that work out at? In 2010, many TVs will have up to four HDMI ports, but even taking a pessimistic average of two ports per TV, a simple calculation shows us that ***one billion HDMI cables*** could be needed to connect HDMI-enabled products purchased up to 2010.

Now let's look at the materials that can be saved with one billion thinner active cable solutions:

	9.8mm Standard Cable	2.8mm Active Cable	Savings
Copper Weight	160,000 metric tons	18,000 metric tons	89%
PVC Weight	76,000 metric tons	9,000 metric tons	89%
Total Weight	83,000 metric tons	9,000 metric tons	89%
Total Volume	1,200,000 cubic meters	108,000 cubic meters	91%

Table 2: Comparison of raw material saved between a Standard HDMI cable and an active HDMI cable

Shipping Reductions with Thinner Cables

Goods are shipped in containers around the world. These containers are measured in twenty-foot equivalent units (TEU) with a standard TEU measuring 20 × 8.0 × 8.5 feet (6.1 × 2.4 × 2.6 meters) or 38 cubic meters. Using thinner cables would save up to ***29,000 standard TEU containers*** for one billion HDMI cables.

Cosco is China's leading shipping company and is one of the largest in the world. The Cosco Guangzhou is their largest vessel and it has a capacity of 9,450 TEUs.

Using thinner cables would mean ***three*** less journeys required by a vessel such as the *Guangzhou*.

Toxin Reductions with Thinner Cables

PVC or low density polyolefins such as PE are widely used for cable insulation and shielding.

Reducing the amount of PVC used is essential for the environment and human health. When PVC burns, two hazardous substances are produced. Hydrogen chloride gas is released and dioxins remain. Hydrogen chloride forms a corrosive acid on contact with water. Dioxin is one of the most toxic substances known and has been found to cause cancer and reproductive disorders. Dioxin can also persists in soil for decades so contamination shave long term consequences.

While halogen-free low-smoke cable insulation exists and can be used as a replacement for PVC, it will be some time before these replacements become broadly and cheaply adopted. One reason for the delay here are the legal disputes over intellectual property associated with the newer substances. Another issue which delays the deployment is the fact the not all production facilities are enabled with this newer technology and development budgets need to be found to change this. Thinner cable technology is however an immediate contribution to the solution. It can reduce the PVC requirement by nearly 90% as shown previously.

Conclusions

The world produces a huge amount of harmful PVC and mines and enormous amounts of copper. These raw materials shipped large distances to be assembled and then re-shipped to consumers around the world. This sequence is very harmful to our planet and is not sustainable. This paper points the way forward on this problem however in that it shows that innovation can dramatically impact the issues problem in the context of High speed AV cables. The addition a novel Integrated circuit to a high speed AV cable dramatically reduces PVC, copper and shipping requirements effectively creating a greener, environmentally friendly A/V cable. Coupled with similar innovation in other offending areas there is indeed hope for a sustainable healthier future.

About RedMere

RedMere provides cable-embedded semiconductors and advanced cable reference designs to cable industry leaders and manufacturing partners. In a world where connection speed increases, RedMere enables easy to use, high quality, smart connectivity for The Home, On the Move and The Office. These new active cable systems deliver the ultimate in compact digital connectivity over HDMI, DisplayPort and USB for Video and Still Cameras, Smartphones, HDTV, Blu-Ray DVD, PS3 and Xbox, as well as enterprise solutions using Infiniband and PCI Express. RedMere is a private company with lead investors Celtic House Venture Partners and EdgeStone Capital Partners.