Automotive High-Definition Link – The Solution for Automotive Camera Systems

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Abstract

Lowering system cost for automotive video links is a significant challenge. The performance and cost advantages of analog links are discussed in this document.

Introduction

In the automotive landscape manufacturers are constantly driven to create higher levels of functionality and at ever higher safety levels. One aspect of this challenge is to give the operator increased visibility of the 360° surrounding a vehicle. Structural constraints block vehicle sightlines, requiring one or more cameras to provide visibility in these blind spots. In addition, this information needs to feed into object detection system software with sufficient resolution to detect potential safety hazards. Initially these systems consisted of a single CVBS backup camera displaying the area behind the vehicle. This system was relatively simple and low cost but unfortunately had insufficient resolution to support object detection.

High-Definition Video Transmission Options Needed

To support object detection, high-definition (HD) cameras were required. HD cameras were typically used and connected to the center console display through a high-speed digital link. These links operate at speeds greater than 1.5GHz, requiring specialized heavily shielded cables and high-performance connectors representing a significant part of the system cost. Single-camera systems do not meet the functionality or safety targets of today's automotive market, so systems consisting of four or more cameras are becoming the norm. These additional cameras almost directly multiply the overall system cost. As a result, the automotive OEMs have solicited an alternative solution that meets the design safety and performance targets while also addressing the system cost issues.

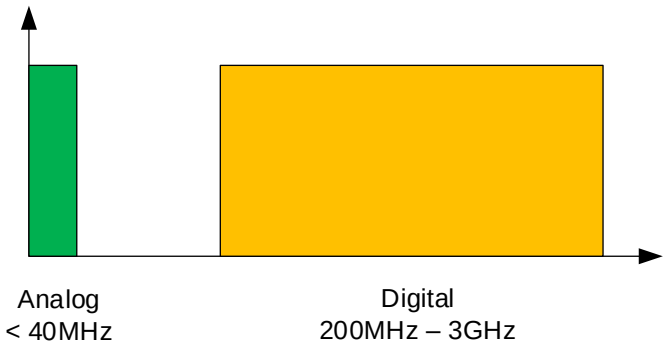

Figure 1. Frequency Content Analog vs. Digital

The high cost of digital links is largely driven by their bandwidth requirement. At GHz speeds, accurate impedance control of cables and connectors is essential for system performance. In a vehicle this becomes a significant challenge since cable routing can be as much as three times as long as the distance between endpoints and multiple connectors are required for maintenance and repair. A possible solution to this problem is to transport high-definition video using an analog format. The bandwidth requirement is dropped to tens of MHz, making transmission line effects less significant, and allowing the use of low-cost cables and interconnects.

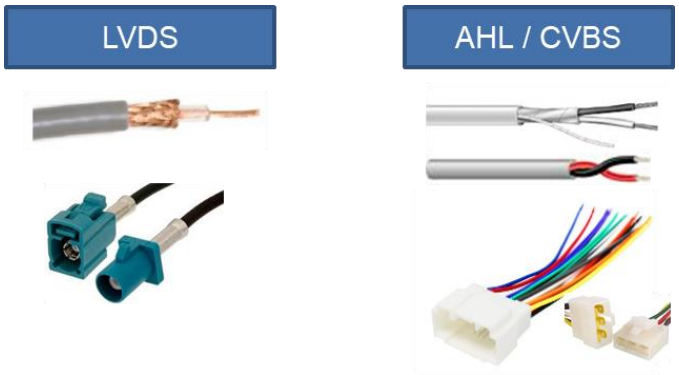

Figure 2. Cable and Connector Examples

New Automotive High-Definition Link from Renesas

Renesas' new Automotive High-Definition Link (AHL) technology can transport high-definition video over the same cables and interconnects as standard definition CVBS systems while meeting automotive safety and EMI/EMC requirements. This is accomplished using a modulation scheme similar to the one that is used in traditional CVBS.

A key AHL performance and cost-reducing feature is the ability to control the camera simultaneously over the same pair of wires (UTP) during video transmission. AHL has a full-time control channel that operates independent of the video data so it can be used to initialize the camera settings at start-up, as well as communicate with the camera during active video transmission, sending I2C, GPIO, and interrupt commands between cameras and a single video processing unit.

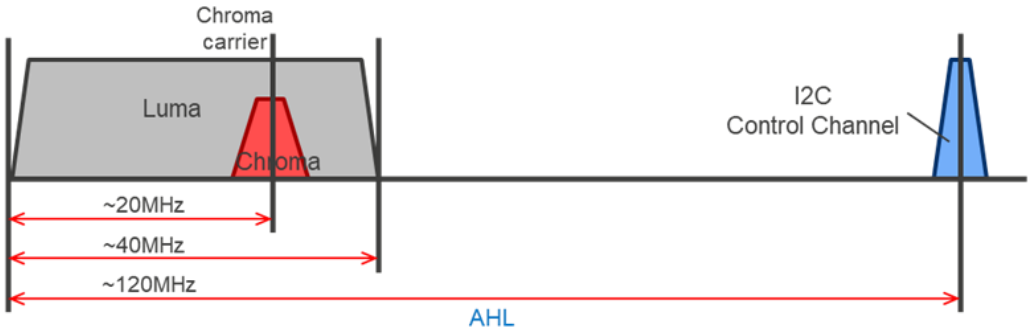

Figure 3. Simplified AHL Signal with Independent Control Channel

Another benefit of AHL is its performance in comparison to a digital link being degraded due to a failure in the cable harness or connector assembly. In a digital link, weak signals can cause macroblocks to appear, hiding large portions of the viewing area. In extreme cases, the screen can completely freeze and not provide the operator with any indication that a problem has occurred, resulting in a safety and reliability hazard. The same situation in an AHL link would present a slight change in video color or contrast but all pixels would appear on the screen. In the event of total signal loss such as a broken cable, the viewing area becomes black – a clear indication that a problem has occurred. In addition, a cable short to battery, or cable short to ground can be detected and polled by software or configured as an interrupt to the video processor.

Conclusion

AHL is an innovative lower cost and reliable alternative to today's high-performance digital links. It transports excellent quality high-definition video over low-cost interconnect technologies with a rich feature set that includes multiple diagnostic and safety features, making it a robust technology for the automotive industry.

Related Information

- RAA279971 – Automotive Analog High Definition Link Encoder
- RAA279972 – Automotive Analog High Definition Link Decoder
- RTKA279971DA2000BU – Automotive Analog High Definition Link Encoder Evaluation Board
- RTKA279972DA1000BU – Automotive Analog High Definition Link Decoder Evaluation Board

References

- https://www.keysight.com/us/en/assets/7018-03411/white-papers/5991-0168.pdf

Revision History

Revision	Date	Description
1.0	Jun 24, 2021	Initial release.