

DS15MB200,DS90LV004

***Overcoming Impedance Discontinuities in High-Speed Signal Paths by Using
LVDS (Signal Conditioners)***



Literature Number: SNLA175



Overcoming Impedance Discontinuities in High-Speed Signal Paths by Using LVDS

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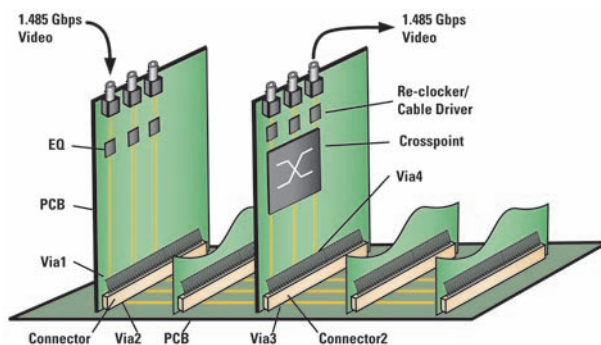


Figure 1. HD Video Router Diagram

At data rates from 400 Mbps to 1.5 Gbps, data signal paths become transmission lines. At these speeds the signal path model must include the reactive parasitic components in the cable or backplane. It is not just the data rate itself—the fast edge rates contain even higher frequency energy that react worse in distributed impedance environments. Ignoring parasitic impedances and impedance discontinuities above 200 Mbps will cause added noise in the transmission line, and data bit errors will occur.

Consider a basic High-Definition (HD) digital video router as an example of this challenge: HD video routers manage multiple HD source streams for distribution in broadcast, studio, or production video facilities. HD video channels operate from 270 Mbps up to 1.485 Gbps, demanding careful layout and consistent design practices to ensure the switching router system does not degrade the integrity of the video data.

In this system (Figure 1), an Adaptive Equalizer (EQ) receives the HD signal directly from the BNC connector.

A common backplane connects the signals from the input card to the switch card for output to the desired destination channel. The signals travel point-to-point from the EQ across the PCB approximately 8 inches to the backplane connector, then across ~3 to 15 inches of backplane (depending on the slot used) to a second connector, then across another 8 inches of PCB to the inputs of the crosspoint switch device. A re-clocker/cable driver connects directly to the outputs of the crosspoint switch to drive the signals across cables. These HD video router systems are modular and may have anywhere from 8 to 1000 input/output channels. Therefore, signal density can be very high.

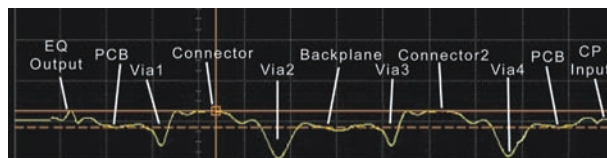


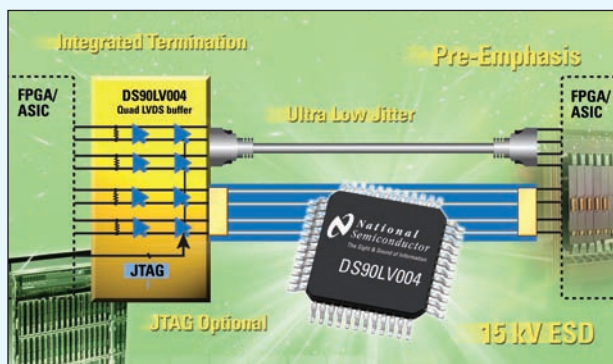
Figure 2. Example TDR Plot of Impedance Across the Signal Path
(See Figure 1 for discontinuity locations)

The common FR4 circuit board materials are a consistent impedance environment, but the distributed parasitic impedances will have a negative effect on the signal quality. Most affected are the fast edge rates as a result of the numerous frequency components operating higher than the fundamental data rate, causing signal losses and sluggish transition times. In addition, all the interconnections between the components (such as the BNC connectors, integrated circuits, vias between board layers, or the connectors between boards) can cause impedance mismatches from the characteristic impedance (Z_0), which will also affect signal quality (Figure 2). The dense backplane connectors inductively load the signal path,

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Four-Channel LVDS Repeater with Pre-Emphasis

The DS90LV004 is a four channel 1.5 Gbps LVDS buffer/repeater. High-speed data paths and flow-through pinout minimize internal device jitter and simplify board layout, while configurable pre-emphasis overcomes ISI jitter effects from lossy backplanes and cables. The differential inputs interface to LVDS, and Bus LVDS signals such as those on National's 10-, 16-, and 18-bit Bus LVDS SerDes, as well as CML and LVPECL. The differential inputs and outputs are internally terminated with a 100Ω resistor to improve performance and minimize board space. The repeater function is especially useful for boosting signals for longer distance transmission over lossy cables and backplanes.

Features

- Hot-plug protection
- LVDS/CML/LVPECL compatible input, LVDS output
- On-chip 100Ω input and output termination
- 15 kV ESD protection on LVDS inputs and outputs
- Single 3.3V supply
- Very low power consumption

The DS90LV004 operates over a wide temperature range (-40 to +85°C) making it ideal for telecom, datacom, industrial, medical, automotive, and office imaging applications applications. It is available in a TQFP-48 package.

For FREE samples, datasheets, and more, visit www.national.com/pf/DS/DS90LV004.html

Dual 1.5 Gbps 2:1/1:2 LVDS Mux/Buffer with Pre-Emphasis

The DS15MB200 is a dual-port 2 to 1 multiplexer and 1 to 2 repeater/buffer. High-speed data paths and flow-through pinout minimize internal device jitter and simplify board layout, while pre-emphasis overcomes ISI jitter effects from lossy backplanes and cables. The differential inputs and outputs interface to LVDS or Bus LVDS signals such as those on National's 10-, 16-, and 18-bit Bus LVDS SerDes, or to CML or LVPECL signals

Features

- 1.5 Gbps data rate per channel
- Configurable off/on pre-emphasis drives lossy back planes and cables
- Low output skew and jitter
- On-chip 100Ω input and output termination
- 15 kV ESD protection on LVDS inputs/outputs
- Hot-plug protection



The DS15MB200 features a 3.3V supply, CMOS process, and robust I/O ensure high performance at low power over a wide temperature range (-40 to +85°C) making it ideal for base-stations, DSLAMs, routers, switchers, and industrial systems applications. It is available in LLP-48 packaging.

For FREE samples, datasheets, and more, visit www.national.com/pf/DS/DS15MB200.html

Overcoming Impedance Discontinuities in High-Speed Signal Paths by Using LVDS

while vias in the PCB capacitively load the signal path. Signal reflections will occur at any location along a transmission path where a change in impedance exists. These reflections and parasitic impedances will cause loss of signal amplitude, ringing, rise time degradation, and EMI.

In this example system there can be up to 31 inches of FR4 from the EQ outputs to the input of the crosspoint switch, with several impedance discontinuities along the way. If the speed of the incident edge is 175 to 200 ps/inch down this path, and the data rate is 1.485 Gbps (half-wavelength = 343 ps), then there can be as many as 18 transitional edges on the path at any given time. Reflections caused by the incident edge at impedance mismatches will affect all the edges present on the signal path. Reflections from edges 1 through 17 will greatly distort edge number 18 by the time it arrives at the end of the signal path. The resulting eye pattern (Figure 3) shows the loss of amplitude, excessive jitter, and rise/fall time degradation.

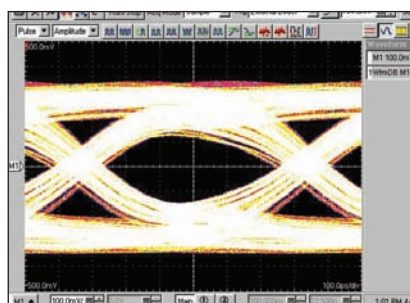


Figure 3. Eye Pattern at Input to Crosspoint Switch After 31" of FR4

One possible solution to this challenge is to use higher quality connectors between the daughter cards and the backplane. This will minimize the discontinuities of the connectors. Better via design will further flatten the TDR measurement plots so that the apparent impedance over the length of the signal path stays much closer to Z_0 .

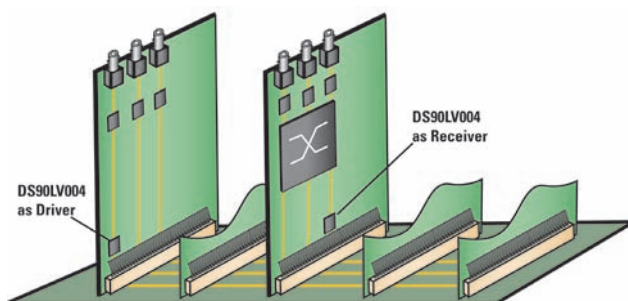


Figure 4. Buffer Locations to Overcome Impedance Discontinuities

Another, more cost-effective solution is to use a simple LVDS buffer, such as the DS90LV004, to drive and receive the signal across the backplane. This effectively breaks the transmission path into smaller segments to mask the impedance mismatch and diminish signal attenuation. Place a buffer at the edge of the daughter card to drive the connector and backplane, a second buffer on the switch daughter card to receive the signals (Figure 4), and re-drive them to the input of the crosspoint switch to effectively hide the impedance discontinuities between the two buffers (Figure 5). Proper terminations also ensure that the receiver absorbs all the energy in the line and none reflects back to the source.

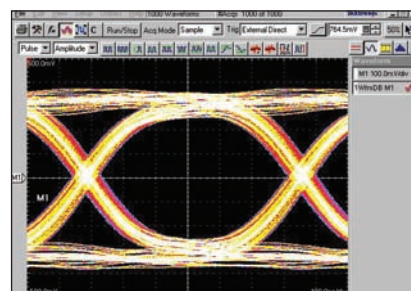


Figure 5. Eye Pattern at the Crosspoint Input with DS90LV004 Buffers Isolating the Backplane Connections

In addition, the buffers typically offer additional signal quality enhancements to improve the original signal. For example, buffers featuring input equalization will remove the deterministic jitter from the media losses before delivery across the backplane. Output pre-emphasis can boost the amplitude of the signal, further opening the eye pattern at the crosspoint inputs or receiver. High ESD ratings on the buffer I/O protect the other components on the daughter cards from ESD events elsewhere on the backplane.

Summary

High-speed interfaces across backplanes require impedance control along the entire signal path. Using simple LVDS buffers to isolate impedance discontinuities or to shorten the interconnect lengths can reduce system costs and enhance the interface performance by eliminating the need for expensive high-frequency connectors. ■

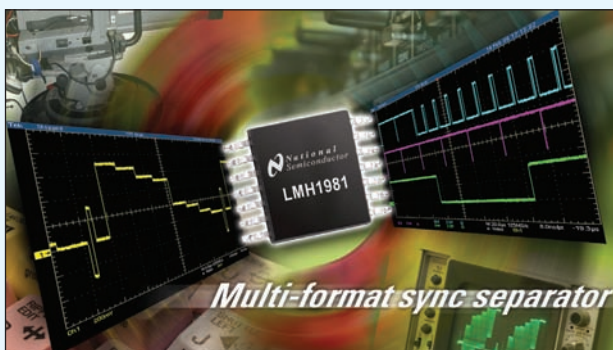
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Multi-Format Video Sync Separator

The LMH1981 is a multi-format sync separator for high-definition broadcast and professional video systems. The device automatically detects the input video format and performs all the necessary sync separation to generate low-jitter horizontal and vertical sync signals for standard and high-definition video formats, including NTSC, PAL, SECAM, 480i, 480p, 576i, 576p, 720p, 1080i, and 1080p.

The LMH1981 features the timing outputs needed for any video system, including horizontal, vertical and composite sync, odd/even field, burst/back porch clamp, and a patented automatic video-format detection feature. The device accepts both bi- and tri-level sync video inputs and features 50% slicing to ensure accurate separation of signals that vary in amplitude, offset, and noise. The device has a wide input range, allowing the inputs to accept video signals from 500 mV_{P-P} to 2 V_{P-P}.



Features

- 50% Sync slicing
- Low jitter horizontal sync outputs
- Supports NTSC, PAL, SECAM, 480i, 480p, 576i, 576p, 720p, 1080i, and 1080p
- Accepts video signals from 500 mV_{P-P} to 2 V_{P-P}
- No external programming with μ C required
- Horizontal sync output propagation delay <50 ns

The LMH1981 is ideal for use in a wide range of video applications such as, broadcast video equipment, video distribution, DTV and HDTV systems, and is available in TSSOP-14 packaging.

For FREE samples, datasheets, and more, visit www.national.com/pf/LM/LMH1981.html



Analog Crosspoint Switches for High-Resolution Video Applications



The LMH[®] family of high speed amplifiers is joined by the LMH6582 and LMH6583 16 x 8 analog crosspoint switches. The devices are available in a gain of 1 (LMH6582) and gain of 2 (LMH6583) options and are completely non-blocking. Allowing an output to be connected to any input, including an input that is already selected. The devices can be used in distribution applications where each output is connected to the same input, also known as broadcast mode. The inputs and outputs are also fully-buffered, allowing impedance matching to any source at the inputs and capability to drive up to two back terminated 75 Ω video loads on the outputs.

Designed on National's proprietary VIP10 process, both devices offer significant speed and crosstalk performance over competitive solutions. The 500 MHz of bandwidth and 0.1 dB gain flatness out to 100 MHz support high resolution video formats to QXGA (2048 x 1536) and beyond.

Features

- 500 MHz, -3 dB Bandwidth
- Fast slew rate: 3000 V/ μ s
- 100 MHz, 0.1 dB gain flatness
- Low crosstalk:
 - -70 dBc at 5 MHz
 - -50 dBc at 100 MHz
- Gain =1 and gain =2 options available
- Serial programming

The LMH6582 and LMH6583 are ideal for use in wideband routers and switchers, conference room systems, keyboard/video/mouse systems, multimedia video systems, and professional A/V systems. These products are available in a unique TQFP-64 package.

For FREE samples, datasheets, and more, visit www.national.com/pf/LM/LMH6582.html
www.national.com/pf/LM/LMH6583.html

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