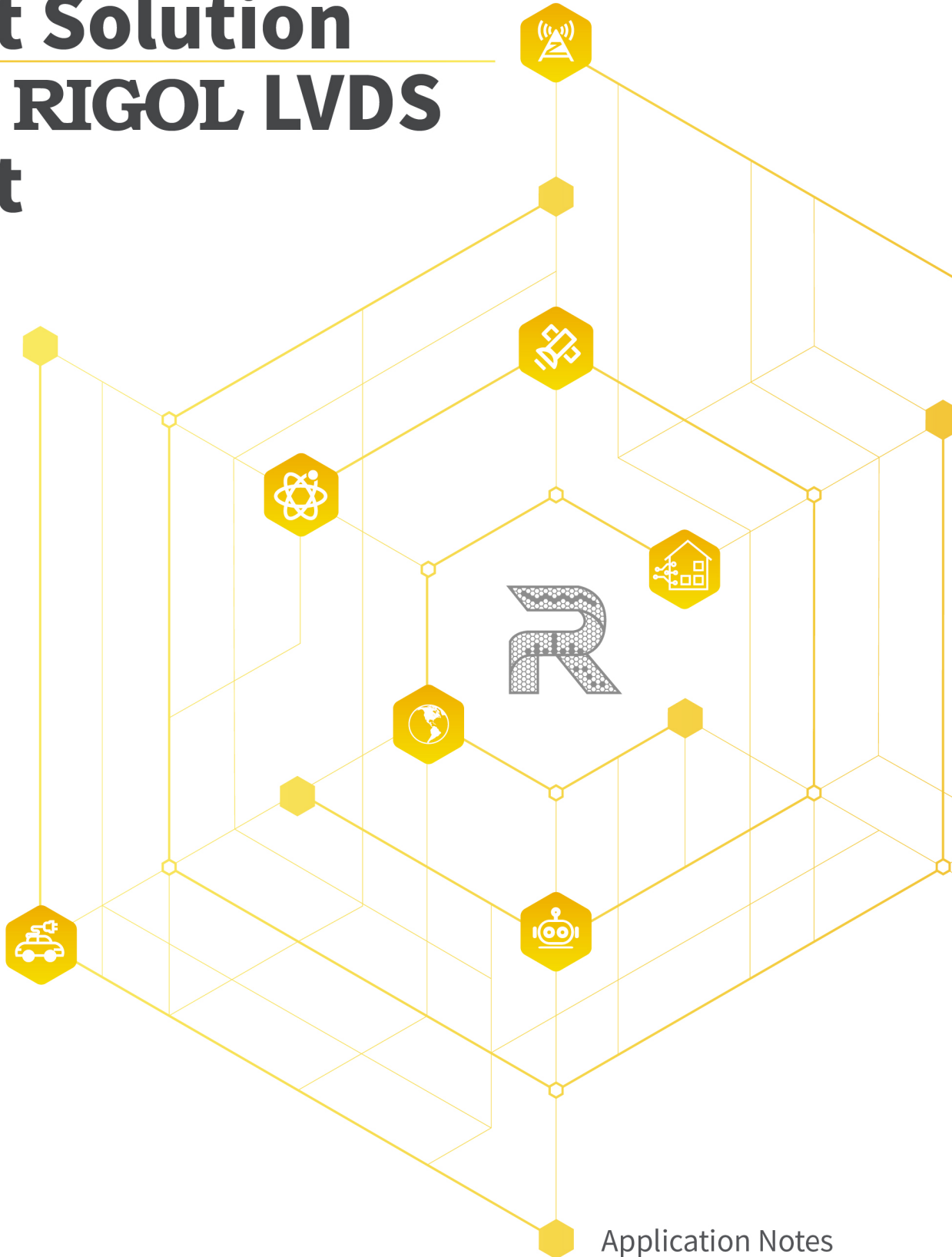




RIGOL

Test Solution For RIGOL LVDS Test



Application Notes

ANW01100-1220-0013

1 Introduction

Low-Voltage Differential Signaling (LVDS) is a popular signaling system, available for applications that transmit high-speed data with low power. The high immunity to external interference is achieved by using the differential conductors that are close to each other. The interference affects the two traces equally (common mode) and is ignored by receivers operating in differential mode. LVDS is designed for the low EMI interference. The two traces carry signals of opposite polarity, creating an offset magnetic field.

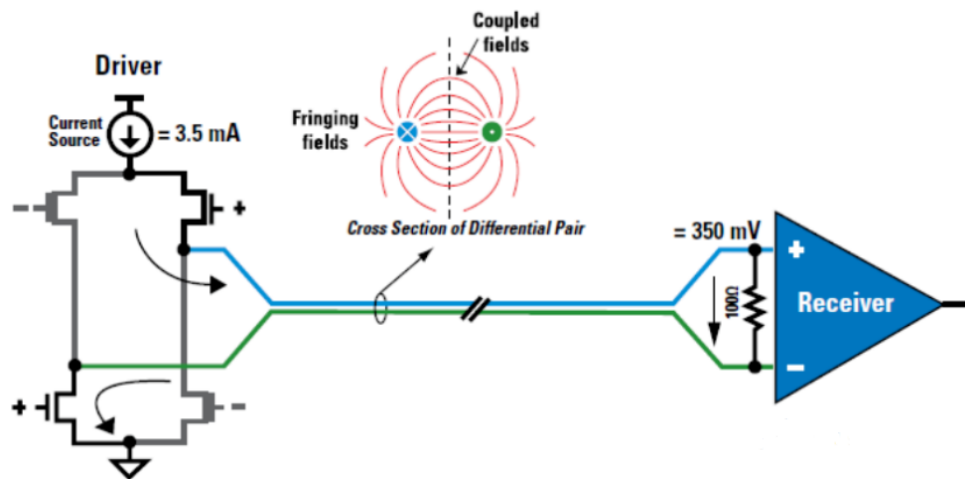


Figure 1.1 LVDS Interface Principle

2 LVDS Basic Concepts

LVDS is the low voltage differential signaling technology interface. It is a digital video signal transmission method developed by the US National Semiconductor Corporation to overcome the disadvantages of the high power consumption and high EMI interference, etc. in transmitting broadband high-rate data at TTL level.

The LVDS output interface utilizes the low voltage swing (350 mV) to transmit data differentially over the two PCB routes or a pair of balanced cables. The LVDS output interface allows to transmit signal at a rate of hundreds of Mbps on a differential PCB line or balanced cable. It enables the low noise and low power consumption with the low voltage and low current drive methods. LVDS output interface is widely used in LCD monitors in 17 inches and above.

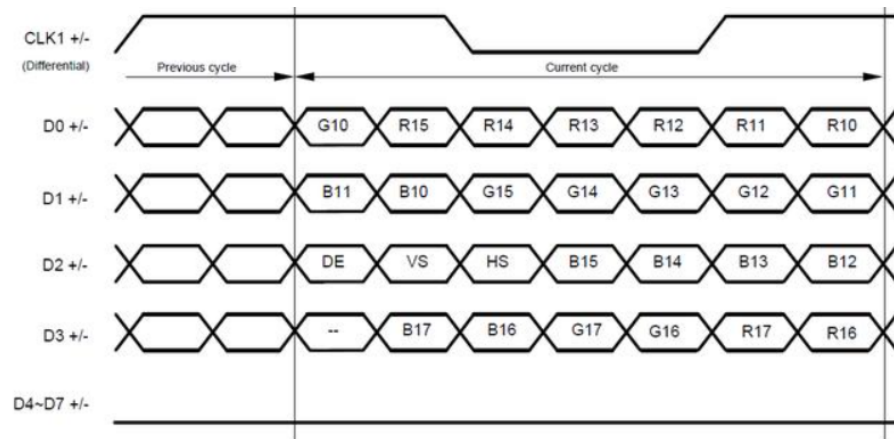


Figure 2.1 LVDS Data Signal

3 Test Challenges

Traditional parallel data communication, where the multiple-channel data and the clock signal are transmitted separately, often results in setup and hold time violations due to inconsistent transmission paths. When the data rate increases, accurately controlling transmission delay becomes difficult; thus today the new data communication is already the serial communication. In addition to the increase in data rate, the alteration from parallel to serial places new requirements for test methods.

- **Reliable test equipment:** LVDS adopts multiple pairs of high-rate differential signals to transmit data at rates ranging from hundreds of Mbps to several Gbps. To ensure the high-rate signal transmission, LVDS adopts differential lines to provide bi-directional data transmission, realizing the higher transmission rate with the smaller signal swing. The reliable measurement of LVDS delivers high requirement for oscilloscopes and probes because of the high-rate of LVDS.
- **Excellent eye diagram analysis capability:** The oscilloscope analysis software for testing the eye diagram and template is necessary to verify the signal quality of LVDS. The clock recovery for different standard LVDS requires different clock recovery methods, which requires to ensure that the oscilloscope clock recovery method meets the test requirements.
- **Accurately test signal jitter results:** Jitter often causes problems for the high-rate signal while the clock jitter may also cause problems for LVDS. The causes of the jitter in the clock and signal are complex. The total jitter (TJ) contains deterministic jitter (DJ) and random jitter (RJ), while DJ and RJ are also affected by many factors. Therefore, the LVDS test should include measurements of various jitter components.

4 RIGOL LVDS Test Solution

Devices required in LVDS signal test mainly include the following hardware and software:

- DS70304 digital oscilloscope
- PVA7250 active differential probe
- PCA1030 current probe
- DS70000-JITTER eye diagram jitter analysis (option)
- Testing cables

High-Speed and Stable Acquisition Equipment

DS70000 series digital oscilloscope, the 8th generation of RIGOL's self-developed oscilloscopes, is used as the acquisition equipment in the test solution. Based on the StationMAX II platform, DS70000 oscilloscope achieves up to 20 GSa/s real-time sample rate and 3 GHz analog bandwidth. In addition to the improvement in hardware specification, DS7000 series also provides diverse user-friendly designs to ensure the LVDS testing speed required by the customer and the test efficiency.

PVA7000, with more than 2.5 GHz bandwidth, is an active probe for high frequency application. It can be used to measure differential and single-ended signals with better common mode rejection. PVA7000 uses plug-on socket probe head and supports 3 types of interchangeable probe heads to optimize the performance and usability. Besides, its replaceable probe tip prolongs the service life of the probe and the probe tip spacing can be precisely adjusted to fit different test point spacings.

This device can be directly connected to a BNC input connector of a waveform measurement instrument. Once being clamped on a conductor to be measured through the sensor head, it can capture the current waveform easily. This probe has the following characteristics: highly accurate current detection, easy current measurement, excellent broadband frequency, easy protect function at excessive input, and unique thin film Hall effect element.

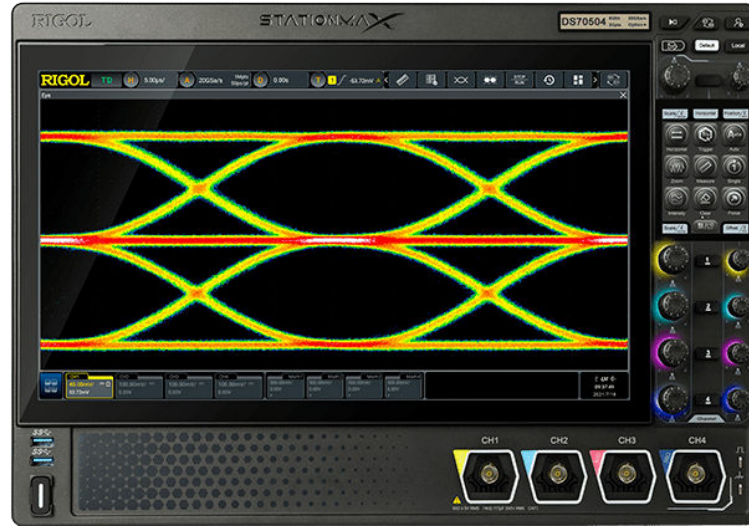


Figure 4.1 Oscilloscope DS70304



Figure 4.2 Active Differential Probe PVA7250

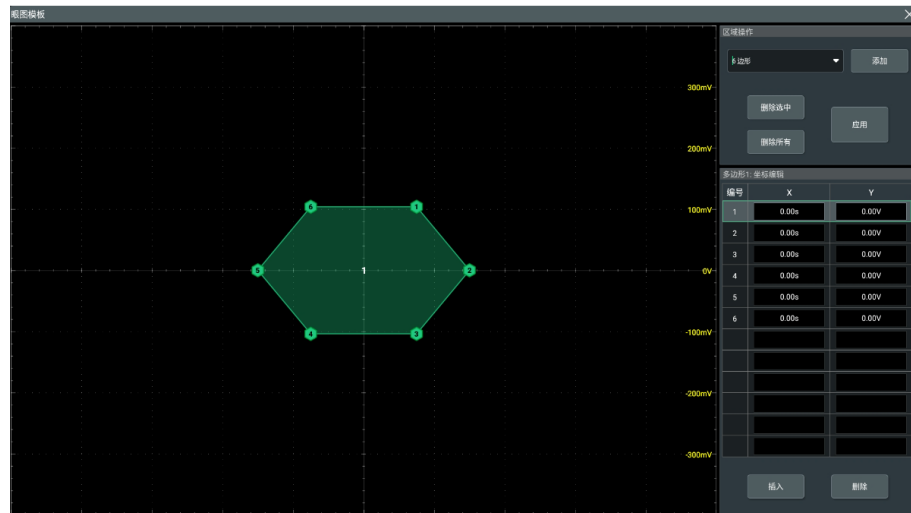


Figure 4.5 Eye Template Editing Function

Jitter is one of the important factors affecting the quality and performance in high-rate digital signal system. Jitter testing of the DS70000 enables engineers to have insight into the sequential characteristics of the signal and identify potential problems. This detailed analysis helps to find the source of jitter and take appropriate measures to optimize it. The measurement results can be displayed in a jitter histogram and trend graph, providing a visual representation of the jitter distribution and trend. These charts help engineers understand the jitter characteristics more visually and perform in-depth troubleshooting and performance optimization.

Jitter Test Items
Total Jitter (TJ)
Random Jitter (RJ)
Deterministic Jitter (DJ)
Periodic Jitter (PJ)
Data Dependent Jitter (DDJ)
Duty Cycle Distortion (DCD)
Inter-Symbol Interference (ISI)
Bit Ratio (BR)

5 Test Results



Figure 5.1 LVDS Eye Diagram Test Results



Figure 5.2 LVDS Signal Jitter Test Results



Figure 5.3 Tests Result for Rush Current at Power-up Moment

6 Summary

RIGOL provides a complete set of tools, including digital oscilloscope, professional test probe, and eye diagram testing software, enabling LVDS device designers to capture, test and analyze signals efficiently and accurately.

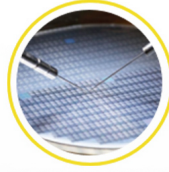
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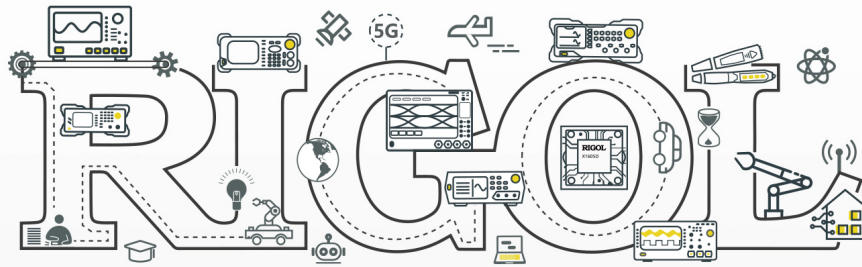
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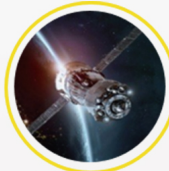


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

Communication





System Integration







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