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UL 4000

Outline of Investigation for High Speed Cables

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Summary of Topics

This first issue of the Outline of Investigation for High Speed Cables, UL 4000, covers the transmission performance evaluation of high speed cables.

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INTRODUCTION

1 Scope

1.1 This outline of investigation describes the requirements used to evaluate the transmission performance of high speed cables.

2 References

2.1 Any undated reference to a code or standard appearing in the requirements of this outline shall be interpreted as referring to the latest edition of that code or standard.

3 Units of Measurement

3.1 The unit of measure shall be SI. If a value for measurement is followed by a value in other units in parentheses, the second value represents a direct conversion or an alternative value.

4 Definitions

4.1 For the purpose of this Outline, the following definitions apply.

4.2 DUT – Device Under Test.

4.3 TMDS – Transmission Minimized Differential Signaling.

4.4 CROSSTALK – A measure of the unwanted signal coupling from one pair into another pair.

4.5 INSERTION LOSS – The signal loss resulting from the insertion of a component, or link, or channel, between a transmitter and receiver (often referred to as attenuation).

5 Construction

5.1 The length of a cable assembly shall be within +/- 10% of the marked length when measured from the face of one connector to the face of the connector at the far end of the cable.

5.2 High-speed cable assemblies may be required to comply with specifications applicable to their particular configuration and use. Other national, international or private performance specifications, applicable to high-speed cables may also be used to evaluate high speed cables as described in particular certification programs.

PERFORMANCE

6 High Speed Cable Assembly Physical Layer Electrical Characteristics

6.1 The measurements shown in Table 6.1 are to be made on high-speed audio/video cable assemblies.

Table 6.1
High-speed audio/video cable assembly electrical characteristics

Test	Section Reference
Maximum Cable Assembly Intra-Pair Skew	7.4
Maximum Cable Assembly Inter-Pair Skew	7.5
Differential Output Eye Mask	8
Differential Insertion Loss	9.2
Differential Insertion Loss Deviations (ILD)	9.3
Inter-pair Differential ILD	9.4
Differential Input Return Loss	10
Far-end Crosstalk	11
Differential Impedance	12

6.2 Unless specified otherwise within the parameters respective subsection, all tests defined in Table 6.1 are to be measured over a frequency range of N uniformly-spaced frequencies from start frequency f_{min} to stop frequency f_{max} with step size no larger than Δf . Where f_{min} , f_{max} and Δf are defined in Table 6.2.

Table 6.2
Frequency values

Parameter	Bit Rate	
	3.4 Gbps	6 Gbps
f_{min}	1 MHz	
f_{max}	3400 MHz	6000 MHz
Δf	10 MHz	

Note: The bit rates or data rates of high-speed audio/video cables are often referred to by the total rate for three channels. For example, 10.2 Gbps (3 X 3.4 Gbps) and 18 Gbps (3 X 6 Gbps).

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7 Skew

7.1 General

7.1.1 This section defines the Intra-Pair and Inter-Pair skew for a high speed cable assembly. Table 7.1 defines the maximum skew values for assemblies that support a TMDS bit rate up to 3.4 Gbps and 6 Gbps. Both the intra-pair and inter-pair skew is to be measured on the CLOCK, DATA0, DATA1, and DATA2 differential channels of the cable assembly.

7.2 Apparatus

7.2.1 The apparatus shall consist of a Time Domain Reflectometer (TDR) and two Module/Cable Compliance Boards.

7.3 Preparation of DUT

7.3.1 The DUT shall be stored in an area that is under lab conditions prior to the test.

7.4 Maximum cable assembly intra-pair skew

7.4.1 General

7.4.1.1 The intra-pair skew is defined as the absolute difference between the propagation delay of the positive and negative polarity wire within the same differential lanes. The intra-pair skew shall be less than the values specified in Table 7.1.

7.4.2 Procedure

7.4.2.1 The TDR is calibrated from -2ns to 10ns using electronic calibration.

7.4.2.2 The DUT is connected to the TDR via two module compliance boards and all unused lanes are terminated to a 50 ohm load.

7.4.2.3 A single-ended impedance vs. time measurement of the CLK channel is made for both the positive (+) and negative (-) polarity.

7.4.2.4 This process is then repeated for each of the other signaling channels.