HDMI/E-SATA and HDMI/HDMI Stacked Connector Assemblies

1. INTRODUCTION

1.1. Purpose

Testing was performed on Tyco Electronics HDMI/E-SATA and HDMI/HDMI Stacked Connector Assemblies to determine their conformance to the requirements of Version 1.3a of the High-Definition Multimedia Interface Specification, Version 1.3c of the HDMI Compliance Test Specification, and Revision 2.6 of the Serial ATA as applicable.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of the HDMI/E-SATA and HDMI/HDMI Stacked Connector Assemblies. Testing was performed at the EME Laboratory and the Engineering Assurance Product Testing Laboratory between 21Feb07 and 19Jul07. The test file numbers for this testing are EMEB079940-001, CTLB079940-004, CTLB079940-006, CTLB079940-007, CTLB079940-008, CTLB079940-009, CTLB079940-010 and CTLB079940-011. Additional testing was performed on 11Jun08. The test file number for this testing is EA20080513T. This documentation is on file at and available from the EME Laboratory and the Engineering Assurance Product Testing Laboratory.

1.3. Conclusion

The HDMI/E-SATA and HDMI/HDMI Stacked Connector Assemblies listed in paragraph 1.5., conformed to the electrical, mechanical, and environmental performance requirements of Version 1.3a of the High-Definition Multimedia Interface Specification, Version 1.3c of the HDMI Compliance Test Specification, and Revision 2.6 of the Serial ATA as applicable.

1.4. Product Description

The HDMI/E-SATA and HDMI/HDMI Stacked Connector Assemblies combines video and audio into a single digital interface for use with DVD players, set-top boxes, televisions and other audiovisual devices.

1.5. Test Specimens

Test specimens were representative of normal production lots. Specimens identified with part numbers 1888540-1 and 1888811-1 were used for testing. Specimens were tested with 0.3 µm minimum gold plating on the mating surface of the contacts and gold flash over 0.3 µm minimum palladium-nickel plating on the mating surface of the contacts.

1.6. Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

- Temperature: 15 to 35˚C
- Relative Humidity: 25 to 75%

* Trademark
| Indicates change

2. QUALIFICATION TEST SEQUENCES

2.1. High-Definition Multimedia Interface Specification, Version 1.3a

Test or Examination	Test Group				
	1	2	3	4	5
	Test Sequence				
Contact and shell resistance	2,6				
Insulation resistance		2			
Dielectric strength		1			
Current rating				1	
Applied voltage rating		3			
Electrostatic discharge			1		
Time domain impedance					1
Crosstalk (FEXT)					2
Insertion force	1,5				
Withdrawal force	3,7				
Durability, 10000 cycles	4				

| 2.2. HDMI Compliance Test Specification, Version 1.3c

Test or Examination	Test Group			
	1	2	3	4
	Test Sequence			
Contact and shell resistance	1,3,5,7,9	1,3,5		
Insulation resistance	10		4,6	
Dielectric strength	11		1,3	
Electrostatic discharge				1
Durability, 100 cycles	2(a)			
Mechanical shock		4		
Vibration		2		
Humidity/temperature cycling	8(b)		5(c)	
Thermal aging	6			
Thermal shock	4		2	

NOTE

(a) One hundred durability cycles performed on only one half of the specimens.
(b) Specimens unmated.
(c) Specimens mated.

2.3. Serial ATA, Revision 2.6

A. Electrical and Mechanical Requirements

Test or Examination	Test Group				
	A	B	C	D	E
	Test Sequence				
Examination of product	1,5	1,9	1,7	1,8	1,7
LLCR	2,4	3,7	2,4,6		4,6
Insulation resistance				2,6	
Dielectric withstanding voltage				3,7	
Insertion force		2			
Removal force		8			
Durability	3	4			2
Mechanical shock		6			
Vibration		5			
Humidity				5	
Temperature life			3		
Reseating			5		5
Mixed flowing gas					3
Thermal shock				4	

B. High Speed Signal Requirements

Test or Examination	Test Group					
	A	B	C	D	E	F
	Test Sequence					
Mated connector differential impedance	1					
Common mode impedance		1				
Maximum insertion loss of cable (10 to 4500 MHz)			1			
Maximum crosstalk (10 to 4500 MHz)				1		
Maximum rise time					1	
Maximum intra-pair skew						1

2.4. Component Heat Resistance to Lead-Free Reflow Soldering

3. SUMMARY OF TESTING

3.1. High-Definition Multimedia Interface Specification, Version 1.3a and HDMI Compliance Test Specification Version, 1.3c

A. Contact and Shell Resistance

The change in all contact resistance measurements from the initial measurements were less than 30 milliohms. The change in all shell resistance measurements from the initial measurements were less than 50 milliohms.

B. Insulation Resistance

All insulation resistance measurements were greater than 100 megohms for unmated specimens and 10 megohms for mated specimens.

C. Dielectric Strength

No dielectric breakdown or flashover occurred.

D. Current Rating

All contact current rating measurements were greater than 0.5 ampere.

E. Applied Voltage Rating

No breakdown or flashover occurred.

F. Electrostatic Discharge

There was no evidence of discharge to the contacts.

G. Time Domain Impedance

All time domain impedance measurements were within 100 ohms ± 15% differential.

H. Crosstalk (FEXT)

All FEXT ratios were less than 5%.

I. Insertion Force

All insertion force measurements were less than 44.1 N.

J. Withdrawal Force

All withdrawal force measurements were less than 39.2 N and greater than 9.8 N.

K. Durability

No physical damage occurred as a result of mating and unmating the specimens either 10000 or 100 times.

L. Mechanical Shock

No discontinuities were detected during mechanical shock testing. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

M. Vibration

No discontinuities were detected during vibration testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

N. Humidity/temperature Cycling

No evidence of physical damage was visible as a result of humidity/temperature cycling.

O. Thermal Aging

No evidence of physical damage was visible as a result of thermal aging.

P. Thermal Shock

No evidence of physical damage was visible as a result of thermal shock testing.

3.2 Serial ATA Revision 2.6

A. Electrical and Mechanical Requirements

1. Examination of Product

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

2. Low Level Contact Resistance (LLCR)

All LLCR measurements were less than 30 milliohms initially and the increase in resistance was less than 15 milliohms after testing.

3. Insulation Resistance

All insulation resistance measurements were greater than 1000 megohms.

4. Dielectric Withstanding Voltage

No dielectric breakdown or flashover occurred.

5. Insertion Force

All insertion force measurements were less than 40 N.

6. Removal Force

All removal force measurements were greater than 10 N.

7. Durability

No physical damage occurred as a result of mating and unmating the specimens 2500 times.

8. Mechanical Shock

No discontinuities were detected during mechanical shock testing. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

9. Vibration

No discontinuities were detected during vibration testing. Following vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

10. Humidity

No evidence of physical damage was visible as a result of humidity testing.

11. Temperature Life

No evidence of physical damage was visible as a result of temperature life testing.

12. Reseating

No physical damage occurred as a result of mating and unmating the specimens 3 times.

13. Mixed Flowing Gas

No evidence of physical damage was visible as a result of exposure to the pollutants of mixed flowing gas.

14. Thermal Shock

No evidence of physical damage was visible as a result of thermal shock testing.

B. High Speed Signal Requirements

1. Mated Connector Differential Impedance

All mated connector differential impedance measurements were within 100 ohms ± 15%.

2. Common Mode Impedance

All common mode impedance measurements were within 25 to 40 ohms.

3. Maximum Insertion Loss of Cable (10 to 4500 MHz)

All insertion loss of cable (10 to 4500 MHz) measurements were less than 8 dB.

4. Maximum Crosstalk (10 to 4500 MHz)

All crosstalk (10 to 4500 MHz) loss measurements were less than 26 dB.

5. Maximum Rise Time

Tests were conducted with rise time less than 150 picoseconds (20 to 80%).

6. Maximum Intra-pair Skew

Tests were conducted with inter-pair skew less than 20 picoseconds.

3.3. Component Heat Resistance to Lead-Free Reflow Soldering

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

4. TEST METHODS

4.1. High-Definition Multimedia Interface Specification, Version 1.3a and HDMI Compliance Test Specification Version, 1.3c

A. Contact and Shell Resistance

Contact resistance measurements were made using a 4 terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage for contact resistance measurements and 100 milliamperes maximum with a 5 volt maximum open circuit voltage for the shell resistance measurements.

B. Insulation Resistance

Insulation resistance was measured between adjacent terminals of both mated and unmated specimens. A test voltage of 150 volts DC was applied to mated specimens and 500 volts DC was applied to unmated specimens. These voltages were applied for 2 minutes before the resistance was measured.

C. Dielectric Strength

A test potential of 300 volts AC was applied between adjacent terminals of mated specimens. A test potential of 500 volts AC was applied between adjacent terminals of unmated specimens. These potentials were applied for 1 minute and then returned to zero.

D. Current Rating

The temperature of specimens fully energized at 0.5 ampere was measured using thermal imaging. A small hole was drilled in the back of the specimens to expose the contact tails at the 90 degree bend. Specimens were coated with an emissivity correction coating with a correction factor of 0.93. Thermal imaging equipment was used for data processing. The software uses a temperature box measurement feature which allows a measurement inside the box when placed on the area of interest.

E. Applied Voltage Rating

A test potential of 40 volts AC was applied between contacts and the shield. This potential was applied for 1 minute and then returned to zero.

F. Electrostatic Discharge

Unmated specimens were subjected to 10 pulses of positive 8 kilovolts and 10 pulses of negative 8 kilovolts using an 8 mm ball probe.

G. Time Domain Impedance

Time domain impedance was measured per EIA-364-108.

H. Crosstalk (FEXT)

FEXT was measured per EIA-364-90.

I. Insertion Force

The force required to mate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 25 mm per minute.

J. Withdrawal Force

The force required to unmate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 25 mm per minute.

K. Durability

Specimens were mated and unmated either 10000 or 100 times at a rate of 100 ± 50 cycles per hour.

L. Mechanical Shock

Specimens were subjected to a mechanical shock test having a half-sine waveform of 50 gravity units (g peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the 3 mutually perpendicular planes for a total of 18 shocks. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

M. Vibration

Specimens were subjected to sinusoidal vibration, having a simple harmonic motion with an amplitude of 1.52 mm double amplitude (15 g peak). The vibration frequency was varied uniformly between the limits of 50 and 2000 Hz and returned to 50 Hz in 20 minutes. This cycle was performed 12 times in each of 3 mutually perpendicular planes. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

N. Humidity/temperature Cycling

Specimens were exposed to 4 humidity/temperature cycles. Each cycle lasted 24 hours and consisted of cycling the temperature between 25 and 85˚C while maintaining 80 to 95% humidity.

O. Thermal Aging

Specimens were exposed to a temperature of 105 ± 2˚C for 250 hours.

P. Thermal Shock

Specimens were subjected to 10 cycles of thermal shock with each cycle consisting of 30 minute dwells at -55 and 85˚C. The transition between temperatures was less than 1 minute.

4.2 Serial ATA Revision 2.6

A. Electrical and Mechanical Requirements

1. Examination of Product

Specimens were examined visually and dimensionally and no evidence of physical damage detrimental to product performance was observed.

2. Low Level Contact Resistance (LLCR)

   LLCR measurements were made using a 4 terminal measuring technique. The test current was maintained at 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage for mated specimens.

3. Insulation Resistance

   Insulation resistance was measured between adjacent contacts of mated and unmated specimens. A test voltage of 500 volts DC was applied for 1 minute before the resistance was measured.

4. Dielectric Withstanding Voltage

   A test potential of 500 volts AC was applied between adjacent contacts of mated and unmated specimens. This potential was applied for 1 minute and then returned to zero.

5. Insertion Force

   The force required to mate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm per minute.

6. Removal Force

   The force required to unmate individual specimens was measured using a tensile/compression device with a free floating fixture and a rate of travel of 12.7 mm per minute.

7. Durability

   Specimens were mated and unmated 2500 times at a maximum rate of 200 cycles per hour.

8. Mechanical Shock

   Mated specimens were subjected to a mechanical shock test having a half-sine waveform of 30 gravity units (g peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the 3 mutually perpendicular planes for a total of 18 shocks. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes DC.

9. Vibration

   Mated specimens were subjected to a random vibration test, specified by a random vibration spectrum, with excitation frequency bounds of 50 and 2000 Hz. The Power Spectral Density (PSD) at 50 Hz was 0.005 G^2/Hz. The spectrum sloped up at 6 dB per octave to a PSD of 0.02 G^2/Hz at 100 Hz. The spectrum was flat at 0.02 G^2/Hz from 100 to 1000 Hz. The spectrum sloped down at 6 dB per octave to the upper boundary frequency of 2000 Hz at which the PSD was 0.005 G^2/Hz. The root-mean square amplitude of the excitation was 5.35 GRMS. This was performed for 30 minutes in each of 3 mutually perpendicular planes for a total vibration time of 90 minutes. Specimens were monitored for discontinuities of 1 microsecond or greater using a current of 100 milliamperes in the monitoring circuit.

10. Humidity

    Mated specimens were subjected to a relative humidity of 90 t0 95% and a temperature of 40˚C for 96 hours.

11. Temperature Life

Mated specimens were exposed to a temperature of 85˚C for 500 hours.

12. Reseating

Specimens were manually mated and unmated 3 times.

13. Mixed Flowing Gas

Mated and unmated specimens were exposed for 14 days to a mixed flowing gas Class IIA exposure. Half the specimens were unmated for the first 7 days and then mated for the remaining 7 days, the other half of the specimens were mated for the entire 14 days. Class IIA exposure is defined as a temperature of 30˚C and a relative humidity of 70% with the pollutants of Cl_2 at 10 ppb, NO_2 at 200 ppb, H_2S at 10 ppb and SO_2 at 100 ppb.

14. Thermal Shock

Mated specimens were subjected to 10 cycles of thermal shock with each cycle consisting of 30 minute dwells at -55 and 85˚C. The transition between temperatures was less than 1 minute.

B. High Speed Signal Requirements

1. Mated Connector Differential Impedance

Measured per procedure P1 of Revision 2.6 of the Serial ATA.

2. Common Mode Impedance

Measured per procedure P4 of Revision 2.6 of the Serial ATA.

3. Maximum Insertion Loss of Cable (10 to 4500 MHz)

Measured per procedure P5 of Revision 2.6 of the Serial ATA.

4. Maximum Crosstalk (10 to 4500 MHz)

Measured per procedure P6 of Revision 2.6 of the Serial ATA.

5. Maximum Rise Time

Measured per procedure P8 of Revision 2.6 of the Serial ATA.

6. Maximum Intra-pair Skew

Measured per procedure P10 of Revision 2.6 of the Serial ATA.

4.3. Component Heat Resistance to Lead-Free Reflow Soldering

Specimens were exposed to a temperature of 85˚C and 85% relative humidity for 168 hours. Specimens were then placed on ceramic substrates on the conveyor belt of a convection air oven where they were exposed to temperatures between 150 and 200˚C for 60 to 180 seconds, between 255 and 260˚C for 20 to 40 seconds, and above liquidus (217˚C) for 60 to 150 seconds. Specimens were allowed to cool prior to repeating this sequence twice more for a total of 3 cycles.