SCSI cable media performance working group (SCMP) 99-328r1
November 30, 1999
Rochester, MN

Subject: Approved minutes for the SCSI cable media performance working group CMP on October 26, 27, 1999 in Huntington Beach CA

Zane Daggett of Hitachi led the meeting. Bill Ham of Compaq took these minutes. There was a good attendance from a broad spectrum of the industry. Dean Wallace of QLogic hosted the meeting.

1. Introduction

Zane opened the meeting and conducted the introductions and reviewed the meeting purpose.

2. Attendance

The following folks were present:

Martin Ogbuokiri, Molex, mobuokiri@molex.com
Larry Barnes, LSI Logic, larry.barnes@lsil.com
Jonathan Fasig, Western Digital, jonthan.L.Fasig@wdc.com
Bill Ham, Compaq, bill_ham@ix.netcom.com
Andrew Bishop, Quantum, andrew.bishop@quantum.com
Dave Chapman, Amphenol, dave.chapman@aipc.fabrik.com
Greg Vaupotic, Amphenol, greg/vaupotic@snet.net
Jie Fan, Madison Cable, jfan@tycoelectronics.com
Zane Daggett, Hitachi Cable, zdaggett@hcm.hitachi.com
Donald R. Getty, TI, donald_getty@ti.com
J. Pat Young, CMD technology, Young@CMD.com
Dean Wallace, Qlogic, d_wallace@qlc.com

3. Agenda development

The agenda shown was that used.

4. Approval of previous minutes

Greg Vaupotic moved and Andrew Bishop seconded that the draft minutes from the previous meeting be approved as modified. Motion passed unanimously.

The methodology for minutes uses the draft/approved minutes scheme with posting to the t10 web site of the minutes as the vehicle for publication. Postings are announced to the SCSI reflector after the posting is verified to be on the web site.

Minutes will be in .pdf format.

5. Methodology for this meeting

For this meeting only the detailed discussions are captured as a separate documents structured as a set of comments against SPI-3 rev 10 that is presently out for letter ballot. This document is appended to these minutes. Many of these comments were agreed during the meeting without formal motions. A few others required voting as noted in the following two items.

6. Discussion of the wording relating to measuring non uniform media - Vaupotic

Greg suggested that non-uniform media be subjected to the requirements in the documents by making media that consists only of the media constructions between the connectorized areas and testing the uniform media. Zane noted that the twist direction may alternate between flat areas (in the twisted/flat constructions) and that making a cable sample that has no flats could be different. It was agreed that having some guidance is better than no guidance and revised wording was created a placed into the comments document.

7. Review of 99-111r7 (performance requirements)

The document was reviewed as the basis for comments against SPI-3 in the performance requirements sections (mainly section 6 of SPI-3). The changes recommended are attached to these minutes.

Zane moved and Greg V seconded that the lower limit for SE capacitance be changed to 30 pF/m from 40 pF/m. The motion passed 7/0/3.

8. Annex E review

The SPI-3 rev 10 document changed the annex number relating to test requirements to Annex E from Annex F.

A line by line review of both SPI-3 rev 10 Annex E and the earlier document 99-219r5 was conducted. A number of editorial changes were made to the summary table.

The calibration methodology for the local impedance profile tests was extensively discussed. Two methods are commonly use for calibration: resistors and air lines.

Larry Barnes moved and Bill Ham seconded that the SCSI cable performance working group recommend adoption of the methodology in 98-219r5 for the calibration of local impedance measurement (using resistors). Motion passed 9/1/2. The no vote was based on the existence of reference line methodologies as an alternate and should also be included.

9. Next meetings

Nov 30, 1999 Rochester, MN
Future requested dates:
Feb 01, 2000 Huntington Beach (Qlogic?)
Feb 29, 2000 Manchester NH (Hitachi)

10. Action Items:

Old action items from previous meetings:

Larry Barnes to provide a proposal for dielectric constant measurements for SPI-3.
Status: ongoing

New actions from this meeting:

Bill Ham to ensure that the meeting schedules for SCMP; and SSM are consistent with T10 schedules.
Status: new

Date: October 27, 1999 Document number xxxxxxxxxxx

Comments against SPI-3 rev 10

1. technical

Section 6.3.1 Change:

The requirements in this clause apply to uniform cable media. Uniform media is media that is not designed to be non-uniform for the purposes of enabling connector attachment. These non-uniformities (e.g., a planar section created for connector attachment within a normally round cable media) is considered to be part of a cable assembly or harness whose performance is affected by the attached (sometimes unused) connectors as well as by the non-uniformity in the media.

To:

The requirements in this clause apply to uniform cable media. Non-uniform media is media that contains dissimilar sections for purposes of enabling connector attachment.

Non-uniformities (for example a planar section created for connector attachment) are considered to be part of a cable assembly or harness whose performance is affected by the attached (sometimes unused) connectors as well as by the non-uniformity in the media.

Implementers using non-uniform media may construct special uniform test media using manufacturing processes similar to that used for the non-uniform media for purposes of measuring the properties of the media between the connector attachment areas (e.g. the twisted regions in a twisted/flat planar construction).

For length dependent parameters both total and per unit length requirements are specified. This ensures performance compliance when concatenating cables in the same SCSI bus segment. Implementers have the practical option to use only the total requirements and to loosen the per unit length requirements in non-concatenated applications; however, this practice will create non conforming cables. Any cable media not meeting the per unit length requirements shall be labeled in a manner indicating that it is not suitable for use in cable assemblies that might be used in a concatenated manner.

2. editorial

The term “flat” needs to be replaced with the word “planar” in all usage that refers to the physical construction of cable media except in the cases where clarifying of the meaning of the word “flat” in the context of cable media. (This change is needed to avoid confusion between unbalanced planar, the usual “flat” construction, and balanced planar, the twisted flat construction).

3. technical

Remove Table 9.:recommended minimum conductor size.

(information is now contained in new table 12)

4. technical

Change Table 10 to:

Cable construction	**Local SE transmission line impedance ****		**Local DIFF transmission line impedance ****	
	Min	Max	Min	Max
All	84 (78*)	96	110	135

All values are measured by time domain reflectometry
* If SCSI loads attached to the cable media are separated by more than 1.0 m use the value of 78 Ohms
** Ideally one design will meet both SE and DIFF criteria
Lower impedance values may be desirable when attaching directly to a backplane or other heavily loaded environments

5. technical

Change:

6.3.4 Extended distance transmission line impedance

The swept frequency (extended distance) differential impedance limits shall be a maximum peak to peak variation of 30 ohms over the frequency range 1 MHz to 1 GHz on a 30 meter cable.

To:
6.3.4 Extended distance transmission line impedance

Swept frequency (extended distance) differential impedance limits: max peak to peak variation of 60 ohms over the frequency range 30 MHz to 600 MHz on a 30 meter cable.

6. technical

6.3.8 SE attenuation

Change from:
The maximum sine wave signal attenuation shall be 0,095 dB maximum per meter at 5 MHz, measured differentially or a maximum sine wave signal attenuation of 1,41 dB at 5 MHz for the entire bus measured differentially.

To:

SE attenuation requirements are not separately specified. SE attenuation requirements are indirectly specified through the differential requirements in section 6.3.9.

7. technical

Change Table 12 to:

Table 12 - Attenuation requirements for SCSI cable media

Distance between SCSI bus terminators (meters)	Attenuation per meter max (dB) @ 200 MHz	Attenuation of length equivalent to terminator to terminator distance max (dB) @ 200 MHz	Distances are consistent with these minimum size conductors when used with high quality dielectrics:	Notes:
0 to 9	0.63	6	32 AWG solid/ 30 AWG stranded	multiple loads allowed
0 to 12	0.48	6	30 AWG solid/ 28 AWG stranded	multiple loads allowed
>12 to 25	0.48	12	30 AWG solid/ 28 AWG stranded	point to point only
Both the per meter and the length equivalent to the terminator to terminator spacing requirements shall be simultaneously met				

8. technical

Change note 17 to read as follows:

NOTE 17 - SCSI devices connected with a maximum length SE A cable (table 3) are not able to meet the source current requirements in table 27 unless the TERMPWR conductor size is 0,080 98 mm 2 (28 AWG) minimum because the SE A cable contains only one TERMPWR line.

9. technical

Change Table 11 to include the requirement of minimum as well as maximum values of capacitance and rewording of the dielectric constant requirements. The contents of table 11 should be:

Capacitance limits: SE 30 min to 66 pF/m max at 100 kHz and 1 MHz

DIFF 26 min to 46 pF/m max at 100 kHz and 1 MHz

10. technical

In 6.3.5

Change:

To calculate the allowable dielectric constant variation between 100 kHz and 1 GHz the maximum dielectric constant in the frequency range minus the minimum dielectric constant in the frequency range shall be less than 5% of the maximum dielectric constant in the frequency range.

To:

Dielectric constant variation in the material forming the insulation directly in contact with the conductors in the cable media between 300 kHz and 600 MHz: max dielectric constant in the frequency range divided by the min dielectric constant in the frequency range is less than 1.10.

11. technical

Change 6.3.6 to:

SE propagation time requirements are not separately specified. SE propagation time requirements are indirectly specified through the differential requirements in section 6.3.7.

12. technical

Section 6.2

Change:

Interconnection of SCSI devices by means other than cables is allowed (e.g., by backplanes using printed wiring boards) (see annex J). Detailed descriptions of these other means are not part of this standard; however, they are subject to the electrical characteristics presented in this standard. Examples of these electrical characteristics are:
a) transmission line impedance (see 6.3);
b) propagation delay (see 6.3);
c) cumulative length (see 6.6 and 6.7); and
d) signal attenuation (see 6.3).

To:

Interconnection of SCSI devices by means other than cables is allowed (e.g., by backplanes using printed wiring boards) (see annex J). Detailed descriptions of these other means are not part of this standard; however, they are subject to the electrical requirements in sections 6.3.

13. editorial

Change:
NOTE 6 - Use of non-twisted flat cables causes cross-talk problems.

To:

NOTE 6 - Use of unbalanced media such as planar untwisted construction typically produces higher cross talk than balanced constructions but may be used if all performance requirements are met.

14. Technical

Table 15

Change:

Note: Media capacitance with no SCSI devices attached measured between a signal conductor and ground when all other conductors in the path are connected to ground.

To:

Note: SE media capacitance with no SCSI devices attached measured per Annex E.

15. Technical

Annex E-1

Change

This annex defines the electrical performance requirements for shielded and unshielded cable media and specifies the details of a measurement methodology to minimize the error between measurements executed in different laboratories.

Several parameters are required to specify the electrical requirements:

To:

This annex defines the electrical measurement methodology requirements to be used for both shielded and unshielded cable media. These methods are required to minimize the error between measurements executed in different laboratories.

The methodologies are specified to extract parameters in each of the following performance requirements:

16. technical

Annex E-1

Change: This annex also specifies methods for testing for these parameters. Table E.1 summarizes the testing requirements.

To: Table E.1 summarizes the measurement methodology requirements.

17. editorial

Remove the wording just before E-2: The test methods defined in this annex may or may not be applicable to complete SCSI bus segment performance. This annex does not address performance other than that of media designed to be uniform.

18. technical

Change:

E.2.1.2.2 Measurement system (with test fixture) calibration

Connect the 50 Ω cable to the test fixture. In place of “B” in figure E.1, connect a 100 Ω 0,1% (preferred) low inductance chip resistor. Use an unfiltered trace and the TDR cursors to measure the resistance value, R100, approximately 4 ns (displayed) after the resistor discontinuity. See figure E.2.

In a similar manner, in place of “B” in figure E.1, connect a 50 Ω 0,1% (preferred) low inductance chip resistor. Use an unfiltered trace and use the TDR cursors to measure the resistance value, R50, approximately 4 ns (displayed) after the resistor discontinuity.

To:

E.2.1.2.2 Measurement system (with test fixture) calibration

Connect the 50 Ω cables to the test fixture. In place of “B” in figure E.1, connect a 100 Ω ±0,1% (preferred) low inductance chip resistor (IMS style TPI-1206 or equivalent). Use an unfiltered trace and the TDR cursors to measure the resistance value, R100, approximately 4 ns (displayed) after the resistor discontinuity. See figure E.2.

In a similar manner, in place of “B” in figure E.1, connect a 75Ω ± 0,1% (preferred) low inductance chip resistor. Use an unfiltered trace and use the TDR cursors to measure the resistance value, R75, approximately 4 ns (displayed) after the resistor discontinuity.

19. technical

Immediately before sections E.2.1.2.3

Change:

Subtract R50 from R100 producing Delta R.
Correction factor for vertical scale and cursor readings = (Delta R) / 50

To:

For R100 and R75 the equation for determining the corrected (actual) impedance is:

$Z_{corrected} = 25(4*X_1 - 3*X_2 - Z_{measured})/(X_1-X_2)$

Where:

X_1 is the measured value using the 75Ω resistor
X_2 is the measured value using the 100Ω resistor

20. technical

In E.2.1.3 change:

f) With the filter turned on to 3ns connect the DUT.
g) DUT shall be suspended in air. No metallic supports should be used.
h) Set the TDR cursor to measure minimum, mean, and maximum ohms with cursors set on the trace as it crosses the 5th and 6th times divisions.

To:

f) With the rise time filter adjusted to achieve 3ns connect the DUT.
g) Note: unshielded DUT's shall be suspended in air. No metallic supports should be used.
h) Set the TDR cursor to measure minimum and maximum ohms with cursors set on the trace as it crosses the 5th and 6th times divisions.

21. technical

change:

E.2.2.2.3 Measurement system (with test fixture) calibration
Connect the 50 Ω cable to the test fixture. In place of "B" in Figure E.1, connect a 100Ω ±0,1% (preferred) low inductance chip resistor across the pair. Use a differential unfiltered trace and use TDR cursors to measure the resistance value, R100, approximately 4 ns (displayed) after the resistor discontinuity. See figure E.2. The method shown in figure E.2 applies to differential except a 100 Ω level from the test fixture will be seen and differential signals are displayed.
In a similar manner, in place of "B" in figure E.1, connect a 50Ω ±0,1% (preferred) low inductance chip resistor across the pair. Use a differential unfiltered trace and use the TDR cursors to measure the resistance value, R50, approximately 4 ns (displayed) after the resistor discontinuity.
Subtract R50 from R100 producing Delta R.
Correction factor for vertical scale and cursor readings = (Delta R) / 50

To:

E.2.2.2.3 Measurement system (with test fixture) calibration

Connect the 50 Ω cables to the test fixture. In place of “B” in Figure E.1, connect a 137Ω ±0,1% (preferred) low inductance chip resistor (IMS style TPI-1206 or equivalent) across the pair. Use a differential unfiltered trace and use TDR cursors to measure the resistance value, R137, approximately 4 ns (displayed) after the resistor discontinuity. See figure E.2. The method shown in figure E.2 applies to differential except a 100 Ω level from the test fixture will be seen and differential signals are displayed.

In a similar manner, in place of “B” in figure E.1, connect a 100Ω ±0,1% (preferred) low inductance chip resistor (IMS style TPI-1206 or equivalent) across the pair. Use a differential unfiltered trace and use the TDR cursors to measure the resistance value, R100, approximately 4 ns (displayed) after the resistor discontinuity.

For R137 and R100 the equation for determining the corrected (actual) impedance is:

$$Z_{corrected} = 25(1.37*X_1 - X_2 - 0.37*Z_{measured})/(X_1-X_2)$$

Where:

X_1 is the measured value using the 100Ω resistor
X_2 is the measured value using the 137Ω resistor

22. technical

A figure is needed in section E.2.2.3 to illustrate the differential measurements.

This new figure is not available as of the date of these comments but will be available in time for the comments resolution working group.

23. technical

In E.2.2.2.4 move the 6th item in the list to its own paragraph following the list.

24. technical

In section E.2.2.3

Change:

f) With the filter turned on to 1ns connect the DUT.
g) DUT shall be suspended in air. No metallic supports should be used.
h) Set the TDR cursor to measure minimum, mean, and maximum ohms with cursors set on the trace as it crosses the 5th and 6th times divisions.
i) Set the filter to 3 ns.

j) Set the TDR cursor to measure minimum, mean, and maximum ohms with cursors set on the trace as it crosses the 5th and 6th times divisions.

To:

f) With the rise time filter adjusted to achieve 3ns connect the DUT.
g) Note: unshielded DUT's shall be suspended in air. No metallic supports should be used.
h) Set the TDR cursor to measure minimum and maximum ohms with cursors set on the trace as it crosses the 5th and 6th times divisions.
i) Set the filter to 3 ns.
j) Set the TDR cursor to measure minimum and maximum ohms with cursors set on the trace as it crosses the 5th and 6th time divisions.

25. technical

In section E.2.3.1

Change bullet item 2 to read: Remove 5,0 cm of outer jacket from both ends

and add a bullet item 6 to read: Attach a 122 Ω resistor to the far end of the pair under test.

26. technical

In section E.2.3.2.1

Change:
The first type is constructed using two baluns mounted on aluminum base and electrically isolated from each other by aluminum screen (test fixture 1 figure E.6).
The second type uses high speed PCB with microstrip construction. Two baluns are mounted at one edge of the board with sufficient separation to reduce mutual coupling by a minimum of 20 dB. The interconnect traces of the signal pairs are further separated from each other in a radial form and the signal traces run at 61Ω to ground for each differential line (test fixture 2 figure E.6).

To:

The first type is constructed using two baluns mounted on a metallic base and electrically isolated from each other by a metallic screen (test fixture 1 figure E.6).
The second type uses high speed PCB with microstrip construction. Two baluns are mounted at one edge of the board with sufficient separation to reduce mutual coupling by a minimum of 20 dB. The interconnect traces of the signal pairs are further separated from each other in a radial form and the signal traces run at 61Ω nominal to ground for each differential line (test fixture 2 figure E.6).

27. technical and editorial

Change the existing sections E.2.3.2.3 and E.2.3.2.4 to the following:

E.2.3.2.3 Test Fixtures
For the metallic base test fixture (test fixture 1), the transmission line is provided by the baluns as the signal paths and the metallic base as the current return path. The baluns provide a 50 to 61 Ω impedance matching between the test instrument system and the DUT, as well as provide differential signals. The metallic screen provides electric field isolation between the two baluns. The DUT connects to the fixture via a mechanical clamp system. The DUT should self terminate given its length.

E.2.3.2.4 Fixture board design requirements (test fixture 2 figure E.6):

For the PCB test fixture, the test fixture consists of a printed circuit board incorporating controlled impedance trace construction of 61 Ω (refer to test fixture 2 figure E.6). The transmission line is provided by the connected baluns and PCB traces for the signal paths and the ground plane of the board for the return current path. A coaxial cable (same transmission line impedance as the test instrument) connects one end of the cable to the instrument test port through the baluns and the PCB fixture trace combination. The baluns provide a 50 to 61 Ω impedance matching between the test instrument system and the DUT, as well as provide differential signals. The separation of the baluns and the signal lines provide electric field isolation between the two baluns and the signal lines. The DUT connects to the fixture via a mechanical clamp system. The DUT should self terminate given its length.

NOTE 54 - The baluns required for this test are high frequency (650 MHz or greater) precision types.

A stand is recommended for mounting fixture board and to support the DUT. It is recommended that the stand keep the fixture board at least 7 cm from the top of the lab bench to minimize coupling.

Traces are constructed on the PCB to conform with the differential transmission scheme. The fixture shall be through hole or surface mount PCB. The signal traces are connected to the balun’s differential pins using microstrip construction with controlled transmission line impedance of 61 _. The length of the connections shall permit the board to operate at the desired frequencies and accommodate the required number of signal lines, including sufficient separation to reduce mutual coupling by a minimum of 20 dB. It is recommended that the bandwidth of the board be at least 650 MHz. Board impedance shall be tightly controlled to within 5% of the impedance of the environment.

The fixture board shall include calibration traces for measuring the effects of the test fixturing on the measured data. This board construction is useful for other frequency domain measurements but is not designed to accommodate time domain.

28. technical

In section E.2.3.4 add the statement:

Note: unshielded DUT’s shall be suspended in air. No metallic supports should be used.

Immediately before the existing wording:

Connect the near end of the sample to the output balun on the test fixture, keeping the leads as short as….

29. technical

Delete the following from section E.3.1.1

For round cables shield floating:
1) Cut sample length to 3 m.
2) Remove 5,0 cm of outer jacket from one end.
3) Cut braid wire back to jacket.
4) Trim filler and tape materials to the base of braid wire.
5) Strip 0,5 cm insulation from all conductors.

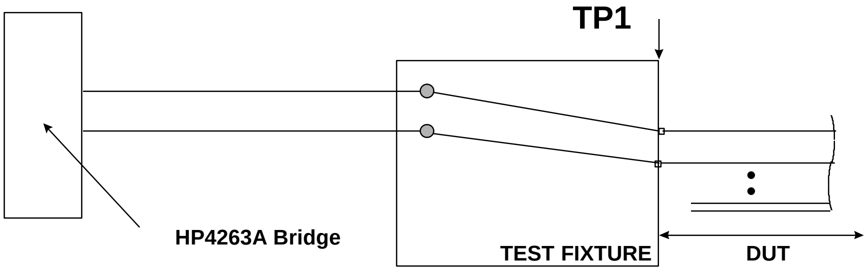
30. technical

In section E.3.1.2

change: See E.2.2.2 for appropriate test fixtures.

To: Figure x shows the configuration to use for this measurement procedure.

Add the following figure x describing the test fixture to section E.3.1.2 with the title “Test fixture for single ended capacitance measurement”.



TEST FIXTURE / MEASUREMENT PROCESS IS CALIBRATED TO REPORT AT TP1

31. technical

In section E.3.1.3

Change the second bullet to:

2) Connect a wire (short) to the sockets of the test fixture and perform a “short” calibration as
specified by HP.

32. technical

Remove the following section:

E.3.1.4.1 Flat cables - G-S
With the bridge set at the desired frequency, connect the pair to the test fixture and record the capacitance.

33. technical

Change:

E.3.1.4.3 Round cables - shielded
With the bridge set at the desired frequency, connect one half of the twisted pair to one side of the test fixture and the other half of the

twisted pair to the shield and to the other side of the test fixture. Record the capacitance.

To:

E.3.1.4.3 Round cables - shielded
With the bridge set at the desired frequency, connect one conductor of the twisted pair to one side of the test fixture. Connect the commoned conductors and shield to the other side of the test fixture (ground). Record the capacitance.

34. technical

Remove the following section:

E.3.1.4.4 Round Cables - floating shield
With the bridge set at the desired frequency, connect the twisted pair to the test fixture. Record the capacitance.

35. technical

Remove the following material:

For round cables shield connected:
1) Cut sample to a length that eliminates resonance.
2) Remove 5,0 cm of outer jacket from both end.
3) Comb out braid wire strands to form a pig tail.
4) Trim filler and tape materials to the base of braid wire.
5) Strip 0,5 cm insulation from all conductors.
6) Connect one (1) conductor of each pair to the shield.

36. technical

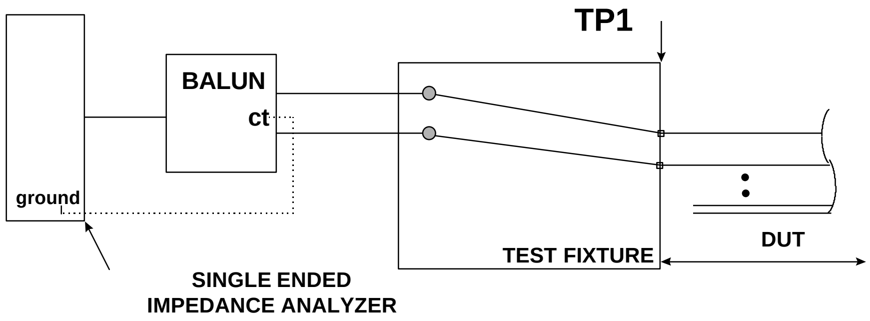
In section E.3.2.2

Change:

See E.2.2.2 for appropriate test fixtures.

To:

Refer to Figure x for the proper test configuration.
[Add a new Figure x shown below titled “Test fixture for differential capacitance measurements”].



TEST FIXTURE / MEASUREMENT PROCESS IS CALIBRATED TO REPORT AT TP1

37. editorial

In E.3.2.3.1 change bullet 6 to:

6) Record the linear measurement

38. editorial

In E.3.2.3.2 change:

For other manufacture’s equipment, follow the calibration procedures specified by the manufacturer for reliable results.

To:

For other instruments follow the calibration procedures specified by the manufacturer for reliable results.

39. technical

In Section E.3.3

Change:

Selection of this test method is on underway.

To:

This measurement procedure is not specified in this document.

40. technical

In E.4.1 remove bullet 6):

6) Each pair under test shall be terminated with a 100 Ω resistor at the far end of the cable.

41. technical

In section E.4.2

Change:

See E.2.2.2 for appropriate test fixtures.

To: See Figure E-14 for appropriate test fixture.

42. technical

In section E.4.3 Change:

The analyzer shall be set to perform a S12 measurement with the power set at a minimum of 6 dbm, the number of points set to a minimum of 401, the band width at a maximum of 200 Hz, averaging at a minimum of 2 averages, and the start/stop frequencies per the table. Perform a transmission calibration using a sample of the cable to be tested keeping the sample as short as possible.

To:

The analyzer shall be set to perform an S12 measurement with the power set at a minimum of 6 dBm, the number of points set to a minimum of 401, the resolution bandwidth at a maximum of 200 Hz, averaging at a minimum of 2 averages, and the start/stop frequencies per Table E.1. Perform a transmission calibration using a sample of the cable to be tested keeping the sample as short as possible.

43. editorial

In E.4.4 change:

With the analyzer set up in the delay mode, connect one end of the sample to the balun on the output port and the opposite end to the balun on the input port with the markers turned on record the minimum and maximum delay across the band width as listed in table E.1.

To:

With the analyzer set up in the delay mode, connect one end of the sample to the balun on the output port and the opposite end to the balun on the input port. With the markers turned on record the minimum and maximum delay across the bandwidth as listed in table E.1.

44. technical

In section E.5.1 change:

This test requires type D sample (see table E.1) prepared in the following way:

To:

This test requires type H sample (see table E.1) prepared in the following way:

45. technical

In section E.5.1 change:

For round cables shield connected:

To:

For round cables shield floating:

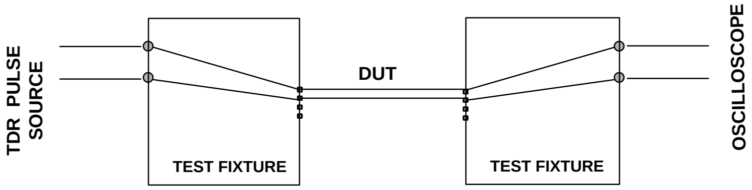
46. technical

In section E.5.2 change:

See E.2.2.2 for appropriate test fixtures.

To: See Figure x for appropriate test fixture.

Add new figure x given below showing the test fixture with the title "Propagation time measurement setup".



TEST FIXTURE TO MEASURE PROPAGATION TIME

47. technical

In Table E-1 under Diff propagation time (frequency) change:

An S12 measurement

To: An S12 measurement swept from 10 MHz to 650 MHz (normative measurement with no pass/fail levels

48. technical

In Table E-1 under Diff propagation time (time) change:

(G) Modified to 3 m

To: Sample 6m

49. editorial

In Table E-1 under Diff attenuation change:

(H) Sample leave all other lines open -long enough to produce at least 1dB at the low frequency shelf (note 3) (typically> 30 m)

To:

(I) Sample leave all other lines open -long enough to produce at least 1dB at the low frequency shelf (note 3) (typically> 30 m)

50. editorial

Under E.5.3 change: For other manufacture’s equipment, use the same procedure adapted for that instrument.

To: For other instruments, use the same procedure adapted for that instrument.

51. technical

Under E.6.1 change: Maximum propagation time minus the minimum propagation time renders the overall propagation time skew of the pair under test.

To: Using the time domain (through) measurement, maximum propagation time minus the minimum propagation time renders the overall propagation time skew of the pair under test.

52. technical

In section E.7.1 change:

Attenuation (dB) = 20 $\log_{10}$ (input signal / output signal). and
Gain (dB) = 20 $\log_{10}$ (output signal / input signal)

To:

Attenuation (dB) = 20 $\log_{10}$ (input voltage / output voltage). and
Gain (dB) = 20 $\log_{10}$ (output voltage / input voltage)

53. technical

In section E.7.1 change:

At higher frequencies, the conductor loss increases due to skin effect. Skin effect is where the current become increasing confined in the outer “skin” of the conductor as the frequency increases. This effectively reduces the conductor area available for current flow. The attenuation for a given balanced transmission line will be affected by the conductor metal composition and size, and the composition, uniformity, and thickness of the dielectric that surrounds the conductors.

To:

At higher frequencies, the conductor loss increases due to skin effect. Skin effect is where the current becomes increasingly confined to the outer “skin” of the conductor as the frequency increases. This effectively reduces the conductor area available for current flow. The attenuation for a given transmission line will be affected by the conductor metal composition and size, and the composition, uniformity, and thickness of the dielectric that surrounds the conductors.

54. technical

Insert the following new section in front of the present section E.7.1.1:

E.7.1.1 Sample preparation

1) Cut sample to a length that produces at least 1 dB attenuation at the low frequency shelf (typically at least 30 meters).
2) Remove 5,0 cm of outer jacket from both ends.
3) Cut braid wire back to jacket.
4) Trim filler and tape materials to the base of braid wire.
5) Strip 0,5 cm insulation from all conductors.

55. technical

In section E.7.1.1 change

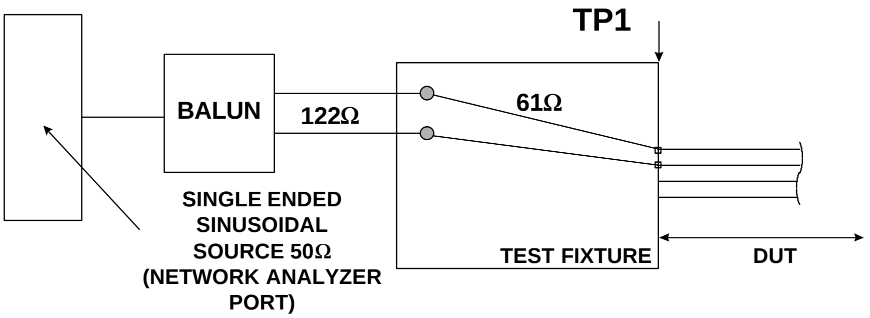
A test fixture having 75 Ω single ended paths for each signal line is used for the measurement as shown in

To:

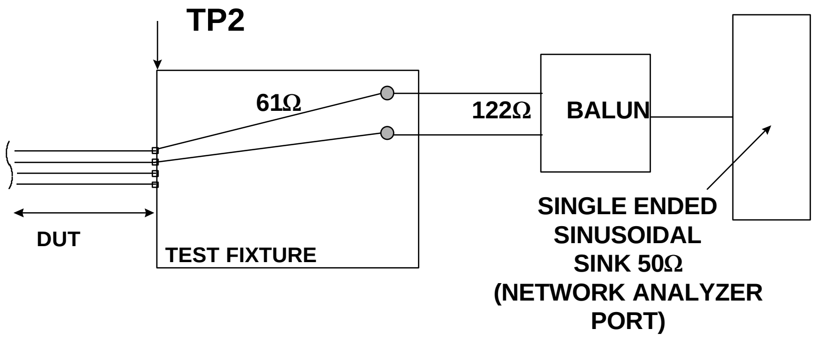
A test fixture having 61 Ω single ended paths for each signal line is used for the measurement as shown in

56. technical

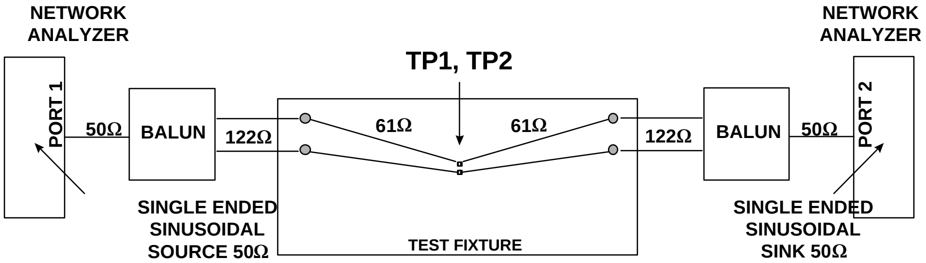
In section E.7.1.1 replace Figures E.12, E.13, and E.14 with the following respective figures: (same figure titles)



TEST FIXTURE / MEASUREMENT PROCESS IS CALIBRATED
TO REPORT AT TP1



TEST FIXTURE / MEASUREMENT PROCESS IS CALIBRATED
TO REPORT VALUES AT TP2



TEST FIXTURE / MEASUREMENT PROCESS IS CALIBRATED TO REPORT VALUES AT IUT CONNECTION POINT (TP1, TP2)

57. editorial

Change the last sentence in E.7.1.3: The separable DUT is connected between the source and sink test fixtures.

To: The DUT is connected between the source and sink test fixtures.

58. editorial

In the last sentence in E.7.1.4 change “from” to “for”.

59. editorial

In E.7.1.5

Change:
The instrument automatically accounts for the attenuation found in the calibration scan.

To: The instrument automatically compensates for the attenuation found in the calibration scan.

60.

In E.7.1.5 change: When the attenuation of the cable exceeds ~ 50 dB or

To: When the attenuation of the cable exceeds approximately 50 dB or

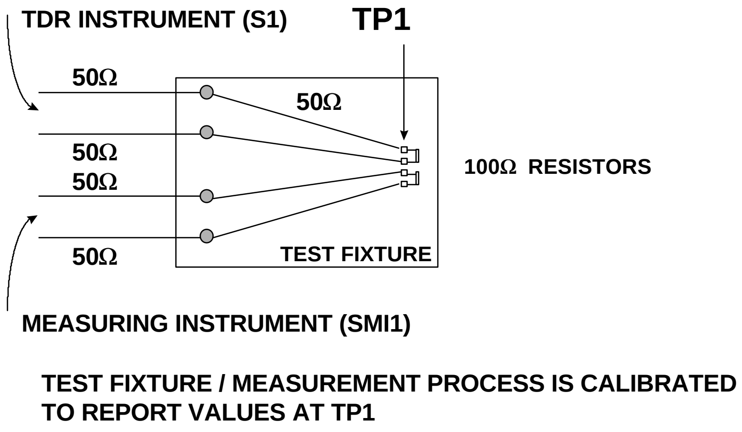
61. technical

In E.8 change: Single pulse tests eliminate the effects of resonance, are very deterministic

To: Single pulse tests that eliminate the effects of resonance, are very deterministic

62. technical

In section E.8.3 change Figure E.17 to:



63. technical

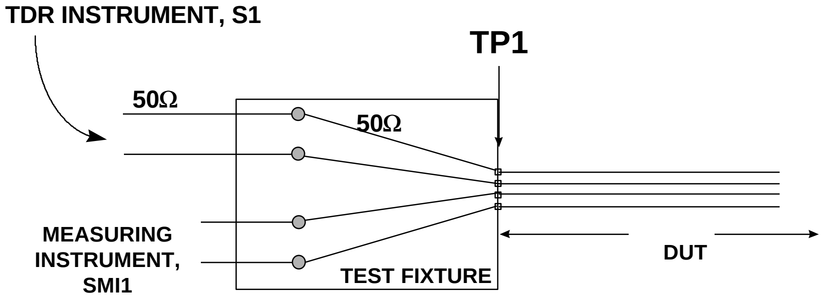
In E.8.3 change:

Use the 100% differential amplitude.

To: Use the 100% differential amplitude as defined in Figure E.3

64. technical

In E.8.4 change: Figure E.18 to:



TEST FIXTURE / MEASUREMENT PROCESS IS CALIBRATED
TO REPORT VALUES AT TP1