

Test Report



**Conformance testing of 100 Ω channel
(3 and 4 connectors)
Category 5e and Class D**

Performed for RiT Technologies Ltd.

Project no.: E311590-01, rev. 1

DANAK 19J1003

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3 appendices

2002-09-17

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Title	Conformance testing of channels
Channel identification 3 connector channel #1	85 metres of horizontal cable: R3729040 5+4+1 metres of flexible patch cord: R3259500, R3259400, R3259100 Wall outlet: R3010012 Patch panel: R3801020B Plug: R3209001
Channel identification 4 connector channel #2 & #3	85 metres of horizontal cable: R3729040 5+5+4+1 metres of flexible patch cord: R3259500, R3259500, R3259400, R3259100 Wall outlet: R3010012 Patch panel: R3801020B Plug: R3209001
Attestation of Conformity	No. 2002-131
Report no.	DANAK-19J1003
Project no.	E311590-01, rev. 1
Test object received	2002-08-12
Test period	August 2002
Client	RiT Technologies Ltd. 24 Raoul Wallenberg St. Tel-Aviv 69719 Israel
Contact person	Mr. Kobi Haggay
Specifications	ANSI/TIA/EIA-568-B.2 ISO/IEC 11801 2 nd edition FDIS (2002) EC VERIFIED Requirements
Results	Compliance with specifications is verified

Prepared by Ole Christensen

Reviewed by Erik Bech

Date 2002-09-17

Responsible 

Erik Bech, Test Manager
DELTA LAN Components and Systems Testing

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1. Summary

Three communication channels have been subjected to a transmission conformance test programme to verify that they comply with generic cabling standards.

The channels for this electrical performance test were assembled and delivered to DELTA by the client.

The channel testing has been performed under laboratory conditions at the European Cabling group of DELTA.

This report firstly gives an overview of the test procedures and lists the applied standards. Then the test results are reported and compared with the requirements. Based on the results, it is concluded if the communication channels under test comply with the requirements.

2. Reference to applicable standards and documents

Test of the channel under test is performed with reference to the generic cabling standards:

- Ref. 1. ANSI/TIA/EIA-568-B.2. Commercial Building Telecommunications Cabling Standard. Category 5e (2001).
(This standard covers Category 5e cables, patch cords, connecting hardware, and cabling).
- Ref. 2 ISO/IEC 11801 2nd edition FDIS (2002). (1/SC25 / N780).
Information Technology. Generic cabling systems for customer premises.
(This draft standard covers all cabling classes up to class 7).

Special requirements for EC VERIFIED

- Ref. 1. DQP231006 Terms and conditions for use of the EC VERIFIED marking on generic cabling products, dated 2002-02-12.

3. Channel components

The channel is defined as shown in Fig. 3.1.

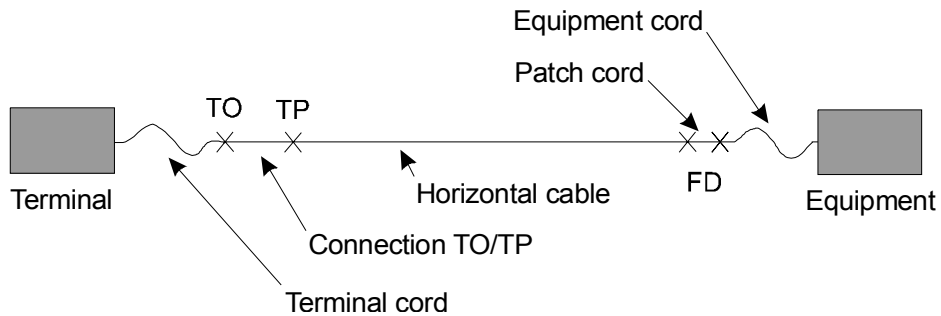


Fig 3.1 Definition of channel (4 connector model).

The channel consists of the following components:

Channel part	Cable type	Length	Connecting hardware
Terminal cord	Flexible cable	5 m	1 plug
Connection TO/TP	Flexible or horizontal cable	5 m	1 plug 1 socket
Floor cable	Horizontal cable	85 m	2 sockets
Patch cord	Flexible cable	1 m	2 plugs
Equipment cord	Flexible cable	4 m	1 socket

3.1 Test samples 3 connector channel (one sample)

90 metres of horizontal cable:

R3729040

5+4+1 metres of flexible patch cord:

R3259500, R3259400, R3259100

Wall outlet:

R3010012

Patch panel:

R3801020B

3.2 Test samples 4 connector channel (two samples)

85 metres of horizontal cable:

R3729040

5+5+4+1 metres of flexible patch cord:

R3259500, R3259500, R3259400, R3259100

Wall outlet:

R3010012

Patch panel:

R3801020B

Plug:

R3209001

4. **Test procedures and equipment**

The tests carried out on the communication channel under test are performed according to test procedures worked out by DELTA and approved by DANAK. These procedures are as far as possible in compliance with the standardised procedures that are referred in the standards for cables and cabling. For those test methods that are still for further study, DELTA has chosen appropriate tests, which are proposed by the working groups in the standardisation committees. DELTA is actively participating in many of these groups. Information on the detailed procedures is given upon request. In this section the procedures are described briefly and the applied equipment for the tests are listed.

4.1 **Electrical tests**

The electrical tests on the communication channel under test are performed according to the procedures described in this section. The performed tests are shown in the following table. The floor cable is stretched on a non-conductive surface.

	Measured from	
	Terminal end (wall outlet)	Equipment end (patch panel)
Attenuation	X	
Near end crosstalk (NEXT)	X	X
Equal level far end crosstalk (ELFEXT)	X	
Return loss	X	X
Propagation delay	X	
Delay skew	X	
LCL balance	X	X

4.1.1 Attenuation

The tests are performed in a set-up as shown in Fig. 4.1.

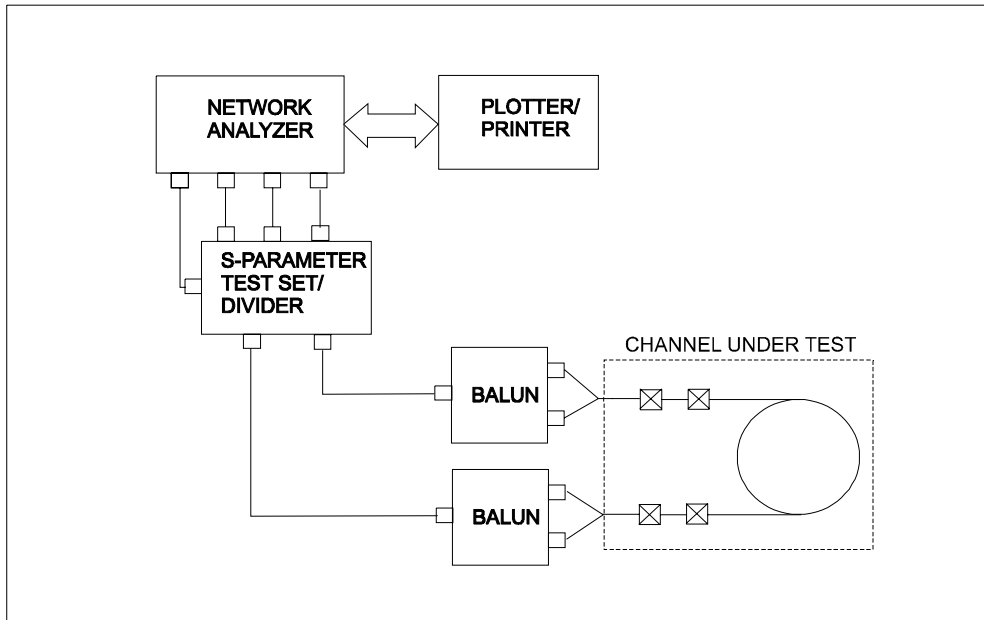


Fig. 4.1 Set-up for attenuation measurements.

Wall outlet end and Patch panel end are connected to one balun each.

Equipment:

Network Analyzer, HP 8753D
Test Box

Instrument no.: 31094
Instrument no.: 31113

4.1.2 Near end crosstalk (NEXT)

When measuring near end crosstalk, pairs are terminated with a fixed resistor equal to the characteristic impedance of the cable.

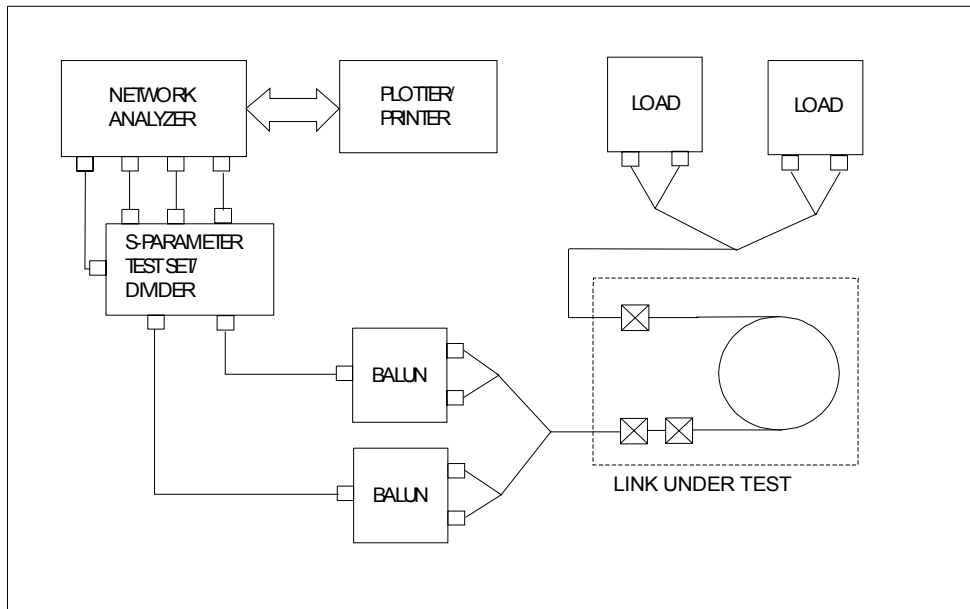


Fig. 4.2 Near end crosstalk measurement.

Equipment:

Network Analyzer, HP 8753D
Test box

Instrument no.: 31094
Instrument no.: 31113

4.1.3 Attenuation to crosstalk loss ratio (ACR)

ARC is calculated for each pair considering the minimum near end crosstalk measured for the three pair combination in question.

4.1.4 Equal level far end crosstalk (ELFEXT)

ELFEXT is calculated from the measured values of far end crosstalk (FEXT) and attenuation.

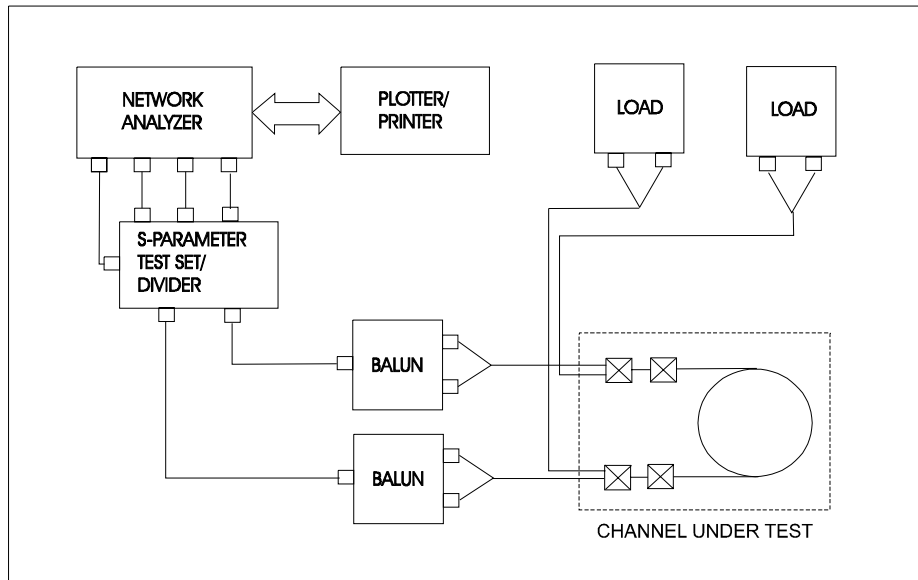


Fig 4.3 Measuring of far end crosstalk.

Equipment:

Network Analyzer, HP 8753D
Test Box

Instrument no.: 31094
Instrument no.: 31113

4.1.5 Return loss

The tests are performed in a set-up as shown in Fig. 4.4.

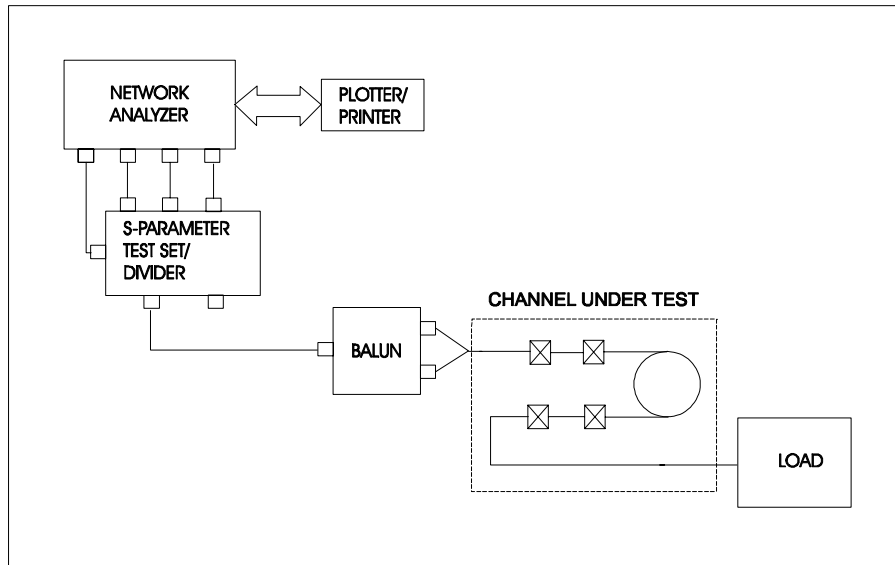


Fig 4.4 Measuring of return loss.

Equipment:

Network Analyzer, HP 8753D
Test box

Instrument no.: 31094
Instrument no.: 31113

4.1.6 Propagation delay

Propagation delay is measured by determining the phase delay of a signal transmitted through the channel.

$$\delta = \frac{\varphi}{2\pi \times f}$$

where δ is the phase delay, φ is the accumulated phase in radians, and f is the frequency in Hertz.

The accumulated phase is calculated from the angle of S_{21} , obtained in the attenuation measurement (see section 4.1.1).

4.1.7 DC loop resistance

DC loop resistance is measured from wall outlet end of the link. Pairs are shorted at the patch end.

Equipment:

Keithley micro-ohmmeter, type 2000

Instrument no.: 31092

4.1.8 Longitudinal conversion loss (LCL)

The tests are performed in a set-up as shown in Fig. 4.5.

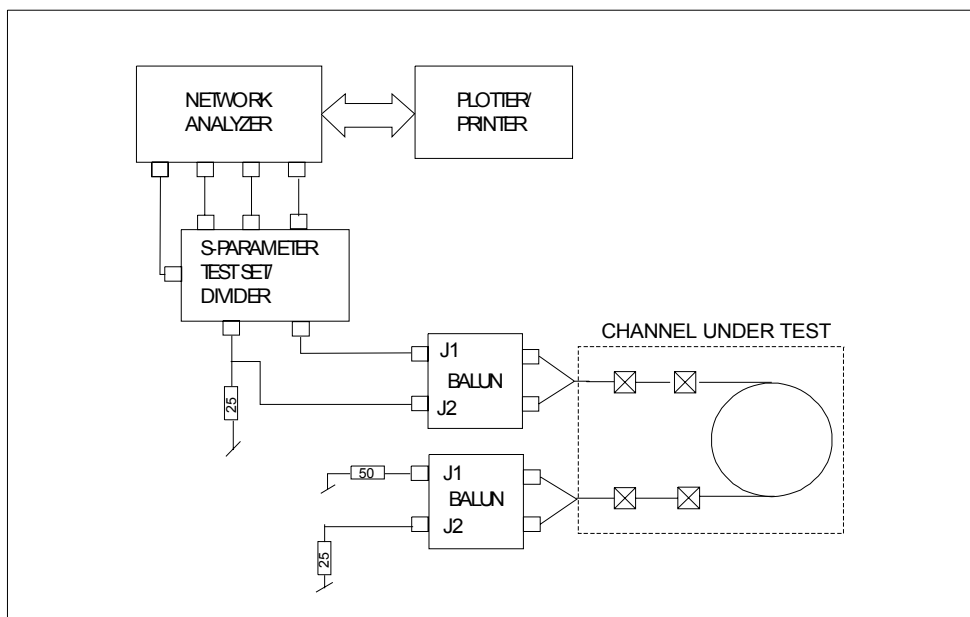


Fig 4.5 Measuring of longitudinal conversion loss.

When measuring the longitudinal conversion loss, all unmeasured pairs are terminated in both ends with a fixed resistor equal to the characteristic impedance of the cable.

Equipment

Network Analyzer, HP 8753D

Test box

Instrument no.: 31094

Instrument no.: 31113

4.2 Test software

Test software according to information in the table below is used for the conducted tests.

Software name	Function	File name	Version	Date
Cable test programme	Electrical cable tests	Cabltotal.vee	3.85	020307
Report programme	Report	XReport.vbp	11.00	020617

5. **Test results**

The test results for the 3 tested samples are shown in *Appendix 1* to 3.

The test results are only valid for the tested items.

Appendix 1, Test on the channel #1:	Page
Attenuation	1
NEXT, terminal end	1
NEXT Power Sum, terminal end	2
ELFEXT	2-3
ELFEXT Power Sum	4
Return loss, terminal end	4
Propagation delay	5
Delay skew	5
ACR	6
ACR Power Sum	6
LCL, terminal end	7
DC loop resistance	7
NEXT, equipment end	8
Return loss, equipment end	8
LCL, equipment end	9

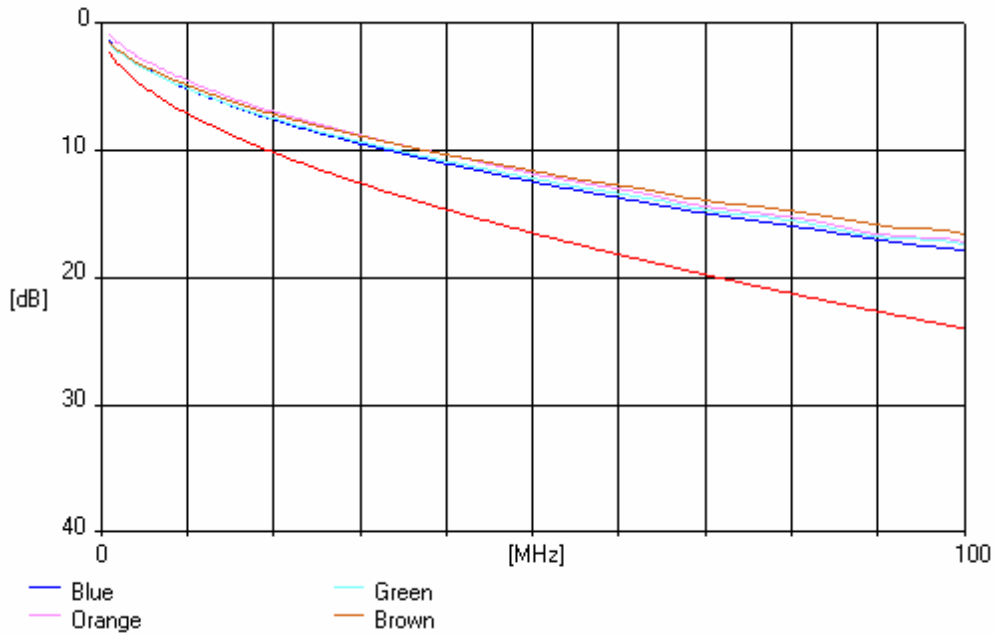
Appendices 2 and 3, Test on the channels #2 and #3:	Page
Attenuation	1
NEXT, terminal end	1
NEXT Power Sum, terminal end	2
ELFEXT	2-3
ELFEXT Power Sum	4
Return loss, terminal end	4
Propagation delay	5
Delay skew	5
ACR	6
ACR Power Sum	6
LCL, terminal end	7
DC loop resistance	7
NEXT, equipment end	8
Return loss, equipment end	8
LCL, equipment end	9

6. Conclusion

The transmission conformance testing of the communication channels has shown compliance with the transmission requirements of the Generic Cabling Standards.

BALANCED MODE ATTENUATION

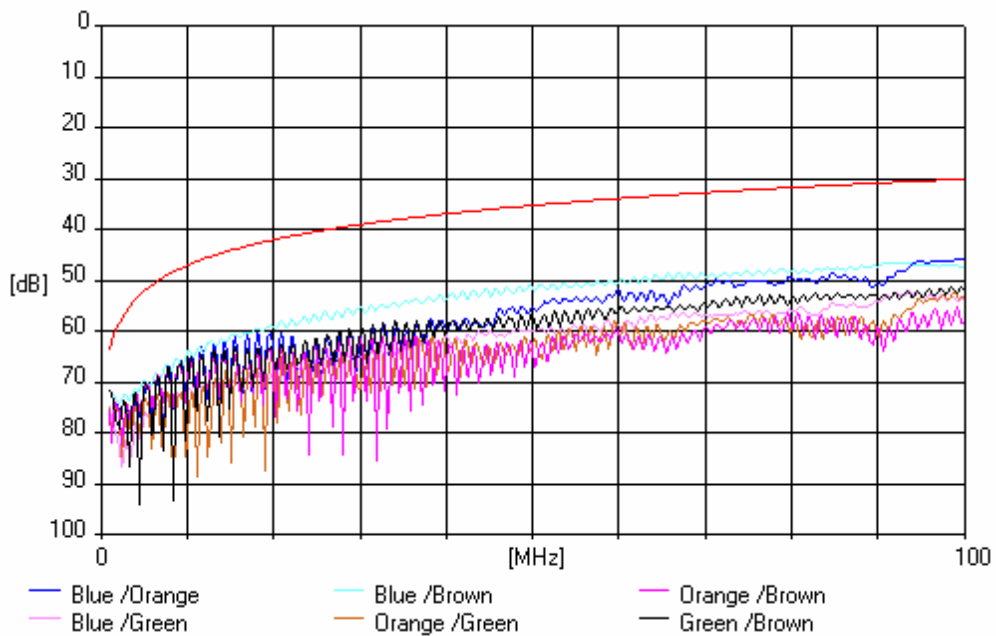
Channel #1 Room temperature (3 connector channel)



311590 Tue 13/Aug/2002 13:04:36

NEAR END CROSSTALK (NEXT)

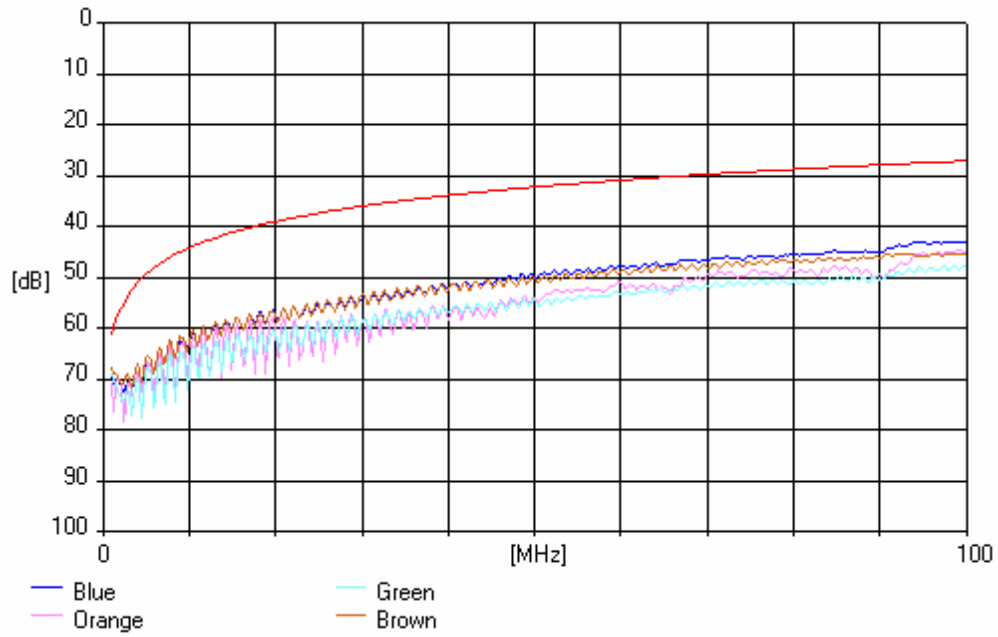
Channel #1



311590 Tue 13/Aug/2002 13:04:36

NEAR END CROSSTALK POWERSUM (PSNEXT)

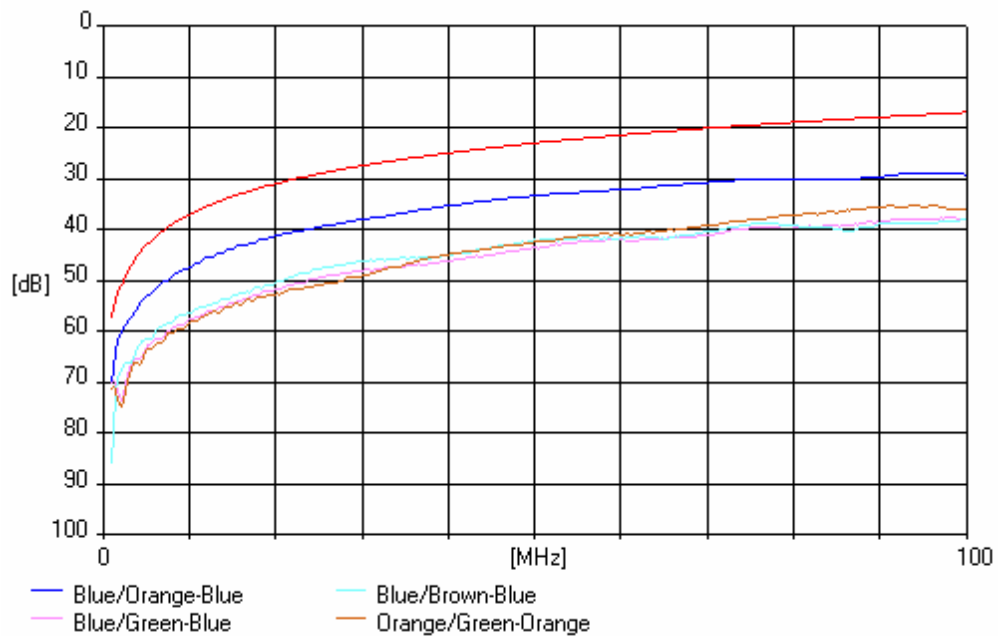
Channel #1



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EQUAL LEVEL FAR END CROSSTALK (ELFEXT)

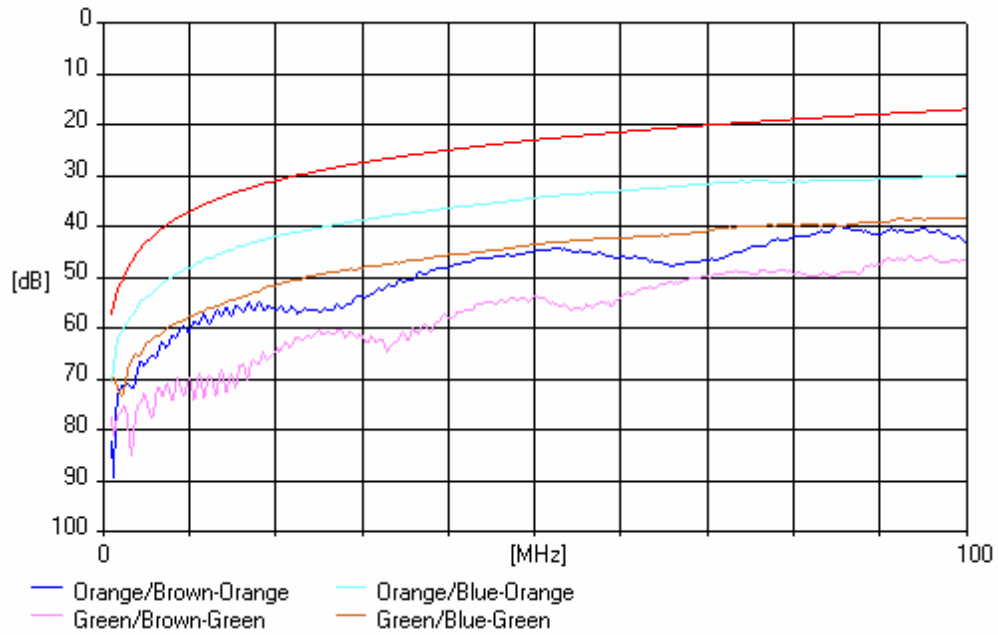
Channel #1



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EQUAL LEVEL FAR END CROSSTALK (ELFEXT)

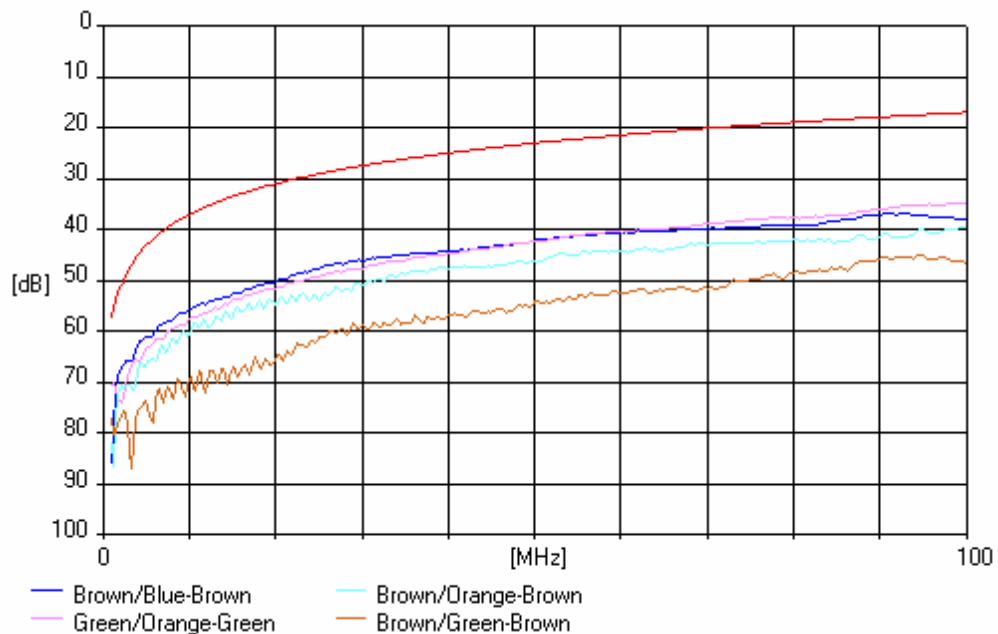
Channel #1



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EQUAL LEVEL FAR END CROSSTALK (ELFEXT)

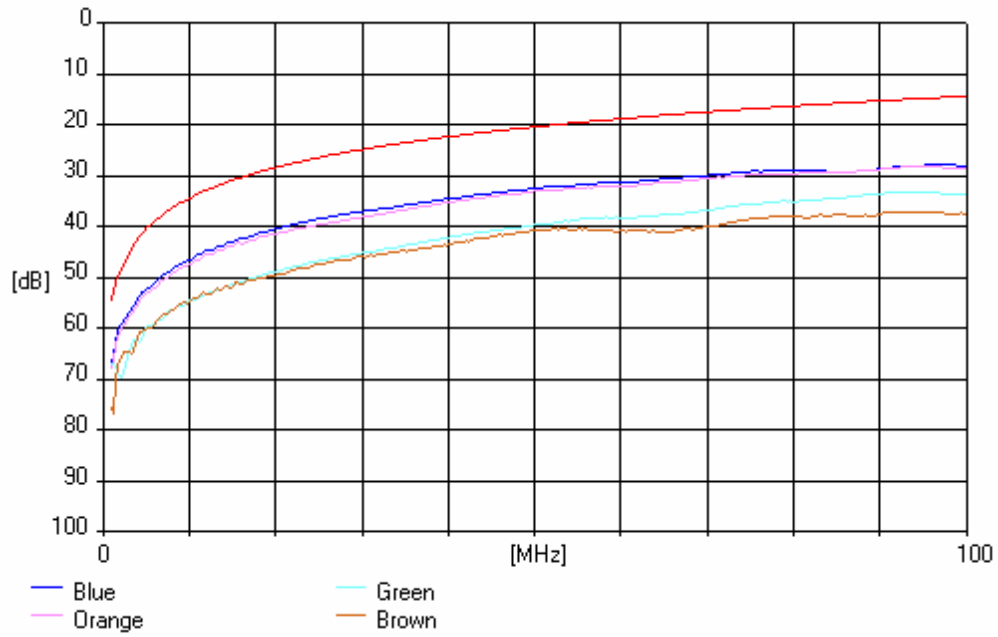
Channel #1



311590 Tue 13/Aug/2002 13:04:36

EQUAL LEVEL FAR END CROSSTALK POWERSUM (PSELFEXT)

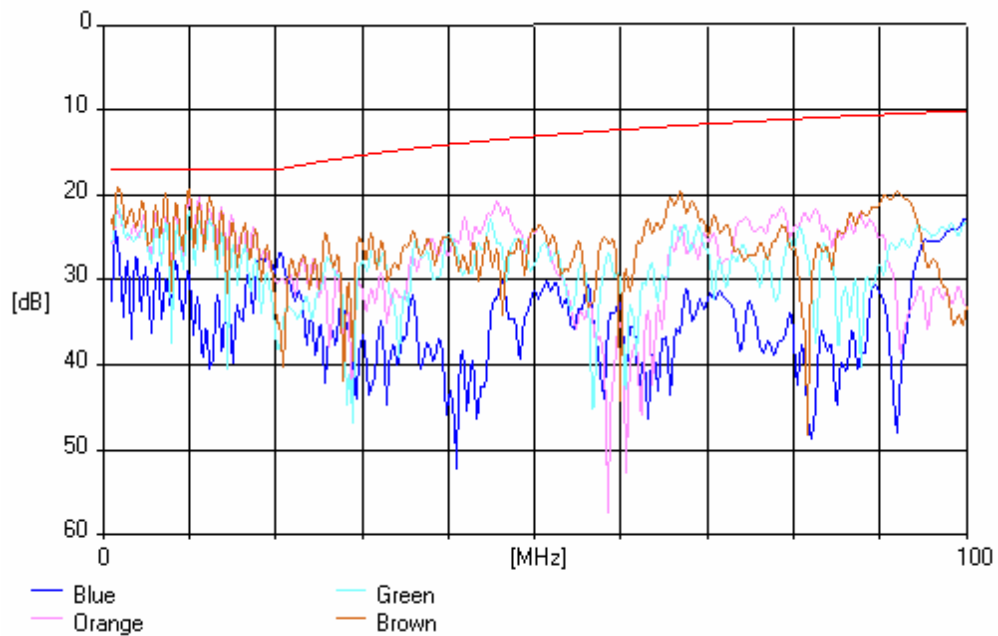
Channel #1



311590 Tue 13/Aug/2002 13:04:36

RETURN LOSS

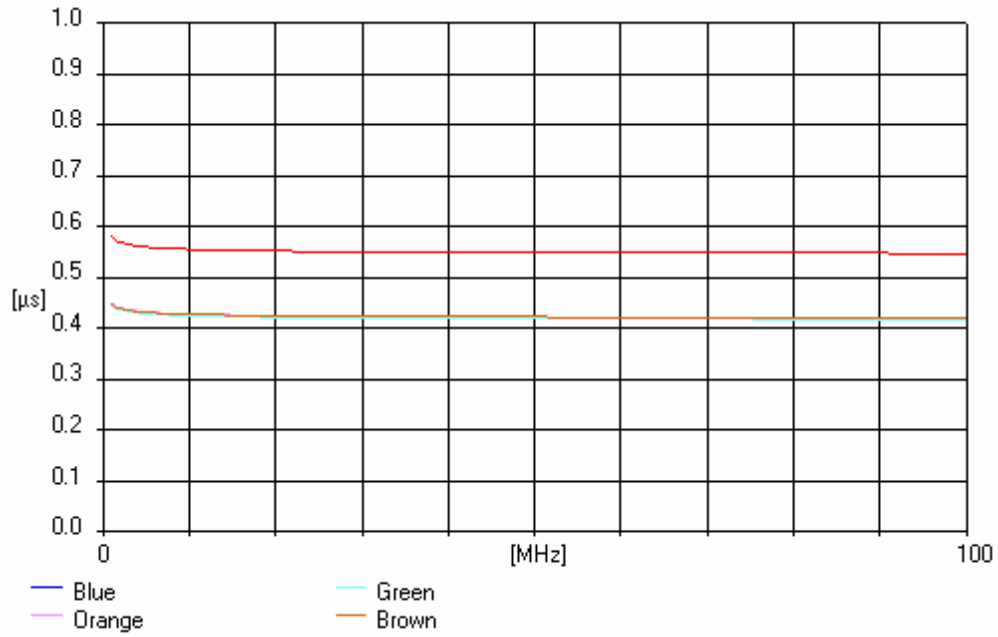
Channel #1



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PROPAGATION DELAY

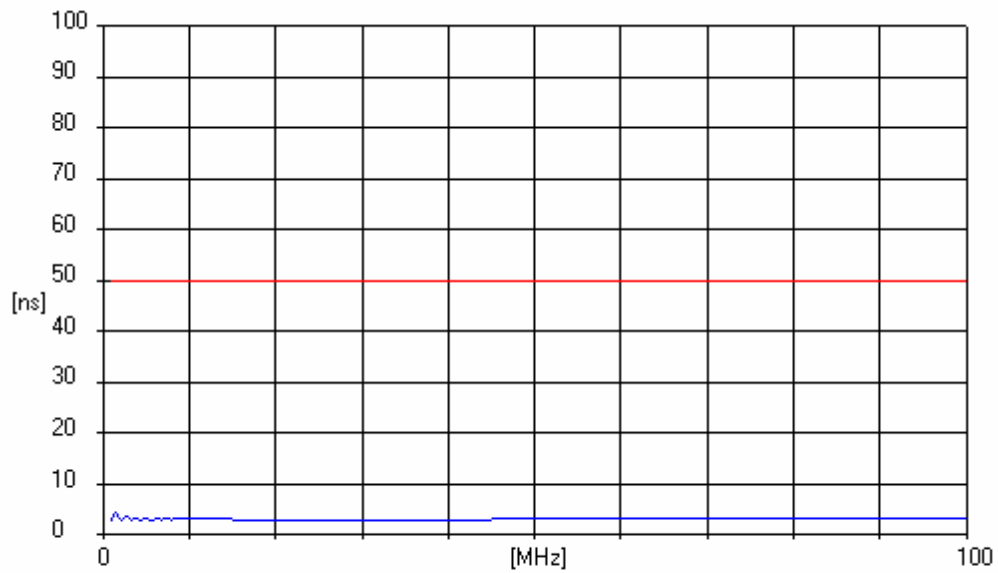
Channel #1



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DELAY SKEW

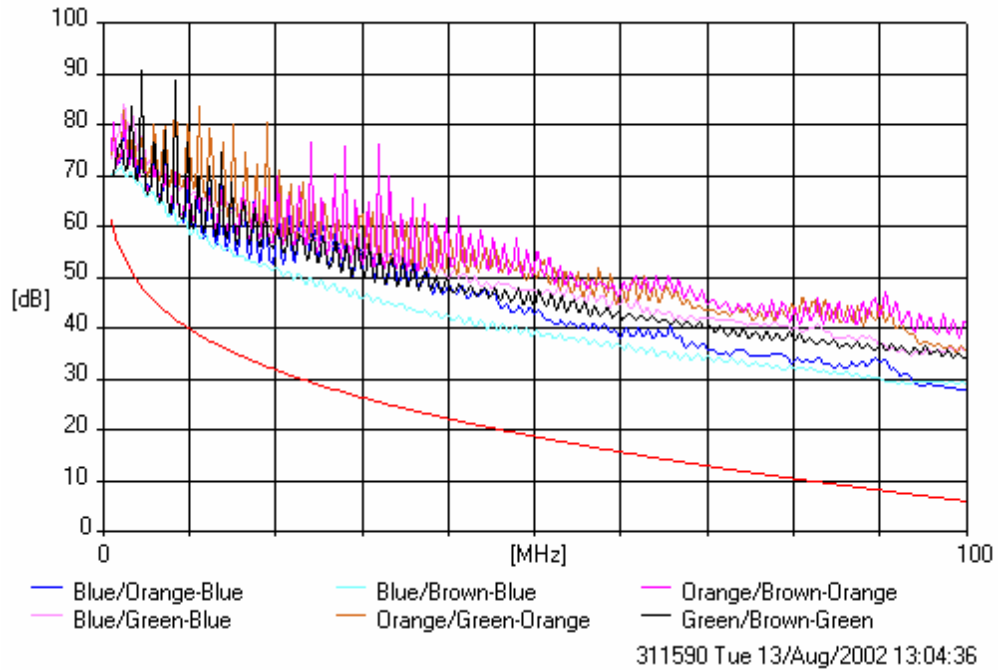
Channel #1



311590 Tue 13/Aug/2002 13:04:36

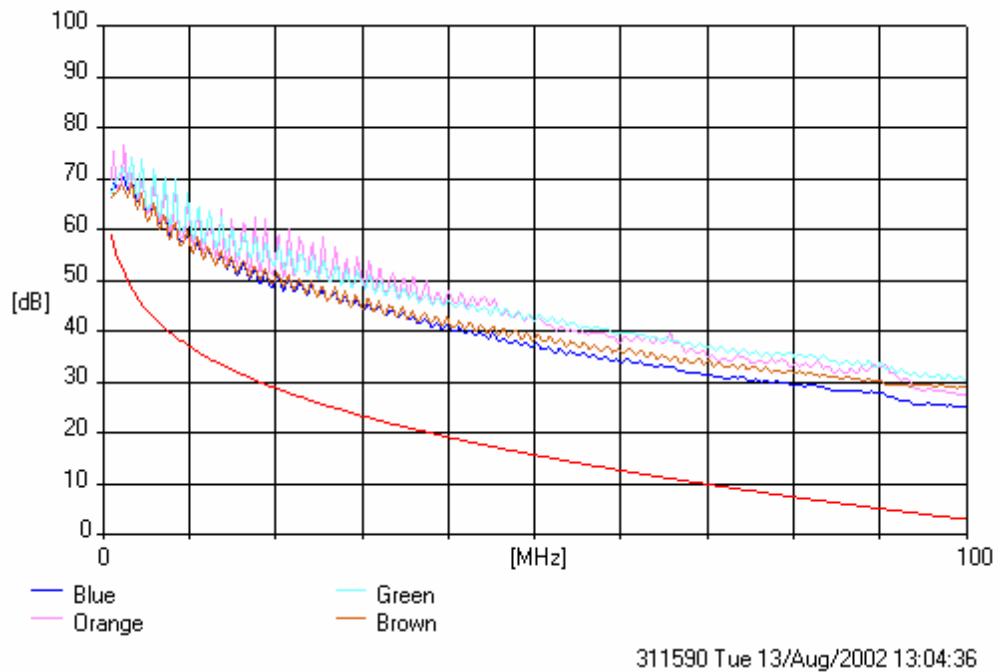
ATTENUATION TO CROSSTALK LOSS RATIO (ACR)

Channel #1 room temperature



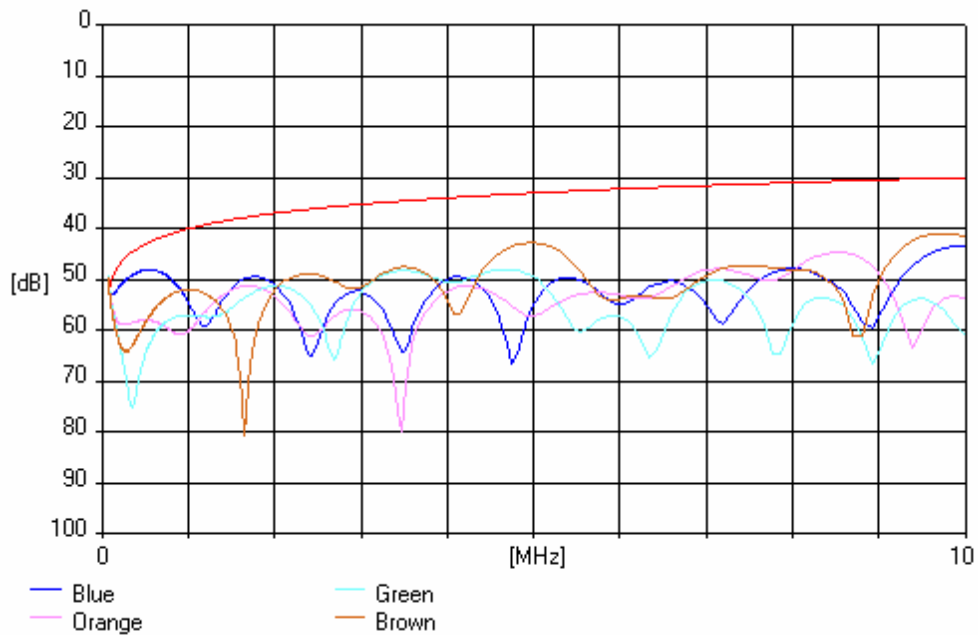
ATTENUATION TO CROSSTALK LOSS RATIO POWERSUM (PSACR)

Channel #1 room temperature



LONGITUDINAL CONVERSION LOSS (LCL)

Channel #1



311590 Tue 13/Aug/2002 13:04:36

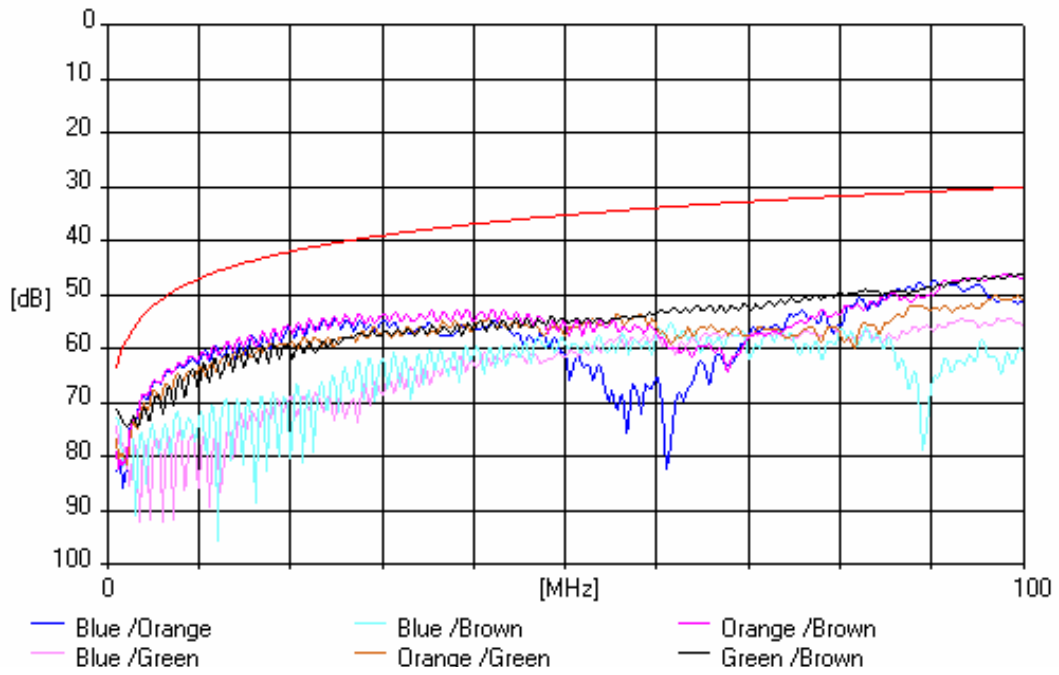
DC LOOP RESISTANCE [Ω] and UNBALANCE

Channel #1

Ambient Temperature: 27°C				Required: Max. 25 Ω	Required: Max. 3 %
Pair No.	Color	Resistance [Ω]	Corrected to 20 °C	Loop resistance [Ω]	Unbalance [%]
Pair No. 1	White/Blue	7.700	7.89		
	Blue	7.695	7.89	15.77	0.03
Pair No. 2	White/Orange	7.686	7.88		
	Orange	7.720	7.91	15.79	0.22
Pair No. 3	White/Green	7.625	7.81		
	Green	7.650	7.84	15.65	0.16
Pair No. 4	White/Brown	7.688	7.88		
	Brown	7.691	7.88	15.76	0.02

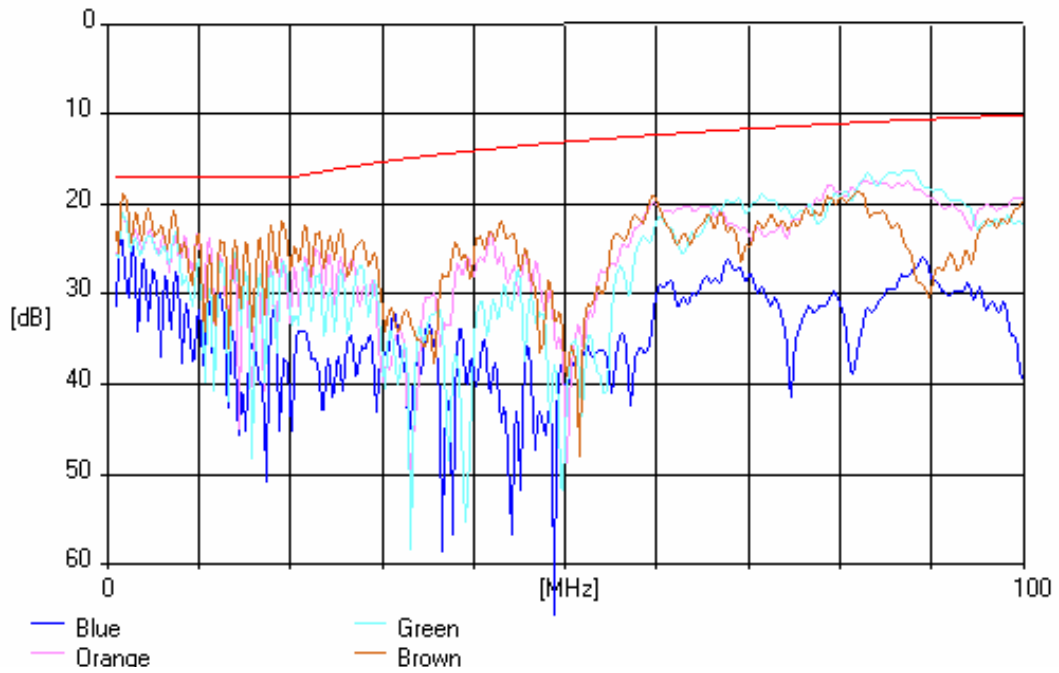
NEAR END CROSSTALK (NEXT)

Channel #1



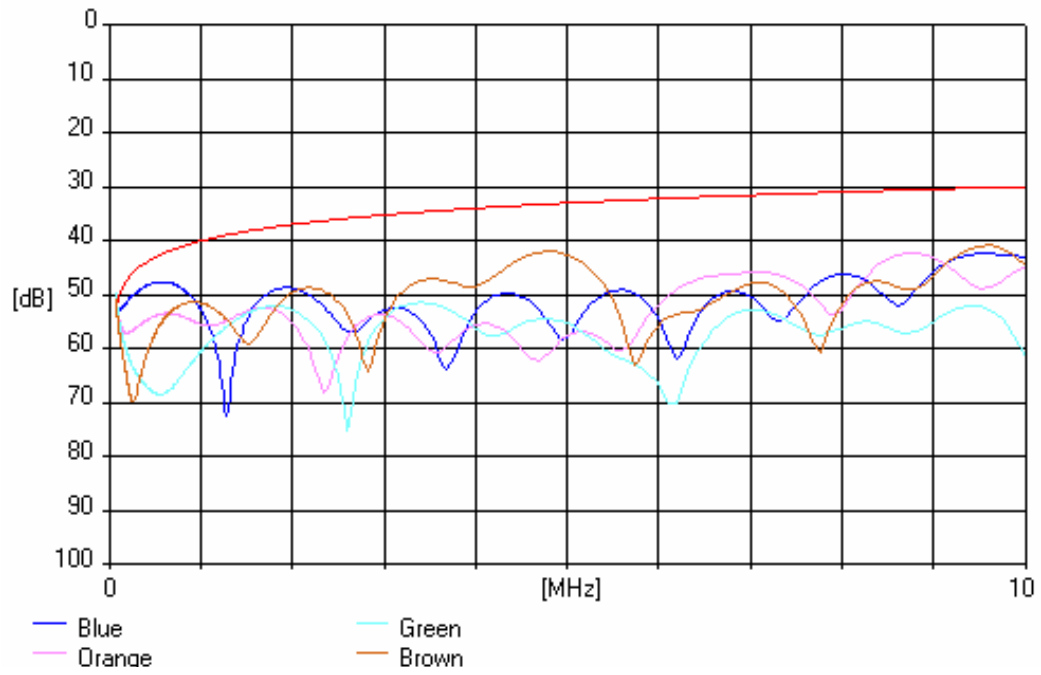
RETURN LOSS

Channel #1



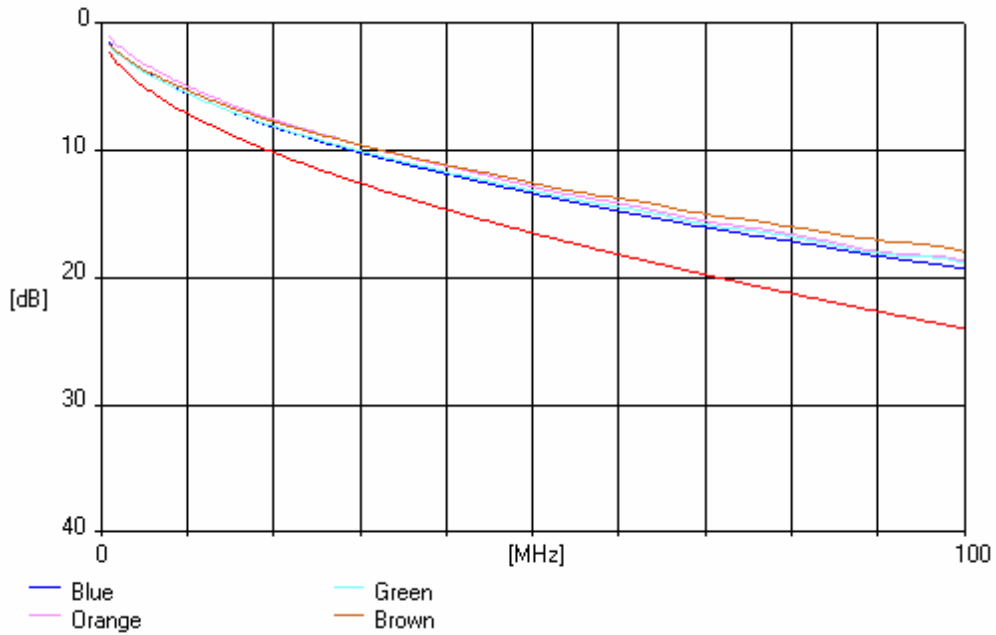
LONGITUDINAL CONVERSION LOSS (LCL)

Channel #1



BALANCED MODE ATTENUATION

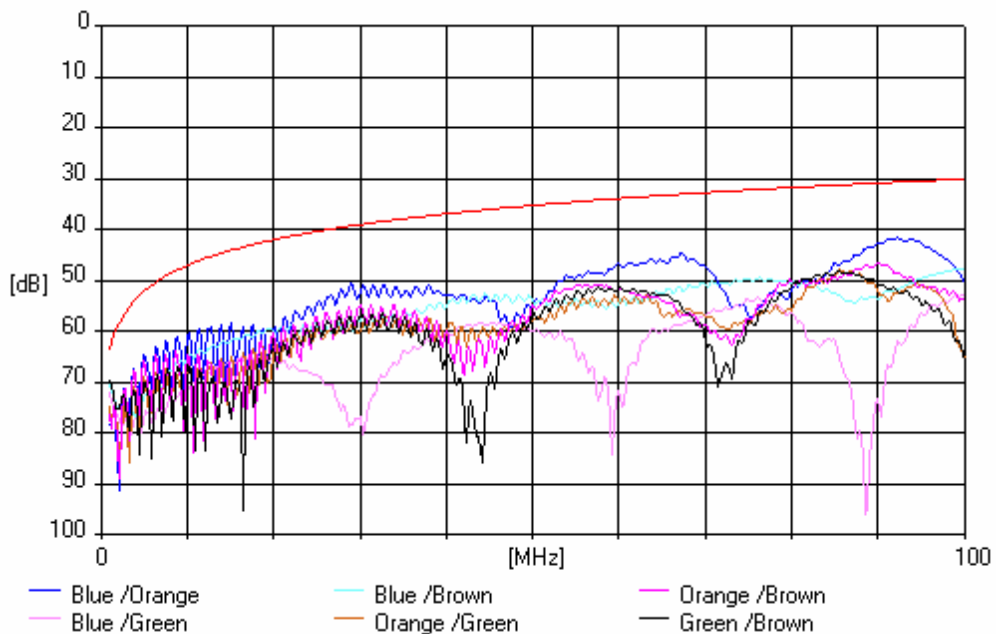
Channel 2 Room temperature, (4 connector channel)



311590 Tue 13/Aug/2002 14:19:46

NEAR END CROSSTALK (NEXT)

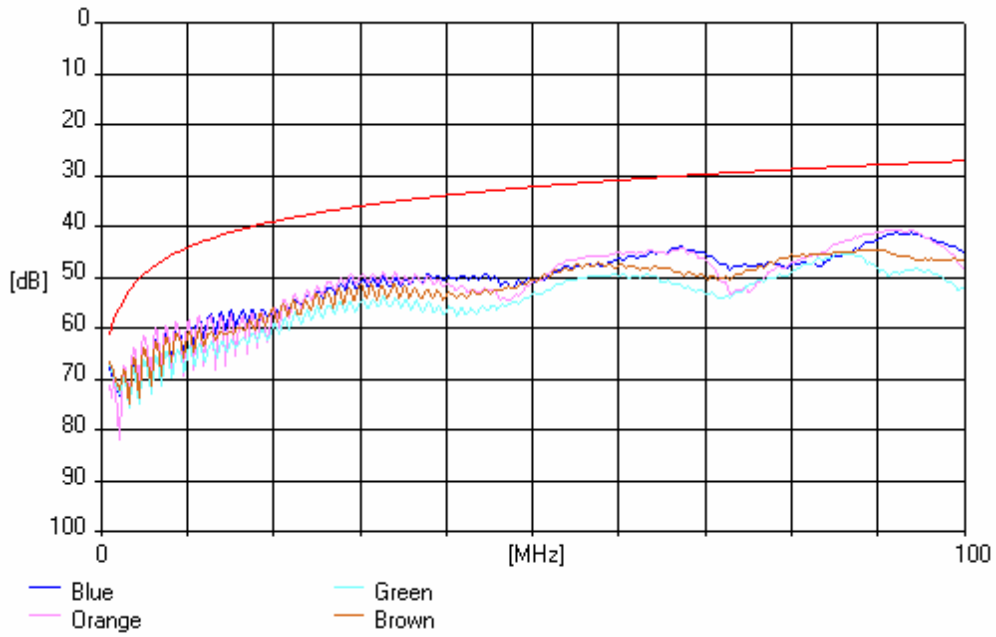
Channel 2



311590 Tue 13/Aug/2002 14:19:46

NEAR END CROSSTALK POWERSUM (PSNEXT)

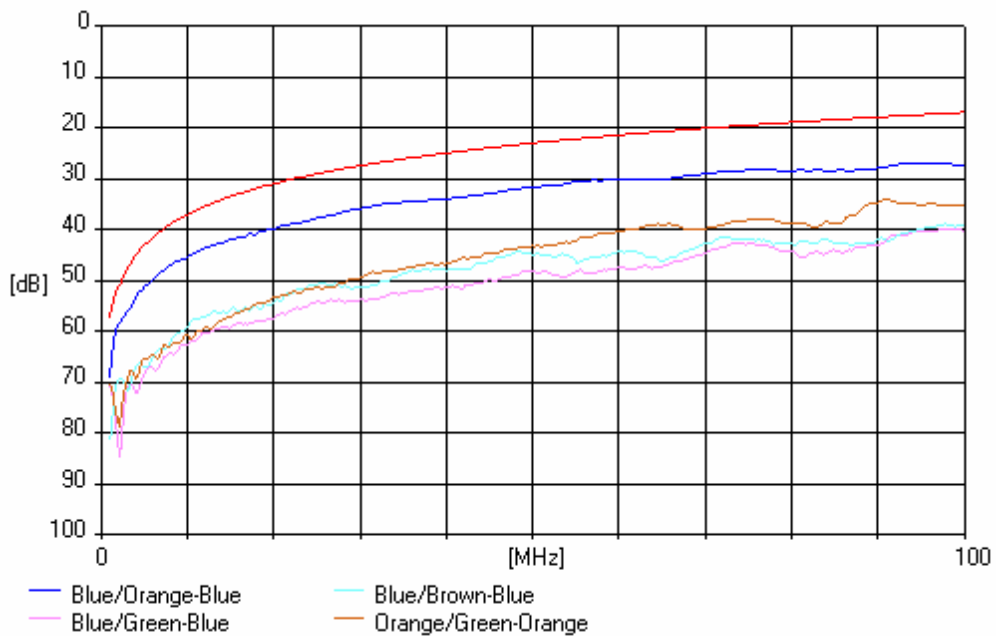
Channel 2



311590 Tue 13/Aug/2002 14:19:46

EQUAL LEVEL FAR END CROSSTALK (ELFEXT)

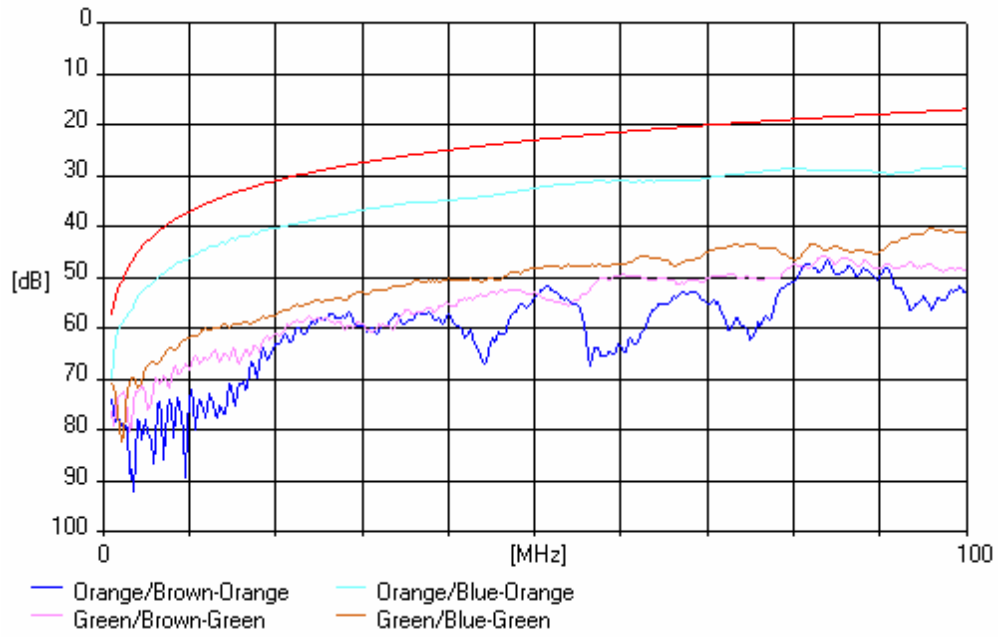
Channel 2



311590 Tue 13/Aug/2002 14:19:46

EQUAL LEVEL FAR END CROSSTALK (ELFEXT)

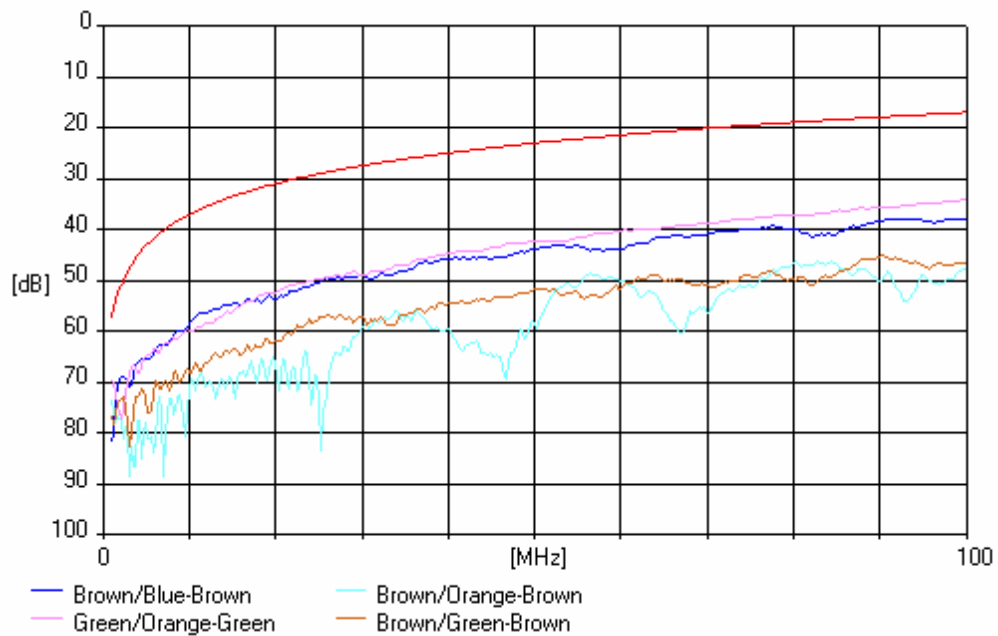
Channel 2



311590 Tue 13/Aug/2002 14:19:46

EQUAL LEVEL FAR END CROSSTALK (ELFEXT)

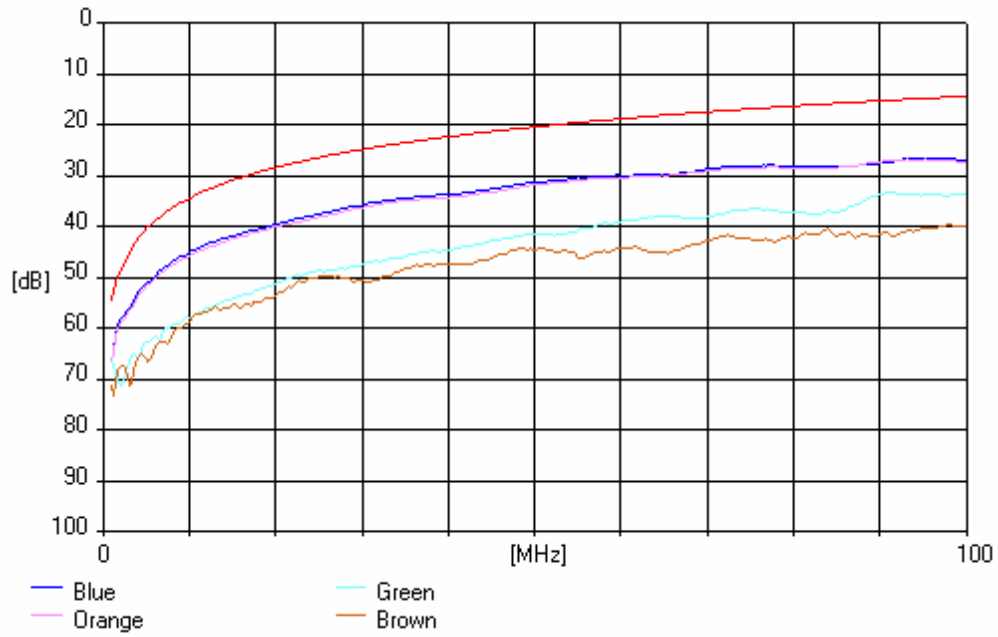
Channel 2



311590 Tue 13/Aug/2002 14:19:46

EQUAL LEVEL FAR END CROSSTALK POWERSUM (PSELFEXT)

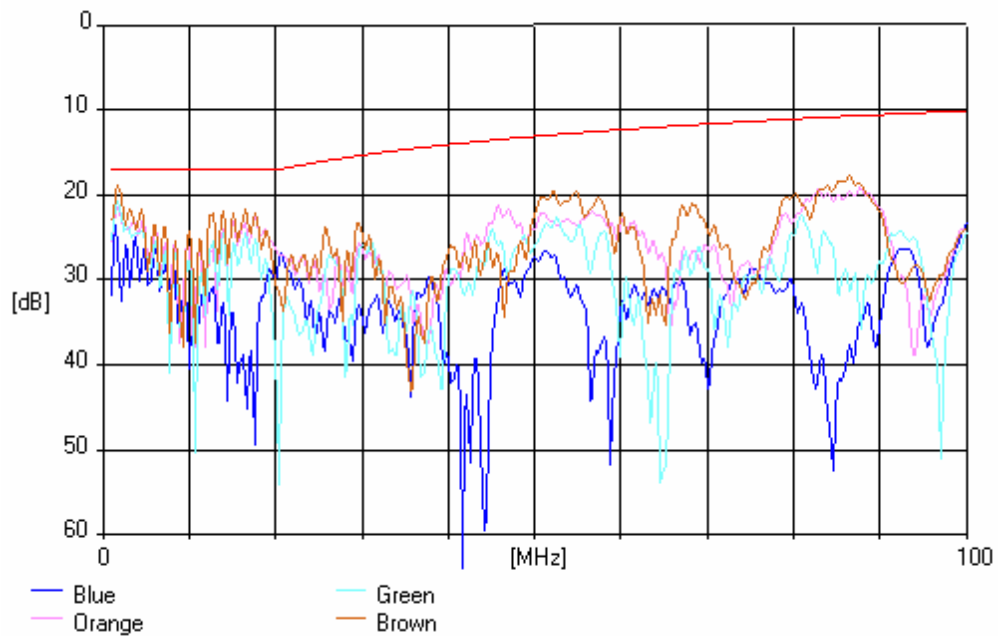
Channel 2



311590 Tue 13/Aug/2002 14:19:46

RETURN LOSS

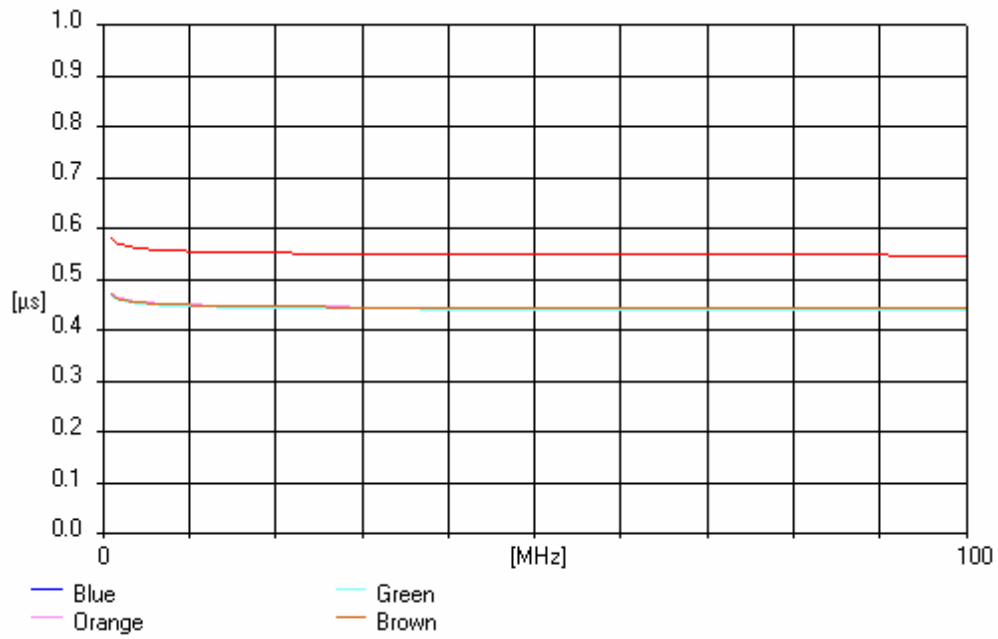
Channel 2



311590 Tue 13/Aug/2002 14:19:46

PROPAGATION DELAY

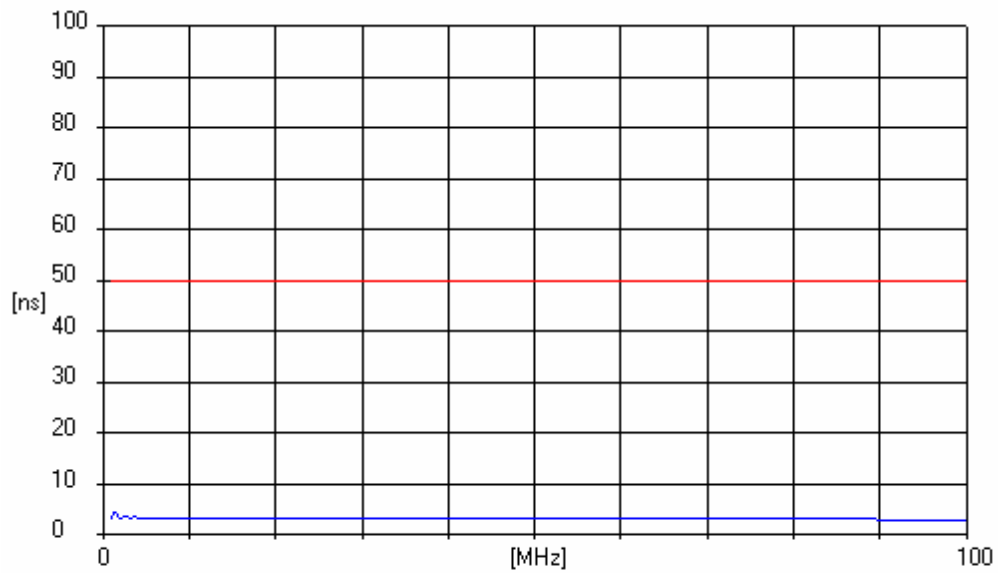
Channel 2



311590 Tue 13/Aug/2002 14:19:46

DELAY SKEW

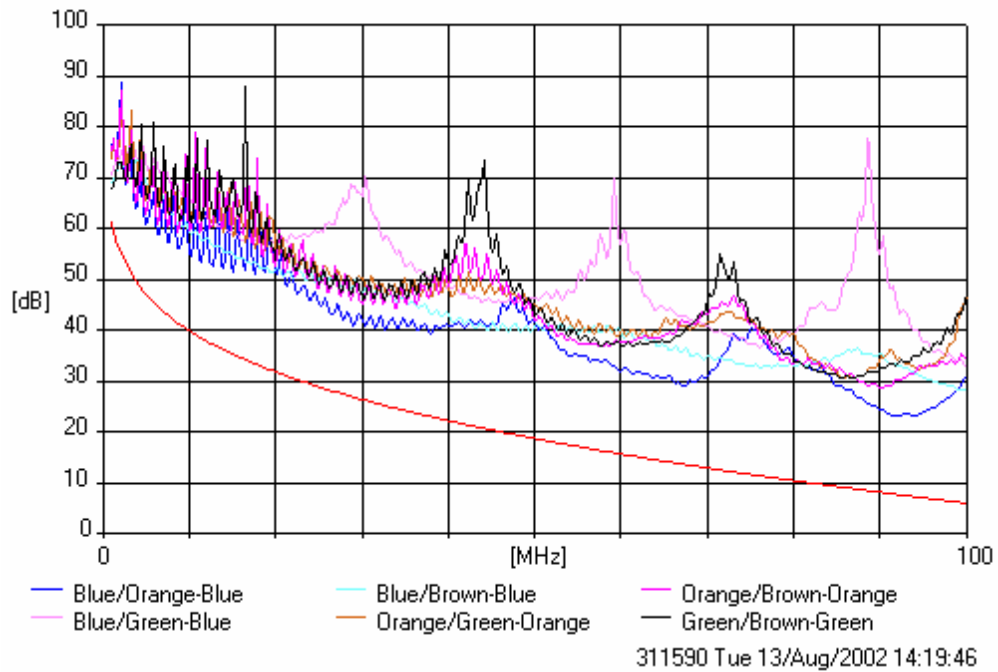
Channel 2



311590 Tue 13/Aug/2002 14:19:46

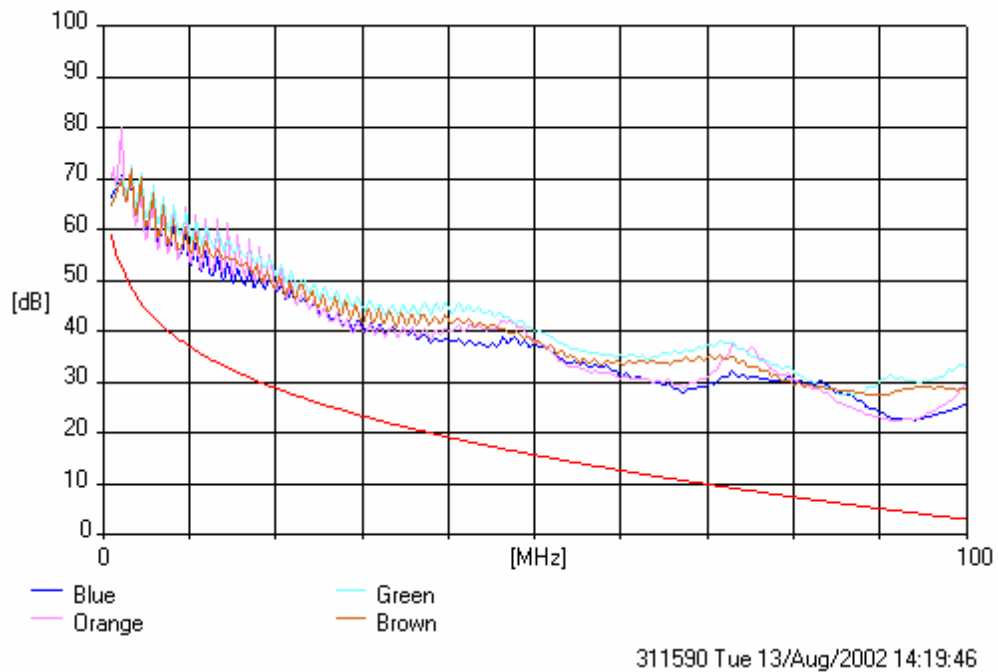
ATTENUATION TO CROSSTALK LOSS RATIO (ACR)

Channel 2 room temperature



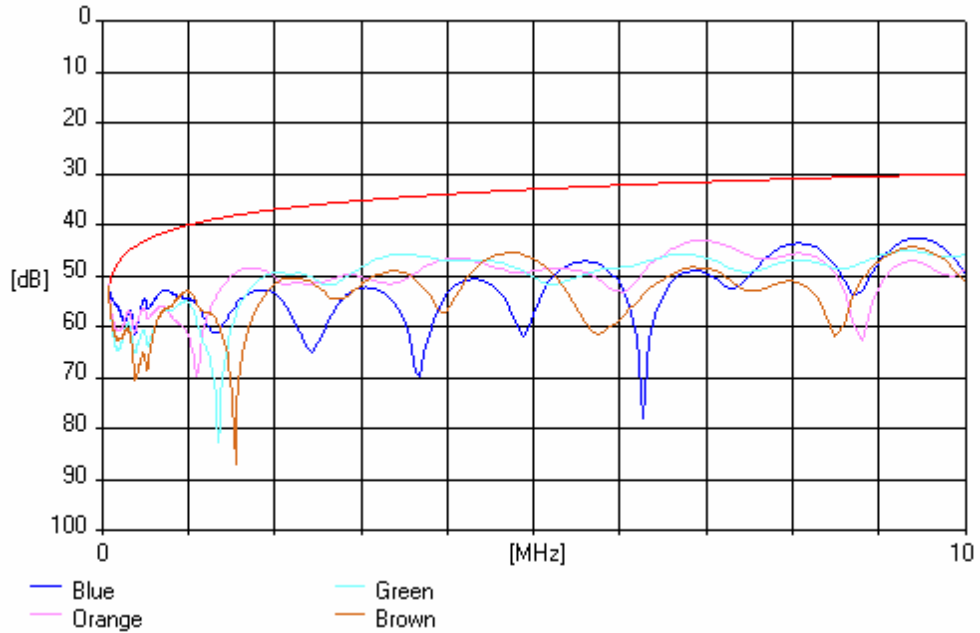
ATTENUATION TO CROSSTALK LOSS RATIO POWERSUM (PSACR)

Channel 2 room temperature



LONGITUDINAL CONVERSION LOSS (LCL)

Channel #2



311590 Tue 13/Aug/2002 14:19:46

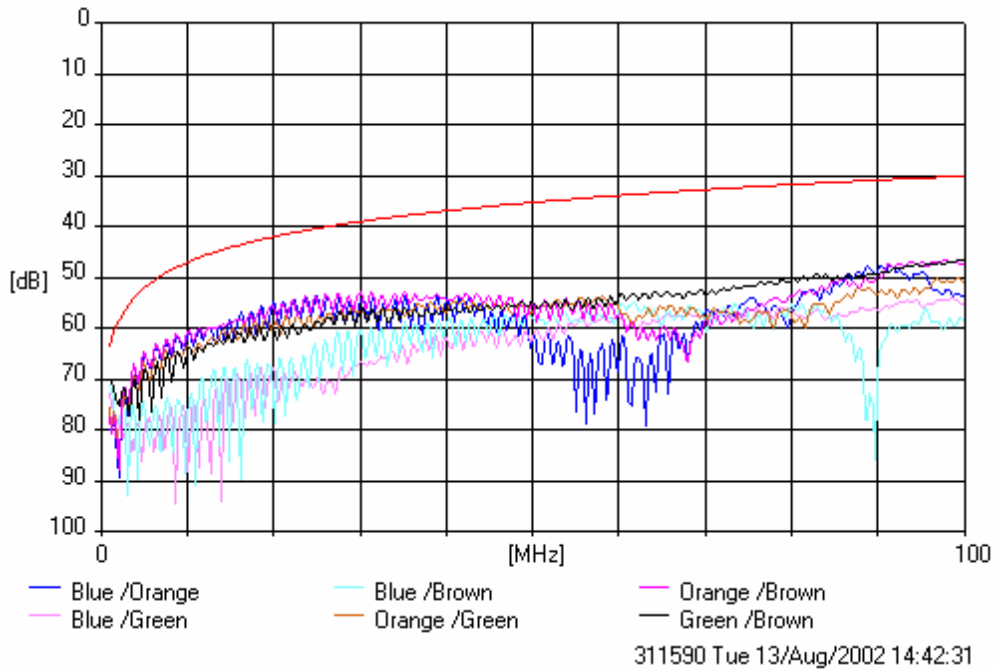
DC LOOP RESISTANCE [Ω] and UNBALANCE

Channel #2

Ambient Temperature: 27.4°C		Resistance [Ω]	Corrected to 20 °C	Required: Max. 25 Ω	Required: Max. 3 %
				Loop resistance [Ω]	Unbalance [%]
Pair No. 1	White/Blue	8.416	8.18	16.37	0.08
	Blue	8.430	8.19		
Pair No. 2	White/Orange	8.430	8.19	16.42	0.19
	Orange	8.462	8.22		
Pair No. 3	White/Green	8.337	8.10	16.25	0.28
	Green	8.384	8.15		
Pair No. 4	White/Brown	8.387	8.15	16.32	0.10
	Brown	8.403	8.17		

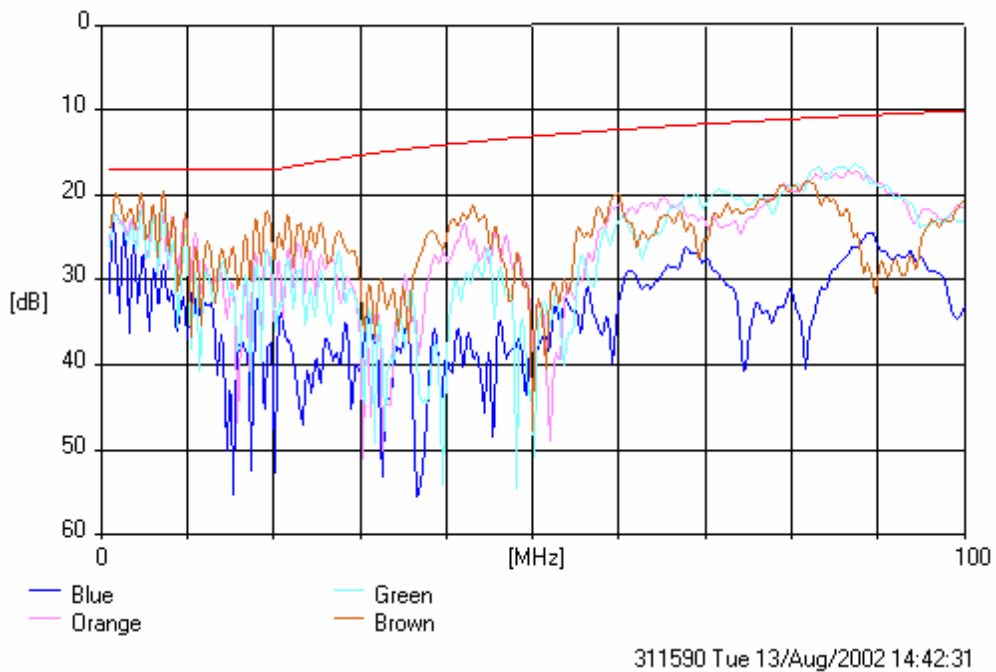
NEAR END CROSSTALK (NEXT)

Channel #2



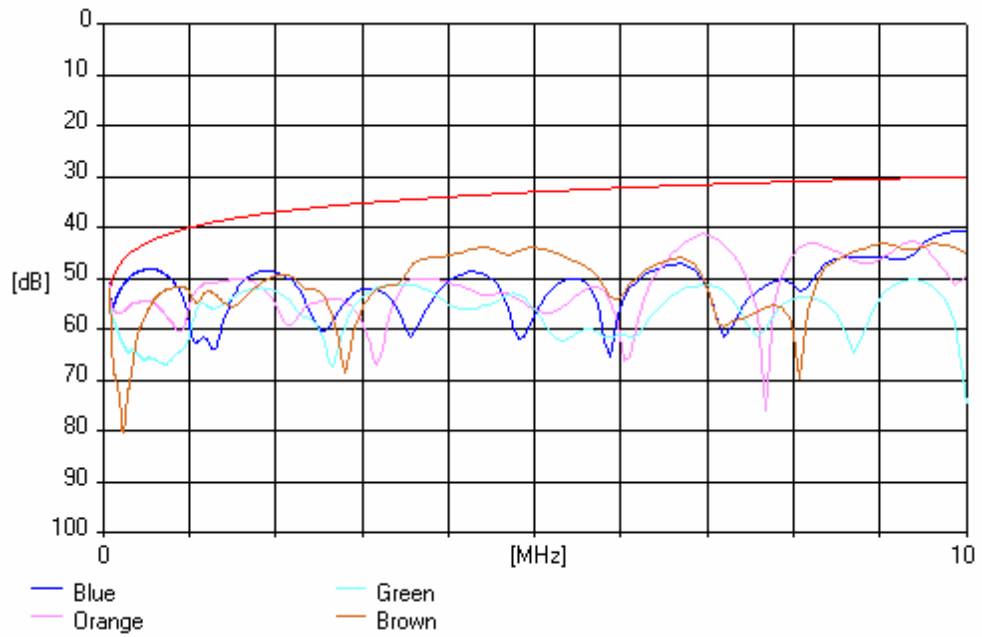
RETURN LOSS

Channel #2



LONGITUDINAL CONVERSION LOSS (LCL)

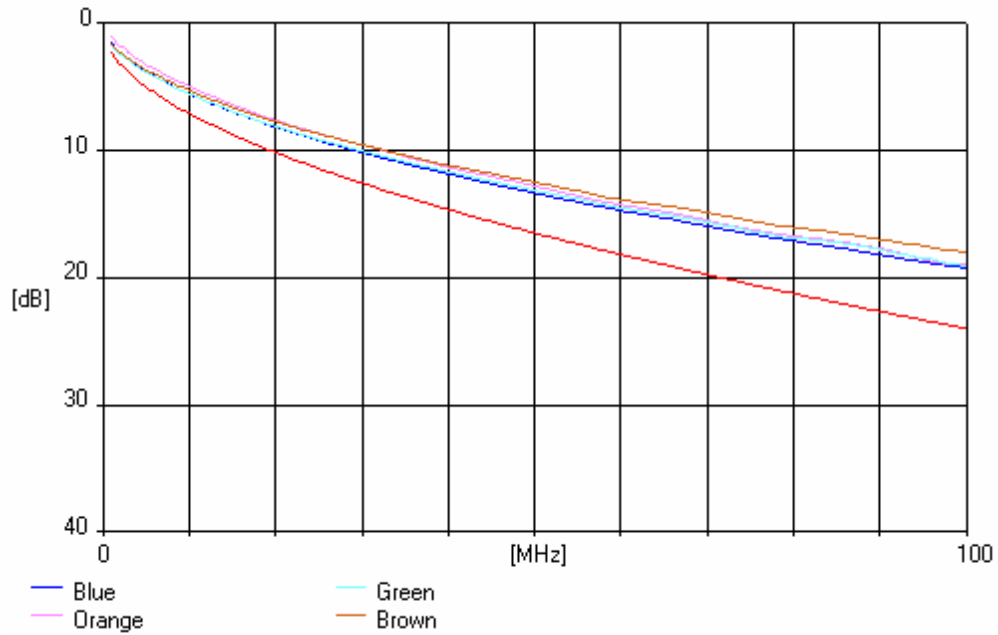
Channel #2



311590 Tue 13/Aug/2002 14:42:31

BALANCED MODE ATTENUATION

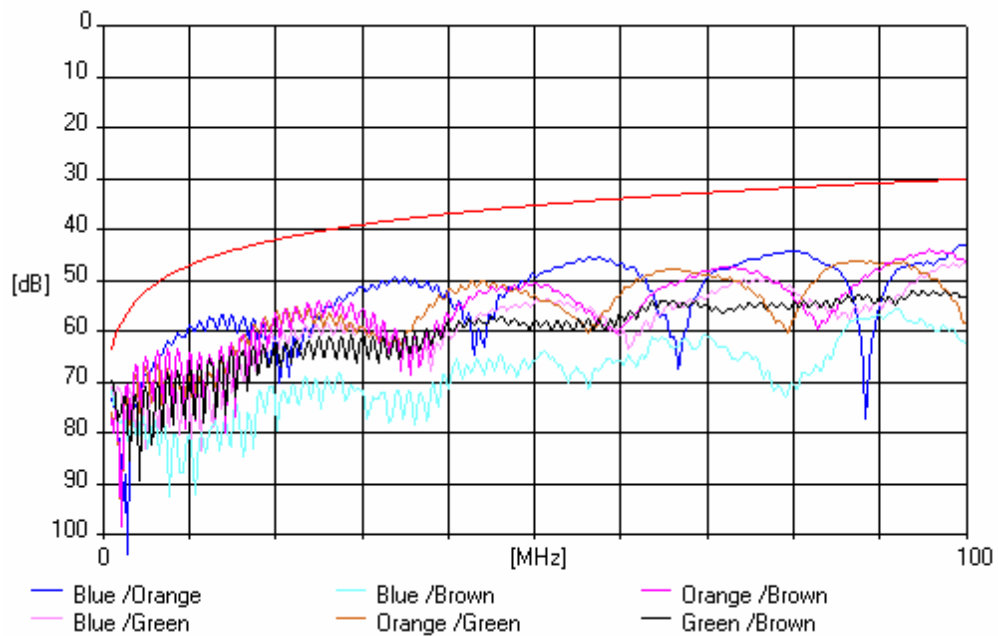
Channel #3 Room temperature, (4 connector channel)



311590 Tue 13/Aug/2002 15:16:59

NEAR END CROSSTALK (NEXT)

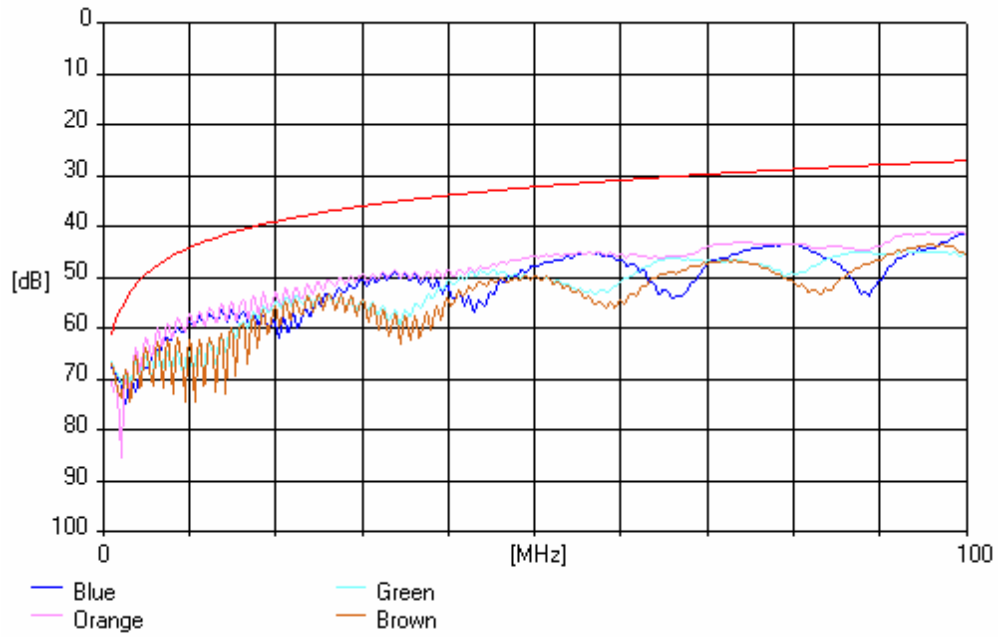
Channel #3



311590 Tue 13/Aug/2002 15:16:59

NEAR END CROSSTALK POWERSUM (PSNEXT)

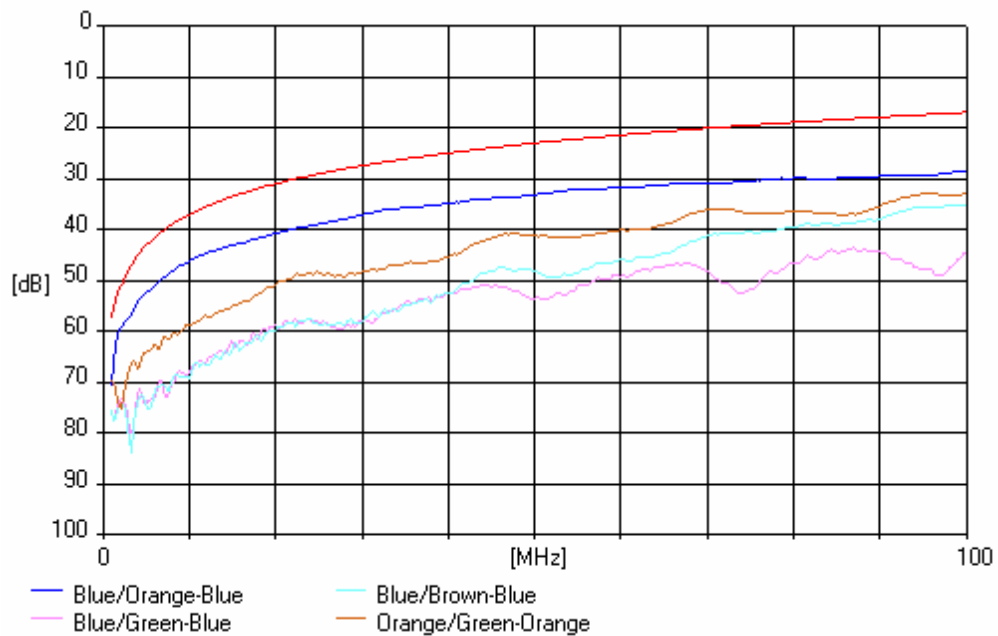
Channel #3



311590 Tue 13/Aug/2002 15:16:59

EQUAL LEVEL FAR END CROSSTALK (ELFEXT)

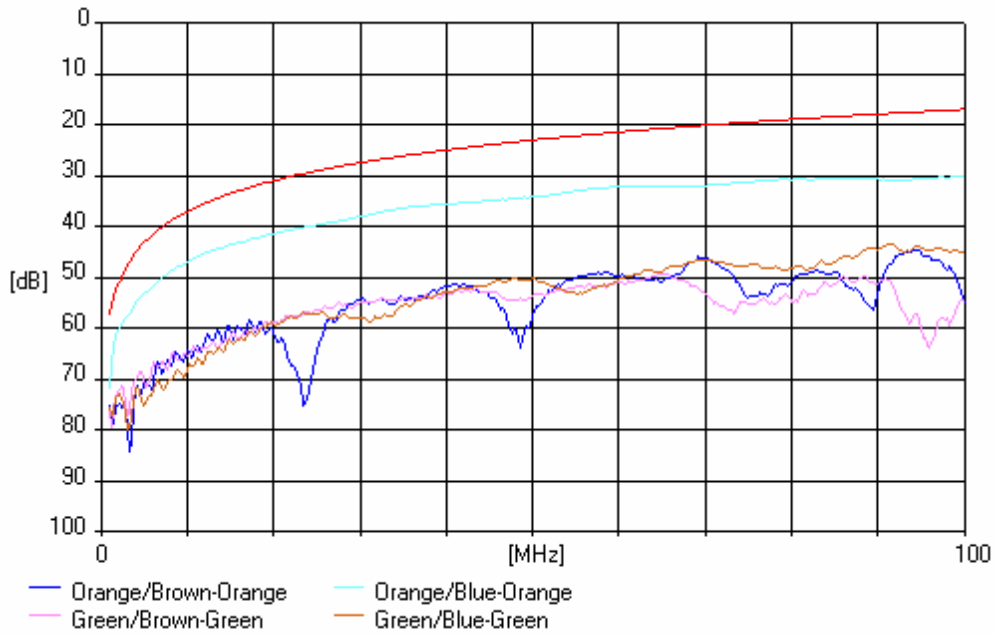
Channel #3



311590 Tue 13/Aug/2002 15:16:59

EQUAL LEVEL FAR END CROSSTALK (ELFEXT)

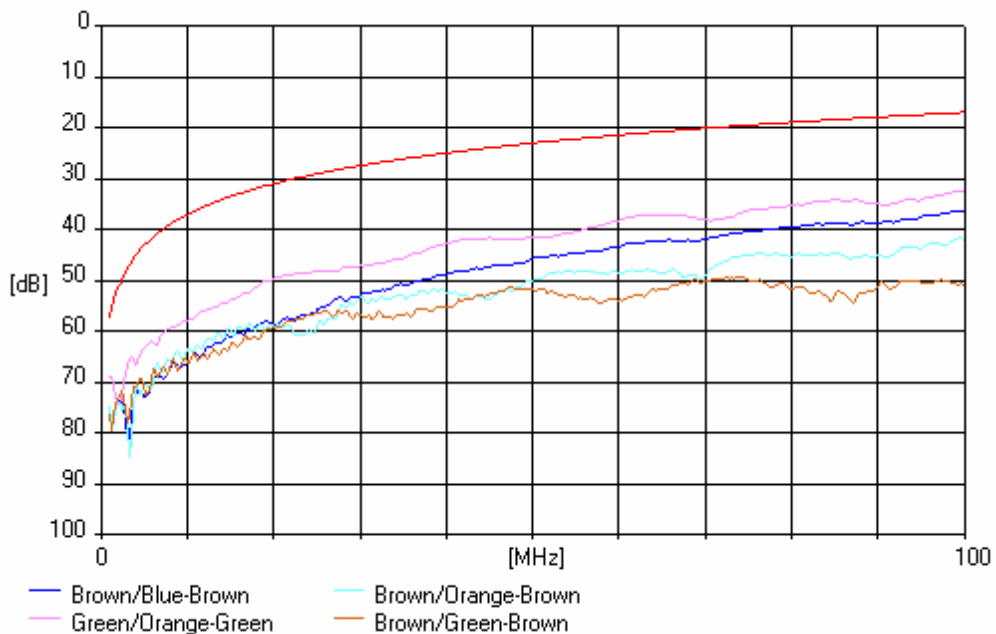
Channel #3



311590 Tue 13/Aug/2002 15:16:59

EQUAL LEVEL FAR END CROSSTALK (ELFEXT)

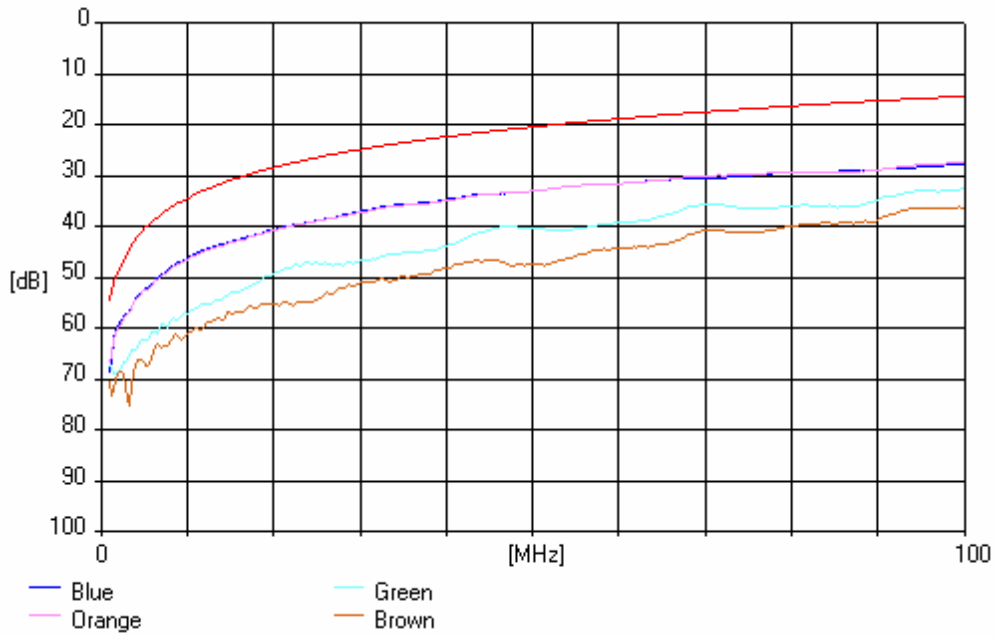
Channel #3



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EQUAL LEVEL FAR END CROSSTALK POWERSUM (PSELFEXT)

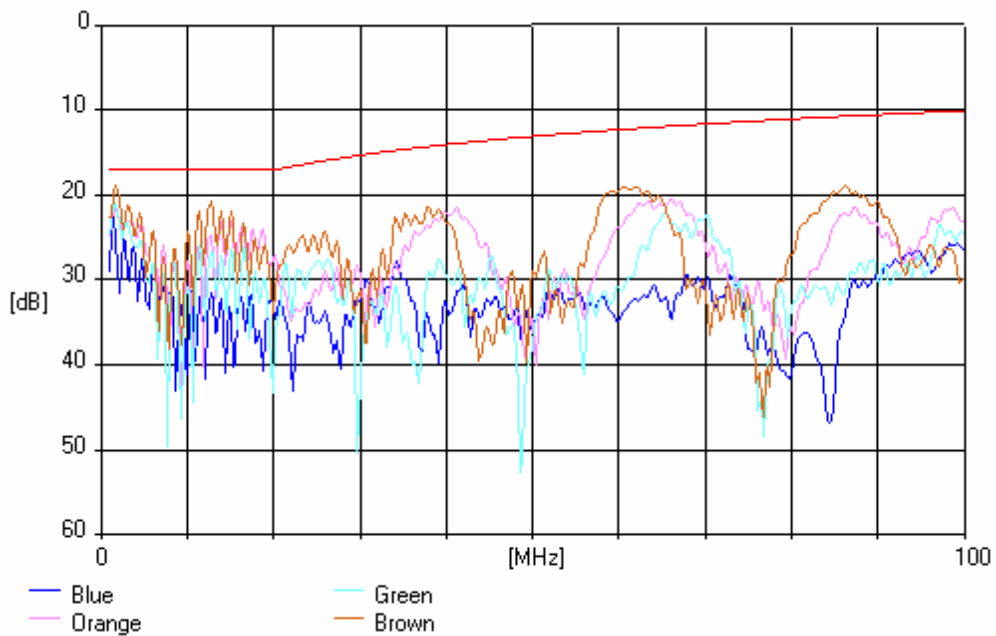
Channel #3



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RETURN LOSS

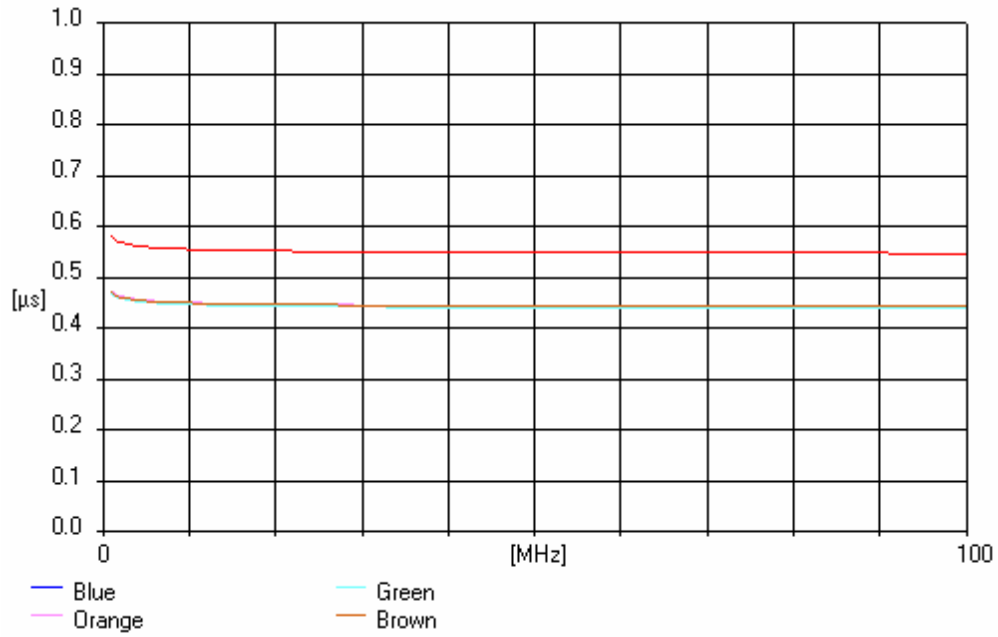
Channel #3



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PROPAGATION DELAY

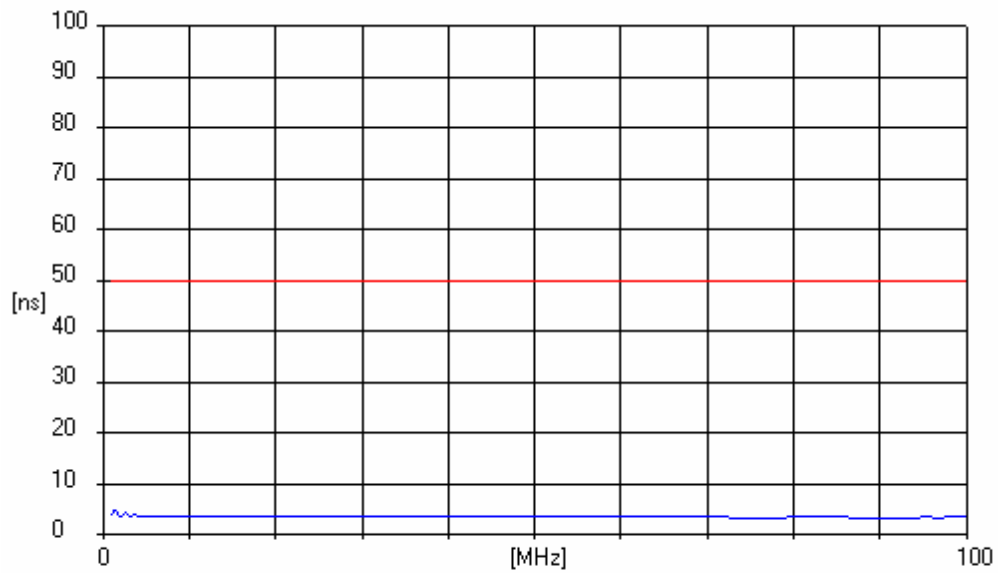
Channel #3



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DELAY SKEW

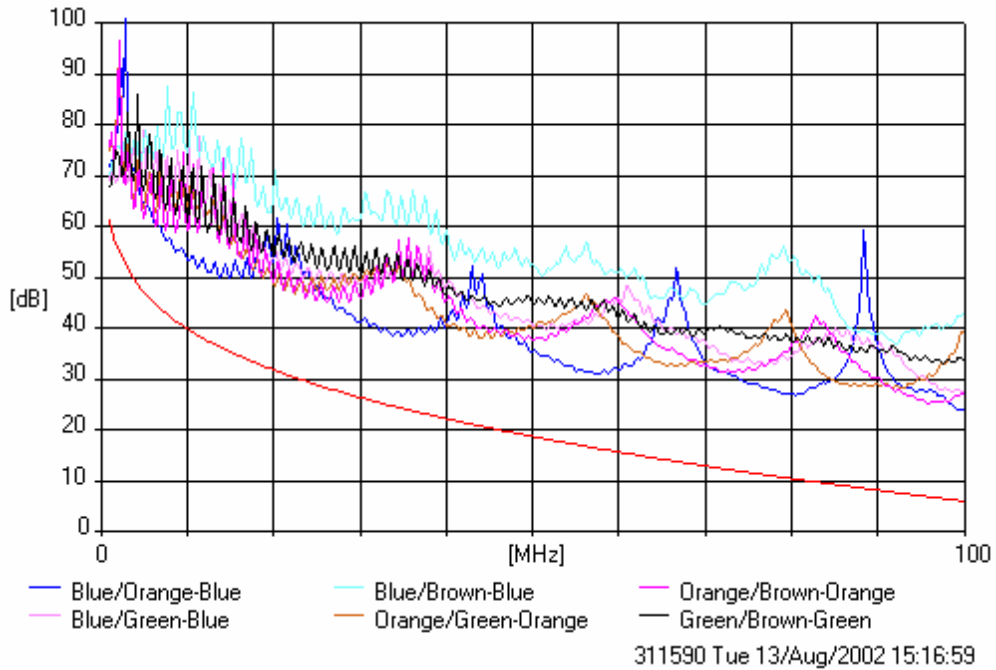
Channel #3



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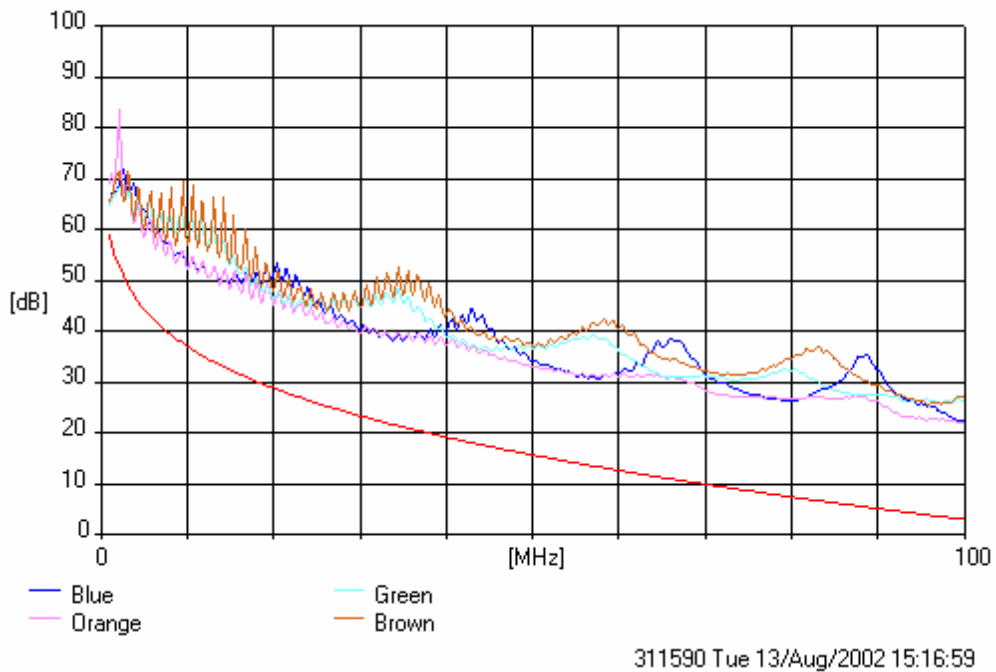
ATTENUATION TO CROSSTALK LOSS RATIO (ACR)

Channel #3 room temperature



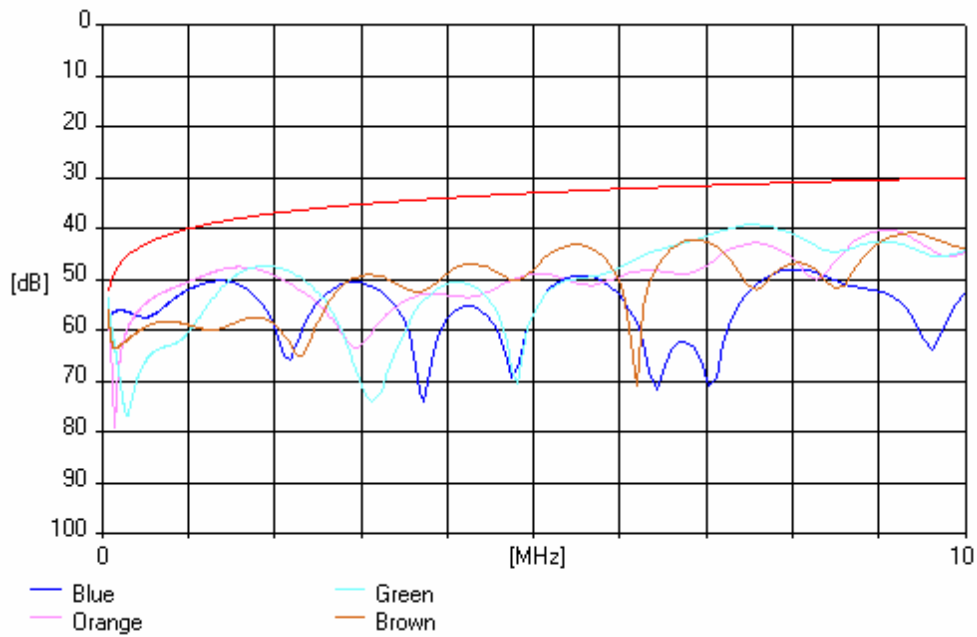
ATTENUATION TO CROSSTALK LOSS RATIO POWERSUM (PSACR)

Channel #3 room temperature



LONGITUDINAL CONVERSION LOSS (LCL)

Channel #3



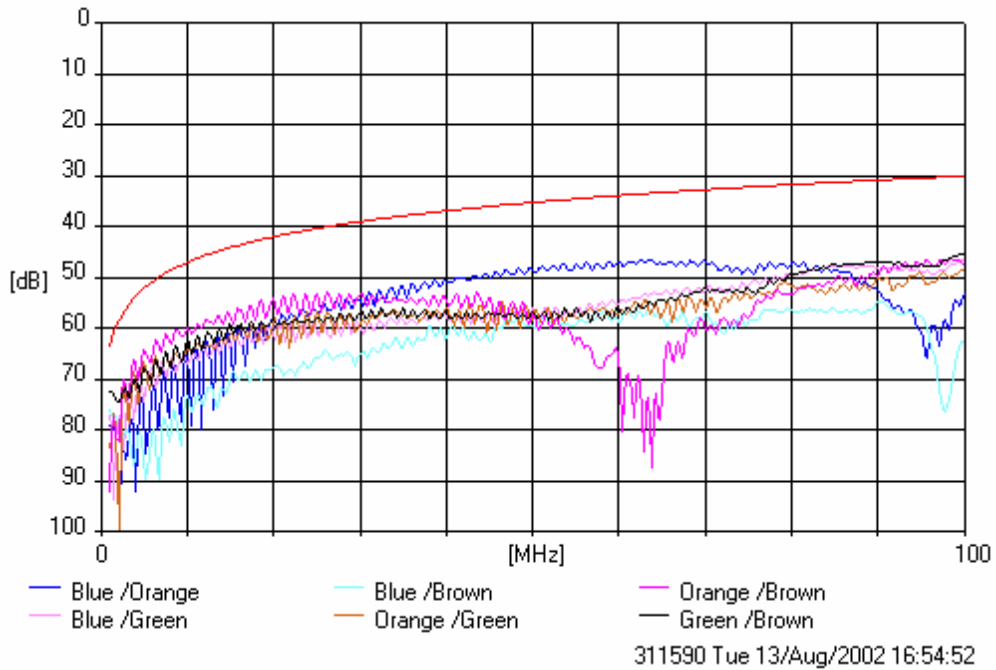
DC LOOP RESISTANCE [Ω] and UNBALANCE

Channel #3

Ambient Temperature: 27.4°C		Resistance [Ω]	Corrected to 20 °C	Required: Max. 25 Ω	Required: Max. 3 %
Pair No.	Color			Loop resistance [Ω]	Unbalance [%]
Pair No. 1	White/Blue	8.524	8.29	16.53	0.23
	Blue	8.485	8.25		
Pair No. 2	White/Orange	8.531	8.29	16.66	0.44
	Orange	8.606	8.36		
Pair No. 3	White/Green	8.453	8.22	16.49	0.36
	Green	8.514	8.28		
Pair No. 4	White/Brown	8.473	8.24	16.52	0.27
	Brown	8.519	8.28		

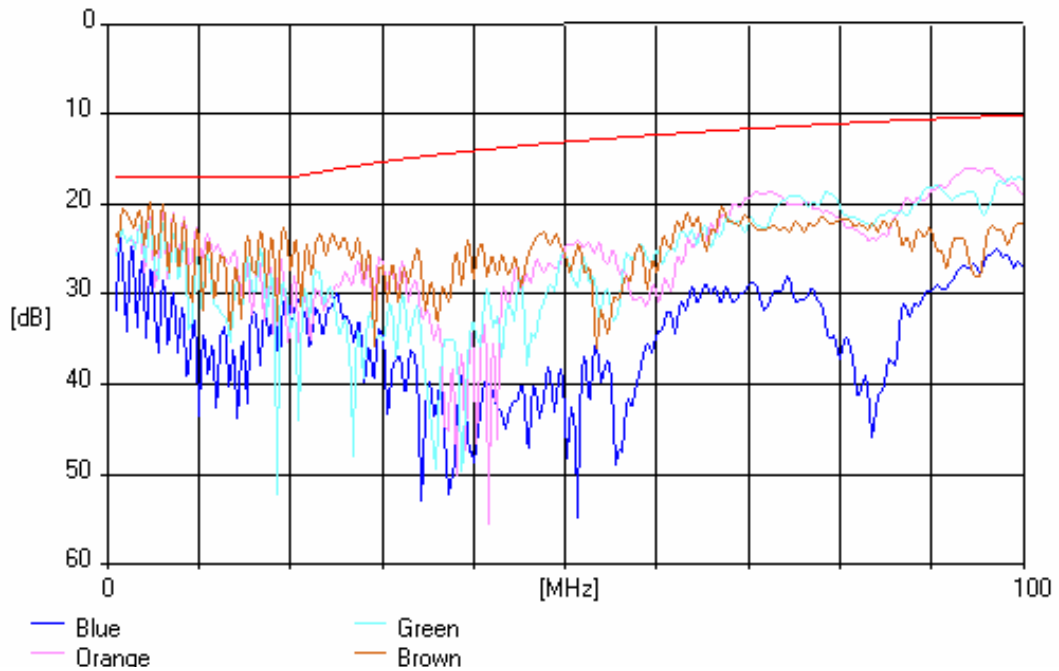
NEAR END CROSSTALK (NEXT)

Channel #3



RETURN LOSS

Channel #3



LONGITUDINAL CONVERSION LOSS (LCL)

Channel #3

