



Category 8 Cable Testing



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AGENDA

Copper Field Testing Standards Update



Emerging Ethernet Technologies

- Copper based Technologies

- New speeds introduced for Copper Cables

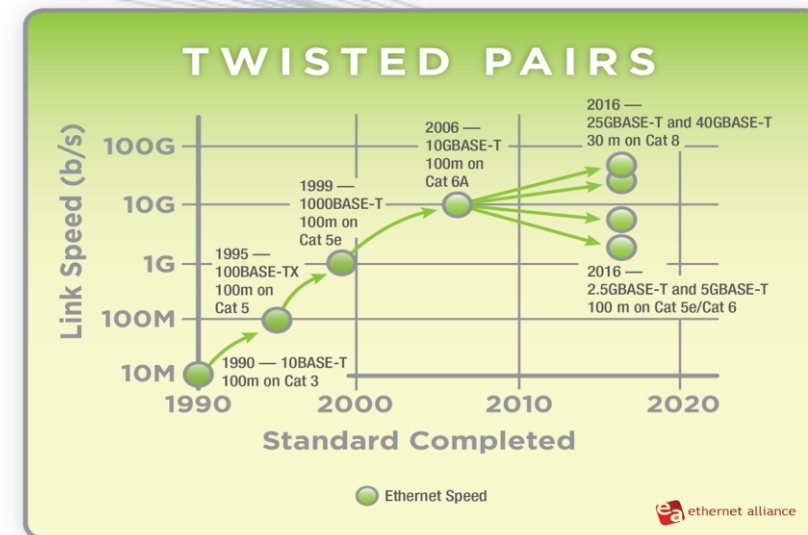
- IEEE802.3bz, sometimes referred to as NBASE-T
 - 2.5GBASE-T and 5GBASE-T on Cat 5e or Cat 6 cables
- 25GBASE-T and 40GBASE-T on Cat 8 cabling

- Longer Channels

- 200m Channel at 2.5GBASE-T is possible, happening already.

- More Power delivered

- 802.3bt will be able to deliver in excess of 90 watts.





What are the relevant standards for Cat 8 cabling?

- IEEE 802.3bq 25G/40GBASE-T, published 8 September 2016 – This defines minimum transmission characteristics for the application on a twisted pair channel to support 25 Gbps and 40 Gbps over twisted pair cabling.
- ANSI/TIA-568-C.2-1 published 30 June 2016 - Defines Category 8 Channels and Permanent Links and includes limits for Resistance Unbalance, TCL, ELTCTL.
- ANSI/TIA-1152-A published, 10 November 2016 - Defines field tester measurement and accuracy requirements for Category 8, including the new “2G” accuracy requirements for Cat 8 testers
- ISO/IEC Standards are expected in 2017, including ISO/IEC 11801-99-1 which defines the Class I/II Channels and Permanent Links and IEC 61935-1 Ed5.0 which defines tester measurement and accuracy requirements, including the same “2G” requirement from ANSI/TIA1152-A.



IEC 61935-1 Ed.5

- Defines field tester accuracy for ISO/IEC 11801:2010
 - Level IIe, supports Class D (100 MHz)
 - Level III, supports Class E (250 MHz)
 - Level IIIe, supports Class EA (500 MHz)
 - Level IV, supports Class F (600 MHz)
 - Level V, supports Class FA (1,000 MHz)
 - Level VI, supports Cat 8 (2GHz)



ANSI/TIA-1152 -A

- Defines field tester accuracy for ANSI/TIA-568-C.2
 - Level IIe, supports Category 5e (100 MHz)
 - Level III, supports Category 6 (250 MHz)
 - Level IIIe, supports Category 6A (500 MHz)
 - Level 2G, supports Cat 8 (2GHz)



3933 US Route 11
 Cortland, New York 13045 USA
 Phone Number: (800) 345-3851
 Fax Number: (607) 758-6637
 Web: www.intertek.com

ETL Verified Certificate of Conformance Number: 102821857CRT-001

On the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the essential requirements of the referenced specifications at the time the tests were carried out.

Rendered to:
Fluke Corporation
 6920 Seaway Blvd.
 Everett, WA 98203

www.flukenetworks.com

Contact: Mr. Theodore Billhart

Verification/Report Number	102821857CRT-001
Product Tested	Field Tester
Model(s) and or Brand Name:	DSX-8000 CableAnalyzer
Standard(s)/Specification	ANSI/TIA-1152-A Level 2G with the applicable measurement accuracy
Product package marking shall include:	ETL Verified to ANSI/TIA-1152-A Level 2G and the product model(s) and or brand name.

Continuing compliance to this specification is monitored through production testing, quarterly inspections by Intertek at the production facility and random sample testing.

Date Verified: June 22, 2017

Approved By:

Antoine Pelletier
 Antoine Pelletier, Project Engineer

This verification supersedes all previous verifications with the noted Verification/Report number(s) dated before this verification notice.

NOTE: This verification is part of the full test report(s) and should be read in conjunction with it.

This Verification is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this Verification. Only the Client is authorized to copy or distribute this Verification. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results referenced from this Verification are relevant only to the sample tested. This Verification by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.





What other tests are performed by a CAT 8 tester?

- Resistance Unbalance: which is important for successful PoE operation
- TCL and ELTCL balance measurements



Field test requirements

- With the new ANSI/TIA-1152-A and Draft IEC 61935-1 Ed. 5 we also get some changes in field testing.
 - We carry out all the usual parametric tests but now out to 2GHz, to cover all types of Cat 8.
 - Wiremap has a requirement, when testing Cat 8 installations, to check the shield continuity along the path of the cabling.
 - Prevents the field tester being fooled by ground paths via racking and the earth connections.
 - Optional tests added to support the emerging IEEE 802.3bt PoE++ standard.
 - Channel dc loop resistance is to be below 25Ω
 - Current imbalance between pairs is to be minimised. This is achieved with Resistance Unbalance measurements within the pair and between pairs.

	Copper Certification	
	ISO/IEC 11801 Edition 3 Conformance Requirements	IEC 61935-1 Edition 5 Field Test Requirements
Wire Map *	✓	✓
Length	✓	✓
Propagation Delay	✓	✓
Delay Skew	✓	✓
dc Loop Resistance	✓	✓
Resistance Unbalance **	✓	Optional
Insertion Loss	✓	✓
NEXT, PS NEXT	✓	✓
Return Loss	✓	✓
ACR-F, PS ACR-F	✓	✓
TCL, ELTCTL	✓	Optional
Coupling Attenuation	✓	Optional
PS ANEXT, PS AACR-F	✓	✓

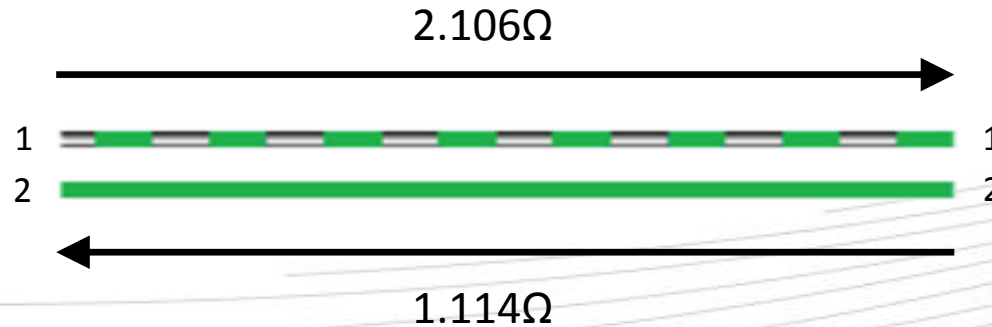
* For Level 2G testers screen continuity is tested along the path of the cabling.
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** Proposed Measurement requirement to support IEEE 802.3bt DTE Power over MDI
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Resistance Unbalance

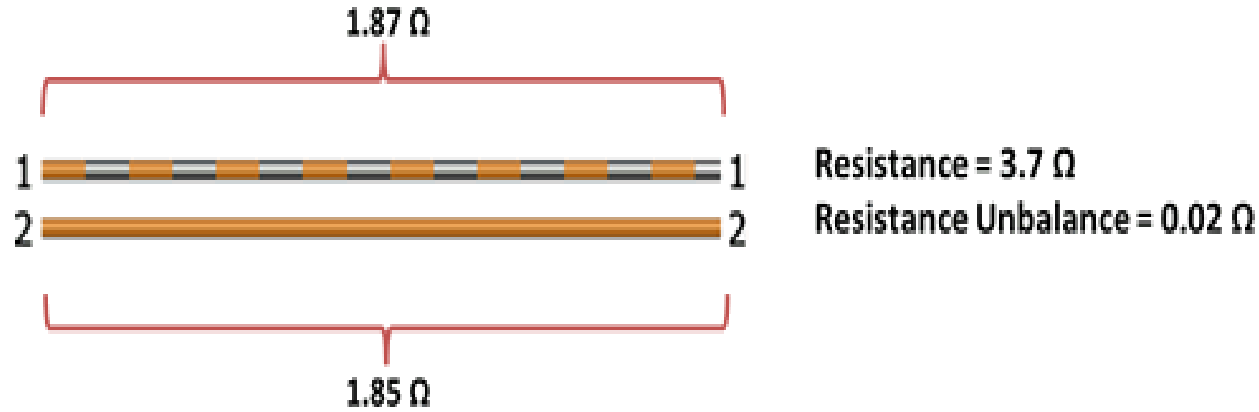
- They are optional tests for field testing that allows an installed link to be evaluated for PoE transmission.
 - Adds a Loop Resistance check (Already an ISO 11801 requirement)
 - Adds a DC Resistance Unbalance check within the pairs



$$\text{Loop Resistance} = 2.106 + 1.114 = 3.22 \text{ Ohms}$$
$$\text{DC Resistance Unbalance} = |2.106 - 1.114| = 0.992 \text{ Ohms}$$



Resistance Unbalance



06/11/2013 8:15:39 pm

TEST LIMIT

TIA

TIA TSB155 Ch
TIA Cat 6A Perm. Link (+PoE)
TIA Cat 6 Perm. Link (+PoE)
TIA Cat 5e Perm. Link (+PoE)
TIA TSB155 PL (+PoE)
TIA 1005 Cat 6A Perm. Link (+PoE)
TIA 1005 Cat 6 Perm. Link (+PoE)
TIA 1005 Cat 5e Perm. Link (+PoE)

06/11/2013 8:16:01 pm

TEST LIMIT

ISO

ISO11801 Channel Class C
ISO11801 PL2 Class Fa (+PoE) (1 GHz)
ISO11801 PL2 Class Fa (+PoE) (600 MHz)
ISO11801 PL2 Class E (+PoE)
ISO11801 PL Class F (+PoE)
ISO11801 PL Class E (+PoE)
ISO11801 PL Class D (+PoE)
ISO11801 Channel Class Fa (+PoE) (1 GHz)

06/13/2013 3:08:25 am

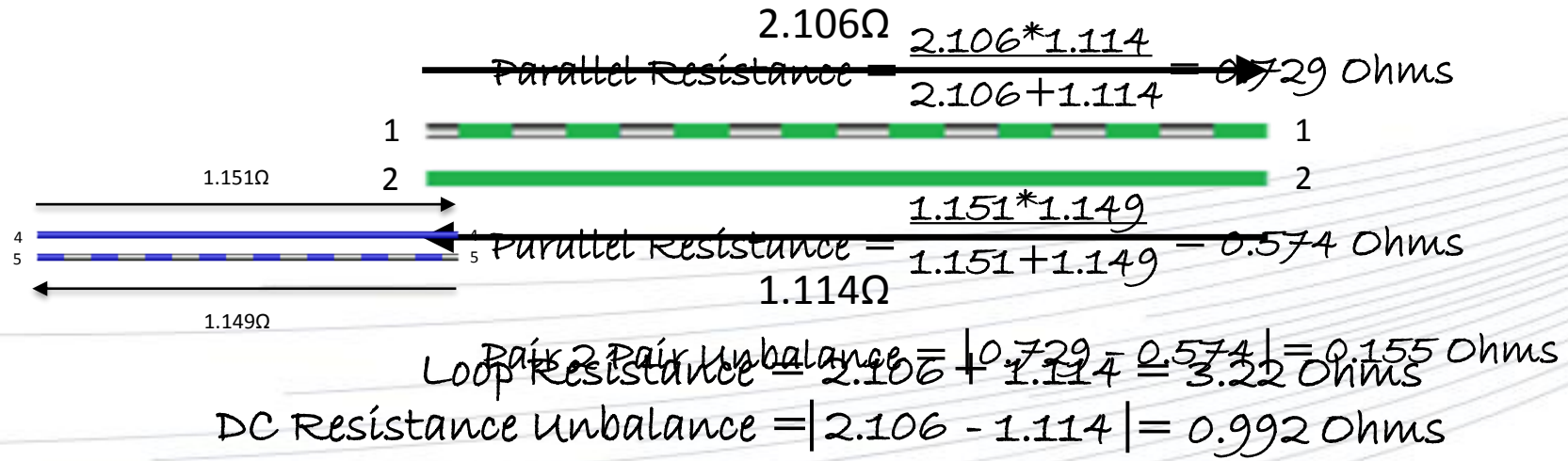
Result not saved **PASS**

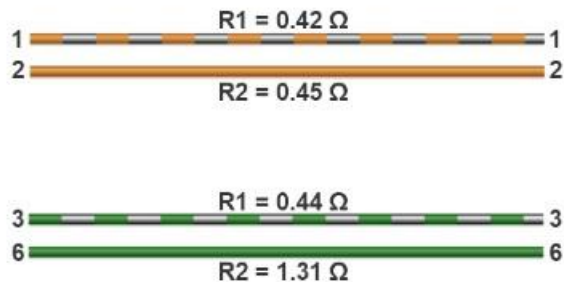
	RESISTANCE VALUE Ω	RESISTANCE UNBALANCE VALUE Ω	LIMIT Ω
1,2	3.5	0.04	0.20
3,6	3.5	0.03	0.20
4,5	3.6	0.00	0.20
7,8	3.5	0.02	0.20
LIMIT	25.0		



Resistance Unbalance

- They are optional tests for field testing that allows an installed link to be evaluated for PoE transmission.
 - Adds a Loop Resistance check (Already an ISO 11801 requirement)
 - Adds a DC Resistance Unbalance check within the pairs
 - Adds a DC Resistance Unbalance check between the pairs





- $R_{t1} = 0.22 \Omega$, $R_{t2} = 0.33 \Omega$
- $RT = 0.33 - 0.22 = 0.11 \Omega$

DC resistance unbalance between pairs calculation FAIL		
LOOP	PAIR UBL	P2P UBL
	✓	
	VALUE (Ω)	
1,2	0.9	
3,6	1.8	
4,5	0.8	
7,8	0.8	
LIMIT	25.0	

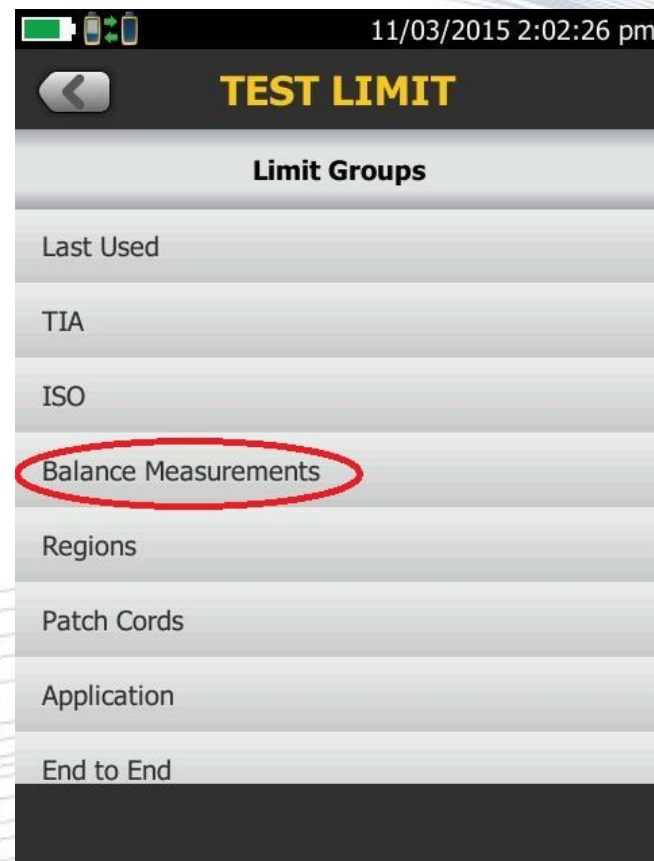
DC resistance unbalance between pairs calculation FAIL		
LOOP	PAIR UBL	P2P UBL
	✗	
	VALUE (Ω)	LIMIT (Ω)
1,2	0.03	0.20
3,6	0.87	0.20
4,5	0.01	0.20
7,8	0.03	0.20

DC resistance unbalance between pairs calculation FAIL		
LOOP	PAIR UBL	P2P UBL
	✓	
	VALUE (Ω)	LIMIT (Ω)
1,2-3,6	0.11	0.20
1,2-4,5	0.01	0.20
1,2-7,8	0.01	0.20
3,6-4,5	0.13	0.20
3,6-7,8	0.13	0.20
4,5-7,8	0.00	0.20

Balance



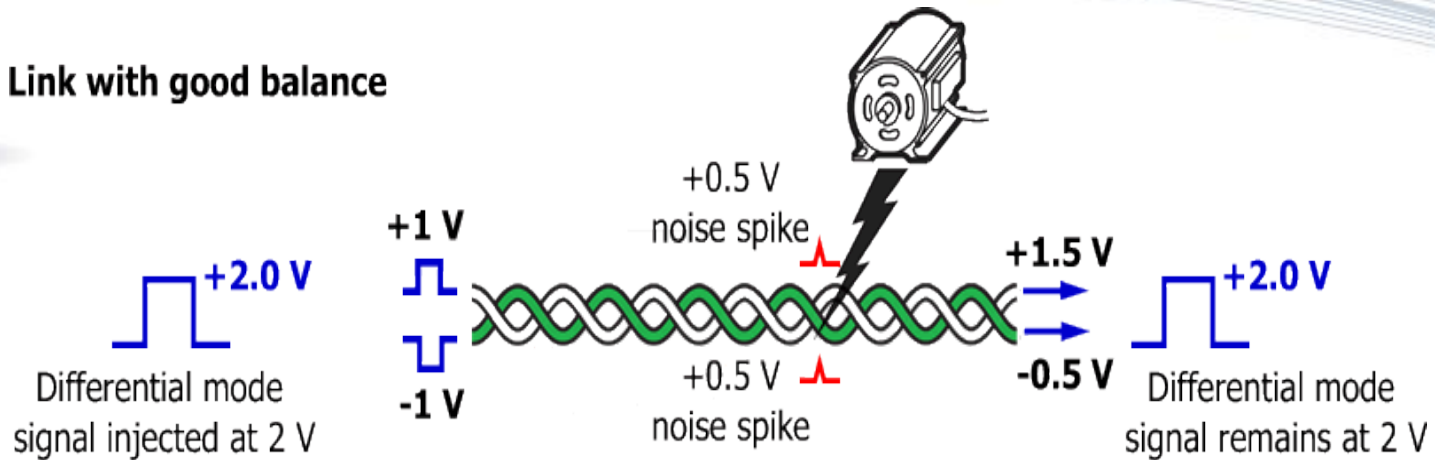
- Balance is critical for successful transmission
- Reduces emissions
- Mitigates external noise sources



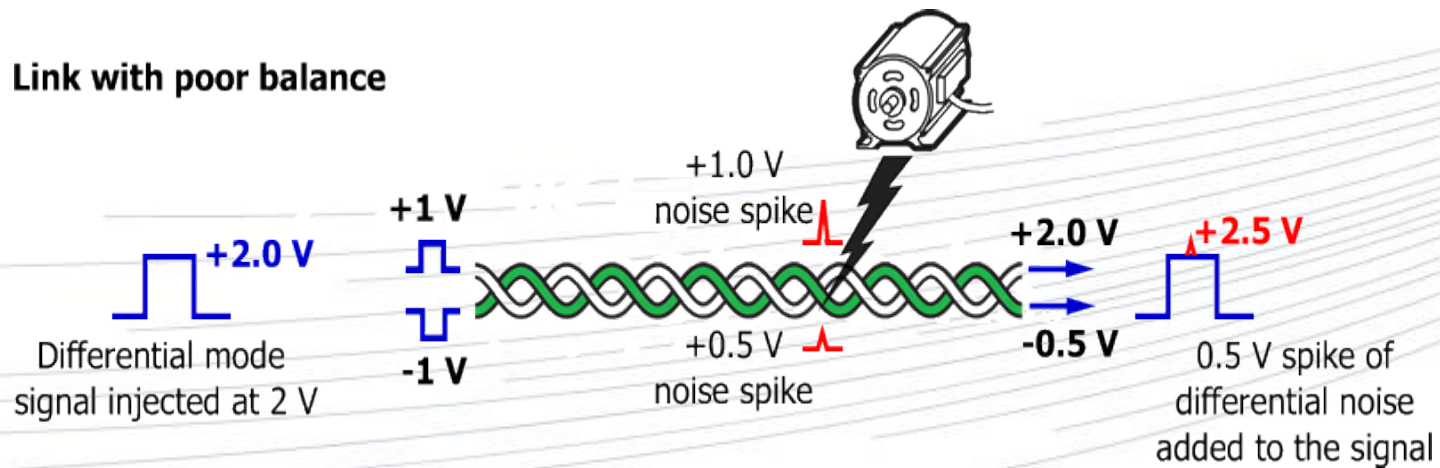


Why Balance Matters?

Link with good balance



Link with poor balance





Mode Conversion Testing

- TCL
- TCTL
- ELTCTL
- CDNEXT
- CMRL

11/03/2015 1:58:18 pm

Result not saved **PASS**

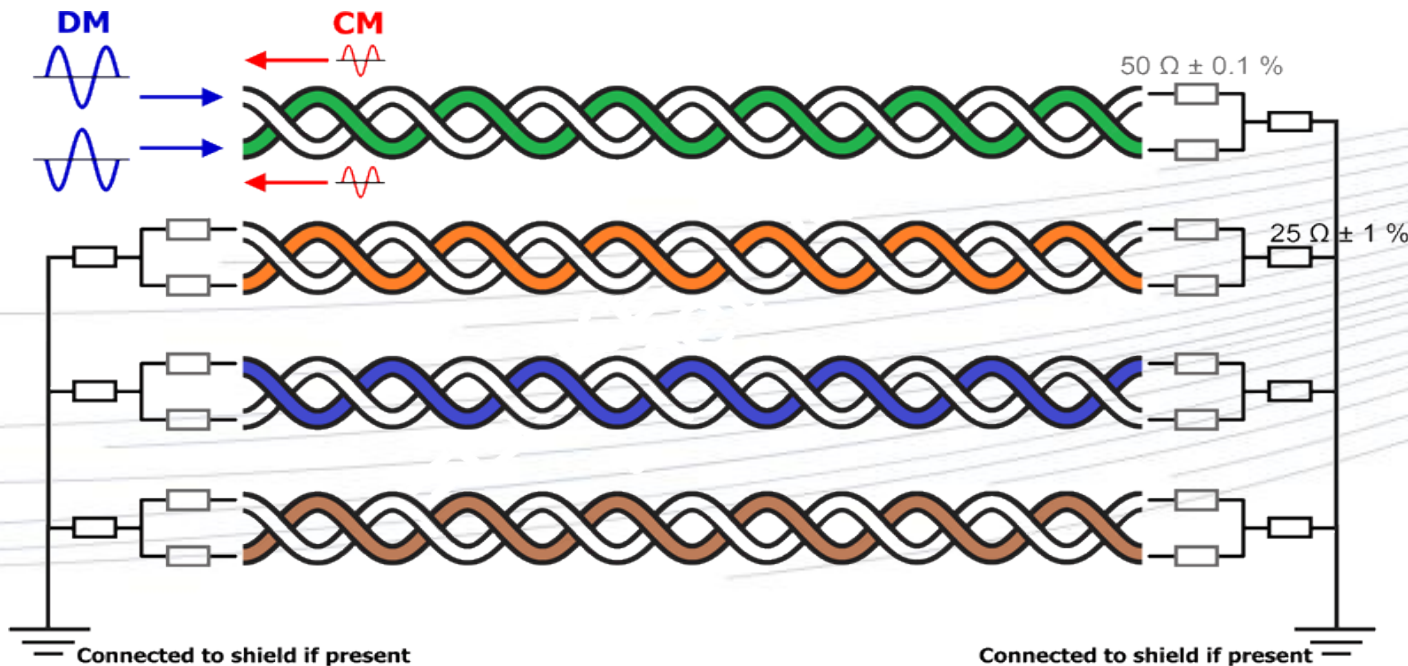
WIRE MAP	PERFORMANCE
ACR-N	(20,1 dB) i
PS ACR-N	(22,6 dB) i
ACR-F	(23,2 dB) ✓
PS ACR-F	(24,3 dB) ✓
CMRL	i
CDNEXT	i
TCL	i
ELTCTL	i

SAVE **✓ TEST**



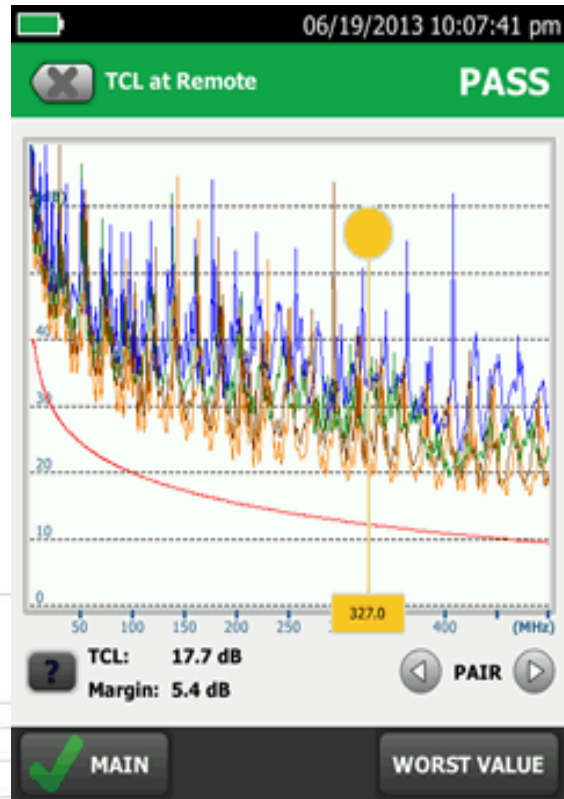
Transverse Conversion Loss

- Transverse Conversion Loss is the ratio of a common-mode voltage measured on a wire pair relative to a differential-mode voltage applied to the same end of the pair.





Transverse Conversion Loss



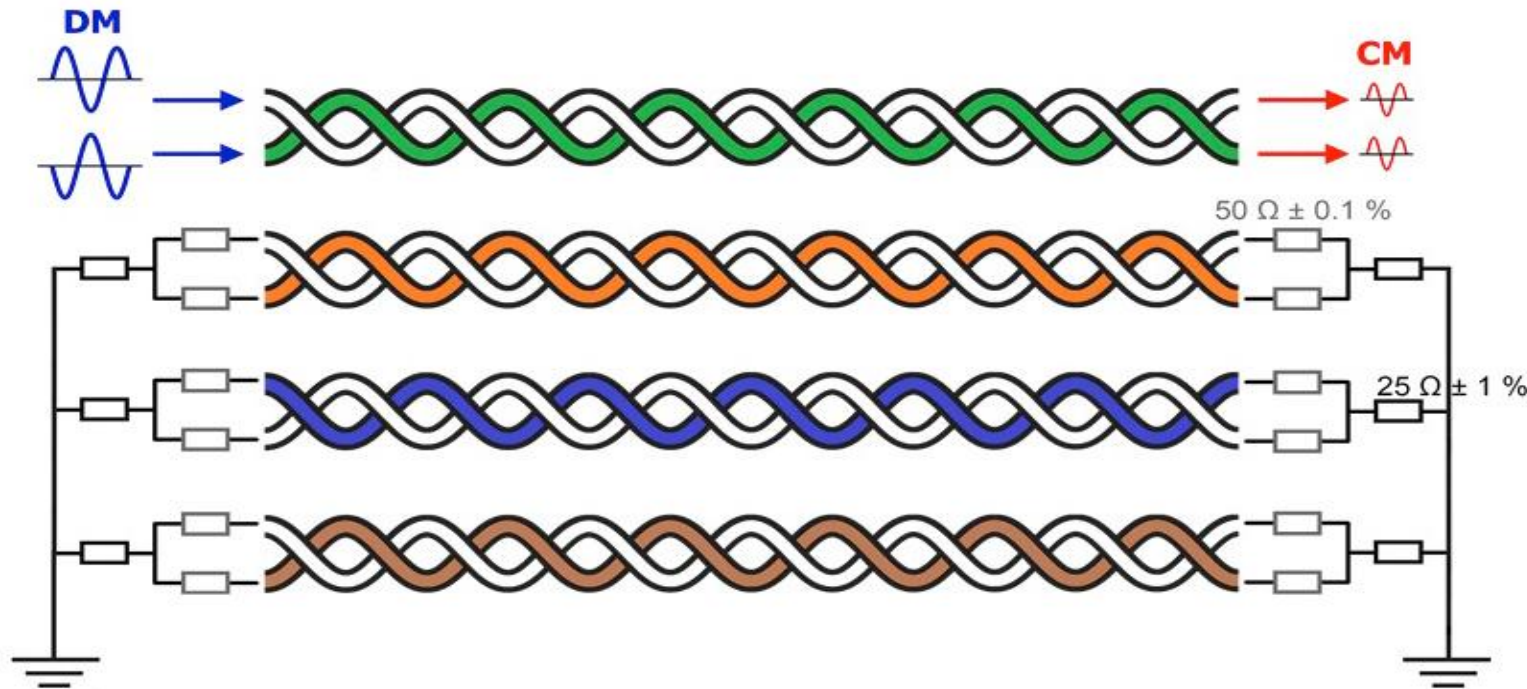
↑
Better performance

High TCL values correspond to better noise immunity and lower emissions.



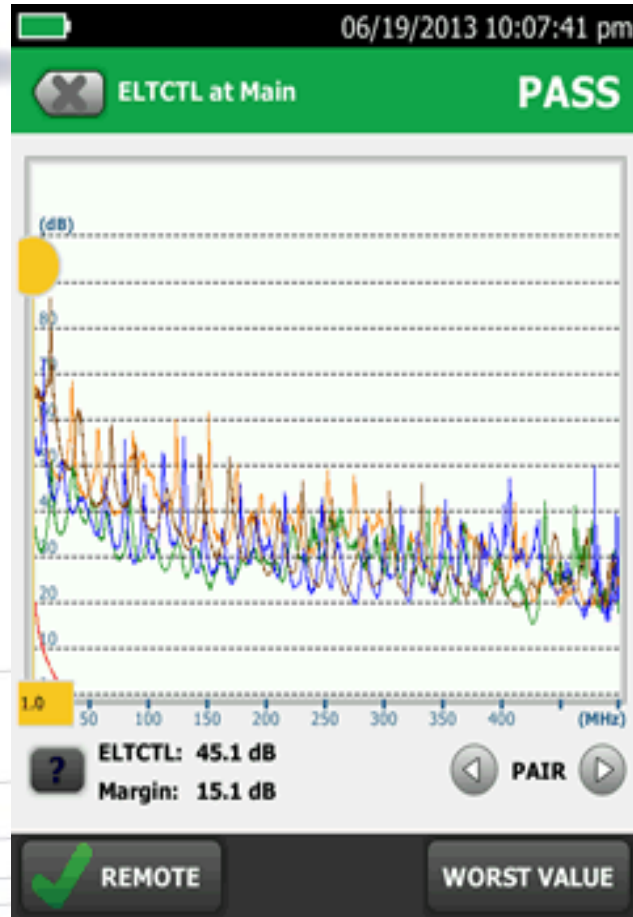
ELTCTL (Transverse Conversion Transfer Loss)

- Transverse Conversion Transfer Loss is the ratio of a common-mode voltage measured at the far end of a wire pair relative to a differential-mode voltage applied to the near end of the same pair.





ELTCTL

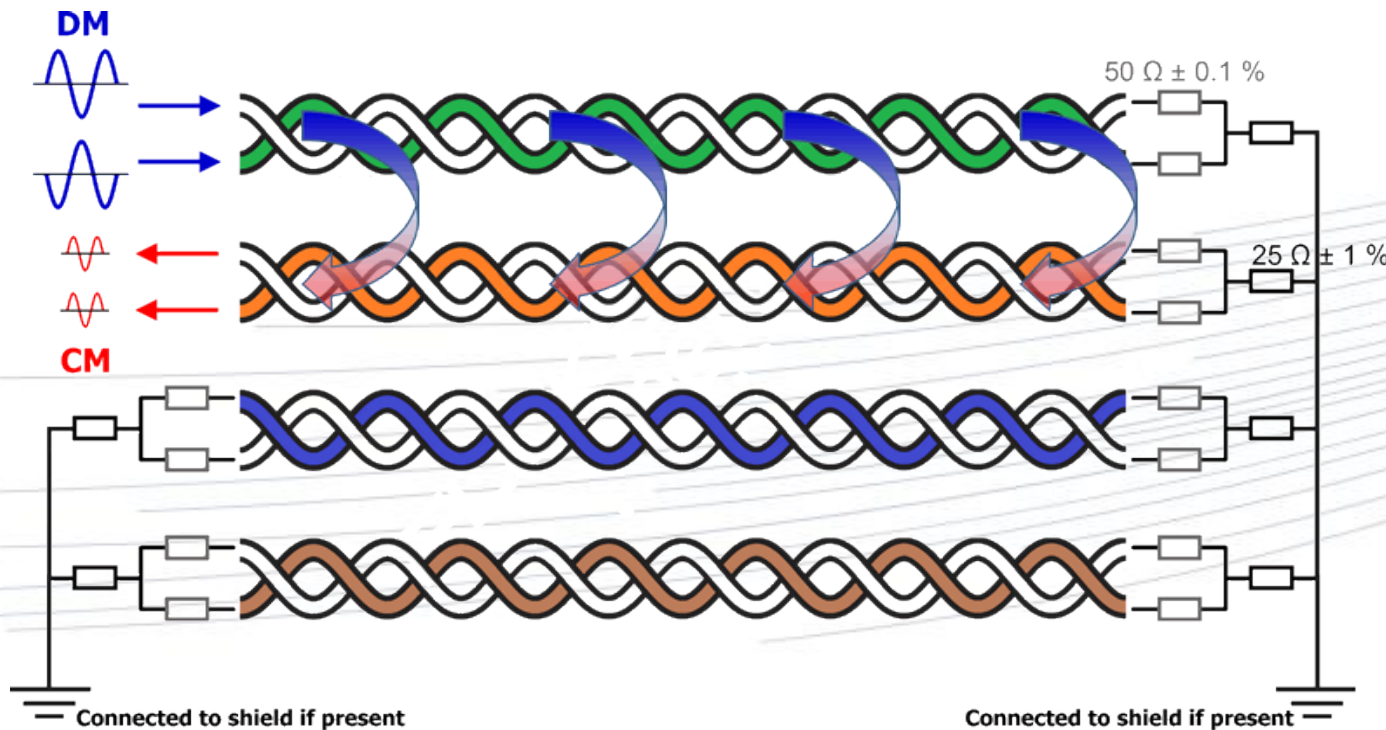


Better performance ↑

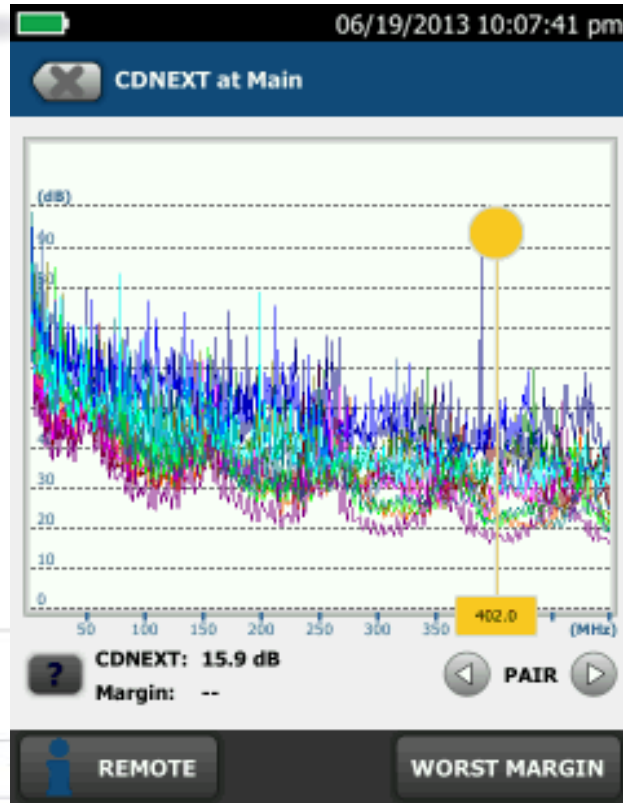
High ELTCTL values correspond to better noise immunity and lower emissions.

CDNEXT

- There are no test limits in ANSI/TIA-568-C.2, ANSI/TIA-1005 or ISO/IEC 11801:2010. However, you will find it discussed in TIA-TSB-1197.



CDNEXT



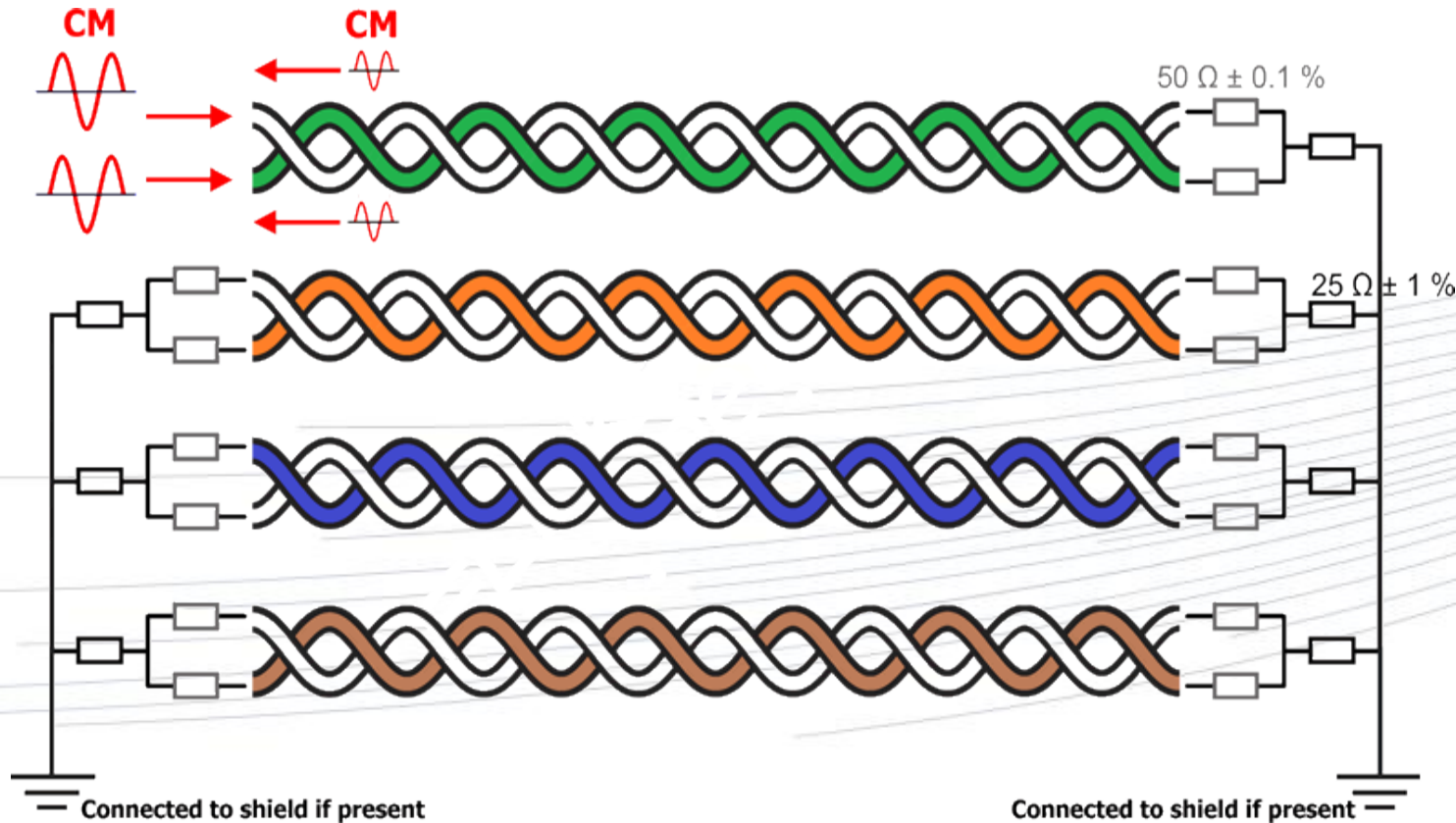
↑
Better performance

High CDNEXT values correspond to better noise immunity and lower emissions.

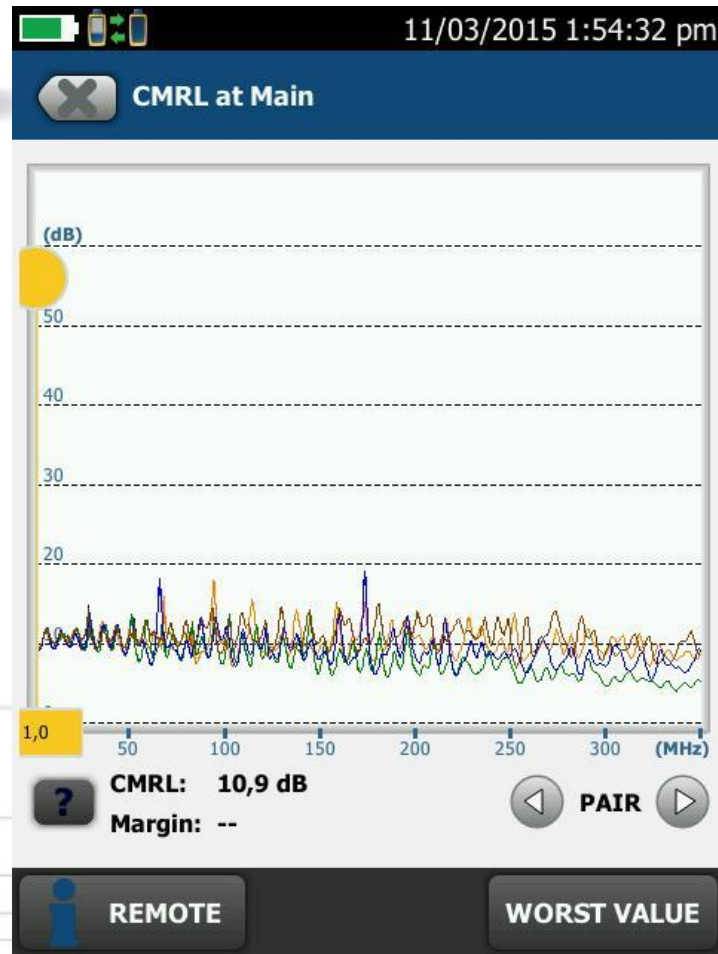


CMRL

- no test limits in ANSI/TIA-568-C.2, ANSI/TIA-1005 or ISO/IEC 11801:2010.



CMRL



High CMRL values correspond to better noise immunity and lower emissions.



Test Report

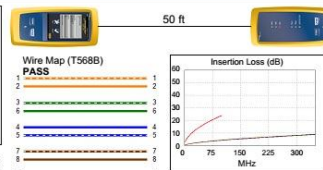


Cable ID: 001NEX2
 Date / Time: 11/03/2015 01:50:38 PM
Headroom 14.4 dB (NEXT 45-78)
 Test Limit: TIA Cat 5e Channel (+All)
 Cable Type: Cat 5e U/UTP
 Calibration Date: 06/19/2013

Operator: DENIZAR
 Software Version: V4.3 Build 6
 Limits Version: V4.3
 NVP: 69.0%

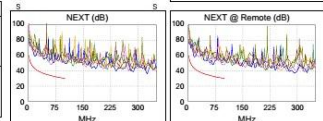
Test Summary: PASS
 Model: DSX-5000
 Main S/N: 2420780
 Remote S/N: 2420780
 Main Adapter: DSX-CHA004
 Remote Adapter: DSX-CHA004

Length (ft), Limit 328	[Pair 45]	50
Prop. Delay (ns), Limit 555	[Pair 36]	77
Delay Skew (ns), Limit 50	[Pair 36]	3
Resistance (ohms), Limit 25.0	[Pair 78]	2.6
Resist. Unbal. (ohms), Limit 0.20	[Pair 36]	0.04
Resist. P2P Unbal. (ohms), Limit 0.20	[Pair 12-78]	0.04
Insertion Loss Margin (dB)	[Pair 36]	19.6
Frequency (MHz)	[Pair 36]	100.0
Limit (dB)	[Pair 36]	24.0

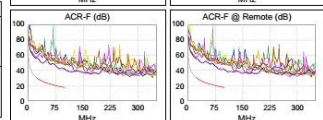


Worst Case Margin Worst Case Value

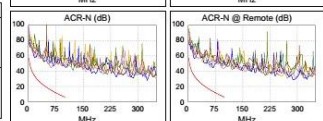
PASS	MAIN	SR	MAIN	SR
Worst Pair	45-78	12-78	45-78	12-78
NEXT (dB)	14.4	14.8	14.5	14.8
Freq. (MHz)	61.8	68.5	62.5	68.5
Limit (dB)	33.7	32.9	33.6	32.9
Worst Pair	78	78	78	45
PS NEXT (dB)	16.6	15.9	19.8	18.3
Freq. (MHz)	60.3	60.3	100.0	93.0
Limit (dB)	30.9	30.9	27.1	27.6



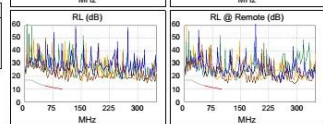
PASS	MAIN	SR	MAIN	SR
Worst Pair	36-78	78-36	36-78	78-36
ACR-F (dB)	22.5	22.5	23.6	23.5
Freq. (MHz)	88.5	89.5	100.0	100.0
Limit (dB)	18.5	18.4	17.4	17.4
Worst Pair	36	36	36	36
PS ACR-F (dB)	24.1	24.4	25.8	25.1
Freq. (MHz)	2.3	1.9	100.0	100.0
Limit (dB)	47.4	48.9	14.4	14.4



N/A	MAIN	SR	MAIN	SR
Worst Pair	12-78	12-78	45-78	45-78
ACR-N (dB)	20.8	20.4	29.8	37.1
Freq. (MHz)	2.3	1.6	62.5	97.8
Limit (dB)	54.3	56.9	15.0	6.5
Worst Pair	12	12	78	45
PS ACR-N (dB)	22.9	22.8	39.5	37.4
Freq. (MHz)	2.3	1.6	100.0	93.0
Limit (dB)	51.3	53.9	3.1	4.5



PASS	MAIN	SR	MAIN	SR
Worst Pair	78	12	78	12
RL (dB)	6.7	6.9	7.8	7.0
Freq. (MHz)	61.0	86.3	91.8	86.8
Limit (dB)	12.2	10.7	10.4	10.6



Compliant Network Standards:
 10BASE-T 100BASE-TX 100BASE-T4
 100BASE-T ATM-25 ATM-51
 ATM-155 100V-Any_Lan TR-4
 TR-16 Active TR-16 Passive

Project: DENNIS Untitled1

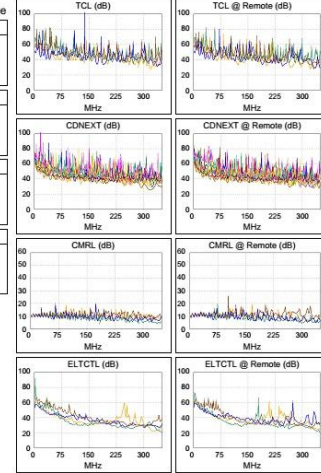


Cable ID: 001NEX2
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 Calibration Date: 06/19/2013

Operator: DENIZAR
 Software Version: V4.3 Build 6
 Limits Version: V4.3
 NVP: 69.0%

Test Summary: PASS
 Model: DSX-5000
 Main S/N: 2420780
 Remote S/N: 2420780
 Main Adapter: DSX-CHA004
 Remote Adapter: DSX-CHA004

N/A	MAIN	SR	MAIN	SR
Worst Pair	12	45	27.9	27.3
TCL (dB)			319.0	335.0
Freq. (MHz)				
Limit (dB)				
Worst Pair	36-12	78-45	25.1	26.7
CDNEXT (dB)			318.0	335.0
Freq. (MHz)				
Limit (dB)				
Worst Pair	36	36	4.1	4.3
CMRL (dB)			337.0	301.0
Freq. (MHz)				
Limit (dB)				
Worst Pair			36	36
ELTCTL (dB)			20.5	19.9
Freq. (MHz)			350.0	350.0
Limit (dB)				



Project: DENNIS Untitled1





The Real CAT 8 Tester?

- The Permanent Link and Channel adapters with a full 2 GHz range.
- The tester to be endorsed by a Cat 8 cabling manufacturer. One of the main reasons for certifying installed cabling is to obtain a manufacturer's warranty.
- The tester independently verified to meet the ANSI/TIA-1152-A Level 2G requirements for measurement accuracy required for Cat 8 testers.
- The tester to test screen continuity along the path of the cabling as required for Level 2G testers



THANK YOU