

Impact of Patch Cords on PoE Performance

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Standards Reference for Power Delivery over 4/2/1 pair Cabling

- IEEE Std 802.3af-2003 DTE Power via media dependent interface (MDI)
- IEEE Std 802.3at-2009 DTE Power Enhancements
- IEEE P802.3bt DTE Power via MDI over 4-Pair Task Force
 - 10M/100M/1G/2.5G/5G/10G (4-pair,2-pair)
- IEEE Std 802.3bu-2016 1-Pair Power over Data Lines (PoDL)
 - 10M/100M/1G/10G (2.5G/5G) (1-pair)

❖ An objective of Power over Ethernet: A PSE designed to the standard does not introduce non-SELV (Safety Extra Low Voltage*) power into the wiring plant.



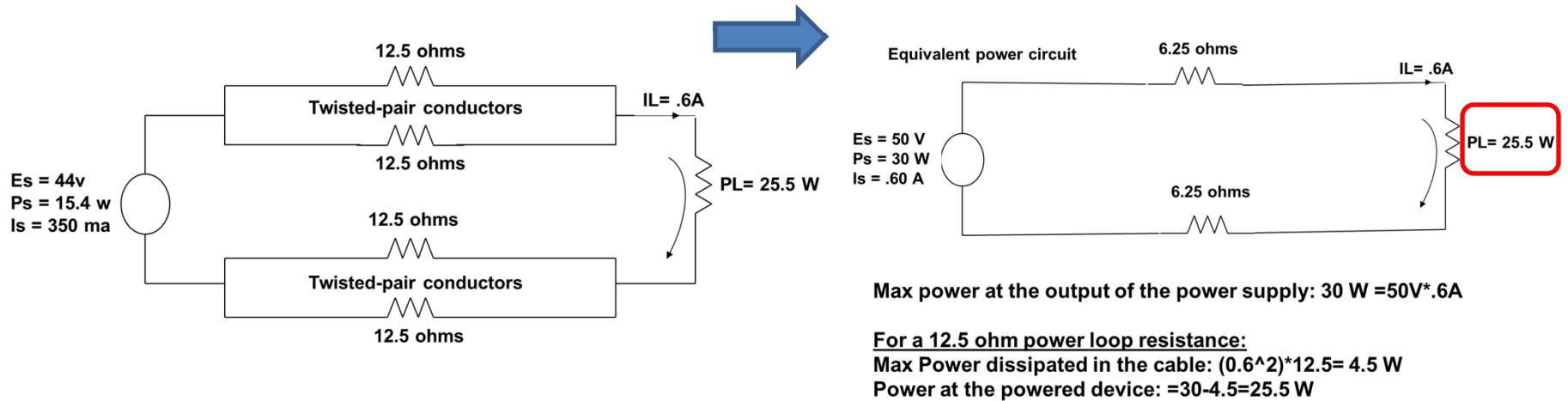
Standards Reference for Power Delivery over 4/2/1 pair Cabling

- ISO/IEC/TIA guidelines to support (SELV) limited power source (LPS) applications. Guidelines include considerations for temperature rise and current capacity of bundled cabling.
 - ISO/IEC TR29125 and TIA TSB-184 (2009)
 - ISO/IEC TS29125 and TIA TSB-184-A (2017)



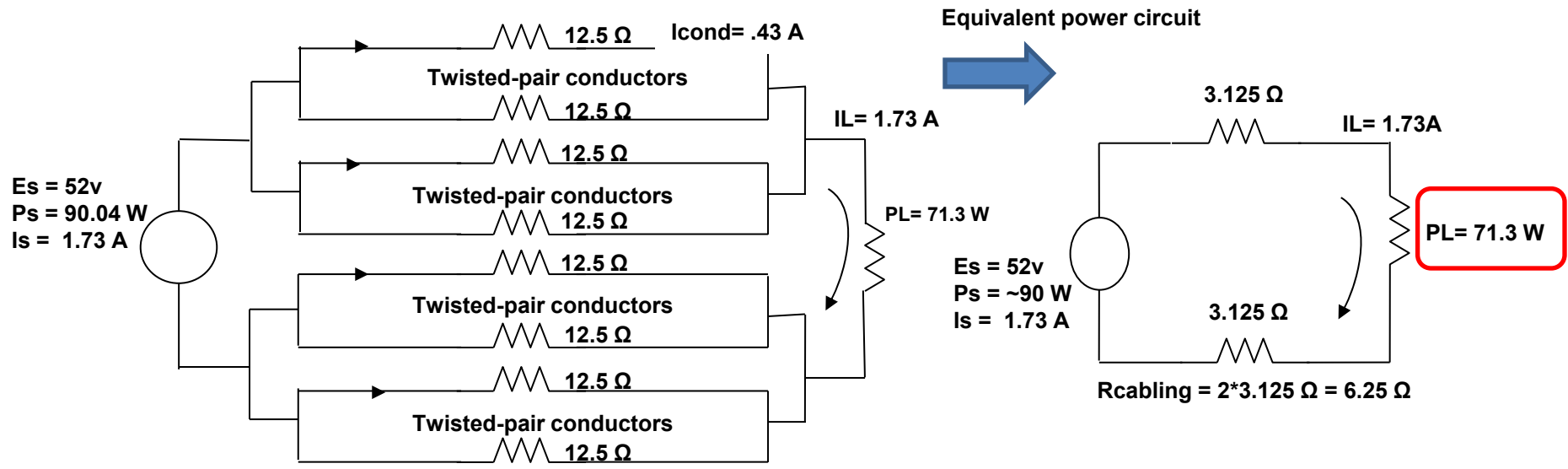
Standards Reference for Power Delivery over 2 pair Cabling

IEEE 802.3at - 2 pair



Standards Reference for Power Delivery over 4 pair Cabling

IEEE 802.3bt – 4 pair



Requirements for Channels to be compliant for PoE delivery

- As specified in ANSI/TIA-568.2-D & TIA TSB-184A D3.0
 - DC Loop Resistance for Cat3,5e/6/6A shall not exceed 25 Ohms
 - DC Resistance UnBalance < 200mOhms or 3% of UnBal in pair
 - DC Resistance UnBalance between pairs <200mOhms or 7% of UnBal between pairs



Patch Cord Specifications

- ANSI/TIA-568.2-D specifies requirements for Modular Cords.
- ONLY NEXT & Return Loss are specified
- No requirements for DC Resistance, DC Res UnBalance



Impact of Patch Cords on Channel Measurements

- Patch Cord contribution to Channels can be significant for Shorter Channels
- Resistance UnBalance in Patch Cords can impact Data Transmission during Power Delivery



DC Resistance Measurements – Patch

Patch Cord	DC Resistance				DC Res UnBalance within pair				DC Res UnBalance between pairs					
	12	36	45	78	12	36	45	78	12-36	12-45	12-78	36-45	36-78	45-78
Cat6A Patch Cord, 26AWG, PCB Plug, 2m -A	0.7	0.69	0.762	0.792	0.021	0.005	0.043	0.05	0.003	0.015	0.022	0.017	0.025	0.008
Cat6A Patch Cord, 26 AWG, PCB Plug, 2m -B1	1.026	0.725	0.767	0.806	0.246	0.001	0.012	0.019	0.061	0.05	0.04	0.01	0.02	0.01
Cat6A Patch Cord, 26 AWG, PCB Plug, 2m -B2	0.86	0.769	0.803	0.858	0.037	0.009	0.016	0.025	0.022	0.014	0.006	0.008	0.022	0.013
Cat6A Patch Cord, 26AWG, Wired Plug, 2m-A	0.664	0.651	0.669	0.708	0.015	0.014	0.011	0.023	0.003	0.001	0.011	0.004	0.014	0.01
Cat6A Patch Cord, 26AWG, Wired Plug, 2m-B	0.698	0.738	0.756	0.995	0.028	0.046	0.026	0.15	0.009	0.014	0.069	0.005	0.059	0.054
Cat5e PatchCord, 26 AWG, Molded Plug, 1m	0.54	0.505	0.631	1.134	0.001	0.023	0.03	0.307	0.009	0.022	0.128	0.031	0.137	0.105
Cat5e Patch Cord, 26 AWG, Molded Plug, 2m-A	0.628	0.587	0.607	0.645	0.045	0.005	0.004	0.017	0.009	0.004	0.005	0.005	0.014	0.009
Cat5e Patch Cord, 26 AWG, Molded Plug, 2m-B	0.629	0.601	0.615	0.661	0.031	0.003	0.009	0.019	0.007	0.003	0.008	0.004	0.015	0.011
Self Crimped Patch Cord, 26 AWG, 0.3m	0.635	1.845	0.618	1.344	0.367	0.845	0.253	0.925	0.259	0.023	0.071	0.236	0.188	0.048

Impact of Patch Cords on Channel Measurements

- Patch Cord contribution to Channels can be significant for Shorter Channels
- Resistance UnBalance in Patch Cords can impact Data Transmission during Power Delivery



DC Resistance Measurements – Patch Cord

The application interface shows the following DC Resistance measurements:

DC Resistance (Ω) - 19/06/19 08:27 (Main 87%)

Pair	Result	Data	Limit
12	Loop	0.581	25.000
36	Loop	0.565	25.000
45	Loop	0.619	25.000
78	Loop	0.653	25.000

DC Resistance (Ω) - 19/06/19 08:28 (Main 88%)

Pair	Result	Data	Limit
12	UnBal. in Pair	0.021	0.200
36	UnBal. in Pair	0.013	0.200
45	UnBal. in Pair	0.036	0.200
78	UnBal. in Pair	0.047	0.200

DC Resistance (Ω) - 19/06/19 08:28 (Main 88%)

Pair	Result	Data	Limit
12-36	UnBal. in Pair	0.004	0.200
12-45	UnBal. in Pair	0.009	0.200
12-78	UnBal. in Pair	0.017	0.200
36-45	UnBal. in Pair	0.013	0.200
36-78	UnBal. in Pair	0.021	0.200
45-78	UnBal. in Pair	0.008	0.200

DC Resistance Measurements – Patch Cord

The application interface shows the following components:

- Autotest Menu:** Includes 'Autotest' (highlighted in red), 'Expert Tools', and navigation buttons.
- Verification Cat6A Baseline:** Shows a '*PASS' status and a 'Summary' tab with the following data:

Length(m)	0.2
Delay(ns)	1.0
Resistance(Ω)	0.4
NEXT(dB)	3.2
RL(dB)	0.1
IL(dB)	0.6
ELTCTL(dB)	3.2
- DC Resistance (Ω) Results:** Three sequential screens showing results for pairs 12, 36, 45, and 78. Each screen has status indicators: 'Loop' (green), 'UnBal. in Pair' (green, highlighted in red), and 'UnBal. P2P' (green).

PoE Internal Load Testing


19/06/19 12:59 Main 100%

- Cable Certification
- Multi-Gig 2.5G/10Gbps
- POE**
- BASE-T 100/1000Mbps
- Data
- Project: Defaul... Profile: Valid...
- Settings

19/06/19 12:59 Main 100%

PoE

Select Standard:
802.3bt (90W)



PSE Detected	Yes
Voltage	56.24 V
PSE Type	4
PD Class	8
PoE Cable Pairs	12-36, 45-78
Allocated Power	71.00 W

Navigation: Back, Refresh, Power

19/06/19 13:00 Main 100%

PoE Load Test

	Value
Voltage	50.40 V
Current	1.27 A
RealPower	63.79 W

Refresh

Navigation: Back, External



PoE Load Testing in presence of Data Transmission


2m Patch Cord

19/06/19 13:57 Main 100%

PoE External Load Test

	Value
Voltage	54.42 V
Current	1.60 A
RealPower	87.05 W

Pair	SNR	Rx Power
A	11.4 dB	2 dBm
B	12.7 dB	2 dBm
C	12.7 dB	2 dBm
D	12.7 dB	2 dBm




100m Compliant Channel

19/06/19 13:55 Main 100%

PoE External Load Test

	Value
Voltage	48.82 V
Current	1.60 A
RealPower	78.31 W

Pair	SNR	Rx Power
A	8.5 dB	-5.6 dBm
B	10.5 dB	-5.6 dBm
C	9.9 dB	-5.6 dBm
D	10.5 dB	-5.6 dBm




100m Non-Compliant Channel

19/06/19 14:10 Main 100%

PoE External Load Test

	Value
Voltage	36.49 V
Current	1.60 A
RealPower	58.22 W

Pair	SNR	Rx Power
A	2.7 dB	-9.6 dBm
B	0 dB	-9.6 dBm
C	2.7 dB	-9.6 dBm
D	1.6 dB	-9.6 dBm



Summary

- Need to take into consideration DC Loop Resistance & DC Res UnBalance of Patch Cords for PoE Power delivery.
- Non compliant Patch Cords can cause reduced Signal Margin & Data Transmission errors.

