DC Modeling for Cabling Balance

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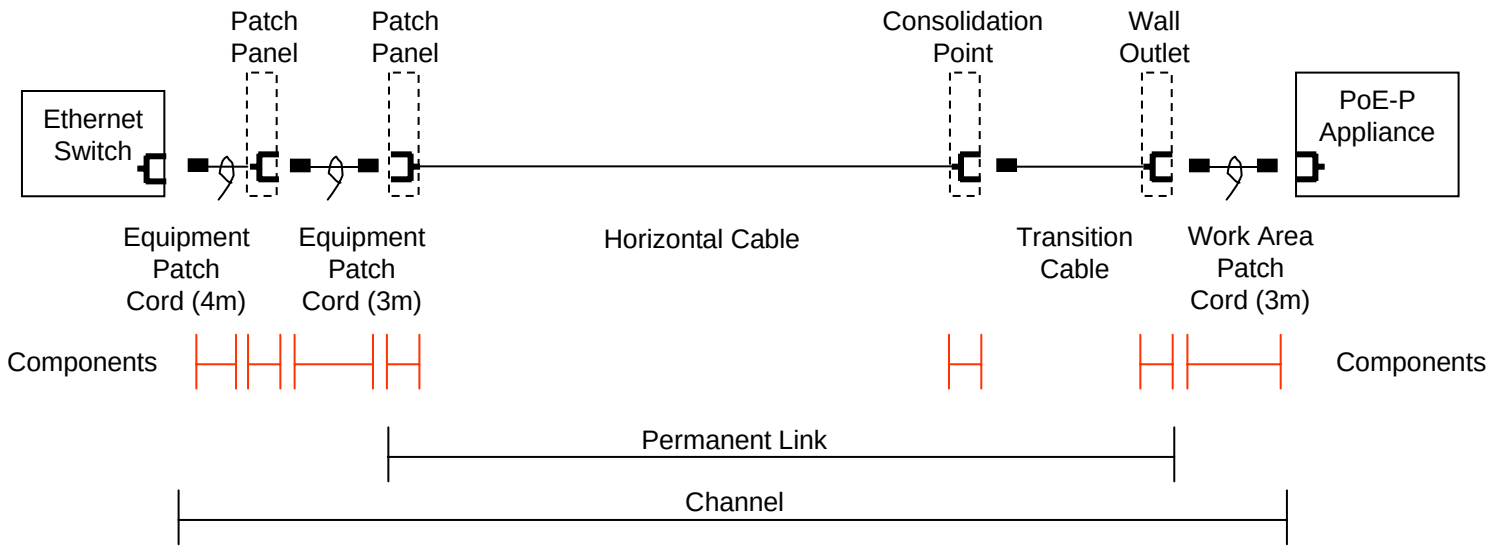
Objectives:

- To specify a cabling model for “balance” within a pair
- To specify a cabling model for “balance” between pairs

Cabling Topology

4 connector cabling model



Connector:

Cat 6 or Cat5e Specification
- DC Resistance < 0.2 Ω per connector (at 20 ºC)
- DC Resistance unbalance < 50 mΩ

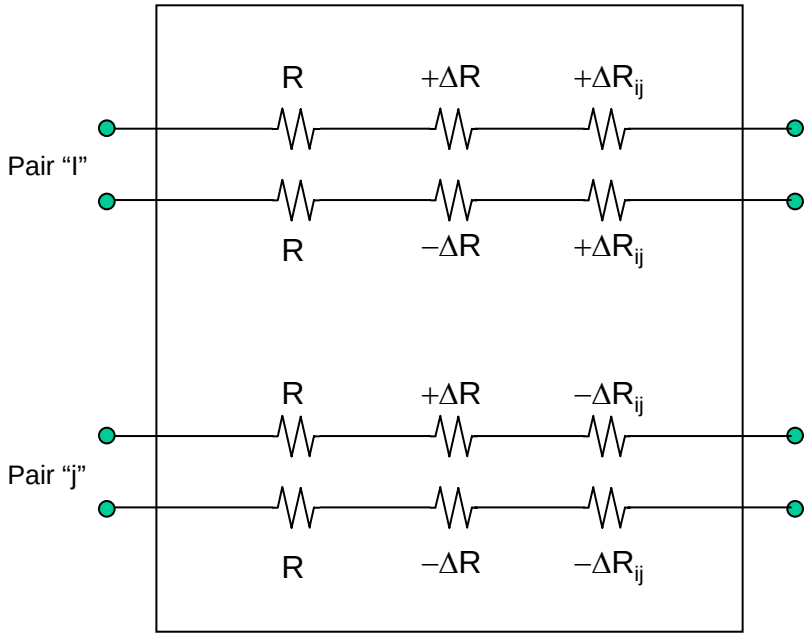
Cat 6 or Cat5e Nominal
- DC Resistance = 0.05 Ω per connector (at 20 ºC)
- DC Resistance unbalance < 25 mΩ

Cable:

Horizontal Cable
Cat 6 or Cat5e Specifications
- DC Resistance < 9.38 Ω per 100m (at 20 ºC)
- DC Resistance unbalance < 5% (at 20 ºC)

Nominal Values
- DC Resistance < 7.0 Ω per 100m (at 20 ºC)
- DC Resistance unbalance < 3% (at 20 ºC)

Cable Model

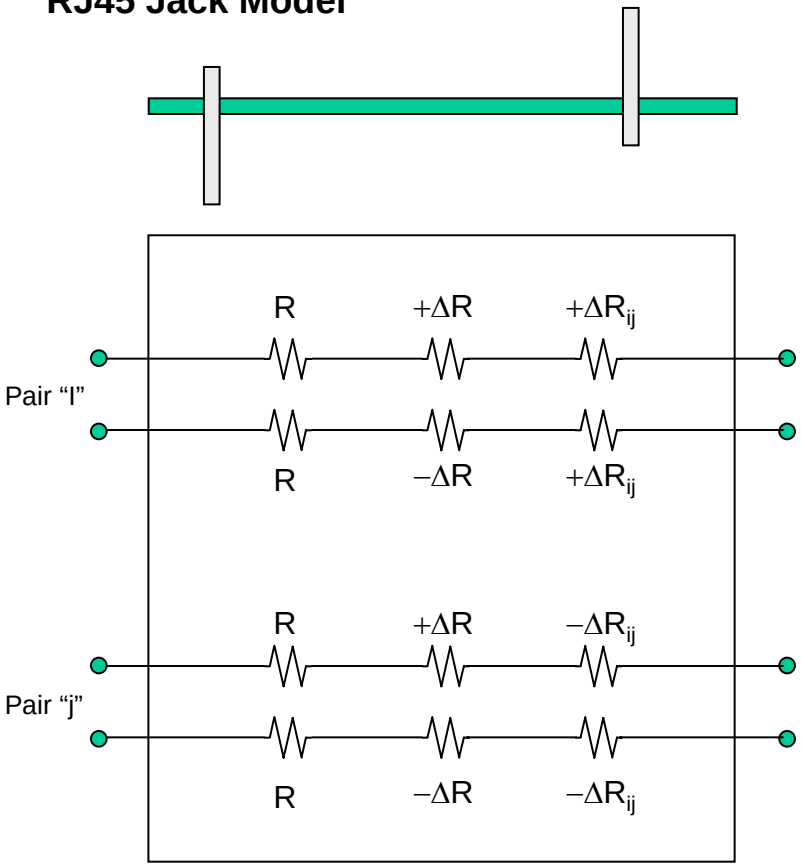


R = cable resistance

ΔR = resistance imbalance within a pair

ΔR_{ij} = resistance imbalance between pairs

RJ45 Jack Model

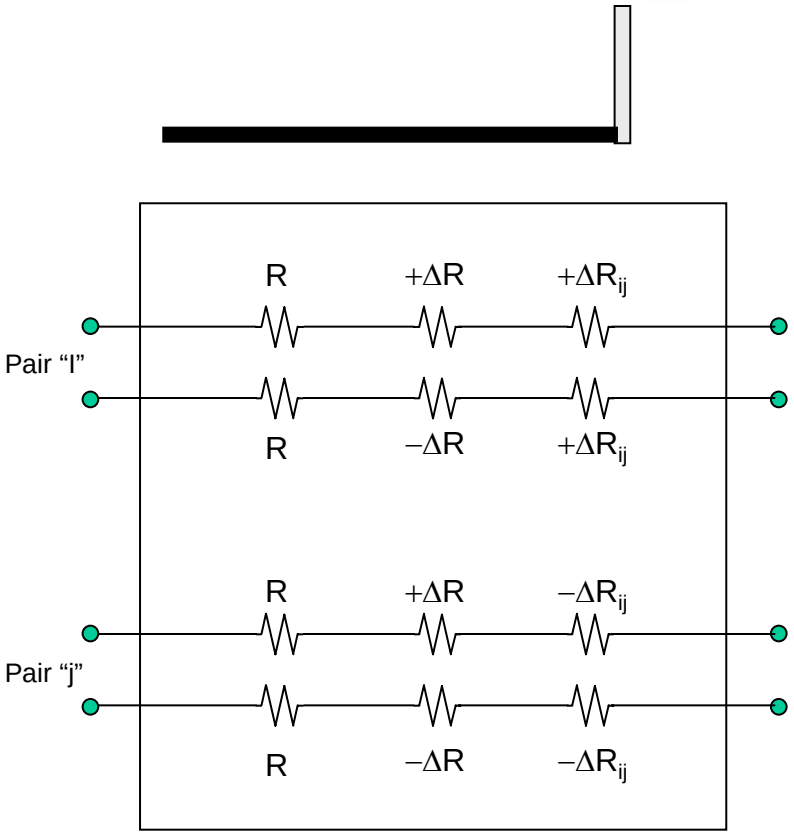


R = Bulk resistance

ΔR = resistance imbalance within a pair

ΔR_{ij} = resistance imbalance between pairs

RJ45 Plug Model

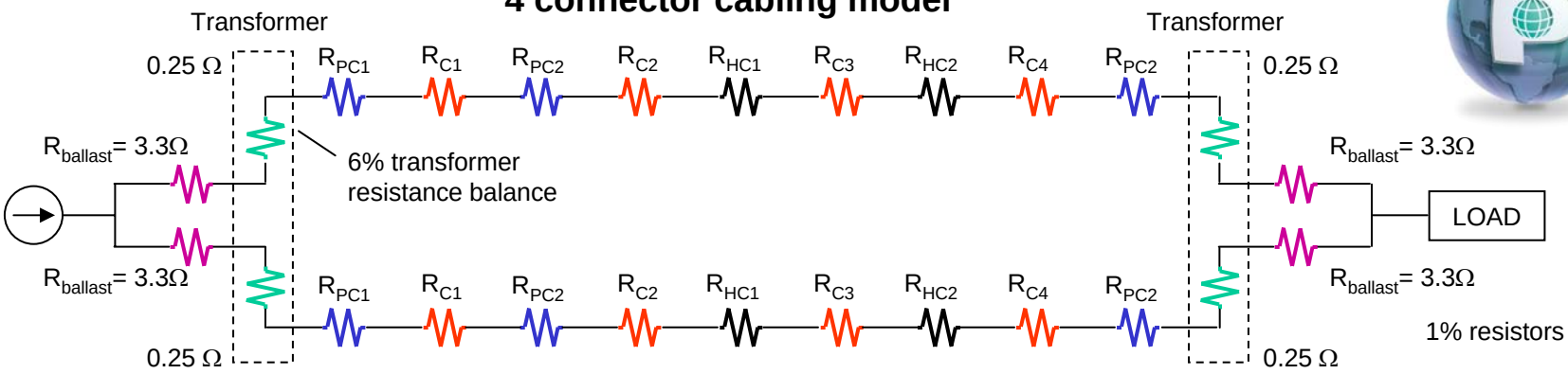


R = Bulk resistance

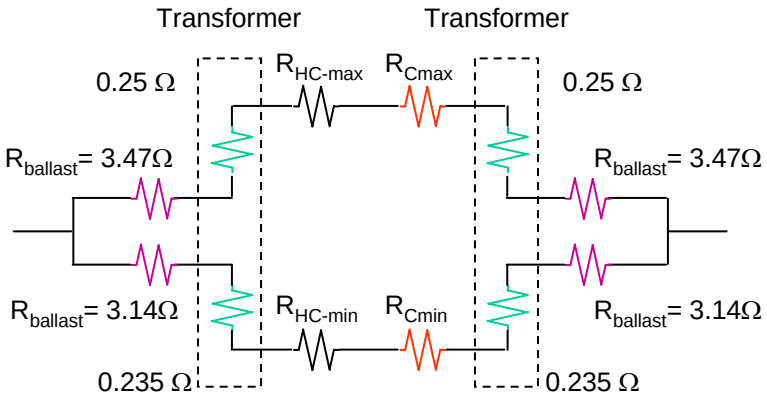
ΔR = resistance imbalance within a pair

ΔR_{ij} = resistance imbalance between pairs

4 connector cabling model



Within a pair



Assumptions:

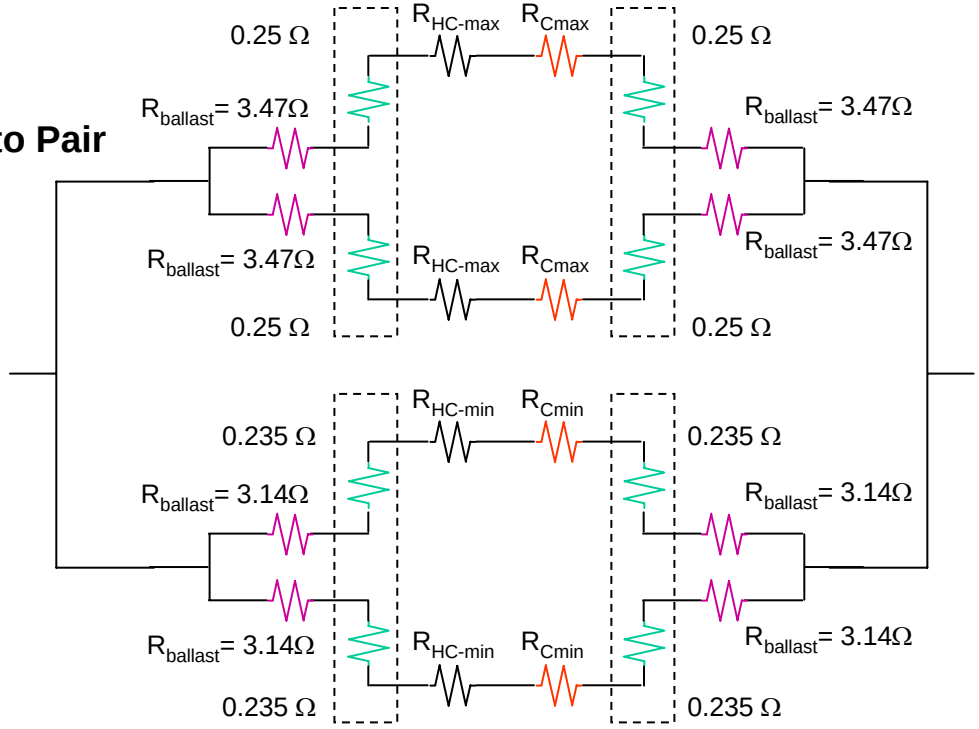
Standards based analysis

R_{HC-max} = 9.38 Ω per 100 m ($R_{PC} = R_{HC}$)

R_{HC-min} = 8.91 Ω per 100 m ($R_{PC} = R_{HC}$)

$R_{C\ (max)}$ = 0.2 Ω $R_{C\ (min)}$ = 0.15 Ω

Pair to Pair



Assumptions:

Nominal value based analysis:

R_{HC-max} = 7.0 Ω per 100 m

R_{HC-min} = 6.65 Ω per 100 m

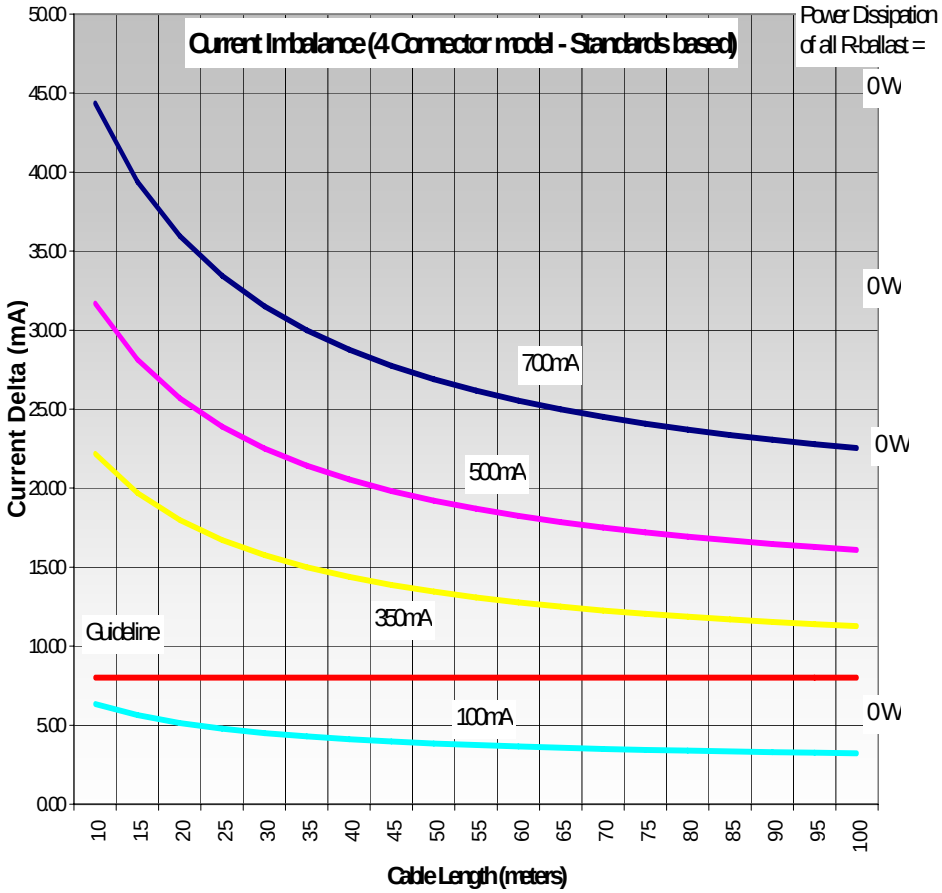
$R_{C\ (max)}$ = 0.05 Ω $R_{C\ (min)}$ = 0.025 Ω

$R_{C\ (max)}$ = 0.2 (.05) Ω $R_{C\ (min)}$ = 0. 1 (.01) Ω

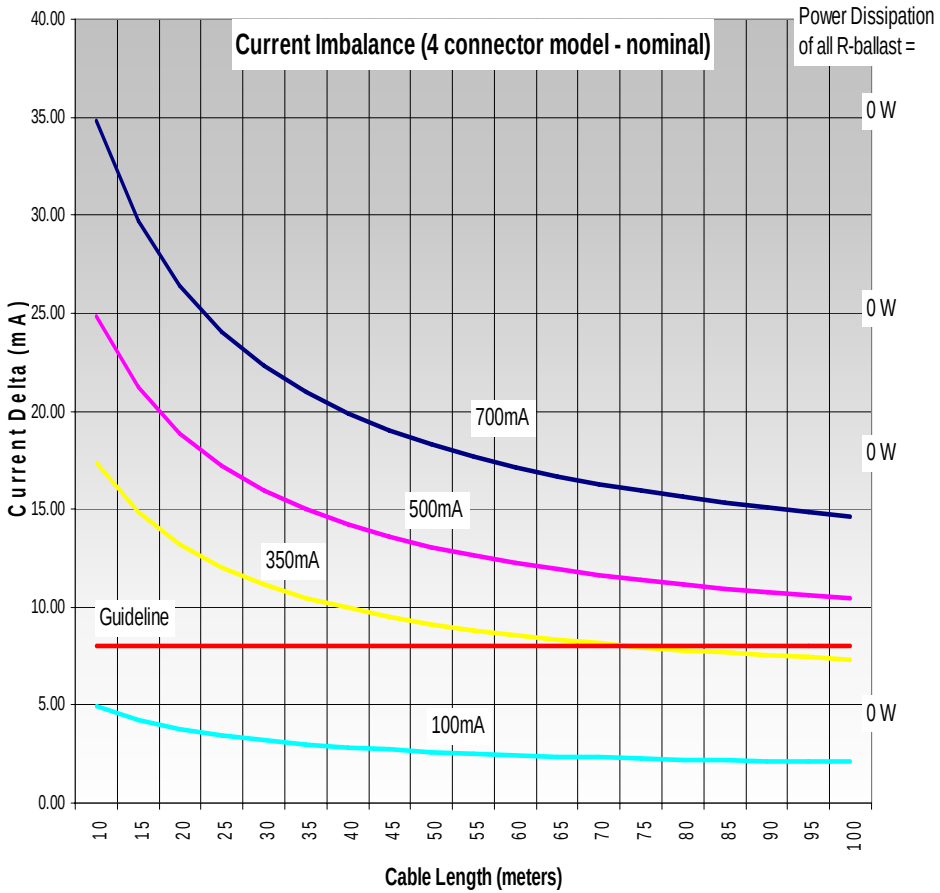
R_{HC} between pairs can be 1% different

With-in a Pair Analysis

$R_{ballast} = 0\ \Omega$

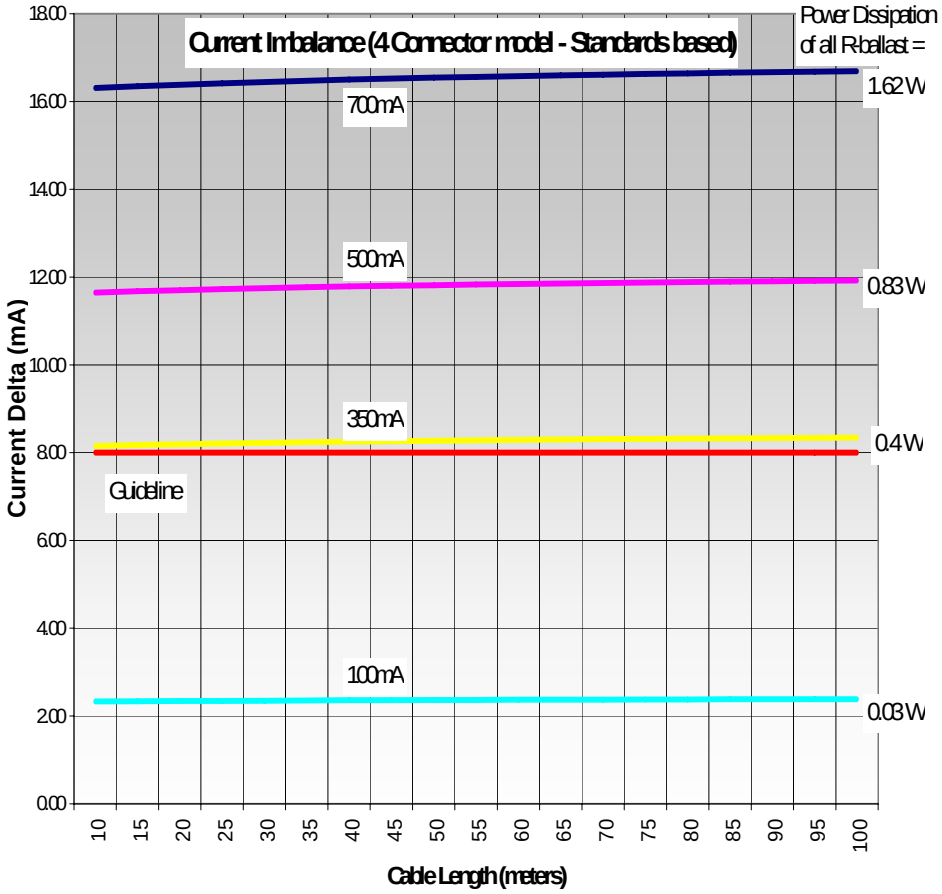


$R_{ballast} = 0\ \Omega$

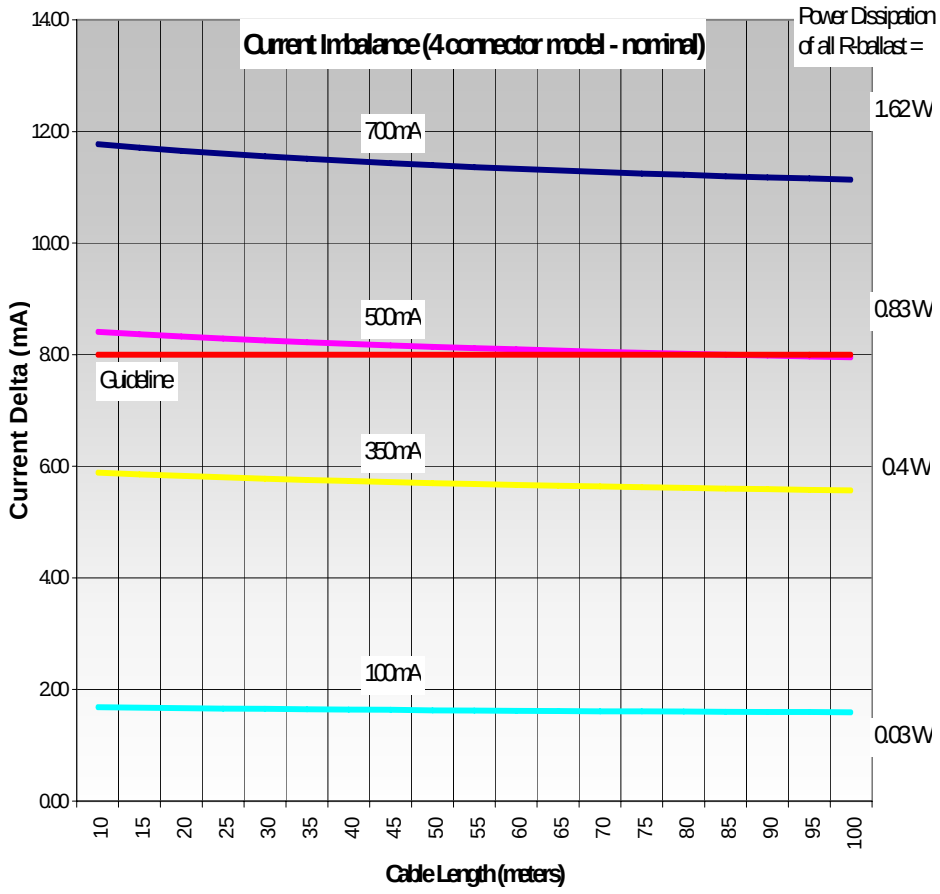


With-in a Pair Analysis

$R_{ballast}$ = 3.3 Ω

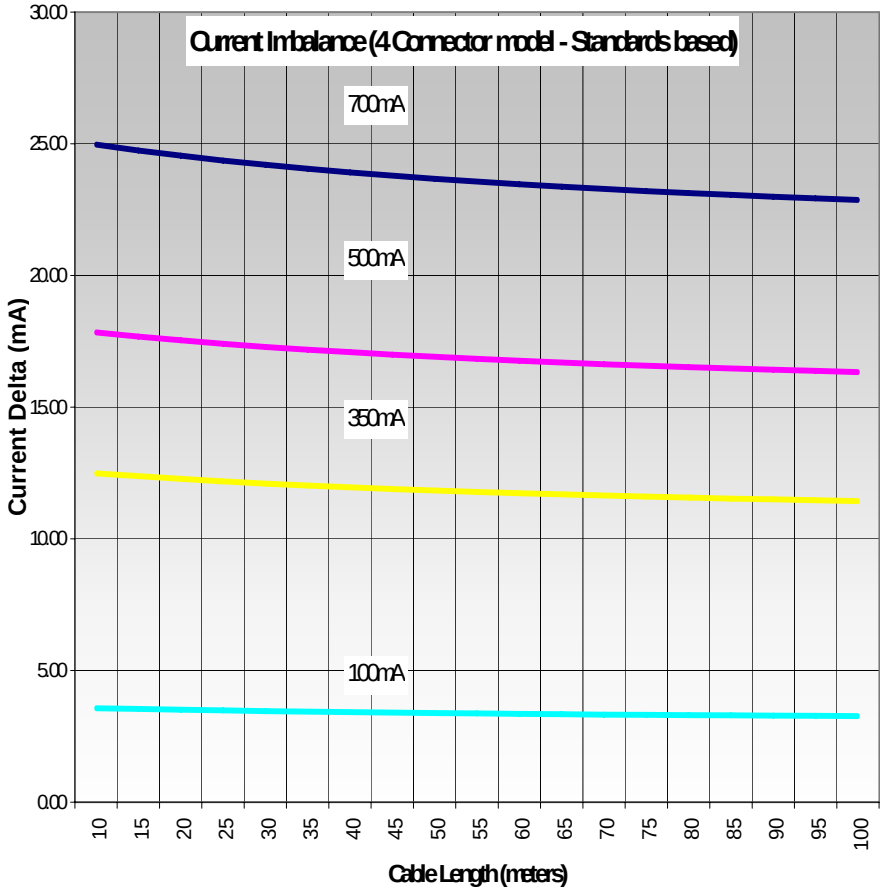


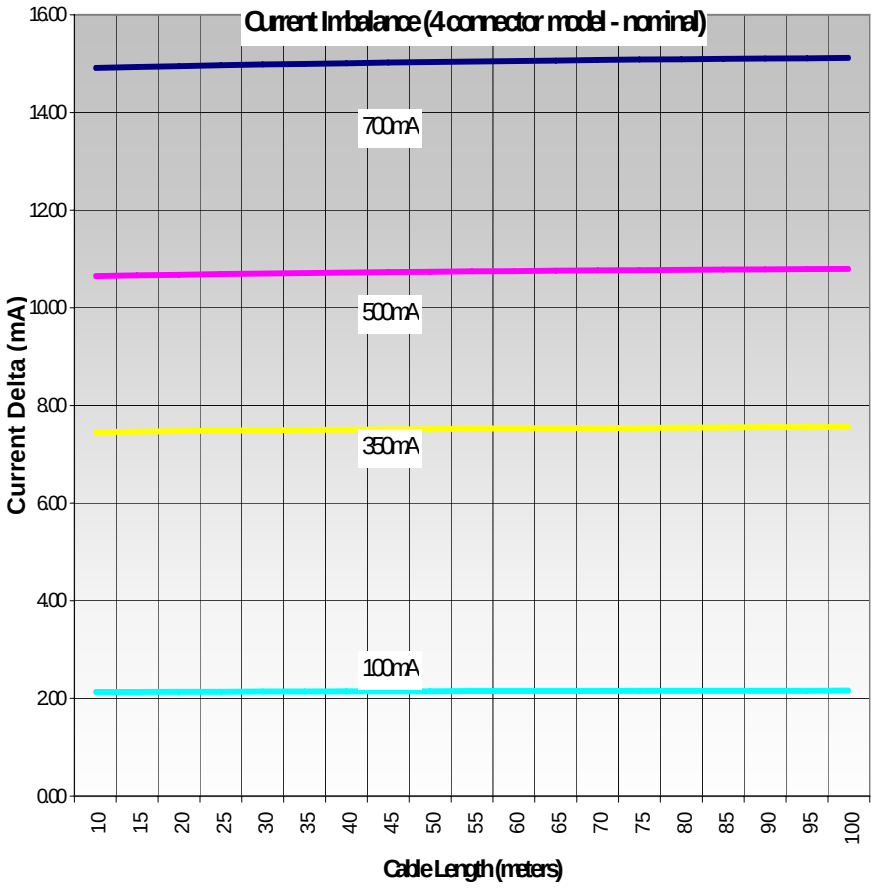
$R_{ballast}$ = 3.3 Ω



Pair to Pair Analysis

$R_{ballast} = 3.3\ \Omega$





Assumptions that we must agree upon:

1.) Maximum imbalance (or saturation) current in the transformer.
- I used 8 mA, can we get by with 12 mA?

2.) Maximum current per wire pair.
- 420 mA? (which means a launch of about 45 W from PSE)
(210 mA per wire)

3.) Cabling ad-hoc sub-team should set the values that the model requires and support them through measurement verification.

Note that if the per pair current is limited to about 500 mA, balance within a pair as well as between pairs can be accomplished simply with the use of passive ballasting resistors – a Power dissipation penalty exists however.

SUMMARY:

- **key model parameters need to be agreed too prior to concluding current balance issues**
- **recommend that the cabling ad-hoc group take this on as a work item**