Cable Temperature Rise from Power Over Ethernet Applications

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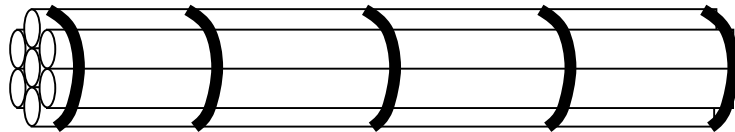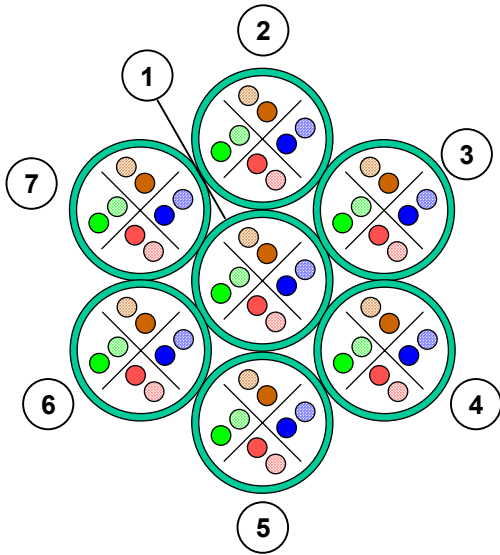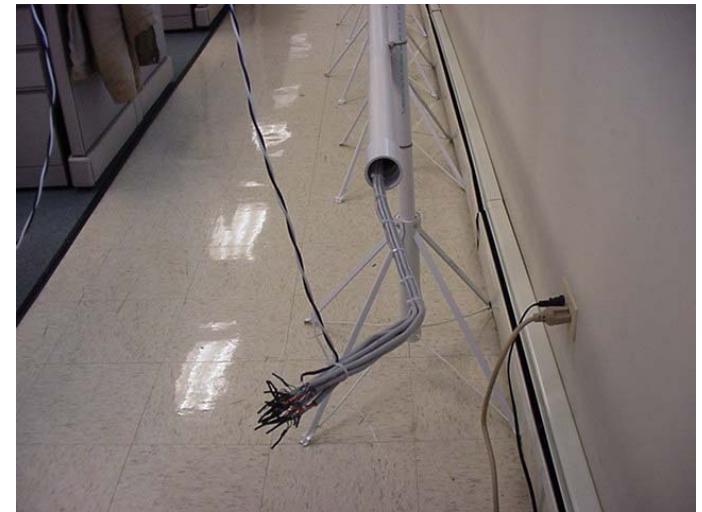Rick Rago
Panduit Corp.

Objectives:

- To quantify the temperature rise above ambient of Cat 5e 24 AWG cable when PoE Power is applied for 2 pair and 4 pair systems

- Develop design curves of temperature (rise above ambient) versus Current
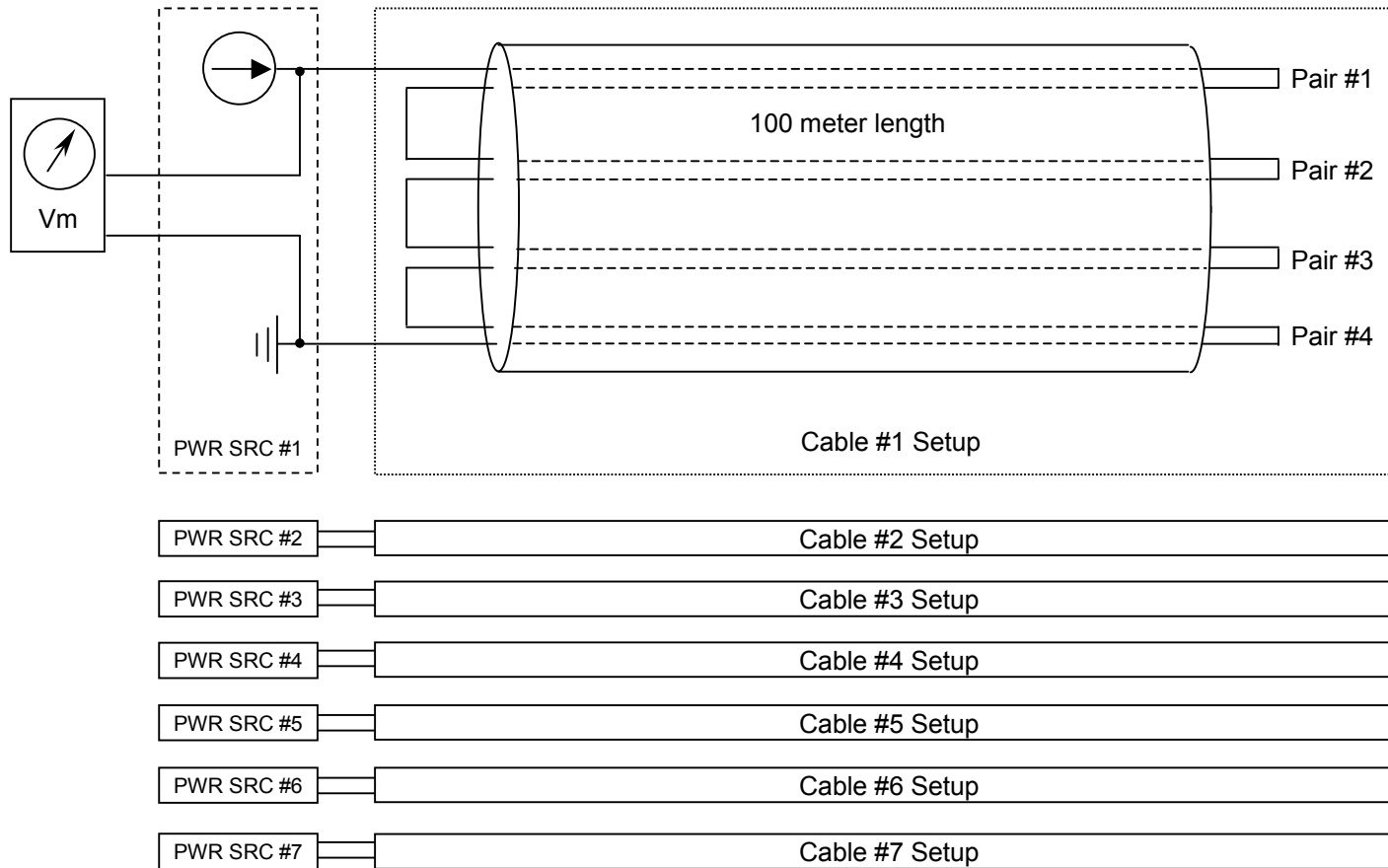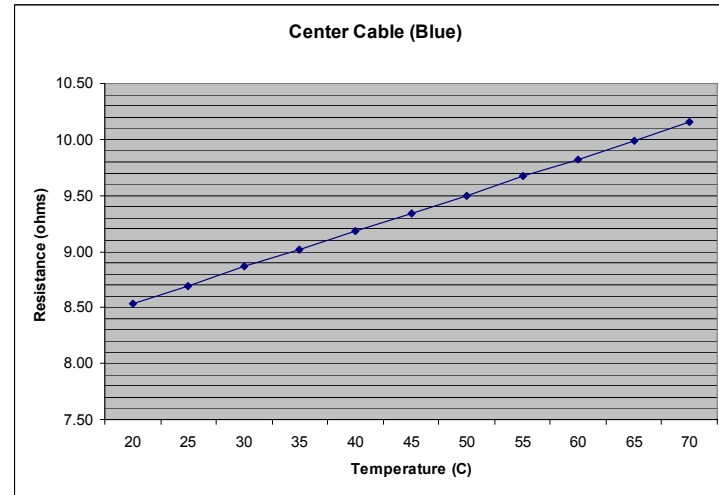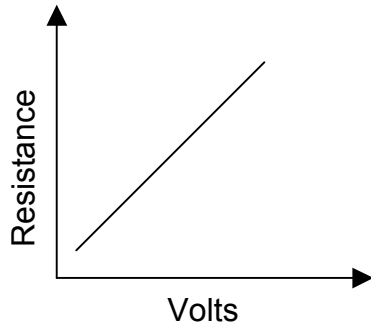
Experimental Setup
(6 cables surround 1 cable)

Experimental Setup

Measurements (with constant current)

Center Cable (Blue)

Thermal Resistance (R_Θ)
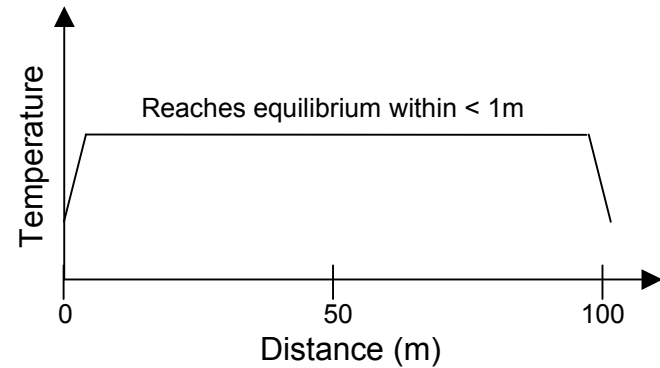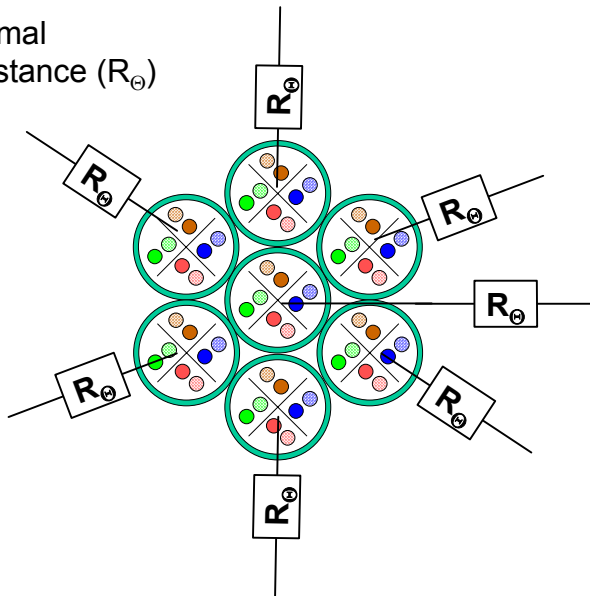
Reaches equilibrium within < 1m

Results

(Current transmitted on all 4 pairs in all 7 cables in open air configuration)

Cat 5e 24 AWG, R=8.5 Ohm@20C, Rt:0.14,current on 4 pair

Legend:
- CableWithstand:60C
- Cable Withstand:65C
- Cable Withstand:70C
- Cable Withstand:75C

X-axis: Max Ambient temperature [Deg-C]
Y-axis: Current [Amper]
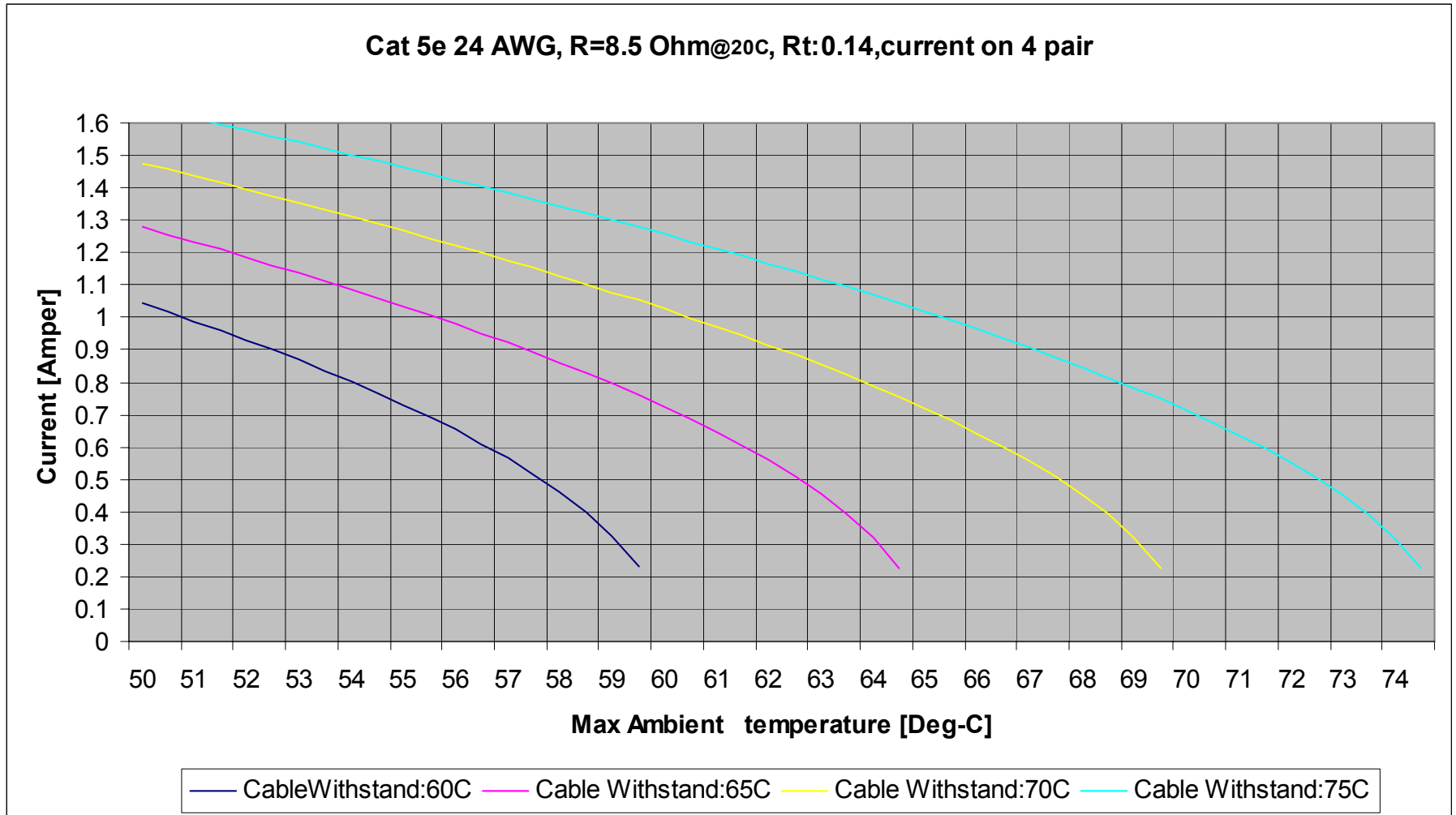
Results

(Current transmitted on 2 pairs in all 7 cables in open air configuration)

Cat 5e 24 AWG, R=8.5 Ohm@20C, Rt:0.19, current on 2 pair

Legend: CableWithstand:60C — Cable Withstand:65C — Cable Withstand:70C — Cable Withstand:75C

X-axis: Max Ambient temperature {Deg-C}
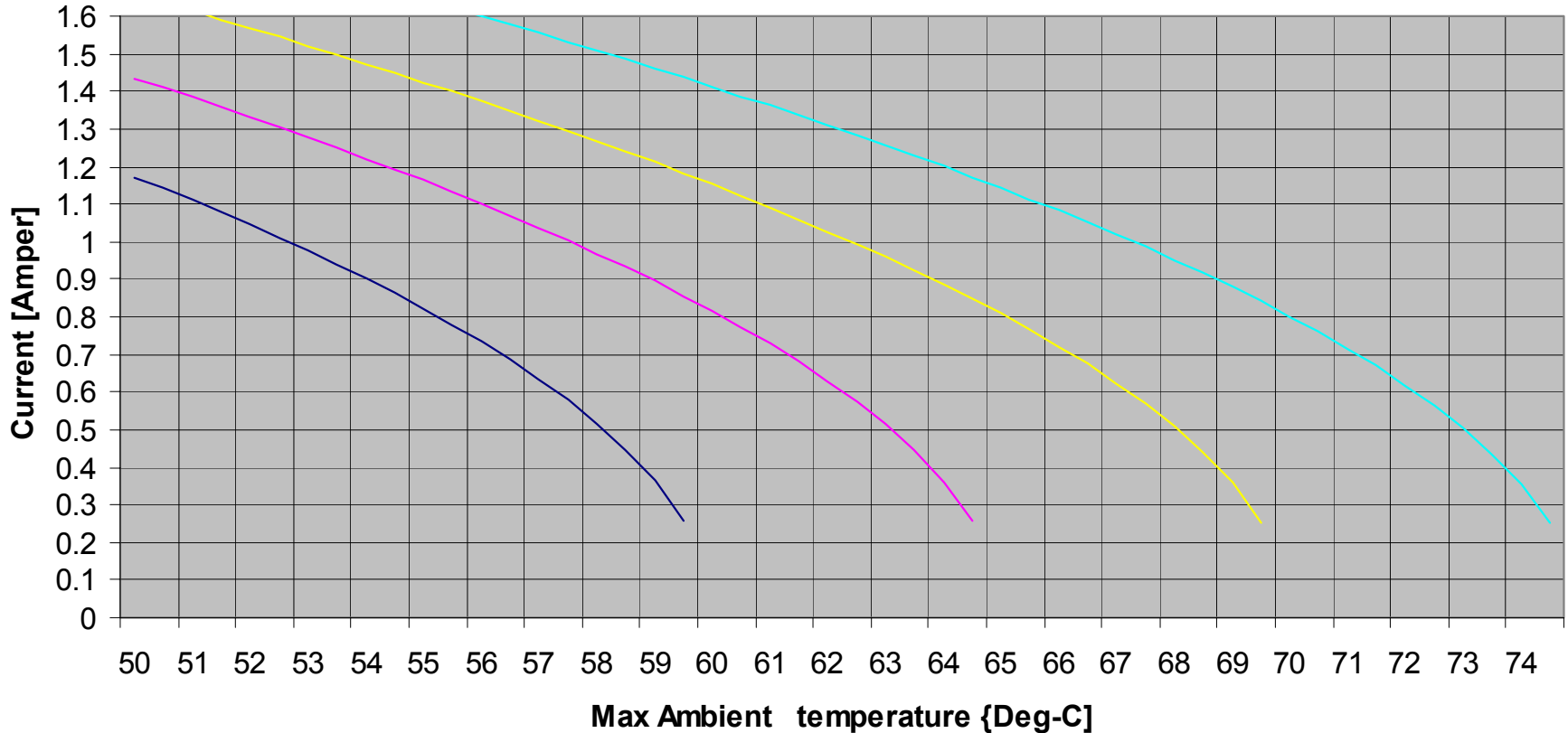Y-axis: Current [Amper]

Results

(Current transmitted on all 4 pairs in all 7 cables in PVC pipe configuration)

Cat 5e 24 AWG, R=8.5 Ohm@20C, Rt:0.34(on the center cable), 6 around 1 in the PVC pipe, current on 4 pair

Legend:
— CableWithstand:60C — Cable Withstand:65C — Cable Withstand:70C — Cable Withstand:75C

X-axis: Max Ambient temperature [Deg-C]
Y-axis: Current [Amper]

Results

(Current transmitted on 2 pairs in all 7 cables in PVC pipe configuration)
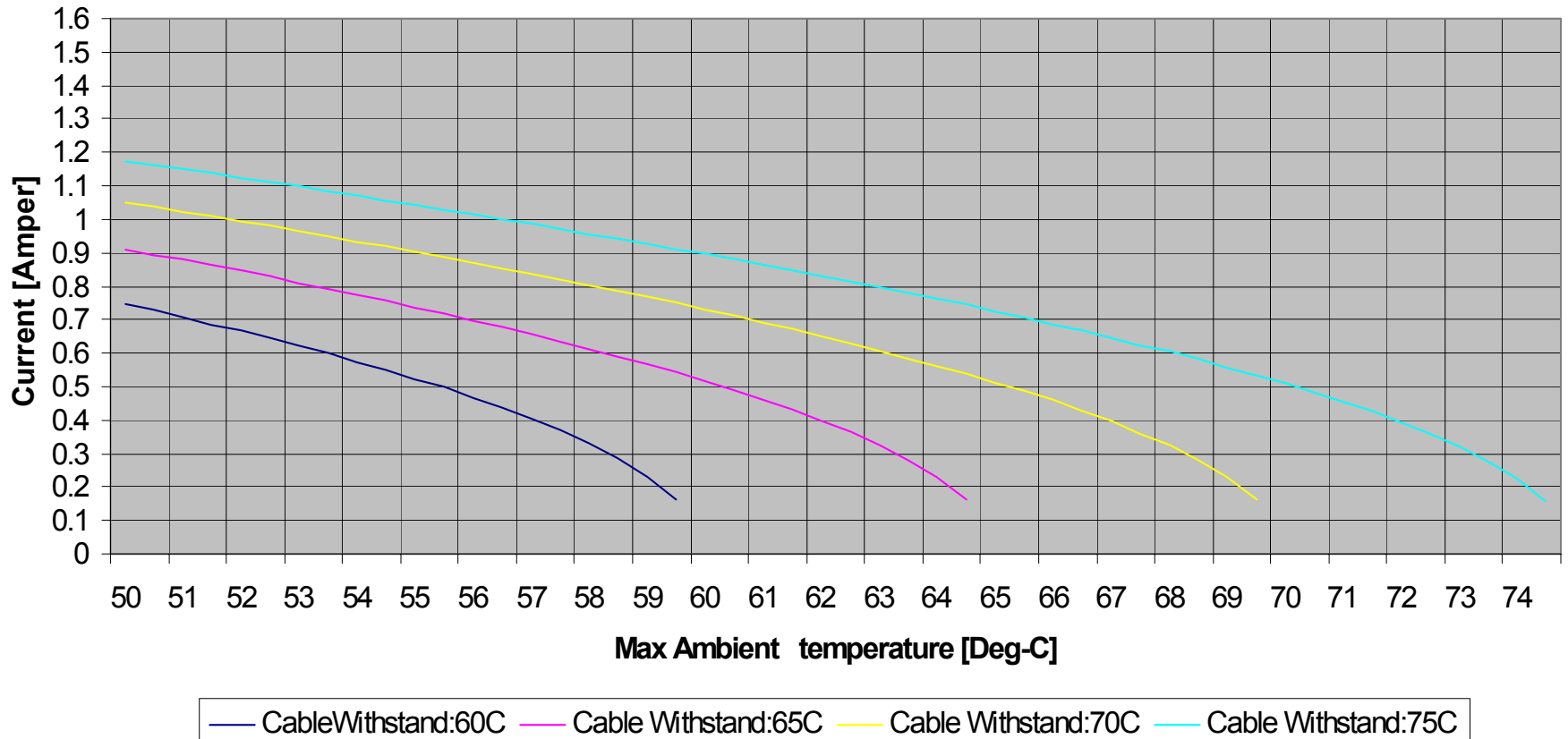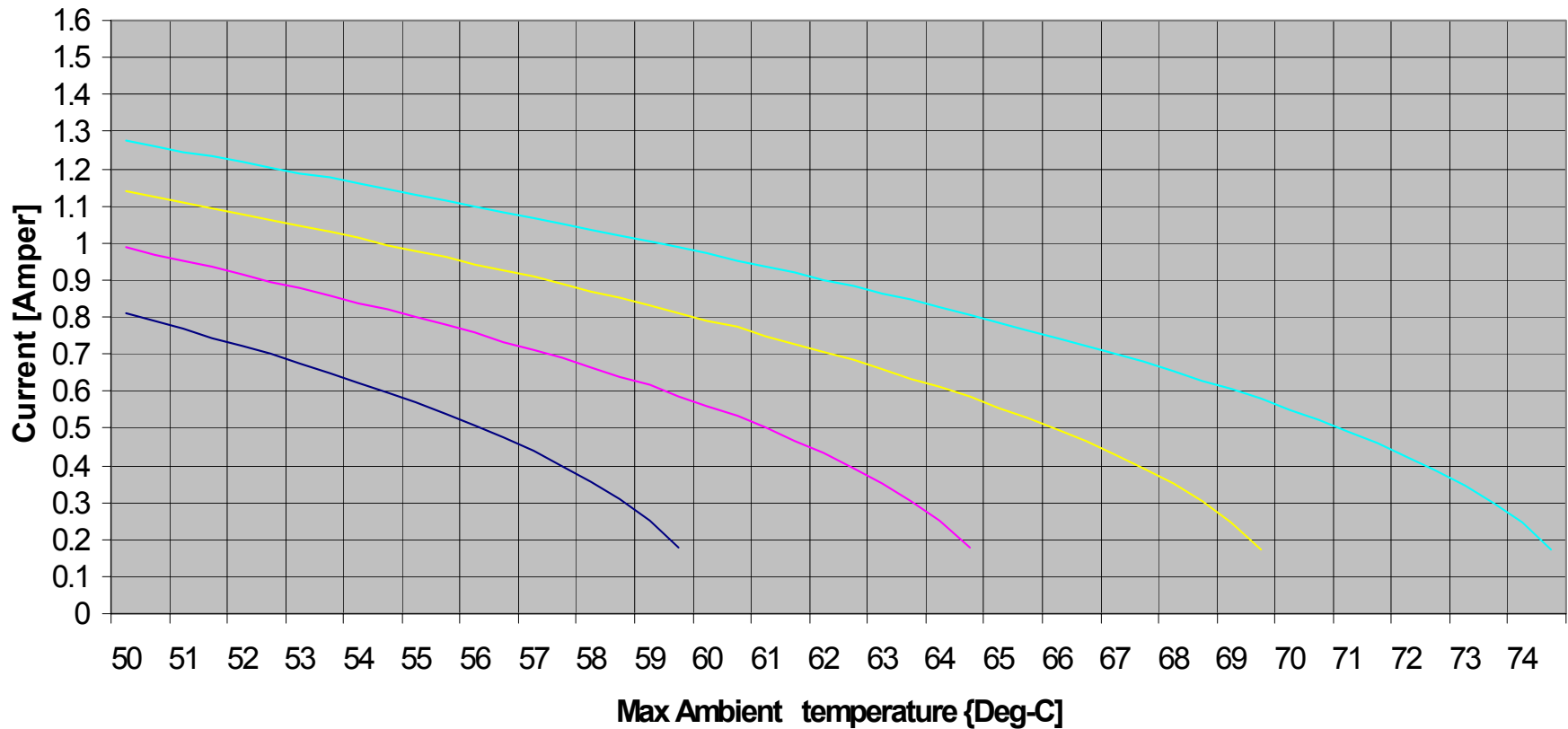

Cat 5e 24 AWG, R=8.5 Ohm@20C, Rt:0.29, 6 around 1 in the PVC pipe

Legend:
- CableWithstand:60C
- Cable Withstand:65C
- Cable Withstand:70C
- Cable Withstand:75C

X-axis: Max Ambient temperature {Deg-C}
Y-axis: Current [Amper]

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PoE-Plus Study Group

Summary:

- Thermal Resistance of worse case cable to ambient:
  - R_θ = 0.14 $^\circ$C/W (for 4 pair current transfer with cable in air)
  - R_θ = 0.19 $^\circ$C/W (for 2 pair current transfer with cable in air)
  - R_θ = 0.29 $^\circ$C/W (for 4 pair current transfer with cable in PVC pipe)
  - R_θ = 0.34 $^\circ$C/W (for 2 pair current transfer with cable in PVC pipe)
- Cable Temperature Rise above ambient:
  - ΔT = 2 $^\circ$C (for 4 pair current transfer with cable in air)
  - ΔT = 7.5 $^\circ$C (for 2 pair current transfer with cable in air)
  - ΔT = 4.5 $^\circ$C (for 4 pair current transfer with cable in PVC pipe)
  - ΔT = 15.5 $^\circ$C (for 2 pair current transfer with cable in PVC pipe)
- PoE power transfer efficiency (at 48 V)

	Cable-res [Ohm]	Curr. [A]	P-cable [W]	P-load [W]	Efficiency [%]
2-pair	9	0.35	4.41	33.6	88.40
4-pair	9	0.5	18	96	84.21
2-pair	9	1	36	96	72.73

Next Step …

Recommendation to utilize all 4 pairs for PoE Plus
- less temperature impact
- less power dissipation (better transfer efficiency)