

PoE Plus

# CAT-5 Cable Bundle Heating Experiment

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## PoE Plus-Cable Heating Experiment

- Want to understand heating of a cable bundle embedded in a “typical” wall.
- Is temperature at center of bundle a problem?
- Does 2 pair or 4 pair have different thermal performance?
- How much current can be carried safely?

# PoE Plus-Cable Heating Experiment

## DISCLAIMER

- I'm not an expert in cabling systems.
- Linear Technology has no involvement with cabling systems.
- I am reporting results of an experiment.
- I am suggesting an approach to the cable heating problem that might be useful.
- I am hoping that cabling experts will take over and drive this issue to conclusion.

# PoE Plus-Cable Heating Experiment

## Experiment

- Typical wall was simulated using 2x4s and drywall.
- Cat-5 bundle was simulated with a 100M cable tied in a bundle configuration.
- Insulation was installed on top and bottom so that most of heat transfer was out through drywall or out through 2x4s.
- Current was driven through Cat-5 cable, simulating either 2 pair or 4 pair configuration.
- Temperature of cable bundle core was measured as a function of current.

# PoE Plus-Cable Heating Experiment

## Simulated Wall



Wall in Test Position



Wall Internal Design

# PoE Plus-Cable Heating Experiment

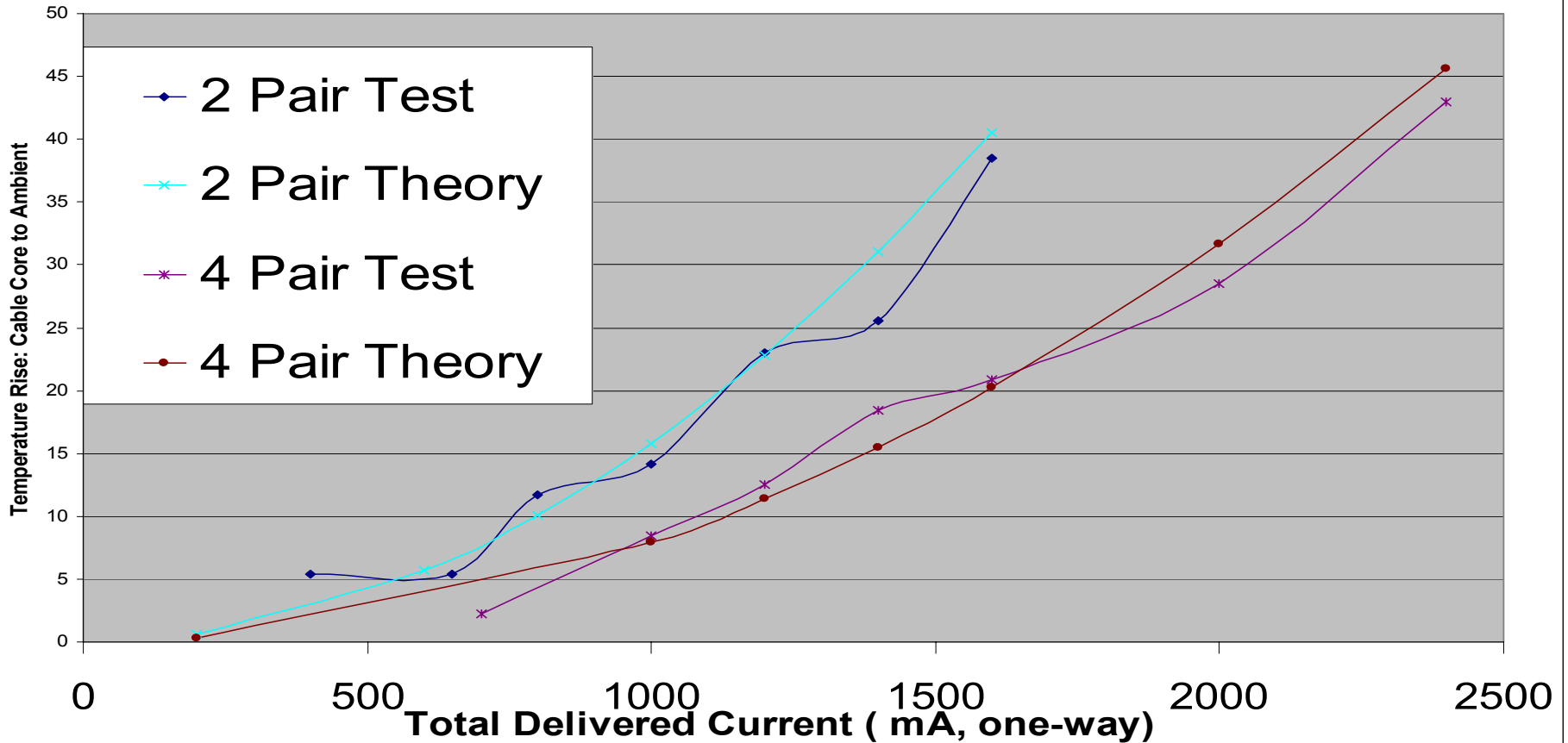
## Results

- It became obvious that from a thermal standpoint, cable bundle in wall was equivalent to a resistor in the wall.
- 100M Cable resistance was  $9\Omega$  per conductor, i.e. 2-pair loop  $R=9\Omega$ ; 4-pair loop  $R=4.5\Omega$
- From test data, can estimate thermal coeff. of wall to be  $\sim 1.8\text{ }^{\circ}\text{C/W}$  (see graph).

# PoE Plus-Cable Heating Experiment

## Cable Bundle Temp Rise vs. Delivered Current

Test Data and Theory (based on ThetaJA)

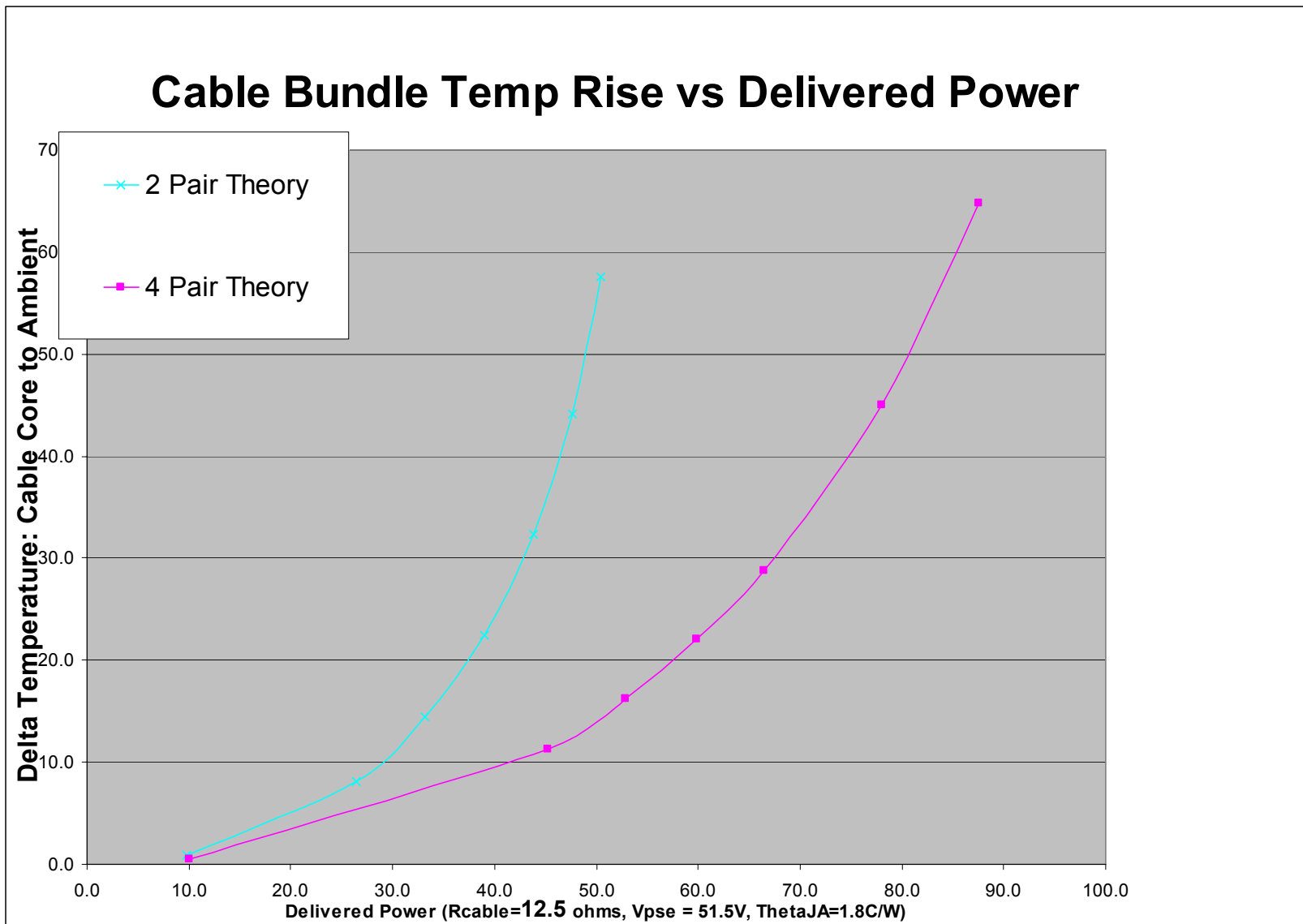


$\Theta_{\text{core-ambient}} \sim 1.8 \text{ C/W}$

For given current, 2-pair 2x temp rise

For given heating, 4-pair carries 1.4x current

# PoE Plus-Cable Heating Experiment





## PoE Plus-Cable Heating Experiment

With this information can calculate maximum power

For example:

- Assume cable heating is limiting parameter for PoE Plus.
- Assume maximum cable temperature is 65°C.
- Assume maximum allowable ambient temperature is 120°F = 49°C.
- Allowable temperature rise is 65-49 = 16°C.
- Based on this experiment:
- Using 2 pair, maximum delivered power is ~35W.
- Using 4 pair, maximum delivered power is ~52W.

# PoE Plus-Cable Heating Experiment

## Work To Be Done

- Define worst-case cable-bundle installation
- Build model of worst-case installation
- Repeat this experiment on worst-case model
- Derive thermal coefficient of installation
  
- Need to also define highest ambient temperature
- Need to confirm maximum allowable cable temperature, 60C or 65C?
  
- With this information, can calculate maximum allowable current.