



UTP Cable Modes

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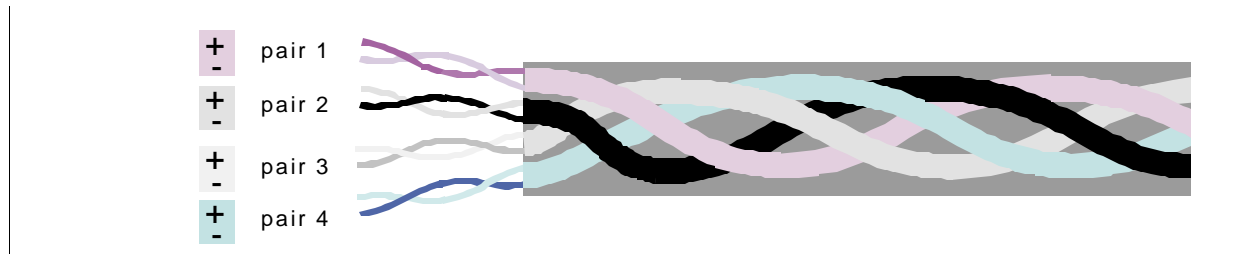
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Cable Mode Terminology

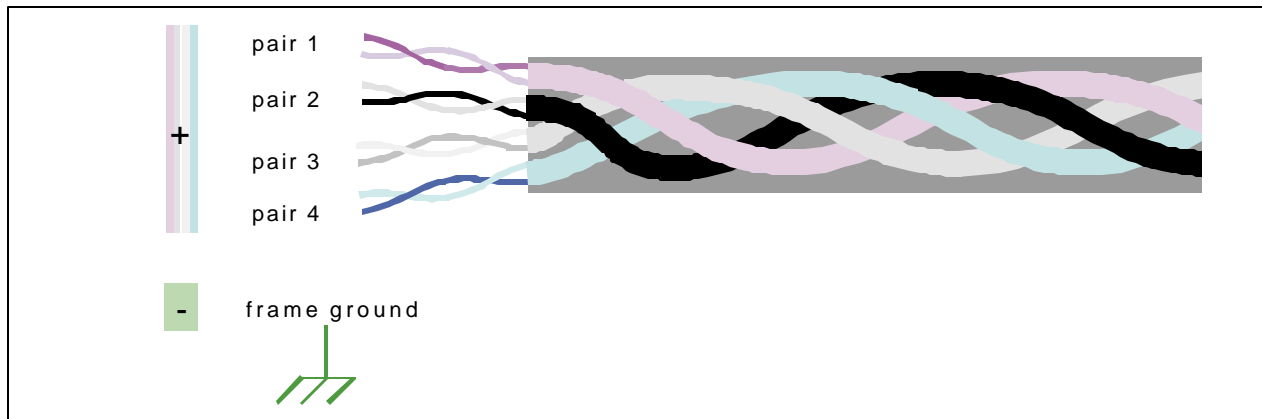
- **Differential mode**

- within a given twisted pair



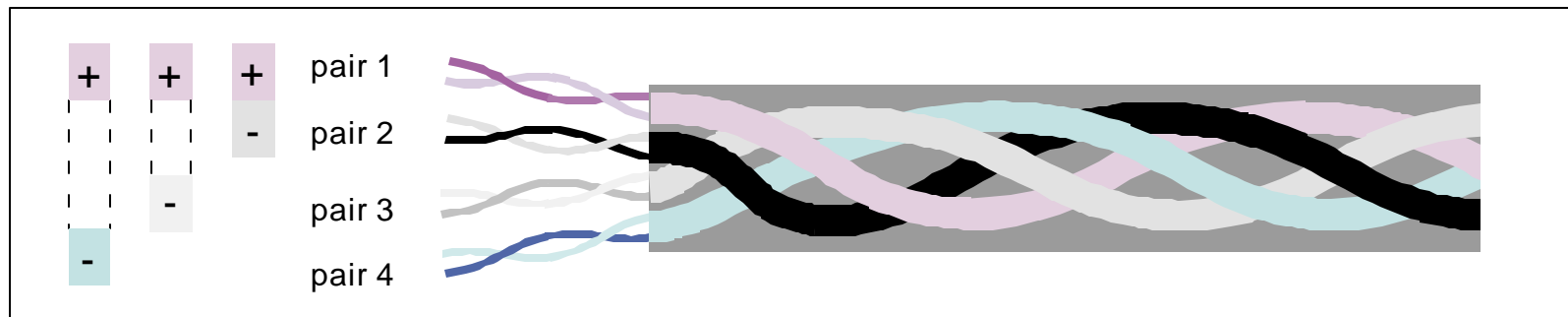
- **Common mode**

- a signal that is common to all wires within a cable



Cable Mode Terminology

- **Pair to Pair mode**
 - a signal from one twisted pair to another twisted pair

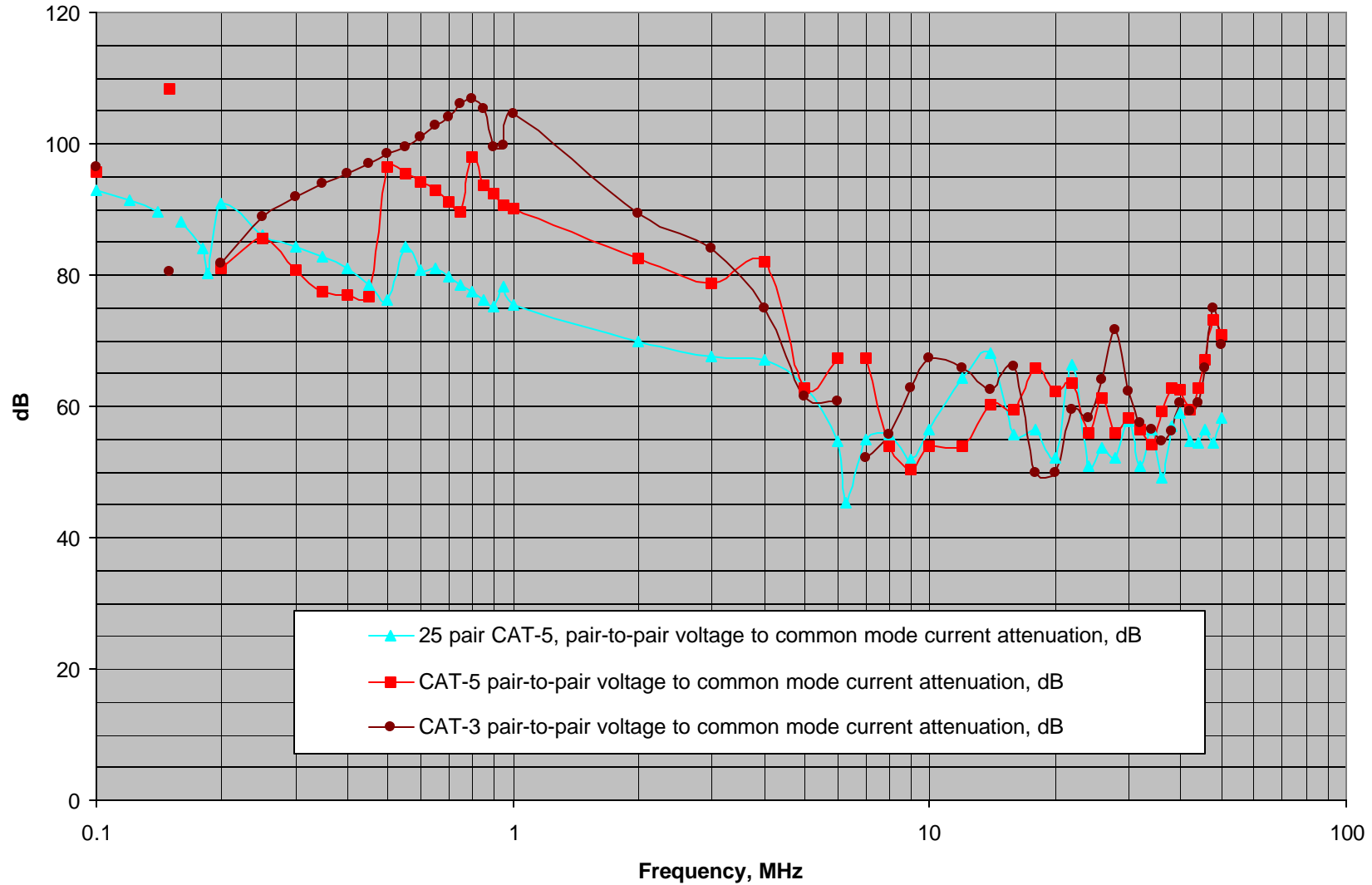


The Pair to Pair Mode

- There is no specification for Pair to Pair Mode in CAT-3 and CAT-5 cables.
- Discovery and DTE power are driven in the pair to pair mode
- We care because signals and noise in the pair to pair mode can interfere with data links, and create conducted and radiated emissions
- In this empirical approach, I measure how the pair to pair mode couples into the common mode
- I have looked at CAT-3, CAT-5, and 25 pair CAT-5, the graphs follow
- First, I inserted a sine wave driving the pair to pair mode on 100 meter lengths of cable, and then I recorded the common mode current produced at each frequency. In all cases, common mode terminations were present at both ends of the cable
- I also recorded the pair to pair voltage level that caused an observable 100Base-TX link degradation on a long CAT-5 cable. This shows that “3 fingers”

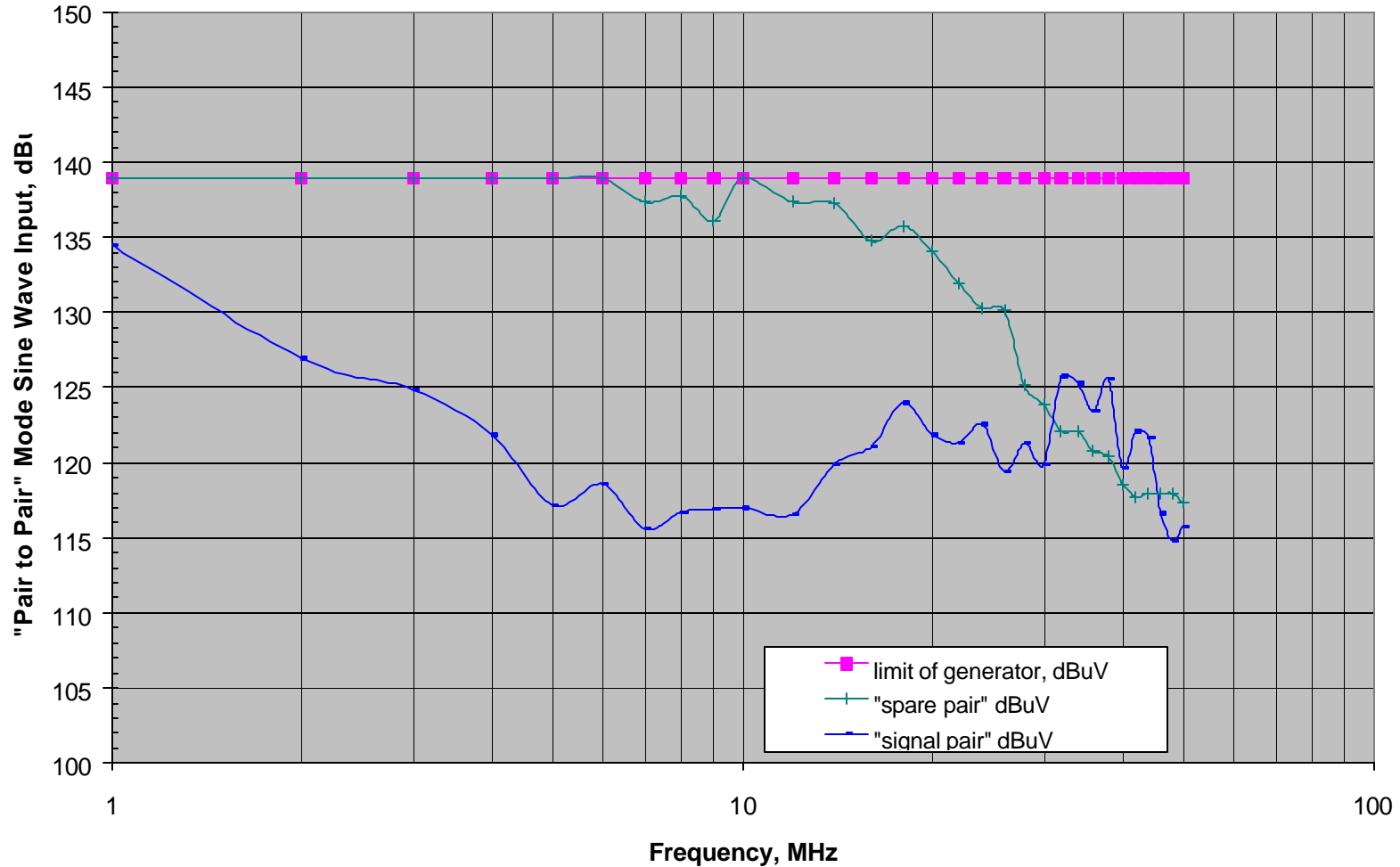
CAT-3, CAT-5, and 25 pair CAT-5 Mode Coupling

Comparison of "pair to pair" mode voltage to common mode current coupling in CAT-3, CAT-5, and 25 pair CAT-5 100 meter cables



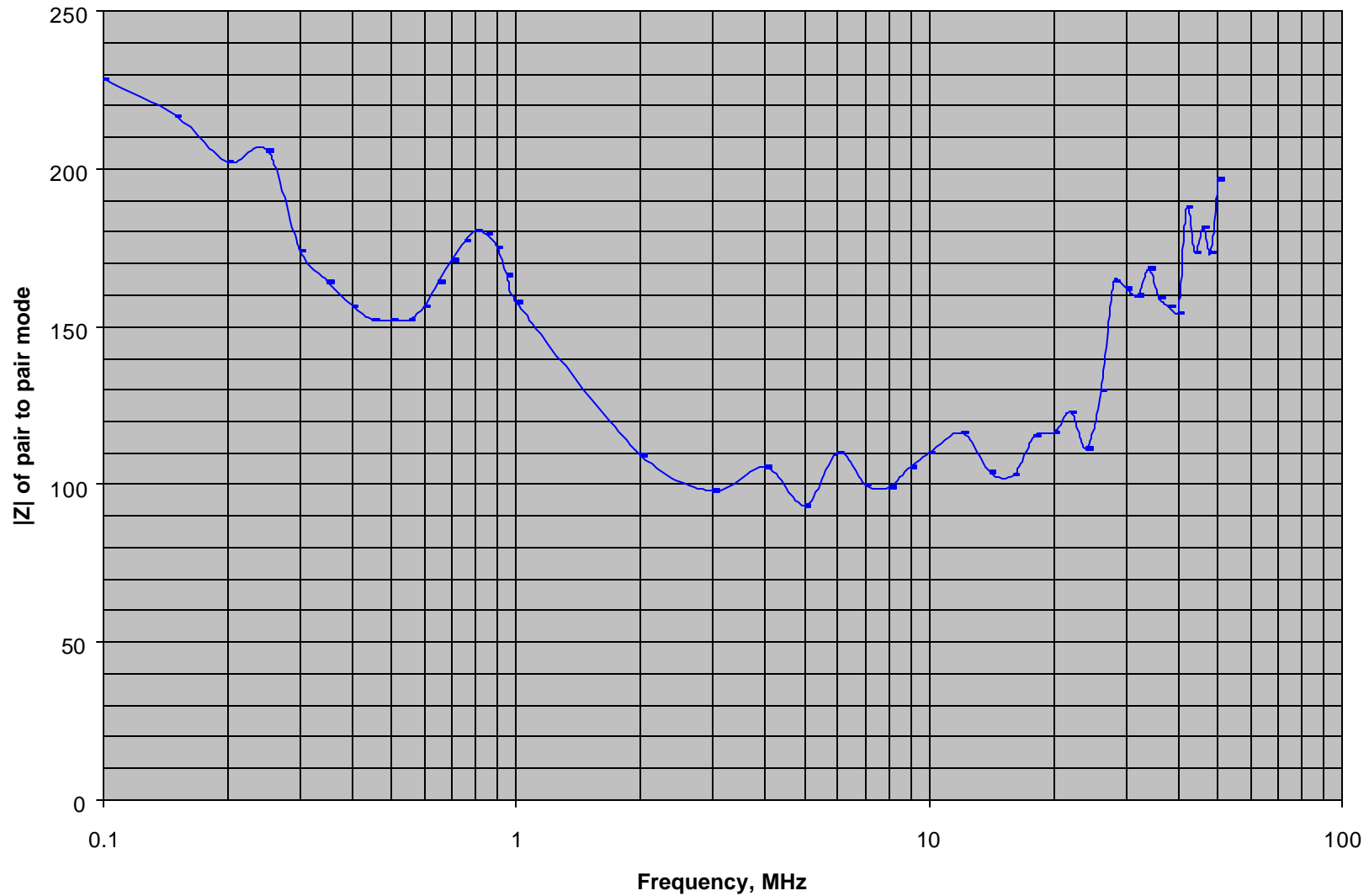
The Famous "3 Fingers", spare pair and signal pair

Signal Pair and Spare Pair comparison threshold of 100Base-T degradation
on a marginal 130 meter CAT-5 link
Sine wave generator was hooked between 1,2 and 3,6 for the "signal pair"
Sine wave generator was hooked between 4,5 and 7,8 for the "spare pair"



Pair to Pair Mode Impedance, common mode termination at both ends

Pair to Pair Mode Impedance (magnitude), 130 meter CAT-5



Summary

- **Like the differential mode, the pair to pair mode does not couple well into the common mode**
- **Here is a summary of what I've measured:**
 - I have looked at CAT-3, CAT-5, and 25 pair CAT-5
 - CAT-6 has also been measured, as expected, it has lower coupling from the pair to pair mode into the common mode compared with the other cables tested
 - The pair to pair mode seems fairly well controlled and predictable in the cables that I've measured
 - The lower the frequency, the lower the coupling from the pair to pair mode to the common mode
 - The reverse is true; as the frequency is increased, the mode coupling increases
 - Above 5 MHz, this attenuation factor is greater than about 45 dB
 - Below 1 MHz, this attenuation factor is greater than 70 dB
- **We care primarily because of noise on the DTE power supply**