Power Supply Noise
or
“Terms of Impairment”

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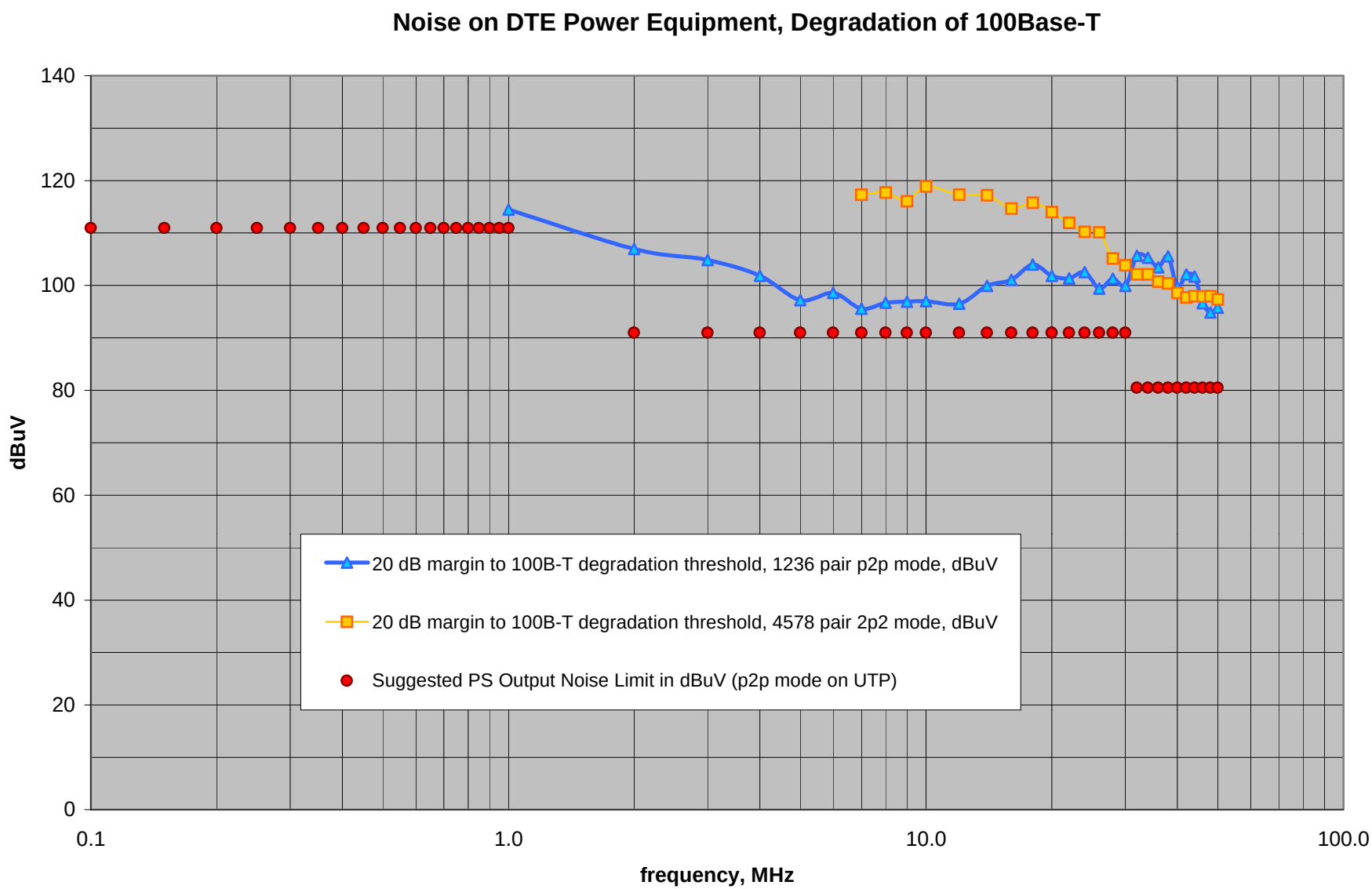
Power Supply Noise In General - Conducted Emissions and Link Degradation

- **Definition of Terms**
- **Common Mode:**
  - signals that are measured with respect to frame ground
- **Pair to Pair Mode:**
  - signals that are common on one pair of the UTP cable and are measured from one pair set to another pair set within the UTP cable
  - The differential output noise of the DTE Power Supply produces a Pair to Pair mode on the UTP cable
- **Differential Mode:**
  - signals within a given pair of the UTP, and are measured from one wire within a pair, to the other wire within that pair
- **Mode Conversion:**
  - Imperfect or non-ideal cable construction causes signals propagating in one mode of the UTP cable to couple into another mode. Transformers, receivers, transmitters, and PC board layout can also have or cause coupling.
  - To a first order, the following modes show coupling:
    - differential mode to common mode — compliance issue
    - pair to pair mode to common mode — compliance issue
    - pair to pair mode to differential mode — data impairment issue

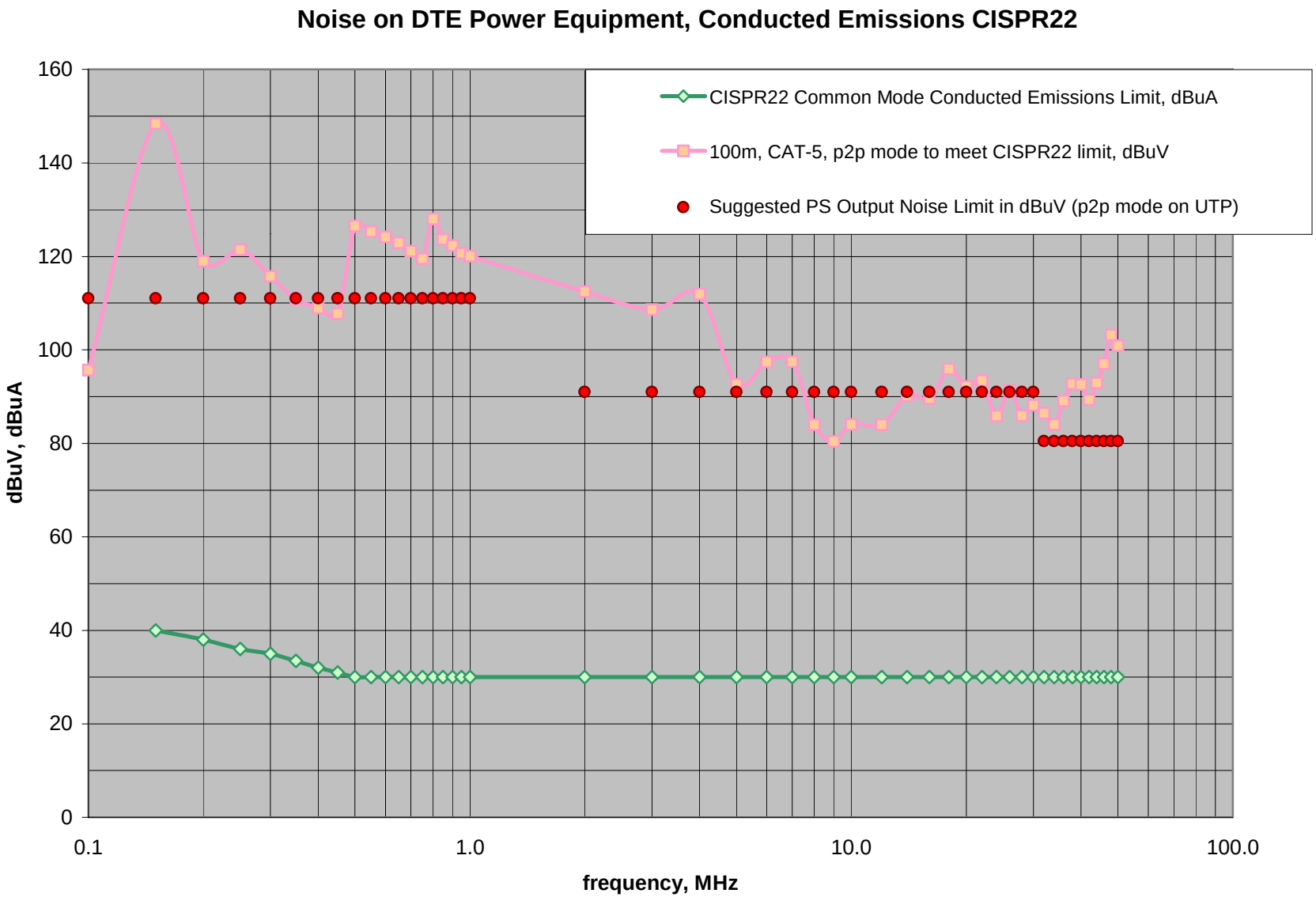
- **Power Supply noise, in either the pair to pair mode, or in the common mode, can cause data transmission impairment by coupling into the differential mode**

- **Power Supply noise in the pair to pair mode can also couple into the common mode, or the Power Supply can actually generate common mode signals directly**

Power Supply Noise Relating to 100Base-TX Degradation (Long Cable)



Power Supply Noise Relating to Conducted Emissions per CISPR22



Power Supply Noise and Slew Rate

- **The output noise of the DC power at the RJ-45 port should not exceed the following values as a starting point**

Frequency	**Maximum Pair to Pair Noise at the RJ-45, PSE and PD**
1 MHz and below	**110 dBuV rms**
>1 MHz to 30 MHz	**90 dBuV rms**
>30 MHz	**80 dBuV rms**

- **Slew Rate (see the separate paper that describes the method):**
- **The maximum slew rate of voltage and current should be specified.**
  - To prevent impairment of the data
  - Keep the UTP cable, PSE, PD connection acting as a lumped load to promote stable behavior of the power control loops and to prevent transmission line ringing
  - Minimize the interaction between ports

- **Maximum voltage slew rate at the RJ-45, PSE and PD**

  3.5 volts/us

- **Maximum current slew rate at the RJ-45, PSE and PD**

  35 ma/us

Power Supply Noise Methods and Disclaimer

- **The data shown in this paper were taken using the Nortel Discovery Prototype proof of concept. The original information was presented at the November 2000 plenary in Tampa FL**

See: http://www.ieee802.org/3/af/public/nov00/index.html for the papers presented by Rick Brooks for more information

- **There is no theoretical basis for determining the maximum allowable noise for DTE power, since there is no specification on UTP cable for mode conversion.**

- **This paper used an empirical approach to determine the maximum allowable noise based on two constraints.**
  - Do not interfere with 100Base-TX data on a long (130m to 140m) CAT5 cable, then add a 20dB margin to this measurement
  - Do not create a conducted emissions issue (technically outside the 802.3af scope)
    - start with CISPR22 limit in dBuA, then add the measured “pair to pair” (p2p) to common mode conversion ration, in dB to obtain a “pair to pair” mode noise in dBuV

- **The IEEE802.3af spec should cover what it take to not interfere with the data, compliance issues are outside of the scope of the standard.**

- **Since this paper is only one data point, the conclusions presented here should be verified through separate means by others**