Category 8 Cabling Demonstration

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  - **Shadi AbuGhazaleh, Hubbell**
  - **Andrew Jimenez, Anixter**
  - **Tim West, Superior Essex**

Category 8 Cabling Demonstration

- This contribution is being made to show the technical feasibility of a cabling system as follows:
  - Two RJ-45 connectors
  - Balanced twisted-pair cables with the traditional four pairs
  - Transmission performance per TIA category 8 draft standard 0.5
- It is expected that the study group will use the technical feasibility of the cabling system to further develop technical feasibility of 40G transmission.
- Broad market potential is supported by the use of the 8-pin modular (commonly known as RJ-45) connector.
- Compatibility, for auto-negotiation, is facilitated by the use of the RJ-45 connector, that is currently defined for lower speed Ethernet applications.

Category 8 Cable Development Process

- Starts with a design concept
- Known design parameters such as R, G, L, and C are used to size the construction for targeted transmission performance
- Known empirical design parameters such as materials and twist lengths are selected
- Prototypes are made to explore design options and the transmission performance is compared with the expected results for all parameters
- Several iterations are needed to refine the design until the desired results are achieved
- The results presented here are not a final iteration and further improvements are anticipated

Test Summary
Category 8 F/UTP cable

•F/UTP Cable uses outer shield but does not have individually shielded pairs

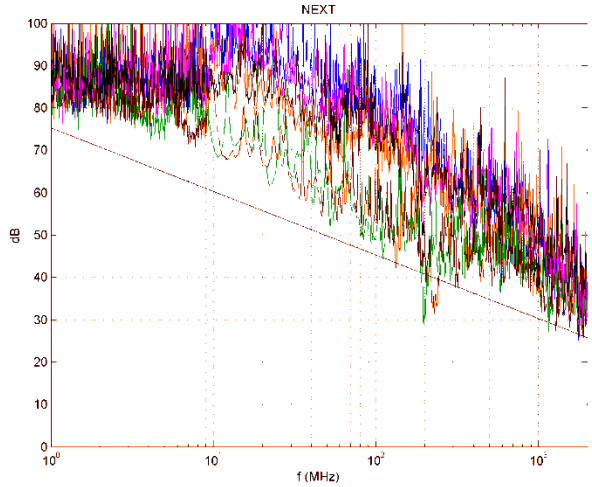
•Cable is round with a diameter less than 0.300” (<7.62 mm)

•Good progress has been made to establish smooth transmission performance up to 2000 MHz

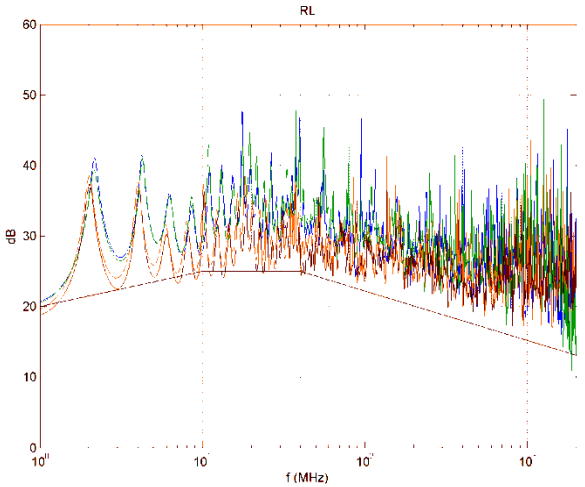
•The NEXT spike at 200/250MHz is a known and understood cable design parameter that will be addressed in the next prototype iteration

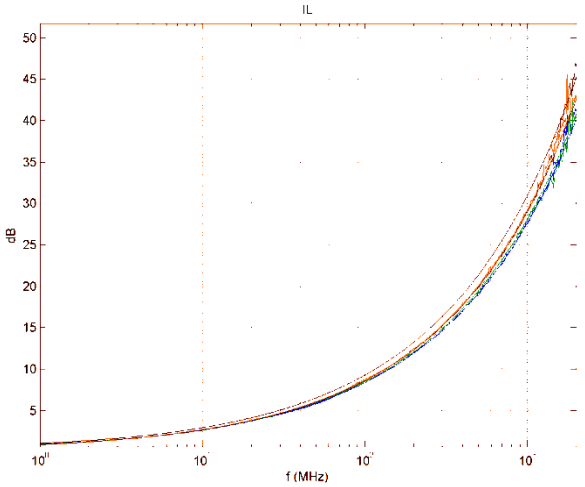
•The low frequency RL margin is known to be related to impedance centering. This prototype was slightly above 100 Ohms. The next prototype will be adjusted.

•The high frequency IL roughness is due to known process parameters that will be addressed in future prototypes



Category 8 Prototype Cable Performance measured to 2000 MHz (50 meter length)





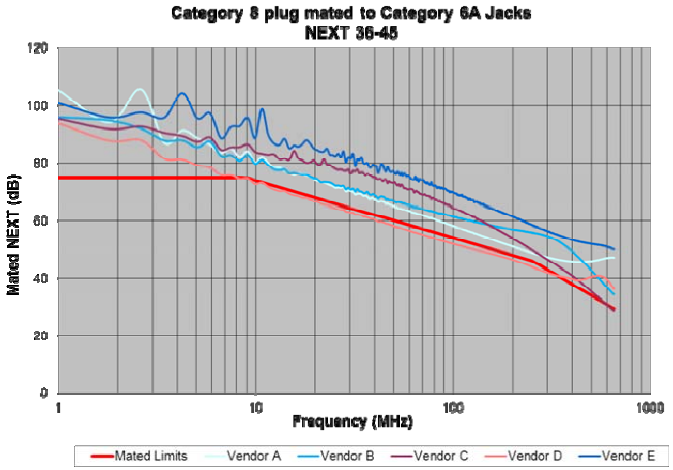
Category 8 Connector Development Process

- Starts with a design concept
- Simulation software is used to determine the transmission performance of a “plug-jack” connection modeled as a cascaded network of 3D coupled transmission line sections
- A prototype is made and the transmission performance compared with the simulation results for all parameters
- Several iterations are needed to refine the design until the desired results are achieved
- The results presented here are for a second iteration. It is not yet the final design

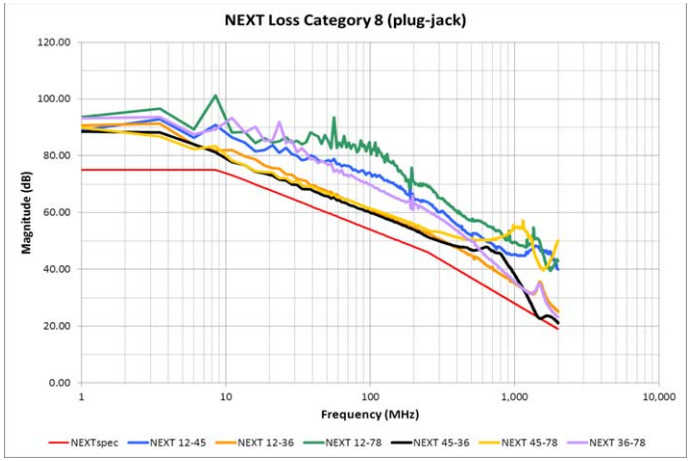
Test Summary
Category 8 modular (RJ45) connecting hardware

Backward compatibility for a mated plug-jack connection

In addition to measuring a mated Category 8 plug-jack connection, we also measured the performance of a Category 8 plug with five different vendors Category 6A jacks. The results are shown below



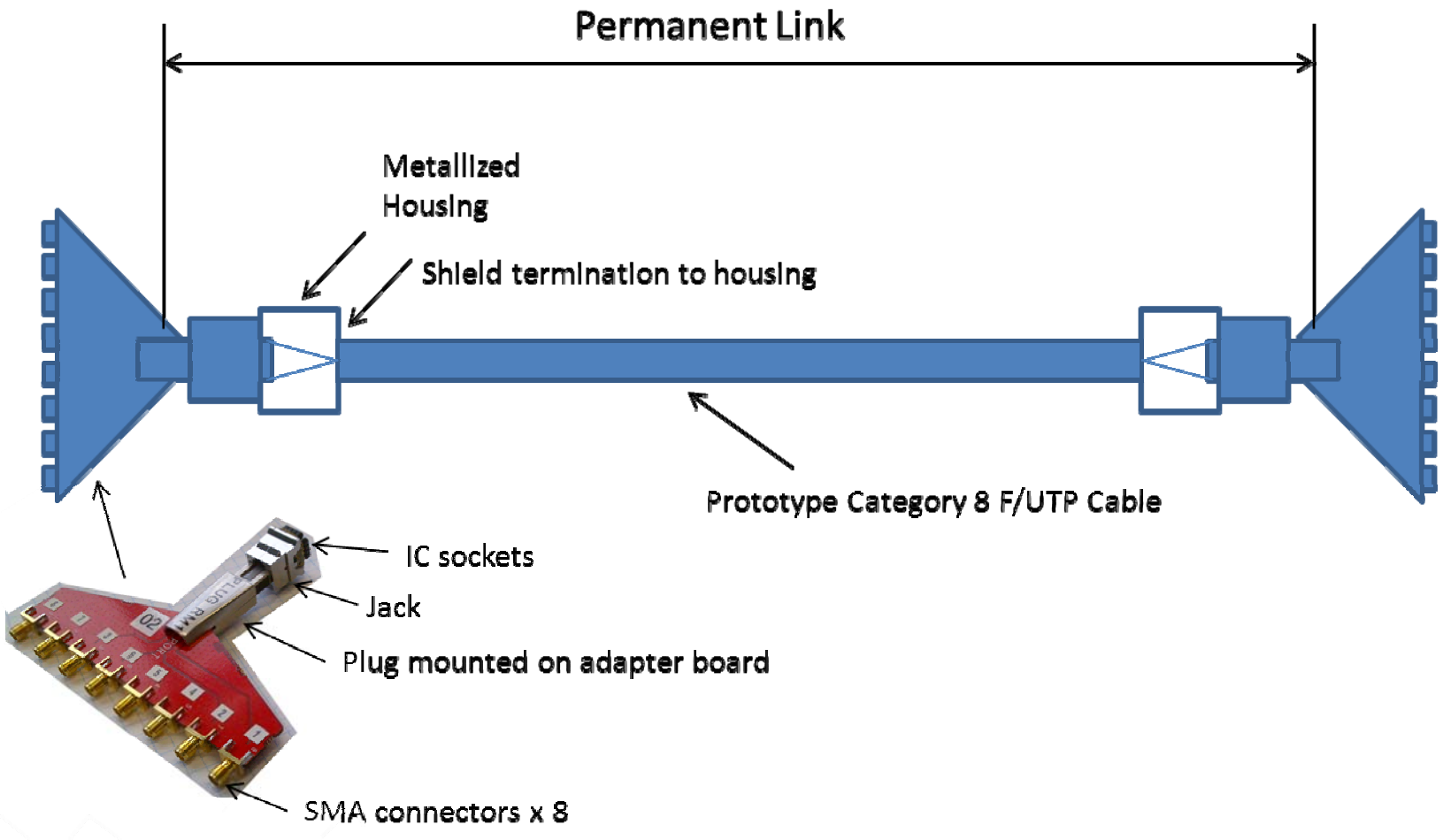
Category 8 Connector Performance measured to 2000 MHz



Description of the independent 3rd party testing

- Third party test laboratories follow the industry standards
- The cabling test and measurement standards have significantly evolved allowing accurate and reliable testing up to 2000 MHz
- The third party test laboratories offer independent performance verification of products (example: ETL Verified mark shown on this slide)

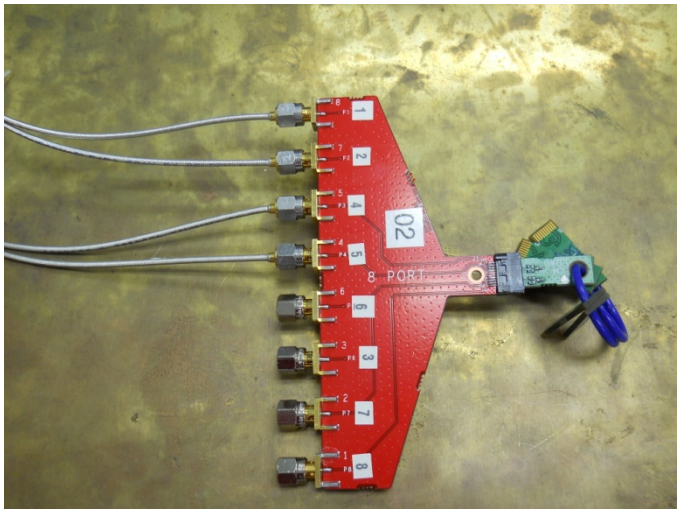
Test Configuration



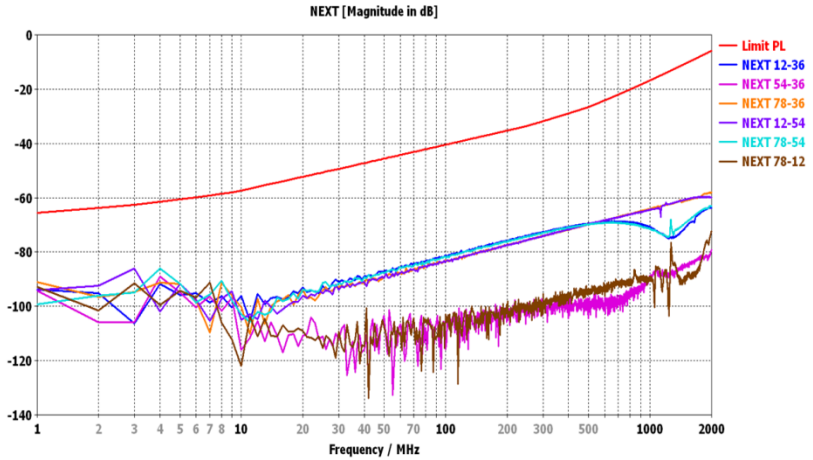
Baseline Measurements

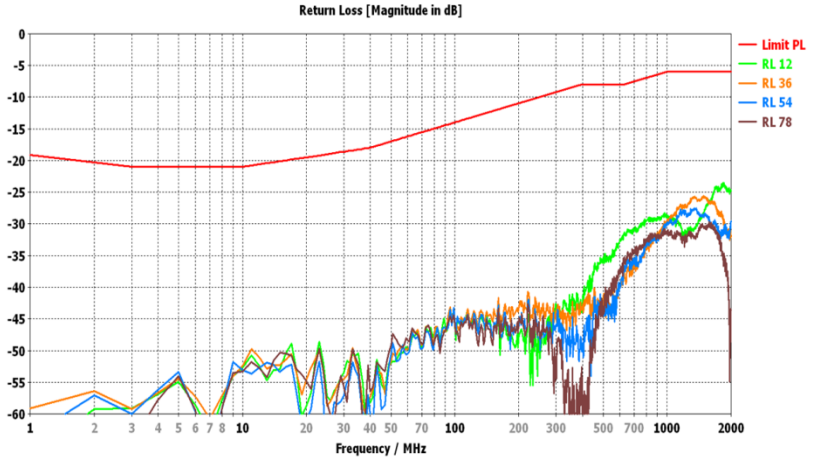
The baseline measurements were performed using the SMA adapter board with the “keychain DMCM load artifact” plugged into the socket, see picture below.

The baseline NEXT and RL measurements shown on the Right Hand Side are plotted after de-embedding the SMA adapter board



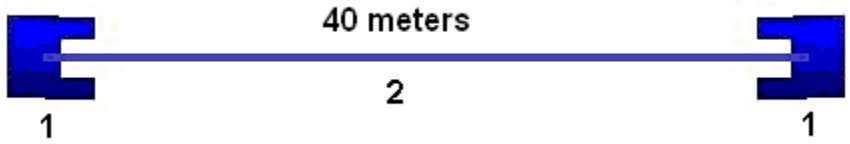
NEXT & RL Baseline measured to 2 GHz





Test report number 100948530CRT-001a
TIA-568-C.2-1, Draft 0.5
Permanent link, 40 meters

- **Standard used:** PN-568-C.2-1 (Draft 0.5, Dated October 16, 2012); to be published as ANSI/TIA-568-C.2-1
- **Tests performed:** Insertion Loss, Return Loss, NEXT, PSNEXT, ACRF, PSACRF, Delay, Delay Skew
- **Test configuration:** 2-Connector permanent link



Component ID	*Description*
1	RJ45 Connector
2	4-Pair F/UTP Cable

- **Test equipment used:** 4-Port Network Analyzer, Agilent model number E5071C (serial number MY46214986), calibrated by Agilent on October 1, 2012 and by the user before the test with an ECal module
- **Test dates:** November 1-2, 2012
- **Test report revision history:**

Issue	*Description*	*Date*
First issue	Original document	November 2, 2012

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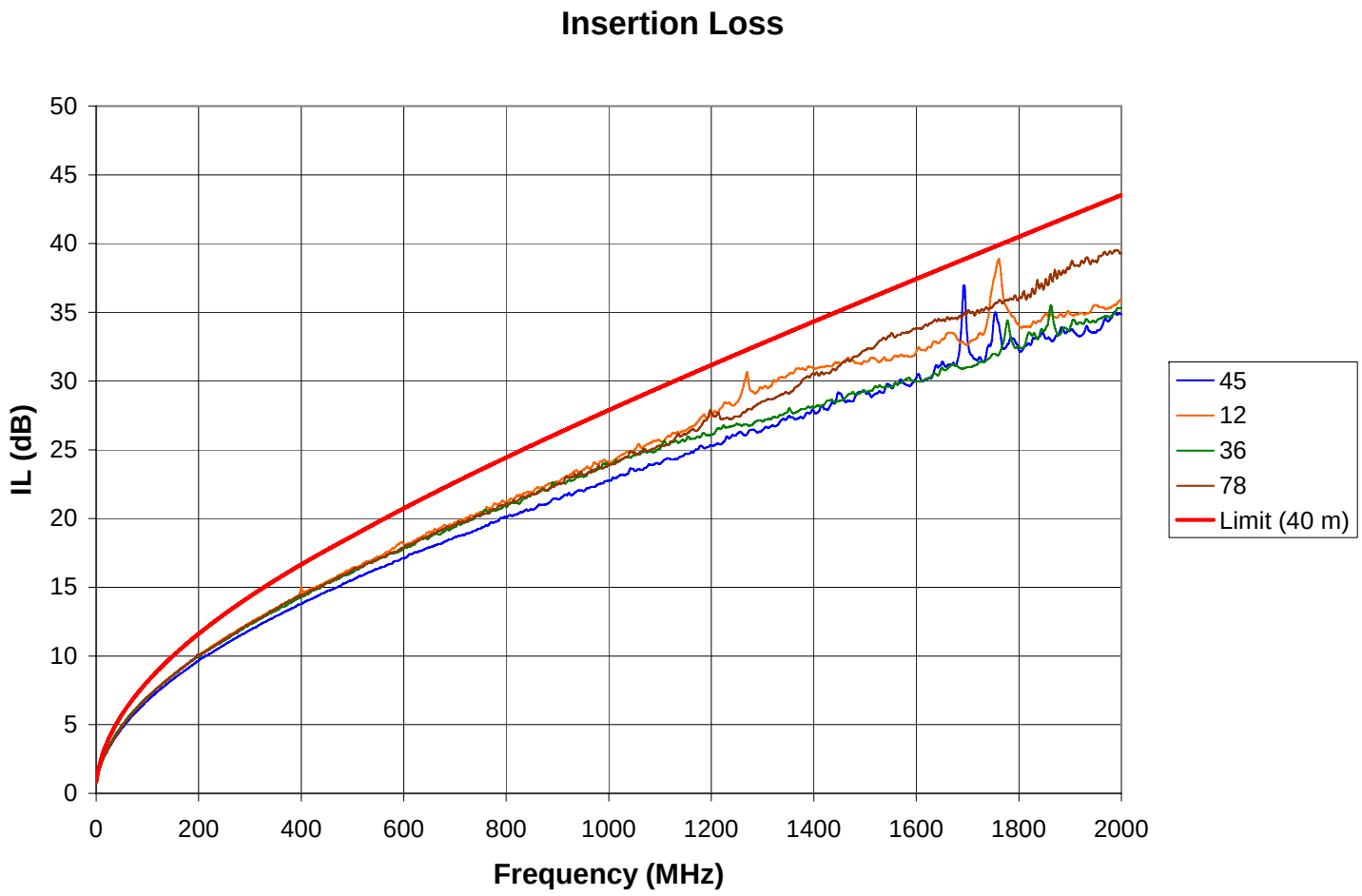

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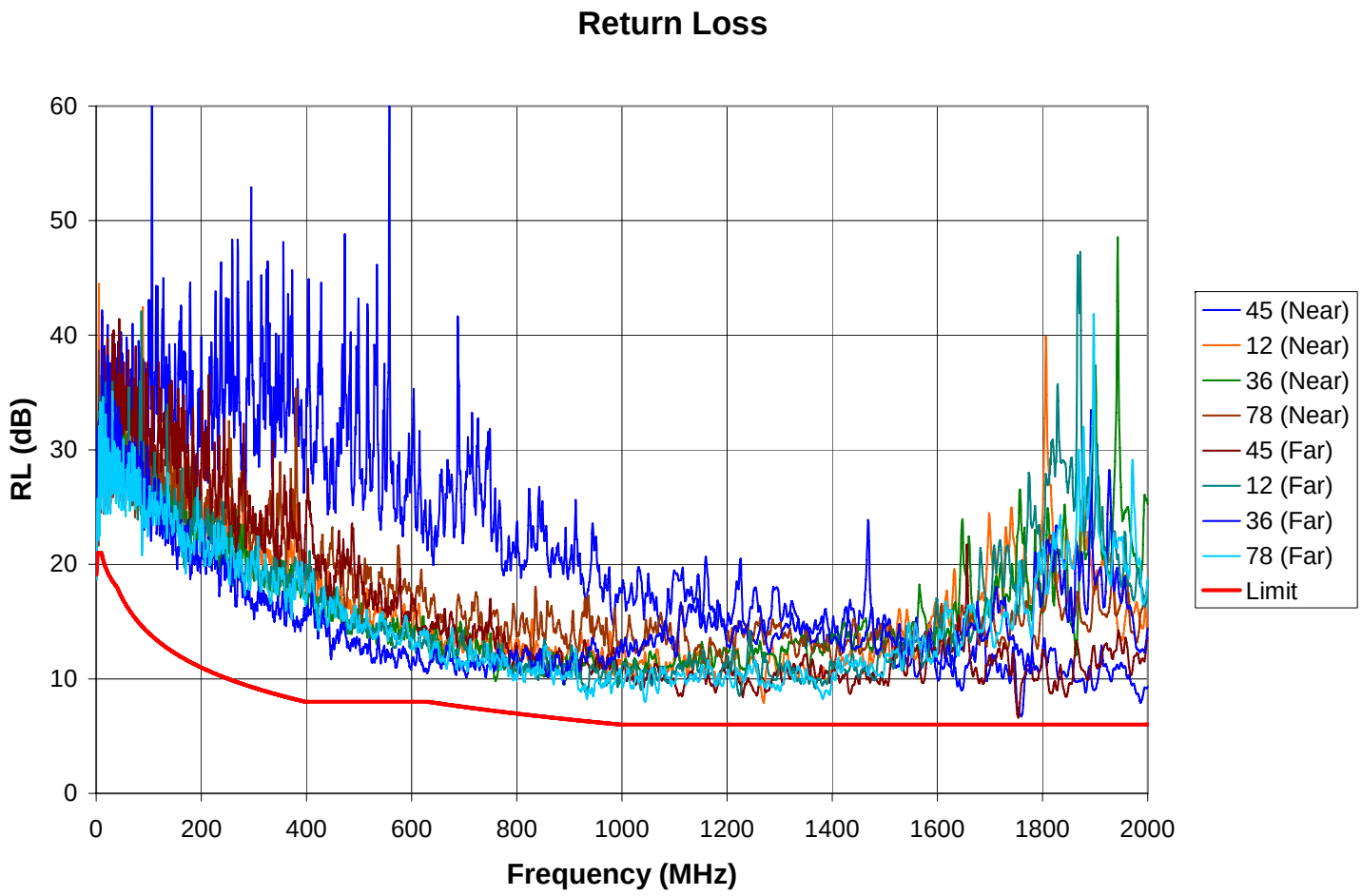

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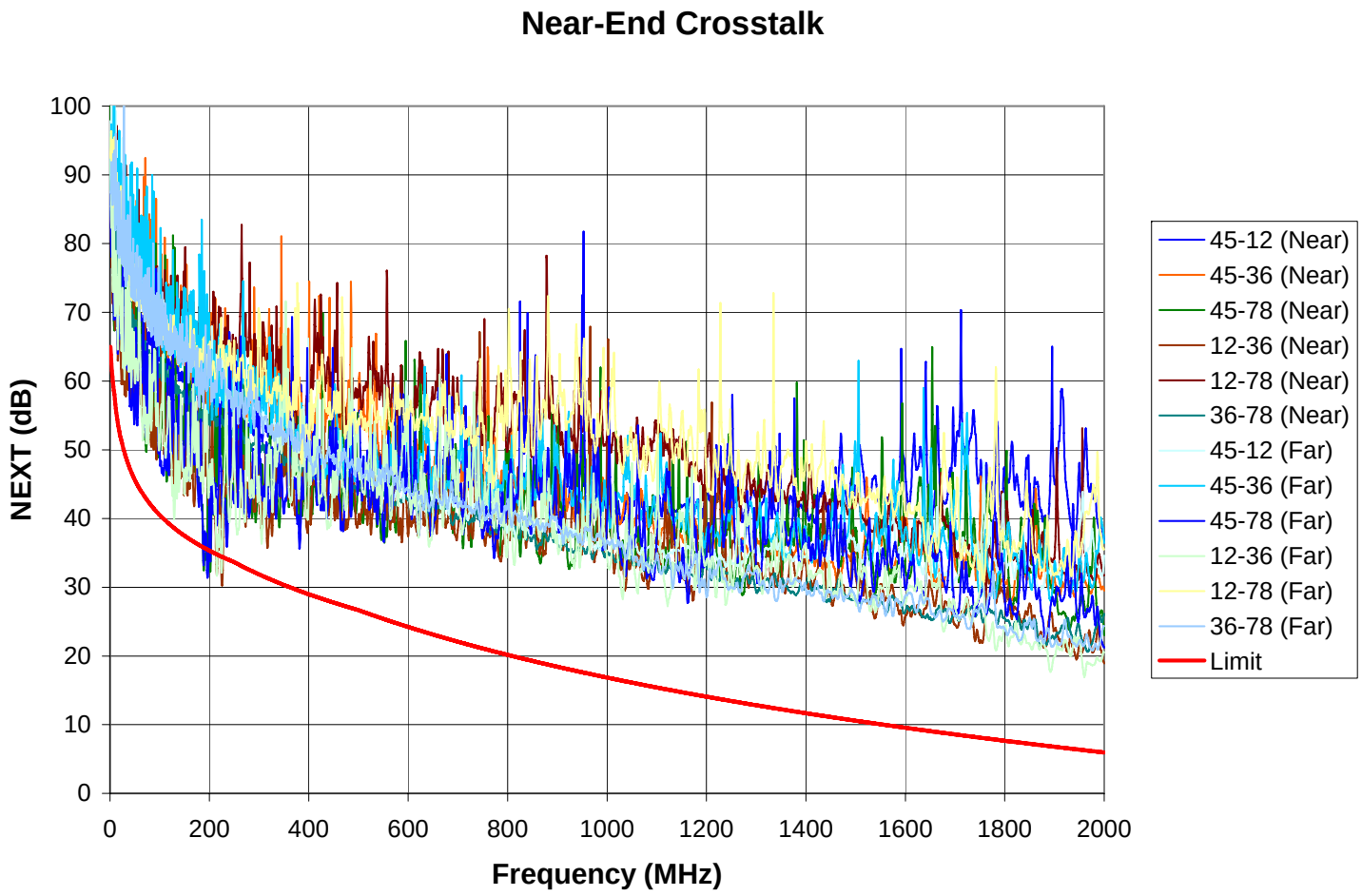

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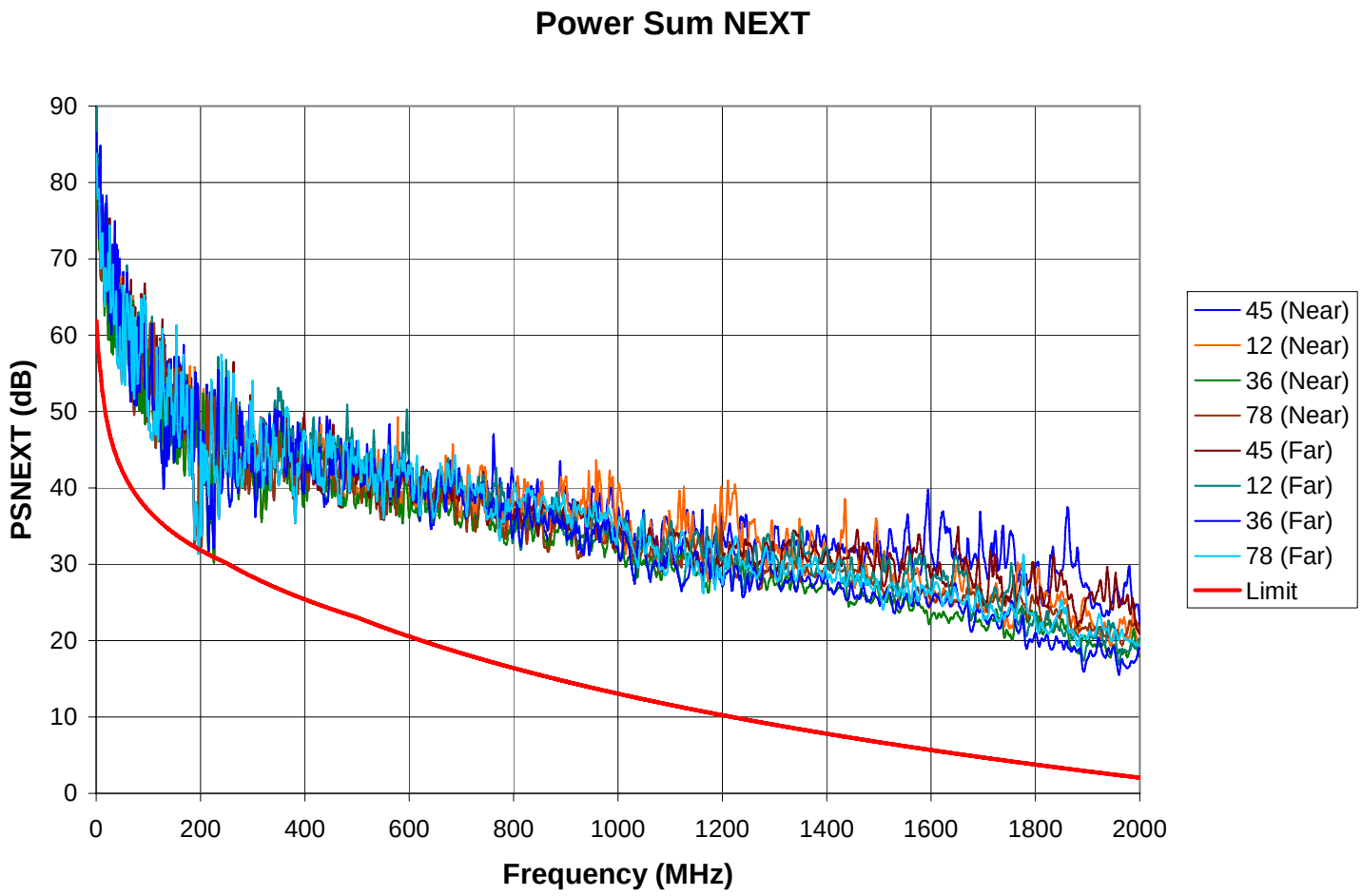

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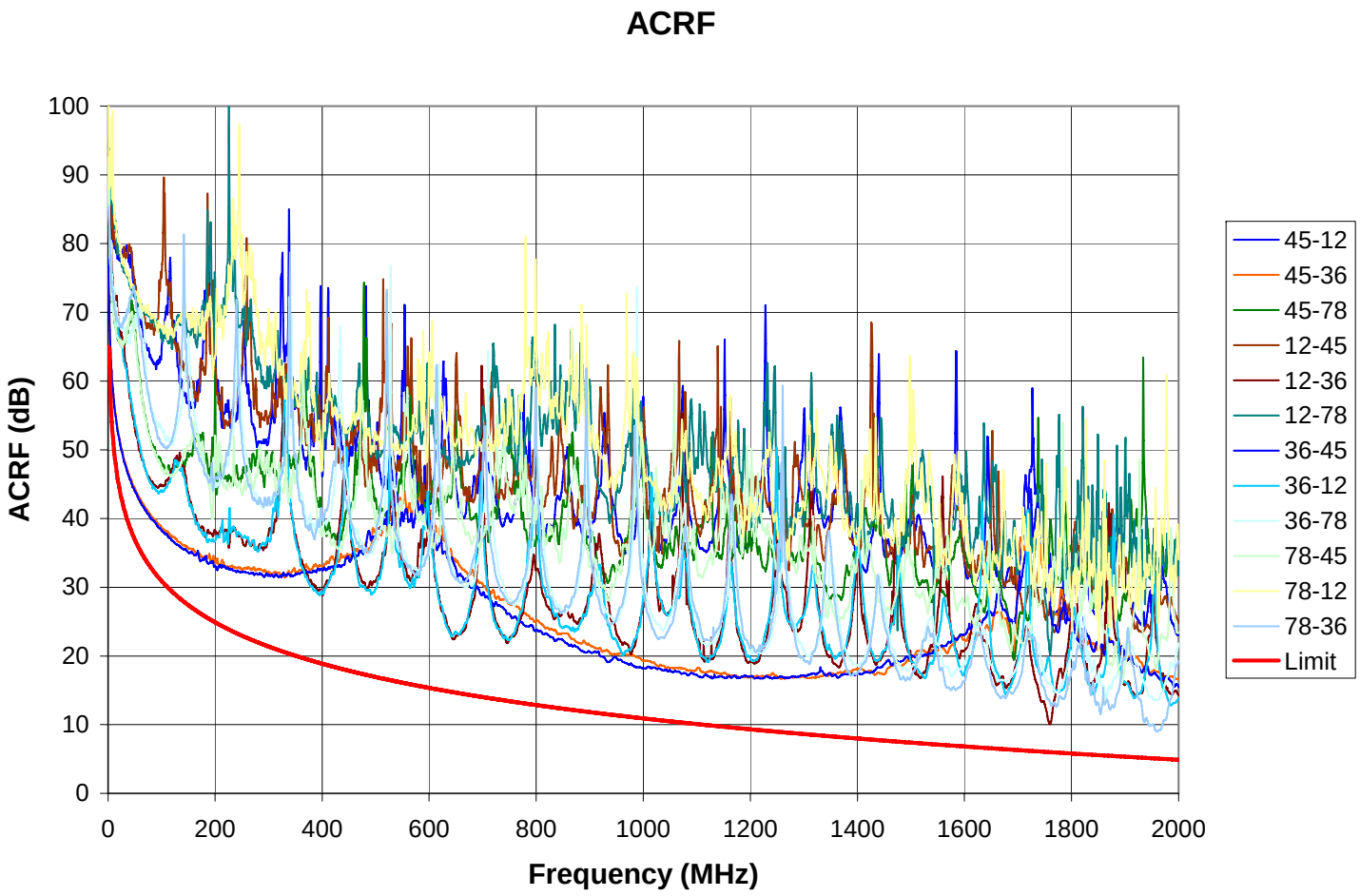

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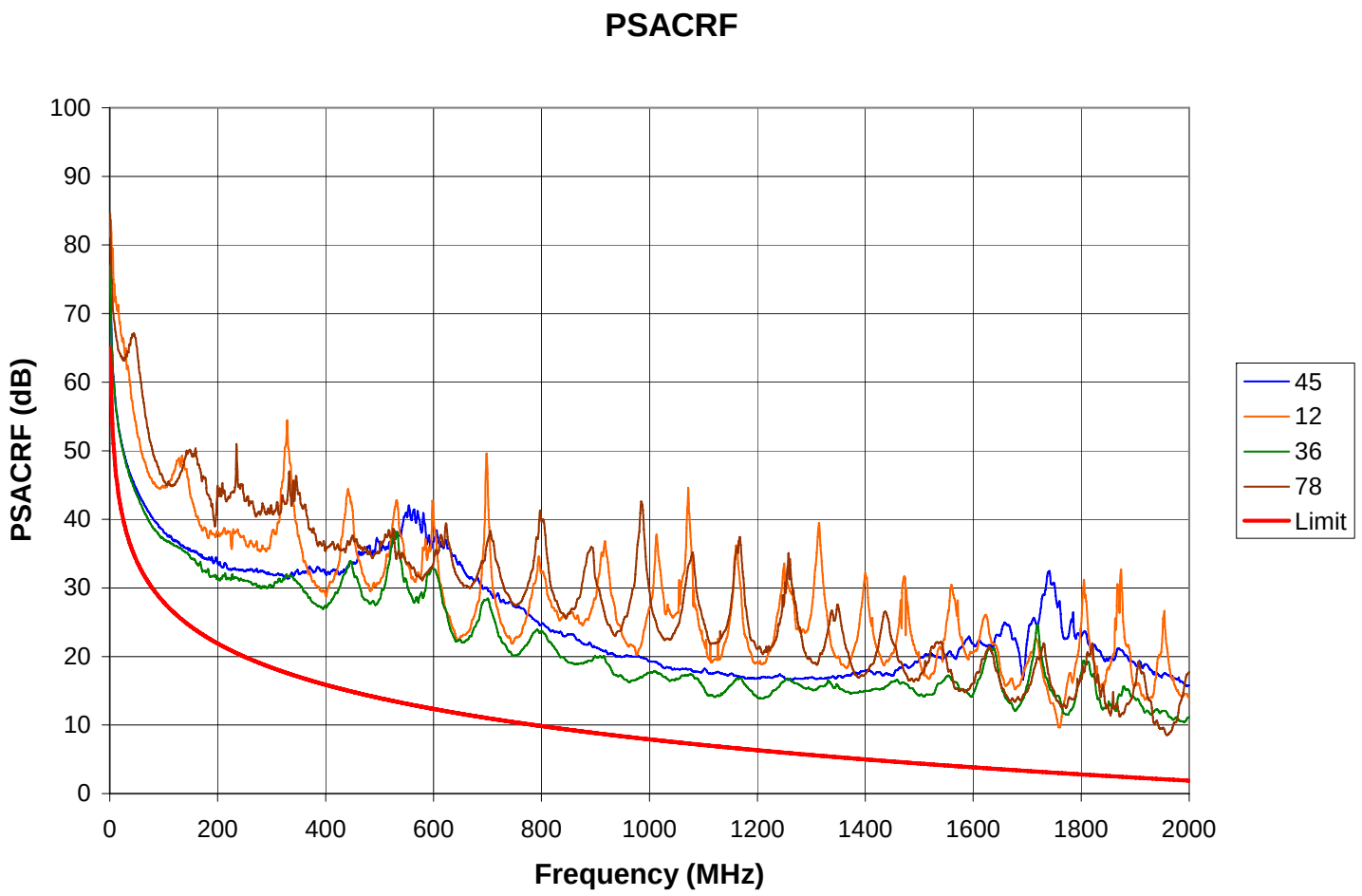

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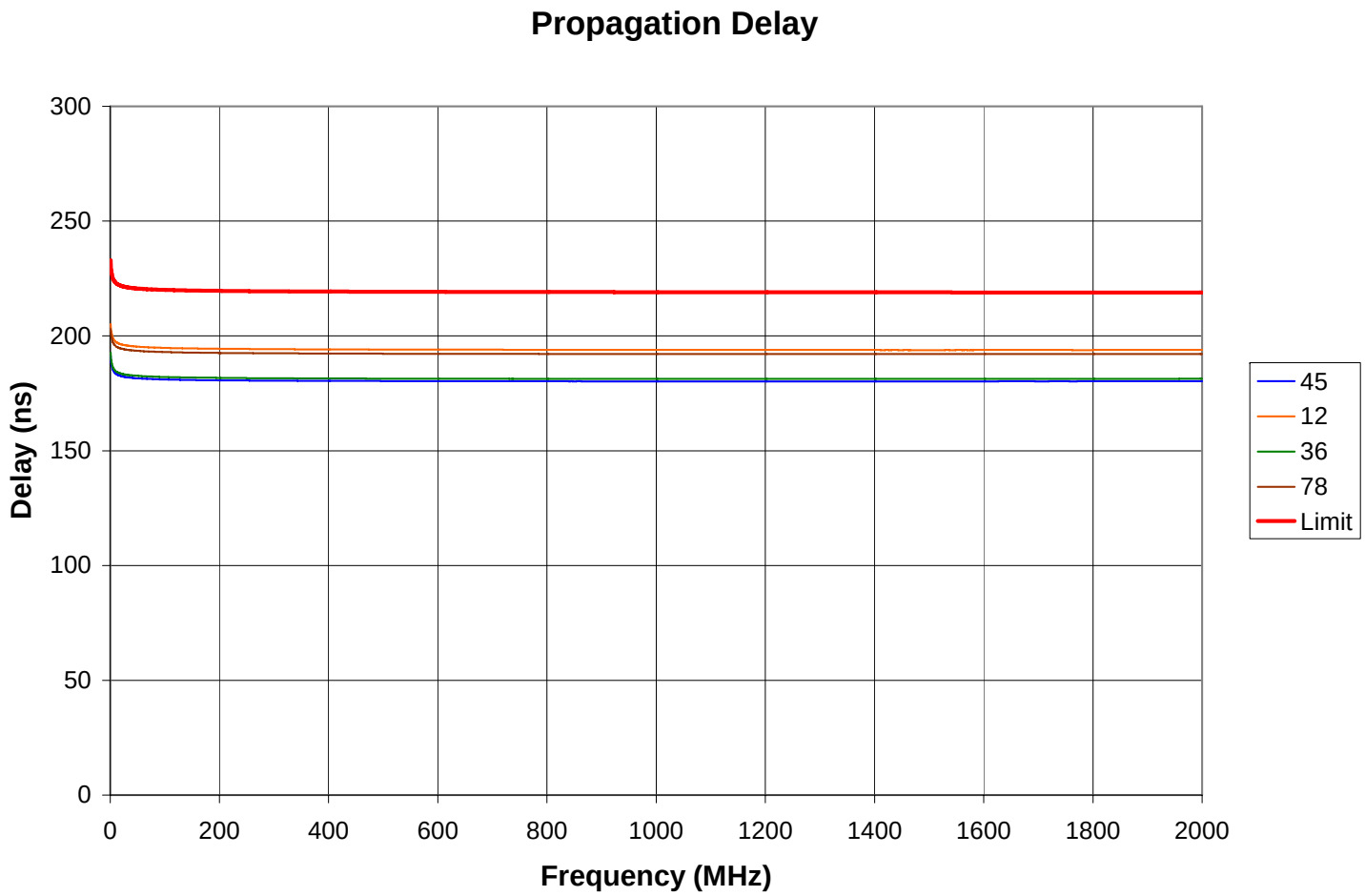

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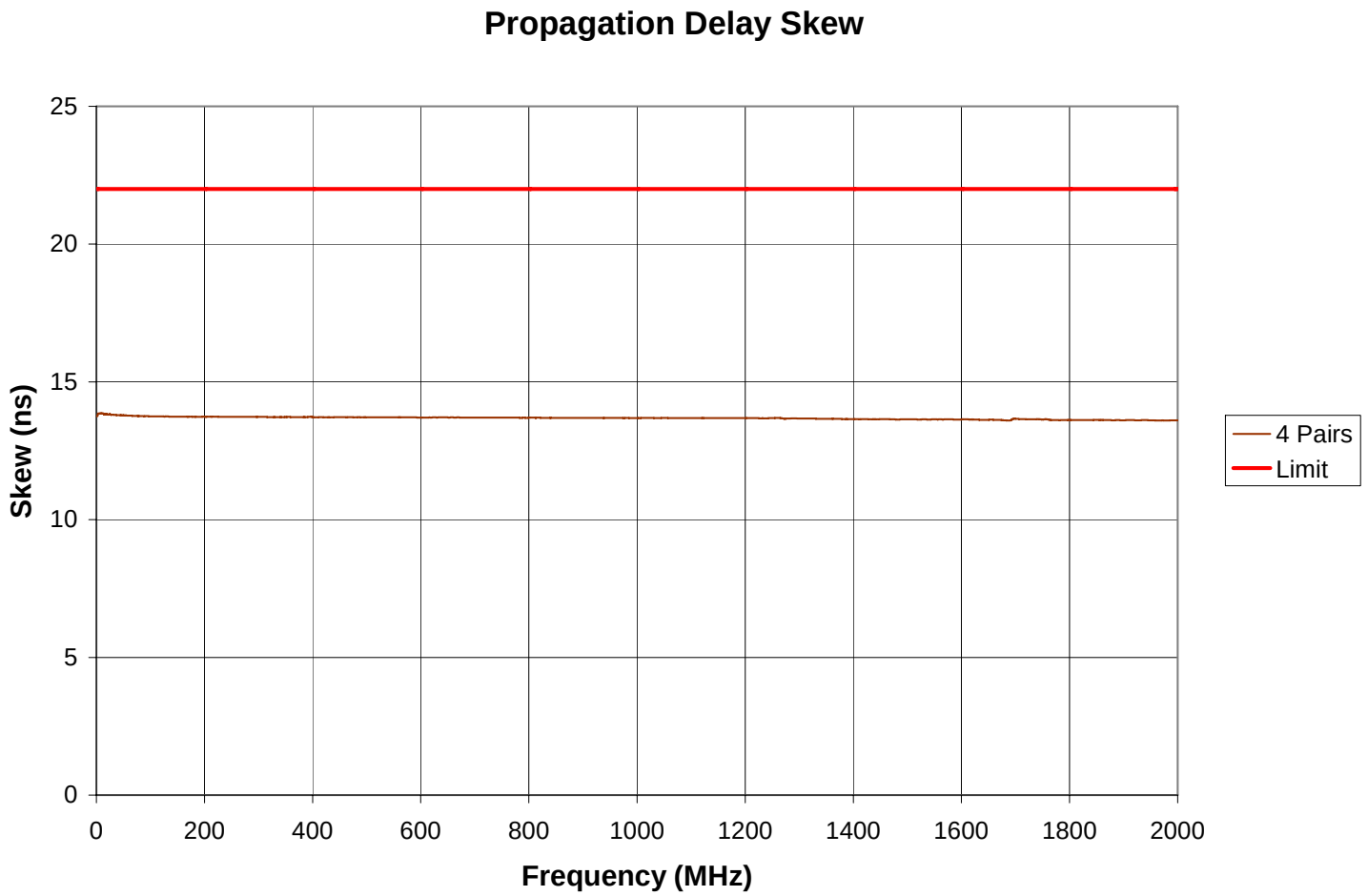
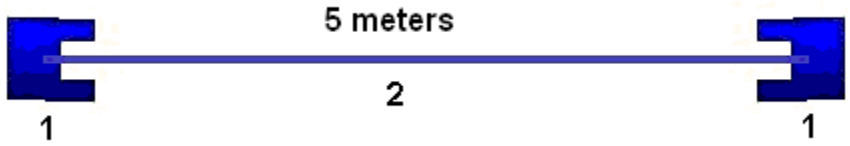


Test report number 100948530CRT-001b
TIA-568-C.2-1, Draft 0.5
Permanent link, 5 meters

- **Standard used:** PN-568-C.2-1 (Draft 0.5, Dated October 16, 2012); to be published as ANSI/TIA-568-C.2-1
- **Tests performed:** Insertion Loss, Return Loss, NEXT, PSNEXT, ACRF, PSACRF, Delay, Delay Skew
- **Test configuration:** 2-Connector permanent link



Component ID	*Description*
1	RJ45 Connector
2	4-Pair F/UTP Cable

- **Test equipment used:** 4-Port Network Analyzer, Agilent model number E5071C (serial number MY46214986), calibrated by Agilent on October 1, 2012 and by the user before the test with an ECal module
- **Test dates:** November 1-2, 2012
- **Test report revision history:**

Issue	*Description*	*Date*
First issue	Original document	November 2, 2012

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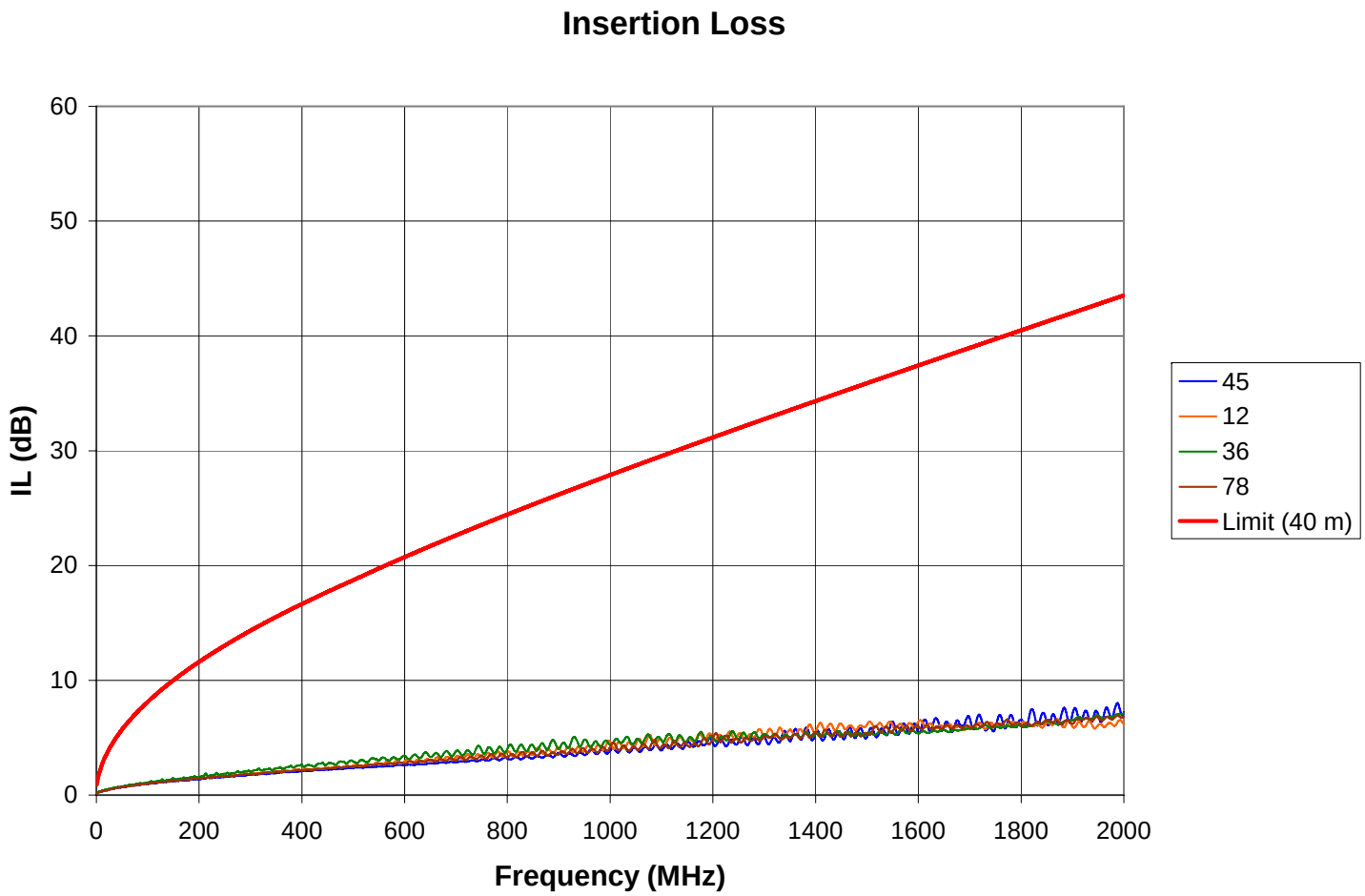
Permanent link, 5 meters



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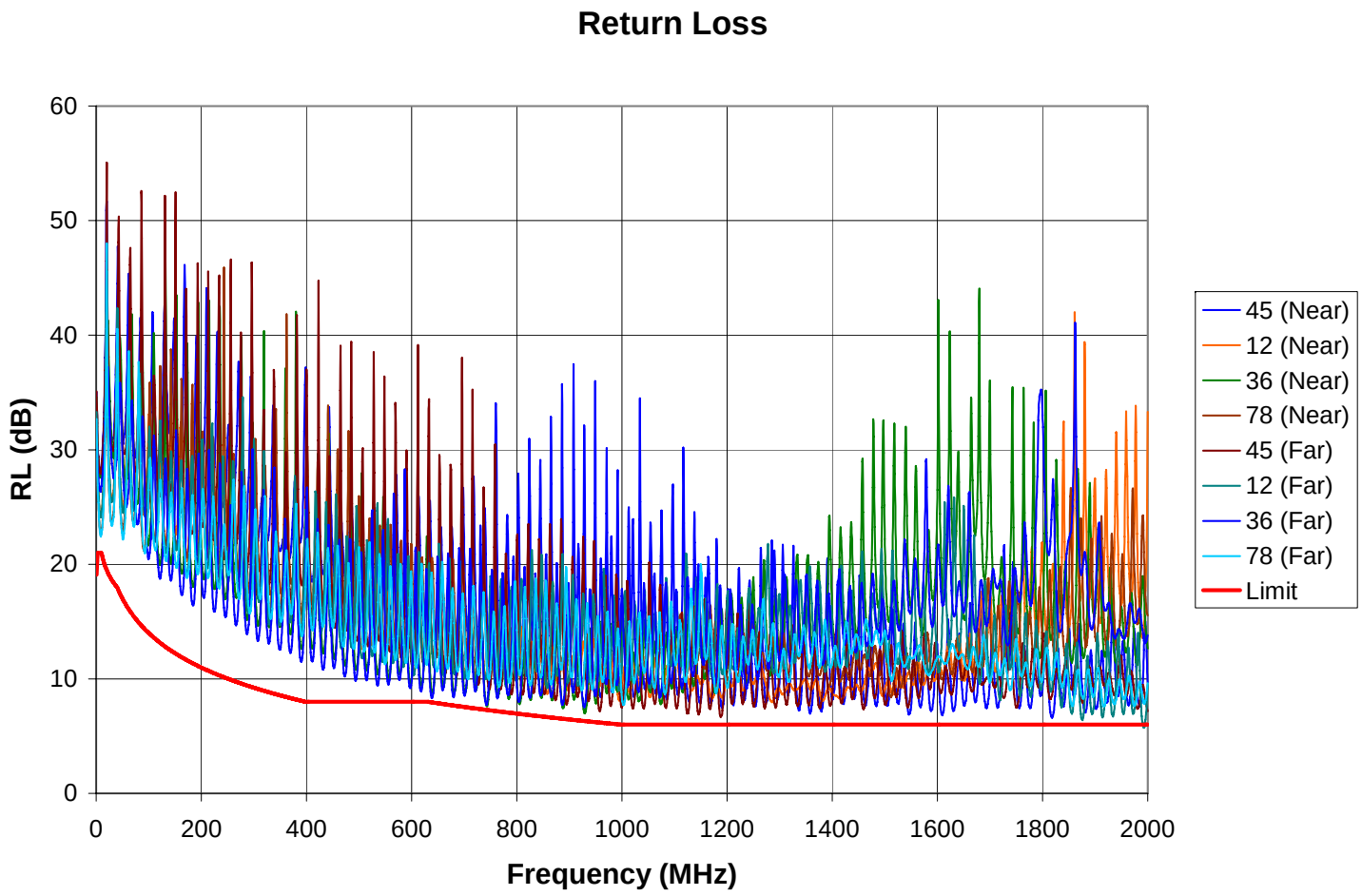

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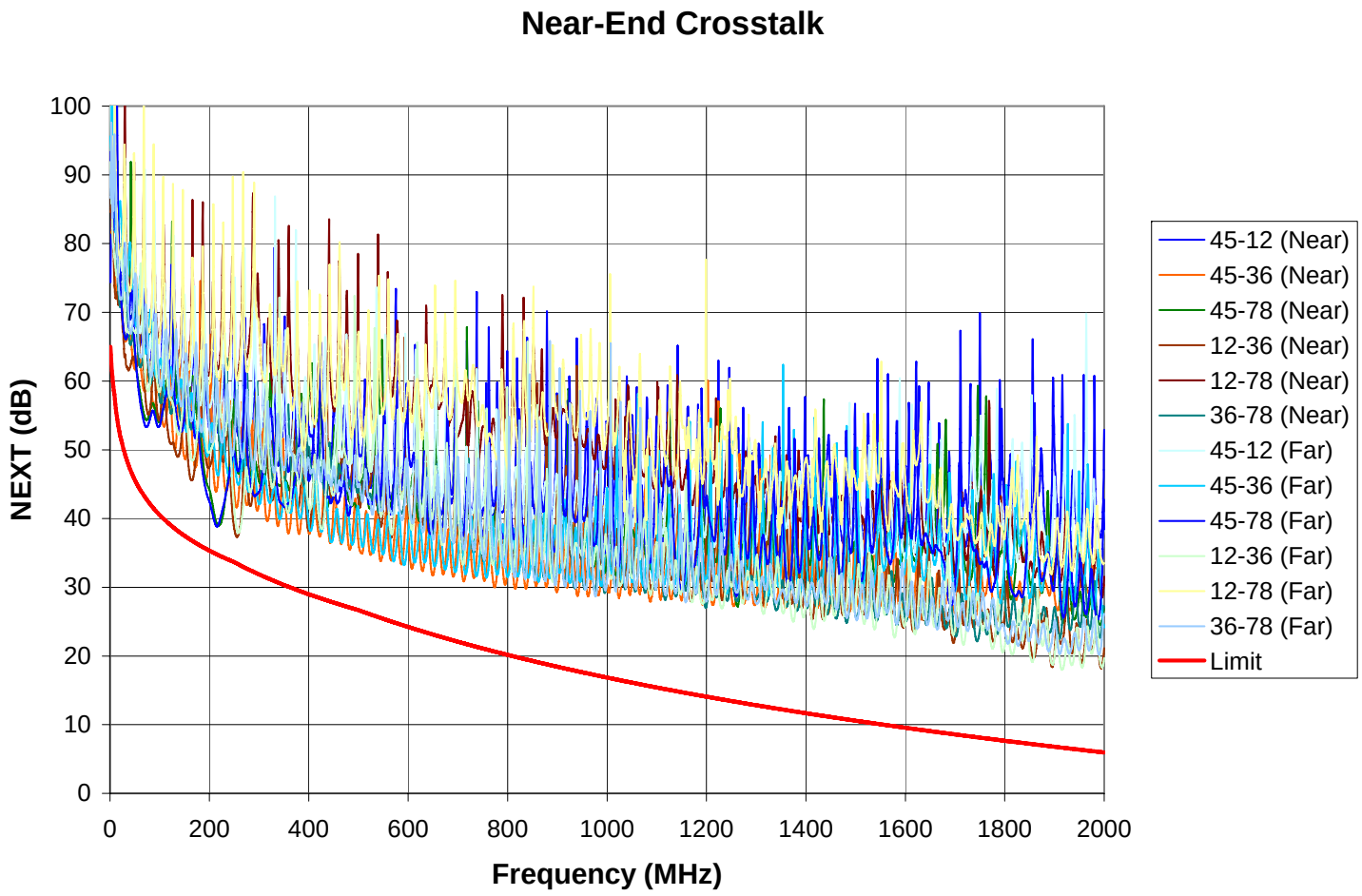

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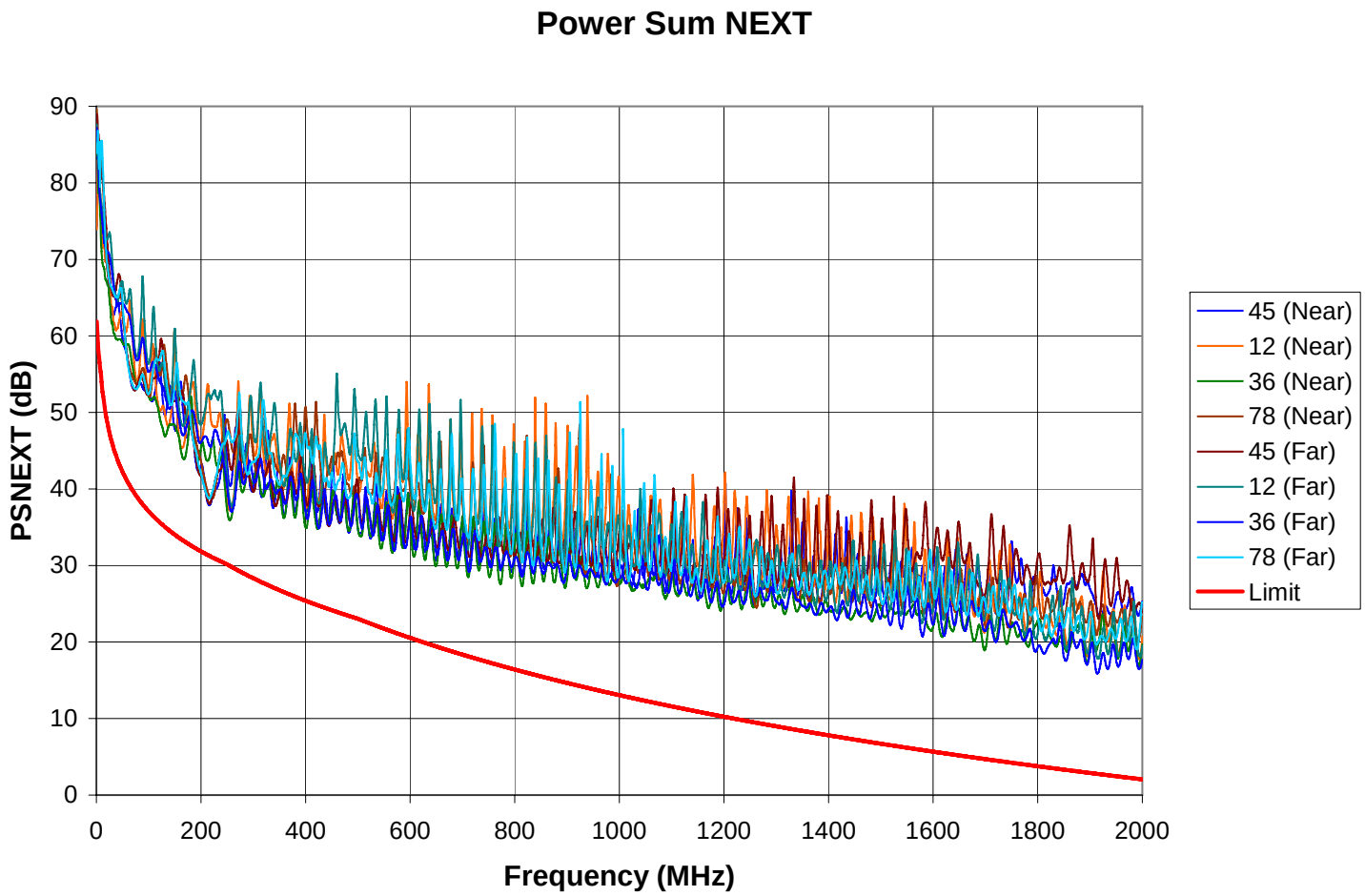

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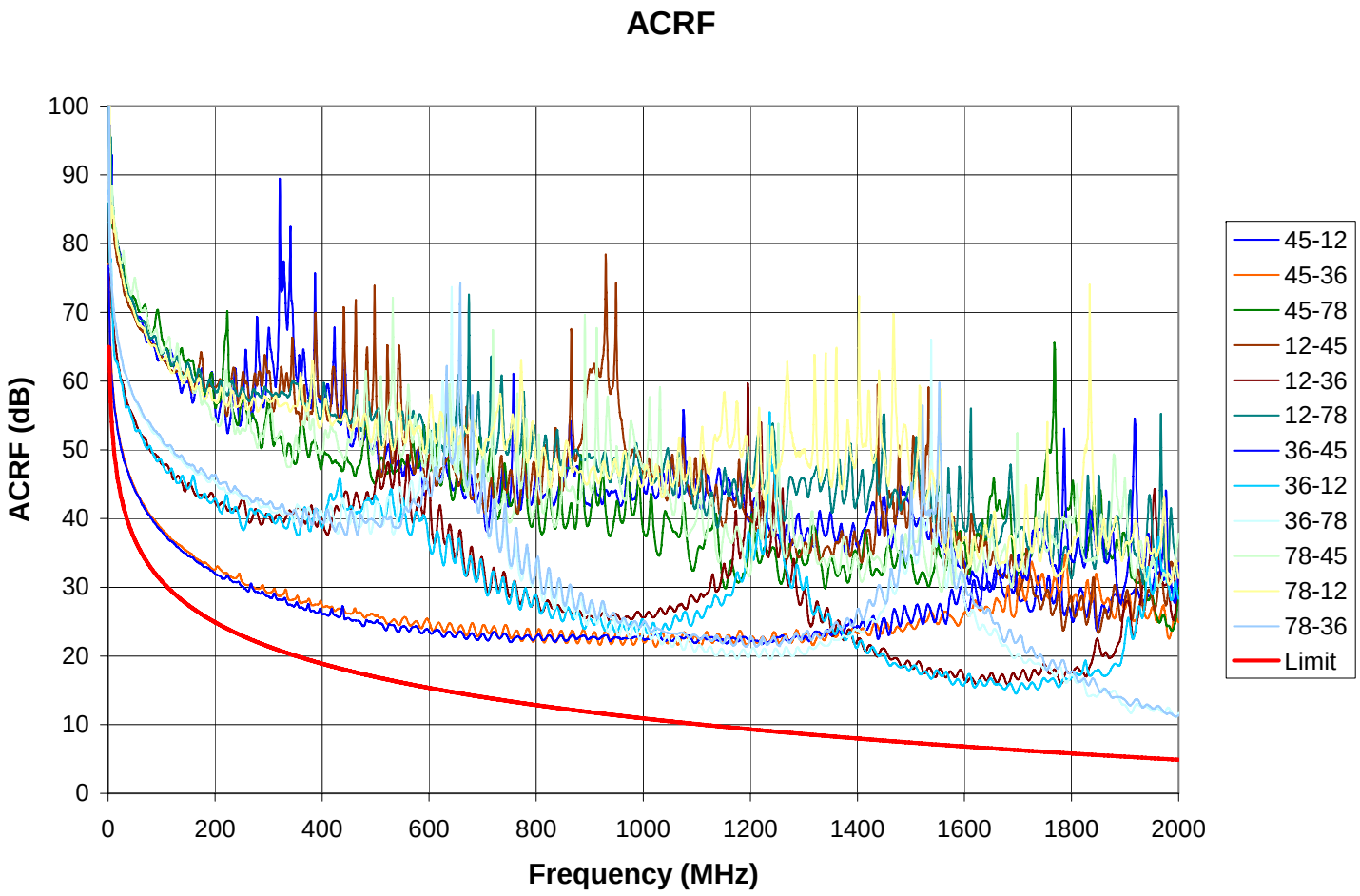

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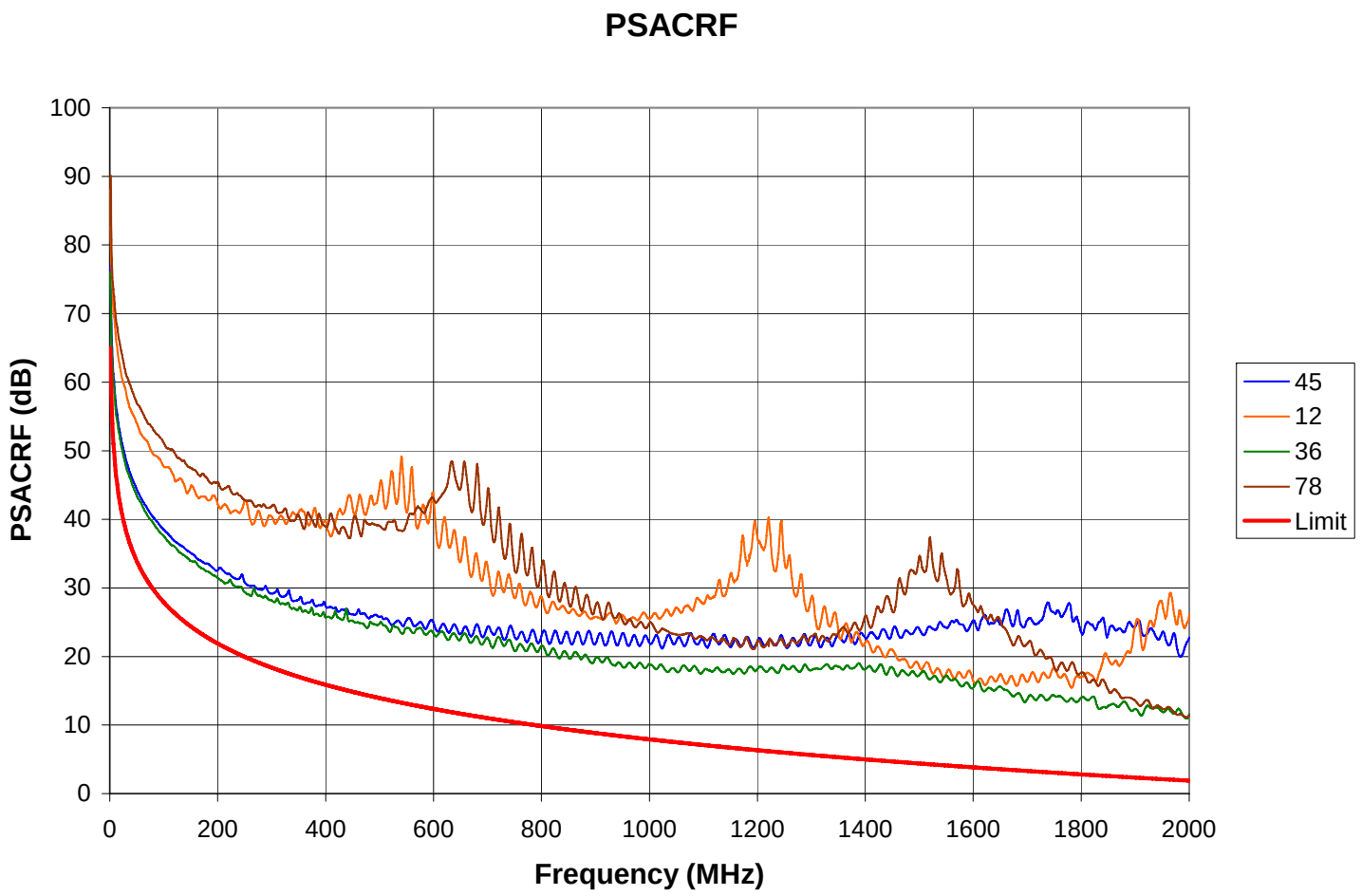

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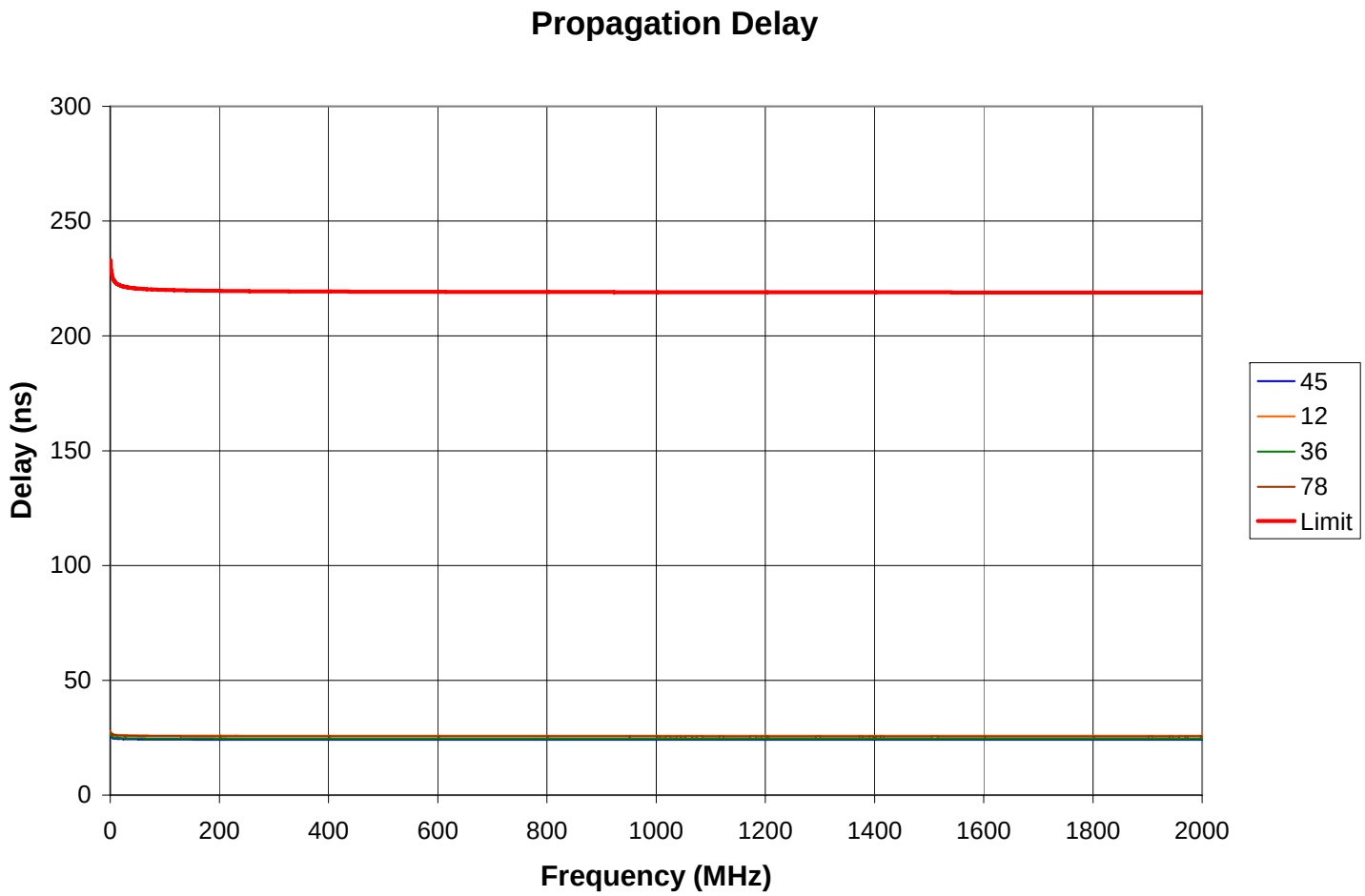

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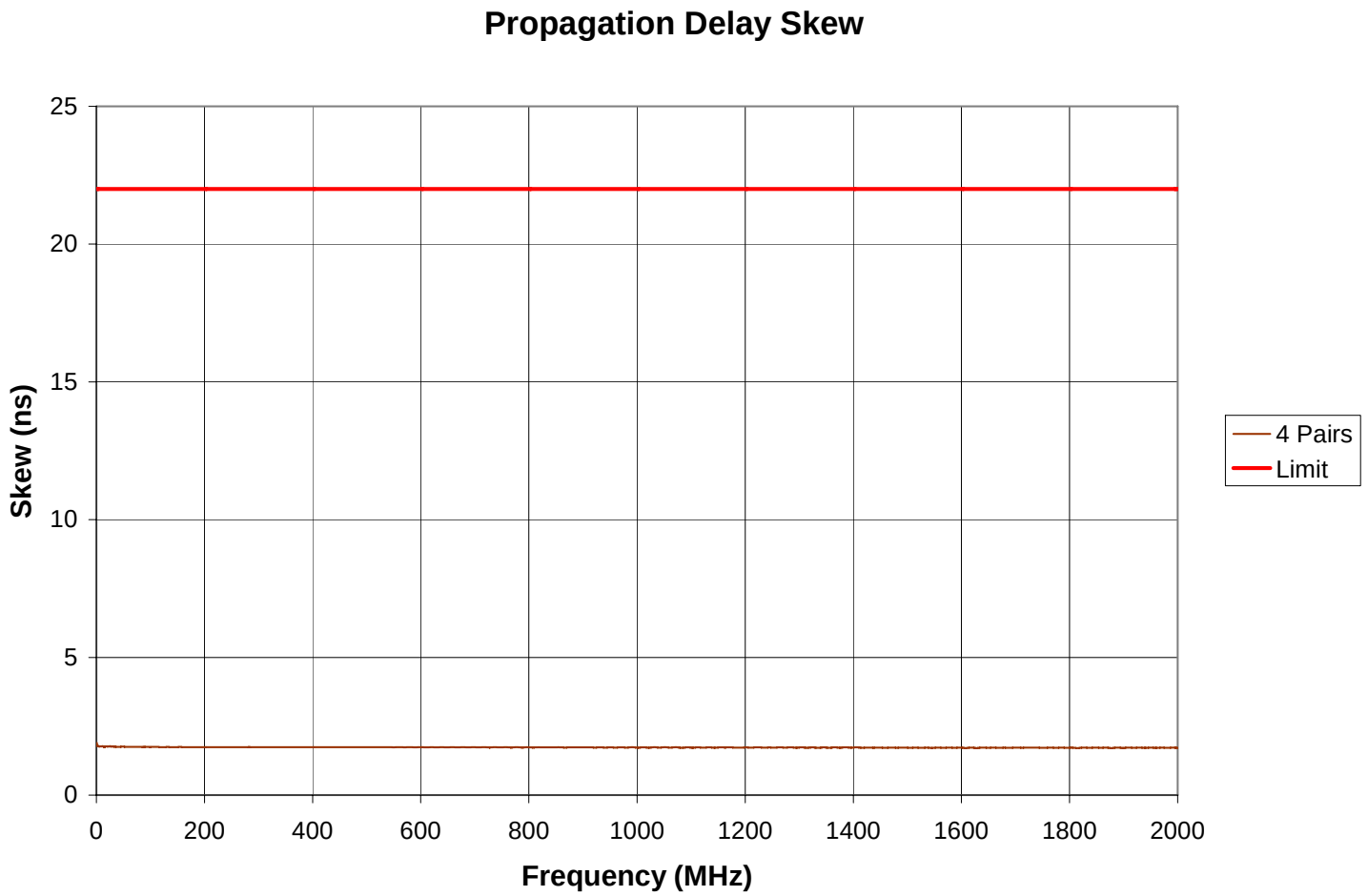

Verification Established

- This demonstration shows that short and long permanent links using multi-vendor components can meet the Category 8 requirements, including:
  - Shielded solutions free from alien crosstalk or EMI issues
  - Improved RJ-45 equipment connector:
    - Smooth performance extended to 2000 MHz
    - Backward compatible to legacy RJ-45
    - Suitable for auto-negotiation
  - Cable design extended to 2000 MHz without insertion loss dropouts or performance spikes
  - Demonstrates compatibility and interoperability between two different manufacturers that will be compliant to component specifications in TIA Category 8 draft 0.5.
- It is feasible to make components that meet the requirements in the draft Category 8 Standard
- Modeling to add these components into links and channels has been verified by measurements
- The measured results support the model data and are confirmed by independent third party testing

Conclusions

- Technical feasibility is supported by the transmission performance data.
- Broad market potential and compatibility are supported by the use of the common RJ-45 connector.
- Further information, including the measured data, is available in the backup material.