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# **10GBASE-T**

## **Cabling Model Development**

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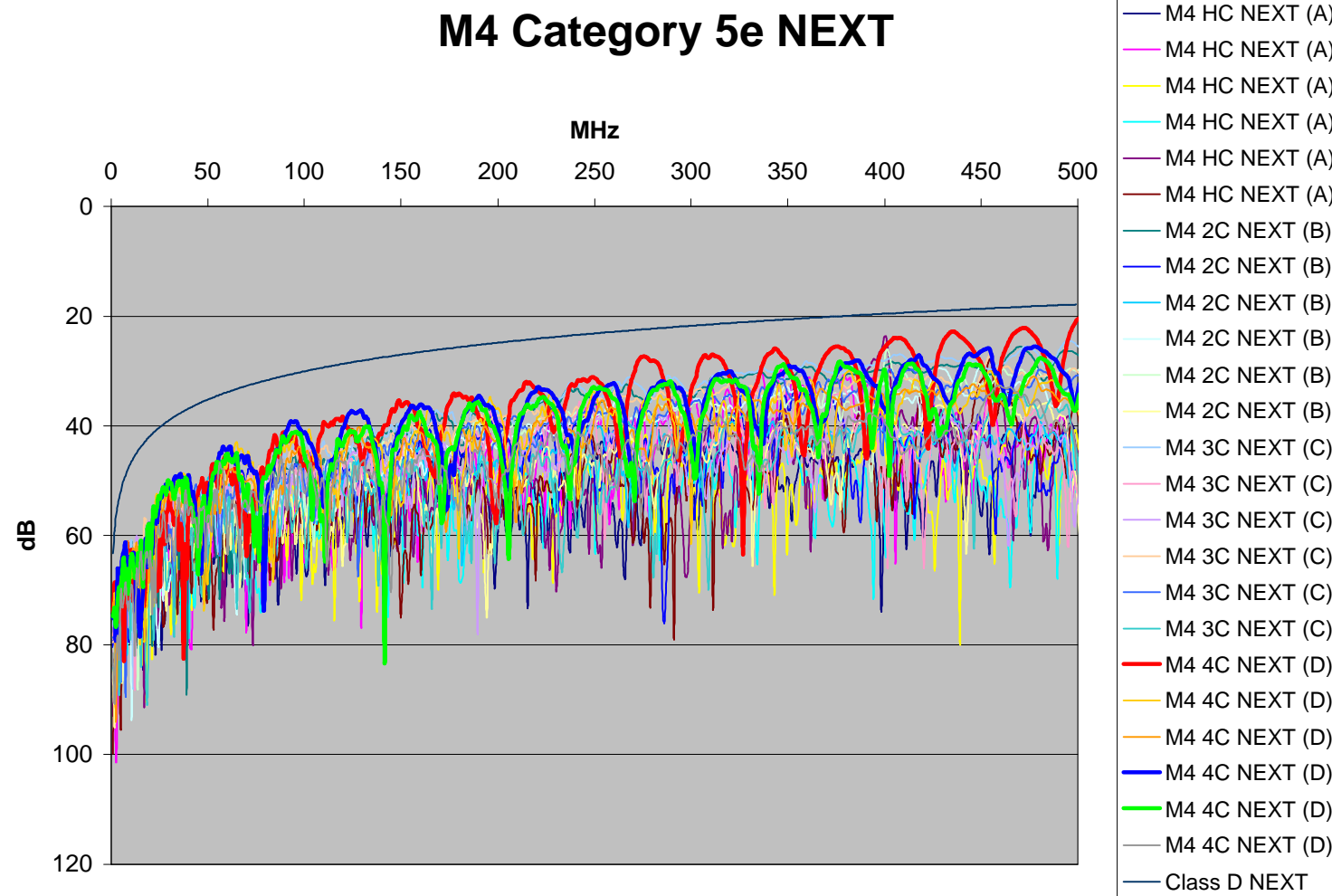
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# Cabling Model Development - Scaling Methods

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- Identification of worst case disturbers
- Scaling Method

## NEXT and FEXT: Identify 3 worse pair-to-pair disturbers from measured data



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## Multi-disturber scaling: NEXT and FEXT

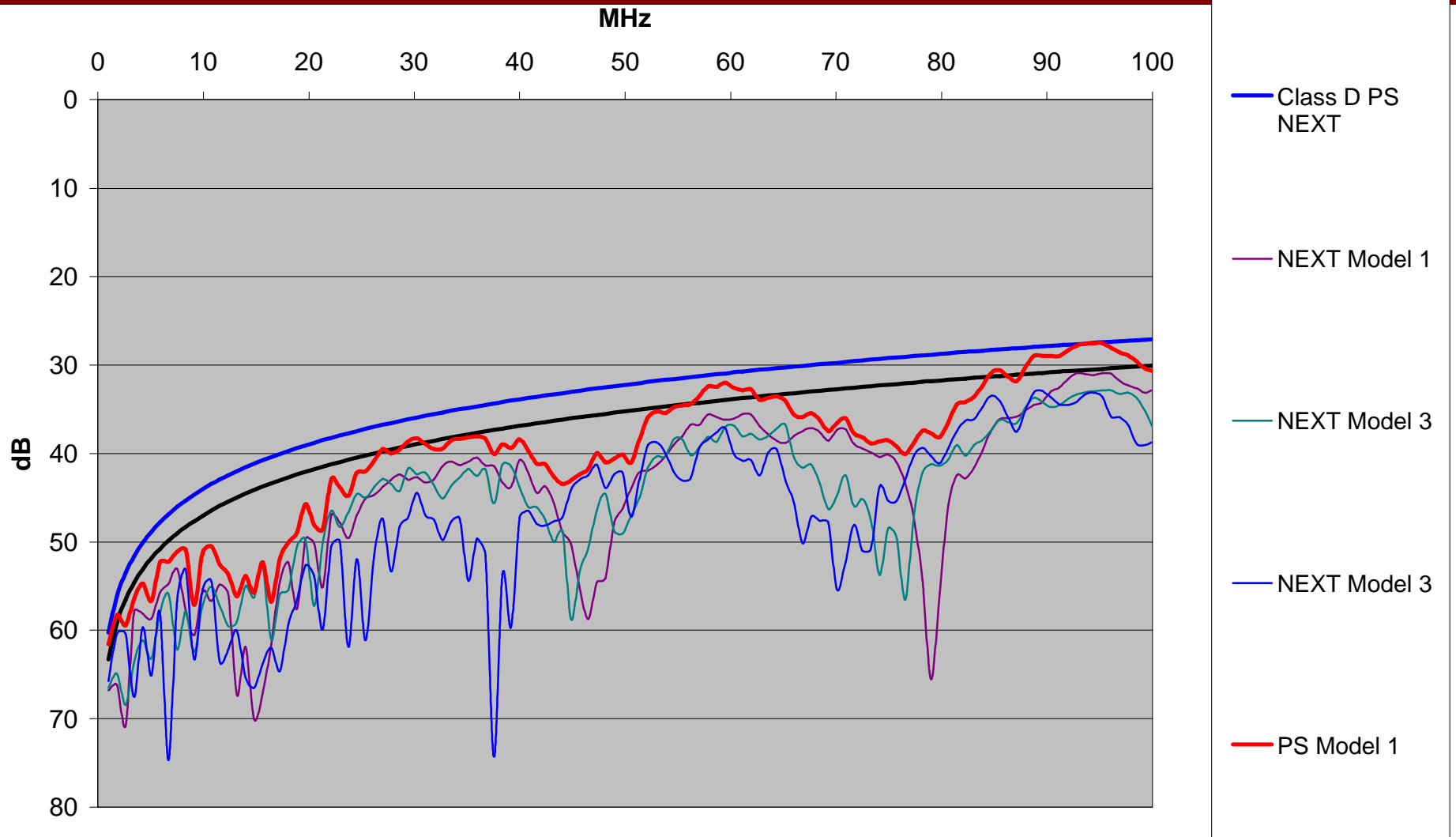
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- Method applied to both NEXT and FEXT (NEXT example illustrated)
- Power sum the three disturbers
- Calculate the scale number by finding the minimum value of the difference between the Class D PS NEXT limit and the power sum of the three disturbers.
- The minimum value is the peak value of the disturber relative to the Class D PS NEXT Limit between 1 MHz and 100 MHz.

$\text{NEXT\_Scale\_number}(f) = \text{minvalue}(\text{CLASS D PS NEXT Limit} - \text{power sum of the three disturbers})$

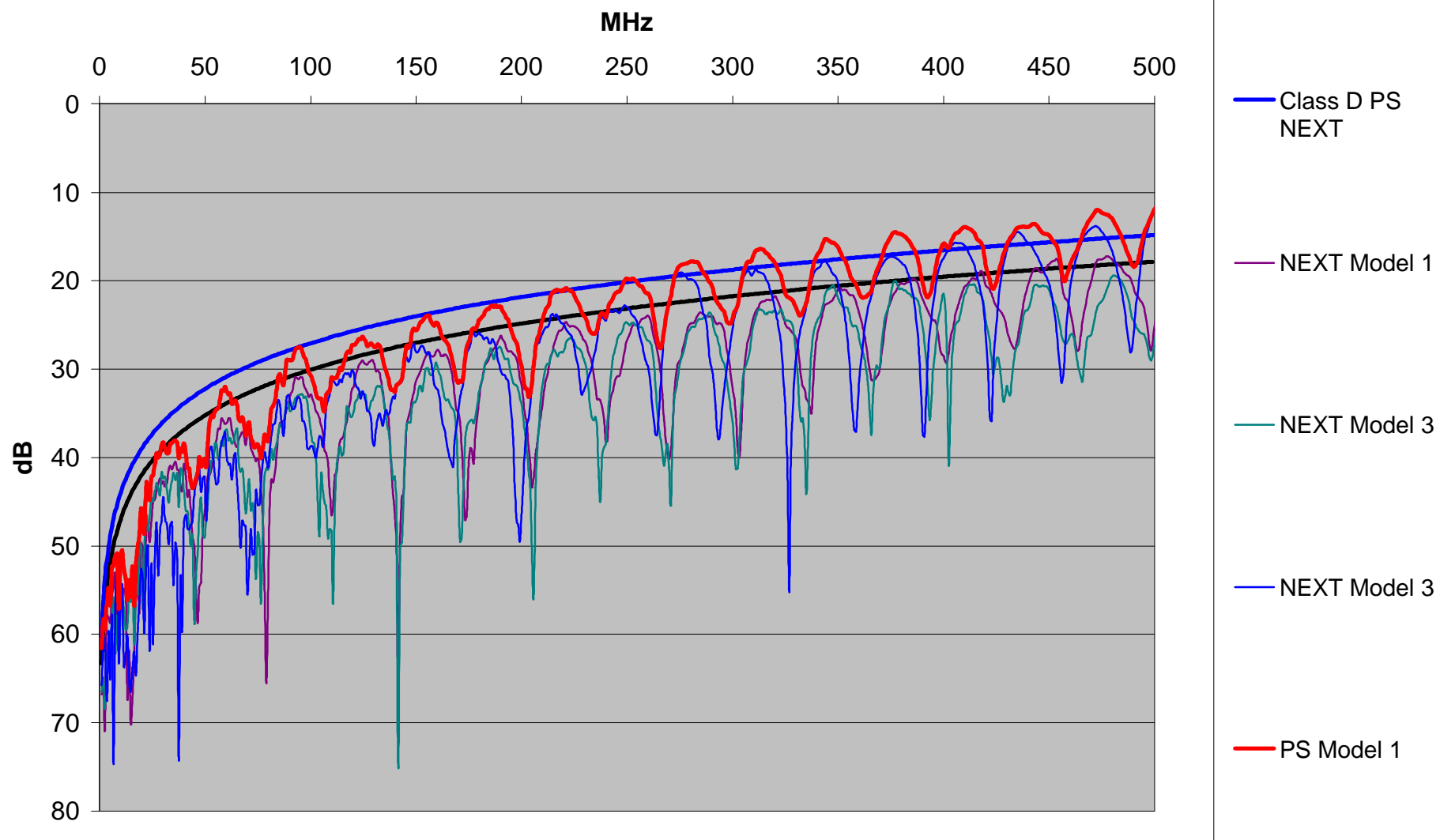
- Scale each of the NEXT disturbers by  $\text{NEXT\_Scale\_number}(f)$

## Category 5e - 3 Disturber Model- PSNEXT and Worse Pair-to-Pair ( Scaled - 1MHz-100MHz)



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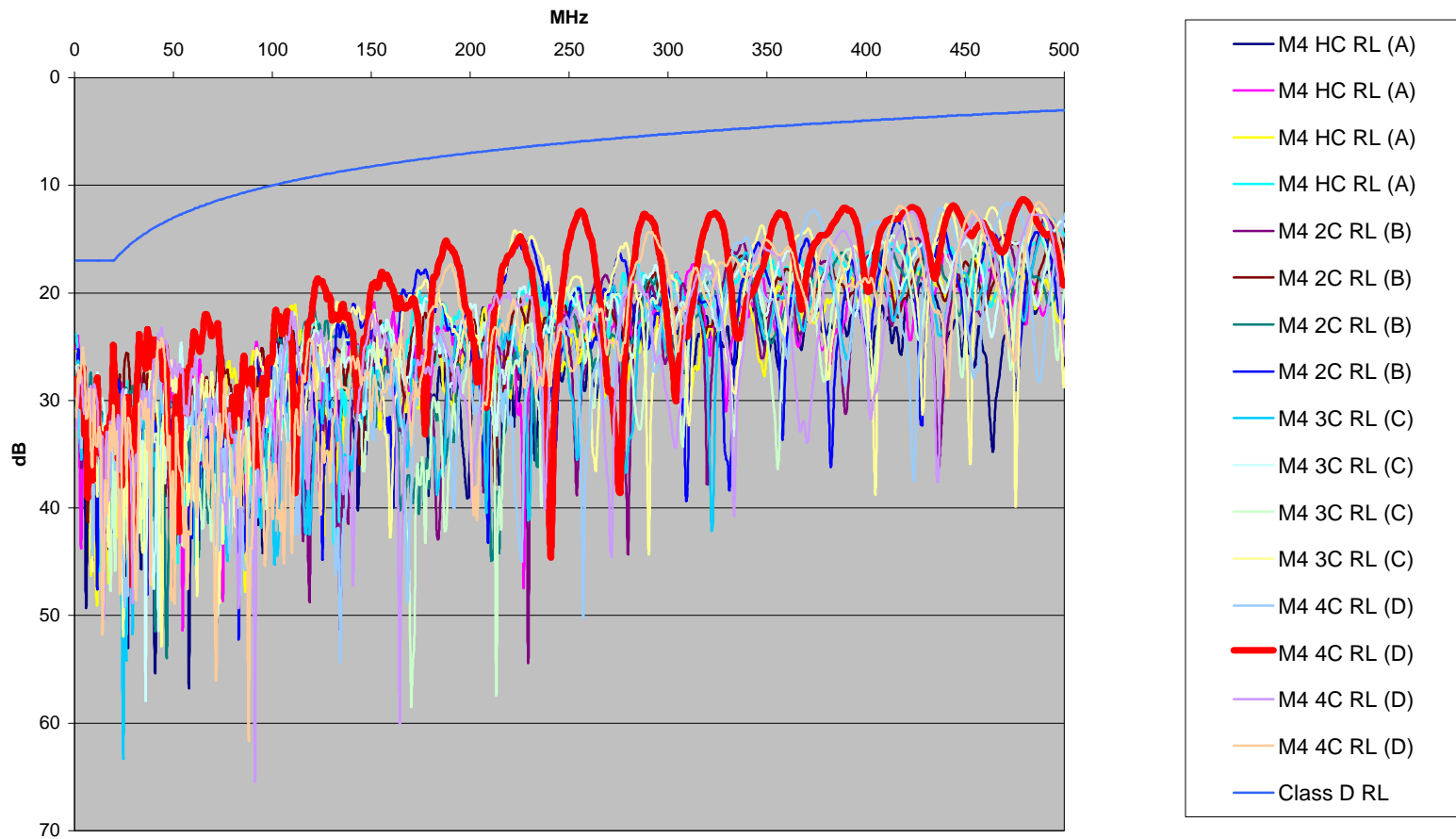
## Category 5e - 3 Disturber Model- PSNEXT and Worse Pair-to-Pair ( Scaled - 1MHz-100MHz)



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# Return Loss: Identify worst case from measured data

## M4 Category 5e RL



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# Return Loss scaling

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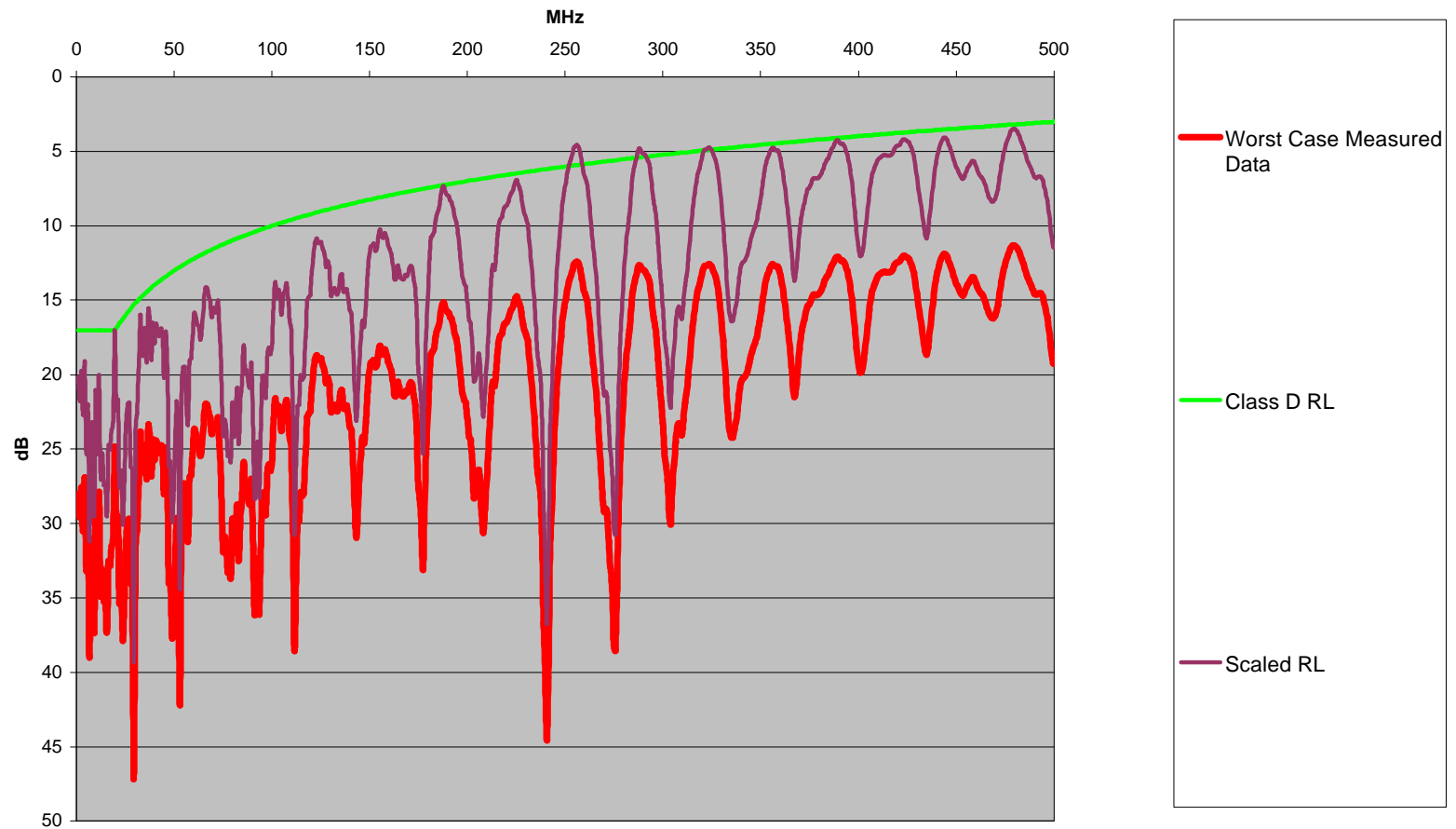
- Calculate the scale number by finding the minimum value of the difference between the Class D RL limit and the measured data
- The minimum value is the peak value of the measured data to the Class D RL Limit between 1 MHz and 100 MHz.

$RL\_Scale\_number(f) = \minvalue(CLASS\ D\ RL\ Limit - RL\ measured\ data)$



# Category 5e Return Loss - (Scaled 1 MHz-100MHz)

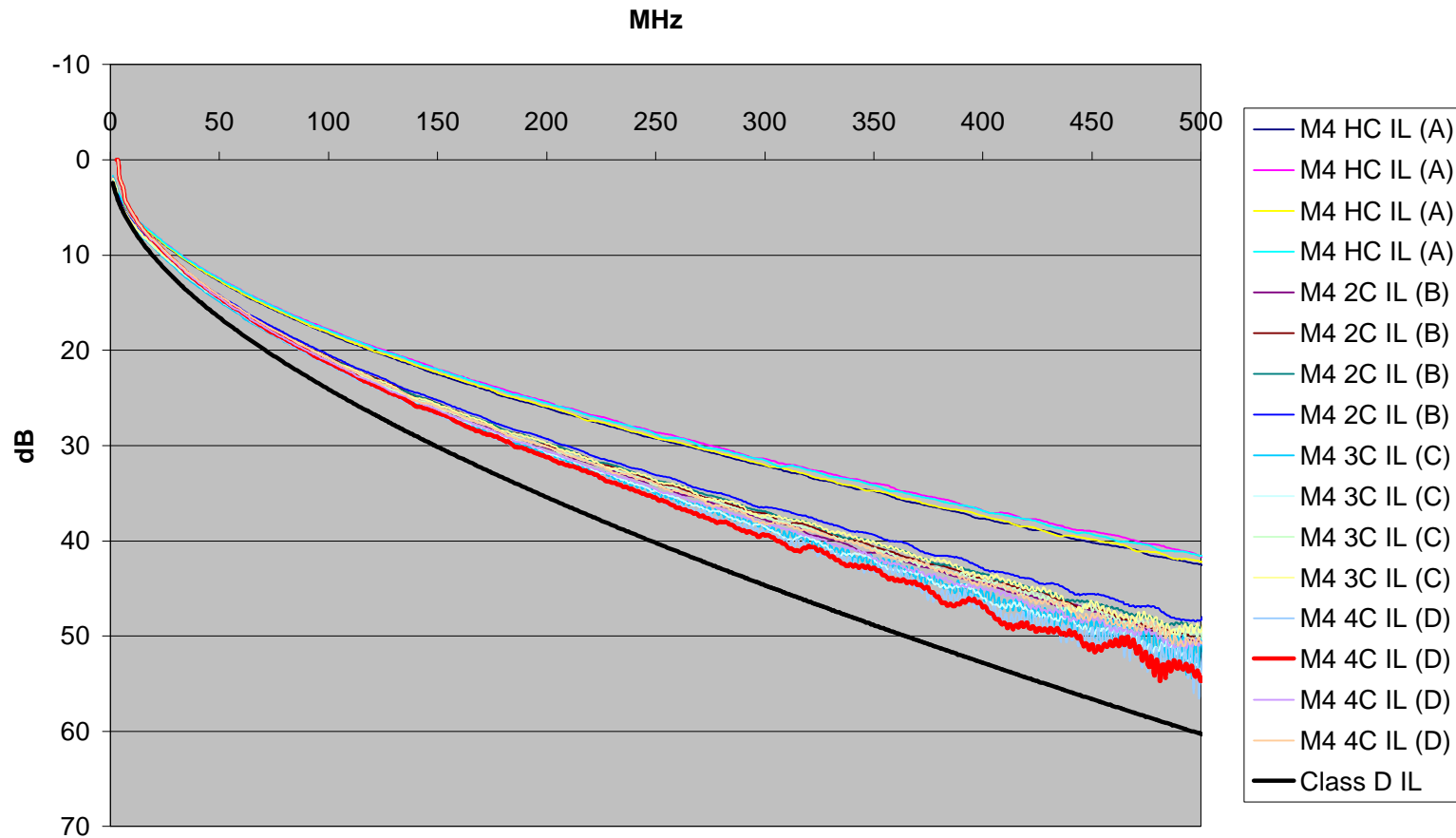
## Category 5e Return Loss Model



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# Category 5e IL- Identify worst case from measured data

## M4 Category 5e IL



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# Insertion Loss Fitting

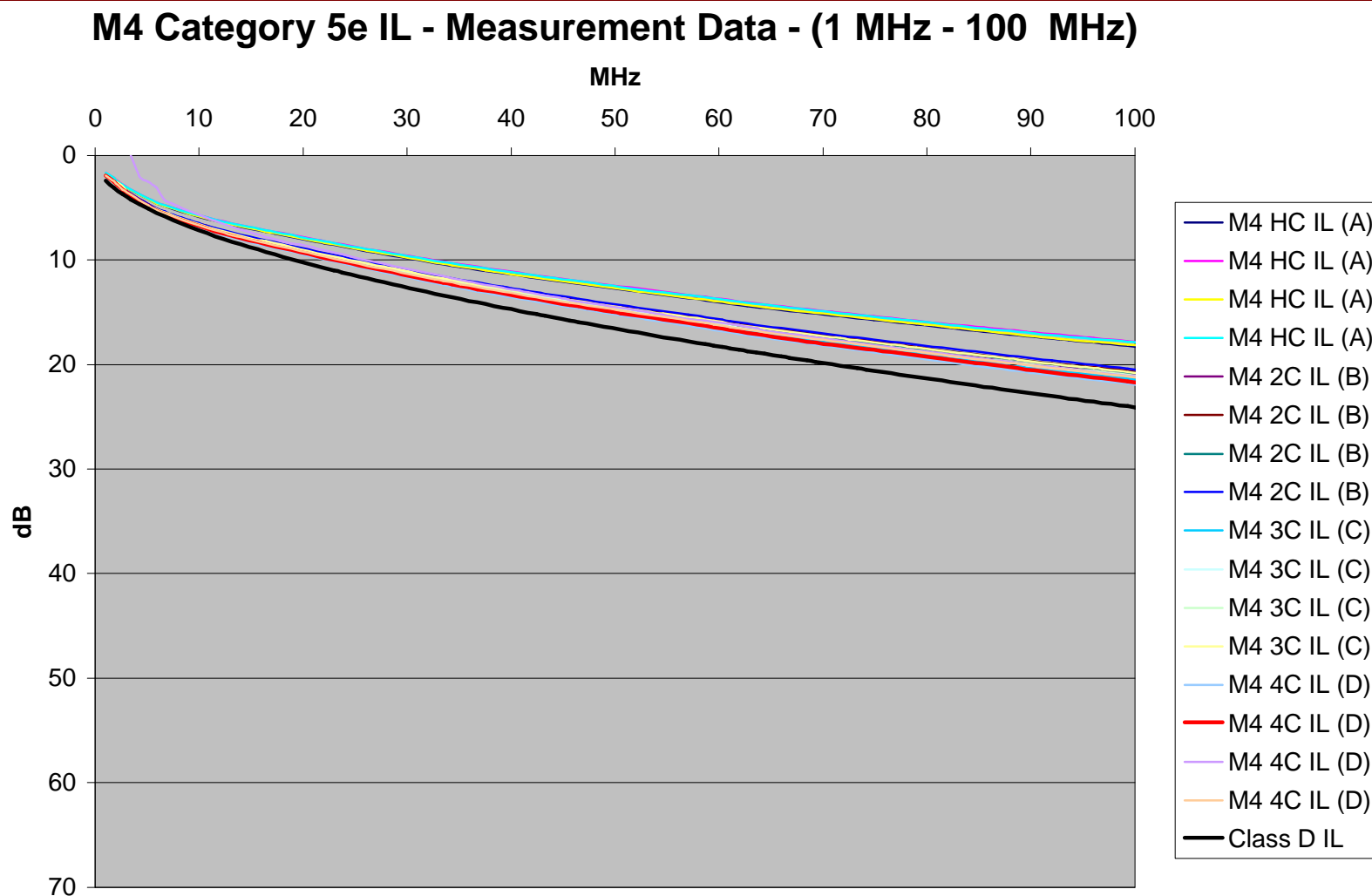
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- For 1000BASE-T- the Insertion Loss measurement model was a “best fit” to the Category 5 insertion loss limit.
- For 10GBASE-T - “fitting” the measured insertion loss to the extrapolated limit legitimizes the extrapolated limit as a specification limit
- The extrapolated limit is not representative of the measured data
- All of the measured data shows significant margin from the extrapolated limit
- At this point, I advocate utilizing the worst case measured data until we sort out the extended frequency behavior
- The worst case measurement data is ~2.54 dB better than Class D @100 MHz

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# Category 5e IL Measurement (1 MHz - 100 MHz)



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