

# Comment 124: Realigning the Cable Spec



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# Supporters

- Nathan Tracy, TE
- Greg McSorley, Amphenol
- Rich Mellitz, Samtech
- Ali Ghiasi, Ghiasi Quantum
- Upen Reddy Kareti, Cisco
- Pirooz Tooyserkani, Cisco
- Brad Booth, Microsoft
- Yasuo Hidaka, Fujitsu

# Problem Statement:

- Loss budgeting at a single frequency point of insertion loss is an outdated method for specifying a channel
- COM was explicitly created to address this and allow for trade off between loss and noise
- The current Insertion Loss Limit listed in clause 136.10 is overly restrictive and undermines COM results of higher loss, higher performance cables

# Purpose:

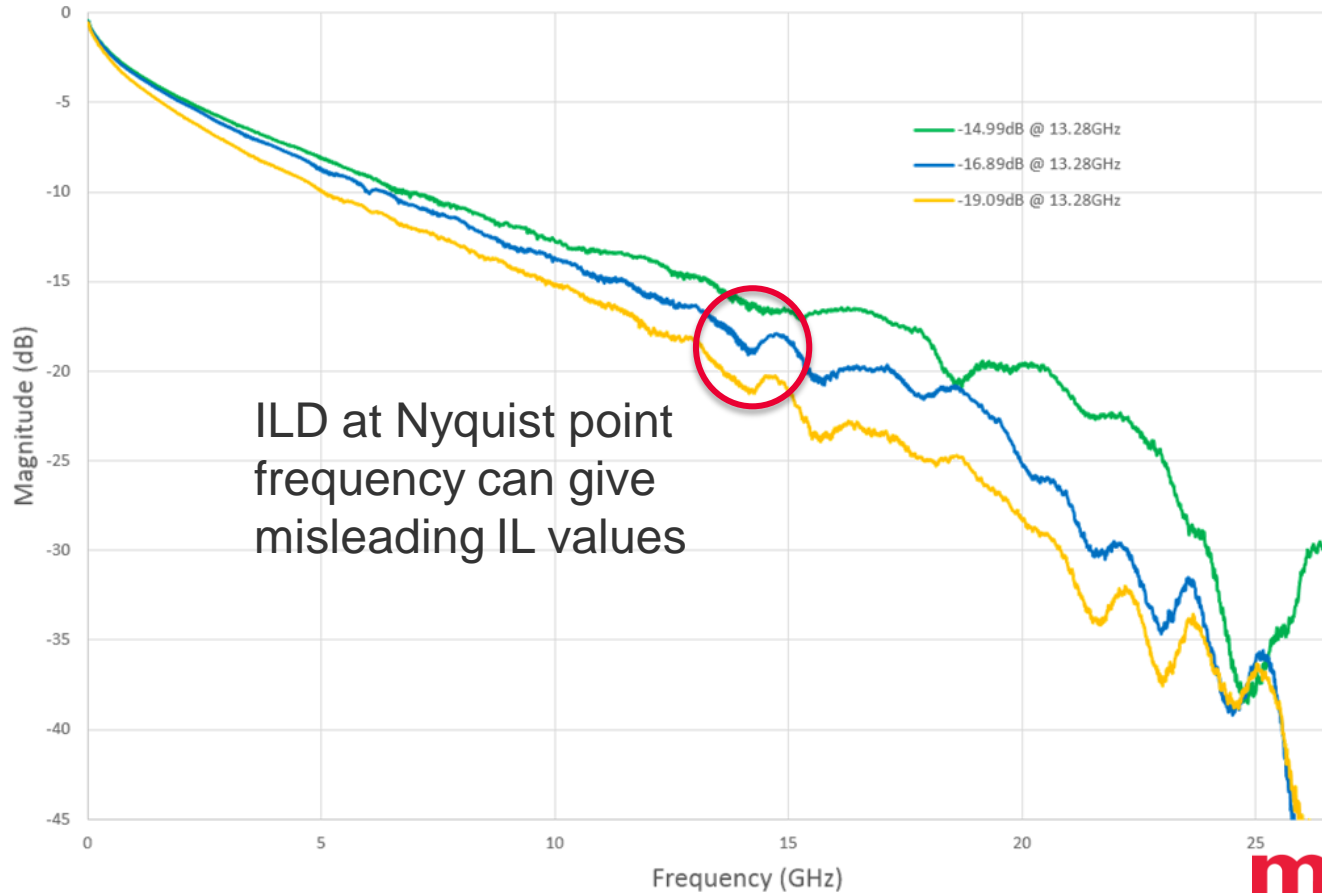
- Insertion loss & COM values are presented for low, mid, and high loss channels
- Data demonstrates the Insertion Loss Limit may be adjusted if other performance parameters (e.g. crosstalk, return loss, etc.) improve proportionally. This allows for new cable types with inherently higher loss to achieve 3m reaches.

# Analysis:

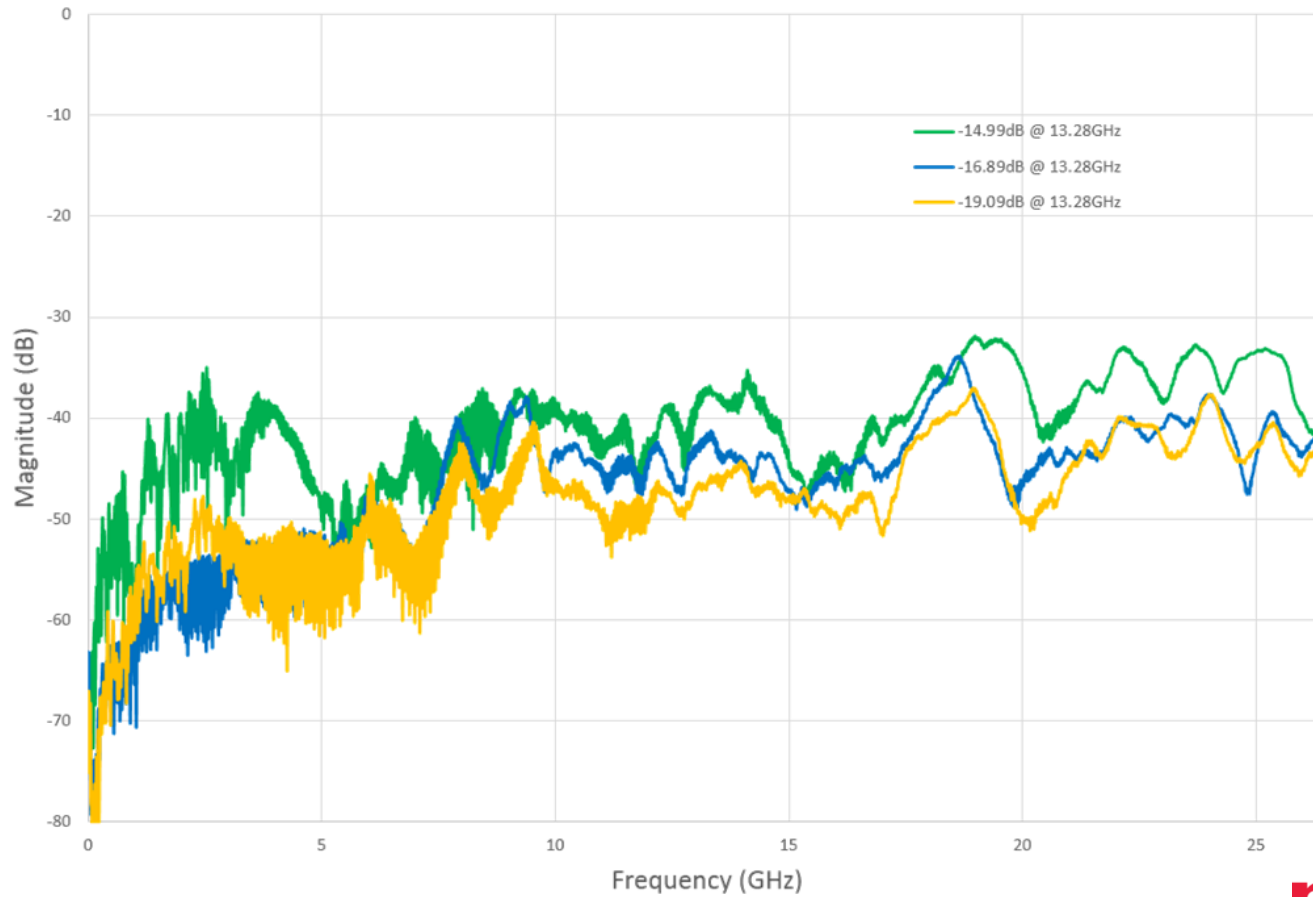
- Compare channels with different losses:
  - Low loss: pass the current 16.06dB limit
  - Mid loss: passes the proposed 18.00dB limit
  - High loss: loss greater than 18.00dB
- Calculate COM with different settings:
  - A Settings: D2.0 settings
  - B Settings: Yasuo's proposed settings

| Varied Parameters | Settings |       |
|-------------------|----------|-------|
|                   | A        | B     |
| A_v               | 0.45     | 0.415 |
| A_fe              | 0.45     | 0.415 |
| A_ne              | 0.63     | 0.604 |
| package_Z_c       | 90       | 95    |

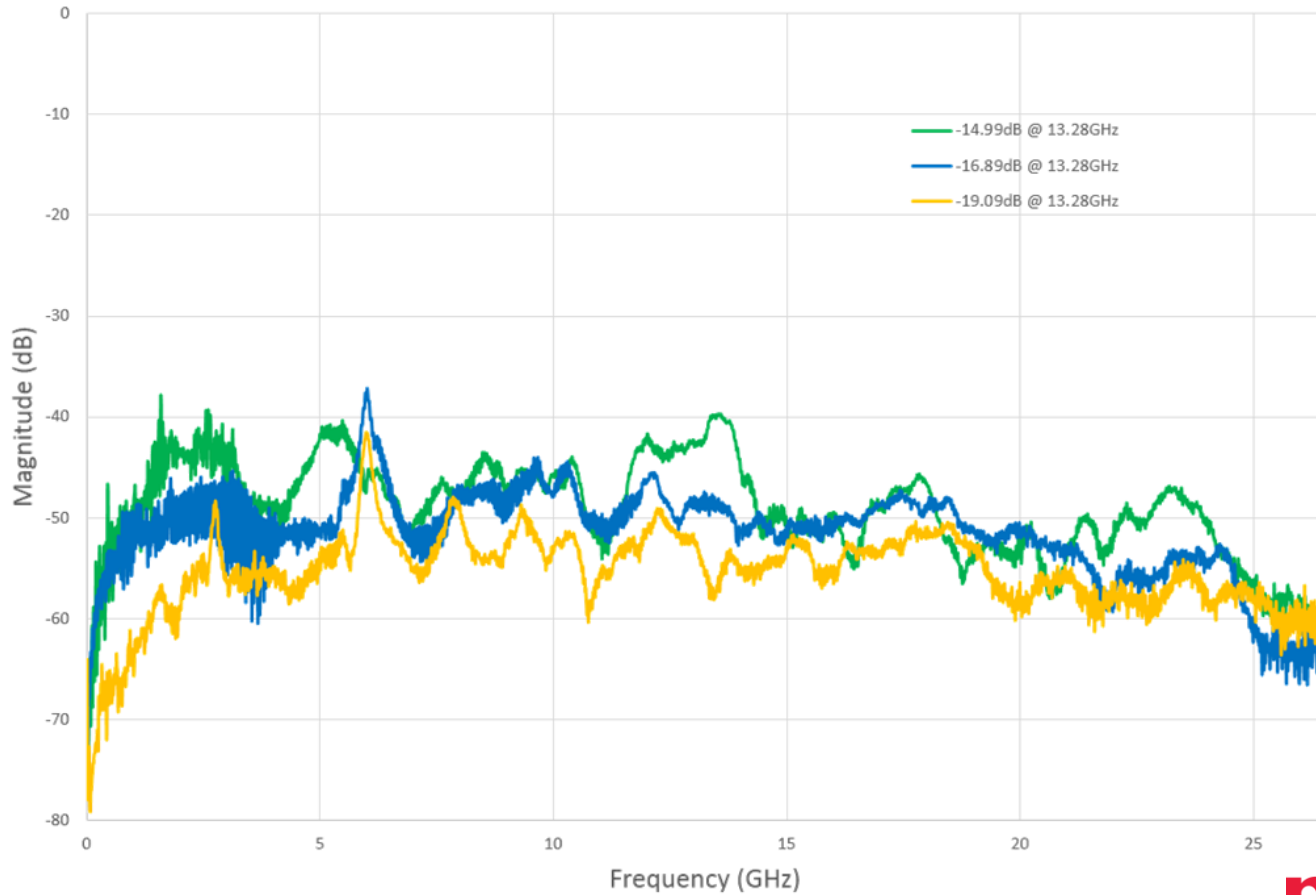
# Insertion Loss



# MDNEXT



# MDFEXT





# COM Results

| Channels                  | Low Loss |         | Mid Loss |         | High Loss |         |
|---------------------------|----------|---------|----------|---------|-----------|---------|
|                           | A        | B       | A        | B       | A         | B       |
| IL (dB)                   | 14.99    |         | 16.89    |         | 19.09     |         |
| COM (dB)                  | 4.1382   | 4.0132  | 3.6355   | 3.4526  | 3.3498    | 3.1229  |
| Interference (mV)         | 2.6804   | 2.5425  | 2.3806   | 2.2732  | 2.2095    | 2.1206  |
| Channel Interference (mV) | 1.7093   | 1.5901  | 1.5051   | 1.4174  | 1.3582    | 1.2821  |
| ISI (mV)                  | 1.2776   | 1.1542  | 0.98047  | 0.88627 | 0.89356   | 0.81422 |
| MDXTK (mV)                | 1.0661   | 1.0332  | 1.118    | 1.0825  | 0.98454   | 0.95398 |
| MDNEXT (mV)               | 0.98844  | 0.96051 | 1.0384   | 1.0114  | 0.88056   | 0.85676 |
| MDFEXT (mV)               | 0.38415  | 0.35918 | 0.40159  | 0.37886 | 0.40616   | 0.38281 |
| Signal after Eq. (mV)     | 4.3163   | 4.0358  | 3.618    | 3.3827  | 3.2493    | 3.0381  |

# Conclusion:

- Enough COM margin exists in high performance channels that the limit on insertion loss can be loosened to 18dB without having a detrimental effect on channel performance
- The current insertion loss limits are unnecessarily restrictive on channels that have wide margin on COM requirements
- Channel insertion loss deviations around the Nyquist point frequency can give misleading IL measurements

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# COM Settings:

| Table 93A-1 parameters |                 |       |                     |
|------------------------|-----------------|-------|---------------------|
| Parameter              | Setting         | Units | Information         |
| f_b                    | 26.5625         | GBd   |                     |
| f_min                  | 0.05            | GHz   |                     |
| Delta_f                | 0.01            | GHz   |                     |
| C_d                    | [1.8e-4 1.8e-4] | nF    | [TX RX]             |
| z_p select             | [1]             |       | [test cases to run] |
| z_p (TX)               | [30]            | mm    | [test cases]        |
| z_p (NEXT)             | [12]            | mm    | [test cases]        |
| z_p (FEXT)             | [30]            | mm    | [test cases]        |
| z_p (RX)               | [30]            | mm    | [test cases]        |
| C_p                    | [1.1e-4 1.1e-4] | nF    | [TX RX]             |
| R_0                    | 50              | Ohm   |                     |
| R_d                    | [55 55]         | Ohm   | [TX RX]             |
| f_r                    | 0.75            | *fb   |                     |
| c(0)                   | 0.6             |       | min                 |
| c(-1)                  | [-0.25:0.05:0]  |       | [min:step:max]      |
| c(-2)                  | [0:0.025:1]     |       | [min:step:max]      |
| c(1)                   | [-0.25:0.05:0]  |       |                     |
| g_DC                   | [-20:1:-15]     | dB    | [min:step:max]      |
| f_z                    | 10.625          | GHz   |                     |
| f_p1                   | 10.625          | GHz   |                     |
| f_p2                   | 2.66E+01        | GHz   |                     |

| A_v                 | Varies    | V                   |                |
|---------------------|-----------|---------------------|----------------|
| A_fe                | Varies    | V                   |                |
| A_ne                | Varies    | V                   |                |
| L                   | 4         |                     |                |
| M                   | 32        |                     |                |
| N_b                 | 12        | UI                  |                |
| b_max(1)            | 0.7       |                     |                |
| b_max(2..N_b)       | 0.2       |                     |                |
| sigma_RJ            | 0.01      | UI                  |                |
| A_DD                | 0.02      | UI                  |                |
| eta_0               | 1.64E-08  | V <sup>2</sup> /GHz |                |
| SNR_TX              | 32.5      | dB                  |                |
| R_LM                | 0.95      |                     |                |
| DER_0               | 1.00E-04  |                     |                |
| Operational control |           |                     |                |
| COM Pass threshold  | 3         | dB                  |                |
| Include PCB         | 1         | Value               | 0, 1, 2        |
| g_DC_HP             | [-6:1:-2] |                     | [min:step:max] |
| f_HP_PZ             | 0.6640625 | GHz                 |                |

# COM Settings Continued:

| I/O control                  |           |         |
|------------------------------|-----------|---------|
| DIAGNOSTICS                  | 1         | logical |
| DISPLAY_WINDOW               | 0         | logical |
| Display frequency domain     | 0         | logical |
| CSV_REPORT                   | 1         | logical |
| RESULT_DIR                   | .\Folder\ |         |
| SAVE_FIGURES                 | 0         | logical |
| Port Order                   | [1 3 2 4] |         |
| RUNTAG                       | _CR-4     |         |
| Receiver testing             |           |         |
| RX_CALIBRATION               | 0         | logical |
| Sigma BBN step               | 5.00E-03  | V       |
| IDEAL_TX_TERM                | 0         | logical |
| T_r                          | 1.20E-02  | ns      |
| T_r_filter_type              | 1         | logical |
| T_r_meas_point               | 0         | logical |
|                              |           |         |
| Non standard control options |           |         |
| INC_PACKAGE                  | 1         | logical |
| IDEAL_RX_TERM                | 0         | logical |
| INCLUDE_CTLE                 | 1         | logical |
| INCLUDE_TX_RX_FILTER         | 1         | logical |
| COM_CONTRIBUTION             | 0         | logical |

| Table 93A-3 parameters  |                       |       |
|-------------------------|-----------------------|-------|
| Parameter               | Setting               | Units |
| package_tl_gamma0_a1_a2 | [0 1.734e-3 1.455e-4] |       |
| package_tl_tau          | 6.141E-03             | ns/mm |
| package_Z_c             | Varies                | Ohm   |
|                         |                       |       |
| Table 92-12 parameters  |                       |       |
| Parameter               | Setting               |       |
| board_tl_gamma0_a1_a2   | [0 4.114e-4 2.547e-4] |       |
| board_tl_tau            | 6.191E-03             | ns/mm |
| board_Z_c               | 110                   | Ohm   |
| z_bp (TX)               | 151                   | mm    |
| z_bp (NEXT)             | 72                    | mm    |
| z_bp (FEXT)             | 72                    | mm    |
| z_bp (RX)               | 151                   | mm    |