FORCE10™

Channel Model and Material Characteristics

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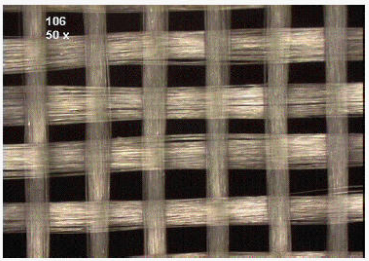
Abstract: This technical presentation covers channel model changes and the resulting changes to material definitions.

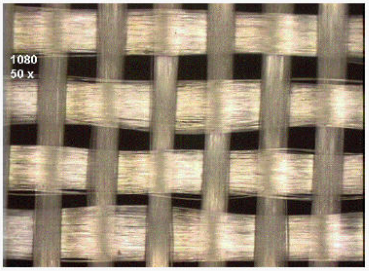
Ad hoc Discussions

- Channel SDD21 Limit line to change
- ICR Limit Line to change based on SDD21 Change
- Material Dk/Df to change based on SDD21 Change
- TX jitter to be reduced from 0.30UI to 0.28UI.
- DCD will not be added to the EIT Test.
- EIT value to be XXmv
- The simulations will be run with the latest channel models. In order to be consistent:
  - DCD at the TX 0.05
  - Transmit Jitter 0.28UI
  - Latest Package model
  - For the M20 channel NEXT2, NEXT6 and FEXT1 should be used.

General Glass Construction



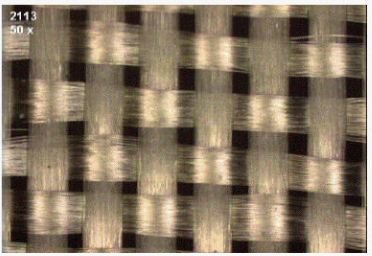
Glass Style: 106
Plain Weave
Count: 56x56 (ends/in)
Thickness: 0.0015 (in)



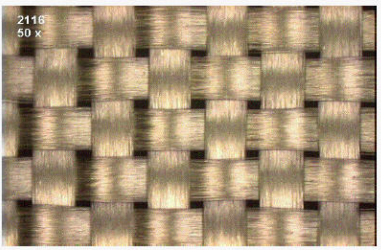
Glass Style: 1080
Plain Weave
Count: 60x47 (ends/in)
Thickness: 0.0025 (in)

NOTE:
The plain weave yarn consists of yarns interlaced in an alternating fashion one over and one under every yarn.

Circuit board material is just multiple sheets of glass with copper traces and copper planes added for electrical connections.

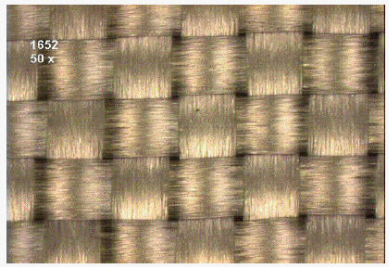


Glass Style: 2113
Plain Weave
Count: 60x56 (ends/in)
Thickness: 0.0029 (in)

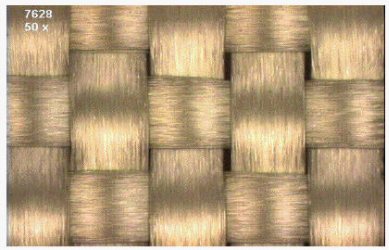


Glass Style: 2116
Plain Weave
Count: 60x58 (ends/in)
Thickness: 0.0038 (in)

NOTE:
The plain weave yarn consists of yarns interlaced in an alternating fashion one over and one under every yarn.



Glass Style: 1652
Plain Weave
Count: 52x52 (ends/in)
Thickness: 0.0045 (in)

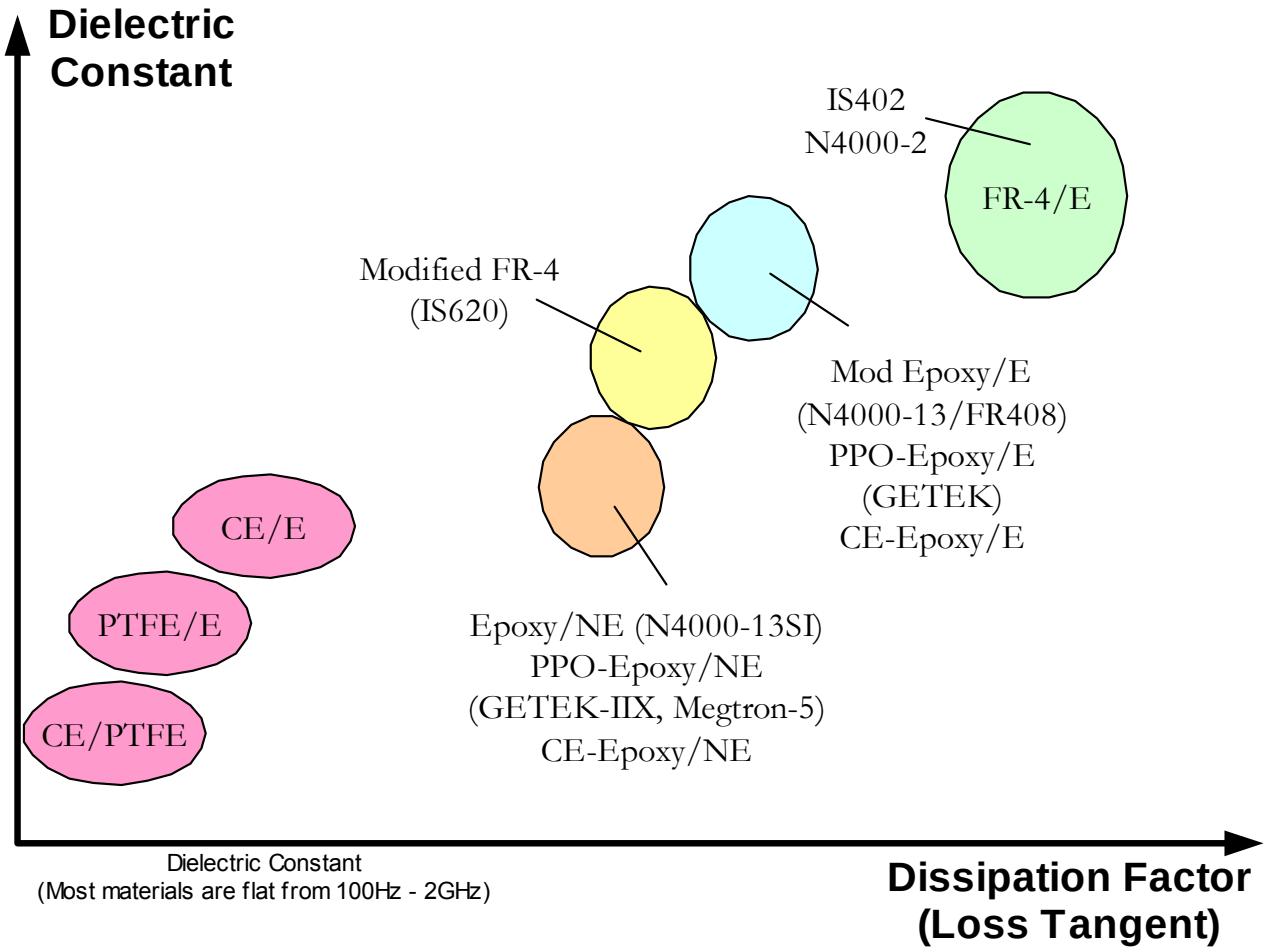


Glass Style: 7628
Plain Weave
Count: 44x32 (ends/in)
Thickness: 0.0068 (in)

NOTE:
The plain weave yarn consists of yarns interlaced in an alternating fashion one over and one under every yarn.

Reference: Isola

Materials in Perspective

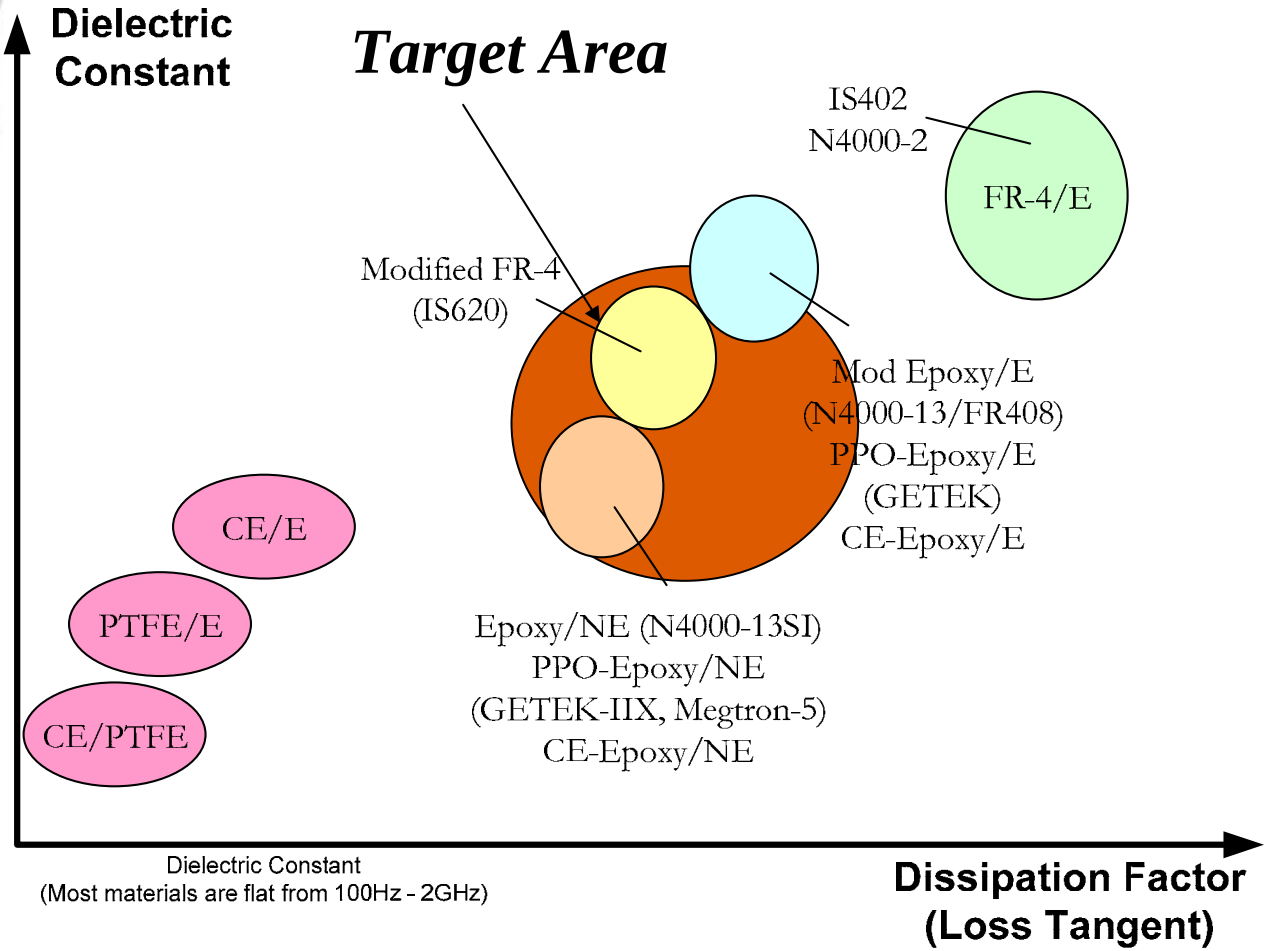


Graph provided by Zhi Wong zwong@altera.com

Definition: “Improved FR-4” as defined by IEEE P802.3ap

- Improved FR-4 (Mid Resolution Signal Integrity):
  - 100Mhz: Dk ≤ 3.60; Df ≤ .0092
  - 1Ghz: Dk ≤ 3.60; Df ≤ .0092
  - 2Ghz: Dk ≤ 3.50; Df ≤ .0115
  - 5Ghz: Dk ≤ 3.50; Df ≤ .0115
  - 10Ghz: Dk ≤ 3.40; Df ≤ .0125
  - 20Ghz: Dk ≤ 3.20; Df ≤ .0140
- Temperature and Humidity Tolerance (0-55degC, 10-90% non-condensing):
  - Dk:+/- .04
  - Df: +/- .001
- Resin Tolerance (standard +/-2%):
  - Dk:+/- .02
  - Df: +/- .0005

Channel Model Perspective



Graph provided by Zhi Wong zwong@altera.com

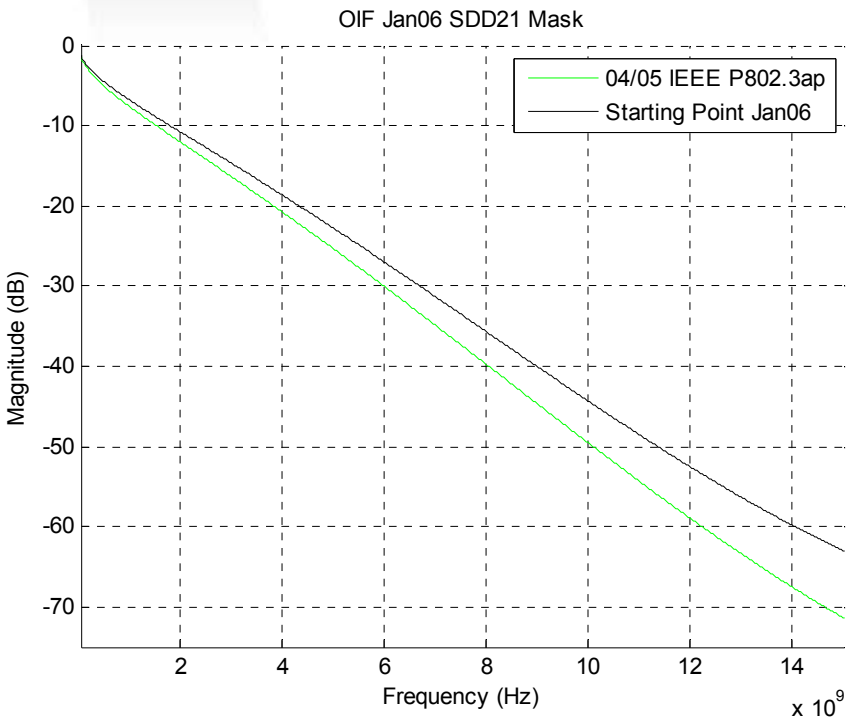
New Definition “Improved FR-4”

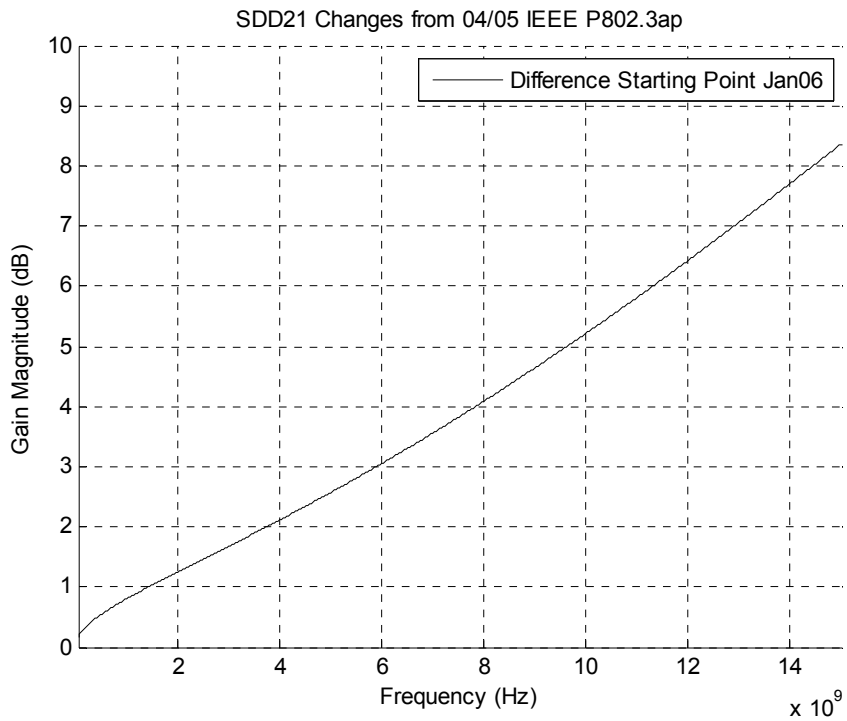
- Improved FR-4 (Mid Resolution Signal Integrity):
  - 100Mhz: Dk ≤ 3.60; Df ≤ .010
  - 1Ghz: Dk ≤ 3.57; Df ≤ .010
  - 2Ghz: Dk ≤ 3.50; Df ≤ .011
  - 5Ghz: Dk ≤ 3.50; Df ≤ .011
  - 10Ghz: Dk ≤ 3.40; Df ≤ .012
  - 20Ghz: Dk ≤ 3.20; Df ≤ .0125
- Temperature and Humidity Tolerance (0-55degC, 10-90% non-condensing):
  - Dk:+/- .04
  - Df: +/- .001
- Resin Tolerance (standard +/-2%):
  - Dk:+/- .02
  - Df: +/- .0005

Channel Model Equation

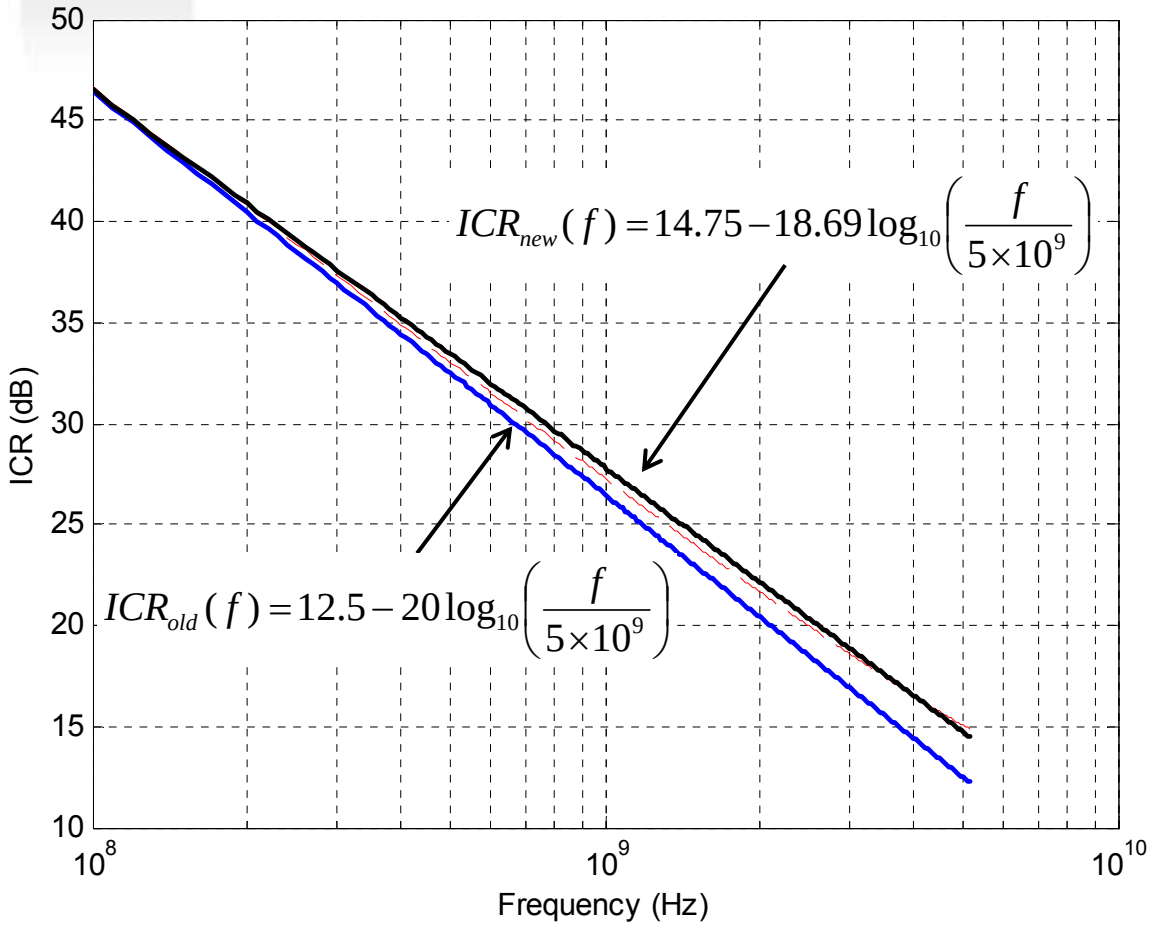
- b1 = 2.00e-5
- b2 = 1.10e-10
- b3 = 3.20e-20
- b4 = -1.20e-30
- SDD21 = -20*log10(e)*(b1*sqrt(f) + b2*f + b3*f^2 + b4*f^3)
- f = 50Mhz to 15000Mhz

New Limit Line



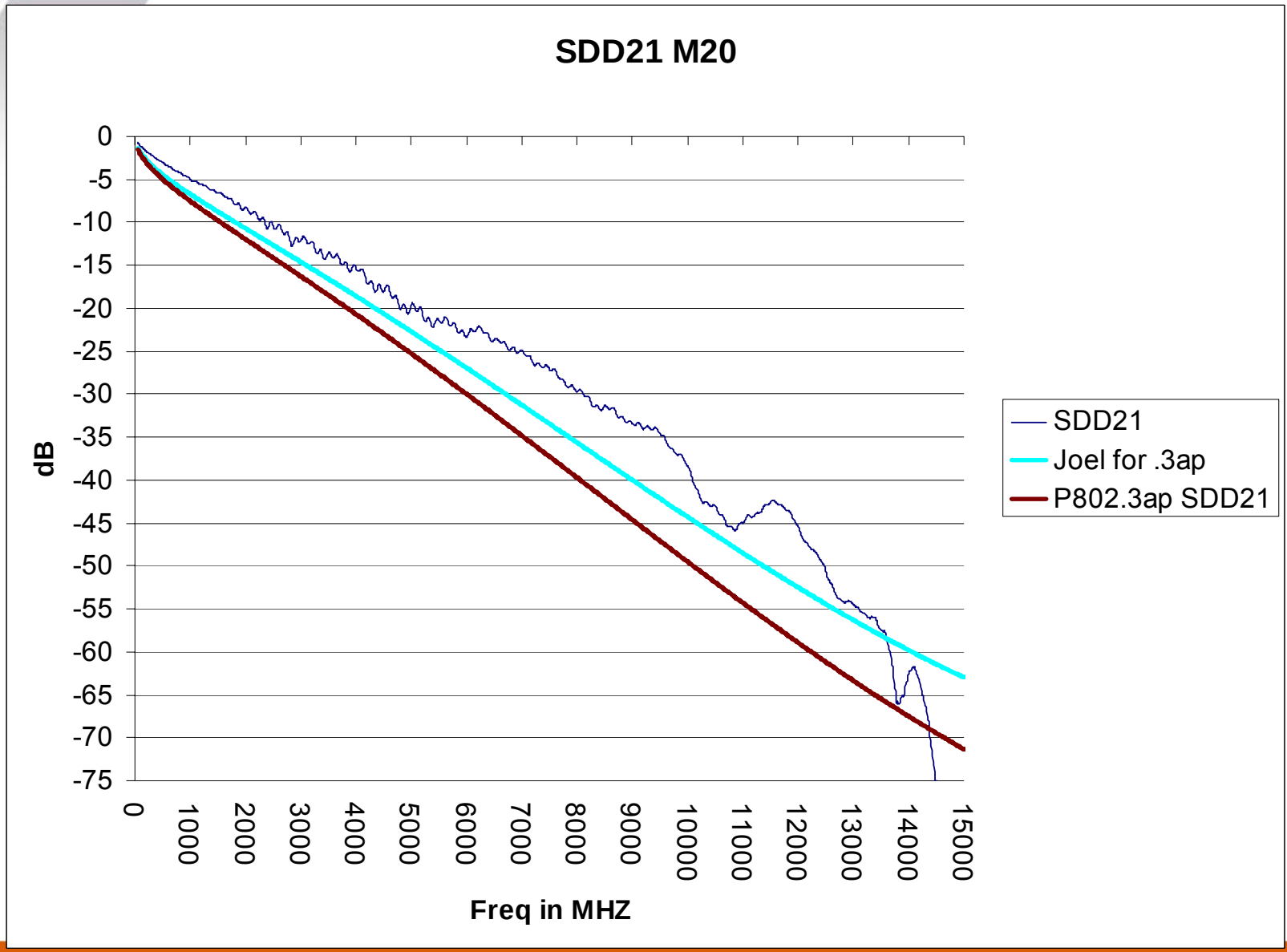


New ICR Line

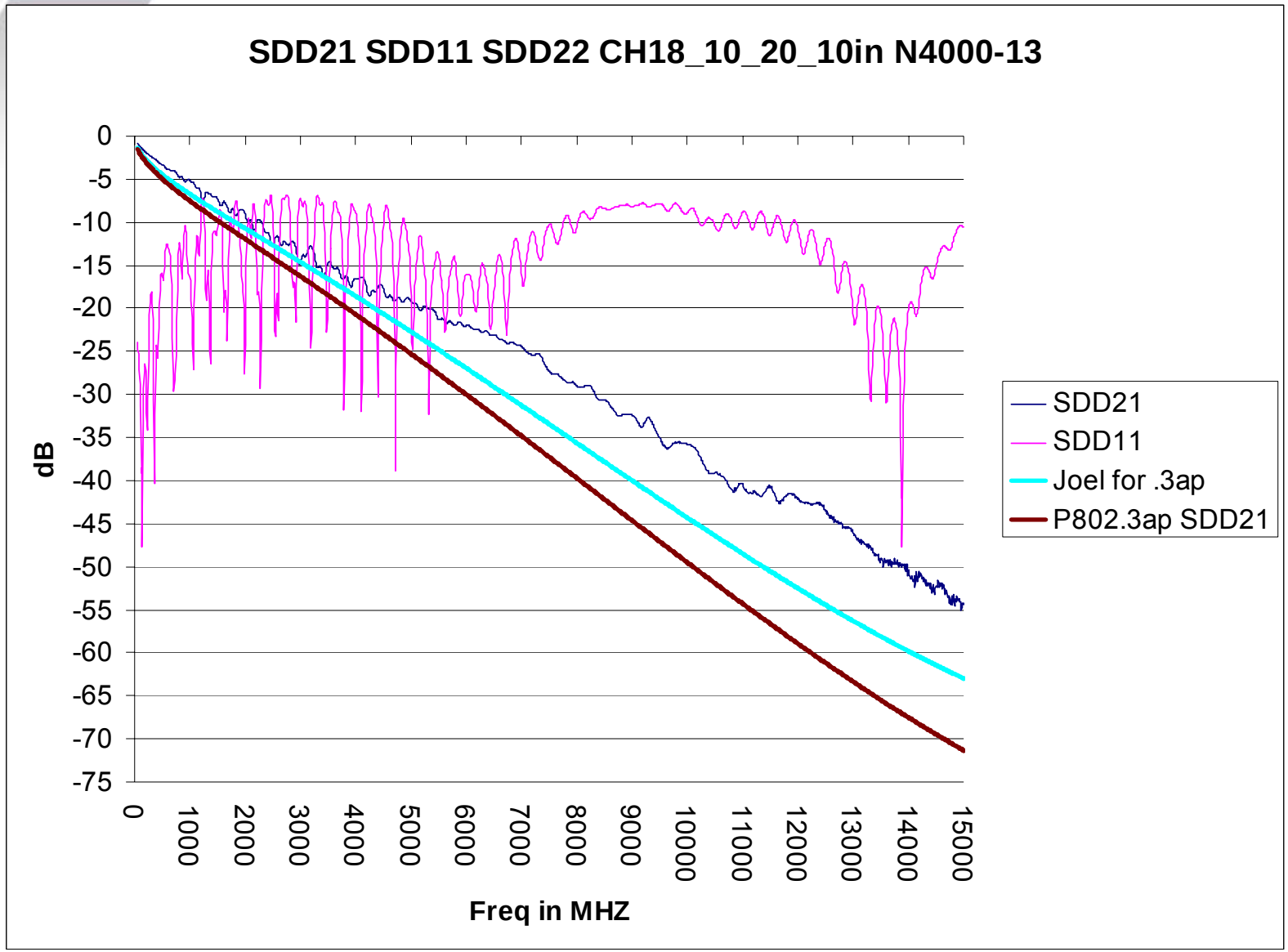


Black – new
Blue - old

Channel Model M20



Channel Model CH18_10_20_10



Channel Model CH20_5_5_20_10