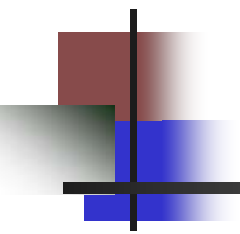


Informative IL Spec Value Recommendations

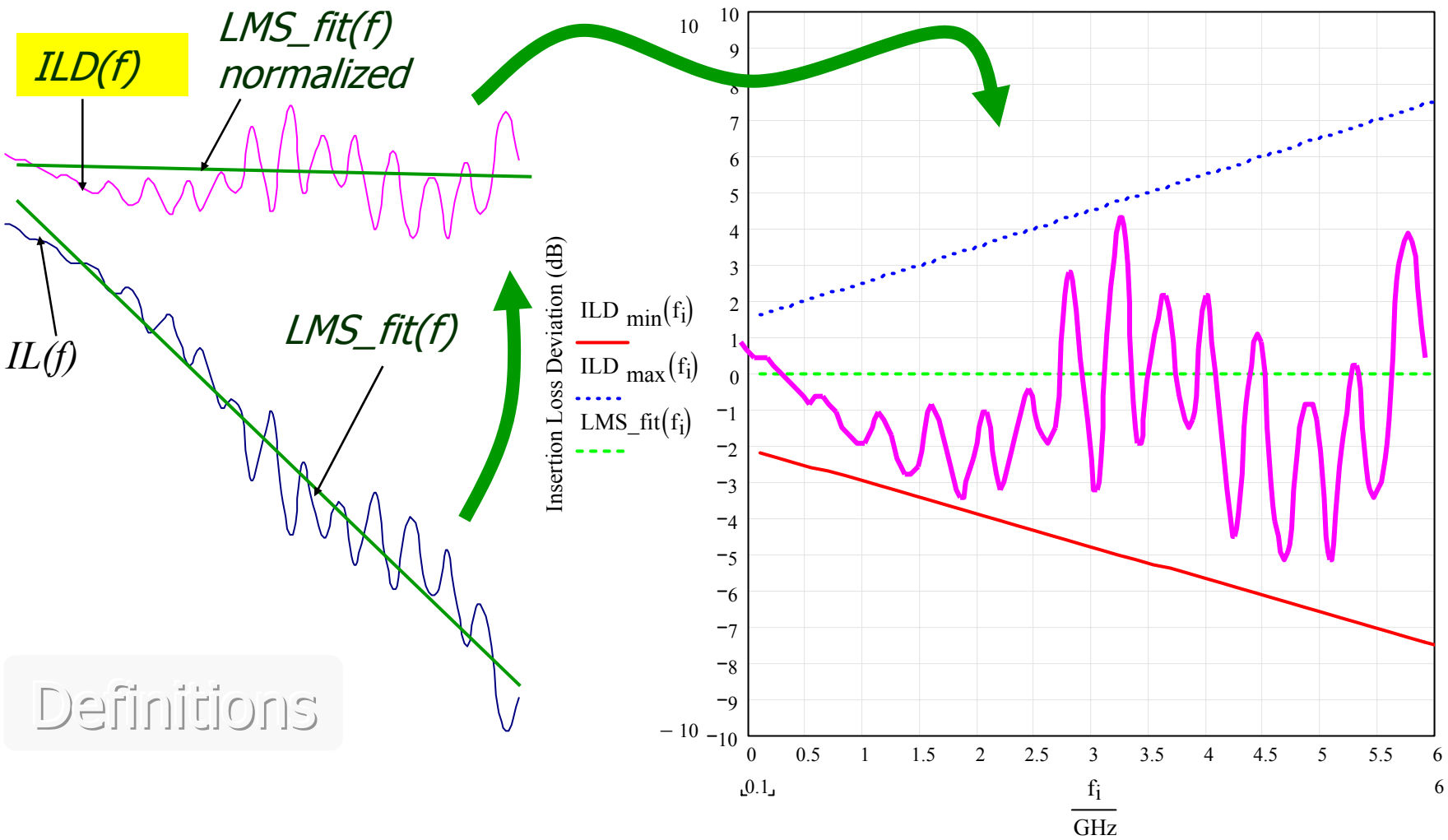
Richard Mellitz

6/7/2005

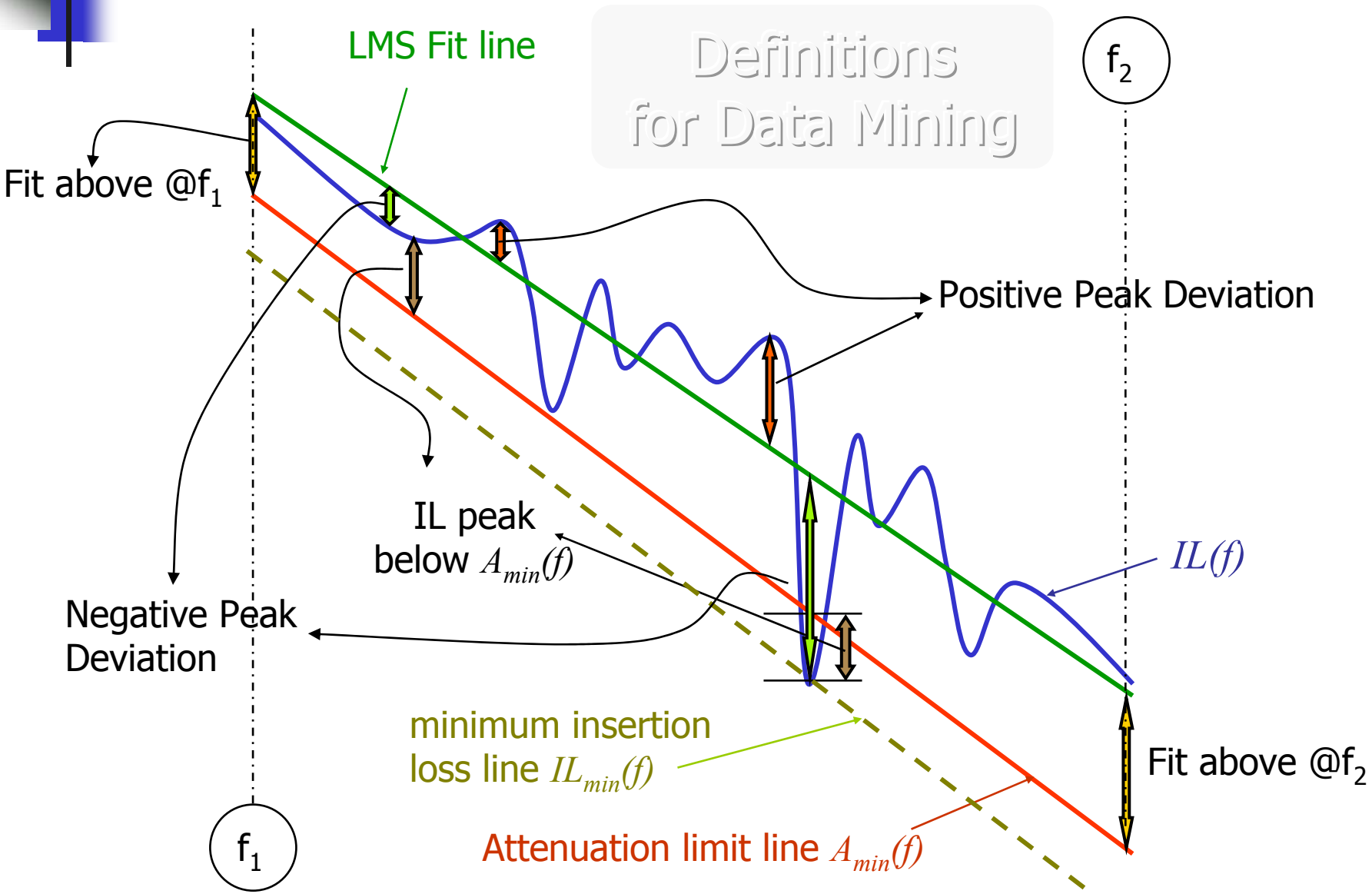
ToC

- Insertion loss deviation and SDD21 IL deviation parameters
- Minimum Insertion loss
- Data
- IL deviation and loss limit table
- Potential Recommended text changes
- Alternative compromise

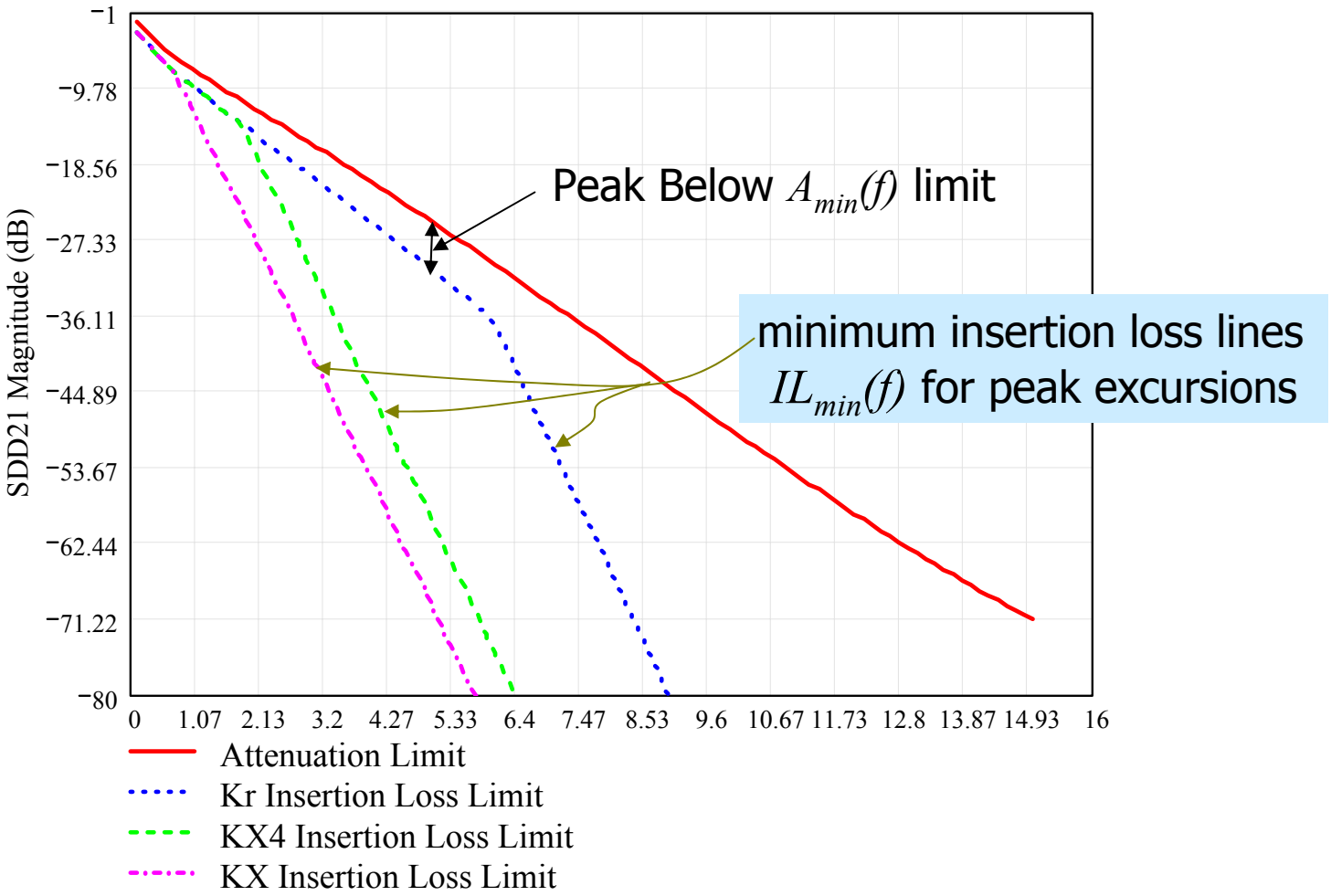
Deviation parameter concept



IL Measurement Parameters



Minimum Insertion Loss Limits



Data following for

- 3 summary plots for all port types together (KX, KX4, and KR)
  - Peaks Below $A_{min}(f)$
  - Positive IL Peak Deviations
  - Negative IL Peak Deviations
- 9 individual port type plots (KX, KX4, and KR) for the above.

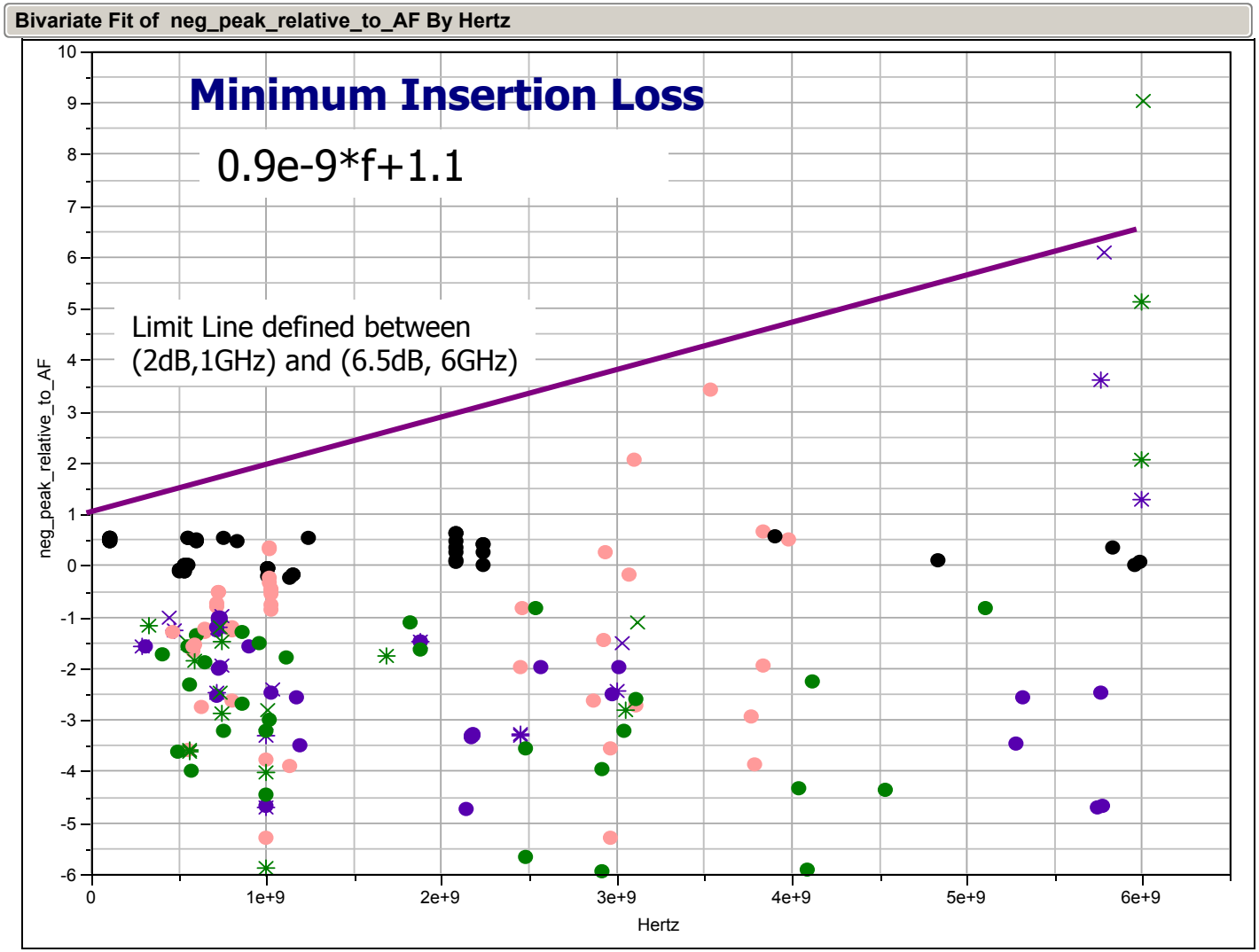
IL peak below $A_{min}(f)$ all ports

Kr,Kx,Kx4

Positive numbers are peaks below Attenuation Limit line

Tyco case6 and top channel exceed 10db/GHz limit above 6GHz

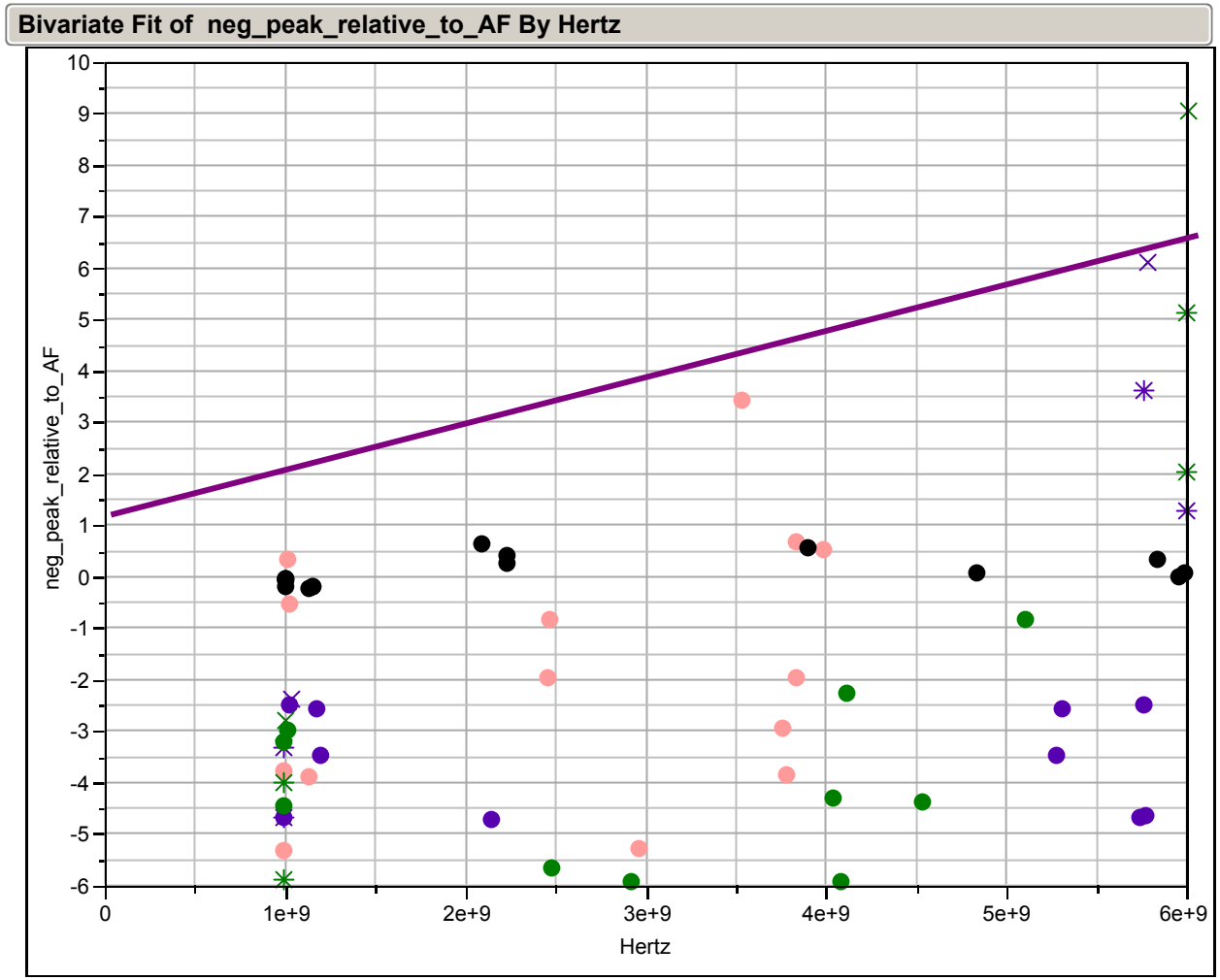
1	Tyco Cases
2	Molex Cases
3	peters 0305 middle & bottom
4	peters 0305 top
5	peters_01_0305_T20
6	peters 0904 middel & bottom
7	peters 0904 top
8	peters_01_0904_T20



S-parameters alone (no package)

IL peak below $A_{min}(f)$ for KR

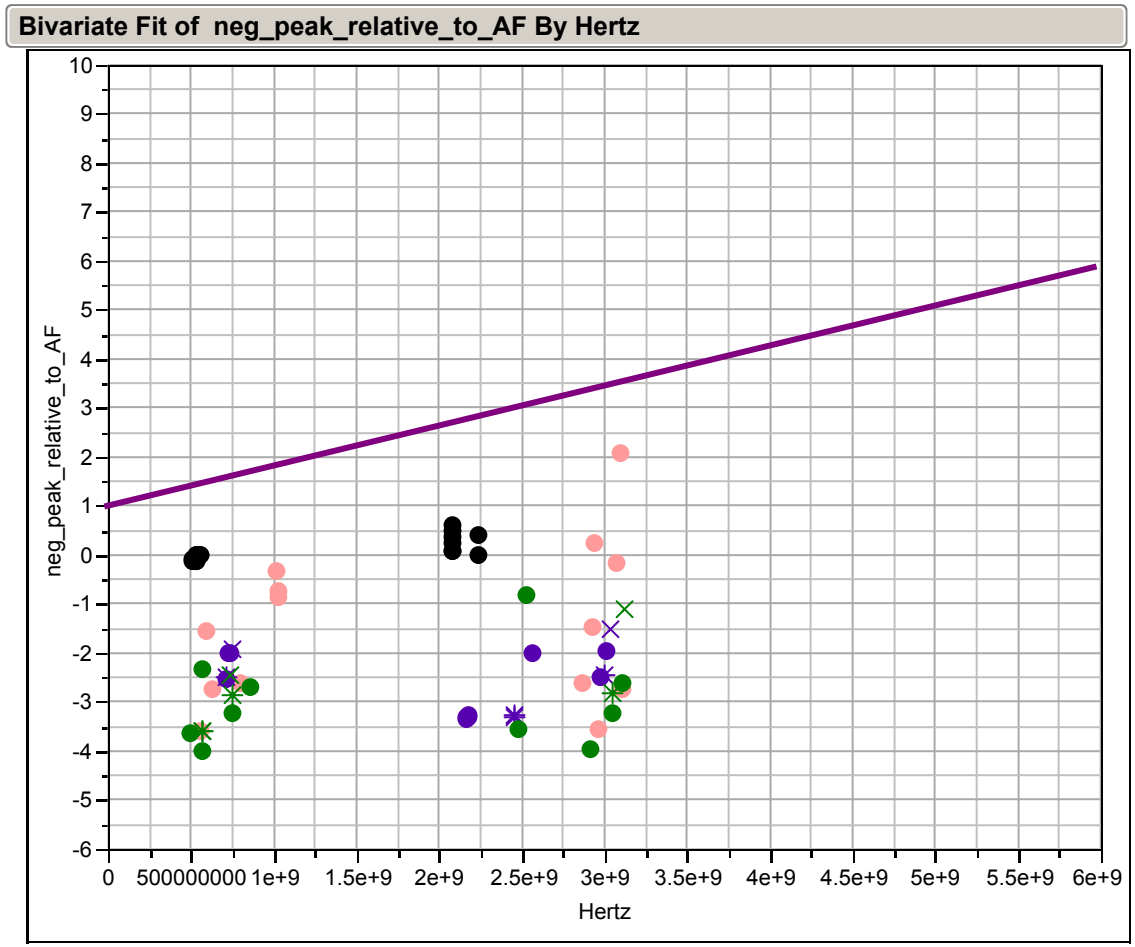
Positive numbers are peaks below Attenuation Limit line



1	Tyco Cases
2	Molex Cases
3	peters 0305 middle & bottom
4	peters 0305 top
5	peters_01_0305_T20
6	peters 0904 middel & bottom
7	peters 0904 top
8	peters_01_0904_T20

IL peak below $A_{min}(f)$- for KX4

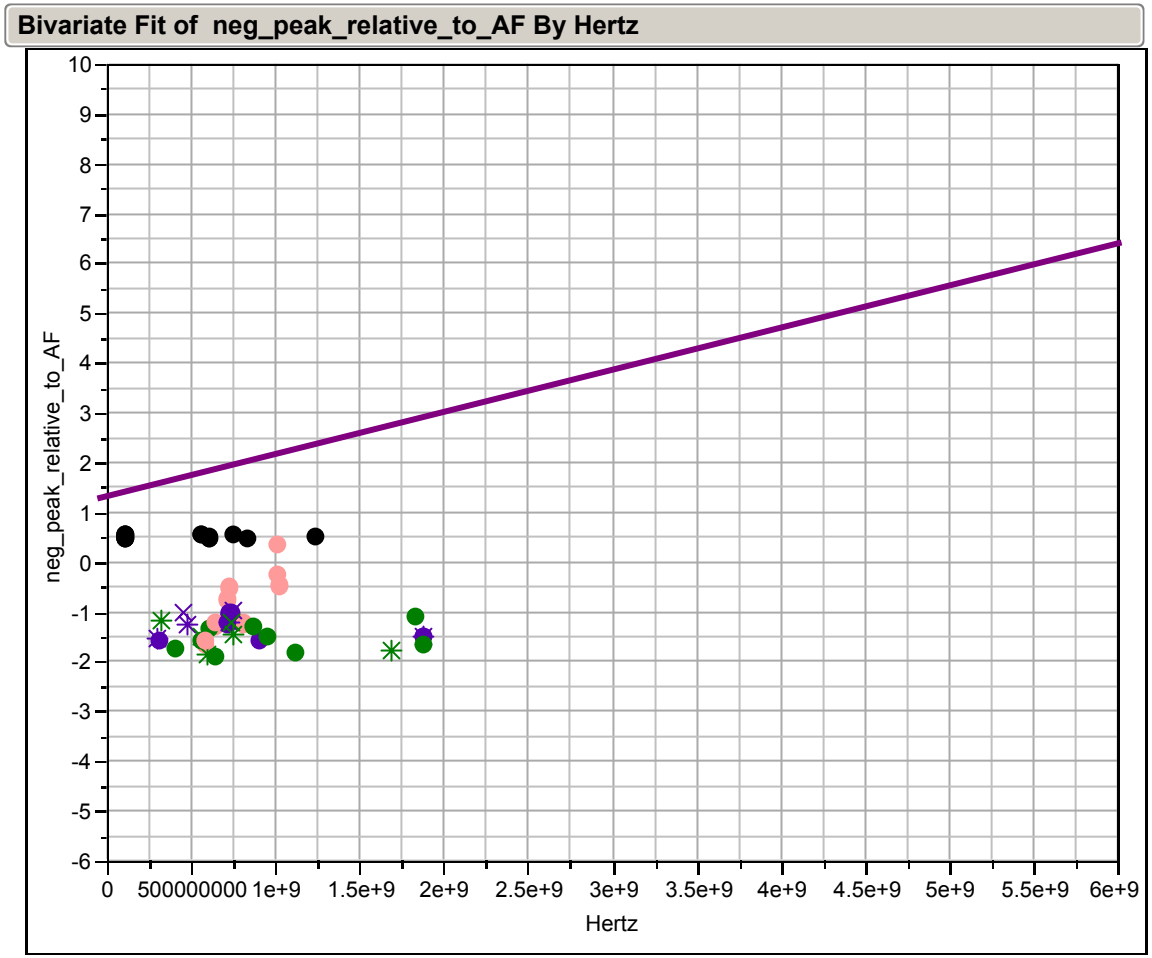
Positive numbers are peaks below Attenuation Limit line



1	Tyco Cases
2	Molex Cases
3	peters 0305 middle & bottom
4	peters 0305 top
5	peters_01_0305_T20
6	peters 0904 middel & bottom
7	peters 0904 top
8	peters_01_0904_T20

IL peak below $A_{min}(f)$ for KX

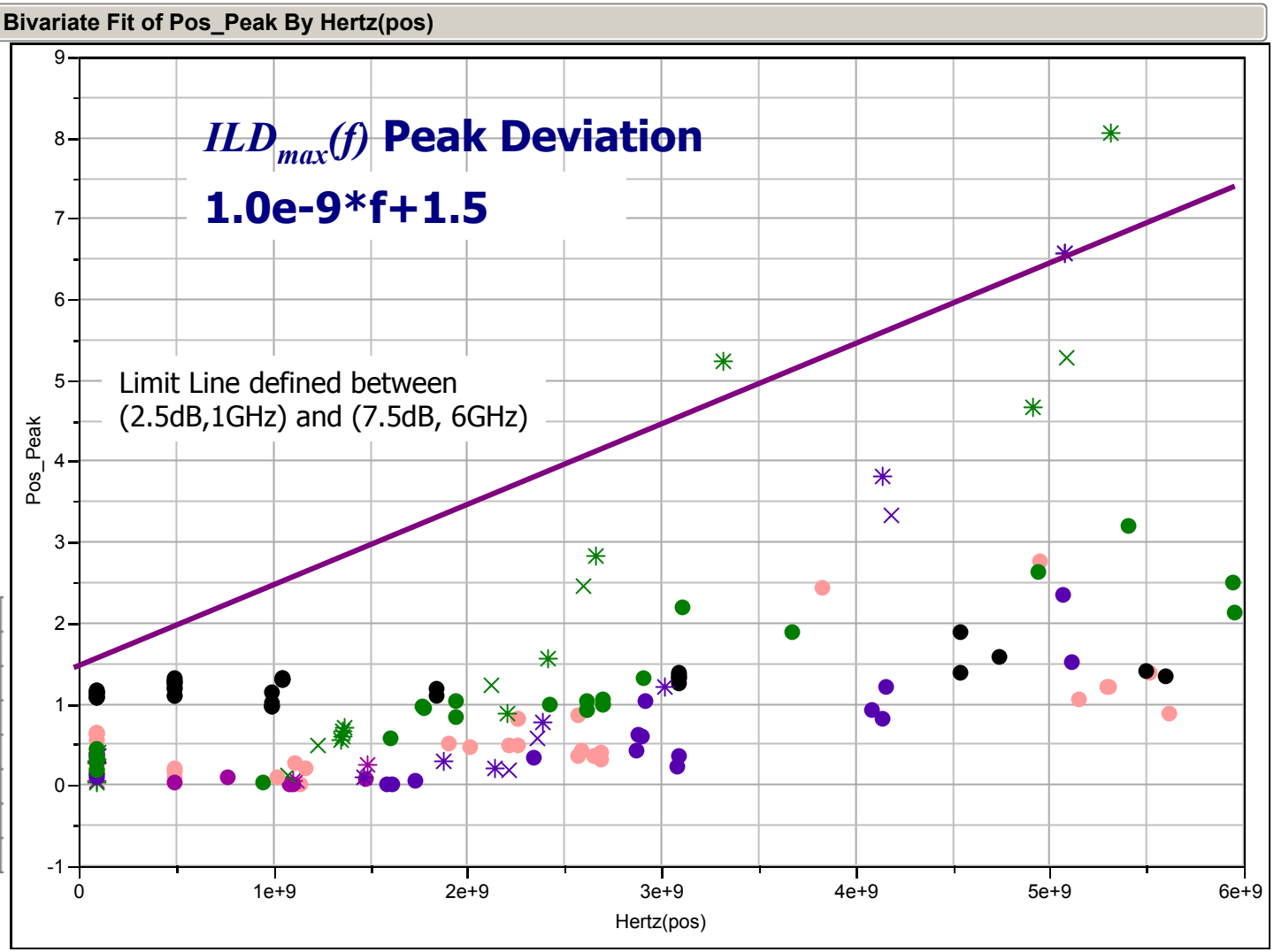
Positive numbers are peaks below Attenuation Limit line



1	Tyco Cases
2	Molex Cases
3	peters 0305 middle & bottom
4	peters 0305 top
5	peters_01_0305_T20
6	peters 0904 middel & bottom
7	peters 0904 top
8	peters_01_0904_T20

Positive IL Deviation Peaks

Kr,Kx,Kx4

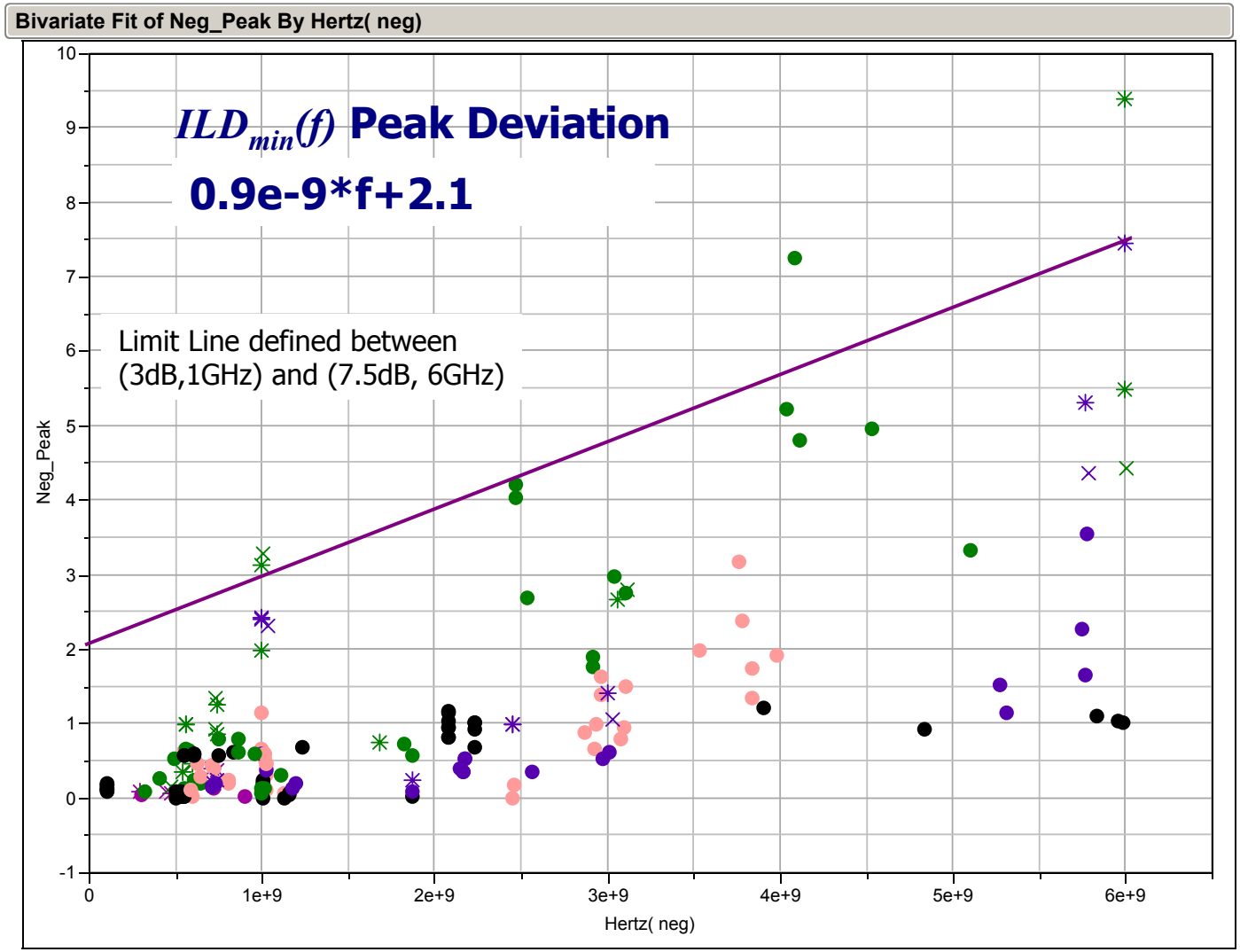


1	Tyco Cases
2	Molex Cases
3	peters 0305 middle & bottom
4	peters 0305 top
5	peters_01_0305_T20
6	peters 0904 middel & bottom
7	peters 0904 top
8	peters_01_0904_T20

S-parameters alone were used (no package)

Negative IL Deviation Peaks

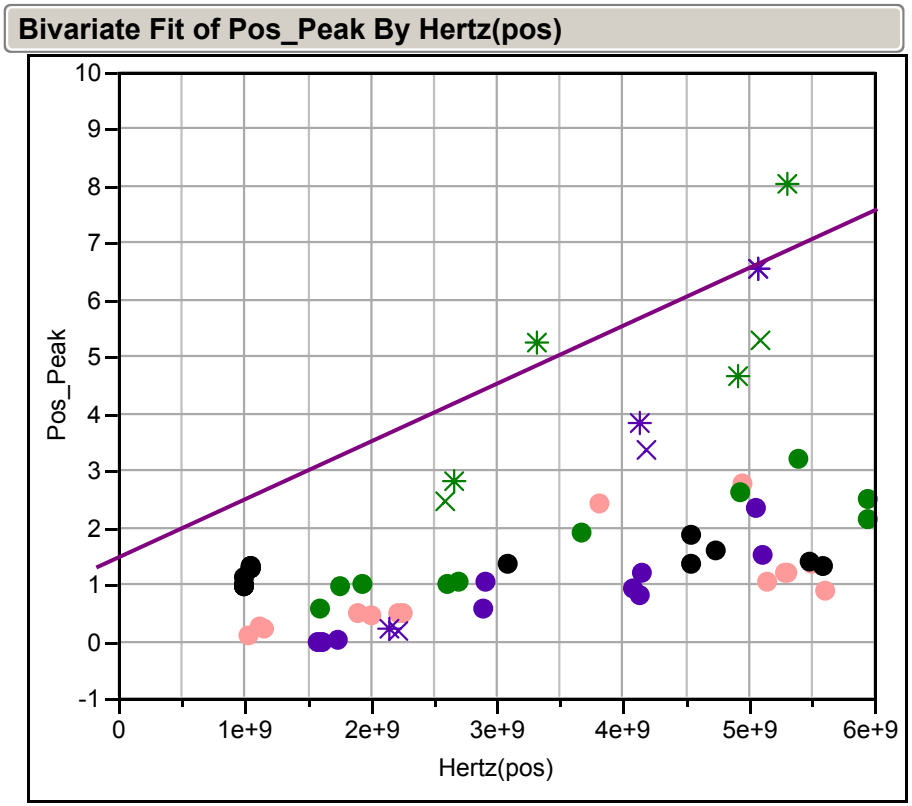
Kr,Kx,Kx4

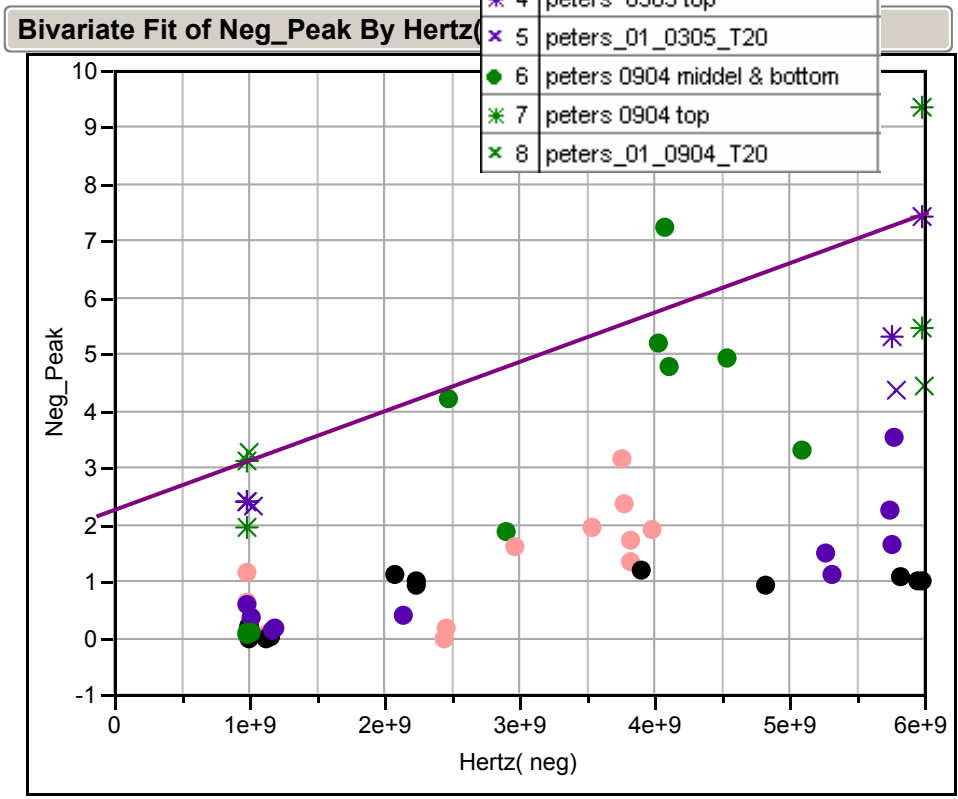


1	Tyco Cases
2	Molex Cases
3	peters 0305 middle & bottom
4	peters 0305 top
5	peters_01_0305_T20
6	peters 0904 middel & bottom
7	peters 0904 top
8	peters_01_0904_T20

S-parameters alone were used (no package)

Positive and Negative IL Deviation Peaks - KR





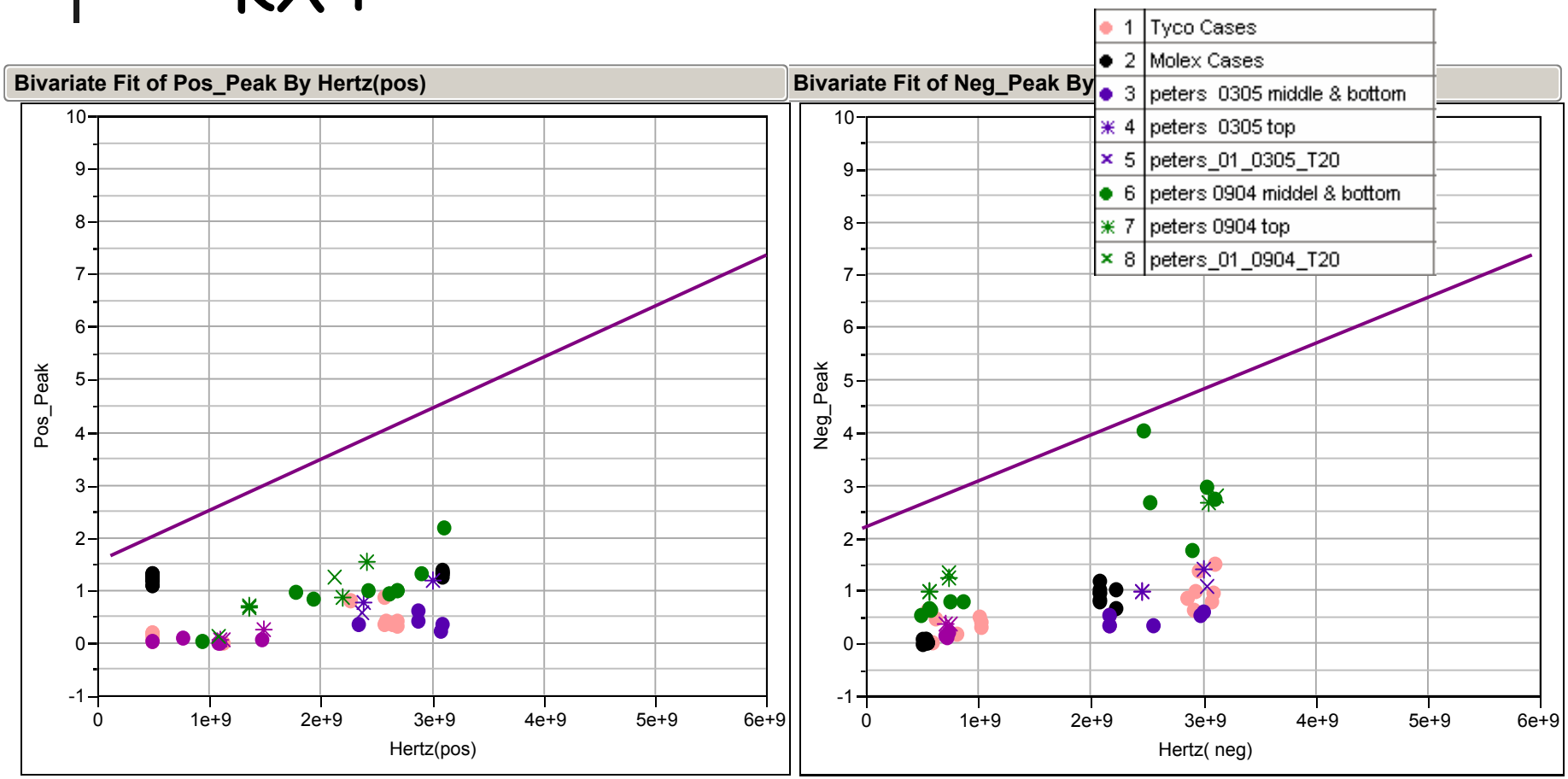
$ILD_{max}(f)$ Peak Deviation

1.0e-9*f+1.5

$ILD_{min}(f)$ Peak Deviation

0.9e-9*f+2.1

Positive and Negative IL Deviation Peaks - KX4



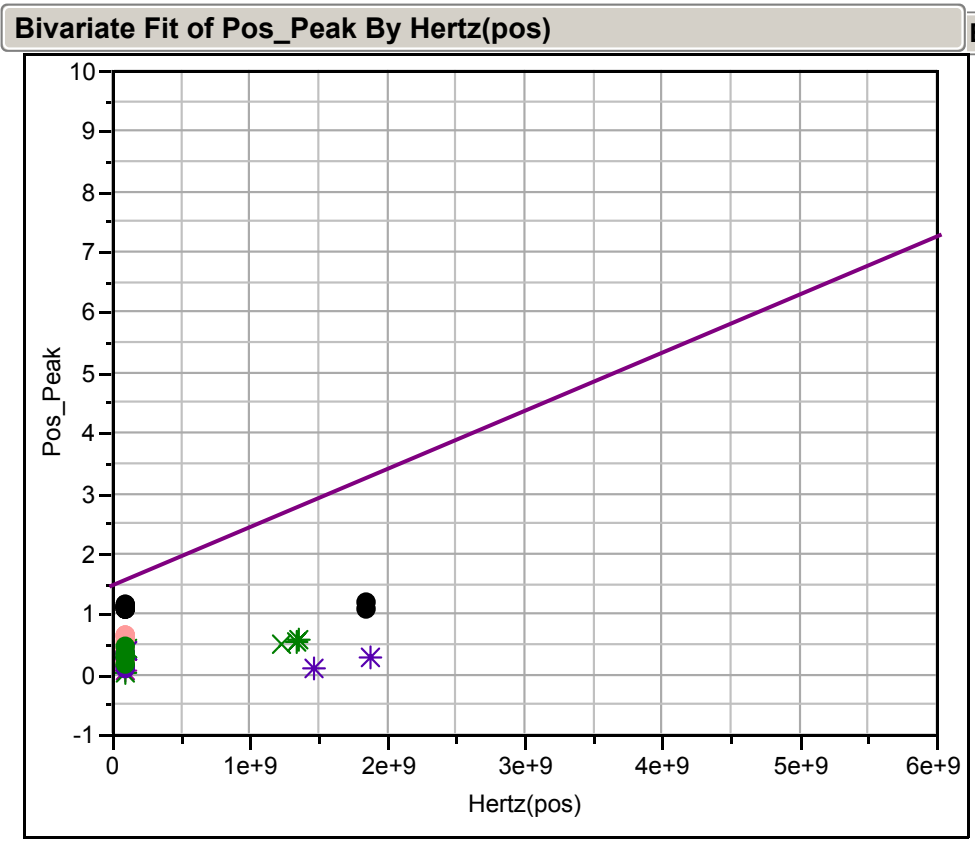
$ILD_{max}(f)$ **Peak Deviation**

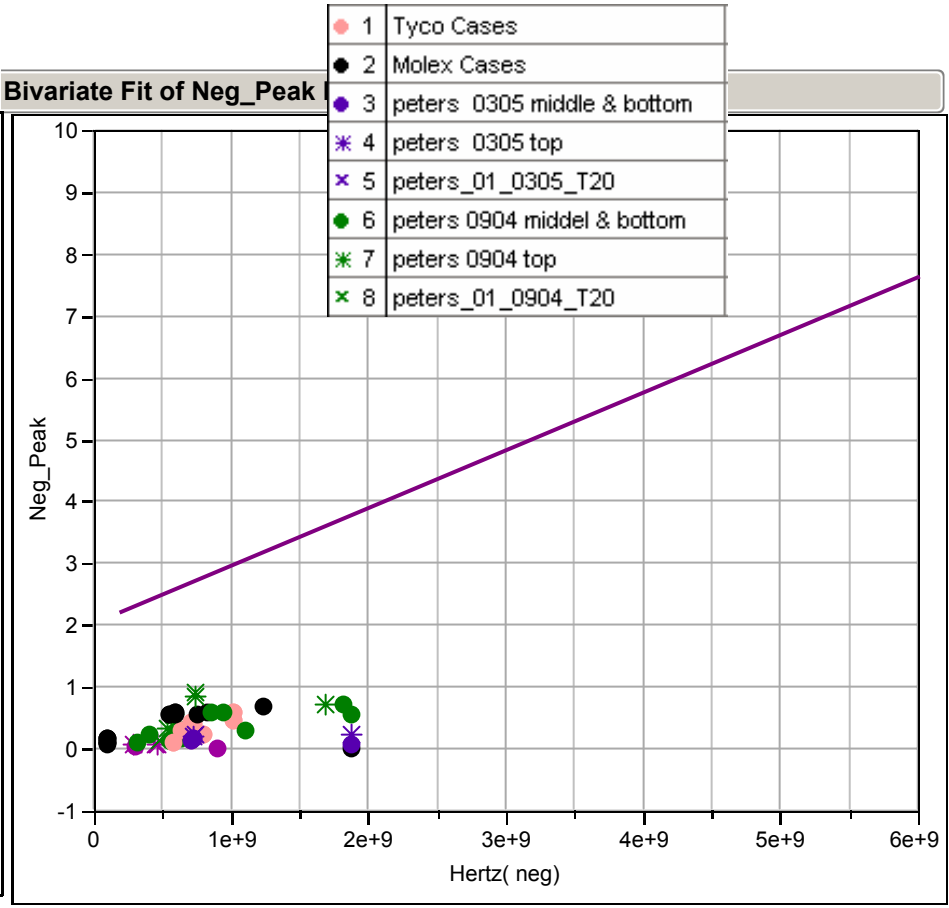
*1.0e-9*f+1.5*

$ILD_{min}(f)$ **Peak Deviation**

*0.9e-9*f+2.1*

Positive and Negative IL Deviation Peaks - KX





$ILD_{max}(f)$ Peak Deviation

1.0e-9*f+1.5

$ILD_{min}(f)$ Peak Deviation

0.9e-9*f+2.1

Recommendations

Replace Table 69-2

Parameter	KX Value	KX4 Value	KR Value	Units
fmin	0.05			GHz
fmax	15			GHz
b1	2.25E-0.5			
b2	1.20E-10			
b3	3.50E-20			
b4	–1.25E-30			
f1	0.125	0.312	1	GHz
f2	1.25	3.125	6	GHz
Maximum Peak Attenuation, $IL_{min}(f)$	$A_{\min}(f) - \begin{cases} (1.1 + f * 9.0 * 10^{-10}\ \text{sec}), f_1 \le f \le f_2 \\ (1.1 + f_2 * 9.0 * 10^{-10}\ \text{sec} + (f - f_2) * 10^{-8}\ \text{sec}), f_2 \le f \le f_{\max} \end{cases}$			dB
Positive Peak Deviation, $ILD_{max}(f)$	$1.5 + f * 1.0 * 10^{-9}\ \text{sec}, f_1 \le f \le f_2$			dB
Negative peak Deviation , $ILD_{min}(f)$	$-(2.1 + f * 0.9 * 10^{-9}\ \text{sec}), f_1 \le f \le f_2$			dB

Equation used for LMS fit line

- Add these equations to spec

$$slope = m = \frac{\sum_{i=F1index}^{F2index} [f_i - f_{avg}] * [IL(f_i) - IL_{avg}]}{\sum_{i=F1index}^{F2index} [f_i - f_{avg}]^2}$$

$$b = IL_{avg} - m * f_{avg}$$

$$LMS\_fit(f) = m * f + b$$

- Add equation: *ILD(f)=SDD21(f)-LMS_fit(f)*

Original Insertion Loss Deviation

$$A(f) \geq A_{min} f = -20\log(e) \times (b_1 \sqrt{f} + b_2 f + b_3 f^2 + b_4 f^3), f_{min} \leq f \leq f_{max} \qquad (69\text{–}2)$$

where f is expressed in Hz and the coefficients b_1 through b_4 are given in Table 69–2. The attenuation limit is illustrated in Figure 69–3.

69.3.3.2 Insertion loss deviation

The insertion loss deviation is defined to be the difference between the insertion loss and the least mean squares line fit defined in 69.3.3.1 over the frequency range f_1 to f_2. The insertion loss deviation, ILD(f) is recommended to be constrained within the limits defined by the equations

$$ILD(f) \leq ILD_{min}(f) = \Delta_1(min) + f\frac{\Delta_2(min) - \Delta_1(min)}{f_2 - f_1}, f_1 \leq f \leq f_2 \qquad (69\text{–}3)$$

$$ILD(f) \leq ILD_{max}(f) = \Delta_1(max) + f\frac{\Delta_2(max) - \Delta_1(max)}{f_2 - f_1}, f_1 \leq f \leq f_2$$

Replace IL deviation text with this text

69.3.3.2 Insertion loss deviation

The insertion loss deviation is defined the follow equation to be the difference between the insertion loss and the least mean squares line fit defined in 69.3.3.1 over the frequency range f1 to f2.

$$ILD(f) = IL(f) - LMS\_fit(f)$$

The *LMS_fit(f)* is defined as

$$slope = m = \frac{\sum_{i=F1index}^{F2index} [f_i - f_{avg}] * [IL(f_i) - IL_{avg}]}{\sum_{i=F1index}^{F2index} [f_i - f_{avg}]^2}$$

$$b = IL_{avg} - m * f_{avg}$$

$$LMS\_fit(f) = m * f + b$$

The insertion loss deviation, *ILD(f)* is recommended to be constrained within the limits defined by the equations

$$ILD(f) \geq ILD_{\min}(f) = -(2.1 + f * 0.9 * 10^{-9} \text{ sec}), f_1 \leq f \leq f_2$$

$$ILD(f) \leq ILD_{\max}(f) = 1.5 + f * 1.0 * 10^{-9} \text{ sec}, f_1 \leq f \leq f_2$$

where the values of f1 and f2 are given in Table 69–2. The insertion loss limit deviation is illustrated in Figure 69–4.

Replace IL and attenuation limits figure

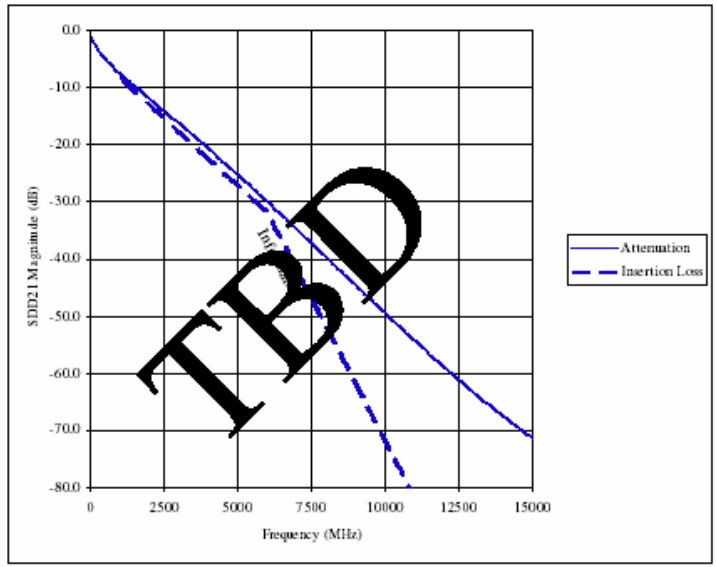
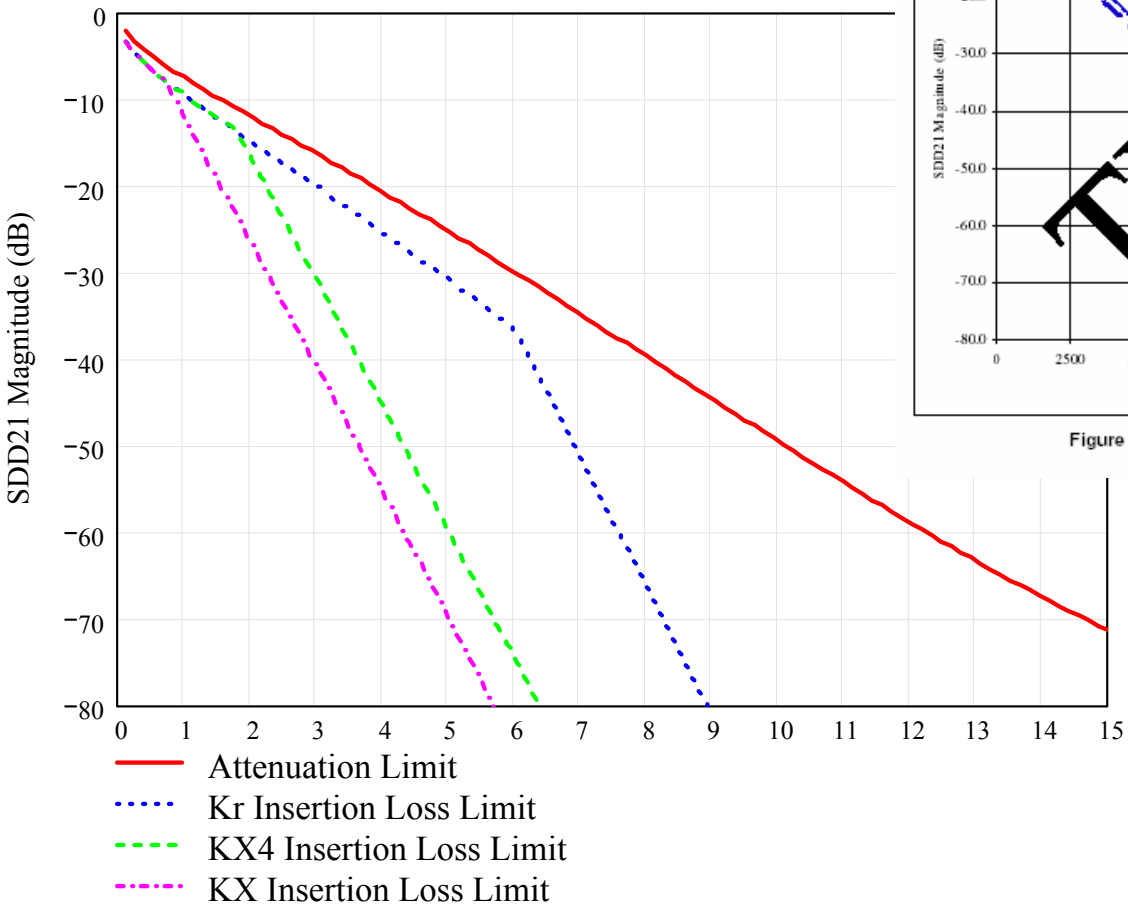


Figure 69–3— Insertion loss and attenuation limits



Insertion loss and attenuation limits

Original Insertion loss text

69.3.3 Insertion loss

The insertion loss is defined as the magnitude, expressed in decibels, of the differential response measured from TP1 to TP4. It is recommended that the insertion loss magnitude, IL(f), be greater than the lower limit defined by the equation:

$$IL(f) \le IL_{min}(f) = IL_1 + f\frac{IL_2 - IL_1}{f_2 - f_1}, f_1 \le f \le f_2 \quad (69\text{–}1)$$
$$= IL_2 + fm_{HF}, f_2 \le f \le f_{max}$$

where the values of f_1, f_2, f_{max}, IL_1, IL_2, and m_{HF} are given in Table 69–2. The insertion loss limit is illustrated in Figure 69–2.

Replace Insertion loss text w/ this

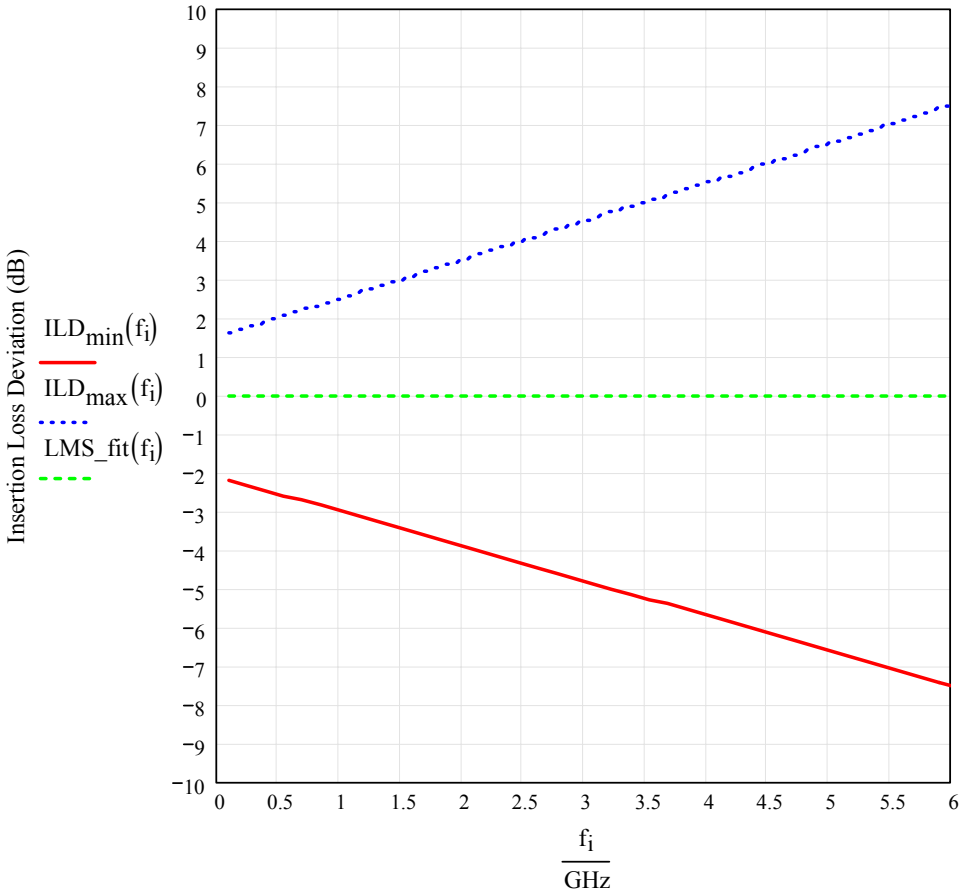
69.3.3 Insertion loss

The insertion loss is defined as the magnitude, expressed in decibels, of the differential response measured from TP1 to TP4. It is recommended that the insertion loss magnitude, IL(f), be greater than the lower limit defined by the equation:

$$IL(f) \le IL_{\min}(f) = A_{\min}(f) + \begin{cases} -(1.1 + f * 9.0 * 10^{-10}\ \text{sec}), f_1 \le f \le f_2 \\ -(1.1 + f_2 * 9.0 * 10^{-10}\ \text{sec} + (f - f_2) * 10^{-8}\ \text{sec}), f_2 \le f \le f_{\max} \end{cases}$$

where the values of f1, f2, are f_{max} are given in Table 69–2 and the attenuation limit $A_{min}(f)$ is given in eq??. In addition, it is recommended that the insertion loss also satisfy the attenuation limit defined in 69.3.3.1 and the insertion loss deviation limit defined 69.3.3.2. The insertion loss limit is illustrated in Figure 69–2.

Replace IL deviation limits figure



Insertion loss deviation limits

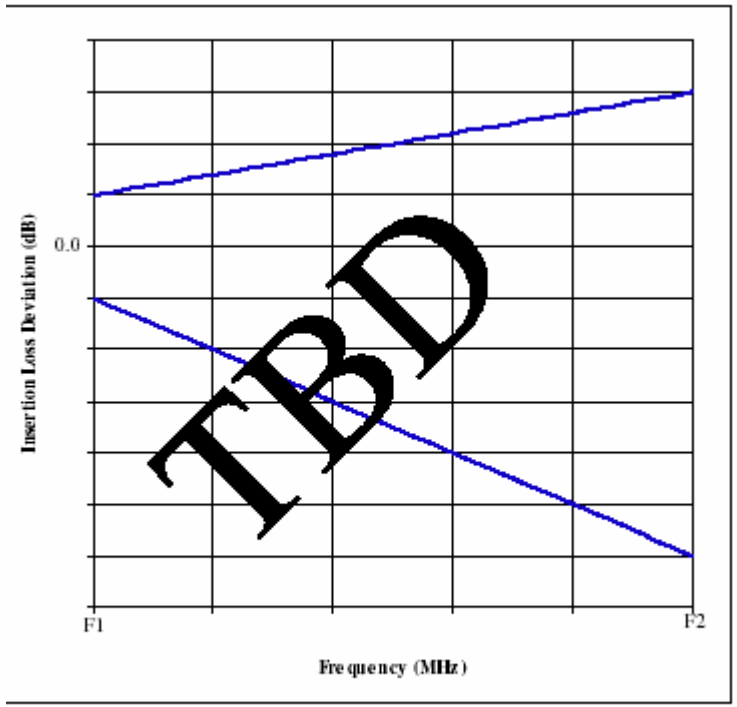
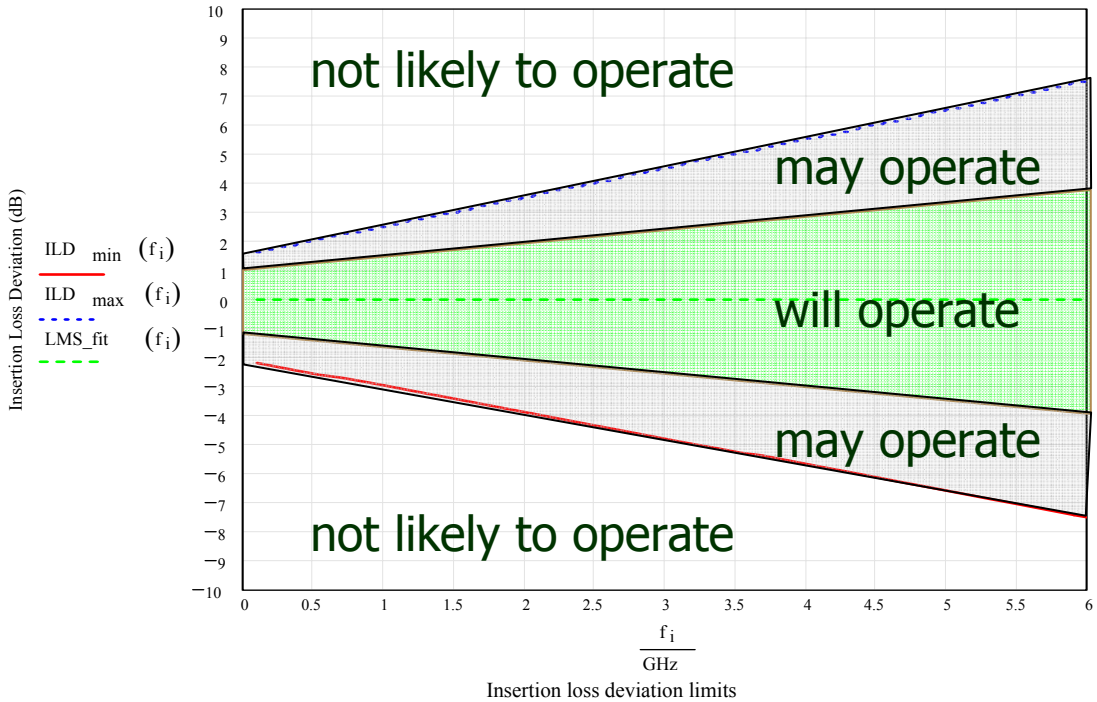


Figure 69–4— Insertion loss and deviation limits

Informative Alternatives: Green – Gray Approach

- Within a green region, all channel will operate as long as ICR is green.
- Within a gray region, a channel may operate as long as ICR is green or grey.
- Outside either region, a channel is not likely to operate.
- The gives a channel developer good information on channel design



Example

Replace Table 69-2

Parameter	KX Value	KX4 Value	KR Value
fmin	0.05		
fmax	15		
b1	2.25E-0.5		
b2	1.20E-10		
b3	3.50E-20		
b4	–1.25E-30		
f1	0.125	0.312	1
f2	1.25	3.125	6
Gray Maximum Peak Attenuation, $IL_{min}(f)$	$A_{min}(f) - \begin{cases} (1.1 + f * 9.0 * 10^{-10}\ \text{sec}), & f_1 \le f \le f_2 \\ (1.1 + f_2 * 9.0 * 10^{-10}\ \text{sec} + (f - f_2) * 2 * 10^{-8}\ \text{sec}), & f_2 \le f \le f_{max} \end{cases}$		
Gray Positive Peak Deviation, $ILD_{max}(f)$	$1.5 + f * 1.0 * 10^{-9}\ \text{sec},\ f_1 \le f \le f_2$		
Gray Negative peak Deviation , $ILD_{min}(f)$	$-(2.1 + f * 0.9 * 10^{-9}\ \text{sec}),\ f_1 \le f \le f_2$		
Green, Maximum Peak Attenuation, $IL_{min}(f)$	$A_{min}(f) - \begin{cases} (0.8 + f * 2.0 * 10^{-10}\ \text{sec}), & f_1 \le f \le f_2 \\ (0.8 + f_2 * 2.0 * 10^{-10}\ \text{sec} + (f - f_2) * 10^{-8}\ \text{sec}), & f_2 \le f \le f_{max} \end{cases}$		
Green, Positive Peak Deviation, $ILD_{max}(f)$	$1.0 + f * 0.5 * 10^{-9}\ \text{sec},\ f_1 \le f \le f_2$		
Green Negative peak Deviation , $ILD_{min}(f)$	$-(1.0 + f * 0.5 * 10^{-9}\ \text{sec}),\ f_1 \le f \le f_2$		

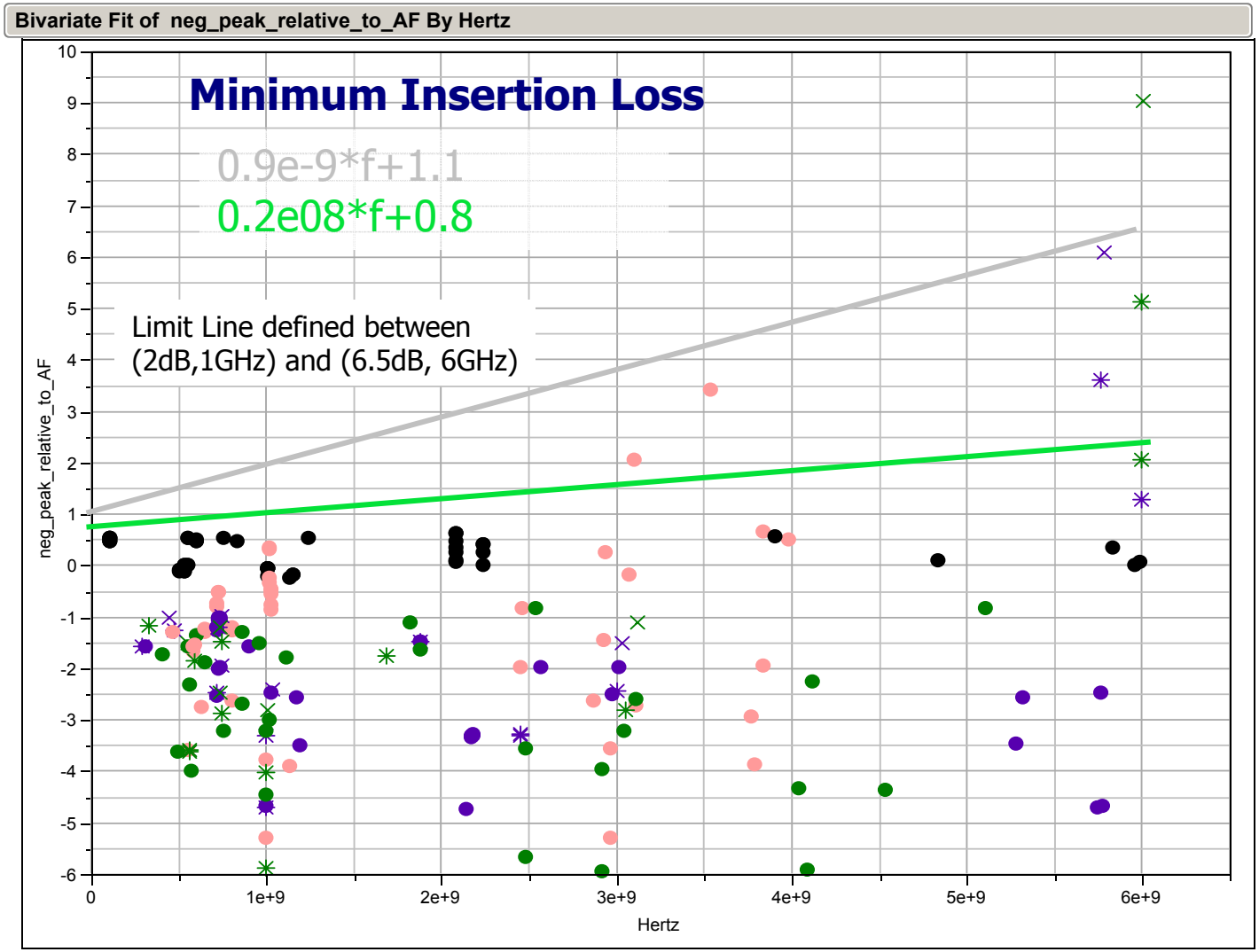
IL peak below $A_{min}(f)$ all ports - Green/Gray line

Kr,Kx,Kx4

Positive numbers are peaks below Attenuation Limit line

Tyco case6 and top channel exceed 10db/GHz limit above 6GHz

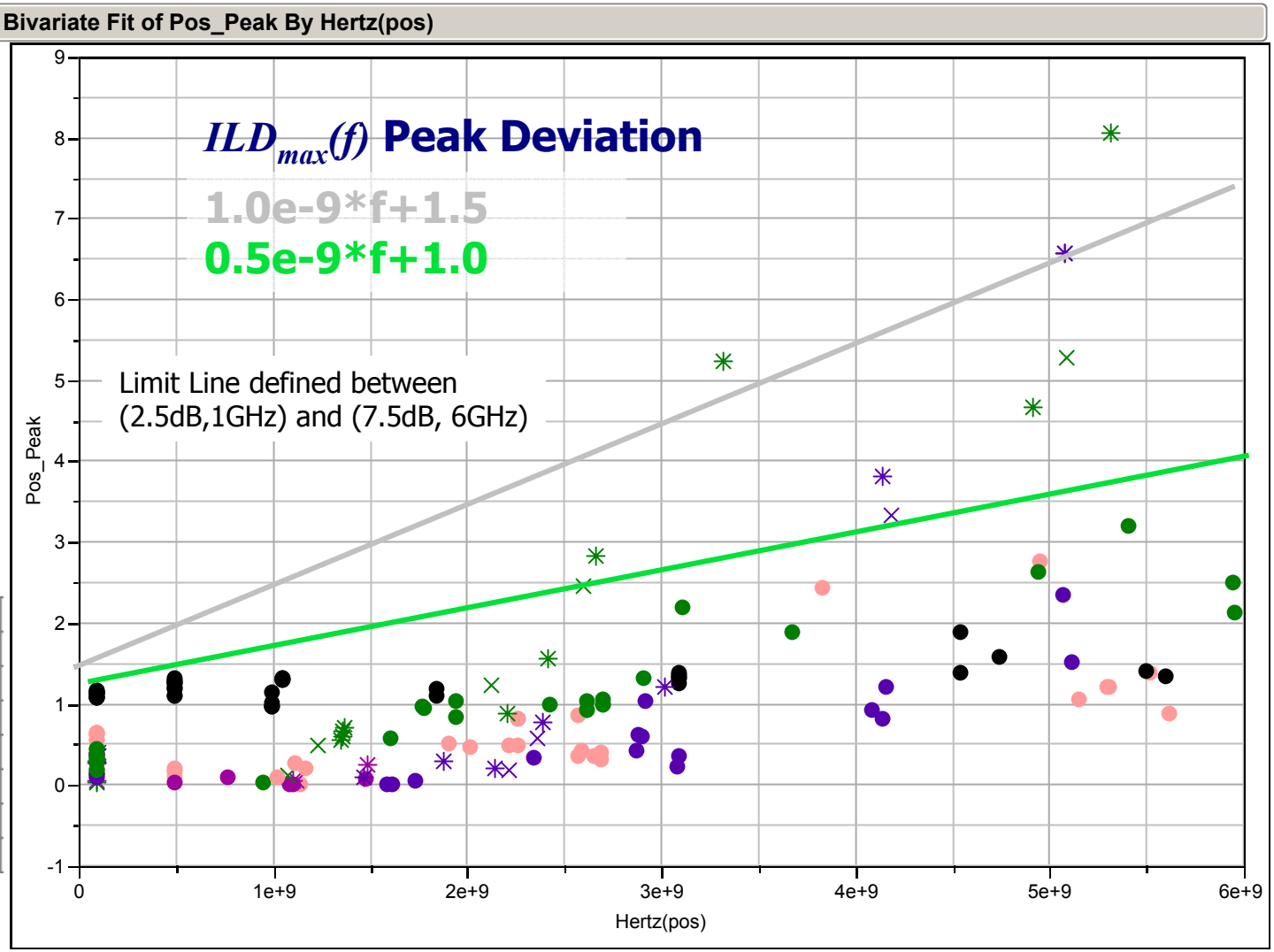
1	Tyco Cases
2	Molex Cases
3	peters 0305 middle & bottom
4	peters 0305 top
5	peters_01_0305_T20
6	peters 0904 middel & bottom
7	peters 0904 top
8	peters_01_0904_T20



S-parameters alone (no package)

Positive IL Deviation Peaks

Kr,Kx,Kx4

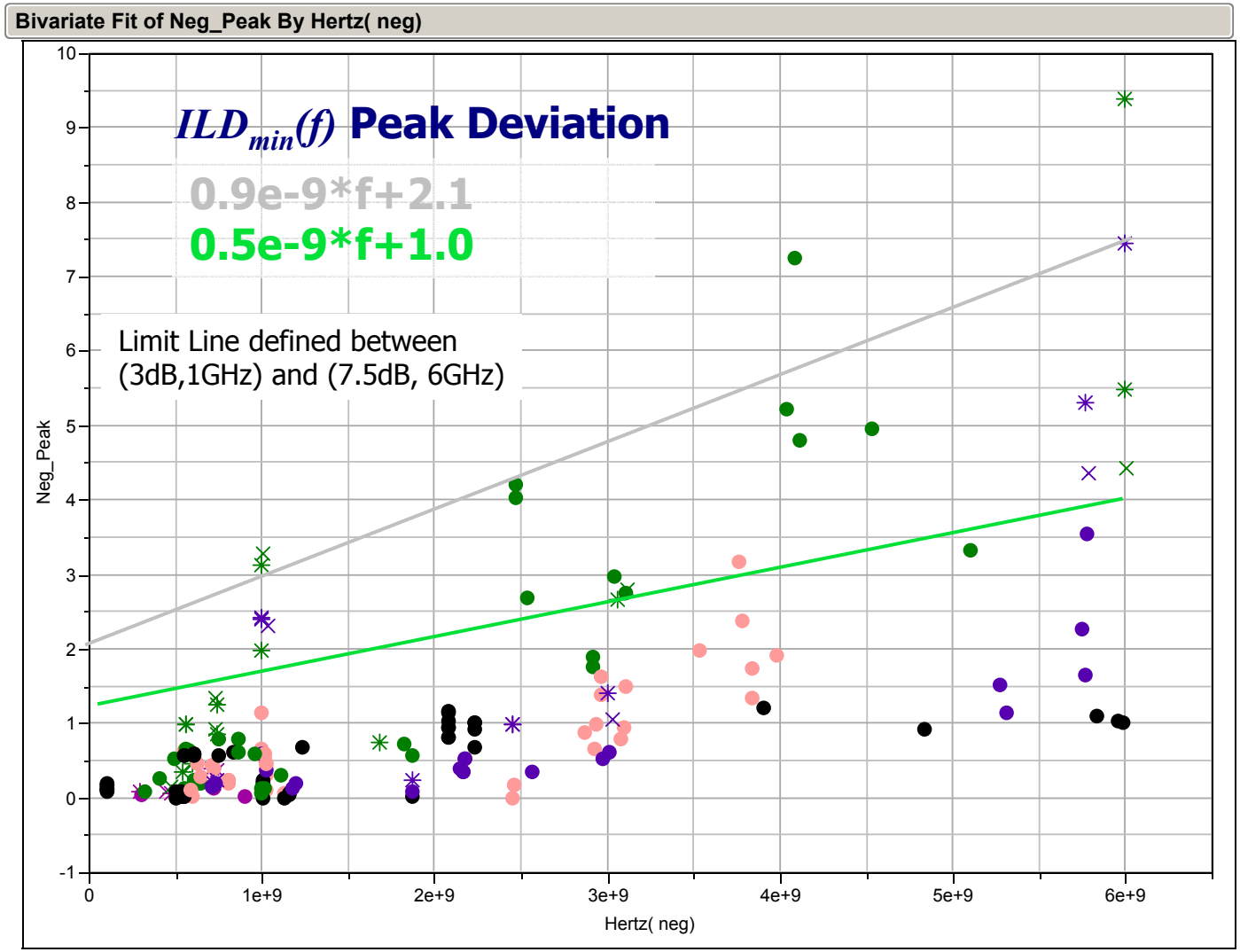


1	Tyco Cases
2	Molex Cases
3	peters 0305 middle & bottom
4	peters 0305 top
5	peters_01_0305_T20
6	peters 0904 middel & bottom
7	peters 0904 top
8	peters_01_0904_T20

S-parameters alone were used (no package)

Negative IL Deviation Peaks

Kr,Kx,Kx4



1	Tyco Cases
2	Molex Cases
3	peters 0305 middle & bottom
4	peters 0305 top
5	peters_01_0305_T20
6	peters 0904 middel & bottom
7	peters 0904 top
8	peters_01_0904_T20

S-parameters alone were used (no package)