ICR (Insertion Crosstalk Ratio) “Self Noise” Trade Off Proposal

Richard Mellitz

Contents

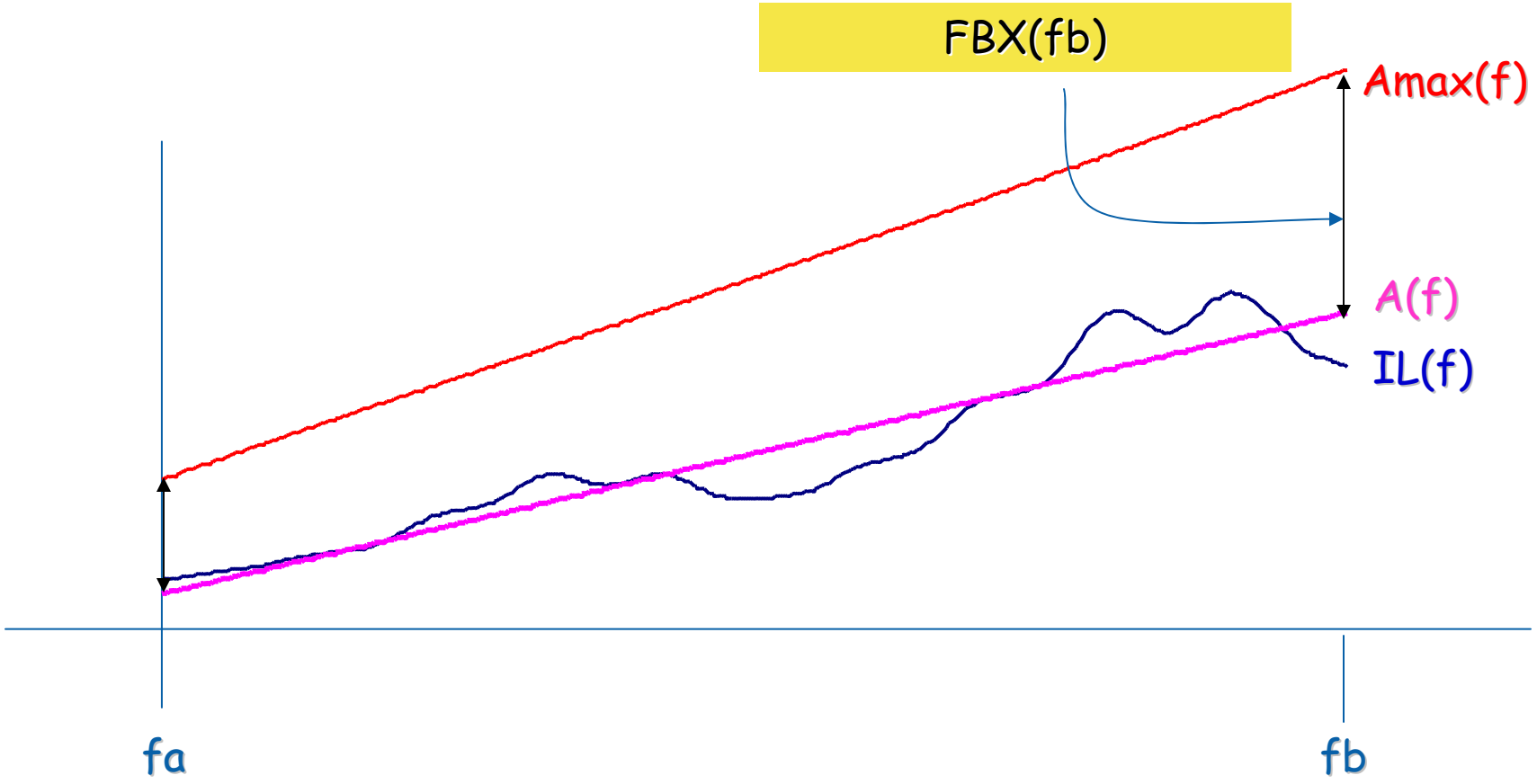
- Background: Need for ICR penalty
- New derived channel parameters
- High ILD with high RL Example
- ICR penalty proposal and results
- Backup material

In Response to "Spagna_C1_0406"

- The backplane designer (and the system architect) can trade-off one form of noise for the other (i.e. allow more xtalk and reduce the self noise) but, in practice, this maybe somewhat difficult without providing some further information. This additional information could take the form of :
  1. an additional ICR limit curve, derived from a channel with **maximum self noise** (e.g. max RL and/or max ILD).
     - This would bound the amount of xtalk allowable when maximum self-noise is present
  2. an additional return loss curve (or ILD curve) derived from a channel with **minimum ICR limit**
     - This would bound the amount of self-noise allowable when maximum xtalk is present

- The Challenge: To create an ICR penalty that is a function of the "self noise".
- Process: Use "valliappan_c1_0406.pdf" performance data and frequency dependant 69B channel parameters to optimally determine a "self noise" penalty to ICR
- The best fit proved to utilize 2 parameters derived from insertion loss to determine an ICR penalty.
  - Multi-parameter RMS fit reduction utilized

Consider the attenuation fit below Amax at frequency fb named, FBX(fb), as one parameter



Consider the integral of ILD‡ as the second parameter named, IILD^2.

$$IILD^2 = \frac{\int_{fa}^{fb} ILD(f)^2 \, df}{1GHz}$$

This is used to put a single number on return loss effects.

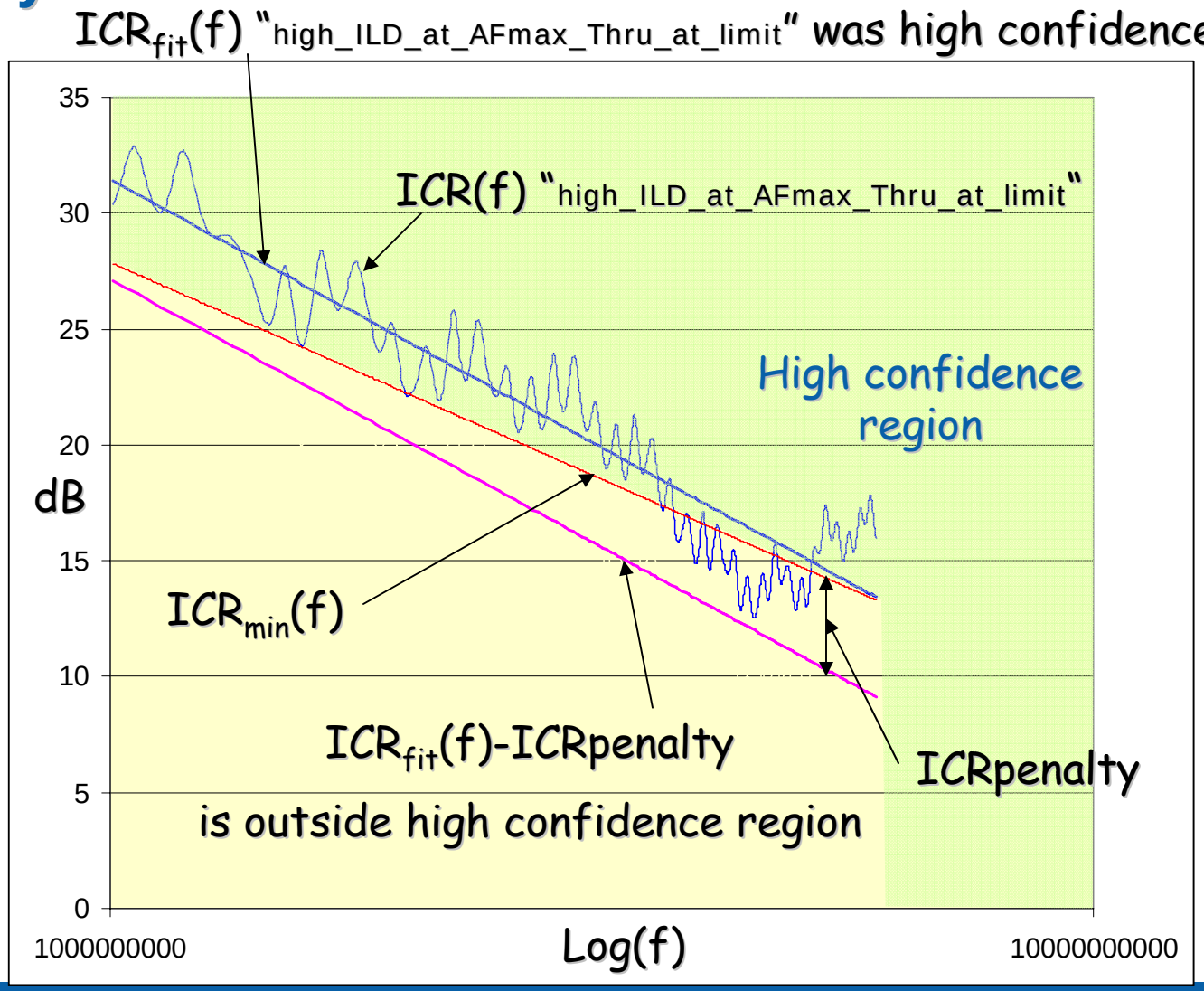
See backup for other algorithms tried.

‡ Insertion Loss Deviation

Example: "high_ILD_at_AFmax_Thru_at_limit.s4p" ICR Penalty

Channel Characteristics.

- A(F) less than 1dB below Amax
- ILD just about at max
- RL at max



Suggestion for ICR penalty

- ICR_penalty =

  IF (-2.21 + 0.9 IILD^2+ 0.0351 * (FBX(fb) - 3.57)) > 0

  THEN -2.21 + 0.9 IILD^2+ 0.0351 * (FBX(fb) - 3.57)

  ELSE 0

- Equation 69B-24 Becomes

  ICRfit(f)- ICR_penalty >= ICRmin(f)=14.8-18.7*log(f/5GHz)

- This enables the systems designers to trade off ILD for crosstalk and visa versa.

Results: Not perfect but does allow for ICR/self noise trade off and links back to EIT through Table 2 and Table 5 in spagna_C1_0406

Compare entries to limit below

green/red = pass/fail limit

	BRDCM_04_06 (BER)	ICRfit(fa) - icr_penalty	ICRfit(fb) - icr_penalty	icr_penalty	FXB(fb)	ILD^2
Case1 FM 13SI 20 T D13SI L10.s4p	-15	33.69	15.71	0.00	-0.65	1.50
Case2 FM 13SI 20 T D13 L10.s4p	-13.8	34.14	14.95	0.00	-1.80	1.65
Case3_FM_13SI_20_T_D6_L10.s4p	-11.7	34.01	15.70	0.00	-5.15	2.79
Case4 FM 13SI 20 T D13 L6.s4p	-14.6	33.90	15.56	0.00	3.54	2.20
Case5 DS 13 10 T D13 L6.s4p	-15.1	33.50	18.03	0.17	9.99	2.39
Case6 DS 13 10 T D13 L6.s4p	-6.6	31.78	13.86	4.30	4.58	7.20
Case7 FM 13SI 1 T D13SI L6.s4p	-12.8	35.44	17.13	1.41	12.12	3.69
Case7_FM_13SI_1_T_D13SI L6.s4p	-12.8	35.44	17.13	1.41	12.12	3.69
m_82_ripple_90OK.s4p	-9.8	32.31	10.43	0.00	3.41	0.86
m_60_ripple_98OK.s4p	-8.9	25.07	16.95	0.00	8.87	1.81
ITTC_20dB_returnlossOK.s4p a12	.	39.16	21.15	0.00	0.02	0.07
ITTC_20dB_returnlossOK.s4p a8	.	40.94	23.95	0.00	0.02	0.07
ITTC_20dB_returnlossOK.s4p icr	.	30.93	14.92	0.00	0.02	0.07
ITTC_20dB_returnlossOK.s4p b6	.	22.64	8.79	0.00	0.02	0.07
ITTC_20dB_returnlossOK.s4p b10	.	17.46	4.10	0.00	0.02	0.07
high_ILD_at_AFmax_Thru_at_limit.s4p	.	25.57	9.09	5.87	1.01	9.08
high_ILD_at_AFmax_Thru.s4p	.	21.84	6.59	8.18	1.00	11.64
peters_01_0605_B20_thru.s4p	-16.5	32.19	15.17	0.00	5.98	1.24
peters_01_0605_B12_thru.s4p	-16.7	31.69	16.10	0.00	9.90	1.57
peters_01_0605_B1_thru.s4p	-16.6	28.48	14.62	2.37	14.82	4.65
peters_01_0605_M1_thru.s4p	-15.4	25.12	16.03	6.67	12.80	9.51
peters_01_0605_T20_thru.s4p	-4	33.09	0.25	6.62	-7.26	10.24
peters_01_0605_T1_thru.s4p	-0.3	-9.39	-34.47	46.47	2.20	54.14
peters_01_0605_T12_thru.s4p	-4.4	25.98	-2.84	12.48	-3.64	16.60
peters_01_0605_M20_thru.s4p	-16.3	32.37	19.74	0.00	3.58	1.01
OUT_sj4k4g4h4_SPARS.s4p	-8.8	29.98	12.87	0.00	0.81	0.28
OUT_sj3k3g3h3_SPARS.s4p	-8.4	29.56	12.93	0.00	0.82	0.39
OUT_sj2k2g2h2_SPARS.s4p	-12.5	32.41	15.73	0.00	1.00	0.35
OUT_sj5k5g5h5_SPARS.s4p	-13.5	32.36	15.68	0.00	0.99	0.35
IN_sj4k4g4h4_SPARS.s4p	-6.3	27.62	10.06	0.00	-0.85	0.73
IN_sj3k3g3h3_SPARS.s4p	-5.4	25.95	9.49	0.00	-0.57	0.52
IN_sj2k2g2h2_SPARS.s4p	-8.6	28.70	12.48	0.00	-0.30	0.46
IN_sj5k5g5h5_SPARS.s4p	-9.3	28.78	12.60	0.00	-0.20	0.60
limit	-12.00	27.87	14.55			

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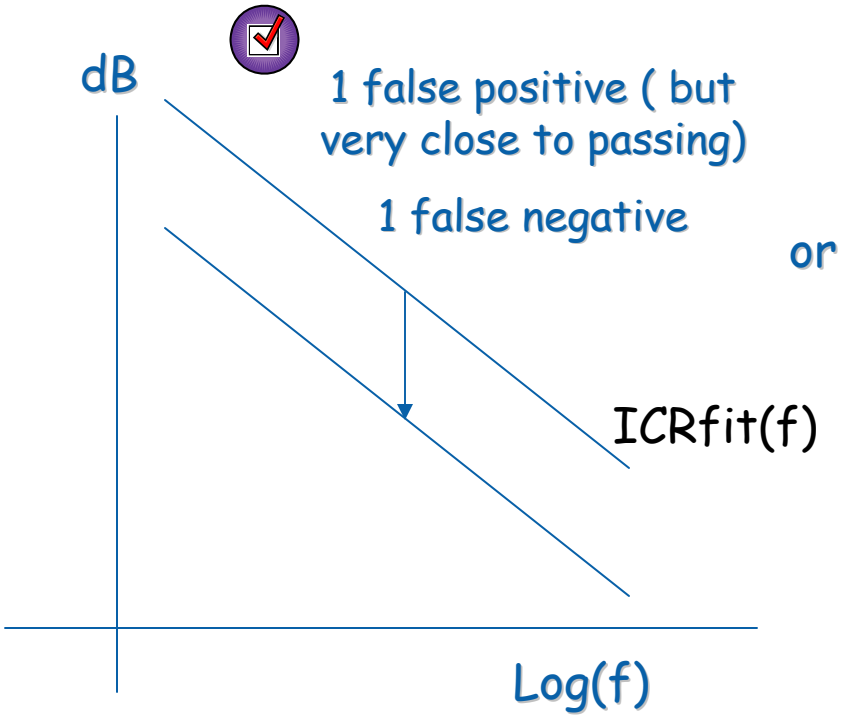
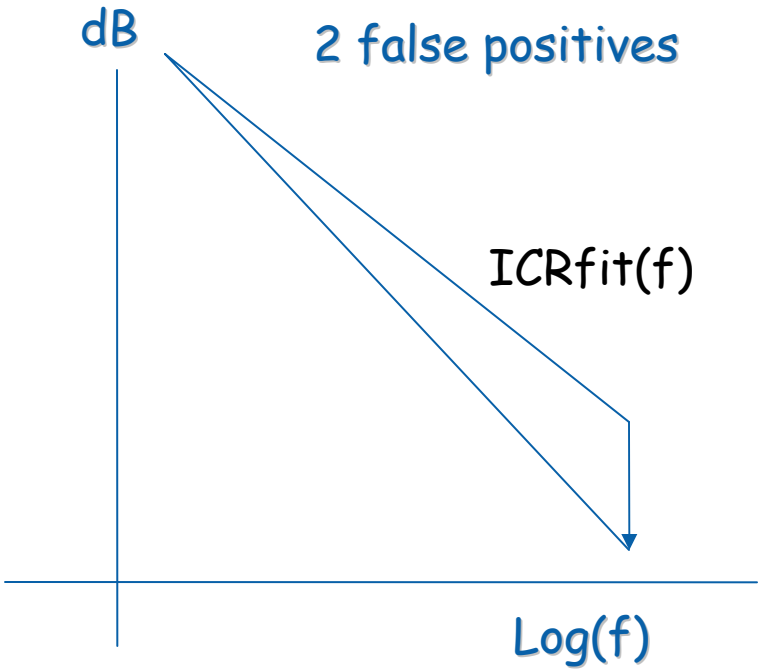
Backup Material

Choice of how to apply penalty



or



ICRfit(f)- ICR_penalty >= ICRmin(f)= 14.8-18.7*log(f/5GHz)

ICRfit(f)- ICR_penalty*log(f/1Ghz)/log(5) >= ICRmin(f)= 14.8-18.7*log(f/5GHz)

Other parameters considered

$$\frac{\int_{fx}^{fy} ILD(f)^2 A(f)\, df}{1GHz} \qquad \int_{fx}^{fy} \frac{ILD(f)^2}{f} df \qquad \int_{fx}^{fy} \frac{ILD(f)^2}{f} \cdot 10^{\frac{-A(f)}{20}} df$$

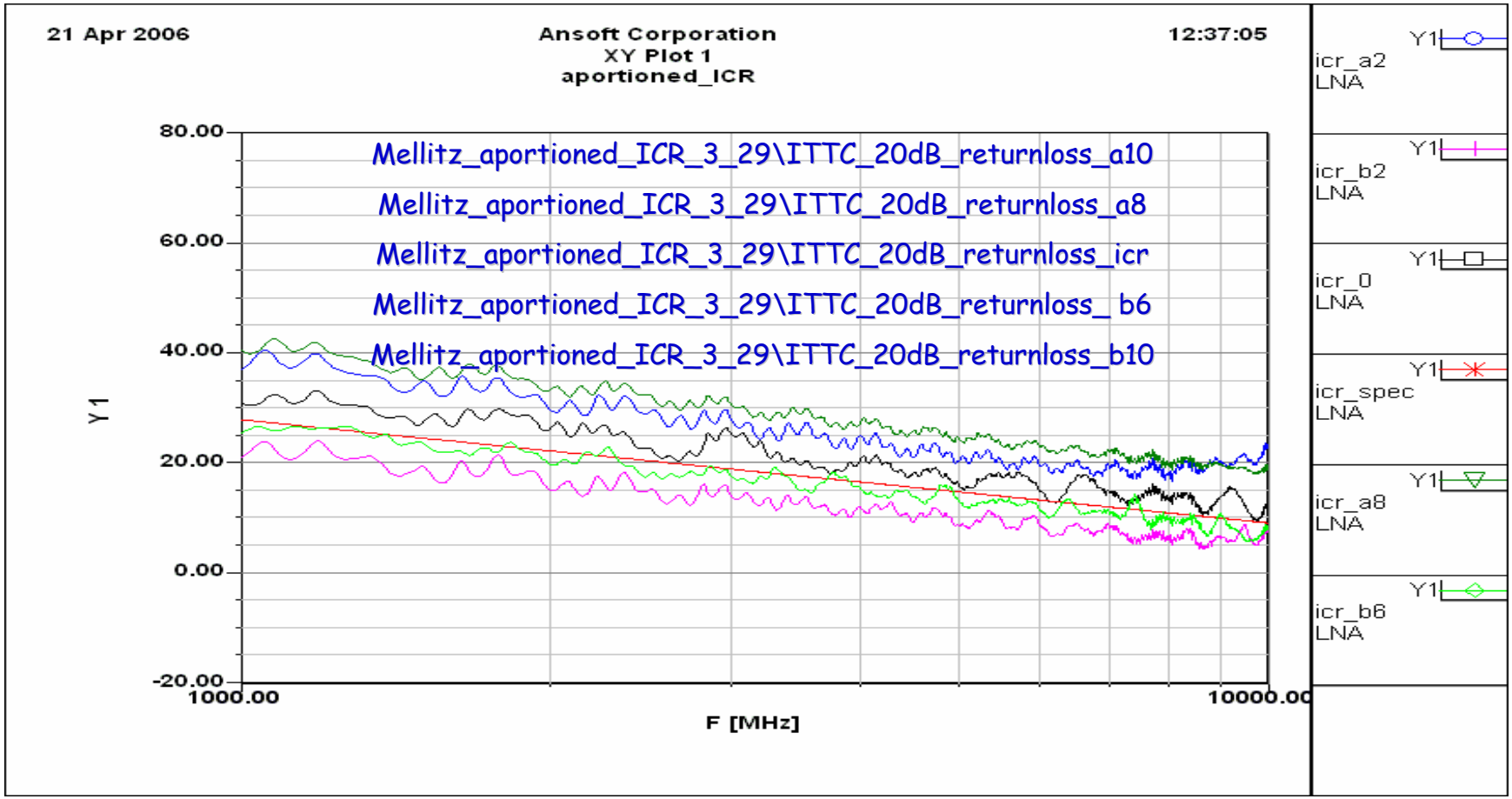
$$\frac{\int_{fx}^{fy} (1 - sdd11(f))^2 \operatorname{sinc}(\pi \cdot UI \cdot f)^2 df}{1GHz} \qquad \frac{\int_{fx}^{fy} ILD(f)^2 \operatorname{sinc}(\pi \cdot UI \cdot f)^2 df}{1GHz} \qquad \frac{\int_{fx}^{fy} ILD(f)^2 df}{1GHz}$$

$$fx = (50MHz \;\; 500MHz \;\; fa) \qquad fy = (500MHz \;\; fb)$$

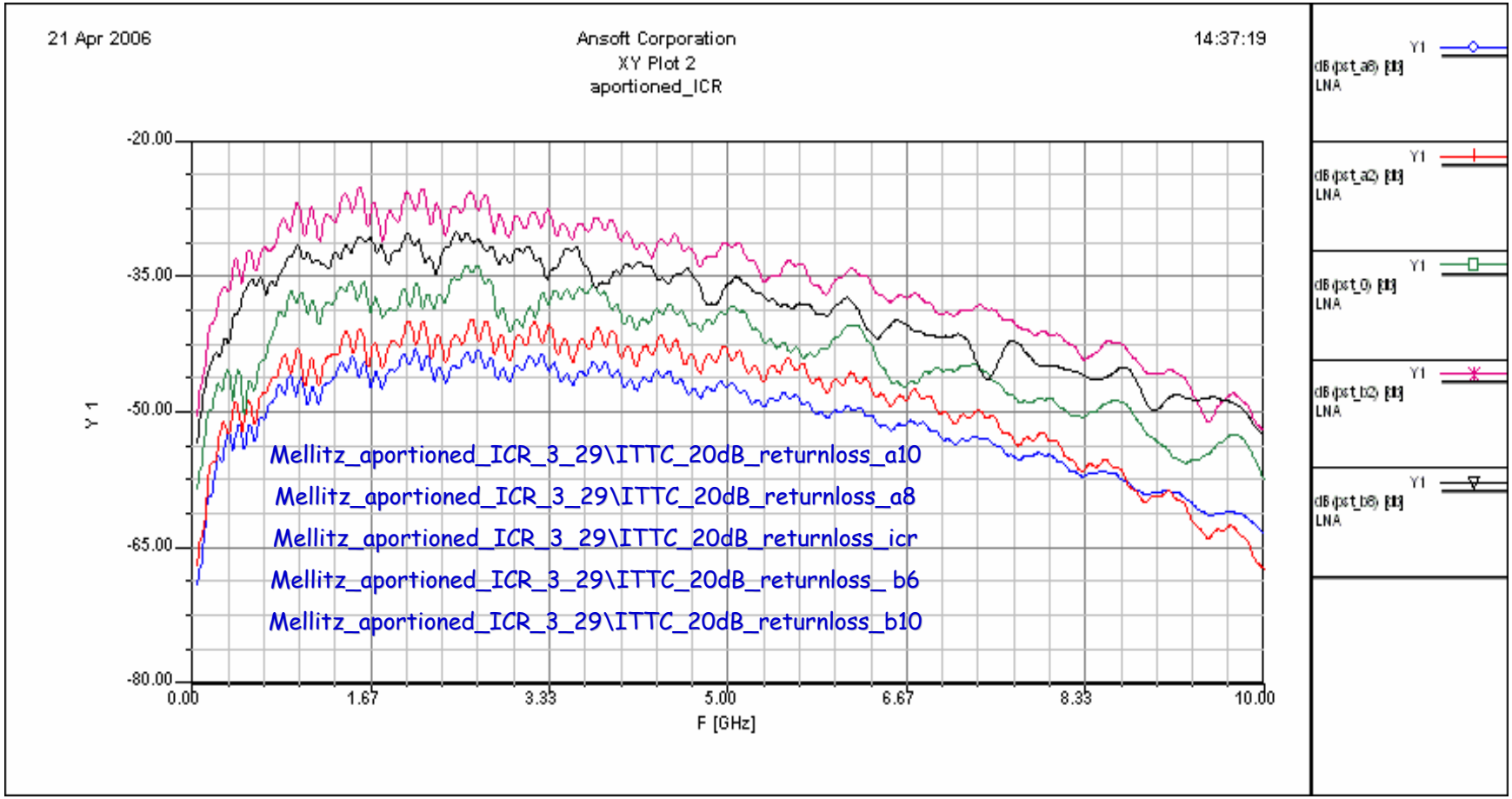
Pathological Channels Added –

- Proportioned ICR
- ILD max with and without RL failure

Apportioned ICR plots



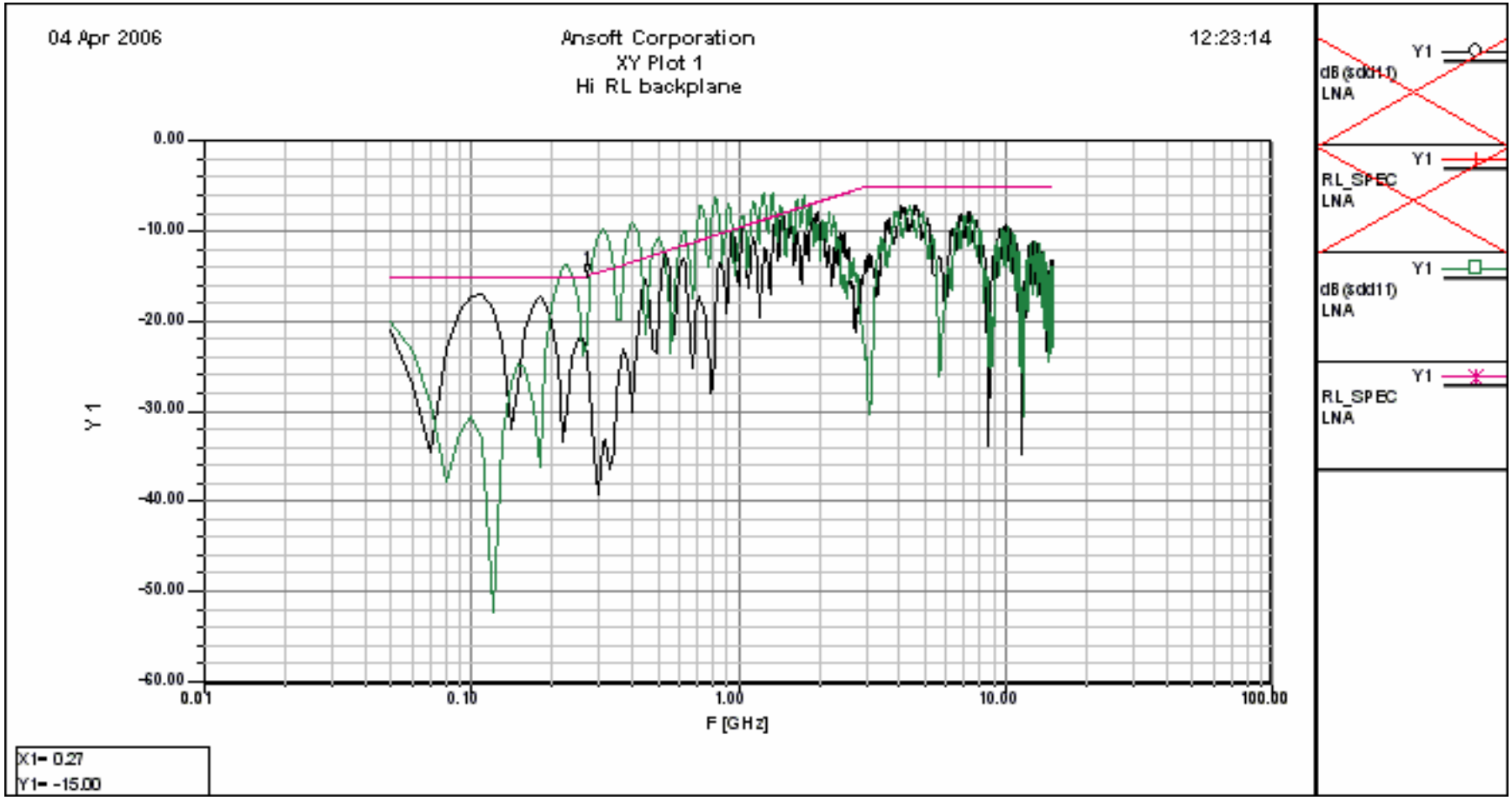
Single channel crosstalk



Two High ILD channel

- high_ILD_at_AFmax_Thru.s4p
  - Excessive low end RL
- high_ILD_at_AFmax_Thru_at_limit.s4p
  - RL at limit
- Both Channel have about the same ILD
- Both Channels are the ICR limit with high_ILD_at_ICR_crosstalk.s4p

RL differences



Small differences in ILD