Calculation of THRU to XTALK power ratios using an integral method

Matt Brown

Quake Technologies

mbrown@quaketech.com

Introduction

- This slide package presents a set of calculations based on the method proposed in mellitz_01_0106.

- The calculations also take into consideration the band limiting effects of the transmitter and receiver and the frequency shaping of the transmitter FFE.

Assumptions

- THRU and XTALK channels proposed by Charles Moore of Avago

  - THRU = modITTC23withCoupler.s4p

  - XTALK =

    - Molex/1m_OUTBOUND_FEXT/sj5k5g4h4_SPARS.s4p (molex out5 fext4)

    - Tyco/Case5/Case5DS1310N2D13L6.s4p (tyco case6 next2)

    - Intel/peters_01_0605_T1_next5.s4p (intel_0605 t1 next5)

- Three frequency shaping scenarios

  - no Tx FFE and no Rx or Tx band limiting

    - PSD of PRBS is sinc function

  - Tx FFE using nominal coefficient values and no Rx/Tx band limiting

    - Tx coefficients = [-0.05,0.675,-0.275]

  - Tx FFE using nominal coefficient values with Rx/Tx band limiting

    - Tx: 9 GHz, 2nd order butterworth, lowpass

    - Tx: 7.5 GHz, 2nd order butterworth, lowpass

Results

- For each of the three XTALK channels, the Power Ratio (or SNR) was calculated for each of the three calculation scenarios listed on previous slides.

- For all three calculation scenarios, the Molex XTALK channel resulted in at least 5 dB worse power ratio compared with the Tyco and Intel XTALK channels.

- The Tyco and Intel XTALK channels consistently resulted in very similar power ratios.

|	no Tx FFE no BL SNR1	Tx FFE no BL SNR2	Tx FFE BL SNR3
molex out5 fext4	31.1	24.7	25.0
tyco case5 next2	37.7	31.2	33.0
intel_0605 t1 next5	36.7	30.3	32.7
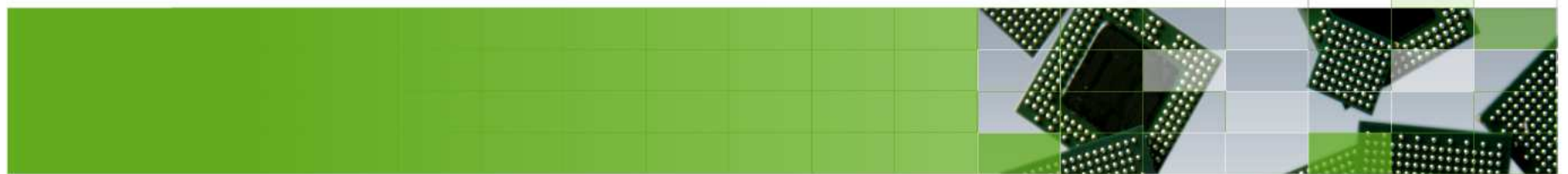
Background

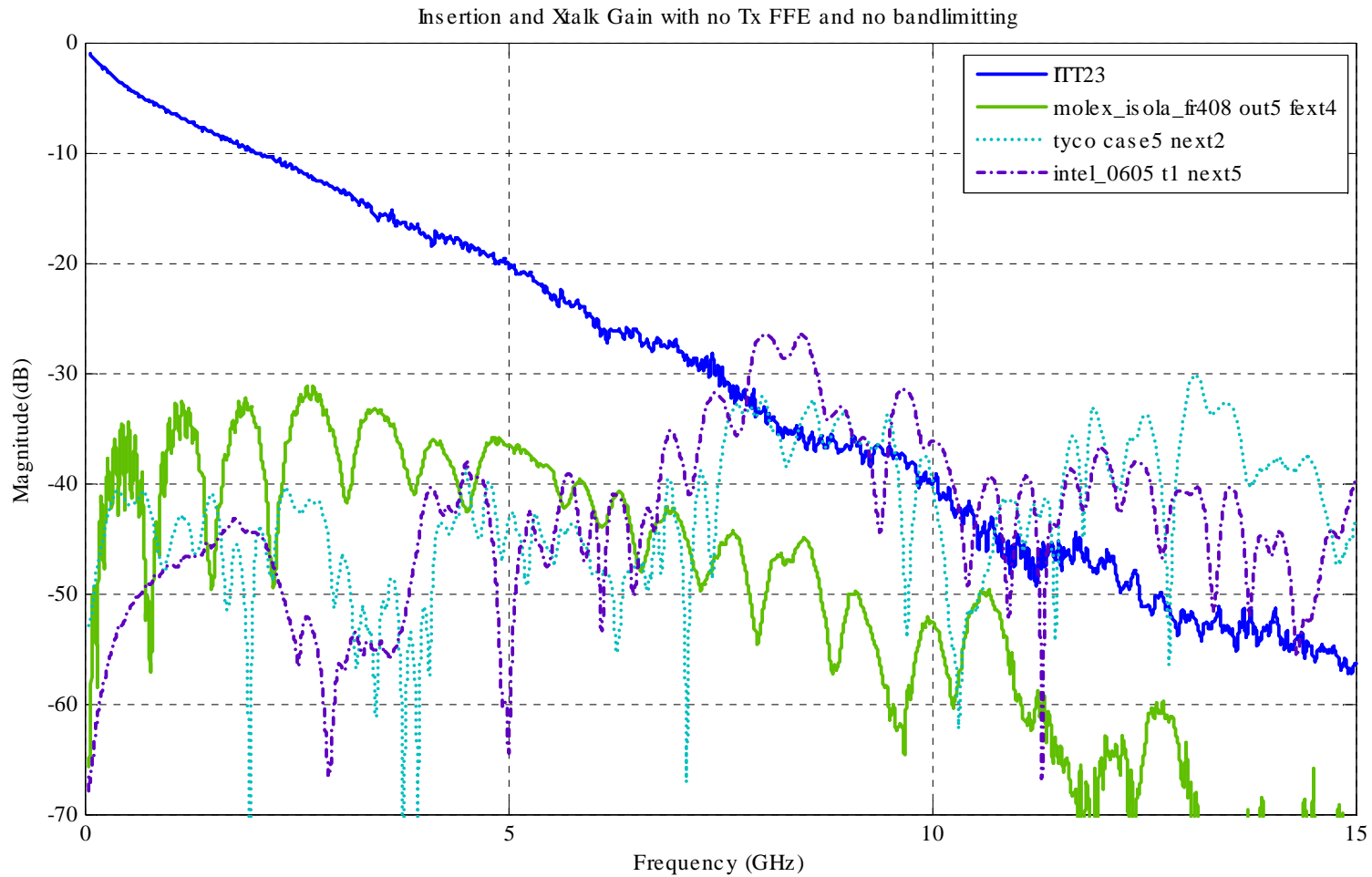# Equations

- Equation for case with no Tx FFE or band limitting

  - $SNR1 = 10*log10(Pthru1 / Pxt1)$

  - $Pthru1 = integral((sinc(f/fb) * IL(f) * XTL(f))\^2)$

  - $Pxt1(f) = integral((sinc(f/fb) * IL(f) * XTL(f))\^2)$

  - Note that constants common to both integrals have been left out.

- Equation for case with Tx FFE and no band limiting

  - $SNR2 = 10*log10(Pthru2 / Pxt2)$

  - $Pthru2 = integral((sinc(f/fb) * IL(f) * XTL(f) * GFFE(f))\^2)$

  - $Pxt2 = integral((sinc(f/fb) * IL(f) * XTL(f) * GFFE(f))\^2 *)$

  - $GFFE(f) = c(1) * exp(-j*2*pi*Tb*2) + c(0) * exp(-j*(2*pi*Tb)) + c(-1)$

- Equation for case with Tx FFE and band limitting

  - $SNR3 = 10*log10(Pthru3 / Pxt3)$

  - $Pthru3 = integral((sinc(f/fb) * IL(f) * XTL(f) * GFFE(f) * GRx(f) * GTx(f))\^2)$

  - $Pxt3 = integral((sinc(f/fb) * IL(f) * XTL(f) * GFFE(f) * GRx(f) * GTx(f))\^2 *)$

  - $GRx(f)$ and $GTx(f)$ are response of 2nd order Butterworth LPF with 7.5 GHz and 9.0 GHz bandwidth, respectively.
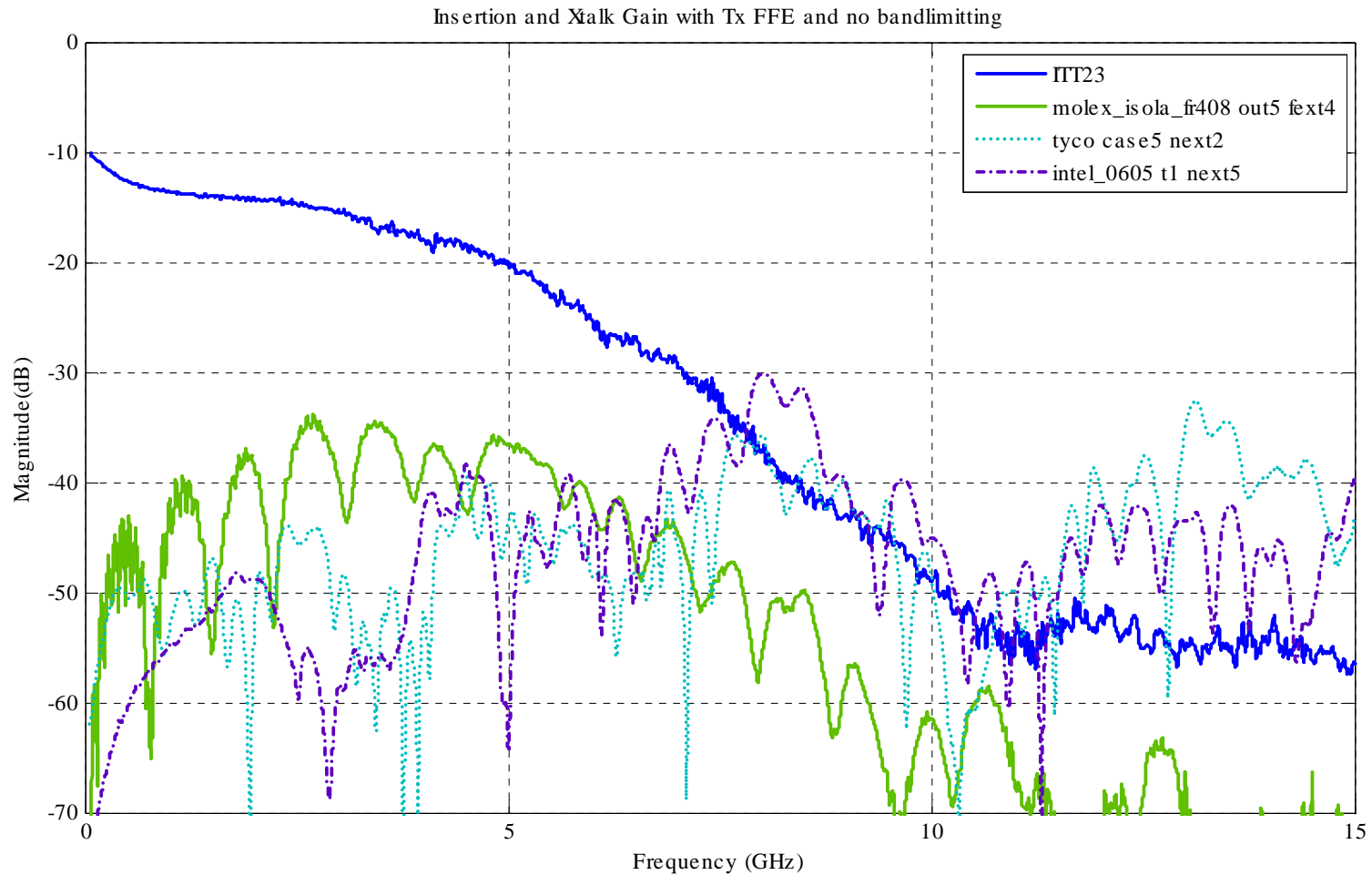
Applied responses

Channel Filters

Quake | Technologies
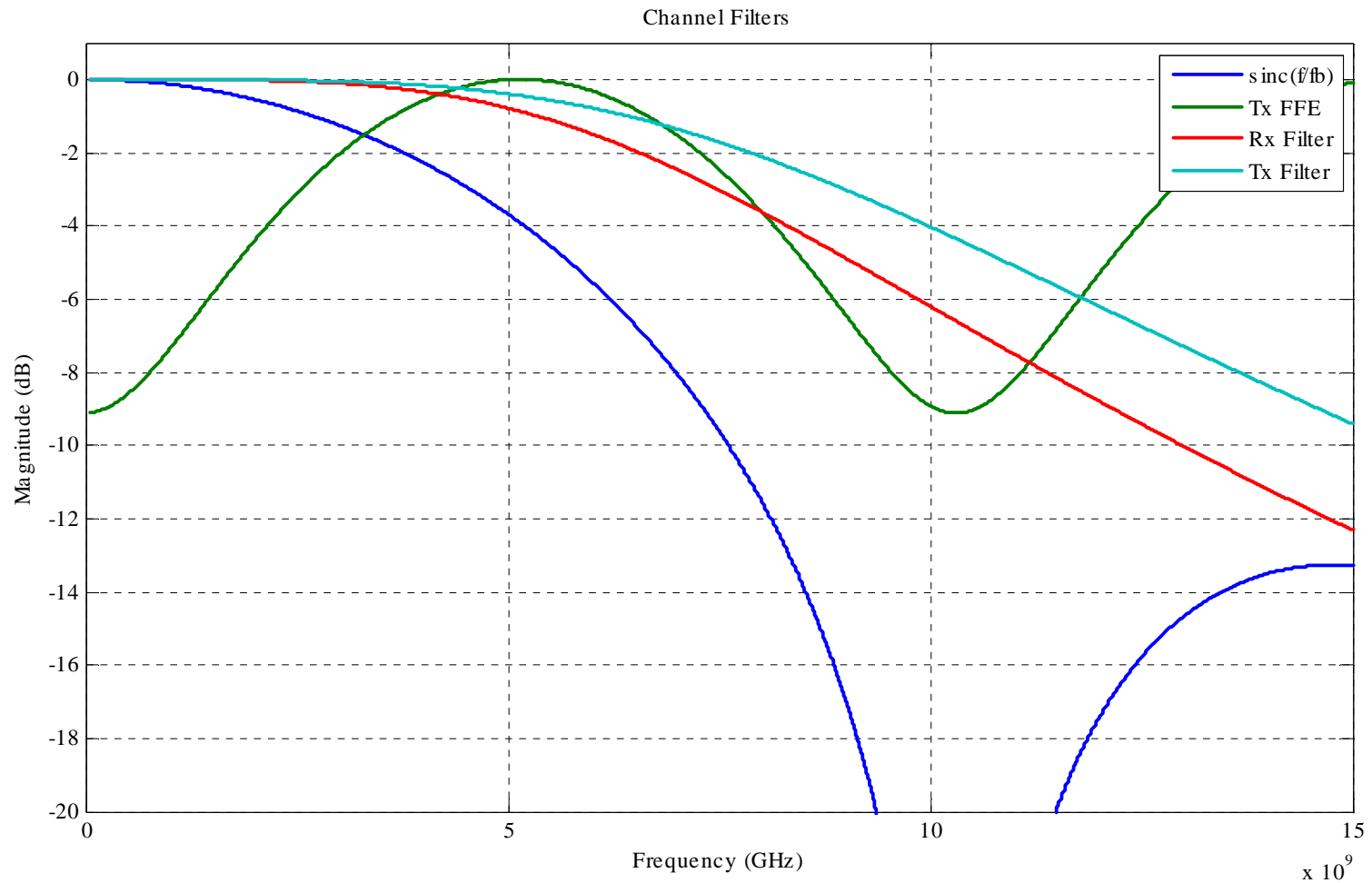
IL and XTALK loss with no Tx FFE and no band limiting

Insertion and Xtalk Gain with no Tx FFE and no bandlimitting

IL and XTALK loss with Tx FFE and no band limiting

Insertion and Xtalk Gain with Tx FFE and no bandlimitting

Legend:
- ITT23
- molex_isola_fr408 out5 fext4
- tyco case5 next2
- intel_0605 t1 next5

Magnitude (dB) vs Frequency (GHz)

IEEE 802.3ap Channel Adhoc
January 25, 2006

IL and XTALK loss with Tx FFE and Rx/Tx band limiting

Insertion and Xtalk Gain with Tx FFE and Rx/Tx bandlimitting

Legend:
- ITT23
- molex_isola_fr408 out5 fext4
- tyco case5 next2
- intel_0605 t1 next5

Y-axis: Magnitude(dB)
X-axis: Frequency (GHz)

Quake Technologies