

# ***Bounds on Interference Tolerance Spec***

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# Goal:

**We have defined an interference tolerance test in annex 72A. We decided at the Austin meeting to make the test normative for KX, KX4 and KR. But we have not defined a useful normative value for the test to be made to. The current value is just a place holder.**

**Today I do not know the correct values for any of the three specs but I can put bounds on the value and recommend working values**



# Outline:

- 1. Lower bound**
- 2. Upper bound**
- 3. Recommended value**
- 4. Future work**



# Lower Bound

I will derive a lower bound from the expected maximum crosstalk to the channel. To get the maximum crosstalk I combined the Attenuation to Crosstalk Ratio recommended by in dambrosia\_03\_0904 and the attenuation line recommended in goergen\_03\_0904 to get an upper bound on the crosstalk allow in a maximum loss channel, ie the compliance channel



## Lower Bound, continued

To find RMS crosstalk, first find the power spectral density, then integrate

$$\text{PSD}_{\text{XT}} = \text{Tx}(f) * \text{Rx}(f) * 10^{\text{XT}_{\text{Max}}(f)/10}$$

$$\text{Tx}(f) = \tau * \text{MaxPeak}^2 * \text{sinc}^2(f * \tau) / (1 + (f * \tau / .75)^2)$$

$$\text{Rx}(f) = 1 / (1 + (f * \tau / .75)^2)$$

$$\tau = \text{bit}_{\text{time}}$$

$$\text{RMS}_{\text{XT}} = 2 * \int_0^{\infty} \text{PSD}(f) * df$$



## Lower Bound, continued

If the RMS value of the test interference is equal to the maximum expected crosstalk, its peak to peak will be 2.8 times greater than the RMS of the maximum expected crosstalk



## Lower Bound

This gives:

MDA	RMS xtalk	p-p sine wave
KX	6.2mV	17.5mV
KX4	10.3mV	29.2mV
KR	9.3mV	26.6mV

Table 1

Which I will use as lower bounds for the Sinusoidal interference



# Upper Bound:

I will look at two sources to define upper bounds for interference tolerance:

- Sustain (steady state) transmitted signal
- Received 101010 pattern





# Upper Bound: from Sustain value:

1. For KX, there is no peaking so use full amplitude, from table 70-5 the middle of range is 1200mV p-p
2. For KX4, from table 71-5, Clause 71.6.1.5 and figure 71-5, the Sustain value at the middle of amplitude range is 828mV p-p
3. For KR, per healey\_01\_0505 and Table 72-5, the Sustain value at the middle of amplitude range is 100mV p-p



# Upper Bound: from 10101 pattern:

1. For KX, attenuation at Nyquist will be 5.6dB. Assuming the signal is still a square wave, the p-p amplitude will be 625mV.
2. For KX4, attenuation at Nyquist will be 10dB. Here I will assume that just the fundamental is left which will have a p-p amplitude 2dB greater than the square wave would (see [BP]Informative channel, letters by Charles Moore and Mitsutoshi Sugawara). This gives p-p amplitude of 480mV.
3. For KR, attenuation at Nyquist will be 26dB. Again assuming only a sine wave is left, the amplitude will be 63.8mV



# Upper Bound:

For all three MDAs the Upper Bound from 101010 pattern is lower than the one from Sustain value so I will use those values

MDA	Upper Bound p-p
KX	625mV
KX4	480mV
KR	63.8mV

Table 2



# Recommended values:

For KX I have a wide range to select from. Picking a value near the lower bound will make the silicon easy but limit channel choice, picking a number near the upper bound will make the channel easy but limit choices for silicon. I recommend a value of 100mV, a round number  $> 14$  times the RMS crosstalk.

At KX4 the range is still wide. I recommend 150mV for similar reasons.

For KR the range is very narrow and I will choose the mean (rounded)



# Recommended values:

MDA	Recommended Interference Tolerance p-p
KX	100mV
KX4	150mV
KR	45mV

Table 3



# Further Work:

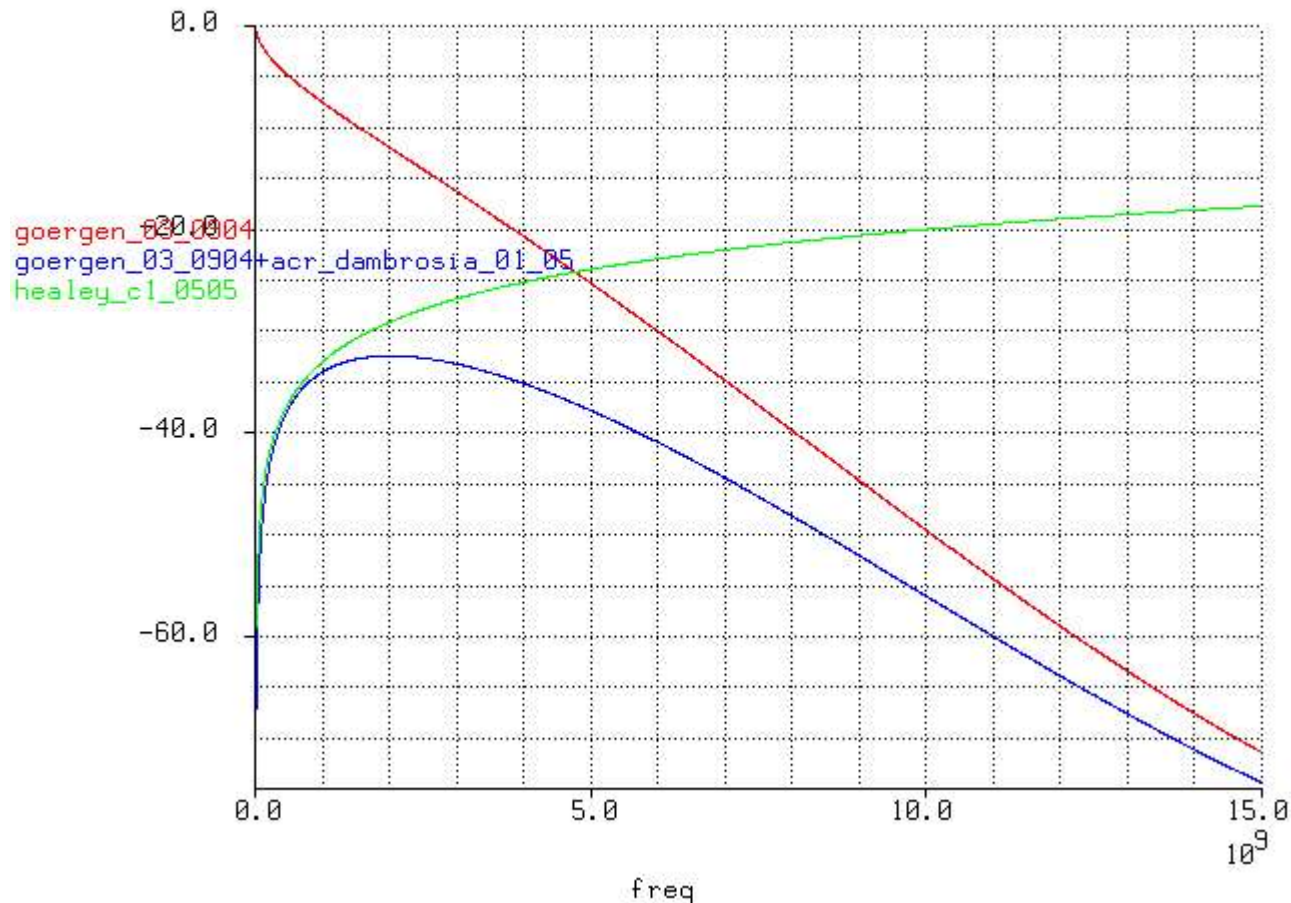
I would like to see better validation of these numbers:

3. From Simulation. Either
  - StatEye, Shannon Sawyer and Steve Anderson are looking into this.
  - Other simulators. E.g. propriatory simulators if possible.
2. From measurement. At Agilent we have measured our own parts, scaled in frequency for KR since we do not have 10gb parts. We plan to measure other Silicon vendor's parts as we can arrange to do so. We would also encourage other vendors to run their own tests.



# Suport slide

Channel and crosstalk limits



SDD21 for thru limit, and 2 proposed Summed crosstalk