SNDR and uncorrelated jitter limits at TP2

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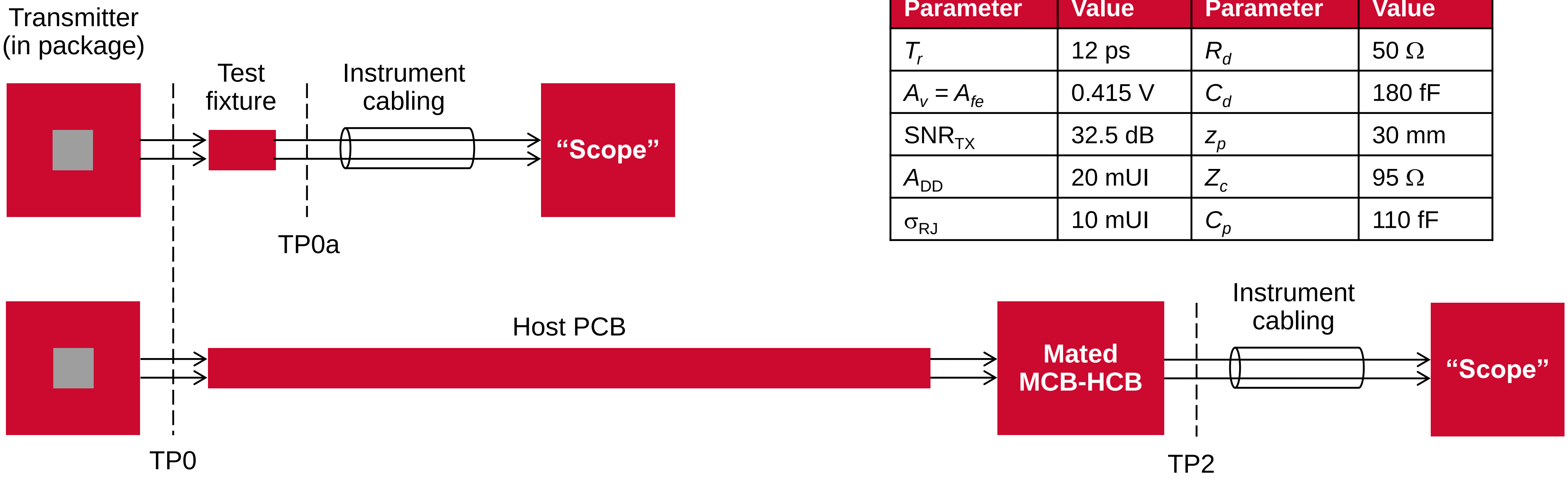
Introduction

- The SNDR and uncorrelated jitter requirements at TP0a and TP2 are the same
  - Compare 136A.2 to 136.9.3
- It seems there should be additional allowances at TP2 to account for the impact of the host PCB trace and connector, HCB, etc.
- This is the subject of comments i-105 and i-106 (and perhaps others)

Simulation description

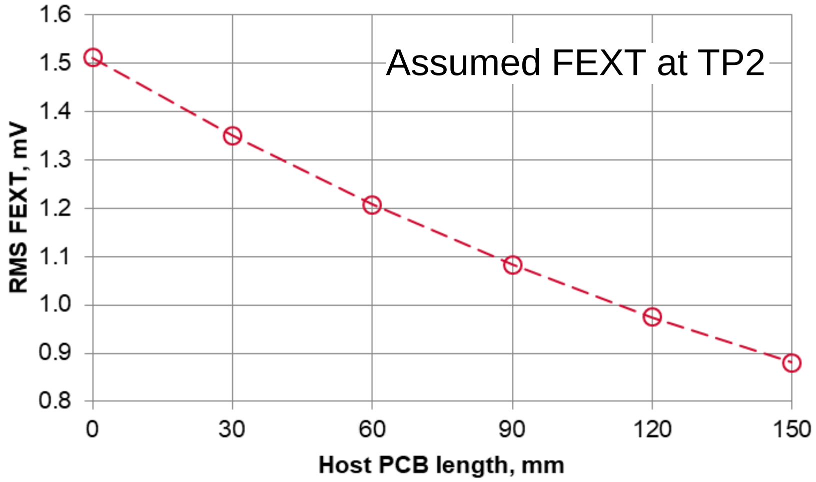


Transmitter model (from Table 137−5)

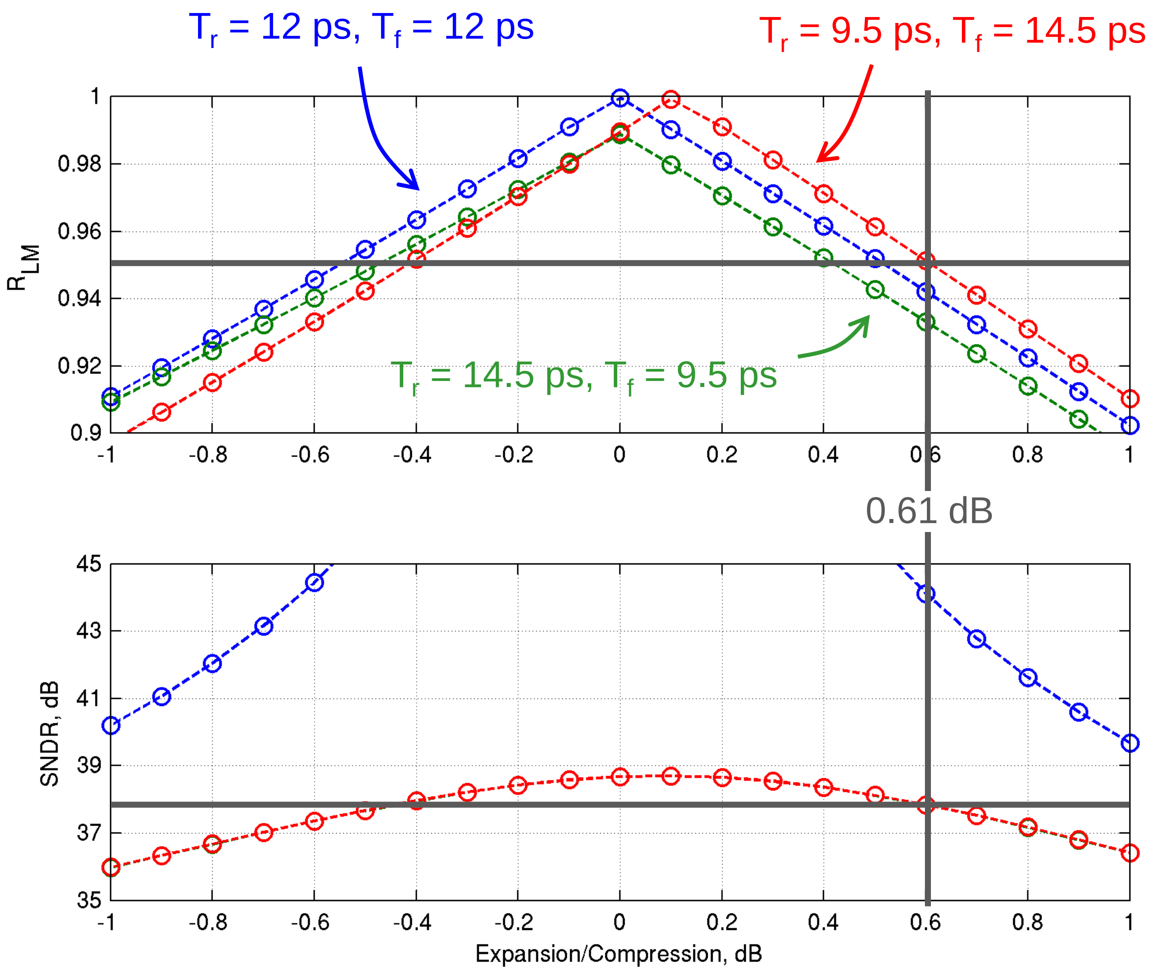
Parameter	Value	Parameter	Value
T_r	12 ps	R_d	50 Ω
$A_v = A_{fe}$	0.415 V	C_d	180 fF
$\mathrm{SNR}_{\mathrm{TX}}$	32.5 dB	z_p	30 mm
A_{DD}	20 mUI	Z_c	95 Ω
σ_{RJ}	10 mUI	C_p	110 fF

Host PCB model is based on the parameters in Table 92−12 with the exception that Z_c = 100 Ω.

150 mm host PCB length corresponds to a ~10 dB insertion loss (at 13.3 GHz) from TP0 to TP2.



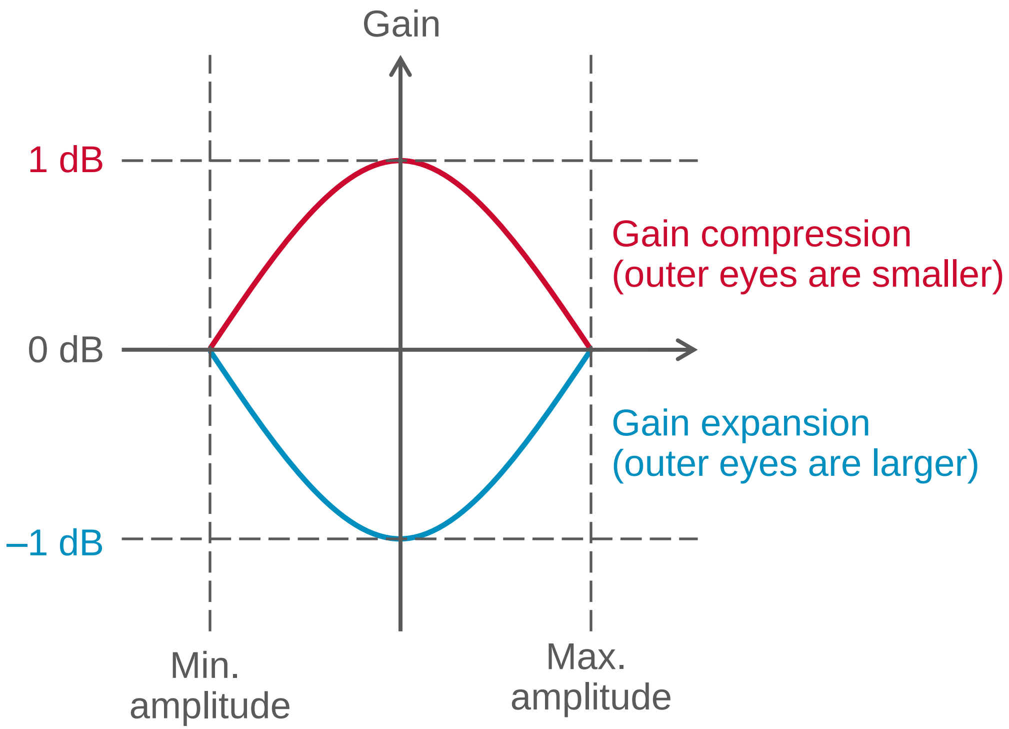
Distortion model for SNDR calculations



R_{LM} = 0.95

0.61 dB

SNDR = 37.8 dB
(w/o noise)



SNR_{TX} is set to 34 dB for cases that include this distortion model.

This maintains 32.5 dB SNDR at TP0a in all cases.

Some notes on SNR$_{TX}$

$$\sigma_{TX}^2 = [h^{(0)}(t_s)]^2 10^{-SNR_{TX}/10} \qquad (93A–30)$$

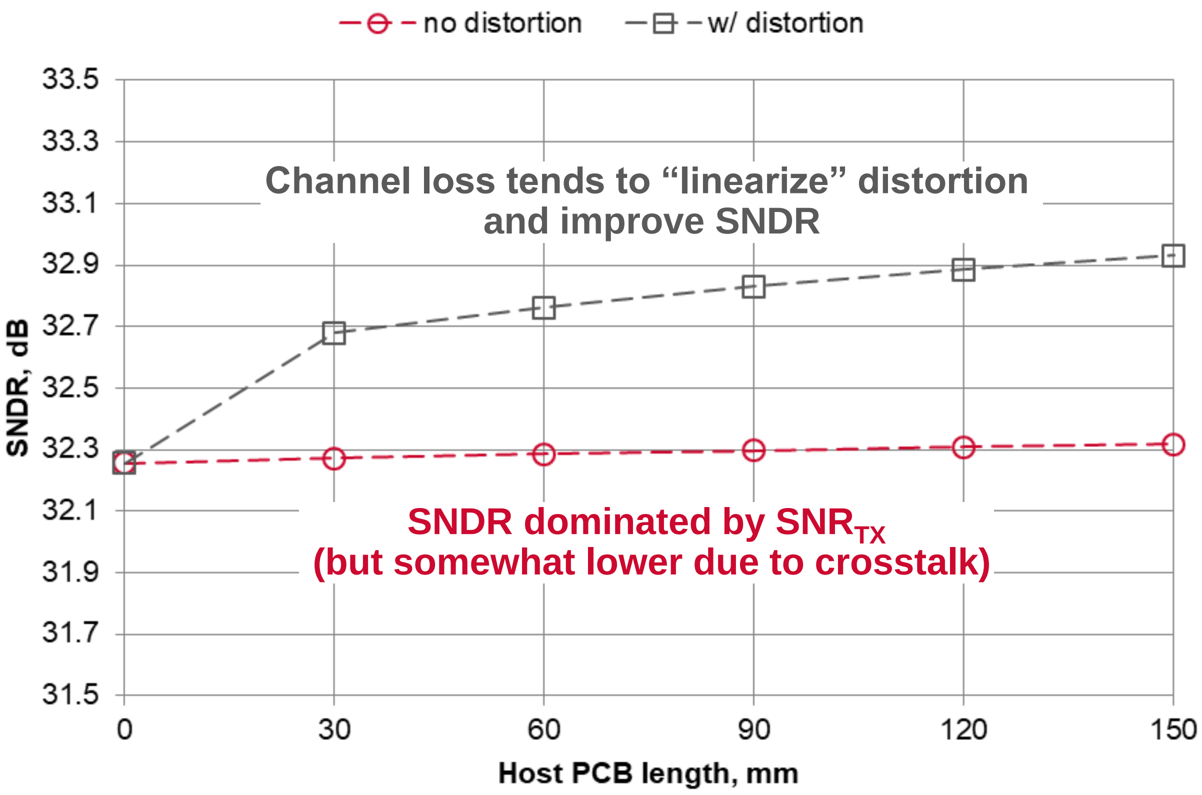
- COM assumes the RMS value of the transmitter noise is proportional to the cursor amplitude
- SNR$_{TX}$ is the same (or worse) at the output of a lossy channel since $p_{max} \geq h^{(0)}(t_s)$
- Further, COM assumes this noise appears only at the sampling phase
- If the noise was present at all phases, then σ_{RJ} should have been adjusted for the conversion of noise to jitter via the slope of the waveform at the threshold crossing
- The reality of the situation is dependent on exact nature of the noise and distortion (which is implementation-dependent)
- The COM assumptions are used in this analysis (with $p_{max} = h^{(0)}(t_s)$)

Slope around threshold level (no Tx equalization), V/UI

Label	TP0a	TP2					
		0 mm	30 mm	60 mm	90 mm	120 mm	150 mm
R03	0.843	0.659	0.564	0.511	0.446	0.402	0.355
F30	−0.833	−0.633	−0.57	−0.508	−0.448	−0.394	-0.351
R12	0.257	0.167	0.174	0.16	0.143	0.122	0.108
F21	−0.31	−0.227	−0.188	−0.177	−0.163	−0.139	-0.119
R01	0.179	0.066	0.058	0.107	0.155	0.184	0.204
F10	−0.25	−0.188	−0.14	−0.124	−0.092	−0.069	-0.049
R23	0.269	0.131	0.121	0.094	0.03		
F32	−0.136	−0.083	−0.049	−0.015	−0.014		
R02	0.488	0.33	0.32	0.252	0.205	0.177	0.152
F20	−0.586	−0.451	−0.41	−0.366	−0.332	−0.3	−0.275
R13	0.597	0.467	0.413	0.370	0.334	0.3	0.275
F31	−0.539	−0.402	−0.332	−0.279	−0.227	−0.18	−0.153
Avg. mag.	**0.441**	**0.317**	**0.278**	**0.247**	**0.216**	**0.189**	**0.17**

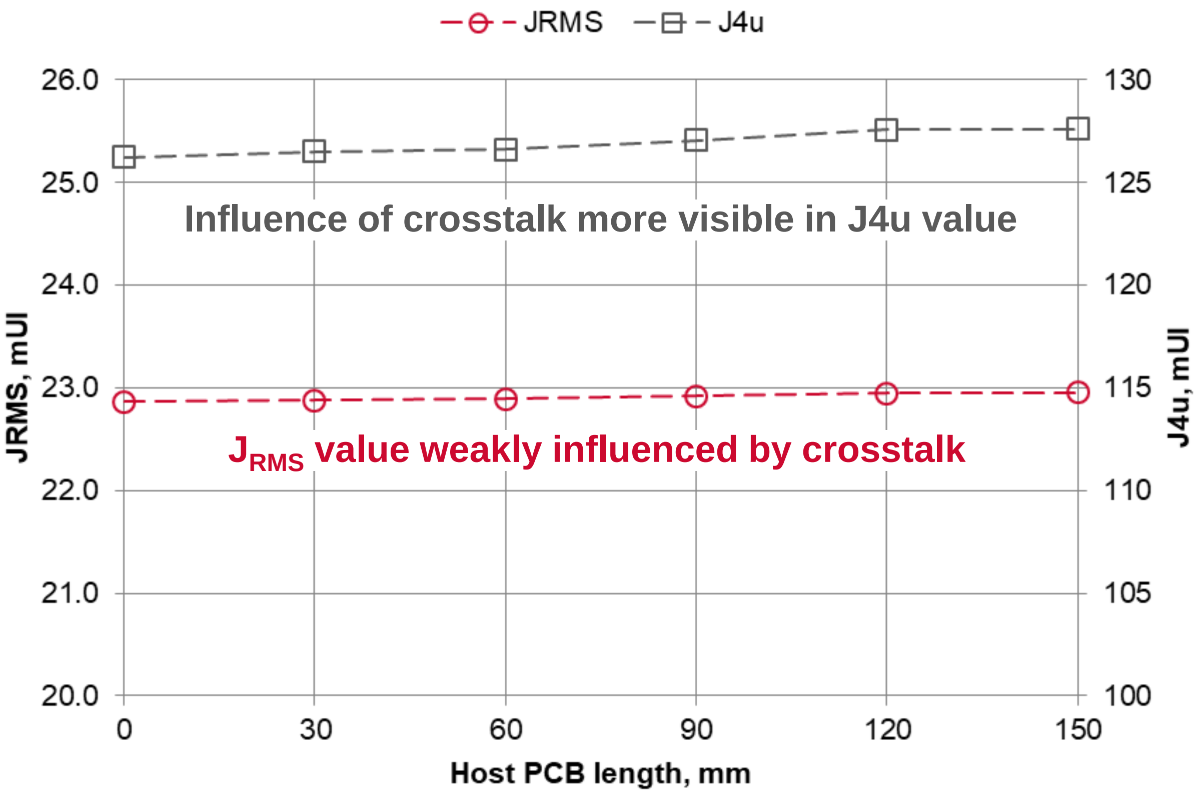
Some transitions failed to cross the threshold level for higher loss channels and no Tx equalization!

Calculated SNDR and uncorrelated jitter at TP2



Channel loss tends to “linearize” distortion and improve SNDR

SNDR dominated by SNR_{TX} (but somewhat lower due to crosstalk)



Influence of crosstalk more visible in J4u value

J_{RMS} value weakly influenced by crosstalk

Recommendations

- In Table 136-11…
- Reduce SNDR (min.) to a value no greater than 32.2 dB
  - dudek_011018_3cd_adhoc.pdf proposes 32 dB based on different simulation conditions
- Increase J4u (max.) to a value no less than 0.128 UI
- For output jitter, add the following exception to 120D.3.1.8
  - "J4u, J_{RMS}, and Even-odd jitter measurements are made with the transmit equalizer set to offset the impact of the host channel and achieve the most accurate measurement."

- These recommendations do not make noisy/jittery transmitters compliant
  - Such transmitters would not meet the recommendations of 136A.2
- These recommendations have no impact on cable assembly requirements
  - They simply project existing TP0 (TP0a) requirements to the TP2 measurement point

Comments on transmit equalizer settings for jitter testing

- There may be other ways to enable verification of uncorrelated/even-odd jitter measurements at TP2 “regardless of equalization setting”
  - E.g., addition of software equalization to offset the host channel impact
- However, 136A.2 states the transmitter is constrained at TP0a by 137.9.2 and the jitter requirements of 137.9.2 apply “regardless of equalization setting”
- The difference between TP0a and TP2 is passive electrical channel that is not expected to introduce dependencies on equalization settings (except to impair the execution and accuracy of the measurement)
- So the simplest solution to this issue is proposed as a way to move forward