Difference SNDR

(comment #206)

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Signal-to-noise-and-distortion ratio (SNDR) requirements

- 179.9.4.6 includes the following requirement

  “The transmitter SNDR shall meet the requirement when the transmitter equalization is set to each of the initial conditions defined in Table 179–8.”
- This requirement included in other clauses and annexes by reference
- The reference transmitter used to compute Channel Operating Margin (COM) only meets the SNDR requirement for preset 1
- Transmitter implementations do not need to meet requirements that the reference transmitter does not meet
- The requirement could be restated to only apply to Preset 1
- Alternatively, the measured SNDR could be compared to the calculated SNDR of the reference transmitter for a given preset
- This contribution describes this alternative approach in more detail

Calculation of SNDR for the reference transmitter

$$H_{noffe}(f) = H_t(f)H_{21}^{(ref)}(f)H_{bt}(f)$$

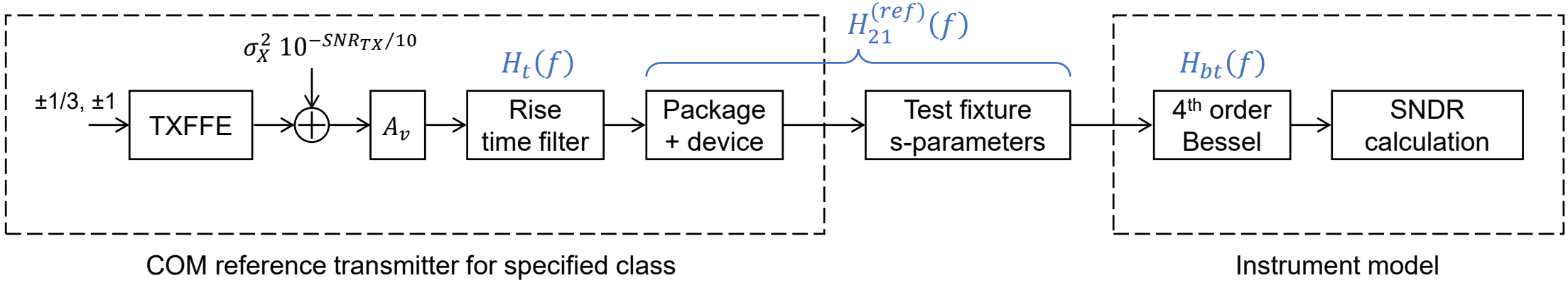
Voltage transfer function includes the device and package model for the specified class with a test fixture model. A host model also needs to be included for Clause 179 and Annex 176D. Note that the notation used here is fully defined in Annex 178A.

$$h_{noffe}(t) = \mathrm{IDFT}\left[A_v T_b \mathrm{sinc}(fT_b) H_{noffe}(f)\right]$$

Corresponding time-domain response (no TXFFE)

$$h_{txffe}(t) = \sum_n c(n)\, h_{noffe}(t - T_b)$$

Include TXFFE



Calculation of SNDR for the reference transmitter, continued

$$h_{txffe}(t_{max}) = \max\left[h_{txffe}(t)\right]$$ Time at which the pulse peak (with TXFFE) occurs

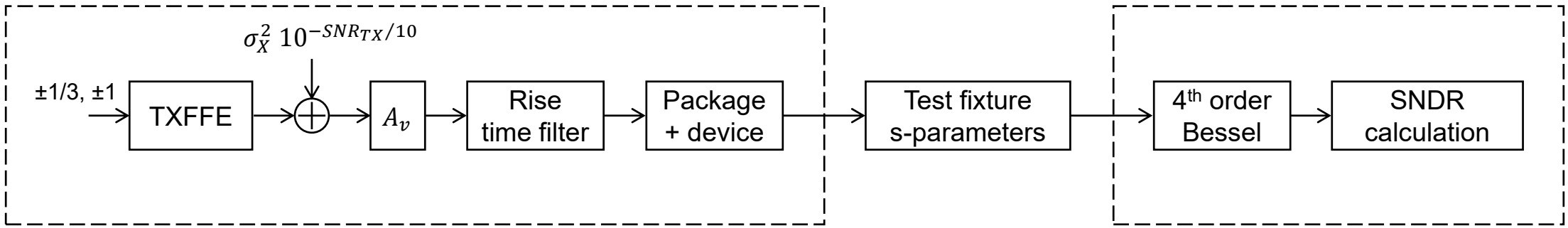
$$h_{tn}(n) = h_{noffe}(t_{max} + nT_b)$$

$$\sigma_{ts}^2 = \sum_{n=-D_p}^{N_p - D_p - 1} h_{txffe}^2\,(t_{max} + nT_b)$$ Signal (pulse) power

$$S_{tn}(\theta) = \sigma_X^2 10^{-SNR_{TX}/10}\,|\mathrm{DFT}[h_{tn}(n)]|^2 / f_b$$

$$\sigma_{tn}^2 = f_b \int_{-\pi}^{\pi} S_{tn}(\theta)\,df$$ Noise power

$$SNDR^{(ref)} = 10\log_{10}(\sigma_{ts}^2/\sigma_{tn}^2)$$ SNDR for reference transmitter



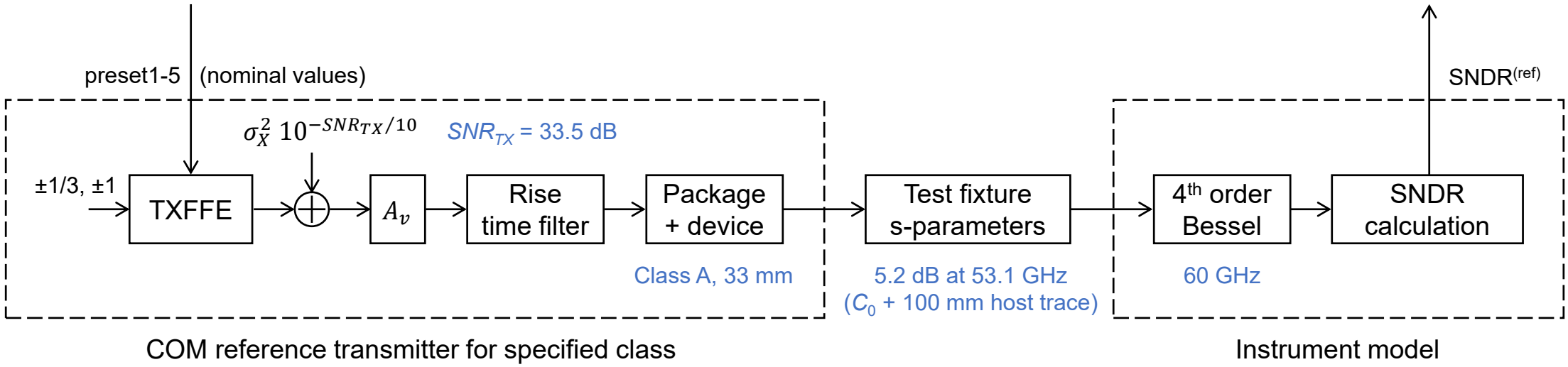
Reference transmitter does not meet SNDR requirements

Coefficient initial conditions (nominal values)

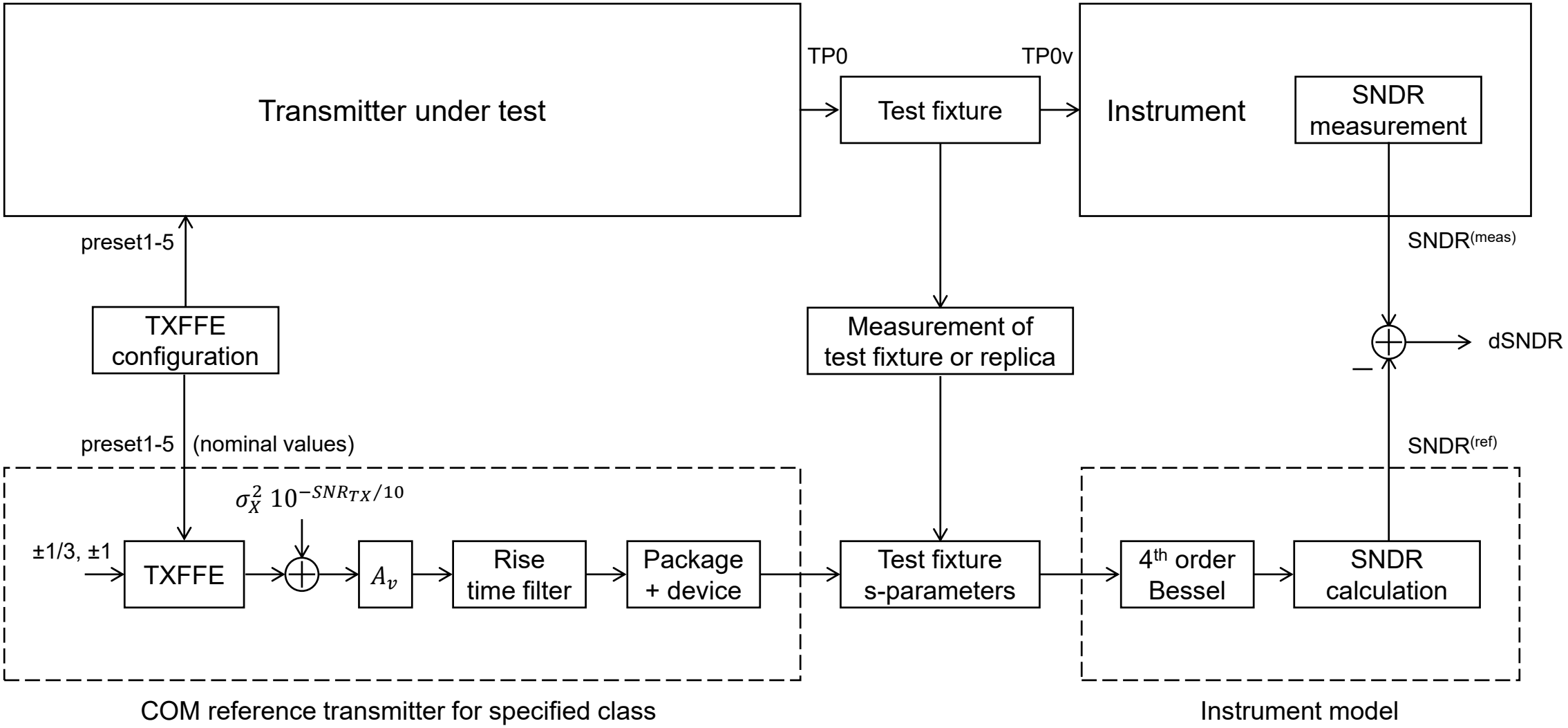
Preset	*c*(−3)	*c*(−2)	*c*(−1)	*c*(0)	*c*(1)
1	0			1	0
2	0	0	0	0.5	0
3	0	0	−0.075	0.75	0
4	0	0.05	−0.2	0.75	0
5	−0.025	0.075	−0.25	0.65	0

Example calculation results

Preset	SNDR$^{(ref)}$, dB	Min. limit, dB
1	33.5	33.5
2	27.5	
3	30.7	
4	30.2	
5	28.7	



“Difference SNDR” or dSNDR



Difference SNDR test procedure

1. Measure the s-parameters of the test fixture [a]

For a given preset *i*...

2. Compute the reference SNDR using the procedure in slides 3 and 4 and the nominal coefficients for preset *i* [b]
3. Configure the transmitter under test to use preset *i*
4. Measure the SNDR of the transmitter under test using the procedure 179.9.4.6
5. Compute the difference between the measured and reference SNDR (call it dSNDR)
6. Repeat steps 2 through 6 for all presets

[a] For host or module testing, the test fixture is a mated pair of host and module compliance boards
[b] For host testing, the reference transmitter includes the host channel model for the corresponding host class

Summary and proposal

- Align transmitter requirements to reference transmitter behavior by...
- ...changing SNDR requirements to apply only to preset 1 or...
- ...replacing SNDR requirements with “difference SNDR” requirements
- Latter option aligns with specification method for steady-state voltage, linear fit pulse peak ratio, and effective return loss
- Propose that the minimum limit for difference SNDR be 0 dB