CM Measurement Specification Recommendations

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CM Comment

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Common mode measurements are not well enough defined to precisely specify CM voltage at TP0v, TP1a, TP4 and TP2. In addition, all aspects of a common mode voltage may not be detrimental as illustrated in mellitz_3ck_adhoc_01_090821.

- Proposed Change:

Add section "93A.6 Common Mode measurements". See presentation mellitz_3ck_01_0921

Common mode voltage depends on use case

Add measurement for correlated common mode voltage

- ❑ Specify when TP0v is not used
  - $Pmax_{ccm}$: maximum CM fitted waveform of v_{cmi} (120E.3.1 figure 120E-7)
- ❑ Specify when TP0v is used
  - SNR_{ccm} : dB ratio of P_{max} to $Pmax_{ccm}$

Add measurement for un-correlated common mode voltage

- ❑ Specify in all use cases
  - SNR_{ucm} : dB ratio of P_{max} to σ_{ncm}

Add section for CM waveform fitting

Define parameter $Pmax_{ccm}$

Option 1

- Compute the linear fit to the averaged captured waveform $v_{CMI}(t)$ and the linear fit pulse response, according to 120D.3.1.3 by replacing Y with v_{cmi}, and P with P_{cm}.
- Define the fitted waveform as $P_{cm}X_1$ *(ref eq 85.8)*.
- Denote $Pmax_{ccm}$ = Maximum | $P_{cm}X_1$ |

Option 2

- Denote $Pmax_{ccm}$ = Maximum | averaged($v_{cmi}(t)$) |
  - Averaging over repeated PRBSQ13 patterns

Option 3

- Denote $Pmax_{ccm}$ *as* vf_{cm} using the same method as vf is computed using P_{cm} instead of P.

option 1 seems attractive but recommend option 2 as it provide a simpler method.

Define parameter σ_{ncm}

- from 120D.3.1.6 and
  Using the same configuration of the transmitter equalizer, measure the RMS deviation from the mean of the CM voltage at a time point corresponding to where the DM signal is at a fixed low-slope point in runs of at least 6 consecutive identical PAM4 symbols. PRBS13Q includes such a run for each of the PAM4 levels. The average of the four measurements is denoted as σ_{ncm}.

Denote 2 more specification parameters

- $SNR_{ccm} = 20log_{10}\left(\frac{P_{max}}{Pmax_{cm}}\right)$
- $SNR_{ucm} = 20log_{10}\left(\frac{P_{max}}{\sigma_{ncm}}\right)$

Usage

For 120G (table 120G-1, 120G-3) and 162 (table 162-10)

- Replace item "AC common-mode RMS output voltage (max)"
- With "Peak fitted AC common mode (max) $Pmax_{ccm}$"

For 120F (table 120F-1) and 163 (table 163-5) (TP0v specs)

Option A

- Replace item "AC common-mode RMS output voltage (max)"
- With "Correlated AC common mode SNR (min), SNR_{ccm}"

Option B

- Remove item "AC common-mode RMS output voltage (max)"
- Do not specify because the test point is far away where the Rx needs protecting
- Also correlated common mode is already include in insertion loss.

Recommend option B

- For 120F, 120G, 162, 163 add to the transmitter tables
- "Uncorrelated AC common mode SNR (min), SNR_{ucm}"

Suggested specification values

table	$Pmax_{cm}$	SNR_{ccm}	SNR_{ucm}
120G-1	50 mV	NA	28 dB
120G-3	50 mV	NA	28 dB
162-10	50 mV	NA	28 dB
120F-1	NA	NA (13 dB for option A)	28 dB
163-5	NA	NA (13 dB for option B)	28 dB

- 13 dB SNR_{ccm} is approximate the dB ratio of the minimum peak reference package pulse at tp0 divided by 50 mV
  - 50 mV is essentially a CM tolerance value ($Pmax_{cm}$)
- 28 dB SNR_{ucm} is approximate the dB ratio of the minimum peak reference pulse at tp0 divided by 10 mV RMS
  - 10 mV broadband AC CM uncorrelated noise at TP0 has little effect on effective SNDR or COM (see mellitz_3ck_adhoc_01a_061720)

Thank You!