



# Revised PSE and PD Ripple Limits

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# Presentation Objectives

- To propose revised limits for PSE ripple voltage and PD ripple current required to ensure data integrity of the PHYs in response to comments 66 and 108.

# Existing Ripple Voltage and Current Limits

- From Table 104-3 (PSE Power Supply Limits):

4	Power feeding ripple and noise:							
	1 kHz<f<10 MHz		V <sub>p-p</sub>	—	$\frac{0.2}{\sqrt{1 + \left(\frac{f}{50kHz}\right)^2}}$	All	A	See 104.4.6.3
1 kHz<f<10 MHz			—	$\frac{0.2}{\sqrt{1 + \left(\frac{f}{280kHz}\right)^2}}$		B		

- From Table 104-6 (PD Power Supply Limits):

3	Ripple current							
	1 kHz<f<10 MHz		A <sub>p-p</sub>	—	100 Hz/f	A	See 104.5.6.3	
—				1000 Hz/f	B			

# Issue with Existing Ripple Limits

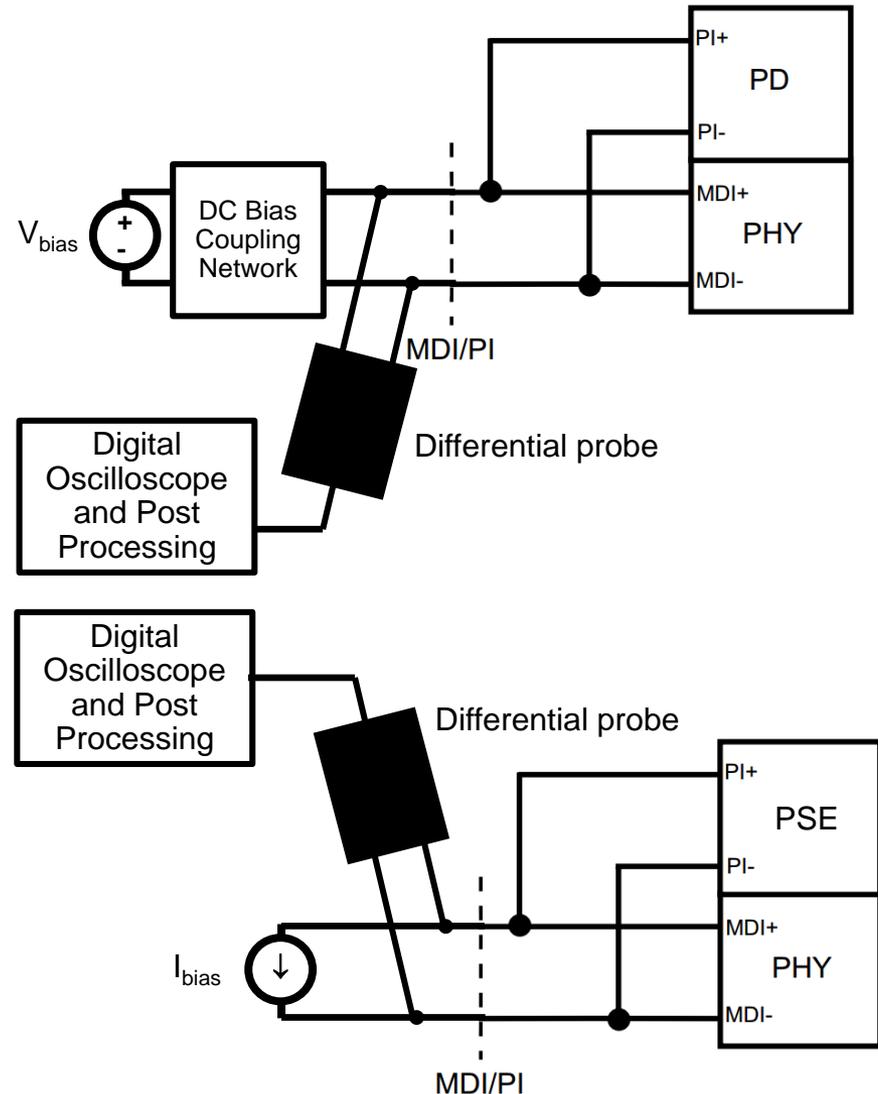
- The existing limits are a function of frequency and only apply to discrete ripple harmonics.
- Maximum ripple voltage over an integrated bandwidth should be specified in order to ensure data integrity for any number of ripple harmonics.

# Assumptions for Specifying and Testing Ripple Limits

- PSE and PD ripple voltage is measured at the MDI/PI.
- Voltage is sourced to a PD under test through a DC bias coupling network with MDI return loss as specified by the relevant physical layer.
- Ripple voltage should result in less than 100mV peak as seen across the PHYs' 100  $\Omega$  terminations and less than 10mV peak as seen after the PHY's internal high-pass filter.
- A 100BASE-T1 PHY uses a 100nF DC blocking capacitor and a 1 MHz internal high-pass pole.
- A 1000BASE-T1 PHY uses a 10nF DC blocking capacitor and a 10 MHz internal high-pass pole.

# Basic Approach for Measuring Ripple

- Measure PSE and PD PI voltage and post-process with filters to test for ripple voltage compliance.
- This approach is conservative since the impedance of the link and link partner PHY in shunt with the PI attenuates the effect of the power supply ripple voltage on the local PHY.



# Proposed Changes to Table 104-3 (PSE output requirements)

- Replace existing item 4 with:

Item	Parameter	Symbol	Unit	Min	Max	Class	Type	Additional Information
	Power feeding ripple and noise							
4a	1 kHz < f < 10 MHz		V <sub>p-p</sub>		100mV	All	All	See 104.4.6.3
4b	1 kHz < f < 10 MHz				10mV			

# Proposed Changes to Baseline Text

- Change 104.4.6.3 as follows:

The ripple and transient limits specified in Table 104–3, items (4) and (3) respectively, are meant to preserve data integrity.

A digital oscilloscope or data acquisition module with a differential probe is used to observe the voltage at the MDI/PI of the PSE DUT as shown in Figure 104-8.

When measuring the ripple voltages for a Type A PSE as specified by Table 104-3 items (4a) and (4b), the voltage observed at the MDI/PI shall be filtered with the transfer functions specified in Equation (104-2) and Equation (104-3), respectively, where  $f_1 = 31.8 \text{ kHz} \pm 1\%$  and  $f_2 = 1 \text{ MHz} \pm 1\%$ .

When measuring the ripple voltages for a Type B PSE as specified by Table 104-3 items (4a) and (4b), the voltage observed at the MDI/PI shall be filtered with the transfer functions specified in Equation (104-2) and Equation (104-3), respectively, where  $f_1 = 318 \text{ kHz} \pm 1\%$  and  $f_2 = 10\text{MHz} \pm 1\%$ .

$$H_1(f) = \frac{f}{\sqrt{f^2 + f_1^2}} \quad (104-2)$$

$$H_2(f) = H_1(f) \times \frac{f}{\sqrt{f^2 + f_2^2}} \quad (104-3)$$

# Proposed Changes to Baseline Text cont'd

- Insert Figure 104-8 shown below after 104.4.6.3:

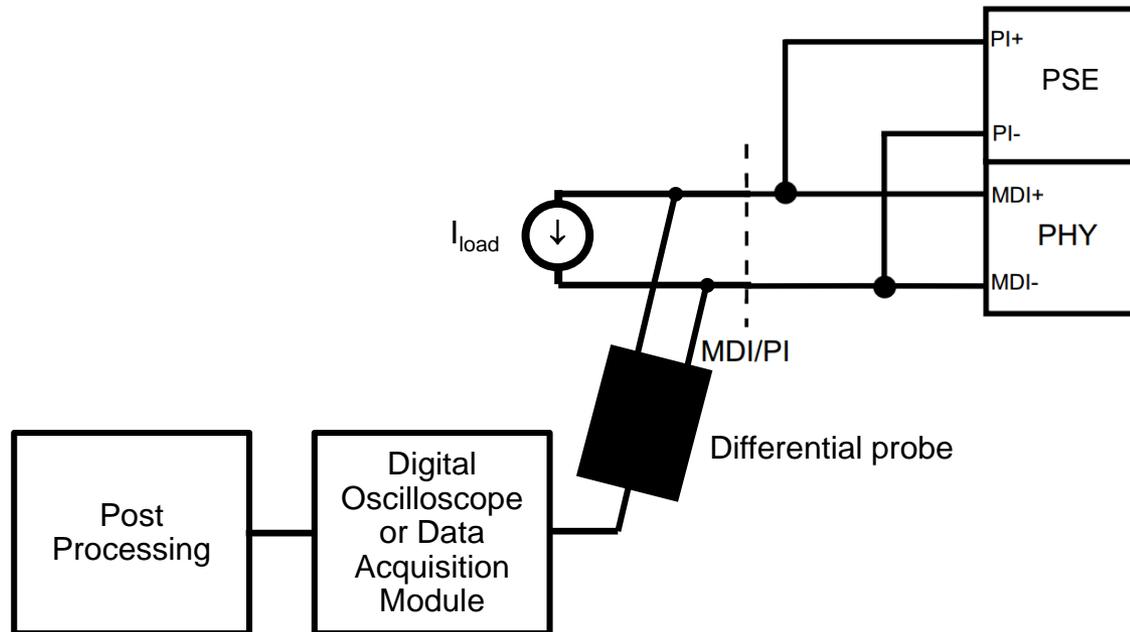


Figure 104-8-PSE ripple voltage test fixture

# Proposed Changes to Table 104-6 (PD power supply limits)

- Replace existing item 3 with:

Item	Parameter	Symbol	Unit	Min	Max	Class	Type	Additional Information
	Ripple voltage							
3a	1 kHz < f < 10 MHz		V <sub>p-p</sub>		100mV	All	All	See 104.5.6.3
3b	1 kHz < f < 10 MHz				10mV			

# Proposed Changes to Baseline Text cont'd

- Change 104.5.6.3 as follows:

The specifications for ripple and transients in Table 104–6 apply to the voltage at the PD PI generated by the PD circuitry. Ripple and transient limits are provided to preserve data integrity.

The PD DUT is connected to a power supply through a DC bias coupling network as shown in Figure 104-10. A digital oscilloscope or data acquisition module with a differential probe is used to observe the voltage at the MDI/PI.

The ripple and transient specifications for a Type A PD shall be met for all operating voltages in the range of  $V_{PD}$  sourced through a DC bias coupling network with MDI return loss as specified by Equation (104-5), and over the range of  $P_{PD}$ . ~~Ripple and transient limits are provided to preserve data integrity.~~ The ripple and transient specifications for a Type B PD shall be met for all operating voltages in the range of  $V_{PD}$  sourced through a DC bias coupling network with MDI return loss as specified by clause 97, and over the range of  $P_{PD}$ .

# Proposed Changes to Baseline Text cont'd

Changes to 104.5.6.3 cont'd:

When measuring the ripple voltages for a Type A PD as specified by Table 104-6 items (3a) and (3b), the voltage observed at the MDI/PI shall be filtered with the transfer functions specified in Equation (104-2) and Equation (104-3), respectively, where  $f_1 = 31.8 \text{ kHz} \pm 1\%$  and  $f_2 = 1 \text{ MHz} \pm 1\%$ .

When measuring the ripple voltages for a Type B PD as specified by Table 104-6 items (3a) and (3b), the voltage observed at the MDI/PI shall be filtered with the transfer functions specified in Equation (104-2) and Equation (104-3), respectively, where  $f_1 = 318 \text{ kHz} \pm 1\%$  and  $f_2 = 10 \text{ MHz} \pm 1\%$ .

# Proposed Changes to Baseline Text cont'd

- Insert Figure 104-10 shown below after 104.5.6.3:

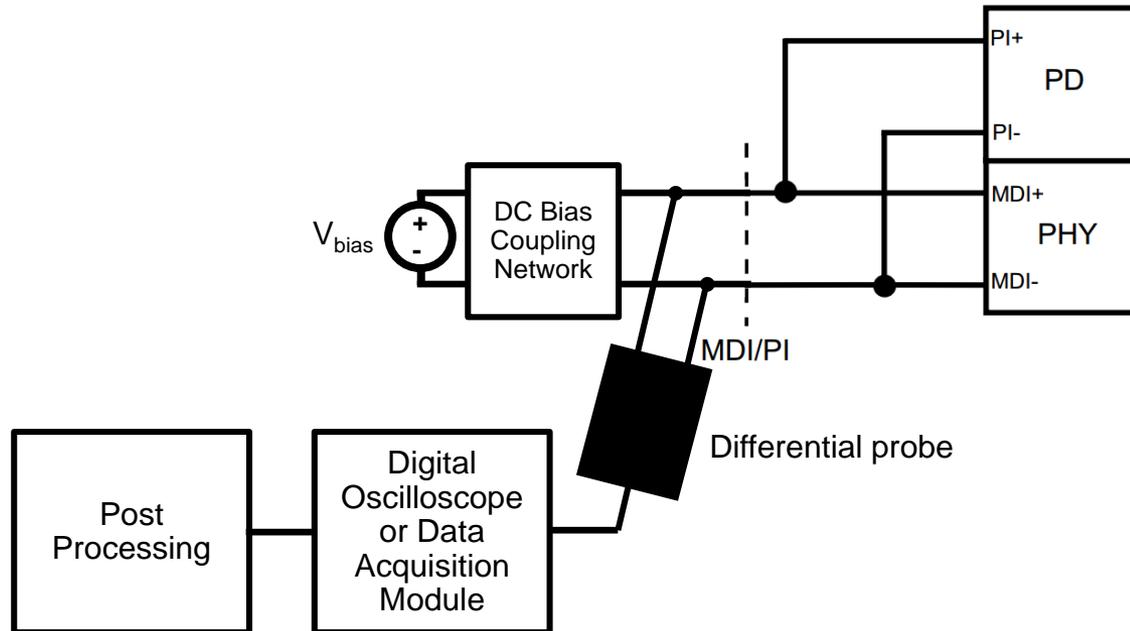


Figure 104-10-PD ripple voltage test fixture

# Questions?