Comment #65, #144 (Page 201, Line 8 clause 145.3.8.10)

In the text "Single-signature PDs shall not exceed ICon-2P-unb for longer than TCUT-2P min and 5 % duty cycle, and shall not exceed IPeak-2P-unb, as defined in Table 145–16 on any pair when PD PI pairs…", there are few problems that makes the spec broken:

1) IPeak-2P-unb is not defined in Table 145-16. It is defined by Equation 145-12.

2) IPeak-2P-unb is a PSE parameter and not a PD parameter. We need separate parameter name and content for the PD i.e. IPeak_PD-2P_unb for PD (as we did for Icon and named it Icon_PD for the PD).

3) Equation 145-12 belongs to PSE section and set the actual Ipeak-2P_unb current which is not the maximum Ipeak-2P_unb since it depends on PSE voltage. PDs must be designed to the maximum Ipeak-2P_ub (and to the maximum Icon-2P_unb as we did for PD during last cycle) due to the fact that the PD doesn't control the actual Ipeak-2P-unb since it doesn't have the knowledge of PSE voltage and more important, they can be connected to PSE with the minimum voltage which will create the maximum possible current.

As a result of the above arguments we need to define new PD parameters name for Icon-2P_unb and Ipeak-2P_unb i.e. Icon_PD-2P_unb and Ipeak_PD-2P_unb with fixed maximum values that are PD parameters and not depend on PSE (as we did per the concept we adopt on march for comment #320 from D2.3, see yseboodt_08_0315_peakunbalance.pdf arguments that has generated the new Equation 145-28 and 145-29).

Suggested Remedy

See next page

[BASELINE STARTS HERE]

1. Add the following rows to Table 145-28

Item	Parameter	Symbol	Unit	Min	Max	PD Type	Additional information
X1	Pairset current continuous including unbalance effect per the assigned Class for a single-signature PDs						
	Class 1 to 4	Icon_PD-2P-unb	A		Icon_PD[a]	3, 4	See 145.3.8.X and 145.3.8.10
	Class 5				0.55	3, 4	
	Class 6				0.682	3, 4	
	Class 7				0.781	4	
	Class 8				0.932	4	
Y1	Pairset peak current including unbalance effect per the assigned Class for a single-signature PDs						
	Class 1 to 4	Ipeak_PD-2P-unb	A		IPeak_PD	3, 4	See 145.3.8.X and 145.3.8.10
	Class 5				0.560	3, 4	
	Class 6				0.700	3, 4	
	Class 7				0.827	4	
	Class 8				***0.988***	4	
Z1	Overload time limit per pairset	T_{cut_PD-2P}	ms		50	3, 4	See 145.3.8.X, 145.3.8.4 and 145.3.8.10

[a]The I_{con_PD} value is higher than the value for Class 5 as unbalance for Class 4 is not restricted.

2. Make the following changes:

145.3.8.4 Peak operating power

$V_{Overload-2P}$ is the PD PI voltage when the PD is drawing the permissible P_{Peak_PD} for single-signature PDs, or P_{Peak_PD-2P} for dual-signature PDs.

At any static voltage at the PI, and any PD operating condition, with the exception described in 145.3.8.4.1, the peak power for single-signature PDs shall not exceed P_{Class_PD} for more than T_{cut_PD-2P} ~~$T_{CUT-2P\ min}$~~, as defined in ~~Table 145–16~~ Table 145–28 and 5% duty cycle. Peak operating power shall not exceed P_{Peak_PD}.

At any static voltage at the PI, and any PD operating condition, with the exception described in 145.3.8.4.1, the peak power for a dual-signature PD shall not exceed P_{Class_PD-2P} for more than T_{cut_PD-2P} ~~$T_{CUT-2P\ min}$~~, as defined in Table 145–28~~Table 145–16~~ and 5% duty cycle. Peak operating power shall not exceed P_{Peak_PD-2P}.

NOTE—The duty cycle of the peak current is calculated using any sliding window with a width of 1 s.

Peak power is defined in Table 145–28 and depends on the Class assigned by the PSE. The equations in Table 145–28 are used to approximate the ratiometric peak powers of Class 1 through Class 8. These equations may be used to calculate P_{Peak_PD} or P_{Peak_PD-2P} for Data Link Layer classification by substituting P_{Class_PD} or P_{Class_PD-2P} with PDMaxPowerValue and for Autoclass by substituting P_{Class_PD} with $P_{Autoclass\_PD}$.

145.3.8.4.1 Peak operating power exceptions

For Class 6 and Class 8 single-signature PDs and for Class 5 dual-signature PDs, when additional information is available to the PD regarding actual channel DC resistance between the PSE PI and the PD PI, in any operating condition with any static voltage at the PI, the peak power shall not exceed P_{Port_PD} for single-sig-nature PDs and P_{Port_PD-2P} for dual-signature PDs at the ~~PSE PI~~ PD PI for more than T_{cut_PD-2P} ~~$T_{CUT-2P\ min}$~~, as defined in Table 145–28~~Table 145–16~~ and with 5% duty cycle. Peak operating power shall not exceed 1.05 × P_{Port_PD} for single-signature PDs and shall not exceed 1.05 × P_{Port_PD-2P} for dual-signature PDs on each pairset.

Operating under 145.3.8.4.1 conditions is allowed if P_{Peak_PD} and $P_{Peak\_PD\text{-}2P}$ requirements are met and the total input power is less than or equal to P_{Class} or $P_{Class\text{-}2P}$ at the PSE PI respectively when calculated over a 1 second interval.

145.3.8.10 PD pair-to-pair current unbalance

……..

Single-signature PDs shall not exceed ~~ICon_2P_unb~~ ICon_PD-2P_unb as defined in Table 145-28 for longer than ~~TCUT_2P~~$T_{CUT\_PD\text{-}2P}$ ~~_min~~ and 5 % duty cycle, and shall not exceed ~~IPeak_2P_unb~~ $I_{Peak\_PD\text{-}2P\_unb}$, as defined in ~~Table 145-16~~ Table 145-28 on any pair when PD PI pairs of the same polarity are connected to any voltage in the range of VPort_PSE-2P through two common mode resistances, Rsource_min and Rsource_max, as defined in Equation (145–27) and shown in Figure 145–32.

Dual-signature PDs shall not exceed ICon_PD-2P as defined in ~~Equation (145-28)~~ Equation (145–Y8) for longer than ~~TCUT_2P~~$T_{CUT\_PD\text{-}2P}$ as defined in Table 145-28 ~~_min~~ and 5 % duty cycle~~, as defined in Table 145-16~~, and shall not exceed IPeak_PD-2P as defined by Equation (145-Y10) on any pair when PD PI pairs of the same polarity are connected to any voltage in the range of VPort_PSE-2P through two common mode resistances, Rsource_min and Rsource_max, as defined in Equation (145–27) and shown in Figure 145–32.

NOTE—The duty cycle of the peak current is calculated using any sliding window with a width of 1 second.

$$R_{source\_max} = \left\{ (-0.03 \times R_{source\_min} + 1.324) \times R_{source\_min} \text{ for } (0.145\Omega \le R_{source\_min} \le 5.47\Omega) \right\}_{\Omega} \quad (145\text{–}27)$$

Note part of the baseline
Equations 145-28 and 145-29 were deleted and moved to the new sub clause 145.3.8.X as Equations 145-Y8 and 145-Y9

$$I_{Con\_PD\text{-}2P} = \left\{ \frac{P_{Class\_PD\text{-}2P}}{V_{PD}} \right\}_{A} \quad (145\text{–}28)$$

$$I_{Peak\_PD\text{-}2P} = \left\{ \frac{P_{Peak\_PD\text{-}2P}}{V_{PD}} \right\}_{A} \quad (145\text{–}29)$$

…….

R_{PD_min}, R_{PD_max} ensures that along with any other parts of the system, i.e., channel (cables and connectors) and the PSE, the maximum pair current including unbalance does not exceed ~~ICon_2P_unb~~ Icon_PD-2P-unb as defined in ~~Table 145-16~~ Table 145-28 during normal operating conditions. See Annex 145A.

3. Add the following text after Table 145-28 and before 145.3.8.10

Note part of the baseline
I have used the same concept and text used in the PSE side so the concept is proven and clear. The main changes made to have separate variable names for the PD as done in many cases in the spec to separate PSE variables and PD variables to be independent

145.3.8.X Continuous output current capability in the POWERED state

$I_{Port\_PD\text{-}2P}$ and $I_{Port\_PD\text{-}2P\_other}$ are the currents on the pairs with the same polarity of the two pairsets and are defined in Equation (145–Y1) and Equation (145–Y2).

$$I_{Port\_PD-2P} = \left\{ \begin{array}{llll} \text{IPort\_PD - 2P\_modeA} & \text{for} & \text{mode} & A \\ \text{IPort\_PD - 2P\_modeB} & \text{for} & \text{mode} & B \end{array} \right\}_A \quad \text{(145-Y5)}$$

$$I_{Port\_PD-2P\_other} = \left\{ \begin{array}{llll} \text{IPort\_PD - 2P\_modeB} & \text{for} & \text{mode} & B \\ \text{IPort\_PD - 2P\_modeA} & \text{for} & \text{mode} & A \end{array} \right\}_A \quad \text{(145-Y6)}$$

IPort_PD is the total current on both pairs with the same polarity and is defined in Equation (145-Y7).

$$I_{Port\_PD} = \{I_{Port\_PD-2P} + I_{Port\_PD-2P\_other}6\}_A \quad \text{(145-Y7)}$$

where
IPort_PD-2P is the input current consumed by mode A or mode B
IPort_PD-2P is the input current consumed by mode B or mode A

PDs shall be able to support Icon_PD-2P, the current the PD supports on each powered pairset, as defined in Equation (145–Y8).

Note part of the baseline
We could use PClass_PD/VPD instead of ICon_PD in Equation 145-7a however the requirements for 4-pairs are better understood with the next introduction using Icon_PD and Icon_PD-2P_unb.

When powering a single-signature PD over 4 pairs, a PD supports:
— A total current of ICon_PD, defined in Equation (145– Y7a), over both pairs with the same polarity;
— A minimum current of Icon_PD-2P_unb over one of the pairs of the same polarity under maximum unbalance condition (see 145.3.8.10) in the POWERED state.

$$I_{Con\_PD} = \left\{ \frac{P_{Class\_PD}}{V_{PD}} \right\}_A \quad \text{(145-Y7a)}$$

where

*P*Class_PD	is PClass_PD as defined in Table 145-28
*V*PD	is the voltage on the pairset at the PD PI as defined in 145.1.3.

$$I_{Con\_PD-2P} = \left\{ \begin{array}{cc} I_{Con\_PD} & \text{when in } 2-\text{pair mode} \\ \min\left(I_{Con\_PD} - I_{Port\_PD-2P\_other}, I_{Con\_PD-2P\_unb}\right) & \text{when a single-signature PD is powered in } 4-\text{pair mode}-2P \\ \mathrm{P_{Class\_PD2P}/V_{PD}} & \text{when a dual-signature PD is powered in } 4-\text{pair mode} \end{array} \right\}_A \quad \text{(145-Y8)}$$

where

*I*con_PD	is the total current a PD is able to consume as defined in Equation (145–Y7a)
*V*PD	is the voltage on the pairset at the PD PI as defined in 145.1.3.
*I*Port_PD-2P_other	is the output current on the other pairset as defined in Equation (145–Y6).
*I*con_PD-2P_unb	is the minimum current due to unbalance effects that a PD must support on a pairset when powering a single-signature PD over 4 pairs as defined in Table 145-28
*P*Class_PD-2P	is PClass_PD-2P as defined in Table 145-28.

The PD shall support the AC current waveform parameter IPeak_PD-2P, defined in Equation (145–Y9), on each powered pairset, while within the operating voltage range of VPort_PD-2P, for a minimum of TCUT_PD-2P and a duty cycle of at least 5%.

$$I_{Peak\_PD-2P} = \left\{ \begin{array}{cc} P_{Peak\_PD}/Vpd & when\ in\ 2-pair\ mode \\ \min\left(P_{Peak\_PD}/Vpd - I_{Port\_PD-2P\_other}, I_{Peak\_PD-2P\_unb}\right) & when\ a\ single-signature\ PD\ is\ powere\ in\ 4-pair\ mode \\ P_{Peak\_PD-2P}/Vpd & when\ a\ dual-signature\ PD\ is\ powere\ in\ 4-pair\ mode \end{array} \right\}_A \quad (145\text{-}Y9)$$

where

Ppeak_PD is the total peak power a PD may consume per Table 145-28

*I*Port_PD-2P_other is the output current on the other pairset as defined in Equation (145–Y6).

*I*Peak_PD-2P_unb is the minimum current due to unbalance effects a PD must support on a pairset as defined in Table 145-28 during peak operating power condition. See 145.3.8.4.

*V*PD is the voltage on the pairset at the PD PI as defined in 145.1.3.

*P*Peak_PD-2P is the peak power a dual-signature PD may draw per its assigned Class on a pair-set; see Table 145–28

IPeak, defined in Equation (145–Y10), is the total current of the powered pairs with the same polarity that a PD supports, when powering a PD over 2-pairs or powering a single-signature PD over 4 pairs.

$$I_{Peak\_PD} = \left\{ \frac{P_{Peak\_PD}}{V_{PD}} \right\}_A \quad (145\text{-}Y10)$$

where

*V*PD is the voltage on the pairset at the PD PI as defined in 145.1.3.

*P*Peak_PD is the total peak power a PD may draw for its Class; see Table 145–28

4. Replace Tcut-2P with Tcut_PD-2P in the following locations:
PD50, PD51, PD52, PD56, PD69 and PD70.

5. Replace the reference to Table 16 with Table 28in the following locations: PD51 and PD56