Info (not part of baseline)

Draft 1.5 has inconsistent rules pertaining to dual-signature PDs. The goal of this baseline is to simplify the text and make it consistent throughout. The text is based on the following guiding principles:

- Type 3 and 4 PSEs, when powering a dual-signature PD will provide $P_{\text{Class-2P}}$ for each pairset independently
- Type 3 and 4 dual-signature PDs *are required* to police their power consumption *per pairset* → $P_{\text{Class\_PD-2P}}$ is introduced as a new parameter

The result is that all dual-signature PDs can be treated in the same way, regardless if they advertise a different class on each pairset or not.

Red text is to be inserted ~~or removed~~ with regard to existing text in black.

This is an instruction to the editor.

33.2.6 PSE classification of PDs and mutual identification

...

Based on the response of ~~the~~ a single-signature PD, the minimum power level at the output of the PSE is P_{Class} as shown in Equation (33–3). ~~P_{Class} applies to the total PD power.~~ P_{Class} is the power the PSE supports at the PI. Based on the response of a dual-signature PD, the minimum power level supported for a pairset at the output of the PSE is $P_{\text{Class-2P}}$ as shown in Equation 33–3a. Physical Layer classification encompasses...

The minimum power output by the PSE for a particular PD Class, when powering a single-signature PD, or supplying power in 2-pair mode, is defined by Equation (33–3). ~~This equation applies to 2-pair operation, and 4-pair operation when connected to a single-signature PD, or connected to a dual-signature PD that advertised the same class signature on both pairsets.~~

Remove the n parameter from Equation 33–3 and parameter description as follows:

$$P_{\text{Class}} = \left\{ V_{\text{PSE}} \times \left(\frac{V_{\text{PSE}} - \sqrt{V_{\text{PSE}}^2 - 4 \times R_{\text{Chan}} \times P_{\text{Class\_PD}}}}{2 \times R_{\text{Chan}}} \right) \right\}_{\text{W}} \tag{33–3}$$

where

V_{PSE}	is the voltage at the PSE PI as defined in 1.4.426
R_{Chan}	is the channel DC loop resistance
$P_{\text{Class\_PD}}$	is the PD's power classification (see Table 33–16a)

...

The minimum output power on a pairset for Type 3 and Type 4 PSEs that apply 4-pair power to a dual-signature PD ~~which requests a different class signature on each pairset~~ is defined by Equation (33–3a). Alternatively, PSE implementations may use $V_{\text{PSE}} = V_{\text{Port\_PSE-2P}}$ min and $R_{\text{Chan}} = R_{\text{Ch}}$ to arrive at over-margined values shown in Table 33–7b.

$$P_{\text{Class-2P}} = \left\{ V_{\text{PSE}} \times \left(\frac{V_{\text{PSE}} - \sqrt{V_{\text{PSE}}^2 - 4 \times R_{\text{Chan}} \times P_{\text{Class\_PD-2P}}}}{2 \times R_{\text{Chan}}} \right) \right\}_{\text{W}} \tag{33–3a}$$

Update the parameter description for Equation (33–3a):

where

V_{PSE}	is the voltage at the PSE PI as defined in 1.4.426
R_{Chan}	is the channel DC loop resistance
~~P_{Class_PD}~~	~~is the PD's power classification (see Table 33–16a)~~
$P_{Class\_PD\text{-}2P}$	is the PD's power classification for a pairset (see Table 33–16b)

Remove the Editor's note on page 93, line 1

Remove Table 33–7a

33.2.7.4 Continuous output current capability in the POWER_ON state

Info (not part of baseline)

Section 33.2.7.4 in D1.5 is a replacement of the 802.3-2012 section. An issue with the D1.5 text is that it has multiple equations assigning to the same variable (for different cases). Fixing that implies significant reformatting, so this is a proposed complete replacement of the current D1.5 section 33.2.7.4.
Note: Equation numbering is out of order, but references are correct → this will get proper numbering during editing.

Replace 33.2.7.4 as follows:

$I_{Port\text{-}2P}$ and $I_{Port\text{-}2P\text{-}other}$ are the currents on the pairs with the same polarity of the two pairsets and are defined in Equation (33–3g) and Equation (33–3h).

$$I_{Port\text{-}2P} = \left\{ \begin{array}{ll} I_{Port\text{-}2P\text{-}pri} & \text{for the Primary Alternative} \\ I_{Port\text{-}2P\text{-}sec} & \text{for the Secondary Alternative} \end{array} \right\}_{A} \quad (33\text{–}3g)$$

$$I_{Port\text{-}2P\text{-}other} = \left\{ \begin{array}{ll} I_{Port\text{-}2P\text{-}sec} & \text{for the Primary Alternative} \\ I_{Port\text{-}2P\text{-}pri} & \text{for the Secondary Alternative} \end{array} \right\}_{A} \quad (33\text{–}3h)$$

where

$I_{Port\text{-}2P\text{-}pri}$	is the total output current sourced by the Primary Alternative
$I_{Port\text{-}2P\text{-}sec}$	is the total output current sourced by the Secondary Alternative

PSEs shall be able to source I_{Con}, $I_{Con\text{-}2P}$, and $I_{Con\text{-}2P\text{-}unb}$ as specified in Table 33–11 and Equation (33–3c).

$$I_{Con\text{-}2P} = \left\{ \begin{array}{ll} P_{Class}/V_{PSE} & \text{when in 2-pair mode} \\ \min(I_{Con} - I_{Port\text{-}2P\text{-}other},\ I_{Con\text{-}2P\text{-}unb}) & \text{when 4-pair powering a single-signature PD} \\ P_{Class\text{-}2P}/V_{PSE} & \text{when 4-pair powering a dual-signature PD} \end{array} \right\}_{A} \quad (33\text{–}3c)$$

where

P_{Class}	is P_{Class} as defined in Table 33–7
$P_{Class\text{-}2P}$	is $P_{Class\text{-}2P}$ as defined in Table 33–7b
V_{PSE}	is the voltage at the PSE PI as defined in 1.4.426
I_{Con}	is the total current a PSE is able to continuously source as defined in Table 33–11
$I_{Con\text{-}2P\text{-}unb}$	is the current a PSE is able to source continuously on a pairset due to unbalance as defined in Table 33–11.
$I_{Port\text{-}2P\text{-}other}$	is the output current on the other pairset

$I_{Con\text{-}2P}$ is the current the PSE supports on each pairset and is defined by Equation (33–3c). A PSE is not required to support $I_{Con\text{-}2P}$ values greater than $I_{Con\text{-}2P\text{-}unb}$. I_{Con} is the total current of both pairs with the same polarity that a PSE supports. $I_{Con\text{-}2P\text{-}unb}$ is the maximum current the PSE supports over one of the pairs of same polarity under maximum unbalance condition (see 33.2.7.4.1) in the POWER_ON state.

In addition to I_{Con}, $I_{Con\text{-}2P}$ and $I_{Con\text{-}2P\text{-}unb}$ as specified in Table 33–11, the PSE shall support the following AC current waveform parameters, while within the operating voltage range of $V_{Port\_PSE\text{-}2P}$:

I_{Peak}, $I_{\text{Peak-2P-unb}}$, and $I_{\text{Peak-2P}}$ minimum for $T_{\text{CUT-2P}}$ minimum and 5% duty cycle minimum on each powered pairset, where

$$I_{\text{Peak}} = \left\{ \frac{V_{\text{PSE}} - \sqrt{V_{\text{PSE}}^2 - 4 \times R_{\text{Chan}} \times P_{\text{Peak\_PD}}}}{2 \times R_{\text{Chan}}} \right\}_{\text{A}} \tag{33–4}$$

where

V_{PSE} is the voltage at the PSE PI as defined in 1.4.426

R_{Chan} is the channel loop resistance; this parameter has a worst-case value of R_{Ch} which is defined in Table 33–1.

$P_{\text{Peak\_PD}}$ is the total peak power a PD may draw for its Class; see Table 33–18.

I_{Peak} is the total current of both pairs with the same polarity that a PSE supports. $I_{\text{Peak-2P-unb}}$ is the minimum current due to unbalance effects that a PSE must support on a pairset as defined by Equation (33–4a). $I_{\text{Peak-2P}}$ is the minimum current a PSE must support on every powered pairset, as defined by Equation (33–4c).

$$I_{\text{Peak-2P-unb}} = \left\{ (1 + K_{\text{I}_{\text{Peak}}}) \cdot \frac{I_{\text{Peak}}}{2} \right\}_{\text{A}} \tag{33–4a}$$

where

$K_{\text{I}_{\text{Peak}}}$ The value of $K_{\text{I}_{\text{Peak}}}$, defined in Equation 33–4b, is based on a curve fit and is dimensionless.

I_{Peak} is the total peak current a PSE supports per Equation 33–4

$$K_{\text{I}_{\text{Peak}}} = \left\{ \begin{array}{ll} \min(0.214 \times R_{\text{Chan}}^{-0.363},\ 0.330) & \text{for Class 5} \\ \min(0.199 \times R_{\text{Chan}}^{-0.350},\ 0.300) & \text{for Class 6} \\ \min(0.180 \times R_{\text{Chan}}^{-0.326},\ 0.270) & \text{for Class 7} \\ \min(0.176 \times R_{\text{Chan}}^{-0.325},\ 0.260) & \text{for Class 8} \end{array} \right\} \tag{33–4b}$$

where R_{Chan} is the channel DC loop resistance.

$$I_{\text{Peak-2P}} = \left\{ \begin{array}{ll} I_{\text{Peak}} & \text{when in 2-pair mode} \\ \min(I_{\text{Peak}} - I_{\text{Port-2P-other}},\ I_{\text{Peak-2P-unb}}) & \text{when 4-pair powering a single-signature PD} \\ \dfrac{V_{\text{PSE}} - \sqrt{V_{\text{PSE}}^2 - 4 \times R_{\text{Chan}} \times P_{\text{Peak\_PD-2P}}}}{2 \times R_{\text{Chan}}} & \text{when 4-pair powering a dual-signature PD} \end{array} \right\}_{\text{A}} \tag{33–4c}$$

where

I_{Peak} is the total peak current a PSE supports per Equation (33–4)

$I_{\text{Port-2P-other}}$ is the output current on the other pairset (see 33.2.4.4)

$I_{\text{Peak-2P-unb}}$ is the minimum current due to unbalance effects a PSE must support on a pairset as defined by Equation (33–4a).

V_{PSE} is the voltage at the PSE PI as defined in 1.4.426

R_{Chan} is the channel loop resistance; this parameter has a worst-case value of R_{Ch} which is defined in Table 33–1.

$P_{\text{Peak\_PD-2P}}$ is the total peak power a dual-signature PD may draw per its Class on a pairset; see Table 33–18.

Editor's Note: Text needs to be inserted in 33.3.7.10 to address dual-signature PD test requirements to make sure they work with PSEs that exhibit unbalance. This is required to make sure that dual-signature PDs correctly police $P_{\text{Class\_PD-2P}}$ also under unbalance conditions.

33.2.7.7 Output current at short circuit condition

Delete the first paragraph.

No changes to this paragraph as result of this baseline:

A PSE may remove power from the PI if the PI current meets or exceeds the "PSE lowerbound template" in Figure 33–14, Figure 33–14a, and Figure 33–14b. Power shall be removed from ~~the~~ a pairset ~~PI~~ of a PSE before the pairset ~~PI~~ current exceeds the "PSE upperbound template" in Figure 33–14, Figure 33–14a, and Figure 33–14b. When connected to a single signature PD, a Type 3 or Type 4 PSE should (TBD) remove power from both pairsets before the current exceeds the "PSE upperbound template" on either pairset.

Insert the following text before Figure 33–14:

- For Type 1 and Type 2 PSEs, Figure 33–14, Equation (33–6) and Equation (33–7) apply.
- For Type 3 PSEs, Figure 33-14a, Equation (33–6a) and Equation (33–7a) apply.
- For Type 4 PSEs, Figure 33-14b, Equation (33–6b) and Equation (33–7b) apply.

Info (not part of baseline)

Figures 33–14 can be simplified with a direct mapping between PSE Type and Figure.

Replace D1.5 Figures 33–14, 33–14a, 33–14b and 33–14c with the following:

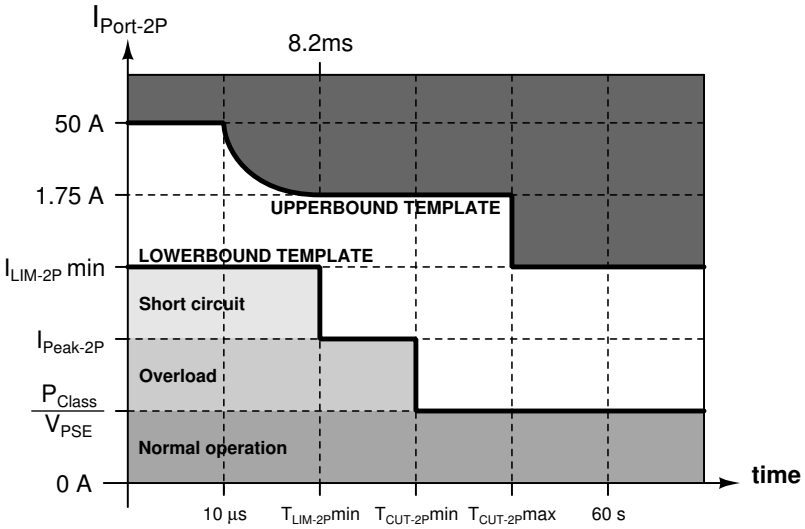

Figure 33–14—POWER_ON state, per pairset operating current template for Type 1 and Type 2 PSEs.

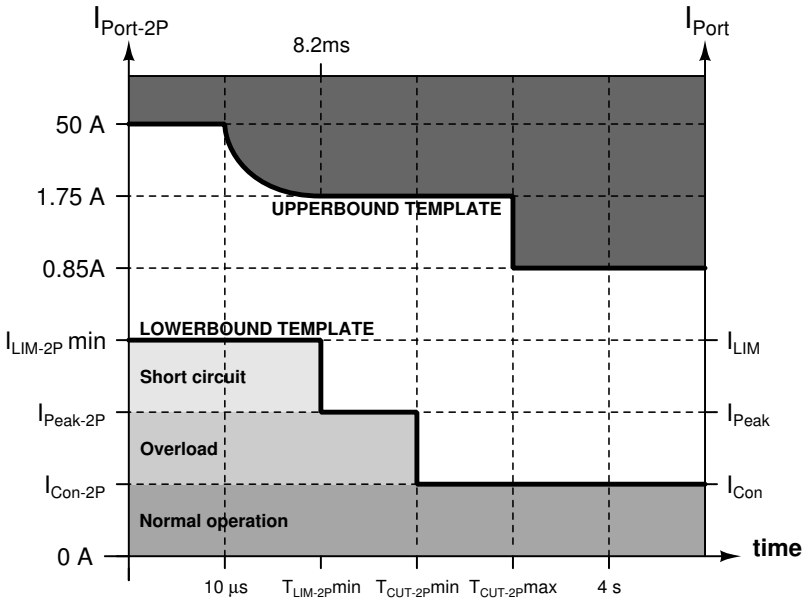

Figure 33–14a—POWER_ON state, per pairset operating current template for Type 3 PSEs.

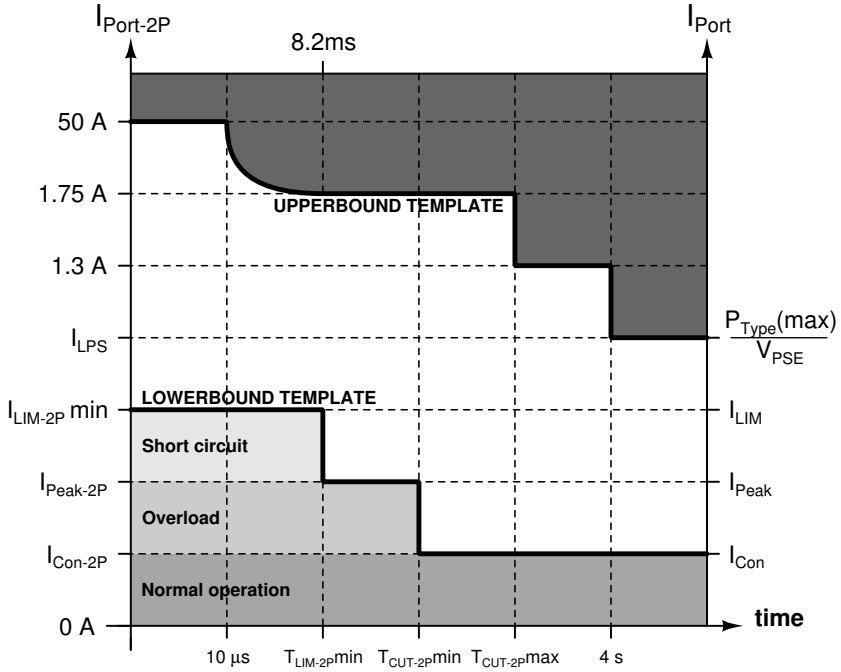

Figure 33–14b—POWER_ON state, per pairset operating current template for Type 4 PSEs.

Info (not part of baseline)

The following modifications are needed:

- Figure 33–14a has been removed, the corresponding Equations must also be removed
- Equations need to assign to a unique parameter name

- ***Delete Equations (33–6a) and (33–7a) and renumber.***
- ***Rename $I_{PSEUT\text{-}2P}$ from Equation (33–6a) to $I_{PSEUT\text{-}Type3\text{-}2P}$***
- ***Rename $I_{PSEUT\text{-}2P}$ from Equation (33–6b) to $I_{PSEUT\text{-}Type4\text{-}2P}$***
- ***Rename $I_{PSELT\text{-}2P}$ from Equation (33–7a) to $I_{PSELT\text{-}Type3\text{-}2P}$***
- ***Rename $I_{PSELT\text{-}2P}$ from Equation (33–7b) to $I_{PSELT\text{-}Type4\text{-}2P}$***

– ***Adjust parameter list as appropriate***

33.2.7.12 Type power

Info (not part of baseline)

A Type 4 PSE that is operating 2P mode would be allowed to source up to 1.3A over 2P indefinitely according to the D1.5 Equation 33–7d.

Change Equation 33–7d as follows:

$$I_{\text{LPS}} = \left\{ \begin{array}{ll} 0.85 & \text{when in 2-pair mode} \\ \min\left(\dfrac{P_{\text{Type}}\ \max}{V_{\text{PSE}}} - I_{\text{Port-2P-other}},\ 1.3 \right) & \text{when in 4-pair mode} \end{array} \right\}_{\text{A}} \qquad \text{(33–7d)}$$

33.3.5.2 PD Multiple-Event class signature

PDs implementing a Multiple-Event Physical Layer classification shall present class_sig_A during DO_CLASS_EVENT1 and DO_CLASS_EVENT2 and class_sig_B during DO_CLASS_EVENT3, DO_CLASS_EVENT4, DO_CLASS_EVENT5 and DO_CLASS_EVENT6, as defined in Table 33–16a and Table 33-16b.

Remove the dual-signature rows from Table 33–16a as follows:

Table 33–16a—Physical Layer Classifications and Multiple Event Responses for single-signature PDs

PD Type	Class	class_sig_A	class_sig_B	$P_{\text{Class\_PD}}$(W)
1	0	0	0	13.0
	1	1	1	3.84
	2	2	2	6.49
	3	3	3	13.0
2	4	4	4	25.5
3	1	1	1	3.84
	2	2	2	6.49
	3	3	3	13.0
	4	4	4	25.5
	5	4	0	40.0
	6	4	1	51.0
4	7	4	2	62.0
	8	4	3	71.0

Insert new Table 33–16b as follows:

Table 33–16b—Physical Layer Classifications and Multiple Event Responses for dual-signature PDs

PD Type	Class	class_sig_A	class_sig_B	$P_{Class\_PD\text{-}2P}$(W)
3	1	1	0	3.84
	2	2	0	6.49
	3	3	0	13.0
	4	4	0	25.5
4	5	4	3	35.5

. . .

Dual-signature PDs shall advertise a class signature ~~of~~ corresponding with Class 1, 2, 3, 4, or 5 on each pairset as defined in Table 33–16b. The Class advertised on each pairset is the power requested by the PD on that pairset. Dual-signature PDs may advertise ~~a~~ different class signatures on each pairset. It is not recommended to use different class signatures if the dual-signature PD powers a single electrical load.

. . .

33.3.7 PD power

Insert new item 4a in Table 33–18:

Item	Parameter	Symbol	Unit	Min	Max	PD Type	Additional information
4	Input average power	P_{Port_PD}	W		P_{Class_PD}	All	See 33.3.7.2, Table 33–1, Table 33–16a
4a	Pairset average power	$P_{Port\_PD\text{-}2P}$	W		$P_{Class\_PD\text{-}2P}$	3, 4	See 33.3.7.2, Table 33–1, Table 33–16b

Insert new item 7a in Table 33–18:

Item	Parameter	Symbol	Unit	Min	Max	PD Type	Additional information
7a	Peak operating power for a pairset						
	Class 0 and Class 3	$P_{Peak\_PD\text{-}2P}$	W		14.4	3	See 33.3.7.4
	Class 1				5.00	3	
	Class 2				8.36	3	
	Class 4				$1.11 \times P_{Class\_PD\text{-}2P}$	3	
	Class 5				$1.05 \times P_{Class\_PD\text{-}2P}$	4	

33.3.7.2 Input average power

P_{Class_PD} and $P_{Class\_PD\text{-}2P}$ in Table 33–18 ~~is~~ are determined by the Class assigned by the PSE. P_{Class_PD} values for each Class are shown in Table 33–16a, $P_{Class\_PD\text{-}2P}$ values for each Class are shown in Table 33–16b. The assigned PSE Class is determined by the number of classification events and the advertised Class by the PD, as shown in Table 33–7~~, Table 33–7a, and Table 33–7b~~ and Table 33–7a.

P_{Class_PD} is the maximum average PI power and applies to Type 1, Type 2 and single-signature PDs. $P_{Class\_PD\text{-}2P}$ is the maximum average power on a pairset and applies to dual-signature PDs.

The maximum average power, P_{Class_PD} or $P_{Class\_PD\text{-}2P}$ in Table 33–16a, Table 33–16b and Table 33–18 or PDMaxPowerValue in 33.6.3.3, is calculated over a 1 second interval. PDs may dynamically adjust their maximum required operating power below P_{Class_PD} or $P_{Class\_PD\text{-}2P}$ as described in 33.6. PDs may also adjust their maximum required operating power below P_{Class_PD} or $P_{Class\_PD\text{-}2P}$ using Autoclass (see 33.3.5.3).

33.3.7.2.1 System stability test conditions during startup and steady state operation

When the PD is ~~fed by~~ supplied with ~~$V_{\text{Port\_PSE}}$~~$V_{\text{Port\_PSE-2P}}$ min to ~~$V_{\text{Port\_PSE}}$~~$V_{\text{Port\_PSE-2P}}$ max with R_{Ch} (as defined in Table 33–1) in series, $P_{\text{Port\_PD}}$ shall be defined as shown in Equation (33–9):

$$P_{\text{Port\_PD}} = \{V_{\text{Port\_PD}} \times I_{\text{Port}}\}_{\text{W}} \quad (33\text{–}9)$$

where…

When a dual-signature PD is fed by $V_{\text{Port\_PSE-2P}}$ min to $V_{\text{Port\_PSE-2P}}$ max with R_{Ch} in series, $P_{\text{Port\_PD-2P}}$ shall be defined as shown in Equation (33–9a):

$$P_{\text{Port\_PD-2P}} = \{V_{\text{Port\_PD-2P}} \times I_{\text{Port-2P}}\}_{\text{W}} \quad (33\text{–}9a)$$

where

$V_{\text{Port\_PD-2P}}$ is the static input voltage over the pairset as defined in Table 33–18

$I_{\text{Port-2P}}$ is the current on a pairset as defined 33.2.7.4

33.3.7.4 Peak operating power

Info (not part of baseline)

There is a double definition of $P_{\text{Peak\_PD}}$, once in Table 33–18 item 7, and again in Equations 33–12 and 33–12a. Given that for some of the legacy Classes, $P_{\text{Peak\_PD}}$ is given numerically, and for new Classes this is done through a ratio, it is best to expand the Table and strike the equations.

Replace this paragraph:

Peak power, $P_{\text{Peak\_PD}}$, for Class 4 is based on Equation (33–12). Peak power, $P_{\text{Peak\_PD}}$, for Class 5 through 8 is based on Equation (33–12a). Equation (33–12) and Equation (33–12a) are used to approximate the ratiometric peak powers of Class 0 through Class 8. This equation may be used to calculate peak operating power for $P_{\text{Peak\_PD}}$ values obtained via Data Link Layer classification or Autoclass.

with the following:

Peak power is defined in Table 33–18 and depends on the Class assigned by the PSE. The equations in Table 33–18 are used to approximate the ratiometric peak powers of Class 0 through Class 8. These equations may be used to calculate peak operating power for $P_{\text{Peak\_PD}}$ or $P_{\text{Peak\_PD-2P}}$ obtained via Data Link Layer classification or Autoclass.

Delete Equations 33–12 and 33–12a.

Move the following note to before the paragraph that starts with "Ripple current content…":

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

33.3.7.5 Peak transient current

Under normal operating conditions when there are no transients applied at the PD PI, Class 6 or Class 8 PDs, shall operate below the PD extended template defined in Figure 33–18. Single-signature PDs of all other Classes shall operate below the PD upperbound template defined in Figure 33–18. Dual-signature PDs shall operate below the PD upperbound template defined in Figure 33–18a.

See 33.3.7.2 for details on Class 6 and Class 8 PD allowances.

Change the caption of Figure 33–18 to:
"Figure 33–18—Type 1, Type 2 and single-signature PD static operating mask"

Insert new Figure 33–18a before the last paragraph as follows:

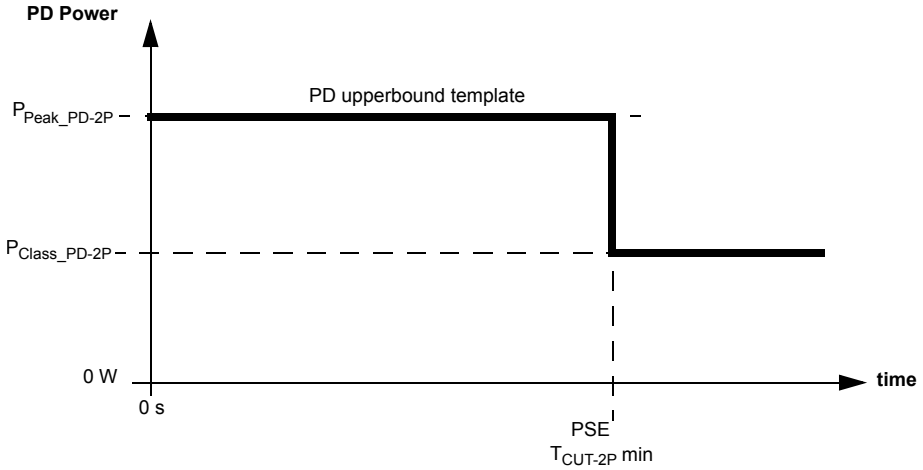

Figure 33–18a—Dual-signature PD static operating mask

The PD upperbound template in Figure 33–18a, P_{DSUT}, is described by Equation (33–13b):

$$P_{DSUT} = \left\{ \begin{array}{ll} P_{Peak\_PD\text{-}2P} & \text{for } (0 \leq t < T_{CUT\text{-}2P} \text{ min}) \\ P_{Class\_PD\text{-}2P} & \text{for } (T_{CUT\text{-}2P} \text{ min} \leq t) \end{array} \right\}_{W} \quad (33\text{–}13b)$$

where

$P_{Peak\_PD\text{-}2P}$ is the peak power on a pairset as defined in Table 33–18

$P_{Class\_PD\text{-}2P}$ is the maximum average input power on a pairset as defined in Table 33–16b

$T_{CUT\text{-}2P}$ min is $T_{CUT\text{-}2P}$ min, as defined in Table 33–11

Rename P_{PDUT} to P_{SSUT}. Rename P_{PDET} to P_{SSET}.