Comment (Clause 145.2.7, #45, Page 151, L15)

Table 145-11 and the following text in page 150 lines 9-11:
" PSE implementations may use VPSE = VPort_PSE-2P min and RChan = RCh when powering using a single pairset, or RChan = RCh/2 when powering using two pairsets to arrive at over-margined values as shown in Table 145–11"

There are few problems:

a) If we plug the worst-case values of Vpse and Rch in Equations 145-2 and 145-3, we will not get the over margined fixed values in Table 145-11. There are significant unexplained differences in the specification.
b) Class 1-3 value differences could be justified when Type 1 and Type PSEs was part of the 802.3bt spec. Now they are in separate clause 33.
c) The value RCh=20 Ω for Type 1 is not realistic and should not imposed on Type 3 and 4 PSE systems and even if we impose it, the Pclass values will be lower than Table 145-11.
d) Table 145-11 numbers for Pclass define for class 1-6 with Type 4 PSEs are much lower due to lower Rch and/or higher Vpse_min.
e) The PSE can set the true minimum PClass and PClass-2P by using Equation 145-2 and 145-3 as the intent of this spec but currently this objective is not met.
f) In addition, Vpd per the assigned class need to be verified per the above arguments.

The solution for the problems above consist of 3 elements:

1. To disconnect between Table 145-11 and how we get the over-margined value, for example:
" PSE implementations may use VPSE = VPort_PSE-2P min and RChan = RCh when powering using a single pairset, or RChan = RCh/2 when powering using two pairsets to arrive at over-margined values. ~~as shown in Table 145–11~~"

2. Clarify that the values in Table 145-11 are based on the lower PSE type used per the assigned class which will generate the maximum Pclass or Pclass-2P.

3. To update Table 145-11 numbers per the overmargined values obtained from Equation 145-2 AND 145-3 when the worst case relevant Type parameters are used. See Annex A for details.

Discussion:

In some rows in the table below, the actual calculated worst case values per* Equations 145-2 and 145-3 *are significantly lower that the values in Table 145-11.

Table 145–11—Physical Layer power classifications

PD Requested Class	Number of PSE class events	Assigned Class	P_{Class}	$P_{Class-2P}$
PSEs connected to a single-signature PD				
1	1	1	4 W	—
2	1	2	7 W	—
0, 3 to 8	1	3	15.4 W	—
4 to 8	2 or 3	4	30 W	—
5	4	5	45 W	—
6 to 8	4	6	60 W	—
7	5	7	75 W	—
8	5	8	90 W	—
PSEs connected to a dual-signature PD (classification per pairset)				
1	1, 2, or 3	1	—	4 W
2	1, 2, or 3	2	—	7 W
3	1, 2, or 3	3	—	15.4 W
4 or 5	1	3	—	15.4 W
4 or 5	2 or 3	4	—	30 W
5	4	5	—	45 W

Fixed values based on Type 1 systems Vpse=44V and Rch=20Ω

Fixed values based on Type 2 systems Vpse=50V and Rch=12.5Ω

Fixed values based on Type 3 systems Vpse=50V and Rch=12.5Ω

Fixed values based on Type 4 systems Vpse=52V and Rch=12.5Ω

Fixed values based on Type 4 **assigned class 1-6** doesn't match Table 145-11 due to the fact that In Type 4 Vpse is higher than in Type 3.

NOTE 1—PClass is the minimum required power at the PSE PI calculated using minimum VPort PSE-2P and maximum RChan. Use Equation (145–2) for other values of VPort PSE-2P and RChan. For maximum power available to PDs, see Table 145–24.
NOTE 2—PClass-2P is the minimum required power for a pairset calculated using minimum VPort PSE-2P and maximum RChan-2P. Use Equation (145–3) for other values of VPort PSE-2P and RChan-2P. For maximum power available to PDs, see Table 145–25.
NOTE 3—The number of PSE class events refers to the number of class events since the most recent PD reset.

The minimum power output a PSE supports for the PD's assigned Class, when powering a single-signature PD, or supplying power in 2-pair mode, is defined by Equation (145–2). PSE implementations may use VPSE = VPort_PSE-2P min and RChan = RCh when powering using a single pairset, or RChan = RCh/2 when powering using two pairsets to arrive at over-margined values as shown in Table 145–11. PClass may subsequently be adjusted using Data Link Layer classification.

$$P_{Class} = \left\{ V_{PSE} \times \left(\frac{V_{PSE} - \sqrt{V_{PSE}^2 - 4 \times R_{Chan} \times P_{Class\_PD}}}{2 \times R_{Chan}} \right) \right\}_W \qquad (145\text{–}2)$$

The minimum output power a PSE supports on a pairset for PSEs connected to a dual-signature PD is defined by Equation (145–3). PSE implementations may use VPSE = VPort_PSE-2P min and RChan = RCh to arrive at over-margined values as shown in Table 145–11. PClass-2P may subsequently be adjusted using Data Link Layer classification.

$$P_{Class\text{-}2P} = \left\{ V_{PSE} \times \left(\frac{V_{PSE} - \sqrt{V_{PSE}^2 - 4 \times R_{Chan} \times P_{Class\_PD\text{-}2P}}}{2 \times R_{Chan}} \right) \right\}_W \qquad (145\text{–}3)$$

The differences between calculations per Equations 145-2 and 145-3 and Table 145-11.

Values that are >|0.1W| from the spec are marked with RED color.

		This column information is no longer part of clause 145				
Requested Class	**Spec. Table 145-11**	**Type 1/2 over 2-pairs**	**Type 3 Over 2-pairs**	**Type 4 Over 2-pairs**	**Type 3 Over 4-pairs**	**Type 4 Over 4-pairs**
1	4W	4.006	3.92	3.91	3.88	3.88
2	7W	6.996	6.716	6.7	6.6	6.59
3	15.4W	15.4	14	13.89	13.45	13.42
4	30W	30	30	29.53	27.37	27.21
5	45W			45.02	45.08	44.6
6	60W				60	59.06
7	75W					75
8	90W					90.04
Max Diff[W]		**0.006**	**1.4**	**1.51**	**2.63**	**2.79**

Notes:

Type 1,2 class 1-4 calculations per Equation 145-3 meets Table 145-11. They were calculated with Vpse=44V and Rch=20 Ω.

Type 3 class 1-3 calculated values per Equation 145-3 are lower than Table 145-11 values. They were calculated with Vpse=50V and Rch=12.5 Ω.

Type 4 class 1-4 calculated values per Equation 145-3 are different than Table 145-11 values. They were calculated with Vpse=52V and Rch=12.5 Ω.

Type 3 class 1-4 calculated values per Equation 145-2 are different than Table 145-11 values. They were calculated with Vpse=50V and Rchan=6.25 Ω.

Type 4 class 1-5 calculated values per Equation 145-2 are different than Table 145-11 values. They were calculated with Vpse=52V with and Rchan=6.25 Ω.

BASELINE STARTS HERE

Suggested Remedy

There are 3 options. Options B and C are shown in the annexes for reference.

Option A (Based on the calculations in Annex A)

1. *Modify* Pclass and Pclass -2P *in Table 145-11 per the following:*

Pclass	Pclass-2P
~~4~~ 3.92	-
~~7~~ 6.72	-
~~15.4~~ 14	-
30	-
~~45~~ 45.1	-
60	-
75	-
90	-
-	~~4~~ 3.92
-	~~7~~ 6.72
-	~~15.4~~ 14
-	~~15.4~~ 14
-	30
-	45

2. *Modify the following text:*

The minimum power output a PSE supports for the PD's assigned Class, when powering a single-signature PD, or supplying power in 2-pair mode, is defined by Equation (145–2). PSE implementations may use VPSE = VPort_PSE-2P min when powering using a single pairset, or RChan = RCh/2 when powering using two pairsets to arrive at over-margined values. ~~as shown in~~ Table 145–11 shows over-margined values for worst case PSE Type parameters. PClass may subsequently be adjusted using Data Link Layer classification.

$$P_{Class} = \left(V_{PSE} \times \left[\frac{V_{PSE} - \sqrt{V_{PSE}^2 - 4 \times R_{Chan} \times P_{Class\_PD}}}{2 \times R_{Chan}} \right] \right)_W \qquad (145\text{–}2)$$

The minimum output power a PSE supports on a pairset for PSEs connected to a dual-signature PD is defined by Equation (145–3). PSE implementations may use VPSE = VPort_PSE-2P min and RChan = RCh to arrive at over-margined values. ~~as shown in~~ Table 145–11 shows over-margined values for worst case PSE Type parameters. PClass-2P may subsequently be adjusted using Data Link Layer classification.

$$P_{Class\text{-}2P} = \left(V_{PSE} \times \left[\frac{V_{PSE} - \sqrt{V_{PSE}^2 - 4 \times R_{Chan} \times P_{Class\_PD\text{-}2P}}}{2 \times R_{Chan}} \right] \right)_W \qquad (145\text{–}3)$$

3. Modify Table 145-28 for Vport_PD-2P as follows (See Annex C for details):

	From	*To*
Class 1	*42.1*	*48*
Class 2	*40.8*	*47*
Class 0,3	*37*	*44*
Class 4	*42.5*	*42.5*
Class 5, single-signature PD	*44.3*	*44.3*
Class 5, dual-signature PD	*41.2*	*41.2*
Class 6	*42.5*	*42.5*
Class 7	*42.9*	*42.9*
Class 8	*41.2*	*41.2*

End OF Baseline

Annex A: Option A calculations for D2.5

Notes:

1. Type 1 and Type 2 PSEs are not part of clause 145.
2. Type 1 and Type 1 PDs need to be supported by Type 3 and Type 4 PSEs according to Table 145-1 RCh=12.5Ω and not RCh=20Ω. Therefore, the case of RCh=20Ω is not part of the calculations to derive the spec for clause 145.
3. The numbers for option A were rounded to the next 2 decimal point accuracy. In addition, the numbers for option A for class 1-4 were calculated to be the maximum of 2-pairs and 4-pairs values regardless if it is Type 3 or Type 4 (since there is only one value column for both PSE types and PSE may work on 2-pairs or 4-pairs).

				(Rounded numbers to 2 decimal point, to be used for Option 2)				Option A			
	Not part of clause 145 spec			Part of clause 145 SPEC				Part of clause 145 SPEC			
Vpse	44	50	52	50	52	50	52	Pclass [W]		Pclass-2P[W]	
Rch	20	20	20	12.5	12.5	6.25	6.25				
	Type 1,2	Type 3	Type 4	Type 3	Type 4	Type 3	Type 4				
	Pclass 2-pais[W]			Pclass 2-pais[W]		Pclass 4-pais[W]					
Class 1	4.006	3.966	3.956	3.917	3.911	3.878	3.875	3.92	max(2-pairs, 4-pairs)	3.92	max(2-pairs)
Class 2	6.996	6.867	6.836	6.715	6.697	6.599	6.590	6.72	max(2-pairs, 4-pairs)	6.72	max(2-pairs)
Class 3	15.400	14.672	14.506	13.977	13.892	13.452	13.416	13.98	max(2-pairs, 4-pairs)	13.98	max(2-pairs)
Class 4	30.000	30.000	29.532	30.000	29.532	27.373	27.212	30	max(2-pairs, 4-pairs)	30.00	max(2-pairs)
Class 5	-	-		-	45.019	45.081	44.597	45.08	max(4-pairs)	45.02	max(2-pairs)
Class 6	-	-		-	-	60	59.063	60	max(4-pairs)		-
Class 7	-	-		-	-	-	75.002	75	max(4-pairs)		-
Class 8	-	-		-	-	-	90.038	90.04	max(4-pairs)		-

Annex B: Option B calculations for D2.5

Notes:

1. Type 1 and Type 2 PSEs are not part of clause 145.
2. Type 1 and Type 1 PDs need to be supported by Type 3 and Type 4 PSEs according to Table 145-1 RCh=12.5Ω and not RCh=20Ω. Therefore, the case of RCh=20Ω is not part of the calculations to derive the spec for clause 145.
3. The numbers for option B were rounded to the next 2 decimal point accuracy.
4. The numbers for option B for class 1-4 were calculated per each Type separately and the maximum of 2-pairs and 4-pairs values for each Type was taken. This is different than Option A where we had one column for the values. As we can see, option B is more accurate and there are significant differences between D2.4 spec and Option B.

	Not part of clause 145 spec			Part of clause 145 SPEC				Option B spec			
Vpse	44	50	52	50	50	52	52	Pclass		Pclass-2P	
Rch	20	20	20	12.5	6.25	12.5	6.25				
	Type 1,2	Type 3	Type 4	Type 3	Type 3	Type 4	Type 4	Type 3	Type 4		
	Pclass 2-pais			Pclass-2P	Pclass	Pclass-2P	Pclass	Pclass		Pclass-2P	
Class 1	4.006	3.966	3.956	3.917	3.878	3.911	3.875	3.92	3.92	3.92	3.92
Class 2	6.996	6.867	6.836	6.715	6.599	6.697	6.590	6.72	6.72	6.72	6.7
Class 3	15.400	14.672	14.506	13.977	13.452	13.892	13.416	13.98	13.98	13.98	13.9
Class 4	30.000	30.000	29.532	30.000	27.373	29.532	27.212	30.00	30.00	30.00	29.53
Class 5	-	-		-	45.081	45.019	44.597	45.08	44.597	-	45.02
Class 6	-	-		-	60.000	-	59.063	60.00	59.063	-	-
Class 7	-	-		-	-	-	75.002	-	75.002	-	-
Class 8	-	-		-	-	-	90.038	-	90.038	-	-

Option B (Based on the calculations in Annex B)

1. Modify Pclass and Pclass -2P *in Table 145-11 as follows:*

Pclass		Pclass-2P	
Type 3	Type 4	Type 3	Type 4
~~4~~ 3.92	~~4~~ 3.92	-	-
~~7~~ 6.72	~~7~~ 6.72	-	-
~~15.4~~ 14	~~15.4~~ 14	-	-
30	30	-	-
~~45~~ 45.1	~~45~~ 44.6	-	-
60	~~60~~ 59.1	-	-
	75	-	-
	90	-	-
-	-	~~4~~ 3.92	~~4~~ 3.92
-	-	~~7~~ 6.72	~~7~~ 6.7
-	-	~~15.4~~ 14	~~15.4~~ 13.9
-	-	~~15.4~~ 14	~~15.4~~ 13.9
-	-	30	~~30~~ 29.53
-	-	-	45

2. Modify the following text:

The minimum power output a PSE supports for the PD's assigned Class, when powering a single-signature PD, or supplying power in 2-pair mode, is defined by Equation (145–2). PSE implementations may use VPSE = VPort_PSE-2P min when powering using a single pairset, or RChan = RCh/2 when powering using two pairsets to arrive at over-margined values. ~~as shown in~~ Table 145–11 shows over-margined values for worst case PSE Type parameters. PClass may subsequently be adjusted using Data Link Layer classification.

$$P_{Class} = \left(V_{PSE} \times \left(\frac{V_{PSE} - \sqrt{V_{PSE}^2 - 4 \times R_{Chan} \times P_{Class\_PD}}}{2 \times R_{Chan}} \right) \right)_W \qquad (145\text{–}2)$$

The minimum output power a PSE supports on a pairset for PSEs connected to a dual-signature PD is defined by Equation (145–3). PSE implementations may use VPSE = VPort_PSE-2P min and RChan = RCh to arrive at over-margined values. ~~as shown in~~ Table 145–11 shows over-margined values for worst case PSE Type parameters. PClass-2P may subsequently be adjusted using Data Link Layer classification.

$$P_{Class\text{-}2P} = \left(V_{PSE} \times \left(\frac{V_{PSE} - \sqrt{V_{PSE}^2 - 4 \times R_{Chan} \times P_{Class\_PD\text{-}2P}}}{2 \times R_{Chan}} \right) \right)_W \qquad (145\text{–}3)$$

Option C **(significant differences between the actual worst case numbers and Table 145-11 values)**

Modify the following text:

The minimum power output a PSE supports for the PD's assigned Class, when powering a single-signature PD, or supplying power in 2-pair mode, is defined by Equation (145–2). PSE implementations may use VPSE = VPort_PSE-2P min when powering using a single pairset, or RChan = RCh/2 when powering using two pairsets to arrive at over-margined values. ~~as shown in~~ Table 145–11 shows over-margined values for worst case PSE Type parameters. PClass may subsequently be adjusted using Data Link Layer classification.

$$P_{Class} = \left\{ V_{PSE} \times \left(\frac{V_{PSE} - \sqrt{V_{PSE}^2 - 4 \times R_{Chan} \times P_{Class\_PD}}}{2 \times R_{Chan}} \right) \right\}_W \qquad (145\text{–}2)$$

The minimum output power a PSE supports on a pairset for PSEs connected to a dual-signature PD is defined by Equation (145–3). PSE implementations may use VPSE = VPort_PSE-2P min and RChan = RCh to arrive at over-margined values. ~~as shown in~~ Table 145–11 shows over-margined values for worst case PSE Type parameters. PClass-2P may subsequently be adjusted using Data Link Layer classification.

$$P_{Class\text{-}2P} = \left\{ V_{PSE} \times \left(\frac{V_{PSE} - \sqrt{V_{PSE}^2 - 4 \times |R_{Chan} \times P_{Class\_PD\text{-}2P}}}{2 \times R_{Chan}} \right) \right\}_W \qquad (145\text{–}3)$$

Annex C – PD input voltage calculations

	Type 1,2	Type 3	Type 4	Type 3	Type 4	Type 3	Type 4
	2P	2P	2P	2P	2P	4P	4P
Rch	20 for class 1-3 12.5 for class 4	20	20	12.5	12.5	12.5	12.5
Class 1	42.18	48.41	50.48	49.02	51.06	49.52	51.53
Class 2	40.82	47.25	49.37	48.32	50.39	49.18	51.21
Class 3	37.00	44.13	46.42	46.51	48.66	48.32	50.39
Class 4	42.50	42.50	44.90	42.50	44.90	46.58	48.73
Class 5					41.18	44.36	46.64
Class 6						42.50	44.90
Class 7							42.99
Class 8							41.18