



IEE802.3 4P Task Force

Updates for ILIM-2P (min) for 802.3bt D.12 based on 802.3bt D1.1 changes.

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Updated Table 33-11 Item 9, I LIM-2P

Item	Parameter	Symbol	Unit	Min	Max	PSE Type	Additional Information
9	Output current per pair set – at short circuit condition	I LIM-2P	A	0.400	See info	1	For Class 0-3. See 33.2.7.7. Maximum value defined by Figure 33-14.
				1.14xIcable		2	For class 4. Maximum value defined by Figure 33-14.
				0.551		3	For Class 5. Maximum value defined by Figure 33-14.
				0.817 0.691		3	For Class 6. Maximum value defined by Figure 33-14.
				0.829		4	For Class 7. Maximum value defined by Figure 33-14.
				1.162 0.990		4	For Class 8. Maximum value defined by Figure 33-14.

-----End of Baseline Text -----

Text changes for D1.2 are marked blue.
See annex A for ILIM-2P values derivation.



Annex A: Derivation of ILIM_2P_MIN, Table 33-11 Item 9, I LIM-2P

The following calculations are based on:

1. Using $\text{Peak_PD}=1.05*\text{Pclass_PD}$ for Type 3 and Type 4 for power levels above class 4 per equation 33-12a in IEEE802.3bt D1.1.
2. Not keeping the same ratios between $\text{Icut_max}/\text{Icon-2P_unb}$ of 802.3AT as we had in 802.3bt D1.1. This allow reduction of ILIM(min) and if user wants to keep $\text{Icut_max}/\text{Icon-2P_unb}$ of 802.3AT, it can be used as implementation specifics i.e. user can use any Ilim above Ilim_min per figure 33-14.
3. Continue to use the concept that $\text{Ilim_min}=\text{Icut_max}+\text{small margin}$. $\text{Icut_max}=\text{Ipeak-2P}$ including E2EP2P_Iunb effect.

Background

$\text{ILIM-2P_MIN} \geq \text{Ipeak-2P_max}$ per figure 33-14. ILIM-2P_MIN for Type 2 is: $1.14*\text{Icable}=\text{Ipeak-2P_max}^1$

ILIM-2P_MIN for type 2 is 0.684A and Ipeak is 0.682A which is 2mA difference hence $\text{ILIM-2P} > \text{Ipeak-2P}$ as required.

We will use same concept for Type 3 and 4 with the additional effect of P2P_Iunb.

Ipeak_2P max for Vpse_min for Type 3 and 4 can be found by equation 33-4 for maximum and minimum channel resistance ($R_{ch}=12.5\Omega$ and $R_{ch}=0.1\Omega$) and maximum Ppeak_PD-2P per Table 33-18 item 7.

The calculation procedure will be based on the fact that we need minimum ILIM-2P(min) requirement per PD class that is fixed number so we will not have to adjust ILIM-2P per PSE voltage and Channel Resistance. The way to do it is to calculate Ipeak-2P for the channel resistance that will generate maximum current by using equation 33-4 and 33-4a that specifies the K factor that give us the ratio between Ipeak-2P of unbalanced system and Ipeak-2P of perfect balance system as function of channel resistance. This gives the worst case possible ILIM-2P.

Ppeak_PD can be calculated per equation 33-12a

Class 5: $\text{Ppeak_pd}=1.05*\text{Pclass_PD}=1.05*40\text{W}=42\text{W}$

Class 6: $\text{Ppeak_pd}=1.05*\text{Pclass_PD}=1.05*51\text{W}=53.55\text{W}$

Class 7: $\text{Ppeak_pd}=1.05*\text{Pclass_PD}=1.05*62\text{W}=65.1\text{W}$

Class 8: $\text{Ppeak_pd}=1.05*\text{Pclass_PD}=1.05*71\text{W}=74.55\text{W}$

Running simulations for the above Ppeak_PD for all classes as function of channel resistance and Vpse_min resulted with the numbers in the proposed Table 33-11 item 9 with additional 2mA for margin to ensure $\text{ILIM-2P} > \text{Ipeak-2P}$:

The results were confirmed by calculating per equation 33-4 and using the K that corresponds to the channel resistance where the maximum current is obtained (in Type 4 it is with long cable and for Type 3 it is in short cable).

See calculated and simulated results in next table.

Notes:

1. $(\text{Ipeak}/\text{Icon_max})=1.14$ is the ratio used in 802.3af and 802.3at.
2. The values of ILIM-2P min will be the same for extended power mode.

Annex B: Simulation vs Calculation comparison

#	Notes		Class 5	Class 6	Class 7	Class 8
Calculated Results						
1		Rch [Ω]	0.1	0.1	12.5	12.5
2	Eq 33-4a From darshan_04_0915.pdf	K	0.306	0.283	0.080	0.078
3	Table 33-11	Vpse [V]	50	50	52	52
4	Table 33-18	Pclass_PD [W]	40	51	62	71
5	Eq 33-12a	Ppeak_PD [W]	42	53.55	65.1	74.55
6	Ppeak-PD/2	Ppeak_PD-2P [W]	21	26.775	32.55	37.275
7	Eq 33-4	Ipeak-2P for K=0 [A].	0.421	0.537	0.768	0.921
8	Eq 33-4	Ipeak-2P_unb (K>0) [A]	0.550	0.689	0.829	0.992
9	ILIM-2P table 33-11	ILIM-2P_min ¹ =Ipeak-2P+2mA [A]	0.552	0.691	0.831	0.994
Simulation Results^{1,3,4}						
10	NEW Proposed Spec. ²	ILIM-2P_min ¹ =Ipeak+2mA	0.552	0.691	0.829	0.990
11	Old proposal D1.2 per old concept that was using higher Ppeak_PD/Pclass_PD ratio.	ILIM-2P_min ¹ =Ipeak+2mA	TBD	0.817	TBD	1.162
12	Table 33-11 item 4a	Icont-2P_unb ⁵	0.536	0.668	0.778	0.926
13	The difference between ILIM-2P and Icont-2P_unb		0.016	0.023	0.051	0.064

Notes:

- Item 2: The results are per the calculations of Eq 33-4a for the new curve fit per class which was done for September 2015 meeting.
- Items 9 and 10: The error between calculated values and simulated values are due to the usage of curve fit for K. The simulation results are the accurate results and based on worst case system model.
- Item 11: Old proposal for ILIM-2P from D1.2 is given for reference.
- TIA spec for channel pair to pair resistance unbalance of 7% flat or 0.1 ohm whichever is greater adds 10mA to Class 8 limits.
- The simulation was using the system model that generates channel pair to pair resistance unbalance =7.5% at the 0.1 ohm point and the 7.5% is decreasing as channel resistance is decreasing which gives more accurate results. Therefore the simulation results were chosen to be for the specification of ILIM-2P minimum value.
- Item 12 and 13: Icont-2P_unb is shown for reference in order to show the difference between DC maximum current and peak current under E2EP2P_Iunb condition over the pair with the maximum current.

Annex C: Why we need ILIM(min) per class 5 to 8?

In IEEE802.3bt D1.1 we have defined ILIM-2P (MIN) value for class 5 and 7 (class 6 and 8 were already defined).

ILIM(min) per class adds design flexibility to the PSE due to the fact that PSEs allowed to support power levels lower than their maximum Ptype so PSE is not required to be designed for higher current when there is no need for it.

PSE limits the current when pair-set current hits ILIM-2P threshold. Port current hits Due to the fact that PSE is designed to support ILIM-2P were normally ILIM-2P threshold point is higher than ILIM-2P (MIN) .Until current reaches this point, PSE may supply the full current so pairs and their components need to be designed to support that current.

Examples:

1. There is no point that PSE Type 3 that supports up to class 2 power (25W) that needs ILIM(min)=~0.35A to support ILIM(min)=0.700A
2. There is no point that PSE Type 4 that supports up to class 5 power (40W) that needs ILIM(min)=0.536A to support ILIM(min)=0.990A