Annex XX

(informative)

Power system and parameters

This annex provides additional information for the system parameters of current and direct current resistance (DCR) given in Table 145–1 and the power system delivery to enable consideration for applications not operating at the nominal highest current and maximum DC loop resistance.

145A.1 Constant power

The power system provides constant power to the powered device (PD). Powering schematics with the nominal highest current per pair and the maximum DC loop resistance are illustrated in Figure 1 for a Class 4 powered device (PD) with a constant power of 25.5 W and in Figure 3 for a Class 8 PD with a constant power of 71.3 W. The 4-conductor connection is defined in 802.3bt as a “pairset”.

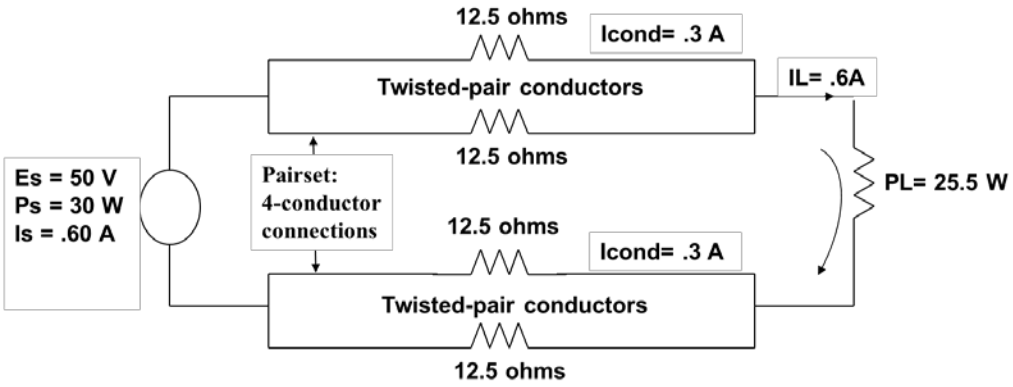

Figure 1: Class 4 PD powering schematic

The power schematic is simplified in Figure 2. By combining the parallel 12.5 Ω resistors in Figure 1.

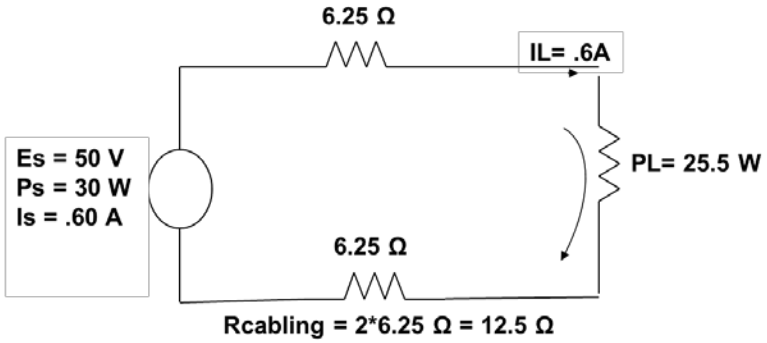

Figure 2: Class 4 PD powering schematic simplified

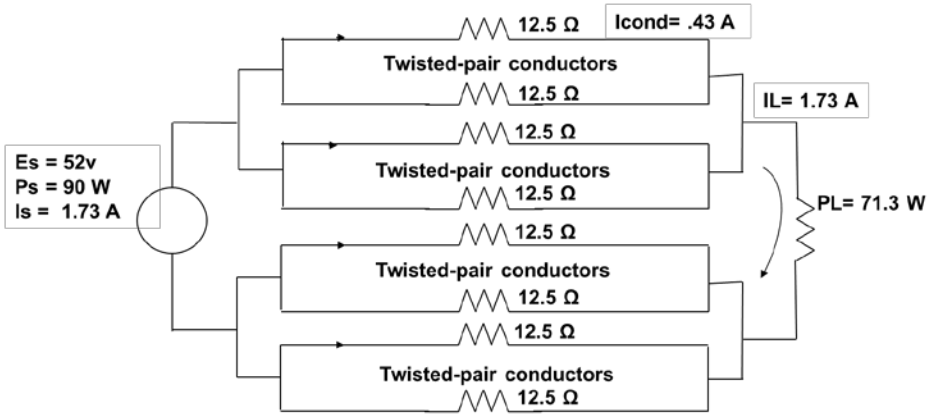

Figure 3: Class 8 PD powering schematic

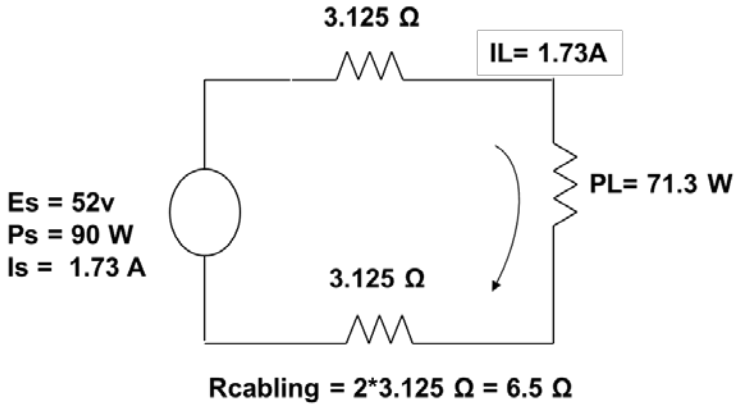

Figure 4: Class 8 powering schematic simplified

145A.2 Current

The value of currents for the example power schematics in Figures 1-4 are derived using Equation (xx–1). Note that Equation (xx–1) is of the same form for the current given in Equation (145–3).

$$Is = \left(\frac{Es - \sqrt{Es^2 - 4\ x\ Rcabling\ x\ PL}}{2\ x\ Rcabling}\right)$$ Equation (xx-1)

Equation (xx-1) can be applied to all PD Classes. The currents *Is* using Equation (xx-1) are provided in Table 1 as a function of Rcabling with a constant voltage (52 V) and power (71.3 W) for Class 8. The maximum Rcabling assumes a 100 meter cabling topology. The cable DCR scales linearly so that 50% of Rcabling is representative of a cabling topology of approximately 50 meters. Note that for a 50% reduction in the maximum Rcabling (3.125 Ω), associated with approximately 50 meters of cabling, the current decreases from 0.43 A to 0.38 A and the power dissipated in the cabling decreases from 18.7 W to 7.1 W.

Rcabling (Ω)	Is (A)	Icabling conductor (A)	Pcabling (W)
0.5	1.39	0.35	0.97
1	1.41	0.35	1.99
1.5	1.43	0.36	3.07
2	1.45	0.36	4.22
2.5	1.48	0.37	5.45
3	1.50	0.38	6.76
3.5	1.53	0.38	8.18
4	1.56	0.39	9.71
4.5	1.59	0.40	11.38
5	1.63	0.41	13.20
5.5	1.66	0.42	15.23
6	1.71	0.43	17.50
6.25	1.73	0.43	18.74

Table 1: Current *Is* as a function of Rcabling

145A.2 Direct current resistance (DCR)

The maximum conductor DCR of 12.5 Ω in Figures 1 and 3 are derived from a cabling topology consisting of:

- 90 meters of 24 AWG horizontal cable (0.0938 Ω/m),
- 10 meters of 26 AWG patch cord (0.14 Ω/m),
- four inline connectors (.3 Ω/m per connector).

The DCR of the 90 meters of cable is adjusted for a temperature increase of 45°C from 20°C to 65°C with a .4 % increase per degree C (.1107 Ω/m).

degC	90 meters horizontal cable (Ω)	4 connectors (Ω)	10 m patch card (Ω)	100 m cabling condutor DCR (Ω)
	(24 AWG)	(4x .3 Ω per connector)	(26 AWG)	
20	8.44	1.2	1.4	11.04
30	8.78	1.2	1.4	11.38
40	9.12	1.2	1.4	11.72
50	9.46	1.2	1.4	12.06
60	9.79	1.2	1.4	12.39
65	9.96	1.2	1.4	12.56

Table 2. Cabling conductor DCR with 24 AWG horizontal cable

Note that using 23 AWG and 22 AWG reduces the per meter cable DCR; see Table 3.

AWG	Diameter(in)	Resistance per meter (Ω)	Resistance per 100 meter (Ω)	Resistance per 90 meter (Ω)
22	0.025346	0.0590	5.90	5.31
23	0.022571	0.0744	7.44	6.70
24	0.020100	0.0938	9.38	8.44

Table 3. Cable conductor DCR

145A.3 Bundled cabling applications

Table 145–1 gives the nominal highest current per pair and the maximum DCR loop resistance. The maximum current is used in ISO/IEC TS 29125, TIA TSB- 184A and the NFPA 70: National Electrical Code (NEC) to limit the maximum number of 4-pair cables in a bundle. The additional information provided in this Annex will enable considerations for the number of 4-pair cables in a cabling bundle that are not at the nominal highest current and maximum DC loop resistance.