IEEE802.3at Task Force

Vport ad hoc

Conversion from Ipeak domain to Ppeak Domain

Rational behind the remedy for comment #86, Draft D3.0

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Objectives

- The ratio between Iport_peak to Iport_avg was set to the same ratio as used in 802.3af i.e. Ki=0.4/0.35.
- In the PD we changed the parameters from Ipeak to Ppeak as we find it easier for matching behavior to legacy 802.3af PDs.
- As a result we want to define the ratio between Ppeak to Pclass in order to keep the same current ratio Ipeak/Iport=0.4/0.35 in Type 2 (Class 4) PDs.
- The PD model is approximated to constant power load
- Ppd is the PD requested power i.e. Pclass
- Ppd_peak is the peak PD power during PD load dynamic changes i.e. PD current is up to (0.4/0.35)*Ipd for 50msec max.
- Voverload is the PD input voltage during Ppd_peak

Equation Derivations

- Objective: Keep the ratio $Ki = \frac{Ipd\_peak}{Ipd} = \frac{0.4}{0.35} = 1.142857$
- We need to find: $Kp = \frac{Ppd\_eak}{Ppd}$
- ➔ Ppeak=Kp*Pclass
- From previous work[1] we can derive Iport and Iport_peak as function of system parameters:
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$$Vpd = \frac{Vpse + \sqrt{(Vpse^2 - 4 \cdot Rch \cdot Pclass)}}{2}$$

$$Ipd = \frac{Vpse - Vpd}{Rch}$$

$$\therefore Ipd = \frac{Vpse - \sqrt{(Vpse^2 - 4 \cdot Rch \cdot Ppd)}}{2 \cdot Rch}$$

$$Vpd\_overload = \frac{Vpse + \sqrt{(Vpse^2 - 4 \cdot Rch \cdot Kp \cdot Ppd)}}{2}$$

$$Ipd\_peak = \frac{Vpse - \sqrt{(Vpse^2 - 4 \cdot Rch \cdot Kp \cdot Ppd}}{2 \cdot Rch}$$

Equation Derivations

$$Ki=\frac{Ipd\_peak}{Ipd}=\frac{0.4}{0.35}=\frac{\dfrac{Vpse-\sqrt{(Vpse^{2}-4\cdot Rch\cdot Kp\cdot Ppd)}}{2\cdot Rch}}{\dfrac{Vpse-\sqrt{(Vpse^{2}-4\cdot Rch\cdot Ppd)}}{2\cdot Rch}}$$

$$Ki=\frac{Vpse-\sqrt{(Vpse^{2}-4\cdot Rch\cdot Kp\cdot Ppd)}}{Vpse-\sqrt{(Vpse^{2}-4\cdot Rch\cdot Ppd)}}$$

$$\sqrt{(Vpse^{2}-4\cdot Rch\cdot Kp\cdot Ppd)}=Vpse-Ki\cdot\left(Vpse-\sqrt{(Vpse^{2}-4\cdot Rch\cdot Ppd)}\right)$$

$$(Vpse^{2}-4\cdot Rch\cdot Kp\cdot Ppd)=\left(Vpse-Ki\cdot\left(Vpse-\sqrt{(Vpse^{2}-4\cdot Rch\cdot Ppd)}\right)\right)^{2}$$

$$(Vpse^{2}-\left(Vpse-Ki\cdot\left(Vpse-\sqrt{(Vpse^{2}-4\cdot Rch\cdot Ppd)}\right)\right)^{2})=4\cdot Rch\cdot Kp\cdot Ppd$$

$$Kp=\frac{Vpse^{2}-\left(Vpse-Ki\cdot\left(Vpse-\sqrt{(Vpse^{2}-4\cdot Rch\cdot Ppd)}\right)\right)^{2}}{4\cdot Rch\cdot Ppd}$$

Results

- Solving for Kp for the worst case conditions:
  - Rch=12.5 ohms
  - Vpse=50V
  - Ki=0.4/0.35
  - Ppd=25.5W for Icable=600mA

$$Kp = \frac{Vpse^2 - \left(Vpse - Ki \cdot \left(Vpse - \sqrt{(Vpse^2 - 4 \cdot Rch \cdot Ppd)}\right)\right)^2}{4 \cdot Rch \cdot Ppd} =$$

$$= \frac{50^2 - \left(50 - \frac{0.4}{0.35} \cdot \left(50 - \sqrt{(50^2 - 4 \cdot 12.5 \cdot 25.5)}\right)\right)^2}{4 \cdot 12.5 \cdot 25.5} = 1.114$$

References

- 1. http://www.ieee802.org/3/at/public/jan08/darshan_3_0108.pdf pages 22 and 23 done for 29.5W/0.72A PD showing how we got Ki and Kp.