Power Matters

IEEE802.3bu 1PODL Task Force

Table 200-1: Flexible Design guide lines for PD available power

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Objectives

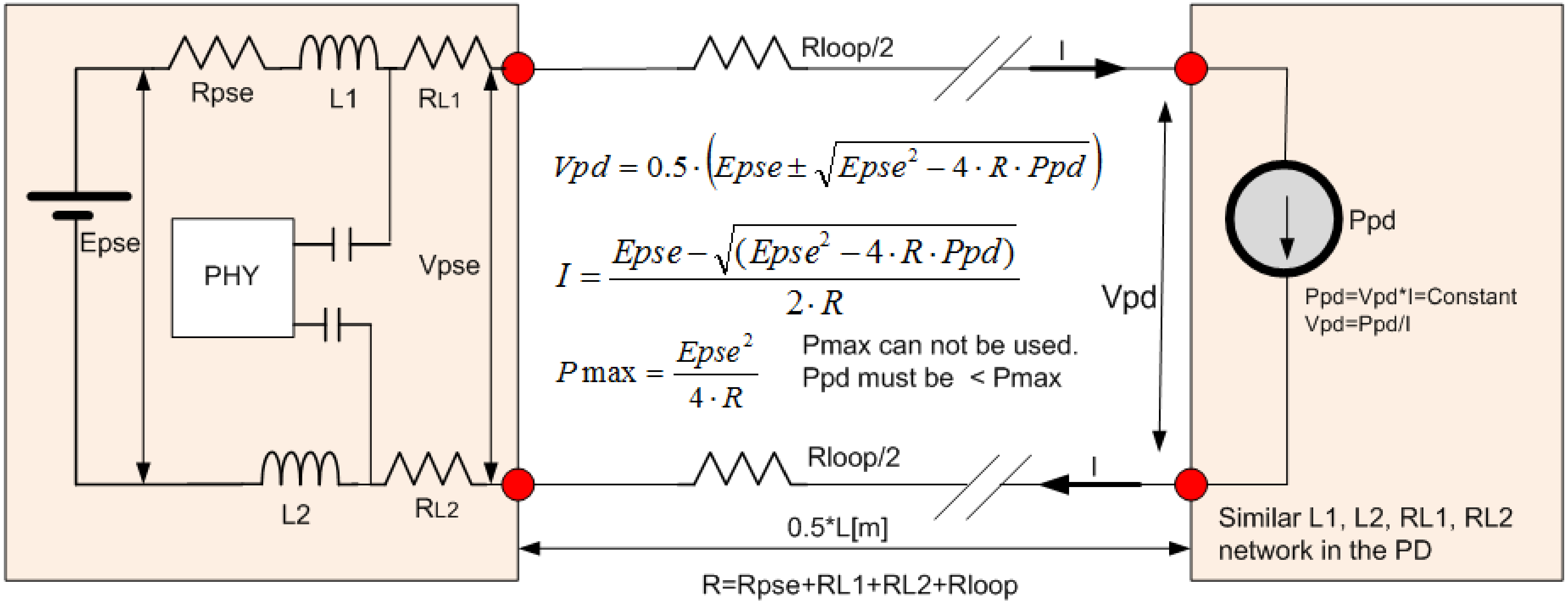
- To complete the proposed remedy for Comment #51 in D0.2 which is: to supply design guide lines by form of equation for addressing use case that are not specified in Table 200-1.

- Background material:
- http://www.ieee802.org/3/bu/public/sep14/darshan_3bu_1_0914.pdf

Back ground

- The automotive OEMs use all different gauge cables among themselves and for different use cases.
- As a result, this presentation will address the general case for setting the requirements for wire resistance per meter as function of system parameters.

Simplified system model



Rs=Rpse+RL1+RL2
R=Rs+Rloop

Wire resistance per meter as function of system parameters

$$\rho(\Omega / m) = \frac{1}{L} \cdot \left(\frac{K \cdot Epse^2}{4 \cdot Ppd_{\max}} - Rs \right)$$

- K=0.7 to 0.8. e.g. K=0.8 (20% power loss on Rloop+Rs.)
- Rs=PSE internal output resistance
- Ppd=PD input power measured at the PI.
- Epse=PSE open load voltage at the PI. Epse=Vpse at no load. L[m]=Round loop of Wire length. E.g if channel length is 15m than L=30m

Thank You

Math

$$Vpd = \frac{Epse + \sqrt{Epse^2 - 4 \cdot R \cdot Ppd}}{2}$$

$$R = Rs + R_{loop}$$

For maximum power available:

$$Epse^2 - 4 \cdot R \cdot Ppd = 0$$

$$Ppd_{\max} = \frac{Epse^2}{4 \cdot R} = \frac{Epse^2}{4 \cdot (Rs + R_{loop})}$$

For stability:

$$Epse^2 - 4 \cdot R \cdot Ppd > 0$$

$$Ppd_{\max} < \frac{Epse^2}{4 \cdot (Rs + R_{loop})}$$

As a result: $Ppd_{\max} = \frac{K \cdot Epse^2}{4 \cdot (Rs + R_{loop})}$

$$K = \frac{Ppd}{P_{Epse}} = \frac{P_{Epse} - I^2 \cdot (Rs + R_{loop})}{P_{Epse}}$$

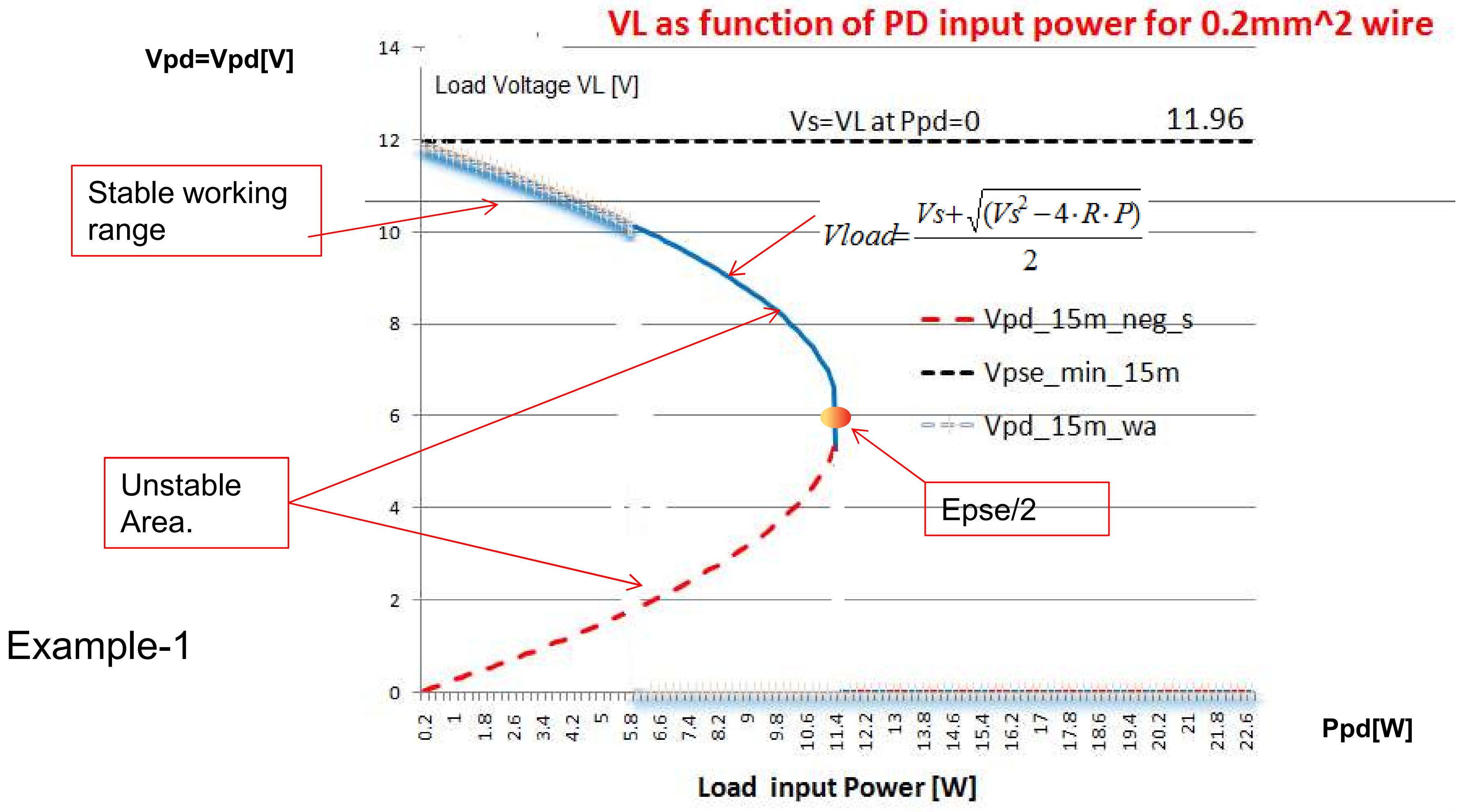
K<1. K is the ratio between PD input power and Epse power, Pepse. This is a measure of channel efficiency which is function of the power loss of Rs+Rloop that we can cost effectively ensures stability by using UVLO Von, Voff limits.

$$(Rs + R_{loop}) = \frac{K \cdot Epse^2}{4 \cdot Ppd_{\max}}$$

$$R_{loop} = \frac{K \cdot Epse^2}{4 \cdot Ppd_{\max}} - Rs = \rho \cdot L$$

$$\rho = \frac{Rloop}{L} = \frac{1}{L} \cdot \left(\frac{K \cdot Epse^2}{4 \cdot Ppd_{\max}} - Rs \right)$$

Example for: Vs=12V, 15m cable (Rs=0.4Ω)
Wire: AWG24 (d=0.511mm, 0.205mm^2, 0.082Ω/m).



- Plot of real system: load voltage vs. load power for 12V source (with 0.4Ω output DC resistance) for supporting 5-6W load