PowerDsine

IEEE 802.3 DTE Power via MDI

Considerations in Selecting Feeding Voltage/Current

Presented by PowerDsine:

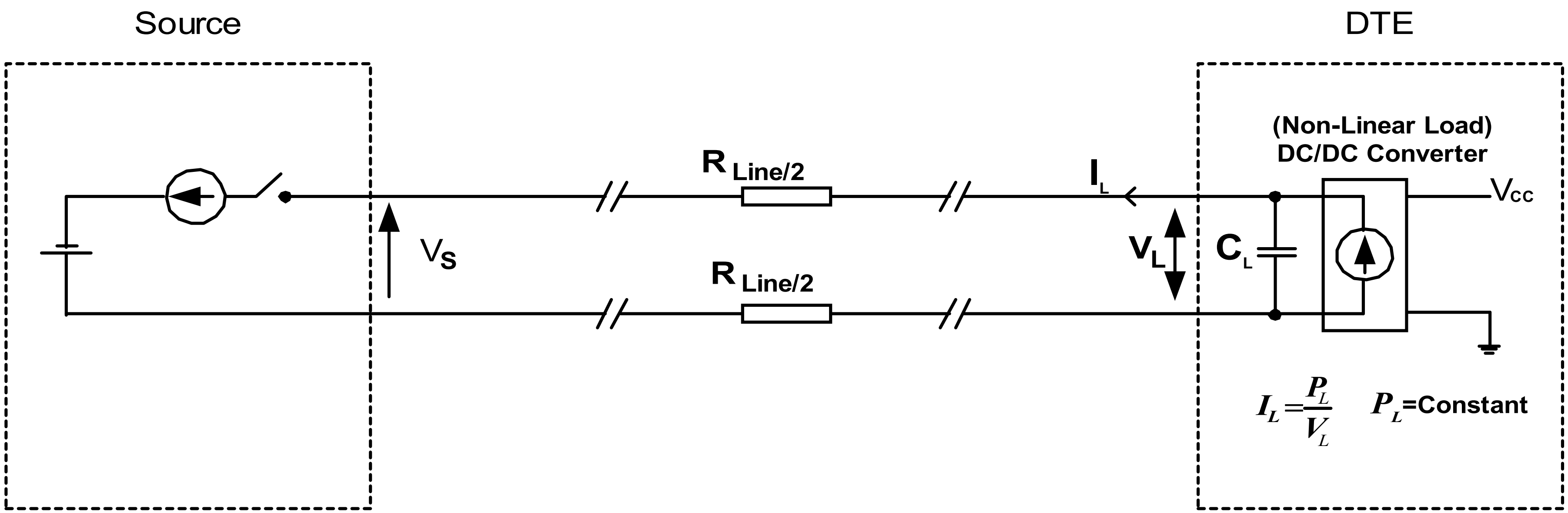
Amir Lehr - amirl@powerdsine.com

Yair Darshan - yaird@powerdsine.com

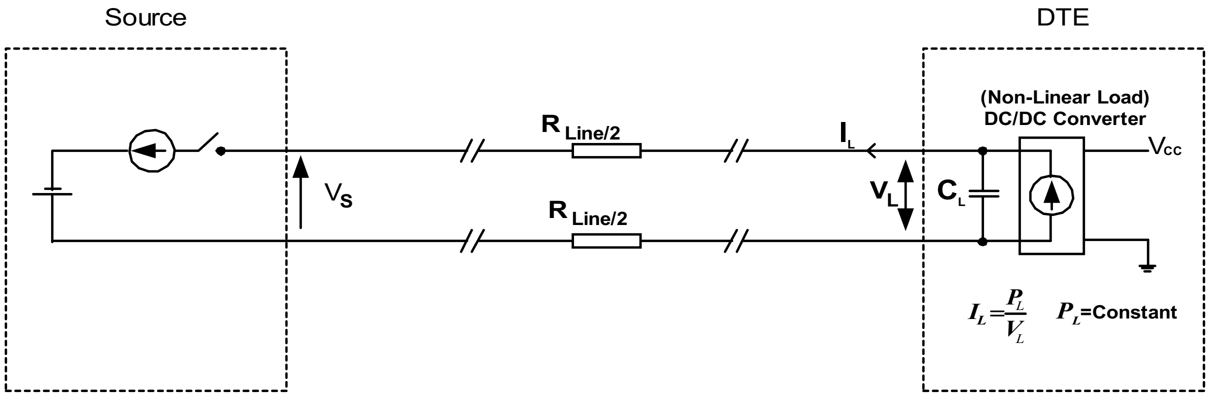
Avinoam Levy - avinoaml@powerdsineusa.com

System Description

- 100 meter TIA/EIA-568 Cat 5 cable
- Using two wire pairs link
- 40W max. DC loop resistance, 20W max. link resistance
- Non-Linear load (I.e. DC/DC converter)



Basic Equations



Eq. 1 $$I_L = \frac{(V_S - V_L)}{R_{Line}}$$

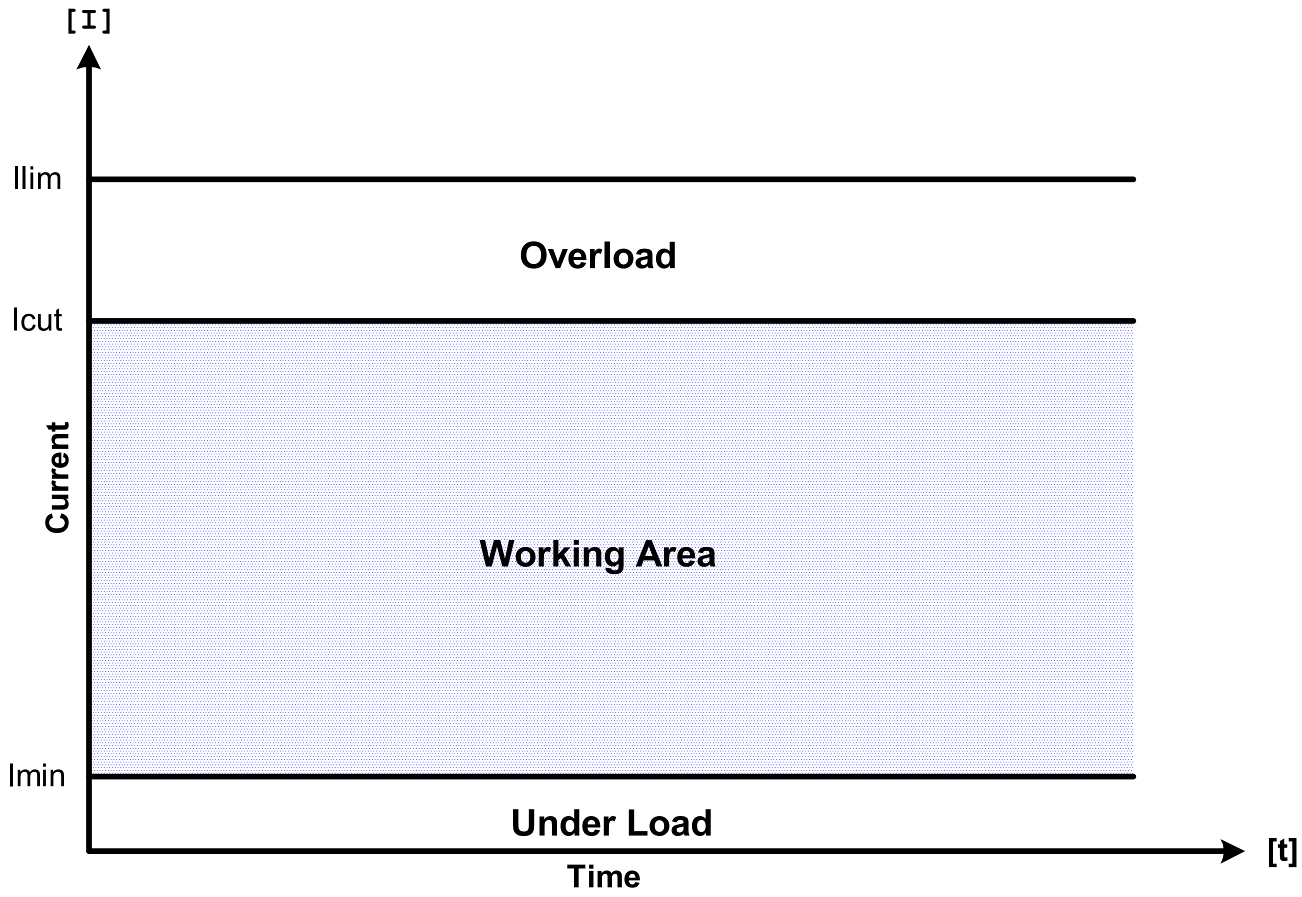
Eq. 2 $$I_L = \frac{P_L}{V_L}$$

Assuming constant DC/DC converter efficiency across entire Vin range

Eq. 3 $$V_L^{\,2} - V_S \times V_L + P_L \times R_{Line} = 0$$

Eq. 4 $$V_L 1, V_L 2 = \frac{\left(V_S \pm \left(V_S^{\,2} - 4 \times P_L \times R_{Line}\right)^{0.5}\right)}{2}$$

Operation Over/Under Load Protection



Eq.3 Steady-State (Non Oscillating) Solutions have to meet

$$Vs^2 > 4 \bullet P_L \bullet R_{Line}$$

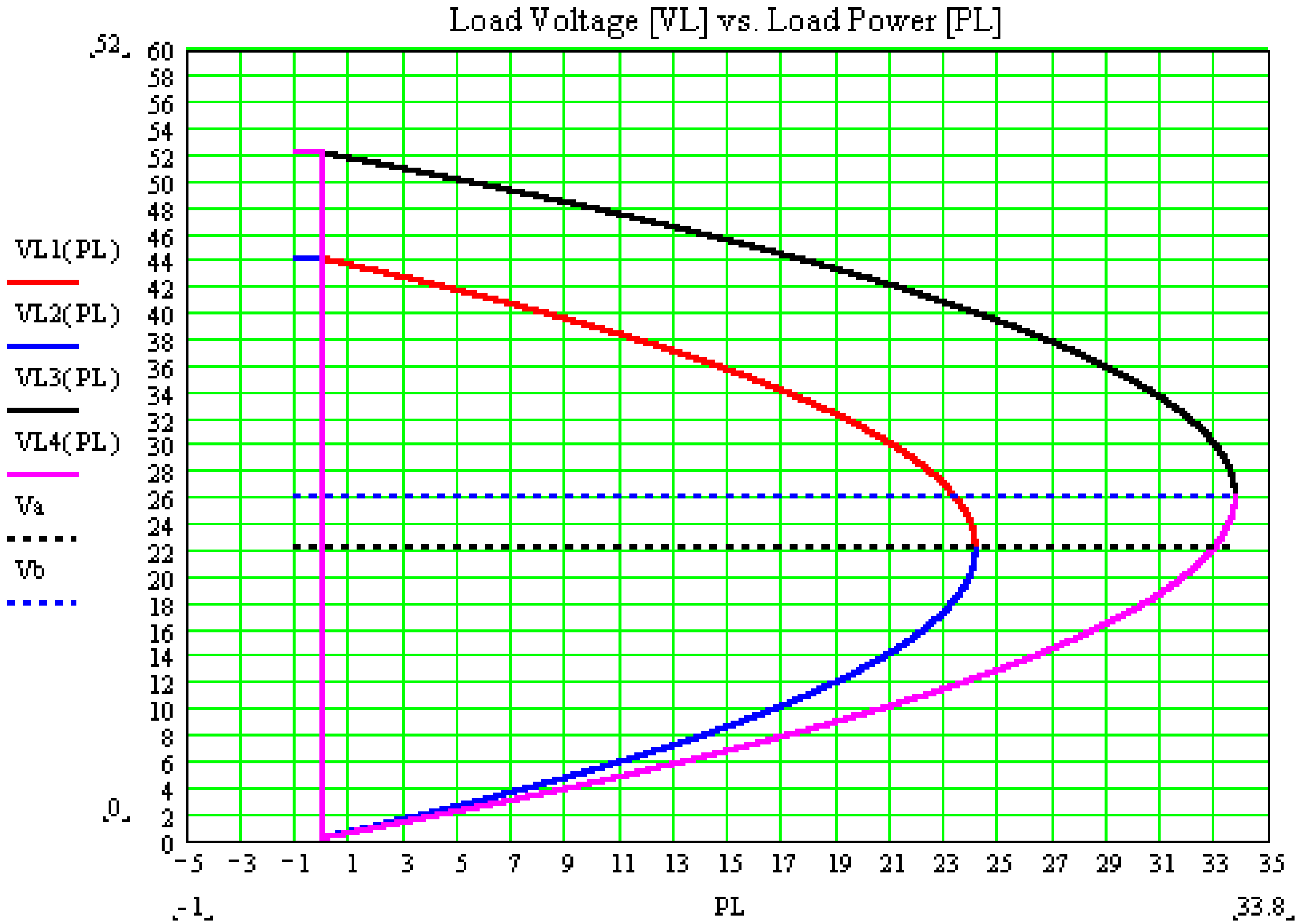
or

$$P_L < Vs^2 / (4 \bullet R_{Line})$$

Solution 1 $$V_L 1 = \frac{\left(V_S + \left(V_S{}^2 - 4 \times P_L \times R_{Line}\right)^{0.5}\right)}{2}$$

Solution 2 $$V_L 2 = \frac{\left(V_S - \left(V_S{}^2 - 4 \times P_L \times R_{Line}\right)^{0.5}\right)}{2}$$

Stable Operation Conditions



Maximum Available Load Power

Given $$Vs^2 = 4 \bullet P_L \bullet R_{Line}$$

Than $$V_L 1 = V_L 2 = V_L = \frac{Vs}{2}$$

Hence $$P_L \max = \frac{{Vs_{MIN}}^2}{4 \times R_{Line}} \qquad I_L \max = \frac{Vs_{MIN}}{2 \times R_{Line}}$$

Example, System Limitations for 48. 4Vdc Feeding Voltage

Assuming 20. link resistance, I_{cut}=500mA

Set UVLO to UVLOmin = $\max\{V_{s\ max}/2, (V_{s\ min} - I_{LIM} x R_{line})\}$
= max {(48+4)/2, (48-4)-0.5x20}=34Vdc

Max current should be limited to $V_{s\ min}/2R_{line}$
= (48-4)/2x20= 1.1A

*** Max. load power = $V_{s\ MIN}^{2}/\ 4xR_{line}$ = $(48-4)^{2}/4x20$=24.2W**

* Added after presentation

Information Derived from Equations Presented

- Min. source voltage for max. load power required to meet stable operation criteria.

or

- Max. load power for given min. source voltage required to meet stable operation criteria.

Conclusions

- **Under-Voltage-Lockout circuitry at the PDTE will assure reliable start-up & prevents load oscillations**
- **Set UVLOmin to: max. { $V_{s\ max}/2$, $(V_{s\ min} - I_{LIM} x R_{line})$ }**
- **Max. current should be limited to $V_{s\ min}/2R_{line}$**
- **Soft-Start circuitry should limit inrush to $<V_{s\ min}/2R_{line}$**