ANALOG DEVICES

AHEAD OF WHAT'S POSSIBLE™

Unbalance

Rev. 3

MICHAEL PAUL

Summary

- A new variable "$I_{Unbalance-2p}$" was introduced in Draft 3.1 and is used in place of $I_{Con-2p-unb}$ in some areas
- In Draft 3.1, $I_{Con-2p-unb}$ has the same value as $I_{Unbalance-2p}$
- Unbalance interoperability has been compromised
  - $I_{Con-2p-unb}$ limits were increased in Draft 3.1 in such a way that both the PSE and PD may now be more unbalanced and *interoperability is not guaranteed*
  - **Fix $I_{Con-2p-unb}$ limits**

Class 5 Case Study

- $I_{Unbalance-2p}$ (550mA) based on worst case cable/connection/diode model delivering 40W
- System Unbalance system models are calibrated with:
  - Diode area mismatch of 10
  - R_{PSE_alpha} = 2.182 (R_{PSE_alpha} is the gain factor in Eqn. 145-13)
  - $I_{Con-2p,max}$ was measured as 550mA and this was used as the $I_{Con-2p-unb}$ limit until Draft 3.1

$$0 < R_{PSE\_max} \leq \left\{ \begin{array}{ll} 2.182 \times R_{PSE\_min} - 0.04 & \text{for Class 5} \\ 1.999 \times R_{PSE\_min} - 0.04 & \text{for Class 6} \\ 1.904 \times R_{PSE\_min} - 0.03 & \text{for Class 7} \\ 1.832 \times R_{PSE\_min} - 0.03 & \text{for Class 8} \end{array} \right\}_{\Omega} \qquad (145\text{–}13)$$

where

R_{PSE_max} is, given R_{PSE_min}, the highest allowable common mode effective resistance in the powered pairs of the same polarity

R_{PSE_min} is the lower PSE common mode effective resistance in the powered pairs of the same polarity

Class 5 Case Study

- Draft 3.1 $I_{Unbalance\text{-}2p}$ was changed to 560mA to provide margin.
  - Now, using the PSE test from table 145-18, R_{PSE_alpha} can be changed to 2.67 and pass the compliance test
    - That is the PSE can be more unbalanced and pass the hardware compliance test

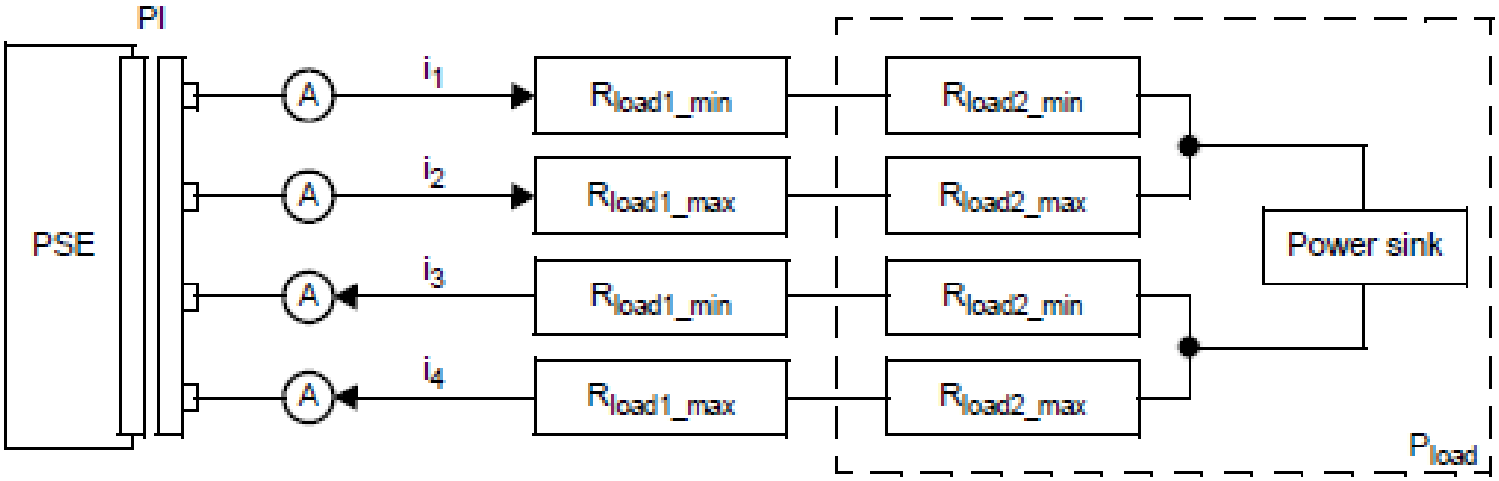
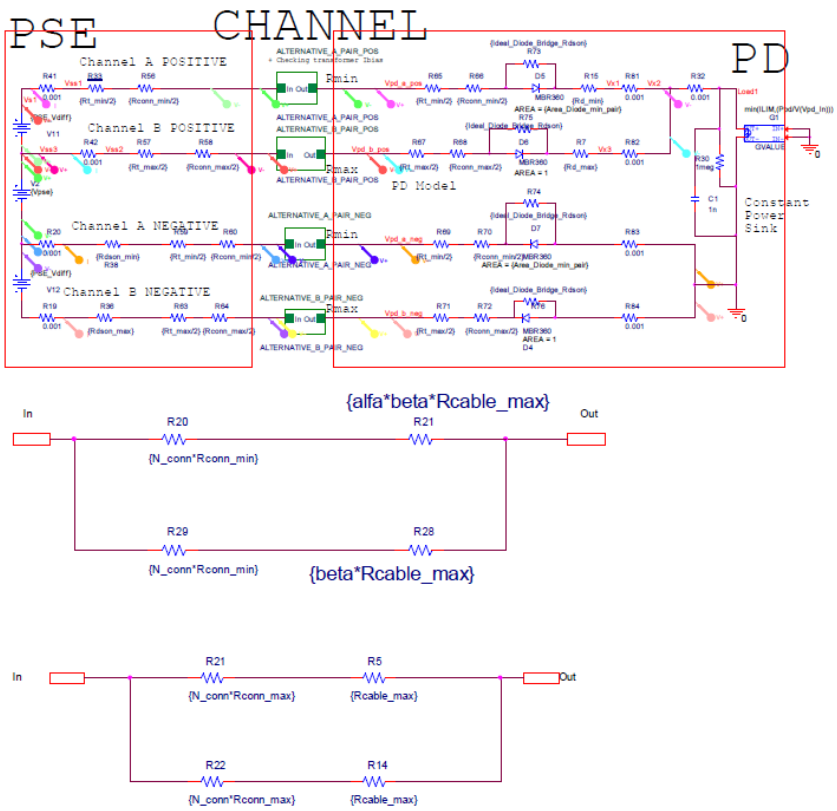


Figure 145–22—PSE PI unbalance specification and system resistance unbalance

Class 5 Case Study

- Plugging R_{PSE_alpha} = 2.67 back into the System Unbalance model gives $I_{Unbalance\text{-}2p,max}$ = 571mA
- This PSE passes the compliance test but may fail to interoperate



Credit: darshan_01_0317

How do we add margin?

- We need two unbalance numbers
  - $I_{Unbalance\text{-}2p}$ for the hardware unbalance test (component unbalance contribution)
  - $I_{Con\text{-}2p\text{-}unb}$ for the system at runtime (software-controlled current threshold)
  - The hardware test limit must be less than the runtime unbalance limit to ensure margin
- $I_{Unbalance\text{-}2p}$ is the hardware unbalance test
  - PSEs and PDs should not exceed $I_{Unbalance\text{-}2p}$ when connected to the test load/source
  - $I_{Unbalance\text{-}2p}$ should use the $I_{Con\text{-}2p\text{-}unb}$ numbers from Draft 3.0
  - Draft 3.0 $I_{Con\text{-}2p\text{-}unb}$ numbers define system performance given PSE, cable and PD unbalance allocations
- $I_{Con\text{-}2p\text{-}unb}$ is the runtime test
  - A PSE should not remove power from a PD until at least $I_{Con\text{-}2p\text{-}unb}$ is drawn from a pairset
  - $I_{Con\text{-}2p\text{-}unb}$ should maintain the numbers specified in Draft 3.1