MPS Digital Multiphase VR Introduce

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Outlines

- Basic terminologies
- Multiphase VR control methods
- Multiphase VR current balance
- MPS multiphase VR road map

Basic Terminologies

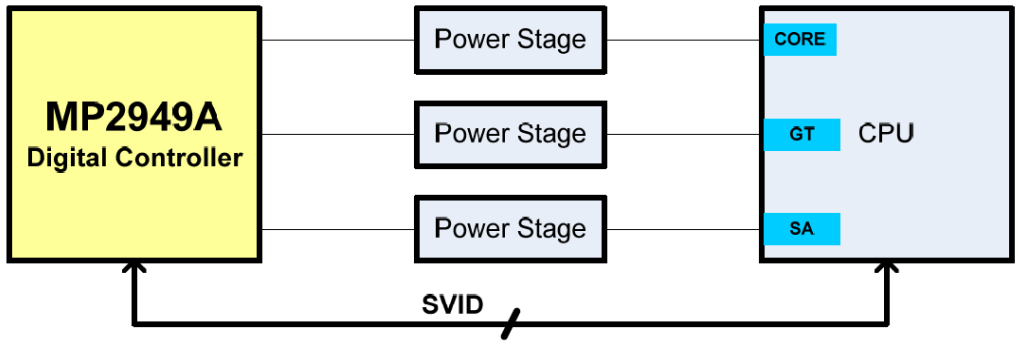
Phase and Rail

MP2949A

Tri-Loop Digital Multi-Phase Controller with PMBus Interface for IMVP8/9

FEATURES

- Up to 6-Phase Triple-Rail Digital PWM Controller
- Configurable Phase Number: 3+2+1, 4+1+1, 2+1+1, 1+1+1, etc.

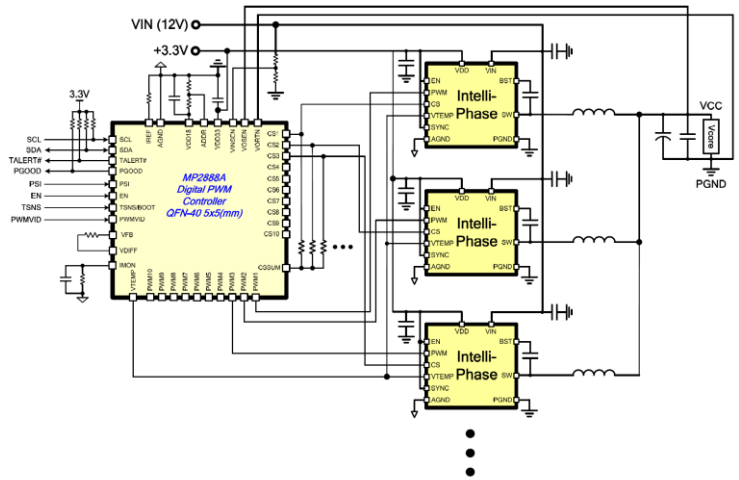


MP2888A

Digital, Multi-Phase PWM Controller with PMBus and PWM-VID

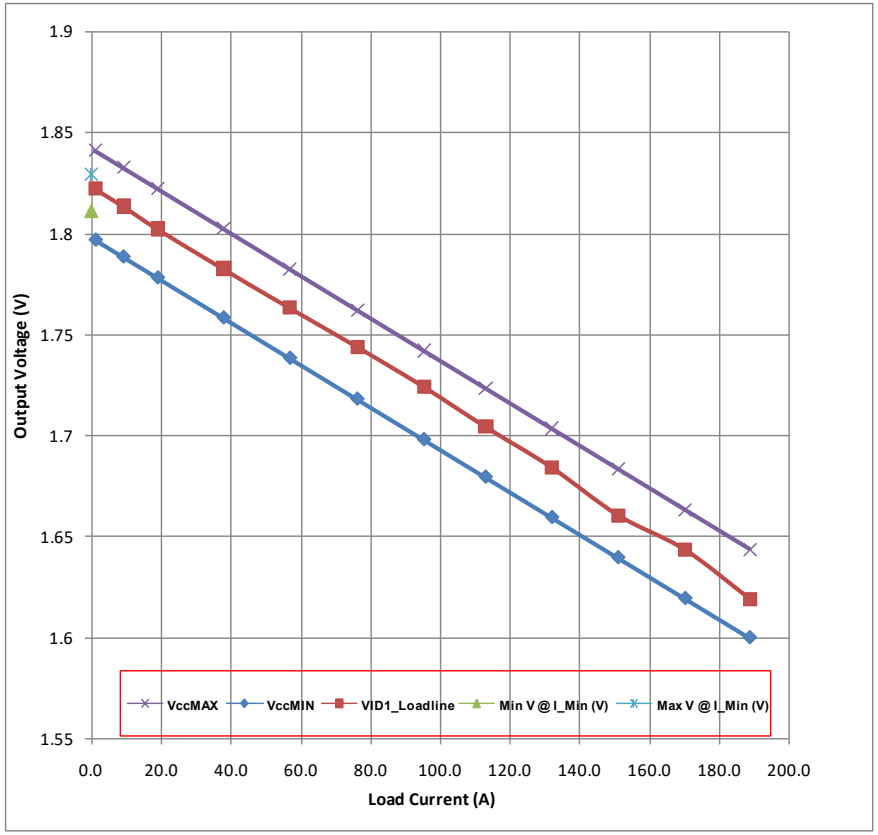
FEATURES

- Programmable Multi-Phase up to 10 Phases



VR/MTP/VID/DVID/CS/APS/Loadline(droop resistor)

- VR means voltage regulator
- MTP means multiple-time programmer
- VID is same as Vref of DCDC converter
- DVID means dynamic VID
- CS means current sense
- APS means auto phase shedding
- Loadline(droop resistor) shows as picture



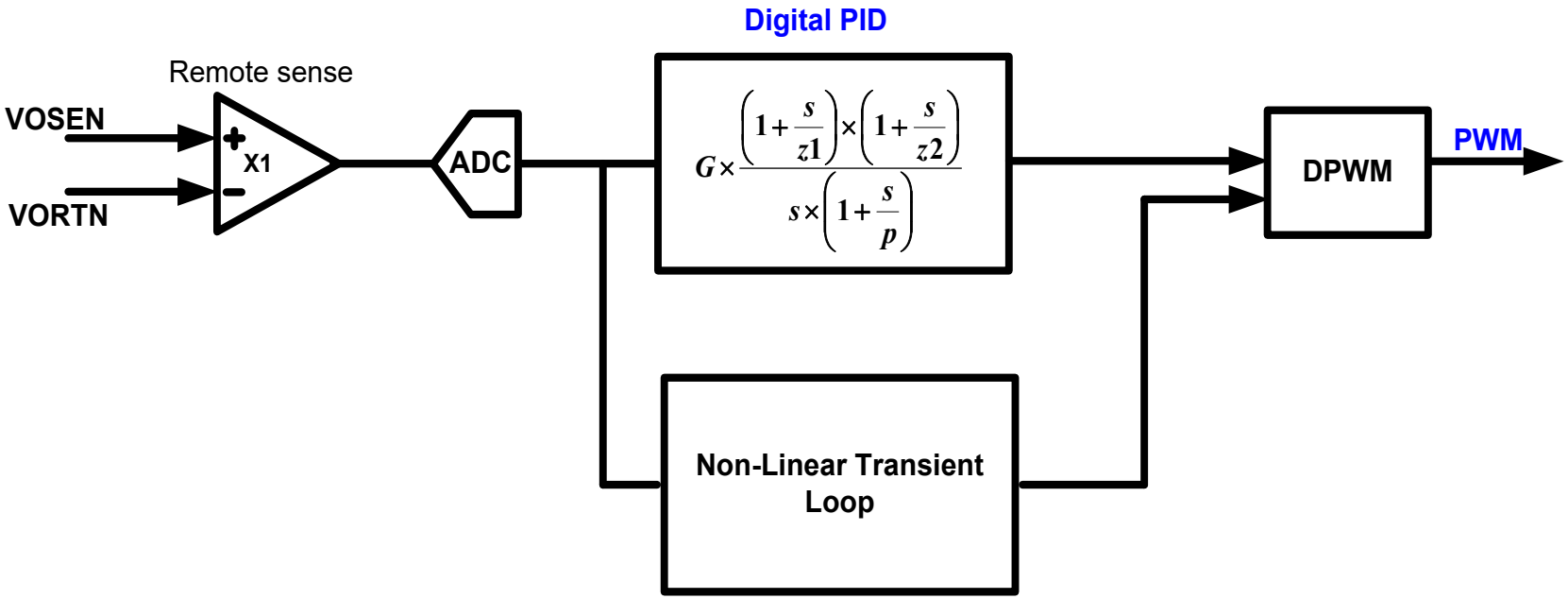
Protocols: SVID/SVI2/3/OVR/PVID/AVS/PMBUS

- SVID→ Intel
- SVI2/3→ AMD
- OVR→ NVidia
- PVID→ early Intel/POL
- AVS→ Arm-base IC
- PMBUS→ MPS and so on

Multiphase VR Control Methods

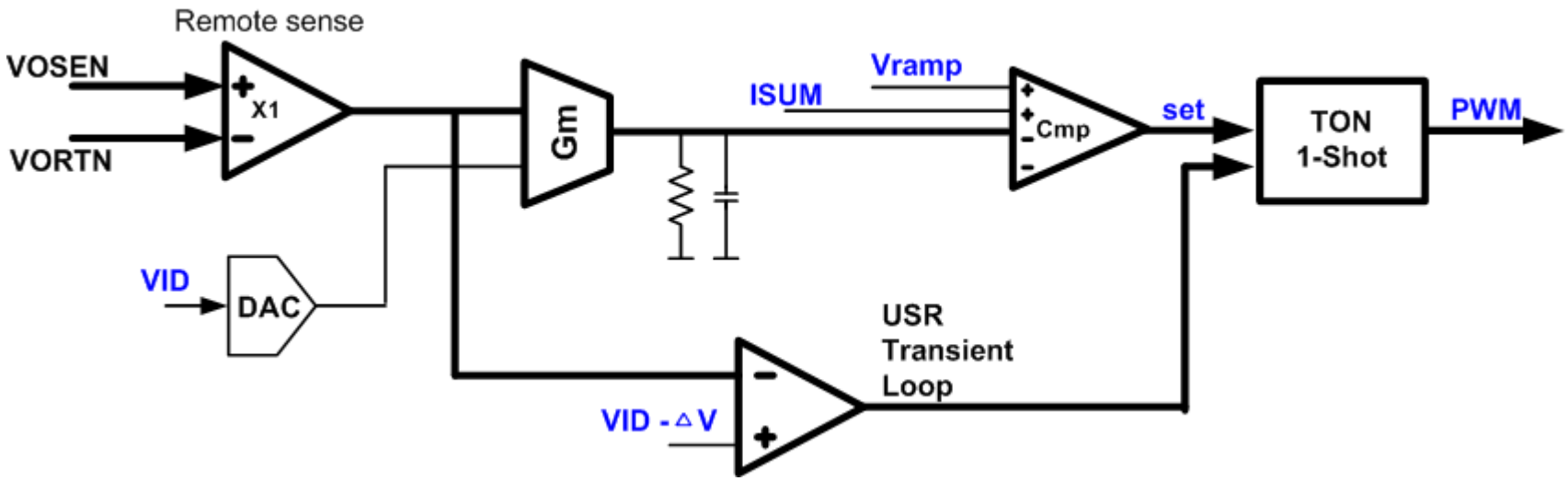
Typical Voltage Mode Digital Control

- Sophisticated pole and zero adjustment during operation
- Separated non-linear loop creates undershoot or ringback during tranisent
- Voltage mode control doesn't guarantee cycle by cycle current sharing



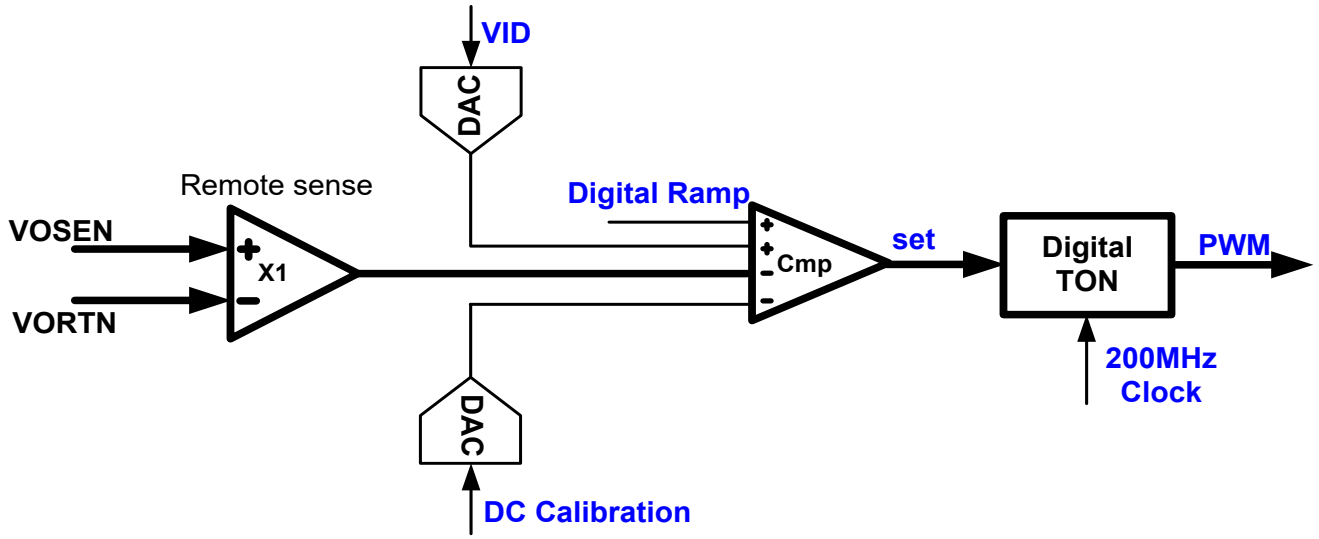
Dual Loop COT Control

- Separated non-linear loop creates undershoot or ringback during tranisent

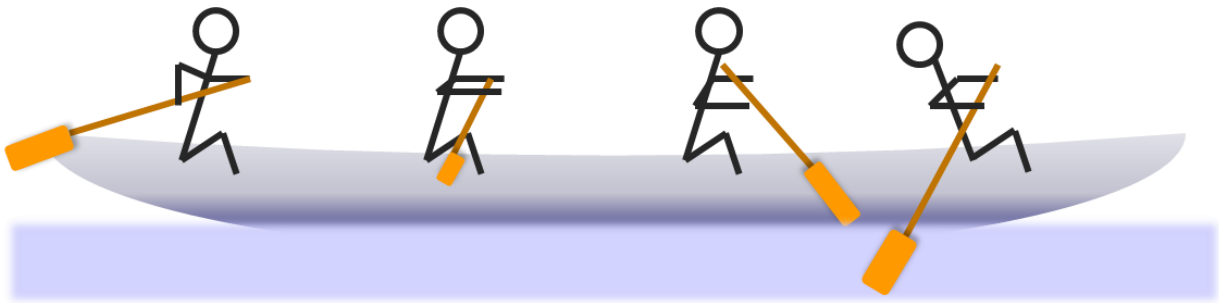


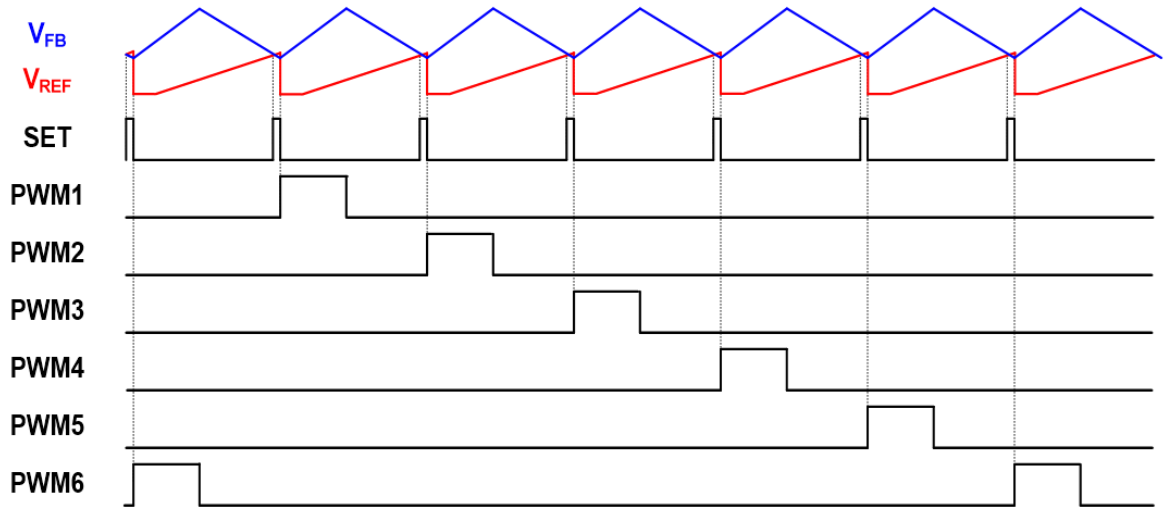
MPS Digital COT Control

- One fast loop takes care of both steady state and load transient
- MPS patented Technology-Simple, Fast and Fully Digital.

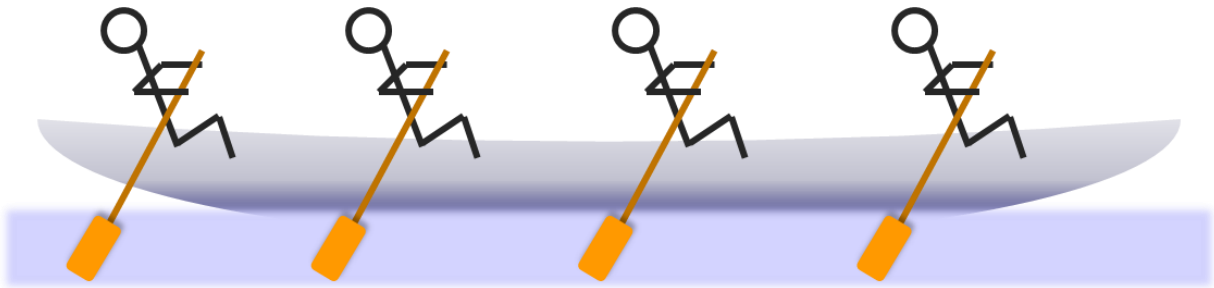


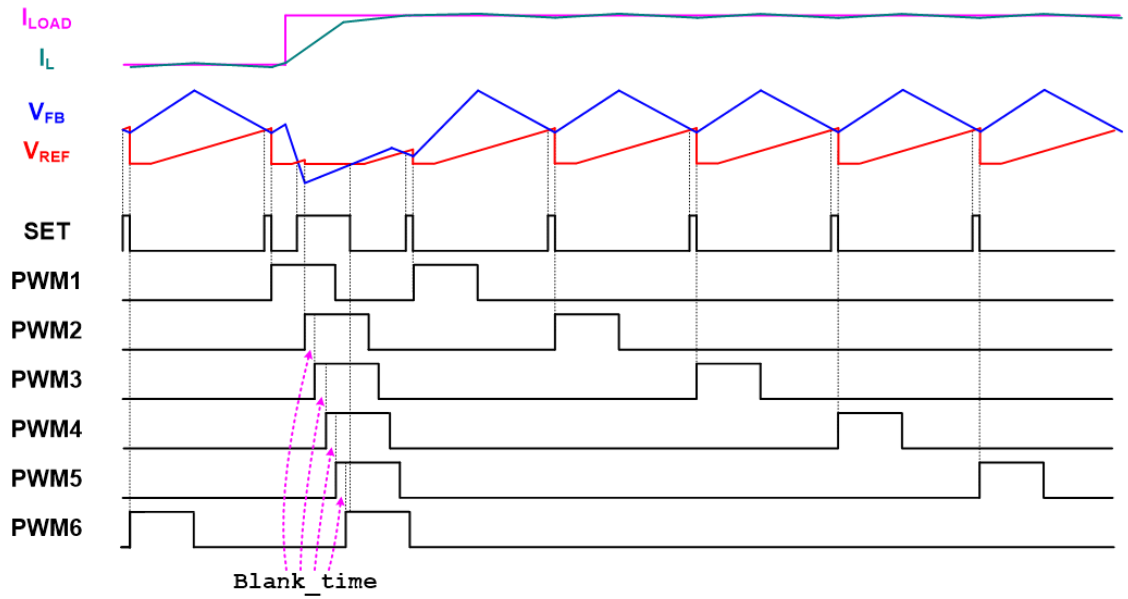
Digital COT Control – Steady State



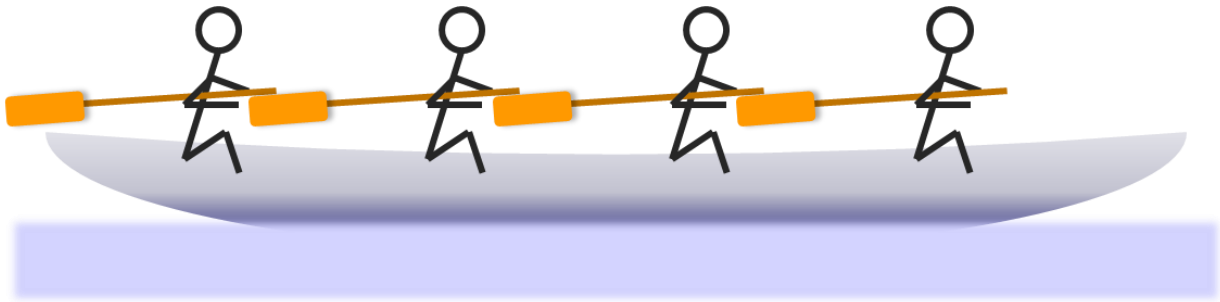


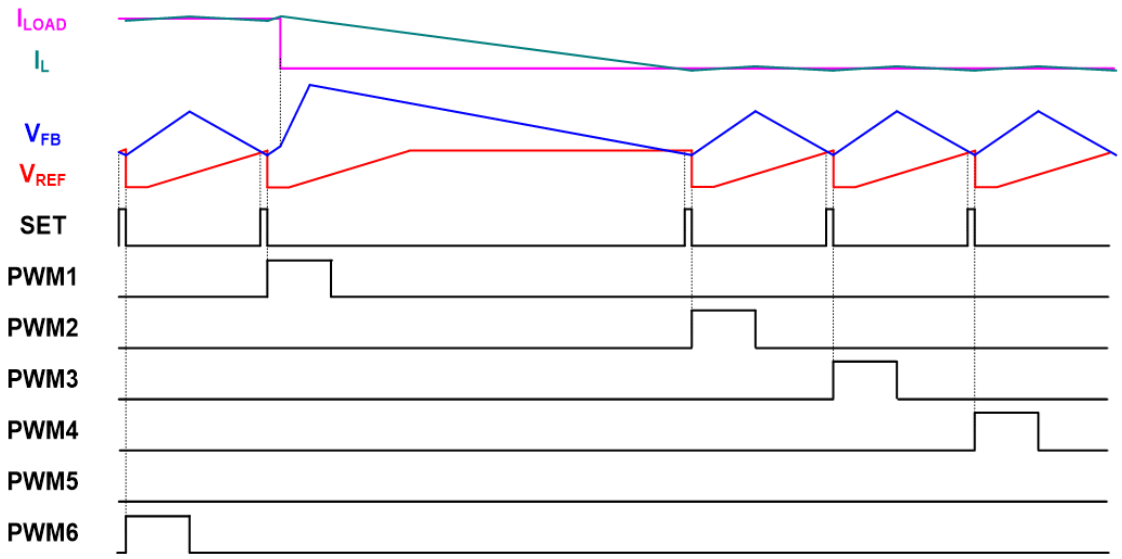
Digital COT Control – Load Step Up





Digital COT Control – Load Step Down

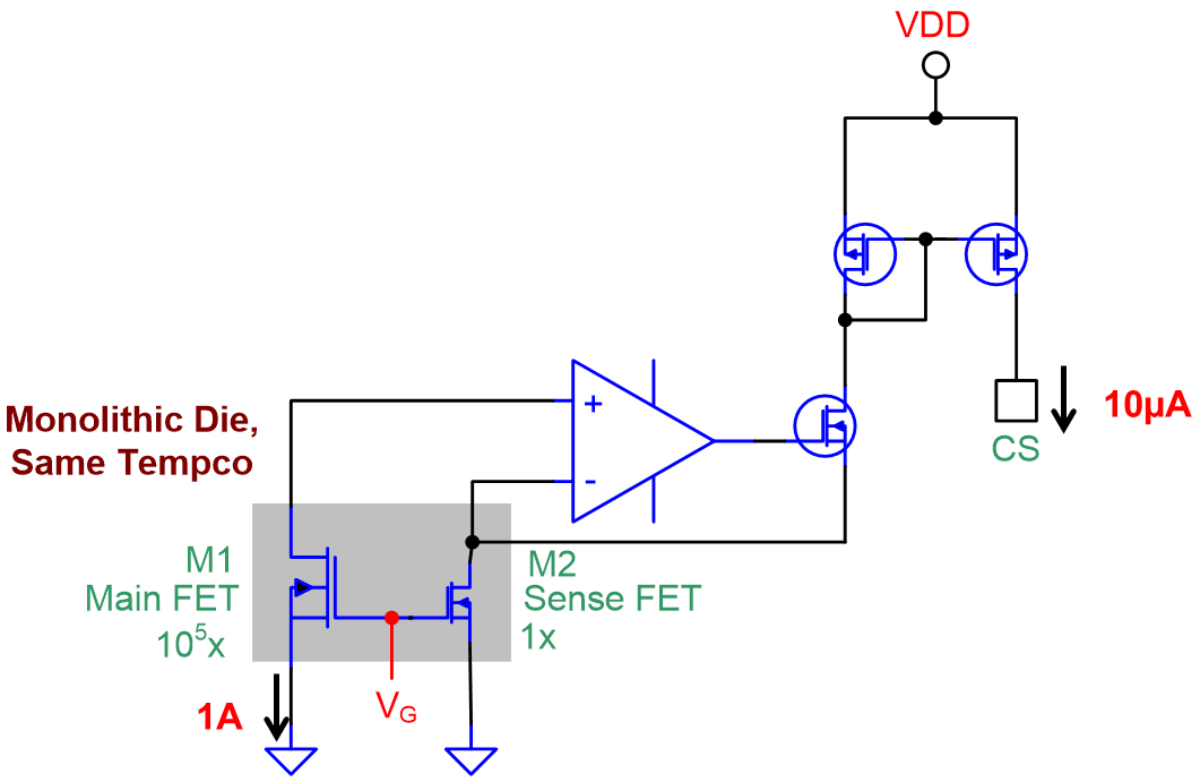


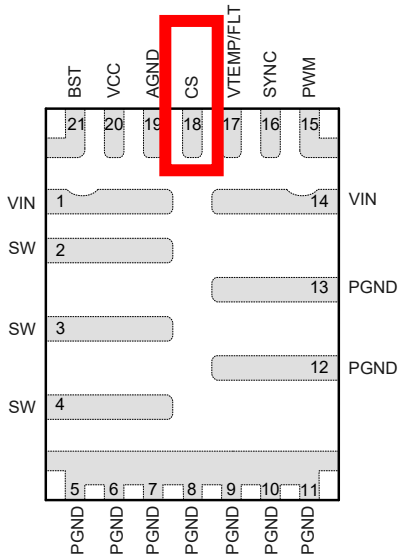


Multiphase VR Current Balance

Intelli-Phase Current Sense Principle

- Zero tempco due to monolithic die current sensing





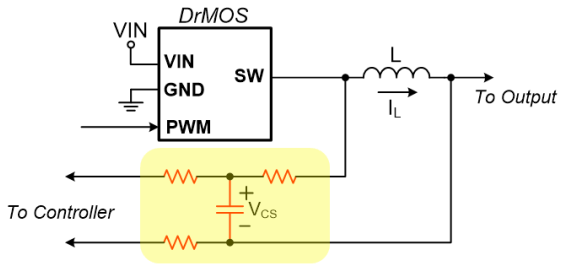
On-Die Current Sense Advantages

- CS outputs current proportional to inductor current. (10µA/A)
- Tracks cycle by cycle.
- Independent of the Temperature, Rdson, Inductor DC resistance, Duty-cycle and Frequency variations.

CS output matches inductor current very well during transient

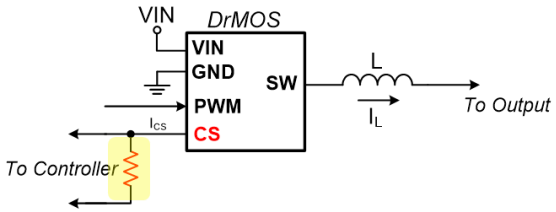
On-Die Current Sense Advantages

DCR Sensing



- Need 21 Components (Rx15 + Cx5 + NTC)
- 6%-8% DCR sensing error (at 25C)
- Noisy
- Hard to tune

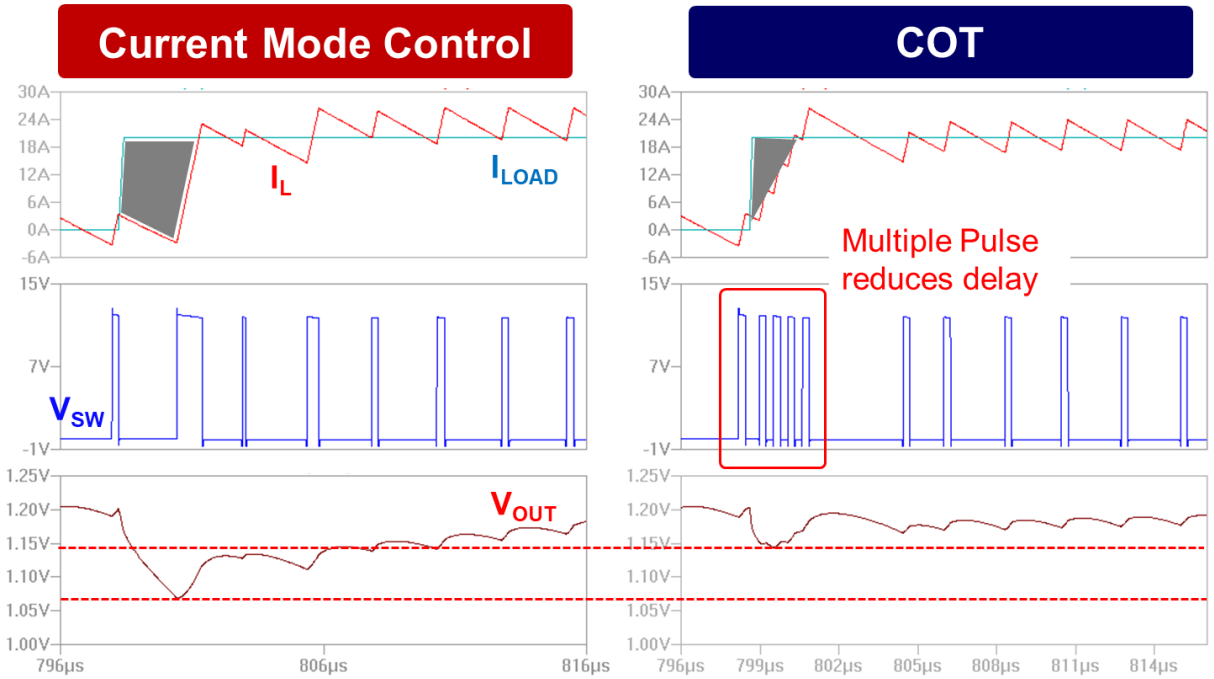
MPS Accu-Sense



- Only need 5 Resistors
- 3% current sensing error over temp.
- Clean signal
- Very easy to use

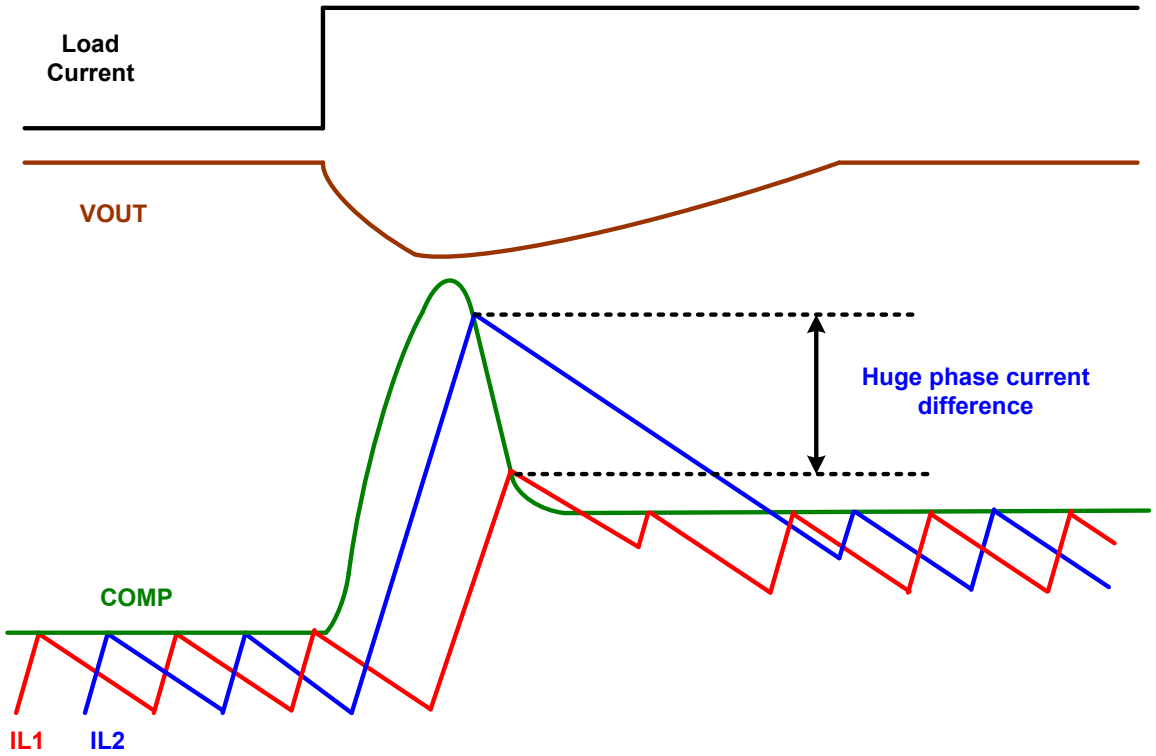
Saves Component Count & Cost!

Current Balance Introduce



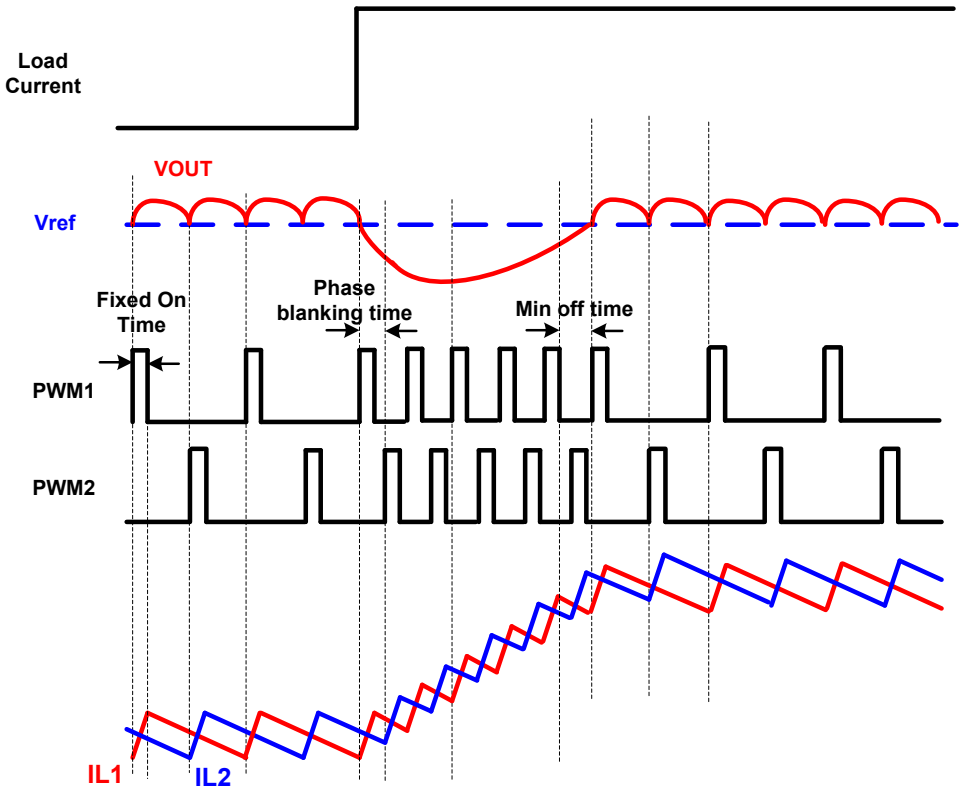
Current Balance Introduce

- Why dynamic current sharing for multiphase is difficult for voltage and current control
- In load step up mode, the leading phase would increase PWM on time dramatically, but due to PWM switching cycle delay, the lagging phase supports less current
- Huge current stress on one phase during fast load step up



Current Balance Introduce

- Reducing PWM off time to support load step up, while PWM on time keeps constant
- PWMs are evenly distributed to each phase , so each phase carries the average current even transient
- Inherently much better dynamic current sharing than voltage and current control



Thank you