APID New Products Update August,2021

MIC21LV32/MIC21LV33
Stackable, Dual Phase Adaptive Constant On Time Controllers

A Leading Provider of Smart, Connected and Secure Embedded Control Solutions

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Analog Power & Interface Division
Microchip Technology

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SMART | CONNECTED | SECURE

Step-Down (Buck) External SW

75V
- **MIC2103/4** – COT, HLL, HS, 3x3 QFN
- **MIC2176-1/2/3** – COT, HS 100/200/300kHz
- **MIC2128** – COT, HS, SS, 3x3 QFN
- **MIC2127A** – 75V, COT, HLL, HS, 3x3 QFN

40V
- **MIC2130/1** – VM, Low EMI, 4x4mm QFN

38V
- **MIC2101/2** – COT, HLL, HS, 3x3 QFN

36V
- **MIC21LV32/33** – Dual Phase,COT, Stackable, 5x5 QFN

32V
- **MIC2182** – CM/Skip Mode, 300kHz, Low IQ, SOP
- **MIC2198** – CM, 500kHz, 4x4 QFN
- **MIC2199** – CM, 300kHz, 4x4 QFN

30V
- **MCP19035** – VM, 300/600kHz, 3x3 DFN

28V
- **MIC2164/-2/-3/C** – 1% Vref, 270/300kHz/1MHz
- **MIC2165** – COT, 1% Vref, 600kHz
- **MIC2166** – COT, 1% Vref, 600kHz
- **MIC2125** – 1% Vref, 600kHz, Int LDO
- **MIC2126** – HS/HLL 200/750kHz, 0.6 Vref

26V
- **LX7302** – 200kHz-1MHz, Int/Ext Vref
- **LX7309** – 20V, 100-500kHz, Freq Sync

18V
- **MIC2124** – 1% vref, 300kHz, 0.8V Vref

16V
- **MCP1631HV** – Prog. Charger, 2MHz

15V
- **MIC2168/A** – Sych Buck, 1MHz, 10pin MSOP
- **MIC2169/A/B** – Sych Buck, 500kHz, 10pin MSOP

14.5V
- **2 Phase**
  - **MIC2155/56** – 2 Phase w/ Sync, 300/500kHz,
- **Dual Output**
  - **MIC2150/51** – Dual Output, 300/500kHz

14V
- **MIC2183** – 2.9V-14V, 400/600kHz, w/Sync
- **MIC2184** – Non-Sync, 400/600kHz, w/Sync
- **MIC2193** – 2.9V-14V, 400kHz, 100% Duty Cycle
- **MIC2194** – Non-Synch, 400kHz, 100% Duty cycle

6V
- **MIC2111B** – Multi-Mode, Driverless 0.6V Vref, 200kHz/2MHz

= New product

What Is MIC21LV32 And MIC21LV33

New Best In Class 36V Input, High Current, Advanced Dual Phase Controller Featuring:

- Wide input voltage rating (4.5V to 36V operating, 40V max)
- Able to operate at VIN of 2V with external 5V bias
- 0.5% reference accuracy for -40 to 105° C
- 1% reference accuracy for -40 to 125° C
- Accurate Current Sharing - Patented
- Stackable Operation (MIC21LV32) up to 8 phases (~200A) - Patented
- Phase shedding, DCM for light load efficiency
- Droop feature - adaptive voltage positioning to improve output Voltage accuracy, reduce output capacitor count and reduce solution size
- Precision enable Input – For low standby current
- Able to work with MCU

36V, Dual Phase ACOT Switching Buck Controller

- Input voltage range: 4.5V to 36V
- Adjustable output from 0.6V to 32V
- MIC21LV33 operate in two phases with phase shedding

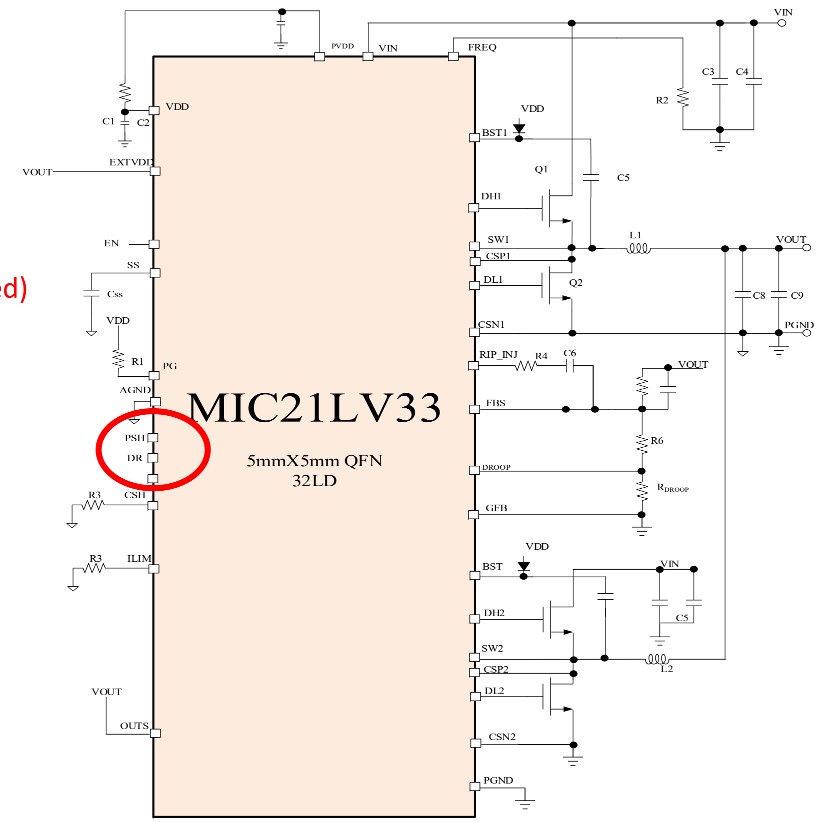
- Accurate Current balancing between phases(Patent Issued)
- Accurate phasing between phases which are always 180° out of phase (Patent Issued)

- 200 KHZ to 800KHZ switching Frequency per phase
- Supports start up to pre-bias output
- Internal compensator for tight output regulation

- Supports Adaptive voltage positioning(AVP) or Droop
- Precision Enable function for low stand-by current

- External programmable soft start to reduce inrush current
- Programmable current limit and hiccup short circuit protection

- Compact size – 5 X 5 mm 32-pin QFN
- –40°C to +125°C junction temperature range



MIC21LV33 Pins for phase shedding & OVP

36V, Dual Phase ACOT Switching Buck Controller

- Input voltage range: 4.5V to 36V
- Adjustable output from 0.6V to 32V
- MIC21LV32 operate in CCM,stackable for multiphase operation up to 8 phases

- Accurate Current balancing between phases(Patent Issued)
- Accurate phasing between phases which are always 180° out of phase (Patent Issued)

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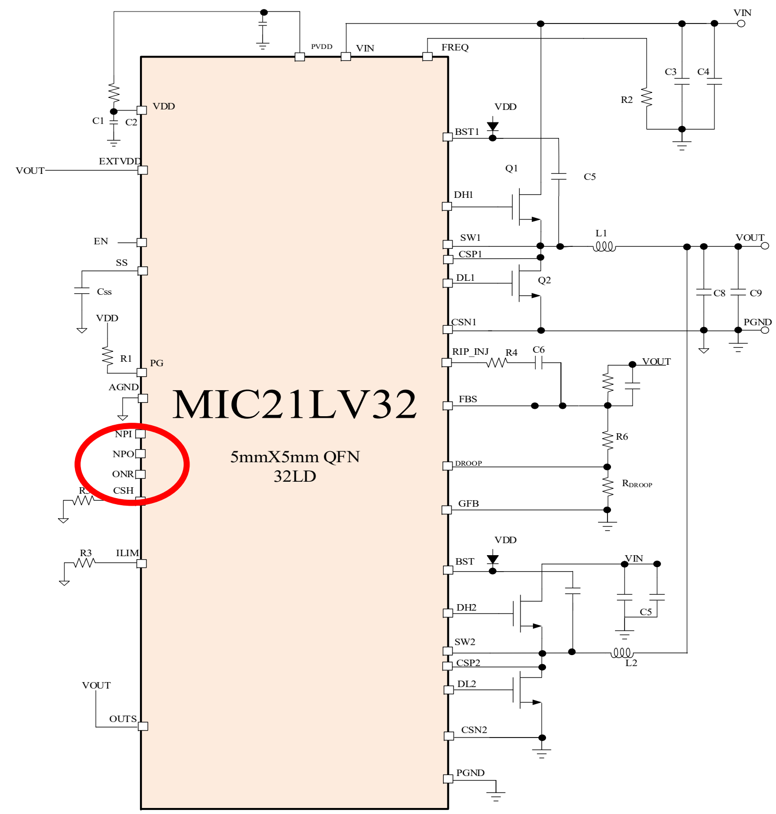
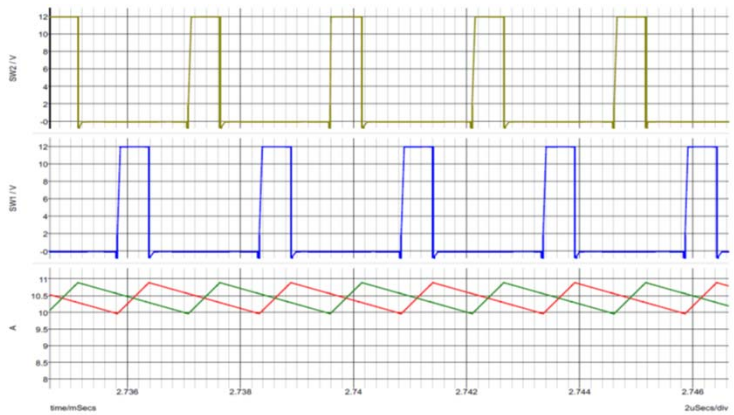
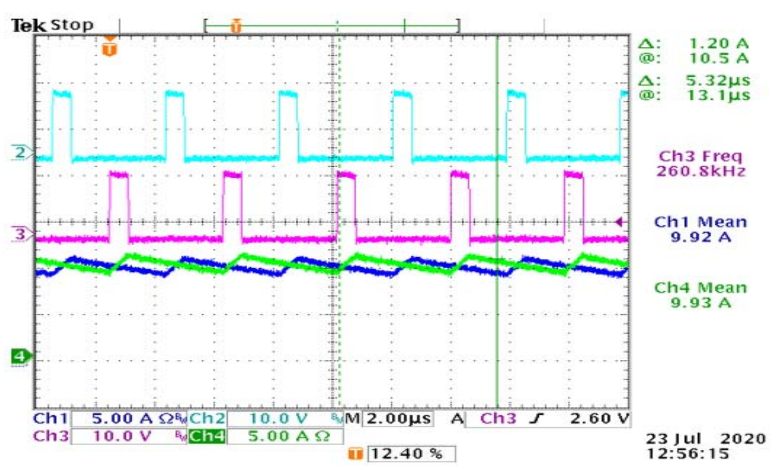


MIC21LV32 Pins for stacking

MIC21LV33 Dual-phase Operation - Steady state

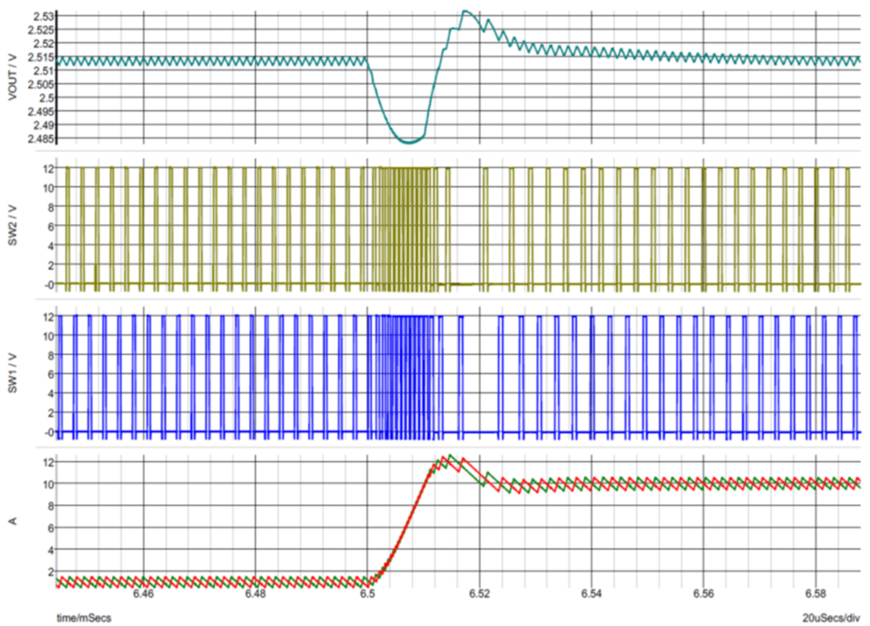


Simplis Simulation - MIC21LV33 @ 2.5V,20A Output



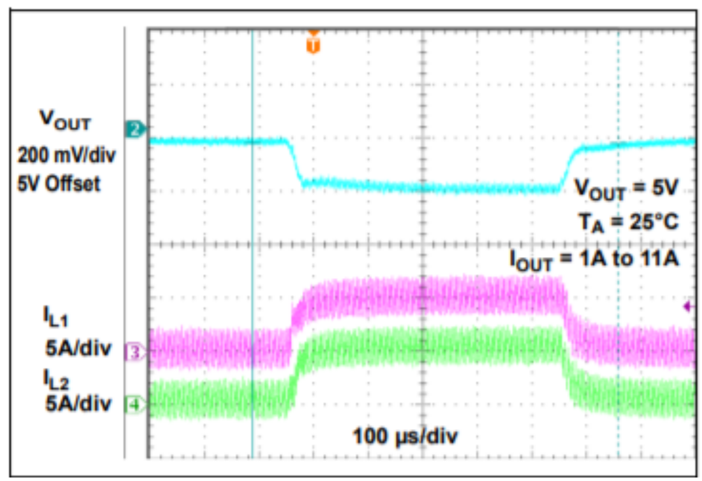
Evaluation Board - MIC21LV33 @ 2.5V,20A Output

MIC21LV33 – Load Transient



Simplis Simulation - MIC21LV33 @ 12V Input, Output 2A to 20A

Scope Shot -MIC21LV33 @ 12V Input, Output 1A to 11A



Adaptive Voltage Positioning (AVP), i.e., DROOP

- AVP is Not Dynamic Voltage Scaling(DVS) !-----Don't confuse
- Dynamic voltage scaling, or DVS, is a method of reducing the average power consumption in embedded systems.
- This is accomplished by reducing the switching losses of the system by selectively reducing the frequency and voltage of the system.

- Why AVP?

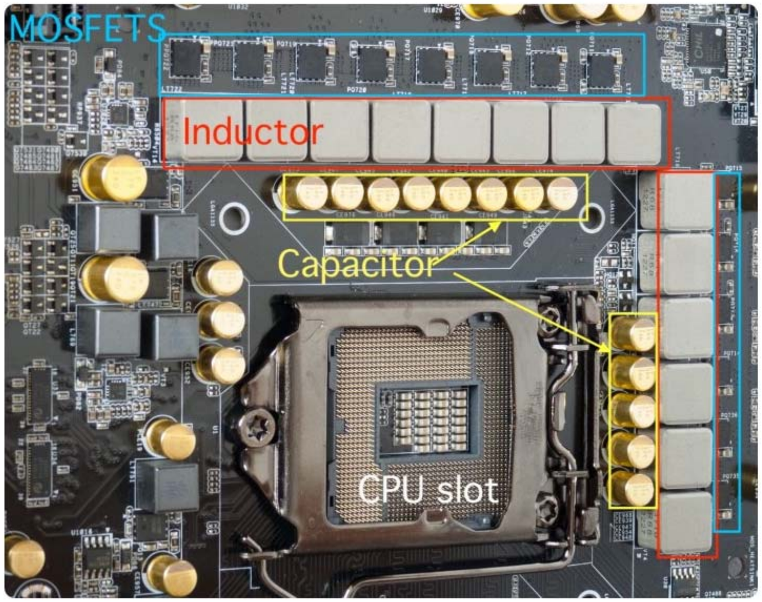
Processor

- the core static currents will increase up to 150A;
- the dynamic current slew rate will rise up to 120A/ns;
- and the core voltage will reduce to 0.8V
- Moore's Law

Challenging for Voltage Regulator Module (VRM)

- Many output capacitors have been used to reduce the voltage spikes that occur during the transient period.
- Increasing the number of capacitors : cause size and cost issues

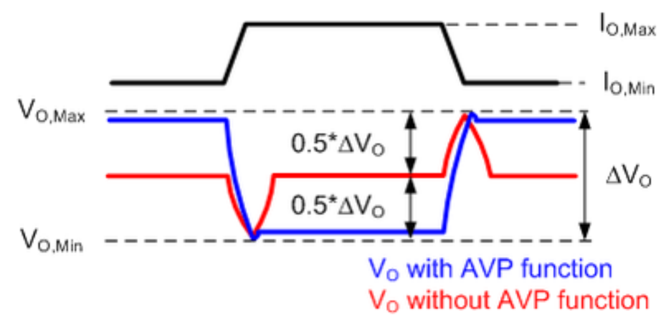
VRM

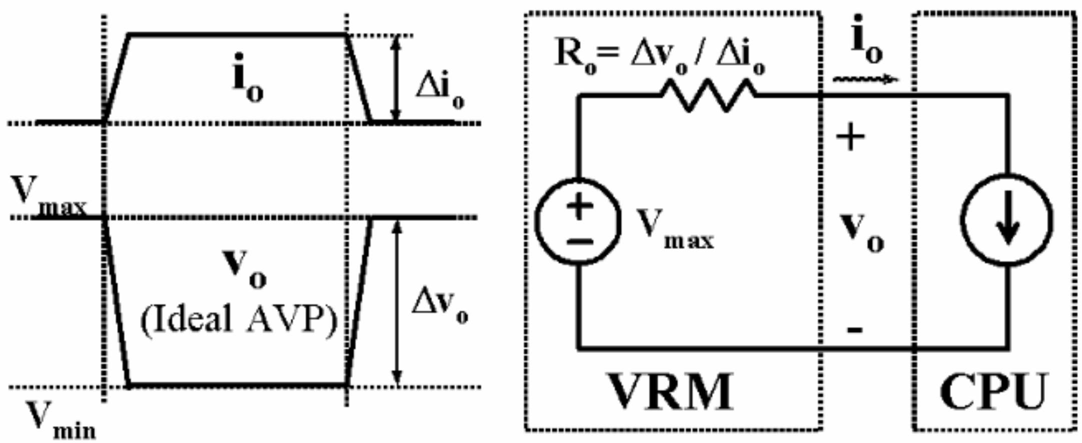


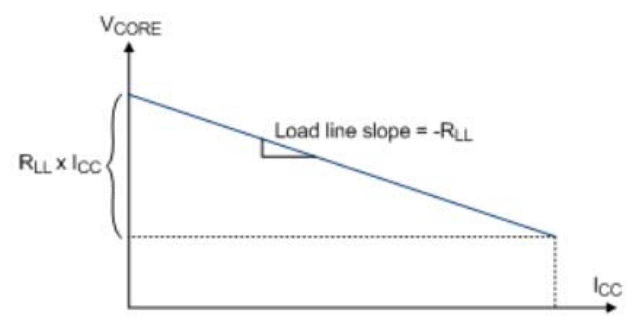
Adaptive Voltage Positioning (AVP), i.e., DROOP

- What is AVP?

- concept was proposed by Intel, by which the VRM should represent a constant output impedance. This means the output voltage will reduce with the higher output currents, and a significant number of output capacitors can be saved.
- transients between the two steady-state stages: no spikes and no oscillations.
- The transient can take advantage of the entire voltage tolerance window.
- VRM equals an ideal voltage source in series with a constant resistor R0.
- Numerous Synonym : such as "Programmable Active Droop", "Active Voltage Positioning" "Adaptive Voltage Positioning" , "Summing-Mode Control" ,"Intel Mobile Voltage Positioning (IMVP)" etc.

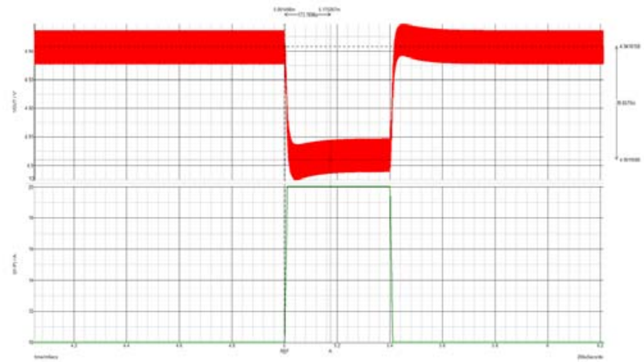






MIC21LV33 – Droop Function

V_{Out}



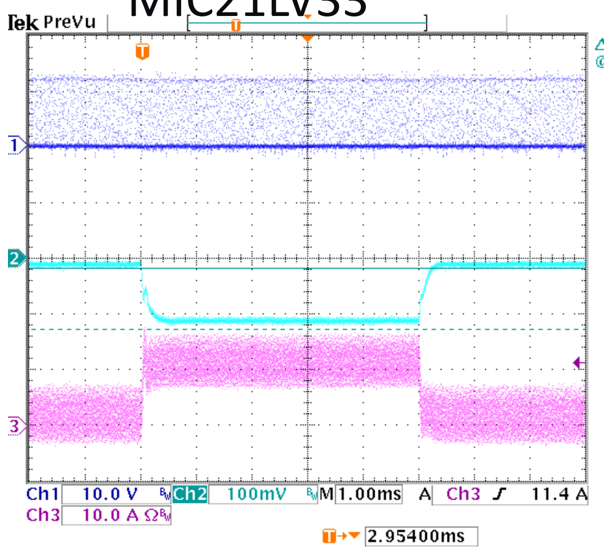
Simplis Simulation

MIC21LV33

SW

V_{Out}

IL1 Current



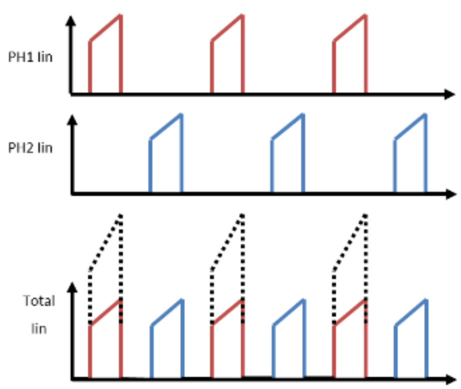
Evaluation Board

Pros of Multiphase Buck Regulators

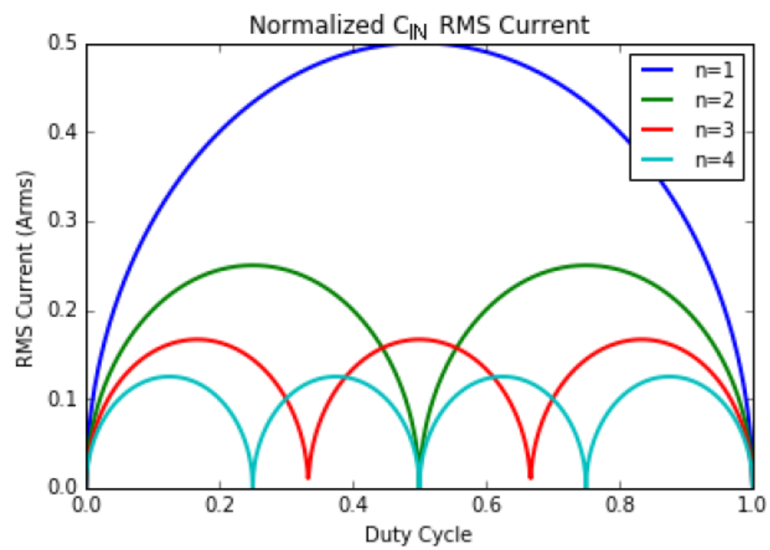
- Advantages 1: Reduced input capacitance
  - lower RMS and peak currents
  - provides less current stress on the upper MOSFET of each phase
  - At several points,the Iin_rms drops to zero due to ripple currents cancellation.

$$I_{CIN_{norm}(RMS)} = \sqrt{\left(D - \frac{m}{n}\right) \times \left(\frac{1+m}{n} - D\right)}$$

- $D = V_{OUT} / V_{IN}$
- n = # of phases
- m = floor (n × D)



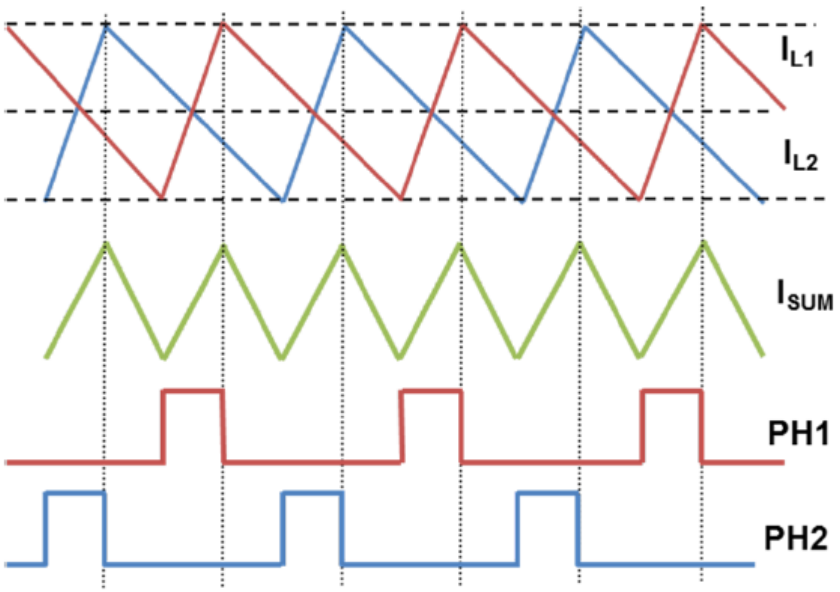
Input Current Waveforms



Normalized Input Capacitance RMS Current

Pros of Multiphase Buck Regulators

- Advantages 2: Reduced output capacitance
  - ISUM, the AC portion of which gets absorbed by the output capacitance.
  - Smaller ripple current in the output capacitors lowers the overall output voltage ripple which in turn lowers the amount of capacitance needed to keep VOUT within tolerance.



Inductor Ripple Current Waveforms

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Pros of Multiphase Buck Regulators

- Advantages 3: Transient Response

  - fewer output capacitors

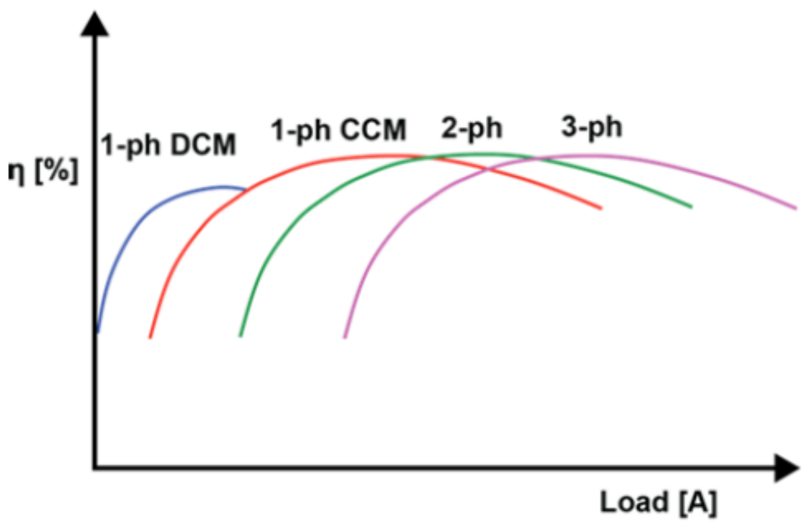
  - reduced equivalent inductance (Lequ=Lsingle_phase/phase number) . With a smaller Lequ, charge can quickly be supplied from the supply to the output caps reducing undershoot.

  - overshoot is decreased by less energy stored in the inductors ,which is shifted to the output capacitors when the phases are shut down.

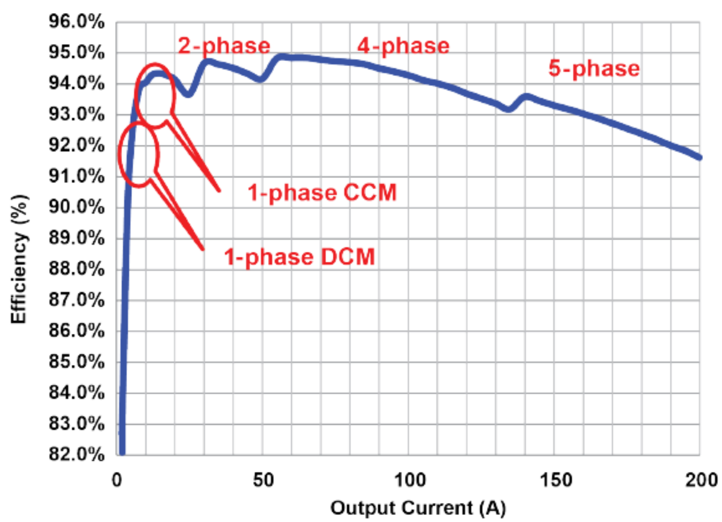
Pros of Multiphase Buck Regulators

- Advantages 4:Efficiency &Thermal Performance

- Phase management: Phase Shedding Operation to achieve the highest possible efficiency.

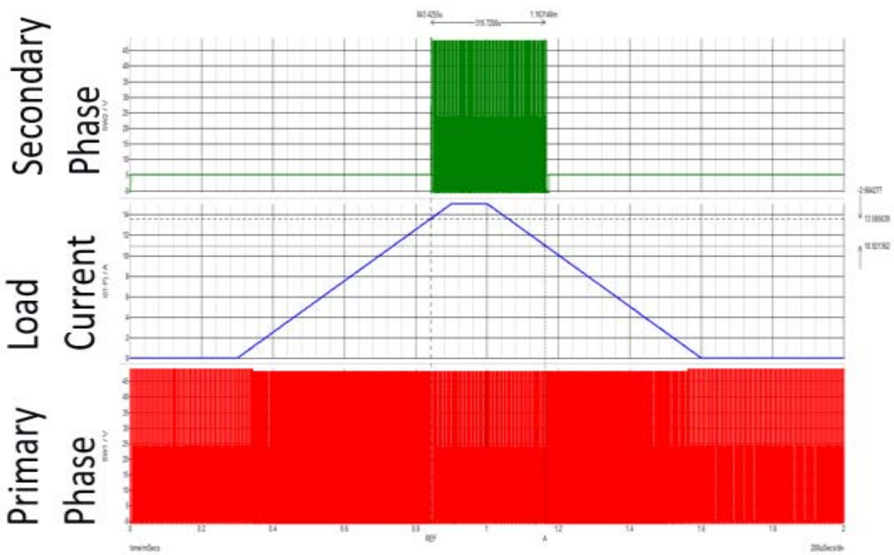


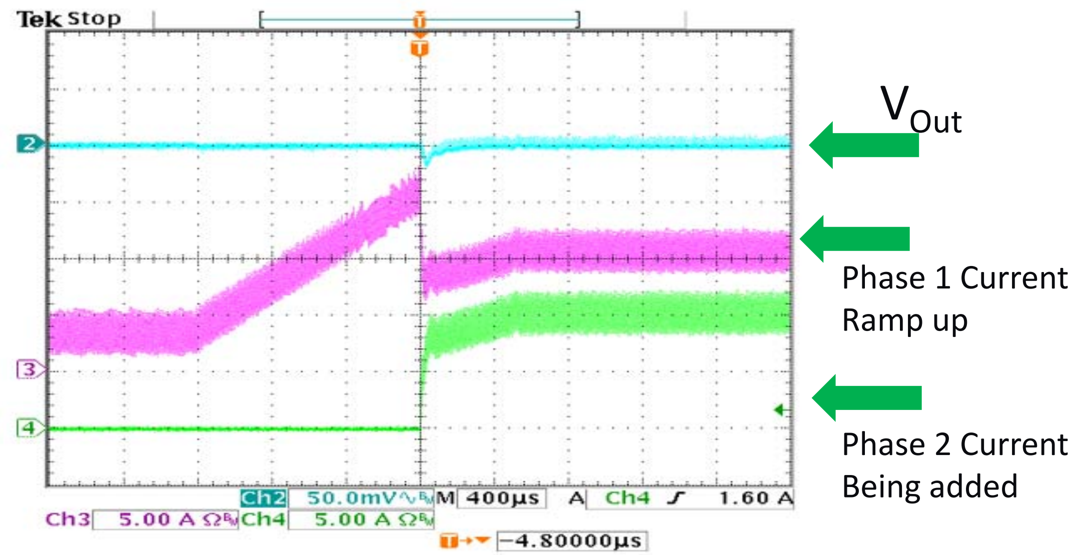
Efficiency vs Phase Number



A typical multiphase buck Efficiency Curve

MIC21LV33 - Phase Shedding Operation

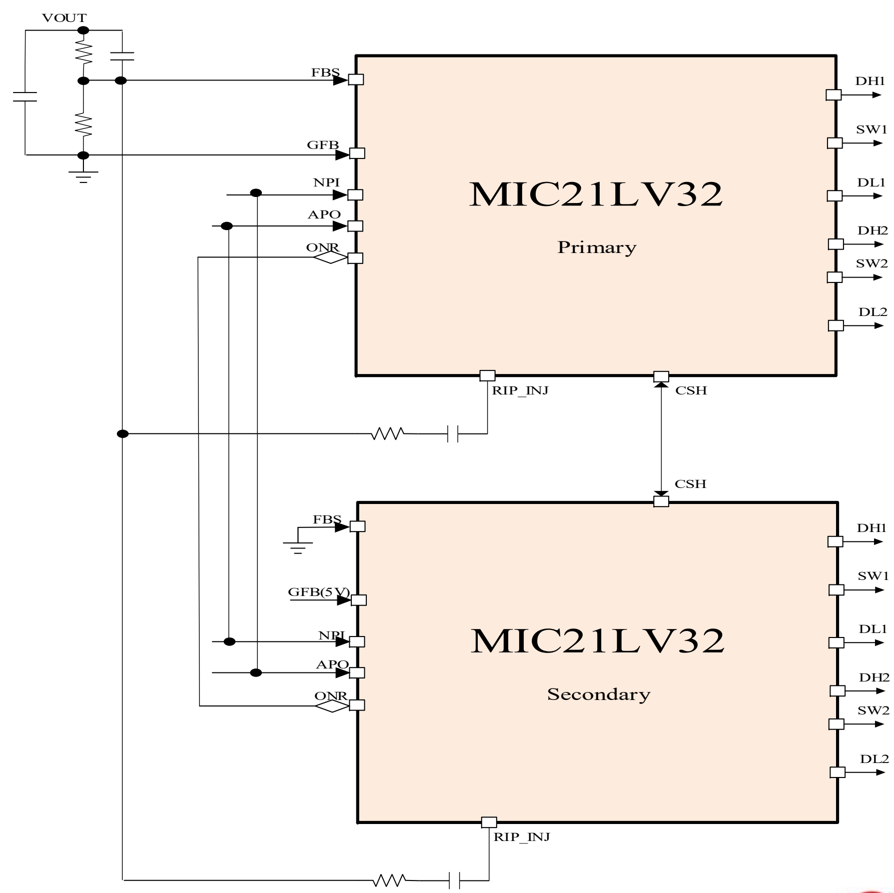




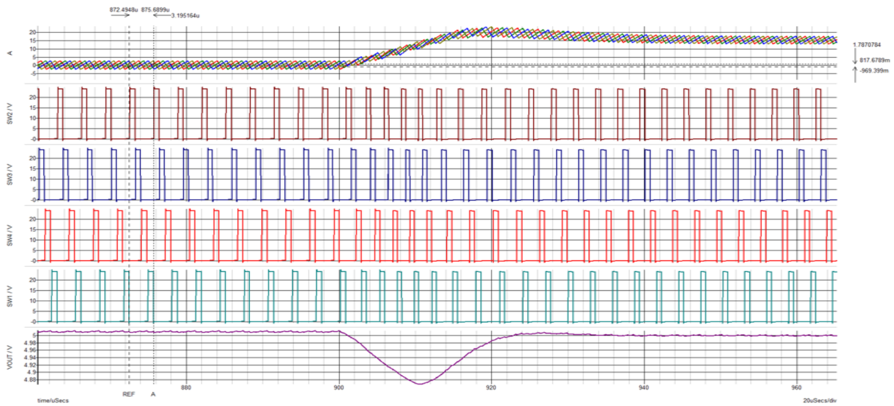
- Phase Shedding threshold is programmed through a resistor
- Hysteresis is 10% of threshold to cover range of FETs

MIC21LV32 - Stacking for Multiphase

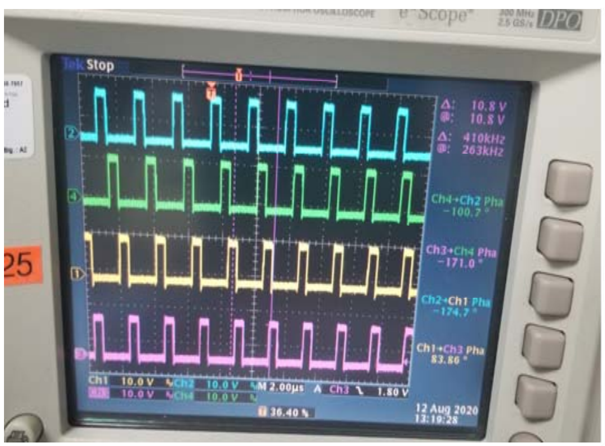
- **Four MIC21LV32's can be stacked supporting up to 8 phases/200A**
  - ONR(On-Time Request) pins need to tied together
  - GFB(Ground Feedback Remote Sense) pin of secondary need to be 5V
  - NPI (Next Phase In)pin of primary connects to APO (Active Phase Output) of first secondary NPI pin of last secondary connect to APO of primary
- Daisy chain operation

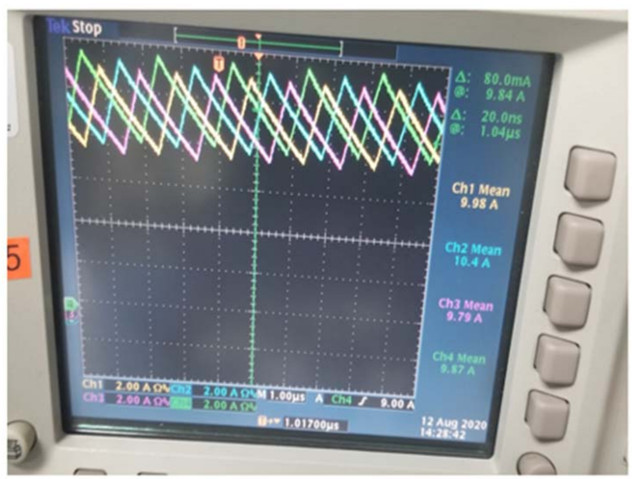


MIC21LV32 4-Phase - Phasing & Sharing



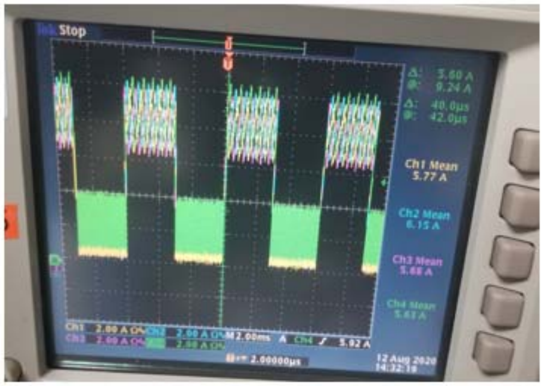
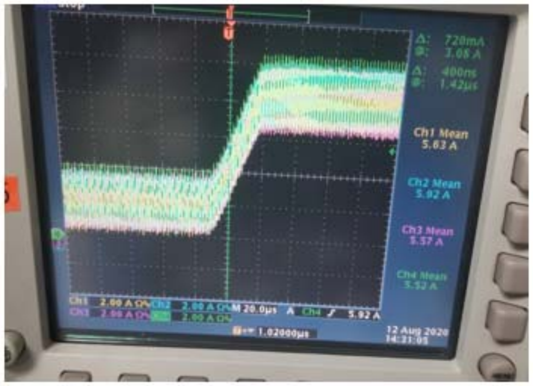
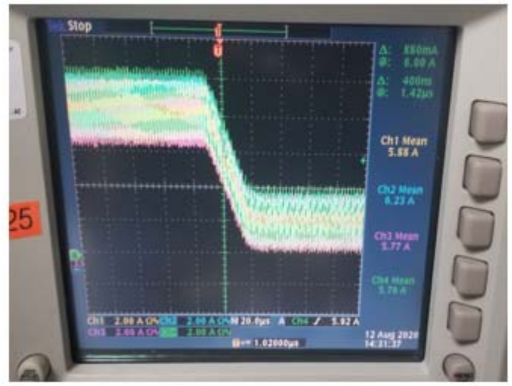
Simplis Simulation





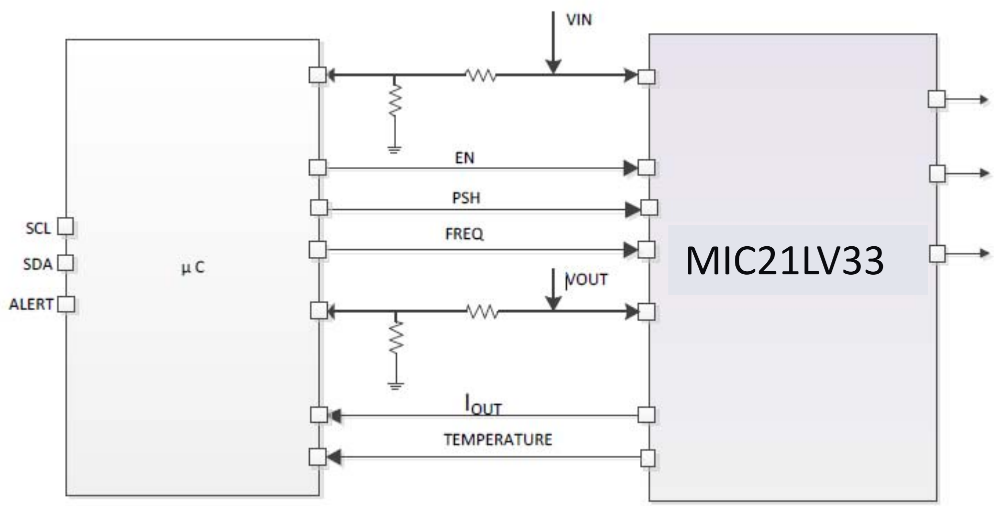
Evaluation Board

Load Transient Scope Shots

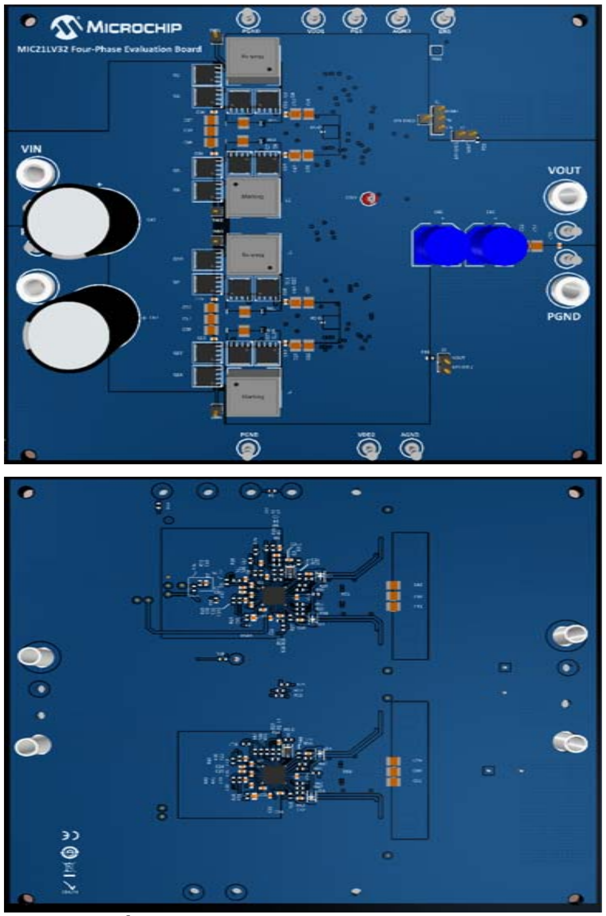
- Load currents are equal both in steady state and during transient (Four Phase Operation)

MCU Connections

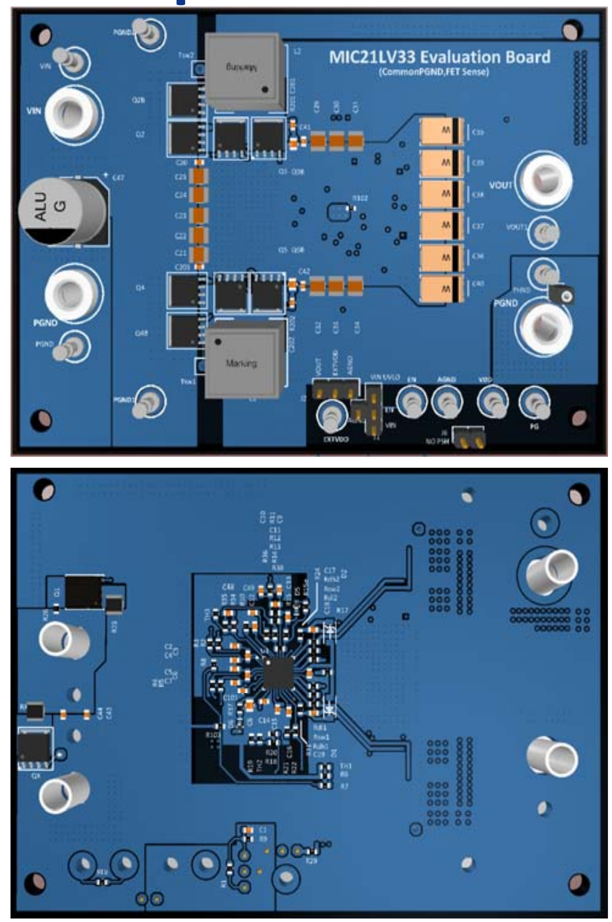


MCU can access:
Enable Control
Frequency setting Control
Phase Shedding Control
Input VIN telemetry
IOUT Telemetry
Temperature Telemetry
VOUT Telemetry

MIC21LV32/33 EVBs – Available On Request

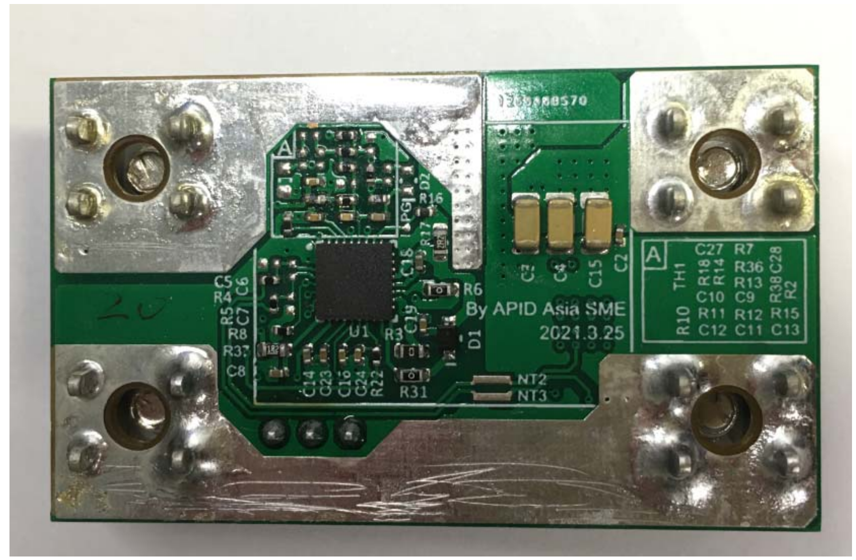


MIC21LV32 4Ø EVB Top and Bottom Views



MIC21LV33 2Ø EVB Top and Bottom Views

1-Phase Prototype- Top &bottom side

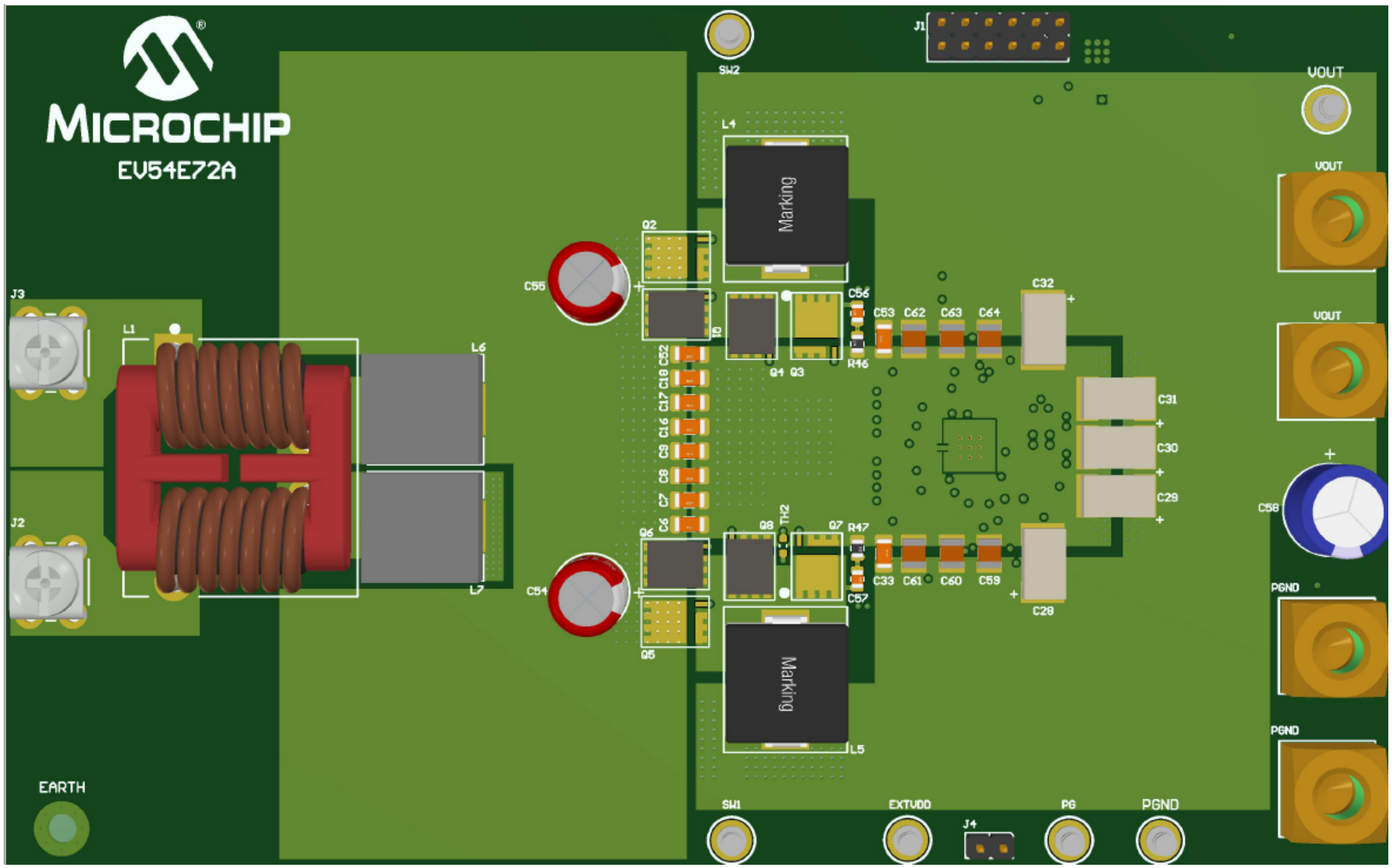


Profile

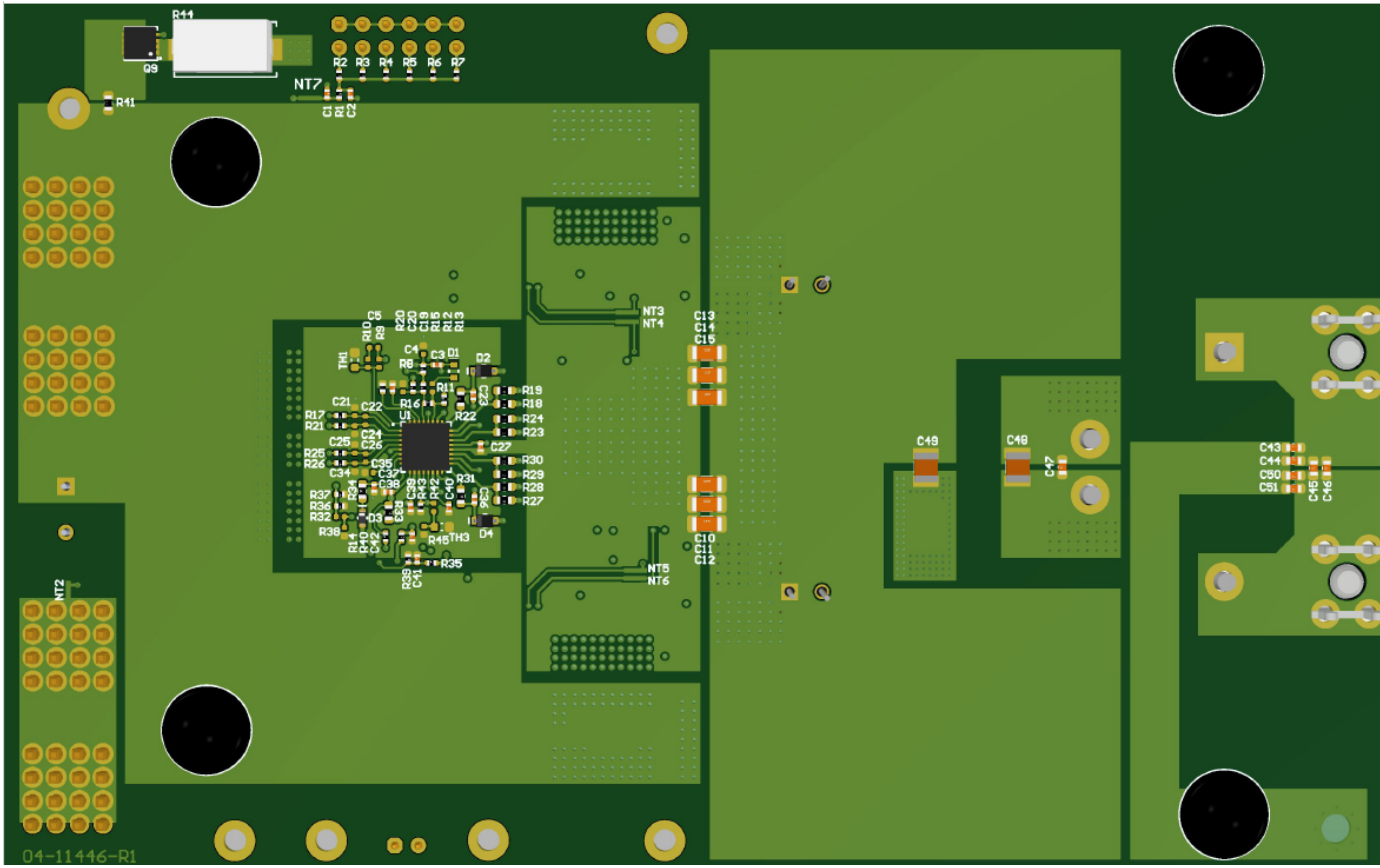
- **The MIC21LV33 dual phase 12V to 1V80A Demo Board** is used to demonstrate MIC21LV33 which is dual phase synchronous buck controller featuring a unique adaptive ON-time control architecture with Hyperlight Load® and phase shedding features and input EMI filter.
- **Input Voltage: 12Vdc typical(4.5-36Vdc);**
- **Output: 1Vdc/80A** dual phase**;**
- **MCHP PN#**

  MIC21LV33YML-TR

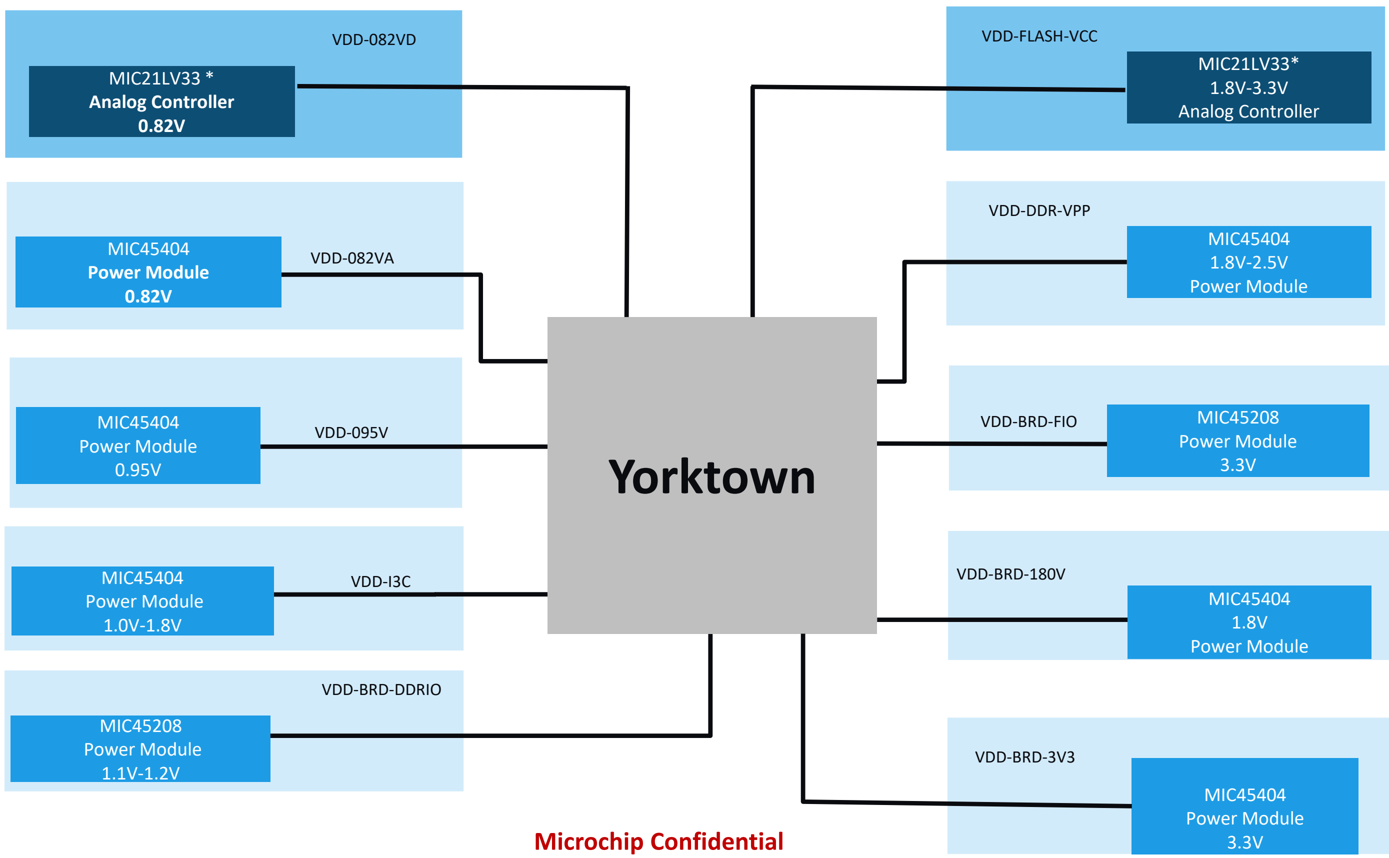
Prototype-Top side



Prototype-bottom side



DCS Yorktown 16CH DDR4 Evaluation Board - Power Solution



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