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High Efficiency Data Center PSU Based on Multiphase Synchronous Buck Converter With Extended Duty Cycle

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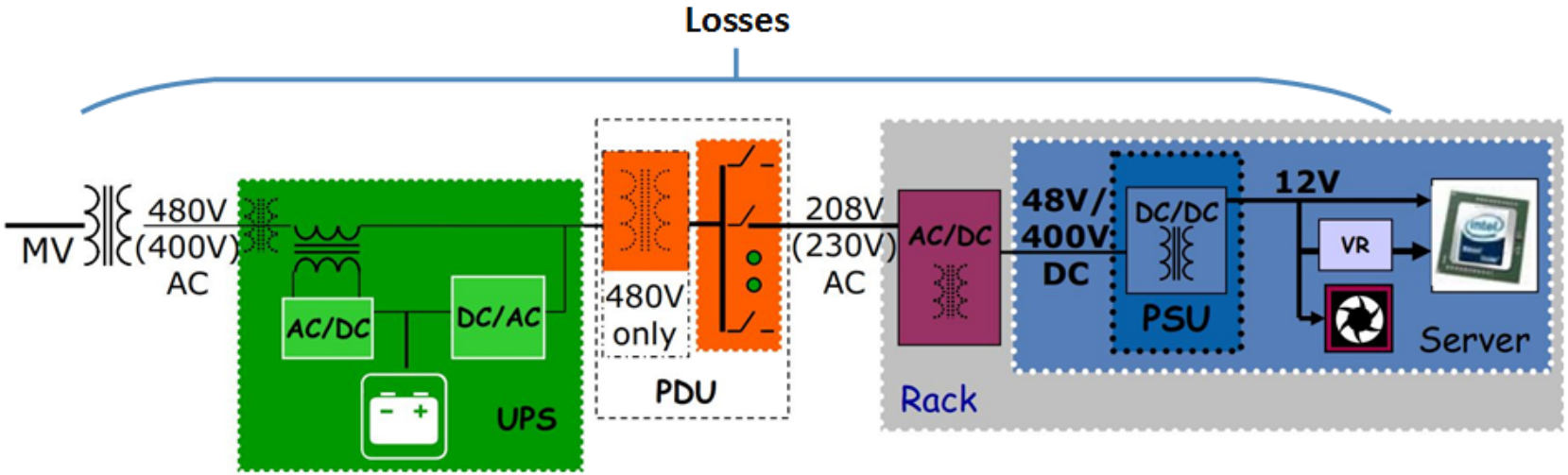
Headlines

- Power Supply Unit (PSU)
- Buck Converter
  - Synchronous Buck Converter
  - Multiphase Synchronous Buck Converter
- Experimental Results
- Conclusion

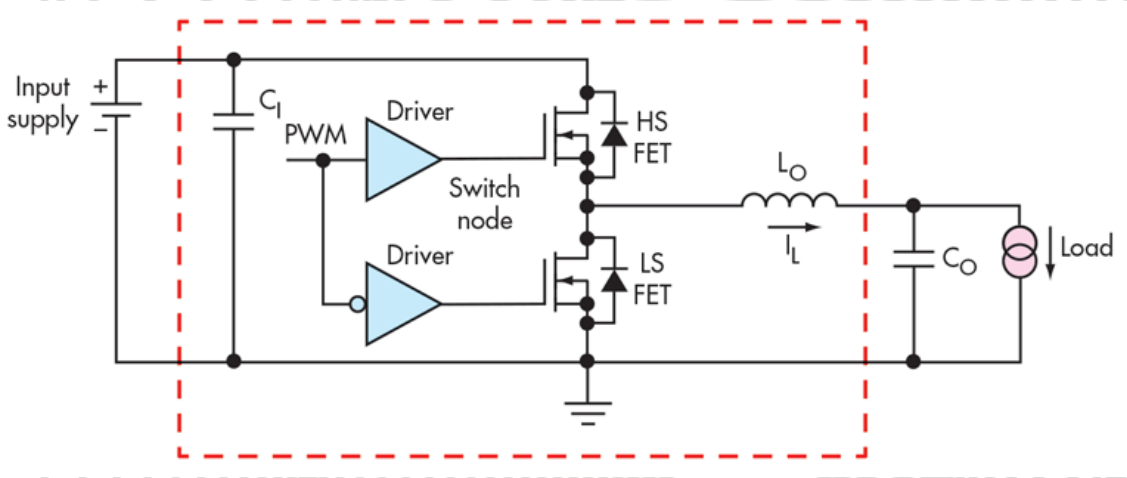
Power Supply Unit (PSU)

- Half of the input power losses (Power Conversation, Distribution, Cooling).
- Output Voltage is Lower than Input so we need Buck Converter.
- To increase power efficiency, Multiphase Synchronous Buck Converter is good choice.



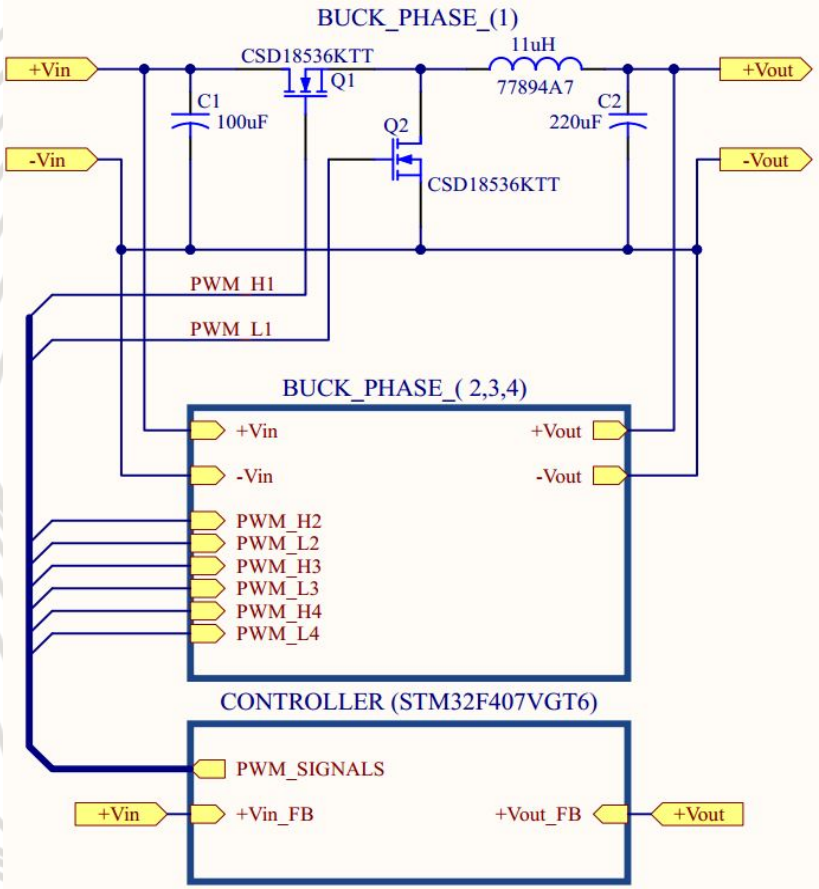
Synchronous Buck Converter

- Lower power losses
- Higher Duty Cycle rate
- Higher Power Range
- Extra switching device
- More complicated
- Higher voltage and current ripple



Multiphase Synchronous Buck Converter

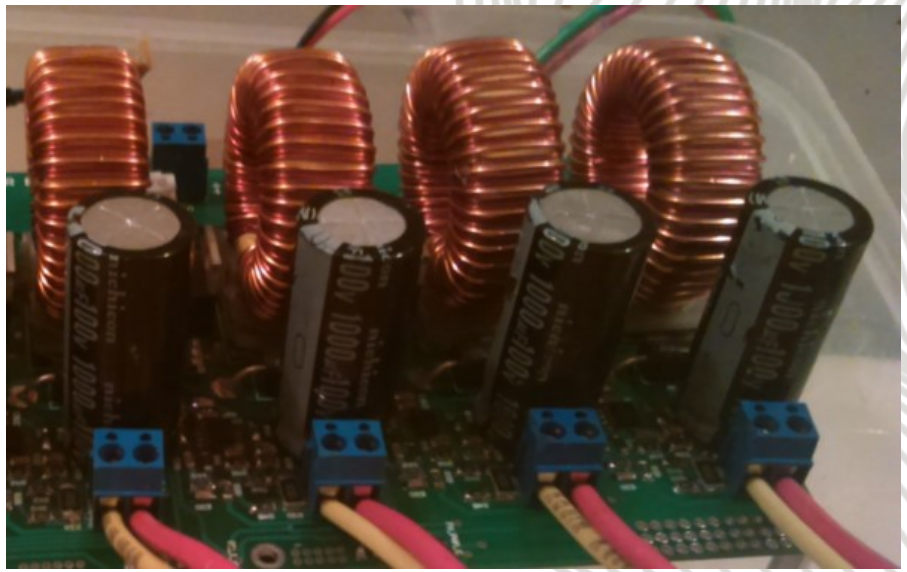
- Four phase buck converter paralleled
- 90-degree phase shift
- Microcontroller based (intelligent) control
- Lower voltage and current ripple
- Lower inductor and In/Out capacitors
- Lower stress on MOSFET
- Extended Duty Cycle
- More Cost



Experimental Result

- Prototyped with off-the-shelf components

ELECTRICAL COMPONENTS			
Name		**Value**	**Unit**
Inductor		11	uH
Input Capacitor		100	uF
Output Capacitor		250	uF
MOSFET	V_{DS}	60	V
	I_D	349	A
	R_{DS}	1.7	mΩ

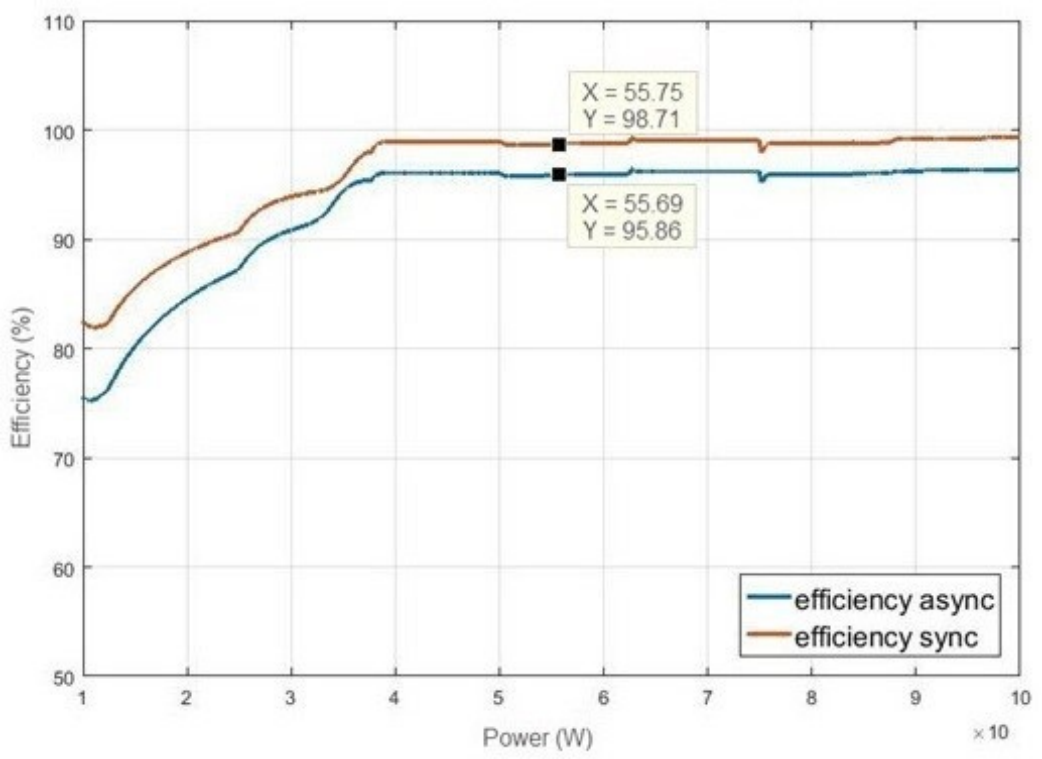


ELECTRICAL CHARACTERISTICS		
V_{in}	48	V
V_{out}	12	V
I_{in}	2.1	A
I_{out}	8.3	A
P_{in}	101.3	W
P_{out}	100	W
f	250	kHz
η	98.71	%

Experimental Result

- Performance analysis: **Efficiency**

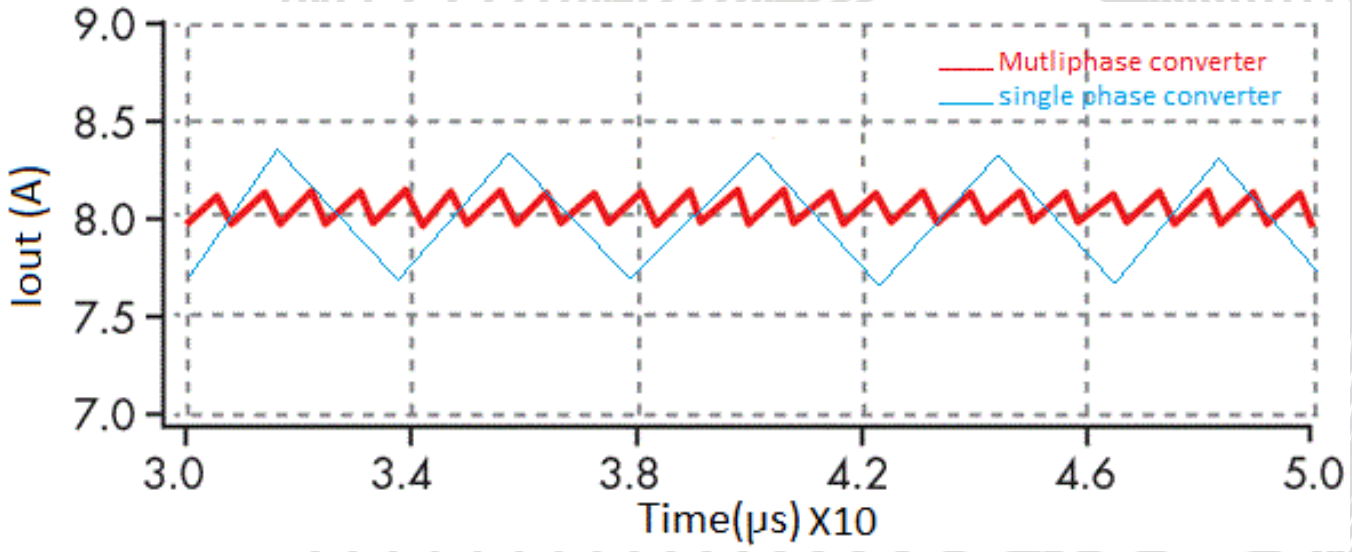
EFFICIENCY		
Buck Converter	Conventional	95.86%
	Synchronous	98.71%



Experimental Result

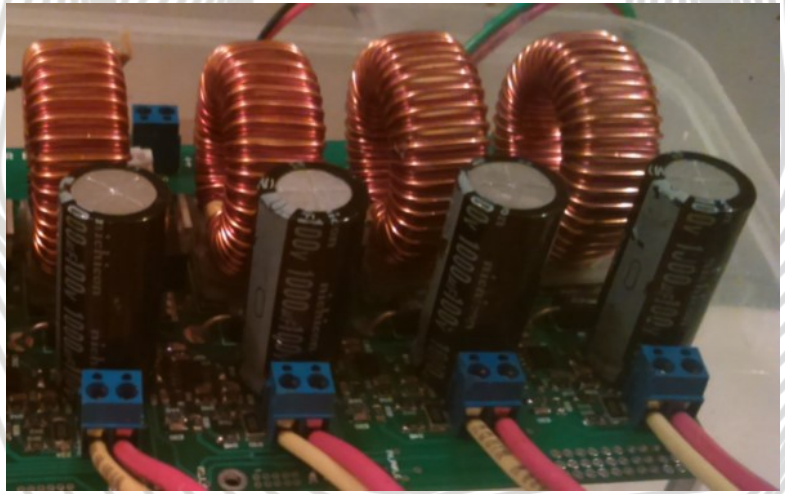
- Performance analysis: **Current and Voltage Rippling**

Ripple		
Buck Converter	Single Phase	High
	Multi Phase	Low



Conclusion

- High power rating (extended duty cycle)
- High efficiency conversation
- Low heating losses
- Low voltage and current rippling
- Low stress on devices



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