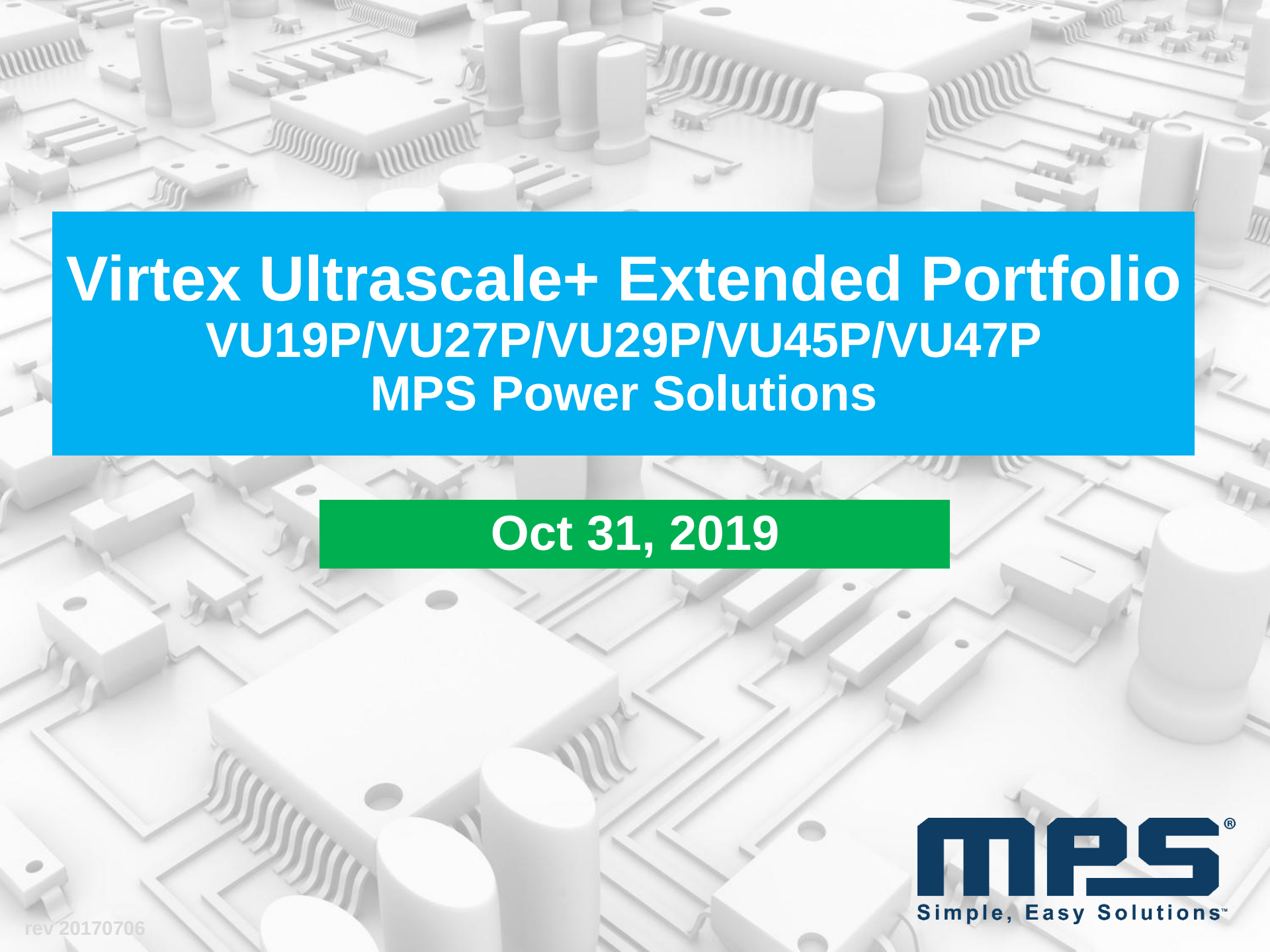




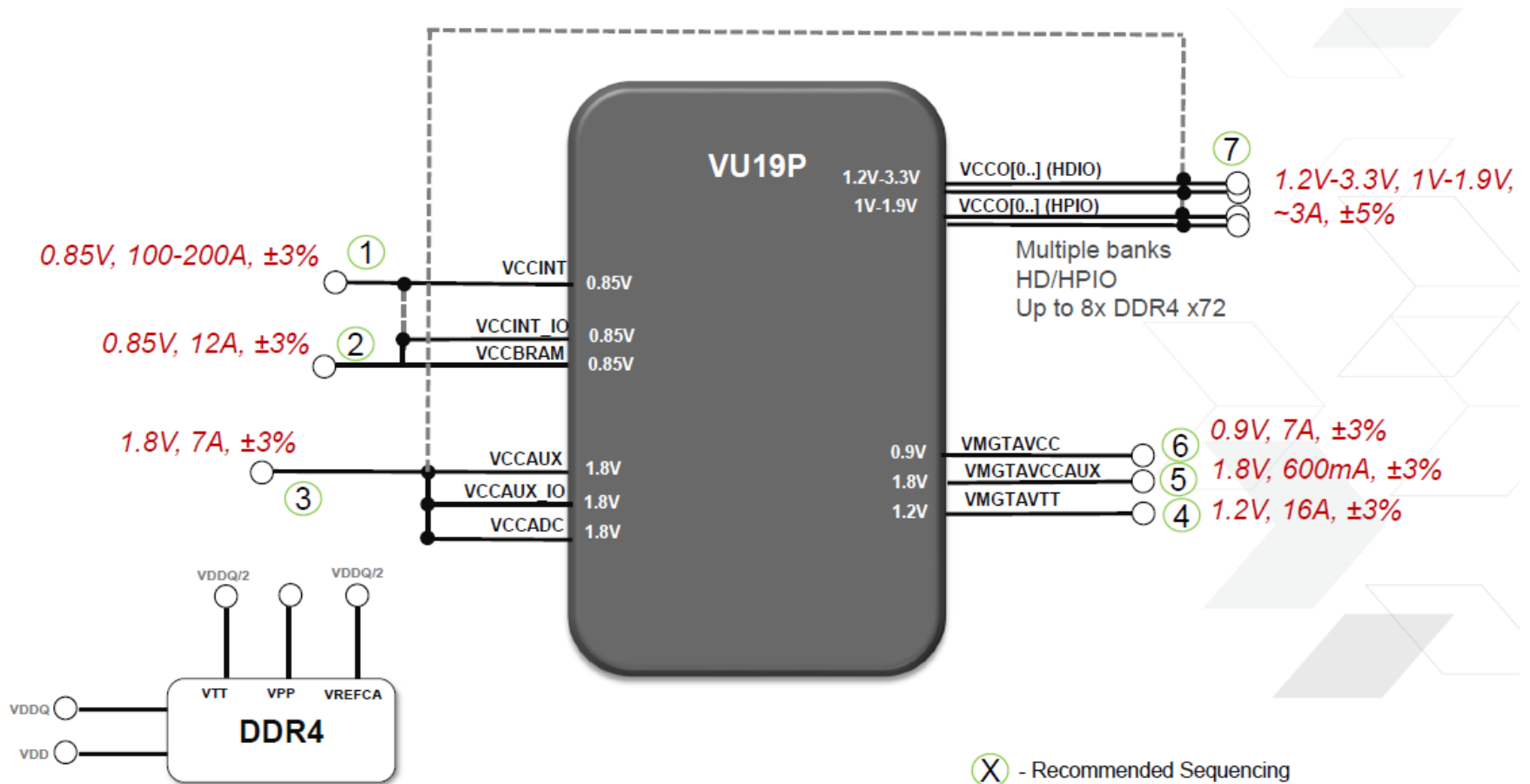
Virtex Ultrascale+ Extended Portfolio

VU19P/VU27P/VU29P/VU45P/VU47P

MPS Power Solutions

Oct 31, 2019

VU19P Power Rails



VU19P Power Requirements

	Rail Name	Voltage	Seq	Ripple	Load	Load Step
	VIN	12V				
Rail 1	VCCINT	0.85V	1	+/-3%	100A-200A	25%, 100A/uS
Rail 2	VCCBRAM, VCCINT-IO	0.85V	2	+/-3%	12A	40%, 10A/uS
Rail 3	VCCAUX, VCCAUX_IO, VCCADC	1.8V	3	+/-3%	7A	90%, 10A/uS
Rail 4	MGTAVCC	0.9V	6	+/-3% (10mVpp)	7A	25%, 10A/uS
Rail 5	MGTYVCCAUX	1.8V	5	+/-3% (10mVpp)	600mA	25%, 10A/uS
Rail 6	MGTAVTT	1.2V	4	+/-3% (10mVpp)	16A	25%, 10A/uS
Rail 7	VCCO(HDIO), VCCO(HPIO)	1.2V-3.3V, 1V-1.9V	7	+/-3%/ +/-5%	3A	90%, 10A/uS

Discrete solutions for VU19P

Highest Efficiency

200A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency (%)	PMBus/I2C
						MP2972	Contact MPS	600		
Rail1	VCCINT	12	0.85	3%	200	MP86966 (10x)		935	90.5%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	12	MP8733B		216	87%	no
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	7	MP8733A		216	92%	no
Rail4	MGTYAVCC	12	0.9	3%	7	MP8733A		216	87%	no
Rail5	MGTYAVAUX	12	1.8	3%	0.6	MP2322		90	86%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MP8733B		216	88%	no
Rail7	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MP2326		90	85%	no
						Total		2579sqmm		
								3.98sq in		

100A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency (%)	PMBus/I2C
						MP2972	Contact MPS	400		
Rail1	VCCINT	12	0.85	3%	100	MP86966 (6x)		561	90.5%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	12	MP8733B		216	87%	no
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	7	MP8733A		216	92%	no
Rail4	MGTYAVCC	12	0.9	3%	7	MP8733A		216	87%	no
Rail5	MGTYAVAUX	12	1.8	3%	0.6	MP2322		90	86%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MP8733B		216	88%	no
Rail7	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MP2326		90	85%	no
						Total		2005sqmm		
								3.10sq in		

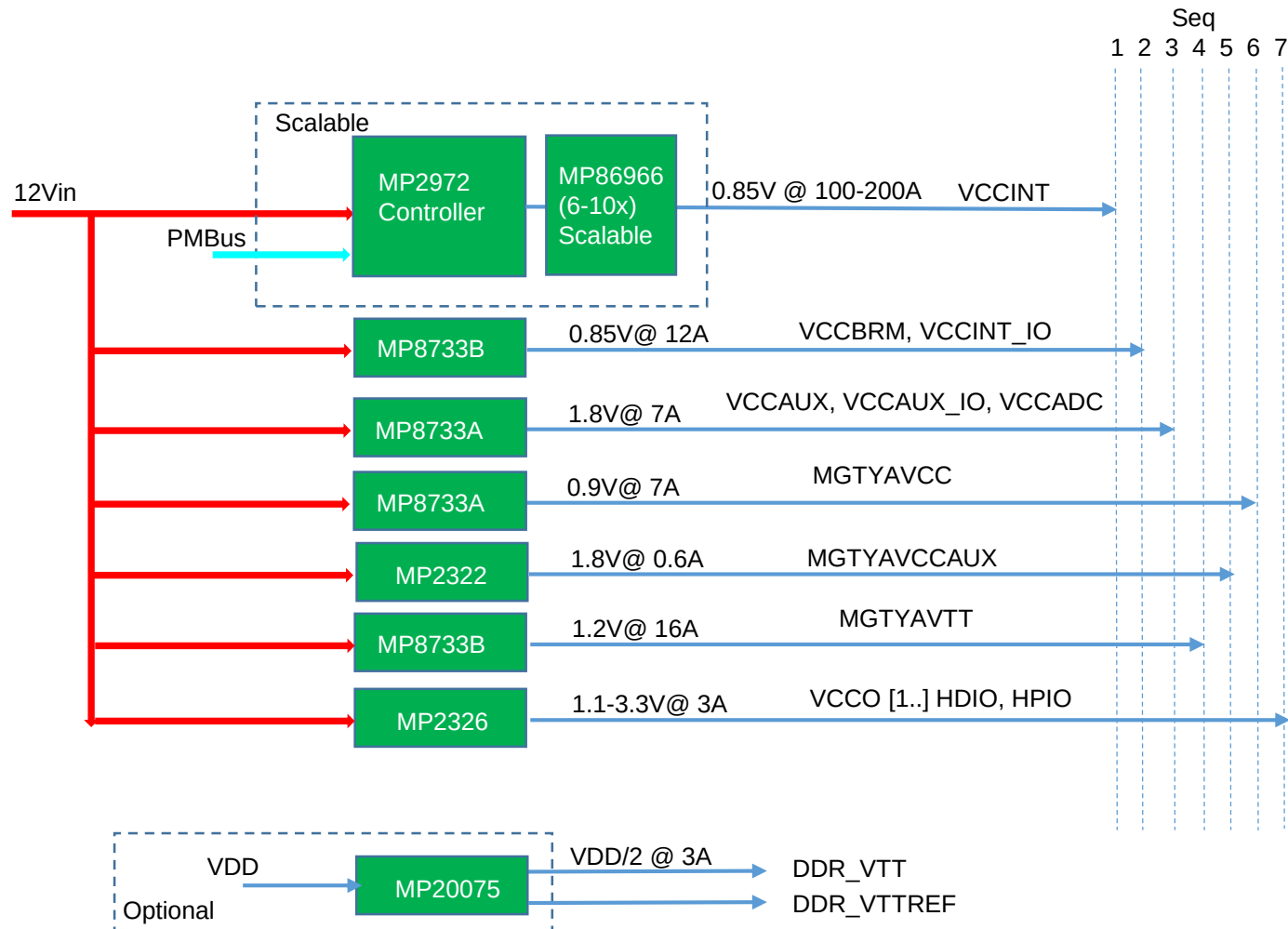


Efficiency 90%, size 3.1 to 4.0sqin

Please contact MPS for other configurations and accurate pricing

VU19P

Discrete solution



Module based solutions for VU19P

Smallest size

200A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency (%)	PMBus/I2C
Rail1	VCCINT	12	0.85	3%	200	MPM3695-100 (2x)	Contact MPS	900	85%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	12	MPM3695-25		230	86%	yes
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	7	MPM3695-10		160	88%	yes
Rail4	MGTYAVCC	12	0.9	3%	7	MPM3695-10		160	82%	yes
Rail5	MGTYAUX	12	1.8	3%	0.6	MPM3632C		55	83%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MPM3695-25		230	84%	yes
Rail7	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MPM3650		76	88%	no
						Total		1811 sqmm		
								2.80 sq in		

100A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency (%)	PMBus/I2C
Rail1	VCCINT	12	0.85	3%	100	MPM3695-100 (1x)	Contact MPS	450	85%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	12	MPM3695-25		230	86%	yes
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	7	MPM3695-10		160	88%	yes
Rail4	MGTYAVCC	12	0.9	3%	7	MPM3695-10		160	82%	yes
Rail5	MGTYAUX	12	1.8	3%	0.6	MPM3632C		55	83%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MPM3695-25		230	84%	yes
Rail7	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MPM3650		76	88%	no
						Total		1361 sqmm		
								2.10 sq in		



Efficiency ~85%, size 2.1 to 2.8sqin

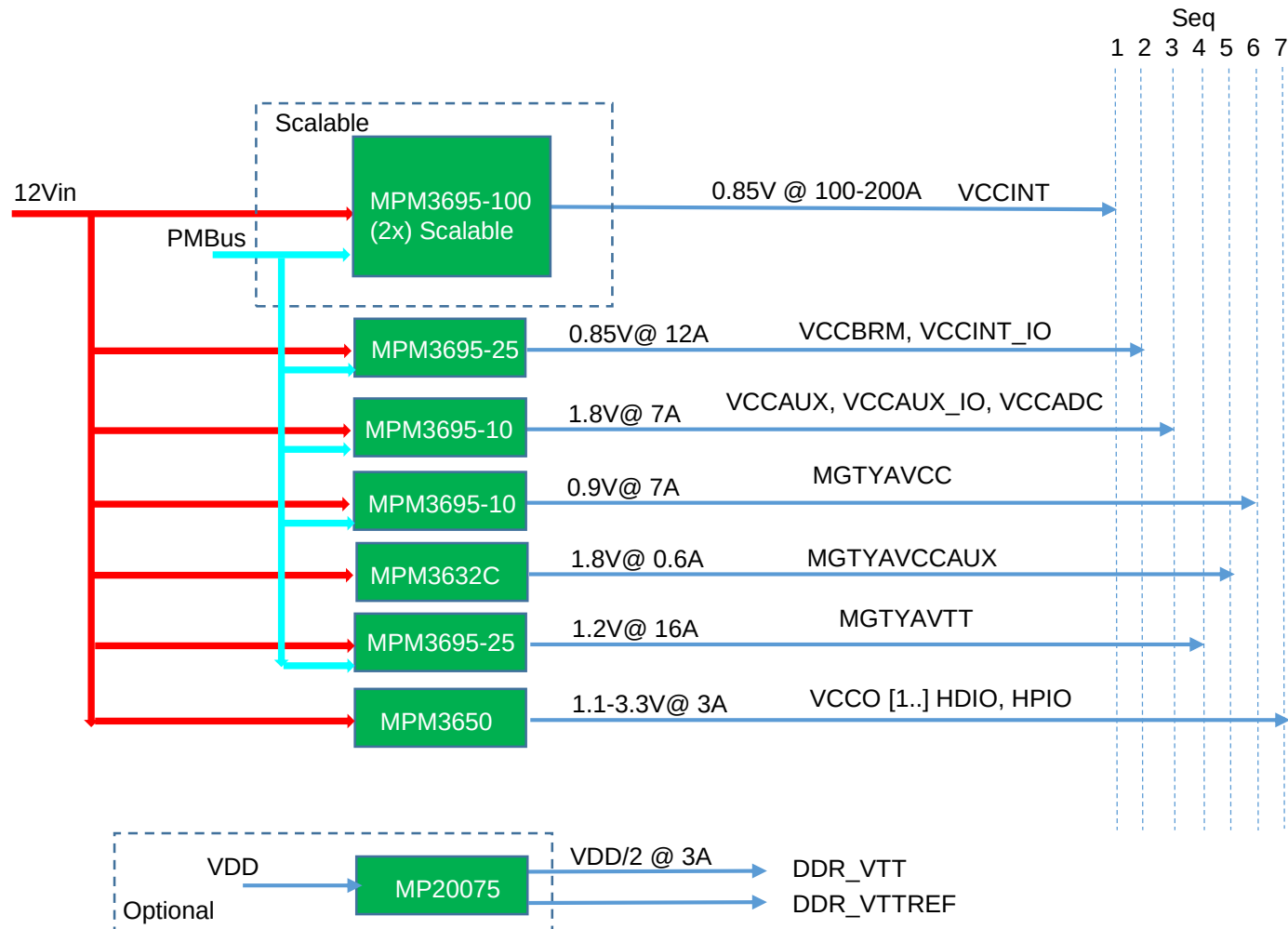
Please contact MPS for other configurations and accurate pricing

MPM modules have integrated inductors



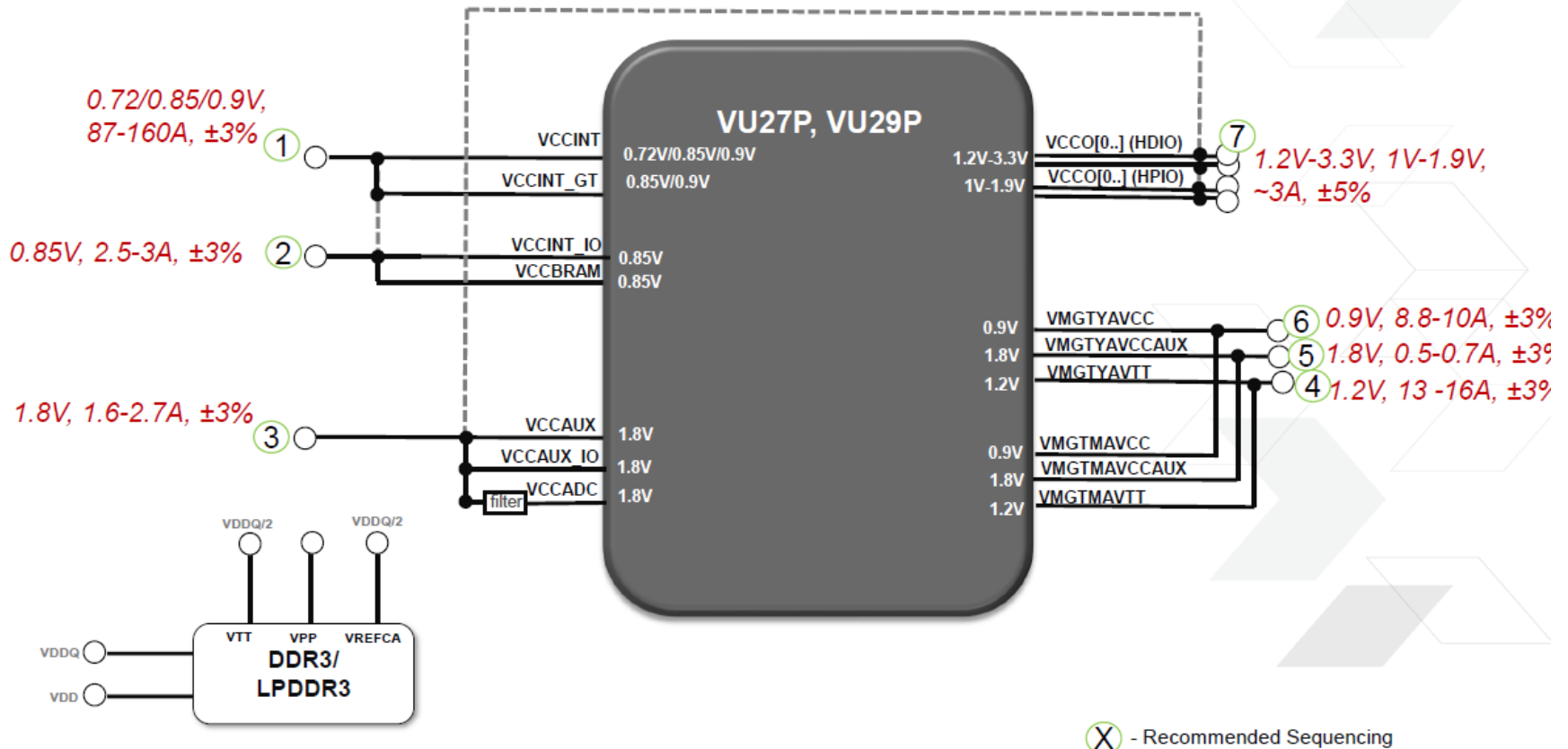
VU19P

Module solution



VU27P, VU29P Power Rails

VU27P, VU29P – 58G PAM4 SerDes



VU27P, VU29P Power Requirements

	Rail Name	Voltage	Seq	Ripple	Load	Load Step
	VIN	12V				
Rail 1	VCCINT	0.72/0.85/ 0.9V	1	+/-3%	87A-160A	25%, 100A/uS
Rail 2	VCCBRAM, VCCINT-IO	0.85V	2	+/-3%	3A	40%, 10A/uS
Rail 3	VCCAUX, VCCAUX_IO, VCCADC	1.8V	3	+/-3%	3A	90%, 10A/uS
Rail 4	MGTAVCC	0.9V	6	+/-3% (10mVpp)	10A	25%, 10A/uS
Rail 5	MGTYVCCAUX	1.8V	5	+/-3% (10mVpp)	700mA	25%, 10A/uS
Rail 6	MGTAVTT	1.2V	4	+/-3% (10mVpp)	16A	25%, 10A/uS
Rail 7	VCCO(HDIO), VCCO(HPIO)	1.2V-3.3V, 1V-1.9V	7	+/-5%	3A	90%, 10A/uS

Discrete solutions for VU27P, VU29P

Highest Efficiency

160A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency (%)	PMBus/I2C
						MP2972	Contact MPS	600		
Rail1	VCCINT	12	0.85	3%	160	MP86966 (8x)		748	90.5%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	3	MP2326		90	83%	no
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	3	MP2326		90	86%	no
Rail4	MGTYAVCC	12	0.9	3%	10	MP8733A		216	87%	no
Rail5	MGTYAVAUX	12	1.8	3%	0.7	MP2322		90	86%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MP8733B		216	88%	no
Rail7	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MP2326		90	85%	no
						Total		2140sqmm		
								3.30sq in		

90A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency (%)	PMBus/I2C
						MP2972	Contact MPS	400		
Rail1	VCCINT	12	0.85	3%	90	MP86966 (5x)		467.5	90.5%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	3	MP2326		90	83%	no
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	3	MP2326		90	86%	no
Rail4	MGTYAVCC	12	0.9	3%	10	MP8733A		216	87%	no
Rail5	MGTYAVAUX	12	1.8	3%	0.7	MP2322		90	86%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MP8733B		216	88%	no
Rail7	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MP2326		90	85%	no
						Total		1659.5sqmm		
								2.56sq in		

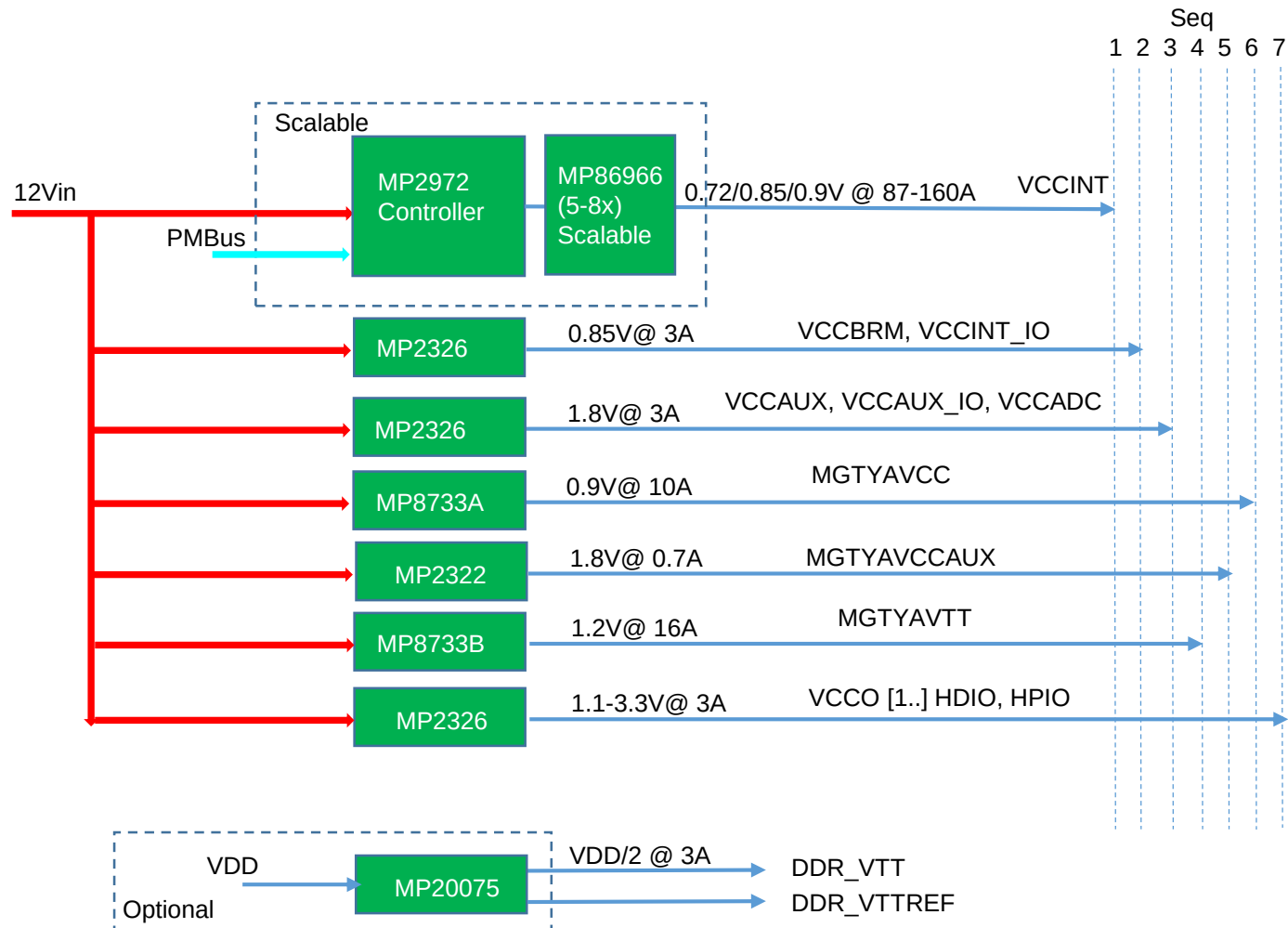


Efficiency 90%, size 2.6 to 3.3sqin

Please contact MPS for other configurations and accurate pricing

VU27P, VU29P

Discrete solution



Module based solutions for VU27P, VU29P

Smallest size

160A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency	PMBus/I2C
Rail1	VCCINT	12	0.85	3%	160	MPM3695-100 (2x)	Contact MPS	900	85%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	3	MPM3650		76	83%	no
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	3	MPM3650		76	88%	no
Rail4	MGTYAVCC	12	0.9	3%	10	MPM3695-10		160	82%	yes
Rail5	MGTYAVAUX	12	1.8	3%	0.7	MPM3632C		55	83%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MPM3695-25		230	84%	yes
Rail7	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MPM3650		76	88%	no
Total								1573sqmm		
								2.43sq in		

90A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency	PMBus/I2C
Rail1	VCCINT	12	0.85	3%	90	MPM3695-100 (1x)	Contact MPS	450	85%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	3	MPM3650		76	83%	no
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	3	MPM3650		76	88%	no
Rail4	MGTYAVCC	12	0.9	3%	10	MPM3695-10		160	82%	yes
Rail5	MGTYAVAUX	12	1.8	3%	0.7	MPM3632C		55	83%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MPM3695-25		230	84%	yes
Rail7	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MPM3650		76	88%	no
Total								1123sqmm		
								1.73sq in		



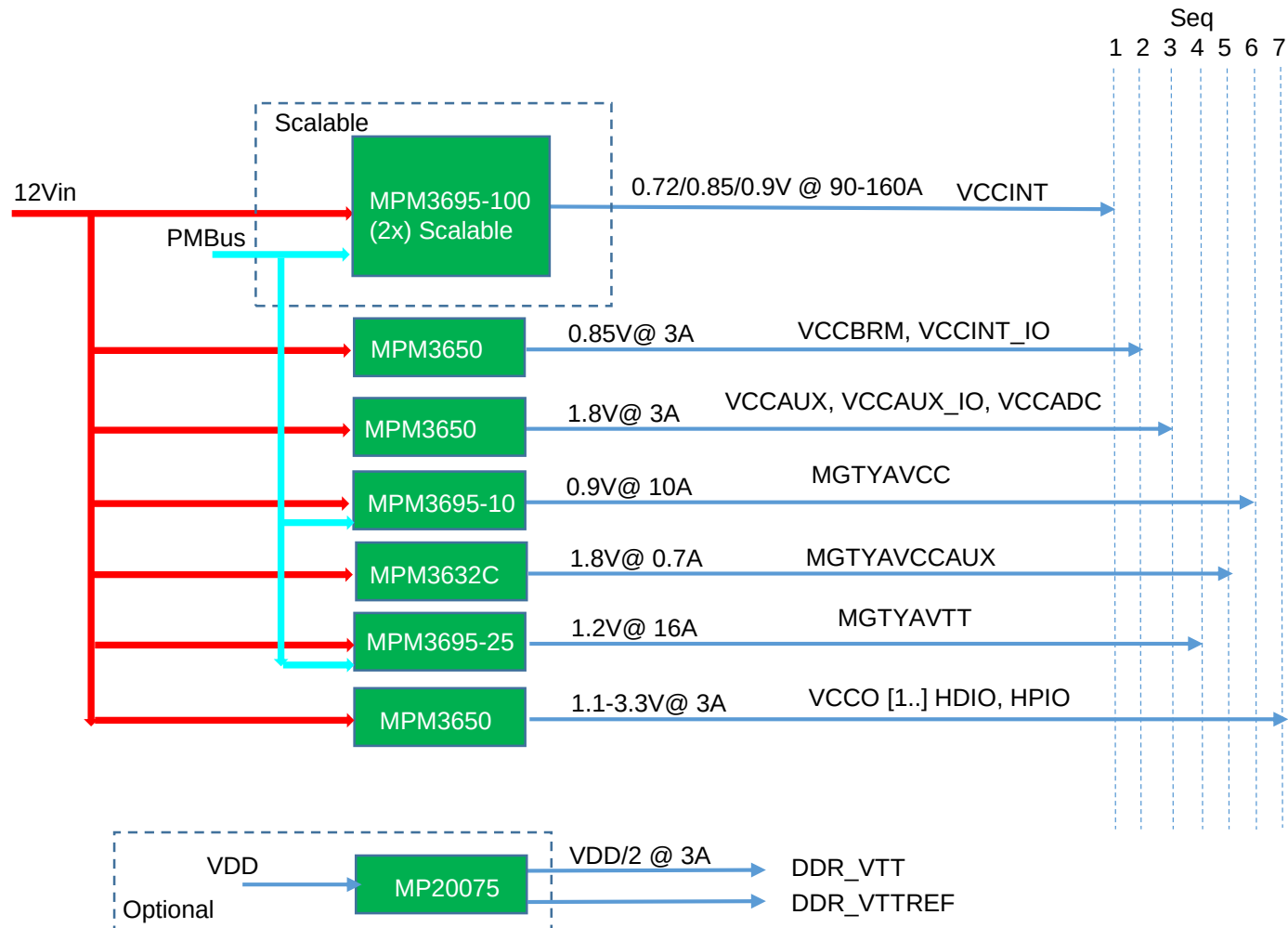
Efficiency ~85%, size 1.7 to 2.4sqin

Please contact MPS for other configurations and accurate pricing

MPM modules have integrated inductors

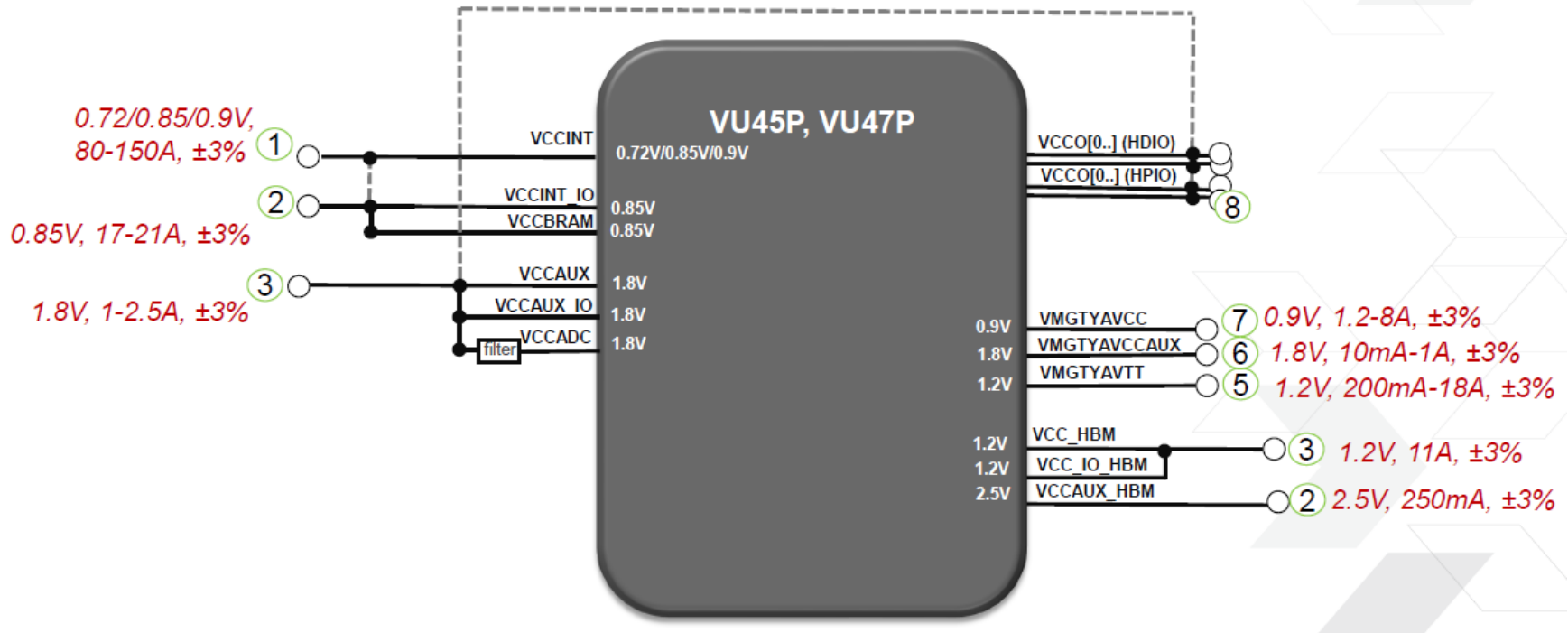


VU27P, VU29P Module solution



VU45P, VU47P Power Rails

VU45P, VU47P – 16GB HBM



ⓧ - Recommended Sequencing

VU45P, VU47P Power Requirements

	Rail Name	Voltage	Seq	Ripple	Load	Load Step
	VIN	12V				
Rail 1	VCCINT	0.85V	1	+/-3%	80A-150A	25%, 100A/uS
Rail 2	VCCBRAM, VCCINT-IO	0.85V	2	+/-3%	17A-20A	40%, 10A/uS
Rail 3	VCCAUX, VCCAUX_IO, VCCADC	1.8V	3	+/-3%	2.5A	90%, 10A/uS
Rail 4	MGTAVCC	0.9V	6	+/-3% (10mVpp)	8A	25%, 10A/uS
Rail 5	MGTYVCCAUX	1.8V	5	+/-3% (10mVpp)	1A	25%, 10A/uS
Rail 6	MGTAVTT	1.2V	4	+/-3% (10mVpp)	18A	25%, 10A/uS
Rail 9	VCCO(HDIO), VCCO(HPIO)	1.2V-3.3V, 1V-1.9V	7	+/-3%/ +/-5%	3A	90%, 10A/uS
Rail8	VCCAUX_HMB	2.5V	2	+/-3%	250mA	25%, 10A/uS
Rail7	VCC_HBM	1.2V	3	+/-3%	11A	25%, 10A/uS

Discrete solutions for VU45P, VU47P

Highest Efficiency

150A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency	PMBus/I2C
						MP2972	Contact MPS	600		
Rail1	VCCINT	12	0.85	3%	150	MP86966 (8x)		748	90.5%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	12	MP8733B		216	87%	no
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	7	MP8733A		216	92%	no
Rail4	MGTYAVCC	12	0.9	3%	7	MP8733A		216	87%	no
Rail5	MGTYAVAUX	12	1.8	3%	0.6	MP2322		90	86%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MP8733B		216	88%	no
Rail9	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MP2326		90	85%	no
Rail8	VCCAUX_HBM	12	2.5	3%	0.25	MP2322		90	88%	no
Rail7	VCC_HBM	12	1.2	3%	11	MP8733B		216	87%	no
						Total		2698sqmm		
								4.17 sq in		

80A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm2)	Efficiency	PMBus/I2C
						MP2972	Contact MPS	400		
Rail1	VCCINT	12	0.85	3%	80	MP86966 (4x)		374	90.5%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	12	MP8733B		216	87%	no
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	7	MP8733A		216	92%	no
Rail4	MGTYAVCC	12	0.9	3%	7	MP8733A		216	87%	no
Rail5	MGTYAVAUX	12	1.8	3%	0.6	MP2322		90	86%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MP8733B		216	88%	no
Rail9	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MP2326		90	85%	no
Rail8	VCCAUX_HBM	12	2.5	3%	0.25	MP2322		90	88%	no
Rail7	VCC_HBM	12	1.2	3%	11	MP8733B		216	87%	no
						Total		2124sqmm		
								3.28sq in		

Please contact MPS for other configurations and accurate pricing

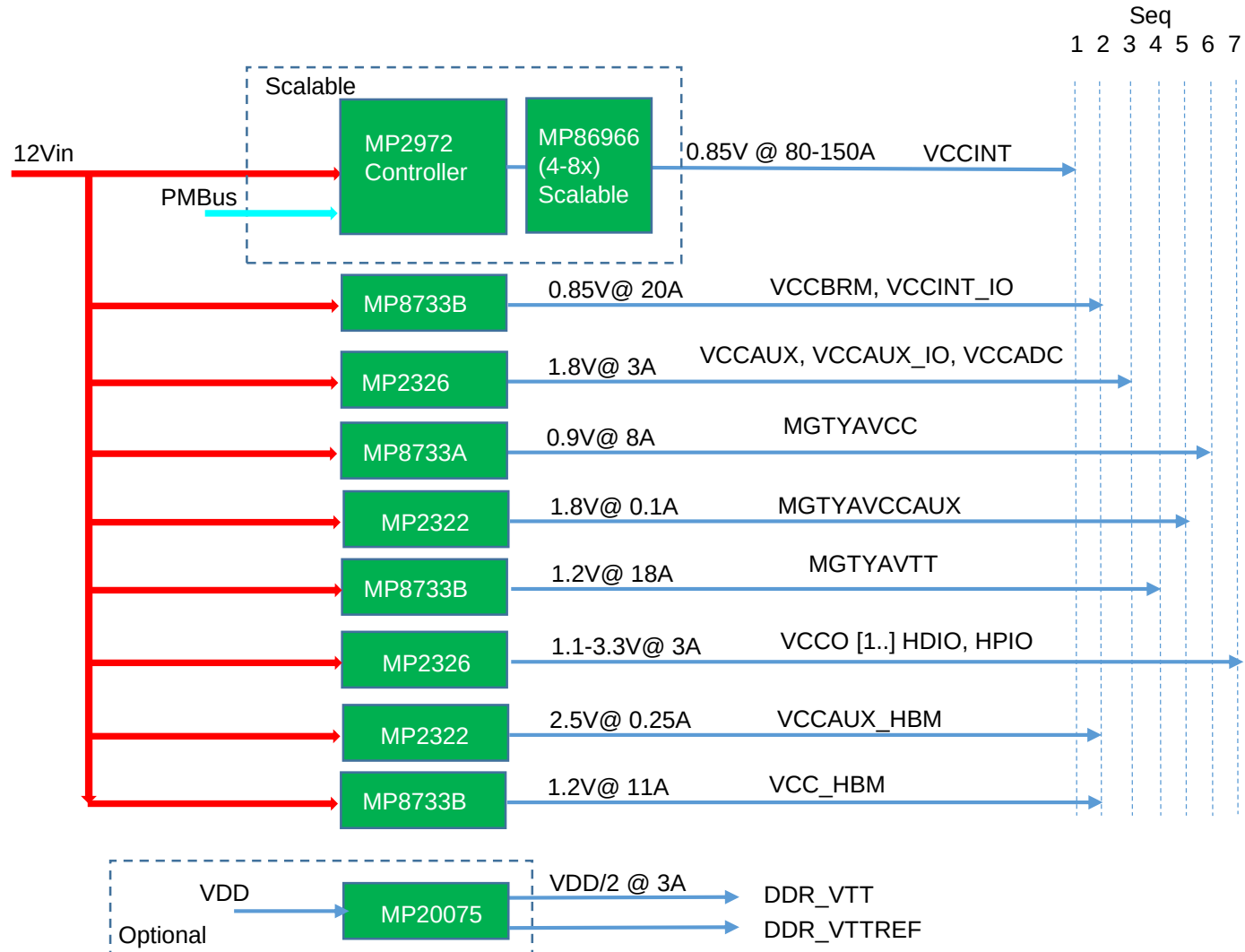


Efficiency 90%, size 3.3 to 4.1sqin

MPS
Simple, Easy Solutions™

VU45P, VU47P

Discrete solution



Module based solutions for VU45P, VU47P

Smallest size

150A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm ²)	Efficiency (%)	PMBus/I2C
Rail1	VCCINT	12	0.85	3%	150	MPM3695-100 (2x)	Contact MPS	900	85%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	12	MPM3695-25		230	86%	yes
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	7	MPM3695-10		160	88%	yes
Rail4	MGTYAVCC	12	0.9	3%	7	MPM3695-10		160	82%	yes
Rail5	MGTYAUX	12	1.8	3%	0.6	MPM3632C		55	83%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MPM3695-25		230	84%	yes
Rail9	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MPM3650		76	88%	no
Rail8	VCCAUX_HBM	12	2.5	3%	0.25	MPM3606A		35	75%	no
Rail7	VCC_HBM	12	1.2	3%	11	MPM3695-25		230	84%	yes
Total								2076 sqmm		
								3.21 sq in		

80A

Rail	Power Rail	Vin (V)	Vout (V)	Tolerance (%)	Iout (A)	MPS part#	Pricing 10ku (\$)	Area (mm ²)	Efficiency (%)	PMBus/I2C
Rail1	VCCINT	12	0.85	3%	80	MPM3695-100 (1x)	Contact MPS	450	85%	yes
Rail2	VCCBRM, VCCINT_IO	12	0.85	3%	12	MPM3695-25		230	86%	yes
Rail3	VCCAUX, VCCAUX_IO, VCCADC	12	1.8	3%	7	MPM3695-10		160	88%	yes
Rail4	MGTYAVCC	12	0.9	3%	7	MPM3695-10		160	82%	yes
Rail5	MGTYAUX	12	1.8	3%	0.6	MPM3632C		55	83%	no
Rail6	MGTYAVTT	12	1.2	3%	16	MPM3695-25		230	84%	yes
Rail9	VCCO [1..] HDIO, HPIO	12	3.3	5%	3	MPM3650		76	88%	no
Rail8	VCCAUX_HBM	12	2.5	3%	0.25	MPM3606A		35	75%	no
Rail7	VCC_HBM	12	1.2	3%	11	MPM3695-25		230	84%	yes
Total								1626 sqmm		
								2.51 sq in		

Please contact MPS for other configurations and accurate pricing

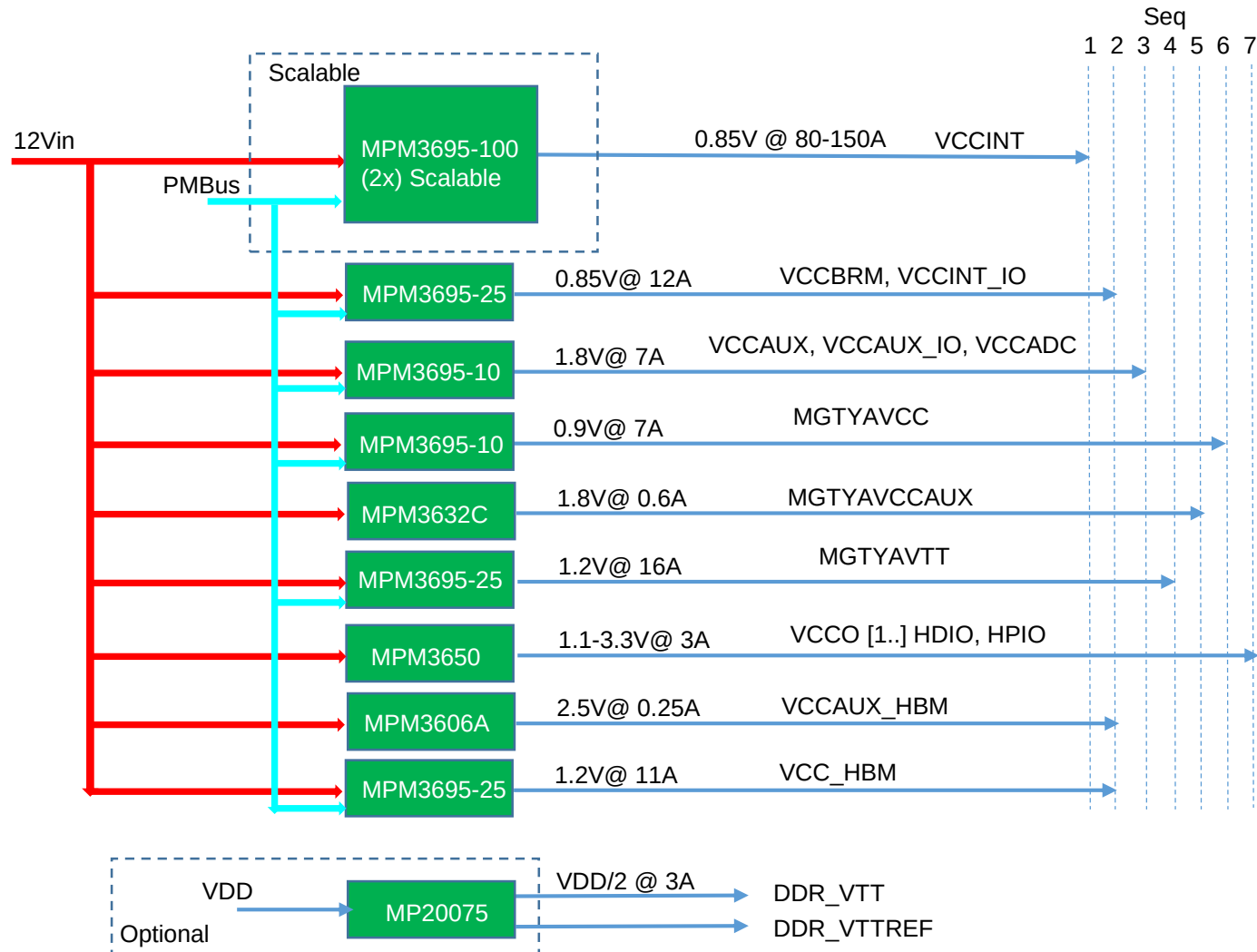


Efficiency ~85%, size 2.5 to 3.2sqin

MPM modules have integrated inductors



VU45P, VU47P Module solution



Discrete

- MP2972
- MP86966
- MP8733A
- MP8733B
- MP2326
- MP2322
- MP20075

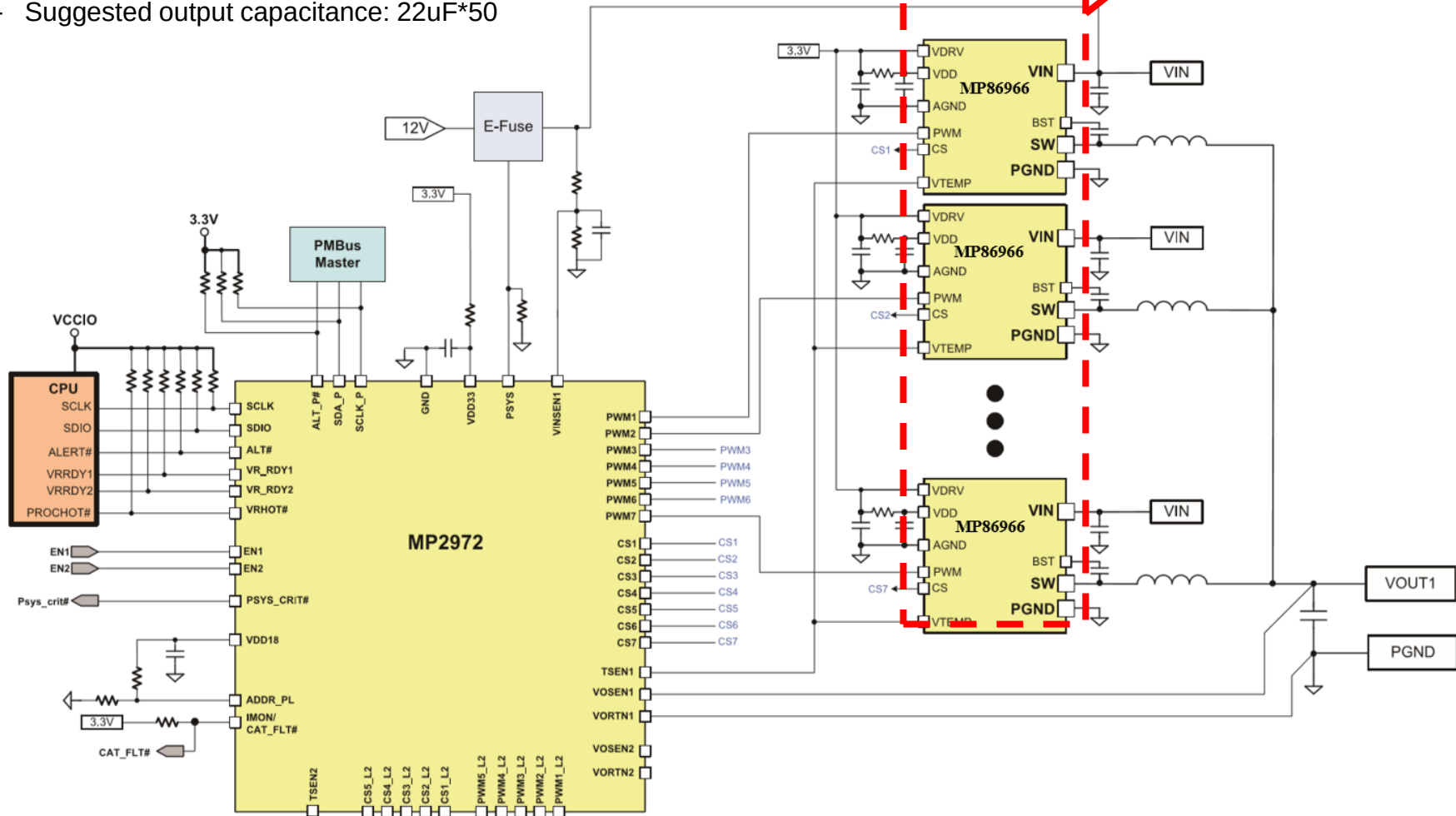
Modules

- MPM3695-100
- MPM3695-25
- MPM3695-10
- MPM3650
- MPM3632C

VCCINT 0.85V, 100 to 200A (Scalable) Block Diagram

MP2972 + MP86966 (10 ph)

- 100A to 200A Continuous
- Suggested output inductance: 70nH*10phase
- Suggested output capacitance: 22uF*50

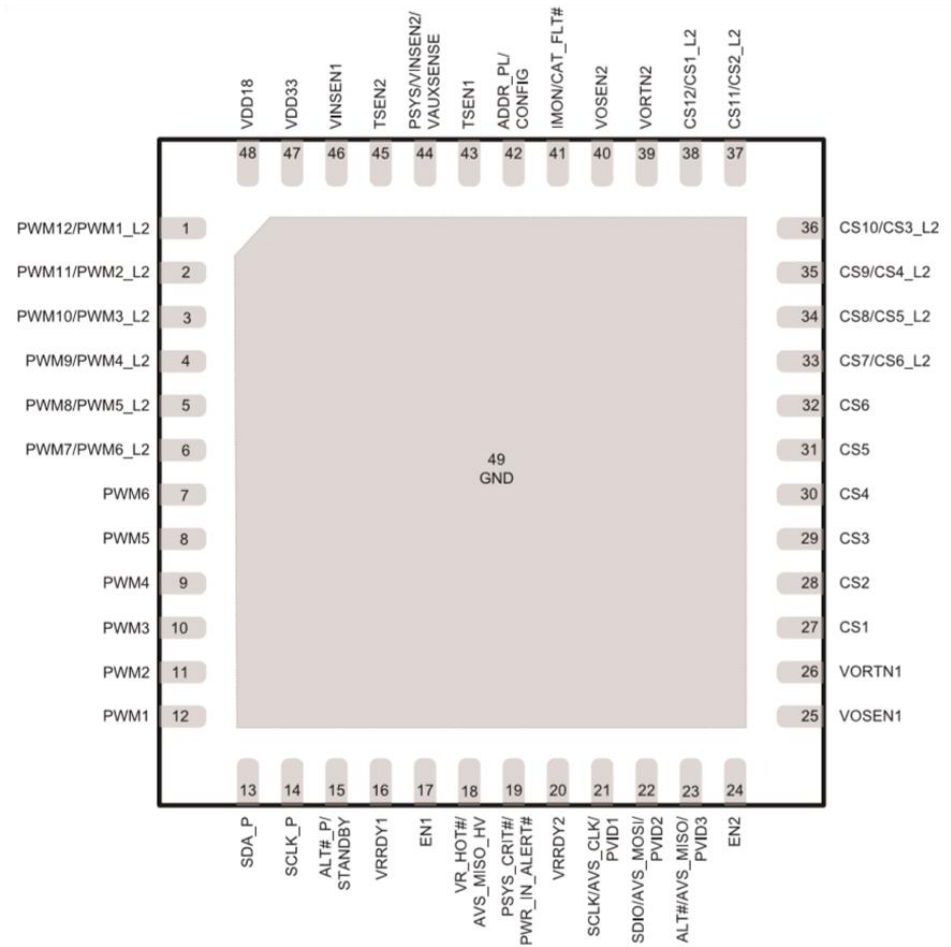


❑ The MP2972 is a dual loop digital multi-phase controller that provides power for the CPU core of VR13.HC platforms and CPU core based on AVSBus.

❑ Key features:

- Provides 12 PWMs in total and can be configured up to 12-phase operation;
- Auto phase shedding to improve overall efficiency
- PMBus/I2C & AVSBUS Compliant;
- Switching frequency up to 3MHz.

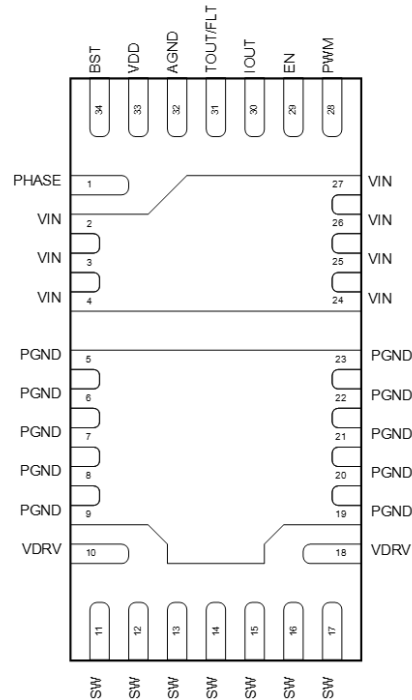
QFN-48 (6mm x 6mm)



❑ The MP86966 is a monolithic half-bridge with built-in internal power MOSFETs and gate drivers. It is able to achieve 70A of continuous output current.

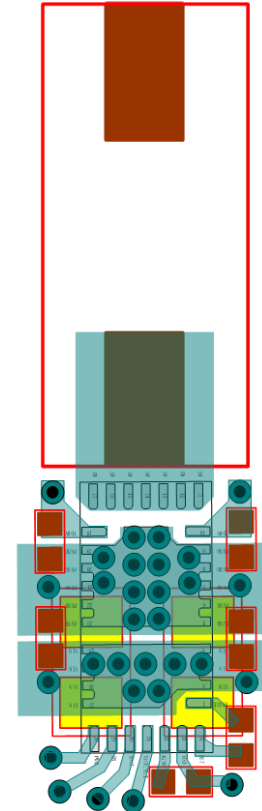
❑ Top view:

TLGA-34 (3mm x 6mm)
0.028 sq inch



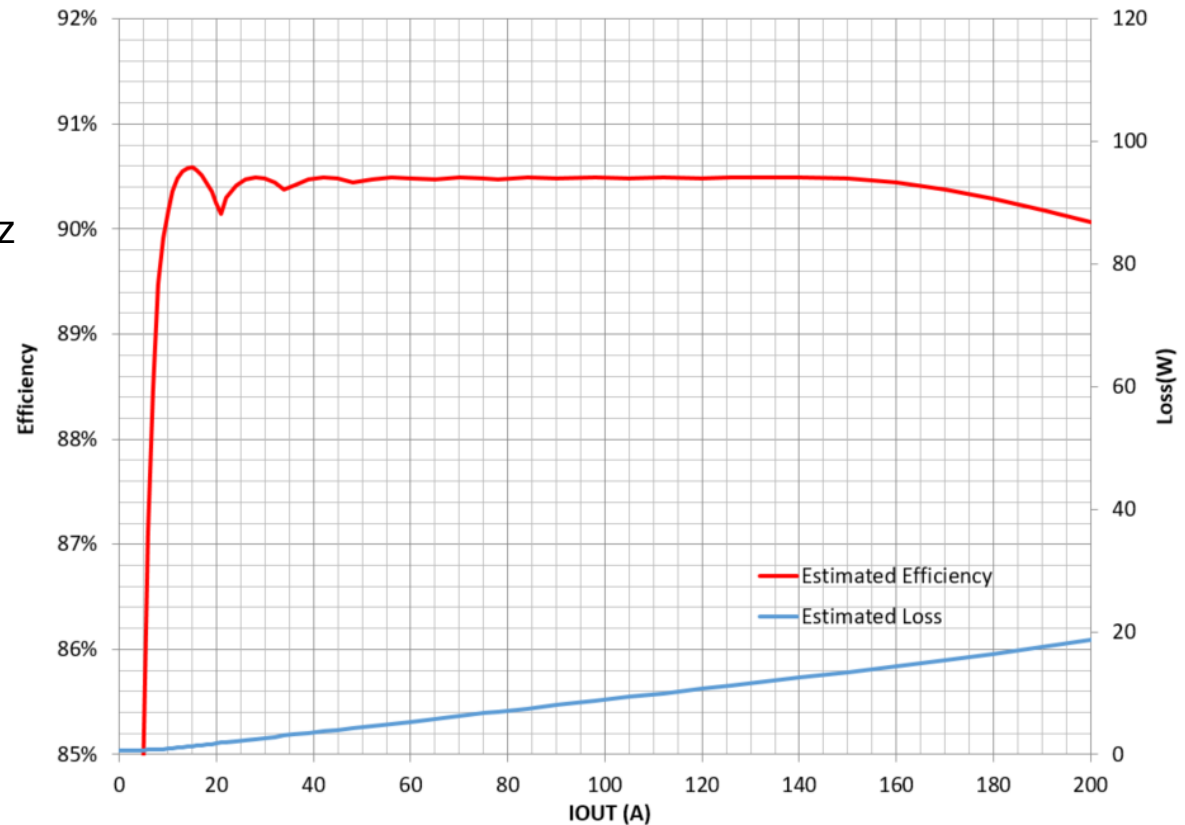
❑ 1-phase PCB size including inductor:

4.9mm x 19mm
0.144 sq inch



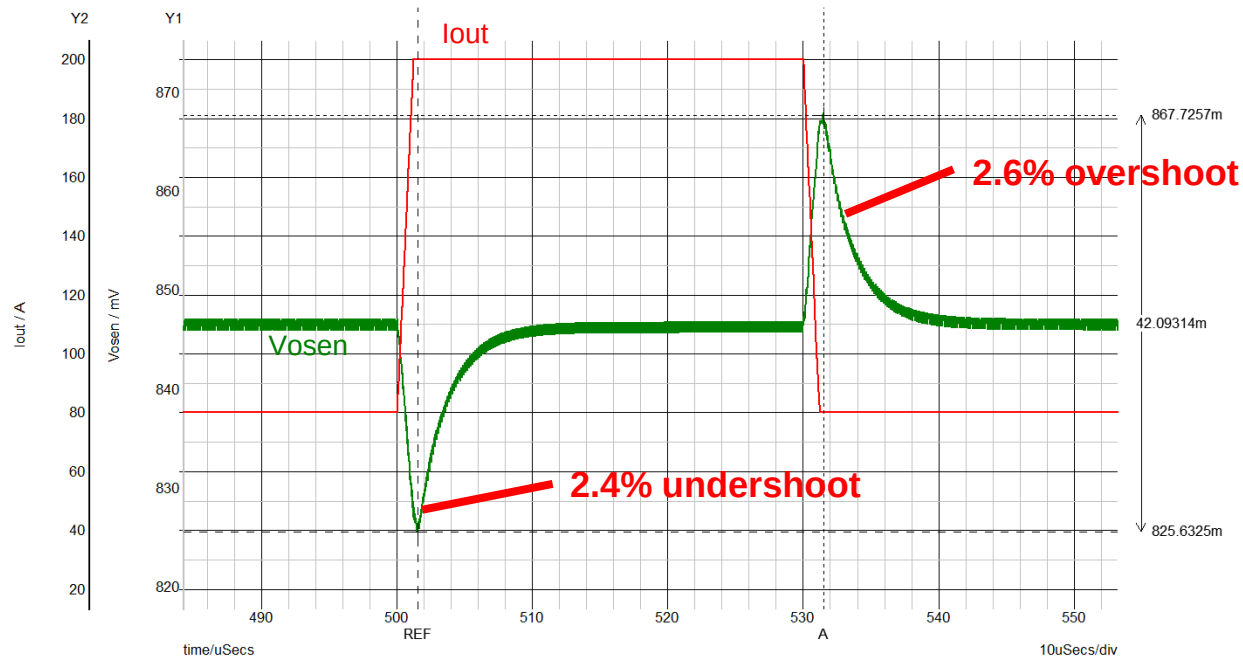
Efficiency Estimate

- $V_{in}=12V$, $V_{out}=0.85V$
- Inductor: 70nH
- Inductor DCR: 0.2m Ω
- Switching frequency: 700kHz
- Auto phase shedding



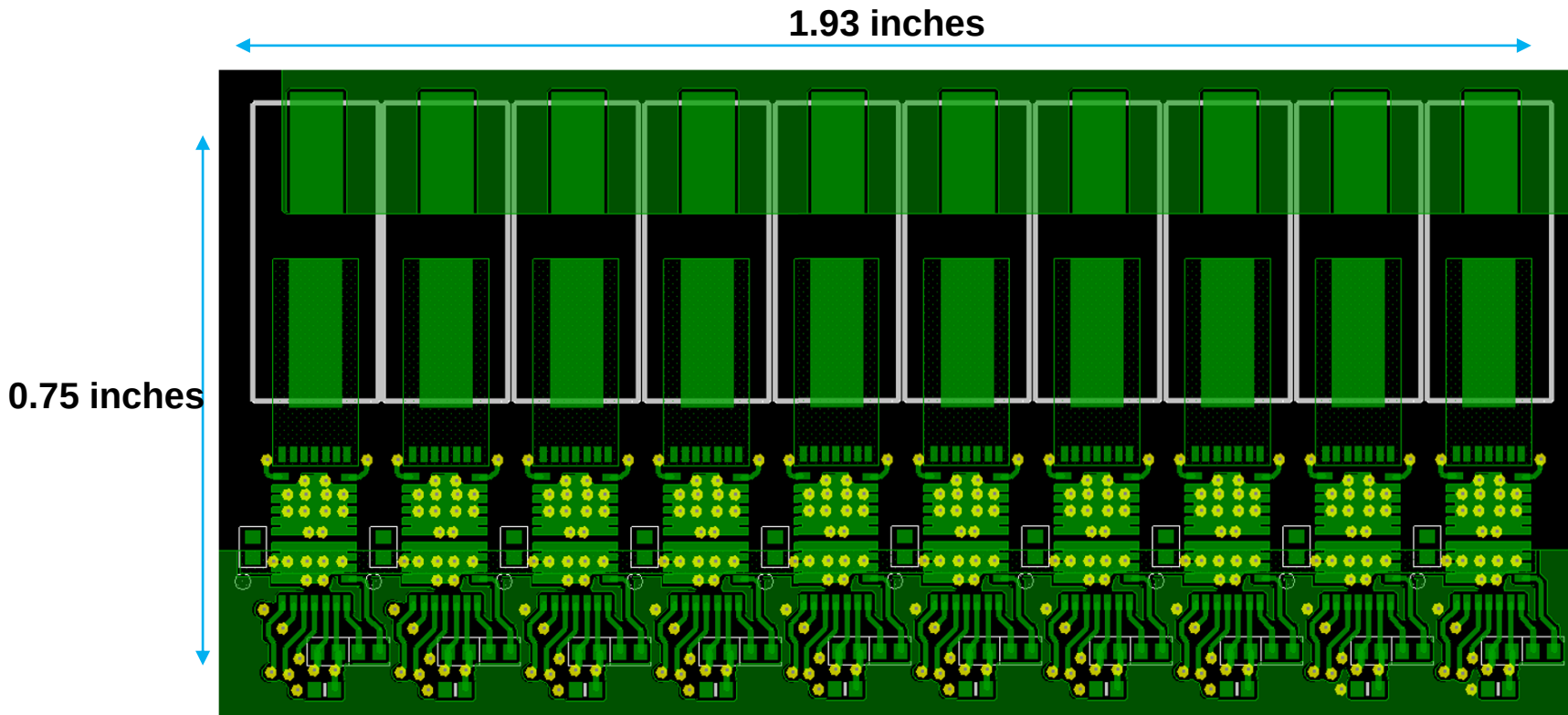
Transient performance

- $V_{in}=12V$, $V_{out}=0.85V$
- Load step: 80A-200A-80A
- Slew rate: 100A/us
- Output capacitors: 22uF*50



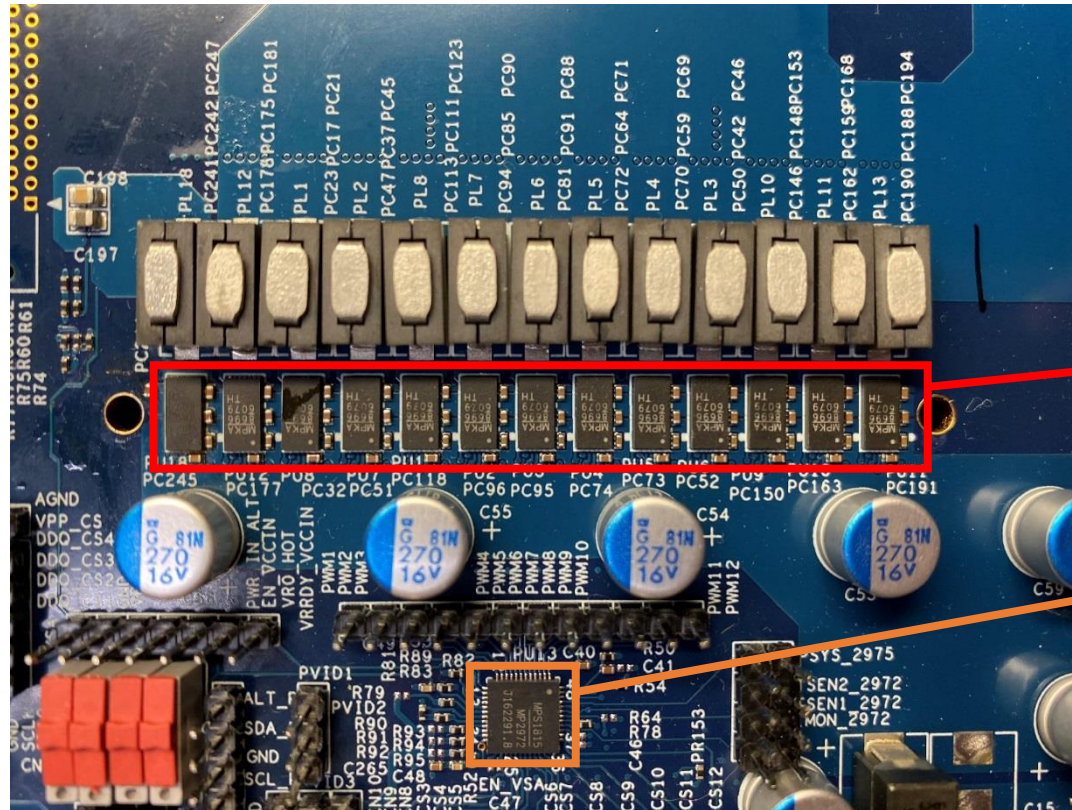
Layout & PCB Area

- PCB area estimate: 1.45 sq inch



Existing EVB with Similar Design

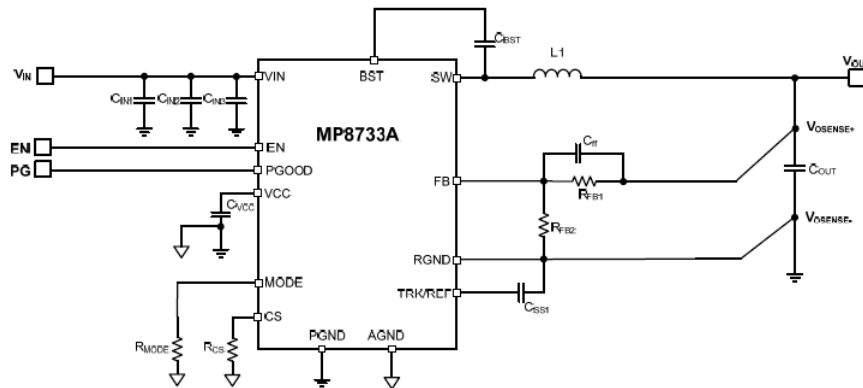
- 2 rail, 12+1 phases



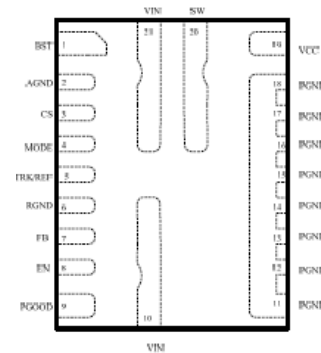
MP8696

MP2972 controller

Schematics

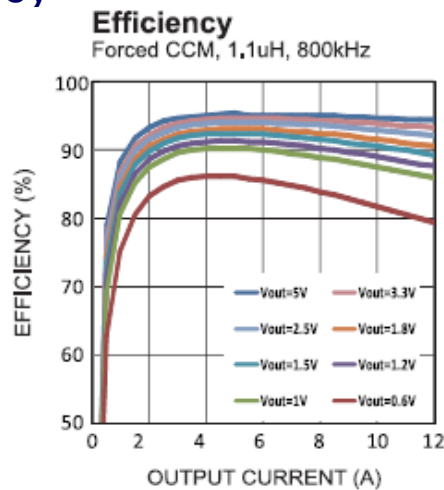


Package

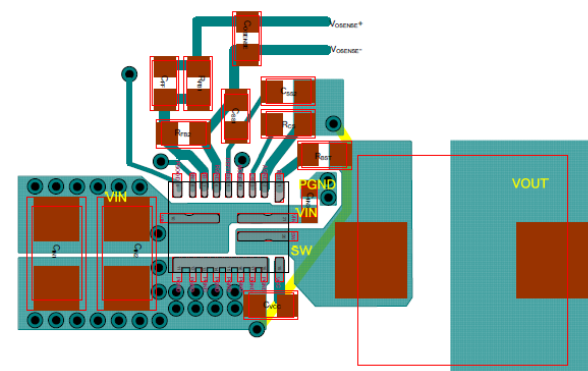


(QFN-21)

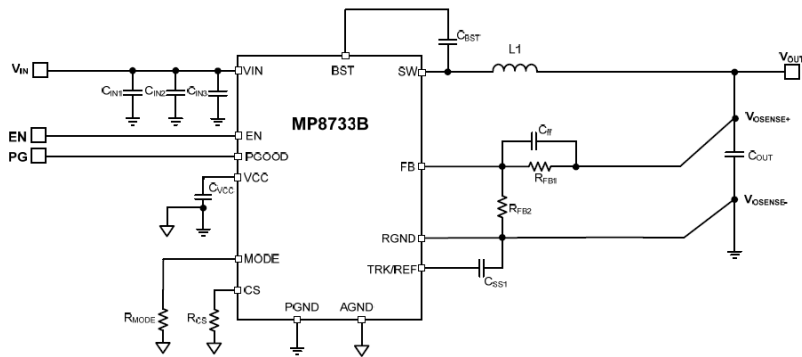
Efficiency



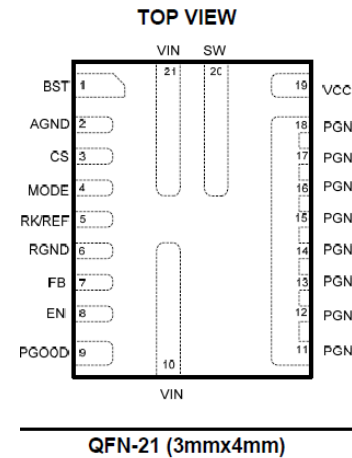
Layout



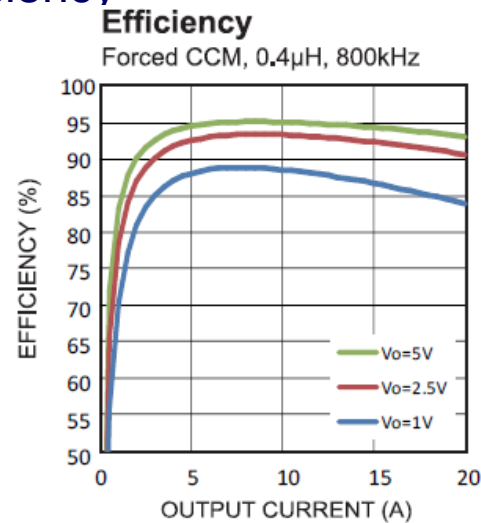
Schematics



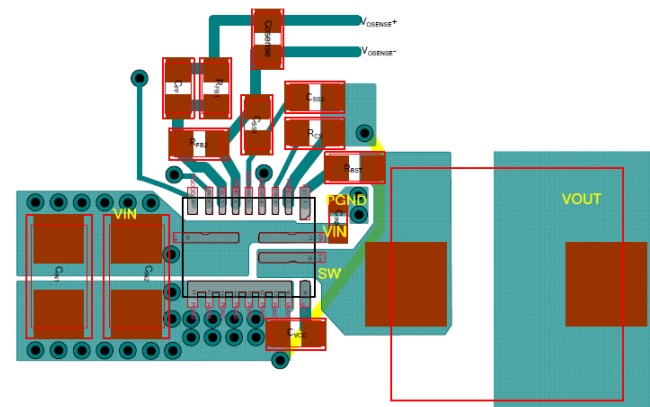
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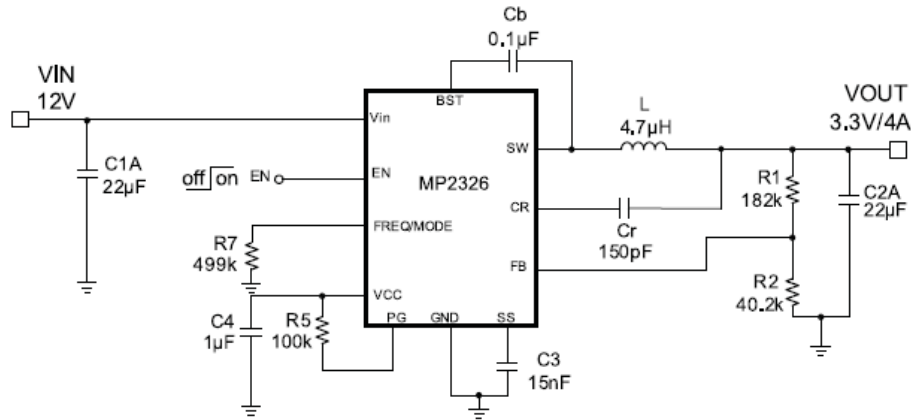
Efficiency



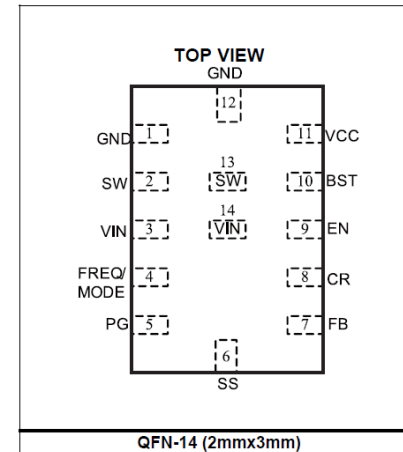
Layout



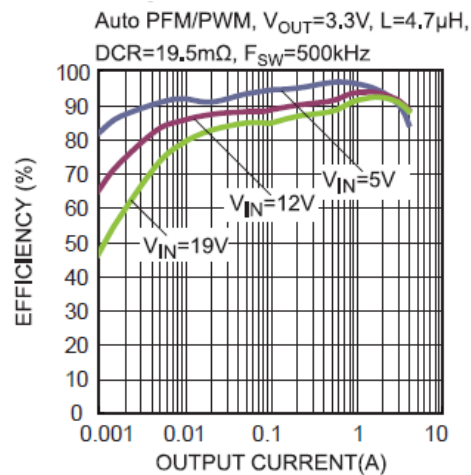
Schematics



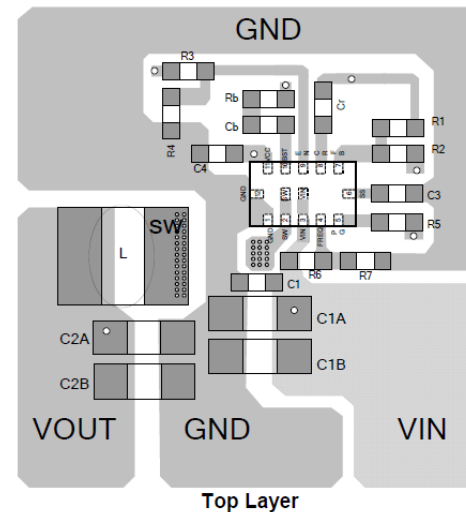
Package



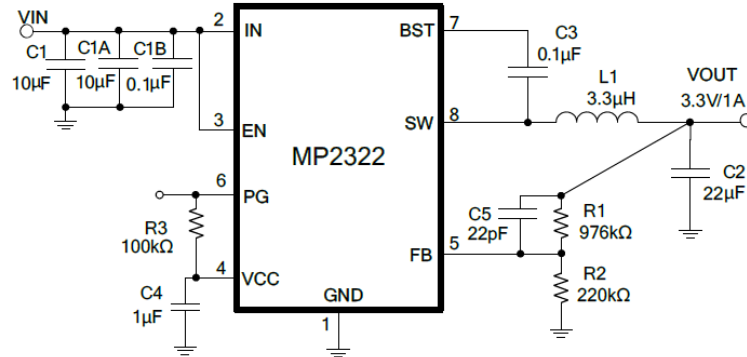
Efficiency



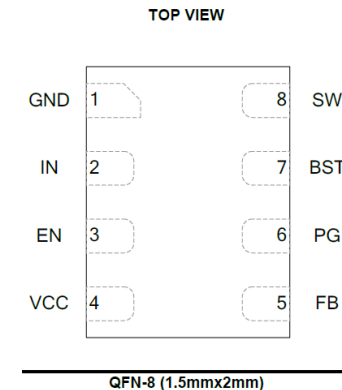
Layout



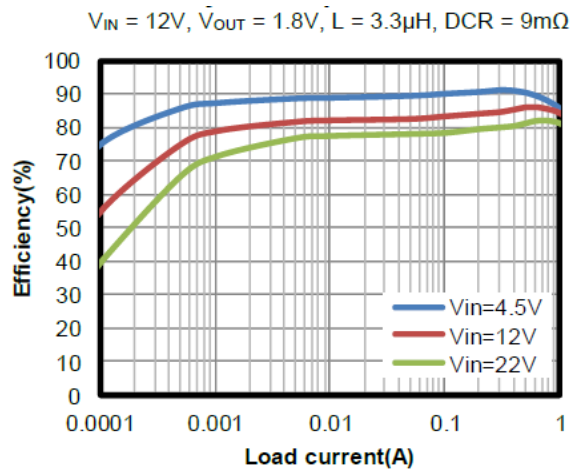
Schematics



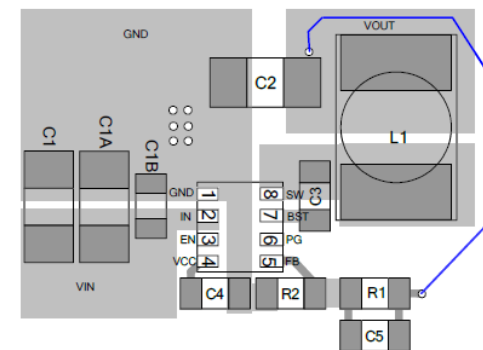
Package



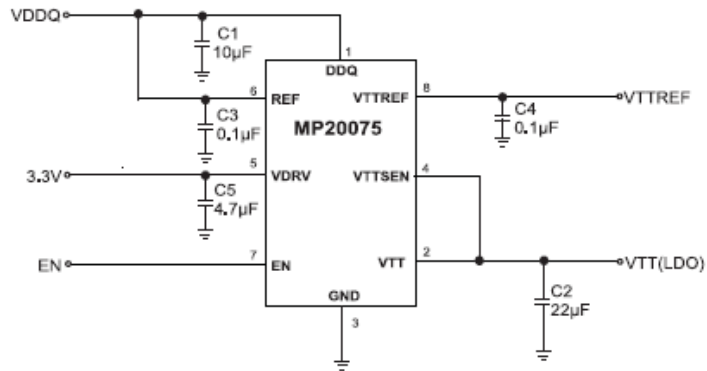
Efficiency



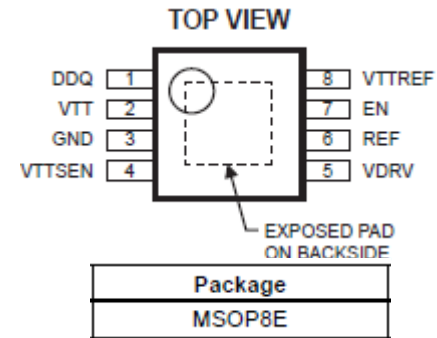
Layout



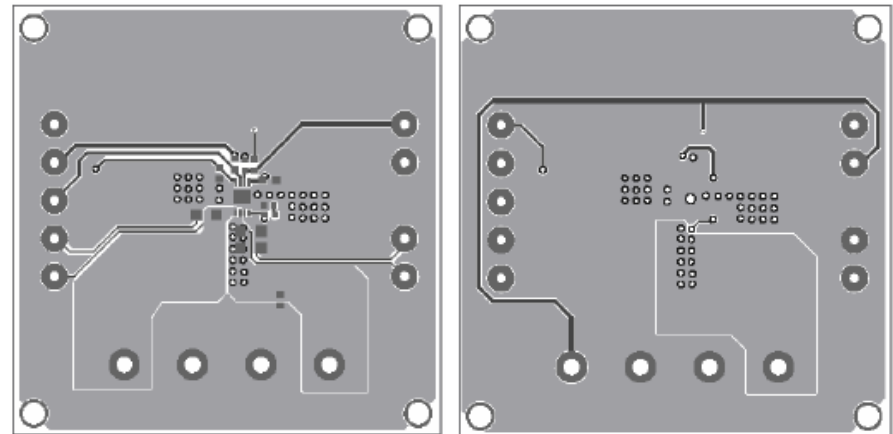
Schematics



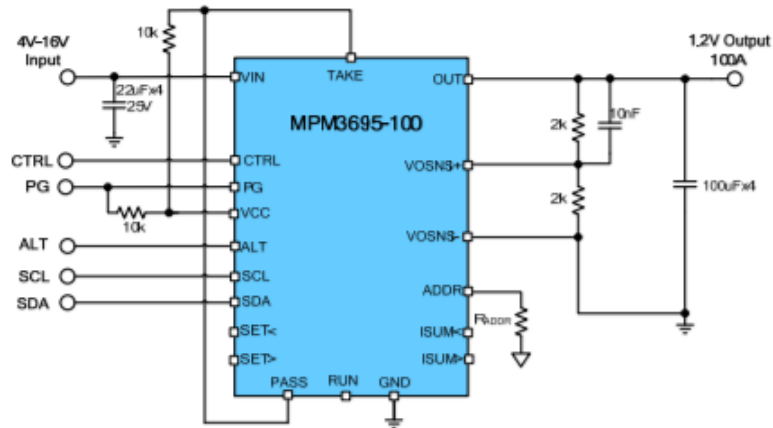
Package



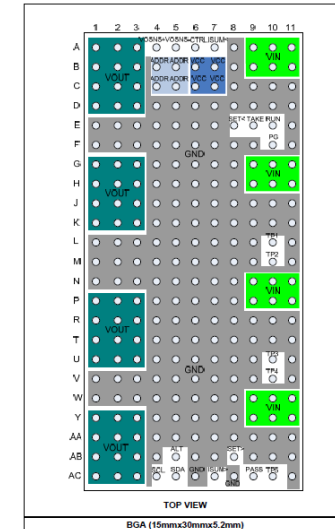
Layout



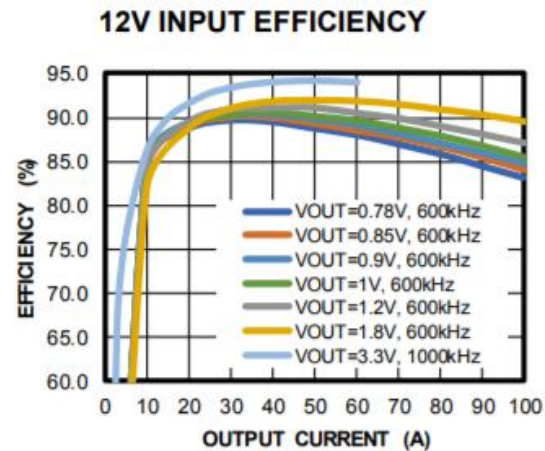
Schematics



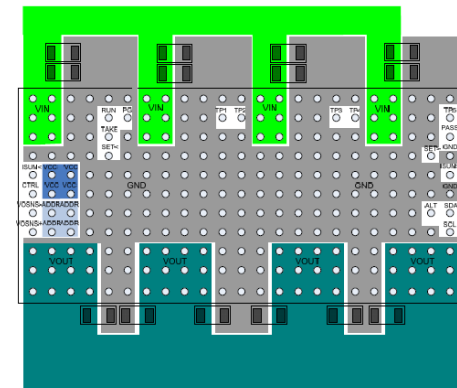
Package



Efficiency



Layout



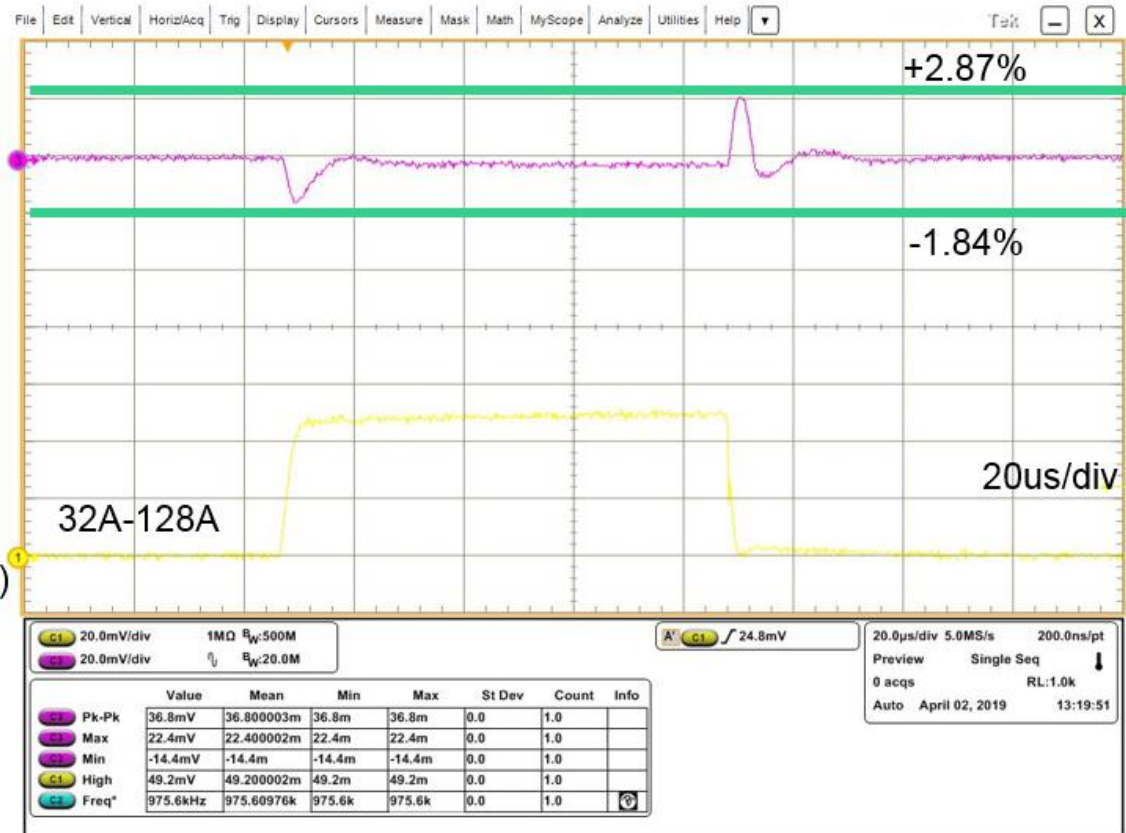
MPM3695-100

Transient performance

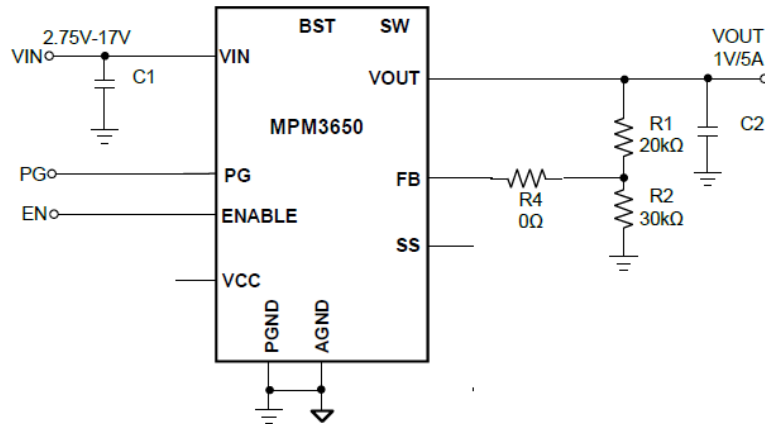
Parameter	Value
Input voltage	12V
Output voltage	0.78V
Transient load step	96A
Slew rate	100A/us
Switching frequency	600kHz
Number of power modules	2
Maximum output current	200A
Ceramic output capacitor	47uFx16 per module 6.3V 0805
SP-Cap output capacitor	220uFx8 total

VOUT/AC
(20mV/div)

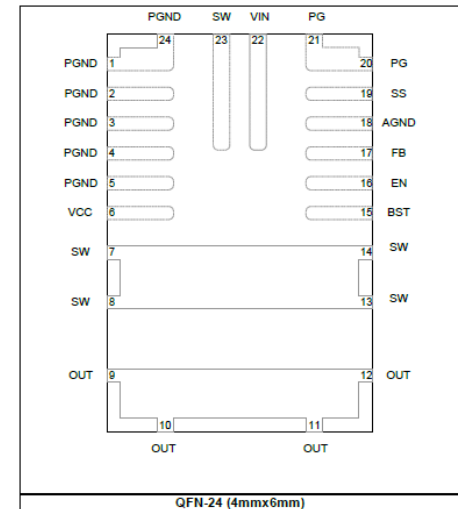
IOUT
(0.5mV/A)



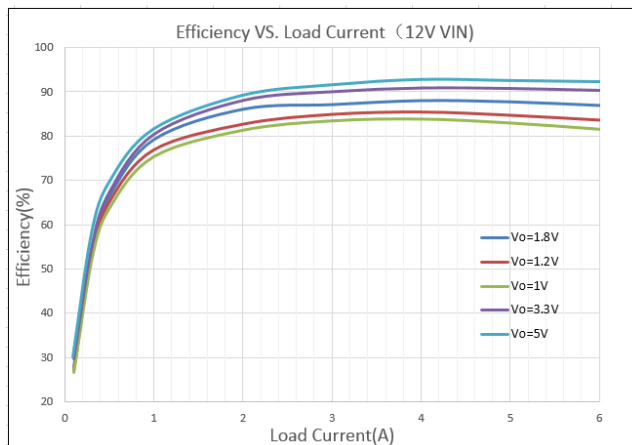
Schematics



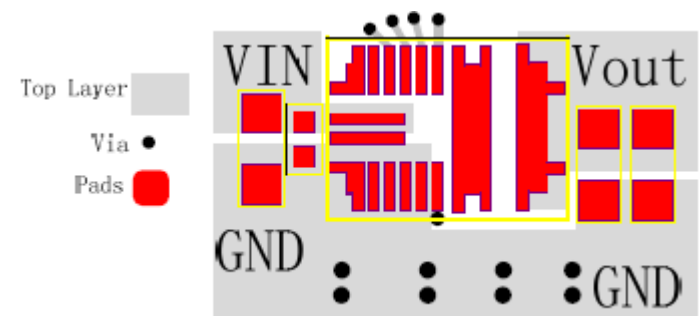
Package



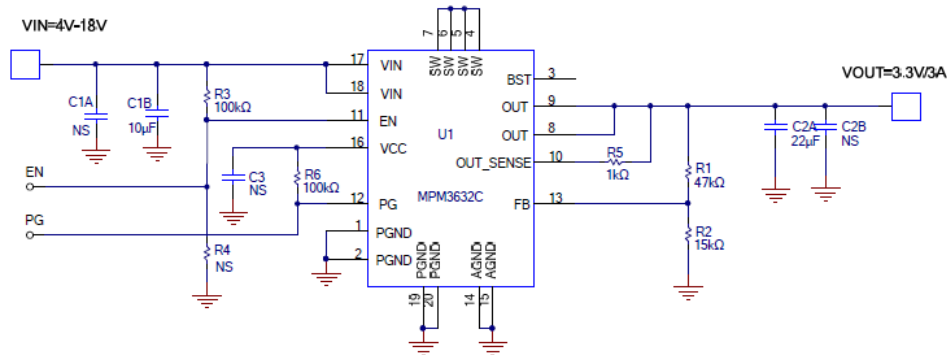
Efficiency



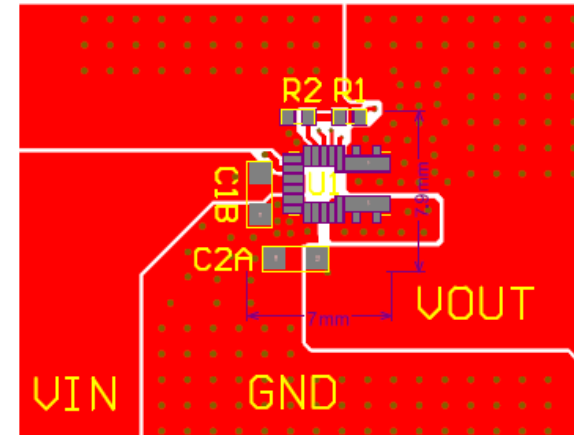
Layout



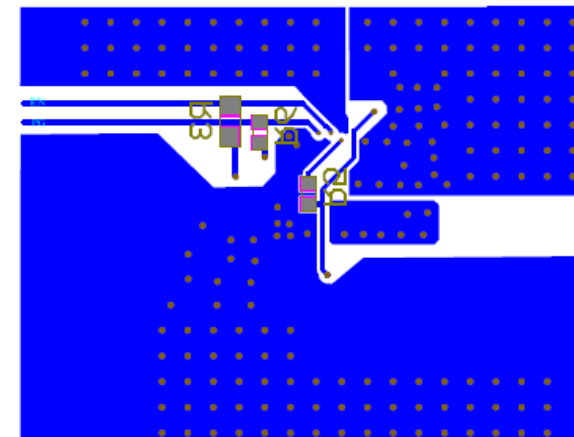
Schematics



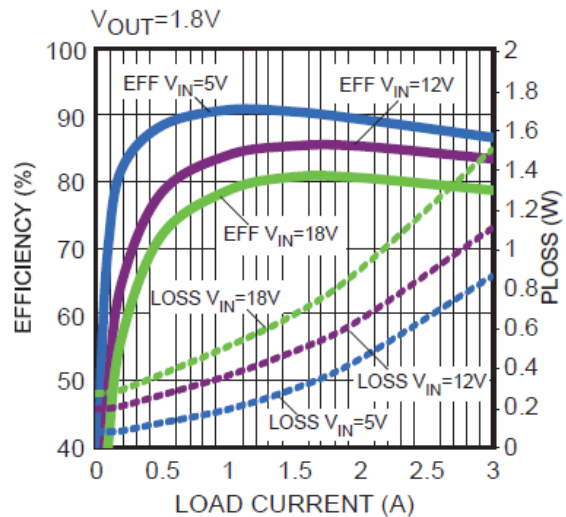
Layout guidelines



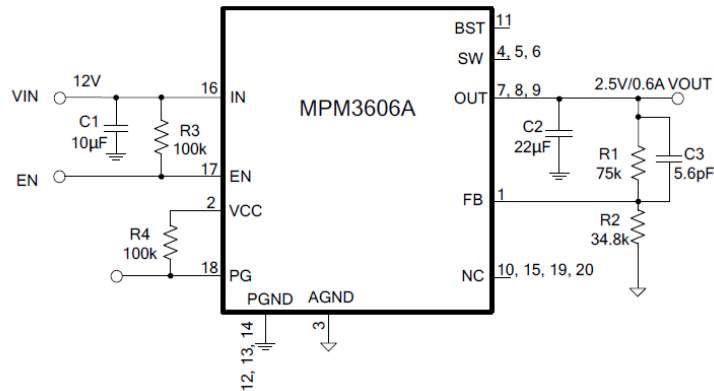
Top Layer



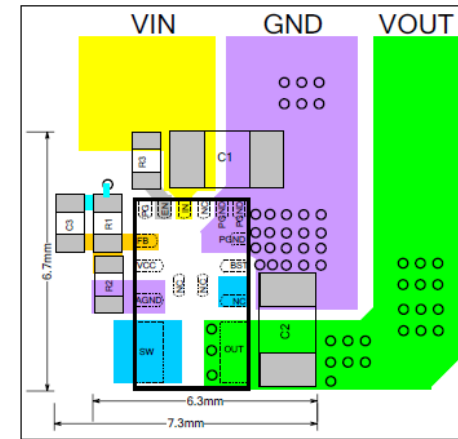
Efficiency



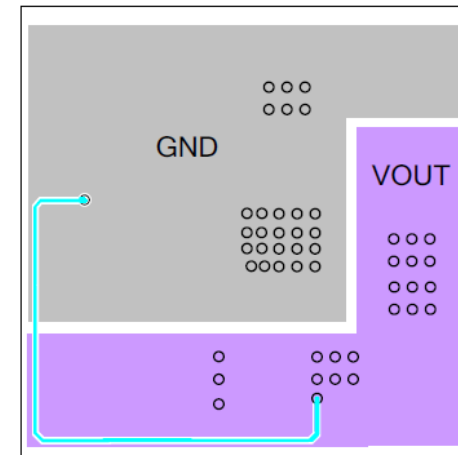
Schematics



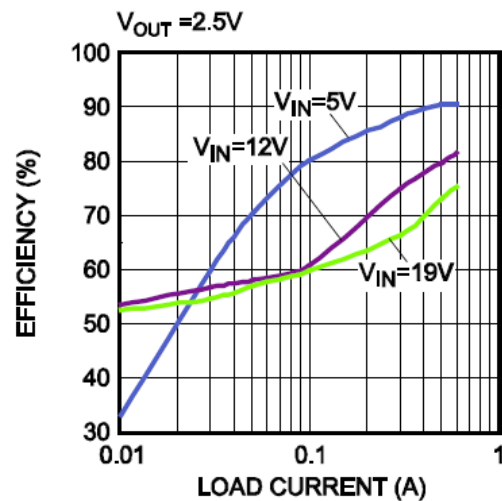
Layout guidelines



Top Layer



Efficiency



MPS Contact Information

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For general information
<http://www.monolithicpower.com>