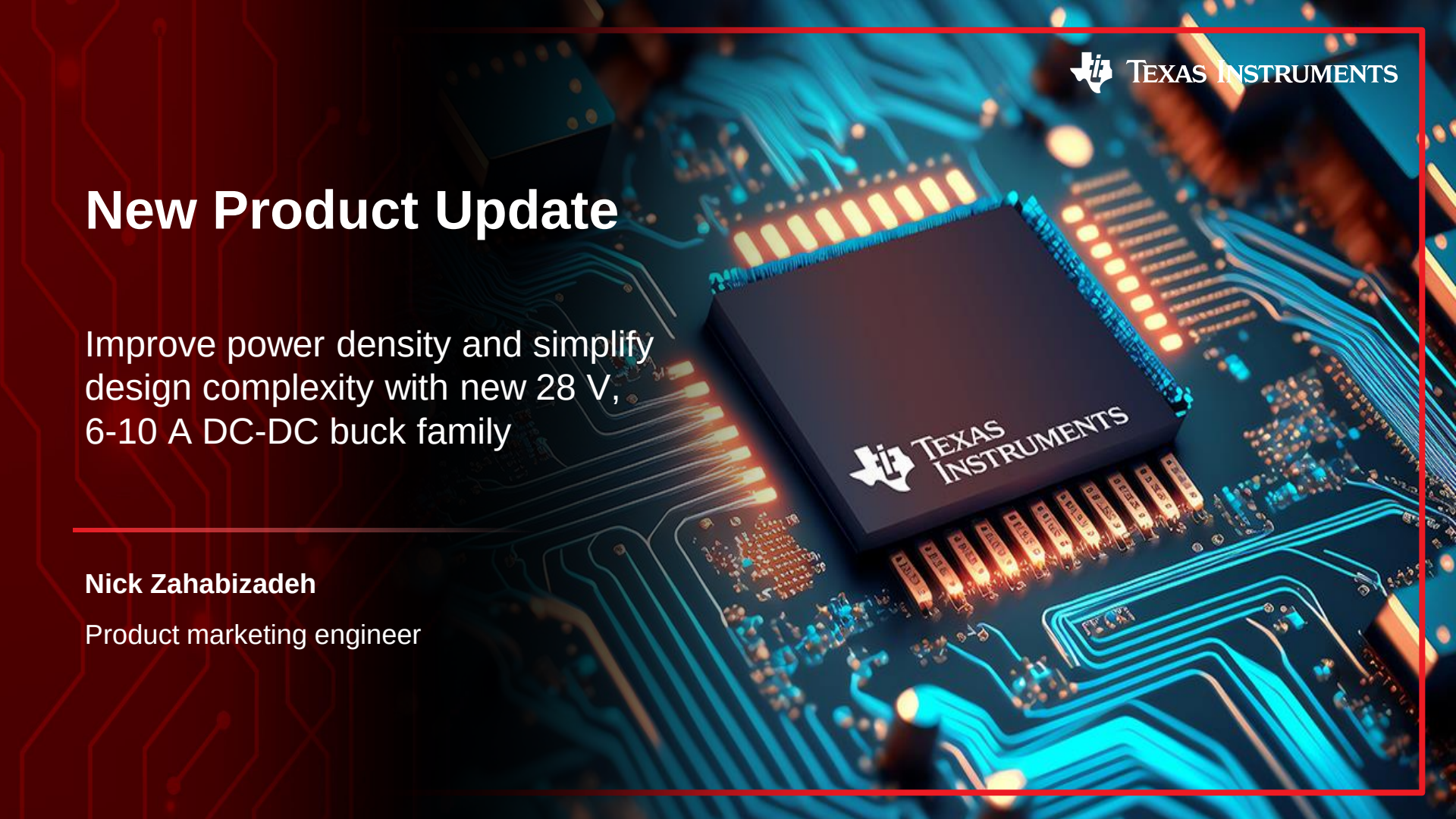
New Product Update

Improve power density and simplify design complexity with new 28 V, 6-10 A DC-DC buck family



Nick Zahabizadeh

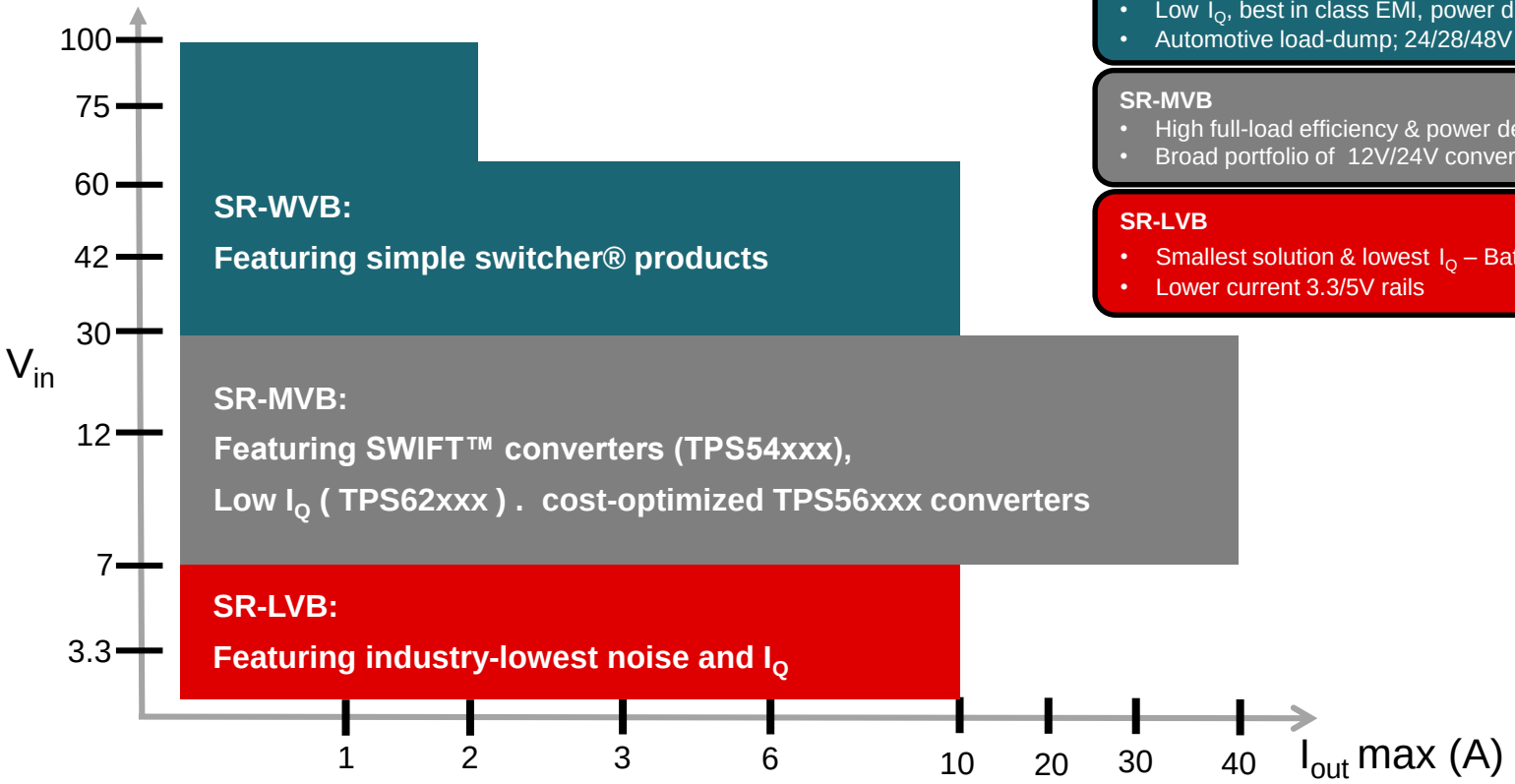
Product marketing engineer

Agenda

In this session, you will learn how new the DC/DC buck family of converters and modules can enable you to scale power density needs across your product stack while saving board space, design time, and BoM.

- Quick introduction to TI switching regulators
- TPS56x3x overview
  - Design benefits and application examples
- Buck converters vs buck modules advantages/disadvantages
  - Buck module board space and BoM comparison
- Q&A

TI's step-down DC/DC converter portfolio



SR-WVB
- Low I_Q, best in class EMI, power density devices
- Automotive load-dump; 24/28/48V rails

SR-MVB
- High full-load efficiency & power density
- Broad portfolio of 12V/24V converters for all markets

SR-LVB
- Smallest solution & lowest I_Q – Battery power
- Lower current 3.3/5V rails

Cassiopeia family overview

✓ Released In development

IC / Module	PN	Mode	FSW (Hz)	Vout range	Iout	Package	Notes
IC	TPS56837 ✓	PSM	500k/800k/1200k	0.6-13V	8	RPA VQFN 10pins 3mm x 3mm Share P2P footprint, including TPS56637	Light load efficiency for general applications
	TPS56836 ✓	OOA	500k/800k/1200k	0.6-13V	8		Out of audio noise support with OOA™
	TPS56838 ✓	FCCM	500k/800k/1200k	0.6-13V	8		Low output ripple support during light load
	TPS56837H ✓	PSM	500k	4-22V	8		Higher Vout & USB-C PD support
	TPS56A37 ✓	PSM	500k	0.6-13V	10		Continuous current output up to 10A
Module	TPSM86838 ✓	FCCM	800k/1200k	0.6-5.5V	8	RCG B3QFN 19pins 5mm x 5.5mm x 4mm	Module integrated inductor & passive up to 8A
	TPSM86638	FCCM	800k/1200k	0.6-13V	6		Module integrated inductor & passive 6A support higher output up to 13V
	TPSM86837	PSM	800k/1200k	0.6-5.5V	8		Light load efficiency for general applications
	TPSM86637	PSM	800k/1200k	0.6-13V	6		Light load efficiency for general applications

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TPS56837/836/838/A37

4.5-V to 28-V input, 8A/10A synchronous buck converter

Features

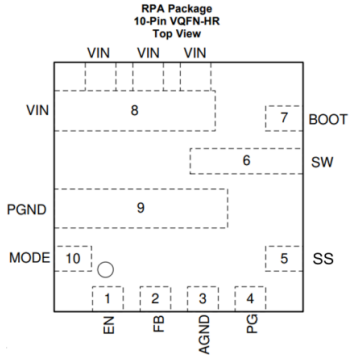
- 4.5-V to 28-V wide input voltage range
- 0.6-V to 13-V wide output voltage range
- **8-A** maximum continuous output current
- Integrated **20.4-mΩ and 9.5-mΩ** MOSFETs
- **500KHz/800KHz/1.2MHz** adjustable switching frequency
- D-CAP3™ control mode for fast transient response
- Eco-mode/**OOA mode (TPS56836)/** FCCM (TPS56838)
- Internal 1.8-ms soft start and external adjustable
- 0.6-V ±1% reference voltage
- Built-in output discharge function
- Power good indicator, OVP/UVP/OTP protection
- HotRod™ 3x3 package (P2P 6A, 8A, 10A family)

Applications

- Enterprise systems: multifunction printers, storage
- Industrial applications: IPC, EPOS, factory automation and control
- Personal electronics: Monitors, DTV, speakers, PC & NB, portable electronics
- General purposes for 12-V,19-V, 24-V power-bus supply

Benefits

- High efficiency at heavy loading
- Improved light-load efficiency
- OOA operation to avoid audio noise (TPS56836)
- Adjustable switching frequency
- D-CAP3 control with fast transient response
- **98% large duty support**
- Lowest external component count
- Small footprint to save PCB area
- Cost effective



TPS56837 advantages

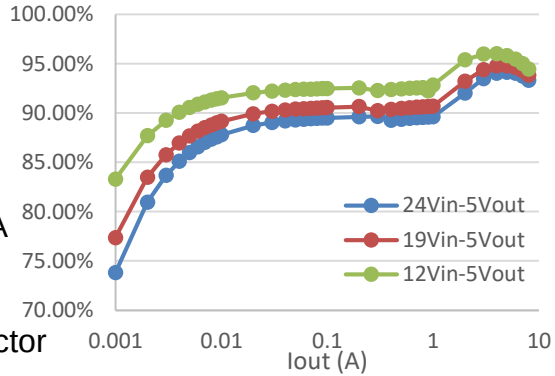
Features

- 4.5-V to **28-V** wide input, 0.6-V to **13-V** wide output
- **8-A** continuous output current
- 500KHz/800KHz/1200KHz **Adj. Fsw**
- **Adj. over current limit & soft start time**
- D-CAP3™ PSM for TPS56837
- OOA is offered by TPS56836, FCCM by TPS56837

High efficiency

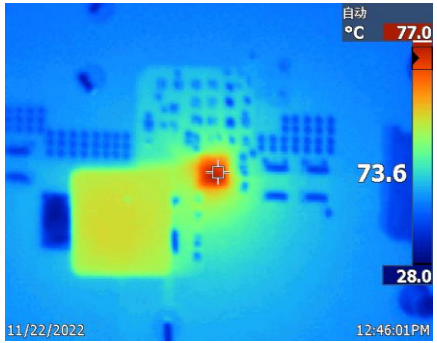
- 94.0% @24Vin-5Vout-8A
- 94.5% @24Vin-5Vout-6A
- 87.8% @24Vin-5Vout-10mA
- 94.9% @12Vin-5Vout-8A

By using WE 744325330 inductor



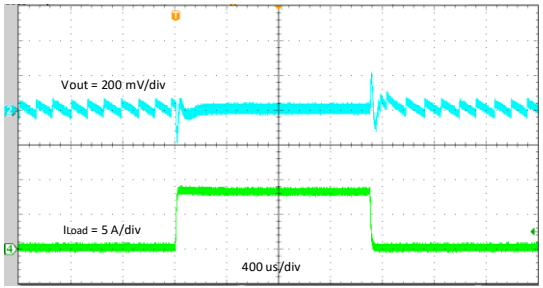
Thermal

Vin=24V, Vout=5V, Iout=8A, 500K, 15mins



Fast transient response

- 209mv/189mV overshoot/undershoot
- @500KHz
- 24Vin-5Vout-0-8A transient
- L=3.3uH, Cout_eff=35uF
- Cff=150pF



*simulated data

TPS56A37 – Cassiopeia

4.5-V to 28-V input, 10-A synchronous buck converter

Features

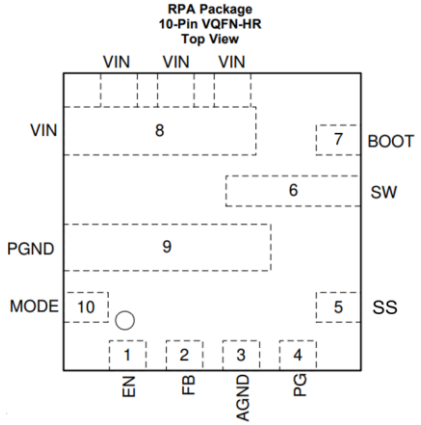
- 4.5-V to 28-V wide input voltage range
- 0.6-V to 13-V wide output voltage range
- **10-A** maximum continuous output current
- Integrated **19.4-mΩ and 8.5-mΩ** MOSFETs
- 500KHz switching frequency
- D-CAP3™ control mode for fast transient response
- Eco-mode
- Internal 1.8-ms soft start and external adjustable
- 0.6-V ±1% reference voltage
- Built-in output discharge function
- Power good indicator, OVP/UVP/OTP protection
- HotRod™ 3x3 package ((P2P with TPS56637 & TPS56837)

Applications

- Enterprise systems: Multifunction printers, storage
- Industrial applications: IPC, EPOS, factory automation and control
- Personal electronics: Monitors, DTV, speakers, PC & NB, portable electronics
- General purposes for 12-V,19-V, 24-V power-bus supply

Benefits

- High efficiency at heavy loading
- Improved light-load efficiency
- D-CAP3 control with fast transient response
- **98% large duty support**
- Lowest external component count
- Small footprint to save PCB area
- Cost effective



TPS56837H

4.5-V to 28-V input, 8A synchronous buck converter

Features

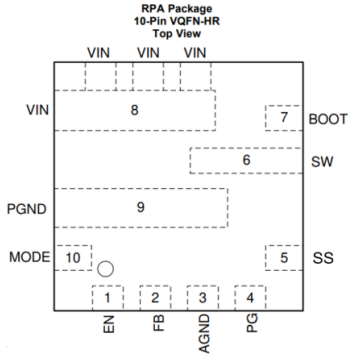
- 4.5-V to 28-V wide input voltage range
- 4-V to **22-V** output voltage range
- **8-A** continuous output current
- Integrated **20.4-mΩ and 9.5-mΩ** MOSFETs
- **500KHz** switching frequency
- D-CAP3™ control mode for fast transient response
- PSM mode for higher light load efficiency
- **Adjustable soft start**
- 0.6-V ±1% reference voltage
- Built-in output discharge function & power good indicator
- UVP/OVP/OTP
- HotRod™ 3x3 package (P2P with TPS56637 & TPS56837)

Applications

- USB power supplies with PD
- Industrial applications: IPC, EPOS, factory automation and control
- Personal electronics: Monitors, DTV, speakers, PC & NB, portable electronics
- General purposes for 12-V,19-V, 24-V power-bus supply

Benefits

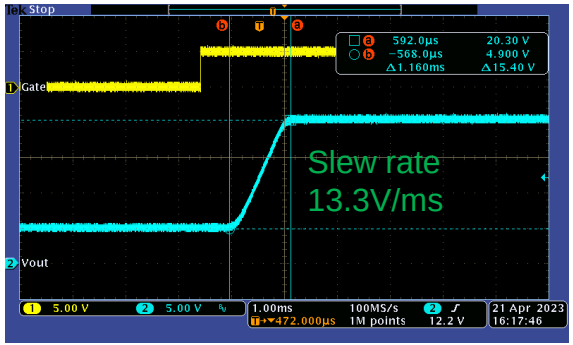
- High efficiency at heavy loading
- Improved light-load efficiency
- D-CAP3 control with fast transient response
- **98% large duty support**
- **Wide output voltage**
- **Dynamic change 5Vo-9Vo-15Vo-20Vo covers type-C application**
- Lowest external component count
- Small footprint to save PCB area
- Cost effective

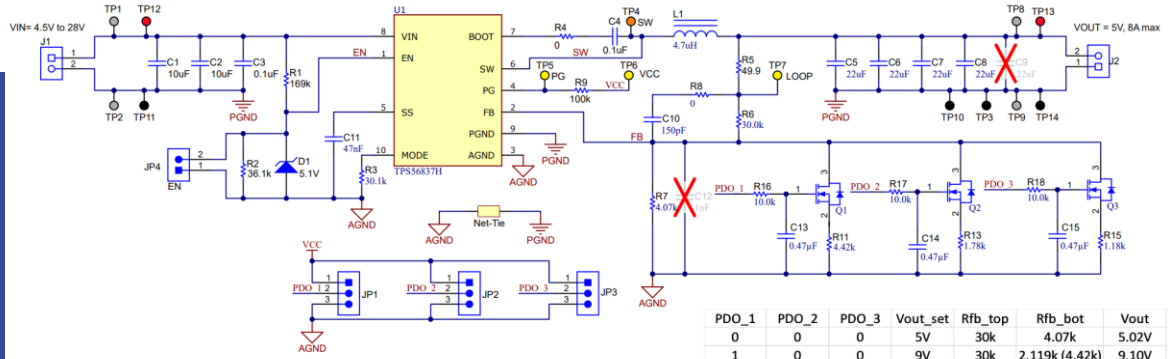


TPS56837H advantages

Dynamic change 5Vo-9Vo-15Vo-20Vo

- 24Vin 5Vo to 20Vo @5A



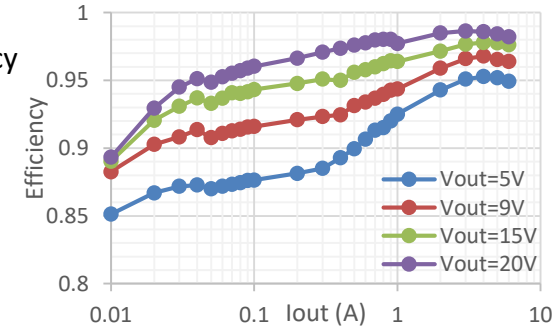


PDO_1	PDO_2	PDO_3	Vout_set	Rfb_top	Rfb_bot	Vout
0	0	0	5V	30k	4.07k	5.02V
1	0	0	9V	30k	2.119k (4.42k)	9.10V
0	1	0	15V	30k	1.238k (1.78k)	15.13V
0	0	1	20V	30k	0.915k (1.18k)	20.28V

Higher efficiency

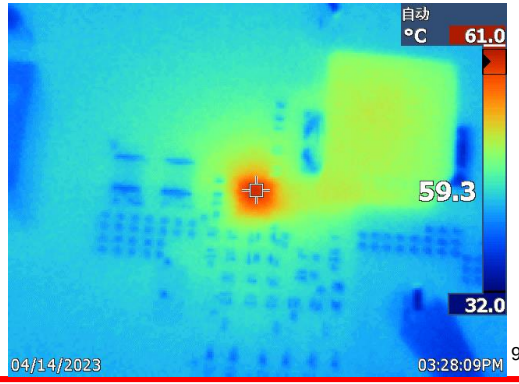
- 24Vin @5A efficiency

5Vo	95.19%
9Vo	96.53%
15Vo	97.77%
20Vo	98.44%



Good thermal

- 24Vin-20Vo @5A
- Thermal is 61C



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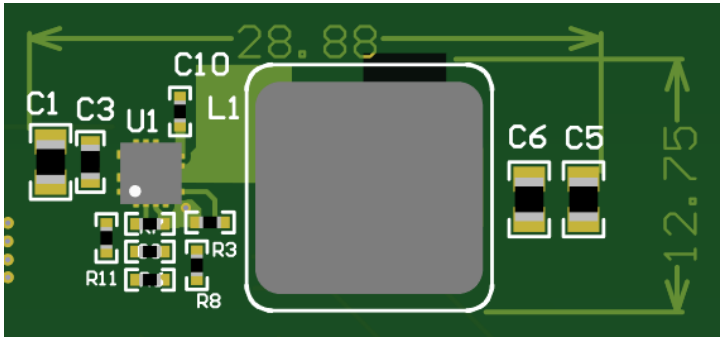
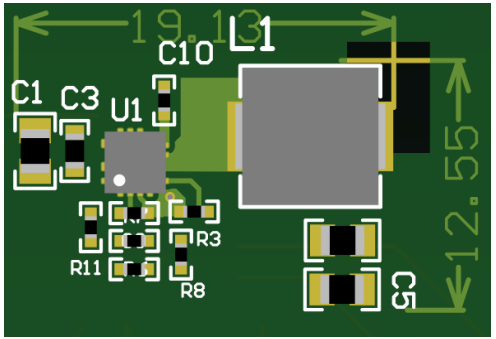
500KHz VS 1200KHZ

FSW=500KHz
3.3uH inductor - 744325330
AUP $3.4, solution size 377mm²



35% area reduction

FSW=1200KHz
1.5uH inductor - 74437349015
AUP $1.8, solution size 240mm²



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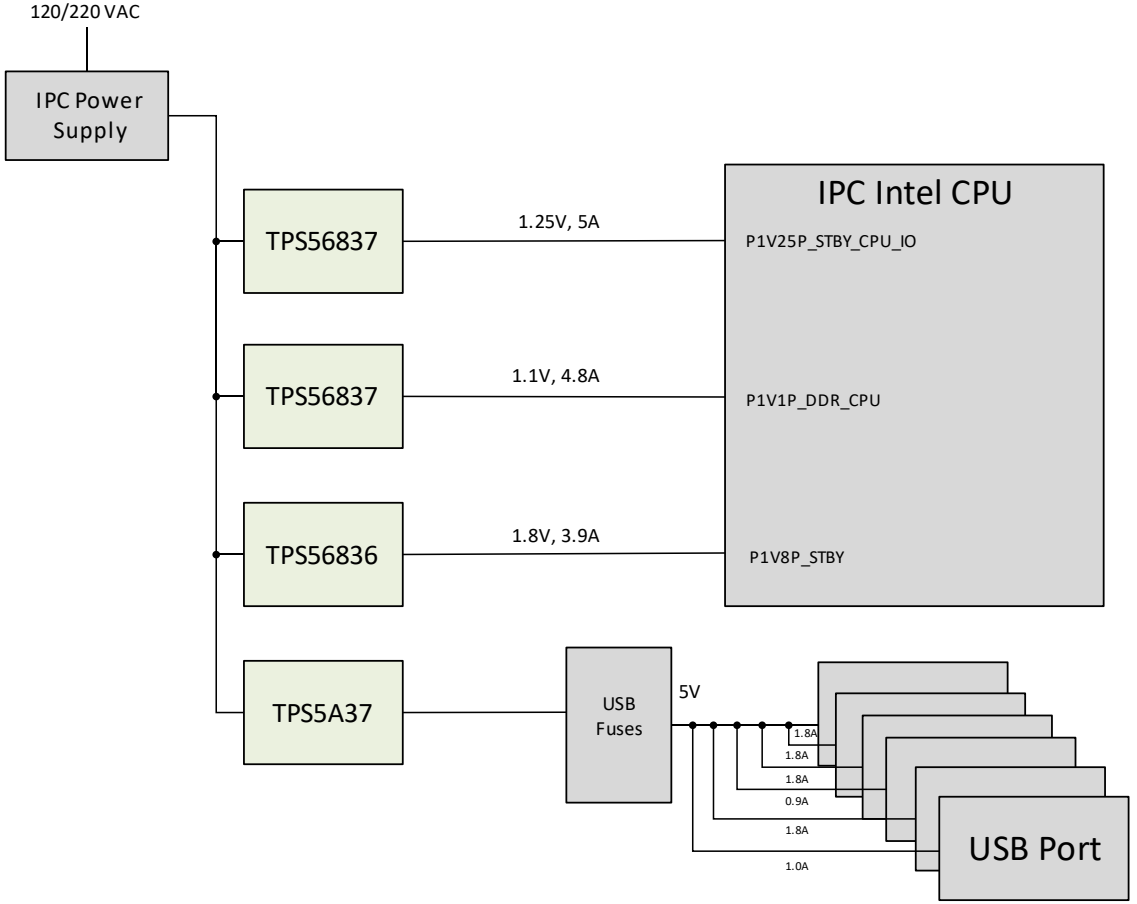
Use case | Industrial PC

- Scalability across different socket needs
- High efficiency
- OOA operational mode



TPS5683x and TPS56A37 powering CPU standby, DDR, and system USB rails

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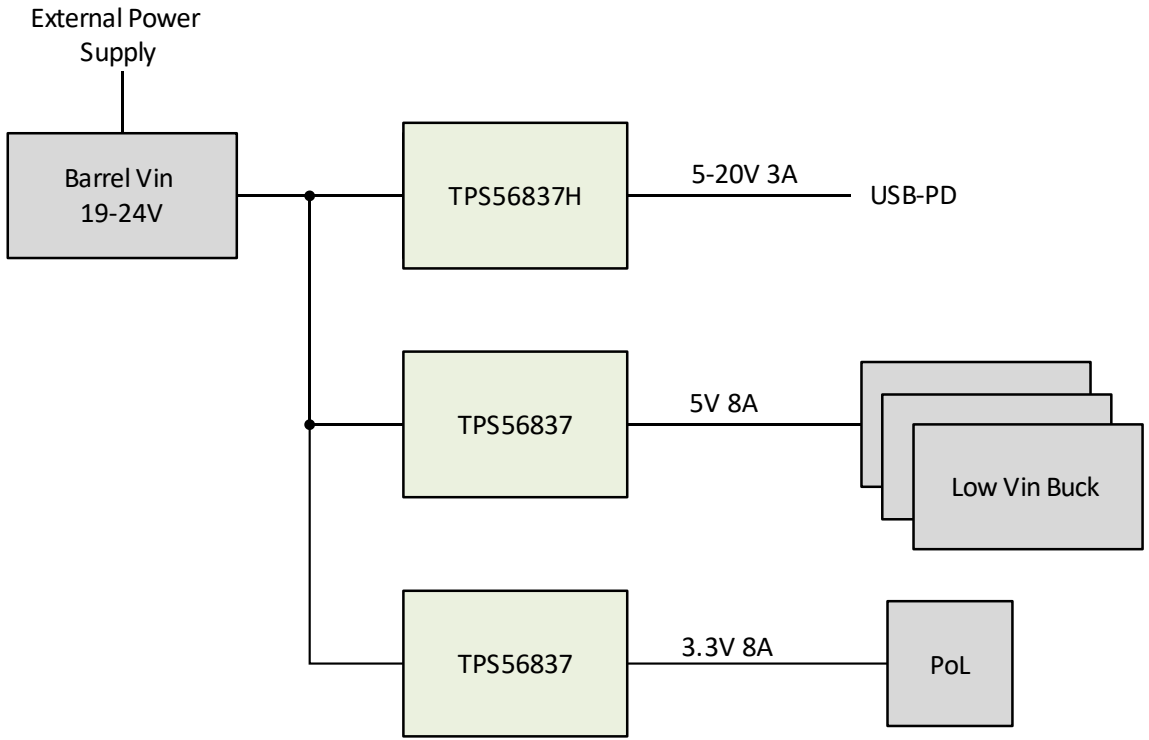
Use case | Monitor

- USB-PD 20Vout delivery capability
- Light load efficiency



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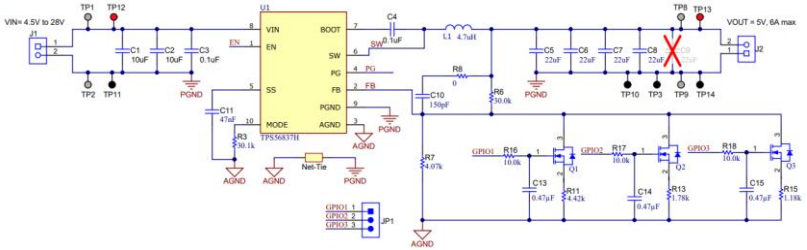
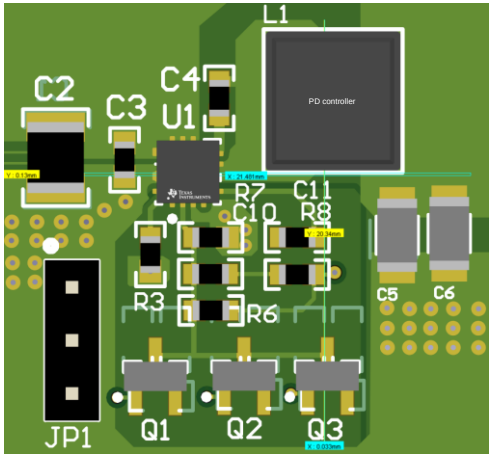
Use case | USB-C PD charger

~21mm x 20mm = 420mm^2

PD controller GPIO for TPS56837H control

- Simple GPIO operation
- Available for more controllers across market

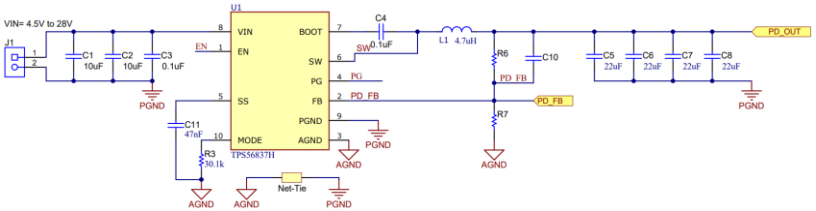


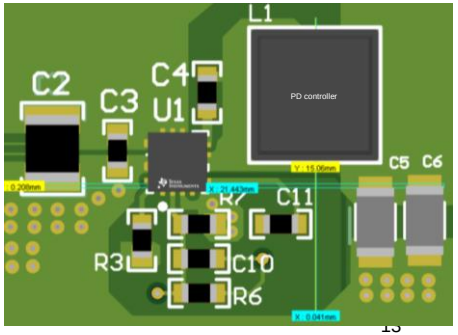


PD controller FB output for TPS56837H control

~21mm x 15mm = 315mm^2

- Simpler schematic design and smaller design size
- Design effort required for R and C per PD controller parameters





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TPSM86x38 (Cassiopeia Module)

4.5V – 28V, 6A/8A buck power module

Features

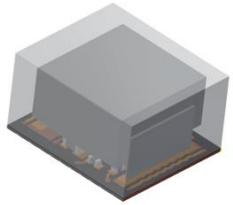
- 4.5-V to 28-V wide input voltage range
- 0.6-V to 5.5V output voltage range for 8-A
- 0.6-V to 13V output voltage range for 6-A
- **800KHz/1200KHz** adjustable switching frequency
- D-CAP3™ control mode for fast transient response
- FCCM for small output ripple during light load
- **Adjustable soft start**
- 0.6-V ±1% reference voltage @25C
- Built-in output discharge function & power good indicator
- OVP/UVP/OTP
- **Package: QFN 2.1, 5x5.5x4mm**

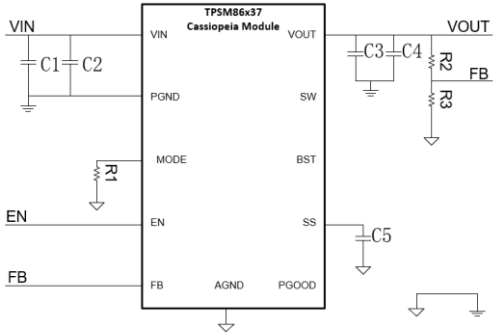
Applications

- Industrial: IPC, factory automation and control, medical applications
- Enterprise Systems: Servers, routers, networking, base stations
- High power density POL conversion

Benefits

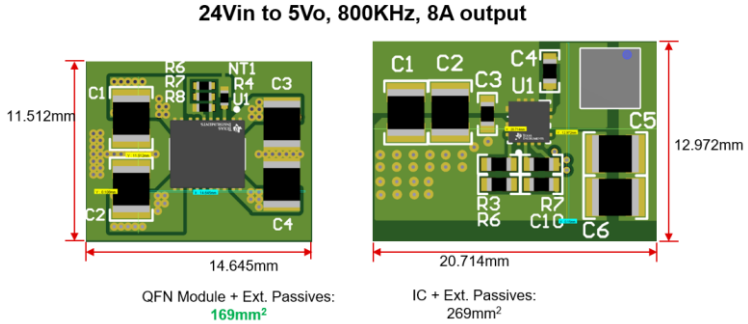
- Highest power density module for 28V device
- High efficiency at heavy loading
- Improved light-load efficiency with PSM
- Adjustable switching frequency
- D-CAP3 control with fast transient response
- **98% large duty support**
- Lowest external component count
- Small footprint to save PCB area
- Cost effective





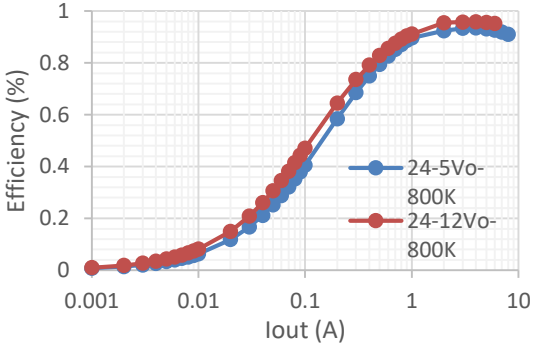
TPSM86x38 advantages

Easy for design and save PCB area



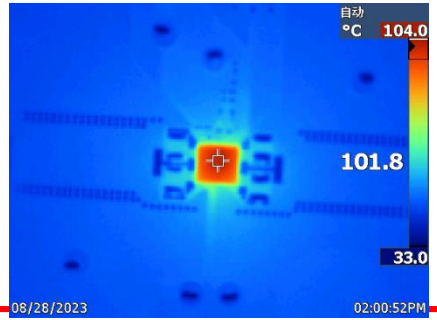
High efficiency

- 91.92% @24Vin-5Vout-7A
- 92.63% @24Vin-5Vout-6A
- 95.61% @24Vin-12Vout-6A @800KHz

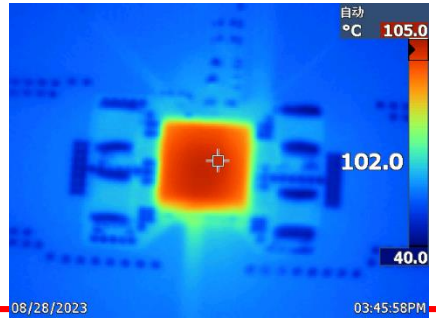


Thermal

24Vin-5Vout-7A 800K

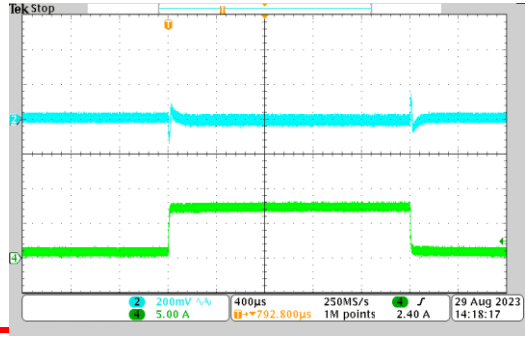


24Vin-12Vout-6A 800K



Fast transient response

- 24Vin-5Vout-0.8-7.2A 800KHz transient
- 162mv/150mV overshoot/undershoot



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Module vs discrete BoM:

15 components, 11 line items

20% component reduction

12 components, 9 line items

Discrete

REFERENCE DESIGNATOR	QUANTITY	VALUE	DESCRIPTION
C1, C2	2	10uF	CAP, CERM, 10 uF, 35 V, +/- 10%, X7R, 1210
C3, C4, C5	3	22uF	CAP, CERM, 22 uF, 25 V, +/- 10%, X7R, 1210
Cin, Cbst	2	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 0603
L	1	1.5uH	L = 1.5 µH, DCR = 14 mΩ, IDC = 9 A
C8	1	47pF	CAP, CERM, 47 pF, 50 V, +/- 1%, C0G/NP0, 0402
C9	1	0.047uF	CAP, CERM, 0.047 uF, 50 V, +/- 10%, X7R, 0402
R4	1	162k	RES, 162 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402
R7	1	20.0k	RES, 20.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402
R8	1	10.0k	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402
R9	1	100k	RES, 100 k, 1%, 0.063 W, 0402
U1	1		4.5-V to 28-V Input, 8-A Synchronous Buck Converter

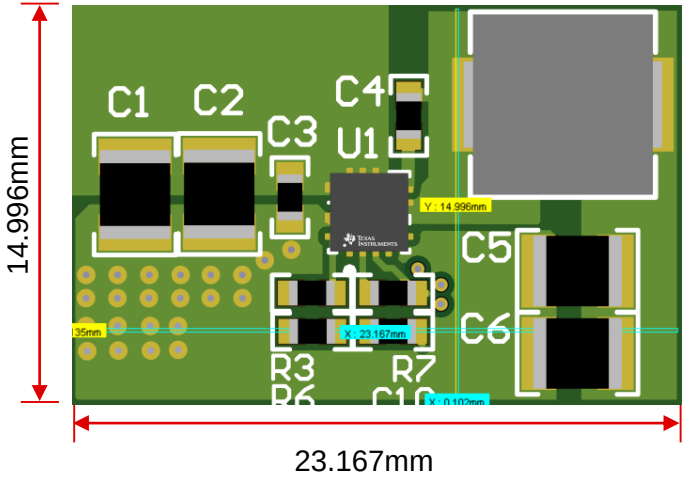
Module

REFERENCE DESIGNATOR	QUANTITY	VALUE	DESCRIPTION
C1, C2	2	10uF	CAP, CERM, 10 uF, 35 V, +/- 10%, X7R, 1210
C3, C4, C5	3	22uF	CAP, CERM, 22 uF, 25 V, +/- 10%, X7R, 1210
C8	1	47pF	CAP, CERM, 47 pF, 50 V, +/- 1%, C0G/NP0, 0402
C9	1	0.047uF	CAP, CERM, 0.047 uF, 50 V, +/- 10%, X7R, 0402
R4	1	162k	RES, 162 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402
R7	1	20.0k	RES, 20.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402
R8	1	10.0k	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402
R9	1	100k	RES, 100 k, 1%, 0.063 W, 0402
U1	1		4.5V-28V, 8A Buck Power Module

Module vs discrete size:

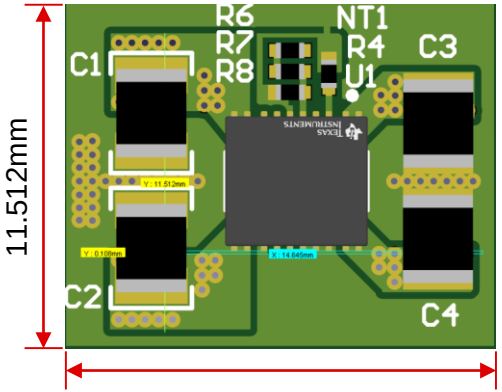
24Vin to 5Vo, 500KHz, 8A output

IC + Ext. passives:
347mm^2



~51% area savings

QFN module + Ext. passives:
169mm^2



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