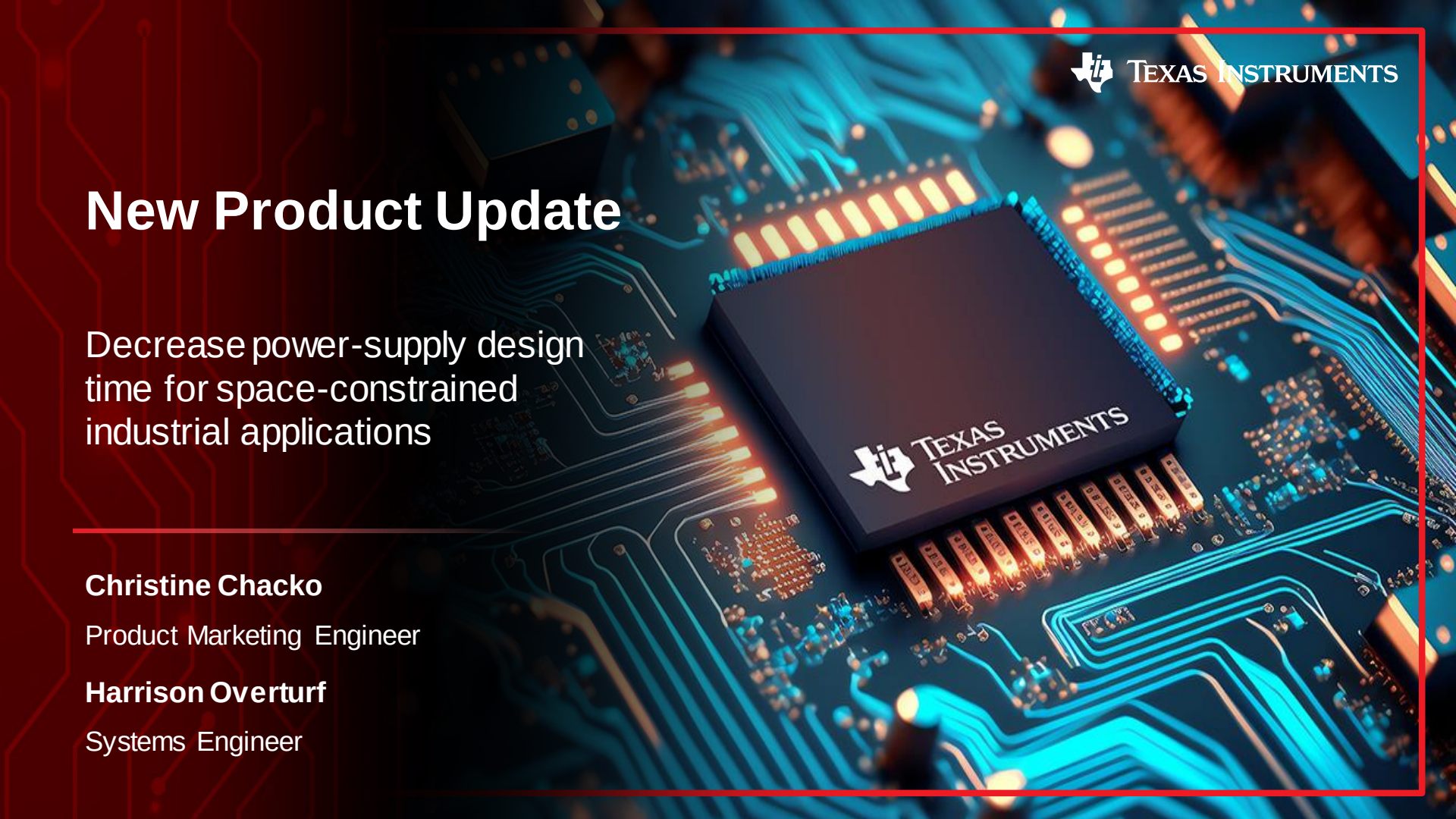
New Product Update

Decrease power-supply design time for space-constrained industrial applications



Christine Chacko

Product Marketing Engineer

Harrison Overturf

Systems Engineer

Agenda

- What is a buck module?
- TPSM365R1 and TPSM365R15 product overview
- Benefits of using a buck module solution

What is a buck module?

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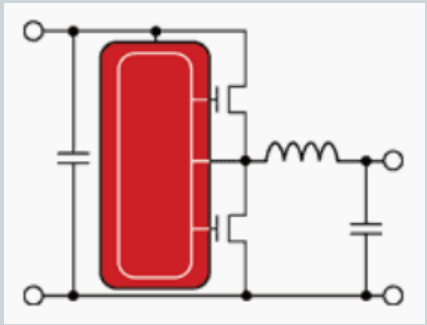
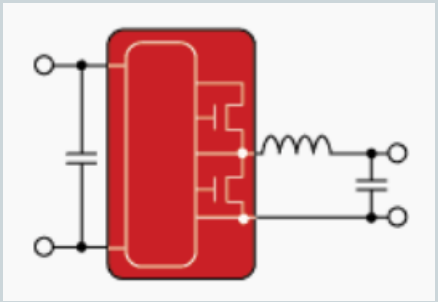
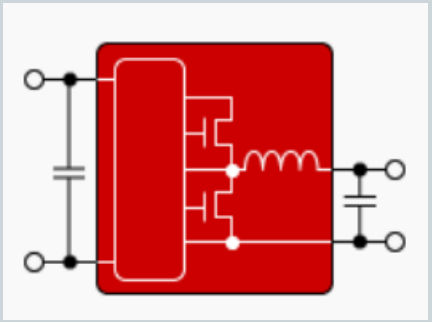
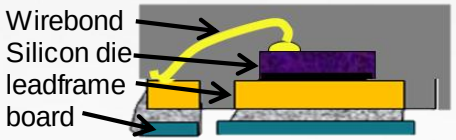
Step-down (buck) switching regulators

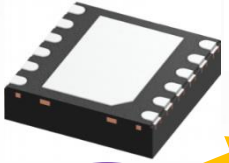
Controller	Converter	Power Module
		
- External FETs - External inductor	- Internal FETs - External inductor	- Internal FETs - Internal inductor - Internal caps and resistors

Package evolution



Leaded package with Thermal PAD

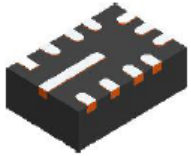
HTSSOP package



Reduced package size

WSON QFN

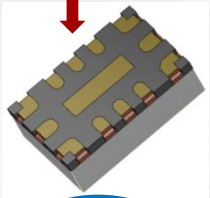
- Optimized thermals
- Unleaded package



Wirebonds eliminated

HotRod QFN

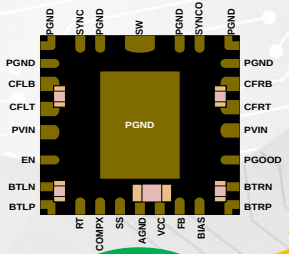
- Optimized EMI
- Optimized size
- Thermal performance constrained by pin out



Optimized thermals

Enhanced HR QFN

- Optimized EMI
- Optimized thermals
- Bump spacing 160 µm for high density routing



Optimized EMI

Integrated caps

- High integration, passive footprints hidden from user
- Improved EMI
- Bump spacing 160 µm for high density routing

Power module

Integrated inductor

- Highest integration
- Best EMI
- Fastest time to market

TPSM365R1 and TPSM365R15 product overview

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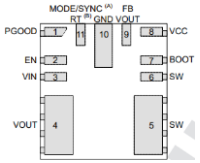
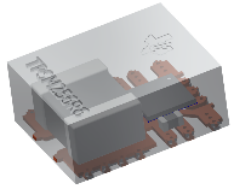
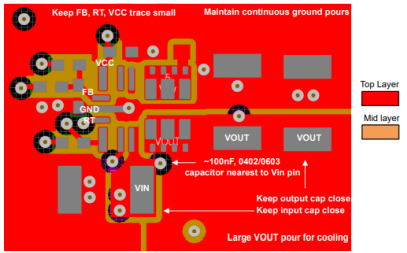
Benefits overview

- The TPSM365R1/15 provides pin-to-pin scalability with the TPSM33625 and TPSM365R6 across the 36V and 65V space from 0.1A to 2.5A
- Improved EMI performance with FCOL packaging, integrated boot capacitor and Spread Spectrum
- Reduce time to market with lower BOM count with module solution
- Excellent I_Q performance
- Small, simplified layout
  - Package area: 15.75 mm^2







TPSM365R1/15

65 V, 100 mA and 150 mA Synchronous Step-Down DC-DC Power Module

Features

- **6 µA No Load Iq** with **Fixed VOUT/ BIAS** option
- **Combined Fixed V_{OUT} and ADJ V_{OUT} into one device**
  - Fixed 3.3-V / ADJ (1 V-16 V)
  - Fixed 5.0-V / ADJ (1 V-16 V)
- **Highest Low Load Efficiency**
- **Wide VIN range: 3.4 V – 65 V (Abs. Max = 70 V)**
  - **VIN UVLO Falling = 3 V**
- **MODE/SYNC** version pin variant
  - **Pin-select Auto Mode or FPWM** operation at light load
  - **Synchronizable** to External Clock 200 kHz to 2.2 MHz
- **RT pin** for Adjustable Output. Configurations:
  - RT → GND=1 MHz, RT → VCC=2.2 MHz, Resistor Program=200 kHz-2.2 MHz
- **Designed for Low EMI**
  - **FCOL Package (4.5 mm X 3.5 mm X 2 mm)**
  - **Pseudo Random Spread Spectrum (PRSS)**
- **Precision EN/UVLO and PGOOD with delay**
- **Operating Junction temp. range -40°C to 125°C**

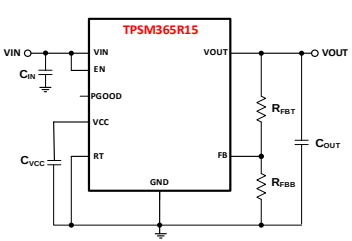
Applications

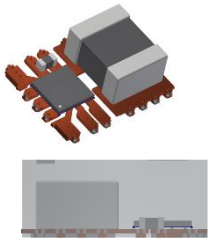
- Industrial: Control/field transmitters, test equipment, PLC

Benefits

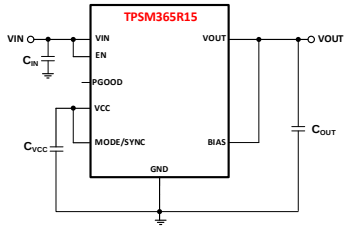
- Wide input for applications with unregulated 24-V bus. No input protection needed.
- Mode pin to enable fixed frequency and ultra low ripple over entire load range. PFM mode for applications which require high efficiency at light loads
- Adjustable frequency to enable a wide VOUT range.
- Bias input for Fixed VOUT options to improve efficiency over load
- Ease of power sequencing with PGOOD

Adjustable VOUT





Fixed VOUT



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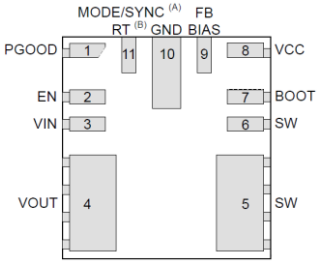
Pin-to-pin compatibility

4.5-mm × 3.5-mm × 2-mm pin-to-pin compatible HR-QFN 11-pin package solution from 100 mA to 2.5 A

65 V_{IN}	65 V_{IN}	65 V_{IN}	65 V_{IN}	36 V_{IN}	36 V_{IN}
0.1 A	**0.15 A**	**0.3 A**	**0.6 A**	**1.5 A**	**2.5 A**
TPSM365R1	**TPSM365R15**	**TPSM365R3**	**TPSM36R6**	**TPSM33615**	**TPSM33625**



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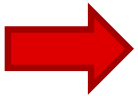
Benefits of using a buck module solution

Design factors to consider

Total solution cost consists of

- Material cost a.k.a. “BOM” price
  - IC price
  - Inductor, capacitors, resistors, etc.
- PCB costs
  - Footprint area
  - Via costs
  - Individual component placement cost
- Design time
  - R&D cost, time sensitivity of market

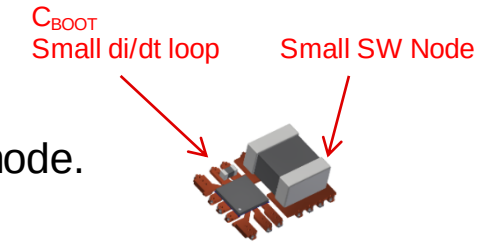


Benefits to using a module

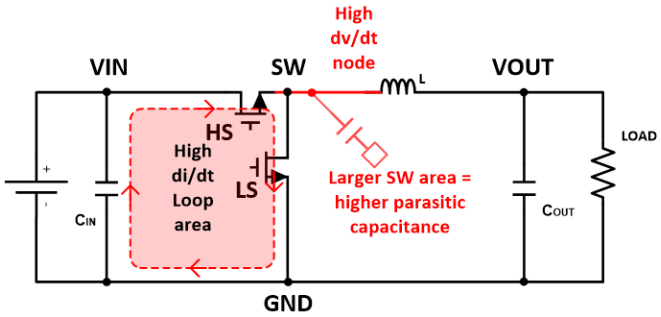
- Materials
  - Less needed passives and less sourcing of material
  - TI offers competitive pricing which may offer you a better deal on materials
- PCB costs
  - Modules enable smaller footprints and easier layouts
- Design time
  - Less validation and research needed when selecting components
  - Faster and easier designs allow for engineers to focus on other critical challenges and speed time to market

EMI advantages by optimizing layout

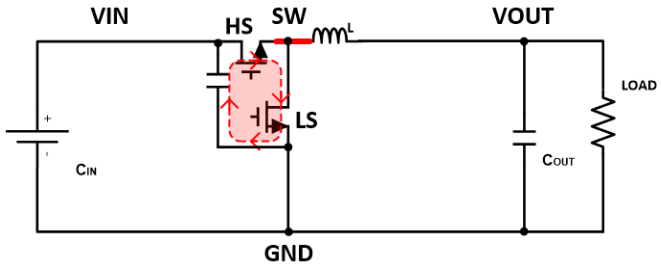
- Reducing the high di/dt loop area – integrated input capacitance.
- Reducing the high dv/dt node area – integrated L and smaller switch node.



Discrete solution without optimized layout



DC-DC Power Module



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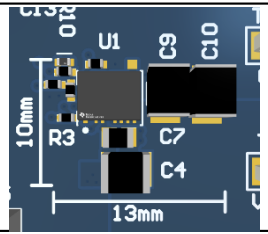
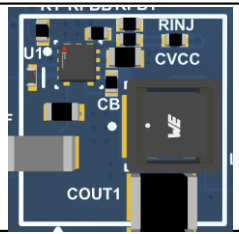
Converter vs module

Design specifications: V_{IN} (nominal) = 24 V V_{OUT} = 3.3 V | I_{OUT} = 0.15 A	Module TPSM365R15 65 V_{IN}, 0.15-A, 6.5-mm x 7.5-mm QFN	Converter alternative LMR36502 65-V_{IN}, 0.15-A, 2.0-mm x 2.0-mm VQFN
Optimized layout (EVM)		
Efficiency [24 V to 3.3 V, 0.15 A]	75%	82%
Solution area	130 mm^2	150 mm^2
Solution component count	5 (11 on EVM*)	7 (17 on EVM*)
1-ku Web price	$1.30	$1.25
1-ku BOM cost**	$1.46	$1.65

*EVM optimized for multiple use cases
**Cost will change based on available passive components

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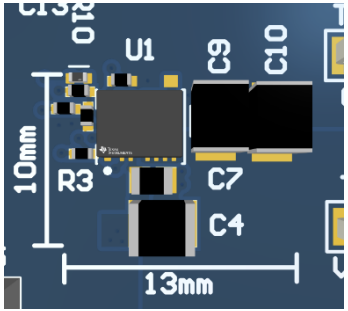
Buck modules | innovation in power density

Smallest solution size while quickly meeting EMI standards by reducing emissions

Smaller footprint

Reduce the BOM and PCB area

- Innovative package techniques and High performance silicon
- **Shrink solution sizes up to 50%** and use as little as 4 external components



Reduce design time and complexity

Allow TI engineers to do the heavy work & Speed time to market

- **Easy to use** and design with TI modules allowing more time to be spent on other critical design aspects
- TI Module designer selects optimal BoM and passives for the IC and does rigorous vetting of internal BOM components

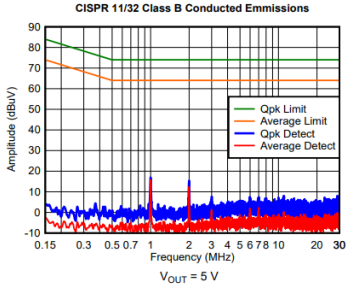
Eliminate:

- Control architecture influences
- Layout challenges
- Inductor sourcing
- Lab prototyping

Ultra-Low EMI Performance

Fundamentally reduce generated EMI at the source

- Integrated passives and low-EMI performance features create inherent low noise devices
- **Shrink filters** and **meet EMI standards easier** with features like: DRSS, low noise package design, minimized parasitic loops with integrated passives and more



Texas Instruments has been investing for decades in **TIME-SAVING** and **COST-EFFECTIVE** innovations to shrink solutions and reduce EMI in power supplies.

Getting started

You can start evaluating this device leveraging the following:

Content type	Content title	Link to content or more details
Product folder	TPSM365R1/15	https://www.ti.com/product/TPSM365R1 https://www.ti.com/product/TPSM365R15
Training video	Exploring the value of modules	https://training.ti.com/exploring-value-power-modules
Technical blog content or white paper	Enabling Small, Cool and Quiet Power Modules with Enhanced HotRod™ QFN Packaging	https://www.ti.com/lit/pdf/slyy181
Selection and design tools and models	WEBENCH® circuit design and selection simulation services	https://webench.ti.com/power-designer/
Development tool or evaluation kit	TPSM3365R15EVM	https://www.ti.com/tool/TPSM365R15EVM

Visit www.ti.com/npu

For more information on the New Product Update series, calendar and archived recordings

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