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Texas Instruments New Product Update

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- **Phone lines are muted**
- **Please post questions in the chat or contact your TI sales contact or field applications engineer**

SPEED UP TIME TO MARKET AND INCREASE POWER DENSITY WITH BUCK MODULES

New Product Update

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Agenda

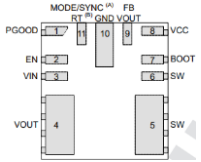
- Product overview
  - TPSM33625 (36 V, 2.5 A) and TPSM365R6 (65 V, 0.6 A)
- Benefits of using a buck module solution
- Latest advancements in buck module technology
  - Improved EMI performance, low quiescent current (I_Q), and high efficiency at light loads

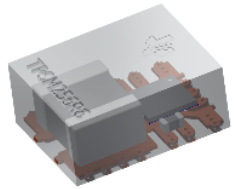
Please feel free to “chat” with Denislav, Applications Engineer Manager, who is available to answer any questions you have throughout this presentation.

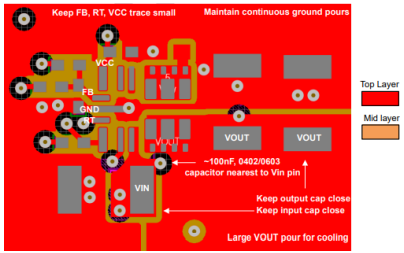
Product overview

Benefits overview

- The TPSM33625 and TPSM365R6 provides pin-to-pin power scalability in the 36 V and 65 V space from 0.6 A to 2.5 A
- Improved EMI performance with FCOL packaging, integrated boot capacitor and Pseudo-Random Spread Spectrum (PRSS)
- Reduce time to market with lower BOM count with module solution
- Excellent I_Q performance
- Small, simplified layout
  - Package area: 15.75 mm^2
- IPC2221A(L) compliant

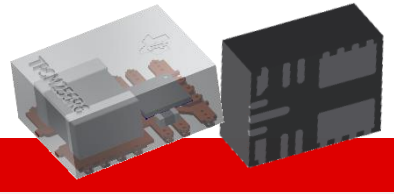






TPSM365R6

65-V, 600-mA synchronous step-down DC/DC power module



Features

- Adjustable output voltage range of **1 V to 13 V** and **fixed 3.3 V, 5 V** variants
- **Lowest I_Q solution** – 4 µA at 24 V_{IN} to 3.3 V_{OUT} (fixed-output option)
- **SYNC/MODE with fixed output**
  - FPWM (Fixed-frequency operation at no load)
  - PFM (Improved light load efficiency at light load)
- **BIAS input with fixed V_{OUT}** to enable high efficiency for wide-V_{IN} operation
- **RT pin** for adjustable output. Configurations:
  - RT -> GND = 1 MHz, RT -> VCC = 2.2 MHz, resistor program = 400 kHz to 2.2 MHz
- **Low EMI solution** with PSRR spread spectrum and FCOL package
- Pin spacing complies with IPC2221A(L)
- **FCOL package 4.5 mm x 3.5 mm x 2.0 mm**

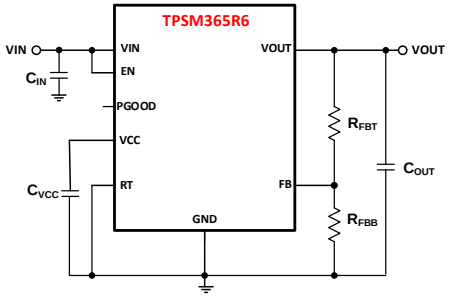
Applications

- Control/field transmitters
- Application specific test equipment
- PLC, DCS

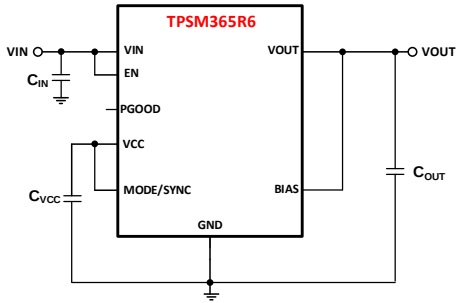
Benefits

- 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 V_{OUT} range.
- Bias input for fixed V_{OUT} options to improve efficiency over load.
- Ease of power sequencing with PGOOD.

Adjustable VOUT



Fixed VOUT



TPSM33625

36-V, 2.5-A synchronous step-down DC/DC power module

Features

- **Combined Fixed V_{OUT} and ADJ V_{OUT} into one device**
  - Fixed-3.3 V / ADJ and fixed-5.0 V / ADJ versions available
- **1.5-µA standby I_Q** with 13.5 V to fixed 3.3 V no load
- **MODE/SYNC** version (fixed 1 MHz)
  - **Pin-select auto mode or FPWM** operation at light load
  - **Synchronizable** to external clock 250 kHz to 2.2 MHz
- **RT version**
  - **Frequency adjustable** (200kHz to 2.5MHz) by external resistor
- **Design for low EMI**
  - **Leadless FCOL package -** 4.5 mm x 3.5 mm x 2.0 mm
  - **Advanced spread spectrum - DRSS**
  - Adjustable F_{SW} from **200 kHz to 2.2 MHz** with RT pin variant
    - Forced PWM / PFM factory setting
- **FCOL package 4.5 mm x 3.5 mm x 2.0 mm**

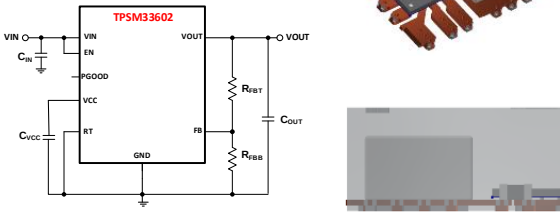
Applications

- Factory automation
- Test & measurement
- Grid

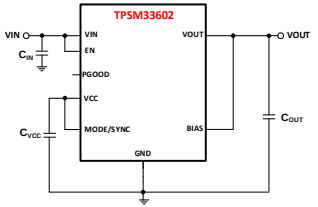
Benefits

- 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 V_{OUT} range.
- Bias input for fixed V_{OUT} options to improve efficiency over load.
- Ease of power sequencing with PGOOD.

Adjustable V_{OUT}



Fixed V_{OUT}



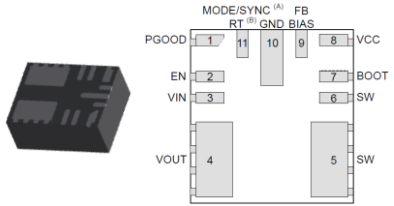
Pin-to-pin compatibility

4.5-mm × 3.5-mm × 2-mm pin-to-pin compatible HR-QFN 11-pin package solution from 150 mA to 2.5 A

65 V_{IN}
0.15 A
(under development)

65 V_{IN}
0.6 A
TPSM36R6

36 V_{IN}
2.5 A
TPSM33625

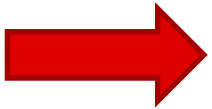


Benefits of using a buck module solution

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

Design factors to consider

General design challenges:

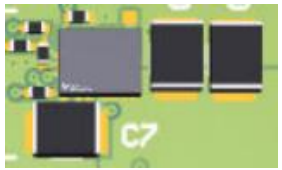
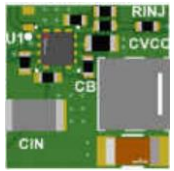
- Control architecture influences
- Layout challenges
- Inductor and passive sourcing
- Lab prototyping
- Validation of components
- Selecting BOM components that are optimal for the design

Benefits to using a module

TI module designer does the heavy lifting!

- Optimal converter is selected to cover design specifications
- Selects BOM components that are optimal for the converter
- Characterizes solution across corner cases
- Leverages latest technology to meet market requirements
- Rigorous vetting of internal BOM components – not every inductor or capacitor is created equal!

Converter vs module

Design specifications: V_{IN} (nominal) = 24 V V_{OUT} = 3.3 V | I_{OUT} = 2 A	Module TLVM23625 36 V_{IN}, 2.5 A, 6.5-mm x 7.5-mm QFN	Converter alternative LMR43620-Q1 36-V_{IN}, 8-A, 4.5-mm x 3.5-mm VQFN
Optimized layout (EVM)		
Efficiency [24 V to 5 V, 8 A]	86.45%	87.4%
Solution area	82.6 mm^2	160 mm^2
Solution component count	7	9
1-ku Web price	$1.50*	$1.03
1-ku BOM cost**	$1.83	$1.70

*Price may change prior to release

**Cost will change based on available passive components

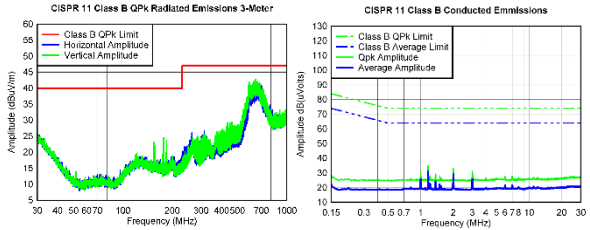
Latest advancements in buck module technology

Modules – Leaders in integration and ease of use

Less noise

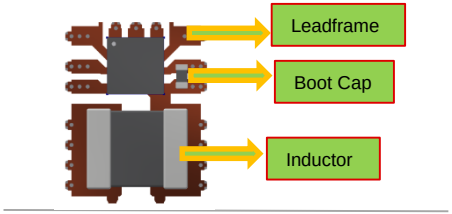
Wide range of EMI mitigating features for noise sensitive applications:

- Spread spectrum to reduce peak emissions
- Pin selectable FPWM mode or FSW synchronization with MODE/SYNC
- Low-noise package with dual-input paths and integrated capacitors reduces switch ringing
- Resistor-adjustable switch-node slew rate
- Meets CISPR 11 and 32 Class B emissions



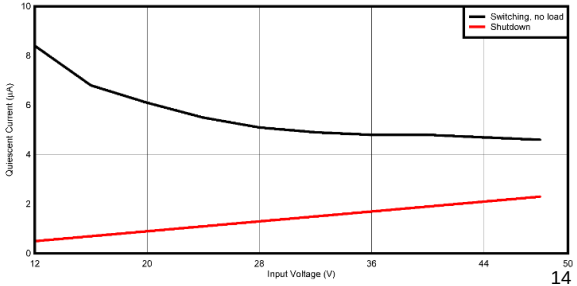
Small area, Few components, Fast design time

- Integrated inductor and boot capacitors to cut down BOM
- Requires minimal external components for fixed output solutions
- Integrated loop compensation cuts down design time
- Hotrod™ QFN package for EMI mitigation and enhanced QFN package for EMI mitigation and exceptional thermal performance

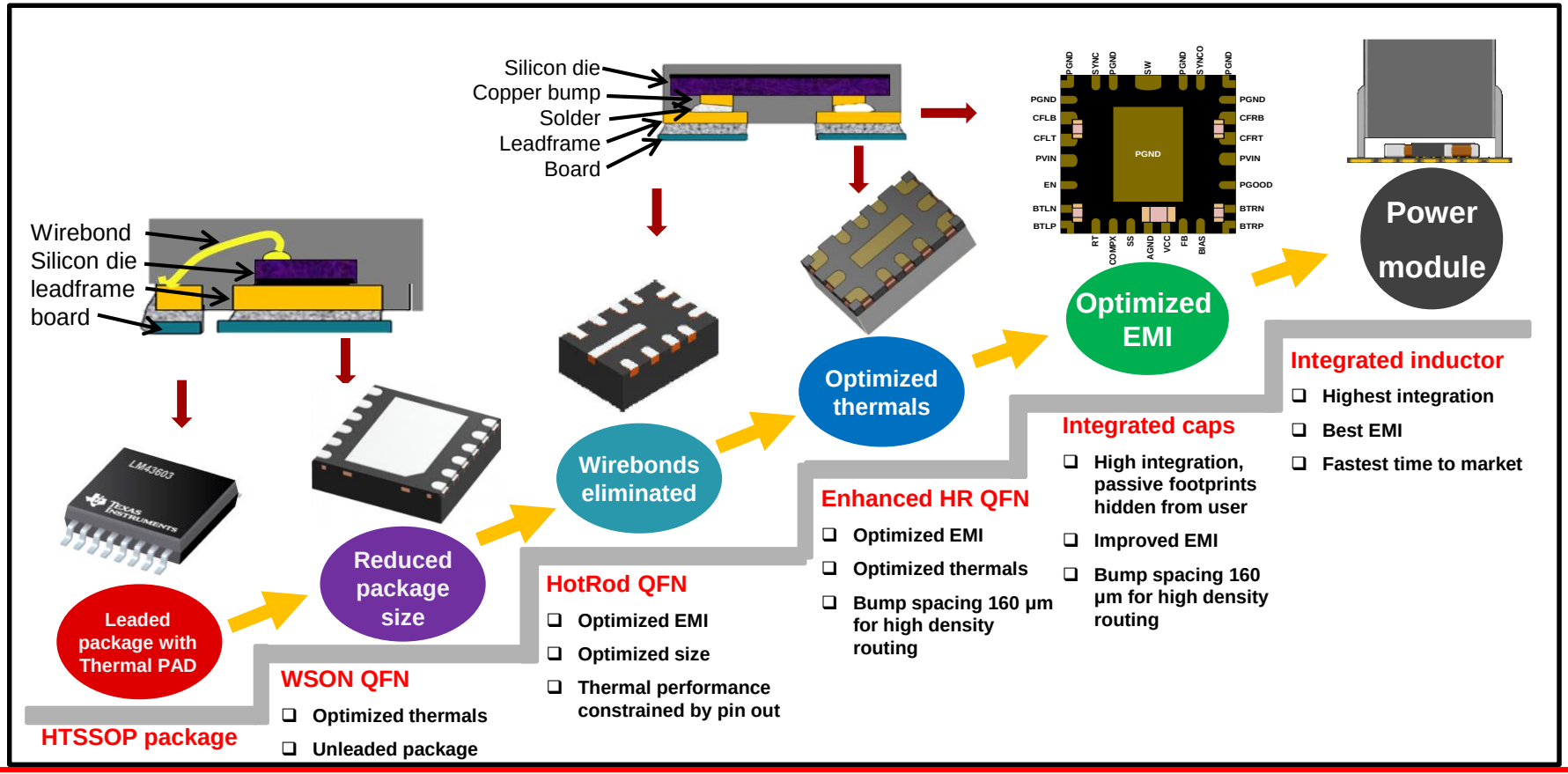


Low I_Q

- Ultra-low operating quiescent current at switching (no load) and at shutdown for increased shelf life for battery powered solutions



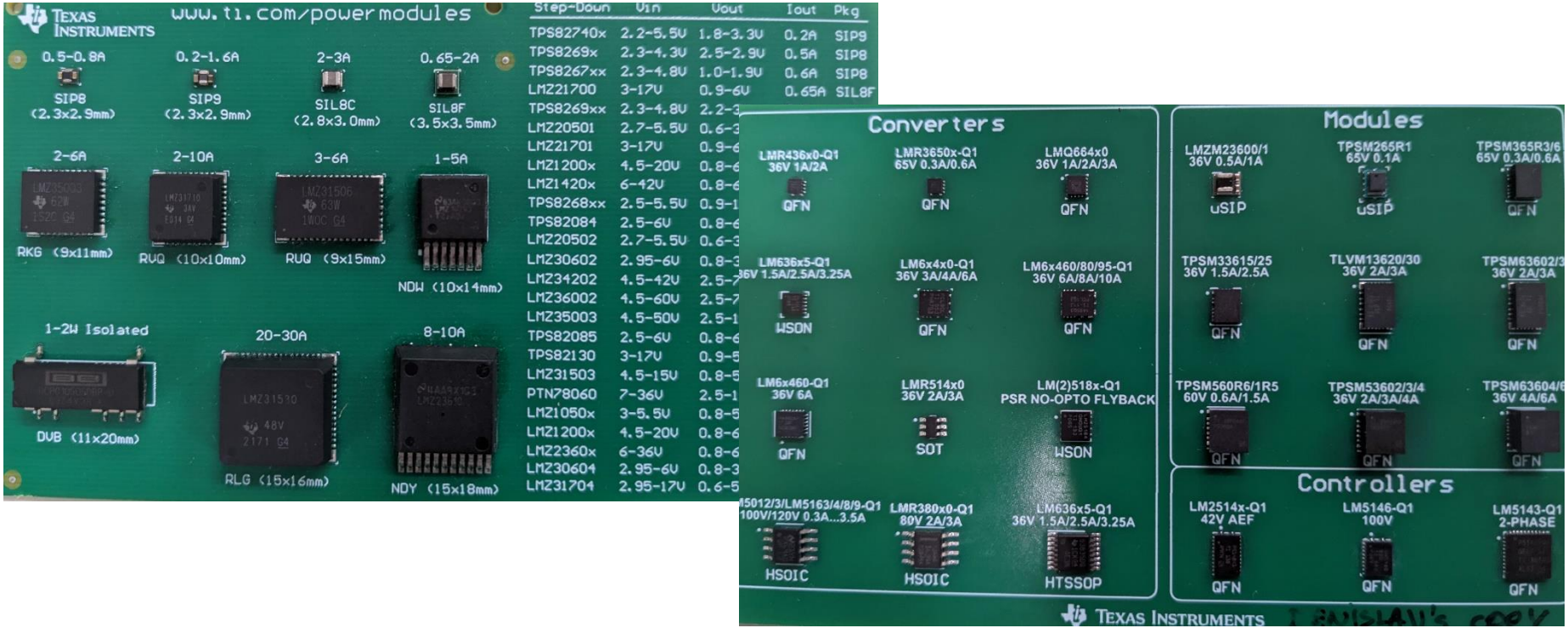
Package evolution



Advanced EMI reduction features

Feature	Benefit
Integrating the inductor and C_{BOOT} cap	Reduces parasitic noise by placing components as close as possible to sensitive nodes
HotRod™ QFN and FCOL package	Reduces parasitic inductances on high $\frac{di}{dt}$ current loops
PRSS (Psuedo-Random Spread Spectrum) DRSS (Dual-Random Spread Spectrum)	Reduces peak emissions at low and high frequency without concern for spread spectrum-induced audible noise, ensuring good EMI performance.
FPWM mode	Helps keep switching frequency constant across load range

Achieving power dense products



Getting started

You can start evaluating this device leveraging the following:

Content type	Content title	Link to content or more details
Product folder	TPSM33625 TPSM365R6	https://www.ti.com/product/TPSM33625 https://www.ti.com/product/TPSM365R6
Training video	Exploring the value of modules	https://training.ti.com/exploring-value-power-modules
Technical blog content or white paper	• Addressing Factory Automation Challenges With Innovations in Power Design • Enabling Small, Cool and Quiet Power Modules with Enhanced HotRod™ QFN Packaging	https://www.ti.com/lit/pdf/slyy212 https://www.ti.com/lit/pdf/slyy181
Selection and design tools and models	WEBENCH® circuit design and selection simulation services	Webench design link
Development tool or evaluation kit	TPSM33625EVM TPSM33625FEVM TPSM365R6EVM TPSM365R6FEVM	https://www.ti.com/tool/TPSM33625EVM https://www.ti.com/tool/TPSM33625FEVM https://www.ti.com/tool/TPSM365R6EVM https://www.ti.com/tool/TPSM365R6FEVM

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