Welcome!
Texas Instruments New Product Update

- This webinar will be recorded and available at www.ti.com/npu
- Phone lines will be muted
- Please post questions in the chat or contact your sales person or field applications engineer

New Product Update:

Using high-density wide V_{IN} bucks to solve industrial design challenges

Tristan Scott

2/11/2021

Agenda

- Wide V_{IN} switching regulators introduction
- Package technology evolution
- Newly-released and sampling power-density leaders
  - Package size comparison
  - Solution size comparison
- Device overviews and value propositions

>30V Wide V_{IN} DC/DC converters, controllers & power modules

Focus Applications

Automotive
12V/24/48V battery

Industrial
24V & higher Bus

Communications
24V/48V systems

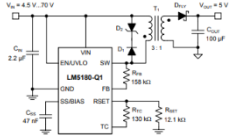
Products

Integrated Buck Modules

Buck Converters

Buck Controllers

Isolated DC-DC: Fly-Buck, PSR Flyback



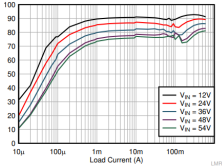
System Benefits

Wide Vin Operation

Withstand transients with less protection circuitry

WIDEV_{IN}

High Efficiency



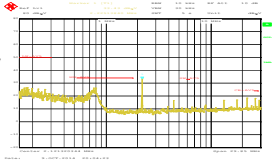
2MHz Switching

Smaller PCB area, AM band avoidance

Low Iq

High light load efficiency, long battery life

Reduced EMI



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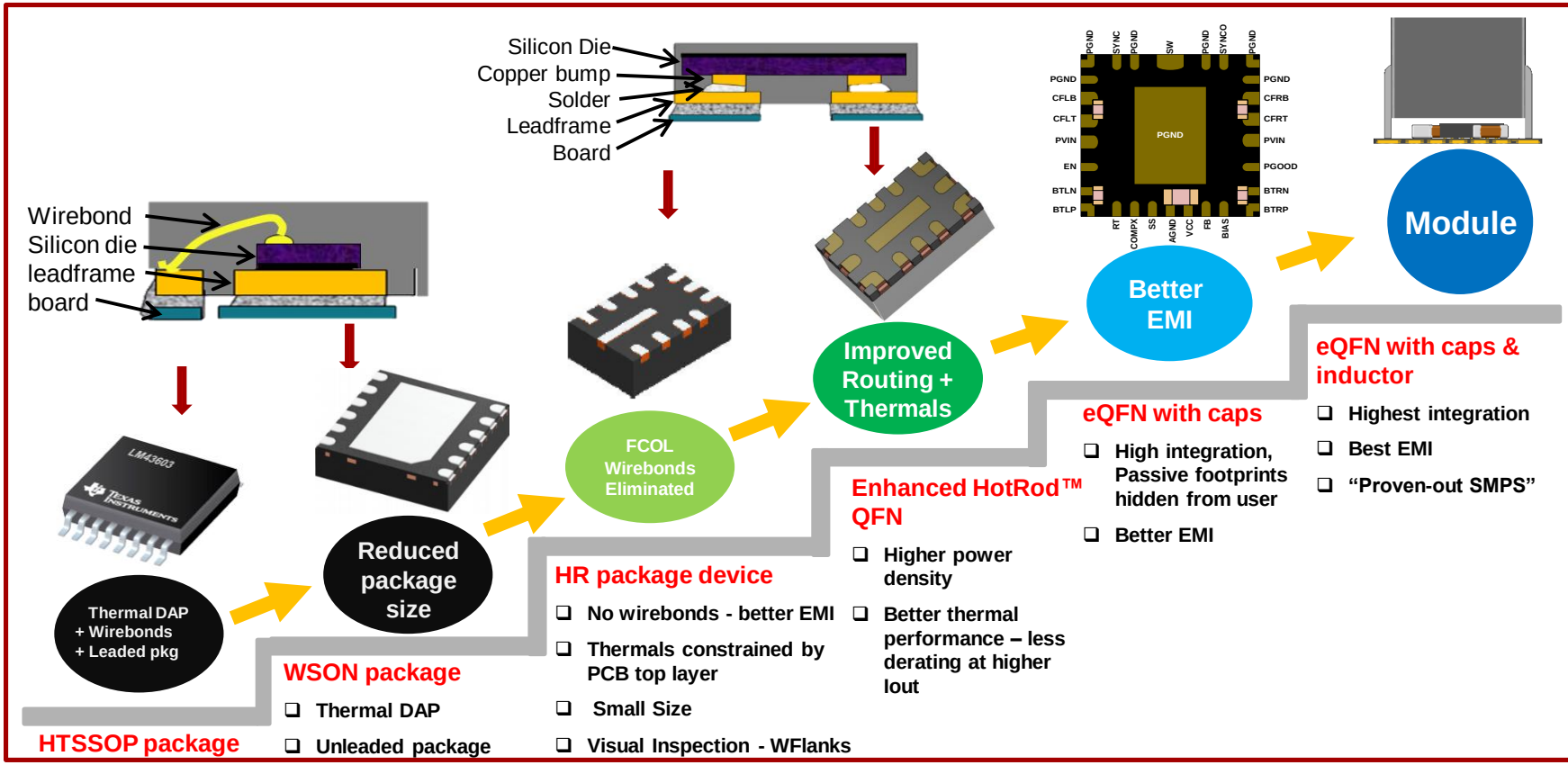
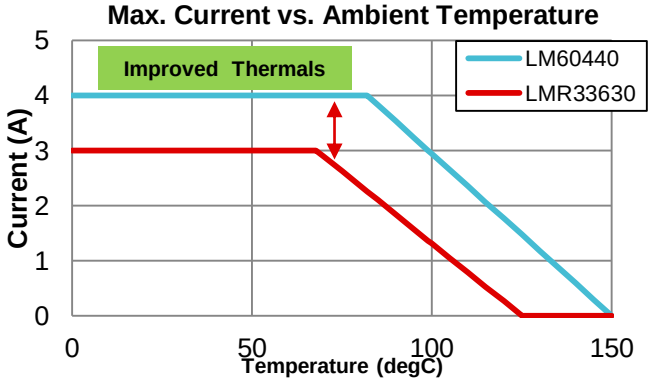
Wide V_{IN} buck regulator packaging evolution



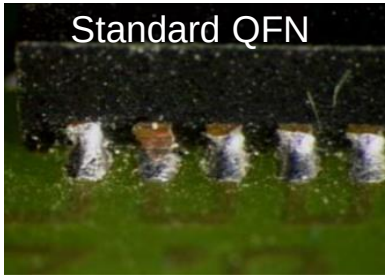
Enhanced HotRod QFN: Optimized EMI & Thermals

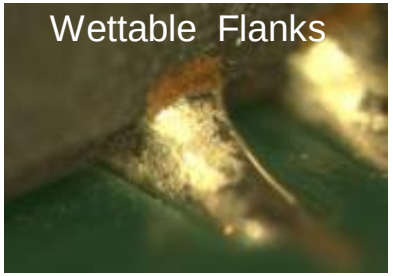
Optimized for EMI and Thermals



Optimized for Manufacturing

- **Wettable flanks** guarantees visible side-wetting at good solder joints
- **Corner pins** with **NiPdAu** finish improves BLR performance
  - Previous Gen: 3024 cycles of Board Level Reliability (BLR)*
  - LM60440: 5737 cycles of BLR with no failure

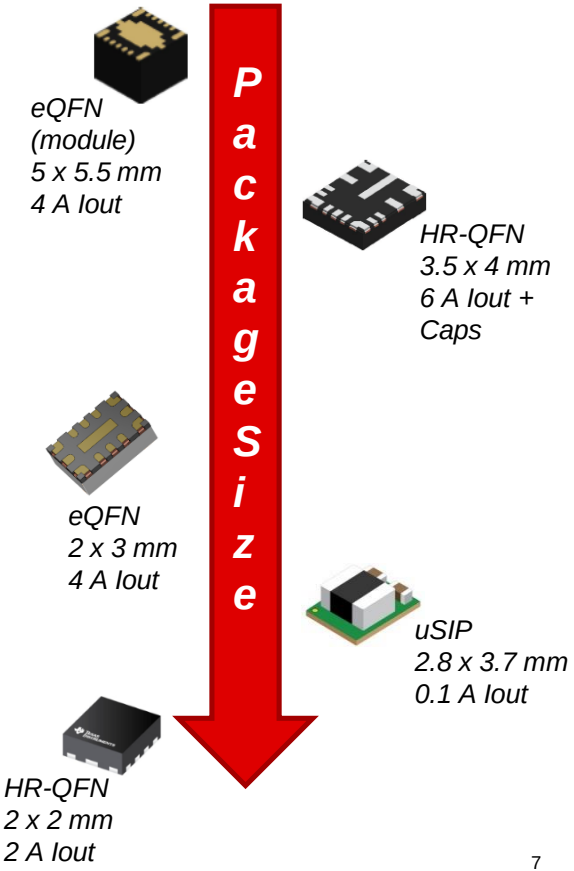




*Note: BLR is used to evaluate the solder connections between the IC and PCB.

How small is small?

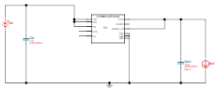
- New wide V_{IN} power-dense products to highlight
  - LMQ61460 (36V, 6A)
    - ***3.5 x 4 mm*** HR-QFN pkg w/ integrated caps
  - LM60440 (36V, 4A)
    - ***2 x 3 mm*** eQFN pkg
  - TPSM53604 (36V, 4A) & TPSM5601R5H (60V, 1.5A)
    - ***5 x 5.5 mm*** eQFN w/ integrated inductor
  - LMR36506 (65V, 600mA)
    - ***2 x 2 mm*** HR-QFN
  - TPSM265R1 (65V, 100mA)
    - ***2.8 x 3.7 mm*** uSIP pkg w/ integrated inductor



WEBENCH® Power Designer solution size comparison

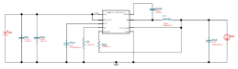
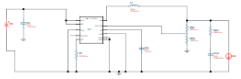
65V, 100mA Comparison

VIEW OPTIONS: Basic / Advanced

	TPSM265R1V5 **New!**	LM5165X
	3-V to 65-V input, 100-mA, step-down power module in 2.8 x 3.7 mm package	3V-65V, 150mA Synchronous Buck Converter With Ultra-Low IQ
		
	CUSTOMIZE DESIGN	CUSTOMIZE DESIGN
Basic Details		
Design Considerations	3-V to 65-V input, 100-mA, step-down power module in 2.8 x 3.7 mm package	3V-65V, 150mA Synchronous Buck Converter With Ultra-Low IQ
BOM Area	38mm²	82mm²

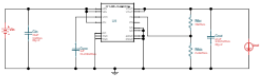
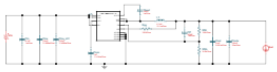
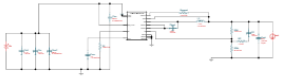
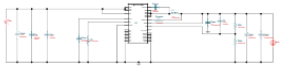
60V, 500mA Comparison

VIEW OPTIONS: Basic / Advanced

	TPSM5601R5H **New!**	LMR36506R5 **New!**	LM5166
	60-V input, 1-V to 16-V output, 1.5-A power module in enhanced HotRod QFN package	3-V to 65-V, 0.6-A ultra-small synchronous buck converter with 4 A IQ	3V-65V Input, 500mA Synchronous Buck Converter With Ultra-Low Iq
			
	CUSTOMIZE DESIGN	CUSTOMIZE DESIGN	CUSTOMIZE DESIGN
Basic Details			
Design Considerations	60-V input, 1-V to 16-V output, 1.5-A power module in enhanced HotRod QFN package	3-V to 65-V, 0.6-A ultra-small synchronous buck converter with 4 A IQ	3V-65V Input, 500mA Synchronous Buck Converter With Ultra-Low Iq
BOM Area	86mm²	87mm²	113mm²

36V, 4-6A Comparison

VIEW OPTIONS: Basic / Advanced

	TPSM53604 **New!**	LM60440D **New!**	LMQ61460 **New!**	LM73605
	36-V, 4-A step-down power module in small 5.5 x 5 x 4-mm Enhanced HotRod QFN with simple footprint	36-V, 4-A synchronous converter in an enhanced EMI QFN package with wettable flank and external pad	Industrial 3-V to 36-V, 6-A, low-noise synchronous step-down converter	3.5V to 36V, 5A Synchronous Step-Down Voltage Converter
				
	CUSTOMIZE DESIGN	CUSTOMIZE DESIGN	CUSTOMIZE DESIGN	CUSTOMIZE DESIGN
Basic Details				
Design Considerations	36-V, 4-A step-down power module in small 5.5 x 5 x 4-mm Enhanced HotRod QFN with simple footprint	36-V, 4-A synchronous converter in an enhanced EMI QFN package with wettable flank and external pad	Industrial 3-V to 36-V, 6-A, low-noise synchronous step-down converter	3.5V to 36V, 5A Synchronous Step-Down Voltage Converter
BOM Area	117mm²	139mm²	175mm²	334mm²

LMR36506/03

AEC-Q100 Grade 1

Industry's smallest, highest power density & lowest I_Q 65V, 600mA & 300mA synchronous step-down DC-DC converter

Features

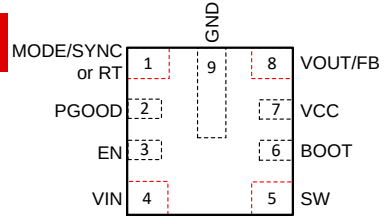
- **2 mm x 2 mm HotRod™ package**; -40C to 150C T_J operation
- **<6µA Low Iq** (Standby) with VOUT/BIAS
- Wide VIN range: **3.6 V – 65 V** (Abs. Max = 70V)
  - VIN UVLO Falling = 3V
- **Adjustable Fsw** with RT variant(200kHz – 2.2MHz)
  - FPWM (OTP variant; for fixed Frequency at all load)
  - PFM (OTP variant ; for Improved light load Efficiency)
- MODE/SYNC variant (fixed 400kHz/1MHz/2.2MHz)
  - FPWM and PFM selectable
- Peak Current mode control with internal compensation
- Precision EN/UVLO and PGOOD with delay
- **Fixed (3.3V/5V)** and Adj. **VOUT options available**

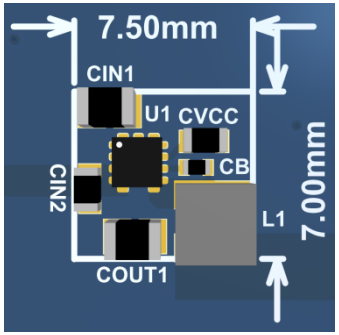
Benefits

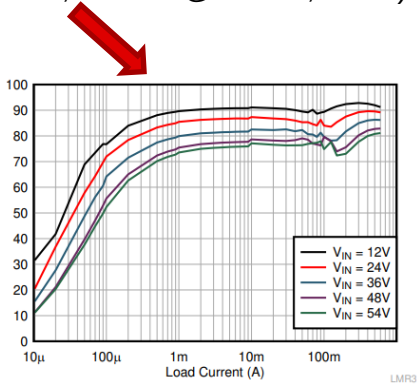
- Industry's Smallest, Highest Power Density and Lowest **Iq** in the 60V <1A space
- Allows ultra small solution size suitable for space constrained applications
- Capable of handling **input transients up to 70V**
- **Fixed frequency** (with adjustable option) and ultra low output voltage ripple over entire load range
- Best in class Wide-V_{IN} TI solution for <10uA standby current requirements
  - Typ. Industrial (**~90%** @24VIN, 5VOUT @500mA, 1MHz)

Applications

- FA&C → Field Transmitters & Process Sensors, Proximity Sensors
- Appliances
- Building Automation







LMQ61460 & LMQ62440

AEC-Q100 Grade 1

Industry's lowest EMI and highest power density 36V 2.1MHz 4A/6A synchronous buck converter

Features

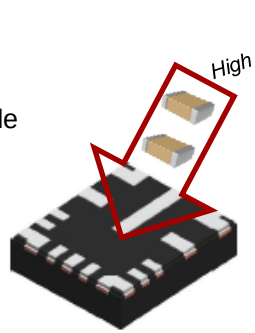
- **<7 µA standby Iq** with BIAS to Vout (2.1MHz 13.5V to 3.3V no load)
- **3.5 mm x 4 mm HotRod™ package; -40C to 150°C T_J operation**
- Spread Spectrum + Adjustable SW node rise time to reduce EMI
- Internal Bypass Capacitors Reduce EMI
- LMQ62440-Q1: pin 6 = MODE/SYNC (4A DC current max)
  - **Pin-select Auto Mode or FPWM operation**
  - Fixed 2.1MHz & Synchronizable **to External Clock: 200 kHz to 2.2 MHz**
- LMQ61460-Q1: pin 6 = RT (6A DC current max)
  - Program frequency by resistor and Synchronizable : **200kHz to 2.2MHz**
  - Factory programmed Auto Mode or FPWM versions
- 65ns (max) minimum on-time
- 3V – 36 V (Abs. Max = 42V) Wide input voltage range
- **Fixed 3.3V, fixed 5V** and **Adj.** output voltage versions available

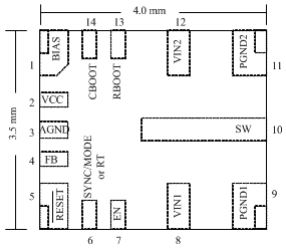
Benefits

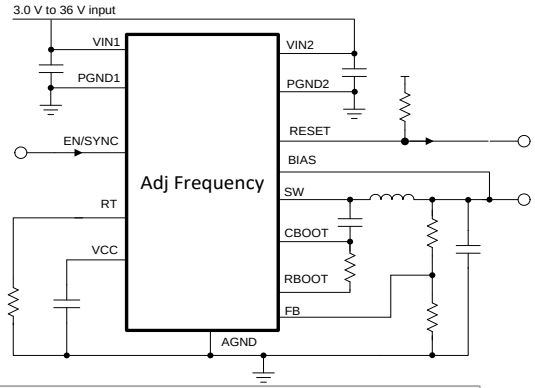
- **High Efficiency at Light Load with no load Iq as low as 9µA** and auto mode for long standby time
- **Low EMI Noise** with Wettable Flank HotRod™ package, spread spectrum and pin-adjustable SW node rise time
- **Small solution size** with **3.5mm x 4mm** Wettable Flank HotRod™ package and **2.2-MHz** max frequency
- **Flexible design options** with Auto Mode (high efficiency at light load and low Iq) or FPWM (fixed frequency for noise reduction)
- **High Ambient Temp Operation** with high efficiency at heavy load and **150°C T_{JMAX}**

Applications

- Automotive infotainment, ADAS and body applications
- Industrial distributed power
- General purpose Wide VIN

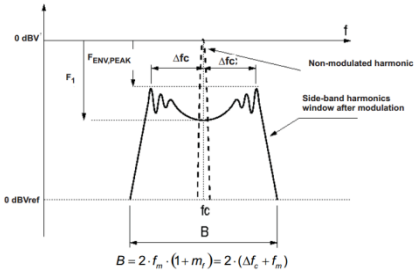




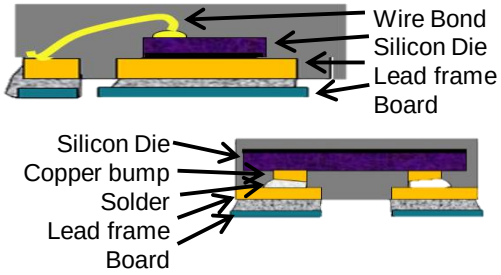


Texas Instruments

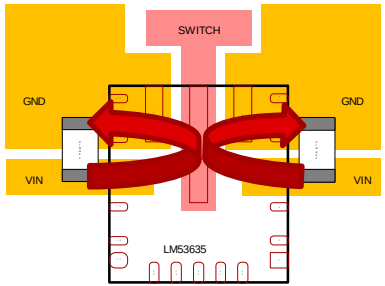
Features for great EMI: LMQ6x460-Q1



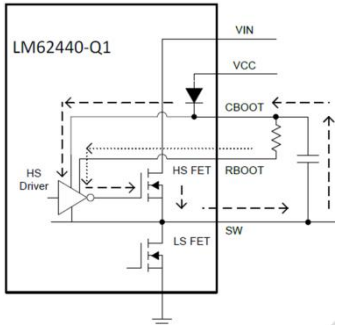
Pseudo-Random Spread Spectrum



HotRod Package

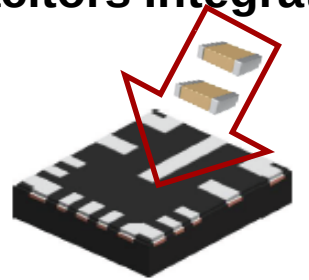


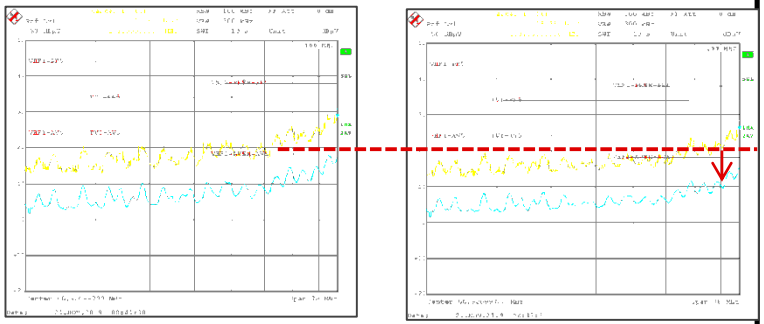
Symmetrical PINOUT



Slew Rate Control w/ RBOOT

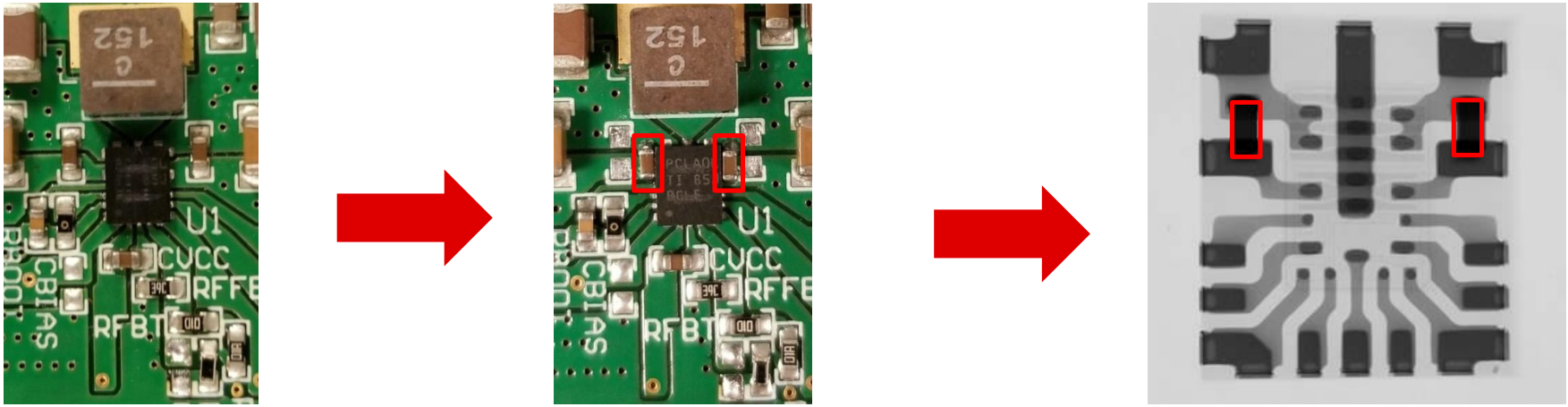
High Frequency Input Capacitors Integrated





>5 dB improvement **with** integrated caps even with poor PCB layout

Capacitor location impacts EMI performance



Notes:

1. Minimizes the ESL impact at high frequency, thus minimizes the ringing at SW node
2. Minimizes the solution size

LM60440/30

AEC-Q100 Grade 1

Industry's smallest 36V, 3A/4A synchronous converter in Enhanced HotRod QFN package

Features

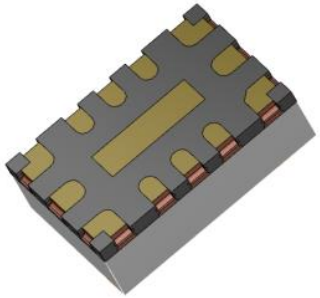
- **2 x 3 mm Enhanced HotRod™ QFN** package with **wettable flanks** and External Pad
  - **Up to 7% improvement in thermal performance**
- -40C to **150C** T_J operation
- **Low 85/55 mOhm Internal HS & LS Rdson**
- **50ns min ON time, 75ns min OFF-time**
- **<25µA quiescent current at no load**
- Vin range 3.8V - 36V; Vout Range Adjustable from 1.0V to 95%Vin (38V Abs Max)
- Switching frequency = 400 kHz and 1MHz
- Soft-start time = 5 ms; Starts into pre-biased load
- Cycle by cycle current limit & Hiccup Short Circuit Protection

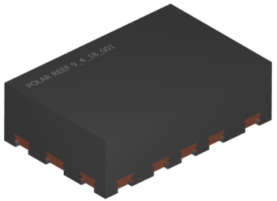
Applications

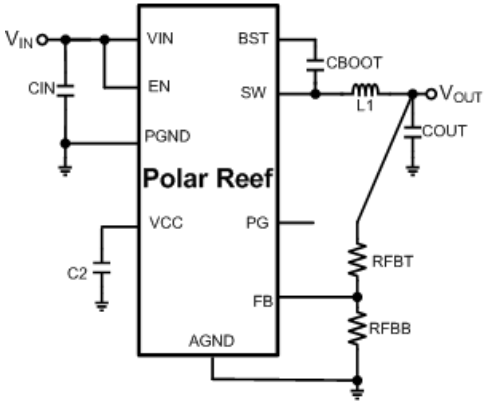
- CPU (PLC Controller), Industrial PC, and Automotive USB Charging
- General purpose wide input power supply

Benefits

- Enhanced QFN Package with no Bond-Wires for best EMI performance and Wettable Flanks for easy visual inspection
- Wide vin operation to accommodate industrial line variation
- High efficiency with increased thermal performance to withstand higher ambient temperatures
- Highest 36V converter Power Density

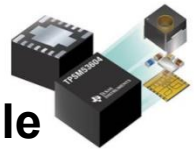






TPSM53604/3/2

Industry's highest density 36V, 2A/3A/4A power module



Newly Released!!

Features

- **Enhanced HotRod™ QFN Package Technology**
- **4 to 36V** Input Voltage Range
- **2A, 3A, and 4A** Output Current Options
- **1V to 7V** Output Voltage Range
- **5 x 5.5 x 4 mm Enhanced HotRod™ QFN Package**
- **-40 ºC - 105 ºC Operating Temp Range** (125 ºC Junction)
- Pin out engineered to **reduce EMI**
- **High efficiency across load range**
- PG, Pre-Biased Start Up and Prog UVLO
- ***LMR33630 Silicon***

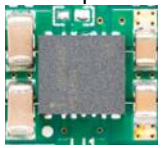
Applications

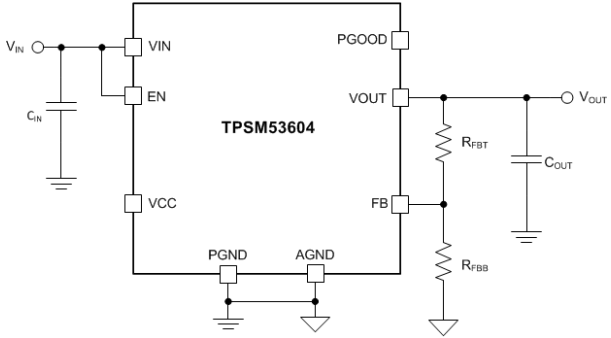
- Factory Automation
- Test & Measurement
- Grid
- Defense
- Industrial Transport

Benefits

- Reduced design risk – integrated inductor and small passives in easy to handle QFN packaging
- Smallest 36V, 4A/3A solution (30% smaller than discrete implementation and competition module solution)
- Best in class efficiency (89% at 24Vin, 5Vout, 3A)
- Up to 20W output power at 85ºC with no airflow
- Low EMI – Meets CISPR11 radiated emissions

Footprint





TPSM5601R5H

Sampling Now!

Industry's highest density 60V, 600mA/1.5A power module

Features

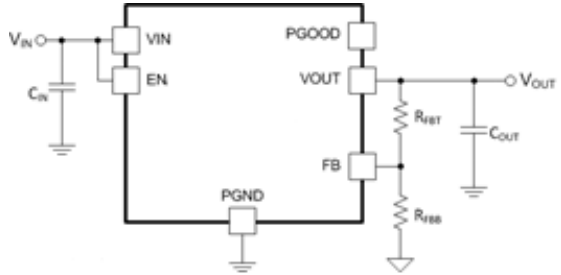
- **4.2V to 60V** Input Voltage Range
- **1.5A** Output Current Options
- Output Voltage Range:
  - 1V - 6V ADJ, 400kHz
  - 1V - 16V ADJ, 1MHz
- **5 x 5.5 x 4mm Enhanced HotRod™ QFN package**
- **-40 ºC - 105 ºC Operating Temp Range** (125 ºC Junction)
  - **-55C Rated** Option Available
- **FPWM** operation and **Spread Spectrum** option to **reduce EMI**
- PG, Pre-Biased Start Up and Prog UVLO
- ***LMR36015 Silicon***

Applications

- Factory & Building Automation, Smart Grid & Energy
- Medical
- Aerospace & Defense

Benefits

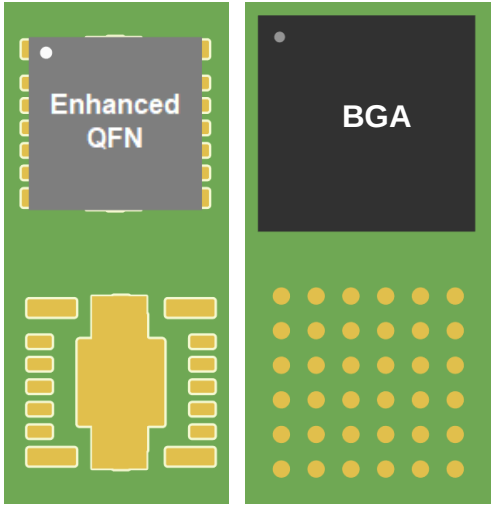
- Smallest 60V, 1.5A solution (60% smaller than competition) with Best in class efficiency (85% at 24Vin, 3.3Vout, 1.5A)
- Reduced manufacturing complexity for customer with standard footprint
- Pass radiated EMI requirement with minimal effort
  - HotRod® silicon minimize noise loop and improves efficiency
  - Fixed Frequency operation and Spread Spectrum feature further enable mitigating EMI



Better thermal performance in smaller Power Module package

TPSM53604
3.8-36 V
4 A
5x5.5 mm
Enhanced QFN

Area = 27.5 mm²

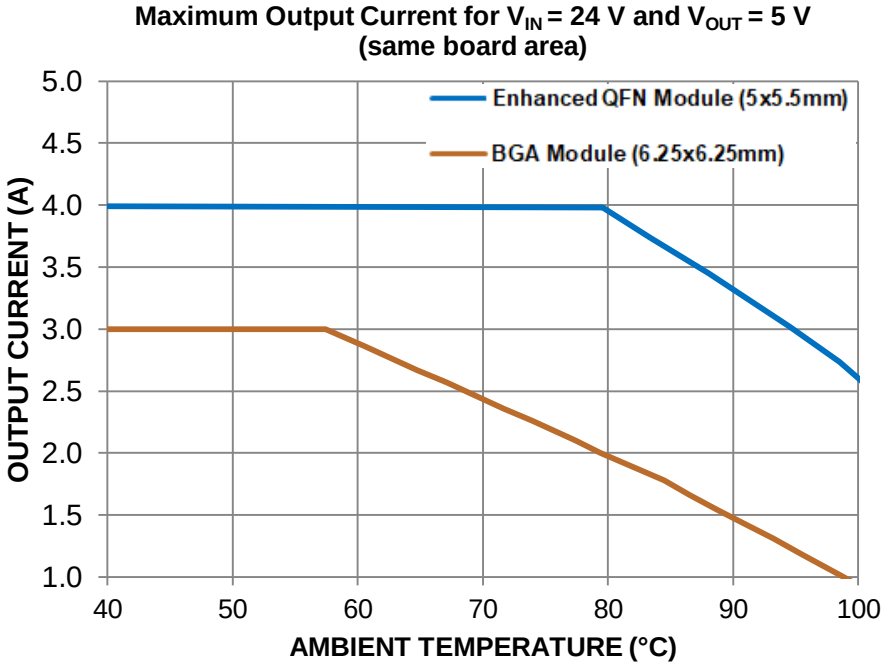


Thermal contact
42% of package area

Thermal contact
18% of package area

Competitor
3.4-40 V
3.5 A “peak”
6.25x6.25 mm
BGA

Area = 39 mm²



TPSM265R1

Industry's highest density 65V, 100mA power module with ultra low I_Q

Newly Released!

Features

- Input voltage range from **3V to 65V**
- **10.5µA no-load I_Q, 2 µA Shutdown I_Q**
- PFM Mode For **Excellent Light Load Efficiency**
- **Miniature 2.8mm x 3.7mm x 1.9mm** package with integrated inductor
- Output Voltage options:
  - **3.3V, 5V** Fixed Vout
  - **1.3V to 15V** Adjustable Output Voltage
- Power Good flag, Internal + external soft start
- Precision input UVLO

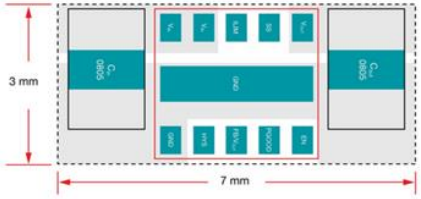
Applications

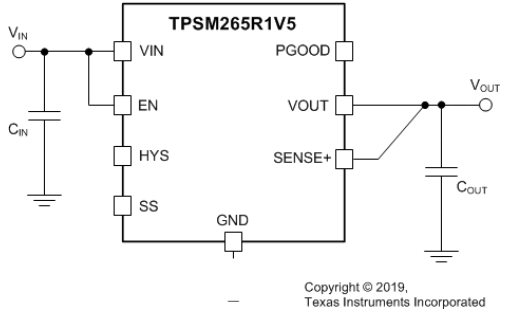
- Factory Automation
- Process and Field Sensors
- 4-20 mA current-loop powered sensors

Benefits

- **Continuous 65V operation**. No need to transient suppressors.
- Smallest 65V capable 100mA solution (**11% smaller than competition solution space for 3.3V/5V rail**)
- Fixed output voltage versions guarantee lowest BOM count (**Just C_{IN} and C_{OUT} required**)
- Form Factor and pin out engineered to:
  - Ensure **one side to be no more than 3mm**
  - Ensure small switching current loops and low noise operation

Single-sided layout solution size
5V or 3.3V output



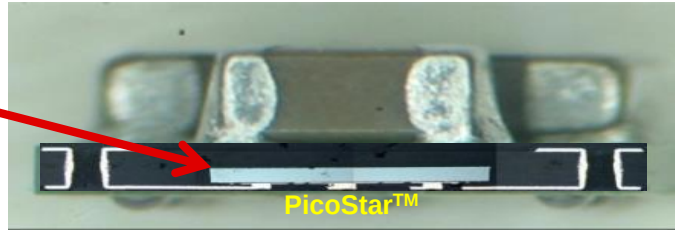


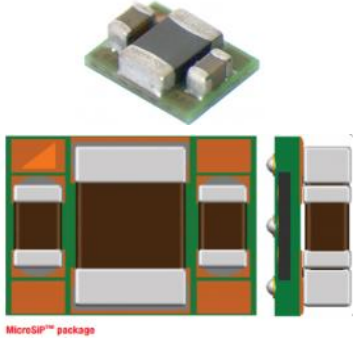
Embedded module technology

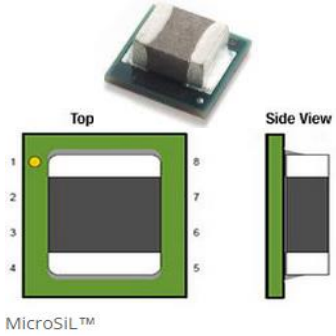
System-in-Package integrates the IC inside the printed circuit board (laminate substrate) with SMD components on top of the package.

Texas Instruments is the first company that made high volume production with this packaging technology as MicroSiP/L™ with an embedded die Picostar™.

MicroSiP™	MicroSiL™
Fully embedded IC inside PCB	
ALL Passive components (L, CIN, COUT)are on the PCB	Inductor is on the PCB
Module package is BGA (WCSP)	Module package is in QFN format







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

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