

# Power Management Guide



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Innovation**

Power Management Guide 2015

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2015

# Power Management Guide

## Introduction and Contents

Texas Instruments (TI) offers complete power solutions with a full line of high-performance products. These products, which range from standard linear regulators to highly efficient DC/DC converters and battery management, are tailored to meet your design challenges. And, TI makes designing easier with leading-edge support tools such as the WEBENCH® Design Center, a broad selection of evaluation modules (EVMs), application notes, comprehensive technical documentation and more. TI also offers samples and small orders (shipped within 24 hours via authorized distributors) to help accelerate your time-to-market.

Included in this selection guide are design factors, featured products, graphic representations of portfolios and parametric tables.

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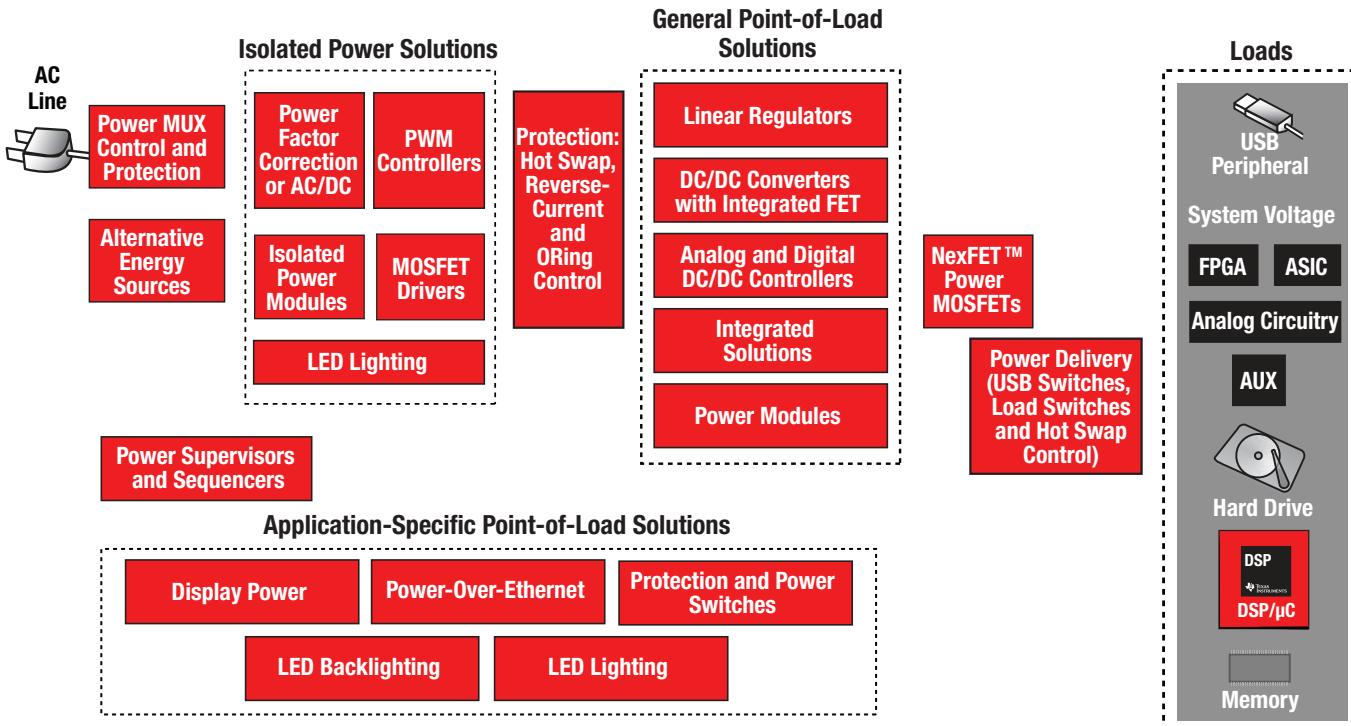
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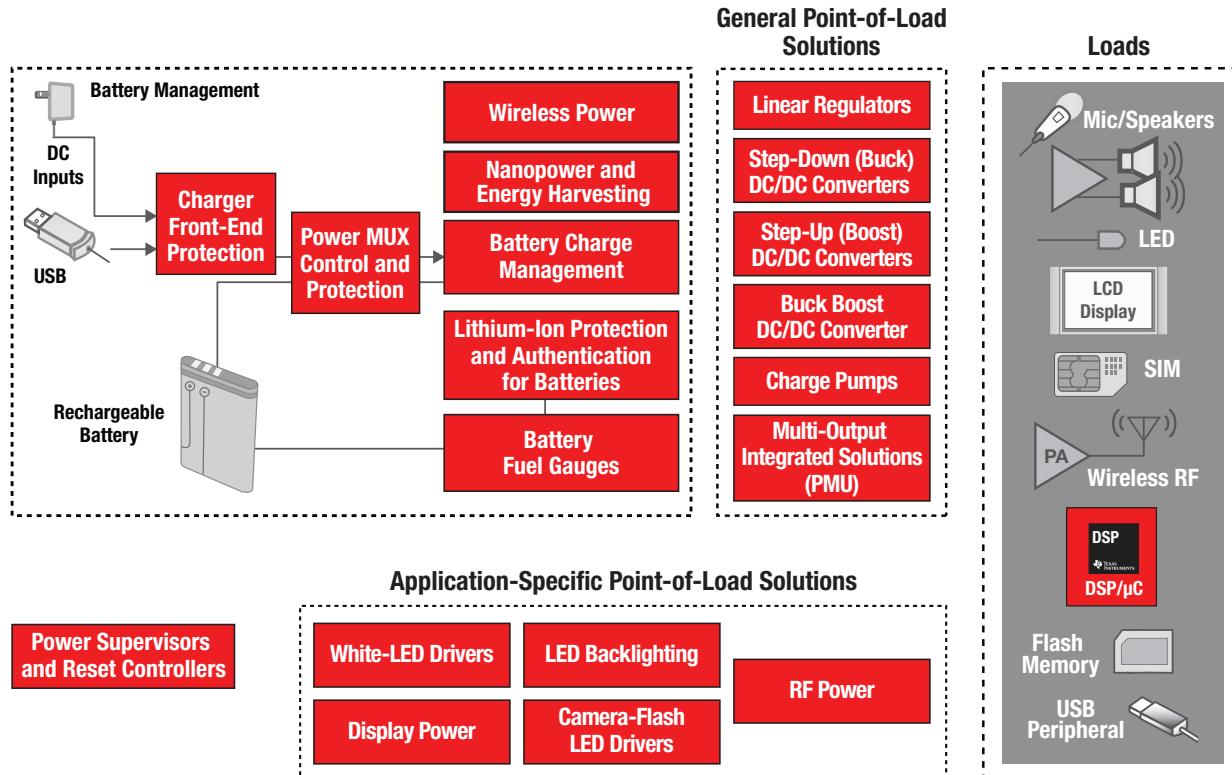
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# Portable and Line Power Solutions

## Line Power Solutions



## Portable Power Solutions



# AC/DC and Isolated DC/DC Power Supplies

## Overview

The TI portfolio of isolated power-conversion solutions covers the complete end-to-end power-supply building blocks from front-end PFC controllers to PWM controllers. These solutions support the most popular isolated-power topologies, including the advanced phase-shifted full-bridge. The portfolio also includes a variety of MOSFET gate drivers that support both primary and secondary MOSFET-driver applications, including synchronous-rectifier driver topologies and many other power-supply support products.

### Power-Supply Solutions

- PFC controllers:
  - Transition mode
  - Continuous-current mode
  - Interleaved
  - Bridgeless
- PWM controllers:
  - Single-ended: Flyback, forward, active-clamp
  - Double-ended: Half-bridge, phase-shifted full-bridge, push-pull, LLC half-bridge
  - UCD3K digital control solutions
- Gate drivers:
  - GaN FET driver
  - Synchronous-rectifier driver
  - Single low-side
  - Dual low-side
  - 110-V high-side/low-side
  - Synchronous-buck

### Design Factors

#### Control Method

**Average-Current Mode (ACM)** — Optimum control method to achieve PFC and low harmonic distortion.

**Transition Mode (TM)** — Simpler, inexpensive control with high peak currents and filtering requirements.

**Interleaved** — TM- and ACM-compatible multiphase, high-power, high-density topology. Delivers better EMI, smaller magnetics and reduced ripple currents.

#### Zero-Voltage-Transition (ZVT) Mode

— A type of soft-switching technique, which reduces EMI and allows for higher frequency operations.

#### Protection

- Overvoltage protection (OVP) prevents output capacitor, switches and load from overcharge condition
- Soft-start (programmable) provides controlled start-up
- Overcurrent protection (OCP) provides protection during overload conditions

#### Performance

- Voltage feed-forward for linearized performance and faster transient response over wide line voltage range
- Multiplier linearity and zero power detect functions improve light load operation
- Onboard high output current drive capability without external MOSFET drivers

### Flexibility

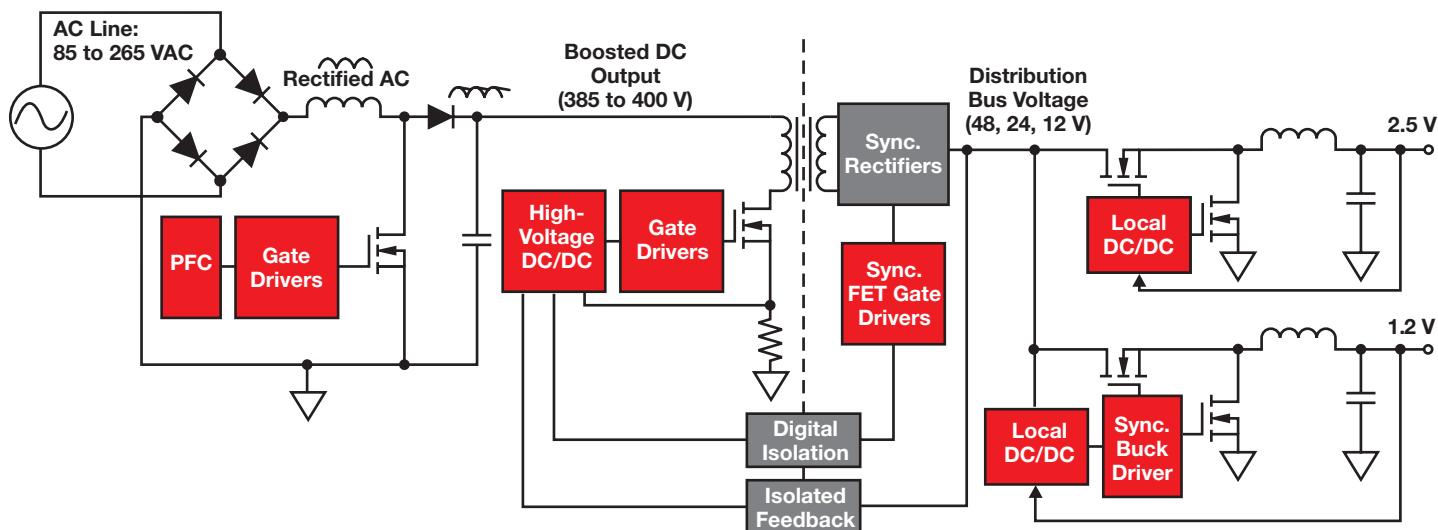
- Versatile advanced PWM controllers and bias supply converters for high-performance secondary-side control
- Ability to work with a wide line voltage range
- Different levels of undervoltage lockout thresholds for self bias and auxiliary bias applications
- Ability to synchronize controllers to eliminate noise issues

### Power Level

- IEC requirements are applicable to all power supplies above 75 W
- Higher power converters may require zero-current-switching (ZCS) and ZVT-switching techniques to achieve high efficiencies
- Some of the simpler control techniques not usable at high power levels

### Features

- From 50 W to 5 kW, TI PFC controllers deliver EN61000-3-2 compliance
- Industry standard architecture
- Deliver PF > 0.993
- Integrated controllers with on-chip start-up circuit and MOSFET drivers for high-density primary-side control
- Integrated synchronous rectifier control with pre-bias operation for monotonic start-up
- Superior applications support



# AC/DC and Isolated DC/DC Power Supplies

## Power Factor Correction (PFC)

### Interleaved PFC

Interleaved PFC is gaining popularity in external and embedded-type power-supply architectures. It is exceptionally flexible and provides many cost-saving features such as passive-component size reductions, smaller EMI filtering components and higher efficiencies. TI offers both transition mode (UCC28063) and continuous conduction mode (CCM) (UCC28070A) control methods.

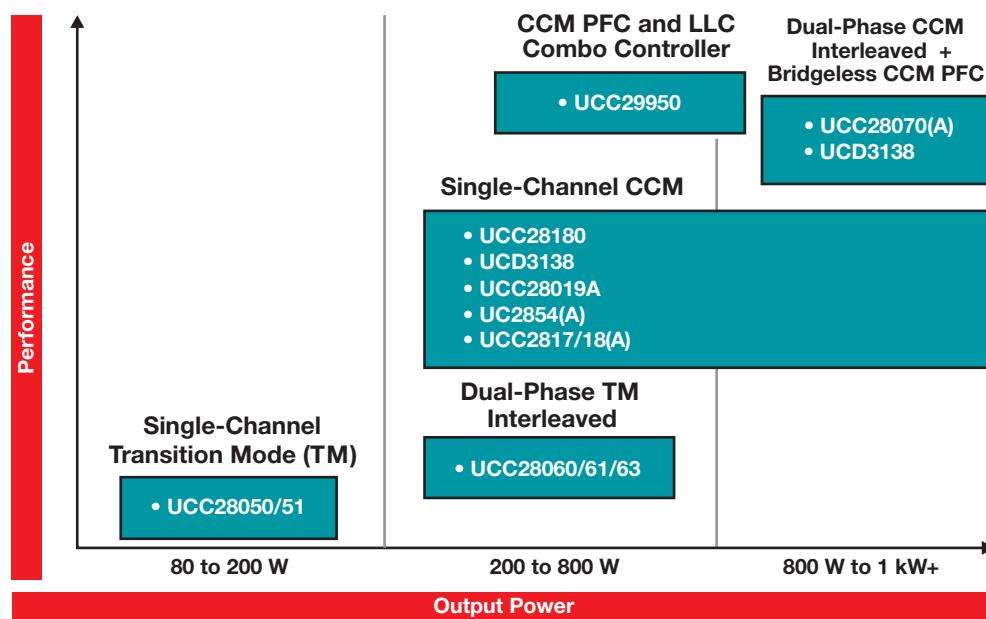
### Why Interleave?

- Lower system cost from ripple-current cancellation
- Enables ultraslim and high-density designs
- Lower total inductor volume
- Smaller or lower-cost EMI filter and output capacitors
- Facilitates higher efficiency

### Applications

- Digital TV
- Telecom power supplies and rectifiers
- Professional and consumer audio
- Merchant power supplies
- Air conditioning and refrigeration compressors
- Variable-speed motors
- Low-profile power-supply applications

## PFC Controllers and Combos



Get more information: [www.ti.com/power](http://www.ti.com/power)

# AC/DC and Isolated DC/DC Power Supplies

## PWMs, Resonant Controllers and Switchers

### Green-Mode Controllers (up to 150 W) and 700-V Switchers (<10 W)

<b>UCC28880 UCC28910</b> 700-V Switchers	<b>UCC28600/10 LM5021 LM5023</b> 8-Pin Green-Mode Controllers	<b>UCC28700/1/2/3</b> Constant Voltage, Constant Current with Primary-Side Regulation Flybacks	<b>UCC2871X UCC2872X</b> Constant Voltage and Constant Current with 700-V Start-Up Switch Flybacks	<b>UCC28740</b> Constant Voltage and Constant Current Flyback with Optocoupler Feedback	<b>UCC28630</b> High-Power Flyback with Primary-Side Regulation and Peak-Power Mode
<b>Switchers</b>	<b>Green-Mode Controllers</b>				

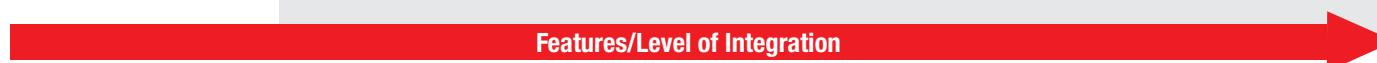
**Features/Level of Integration**



### Low- to Medium-Power PWM Controllers (25 W to 350 W)

Active-Clamp Forward	<b>UCC2897A</b> Adv. I-Mode Act-Clamp, HV Start-Up	<b>LM5026</b> I-Mode Act-Clamp, HV Start-Up	<b>LM5025</b> Act-Clamp, HV Start-Up	<b>LM5027</b> Act-Clamp with Pre-Bias, HV Start-Up	<b>Voltage Mode</b>
Dual Outputs Push-Pull, Half-Bridge, Full-Bridge	<b>UCC25600</b> Resonant Half-Bridge	<b>LM(2)5037</b> Dual-Mode PWM Controller with Alternating Outputs	<b>LM5035/9</b> Half-Bridge with Integrated Drivers, HV Start-Up	<b>UCC28230/1</b> Intermediate Bus	<b>Current Mode</b>
				<b>UCC28250</b> Half-Bridge with Pre-Bias	<b>Voltage or Current Mode</b>
				<b>LM5045/6</b> Full-Bridge, with Integrated Drivers, Pre-Bias, HV Start-Up	

**Features/Level of Integration**



### Medium- to High-Power PWM Controllers (>300 W)

Soft-Switching, ZVT, ZVS (Phase-shifted full-bridge, resonant, active-clamp forward)	<b>UCC2897A</b> Adv. I-Mode Act-Clamp, HV Start-Up	<b>LM5026</b> Adv. I-Mode Act-Clamp, HV Start-Up	<b>UCC2895</b> BiCMOS Adv. $\phi$ -Shift PWM Controller	<b>UCC28950</b> Green $\phi$ -Shift Full-Bridge Controller with Synchronous Rectification	<b>LM5046</b> $\phi$ -Shift Full-Bridge Integrated Drivers, HV Start-Up, Pre-Bias
Push-Pull, Half-Bridge, Full-Bridge	<b>UCC28230/1</b> Intermediate Bus	<b>LM(2)5037</b> Dual-Mode PWM Controller with Alternating Outputs	<b>UCC25600</b> Resonant Half-Bridge	<b>UCC28250</b> Half-Bridge with Pre-Bias	<b>LM5045</b> Full-Bridge Controller Integrated Drivers, HV Start-Up, Pre-Bias
Secondary Side Control	<b>Voltage Mode</b>				
	<b>Current Mode</b>				
	<b>Voltage or Current Mode</b>				
	<b>UCC28250</b> Half-Bridge with Pre-Bias Operation				
	<b>UCC28950</b> Green $\phi$ -Shift Full-Bridge Controller with Synchronous Rectification				

**Features/Level of Integration**



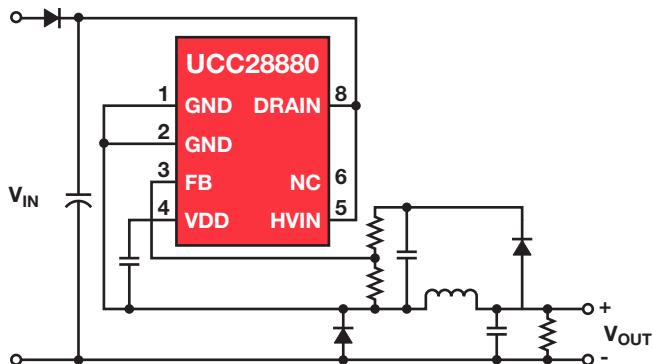
# AC/DC and Isolated DC/DC Power Supplies

## PWMs, Resonant Controllers and Switchers

### 700-V, Lowest Quiescent Current, Off-Line Switcher

#### UCC28880

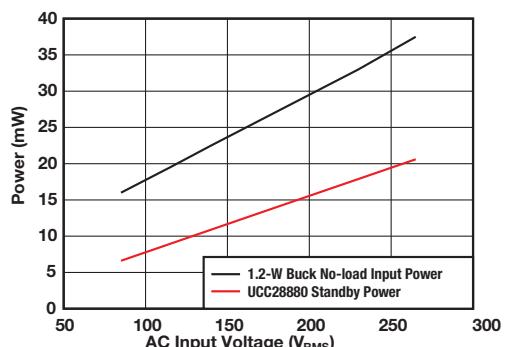
The UCC28880 integrates the controller and a 700-V power MOSFET into one monolithic device. The device also integrates a high-voltage current source, enabling start-up and operation directly from the rectified mains voltage. The low quiescent current of the device enables excellent efficiency. With the UCC28880, the most common converter topologies such as buck, buck-boost and flyback can be built using a minimum number of external components.



Get more information: [www.ti.com/product/UCC28880](http://www.ti.com/product/UCC28880)

#### Applications

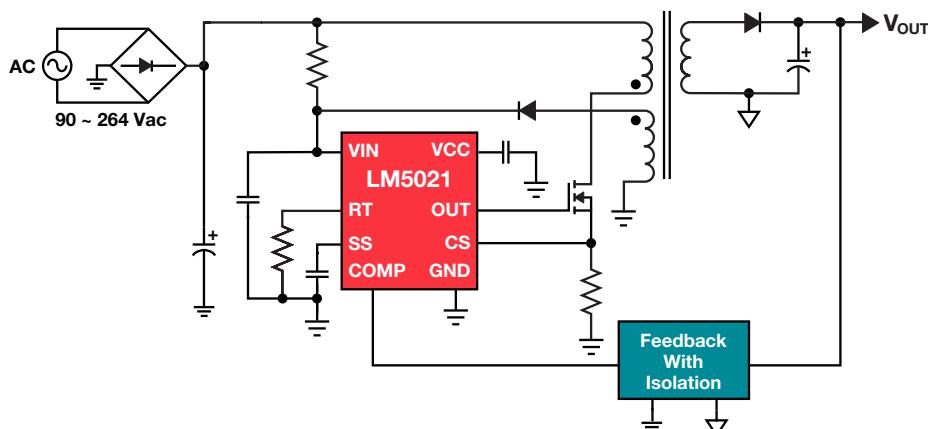
- AC-to-DC power supplies with output currents up to 100 mA across temperature and input voltage range
- Metering, home automation, infrastructure SMPS
- Low-side buck topology for TRIAC driver
- Appliances, white goods and LED drivers



### AC-DC Current-Mode PWM Controller for Flyback and Forward Power Converters

#### LM5021

The LM5021 off-line pulse width modulation (PWM) controller contains all of the features needed to implement highly efficient off-line single-ended flyback and forward power converters using current-mode control. Features include an ultra-low (25  $\mu$ A) start-up current that minimizes power losses in the high-voltage start-up network, skip-cycle mode that reduces power consumption with light loads for energy conserving



Get more information: [www.ti.com/product/LM5021](http://www.ti.com/product/LM5021)

applications (ENERGY STAR<sup>®</sup>, CEC), under-voltage lockout, cycle-by-cycle current limit, hiccup-mode overload protection, slope compensation, soft-start and oscillator synchronization capability. This high-performance 8-pin IC has total propagation delays less than 100 ns and a 1-MHz-capable oscillator that is programmed with a single resistor.

#### Applications

- PLC/factory automation
- System bias supplies
- White goods
- Switching power supplies/power modules
- AC/DC power supplies

# AC/DC and Isolated DC/DC Power Supplies

## PWMs, Resonant Controllers and Switchers

### Selection Guide

Device <sup>1</sup>	Typical Power Level (W)	Control Method			Topologies	Maximum Practical Frequency	Supply Voltage (V)	700-V Start-Up Circuit	110-V Start-Up Circuit	Soft Start	Output Drive (Sink/Source) (A)	Package(s)	Automotive	Price*
		Voltage Mode	Current Mode	Avg. Current Mode										
<b>Green Mode PWM Controllers</b>														
<b>UCC28710/1</b>	Up to 25	✓			Flyback	130 kHz	9 to 35	✓	✓		0.025/7	7-SOIC, 6-SOT-23		0.42
<b>UCC28700/1/2/3</b>	Up to 30	✓			Flyback	130 kHz	9 to 35		✓		0.025/7	6-SOT-26		0.35
<b>UCC28720</b>	Up to 30	✓			Flyback	80 kHz	9 to 35	✓	✓		0.37/1	8-SOIC		0.40
<b>UCC28740</b>	Up to 30	✓			Flyback	100 kHz	9 to 35	✓	✓		0.25/7	8-SOIC		0.42
<b>UCC28610</b>	10 to 40	✓			Buck, Flyback (SEPIC, Cuk)	140 kHz	9 to 20				—	8-SOIC		0.60
<b>LM5023</b>	5 to 100	✓			Quasi-Resonant Mode Flyback	130 kHz	8 to 15		✓		0.3/0.7	8-MSOP		0.38
<b>UCC28630/1/2/3</b>	Up to 150	✓			PSR Flyback Controller w/700-V startup	120 kHz	8 to 18	✓			1/2	7-SOIC		0.60
<b>UCC28600</b>	50 to 150	✓			Flyback (SEPIC, Cuk)	130 kHz	30		✓		1/0.75	8-SOIC	✓	0.49
<b>Switchers with Integrated FETs</b>														
<b>UCC28880</b>	<5				High Voltage Switcher for Non-isolated AC/DC Conversion	66 kHz	—	✓	✓		—	7-SOIC		0.55
<b>UCC28910</b>	<10	✓			High Voltage Flyback Switcher w/PSR	115 kHz	—	✓	✓		—	7-SOIC		0.75
<b>General-Purpose Single-Ended Controllers</b>														
<b>UCC3889</b>	<10	✓			Flyback (SEPIC, Cuk)	250 kHz	9		✓		0.2/0.15	8-SOIC-W/DIL (PDIP)		0.59
<b>LM5020</b>	10 to 100	✓			Buck, Boost, Flyback (SEPIC, Cuk)	1 MHz	13 to 100	✓	✓		1	10-MSOP/QFN		0.90
<b>LM5021</b>	10 to 100	✓			Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	8 to 30		✓		0.7	8-MSOP		0.66
<b>LM5022</b>	25 to 100	✓			Buck, Boost, Flyback (SEPIC, Cuk)	2 MHz	6 to 60		✓		1	10-MSOP		1.13
<b>UCC3800/1/2/3/4/5</b>	10 to 200	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%)	1 MHz	4.1 to 15		✓		1/1	8-TSSOP/SOIC/DIL (PDIP)		1.35
<b>UCC3807-1-2-3</b>	10 to 200	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	6.9 to 15		✓		1/1	8-SOIC/DIL (PDIP)		1.50
<b>UCC3809-1-2</b>	10 to 200	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	8 to 19		✓		0.8/0.4	8-MSOP/TSSOP/SOIC/DIL (PDIP)		0.85
<b>UCC3813-0/1/2/3/4/5</b>	10 to 200	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd) <sup>2</sup> , Forward (D > 50%) <sup>2</sup>	1 MHz	7.2 to 15 <sup>2</sup>		✓		1/1	8-TSSOP/SOIC/DIL (PDIP)		0.80
<b>UCC3884</b>	50 to 250	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	8.9 to 15		✓		1/0.5	16-SOIC/DIL (PDIP)		1.60
<b>UCC38C40/1/2/3/4/5</b>	10 to 250	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	5 Options				1/1	8-MSOP/SOIC/DIL (PDIP)		0.95
<b>TL3842B/3B/4B/5B</b>	30 to 350	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	500 kHz	10 to 30				1/1	8/14-SOIC, 8-DIL (PDIP)		0.54
<b>UC3842A/3A/4A/5A</b>	30 to 350	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	500 kHz	10 to 30				1/1	8/14-SOIC, 8-DIL (PDIP)		0.80
<b>UC28023</b>	50 to 750	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	9 to 30		✓		1.5/1.5	16-SOIC-W/DIL (PDIP)		1.35
<b>UC3823A/B</b>	50 to 750	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	9 to 22		✓		2/2	16-SOIC-W/DIL (PDIP), 20-PLCC		4.90
<b>Dual Output Controllers</b>														
<b>LM5015</b>	30 to 250	✓			Fwd (Including 2-Switch Fwd)	750 kHz	4.25 to 75		✓		1	14-TSSOP		2.05
<b>LM5032</b>	30 to 250	✓			Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd)	1 MHz	13 to 100	✓	✓		2.5/2.5	16-TSSOP		1.55
<b>LM5034</b>	30 to 250	✓			Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd)	1 MHz	8 to 100	✓	✓		2.5/2.5	20-TSSOP		1.90
<b>UC3824</b>	50 to 250	✓	✓		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	9 to 30		✓		1.5/1.5	16-SOIC-W/DIL (PDIP)		4.55
<b>UCC28089</b>	25 to 250				Interleaved Fwd/Flyback/Boost, Push-Pull, Half-Bridge, Full-Bridge	500 kHz	8 to 15		✓		0.5/1.0	8-SOIC		0.65
<b>LM5035/A/B/C</b>	50 to 300	✓			Half-Bridge	2 MHz	8 to 100	✓	✓		2/2	28-TSSOP, 20-HTSSOP, 24-QFN		1.90
<b>LM(2)5037</b>	30 to 300	✓	✓		Push-Pull, Half-Bridge, Full-Bridge	2 MHz	13 to 75/100	✓	✓		1.2/1.2	16-TSSOP		1.35/1.62
<b>LM5039</b>	50 to 300	✓			Half-Bridge	2 MHz	8 to 100	✓	✓		2/2	20-HTSSOP, 24-QFN		1.90
<b>LM5045</b>	50 to 400	✓	✓		Full-Bridge	2 MHz	14 to 100	✓	✓		1.5/2	28-HTSSOP/QFN		2.25
<b>TL494 or TL594</b>	50 to 500	✓			Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%), Interleaved Fwd/Flyback/Boost, Push-Pull, Half-Bridge, Full-Bridge	300 kHz	7 to 40				0.2/0.2	16-TSSOP/SOIC/DIL (PDIP)		0.23
<b>TL598</b>	50 to 500	✓			Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%), Interleaved Fwd/Flyback/Boost, Push-Pull, Half-Bridge, Full-Bridge	300 kHz	7 to 40				0.2/0.2	16-SOIC/DIL (PDIP)		0.81
<b>UC3524A</b>	50 to 500	✓			Push-Pull, Half-Bridge, Full-Bridge	250 kHz	8 to 40		✓		0.2/0.2	16-SOIC/DIL (PDIP)		1.70
<b>UC3525B - UC3526A</b>	50 to 500	✓			Push-Pull, Half-Bridge, Full-Bridge	250 kHz	8 to 40		✓		0.2/0.2	16-SOIC/DIL (PDIP), 20-PLCC		1.05

<sup>1</sup>UC2xxx and UCC2xxx devices are extended temperature-range versions of the UC3xxx and UCC3xxx devices.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**.

<sup>2</sup>Value varies by part number suffix. Please check datasheet.

# AC/DC and Isolated DC/DC Power Supplies

## PWMs, Resonant Controllers and Switchers

### Selection Guide (Continued)

Device <sup>1</sup>	Typical Power Level (W)	Control Method			Topologies	Maximum Practical Frequency	Supply Voltage (V)	700-V Start-Up Circuit	110-V Start-Up Circuit	Soft Start	Output Drive (Sink/Source) (A)	Package(s)	Automotive	Price*
		Voltage Mode	Current Mode	Avg. Current Mode										
<b>Dual Output Controllers (Continued)</b>														
UC3827-1/-2	50 to 500	✓			I-Fed/V-Fed Push-Pull	450 kHz	8.4 to 20			✓	1/0.8	24-SOIC-W/DIL (PDIP), 28-PLCC		3.50
UCC3808-1/-2/A-1/A-2	50 to 500	✓			Push-Pull, Half-Bridge, Full-Bridge	1 MHz	4.3 to 15			✓	1.0/0.5	8-TSSOP/SOIC/DIL (PDIP)		1.30
UCC38083/4/5/6	50 to 500	✓			Push-Pull, Half-Bridge, Full-Bridge	1 MHz	8.3 to 15			✓	1.0/0.5	8-TSSOP/SOIC/DIL (PDIP)		1.10
UCC3810	50 to 500	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Interleaved Fwd/Flyback/Boost	1 MHz	8.3 to 11				1/1	16-SOIC/DIL (PDIP)		1.85
LM5030	50 to 600		✓		Act-Clamp Fwd/Flyback, Half-Bridge, Full-Bridge	1 MHz	14 to 100	✓	✓		1.5/1.5	20-TSSOP		1.10
LM5033	50 to 600	✓			Push-Pull, Half-Bridge, Full-Bridge	1 MHz	15 to 100	✓	✓		1.5/1.5	10-MSOP/QFN		1.00
UC28025	50 to 750	✓	✓		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	9 to 30			✓	1.5/1.5	16-SOIC-W/DIL (PDIP)		1.35
UC3825	50 to 750	✓	✓		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	9 to 30			✓	1.5/1.5	16-SOIC-W/DIL (PDIP), 20-PLCC		1.60
UC3825A/B	50 to 750	✓	✓		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	9 to 22			✓	2/2	16-SOIC-W/DIL (PDIP), 20-PLCC		2.65
UC3846/56	50 to 750	✓	✓		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	8 to 40			✓	0.5/0.5	16-SOIC-W/DIL (PDIP), 20-PLCC		1.60
UCC3806	50 to 750	✓	✓		Push-Pull, Half-Bridge, Full-Bridge	350 kHz	7 to 15			✓	0.5/0.5	16-SOIC/W/DIL (PDIP), 20-PLCC		4.10
LM5041/A/B	50 to 800		✓		I-Fed/V-Fed Push-Pull	1 MHz	15 to 100	✓	✓		1/5/1.5	16-TSSOP/QFN		2.15
UCC28250/1	100 to 800	✓	✓		Fwd (Including 2-Switch Fwd), Interleaved Fwd/Flyback/Boost, Act-Clamp Fwd/Flyback, Push-Pull, Half-Bridge	1 MHz	4.7 to 17			✓	—	20-TSSOP/QFN		1.70
UCC28220/1	50 to 800	✓			Interleaved Fwd/Flyback/Boost	1 MHz/ch.	8 to 14.5	✓	✓	0.01/0.01	16-TSSOP/SOIC	✓	1.60	
<b>Soft-Switching, ZVT and ZVS Controllers</b>														
UCC29950	300	✓			CCM Boost LLC and Combo Controller	—	-0.3 to 20				—	16-SOIC		1.20
LM5025/A/B/C	50 to 250	✓			Act-Clamp Fwd/Flyback	1 MHz	8 to 100	✓	✓		3/3	16-TSSOP/QFN		1.25
LM5026	50 to 250	✓			Act-Clamp Fwd/Flyback	1 MHz	8 to 100	✓	✓		3/3	16-TSSOP/QFN		1.30
LM5027/A	50 to 250	✓			Act-Clamp Fwd/Flyback	1 MHz	8 to 105	✓	✓		2/2	24-TSSOP, 20-QFN		1.75
LM5046	50 to 400	✓	✓		Φ-Shifted FB	2 MHz	14 to 100	✓	✓		2/2	28-HTSSOP/QFN		2.45
UCC2897A	75 to 600	✓	✓		Forward (D > 50%), Act-Clamp Fwd/Flyback	1 MHz	8.5 to 14.5	✓	✓		2/2, 2/2	20-TSSOP, 16-SOIC		1.50
UCC25600	200 W to 1 kW				Half-Bridge	350 kHz	11.5 to 18			✓	0.4/0.8	8-SOIC		0.80
UCC28950	200 W to 2 kW	✓	✓	✓	Φ-Shifted FB	1 MHz	8 to 17			✓	—	24-TSSOP	✓	4.25
UCC3895	200 W to 2 kW	✓	✓	✓	Φ-Shifted FB	1 MHz	11 to 17			✓	Four at 0.1/0.1	20-SOIC-W/DIL (PDIP)/PLCC		4.35
<b>Wide-Input Range Voltage Mode Controllers</b>														
UCC35701/2	25 to 250	✓			Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%)	700 kHz	8.8 to 15			✓	1.2/1.2	14-TSSOP/SOIC/DIL (PDIP)		2.95
UCC35705/6	25 to 250	✓			Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%)	4 MHz	8.0 to 15				0.1/0.1	8-MSOP/SOIC/DIL (PDIP)		0.75
<b>Intermediate Bus Controllers</b>														
UCC28230/1	150 to 500				Half-Bridge, Full-Bridge	2 MHz	-0.3 to 20			✓	0.2/0.2	12-SON, 14-TSSOP		1.20
<b>Secondary-Side, Post Regulation</b>														
LM(2)5115/A	—	✓			Synchronous Secondary-Side Post Regulator	1 MHz	4.5 to 42/75			✓	2/2.5	16-TSSOP/QFN		1.35/1.80

<sup>1</sup>UC2xxx and UCC2xxx devices are extended temperature-range versions of the UC3xxx and UCC3xxx devices.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

<sup>2</sup>Value varies by part number suffix. Please check datasheet.

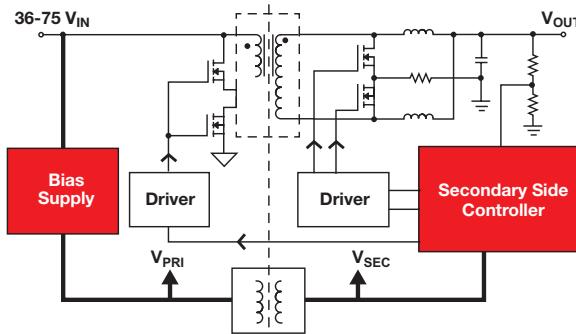
# AC/DC and Isolated DC/DC Power Supplies

## Auxiliary Bias Supply Regulators

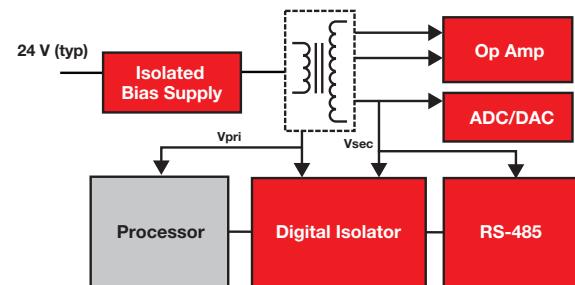
Isolated bias supplies are widely used in telecommunications and industrial equipment to provide a lower-power, isolated bias supply for a system microcontroller or secondary-side PWM controller so it can then power up the rest of the system. The typical bus voltage in telecommunication equipment ranges from 36 to 75 V, and 24-V industrial bus voltages can

be subjected to transients as high as 60 V. When used with the right transformer, an isolated bias supply can support multiple output voltages for isolating noise-sensitive analog circuitry in industrial automation. It can also provide both primary and secondary-side bias supplies for an isolated DC/DC converter module. Examples of these scenarios are shown below.

### Isolated Primary and Secondary Supplies



### Isolated Primary and Secondary Supplies

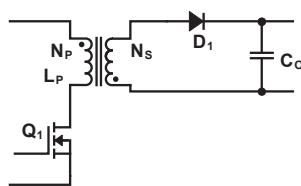


Typically there are two types of solutions to generate isolated bias supply: Flyback and Fly-Buck.<sup>TM</sup>

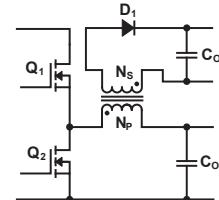
The Flyback converter uses a boost converter IC as the PWM controller along with a transformer to generate isolation between the input and any outputs, and it is suitable for generating single or multiple output rails. Typically it requires secondary voltage

feedback through opto-coupler. The Fly-Buck converter is based on a buck regulator but adds coupled windings to the inductor to generate isolated output rails. It utilizes primary side control thus eliminating the opto-coupler. The Fly-Buck converter brings easy-to-design, small size solution to multi-output and isolated power supply design.

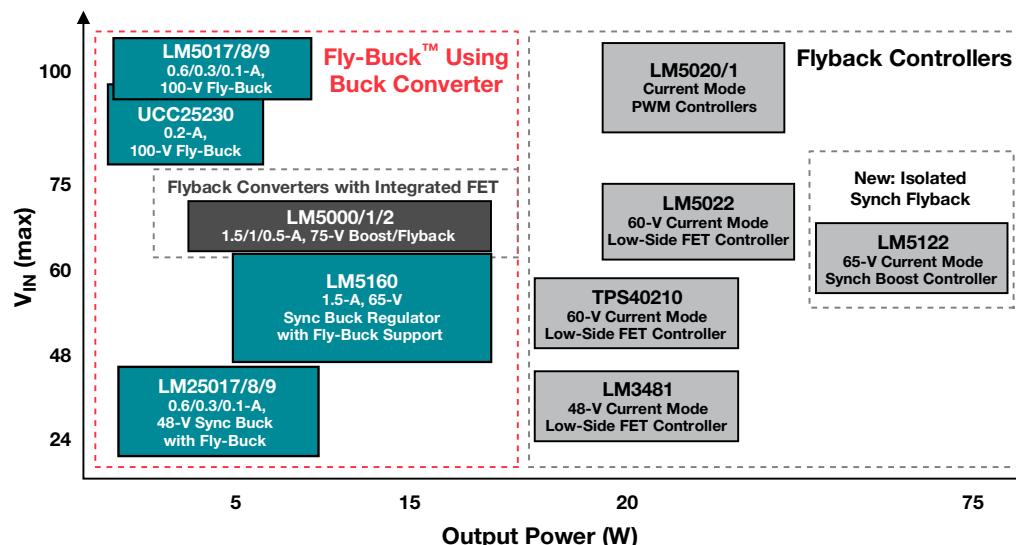
### Flyback Diagram



### Fly-Buck<sup>TM</sup> Diagram



### Bias Supply Family



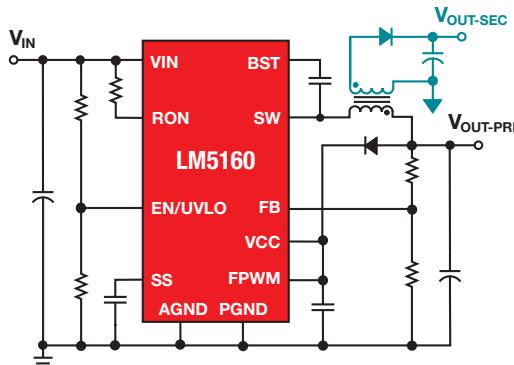
# AC/DC and Isolated DC/DC Power Supplies

## Auxiliary Bias Supply Regulators

### 65-V, 1.5-A Synchronous Buck Converter with Fly-Buck™ Isolated Bias Supply Support

#### LM5160

When used with a multi-winding transformer, the LM5160 synchronous buck converter offers a simple, low-cost solution for generating one or more isolated bias supplies with high efficiency, good voltage regulation and with no optocoupler required. The converter provides programmable soft-start to minimize inrush currents at startup and integrated synchronous MOSFETs reduce external components and PCB area.



Get more information: [www.ti.com/product/LM5160](http://www.ti.com/product/LM5160)

#### Key Features

- Wide  $V_{IN}$  operation: 4.5 to 65 V
- Integrated synchronous MOSFETs
- Constant on-time eliminates loop compensation components
- No optoisolator required

#### Applications

- Programmable logic controllers (PLCs)
- AC motor drive; IGBT driver bias
- Automotive HEV/EV inverters
- PoE IP cameras

Reference Designs available at:

[www.ti.com/tool/pmp10531](http://www.ti.com/tool/pmp10531)

[www.ti.com/tool/pmp10532](http://www.ti.com/tool/pmp10532)

#### Selection Guide

Device <sup>1</sup>	Typical Power Level (W)	Control Method			Topologies	Maximum Practical Frequency	Supply Voltage (V)	Soft Start	Output Drive (Sink/Source) (A)	Package(s)	Automotive	Price*
		Voltage Mode	Current Mode	Avg. Current Mode								
<b>Auxiliary Bias Supplies</b>												
TPS55010	<2	✓	✓		Fly-Buck™ (Forward Flyback)	2 MHz	2.95 to 6	✓	—	16-QFN		0.99
UCC25230	1 to 2	✓			Buck, Fly-Buck (Forward Flyback)	445 kHz	12 to 75	✓	—	8-SON		1.35
LM34927/6/5	3 to 7	Note 2			Buck, Fly-Buck (Forward Flyback)	1 MHz	7.5 to 100	0.6/0.3/0.15	8-LLP/PSOP			1.65
LM5017	3 to 7	Note 2			Buck, Fly-Buck (Forward Flyback)	1 MHz	7.5 to 100		0.6	8-LLP/PSOP		1.65
LM5160	3 to 15	Note 2			Buck, Fly-Buck	1 MHz	4.5 to 65	✓	1.5	12-WSON		1.80
LM5015	5 to 15	✓			Boost, Buck, Flyback, Forward, Inverting Buck-Boost	750 kHz	4.25 to 75		1.4	14-HTSSOP		1.85
TPS40210	>15	✓✓			Boost, SEPIC, Flyback	1 MHz	4.5 to 52	0.4	10-MSOP, 10-VSON	✓	0.80	
LM3481	>15	✓✓			Boost, SEPIC, Flyback	1 MHz	2.97 to 48	1	10-VSSOP	✓	0.80	
LM5020	>15	✓✓			Flyback, Forward	1 MHz	13 to 100	1	10-VSSOP, 10-WSON		0.80	
LM5021	>15	✓✓			Boost, Flyback	560 kHz	8 to 30	0.7	8-VSSOP, 8-PDIP	✓	0.50	
LM5022	>15	✓✓			Boost, SEPIC, Flyback	1 MHz	6 to 60	1	10-VSSOP		0.90	
LM5122	>15	✓✓			Boost, Synchronous Flyback	1 MHz	3 to 65	2	20-HTSSOP	✓	1.80	

<sup>1</sup>UC2xxx and UCC2xxx devices are extended temperature-range versions of the UC3xxx and UCC3xxx devices.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

<sup>2</sup>Constant ON-time control.

# AC/DC and Isolated DC/DC Power Supplies

## Gate Drivers

### Design Factors

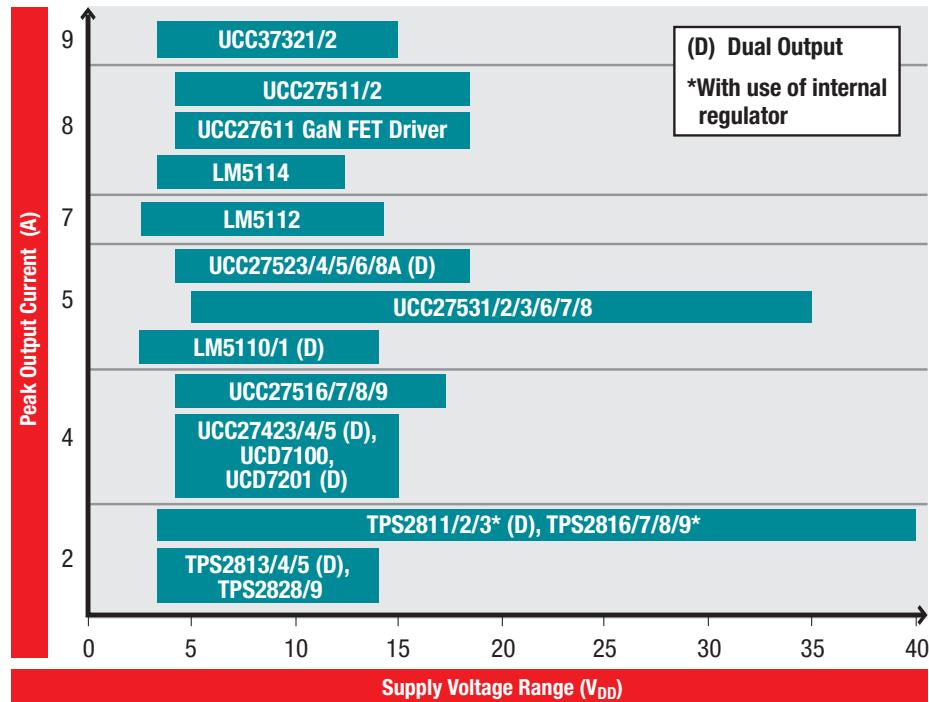
**Supply Voltage Range** — With internal voltage regulators, MOSFET drivers can operate over a wide input voltage range, making them flexible for many applications.

**Number of Outputs** — Single and dual drivers are available to complement DC/DC switching and motor control applications.

**Output Configuration** — Inverting, non-inverting, AND and NAND configurations are available.

New single-channel low-side drivers offer split outputs (for independent source and sink to allow optimization of switch timing) and asymmetrical drive (higher sink than source current) for faster transition through Miller Plateau.

### Low-Side Gate Driver Portfolio



### Product Highlights

#### UCC2751x and UCC2752xA

- Asymmetrical drive and split output options available on select single-channel drivers
- Best-in-class propagation delay and higher V<sub>DD</sub> compatibility with IGBT power switches
- UCC27528 features CMOS input thresholds

#### UCC27531

- FET and IGBT single-gate drivers
- 2.5 A and 5 A, 35-V maximum V<sub>DD</sub>

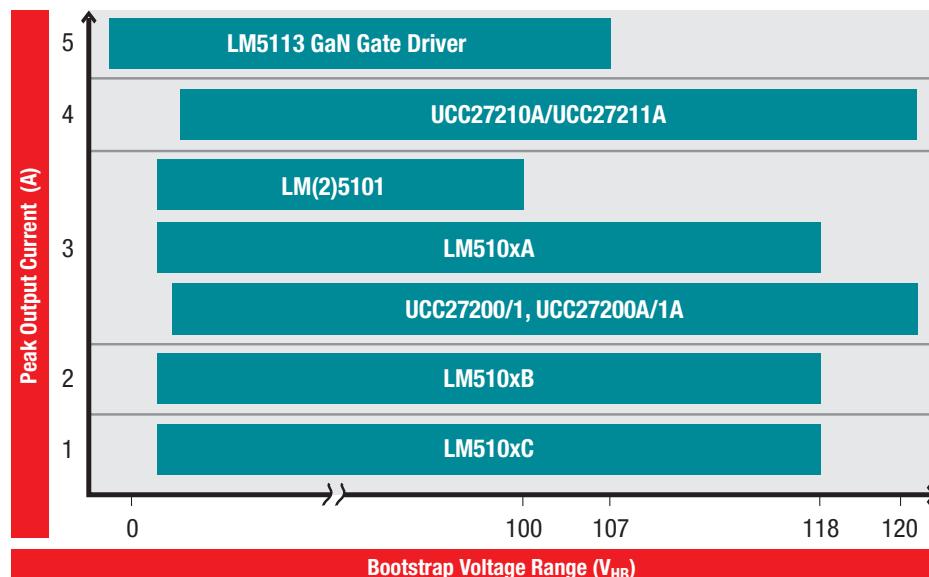
#### LM5114

- Next-generation 7.6-A, 12-ns single-channel MOS and GaN FET-compatible driver

#### UCC27611

- High-speed 5-V GaN FET driver

### High-Side/Low-Side Bridge Driver Portfolio



### Product Highlights

#### UCC2721xA

- 4-A next generation of popular UCC2720x has 120-V boot voltage, -10-V input-voltage capability and ESD enhancements

#### LM510xx Family

- Drive capability scales with power-converter requirements

#### LM5113

- Industry's only 100-V driver for enhancement-mode GaN FETs

# AC/DC and Isolated DC/DC Power Supplies

## Gate Drivers

### 2.5-A/5-A, 35-V Max Single-Gate Driver for FETs, IGBTs and SiC FETs

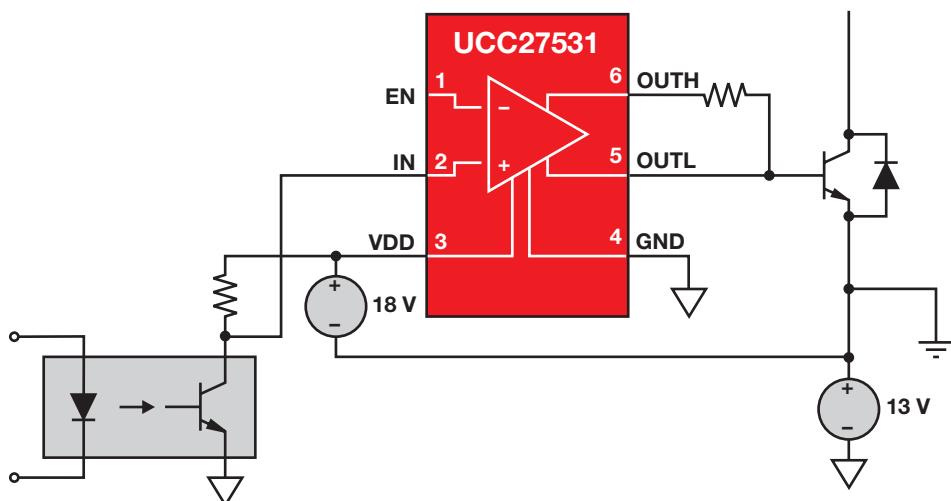
#### **UCC27531**

##### Advantages over Discrete Design

- Built-in level shifting
- Flexibility: Inverting and non-inverting configurations
- Matches parasitic and improves layout
- Reduced number of devices (three needed for discrete design)
- Reduced overall cost—transistor/FET and PC board space

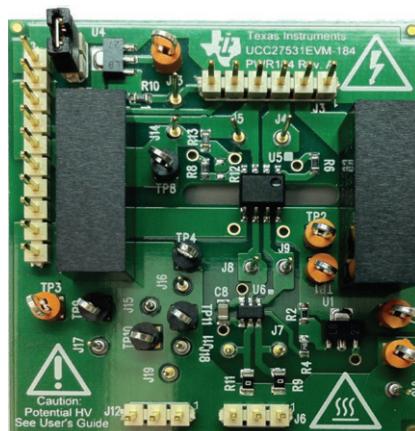
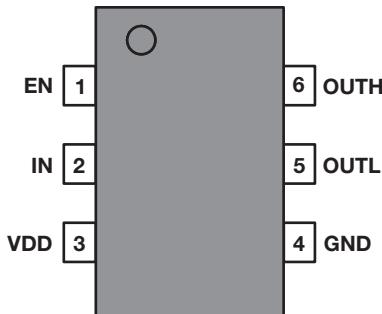
##### Key Features

- High  $V_{DD}$ : 35 V allows significant margin
- Strong output-drive capability: 2.5-A source/5-A sink allows fast charging
- Fastest propagation time: 17-ns typical delay
- High reliability: UVLO setting and rail-to-rail output voltage provide system protection
- Negative-input-voltage handling allows driver to support “noisy” industrial designs
- Can be used for low side and high side
- Used with TI’s UCD3138 digital power controller or C2000™ microcontrollers



##### Applications

- Solar inverters
- Motor control
- UPS
- HEV/EV chargers
- Switch-mode power
- Intelligent power modules



UCC27531EVM-184 evaluation module.

Get more information: [www.ti.com/product/UCC27531](http://www.ti.com/product/UCC27531)

[www.ti.com/lit/slua669](http://www.ti.com/lit/slua669)

[www.ti.com/tool/UCC27531EVM-184](http://www.ti.com/tool/UCC27531EVM-184)

# AC/DC and Isolated DC/DC Power Supplies

## Gate Drivers

### Selection Guide

Device	No. of Channels	Output Configuration	Output Type <sup>1</sup>	Peak I <sub>out</sub> Source/Sink (A)	Rise/Fall Time (ns)	V <sub>CC</sub> Range (V)	Prop Delay (ns)	Input Threshold	Enable	Dead Time Control	Protection Features <sup>2</sup>	Internal Regulator	Automotive	Price*
<b>General-Purpose Low-Side Drivers</b>														
<b>UCC27524A</b>	2	Non-inverting	—	5/5	9/7	4.5 to 18	14	TTL	✓	—	—	—	✓	0.75
<b>UCC27525A</b>	2	See Note 3	—	5/5	9/7	4.5 to 18	14	TTL	✓	—	—	—	—	0.75
<b>UCC27526A</b>	2	See Note 3	—	5/5	9/7	4.5 to 18	14	TTL	✓	—	—	—	—	0.75
<b>UCC27528</b>	2	Non-Inverting	--	5/5	7/6	4.5 to 18	13	CMOS	✓	—	—	—	—	0.75
<b>UCC27523</b>	2	Inverting	—	5/5	9/7	4.5 to 18	14	TTL	✓	—	—	—	—	0.75
<b>UCC27511</b>	1	Non-inverting	Split	4/8	9/9	4.5 to 18	14	Dual input TTL	—	—	—	—	—	0.49
<b>UCC27512</b>	1	Non-inverting	—	4/8	9/7	4.5 to 18	14	Dual input TTL	—	—	—	—	—	0.49
<b>UCC27516</b>	1	See Note 3	—	4/4	9/7	4.5 to 18	14	TTL	—	—	—	—	—	0.49
<b>UCC27517A</b>	1	See Note 3	—	4/4	9/7	4.5 to 18	14	TTL	—	—	—	—	✓	0.49
<b>UCC27518</b>	1	Inverting	—	4/4	9/7	4.5 to 18	14	CMOS	—	—	—	—	—	0.49
<b>UCC27519</b>	1	Non-inverting	—	4/4	9/7	4.5 to 18	14	CMOS	—	—	—	—	—	0.49
<b>UCC27531</b>	1	Non-inverting	—	-2.5/5	15/7	—	17	TTL	—	—	—	—	—	0.75
<b>UCC27532</b>	1	Non-inverting	—	-2.5/5	15/7	—	17	CMOS	—	—	—	—	—	0.75
<b>UCC27533</b>	1	See Note 3	—	-2.5/5	15/8	—	15	TTL	—	—	—	—	—	0.75
<b>UCC27536</b>	1	Inverting	—	-2.5/5	15/8	—	15	TTL	—	—	—	—	—	0.75
<b>UCC27537</b>	1	Non-inverting	—	-2.5/5	15/8	—	15	TTL	—	—	—	—	—	0.75
<b>UCC27538</b>	2	Non-inverting	—	-2.5/5	15/8	—	15	TTL	—	—	—	—	—	0.75
<b>UCC27611</b>	1	See Note 3	—	-4/8	5/5	—	14	TTL	—	—	—	—	—	0.85
<b>UCC37321</b>	1	Inverting	TrueDrive™	9/9	20/20	4 to 15	30	TTL/CMOS	✓	—	—	—	—	0.99
<b>UCC37322</b>	1	Non-inverting	TrueDrive	9/9	20/20	4 to 15	30	TTL/CMOS	✓	—	—	—	—	0.99
<b>LM5112</b>	2	Non-inverting	Split	7/3	14/12	3.5 to 15	25	CMOS	—	—	✓	—	—	0.50
<b>LM5111</b>	2	Non-inverting	Split	5/3	14/12	3.5 to 15	25	TTL	—	—	✓	—	—	0.65
<b>LM5110</b>	2	Non-inverting	Split	5/2	14/12	3.5 to 15	25	TTL	—	—	✓	—	—	0.65
<b>LM5114A/B</b>	1	Non-inverting	Split	1.3/7.6	8/3.2	4 to 12.6	—	TTL/CMOS	—	—	—	—	—	0.60
<b>LM5134</b>	2	Non-inverting with Pilot output	Split	4.5/7.6 0.66/0.82	5.3/4.7	4 to 12.6	12	TTL/CMOS	—	—	—	—	—	0.60
<b>UCD7100PWP</b>	1	Uncommitted/ Non-inverting	TrueDrive	4/4	10/10	4.5 to 16	20	CMOS/TTL	—	Adaptive	—	—	—	0.99
<b>UCD7201PWP</b>	2	Uncommitted/ Non-inverting	TrueDrive	4/4	10/10	4.5 to 16	20	CMOS/TTL	—	Adaptive	—	—	—	1.20
<b>TPS2812</b>	2	Non-inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✓	—	0.90
<b>TPS2814</b>	2	Dual 2-input AND; one inverting	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	—	—	0.90
<b>TPS2828</b>	1	Inverting	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	—	—	0.60
<b>TPS2829</b>	1	Non-inverting	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	—	—	0.60
<b>EMB1412</b>	2	Non-inverting	Split	7/3	14/12	3.5 to 15	25	CMOS	—	—	✓	—	—	0.60
<b>SM72482</b>	2	Non-inverting	Split	5/3	14/12	3.5 to 15	25	TTL	—	—	✓	—	—	0.62
<b>SM74101</b>	2	Non-inverting	Split	7/3	14/12	3.5 to 15	25	CMOS	—	—	✓	—	—	0.50
<b>Synchronous-Rectifier Drivers</b>														
<b>UCC24610</b>		Non-inverting	—	3/3	30/25	4.5 to 5.5	44	CMOS/TTL	✓	Adaptive	✓	—	—	0.75
<b>Synchronous Buck Drivers</b>														
<b>TPS2838</b>	2	Non-inverting	TrueDrive	4/4	120	10 to 15	40	TTL	✓	Adaptive	—	✓	—	1.30
<b>TPS2839</b>	2	Inverting	TrueDrive	4/4	120	10 to 15	40	TTL	✓	Adaptive	—	✓	—	1.30
<b>TPS2848</b>	2	Non-inverting	TrueDrive	4/4	120	10 to 15	20	TTL	✓	Adaptive	—	✓	—	1.25
<b>TPS2849</b>	2	Inverting	TrueDrive	4/4	120	10 to 15	20	TTL	✓	Adaptive	—	✓	—	1.25
<b>UCD7230</b>	2	Non-inverting	CMOS	4/4	10/10	4.5 to 15.5	25	CMOS/TTL	—	Adaptive	Adjustable	—	—	0.80
<b>UCC27221</b>	2	Inverting	TrueDrive	3.3/3.3	20/20	3.7 to 20	82/103	TTL	—	PGD <sup>4</sup>	—	✓	—	1.70
<b>UCC27222</b>	2	Non-inverting	TrueDrive	3.3/3.3	20/20	3.7 to 20	82/103	TTL	—	PGD <sup>4</sup>	—	✓	—	1.70

<sup>1</sup>Output type: TrueDrive is the hybrid bipolar/CMOS output architecture for improved current drive capability at low voltages (at Miller threshold).

<sup>4</sup>Predictive Gate Drive™.

New devices are listed in bold red.

<sup>2</sup>OVP = overvoltage protection crowbar; UVLO = undervoltage lockout.

<sup>5</sup>Maximum boot voltage at HS pin.

<sup>3</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

# AC/DC and Isolated DC/DC Power Supplies

## Gate Drivers

### Selection Guide (Continued)

Device	No. of Channels	Output Configuration	Output Type <sup>1</sup>	Peak I <sub>OUT</sub> Source/Sink (A)	Rise/Fall Time (ns)	V <sub>CC</sub> Range (V)	Prop Delay (ns)	Input Threshold	Enable	Dead Time Control	Protection Features <sup>2</sup>	Internal Regulator	Automotive	Price*
<b>Synchronous Buck Drivers (Continued)</b>														
<b>UCC27223</b>	2	Non-inverting	TrueDrive	3.3/3.3	25/35	4.15 to 20	82/103	TTL	✓	PGD <sup>4</sup>	—	✓	—	1.70
<b>TPS2830</b>	2	Non-inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	✓	Adaptive	OVPC	—	—	1.05
<b>TPS2831</b>	2	Inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	✓	Adaptive	OVPC	—	—	1.05
<b>TPS2832</b>	2	Non-inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	—	Adaptive	—	—	—	1.00
<b>TPS2833</b>	2	Inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	—	Adaptive	—	—	—	1.00
<b>TPS2834</b>	2	Non-inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	✓	Adaptive	OVPC	—	—	1.05
<b>TPS2835</b>	2	Inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	✓	Adaptive	OVPC	—	—	1.05
<b>TPS2836</b>	2	Non-inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	—	Adaptive	—	—	—	1.25
<b>TPS2837</b>	2	Inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	—	Adaptive	—	—	—	1.25
<b>TPS28225</b>	2	Non-inverting	CMOS	2/4	10/10	4.5 to 8.8	14	TTL/CMOS	✓	Adaptive	UVLO	—	✓	0.60
<b>TPS28226</b>	2	Non-inverting	CMOS	2/4	10/10	4.5 to 8.8	14	TTL/CMOS	✓	Adaptive	UVLO	—	—	0.60
<b>High-Side Low-Side Drivers—Half Bridge, Full Bridge</b>														
<b>UCC27210</b>	2	Non-inverting	—	4/4	12/9	to 115 <sup>5</sup>	20	CMOS	—	—	UVLO	—	—	1.50
<b>UCC27211/A</b>	2	Non-inverting	—	4/4	12/9	to 115 <sup>5</sup>	20	TTL	—	—	UVLO	—	—	1.50
<b>LM25101A/B/C</b>	2	Non-inverting	CMOS	3/3	8/8	to 80	25	TTL	—	—	UVLO	—	—	1.25
<b>LM5100A/B/C</b>	2	Non-inverting	CMOS	3/3	8/8	to 118	25	CMOS	—	—	UVLO	—	—	1.25
<b>LM5101A/B/C</b>	2	Non-inverting	CMOS	3/3	8/8	to 118	25	TTL	—	—	UVLO	—	—	1.25
<b>UCC27200/A</b>	2	Non-inverting	TrueDrive	3/3	8/7	to 110 <sup>5</sup>	20	CMOS	—	—	UVLO	—	✓	1.30
<b>UCC27201/A</b>	2	Non-inverting	TrueDrive	3/3	8/7	to 110 <sup>5</sup>	20	TTL	—	—	UVLO	—	✓	1.30
<b>LM5113</b>	2	Non-inverting	GaN FET	1.2/5	4/4	to 100 <sup>5</sup>	30	TTL	—	—	UVLO	—	—	1.49
<b>SM72295</b>	4	Non-inverting	CMOS	3/3	8/8	to 118	22	TTL	—	—	UVLO	—	—	1.90

<sup>1</sup>Output type: TrueDrive is the hybrid bipolar/CMOS output architecture for improved current drive capability at low voltages (at Miller threshold).

<sup>4</sup>Predictive Gate Drive™.

New devices are listed in **bold red**.

<sup>2</sup>OVPC = overvoltage protection crowbar; UVLO = undervoltage lockout.

<sup>5</sup>Maximum boot voltage at HS pin.

<sup>\*</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

<sup>3</sup>One inverting, one non-inverting.

### Automotive-Grade Gate Drivers

Device	Description	Max V <sub>CC</sub> (V)	Peak Current (A)	Prop Delay (ns)	Pin/Package
<b>UCC27511A-Q1</b>	Single-channel high-speed, low-side gate driver with 5-V negative input voltage handling ability with split output	18	8	13	6SOT-23
<b>UCC27517A-Q1</b>	Single-channel 4-A high-speed, low-side gate driver with inverting or non-inverting configuration with 5-V negative input voltage handling ability	18	4	13	5SOT-23
<b>UCC27518A-Q1</b>	Single-channel 4-A high-speed, low-side gate driver with inverting configuration and CMOS input with 5-V negative input voltage handling ability	18	4	13	5SOT-23
<b>UCC27519A-Q1</b>	Single-channel 4-A high-speed, low-side gate driver with non-inverting configuration and CMOS input with 5-V negative input voltage handling ability	18	4	13	5SOT-23
<b>UCC27524A-Q1</b>	Dual-channel 5-A high-speed, low-side gate driver with negative input voltage capability	18	5	14	8MSOP, 8SOIC
<b>UCC27531-Q1</b>	Single-channel 2.5-A/5-A, 35-V Max VDD, FET and IGBT gate driver with split output and with 5-V negative input voltage handling ability	35	5	17	6SOT-23
<b>UCC27532-Q1</b>	Single-channel 2.5-A/5-A, 35-V Max VDD, FET and IGBT gate driver with split output and CMOS input and with 5-V negative input voltage handling ability	35	5	17	6SOT-23
<b>LM5112-Q1</b>	Tiny 7-A single-channel MOSFET gate driver	14	7	25	6WSON

# Power Modules (Non-Isolated)

## Overview

Design with TI's comprehensive power module portfolio for wide input-voltage and output-current ranges, flexible packaging options and easy-to-use integrated solutions for a variety of non-isolated, industrial, medical, and communications applications.



### PTH08T2xx "T2" Power Modules

High-current modules for applications that require up to 50 A.

- High output current of up to 50 A
- TurboTrans™ feature for tunable transient response
- Current sharing (50-A version)

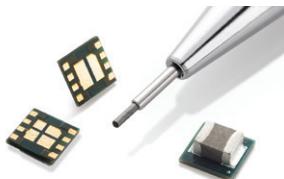


### SIMPLE SWITCHER® Power Modules

#### QFN Package: LMZ3 Series

Easy-to-use high-power-density modules for applications requiring a small footprint.

- Input-voltage range: 2.95 to 50 V
- Output current up to 30 A
- Feature-rich and flexible
- Only three external components required



#### QFN Package: Nano Series

Tiny modules for point-of-load applications that require up to 2 A.

- Input-voltage range: 2.7 to 17 V
- Tiny 3.5 x 3.5 x 1.75-mm packaging
- High efficiency up to 96%
- Low output ripple



#### Leaded Package

Easy-to-use modules for applications requiring high input voltages of up to 42 V.

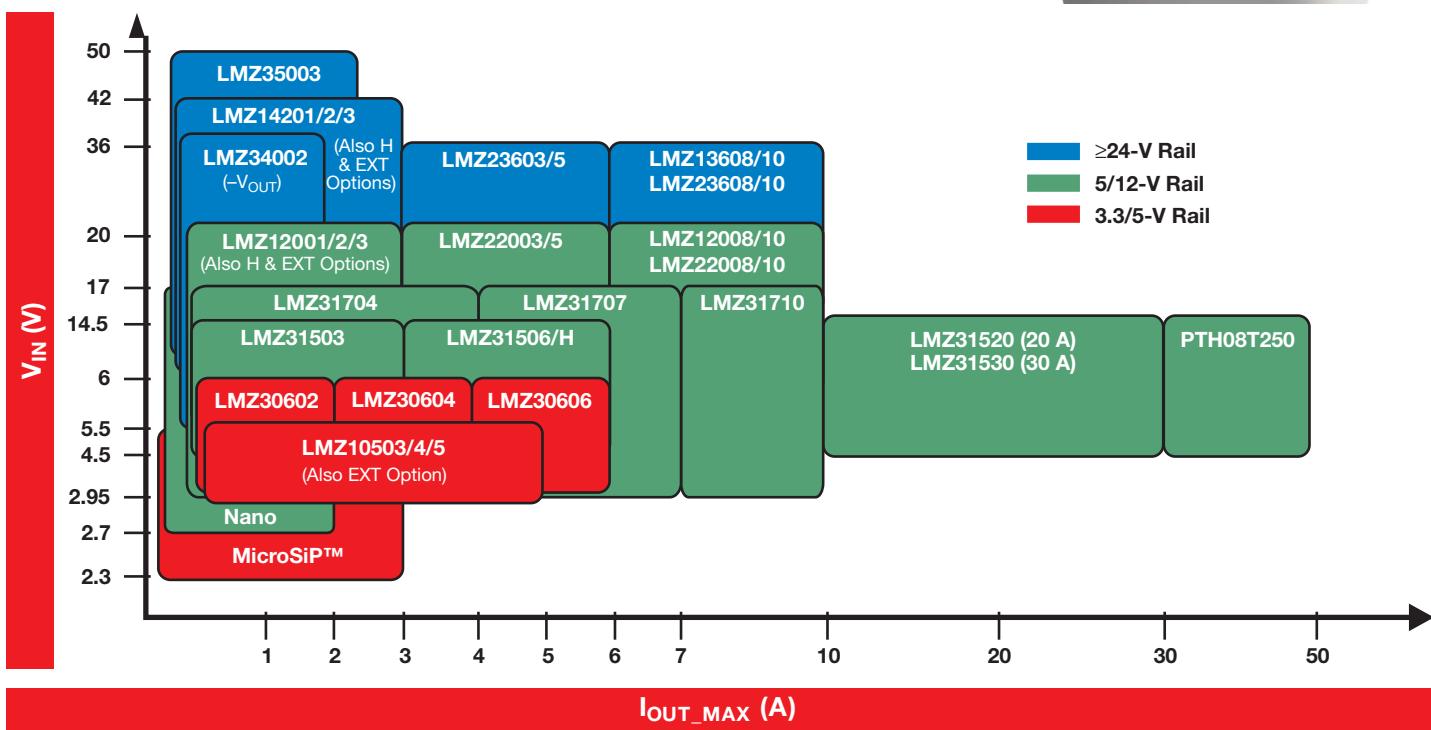
- Single exposed bottom
- Supports 5-V, 12-V and 24-V rails
- Output current up to 10 A

#### MicroSiP™ Modules:

#### TPS81k (Boost) Family and TPS82k (Step-Down) Family

Smallest total-solution footprint.

- Integrates all required components
- Achieves 238 mA/mm<sup>2</sup>
- High efficiency over entire load range
- Supports noise-critical applications through spread-spectrum modulation



# Power Modules (Non-Isolated)

## Step-Down (Buck) Modules

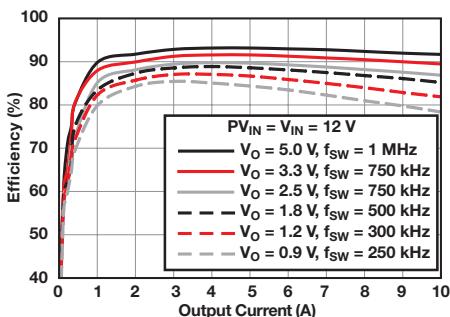
### SIMPLE SWITCHER® QFN Power Modules

#### LMZ31710

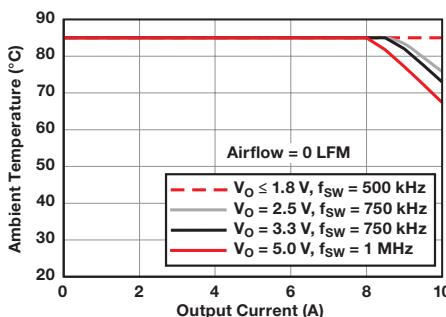
##### Key Features

- World's smallest 10-A power solution in a tiny 10 x 10 x 4.3-mm QFN package
- 2.95- to 17-V input
- 0.6- to 5.5-V output up to 10 A
- Pin-compatible with LMZ31707 (7 A) and LMZ31704 (4 A)

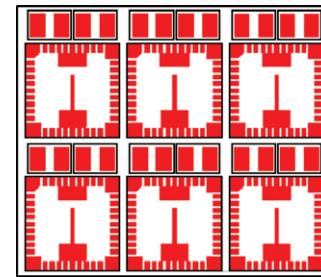
- Current sharing up to 60 A
- Low noise: Meets EN55022 Class B emissions
- Wide operating temperature: Up to 125°C T<sub>J</sub>



High-power efficiency from 5 V and 12 V.



Great thermal efficiency even without forced air.



Capable of current sharing up to six devices for 60 A.

Get more information: [www.ti.com/LMZ3](http://www.ti.com/LMZ3)

[www.ti.com/product/LMZ31710](http://www.ti.com/product/LMZ31710) (10 A) or [LMZ31707](http://www.ti.com/product/LMZ31707) (7 A) or [LMZ31704](http://www.ti.com/product/LMZ31704) (4 A)

### SIMPLE SWITCHER® QFN Power Modules Selection Guide

Device	I <sub>OUT</sub> (A)	V <sub>IN</sub> (V)	V <sub>OUT</sub> (V)	Package θ <sub>JA</sub> (°C/W)	Switching Frequency (kHz)	Features						EVM	Package(s)	Price*	
						Power Good Pin	Sync Pin	Adj. Soft Start	180° Out of Phase	Sequencing/Tracking	Current Sharing				
<b>Low Input Voltage</b>															
LMZ30602	2	2.95 to 6.0	0.8 to 3.6	12	500 to 2000	✓	✓	✓			✓		✓	39 QFN (9x11x2.8 mm)	2.95
LMZ30604	4	2.95 to 6.0	0.8 to 3.6	12	500 to 2000	✓	✓	✓			✓		✓	39 QFN (9x11x2.8 mm)	3.80
LMZ30606	6	2.95 to 6.0	0.8 to 3.6	12	500 to 2000	✓	✓	✓			✓	✓	✓	39 QFN (9x11x2.8 mm)	4.50
<b>Mid Input Voltage</b>															
LMZ31503	3	4.5 to 14.5	0.8 to 5.5	13	330 to 780	✓	✓	✓			✓		✓	47 QFN (9x15x2.8 mm)	4.25
LMZ31704	4	2.95 to 17	0.6 to 5.5	13	200 to 1200	✓	✓	✓	✓		✓	✓	✓	44 QFN (10x10x4.3 mm)	5.25
LMZ31506	6	4.5 to 14.5	0.6 to 5.5	13	250 to 780	✓	✓	✓			✓	✓	✓	47 QFN (9x15x2.8 mm)	5.45
LMZ31707	7	2.95 to 17	0.6 to 5.5	13	200 to 1200	✓	✓	✓	✓		✓	✓	✓	44 QFN (10x10x4.3 mm)	6.50
LMZ31710	10	2.95 to 17	0.6 to 5.5	13	200 to 1200	✓	✓	✓	✓		✓	✓	✓	44 QFN (10x10x4.3 mm)	8.95
LMZ31520	20	4.5 to 14.5	0.6 to 2.8	8.6	500/900	✓		✓			✓		✓	68 QFN (15x16x5.8 mm)	14.00
LMZ31530	30	4.5 to 14.5	0.6 to 2.8	8.6	500/900	✓		✓			✓		✓	68 QFN (15x16x5.8 mm)	17.00
<b>Wide Input Voltage</b>															
LMZ35003	2.5	7 to 50	2.5 to 15	12	400 to 1000	✓	✓	✓			✓		✓	41 QFN (9x11x2.8 mm)	7.95
LMZ34002	2	4.5 to 40	-3 to -17	14	700 to 900		✓	✓					✓	41 QFN (9x11x2.8 mm)	6.75

All of the above devices have undervoltage lockout and thermal protection built in.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

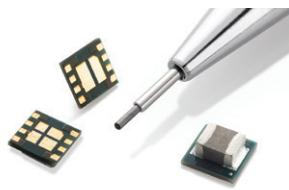
WEBENCH® models available for all SIMPLE SWITCHER® QFN devices: [www.ti.com/webench](http://www.ti.com/webench)

# Power Modules (Non-Isolated)

## Step-Down (Buck) Modules

### SIMPLE SWITCHER® Nano Modules

The new SIMPLE SWITCHER nano modules combine ease of use and high performance in a tiny solution size. Nano modules provide enhanced system performance and can be used to reduce board area in applications with space and height limitations.



### Easy-to-Use Package

- 2.6 x 3 x 1.5-mm footprint
- Eight pins and a thermal pad
- 50°C/W  $\theta_{JA}$
- MSL3
- 260°C peak reflow temperature
- No exposed die

### SIMPLE SWITCHER® Nano Modules

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Operating Junction Temperature (°C)	Features	Frequency (kHz)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	CISPR22 Class B EMI	Package Size (mm)	Price*
LMZ10500/01	0.65/1	2.7 to 5.5	0.6 to 3.6	-40 to 125	EN, SS	2000	6500	11	✓	2.6 x 3 x 1.5	1.30/1.50
LMZ20501/02	1/2	2.7 to 5.5	0.8 to 3.6	-40 to 125	EN, SS, PG, Eco-mode™	3000	64	1	✓	3.5 x 3.5 x 1.75	1.70/1.90
LMZ21700/01	0.65/1	3 to 17	0.9 to 6	-40 to 125	EN, SS, PG, Eco-mode	2000	17	1.5	✓	3.5 x 3.5 x 1.75	1.55/1.75

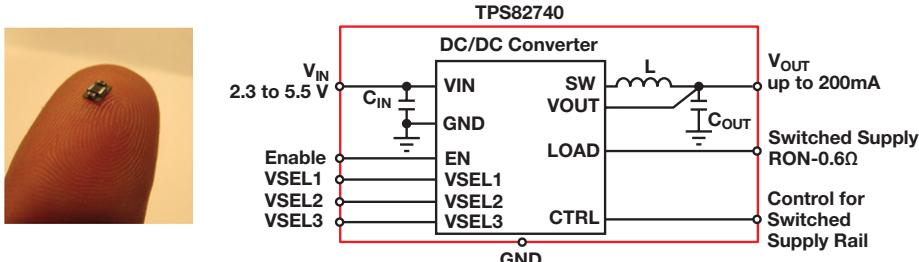
\*Suggested resale price in U.S. dollars in quantities of 1,000.

### MicroSiP™ Modules

#### World's Smallest, 200-mA Step-Down Module with Ultra-Low, 360-nA $I_Q$

##### TPS82740A

The TPS82740A is the industry's first step-down converter module featuring 360-nA quiescent current (typical). It is a complete MicroSiP™ DC/DC step-down power solution intended for ultra-low-power applications. The integration of all required passive components enables a tiny solution size of only 6.7 mm<sup>2</sup>. With the DCS-Control™ feature, it extends the light-load efficiency range below 10-µA load currents. It also supports currents up to 200 mA. The device operates from rechargeable Li-Ion batteries, including Li-primary battery chemistries such as Li-SOCl<sub>2</sub> and Li-MnO<sub>2</sub>, in addition to two- or three-cell alkaline batteries. An input-voltage range of up to 5.5 V also allows operation from an USB port and thin-film solar modules.



Get more information: [www.ti.com/microsip](http://www.ti.com/microsip)

### MicroSiP™ Power Modules Selection Guide

Device	Base Function	$I_{OUT}$ (mA)	$V_{IN}$ (V)	Fixed $V_{OUT}$ (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Active Output Capacitor Discharge	Total Solution Size (mm <sup>2</sup> )	MicroSiP™ Package	EVM	Features and Differentiators	Price*
<b>Fully Integrated Solutions (Inductor plus input/output capacitors on device)</b>														
TPS82740A	Step-Down	200	2.2 to 5.5	1.8 to 2.5	90	2000	0.36	0.07	✓	<6.7	9	✓	Enable, light load efficiency	1.50
TPS82695	Step-Down	500	2.3 to 4.35	2.5 to 2.85	95	4000	24	0.5	✓	<6.7	8	✓		1.10
TPS82671	Step-Down	600	2.3 to 4.8	1.0 to 1.9	90	5500	17	0.5	✓	<6.7	8	✓	Spread spectrum	1.10
TPS82693	Step-Down	800	2.3 to 4.8	2.2 to 3.2	95	3000	21	0.5	✓	<6.7	8	✓	Spread spectrum	1.50
TPS8268105	Step-Down	1600	2.5 to 5.5	0.9 to 1.5	83	5500	7000	0.5	✓	<6.7	9	✓	Spread spectrum	1.50
TPS82085	Step-Down	3000	2.5 to 6	0.8 to Vin	95	2400	17	0.7	✓	<35	8	✓	DCS-Control™, PSM, output discharge	2.75

All of the above devices have undervoltage lockout and thermal protection built in.

New devices are listed in bold red. Preview devices are listed in bold teal.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

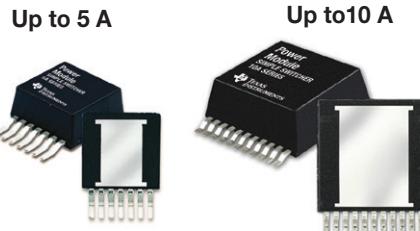
# Power Modules (Non-Isolated)

## Step-Down (Buck) Modules

### SIMPLE SWITCHER® Leaded Power Modules

The SIMPLE SWITCHER leaded power modules allow you to design and optimize robust power supplies with a minimum set of external components. All SIMPLE SWITCHER power modules provide you with low EMI, excellent thermal performance and pin-to-pin compatibility for added design flexibility. Plus, SIMPLE SWITCHER power modules utilize WEBENCH® Power Designer online design tools, feature evaluation boards and reference designs, and include application notes and videos to make design easy.

#### Easy-to-Use Packaging



#### Key Features

- Integrated shielded inductor
- Precision enable, external soft-start, and tracking for sequencing
- Best-in-class thermal performance
- Low output voltage ripple
- Standard junction temperature grade: –40 to +125°C
- Easy-to-use package with single exposed copper bottom
- Passes EN55022 (CISPR22) Class B Radiated and Conducted EMI Standard

### SIMPLE SWITCHER® LMZ1-Series Power Modules

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Peak Efficiency (%)	Operating Junction Temperature (°C)	Features	EMI EN55022/CISPR22 Class B Certification		Package(s)	Price*
							Radiated	Conducted <sup>1</sup>		
LMZ10503/04/05	3/4/5	2.95 to 5.5	0.8 to 5	96	–40 to 125	EN, SS	✓	✓	TO-PMOD-7	3.95/4.50/4.95
LMZ12001/02/03	1/2/3	4.5 to 20	0.8 to 6	92	–40 to 125	EN, SS	✓	✓	TO-PMOD-7	4.46/5.10/5.95
LMZ14201/02/03	1/2/3	6 to 42	0.8 to 6	90	–40 to 125	EN, SS	✓	✓	TO-PMOD-7	6.18/7.13/8.95
LMZ12008/10	8/10	6 to 20	0.8 to 6	92	–40 to 125	EN, SS	✓	✓	TO-PMOD-11	10.93/13.30
LMZ13608/10	8/10	6 to 36	0.8 to 6	92	–40 to 125	EN, SS	✓	✓	TO-PMOD-11	15.68/17.10

<sup>1</sup>Additional input filter required.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### High Output Voltage Power Modules

The LMZ1420xH SIMPLE SWITCHER power modules have an output voltage range from 5 to 30 V. These power modules are a good choice for intermediate rail conversions, powering fans or other types of non-traditional points of load, and for sensing applications requiring voltages below –6 V.

### Extended Temperature (EXT) Family of Power Modules

The SIMPLE SWITCHER EXT power modules provide excellent performance in the most extreme conditions, with extended ambient temperatures guaranteed down to –55°C and shock and vibration compliant to meet military MIL-STD-883 standards.

### High Output Voltage and Extended Temperature Power Modules

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Peak Efficiency (%)	Operating Junction Temperature (°C)	Features	EMI EN55022/CISPR22 Class B Certification		Shock and Vibration Compliant	Package(s)	Price*
							Radiated	Conducted <sup>1</sup>			
LMZ10503/04/05EXT	3/4/5	2.95 to 5.5	0.8 to 5	96	–55 to 125	EN, SS	✓	✓	✓	TO-PMOD-7	12.60/13.50/14.40
LMZ12001/02/03EXT	1/2/3	4.5 to 20	0.8 to 6	92	–55 to 125	EN, SS	✓	✓	✓	TO-PMOD-7	9.50/11.40/13.80
LMZ14201/02/03EXT	1/2/3	6 to 42	0.8 to 6	94	–55 to 125	EN, SS	✓	✓	✓	TO-PMOD-7	12.40/14.30/17.20
LMZ14201H/02H/03H	1/2/3	6 to 42	5 to 24	97	–40 to 125	EN, SS	✓	✓	✓	TO-PMOD-7	6.18/7.13/8.95

<sup>1</sup>Additional input filter required.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### SIMPLE SWITCHER® LMZ2-Series Power Modules

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Operating Junction Temperature (°C)	Features	EMI EN55022/CISPR22 Class B Certification		Package(s)	Price*
						Radiated	Conducted <sup>1</sup>		
LMZ22003/5	3/5	6 to 20	0.8 to 5	–40 to 125	EN, SS, Freq Sync	✓	✓	TO-PMOD-7	5.50/6.25
LMZ23603/5	3/5	6 to 36	0.8 to 6	–40 to 125	EN, SS, Freq Sync	✓	✓	TO-PMOD-7	9.85/12.50
LMZ22008/10	8/10	6 to 20	0.8 to 6	–40 to 125	EN, SS, Freq Sync, Current Share	✓	✓	TO-PMOD-11	11.50/14.00
LMZ23608/10	8/10	6 to 36	0.8 to 6	–40 to 125	EN, SS, Freq Sync, Current Share	✓	✓	TO-PMOD-11	16.50/18.00

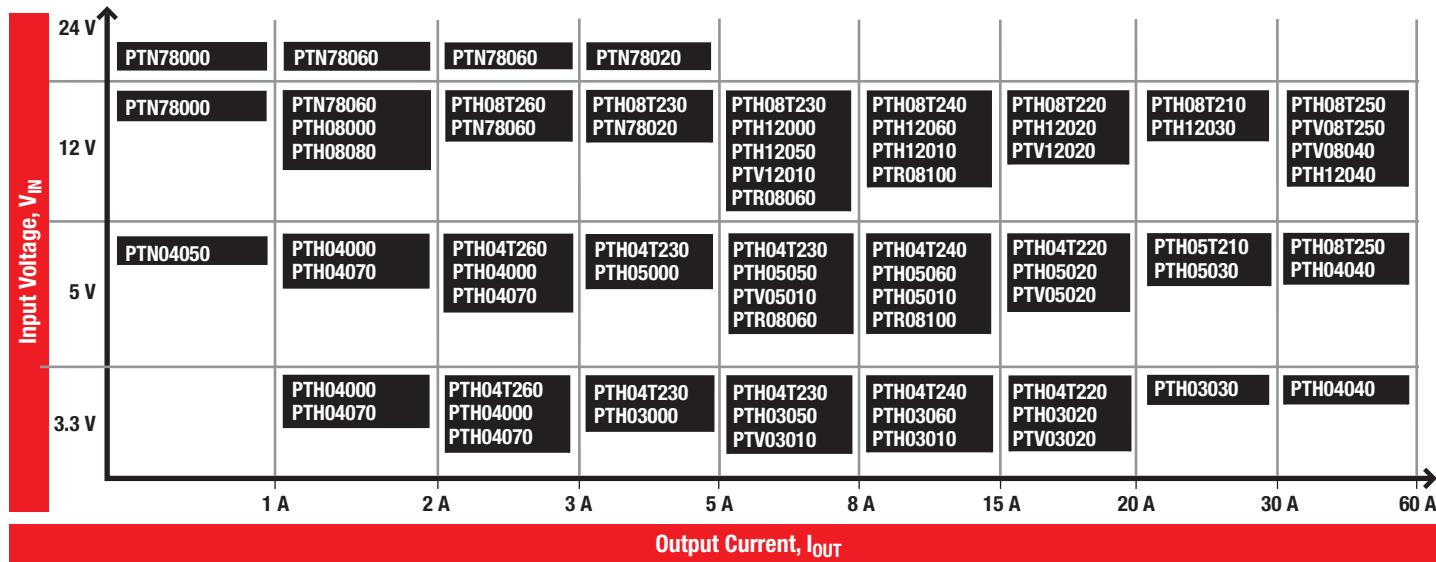
<sup>1</sup>Additional input filter required.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Power Modules (Non-Isolated)

## Step-Down (Buck) Modules

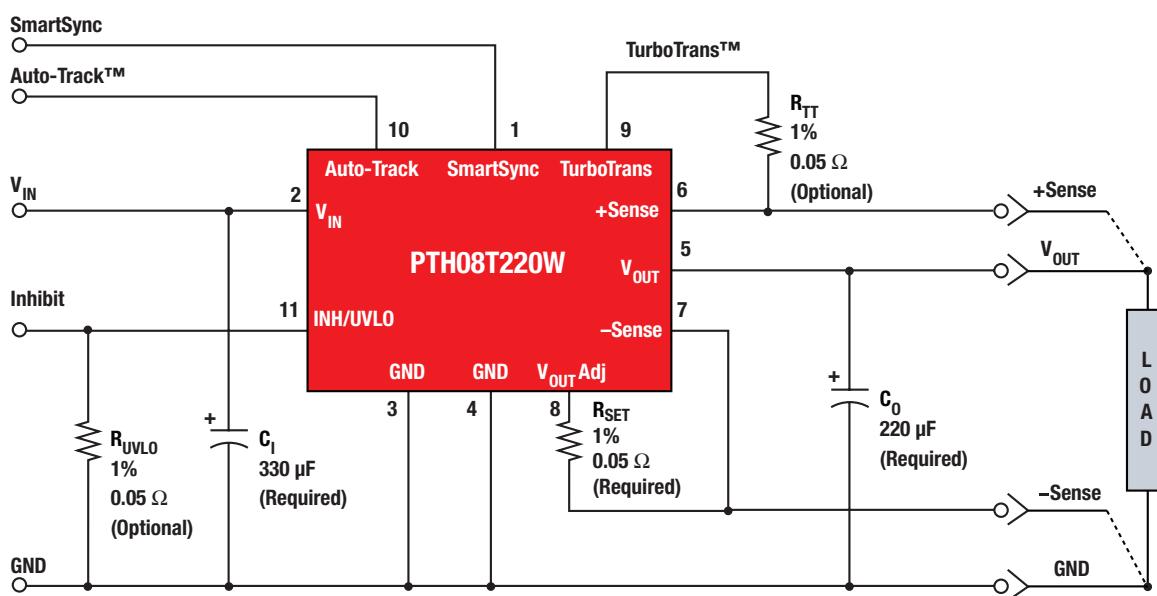
### Non-Isolated Plug-In Power Modules (POLA™ and Others) Family of Products



### 16-A, 4.5-V to 14-V Input, POL Module with TurboTrans™ Technology

#### PTH08T220W

The PTH08T220W is a high-performance, 16-A-rated, T2 point-of-load (POL) power module. Operating from an input voltage range of 4.5 V to 14 V, the PTH08T220W requires a single resistor to set the output voltage to any value over the range of 0.7 V to 5.5 V. The PTH08T220W incorporates TurboTrans™ technology, SmartSync and Auto-Track™ sequencing.



Get more information: [www.ti.com/product/PTH08T220W](http://www.ti.com/product/PTH08T220W)

# Power Modules (Non-Isolated)

## Step-Down (Buck) Modules

### Selection Guide

Device <sup>1</sup>	Input Bus Voltage	Description	P <sub>OUT</sub> or I <sub>OUT</sub>	V <sub>O</sub> Range (V)	V <sub>O</sub> Adj.	Auto-Track™ Sequencing	POL™	DDR-QDR	Price*
<b>Non-Isolated Single Positive Output</b>									
PTH03000W	3.3 V	3.3-V Input 6-A POL	6 A	0.8 to 2.5	✓				7.59
PTH03010W	3.3 V	3.3-V Input 15-A POL with Auto-Track™ Sequencing	15 A	0.8 to 2.5	✓	✓	✓		14.04
PTH03020W	3.3 V	3.3-V Input 22-A POL with Auto-Track Sequencing	22 A	0.8 to 2.5	✓	✓	✓		18.15
PTH03030W	3.3 V	3.3-V Input 30-A POL with Auto-Track Sequencing	30 A	0.8 to 2.5	✓	✓	✓		20.57
PTH03050W	3.3 V	3.3-V Input 6-A POL with Auto-Track Sequencing	6 A	0.8 to 2.5	✓	✓	✓		8.35
PTH03060W	3.3 V	3.3-V Input 10-A POL with Auto-Track Sequencing	10 A	0.7 to 2.5	✓	✓	✓		11.86
PTH04000W	3.3 V/5 V	3-V to 5.5-V Input 3-A POL with Auto-Track Sequencing	3 A	0.9 to 3.6	✓	✓	✓		5.45
PTH04070W	3.3 V/5 V	3-V to 5.5-V Input 3-A POL	3 A	0.9 to 3.6	✓				4.71
PTH04040W	3.3 V/5 V	3-V to 5.5-V Input 60-A POL with Auto-Track Sequencing	60 A	0.8 to 3.6	✓	✓	✓		52.94
PTH04T220/221W	3.3 V/5 V	2.2- to 5.5-V Input, 16-A T2 2nd Gen PTH POL with TurboTrans™	16 A	0.7 to 3.6	✓	✓	✓		13.86
PTH04T230/231W	3.3 V/5 V	2.2- to 5.5-V Input, 6-A T2 2nd Gen PTH POL with TurboTrans	6 A	0.7 to 3.6	✓	✓	✓		8.69
PTH04T240/241W	3.3 V/5 V	2.2- to 5.5-V Input, 10-A T2 2nd Gen PTH POL with TurboTrans	10 A	0.7 to 3.6	✓	✓	✓		11.88
PTH04T260/261W	3.3 V/5 V	2.2- to 5.5-V Input, 6-A T2 2nd Gen PTH POL with TurboTrans	3 A	0.7 to 3.6	✓	✓	✓		6.88
PTH05000W	5 V	5-V Input 6-A POL	6 A	0.8 to 3.6	✓				7.59
PTH05010W	5 V	5-V Input 15-A POL with Auto-Track Sequencing	15 A	0.8 to 3.6	✓	✓	✓		14.04
PTH05020W	5 V	5-V Input 22-A POL with Auto-Track Sequencing	22 A	0.8 to 3.6	✓	✓	✓		18.15
PTH05030W	5 V	5-V Input 30-A POL with Auto-Track Sequencing	30 A	0.8 to 3.6	✓	✓	✓		20.57
PTH05050W	5 V	5-V Input 6-A POL with Auto-Track Sequencing	6 A	0.8 to 3.6	✓	✓	✓		8.35
PTH05060W	5 V	5-V Input 10-A POL with Auto-Track Sequencing	10 A	0.8 to 3.6	✓	✓	✓		11.86
PTH05T210W	5 V	5-V Input, 30-A T2 2nd Gen PTH POL with TurboTrans	30 A	0.7 to 3.6	✓	✓	✓		27.23
PTH08000W	5 V/12 V	4.5-V to 18-V Input, 2.25-A POL with Auto-Track Sequencing	2.25 A	0.9 to 5.5	✓	✓	✓		5.45
PTH08080W	5 V/12 V	4.5-V to 18-V Input, 2.25-A POL	2.25 A	0.9 to 5.5	✓				4.71
PTH08T210W	12 V	5.5- to 14-V Input, 30-A T2 2nd Gen PTH POL with TurboTrans	30 A	0.7 to 3.6	✓	✓	✓		21.78
PTH08T220/221W	5 V/12 V	4.5- to 14-V Input, 16-A T2 2nd Gen PTH POL with TurboTrans	16 A	0.7 to 5.5	✓	✓	✓		15.25
PTH08T230/231W	5 V/12 V	4.5- to 14-V Input, 6-A T2 2nd Gen PTH POL with TurboTrans	6 A	0.7 to 5.5	✓	✓	✓		8.69
PTH08T240/241W	5 V/12 V	4.5- to 14-V Input, 10-A T2 2nd Gen PTH POL with TurboTrans	10 A	0.7 to 5.5	✓	✓	✓		13.07
PTH08T240F	5 V/12 V	4.5- to 14-V Input, 10-A T2 2nd Gen PTH POL for 3-GHz DSP Systems	10 A	0.7 to 2.0	✓	✓	✓		13.07
PTH08T250/255W	5 V/12 V	4.5- to 14-V Input, 50-A T2 2nd Gen PTH POL with TurboTrans	50 A	0.7 to 5.5	✓	✓	✓		43.56
PTH08T260/261W	5 V/12 V	4.5- to 14-V Input, 3-A T2 2nd Gen PTH POL with TurboTrans	3 A	0.7 to 5.5	✓	✓	✓		6.88
PTH12000L/W	12 V	12-V Input 6-A POL	6 A	0.8 to 1.8/1.2 to 5.5	✓				7.59
PTH12010L/W	12 V	12-V Input 12-A POL with Auto-Track Sequencing	12 A	0.8 to 1.8/1.2 to 5.5	✓	✓	✓		14.04
PTH12020L/W	12 V	12-V Input 18-A POL with Auto-Track Sequencing	18 A	0.8 to 1.8/1.2 to 5.5	✓	✓	✓		18.15
PTH12030L/W	12 V	12-V Input 26-A POL with Auto-Track Sequencing	26 A	0.8 to 1.8/1.2 to 5.5	✓	✓	✓		25.72
PTH12040W	12 V	12-V Input 50-A POL with Auto-Track Sequencing	50 A	0.8 to 5.5	✓	✓	✓		42.35
PTH12050L/W	12 V	12-V Input 6-A POL with Auto-Track Sequencing	6 A	0.8 to 1.8/1.2 to 5.5	✓	✓	✓		8.35
PTH12060L/W	12 V	12-V Input 10-A POL with Auto-Track Sequencing	10 A	0.8 to 1.8/1.2 to 5.5	✓	✓	✓		11.86
PTH03010Y	3.3 V	3.3-V Input 15-A DDR Terminating Module	15 A	Follows V <sub>REF</sub>	✓	✓	✓	✓	17.55
PTH03050Y	3.3 V	3.3-V Input 6-A DDR Terminating Module	6 A	Follows V <sub>REF</sub>	✓	✓	✓	✓	8.35
PTH03060Y	3.3 V	3.3-V Input 10-A DDR Terminating Module	10 A	Follows V <sub>REF</sub>	✓	✓	✓	✓	11.86
PTH05010Y	5 V	5-V Input 15-A DDR Terminating Module	15 A	Follows V <sub>REF</sub>	✓	✓	✓	✓	17.55
PTH05050Y	5 V	5-V Input 6-A DDR Terminating Module	6 A	Follows V <sub>REF</sub>	✓	✓	✓	✓	10.44
PTH05060Y	5 V	5-V Input 10-A DDR Terminating Module	10 A	Follows V <sub>REF</sub>	✓	✓	✓	✓	14.83
PTH12010Y	12 V	12-V Input 12-A DDR Terminating Module	12 A	Follows V <sub>REF</sub>	✓	✓	✓	✓	17.55
PTH12050Y	12 V	12-V Input 6-A DDR Terminating Module	6 A	Follows V <sub>REF</sub>	✓	✓	✓	✓	10.44
PTH12060Y	12 V	12-V Input 8-A DDR Terminating Module	8 A	Follows V <sub>REF</sub>	✓	✓	✓	✓	14.83
PTN04050C	3.3 V/5 V	3-V/5-V Input, 12-W Output Step-Up (Boost) ISR	12 W	5 to 15	✓				10.89
PTN78000W/H	V <sub>O</sub> + 2 to 36 V	Wide-Input, Wide-Output 1.5-A Positive Step-Down ISR	1.5 A	2.5 to 12/12 to 22	✓				9.08
PTN78060W/H	V <sub>O</sub> + 2 to 36 V	Wide-Input, Wide-Output 3-A Positive Step-Down ISR	3 A	2.5 to 12/12 to 22	✓				13.31
PTN78020W/H	V <sub>O</sub> + 2 to 36 V	Wide-Input, Wide-Output 6-A Positive Step-Down ISR	6 A	2.5 to 12/12 to 22	✓				16.94
PTR08060W	5 V/12 V	4.5- to 14-V Input, 6-A POL	6 A	0.6 to 5.5	✓				6.00
PTR08100W	5 V/12 V	4.5- to 14-V Input, 10-A POL	10 A	0.6 to 5.5	✓				8.00
PTV03010W	3.3 V	5-V Input 8-A Vertical SIP with Auto-Track Sequencing	8 A	0.8 to 2.5	✓	✓	✓		10.44
PTV03020W	3.3 V	5-V Input 18-A Vertical SIP with Auto-Track Sequencing	18 A	0.8 to 2.5	✓	✓	✓		17.55
PTV05010W	5 V	5-V Input 8-A Vertical SIP with Auto-Track Sequencing	8 A	0.8 to 3.6	✓	✓	✓		10.44
PTV05020W	5 V	5-V Input 18-A Vertical SIP with Auto-Track Sequencing	18 A	0.8 to 3.6	✓	✓	✓		17.55
PTV08T250W	12 V	8-V to 14-V Input, 50-A T2 2nd Gen PTH POL with TurboTrans	50 A	0.8 to 3.6	✓	✓	✓		48.13
PTV12010L/W	12 V	12-V Input 8-A Vertical SIP with Auto-Track Sequencing	8 A	0.8 to 1.8/1.2 to 5.5	✓	✓	✓	✓	10.44
PTV12020L/W	12 V	12-V Input 18-A Vertical SIP with Auto-Track Sequencing	16 A	0.8 to 1.8/1.2 to 5.5	✓	✓	✓	✓	14.04

<sup>1</sup>See [www.ti.com/power](http://www.ti.com/power) for a complete product offering.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

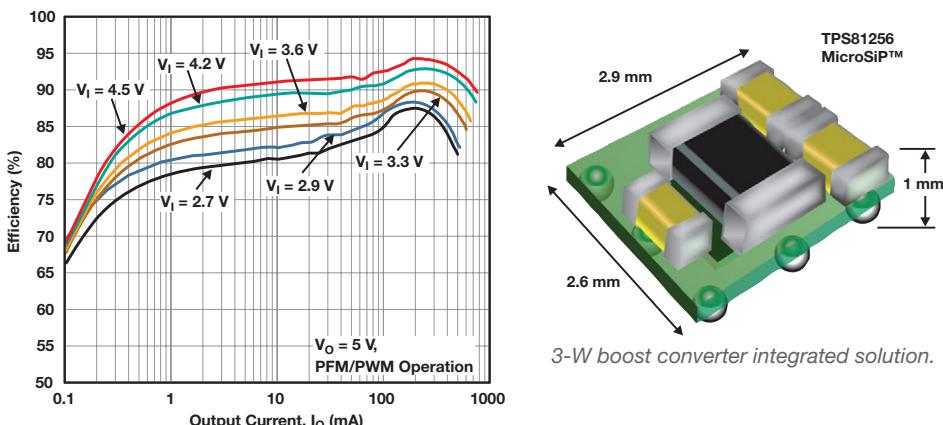
# Power Modules (Non-Isolated)

## Step-Up (Boost) and Negative Output Modules

### 3-W, High-Efficiency Step-Up Converter

#### TPS81256

The TPS81256 MicroSiP™ converter is a 3-W boost converter that integrates the inductor and input/output capacitors to achieve a solution less than 9 mm<sup>2</sup> and sub-1 mm high, simplifying design and saving up to 50% more board space than competing solutions. The 4-MHz, 600-mA TPS81256 module supports a 5-V output with a power density of 400 mW/mm<sup>3</sup>. The device extends battery life by reducing the supply current to 43 µA during light-load operation. Over a Li-Ion battery's full voltage range of 2.5 to 5.5 V, the TPS81256 also achieves a power efficiency of up to 91% that enables it to efficiently manage 3 W in a module format of less than 9 cubic millimeters.



Get more information: [www.ti.com/product/TPS81256](http://www.ti.com/product/TPS81256)

#### MicroSiP™ Boost Power Module

Device	Base Function	$I_{OUT}$ (mA)	$V_{IN}$ (V)	Fixed $V_{OUT}$ (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Synchronous Rectifier	Active Output Capacitor Discharge	Total Solution Size (mm <sup>2</sup> )	MicroSiP™ Package	EVM	Features and Differentiators	Price*
<b>Fully Integrated Solutions (Inductor plus input/output capacitors on device)</b>															
TPS81256	Boost	700	2.5 to 5.5	5	91	4000	37	0.85	✓		<9	9	✓	True load disconnect	1.50

All of the above devices have undervoltage lockout and thermal protection built in.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

#### Boost and Negative Output Modules

Device	Input Bus Voltage	Description				$P_{OUT}$ or $I_{OUT}$	$V_0$ Range (V)		$V_0$ Adj.	Price*
PTN04050C	3.3 V/5 V	12 W Wide-Output Boost Power Module				1 A	5 to 15		✓	10.89
PTN04050A	3.3 V/5 V	3-V to 5-V Input, 6-W Positive to Negative (Buck-Boost) ISR				1 A	-3.3 to -15		✓	10.89
PTN78000A	7 to 29 V	Wide-Input, Wide-Output 1.5-A Positive to Negative (Buck-Boost) ISR				1.5 A	-3 to -15		✓	9.08
PTN78060A	9 to 29 V	Wide-Input, Wide-Output 15-W Positive to Negative (Buck-Boost) ISR				15 W	-3 to -15		✓	13.31
PTN78020A	9 to 29 V	Wide-Input, Wide-Output 25-W Positive to Negative (Buck-Boost) ISR				25 W	-3 to -15		✓	16.94

Device	$I_{OUT}$ (A)	$V_{IN}$ (V)	$V_{OUT}$ (V)	Package Theta J <sub>A</sub> (°C/W)	Switching Frequency (kHz)	Features		EVM	Package(s)	Price*
						Sync Pin	Adj. Soft Start			
<b>SWIFT™ Wide Input Power Module</b>										
TPS84259	2 <sup>1</sup>	4.5 to 40	-3 to -17	12	500/800	✓	✓	✓	41 QFN (9x11x2.8 mm)	6.00

All of the above devices have undervoltage lockout and thermal protection built in.

<sup>1</sup>Maximum current depends on input and output voltages.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

#### Key Features

- Smallest solution size: Achieves a solution less than 9 mm<sup>2</sup> and sub-1 mm high, providing a power density of 400 mW/mm<sup>3</sup>
- Simplifies design: High integration, including passives and capacitors, significantly reduces the effort required for hardware design and layout
- High performance: Up to 91% peak efficiency, and high efficiency over a wide load range

#### Applications

- Cell phones, smartphones, tablet PCs
- Powering mono and stereo APA
- Powering USB-OTG, HDMI
- USB charging port (5 V)

# DC/DC Switching Regulators

## Overview

TI's large portfolio of non-isolated DC/DC point-of-load solutions address size, efficiency, performance or cost constraints. Our solutions range from discrete devices to integrated power solutions that contain magnetics within the IC package.

With operating voltages of up to 100 V, TI's wide-V<sub>IN</sub> portfolio eliminates input protection components to reduce cost and solution size.

**Step-Down DC/DC Converters** — Integrated MOSFET technology has reached high levels of density over the past few years to provide higher efficiency in smaller packages. TI's DC/DC converters offer many compelling solutions up to 30 A.

**Step-Up Boost Converters** — The datasheet specifies the current limit of the integrated power MOSFET switches. A rough estimate for the actual output current achievable is a function of the duty cycle and can be estimated with the following formula:

$$I_{OUT} = 0.65 \times I_{Switch(min)} \times (V_{IN}/V_{OUT})$$

**Buck-Boost Converters** — A DC/DC converter must be able to regulate the output voltage at all possible input-

voltage conditions, whether V<sub>IN</sub> is higher or lower than V<sub>OUT</sub>. TI's single-inductor buck-boost converters integrate four power MOSFETs on-chip to save space and to seamlessly transition in between the modes of operation.

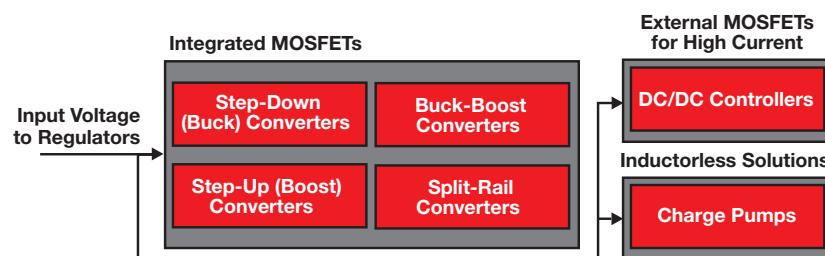
**Split-Rail Converters** — Each member of the TPS6513x family of split-rail converters (+V<sub>OUT1</sub>/−V<sub>OUT2</sub>) creates regulated positive and negative supply voltages out of one input rail. This decreases BOM costs and space while providing best-in-class performance for industrial and automotive applications.

**DC/DC Controllers** — The output current is set by external MOSFETs, which allows the designer to optimize the efficiency and performance. Strong MOSFET drivers in TI's controllers can drive more external MOSFETs.

**Charge Pumps** — TI's family of low-voltage charge pumps provides a low-noise solution to boost the voltage without an inductor. Charge pumps achieve 90% peak efficiency and are useful for output currents under 300 mA.

**Power-Management ICs (PMICs)** — Multiple DC/DC converters in one package simplify the power design by reducing component count. TI's PMICs integrate several inductive step-down converters with linear regulators, charge pumps or other analog circuits such as battery chargers and an I<sup>2</sup>C interface to save space.

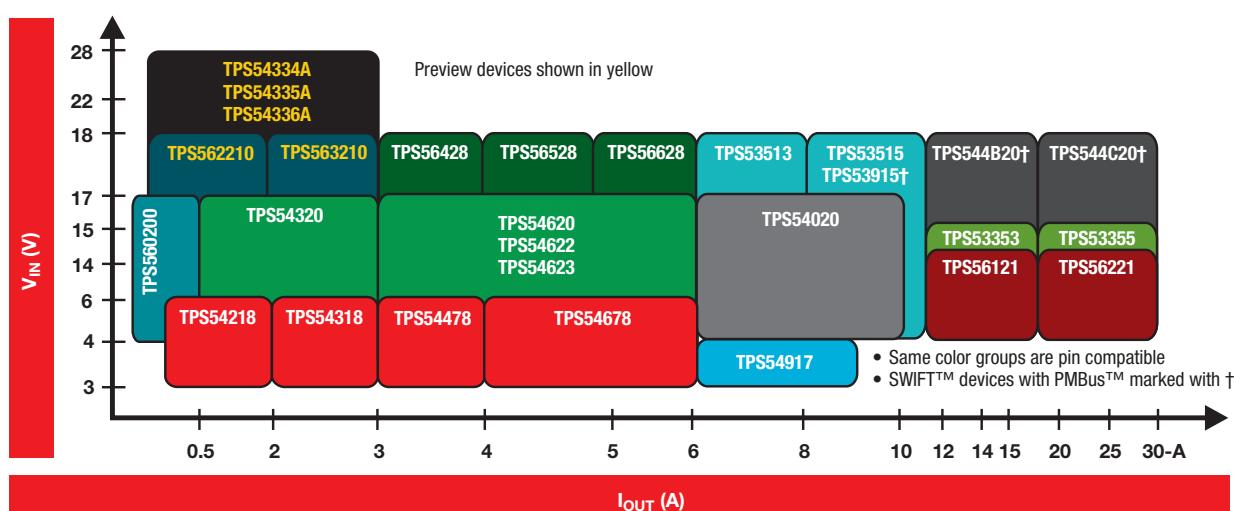
Visit [www.ti.com/power](http://www.ti.com/power) to find the latest point-of-load solutions by simply providing the voltages and output current of your system.



## Step-Down Converters (Line and Portable Power)

### SWIFT™ Featured DC/DC Converters

TI's SWIFT DC/DC converters are switchers with integrated FETs that deliver a high power density, high efficient and high-performance point-of-load power supply. Learn more at [www.ti.com/swift](http://www.ti.com/swift)

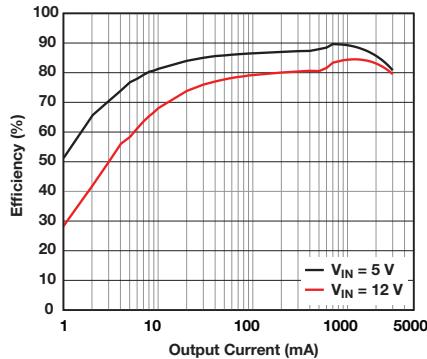
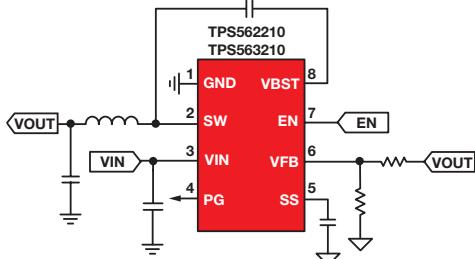


# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### 2-/3-A SWIFT™ Converters in SOT-23, with Power-Good, Adjustable Soft-Start, Advanced Eco-mode™ TPS562210, TPS563210

The TPS562210 and 563210 are TI's latest offering of low-cost, 2-/3-A step-down converters with Advanced Eco-mode (light-load efficiency) in SOT-23 packages. Its great efficiency (shown in below chart) is ideal for applications that require low standby current.



Get more information: [www.ti.com/product/TPS562210](http://www.ti.com/product/TPS562210) or [TPS563210](http://www.ti.com/product/TPS563210)

### SWIFT™ Converters Selection Guide

Device	V <sub>IN</sub> (V)	V <sub>OUT</sub> (V)	I <sub>OUT</sub> (A)	Frequency (kHz)	Control Mode	Package(s)	Features	Price*
<b>Low Input (3.3/5 V)</b>								
<b>TPS54218</b>	2.95 to 6	0.8 to 4.5	2	200 to 2000	CM	3x3 mm, 16 QFN	PG, EN, Sync Fsw, Pre-Biased and Adj. Soft Start, Ext. Comp.	1.40
<b>TPS54318</b>	2.95 to 6	0.8 to 4.5	3	200 to 2000	CM	3x3 mm, 16 QFN	PG, EN, Sync Fsw, Pre-Biased and Adj. Soft Start, Ext. Comp.	1.90
<b>TPS54478</b>	2.95 to 6	0.6 to 4.5	4	200 to 2000	CM	3x3 mm, 16 QFN	PG, EN, Sync Fsw, Track, Pre-Biased and Adj. Soft Start, Ext. Comp.	2.30
<b>TPS54678</b>	2.95 to 6	0.6 to 4.5	6	200 to 2000	CM	3x3 mm, 16 QFN	PG, EN, Sync Fsw, Track, Pre-Biased and Adj. Soft Start, Ext. Comp.	2.85
<b>TPS54917</b>	3 to 4	0.9 to 2.5	9	280 to 1600	VM	3.5x7 mm, 34 QFN	PG, EN, Sync Fsw, Adj. Soft Start, Ext. Comp.	3.30
<b>Medium Input (5/12 V)</b>								
<b>TPS560200</b>	4.5 to 17	0.8 to 6.5	0.5	600	D-CAP2™	SOT2-3	EN, Pre-Biased Soft Start, Advanced Eco-mode™	0.50
<b>TPS562210</b>	4.5 to 17	0.76 to 7	2	650	D-CAP2	SOT2-3	PG, EN, Pre-Biased and Adj. Soft Start, Advanced Eco-mode	0.71
<b>TPS54320</b>	4.5 to 17	0.8 to 16	3	200 to 1200	CM	3.5x3.5 mm, 14 QFN	PG, EN, Sync Fsw, Track, Pre-Biased and Adj. Soft Start, Ext. Comp.	1.60
<b>TPS563210</b>	4.5 to 17	0.76 to 7	3	650	D-CAP2	SOT2-3	PG, EN, Pre-Biased and Adj. Soft Start, Advanced Eco-mode	0.83
<b>TPS56428</b>	4.5 to 18	0.6 to 5.5	4	650	D-CAP2	SOIC-8	PG, EN, Pre-Biased Soft Start, Advanced Eco-mode	1.22
<b>TPS56528</b>	4.5 to 18	0.6 to 5.5	5	650	D-CAP2	SOIC-8	PG, EN, Pre-Biased Soft Start, Advanced Eco-mode	1.30
<b>TPS54622</b>	4.5 to 17	0.6 to 16	6	200 to 1600	CM	3.5x3.5 mm, 14 QFN	PG, EN, Sync Fsw, Track, Pre-Biased and Adj. Soft Start, Ext. Comp.	2.50
<b>TPS53113</b>	4.5 to 18	0.6 to 5.5	8	250 to 1000	D-CAP3™	3.5x4.5 mm, 28 QFN	PG, EN, Pre-Biased and Selectable Soft Start, ILIM, Eco-mode	2.55
<b>TPS54020</b>	4.5 to 17	0.6 to 5.0	10	200 to 1200	CM	3.5x3.5 mm, 15 QFN	PG, EN, Sync Fsw, Track, Pre-Biased and Adj. Soft Start, Eco-mode, 180° Out of Phase, ILIM, Ext. Comp.	3.45
<b>TPS53115</b>	4.5 to 18	0.6 to 5.5	12	250 to 1000	D-CAP3	3.5x4.5 mm, 28 QFN	PG, EN, Pre-Biased and Selectable Soft Start, ILIM, Eco-mode	2.70
<b>TPS53319</b>	4.5 to 18	0.6 to 5.5	14	250 to 1000	D-CAP™	5x6 mm, 22 QFN	PG, EN, Pre-Biased and Selectable Soft Start, ILIM, Eco-mode	3.25
<b>TPS56121</b>	4.5 to 14	0.6 to 12	15	300/500/1000	VM	5x6 mm, 22 QFN	PG, EN, Pre-Biased and Adj. Soft Start, ILIM, Ext. Comp.	3.50
<b>TPS53353</b>	4.5 to 15	0.6 to 5.5	20	250 to 1000	D-CAP	5x6 mm, 22 QFN	PG, EN, Pre-Biased and Selectable Soft Start, ILIM, Eco-mode	3.50
<b>TPS56221</b>	4.5 to 14	0.6 to 12	25	300/500/1000	VM	5x6 mm, 22 QFN	PG, EN, Pre-Biased and Adj. Soft Start, ILIM, Ext. Comp.	3.75
<b>TPS53355</b>	4.5 to 15	0.6 to 5.5	30	250 to 1000	D-CAP	5x6 mm, 22 QFN	PG, EN, Pre-Biased and Selectable Soft Start, ILIM, Eco-mode	3.75
<b>TPS54334</b>	4.2 to 28	0.8 to 25	3	340	CM	3x3 mm, 10 SON, 8 HSOIC	PG, EN, Pre-Biased Soft Start, Ext. Comp.	0.90
<b>TPS54335A/6A</b>	4.5 to 28	0.8 to 25	3	340/50 to 1500	CM	3x3 mm, 10 SON, 8 HSOIC	EN, Pre-Biased and Adj. Soft Start, Ext. Comp.	0.90
<b>SWIFT™ with PMBus™</b>								
<b>TPS53915</b>	4.5 to 18	0.6 to 5.5	12	250 to 1000	D-CAP3	3.5x4.5 mm, 28 QFN	PG, EN, Eco-mode Efficiency, PMBus Programmable	3.05
<b>TPS544B20</b>	4.5 to 18	0.6 to 5.5	20	250 to 1000	D-CAP, D-CAP2	5x7 mm, 40 QFN	PG, EN, Remote Sense, PMBus Programmable with Telemetry	3.70
<b>TPS544C20</b>	4.5 to 18	0.6 to 5.5	30	250 to 1000	D-CAP, D-CAP2	5x7 mm, 40 QFN	PG, EN, Remote Sense, PMBus Programmable with Telemetry	3.90

<sup>\*</sup>Also available in 14-HTSSOP.

<sup>\*</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**. Preview devices are listed in **bold teal**.

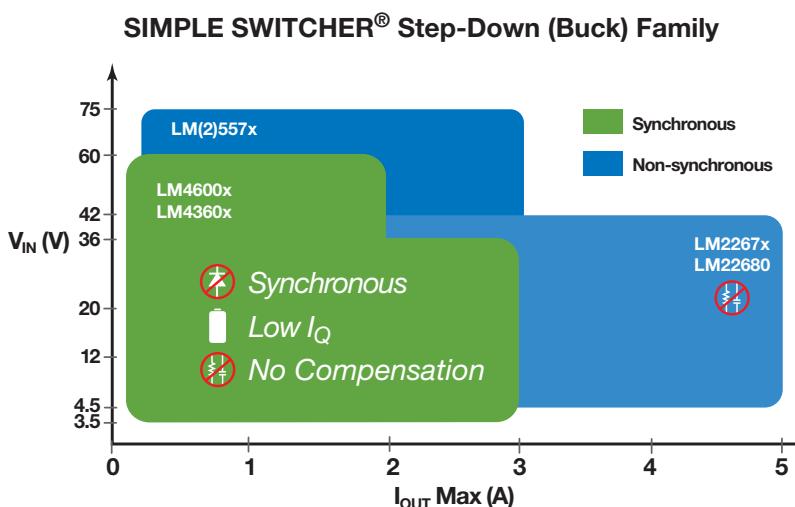
# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### SIMPLE SWITCHER® Converters

Award-winning SIMPLE SWITCHER products from Texas Instruments allow you to design and optimize robust power supplies with a minimum set of external components. Supporting input voltage ranges of 3 to 75 V, each SIMPLE SWITCHER series provides you with multiple products with pin-to-pin compatibility for added design flexibility. Plus, all SIMPLE SWITCHER products utilize the WEBENCH® Power Designer end-to-end design and prototyping tools.

For more information, please visit:  
[www.ti.com/switcher](http://www.ti.com/switcher)



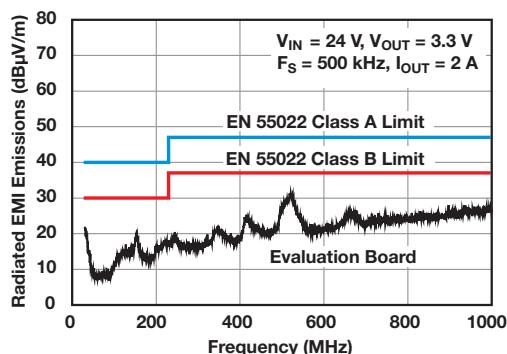
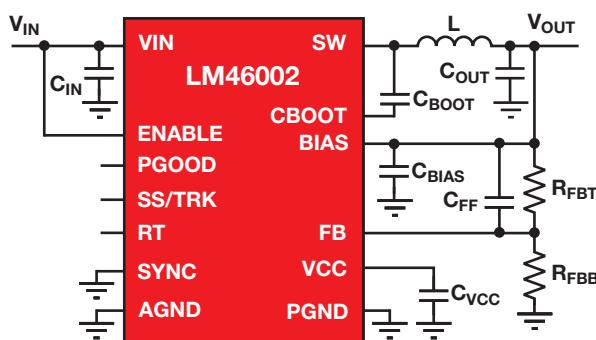
### SIMPLE SWITCHER® Synchronous Regulator Series

#### LM4360x, LM4600x

The LM4360x and LM4600x are the first fully synchronous family of SIMPLE SWITCHER converters with up to 60-V input capability and a high light-load efficiency architecture. Load currents of up to 3 A are supported for the 36-V devices, and up to 2 A for the 60-V devices. Each member of the family is available in a pin- and footprint-compatible HTSSOP-16 package, offering scalability benefits and simplifying design updates. Because the pin configuration is unique, layouts can exhibit excellent radiated EMI performance. As with all SIMPLE SWITCHER devices, there is full support by WEBENCH design tools with all of the latest features, like Schematic Editor and PCB Export.

#### Key Features

- Wide V<sub>IN</sub> range from 3.5 to 60 V
- 27-µA quiescent current in regulation
- High light-load efficiency (DCM and PFM)
- Meets EN55022/CISPR 22 EMI standards
- Integrated synchronous rectification
- Internal compensation



Get more information: [www.ti.com/product/LM43600](http://www.ti.com/product/LM43600) or [LM46000](http://www.ti.com/product/LM46000)

### LM4600x and LM4360x SIMPLE SWITCHER® Synchronous Regulators

Device	Output Current (mA)	V <sub>IN</sub> (max) (V)	V <sub>IN</sub> (min) (V)	V <sub>OUT</sub> (min) (V)	V <sub>OUT</sub> (max) (V)	Light Load Efficiency	I <sub>Q</sub> (µA)	CISPR 22 EMI	Frequency Range (kHz)	PWM Mode	Package(s)	Price*
LM43600	500	36	3.5	1	28	✓	33	✓	200 to 2000 Adj	Current	HTSSOP-16	1.50
LM43601	1000	36	3.5	1	28	✓	33	✓	200 to 2000 Adj	Current	HTSSOP-16	1.60
LM43602	2000	36	3.5	1	28	✓	27	✓	200 to 2000 Adj	Current	HTSSOP-16	1.75
LM43603	3000	36	3.5	1	28	✓	27	✓	200 to 2000 Adj	Current	HTSSOP-16	1.85
LM46000	500	60	3.5	1	28	✓	24	✓	200 to 2000 Adj	Current	HTSSOP-16	1.65
LM46001	1000	60	3.5	1	28	✓	24	✓	200 to 2000 Adj	Current	HTSSOP-16	1.75
LM46002	2000	60	3.5	1	28	✓	27	✓	200 to 2000 Adj	Current	HTSSOP-16	1.85

All devices in this family are pin to pin and footprint compatible. \* Suggested resale price in U.S. dollars in quantities of 1,000.

# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### LM2267x and LM22680 SIMPLE SWITCHER® Non-Synchronous Regulators

Device	Output Current (mA)	V <sub>IN</sub> (max) (V)	V <sub>IN</sub> (min) (V)	V <sub>OUT</sub> (min) (V)	Frequency Range (kHz)	f <sub>sync</sub>	PWM Mode	Package(s)	Price*
LM22671/74	500	42	4.5	1.285	200 to 1000 Adj	✓/-	Voltage	PSOP-8	1.38/1.32
LM22672/75	1000	42	4.5	1.285	200 to 1000 Adj	✓/-	Voltage	PSOP-8	1.78/1.68
LM22680	2000	42	4.5	1.285	200 to 1000 Adj	✓	Voltage	PSOP-8	1.85
LM22670/73/76	3000	42	4.5	1.285	200 to 1000 Adj	✓/-/-	Voltage	T0263-7 Thin, PSOP-8	1.98/1.98/1.92
LM22677/78/79	5000	42	4.5	1.285	200 to 1000 Adj	✓/-/-	Voltage	T0263-7 Thin	3.38/3.25/3.38

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### LM2557x and LM557x SIMPLE SWITCHER® Non-Synchronous Regulators

Device	Output Current (mA)	V <sub>IN</sub> (max) (V)	V <sub>IN</sub> (min) (V)	V <sub>OUT</sub> (min) (V)	V <sub>OUT</sub> (max) (V)	Frequency Range (kHz)	f <sub>sync</sub>	On/Off Pin	PWM Mode	Package(s)	Price*
LM25574	500	42	6	1.23	40	50 to 1000	✓	✓	Current	TSSOP-16	1.48
LM5574	500	75	6	1.23	70	50	✓	✓	Current	TSSOP-16	1.75
LM25575	1500	42	6	1.23	40	50 to 1000	✓	✓	Current	eTSSOP-16	1.76
LM5575	1500	75	6	1.23	70	50	✓	✓	Current	eTSSOP-16	2.20
LM25576	3000	42	6	1.23	40	50 to 1000	✓	✓	Current	eTSSOP-20	2.40
LM5576	3000	75	6	1.23	70	50	✓	✓	Current	eTSSOP-20	3.05

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### LM310x and LM285x SIMPLE SWITCHER® Synchronous Regulators

Device	Output Current (mA)	V <sub>IN</sub> (max) (V)	V <sub>IN</sub> (min) (V)	V <sub>OUT</sub> (min) (V)	V <sub>out</sub> (max) (V)	Frequency Range (kHz)	PWM Mode	Package(s)	Price*
LM3103	750	42	4.5	0.6	38	1000	COT <sup>1</sup>	eTSSOP-16	1.80
LM3100	1500	36	4.5	0.8	7	1000	COT	eTSSOP-20	2.35
LM3102	2500	42	4.5	0.8	7	1000	COT	eTSSOP-20	1.90
LM2852	2000	5.5	2.85	0.8	3.3	500, 1500	Voltage	eTSSOP-14	2.59
LM2853	3000	5.5	3	0.8	3.3	550	Voltage	eTSSOP-14	2.00
LM2854	4000	5.5	2.95	0.8	5	500, 1000	Voltage	eTSSOP-16	2.40

<sup>1</sup>COT = Constant ON-time control.

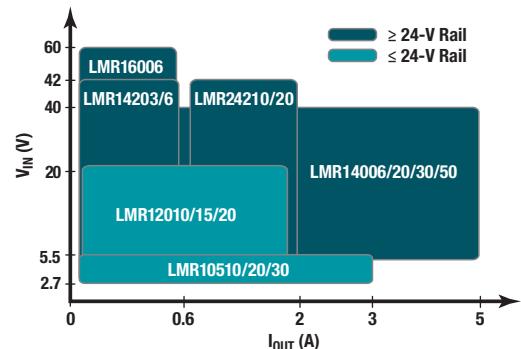
\*Suggested resale price in U.S. dollars in quantities of 1,000.

# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### SIMPLE SWITCHER® Step-Down (Buck) Nano Regulators

The new SIMPLE SWITCHER nano regulators feature tiny packaging, 1-MHz or greater switching frequency for extremely small surface mount inductors and chip capacitors, and a minimal BOM to reduce board space. All nano regulators are offered in either LLP, SOT-23, or micro SMD packaging for added design flexibility.



### SIMPLE SWITCHER® Step-Down (Buck) Nano Regulators

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Frequency (kHz)	Features	Package(s)	Price*
<b>Nano Step-Down (Buck)</b>							
<b>LMR10510</b>	1	3 to 5.5	0.6 to 4.5	1600, 3000	EN, SS	LLP-6, SOT-23	0.30
<b>LMR10515</b>	1.5	3 to 5.5	0.6 to 4.5	1600, 3000	EN, SS	LLP-6, SOT-23	0.85
<b>LMR10520</b>	2	3 to 5.5	0.6 to 4.5	1600, 3000	EN, SS	LLP-6	0.38
<b>LMR12007</b>	0.75	3 to 18	1.25 to 16	550, 1600	EN, SS	TSOT23	0.80
<b>LMR12010</b>	1	3 to 20	0.8 to 16	1600, 3000	EN, SS	TSOT-23	0.79
<b>LMR14006</b>	0.6	4 to 40	0.765 to 36	1100, 2100	EN, Low $I_Q$	TSOT	1.10
<b>LMR14020</b>	2	4 to 40	1 to 36	2500 max	EN, SS, Low $I_Q$	HSOIC-8	1.32
<b>LMR14030</b>	3.5	4 to 40	1 to 36	2500 max	EN, SS, Low $I_Q$	HSOIC-8	1.68
<b>LMR14050</b>	5	4 to 40	1 to 36	2500 max	EN, SS, Low $I_Q$	HSOIC-8	2.34
<b>LMR14203</b>	0.3	4.5 to 42	0.765 to 34	1250	EN, SS	TSOT-23	0.90
<b>LMR14206</b>	0.6	4.5 to 42	0.765 to 34	1250	EN, SS	TSOT-23	1.01
<b>LMR24210</b>	1	4.5 to 42	0.8 to 24	1000 max	EN, SS	micro SMD-28	1.50
<b>LMR24220</b>	2	4.5 to 42	0.8 to 24	1000 max	EN, SS	micro SMD-28	2.00
<b>LMR16006</b>	0.6	4 to 60	0.8 to 55	2100 max	EN, Low $I_Q$	SOT-6	1.20

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

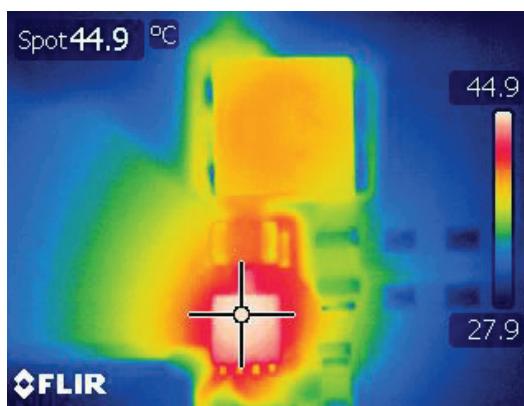
### 3-A Step-Down Converter with HotRod™ Leadframe Allows <65-mm<sup>2</sup> Solution Size

#### TPS62085

The TPS62085 is a high-frequency, synchronous 6-V<sub>IN</sub>/3-A, step-down converter optimized for high efficiency and small solution size. The new innovative HotRod™ package uses a manufacturing process similar to QFN that allows high power density for space-critical applications.



Evaluation module layout.



Only about 25°C rise at 6-V input and 1.2-V output at 3 A.

#### Key Features

- DCS-Control™ architecture
- Up to 95% efficiency
- 100% duty cycle
- 2.5- to 6.0-V input range
- 17-µA quiescent current
- Short-circuit protection (HICCUP)
- 2x2-mm SON package

#### Applications

- Portable industrial and medical
- Portable computing
- Storage/SSD

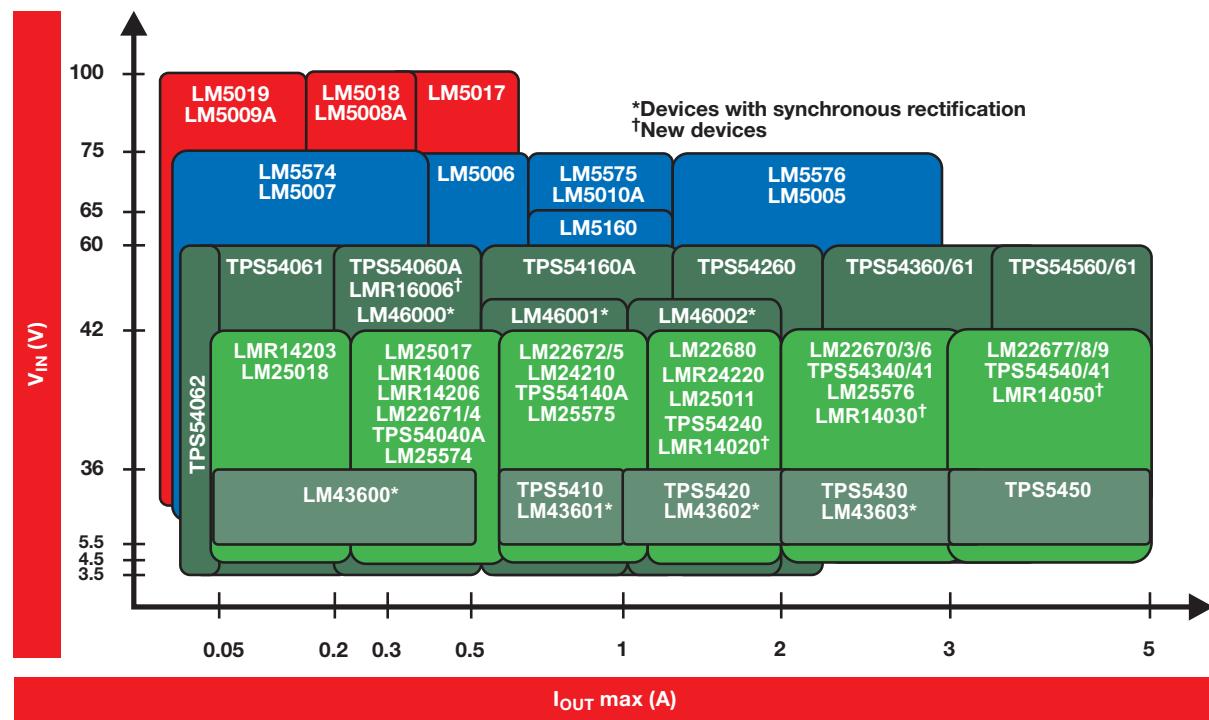
Get more information:

[www.ti.com/product/TPS62085](http://www.ti.com/product/TPS62085)  
or [www.ti.com/dcs-control](http://www.ti.com/dcs-control)

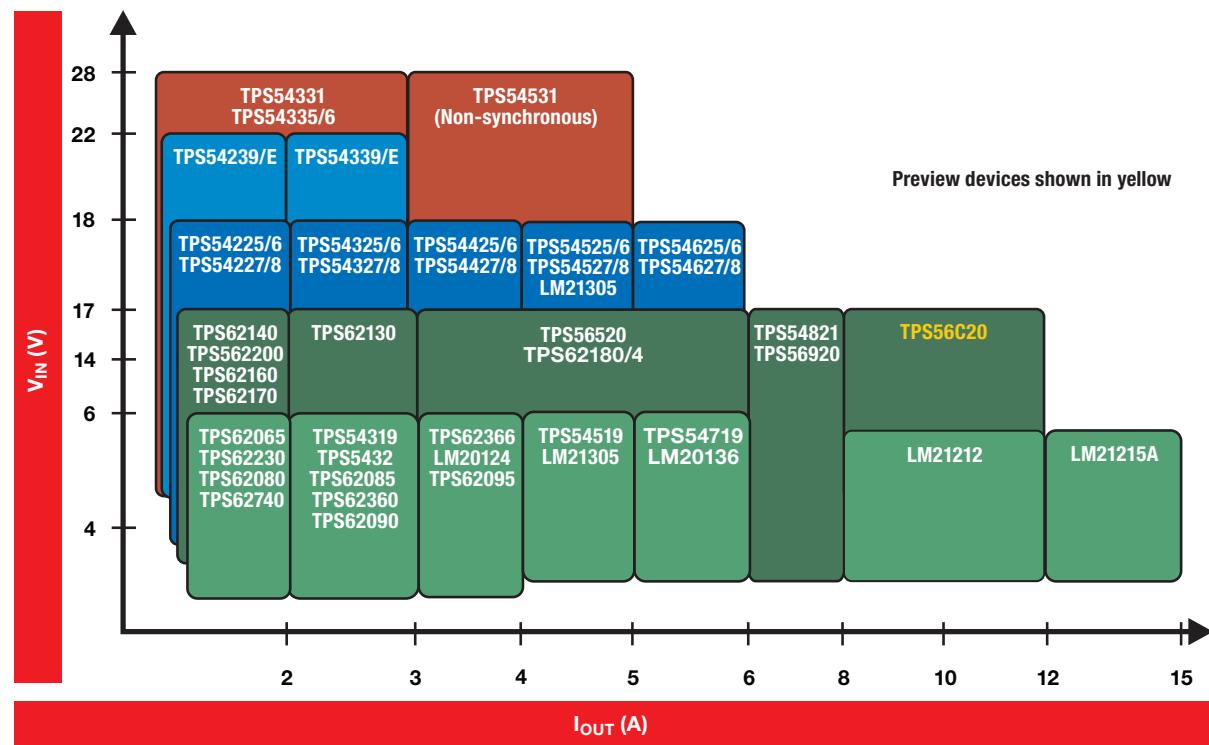
# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### Wide-V<sub>IN</sub> Step-Down Converters with Integrated FETs



### Low- and Mid-V<sub>IN</sub> Synchronous Step-Down Converters with Integrated FETs

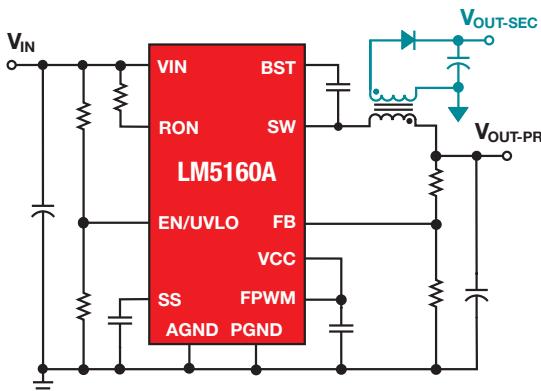


# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### Wide-Input, 65-V, 1.5-A Synchronous Buck/Fly-Buck™ Converter LM5160A

TI's family of high-voltage converters is characterized by a constant-on-time (COT) architecture that reduces the number of required external components to keep solution sizes small and simplify designs. The LM5160A has integrated high-side and low-side MOSFETs and an internal feedback amplifier that maintains  $\pm 1\%$  output-voltage regulation over the entire operating temperature range. The LM5160A is programmed through the FPWM pin to operate in continuous conduction mode (CCM) from no load to full load or to automatically switch to discontinuous conduction mode (DCM) at light load for higher efficiency. Forced CCM operation supports Fly-Buck™ for single or multiple isolated outputs by using a coupled inductor or transformer.



Get more information: [www.ti.com/product/LM5160A](http://www.ti.com/product/LM5160A)  
[www.ti.com/lit/SVNA674](http://www.ti.com/lit/SVNA674)

#### Key Features

- Wide 4.5- to 65-V input voltage range
- Integrated high- and low-side switches
- 1.5-A maximum load current
  - Constant on-time control—No compensation needed
- Selectable forced CCM or DCM operation
- CCM option supports multi-output Fly-Buck
- Programmable soft-start time
- $\pm 1\%$  feedback voltage reference

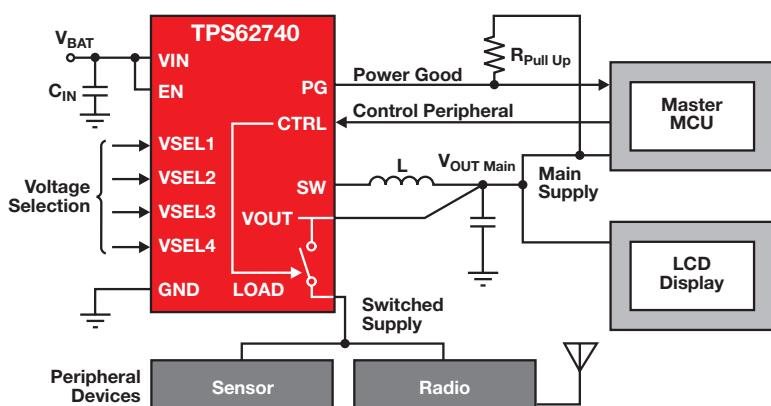
#### Applications

- Industrial programmable logic controller
- IGBT gate drive bias supply
- Telecom primary/secondary side bias
- E-meter power line communication
- Low power isolated DC/DC (Fly-Buck)
- Automotive electronics

Reference Design:  
[www.ti.com/tool/pmp10532.1](http://www.ti.com/tool/pmp10532.1)

### Step-Down Converter with 360-nA $I_Q$ , Voltage Select and Load Switch TPS62740, TPS62742

The TPS6274x consumes only 360 nA of quiescent current. The output voltage is set with four VSEL pins. The TPS6274x also features dynamic voltage scaling. Once the battery voltage comes close to the output voltage, the device enters a no-ripple 100% mode to prevent RF interference. The device then stops switching and connects the output to the input voltage.



Get more information: [www.ti.com/lit/SLYT531](http://www.ti.com/lit/SLYT531)  
[www.ti.com/product/TPS62740](http://www.ti.com/product/TPS62740) or [TPS62742](http://www.ti.com/product/TPS62742)  
[www.ti.com/dcs-control](http://www.ti.com/dcs-control)

#### Key Features

- 360-nA operating  $I_Q$
- Output current: 300 mA (TPS62740), 400 mA (TPS62742)
- Up to 95% efficiency
- Integrated load switch
- 16 selectable output voltages
- Power-Good and capacitor discharge
- 2x3-mm SON package
- NEW: TPS82740 in SIP module and TPS62743 in WCSP

#### Applications

- Wearable electronics
- Bluetooth® low energy (BLE)
- Metering
- Energy harvesting

# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### Selection Guide for Line Power

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	Min V <sub>OUT</sub> (V)	Max Duty Cycle (%)	Switching Frequency (kHz)	Features							EVM	Package(s)	Automotive	Price*	
						Synchronous Rectifier	Power Good Pin	Sync Pin	180° Out-of- Phase Switching	Adj. Soft Start	Light-Load Efficiency	External Compensation					
<b>Low Input Voltage Step-Down Converters (&lt;7 V<sub>IN</sub> Max)</b>																	
TPS57112-Q1	2000	2.95 to 6.0	0.8	98	200 to 2000	✓	✓					✓		16 WQFN (3x3 mm)	✓	1.64	
TPS62085	3000	2.5 to 6.0	0.8	100	2400	✓	✓					✓		7 QFN (2x2 mm)		0.95	
LM20123/33/43	3000	2.95 to 5.5	0.8	—	250 to 1500	✓	✓	✓		✓		✓		16 eTSSOP		1.36	
TPS54319	3000	2.95 to 6.0	0.8	98	300 to 2000	✓	✓	✓		✓		✓		16 QFN (3x3 mm)		0.80	
TPS54338-Q1	3000	2.95 to 6.0	0.8	98	200 to 2000	✓	✓					✓		16 WQFN (3x3 mm)	✓	2.35	
TPS57114-Q1	4000	2.95 to 6.0	0.8	98	200 to 2000	✓	✓					✓		16 WQFN (3x3 mm)	✓	2.75	
TPS53311	3000	2.9 to 6.0 <sup>1</sup>	0.6	85	1000	✓		✓			✓	✓		16 QFN (3x3 mm)		2.15	
LM20124/34/44/54	4000	2.95 to 5.5	0.8	—	250 to 1500	✓	✓	✓		✓		✓		16 eTSSOP		1.50	
LM20125/45	5000	2.95 to 5.5	0.8	—	250 to 1500	✓	✓			✓		✓		16 eTSSOP		1.56	
TPS53316	5000	2.95 to 6	0.6	80	750/1100/2000	✓	✓					✓		16 QFN (3x3 mm)		2.55	
LM20136/46	6000	2.95 to 5.5	0.8	—	250 to 1500	✓	✓	✓		✓		✓		16 eTSSOP		1.68	
LM21212-1	12000	2.95 to 5.5	0.6	100	300 to 1500	✓	✓	✓		✓		✓		20 eTSSOP		3.30	
LM21212-2	12000	2.95 to 5.5	0.6	100	300 to 1500	✓	✓			✓		✓		20 eTSSOP		3.30	
LM21215	Up to 15000	2.95 to 5.5	0.6	100	500	✓	✓			✓		✓		20 eTSSOP		3.55	
LM21215A	15000	2.95 to 5.5	0.6	100	300 to 1500	✓	✓	✓		✓		✓		20 eTSSOP		3.55	
<b>Mid Input Voltage Step-Down Converters (7 to 30 V<sub>IN</sub> Max)</b>																	
LM2734	1000	3.0 to 20	0.8	100	550 to 1600								✓	6 TSOP		0.95	
LM2650	3000	4.5 to 18	1.5	—	300	✓		✓		✓	✓	✓		20 TSSOP		3.50	
LM2651	1500	4 to 14	1.8	—	300	✓				✓	✓	✓		16 TSSOP		1.40	
LM2653	1500	4 to 14	1.5	—	300	✓				✓	✓	✓		16 TSSOP		1.50	
LM2655	2500	4 to 14	1.5	—	300	✓				✓	✓	✓		16 TSSOP		1.63	
LM27341	1500	3 to 20	1	93	2000		✓						✓	10 WSON, 10 MSOP		1.10	
LM27342	2000	3 to 20	1	93	2000		✓						✓	10 WSON, 10 MSOP		1.20	
LM2736	750	3 to 18	1.25	96	550, 1600								✓	6 SOT		0.85	
LM2738	1500	3 to 20	0.8	95	550, 1600								✓	8 WSON, 8 MSOP		1.20	
LM2717-ADJ	2200/3200	4 to 20	0.6	90	300, 600					✓			✓	24 TSSOP		2.65	
LM2717	2200/3200	4 to 20	0.6	90	300, 600					✓			✓	24 TSSOP		2.65	
TPS62175	500	4.75 to 28	1.0	100	1000	✓				✓			✓	10 WSON (2x3 mm)		0.70	
TPS62160	1000	3.0 to 17	0.9	100	2500	✓	✓			✓			✓	8 MSOP/WSON (2x2 mm)	✓	0.85	
TPS62140	2000	3.0 to 17	0.9	100	2500	✓	✓			✓	✓		✓	16 QFN (3x3 mm)		1.00	
TPS5403/05	1700/2000	4.5/6.5 to 23	3.3/5.0	93	50 to 1100					✓	✓	✓	✓	8 SOIC		1.05	
TPS62200/09	2000	4.5 to 17	0.76	80	650	✓				✓/-			✓	SOT-23		0.69/0.58	
TPS562219	2000	4.5 to 17	0.76	80	650	✓	✓			✓	✓/-		✓	SOT-23		0.60	
TPS54231/2/3	2000	3.5 to 28	0.8	93	570/1000/300					✓	✓	✓		8 SOIC	✓	0.55	
TPS54239/239E	2000	4.5 to 23	0.76	90	600	✓				✓	-/✓		✓	8 HSOIC		0.73/0.75	
TPS54320	3000	4.5 to 17	0.8	98	200 to 1200	✓	✓	✓		✓		✓	✓	14 QFN		1.70	
TPS563200/09	3000	4.5 to 17	0.76	80	650	✓				✓/-			✓	SOT-23		0.81/0.70	
TPS563219	3000	4.5 to 17	0.76	80	650	✓	✓			✓	✓/-		✓	SOT-23		0.71	
TPS54331	3000	3.5 to 28	0.8	93	570					✓	✓	✓		8 SOIC	✓	0.60	
TPS54339/339E	3000	4.5 to 23	0.76	90	600	✓				✓	-/✓		✓	8 HSOIC		0.85/0.87	
TPS54332	3500	3.5 to 28	0.8	93	1000					✓	✓	✓	✓	8 HSOIC		0.73	
TPS54427/8	4000	4.5 to 18	0.76	90 <sup>2</sup>	700	✓				✓	-/✓		✓	8 HSOIC, 10 SON		0.83/0.85	
TPS56428	4000	4.5 to 18	0.76	85	650	✓	✓			✓			✓	8 HSOIC		1.15	
TPS56528	4000	4.5 to 18	0.76	85	650	✓	✓			✓			✓	8 HSOIC		1.20	
TPS56520	5000	4.5 to 17	0.6	80	500	✓	✓			✓	✓		✓	20 HTSSOP		1.40	
LM21305	5000	3 to 18	0.6	100	250 to 1500		✓	✓		✓	✓	✓	✓	28 LLP		2.50	
TPS54527/8	5000	4.5 to 18	0.76	90 <sup>2</sup>	700	✓				✓	-/✓		✓	8 HSOIC		0.98/1.00	
TPS54531	5000	3.5 to 28	0.8	90	570					✓	✓	✓		8 SOIC		0.80	
TPS54627/8	6000	4.5 to 18	0.76	85	650	✓				✓	-/✓		✓	8 HSOIC		1.30/1.35	
TPS56628	6000	4.5 to 18	0.76	85	700	✓	✓			✓			✓	8 HSOIC		1.40	
TPS53313	6000	4.5 to 16	0.6	70	250 to 1500		✓	✓		✓		✓		16 QFN (4x4 mm)		2.60	
TPS62180	6000	4 to 15	0.9	100	2000		✓			✓		✓		DSBGA		1.75	
TPS56720	7000	4.5 to 17	0.6	80	500	✓	✓			✓	✓		✓	20 HTSSOP		1.80	
TPS56920	9000	4.5 to 17	0.6	80	500	✓	✓			✓	✓		✓	20 HTSSOP		2.00	

<sup>1</sup>Requires 2.9- to 3.5-V bias input.

<sup>3</sup>Maximum V<sub>OUT</sub> is 5.5 V.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

<sup>2</sup>Maximum V<sub>OUT</sub> is 5.5 V.

<sup>4</sup>Maximum V<sub>OUT</sub> is 5.5 V.

New devices are listed in **bold red**.

Preview devices are listed in **bold teal**.

# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### Selection Guide for Line Power (Continued)

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	Min V <sub>OUT</sub> (V)	Max Duty Cycle (%)	Switching Frequency (kHz)	Features						EVM	Package(s)	Automotive	Price*			
						Synchronous Rectifier	Power Good Pin	Sync Pin	180° Out-of- Phase Switching	ADJ. Soft Start	Light-Load Efficiency	External Compensation						
<b>Mid Input Voltage Step-Down Converters (7 to 30 V<sub>IN</sub> Max) (Continued)</b>																		
TPS51315	10000	3 to 14 <sup>3</sup>	0.76	100 <sup>4</sup>	100 to 1000	✓	✓				✓			✓	QFN (5x7 mm)		2.65	
TPS51362	10,000	3.0 to 22	0.6	87	800	✓	✓			✓	✓			✓	28 QFN		1.25	
TPS56C20	12000	4.5 to 17	0.6	80	500	✓	✓			✓	✓			✓	24 HTSSOP		2.40	
TPS51367	12,000	3.0 to 22	0.6	87	800	✓	✓			✓	✓			✓	28 QFN		1.30	
<b>Wide Input Voltage Step-Down Converters (&gt;30 V<sub>IN</sub> Max)</b>																		
TPS54062	50	4.7 to 60	0.8	98	100 to 400	✓		✓				✓		✓	8 MSOP		1.10	
LM(2)5019	100	9 to 48/100	1.23	—	250 to 1000	✓								✓	8 LLP, 8 PSOP		1.25	
LM5009/A	150	8/6 to 95	—	—	50 to 600									✓	8 LLP, 8 MSOP		1.00/1.25	
TPS54061	200	4.7 to 60	0.8	98	50 to 1100	✓		✓		✓	✓	✓		✓	8 SON (3x3 mm)		1.30	
LM(2)5018	300	9 to 48/100	1.23	—	250 to 1000	✓								✓	8 LLP, 8 PSOP		1.12/1.40	
LM5008/A	350	8/6 to 95	—	—	50 to 600									✓	8 LLP, 8 MSOP		1.18/1.20	
LM(2)5007	500	9 to 42/75	2.5	—	50 to 800									✓	8 LLP, 8 MSOP		1.05/1.30	
TPS54040A/60A	500	3.5 to 42/60	0.8	98	100 to 2500		✓	✓		✓	✓	✓	✓	✓	10 MSOP, 10 SON (3x3mm)	✓	1.15/1.45	
LM(2)5017	600	9 to 48/100	1.23	—	250 to 1000	✓								✓	8 LLP, 8 PSOP		1.25/1.65	
LM34919/B/C	600	6/4.5 to 40/50	2.5	—	Up to 2600		✓			✓				✓	10 micro SMD, 12 WSON, DSBGA		1.20/1.25	
LM5006	650	6 to 75	2.5	—	50 to 600									✓	10 MSOP		1.50	
LM(2)5010/A	1000	8/6 to 42/75	2.5	—	50 to 1000					✓				✓	10 LLP, 14 eTSSOP		1.15/1.53	
TPS5410	1000	5.5 to 36	1.23	87	500									✓	8 SOIC	✓	1.60	
TPS54162-Q1	1000	3.6 to 48	0.9	90	200 to 2200	✓				✓				✓	20 HTSSOP	✓	2.55	
LM34917A	1250	8 to 33	2.5	—	2000					✓					12 micro SMD		1.35	
LM34910/C	1250	8 to 36/50	2.5	—	1000					✓					10 LLP		1.32	
LM26001	1500	3 to 38	1.25	—	150 to 500	✓	✓	✓		✓	✓	✓		✓	16 TSSOP		2.85	
LM5160/A	1500	4.5 to 65	2	—	250 to 1000	✓				✓	✓				12 WSON		1.80	
TPS54140A/60A	1500	3.5 to 42/60	0.8	98	100 to 2500	✓	✓			✓	✓	✓	✓	✓	10 MSOP, 10 SON (3x3mm)	✓	1.40/1.75	
LM25011/A	Up to 2000	6 to 42	2.5	—	Up to 2000	✓				✓				✓	10 MSOP		1.30	
LM20242	2000	4.5 to 36	0.8	—	1000	✓				✓				✓	16 eTSSOP		1.46	
TPS5420	2000	5.5 to 36	1.23	87	500									✓	8 SOIC	✓	1.70	
TPS54262-Q1	2000	3.6 to 48	0.9	90	200 to 2200	✓				✓				✓	20 HTSSOP	✓	2.70	
LM(2)5005	2500	7 to 42/75	1.23	—	50 to 500		✓			✓				✓	20 eTSSOP		1.95	
TPS54240/60	2500	3.5 to 42/60	0.8	98	100 to 2500	✓	✓			✓	✓	✓	✓	✓	10 MSOP, 10 SON (3x3mm)	✓	1.55/1.95	
LM26003	3000	3 to 38	1.25	—	150 to 500	✓	✓	✓		✓	✓			✓	20 eTSSOP		3.52	
LM20323/33/43	3000	4.5 to 36	0.8	—	250 to 1500	✓	✓			✓	✓	✓	✓	✓	20 eTSSOP		1.50	
TPS5430	3000	5.5 to 36	1.23	87	500									✓	8 HSOIC	✓	1.85	
TPS54341/61	3000	4.5 to 42/60	0.8	98	100 to 2500	✓	✓			✓	✓	✓	✓	✓	10 SON	✓	2.00/2.60	
TPS54362-Q1	3000	3.6 to 48	0.9	90	200 to 2200	✓				✓				✓	20 HTSSOP	✓	2.78	
TPS65281/65281-1	3000	4.5 to 18	0.8	95	300 to 1400	✓	✓	✓		✓	✓	✓		✓	16 VQFN		1.20	
TPS54340/60	3500	4.5 to 42/60	0.8	98	100 to 2500					✓	✓	✓		✓	8 HSOIC	✓	1.75/2.10	
TPS65280	4000	5.5 to 18	5	—	300 to 1400	✓	✓	✓		✓				✓	24 VQFN		1.95	
TPS65282	4000	4.5 to 18	0.8	95	300 to 1400	✓	✓	✓		✓				✓	24 VQFN		1.95	
TPS5450	5000	5.5 to 36	1.23	87	500									✓	8 HSOIC	✓	2.25	
TPS54540/60	5000	4.5 to 42/60	0.8	98	100 to 2500					✓	✓	✓		✓	8 HSOIC	✓	1.95/2.30	
TPS54541/61	5000	4.5 to 42/60	0.8	98	100 to 2500	✓	✓			✓	✓	✓	✓	✓	10 SON	✓	2.30/3.00	
TPS65286	6000	4.5 to 28	0.6	95	500	✓	✓	✓		✓	✓	✓		✓	28 VQFN		2.00	
<b>Dual-Channel Step-Down Converters</b>																		
TPS54290/1/2	1500/2500	4.5 to 18	0.8	90	300/600/1200	✓				✓				✓	✓	16 HTSSOP		2.95
TPS54294/5	2000 each	4.5 to 18	0.76	85	700	✓	✓/-			-/-				✓	✓	16 HTSSOP, 16 QFN		2.40
TPS54283/6	2000 each	4.5 to 28	0.8	90/85	300/600					✓				✓	✓	14 HTSSOP		2.40
TPS55383/6	3000 each	4.5 to 28	0.8	90/85	300/600					✓				✓	✓	16 HTSSOP		2.65
TPS65283/65283-1	3500/2500	4.5 to 18	0.6	95	200 to 2000	✓	✓	✓		✓				-/-	✓	24 VQFN		2.00
TPS54494/5	4000/2000	4.5 to 18	0.76	85	700	✓	✓/-			-/-				✓	✓	16 HTSSOP, 16 QFN		2.90
TPS65279	5000/5000	4.5 to 18	0.6	—	200 to 1600	✓	✓	✓		✓	✓	✓		✓	✓	32 HTSSOP, 36 QFN		2.50
<b>TPS65279V</b>	5000/5000	4.5 to 18	0.6	—	200 to 1600	✓	✓	✓		✓	✓	✓		✓	✓	32 HTSSOP, 36 QFN		2.50

<sup>1</sup>Requires 2.9- to 3.5-V bias input.  
<sup>2</sup>Maximum V<sub>OUT</sub> is 5.5 V.

<sup>3</sup>Maximum V<sub>OUT</sub> is 5.5 V.  
<sup>4</sup>Maximum V<sub>OUT</sub> is 5.5 V.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**.  
Preview devices are listed in **bold teal**.

# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### Selection Guide for Line Power (Continued)

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	Min V <sub>OUT</sub> (V)	Max Duty Cycle (%)	Switching Frequency (kHz)	Features								EVM	Package(s)	Automotive	Price*	
						Synchronous Rectifier	Power Good Pin	Sync Pin	180° Out-of- Phase Switching	Aj. Soft Start	Light-Load Efficiency	External Compensation	Sequencing/ Tracking					
<b>Triple-Channel Step-Down Converters</b>																		
TPS65261/-1	3000/2000/2000	4.5 to 18	0.6	95	250 to 2000	✓	✓	✓	✓	✓	✓	✓	✓	✓	32 VQFN		1.90	
TPS65262/-1	3000/1000/1000	4.5 to 18	0.6	95	600	✓	✓		✓	✓	✓	✓	✓	✓	32 VQFN		2.05	
TPS65263	3000/2000/2000	4.5 to 18	0.6	95	600	✓	✓		✓	✓	✓	✓	✓	✓	32 VQFN	✓	2.35	
TPS65263Q1	3000/2000/2000	4.5 to 18	0.6	95	200 to 2300	✓	✓	✓	✓	✓	✓	✓	✓	✓	32 VQFN		3.00	
TPS65580/1	2500/1500/1500	4.5 to 18	0.76		700	✓	✓								20 TSSOP		1.72	
TPS652510	3000/2000/2000	4.5 to 16	0.8	95	300 to 2200	✓	✓	✓	✓	✓	✓	✓	✓	✓	40 VQFN	✓	2.10	
TPS65251	3000/2000/2000	4.5 to 18	0.8	95	300 to 2200	✓	✓	✓	✓	✓	✓	✓	✓	✓	40 VQFN	✓	2.10	
TPS65250	3000/2000/2000	4.5 to 18	0.8	95	300 to 2200	✓	✓	✓	✓	✓	✓	✓	✓	✓	40 VQFN		2.10	
TPS65251-1/-2/-3	3000/2000/2000	4.5 to 18	0.8	95	300 to 2200	✓	✓	✓	✓	✓	✓	✓	✓	✓	40 VQFN		2.10	
TPS65257	3000/2000/2000	4.5 to 18	0.8	95	300 to 2200	✓	✓	✓	✓	✓	✓	✓	✓	✓	40 VQFN		2.85	
TPS65287	3000/2000/2000	4.5 to 18	0.8	95	300 to 2200	✓	✓	✓	✓	✓	✓	✓	✓	✓	40 VQFN		2.75	
TPS65288	3000/2000/2000	4.5 to 18	0.8	95	300 to 2200	✓	✓	✓	✓	✓	✓	✓	✓	✓	40 VQFN		2.75	
<b>Quad-Channel Step-Down Converters</b>																		
TPS65400	4000/4000/2000/2000	4.5 to 18	0.6	95	275 to 2200	✓	✓	✓	✓	✓	✓	✓	✓	✓	48VQFN	✓	3.20	

<sup>1</sup>Requires 2.9- to 3.5-V bias input.

<sup>3</sup>Maximum V<sub>OUT</sub> is 5.5 V.

<sup>4</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

<sup>2</sup>Maximum V<sub>OUT</sub> is 5.5 V.

<sup>4</sup>Maximum V<sub>OUT</sub> is 5.5 V.

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Preview devices are listed in **bold teal**.

### Selection Guide for Portable Power

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adjustable/Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (µH)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Power Good	Sync to Ext. CLK (opt.)	DQS-Control™ Topology	Package(s)	EVM	Features and Differentiators	Automotive	Price*	
<b>General Purpose, Step-Down (Buck) Regulators — Small, Efficient, Low I<sub>q</sub></b>																	
TPS62240	300	2.0 to 6.0	Adj. (0.6 to V <sub>IN</sub> )/1.2/1.8	95	2250	2.2	15	0.1					TSOT-23, SON	✓			0.47
LM3670	350	2.5 to 5.5	0.7 to 3.3	—	1000	10	15	0.1					SOT-23	✓			0.57
LM3671	600	2.7 to 5.5	1.1 to 3.3	—	2000	2.2	16	0.01					SOT-23, QFN	✓			0.70
TPS62260	600	2.0 to 6.0	Adj. (0.6 to V <sub>IN</sub> )/1.2/1.8	95	2250	2.2	15	0.1					SOT-23, QFN	✓		✓	0.59
TPS62250	700	2.0 to 6.0	Adj. (0.6 to V <sub>IN</sub> )	95	2250	2.2	15	0.1					QFN		USB applications		0.78
TPS62290	1000	2.3 to 6.0	Adj. (0.6 to V <sub>IN</sub> )/1.8/3.3	95	2250	2.2	15	0.1					QFN	✓		✓	0.80
TPS62080	1200	2.3 to 6.0	Adj. (0.5 to 4.0)/1.8/3.3	94	2000	1	30	6.5	✓	✓			QFN, MSOP	✓	Snooze mode, active discharge		0.75
TPS62510	1500	1.8 to 3.8	Adj. (0.6 to V <sub>IN</sub> )	97	1500	2.2	22	0.1					QFN	✓	Output-voltage tracking		0.95
TPS62060	1600	2.3 to 6.0	Adj. (0.6 to V <sub>IN</sub> )/1.8/3.3	94	3000	1.0	18	0.1					2x2 QFN	✓			0.80
TPS62065	2000	2.3 to 6.0	Adj. (0.6 to V <sub>IN</sub> )	94	3000	1.0	18	0.1					2x2 QFN	✓		✓	0.85
TPS62067	2000	2.9 to 6.0	Adj. (0.6 to V <sub>IN</sub> )	97	3000	1.0	18	0.1	✓				2x2 QFN	✓		✓	0.93
TPS62097	2000	2.5 to 6.0	Adj. (0.8 to V <sub>IN</sub> )	95	1500-2500	1	17	0.7	✓	✓			QFN	✓	Tracking, PG, Output Discharge	TBD	
TPS62085	3000	2.5 to 6.0	Adj. (0.8 to V <sub>IN</sub> )/1.8/3.3	95	2400	0.47	17	0.7	✓	✓			2x2 QFN	✓	HotRod™ leadframe		1.05
TPS62090	3000	2.0 to 5.5	Adj. (0.8 to V <sub>IN</sub> )/1.8/2.5/3.3	96	2800/1400	0.47	20	0.6	✓	✓			3x3 QFN	✓	Adj. soft start, frequency select	✓	0.95
TPS62095	4000	2.5 to 5.5	Adj. (0.8 to V <sub>IN</sub> )	95	1400	1	20	0.6	✓	✓			3x3 QFN	✓	Adj. soft start		1.30
<b>General Purpose, Step-Down (Buck) Regulators — Value Line, Relaxed Specification</b>																	
TPS62560	600	2.5 to 5.5	Adj. (0.6 to V <sub>IN</sub> )/1.8	95	2250	2.2	15	0.1					SOT-23, QFN	✓	3% V <sub>OUT</sub> tolerance		0.47
TLV62150	1000	4.0 to 17	Adj. (0.9 to 5.0)	96	2250	2.2	19	1.5	✓	✓			QFN	✓	Adj. soft start (opt.)		0.71
TLV62080	1200	2.5 to 5.5	Adj. (0.5 to 4.0)	94	2000	1	30	0.6	✓	✓			QFN	✓			0.52
TLV62565	1500	2.7 to 5.5	Adj. (0.6 to V <sub>IN</sub> )	94	1500	2.2	50	0.1	✓				SOT-23	✓			0.60
TLV62084	2000	2.7 to 5.5	Adj. (0.5 to 4.0)	94	2000	1	30	0.6	✓	✓			SON	✓	Pin-to-pin to TLV62080 (2 A)		0.68
TLV62090	3000	2.5 to 5.5	Adj. (0.8 to V <sub>IN</sub> )	96	1400	0.47	20	0.6	✓	✓			QFN	✓	Adj. soft start		0.74
TLV62130	3000	4.0 to 17	Adj. (0.9 to 5.0)	96	2250	2.2	19	1.5	✓	✓			QFN	✓	Adj. soft start (opt.)		0.86

All of the above devices have an on-chip soft start, undervoltage lockout and thermal protection built in.

New devices are listed in **bold red**. Preview devices are listed in **bold teal**.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# DC/DC Switching Regulators

## Step-Down Converters (Line and Portable Power)

### Selection Guide for Portable Power (Continued)

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adjustable/Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Power Good	Synch. to Ext. CLK (Opt.)	DGS-Control™ Topology	Package(s)	EVM	Features and Differentiators	Automotive	Price*
<b>Special-Function Step-Down (Buck) Regulators</b>																
TPS62736	50	2.0 to 5.5	Adj. (1.3 to 5.0)	96	2000 (max)	10	0.35	0.02		✓		QFN	✓	Ultra-low I <sub>Q</sub> , low-battery indicator		0.80
TPS62120	75	2.0 to 15	Adj. (1.2 to 5.5)	96	800	22	11	0.3	✓	✓	SOT-23, QFN	✓	Ext. UVLO hysteresis		0.56	
TPS62730	100	1.9 to 3.9	1.9/2.1/2.3	95	3000	2.2	25	0.03		✓		QFN	✓	Bypass switch; for BLE and RF4CE		0.55
<b>TPS62740</b>	300	2.2 to 5.5	1.3, 1.8 to 2.8, 3.3	95	3000	2.2	0.36	0.07	✓	✓		WSON	✓	Load switch; 4-pin V <sub>select</sub>		1.12
TPS62125	300	3.0 to 17	Adj. (1.2 to 10)	93	1000	10	5	0.3	✓	✓		QFN	✓	Program. EN threshold and hysteresis		0.61
TPS62743	400	5.5	1.2, 1.5, 1.8, 2.1, 2.5, 2.8, 3.0, 3.3	90	3000	2.2	0.36	0.07		✓		WCSP8	✓	Smallest solution size		TBD
TPS62737	500	2.0 to 5.5	Adj. (1.3 to 5.0)	96	2000 (max)	10	0.35	0.02				QFN	✓	Ultra-low I <sub>Q</sub> , low-battery indicator		1.00
TPS62750	1300	2.9 to 6.0	Adj. (0.8 to 0.85 × V <sub>IN</sub> )	94	2250	2.2	745	0.2				SON	✓	Powered by USB; progr. input-current limit		0.85
<b>Extended Input-Voltage Range</b>																
TPS62170	500	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	92	2500	2.2	17	1.5	✓	✓		QFN	✓		✓	0.60
TPS62175	500	4.75 to 28	Adj. (1 to 6)/3.3/5.0	90	1000	10	4.8	1.5	✓	✓		QFN	✓	Snooze mode		0.70
TPS62050	800	2.7 to 10.0	Adj. (0.7 to 6)/1.5/1.8/3.3	95	850	10	12	1.5	✓	✓		MSOP	✓	Low-battery indicator		0.90
TPS62150	1000	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	96	2500/1250	2.2	17	1.5	✓	✓		QFN	✓	Soft start (opt.), tracking, voltage and frequency select pin	✓	0.85
TPS62160	1000	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	92	2500	2.2	17	1.5	✓	✓		QFN, VSSOP	✓		✓	0.80
TPS62110	1500	3.1 to 17	Adj. (1.2 to 16)/3.3/5	95	1000	6.8	18	1.5	✓	✓		QFN	✓	Low-battery indicator	✓	1.20
TPS62140	2000	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	96	2500/1250	2.2	17	1.5	✓	✓		QFN	✓	Soft start (opt.), tracking, voltage and frequency select pin		0.95
TPS62130A	3000	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	96	2500/1250	2.2	17	1.5	✓	✓		QFN	✓	Soft start (opt.), tracking, voltage and frequency select pin	✓	1.10
<b>TPS62184</b>	5000	4.0 to 17	Adj. (0.9 to 6)	96	2000	1	28	2.8	✓			DSBGA	✓	Smallest 5-A buck solution		1.80
<b>TPS62180</b>	6000	4 to 15	Adj. (0.9 to 6)	96	2000	1	28	2.8	✓			DSBGA	✓	Smallest 6-A buck solution		1.75
<b>Dual Output, 180° Out-of-Phase</b>																
TPS62400	400 + 600	2.5 to 6.0	Adj. (0.6 to V <sub>IN</sub> ) /1.1 to 1.9/3.3	95	2250	3.3	30	0.1				QFN	✓	EasyScale™ interface	✓	0.78
TPS62410	800 + 800	2.6 to 6.0	Adj. (0.6 to V <sub>IN</sub> )	95	2250	3.3	30	0.1				QFN		EasyScale interface	✓	0.93
TPS62420	600 + 1000	2.6 to 6.0	Adj. (0.6 to V <sub>IN</sub> )	95	2250	3.3	30	0.1				QFN	✓	EasyScale interface	✓	0.93
<b>Smallest Solution Size, High Switching Frequency</b>																
TPS62619	350	2.3 to 5.5	1.2, 1.3, 1.5, 1.8, 2.15	90	6000	0.47	31	0.2				CSP		0.4-mm solution height		0.45
TPS62690	500	2.3 to 4.8	2.2, 2.8, 2.85	95	4000	1.0	19	0.2				CSP	✓	Spread spectrum		0.58
TPS62230	500	2.05 to 6.0	1.0 to 3.3	94	3000	1	22	0.1		✓		QFN	✓	Up to 90-dB PSRR		0.49
TPS62674	500	2.3 to 4.8	1.05, 1.2, 1.26, 1.5, 1.8	92	5500	0.47	5000	0.2				CSP	✓	Spread spectrum		0.50
LM8801	600	2.3 to 5.5	1.0 to 2.9	—	6000	—	—	—				CSP	✓			0.80
TPS62620	600	2.3 to 5.5	1.2, 1.225, 1.5, 1.8, 1.82	90	6000	0.47	31	0.2				CSP	✓			0.58
LM3691	1000	2.3 to 5.5	0.75 to 3.3	—	4000	—	—	—				CSP	✓			0.80
TPS62660	1000	2.3 to 5.5	1.2/1.8	91	6000	0.47	31	0.2				CSP	✓	Active cap discharge		0.80
LM3281	1200	3.0 to 5.5	3.3	94	6000	0.47	15	0.1				CSP	✓	Soft Start, Analog Bypass		0.30
LM3678	1500	2.5 to 5.5	0.8 to 3.3	—	3300	—	—	—				QFN	✓			1.15
<b>Processor Power, Dynamic Voltage Scaling</b>																
TPS62270	400	2.0 to 6.0	0.9, 1.15, 2.1, 2.5, 3.3	95	2250	2.2	15	0.1				QFN	✓	V <sub>select</sub> pin		0.49
TPS62650	800	2.3 to 5.5	Adj. (0.75 to 1.44)	86	6000	0.47	38	0.5				CSP		I <sup>2</sup> C Interface	✓	0.67
TPS62360	3000	2.5 to 5.5	Adj. (0.5 to 1.77)	91	2500	1	56	0.5		✓		CSP	✓	I <sup>2</sup> C interface, different. sense		0.77
<b>TPS62134A</b>	3200	3.0 to 17	Adj. (0.7 to 1.05)	—	—	1	20	—	✓	✓		VQFN-16		Skylake, EN, Soft start (opt.), Low power mode logic input		1.20
TPS62366	4000	2.5 to 5.5	Adj. (0.5 to 1.77)	91	2500	1	56	0.5		✓		CSP	✓	I <sup>2</sup> C interface, different. sense		0.86

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\*Suggested resale price in U.S. dollars in quantities of 1,000.

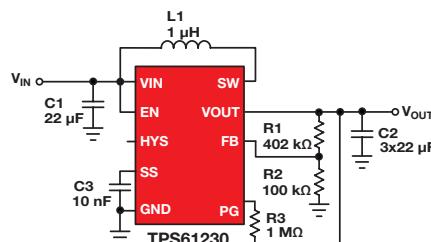
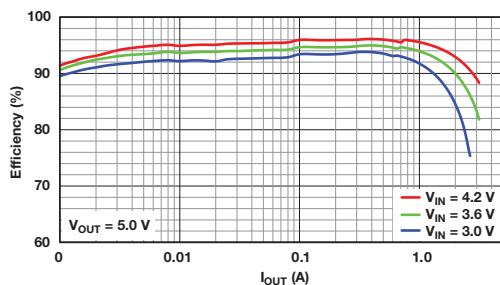
# DC/DC Switching Regulators

## Step-Up (Boost)/Flyback/SEPIC and Inverting Converters

### 2-A Synchronous Step-Up Converter in SON Package

#### TPS61230

The TPS61230 device family is optimized for products powered by a one-cell Li-Ion battery, or a regulated power rail of 3.3 V. The IC integrates a 5-A switch and is capable of delivering output currents up to 2.1 A at a 5-V output with a 3.3-V input supply. The device is based on a quasi-constant, on-time valley current-mode control scheme. The typical operation frequency is 2 MHz, which allows the use of small inductors and capacitors to achieve a small solution size.

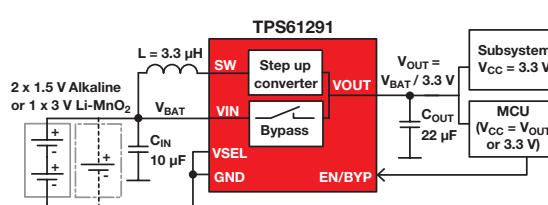
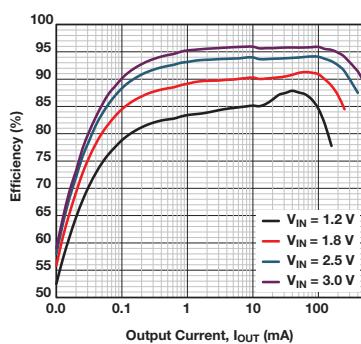


Get more information: [www.ti.com/TPS61230](http://www.ti.com/TPS61230)

### 1-A Boost Converter with Bypass-Mode and Low I<sub>Q</sub>

#### TPS61291

The TPS61291 is a boost converter with pin-selectable output voltages and an integrated bypass mode. In bypass operation, the device provides a direct path from the input to the system and allows a low-power microcontroller (MCU) such as the MSP430™ to operate directly from a single 3-V Li-MnO<sub>2</sub> battery or dual alkaline battery cells. The quiescent current consumption drops down to only 15 nA (typical) in bypass mode. In boost mode the device provides a minimum output current of 200 mA at 3.3 V from a 1.8-V supply. The boost converter is based on a current-mode controller that consumes typically 5.7 μA from the output.



Get more information: [www.ti.com/product/TPS61291](http://www.ti.com/product/TPS61291)

### Key Features

- Input supply voltage supervisor with adjustable threshold/hysteresis
- Load disconnect during shutdown
- Power-save mode for light-load efficiency
- 3x3-mm SON package

### Applications

- Low-voltage Li-Ion battery-powered products
- USB power supply
- tablet PCs
- Power banks, battery backup units
- Industrial metering equipment

### Key Features

- 15-nA typical quiescent current in bypass mode
- 5.7-μA typical quiescent current in boost mode
- Bypass switch from V<sub>IN</sub> to V<sub>OUT</sub>
- 2x2 SON package

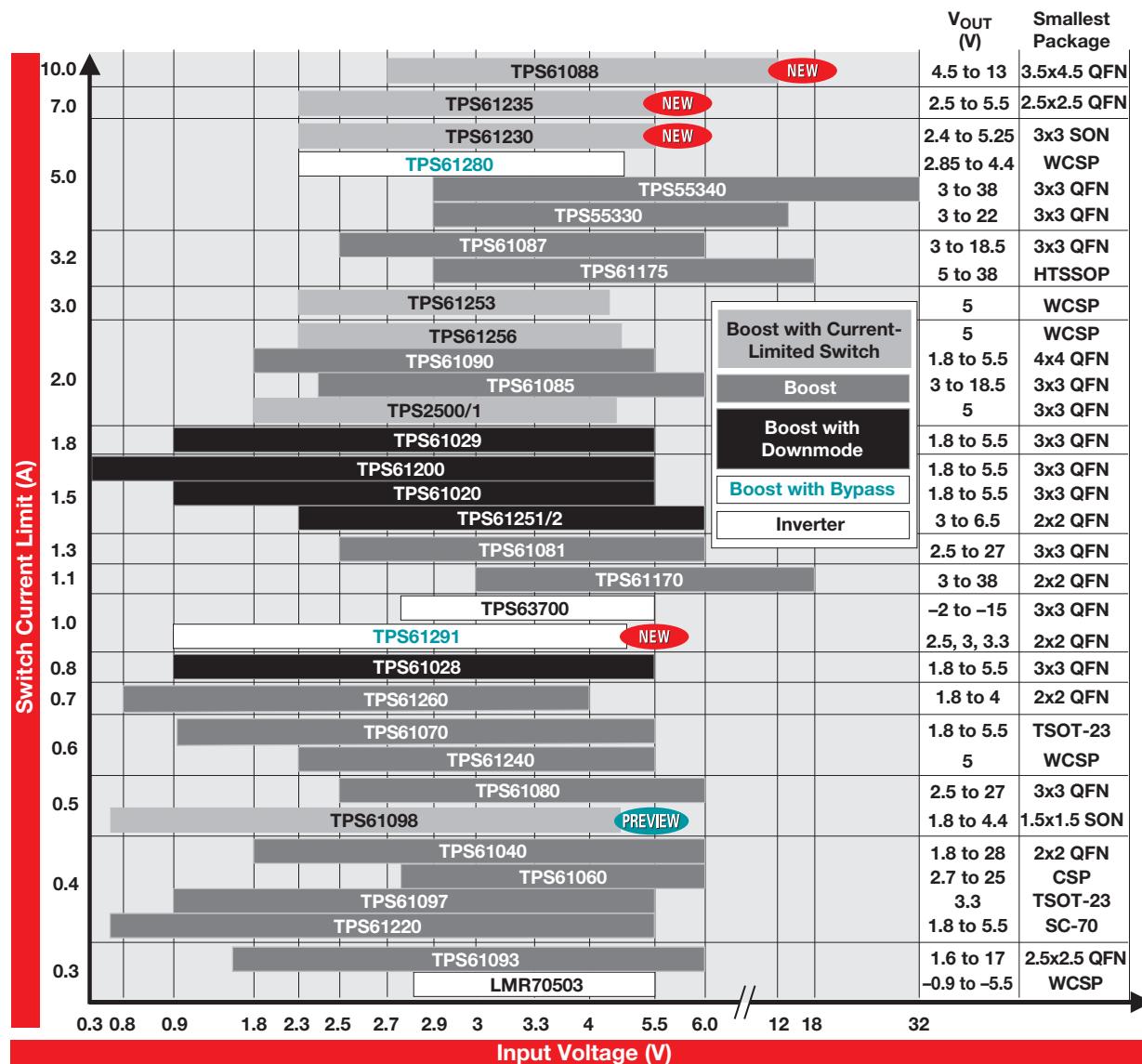
### Applications

- Metering (gas, water, smart meters)
- Remote controls
- Home security/home automation
- Single 3-V or 2 x 1.5-V alkaline cell powered applications

# DC/DC Switching Regulators

## Step-Up (Boost)/Flyback/SEPIC and Inverting Converters

### DC/DC Step-Up Converters (Integrated Switch) Family of Products



### Selection Guide for Step-Up (Boost) Converters

Device <sup>1</sup>	Switch Current Limit (typ) (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	V <sub>OUT</sub> Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Synchronous Rectification	Features <sup>2</sup>	Package(s)	EVM	Automotive	Price*
<b>Step-Up Regulators — Up to 10-A Switch Limit</b>															
TPS61041	250	1.8 to 6.0	V <sub>IN</sub> to 28	—	87	1000	10	28	0.1	✓	UVLO	SOT23-5/TSOT23-5	✓	✓	0.60
TPS61097-33	350	0.9 to 5.5	—	3.3	90	—	10	4	0.005	✓	UVLO	5 SOT23			0.70
TPS61040	400	1.8 to 6.0	V <sub>IN</sub> to 28	—	87	1000	10	28	0.1	✓	UVLO	SOT23-5/TSOT23-5	✓	✓	0.60
TPS61220	400	0.7 to 5.5	1.8 to 6	3.3/5	95	—	4.7	5.5	0.2	✓	UVLO	6 SOIC	✓		0.43
<b>TPS61098</b>	450	0.7 to 4.5	1.8 to 4.4	—	95	—	2.2	0.3	0.1	✓	Automatic Pass-Through Function	(1.5x1.5 mm) 6-SON	✓		TBD
LM5002	500	3.1 to 75	1.26 and up	—	95	1500	330	3100	95		UVLO	8 SOIC, (4x4 mm) SON			1.70

<sup>1</sup>All devices listed have thermal and/or short-circuit protection except TL499A and TL497A.

<sup>2</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

<sup>2</sup>UVLO = undervoltage lockout; LBI = low-battery indicator; PG = Power Good;

VSEL = ability to select different output voltages.

New devices are listed in bold red.

Preview devices are listed in bold teal.

# DC/DC Switching Regulators

## Step-Up (Boost)/Flyback/SEPIC and Inverting Converters

### Selection Guide for Step-Up (Boost) Converters (Continued)

Device <sup>1</sup>	Switch Current Limit (typ) (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	V <sub>OUT</sub> Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Synchronous Rectification	Features <sup>2</sup>	Package(s)	EVM	Automotive	Price*
<b>Step-Up Regulators — Up to 10-A Switch Limit (Continued)</b>															
TL497A	500	4.5 to 12	(V <sub>IN</sub> + 2) to 30	—	85	—	—	11 mA	6000	—	UVLO	14 TSSOP, 14 SOIC (3x3 mm) QFN	✓	0.95	
TPS61080	500	2.5 to 6.0	V <sub>IN</sub> to 27	—	87	600/1200	4.7	—	—	—	UVLO	(2x2) SON, 6-WCSP	✓	0.55	
TPS61240	600/700	2.3 to 5.5	—	5	90	3500	1	30	1.5	✓	UVLO	6 SOT-23	✓	0.45	
TPS61070	600	0.9, 2.3 to 5.5	1.8, 2.3 to 5.5	—	90	1200, 600	4.7	19	0.05	✓	UVLO	(2x2 mm) SON	✓	0.55	
TPS61260	700	0.8 to 4.0	1.8 to 4.0	3.3	95	2.3	4.7	29	0.1	✓	UVLO	(3x3 mm) QFN	✓	0.75	
TPS61028	800	0.9 to 5.5	1.8 to 5.5	—	96	600	6.8	25	0.1	✓	LBI, UVLO	8 TSSOP	✓	0.65	
LM2621	1000	1.2 to 1.4	1.24 to 14	—	90	2000	6.8	80	2.5	—	UVLO	8 SOIC, (4x4 mm) SON	✓	1.85	
LM5001	1000	3.1 to 75	1.26 and up	—	96	1500	100	3100	95	—	UVLO	(2x2 mm) QFN	✓	0.68	
<b>TPS61291</b>	1000	0.9 to 5.0	—	2.5, 3, 3.3	95	—	3.3	6.1	0.015	✓	UVLO, boost + bypass	10 MSOP, (3x3 mm) QFN	✓	1.26	
TPS61014	1010, 1060, 1130	0.8 to 3.3	—	2.8, 3, 3.3	95	500	10	36	1	✓	LBI, UVLO	(2.5x2.5 mm) SON	✓	1.20	
TPS61093	1100	1.6 to 6	V <sub>IN</sub> to 17	—	88	1200	2.2	900	1	—	UVLO	10 MSOP, (3x3 mm) QFN	✓	1.16	
TPS61010	1130	0.8 to 3.3	1.5 to 3.3	—	95	500	10	36	1	✓	LBI, UVLO	(3x3 mm) SON	✓	1.80	
LM4510	1200	2.7 to 5.5	V <sub>IN</sub> to 18	—	85	1000	4.7	1700	—	—	UVLO	(3x3 mm) QFN	✓	1.25	
TPS61081	1200	2.5 to 6.0	V <sub>IN</sub> to 27	—	87	1200	4.7	6000	1	—	UVLO	(2x2) QFN	✓	1.20	
TPS61170	1200	3.0 to 18	V <sub>IN</sub> to 38	—	93	1200	10	2300	1	—	UVLO	5 SOT-23	✓	0.61	
LM27313	1250	2.7 to 14	V <sub>IN</sub> to 28	—	90	1600	10	2100	—	—	UVLO	5 SOT-23	✓	1.08	
LM2731	1400	2.7 to 14	V <sub>IN</sub> to 22	—	90	1600	10	2000	—	—	UVLO	(4x4 mm) QFN, 8 SOIC	✓	0.21	
MC34063A	1500	3 to 40	3 to 39.5	—	—	100	—	—	1	—	UVLO	(3x3 mm) QFN	✓	0.80	
TPS61020	1500	0.9 to 5.5	1.8 to 5.5	—	96	600	6.8	26	0.1	✓	LBI, UVLO	(4x4 mm) QFN	✓	0.80	
TPS61024	1500	0.9 to 5.5	1.8 to 5.5	3, 3.3, 5	96	600	6.8	26	0.1	✓	LBI, UVLO	(3x3 mm) QFN	✓	0.80	
TPS61200	1500	0.3 to 5.5	0 to V <sub>IN</sub>	3.3, 5	90	<1650	2.2	50	1	✓	UVLO	(2x2 mm) QFN	✓	1.00	
TPS61251	1500	2.3 to 6	3 to 6.5	—	92	3500	1.5	30	0.85	✓	PG, UVLO	(2x2 mm) QFN	✓	0.75	
TPS61252	1500	2.3 to 6	3 to 6.5	—	92	3250	1.5	30	0.85	✓	PG, UVLO	(2x2 mm) QFN	✓	0.75	
LM2733	1550	2.7 to 14	V <sub>IN</sub> to 40	—	90	1600	10	2100	—	—	UVLO	5 SOT-23	✓	1.04	
LM2622	1650	2 to 12	V <sub>IN</sub> to 18	—	90	1300	10	1300	—	—	UVLO	8 MSOP	✓	0.91	
TPS61026	1800	0.9 to 5.5	1.8 to 5.5	—	96	600	6.8	26	0.1	✓	LBI, UVLO	(3x3 mm) QFN	✓	0.85	
LM2698	1900	2.7 to 12	V <sub>IN</sub> to 17	—	94	1250	10	1300	—	—	UVLO	8 MSOP	✓	1.83	
LM5000	2000	3.1 to 40	1.26 and up	—	90	1300	33	2000	18	—	UVLO	16 TSSOP, (4x4 mm) SON	✓	2.00	
TPS61254	2150	2.5 to 4.85	—	4.5, 5	93	3500	1	37	0.85	✓	UVLO	(1.2x1.3 mm) 9 CSP	✓	0.75	
TPS61091	2200	1.8 to 5.5	—	3.3, 5	96	600	6.8	20	0.1	✓	LBI, UVLO	(4x4 mm) QFN	✓	0.95	
LM2623	2200	0.8 to 14	1.24 to 14	—	90	2000	4.7	80	—	—	UVLO	8 MSOP, (4x4 mm) SON	✓	1.09	
TPS61090	2200	1.8 to 5.5	1.8 to 5.5	—	96	600	6.8	20	0.1	✓	LBI, UVLO	(4x4 mm) QFN	✓	0.95	
LM3224	2450	2.7 to 7	V <sub>IN</sub> to 20	—	90	1250	10	1300	—	—	UVLO	8 MSOP	✓	1.10	
LM3310	2600	2.5 to 7	V <sub>IN</sub> to 20	—	93	1280	10	3100	—	—	UVLO	(4x4 mm) QFN	✓	1.38	
LM3311	2600	2.5 to 7	V <sub>IN</sub> to 20	—	93	1280	10	3100	—	—	UVLO	(4x4 mm) QFN	✓	1.38	
TPS61085	2600	2.3 to 6	(V <sub>IN</sub> + 0.5) to 18.5	—	91	650/1200	6.8/3.3	70	1	—	UVLO, adj SS, sel. fsw	8 TSSOP, 8 MSOP	✓	0.95	
TPS61086	2600	2.3 to 6	(V <sub>IN</sub> + 0.5) to 18.5	—	91	1200	3.3	70	1	—	UVLO, adj SS, sel. forced PWM	(3x3 mm) QFN	✓	0.95	
LM2735	3000	2.7 to 5.5	V <sub>IN</sub> to 24	—	90	1600	15	3400	—	—	UVLO	5 SOT-23, 8 MSOP, (3x3) QFN	✓	1.25	
LM2700	3600	2.2 to 12	1.26 to 17.5	—	92	1250	4.7	1300	—	—	UVLO	14 TSSOP, (4x4) QFN	✓	1.71	
TPS61253	3620	2.65 to 4.85, 4.35, 4.85	—	4.5, 5, 5.1	93	3500	1	37	0.85	✓	UVLO	(1.2x1.3 mm) 9 CSP	✓	0.80	
TPS61175	3800	2.9 to 18	V <sub>IN</sub> to 38	—	93	200-2200	10	3500	1.5	—	UVLO	14 TSSOP	✓	1.60	
TPS61087	4000	2.5 to 6.0	(V <sub>IN</sub> + 0.5) to 18.5	—	91	650/1200	3.3	75	1	—	UVLO, adj SS, sel. fsw	(3x3 mm) QFN	✓	1.60	
TPS61030	4000	1.8 to 5.5	1.8 to 5.5	3.3, 5	96	600	6.8	20	0.1	✓	LBI, UVLO	(4x4 mm) QFN, 16 TSSOP	✓	1.25	
<b>TPS61230</b>	5000	2.3 to 5.5	2.4 to 5.25	—	96	2000	1	35	1.5	✓	UVLO	(3x3) SON	✓	1.15	
TPS55330	6600	2.9 to 16	3 to 22	—	92	1200	2.2	500	2.7	—	PG, UVLO	(3x3) QFN	✓	1.75	
TPS55340	6600	2.9 to 32	3 to 38	—	95	1200	10	500	2.7	—	PG, UVLO	14 TSOP, (3x3) QFN	✓	1.85	
<b>TPS61235</b>	7000	2.3 to 5.5	—	5.1	96	1000	1	<5	0.2	✓	SS, overload, overvoltage and over-thermal protections	QFN	✓	TBD	

<sup>1</sup>All devices listed have thermal and/or short-circuit protection except TL499A and TL497A.

<sup>\*</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

<sup>2</sup>UVLO = undervoltage lockout; LBI = low-battery indicator; PG = Power Good;

New devices are listed in bold red.

Preview devices are listed in bold teal.

# DC/DC Switching Regulators

## Step-Up (Boost)/Flyback/SEPIC and Inverting Converters

### Selection Guide for Step-Up (Boost) Converters (Continued)

Device <sup>1</sup>	Switch Current Limit (typ) (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	V <sub>OUT</sub> Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Synchronous Rectification	Features <sup>2</sup>	Package(s)	EVM	Automotive	Price*
<b>Step-Up Regulators — Up to 10-A Switch Limit (Continued)</b>															
<b>TPS61280A</b>	7400	2.3 to 4.85	2.85 to 4.4	—	95	2300	0.47	55.5	2.6	✓	UVLO, bypass switch (35 mΩ), I <sup>2</sup> C programmable current limit and V <sub>OUT</sub>	DSBGA	✓		1.27
<b>TPS61088</b>	10000	2.7 to 12	4.5 to 13.2	—	90	200-2000	2.2	500	2.7	✓	Adj. peak current limit, overvoltage protection, undervoltage lockout	QFN			TBD
<b>Step-Up (Boost) Regulators with Integrated LDO (Dual Output)</b>															
<b>TL499A</b>	—	1.1 to 10	2.9 to 30	—	85	—	—	—	15	100/Adj.			8 SOIC		1.20
<b>TPS61120</b>	1300	1.8 to 5.5	2.5 to 5.5	—	95	500	10	20	0.2	200/Adj.	✓	PG, LBI, UVLO	16 TSSOP, (4x4) QFN	✓	1.65
<b>TPS61121</b>	1300	1.8 to 5.5	—	1.5, 3.3	95	500	10	20	0.2	200/1.5	✓	PG, LBI, UVLO	16 TSSOP, (4x4) QFN		2.00
<b>Inverting Regulators</b>															
<b>LMR70503</b>	300	2.8 to 5.5	-0.9 to -5.5	—	79	500	—	0.245 mA	0.01	—		UVLO	(1.64x0.86) CSP	✓	1.15
<b>TL497A</b>	500	4.5 to 12	-1.2 to -25	—	85	—	—	11 mA	6000	—			14 TSSOP, 14 SOIC		0.90
<b>TPS63700</b>	1000	2.7 to 5.5	-2 to -15	—	84	1400	4.7	—	0.014	—		UVLO	(3x3) SON	✓	0.90
<b>MC34063A</b>	1500	3 to 38	-1.25 to -36.3	—	100	—	—	330	0.2	—		UVLO	8 SOIC, (4x4 mm) QFN	✓	0.21

<sup>1</sup>All devices listed have thermal and/or short-circuit protection except TL499A and TL497A.

<sup>\*</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

<sup>2</sup>UVLO = undervoltage lockout; LBI = low-battery indicator; PG = Power Good;

VSEL = ability to select different output voltages.

Preview devices are listed in bold teal.

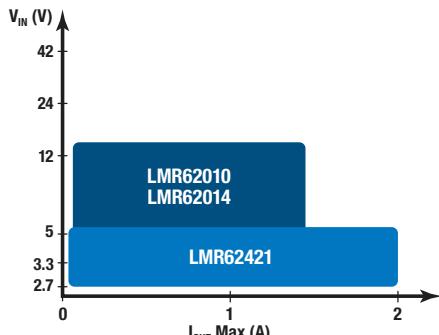
### SIMPLE SWITCHER® Boost/Flyback/SEPIC

Device	I <sub>OUT</sub> (A)	V <sub>IN</sub> (max) (V)	V <sub>IN</sub> (min) (V)	V <sub>OUT</sub> (min) (V)	Frequency Range (kHz)	Package(s)	Price*
<b>LM2585</b>	3	40	4	1.23	100	TO-220, TO-263	3.17
<b>LM2586</b>	3	40	4	1.23	100 to 200	TO-220, TO-263	3.27
<b>LM2587</b>	5	40	4	1.23	100	TO-220, TO-263	4.17
<b>LM2588</b>	5	40	4	1.23	100 to 200	TO-220, TO-263	4.50

<sup>\*</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

### SIMPLE SWITCHER® Step-Up (Boost) Nano Regulators

The new SIMPLE SWITCHER nano regulators feature tiny packaging, 1-MHz or greater switching frequency for extremely small surface mount inductors and chip capacitors, and a minimal BOM to reduce board space. All nano regulators are offered in either LLP, SOT-23, or micro SMD packaging for added design flexibility.



### SIMPLE SWITCHER® Step-Up (Boost) Nano Regulators

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Frequency (kHz)	Features	Package(s)	Price*
<b>LMR62421</b>	2.1	2.7 to 5.5	3 to 24	1600	EN, SS	SOT-23, LLP-6	0.74
<b>LMR62014</b>	1.4	2.7 to 14	3 to 20	1600	EN	SOT-23	0.54
<b>LMR64010</b>	1	2.7 to 14	3 to 40	1600	EN	SOT-23	0.59

<sup>\*</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

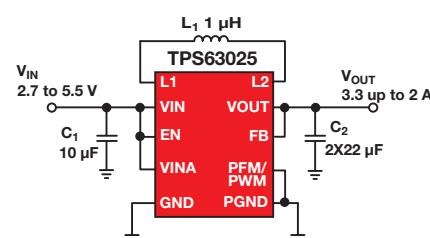
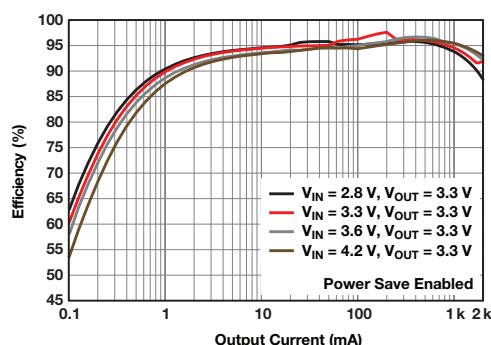
# DC/DC Switching Regulators

## Buck-Boost Converters

### World's Smallest 4-A switch, Single-Inductor Buck-Boost Converter

#### TPS630250

The TPS63025x buck-boost converters feature high efficiency and low quiescent current and they are suitable for application where the input voltage is higher or lower than the output. Output currents can go as high as 2 A in boost mode and as high as 4 A in buck mode. The maximum average current in the switches is limited to a typical value of 4 A. The converters have automatic switching between buck or boost mode, which ensures a seamless transition between modes. They also offer high efficiency over the complete load current range. The output voltage is programmable using an external resistor divider, or is fixed internally on the chip. The converters can be disabled to minimize battery drain.



Get more information: [www.ti.com/product/TPS630250](http://www.ti.com/product/TPS630250)

#### Key Features

- Output capacitor discharge function
- True shutdown function
- Efficiency up to 95% in buck or boost mode and up to 97% when  $V_{IN} = V_{OUT}$
- 1.7x2-mm WCSP package, also available in 2.5x3-mm QFN/HotRod™

#### Applications

- Smart phones and tablets
- PC and phone accessories
- EPOS
- Portable industrial and other battery powered applications

#### Selection Guide

Device	I <sub>OUT</sub> <sup>1</sup> (mA)	Switch-Current Limit (typ) (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	V <sub>OUT</sub> Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Adj. Input-Current Limit	Load Disconnect During Shutdown	Synch. to Ext. CLK Pin	Power Good Pin	Undervoltage Lockout	Package(s)	EVM	Automotive	Price*
LM2611	300	1200	2.7 to 14	—	-5	96	1400	22	270	0.01				✓		SOT-23	✓	0.95	
TPS61130	300	1300	1.8 to 6.5	2.5 to 5.5	1.5, 3.3	90	500	22	40	0.2	✓	✓	✓			QFN, TSSOP	✓	1.55	
TPS63030	500	1000	1.8 to 5.5	1.2 to 5.5	3.3	96	2400	2.2	29	0.1	✓	✓	✓			10 QFN	✓	0.87	
<b>TPS63050<sup>2</sup></b>	500	1000	2.5 to 5.5	2.5 to 5.5	3.3	96	2500	1.5	43	0.1	✓	✓	✓	✓	✓	12 WCSP, HotRod™	✓	0.87	
TPS63000	800	1800	1.8 to 5.5	1.2 to 5.5	3.3, 5.0	90	1400	2.2	30	0.1	✓	✓	✓	✓		10 QFN	✓	1.15	
TPS63010	800, 1200	2200	2 to 5.5	1.2 to 5.5	2.8, 2.9, 3.3, 3.4	96	2400	1.5	5	0.1	✓	✓	✓			20 WCSP	✓	1.10	
LM3668	1000	1850	2.8 to 5.5	2.8 to 5.0	2.8, 3.3	96	2200	2.2	45	0.01		✓	✓			12 QFN	✓	2.25	
TPS63060	1000, 1300, 2000	1800	2.5 to 12	2.5 to 8	5	93	2400	1	37	0.3	✓	✓	✓			10 SON	✓	1.38	
<b>TPS63024</b>	1500	3000	2.3 to 5.5	2.3 to 3.6	2.9/3.3	97	2500	1	35	0.1	✓		✓			20 WCSP		1.20	
<b>TPS630250</b>	2000	4500	2.3 to 5.5	2.3 to 3.6	2.9/3.3	97	2500	1	35	0.1	✓		✓			20 WCSP, HotRod™	✓	1.40	
<b>TPS63020</b>	2000, 3000	4000	1.8 to 5.5	1.2 to 5.5	3.3	96	2400	1.5	30	0.1	✓	✓	✓	✓		14 QFN	✓	1.40	

<sup>1</sup> $V_{OUT} = 3.3 \text{ V, boost mode}$

New devices are listed in bold red.

<sup>2</sup>Adjustable average input-current limit and soft start.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

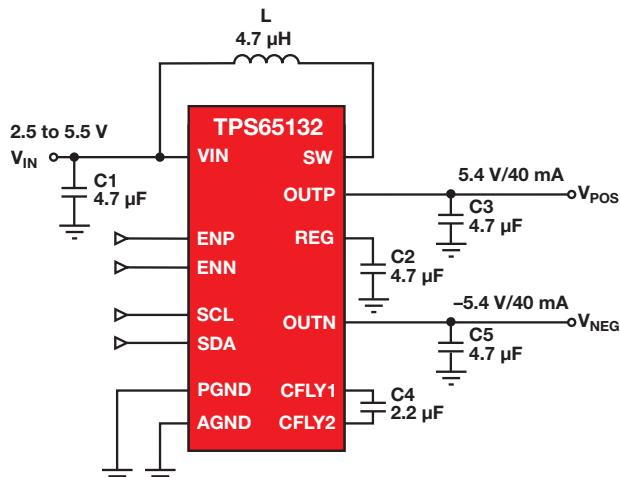
# DC/DC Switching Regulators

## Split-Rail (+V<sub>OUT1</sub>/−V<sub>OUT2</sub>) Converters

### Split-Rail Converter, Dual-Output (Bipolar) SIMO Regulator for General Dual-Supply Applications

#### TPS65132

The TPS65132 is a split-rail converter designed to drive general-purpose, dual-power-supply applications (headphone amplifier for instance). The device uses a single-inductor scheme for the smallest solution size possible and provides high efficiency.



Get more information: [www.ti.com/product/TPS65132](http://www.ti.com/product/TPS65132)

#### Key Features

- >85% efficiency
- Dual output with only one inductor
- 15-bump CSP or 20-pin QFN packages
- Maximum output current: 80 mA
- Internal memory (EEPROM type 1000x programmable)
- Programmable sequencing
- Enable pin function—no hard reset (values stay in memory)
- 2.5- to 5.5-V input-voltage range
- Output voltages:
  - +4.0 to 6.0 V (0.1-V steps)
  - −4.0 to −6.0 V (0.1-V steps)
- Excellent line-transient regulation
- Programmable active discharge
- UVLO rising/falling

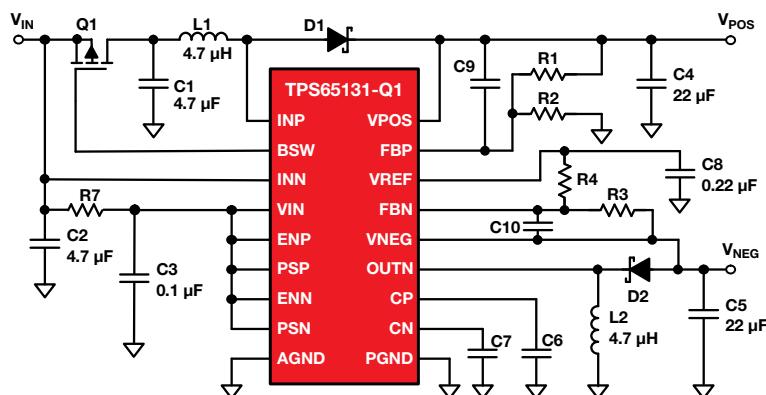
#### Applications

- Dual power-supply applications

### Split-Rail Converter for Automotive Applications

#### TPS65131-Q1

The TPS65131-Q1 is a split-rail converter designed to drive dual-power-supply automotive applications (infotainment and clusters displays for instance). This AEC-Q100 qualified device generates positive and negative outputs with currents of typically 300 mA.



Get more information: [www.ti.com/product/TPS65131-Q1](http://www.ti.com/product/TPS65131-Q1)

#### Key Features

- 3.3- to 5-V input (2.7-V crank)
- Dual adjustable output voltages up to 15 V and down to −15 V
- 2-A typical switch current limit
- Up to 89%/81% efficiency on +/- rails
- Power-save mode
- Independent enable inputs
- Fixed-frequency PWM operation
- Overvoltage protection on both outputs
- Q1 qualification

#### Applications

- Automotive displays (infotainment, clusters)
- Automotive dual-power-supply applications

### Selection Guide

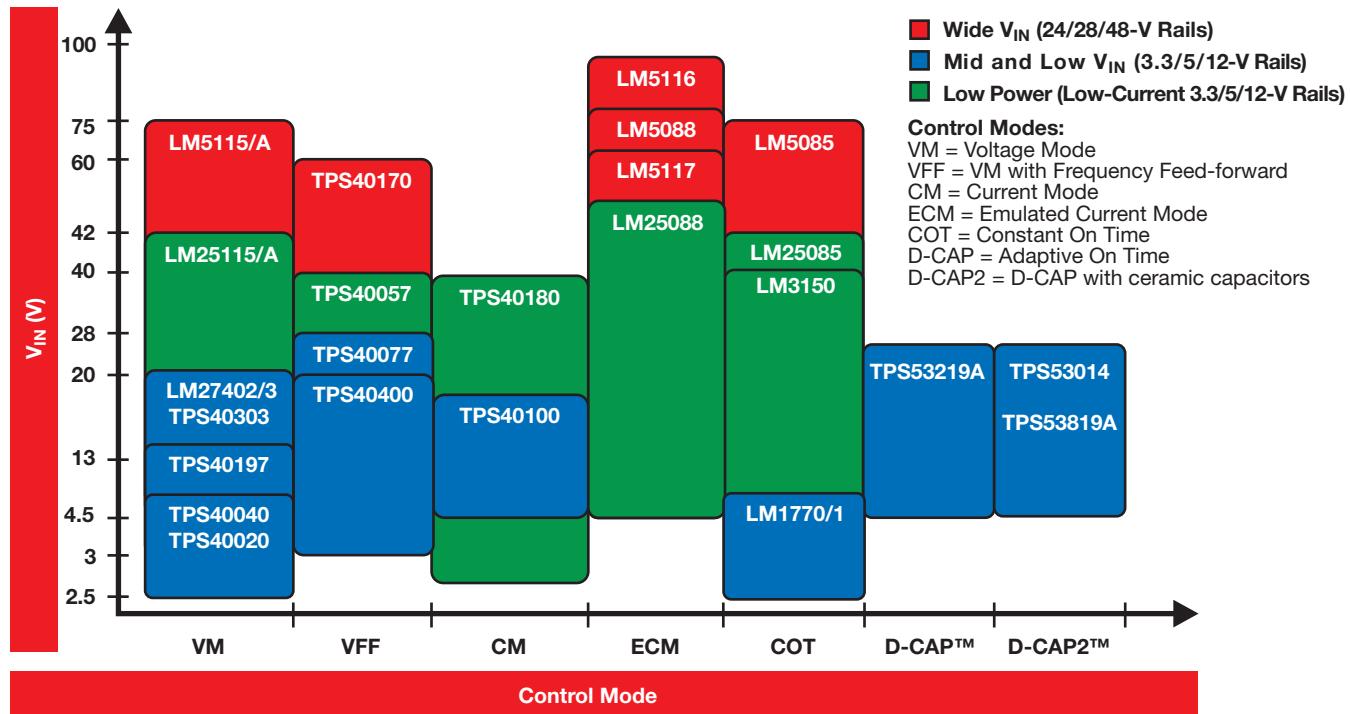
Device	V <sub>IN</sub>		V <sub>OUTN</sub>		V <sub>OUTP</sub>		I <sub>OUT</sub> (max) (mA)	Automotive	Price*
	(min) (V)	(max) (V)	(min) (V)	(max) (V)	(min) (V)	(max) (V)			
TPS65130	2.7	5.5	−2	−15	3.2	15	300		2.20
TPS65131	2.7	5.5	−2	−15	3.2	15	300		2.20
TPS65131-Q1	2.7	5.5	−2	−15	3.2	15	300	✓	2.53
TPS65132	2.5	5.5	−4	−6	4	6	80		1.30
TPS65133	2.9	5	−5	−5	5	5	250		1.00
TPS65135	2.5	5.5	−2.5	−7	3	6	80		1.20

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# DC/DC Switching Regulators

## Controllers (External Switch)

### Single-Channel, Step-Down DC/DC Controllers



### SIMPLE SWITCHER® Synchronous Controllers

Device	$V_{IN}$ (max) (V)	$V_{IN}$ (min) (V)	$V_{OUT}$ (min) (V)	$V_{OUT}$ (max) (V)	Feedback Tolerance (%)	Frequency Range (kHz)	Package(s)	Price*
LM3150	42	6	0.6	Adj	1.50	Adj to 1 MHz	eTSSOP-14	2.30
LM3151	42	6	3.3	3.3	1.50	250 kHz	eTSSOP-14	2.30
LM3152	33	6	3.3	3.3	1.50	500 kHz	eTSSOP-14	2.30
LM3153	18	6	3.3	3.3	1.50	750 kHz	eTSSOP-14	2.30

\*Suggested resale price in U.S. dollars in quantities of 1,000.

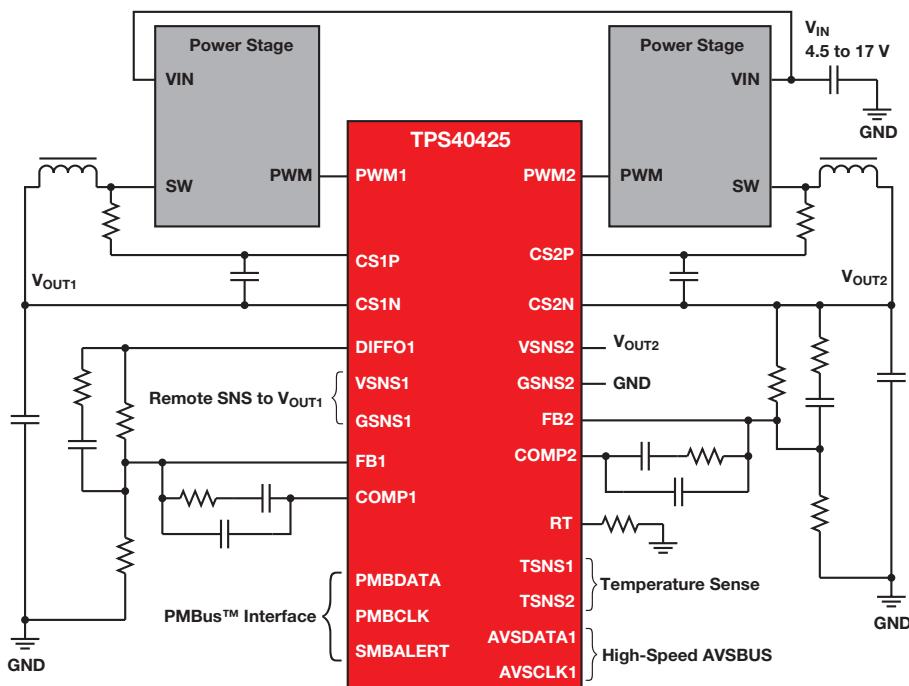
# DC/DC Switching Regulators

## Controllers (External Switch)

### 4.5- to 20-V, Input Stackable, Multiphase Synchronous Buck Controllers with PMBus

#### TPS40425, TPS40428

The TPS40425 and TPS40428 are stackable DC/DC controllers that can be configured as dual-output or 2-phase. It can also support up to 4 phases for load current as high as 120 A. Interleaved phase shifting for 2-, 3-, or 4-phases reduce the input and output ripples, therefore reducing input and output capacitance. Using the PMBus™ standard, the reference voltage, fault limit, UVLO threshold, soft-start time and turn-on and turn-off delay can be programmed. In addition, the device implements an accurate measurement system to monitor the output voltages, currents and temperatures for individual channels.



### Key Features

- Dual/multiphase driverless controllers
  - TPS40425 uses DCR current sensing
  - TPS40428 uses NexFET™ power stage current sensing
- Individual high-speed AVS interface (0.5- to 1.5-V range)
- Current sharing and interleaving for up to 4 phases
- V, I, T monitoring via PMBus
- On-chip non-volatile memory to store custom configurations
- 0.6-V VREF with 0.5% accuracy from 0 to +125°C T<sub>a</sub>
- Programmable 200-kHz to 1.5-MHz switching frequency
- Frequency synchronization
- Support pre-bias start-up
- 40-pin 6x6-mm QFN

### Applications

- Wireless infrastructure
- Switcher/router networking/server/storage

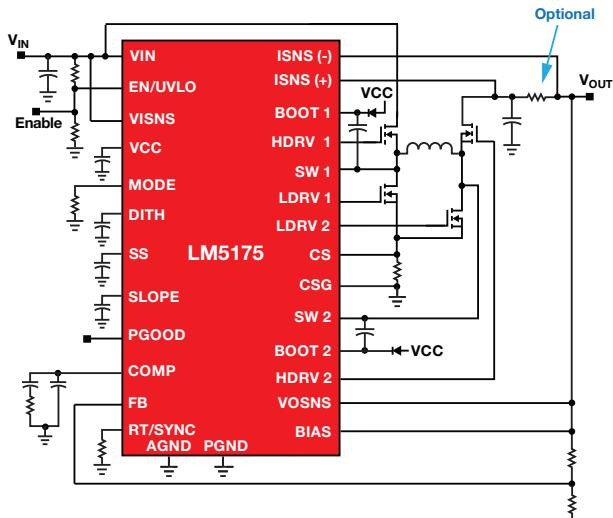
Get more information: [www.ti.com/product/TPS40425](http://www.ti.com/product/TPS40425) or [TPS40428](http://www.ti.com/product/TPS40428)

# DC/DC Switching Regulators

## Controllers (External Switch)

### 3.5- to 42-V, 4-Switch Buck-Boost Controller with Frequency Dithering and Optimized Efficiency LM5175

The LM5175 4-switch buck-boost controller provides best-in-class efficiency during operation in the buck-boost transition region while operating from a wide input-voltage range of 3.5 to 42 V. Well suited for high-powered applications with wide input-voltage ranges, the LM5175 also provides increased flexibility to operate from a variety of different voltage sources while maintaining accurate voltage regulation.

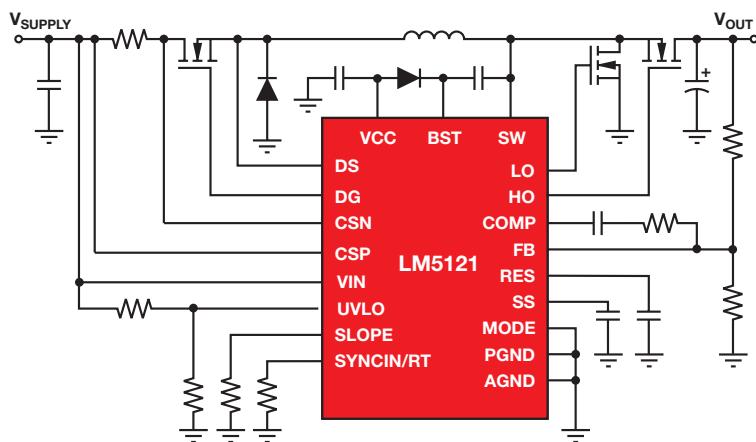


Get more information: [www.ti.com/product/LM5175](http://www.ti.com/product/LM5175)

### Stackable, Wide- $V_{IN}$ , Synchronous Boost Controllers

#### LM5121, LM5122

The LM5121 and LM5122 synchronous boost controllers are intended for high-efficiency, high-power, boost-regulator applications. The control method is based upon peak-current-mode control which provides inherent line feed-forward, cycle-by-cycle current limiting and simplifies loop compensation. Switching frequency is programmable up to 1 MHz.



Get more information: [www.ti.com/product/LM5121](http://www.ti.com/product/LM5121) or [LM5122](http://www.ti.com/product/LM5122)

### Key Features

- Wide input-voltage range of 3.5 to 42 V
- High buck-boost region efficiency
- Frequency dithering
- Hiccup-mode overcurrent protection

### Applications

- Industrial PCs
- USB PD power
- Battery charging
- Automotive start-stop

### Key Features

- AECQ-100 Grade 1 qualified
- Wide-input/output range accommodates automotive cold crank and load dump
- 3- to 65-V  $V_{IN}$  and up to 100  $V_{OUT}$
- Bypass ( $V_{OUT} = V_{IN}$ ) operation
- 1.2-V reference with  $\pm 1.0\%$  accuracy
- Free-run/synchronizable up to 1 MHz
- Peak-current-mode control
- Robust integrated 3-A gate drivers
- LM5122: Multiple-phase capability for high-power industrial, automotive, and telecom requirements
- LM5121: Disconnection switch enables fault protection and complete load disconnect

# DC/DC Switching Regulators

## Controllers (External Switch)

### Selection Guide

All parts have soft start, short-circuit protection, and undervoltage lockout functions.

Device	Mode of Control <sup>1</sup>	V <sub>IN</sub> (min/max) (V)	V <sub>O</sub> (min/max) (V)	Driver Current (A)	Output Current (A) <sup>2</sup>	Frequency (kHz)	V <sub>REF</sub> Tolerance (%)	Internal Bootstrap	Package(s)	Pwr Good	Source and Sink <sup>3</sup>	Pre-biased Operation	Ext Synch Pin	Predictive Gate Drive™	DDR <sup>4</sup>	Remote Sense	Automotive	Price*
<b>General-Purpose DC/DC Step-Down Controllers</b>																		
TPS40000/2	V	2.25 to 5.5	0.7 to 4	1	15	300/600	1	Yes	10 MSOP			Yes		Yes				0.99
TPS4007/9	V	2.25 to 5.5	0.7 to 4	1	15	300/600	1	Yes	10 MSOP		Yes <sup>5</sup>	Yes		Yes				1.20
TPS40040	V	2.25 to 5.5	0.6 to 4.95	1	15	300	1	Yes	8 SON		Yes <sup>5</sup>	Yes						0.90
TPS40041	V	2.25 to 5.5	0.6 to 4.88	1	15	600	1	Yes	8 SON		Yes <sup>5</sup>	Yes						0.90
TPS40042	V	3 to 5.5	0.7 to 4.95	1.2	15	600	Ext	Yes	10 SON		Yes <sup>5</sup>	Yes			Yes			0.90
LM3743	V	3 to 5.5	0.8 to 4.6	3.1	10	300 to 1000	1.75		10 MSOP					Yes				1.10
LM2745	V	1 to 17	0.6	1.9	20	50 to 1000	1.5		14 TSSOP	Yes		Yes	Yes					1.15
LM3475	Hysteretic	2.7 to 10	0.8 to V <sub>IN</sub>	0.5	5	0 to 2000	1.5		5 SOT23									0.52
TPS40190	V	4.5 to 15	0.59 to 12.75	1.2	20	300	1	Yes	10 SON		Yes <sup>5</sup>	Yes						1.00
LM2742	V	1 to 16	0.6	1.6	20	50 to 2000	1.5		14 TSSOP	Yes								1.25
LM2743	V	1 to 16	0.6	1.6	20	50 to 1000	2		14 TSSOP	Yes								1.15
LM2744	V	1 to 16	0.6	1.6	20	50 to 1000	1.5		14 TSSOP	Yes								1.15
LM2748	V	1 to 16	0.6	1.9	20	50 to 1000	1.5		14 TSSOP	Yes		Yes	Yes					1.15
LM2747	V	1 to 17	0.6	1.9	20	50 to 1000	1		14 TSSOP	Yes		Yes	Yes					1.45
TPS40100 <sup>6</sup>	CM	4.5 to 18	0.7 to 5.5	1.3	20	600	1		24 QFN	Yes	Yes <sup>5</sup>	Yes	Yes			Yes		1.95
TPS40101 <sup>6</sup>	V	4.5 to 18	0.7 to 5.5	1.3	20	1000	1		24 QFN	Yes	Yes <sup>5</sup>	Yes	Yes			Yes		1.95
LM3753/54	V	4.5 to 18	0.6 to 3.6	1.9	50	200 to 1000	1		32 LLP	Yes		Yes	Yes			Yes		2.95
TPS40192/3	V	4.5 to 18	0.59 to 14.4	1.2	15/20	600/300	0.5	Yes	10 SON	Yes	Yes <sup>5</sup>	Yes						1.05
TPS40195 <sup>7</sup>	V	4.5 to 20	0.59 to 17	1.2	20	Adj. to 600	0.5	Yes	16 TSSOP, 16 QFN	Yes	Yes <sup>5</sup>	Yes	Yes <sup>8</sup>					1.50
TPS40400	VFF, PMBus™	3 to 20	0.6 to 12	2	25	Adj. to 2000	1	Yes	24 QFN	Yes	Yes	Yes	Yes			Yes		2.15
TPS40303/4/5	V	3 to 20	0.6 to 18	2	25	300/600/1200	1	Yes	10 SON	Yes	Yes <sup>5</sup>	Yes						1.50
LM27402	V	3 to 20	0.6 to 19	2.6	30	200 to 1200	1		LLP-16, 16 TSSOP	Yes		Yes	Yes					1.10
LM27403	V	3 to 20	0.6 to 19	2.6	30	200 to 1200	1		24 WQFN	Yes		Yes	Yes					1.20
TPS53125/6/7 (dual output)	D-CAP2™	4.5 to 26	0.76 to 5.5	1.5	15	350/700	1	Yes	24 QFN, 24 TSSOP			Yes	Yes					1.60
TPS53014/15	D-CAP2	4.5 to 28	0.76 to 7	1.5	25	500	1	Yes	10 MSOP	No/ Yes	Yes	Yes						0.90
TPS40075	VFF	4.5 to 28	0.7 to 23	1	20	Adj. to 1000	1	Yes	20 QFN	Yes	Yes <sup>5</sup>	Yes	Yes	Yes		Yes		1.80
TPS40077	VFF	4.5 to 28	0.7 to 23	1	20	Adj. to 1000	1	Yes	16 PowerPAD™	Yes	Yes <sup>5</sup>	Yes	Yes	Yes				1.60
TPS53819A	D-CAP2, PMBus	3 to 28	0.6 to 5.5	2	40	270 to 1000	0.5	Yes	16 QFN	Yes	Yes	Yes						1.65
LM3485	Hysteretic	4.5 to 35	1.242 to V <sub>IN</sub>	0.4	4	0 to 1400	2		8 MSOP									0.55
LM3489	Hysteretic	4.5 to 35	1.239 to V <sub>IN</sub>	0.4	4	0 to 1400	2		8 MSOP									0.62
LM3477	CM	2.97 to 35	1.265 to 30.8	1.0	6	500	1.5		8 MSOP									0.92
TPS40050/1/4/5	VFF	8 to 40	0.7 to 35	1	20	Adj. to 1000	1	Yes	16 PowerPAD		55, 57 <sup>5</sup>	57	Yes			✓		1.65
TPS40056	V	10 to 40	0.7 to 35	1	20	Adj. to 1000	Ext	Yes	16 PowerPAD		Yes		Yes		Yes			1.65
TPS40200 <sup>8</sup>	VFF	4.5 to 52	0.7 to 46	0.2	3	Adj. to 500	1	Note <sub>9</sub>	8 SOIC				Yes			✓		0.75
TPS40170	VFF	4.5 to 60	0.6 to 58	1.2	15	Adj. to 600	1	Yes	20 QFN	Yes	Yes <sup>5</sup>	Yes	Yes			✓		2.25
LM(2)5117	ECM	4.5 to 65	0.8 to 60	2.2	20	50 to 750	1.5		20 TSSOP, 24 LLP				Yes					1.75/2.04
LM(2)5085/A	COT	4.5 to 42/75	1.25/0.9 to V <sub>IN</sub>	1.5	10	1000	2		8 MSOP, 8 LLP									0.79/0.85/ 1.00
LM(2)5088	ECM	4.5 to 42/75	1.2 to 40/70	1.5	10	50 to 1000	1.5		e16 TSSOP				Yes					1.40/1.84
LM(2)5115/A	V	4.5 to 42/75	0.75 to 13.5	2.5	20	100 to 1000	1.7		16 TSSOP				Yes					1.40/1.85
LM(2)5116	ECM	6 to 100	1.2 to 80	3.5	20	50 to 1000	1.5		20 eTSSOP				Yes					1.85/2.42

<sup>1</sup>V = Voltage-mode control, CM = Current-mode control, VFF = Voltage mode with voltage feed-forward compensation, ECM = Emulated current mode and COT = Constant ON-time control.

<sup>2</sup>Current levels of this magnitude can be supported with commonly available commercial FETs.

<sup>3</sup>The controller of choice for most applications will be the source/sink version, which has two-quadrant operation and will source or sink output current.

<sup>4</sup>DDR = Supports DDR memory.

<sup>5</sup>During soft start: source only.

<sup>6</sup>Provides advanced start-up sequencing and output voltage margining.

<sup>7</sup>Bidirectional 180° out-of-phase synchronization.

<sup>8</sup>Non-synchronous, drives P-FETs.

<sup>9</sup>Drives high-side P-FET.

<sup>10</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

# DC/DC Switching Regulators

## Controllers (External Switch)

### Selection Guide (Continued)

All parts have soft start, short-circuit protection, and undervoltage lockout functions.

Device	Mode Control <sup>1</sup>	Switched Outputs	Phases	V <sub>IN</sub> (min/max) (V)	V <sub>O</sub> (min/max) (V)	Driver Current (A)	Output Current (A) <sup>2</sup>	Frequency (kHz)	V <sub>REF</sub> Tol (%)	Package(s)	Pwr Good	Ovoltage Protection	Source and Sink <sup>3</sup>	Pre-biased Operation	Ext Synch Pin	Remote Sense	Price*
<b>Multiphase Synchronous DC/DC Buck Controllers</b>																	
LM2642	CM	1 or 2	1 or 2	4.5/30	1.3/96% x V <sub>IN</sub>	1.1	25/phase	300	1.8	28L TSSOP	Yes	Yes	—	—	No	—	1.48
LM2647	VFF	1 or 2	1 or 2	5.5/28	0.6/7.8	2	25/phase	Adj. 200 to 500	1.5	28L TSSOP	Yes	Yes	—	—	No	—	1.80
LM2657	VFF	1 or 2	1 or 2	4.5/28	0.6/7.4	2	25/phase	Adj. 200 to 500	1.5	28L TSSOP	Yes	Yes	—	—	No	—	1.80
LM3000	ECM	1 or 2	1 or 2	3.3/18.5	0.6/80% x V <sub>IN</sub>	—	25/phase	Adj. 200 to 1500	1.5	32L LLP	Yes	Yes	—	Yes	No	—	2.75
LM3753	VFF	1 or 2	1 or 2	4.5/18	0.6/3.6	4	25/phase	Adj. 200 to 1000	1	32L LLP	Yes	Yes	—	Yes	Yes	—	2.75
LM3754	VFF	1 or 2	1 or 2	4.5/18	0.6/3.6	4	25/phase	Adj. 200 to 1000	1	32L LLP	Yes	Yes	—	Yes	Yes	—	2.75
LM(2)5119	ECM	1	2	4.5/5.5 to 42/65	0.8 to 38/59	2.2	50	50 to 750	1.5	32 LLP	—	—	—	—	Yes	—	2.60/3.25
LM5642	CM	1 or 2	1 or 2	4.5/36	1.3/90% x V <sub>IN</sub>	1.1	25/phase	200	1.7	28L TSSOP	No	Yes	—	—	Yes	—	1.75
LM5642x	CM	1 or 2	1 or 2	4.5/36	1.3/90% x V <sub>IN</sub>	1.1	25/phase	375	1.7	28L TSSOP	No	Yes	—	—	Yes	—	1.75
TPS40132	CM	1	2	1/40	0.6/5.8	1	50	Adj. to 1000	0.8	32 QFN	Yes	Yes	Yes	Yes	Yes	Yes	2.95
TPS40140 <sup>4</sup>	CM	1 or 2	1 or 2	2/40	0.7/5.8	1.2	25/phase	Adj. to 1000	0.5	36 QFN	Yes	Yes	Yes	Yes	Yes	Yes	3.05
TPS40180 <sup>5</sup>	CM	1	1	2/40	0.7/5.8	1.2	25	Adj. to 1000	0.75	24 QFN	Yes	Yes	Yes	Yes	Yes	Yes	2.05
TPS40322	VFF	1 or 2	1 or 2	3/20	0.6/5.6	2	25/phase	Adj. to 1000	1	32 QFN	Yes	Yes	Yes	Yes	Yes	Yes	2.40
TPS40422	VFF/PMBus	1 or 2	1 or 2	4.5/20	0.6/5.6	2	25/phase	Adj. to 1000	1	40 QFN	Yes	Yes	Yes	Yes	Yes	Yes	3.10
TPS40425/8 <sup>11</sup>	VFF/PMBus	1 or 2	1 or 2	4.5/20	0.6/5.0	2	25/phase	Adj. 200 to 1500	0.5	40 QFN	Yes	Yes	Yes	Yes	Yes	Yes	4.80
Device	Switched Outputs	LDO Outputs	Phases	V <sub>IN</sub> (min/max) (V)	V <sub>O</sub> (min/max) (V)	Driver Current (A)	Output Current (A) <sup>2</sup>	Frequency (kHz)	V <sub>REF</sub> Tol (%)	Control Method	Internal Bootstrap	Package(s)	Ovoltage Protection	Power Good	ULQ <sup>TM</sup> <sup>6</sup>	Price*	
<b>DC/DC Synchronous Buck Controllers with Light-Load Efficiency</b>																	
TPS53128/29	2	0	1	4.5/24	0.76/24	1.5	15	350/700	1	D-CAP2 <sup>TM</sup> Mode	Yes	24 QFN, 28 TSSOP	Yes	No	No	1.70	
TPS51220A	2	2	1	4.5/32	1.0/12.0	2	20	200 to 1000	1	Current or D-CAP <sup>TM</sup> Mode	Yes	32 QFN	Yes	Yes	No	2.25	
TPS51225/B/C	2	2	1	5.5/24	3.3/5.0 <sup>7</sup>	1.7	10	300 to 335	1	D-CAP Mode	Yes	20 QFN	Yes	Yes	No	1.05	
TPS51275/B/C	2	2	1	5.0/24	3.3/5.0 <sup>7</sup>	1.7	20	330 to 335	1	D-CAP Mode	Yes	20 QFN	Yes	Yes	No	1.05	
TPS51285A/B	2	2	1	5.0/24	3.3/5.0 <sup>7</sup>	1.7	20	400 to 475	1	D-CAP Mode	Yes	20 QFN	Yes	Yes	Yes	1.05	
TPS53211	1	0	1	4.5/15	0.8/0.7 x V <sub>IN</sub>	2	25	200 to 600	0.5	Voltage	Yes	16 QFN	Yes	Yes	No	2.00	
TPS53219A	1	0	1	4.5/28	0.6/5.5	2	25	Select up to 1000	0.5	D-CAP Mode	Yes	16 QFN	Yes	Yes	No	1.35	
TPS59124	2	0	1	3/28	0.76/5.5	3	10	300, 360, 420	1	D-CAP Mode	No	24 QFN	Yes	Yes	No	1.90	
Device	V <sub>IN</sub> (min/max) (V)	V <sub>O</sub> (min/max) (V)			Frequency Range (kHz)	f <sub>sync</sub>	On/Off Pin	Topology				Package(s)		Price*			
<b>Boost and Buck-Boost Controllers</b>																	
LM3017	5.0/18	6.0—			600	—	—	Boost, SEPIC, flyback				10 QFN		0.95			
LM3430	6.0/40	1.25—			50 to 2000	✓	—	Boost				12 LLP		1.00			
LM3478	2.95/40	1.26—			100 to 1000	✓	✓	Boost, SEPIC, flyback				8 MSOP		0.93			
LM3481	2.97/48	1.275—			100 to 1000	✓	✓	Boost, SEPIC, flyback				10 MSOP		0.95			
LM3488	2.95/40	1.26—			100 to 1000	✓	✓	Boost, SEPIC, flyback				8 MSOP		0.99			
LM5020	13/100	Set by external feedback network			50 to 1000	✓	✓	Flyback, inverting, buck, boost, forward				10 MSOP, 10 LLP		0.99			
LM5022/C	6.0/60	1.25—			50 to 2000	✓	✓	Boost, SEPIC				10 MSOP		1.13			
LM(2)5118	3.0/(42/75)	1.23/38 or 70			50 to 500	✓	✓	Buck-boost				20 eTSSOP		2.00/2.38			
LM5121/2 <sup>8</sup>	3.0/65	3.0/100			50 to 1000	✓	✓	Boost				20 HTSSOP		2.05/1.80			
TPS40210/1 <sup>9</sup>	4.5/52	5/26			Adj. to 1000	✓	✓	Boost, SEPIC, flyback				10 MSSOP/SON		1.10			
TPS43000 <sup>10</sup>	1.8/9	0.8/8			Adj. to 2000	✓	✓	Boost, SEPIC, flyback				16 TSSOP		2.25			
TPS43060/61 <sup>10</sup>	4.5/38	4.5/60			50 to 1000	✓	✓	Synchronous boost (60 V)				16 QFN		1.40			
LM5175	3.5/42	0.8/55			100 to 600	✓	✓	Synchronous buck-boost				28 HTSSOP		4.25			
SM72442	4.75/5.25	—			220	—	—	Buck-boost				28 TSSOP		3.95			
SM72445	4.75/5.25	—			110, 135 or 215	—	—	Buck-boost				28 TSSOP		3.95			

<sup>1</sup> CM = Current-mode control and VFF = voltage mode with voltage feed-forward compensation.

<sup>2</sup> Current levels of this magnitude can be supported with commonly available commercial FETs.

<sup>3</sup> The controller of choice for most applications will be the source/sink version, which has two-quadrant operation and will source or sink output current.

<sup>4</sup> Stackable to 16 phases.

<sup>5</sup> Stackable to 8 phases, reference is trimmable.

<sup>6</sup> ULQ = Ultralow quiescent-current mode.

<sup>7</sup> Fixed range: OUT1 = 5.0 V ±10% and OUT2 = 3.3 V ±10%.

<sup>8</sup> Input current limiting and disconnect switch (LM5121).

<sup>9</sup> Ovoltage protection, source only.

<sup>10</sup> External sync pin.

<sup>11</sup> Stackable to 4 phases.

New devices are listed in bold red.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# DC/DC Switching Regulators

## Controllers (External Switch)

### V-Core Controllers Selection Guide

Device	Mode of Control	Conversion Voltage Range (V)	Regulated Outputs	Phases	Max. Output Current (A)	Selectable Frequency	VID	CPU	Platform	Package	Price*
<b>TPS59610</b>	D-CAP+™	3 to 28	1	1	30	200 kHz to 500 kHz	IMVP6+	Tunnel Creek	Embedded	5x5-mm 32 QFN	1.40
<b>TPS59620</b>	D-CAP+	3 to 28	1	2	60	200 kHz to 500 kHz	IMVP6+	Penryn	Embedded	6x6-mm 40 QFN	2.20
<b>TPS51611</b>	D-CAP+	3 to 28	1	1	30	250 kHz to 500 kHz	IMVP6.5	Arrandale	Client	5x5-mm 32 QFN	1.25
<b>TPS59621</b>	D-CAP+	3 to 28	1	2	60	200 kHz to 500 kHz	IMVP6.5	Arrandale	Client	6x6-mm 40 QFN	1.80
<b>TPS59640</b>	D-CAP+	3 to 28	2	3+1	90	200 kHz to 600 kHz	IMVP7	Sandy Bridge	Client/Server	6x6-mm 48 QFN	2.25
<b>TPS59650</b>	D-CAP+	3 to 28	2	3+2	90	200 kHz to 600 kHz	IMVP7	Ivy Bridge	Client/Server	6x6-mm 48 QFN	2.65
<b>TPS59641</b>	D-CAP+	3 to 28	2	3+1	90	200 kHz to 600 kHz	VR 12.1	Baytrail-M/D/I	Client	6x6-mm 48 QFN	2.25
<b>TPS51631/A</b>	D-CAP+	3 to 28	1	3	90	300 kHz to 1 MHz	VR 12.5	Haswell/Broadwell/Broadwell-DE	Client/Tablet	4x4-mm 32 QFN	1.65
<b>TPS51622A</b>	D-CAP+	4.5 to 28	1	2	40	300 kHz to 1 MHz	VR 12.6	Haswell/Broadwell-U/Y	Client/Tablet	4x4-mm 32 QFN	1.60
<b>TPS51624</b>	D-CAP+	4.5 to 28	1	2	40	300 kHz to 1.5 MHz	VR 12.6	—	Client/Tablet	4x4-mm 32 QFN	1.65
<b>TPS51678</b>	D-CAP+, I <sup>2</sup> C	4.5 to 28	1	2	40	300 kHz to 1.5 MHz	VR 12.6	Broadwell-Y	Client/Tablet	4x4-mm 32 QFN	1.85
<b>TPS51633</b>	D-CAP+	4.5 to 28	1	3	90	300 kHz to 1 MHz	VR 12.6	Broadwell-H	Client	4x4-mm 32 QFN	1.85
<b>TPS51623</b>	D-CAP+	4.5 to 28	1	2	60	300 kHz to 1 MHz	VR 12.1	Braswell-M/D/I	Client	4x4-mm 32 QFN	1.20
<b>TPS53640</b>	D-CAP+, PMBus™	4.5 to 17	1	3	120	300 kHz to 1 MHz	VR 12.5	Broadwell – EN/EP	Server	5x5-mm 40 QFN	2.80
<b>TPS53640A</b>	D-CAP+, PMBus	4.5 to 17	1	4	160	300 kHz to 1 MHz	VR 12.5	Broadwell – EN/EP	Server	5x5-mm 40 QFN	3.10
<b>TPS53631</b>	D-CAP+, PMBus	4.5 to 17	1	3	120	300 kHz to 1 MHz	VR 12.5	Broadwell – EN/EP	Server	5x5-mm 40 QFN	2.80
<b>TPS53641</b>	D-CAP+, PMBus	4.5 to 17	1	4	160	300 kHz to 1 MHz	VR 12.5	Broadwell – EN/EP	Server	5x5-mm 40 QFN	3.30
<b>TPS53661</b>	D-CAP+, PMBus	4.5 to 17	1	6	240	300 kHz to 1 MHz	VR 12.5	Broadwell – EN/EP	Server	5x5-mm 40 QFN	3.80

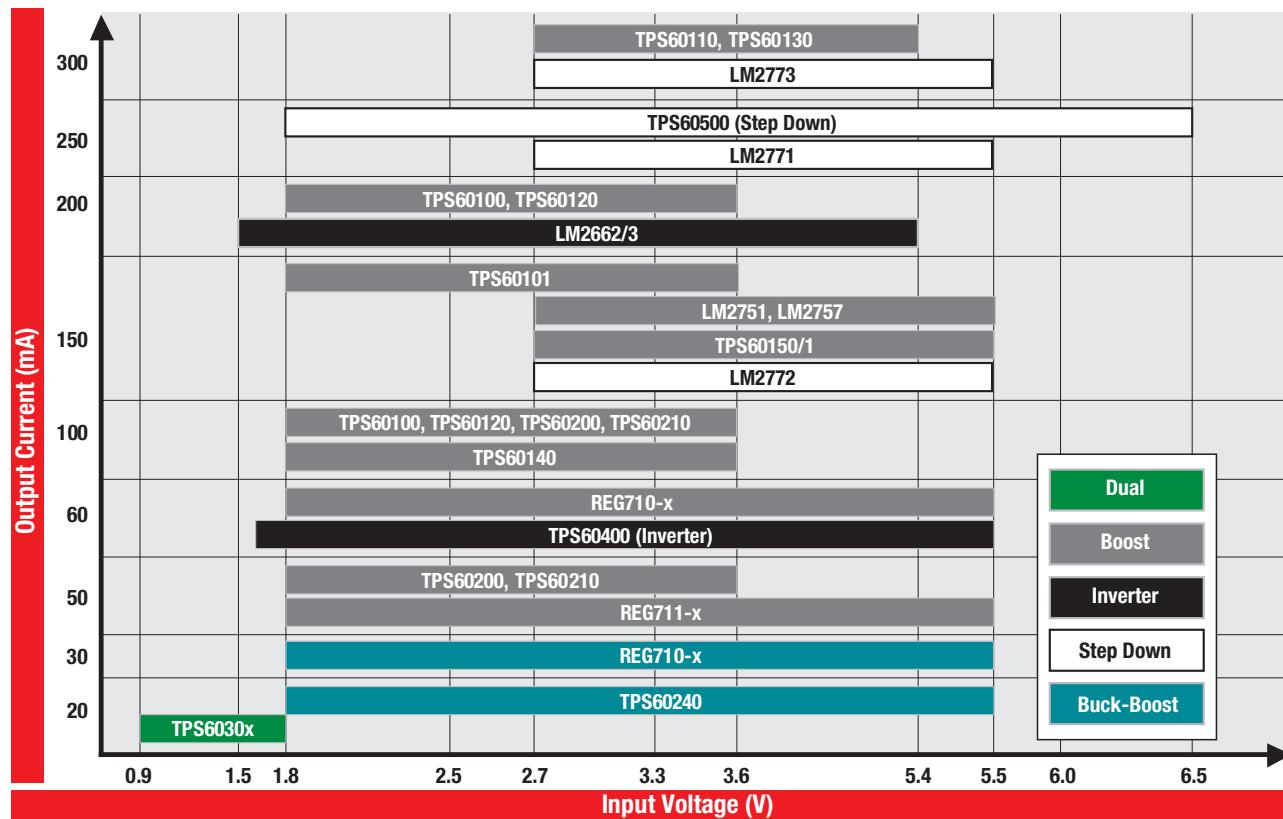
\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**.

# DC/DC Switching Regulators

## Charge Pumps

### Inductorless DC/DC Regulators (Charge Pumps) Family of Products



### Selection Guide

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	V <sub>OUT</sub> Fixed (V)	Efficiency (%)	Switching Frequency (max) (kHz)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Features						Package(s)	EVM	Automotive	Price*
									Shutdown	Low Battery	Power Good	Undervoltage Lockout	Current Limit	Thermal Limit				
<b>Step-Down (Buck) Regulators</b>																		
LM2772	150	2.7 to 5.5	—	1.2	—	1100	45	—	✓						QFN-10	✓		0.75
TPS60500	250	1.8 to 6.5	0.8 to 3.3	1.5, 1.8, 3.3	90	1200	40	0.05	✓	✓	✓	✓	✓	✓	MSOP-10	✓		0.55
LM2771	250	2.7 to 5.5	—	1.5	—	1100	45	—	✓						QFN-10			0.85
LM2773	300	2.5 to 5.5	1.6 to 1.8	—	—	1150	48	—	✓						micro SMD-9	✓		0.90
<b>Boost Regulators</b>																		
LM2751	150	2.8 to 5.5	—	4.5, 5	90	725	425	0.77	✓				✓	✓	WSON-10			0.74
LM2757	180	2.7 to 5.5	—	4.1, 4.5, 5	93	1240	2400	1.1	✓				✓	✓	DSBGA-12			1.55
LM2660	100	2.5 to 5.5	—	2V <sub>IN</sub>	88	10, 80	120	—							SO-8			0.50
LM2662/3	200	2.5 to 5.5	—	2V <sub>IN</sub>	86	20, 150	300	10	LM2663						SO-8			0.75
TL7660	20	1.5 to 10	—	< 2V <sub>IN</sub>	99	10.35	80	—							SOT-23, MSOP-8			0.80
TPS60202	50	1.8 to 3.6	—	3.3	90	400	35	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓			MSOP-10	✓		0.65
TPS60212	50	1.8 to 3.6	—	3.3	90	400	35	2	Snooze	✓ <sup>1</sup>	✓ <sup>1</sup>	✓			MSOP-10			0.65
TPS60101	100	1.8 to 3.6	—	3.3	90	400	50	0.05	✓				✓	✓	TSSOP-20			0.65
TPS60120	100, 200 <sup>1</sup>	1.8 to 3.6	—	3.0, 3.3 <sup>1</sup>	85	450	55	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓	✓	TSSOP-20			0.80
TPS60140	100	1.8 to 3.6	—	5.0	70	450	65	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓	✓	TSSOP-20	✓		0.65
TPS60200	100	1.8 to 3.6	—	3.3	90	400	35	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓			MSOP-10	✓		0.65
TPS60210	100	1.8 to 3.6	—	3.3	90	400	35	2	Snooze	✓ <sup>1</sup>	✓ <sup>1</sup>	✓			MSOP-10	✓		0.65
TPS60150	140	2.7 to 5.5	—	5.0	90	1500	4.7	1	✓					✓	QFN-6	✓		0.50

<sup>1</sup>Device parameter, feature and/or price may vary with each device number in family.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# DC/DC Switching Regulators

## Charge Pumps

### Selection Guide (Continued)

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	V <sub>OUT</sub> Fixed (V)	Efficiency (%)	Switching Frequency (max) (kHz)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Features						Package(s)	EVM	Automotive	Price*
									Shutdown	Low Battery	Power Good	Undervoltage Lockout	Current Limit	Thermal Limit				
<b>Boost Regulators (Continued)</b>																		
TPS60111	150	2.7 to 5.4	—	5.0	90	300	60	0.05	✓		✓	✓			TSSOP-20			0.70
TPS60130	300 <sup>1</sup>	2.7 to 5.4	—	5.0	90	450	60	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓			TSSOP-20			0.80
TPS60100	200	1.8 to 3.6	—	3.3	90	400	50	0.05	✓			✓	✓		TSSOP-20	✓		0.80
TPS60110	300	2.7 to 5.4	—	5.0	90	400	60	0.05	✓			✓	✓		TSSOP-20	✓		0.80
<b>Dual-Output Regulators</b>																		
TPS60300	20, 40	0.9 to 1.8	—	3.3, 2 V <sub>IN</sub> <sup>1</sup>	90	900	35	1	✓		✓	✓			MSOP-10	✓		0.70
TPS60310	20, 40	0.9 to 1.8	—	3.3, 2 V <sub>IN</sub> <sup>1</sup>	90	900	35	2	Snooze		✓	✓			MSOP-10			0.65
<b>Buck-Boost Regulators</b>																		
REG710	30	1.8 to 5.5	—	2.5 to 5.0	90	1000	65	0.01	✓			✓	✓		SOT-23			0.45
REG71050	60	2.7 to 5.5	—	5.0	90	1000	65	0.01	✓			✓	✓		TSOT-23, TQFN-6	✓		0.50
REG711	50	1.8 to 5.5	—	2.5 to 5.0	90	1000	60	0.01	✓			✓	✓		MSOP-8			0.48
TPS60240	25	1.8 to 5.5	—	3.3	90	160	250	0.1	✓			✓	✓		MSOP-8			0.55
<b>Inverting Regulators</b>																		
LM2660	100	2.5 to 5.5	—	2 V <sub>IN</sub>	88	10, 80	120	—							SO-8			0.50
LM2662/3	200	2.5 to 5.5	—	2 V <sub>IN</sub>	86	20, 150	300	10	LM2663						SO-8			0.75
TPS60400	60	1.6 to 5.5	-16.6 to -5.25	—	99	50 to 250	125	—							SOT-23	✓	✓	0.36
TPS60401	60	1.6 to 5.5	-16.6 to -5.25	—	99	20	65	—							SOT-23		✓	0.36
TPS60402	60	1.6 to 5.5	-16.6 to -5.25	—	99	50	120	—							SOT-23		✓	0.36
TPS60403	60	1.6 to 5.5	-16.6 to -5.25	—	99	250	425	—							SOT-23		✓	0.36

<sup>1</sup>Device parameter, feature and/or price may vary with each device number in family.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# RF Power Solutions

## Overview

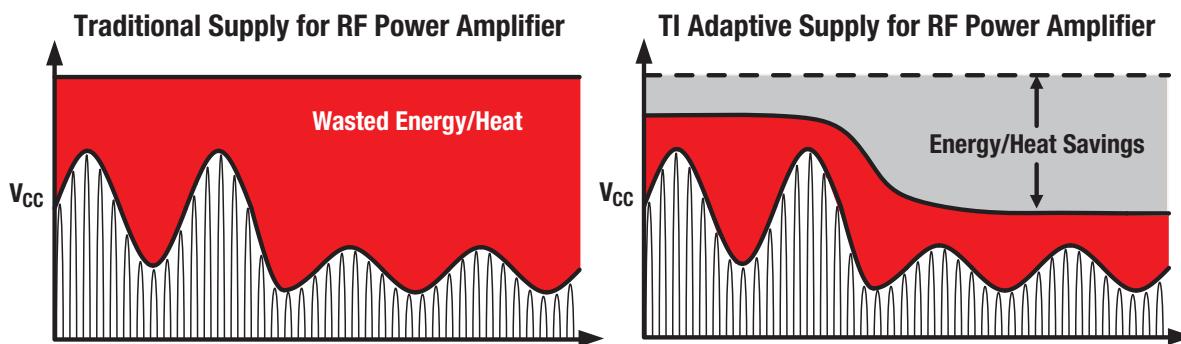
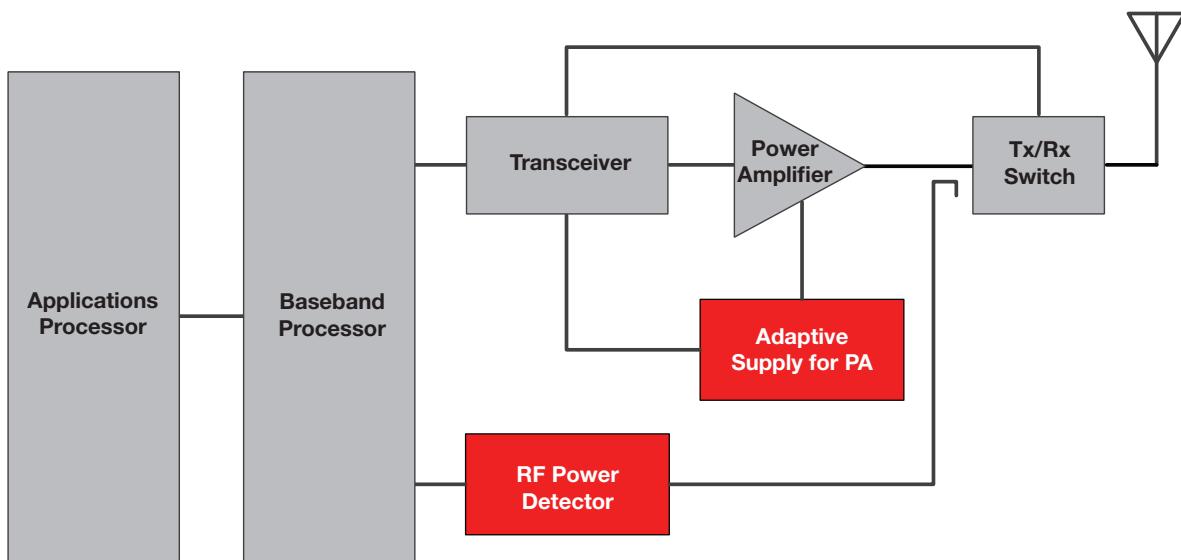
### RF Front End Power Solutions for 2G, 3G and 4G Portable Devices

Operation of the radio circuitry in a portable device accounts for a significant amount of the total power consumption—leading to less battery life and more heat. Traditionally, the RF power amplifier (PA), which is used to drive the antenna, is connected directly to the battery. However, this approach wastes a significant amount of energy as the

PA is supplied with maximum power when often only a fraction is required to reliably ensure wireless voice and data connection. TI's portfolio of RF power management products delivers energy and heat saving solutions that enable higher performing RFFE systems. Supply for Power Amplifier products are dynamically adjustable power supplies for RF power amplifiers that optimize power usage—especially when maximum PA power is not needed—to extend battery

life and reduce heat dissipation. TI's family of RF detectors provides transmit power control so that only the necessary amount of power is used, saving power and increasing transmission range. These RF detectors feature high linearity and accuracy over temperature to reduce PA power guard-band requirements for more coverage range, battery power savings, and increased channel quality.

Get more information: [www.ti.com/rfpower](http://www.ti.com/rfpower)



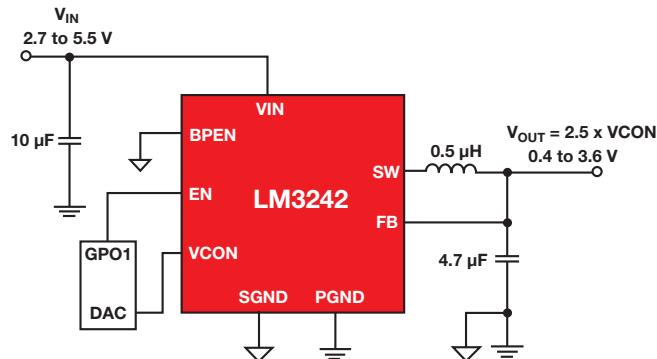
*RF power solutions from TI enable efficient RF front-end designs.*

# RF Power Solutions

## RF DC/DC Converters

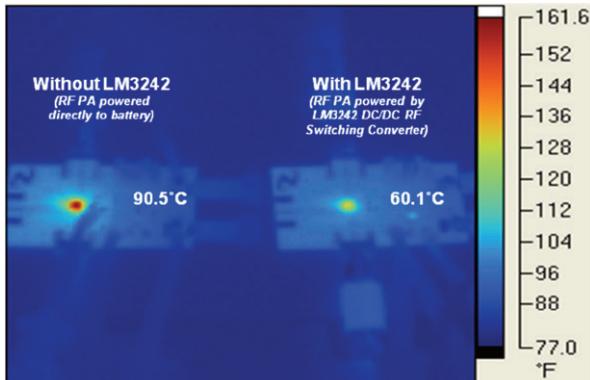
### 6-MHz, 750-mA Miniature, Adjustable, Step-Down Converter for 3G/4G RF Power Amplifiers LM3242

TI's Supply for Power Amplifier products are dynamic power supplies for RF power amplifiers. Converters like the LM3242 enable active adjustment of the power delivered to the RF power amplifier in order to optimize the power usage—especially when maximum power is not required—to drastically increase efficiency. These energy savings extend battery life for more talk and data usage time and reduce heat dissipation by up to 30°C for a more reliable, easier-to-design system.



LM3242 application circuit with just three tiny surface-mount components.

#### Thermal Imaging—RF Power Amplifier

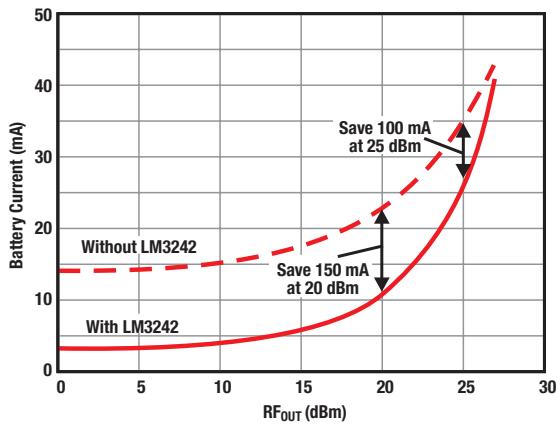


LM3242 reduces PA heat by 30°C at maximum RF power (28 dBm).

#### Key Features

- Operates from a single Li-Ion cell (2.7 to 5.5 V)
- Adjustable output voltage (0.4 to 3.6 V) maximizes RF PA power savings
- 750-mA maximum load capability (up to 1 A in bypass) increases performance reliability during transients
- 6-MHz (typ) PWM switching frequency minimizes inductor footprint
- Automatic ECO/PWM/BP mode change for optimal operation during all load requirements and battery conditions
- Current and thermal overload protection
- Small solution size

Get more information:  
[www.ti.com/product/LM3242](http://www.ti.com/product/LM3242)



LM3242 extends battery life with dramatically reduced current consumption.

### RF DC/DC Switching Converters with Adjustable Output Power for RF Power Amplifiers

Device	Topology	V <sub>IN</sub> (V)	V <sub>OUT</sub> (V)	I <sub>OUT</sub> (max) (mA)	Bypass Modes	Soft Start	Switching Frequency (MHz)	Package(s)	Description/Features	Price*
LM3209-G3	Buck-boost	2.7 to 5.5	0.6 to 4.2	1000	None	No	2.4	12-bump micro SMD		0.90
LM3269	Buck-boost	2.7 to 5.5	0.6 to 3.8	1000	None	No	2.4	12-bump micro SMD		0.75
LM3212	Buck	2.7 to 5.5	0.5 to 3.4	2500	Forced and active	No	1.6	16-bump micro SMD		1.10
TPS62730	Buck	1.9 to 3.9	1.9/2.1/2.3	100	Active	Yes	3	SON	BLE, RF4CE, status pin	0.65
TPS62740	Buck	2.2 to 5.5	1.3 to 3.3	300	None	Yes	3	2x3-mm WSON	Load switch, 4-pin V <sub>select</sub>	1.15
LM3241	Buck	2.7 to 5.5	0.6 to 3.4	750	None	Yes	6	6-bump micro SMD		0.40
LM3242	Buck	2.7 to 5.5	0.4 to 3.6	750	Forced and auto	Yes	6	9-bump micro SMD		0.37
LM3262	Buck	2.5 to 5.5	0.4 to 3.6	800	Forced and auto	Yes	6	9-bump micro SMD		0.40
LM3243	Buck	2.7 to 5.5	0.4 to 3.6	2500	Forced and active	No	2.7	16-bump micro SMD		0.45
LM3263	Buck	2.7 to 5.5	0.4 to 3.6	2500	Forced and active	No	2.7	16-bump micro SMD		0.48
LM3290/91	Envelope tracking power supply	2.7 to 5.0	0.6 to 4.5	1300	None	No	2.7	30-bump/12-bump micro SMD		0.80/0.70
LM3248	Boost-buck	2.7 to 5.5	0.4 to 4.0	2500	None	No	2.7	30-bump micro SMD		0.85
LM3279	Buck-boost	2.7 to 5.5	0.4 to 4.2	1000	None	No	2.5	16-bump micro SMD		0.75

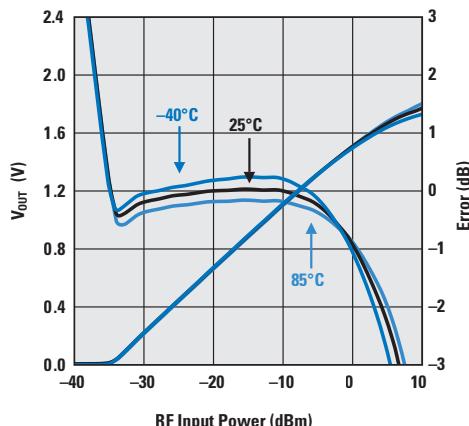
\*Suggested resale price in U.S. dollars in quantities of 1,000.

# RF Power Solutions

## RF Power Detectors

### 8-GHz LOG/LIN RMS RF Power Detector

**LMH2110, LMH2120**



#### Key Features

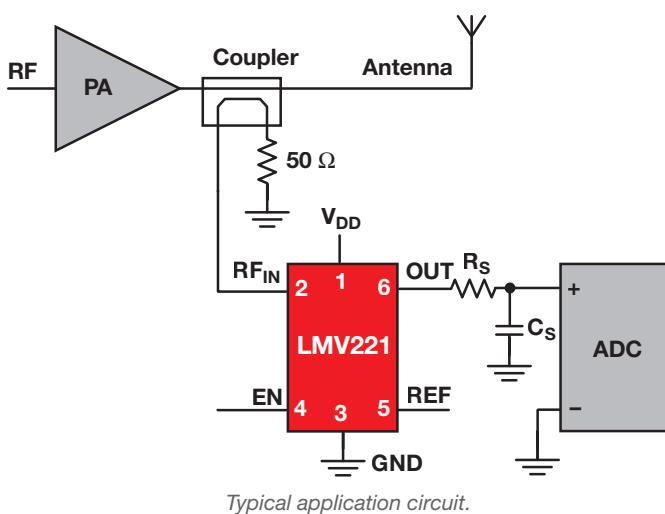
- LMH2110: 40-dB linear-in-dB power detection range
- LMH2120: 40-dB linear-in-V power detection range
- > 30-dB dynamic range, 1900 MHz,  $n = 50$ 
  - $\pm 0.3$ -dB log conformance error
  - $\pm 0.3$ -dB variation over temperature
  - 0.05-dB (typ) output variation due to modulation, WCDMA

- Shutdown pin
- Multi-band operation from 50 MHz up to 8 GHz
- Available in micro SMD-6 packaging (0.84 x 1.24 mm)

Get more information: [www.ti.com/product/LMH2110](http://www.ti.com/product/LMH2110) or [LMH2120](http://www.ti.com/product/LMH2120)

### 50-MHz to 4-GHz 40-dB Logarithmic Power Detector for CDMA and WCDMA

**LMV221, LMH2100**



#### Key Features

- 40-dB linear-in-dB power detection range
- 0.3-V to 2-V output voltage range
- Shutdown pin
- Multi-band operation from 50 MHz to 3.5 GHz
- 0.5-dB accurate temperature compensation
- External configurable output filter bandwidth
- Available in LLP-6 packaging, 2.2 x 2.5 x 0.8 mm (LMV221)
- Available in micro SMD-6 packaging, 0.85 x 1.25 x 0.6 mm (LMH2100)

Get more information: [www.ti.com/product/LMV221](http://www.ti.com/product/LMV221) or [LMH2100](http://www.ti.com/product/LMH2100)

## RF Power Detectors

Device	Application	Channels	Supply Voltage Range (V)	Dynamic Range (dB)	Frequency Range (MHz)	Type	Package(s)	EVM	Price*
LMV221	CDMA, WCDMA, GSM, GPRS	1	2.7 to 3.3	40	50 to 3500	LOG Amp	LLP-6	✓	0.90
LMV225	CDMA, WCDMA, GSM, EDGE, GPRS, TDMA	1	2.7 to 5.5	>30	450 to 2000	LOG Amp	micro SMD-4, LLP-6	✓	0.32
LMV226	CDMA, WCDMA, GSM, EDGE, GPRS, TDMA	1	2.7 to 5.5	>30	450 to 2000	LOG Amp	micro SMD-4	✓	0.42
LMV228	CDMA, WCDMA, GSM, EDGE, GPRS, TDMA	1	2.7 to 5.5	>30	450 to 2000	LOG Amp	micro SMD-4	✓	0.36
LMV232	3G, UMTS, WCDMA, CDMA2000, LAN, GPS	2	2.5 to 3.3	20	50 to 2000	LIN MS Amp	micro SMD-8	✓	0.85
LMV242	GSM, GPRS, TDMA, LAN	2	2.6 to 5.5	50	450 to 2000	LOG Amp	LLP-10	✓	0.55
LMH2100	CDMA, WCDMA, GSM, GPRS	1	2.7 to 3.3	40	50 to 4000	LOG Amp	micro SMD-6	✓	0.95
LMH2110	LTE, UMTS, WCDMA, CDMA2000, GSM/EDGE	1	2.7 to 5	45	50 to 8000	LOG RMS	micro SMD-6	✓	0.80
LMH2120	LTE, UMTS, WCDMA, CDMA2000, GSM/EDGE	1	2.7 to 5	40	50 to 6000	LIN RMS	micro SMD-6	✓	0.80
LMH2121	LTE, UMTS, WCDMA	1	2.7 to 5	40	100 to 3000	Fast LIN Amp	micro SMD-4		0.60

\*Suggested resale price in U.S. dollars in quantities of 1,000.

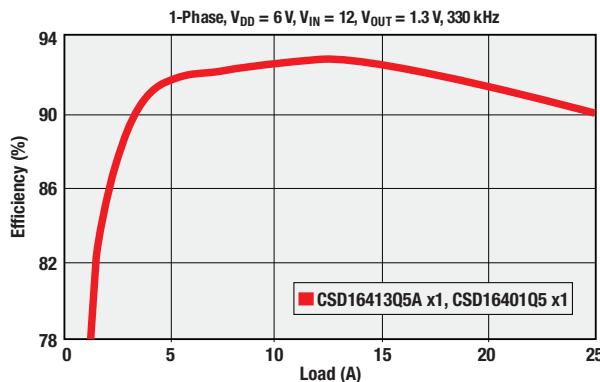
# NexFET™ Power MOSFETs

TI's premier power management innovation called NexFET™ technology combines vertical current flow with a lateral power MOSFET. It provides a low on resistance and requires an extremely low gate charge with industry-standard package outlines—a combination not previously possible with existing silicon platforms.

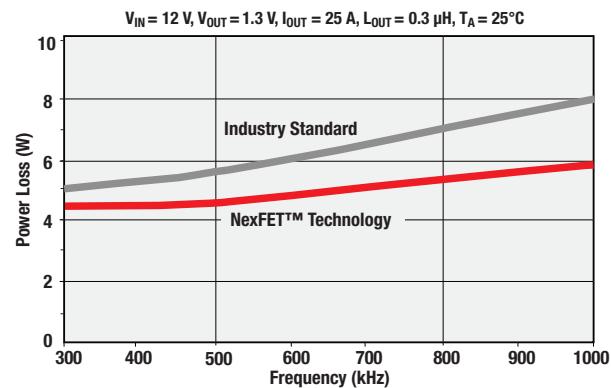
NexFET technology delivers high performance for both N- and P-channel power MOSFET devices. Designers are able to achieve 90% power supply efficiencies from light to full loads with high output currents and low duty cycles, representing a breakthrough in discrete designs.

	<b>NexFET™ Technology</b>	<b>Industry Standard</b>
<b>Control FET</b>	$R_{DS(on)} = 5.8 \text{ m}\Omega$	$R_{DS(on)} = 6.6 \text{ m}\Omega$
	$Q_G = 6.5 \text{ nC}$	$Q_G = 12.3 \text{ nC}$
<b>Sync FET</b>	$R_{DS(on)} = 2.5 \text{ m}\Omega$	$R_{DS(on)} = 2.3 \text{ m}\Omega$
	$Q_G = 13.2 \text{ nC}$	$Q_G = 39.8 \text{ nC}$

## 90% Efficiency from Light to Full Load

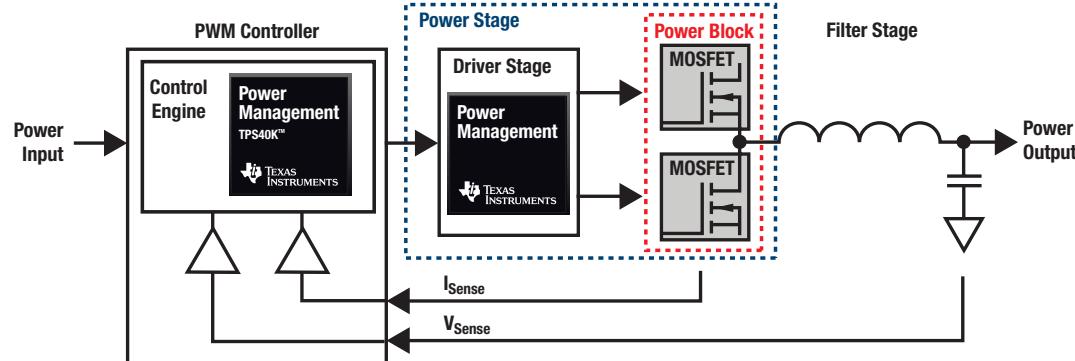


## Same Power Loss, Double the Frequency



## System Block Diagram of TI Electronics in a Power System Design

### NexFET™ Technology



# NexFET™ Power MOSFETs

## N-Channel MOSFETs Selection Guide

Device	V <sub>DS</sub> (V)	V <sub>GS</sub> (V)	Typical V <sub>GS(th)</sub> (V)	Maximum R <sub>DS(on)</sub> (mΩ)			I <sub>D</sub> , Package Limited (A)	I <sub>D</sub> , Silicon Limited at T <sub>C</sub> = 25°C (A)	I <sub>DM</sub> (max), Pulsed Drain Current (A)	Typical Q <sub>G</sub> (nC)	Typical Q <sub>GS</sub> (nC)	Typical Q <sub>GD</sub> (nC)	Price*										
				at 10 V	at 4.5 V	at 2.5 V																	
<b>WLP 1x1</b>																							
<b>Single</b>																							
CSD13201W10	12	8	0.8	—	34	39	1.6	—	20.2	2.3	0.5	0.3	0.20										
<b>WLP 1x1.5</b>																							
<b>Single</b>																							
CSD13303W1015	12	8	0.85	—	20	23	3.5	—	31	3.9	1	0.4	0.25										
<b>WLP 1.7x2.3</b>																							
<b>Dual Common Source</b>																							
CSD86311W1723	25	10	1	—	42	51	4.5	—	4.5	3.1	0.85	0.33	0.43										
<b>LGA 1x0.6</b>																							
<b>Single</b>																							
CSD13381F4	12	8	0.85	—	180	225	2.1	—	7	1.06	0.23	0.14	0.06										
<b>CSD13383F4</b>	12	8	1	—	44	65	2.9	—	27	2	0.4	0.6	0.10										
CSD17381F4	30	12	0.85	—	117	143	3.1	—	10	1.04	0.226	0.133	0.10										
CSD17483F4	30	12	0.85	—	260	310	1.5	—	5	1.01	0.22	0.13	0.06										
<b>LGA 2.2x1.15</b>																							
<b>Dual Common Drain</b>																							
<b>CSD83325L</b>	12	10	0.95	—	11.9	23	8	—	52	8.4	2.2	1.9	0.19										
<b>LGA 3.37x1.47</b>																							
<b>Common Drain Configuration</b>																							
<b>CSD87501L</b>	30	20	1.8	—	11	—	14	—	72	31	5	6	0.32										
<b>S0-8</b>																							
<b>Dual</b>																							
CSD88537ND	60	20	2	15	—	—	15	16	108	14	4.6	2.3	0.25										
CSD88539ND	60	20	2	28	—	—	15	11.7	46	7.2	2.7	1.1	0.19										
<b>SON 2x2</b>																							
<b>Single</b>																							
CSD13202Q2	12	8	0.8	—	9.3	11.6	22	—	76	5.1	0.98	0.76	0.15										
CSD15571Q2	20	20	1.45	15	19.2	—	22	—	52	2.5	0.93	0.66	0.14										
CSD16301Q2	25	10	1.1	—	29	—	5	5	20	2	0.6	0.4	0.15										
CSD17313Q2	30	10	1.3	—	32	—	5	5	20	2.1	0.7	0.4	0.15										
CSD17313Q2Q1	30	10	1.3	30	32	—	5	5	20	2.1	0.7	0.4	0.18										
CSD17571Q2	30	20	1.6	24	29	—	22	—	39	2.4	0.9	0.6	0.14										
<b>Dual</b>																							
<b>CSD85301Q2</b>	20	10	0.9	—	27	39	5	—	26	4.2	1.1	1	0.25										
<b>SON 3x3</b>																							
<b>Single</b>																							
CSD16323Q3	25	10	1.1	—	5.5	—	60	—	112	6.2	1.8	1.1	0.39										
CSD16327Q3	25	—	1.2	—	4.8	—	60	—	112	6.2	1.8	1.1	0.39										
CSD16340Q3	25	10	0.85	—	5.5	—	60	—	115	6.5	2.1	1.2	0.39										
CSD16406Q3	25	16	1.7	5.3	7.4	—	60	—	114	5.8	2.5	1.5	0.39										
CSD16409Q3	25	16	2	8.2	12.4	—	60	—	90	4	2.1	1	0.33										
CSD16411Q3	25	16	2	10	15	—	56	—	138	2.9	1.5	0.7	0.30										
CSD17304Q3	30	10	1.3	—	8.8	—	56	—	88	5.1	1.8	1.1	0.32										
CSD17308Q3	30	10	1.3	—	11.8	—	47	—	78	3.9	1.3	0.8	0.30										
CSD17309Q3	30	10	1.2	—	6.3	—	60	—	112	7.5	2.5	1.7	0.39										
CSD17551Q3A	30	20	1.6	9	11.8	—	48	48	71	6	2.3	1.5	0.17										
CSD17552Q3A	30	20	1.5	6	8.1	—	60	74	84	9	3.6	2.3	0.20										
<b>CSD17577Q3A</b>	30	20	1.4	4.8	6.4	—	35	83	239	13	4.1	2.8	0.25										
<b>CSD17578Q3A</b>	30	20	1.5	7.3	9.4	—	20	54	142	7.9	3.3	1.7	0.22										
<b>CSD17579Q3A</b>	30	20	1.5	10.2	14.2	—	20	39	106	5.3	2.2	1.2	0.20										
<b>Dual Common Source</b>																							
<b>CSD85312Q3E</b>	20	10	1.1	—	14	—	39	—	76	11.7	3.5	1.6	0.46										
<b>CSD87312Q3E</b>	30	10	1	—	38	—	39	—	45	6.3	1.9	0.7	0.35										

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**.

# NexFET™ Power MOSFETs

## N-Channel MOSFETs Selection Guide (Continued)

Device	V <sub>DS</sub> (V)	V <sub>GS</sub> (V)	Typical V <sub>GS(th)</sub> (V)	Maximum R <sub>DS(on)</sub> (mΩ)			I <sub>D</sub> , Package Limited (A)	I <sub>D</sub> , Silicon Limited at T <sub>C</sub> = 25°C (A)	I <sub>PM</sub> (max), Pulsed Drain Current (A)	Typical Q <sub>G</sub> (nC)	Typical Q <sub>GS</sub> (nC)	Typical Q <sub>GD</sub> (nC)	Price*										
				at 10 V	at 4.5 V	at 2.5 V																	
<b>DualCool™ SON 3x3</b>																							
<b>Single</b>																							
<b>CSD16323Q3C</b>	25	10	1.1	—	5.5	—	60	—	112	6.2	1.8	1.1	0.43										
<b>SON 5x6</b>																							
<b>Single</b>																							
<b>CSD16321Q5</b>	25	10	1.1	—	2.6	—	100	—	200	14	4	2.5	0.65										
<b>CSD16322Q5</b>	25	10	1.1	—	5.8	—	100	—	136	6.8	2.4	1.3	0.41										
<b>CSD16325Q5</b>	25	10	1.1	—	2.2	—	100	—	200	18	6.6	3.5	0.95										
<b>CSD16342Q5A</b>	25	10	—	—	5.5	—	100	—	131	6.5	2.1	1.2	0.42										
<b>CSD16401Q5</b>	25	16	1.5	1.6	2.3	—	100	—	240	21	8.3	5.2	0.95										
<b>CSD16403Q5A</b>	25	16	1.6	2.8	3.7	—	100	—	184	13.3	5.5	3.5	0.60										
<b>CSD16404Q5A</b>	25	16	1.8	5.1	7.2	—	81	—	135	6.5	3	1.7	0.39										
<b>CSD16407Q5</b>	25	16	1.6	2.4	3.3	—	100	—	200	13.3	5.3	3.5	0.65										
<b>CSD16408Q5</b>	25	16	1.8	4.5	6.8	—	100	—	141	6.7	3.1	1.9	0.45										
<b>CSD16410Q5A</b>	25	16	1.9	8.5	12	—	59	—	158	3.9	1.8	1.1	0.32										
<b>CSD16412Q5A</b>	25	16	2	11	16	—	52	—	91	2.9	1.4	0.7	0.30										
<b>CSD16413Q5A</b>	25	16	1.6	3.9	5.6	—	100	—	156	9	3.5	2.5	0.44										
<b>CSD16414Q5</b>	25	16	1.6	1.9	2.6	—	100	—	213	16.6	7.3	4.4	0.75										
<b>CSD16415Q5</b>	25	16	1.5	1.15	1.8	—	100	—	200	21	8.3	5.2	1.05										
<b>CSD16556Q5B</b>	25	20	1.4	1.07	1.5	—	100	263	400	37	12	13	1.00										
<b>CSD16570Q5B</b>	25	20	1.5	0.59	0.82	—	100	456	400	95	29	31	1.08										
<b>CSD17301Q5A</b>	30	10	1.1	—	3	—	100	—	181	19	5.7	4.3	0.60										
<b>CSD17302Q5A</b>	30	10	1.2	—	9	—	87	—	104	5.4	1.7	1.2	0.32										
<b>CSD17303Q5</b>	30	10	1.1	—	2.6	—	100	—	200	18	5.6	4	0.65										
<b>CSD17305Q5A</b>	30	10	1.1	—	2.8	—	100	—	200	14.1	4.5	3	0.49										
<b>CSD17306Q5A</b>	30	10	1.1	—	4.2	—	100	—	181	11.8	3.5	2.4	0.44										
<b>CSD17307Q5A</b>	30	10	1.3	—	12.1	—	73	—	92	4	1.3	1	0.30										
<b>CSD17310Q5A</b>	30	10	1.3	—	5.9	—	100	—	134	8.9	2.7	2.1	0.39										
<b>CSD17311Q5</b>	30	10	1.2	—	2.3	—	100	—	200	24	6.3	5.2	0.75										
<b>CSD17312Q5</b>	30	10	1.1	—	1.7	—	100	—	200	28	8.4	6	0.95										
<b>CSD17322Q5A</b>	30	10	1.6	—	12.4	—	87	—	104	3.6	1.6	1.1	0.32										
<b>CSD17327Q5A</b>	30	10	1.6	—	15.5	—	65	—	85	2.8	1.2	0.8	0.30										
<b>CSD17501Q5A</b>	30	20	1.3	2.9	3.7	—	100	—	187	13.2	5.4	3.5	0.60										
<b>CSD17505Q5A</b>	30	20	1.3	3.5	4.6	—	100	—	153	10	3.5	2.7	0.49										
<b>CSD17506Q5A</b>	30	20	1.3	4	5.3	—	100	—	150	8.3	3.1	2.3	0.44										
<b>CSD17507Q5A</b>	30	20	1.6	10.8	16.1	—	65	—	85	2.8	1.3	0.7	0.30										
<b>CSD17510Q5A</b>	30	20	1.5	5.2	7.3	—	55	—	129	6.4	2.7	1.9	0.39										
<b>CSD17522Q5A</b>	30	20	1.6	8.1	12.4	—	87	—	104	3.6	1.6	1.1	0.32										
<b>CSD17527Q5A</b>	30	20	1.6	10.8	15.5	—	65	—	85	2.8	1.2	0.8	0.30										
<b>CSD17551Q5A</b>	30	20	1.7	8.8	11	—	48	—	85	6	2.8	1.4	0.28										
<b>CSD17552Q5A</b>	30	20	1.5	6.2	7.5	—	60	88	106	9	3.6	2	0.33										
<b>CSD17553Q5A</b>	30	20	1.5	2.7	3.5	—	100	—	151	17.5	5.8	4.7	0.48										
<b>CSD17555Q5A</b>	30	20	1.5	2.7	3.4	—	100	116	153	23	7.5	5	0.58										
<b>CSD17556Q5B</b>	30	20	1.4	1.4	1.8	—	100	215	400	28.5	10.7	6.9	1.03										
<b>CSD17559Q5</b>	30	20	1.4	1.15	1.5	—	40	—	400	39	14.4	9.3	1.12										
<b>CSD17570Q5B</b>	30	20	1.5	0.69	0.92	—	100	407	400	93	27	34	1.08										
<b>CSD17573Q5B</b>	30	20	1.4	1	1.45	—	100	332	400	49	17.1	11.9	0.67										
<b>CSD17576Q5B</b>	30	20	1.4	2	2.9	—	100	184	400	25	8.9	5.4	0.49										
<b>CSD17577Q5A</b>	30	20	1.4	4.2	5.8	—	60	83	280	13	5.1	2.8	0.27										
<b>CSD18501Q5A</b>	40	20	1.8	3.2	4.3	—	100	161	400	42	8.1	5.9	0.80										
<b>CSD18502Q5B</b>	40	20	1.8	2.3	3.3	—	100	211	400	52	10.3	8.4	1.01										
<b>CSD18503Q5A</b>	40	20	1.8	4.3	6.2	—	100	120	400	27	4.5	4.3	0.65										
<b>CSD18504Q5A</b>	40	20	1.9	6.6	9.8	—	50	75	275	16	3.2	2.4	0.50										
<b>CSD18509Q5B</b>	40	20	1.8	1.2	1.7	—	100	299	400	150	29	17	1.09										
<b>CSD18531Q5A</b>	60	20	1.8	4.6	5.8	—	100	134	370	36	6.9	5.9	0.80										

\*Suggested resale price in U.S. dollars in quantities of 1,000.

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# NexFET™ Power MOSFETs

## N-Channel MOSFETs Selection Guide (Continued)

Device	V <sub>DS</sub> (V)	V <sub>GS</sub> (V)	Typical V <sub>GS(th)</sub> (V)	Maximum R <sub>DS(on)</sub> (mΩ)			I <sub>D</sub> , Package Limited (A)	I <sub>D</sub> , Silicon Limited at T <sub>C</sub> = 25°C (A)	I <sub>PM</sub> (max), Pulsed Drain Current (A)	Typical Q <sub>G</sub> (nC)	Typical Q <sub>GS</sub> (nC)	Typical Q <sub>GD</sub> (nC)	Price*										
				at 10 V	at 4.5 V	at 2.5 V																	
<b>SON 5x6 (Continued)</b>																							
<b>Single (Continued)</b>																							
<b>CSD18532NQ5B</b>	60	20	2.8	3.4	—	—	100	163	400	49	16	7.9	1.01										
<b>CSD18532Q5B</b>	60	20	1.8	3.2	4.3	—	100	172	400	44	10	6.9	1.01										
<b>CSD18533Q5A</b>	60	20	1.9	5.9	8.5	—	100	103	267	29	6.6	5.4	0.63										
<b>CSD18534Q5A</b>	60	20	1.9	9.8	12.4	—	50	69	229	17	3.2	3.5	0.50										
<b>CSD18537NQ5A</b>	60	20	3	13	—	—	50	54	154	14	4.7	2.3	0.41										
<b>CSD18540Q5B</b>	60	20	1.9	2.2	3.3	—	100	221	400	41	8.8	6.7	1.09										
<b>CSD18563Q5A</b>	60	20	2	10.8	6.8	—	100	93	251	15	3.3	2.9	0.60										
<b>CSD19502Q5B</b>	80	20	2.7	4.1	—	—	100	157	400	48	14	8.6	1.02										
<b>CSD19531Q5A</b>	100	20	2.7	6.4	—	—	100	110	337	37	10.5	6.6	0.90										
<b>CSD19532Q5B</b>	100	20	2.6	4.9	—	—	100	140	400	48	13	8.7	1.22										
<b>CSD19533Q5A</b>	100	20	2.8	9.4	—	—	100	75	231	27	7.9	4.9	0.76										
<b>CSD19534Q5A</b>	100	20	2.8	14.1	—	—	50	44	137	17	5.1	3.2	0.60										
<b>DualCool™ SON 5x6</b>																							
<b>Single</b>																							
<b>CSD16321Q5C</b>	25	10	1.1	—	2.6	—	100	69	81	14	4	2.5	0.75										
<b>CSD16322Q5C</b>	25	10	1.1	—	5.8	—	97	54	91	6.8	2.4	1.3	0.45										
<b>CSD16325Q5C</b>	25	10	1.1	—	2.2	—	100	62	72	18	6.6	3.5	1.05										
<b>CSD16407Q5C</b>	25	16	1.6	2.4	3.3	—	100	91	96	13.3	5.3	3.5	0.75										
<b>CSD16408Q5C</b>	25	16	1.8	4.5	6.8	—	113	—	—	6.7	3.1	1.9	0.49										
<b>TO-220</b>																							
<b>Single</b>																							
<b>CSD18502KCS</b>	40	20	1.8	2.9	4.3	—	100	212	400	52	10.3	8.4	0.97										
<b>CSD18503KCS</b>	40	20	1.9	4.5	6.8	—	100	141	357	30	7.7	4.6	0.71										
<b>CSD18504KCS</b>	40	20	1.9	7	10	—	100	89	238	19	4.4	3.5	0.58										
<b>CSD18532KCS</b>	60	20	1.8	4.2	5.3	—	100	169	400	44	10	6.9	0.97										
<b>CSD18533KCS</b>	60	20	1.9	6.3	9	—	100	118	293	28	9.4	3.9	0.71										
<b>CSD18534KCS</b>	60	20	1.9	9.5	13.3	—	100	73	164	19	4.8	3.1	0.58										
<b>CSD18537NKCS</b>	60	20	3	14	—	—	50	56	147	14	5.2	2.3	0.49										
<b>CSD19501KCS</b>	80	29	2.7	6.6	—	—	100	129	305	38	12.4	5.8	1.02										
<b>CSD19503KCS</b>	80	20	2.8	9.2	—	—	100	94	207	28	9.8	5.4	0.88										
<b>CSD19505KCS</b>	80	20	2.6	3.1	—	—	150	208	400	76	25	11	1.55										
<b>CSD19506KCS</b>	80	20	2.6	2.3	—	—	150	273	400	120	37	25	2.29										
<b>CSD19531KCS</b>	100	20	2.7	7.7	—	—	100	110	285	37	11.9	7.5	1.02										
<b>CSD19533KCS</b>	100	20	2.8	10.5	—	—	100	86	207	27	9	5.4	0.88										
<b>CSD19534KCS</b>	100	20	2.8	16.5	—	—	100	54	138	17.1	5.1	3.2	0.72										
<b>CSD19535KCS</b>	100	20	2.7	3.6	—	—	150	187	400	78	25	13	1.55										
<b>CSD19536KCS</b>	100	20	2.5	2.7	—	—	150	259	400	118	37	17	2.29										

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New devices are listed in **bold red**.

## P-Channel MOSFETs Selection Guide

Device	V <sub>DS</sub> (V)	V <sub>GS</sub> (V)	Typical V <sub>GS(th)</sub> (V)	Maximum R <sub>DS(on)</sub> (mΩ)			I <sub>D</sub> , Package Limited (A)	I <sub>DM</sub> (max), Pulsed Drain Current (A)	Typical Q <sub>G</sub> (nC)	Typical Q <sub>GS</sub> (nC)	Typical Q <sub>GD</sub> (nC)	Price*									
				at 4.5 V	at 2.5 V	at 1.8 V															
<b>LGA 1x0.6</b>																					
<b>Single</b>																					
<b>CSD23381F4</b>	-12	-8	-0.95	175	300	970	-2.3	-9	1.14	0.3	0.19	0.06									
<b>CSD23382F4</b>	-12	-8	-0.8	76	105	199	-3.5	-22	1.05	0.5	0.15	0.10									
<b>CSD25481F4</b>	-20	-12	-0.95	105	174	800	-2.5	-10	0.913	0.24	0.153	0.10									
<b>CSD25483F4</b>	-20	-12	-0.95	245	390	1070	-1.6	-6.5	0.959	0.252	0.16	0.06									

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# NexFET™ Power MOSFETs

## P-Channel MOSFETs Selection Guide (Continued)

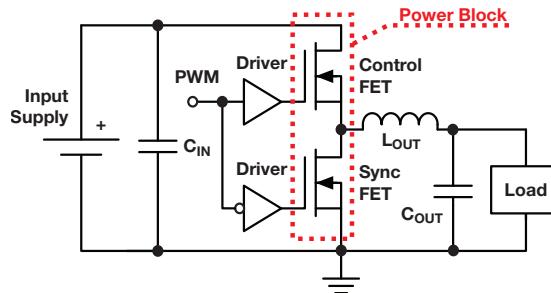
Device	$V_{DS}$ (V)	$V_{GS}$ (V)	Typical $V_{GS(th)}$ (V)	Maximum $R_{DS(on)}$ (mΩ)			$I_D$ , Package Limited (A)	$I_{DM}$ (max), Pulsed Drain Current (A)	Typical $Q_G$ (nC)	Typical $Q_{GS}$ (nC)	Typical $Q_{GD}$ (nC)	Price*									
				at 4.5 V	at 2.5 V	at 1.8 V															
<b>WLP 1x1</b>																					
<b>Single</b>																					
CSD25213W10	-20	-6	-0.85	47	67	—	-1.6	-16	2.2	0.74	0.14	0.22									
<b>CSD23202W10</b>	-12	-6	-0.6	53	66	92	-2.2	-25	2.9	0.55	0.28	0.20									
<b>WLP 1x1.5</b>																					
<b>Single</b>																					
<b>CSD23203W</b>	-8	-6	-0.8	19.4	26.5	53	-3.0	-54	4.9	1.3	0.6	0.19									
CSD25211W1015	-20	-6	-0.8	33	44	—	-3.2	-9.5	3.4	1.1	0.2	0.25									
<b>CSD25304W1015</b>	-20	-8	-0.8	32.5	45.5	92	-3.0	-41	3.3	0.7	0.5	0.25									
<b>Dual Common Source</b>																					
<b>CSD75208W1015</b>	-20	-6	-0.8	108	150	295	-1.6	-22	1.9	0.48	0.23	0.24									
<b>WLP 1.5x1.5</b>																					
<b>Single</b>																					
<b>CSD25202W15</b>	-20	-6	-0.75	26	32	52	-4	-38	5.8	1.1	0.8	0.28									
CSD22202W15	-8	-6	-0.8	12.2	17.4	—	-10	-48	6.5	1.6	1	0.32									
<b>Dual Common Source</b>																					
<b>CSD75207W15</b>	-20	-6	-0.8	27	39	81	-3.9	-24	2.9	0.7	0.4	0.35									
<b>SON 2x2</b>																					
<b>Single</b>																					
<b>CSD25310Q2</b>	-20	-8	-0.8	23.9	32.5	89	-20	48	3.6	1.1	0.5	0.18									
<b>SON 3x3</b>																					
<b>Single</b>																					
<b>CSD25402Q3A</b>	-20	-12	-0.9	8.9	15.9	300	-35	-82	7.5	2.4	1.1	0.31									

\*Suggested resale price in U.S. dollars in quantities of 1,000.

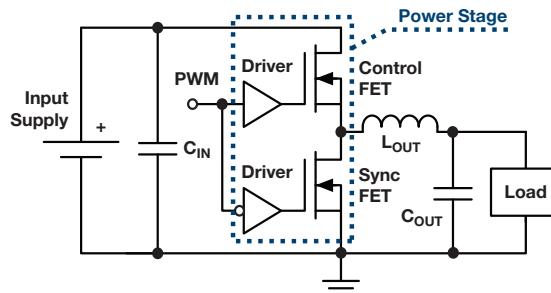
New devices are listed in **bold red**.

# NexFET™ Power MOSFETs

**CSD8xxx NexFET™ Power Block and Power Block II families contain an optimized MOSFET pair in innovative packages**



**CSD9xxx NexFET Power Stage integrates enhanced gate drivers with two MOSFETs in TI's PowerStack™ package**



## Power MOSFET Modules Selection Guide

Device	Attributes	Integrated Driver	V <sub>DS</sub> (V)	V <sub>GS</sub> (V)	Power Loss (W)	P <sub>loss</sub> Current (A)	Maximum Current (A)	Price*
<b>LGA Power Block II</b>								
CSD87381P	N-Channel	No	30	10	1	8	15	0.32
CSD87588N	N-Channel	No	30	20	2.1	15	25	0.48
CSD87384M	N-Channel	No	30	10	3.7	25	30	0.67
<b>SON 3x3 Power Block and Power Stage</b>								
CSD86330Q3D	N-Channel	No	25	10	1.9	15	20	0.65
CSD87330Q3D	N-Channel	No	30	10	2.0	15	20	0.65
CSD87331Q3D	N-Channel	No	30	10	1.3	10	15	0.53
CSD87333Q3D	N-Channel	No	30	10	1.5	8	15	0.51
CSD95379Q3M	N-Channel	Yes	20	—	1.8	12	20	0.75
<b>SON 3.5x4.5 Power Stage</b>								
CSD95375Q4M	N-Channel	Yes	20	—	2.2	15	25	0.87
CSD97374Q4M	N-Channel	Yes	30	—	2.3	15	25	0.94
CSD97376Q4M	N-Channel	Yes	30	—	2.2	12	20	0.82
<b>SON 5x6 Power Block and Power Stage</b>								
CSD86350Q5D	N-Channel	No	25	10	2.8	25	40	1.04
CSD86360Q5D	N-Channel	No	25	10	2.6	25	50	1.18
CSD87350Q5D	N-Channel	No	30	10	3	25	40	1.04
CSD87351Q5D	N-Channel	No	30	10	2.5	20	32	0.87
CSD87351ZQ5D	N-Channel	No	30	10	2.5	20	32	0.87
CSD87352Q5D	N-Channel	No	30	10	1.8	15	25	0.72
CSD87353Q5D	N-Channel	No	30	10	3.3	25	40	1.18
CSD95372AQ5M	N-Channel	Yes	25	—	3.3	30	60	1.85
CSD95372BQ5M	N-Channel	Yes	20	—	2.8	30	60	2.19
CSD95372BQ5MC	N-Channel	Yes	20	—	2.8	30	60	2.41
CSD95373AQ5M	N-Channel	Yes	20	—	2.6	25	45	1.39
CSD95373BQ5M	N-Channel	Yes	20	—	2.6	25	45	1.85
CSD95378BQ5M	N-Channel	Yes	20	—	2.8	30	60	2.19
CSD95378BQ5MC	N-Channel	Yes	20	—	2.8	30	60	2.41
CSD96370Q5M	N-Channel	Yes	25	—	2.6	25	40	1.57
CSD96371Q5M	N-Channel	Yes	25	—	2.4	25	50	1.57
CSD97370AQ5M	N-Channel	Yes	30	—	2.8	25	40	1.57
CSD97370Q5M	N-Channel	Yes	30	—	2.8	25	40	1.69

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Gallium Nitride (GaN) Solutions

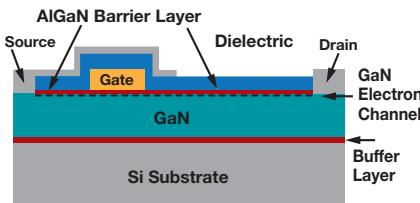
## GaN FET Modules

### Overview

One important innovation that promises to contribute significantly to obtain more efficient electrical power conversion is the use of gallium-nitride (GaN). GaN is already an established semiconductor material, employed extensively in LED lighting and increasingly important in wireless applications. Now, with process advances and defect rate improvements, GaN is providing a number of advantages in electronic power supplies.

The GaN-based switching power transistors that enable new power applications can operate at high voltages with much higher performance than traditional silicon (Si) transistors. The GaN devices use a GaN-on-Si process that fits into the existing Si manufacturing flow. Given the much smaller size of the GaN device for the same current capabilities, the GaN transistor should eventually be as cost effective as its Si equivalent.

The diagram below shows the basic structure of a GaN transistor.



### Advantages of GaN for SMPS Systems

GaN has important advantages over silicon for power supply switching because it offers lower losses at higher voltages. It also uses less energy to turn on and off.

GaN offers power designers the opportunity to reduce the physical size of their solution by operating at higher switching frequencies while maintaining desired efficiencies for a very large range of input and output voltages. Applications where GaN is most valuable tend to be those

where the power solution needs to be miniaturized as much as possible.

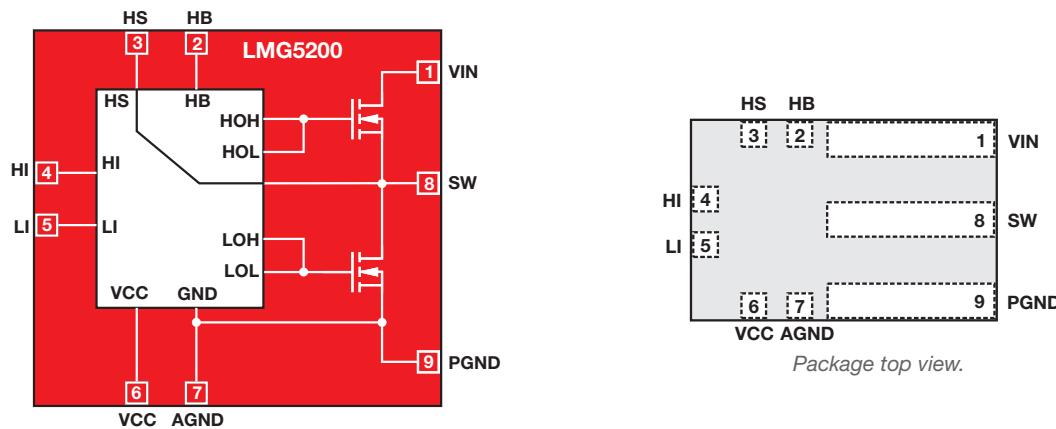
The higher frequency capability of a GaN transistor demands greater timing precision in the switch driving signal, and the switches are highly sensitive to parasitic impedances from packages, interconnect and outside sources. Integrated Si-based GaN drivers that turn GaN switches on and off at high speeds have helped move GaN-enabled SMPS design along. For example, TI's LM5113 gate driver was created to control high- and low-side enhancement-mode GaN power switches at medium voltage levels. Now, TI offers the LMG5200 half-bridge power module that integrates the gate driver with GaN switches. The LMG5200 not only reduces board space but also helps simplify design and provides important protections for the efficient, precise operation of a GaN converter.

Get more information:  
[www.ti.com/lit/SSZY017](http://www.ti.com/lit/SSZY017)

### GaN Half-Bridge Power Stage

#### LMG5200

The LMG5200 is a 80-V GaN power stage that integrates an optimized driver and two 18-mΩ enhancement-mode GaN FETs in a half-bridge configuration. The GaN half bridge supports hard-switched and resonant switching applications in an easy-to-use 9-pin QFN package. The LMG5200 simplifies board design while minimizing the gate and power-loop inductances.



Simplified block diagram.

Device	Integrated Driver	V <sub>DS</sub> (V)	R <sub>DS(on)</sub> Hi-Side FET (mΩ)	R <sub>DS(on)</sub> Low-Side FET (mΩ)	Max Continuous Current (A)	Switching Frequency (MHz)	Q <sub>G</sub> V <sub>DS</sub> 50 V (nC), V <sub>GS</sub> 5 V	Q <sub>oss</sub> /FET, V <sub>DS</sub> 50 V (nC)
LMG5200	Yes	80	18	18	10	5	3.8	20

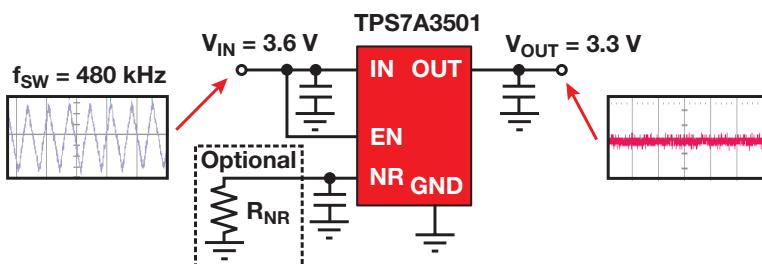
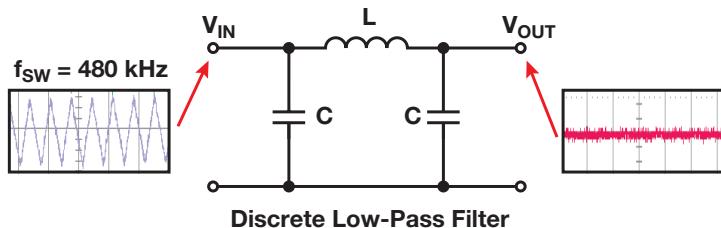
Get more information: [www.ti.com/product/LMG5200](http://www.ti.com/product/LMG5200)

# Linear Regulators

## TI's First Power Filter Removes Switching Noise

### TPS7A3501

The TPS7A3501 is a positive-voltage, low-noise power filter that is capable of sourcing up to 1 A in quiet supply fashion. Rather than regulate output voltage like a traditional LDO, the TPS7A3501 regulates the voltage drop across the input and output. The power filter maintains a fixed efficiency while still cleaning up the switching noise from DC/DC converters upstream. In addition, the device comes in a small 2x2-mm package, which makes it a great alternative solution to many passive filters and large LDOs being used in space-constrained applications.



TPS7A3501 typical application and waveforms.

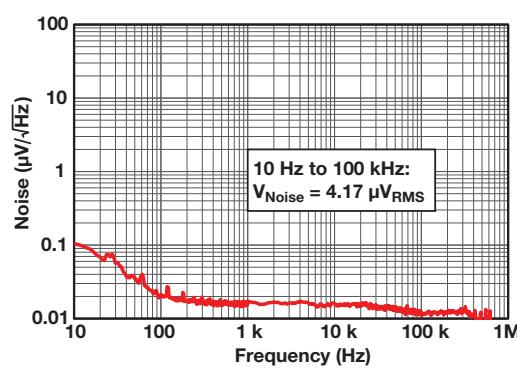
Get more information: [www.ti.com/product/TPS7A3501](http://www.ti.com/product/TPS7A3501)

## Industry's Cleanest, Ultra-Low-Noise LDO

### TPS7A4700, TPS7A4701

The TPS7A4700/1 devices are positive-voltage (+36 V), ultra-low-noise ( $4.17 \mu\text{V}_{\text{RMS}}$ ) linear regulators capable of sourcing a 1-A load. In addition, the LDO output voltage is fully user adjustable via a PCB layout without the need of external resistors or feed-forward capacitors, reducing overall component count.

The TPS7A4701 retains the same functionality of the TPS7A4700 and provides the option to set the output voltage via external resistors.



TPS7A4700/1 spectral noise plot

Get more information: [www.ti.com/product/TPS7A4700](http://www.ti.com/product/TPS7A4700) or [TPS7A4701](http://www.ti.com/product/TPS7A4701)

## Key Features

- Regulates input-to-output voltage
- High PSRR: >32 dB (360 kHz to 3.9 MHz)
- Low Noise Output:  $4 \mu\text{V}_{\text{RMS}}$
- Output voltage range: 1.21 to 4.5 V
- 2x2-mm SON-6 package

## Key Benefits

- Maintains high efficiency
- Eliminates switching noise
- Provides clean rail
- Post-DC/DC regulation
- Small size for space-constrained solutions

## Key Features

- Extremely low noise/high PSRR
- Robust for high-line voltage transients
- Higher precision for VCO/PLL/ADC
- Improved size/cost
- No external resistors required to set  $V_{\text{OUT}}$

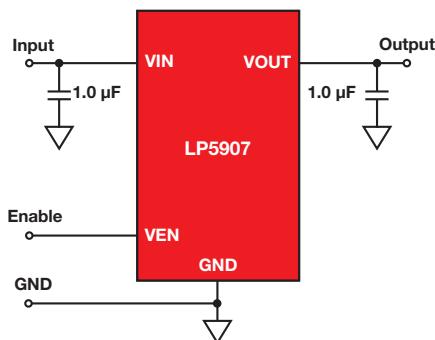
# Linear Regulators

## Ultra-Low Noise, 250-mA Linear Regulator for RF/Analog Circuits

### LP5907

The LP5907 is a linear regulator capable of supplying 250-mA output current. Designed to meet the requirements of RF and analog circuits, the LP5907 device provides low noise, high PSRR, low quiescent current, and low line or load transient-response figures. Using new innovative design techniques, the LP5907 offers class-leading noise performance without a noise bypass capacitor and the ability for remote output capacitor placement.

The device is designed to work with a 1- $\mu$ F input and a 1- $\mu$ F output ceramic capacitor (no bypass capacitor is required). It is available in 4-bump, ultra-thin DSBGA, 5-pin SOT-23, and 4-pin X2SON packages.



Output voltages are available between 1.2 V and 4.5 V in 25-mV steps. Contact Texas Instruments Sales for specific voltage option needs.

#### Key Features

- Very low noise: 6.5  $\mu$ Vrms
- High PSRR: 82 dB at 1 kHz
- Stable with ceramic output caps  $\geq$  0.47  $\mu$ F
- $\pm 2\%$  total output voltage tolerance

#### Applications

- Smartphone/tablets (Bias for camera sensor, audio amp, other sensors)
- Power for PLL, VCO, synthesizer blocks
- Smart meters
- Human machine interface

Get more information: [www.ti.com/product/LP5907](http://www.ti.com/product/LP5907)

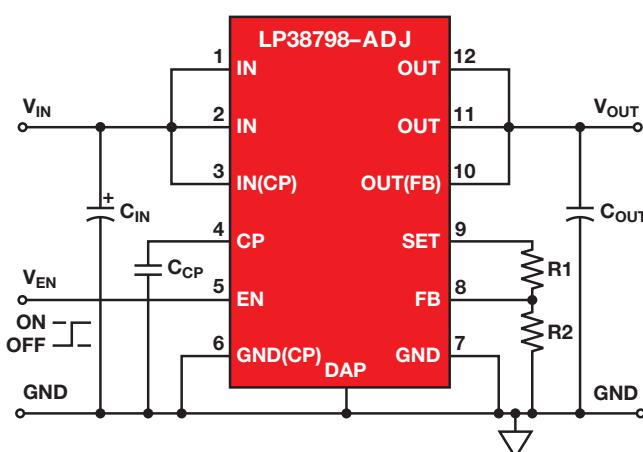
## Ultra-Low Noise, 800-mA Linear Regulator for RF/Analog Circuits

### LP38798

The LP38798-ADJ is a high-performance linear regulator capable of supplying 800-mA output current. Designed to meet the requirements of sensitive RF/analog circuitry, the regulator implements a novel linear topology on an advanced CMOS process to deliver ultra-low output noise and high PSRR at power supply switching frequencies. The LP38798SD-ADJ is stable with both ceramic and tantalum output capacitors and requires a minimum output capacitance of only 1  $\mu$ F for stability.

The LP38798-ADJ can operate over a wide input voltage range (3.0 V to 20 V) that makes it well suited for many post-regulation applications.

The LP38798-ADJ is available in a 12-lead WSON package (4x4x0.8 mm) with a thermal pad.



#### Key Features

- Ultra-low output noise: 5  $\mu$ V<sub>RMS</sub> (10 Hz to 100 kHz)
- High PSRR: 90 dB at 10 kHz, 60 dB at 100 kHz
- Wide operating input voltage range: 3.0 V to 20 V
- $\pm 1.0\%$  output voltage initial accuracy ( $T_J = 25^\circ\text{C}$ )
- Very low dropout: 200 mV (typical) at 800 mA
- Stable with ceramic or tantalum output capacitors
- Excellent line and load transient response
- Current-limit and over-temperature protection

#### Applications

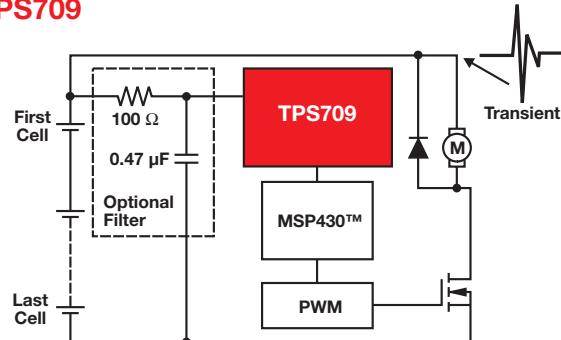
- RF and VCO power
- Wireless LAN devices
- Wireless cable modems
- Low-noise post-regulation

Get more information: [www.ti.com/product/LP38798](http://www.ti.com/product/LP38798)

# Linear Regulators

## High-Voltage, Low- $I_Q$ Linear Voltage Regulator for Battery Packs

### TPS709



#### Key Features

- $V_{IN}$ : 2.7 to 30 V
- $I_{OUT}$ : 150 mA
- $V_{DO}$ : 245 mV at 50 mA
- $I_Q$  of 1  $\mu$ A
- Accuracy: 2% over temperature
- 2x2-mm SON and SOT23-5 packages

#### Applications

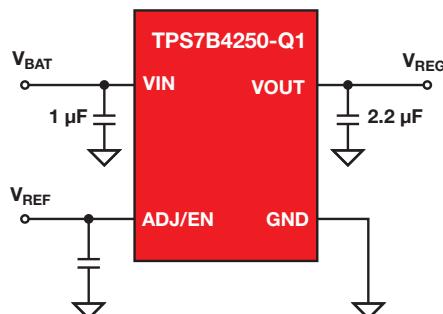
- E-metering
- Remote controllers
- Portable electronics powered from 9- to 12-V battery
- Smoke detectors/security
- Automotive
- High-cell-count battery packs for power tools

Get more information: [www.ti.com/product/TPS709](http://www.ti.com/product/TPS709)

## 50-mA, Low-Dropout, Voltage-Tracking LDO

### TPS7B4250-Q1

The TPS7B4250-Q1 device is a monolithic, integrated low-dropout voltage tracker. Designed to supply off-board sensors in an automotive environment. The device has integrated protection for overload, over temperature, reverse polarity and output short to the battery and ground. The output voltage range is between 1.5 V and 18 V.



#### Key Features

- Qualified for automotive applications
- -20- to 45-V wide-input voltage range
- 50-mA output current
- Ultra-low output-tracking tolerance, max 5 mV
- 100-mV low-dropout voltage at  $I_{OUT} = 10$  mA
- Low quiescent current, 40  $\mu$ A typical
- Reverse-polarity protection, over-temperature protection, output short-circuit proof, short-to-battery protection
- Stable with ceramic 1- $\mu$ F to 50- $\mu$ F, ESR 1-mΩ to 20- $\Omega$  output capacitor
- SOT23 package

#### Benefits

- Wide- $V_{IN}$  operating range
- Full protection for off-board power
- High-accuracy voltage tracking
- Wide-range output capacitor and ESR

#### Applications

- Off-board sensor supply
- High-precision voltage tracking
- HVAC system
- Body control module
- Power train

Get more information: [www.ti.com/product/TPS7B4250-Q1](http://www.ti.com/product/TPS7B4250-Q1)

# Linear Regulators

## Low Dropout (LDO) Regulators Selection Guide

Device	V <sub>IN</sub> Range (V)	I <sub>OUT</sub> (mA)	Automotive	Price*
<b>Wide V<sub>IN</sub></b>				
TPS715Axx	2.5 to 24	80		0.40
TPS709xx	2.7 to 30	150	✓	0.39
LM317x	3 to 40	1500		0.27
TPS7A16xx	3 to 60	100	✓	1.39
TPS7A69xx-Q1	4 to 40	150	✓	0.60
TPS7A66xx-Q1	4 to 40	150	✓	0.60
TPS7B67xx-Q1	4 to 40	450	✓	0.80
TPS7B69xx-Q1	4 to 40	150	✓	0.50
LM1084	5 to 27	5000		1.00
LM9076	5.35 to 70	150		0.78
LM2936HV	5.5 to 60	50		0.62
TPS7A40xx	7 to 100	50		1.05
TL783	20 to 125	700		1.15

Device	Dropout (mV)	V <sub>IN</sub> Range (V)	I <sub>OUT</sub> (A)	Automotive	Price*
<b>Low Dropout Voltage (With Bias Control Input)</b>					
TPS747xx	50	0.8 to 5.5	0.5	✓	0.75
TPS74(2/3)xx	55/55/60	0.8 to 5.5	1.5	✓	2.00
TPS74(4/9)xx	115/120	0.8 to 5.5	3		2.75/1.50
LP38851	115	0.95 to 5.5	0.8		0.71
TPS720xx	130	1.1 to 4.5	0.32		0.37
LP3885(2/5/8)	130	1.15 to 5.5	1.5		1.05/0.85/0.85
LP3885(3/6/9)	240	1.15 to 5.5	3		1.65/1.60/1.60
TPS7A8300	125	1.1 to 6.5	2		2.45

Device	Dropout (mV)	V <sub>IN</sub> Range (V)	I <sub>OUT</sub> (A)	Automotive	Price*
<b>Low Dropout Voltage (Without Bias Control Input)</b>					
TPS73(1/2/6)xx	30/40/75	1.7 to 5.5	0.15/0.25/0.40	✓	0.33/0.45/0.75
TPS799xx	100	2.7 to 6.5	0.2	✓	0.30
TPS7A7(1/2/3)xx	200	1.5 to 7.0	1/2/3		0.80/1.00/1.25
LP388(1/2/3)	75/110/210	1.5 to 5.5	0.8/1.5/3		1.95/1.95/2.40
TPS73(5/7)xx	280/130	2.2 to 5.5	0.5/1	✓	0.49/0.58
LP3851(1/2/3)	135/250/425	2.25 to 5.5	0.8/1.5/3		0.60/0.75/1.00
TPS7A37xx	130	2.2 to 5.5	1		0.66
LP298(1/5)/A	200/280	2.2 to 16	0.1/0.15		0.29

Device	Package	V <sub>IN</sub> Range (V)	I <sub>OUT</sub> (mA)	Price*
<b>Small Package</b>				
TLV713xx	1x1-mm SON	1.4 to 5.5	150	0.12
TLV717xx	1x1-mm SON	1.7 to 5.5	150	0.12
TLV707xx	1x1-mm SON	2 to 5.5	200	0.12
TLV705xx	0.8x0.8-mm DSBGA	2.2 to 5.6	200	0.18
LP5907	1x1-mm SON	2.2 to 5.5	250	0.14
TLV733xx	1x1-mm SON	1.4 to 5.5	300	0.17

\*Suggested resale price in U.S. dollars in quantities of 1,000.

Device	Load Transient (mV)	V <sub>IN</sub> Range (V)	I <sub>OUT</sub> (A)	Price*
<b>Fast Transient Response</b>				
LP5907	±20	2.2 to 5.5	0.25	0.14
TPS7A37xx	±25	2.2 to 5.5	1	0.66
TPS7A8101	±50	2.2 to 6.5	1	1.00
TPS727xx	±50	2 to 5.5	0.25	0.48
TPS74(2/3/4)xx	±50	0.8 to 5.5	1.5/3	2.00/2.00/2.75
LP3851(1/2/3)	±50	2.25 to 5.5	0.8/1.5/3	0.60
TPS717xx	±65	2.5 to 5.5	0.15	0.36

Device	Noise (µV <sub>rms</sub> )	PSRR at 100 kHz (dB)	V <sub>IN</sub> Range (V)	I <sub>OUT</sub> (A)	Price*
<b>Ultralow Noise/High PSRR</b>					
TPS7A3501	3.8	40	1.7 to 5	1	0.75
TPS7A470(0/1)	4	68	3 to 36	1	2.10
LP38798-ADJ	5	60	3 to 20	0.8	1.3
TPS7A8300	6	47	1.1 to 6.5	2	2.45
LP590(0/7)	6.5	85/70	2.2 to 5.5	0.15/0.25	0.20/0.14
TPS7A4901	15	54	3 to 36	0.15	1.10
TPS7A3001	15	55	-3 to -36	0.2	1.50
TPS7A3301	16	64	-3 to -36	1	2.70
LP2989/LV	18	30	2.1 to 16	0.5	0.90
TPS7A8101	23.5	60	2.2 to 6.5	1	1.00

Device	I <sub>Q</sub> (no load) (µA)	V <sub>IN</sub> Range (V)	I <sub>OUT</sub> (mA)	Automotive	Price*
<b>Low I<sub>Q</sub></b>					
TPS78(0/2)xx	0.5	2.2 to 5.5	150	✓	0.35
TPS709xx	1	2.7 to 30	150	✓	0.39
TPS797xx	1	1.8 to 5.5	50	✓	0.34
TPS715Axx	3	2.5 to 24	80		0.40
TPS7A16xx	5	3 to 60	100	✓	1.39
TPS7A69xx-Q1	12	4 to 40	150	✓	0.60
TPS7A66xx-Q1	12	4 to 40	150	✓	0.60
TPS7B67xx-Q1	15	4 to 40	450	✓	0.80
TPS7B69xx-Q1	15	4 to 40	150	✓	0.50
LP8340	19	2.7 to 10	1000		0.53

# Linear Regulators

## Dual Output LDOs Selection Guide

Device	$I_{O1}$ (mA)	$I_{O2}$ (mA)	$V_{D01}$ at $I_{O1}$ (mV)	$V_{D02}$ at $I_{O2}$ (mV)	$I_Q$ ( $\mu$ A)	Output Options		Accuracy (%)	Package(s)	$V_0$		Enable	$V_{IN}$		Comments	Price*
						Fixed Voltage (V)				(min)	(max)		(min)	(max)		
TLV716	150	150	210	210	50	1.2/2.75, 2.8/1.8, 2.8/2.8, 3.0/3.0, 3.3/1.8	1.5	SON 6	1.8	3.3	EN	1.4	5.5	Capacitor-free functionality allows for smallest 150-mA dual-LDO solution	0.18	
LP2966	150	150	135	135	300	1.8/3.3, 2.5/1.8, 2.5/2.5, 2.8/2.8, 3.3/2.5, 5.0/5.0	3	Mini-S08	1.8	5	EN	1.8	5	Independent shutdown of each LDO regulator	0.70	
LP3996	150	300	110	210	35	0.8/3.3, 1.0/1.8, 1.5/2.5, 1.8/3.3, 2.8/2.8, 3.0/3.0, 3.0/3.3, 3.3/0.8, 3.3/3.3	1.5	LLP10	0.8	3.3	EN	2	6	Power Good	0.30	
LP5996	150	300	110	210	35	0.8/3.3, 1.0/1.8, 1.5/2.5, 2.5/3.3, 2.8/2.8, 3.0/3.0, 3.0/3.3, 3.3/0.8, 3.3/3.3	1.5	LLP10	0.8	3.3	EN	2	6		0.30	
LP8900	200	200	110	110	85	2.8/2.8, 2.7/2.7, 2.8/2.7, 2.8/1.2	1	WCSP	1.2	3.6	EN	1.8	5.5	Ultralow noise, high accuracy	0.30	
TLV710	200	200	175	175	70	1.8/2.8, 3.3/1.8	2	SON 6	1.2	4.8	EN	2.0	5.5	Value dual LDO	0.19	
TLV711	200	200	175	175	70	1.2/2.5, 1.2/3.3, 1.3/2.3, 1.3/3.3, 1.5/1.8, 1.5/3.3, 1.8/1.2, 1.8/3.3, 1.9/3.0, 2.5/1.25, 2.5/2.5, 2.85/1.8, 2.85/2.85, 3.0/2.5, 3.0/3.0, 3.3/1.8, 3.3/2.85, 3.3/3.0, 3.3/3.3	2	SON 6	1.2	4.8	EN	2.0	5.5	TLV710xx w/active output pulldown	0.19	
TPS718	200	200	230	230	90	1.2/3.3, 1.8/2.7, 1.8/3.3, 2.5/1.2, 2.8/2.8, 2.8/3.0	3	QFN/WCSP	0.9	3.6	EN	2.5	6.5	High PSRR, low noise	0.55	
TPS719	200	200	230	230	90	1.3/2.8, 1.8/1.2, 1.8/1.3, 2.1/2.2, 2.6/1.5, 2.8/2.8, 2.85/2.85, 3.3/2.8, 3.3/3.3, 3.6/3.15	3	QFN/WCSP	0.9	3.6	EN	2.5	6.5	TPS718xx w/active output pulldown	0.55	
LP2967	200	200	240	240	200	1.8/25, 1.8/3.3, 2.5/2.8, 2.5/3.3, 2.6/2.6, 2.8/2.8	3	Mini-S08, micro SMD	1.8	3.3	EN	1.6	16	Smallest possible size (micro SMD package)	0.99	
TPS712	250	250	125	125	300	1.8/2.85, 1.8/Adj., 2.8/2.8, 2.8/Adj., 2.85/2.85, Adj./Adj.	3	SON 6	1.2	5.3	EN	2.7	5.5	High PSRR, low noise	0.80	

\*Suggested resale price in U.S. dollars in quantities of 1,000.

## Voltage References

TI's broad voltage-reference portfolio offers performance features such as low-temperature coefficients, precise initial accuracy, low noise, and excellent

long-term stability. Series and shunt references support a wide variety of applications, including high-precision references for data converters with up to 20-bit precision accuracy and

low-noise references for sensor conditioning. Voltage references are also commonly used as voltage monitors, current limiters, and programmable current sources.

## Voltage References Selection Guide

Device	Initial Accuracy (%)	Adjustable	Output Voltage (V)	Temp Drift (ppm/°C)	Package	Automotive	Price*
<b>Shunt <math>V_{REF}</math></b>							
LM2/385/B	1.0, 2.0	—	1.2, 2.5	20	TSSOP, SOIC-8, T0-92		0.28
LM4040 A/B/C	0.1, 0.2, 0.4	—	2.0, 2.5, 3.0, 4.0, 5.0, 8.2	100	3SOT-23, SC-70, T0-92		1.30
TLV431/2 A/B	0.5, 1.0, 2.0	Up to 36 V	2.5	150	3/SOT-23	✓	0.11
TLV431 A/B	0.5, 1.0	Up to 6 V	1.24	150	3/SOT-23, T0-92'	✓	0.23
TLV4050/1 A/B/C	0.1, 0.2, 0.5	Up to 10 V	1.2, 2.5, 4, 5, 10	50	3/SOT-23	✓	1.15
<b>Series <math>V_{REF}</math></b>							
REF50xx	0.05	—	2.0, 2.5, 3.0, 4.1, 4.5, 5.0, 10	3	MSOP-8	✓	1.35
LM4132A/E	0.05, 0.5	—	1.8, 2.0, 2.5, 3.3, 4.1	10/30	5SOT-23		0.78
LM4140C	0.1	—	1.0, 1.2, 2.0, 2.5, 4.1	10	SOIC-8		1.35
LM4120/1/5 A	0.5, 0.2	Up to 5 V	1.8, 2.0, 2.5, 3.0, 3.3, 4.1, 5.0	50	5SOT-23		0.70
REF29xx	2.0	—	1.2, 2.0, 2.5, 3.0, 3.3, 4.1	100	3SOT-23		0.49

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Battery Management Products

## Overview

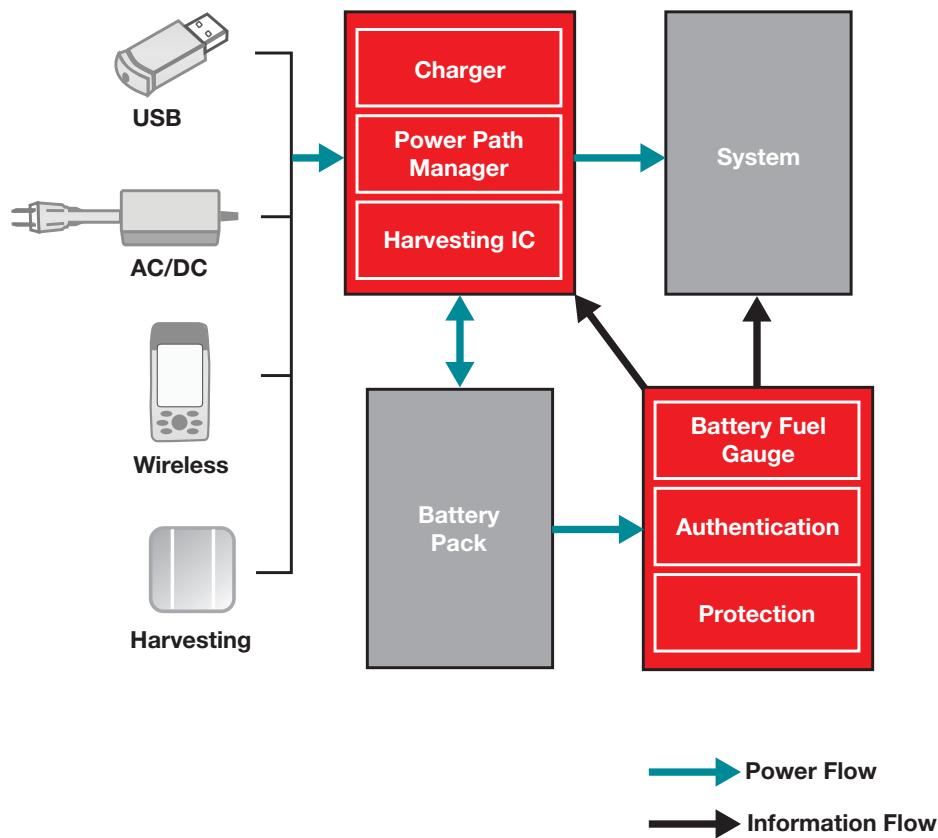
End applications in wireless, computing, consumer, industrial and medical markets continue to expand into the portable space. TI's battery management solutions help address system protection, cost-effective linear and highly-efficient switch-mode battery charging. New advances in switch-mode charging increase efficiency and decrease power dissipation, promoting a green environment by wasting less energy. With battery-powered systems demanding increased reliability, TI ensures maximum product safety with chargers that protect batteries from overvoltage and over-current conditions.

### Battery Chemistry

Lithium Ion (Li-Ion) is the most widely used chemistry family for rechargeable batteries. There are different chemistries in the Li-Ion family with different operating characteristics such as discharge profiles and self-discharge rate. TI battery management ICs are developed by chemistry to account for these differences to charge the battery more efficiently and report the remaining energy in the battery more accurately.

### Fundamentals

TI products support applications such as mobile phones, smartphones, tablets, portable consumer devices, portable navigation devices, notebook computers and many industrial and medical applications. TI has a battery-management IC to match your design specifications. We also offer the evaluation modules, application notes, samples and data sheets needed to get your design to market faster.



# Battery Management Products

## Battery Charger Solutions

### Selection Guide

Device	Number of Cells	V <sub>IN</sub> Absolute Max (V)	V <sub>IN</sub> OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET	Temperature Monitor	Packaging		Comments	Automotive	Price*	
										WCSP	QFN/MLP				
<b>Multi-Chemistry (Li-Ion and NiCd/NiMH)</b>															
bq24030/31/35	1	18	6.4	2	4.2/4.1/4.2	Stand Alone	Linear	Yes	Yes	20	✓	Dual Input, Regulated 4.4-V output for AC input condition, Power path	✓	1.80	
bq24032A/38	1	18	6.4	2	4.2/ (4.24/4.36)	Stand Alone	Linear	Yes	Yes	20	✓	Dual Input, Regulated 4.4-V output for AC input condition, Power path		1.80	
bq24040/41	1	30	6.6/7.1	1	4.2	Stand Alone	Linear	Yes	Yes	10	✓			0.45	
bq24045	1	30	6.6/7.1	1	4.35	Stand Alone	Linear	Yes	Yes	10	✓			0.45	
bq24050/52	1	30	6.6	0.8	4.2	Stand Alone	Linear	Yes	Yes	10	✓	JEITA Charging (100K NTC — bq24052)		0.50	
bq24055	1	30	6.6	0.8	4.2	Stand Alone	Linear	Yes	Yes	12	✓	JEITA, PG Pin		0.60	
bq24072/72T	1	28	6.6	1.5	4.3 / 4.2	Stand Alone	Linear	Yes	Yes	16	✓	VOUT tracks VBAT, VIN_DPPM, Power path		1.00	
bq24073	1	28	6.6	1.5	4.2	Stand Alone	Linear	Yes	Yes	16	✓	VIN_DPPM, Power path		1.00	
bq24074	1	28	10.5	1.5	4.2	Stand Alone	Linear	Yes	Yes	16	✓	VIN_DPPM, Power path		1.00	
bq24075T/79T	1	28	6.6	1.5	4.2/4.1	Stand Alone	Linear	Yes	Yes	16	✓	SYSOFF pin disconnects battery, VIN_DPPM, powers system and charges battery, Power path		1.00	
bq24090/91	1	12	6.6	1	4.2	Stand Alone	Linear	Yes	Yes	10	✓	10K NTC (100K NTC — bq24091)		0.40	
bq24092/93	1	12	6.6	1	4.2	Stand Alone	Linear	Yes	Yes	10	✓	JEITA, 10K NTC (JEITA, 100K NTC — bq24093)		0.40	
bq24095	1	12	6.6	1	4.35	Stand Alone	Linear	Yes	Yes	10	✓	10K NTC		0.40	
bq24140	1	20	9.8	1.5	Adj	I <sup>2</sup> C	Switching	Yes	No	30		✓	Dual input, Simultaneous charge and USB OTG output		1.60
bq24153A/58	1	20	6.5	1.25	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	No	20		✓	USB OTG supported with boost, no battery detect on power up (bq24158)		0.95
bq24156A/59	1	20	9.8	1.5	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	No	20		✓	No battery detect on power up (bq24159)		0.95
bq24157	1	20	6.5	1.25	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	No	20		✓	USB OTG supported with boost, no battery detect on power up, safety timer disabled		0.90
<b>bq24157S</b>	1	20	6.5	1.25	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	No	20			Spread spectrum for lower EMI. USB OTG supported with boost, no battery detect on power up, safety timer disabled		0.95
bq24160/A	1	20	10.5/6.5(USB)	2.5/1.5	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	49	24	✓	Dual input, D+/D- detect, JEITA, 3-V VBAT_SHORT, Power path		1.95
bq24161/B	1	20	10.5/6.5(USB)	2.5/1.5	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	49		✓	Dual input, USB selection pin, std temp, Power path		1.95
bq24163	1	20	10.5/6.5(USB)	2.5/1.5	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	No	49	24	✓	Dual input, D+/D- detect, JEITA, Power path		1.95
bq24165	1	20	10.5/6.5(USB)	2.5/1.5	4.2	Stand Alone	Switching	Yes	No	49		✓	Dual input, IUSB1/2/3 USB select, no temp monitor, JEITA, Power path		1.95
bq24166	1	20	10.5/6.5(USB)	2.5/1.5	4.2	Stand Alone	Switching	Yes	Yes	49		✓	Dual input, IUSB1/2/3 USB select, temp monitor, std temp, Power path		1.95
bq24167	1	20	10.5/6.5(USB)	2.5/1.5	4.2	Stand Alone	Switching	Yes	Yes	49	24	✓	Dual input, IUSB1/2/3 USB select, temp monitor, JEITA, Power path		1.95
bq24168	1	20	6.5/6.5(USB)	2.5/1.5	3.5 to 4.4	Stand Alone	Switching	Yes	Yes	49	24	✓	Dual input, USB select pins, JEITA, no timers, Power path		1.95
bq24180	1	20	16.5	1.5	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	25		✓	Accessory power output		1.00
bq24185	1	20	16.5	1.5	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	25		✓	USB OTG supported with boost		1.00
bq24187	1	30	6.5	2.0	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	36	24	✓	PSEL detect, JEITA, Integrated RSNS, OTG		1.50
bq24190	1	20	18	4.5	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes		24	✓	D+/D-, 1.3-A OTG, standard temp., 12-mW battery FET		2.50
bq24192	1	20	18	4.5	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes		24	✓	PSEL, 1.3-A OTG, standard temp., 12-mW battery FET		2.50
<b>bq24192I</b>	1	20	18	4.5	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes		24	✓	PSEL, 1.3-A OTG, standard temp., 4.1-V and 1.5-A default charging		2.50
bq24193	1	20	18	4.5	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes		24	✓	PSEL, 1.3-A OTG, JEITA, 12-mW battery FET		2.50
bq24196	1	20	18	2.5	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes		24	✓	PSEL, 1.3-A OTG, standard temp., 12-mW battery FET		2.25
bq24195L	1	20	18	2.5	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes		24	✓	D+/D-, 5.1-V, 1.0-A synchronous boost for power bank		2.50
bq24195	1	20	18	4.5	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes		24	✓	D+/D-, 5.1-V, 2.1-A synchronous boost for power bank		2.80
bq24232	1	28	10.5	0.5	4.2	Stand Alone	Linear	Yes	Yes	16	✓		SYSOFF pin disconnects battery, VIN_DPPM, powers system and charges battery, Power path		1.00
bq24232H	1	28	10.5	0.5	4.35	Stand Alone	Linear	Yes	Yes	16	✓		Higher voltage battery pack flexibility (4.35 V), USB friendly, powers system and charges battery, Power path		1.15
bq24250/51	1	20	10.5	2.0	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes	30	24	✓	EN1-2 or D+/D- detection, JEITA, Power Path		1.15
bq24253	1	20	10.5	2.0	4.2	Stand Alone	Switching	Yes	Yes	30	24	✓	D+/D- detection, JEITA, Power Path		1.15
bq24257	1	20	6.5	2.0	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes	30	24	✓	D+/D- detection, JEITA		1.15
bq24260	1	30	10.5	3.0	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	36	24	✓	D+/D- detect, JEITA, Power Path, OTG		1.75
bq24261	1	30	14	3.0	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	36	24	✓	PSEL detect, JEITA, Power Path, OTG		1.75
bq24262	1	30	6.5	3.0	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	36	24	✓	PSEL detect, JEITA, Power Path, OTG		1.75
<b>bq24270/71</b>	1	20	6.5	1.5	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	49	24	✓	D+/D- detect or PSEL, JEITA, Power Path		1.25
bq24272	1	20	10.5	2.5	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	49	24	✓	Power Path		1.25
bq24273	1	20	10.5	2.5	3.5 to 4.4	I <sup>2</sup> C	Switching	Yes	Yes	49		✓	Non-Power Path		1.25
bq24278	1	20	10.5	2.5	4.2	Stand Alone	Switching	Yes	Yes	49	24	✓	Input current limit programming input		1.25

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**.

# Battery Management Products

## Battery Charger Solutions

### Selection Guide (Continued)

Device	Number of Cells	V <sub>IN</sub> Absolute Max (V)	V <sub>IN</sub> OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET	Temperature Monitor	Packaging		Comments	Price*
										WCSP	QFN/MLP		
<b>Multi-Chemistry (Li-Ion and NiCd/NiMH) (Continued)</b>													
bq24295	1	16	6.4	3	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes	24	✓	D+/D-, USB and non-standard port detection, 1.5-A, 4.5-V-5.5 V adjustable OTG voltage for power bank	1.65
bq24296	1	16	6.4	3	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes	24	✓	PSEL, Compatible to BC1.2, standard temp., shipping mode	1.95
bq24297	1	16	6.4	3	3.5 to 4.4	I <sup>2</sup> C/Stand Alone	Switching	Yes	Yes	24	✓	D+/D-, USB and non-standard port detection, 1.5-A, 4.5-V-5.5 V adjustable OTG voltage	1.95
bq25040	1	30	6.9	1.1	4.2	Stand Alone	Linear	Yes	Yes	10	✓	USB compliant w/50-mA integrated LDO	0.55
bq25050	1	30	6.5	1	4.2	Single Wire	Linear	Yes	Yes	10	✓	Single-wire interface, Power path	0.60
bq25060	1	30	10.5	1	4.2	Stand Alone	Linear	Yes	Yes	10	✓	USB compliant w/50-mA integrated LDO, Power path	0.65
bq25100	1	30	6.6	0.25	4.2	Stand Alone	Linear	Yes	Yes	6	✓	Small linear charger with programmable termination down to 1-mA and 75-nA battery leakage, 4.2-V battery	0.75
bq25100A	1	30	6.6	0.25	4.3	Stand Alone	Linear	Yes	Yes	6	✓	Small linear charger with programmable termination down to 1-mA and 75-nA battery leakage, 4.3-V battery	0.75
bq25100H	1	30	6.6	0.25	4.35	Stand Alone	Linear	Yes	Yes	6	✓	Small linear charger with programmable termination down to 1-mA and 75-nA battery leakage, 4.35-V battery	0.75
bq25101	1	30	6.6	0.25	4.2	Stand Alone	Linear	Yes	Yes	6	✓	Small linear charger with /CHG pin, 1-mA termination support and 75-nA battery leakage, 4.2-V battery	0.75
bq24130	1 to 3	20	Adj	4	Adj	I <sup>2</sup> C	Switching	Yes	Yes	20	✓	Host control, supports Li-Ion and Super Cap	1.95
bq24133	1 to 3	20	Adj	2.5	4.2/Cell	Stand Alone	Switching	Yes	Yes	24	✓	Power Path	1.75
bq24170	1 to 3	20	Adj	4	4.2/Cell	Stand Alone	Switching	Yes	Yes	24	✓	Power Path	1.80
bq24171	1 to 3	20	Adj	4	Adj	Stand Alone	Switching	Yes	Yes	24	✓	JEITA, Power Path	1.80
bq24172	1 to 3	20	Adj	4	Adj	Stand Alone	Switching	Yes	Yes	24	✓	Adjustable charge voltage, Power Path	1.80
bq24707A	1 to 4	30	Adj	8	Adj	SMBus	Switching	No	No	20	✓	Programmable switching frequency	2.90
bq24735	1 to 4	30	Adj	8	Adj	SMBus	Switching	No	No	20	✓	Intel™ CPU Turbo Mode support	3.00
bq24617	1 to 5	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	Yes	24	✓	600 kHz	2.90
bq24600	1 to 6	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	Yes	16	✓	1200 kHz	2.50
bq24610	1 to 6	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	Yes	24	✓	600 kHz	2.90
bq24616	1 to 6	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	Yes	24	✓	JEITA	2.90
bq24618	1 to 6	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	Yes	24	✓	USB VIN and adapter	2.90
bq24715	2 to 3	30	26	8	Adj	SMBus	Switching	No	No	20	✓	NVDC charger	2.25
bq24725A	2 to 4	30	Adj	8	Adj	SMBus	Switching	No	No	20	✓	Programmable switching frequency, enhanced safety, battery learn	2.90

Device	Number of Cells	V <sub>IN</sub> Absolute Max (V)	V <sub>IN</sub> OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET	Temperature Monitor	Packaging		Comments	Price*		
										QFN/MLP	TSSOP	SOIC	DIP	EVM	
<b>Solar/Energy Harvesting (Li-Ion)</b>															
bq24210	1	20	7.7	0.800	4.2	Stand Alone	Linear	Yes	Yes	10			✓	Solar panel V <sub>IN</sub>	1.10
bq25504	1	5.5	Adj	0.1	2.5 to 5.25	Stand Alone	Boost	Yes	Yes	16			✓	Energy harvester, ultra-low power and quiescent current, high efficiency, dynamic MPPT	2.10
bq25505	1	5.5	Adj	0.1	2.5 to 5.25	Stand Alone	Boost	Yes	Yes	16			✓	Energy harvester, 330-nA ultra-low power and quiescent current, high efficiency, dynamic MPPT, autonomous power-path multiplexing	2.40
bq25570	1	5.5	Adj	0.1	2.5 to 5.25	Stand Alone	Boost-Buck	Yes	Yes	16			✓	Energy harvester, <488-nA ultra-low power and quiescent current, high efficiency, dynamic MPPT	2.90
bq24650	1 to 6	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	Yes	16			✓	Max power point tracking	2.85
<b>LiFePO<sub>4</sub></b>															
bq25070	1	30	10.5	1	3.5	1 Wire Interface	Linear	Yes	Yes	10			✓	LiFePO <sub>4</sub> , 50-mA LDO	0.75
bq25071	1	30	10.5	1	3.5	Stand Alone	Linear	Yes	Yes	10			✓	LiFePO <sub>4</sub> , 50-mA LDO	0.75
bq24620	1 to 7	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	Yes	16			✓	LiFePO <sub>4</sub> , 300 kHz	2.90
bq24630	1 to 7	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	Yes	24			✓	LiFePO <sub>4</sub> , 300 kHz, power selector	2.90
<b>Super Cap</b>															
bq24640	1 to 9	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	Yes	16			✓	SuperCap	2.90

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**.

# Battery Management Products

## Battery Charger Solutions

### Selection Guide (Continued)

Device	Number of Cells	$V_{IN}$ Absolute Max (V)	$V_{IN}$ OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET	Temperature Monitor	Packaging		Comments	Price*	
										QFN/MLP	TSSOP	SOIC	DIP	EVM
<b>NiCd/NiMH Chemistry</b>														
bq2002/C/E/F	Multiple	7	—	>2	6	Stand Alone	Current-limited	No	Yes	8	8	Trickle charge	0.85	
bq2004/E/H	Multiple	7	—	>2	5.5	Stand Alone	Switching	No	Yes	16	16	Selectable timers and pulse-trickle rates	2.15	
bq2005	Multiple	7	—	>2	5.5	Stand Alone	Switching	No	Yes	20	20	Sequential fast charge of two battery packs	2.15	
bq24400/1	Multiple	7	—	>2	5.5	Stand Alone	Switching	No	Yes	8	8		1.55	
<b>Lead-Acid Chemistry</b>														
bq24450	Multiple	40	—	>2	—	Stand Alone	Linear	No	No	16	16	Temp-compensated internal reference	2.75	
bq2031	Multiple	7	—	>2	—	Stand Alone	Switching	No	Yes	16	16	✓ Three user-selectable charge algorithms to accommodate cyclic and standby applications	2.80	
<b>Multi-Chemistry (Li-Ion and NiCd/NiMH)</b>														
bq2000/T	Multiple	7	—	—	—	Stand Alone	Switching	Yes	Yes	8	8	8	✓ Charges NiCd, NiMH, and Li-Ion	1.50
bq24650	1 to 6	33	32	10 A (Ext)	Adj	Stand Alone	Switching	No	Yes	16		✓	Max power point tracking	2.85
bq24765	2 to 4	30	—	—	—	Stand Alone	Switching	Yes	No	34		✓	SMBus charger with integrated power FETs	3.95

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

For Wireless Charger solutions, see page 68.

## Battery Charger Protection

### Selection Guide

Device	$V_{IN}$ Max (V)	OVP (V)	OCP	Battery OVP (V)	LDO Output (V)	Max Operating Current ( $\mu$ A)	Package(s)	EVM	Comments	Price*
bq24300/4/5	30	10.5	Fixed 300 mA	4.35	5.5/4.5/5.0	400/500/500	8-QFN/SON	✓	Reverse polarity protection	0.30
bq24308	30	6.3	Fixed 700 mA or Prog. <1.5 A	4.35	5	500	8-QFN/SON	✓	Reverse polarity protection	0.30
bq24312	30	5.85	Prog. <1.5 A	4.35	—	500	8/12-QFN/SON		Fault indication	0.35
bq24313	11	10.5	Prog. <1.5 A	4.35	—	500	8/12-QFN/SON		Fault indication	0.35
bq24314/A	30	5.85	Prog. <1.5 A	4.35	—	600	8/12-QFN/SON	✓	Fault indication	0.35
bq24314C	30	5.85	Prog. <1.5 A	4.45	—	600	8/12-QFN/SON	✓	Fault indication	0.35
bq24315	30	5.85	Prog. <1.5 A	4.35	5.5	600	8-QFN/SON	✓	Fault indication	0.35
bq24316	30	6.8	Prog. <1.5 A	4.35	—	600	8/12-QFN/SON	✓	Fault indication	0.35
bq24380	30	6.3	No OCP	4.35	5.5	250	8-QFN/SON	✓	Fault indication	0.25
bq24381	30	7.1	No OCP	4.35	5	300	8-QFN/SON	✓	Fault indication	0.25
bq24382	30	10.5	No OCP	4.35	5	300	8-QFN/SON		Fault indication	0.25
bq24350	30	6.17	Fixed 1.2 A	4.35	5.5	500	8-QFN/SON	✓	Integrated charge FET	0.40
bq24351	30	10.5	Fixed 1.2 A	4.35	6.38	500	8-QFN/SON	✓	Integrated charge FET	0.40
bq24352	30	7.1	Fixed 1.2 A	4.35	5.5	500	8-QFN/SON	✓	Integrated charge FET	0.40

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Battery Management Products

## Battery Fuel Gauges

### Single-Cell Fuel Gauges Selection Guide

Device	Min Max Series Cell	SHA-1 Authentication	System or Pack	Communication Protocol	Other Features	Package	Price*
<b>Lithium-Ion, Lithium-Polymer Chemistry</b>							
bq27541	1	Yes	Pack	I <sup>2</sup> C/HDQ	Pack-side fuel gauge with Impedance Track™ technology	12-pin QFN	1.45
bq27545	1	Yes	Pack	I <sup>2</sup> C/HDQ	Pack-side fuel gauge with Impedance Track technology	15-pin CSP	1.23
bq27411	1	—	Pack	I <sup>2</sup> C	Pack-side fuel gauge with Impedance Track - Lite technology	12-pin QFN	1.15
bq27510	1	—	System	I <sup>2</sup> C	System-side fuel gauge with Impedance Track technology with integrated LDO	12-pin QFN	1.45
bq27441	1	—	System	I <sup>2</sup> C	System-side fuel gauge with Impedance Track-Lite technology with integrated LDO	12-pin QFN	1.15
bq27520	1	—	System	I <sup>2</sup> C	System-side fuel gauge with Impedance Track technology with integrated LDO	15-ball CSP	1.50
bq27425	1	—	System	I <sup>2</sup> C	System-side fuel gauge with Impedance Track Lite technology with integrated sense resistor	15-ball CSP	1.40
bq27421	1	—	System	I <sup>2</sup> C	System-side fuel gauge with Impedance Track technology with integrated sense resistor	9-pin CSP	1.40
bq27621	1	—	System	I <sup>2</sup> C	System-side fuel gauge with DVC fuel gauge technology; no need for sense resistor	9-CSP	1.10
bq2753x	1	—	System	I <sup>2</sup> C	Impedance Track technology fuel gauge with charger control	15-pin CSP	1.80
bq28z560	1	Yes	Pack	SMBus/HDQ	Pack-side fuel gauge with Impedance Track technology	12-pin QFN	3.15
bq28550	1	Yes	Pack	SMBus	Pack-side fuel gauge with CEDV technology with integrated LDO	12-pin QFN	2.90

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### Multi-Cell Fuel Gauges Selection Guide

Device	Approx. Battery Capacity (mAh)	Min Max Series Cell	Number of LEDs	Communication Protocol	Other Features	Package	Automotive	Price*
<b>Lithium-Ion, Lithium-Polymer, LiFePO<sub>4</sub> Chemistry</b>								
bq3060	500 to 32000	2 to 4	—	SMBus	CEDV+ gas gauge with integrated protector	24-pin TSSOP		3.55
bq20z655-R1	800 to 32000	2 to 4	3, 4, 5 or LCD	SMBus	Impedance Track fuel gauge with LED or LCD and integrated protector	44-pin TSSOP		5.20
bq34z100	65000 and above	1 to 16	4	I <sup>2</sup> C or HDQ	Wide-range fuel gauge with Impedance Track™ technology	14-pin TSSOP		2.50
bq34z950	800 to 32000	2 to 4	3, 4 or 5	SMBus or HDQ	Gas gauge and protection with Impedance Track technology	44-pin TSSOP		2.30
<b>Lead Acid Chemistry</b>								
bq34z110	Up to 650 Ah	1 to 16	4	I <sup>2</sup> C or HDQ	Wide-range fuel gauge with Impedance Track technology	14-pin TSSOP		3.90
<b>Super Cap</b>								
bq33100	—	2 to 5	—	SMBus	Fully integrated 2, 3, 4 and 5 series super capacitor manager	24-pin TSSOP		4.20
<b>Battery Monitors</b>								
bq76920	—	3 to 5	—	I <sup>2</sup> C	Battery Monitor with digital I <sup>2</sup> C interface, integrated ADCs and hardware protection	20-pin TSSOP		1.50
bq76930	—	6 to 10	—	I <sup>2</sup> C	Battery Monitor with digital I <sup>2</sup> C interface, integrated ADCs and hardware protection	30-pin TSSOP		2.75
bq76940	—	9 to 15	—	I <sup>2</sup> C	Battery Monitor with digital I <sup>2</sup> C interface, integrated ADCs and hardware protection	44-pin TSSOP		3.95
bq76PL536A	—	3 to 192	—	SPI	3- to 6-cell EV and UPS stackable monitor and cell-balancing AFE	64-pin HTQFP		6.30
bq76PL536A-Q1	—	3 to 192	—	SPI	3- to 6-cell automotive-qualified EV and UPS stackable monitor and cell-balancing AFE	64-pin HTQFP	✓	8.00
bq77PL900	—	5 to 10	—	I <sup>2</sup> C	Dual-mode analog front-end standalone voltage, current and temperature pack protector	48-pin SSOP		2.95

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### Authentication and ID Selection Guide

Device	Interface	Pins	Security	Temp (°C)	Package	Price*
bq2022A	SDQ™	3	ID number	-40 to 85	3 SOT-23, 3 TO-92	0.90
bq2024	SDQ	3	ID number	-40 to 85	3 SOT-23	0.95
bq2026	SDQ	3	CRC	-20 to 70	3 SOT-23, 3 TO-92	0.90
bq2028	HDQ	12	ID number	-40 to 85	12 DSBGA	1.10
bq26100	SDQ	6	SHA-1 Authentication	-40 to 85	6 VSON	0.95

Suggested resale price in U.S. dollars in quantities of 1,000.

# Battery Management Products

## Battery (Li-Ion) Protection

### Selection Guide

Device	Number of Series Cells	Charge/Discharge Current (A)	Shutdown Current ( $\mu$ A)	Other Features					Package(s)	Automotive	Price*
bq29700	1	—	4 <sup>1</sup>	Overvoltage safety for chemical fuse activation					6-pin SON		0.26
bq2920x	2	—	3	Overvoltage safety with cell balancing					8-pin SON		0.30
bq2944x	2 to 4	—	3	Overvoltage safety for chemical fuse activation					8-pin SON		0.45
bq2945xy	2 or 3	—	4	Overvoltage safety for chemical fuse activation					6-pin SON		0.40
bq2946xy	1	—	4	Overvoltage safety for chemical fuse activation					6-pin SON		0.38
bq76925	3 to 6	—	1	Host-controlled protector with cell balancing					20-pin TSSOP, 24-pin QFN		1.50
bq76PL536A	3 to 192	External NFET	12	3- to 6-cell EV and UPS stackable monitor and cell-balancing AFE					64-pin HTQFP		6.30
bq76PL536A-Q1	3 to 192	External NFET	12	3- to 6-cell automotive-qualified EV and UPS stackable monitor and cell-balancing AFE					64-pin HTQFP	✓	8.00
bq77PL900	5 to 10	External PFET	—	Stand-alone or host-controlled protector with cell balancing					48-pin SSOP		2.95
bq7716xy	2 to 4	—	1	Overvoltage protection with external delay capacitor					8-pin QFN		0.51
bq7718xy	2 to 5	—	1	Overvoltage protection with internal delay timer					8-pin QFN		0.79
bq77PL157A4225	3 to 6	External NFET	3	Stackable overvoltage protector; stack 3 for 18 series cells					16-pin TSSOP		0.65

<sup>1</sup>Shutdown - 100 nA

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### Wireless Power

### Selection Guide

Device	Standard	Charge Current (A)	Output Voltage (V)	Topology	V <sub>IN</sub> Absolute Max (V)	Control Interface	Integrated FET	Temperature Monitor	QFN/MLP	Chip Scale	EVM	Comments	Price*
<b>Wireless Power Receivers</b>													
bq51003	WPC1.1	0.5	5	Linear	20	Stand Alone	✓	✓	✓	3x2x0.5	✓	2.5-W WPC1.1 receiver solution for wearable applications	1.30
bq51013B	WPC1.1	1	5	Linear	20	Stand Alone	✓	✓	✓	3x2x0.5	✓	~4-W WPC1.1 receiver solution	1.50
bq51050B/51B	WPC1.1	1	4.2/4.35	Battery Charger	20	Stand Alone	✓	✓	✓	3x2x0.5	✓	~4-W direct battery charger, WPC1.1 receiver solution	1.90
bq51010B	WPC1.1	1	7	Linear	20	Stand Alone	✓	✓	✓	3x2x0.5	✓	~4-W WPC1.1 receiver solution with 7-V outputs for reduced power loss	1.70
bq51020	WPC1.1	1.5	Adj (4-8)	Linear	20	I <sup>2</sup> C	✓	✓	—	3.6x2.9x0.5	✓	High-efficiency, >5-W WPC1.1 receiver solution with adj output voltage	2.50
bq51021	WPC1.1	1.5	Adj (4-8)	Linear	20	I <sup>2</sup> C	✓	✓	—	3.6x2.9x0.5	✓	High-efficiency, >5-W WPC1.1 receiver solution with adj output voltage and I <sup>2</sup> C control	2.60
bq51221	WPC1.1/ PMA	1.5	Adj (4-8)	Linear	20	I <sup>2</sup> C	✓	✓	—	3.6x2.9x0.5	✓	Dual-mode, high-efficiency, >5-W WPC1.1 and PMA receiver solution	3.00
bq51025	WPC1.1	2	Adj (4-10)	Linear	20	I <sup>2</sup> C	✓	✓	—	3.6x2.9x0.6	✓	10-W WPC1.1 receiver. Compatible with all WPC1.1 transmitters but supports 10 W with bq500215	4.00

Device	Standard	Transmitter Type	Number of Coils Supported	V <sub>IN</sub> (V)	Power (W)	Dynamic Power Limit	Comments				Automotive	Price*
<b>Wireless Power Transmitters</b>												
bq500210	WPC1.0	A1/A10	1	19	5	✓	WPC1.0 transmitter solution for 19-V <sub>IN</sub> systems					1.90
bq500211	WPC1.1	A5/A11	1	5	5	✓	WPC1.0 transmitter for low-cost, 5-V, non-WPC transmitters					1.90
bq500212A	WPC1.1	A5/A11	1	5	5	✓	Latest WPC1.1, 5-V transmitter with reduced BOM and improved, simplified FOD					2.00
bq500412A	WPC1.1	A6/A19	1,2,3	12	5	✓	Latest WPC1.1, A6 transmitter with reduced BOM and improved, simplified FOD					2.10
bq500414Q	WPC1.1	A6/A19/A21	1,2,3	12	5	✓	Q100-qualified A6 transmitter for automotive applications				✓	3.92
bq500215	WPC1.1	A29	1	12	10	✓	10-W WPC1.1 transmitter when working with bq51025. 5 W for all others					4.00

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

# LED Lighting

## General Illumination and Automotive Exterior

LED efficacy improvements and driver-IC integration are evolving at a fast pace, which drives down system costs for solid-state lighting (SSL). The result is that LEDs are becoming a standard for lighting applications that require:

- High efficiency
- Long lifetime
- Excellent dynamic range
- High controllability

Solid-state LED-based lighting is commonly found in:

- Indoor and outdoor area lighting
- Automotive interior and exterior lighting
- Retrofit replacement lamps

To address the demanding power requirements of solid-state lighting, Texas Instruments presents an extensive IC portfolio to support power conversion for a wide variety of LED products.

**AC/DC LED drivers** — TI offers AC/DC, LED-lighting-driver solutions that are dimmable, isolated and non-isolated, highly efficient and power-factor corrected. They also support long-life and compact form-factors while maintaining compatibility with installed fixtures and dimmers. Other features like overvoltage, overcurrent and overtemperature

protection ensure that LED lighting products are safer than the traditional bulbs they replace.

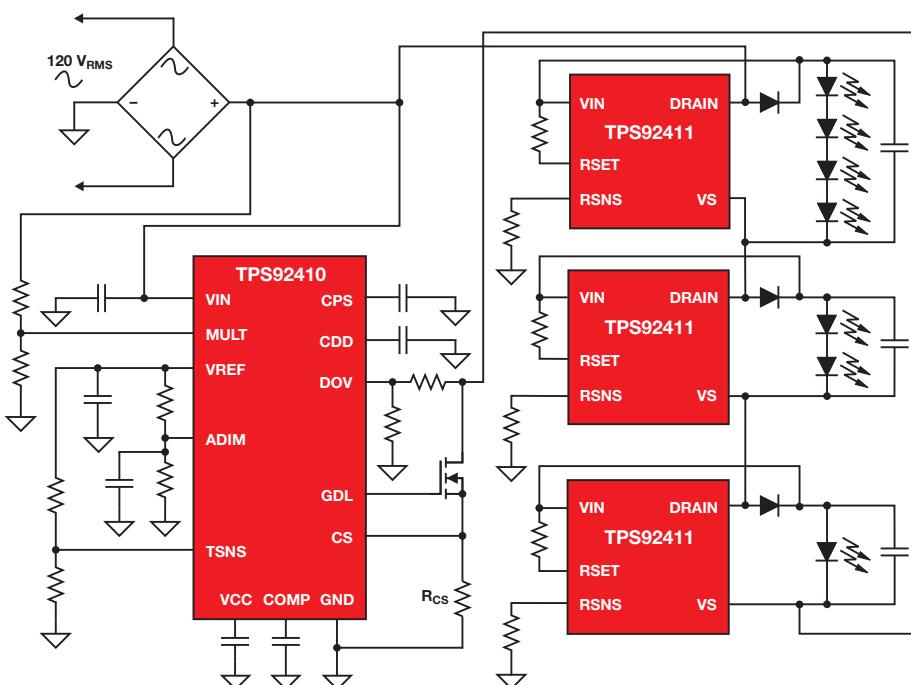
**DC/DC LED Drivers** — TI offers DC/DC lighting-driver solutions with wide input/output operating ranges that can be used in buck, boost, SEPIC and flyback architectures. Small solution sizes facilitate automotive exterior lighting, indoor and outdoor area lighting, and 12- to 24-V retrofit lamps such as MR16 and AR111.

Get more information:  
[www.ti.com/led](http://www.ti.com/led)

### Floating Switch for Offline AC Linear Direct Drive of LEDs with Low Ripple Current (Inductor and Transformer Free) with Integrated Linear Controller

#### TPS92410, TPS92411

The TPS92410/11 is an AC linear direct-drive solution capable of replacing a switch-mode power supply in LED lamps and downlights. It greatly reduces design complexity by eliminating magnetic components, yet delivers low-ripple and constant LED current using a novel energy storage technique. The solution yields near unity power factor, low total harmonic distortion, and near perfect compatibility with TRIAC and reverse phase dimmers. The TPS92410 current controller provides an analog interface for easy dimming when used in microcontroller-based lighting systems.

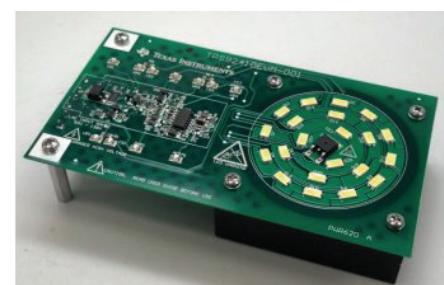


#### Applications

- LED lamps and light bulbs
- LED luminaires and downlights
- Indoor/outdoor area lighting

#### Evaluation Modules

Part Number	Description
TPS92410EVM-001	TPS92410 120-VAC, 5-W evaluation module
TPS92410EVM-002	TPS92410 230-VAC, 9.2-W evaluation module



Get more information:  
[www.ti.com/product/TPS92410](http://www.ti.com/product/TPS92410)  
or [TPS92411](http://www.ti.com/TPS92411)

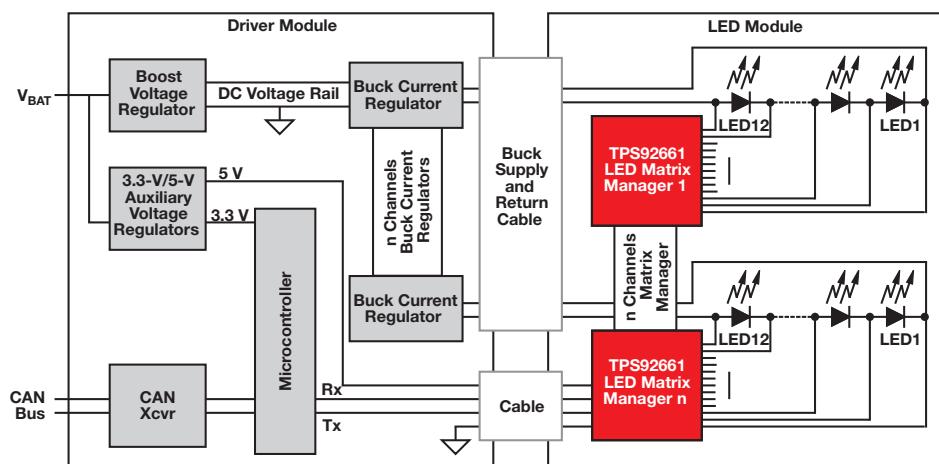
# LED Lighting

## General Illumination and Automotive Exterior

### High-Brightness LED Matrix Manager for Automotive Headlight Systems

#### TPS92661-Q1

The TPS92661-Q1 is the first integrated LED Matrix Manager IC for automotive headlamps. It reduces design complexity in dynamic headlamp systems through integration of 12-LED pixel channels, communications interface, control logic, and fault detection/reporting. Up to 8 TPS92661-Q1 devices can be controlled from a single MCU serial interface, which allows for individual control of up to 96 LEDs.



#### Applications

- Adaptive automotive headlight systems
- High-brightness LED matrix systems

#### Evaluation Module

Part Number	Description
TPS92661EVM-001	TPS92661-Q1 LED Matrix evaluation module

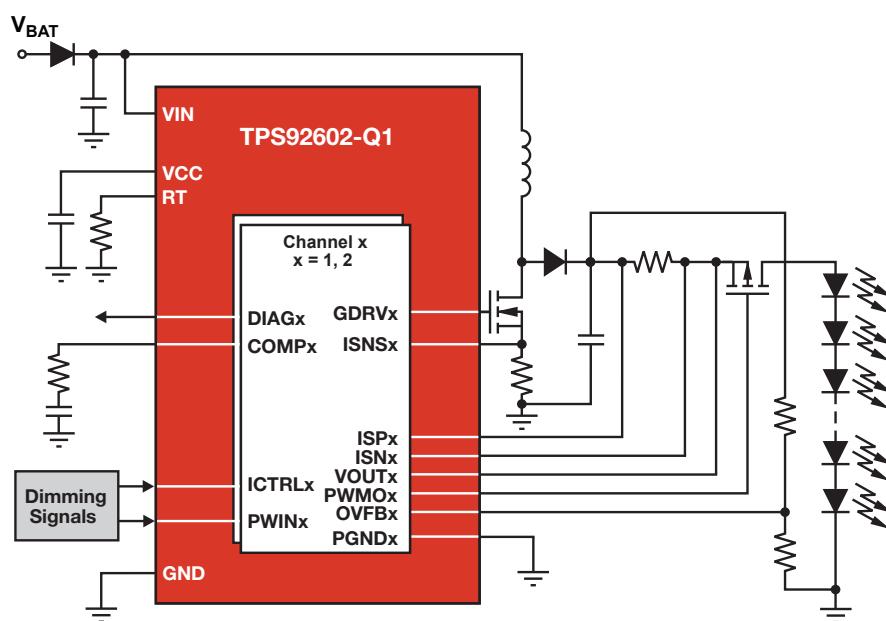
Get more information:

[www.ti.com/product/TPS92661-Q1](http://www.ti.com/product/TPS92661-Q1)

### 2-Channel, High-Side Current Sense, Switching LED Driver

#### TPS92602-Q1

The TPS92602-Q1 device is a dual-channel LED driver with high-side current sensing. With full protection and diagnostics, this device is dedicated to automotive front lighting. The base of each independent driver is a peak-current-mode boost controller. Each controller has a current-feedback loop with a high-side current-sensing shunt and a voltage-feedback loop with an external resistor-divider network.



#### Applications

- Automotive headlight systems
- High-brightness LED applications

#### Evaluation Module

Part Number	Description
TPS92602EVM	Dual-channel, high-side current sense, LED-driver evaluation module

Get more information:

[www.ti.com/product/TPS92602-Q1](http://www.ti.com/product/TPS92602-Q1)

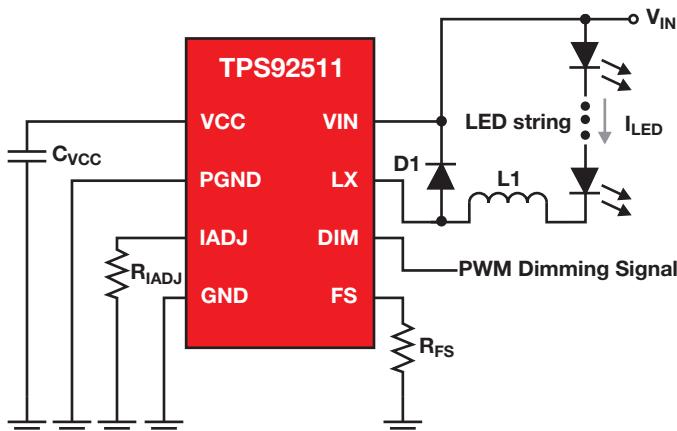
# LED Lighting

## General Illumination and Automotive Exterior

### 500-mA, 65-V Common-Anode, Constant-Current, Buck LED Driver without External Current-Sense Resistor

#### TPS92511

The TPS92511 is a 65-V input, 500-mA output, constant-current buck converter that requires only five external components for operation. Switching frequency is programmable from 50 kHz to 500 kHz using a high-value external resistor. LED brightness can be controlled using PWM or analog dimming methods with up to 1000:1 contrast ratio. LED current is sensed internally, which eliminates the need for an expensive power resistor. Protection features include: internal UVLO, internal current limit and thermal shutdown.

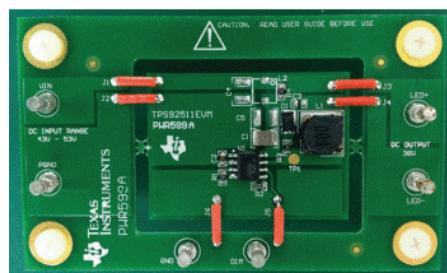


#### Applications

- Indoor/outdoor area lighting
- Architectural lighting
- White-goods lighting

#### Evaluation Module

Part Number	Description
TPS92511EVM	TPS92511 43- to 55-VDC input, 19-W, evaluation module



Get more information:  
[www.ti.com/product/TPS92511](http://www.ti.com/product/TPS92511)

#### Selection Guide

Device	V <sub>IN</sub> (min) (V)	V <sub>IN</sub> (max) (V)	LED Voltage (max) (V)	Switching Frequency	DC/DC or AC/DC Control	Isolated Applications	Non-Isolated Applications	Topology	LED Configuration	Dimming	PFC	EVM	Package(s)	Price*
<b>AC/DC High-Brightness LED Drivers</b>														
TPS92023	11.5	18	Configurable	Adj: 40 to 380 kHz	DC/DC	✓	✓	Half-Bridge	Multi-String Series/Parallel	PWM		✓	8 SOIC	0.65
TPS92210	9	20	Configurable	Adj: 30 to 140 kHz	AC/DC	✓	✓	Flyback	Series/Parallel	External	✓	✓	8 SOIC	0.60
TPS92074	11	18.5	Configurable	Adj: 50 to 300 kHz	AC/DC		✓	Buck/Buck-Boost	Series/Parallel	External	✓		6 TSOT, 8 SOIC	0.45
TPS92075	11	18.5	Configurable	Adj: 50 to 300 kHz	AC/DC		✓	Buck/Buck-Boost	Series/Parallel	TRIAC, TE	✓	✓	6 TSOT, 8 SOIC	0.65
TPS92310	13	36	Configurable	Adj: 60 to 150 kHz	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	External	✓	✓	10 MSOP/16 SOIC	0.50
TPS92314/14A	13	35	Configurable	Adj: 60 to 150 kHz	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	External	✓	✓	8 SOIC	0.50
TPS92315	9	35	Configurable	Adj: 44 to 130 kHz	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	External		✓	6 SOT23	0.35
LM3444	8	13	Configurable	Adj: 30 kHz to 1 MHz	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	External	✓	✓	10 MSOP	0.55
LM3445	8	12	Configurable	Adj: 30 kHz to 1 MHz	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	TRIAC, TE	✓	✓	10 MSOP, 14 SOIC	0.60
LM3447	7.5	17.5	Configurable	Adj: 60 to 120 kHz	AC/DC	✓	✓	Flyback	Series/Parallel	TRIAC, TE	✓	✓	14 TSSOP	0.65
LM3450/50A	8.5	20	Configurable	Adj: 60 to 120 kHz	AC/DC	✓	✓	Flyback	Series/Parallel	TRIAC, TE	✓	✓	16 TSSOP	1.00
UCC28810	15.4	18	Configurable	Adj: 5 to 250 kHz	AC/DC	✓	✓	Flyback/Boost	Series/Parallel	External	✓	✓	8 SOIC	0.32
UCC28811	12	18	Configurable	Adj: 5 to 250 kHz	AC/DC	✓	✓	Flyback/Boost	Series/Parallel	PWM/Analog	✓	✓	8 SOIC	0.32
TPS92561	6.5	42	Configurable	Adj: 50 kHz to 1.5 MHz	AC/DC		✓	Boost	Series/Parallel	TRIAC, TE	✓	✓	8 eMSOP	0.65
TPS92410	9.5	450	Configurable	—	AC/DC		✓	Linear	Series/Parallel	TRIAC, TE, PWM	✓	✓	13 SOIC	0.65
TPS92411	7.5	100	Configurable	—	AC/DC		✓	Linear	Series	TRIAC, TE	✓	✓	5 SOT23, 8 PSOP	0.23

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# LED Lighting

## General Illumination and Automotive Exterior

### Selection Guide (Continued)

Device	Max LED Current (A)	Input Voltage Range (V)	Max Output Voltage (V)	Max Number of LEDs in Series	Switching Frequency	Topology	Features	Packaging	Automotive	Price*
<b>DC/DC High-Brightness LED Drivers</b>										
<b>LM3402/02HV</b>	0.5	6.0 to 42/75	40/73	12/20	Adj: 20 kHz to 1 MHz	Buck	Fast PWM dimming, no control loop compensation, supports ceramic capacitor and capacitor-less outputs	8 SSOP/PSOP		0.80/0.85
<b>LM3404/04HV</b>	1	6.0 to 42/75	40/73	12/20	Adj: 20 kHz to 1 MHz	Buck	Fast PWM dimming, no control loop compensation, supports ceramic capacitor and capacitor-less outputs	8 SOIC/PSOP		0.85/0.90
<b>LM3406/06HV</b>	1.5	6.0 to 42/75	40/73	12/20	Adj: 20 kHz to 1 MHz	Buck	Fast PWM dimming, no control loop compensation, supports ceramic capacitor and capacitor-less outputs	14 eTSSOP	✓	0.95/1.00
<b>TPS92510</b>	1.5	3.5 to 60	57	15	Prog: 100 kHz to 2.5 MHz	Buck	Thermal foldback, analog and PWM dimming, frequency sync	10 eMSOP		1.05
<b>TPS92511</b>	0.5	4.5 to 65	60	17	Prog: 100 to 500 kHz	Floating Buck	Pulse level modulation method, thermal foldback, no current sense resistor	8 HSOIC		0.60
<b>LM3414/14HV</b>	1	4.5 to 45/65	42/63	16	Prog: 250 kHz to 1 MHz	Floating Buck	Thermal foldback, analog and PWM dimming, no external current sense resistor	8 ePSOP/WSON		0.70/0.80
<b>LM3409/09HV</b>	5	6.0 to 42/75	42/73	13/20	Adj: 50 kHz to 2 MHz	Buck	PWM and analog dimming, high-side current sense, 100% duty cycle achievable	10 VSSOP/14 PDIP	✓	0.70/0.75
<b>TPS92550</b>	0.45	4.5 to 36	34	10	400 kHz	Buck	Integrated micro-module	7 TO-PMOD		3.00
<b>TPS92551</b>	0.45	4.5 to 60	57	16	800 kHz	Buck	Integrated micro-module	7 TO-PMOD		3.25
<b>TPS92690</b>	>3	4.5 to 75	75	22	Prog: 200 kHz to 2 MHz	Boost, SEPIC, Cuk, Flyback	Synchronizable, fixed frequency with low-side sense resistor and overvoltage protection	16 eTSSOP	✓	1.45
<b>LM3421/23/29</b>	>3	4.5 to 75	75	22	Adj: 100 kHz to 2 MHz	Boost, Buck-Boost, SEPIC, Buck, Flyback	Fast PWM dimming, LED ready, broken open check overvoltage protection, FLT, cycle-by-cycle current limit, high-side sense resistor	14/16/20 eTSSOP	✓	1.15/1.25/1.00
<b>LM3424</b>	>3	4.5 to 75	75	22	Prog: 25 kHz to 2 MHz	Boost, Buck-Boost, SEPIC, Buck, Flyback	Temperature foldback, synchronizable 50-kHz max PWM dimming, high-side sense resistor	20 HTSSOP	✓	1.30
<b>TPS92601-Q1</b>	>3	4.0 to 40	75	22	Prog: 100 kHz to 600 kHz	Boost, Buck-Boost, SEPIC, Buck, Flyback	Synchronizable, fixed-frequency, current monitor output, LED open detection, output short detection and protection	20 HTSSOP	✓	2.12
<b>TPS92602-Q1</b>	>3	4.0 to 40	75	22	Prog: 100 kHz to 600 kHz	Boost, Buck-Boost, SEPIC, Buck, Flyback	Dual-channel synchronizable, fixed-frequency, current monitor output, LED open detection, output short detection and protection	28 HTSSOP	✓	3.00
<b>TPS92661-Q1</b>	1.5	4.5 to 60	—	12	—	Switch	12-channel LED matrix controller with LED open/short detection and protection, UART serial communications interface	48 HTQFP	✓	3.70
<b>TPS92630-Q1</b>	0.45	5.0 to 40	39	12	—	Linear	3-channel LED open/short detection and protection	16 HTSSOP	✓	0.90
<b>TPS92638-Q1</b>	0.56	5.0 to 40	39	12	—	Linear	8-channel LED open/short detection and protection	20 HTSSOP	✓	TBD
<b>LM3463</b>	1.2	12 to 95	95	25	—	Linear	Dynamic headroom control, 6 output channels	48 WQFN		2.35
<b>LM3464/64A</b>	1.4	12 to 80/95	80/95	25	—	Linear	Dynamic headroom control, 4 output channels	28 eTSSOP		2.00/2.10
<b>LM3466</b>	1.5	6 to 70	70	20	—	Linear	LED string current equalization	8 ePSOP		0.75
<b>LM3410X/Y</b>	1	2.7 to 5.5	24	6	525 kHz/1.6 MHz	Boost, SEPIC	PWM dimming, small footprint, low external component count	5 SOT23, 6 WSON, 8 MSOP	✓	1.00
<b>LM3431</b>	0.6	5.0 to 36	40	11	Prog: 200 kHz to 1 MHz	Boost	3-output channels, linear current controller	28 TSSOP/LLP	✓	1.20
<b>LM3492/92HC</b>	0.2/0.25	4.5 to 65	65	17	Prog: 200 kHz to 1 MHz	Boost	2 output channels, dynamic headroom control, 10000:1 dimming contrast ratio	20 eTSSOP	✓	1.00/1.30
<b>TPS40211</b>	>3	4.5 to 52	50	15	Prog: 35 kHz to 1 MHz	Boost, SEPIC, Flyback	Programmable soft start, overcurrent protection with auto retry, external synchronization frequency	10 MSOP, 10 SON	✓	0.80
<b>TPS92560</b>	>1	6.5 to 42	42	11	Adj: 50 kHz to 1.5 MHz	Buck, SEPIC	Integrated active low-side input rectifiers	10 SOIC		0.72
<b>TPS92640/41</b>	5	7 to 85	83	23	Adj: 50 kHz to 1 MHz	Buck	Wide dimming range: Up to 20000:1 with shunt FET PWM	14/16 TSSOP		1.20/1.40
<b>TPS92660</b>	>2	10 to 80	75	21	Adj: 50 kHz to 1 MHz	Buck + Linear	2-string LED driver with I <sup>2</sup> C/EEPROM current trim for high CRI lighting	20 eTSSOP		1.30
<b>LM3433/34</b>	>6	-9.0 to -14/-30	-11/-27	1	Adj: 200 kHz to 1 MHz	Buck	Drives common-anode LEDs tied to the ground referenced chassis, no output capacitor, analog and fast PWM dimming	24 LLP/WQFN		1.25/1.29

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**.

Preview devices are listed in **bold teal**.

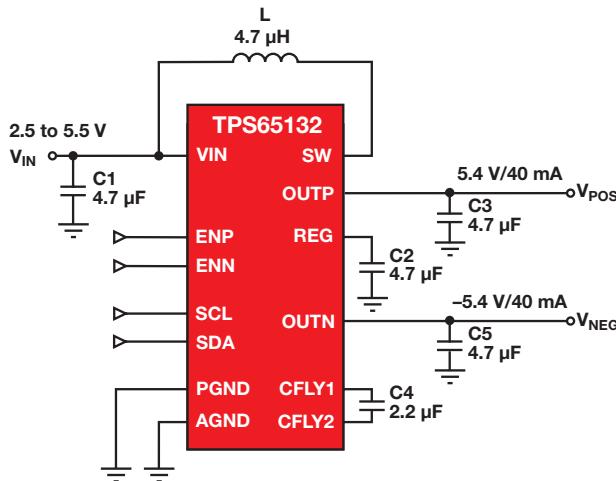
# Display Power

## LCD Bias and AMOLED Bias Solutions

### Dual-Output LCD Bias for Smartphones, Tablets and Other Split-Rail Power-Supply Applications

#### TPS65132

The TPS65132 is designed to support positive/negative-driven TFT-LCD panels up to at least 10 inches. It can also be used as a split-rail converter to drive general-purpose, dual-power-supply applications such as a headphone amplifier. The two output rails are usually connected to the source-driver IC. The device uses a single inductor scheme for the smallest solution size possible as well as high efficiency.



Get more information: [www.ti.com/product/TPS65132](http://www.ti.com/product/TPS65132)

#### Key Features

- >85% efficiency
- Dual output with only one inductor
- 15-bump CSP or 20-pin QFN packages
- Maximum output current: 80 mA
- Internal memory (EEPROM type 1000x programmable)
- Programmable sequencing
- Enable pin function—no hard reset (values stay in memory)
- 2.5- to 5.5-V input-voltage range
- Positive output voltage: 4.0 to 6.0 V (0.1-V steps)
- Negative output voltage: -4.0 to -6.0 V (0.1-V steps)
- Excellent line-transient regulation
- Programmable active discharge
- UVLO rising/falling

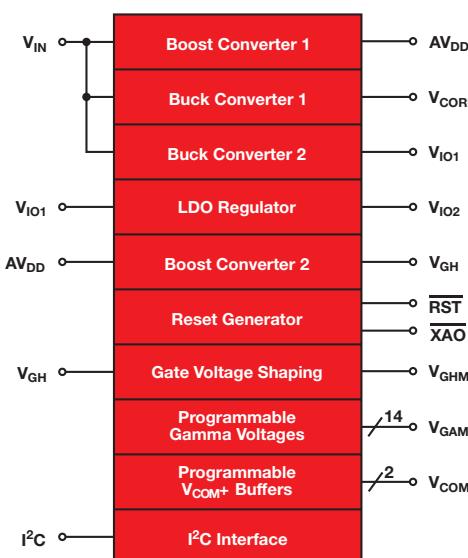
#### Applications

- Smartphone and tablet
- Dual-power-supply applications

### LCD Bias with Integrated Gamma Reference for Notebook PCs, Tablets and Monitors

#### TPS65642

The TPS65642 is a compact LCD bias solution primarily intended for use in notebook PCs and tablets. The device comprises two boost converters to supply the LCD panel's source driver and gate driver/level shifter; two buck converters and an LDO linear regulator to supply the system's logic voltages; a programmable V<sub>COM</sub> generator with two high-speed amplifiers; 14-channel gamma-voltage correction; and a gate-voltage shaping function.



Get more information: [www.ti.com/product/TPS65642](http://www.ti.com/product/TPS65642)

#### Key Features

- Supports GIP and non-GIP displays
- I<sup>2</sup>C interface
- 56-ball, 3.16 × 3.45-mm WCSP package with 0.4-mm pitch
- 2.6- to 6.0-V input-voltage range
- Programmable synchronous boost converter (AV<sub>DD</sub>)
- Nonsynchronous boost converter with optional temperature compensation
- Programmable synchronous buck converters (V<sub>CORE</sub> and V<sub>IO1</sub>)
- Programmable low-dropout regulator
- Programmable V<sub>COM</sub> calibrator with two integrated buffer amplifiers
- 14-channel, 10-bit programmable gamma-voltage reference
- Gate-voltage shaping
- /XAO panel and T-CON reset signals
- E2PROM with write protect
- Thermal shutdown

#### Applications

- Notebook PCs
- Tablets

# Display Power

## LCD Bias and AMOLED Bias Solutions

### Selection Guide

Device	V <sub>IN</sub> (V)	Boost I <sub>Limit</sub> (min) (A)	Buck I <sub>Limit</sub> (min) (A)	Features <sup>1</sup>								Price*			
				Isolation Switch	V <sub>GH</sub>	V <sub>GL</sub>	GVS	V <sub>Com</sub>	Other						
<b>Solutions for Large LCDs (TVs)</b>															
TPS65160/A	12	2.8	2	External	Driver	Driver	—	—					2.14		
TPS65161	12	2.8	2.3	External	Driver	Driver	—	—					2.78		
TPS65161A	12	3.7	2.3	External	Driver	Driver	—	—					2.78		
TPS65161B	12	3.7	2.5	External	Driver	Driver	—	—					2.78		
TPS65162	12	2.8	2.8	Integrated	Driver	Driver	Yes	2 op amps					2.45		
TPS65163	12	2.8	1.5	External	Controller	Controller	In level shifter	—	9-ch level shifter, LCD discharge, reset generator				2.32		
TPS65168	12	3.5	2.8	Integrated	Controller	Controller	—	—	I <sup>2</sup> C programmable, 2 buck, temp. compensation, reset				2.10		
TPS65170	12	2.8	1.5	External	Controller	Controller	—	—	Reset				1.40		
TPS65176	12	3.5	2.5	External	Controller	Controller	—	—	Max AVDD 18.5 V, Vlogic 3.3 V				1.00		
TPS65178	12	3.5	2.6	Integrated	Controller	Controller	—	—	Integrated 6-ch gamma buffer, I <sup>2</sup> C, V <sub>Com</sub> , bucks for HVDD, VCC, VCORE, VEPI, boost for VDD				1.90		
TPS65177	12	4.25	3	Integrated	Controller	Controller	Yes	—	Temp compensation, I <sup>2</sup> C, 1 boost, 3 bucks				1.90		
TPS65175/B	12	3.5	2.6	Integrated	Controller	Controller	Yes	1 op amp	Integrated 6-ch gamma buffer, I <sup>2</sup> C, V <sub>Com</sub> , bucks for HVDD, VCC, VCORE, VEPI, boost for VDD, 12-ch level shifter				2.00		
Device	V <sub>IN</sub> (V)	Boost I <sub>Limit</sub> (min) (A)	Overvoltage Protection	Isolation Switch	V <sub>Logic</sub>	V <sub>GH</sub>	V <sub>GL</sub>	GVS	V <sub>Com</sub>	Other	Automotive	Price*			
<b>Solutions for Medium and Small LCDs (Monitors and Notebooks)</b>															
TPS65100/Q1	5	1.6	Yes	—	LDO controller	Integrated	Driver	—	1 buffer				✓ 1.87		
TPS65105	5	0.96	Yes	—	LDO controller	Integrated	Driver	—	1 buffer				1.87		
TPS65140/Q1	5	1.6	Yes	—	LDO controller	Integrated	Driver	—	—				✓ 1.71		
TPS65142	5	1.8	Yes	—	LDO	Driver	External	Yes	1 buffer	Integrated 6-ch WLED backlight driver, with integrated MOSFET			1.35		
TPS65145/Q1	5	0.96	Yes	—	LDO controller	Integrated	Driver	—	—				✓ 1.71		
TPS65146	2.5 to 6	2	Yes	—	LDO	Integrated	External	Yes	1 buffer				1.40		
TPS65148	2.5 to 6	4	Yes	External	LDO	External	External	Yes	1 buffer	LDO for gamma, reset (/XAO), LCD discharge			2.10		
TPS65149	3 to 6	4.0	Yes	External	—	Controller	Controller	—	Programmable, no buffer	Level shifters, reset			1.90		
TPS65150/Q1	5	2	Yes	External	—	Driver	Driver	Yes	1 buffer				✓ 1.92		
TPS65165	5	4.4	Yes	—	—	Integrated	Driver	Yes	2 op amps, 1 buffer				1.80		
TPS65642/A	5	2.5	Yes	—	LDO	Integrated	External	Yes	2 buffers	I <sup>2</sup> C, 14-ch gamma buffer			1.70		
TPS65154	5	2.4	Yes	—	LDO	Integrated	Integrated	Yes	1 buffer	6-ch WLED backlight driver, I <sup>2</sup> C			1.35		

<sup>1</sup>V<sub>GH</sub> = Positive LCD rail voltage, V<sub>GL</sub> = Negative LCD rail voltage, GVS = Gate-voltage shaping for V<sub>GH</sub>,

\*Suggested resale price in U.S. dollars in quantities of 1,000.

V<sub>Com</sub> = LCD V<sub>Com</sub> voltage source, and HVS = High-voltage stress-test control.

Device	Description	Number of Channels			V <sub>GH1</sub> (max) (V)	V <sub>GH2</sub> (max) (V)	V <sub>GL</sub> (max) (V)	V <sub>Com</sub>	GVS/GPM	Charge Sharing	Other	Package	Price*
		Clock	Discharge	Additional									
<b>LCD Support IC Solutions (Scan Drivers/Level Shifters)</b>													
TPS65192	10-channel level shifter for LCD displays w/GPM	7	1	2	38	38	-15	—	Yes	—	LCD discharge	QFN-28	1.40
TPS65194	13-channel level shifter for LCD displays w/V <sub>Com</sub> op amp	6	1	6	38	38	-15	Op amp 200 mA	—	—	State machine	QFN-24	0.80
TPS65193	5-channel level shifter for LCD displays (dual channel scan driver)	5	—	—	35	—	-28	—	—	—	Yes	QFN-24	0.80
TPS65196	15-channel level shifter for LCD displays	8	1	6	38	38	-23	—	Yes	—	Soft-start	QFN-28	0.80
TPS65198	13-channel level shifter for LCD displays w/V <sub>Com</sub> op amp	6	1	6	38	38	-23	Op amp 200 mA	Yes	—	4x4 package	QFN-24	1.00
TPS65197	8-channel level shifter supporting different charge-sharing methods and panel discharge	6	2	—	45	—	-20	—	—	Selectable: Disable, Method 1, Method 2	4x4 package	QFN-28	1.00

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Display Power

## LCD Bias and AMOLED Bias Solutions

### Selection Guide (Continued)

Device <sup>1</sup>	V <sub>IN</sub> (V)	LDO 1	LDO 2	Charge Pump 1	Charge Pump 2	Application	Communication Interface	V <sub>Com</sub> Adjust	Active Discharge	P2P with TPS65181/2	Package	Price*
<b>Solutions for E-Readers</b>												
TPS65185	3 to 6	15 V, 120 mA	-15 V, 120 mA	22 V, 10 mA	-20 V, 12 mA	Power supply for Active Matrix E Ink® Vizplex® panels	I <sup>2</sup> C	User programmable (internal)	Yes	No	QFN-48 (0.5 mm 7x7 or 0.4 mm 6x6)	1.75
TPS65186	3 to 6	15 V, 120 mA	-15 V, 120 mA	22 V, 10 mA	-20 V, 12 mA	Power Supply for Active Matrix E Ink Vizplex panels	I <sup>2</sup> C	User programmable (internal)	No	Yes	QFN-48 (0.5 mm 7x7)	1.75

<sup>1</sup>See datasheets for more specifications.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

Device	Description	Features	V <sub>IN</sub> (min) (max) (V)	Frequency	A <sub>VDD</sub> I <sub>Limit</sub> (min) (mA)	A <sub>VDD</sub> (max) (V)	Isolation Switch	V <sub>Logic1</sub> I <sub>Limit</sub> (min) (A)	V <sub>Logic1</sub> (min) (V)	V <sub>GH</sub> (I <sub>GH</sub> )	V <sub>GL</sub> (I <sub>GL</sub> )	Other	Package	Price*	
<b>LCD SFF/MFF — IPS and OLED Solutions (&lt;5 V)</b>															
TPS65120	4-ch single inductor multiple outputs (SIMO) bias IC w/fixed 3.3-V V <sub>Logic</sub>	Small form factor	2.5	5.5	4 MHz	7.5/25	5.6	Internal	LDO controller	Fixed 3.3	Integrated 20 V max. (6 mA)	Inverter -18 V max. (6 mA)	—	QFN-16	0.95
TPS65121	4-ch single inductor multiple outputs (SIMO) bias IC w/fixed 1.8-V V <sub>Logic</sub>	Small form factor	2.5	5.5	4 MHz	7.5/25	5.6	Internal	LDO controller	Fixed 1.8	Integrated 20 V max. (6 mA)	Inverter -18 V max. (6 mA)	—	QFN-16	0.95
TPS65124	3-ch single inductor multiple outputs (SIMO) bias IC w/ adjustable sequencing	Small form factor	2.5	5.5	4 MHz	7.5/25	5.6	Internal	—	—	Integrated 20 V max. (6 mA)	Inverter -18 V max. (6 mA)	Adjustable sequencing	QFN-16	0.95
TPS65130	Dual positive and negative outputs (700 mA)	OLED, CCD sensor	2.7	5.5	1.4 MHz	—	—	External	—	—	Boost 15 V max. (0.7 A I <sub>Limit</sub> )	Inverter -15 V max. (0.7 A I <sub>Limit</sub> )	—	QFN-24	1.70
TPS65131/Q1 <sup>†</sup>	Dual positive and negative outputs (1800 mA)	OLED, CCD sensor	2.7	5.5	1.4 MHz	—	—	External	—	—	Boost 15 V max. (1.8 A I <sub>Limit</sub> )	Inverter -15 V max. (1.8 A I <sub>Limit</sub> )	—	QFN-24	2.20
TPS65136	Single inductor multiple outputs (SIMO) for positive and negative output	AMOLED	2.3	5.5	40 kHz to 1 MHz	—	—	Internal	—	—	Boost fixed 4.6 V (80 mA)	Inverter -6 V max. (80 mA)	—	QFN-16	1.20
TPS65137	Dual positive and negative output w/digital V <sub>neg</sub> adjustment	AMOLED	2.3	5.5	1.6 MHz	—	—	Internal	—	—	Boost fixed 4.6 V (200 mA)	Inverter -5.2 V max. (200 mA)	Digital adjust for V <sub>GL</sub>	QFN-10	0.85
TPS65138	Dual positive and negative output w/digital V <sub>neg</sub> adjustment	AMOLED	2.9	4.5	1.6 MHz	—	—	Internal	—	—	Boost fixed 4.62 V (300 mA)	Inverter -2.2 down to -5.2 V max. (300 mA)	0.8% Vpos accuracy	QFN-10	0.95
TPS65631	Dual-output AMOLED display power supply	AMOLED	2.9	4.5	1.7 MHz	—	—	Internal	—	—	Boost fixed 4.6 V (300 mA)	Inverter -1.4 down to -4.4 V max. (300 mA)	0.5% Vpos accuracy	QFN-12	1.20
TPS65631W	Dual-output AMOLED display power supply	AMOLED	2.9	4.5	1.7 MHz	—	—	Internal	—	—	Boost fixed 4.6 V (300 mA)	Inverter -1.4 down to -4.4 V max. (250 mA)	0.5% Vpos accuracy	QFN-10	1.20
TPS65632A	Triple-output AMOLED display power supply	AMOLED	2.9	4.5	1.7 MHz	—	—	Internal	—	—	Boost fixed 4.6 V (300 mA)	Inverter -1.4 down to -4.4 V max. (300 mA)	0.5% Vpos accuracy, fixed AVDD of 7.7 V	QFN-16	1.50
TPS65135	Single inductor multiple outputs (SIMO) for positive and negative output	SFF/MFF IPS panel	2.5	5.5	1 MHz	—	—	Internal	—	—	Boost up to 6 V	Inverter down to -7 V	80-mA output current, 50% current mismatch	QFN-16	1.20
TPS65132	Dual-output SIMO for smartphones, tablets & general purpose dual supplies	SFF/MFF IPS panel	2.5	5.5	1.8 MHz	—	—	Internal	—	—	Boost up to 6 V	Inverter down to -6 V	80-mA output current, 100% current mismatch, single inductor	CSP-15	1.30
TPS65132W	Dual-output SIMO for smartphones, tablets & general purpose dual supplies	SFF/MFF IPS panel	2.5	5.5	1.8 MHz	—	—	Internal	—	—	Boost up to 6 V	Inverter down to -6 V	80-mA output current, 100% current mismatch, single inductor	QFN-20	1.30
TPS65133	Dual-output SIMO for smartphones, tablets & general purpose dual supplies	SFF/MFF IPS panel	2.9	5	1.7 MHz	—	—	Internal	—	—	Boost fixed at 5 V	Buck-boost fixed at -5 V	250-mA output current, 100% current mismatch, dual inductor	QFN-12	1.00

<sup>†</sup>Automotive qualified.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### Gamma Buffers

Channels	0-V <sub>Com</sub> Channels	1-V <sub>Com</sub> Channels	2-V <sub>Com</sub> Channels	Channels	0-V <sub>Com</sub> Channels	1-V <sub>Com</sub> Channels	2-V <sub>Com</sub> Channels
22 (+2 static)			BUF22821	8		BUF08821, BUF08832, BUF08630	
18		LM8207	BUF18830, BUF20800, BUF20820	7		BUF08800	
16			BUF16821	6	BUF06703, BUF06704	BUF07702/3/4	
14			BUF16820	4	BUF04701	BUF05703, BUF05704	
12	BUF12800, BUF12840			0		BUF01900, BUF01901	
10		BUF11702/4/5					

# Display Power

## LED Drivers—Backlighting

### Design Factors

**Dot Correction** — Creates uniform LED brightness. Gives the ability to dynamically control the output current.

**Grayscale** — Provides an enhanced color spectrum per LED equivalent with the number of grayscale steps available.

### Output Voltage Monitor

Monitors voltages at constant current output terminals to detect LED failure and short circuit.

**LED Open Detection** — Indicates a broken or disconnected LED at an output terminal.

**Thermal Error Flag** — Indicates an overtemperature condition.

**Watchdog Timer** — Turns output off when scan signal is stopped.

**Thermal Shutdown** — Turns output off when junction temperature exceeds its limit.

### LED Drivers Function Guide

Multichannel	TPS61150/1 ~14 WLEDs, 2 x 35 mA, $V_{OUT}$ (max) = 27 V, $V_{IN}$ = 2.5 to 6.0 V	TPS61185 ~80 WLEDs, 8 x 25 mA, $V_{OUT}$ (max) = 38 V, $V_{IN}$ = 4.2 to 24 V	TPS61176 60 LEDs, 6 x 30 mA, $V_{OUT}$ (max) = 40 V, $V_{IN}$ = 2.7 to 6.5 V	TPS61196 120 LEDs, 6 x 200 mA*, $V_{OUT}$ (max) = 120 V, $V_{IN}$ = 8 to 30 V
Single Channel	TPS61183 ~80 WLEDs, 6 x 30 mA, $V_{OUT}$ (max) = 38 V, $V_{IN}$ = 4.5 to 24 V	LM3532 30 LEDs, 3 x 30 mA, $V_{OUT}$ (max) = 40 V, $V_{IN}$ = 2.7 to 5.5 V	LP8553 40–44 WLEDs, 4 x 55 mA, $V_{OUT}$ (max) = 40 V, $V_{IN}$ = 2.7/4.5 to 22 V	TPS61199 ~120 WLEDs, 8 x 80 mA, $V_{OUT}$ (max) = 60 V, $V_{IN}$ = 4.5 to 21 V
	LM3630 20 LEDs, 2 x 28 mA, $V_{OUT}$ (max) = 40 V, $V_{IN}$ = 2.3 to 5.5 V	LM3533 20 LEDs, 2 x 30 mA, $V_{OUT}$ (max) = 40 V, $V_{IN}$ = 2.7 to 5.5 V	LP8545 40–44 WLEDs, 4 x 55 mA, $V_{OUT}$ (max) = 40 V*, $V_{IN}$ = 2.7/4.5 to 22 V	TPS61195 ~96 WLEDs, 8 x 30 mA, $V_{OUT}$ (max) = 45 V, $V_{IN}$ = 4.5 to 21 V
	TPS61166 ~3s3p WLEDs, 300 mA, $V_{OUT}$ (max) = 18 V, $V_{IN}$ = 2.5 to 10 V	TPS61062 ~5 WLEDs, 25 mA, $V_{OUT}$ (max) = 23 V, $V_{IN}$ = 2.7 to 6.0 V	TPS61500 ~12 WLEDs, 3.8 A, $V_{OUT}$ (max) = 38 V, $V_{IN}$ = 2.9 to 18 V	TPS61165 ~27 WLEDs, 3s9p, 350 mA, $V_{OUT}$ (max) = 38 V, $V_{IN}$ = 3.0 to 18 V
	TPS61060 ~3 WLEDs, 40 mA, $V_{OUT}$ (max) = 14 V, $V_{IN}$ = 2.7 to 6.0 V	TPS61160 ~6 WLEDs, 20 mA, $V_{OUT}$ (max) = 26 V, $V_{IN}$ = 2.7 to 18 V	LM3530 10 LEDs, 1 x 30 mA, $V_{OUT}$ (max) = 40 V, $V_{IN}$ = 2.7 to 5.5 V	TPS61161 ~10 WLEDs, 20 mA, $V_{OUT}$ (max) = 38 V, $V_{IN}$ = 2.7 to 18 V
	TPS61061 ~4 WLEDs, 30 mA, $V_{OUT}$ (max) = 18 V, $V_{IN}$ = 2.7 to 6.0 V			

20

30

40

60

Overvoltage Protection,  $V_{OUT}$  Maximum (V)

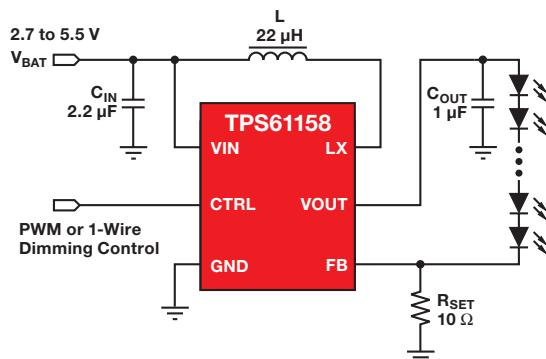
# Display Power

## LED Drivers—Backlighting

### 30-V WLED Driver with Integrated Power Diode

#### TPS61158

With a 30-V-rated integrated switch FET and power diode, the TPS61158 is a boost converter that drives LEDs in series. The boost converter runs at a 750-kHz fixed switching frequency to reduce output ripple, improve conversion efficiency and allow for the use of small external components.



#### Applications

- Feature phones
- Smartphones
- Portable media players
- Ultra mobile devices
- GPS receivers
- Backlight for small- and media-form-factor LCD display

Get more information: [www.ti.com/product/TPS61158](http://www.ti.com/product/TPS61158)

#### Key Features

- Integrated 0.6-A, 30-V internal switch FET and power diode
- 2 x 2 x 0.8-mm, 6-pin QFN package with thermal pad
- Flexible digital and PWM brightness control (analog dimming implemented)
- PWM dimming-control interface (20 kHz up to 100 kHz)
- 2.7- to 5.5-V input-voltage range
- 28-V open LED protection (up to 8 LEDs)
- 750-kHz switching frequency
- 1-wire control interface (EasyScale™)
- Up to 100:1 PWM dimming ratio
- Integrated loop compensation
- Built-in soft start
- Built-in WLED open protection
- Thermal shutdown

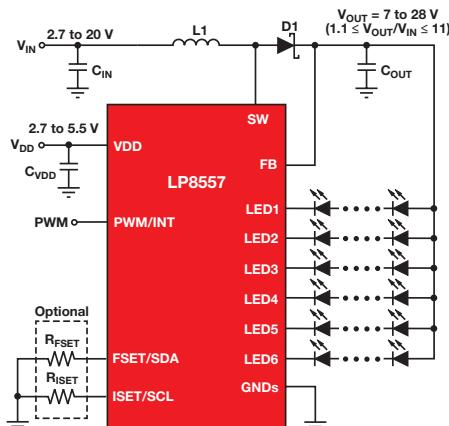
### 6-Channel, High-Efficiency WLED Drivers Supporting Single-Cell-Battery Inputs

#### LP8557, TPS61176

The LP8557 and TPS61176 provide highly integrated solutions for tablet PC backlighting and support an input voltage as low as 2.7 V (suitable for a single-cell battery). Both devices support 6 channels of LEDs and mixed-mode dimming for high efficiency.

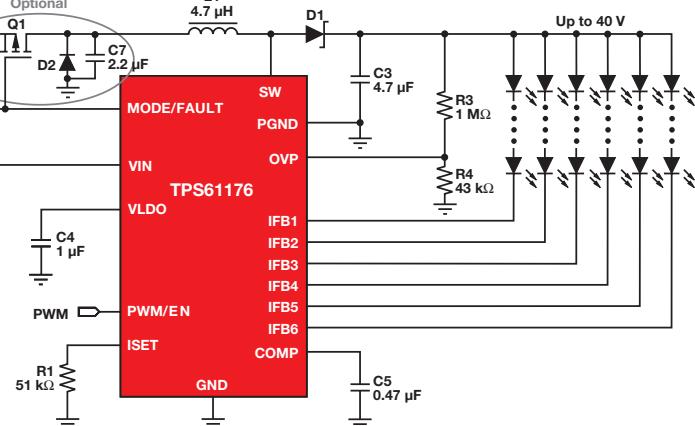
#### Key Features (LP8557/TPS61176)

- Maximum LED current per channel: 25 mA/30 mA
- Dimming methods: PWM, adaptive, pure analog
- Programmability: Resistor
- Package: 16 SMD/16 QFN
- Content adjusted backlight (LP8557)



- Backlight for small and medium form-factor LCD display with input from single-cell or multicell battery

#### Applications



Get more information: [www.ti.com/product/LP8557](http://www.ti.com/product/LP8557) or [TPS61176](http://www.ti.com/product/TPS61176)

# Display Power

## LED Drivers—Backlighting

### Selection Guide

Device	V <sub>IN</sub> (V)	Synchronous	Type	Number of LEDs <sup>1</sup>	OLED Capable	LED Configuration	Switch Current Limit (typ) (mA)	Current Regulation	Overvoltage Protection (min) (V)	Output Capacitor	Load-Disconnect During Shutdown	Dimming <sup>2</sup>	Peak Efficiency <sup>3</sup> (%)	Quiescent Current (typ) (mA)	Shutdown Current (typ) (µA)	Package(s)	Automotive	Price*
<b>WLED Drivers</b>																		
TPS61041	1.8 to 6.0		Inductive	4		Series	250		No	1 µF		Yes	85	0.028	0.1	SOT-23	✓	0.65
TPS61040	1.8 to 6.0		Inductive	6		Series	400		No	1 µF		Yes	86	0.028	0.1	SOT-23	✓	0.65
TPS61043	1.8 to 6.0		Inductive	4		Series	400	✓	17	100 nF	✓	Yes	85	0.038	0.1	QFN-8		0.60
TPS61042	1.8 to 6.0		Inductive	6		Series	500	✓	27.5	100 nF	✓	Yes	85	0.038	0.1	QFN-8		0.60
TPS61045	1.8 to 6.0		Inductive	6	✓	Series	375	✓	28	100 nF	✓	Yes	85	0.040	0.1	QFN-8		0.65
TPS61140	2.5 to 6.0	✓	Inductive	4 + 1 OLED	✓	2 Series	2 x 550	✓	28	—		1-pin	82	2	1.5	QFN-10		1.00
TPS61150A	2.5 to 6.0	✓	Inductive	Up to 2 x 6		2 Series	2 x 550	✓	28	—		1-pin	83	2	1.9	QFN-10		1.00
TPS61166	2.5 to 6.0	✓	Inductive	5		Series	1100 <sup>4</sup>	✓	19	4.7 µF	✓	Yes		1.5	1	QFN-10		1.35
TPS61160	2.7 to 18		Inductive	6		Series	700	✓	26	1 µF		1-pin	90	1.8	1	QFN-6		0.72
TPS61161	2.7 to 18		Inductive	10		Series	700	✓	38	1 µF		1-pin	90	1.8	1	QFN-6	✓	0.76
TPS61165	3.0 to 18		Inductive	10 to 40		Series	1200	✓	38	1 µF		1-pin	90	2.3	1	QFN-6	✓	1.10
TPS61060	2.7 to 6.0	✓	Inductive	3		Series	400	✓	14	220 nF		Yes	80	<1	1	QFN-8/WCSP-8		0.70
TPS61061	2.7 to 6.0	✓	Inductive	4		Series	400	✓	18	220 nF		Yes	80	<1	1	QFN-8/WCSP-8		0.70
TPS61062	2.7 to 6.0	✓	Inductive	5		Series	400	✓	22	220 nF		Yes	80	<1	1	QFN-8/WCSP-8		0.70
REG71050	3.2 to 5.5		Charge pump	3		Parallel	—		—	2.2 µF		No	92	0.065	0.01	SOT-23		0.55
TPS60230	2.7 to 6.5		Charge pump	5, 3		Parallel	—	✓	—	1 µF		Yes	85	0.200	0.1	QFN-16		0.48
TPS60250/5	2.7 to 6.0		Charge pump	7		Parallel	—	✓	—	4.7 µF	I <sup>2</sup> C	—	6.7	1.3	QFN-16		0.80	
TPS60251	3.0 to 6.0		Charge pump	7 + Aux		Parallel	—	✓	—	4.7 µF	I <sup>2</sup> C	—	6.7	1.3	QFN-24		0.80	
TPS75103	2.7 to 5.5		LDO	2 or 4		Parallel	—	✓	—	—		Yes	—	0.18	0.1	WCSP-9		0.65
TCA6507	1.65 to 3.6		Parallel	7		Parallel	—	—	—	—		—	—	—	—	WCSP-12/QFN-12		0.80
TPS61183	4.5 to 24		Inductive	10 x 6		6 Channels	2000	✓	38	10 µF		Yes	95	4	11	QFN-20		1.85
TPS61185	4.2 to 24		Inductive	10 x 8		8 Channels	2000	✓	38	10 µF		Yes	94	<3	<10	QFN-24		1.80
TPS61195	4.5 to 21		Inductive	8 x 10		10 Channels	3500	✓	50	10 µF		Yes	95	<3	<10	QFN-28		1.95
TPS61176	2.7 to 6.5		Inductive	6 x 10/11		6 Channels	1000	✓	38	4.7 µF		Mixed-Mode	90	<3	<4	QFN-16		1.10
TPS61199 <sup>5</sup>	8 to 30		Inductive	15 x 8		8 Channels	5000	✓	30	3 x 33 µF		Yes	93	<1.5	<10	SOP-20/HTSSOP-20		1.85
LP8543	4.5 to 22		Inductive	7 x 10		7P10S	2500	✓	V <sub>BOOST</sub> + 1.6 V	4.7, 10 µF	PWM, I <sup>2</sup> C, ALS	92	<3.5, Boost ON	—	—	QFN-24		2.30
TPS61196	8 to 30		Inductive	20 x 6		6 Channels	—	✓	38	100 µF	PWM	96	<1.5	<15	HTSSOP-28		1.85	
LP8545	4.5 to 22		Inductive	6 x 10		6P10S	2500	✓	V <sub>BOOST</sub> + 1.6 V	4.7, 10 µF	PWM, I <sup>2</sup> C	95	<4, Boost ON	—	—	QFN-24		0.99
LP8550	4.5 to 22		Inductive	6 x 10		6P10S	2500	✓	V <sub>BOOST</sub> + 1.6 V	4.7, 10 µF	PWM, I <sup>2</sup> C	95	<3, Boost ON	—	—	micro SMD-25		0.82
LP8553	4.5 to 22		Inductive	4 x 10		4P10S	2500	✓	V <sub>BOOST</sub> + 1.6 V	4.7, 10 µF	PWM, I <sup>2</sup> C	95	<3, Boost ON	—	—	micro SMD-25		0.82
LP8556	2.7 to 20		Inductive	6 x 10		6P10S	2600	✓	V <sub>BOOST</sub> + 1.6 V	4.7, 10 µF	PWM, I <sup>2</sup> C	95	2.2	—	—	micro SMD-25/ QFN-24		0.95
LP8557	2.7 to 5.5		Inductive	6 x 10		6P7S	1800	✓	V <sub>BOOST</sub> + 1.6 V	4.7, 10 µF	PWM, I <sup>2</sup> C	95	2.2	—	—	WCSP-16		0.82
LM3528	2.5 to 5.5		Inductive	12	✓	2P6S	770	✓	19.25	1 µF	✓	I <sup>2</sup> C	85	0.25	1.8	WCSP-12		1.00
LM3530	2.7 to 5.5		Inductive	11		10 Series	839	✓	40	1 µF	✓	I <sup>2</sup> C	88	1.35	1	WCSP-12		0.47
LM3532	2.7 to 5.5		Inductive	30		3P10S	1000	✓	40	1 µF	✓	I <sup>2</sup> C	87	1.35	1	WCSP-16		0.45
LM3533	2.7 to 5.5		Inductive	22		2P10S	1000	✓	40	1 µF	✓	I <sup>2</sup> C	87	—	—	WCSP-20		0.70
LM3535	2.7 to 5.5		Charge pump	8		8P	—	✓	—	1 µF	✓	I <sup>2</sup> C	92	1.1	1.7	WCSP-20		0.65
LM3537	2.7 to 5.5		Charge pump	8		8P	—	✓	—	1 µF	✓	I <sup>2</sup> C	92	1.1	0.2	WCSP-30		0.85
LM3538	2.7 to 5.5		Charge pump	8		8P	—	✓	—	1 µF	✓	I <sup>2</sup> C	92	1.1	0.2	WCSP-30		0.80
LM3630	2.7 to 5.5		Inductive	20		2P10S	1200	✓	40	1 µF	✓	I <sup>2</sup> C	90	—	1.8	WCSP-12		0.36
LM3697	2.7 to 5.5		Inductive	21		3P7S	1000	✓	40	1 µF	✓	I <sup>2</sup> C	90	—	1.8	WCSP-12		0.40

<sup>1</sup>More LEDs can be driven in parallel string configuration.

<sup>4</sup>Output current is limited to 300 mA.

<sup>2</sup>May be via ENABLE pin, CONTROL pin or analog feedback network.

<sup>5</sup>External FET needed.

<sup>3</sup>Depends on LED current, input voltage, number of LEDs, ILED pin.

<sup>\*</sup>Suggested resale price in U.S. dollars in quantities of 1,000.

# Display Power

## LED Drivers—Backlighting

### Selection Guide (Continued)

Device	V <sub>IN</sub> (V)	Synchronous	Type	Number of LEDs <sup>1</sup>	OLED Capable	LED Configuration	Switch Current Limit (typ) (mA)	Current Regulation	Oversupply Protection (min) (V)	Output Capacitor	Load-Disconnect During Shutdown	Dimming <sup>2</sup>	Peak Efficiency <sup>3</sup> (%)	Quiescent Current (typ) (mA)	Shutdown Current (typ) (μA)	Package(s)	Automotive	Price*
<b>WLED Drivers (Continued)</b>																		
LM2756	2.7 to 5.5	—	Charge pump	8	—	8P	—	✓	—	1 μF	✓	I <sup>2</sup> C	92	2.1	3.7	WCSP-20	—	1.40
LP5521	2.7 to 5.6	—	Charge pump	3	—	3P	—	✓	—	1 μF	✓	I <sup>2</sup> C	—	—	—	WCSP-20	—	0.40
LP5522	2.7 to 5.7	—	Charge pump	1	—	—	—	✓	—	—	✓	1 Pin	—	—	—	WCSP-06	—	0.40
LP5523	2.7 to 5.8	—	Charge pump	9	—	9P	—	✓	—	1 μF	✓	I <sup>2</sup> C	—	—	—	WCSP-25	—	0.85
LP5524	2.7 to 5.9	—	Charge pump	4	—	4P	—	✓	—	—	✓	—	—	—	—	WCSP-09	—	0.60
LM8502	2.7 to 5.10	✓	Inductive	10	—	10P	—	✓	—	10 μF	✓	I <sup>2</sup> C	—	—	—	WCSP-30	—	1.50
TPS61046	1.8 to 5.5	—	Inductive	—	✓	—	900	—	28	2.2 μF	✓	—	87	0.1	—	WCSP	—	TBD

<sup>1</sup>More LEDs can be driven in parallel string configuration.

<sup>2</sup>May be via ENABLE pin, CONTROL pin or analog feedback network.

<sup>3</sup>Depends on LED current, input voltage, number of LEDs, ILED pin.

<sup>4</sup>Output current is limited to 300 mA.

<sup>5</sup>External FET needed.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

Preview devices are listed in **bold teal**.

Device	No. of Chan.	V <sub>IN</sub> Min (V)	V <sub>IN</sub> Max (V)	Output Current I <sub>LED</sub> (mA)	Channel-to- Channel Accuracy (%)	Dev.-to-Dev. Accuracy (%)	Short Detection	Open Detection	Overtemperature Detection	Comments	Price*
<b>LED Drivers</b>											
TLC5960	8	10	28	350 <sup>1</sup>	0.3	±1	✓	✓	✓	4 iHVMTM outputs, 4 PWM controls, external FET	1.10

<sup>1</sup>TLC5960 output current is limited by external FET.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

Device	Typical Power Level	Topology	Maximum Practical Frequency (kHz)	Start-Up Current (μA)	Operating Current (mA)	Supply Voltage (V)	UVLO: On/Off (V)	Max Duty Cycle (%)	Soft Start	Output Drive (Sink/ Source) (A)	Package(s)	Price*
<b>LLC Controllers</b>												
UCC25600	200 W to 1 kW	Half-bridge	350	100	7.5	11.5 to 18	11.1/8.9	Variable	✓	0.4/0.8	8-SOIC	0.80
UCC25710	80 W to 500 W	Half-bridge	300	—	—	12 to 18	10/8.5	—	✓	0.4/0.8	20-SOIC	1.50

Note: UCC2xxx devices are extended temperature-range versions of the UCC3xxx devices.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Display Power

## LED Drivers—Camera Flash

### Design Factors

#### Series or Parallel LED Configuration

— Drives the driver topology. Inductive boost converters provide the necessary high voltage to a series LED string. This requires only one current regulation loop and two connection points for the LED string.

Charge pumps typically drive parallel LEDs; but unless each LED is current-regulated, each leg requires a current-set resistor.

**Current Regulation** — Avoids brightness variations in LED strings or legs that consist of LEDs with different forward voltages ( $V_f$ ).

#### Overvoltage Protection (OVP) —

Protects the inductive driver from destruction in case faulty LEDs open the LED string.

**Dimming** — LED drivers typically feature analog and/or digital dimming to adjust the LED brightness.

### Selection Guide

Device <sup>1</sup>	V <sub>IN</sub> (V)	Max. Number of LEDs	Privacy LED	I <sub>OUT</sub> (max) (mA)	Typical Switch Current (mA)	Super-Capacitor Support	Down Mode when V <sub>IN</sub> > V <sub>OUT</sub>	Control Interface	LED Temperature Monitoring	Power Save Mode	Battery Voltage-Droop Monitoring	Package(s)	Features and Differentiators	Total Solution Size (mm <sup>2</sup> )	Price*
<b>Camera Flash LED Drivers</b>															
TPS61050	2.5 to 5.5	1	✓	1200	2000			I <sup>2</sup> C				QFN-10, W CSP-12	Voltage-mode selection pin	25	0.45
TPS61054	2.5 to 6	1		700/500	1500/1000			Simple logic signal				QFN-10, W CSP-12		25	0.43
TPS61310	2.5 to 5.5	3	✓	1500	—		✓	I <sup>2</sup> C	✓	✓	✓	WCSP-20	HW-reset input, dual-wire camera-module interface, Power Good	25	0.55
TPS61325	2.5 to 5.5	3	✓	4100	—	✓	✓	I <sup>2</sup> C	✓	✓		WCSP-20	Dual-wire camera-module interface, super-capacitor balancing, flash ready output	25	0.85
TPS61300	2.5 to 5.5	3	✓	4100	1850	✓	✓	I <sup>2</sup> C	✓	✓		WCSP-20	Voltage-mode selection pin (TPS61300/1) DC light-mode selection pin (TPS61300) Flash ready output, HW-reset input (TPS61301/5)	25	1.70
LM3561	2.5 to 5.5	1		600	1000/1500		✓	I <sup>2</sup> C	✓			WCSP-12	600-mA compact solution with integrated protection features	15	0.55
LM3554	2.5 to 5.5	2		1200	1000/1500/2000/2500		✓	I <sup>2</sup> C	✓	✓		WCSP-16	1.2-A inductive driver with protection features and voltage mode	23	0.46
LM3555	2.5 to 5.5	2		500	1250/1500/1750/2000			I <sup>2</sup> C	✓			WCSP-12	Series driver with 90% efficiency and indicator LED	31	0.35
LM3556	2.5 to 5.5	1		1500	1700/1900/2500/3100		✓	I <sup>2</sup> C	✓	✓		WCSP-16	4-MHz LED driver with tiny solution size and integrated protection features	18	0.50
LM3559	2.5 to 5.5	2		1800	1400/2100/2700/3200		✓	I <sup>2</sup> C	✓	✓		WCSP-16	1.8-A inductive flash LED driver with programmable indicator blinking	26	0.55
LM3560	2.5 to 5.5	2		2000	1600/2300/3000/3600		✓	I <sup>2</sup> C	✓			WCSP-16	1.8-A inductive flash LED driver with programmable indicator blinking	26	0.80
LM3550	2.5 to 5.5	4		5000	—	✓		I <sup>2</sup> C				LLP	Super-cap flash LED driver with optimal mode to limit power dissipation	—	0.70
LM3642	2.5 to 5.5	1		1500	1700/1900		✓	I <sup>2</sup> C	✓	✓		WCSP-9	4-MHz LED driver with tiny solution size and integrated protection features	18	0.35
LM3646	2.5 to 5.5	1		1500	1000/3100		✓	I <sup>2</sup> C	✓	✓		WCSP-20	4-MHz LED driver with tiny solution size and integrated protection features	22	0.45
LM3565	2.5 to 5.5	1		930	2300/2600/2900/3300		✓	I <sup>2</sup> C	✓	✓		WCSP-16	4-MHz dual series LED driver with tiny solution size and integrated protection features	26	0.44

<sup>1</sup>All of these devices have TX-Mask and safety timer DC/Flash.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Display Power

## LED Drivers—Signage/Linear

TI's signage and linear LED drivers offer constant-current-sink, RGB and/or white LED lamp drivers for applications requiring multichannel drives.

### LED Dot-Matrix Display Drivers for Signage

TI is leading the market for LED signage drivers with the world's first 48-channel drivers (see featured devices on the next page). The TLC592x/4x/5x series drives LED dot-matrix displays in LED signage applications such as stadium video/score screens, roadside advertisements and station/airport information boards. The TLC592x series uses simple on/off control for flexible system design with high-power image processors and the TLC594x/5x series uses an integrated PWM generator for reduced controller power.

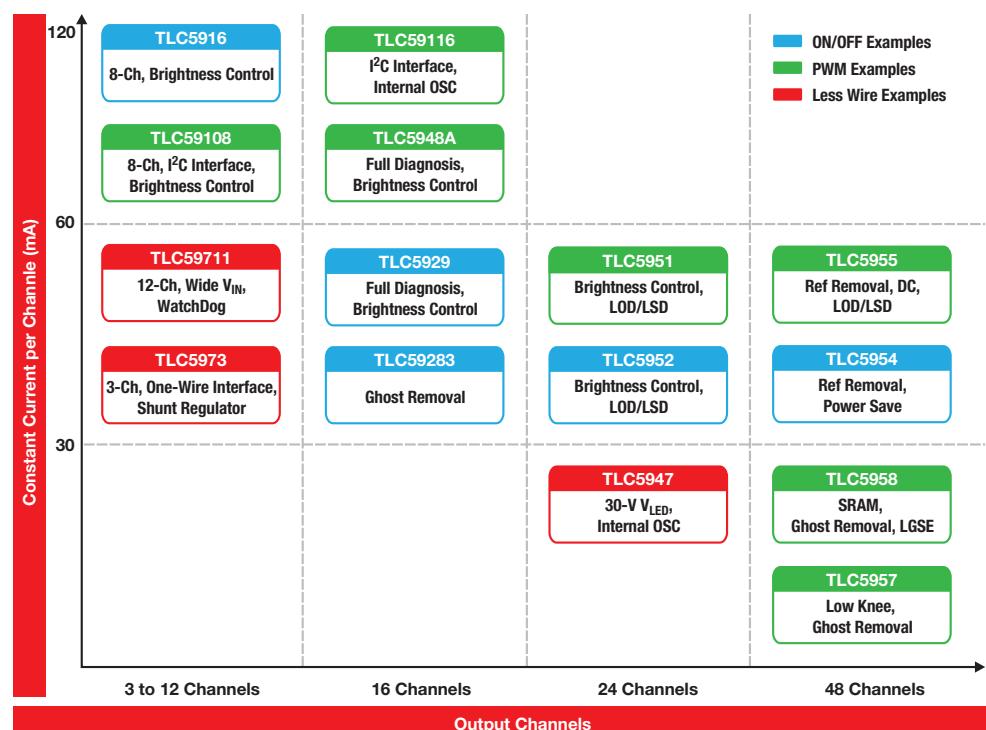


LED drivers from Texas Instruments are used in video displays throughout the world.

### RGB and White LED Architectural/Illumination Linear Drivers

The TLC597x series supports nontypical LED dot-matrix display applications such as rainbow-colored wall lightings/decorations for buildings; LED "mesh" displays; and RGB LED illuminations.

### LED Driver Examples for Signage



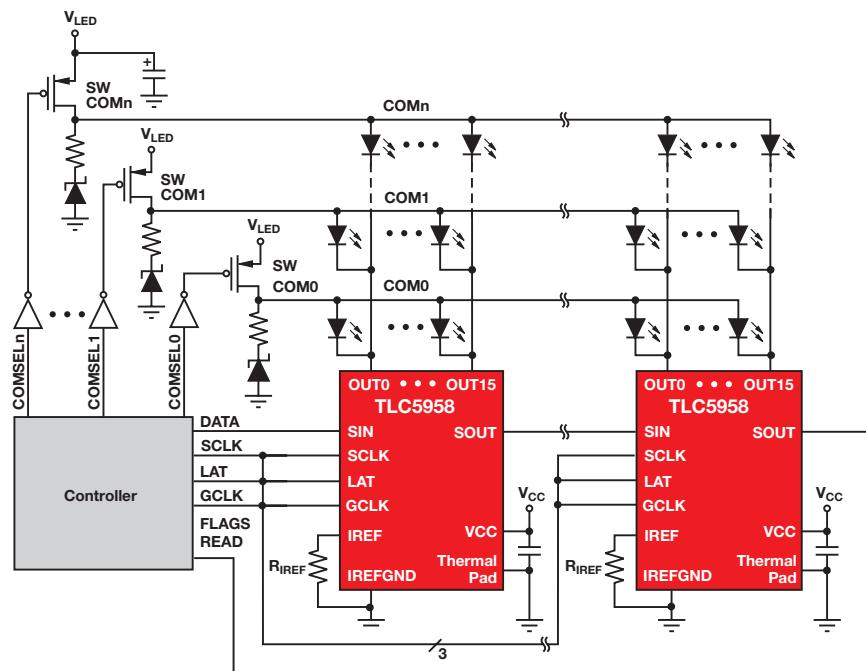
Get more information: [www.ti.com/signage](http://www.ti.com/signage)

# Display Power

## LED Drivers—Signage/Linear

**48-Channel, 16-Bit PWM LED Driver with 48K SRAM, LOD and pre-charge FET)**

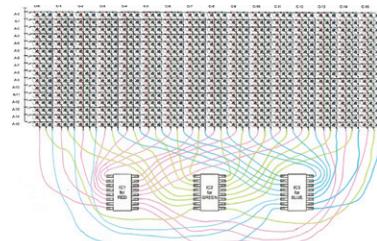
### TLC5958



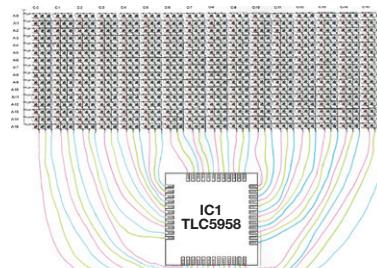
Get more information: [www.ti.com/product/TLC5958](http://www.ti.com/product/TLC5958)

### Key Features

- 48-channel, easy for layout
- 48K SRAM, supports 32 multiplex
- Great low grayscale performance
- Pre-charge FET for ghost cancelling



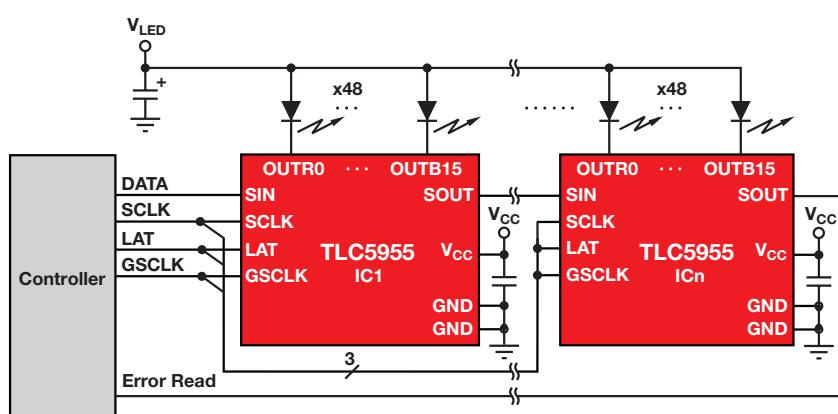
Three LED driver ICs.



One LED driver IC.

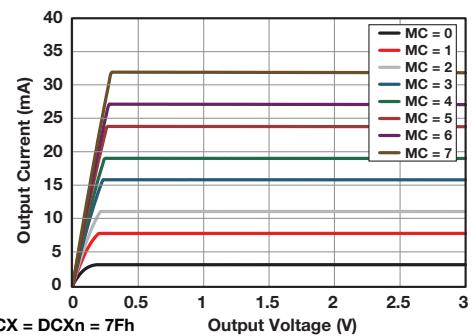
**48-Channel, 16-Bit PWM LED Driver with Dot-Correction, Brightness Control, Open/Short Detection**

### TLC5955



### Key Features

- 48-channel, easy for layout
- Least BOM, no external resistor
- 7-bit dot correction for each channel
- Low knee voltage
- LED open/short detection



Get more information: [www.ti.com/product/TLC5955](http://www.ti.com/product/TLC5955)

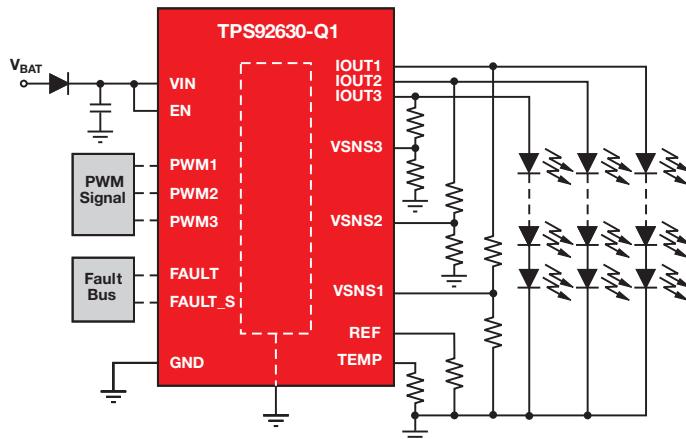
# Display Power

## LED Drivers—Signage/Linear

### 3-Channel, 150-mA Constant-Current, Linear LED Driver

#### TPS92630-Q1

The TPS92630-Q1 device is a 3-channel, constant-current, linear LED driver with analog and PWM dimming control. Its full diagnostic and built-in protection capabilities make it an excellent solution for variable-intensity LED lighting applications up to the medium-power range.



Get more information: [www.ti.com/product/TPS92630-Q1](http://www.ti.com/product/TPS92630-Q1)

#### Applications

- Automotive lighting (Rear combination light, turn, brake, etc.)
- Interior lighting
- General lighting

#### Evaluation Module

Part Number	Description
TPS92630EVM	3-channel, linear LED driver evaluation module

#### Selection Guide

Device	No. of Chan.	V <sub>IN</sub> Min (V)	V <sub>IN</sub> Max (V)	Output Current I <sub>LED</sub> (mA)	Channel-to-Channel Accuracy (%)	Dev.-to-Dev. Accuracy (%)	Recharged FET	Short Detection	Open Detection	Overtemperature Detection	Brightness Control (Bits)	Dot Correction (Bits)	PWM Grayscale Control (Bits)	Interface	Comments	Automotive	Price*
TL4242	1	4.5	42	500	—	—	✓	✓	✓	—	—	—	—	—	✓	0.35	
TPS92630-Q1	3	5	40	150	±1.5%	±2.5%	✓	✓	✓	—	—	—	—	—	High-side current sense, full diagnostic and support "one fail all fail"	✓	0.90
TPS92638-Q1	8	5	40	70	±4%	±5%	✓	✓	✓	—	—	—	—	—	High-side current sense, full diagnostic and support "one fail all fail"	✓	1.20
TLC6C598-Q1	8	3	5.5	50	—	—	—	—	—	—	—	—	—	Serial	8-bit shift register with 40-V breakdown voltage	✓	0.34/0.38
TLC6C5912-Q1	12	3	5.5	50	—	—	—	—	—	—	—	—	—	Serial	12-bit shift register with 40-V breakdown voltage	✓	0.50/0.54
TLC5916	8	3.3	5.5	120	±3 (Max)	±6 (Max)	✓	✓	✓	8	—	—	—	SPI	—	✓	0.47
TLC5917	8	3.3	5.5	120	±3 (Max)	±6 (Max)	✓	✓	✓	8	—	—	—	SPI	—	✓	0.60
TLC59108	8	3	5.5	100	±3 (Max)	—	✓	✓	✓	8	8	I <sup>2</sup> C	Constant-current output	—	—	0.80	
TLC59108F	8	3	5.5	100	±3 (Max)	—	✓	✓	✓	8	8	I <sup>2</sup> C	Open-drain output	—	—	0.80	
TLC59208F	8	3	5.5	50	±3 (Max)	—	✓	✓	✓	8	8	I <sup>2</sup> C	Open-drain output, programmable I <sup>2</sup> C address	—	—	0.65	
TLC59116	16	3	5.5	100	±6 (Max)	—	✓	✓	✓	8	8	I <sup>2</sup> C	Constant-current output	—	—	1.45	
TLC59116F	16	3	5.5	100	±6 (Max)	—	✓	✓	✓	8	8	I <sup>2</sup> C	Open-drain output	—	—	1.45	
TLC59210	8	3	5.5	200	—	—	—	—	—	—	—	Parallel	Clear function and clock pin for data latch	—	—	0.60	
TLC59211	8	3	5.5	200	—	—	—	—	—	—	—	Parallel	No clear function and clock pin for data latch	—	—	0.55	
TLC59212	8	3	5.5	40	—	—	—	—	—	—	—	Parallel	—	—	—	0.48	
TLC59213/A	8	3	5.5	-500	—	—	—	—	—	—	—	Parallel	"A" version has 15 ns (non-"A" is 25 ns)	—	—	0.70	
TLC5921	16	4.5	5.5	80	±1	±4 (Max)	✓	✓	—	—	—	SPI	—	—	—	1.25	
TLC5922	16	3	5.5	80	±1	±4	—	—	—	7	SPI	—	—	—	—	1.35	
TLC5923	16	3	5.5	80	±1	±4	—	✓	✓	7	SPI	—	—	—	—	1.40	
TLC5924	16	3	5.5	80	±1	±4	✓	✓	✓	7	SPI	—	—	—	—	1.50	
TLC5925	16	3	5	45	±4 (Max)	±6 (Max)	—	—	✓	—	—	SPI	—	—	—	0.50	

<sup>1</sup>Output current with V<sub>CC</sub>>3.6 V.

<sup>2</sup>Output current with V<sub>CC</sub>≤3.6 V.

<sup>3</sup>16E = 16-bit enhanced-spectrum PWM. 16E/C or 12E/C = 16-bit or 12-bit enhanced-spectrum or conventional PWM selectable.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**.

Preview devices are listed in **bold teal**.

# Display Power

## LED Drivers—Signage/Linear

### Selection Guide (Continued)

Device	No. of Chan.	V <sub>IN</sub> Min (V)	V <sub>IN</sub> Max (V)	Output Current I <sub>LED</sub> (mA)	Channel-to-Channel Accuracy (%)	Dev.-to-Dev. Accuracy (%)	Recharged FET	Short Detection	Open Detection	Overtemperature Detection	Brightness Control (Bits)	Dot Correction (Bits)	PWM Grayscale Control (Bits)	Interface	Comments	Automotive	Price*
TLC59025	16	3	5	45	±4 (Max)	±6 (Max)			✓					SPI			0.55
TLC5926	16	3	5.5	120	±6 (Max)	±6 (Max)		✓	✓	8				SPI		✓	0.60
TLC5927	16	3	5.5	120	±6 (Max)	±6 (Max)	✓	✓	✓	8				SPI		✓	0.65
TLC5928	16	3	5.5	35	±1	±1		✓	✓					SPI			0.50
TLC59281	16	3	5.5	35	±1	±1								SPI			0.43
TLC59283	16	3	5.5	45	±1.4	±2	✓							SPI	4-channel grouped delay		0.55
TLC59284	16	3	5.5	45	±1.4	±2								SPI	4-channel grouped delay		0.45
TLC5929	16	3	5.5	50	±1	±2		✓	✓	✓	7			SPI	Full protection/monitor for remote-controlled systems		0.85
TLC5940	16	3	5.5	120 <sup>1</sup> /60 <sup>2</sup>	±1	±2/-2.7		✓	✓		6	12		SPI			1.20
TLC59401	16	3	5.5	120 <sup>1</sup> /80 <sup>2</sup>	±1	+2/-2.7		✓	✓		6	12		SPI			1.20
TLC5941	16	3	5.5	80	±1	+2/-2.7		✓	✓		6	12		SPI		✓	0.95
TLC5942	16	3	5.5	50	±1.5	±3		✓	✓		7	12		SPI			1.00
TLC5943	16	3	5.5	50	±1.5	±3		✓	✓	7	16E <sup>3</sup>			SPI	4-channel grouped delay, LED open auto-off		1.20
TLC5944	16	3	5.5	60	±1	±3	✓	✓	✓		6	12		SPI	4-channel grouped delay, LED open auto-off		1.05
TLC5945	16	3	5.5	80	±1	+2/-2.7		✓	✓		6	12		SPI			1.00
TLC5946	16	3	5.5	40	±1	±2		✓	✓		6	12		SPI	4-channel grouped delay, LED open auto-off		0.95
TLC59461	16	3	5.5	40	±1	±2		✓	✓		6	12		SPI	4-channel grouped delay		0.95
TLC5947	24	3	5.5	30	±2	±2			✓			12		SPI	30-V V <sub>LED</sub> , internal oscillator		1.95
TLC59470	24	3	5.5	30	±2	±2			✓			12		SPI	30-V V <sub>LED</sub> , internal oscillator	✓	2.34
TLC5948A	16	3	5.5	60 <sup>1</sup> /45 <sup>2</sup>	±0.6	±1		✓	✓	✓	7	7	16E/C <sup>3</sup>	SPI	Full protection/monitor for remote-controlled systems		1.30
TLC59482	16	3	5.5	45 <sup>1</sup> /35 <sup>2</sup>	±1	±2				6	16E <sup>3</sup>			SPI	4-channel grouped delay		1.15
TLC5949	16	3	3.6	45	±0.6	±1		✓	✓	✓	7	12E/C <sup>3</sup>		SPI	Full protection/monitor for remote-controlled systems		1.25
TLC5951	24	3	5.5	40	±1.5	±3		✓	✓	✓	8	7	12, 10, 8	SPI	For 8 RGB LED lamps		1.55
TLC5952	24	3	5.5	35	±1	±3		✓	✓	✓	7			SPI	For 8 RGB LED lamps		1.35
TLC5954	48	3	3.6	34.9	±1	±2		✓	✓		MC 3, BC 7 <sup>3</sup>			SPI	Ref removal; power save mode		2.40
TLC5955	48	3	5.5	31.9	±2	±2		✓	✓		MC 3, BC 7 <sup>3</sup>	7	16	SPI	Rref removal; Low knee voltage		2.85
TLC5957	48	3	5.5	25	±1	±2	✓	✓	✓	✓	BC 3, CC 9 <sup>3</sup>	9-16		SPI	Low knee voltage; caterpillar removal; LGSE		2.85
TLC5958	48	3	5.5	25	±1	±1	✓	✓	✓	✓	BC 3, CC 9 <sup>3</sup>	16		SPI	Integrated SRAM; LGSE		4.50
TLC5971	12	3	17	60	±1	±1			✓	7	16E <sup>3</sup>			SPI	Integrated LDO and oscillator for PWM		1.20
TLC59711	12	3	17	60	±1	±1			✓	7	16E <sup>3</sup>			SPI	Integrated LDO and oscillator for PWM, WDT		1.30
TLC5973	3	3	6	50	±0.5	±0.5						12	Single-wire		Shunt regulator, internal PWM clock		0.45
TLC59731	3	3	6	50	—	—						8	Single-wire		Open-drain output, shunt regulator, internal PWM clock		0.28

<sup>1</sup>Output current with V<sub>CC</sub> > 3.6 V.

<sup>2</sup>Output current with V<sub>CC</sub> ≤ 3.6 V.

<sup>3</sup>16E = 16-bit enhanced-spectrum PWM, 16E/C or 12E/C = 16-bit or

12-bit enhanced-spectrum or conventional PWM selectable. MC = Maximum current control,

BC = Global brightness control, CC = Group color brightness control.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

Preview devices are listed in bold teal.

# Multi-Output Power Management Integrated Circuits (PMICs)

## Overview

Our world is continuing to shrink around us. The golden age of the Internet has linked people around the world, enabling faster communication in the fields of finance, research and social media. All around us the world is getting smaller, and this is no more noticeable than in our electronic devices. Cell phones and computers have transformed into high-performance, portable, multipurpose tools that can fit into your pocket or briefcase.

The key to these devices becoming more powerful and portable are the advances in semiconductor technology. In keeping with Moore's law, the number of transistors in a given space has increased a million-fold over the last 40 years, allowing for higher performance in smaller packages. But to further reduce these package sizes, integration of functions needs to occur. With several different operations being performed in a single integrated circuit (IC) instead of individual discrete ICs, end products can be made smaller and often more efficient.

The integration in the digital realm has been mirrored in the analog realm, and that is where TI's portfolio of multichannel power management units (PMICs) enters the playing field. Whether your product requires multiple rails for automotive solutions, processor power management or just a multi-output solution with a communication interface, TI has a wide range of options to choose from to match your power-design needs. TI's power solutions come in very small packages, such as QFN and DSBGA bump packaging; and the high-frequency operation of TI's PMIC products also reduces the size of passive elements such as inductors and capacitors. All of these factors ultimately result in a drastically reduced PCB footprint and eliminate the need for multiple single-function components.

Whatever your power-management needs, TI will be there to help you through the effort. With a vast portfolio of evaluation modules, accessible reference designs and available technical support, TI supplies you with the tools you need for a successful power design.

### Processor-Agnostic PMICs

PMICs have always been associated with processors, however, the technology has changed in past few years. PMICs used to have no memory and no EEPROM. Today's PMICs have evolved as independent devices that are processor agnostic. The advanced features now available make PMICs suitable to work with more than one processor just by a spin of a power sequence. Technological changes have led to a level of integration where they can store different power sequences, voltages and load-change capabilities. Also, PMICs now include I<sup>2</sup>C control, power monitoring, Eco-mode™ and over-temperature protection (OTP), which makes them much more effective than legacy PMICs that only controlled power sequence.

The TPS65218 is an advanced PMIC used to power the AM437x, but it can also power the Cyclone® (low end) FPGA and Ambrella processors. The TPS65083x is designed to power the x86 Skylake platform and the TPS65084x is designed to power the x86 Braswell platform. These features are why these PMICs are sometimes referred to as system-power solutions that are processor agnostic.

### Processor Attachment PMICs

TI offers several highly efficient PMIC solutions aligned with today's major processors and provides comprehensive technical support for them. Evaluation modules and reference designs are available for PMIC/enhanced-product solutions, as well as application guides and extensive online support via E2E™ forums. TI not only supports the latest Davinci™, OMAP™ and Sitara™-based processors but also offers solutions for a variety of processors from other manufacturers. Included are automotive-qualified power solutions for processors such as the i.MX from Freescale and Tegra family from Nvidia and FPGA. Refer to the "Embedded Processors Supported by TI PMICs" table in this section to find the power solution right for your application.

### Automotive PMICs

An ever expanding product portfolio in Q100-qualified automotive parts makes TI one of the leaders in power solutions for infotainment, telematics, advanced driver assistant systems (ADASs) and automotive safety. TI provides a multitude of analog and embedded processing products for rich, dedicated human/machine-interface environments complementing multimodal applications. These applications include:

- Voice, gesture and face recognition
- Consumer multimedia systems such as video games, audio, digital radio and portable electronics
- Telematics applications such as emergency call (E-Call) and rear-seat entertainment

TI's ADAS power solutions complement the embedded processing and analog components required for these systems. ADAS functions such as collision warning, surround-view cameras and ultrasonic park assist require processors with DSP and/or integrated SoCs. TI also has high-voltage devices with a wide V<sub>IN</sub> range in addition to low-voltage devices qualified for automotive applications.

### Special Function PMICs

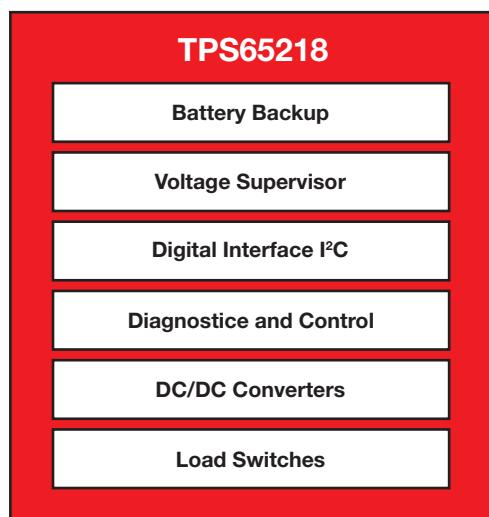
Integration does not have to be a benefit for processor-based end equipment alone. TI has a broad portfolio of PMICs that couple DC/DC converters and LDOs with other features such as linear or switching battery chargers, load switches, charge pumps or WLED boost drivers to fit the needs of a wide range of applications. TI PMICs support lower-power products like Bluetooth® headsets and 3D glasses, as well as higher-power products like embedded and digital cameras. And flexibility designed into the devices opens up a vast space beyond their original target applications. Examples of such devices are our TPS65090, a front-end PMIC for charging two to three Li-Ion batteries in series, and the TPS657120, a PMIC designed for supplying baseband and RF-PA power. These devices have associated application guides, reference designs and evaluation modules available at the TI.com Web site.

# Multi-Output Power Management Integrated Circuits (PMICs)

## Processor Attachment PMICs

### PMIC for A8/A9 Processors and FPGAs

#### TPS65218



#### Key Features

##### Power providers

- 3 step-down converters with various configurations
- Single phase (1.8 A max)
- DVS enabled, auto PFM to PWM conversion
- Soft-start, short-circuit, power-good features
- 1 general-purpose LDO
- 1 buck-boost converter
- 2 step-down converters for back battery power

##### Load Switch

- 5-V load switch with 100-/500-mA selectable current limit
- Low voltage/impedance (110 mΩ max) load switch with 350-mA current limit

#### Digital Control

- Power-management FSM/configuration registers
- Interrupt management
- GPIOs
- I<sup>2</sup>C interface

#### SVS Circuitry

- DCDC1, DCDC2, DCDC3: ±4%
- DCDC4 and LDO1 to ±5%

#### Applications

- Industrial automation
- EtherCAT® applications
- Point-of-sale systems
- Test and measurement

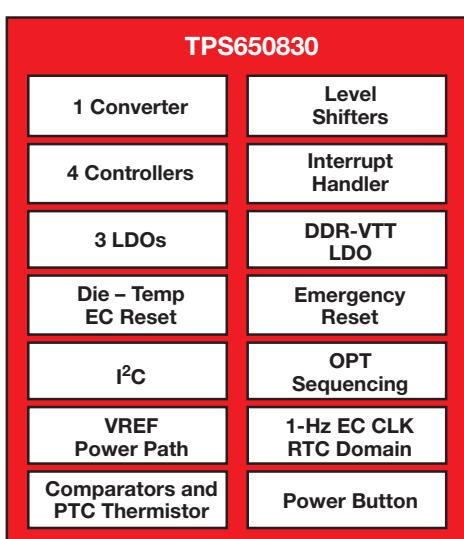
#### Benefits

- Smaller PCB footprint when compared to discrete solution
- Coin-cell backup allows for processor RTC up to ~5 years
- Works with various battery chemistries
- Adjustable voltage support for DDR2, DDR3, DDR3L

Get more information: [www.ti.com/product/TPS65218](http://www.ti.com/product/TPS65218)

### Programmable Wide-V<sub>IN</sub> PMIC for x86 Skylake

#### TPS650830, TPS650831, TPS650832



#### Key Features

- 4 step-down controllers
- 3 misc LDOs and 3.1-V<sub>REF</sub> LDO
- 1 LDO supports DDR (3/4/LP/3S) VTT
- 8 power-good comparator/outputs
- 3 power path comparators: Adaptor/bat1/bat2
- 1 temperature comparator for multiple PTC thermistors
- Push button and EC wake CLK
- 2 level shifters

- Control logic for external load switches
- Full sequence control
- I<sup>2</sup>C control: DVS and Decay mode
- RTC backup battery selector
- Undervoltage and overtemp protection
- Connected standby mode

#### Applications

- Notebooks, ultra books, tablets and mobile PCs
- Medical products
- Industrial applications

Get more information: [www.ti.com/product/TPS650830](http://www.ti.com/product/TPS650830)

# Multi-Output Power Management Integrated Circuits (PMICs)

## Processor Attachment PMICs

### Selection Guide

Device	V <sub>IN</sub> (V)	No. of Regulator Outputs	Charger	Audio Codec	USB 2.0 OTG Transceiver	WLED Boost	DC/DC Step-Down Converter	DC/DC Step-Down Controller	LDO	Communication Interface	Description	Package(s)	Automotive	Price*
<b>ARM® Cortex™-R4</b>														
<b>TPS65381-Q1</b>	5.8 to 36	5	—	—	—	—	1	—	4	SPI	Safety-critical applications	HTSSOP-32	✓	2.57
<b>ARM Cortex A8 PMICs</b>														
<b>LP3925</b>	4.5 to 6.5	18	Linear	—	—	Yes	3	—	15	I <sup>2</sup> C	Smartphone PMIC	Micro SMD-81		1.40
<b>LP3974</b>	4.5 to 6.5	20	Linear	—	—	—	4	—	16	I <sup>2</sup> C	Smartphone PMIC	Micro SMD-100		2.46
<b>TPS65023x</b>	2.5 to 6.0	6	—	—	—	—	3	—	3	I <sup>2</sup> C	Flexible 6-channel PMIC, also W CSP package	QFN-40	✓	2.95
<b>TPS65024x</b>	2.5 to 6	6	—	—	—	—	3	—	3	I <sup>2</sup> C	Flexible 6-channel PMIC	VQFN-32	✓	2.60
<b>TPS650250</b>	2.5 to 6.0	6	—	—	—	—	3	—	3	—	Flexible PMIC with adjustable V <sub>OUT</sub> , optimized for AM335x	QFN-32	✓	2.20
<b>TPS65053</b>	2.5 to 6.0	5	—	—	—	—	2	—	3	—	Low-cost 5-channel PMIC, optimized for DM355x	QFN-24	✓	1.95
<b>TPS65070/2/3x</b>	2.8 to 6.3	5	Linear	—	—	Yes	3	—	2	I <sup>2</sup> C	With and without touch-screen controller, Jacinto 3	QFN-48	✓	3.60
<b>TPS65217x</b>	2.7 to 6.5	7	Linear	—	—	Yes	3	—	4	—	Optimized for AM335x processors	QFN-48		3.45
<b>TPS65910x</b>	2.7 to 5.5	13	—	—	—	—	3	—	9	2x I <sup>2</sup> C	Flexible PMIC with 5-V boost, powers multiple processors	QFN-48		3.30
<b>TPS65921</b>	2.7 to 4.5	7	—	—	Yes	—	3	—	4	2x I <sup>2</sup> C	Optimized for OMAP™35x processors	BGA-139		3.20
<b>TPS65930</b>	2.7 to 4.5	7	—	Yes	Yes	—	3	—	4	2x I <sup>2</sup> C	Optimized for OMAP35x processors	BGA-139		3.80
<b>TPS65950</b>	2.7 to 4.5	13	Linear	Yes	Yes	—	3	—	10	2x I <sup>2</sup> C	Optimized for OMAP35x processors	BGA-209		4.40
<b>TPS65951</b>	2.7 to 4.5	13	—	Yes	Yes	—	3	—	10	2x I <sup>2</sup> C	Optimized for OMAP35x, 0.8-mm pitch	BGA-169		4.40
<b>TPS65218</b>	2.7 to 5.5	7	—	—	—	—	5	—	1	2x I <sup>2</sup> C	Flexible PMIC for AM437x and multiple processors	QFN & QFP		3.45
<b>ARM Cortex A9 PMICs</b>														
<b>TPS65862x/4x</b>	4.3 to 6.5	14	Linear	—	—	Yes	3	—	11	I <sup>2</sup> C	Optimized for Tegra® 2	BGA-121		5.95
<b>TPS659110/2/3/9</b>	2.7 to 5.5	13	—	—	—	—	3	1	9	2x I <sup>2</sup> C	With DC/DC controller up to 10 A, TPS659119 optimized for Jacinto 4/5 and Tegra 3, Galelio	BGA-98	✓	3.75
<b>TPS65912x</b>	2.3 to 5.5	14	—	—	—	—	4	—	10	I <sup>2</sup> C/SPI	Flexible PMIC with four DC/DC converters, power multiple processors, i.MX6	WCSP-81		4.95
<b>TWL6030/32/40/41</b>	2.3 to 5.5	18	Switch	Yes	—	—	7	—	11	2x I <sup>2</sup> C	OMAP 4 power and audio	FBGA + PBGA		4.30
<b>TPS80032</b>	2.3 to 5.5	16	Switch	—	—	—	5	—	11	2x I <sup>2</sup> C	i.MX6, flexible PMIC powers multiple processor	WCSP		4.49
<b>ARM Cortex A15 PMICs</b>														
<b>TPS659039-Q1</b>	3.135 to 5.25	13	—	—	—	—	7	—	6	SPI, 2x I <sup>2</sup> C	Automotive power management IC (PMIC) for Jacinto 6 and TDA2X	nFBGA-169	✓	7.60
<b>TPS65913</b>	2.3 to 5.5	18	—	—	—	1	6	—	11	2x I <sup>2</sup> C	Cortex A15 processors	WCSP, mrQFN	TBD	
<b>TWL6040/41</b>	2.3 to 5.5	18	—	—	—	1	6	—	11	2x I <sup>2</sup> C	OMAP 5 power and audio	WCSP, mrQFN		1.70/1.50

\*Suggested resale price in U.S. dollars in quantities of 1,000.

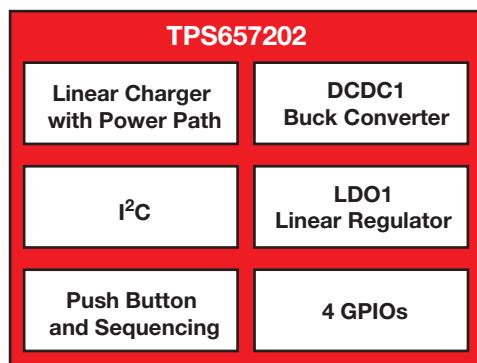
New devices are listed in **bold red**.  
Preview devices are listed in **bold teal**.

# Multi-Output Power Management Integrated Circuits (PMICs)

## Special Function PMICs (Wearable PMICs)

### PMIC for Small Battery-Powered Applications

#### TPS657202



#### Key Features

- Li-Ion battery charger with power path management
- 300-mA charge current
- 200-mA step-down converter
- Up to 96% efficiency
- 100% duty cycle for lowest dropout
- Dynamic voltage scaling (DVS)
- Power save mode at light load current
- Output voltage accuracy in PWM mode  $\pm 2.0\%$
- General purpose 200-mA LDO
- I<sup>2</sup>C interface
- 25-ball chip-scale package with 0.4-mm pitch

#### Benefits

- Improved user run time with high-efficiency PWM and PFM
- Easy design with full system power control
- Reduced board cost with W CSP

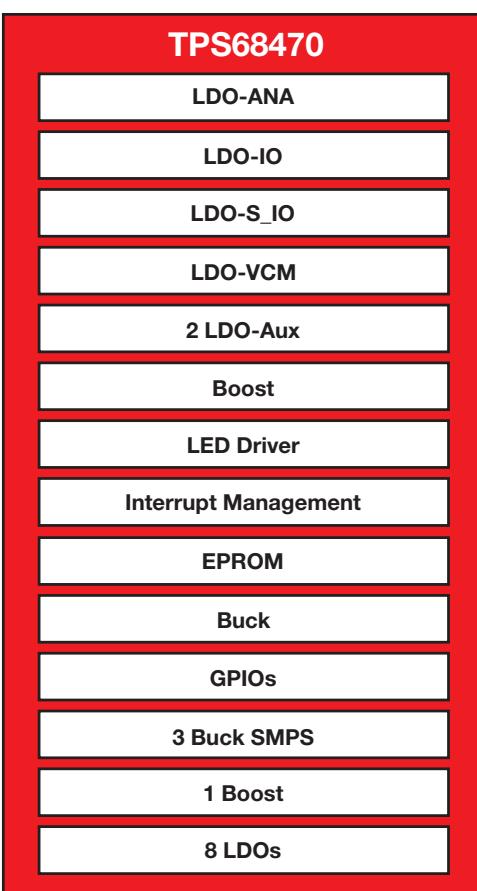
#### Applications

- Bluetooth® headsets
- Stereo headsets
- Wearables
- Gaming peripherals

Get more information: [www.ti.com/product/TPS657202](http://www.ti.com/product/TPS657202)

### MIPI®-Based Camera PMIC

#### TPS68470



#### Key Features

- High-efficiency buck for sensor core supply: 0.9 to 1.95 V/500 mA
- Low-noise linear regulator for sensor analog supply: 2.4 to 3.1 V/200 mA
- Linear regulator for sensor I/O supply: 0.9 to 3.0 V/150 mA
- Linear regulator for I/O supply: 0.9 to 3.0 V/50 mA
- Linear regulator for VCM driver power: 2.4 to 3.1 V/500 mA
- Two linear regulators for auxiliary power: 0.9 to 3.0 V/150 mA and 1.6 to 3.0 V/150 mA
- Dual flash LED driver: 1 A
- Clock generator
- Packaging: 3.3x2.4-mm, 56-ball DSBGA, 0.4-mm ball pitch

#### Applications

- Compact camera module
- Industrial and automotive
- Medical equipment

#### Benefits

- Intel Skycam PMIC reference design for Skylake platform
- Integration: Smaller footprint than discrete, ideal for portable applications
- GPIOs

Get more information: [www.ti.com/product/TPS68470](http://www.ti.com/product/TPS68470)

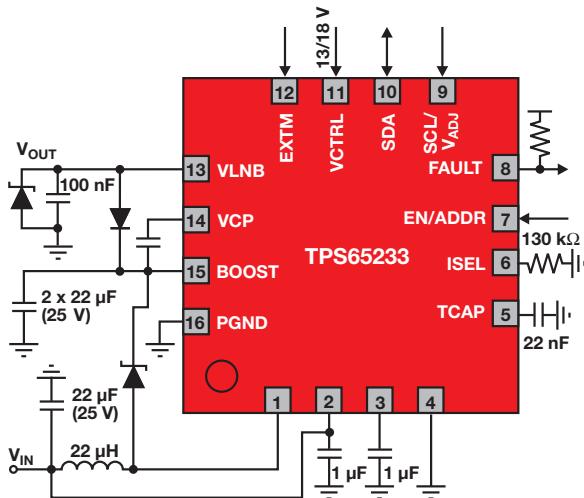
# Multi-Output Power Management Integrated Circuits (PMICs)

## Special Function PMICs (Wearable PMICs)

### LNB Voltage Regulator with I<sup>2</sup>C Digital Interface for Satellite Receiver

#### TPS65233

TI recently won design-ins and secured socket TPS65233 in satellite receivers. This is a monolithic voltage regulator with I<sup>2</sup>C interface, specifically to provide the 13-V/18-V power supply and the 22-kHz tone signaling to the LNB down-converter in the antenna dish or to the multi-switch box. It offers a complete solution with very low component count, low power dissipation, simple design, smallest package, high efficiency and cost effectiveness.



#### Key Features

- Support 5-V/12-V system
- Providing 13-V/18-V output voltage and 22-kHz tune generator with configurability
- Adaptive scaling dropout voltage
- Support DisEqC 1.x

Get more information:  
[www.ti.com/product/TPS65233](http://www.ti.com/product/TPS65233)

### Selection Guide

Device	V <sub>IN</sub> (V)	No. of Regulator Outputs	Charger	WLed Boost	DC/DC Step-Down Converter	LDO	DC/DC Step-Up Converter	Communication Interface	Description	Package(s)	Price*
<b>LM10502</b>	2.5 to 5.5	3	—	—	2	1	—	SPI	PMIC for SSD memory	Micro SMD-34	0.90
<b>LP3910</b>	2.5 to 6	5	Linear	—	2	2	1	I <sup>2</sup> C	PMIC for HDD-based media player	WQFN-48	2.11
<b>LP3913</b>	2.5 to 6	5	Linear	—	3	2	—	I <sup>2</sup> C	PMIC for flash-based media player	WQFN-48	2.11
<b>LP3918</b>	3 to 5.5	7	Linear	—	—	7	—	I <sup>2</sup> C	Battery charge management PMIC	DSBGA-25	0.53
<b>LP3921</b>	3 to 5.5	7	Linear	—	—	7	—	I <sup>2</sup> C	Battery management PMIC for audio amp	WQFN-32	0.90
<b>LP3923</b>	3 to 5.5	8	Linear	—	—	8	—	I <sup>2</sup> C	Cell phone PMIC	DSBGA-30	0.60
<b>LP3925</b>	2.5 to 4.5	18	Linear	—	3	15	—	I <sup>2</sup> C	High-performance PMIC for handsets w/USB 2.0	DSBGA-30	1.40
<b>LP3927</b>	3 to 5.5	5	—	—	—	5	—	—	PMIC for cellular/handsets	WQFN-28	2.16
<b>TPS65030</b>	2.5 to 6	1	—	—	—	1	—	—	Three charge pumps for USB OTG	25-ball chip scale	2.75
<b>TPS65090</b>	5.0 to 17.0	5	Switch	—	3	2	—	I <sup>2</sup> C	Front-end PMIC for two to three Li-Ion in series	QFN-100	4.95
<b>TPS65200</b>	2.5 to 6.5	0	Switch	Yes	—	—	—	I <sup>2</sup> C	Front-end PMIC with charger+WLed	WCSP, QFN	2.45
<b>TPS65233</b>	4.5 to 20	2	—	—	—	1	1	I <sup>2</sup> C	LNB voltage regulator for satellites	QFN-16	0.90
<b>TPS65291</b>	4 to 10	3	—	—	2	1	—	I <sup>2</sup> C	Meters, energy harvesting, +10-year battery	HTSSOP-14	1.50
<b>TPS65290</b>	2.5 to 5.5	2	—	—	1	1	—	I <sup>2</sup> C	Meters, energy harvesting, +10-year battery	QFN-24	1.75
<b>TPS65471</b>	2.7 to 5.75	5	Linear	Yes	—	4	1	—	PMIC for handheld devices	QFN-40	2.25
<b>TPS65510</b>	2.7 to 5.5	5	—	—	—	4	1	—	Battery-backup IC	QFN-16	1.50
<b>TPS65530/30A</b>	1.5 to 5.5	9	—	—	7	1	1	—	PMIC for digital still cameras	QFN-48	3.90
<b>TPS657120</b>	2.8 to 5.5	—	—	—	3	2	—	MIPI® RFFE, 2x GPIO	PMIC for baseband and RF-PA power	WCSP-30	1.95
<b>TPS65735/x835</b>	2.5 to 6.4	2	Linear	—	—	1	—	—	3D glasses, x835 with MSP430™	QFN-40	1.25
<b>TPS658310</b>	3.0 to 6.0	0	Switch	Yes	—	—	—	I <sup>2</sup> C	Front-end PMIC with charger+flash+WLed	WCSP-49	3.45
<b>TPS657202</b>	2.2 to 5.6	3	Linear	—	1	1	—	I <sup>2</sup> C	Charger with Power path	DSBGA-25	TBD
<b>TPS68470</b>	2.97 to 3.63	6	—	Yes	1	5	—	I <sup>2</sup> C	Dual Flash LED driver, CLK, GPIOs	WCSP	1.15

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red. Preview devices are listed in bold teal.

# Multi-Output Power Management Integrated Circuits (PMICs)

## General Purpose PMICs

### Selection Guide

Device	V <sub>IN</sub> (V)	No. of Regulator Outputs	Charger	WLED Boost	DC/DC Step-Down Converter	LDO	Load Switches	Communication Interface	Description	Package(s)	Automotive	Price*
LM10503	3 to 5.5	3	—	—	3	—	—	PWI™	Ideal for ASIC and SOC designs	WQFN-36		3.75
LM10504/6	3 to 5.5	4	—	—	3	1	—	SPI	Ideal for flash and SSDs	DSBGA-34		1.20
LM10524	3 to 5.5	3	—	—	3	—	—	SPI	Ideal for flash and SSDs	SMD-46		2.15
LM26400Y	3.0 to 20.0	2	—	—	2	—	—	—	Dual buck	LLP-16		2.10
LM26420	3 to 5.5	2	—	—	2	—	—	—	Dual 2.0-A buck	WQFN-16, HTSSOP-20		2.05
LM26480	2.8 to 5.5	4	—	—	2	2	—	—	General purpose	LLP-24		0.95
LM26484	3 to 5.5	3	—	—	2	1	—	—	General purpose	WQFN-24		0.70
LM3280	2.7 to 5.5	4	—	—	1	3	—	—	Battery-powered RF	SMD-16		0.65
LM3686	2.7 to 5.5	3	—	—	1	2	—	—	Low-power PMIC	DSBGA-12		0.40
LM3687	2.7 to 5.5	3	—	—	1	1	—	—	Low-power PMIC	DSBGA-9		0.40
LP3905	3 to 5.5	4	—	—	2	2	—	—	General purpose	WSON-14		1.17
LP3906	2.7 to 5.5	4	—	—	2	2	—	I <sup>2</sup> C	General purpose	WQFN-24		1.17
LP3907	2.8 to 5.5	4	—	—	2	2	—	I <sup>2</sup> C	General purpose	DSBGA-25, WQFN-24		0.95
LP3910	2.7 to 5.5	5	Linear	—	3	2	—	I <sup>2</sup> C	Portable with buck-boost	LLP-48		2.11
LP3971/2	2.7 to 5.5	9	Backup	—	3	6	—	I <sup>2</sup> C	PMIC for advanced applications processors	WQFN-40		3.25
LP3974	2.7 to 5.5	15	Linear	—	4	11	—	I <sup>2</sup> C	PMIC for advanced applications processors	Micro SMD-100		2.46
LP8720	2.7 to 4.5	6	—	—	1	5	—	I <sup>2</sup> C	General purpose	DSBGA-20		0.70
LP8725	2.6 to 4.5	9	—	—	2	7	—	I <sup>2</sup> C	General purpose	DSBGA-30		1.29
TPS6500x	1.8 to 6.0	3	—	—	1	2	—	—	General purpose	QFN-16	✓	1.40
TPS6501x	4.5 to 5.5	4	Linear	—	2	2	—	I <sup>2</sup> C	General purpose	QFN-48		2.55
TPS65050/1/2/4/6	2.5 to 6.0	6	—	—	2	4	—	Logic H/L	Low-cost 6-channel PMIC	QFN-32	✓	1.75
TPS65053/8	2.5 to 6.0	5	—	—	2	3	—	—	Low-cost 5-channel PMIC	QFN-24	✓	1.65
TPS65266	2.7 to 6.5	3	—	—	3	—	—	—	Triple buck converters (3 A/2 A/2 A)	QFN		2.10
TPS65266A	2.7 to 6.5	3	—	—	3	1	—	—	Triple buck converters (3 A/2 A/2 A) with a 500-mA LDO	QFN		2.10
TPS65262-1	4.5 to 18	5	—	—	3	2	—	—	Triple buck converters (3 A/1 A/1 A) with dual LDO (150 mA/350 mA)	QFN		2.05
TPS65263	4.5 to 18	3	—	—	3	—	—	I <sup>2</sup> C	Triple buck converters (3 A/2 A/2 A) with I <sup>2</sup> C interface	QFN		2.35
TPS65283	4.5 to 18	3	—	—	2	—	1	—	Dual buck converters (3.5 A/2.5 A) with a power distribution switch	QFN		2.00
TPS65286	4.5 to 28	3	—	—	3	—	—	—	Single buck converter (6 A) with a power distribution switch	QFN		2.00
TPS65400	4.5 to 18	4	—	—	3	—	—	PMBus™/I <sup>2</sup> C	Quad buck converters (4 A/4 A/2 A/2 A) buck converters with PMBus/I <sup>2</sup> C interface	QFN		3.20
TPS657051/2	3.3 to 6	3	—	—	2	1	—	—	PMIC for embedded cameras	WCSP-16		1.20
TPS65708	3.6 to 6	4	—	—	2	2	—	—	PMIC for embedded cameras	WCSP-16		1.65
TPS65720/1	1.8 to 5.6	2	Linear	—	1	1	—	I <sup>2</sup> C	Smallest single-Li-Ion applications	DSBGA-25, QFN-32		1.65
TPS65800/10/11/20	4.3 to 16	11	Linear	Yes	2	7	—	I <sup>2</sup> C, 3 GPIOs	Advanced PMIC w/ LED drivers	QFN-56		5.75
TPS65083x	5.4 to 24	8	—	—	1	3	—	I <sup>2</sup> C GPIOs	Advanced PMIC with 4 controllers for high power rails	BGA - 168 , 7x7 & BGA- 151, 9x9		5.90
TPS65084x	5.4 to 24	11	—	—	3	4	3	I <sup>2</sup> C, GPIOs	Advanced PMIC w/3 controllers for high power rails	QFN-64		4.90
TPS65085x	5.4 to 24	8	—	—	1	3	—	I <sup>2</sup> C, GPIOs	Advanced PMIC with 4 controllers for high power rails	BGA - 168 , 7x7 & BGA- 151, 9x9		6.49
TPS65086x	5.4 to 24	11	—	—	3	4	3	I <sup>2</sup> C, GPIOs	Advanced PMIC w/3 controllers for high power rails	QFN-64		5.49

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**. Preview devices are listed in **bold teal**.

# Multi-Output Power Management Integrated Circuits (PMICs)

## Embedded Processor Support

### Embedded Processors and FPGAs Supported by TI PMICs

Processor	Part Number	PMIC	Processor	Part Number	PMIC
TI	C2834x	TPS65000, TPS650061, TPS65300/301-Q1 <sup>†</sup>	Altair	3100/6200	TPS659122
TI	C55x	TPS65000x	Altera	Cyclone III	TPS65023, TPS65050, TPS650250
TI	C6742/6/8	TPS65910, TPS65070, TPS65023-Q1 <sup>†</sup>	Altera	Cyclone IV	TPS65218, TPS650250, TPS65911
TI	C6745/7	TPS65910, TPS65023	Altera	Cyclone V	TPS65086x
TI	C6A814x	TPS659113	Altera	Arria V	TPS65085x
TI	C6A816x	TPS659112	Altera	Arria 10	TPS65085x
TI	DM335, DM355, DM365, DM367	TPS65053, TPS65070/73	Altera	Max II	TPS65000
TI	DM368	TPS650532, TPS65023	Altera	Max V	TPS65000
TI	DM385	TPS659113	Ambarella	A7L	TPS65217, TPS80032
TI	DM37x 800MHz	TPS6595x/30/2x/10, TPS65023, TPS650731	Ambarella	iOne	TPS65217
TI	DM37x 1GHz	TPS65950A3/x51/x21B1/x10, TPS65023, TPS650731	Freescale	IMX25	TPS65051/2
TI	DM643x, DM644x	TPS65023-Q1 <sup>†</sup> , TPS659105	Freescale	IMX27	TPS65053-Q1 <sup>†</sup> , TPS659107
TI	DM812x/ DM814x	TPS659113	Freescale	IMX35/37	TPS650250-Q1 <sup>†</sup> , TPS659107
TI	DM816x	TPS659112	Freescale	IMX508	TPS659108
TI	AM17x	TPS65910, TPS65000x, TPS650061, TPS65023-Q1 <sup>†</sup>	Freescale	IMX51	TPS659109
TI	AM18x	TPS65910, TPS65000x, TPS650061, TPS65070/73	Freescale	IMX53	TPS659106
TI	AM335x	TPS65910A/A3, TPS65217/8, TPS650250-Q1 <sup>†</sup>	Freescale	IMX6x	TPS80032, TPS65912, TPS65911
TI	AM35x	TPS65910, TPS650732-Q1 <sup>†</sup> , TPS65023-Q1 <sup>†</sup>	Freescale <sup>†</sup>	Qorivva (57xx)	TPS65381-Q1 <sup>†</sup>
TI	AM572x	TPS65913	Freescale <sup>†</sup>	Qorivva (576x)	TPS65381-Q1 <sup>†</sup>
TI	AM437x	TPS65218	Infineon <sup>†</sup>	Aurix (TC27x)	TPS65381-Q1 <sup>†</sup>
TI	AM37x 800MHz	TPS6595x/30/2x/10, TPS65023-Q1 <sup>†</sup> , TPS650731	Marvell	PXA270	TPS65021/2
TI	AM37x 1GHz	TPS65950A3/x51/x21B1/x10, TPS65023, TPS650731	Marvell	Armada	Please ask TI
TI	AM387x	TPS659113	Nvidia	Tegra 2	TPS658621/2/3, TPS658640/3, TPS658629-Q1 <sup>†</sup>
TI	AM389x	TPS659112	Nvidia	Tegra 3	TPS659110/9, TPS659119-Q1 <sup>†</sup>
TI	RM4x, TMS570	TPS65300/301-Q1 <sup>†</sup> , TPS6531x-Q1 <sup>†</sup> , TPS65381-Q1 <sup>†</sup>	Nvidia	Tegra 4	TPS65913
TI	OMAP™3503/15/25/30	TPS6595x/30/2x/10, TPS65073x, TPS65023-Q1 <sup>†</sup>	Nvidia	Tegra 4 (SP30)	TPS65712x, LP8755
TI	OMAP3611/21/30	TPS6595x/30/2x/10, TPS65023	Nvidia	i450, i500	TPS659121
TI	OMAP-L132, L137, L138	TPS65910, TPS65023, TPS650061, TPS65070	Renesas <sup>†</sup>	RH850/V850	TPS65381-Q1 <sup>†</sup>
TI	OMAP4430/60/70	TWL6030/32, TWL6040/41 TPS659119-Q1 <sup>†</sup>	Rockchip	RK29	TPS659102
TI	OMAP543x	TWL6040/41, TPS659038-Q1 <sup>†</sup>	Rockchip	RK30	TPS659102
TI	Jacinto 3 (DRA5xx)	TPS650732-Q1 <sup>†</sup>	Samsung	S5PV210, S5PC110	TPS659101
TI	Jacinto 4 (DRA64x)	TPS65911x, TPS659119-Q1 <sup>†</sup>	Samsung	S5PC100	TPS659103, LP3974
TI	Jacinto 5 (DRA62x/65x)	TPS65911x, TPS659119-Q1 <sup>†</sup>	Samsung	S5P6440	TPS659104
TI	Jacinto 6 (DRA72x/74x)	TPS659038-Q1 <sup>†</sup>	Samsung	S5PV310	Please ask TI

<sup>†</sup>Automotive-only processor or automotive qualified.

<sup>†</sup>Automotive-only processor or automotive qualified.

Reference designs for these TI processor families are available online. Bookmark these pages to find new designs for the latest DSP and microprocessor generations.

PMIC solutions with and without battery charger:  
[www.ti.com/pmic](http://www.ti.com/pmic)

TI power-management reference designs:  
[www.ti.com/processorpower](http://www.ti.com/processorpower)

# Multi-Output Power Management Integrated Circuits (PMICs)

## Automotive PMICs—Wide V<sub>IN</sub>

### 40-V Step-Down Converter with Eco-mode™ and LDO

#### TPS65320-Q1

##### TPS65320-Q1

3.2-A high-V<sub>IN</sub> asynchronous buck converter at 1.1 to 20 V

280-mA adjustable LDO

Eco-mode™

Overcurrent protection

Overtemperature protection

Extended temperature range

#### Key Features

- High-V<sub>IN</sub> (3.6- to 40-V) asynchronous buck converter:
  - 1.1 to 20 V at 3.2 A
  - Supports high-duty-cycle operation
  - 100-kHz to 2.5-MHz adjustable-frequency PWM control
  - Less than 140-µA standby current in low-power mode
- 280-mA adjustable LDO:
  - 1.1- to 5.5-V output voltage
  - Input-supply auto-source to balance efficiency and low standby current
  - Power Good output

- Extended temperature range: -40 to 125°C
- Available in 14-pin HTSSOP package with PowerPAD™

#### Applications

- Infotainment, telematics
- TFT cluster
- Advanced driver assistant system (ADAS)



Evaluation module.

Get more information: [www.ti.com/product/TPS65320-Q1](http://www.ti.com/product/TPS65320-Q1)

### High-Voltage PMIC for Automotive Safety Applications

#### TPS65311-Q1

##### TPS65311-Q1

Synchronous buck controller

Dual synchronous buck converter

Adjustable 350-mA LDO

Asynchronous boost converter

Independent voltage monitoring

SPI interface

Integrated window watchdog

High-side and LED drivers

#### Key Features

- High V<sub>IN</sub> range (4 to 40 V) with transients up to 60 V
- Synchronous buck controller:
  - Peak gate-drive current: 0.6 A
  - 490-kHz fixed switching frequency
- 2-A dual synchronous buck converter:
  - Out-of-phase switching
  - 2.45-MHz switching frequency
- Adjustable 350-mA LDO
- 1-A asynchronous boost converter
- Soft-start feature on all outputs
- Independent voltage monitoring
- UV/OV protection
- SPI interface
- High-side driver for external FETs
- LED driver
- 56-pin QFN enhanced PowerPAD™ package

#### Applications

- Camera- or radar-based vision systems (ADAS)
- Multirail DC power-distribution systems
- Safety-critical automotive applications

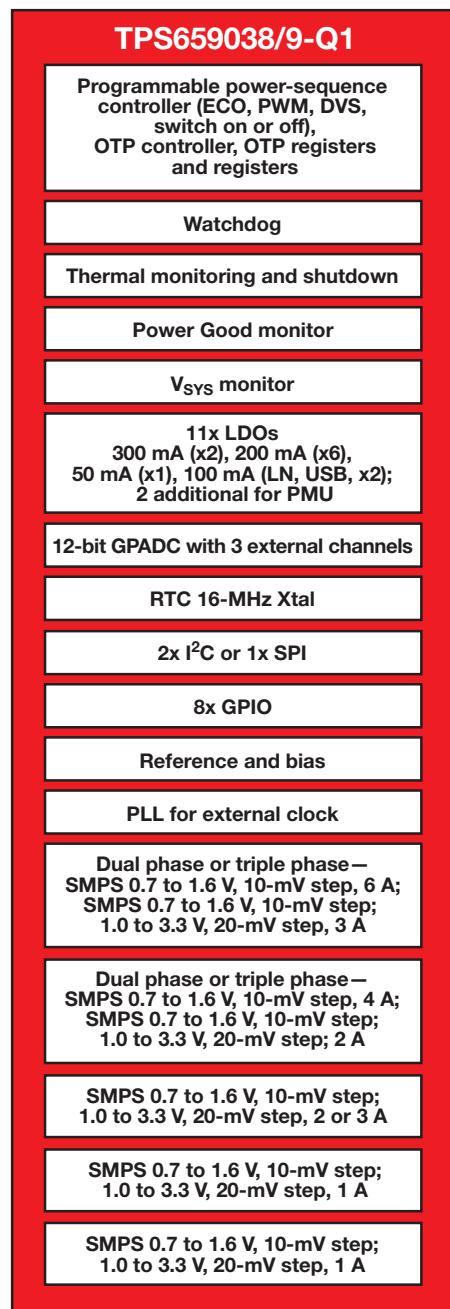
Get more information: [www.ti.com/product/TPS65311-Q1](http://www.ti.com/product/TPS65311-Q1)

# Multi-Output Power Management Integrated Circuits (PMICs)

## Automotive PMICs—Low-Voltage

### Integrated PMIC for Arm Cortex™ A15 Processors

TPS659038-Q1, TPS659039-Q1



### Key Features

- Qualified for automotive applications
  - Temperature grade 3: -40 to 85
  - ESD classification: HBM Level 2; CDM Level C4B
  - Latch up classification: Level IIB for µC and SPI terminals; Level II A for all other terminals
- Seven step-down switched-mode power supply (SMPS) regulators:
  - One 0.7 to 1.65 V at 6 A (10-mV steps); dual phase configuration with DVS control
  - One 0.7 to 3.3 V at 3 A (10 or 20-mV steps): Single phase configuration; regulator can be combined with the 6 A resulting in a 9-A triple-phase regulator (DVS controlled)
  - Two 0.7 to 3.3 V at 2 A (10 or 20-mV steps): Single phase configuration; one regulator with DVS control, which can also be configured as a 3-A regulator
  - Two 0.7 to 3.3 V at 1 A (10 or 20 mV steps): Single phase configuration; one regulator with DVS control
  - Output current measurement in all except 1-A SMPS regulator
  - Differential remote sensing (output and ground) in dual phase and triple phase regulators
  - Hardware and software controlled Eco-mode™, up to 5 mA with 15-µA quiescent current
  - Short circuit protection
  - Power Good indication (voltage and overcurrent indication)
  - Internal soft-start for in-rush current limitation
  - Ability to synchronize SMPS to external clock or internal fallback clock with phase synchronization
- Eleven general purpose low drop out (LDOs) (50 mV steps)
  - Two 0.9 to 3.3 V at 300 mA with pre-regulated supply
  - Six 0.9 to 3.3 V at 200 mA with pre-regulated supply
- One 0.9 to 3.3 V at 50 mA with pre-regulated supply
- One 100-mA USB LDO
- One low-noise LDO 0.9 to 3.3 V up to 100 mA (low-noise performance up to 50 mA)
- Two additional LDOs for PMU internal use
- Short-circuit protection
- Clock management 16-MHz crystal oscillator and 32-kHz RC oscillator
  - Ne buffered 32-kHz output
- Real-time clock (RTC) with alarm wake-up mechanism
- 12-bit sigma-delta general purpose analog-to-digital converter (GPADC) with three external input channels and six internal channels for self-monitoring
- Thermal monitoring
  - High temperature warning
  - Thermal shutdown
- Control
  - Configurable power-up and power-down sequences (OTP)
  - Configurable sequences between the sleep and active states (OTP programmable)
  - One dedicated digital output signal (REGEN) that can be included in the start up sequence
  - Three digital output signals MUXed with GPIO that can be include in the start-up sequence
  - Selectable control interface: One serial peripheral interface (SPI) for resource configurations with DVS control
  - Undervoltage lockout
  - System voltage range from 3.135 to 5.25 V
  - Package options: 12x12-mm, 169-pin nFBGA with 0.8-mm ball pitch

### Applications

- Automotive head unit
- Cluster
- Surround view
- Car black box
- Digital radio

Get more information:

[www.ti.com/product/TPS659038-Q1](http://www.ti.com/product/TPS659038-Q1) or [TPS659039-Q1](http://www.ti.com/product/TPS659039-Q1)

# Multi-Output Power Management Integrated Circuits (PMICs)

## Automotive PMICs

### Selection Guide

Device	V <sub>IN</sub> (V)	No. of Regulator Outputs	Boost	DC/DC Step-Down Converter	DC/DC Step-Down Controller	LDO	Communication Interface	Description	Package(s)	Automotive	Price*
<b>V<sub>IN</sub> (max) ≤ 20 V</b>											
<b>TPS659038-Q1</b>	3.135 to 5.25	18	—	7	—	11	SPI, 2x I <sup>2</sup> C	Automotive PMIC for OMAP54xx	nFBGA-169	✓	8.00
<b>TPS659039-Q1</b>	3.135 to 5.25	13	—	7	—	6	SPI, 2x I <sup>2</sup> C	Automotive PMIC for Jacinto 6 and TDA2x	nFBGA-169	✓	7.60
<b>TPS659119-Q1</b>	2.7 to 5.5	11	—	3	—	8	I <sup>2</sup> C, GPIOs	Advanced PMIC w/embedded processor controller	HTQFP-80	✓	4.49
<b>LP3907</b>	2.8 to 5.5	4	—	2	—	2	I <sup>2</sup> C	General purpose	SMD-25, LLP-24	✓	1.10
<b>TPS658629-Q1</b>	2.9 to 5.5	14	Yes	3	—	11	I <sup>2</sup> C	Advanced PMIC	nFBGA-169	✓	7.00
<b>LM26420</b>	3 to 5.5	2	—	2	—	—	—	Dual 2.0-A buck	WQFN-16, HTSSOP-20	✓	2.05
<b>LM26480</b>	3 to 5.5	2	—	4	—	2	—	Dual buck, dual LDO	LLP-24	✓	1.10
<b>LP8728</b>	4.5 to 5.5	4	—	4	—	—	—	General purpose	QFN-28	✓	1.60
<b>TPS65000-Q1</b>	2 to 6	3	—	1	—	2	—	General purpose	QFN-16	✓	1.64
<b>TPS65023-Q1</b>	2.5 to 6	6	—	3	—	3	I <sup>2</sup> C	6-channel PMIC	QFN-40	✓	3.45
<b>TPS650241/3/4-Q1</b>	2.5 to 6	6	—	3	—	3	I <sup>2</sup> C	Flexible 6-channel PMIC	VQFN-32	✓	3.04
<b>TPS650250-Q1</b>	2.5 to 6	6	—	3	—	3	—	Flexible 6-channel PMIC	VQFN-32	✓	2.57
<b>TPS65051-Q1</b>	2.5 to 6	6	—	2	—	4	—	6-channel PMIC, digital voltage selection for LDOs	QFN-32	✓	2.05
<b>TPS65053-Q1</b>	2.5 to 6	5	—	2	—	3	—	Low-cost 5-channel PMIC, optimized for DM355x	QFN-24	✓	1.95
<b>TPS650732-Q1</b>	2.8 to 6.3	5	Yes	3	—	2	I <sup>2</sup> C	Versatile 5-channel PMIC w/charger	QFN-48	✓	4.25
<b>TPS65917-Q1</b>	2.3 to 7	10	—	5	—	5	I <sup>2</sup> C, SPI	PMIC for ADAS and scalable infotainment systems, optimized power for i6Eco	BTSSOP-48 PowerPAD™	✓	TBD
<b>TPS652510-Q1</b>	4.5 to 16	3	—	3	—	—	—	General purpose with soft start	QFN-40	✓	2.10
<b>TPS65251</b>	4.5 to 18	3	—	3	—	—	—	General purpose with soft start	QFN-40	✓	2.10
<b>V<sub>IN</sub> (max) &gt; 20 V</b>											
<b>TPS43331-Q1</b>	5 to 30	4	—	—	2	2	I <sup>2</sup> C	Dual buck controllers, dual LDO and high-side switch for PMICs and DSPs	HTSSOP-38	✓	3.20
<b>TPS65381-Q1</b>	5.8 to 36	5	—	1	—	4	SPI	PMIC w/MCU interface for automotive safety	HTSSOP-32	✓	2.57
<b>TPS4333x-Q1</b>	2 to 40	3	Yes	—	2	—	—	Wide input range, boost and dual buck controller family	HTSSOP-38	✓	2.20
<b>TPS65320-Q1</b>	3.6 to 40	2	—	1	—	1	—	General purpose w/soft start and Eco-mode™	HTSSOP-14	✓	1.45
<b>TPS43340-Q1</b>	4 to 40	4	—	1	2	1	—	Wide input range, quad-rail power solution	HTQFP-48	✓	3.75
<b>TPS4335x-Q1</b>	4 to 40	2	—	—	2	—	—	Wide input range, dual synchronous buck controller family	HTSSOP-38	✓	2.60
<b>TPS65310A/11-Q1</b>	4 to 40	5	—	2	1	1	SPI	Optimized for automotive safety	QFN-56	✓	4.99
<b>TPS65300-Q1</b>	5.6 to 40	4	—	1	—	3	—	PMIC w/soft start and voltage supervisor	HTSSOP-24, QFN-24	✓	1.98
<b>TPS65301-Q1</b>	5.6 to 40	4	—	1	—	3	—	High-voltage PMIC for automotive safety applications	HTSSOP-24, QFN-24	✓	2.15
<b>LM25119</b>	4.5 to 42	2	—	—	2	—	—	Dual channels with phase interleaving and current sharing	QFN-32	✓	2.60
<b>LM5119</b>	5.5 to 65	2	—	—	2	—	—	Dual channels with phase interleaving and current sharing	QFN-32	✓	3.25

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in **bold red**. Preview devices are listed in **bold teal**.

# Power Protection, Distribution and Monitoring

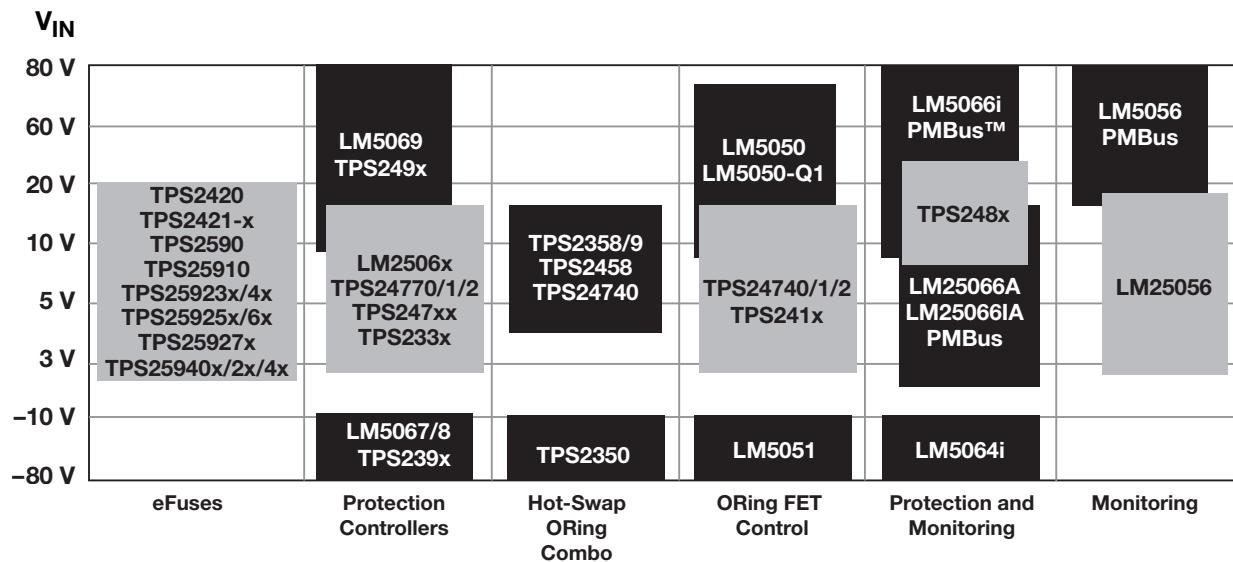
## Overview

The management, protection, and monitoring of a power distribution system and its associated supplies and loads is a continuous challenge. Load currents, accuracy requirements, and protection demands are steadily increasing while error budgets and power-dissipation allowances are shrinking.

Texas Instruments continues to address these changing requirements with a growing portfolio of protection solutions that are designed to match common application and protection requirements. From simple, easy-to-use, integrated-FET eFuses to precision monitoring and protection devices, there is a solution for every application.

More applications are demanding tighter precision in current-limit accuracy and power/current monitoring. These requirements are driven by the need for lower power-supply margins and smart power management. Pushing these trends even further are legislated efficiency mandates and industry attempts to self regulate to a variety of green standards.

## Protection Power Portfolio



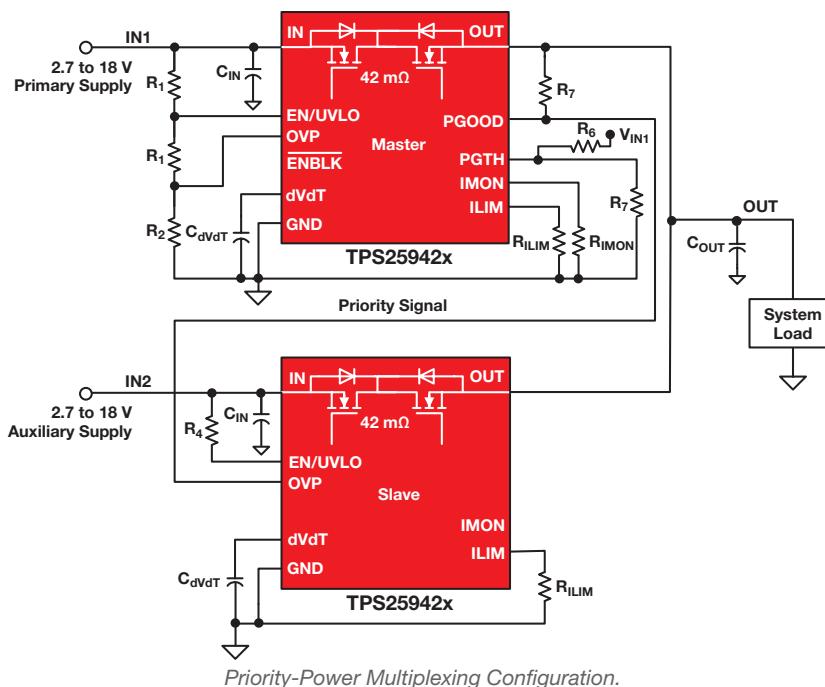
# Power Protection, Distribution and Monitoring

## eFuses, Hot-Swap Control, Protection and Monitoring

### 18-V, 5-A eFuse with Internal Back-to-Back FETs

#### TPS25942x, TPS25944x

The TPS25942x and TPS25944x family delivers a new level of integration in low-voltage eFuses. Internal back-to-back FETs limit current to a safe and programmable level in the forward direction and prevent current flow entirely in the reverse direction. The overcurrent threshold can be programmed between 0.6 A and 5.3 A via an external resistor. These eFuses are designed to control redundant power-supply systems. The devices monitor  $V_{IN}$  and  $V_{OUT}$  to provide true reverse blocking from output when reverse condition or input power-fail condition is detected. Also, a pair of TPS25942x or TPS25944x devices can be configured to assign priority to the main power supply over the auxiliary power supply.



Get more information: [www.ti.com/product/TPS25942A](http://www.ti.com/product/TPS25942A) or [TPS25944A](http://www.ti.com/product/TPS25944A)

### eFuse (Integrated FET) Selection Guide

Device	Description	Channels	$V_{IN}$ (V)	$V_{absmax\_cont}$ (V)	Current-Limit Threshold (typ) (A)	Fault Response	$R_{ON}$ (mΩ)	ON/OFF Control Input(s)	Status Output	Package(s)	Automotive	Price*
TPS2420	3- to 20-V, 2- to 5-A eFuse with load current monitoring	1	2.9 to 20	25	1 to 5	Prog	30	EN\	FLT, IMON, PG	16 QFN		1.38
TPS2421-1/2	3- to 20-V, 2- to 5-A eFuse	1	2.9 to 20	25	1 to 5	Latch/Retry	33	EN\	FLT, PG	8 SO PowerPAD™		1.06
TPS24750/1	2.5- to 18-V, 12-A eFuse, current limit at startup only	1	2.5 to 18	30	Adjustable	Latch/Retry	3	ENUV	FLT, IMON, PG\	36 VQFN		1.80
TPS2590	3- to 20-V, 0- to 6.5-A eFuse	1	2.9 to 20	25	1 to 5	Prog	30	EN\	FLT	16 QFN		0.90
TPS25910	3- to 20-V, 2- to 6.5-A eFuse with dV/dt control	1	2.9 to 20	22	0.8 to 6.5	Auto Retry	30	EN\	FLT	16 QFN		0.90
TPS2592AA/AL	12-V, 2- to 5-A eFuse/surge clamp with block FET driver	1	4.5 to 13.8	20	2 to 5	Retry/Latch Off	28	ENUV	—	10 SON		0.55
TPS2592BA/BL	5-V, 2- to 5-A eFuse/surge clamp with block FET driver	1	4.5 to 5.5	20	2 to 5	Retry/Latch Off	28	ENUV	—	10 SON		0.55
TPS2592ZA	19-V, 2- to 5-A eFuse with block FET driver	1	4.5 to 19	20	2 to 5	Auto Retry	28	ENUV	—	10 SON		0.55
UCC2912	3- to 8-V, 0- to 3-A single hot-swap IC high-side MOSFET	1	3 to 8	8	IFAULT +1 or 4 A	Auto Retry	150	SHTDW\	FLT\	16 SOIC, 24 TSSOP		3.25

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### Key Features

- TPS25942x – Limits current to programmed maximum during overload
- TPS25944x – Allows current to exceed the programmed limit ( after inrush ) for < 4 ms
- Precise current monitor output for health monitoring of the system
- Precise power good comparator for external rail monitoring
- Self protection using thermal shutdown
- Latched or automatic restart mode

# Power Protection, Distribution and Monitoring

## eFuses, Hot-Swap Control, Protection and Monitoring

### eFuse (Integrated FET) Selection Guide (continued)

Device	Description	Channels	V <sub>IN</sub> (V)	V <sub>absmax_cont</sub> (V)	Current-Limit Threshold (typ) (A)	Fault Response	R <sub>ON</sub> (mΩ)	ON/OFF Control Input(s)	Status Output	Package(s)	Automotive	Price*
<b>UCC2915</b>	7- to 15-V, 0- to 3-A high-side MOSFET, 100-µA I <sub>Q</sub>	1	7 to 15	15.5	IFAULT +1 or 4 A	Auto Retry	150	SHTDW\N	FLT\N	16 SOIC		5.00
<b>UCC3912</b>	3- to 8-V, 0- to 3-A single hot-swap IC high-side MOSFET	1	3 to 8	8	IFAULT +1 or 4 A	Auto Retry	150	SHTDW\N	FLT\N	16 SOIC, 24 TSSOP		2.30
<b>UCC3915</b>	0- to 3-A, 7- to 15-V high-side MOSFET, 100-µA I <sub>Q</sub>	1	7 to 15	15.5	IFAULT +1 or 4 A	Auto Retry	150	SHTDW\N	FLT\N	16 SOIC, 24 TSSOP		2.55
<b>UCC3916</b>	4- to 6-V, 1.65-A high-side MOSFET for SCSI	1	4 to 6	6	2	Auto Retry	220	SHTDW\N	FLT	8 SOIC		2.55
<b>UCC3918</b>	3- to 6-V, 0- to 4-A low R <sub>ON</sub> high-side protection	1	3 to 6	8	0.5 to 5	Auto Retry	75	SHTDW\N	FLT\N	16 SOIC		2.35
<b>TPS2556/7</b>	2.5- to 6.5-V, 0.5- to 5-A precision limit eFuse	1	2.5 to 6.5	7	0.5 to 5	Auto Retry	22	1L/1H	FLT\N	8 QFN		0.90
<b>TPS2560/A</b>	2.5- to 6.5-V, 0.25- to 2.8-A dual precision limit eFuse	2	2.5 to 6.6	7	0.25 to 2.8	Auto Retry	44	2L	FLT\N	10 QFN		0.90
<b>TPS2561/A</b>	2.5- to 6.5-V, 0.25- to 2.8-A dual precision limit eFuse	2	2.5 to 6.7	7	0.25 to 2.8	Auto Retry	44	2H	FLT\N	10 QFN		0.90
<b>TPS25921A/L</b>	eFuse with precise current limit and over voltage protection	1	4.5 to 18	20	0.4 to 1.6 ±2%@1 A	Retry/Latch Off	90	ENUV, OV, SS	FLT\N	8 SOIC		0.50
<b>TPS25940A/L</b>	eFuse with true reverse blocking and DevSleep support for SSDs	1	2.7 to 18	20	0.65 to 5.3	Retry/Latch Off	42	EN, OV, DEVSLP, dV/dT	PG, FLT\N	20 WQFN		0.85
<b>TPS25942A/L</b>	eFuse power MUX with multiple protection Modes	1	2.7 to 18	20	0.65 to 5.3	Retry/Latch Off	42	EN, OV, ENBLK\N, dV/dT	PG, FLT\N, IMON	20 WQFN		1.10
<b>TPS259250/1</b>	5-V, 2- to 5-A eFuse/surge clamp	1	4.5 to 5.5	20	2 to 5	Latch Off/Retry	28	ENUV	—	10 SON		0.38
<b>TPS259260/1</b>	12-V, 2- to 5-A eFuse/surge clamp	1	4.5 to 13.8	20	2 to 5	Latch Off/Retry	28	ENUV	—	10 SON	✓	0.38
<b>TPS259230/1</b>	5-V, 2- to 5-A eFuse/surge clamp, block FET drive	1	4.5 to 5.5	20	2 to 5	Latch Off/Retry	28	ENUV	—	10 SON		0.55
<b>TPS259240/1</b>	12-V, 2- to 5-A eFuse/surge clamp, block FET drive	1	4.5 to 13.8	20	2 to 5	Latch Off/Retry	28	ENUV	—	10 SON		0.55
<b>TPS259270/1</b>	4.5- to 18-V, 2- to 5-A eFuse/surge clamp, block FET	1	4.5 to 18	20	2 to 5	Latch Off/Retry	28	ENUV	—	10 SON		0.55

\*Suggested resale price in U.S. dollars in quantities of 1,000.

Preview devices are listed in bold teal. New devices are listed in bold red.

### Hot Swap Controllers (External FET) Selection Guide

Device	Target Applications	Channels	V <sub>IN</sub> Range (V)	Features <sup>1</sup>							Ramp	FET SOA Protection	Package(s)	Automotive	Price*
				Enable/Shutdown	UV	OV	Fault	PG	Latch	Auto Retry					
<b>TPS2300/01</b>	CompactPCI®, general	2	3 to 13/3 to 5.5	1L/1H	✓		✓	✓	✓			Voltage	No	20-pin TSSOP	1.60
<b>TPS2310/11</b>	CompactPCI, general	2	3 to 13/3 to 5.5	1L/1H	✓		✓	✓	✓	✓		Voltage	No	20-pin TSSOP	1.60
<b>TPS2320/21</b>	CompactPCI, general	2	3 to 13/3 to 5.5	1L/1H	✓		✓	✓	✓	✓		Voltage	No	16-pin SOIC/TSSOP	1.35
<b>TPS2330/31</b>	CompactPCI, general	1	3 to 13	1L/1H	✓		✓	✓	✓	✓		Voltage	No	14-pin SOIC/TSSOP	1.25
<b>TPS2342</b>	CompactPCI, PCI-X®, PC-X2.0	12	3.3, V <sub>aux</sub> , V <sub>I0</sub> , 5, +12, -12	1L	✓			✓	✓			Voltage	No	80-pin HTQFP	7.00
<b>TPS2350</b>	Full featured -48-V telecom, LS active ORing	2	-12 to -80	1H	✓	✓	✓	✓	✓	✓		Current	No	14-pin SOIC/TSSOP	1.90
<b>TPS2358</b>	xTCA mezzanine cards, general 12 V	2	8.5 to 17	2L	✓		✓	✓	✓	✓		Current	No	48-pin QFN	4.00
<b>TPS2359</b>	xTCA mezzanine cards, general 12 V	2	8.5 to 17	1H/1L	✓	✓	✓	✓	✓	S <sup>2</sup>	S <sup>2</sup>	Current	No	36-pin QFN	5.00
<b>TPS2363</b>	PCI Express®	6	3.3 V <sub>aux</sub> , 3.3, +12	1L	✓		✓	✓	✓	✓		Voltage	No	48-pin QFP	2.50
<b>TPS2390</b>	Simple -48-V telecom	1	-36 to -80	1H			✓		✓			Current	No	8-pin MSOP	1.00
<b>TPS2391</b>	Simple -48-V telecom	1	-36 to -80	1H			✓		✓		✓	Current	No	8-pin MSOP	1.00
<b>TPS2392</b>	Full featured -48-V telecom	1	-20 to -80	1H	✓	✓	✓	✓	✓	✓		Current	No	14-pin TSSOP	1.35
<b>TPS2393</b>	Full featured -48-V telecom	1	-20 to -80	1H	✓	✓	✓	✓	✓	✓		Current	No	14/44-pin TSSOP	1.35
<b>TPS2393A</b>	Full featured -48-V telecom (Fast retry)	1	-20 to -80	1H	✓	✓	✓	✓	✓	✓		Current	No	14-pin TSSOP	1.35
<b>TPS2394</b>	Full featured, ESD ruggedized -48-V hotswap	1	-12 to -80	1H	✓	✓	✓	✓	✓	✓		Current	No	14-pin TSSOP	1.35
<b>TPS2398</b>	Simple -48-V telecom with PG	1	-36 to -80	1H				✓	✓			Current	No	8-pin MSOP	1.35
<b>TPS2399</b>	Simple -48-V telecom with PG	1	-36 to -80	1H				✓		✓		Current	No	8-pin MSOP	1.35
<b>TPS2400</b>	Overvoltage/undervoltage protection IC	1	2 to 100	1H	✓	✓			✓		—	No	5-pin SOT-23	0.80	
<b>TPS2456/A</b>	Inrush controller with reverse current control	2	8.5 to 15	2H	✓		✓	✓	✓	✓		Current	No	36-pin QFN	3.75
<b>TPS2458</b>	xTCA mezzanine cards, general 12 V	1	8.5 to 15	1L	✓		✓	✓	✓	✓		Current	No	32-pin QFN	2.00
<b>TPS2459</b>	xTCA mezzanine cards, general 12 V	1	8.5 to 15	1H/1L	✓	✓	✓	✓	✓	S <sup>2</sup>	S <sup>2</sup>	Current	No	32-pin QFN	2.50
<b>TPS24700</b>	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓			✓	✓	✓		Current	No	8-pin MSOP	1.10
<b>TPS24701</b>	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓			✓	✓	✓		Current	No	8-pin MSOP	1.10
<b>TPS24710</b>	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓	L	L	L	✓			Current	Yes	10-pin MSOP	✓ 1.25

<sup>1</sup>Pin function: L = active low, H = active high. <sup>2</sup>S = Selectable.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

# Power Protection, Distribution and Monitoring

## eFuses, Hot-Swap Control, Protection and Monitoring

### Hot Swap Controllers (External FET) Selection Guide (continued)

Device	Target Applications	Channels	V <sub>IN</sub> Range (V)	Features <sup>1</sup>							Ramp	FET SOA Protection	Package(s)	Automotive	Price*
				Enable/Shutdown	UV	OV	Fault	PG	Latch	Auto Retry					
TPS24711	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓		L	L		✓	Current	Yes	10-pin MSOP		1.25
TPS24712	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓		H	H	✓		Current	Yes	10-pin MSOP		1.25
TPS24713	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓		H	H		✓	Current	Yes	10-pin MSOP		1.25
TPS24720	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓	✓	✓	✓	S <sup>2</sup>	S <sup>2</sup>	Current	Yes	16-pin SON		1.40
<b>TPS24770/1/2</b>	High performance hotswap controller	2	2.5 to 18	1H	✓	✓	L	H	-0, -2	-1	Current	Yes	24-pin QFN		3.50
TPS2490	Servers, basestations, +48 V, +12 V	1	9 to 80	1H	✓			✓	✓		Current	Yes	10-pin MSOP		1.40
TPS2491	Servers, basestations, +48 V, +12 V	1	9 to 80	1H	✓			✓		✓	Current	Yes	10-pin MSOP		1.40
TPS2492	Servers, basestations, industrial, +48 V, +12 V	1	9 to 80	1H	✓	✓	✓	✓	✓		Current	Yes	14-pin TSSOP		1.45
TPS2493	Servers, basestations, industrial, +48 V, +12 V	1	9 to 80	1H	✓	✓	✓	✓		✓	Current	Yes	14-pin TSSOP		1.45
LM25069	12-V hotswap controller with power limiting	1	2.9 to 17	1H	✓	✓	✓	H	-1	-2	Current	Yes	10-pin MSOP		1.19
LM25061	12-V hotswap controller with power limiting	1	2.9 to 17	1H	✓		✓	H	-1	-2	Current	Yes	10-pin MSOP		1.33
LM5060/Q	Low I <sub>q</sub> high-side protection controller	1	5.5 to 65	1H	✓	✓	✓	L	✓		Voltage	No	10-pin MSOP	✓	1.28/1.40
LM5069	+48-V hotswap controller with power limiting	1	9 to 80	1H	✓	✓	✓	H	-1	-2	Current	Yes	10-pin MSOP		1.35
LM5068	Simple -48-V hotswap controller family	1	-10 to -90	1H	✓	✓	✓	H/H L/L	-1/-3	-2/-4	Current	No	8-pin MSOP		1.35
LM5067	-48-V hotswap controller with power limiting	1	-9 to -80	1H	✓	✓	✓	H	-1	-2	Current	Yes	10-pin MSOP/14-pin SOIC		1.50

<sup>1</sup>Pin function: L = active low, H = active high. <sup>2</sup>S = Selectable.

New devices are listed in bold red.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### Protection and Monitoring with PMBus™/I<sup>2</sup>C Selection Guide

Device	V <sub>IN</sub> Range (V)	Enable/Shutdown	UV	OV	Fault	PG	Latch	Auto Retry	Interface			FET SOA Protection	Package(s)	Price*
									I <sup>2</sup> C	SMBus	PMBus			
LM25066/A	2.9 to 17	1H	✓	✓	✓	✓		Prog	Prog	I <sup>2</sup> C, SMBus, PMBus	Yes	24-pin LLP	2.33/2.80	
LM25066/A	2.9 to 17	1H	✓	✓	✓	✓		Prog	Prog	I <sup>2</sup> C, SMBus, PMBus	Yes	24-pin LLP	2.33/2.80	
TPS2480/1	9 to 24	1H	✓				✓	Prog	Prog	I <sup>2</sup> C	Yes	20-pin TSSOP	2.50	
TPS2482/3	9 to 36	1H	✓				✓	Prog	Prog	I <sup>2</sup> C	Yes	20-pin TSSOP	3.00	
LM5066	10 to 80	1H	✓	✓	✓	✓	✓	Prog	Prog	I <sup>2</sup> C, SMBus, PMBus	Yes	28-pin eTSSOP	3.95	
LM5066i	10- to 80-V hotswap power monitor with Intel node-manager compliance	1H	✓	✓	✓	✓	✓	Prog	Prog	I <sup>2</sup> C, SMBus, PMBus	Yes	28-pin eTSSOP	4.45	
LM5064	-10 to -80	1H	✓	✓	✓	✓	✓	Prog	Prog	I <sup>2</sup> C, SMBus, PMBus	Yes	28-pin eTSSOP	3.45	

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

### Monitoring with PMBus/I<sup>2</sup>C Selection Guide

Device	V <sub>IN</sub> Range (V)	Enable/Shutdown	Fault	Telemetry Data				Interface			Package(s)	Price*
				V <sub>IN</sub>	I <sub>IN</sub>	P <sub>IN</sub>	Temp					
LM25056/A	3 to 17	1H	✓	✓	✓	✓	✓	I <sup>2</sup> C, SMBus, PMBus			24-pin LLP	1.50/1.70
LM5056	10 to 80	1H	✓	✓	✓	✓	✓	I <sup>2</sup> C, SMBus, PMBus			28-pin TSSOP	2.49

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### ORing Controllers Selection Guide

Device	Description	Channels	V <sub>IN</sub> Range (V)	Enable/Shutdown	UV	OV	Fault	PG	ORing Linear Gate Drive	ORing Control	Package(s)		Price*
											Linear	Transistor	
TPS2410	ORing FET controller/MUX controller	1	0.8 to 16.5	1H	✓	✓	✓	✓		✓	14-pin TSSOP		1.70
TPS2411	ORing FET controller/MUX controller	1	0.8 to 16.5	1H						✓	14-pin TSSOP		1.70
TPS2412	ORing FET controller	1	0.8 to 16.5								8-pin SOIC, 8-pin TSSOP		1.20
TPS2413	ORing FET controller	1	0.8 to 16.5							✓	8-pin SOIC, 8-pin TSSOP		1.20
TPS2419	ORing FET controller with OV/enable	1	3 to 16.5	1H		✓				✓	8-pin SOIC		1.20
LM5050-1	Positive HV ORing controller with AUX input	1	5 to 80	L						✓	6-pin TSOT		1.25
LM5050-2	Positive HV ORing controller with FET test	1	6 to 80	L			✓			✓	6-pin TSOT		1.25
LM5051	Negative HV ORing controller with FET test	1	-6 to -100	L			✓			✓	8-pin SOIC		1.25
<b>TPS24740/1/2</b>	High performance hotswap/ORing controller	1	2.5 to 18	1H	✓	✓	✓	✓		✓	24-pin QFN		2.00
TPS2456/A	Inrush/reverse current controller for dual sources	2	8.5 to 15	2H	✓	✓	✓	✓			36-pin QFN		3.45
TPS2358	Dual 12-V/3.3-V hotswap/ORing controller	2	8.5 to 15	2L						✓	48-pin QFN		4.00
TPS2359	Dual 12-V/3.3-V hotswap/ORing controller	2	8.5 to 15	Via I <sup>2</sup> C						✓	36-pin QFN		5.00

\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

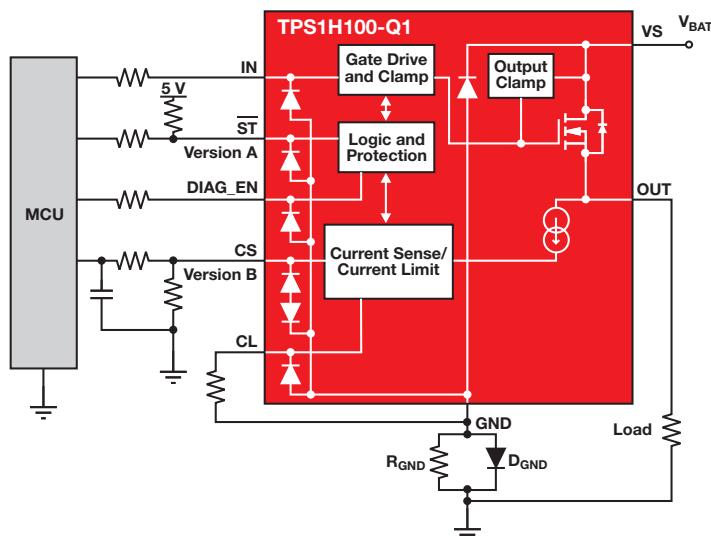
# Power Protection, Distribution and Monitoring

## Smart Power Switch

### 40-V/100-mΩ, Single-Channel, Smart High-Side Power Switch

#### TPS1H100-Q1

The TPS1H100-Q1 is a fully protected high-side power switch with an integrated NMOS power FET and charge pump. It is targeting for the intelligent control of the variable kinds of resistive, inductive and capacitive loads. Accurate current sensing and programmable current limiting offer unique capabilities in the market.



Get more information: [www.ti.com/product/TPS1H100-Q1](http://www.ti.com/product/TPS1H100-Q1)

#### Key Features

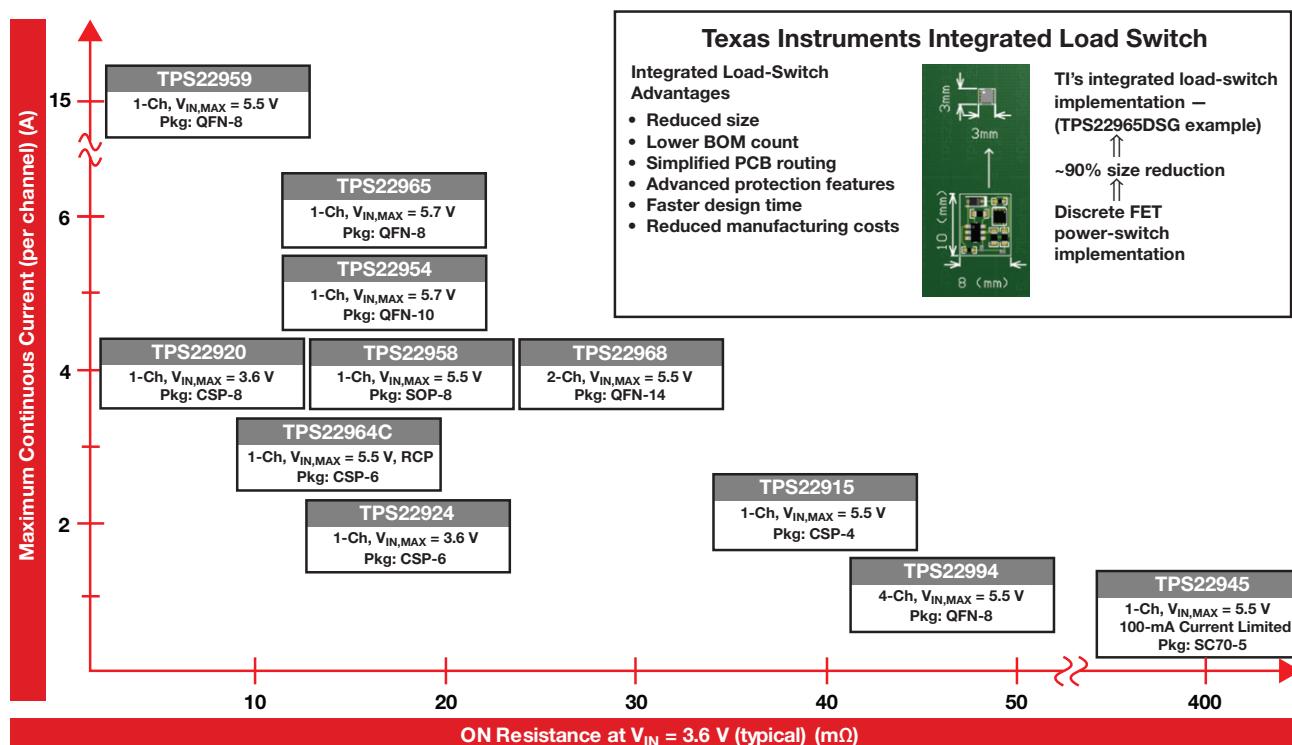
- Operating Voltage: 3.5 to 40 V
- Operating junction temperature: -40 to 150°C
- Very low standby current: < 0.5 μA
- High accurate current sense: ±30 mA at 1 A, ±4 mA at 5 mA
- Programmable current limit: ±20% when > 500 mA
- AECQ100-12 Grade A, 1M times, short to GND test
- Certification of ISO7637-2 and ISO16750-2 without external components
- Package: HTSSOP-14

#### Applications

- High-side relay/solenoid drivers
- Power switch for sub-module power supply
- Low-wattage lamp power switch
- General resistive, inductive and capacitive loads

## Current-Limited and Non-Current-Limited Load Switches

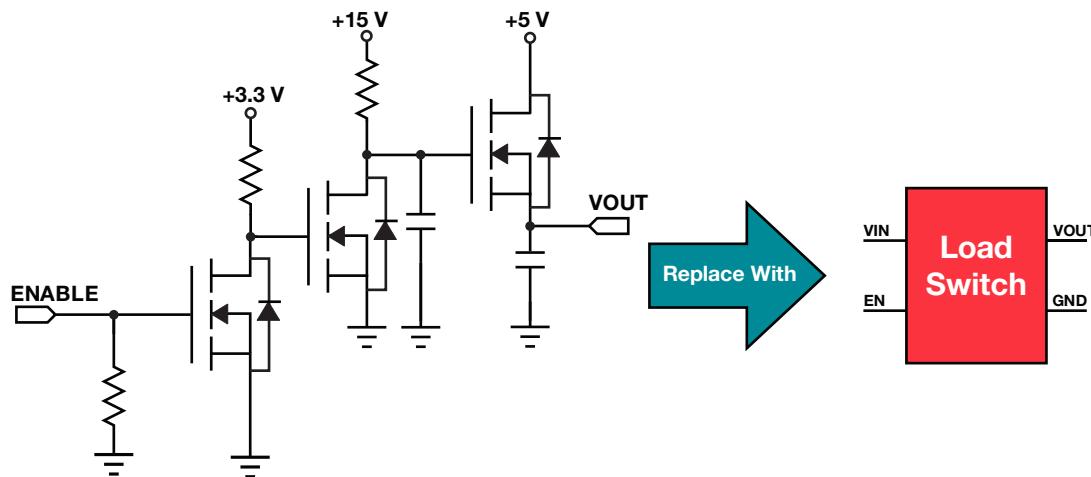
### Load Switch Product Portfolio



# Power Protection, Distribution and Monitoring

## Current-Limited and Non-Current-Limited Load Switches

### The Integration/Size Advantage of Load Switches



### Selection Guide

Device	Input Voltage Range (V)	R <sub>ON</sub> at 3.3 V (typ) (mΩ)	Shutdown Current (I <sub>SD</sub> ) (typ) (µA)	I <sub>MAX</sub> (A)	Number of Channels	Special Features	Package(s)	Automotive	Price*
<b>Non-Current-Limiting Load Switches</b>									
TPS22965	0.8 to 5.7	16	0.2	6	1	Adjustable rise time, quick output discharge	QFN-8		0.30
TPS22915	1.05 to 5.5	38	0.5	2	1	Hysteresis input, quick output discharge	CSP-4		0.24
TPS22920	0.75 to 3.6	5.3	5.5	4	1	Quick output discharge	CSP-8		0.31
TPS22924	0.75 to 3.6	18.3	3.5	2	1	Quick output discharge	CSP-6		0.28
TPS22954	0.7 to 5.7	16	4.3	5	1	Power good, adjustable rise time, quick output discharge	QFN-10		0.35
TPS22958	0.6 to 5.5	14	0.2	4 / 6	1	Adjustable rise time, quick output discharge	DGK-8 (4 A, no thermal pad), DGN-8 (6 A, with thermal pad)		0.42
TPS22959	0.8 to 5.5	4.4	1.1	15	1	Quick output discharge	QFN-8		0.68
TPS22964C	1 to 5.5	13.8	0.76	3	1	Reverse current protection, quick output discharge	CSP-6		0.28
TPS22968	0.8 to 5.5	25	0.5	4	2	Adjustable rise time, quick output discharge	QFN-14		0.36
TPS22994	1 to 3.6	41	7	1	4	Configurable rise time, I <sup>2</sup> C controllable, quick output discharge	QFN-20		0.60
<b>Automotive Grade Load Switches</b>									
TPS22965-Q1	0.8 to 5.5	16	0.2	4	1	Adjustable rise time, quick output discharge	QFN-8	✓	0.38
TPS22965N-Q1	0.8 to 5.5	16	0.2	4	1	Adjustable rise time	QFN-8	✓	0.38
TPS22966-Q1	0.8 to 5.5	16	0.5	4	2	Adjustable rise time, quick output discharge	QFN-14	✓	0.54
TPS22968-Q1	0.8 to 5.5	27	0.5	4	2	Adjustable rise time, quick output discharge, wettable flanks, AEC-Q100 Grade 1	QFN-10	✓	0.42
TPS22918-Q1	1.05 to 5.5	46	0.5	2	1	Adjustable rise time, selectable quick output discharge, AEC-Q100 Grade 1	SOT-23	✓	0.28
Device	Input Voltage Range (V)	R <sub>ON</sub> at 3.3 V (typ) (mΩ)	Current Limit (mA)	Current-Limit Blanking Time (ms)	Auto-Restart Time (ms)	Active	Package(s)	Price*	
<b>Current-Limiting Load Switches</b>									
TPS22941	1.62 to 5.5	500	40	10	80	Low	5 SC70	0.42	
TPS22942	1.62 to 5.5	500	100	10	80	Low	5 SC70	0.42	
TPS22943	1.62 to 5.5	500	40	0	—	High	5 SC70	0.42	
TPS22944	1.62 to 5.5	500	100	0	—	High	5 SC70	0.42	
TPS22945	1.62 to 5.5	500	100	10	80	High	5 SC70	0.42	
TPS22946	1.62 to 5.5	400	155/70/30	10	70	High	6 CSP	0.55	
LM34902/4	2.8 to 5.3	560	300/500	—	—	High	micro SMD-6	0.29/0.33	

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Power Protection, Distribution and Monitoring

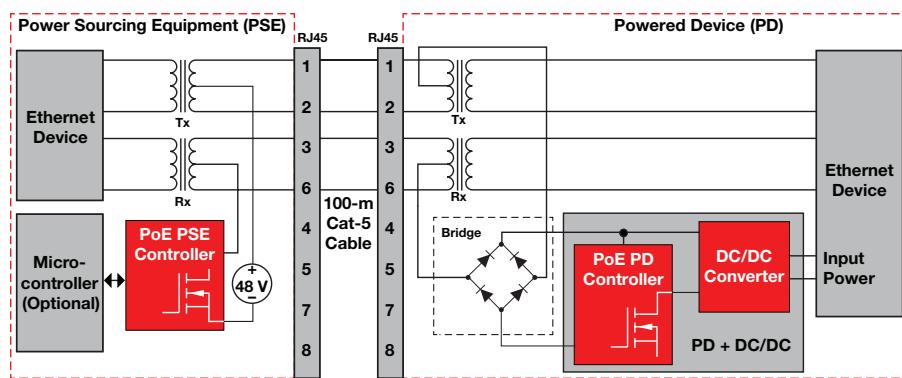
## Power-over-Ethernet (PoE)

### What is PoE?

PoE is a growing technology that conveniently delivers power through new or existing CAT5 Ethernet cables to a load. The original IEEE 802.3af standard could provide up to 13 W to enterprise IP phones. The latest 802.3at standard is able to provide up to 25.5 W and can be found in security cameras, access control points, wireless backhaul systems and more.

### Why Do You Need PoE?

Customers like PoE systems for reliability, convenience, low OpEx and low CapEx. The available 25-W per port is able to power many common applications. Also, because PoE systems are classified as low-power systems, licensed personnel are not required for installation and maintenance.



Get more information: [www.ti.com/poe](http://www.ti.com/poe)

Visit TIDesigns library for examples of more PoE solutions:  
[www.ti.com/refdesigns-poe](http://www.ti.com/refdesigns-poe)

### IEEE 802.3at PoE High-Power PD Interface

#### TPS2378, TPS2379

The TPS2378 and TPS2379 are IEEE 802.3at compliant, type 2 PoE PDCs targeted specifically for high-power PDs such as surveillance-system cameras and wireless access points.

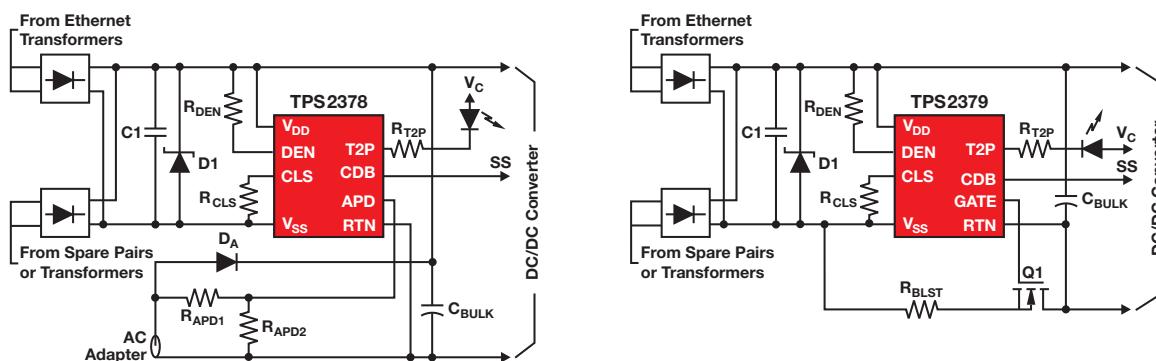
The TPS2378 and TPS2379 enable nonstandard, 51-W (four-pair) PDs

such as Cisco UPOE™ in either forced (TPS2378) or LLDP-based (TPS2379) modes.

#### Key Features

- TPS2378: Supports high-power auxiliary adapters (APD pin)
- TPS2378: Supports forced UPOE (SLVA625)

- TPS2379: External NFET drive for high power loads (>25 W) (GATE pin)
- TPS2379: LLDP UPOE (SLVA498)
- Start-up control for the DC/DC converter (CDB pin)
- IEEE 802.3at compliant
- 100-V monolithic process



Get more information: [www.ti.com/product/TPS2378](http://www.ti.com/product/TPS2378) or [TPS2379](http://www.ti.com/product/TPS2379)

# Power Protection, Distribution and Monitoring

## Power-over-Ethernet (PoE)

### Selection Guide

Device	Description	Abs Max V <sub>IN</sub> (V)	Operating Temp (°C)	Full Inrush Current Limiting	Current Limit (mA)	Second Gate Driver for Maximum Efficiency	Package(s)	Price*				
<b>Power-over-Ethernet (PoE) Powered Device (PD) Controllers with Integrated DC/DC Controllers</b>												
TPS23750/70	Integrated PD with PWM controller	100	-40 to 85	Fixed	405	No	TSSOP-20	1.50				
TPS23753A	PD+controller with AUX ORing	100	-40 to 85	Fixed	405	No	TSSOP-14	1.45				
TPS23754/6	High-power PD + high-efficiency controller	100	-40 to 125	Fixed	850	Yes	TSSOP-20 PowerPAD™	1.90				
TPS23757	PD + high-efficiency controller	100	-40 to 125	Fixed	405	Yes	TSSOP-20	1.65				
TPS23751/2	PD with Green Mode PWM	100	-40 to 85	Fixed	800	No - VF	TSSOP-20	1.50				
Device	Description	Detection	Classification	Abs Max V <sub>IN</sub> (V)	Operating Temp (°C)	Full Inrush Current Limiting	Current Limit (mA)	Auto Retry or Latch Off in Fault	UVLO	DC/DC Interface	Package(s)	Price*
<b>Power-over-Ethernet (PoE) Powered Device (PD) Interface Front-End Controllers</b>									UVLO	DC/DC Interface	Package(s)	Price*
TPS2375/1	Powered device controller	4	Yes, Class 0-4	100	-40 to 85	Programmable	450	Latch Off/Retry	802.3af (30.6/39.4 V)	PG	SOIC-8, TSSOP-8/TSSOP-8	1.00
TPS2376	Powered device controller	4	Yes, Class 0-4	100	-40 to 85	Programmable	450	Latch Off	Adjustable	PG	SOIC-8, TSSOP-8	1.00
TPS2376-H	High-power PD controller	4	Yes, Class 0-4	100	-40 to 85	Programmable	600	Auto Retry	Adjustable	PG	SOIC-8	1.25
TPS2377	Powered device controller	4	Yes, Class 0-4	100	-40 to 85	Programmable	450	Latch Off	Legacy (30.5/35.0 V)	PG	SOIC-8, TSSOP-8	1.00
TPS2377-1	Powered device controller	4	Yes, Class 0-4	100	-40 to 85	Programmable	450	Auto Retry	Legacy (30.5/35.0 V)	PG	SOIC-8	1.00
TPS2378	PD with AUX control	4	Yes, Class 0-4	100	-40 to 85	Fixed	800	Auto Retry	30.5/35	PG	SOIC-8	1.00
TPS2379	PD with high power	4	Yes, Class 0-4	100	-40 to 85	Fixed	800	Auto Retry	30.5/35	PG	SOIC-8	1.00
LM5073	PD controller w/AUX control	4	Yes, Class 0-4	100	-40 to 85	Programmable	800	Auto Retry	Adjustable	PG	TSSOP-14	1.30
Device	Applications	Channels	Abs Max V <sub>IN</sub> (V)	Operating Temp (°C)	IEEE Compliant	Interface	Disconnect	Measurements	Power FET	Package	Price*	
<b>Power-over-Ethernet (PoE) Power Sourcing Equipment (PSE) Controllers</b>									Internal	64-pin LQFP	4.75	
TPS2384	Routers, switches, SOHO hubs, midspans	4	80	-40 to 125	802.3af	I <sup>2</sup> C	Both AC and DC	Current, voltage, capacitance and temperature	Internal	64-pin LQFP	4.75	
TPS23841	Proprietary, higher-power 24-V/48-V PoE switches, hubs, midspans	4	80	-40 to 125	802.3af	I <sup>2</sup> C	Both AC and DC	Current, voltage, capacitance and temperature	Internal	64-pin LQFP	7.50	
TPS23861	QUAD IEEE 802.3at Power-Over-Ethernet PSE Controller	4	70	-40 to 125	802.3at Type 1 & 2	Optional I <sup>2</sup> C	Both AC and DC	Current, voltage and temperature	External	28 TSSOP	3.40	

\*Suggested resale price in U.S. dollars in quantities of 1,000.

### Reference Designs

Reference Design	Description	Device	V <sub>IN</sub> (VDC)	V <sub>OUT</sub> (V) at I <sub>OUT</sub> (A)	Class	Topology	Efficiency (%)
TIDA-00290	PoE PSE, Type 2 (30 W), IEEE 802.3at, fully autonomous quad-port solution	TPS23861	44 to 57	48 at 0.6	—	PoE	—
PMP9013	Class 4 synchronous flyback converter (5 V at 4.5 A) w/sleep mode for PoE reference design	TPS23752	21.6 to 57	5 at 4.5	4	Isolated, flyback-synchronous PoE	88
PMP7499	Non-standard (>25.5 W) PoE, high-efficiency forward converter (12 V at 5 A)	TPS2379	42 to 57	12 at 5	High Power	Isolated, forward-active-clamp PoE	93.6
PMP10572	Isolated Fly-Buck™ power module	TPS2378	40 to 57	12 at 1	3	Isolated Fly-Buck	85

Check for reference designs similar to your application: [www.ti.com/poe](http://www.ti.com/poe)

# Power Protection, Distribution and Monitoring

## Power-over-Ethernet (PoE)

### Power-over-Ethernet (PoE) Evaluation Modules

EVM Name <sup>1</sup>	Topology Description	Input-Voltage Source(s)	Output Power	Class	Efficiency at Full Load: DC/DC Converter at V <sub>IN</sub> PoE End-to-End
<b>TPS23753AEVM-001 (HPA304)</b>	CCM/DCM flyback diode rectifier	PoE, 24/48-V adapters. 12-V adapter at reduced output power.	7 W (5 V, 1.4 A)	3	82% at 48 V, 80% at PoE 48 V
<b>TPS23750EVM-107 (HPA107)</b>	Low-side buck	PoE, 48-V adapters	10 W (5 V, 2 A)	3	84% at 44 V, 80% at PoE 48 V
TPS23750EVM-107 (HPA107)	Low-side buck	PoE, 48-V adapters	10 W (3.3 V, 2.5 A)	3	79% at 44 V, 75% at PoE 48 V
<b>TPS23750EVM-108 (HPA108)</b>	CCM flyback synchronous rectifier (self-driven)	PoE, 48-V adapters	10 W (3.3 V, 3 A)	3	84% at 44 V, 81% at PoE 48 V
TPS23750EVM-108 (HPA108)	CCM flyback synchronous rectifier (self-driven)	PoE, 48-V adapters	10 W (5 V, 2 A)	3	84% at 44 V, 80% at PoE 48 V
<b>TPS23753AEVM-004 (HPA305)</b>	CCM flyback synchronous rectifier (self-driven)	PoE, 24/48-V adapters. 12-V adapter at reduced output power.	10 W (3.3 V, 3.0 A)	3	87% at 48 V, 83% at PoE 48 V
<b>TPS23757EVM (HPA480)</b>	CCM flyback synchronous rectifier (driven)	PoE, 24/48-V adapters	11 W (5 V, 2.2 A)	3	91% at 48 V, 89% at PoE 48 V
TPS23757EVM (HPA480)	CCM flyback synchronous rectifier (driven)	PoE, 24/48-V adapters	11 W (3.3 V, 3.3 A)	3	88% at 48 V, 85% at PoE 48 V
<b>TPS2375EV (HPA028)</b>	PD controller only (no DC/DC)	PoE	13 W	3	NA, 95% at PoE 48 V
<b>TPS2378EVM-105 (PWR105)</b>	Type 2 PD controller only (no DC/DC)	PoE, 48-V adapters	25 W	4	NA, 97.4% (2-pair) at PoE 48 V
<b>TPS23751EVM-104 (PWR104)</b>	Efficient CCM flyback synchronous rectifier (self-driven)	PoE, 24/48-V adapters	25 W (5 V, 4.5 A)	4	90% at 48 V, 87.5% at PoE 48 V
<b>TPS23752EVM-145 (PWR145)</b>	High-efficiency CCM flyback synchronous rectifier (driven)	PoE, 24/48-V adapters	25 W (5 V, 5.0 A)	4	93% at 48 V, 90% at PoE 48 V
<b>TPS23754EVM-383 (HPA383)</b>	Active-clamp forward synchronous rectifiers (self-driven)	PoE, 48-V adapters	25 W (12 V, 2.0 A)	4	89% at PoE 48 V
<b>TPS23754EVM-420 (HPA420)</b>	CCM flyback synchronous rectifier (driven)	PoE, 24/48-V adapters	25 W (5 V, 5.0 A)	4	88% at 48 V, 85% at PoE 48 V
TPS23754EVM-420 (PMP6672)	CCM flyback synchronous rectifier (driven)	PoE, 24/48-V adapters	25 W (5 V, 5.0 A)	4	92% at 48 V, 89% at PoE 48 V
<b>TPS23756EVM (HPA479)</b>	Active-clamp forward synchronous rectifier (self-driven)	PoE, 12/24/48-V adapters	25 W (5 V, 5.0 A)	4	91% at 12 V, 92% at 24 V, 88% at 48 V, 86% at PoE 48 V
<b>TPS2376HEVM (HPA244)</b>	CCM flyback synchronous rectifier	PoE, 48-V adapters	25 W (5 V, 5 A)	4	87% at 48 V, 82% at PoE 48 V
<b>TPS2379EVM-106 (PWR106)</b>	Type 2 PD controller only, with external boost FET (no DC/DC)	PoE and extended PoE	60 W	4+	NA, 97.5% (4-pair) at PoE 48 V

<sup>1</sup>Bold indicates a fully orderable (as is) device. Otherwise PD is configurable via BOM changes.

# Power Protection, Distribution and Monitoring

## USB and Power Switches

### 1 & 2 Channels, 4.5- to 5.5-V USB Switches

Channels	Rated Current Amps	Enable Polarity	Output Discharge	SOIC	MSOP DGN PowerPAD™	MSOP DGK	SOT-23	SON DRC
1	0.5	L	Y				<b>TPS2041CDBV</b>	
		H	Y				<b>TPS2051CDBV</b>	
	1	L	Y		<b>TPS2061CDGN</b>		<b>TPS2061CDBV</b>	
		H	Y		<b>TPS2065CDGN</b>		<b>TPS2065CDBV</b>	
			N		<b>TPS2065CDGN-2</b>		<b>TPS2065CDBV-2</b>	
	1.5	L	Y		<b>TPS2068CDGN</b>			
		H	Y		<b>TPS2069CDGN</b>		<b>TPS2069CDBV</b>	
			N		<b>TPS2069CDGN-2</b>			
	2	L	Y		<b>TPS2000CDGN</b>	<b>TPS2000CDGK</b>		
		H	Y		<b>TPS2001CDGN</b>	<b>TPS2001CDGK</b>		
2	0.5	H	Y		<b>TPS2052CDGN</b>			
	1	L	Y	<b>TPS2062CD</b>	<b>TPS2062CDGN</b>			
			N					<b>TPS2062CDRB-2</b>
		H	Y	<b>TPS2066CD</b>	<b>TPS2066CDGN</b>			
			N		<b>TPS2066CDGN-2</b>			
	1.5	L	Y		<b>TPS2060CDGN</b>			
		H	Y		<b>TPS2064CDGN</b>			
			N		<b>TPS2064CDGN-2</b>			
	2	L	Y					<b>TPS2002CDRC</b>
		H	Y					<b>TPS2003CDRC</b>

Value devices are listed in bold red.

### Fixed I<sub>LIMIT</sub>

### Single Channel, 2.7- to 5.5-V USB Switches

Rated Current Amps	Enable Polarity	Output Discharge	SOIC D	MSOP DGN PowerPAD™	SOT-23 DBV	P
0.1	L	N	<b>TPS2049D</b>			
0.2	L	N	<b>TPS2020D, TPS2020IDRQ1</b>			
	H	N	<b>TPS2030D, TPS2030DRQ1</b>			<b>TPS2030P</b>
0.25	L	N	<b>TPS2045AD</b>			
	H	N	<b>TPS2055AD</b>			
0.5	L	N	<b>TPS2041BD, LM3525M-L</b>	<b>TPS2041BDGN</b>	<b>TPS2530BV, TPS2041BDBV, TPS2041BMDBVT, TPS2041BQDBVRQ1</b>	
	H	N	<b>TPS2051BD, TPS2051BD, LM3525M-H</b>	<b>TPS2051BDGN</b>	<b>TPS2051BDBV</b>	
0.6	L	N	<b>TPS2021D, TPS2021DRQ1</b>			<b>TPS2021P</b>
	H	N	<b>TPS2031D</b>			<b>TPS2031P</b>
1	L	N	<b>TPS2022D, TPS2022DRQ1, TPS2061D</b>	<b>TPS2061DGN</b>	<b>TPS2061DBV</b>	
	H	Y		<b>TPS2065DGN-1</b>		
		N	<b>TPS2065D, TPS2032D, TPS2032DRQ1</b>	<b>TPS2065DGN, TPS2065DGNRQ1</b>	<b>TPS2065DBV</b>	
1.5	L	N	<b>TPS2023D, TPS2068D, TPS2068IDGNRQ1</b>	<b>TPS2068DGN</b>		<b>TPS2023P</b>
	H	N	<b>TPS2033D</b>	<b>TPS2069DGN</b>		
2	L	N	<b>TPS2024D, TPS2024IDRQ1</b>			<b>TPS2024P</b>
	H	N	<b>TPS2034D</b>			<b>TPS2034P</b>

Value devices are listed in bold red.

Most TI USB switches are recognized by UL under UL2367. Please consult datasheet for latest status.

# Power Protection, Distribution and Monitoring

## USB and Power Switches

### Fixed $I_{LIMIT}$ Dual Channels, 2.7- to 5.5-V USB Switches

Rated Current Amps	Enable Polarity	Output Discharge	SOIC D	MSOP DGN PowerPAD™	SON DRC
0.25	L	N	TPS2046BD		
	H	N	TPS2056AD		
0.5	L	N	TPS2042BD, TPS2042BQDRQ1, LM3526M-L	TPS2042BDGN	TPS2042BDRB
	H	N	TPS2052BD, LM3526M-H	TPS2052BDGN	TPS2052BDRB
1	L	Y	TPS2062D-1		
		N	TPS2062AD, TPS2062D	TPS2062QDGNRQ1, TPS2062DGN	TPS2062ADBR
	H	Y		TPS2066DGN-1	
		N	TPS2066AD, TPS2066D	TPS2066DGN, TPS2066QDGNRQ1	TPS2066ADBR
1.5	L	N		TPS2060DGN	TPS2060DBR
	H	N		TPS2064DGN	TPS2064DBR

### Fixed $I_{LIMIT}$ with Boost Converter USB Switches

V Operating	USB Channels	$I_{LIMIT}$ Adj. Range (Amps/Channel)	3.3-V LDO	Enable Polarity	$F_{VARIABLE}$ Eco-mode™	QFN20	SON10 DRC
1.8 to 5.5	1	0.13 to 1.4	N	H	Y		TPS2500
					N		TPS2501
	2	0.1 to 1.1			Y	TPS2505	

### Precision Adjustable $I_{LIMIT}$ USB Switches

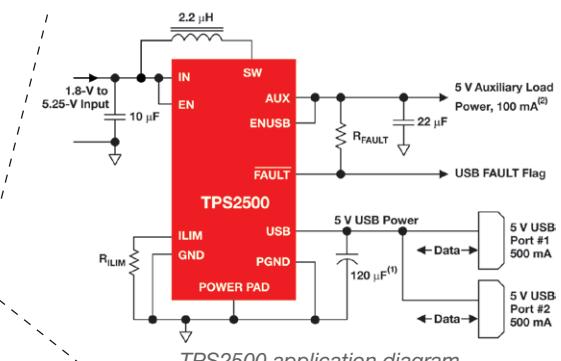
Channels	$I_{CONT.}$ Adj. Range (Amps/Channel)	V Operating	V <sub>ABSMAX</sub>	Number of Programmable Thresholds	Latch Off Retry	Output Discharge	Active Reverse Current Blocking Threshold (mV)	R <sub>ON</sub> (mΩ)	Packages	Device			
1	0.1 to 1.0	2.5 to 6.5	7	1	Retry	N	135	85	SOT 23-6	TPS2551QDBVRQ1			
	SOT 23-6								TPS2552DBV				
	SON6 2x2 mm								TPS2552DRV				
	SOT 23-6								TPS2552DBV-1				
	Latch Off				SON6 2x2 mm				TPS2552DRV-1				
					SOT 23-6				TPS2553DBV				
	Retry				SON6 2x2 mm				TPS2553QDBVRQ1				
					SOT 23-6				TPS2553DRV				
	0.075 to 2.5				Latch Off				SOT 23-6	TPS2553DBV-1			
	0.075 to 2.5								SOT 23-6	TPS2553DRV			
2	0.5 to 2.5 Dual Adjustable, Selectable	4.5 to 5.5	7	2	Retry	Y	na	73	SON10 3x3 mm	TPS2555DRC			
	2.5 to 6.5	7	1	Retry	N	na	22	SON10 3x3 mm	TPS2554DRC				
								SON8 3x3 mm	TPS2556DRB				
								SON8 3x3 mm	TPS2557DRB				
2	0.25 to 2.8	2.5 to 6.5	7	1	Retry	N	na	45	SON10 3x3 mm	TPS2560DRC			
2	0.25 to 2.8 (Tuned for $I_{LIMIT} = 2.3 \pm 0.2$ A)								SON10 3x3 mm	TPS2561DRC			
1	1.2 to 4.7 ± 4.4%	2.5 to 6.5	7	1	Retry	N	na	13	SON10 3x3 mm	TPS2559DRC			

Most TI USB switches are recognized by UL under UL2367. Please consult datasheet for latest status.

New devices are listed in bold red.

### Fixed $I_{LIMIT}$ 3 & 4 Channels, 2.7- to 5.5-V USB Switches

V Operating	Channels	Rated Current Amps	Enable Polarity	SOIC D16
2.7 to 5.5	3	0.25	L	TPS2047BD
			H	TPS2057AD
		0.5	L	TPS2043BD
	4	1	H	TPS2053BD
		0.25	L	TPS2063D
		0.5	H	TPS2067D
4	2.5 to 5.5	0.25	L	TPS2048AD
		0.5	H	TPS2058AD
		0.5	L	TPS2044BD, LM3544M-L
	4	0.5	H	TPS2054BD, LM3544M-H
		0.5	L	
		0.5	H	



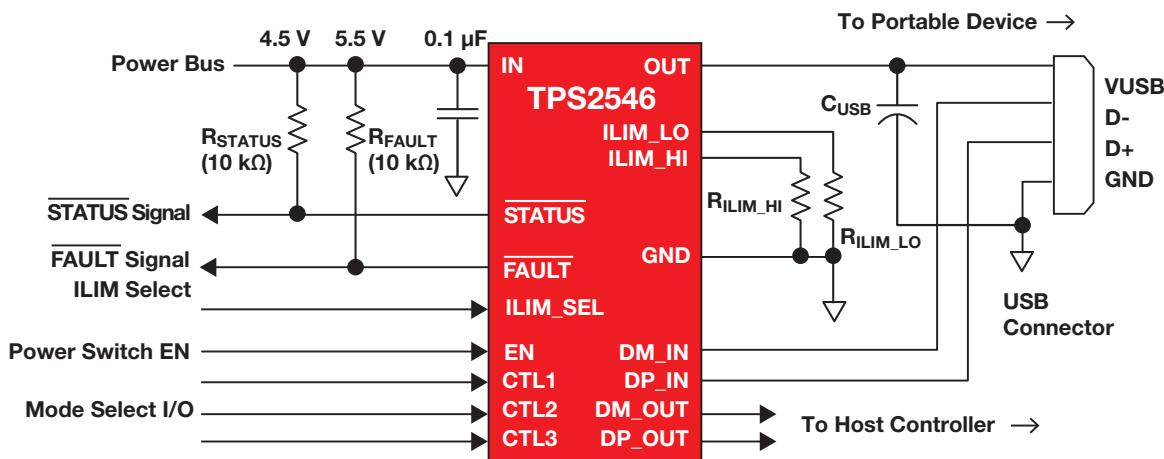
# Power Protection, Distribution and Monitoring

## USB and Power Switches

### USB Charging Port Controllers (USB-CPC)

Device	Internal Power Switch	CDP	SDP	DCP/Auto					S3 Mouse HID Wake	Load Detect	UL Listed	Package(s)
				BC1.2 Mode	Divide Mode 1 2.0/2.7 V	Divide Mode 2 2.7/2.0 V	1.2/1.2 V	Divide Mode 3 2.7/2.7 V				
TPS2513A/3AQ100/4A	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	SOT-23
TPS2513/14	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	SOT-23
TPS2511/Q100	Yes	No	No	Yes	Yes	Yes	Yes	No	No	50% of $I_{LIMIT}$	Yes	MSOP 8
TPS2546	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	LS/FS	50 mA	Yes	QFN 16
TPS2544	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	LS/FS	No	Yes	QFN 16
TPS2543/Q100	Yes	Yes	Yes	Yes	Yes	Yes	No	No	LS	50 mA	Yes	QFN 16

- All switch devices are UL recognized.
- SDP = BC1.2 standard downstream port, supports USB 2.0 (500 mA) and USB 3.0 (900 mA).
- CDP = BC1.2 charging downstream port, supports charging to 1.5 A.
- DCP = BC1.2 dedicated charging port, a stand-alone charger with no data path (wall charger).
- Divider mode 2 allows charging to 2.1 A.
- TPS2546 pin/function compatible to TPS2543; TPS2544 pin/function compatible to TPS2543/6.
- TPS2513/A = 2 channels; TPS2514/A = 1 channel; TPS2513A/14A support 2.7/2.7-V divider mode.



TPS2546 application schematic.

Most TI USB switches are recognized by UL under UL2367. Please consult datasheet for latest status.

# Power Protection, Distribution and Monitoring

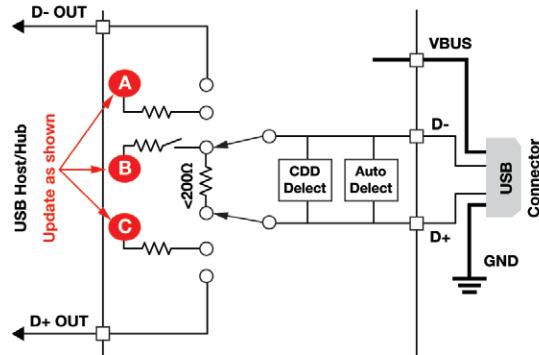
## USB and Power Switches

### A Brief Explanation of USB Charging Handshakes

TI USB charging controllers support, to varying degrees, four of the most common USB charging schemes found in popular handheld media and cellular devices:

- USB Battery Charging Specification BC1.2
- Chinese Telecommunications Industry Standard YD/T 1591-2009
- Divider Mode 1 and Divider Mode 2
- 1.2-V mode

YD/T 1591-2009 is a subset of the BC1.2 specification which supports the vast majority of devices that implement USB charging. Divider Modes 1 and 2 and 1.2-V charging schemes support popular devices from specific manufacturers. BC1.2 lists three different port types as listed below.



USB charging controller handshake interface.

### Handshaking Schemes Supported by TI USB Charging Controllers

Mode	Switch		Node (V)		
	D-	D+	A	B	C
BC1.2	200 Ω to D+	200 Ω to D-	—	—	—
Divider 1	2.7 V	2.0 V	2.7	—	2.0
Divider 2	2.0 V	2.7 V	2.0	—	2.7
Divider 3	2.7 V	2.7 V	2.7	—	2.7
1.2 V	1.2 V	1.2 V	—	1.2	—

### DCP BC1.2 and YD/T 1591-2009

Both standards define that the D+ and D- data lines should be shorted together at the host with a maximum series impedance of 200 Ω as shown here in the table and figure.

### DCP Divider Charging Scheme

Some charging controllers support Divider Modes 1 and 2. The DCP interface configurations for Divider 1 and Divider 2 are shown in the table and figure. Divider 1 charging applies 2.0 V and 2.7 V to D+ and D- data lines, respectively. This is reversed in Divider Mode 2. Divide Mode 3 applies 2.7 V to D+ and D- and supports 2.4-A charging.

### DCP 1.2-V Charging Scheme

1.2-V charging scheme is used by some handheld devices to enable fast charging at 2.0 A. Certain devices (as shown) support this scheme in the DCP-Auto mode before the device enters BC1.2 shorted mode. To simulate this charging scheme, D+/D- lines are shorted and pulled up to 1.2 V for a fixed duration; then the device moves to DCP shorted mode as defined in BC1.2 specification.

Most TI USB switches are recognized by UL under UL2367. Please consult datasheet for latest status.

# Digital Power Control Solutions

Complete Isolated Telecom DC/DC PMBus™ Power Solution

## Digital Power Means Smart Power

For many years, digital communication and processing have been making their way into the power supply. Power-hungry data systems like mobile phone base stations, servers and disk arrays need to increase efficiency and quality of service in smaller form factors while integrating some form of digital capability into the power supply. This digital integration allows designers to make smarter systems where the data traffic and power supply can work together. Below is a typical application example of just such a "smart" power system.

Digital power products range from analog controllers with digital blocks for configuration and telemetry and a digital port for communication, to complex microcontrollers with multiple processors, digital control blocks and multiple communication ports. All of these power solutions perform the required power management but with various degrees of digital integration. The more digital integration there

is, the more you can do with your power supply—in the same or a smaller space.

## Digital Controllers

TI's digital power controllers include the hardware-optimized, fully programmable UCD3K family of digital controllers for isolated power supplies; the configurable UCD9K family of digital non-isolated point-of-load controllers; and the UCD7K digital-compatible drivers with a programmable current limit. In addition to power-management digital controllers, TI's fully programmable TMS320F28x MCUs support many power- and energy-related applications, offering versatility and performance.

## Analog Control with PMBus™

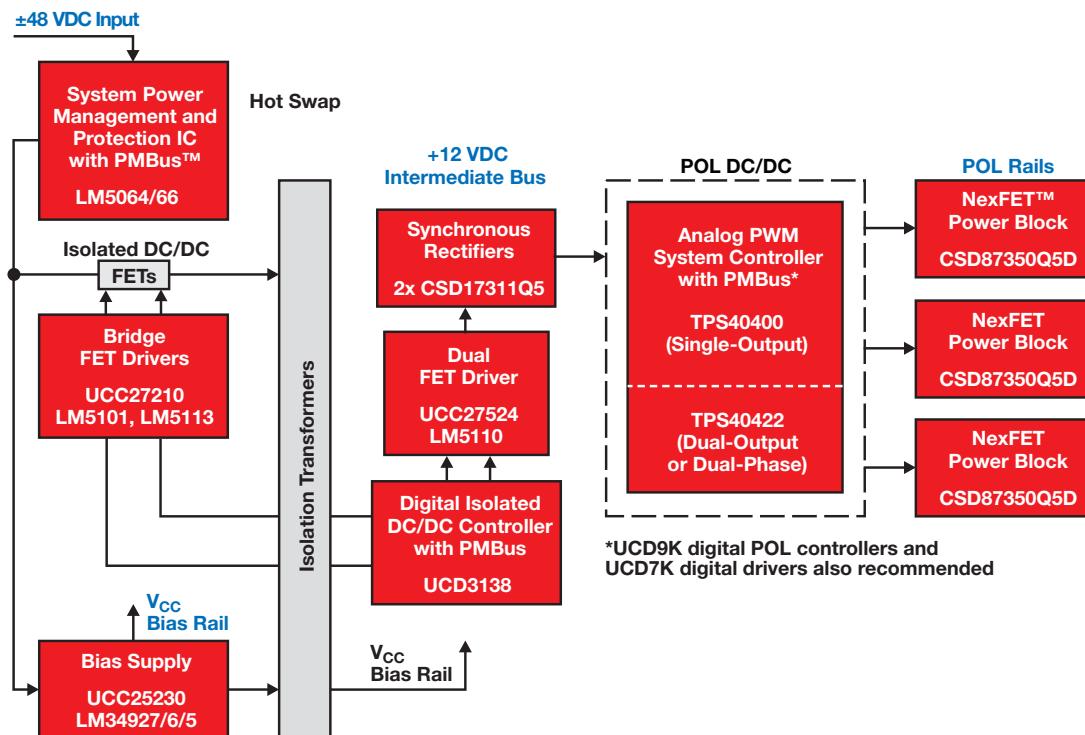
Power-supply designers who prefer the benefits and familiarity of analog solutions now have the functionality of digital configuration and communication that won't impact the analog performance. TI offers the TPS404xx family of 20-V step-down voltage regulators with a PMBus-compatible digital interface and an adaptive voltage-scaling capability for

non-isolated point-of-load designs. Together with the high-voltage LM(2)50xx hot-swap system protection and power-management products, TI provides complete single-, dual- and multi-rail, multi-phase PMBus solutions—allowing telecom and server designers to intelligently monitor, protect and manage their power systems.

## Fusion Digital Power™ Designer

The UCD3K and UCD9K families of digital controllers, the LM5066 and LM5064 hot-swap controllers and the TPS40400 and TPS40422 analog PWM controllers are supported by TI's Fusion Digital Power designer GUI tool. This GUI allows power-supply designers to select compensation networks; configure device parameters such as output voltage and fault-limit values; read back a variety of real-time parameters such as voltage, current, power and temperature; and perform PMBus command, fault and data logging.

Get more information: [www.ti.com/digitalpower](http://www.ti.com/digitalpower)



# Digital Power Control Solutions

## Isolated and Non-Isolated Digital Power Controllers

TI focuses on non-isolated (UCD9K) and isolated (UCD3K) PWM digital power controllers, complementary Power Stage solutions (UCD7K), and PTD-series modules. These products are power-management specific and are well-suited for applications that benefit from configurability, communications, diagnostics and adaptive control solutions. They include both isolated and non-isolated solutions from AC line to point-of-load, covering uninterruptible power supplies (UPS), server, telecom and datacom applications. The digital power ICs provide cost-effective solutions with greater levels of performance, reliability and flexibility than today's pure analog designs. For the most up-to-date information on digital power technology and product availability, go to: [www.ti.com/digitalpower](http://www.ti.com/digitalpower)

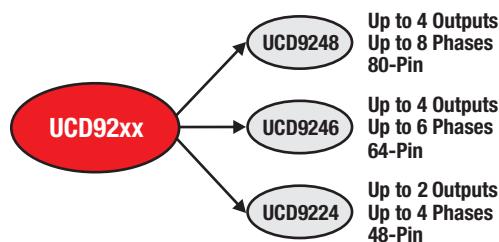
### Key Benefits

- High levels of integration:
  - Multiple outputs and phases with a single controller
  - Integrated supply-voltage sequencing, monitoring and margining
  - Improved reliability with fewer parts
- Advanced functionality:
  - Real-time power monitoring, data logging and failure prediction
  - Flexible control for varying operation modes and load characteristics
  - Calibration in manufacturing
- System optimization:
  - Easily set fault limits, start characteristics after system is assembled
  - Enhanced phase management
- Full programmability (UCD3K)

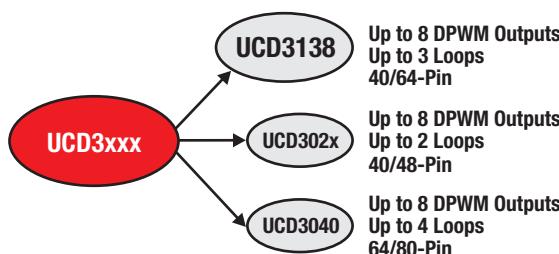
### Digital Solution Features

- PMBus Version 1.1
- Power + Designer Graphical User Interface tool
- Programmable soft-start/stop configuration
- Voltage sequencing and tracking
- Voltage margining and monitoring
- Pre-biased, monotonic start-up
- Multiple levels of fault protection with selectable response
- Hardware-accelerated digital compensator
- Load sharing on multiphase power stages
- Frequency synchronization
- Digital monitoring of power-supply parameters

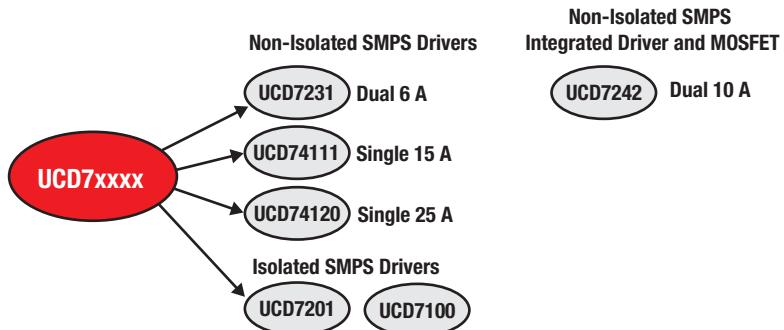
### UCD9K Buck Controllers



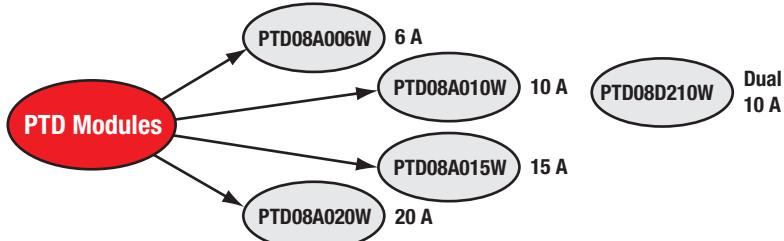
### UCD3K Isolated Power Controllers



### Digital Power Stage Solutions



### Non-Isolated Digital Power-Train Modules

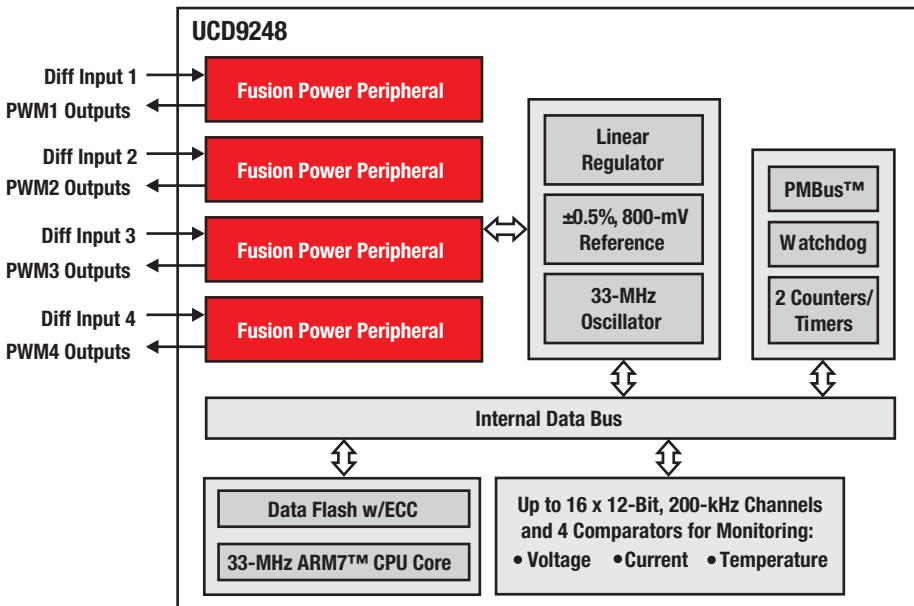


# Digital Power Control Solutions

## Isolated and Non-Isolated Digital Power Controllers

### Digital Point-of-Load Controller

#### UCD9248

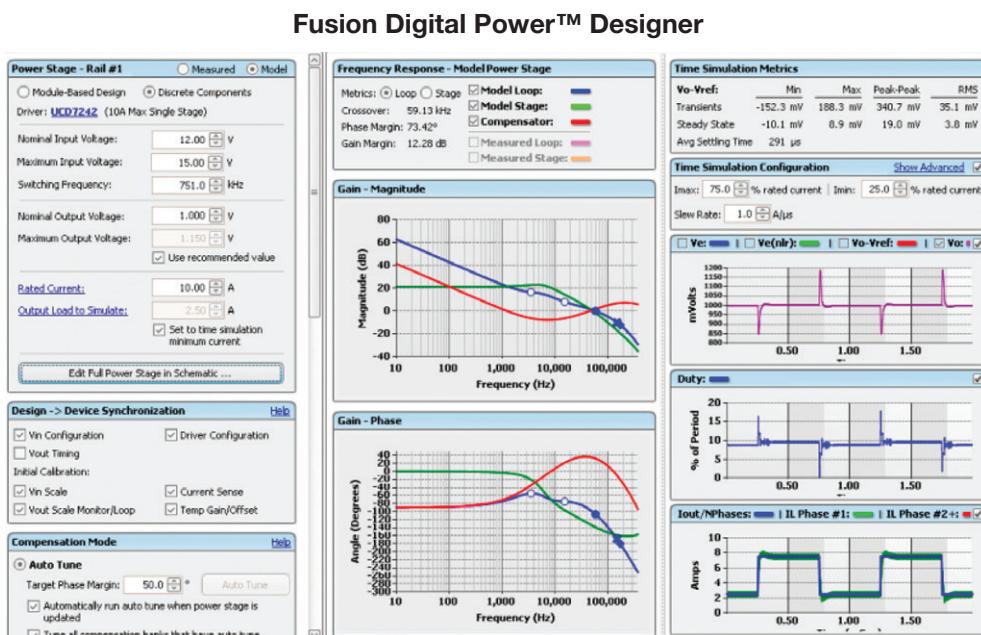


UCD9248 controller overview.

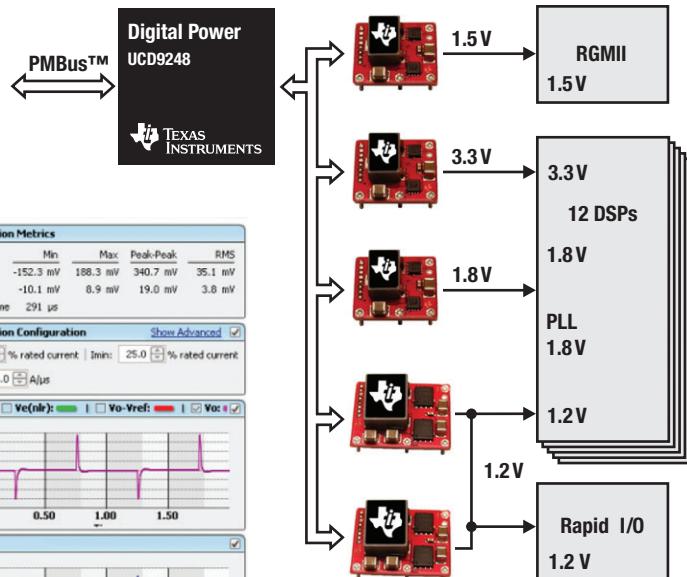
Get more information: [www.ti.com/product/UCD9248](http://www.ti.com/product/UCD9248)

### Key Features

- Controls up to 8 power stages and up to 4 voltage-feedback control loops
- Output voltage is configurable from 0.4 to 4.0 V
- Flexible configuration to control:
  - Four single or two dual power stages,
  - Two 4-phase power stages, or
  - One 2-, 4-, 6- or 8-phase power stage
- Switching frequencies of up to 2 MHz
- Supports conversion ratio of 12:1 at 2 MHz with 250-ps duty-cycle resolution
- $\pm 1\text{-mV}$  feedback resolution
- Hardware-accelerated, digital 3-pole/3-zero compensator
- Can synchronize PWM clocks between multiple UCD9248 devices



Graphical user interface (GUI) Digital Power developer tool simplifies the design process.



Multiprocessor, multiple-supply-rail systems (three single-phase outputs and one dual-phase output) featuring UCD9248 and first-generation PTD modules.

# Digital Power Control Solutions

## Isolated and Non-Isolated Digital Power Controllers

### Isolated Digital Power-Control Solutions

#### UCD3138

The UCD3138 is a highly integrated and configurable digital-power-management controller that is optimized for AC/DC and isolated DC/DC power-supply applications. The device offers an innovative path to increase power density and reliability in a broad range of power-supply topologies used in servers, telecom rectifiers and high-power DC/DC modules. Digital control capabilities allow designers to do more with their power systems, including reuse of hardware designs across multiple platforms. Designers also have the versatility to fine-tune the performance and control parameters for each application, thus allowing faster time to market. The UCD3138 combines a powerful 32-bit microprocessor, high-speed precision data converters, multiple programmable hardware control loops and various communication engines in a small 6x6-mm package.

#### Key Features

- Digital control—Three voltage or current feedback loops with up to six high-resolution digital pulse-width-modulated (DPWM) outputs.
- Boosted peak- and light-load efficiency—Includes sync-FET soft on-off control, dynamic phase shedding, dynamic frequency adjustment and dynamic mode switching.
- Supports all isolated power-supply topologies—Controller support for single-phase, two-phase interleaved, or bridgeless power factor correction; hard-switching full bridge, phase-shifted full bridge, resonant LLC and other topologies.
- Integrates all essential protection features—Included functions are peak current-mode control, cycle-by-cycle peak-current limiting, high-speed input voltage feed-forward, overvoltage, overcurrent and overtemperature protection.

#### Easy-to-Use GUI and Development Tools

Designers will have easy access to several digital-power development tools such as full-voltage and feature-rich evaluation modules, development kits, reference designs, application firmware source code, programmer's manuals and the Code Composer Studio™ software development environment. TI's Fusion Digital Power™ Designer graphical user interface (GUI) software tool provides flexible configuration of key power parameters, as well as telemetry, logging and communication functions. A broad range of hardware design tools, such as control-card and open-loop evaluation modules, are available to select customers. In addition, TI offers easy-to-use development kits and reference designs.

#### Evaluation Modules

- UCD3138CC64EVM-030 control card
- UCD3138OL64EVM-031—UCD3138 64-pin, open-loop board with socket

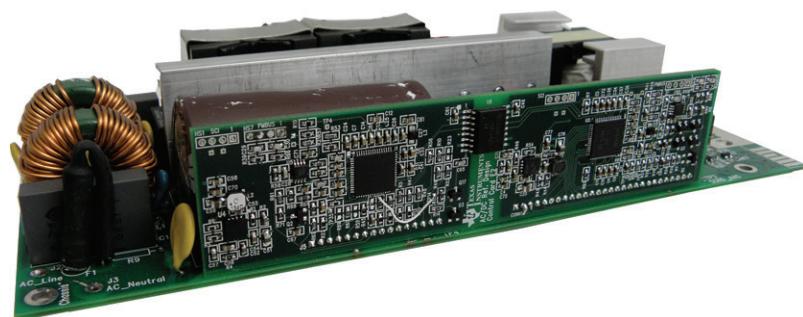
- UCD3138OL40EVM-032—UCD3138 40-pin, open-loop board with socket
- UCD3138064EVM-166—Control card in digitally controlled off-line isolated power converters

#### Development Kits

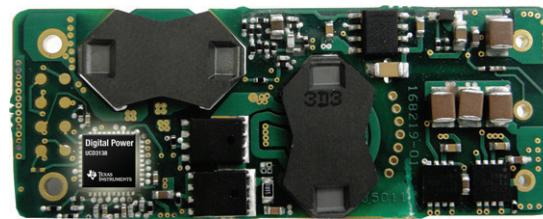
- UCD3138PFCEVM-026—Universal-input, 400-V<sub>OUT</sub>, AC/DC PFC development kit that is configurable into single- or two-phase interleaved and bridgeless topologies
- UCD3138PSFBEVM-027—400-V<sub>IN</sub>/12-V<sub>OUT</sub> DC/DC phase-shifted full bridge
- UCD3138LLCEVM-028—400-V<sub>IN</sub>/12-V<sub>OUT</sub> DC/DC half-bridge resonant LLC
- UCD3138HSFBEVM-029—48-V<sub>IN</sub>/12-V<sub>OUT</sub> DC/DC hard-switching full bridge

#### Reference Designs

- 48-V<sub>IN</sub>/12-V<sub>OUT</sub> 1/8-brick DC/DC reference design (hard-switching full bridge)



500-W AC/DC power supply reference design.



250-W 1/8th brick module reference design.

Get more information: [www.ti.com/product/UCD3138](http://www.ti.com/product/UCD3138)

# Digital Power Control Solutions

## Isolated and Non-Isolated Digital Power Controllers

### Selection Guide

Device	Pin Count	Number of Outputs	Number of Phases	Maximum f <sub>sw</sub> (MHz)	PWM Resolution (ps)	Compensator	Nonvolatile Memory	Price*
<b>Digital Point-of-Load Controllers</b>								
UCD9222/44 <sup>1</sup>	48/64	2/4	1	2	250	3-pole/3-zero	3-pole/3-zero	3.15/5.85
UCD9224	48	2	4	2	250	3-pole/3-zero	3-pole/3-zero	2.65
UCD9248/6	80/64	4	8/6	2	250	3-pole/3-zero	Yes w/ECC	4.85/4.50

<sup>1</sup>UCD9222 and UCD9244 digital PWM controllers with support for TMS320C6670 and TMS320C6678 DSPs VID interface.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

Device	Number of Outputs	Output Configuration	Output Type <sup>1</sup>	Peak I <sub>out</sub> Source/Sink (A)	Rise/Fall Time (ns)	V <sub>cc</sub> Range (V)	Propagation Delay (ns)	Input Threshold	Dead-Time Control	Protection Features	Price*
<b>Digital Power MOSFET Drivers</b>											
UCD7231	2	Non-inverting	CMOS	6/6	10/10	4.5 to 15.5	25	CMOS/TTL	Adaptive	Adjustable	0.60
UCD7232	2	Non-inverting	CMOS	6/6	10/10	4.5 to 15.5	25	CMOS/TTL	Adaptive	Adjustable	0.60
UCD7100	1	Uncommitted/Non-inverting	TrueDrive™	4/4	10/10	4.5 to 16	20	CMOS/TTL	Adaptive	Adjustable	0.99
UCD7201	2	Uncommitted/Non-inverting	TrueDrive	4/4	10/10	4.5 to 16	20	CMOS/TTL	Adaptive	Adjustable	1.20

<sup>1</sup>Output type: TrueDrive is the hybrid bipolar/CMOS output architecture for improved current drive capability at low voltages (at Miller threshold).

\*Suggested resale price in U.S. dollars in quantities of 1,000.

Device	Pin Count	Number of DPWM Outputs	Number of Independent Control Loops	DPWM Resolution (ps)	DPWM Maximum Frequency (MHz)	Program Flash Memory Size (KB)	Number of 12-Bit ADC Channels	Compensator	Price*
<b>Digital Isolated Power Controllers</b>									
UCD3020	48	6	2	250	2	32	9	3-pole/3-zero	2.45
UCD3028	40	8	2	250	2	32	9	3-pole/3-zero	2.35
UCD3040	64/80	8	4	250	2	32	11/15	3-pole/3-zero	3.75/4.05
UCD3138	40/64	8	3	250	2	32	7/14	2-pole/2-zero	2.70/4.10
UCD3138064	64	8	3	250	2	64	9	2-pole/2-zero	4.89
UCD3138A64	80	8	3	250	2	64	14	2-pole/2-zero	5.50
UCD3138128	80	8	3	250	2	128	25	2-pole/2-zero	5.90

New devices are listed in bold red

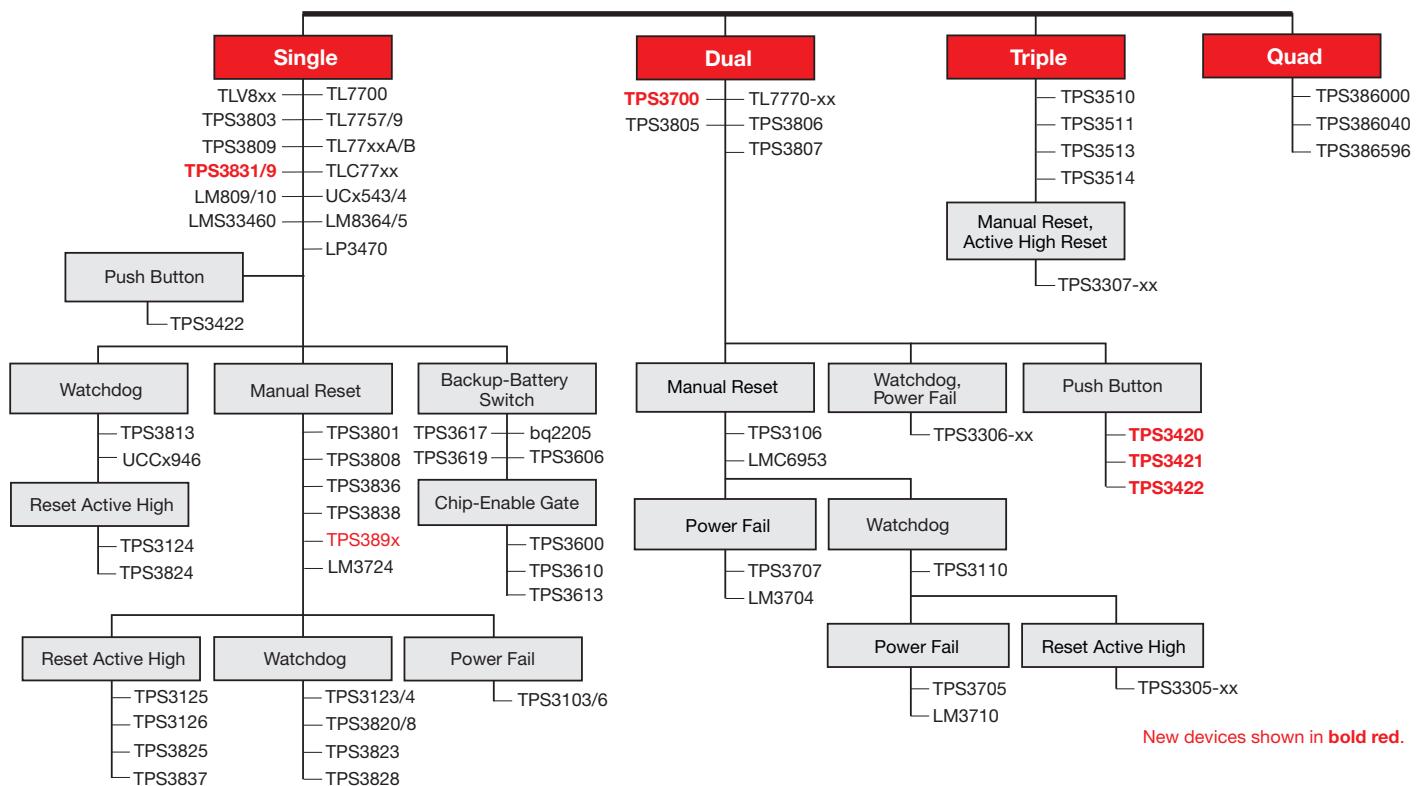
Device	Input Voltage (V)	Output Configuration	Current Rating (A)	Price*
<b>Digital Power Stages</b>				
UCD7242	4.5 to 18	Dual	10/10	2.65
UCD74106	4.5 to 14	Single	6	1.00
UCD74111	4.5 to 14	Single	15	2.95
UCD74120	4.5 to 14	Single	25	3.95

Device	Input Voltage (V)	Output Configuration	Current Rating (A)	Price*
<b>Digital Power-Train Modules</b>				
PTD08A006W	4.75 to 14	Single	6	6.90
PTD08A010W	4.75 to 14	Single	10	8.50
PTD08A015W	4.75 to 14	Single	15	9.80
PTD08A020W	4.75 to 14	Single	20	12.90
PTD08D210W	4.75 to 14	Dual	10/10	9.25
PTD08A210W	4.75 to 14	Single	10	7.50

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Supervisors and Reset ICs

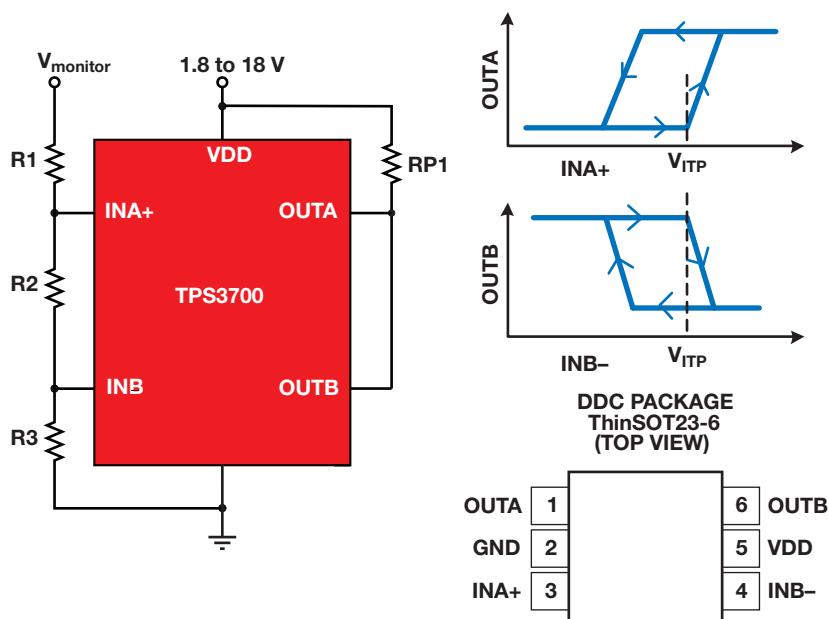
## Supervisory Circuits, Reset ICs and Sequencers Family of Products



For more information, please visit: [www.ti.com/supervisors](http://www.ti.com/supervisors)

### Window Comparator for Over- and Under-Voltage Detection

#### TPS3700



Get more information: [www.ti.com/product/TPS3700](http://www.ti.com/product/TPS3700)

# Supervisors and Reset ICs

## Selection Guide

Device	Number of Supervisors	Supervised Voltages	Package(s)	V <sub>DD</sub> Range (V)	I <sub>DD</sub> (typ) (μA)	Time Delay (ms)	Watchdog Timer WD (sec)	Reset Threshold Accuracy (%)	Manual Reset/Enable Reset	Active-Low Reset/Output	Active-High Reset/Output	Reset Output Topology <sup>1</sup>	Power-Fail PFI/PFO	Oversupply Detection	Oversupply Detection	Chip-Enabled Gating	Comments	Automotive	Price*	
<b>General Purpose Supply Supervisors</b>																				
LM3724	1	2.32, 3.08, 4.63 2.63, 2.75, 2.83, 2.93, 3.08, 3.65, 4.0, 4.38, 4.63, 4.8	SOT23-5, D, W	1 to 5.5	6	190		±2.5	✓	✓		OD	✓						0.95/0.80	
LP3470	1	2.32, 3.08, 3.6	SOT23-5	0.5 to 5	16	1, Prog		±1		✓		OD							0.595/0.562	
LM3704	2	2.32, 3.08, 3.6	VSSOP	1 to 5.5	28	28, 200		±2	✓	✓		CMOS, OD	✓						0.77	
LM3710	2	2.32, 3.08, 4.63	VSSOP	1 to 5.5	28	28, 200	0.0062 to 25.6	±2	✓	✓		CMOS, OD	✓						1.10	
LM8364	1	2.0	SOT23-5	1 to 6	0.65	0.3		±2.5		✓		CMOS, OD							0.24	
LM8365	1	2.75, 4.5	SOT23-5	1 to 6	0.65	0.1, Prog		±2.5		✓		CMOS, OD							0.25	
LM809	1	2.63, 2.93, 3.08, 4.38, 4.63	SOT23-3	1 to 6	15	240		±1.5		✓		CMOS							0.23	
LM810	1	4.63	SOT23-3	1 to 6	15	240		±1.5			✓	CMOS							0.23	
LMS33460	1	3	SC-70	1 to 7	1	0.2		±5		✓		OD							0.17	
LMC6953	2	3.3, 3.5	SOIC-8	1.5 to 6	800	0.0005		±3	✓	✓		OD							1.44	
TPS3895	1	Adj.	SON-6	1.7 to 6.5	6	0.04, Prog	—	0.25	✓		✓	PP						Ultra small	0.60	
TPS3896	1	Adj.	SON-6	1.7 to 6.5	6	0.04, Prog	—	0.25	✓	✓		PP						Ultra small	0.60	
TPS3897	1	Adj.	SON-6	1.7 to 6.5	6	0.04, Prog	—	0.25	✓		✓	OD						Ultra small	0.60	
TPS3898	1	Adj.	SON-6	1.7 to 6.5	6	0.04, Prog	—	0.25	✓	✓		OD						Ultra small	0.60	
TLV803	1	2.5/3/3.3/5	3SOT-23	1.1 to 6	9	200	—	2.00		✓		OD							0.20	
TLV810	1	2.5/3/3.3/5	3SOT-23	1.1 to 6	9	200	—	2.00			✓	PP							0.20	
TPS3808	1	Adj./0.9/1.2/1.5/1.8/2.5/ 3.0/3.5/0.0/EEPROM	SOT-23, SON-6	1.8 to 6.5	2.4	Prog	—	0.5	✓	✓		OD						✓	0.70	
TPS3103	1	1.2/1.5/2.0/3.3	SOT-23	0.4 to 3.3	1.2	130	—	0.75	✓	✓		OD	✓						0.90	
TPS3123	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	1.4	3.6	✓	✓		PP							0.85	
TPS3124	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	1.4	3.6	✓	✓		PP							0.85	
TPS3125	1	1.2/1.5/1.8/3.0	SOT-23	0.75 to 3.3	14	180	—	3.6	✓	✓	✓	PP							0.80	
TPS3126	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	—	3.5	✓	✓	✓	OD							0.80	
TPS3128	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	1.4	3.5	✓	✓		OD							0.85	
TPS3800	1	2.7	SC-70	1.6 to 6.0	9	100	—	2	✓	✓		PP							0.40	
TPS3801	1	Adj./1.8/2.5/3.0/3.3/5.0	SC-70	1.6 to 6.0	9	200	—	2	✓	✓		PP							0.40	
TPS3802	1	3.0/3.3	SC-70	1.6 to 6.0	9	400	—	2	✓	✓		PP							0.40	
TPS3803	1	Adj./1.5	SC-70	1.3 to 6.0	3	—	—	1.5		✓		OD					Voltage detector	✓	0.25	
TLV809	1	2.5/3.0/3.3/5.0	SOT-23	2.0 to 6.0	9	200	—	2.2		✓		PP							0.25	
TPS3813	1	2.5/3.0/3.3/5.0	SOT-23	2.0 to 6.0	9	25	Window	2.2		✓		OD					Window watchdog	✓	0.90	
TPS3820/8	1	3.3/5.0	SOT-23	1.1 to 5.5	15	25/200	0.2/1.6	2.4	✓	✓		PP/OD							✓	0.65
TPS3823	1	2.5/3.0/3.3/5.0	SOT-23	1.1 to 5.5	15	200	1.6	2.4	✓	✓		PP						✓	0.65	
TPS3824	1	2.5/3.0/3.3/5.0	SOT-23	1.1 to 5.5	15	200	1.6	2.2	✓	✓		PP						✓	0.65	
TPS3825	1	3.3/5.0	SOT-23	1.1 to 5.5	15	200	—	2.2	✓	✓	✓	PP						✓	0.55	
TPS3831	1	—	SON-4	0.6 to 6.5	0.15	200	—	1.5	✓	✓		PP					Ultra small	0.30		
TPS3839	1	—	SON-4, SOT-23	0.6 to 6.5	0.15	200	—	1.5		✓		PP					Ultra small	0.21		
TPS3836/8	1	1.8/2.5/3.0/3.3	SOT-23	1.6 to 6.0	0.22	10/200	—	2.5	✓	✓		PP/OD						✓	0.85	
TPS3837	1	1.8/2.5/3.0/3.3	SOT-23	1.6 to 6.0	0.22	10/200	—	2.4	✓		✓	PP						✓	0.85	
TLC77xx	1	Adj./2.5/3.3/3.0/5.0	SO-8, DIP-8, TSSOP-8	2.0 to 6.0	9	Prog	—	5.5		✓	✓	PP							✓	0.65
TPS3807	2	3/3.5	SC-70	1.8 to 6.5	3.5	20	—	1		✓		OD							0.95	
TPS3106	2	Adj./0.9/1.6/3.3	SOT-23	0.4 to 3.3	1.2	130	—	0.75	✓	✓		OD							0.90	
TPS3110	2	Adj./0.9/1.2/1.5/3.3	SOT-23	0.4 to 3.3	1.2	130	1.1	0.75	✓	✓		PP							0.99	
TPS3305	2	1.8/2.5/3.3/5.0	SO-8, MSOP-8	2.7 to 6.0	15	200	1.6	2.7	✓	✓	✓	PP							1.00	
TPS3306	2	1.5/1.8/2.0/2.5/3.3/5.0	SO-8, MSOP-8	2.7 to 6.0	15	100	0.8	2.7	✓	✓		OD	✓					✓	1.05	
TPS3779/80	2	Adj.	SON-6	1.5 to 6.5	1.8	—	—	1		✓		PP/OD					Different Hysteresis Options		0.50	
TPS3847	1	12	SOT-23	4.5 to 18	0.38	20	—	2.5	✓	✓		PP							0.85	
TPS3700	2	Adj.	ThinSOT23-6, SON-6	1.8 to 18	5.5	—	—	0.25		✓	✓	OD	✓				Window comparator	✓	0.70	

<sup>1</sup>PP = push-pull, OD = open drain, OC = open collector.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

Note: Custom voltages can be provided. Minimum order quantities may apply. Contact TI for details and availability.

New devices are listed in bold red.

Preview devices are listed in bold teal.

# Supervisors and Reset ICs

## Selection Guide (Continued)

Device	Number of Supervisors	Supervised Voltages	Package(s)	V <sub>DD</sub> Range (V)	I <sub>DD</sub> (typ) (µA)	Time Delay (ms)	Watchdog Timer WD (sec)	Reset Threshold Accuracy (%)	Manual Reset/Enable/Reset	Active-Low Reset/Output	Active-High Reset/Output	Reset Output Topology <sup>1</sup>	Power-Fail PFI/PFO	Oversupply Detection	Oversupply Detection	Chip-Enabled Rating	Comments	Automotive	Price*
<b>General Purpose Supply Supervisors (Continued)</b>																			
<b>TPS3701</b>	2	Adj.	ThinSOT23-6, SON-6	1.8 to 36	7	—	—	0.25	✓	✓	OD	✓				Window comparator		0.89	
<b>TPS3702</b>	2	1.0/1.2/1.8/3.3/5.0	ThinSOT23-6	1.8 to 18	7	—	—	0.25	✓	✓	OD	✓				Programmable Hysteresis		0.79	
<b>TPS3705</b>	2	3.0/3.3/5.0	SO-8, MSOP-8	2.0 to 6.0	30	200	1.6	2.1	✓	✓	PP	✓						0.80	
<b>TPS3707</b>	2	2.5/3.0/3.3/5.0	SO-8, MSOP-8	2.0 to 6.0	20	200	—	2.2	✓	✓	PP	✓						0.75	
<b>TPS3805</b>	2	Adj./3.3	SC-70	1.3 to 6.0	3	—	—	1.5	✓	✓	PP					Voltage detector		0.34	
<b>TPS3806</b>	2	Adj./2.0/3.3	SOT-23	1.3 to 6.0	3	—	—	2	✓	✓	OD					Voltage detector		0.45	
<b>TPS3307</b>	3	Adj./1.8/2.5/3.3/5.0	SO-8, MSOP-8	2.0 to 6.0	15	200	—	2.7	✓	✓	✓	PP					✓	1.05	
<b>TPS386596</b>	4	Adj./3.0	MSOP-8	1.8 to 6.5	7.5	Prog	—	0.25	✓	✓	OD	✓						1.25	
<b>TL7700</b>	1	0.5	SO-8, TSSOP-8, PDIP-8, VSSOP-8	1.8 to 40	600	Prog	—	2	✓	✓	OD							1.63	
<b>TLV77xxA</b>	1	2.53/4.55/7.6/10.8/13.5	SOIC-8, PDIP-8	3.5 to 18	1800	Prog	—	2	✓	✓	✓	OD						0.27	
<b>TPS3860x0</b>	4	Adj. (includes negative rail)	QFN	1.8 to 6.5	9	Prog	0.6	0.25	✓	✓	✓	PP/OD	✓				✓	1.95	
<b>LMV7231</b>	6	Adj. (includes negative rail)	QFN	2.2 to 5.5	7.7/ch	—	—	1.5	✓	✓	OD	✓				Window comparator		1.42	
<b>Battery Backup Swithchover Supply Supervisors</b>																			
<b>TPS3600</b>	1	2.0/2.5/3.3/5.0	TSSOP-14	1.6 to 5.5	20	100	0.8	2.3	✓	✓	PP	✓				✓		2.15	
<b>TPS3606-33</b>	1	3.3	MSOP-10	1.6 to 5.5	20	100	0.8	2	✓	✓	PP	✓						1.45	
<b>TPS3610</b>	1	1.8/5.0	TSSOP-14	1.6 to 5.5	20	100	0.8	2	✓	✓	PP	✓				✓		1.80	
<b>TPS3613-01</b>	1	Adjustable	MSOP-10	1.6 to 5.5	20	100	—	1.7	✓	✓	✓	PP				✓		1.50	
<b>TPS3619</b>	1	3.3/5.0	MSOP-8	1.6 to 5.5	15	100	—	2	✓	✓	PP	✓						1.10	
<b>Special Function Supply Supervisors</b>																			
<b>TPS3510/1</b>	3	3.3/5.0/12.0	SO-8, DIP-8	4 to 15	1 mA	300	—	9.1	✓	✓	OD	✓	✓			PC power supplies		0.45	
<b>TPS3513/4</b>	3	3.3/5.0/12.0	SO-14, DIP-14	4.5 to 15	1 mA	300	—	9.1	✓	✓	OD	✓	✓	✓		PC power supplies		0.70	

<sup>1</sup>PP = push-pull, OD = open drain, OC = open collector.

\*Suggested resale price in U.S. dollars in quantities of 1,000.

Note: Custom voltages can be provided. Minimum order quantities may apply. Contact TI for details and availability.

New devices are listed in bold red.

Preview devices are listed in bold teal.

# Sequencers

## Selection Guide

Device	Number of Supervisors	Supervised Voltages	Number of Sequenced Outputs	Package(s)	V <sub>DD</sub> Range (V)	I <sub>DD</sub> (typ) (µA)	Time Delay (ms)	Comments	Price*
<b>LM3880</b>	—	—	3	SOT23-6	2.7 to 5.5	25	Fixed		0.50
<b>LM3881</b>	—	—	3	MSOP-8	2.7 to 5.5	80	Prog		0.50
<b>UCD9090</b>	10	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog		3.60
<b>UCD90120A</b>	13	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog		4.95
<b>UCD90124A</b>	13	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog	With fan control	6.45
<b>UCD90160</b>	16	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog		5.65
<b>UCD90910</b>	10	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog	With fan control	5.90

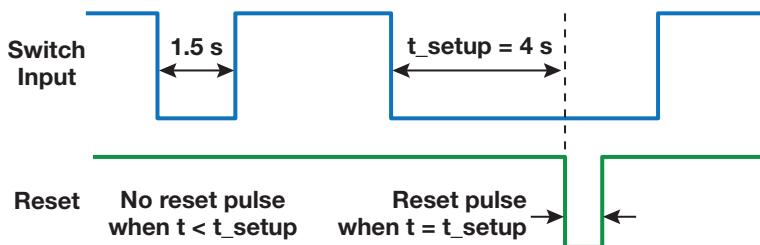
\*Suggested resale price in U.S. dollars in quantities of 1,000.

# Push-Button Controllers

## Single and Dual Push-Button Controllers

### TPS3420, TPS3421, TPS3422

TPS342x family of devices provide the ability to perform a hardware system reset during a software crash. It also eliminates the need to remove batteries to activate a reset. These controllers are used in designs with an embedded battery to ensure a hard- and full-system reset when needed. They include a fail-safe option when the system/microprocessor freezes and a system reset is required. Holding one or two external button switches for x amount of seconds generates a reset. To improve system stability, short-period switch closures are rejected by the setup delay time ( $t_{\text{setup}}$ ), as shown in the timing diagram.



### Key Features

- Very small, 1.45x1-mm SON package
- Low supply current: 250 nA
- User-selectable input delay using two-state logic
- Fixed-pulse or input-dependent reset behavior

### Applications

- Smart phones
- Tablets
- Ultrabooks
- Notebooks
- Routers
- Consumer medical

Get more information: [www.ti.com/product/TPS3420D](http://www.ti.com/product/TPS3420D), [TPS3421EC](http://www.ti.com/product/TPS3421EC) or [TPS3422EG](http://www.ti.com/product/TPS3422EG)

# Current Power Monitors

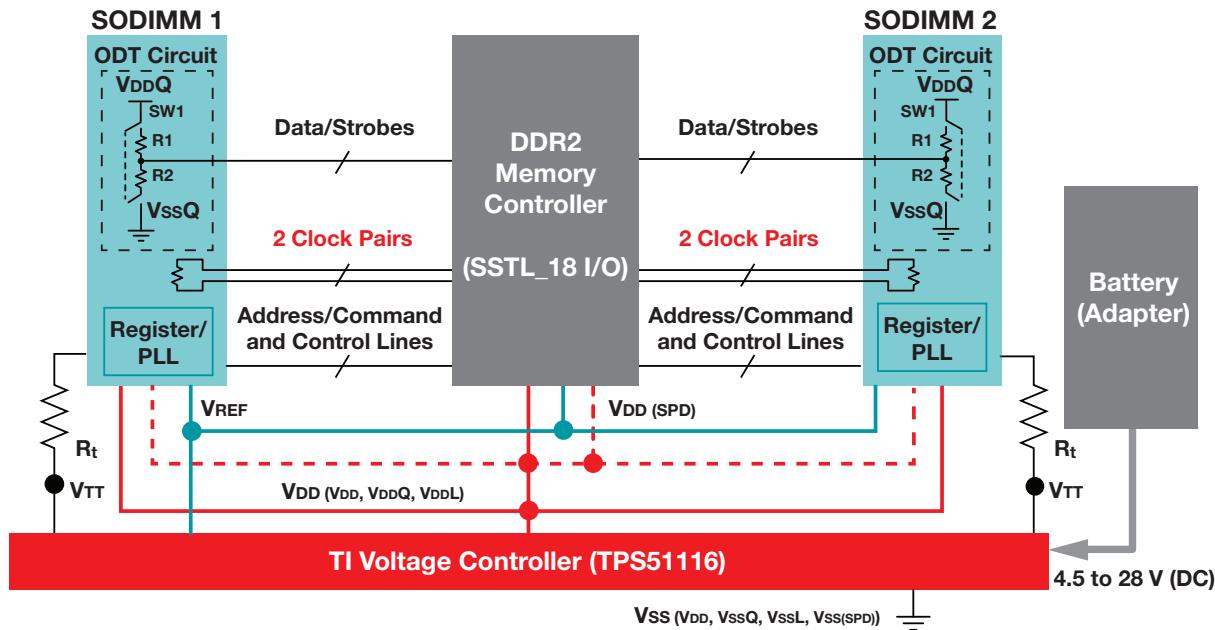
## Selection Guide

Device	Description	Common-Mode Range		Gain (V/V)	Output Type	Input Offset (+/-)(max) (µV)	CMRR (min) (dB)	Quiescent Current (+/-)(typ) (mA)	V <sub>S</sub>		Package(s)	Automotive	Price*
		(min) (V)	(max) (V)						(min) (V)	(max) (V)			
INA226	High-side measurement, bi-directional current power monitor with I <sup>2</sup> C interface	0	36	1	I <sup>2</sup> C	10	126	0.33	2.7	5.5	MSOP-10		1.30
INA210	Voltage output, high/low-side measurement, bi-directional zero-drift series current power monitor	-0.3	26	200	Voltage	35	105	0.065	2.7	26	µQFN-10, SC70-6		0.65
INA219	Zero-drift, bi-directional current power monitor	0	26	Programmable	I <sup>2</sup> C	50	100	0.7	3	5.5	SOIC-8, SOT-23-8		0.80
INA230	Precision digital/current/voltage/power monitor	0	28	1	I <sup>2</sup> C	50	100	330	2.7	5.5	QFN-16		1.15
INA282	Wide common mode range, bidirectional, high accuracy current power monitor	-14	80	50	Voltage	70	120	0.6	2.7	18	SOIC-8	✓	1.25
LMP8640	Precision high-voltage current sense amplifier	-2	76	20, 50, 100	Voltage	900	60	0.72	2.7	12	SOT-6		0.89
LMP8645	Precision high-voltage current sense amplifier	-2	76	Programmable	Voltage	1000	60	0.61	2.7	12	SOT-6		0.89
LMP8646	Precision current limiter	-2	76	Programmable	Voltage	1000	95	0.38	2.7	12	SOT-6		1.20

\*Suggested resale price in U.S. dollars in quantities of 1,000.

# DDR Power Solutions

## TI DDR Power Application



## Selection Guide

Device	V <sub>IN</sub> (V)	I <sub>OUT</sub> (A)	Provides	DDR Type	Automotive
<b>Plug-in Modules</b>					
PTH03010/50/60W	2.95 to 3.65	6/10/15	VTT	1, 2, 3	
PTH05010/50/60W	4.5 to 5.5	6/10/15	VTT	1, 2, 3	
PTH12010/50/60L	10.8 to 13.2	6/10/12	VTT	1, 2, 3	
<b>Controllers</b>					
TPS40042	2.25 to 5.5	Up to 15	VTT	1, 2, 3	
TPS40057	8 to 40	Up to 20	VTT	1, 2, 3	
<b>Controller + LDO</b>					
TPS51116, TPS51216/716/916	3 to 28 <sup>1</sup>	Up to 25 A for VDDQ, 3 (2-A VTT for TPS51216/916)	VTT, VDDQ, VREF	1, 2, 3, LV3, LP3	
<b>Dual Controller</b>					
TPS51020	4.5 to 28	Up to 15	VTT, VDDQ, VREF	1, 2	
<b>Termination Voltage (Source and Sink) LDOs</b>					
TPS51100	1.2 to 3.6 <sup>2</sup>	Up to 3	VTT, VREF	1, 2, 3, LV3, LP3	
TPS51200	1.1 to 3.5 <sup>3</sup>	Up to 3	VTT, VREF	1, 2, 3, LV3, LP3	✓
TPS51206	VTT+0.4 V to 3.5 V	Up to 2	VTT, VREF	1, 2, 3, LV3, LP4	
LP2995	2.2 to 5.5	1.5	VTT, VREF	1	
LP2996	1.8 to 5.5	1.5	VTT, VREF	1, 2	
LP2996A	1.5 to 5.5	1.5	VTT, VREF	1, 2, 3	
LP2997	1.8 to 5.5	0.5	VTT, VREF	1, 2	
LP2998	1.35 to 5.5	1.5	VTT, VREF	1, 2, 3	
<b>Switchers with Integrated FETs</b>					
TPS54372	3 to 6	3	VTT	1, 2, 3	✓
TPS53317, TPS54672	3 to 6	6	VTT	1, 2, 3, LV3, LP3	
TPS54972	3 to 4	9	VTT	1, 2, 3	
TPS51362/7	3 to 22 <sup>1</sup>	10/12	VDDQ	1, 2, 3, LV3, LP3	
TPS560200	4.5 to 17	0.5	VPP	4	

<sup>1</sup>Needs 4.5- to 5.5-V bias.

<sup>2</sup>Needs 4.75- to 5.25-V bias.

<sup>3</sup>Needs 2.4- to 3.5-V bias.

# Resources

## Design Support

### Power Management Reference Design Library

Over 50 years TI innovation has provided solutions to solve the most complex power-design challenges. Whether getting more efficiency to power FPGAs or designing state-of-the-art Qi wireless charging, TI's power portfolio and easy-to-use design tools will help you streamline your next project.

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The image shows the TI Designs Power Management Reference Design Library interface. At the top right is the 'TI Designs' logo. Below it is a search bar labeled 'Power design search parameters' with fields for 'Keywords', 'Input voltage range', 'Output voltage range', 'Output current', 'Isolated / Non-isolated', 'Input type', 'Applications' (checkboxes for Appliances, Automotive, Building Automation, Communications Equipment, Display & Digital Signage, Electronic Point of Sale, Enterprise Systems, Factory Automation & Control, Industrial, Lighting, Medical, Healthcare & Fitness, Motor Drives, Other Industrial, Personal Electronics, Smart Grid & Energy, Space, Avionics & Defense, Test & Measurement), and 'Topology' (checkboxes for Boost, Buck, Buck Boost, Flyback, Flybuck, Forward, Full Bridge, Half Bridge, Hot Swap, Linear Regulator, Multiphase, ORing, Other, PFC, POE, Sepic, USB Switch). A 'Reset filters' button is also present. Below the search bar is a table titled 'Export results to spreadsheet' with 1260 Results. The columns are: Title, Application, TI Devices, V<sub>in</sub>(V) (min), V<sub>in</sub>(V) (max), V<sub>out</sub> (V), I<sub>out</sub> (A), Output Power, Isolated / Non-isolated, Input Type, Topology, and Last Updated. Two rows of results are shown: 'Universal Line Power Supply for PLC using PSSR Flyback and Compact DC/DC Stages Reference Design' and '48VIN 5V / 2A, 1/8 Brick DC-DC Module Reference'.

### WEBENCH® Design Center Saves Development Time and Cost

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# Resources

## Packaging

### Surface Mount Packages

	Package Type	Package Designator	Key Characteristics
<b>Small Outline Packages</b>			
	Small Outline Integrated Circuit (SOIC)	D, DW, DWU, DTH, DTC, DDA, DVB, DWP	High MSL rating* (MSL1/MSL2), variable size availability
	Mini Small Outline Package (MSOP)	DGK, DGS	Small form factor, thin package
	Heat Sink Small Outline Package (HSOP)	DWP, DWD	Thermally enhanced SOP (low to mid power)
	Small Shrink Outline Package (SSOP)	DL, DB, DF, DBQ, DCE, DCT	High MSL rating* (MSL1/MSL2), higher stand-off height
	Thin Shrink Small Outline Package (TSSOP)	DA, PW, DBT	Variable pin count options available, high MSL rating* (MSL1/MSL2), small form factor
	Exposed Pad Thin Shrink Small Outline Package (HTSSOP)	PWP, DAP, DAD, DCA	Thermally enhanced TSSOP (low to high power); various pin count options available
	Power Small Outline Package (PSOP3)	DKP (slug down), DKD (slug up)	Very high power handling capability, mechanically robust package
<b>Quad Leaded Packages</b>			
	Thin Quad Flat Pack (TQFP)	PFB, PAG, PJT, PBS, PAG	High pin count, leadframe based package
	Exposed Pad Thin Quad Flat Pack (HTQFP)	PAP, PJD, PZP, PHP, PNP, PHD	Thermally enhanced TQFP (mid to high power)
<b>Small Outline Transistors</b>			
	Small Outline Transistor (SC-70)	DCK	Mini form factor
	Small Outline Transistor Package (SOT23)	DBV, DCN, DDC, thin SOT	Small form factor, high MSL rating* (MSL1/MSL2)
	Small Outline Transistor (SOT223)	DCY, DCQ	High MSL rating* (MSL1/MSL2)
	Transistor Outline (TO236)	DBZ	Small form factor
<b>Leaded Packages</b>			
	Plastic Flange Mount Package (DDPak/TO-263)	KTT, KTW	Very high power handling capability
<b>Leadless Packages</b>			
	Small Outline No Leads (SON)	DRB, DRC, DRD, DRK, DRM, DRN, DRT, DSE, DSG, DSJ	Small footprint, thermal package (low to mid power)

\*MSL rating should be checked for individual device.

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### Surface Mount Packages (Continued)

	Package Type	Package Designator	Key Characteristics
<b>Leadless Packages (Continued)</b>			
	Quad Flatpack No Leads (QFN)	RGC, RGE, RGF, RGP, RGT, RGW, RGY, RGZ, RHA, RHB, RHD, RHF, RHH, RHL, RSA, RSB, RSH, RSJ, RSL, RSM, RTE, RTH, RTQ, RTT, RUK, RUV, RVA	Compact footprint, thermal package (mid to high power), available in variable thicknesses
	Flip-Chip Power Packages (HotRod™)	RSJ, RLT, RMW, RNC	High power handling capability
<b>Ball Grid Arrays (BGAs)</b>			
	Wafer Chip Scale Package (WCSP)/ Die Sized Ball Grid Array (DSBGA)	YEG, YEK, YEJ, YEA, YZA, YED	Die size package, very small form factor, finer pitch
	MicroStar BGA™	ZGU	Controllable count density, variable thickness option availability
	MicroStar Junior™ BGA	ZQE, ZQZ	Smaller sized MicroStar BGA, controllable pin count density
	PicoStar™	YFM	Extremely small sized package, ultra-thin, board embeddable
	BGA	ZVD	Very high pin count density

### Through-Hole Packages

	Package Type	Package Designator	Key Characteristics
	Plastic Dual Inline Package (PDIP)	P, N, NT, NTD	Recommended for wave soldering, excellent board-level reliability
	Transistor Outline (TO220)	KC	Very high power handling capability, recommended for wave soldering, mechanically robust

### Package Modules

	Package Type	Package Designator	Key Characteristics
	Power Modules	—	Integrated passives, enhanced functionality
	Plastic in System Package (MicroSiP™)	SIP	Integrated passives, enhanced functionality, small solution size

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## Packaging

### Connecting the PowerPAD™

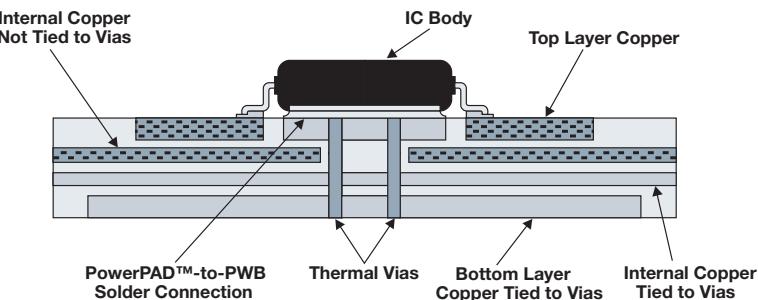
The PowerPAD package should be connected to the appropriate internal signal plane as specified in the product datasheet. Depending on the electrical properties of the thermally conductive epoxy used to connect the Integrated Circuit (IC) to the lead frame, the PowerPAD may have a low impedance connection to the internal signal plane as specified in the product datasheet.

You can find additional information in the following resources. Technical literature can be accessed online with [www.ti.com/lit/litnumber](http://www.ti.com/lit/litnumber) by replacing

**litnumber** with one of the following literature numbers shown in parentheses.

- Remember to check the CAD format for your package under “Symbols/Footprints,” available in all TI Product Folders
- Download the “PowerPAD Made Easy” application brief (SLMA004) in conjunction with the “PowerPAD Thermally Enhanced Package” technical brief (SLMA002)

- Specific information on QFN/SON packages is available in application reports (SLUA271 and SCBA017)
- Ask our experts your specific design questions via email by selecting Analog & Mixed-Signal email support in the Contact Tech Support frame at: [support.ti.com](http://support.ti.com)



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