

Power Management Guide



2012

Automotive
Communications
Computing
Consumer
High Reliability
Industrial



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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 by providing leading-edge support tools such as training, 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 you will find design factors, featured products, graphic representations of portfolios and parametric tables. Also identified are devices qualified for HiRel and automotive applications. Some device options may not be available and pricing will be different.

For more information about HiRel and military versions of Power Management products, please visit:

www.ti.com/hirel

For more information about automotive-qualified Power Management products, please visit:

www.ti.com/automotive

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Power Protection, Control and Monitoring

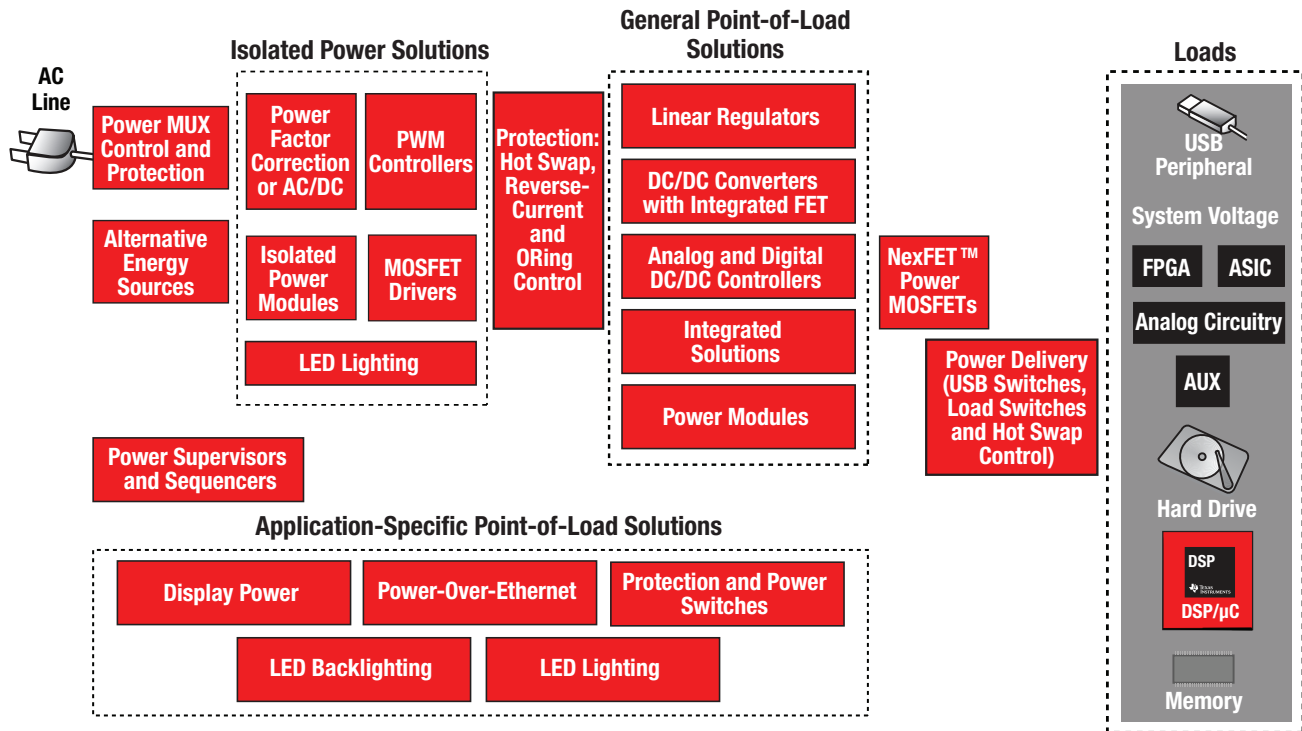
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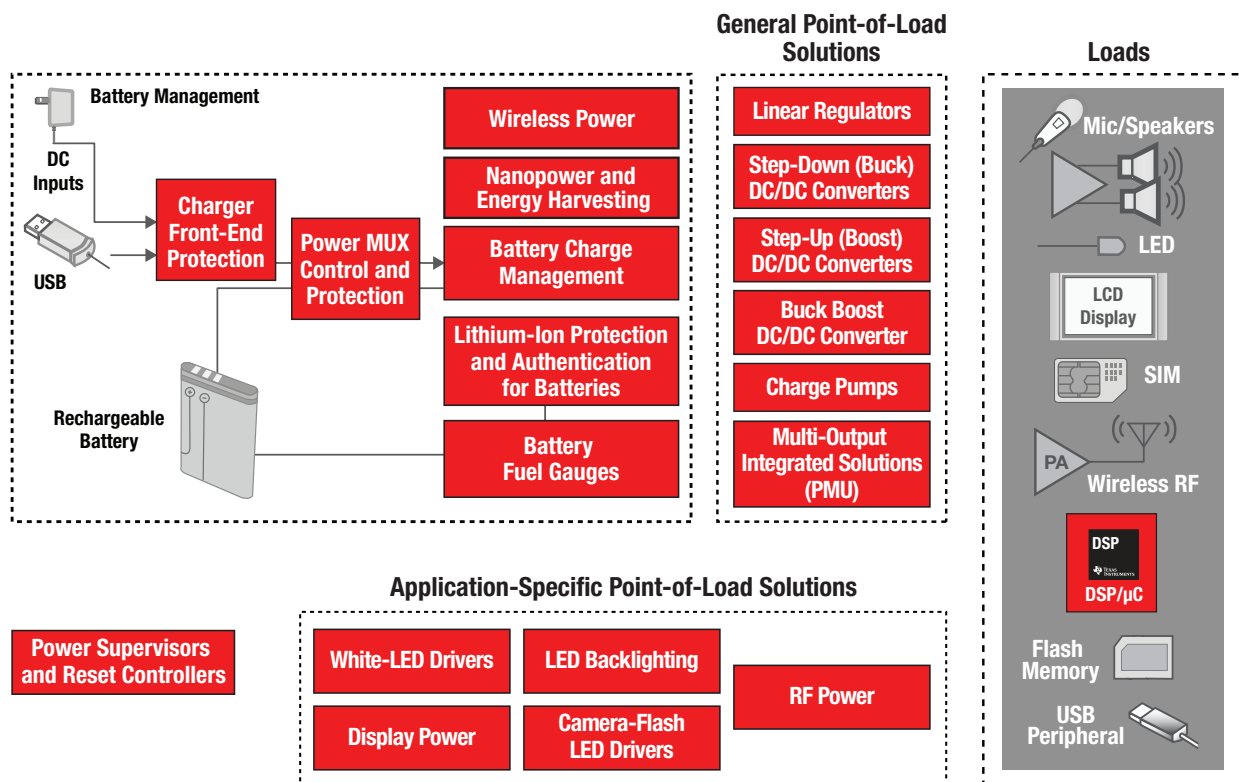
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Line Power Solutions



Portable Power 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 capability 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 different amounts 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 Capability

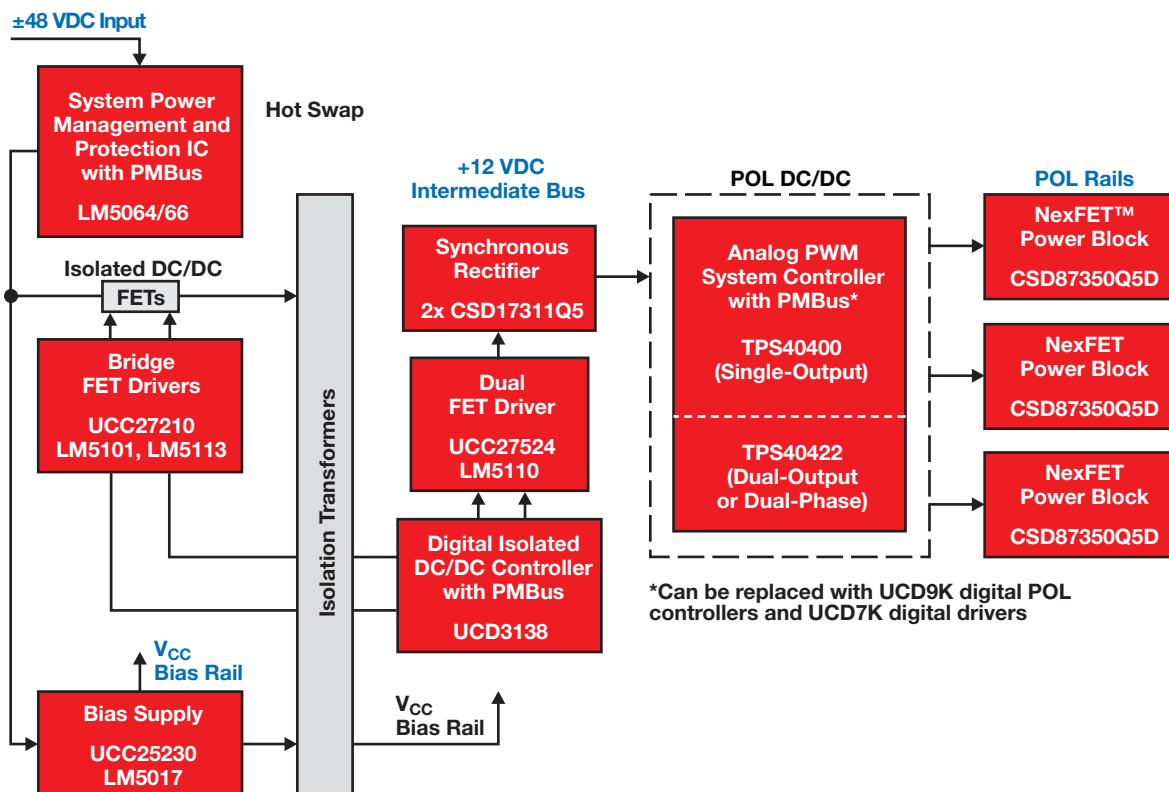
Power-supply designers who prefer the benefits and familiarity of analog solutions now have the functionality of digital configuration and communication that won’t impact the analog performance. TI offers the TPS404xx family of 20-V step-down voltage regulators with a PMBus-compatible digital interface and an adaptive voltage-scaling capability for non-isolated point-of-load designs. Together with the high-voltage LM506x hot-swap system-power-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.

Please visit www.ti.com/digitalpower for more information.



→ Digital PWM Controllers and Drivers

TI focuses on non-isolated PWM digital power controllers (UCD9K), complementary Power Stage solutions (UCD7K), and PTD-series modules. These products are power-management specific and are well-suited for applications where the desire exists for 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

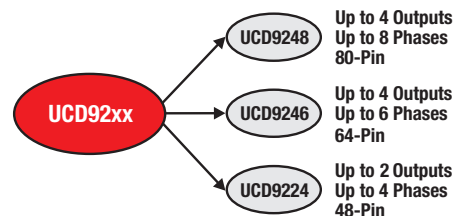
Key Benefits

- High levels of integration:
 - Multiple outputs and phases with one 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

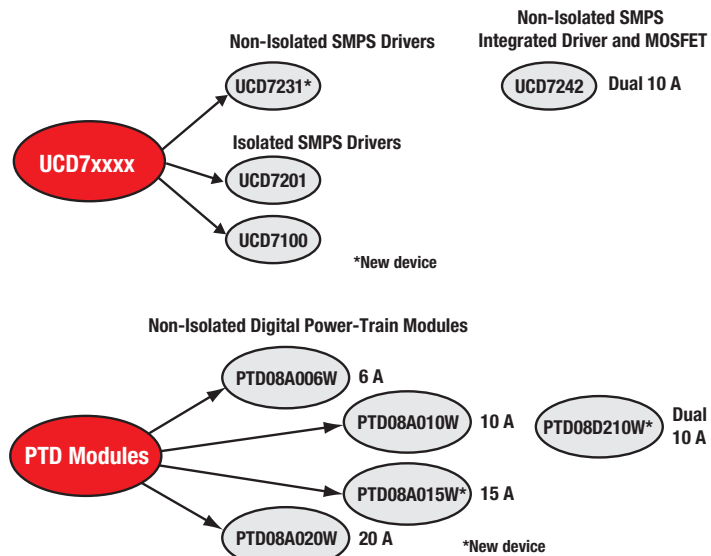
Digital Solution Features

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

UCD9K Buck Controllers



Digital Power Stage Solutions



→ Digital PWM Controllers and Drivers

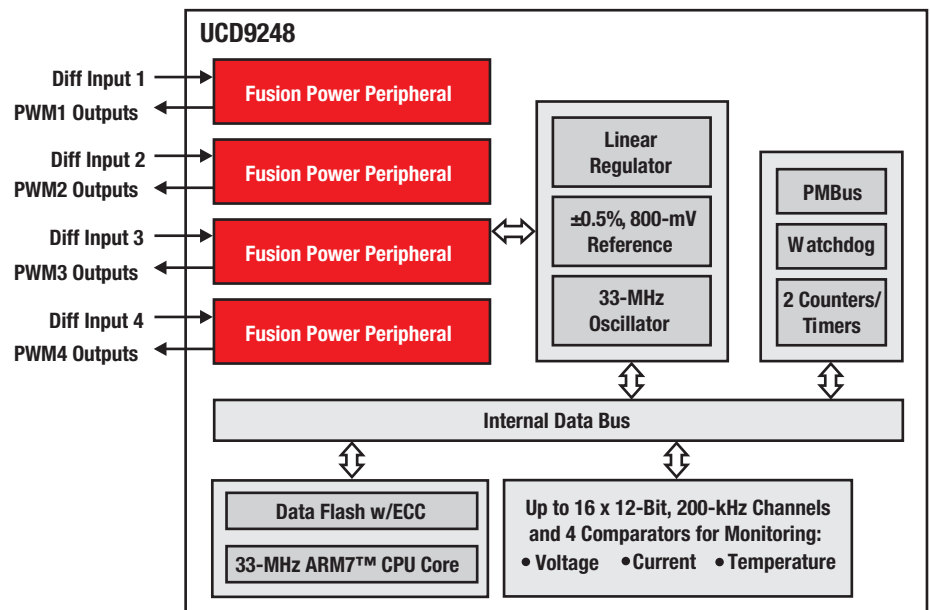
Digital Point-of-Load Controller

UCD9248

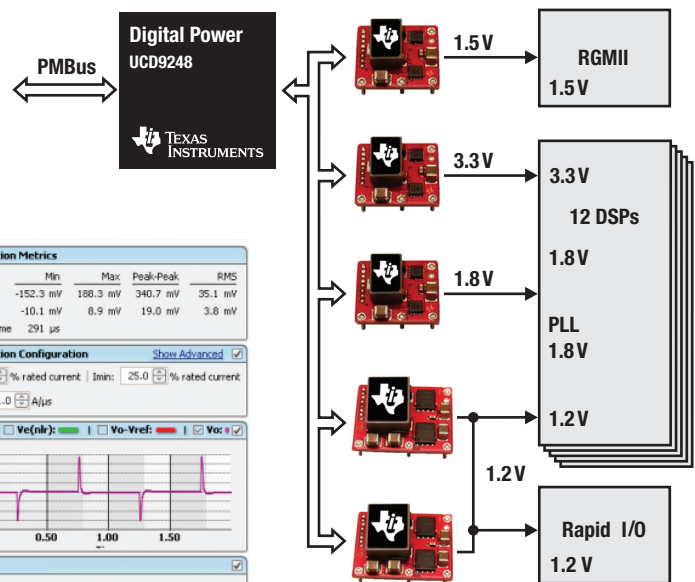
Get samples and datasheets at: www.ti.com/product/UCD9248

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 permits control of:
 - Four single or two dual power stages,
 - Two 4-phase power stages, or
 - One 2-, 4-, 6- or 8-phase power stage
- Supports switching frequencies of up to 2 MHz
- Supports conversion ratio of 12:1 at 2 MHz with 250-ps duty-cycle resolution
- ±1-mV feedback resolution
- Hardware-accelerated, digital 3-pole/3-zero compensator
- Can synchronize PWM clocks between multiple UCD9248 devices
- Enhanced nonvolatile memory with error-correction coding (ECC)

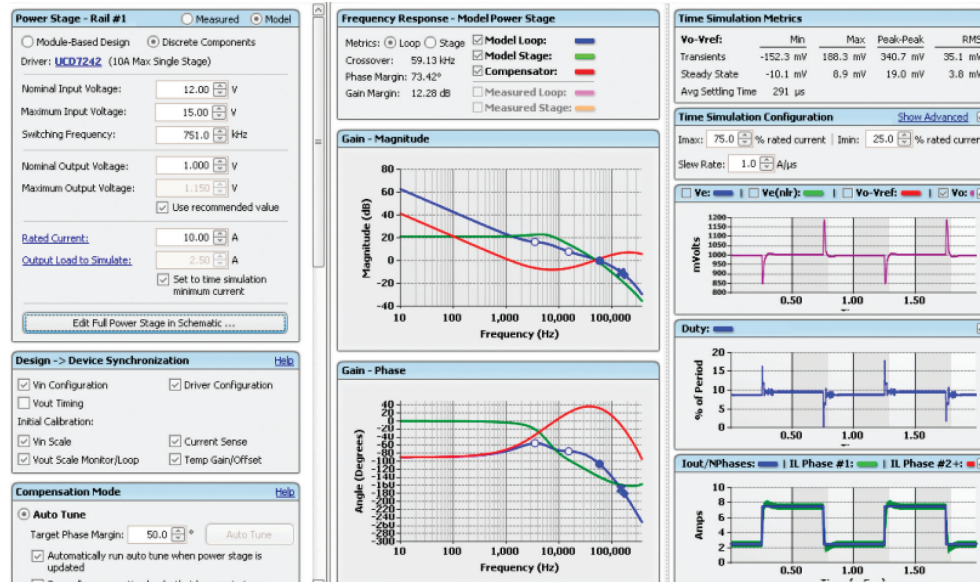


UCD9248 controller overview.



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

Fusion Digital Power™ Designer



GUI Digital Power developer tool simplifies the design process.

➔ Digital PWM Controllers and Drivers

Isolated Digital Power-Control Solutions

UCD3138

Get samples at: www.ti.com/product/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 reusability 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

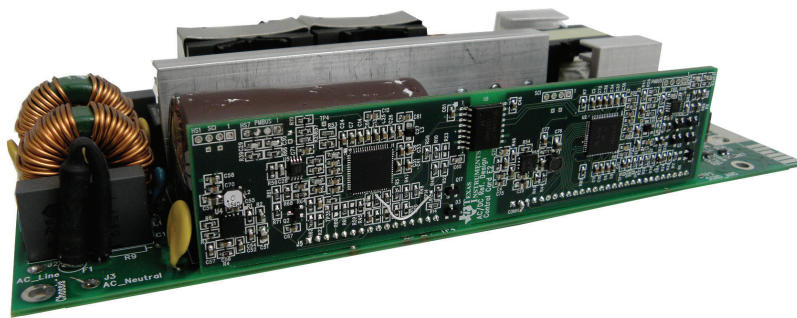
- UCD3138NS64EVM-038—UCD3138 64-pin, open-loop board with IC soldered
- UCD3138NS40EVM-039—UCD3138 40-pin, open-loop board with IC soldered

Development Kits

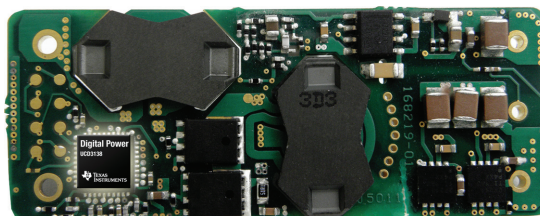
- UCD3138PFCEVM-026—Universal-input, 400-V_{OUT} AC/DC PFC development kit that is configurable into single- or two-phase interleaved and bridgeless topologies
- UCD3138PSFBEVM-027—400-V_{IN}/12-V_{OUT} DC/DC phase-shifted full bridge
- UCD3138LLCEVM-028—400-V_{IN}/12-V_{OUT} DC/DC half-bridge resonant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

Reference Designs

- Universal-input, 12-V_{OUT} 500-W AC/DC reference design (PFC plus LLC and PFC plus phase-shifted full-bridge)
- 48-V_{IN}/12-V_{OUT} 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.

→ Digital PWM Controllers and Drivers

Selection Guide

Device	Pin Count	Number of Outputs	Number of Phases	Maximum f_s (MHz)	PWM Resolution (ps)	Compensator	Nonvolatile Memory	Price*
Digital Point-of-Load Controllers								
UCD9222/442	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

Device	Number of Outputs	Output Configuration	Output Type ¹	Peak I_{OUT} Source/Sink (A)	Rise/Fall Time (ns)	V_{CC} Range (V)	Propagation Delay (ns)	Input Threshold	Dead-Time Control	Protection Features	Price*
Digital Power MOSFET Drivers											
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

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

²UCD9222 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.

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

Device	Pin Count	Number of DPWM Outputs	Number of Independent Control Loops	DPWM Resolution (ps)	DPWM Maximum f_s (MHz)	Program Flash Memory Size (KB)	Number of 12-Bit ADC Channels	Compensator	Price*
Digital Isolated Power Controllers									
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

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

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

Device	Input Voltage (V)	Output Configuration	Current Rating (A)	Price*
Digital Power Integrated Driver/MOSFET				
UCD7242	4.5 to 18	Dual	10/10	2.65
UCD74106	4.5 to 14	Single	6	1.00

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

Device	Input Voltage (V)	Output Configuration	Current Rating (A)	Price*
Digital Power-Train Modules				
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	4.5 to 18	Dual	10/10	9.25
PTD08A210W	4.5 to 18	Single	10	7.50

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

→ Overview

Texas Instruments offers a large portfolio of non-isolated DC/DC point-of-load solutions to address size, efficiency, performance or cost constraints. Our solutions range from discrete devices to integrated power solutions that contain magnetics within the IC package. Visit www.ti.com/power to find the latest point-of-load solutions by simply providing the input voltage, output voltage, and output current.

Integrated Power Solutions — High power density is easily achievable with DC/DC converters that integrate magnetics into the package. TI's integrated power solutions save board space by providing a size-optimized solution with little design effort.

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 25 A.

Power-Management Units (PMUs)

— Multiple DC/DC converters in one package simplify the power design by reducing component count. TI's PMUs integrate several inductive step-down converters with linear regulators, charge pumps or other analog circuits such as battery chargers and an I²C interface to save space.

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_{IN} is higher or lower than V_{OUT} . 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.

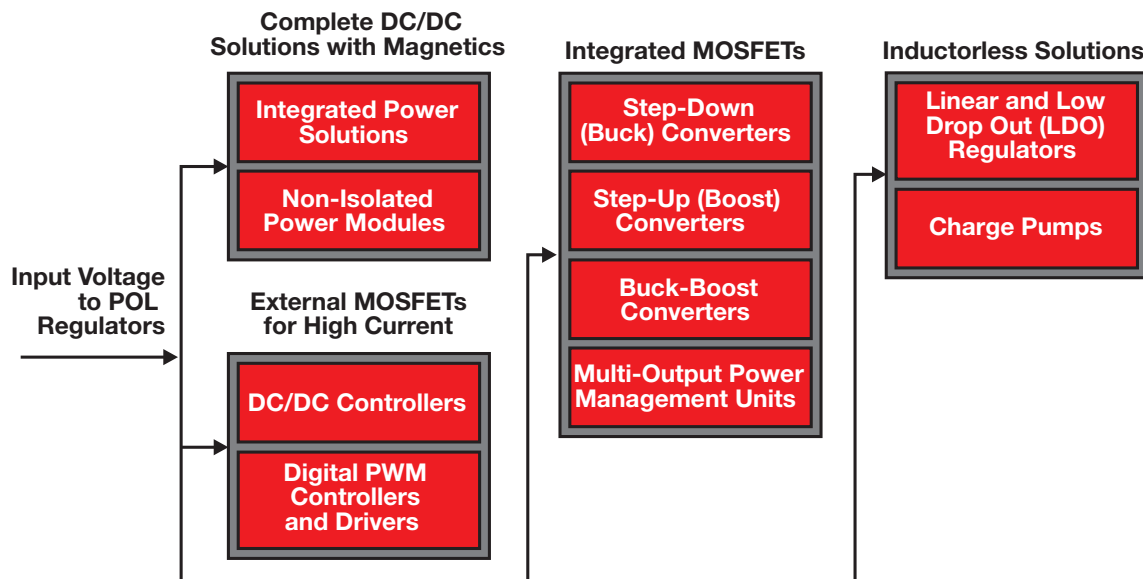
Charge Pumps — TI's family of low-voltage charge pumps provides a low-noise solution to boost the voltage without an inductor. Charge pumps achieve 90% peak efficiency and are useful for output currents under 300 mA.

Linear and Low-Dropout Regulators (LDOs)

— TI's linear regulators support currents from 10 mA to 7.5 A. The selection guide features the minimum output capacitance required as well as the key benefits, such as low quiescent current, fast transient response or low noise.

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. Consider NexFET™ power MOSFETs with best-in-class $r_{DS(on)}$ and gate-charge performance.

Plug-In Power Modules — TI's non-isolated modules are completely integrated and board-mounted. Vertical mounting uses the smallest footprint. Surface mounting and horizontal through-hole mounting are available in most product series.



Point-of-Load Solutions

→ SIMPLE SWITCHER® Products — Power Modules

The SIMPLE SWITCHER® 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.

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 $+125^{\circ}\text{C}$
- Pin-to-pin compatible for different load currents
- Easy-to-use package with single exposed copper bottom
- Passes EN55022 (CISPR22) Class B Radiated and Conducted EMI Standard

LMZ1-Series Power Modules

The LMZ1-series of SIMPLE SWITCHER power modules are ideal for applications requiring a standard feature set. All power modules in the LMZ1-series have a precision enable pin and soft-start pin.

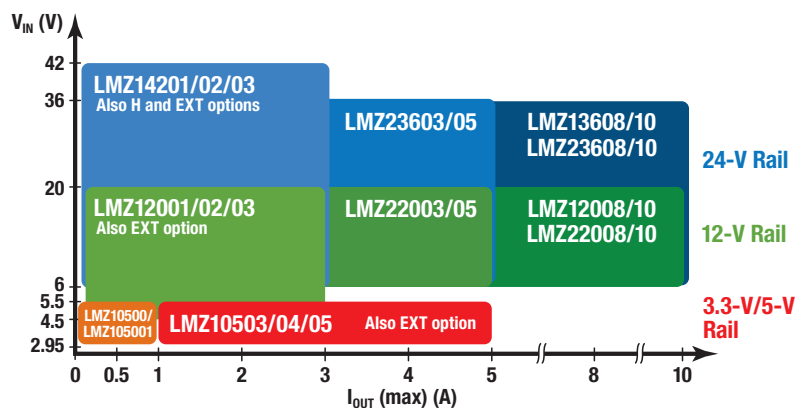
SIMPLE SWITCHER® LMZ1-Series Power Modules

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Peak Efficiency (%)	Operating Junction Temperature ($^{\circ}\text{C}$)	Features	EMI EN55022/CISPR22 Class B Certification		Package(s)	Price*
							Radiated	Conducted ¹		
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

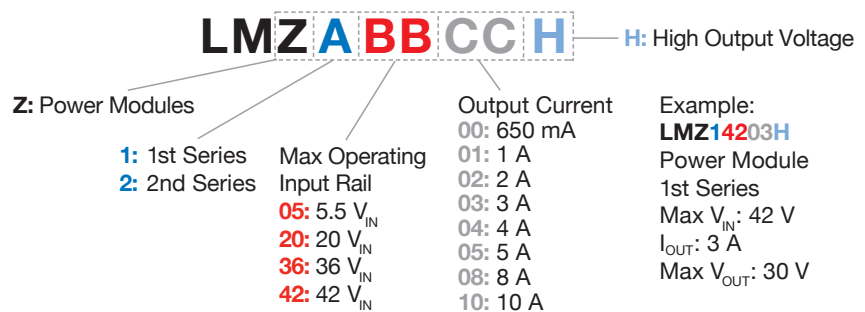
¹Additional input filter required.

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

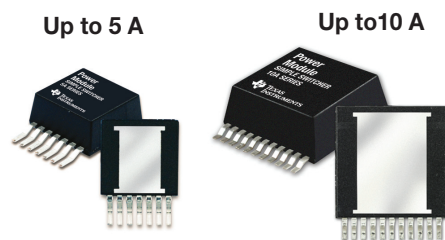
SIMPLE SWITCHER® Power Modules



SIMPLE SWITCHER® Power Modules Nomenclature



Easy-to-Use Packaging



Point-of-Load Solutions

→ SIMPLE SWITCHER® Products — Power Modules

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 ideal 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)	HiRel (H) or Automotive (A)†	Price*
							Radiated	Conducted¹				
LMZ10503/04/05EXT	3/4/5	2.95 to 5.5	0.8 to 5	96	–55 to 125	EN, SS	✓	✓	✓	TO-PMOD-7	H	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	H	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	H	12.40/14.30/17.20
LMZ14201H/02H/03H	1/2/3	6 to 42	5 to 30	97	–40 to 125	EN, SS	✓	✓		TO-PMOD-7		6.18/7.13/8.95

¹Additional input filter required.

†Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.

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

LMZ2-Series Power Modules

The LMZ2-series power modules (LMZ2xxxx) are available in output currents up to 10 A with additional features for powering high current intermediate rails, FPGAs, and noise sensitive applications. They also feature a frequency synchronization pin that controls the switching frequency of the internal circuitry, and a current sharing

pin for paralleling multiple power modules together for achieving up to 60 A of output current.

Frequency Synchronization

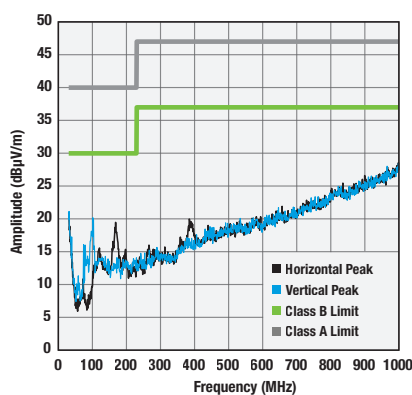
- Optimize efficiency and control switching noise in noise-sensitive systems with the power module's synchronizable switching frequency.
- Synchronization pin can be set to a certain frequency for ease of filtering.

- Multiple power modules can operate at the same frequency or phase shifted to reduce input RMS current and ripple voltage.

Current Sharing

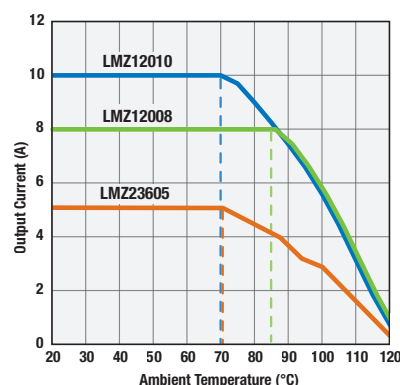
- Parallel multiple modules for up to 60 A of output current in high-current intermediate rail and FPGA applications.

LMZ22010 Radiated EMI Performance



Complies with EN55022 (CISPR22) Class B Radiated EMI Standard.

LMZ22010 Thermal Performance



Thermal performance measured for a 12-V to 3.3-V conversion on a 3.5" x 2.9" four-layer board with no air flow or heatsink.

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	Conducted¹		
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

¹Additional input filter required.

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

Point-of-Load Solutions

→ SIMPLE SWITCHER® Products — Nano Modules

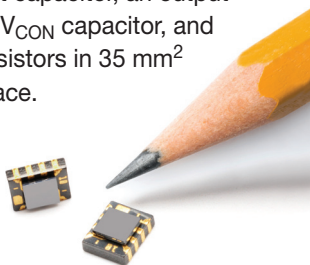
The new SIMPLE SWITCHER® nano modules combine ease of use and high performance in a tiny solution size. The nano modules boast the smallest 1-A package in the market today. It's the first integrated inductor solution with the IC mounted on the inductor to reduce board space requirements and improve performance, making them ideal for space-constrained, point-of-load applications.

The nano modules also feature high performance characteristics including low output ripple, low EMI and high efficiency.

Like all SIMPLE SWITCHER products, the nano modules make it easy to design your power supply by combining ease-of-use products with WEBENCH® online design tools.

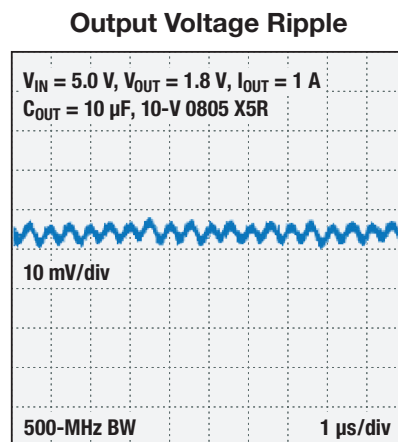
Easy-to-Use Package

The new nano module packaging size of 2.5 x 3 x 1.2 mm, makes it the tiniest 1-A DC/DC solution in the market. By mounting the IC on a shielded inductor, the nano modules save board space and provide a complete solution that requires only an input capacitor, an output capacitor, a V_{CON} capacitor, and feedback resistors in 35 mm² of board space.



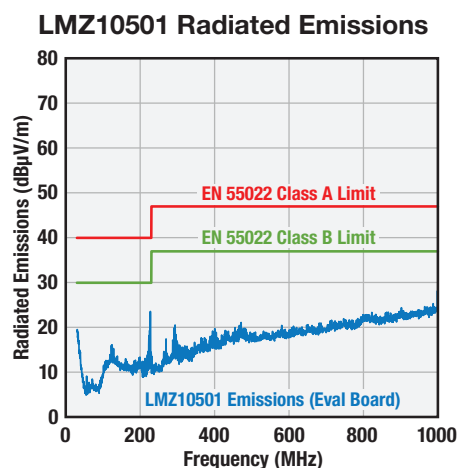
Low Output Voltage Ripple

The nano modules operate at a fixed 2-MHz switching frequency designed to deliver a balance of low output ripple and high efficiency. They are also stable with low ESR ceramic capacitors. A standard solution using a 10-μF X5R 0805 output capacitor provides less than 10-mVPP output ripple allowing for replacement of LDOs where higher efficiency is needed.



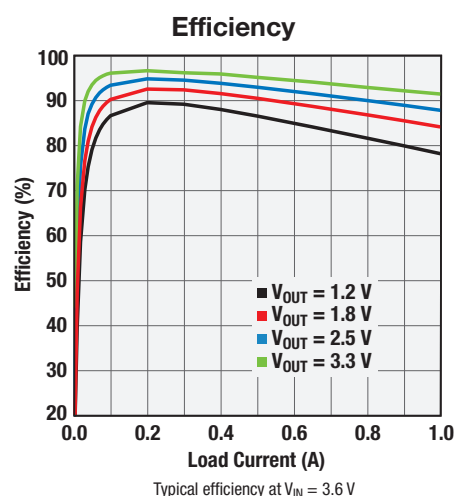
Low Radiated EMI

Low EMI allows for easy PCB layout to meet EMI compliance. The LLP-like footprint allows input and output capacitors to be placed as close as physically possible to the package, reducing the area of the high di/dt current paths. The nano module surpasses the CISPR22 Class B radiated EMI standards with no additional filtering.



High Efficiency

The nano modules improve thermal performance and reduce energy waste by delivering a peak efficiency of 95%.



SIMPLE SWITCHER® Nano Modules

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Operating Junction Temperature (°C)	Features	Frequency (kHz)	CISPR22 Class B EMI	Package Size (mm)	Price*
LMZ10500	0.65	2.7 to 5.5	0.6 to 3.6	-40 to 125	EN, SS	2000	✓	3.0 x 2.5 x 1.2	1.30
LMZ10501	1	2.7 to 5.5	0.6 to 3.6	-40 to 125	EN, SS	2000	✓	3.0 x 2.5 x 1.2	1.80

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

New devices are listed in bold red.

Point-of-Load Solutions

→ SIMPLE SWITCHER® Products — 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.

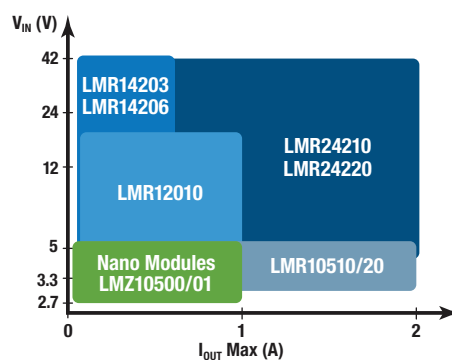
Flexibility and Ease of Use

Nano regulators provide flexibility by supporting wide input voltage ranges and adjustable output voltages for both step-up and step-down conversion. All nano regulators are internally compensated to minimize component count and reduce overall design complexity. All three packages are 1 mm or less in height.

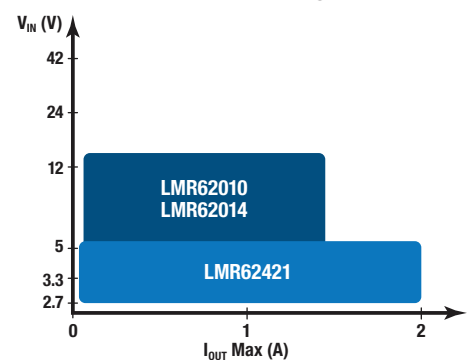
Multi-Rail Demo Board

The nano multi-rail demo board provides a complete system for space-constrained applications. It utilizes two LMZ10501 nano modules at the point-of-load and a LMR24220 nano regulator to convert from an input of 5 V to 24 V converting down to 3.3 V, 1.8 V, and 1.2 V in 0.525" x 0.8" of board space.

Step-Down (Buck) Regulators



Step-Up (Boost) Regulators



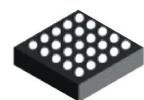
Nano Regulator Packaging Options



SOT-23 6-pin packaging
(2.9 mm x 2.85 mm)

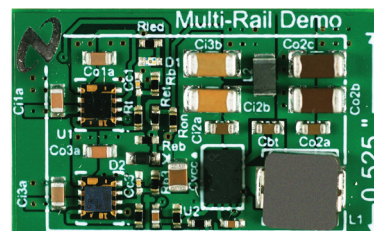


LLP® 6-pin packaging
(3.0 mm x 3.0 mm)



Micro SMD packaging
(2.45 mm x 3.3 mm)

LMR24220RB Multi-Rail Demo Board



SIMPLE SWITCHER® Nano Regulators

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Frequency (kHz)	Features	Package(s)	Price*
Nano Step-Down (Buck)							
LMR10510	1	3 to 5.5	0.6 to 4.5	1600, 3000	EN, SS	LLP®,-6, SOT-23	0.30
LMR10515	1.5	3 to 5.5	0.6 to 4.5	1600, 3000	EN, SS	LLP-6, SOT-23	0.85
LMR10520	2	3 to 5.5	0.6 to 4.5	1600, 3000	EN, SS	LLP-6	0.38
LMR12010	1	3 to 20	0.8 to 16	1600, 3000	EN, SS	TSOT-23	0.79
LMR14203	0.3	4.5 to 42	0.765 to 34	1250	EN, SS	TSOT-23	0.90
LMR14206	0.6	4.5 to 42	0.765 to 34	1250	EN, SS	TSOT-23	1.01
LMR24210	1	4.5 to 42	0.8 to 24	1000 max	EN, SS	Micro SMD-28	1.50
LMR24220	2	4.5 to 42	0.8 to 24	1000 max	EN, SS	Micro SMD-28	2.00
Nano Step-Up (Boost)							
LMR62421	2.1	2.7 to 5.5	3 to 24	1600	EN, SS	SOT-23, LLP-6	0.74
LMR62014	1.4	2.7 to 14	3 to 20	1600	EN	SOT-23	0.54
LMR64010	1	2.7 to 14	3 to 40	1600	EN	SOT-23	0.59

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

New devices are listed in bold red.

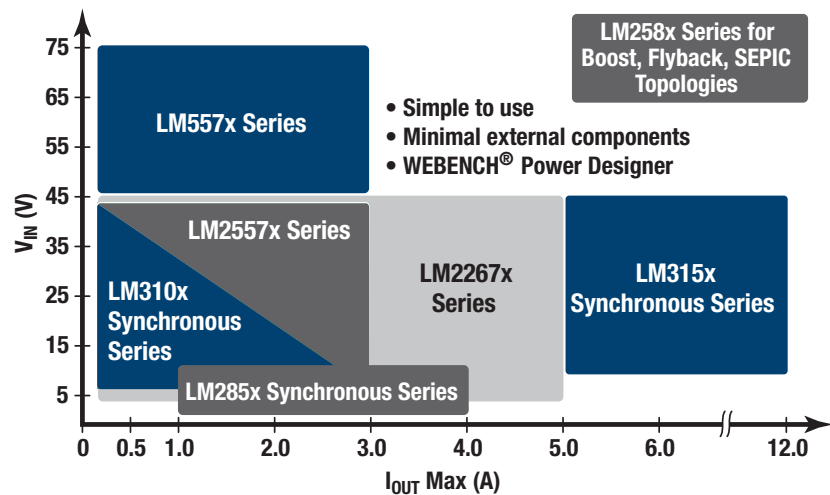
Point-of-Load Solutions

→ SIMPLE SWITCHER® Products — Regulators and Controllers

National's award-winning SIMPLE SWITCHER® products 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

SIMPLE SWITCHER® Step-Down (Buck) Family



LM2267x and LM22680 SIMPLE SWITCHER® Non-Synchronous Regulators

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

[†] Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.
^{*} 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 _{IN} (max) (V)	V _{IN} (min) (V)	V _{OUT} (min) (V)	V _{OUT} (max) (V)	Frequency Range (kHz)	f _{sync}	On/Off Pin	PWM Mode	Package(s)	HiRel (H) or Automotive (A) [†]	Price*
LM25574	500	42	6	1.23	40	50 to 1000	✓	✓	Current	TSSOP-16	A	1.48
LM5574	500	75	6	1.23	70	50	✓	✓	Current	TSSOP-16	A	1.75
LM25575	1500	42	6	1.23	40	50 to 1000	✓	✓	Current	eTSSOP-16	A	1.76
LM5575	1500	75	6	1.23	70	50	✓	✓	Current	eTSSOP-16	A	2.20
LM25576	3000	42	6	1.23	40	50 to 1000	✓	✓	Current	eTSSOP-20	A	2.40
LM5576	3000	75	6	1.23	70	50	✓	✓	Current	eTSSOP-20	A	3.05

[†] Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.
^{*} Suggested resale price in U.S. dollars in quantities of 1,000.

SIMPLE SWITCHER® Boost/Flyback/SEPIC

Device	I _{OUT} (A)	V _{IN} (max) (V)	V _{IN} (min) (V)	V _{OUT} (min) (V)	Frequency Range (kHz)	Package(s)	Price*
LM2585	3	40	4	1.23	100	T0-220, T0-263	3.17
LM2586	3	40	4	1.23	100 to 200	T0-220, T0-263	3.27
LM2587	5	40	4	1.23	100	T0-220, T0-263	4.17
LM2588	5	40	4	1.23	100 to 200	T0-220, T0-263	4.50

^{*} Suggested resale price in U.S. dollars in quantities of 1,000.

→ SIMPLE SWITCHER® Products — Regulators and Controllers

SIMPLE SWITCHER® Synchronous Regulators

Device	Output Current (mA)	V _{IN} (max) (V)	V _{IN} (min) (V)	V _{OUT} (min) (V)	V _{OUT} (max) (V)	Frequency Range (kHz)	PWM Mode	Package(s)	Price*
LM3103	750	42	4.5	0.6	38	1000	COT ¹	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

¹COT = Constant ON-time control.

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

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

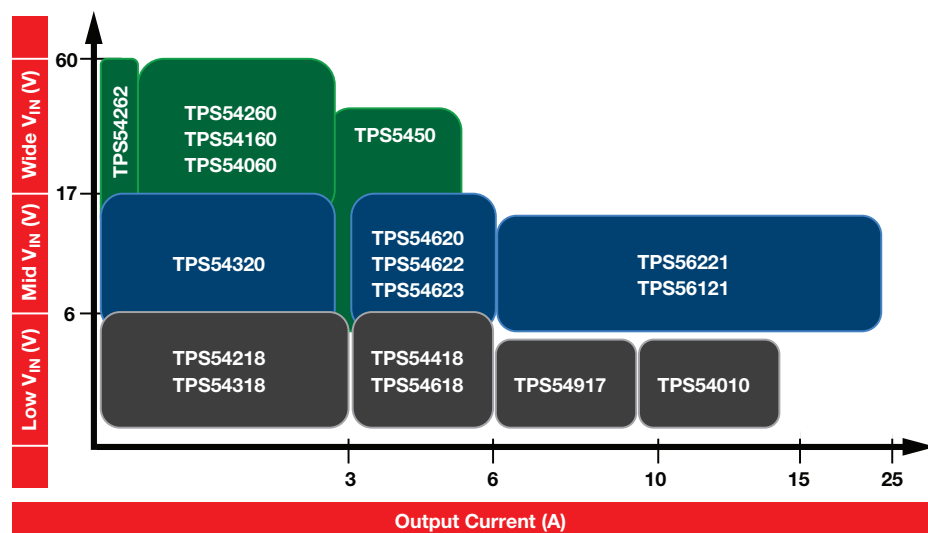
*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Step-Down (Buck) Converters – Line Power

SWIFT™ High Power-Density 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. Whether powering a performance processor or advanced analog circuitry, SWIFT DC/DC converters help solve board-space and power-budget challenges. High-frequency operation and low MOSFET on-resistance in a small package allow designers to reduce board space without sacrificing efficiency.

Learn more at www.ti.com/swift



4.5-V to 17-V Input, 6-A High-Density SWIFT™ Converter with Eco-mode™

TPS54623

NEW

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS54623

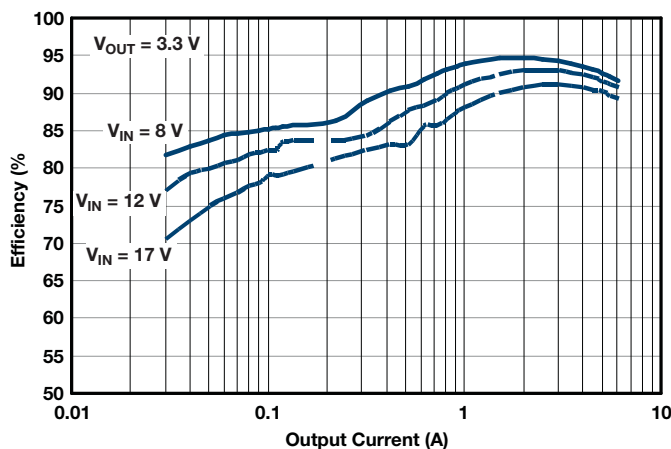
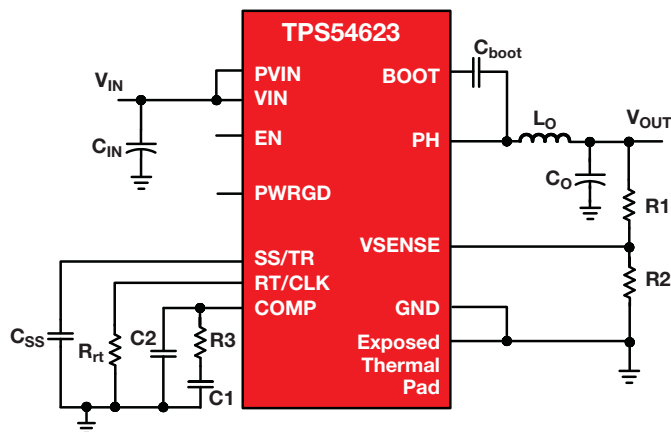
The TPS54623 is a 6-A synchronous step-down DC/DC converter that provides a small design due to its fast switching frequency and package size. Eco-mode™ operation is automatically engaged at light loads to save energy. The TPS54623 is supported by TI's SwitcherPro™ Switching Power Supply Design Tool and an evaluation module.

Key Features

- Integrated 26-mΩ high-side and 19-mΩ low-side MOSFETs
- Auto-skipping Eco-mode operation activates automatically
- 200-kHz to 1.6-MHz operation
- 0.6-V reference with 1% accuracy
- 3.5 x 3.5-mm, 14-pin QFN package

Applications

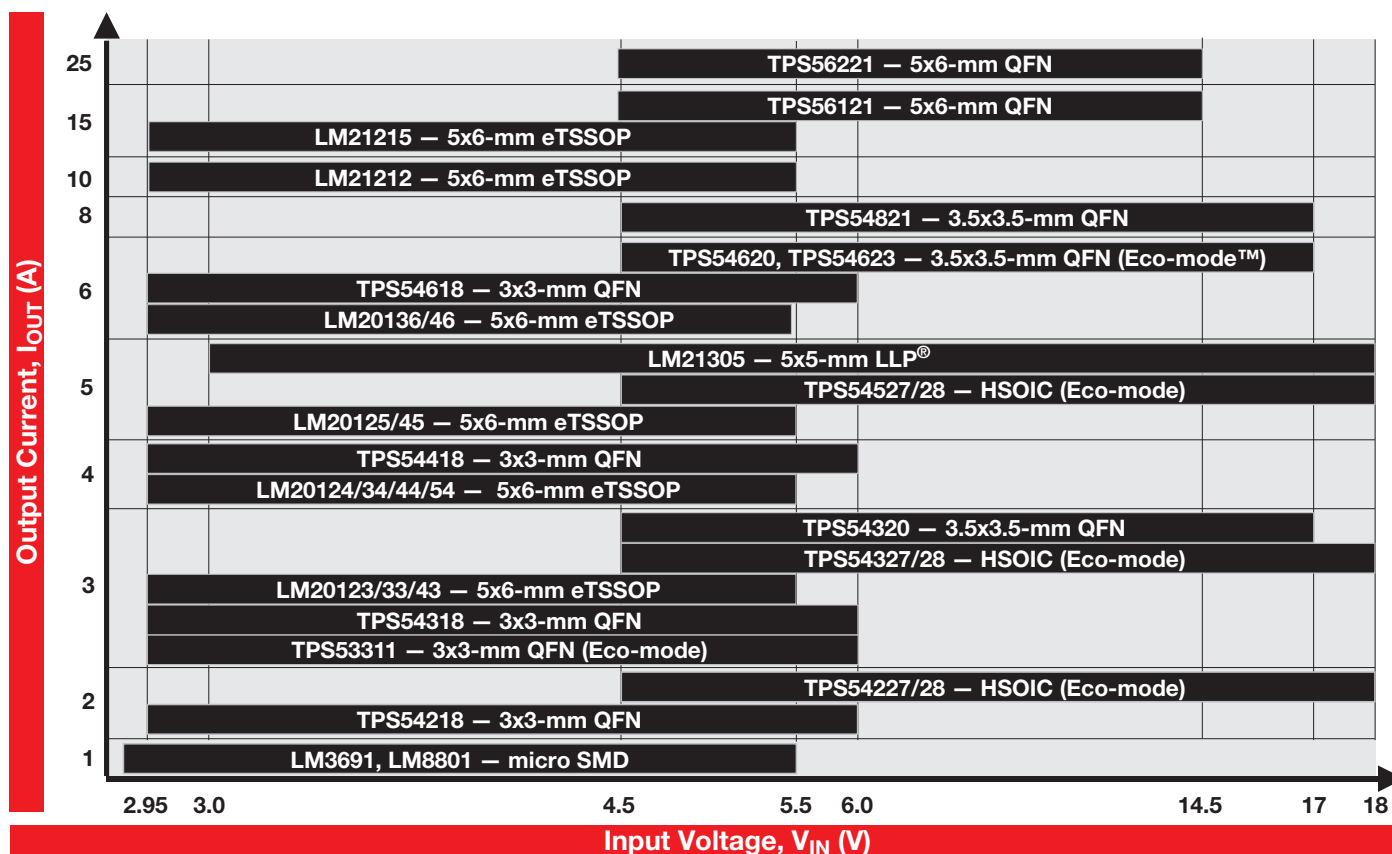
- Broadband and communication infrastructure
- Compact PCI®/PCI Express®/PXI Express®
- DSP and FPGA point-of-load applications



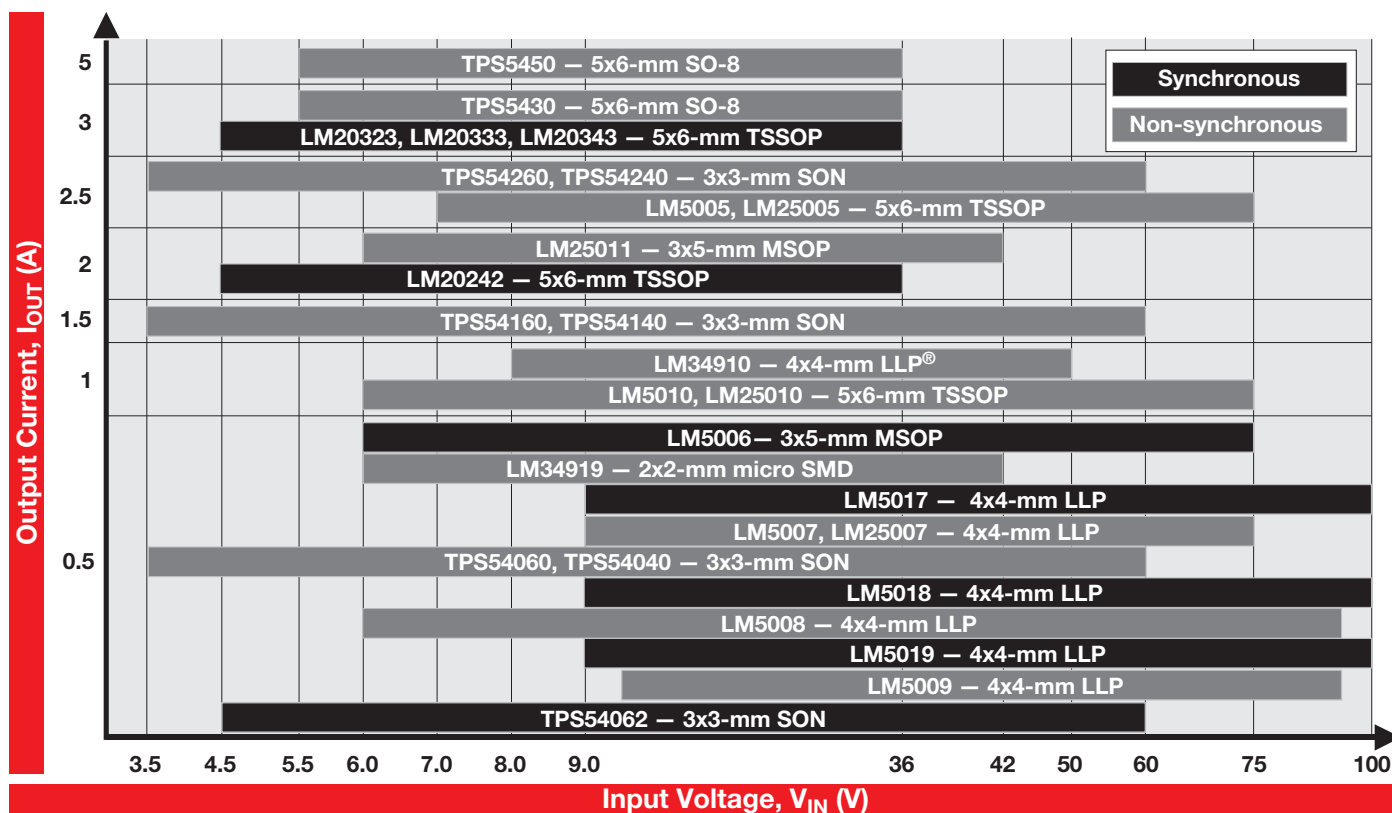
Point-of-Load Solutions

→ Step-Down (Buck) Converters — Line Power

Synchronous Step-Down Converters with < 20-V Maximum Input



Step-Down Converters with > 20-V Maximum Input



→ Step-Down (Buck) Converters — Line Power

100-V Buck Regulator Enhances Reliability for High-Voltage Applications

LM5017

Get samples at: www.ti.com/product/LM5017

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 new LM5017 100-V, 600-mA synchronous buck regulator is the first in a family of the industry's first 100-V converters with integrated high-side and low-side FETs. Continuous conduction mode operation allows for use as a small, isolated bias supply.

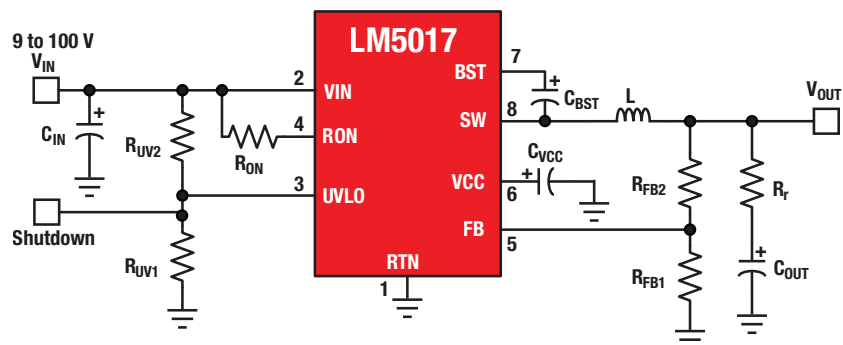
Key Features

- Wide 9- to 100-V input-voltage range
- Integrated, 100-V high- and low-side switches

- Fast transient response
- Frequency adjustable to 1 MHz
- Constant-on-time architecture requires no loop compensation

Applications

- Telecommunication systems
- Automotive electronics
- Isolated bias supply
- Smart power meters



Reference designs available at
www.ti.com/pmp7315 and [pmp7316](http://www.ti.com/pmp7316)

Selection Guide

						Features											
						Power Good Pin	Sync Pin	180° Out-of-Phase Switching	Adj. Soft Start	Synchronous Rectifier	Light-Load Efficiency	External Compensation	Sequencing/Tracking				
Device	I _{OUT} (mA)	V _{IN} (V)	Min V _{OUT} (V)	Max Duty Cycle (%)	Switching Frequency (kHz)									HiRel (H) or Automotive (A) [†]	EVM	Package(s)	Price*
Low Input Voltage Step-Down Converters (<6 V _{IN})																	
TPS54218	2000	2.95 to 6.0	0.8	98	200 to 2000	✓	✓		✓	✓		✓			✓	16 QFN (3x3 mm)	1.50
LM20123/33/43	3000	2.95 to 5.5	0.8	—	250 to 1500	✓	✓		✓	✓		✓	✓	A	✓	eTSSOP-16	1.36
TPS54318	3000	2.95 to 6.0	0.8	98	200 to 2000	✓	✓		✓	✓		✓			✓	16 QFN (3x3 mm)	2.00
TPS53311	3000	2.9 to 6.0 ¹	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	✓	✓		✓	✓		✓	✓	A	✓	eTSSOP-16	1.50
TPS54418	4000	2.95 to 6.0	0.8	98	200 to 2000	✓	✓		✓	✓		✓			✓	16 QFN (3x3 mm)	2.35
LM20125/45	5000	2.95 to 5.5	0.8	—	250 to 1500	✓			✓	✓		✓	✓	A	✓	eTSSOP-16	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	✓	✓		✓	✓		✓	✓		✓	eTSSOP-16	1.68
TPS54618	6000	2.95 to 6.0	0.8	98	200 to 2000	✓	✓		✓	✓					✓	16 QFN (3x3 mm)	2.85
LM21212-1	12000	2.95 to 5.5	0.6	100	300 to 1500	✓	✓		✓	✓		✓	✓		✓	eTSSOP-20	3.30
LM21212-2	12000	2.95 to 5.5	0.6	100	300 to 1500	✓			✓	✓		✓	✓		✓	eTSSOP-20	3.30
LM21215	Up to 15000	2.95 to 5.5	0.6	100	500	✓			✓	✓		✓	✓		✓	eTSSOP-20	3.55
LM21215A-1	15000	2.95 to 5.5	0.6	100	300 to 1500	✓	✓		✓	✓		✓	✓		✓	eTSSOP-20	3.55
Mid Input Voltage Step-Down Converters (<20 V _{IN})																	
TPS54227	2000	4.5 to 18	0.76	90 ²	700					✓	✓				✓	8 HSOIC	1.45
TPS54228	2000	4.5 to 18	0.76	90 ²	700					✓	✓	✓			✓	8 HSOIC	1.50
TPS54231/2/3	2000	3.5 to 28	0.8	93	570/1000/300					✓	✓	✓	✓		✓	8 SOIC	1.25
TPS54320	3000	4.5 to 17	0.8	98	200 to 1200	✓	✓			✓	✓		✓	✓	✓	14 QFN	1.70
TPS54327	3000	4.5 to 18	0.76	90 ²	700					✓	✓				✓	8 HSOIC	1.55
TPS54328	3000	4.5 to 18	0.76	90 ²	700					✓	✓	✓			✓	8 HSOIC	1.60
TPS54331	3000	3.5 to 28	0.8	93	570					✓		✓	✓	A	✓	8 SOIC	1.35

¹Requires 2.9- to 3.5-V bias input.

²Maximum V_{OUT} is 5.5 V.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available. Certain voltage options are not available. Different pricing may apply.

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

New devices are listed in bold red.

Point-of-Load Solutions

→ Step-Down (Buck) Converters — Line Power

Selection Guide (Continued)

Device	I _{OUT} (mA)	V _{IN} (V)	Min V _{OUT} (V)	Max Duty Cycle (%)	Switching Frequency (kHz)	Features								EVM	Package(s)	Price*	
						Power Good Pin	Sync Pin	180° Out-of-Phase Switching	Adj. Soft Start	Synchronous Rectifier	Light-Load Efficiency	External Compensation	Sequencing/Tracking				HiRel (H) or Automotive (A)†
Mid Input Voltage Step-Down Converters (<20 V _{IN}) (Continued)																	
TPS54332	3500	3.5 to 28	0.8	93	1000				✓		✓	✓		✓	8 HSOIC	1.40	
LM21305	5000	3 to 18	0.6	100	250 to 1500	✓	✓		✓	✓	✓	✓	✓	✓	LLP-28	2.50	
TPS54527	5000	4.5 to 18	0.76	90 ²	700				✓	✓				✓	8 HSOIC	1.90	
TPS54528	5000	4.5 to 18	0.76	90 ²	700				✓	✓	✓			✓	8 HSOIC	1.95	
TPS53313	6000	4.5 to 16	0.6	70	250 to 1500	✓	✓		✓	✓		✓		✓	16 QFN (4x4 mm)	2.60	
TPS54620	6000	4.5 to 17	0.8	98	200 to 1600	✓	✓		✓	✓		✓	✓	✓	QFN (3.5x3.5 mm)	2.50	
TPS54623	6000	4.5 to 17	0.6	98	200 to 1600	✓	✓		✓	✓	✓	✓	✓	✓	QFN (3.5x3.5 mm)	2.55	
TPS54821	8000	4.5 to 17	0.6	98	200 to 1600	✓	✓		✓	✓		✓	✓	✓	QFN (3.5x3.5 mm)	2.75	
TPS51315	10000	3 to 14 ³	0.76	100 ⁴	100 to 1000					✓	✓			✓	QFN (5x7 mm)	2.65	
TPS56121	15000	4.5 to 14	0.6	93	300/500/1000	✓			✓	✓		✓		✓	22 QFN (5x6 mm)	5.25	
TPS56221	25000	4.5 to 14	0.6	93	300/500/1000	✓			✓	✓		✓		✓	22 QFN (5x6 mm)	4.35	
TPS53355	30000	3 to 15 ⁵	0.6	90 ⁴	250 to 1000	✓				✓	✓			✓	22 QFN (5x6 mm)	4.65	
High Input Voltage Step-Down Converters (>20 V _{IN})																	
TPS54062	50	4.7 to 60	0.8	98	100 to 400		✓			✓		✓		✓	8 MSOP	1.50	
LM5019	100	9 to 100	1.23	—	250 to 1000					✓				A	✓	LLP®-8, PSOP-8	1.25
LM5009/A	150	8/6 to 95	—	—	50 to 600									✓	LLP-8, MSOP-8	1.00/1.10	
LM5018	300	9 to 100	1.23	—	—					✓				A	✓	LLP-8, PSOP-8	1.40
LM5008/A	350	8/6 to 95	—	—	50 to 600									✓	LLP-8, MSOP-8	1.18/1.20	
LM(2)5007	500	9 to 42/75	2.5	—	50 to 800									✓	LLP-8, MSOP-8	1.05/1.30	
TPS54040	500	3.5 to 42	0.8	98	100 to 2500	✓	✓		✓		✓	✓	✓	A	✓	10 HMSOP	1.35
TPS54060	500	3.5 to 60	0.8	98	100 to 2500	✓	✓		✓		✓	✓	✓	A	✓	10 HMSOP/10 SON	1.75
LM5017	600	9 to 100	1.23	—	250 to 1000					✓				A	✓	LLP-8, PSOP-8	1.65
LM34919/B	600	8/6 to 40	2.5	—	Up to 2600				✓					A	✓	Micro SMD-10	1.20/1.25
LM5006	650	6 to 75	2.5	—	50 to 600					✓				4	MSOP-10	1.50	
LM(2)5010/A	1000	8/6 to 42/75	2.5	—	50 to 1000				✓					A	✓	LLP-10, eTSSOP-14	1.15/1.53
TPS5410	1000	5.5 to 36	1.23	87	500									H, A	✓	8 SOIC	1.60
LM34917A	1250	8 to 33	2.5	—	2000				✓						Micro SMD-12	1.35	
LM34910/C	1250	8 to 36/50	2.5	—	1000				✓						LLP-10	1.32	
LM26001	1500	3 to 38	1.25	—	150 to 500						✓			A	✓	TSSOP-16	2.85
TPS54140	1500	3.5 to 42	0.8	98	100 to 2500	✓	✓		✓		✓	✓	✓	A	✓	10 HMSOP	1.60
TPS54160	1500	3.5 to 60	0.8	98	100 to 2500	✓	✓		✓		✓	✓	✓	A	✓	10 HMSOP/10 SON	1.90
LM25011/A	Up to 2000	6 to 42	2.5	—	Up to 2000	✓			✓					A	✓	MSOP-10	1.30
LM20242	2000	4.5 to 36	0.8	—	1000	✓			✓	✓		✓	✓		✓	eTSSOP-16	1.46
TPS5420	2000	5.5 to 36	1.23	87	500									H, A	✓	8 SOIC	1.70
LM(2)5005	2500	7 to 42/75	1.23	—	50 to 500		✓		✓			✓			✓	eTSSOP-20	1.95/1.95
TPS54240	2500	3.5 to 42	0.8	98	100 to 2500	✓	✓		✓		✓	✓	✓	A	✓	10 HMSOP	1.90
TPS54260	2500	3.5 to 60	0.8	98	100 to 2500	✓	✓		✓		✓	✓	✓	A	✓	10 HMSOP/10 SON	2.30
LM26003	3000	3 to 38	1.25	—	150 to 500						✓			A	✓	eTSSOP-20	3.52
LM20323/33/43	3000	4.5 to 36	0.8	—	250 to 1500	✓	✓		✓	✓		✓	✓		✓	eTSSOP-20	1.50
TPS5430	3000	5.5 to 36	1.23	87	500									H, A	✓	8 HSOIC	1.85
TPS5450	5000	5.5 to 36	1.23	87	500									H, A	✓	8 HSOIC	2.25
Dual-Channel Step-Down Converters																	
TPS54290/1/2	1500/2500	4.5 to 18	0.8	90	300/600/1200			✓		✓			✓		✓	16 HTSSOP	2.95
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

¹Requires 2.9- to 3.5-V bias input.

²Maximum V_{OUT} is 7 V.

³Requires 4.5- to 5.5-V bias input.

⁴Maximum V_{OUT} is 5.5 V.

⁵Requires 4.5- to 25-V bias input.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available. Certain voltage options are not available. Different pricing may apply.

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

New devices are listed in bold red.

Point-of-Load Solutions

→ Step-Down (Buck) Converters — Portable Power

Selection Guide

Device	I _{OUT} (mA)	V _{IN} (V)	V _{OUT} Adjustable/Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Low Battery	Power Good	Package(s)			DCS-Control™ Topology	EVM	Features and Differentiators	HiRel (H) or Automotive (A) [†]	Price*	
											Chipscale (WCSP)	SOT-23	QFN						
General Purpose, Step-Down (Buck) Regulators — Small, Efficient, Low I _q																			
TPS62730	100	1.9 to 3.9	2.1	95	3000	2.2	25	0.03					6	✓	✓	Bypass Switch		0.85	
TPS62240	300	2.0 to 6.0	Adj./1.2/1.8	95	2250	2.2	15	0.1				5	6		✓			0.60	
LM3670	350	2.5 to 5.5	0.7 to 3.3		1000	10	15	0.1				5			✓			0.57	
LM3673	350	2.7 to 5.5	1.1 to 3.3		2000	2.2	16	0.01				5			✓			0.75	
LM3679	350	2.5 to 5.5	1.2 to 1.8		3000	1	16	0.01				5			✓			0.75	
LM3671	600	2.7 to 5.5	1.1 to 3.3		2000	2.2	16	0.01					5	6		✓		0.70	
LM3674	600	2.7 to 5.5	1.0 to 3.3		2000	2.2	300	0.01					5			✓		0.72	
LM3676	600	2.9 to 5.5	1.1 to 3.3		2000	2	16	0.01						8		✓		0.72	
LM3677	600	2.7 to 5.5	1.2 to 3.3		3000	1	16	0.01				5		6		✓		0.75	
TPS62260	600	2.0 to 6.0	Adj./1.2/1.8	95	2250	2.2	15	0.1					5	6		✓		0.70	
TPS62250	700	2.0 to 6.0	Adjustable	95	2250	2.2	15	0.1						6		USB applications		1.10	
TPS62290	1000	2.3 to 6.0	Adj./1.8/3.3	95	2250	2.2	15	0.1						6		✓	A	1.00	
TPS62040	1200	2.5 to 6.0	Adj./1.5/1.6/1.8/3.3	95	1250	6.2	18	0.1						10		✓	MSOP-10 package	1.40	
TPS62080	1200	2.3 to 6.0	Adj./1.8/3.3	94	2000	1	5	6.5		✓				8	✓	✓	Snooze mode, active discharge	1.20	
TPS62750	1300	2.9 to 6.0	Adjustable	92	2250	2.2	745	0.3						10		✓	Progr. input current limit	1.20	
TPS62510	1500	1.8 to 3.8	Adjustable	97	1500	2.2	18	0.1						10		✓	Output voltage tracking	1.25	
TPS62060	1600	2.3 to 6.0	Adj./1.8/3.3	94	3000	1.0	18	0.1						8		✓		1.10	
TPS62065	2000	2.3 to 6.0	Adjustable	94	3000	1.0	18	0.1						8		✓		1.30	
TPS62067	2000	2.9 to 6.0	Adjustable	97	3000	1.0	18	0.1		✓				8		✓		1.40	
TPS62090	3000	2.0 to 5.5	Adj., 1.8/2.5/3.3		2800/1400	0.47	20	0.6		✓					✓	✓	Soft-Start	TBD	
General Purpose, Step-Down (Buck) Regulators — Value Line, Relaxed Specification																			
TPS62560	600	2.5 to 5.5	Adj./1.8	95	2250	2.2	15	0.1					5	6		✓	3% V _{OUT} tolerance		0.50
TPS62590	1000	2.5 to 5.5	Adjustable	95	2250	2.2	15	0.1						6		✓	3% V _{OUT} tolerance	A	0.65
TLV62080	1200	2.5 to 5.5	Adj., 1.8/3.3	94	2000	1	30	0.6		✓				8	✓	✓		0.80	
TLV62065	2000	2.9 to 6	Adjustable	97	3000	1	18	0.1						8				1.00	
Extended Input Voltage Range																			
TPS62120	75	2.0 to 15	Adjustable	96	800	22	11	0.3		✓			8			✓	Ext. UVLO hysteresis		0.80
TPS62122	75	2.0 to 15	Adjustable	96	800	22	11	0.3						6		✓	Ext. UVLO hysteresis		0.80
TPS62125	250	3.0 - 17	Adj./1.8/3.3		1000	10	5	0.3		✓				8	✓		Program. EN threshold and window		TBD
TPS62170	500	3.0 to 17	Adj./1.8/3.3/5.0	92	2500	2.2	17	1.5		✓				8	✓	✓		0.95	
TPS62050	800	2.7 to 10.0	Adj./1.5/1.8/3.3	95	850	10	12	1.5	✓	✓						✓		1.00	
TPS62150	1000	3.0 to 17	Adj./1.8/3.3/5.0	96	2500/1250	2.2	17	1.5		✓				16	✓	✓	Soft-start, tracking, voltage and frequency select		1.25
TPS62160	1000	3.0 to 17	Adj./1.8/3.3/5.0	92	2500	2.2	17	1.5		✓				8	✓	✓		1.15	
TPS62110	1500	3.1 to 17	Adj./3.3/5	95	1000	6.8	18	1.5	✓	✓				16		✓		A, H	1.50
TPS62140	2000	3.0 to 17	Adj./1.8/3.3/5.0	96	2500/1250	2.2	17	1.5		✓				16	✓	✓	Soft-start, tracking, voltage and frequency select		1.45
TPS62130	3000	3.0 to 17	Adj./1.8/3.3/5.0	96	2500/1250	2.2	17	1.5		✓				16	✓	✓	Soft-start, tracking, voltage and frequency select		1.90
Dual Output, 180° Out-of-Phase																			
TPS62400	400 + 600	2.5 to 6.0	Adj./1.1 to 1.9/3.3	95	2250	3.3	30	0.1						10			EasyScale™ interface		1.00
TPS62410	800 + 800	2.6 to 6.0	Adjustable	95	2250	3.3	30	0.1						10			EasyScale interface	A	1.20
TPS62420	600 + 1000	2.6 to 6.0	Adjustable	95	2250	3.3	30	0.1						10	✓		EasyScale interface	A	1.20

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

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New devices are listed in **bold red**.
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Point-of-Load Solutions

➔ Step-Down (Buck) Converters — Portable Power

Selection Guide (Continued)

Device	I _{OUT} (mA)	V _{IN} (V)	V _{OUT} Adjustable/Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Low Battery	Power Good	Package(s)			DCS-Control™ Topology	EVM	Features and Differentiators	HiRel (H) or Automotive (A) [†]	Price*
											Chipscale (WCSP)	SOT-23	QFN					
Smallest Solution Size, High Switching Frequency																		
TPS62619	350	2.3 to 5.5	1.2/1.5/1.8/2.15	90	6000	0.47	31	0.2			6							0.60
TPS62690	500	2.3 to 4.8	2.85	95	4000	1.0	19	0.2			6				✓	Spread spectrum		0.75
TPS62230	500	2.05 to 6.0	1.0 to 3.3	94	3000	1	22	0.1					6	✓	✓	Up to 90-dB PSRR		0.50
TPS62674	500	2.3 to 4.8	1.2/1.26/1.5/1.8	92	5500	0.47	17	0.2			6				✓	Spread spectrum		0.75
LM8801	600	2.3 to 5.5	1.0 to 2.9		6000						6				✓			0.80
TPS62620	600	2.3 to 5.5	1.82/1.8/1.5/1.2	90	6000	0.47	31	0.2			6				✓			0.70
LM3691	1000	2.3 to 5.5	0.75 to 3.3		4000						6				✓			0.80
TPS62660	1000	2.3 to 5.5	1.2/1.8	91	6000	0.47	31	0.2			6				✓	Active Cap-discharge		1.00
LM3678	1500	2.5 to 5.5	0.8 to 3.3		3300								10		✓			1.15
Dynamic Voltage Scaling																		
TPS62270	400	2.0 to 6.0	1.15/0.9-3.3/ 2.1-3.3/2.5	95	2250	2.2	15	0.1					6		✓	Vsel pin		1.60
TPS62700	650	2.5 to 6.0	Adjustable	90	2000	3.3	10	0.01			8				✓	Vcon pin		0.85
TPS62650	800	2.3 to 5.5	Adjustable	86	6000	0.47	38	0.5			9					I ² C interface		0.90
TPS62360	3000	2.5 to 5.5	Adjustable	91	2500	1	56	0.5			16			✓	✓	I ² C interface, remote sense		1.85
TPS62366	4000	2.5 to 5.5	Adjustable		2500	1					16			✓	✓	I ² C interface, remote sense		TBD

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→ Step-Down (Buck) Converters — Integrated Power Solutions

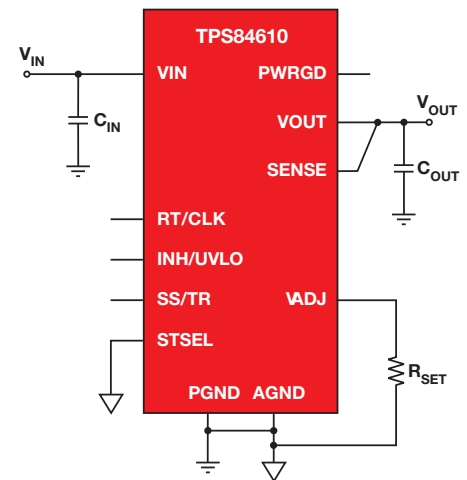
2.95-V to 6-V Input, 6-A Synchronous Buck, Integrated Power Solution

TPS84610

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS84610

The TPS84610 is a compact and easy-to-design point-of-load solution which requires only three external components by integrating the inductor and passives into a standard easy-to-mount QFN package. Efficiency is 9% higher than the competition, which keeps the device up to 30% cooler for better long-term reliability and reduced heat-sinking costs. A 12°C/W package thermal resistance allows the device to deliver, at all output voltages, the full 6-A current at 85°C ambient temperature without airflow. The TPS84610 is supported by the WEBENCH® Power Designer tool and an evaluation module.

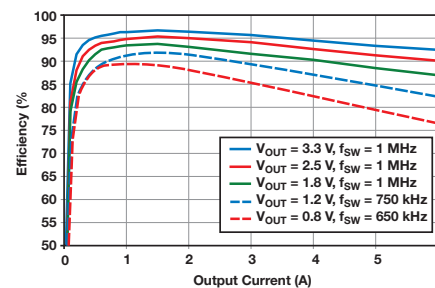
- Adjustable soft start and UVLO with track, clock, enable and PG pins
 - 9 x 11 x 2.8-mm QFN package for a 155-mm² total solution size
- #### Applications
- Broadband and communication infrastructure
 - CompactPCI®/PCI Express®/PXI Express®
 - DSP and FPGA point-of-load applications
 - High-density distributed power systems



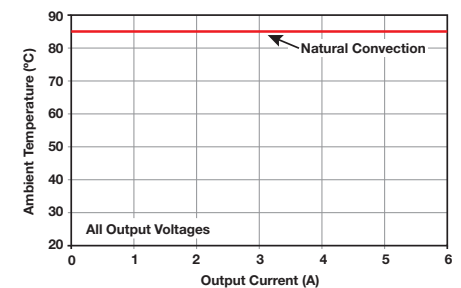
Simplified application.

Key Features

- Integrated inductor and passives—only three components required
- 96% peak efficiency with 12°C/W Θ_{JA} thermal resistance
- Meets EN55022 Class-B emissions
- Adjustable frequency from 500 kHz to 2 MHz



Efficiency versus output current.



6 A at full load with no airflow.

Selection Guide

Device	I _{OUT} (mA)	V _{IN} (V)	V _{OUT} (V)	Package Theta J _A (°C/W)	Switching Frequency (kHz)	Features					EVM	Package(s)	Price*
						Power Good Pin	Sync Pin	Adj. Soft Start	Synchronous Rectifier	Sequencing/ Tracking			
Integrated Power Solutions (Inductor in device)													
TPS84210	2000	2.95 to 6.0	0.8 to 3.6	12	500 to 2000	✓	✓	✓	✓	✓	✓	39 QFN (9x11 mm)	4.50
TPS84320	3000	4.5 to 14.5	0.8 to 5.5	13	330 to 780	✓	✓	✓	✓	✓	✓	47 QFN (9x15 mm)	5.50
TPS84410	4000	2.95 to 6.0	0.8 to 3.6	12	500 to 2000	✓	✓	✓	✓	✓	✓	39 QFN (9x11 mm)	5.50
TPS84610	6000	2.95 to 6.0	0.8 to 3.6	12	500 to 2000	✓	✓	✓	✓	✓	✓	39 QFN (9x11 mm)	6.50
TPS84621	6000	4.5 to 14.5	0.6 to 5.5	13	250 to 780	✓	✓	✓	✓	✓	✓	47 QFN (9x15 mm)	7.00
TPS84620	6000	4.5 to 14.5	1.2 to 5.5	13	480 to 780	✓	✓	✓	✓	✓	✓	47 QFN (9x15 mm)	7.00

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 ²)	MicroSiP™ Package	EVM	Features and Differentiators	Price*
Fully Integrated Solutions (Inductor plus input/output capacitors on device)															
TPS82690/95	Step-Down	500	2.3 to 4.35	2.85/2.5	95	4000	24	0.5	✓	✓	6.7	8	✓		1.30
TPS82671	Step-Down	600	2.3 to 4.8	1.1/1.2/1.5/1.8	90	5500	17	0.5	✓	✓	6.7	8	✓	Spread spectrum	1.30
TPS81256	Boost	600	2.3 to 5.5	5	—	3500	—	—	✓		6.7	8	✓	True load disconnect	TBD

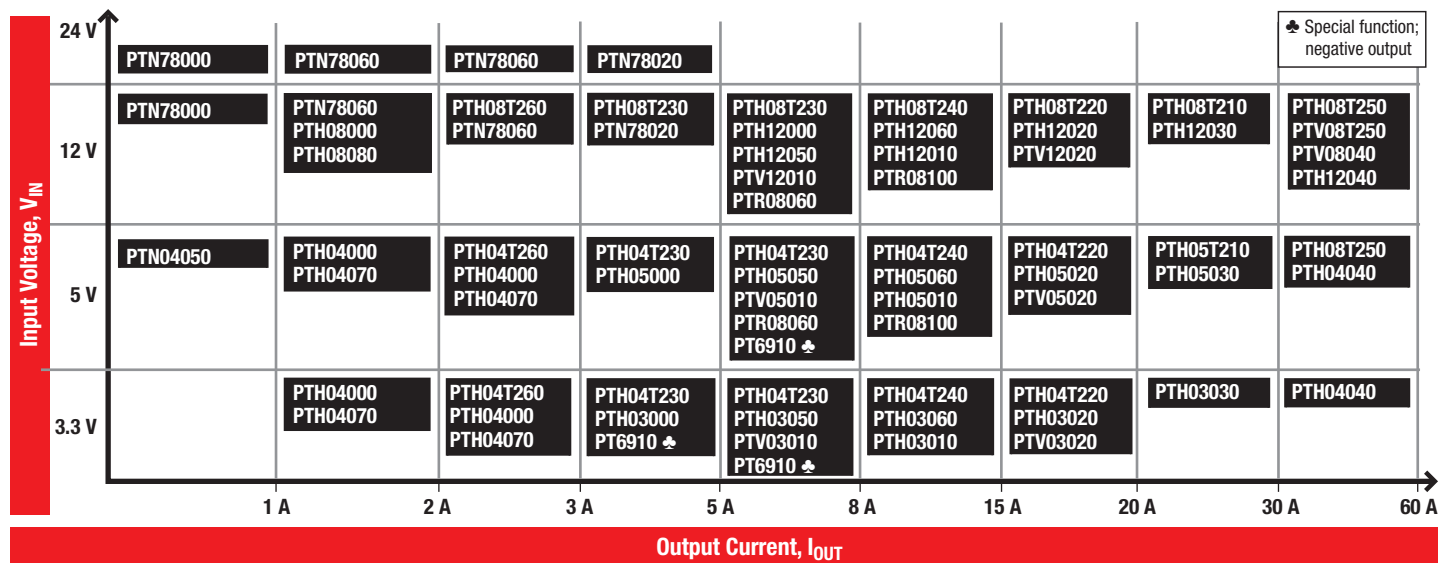
All of the above devices have undervoltage lockout and thermal protection built in.

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

→ Step-Down (Buck) Converters – Non-Isolated Power Modules

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



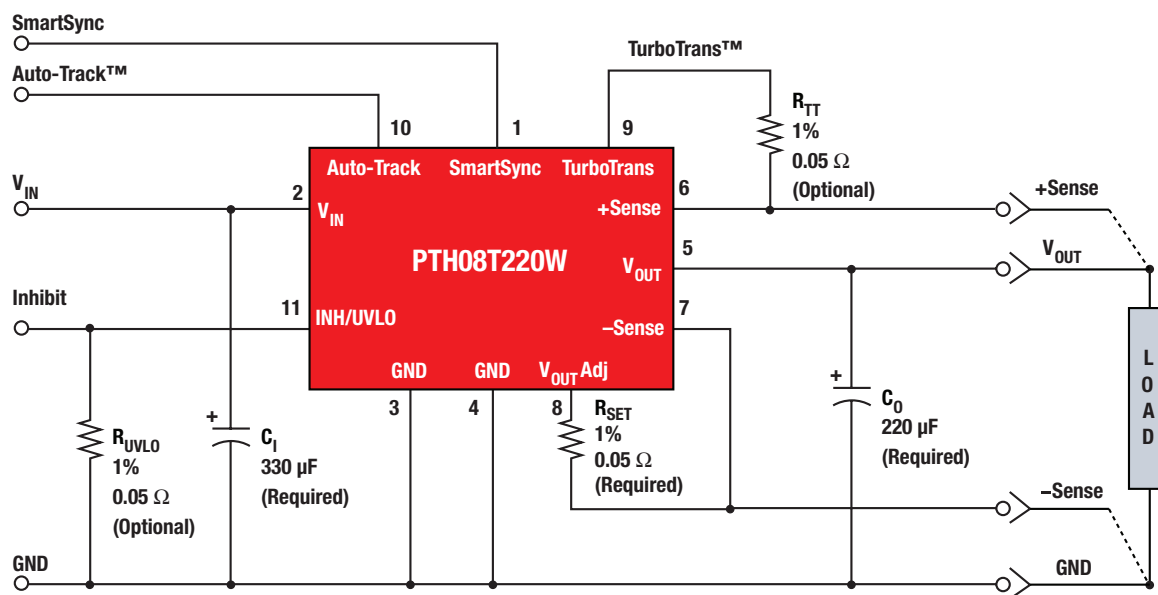
16-A, 4.5-V to 14-V Input, POL Module with TurboTrans™ Technology

PTH08T220W

Get samples, datasheets and app reports at: www.ti.com/product/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.



➔ Step-Down (Buck) Converters — Non-Isolated Power Modules

Selection Guide

Device ¹	Input Bus Voltage	Description	P _{OUT} or I _{OUT}	V _O Range (V)	V _O Adj.	Auto-Track™ Sequencing	POLA™	DDR-QDR	Price*
Non-Isolated Single Positive Output									
PTH03000W	3.3 V	3.3-V Input 6-A POL	6 A	0.8 to 2.5	✓				6.90
PTH03010W	3.3 V	3.3-V Input 15-A POL with Auto-Track Sequencing	15 A	0.8 to 2.5	✓	✓	✓		11.60
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	✓	✓	✓		25.00
PTH03050W	3.3 V	3.3-V Input 6-A POL with Auto-Track Sequencing	6 A	0.8 to 2.5	✓	✓	✓		6.90
PTH03060W	3.3 V	3.3-V Input 10-A POL with Auto-Track Sequencing	10 A	0.7 to 2.5	✓	✓	✓		9.80
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	✓	✓	✓		4.50
PTH04070W	3.3 V/5 V	3-V to 5.5-V Input 3-A POL	3 A	0.9 to 3.6	✓				4.28
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	✓	✓	✓		35.00
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	✓	✓	✓		12.60
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	✓	✓			7.90
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	✓	✓			10.80
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	✓	✓			6.25
PTH05000W	5 V	5-V Input 6-A POL	6 A	0.8 to 3.6	✓				6.90
PTH05010W	5 V	5-V Input 15-A POL with Auto-Track Sequencing	15 A	0.8 to 3.6	✓	✓	✓		11.60
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	✓	✓	✓		25.00
PTH05050W	5 V	5-V Input 6-A POL with Auto-Track Sequencing	6 A	0.8 to 3.6	✓	✓	✓		6.90
PTH05060W	5 V	5-V Input 10-A POL with Auto-Track Sequencing	10 A	0.8 to 3.6	✓	✓	✓		9.80
PTH05T210W	5 V	5-V Input, 30-A T2 2nd Gen PTH POL with TurboTrans	30 A	0.7 to 3.6	✓	✓	✓		18.00
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	✓	✓	✓		4.50
PTH08080W	5 V/12 V	4.5-V to 18-V Input, 2.25-A POL	2.25 A	0.9 to 5.5	✓				4.28
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	✓	✓	✓		18.00
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	✓	✓	✓		12.60
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	✓	✓			7.90
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	✓	✓			10.80
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	✓	✓			10.80
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	✓	✓			36.00
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	✓	✓			6.25
PTH12000L/W	12 V	12-V Input 6-A POL	6 A	0.8 to 1.8/1.2 to 5.5	✓				6.90
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	✓	✓	✓		11.60
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	✓	✓	✓		25.00
PTH12040W	12 V	12-V Input 50-A POL with Auto-Track Sequencing	50 A	0.8 to 5.5	✓	✓	✓		35.00
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	✓	✓	✓		6.90
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	✓	✓	✓		9.80
PTH03010Y	3.3 V	3.3-V Input 15-A DDR Terminating Module	15 A	Follows V _{REF}	✓		✓	✓	11.60
PTH03050Y	3.3 V	3.3-V Input 6-A DDR Terminating Module	6 A	Follows V _{REF}	✓		✓	✓	6.90
PTH03060Y	3.3 V	3.3-V Input 10-A DDR Terminating Module	10 A	Follows V _{REF}	✓		✓	✓	9.80
PTH05010Y	5 V	5-V Input 15-A DDR Terminating Module	15 A	Follows V _{REF}	✓		✓	✓	11.60
PTH05050Y	5 V	5-V Input 6-A DDR Terminating Module	6 A	Follows V _{REF}	✓		✓	✓	6.90
PTH05060Y	5 V	5-V Input 10-A DDR Terminating Module	10 A	Follows V _{REF}	✓		✓	✓	9.80
PTH12010Y	12 V	12-V Input 12-A DDR Terminating Module	12 A	Follows V _{REF}	✓		✓	✓	11.60
PTH12050Y	12 V	12-V Input 6-A DDR Terminating Module	6 A	Follows V _{REF}	✓		✓	✓	6.90
PTH12060Y	12 V	12-V Input 8-A DDR Terminating Module	8 A	Follows V _{REF}	✓		✓	✓	9.80
PTN04050C	3.3 V/5 V	3-V/5-V Input, 12-W Output Step-Up (Boost) ISR	12 W	5 to 15	✓				8.00
PTN78000W/H	V _O + 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	✓				8.00
PTN78060W/H	V _O + 2 to 36 V	Wide-Input, Wide-Output 3-A Positive Step-Down ISR	3 A	2.5 to 12/12 to 22	✓				11.00
PTN78020W/H	V _O + 2 to 36 V	Wide-Input, Wide-Output 6-A Positive Step-Down ISR	6 A	2.5 to 12/12 to 22	✓				15.00
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	✓	✓	✓		6.90
PTV03020W	3.3 V	5-V Input 18-A Vertical SIP with Auto-Track Sequencing	18 A	0.8 to 2.5	✓	✓	✓		11.60

¹See power.ti.com for a complete product offering.

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

Point-of-Load Solutions

→ Step-Down (Buck) Converters — Non-Isolated Power Modules

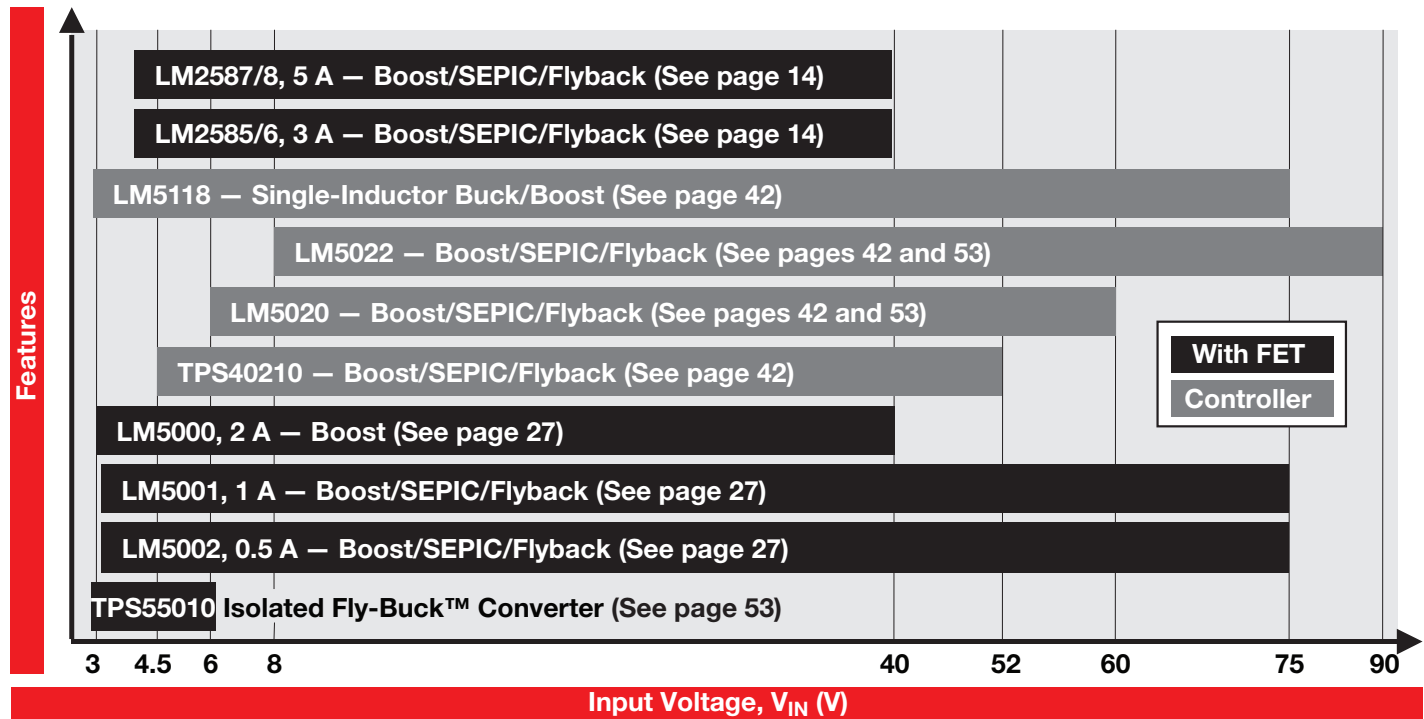
Selection Guide (Continued)

Device ¹	Input Bus Voltage	Description	P _{OUT} or I _{OUT}	V _O Range (V)	V _O Adj.	Auto-Track™ Sequencing	POLA™	DDR-QDR	Price*
Non-Isolated Single Positive Output (Continued)									
PTV05010W	5 V	5-V Input 8-A Vertical SIP with Auto-Track Sequencing	8 A	0.8 to 3.6	✓	✓	✓		6.90
PTV05020W	5 V	5-V Input 18-A Vertical SIP with Auto-Track Sequencing	18 A	0.8 to 3.6	✓	✓	✓		11.60
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	✓	✓			36.00
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	✓	✓	✓		6.90
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	✓	✓	✓		11.60
Non-Isolated Single Negative Output									
PTN04050A	3.3 V/5 V	3-V to 5-V Input, 6-W Positive to Negative (Buck-Boost) ISR	6 W	–3.3 to –15	✓				8.00
PTN78000A	7 to 29 V	Wide-Input, Wide-Output 1.5-A Positive to Negative (Buck-Boost) ISR	1.5 A	–3 to –15	✓				8.00
PTN78060A	9 to 29 V	Wide-Input, Wide-Output 15-W Positive to Negative (Buck-Boost) ISR	15 W	–3 to –15	✓				11.00
PTN78020A	9 to 29 V	Wide-Input, Wide-Output 25-W Positive to Negative (Buck-Boost) ISR	25 W	–3 to –15	✓				15.00

¹See power.ti.com for a complete product offering.

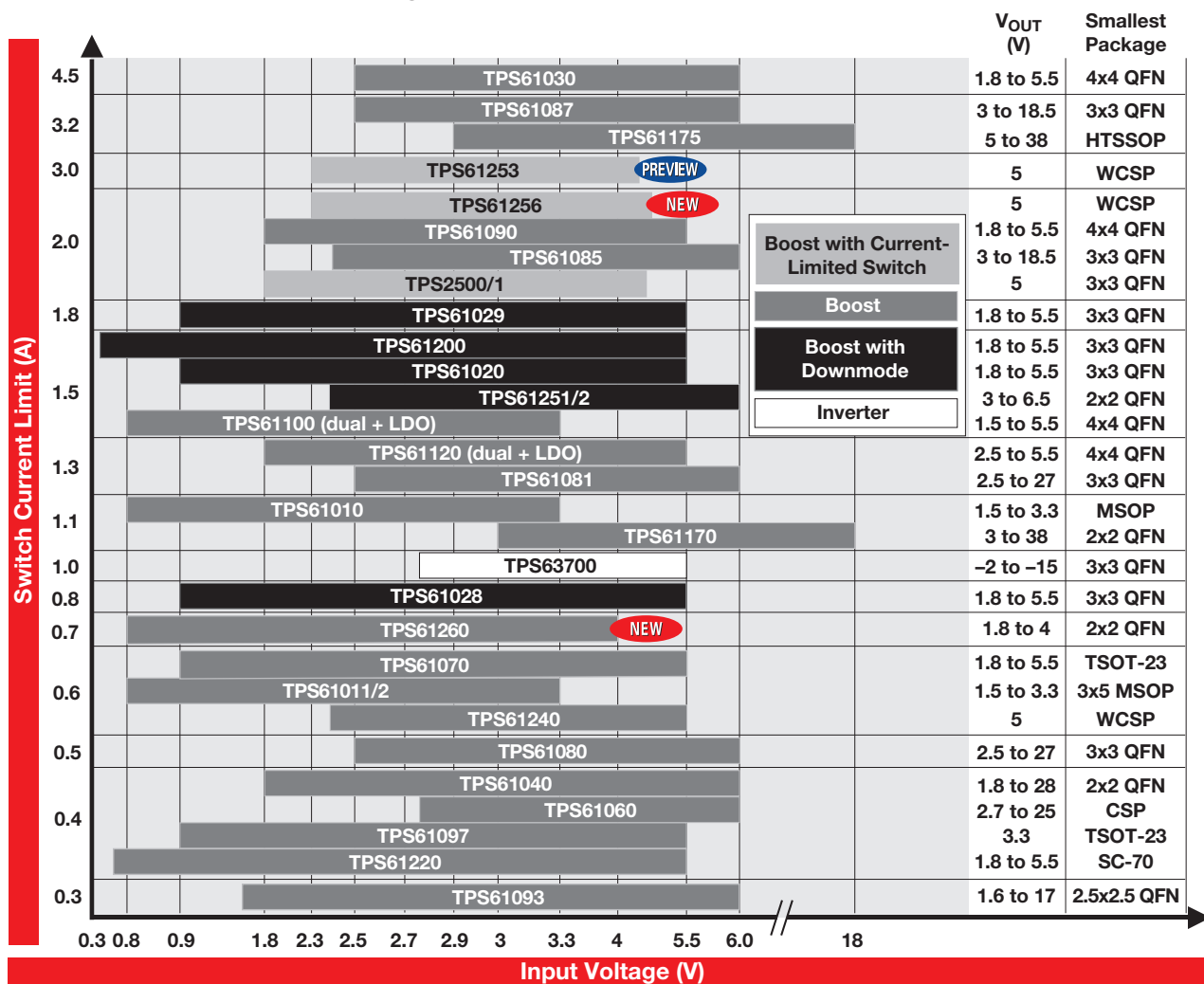
*Suggested resale price in U.S. dollars in quantities of 1,000.

Wide V_{IN} DC/DC Controllers and Converters Other Topology (Boost, Buck/Boost, SEPIC, etc.)



→ Step-Up (Boost) Converters

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



3.5-MHz, 1.5-A Current Limit, 92% Efficient Boost Converter for Battery-Backup Charging

TPS61251

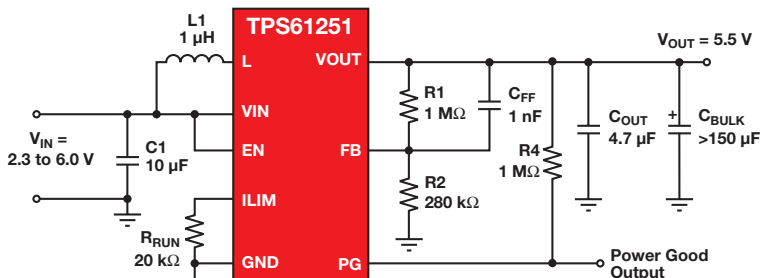
NEW

Get samples, datasheets and evaluation modules at: www.ti.com/product/TPS61251

The TPS61251 is a boost converter with a programmable average-input current limit that will protect the input and avoid overload. The device implements an enhanced Power Save mode, called snooze mode, with very low quiescent current. It features load disconnect to avoid any return path for the current when the device is shut down.

Key Features

- Resistor-programmable input-current-limit protection:
 - $\pm 10\%$ current accuracy at 500 mA over full temperature range
 - Programmable from 100 mA up to 1500 mA
- Snooze mode draws only 2 μ A of quiescent current (typical)
- Designed to charge large capacitor values in the farad range
- V_{IN} range from 2.3 to 6.0 V
- Adjustable output voltage up to 6.5 V
- 100% duty-cycle mode when V_{IN} > V_{OUT}
- Load disconnect and reverse-current protection
- Available in a 2x2-mm QFN-8 package



TPS61251 typical application.

Point-of-Load Solutions

→ Step-Up (Boost) Converters

Selection Guide

Device	I _{OUT} (mA) ¹	Switch Current Limit (typ) (mA)	V _{IN} (V)	V _{OUT} Adj. (V)	V _{OUT} Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Integrated LDO I _{OUT} (mA)/V _{OUT} (V)	Low Battery	Power Good	By Pass	Undervoltage Lockout	Thermal and/or Short-Circuit Protection	Package(s)					EVM	HiRel (H) or Automotive (A) [†]	Price*
																	WCSP (Chip scale)	SOT-23	MSOP	QFN/LLP	TSSOP			
Step-Up Regulators — Up to 6-A Switch Limit																								
TPS61220/21/22	50	400	0.7 to 5.5	1.8 to 5.5	3.3/5	95	—	4.7	5.5	0.2	—				✓	✓					✓		0.65	
TPS61041	50	250	1.8 to 6.0	V _{IN} to 28	—	87	1000	10	28	0.1	—				✓	✓		5			✓	A	0.65	
TPS61040	90	400	1.8 to 6.0	V _{IN} to 28	—	87	1000	10	28	0.1	—				✓	✓		5			✓	A	0.70	
TPS61011/2/3	100	480/560/930	0.8 to 3.3	—	1.5/1.8/2.5	95	500	10	36	1	—	✓			✓	✓			10				1.10	
TPS61260/61	100	700	0.8 to 4.0	1.8 to 4.0	3.3	95	2.3	4.7	29	0.1	—				✓	✓				6		✓	0.70	
TL497A	—	500	4.5 to 12	(V _{IN} + 2) to 30	—	85	—	—	11 mA	6000	—									14	14		0.90	
TPS61097-33	150	350	0.9 to 5.5	—	3.3	90	—	10	4	0.005	—				✓	✓		5		6			0.75	
TPS61080	—	500	2.5 to 6.0	V _{IN} to 27	—	87	1200	4.7	—	—	—					✓				10		✓	1.35	
TPS61014/5/6	200	1000/1100/1130	0.8 to 3.3	—	2.8/3/3.3	95	500	10	36	1	—	✓			✓	✓			10				1.10	
TPS61010	200	1130	0.8 to 3.3	1.5 to 3.3	—	95	500	10	36	1	—	✓			✓	✓			10			✓	1.10	
TPS61028	200	800	0.9 to 5.5	1.8 to 5.5	—	96	720	6.8	25	0.1	—	✓			✓	✓			10			✓	0.85	
TPS61070/1/2/3	250	700	0.9 to 5.5	1.8 to 5.5	—	90	1200 ²	4.7	19	1	—				✓	✓		6				A	0.80	
TPS61093	300	1100 ³	1.6 to 6	V _{IN} to 17	—	88	1200	10	0.9 mA	1	—				✓	✓				10		✓	1.30	
TPS61081	450	1200	2.5 to 6.0	V _{IN} to 27	—	87	1200	4.7	—	—	—					✓				6		✓	1.45	
TPS61240/41	450	600/700	2.3 to 5.5	—	5	90	3500	1	30	1.5	—				✓	✓	6			6		✓	A	0.80
TPS61170	500	1200	3.0 to 18	V _{IN} to 38	—	93	1200	10	—	1	—				✓	✓							1.40	
TPS61020	500	1500	0.9 to 5.5	1.8 to 5.5	—	96	720	6.8	25	0.1	—	✓			✓	✓				10		✓	0.95	
TPS61024/5/7	500	1500	0.9 to 5.5	1.8 to 5.5	3/3.3/5	96	720	6.8	25	0.1	—	✓			✓	✓				10			0.95	
TPS61251	500	1500	2.3 to 6	3 to 6	—	92	3500	1	30	0.85	—		✓		✓	✓				8		✓	1.60	
TPS61252	500	1500	2.3 to 6	3 to 6	—	92	3500	1	30	0.85	—		✓		✓	✓				8		✓	1.25	
LM5002	500	—	3.1 to 75	1.26 and up	—	95	1500	330	3100	95	—				✓	✓				8	8		1.70	
TPS61026/9	600	1800	0.9 to 5.5	1.8 to 5.5	—	96	720	6.8	25	0.1	—	✓			✓	✓				10		✓	A	1.10
TPS61090	700	2200	1.8 to 5.5	1.8 to 5.5	—	96	600	6.8	20	0.1	—	✓			✓	✓				16		✓	1.70	
TPS61091/2	700	2000	1.8 to 5.5	—	3.3/5	96	600	6.8	20	0.1	—	✓			✓	✓				16			1.70	
MC34063A	750	1500	3 to 40	3 to 39.5	—	—	100	—	—	1	—				✓	✓				8	8	✓	0.21	
TPS61200/1/2	800	1500	0.3 to 5.5	0 to V _{IN}	3.3/5	90	1250	2.2	50	1	—				✓	✓				10		✓	0.95	
TPS61254/6	1000	2150	2.5 to 4.35/4.85	—	4.5/5	93	3500	1	22	0.85	—			✓	✓	✓	9					✓	1.60	
TPS61030/1/2	1000	4500	1.8 to 5.5	1.8 to 5.5	3.3/5	96	600	6.8	20	0.1	—	✓			✓	✓				16	16	✓	2.10	
LM5001	1000	—	3.1 to 75	1.26 and up	—	96	1500	100	3100	95	—				✓	✓				8	8	✓	1.85	
LM27313	1000	—	2.7 to 14	V _{IN} to 28	—	90	1600	10	2100	—	—					✓		5				A	0.61	
LM2733	1000	—	2.7 to 14	V _{IN} to 40	—	90	1600	10	2100	—	—					✓		5				✓	1.04	
LM4510	1200	—	2.7 to 5.5	V _{IN} to 18	—	85	1000	4.7	1700	—	—				✓	✓				10		✓	1.80	
TPS61175	1300	3800	2.9 to 18	V _{IN} to 38	—	95	2200	10	—	<1.5	—				✓	✓					14	✓	1.80	
LM2698	1350	—	2.7 to 12	V _{IN} to 17	—	94	1250	10	1300	—	—					✓			8			✓	1.83	
TPS61253	1500	3150	2.5 to 4.5	—	5	93	3500	1	22	0.85	—			✓	✓	✓	9					✓	TBD	
LM2731	1500	—	2.7 to 14	V _{IN} to 22	—	90	1600	10	2000	—	—					✓		5				✓	1.08	
LM2622	1600	—	2 to 12	V _{IN} to 18	—	90	1300	10	1300	—	—					✓			8				0.91	
LM5000	2000	—	3.1 to 40	1.26 and up	—	90	1300	33	2000	18	—				✓	✓				16	16	✓	2.00	
LM3310	2000	—	2.5 to 7	V _{IN} to 20	—	93	1280	10	3100	—	—				✓	✓				24			1.38	
LM3311	2000	—	2.5 to 7	V _{IN} to 20	—	93	1280	10	3100	—	—				✓	✓				24			1.38	

¹For boost converters, max. I_{OUT} can be estimated with 0.65 × switch limit × (V_{IN}/V_{OUT}).

²PWM/PFM (TPS61070); PWM only (TPS61071).

³Output current is limited to 300 mA.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available. Certain voltage options are not available. Different pricing may apply.

*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 blue.

Point-of-Load Solutions

➔ Step-Up (Boost) Converters

Selection Guide (Continued)

Device	I _{OUT} (mA) ¹	Switch Current Limit (typ) (mA)	V _{IN} (V)	V _{OUT} Adj. (V)	V _{OUT} Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Integrated LDO I _{OUT} (mA)/V _{OUT} (V)	Low Battery	Power Good	By Pass	Undervoltage Lockout	Thermal and/or Short-Circuit Protection	Package(s)						EVM	HiRel (H) or Automotive (A) [†]	Price*
																	WCSP (Chip scale)	SOT-23	MSOP	QFN/LLP	TSSOP	SOIC			
Step-Up Regulators — Up to 6-A Switch Limit (Continued)																									
LM2623	2200/1200	—	0.8 to 14	1.24 to 14	—	90	2000	4.7	80	—	—					✓			8	14			✓		1.09
LM2735	2250	—	2.7 to 5.5	V _{IN} to 24	—	90	1600	15	3400	—	—					✓		5	8	6			✓	A	1.25
LM3224	2600	—	2.7 to 7	V _{IN} to 20	—	90	1250	10	1300	—	—					✓			8				✓		1.10
LM2700	3600	—	2.2 to 12	1.26 to 17.5	—	92	1250	4.7	1300	—	—					✓				14	14		✓		1.71
Step-Up (Boost) Regulators with Integrated LDO (Dual Output)																									
TL499A	100	—	1.1 to 10	2.9 to 30	—	85	—	—	—	15	100/Adj.											8			1.20
TPS61100	200	1500	0.8 to 3.3	1.5 to 5.5	—	95	500	10	65	0.5	120/Adj.	✓	✓		✓	✓				24	20		✓		1.50
TPS61103/6/7	200	1500	0.8 to 3.3	—	3.3/3.3/3.3	95	500	10	65	0.5	120/Adj., 1.5, 1.8	✓	✓		✓	✓				24	20				1.50
TPS61120	500	1300	1.8 to 5.5	2.5 to 5.5	—	95	500	10	40	0.2	200/Adj.	✓	✓		✓	✓				16	16		✓		1.65
TPS61121/2	500	1300	1.8 to 5.5	—	3.3/3.6	95	500	10	40	0.2	200/1.5, 3.3	✓	✓		✓	✓				16	16				1.65
Inverting Regulators																									
TL497A	—	500	4.5 to 12	−1.2 to −25	—	85	—	—	11 mA	6000	—									14	14				0.90
TPS63700	360	1000	2.7 to 5.5	−2 to −15	—	84	1400	4.7	—	0.014	—								10			✓			1.30
MC34063A	750	1500	3 to 38	−1.25 to −36.3	—	—	100	—	0.330 mA	—	—				✓	✓			8		8	✓			0.21

¹For boost converters, max. I_{OUT} can be estimated with 0.65 × switch limit × (V_{IN}/V_{OUT}).

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³Output current is limited to 300 mA.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available. Certain voltage options are not available. Different pricing may apply.

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

→ Buck-Boost Converters

12-V Input Voltage, Efficient, Small, Buck-Boost Converter with 2-A Switch

TPS63060

Get samples and datasheets at: www.ti.com/product/TPS63060

The TPS63060 is a very small high-performance buck-boost converter with up to 12-V input voltage. The device features a 2-A switch and reaches up to 93% efficiency. The buck-boost device operates with a wide input-voltage range and supports power from a three- to six-cell alkaline, NiCd or NiMH battery pack, or a one- or two-cell Li-Ion or Li-polymer battery pack.

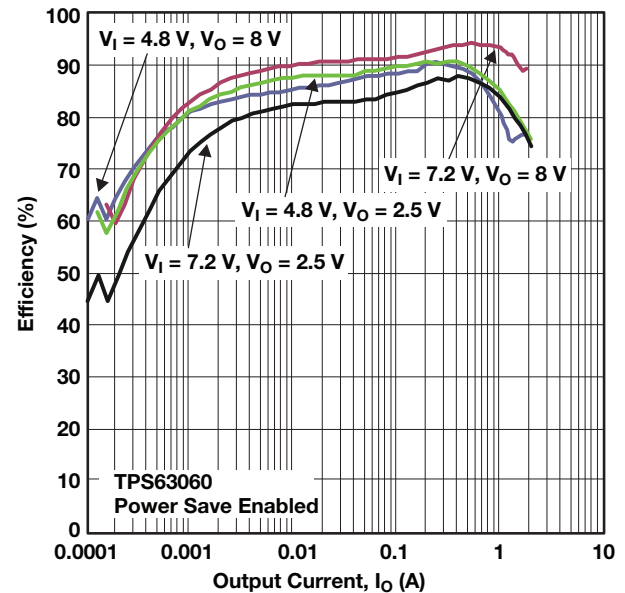
The single inductor, 2.4-MHz TPS63020 converter comes in a 3x3-mm package and can achieve a complete DC/DC converter solution that is smaller than competing devices.

Key Features

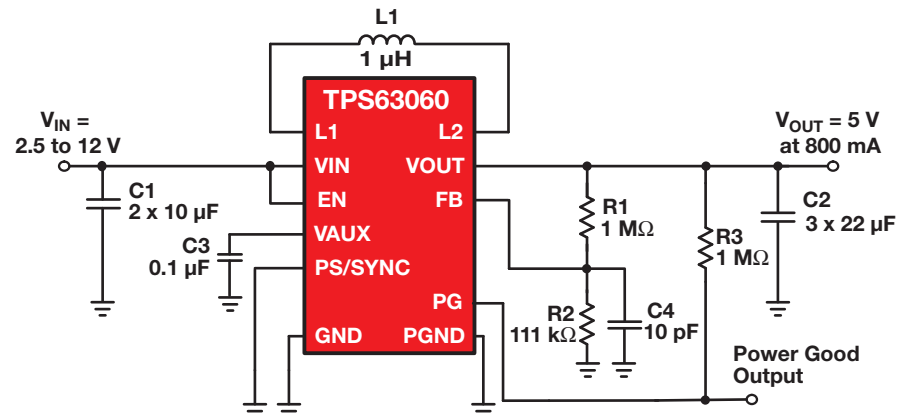
- High output current with 2-A output current at 5 V in step-down mode ($V_{IN} < 10$ V) and 1.3-A output current at 5 V in boost mode ($V_{IN} > 4$ V)
- Automatic transition between step-down and boost mode
- Power-save mode at low output power with $I_Q < 40$ μ A
- 2.4-MHz switching frequency, externally synchronizable ($\pm 20\%$)
- Load disconnect during shutdown
- Power Good

Applications

- Dual Li-Ion application
- DSCs and camcorders
- Industrial metering equipment
- Ultra-mobile PCs and mobile internet devices
- Personal medical products



Typical TPS63060 efficiency with power save enabled.



TPS63060 typical application.

Selection Guide

Device	I_{OUT} (mA)	Switch-Current Limit (typ) (mA)	V_{IN} (V)	V_{OUT} Adj. (V)	V_{OUT} Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (μ H)	Quiescent Current (typ) (μ A)	Shutdown Current (typ) (μ A)	Integrated LDO I_{LDO} (mA)/ V_{OUT} (V)	Low Battery	Power Good	Undervoltage Lockout	Thermal and/or Short-Circuit Protection	Package(s)			HiRel (H) or Automotive (A) [†]	Price*
																WCSP (Chip scale)	QFN	TSSOP		
TPS61130	300	1300	1.8 to 5.5	2.5 to 5.5	—	90	500	10	40	0.2	200/Adj.	✓	✓	✓	✓	16	16	✓		1.55
TPS61131/2	300	1300	1.8 to 5.5	—	3.3/3.3	90	500	10	40	0.2	200/1.5, 3.3	✓	✓	✓	✓	16	16			1.55
TPS63030/31	800	1000	1.8 to 5.5	1.2 to 5.5	3.3	96	2400	1.5	25	0.1	—			✓	✓	10		✓		1.20
LM3668	1000	1850	2.5 to 5.5	2.8 to 5.0	—	96	2200	2.2	45	0.01	—				✓	12		✓		2.25
TPS63000/1/2	1200	1800	1.8 to 5.5	1.2 to 5.5	3.3/5.0	90	1400	2.2	30	0.1	—			✓	✓	10		✓	A	1.50
TPS63010/11/12	1200	2200	2 to 5.5	1.2 to 5.5	3.3/3.4/2.8/2.9	96	2400	1.5	30	0.1	—			✓	✓	20		✓		1.50
TPS63060/1	1200	1800	2.5 to 8	2.5 to 12	5	93	2400	2.2	30	—	—	✓	✓	✓	✓	10				1.40
TPS63020	3000	4000	1.8 to 5.5	1.2 to 5.5	3.3	96	2400	1.5	30	0.1	—	✓	✓	✓	✓	14		✓		2.50

[†] Devices qualified for HiRel (H) or Automotive (A) applications are available. Certain voltage options are not available. Different pricing may apply.

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

New devices are listed in bold red.

→ Linear and Low Dropout (LDO) Regulators

New Wide- V_{IN} Linear Regulators Remove Switching Noise

TPS7A3001 and TPS7A4901

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS7A3001 or [TPS7A4901](http://www.ti.com/product/TPS7A4901)

The waveforms show two examples of connecting an LDO to the output of a switching DC/DC converter with magnetics, which improves the ripple voltage by removing inherent switching noise. The voltage can now be used in noise-sensitive applications to greatly increase the performance of analog sensing circuitry.

The wide-input-voltage TPS54060 DC/DC converter shown in the block diagram is configured in an inverting buck/boost

topology with an off-the-shelf coupled inductor to generate a positive and negative output voltage. Linear regulators TPS7A4901 and TPS7A3001 provide clean positive and negative power to highly noise-sensitive analog circuitry.

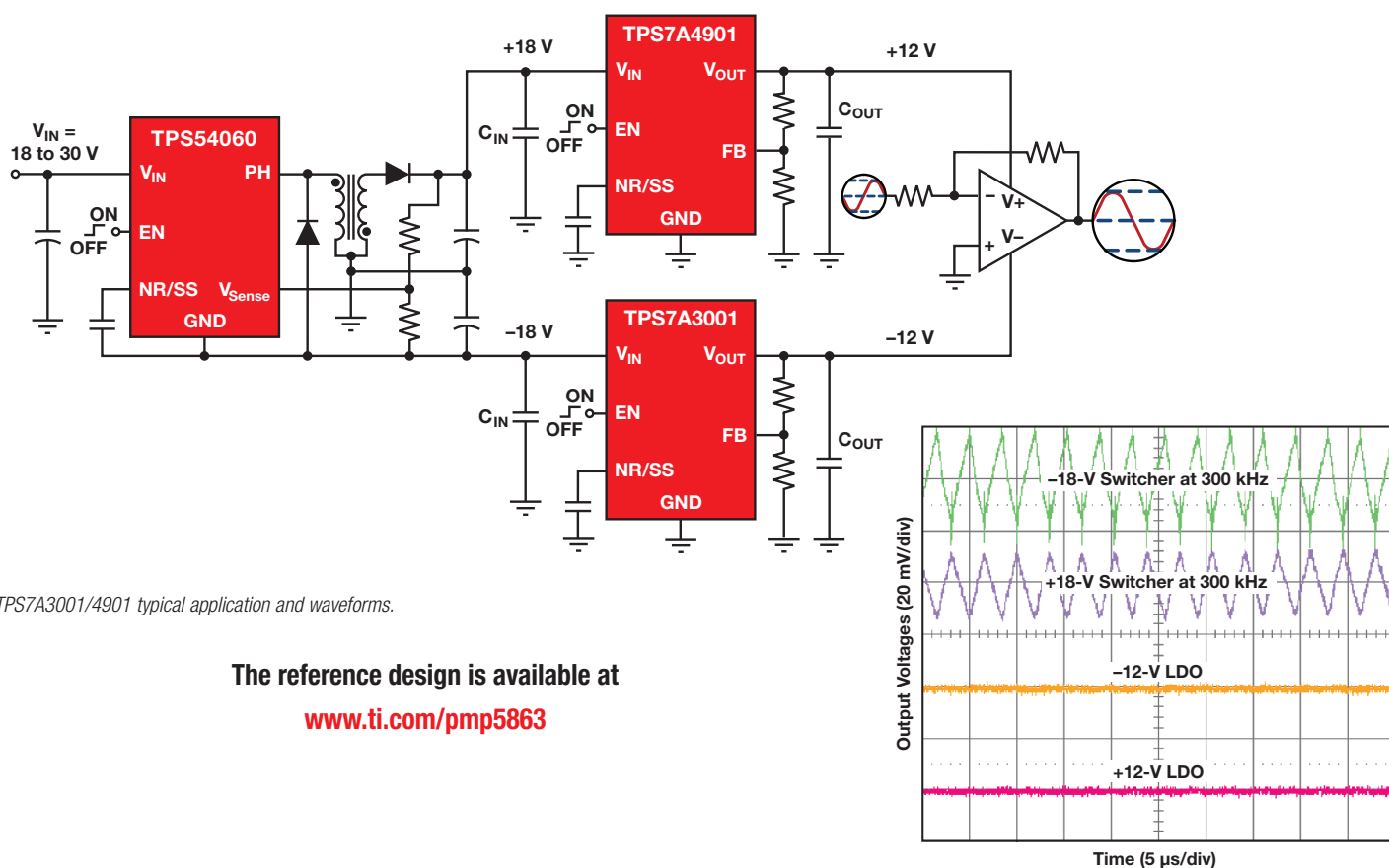
Key Features

- Wide input voltages:
 - TPS7A3001: -3.0 to -36 V
 - TPS7A4901: $+3.0$ to $+36$ V
- 1.5% nominal accuracy
- Stable with >2.2 - μ F ceramic output capacitor

- Low noise/high PSRR:
 - Output noise as low as $16 \mu V_{RMS}$
 - PSRR of 72 dB at 1 kHz and 55 dB at 10 to 700 kHz

Key Benefits

- Better precision for VCOs, PLLs and ADCs
- Smaller size and lower cost than tantalums
- Improved dynamic range in RF applications, filters and handling DC/DC spikes



TPS7A3001/4901 typical application and waveforms.

The reference design is available at

www.ti.com/pmp5863

For more information about linear and LDO regulators, visit:

www.ti.com/lldo

Point-of-Load Solutions

→ Linear and Low Dropout (LDO) Regulators

Ultra-Low Noise, 150-mA Linear Regulator for RF/Analog Circuits

LP5900

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/LP5900

The LP5900 is a linear regulator capable of supplying 150-mA output current. Designed to meet the requirements of RF/analog circuits, the LP5900 device provides low noise, high PSRR, low quiescent current, and low line transient response figures. Using new innovative design techniques the LP5900 offers class-leading device noise performance without a noise bypass capacitor.

The device is designed to work with 0.47- μ F input and output ceramic capacitors. (No bypass capacitor is required) The device is available in Micro SMD package and LLP[®] package. Also available in Exte Thin Micro SMD package.

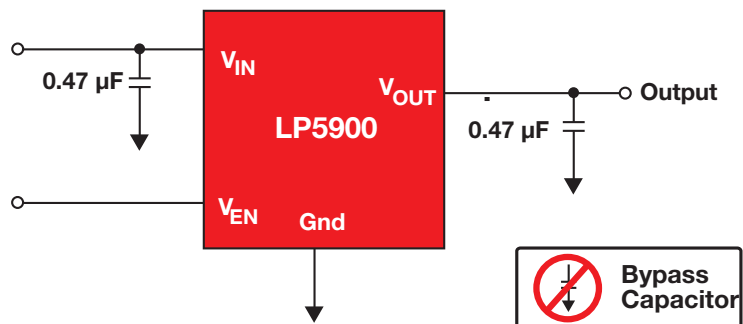
Key Features

- Stable with 0.47- μ F ceramic input and output capacitors
- No noise bypass capacitor required
- Logic controlled enable
- Thermal-overload and short-circuit protection

- -40°C to $+125^{\circ}\text{C}$ junction temperature range for operation

Applications

- Cellular phones
- PDA handsets
- Wireless LAN devices



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

TPS7A16xx

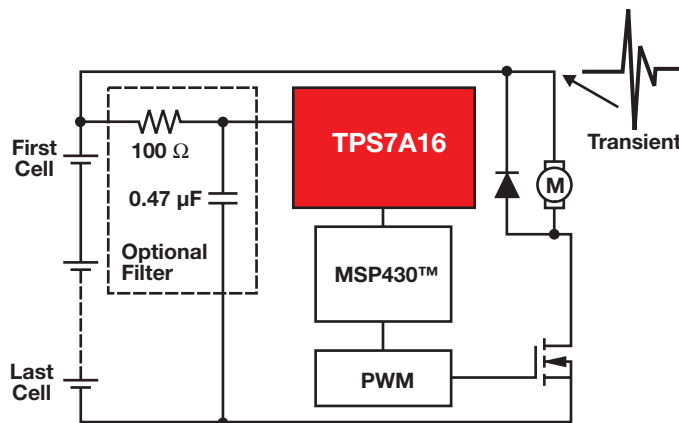
Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS7A1601

Key Features

- V_{IN} : 3 to 60 V
- I_{OUT} : 100 mA
- V_{DO} : 60 mV at 20 mA
- I_Q of 5 μ A
- High- V_{IN} LDO with EN and PG
- MSOP-8 PowerPAD[™] package

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



→ Linear and Low Dropout (LDO) Regulators

Dual LDO Triple SVS Combines Built-In Sequencing for $\pm 5\%$ Power-Rail Accuracy

TPS75005

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS75005

The TPS75005 is a complete power management solution for TI's C2000™ real-time microcontrollers like the TMS320F2833x (Delfino™), F2823x, F281x and F280x. All of these C2000 controllers require $\pm 5\%$ power-rail accuracy. With the combination of high-accuracy LDSs and precision rail monitors (SVSs), the device ensures a $\pm 5\%$ power supply to the C2000 with a power-good (PG) signal.

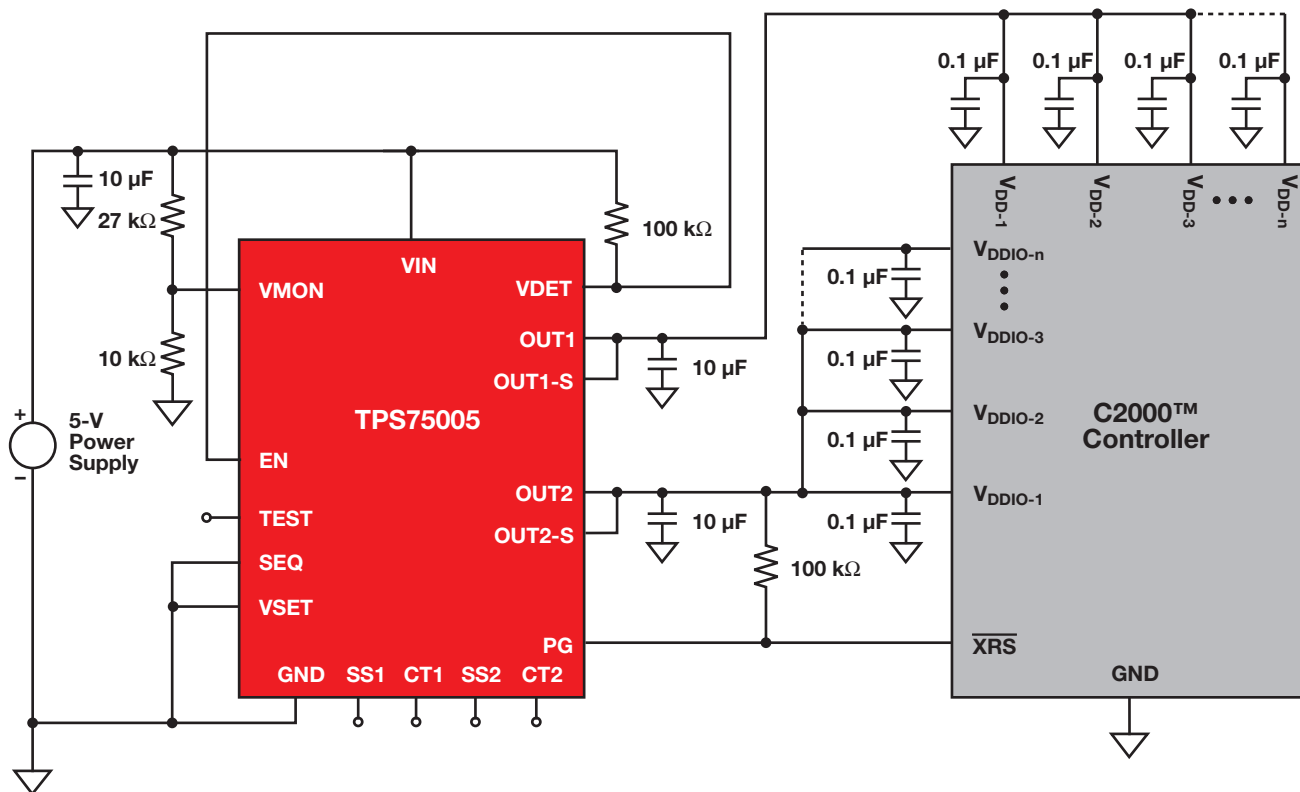
Key Features

- Optimized to supply TI's C2000 MCU series: F2833x (Delfino), F2823x, F281x and F280x/F2801x
- LDO1 and voltage monitor for 1.8 V/ 1.9 V (selectable): $\pm 5\%$ ensured with PG
- LDO2 and voltage monitor for 3.3 V: $\pm 5\%$ ensured with PG
- One general-purpose voltage monitor

- Input voltage range: 3.75 to 6.5 V
- Independent soft start for LDO1 and LDO2
- Preset power-up and power-down sequencing
- Two 10- μ F ceramic output capacitors for C2000
- 5 x 5-mm QFN package

Applications

- Power for C2000 DSP/FPGA/ASIC MCUs



System level application diagram.

→ Linear and Low Dropout (LDO) Regulators

Low Dropout (LDO) Regulators Selection Guide

Device	I _{OUT} (A)	V _{IN} (V)	V _{OUT} (V)	I _Q (μA)	V _{DO} (mV)	Output Noise (μV _{RMS})	PSRR at 1 kHz (dB)	Accuracy (%)	Package(s)	Comments	Price*
Low-Power LDOs											
TPS715A	0.08	2.5 to 24	1.2 to 15	3.2	670	575	60	4	SON	Wide V _{IN}	0.40
TPS782	0.15	2.2 to 5.5	1.8 to 3.3	0.5	130	86	15	3	TSOT23, SON	Ultra-low I _Q	0.25
LP5900	0.15	2.5 to 5.5	1.5 to 4.5	25	80	6.5	75	2	Micro SMD, Extreme Micro SMD, LLP®	Lowest-noise LDO	0.36
TPS717	0.15	2.5 to 6.5	0.9 to 5	45	45	30	70	3	SC70, SON	Wide BW PSRR	0.36
TPS728	0.2	2.2 to 6.5	1.2 to 3.15	50	230	90	65	3	DSBGA, SON	DVS for MSP430™	0.39
LP5904	0.2	2.2 to 5.5	1.2 to 4.4	11	45	6.5	75	2	Micro SMD	Lowest-noise LDO	0.45
TLV710	0.2	2 to 5.5	1.2 to 4.8	35	140	48	70	2	WSON	Dual LDO	0.32
TLV711	0.2	2 to 5.5	1.2 to 4.8	30	175	48	70	2	6WSON	Dual LDO, high PSRR	0.32
TLV700	0.2	2 to 5.5	1.2 to 4.8	31	43	48	68	2	SON, SOT23, SC70	Value line	0.13
TPS727	0.25	2 to 5.5	0.9 to 5	7.9	65	30	70	2	WCS, SON	Wide BW PSRR	0.48
TLV712	0.3	2 to 5.5	0.7 to 1.15	35	260	30	68	2	SOT23, SON	Value line	0.15
TLV702	0.3	2 to 5.5	1.2 to 4.8	30	220	48	68	2	5SOT-23, 6WSON	Low I _Q	0.14
TPS720	0.35	1.1 to 4.5	1 to 1.8	38	110	48	85	2	DIP, TSSOP, SOIC	V _{BIAS} LDO	0.65
High-Power LDOs											
LM2936HV	0.05	3.3 to 60	3, 3.3, 5	15	200	600	60	2	T0252, SOT223, PSOP	–50 V tolerant	0.73
TPS7A40	0.05	7 to 100	1.17 to 90	25.0	290	58.0	65.0	1.5	MSOP	100-V V _{IN}	1.05
TPS7A16	0.10	3 to 60	1.2 to 18.5	5	60	—	50	2	MSOP	Ultra-low I _Q (5 μA)	1.40
TPS7A49	0.15	3 to 36	1.19 to 33	61	260	12.7	72	1.5	MSOP	Power for PA (high PSRR and low noise)	1.10
LM9076	0.15	3.3 to 40	3.3 to 5	25	200	—	60	1.5	T0263, S08	+70 V/–50 V voltage transients	0.95
TPS7A30	0.2	–3 to –36	–1.8 to –33	55	216	14	72	1.5	MSOP	Power for PA (high PSRR and low noise)	1.50
TPS732	0.2	1.7 to 5.5	1.2 to 5.5	400	40	16.15	37	1	SON, SOT23	Solution for C2000™	0.49
TPS734	0.25	2.7 to 6.5	1.2 to 6.2	44	125	28	56	2	SOT, SON	Solution for C2000	0.35
TPS736	0.4	1.7 to 5.5	1.2 to 5.5	300	75	30	37	1	6SOT223, 5SOT23, 8SON	Cap-free, reverse-current protection	0.80
LP2992	0.25	2.2 to 16	1.5 to 5.5	65	450	30	45	1	SOT23, LLP	Low noise	0.41
TPS735	0.5	2.7 to 6.5	1.25 to 6	46	280	28	56	2	6SON, 8SON	Low I _Q , high PSRR	0.70
TPS75005	0.5	4 to 6.5	1.8 to 3.3	175	—	TBD	TBD	5	QFN	Solution for C2000 2 LDO and 3 SVS	1.90
LP2989/LV	0.5	2.1 to 16	1.5 to 5	110	310	18	60	0.75	LLP, SOIC	Low noise	0.94
TPS747	0.5	0.8 to 5.5	0.8 to 3.6	1000	50	200	50	2	SON, SOT23	SS and PG	0.75
LP38693	0.5	2.7 to 10	1.25 to 9	55	250	—	55	2	T0252, SOT223	Wide V _{IN}	0.53
LP38691	0.5	2.7 to 10	1.25 to 9	55	250	—	55	2	T0252, SOT223, LLP	Wide V _{IN} , low I _Q	0.53
LP38511	0.8	2.2 to 5.5	0.5 to 4.5	2000	250	25	73	2	PSOP, T0263 Thin	Fast transient response	0.60
LP3878-ADJ	0.8	2.5 to 16	1 to 5.5	180	150	18	60	2	LLP, PSOP	Low noise	0.85
LP38692	1	2.7 to 10	1.25 to 9	55	450	—	55	2.5	LLP, T0252, SOT223	Wide V _{IN} , low I _Q , with enable	0.55
LP38690	1	2.7 to 10	1.25 to 9	55	450	—	55	2.5	T0252, SOT223, LLP	Wide V _{IN} , low I _Q	0.55
LM2990	1	–26	–5, –5.2 –12, –15	50	600	250	50	5	3T0220, 3T0263, 16TSSOP, 16CERDIP	Fixed output voltages –5, –5.2, –12, –15 V	1.35
LM2991	1	–26	–3 to –24	50	600	200	50	2	5T0220, 16TSSOP, 5T0223, 16CERDIP	Shutdown pin	1.35
TPS7A81	1	2.2 to 6.5	0.8 to 6.0	60	170	12.48	63	2.5	SON	Wide BW high PSRR (up to 10 MHz)	1.00
TPS7A33	1	–3 to –36	–1.18 to –33	210	290	16	72	1.5	7T0220	Ultra-low noise	3.00
TLV1117LV	1	2 to 5.5	1.2 to 4.5	50	115	60	65	0.4	DDPAK, T0263, PFM, T0220, SOT223, SON	Value line	0.29
TPS7A45	1.5	2.1 to 20	1.21 to 20	1000	300	35	68	1	DDPAK, T0263, SOT223	High-current wide V _{IN}	1.30
TPS748	1.5	0.8 to 5.5	0.8 to 3.6	1000	60	20	60	2	10SON, 20VQFN	Programmable soft start	0.85
TPS740	1.5	1.2 to 5.5	0.9 to 3.6	2000	100	—	—	2	VSON, MSOP	V _{BIAS} LDO	1.50
LP38512	1.5	2.2 to 5.5	0.5 to 5	2000	300	25	70	2.5	PSOP, T0263 Thin	Fast transient response	0.75
LP38500	1.5	2.7 to 5.5	0.6 to 5.1	2000	220	100	58	1.5	QFN, T0263 Thin	FlexCap	0.70
LP38502	1.5	2.7 to 5.5	0.6 to 5.1	2000	220	100	56	1.5	LLP8, T0263 Thin	FlexCap	0.70
LP38501	3	2.7 to 5.5	0.6 to 5	2000	420	100	56	1.5	T0263 Thin	FlexCap	0.95
LP38503	3	2.7 to 5.5	0.6 to 5	2000	420	100	56	1.5	T0263	FlexCap	0.95
TPS744	3	0.8 to 5.5	0.8 to 3.6	3000	115	12.8	73	1	QFN, DDPK	V _{BIAS} LDO with SS	2.00
TPS749	3	0.8 to 5.5	0.8 to 3.6	3000	120	20	60	2	20VQFN, 7DDPAK	Programmable soft start	1.50
LP38513	3	2.2 to 5.5	0.5 to 5	2000	425	25	70	2	PSOP, T0263 Thin	Fast transient response	1.00

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

New devices are listed in bold red.

Point-of-Load Solutions

➔ Linear and Low Dropout (LDO) Regulators

Dual Output LDOs Selection Guide

Device	I _{O1} (mA)	I _{O2} (mA)	V _{DO1} at I _{O1} (mV)	V _{DO2} at I _{O2} (mV)	I _O (μA)	Output Options		Adj.	Accuracy (%)	Package(s)	V _O		Features							Comments	Price*	
						Fixed Voltage (V)	Accuracy (%)				(min) (V)	(max) (V)	Enable	PG	SVS	Seq	Low Noise	V _{IN}				C _O ¹
																		(min) (V)	(max) (V)			
TPS51103	100	100	400	400	35	3.3/5.0	—	2	QFN	—	—	EN					4.5	28	100 μF, C	250-kHz clock output for charge pump, always-on 3.3-V, 5-mA LDO output for RTC	1.00	
LP2967	200	200	240	240	200	1.8/2.5, 1.8/3.3, 2.5/2.8, 2.5/3.3, 2.6/2.6, 2.8/2.8	—	1.25	Mini-SO8, Micro SMD	1.8	3.3	EN			✓		16	2.2 μF, C			1.24	
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	—	1	Mini-SO8	1.8	5	EN	✓		✓		7	1 μF, C			0.79	
LP3996	150	300	110	210	35	0.8 to 3.3	✓		LLP10			EN				2	6			Power-on reset	0.50	
LP5996	150	300	110	210	35	0.8 to 3.3	✓		LLP10			EN				2	6				0.40	
LP8900	200	200	110	110	35	1.2 to 3.6	✓	1	WCSP			EN				1.8	5.5	1.0 μF			0.31	
TLV710	200	200	175	175	70	1.8/2.8	—	2	SON 6	1.2	4.8	EN			✓	2.0	5.5	1.0 μF, C	Value-priced dual LDO		0.33	
TLV711	200	200	175	175	70	3.3/3.3	—	2	SON 6	1.2	4.8	EN			✓	2.0	5.5	1.0 μF, C	TLV710xx w/ active output pulldown		0.33	
TPS719xx	200	200	230	230	100	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 See Note 2	—	3	QFN/WCSP	0.9	3.6	EN			✓	2.5	6.5	1.0 μF	TPS718xx w/ active output pulldown		0.55	
TPS718xx	200	200	230	230	100	1.2/3.3, 1.8/2.7, 1.8/3.3, 2.5/1.2, 2.8/2.8, 2.8/3.0 See Note 2	—	3	QFN/WCSP	0.9	3.6	EN			✓	2.5	6.5	1.0 μF	High PSRR, low V _{OUT}		0.55	
TPS712xx	250	250	145	145	400	1.8/2.85, 1.8/Adj., 2.8/2.8, 2.8/Adj., 2.85/2.85	✓	2	QFN	1.2	5.5	EN			✓	2.7	5.5	2.2 μF, C			0.80	
TPS713xx	250	250	145	145	400	3.3/Adj., 1.8/Adj.	✓	2	QFN	1.2	5.5	EN		✓		✓	2.7	5.5	2.2 μF, C	Integrated SVS		0.90
TPS707xx	250	150	83	125	187	See Web	✓	2	PWP	1.2	5	EN	✓	✓	✓	✓	2.7	5.5	10 μF, T	See TPS708xx ³		1.20
TPS701xx	500	250	170	220	187	See Web	✓	2	PWP	1.2	5	EN	✓	✓	✓	✓	2.7	5.5	10 μF, T	See TPS702xx ³		1.50
TPS767D3xx	1000	1000	350	350	85	3.3/2.5, 3.3/1.8	✓	2	PWP	1.5	5.5	EN		✓		2.7	10	10 μF, T	Dual-output fast LDO with integrated SVS		2.00	
TPS703xx	1000	2000	160	190	185	See Web	✓	2	PWP	1.2	5.5	EN	✓	✓	✓	✓	2.7	5.5	22 μF, T	See TPS704xx ³		2.35
TPPM0110/1	1500	300	1000	2500	1000	3.3/1.8, 3.3/1.5	—	2	—	1.8	3.3	—				4.7	5.3	100 μF, T	See TPPM0111 for 3.3-V/1.5-V output		1.60	

¹C = ceramic, T = tantalum.

²EEPROM programmable at the factory, allowing production of custom fixed voltages. Minimum quantities apply. Please contact TI.

³For independent enables instead of integrated sequencing.

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

Standard Linear Voltage Regulators Selection Guide

Device	V _{IN}		I _{OUT} (max) (mA)	V _{OUT} (nom) (V)	Price*
	MIN (V)	MAX (V)			
LM237, LM337	−4.2	−40	1500	Adj. (−1.2 to −37)	0.29
LM317, LM317M	4.2	40	1500, 500	Adj. (1.2 to 37)	0.27
MC79Lxx/A	−7	−20	100	−5, −12, −15	0.13
TL317/L/M	4.2	40	1500/100/500	Adj. (1.2 to 35)	0.14
TL780-xx	7	25	1500	5, 12, 15	0.32
TL783	21.5	125	700	Adj. (1.25 to 125)	1.15
UA723	5	40	150	Adj. (2 to 37)	0.29
UA78Lxx/A	4.75	20	100	2.6, 5, 6.2, 8, 9, 10, 12, 15	0.11
UA78Mxx	7	25	500	3.3, 5, 6, 8, 9, 12	0.25
UA78xx	7	25	1500	5, 8, 10, 12, 15, 24	0.23
UA79xx	−7	−25	1500	−5, −8, −12, −15	0.25
UA79Mxx	−10.5	−25	500	−5, −8	0.25

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

➔ Multi-Output Power Management Units

Processor PMU with Integrated DC/DC Controller

TPS65911x

Get samples and datasheets at: www.ti.com/product/TPS659110

The TPS65911x is an integrated power-management IC that is dedicated to applications that require multiple power rails. The device provides three step-down converters, one controller for external FETs to support a high current rail, and eight LDOs, and is designed to be a flexible PMU for supporting different processors and applications.

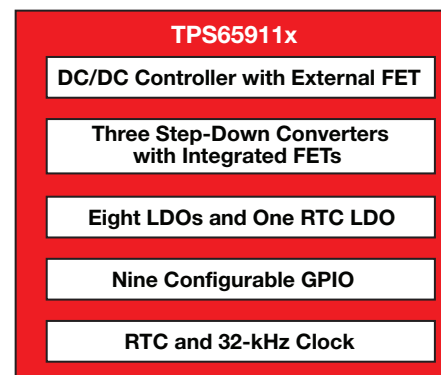
Key Features

- Embedded power controller (EPC)
- Two efficient step-down DC/DC converters for processor cores (VDD1, VDD2)
- One efficient step-down DC/DC converter for I/O power (VIO)
- One controller for external FETs

- Dynamic voltage scaling for processor cores
- Eight LDO voltage regulators and one RTC LDO
- One high-speed I²C interface for general-purpose control commands
- Two independent enable signals for controlling power resources
- Thermal shutdown protection and hot-die detection
- A real-time clock (RTC) resource
- Watchdog
- Nine configurable GPIOs
- 32-kHz clock and reset
- Packaging: 96-pin BGA

Applications

- Power for ARM®+DSP and Cortex® A9 processors



Front-End PMU with Charger for Two- to Three-Cell Applications

TPS65090

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS65090

The TPS65090 is a single-chip power-management IC for portable applications, consisting of a battery charger with power-path management for a dual or triple Li-Ion or Li-Polymer cell battery pack. The charger can be directly connected to an external wall adapter. Three highly efficient step-down converters are targeted for providing a fixed 5-V system voltage, a fixed 3.3-V system voltage and an adjustable voltage rail. The device also has seven load switches built in. They can be used to control the power supply individually for certain circuit blocks in the application circuit. The current flowing through the load switches, the output current of the step-down converters, the input current from the AC adapter, and the charge current are monitored and can be read out using the digital interface.

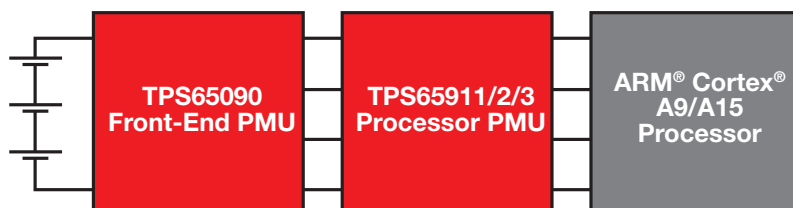
Key Features

- Charger/power-path management:
 - Up to 4-A output current on the power path

- Switch-mode charger: Up to 4-A charge current
- Three step-down converters:
 - High efficiency over a wide output-current range
 - Input-voltage range from 6 V to 17 V
 - Two fixed output voltages (5 V and 3.3 V), up to 6 A
 - One adjustable output voltage (between 1.0 V and 3.3 V), up to 4 A
- Seven current-limited load switches:
 - One system voltage switch (backlight)
 - One 5-V switch (HDMI)
 - One 3.3-V switch (LTE/modem)
 - Four 3.3-V switches (LCD, camera, EMMC, SD)
 - All switches controlled by I²C interface
- Two always-on LDOs:
 - Two fixed output voltages (5 V and 3.3 V)
 - Output-voltage accuracy of ±1.0%
 - Typical 10-µA quiescent current per LDO

Applications

- Two- to three-cell applications like tablets, netbooks and industrial/medical



→ Multi-Output Power Management Units

PMU with Four DC/DC Converters for LTE/4G Modems and Other Portable Applications

TPS65912x

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS659121

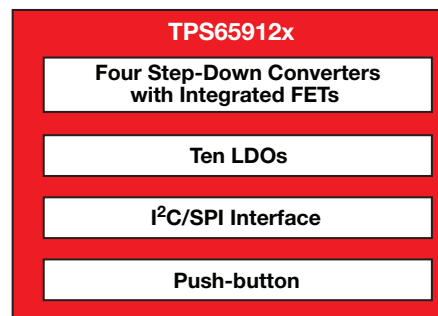
Key Features

- Four step-down converters (2.5, 2.0, 1.2 and 0.75 A)
- Ten LDOs:
 - Eight general-purpose, capless LDOs
 - Two high-PSRR LDOs
- Interfaces:
 - General-purpose, 3.4-MHz I²C interface
 - General-purpose, 15-MHz SPI interface
 - AVS 3.4-MHz I²C interface for DVS
- Power Save mode at light-load current

- ±2% output-voltage accuracy in PWM mode
- Flexible power-up and power-down management
- Push-button ON key
- 3.6 x 3.6-mm 81-pin WCSP package; 0.4-mm pitch

Applications

- LTE/4G modems, Cortex® A9 processors



Ultra-Low-Power PMU for Metering and Energy-Harvesting Applications with Sub-500-nA I_Q

TPS65290

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS65290

The TPS65290 is a new PMU for ultra-low-power applications. Primary application target is to reduce overall power consumption to a minimum in order to guarantee battery life-time of over ten years. The ultra-low quiescent current of the “always-on” sleep mode is in the range of hundreds of nA.

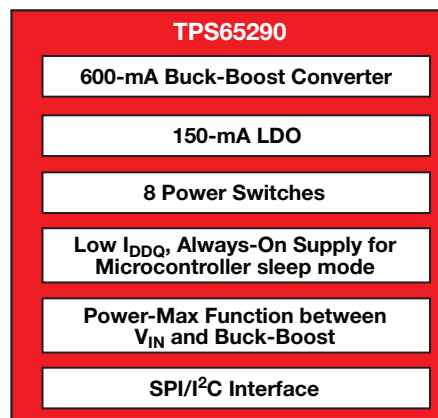
Key Features

- 2.2- to 5.5-V input operating range
- 600-mA buck-boost converter
- 150-mA LDO is stable with 1-μF ceramics
- Always-on bias supply for microcontroller sleep mode with sub-500-nA quiescent current

- Automatic power-max function between V_{IN} and buck-boost output
- 8 power switches
- Factory selectable SPI/I²C interface, GPIO interface
- –40 to 125°C junction temperature range
- 24-pin QFN package

Applications

- Gas/water metering
- Energy harvesting
- Road/bridge safety monitor
- Low-power RF
- General purpose low-power applications



Point-of-Load Solutions

→ Multi-Output Power Management Units

Selection Guide

Device	V _{IN} (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 Qualified†	Price*
General Purpose PMUs														
TPS65280/1/2	4.5 to 18.0	1	—	—	—	—	1	—	—	—	With 1 to 2 power switches	QFN-24	—	TBC
TPS65720/1	4.3 to 28.0	2	Linear	—	—	—	1	—	1	I ² C	Smallest single-Li-Ion applications, also QFN	WCSP-25	—	1.65
TPS65253	4.5 to 16.0	2	—	—	—	—	2	—	—	—	General purpose (3.5 A, 2.5 A)	QFN-28	—	2.95
TPS65270	4.5 to 16.0	2	—	—	—	—	2	—	—	—	General purpose (3 A, 2 A). Ideal for 2-layers	QFN-28	—	2.95
LM26400Y	3.0 to 20.0	2	—	—	—	—	2	—	—	—	Dual buck	LLP-16	—	2.25
TPS65000/6	1.8 to 6.0	3	—	—	—	—	1	—	2	—	General purpose	QFN-16	—	1.40
TPS657051/2	3.3 to 6.0	3	—	—	—	—	2	—	1	—	General purpose	WCSP-16	—	1.20
TPS65250/1	4.5 to 18.0	3	—	—	—	—	3	—	—	—	General purpose	QFN-40	—	3.05
TPS65257/8	4.5 to 16	3	—	—	—	—	3	—	—	—	With 1/2 USB switches	QFN-40	—	3.25
LM3686	2.7 to 5.5	3	—	—	—	—	1	—	2	—	General purpose	SMD-12	—	0.95
TPS6501x	4.5 to 5.5	4	Linear	—	—	—	2	—	2	I ² C	General purpose	QFN-48	—	2.55
LP3907	2.8 to 5.5	4	—	—	—	—	2	—	2	I ² C	General purpose	SMD-25, LLP-24	Yes	2.28
LM26480	2.8 to 5.5	4	—	—	—	—	2	—	2	—	General purpose	LLP-24	Yes	1.90
LM3280	2.7 to 5.5	4	—	—	—	—	1	—	3	—	Battery powered RF	SMD-16	—	2.31
LP3913	2.7 to 5.5	5	Linear	—	—	—	3	—	2	I ² C	Portable equipment	LLP-48	—	3.75
LP3910	2.7 to 5.5	5	Linear	—	—	—	3	—	2	I ² C	Portable, with buck-boost	LLP-48	—	3.95
TPS65053/8	2.5 to 6.0	5	—	—	—	—	2	—	3	—	Low-cost 5x channel PMU	QFN-24	Yes	1.85
TPS65050/1/2/4/6	2.5 to 6.0	6	—	—	—	—	2	—	4	Logic H/L	Low-cost 6x channel PMU	QFN-32	—	1.85
LP8720	2.7 to 4.5	6	—	—	—	—	1	—	5	I ² C	General purpose	Micro SMD-20	—	1.50
LP8725	2.6 to 4.5	9	—	—	—	—	2	—	7	I ² C	General purpose	Micro SMD-30	—	2.30
ARM® Cortex® A8 PMUs														
TPS65070/2/3	2.8 to 6.3	5	Linear	—	—	Yes	3	—	2	I ² C	With and without touch-screen controller	QFN-48	Yes	3.60
TPS65023x	2.5 to 6.0	6	—	—	—	—	3	—	3	I ² C	Flexible 6x-channel PMU, also WCSP package	QFN-40	Yes	3.30
TPS650250	2.5 to 6.0	6	—	—	—	—	3	—	3	—	Flexible PMU with adj V _{OUT}	QFN-32	Yes	2.95
TPS65217	2.7 to 6.5	7	Linear	—	—	Yes	3	—	4	—	Optimized for AM335x processors	QFN-48	—	3.45
TPS65921	2.7 to 4.5	7	—	—	Yes	—	3	—	4	2x I ² C	Optimized for OMAP™35x processors	BGA-139	—	3.60
TPS65930	2.7 to 4.5	7	—	Yes	Yes	—	3	—	4	2x I ² C	Optimized for OMAP35x processors	BGA-139	—	3.95
LP8765	4.5 to 6.8	12	Linear	—	—	Yes	2	—	10	I ² C	Smartphone PMU	Micro SMD-49	—	3.00
TPS65950	2.7 to 4.5	13	Linear	Yes	Yes	—	3	—	10	2x I ² C	Optimized for OMAP35x processors	BGA-209	—	4.50
TPS65951	2.7 to 4.5	13	—	Yes	Yes	—	3	—	10	2x I ² C	Optimized for OMAP35x, 0.8-mm pitch	BGA-169	—	4.50
TPS65910x	2.7 to 5.5	13	—	—	—	—	3	—	9	2x I ² C	Flexible PMU with 5-V boost	QFN-48	—	3.45
LP3925	4.5 to 6.5	18	Linear	—	—	Yes	3	—	15	I ² C	Smartphone PMU	Micro SMD-81	—	3.95
LP3974	4.5 to 6.5	20	Linear	—	—	—	4	—	16	I ² C	Smartphone PMU	Micro SMD-100	—	TBC
LP8788	4.5 to 6.5	26	Linear	—	—	Yes	4	—	22	I ² C	Smartphone PMU	Micro SMD-100	—	TBC
ARM Cortex A9 PMUs														
TPS65911x	2.7 to 5.5	13	—	—	—	—	3	1	9	2x I ² C	Flexible PMU with DC/DC controller up to 10 A	BGA-98	Yes	4.45
TPS65862x	4.3 to 6.5	14	Linear	—	—	Yes	3	—	11	I ² C	Optimized for Nvidia processors	BGA-121	Yes	5.95
TPS65864x	4.3 to 6.5	14	—	—	—	—	3	—	11	I ² C	Optimized for Cortex A8 processors	BGA-121	Yes	4.95
TPS65912x	2.3 to 5.5	14	—	—	—	—	4	—	10	I ² C/SPI	Flexible PMU with 4 DC/DC converters	WCSP-81	—	4.45
TWL6030/32/40	2.3 to 5.5	18	Switch	Yes	—	—	7	—	11	2x I ² C	OMAP4 power and audio	FBGA + PBGA	—	6.35
Special Function PMUs														
TPS65200	2.5 to 6.5	0	Switch	—	—	Yes	—	—	—	I ² C	Phone PMU with charger+WLED	WCSP, QFN	—	2.45
TPS658310	3.0 to 6.0	0	Switch	—	—	Yes	—	—	—	I ² C	Phone PMU with charger+flash+WLED	WCSP-49	—	3.45
TPS65735/x835	2.5 to 6.4	2	Linear	—	—	—	—	—	1	—	3D glasses. x835 with MSP430™	QFN-40	—	1.25
TPS65290	2.5 to 5.5	2	—	—	—	—	1	—	1	I ² C	Meters, energy-harvesting. +10-year battery	QFN-24	—	TBC
TPS65090	5.0 to 17.0	5	Switch	—	—	—	3	—	2	I ² C	Front-end PMU for 2 to 3 Li-Ion in series	QFN-100	—	TBC
LM10504	3.3 to 5.5	4	—	—	—	—	3	—	1	SPI	PMU for SSD memory	Micro SMD-34	—	1.20

† Devices qualified for Automotive (A) applications are available. Certain voltage options are not available. Different pricing may apply.

* 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 blue**.

→ Multi-Output Power Management Units

Embedded Processors Supported by TI Power-Management Units (PMUs)

Processor	Part Number	PMU
TI	C2834x	TPS65000, TPS650061
TI	C55x™	TPS65000x
TI	C6742/6/8	TPS65910, TPS65070, TPS65023
TI	C6745/7	TPS65910, TPS65023
TI	C6A814x	TPS659113
TI	C6A816x	TPS659112
TI	DM335, DM355, DM365, DM367	TPS65053, TPS65070
TI	DM368	TPS650532, TPS65023
TI	DM385	TPS659113
TI	DM37x 800MHz	TPS6595x/30/2x/10, TPS65023, TPS650731
TI	DM37x 1GHz	TPS65950A3/x51/x21B1/x10, TPS65023, TPS650731
TI	DM643x, DM644x	TPS65023, TPS659105
TI	DM812x/ DM814x	TPS659113
TI	DM816x	TPS659112
TI	AM17x	TPS65910, TPS65000x, TPS650061, TPS65023
TI	AM18x	TPS65910, TPS65000x, TPS650061, TPS65070
TI	AM335x	TPS65910A/A3, TPS65217, TPS650250
TI	AM35x	TPS65910, TPS650732, TPS65023
TI	AM37x 800MHz	TPS6595x/30/2x/10, TPS65023, TPS650731
TI	AM37x 1GHz	TPS65950A3/x51/x21B1/x10, TPS65023, TPS650731
TI	AM387x	TPS659113
TI	AM389x	TPS659112
TI	OMAP™3503/15/25/30	TPS6595x/30/2x/10, TPS65073x, TPS65023
TI	OMAP3611/21/30	TPS6595x/30/2x/10, TPS65023
TI	OMAP-L132, L137, L138	TPS65910, TPS65023, TPS650061, TPS65070
TI	OMAP4430/60/70	TWL6030, TWL6032
TI	OMAP5	TWL6035

Processor	Part Number	PMU
Altair	3100/6200	TPS659122
Ambarella	iOne	TPS658646
Freescall	IMX25	TPS65051/2
Freescall	IMX27	TPS65053, TPS659107
Freescall	IMX31	TPS650240
Freescall	IMX35	TPS650250, TPS659107
Freescall	IMX508	TPS659108
Freescall	IMX51	TPS659109
Freescall	IMX53	TPS659106
Freescall	IMX6x	Please ask TI
Leadcore	LC1710/11	LP8765
Marvell	PXA270	TPS65021/2
Marvell	Armada	Please ask TI
Nvidia	Tegra 2	TPS658621/2/3, TPS658640/3
Nvidia	Tegra 3	TPS659110
Nvidia	i450, i500	TPS659121
Rockchip	RK29	TPS659102
Rockchip	RK30	TPS658646
Samsung	S3C2410/2/3	TPS65051/2
Samsung	S3C2416	TPS650250, TPS650240
Samsung	S3C6410	TPS650250, TPS659101
Samsung	S5PV210, S5PC110	TPS659101
Samsung	S5PC100	TPS659103, LP3974
Samsung	S5P6440	TPS659104
Samsung	S5PV310	Please ask TI
STM	SPEAr 300	TPS650532
STM	SPEAr 1310	Please ask TI

Reference designs for these TI processor families are available online. Bookmark these pages and check often to find new designs for the latest DSP and microprocessor generations. PMU solutions with and without battery charger:

www.ti.com/pmu

TI power-management reference designs:

www.ti.com/processorpower

→ DC/DC Controllers (External Switch)

3- to 20-V PMBus Synchronous Buck Controller TPS40400

Get samples, datasheets and evaluation modules at: www.ti.com/product/TPS40400

The TPS40400 is a cost-optimized flexible synchronous buck controller that operates from a nominal 3- to 20-V supply. This controller is an analog PWM controller that allows programming and monitoring via the PMBus interface. Flexible features found on this device include programmable soft-start time, programmable short circuit limit and programmable undervoltage lockout (UVLO).

Key Features

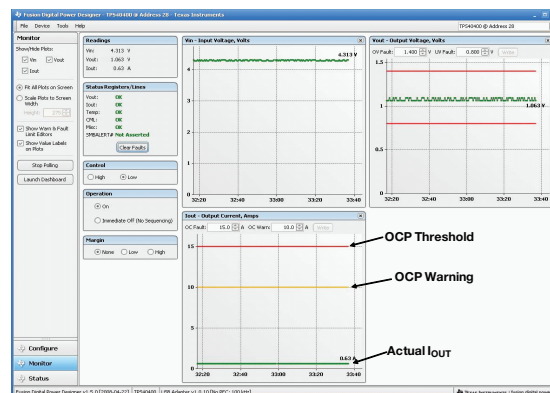
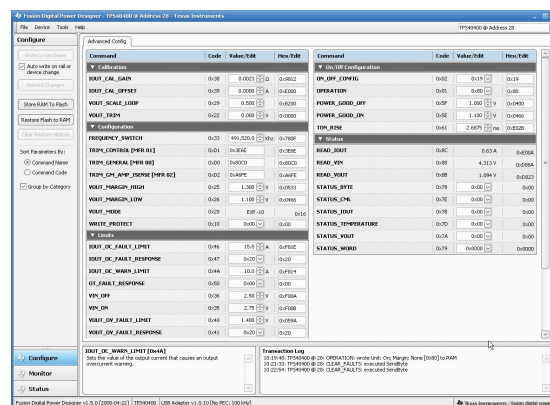
- Input operating voltage: 3 to 20 V
- PMBus enabled analog controller
- Reference 600 mV $\pm$ 1%
- Remote voltage sense amplifier
- Internal 6-V regulator and 6-V gate drive
- Programmable overcurrent protection
- Inductor resistance or series resistance used for current sensing
- Programmable switching frequency: 200 kHz to 2 MHz

- Powergood indicator
- Thermal shutdown
- Programmable soft-start
- Internal bootstrap diode
- Pre-bias output safe
- 24-pin QFN package

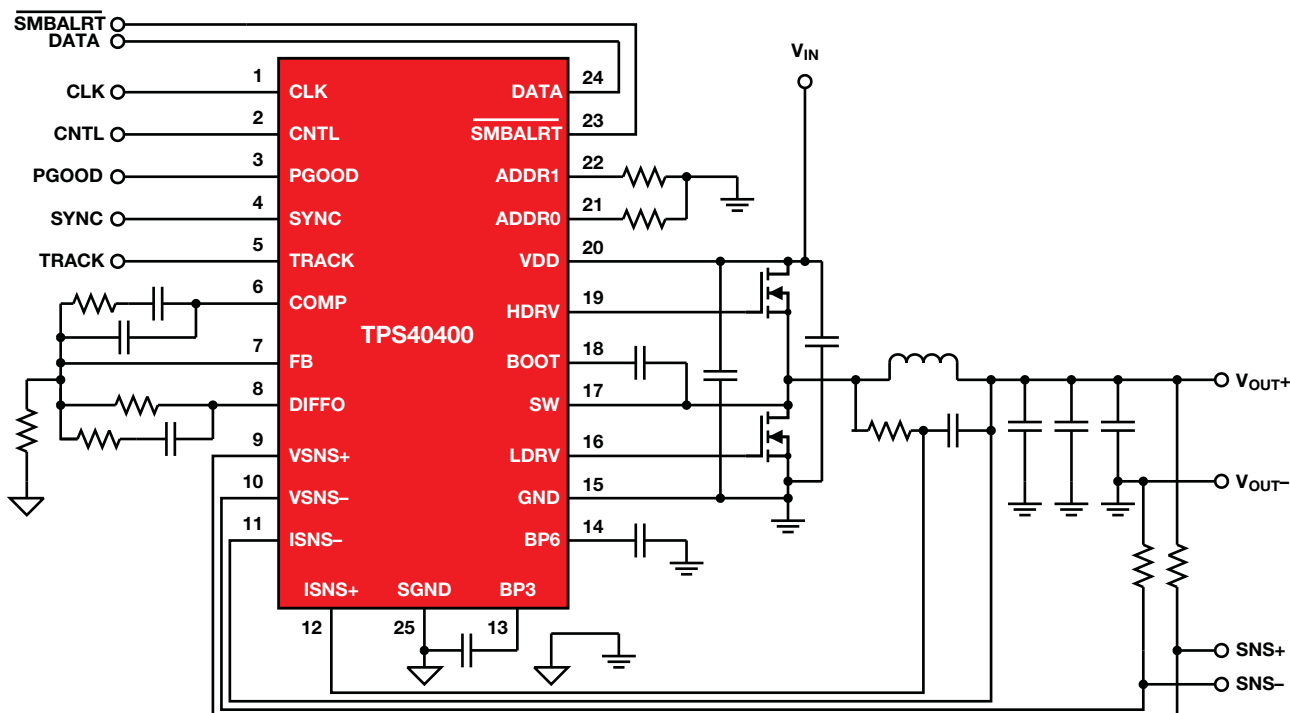
Applications

- Smart power systems
- Power supply modules
- Communications equipment
- Computing Equipment

NEW



TPS40400 evaluation module GUI.



TPS40400 typical application.

→ DC/DC Controllers (External Switch)

High-Voltage Synchronous Buck Controllers with Analog Current Monitor

LM(2)5117

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/LM5117 or [LM25117](http://www.ti.com/product/LM25117)

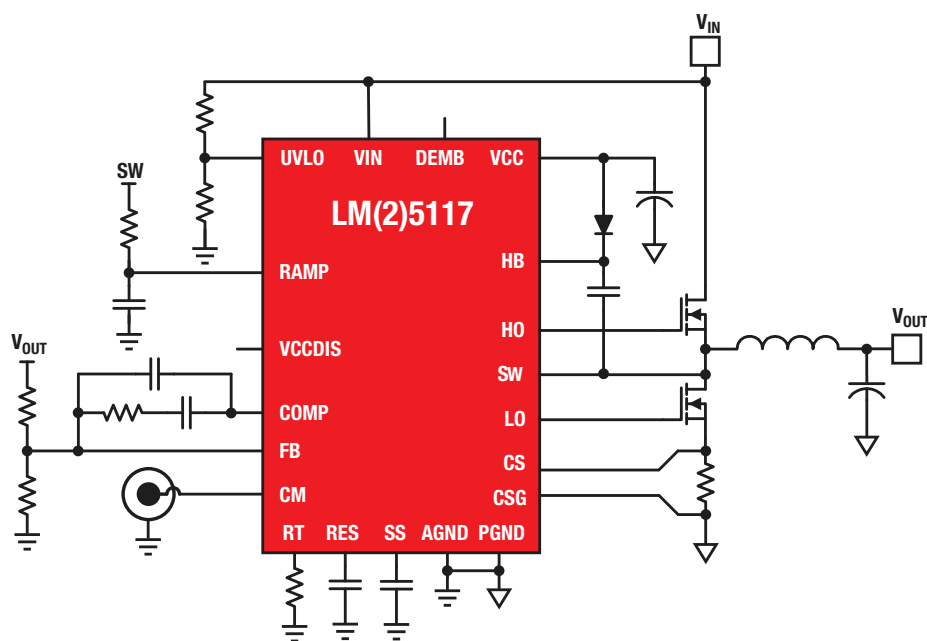
The LM(2)5117 are synchronous buck controllers intended for step-down regulator applications from a high-voltage or widely varying input supply. The control method is based upon current mode control utilizing an emulated current ramp. Current mode control provides inherent line feed-forward, cycle-by-cycle current limiting and ease of loop compensation. The use of an emulated control ramp reduces noise sensitivity of the pulse-width modulation circuit, allowing reliable control of very small duty cycles necessary in high-input-voltage applications.

Key Features

- AECQ-100 Grade 1 qualified
- Emulated current mode (ECM)
- Wide operating range:
 - 5.5 to 65 V (LM5117)
 - 4.5 to 42 V (LM25117)
- Analog current monitor
- Robust 3.3-A peak gate drives
- Optional diode emulation mode
- Programmable output from 0.8 V

Applications

- Base stations
- Servers
- Routers
- Systems with widely changing input voltage
- Systems that require large step-down conversions
- Automotive infotainment systems



Point-of-Load Solutions

→ DC/DC Controllers (External Switch)

Selection Guide

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

Device	Mode of Control ¹	V _{IN} (min/max) (V)	V _O (min/max) (V)	Driver Current (A)	Output Current (A) ²	Frequency (kHz)	V _{REF} Tol (%)	Internal Bootstrap	Package(s)	Pwr Good	Source and Sink ³	Pre-biased Operation	Ext Synchron Pin	Predictive Gate Drive™	DDR ⁴	Remote Sense	Price*
General-Purpose DC/DC Step-Down Controllers																	
TPS40000/2	V	2.25 to 5.5	0.7 to 4	1	15	300/600	1	Yes	10 MSOP			Yes		Yes			0.99
TPS40007/9	V	2.25 to 5.5	0.7 to 4	1	15	300/600	1	Yes	10 MSOP		Yes ¹⁰	Yes		Yes			1.20
TPS40040	V	2.25 to 5.5	0.6 to 4.95	1	15	300	1	Yes	8 SON		Yes ¹⁰	Yes					0.90
TPS40041	V	2.25 to 5.5	0.6 to 4.88	1	15	600	1	Yes	8 SON		Yes ¹⁰	Yes					0.90
TPS40042	V	3 to 5.5	0.7 to 4.95	1.2	15	600	Ext	Yes	10 SON		Yes ¹⁰	Yes			Yes		0.90
TPS40020/21	V	2.25 to 5.5	0.7 to 4	2	25	Adj. to 1000	1	Yes ⁹	16 HTSSOP	Yes	21 ¹⁰	20	Yes	Yes			1.45
LM3743	V	3 to 5.5	0.8 to 4.6	3.1	10	300 to 1000	1.75		MSOP-10				Yes				1.10
LM2745	V	1 to 17	0.6	1.9	20	50 to 1000	1.5		TSSOP-14	Yes		Yes	Yes				1.15
LM3475	Hysteretic	2.7 to 10	0.8 to V _{IN}	0.5	5	0 to 2000	1.5		SOT23-5								0.52
TPS40190	V	4.5 to 15	0.59 to 12.75	1.2	20	300	1	Yes	10 SON		Yes ¹⁰	Yes					1.00
LM2742	V	1 to 16	0.6	1.6	20	50 to 2000	1.5		TSSOP-14	Yes							1.25
LM2743	V	1 to 16	0.6	1.6	20	50 to 1000	2		TSSOP-14	Yes							1.15
LM2744	V	1 to 16	0.6	1.6	20	50 to 1000	1.5		TSSOP-14	Yes							1.15
LM2748	V	1 to 16	0.6	1.9	20	50 to 1000	1.5		TSSOP-14	Yes		Yes	Yes				1.15
LM2747	V	1 to 17	0.6	1.9	20	50 to 1000	1		TSSOP-14	Yes		Yes	Yes				1.45
TPS40100 ⁶	C	4.5 to 18	0.7 to 5.5	1.3	20	600	1		24 QFN	Yes	Yes ¹⁰	Yes	Yes		Yes		1.95
TPS40101 ⁶	V	4.5 to 18	0.7 to 5.5	1.3	20	1000	1		24 QFN	Yes	Yes ¹⁰	Yes	Yes		Yes		1.95
LM3753/54	V	4.5 to 18	0.6 to 3.6	1.9	50	200 to 1000	1		LLP-32	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 ¹⁰	Yes					1.05
TPS40195 ⁷	V	4.5 to 20	0.59 to 17	1.2	20	Adj. to 600	0.5	Yes	16 TSSOP, 16 QFN	Yes	Yes ¹⁰	Yes	Yes ⁷				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 ¹⁰	Yes					1.50
LM27402	V	3 to 20	0.6 to 19	2.6	30	200 to 1200	1		LLP-16, TSSOP-16	Yes		Yes	Yes				1.68
TPS53124 (dual output)	D-CAP Mode™	4.5 to 26	0.76 to 5.5	0.7	12	380	1	Yes	24 QFN, 28 TSSOP		Yes	Yes					1.95
TPS53125/26/27 (dual output)	D-CAP2 Mode™	4.5 to 26	0.76 to 5.5	0.7	12	350/700	1	Yes	24 QFN, 24 TSSOP		Yes	Yes					2.35
TPS53114	D-CAP2 Mode	4.5 to 27	0.76 to 5.5	0.7	12	350/700	1	Yes	16 TSSOP, 16 HTSSOP		Yes	Yes					1.00
TPS40075	VFF	4.5 to 28	0.7 to 23	1	20	Adj. to 1000	1	Yes	20 QFN	Yes	Yes ¹⁰	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 ¹⁰	Yes		Yes			1.60
LM3485	Hysteretic	4.5 to 35	1.242 to V _{IN}	0.4	4	0 to 1400	2		MSOP-8								0.55
LM3489	Hysteretic	4.5 to 35	1.239 to V _{IN}	0.4	4	0 to 1400	2		MSOP-8								0.62
LM3477	C	2.97 to 35	1.265 to 30.8	1.0	6	500	1.5		MSOP-8								0.92
TPS40054/55/57	VFF	8 to 40	0.7 to 35	1	20	Adj. to 1000	1	Yes	16 PowerPAD		55, 57 ¹⁰	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 ⁸	VFF	4.5 to 52	0.7 to 46	0.2	3	Adj. to 500	1		8 SOIC				Yes				0.75
TPS40170	VFF	8 to 60	4.5 to 60	1.2	15	Adj. to 600	1	Yes	20 QFN	Yes	Yes ¹⁰	Yes	Yes				2.40
LM(2)5117	ECM	5.5 to 65	4.5/5.5 to 42/65	2.2	20	50 to 750	1.5		TSSOP-20, LLP-24				Yes				2.28/2.48
LM(2)5085/A	COT	4.5 to 42/75	1.25/0.9 to V _{IN}	1.5	10	1000	2		MSOP-8, LLP-8								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		eTSSOP-16				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		TSSOP-16				Yes				1.40/1.85
LM5116	ECM	6 to 100	1.2 to 80	3.5	20	50 to 1000	1.5		eTSSOP-20				Yes				2.55

¹V = Voltage-mode control, C = Current-feedback control, VFF = Voltage mode with voltage feed-forward compensation, ECM = Emulated current mode and COT = Constant ON-time control.

²Current levels of this magnitude can be supported with commonly available commercial FETs.

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

⁴DDR = Supports DDR memory.

⁵Drives high-side P-FET.

⁶Provides advanced startup sequencing and output voltage margining.

⁷Bidirectional 180° out-of-phase synchronization.

⁸Non-synchronous, drives P-FETs.

⁹Integrated voltage-doubler charge pump for higher drive voltage.

¹⁰During soft start: source only.

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

New devices are listed in bold red.

Point-of-Load Solutions

→ DC/DC Controllers (External Switch)

Selection Guide (Continued)

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

Device	Mode Control ¹	Switched Outputs	Phases	V _{IN} (min/max) (V)	V _O (min/max) (V)	Driver Current (A)	Output Current (A) ²	Frequency (kHz)	V _{REF} Tol (%)	Package(s)	Pwr Good	Overvoltage Protection	Source and Sink ³	Pre-biased Operation	Ext Synch Pin	Remote Sense	Price*
Multiphase Synchronous DC/DC Buck Controllers																	
LM(2)5119	ECM	—	—	4.5/5.5 to 42/65	0.8 to 38/59	2.2	50	50 to 750	1.5	LLP-32	—	—	—	—	Yes		3.80/4.05
TPS40132	C	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 ⁴	C	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
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
TPS40180 ⁵	C	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

Device	Switched Outputs	LDO Outputs	Phases	V _{IN} (min/max) (V)	V _O (min/max) (V)	Driver Current (A)	Output Current (A) ²	Frequency (kHz)	V _{REF} Tol (%)	Control Method	Bootstrap Diode	Package(s)	Overvoltage Protection	Power Good	DDR ⁶	Price*
DC/DC Synchronous Buck Controllers with Light-Load Efficiency																
TPS53211	1	0	1	4.5/15	0.8/0.7 x V _{IN}	2	25	200 to 600	0.5	Voltage	Yes	16 QFN	Yes	Yes	No	2.00
TPS53219	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
TPS59116	1	1	1	3/28	1.5/3.0	0.8	10	Up to 400	1	Current, D-CAP Mode	No	20 PowerPAD™, 24 QFN	Yes	Yes	Yes	1.30
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
TPS59621	1	0	2	3/30	0.3/1.5	8	54	250 to 500	0.5	D-CAP+™	Yes	40 QFN	Yes	Yes	No	1.80
TPS59610/11	1	0	1	3/30	0.3/1.5	8	27	200 to 500	0.5	D-CAP+	Yes	32 QFN	Yes	Yes	No	1.40

Device	V _{IN} (min/max) (V)	V _O (min) (V)	Frequency Range (kHz)	f _{sync}	On/Off Pin	Topology	Package(s)	Price*
Boost and Buck-Boost Controllers								
LM5021	8.0/30	Set by external feedback network	50 to 1000	✓	✓	Flyback, forward	MSOP-8	0.66
LM3430	6.0/40	1.25	50 to 2000	✓	—	Boost	LLP-12	1.00
LM3478	2.95/40	1.26	100 to 1000	✓	✓	Boost, SEPIC, flyback	MSOP-8	0.93
LM3488	2.95/40	1.26	100 to 1000	✓	✓	Boost, SEPIC, flyback	MSOP-8	0.99
LM3481	2.97/48	1.275	100 to 1000	✓	✓	Boost, SEPIC, flyback	MSOP-10	0.95
LM5022/C	6.0/60	1.25	50 to 2000	✓	✓	Boost, SEPIC	MSOP-10	1.13
LM5020	13/100	Set by external feedback network	50 to 1000	✓	✓	Flyback, inverting, buck, boost, forward	MSOP-10, LLP-10	0.99
LM(2)5118	3.0/(42/75)	1.23	50 to 500	✓	✓	Buck-boost	eTSSOP-20	2.30
TPS40210/1 ⁷	4.5/52	5	Adj. to 1000	✓	✓	Boost, SEPIC, flyback	10 MSSOP/SON	1.10
TPS43000 ⁸	1.8/9	0.8	Adj. to 2000	✓	✓	Boost, SEPIC, flyback	16 TSSOP	2.25

¹C = Current-feedback control and VFF = voltage mode with voltage feed-forward compensation.

²Current levels of this magnitude can be supported with commonly available commercial FETs.

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

⁴Stackable to 16 phases.

⁵Stackable to 8 phases, reference is trimmable.

⁶DDR = Supports DDR memory.

⁷Overvoltage protection, source only.

⁸External synch pin.

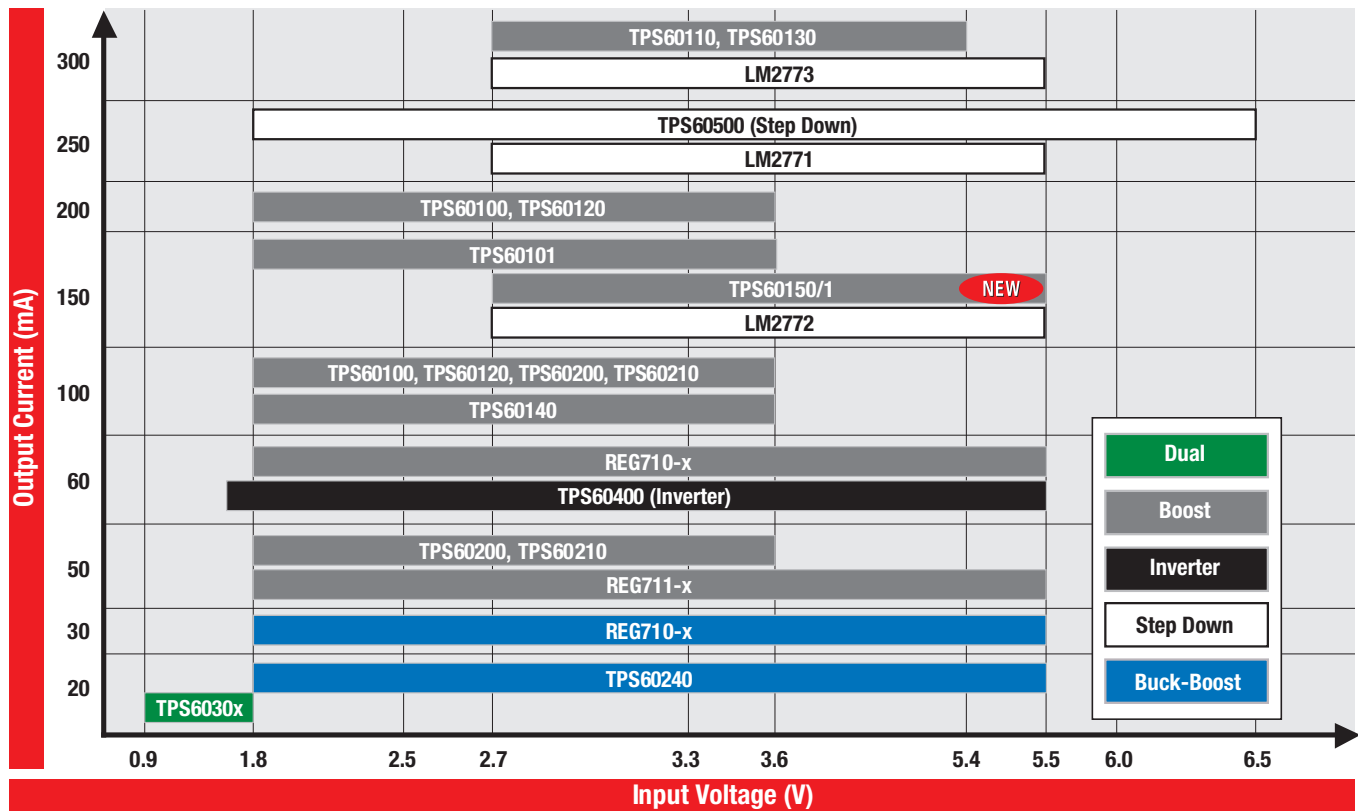
*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

Point-of-Load Solutions

→ Charge Pumps

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



Selection Guide

Device	I _{OUT} (mA)	V _{IN} (V)	V _{OUT} Adj. (V)	V _{OUT} Fixed (V)	Efficiency (%)	Switching Frequency (max) (kHz)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Features						Package(s)				EVM	Price*
									Shutdown	Low Battery	Power Good	Undervoltage Lockout	Current Limit	Thermal Limit	SOT-23	QFN	MSOP	TSSOP		
Step-Down (Buck) Regulators																				
LM2772	150	2.7 to 5.5	—	1.2	—	1100	45	—	✓							10			✓	0.75
TPS60500	250	1.8 to 6.5	0.8 to 3.3	—	90	1200	40	0.05	✓		✓	✓	✓	✓			10		✓	0.65
TPS60501	250	1.8 to 6.5	—	3.3	90	1200	40	0.05	✓		✓	✓	✓	✓			10			0.65
TPS60502	250	1.8 to 6.5	—	1.8	90	1200	40	0.05	✓		✓	✓	✓	✓			10			0.65
TPS60503	250	1.8 to 6.5	—	1.5	90	1200	40	0.05	✓		✓	✓	✓	✓			10			0.65
LM2771	250	2.7 to 5.5	—	1.5	—	1100	45	—	✓							10				0.85
LM2773	300	2.5 to 5.5	1.6 to 1.8	—	—	1150	48	—	✓										✓	0.90
Boost Regulators																				
TPS60100	200	1.8 to 3.6	—	3.3	90	300	50	0.05	✓				✓	✓				20	✓	0.85
TPS60101	100	1.8 to 3.6	—	3.3	90	300	50	0.05	✓				✓	✓				20		0.75
TPS60110	300	2.7 to 5.4	—	5.0	90	300	60	0.05	✓				✓	✓				20	✓	0.90
TPS60111	150	2.7 to 5.4	—	5.0	90	300	60	0.05	✓				✓	✓				20		0.80
TPS60120	200	1.8 to 3.6	—	3.3	85	450	55	0.05	✓	✓ ¹	✓ ¹		✓	✓				20	✓	0.90
TPS60122	100	1.8 to 3.6	—	3.3	85	450	55	0.05	✓	✓ ¹	✓ ¹		✓	✓				20		0.80
TPS60124	200	1.8 to 3.6	—	3.0	85	450	55	0.05	✓	✓ ¹	✓ ¹		✓	✓				20		0.90

¹ Features apply respectively to device numbers shown. For example, only the TPS60120 has the Low Battery feature and only the TPS60121 has the Power Good feature.

² White LED driver.

³ Feature applies only to second device shown. For example, only the TPS60302 has the Power Good feature.

[†] Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.

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

Point-of-Load Solutions

➔ Charge Pumps

Selection Guide (Continued)

Device	I _{OUT} (mA)	V _{IN} (V)	V _{OUT} Adj. (V)	V _{OUT} Fixed (V)	Efficiency (%)	Switching Frequency (max) (kHz)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Features							Package(s)				EVM	Price*
									Shutdown	Low Battery	Power Good	Undervoltage Lockout	Current Limit	Thermal Limit	SOT-23	QFN	MSOP	TSSOP			
Boost Regulators (Continued)																					
TPS60130	300	2.7 to 5.4	—	5.0	90	450	60	0.05	✓	✓ ¹	✓ ¹	✓						20	✓	0.95	
TPS60132	150	2.7 to 5.4	—	5.0	90	450	60	0.05	✓	✓ ¹	✓ ¹	✓						20	✓	0.85	
TPS60140	100	1.8 to 3.6	—	5.0	70	450	65	0.05		✓ ¹	✓ ¹	✓	✓					20	✓	0.80	
TPS60150	140	2.7 to 5.5	—	5.0	90	1500	4.7	0.01	✓					✓		6			✓	0.50	
TPS60200	100	1.8 to 3.6	—	3.3	90	400	40	0.05	✓	✓ ¹	✓ ¹	✓					10		✓	0.80	
TPS60202	50	1.8 to 3.6	—	3.3	90	400	40	0.05	✓	✓ ¹	✓ ¹	✓					10			0.65	
TPS60204	100	1.8 to 3.6	—	3.3	90	400	35	0.05	✓	✓ ¹	✓ ¹	✓					10			0.80	
TPS60210	100	1.8 to 3.6	—	3.3	90	400	35	2	Snooze	✓ ¹	✓ ¹	✓					10		✓	0.80	
TPS60212	50	1.8 to 3.6	—	3.3	90	400	35	2	Snooze	✓ ¹	✓ ¹	✓					10			0.65	
TL7660	20	1.5 to 10	—	< 2 V _{IN}	99	10.35	80	—							8		8			0.80	
Dual-Output Regulators																					
TPS60300	20	0.9 to 1.8	—	3.3	90	900	35	1	✓		✓ ³	✓					10		✓	0.75	
TPS60301	20	0.9 to 1.8	—	3.0	90	900	35	1	✓		✓ ³	✓					10			0.75	
TPS60310	20	0.9 to 1.8	—	3.3	90	900	35	2	Snooze		✓ ³	✓					10			0.70	
TPS60311	20	0.9 to 1.8	—	3.0	90	900	35	2	Snooze		✓ ³	✓					10			0.70	
Buck-Boost Regulators																					
REG710-2.5	30	1.8 to 5.5	—	2.5	90	1000	65	0.01	✓				✓	✓	6					0.49	
REG710-2.7	30	1.8 to 5.5	—	2.7	90	1000	65	0.01	✓				✓	✓	6					0.49	
REG710-3	30	1.8 to 5.5	—	3.0	90	1000	65	0.01	✓				✓	✓	6					0.49	
REG710-3.3	30	1.8 to 5.5	—	3.3	90	1000	65	0.01	✓				✓	✓	6				✓	0.49	
REG71050	60	2.7 to 5.5	—	5.0 ²	90	1000	65	0.01	✓				✓	✓	6				✓	0.55	
REG710-5	60	2.7 to 5.5	—	5.0 ²	90	1000	65	0.01	✓				✓	✓	6				✓	0.49	
REG71055	60	3.0 to 5.5	—	5.5 ²	90	1000	65	0.01	✓				✓	✓	6					0.55	
REG711-2.5	50	1.8 to 5.5	—	2.5	90	1000	60	0.01	✓				✓	✓			8			0.55	
REG711-2.7	50	1.8 to 5.5	—	2.7	90	1000	60	0.01	✓				✓	✓			8			0.55	
REG711-3	50	1.8 to 5.5	—	3.0	90	1000	60	0.01	✓				✓	✓			8			0.55	
REG711-3.3	50	1.8 to 5.5	—	3.3	90	1000	60	0.01	✓				✓	✓			8			0.55	
REG711-5	50	2.7 to 5.5	—	5.0	90	1000	60	0.01	✓				✓	✓			8			0.55	
TPS60240	12	1.8 to 5.5	—	3.3	90	160	25	0.1					✓	✓			8			0.70	
Inverting Regulators																					
TPS60400	60	1.6 to 5.5	–16.6 to –5.25	—	99	50 to 250	125	—							5				✓	0.33	
TPS60401	60	1.6 to 5.5	–16.6 to –5.25	—	99	20	70	—							5					0.33	
TPS60402	60	1.6 to 5.5	–16.6 to –5.25	—	99	50	275	—							5					0.33	
TPS60403	60	1.6 to 5.5	–16.6 to –5.25	—	99	250	400	—							5					0.33	

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²White LED driver.

³Feature applies only to second device shown. For example, only the TPS60302 has the Power Good feature.

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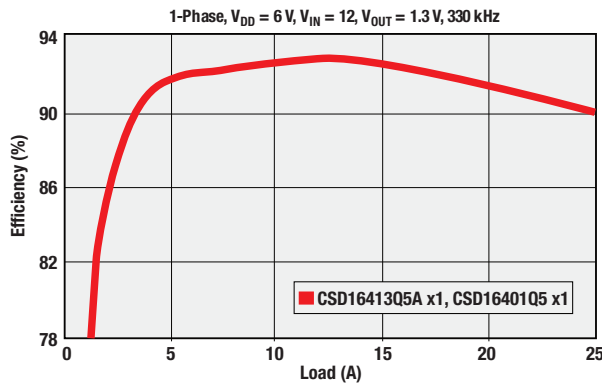


TI's premier power management innovation called NexFET™ technology combines vertical current flow with a lateral power MOSFET. It provides a low on resistance and requires an extremely low gate charge with industry-standard package outlines—a combination not previously possible with existing silicon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

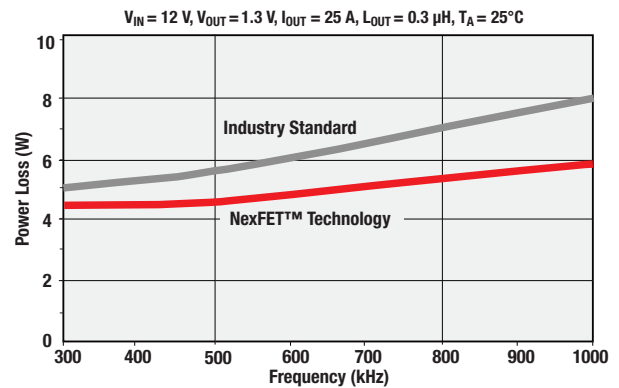
NexFET technology delivers high performance for both N- and P-channel power MOSFET devices. Designers are able to achieve 90% power supply efficiencies from light to full loads with high output currents and low duty cycles, representing a breakthrough in discrete designs.

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

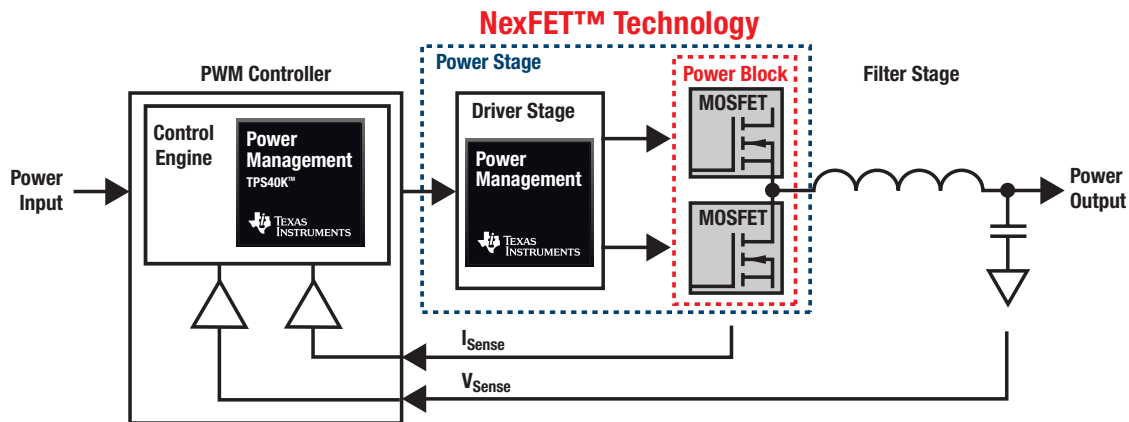
90% Efficiency from Light to Full Load



Same Power Loss, Double the Frequency



System Block Diagram of TI Electronics in a Power System Design



Selection Guide

Device	Channel	V _{DS} (V)	V _{GS} (V)	Typical V _{GS(th)} (V)	Typical R _{DS(on)} (mΩ)						Maximum I _D (A)	Typical Q _G at 4.5 V (nC)	Typical Q _{GS} (nC)	Typical Q _{GD} (nC)	Typical R _G (Ω)	Price*
					at 10 V	at 4.5 V	at 3 V	at 2.5 V	at 1.8 V	at 1.5 V						
WLP 1x1																
Single																
CSD23201W10	P	12	6	0.6	—	66	—	77	—	110	2.2	1.9	0.28	0.26	—	0.20
WLP 1x1.5																
Single																
CSD25301W1015	P	20	8	0.75	—	62	—	80	—	175	2.2	1.9	0.35	0.4	—	0.25
CSD25303W1015	P	20	8	0.75	—	46	—	56	—	72	3	3.3	0.6	0.6	—	0.25
Common Source																
CSD75205W1015	P	20	6	0.65	—	95	—	115	145	—	1.2	1.6	0.3	0.4	—	0.26
CSD75301W1015	P	20	8	0.7	—	80	—	105	150	—	1.2	1.5	0.28	0.3	—	0.26

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



Selection Guide (Continued)

Device	Channel	V _{DS} (V)	V _{GS} (V)	Typical V _{GS(th)} (V)	Typical R _{DS(on)} (mΩ)						Maximum I _D (A)	Typical Q _G at 4.5 V (nC)	Typical Q _{GS} (nC)	Typical Q _{GD} (nC)	Typical R _G (Ω)	Price*
					at 10 V	at 4.5 V	at 3 V	at 2.5 V	at 1.8 V	at 1.5 V						
WLP 1.5x1.5																
Single																
CSD25201W15	P	20	6	0.7	—	33	—	42	52	—	4	4.3	1	0.7	—	0.28
Common Source																
CSD75204W15	P	20	6	0.7	—	80	—	105	140	—	3	2.8	0.5	0.6	—	0.30
WLP 1.7x2.3																
Dual																
CSD86311W1723	N	25	10	1	—	31	—	37	—	—	4.5	2.8	0.7	0.6	—	0.43
CSD75211W1723	P	20	8	0.7	—	32	—	61	80	—	4.5	4.5	0.9	0.9	—	0.43
SON 2x2																
Single																
CSD16301Q2	N	25	10	1.1	—	23	27	—	—	—	5	2	0.6	0.4	1.3	0.15
CSD17313Q2	N	30	10	1.3	—	26	31	—	—	—	5	2.1	0.7	0.4	1.3	0.15
CSD25302Q2	P	20	8	0.65	—	39	—	56	71	—	5	2.6	0.54	0.5	—	0.15
SON 3x3																
Single																
CSD16411Q3	N	25	16	2	8	12	—	—	—	—	56	2.9	1.5	0.7	0.8	0.30
CSD16409Q3	N	25	16	2	6.2	9.5	—	—	—	—	60	4	2.1	1	0.9	0.33
CSD16406Q3	N	25	16	1.8	4.2	5.9	—	—	—	—	60	5.8	2.5	1.5	1.2	0.33
CSD16323Q3	N	25	10	1.1	—	4.4	5.4	—	—	—	60	6.2	1.8	1.1	1.4	0.39
CSD16327Q3	N	25	10	1.1	—	4	—	—	—	—	60	6.2	1.8	1.1	1.4	0.39
CSD16340Q3	N	25	10	0.85	—	4.3	—	6.1	—	—	60	6.5	2.1	1.2	1.5	0.39
CSD17308Q3	N	30	10	1.3	—	9.4	12.5	—	—	—	47	3.9	1.3	0.8	0.9	0.30
CSD17304Q3	N	30	10	1.3	—	6.9	9.8	—	—	—	56	5.1	1.8	1.1	1.1	0.32
CSD17309Q3	N	30	10	1.2	—	4.9	6.3	—	—	—	60	7.5	2.5	1.7	1.2	0.39
CSD25401Q3	P	20	12	0.85	—	8.8	—	13.5	—	—	60	8.8	2.1	2.1	1.2	0.41
SON 5x6																
Single																
CSD16412Q5A	N	25	16	2	9	13	—	—	—	—	52	2.9	1.4	0.7	0.7	0.30
CSD16410Q5A	N	25	16	1.9	6.8	9.6	—	—	—	—	59	3.9	1.8	1.1	0.7	0.32
CSD16404Q5A	N	25	16	1.8	4.1	5.7	—	—	—	—	81	6.5	3	1.7	0.9	0.39
CSD16408Q5	N	25	16	1.8	3.6	5.4	—	—	—	—	113	6.7	3.1	1.9	0.8	0.45
CSD16413Q5A	N	25	16	1.6	3.1	4.1	—	—	—	—	100	9	3.5	2.5	0.9	0.44
CSD16403Q5A	N	25	16	1.6	2.2	2.9	—	—	—	—	100	13.3	5.5	3.5	1.2	0.60
CSD16407Q5	N	25	16	1.6	1.8	2.5	—	—	—	—	100	13.3	5.3	3.5	1.2	0.65
CSD16414Q5	N	25	16	1.6	1.5	2.1	—	—	—	—	100	16.6	7.3	4.4	1.4	0.75
CSD16401Q5	N	25	16	1.5	1.3	1.8	—	—	—	—	100	21	8.3	5.2	1.2	0.95
CSD16322Q5	N	25	10	1.1	—	4.6	5.4	—	—	—	97	6.8	2.4	1.3	1.1	0.41
CSD16321Q5	N	25	10	1.1	—	2.1	2.8	—	—	—	100	14	4	2.5	1.5	0.65
CSD16325Q5	N	25	10	1.1	—	1.7	2.1	—	—	—	100	18	6.6	3.5	1.6	0.95
CSD17307Q5A	N	30	10	1.3	—	9.7	12.8	—	—	—	73	4	1.3	1	0.9	0.30
CSD17302Q5A	N	30	10	1.2	—	7.3	9.5	—	—	—	87	5.4	1.7	1.2	0.8	0.32
CSD17310Q5A	N	30	10	1.3	—	4.5	5.7	—	—	—	100	8.9	2.7	2.1	0.9	0.39
CSD16342Q5A	N	25	10	0.85	—	4.3	—	6.1	—	—	60	6.5	2.1	1.2	1.5	0.42
CSD17306Q5A	N	30	10	1.1	—	3.3	4.2	—	—	—	100	11.8	3.5	2.4	1	0.44
CSD17305Q5A	N	30	10	1.1	—	2.8	3.9	—	—	—	100	14.1	4.5	3	1	0.49
CSD17301Q5A	N	30	10	1.1	—	2.3	2.9	—	—	—	100	19	5.7	4.3	1.3	0.60
CSD17303Q5	N	30	10	1.1	—	2	2.7	—	—	—	100	18	5.6	4	1.4	0.65
CSD17311Q5	N	30	10	1.2	—	1.8	2.3	—	—	—	100	24	6.6	5.2	1.2	0.75
CSD17312Q5	N	30	10	1.1	—	1.4	1.8	—	—	—	100	28	8.4	6	1.1	0.95
CSD17501Q5A	N	30	20/–20	1.3	2.4	3	—	—	—	—	187	13.2	5.4	3.5	—	0.60

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

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

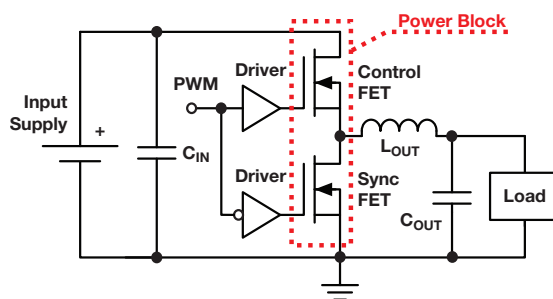


Selection Guide (Continued)

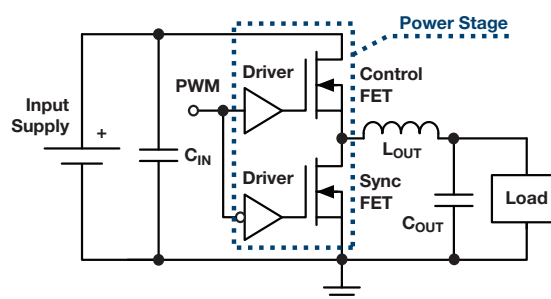
Device	Channel	V _{DS} (V)	V _{GS} (V)	Typical V _{GS(th)} (V)	Typical R _{DS(on)} (mΩ)						Maximum I _D (A)	Typical Q _G at 4.5 V (nC)	Typical Q _{GS} (nC)	Typical Q _{GD} (nC)	Typical R _G (Ω)	Price*
					at 10 V	at 4.5 V	at 3 V	at 2.5 V	at 1.8 V	at 1.5 V						
SON 5x6 (Continued)																
Single (Continued)																
CSD17505Q5A	N	30	20/-20	1.3	2.9	3.7	—	—	—	—	153	10	3.5	2.7	—	0.49
CSD17506Q5A	N	30	20/-20	1.3	3.2	4.2	—	—	—	—	150	8.3	3.1	2.3	—	0.44
CSD17507Q5A	N	30	20/-20	1.6	9	11.8	—	—	—	—	85	2.8	1.3	0.7	—	0.30
CSD17510Q5A	N	30	20/-20	1.5	4.1	5.4	—	—	—	—	129	6.4	2.7	1.9	—	0.39
CSD17322Q5A	N	30	10	1.6	—	10	—	—	—	—	87	3.6	1.6	1.1	4.7	0.32
CSD17327Q5A	N	30	10	1.6	—	12.5	—	—	—	—	65	2.8	1.2	0.8	4.7	0.30
CSD17527Q5A	N	30	20/-20	1.6	—	12.5	—	—	—	—	65	2.8	1.2	0.8	4.7	0.30
CSD17522Q5A	N	30	20/-20	1.6	—	10	—	—	—	—	87	3.6	1.6	1.1	4.7	0.32
DualCool™ SON 5x6																
Single																
CSD16408Q5C	N	25	16	1.8	3.6	5.4	—	—	—	—	113	6.7	3.1	1.9	0.8	0.49
CSD16407Q5C	N	25	16	1.6	1.8	2.5	—	—	—	—	100	13.3	5.3	3.5	1.2	0.75
CSD16322Q5C	N	25	10	1.1	—	4.6	5.4	—	—	—	97	6.8	2.4	1.3	1.1	0.45
CSD16321Q5C	N	25	10	1.1	—	2.1	2.8	—	—	—	100	14	4	2.5	1.5	0.75
CSD16325Q5C	N	25	10	1.1	—	1.7	2.1	—	—	—	100	18	6.6	3.5	1.6	1.05
DualCool SON 3x3																
Single																
CSD16323Q3C	N	25	10	1.1	—	4.6	5.4	—	—	—	60	6.2	1.8	1.1	1.4	0.43

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

CSD8xxx NexFET™ Power Block contains two MOSFETs in TI's new PowerStack™ package



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



Selection Guide

Device	Channel	Integrated Driver	V _{DS} (V)	V _{GS} (V)	Power Loss (W)	P _{loss} Current (A)	Max Current (A)	Max f _{SW} (MHz)	High Duty Cycle Applications	Price*
SON 3x3 Power Block										
CSD86330Q3D	N	No	25	10	1.9	15	20	1.5	No	0.75
CSD87330Q3D	N	No	30	10	2	15	20	1.5	No	0.75
CSD87331Q3D	N	No	30	10	1.3	10	15	1.5	No	0.65
SON 5x6 Power Block and SON 5x6 Power Stage										
CSD86350Q5D	N	No	25	10	2.8	25	40	1.5	No	1.05
CSD87350Q5D	N	No	30	10	3	25	40	1.5	No	1.05
CSD87351Q5D	N	No	30	10	2.5	20	32	1.5	No	0.95
CSD87352Q5D	N	No	30	10	1.8	15	25	1.5	No	1.00
CSD87353Q5D	N	No	30	10	3.3	25	120	1.5	Yes	1.50
CSD96370Q5M	N	Yes	25	—	2.6	25	40	2.0	—	1.35
CSD97370Q5M ¹	N	Yes	30	—	2.8	25	40	2.0	—	1.35
CSD97370AQ5M ²	N	Yes	25	—	2.6	25	40	2.0	—	1.35

¹3.3-V and 5-V PWM signal compatible.

²5-V PWM signal compatible.

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

→ Overview

The Texas Instruments portfolio of isolated power-conversion solutions covers the complete end-to-end power-supply building blocks from front-end PFC controllers to PWM controllers that 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

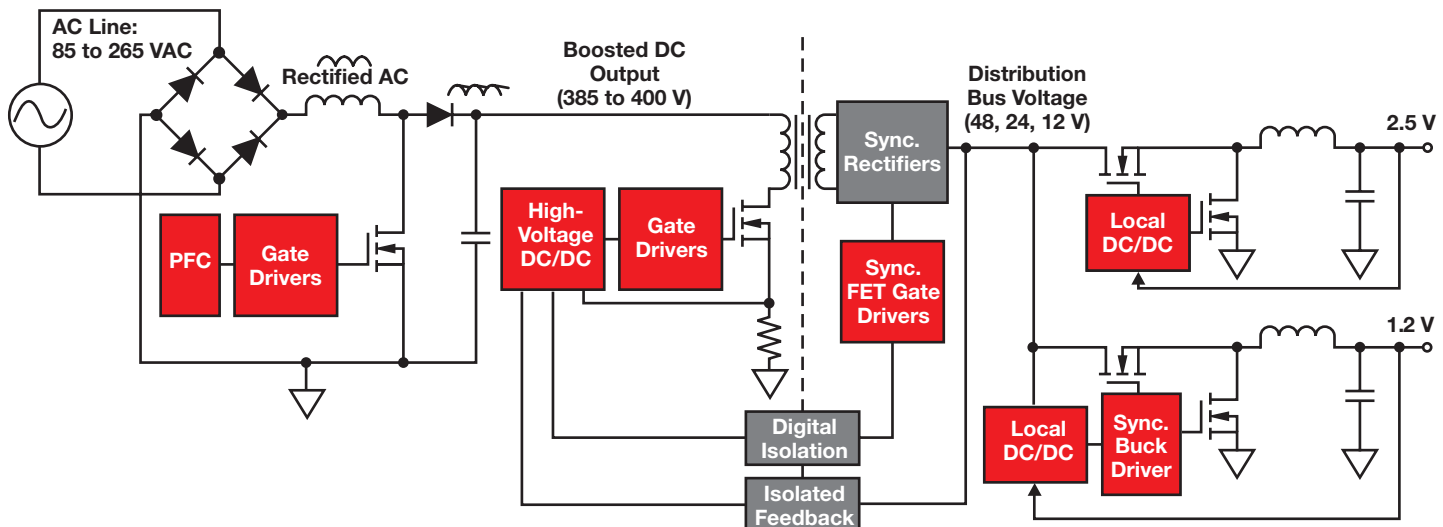
- Versatile advanced PWM controllers and bias supply converters for high-performance secondary-side control
- Ability to work with a wide line voltage range
- Different levels of undervoltage lockout thresholds for self bias and auxiliary bias applications
- Ability to synchronize controllers to eliminate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



→ 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 (UCC28060) and continuous conduction mode (CCM) (UCC28070) control methods.

Other benefits of interleaving include scalability and ultrathin designs. Scalability allows for addressing many different power levels and applications.

www.ti.com/product/UCC28060

www.ti.com/product/UCC28061

www.ti.com/product/UCC28063

www.ti.com/product/UCC28070

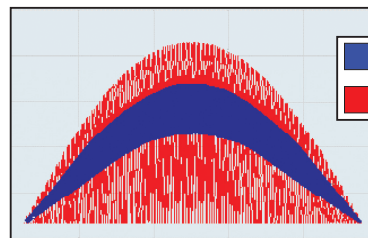
www.ti.com/product/UCC28070A

Why Interleave?

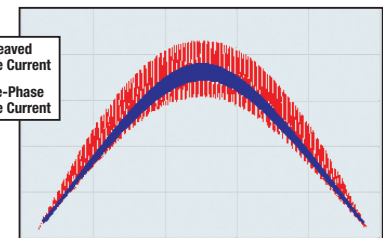
- Lower system cost from ripple-current cancellation
- Enables ultraslim and high-density designs
- Lower total inductor volume
- Smaller or lower-cost EMI filter and output capacitors
- Facilitates higher efficiency

Applications

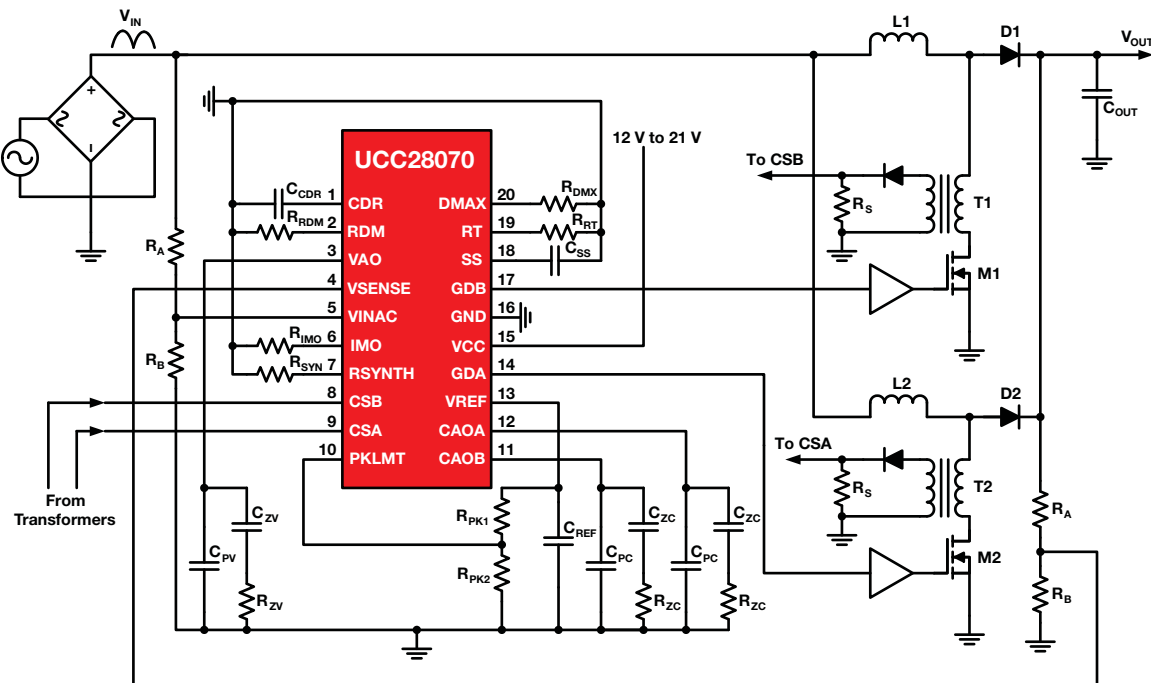
- Digital TV
- Telecom power supplies and rectifiers
- Professional and consumer audio
- Merchant power supplies
- Air conditioning and refrigeration compressors
- Variable-speed motors
- Low-profile power-supply applications



UCC28060 transition mode PFC with Natural Interleaving™ technique.



UCC28070 continuous conduction mode PFC.



Typical application for UCC28070 continuous conduction mode PFC.

→ PWM Power Supply Controllers

Single-Ended Topologies

Control Method

Voltage Mode — Simple, low-noise control method for wide input and output range requirements.

Current Mode — Fast transient response with built-in current limiting.

Level of Integration

- Integrated soft-start (programmable) provides predictable start-up.
- Internal leading edge blanking to suppress switching spike from MOSFET turn-on.

Performance

- Many voltage mode controllers have input voltage feedforward for instantaneous response to input line changes.
- Most controllers have onboard high current drive capability without external MOSFET drivers.
- Lower start-up current for offline applications (for BiCMOS products with UCC prefix).
- Low operating current (for BiCMOS products with UCC prefix) for light-load efficiency.
- Programmable minimum duty cycle clamp for light-load efficiency (UCC3581).

Features

- 10-W to 350-W offline and DC/DC power supplies.
- Single-ended topology power supplies, buck, boost, flyback and forward.

Double-Ended Topologies

Current Mode — Control technique featuring fast transient response with inherent cycle-by-cycle current limiting.

Voltage Mode — Versatile, low-noise control method for wide duty cycle ranges.

Soft Switching

- Zero Voltage Transition (ZVT) soft switching techniques minimize power loss at turn-on.
- Phase shifted, ZVT controllers maximize efficiency in full-bridge converters.

Protection

- Flexible overcurrent limiting circuitry provides programmable fault protection modes.
- Programmable soft-start executes predictable start-up on initialization and after faults.
- High speed, cycle-by-cycle current limiting.

- Maximum duty cycle clamp to prevent transformer saturation.
- Programmable deadtime control to prevent cross conduction of power switches.

Hot Products

- UCC28950: Green advanced phase-shifted full-bridge and synchronous rectifier controller
- UCC28250: Advanced PWM controller with pre-bias startup and synchronous rectification
- UCC24610: Synchronous Green Rectifier™ controller
- UCC29910: Buck PFC controller
- UCC2897A: Active clamp forward
- UCC25600: LLC resonant controller
- UCC28610: Advanced green-mode flyback controller
- LM5046: Phase-shifted full-bridge and SR controller with integrated drivers and high-voltage start-up
- LM5035/39: Half-bridge controller with integrated high-voltage start-up and drivers
- LM5027: Active clamp forward controller with integrated high-voltage start-up and pre-bias

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

					Voltage Mode
					Current Mode
					Voltage or Current Mode
Active-Clamp Forward	UCC2891-4 I-Mode Act-Clamp, HVStart	UCC2897A Adv. I-Mode Act-Clamp, HVStart	LM5025 Adv. I-Mode Act-Clamp, HVStart	LM5027 Act-Clamp with Pre-Bias, HVStart	
Dual Outputs Push-Pull, Half-Bridge, Full-Bridge	UCC25600 Resonant Half-Bridge	LM5035/9 Half-Bridge with Integrated Drivers, HVStart	UCC28230/1 Intermediate Bus	UCC28250 Half-Bridge with Pre-Bias	LM5045/6 Full-Bridge, with Integrated Drivers, Pre-Bias, HVStart
Green-Mode PWMs and Off-Line Bias Regulators (flyback, forward, quasi-resonant flyback)	UCC28600 8-Pin QR Green- Mode Controller	UCC28610 Advanced Green- Mode Controller			
Features/Level of Integration					

→ PWM Power Supply Controllers

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

Soft-Switching, ZVT, ZVS
(Phase-shifted full-
bridge, resonant,
active-clamp forward)

UCC2891-4
I-Mode
Act-Clamp,
HVStart

UCC2897A
Adv. I-Mode
Act-Clamp,
HVStart

UCC3895
Adv. ϕ -Shift

UCC28950
 ϕ -Shift Full-Bridge

LM5046
 ϕ -Shift Full-Bridge
Integrated Drivers,
HVStart, Pre-Bias

Push-Pull, Half-Bridge,
Full-Bridge

UCC28230/1
Intermediate Bus

UCC25600
Resonant Half-Bridge

UCC28250
Half-Bridge
with Pre-Bias

LM5045
Full-Bridge Controller
Integrated Drivers,
HVStart, Pre-Bias

Secondary Side Control

UCC28250
Half-Bridge
with Pre-Bias

UCC28950
 ϕ -Shift Full-Bridge

Voltage Mode

Current Mode

Voltage or
Current Mode

Features/Level of Integration

Most Integrated Family of Full-Bridge PWM Controllers

LM5045, LM5046

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/LM5045 or [LM5046](http://www.ti.com/product/LM5046)

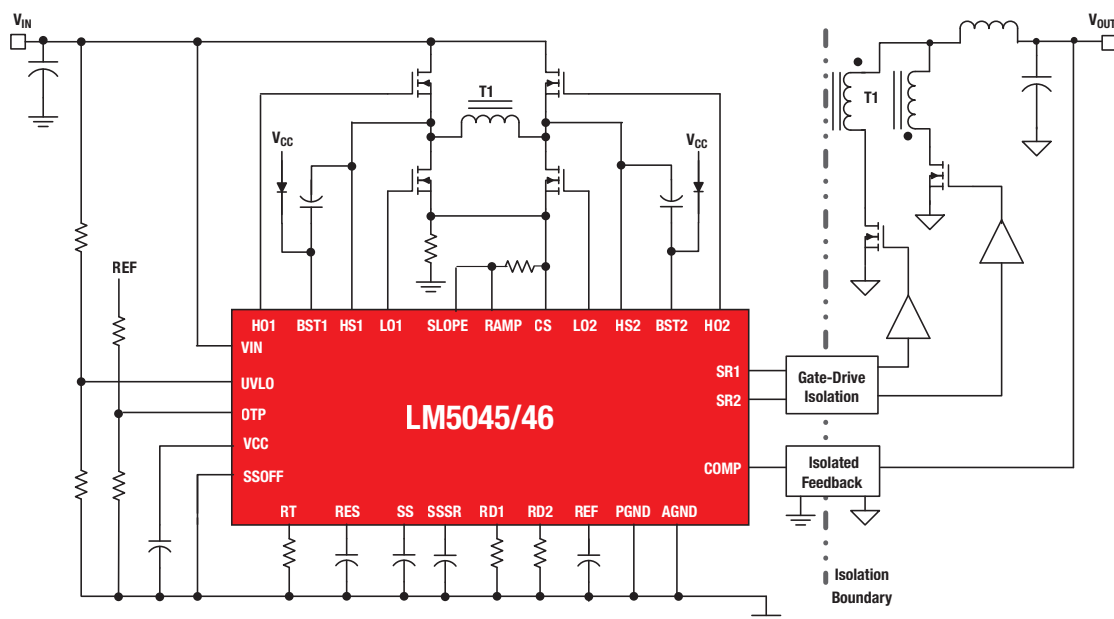
Key Features

- High-current, 2-A full-bridge gate drivers
- Intelligent sync rectifier start-up for linear turn-on into prebiased loads
- 5-V sync rectifier drive for digital isolators or transformer
- 105-V high-current start-up regulator

- Independently programmable synchronous rectifier delays (LM5045)
- Programmable resonant times for ZVS operation (LM5046)

Applications

- Telecom power supplies
- Industrial power supplies
- High-density power modules



→ PWM Power Supply Controllers

Green Advanced Phase-Shifted Full-Bridge and Synchronous Rectifier Controller UCC28950

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/UCC28950

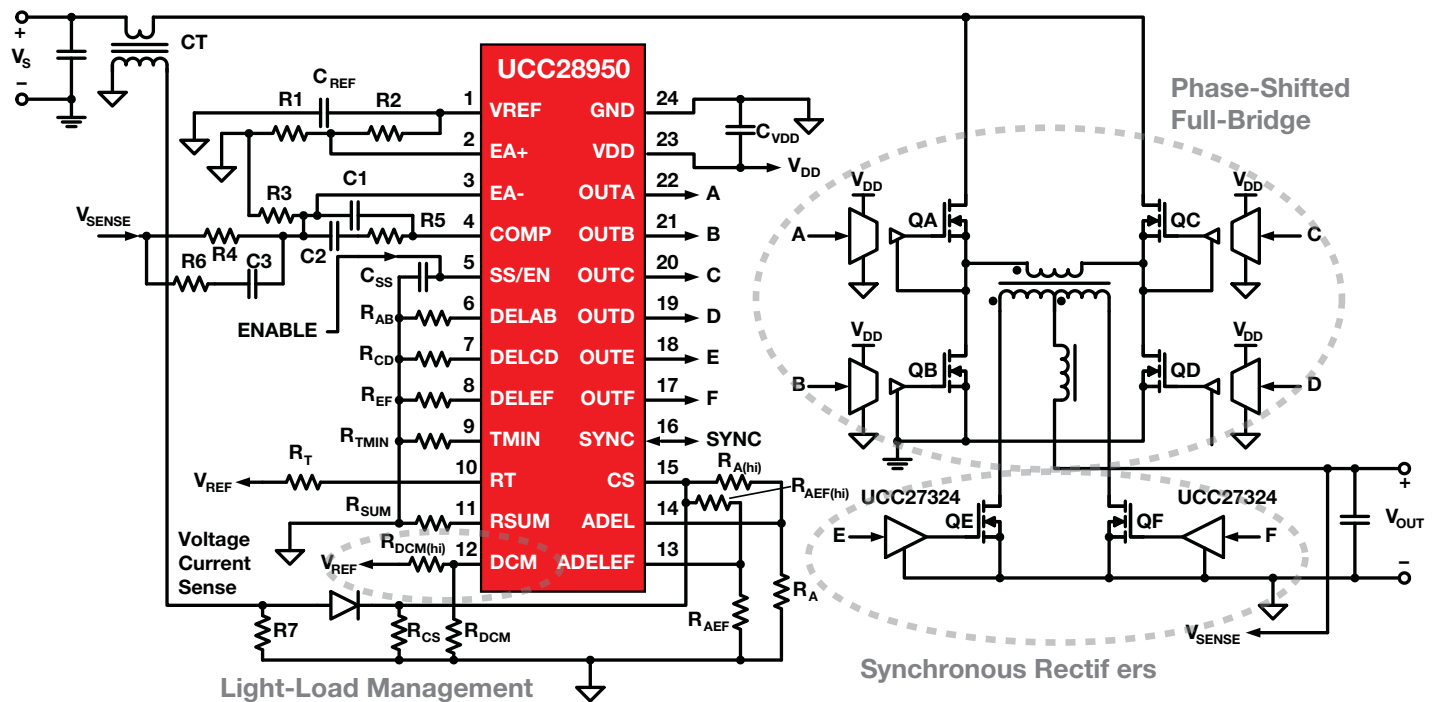
The UCC28950 phase-shifted full-bridge controller offers best-in-class efficiency in today's high-performance power systems. The UCC28950 implements advanced full-bridge control along with active control of the synchronous rectifier's output stage. The primary-side signals allow programmable delays to ensure ZVS operation over wide load current and input voltage range, while the load current naturally tunes the secondary-side synchronous rectifier's switching delays, maximizing overall system efficiency.

Key Features

- Optimized for 90+ efficiency standards
- Adaptive ZVS switching over wide input/output range
- Optimal timing outputs for synchronous-rectifier drivers
- User-programmable operation in DCM mode with lowered frequency at light load (burst)
- Programmable ramp compensation allows current- or voltage-mode control
- Sync in and sync out with 90% phase shift for master/slave interleaved operation of two modules

Applications

- Phase-shifted full-bridge converters
- Server, telecom power supplies
- Industrial power systems
- High-density power architectures
- Solar inverters
- Electric vehicles
- DC motor drives



PWM Power Supply Controllers

Selection Guide

Device ¹	Typical Power Level (W)	Control Method			Topologies	Maximum Practical Frequency	Supply Voltage (V)	110-V Start-Up Circuit	Soft Start	Output Drive (Sink/Source) (A)	Package(s)	HiRel (H) or Automotive (A) [†]	Price*
		Voltage Mode	Current Mode	Avg. Current Mode									
Auxiliary Bias Supplies													
LM5017	3 to 7			COT ²	Buck, Isolated Buck	1 MHz	9 to 100			0.6	8-LLP/PSOP	A	1.65
TPS55010	<2		✓		Fly-Buck™ (Forward Flyback)	2 MHz	2.95 to 6		✓	—	16-QFN		1.65
UCC25230	1 to 2				Buck, Fly-Buck (Forward Flyback)	445 kHz	12 to 75		✓	—	8-SON		1.35
Green Mode Controllers and Offline Bias Regulators													
UCC28610	10 to 40		✓		Buck, Flyback (SEPIC, Cuk)	140 kHz	9 to 20			—	8-SOIC		0.60
UCC28600	50 to 150		✓		Flyback (SEPIC, Cuk)	130 kHz	30		✓	1/0.75	8-SOIC	A	0.49
UCC3888/89	<10	✓			Flyback (SEPIC, Cuk)	250 kHz	9		✓	0.2/0.15	8-SOIC-W/DIL (PDIP)		0.59
Intermediate Bus Controllers													
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
General-Purpose Single-Ended Controllers													
LM5020	10 to 100		✓		Buck, Boost, Flyback (SEPIC, Cuk)	1 MHz	13 to 100	✓	✓	1	10-MSOP/QFN		0.90
LM5021	10 to 100		✓		Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	8 to 30		✓	0.7	8-MSOP		0.66
LM5022	25 to 100		✓		Buck, Boost, Flyback (SEPIC, Cuk)	2 MHz	6 to 60		✓	1	10-MSOP		1.13
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
TL3842B/3B/4B/5B	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
UC28023	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
UC3823	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), 20-PLCC		1.60
UC3823A/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
UC3842A/3A/4A/5A	30 to 350	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	500 kHz	10 to 30			1/1	8/14-SOIC, 8-DIL (PDIP)	H	0.80
UCC3800/1/2/3/4/5	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
UCC3807-1-2-3	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
UCC3809-1-2	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
UCC3813-0/1/2/3/4/5	10 to 200	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd) ³ , Forward (D > 50%) ³	1 MHz	7.2 to 15 ³		✓	1/1	8-TSSOP/SOIC/DIL (PDIP)		0.80
UCC3884	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
UCC38C40/1/2/3/4/5	10 to 250	✓	✓		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	5 Options			1/1	8-MSOP/SOIC/DIL (PDIP)		0.95
Wide-Input Range Voltage Mode Controllers													
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
Dual Output Controllers													
LM(2)5037	30 to 300	✓	✓		Push-Pull, Half-Bridge, Full-Bridge	2 MHz	13 to 75/100	✓	✓	1.2/1.2	16-TSSOP	A	1.35/1.62
LM5015	30 to 250		✓		Fwd (Including 2-Switch Fwd)	750 kHz	4.25 to 75		✓	1	14-TSSOP		2.05
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
LM5032	30 to 250		✓		Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd)	1 MHz	13 to 100	✓	✓	2.5/2.5	16-TSSOP		1.55
LM5033	50 to 600	✓			Push-Pull, Half-Bridge, Full-Bridge	1 MHz	15 to 100	✓	✓	1.5/1.5	10-MSOP/QFN		1.00
LM5034	30 to 250		✓		Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd)	1 MHz	8 to 100	✓	✓	2.5/2.5	20-TSSOP		1.90
LM5035/A/B/C	50 to 300	✓			Half-Bridge	2 MHz	8 to 100	✓	✓	2/2	28-TSSOP, 20-HTSSOP, 24-QFN		1.90
LM5039	50 to 300	✓			Half-Bridge	2 MHz	8 to 100	✓	✓	2/2	20-HTSSOP, 24-QFN		1.90
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

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

²Continuous On-Time architecture.

³Value varies by part number suffix. Please check datasheet.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.

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

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

PWM Power Supply Controllers

Selection Guide (Continued)

Device ¹	Typical Power Level (W)	Control Method			Topologies	Maximum Practical Frequency	Supply Voltage (V)	110-V Start-Up Circuit	Soft Start	Output Drive (Sink/Source) (A)	Package(s)	HiRel (H) or Automotive (A) [†]	Price*
		Voltage Mode	Current Mode	Avg. Current Mode									
Dual Output Controllers (Continued)													
LM5045	50 to 400	✓	✓		Full-Bridge	2 MHz	14 to 100	✓	✓	1.5/2	28-HTSSOP/QFN		2.25
UCC28250	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
TL494 or TL594	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)	H	0.23
TL598	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)	H	0.81
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
UC3524A	50 to 500	✓			Push-Pull, Half-Bridge, Full-Bridge	250 kHz	8 to 40		✓	0.2/0.2	16-SOIC/DIL (PDIP)	H	1.70
UC3525B - UC3526A	50 to 500	✓			Push-Pull, Half-Bridge, Full-Bridge	250 kHz	8 to 40		✓	0.2/0.2	16-SOIC/DIL (PDIP), 20-PLCC	H	1.05
UC3824	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
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	H	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	H	2.65
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
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	H	1.60
UCC28089	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
UCC28220/1	50 to 800		✓		Interleaved Fwd/Flyback/Boost	1 MHz/ch.	8 to 14.5	✓	✓	0.01/0.01	16-TSSOP/SOIC	A	1.60
UCC3806	50 to 750	✓	✓		Push-Pull, Half-Bridge, Full-Bridge	350 kHz	7 to 15		✓	0.5/0.5	16-SSOP/TSSOP/SOIC/SOIC-W/DIL (PDIP), 20-PLCC	H	4.10
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
Soft-Switching, ZVT and ZVS Controllers													
UCC28950	200 W to 2 kW	✓	✓	✓	Φ-Shifted FB	1 MHz	8 to 17		✓	—	24-TSSOP	H	4.25
UCC25600	200 W to 1 kW				Half-Bridge	350 kHz	11.5 to 18		✓	0.4/0.8	8-SOIC		0.80
LM5046	50 to 400	✓	✓		Φ-Shifted FB	2 MHz	14 to 100	✓	✓	2/2	28-HTSSOP/QFN		2.45
UC3875/6/7	200 W to 2 kW	✓	✓	✓	Act-Clamp Fwd/Flyback, Φ-Shifted FB	1+ MHz	10.7 to 20		✓	Four at 2/2	20-SOIC-W/DIL (PDIP), 28-PLCC		4.85
UC3879	200 W to 2 kW	✓	✓		Φ-Shifted FB	500 kHz	11 to 20		✓	Four at 0.1/0.1	20-SOIC-W/DIL (PDIP), 28-PLCC		3.70
UCC2891/3	75 to 600		✓		Forward (D > 50%), Act-Clamp Fwd/Flyback	1 MHz	8.5 to 14.5	✓	✓	2/2, 2/2	16-TSSOP/SOIC		1.50
UCC2892/4	75 to 600		✓		Forward (D > 50%), Act-Clamp Fwd/Flyback	1 MHz	8.5 to 14.5		✓	2/2, 2/2	16-TSSOP/SOIC		1.50
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
UCC3580-1/-2/-3/-4	50 to 500	✓			Forward (D > 50%), Act-Clamp Fwd/Flyback	500 kHz	7 to 15		✓	0.5/1, 0.3/0.3	16-SOIC/DIL (PDIP)		2.40
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
Secondary-Side, Post Regulation													
LM(2)5115/A						1 MHz	4.5 to 42/75		✓	2/2.5	16-TSSOP/QFN		1.35/1.80
UCC3583	50 to 500					500 kHz	8.5 to 15		✓	0.5/1.5	14-SOIC/DIL (PDIP), 20-PLCC		1.75

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

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.

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

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

→ MOSFET and GaN 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.

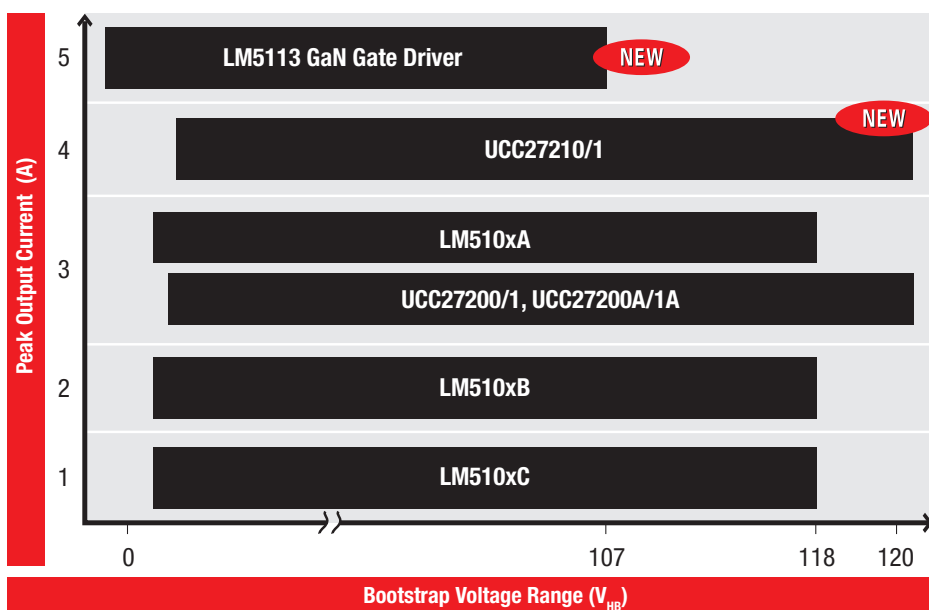
TrueDrive™ Output Stage — Used in TI high-current gate drivers and controllers, the TrueDrive output architecture is constructed of bipolar and CMOS transistors in parallel. TrueDrive technology

delivers high current where it is needed most—at the MOSFET Miller plateau region thresholds—and provides switching efficiency gains.

Predictive Gate Drive™ Technology —

This patented TI technology is a digital control technique to control delay times in high-efficiency, low-output-voltage synchronous buck converters. See our application notes on Predictive Gate Drive for a complete description.

High-Side/Low-Side Bridge Driver Portfolio



Product Highlights

UCC2721x

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

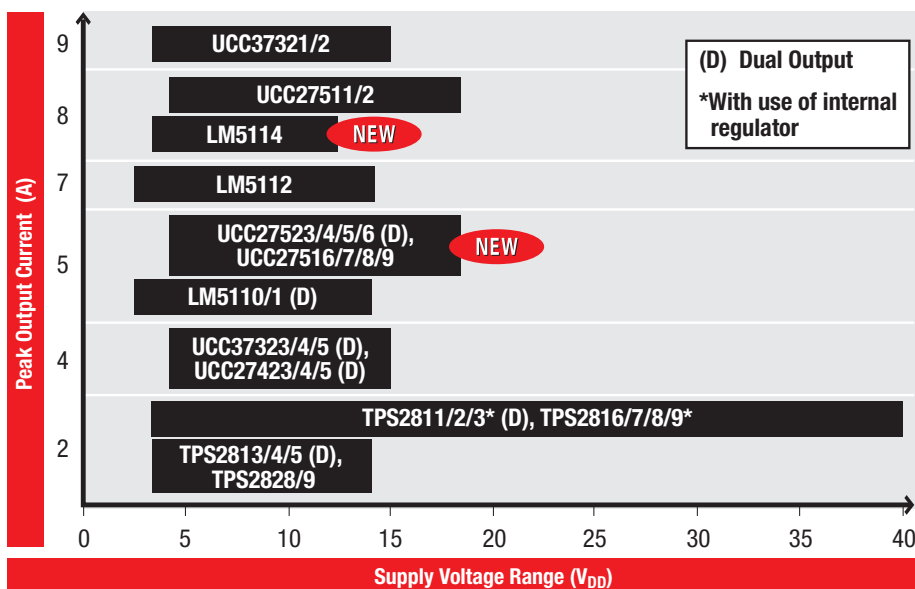
LM5113

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

LM510xx Family

- Drive capability scales with power-converter requirements

Low-Side Gate Driver Portfolio



Product Highlights

UCC2751x/52x

- Next-generation P2P upgrade to most popular competitors' products
- Asymmetrical drive and split output options available on select single-channel drivers
- Best-in-class propagation delay and higher V_{DD} compatibility with IGBT power switches

LM5114

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

→ MOSFET and GaN Drivers

100-V Half-Bridge Gate Driver for Enhancement-Mode GaN FETs

LM5113

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/LM5113

Enhancement mode Gallium Nitride (GaN) power FETs can provide significant power-density benefits over silicon MOSFETs in power converters. They have a much lower figure of merit (FOM) due to lower $R_{DS(on)}$ and lower Qg. With greater efficiencies, faster switching frequencies and an ultra-small package footprint, GaN FETs enable higher-density power converters. However, realizing these benefits does present a new set of challenges. Large source-drain voltages and

the stringent gate-source voltage-drive requirements of GaN power FETs pose new challenges related to limiting the high-side FET drive level to less than 6 V, as well as preventing high dV/dt transients from causing erratic switching behavior.

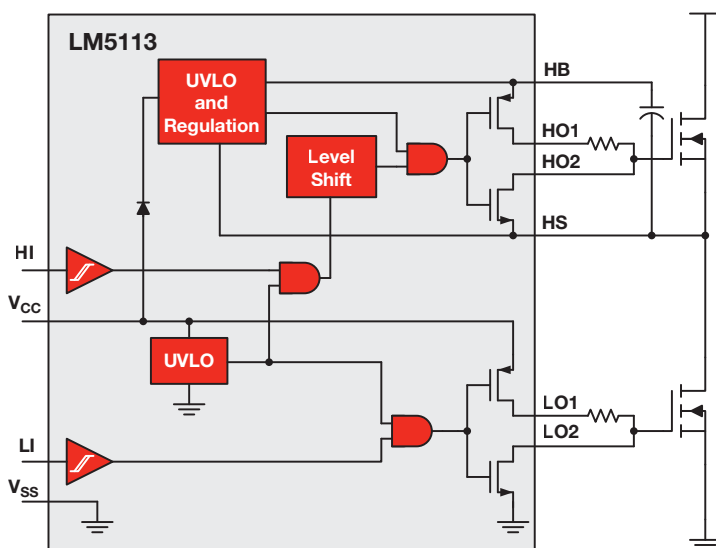
Key Features

- Independent high and low TTL logic inputs
- 1.2-A/5-A peak source/sink current
- High-side floating bias voltage rail operates up to 100 V

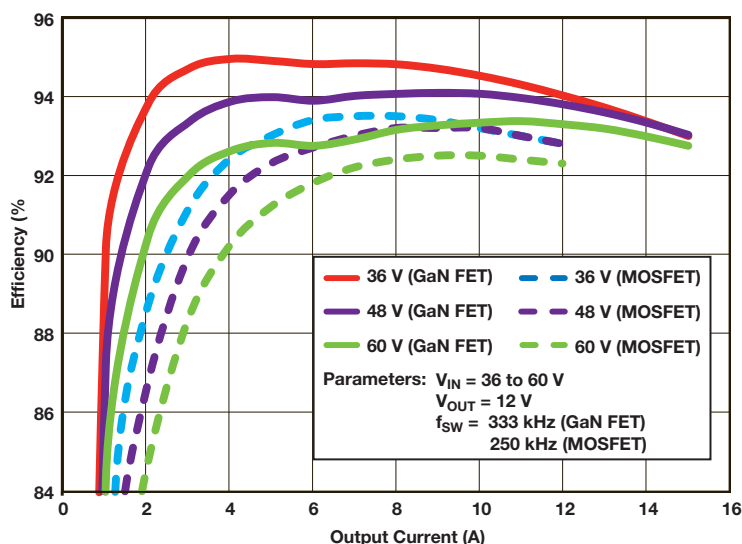
- Internal bootstrap supply-voltage clamping
- Split outputs for adjustable turn-on/turn-off strength
- 0.5-Ω/2-Ω pull-down/pull-up resistance
- Fast propagation times—30 ns typical

Applications

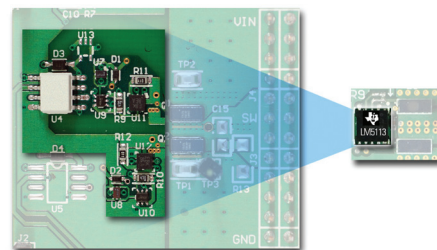
- Current fed push-pull converters
- Half and full-bridge converters
- Synchronous buck converters
- Two-switch forward converters
- Forward with active clamp converters



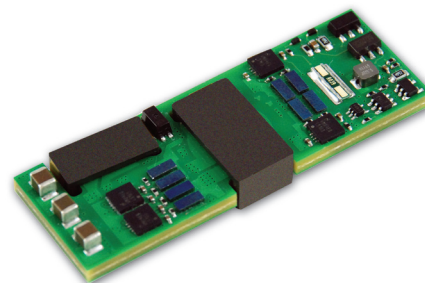
LM5113 block diagram.



GaN FET efficiency vs traditional MOSFET.



Discrete driver solution and integrated LM5113 driver. The LM5113 delivers tremendous efficiency and PCB area savings compared to discrete implementations.



1/8 power brick featuring the EPC2001 eGaN FET and LM5113 GaN FET driver.

→ MOSFET and GaN Drivers

Selection Guide

Device	No. of Channels	Output Configuration	Output Type ¹	Peak I _{OUT} Source/Sink (A)	Rise/Fall Time (ns)	V _{CC} Range (V)	Prop Delay (ns)	Input Threshold	Enable	Dead Time Control	Protection Features ²	Internal Regulator	HiRel (H) or Automotive (A) [†]	Price*
General-Purpose Low-Side Drivers														
TPS2811	2	Inverting	TrueDrive™	2/2	25/25	4 to 40	40	CMOS	—	—	—	✓	A	0.90
TPS2812	2	Non-inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✓		0.90
TPS2813	2	See Note 3	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	✓		0.90
TPS2814	2	Dual 2-input AND; one inverting	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	—		0.90
TPS2815	2	2-input NAND	TrueDrive	2/2	25/25	4 to 14	40	CMOS	✓	—	—	—		0.90
TPS2816	1	Inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✓		0.65
TPS2817	1	Non-inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✓		0.65
TPS2818	1	Inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✓	H	0.65
TPS2819	1	Non-inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✓	H	0.65
TPS2828	1	Inverting	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	—		0.60
TPS2829	1	Non-inverting	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	—	A	0.60
UC3714	2	Non-inverting	Bipolar	0.5/1	30/25	7 to 20	50	TTL/PWM	✓	Adj.	—	—		0.95
UC3715	2	See Note 3	Bipolar	1/2	30/25	7 to 20	50	TTL/PWM	✓	Adj.	—	—		0.90
UCC27323	2	Inverting	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	—	—	—	—		0.65
UCC27324	2	Non-inverting	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	—	—	—	—		0.65
UCC27325	2	See Note 3	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	—	—	—	—		0.65
UCC27423	2	Inverting	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	✓	—	—	—	H, A	0.70
UCC27424	2	Non-inverting	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	✓	—	—	—	H, A	0.70
UCC27425	2	See Note 3	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	✓	—	—	—	A	0.70
UCC37321	1	Inverting	TrueDrive	9/9	20/20	4 to 15	30	TTL/CMOS	✓	—	—	—		0.99
UCC37322	1	Non-inverting	TrueDrive	9/9	20/20	4 to 15	30	TTL/CMOS	✓	—	—	—		0.99
LM5114A/B	1	Non-inverting	Split	1.3/7.6	8/3.2	4 to 12.6	—	TTL/CMOS	—	—	—	—		0.60
UCC27511	1	Non-inverting	Split	4/8	9/9	4.5 to 18	14	Dual input TTL	—	—	—	—		0.60
UCC27512	1	Non-inverting	—	4/8	9/7	4.5 to 18	14	Dual input TTL	—	—	—	—		0.60
UCC27516	1	See Note 3	—	4/4	9/7	4.5 to 18	14	TTL	—	—	—	—		0.49
UCC27517	1	See Note 3	—	4/4	9/7	4.5 to 18	14	TTL	—	—	—	—		0.49
UCC27518	1	Inverting	—	4/4	9/7	4.5 to 18	14	CMOS	—	—	—	—		0.49
UCC27519	1	Non-inverting	—	4/4	9/7	4.5 to 18	14	CMOS	—	—	—	—		0.49
LM5110	2	Non-inverting	Split	5/2	14/12	3.5 to 15	25	TTL	—	—	✓	—		0.65
LM5111	2	Non-inverting	Split	5/3	14/12	3.5 to 15	25	TTL	—	—	✓	—		0.65
LM5112	2	Non-inverting	Split	7/3	14/12	3.5 to 15	25	CMOS	—	—	✓	—		0.50
UCC27523	2	Inverting	—	5/5	9/7	4.5 to 18	14	TTL	✓	—	—	—		0.75
UCC27524	2	Non-inverting	—	5/5	9/7	4.5 to 18	14	TTL	✓	—	—	—		0.75
UCC27525	2	See Note 3	—	5/5	9/7	4.5 to 18	14	TTL	✓	—	—	—		0.75
UCC27526	2	See Note 3	—	5/5	9/7	4.5 to 18	14	TTL	✓	—	—	—		0.75
UCD7100PWP	1	Uncommitted/Non-inverting	TrueDrive	4/4	10/10	4.5 to 16	20	CMOS/TTL	—	Adaptive	—	—		0.99
UCD7201PWP	2	Uncommitted/Non-inverting	TrueDrive	4/4	10/10	4.5 to 16	20	CMOS/TTL	—	Adaptive	—	—		1.20
Synchronous-Rectifier Drivers														
UCC24610		Non-inverting	—	3/3	30/25	4.5 to 5.5	44	CMOS/TTL	✓	Adaptive	✓	—		0.75
Synchronous Buck Drivers														
TPS28225	2	Non-inverting	CMOS	2/4	10/10	4.5 to 8.8	14	TTL/CMOS	✓	Adaptive	UVLO	—	A	0.60
TPS28226	2	Non-inverting	CMOS	2/4	10/10	4.5 to 8.8	14	TTL/CMOS	✓	Adaptive	UVLO	—		0.60
TPS2830	2	Non-inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	✓	Adaptive	OVPC	—		1.05
TPS2831	2	Inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	✓	Adaptive	OVPC	—		1.05
TPS2832	2	Non-inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	—	Adaptive	—	—		1.00
TPS2833	2	Inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	—	Adaptive	—	—		1.00
TPS2834	2	Non-inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	✓	Adaptive	OVPC	—		1.05

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

² OVPC = overvoltage protection crowbar; UVLO = undervoltage lockout.

³ One inverting, one non-inverting.

⁴ Predictive Gate Drive™.

⁵ Maximum boot voltage at HS pin.

[†] Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.

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

New devices are listed in bold red.

→ MOSFET and GaN Drivers

Selection Guide (Continued)

Device	No. of Channels	Output Configuration	Output Type ¹	Peak I _{OUT} Source/Sink (A)	Rise/Fall Time (ns)	V _{CC} Range (V)	Prop Delay (ns)	Input Threshold	Enable	Dead Time Control	Protection Features ²	Internal Regulator	HiRel (H) or Automotive (A) [†]	Price*
Synchronous Buck Drivers (Continued)														
TPS2835	2	Inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	✓	Adaptive	OVPC	—		1.05
TPS2836	2	Non-inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	—	Adaptive	—	—		1.25
TPS2837	2	Inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	—	Adaptive	—	—		1.25
TPS2838	2	Non-inverting	TrueDrive	4/4	120	10 to 15	40	TTL	✓	Adaptive	—	✓		1.30
TPS2839	2	Inverting	TrueDrive	4/4	120	10 to 15	40	TTL	✓	Adaptive	—	✓		1.30
TPS2848	2	Non-inverting	TrueDrive	4/4	120	10 to 15	20	TTL	✓	Adaptive	—	✓		1.25
TPS2849	2	Inverting	TrueDrive	4/4	120	10 to 15	20	TTL	✓	Adaptive	—	✓		1.25
UCC27221	2	Inverting	TrueDrive	3.3/3.3	20/20	3.7 to 20	82/103	TTL	—	PGD ⁴	—	✓		1.70
UCC27222	2	Non-inverting	TrueDrive	3.3/3.3	20/20	3.7 to 20	82/103	TTL	—	PGD ⁴	—	✓		1.70
UCC27223	2	Non-inverting	TrueDrive	3.3/3.3	25/35	4.15 to 20	82/103	TTL	✓	PGD ⁴	—	✓		1.70
UCD7230	2	Non-inverting	CMOS	4/4	10/10	4.5 to 15.5	25	CMOS/TTL	—	Adaptive	Adjustable	—		0.80
High-Side Low-Side Drivers—Half Bridge, Full Bridge														
UCC27200/A	2	Non-inverting	TrueDrive	3/3	8/7	to 110 ⁵	20	CMOS	—	—	UVLO	—	A	1.30
LM5100A/B/C	2	Non-inverting	CMOS	3/3	8/8	to 118	25	CMOS	—	—	UVLO	—		1.25
UCC27201/A	2	Non-inverting	TrueDrive	3/3	8/7	to 110 ⁵	20	TTL	—	—	UVLO	—	A	1.30
LM5101A/B/C	2	Non-inverting	CMOS	3/3	8/8	to 118	25	TTL	—	—	UVLO	—		1.25
UCC27210	2	Non-inverting	—	4/4	12/9	to 115 ⁵	20	CMOS	—	—	UVLO	—		1.40
UCC27211	2	Non-inverting	—	4/4	12/9	to 115 ⁵	20	TTL	—	—	UVLO	—		1.40
LM5113	2	Non-inverting	GaN FET	1.2/5	4/4	to 100 ⁵	30	TTL	—	—	UVLO	—		1.65

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

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

New devices are listed in bold red.

Isolated Solutions

→ Isolated Power Modules

Design Factors

Plug-in power solutions are board-mounted, completely integrated, DC/DC converters requiring only one or two external components.

Input Voltage (V_{IN}) — Plug-in power solutions are designed to work from industry-standard DC bus voltages.

Output Current (I_{OUT}) — The I_{OUT} of the converter should match the maximum current need of your application.

Output Voltage (V_{OUT}) — Choose an adjustable or fixed V_{OUT} that meets your requirements.

Isolation — Converters with electrical input to output isolation are usually more complex and more expensive.

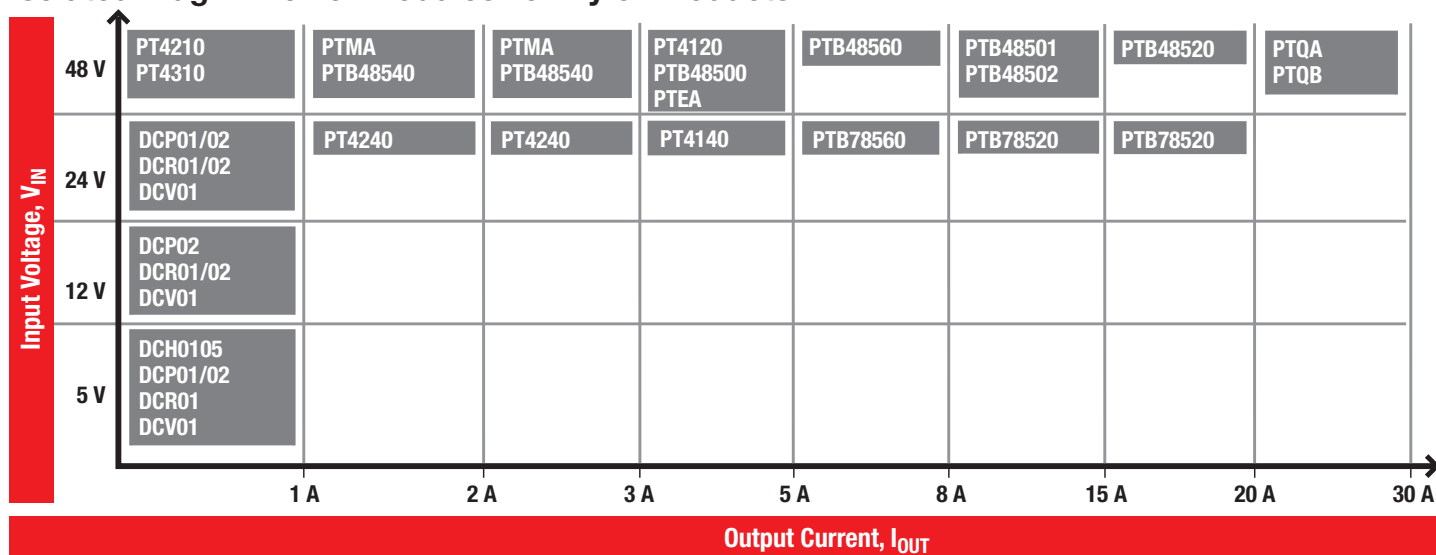
Features — TurboTrans,™ SmartSync, adjustable V_{OUT} , remote sense, over-temperature, overcurrent and output inhibit are some of the many features.

Airflow Requirements — The max current of converters often depends on airflow. Safe-operating-area (SOA) curves determine the airflow needs of converters at specific currents.

Protection — Fault protection can include short circuit, overtemperature, overcurrent and overvoltage protection.

Package — Vertical mounting uses the smallest footprint. Surface mount and horizontal through-hole are available in most product series.

Isolated Plug-In Power Modules Family of Products



Selection Guide

Device ¹	Input Bus Voltage	Description	P_{OUT} or I_{OUT}	V_O Range (V)	V_O Adj.	Auto-Track™ Sequencing	Price*
Isolated Single Output							
DCH01_S	5	1-W Unregulated Isolated DC/DC Converter	1 W	5, 12, 15			4.25
DCP01_B	5, 24	1-W Unregulated Isolated DC/DC Converter with Synchronization	1 W	5, 12, 15			5.35
DCP02	5, 12, 24	2-W Unregulated Isolated DC/DC Converter with Synchronization	2 W	3.3, 5, 7, 9, 12, 15			6.95
DCR01	5, 12, 24	1-W Regulated Isolated DC/DC Converter with Synchronization	1 W	3.3, 5			5.95
PT4210	48 V	3- to 7-W 48-V Input Isolated DC/DC Converter	3 to 7 W	3.3 to 12			18.75
PTB48520W	48 V	25-A 48-V Input Isolated POL Converter with Auto-Track I/O	75 W	1.8 to 3.6	✓	✓	62.00
PTB48540A/B/C	48 V	10-W 48-V Input Isolated PoE Module	10 W	3.3, 5, 12	✓		26.00
PTB48560A/B/C	48 V	30-W 48-V Input Isolated POL Converter with Auto-Track I/O	30 W	3.3, 5, 12	✓	✓	25.00
PTB78520W	18 V to 60 V	20-A 18-V to 60-V Input Isolated POL Converter with Track I/O	65 W	1.8 to 3.6	✓	✓	62.00
PTB78560A/B/C	18 V to 60 V	30-W 18-V to 60-V Input Isolated POL Converter with Track I/O	30 W	3.3, 5, 12	✓	✓	25.00
PTEA4	48 V	50-W 48-V Input Isolated DC/DC Converter—Industry Std Footprint	50 W	2.5, 3.3, 12	✓		26.50
PTMA4	48 V	10-W 48-V Input Isolated DC/DC Converter—Industry Std Footprint	10 W	3.3, 5, 12	✓		20.00
PTQA4	48 V	100-W 48-V Input Isolated DC/DC Converter—Industry Std Footprint	100 W	2.5, 3.3, 5	✓		44.00
PTQB4	48 V	200-W 36- to 75-V Input Isolated Bus Converter w Auto-Track	200 W	8		✓	45.00
Isolated Multiple Output							
DCH01_D	5	1-W Unregulated Isolated DC/DC Converter	1 W	±5, ±12, ±15			4.25
DCP01_DB	5, 15, 24	1-W Unregulated Dual Isolated Converter with Synchronization	1 W	±5, ±12, ±15			5.90
DCP02_D	5, 12, 24	2-W Unregulated Dual Isolated Converter with Synchronization	2 W	±5, ±12, ±15			6.95

¹See power.ti.com for a complete product offering.

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

→ LED Lighting — General Illumination

LED technologies continue to improve and to produce more light while using less power at lower costs. This trend is fueling flexible, creative, cost-effective lighting, backlighting, video, message and signage designs that can be achieved only as a result of these advances in LED technology.

Solid-state LED lighting applications include retrofitted lightbulb replacement, high-bay and street lighting, and fully customized luminaires. Key considerations can include:

- Superior light quality as compared to traditional light sources

- Existing form factor and socket compatibility
- Supply voltage (AC or DC)
- Legacy dimmer compatibility and dimming performance
- High efficiency and long operating life
- Power factor
- Conducted and radiated emissions

Solving these challenges requires a wide variety of LED lighting solutions.

AC/DC LED Drivers — TI offers AC/DC, LED-lighting-driver solutions for dimmable, isolated and non-isolated, highly efficient, power-factor-corrected, long-life, compact form-factor designs

while maintaining compatibility with installed fixtures and dimmers. Over-voltage, over-current and over-temperature protection features 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 12- to 24-V retrofitted designs such as MR-16.

For more information visit: www.ti.com/led

Phase Dimmable Offline LED Driver with Integrated FET for Retrofit Lighting Applications

LM3448

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/LM3448

The LM3448 is designed for integrated LED lamp form factors that require low component count, high-performance, dimmable LED drivers. The phase angle dimming decoder is compatible with leading-edge TRIAC and trailing-edge electronic dimmers allowing full-range LED dimming. The integrated 600-V avalanche-protected, high-voltage and

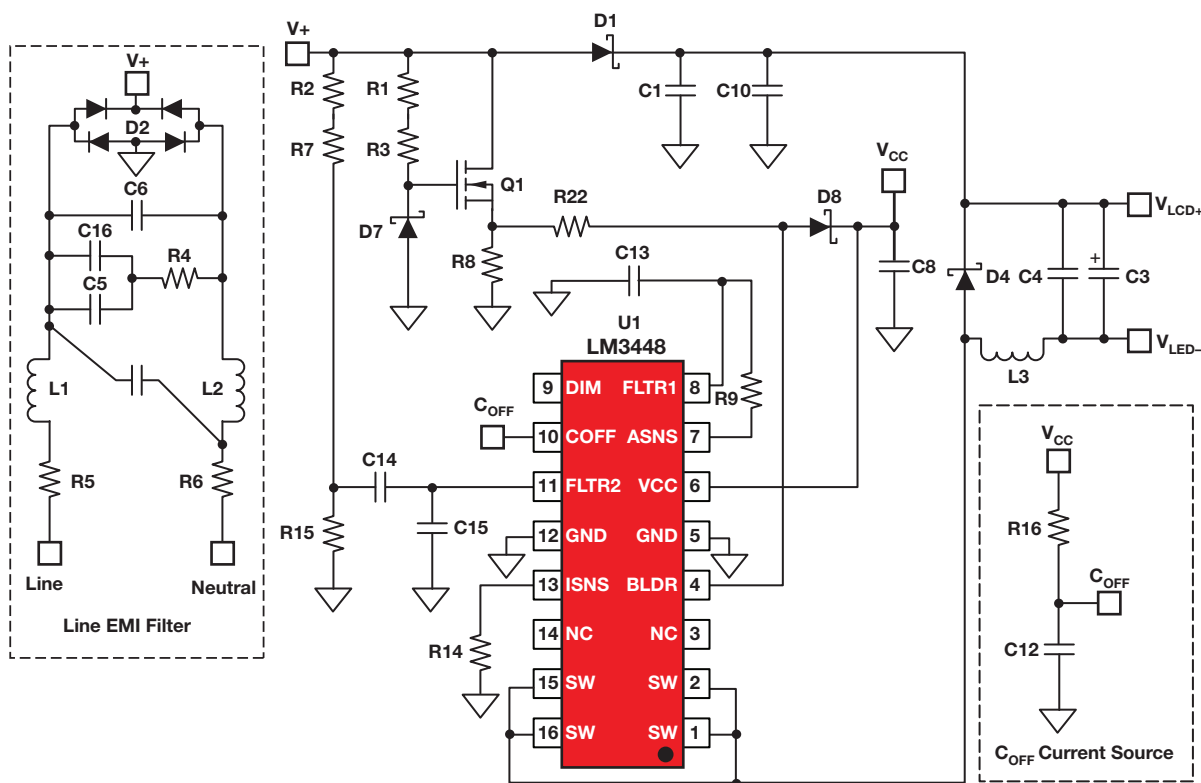
low $R_{DS(on)}$ MOSFET reduces design complexity while improving LED driver efficiency.

Applications

- Dimmable lamps < 8 W: GU10, A19, E26/27
- LED luminaires

Evaluation Modules

Part Number	Description
LM3448-120VFLBK	120-VAC, 6-W isolated flyback LED driver evaluation board
LM3448-230VFLBK	230-VAC, 6-W isolated flyback LED driver evaluation board
LM3448-EDSNEV	A19 Edison retrofit evaluation board



Display Power and LED Lighting

→ LED Lighting – General Illumination

Phase Dimmable Offline Quasi-Resonant LED Lighting Controller for Retrofit Lighting Applications

TPS92070

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS92070

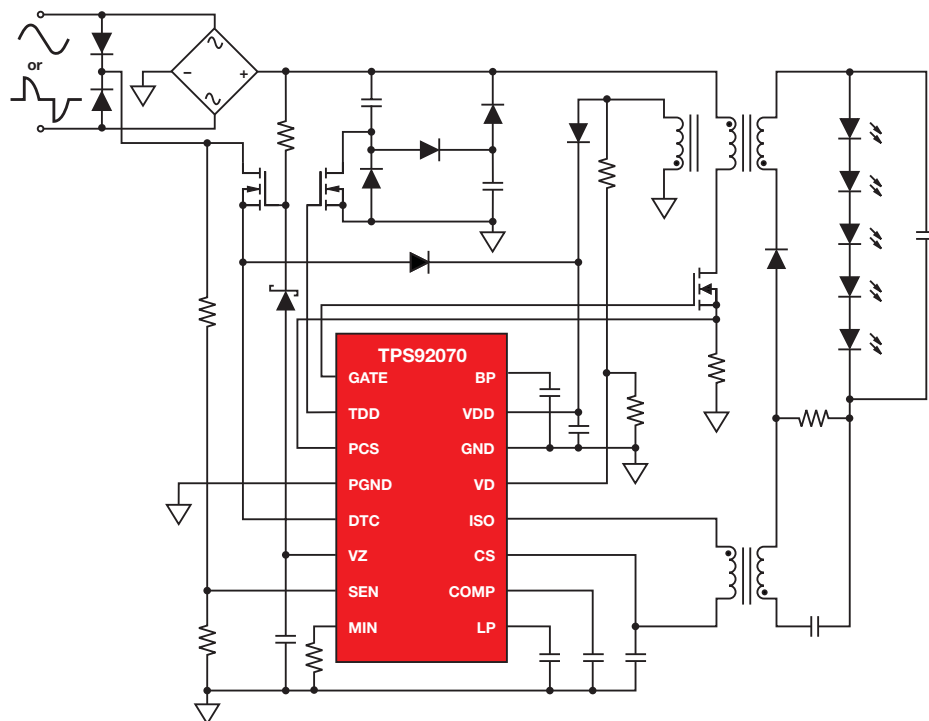
The TPS92070 is an integrated offline dimmable, flyback LED lighting controller which allows customers to easily realize high-performance, form-factor optimized solid-state lighting solutions. The internal precision error amplifier ensures uniform, flicker-free light output between drivers—even under deep dimming.

Applications

- Dimmable lamps: A19, PAR3x
- Downlights
- Retail lighting

Evaluation Modules

Part Number	Description
TPS92070EVM-682	120-VAC, 6-W isolated flyback LED driver evaluation board
TPS92070EVM-648	230-VAC, 6-W isolated flyback LED driver evaluation board



Smart Linear LED Driver for Multi-Channel LED Systems

LM3466

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/LM3466

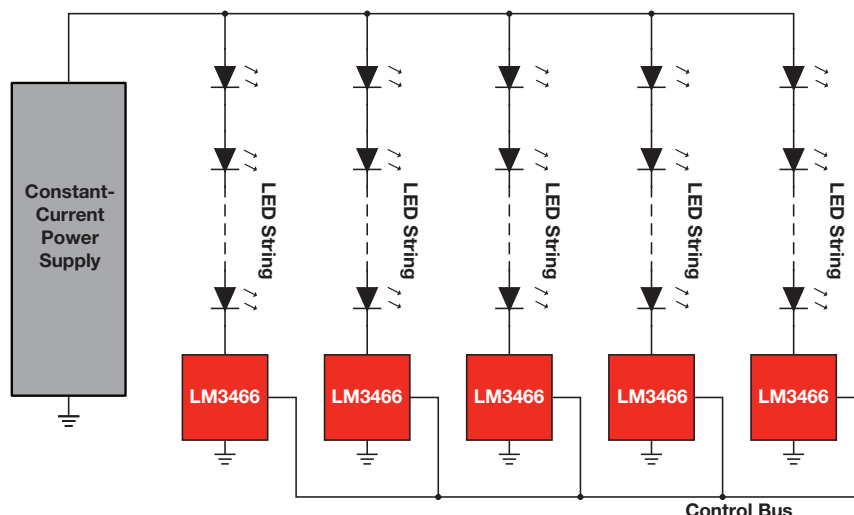
The LM3466 combines the best attributes of the existing series/parallel LED drive solutions, and it is essentially an intelligent ballast resistor. It operates at 6 to 70 V and can support up to 70 LEDs per string while ensuring automatic, accurate current balancing between drivers for even brightness. If one string opens, current is rebalanced in the remaining strings.

Applications

- Streetlights
- Solid-state lighting systems

Evaluation Module

Part Number	Description
LM3466MREVAL	LED driver 5-string reference board



Display Power and LED Lighting

→ LED Lighting — General Illumination

Selection Guide

Device	V _{IN} (min) (V)	V _{IN} (max) (V)	LED Voltage (max) (V)	Switching Frequency (kHz)	DC/DC or AC/DC Control	Isolated Applications	Non-Isolated Applications	Topology	LED Configuration	Dimming	PFC	EVM	Package(s)	Price*
AC/DC High-Brightness LED Drivers														
TPS92001	9	19	Configurable	100	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	TRIAC	✓		8 MSOP, 8 SOIC	0.45
TPS92002	14	19	Configurable	100	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	TRIAC	✓		8 MSOP, 8 SOIC	0.45
TPS92010	6.3	21	Configurable	130	AC/DC	✓	✓	Flyback	Series/Parallel	TRIAC		✓	8 SOIC	0.39
TPS92020	11.5	18	Configurable	350	DC/DC	✓	✓	Half-Bridge	Multi-String Series/Parallel	PWM		✓	8 SOIC	0.80
TPS92210	9	20	Configurable	140	AC/DC	✓	✓	Flyback	Series/Parallel	TRIAC	✓	✓	8 SOIC	0.75
TPS92070	9	21.5	Configurable	146	AC/DC	✓	✓	Flyback	Series/Parallel	TRIAC	✓	✓	16 TSSOP	0.95
LM3444	8	13	Configurable	1000	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	No	✓	✓	10 MSOP	0.70
LM3445	8	12	Configurable	1000	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	TRIAC, TE	✓	✓	10 MSOP, 14 SOIC	1.00
LM3448	8	12	Configurable	1000	AC/DC	✓	✓	Flyback/Buck	Series/Parallel	TRIAC, TE	✓	✓	16 SOIC	1.10
LM3450/A	8.5	20	Configurable	120	AC/DC	✓	✓	Flyback	Series/Parallel	TRIAC, TE	✓	✓	16 TSSOP	1.85
UCC28810	15.4	18	Configurable	140	AC/DC	✓	✓	Flyback/Boost	Series/Parallel	TRIAC	✓	✓	8 SOIC	0.32
UCC28811	12	18	Configurable	140	AC/DC	✓	✓	Flyback/Boost	Series/Parallel	PWM/Analog	✓	✓	8 SOIC	0.32

Device	Max LED Current (mA)	Input Voltage Range (V)	Maximum Output Voltage (V)	Maximum Number of LEDs in Series	Switching Frequency (MHz)	Topology	Features	Packaging	Price*
DC/DC High-Brightness LED Drivers									
LM3464/A	1000+	12 to 80/ 12 to 95	80/95	25	Up to 1 MHz	Boost	Dynamic headroom control, 4 output channels	28 eTSSOP	3.95/4.50
LM3466	1500	6 to 70	70	20	—	Linear	LED string current equalization	8 ePSOP	0.95
LM3414/HV	1000	4.5 to 42/ 4.5 to 65	80/95	16	Up to 1 MHz	Buck	Thermal foldback , analog and PWM dimming	8 ePSOP/LLP®	1.25
LM3492	200	4.5 to 65	65	17	Up to 1 MHz	Boost	Dynamic headroom control, 2 output channels, 1000:1 dimming contrast ratio	20 eTSSOP	1.60
LM3431 E, W	150 per string	5.0 to 36	40+	30	1	Analog, PWM	3-string output	28 TSSOP/LLP	1.95
LM3402/02HV E, W	500	6.0 to 42/ 6.0 to 75	40/70	12/20	Adjustable up to 1 MHz	Buck	Fast PWM dimming, no control loop compensation, supports ceramic capacitor and capacitor-less outputs	8 MSOP/PSOP	1.05/1.30
LM3404/04HV E, W	1000	6.0 to 42/ 6.0 to 75	40/70	12/20	Adjustable up to 1 MHz	Buck	Fast PWM dimming, no control loop compensation, supports ceramic capacitor and capacitor-less outputs	8 SOIC/PSOP	1.30/1.50
LM3410 E, W	1000	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 LLP	1.25
LM3406/06HV E, W	1500	6.0 to 42/ 6.0 to 75	40/70	12/20	Adjustable to 1 MHz	Buck	Fast PWM dimming, no control loop compensation, supports ceramic capacitor and capacitor-less outputs	14 eTSSOP	1.59/1.68
LM3421/23/29 E, W	>2000	4.5 to 75	75	20	Adjustable to 2 MHz	Boost, SEPIC	Fast PWM dimming, LED ready, broken open check overvoltage protection, FLT, cycle-by-cycle current limit	16/20/14 eTSSOP	1.55/1.75/ 1.35
LM3433/34 E, W	6000+	–9.0 to –14	–6	1	Adjustable up to 1 MHz	Buck	Drives common-anode LEDs, analog and fast PWM dimming	24 LLP	2.50/2.70
LM3409/HV E, W	5000	6.0 to 42/ 6.0 to 75	42/75	13/23	1 MHz	Buck	PWM and analog dimming, high-side current sense, 100% duty cycle achievable	10 eMSOP	1.25/1.35
LM3424 E, W	3000+	3.5 to 75	75	18	Adjustable to 2 MHz	Boost, SEPIC	Temperature foldback , synchronizable 50-kHz max PWM dimming	20 eTSSOP	1.75
TPS40211	3000+	4.5 to 52	50	15	Up to 1 MHz	Boost, SEPIC, Flyback	Programmable soft start, overcurrent protection with auto retry, programmable oscillator frequency	10 MSOP, 10 SON	1.25

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

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

Display Power and LED Lighting

→ LED Video Display Drivers

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.

Current Reference Short Flag — Indicates whether the current set resistor is shorted to ground.

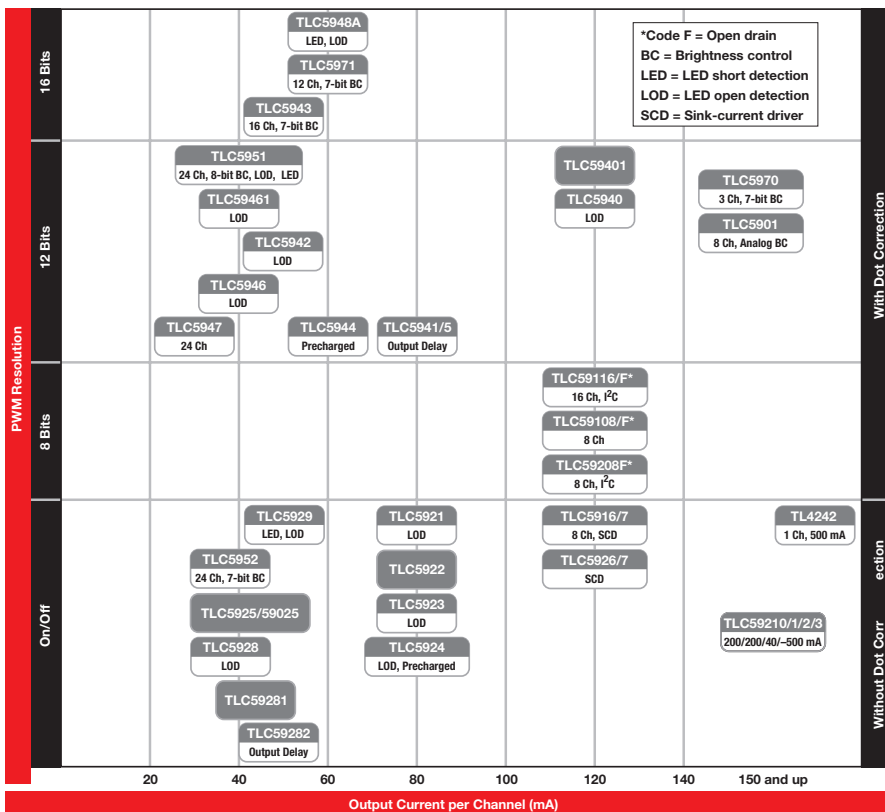
Power Save Mode — Reduces LED driver quiescent current when all outputs are off.

LED Short Detection — Indicates a shorted LED to ground at an output.

Invisible Detection Mode — Indicates LED Open and LED Short conditions while an output is off.

Output Leakage Detection — Indicates high resistance leakage from an output to ground.

LED Display Drivers Function Guide



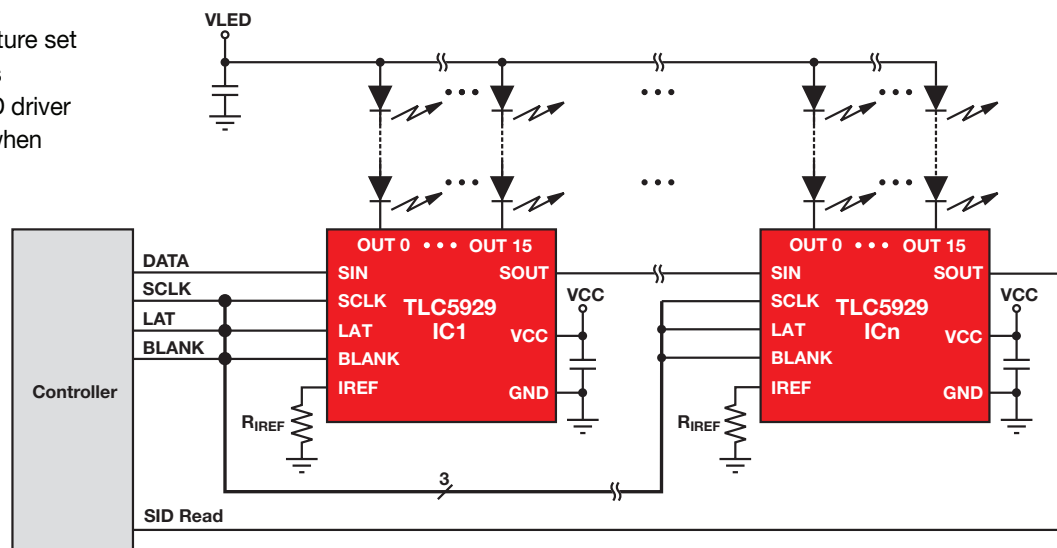
16-Channel LED Driver with 7-Bit Global Brightness, Power Save Mode, Full Diagnostics

TLC5929

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TLC5929

Key Features

- Complete LED diagnostics feature set monitors for all fault conditions
- Power Save mode reduces LED driver current consumption by 100x when image is off
- 33-MHz data transfer rate
- 2 ns per channel delayed switching



Display Power and LED Lighting

→ LED Video Display Drivers

Selection Guide

Device	No. of Chan.	V _{IN} Min (V)	V _{IN} Max (V)	Output Current I _{LED} (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	HiRel (H) or Automotive (A) [†]	Price*
TL4242	1	4.5	42	500	—	—		✓	✓	✓				—		A	0.35
TLC5916	8	3.3	5.5	120	±3 (Max)	±6 (Max)			✓	✓	8			SPI		A	0.47
TLC5917	8	3.3	5.5	120	±3 (Max)	±6 (Max)		✓	✓	✓	8			SPI		A	0.60
TLC59108	8	3	5.5	100	±3 (Max)	—			✓	✓	8		8	I ² C	Constant-current output		0.80
TLC59108F	8	3	5.5	100	±3 (Max)	—			✓	✓	8		8	I ² C	Open-drain output		0.80
TLC59208F	8	3	5.5	50	±3 (Max)	—			✓	✓	8		8	I ² C	Open-drain output but changes the I ² C addressing capability		0.65
TLC59116	16	3	5.5	100	±6 (Max)	—			✓	✓	8		8	I ² C	Constant-current output		1.45
TLC59116F	16	3	5.5	100	±6 (Max)	—			✓	✓	8		8	I ² 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			0.85
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
TLC59025	16	3	5	45	±4 (Max)	±6 (Max)				✓				SPI			0.55
TLC5926	16	3	5.5	120	±6 (Max)	±6 (Max)			✓	✓	8			SPI		A	0.60
TLC5927	16	3	5.5	120	±6 (Max)	±6 (Max)		✓	✓	✓	8			SPI		A	0.65
TLC5928	16	3	5.5	35	±1	±1			✓	✓				SPI			0.50
TLC59281	16	3	5.5	35	±1	±1								SPI			0.43
TLC59282	16	3	5.5	45	±0.6	±1								SPI	4-channel grouped delay		0.47
TLC5929	16	3	5.5	50	±1	±2		✓	✓	✓	7			SPI	Power save mode, invisible error detection, 10-V VLED		0.85
TLC5930	12	3	3.6	40	±1	—				✓	6	8	10	SPI			3.00
TLC5940	16	3	5.5	120	±1	±2			✓	✓		6	12	SPI			1.25
TLC59401	16	3	5.5	120 ¹ /80 ²	±1	+2/–2.7				✓		6	12	SPI			1.80
TLC5941	16	3	5.5	80	±1	±2			✓	✓		6	12	SPI		A	1.00
TLC5942	16	3	5.5	50	±1.5	±3			✓	✓		7	12	SPI			1.10
TLC5943	16	3	5.5	50	±1.5	±3		✓	✓	✓	7		16	SPI			1.50
TLC5944	16	3	5.5	60	±1	±3	✓	✓	✓	✓		6	12	SPI			1.10
TLC5945	16	3	5.5	80	±1	±2			✓	✓		6	12	SPI			1.10
TLC5946	16	3	5.5	40	±1	±2			✓	✓		6	12	SPI			1.00
TLC59461	16	3	5.5	40	±1	±2			✓	✓		6	12	SPI	No auto-off function		1.05
TLC5947	24	3	5.5	30	±2	±2				✓			12	SPI	30-V V _{LED} , internal oscillator		1.40
TLC5948A	16	3	5.5	60	±0.6	±1		✓	✓	✓	7	7	16	SPI	Power save mode, invisible error detection, 10-V VLED		1.35
TLC5951	24	3	5.5	40	±1.5	±3		✓	✓	✓	8	7	12, 10, 8	SPI			3.00
TLC5952	24	3	5.5	35	±1	±3		✓	✓	✓	7			SPI			2.20
TLC5970	3	10	36	150	±0.5	±3		✓	✓	✓	7	7	12	Differential			3.30
TLC5971	12	3	17	60	±1	±1				✓	7		16	SPI	Integrated 3.3-V LDO		1.50

¹Output current with V_{CC} > 3.6 V.

²Output current with V_{CC} ≤ 3.6 V.

³TLC5960/TLC59601 output current is limited by external FET.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.

*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 blue.

Display Power and LED Lighting

→ Display Bias, Level Shifters and Scan Drivers

Multichannel Bias Power for E-Paper Display

TPS65185

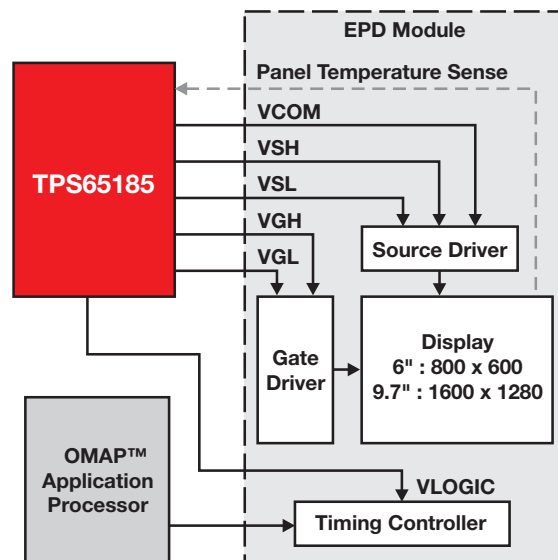
Get more information at: www.ti.com/product/TPS65185

The TPS65185 is a power management IC that is ideal for powering an electronic paper display (EPD). In addition to the bias supplies required by the display drivers and timing controller, the IC also supports display temperature sensing.

Key Features

- 3- to 6-V input voltage range
- Positive charge-pump driver (VDDH): +22 V at 10 mA
- Negative charge-pump driver (VEE): -22 V at 12 mA

- Two adjustable LDOs
 - +15 V at 120 mA (Default output VPOS)
 - -15 V at 120 mA (Default output VNEG)
 - $VPOS + VNEG = \pm 50$ mV
- Adjustable VCOM driver
 - 0 to -5.11 V
 - 9-bit resolution
 - 15-A (max) integrated switch
- Integrated temperature sensor
- Integrated power switch
- Packaging: 7x7-mm QFN



LCD Bias Solution for LCD Panels

TPS65149

Get more information at: www.ti.com/product/TPS65149

The TPS65149 is a highly integrated single-chip IC that is ideal for powering a panel for a monitor or notebook by using ASG/GIP technology. This IC also includes an 8-channel level shifter, a boost converter and a VCOM buffer.

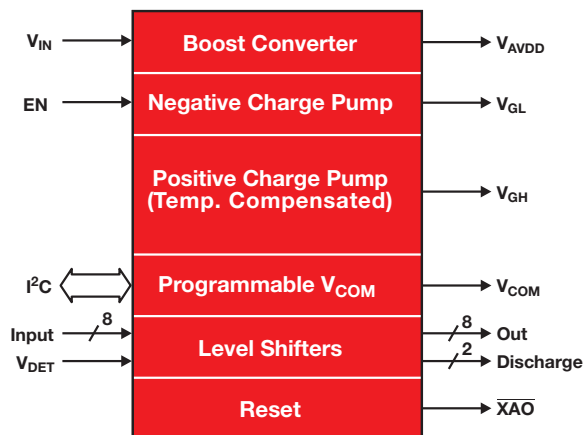
Key Features

- 3- to 6-V input-voltage range
- Boost converter with 4-A switch-current limit
- Boost-converter output voltages up to 18 V
- Temperature-compensated positive-charge-pump controller
- Negative-charge-pump controller
- 8-channel level shifter

- Two panel-discharge signals
- XAO reset signal
- Digitally programmable VCOM buffer
- 56-pin, 7x7-mm QFN package

Applications

- LCD panels using GIP/ASG technology:
 - LCD monitors
 - Small (5-V input) TVs
 - Notebook PCs



Display Power and LED Lighting

→ Display Bias, Level Shifters and Scan Drivers

Selection Guide

Device	V _{IN} (V)	Boost I _{Limit} (min) (A)	Buck I _{Limit} (min) (A)	Features ¹							Price*
				Isolation Switch	V _{GH}	V _{GL}	GVS	V _{Com}	HVS	Other	
Solutions for Large LCDs (TVs)											
TPS61087	5	3.2	—	—	External	External	—	—	—		1.60
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 ² 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 ² C, Vcom, bucks for HVDD, VCC, VCore, VEPI, boost for VDD	1.90

Device	V _{IN} (V)	Boost I _{Limit} (min) (A)	Features ¹								HiRel (H) or Automotive (A) [†]	Price*
			Overvoltage Protection	Isolation Switch	V _{Logic}	V _{GH}	V _{GL}	GVS	V _{Com}	Other		
Solutions for Medium and Small LCDs (Monitors and Notebooks)												
TPS61085	5	2	Yes	—	—	External	External	—	—		A	0.95
TPS61087	5	3.2	Yes	—	—	External	External	—	—			1.60
TPS65100	5	1.6	Yes	—	LDO controller	Integrated	Driver	—	1 buffer		A	1.87
TPS65105	5	0.96	Yes	—	LDO controller	Integrated	Driver	—	1 buffer			1.87
TPS65140	5	1.6	Yes	—	LDO controller	Integrated	Driver	—	—		A	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	5	0.96	Yes	—	LDO controller	Integrated	Driver	—	—		A	1.71
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	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

¹V_{GH} = Positive LCD rail voltage, V_{GL} = Negative LCD rail voltage, GVS = Gate-voltage shaping for V_{GH},

V_{Com} = LCD V_{Com} voltage source, and HVS = High-voltage stress-test control.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.

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

Device	Description	Number of Channels			V _{GH1} (max) (V)	V _{GH2} (max) (V)	V _{GL} (max) (V)	V _{Com}	GVS/GPM	Charge Sharing	Other	Package	Price
		Clock	Discharge	Additional									
LCD Support IC Solutions (Scan Drivers/Level Shifters)													
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 _{Com} 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 _{Com} op amp	6	1	6	38	38	−23	Op amp 200 mA	Yes	—	4x4 package	QFN-24	1.00

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

Display Power and LED Lighting

→ Display Bias, Level Shifters and Scan Drivers

Selection Guide (Continued)

Device ¹	V _{IN} (V)	LDO 1	LDO 2	Charge Pump 1	Charge Pump 2	Application	Communication Interface	V _{Com} Adjust	Active Discharge	P2P with TPS65181/2	Package	Price*
Solutions for E-Readers												
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 ² 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 ² C	User programmable (internal)	No	Yes	QFN-48 (0.5 mm 7x7)	1.75

¹See datasheets for more specifications.

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

Device	Description	Features	V _{IN}		Frequency	AV _{DD} I _{Limit}	AV _{DD}	Isolation Switch	V _{Logic1} I _{Limit}	V _{Logic1}	V _{GH} (I _{GH})	V _{GL} (I _{GL})	Other	Package	Price*
			(min) (V)	(max) (V)		(mA)	(V)		(min) (A)	(V)					
LCD SFF/MFF — IPS and OLED Solutions (<5 V)															
TPS65120	4-ch single inductor multiple outputs (SIMO) bias IC w/fixed 3.3-V V _{Logic}	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 _{Logic}	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 _{Limit})	Inverter –15 V max. (0.7 A I _{Limit})	—	QFN-24	1.70
TPS65131	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 _{Limit})	Inverter –15 V max. (1.8 A I _{Limit})	—	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
TPS65137A	Dual positive and negative output w/digital V _{neg} 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 adjustment for V _{GL}	QFN-10	0.85
TPS65138	Dual positive and negative output w/digital V _{neg} 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% V _{pos} accuracy	QFN-10	0.95
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

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

Gamma Buffers

Channels	0-V _{Com} Channels	1-V _{Com} Channels	2-V _{Com} Channels
22 (+2 static)			BUF22821
18			BUF18830, BUF20800, BUF20820
16		BUF16822	BUF16821, BUF16833
14			BUF16820
12	BUF12800, BUF12840		
10		BUF11702/4/5	
8	BUF08500	BUF08821, BUF08832, BUF08630	
7		BUF08800	
6	BUF06703, BUF06704	BUF07702/3/4	
4	BUF04701	BUF05703, BUF05704	
0		BUF01900, BUF01901	

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

Display Power and LED Lighting

→ LED Backlighting Drivers

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.

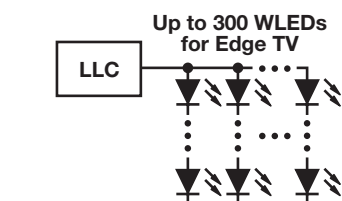
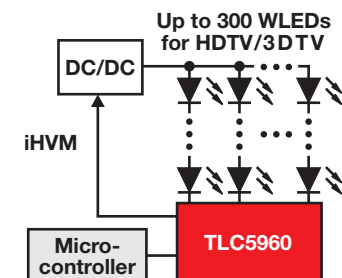
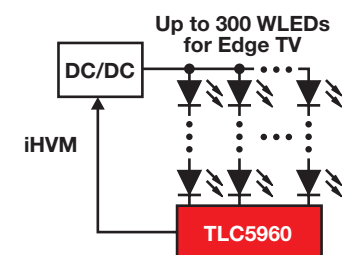
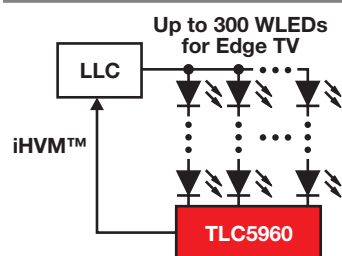
Thermal Error Flag — Indicates an overtemperature condition.

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

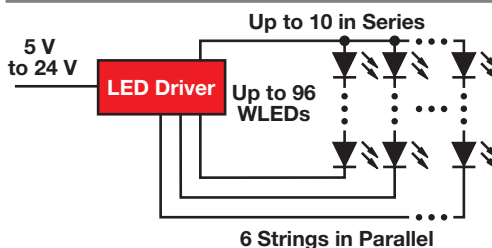
Thermal Shutdown — Turns output off when junction temperature exceeds its limit.

TI LED Driver Configurations

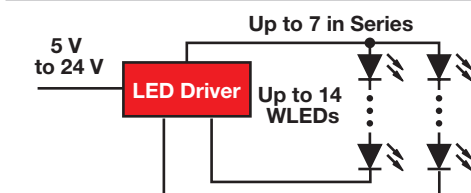
32" LCD TV



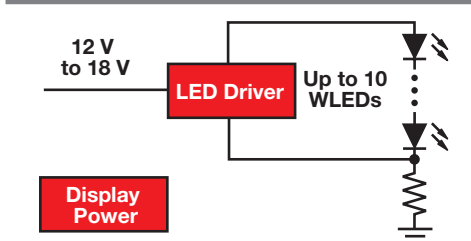
15" to 26" LCD Monitor



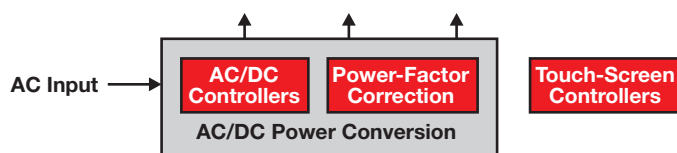
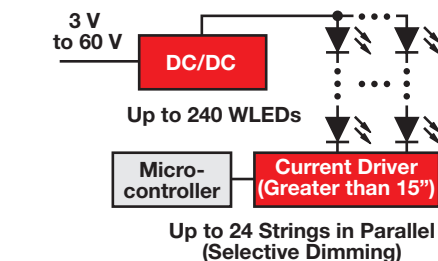
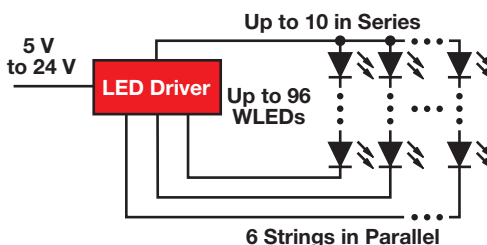
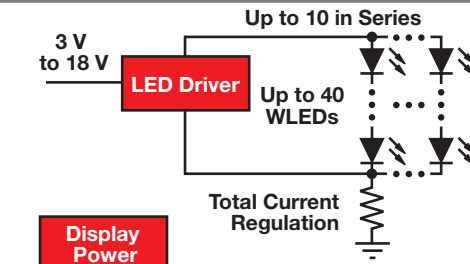
4" to 6" LCD



3" to 5" LCD



7" to 15" LCD



Display Power and LED Lighting

➔ LED Backlighting Drivers

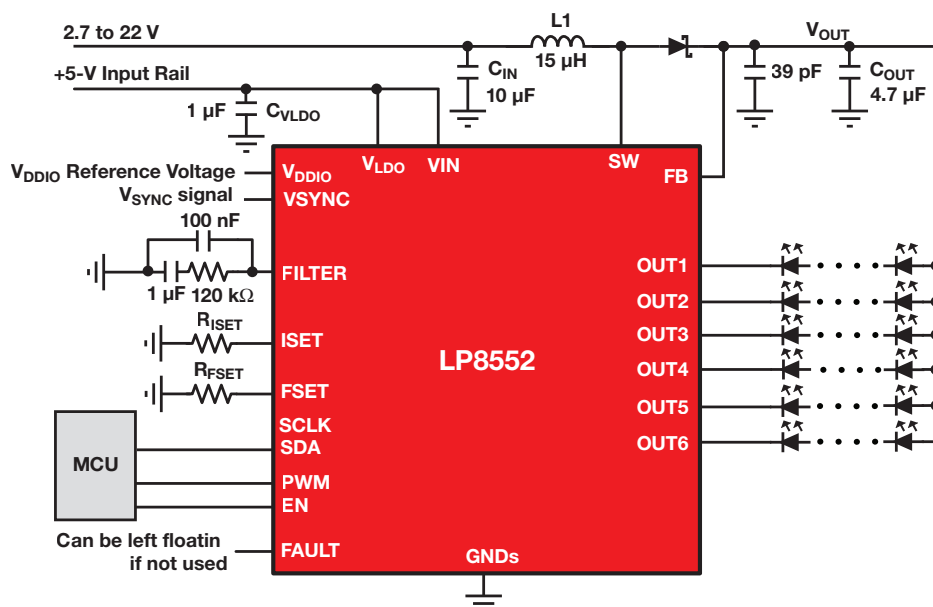
High-Efficiency LED Backlight Driver for Tablets and Notebooks

LP8552

Get samples at: www.ti.com/product/LP8552

Key Features

- Advanced slope control eliminates human eye glitch response of step or linear ramp
- Dithering during transition enables smooth effect
- High-voltage DC/DC boost converter with integrated FET with four switching frequency options: 156/312/625/1250 kHz
- 2.7- to 22-V input-voltage range to support 1x...5x cell Li-Ion batteries
- Programmable PWM resolution
 - True 8- to 13-bit (steady state)
 - Additional 1 to 3 bits using dithering during brightness changes
- I²C and PWM brightness control



Applications

- Notebook and netbook LCD display LED backlight
- LED lighting

iHVM™ with LLC's High Efficiency and Low Cost

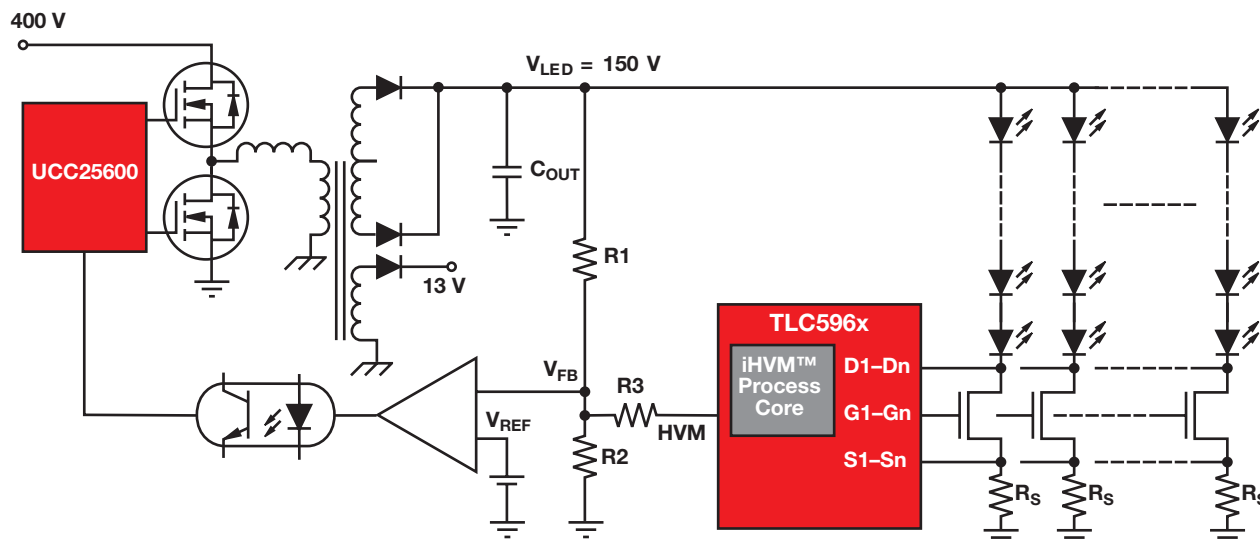
TLC596x + UCC25600

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TLC5960 or [UCC25600](http://www.ti.com/product/UCC25600)

The TLC5960 is an eight-channel LED driver with 250-kHz dimming capability. This is the industry's first LED driver that perfectly fits into systems with direct LED drivers that must provide control back to isolated stages such

as flyback and LLC. The secondary-feedback controlling mechanism of the innovative iHVM™ technology optimizes LED strings' forward-voltage variances automatically. An LLC multiple-output configuration can be

used to regulate the output voltage of the iHVM. The iHVM is flexible enough to utilize a normal DC/DC boost LED power-supply configuration.



TLC596x + UCC25600 block diagram.

Display Power and LED Lighting

→ LED Backlighting Drivers

Selection Guide (Continued)

Device	V _{IN} (V)	Synchronous	Type	Number of LEDs ¹	OLED Capable	LED Configuration	Switch Current Limit (typ) (mA)	Current Regulation	Overvoltage Protection (min) (V)	Output Capacitor	Load-Disconnect During Shutdown	Dimming ²	Peak Efficiency ³ (%)	Quiescent Current (typ) (mA)	Shutdown Current (typ) (μA)	Package(s)	HiRel (H) or Automotive (A) [†]	Price*
TPS61062	2.7 to 6.0	✓	Inductive	5		Series	400	✓	22	220 nF		Yes	81	—	1	QFN-8/WCSP-8		0.97
REG71050	3.2 to 5.5		Charge pump	3		Parallel	—	—	—	2.2 μF		No	92	0.065	0.01	SOT-23		0.55
TPS60230/1	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 ² C	—	6.7	1.3	QFN-16		0.85
TPS60251	2.7 to 6.0		Charge pump	7 + Aux		Parallel	—	✓	—	4.7 μF		I ² C	—	6.7	1.3	QFN-24		0.85
TPS75103/5	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
TPS61183/87	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
TPS61199 ⁵	8 to 30		Inductive	15 x 8		8 Channels	5000	✓	60	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	±0.5	V _{BOOST} + 1.6 V	4.7, 10 μF		PWM, I ² C, ALS	92	< 3.5, Boost ON		QFN-24		2.30
LP8545	4.5 to 22		Inductive	6 x 10		6P10S	2500	±0.5	V _{BOOST} + 1.6 V	4.7, 10 μF		PWM, I ² C	95	< 4, Boost ON		QFN-24		2.30
LP8550	4.5 to 22		Inductive	6 x 10		6P10S	2500	±0.5	V _{BOOST} + 1.6 V	4.7, 10 μF		PWM, I ² C	95	< 3, Boost ON		Micro SMD-25		1.75
LP8552	4.5 to 22		Inductive	6 x 10		6P10S	2500	±0.5	V _{BOOST} + 1.6 V	4.7, 10 μF		PWM, I ² C	95	< 3, Boost ON		Micro SMD-25		1.75
LP8553	4.5 to 22		Inductive	4 x 10		4P10S	2500	±0.5	V _{BOOST} + 1.6 V	4.7, 10 μF		PWM, I ² C	95	< 3, Boost ON		Micro SMD-25		1.75
LM3528	2.5 to 5.5		Inductive	12	✓	2P6S	770	✓	19.25	1 μF	✓	I ² C	0.85	0.25	1.8	WCSP-12		1.10
LM3530	2.7 to 5.5		Inductive	11		10 Series	839	✓	40	1 μF	✓	I ² C	0.88	1.35	1	WCSP-12		1.60
LM3532	2.7 to 5.5		Inductive	30		3P10S	1000	✓	40	1 μF	✓	I ² C	0.87	1.35	1	WCSP-16		1.60
LM3533	2.7 to 5.5		Inductive	22		2P10S	1000	✓	40	1 μF	✓	I ² C	0.87			WCSP-20		1.80
LM3535	2.7 to 5.5		Charge pump	8		8P	—	✓	—	1 μF	✓	I ² C	0.92	1.1	1.7	WCSP-20		1.70
LM3537	2.7 to 5.5		Charge pump	8		8P	—	✓	—	1 μF	✓	I ² C	0.92	1.1	0.2	WCSP-30		1.90
LM3538	2.7 to 5.5		Charge pump	8		8P	—	✓	—	1 μF	✓	I ² C	0.92	1.1	0.2	WCSP-30		1.70
LM2756	2.7 to 5.5		Charge pump	8		8P	—	✓	—	1 μF	✓	I ² C	0.92	2.1	3.7	WCSP-20		1.50
LP5521	2.7 to 5.6		Charge pump	3		3P	—	✓	—	1 μF	✓	I ² C	—	—	—	WCSP-20		0.85
LP5522	2.7 to 5.7		Charge pump	1		—	—	✓	—	—	✓	1 Pin	—	—	—	WCSP-06		0.45
LP5523	2.7 to 5.8		Charge pump	9		9P	—	✓	—	1 μF	✓	I ² C	—	—	—	WCSP-25		0.90
LP5524	2.7 to 5.9		Charge pump	4		4P	—	✓	—	—	✓	—	—	—	—	WCSP-09		0.66
LM8502	2.7 to 5.10	✓	Inductive	10		10P	—	✓	—	10 μF	✓	I ² C	—	—	—	WCSP-30		1.80

¹More LEDs can be driven in parallel string configuration.

²May be via ENABLE pin, CONTROL pin or analog feedback network.

³Depends on LED current, input voltage, number of LEDs, ILED pin.

⁴Output current is limited to 300 mA.

⁵External FET needed.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available. Different pricing may apply.

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

New devices are listed in bold red.

Device	No. of Chan.	V _{IN} Min (V)	V _{IN} Max (V)	Output Current I _{LED} (mA)	Channel-to-Channel Accuracy (%)	Dev.-to-Dev. Accuracy (%)	Short Detection	Open Detection	Overtemperature Detection	Comments	Price*
LED Drivers											
TLC5960	8	10	28	350 ¹	0.3	±1	✓	✓	✓	4 iHVM™ outputs, 4 PWM controls, external FET	1.30

¹TLC5960 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*
LLC Controllers												
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.

New devices are listed in bold red.

Display Power and LED Lighting

→ 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 ¹	V _{IN} (V)	Max. Number of LEDs	Privacy LED	I _{OUT} (max) (mA)	Typical Switch Current (mA)	Super-Capacitor Support	Down Mode when V _{IN} > V _{OUT}	Control Interface	LED Temperature Monitoring	Power Save Mode	Battery Voltage-Drop Monitoring	Package(s)	Features and Differentiators	Total Solution Size (mm ²)	Price*
Camera Flash LED Drivers															
TPS61050/2	2.5 to 5.5	1	✓	1200	2000			I ² C				QFN-10, WCSP-12	Voltage-mode selection pin	25	1.00
TPS61054/5	2.5 to 5.5	1		700/500	1500/1000			Simple logic signal				QFN-10, WCSP-12		25	0.85
TPS61310	2.5 to 5.5	3	✓	1500	2000		✓	I ² C	✓	✓	✓	WCSP-20	HW-reset input, dual-wire camera-module interface, Power Good	25	1.55
TPS61325	2.5 to 5.5	3	✓	4100	1850	✓	✓	I ² C	✓	✓		WCSP-20	Dual-wire camera-module interface, super-capacitor balancing, flash ready output	25	1.70
TPS61300/1/5	2.5 to 5.5	3	✓	4100	1850	✓	✓	I ² 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 ² C	✓			WCSP-12	600mA compact solution with integrated protection features	15	0.60
LM3554	2.5 to 5.5	2		1200	1000/1500/2000/2500		✓	I ² C	✓		✓	WCSP-16	1.2A inductive driver with protection features and voltage mode	23	1.30
LM3555	2.5 to 5.5	2		500	1250/1500/1750/2000			I ² C	✓			WCSP-12	Series driver with 90% efficiency and indicator LED	31	1.30
LM3556	2.5 to 5.5	1		1500	1700/1900/2500/3100		✓	I ² C	✓		✓	WCSP-16	4MHz 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 ² C	✓		✓	WCSP-16	1.8A inductive flash LED driver with programmable indicator blinking	26	1.40
LM3560	2.5 to 5.5	2		2000	1600/2300/3000/3600		✓	I ² C	✓			WCSP-16	1.8A inductive flash LED driver with programmable indicator blinking	26	1.45
LM3550	2.5 to 5.5	4		5000	—	✓		I ² C				LLP®	Super-cap flash LED driver with optimal mode to limit power dissipation	—	1.95

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

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

New devices are listed in bold red.

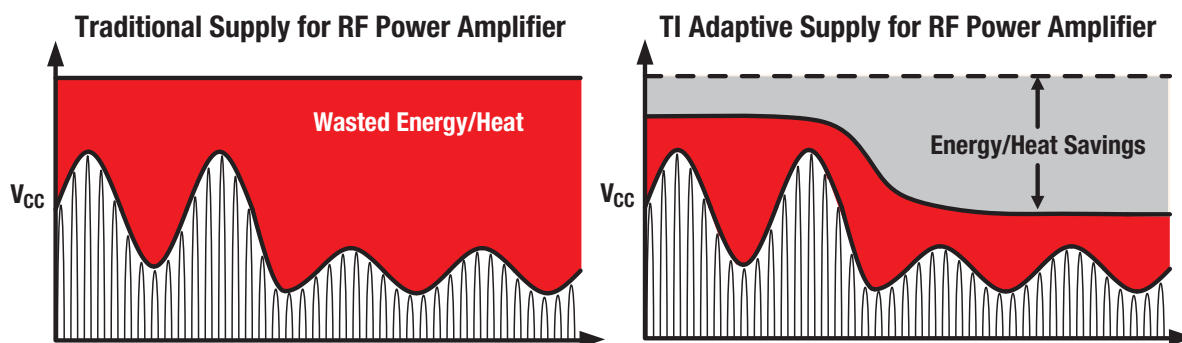
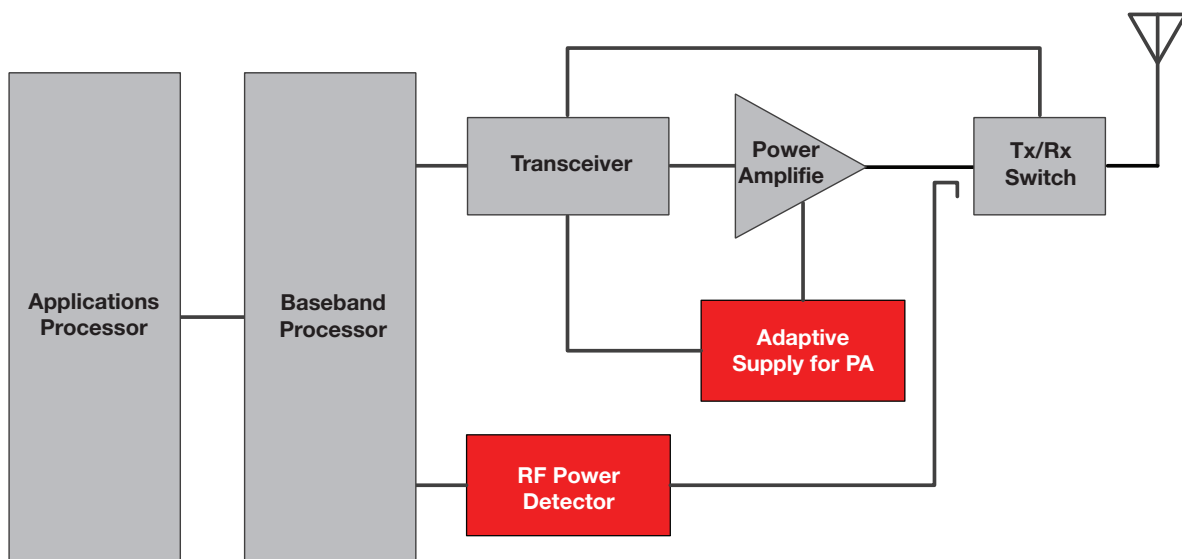
→ Overview

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.



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

→ RF Power Amplifiers

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

LM3242

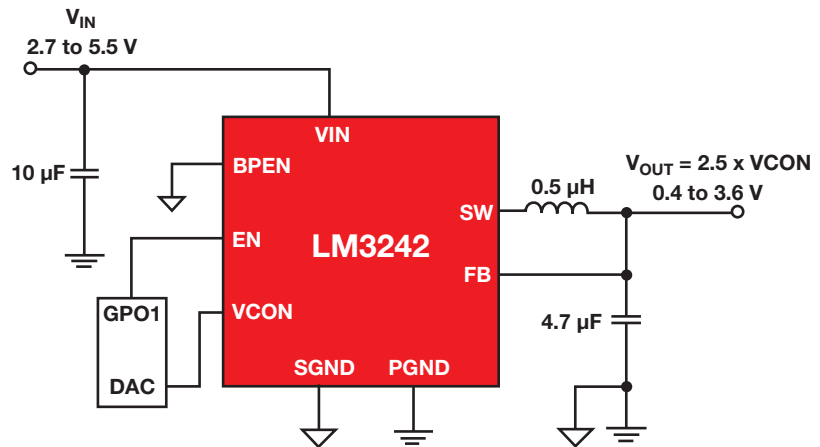
Get samples, datasheets, evaluation modules and app notes at: www.ti.com/product/LM3242

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.

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

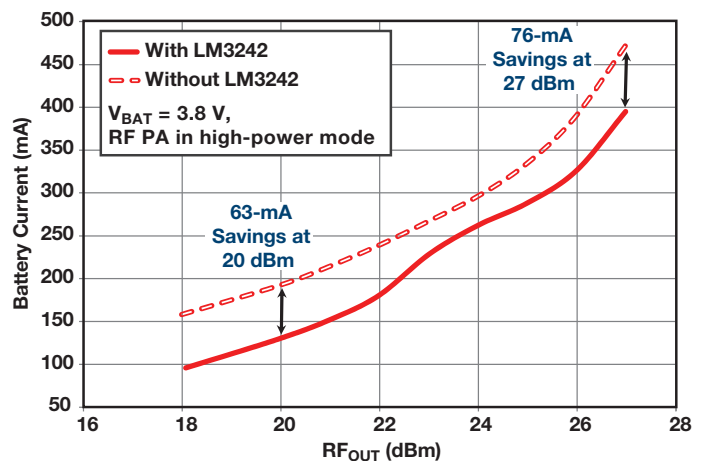


LM3242 application circuit with just three tiny surface-mount components.

Thermal Imaging—RF Power Amplifier



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



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 _{IN} (V)	V _{OUT} (V)	I _{OUT} (max) (mA)	Bypass Modes	Soft Start	Switching Frequency (MHz)	Package(s)	Price*
LM3209-G3	Buck-Boost	2.7 to 5.5	0.6 to 4.2	1000	None	No	2.4	12-bump Micro SMD	1.60
LM3212	Buck	2.7 to 5.5	0.5 to 3.4	2500	Forced and Active	No	1.6	16-bump Micro SMD	1.20
LM3241	Buck	2.7 to 5.5	0.6 to 3.4	750	None	Yes	6	6-bump Micro SMD	0.90
LM3242	Buck	2.7 to 5.5	0.4 to 3.6	750	Forced and Auto	Yes	6	9-bump Micro SMD	0.95
LM3243	Buck	2.7 to 5.5	0.4 to 3.6	2500	Forced and Active	No	2.7	16-bump Micro SMD	1.30

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

New devices are listed in bold red.

→ RF Power Detectors

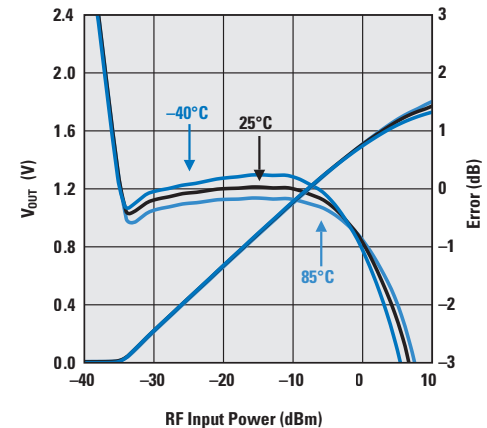
8-GHz LOG/LIN RMS RF Power Detector

LMH2110, LMH2120

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/LMH2110 or [LMH2120](http://www.ti.com/product/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
 - ±0.3-dB log conformance error
 - ±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)



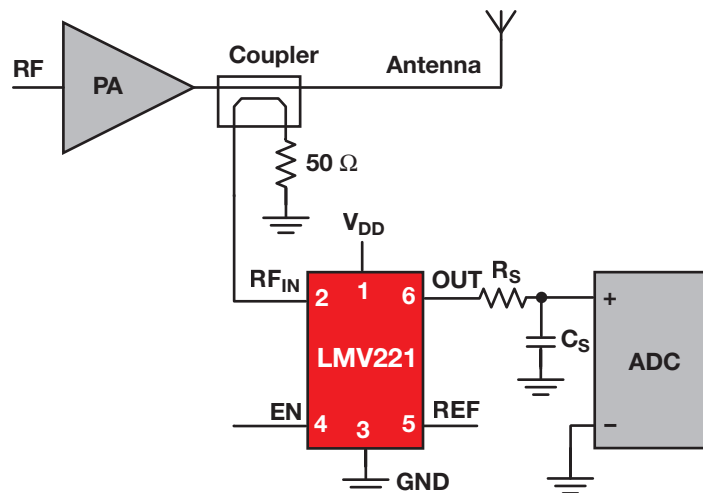
50-MHz to 4-GHz 40-dB Logarithmic Power Detector for CDMA and WCDMA

LMV221, LMH2100

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/LMV221 or [LMH2100](http://www.ti.com/product/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)



Typical application circuit.

RF Power Detectors

Device	Application	Channels	Supply Voltage Range (V)	Dynamic Range (dB)	Frequency Range (MHz)	Type	Package(s)	Price*
LMV221 ¹	CDMA, WCDMA, GSM, GPRS	1	2.7 to 3.3	40	50 to 3500	LOG Amp	LLP-6	1.00
LMV225 ¹	CDMA, WCDMA, GSM, EDGE, GPRS, TDMA	1	2.7 to 5.5	>30	450 to 2000	LOG Amp	Micro SMD-4, LLP-6	0.50
LMV226 ¹	CDMA, WCDMA, GSM, EDGE, GPRS, TDMA	1	2.7 to 5.5	>30	450 to 2000	LOG Amp	Micro SMD-4	0.95
LMV228 ¹	CDMA, WCDMA, GSM, EDGE, GPRS, TDMA	1	2.7 to 5.5	>30	450 to 2000	LOG Amp	Micro SMD-4	0.50
LMV232 ¹	3G, UMTS, WCDMA, CDMA2000, LAN, GPS	2	2.5 to 3.3	20	50 to 2000	LIN MS Amp	Micro SMD-8	0.92
LMH2100 ¹	CDMA, WCDMA, GSM, GPRS	1	2.7 to 3.3	40	50 to 4000	LOG Amp	Micro SMD-6	1.10
LMH2110 ¹	LTE, UMTS, WCDMA, CDMA2000, GSM/EDGE	1	2.7 to 5	45	50 to 8000	LOG RMS	Micro SMD-6	1.25
LMH2120 ¹	LTE, UMTS, WCDMA, CDMA2000, GSM/EDGE	1	2.7 to 5	40	50 to 6000	LIN RMS	Micro SMD-6	1.25
LMV242 ¹	GSM, GPRS, TDMA, LAN	2	2.6 to 5.5	50	450 to 2000	LOG Amp	LLP-10	0.63

¹Evaluation board available.

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

→ Overview

Space is of utmost importance in portable applications. TI offers advanced solutions that incorporate QFN and wafer-level chip-scale packaging and feature a high degree of integration to reduce solution size. In addition to reducing board space, many of these solutions provide lower power dissipation and increase overall efficiency. TI battery management solutions support a wide range of battery chemistries and cell counts, from popular Lithium-Ion (Li-Ion) technologies to industry-standard nickel-metal-hydride and lead-acid batteries.

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 the battery-management device 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.

Design Factors

Battery Chemistry — Each battery chemistry has different operating characteristics, such as discharge profiles and self-discharge rate. TI gas-gauge ICs are developed to account for these differences and accurately display remaining energy in the battery. Also, each battery chemistry has unique requirements for its charge algorithm, which is critical for maximizing its capacity, cycle life and safety.

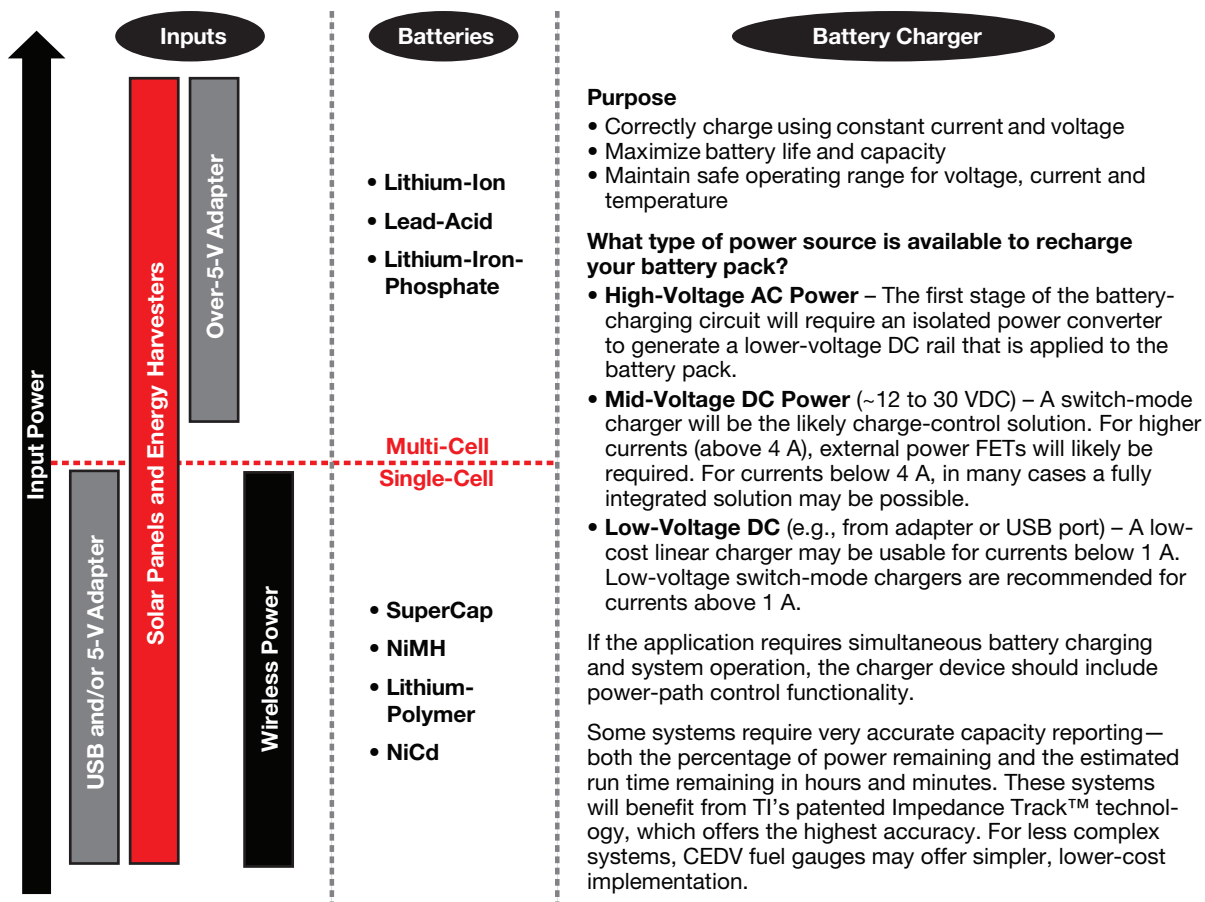
Charge-Control Topology — A simple linear topology works well in applications with low-power (e.g., one- or two-cell Li-Ion) battery packs that are charged at less than 1 A. A switch-mode topology

is ideally suited for fast charging from USB ports or for large battery packs that require charge rates >1 A. The switch-mode conversion minimizes heat generation during charging. A wireless power topology uses shared magnetic fields to provide the benefit of contactless power transfer. Wireless charging provides an additional battery-charging option for portable devices or as a replacement for other 5-V charging sources.

Input Voltage — Wide input-voltage range of the IC and input overvoltage protection offer maximum safety and allow use of low-cost unregulated wall adapters.

Number of Series Cells — A battery pack is constructed from a string of series and parallel cells. Each series cell, or group of parallel cells, requires protection from overcharge, overdischarge and short-circuit conditions.

Battery Management



→ Charger Front-End Protection

Li+ Charger Front-End Protection IC

bq24314

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/bq24314

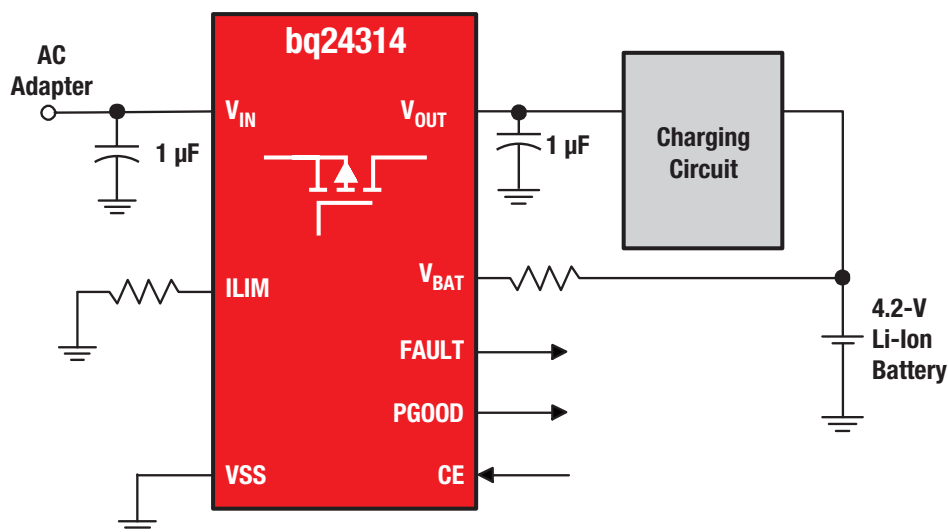
Charger front-end protection ICs provide protection from input overvoltage, input overcurrent and battery overvoltage conditions. The tri-level protection offers maximum safety when charging a handheld device. With integrated FET, the protection IC comes in 2x2-mm and 3x4-mm SON packages.

Key Features

- 30-V maximum input
- Up to 1.5-A input current
- Thermal shutdown
- Enable input
- Provides protection for three variables:
 - Input overvoltage (rapid response <1 μ s)
 - User-programmable overcurrent with current limiting
 - Battery overvoltage

Applications

- Mobile phones and smart phones
- Portable navigation devices
- MP3 Players
- Low-power handheld devices
- *Bluetooth*® headsets



Selection Guide

Device	V _{IN} Max (V)	OVP (V)	OCP	Battery OVP (V)	LDO Output (V)	Max Operating Current (μ 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	0.55
bq24308	30	6.3	Fixed 700 mA or Prog. <1.5 A	4.35	5	500	8-QFN/SON	✓	Reverse polarity protection	0.55
bq24312	30	5.85	Prog. <1.5 A	4.35	—	500	8/12-QFN/SON	✓	Fault indication	0.48
bq24314/A	30	5.85	Prog. <1.5 A	4.35	—	600	8/12-QFN/SON	✓	Fault indication	0.48
bq24315	30	5.85	Prog. <1.5 A	4.35	5.5	600	8-QFN/SON	✓	Fault indication	0.48
bq24316	30	6.8	Prog. <1.5 A	4.35	—	600	8/12-QFN/SON	✓	Fault indication	0.48
bq24380	30	6.3	No OCP	4.35	5.5	250	8-QFN/SON	✓	Fault indication	0.55
bq24381	30	7.1	No OCP	4.35	5	300	8-QFN/SON	✓	Fault indication	0.55
bq24382	30	10.5	No OCP	4.35	5	300	8-QFN/SON	✓	Fault indication	0.55
bq24350	30	6.17	Fixed 1.2 A	4.35	5.5	500	8-QFN/SON	✓	Integrated charge FET	0.65
bq24351	30	10.5	Fixed 1.2 A	4.35	6.38	500	8-QFN/SON	✓	Integrated charge FET	0.65
bq24352	30	7.1	Fixed 1.2 A	4.35	5.5	500	8-QFN/SON	✓	Integrated charge FET	0.65

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

→ Battery Charge Management

Industry's Most Efficient Boost Charger for Nanopower Energy-Harvesting Applications

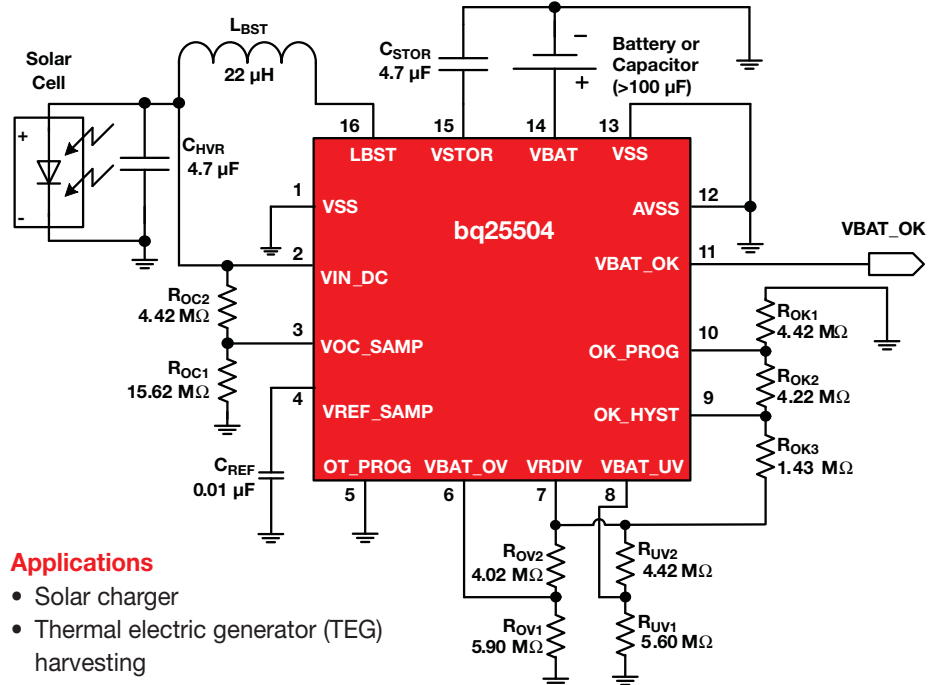
bq25504

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/bq25504

The bq25504 is a highly efficient boost charger IC for nano (ultra-low) power energy-harvesting and management applications. The device manages micro-watts (μW) to milliwatts (mW) of power generated from a variety of sources such as solar, thermal electric, electromagnetic and vibration energy.

Key Features

- Low quiescent current (330 nA typ) and high conversion efficiency
- Maximum power point tracking (MPPT) optimizes energy extracted from DC harvesters such as solar panels and thermoelectric generators
- User programmable settings support a variety of energy sources and energy storage elements (different battery chemistries or super capacitors)
- Low cold-start voltage (330 mV typ) supports startup from single-cell solar panels (under low light) and other low-voltage sources.
- Battery status outputs allows conditional enabling of external loads and protects the storage element



Applications

- Solar charger
- Thermal electric generator (TEG) harvesting
- Wireless sensor networks
- Industrial and environmental monitoring
- Smart building controls
- Portable and wearable health devices
- Remote controls

1-A, Single-Input, Single-Cell LiFePO₄ Linear Battery Charger with 50-mA LDO

bq25070

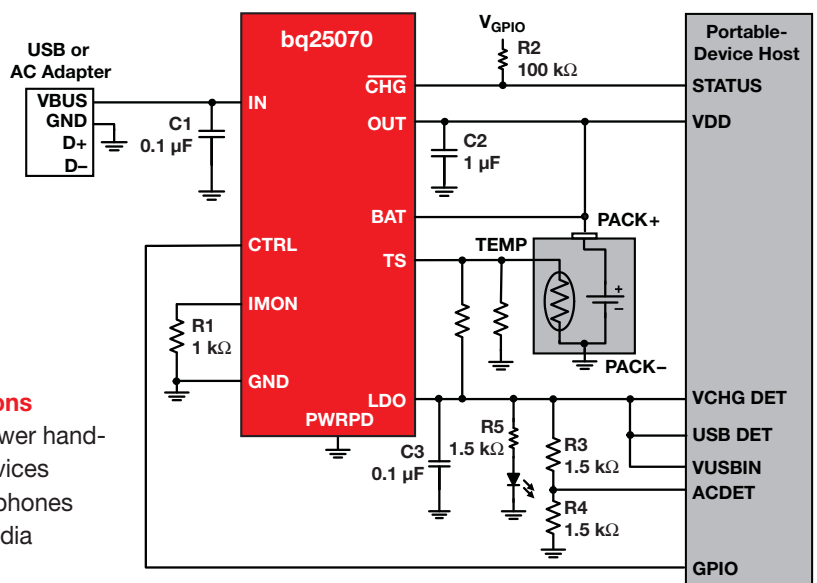
Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/bq25070

Key Features

- Single-cell LiFePO₄ charging algorithm
- 3.75- to 10.2-V V_{IN} (10.5-V OVP) with 30-V input rating (max)
- Up to 1-A charge current
- Integrated 4.9 V at 50 mA LDO linear regulator
- Single output allows simultaneous battery charging and powering of system
- Programmable charge current through single input interface (CTRL)
- Single USB port or AC-adaptor input source
- Thermal regulation and protection
- Soft-start feature
- Battery NTC monitoring
- Charging-status indication
- Small 2 × 3-mm 10-pin SON package

Applications

- Low-power hand-held devices
- Mobile phones
- Multimedia players



Battery Management Products

→ Battery Charge Management

2.5-A, Dual Input, Switch-Mode Charger with Power-Path Management with Host I²C Control or Stand Alone

bq24160, bq24161, bq24163, bq24168 — bq24165, bq24166, bq24167

The bq2416x family of highly integrated, single-cell, Li-Ion battery chargers include system power-path management. They are targeted for space-limited, portable applications with high-capacity batteries.

Key Features

- Startup system from deeply discharged battery or no battery
- Sync 1.5-MHz PWM switch mode
- Supports USB 2.0 and USB 3.0 charger applications
- 20-V max V_{IN} rating
- Integrated FETs with 2.5-A charging from V_{IN} and 1.5 A on USB input
- Integrated power path and driver for optional external discharge FET

- Dual inputs are fully isolated
- Integrated input current sensing and limiting ($\pm 5\%$)
- Control charge parameters, timers, V_{INDPM} threshold
- Thermal regulation protection for output current control
- 2.8x2.8-mm WCSP and 4x4-mm QFN package options

bq24160/1/3/8 Features

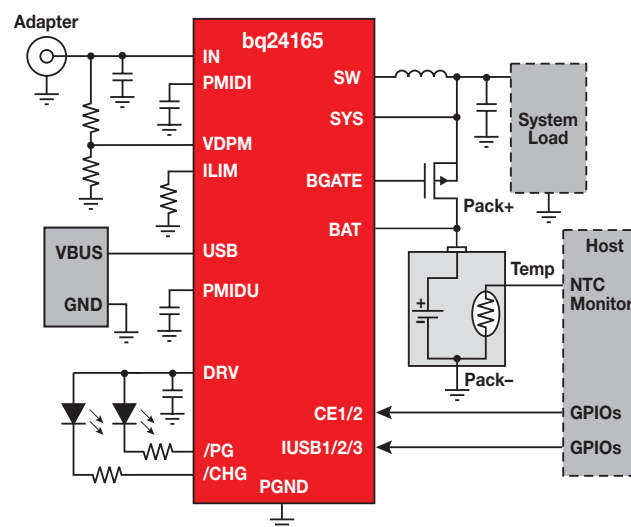
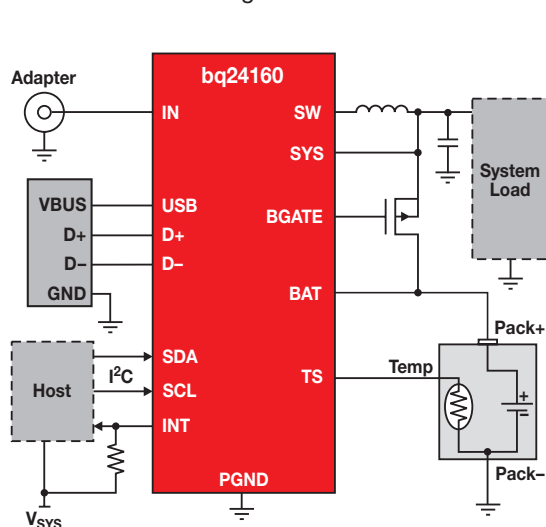
- I²C interface (1.8 V, 400 kbps)
- Automatic USB input detection based on D+/D- (bq24160/3) or pin selectable (bq24161/8)
- User programmable input current limits

bq24165/6/7

- USB settings via $I_{USB1/2/3}$ pins
- Charge parameter selector inputs
- Adjustable charge current, input current, and V_{INDPM} threshold
- Voltage based, NTC temp monitoring input (TS); JEITA (CE1/2) for bq24165, standard temperature range (bq24166), and JEITA (CE1/2) bq24167

Applications

- Handheld portable products
- Portable computing
- Portable media players
- DSC and DVR equipment



Single-Cell Charger Controllers Selection Guide

Device	Number of Cells	V_{IN} Type	V_{IN} Abs Max (V)	V_{IN} OVP (V)	Charge Current (A)	Charge Voltage (V)	Topology	Internal FET	Primary Charge Termination	Charge Timer	Temp Monitor	WCSP	QFN	EVM	USB Detection	Price*
Host Mode with I²C System Interface																
bq24160	1	Adapter and USB	20	10.5 6.5 USB	2.5 1.5 USB	3.5 to 4.4	Switching	Yes	Host-controlled	Yes	Yes, JEITA	49	24	✓	D+/D-	1.95
bq24161	1	Adapter and USB	20	10.5 6.5 USB	2.5 1.5 USB	3.5 to 4.4	Switching	Yes	Host-controlled	Yes	Yes, Std	49	—	✓	PSEL	1.95
bq24163	1	Adapter and USB	20	10.5 6.5 USB	2.5 1.5 USB	3.5 to 4.4	Switching	Yes	Host-controlled	Yes	Yes, JEITA	49	24	✓	D+/D-	1.95
bq24168	1	Adapter and USB	20	6.5 6.5 USB	2.5 1.5 USB	3.5 to 4.4	Switching	Yes	Host-controlled	Yes	Yes, JEITA	49	24	✓	PSEL	1.95
Stand Alone System Interface																
bq24165	1	Adapter and USB	20	10.5 6.5 USB	2.5 1.5 USB	4.2/4.06	Switching	Yes	10% I_{CHG}	Yes	via Host JEITA Adj CE1/2	49	—	✓	$I_{USB1/2/3}$	1.95
bq24166	1	Adapter and USB	20	10.5 6.5 USB	2.5 1.5 USB	4.2/4.06	Switching	Yes	10% I_{CHG}	Yes	Yes/Std	24	—	✓	$I_{USB1/2/3}$	1.95
bq24167	1	Adapter and USB	20	10.5 6.5 USB	2.5 1.5 USB	4.2/4.06	Switching	Yes	10% I_{CHG}	Yes	via Host JEITA Adj CE1/2	24	24	✓	$I_{USB1/2/3}$	1.95

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

New devices are listed in bold red.

Battery Management Products

→ Battery Charge Management

Switch-Mode Li-Ion and Li-Polymer Stand-Alone Battery Charger

bq24170

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/bq24170

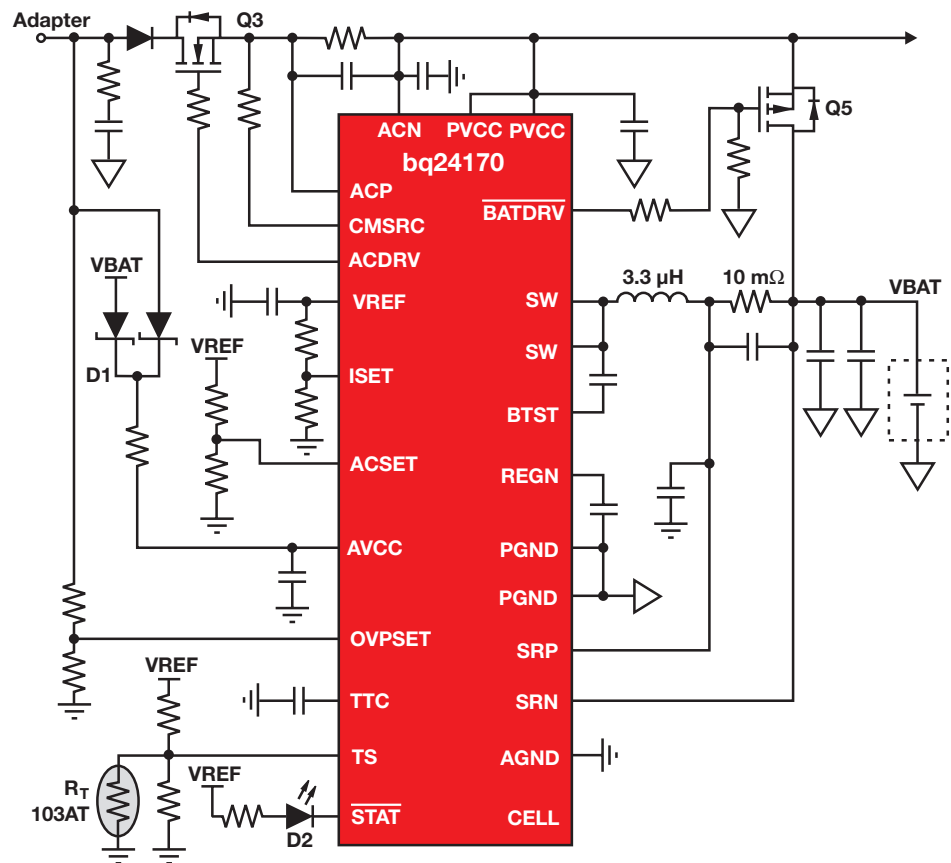
The bq24170 is a highly integrated stand-alone Li-Ion or Li-Polymer switch-mode battery charger with two integrated n-channel power MOSFETs. It offers a constant-frequency synchronous PWM controller with highly accurate regulation of input current, charge current and voltage. It closely monitors the battery-pack temperature to allow charging only in a preset temperature window. It also provides battery detection, preconditioning, charge termination and charge-status monitoring.

Key Features

- 1.6-MHz synchronous switch-mode charger with 4-A integrated n-channel MOSFETs
- Up to 94% efficiency
- 4.5-V to 17-V input operating range
- Battery charge voltage: 1, 2 or 3 cells with 4.2 V per cell

Applications

- Tablet PCs
- Netbooks and ultra-mobile computers
- Portable data-capture terminals
- Portable printers
- Medical-diagnostics equipment
- Battery-bay chargers
- Battery back-up systems



Chargers with Internal FETs Selection Guide

Device	Number of Cells	Control Topology	Host or Stand Alone	Integrated Power FET	Charge Current (A)	V _{IN} Max (V)	Primary Charge Termination Method ¹	Safety Timer	Temp Monitor	Packaging: QFN/MLP	EVM	Comments	Price*
Multi-Cell Switch-Mode Stand-Alone Battery Chargers with Internal FETs (Converters) — Lithium-Ion													
bq24170	1 to 3	Switching	Stand Alone	Yes	4.0	20	Min current	Yes	Yes	24	✓		1.80
bq24171	1 to 3	Switching	Stand Alone	Yes	4.0	20	Min current	Yes	Yes	24	✓	Supports JEITA	1.80
bq24172	1 to 3	Switching	Stand Alone	Yes	4.0	20	Min current	Yes	Yes	24	✓	Supports adjustable charge voltage	1.80
bq24133	1 to 3	Switching	Stand Alone	Yes	2.5	20	Min current	Yes	Yes	24	✓	Supports 2.5-A charge current	1.80
bq24130	1 to 3	Switching	Host	Yes	4.0	20	Min current/Host controlled	—	Yes	24	✓		
bq24100	1	Switching	Stand Alone	Yes	2.0	20	Min current	Yes	Yes	20	✓	On/Off status pin; bq24120 offers enhanced EMI performance	2.00
bq24108	1	Switching	Stand Alone	Yes	2.0	20	Min current	Yes	Yes	20	✓	Blinking status pin; bq24120 offers enhanced EMI performance	2.00
bq24103A	1 or 2	Switching	Stand Alone	Yes	2.0	20	Min current/Host controlled	Yes	Yes	20	✓	bq24123 offers enhanced EMI performance	2.00
bq24113A	1 or 2	Switching	Host	Yes	2.0	20	Min current/Host controlled	Yes	Yes	20	✓	bq24123 offers enhanced EMI performance	2.00
bq24105†	1 to 3	Switching	Host	Yes	2.0	20	Min current/Host controlled	Yes	Yes	20	✓	bq24125 offers enhanced EMI performance	3.50
bq24115	1 to 3	Switching	Host	Yes	2.0	20	Min current/Host controlled	Yes	Yes	20	✓	bq24125 offers enhanced EMI performance	3.50

¹Host controlled = system processor must terminate charging.
^{*}Suggested resale price in U.S. dollars in quantities of 1,000.

[†]Devices qualified for Automotive applications are available. Different pricing may apply.

New devices are listed in bold red.

Battery Management Products

→ Battery Charge Management

Stand-Alone Synchronous Switch-Mode Li-Ion or Li-Polymer Battery Charger

bq24610

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/bq24610

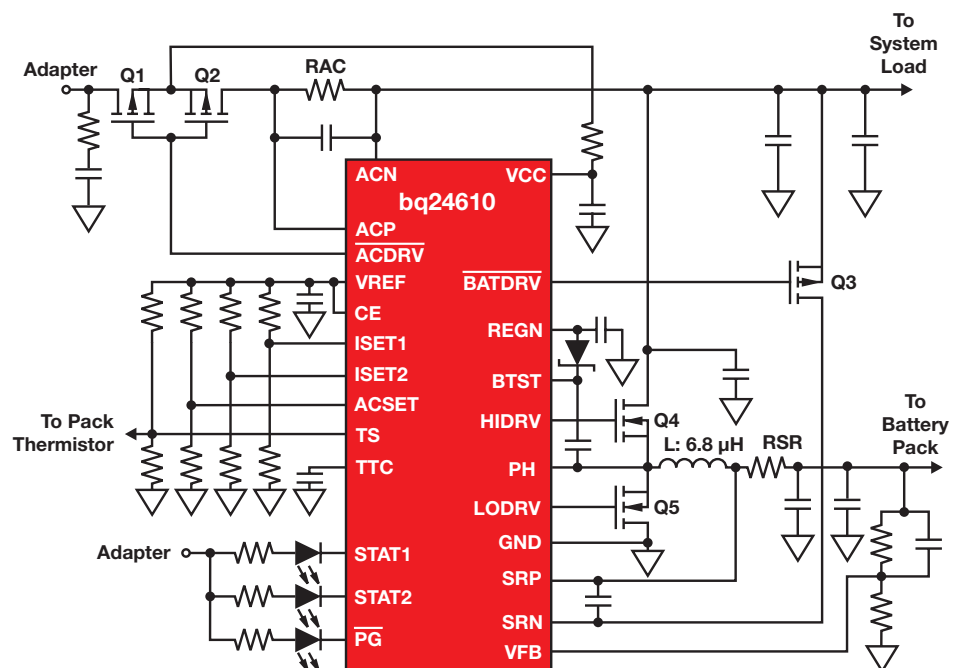
The bq24610 is a highly integrated Li-Ion or Li-Polymer switch-mode battery charger. It offers a constant-frequency synchronous switching PWM controller with highly accurate regulation of charge current and voltage. It also provides charge preconditioning, termination, adapter current regulation and charge-status monitoring.

Key Features

- 600-kHz NMOS/NMOS synchronous buck converter
- Stand-alone charger support for Li-Ion or Li-Polymer battery
- Supports up to six battery cells (bq24610) and has an input operating range of 5- to 28-V V_{CC}
- Up to 10-A charge current and adapter current

Applications

- Netbooks, mobile Internet devices and ultra-mobile PCs
- PDAs
- Handheld terminals
- Industrial and medical equipment



Multi-Cell Charger Controllers Selection Guide

Device	Number of Cells	Control Topology	Integrated Power FET	V_{IN} Max (V)	Primary Charge Termination Method	Safety Timer	Temp Monitor	Packaging: QFN/MLP	EVM	Comments	Price*
Multi-Cell Switch-Mode Stand-Alone Battery Chargers with External FETs (Controllers) — Lithium-Ion (except where noted)											
bq24600	1 to 6	Switching	No	32	Min current	Yes	Yes	16/24	✓	1200 kHz	2.50
bq24610	1 to 6	Switching	No	32	Min current	Yes	Yes	16/24	✓	600 kHz	2.90
bq24616	1 to 6	Switching	No	32	Min current	Yes	Yes	16/24	✓	JEITA, 600 kHz	2.90
bq24617	1 to 5	Switching	No	26	Min current	Yes	Yes	—	✓	600 kHz	2.90
bq24618	1 to 6	Switching	No	32	Min current	Yes	Yes	16/24	✓	Supports 4.7 V_{IN}	2.90
bq24620	1 to 7	Switching	No	32	Min current	Yes	No	16/24	✓	LiFePO ₄	2.90
bq24630	1 to 7	Switching	No	32	Min current	Yes	No	16/24	✓	LiFePO ₄ , system power selector	2.90
bq24640	1 to 9	Switching	No	33	SuperCap-specific	No	Yes	16	✓	Supports SuperCap	3.65
bq24650	1 to 6	Switching	No	33	Min current	Yes	Yes	16	✓	Solar charger for Li-Ion/polymer, LiFePO ₄ , lead-acid chemistries	2.85

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

Battery Management Products

→ Battery Charge Management

Selection Guide

(Device parameters continued on next page)

Device	Number of Cells	V _{IN} Type	V _{IN} Max Operating (V)	V _{IN} Absolute Max (V)	V _{IN} OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET	
Multi-Chemistry (Li-Ion and NiCd/NiMH)											
bq24030/31/35	1	Adapter/USB	16	18	6.4	2	4.2/4.1/4.2	Stand Alone	Linear	Yes	
bq24032A/38	1	Adapter/USB	16	18	6.4	2	4.2/ (4.24/4.36)	Stand Alone	Linear	Yes	
bq24040/41	1	Adapter/USB	6.45	30	6.6/7.1	0.800	4.2	Stand Alone	Linear	Yes	
bq24050/52	1	Adapter/USB	6.45	30	6.6	0.800	4.2	Stand Alone	Linear	Yes	
bq24055	1	Adapter/USB	6.45	30	6.6	0.800	4.2	Stand Alone	Linear	Yes	
bq24072/72T	1	Adapter/USB	6.4	30	6.6	1.5	4.3 / 4.2	Stand Alone	Linear	Yes	
bq24073	1	Adapter/USB	6.4	28	6.6	1.5	4.2	Stand Alone	Linear	Yes	
bq24074	1	Adapter/USB	10.2	28	10.5	1.5	4.2	Stand Alone	Linear	Yes	
bq24075T/79T	1	Adapter/USB	6.4	28	6.6	1.5	4.2/4.1	Stand Alone	Linear	Yes	
bq24090/91	1	Adapter/USB	6.45	7	6.6	0.800	4.2	Stand Alone	Linear	Yes	
bq24092/93	1	Adapter/USB	6.45	7	6.6	0.800	4.2	Stand Alone	Linear	Yes	
bq25040	1	Adapter/USB	6.7	30	6.9	1.1	4.2	Stand Alone	Linear	Yes	
bq25050	1	Adapter/USB	6	20	6.5	1.25	3.5 to 4.4	I ² C	Switching	Yes	
bq25060	1	Adapter/USB	10.2	30	10.5	1	4.2	Stand Alone	Linear	Yes	
bq24140	1	Adapter and USB	9	20	9.8	1.5	Adj	I ² C	Switching	Yes	
bq24153A/58	1	Adapter/USB	6	20	6.5	1.25	3.5 to 4.4	I ² C	Switching	Yes	
bq24156A/59	1	Adapter/USB	9	20	9.8	1.5	3.5 to 4.4	I ² C	Switching	Yes	
bq24160	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	3.5 to 4.4	I ² C	Switching	Yes	
bq24161	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	3.5 to 4.4	I ² C	Switching	Yes	
bq24163	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	3.5 to 4.4	I ² C	Switching	Yes	
bq24165	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	4.2	Stand Alone	Switching	Yes	
bq24166	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	4.2	Stand Alone	Switching	Yes	
bq24167	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	4.2	Stand Alone	Switching	Yes	
bq24168	1	Adapter and USB	18	20	6.5/6.5(USB)	2.5/1.5	3.5 to 4.4	Stand Alone	Switching	Yes	
bq24180	1	Adapter/USB	16	20	16.5	1.5	3.5 to 4.4	I ² C	Switching	Yes	
bq24185	1	Adapter/USB	16	20	16.5	1.5	3.5 to 4.4	I ² C	Switching	Yes	
bq24130	1 to 3	Adapter/USB	18	20	Adj	4	Adj	I ² C	Switching	Yes	
bq24133	1 to 3	Adapter/USB	17	20	Adj	2.5	Adj	Stand Alone	Switching	Yes	
bq24170	1 to 3	Adapter/USB	17	20	Adj	4	4.2	Stand Alone	Switching	Yes	
bq24171	1 to 3	Adapter/USB	17	20	Adj	4	Adj	Stand Alone	Switching	Yes	
bq24172	1 to 3	Adapter/USB	17	20	Adj	4	Adj	Stand Alone	Switching	Yes	
bq24600	1 to 6	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24610	1 to 6	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24616	1 to 6	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24617	1 to 5	Adapter	24	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24618	1 to 6	Adapter/USB	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24707A	1 to 4	Adapter	24	30	Adj	8	Adj	SMBus	Switching	No	
bq24725A	2 to 4	Adapter	24	30	Adj	8	Adj	SMBus	Switching	No	
bq24735	1 to 4	Adapter	24	30	Adj	8	Adj	SMBus	Switching	No	

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

Battery Management Products

→ Battery Charge Management

(Device parameters continued from previous page)

	Device	Primary Charge Termination	Charge Timer	Temperature Monitor	Packaging					EVM	Comments	Price*	
					WCSP	QFN/MLP	MSOP	TSSOP	SOIC				DIP
	Multi-Chemistry (Li-Ion and NiCd/NiMH)												
	bq24030/31/35	Min Current	Yes	Yes		20					✓	Dynamic Power-Path Management powers the system and charges battery. Regulated 4.4-V output for AC input condition"	1.80
	bq24032A/38	Min Current	Yes	Yes		20					✓	Dynamic Power-Path Management powers the system and charges battery. Regulated 4.4-V output for AC input condition	1.80
	bq24040/41	Adj/(C/10)	Yes	Yes		10					✓		0.45
	bq24050/52	Min Current	Yes	Yes		10					✓	JEITA Charging (100K NTC — bq24052)	0.50
	bq24055	Min Current	Yes	Yes		12					✓	JEITA, PG Pin	0.60
	bq24072/72T	Min Current	Yes	Yes		16					✓	V _{OUT} tracks V _{BAT} , V _{IN_DPPM}	1.00
	bq24073	Min Current	Yes	Yes		16					✓	V _{IN_DPPM}	1.00
	bq24074	Adj	Yes	Yes		16					✓	V _{IN_DPPM}	1.00
	bq24075T/79T	Min Current	Yes	Yes		16					✓	SYSOFF pin disconnects battery, V _{IN_DPPM} , powers system and charges battery	1.00
	bq24090/91	Min Current	Yes	Yes		10					✓	10K NTC (100K NTC — bq24091)	0.40
	bq24092/93	Min Current	Yes	Yes		10					✓	JEITA, 10K NTC (JEITA, 100K NTC — bq24093)	0.40
	bq25040	Min Current	No	Yes		10					✓	USB compliant w/50-mA integrated LDO	0.55
	bq25050	Adj	Yes	No		20						USB OTG supported with boost	0.60
	bq25060	Min Current	No	Yes		10					✓	USB compliant w/50-mA integrated LDO	0.65
	bq24140	Min Current	Yes	No	30						✓	Simultaneous charge and USB OTG output	1.60
	bq24153A/58	Host Controlled	Yes	No	20						✓	USB OTG supported with boost, no battery detect on power up (bq24158)	0.95
	bq24156A/59	Host Controlled	Yes	No	20						✓	No battery detect on power up (bq24159)	0.95
	bq24160	Host Controlled	Yes	Yes	49	24					✓	D+/D– detect, JEITA, 3-V V _{BAT_SHORT}	1.95
	bq24161	Host Controlled	Yes	Yes	49						✓	USB selection pin, std temp	1.95
	bq24163	Host Controlled	No	No	49	24					✓	D+/D– detect, JEITA	1.95
	bq24165	10% I _{CHG}	Yes	No	49						✓	I _{USB} 1/2/3 USB select, no temp monitor, JEITA	1.95
	bq24166	10% I _{CHG}	Yes	Yes	49						✓	I _{USB} 1/2/3 USB select, temp monitor, std temp	1.95
	bq24167	10% I _{CHG}	Yes	Yes	49	24					✓	I _{USB} 1/2/3 USB select, temp monitor, JEITA	1.95
	bq24168	10% I _{CHG}	Yes	Yes	49	24					✓	USB select pins, JEITA, no timers	1.95
	bq24180	Host Controlled	Yes	Yes	25						✓	Accessory power output	1.00
	bq24185	Host Controlled	Yes	Yes	25						✓	USB OTG supported with boost	1.00
	bq24130	Adj	No	Yes		20					✓		1.95
	bq24133	Min Current	Yes	Yes		24					✓		1.75
	bq24170	Min Current	Yes	Yes		24					✓		1.80
	bq24171	Min Current	Yes	Yes		24					✓	JEITA	1.80
	bq24172	Min Current	Yes	Yes		24					✓	Adjustable charge voltage	1.80
	bq24600	Min Current	Yes	Yes		16					✓	1200 kHz	2.50
	bq24610	Min Current	Yes	Yes		24					✓		2.90
	bq24616	Min Current	Yes	Yes		24					✓	JEITA	2.90
	bq24617	Min Current	Yes	Yes		24					✓	600 kHz	2.90
	bq24618	Adj	Yes	Yes		24					✓	USB V _{IN} and adapter	2.90
	bq24707A	SMBus	Yes	No		20					✓	Programmable switching frequency	2.90
	bq24725A	SMBus	Yes	No		20					✓	Programmable switching frequency, enhanced safety, battery learn	2.90
	bq24735	SMBus	Yes	No		20					✓	Intel™ CPU Turbo Mode support	3.00

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

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

Battery Management Products

→ Battery Charge Management

Selection Guide

(Device parameters continued on next page)

Device	Number of Cells	V _{IN} Type	V _{IN} Max Operating (V)	V _{IN} Absolute Max (V)	V _{IN} OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET	
Solar/Energy Harvesting (Li-Ion)											
bq24210	1	Adapter/USB	18	20	7.7	0.800	4.2	Stand Alone	Linear	Yes	
bq24650	1 to 6	Solar Panel	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq25504	1	Solar/TEG/Low DC (0.13 V min)	3	5.5	Adj	0.1	2.5 to 5.25	Stand Alone	Boost	Yes	
LiFePO ₄											
bq25070	1	Adapter/USB	28	30	10.5	1	3.5	Stand Alone	Linear	Yes	
bq24620	1 to 7	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24630	1 to 7	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
Super Cap											
bq24640	1 to 9	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
NiCd/NiMH Chemistry											
bq2002/C/E/F	Multiple	Adapter	6	7	—	>2	6	Stand Alone	Current-limited	No	
bq2004/E/H	Multiple	Adapter	5.5	7	—	>2	5.5	Stand Alone	Switching	No	
bq2005	Multiple	Adapter	5.5	7	—	>2	5.5	Stand Alone	Switching	No	
bq24400/1	Multiple	Adapter	5.5	7	—	>2	5.5	Stand Alone	Switching	No	
Lead-Acid Chemistry											
bq24450	Multiple	Adapter	40	40	—	>2	—	Stand Alone	Linear	No	
UC3909	Multiple	Adapter	40	40	—	>2	—	Stand Alone	Switching	No	
bq2031	Multiple	Adapter	5.5	7	—	>2	—	Stand Alone	Switching	No	
Multi-Chemistry (Li-Ion and NiCd/NiMH)											
bq2000/T	Multiple	—	—	7	—	—	—	Stand Alone	Switching	Yes	
bq24765	2 to 4	—	—	30	—	—	—	Stand Alone	Switching	Yes	
bq24650	1 to 6	Solar Panel	28	33	32	10A (Ext)	Adj	Stand Alone	Switching	No	
bq24747	2 to 4	—	—	30	—	—	—	Stand Alone	Switching	No	
Wireless Power Receivers											
bq51011	Reg V _{OUT}	Coil/USB/Adapter	10	20	15	See Comments	5	Stand Alone	Linear	Yes	
bq51013	Reg V _{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes	
bq51013A	Reg V _{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes	
bq51014	Reg V _{OUT}	Coil/USB/Adapter	10	20	12.5	1.5	5	Stand Alone	Linear	Yes	
Device	Description		Number of Channels	Supported Communication Modulation		WPC-Standard Compliance		Transmitter Power Class (W)	Transmitter Input Voltage (Typ) (V)	Package	Price*
Wireless Power Transmitters											
bq500210	Generation 2 Qi-compliant wireless power transmitter manager		1	Resistive and Capacitive		Yes		5	19	48-pin VQFN	4.50

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

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

For a complete list of Resources, visit: www.ti.com/battery

Battery Management Products

→ Battery Charge Management

(Device parameters continued from previous page)

	Device	Primary Charge Termination ¹	Charge Timer	Temperature Monitor	Packaging							Comments	Price*
					WCSP	QFN/MLP	MSOP	TSSOP	SOIC	DIP			
Solar/Energy Harvesting (Li-Ion)													
	bq24210	Min Current	Yes	Yes		10					✓	Solar panel V _{IN}	1.10
	bq24650	C/10	Yes	Yes		16					✓	Max power point tracking	2.85
	bq25504	Voltage	—	Yes		16					✓	Energy harvester, ultra-low power and quiescent current, high efficiency, dynamic MPPT	2.10
LiFePO ₄													
	bq25070	Min Current	No	Yes		10					✓	LiFePO ₄ , 50-mA LDO	0.75
	bq24620	C/10	Yes	Yes		16					✓	LiFePO ₄ , 300 kHz	2.90
	bq24630	Adj	Yes	Yes		24					✓	LiFePO ₄ , 300 kHz, power selector	2.90
Super Cap													
	bq24640	Min Current	No	Yes		16					✓	SuperCap	2.90
NiCd/NiMH Chemistry													
	bq2002/C/E/F	ΔV, PVD, ΔT/Δt	Yes	Yes					8	8		Trickle charge	0.85
	bq2004/E/H	ΔV, PVD, ΔT/Δt	Yes	Yes					16	16		Selectable timers and pulse-trickle rates	2.15
	bq2005	ΔV, ΔT/Δt	Yes	Yes					20	20		Sequential fast charge of two battery packs	2.15
	bq24400/1	PVD /ΔT/Δt	Yes	Yes				8	8				1.55
Lead-Acid Chemistry													
	bq24450	Max V, min I	No	No					16	16		Temp-compensated internal reference	2.75
	UC3909	Max V, min I	No	Yes					20	20		Differential current sense input	3.05
	bq2031	Max V, −Δ2 V, min I	Yes	Yes					16	16	✓	Three user-selectable charge algorithms to accommodate cyclic and standby applications	2.80
Multi-Chemistry (Li-Ion and NiCd/NiMH)													
	bq2000/T	PVD, ΔT/Δt, min current	Yes	Yes				8	8	8	✓	Charges NiCd, NiMH, and Li-Ion	1.50
	bq24765	SMBus	Yes	No		34					✓	SMBus charger with integrated power FETs	3.95
	bq24650	C/10	Yes	Yes		16					✓	Max power point tracking	2.85
	bq24747	SMBus	Yes	No		28					✓	SMBus with input current-detect comp.	2.90
Wireless Power Receivers													
	bq51011	EPT Cmd to Tx	No	Yes	28							Receiver, current limited charge current (400 mA + dynamic I _{LIM})	3.50
	bq51013	EPT Cmd to Tx	No	Yes	28						✓	Receiver, regulated voltage output, compliant to WPC specification 1.0	3.50
	bq51013A	EPT Cmd to Tx	No	Yes	28	20					✓	Receiver, regulated voltage output, dynamic efficiency control, dynamic communications limit	3.50
	bq51014	Programmable	No	Yes	28							Receiver, programmable termination current, 12.5-V AD-OVP, dynamic efficiency control, dynamic communications limit	3.50

¹PVD = peak voltage detection; $\Delta T/\Delta t$ = rate of temperature rise; host controlled = system processor must terminate charging;
 $-\Delta V$ = negative voltage change; max V = maximum voltage; min I = minimum current; $-\Delta 2V$ = second difference of cell voltage.
 *Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.

For a complete list of Resources, visit: www.ti.com/battery

Battery Management Products

→ Single-Cell Solutions — Battery Fuel Gauges

Design Factors

Battery Chemistry — Each battery chemistry has different operating characteristics, such as discharge profiles and the self-discharge rate. The battery chemistry is programmed in the dataflash of the TI fuel gauge to account for these differences. In addition, the conditions of the end-equipment system can be programmed in the gas gauge. Designers can choose to implement the gauge in the

host system or inside the battery pack. The programmed information is processed in TI's Impedance Track™ gauging technology for prediction of remaining battery capacity with >99% accuracy.

Features

TI gas gauges and battery monitors accurately track battery activity to compute the remaining battery capacity and system run-time. The following features are available:

- Patented Impedance Track battery fuel-gauging technology for >99% accuracy
- System- and pack-side implementation
- Turnkey solution with complete CPU and battery fuel-gauge firmware
- Interrupt-driven gas gauge signaling the host with the battery's specific state-of-charge status
- Gas gauge with integrated LDO in small packages

System-Side Impedance Track™ Fuel Gauge with Integrated LDO

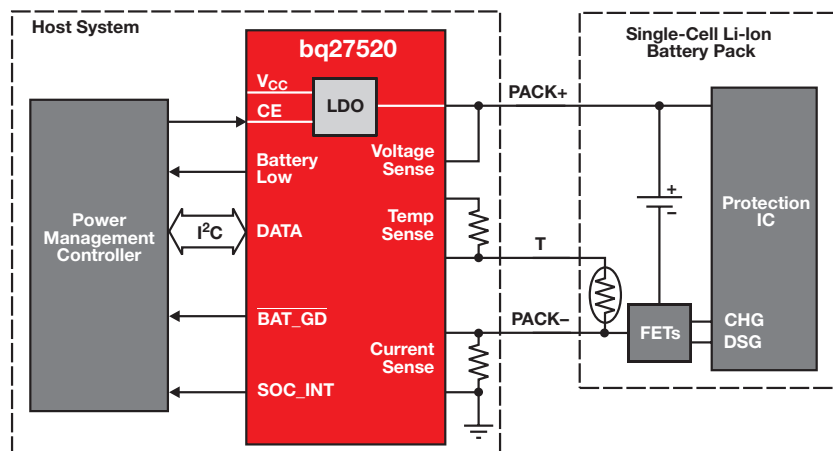
bq27520

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/bq27520

The bq27520 is a high-performance, system-side fuel gauge with excellent accuracy, low power consumption and extremely small package size. By integrating the fuel-gauge function into the system board, portable-equipment designers can use an embedded or removable standard battery pack while adding the capability to accurately display remaining pack capacity and estimated run time. The bq27520 features an integrated voltage regulator that reduces the total component count for the system. The bq27520 also has an interrupt-generation capability that reduces the software burden on the system processor because the fuel gauge does not require repetitive polling from the host.

The bq27520 uses the patented Impedance Track™ algorithm for fuel gauging and provides information such as remaining battery capacity, state of charge, minimum run time to empty, battery voltage, temperature and state

of health. Battery fuel gauging with the bq27520 requires only PACK+ (P+), PACK- (P-) and thermistor (T) connections to a removable battery pack or embedded battery circuit.



Selection Guide

Device	Approx. Battery Capacity (mAh)	Min Max Series Cell	SHA-1 Authentication	System or Pack	Communication Protocol	Other Features	Package	Price*
Lithium-Ion, Lithium-Polymer Chemistry								
bq27010	300 to 6000	1	No	Pack	HDQ	Fuel gauge with compensated-voltage EOD	10-pin DRK	1.25
bq27210	300 to 6000	1	No	Pack	I ² C	Fuel gauge with compensated-voltage EOD	10-pin DRK	1.25
bq27500	300 to 6000	1	No	System	I ² C	System-side fuel gauge with Impedance Track™ technology	12-pin QFN	1.35
bq27510	300 to 6000	1	No	System	I ² C	System-side fuel gauge with Impedance Track technology with integrated LDO	12-pin QFN	1.45
bq27541	300 to 6000	1	Yes	Pack	I ² C/HDQ	Pack-side fuel gauge with Impedance Track technology	12-pin QFN	1.45
bq27545	300 to 6000	1	Yes	Pack	I ² C/HDQ	Pack-side fuel gauge with Impedance Track technology	12-pin QFN	1.45
bq27501	300 to 6000	1	No	System	I ² C	System-side fuel gauge with Impedance Track technology with battery ID resistor	12-pin QFN	1.35
bq27505	300 to 6000	1	No	System	I ² C	System-side fuel gauge with Impedance Track technology	12-ball CSP	1.40
bq27520	300 to 6000	1	No	System	I ² C	System-side fuel gauge with Impedance Track technology with integrated LDO	15-ball CSP	1.50
bq27410	300 to 6000	1	No	System	I ² C	System-side fuel gauge with Impedance Track Lite technology with integrated LDO	12-pin QFN	1.40
bq27425	300 to 6000	1	No	System	I ² C	System-side fuel gauge with Impedance Track Lite technology with integrated sense resistor	15-ball CSP	1.40
bq28z560	300 to 8000	1	Yes	Pack	SMBus/HDQ	Pack-side fuel gauge with Impedance Track technology	12-pin QFN	3.15
bq28550	300 to 6000	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.

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

Battery Management Products

→ Single-Cell Solutions — Authentication for Batteries and Peripherals

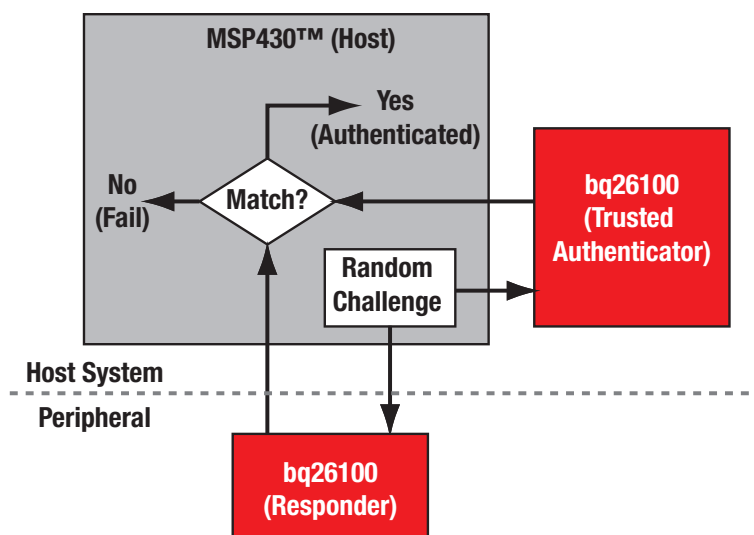
Design Factors

Original equipment manufacturers specify products to achieve required performance and safety goals. Authentication ensures that connected devices fulfill the established requirements and are safe for the consumer.

Features

TI authentication devices use three levels of security.

- **Identification Number** — The host controller can request an identification number that is answered with a fixed response.
- **CRC Algorithm** — The host processor sends a random challenge and reads the response that is an encoding of the challenge and a shared secret key through a CRC with a shared secret polynomial.
- **SHA-1 Encryption** — The host processor sends a random challenge and reads the response that is an encoding of the challenge and a shared secret key through the SHA-1 cryptographic primitive.



Single-cell battery pack with gas gauge and authentication.

Selection Guide

Device	Interface	Pins	Security	Temp (°C)	Price*
bq2022A	SDQ™	3	ID number	−40 to 85	0.90
bq2024	SDQ	3	ID number	−40 to 85	0.95
bq26150	HDQ	5	CRC algorithm	−20 to 70	0.95
bq26100	SDQ	5	SHA-1 encryption	−20 to 70	0.99
bq27541	I²C/HDQ	12	SHA-1 encryption	—	1.45

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

→ Multi-Cell Solutions — Battery Fuel Gauges and Monitors

Design Factors

Battery Chemistry — Each battery chemistry has different operating characteristics, such as discharge profiles and self-discharge rate. TI gas gauge ICs are developed by chemistry to account for these differences to accurately display remaining energy in the battery.

Features

TI gas gauges and battery monitors accurately track battery activity to compute the remaining battery capacity and system run-time. They feature:

- Simple communication protocols.
- High-resolution analog-to-digital converters for accurate charge/discharge measurement.

- Integrated CPU on gas gauges to compute remaining battery capacity and run-time.
- Advanced charge management satisfies JEITA specification of variable charging current and voltage with battery conditions.

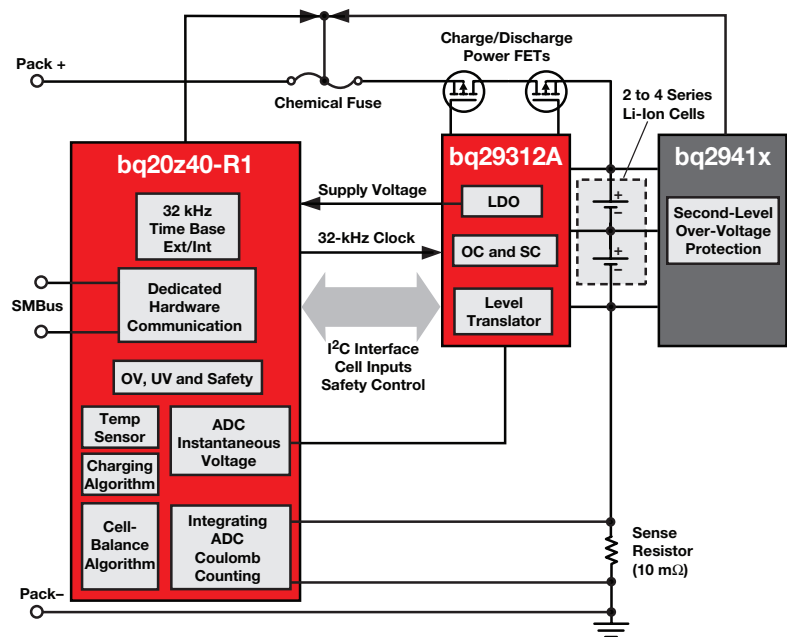
99% Accurate Gas Gauge Maximizes Run-Time

bq20z40-R1, bq20z45-R1, bq20z60-R1, bq20z65-R1, bq20z655-R1, bq34z651

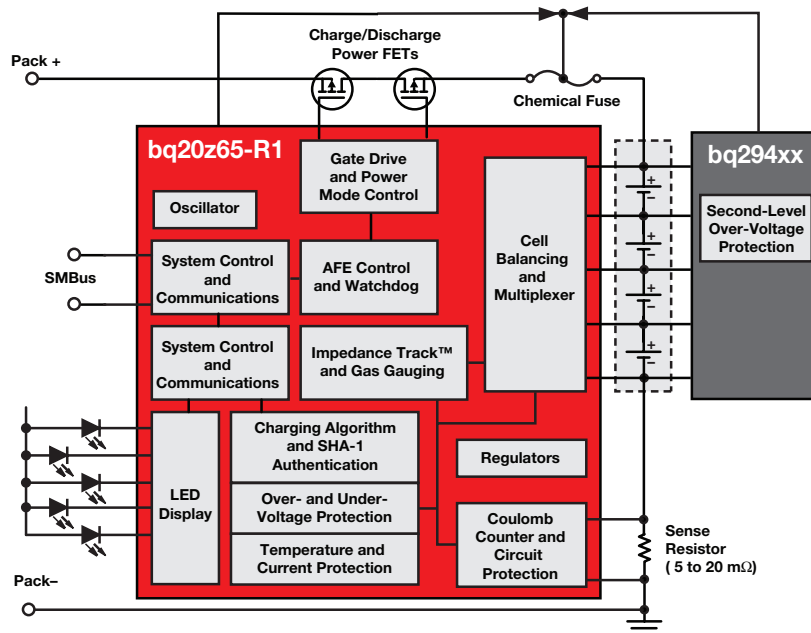
Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/product/bq20z65-R1

The dynamic Impedance Track™ gas gauge algorithm in the bq20z65 extends battery usability, allowing use of the full chemical capacity available in a battery pack. Additional features include instant state-of-charge and real-time impedance learning. Impedance Track also enables reduction in development and production time. Remaining capacity is reported over the entire life of the battery pack with better than 99% accuracy. The bq20z65-R1 is ideally suited for battery packs used in medical and industrial equipment, back-up batteries and laptop computers.



Example of two-chip solution (gas gauge plus AFE).



Example of single-chip solution (gas gauge plus integrated AFE).

Battery Management Products

→ Multi-Cell Solutions — Battery Fuel Gauges and Monitors

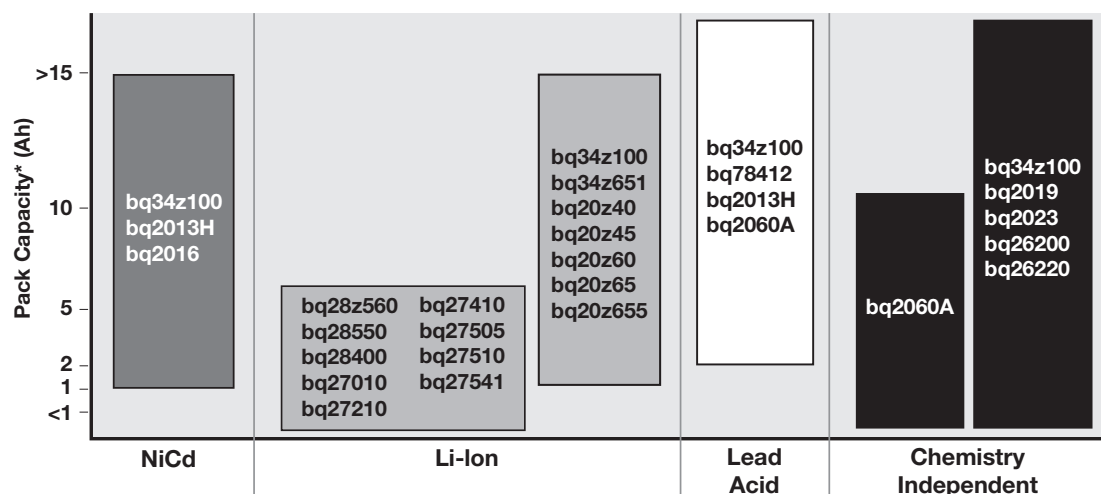
Multi-Cell Fuel Gauges Selection Guide

Device	Approx. Battery Capacity (mAh)	Min Max Series Cell	Number of LEDs	Communication Protocol	Other Features	Package	Price*
NiCd, NiMH Chemistry							
bq2013H	2000 to 15000	—	5	Single wire (HDQ)	Programmable offset error compensation	16-pin SOIC	3.70
bq2014H	500 to 6000	—	5	Single wire (HDQ)	Register compatible with bq2050H	16-pin SOIC	4.60
bq2016	1000 to 4500	—	5	Single wire (HDQ)	Automatic offset calibration	28-pin SSOP	3.75
Lithium-Ion, Lithium-Polymer Chemistry							
bq28400	500 to 16000	2	—	SMBus	CEDV+ gas gauge with integrated protector	20-pin TSSOP	3.20
bq3050	500 to 32000	2 to 4	3, 4 or 5	SMBus	CEDV+ gas gauge with integrated protector	38-pin TSSOP	3.55
bq3055	500 to 32000	2 to 4	—	SMBus	CEDV+ gas gauge with integrated protector	30-pin TSSOP	3.90
bq3060	500 to 32000	2 to 4	—	SMBus	CEDV+ gas gauge with integrated protector	24-pin TSSOP	3.55
bq20z40-R1	800 to 32000	2 to 4	—	SMBus	Impedance Track™ fuel gauge for use with bq29330 protector	20-pin TSSOP	3.65
bq20z45-R1	800 to 32000	2 to 4	—	SMBus	Impedance Track fuel gauge with integrated protector	38-pin TSSOP	4.45
bq20z60-R1	800 to 32000	2 to 4	3, 4 or 5	SMBus	Impedance Track fuel gauge with LED for use with bq29330 protector	30-pin TSSOP	3.90
bq20z65-R1	800 to 32000	2 to 4	3, 4 or 5	SMBus	Impedance Track fuel gauge with LED and integrated protector	44-pin TSSOP	4.75
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
bq34z651	800 to 32000	2 to 4	3, 4 or 5	SMBus	Gas gauge and protection enabled with Impedance Track and external battery heater control	44-pin TSSOP	5.20
bq78PL114	1000 to 650,000	3 to 12	—	SMBus	High-power gas gauge with protection and advanced cell balancing	48-pin QFN	4.50
bq78PL116	1000 to 650,000	3 to 16	—	SMBus	High-power gas gauge with protection and advanced cell balancing	48-pin QFN	4.50
bq76PL102	—	1 to 2	—	PowerLAN™	2-cell cell expansion to bq78PL114 and bq78PL116	12-pin QFN	0.90
Lead Acid Chemistry							
bq78412	1000 to 327,000	—	10	UART	Pb-acid battery state-of-charge indicator with run-time display	44-pin HTSSOP	3.90
Multi-Chemistry							
bq34z100	300 to 65000	1 to 14	5	I ² C or HDQ	Most accurate multi-chemistry gauge from TI supporting Nixx, Li-xxx and PbA battery chemistries	14-pin TSSOP	2.50
bq2060A	800 to 10000	2 to 4	5	SMBus or HDQ	Most accurate multi-chemistry gauge from TI	28-pin SSOP	3.90
Super Cap							
bq33100	—	2 to 5	—	SMBus	Fully integrated 2, 3, 4 and 5 series super capacitor manager	24-pin TSSOP	4.20
Battery Monitors							
bq2019	>20000	—	—	Single wire (HDQ)	64-bit ID ROM and 1 program output non-volatile memory	8-pin TSSOP	1.95
bq2023	>20000	—	—	Single wire (SDQ™)	64-bit ID ROM and 1 program output automatic offset error calibration	8-pin TSSOP	2.00
bq26200	>20000	—	—	Single wire (HDQ)	High-performance battery, coulomb counter	8-pin TSSOP	2.00
bq26220	>20000	—	—	Single wire (HDQ)	64-bit ID ROM and 1 program output on-chip voltage measurement	8-pin TSSOP	2.05
bq76PL536A	—	3 to 192	—	SPI	3- to 6-cell EV and UPS stackable monitor and cell-balancing AFE	64-pin HTQFP	4.30

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

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

Battery Fuel Gauges Family of Products



*Pack capacity ratings provide an approximate range for each gas gauge.

For a complete list of Resources, visit: www.ti.com/battery

→ Multi-Cell Solutions — Lithium-Ion Protection

Design Factors

Number of Series Cells — A battery pack is constructed from a string of series and parallel cells. Each series cell, or group of parallel cells, requires protection from overcharge, overdischarge and short-circuit conditions.

Threshold Voltage — Li-Ion and Li-Polymer cells are produced by many manufacturers. Some manufacturers' technologies create cells of different maximum stress voltages, otherwise known as the "overvoltage threshold." This data is available from the cell supplier.

Threshold Tolerance — The overvoltage threshold has a tolerance that needs to be accounted for in the design for safety reasons.

Shutdown Current — In battery pack applications, constant current draw needs to be very low to preserve battery life.

Charge/Discharge Current — The pass element associated with each protection IC is rated for maximum current whether it be an internal or external FET.

Features

- BiCMOS process results in low current consumption.
- Different overvoltage thresholds allow one design to work with several cell suppliers.
- Sleep current consumption of less than 3.5 μA enables extended battery life.
- 50 mV precision internally trimmed thresholds maximize safety.
- Short-circuit protection eliminates the need for an external fuse.

Selection Guide

Device	Number of Series Cells	Charge/Discharge Current (A)	Shutdown Current (μA)	Other Features	Package(s)	Price*
bq2920x	2	—	3	Overvoltage safety with cell balancing	8-pin SON	0.30
bq2941x	2, 3 or 4	—	3	Overvoltage safety for chemical fuse activation; PTC	8-pin TSSOP	0.45
bq2944x	2, 3 or 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
bq77PL900	5 to 10	External PFET	—	Stand-alone or host-controlled protector with cell balancing	48-pin SSOP	2.95
bq77908A	4 to 8	External NFET	5	Stand-alone protector with cell balancing	38-pin TSSOP	2.70
bq77910A	4 to 10	External NFET	5	Stand-alone protector with cell balancing	38-pin TSSOP	2.70
bq77PL157A4225	3 to 6	External NFET	3	Stackable overvoltage protector; stack 3 for 18 series cells	16-pin TSSOP	0.65

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

New devices are listed in bold red.

Stand-Alone Multi-Cell Precision Protector for Li-Ion Chemistries

bq77910A

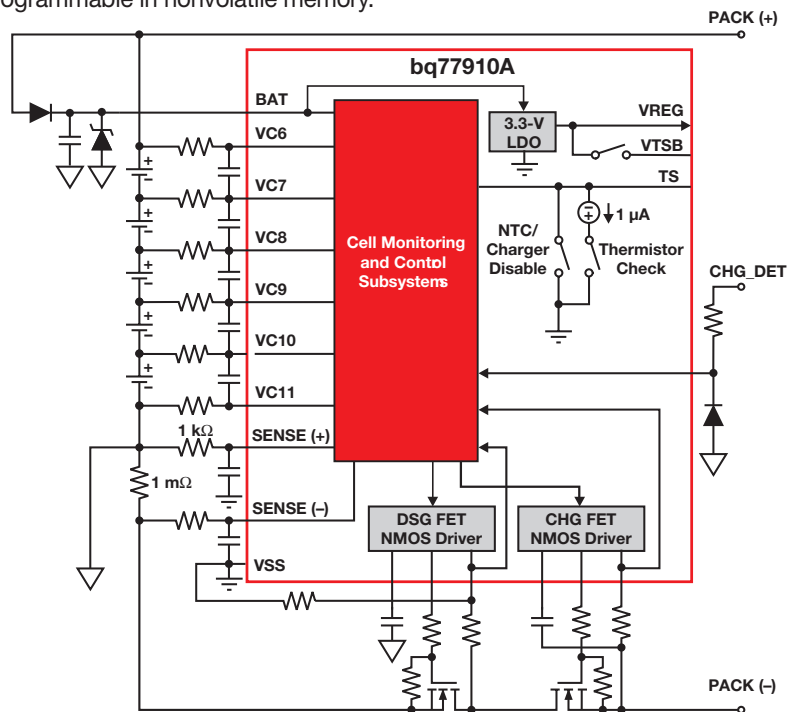
Get datasheets at: www.ti.com/product/bq77910A

The bq77910A precision protector is a complete stand-alone, self-contained battery-protection and cell-balancing device intended for Li-Ion/Li-Polymer battery packs.

The bq77910A monitors 4 to 10 series individual cell voltages and provides fast-acting outputs that can be used to drive n-channel MOSFETs to interrupt the power path. Activation delays and recovery methods for each safety condition are fully programmable in nonvolatile memory.

Key Features

- 4-, 5-, 6-, 7-, 8-, 9- or 10-series cell protection
- Individual cell-voltage monitoring
- Low-side NMOS FET drive for charge and discharge control
- Compatible with 1-m Ω current-sense resistor
- Supply-voltage range: 5.6 V to 50 V
- Integrated 3.3-V micropower LDO regulator



5-cell, series FET configuration schematic using the bq77910A.

→ Wireless Power

Overview

The market demand for the convenience and safety of wireless power systems is growing rapidly. Portable devices like smart phones, music/video players, cameras, and game controllers are just a few of the battery-powered products that can be upgraded to a wireless power system to keep their batteries charged.

While near-field inductive power coupling has been around for some time, applications have been limited to very low power levels. Since today's portable devices require increasing amounts of power, and higher-power batteries require more advanced control systems, a number of safety risks in the design of wireless power systems must be considered. Compliance with Wireless Power Consortium (WPC) specifications helps designers avoid safety problems and ensures interoperability between systems.

The basic wireless power system consists of a power transmitter that is

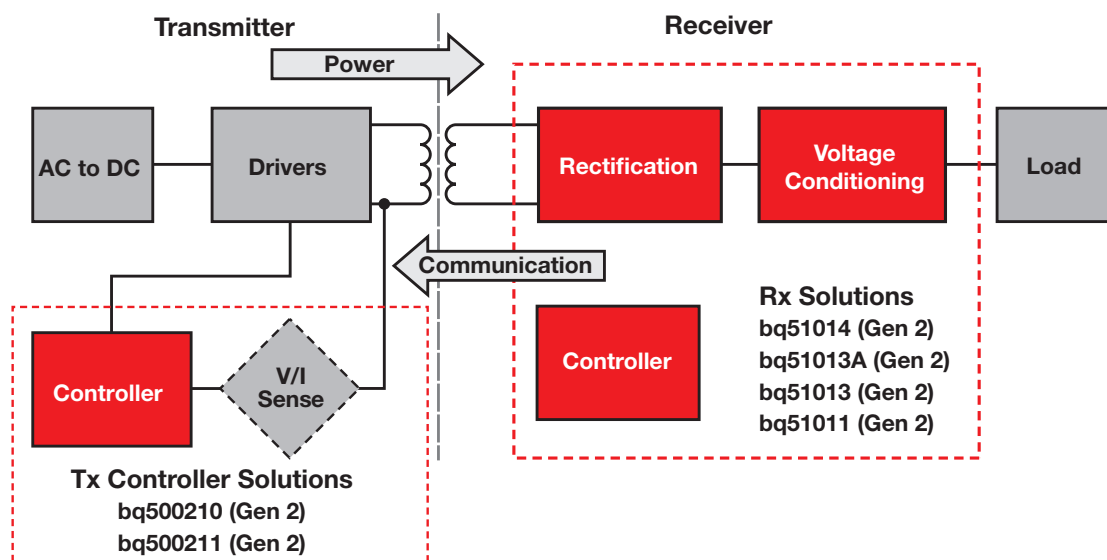
typically located in a base station powered by an AC line or other stable power source. The power receiver is located in the battery-powered device that uses the power received to charge a battery. Both the transmitter and receiver contain wire coils, and power is transferred between them without electrical contact via inductive coupling. Since power is inductively transferred from the transmitter to the receiver via coils, the transmitter must power the coil with a switching current that has sufficient frequency to optimize coupling between coils. The receiver coil then picks up the near-field inductive energy and uses rectifiers and voltage-conditioning circuitry to produce a DC output. To control the power transfer, it is important for the receiver to constantly communicate with the transmitter to indicate when power is required, how much power to send and when to stop sending power. This communications data is exchanged through the same coils that couple the power.

TI offers a growing family of wireless power transmitters and receivers that support the WPC Qi specification. The bq500210 is a new Qi-compliant transmitter manager that offers intelligent control of the power transfer between a base station and a mobile device. The bq5101x Qi-compliant integrated receivers provide a regulated DC output and digital-control feedback to the transmitter. The following pages provide more details about these devices. For more information, visit:

www.ti.com/wirelesspower

Receiver-Side Solutions

TI's Qi-compliant receivers integrate a low-impedance, full synchronous rectifier, a low-dropout regulator (LDO), digital control and accurate voltage and current loops. The entire power stage (rectifier and LDO) utilize low-impedance NMOS FETs to ensure high efficiency and low power dissipation.



→ Wireless Power

Integrated, Qi-Compliant, Wireless Power-Supply Receivers

bq51011, bq51013

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/bq51013

Together with the bq500210 transmitter controller, the bq5101x family of receivers enables a complete contactless power-transfer system for a wireless power-supply solution.

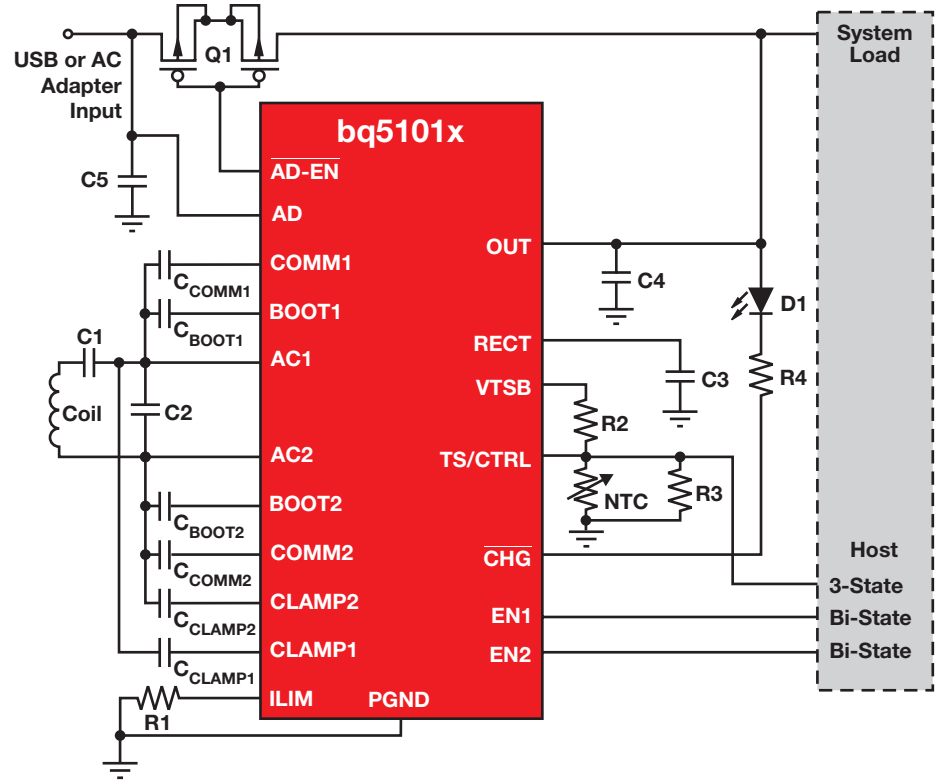
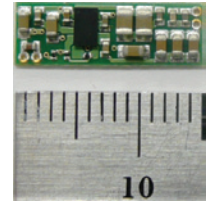
Key Features

- Integrated wireless power receiver with a 5-V regulated supply
- 93% overall peak AC-to-DC efficiency
- Full synchronous rectifier
- WPC v1.0-compliant communication control
- Output-voltage conditioning
- Only IC required between Rx coil and 5-V DC output voltage
- Internal dynamic rectifier control for improved load-transient response
- Supports 20-V maximum input
- Low-power dissipative rectifier over-voltage clamp ($V_{OVP} = 15\text{ V}$)
- Thermal shutdown
- Single NTC/control pin
- Packaging
 - 1.9x3-mm WCSP
 - 4.5x3.5-mm QFN (Coming soon)

Applications

- Cell and smart phones
- Headsets
- Digital cameras
- Portable media players
- Handheld devices

Example 5 x 15-mm PCB with all receiver-side circuitry.



Selection Guide

(Device parameters continued below)

Device	Number of Cells	V_{IN} Type	V_{IN} Max Operating (V)	V_{IN} Absolute Max (V)	V_{IN} OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET
bq51011	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	See Comments	5	Stand Alone	Linear	Yes
bq51013	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes
bq51013A	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes
bq51014	Reg V_{OUT}	Coil/USB/Adapter	10	20	12.5	1.5	5	Stand Alone	Linear	Yes

(Device parameters continued from above)

Device	Primary Charge Termination	Charge Timer	Temperature Monitor	Packaging		EVM	Comments	Price*
				WCSP	QFN			
bq51011	EPT Cmd to Tx	No	Yes	28			Receiver, current limited charge current (400 mA + dynamic I_{LIM})	3.50
bq51013	EPT Cmd to Tx	No	Yes	28		✓	Receiver, regulated voltage output, compliant to WPC specification 1.0	3.50
bq51013A	EPT Cmd to Tx	No	Yes	28	20	✓	Receiver, regulated voltage output, FOD	3.50
bq51014	Programmable	No	Yes	28			Receiver, FOD, programmable termination current, 12.5-V AD-OVP	3.50

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

New devices are listed in bold red.

Battery Management Products

→ Wireless Power

Transmitter-Side Solutions

TI offers dedicated digital controllers that integrate the logic functions required to control wireless power transfer in a single-channel, WPC-compliant, contactless-charging base station. These intelligent controllers periodically ping the

surrounding environment for available devices to be powered, monitor all communication from the device being wirelessly powered, and adjust power applied to the transmitter coil per feedback received from the powered device. They also monitor transfer efficiency with

real-time analysis, which protects the controllers and power receivers from excessive power loss and heat associated with parasitic metal objects placed in the power-transfer path.

Qi-Compliant, Wireless Power-Transmitter Manager

bq500210

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/bq500210

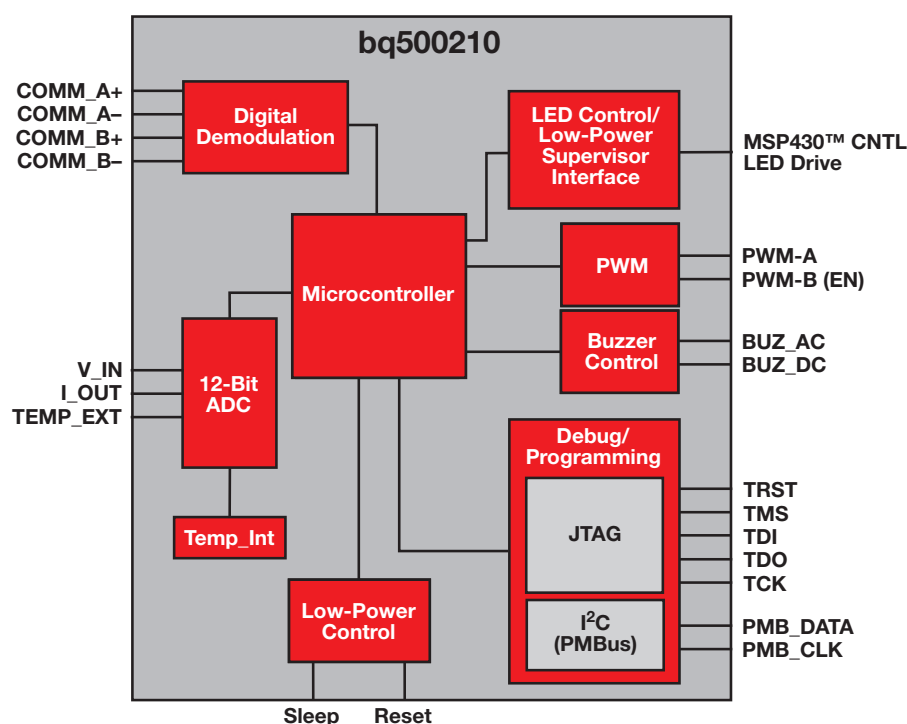
Together with the bq5101x receivers, the bq500210 transmitter controller enables a complete, contactless power-transfer system for a wireless power-supply solution.

Key Features

- Intelligent control of the power transfer between base station and mobile device
- Conforms to WPC v1.0.2 specification
- Demodulates and decodes WPC-compliant message packets from the power-receiving device over the same wireless link that transfers electrical power
- Implements closed-loop communications to control power transfer by varying frequency of the voltage on the transmitting coil
- Parasitic metal-object detection (PMOD)
- Operating-mode status indicators
 - Standby
 - Power transfer
 - Charge complete
 - Fault
- Overload and overtemperature protection
- 7 x 7-mm, 48-pin QFN package

Applications

- Transmitter pad for contactless charging with WPC compliance
- Low-power (<5-W) end equipment: Cell phones, digital cameras, portable media players, remote/gaming controllers, *Bluetooth*® headsets and other portable devices



Selection Guide

Device	Description	Number of Channels	Supported Communication Modulation	WPC-Standard Compliance	Transmitter Power Class (W)	Transmitter Input Voltage (Typ) (V)	Package	Price*
bq500210	Generation 2 Qi-compliant wireless power transmitter manager	1	Resistive and Capacitive	Yes	5	19	48-pin VQFN	3.95

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

New devices are listed in bold red.

→ Wireless Power

bqTESLA™ Development Modules

bq500210EVM-689 (Tx) and bq51013EVM-725 (Rx)

Get more information at: www.ti.com/wirelesspower

TI's combined bqTESLA evaluation modules provide a high-performance, easy-to-use development kit for the design of low-power wireless solutions. The kit features the bq500210 single-channel transmitter and the bq51013 5-V power-supply receiver, enabling designers to speed development of their end applications.

Key Features

- bq500210 single-channel transmitter
- bq51013 5-V power-supply receiver
- No additional software development required
- Allows for true plug-and-play functionality
- Compatible with WPC Qi specifications



Development kit includes bq500210 and bq51013 evaluation modules.

→ Overview

Distributing and controlling power—even after the correct voltage is derived—is becoming more complex. Because increasing numbers of voltage rails are required in today's advanced processing or embedded systems, distributing and managing these rails is a constant challenge.

In these systems, load switches, MUXes, or inrush-protection devices are routinely

required to safely route power where it is needed and deliver it properly. When power needs to be moved from system to system, issues like hot-swap control, safety certification, and monitoring are quickly top priorities.

Digital control takes all of these concerns and capabilities to yet another level.

Microprocessor control and monitoring in system health and power blocks gives

designers even more options to improve the robustness of their system. Using digital interfaces to various functional blocks and sensors, it is possible to monitor the amount of power or current being consumed, the temperature of the system, or other variables, and then take action.

→ Power-over-Ethernet

The concept of providing power along with data is as old as plain old telephone service, but the formal standard for providing power along Ethernet lines is much more recent. Though the original Power-over-Ethernet (PoE) specification was approved in 2005, the IEEE ratified a superseding standard in summer 2009—the IEEE 802.3at. Both standards specify behavior for devices receiving power across Ethernet lines, known as “powered devices” (PDs), and methods for injecting power onto the line, used in equipment known as “power sourcing equipment” (PSE).

Original PoE . . . Only Better!

The vast majority of PoE applications need less than 12.95 W. For this growing market area, TI has a large portfolio of options to consider:

TPS23753A

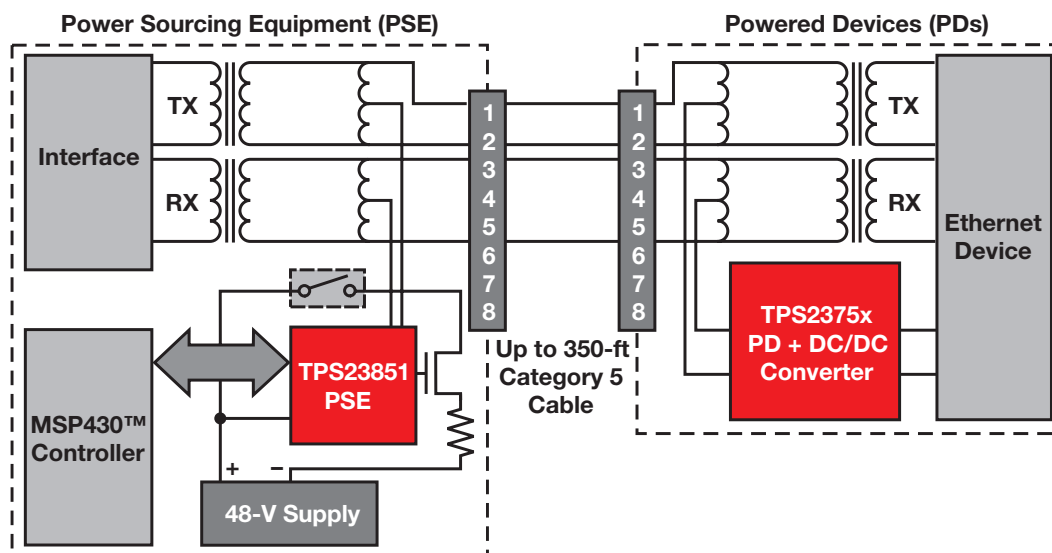
- Simplest, most elegant, lowest-cost solution for a standard PoE PD
- Incorporates rugged tolerance for extended ESD exposure
- Auxiliary power supplies are fully supported—down to 12 V!

TPS23757

- Secondary gate driver enables high-efficiency, isolated topologies for applications requiring 12.95 W or less
- Pin-for-pin compatible with the TPS23756, providing an easy path for low- or high-power applications
- Operates with auxiliary input power supplies as low as 12 V

TPS23750

- TI's original PD front end plus DC/DC converter
- Supports simple, low-cost, non-isolated buck-converter topologies with no transformer required



The new TPS23851 and TPS2375x are IEEE 802.3at-compliant power-management ICs designed for managing the connection between Power Sourcing Equipment (PSE) and Powered Devices (PDs) over Ethernet cables (see: www.ti.com/poe). The TPS23851 is a quad-port PSE power manager with external FETs and individual ADCs per port for maximum monitoring and control.

→ Power-over-Ethernet

IEEE 802.3at PoE High-Power PD Interface

TPS2378, TPS2379

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TPS2378 or [TPS2379](http://www.ti.com/product/TPS2379)

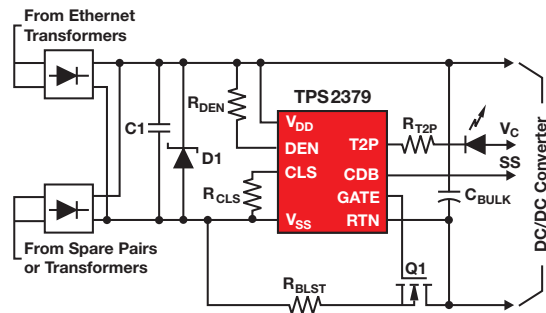
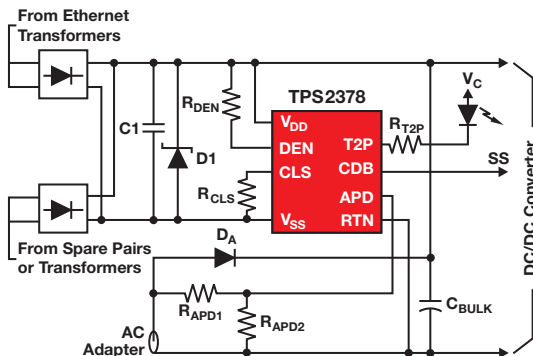
The new TPS2378 and TPS2379 PDs are specifically designed for high-power POE systems such as surveillance system cameras and wireless access points. Full 802.3at compliance along with a large and growing collection of proven reference

designs makes it easy to create a robust, rugged and compliant PD system.

Key Features

- TPS2378 – Programmable AUX input that forces load to be powered from AUX supply if available

- TPS2379 – Gate drive for external NFET allows designer to select external FET for desired current limit
- 802.3at-compliant hardware
- 100-V monolithic process



Selection Guide

Device	Description	Abs Max V_{IN} (V)	Operating Temp (°C)	Full Inrush Current Limiting	Current Limit (mA)	Second Gate Driver for Maximum Efficiency	Package(s)	Price*
Power-over-Ethernet (PoE) Powered Device (PD) Controllers with Integrated DC/DC Controllers								
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	PD with Eco-mode™ PWM	100	-40 to 85	Fixed	800	No - VF	TSSOP-20	TBD
LM5070	Integrated PD with PWM controller	80	-40 to 125	Prog	500	No	TSSOP-16	1.45
LM5071	Integrated PD with PWM controller and AUX interface	80	-40 to 125	Fixed	390	No	TSSOP-16	1.45
LM5072	Integrated PD with PWM controller and AUX control	100	-40 to 125	Prog	800	No	TSSOP16	1.85

Device	Description	Detection	Classification	Abs Max V_{IN} (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*
Power-over-Ethernet (PoE) Powered Device (PD) Interface Front-End Controllers												
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	TBD
TPS2379	PD with high power	4	Yes, Class 0-4	100	-40 to 85	Fixed	800	Auto Retry	30.5/35	PG	SOIC-8	TBD
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_{IN} (V)	Operating Temp (°C)	IEEE Compliant	Interface	Disconnect	Measurements	Power FET	Package	Price*
Power-over-Ethernet (PoE) Power Sourcing Equipment (PSE) Controllers											
TPS2384	Routers, switches, SOHO hubs, midspans	4	80	-40 to 125	802.3af	I ² 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 ² C	Both AC and DC	Current, voltage, capacitance and temperature	Internal	64-pin LQFP	7.50
TPS23851	High power PoE for switches, hubs, midspans and industrial applications	4	70	-20 to 125	802.3at Type 1 & 2	I ² C	Both AC and DC	Current, voltage and temperature	External	36-pin SSOP	4.50

*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 blue**.

→ Protection and Power Switches

Protection Circuitry

Protecting designs from unwanted inrush current, reverse current flow, or malfunction is challenging. The following questions and answers cover typical application design issues.

Can the board ever pull too much current?

If the design involves devices that plug into live systems (hot swaps), the answer is probably “yes.” Also, if the design has subsystems that need to be turned on and off via a pass FET or some other device, unwanted inrush current could be a problem when those systems are activated. In these cases, choosing a current-limiting switch or a hot-swap manager will control this input. Here are some key considerations that will make product selection easier:

1. *What is the voltage? How much nominal current does the system draw?* If the system has low voltage (< 20 V) and draws less than 5 A continuously, a hot-swap controller such as the TPS2420/1 with an internal FET and sense element is a likely choice. For higher voltages and/or higher currents, an external FET and a hot-swap controller IC such as the TPS2492/3 or LM5069 are good solutions.

2. *Are defined periods of time needed during which additional current can flow to the load (for example, during start-up)?* If so, a constant-current switch or a configurable timer on a hot-swap controller is important. Good examples of these are the TPS2552/3 devices, which are simple switches with only thermal shutdown, and the TPS2420, which has a configurable timer.
3. *Does the amount of current flowing to the load need to be monitored?* The TPS2420 and TPS2x58/9 have analog current-monitoring pins that are ideal for use with sequencers such as the UCD90124 on page 109 or with any microcontroller with an onboard ADC such as TI's MSP430™ MCU. The LM(2)5066, LM5064 and TPS2480/1 external FET devices have directly addressable digital outputs of current readings via I²C or SMBus/PMBus.

Is the power supply at risk from reverse current flow?

If the system has a battery backup, super-capacitor, or alternate power supply, the answer is probably “yes.” Also, if it is important to control which source is powering the board, ORing FET controllers such as the LM5050, TPS2410 or

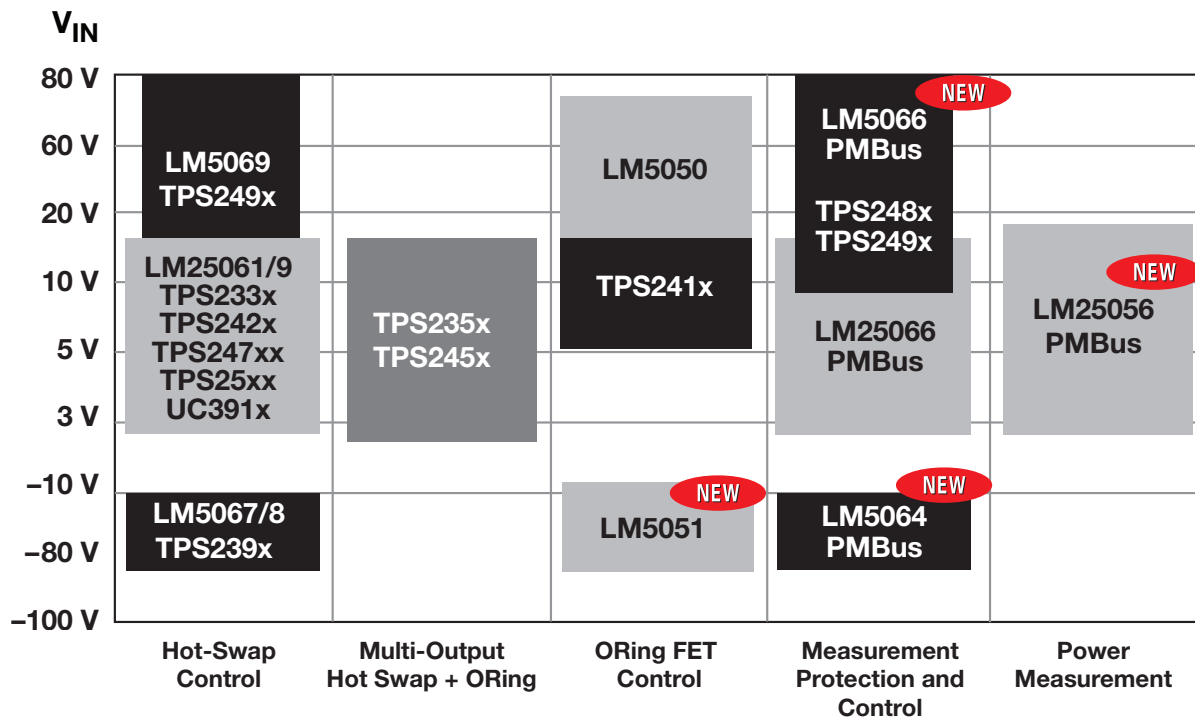
combination devices could be very useful. Here are some key questions to consider:

1. *What is the voltage? How much nominal current does the system draw?* For systems from 0.8 to 16.5 V, the TPS2410/1/2/3 are great options that control external FETs, providing flexibility for the amount of current passing through to the load. Features like soft start, nuisance trip filters, and external control via UV/OV pins are key aspects for many designs.
2. *Are the system's currents and voltages low enough to use a single device?* Many lower-voltage (2.7- to 6.5-V) solutions that consume less than 1.5 A per rail could make use of integrated MUX devices.

If protection from both reverse current and inrush current is needed, check out the TPS2456/8/9 devices, which incorporate both an ORing FET controller and a hot-swap controller.

→ Protection and Power Switches

Protection Power Portfolio



System Power Management and Protection IC with PMBus

LM25066

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/LM25066

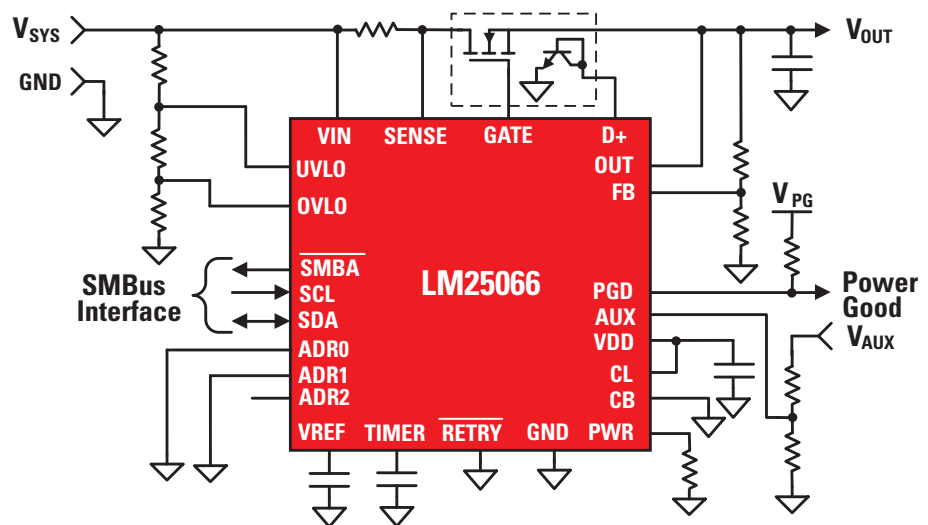
TI's PMBus-enabled system protection and management products combine hot swap control with embedded telemetry measurement, intelligence, and digital communications which enable them to deliver accurate power usage data back to the system to optimize power consumption, reduce operating expenses, and increase reliability

Key Features

- Hot swap with current and power limiting
- Adjustable current limit, circuit breaker thresholds
- Measure voltage, current, power and temperature
- Simultaneous sampling of current and voltage for true power measurement
- Peak and programmable average power capture
- Dynamic configuration of fault and warning levels
- I²C/SMBus interface with PMBus compliance

Applications

- Server backplane systems
- Base station power distribution systems
- Solid-state circuit breakers



Typical application circuit.

→ Protection and Power Switches

Hot Swap Switches (Integrated FET) Selection Guide

Device	Target Applications	Channels	V _{IN} (V)	Current Limit (A)	r _{DS(on)} per FET (typ) (mΩ)	Enable/Shutdown	Ramp	Package(s)	Price*
TPS2420	Hot swap with current monitor & pwr limiting	1	3 to 20	1 to 5	20	1L	Current	16-pin SON	1.95
TPS2421-1	Hot swap with pwr limiting, latch-off on fault	1	3 to 20	1 to 5	20	1L	Current	SOIC-8	1.60
TPS2421-2	Hot swap with pwr limiting, retry on fault	1	3 to 20	1 to 5	20	1L	Current	SOIC-8	1.60
TPS2552	Current-limiting switch, constant-current	1	2.5 to 6.5	0.75 to 1.5	85	1L	Current	6-pin SOT-23, SON	0.70
TPS2552-1	Current-limiting switch, latch-off on fault	1	2.5 to 6.5	0.75 to 1.5	85	1L	Current	6-pin SOT-23, SON	0.70
TPS2553	Current-limiting switch, constant-current	1	2.5 to 6.5	0.75 to 1.5	85	1H	Current	6-pin SOT-23, SON	0.70
TPS2553-1	Current-limiting switch, latch-off on fault	1	2.5 to 6.5	0.75 to 1.5	85	1H	Current	6-pin SOT-23, SON	0.70
TPS2554	Current-limiting switch, constant-current	1	4.5 to 5.5	0.25 to 2.8	73	1H	Current	8-pin SON	0.80
TPS2555	Current-limiting switch, constant-current	1	4.5 to 5.5	0.25 to 2.8	73	1L	Current	8-pin SON	0.80
TPS2556	Current-limiting switch, constant-current	1	2.5 to 6.5	0.5 to 5	22	1L	Current	8-pin SON	0.90
TPS2557	Current-limiting switch, constant-current	1	2.5 to 6.5	0.5 to 5	22	1H	Current	8-pin SON	0.90
TPS2560/A	Current-limiting switch, constant-current	2	2.5 to 6.5	0.25 to 2.5	45	2L	Current	10-pin SON	0.90
TPS2561/A	Current-limiting switch, constant-current	2	2.5 to 6.5	0.25 to 2.5	45	2H	Current	10-pin SON	0.90
TPS2590	Current-limiting switch, configurable fault	1	3 to 20	1 to 5	20	1L	Current	16-pin SON	1.05
UCC3915	Enclosure management, general	1	7 to 15	0 to 3	150	1L	Current	SOIC-16, TSSOP-24	2.55
UCC3912	RAID, SCSI, general	1	3 to 8	0 to 3	150	1L	Current	SOIC-16, TSSOP-24	2.30
UCC3918	RAID, SCSI, general	1	3 to 6	0 to 4	75	1L	Current	SOIC-16, TSSOP-24	2.35

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

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

Hot Swap Controllers (External FET) Selection Guide

Device	Target Applications	Channels	V _{IN} Range (V)	Enable/Shutdown	UV	OV	Fault	PG	Latch	Auto Retry	Ramp	Power Limiting	Package(s)	Price*
TPS2300/01	CompactPCI®, general	2	3 to 13/3 to 5.5	1L/1H	✓		✓	✓	✓		Voltage	No	20-pin TSSOP	1.60
TPS2310/11	CompactPCI, general	2	3 to 13/3 to 5.5	1L/1H	✓		✓	✓	✓		Voltage	No	20-pin TSSOP	1.60
TPS2320/21	CompactPCI, general	2	3 to 13/3 to 5.5	1L/1H	✓		✓	✓	✓		Voltage	No	16-pin SOIC/TSSOP	1.35
TPS2330/31	CompactPCI, general	1	3 to 13	1L/1H	✓		✓	✓	✓		Voltage	No	14-pin SOIC/TSSOP	1.25
UCC3919	Low-voltage general hot swap	1	3 to 8	1H			✓		S ¹	S ¹	Current	No	16-pin SOIC/TSSOP	2.35
TPS2342	CompactPCI, PCI-X®, PC-X2.0	12	3.3, V _{AUX} , V _{IO} , 5, +12, -12	1L	✓			✓	✓		Voltage	No	80-pin HTQFP	7.00
TPS2343	CompactPCI, PCI-X, PC-X2.0	12	3.3, V _{AUX} , V _{IO} , 5, +12, -12	1L	✓			✓	✓		Voltage	No	80-pin HTVSOP	7.50
TPS2350	Full featured -48-V telecom, LS active ORing	2	-12 to -80	1H	✓	✓	✓	✓		✓	Current	No	14-pin SOIC/TSSOP	1.90
TPS2358	xTCA mezzanine cards, general 12 V	2	8.5 to 17	2L	✓		✓	✓	✓		Current	No	48-pin QFN	4.00
TPS2359	xTCA mezzanine cards, general 12 V	2	8.5 to 17	1H/1L	✓	✓	✓	✓	S ¹	S ¹	Current	No	36-pin QFN	5.00
TPS2363	PCI Express®	6	3.3 V _{AUX} , 3.3, +12	1L	✓		✓	✓	✓		Voltage	No	48-pin QFP	2.50
TPS2390	Simple -48-V telecom	1	-36 to -80	1H			✓		✓		Current	No	8-pin MSOP	1.00
TPS2391	Simple -48-V telecom	1	-36 to -80	1H			✓			✓	Current	No	8-pin MSOP	1.00
TPS2392	Full featured -48-V telecom	1	-20 to -80	1H	✓	✓	✓	✓	✓		Current	No	14-pin TSSOP	1.35
TPS2393	Full featured -48-V telecom	1	-20 to -80	1H	✓	✓	✓	✓		✓	Current	No	14/44-pin TSSOP	1.35
TPS2393A	Full featured -48-V telecom (Fast retry)	1	-20 to -80	1H	✓	✓	✓	✓		✓	Current	No	14-pin TSSOP	1.35
TPS2394	Full featured, ESD ruggedized -48-V hotswap	1	-12 to -80	1H	✓	✓	✓	✓		✓	Current	No	14-pin TSSOP	1.35
TPS2395	-48-V hot swap with I ² C-based current monitor	1	-12 to -80	1H	✓	✓	✓	✓		✓	Current	No	20-pin TSSOP	TBD
TPS2398	Simple -48-V telecom with PG	1	-36 to -80	1H				✓	✓		Current	No	8-pin MSOP	1.35
TPS2399	Simple -48-V telecom with PG	1	-36 to -80	1H				✓		✓	Current	No	8-pin MSOP	1.35
TPS2400	Overvoltage/undervoltage protection IC	1	2 to 100	1H	✓	✓			✓		—	No	5-pin SOT-23	0.80
TPS2456	Inrush controller with reverse current control	2	8.5 to 15	2H	✓		✓	✓	✓		Current	No	36-pin QFN	3.75
TPS2458	xTCA mezzanine cards, general 12 V	1	8.5 to 15	1L	✓		✓	✓	✓		Current	No	32-pin QFN	2.00
TPS2459	xTCA mezzanine cards, general 12 V	1	8.5 to 15	1H/1L	✓	✓	✓	✓	S ¹	S ¹	Current	No	32-pin QFN	2.50

¹S = Selectable.

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

→ Protection and Power Switches

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

Device	Target Applications	Channels	V _{IN} Range (V)	Enable/Shutdown	UV	OV	Fault	PG	Latch	Auto Retry	Ramp	Power Limiting	Package(s)	Price*
TPS24700	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓			✓	✓		Current	No	8-pin MSOP	1.10
TPS24701	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓			✓		✓	Current	No	8-pin MSOP	1.10
TPS24710	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✓		L	L	✓		Current	Yes	10-pin MSOP	1.25
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 ¹	S ¹	Current	Yes	16-pin SON	1.40
TPS2480	Servers, basestations, +48 V, +12 V	1	9 to 80	1H	✓			✓	✓		Current	Yes	20-pin TSSOP	3.00
TPS2481	Servers, basestations, +48 V, +12 V	1	9 to 80	1H	✓			✓		✓	Current	Yes	20-pin TSSOP	3.00
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 Iq 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
LM5064	PMBus -48-V hotswap controller with system measurement	1	-10 to -80	1H	✓	✓	✓	✓	Prog	Prog	Current	Yes	28-pin eTSSOP	3.95
LM25066/A	PMBus 12-V hotswap controller with system measurement	1	2.9 to 17	1H	✓	✓	✓	✓	Prog	Prog	Current	Yes	24-pin LLP	2.45/2.95
LM5066	PMBus 48-V hotswap controller with system measurement	1	10 to 80	1H	✓	✓	✓	✓	Prog	Prog	Current	Yes	28-pin eTSSOP	3.95

¹S = Selectable.

Pin function: L = active low, H = active high.

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

New devices are listed in bold red.

ORing FET Controllers/MUX Devices Selection Guide

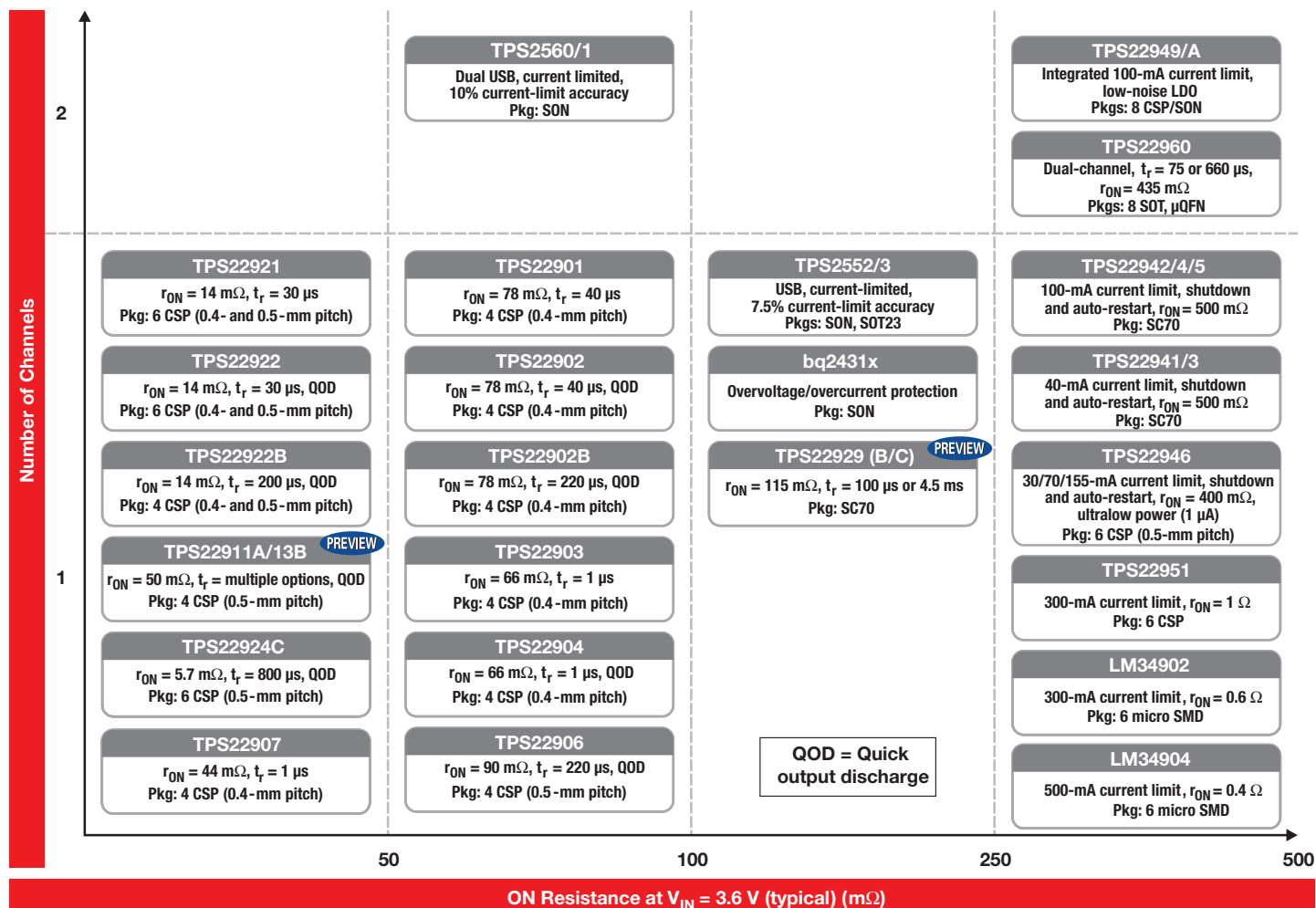
Device	Description	Channels	V _{IN} Range (V)	Enable/Shutdown	UV	OV	Fault	PG	ORing Linear Gate Drive	On/Off ORing Function	Package(s)	Price*
TPS2410	ORing FET controller/MUX controller	1	0.8 to 16.5	1H	✓	✓	✓	✓	✓		14-pin TSSOP	1.70
TPS2411	ORing FET controller/MUX controller	1	0.8 to 16.5	1H						✓	14-pin 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
TPS2456	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 ² C							36-pin QFN	5.00
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

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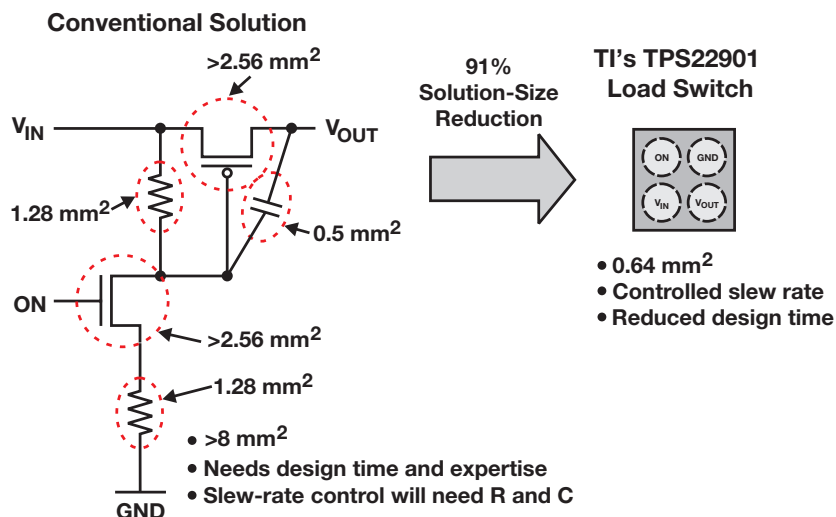
New devices are listed in bold red.

→ Protection and Power Switches

Portable Electronics Integrated Load Switches Product Portfolio

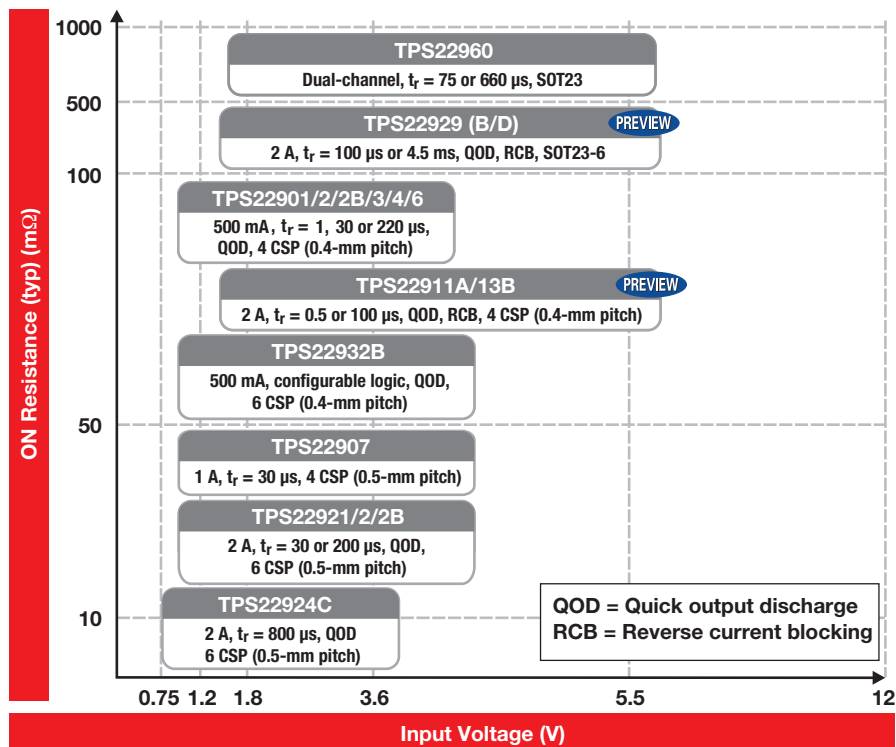


The Integration/Size Advantage of Load Switches



→ Protection and Power Switches

Non-Current-Limited Load Switches Product Portfolio



Selection Guide

Device	Input Voltage Range (V)	Number of Channels	r _{ON} at 3.6 V (mΩ)	Output Rise Time (μs)	Quick Output Discharge	Max Output Current	Enable	Package(s)	Price*
Non-Current-Limiting Load Switches									
TPS22901	1.0 to 3.6	1	78	40	No	500 mA	Active high	CSP (0.8x0.8 mm)	0.32
TPS22902/B	1.0 to 3.6	1	78	40/220	Yes	500 mA	Active high	CSP (0.8x0.8 mm)	0.32
TPS22903	1.1 to 3.6	1	66	1	No	500 mA	Active high	CSP (0.8x0.8 mm)	0.32
TPS22906	1.0 to 3.6	1	90	220	Yes	500 mA	Active high	CSP (0.9x0.9 mm)	0.32
TPS22907	1.1 to 3.6	1	44	36	No	1 A	Active high	CSP (0.9x0.9 mm)	0.38
TPS22921	0.9 to 3.6	1	14	30	No	2 A	Active high	CSP (0.8x1.2 mm or 0.9x1.4 mm)	0.43
TPS22922/B	0.9 to 3.6	1	14	30/200	Yes	2 A	Active high	CSP (0.8x1.2 mm or 0.9x1.4 mm)	0.43
TPS22924B/C	0.75 to 3.6	1	18.3	100/800	Yes	2 A	Active high	CSP (0.9x1.4x0.4/0.5 mm)	0.28
TPS22920	0.75 to 3.6	1	5.3	800	Yes	4 A	Active high	CSP, 0.9x1.9 mm	0.34
TPS22966	0.8 to 5.5	2	15	Adj.	Yes	6 A	Active high	SON-14, 3x2 mm	0.44
Non-Current-Limiting Load Switches with Reverse Current Protection									
TPS22910A	1.4 to 5.5	1	61	1	No	2 A	Active low	CSP (0.9x0.9x0.5 mm)	0.24
TPS22913B	1.4 to 5.5	1	61	100	Yes	2 A	Active high	CSP (0.9x0.9x0.5 mm)	0.24
TPS22913C	1.4 to 5.5	1	61	1000	Yes	2 A	Active high	CSP (0.9x0.9x0.5 mm)	0.24
TPS22912C	1.4 to 5.5	1	61	1000	No	2 A	Active high	CSP (0.9x0.9x0.5 mm)	0.24
TPS22929D	1.4 to 5.5	1	115	4000	Yes	2 A	Active high	SOT23-6 (3x3 mm)	0.24

Device	Input Voltage Range (V)	r _{ON} at 1.8 V (Ω)	Current Limit (mA)	Current-Limit Blanking Time (ms)	Auto-Restart Time (ms)	Active	Package(s)	Price*
Current-Limiting Load Switches								
TPS22941	1.62 to 5.5	1.1	40	10	80	Low	5 SC70	0.42
TPS22942	1.62 to 5.5	1.1	100	10	80	Low	5 SC70	0.42
TPS22943	1.62 to 5.5	1.1	40	0	—	High	5 SC70	0.42
TPS22944	1.62 to 5.5	1.1	100	0	—	High	5 SC70	0.42
TPS22945	1.62 to 5.5	1.1	100	10	80	High	5 SC70	0.42
TPS22946	1.62 to 5.5	0.6	155/70/30	10	70	High	6 CSP	0.55
TPS22949/A	1.62 to 4.5	1	100	12	70	High	8 CSP/SON	0.70
TPS22951	2.8 to 5.3	1	600	—	—	High	6 CSP	0.45
LM34902/4	2.8 to 5.3	0.6/0.4	300/500	—	—	High	Micro SMD-6	TBD

*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 blue.

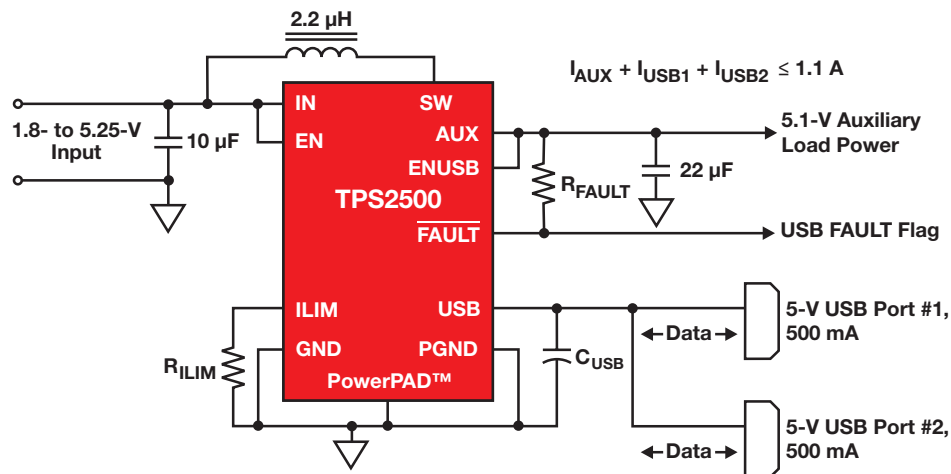
→ Protection and Power Switches

USB Current-Limiting Power Switches

Power switches are used to intelligently turn power on/off and provide fault protection. They are ideal for power sequencing or segmentation and when controlled allocation of power is needed to circuit blocks, modules, add-in cards or cabled connections.

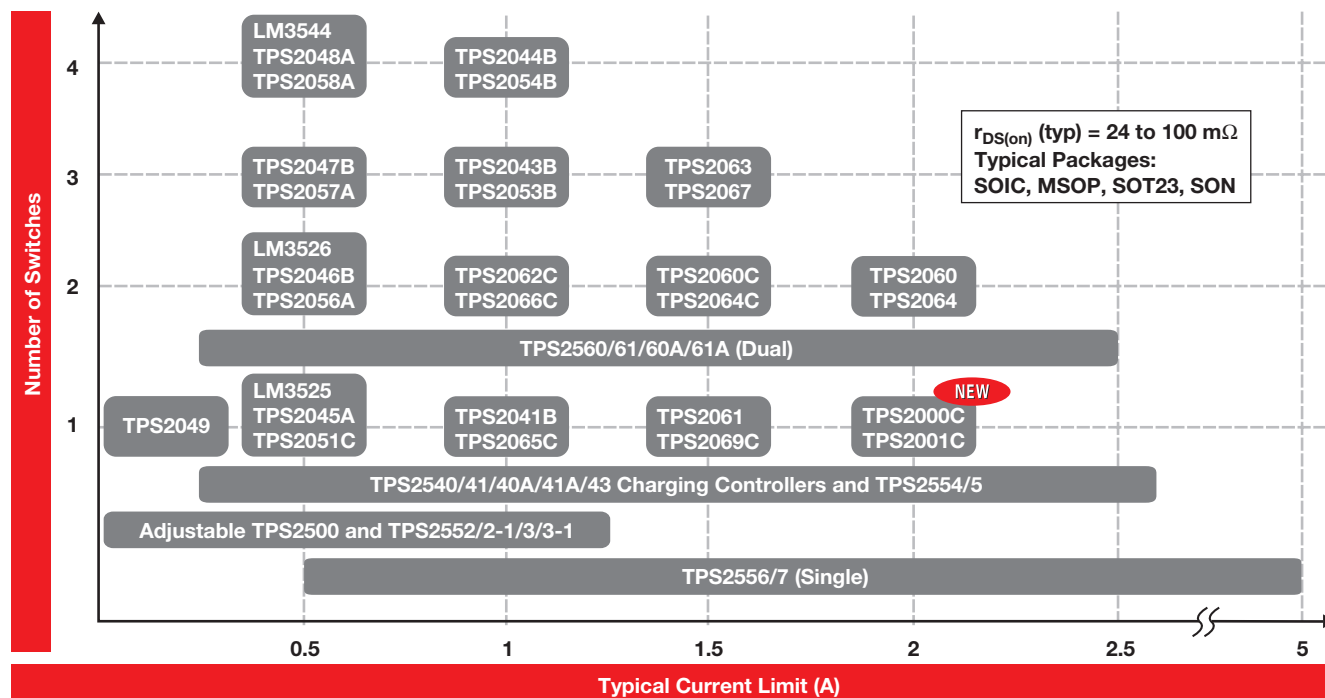
Universal Serial Bus (USB) ports are great examples of where this intelligent protection is vital for protecting your power supply and achieving regulatory compliance. TI's family of low-cost power switches are ideal for USB port designs.

To minimize voltage drop, select devices with the lowest $r_{DS(on)}$ or drain-to-source on-resistance.



The TPS2500/1 combines a boost converter and a current-limiting switch for USB applications where the 5-V rail is not available. It is also ideal for devices with 1.8-V, 2.5-V or 3.3-V rails.

Current-Limited Switch Matrix



→ Protection and Power Switches

USB Mobile Device Charging

What is “universal charging”?

Consumers have long desired a universal device to charge their many mobile electronic devices. Governments (like the European Union and China) and industry groups around the world are now moving to provide just such a framework, with three goals:

1. Provide a universal form factor—the USB interface (Standard-A plug to Micro-B plug)
2. Minimize environmental impact by reducing electronics waste and no-load power consumption
3. Reduce charging times when possible

Consumers will soon expect all USB host ports to be able to charge their devices. So, if your design calls for a USB port, you may want to comply with this standard in your next product release. Common products for which consumers may want a USB charging port include LCD TVs, set-top boxes, notebook/desktop PCs and dedicated charging AC adapters. For all of these devices, the TPS2540/41/40A/41A/43 may be ideal.

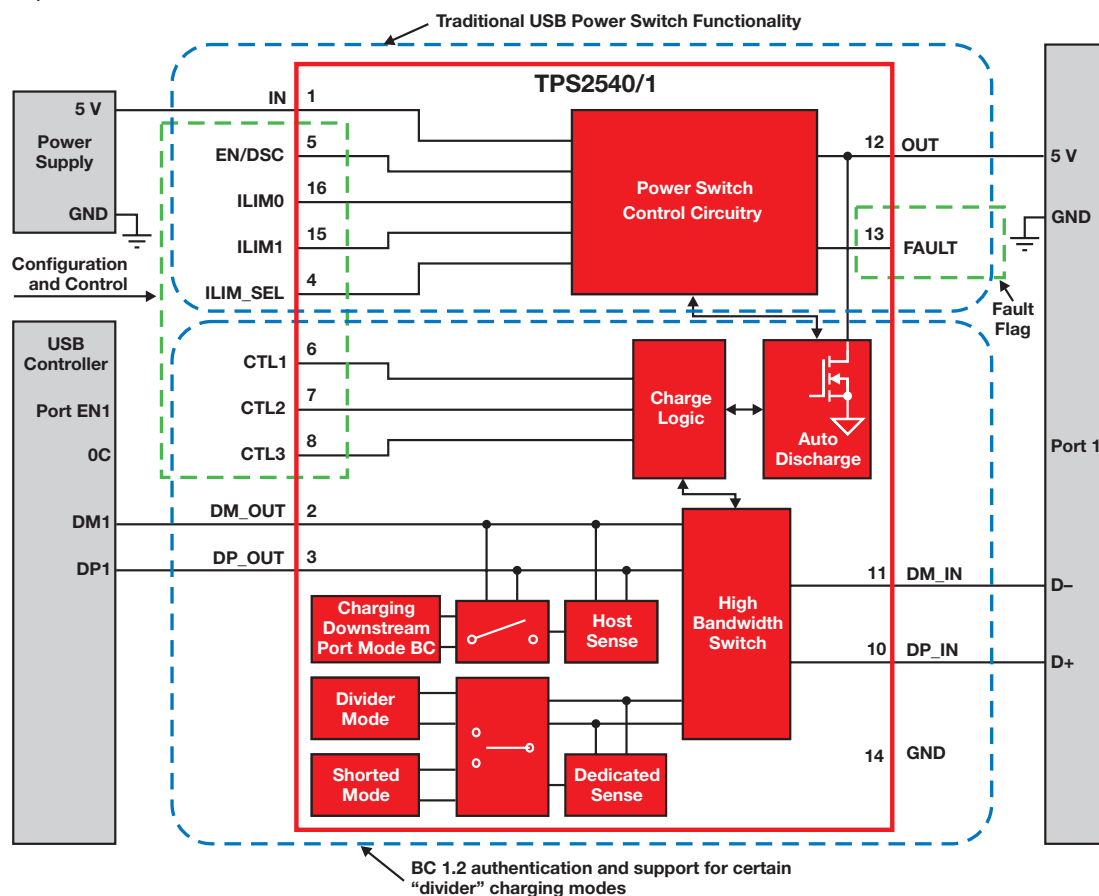
The TPS2540 takes the standard USB power switch and combines it with the special data signaling required to comply with Universal Charger Solution (UCS) requirements. This makes it possible for a USB port to quickly charge UCS-compliant devices and even many popular, proprietary devices that predate the standard (such as Apple devices). All this is accomplished without any special software.

The TPS2540/41/40A/41A/43 are fully released. Order an evaluation board or some samples today!

Battery Charging 1.2 (BC 1.2)

BC 1.2 defines the type of charger, handshaking, allowable current draws, and PD decision-making flowchart that defines the interaction between PD and the host charger.

BC 1.2 Port Type	Definition	5-V Current Capability
Standard Downstream Port (SDP)	Compliant USB 2.0 port. No special charging capability	Up to 500 mA
Dedicated Charging Port (DCP)	Wall charger. No data communication capability	Up to 1.5 A
Charging Downstream Port (CDP)	A USB 2.0 compliant port with intelligent charging capability	Up to 500 mA if authenticated as SCP or up to 1.5 A if authenticated as CDP



The TPS2540/1 incorporates a traditional USB power switch and the BC 1.2 intelligence for universal charging negotiation.

TPS2540/1 Comparison

Device	Identical Pinouts	Functionality	Applications Impact	Ideal Applications
TPS2540/40A	Pin 5 is EN.	Output discharge requires all CTL pins to be low and separate from Enable control.	Discharging voltage on output caps is important during renegotiation. When a power adapter is added or removed, power should be renegotiated.	Notebook PCs or mobile devices.
TPS2541/41A	Pin 5 is DSC.	Output discharge functionality and Enable control in one pin, the DSC.	A simple device, like an AC adapter, may not have much I/O available.	Dedicated chargers or anything with I/O constraints.

→ Protection and Power Switches

USB Current-Limiting Switches Selection Guide

Device	Number of FETs	I _{OS} (min) (A)	R _{DS(on)} (mΩ)	V _{IN} Range (V)	Supply Current (μA)	OC Logic Output	OT Logic Output	Enable	Predecessor	Price*
TPS2010A	1	0.22	30	2.7 to 5.5	73	No	No	L	TPS2010	0.75
TPS2011A	1	0.66	30	2.7 to 5.5	73	No	No	L	TPS2011	0.75
TPS2012A	1	1.1	30	2.7 to 5.5	73	No	No	L	TPS2012	0.75
TPS2013A	1	1.65	30	2.7 to 5.5	73	No	No	L	TPS2013	0.75
TPS2020/30	1	0.22	33	2.7 to 5.5	73	Yes	Yes	L/H	—	0.90
TPS2021/31	1	0.66	33	2.7 to 5.5	73	Yes	Yes	L/H	TPS2014	0.90
TPS2022/32	1	1.1	33	2.7 to 5.5	73	Yes	Yes	L/H	TPS2015	0.90
TPS2023/33	1	1.65	33	2.7 to 5.5	73	Yes	Yes	L/H	—	0.90
TPS2024/34	1	2.2	33	2.7 to 5.5	73	Yes	Yes	L/H	—	0.90
TPS2042B/52B	2	0.7 ea	70	2.7 to 5.5	50	Yes	Yes	L/H	TPS2042/52/42A/52A	0.70
TPS2043B/53B	3	0.7 ea	70	2.7 to 5.5	65	Yes	Yes	L/H	TPS2043/53/43A/53A	0.90
TPS2044B/54B	4	0.7 ea	70	2.7 to 5.5	75	Yes	Yes	L/H	TPS2044/54/44A/54A	1.10
TPS2045A/55A	1	0.3	80	2.7 to 5.5	80	Yes	Yes	L/H	TPS2045/55	0.60
TPS2051C	1	.67	96	4.5 to 5.5	60	Yes	Yes	L	TPS2051A, TPS2051B	0.45
TPS2065C	1	1.3	96	4.5 to 5.5	60	Yes	Yes	L	TPS2065	0.45
TPS2069C	1	1.7	70	4.5 to 5.5	60	Yes	Yes	L	TPS2069	0.65
TPS2000C/1C	1	2.35	72	4.5 to 5.5	60	Yes	Yes	L/H	—	0.45
TPS2062C/6C	2	1.25 ea	70	4.5 to 5.5	100	Yes	Yes	L/H	TPS2062/A, TPS2066/A	0.70
TPS2060C/4C	2	1.83 ea	70	4.5 to 5.5	100	Yes	Yes	L/H	TPS2060, TPS2064	0.70
TPS2002C/3C	2	2.43 ea	70	4.5 to 5.5	100	Yes	Yes	L/H	—	0.80
TPS2049	1	0.1	400	2.7 to 5.5	43	Yes	Yes	L	TPS2041/51/41A/51A	0.55
TPS2063/7	3	1.1 ea	70	2.7 to 5.5	65	Yes	Yes	L/H	—	0.90
TPS2068/9	1	1.5	70	2.7 to 5.5	43	Yes	Yes	L/H	—	0.75
TPS2080/1/2 ¹	2	0.7 ea	80	2.7 to 5.5	85	Yes	Yes	2H, 1L/1H, 2L	—	0.65
TPS2085/6/7 ¹	4	0.7 ea	80	2.7 to 5.5	85	Yes	Yes	4H, 2L/2H, 4L	—	1.05
TPS2090/1/2 ¹	2	0.3 ea	80	2.7 to 5.5	85	Yes	Yes	2H, 1L/1H, 2L	—	0.65
TPS2095/6/7 ¹	4	0.3 ea	80	2.7 to 5.5	85	Yes	Yes	4H, 2L/2H, 4L	—	1.05
TPS2540/ A/1/1A/3	1	0.25 to 2.8	73	4.5 to 5.5	150	Yes	Yes	H	—	0.90
TPS2552/53	1	0.75 to 1.3	85	2.5 to 6.5	120	Yes	Yes	L/H	—	0.75
TPS2552-1/53-1	1	0.75 to 1.3	85	2.5 to 6.5	120	Yes	Yes	L/H	—	0.75
TPS2554/55	1	0.25 to 2.8	73	4.5 to 5.5	150	Yes	Yes	H/L	—	0.80
TPS2556/57	1	0.5 to 5	24	2.5 to 6.5	130	Yes	Yes	L/H	—	0.90
TPS2560/61	2	0.25 to 2.5	48	2.5 to 6.5	130	Yes	Yes	L/H	—	0.90

¹ Can be configured as power MUX ICs.

*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 blue**.

Internal FET Power Switch Selection Guide

Device	Number of FETs	I _{OS} (min) (A)	R _{DS(on)} (mΩ)	V _{IN} Range (V)	Supply Current (μA)	OC Logic Output	OT Logic Output	Enable	Price*
TPS2590	1	1 to 5	28	3 to 20	35	Yes	No	L	1.05
LM3525	1	0.5	80	2.7 to 5.5	0.15	Yes	Yes	H/L	0.69
LM3526	2	0.5 each	100	2.7 to 5.5	0.5	Yes	Yes	H/L	0.73
LM3544	4	0.5 each	90	2.7 to 5.5	1	Yes	Yes	H/L	1.80

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

→ Voltage Supervisors and Digital Sequencers

Design Factors

Manual Reset (MR) — This feature allows the user to manually reset the circuit or control the supervisory circuit by another device of the application.

Watchdog Input (WDI) — In situations where the system processor may not be functioning properly, its onboard watchdog feature may fail to reset. Supervisors with integrated watchdog functionality increase system reliability by being able to trigger a reset.

Active High Output — Allows the use of processors with active high reset input without additional components.

Delay Time — Allows the voltage and other components in the circuit to stabilize first before the normal operation starts again.

Open Collector — Same as open drain, but the RESET output is connected to the collector of the internal transistor.

Open Drain — The RESET output of the supervisory circuit is connected to the drain of the internal MOSFET. Choose an open-drain reset output supervisor when more than one supervisor is connected on the bus.

Push-Pull — A push-pull reset output supervisor is recommended when only one supervisor is needed on the bus. This eliminates the need for a pull-up resistor and offers higher speed.

Quad Supervisor with Programmable Delay and Watchdog Timer

NEW

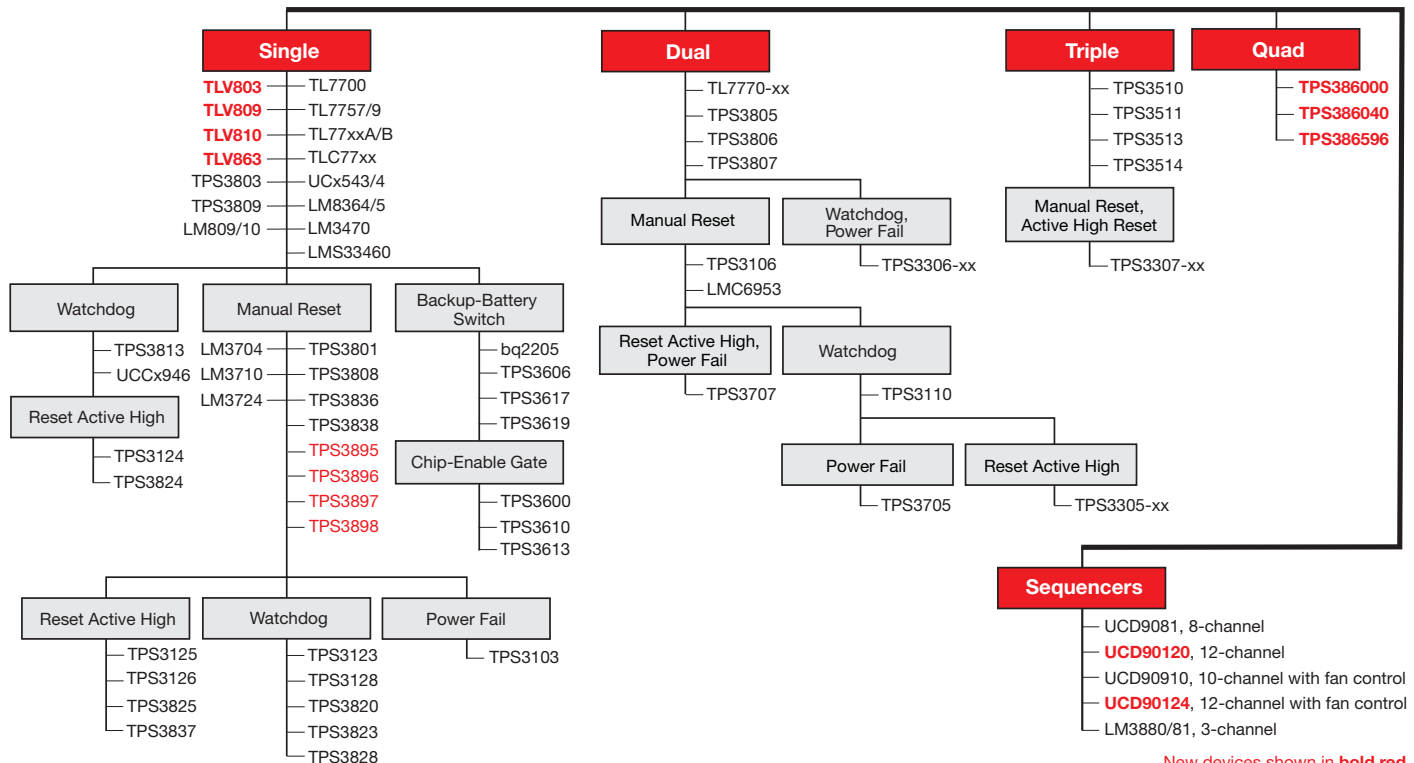
TPS386000, TPS386020, TPS386040, TPS386060

Get samples at: www.ti.com/product/TPS386000

The TPS3860xx family can monitor four power rails that are greater than 0.4 V with a 0.25% threshold accuracy. With external resistors, the threshold of each SVS can be programmed. Each SVS has a programmable delay circuit, and the delay time can be set from 1.25 ms to 10 s. The quiescent current is very low with 12 μ A (typical). Available in a small 4x4-mm, 20-pin QFN package. Options:

- TPS386000: Open-Drain $\overline{\text{RESET}}$ and $\overline{\text{WDO}}$
- TPS386020: Open-Drain $\overline{\text{RESET}}$ and $\overline{\text{WDO}}$
- TPS386040: Push-Pull $\overline{\text{RESET}}$ and $\overline{\text{WDO}}$
- TPS386060: Push-Pull $\overline{\text{RESET}}$ and $\overline{\text{WDO}}$

Supervisory Circuits, Reset ICs and Sequencers Family of Products



➔ Voltage Supervisors and Digital Sequencers

Power-Supply Sequencer

UCD90120, UCD90124

Get samples at: www.ti.com/product/UCD90120A

The UCD90120/4 Power Supply Sequencer and System Health Controller sequences up to 12 independent voltage rails. The devices integrate a 12-bit, 200-kcps ADC with a 1% accurate internal reference for monitoring up to 13 inputs for power supply voltage, current, or temperature. There are 26 GPIO pins that can be used for power supply enables, power-on reset signals, or other system functions. Also, 12 of the 26 GPIO pins can be used as PWM outputs for power supply margining, fan control (UCD90124 only), or general-purpose PWM functions including multiphase clock generation for switch-mode power supplies. Both devices offer non-volatile fault logging for capturing power supply faults, peak rail voltages, and other important data that can aid in system failure analysis. JTAG and PMBus interfaces provide options for preproduction and in-system configuring and monitoring. The TI Fusion Digital Power™ Designer is provided for device configuration. This PC-based graphical user interface offers an intuitive interface for configuring, storing, and monitoring all system operating parameters.

Features

Sequence

- Sequence up to 12 rails on and off
- Dependencies on time, parent rails, GPUs, and I²C

- Independent turn-on and turn-off configurations
- Flexible GPIO for enables, power goods, and more
- Boolean logic builder

Monitor

- Respond to faults by configuring retries, shutdown delays, and slave rails to shutdown
- User settable scale factors convert to actual system units including voltage, current, and temperature
- 6 optional comparators for fault response in < 60 µs

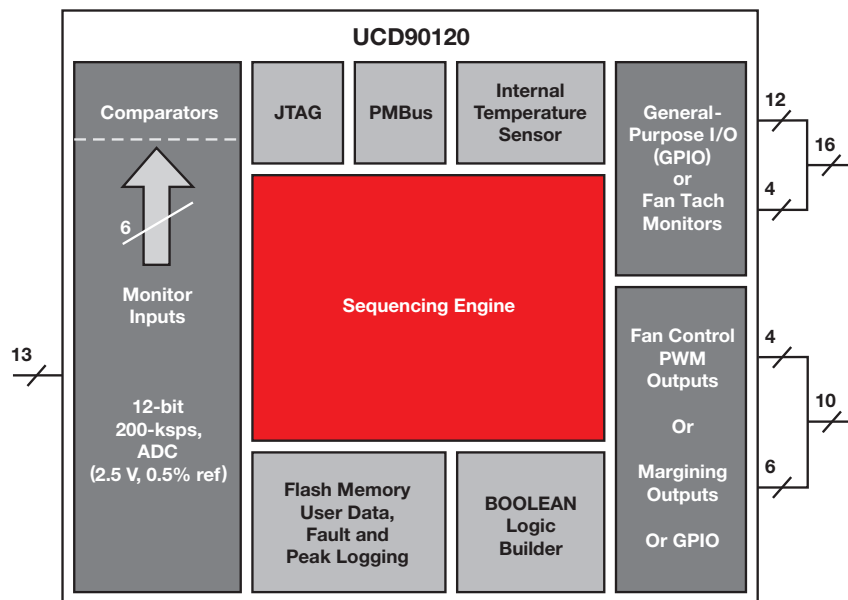
- Nonvolatile fault logging

Margin

- Simultaneously margin up to 10 rails using PWM outputs
- Support for open-loop or closed-loop methods
- Command rails high and low using I²C or GPIO pins
- All unused margining outputs can be used as GPIO

Fan control (UCD90124 only)

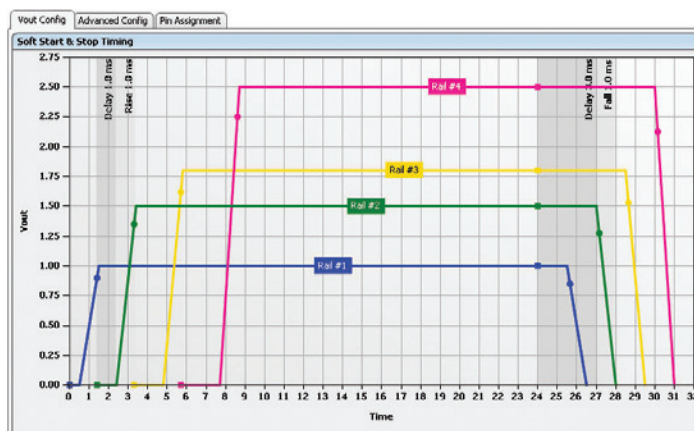
- Monitor and control up to 4 fans (2-, 3-, or 4-wire fans)



Typical application for UCD90120 sequencer.



Monitoring.



Sequencing.

→ Voltage Supervisors and Digital Sequencers

Single-Channel Voltage Monitor in Ultra-Small 1.5 x 1-mm Package

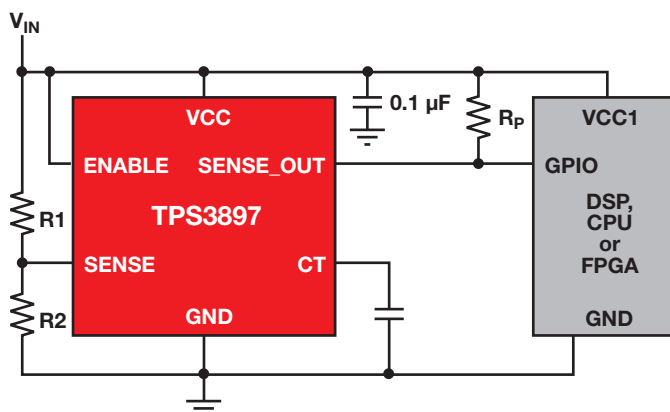
NEW

TPS3895, TPS3896, TPS3897, TPS3898

Get samples, datasheets, evaluation modules and app reports at:

www.ti.com/product/TPS3895, [TPS3896](http://www.ti.com/product/TPS3896), [TPS3897](http://www.ti.com/product/TPS3897) or [TPS3898](http://www.ti.com/product/TPS3898)

The TPS3895/6/7/8 family of supervisory circuits monitors voltages greater than 500 mV with a 0.25% threshold accuracy. The devices offer capacitor-adjustable, delay-time flexibility. This family also has an enable pin to power the output on/off. All devices operate from 1.8 to 6.5 V and have a quiescent current of 6 μ A with an open-drain output rated at 18 V. They are available in an ultra-small micro SON package and are fully specified over the temperature range of $T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$.



Family Comparison

Device	Output
TPS3895	Push-pull, active high
TPS3896	Push-pull, active low
TPS3897	Open drain, active high
TPS3898	Open drain, active low

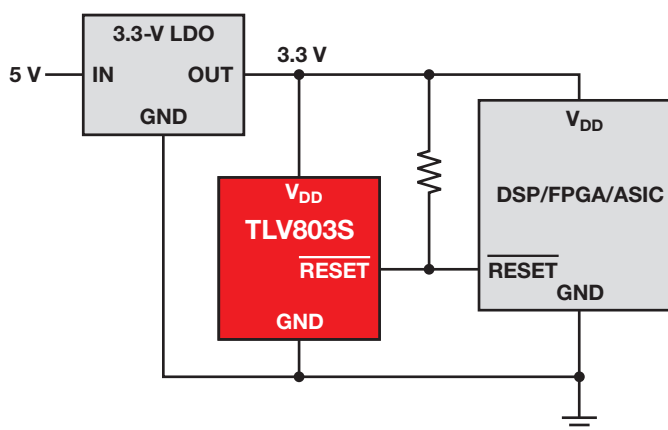
3-Pin Voltage Supervisor

NEW

TLV803, TLV809, TLV810

Get samples, datasheets, evaluation modules and app reports at: www.ti.com/product/TLV803, [TLV809](http://www.ti.com/product/TLV809) or [TLV810](http://www.ti.com/product/TLV810)

This family offers fixed threshold devices and a fixed 200-ms reset delay time, with no external components required to set the threshold. The product spectrum is designed for supply voltages of 2.5, 3, 3.3 and 5 V. The devices are available in a 3-pin SOT-23. The TLV803/TLV810 devices are characterized for operation over a temperature range of -40°C to 125°C .



Family Comparison

Device	Output
TLV803	Open drain, active low
TLV809	Push-pull, active low
TLV810	Push-pull, active high

→ Voltage Supervisors and Digital Sequencers

Selection Guide

Device	Number of Supervisors	Supervised Voltages	Package(s)	V _{DD} Range (V)	I _{DD} (typ) (µA)	Time Delay (ms)	Watchdog Timer WDI (sec)	Reset Threshold Accuracy (%)	Manual Reset/Enable Reset	Active-Low Reset/Output	Active-High Reset/Output	Reset Output Topology ¹	Power-Fail PFI/PFO	Overvoltage Detection	Overcurrent Detection	Chip-Enabled Gating	HiRel (H) or Automotive (A) [†]	Comments	Price*
General Purpose Supply Supervisors																			
LM3724	1	2.5	SOT23-5, D, W	1 to 6	6	0.02		±2.5	✓	✓		OD	✓						0.95/0.80
LP3470	1		SOT23-5	0.5 to 5	16	0.3		±1		✓		OD							0.595/0.562
LM3704	1		Micro SMD-9, MSOP-10	1 to 5.5	28	0.02		±2	✓	✓		CMOS, OD	✓						0.77
LM3710	1	2.5	MINI SOIC	1 to 5.5	28	0.02	0.0062 to 25.6	±2	✓	✓		CMOS, OD	✓						1.10
LM8364	1		SOT23-5	1 to 6	0.65	0.3		±2.5		✓		CMOS, OD							0.239
LM8365	1		SOT23-5	1 to 6	0.65	0.1		±2.5		✓		CMOS, OD							0.249
LM809	1		SOT23-3, LLP-6, D, W	1 to 6	15	0.02		±1.5		✓		CMOS							0.229
LM810	1		SOT23-3, D, W	1 to 6	15	0.02		±1.5			✓	CMOS							0.229
LMS33460	1	3	SC-70	1 to 7	1	0.2		±5		✓		OD							0.169
LMC6953	2		SOIC-8	1.5 to 6	800	0.0005		±3	✓	✓		OD							1.44
LM3880	3		SOT23-6	2.7 to 5.5	25	fix		Power supply sequencer and monitor										A	0.50
LM3881	3		MSOP-8	2.7 to 5.5	80	fix		Power supply sequencer and monitor											0.50
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./0.9/1.2/1.5/1.8/2.5/3.0/3.3/5.0/EEPROM	SOT-23, SON-6	1.8 to 6.5	2.4	Prog	—	0.5	✓	✓		OD					H, A		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					H, A	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					H, A	Window watchdog	0.90
TPS3820/8-xx	1	3.3/5.0	SOT-23	1.1 to 5.5	15	25/200	0.2/1.6	2.4	✓	✓		PP/OD					A		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					A		0.65
TPS3824-xx	1	2.5/3.0/3.3/5.0	SOT-23	1.1 to 5.5	15	200	1.6	2.2		✓	✓	PP					A		0.65
TPS3825-xx	1	3.3/5.0	SOT-23	1.1 to 5.5	15	200	—	2.2	✓	✓	✓	PP					A		0.55
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					H, A		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					H, A		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					H, A		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					H		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-xx	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-xx	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	✓				A		1.05
TPS3705-xx	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
TPS3707-xx	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
TPS3805	2	Adj./3.3	SC-70	1.3 to 6.0	3	—	—	1.5		✓		PP					H, A	Voltage detector	0.34
TPS3806	2	Adj./2.0/3.3	SOT-23	1.3 to 6.0	3	—	—	2		✓		OD						Voltage detector	0.45

¹PP = push-pull, OD = open drain, OC = open collector.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available.

Certain voltage options are not available. Different pricing may apply.

*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**.

→ Voltage Supervisors and Digital Sequencers

Selection Guide (Continued)

Device	Number of Supervisors	Supervised Voltages	Package(s)	V _{DD} Range (V)	I _{DD} (typ) (μA)	Time Delay (ms)	Watchdog Timer WDI (sec)	Reset Threshold Accuracy (%)	Manual Reset/Enable Reset	Active-Low Reset/Output	Active-High Reset/Output	Reset Output Topology ¹	Power-Fail PFI/PFO	Overvoltage Detection	Overcurrent Detection	Chip-Enabled Gating	HiRel (H) or Automotive (A) [†]	Comments	Price*	
General Purpose Supply Supervisors (Continued)																				
TPS3307-xx	3	Adj./1.8/2.5/3.3/5.0	SO-8, MSOP-8	2.0 to 6.0	15	200	—	2.7	✓	✓	✓	PP					A		1.05	
TPS386596	4	Adj./3.0	MSOP-8	1.8 to 6.5	7.5	Prog	—	0.25	✓	✓		OD		✓					1.25	
TPS3860x0	4	Adj. (includes negative rail)	QFN	1.8 to 6.5	9	Prog	0.6	0.25	✓	✓	✓	PP/OD		✓					1.95	
UCD9090	10	Prog. by software GUI	QFN-64	3.3 to 12	50 mA	Prog			Power supply sequencer and monitor											3.60
UCD90120A	13	Prog. by software GUI	QFN-64	3.3 to 12	50 mA	Prog			Power supply sequencer and monitor											4.95
UCD90124A	13	Prog. by software GUI	QFN-64	3.3 to 12	50 mA	Prog			Power supply sequencer and monitor										With fan control	6.45
UCD90160	16	Prog. by software GUI	QFN-64	3.3 to 12	50 mA	Prog			Power supply sequencer and monitor											5.65
UCD90910	10	Prog. by software GUI	QFN-64	3.3 to 12	50 mA	Prog			Power supply sequencer and monitor										With fan control	5.90
Battery Backup Switchover Supply Supervisors																				
TPS3600	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	
TPS3606-33	1	3.3	MSOP-10	1.6 to 5.5	20	100	0.8	2	✓	✓		PP	✓						1.45	
TPS3610	1	1.8/5.0	TSSOP-14	1.6 to 5.5	20	100	0.8	2		✓		PP	✓				✓		1.80	
TPS3613-01	1	Adjustable	MSOP-10	1.6 to 5.5	20	100	—	1.7	✓	✓	✓	PP					✓		1.50	
TPS3619	1	3.3/5.0	MSOP-8	1.6 to 5.5	15	100	—	2	✓	✓		PP	✓					H	1.10	
Special Function Supply Supervisors																				
TPS3510/1	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	
TPS3513/4	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	

¹PP = push-pull, OD = open drain, OC = open collector.

[†]Devices qualified for HiRel (H) or Automotive (A) applications are available.

Certain voltage options are not available. Different pricing may apply.

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

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

→ 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 _S		Package(s)	Price*
		(min)	(max)						(min) (V)	(max) (V)		
INA226	High-side measurement, bi-directional current power monitor with I ² C interface	0	36	1	I ² 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 ² 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 ² 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.

→ Design Support

PowerLab™ Power Reference Design Library

The PowerLab™ library includes an interactive and powerful search engine for design engineers looking for a proven and tested solution to their power-supply requirements. This interactive search tool allows engineers to find designs by application, topology, input type, input voltage or output voltage.

Features

- Extensive collection of tested power-management reference designs
- Hundreds of power-management designs for a wide range of applications and power-conversion topologies
- Reference designs include both isolated and non-isolated designs for lighting, telecommunication, computing, consumer electronics and more

For more information, visit:

www.ti.com/powerlab

PowerLab™ Power Reference Designs Selection Tool

Design	Title	Input Voltage Range (Min)	Input Voltage Range (Max)	Output Voltage (V)	Output Current (A)	Part Number
PMP1090	Sync Buck for MFP (5V @ 2A, 3.3V @ 2A)	22	26	5.0	2.0	PMP1090
PMP1129	Flyback for Automotive (16V @ 5A)	8	36	16.0	5.0	PMP1129
PMP1143	Isolated Flyback for Router Gate Wa	85	265	12.0	1.2	PMP1143
PMP1171	Sync Buck (3.3V @ 2A, 1.2V @ 6.5A)	11	24	3.3	6.5	PMP1171
PMP1281	Boost (-12V @ 300mA)	11	13	-12.0	0.3	PMP1281
PMP1307	Buck/Boost (7.5V @ .5A, 0.5V @ 1.5A)	6	60	0.5	1.5	PMP1307
PMP1329	Sepic for Alarm System (3.6V @ 3A)	2.7	9	3.6	3.0	PMP1329
PMP1353	Boost for Telecom (48V @ 2A)	10.8	13.2	48.0	2.0	PMP1353
PMP1382	Boost (26V @ 44mA)	3.3	6.6	26.0	0.044	PMP1382
PMP1386	Sync Buck for Two Way Satellite Inter	7	40	13.8	5.0	PMP1386
PMP1400	Sync Buck (13.8V @ 5A)	18	30	13.8	5.0	PMP1400
PMP1402	Sync Buck (2.5V @ 20A)	10.8	13.2	2.5	20.0	PMP1402
PMP1446	Sync Buck for Telecom (1.8V @ 3.5A)	3.1	3.5	1.8	3.5	PMP1446

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→ Packaging

Surface Mount Packages

	Package Type	Package Designator	Key Characteristics
Small Outline Packages			
	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
Quad Lead Packages			
	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)
Small Outline Transistors			
	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
Leaded Packages			
	Plastic Flange Mount Package (DDPak/TO-263)	KTT, KTW	Very high power handling capability
Leadless Packages			
	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.



Surface Mount Packages (Continued)

	Package Type	Package Designator	Key Characteristics
Leadless Packages (Continued)			
	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	RSJ	High power handling capability
Ball Grid Arrays (BGAs)			
	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



→ Packaging

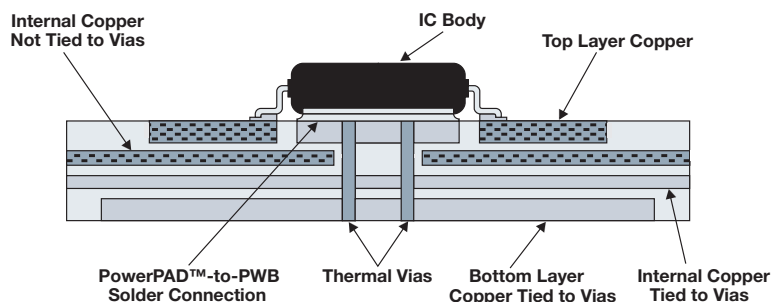
Connecting the PowerPAD™

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 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)
- Visit TI’s Analog & Mixed-Signal KnowledgeBase at: support.ti.com/sc/knowledgebase
- 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



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