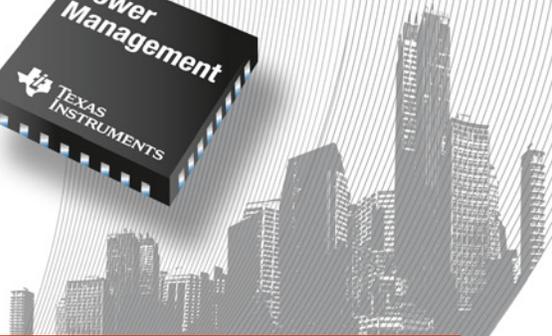
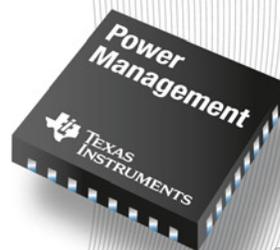


# Power Management Guide



**consumer**



**industrial**



**computing**



**automotive**



**communications**





## Table of Contents

Texas Instruments (TI) offers complete power solutions with a full line of high-performance products. These products, which range from standard linear regulators to plug-in and integrated power solutions, 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 TI authorized distributors) that will help you accelerate your time-to-market.

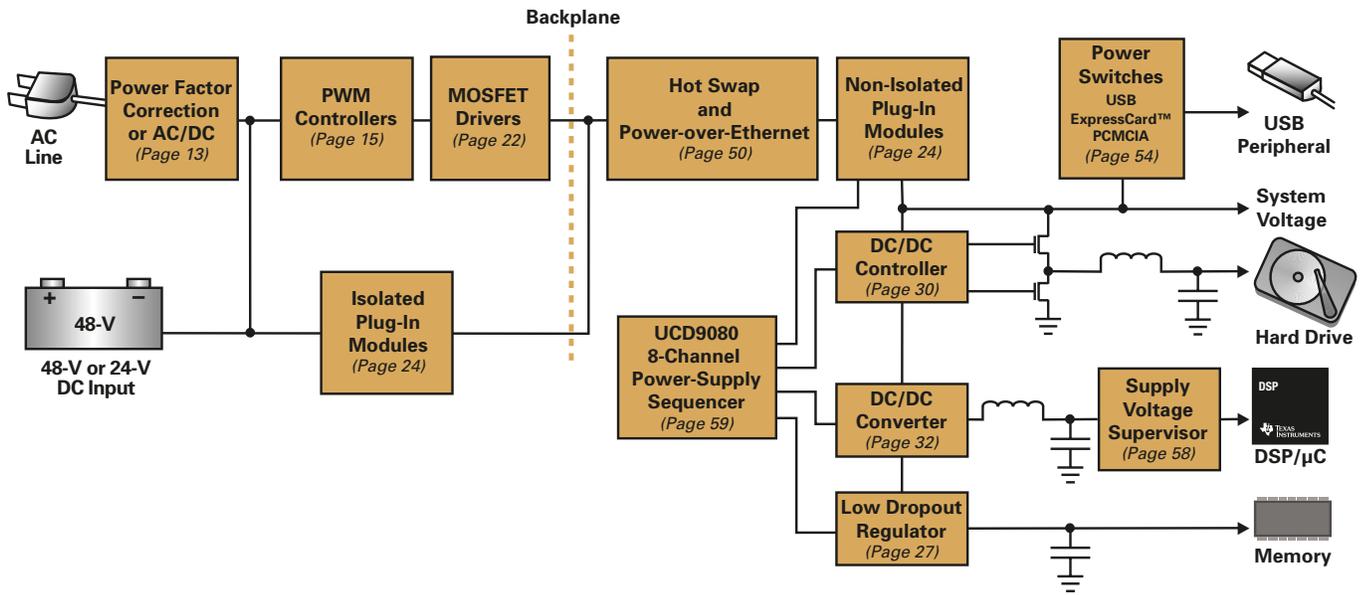
Included in this selection guide you will find design factors, featured products, graphic representations of portfolios and parametric tables.

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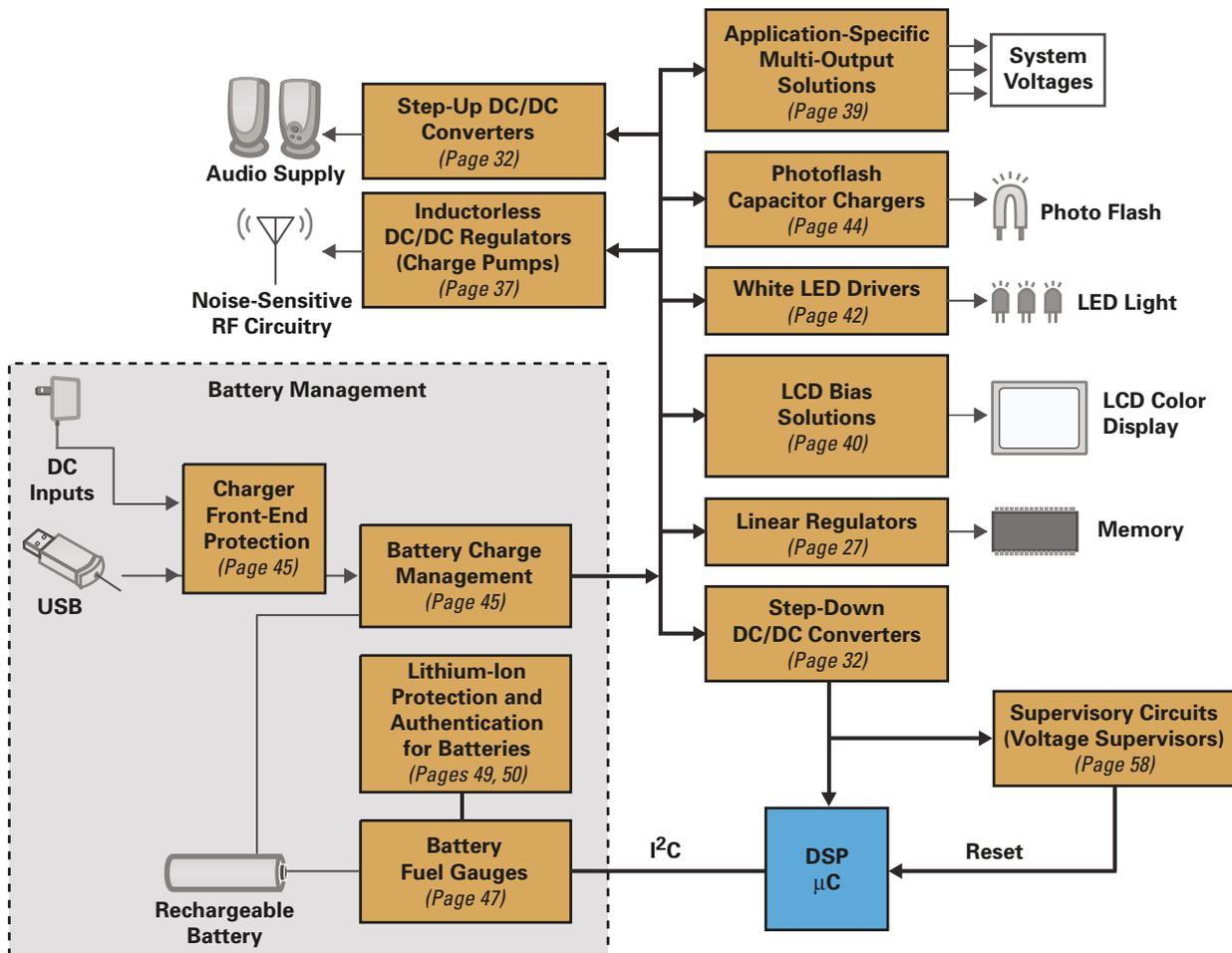
Note: Military versions of some Power Management products are available. Please visit: [power.ti.com/militaryproducts](http://power.ti.com/militaryproducts)



## Line Power Solutions

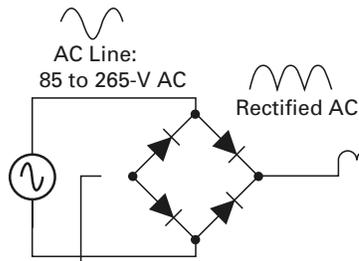


## Portable Power Solutions





## AC/DC Solutions



### Power Factor Correction (Page 13)

#### PFC

**UCC28060**  
**UCC28070**  
**UCC28019A**  
 UCC28019  
 UCC38050/51  
 UCC3817A/18A  
 UCC3819A  
 UC3854/A/B  
 UC3855A/B

#### PFC + PWM

UCC38500-3  
 UCC28510-7  
 UCC28521/28

### PWM Controllers (Page 15)

**PWM (Forward, Flyback)**  
 UCC28220/1  
**UCC28600**  
 UCC2891/2/3/4/7  
 UCC35701/2  
 UCC35705/6  
 UCC3800-5  
 UCC3809  
 UCC3813-x  
 UCC38C40-45

#### Intermediate Bus Converter **UCC28230/31**

**PWM (Half-Bridge, Full-Bridge, Push-Pull)**  
 UCC3895  
 UCC38083-6  
 UCC3806  
 UCC3808/A  
 UC3825/A  
 UC28025  
 UCD8220/8620

#### Primary Side Startup UCC3960/61

### MOSFET Drivers (Page 22)

**±2 A**  
 TPS2811-15  
 TPS2816-19  
 TPS2828-29

**±3 A**  
 UCC27200  
 UCC27201

**±4 A**  
 UCC37323/4/5  
 UCC27423/4/5  
 UCD7201  
 UCD7100

**±9 A**  
 UCC37321/2

### Secondary Side Control (Pages 15, 22)

**PWM**  
 UC3849  
 UCC3839

**Drivers**  
 TPS2811-15  
 TPS28225  
 TPS28226  
 TPS2829-29  
 UCC27423/4/5  
 UCC37321/2  
 UCC37323/4/5  
 UCD7100  
 UCD7201

### Post Regulation (Pages 15, 27)

**PWM**  
 UCC2540  
 UCC3583

**LDOs**  
 TPS7xxx  
 UC382/385

## Isolated DC/DC Solutions

385 to 400-V  
 Boosted DC  
 Output

Bus Voltage  
 3.3 to 48 V

■ New parts in red

■ Green Mode

Isolation

### Feedback (Page 61)

**Shunt Regulators**  
 TL431/A  
 TLV431/A  
 TL1431  
 UC39431/2

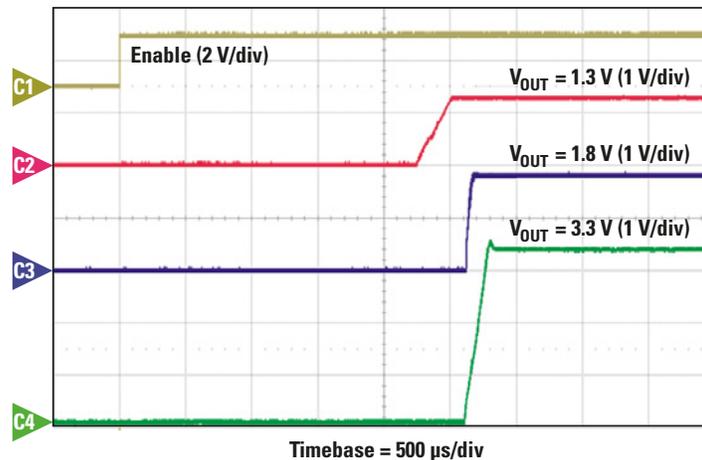
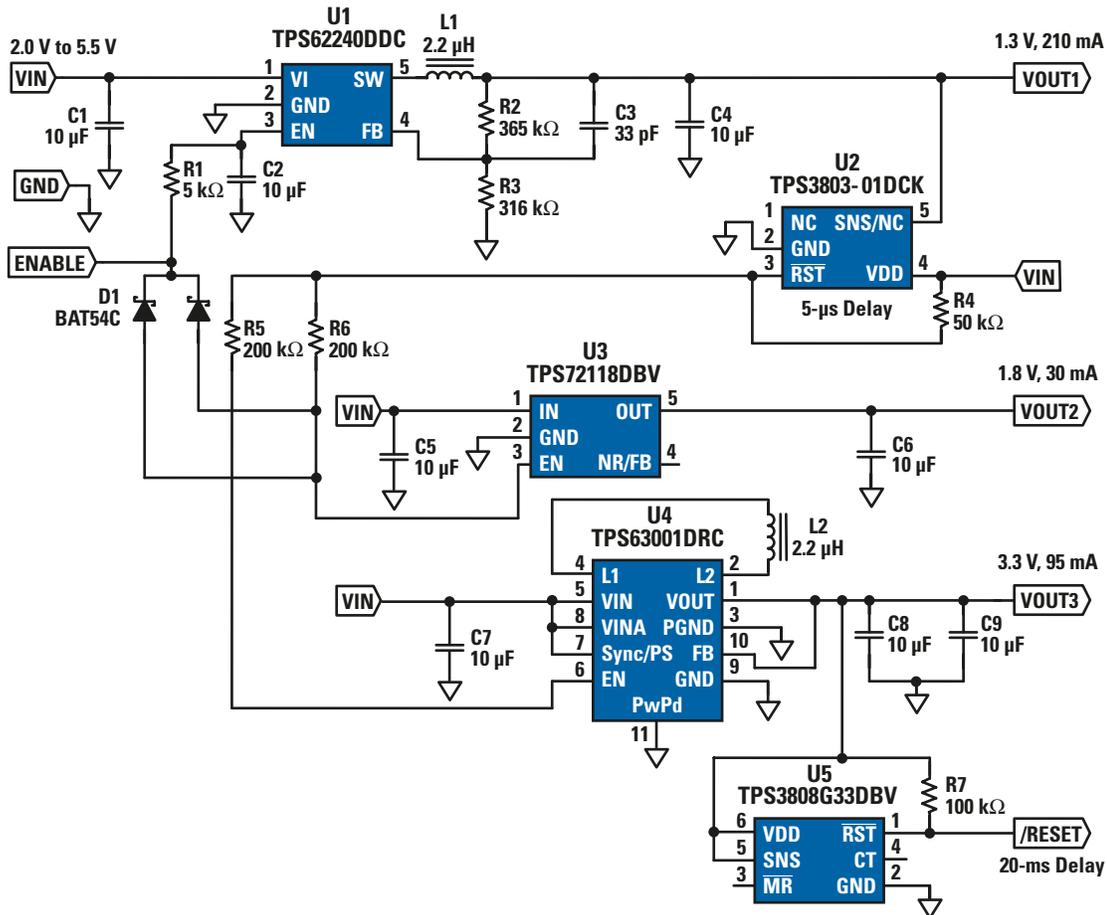


## Processor Power Solutions

[www.ti.com/processorpower](http://www.ti.com/processorpower)

Texas Instruments' power management products provide optimized power for your DSP, FPGA, or any other processor. Whether you are creating a battery-powered handheld device or a high-power wireless base station, you'll find power solutions that meet the stringent requirements of processors used in these applications. The designs and block diagrams on the next few pages highlight a few of these solutions.

### High-Efficiency and Space-Efficient DM355 Reference Design



Typical start-up waveforms.



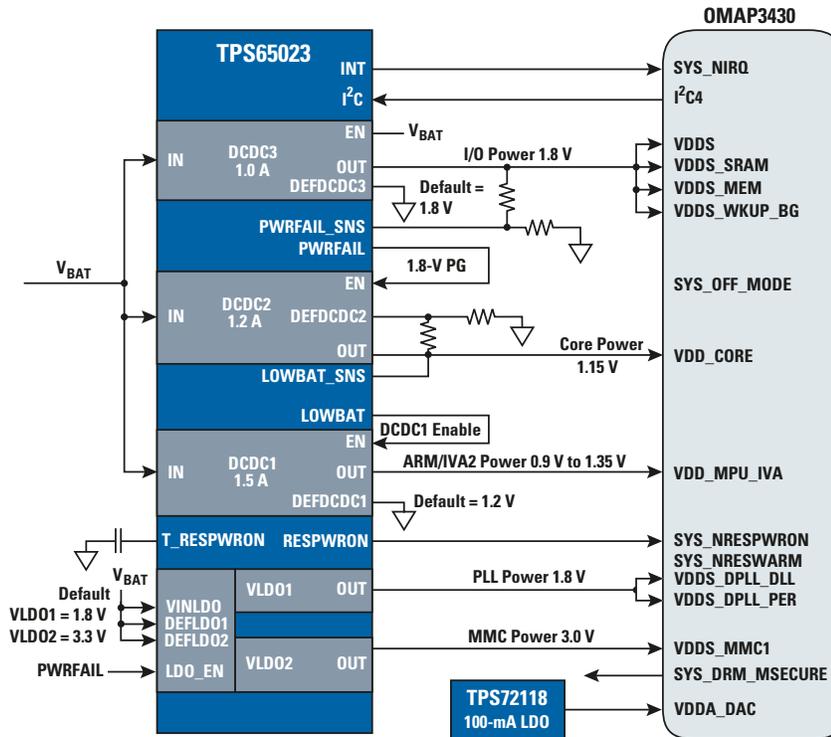
## Processor Power Solutions

[www.ti.com/processorpower](http://www.ti.com/processorpower)

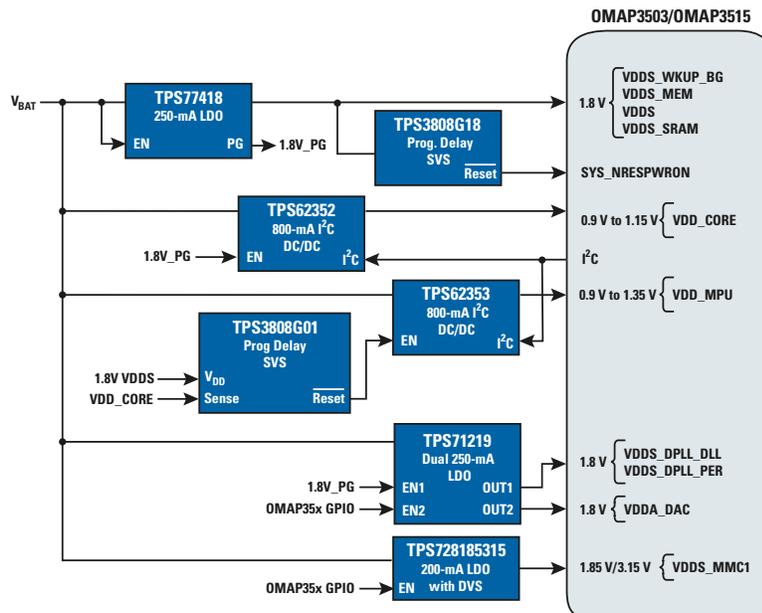
### Power for OMAP35x

The OMAP35x family of processors are capable of communicating via I<sup>2</sup>C bus with the devices providing them power. The OMAP35x processors optimize power consumption through dynamic voltage frequency scaling and SmartReflex™. Both the TPS65023 and TPS62350 have integrated I<sup>2</sup>C ports for optimal communication with OMAP35x processors.

### OMAP35x Power Supply Design Using the TPS65023 (6-Channel Power Management IC with 3 DC/DCs, 3 LDOs, I<sup>2</sup>C Interface and DVS) and TPS72118



### OMAP3503/OMAP3515 Power Supply Design Using Single-Output Devices



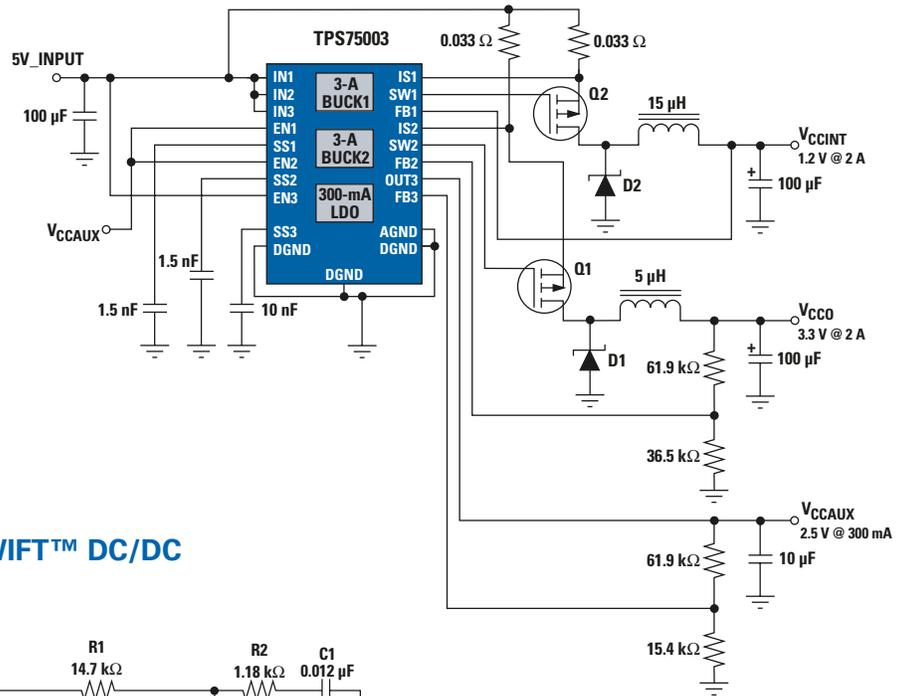


## FPGA and CPLD Power Solutions

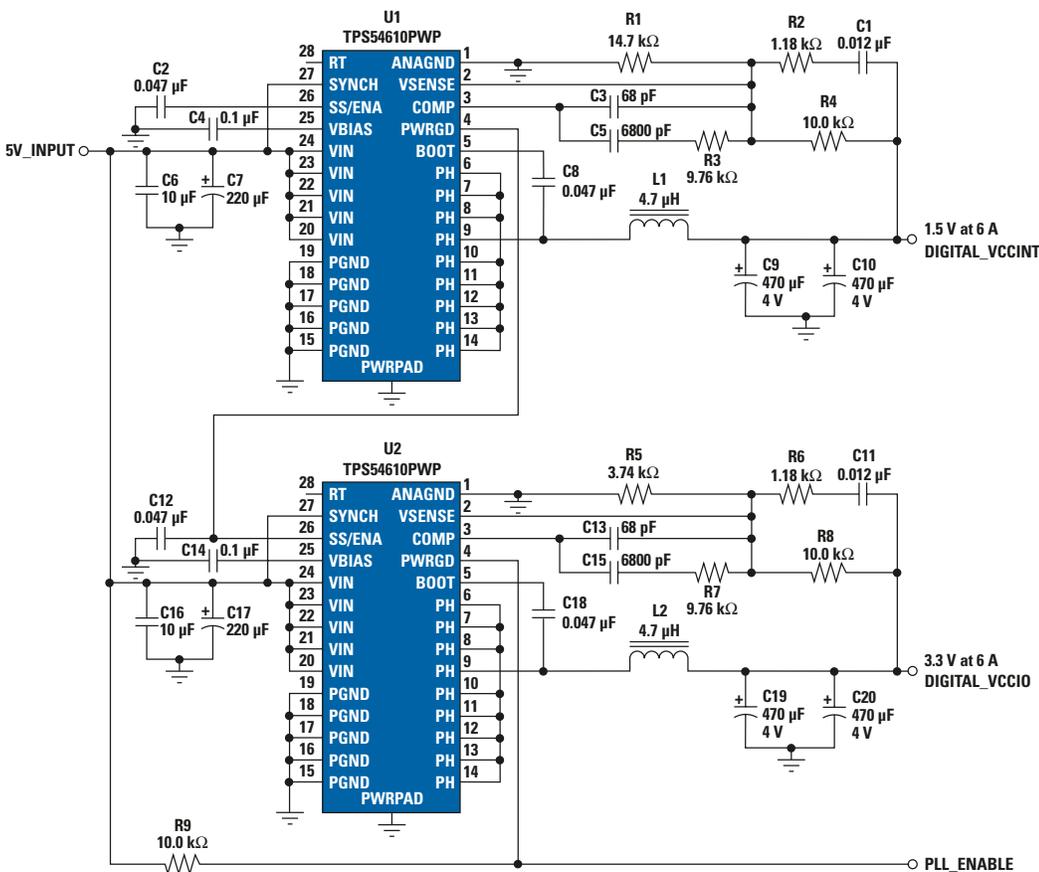
[www.ti.com/xilinxfpga](http://www.ti.com/xilinxfpga) or [www.ti.com/alterafpga](http://www.ti.com/alterafpga)

Access the sites for one-stop power management support for Xilinx® and Altera® FPGAs and CPLDs, including free downloads of power reference designs with complete schematics, bills-of-material and helpful implementation notes.

### Highly Integrated TPS75003 Triple Supply Powering Spartan™-3



### Two Highly Efficient TPS54610 6-A SWIFT™ DC/DC Converters Powering Stratix™ II

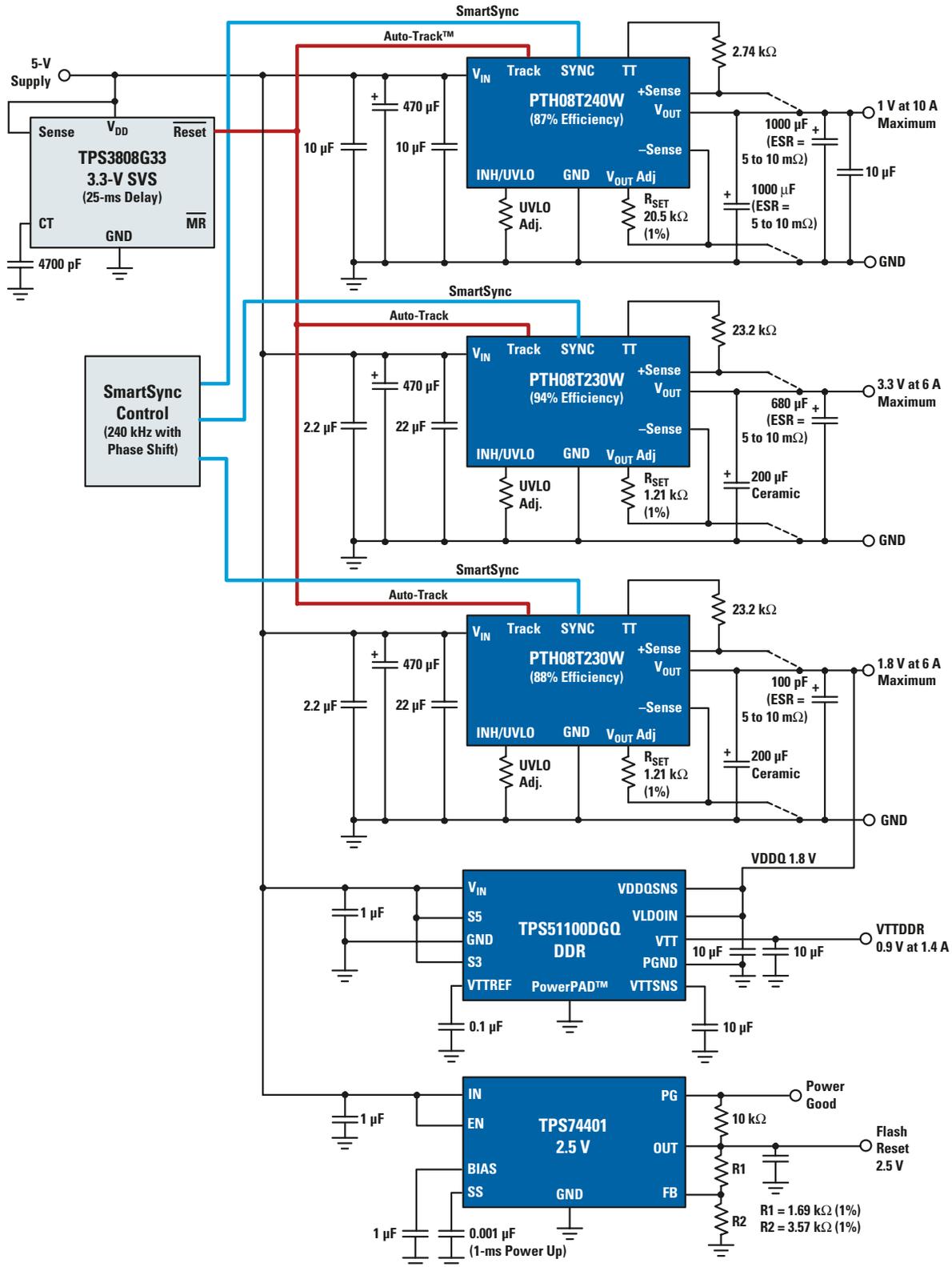




## FPGA and CPLD Power Solutions

[www.ti.com/xilinxfpga](http://www.ti.com/xilinxfpga) or [www.ti.com/alterafpga](http://www.ti.com/alterafpga)

### Multiple T2 Modules with Frequency Synchronization via SmartSync and Sequenced with Auto-Track™ Power Xilinx® Virtex® 5 FPGA

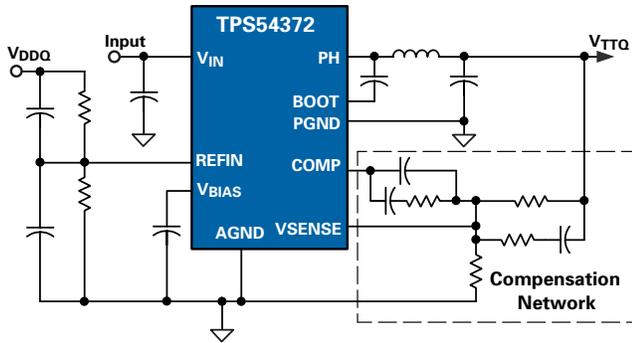




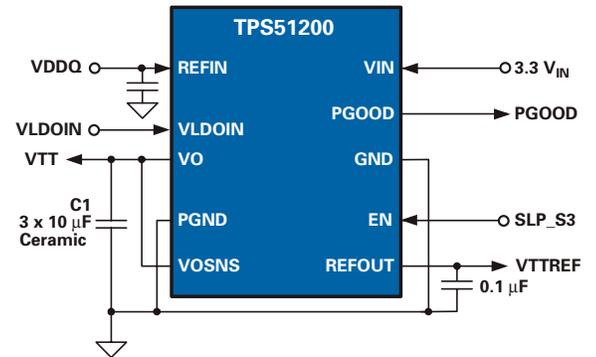
## Active-Bus Termination Solutions (DDR/QDR/GTL/SSTL/HSTL)

TI offers a wide selection of active-bus termination solutions from LDOs and switching controllers to plug-in power. Typical application diagrams and product parameters are provided to aid product selection.

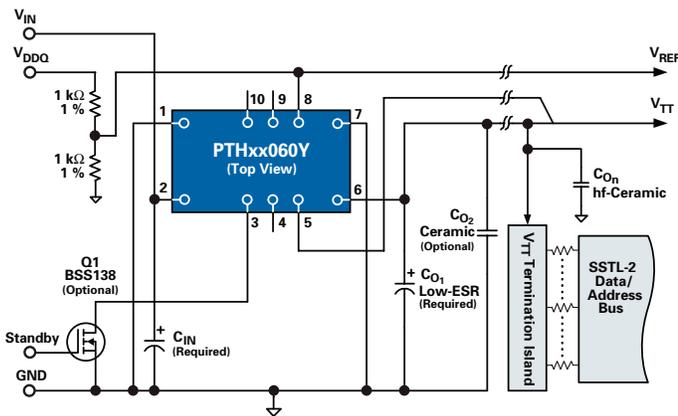
### TPS54372: SWIFT™



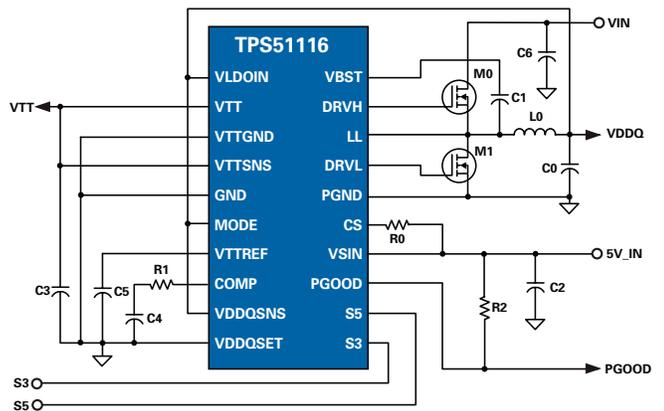
### TPS51200: LDO



### PTHxx060Y: Plug-In Power



### TPS51116: Controller + LDO



## Selection Guide

Device	V <sub>IN</sub> (V)	Topology	I <sub>OUT1</sub> (V <sub>DDQ</sub> ) (A)	I <sub>OUT2</sub> (V <sub>TT</sub> ) (A)	I <sub>OUT3</sub> (Buf. V <sub>REF</sub> ) (mA)	V <sub>OUT1</sub> (V <sub>DDQ</sub> ) (V)	V <sub>OUT2</sub> (V <sub>TT</sub> ) (V)	V <sub>OUT3</sub> (Buf. V <sub>REF</sub> ) (V)	DDR 1	DDR 2	DDR 3	Package(s)	Price*
<b>Plug-In Power Modules</b>													
PTH03010/50/60Y	2.95 to 3.65	Sync. Buck	—	15, 6, 10	—	—	0.55 to 1.8	—	✓	✓	✓	Module	11.60, 6.90, 9.80
PTH05010/50/60Y	4.5 to 5.5	Sync. Buck	—	15, 6, 10	—	—	0.55 to 1.8	—	✓	✓	✓	Module	11.60, 6.90, 9.80
PTH12010/50/60Y	10.8 to 13.2	Sync. Buck	—	15, 6, 8	—	—	0.55 to 1.8	—	✓	✓	✓	Module	11.60, 6.90, 9.80
<b>Converters (with Integrated FETs)</b>													
TPS54372	3.0 to 6.0	Sync. Buck	—	3	—	—	Adj. to 0.2	—	✓	✓	✓	20 HTSSOP	2.25
TPS54672	3.0 to 6.0	Sync. Buck	—	6	—	—	Adj. to 0.2	—	✓	✓	✓	28 HTSSOP	3.20
TPS54872	4.0 to 6.0	Sync. Buck	—	8	—	—	Adj. to 0.2	—	✓	✓	✓	28 HTSSOP	3.65
TPS54972	3.0 to 4.0	Sync. Buck	—	9	—	—	Adj. to 0.2	—	✓	✓	✓	28 HTSSOP	3.80
<b>Controllers (with External FETs)</b>													
<b>TPS40042</b>	3.0 to 5.5	Sync. Buck	—	15	—	—	Adj. to 0.7	—	✓	✓	✓	10 SON	0.90
TPS40056	8 to 40	Sync. Buck	—	20	—	—	Adj. to 0.7	—	✓	✓	✓	16 HTSSOP	1.65
TPS51020	4.5 to 28	Dual Sync. Buck + LDO	< 20	20	3	Adj. to 0.85	V <sub>DDQ</sub> /2	V <sub>DDQ</sub> /2	✓	✓	—	30 TSSOP	2.40
TPS51116	3.0 to 28 <sup>1</sup>	Sync. Buck + LDO	< 10	+3/-3	—	Adj. to 1.5	V <sub>DDQ</sub> /2	V <sub>DDQ</sub> /2	✓	✓	✓	20 HTSSOP/ 24 QFN	1.80
<b>Low Dropout Regulators</b>													
TPS51100	1.2 to 3.6 <sup>1</sup>	LDO	—	+3/-3	10	—	V <sub>DDQ</sub> /2	V <sub>DDQ</sub> /2	✓	✓	✓	10 MSOP	0.80
<b>TPS51200</b>	1.1 to 3.5 <sup>2</sup>	LDO	—	+2/-2	10	—	V <sub>DDQ</sub> /2	V <sub>DDQ</sub> /2	✓	✓	✓	10 SON	0.90

<sup>1</sup>Requires separate 4.75-V to 5.25-V bias supply. <sup>2</sup>Requires separate 2.4-V to 3.5-V bias supply.  
\*Suggested resale price in U.S. dollars in quantities of 1,000.

New devices are listed in bold red.



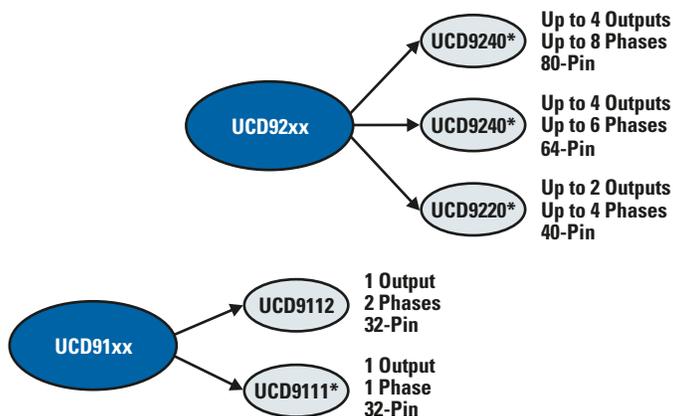
## Introduction

### Introduction

TI's family of Fusion Digital Power™ products focuses on two areas: Digital Power Controllers (UCD9K) and Digital Power Drivers (UCD7K). 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](http://www.ti.com/digitalpower)

### UCD9K Buck Controllers Family



\*Preview device.

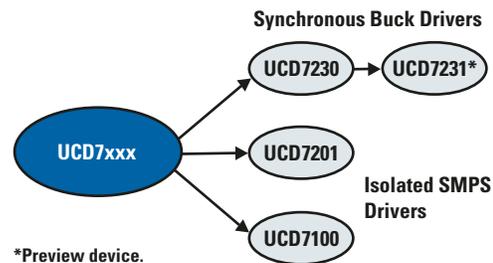
### Key Benefits

- High levels of integration:
  - Multiple outputs and phases with one controller
  - Integrated supply-voltage sequencing and margining
  - Improved reliability with fewer parts
- Advanced functionality:
  - Real-time power monitoring, data logging and failure prediction
  - Adaptive control for varying operation modes and load characteristics
  - Calibration in manufacturing
- System optimization:
  - Dead-band control for improved efficiency
  - Enhanced phase management

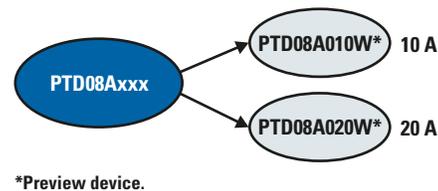
### Digital Solution Features

- Supports PMBus™ Version 1.1
- Power + Designer Graphical User Interface tool
- Programmable soft-start/stop configuration
- Supports voltage tracking and sequencing
- 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

### UCD7K MOSFET Drivers Family



### Digital Power-Train Modules Family

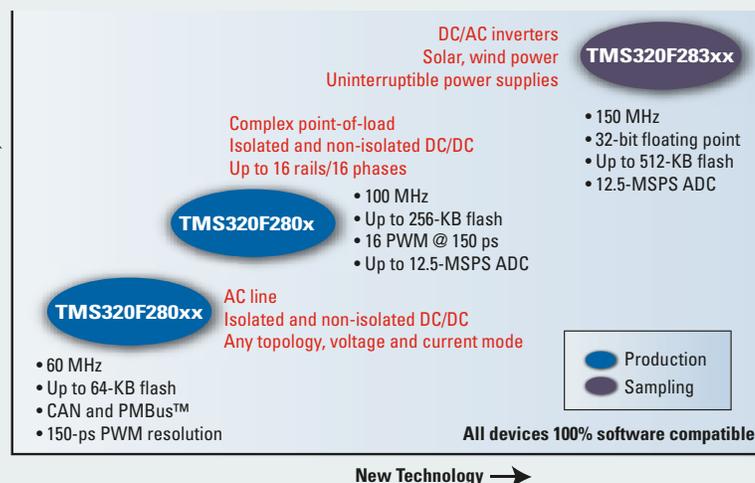


### TMS320C2000™ Digital Signal Controllers

In addition to TI's UCDxxxx digital-power solutions, TI offers fully programmable C2000™ Digital Signal Controllers (DSC) for digital-power applications.

C2000 DSCs are used in digital power systems like telecom rectifiers, non-isolated DC/DC converters, and green applications such as solar inverters and wind turbines. C2000 DSCs are optimized for real-time embedded control applications by integrating fast 12-bit ADCs and the most sophisticated PWM generation technology with a high-performance, 32-bit DSC CPU. The C2000 PWM allows duty-cycle modulation with 150-ps accuracy and the flexibility to support any power stage topology. TI has an extensive software library of common functions. For free download, visit:

[www.ti.com/dpslib](http://www.ti.com/dpslib)



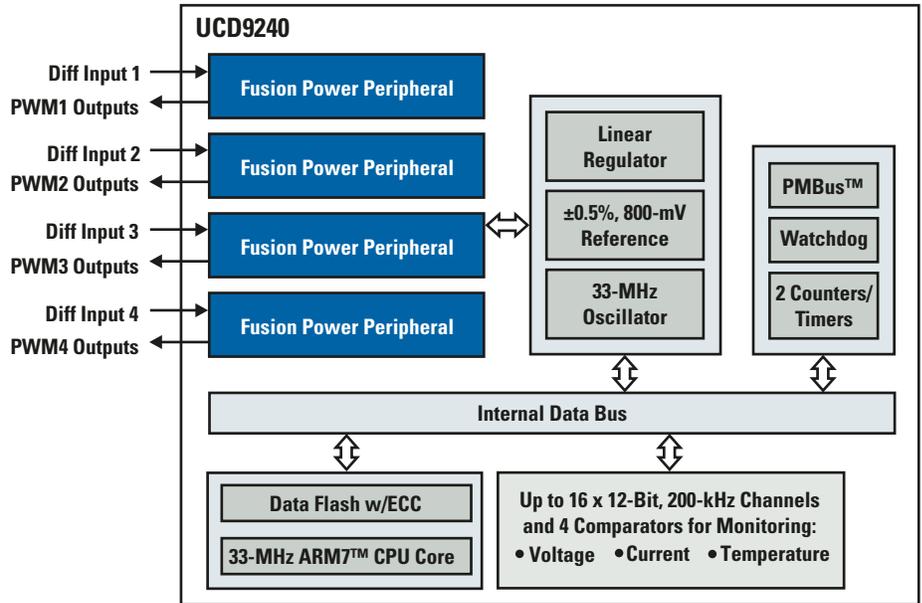
**Digital Point-of-Load Controller**  
**UCD9240**

**PREVIEW\***

Get samples and datasheets at: [www.ti.com/sc/device/UCD9240](http://www.ti.com/sc/device/UCD9240)

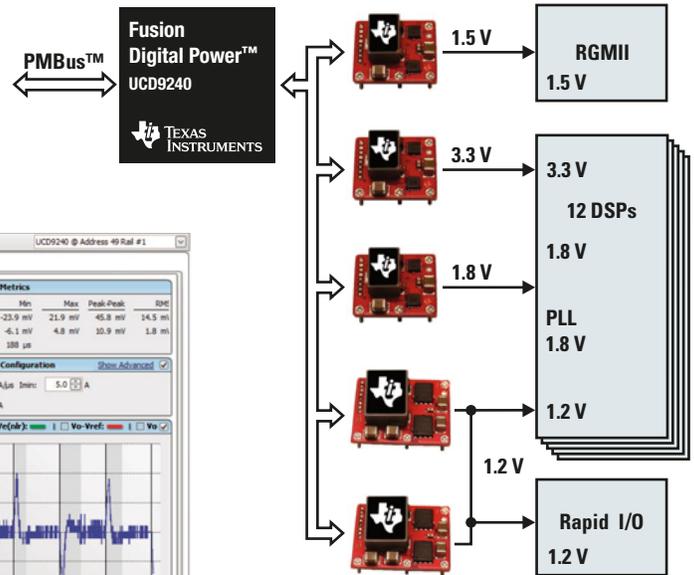
**Key Features**

- 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
- $\pm 1$ -mV feedback resolution
- Hardware-accelerated, digital 3-pole/3-zero compensator
- Can synchronize PWM clocks between multiple UCD9240 devices
- Enhanced nonvolatile memory with error-correction coding (ECC)

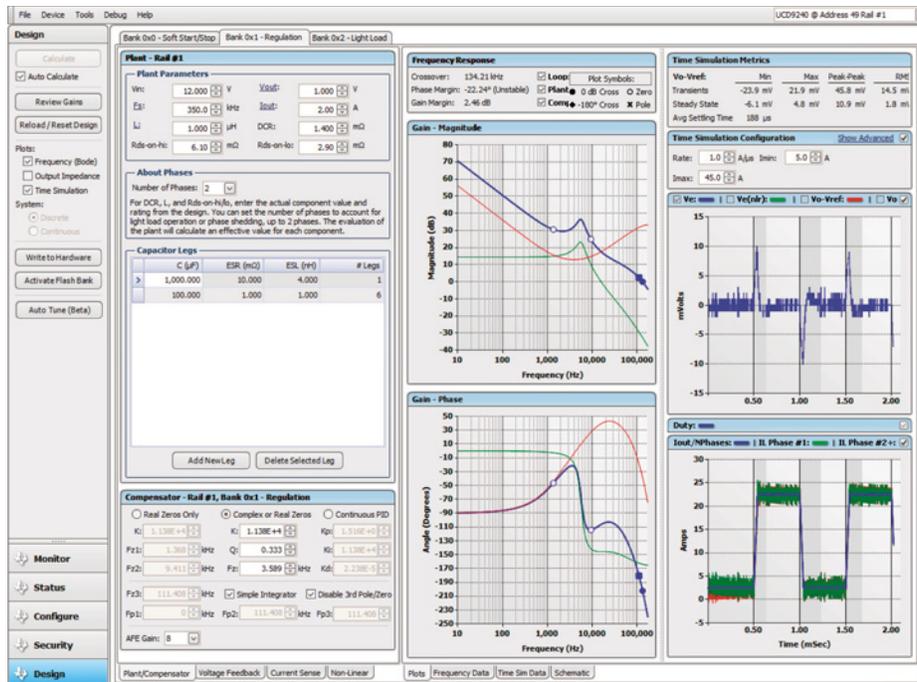


UCD9240 controller overview.

\*Anticipated release: August 2008



**Fusion Digital Power™ Designer**



GUI Digital Power developer tool simplifies the design process.



## Power Factor Correction (PFC)

### 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

- Soft-start (programmable) provides controlled start-up.

- Over-current protection (OCP) provides protection during overload conditions.
- Over-voltage protection (OVP) prevents output capacitor, switches and load from overcharge condition.

#### 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

- Ability to work with a wide line voltage range.
- Different levels of under-voltage 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.
- New BiCMOS generation reduces complexity.
- Optimized PFC/PWM “combo” controllers.
- Superior applications support.

### 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/sc/device/UCC28060](http://www.ti.com/sc/device/UCC28060)

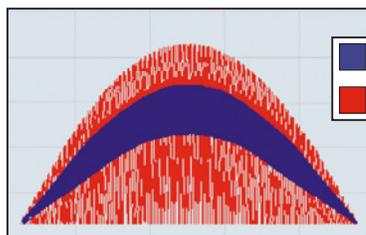
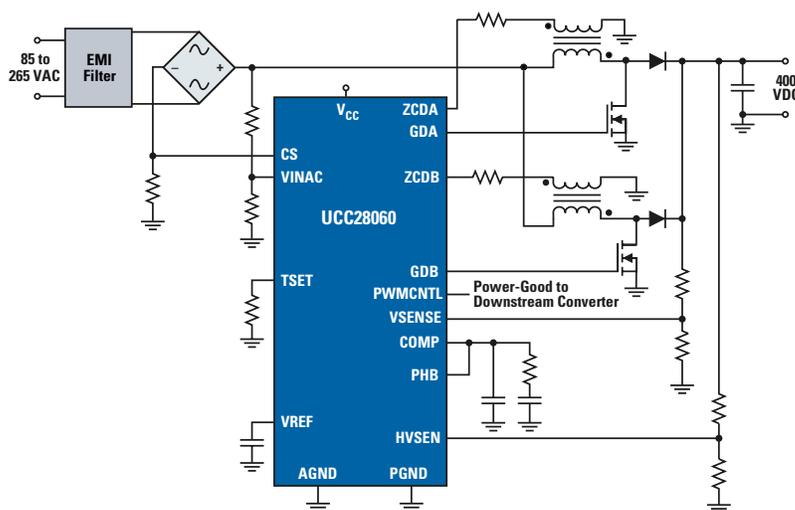
[www.ti.com/sc/device/UCC28070](http://www.ti.com/sc/device/UCC28070)

#### Why Interleave?

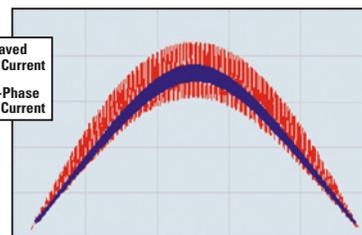
- Lower system cost from ripple-current cancellation
- Enables ultraslim and high-density designs
- Lower total inductor volume
- Smaller or lower-cost EMI filter and output capacitors
- Facilitates higher efficiency

### 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.



## Power Factor Correction (PFC)

### Selection Guide

Device	Description	Control Method <sup>1</sup>	Typical Power Level	Soft Switching <sup>2</sup>	Max Frequency (kHz)	Start-Up Current (mA)	UVLO Thresholds (V)	PWM Prog. Max Duty Cycle	PWM Freq. Option	OVP	Price*
<b>UCC28060</b>	Natural Interleaving™ Transition Mode Controller for 80+™ and Energy Star™ Solutions	TM	100 W to 1 kW	—	Variable	5	12.6/10.35	—	—	✓	1.40
<b>UCC28070</b>	Continuous Conduction Mode Controller for High-Performance Applications	ACM	500 W to 2 kW+	—	300	8	10.2/9.2	—	—	✓	1.95
<b>UCC28061</b>	Natural Interleaving Transition Mode Controller for 80+ and Energy Star Solutions	TM	100 W to 1 kW	—	Variable	5	12.6/10.35	—	—	✓	1.40
UCC28019	8-Pin PFC Controller	ACM	75 W to 600 W	—	65	0.01	10.5/9.5	—	—	—	0.80
UC3852	Transition Mode PFC Controller	TM	<150 W	—	Variable	1	16.3/11.5	—	—	—	1.70
UC3853/A	8-Pin PFC Controller	ACM	75 W to 300 W	—	125	0.25	11.5/9.5	—	—	✓	0.99
UC3854	PFC Controller	ACM	200 W to 2 kW+	—	200	1.5	16/10	—	—	—	1.15
UC3854A/B	Improved PFC Controller	ACM	200 W to 2 kW+	—	200	0.3	16/10 ('3854A), 10.5/10 ('3854B)	—	—	—	1.35
UC3855A/B	High Performance Soft Switching PFC Controller	ACM	400 W to 2 kW+	ZVT	500	0.15	16/10 ('3855A), 10.5/10 ('3855B)	—	—	✓	5.70
UCC38050/1	Transition Mode PFC Controller	TM	50 W to 400 W	—	Variable	0.75	15.8/9.7 ('38050), 12.5/9.7 ('38051)	—	—	✓	0.70
UCC3817A/8A	BiCMOS PFC Controller	ACM	75 W to 2 kW+	—	400	0.1	16/10 ('3817A), 10.5/10 ('3818A)	—	—	✓	1.15
UCC3819A	Tracking Boost PFC Controller	ACM	75 W to 2 kW+	—	400	0.1	10.2/9.7	—	—	✓	1.15
UCC38500/1/2/3	PFC+PWM Combo Controller	ACM	75 W to 1 kW+	—	400	0.1	16/10 ('38500/2), 10.5/10 ('38501/3)	—	1x	✓	2.35
UCC28510/1/2/3	Advanced PFC+PWM Combo Controller	ACM	75 W to 1 kW+	—	600	0.1	16.6/9.3 ('28510/2), 10.2/9.7 ('28511/3)	✓ <sup>3</sup>	1x	✓	1.80
UCC28514/5/6/7	Advanced PFC+PWM Combo Controller	ACM	75 W to 1 kW+	—	600	0.1	16.6/9.3 ('28514/6), 10.2/9.7 ('28515/7)	✓ <sup>3</sup>	2x	✓	1.80
UCC28521/8	Advanced PWM/PFC Combo Controller with TEM/TEM Modulation	ACM	75 W to 1 kW+	—	600	0.1	10.2/9.7	✓ <sup>3</sup>	2x	✓	1.80

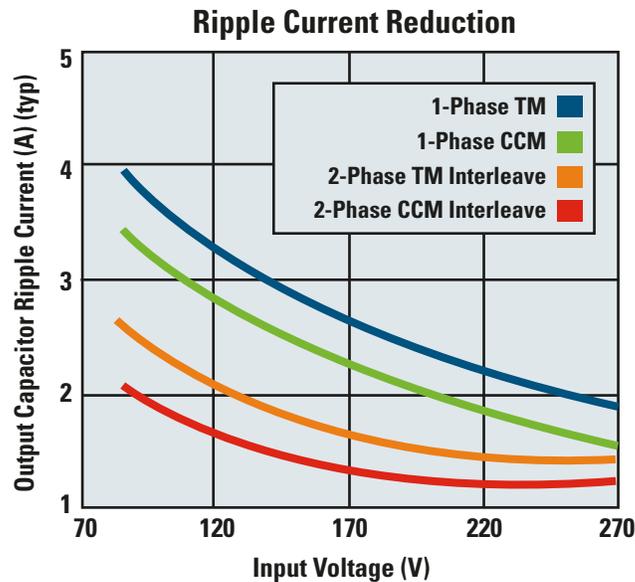
<sup>1</sup>ACM = average current mode; TM = transition mode.

<sup>2</sup>ZVT = zero voltage transition.

<sup>3</sup>Up to 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**.



Interleaved PFC reduces ripple current in the output capacitor.

For a complete list of Resources, visit: [power.ti.com](http://power.ti.com)

## 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.

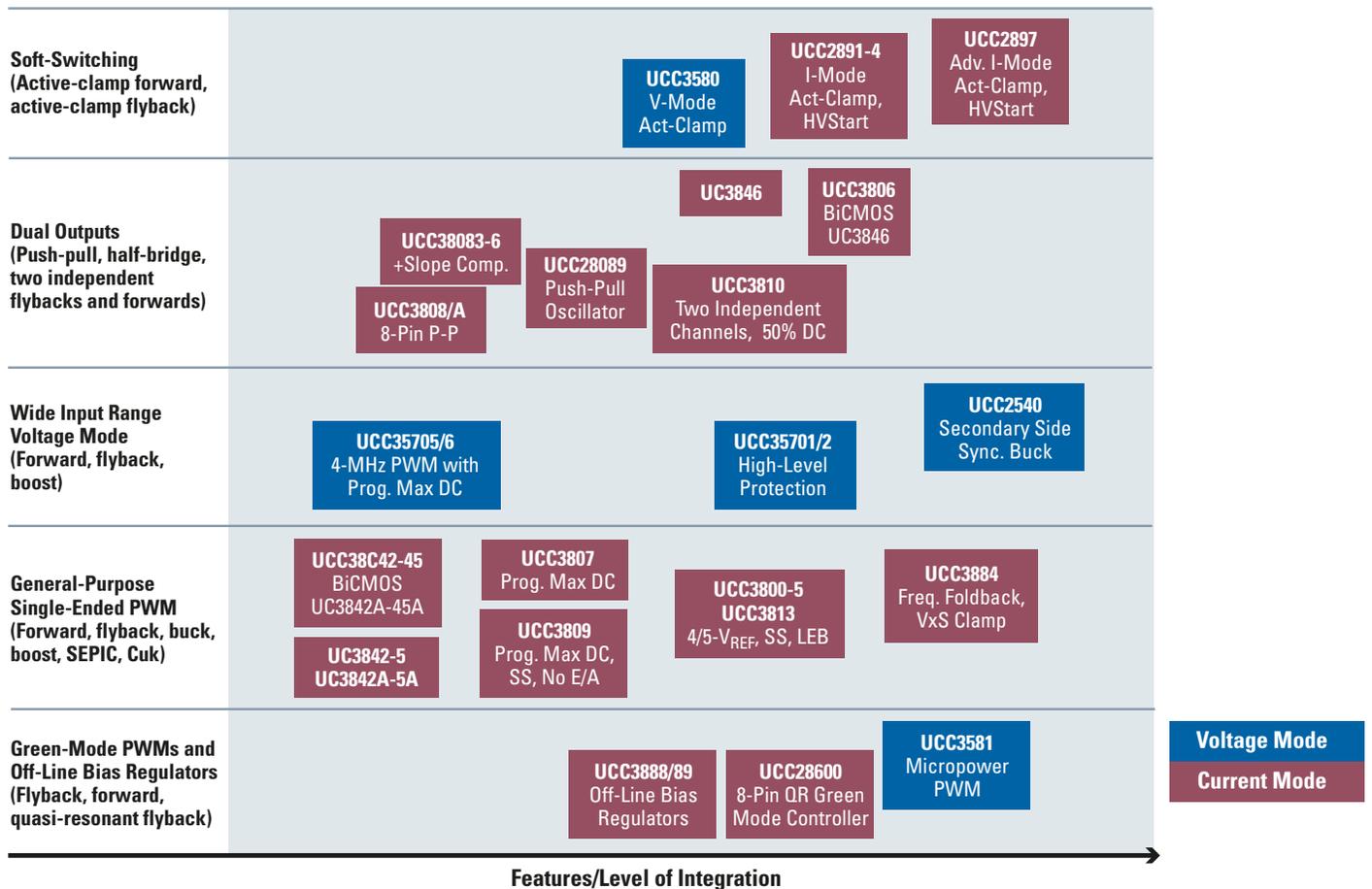
#### Soft Switching

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

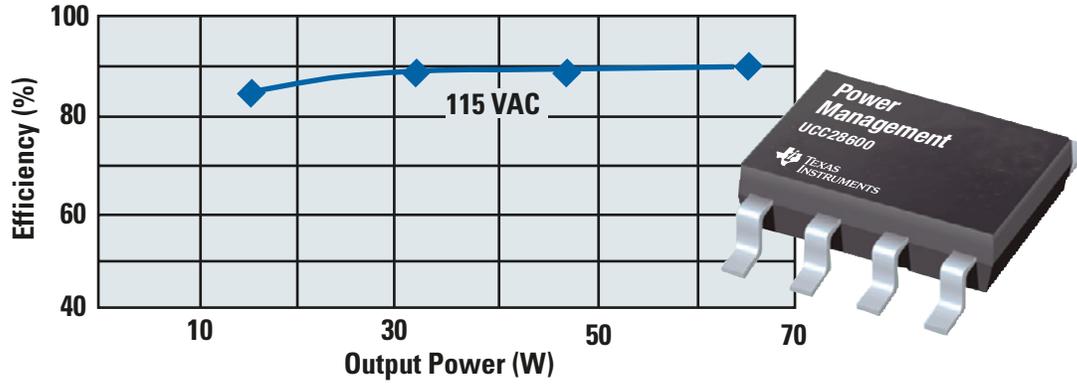
#### Protection

- Flexible over-current 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.

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

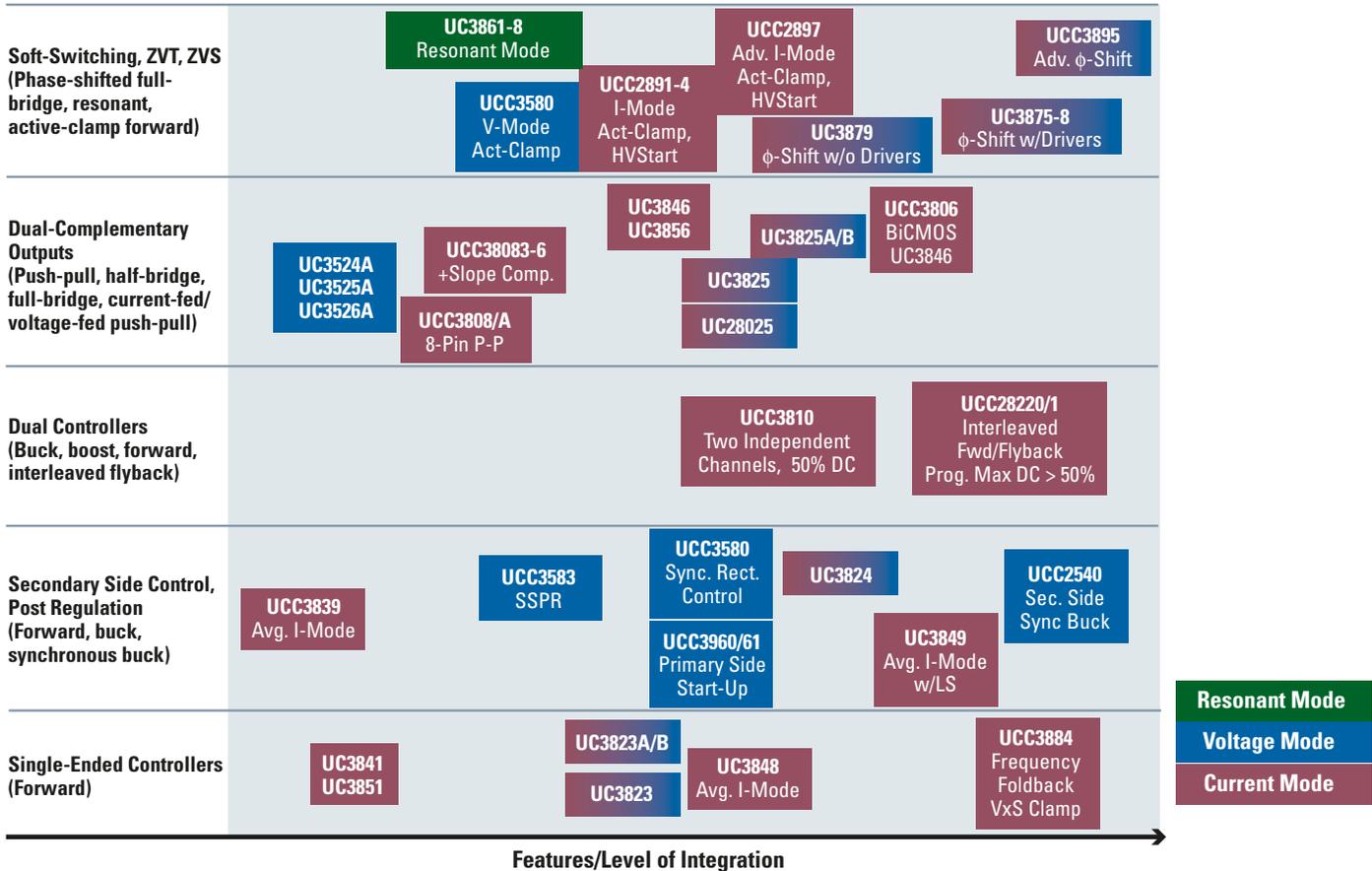


## → PWM Power Supply Controllers



Quasi-resonant flyback using the UCC28600 achieves high efficiency and a cost-effective design.

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



For a complete list of Resources, visit: [power.ti.com](http://power.ti.com)



### PWM Intermediate Bus Controllers

#### UCC28230, UCC28231



Get samples, datasheets and app reports at: [www.ti.com/sc/device/UCC28230](http://www.ti.com/sc/device/UCC28230) or [UCC28231](http://www.ti.com/sc/device/UCC28231)

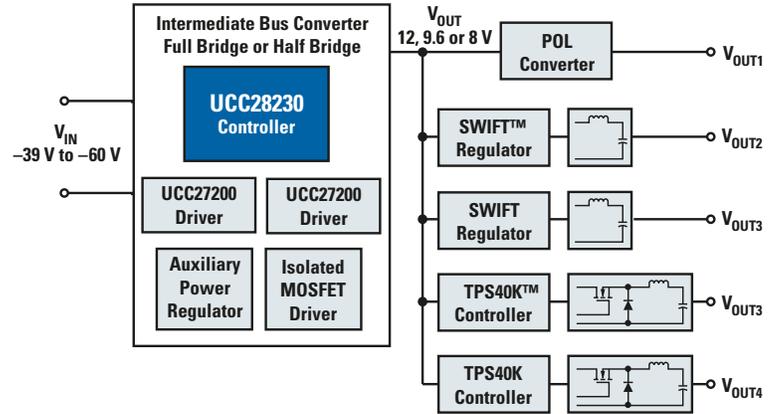
The intermediate bus voltage architecture has become the industry standard for telecom-distributed power systems. Adding an intermediate bus controller that converts a nominal 48 V to a lower unregulated intermediate voltage can achieve higher overall system efficiencies.

The new low-cost UCC28230/1 PWM bus controllers are optimized to use in high-efficiency, high-power-density, unregulated push-pull, half-bridge and full-bridge intermediate bus converter topologies.

The UCC28230/1 employs a load-dependent off-time control method that enables efficiency levels of up to 97%. Also, a start-up frequency control circuit is added that reduces ripple current, allows the use of a small output inductor and provides a constant-current start-up with a large output capacitor.

#### Key Features

- **Start-Up Frequency Control** — Limits output inductor ripple, allows start-up at constant current with smaller inductor, provides higher-efficiency and lower-cost solution

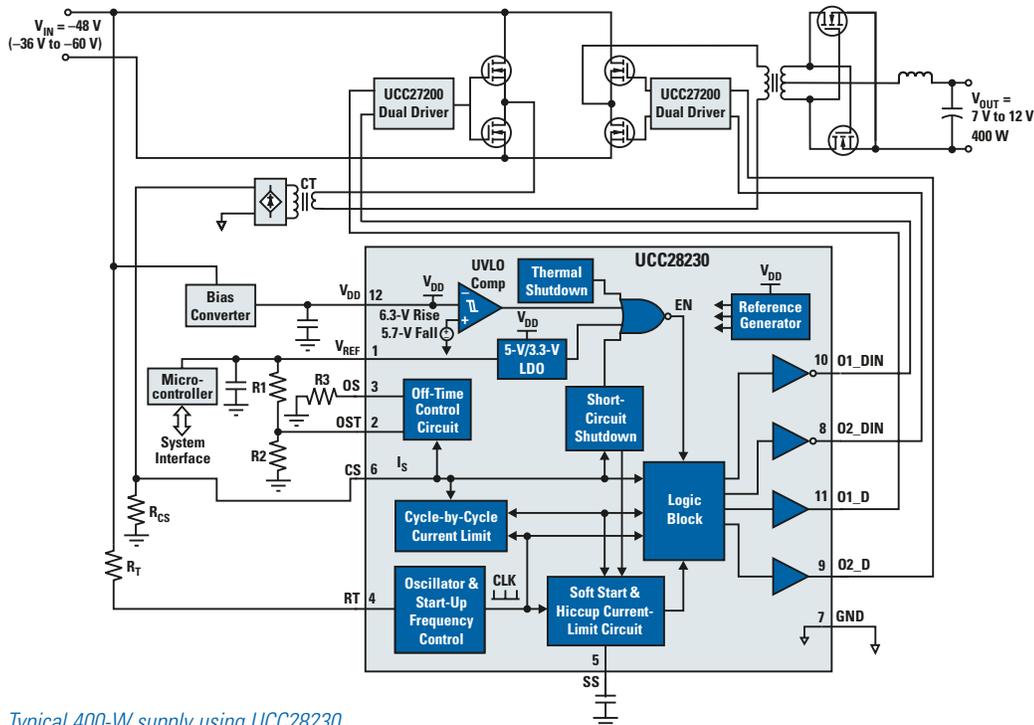


- **1-D Outputs** — Keep self-driven rectifiers under control during start-up, shutdown and transient modes of operation by clamping primary winding
- **Load-Current-Dependent Off Time** — Optimizes efficiency across entire load and allows lower- $V_{DS}$  synchronous rectifier FETs
- **Precise 1.5%, 5-V or 3.3-V Output Options** — Eliminate the need for an external regulator to supply housekeeping functions

- **Matched Output Signals** — Specifically designed logic block provides symmetrical operation, better flux balancing, higher efficiency and smaller size
- **Fixed-Volt-Second or Fixed-Frequency Operation** — Fixed volt-second minimizes transformer size and improves efficiency

#### Applications

- Isolated brick power supplies
- Telecom/datacom motherboards



Typical 400-W supply using UCC28230.



## PWM Power Supply Controllers

### Selection Guide

(Device parameters continued on next page)

Device	Typical Power Level (W)	Control Method			Topologies										Maximum Practical Frequency	Start-Up Current	Operating Current	Supply Voltage (V)	110-V Start-Up Circuit	UVLO: On/Off (V)		
		Voltage Mode	Current Mode	Avg. Current Mode	Buck	Boost	Flyback (SEPIC, Cuk)	Fwd (Including 2-Switch Fwd)	Forward (D > 50%)	Interleaved Fwd/Flyback/Boost	Act-Clamp Fwd/Flyback	Push-Pull	I-Fed/V-Fed Push-Pull	Half-Bridge							Full-Bridge	Φ-Shifted FB
<b>Green Mode Controllers and Offline Bias Regulators</b>																						
UCC3581	10 to 200	✓			✓	✓	✓	✓									100 kHz	85 μA	300 μA	6.8 to 15	—	7.3/6.8
<b>UCC28600</b>	50 to 150		✓														130 kHz	25 μA	50 mA	30	—	13/8
UCC3888/89	<10	✓					✓										250 kHz	150 μA	1.2 mA	9	—	8.4/6.3
<b>Intermediate Bus Controllers</b>																						
<b>UCC28230</b>	150 to 500																2 MHz	150 μA	3 mA	-0.3 to 20	—	6.6 to 6.0
<b>UCC28231</b>	150 to 500																2 MHz	150 μA	3 mA	-0.3 to 20	—	6.6 to 6.0
<b>General-Purpose Single-Ended Controllers</b>																						
TL3842	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.5 mA	11 mA	10 to 30	—	16/10
TL3842B	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.3 mA	11 mA	10 to 30	—	16/10
TL3843	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.5 mA	11 mA	7.6 to 30	—	8.4/7.6
TL3843B	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.3 mA	11 mA	7.6 to 30	—	8.4/7.6
TL3844	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.5 mA	11 mA	10 to 30	—	16/10
TL3844B	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.3 mA	11 mA	10 to 30	—	16/10
TL3845	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.5 mA	11 mA	7.6 to 30	—	8.4/7.6
TL3845B	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.3 mA	11 mA	7.6 to 30	—	8.4/7.6
UC28023	50 to 750	✓	✓		✓	✓	✓	✓									1 MHz	1.1 mA	22 mA	9 to 30	—	9.2/8.4
UC3823	50 to 750	✓	✓		✓	✓	✓	✓									1 MHz	1.1 mA	22 mA	9 to 30	—	9.2/8.4
UC3823A/B	50 to 750	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	28 mA	9 to 22	—	9.2/8.4/16/10
UC3842/A	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.5/0.3 mA	11 mA	10 to 30	—	16.0/10.0
UC3843	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.5 mA	11 mA	7.6 to 30	—	8.4/7.6
UC3843A	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.3 mA	11 mA	7.9 to 30	—	8.5/7.9
UC3844/A	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.5/0.3 mA	11 mA	10 to 30	—	16.0/10.0
UC3845	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.5 mA	11 mA	7.6 to 30	—	8.4/7.6
UC3845A	30 to 350	✓	✓		✓	✓	✓	✓									500 kHz	0.3 mA	11 mA	7.9 to 30	—	8.5/7.9
UC3849	50 to 250			✓				✓	✓								1 MHz	—	21 mA	8.4 to 20	—	8.4/8
UCC35705	25 to 250	✓						✓	✓								4 MHz	50 μA	2.5 mA	8.2 to 15	—	8.8/8.2
UCC35706	25 to 250	✓						✓	✓								4 MHz	50 μA	2.5 mA	8.0 to 15	—	12/8
UCC3800	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	500 μA	7.2 to 15	—	7.2/6.9
UCC3801	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	500 μA	9.4 to 15	—	9.4/7.4
UCC3802	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	500 μA	12.5 to 15	—	12.5/8.3
UCC3803	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	500 μA	4.1 to 15	—	4.1/3.6
UCC3804	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	500 μA	12.5 to 15	—	12.5/8.3
UCC3805	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	500 μA	4.1 to 15	—	4.1/3.6
UCC3807-1	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	1.3 mA	6.9 to 15	—	7.2/6.9
UCC3807-2	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	1.3 mA	8.3 to 15	—	12.5/8.3
UCC3807-3	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	100 μA	1.3 mA	4.1 to 15	—	4.3/4.1
UCC3809-1	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	50 μA	500 μA	8 to 19	—	10.0/8.0
UCC3809-2	10 to 200	✓	✓		✓	✓	✓	✓									1 MHz	50 μA	500 μA	8 to 19	—	15.0/8.0
UCC3813-0/1/2/3/4/5	10 to 200	✓	✓		✓	✓	✓	✓	✓								1 MHz	100 μA	500 μA	7.2 to 15 <sup>1</sup>	—	7.2/6.9 <sup>1</sup>
UCC3884	50 to 250	✓	✓		✓	✓	✓	✓									1 MHz	200 μA	5 mA	8.9 to 15	—	8.9/8.3
UCC38C40	10 to 250	✓	✓		✓	✓	✓	✓									1 MHz	50 μA	2.3 mA	6.6 to 20	—	7.0/6.6
UCC38C41	10 to 250	✓	✓		✓	✓	✓	✓									1 MHz	50 μA	2.3 mA	6.6 to 20	—	7.0/6.6
UCC38C42	10 to 250	✓	✓		✓	✓	✓	✓									1 MHz	50 μA	2.3 mA	9 to 20	—	14.5/9

<sup>1</sup>Value varies by part number suffix. Please check datasheet.

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

New devices are listed in bold red.

## PWM Power Supply Controllers



(Device parameters continued from previous page)

Device	V <sub>REF</sub> (V)	V <sub>REF</sub> ToI. (%)	Max Duty Cycle (%)	Soft Start	E/A	Shut- down Pin	Voltage Feed- forward	Output Drive (Sink/Source) (A)	Slope Comp	Sync Pin	Leading Edge Blanking	Package(s)						Price*
												MSOP	SON	SSOP	TSSOP	HTSSOP-PowerPAD™	SOIC	
<b>Green Mode Controllers and Offline Bias Regulators</b>																		
UCC3581	4	1.5	Prog.	✓	—	✓	—	1/1	—	✓	—					14	14	1.00
<b>UCC28600</b>	—	—	99	✓	—	—	—	1/0.75	—	—	—					8		0.49
UCC3888/89	2.5	3	5.5	✓	—	—	✓	0.2/0.15	—	—	—					8	8	0.59
<b>Intermediate Bus Controllers</b>																		
<b>UCC28230</b>	5	1.5	99	✓	—	—	—	0.2/0.2	—	—	—	12	14					1.20
<b>UCC28231</b>	3.3	1.5	99	✓	—	—	—	0.2/0.3	—	—	—	12	14					1.20
<b>General-Purpose Single-Ended Controllers</b>																		
TL3842	5	2	100	—	✓	—	—	1/1	—	—	—					8/14	8	0.40
TL3842B	5	2	100	—	✓	—	—	1/1	—	—	—					8/14	8	0.54
TL3843	5	2	100	—	✓	—	—	1/1	—	—	—					8/14	8	0.40
TL3843B	5	2	100	—	✓	—	—	1/1	—	—	—					8/14	8	0.54
TL3844	5	2	50	—	✓	—	—	1/1	—	—	—					8/14	8	0.40
TL3844B	5	2	50	—	✓	—	—	1/1	—	—	—					8/14	8	0.54
TL3845	5	2	50	—	✓	—	—	1/1	—	—	—					8/14	8	0.40
TL3845B	5	2	50	—	✓	—	—	1/1	—	—	—					8/14	8	0.54
UC28023	5.1	1	Prog.	✓	✓	—	—	1.5/1.5	—	✓	—					16	16	1.35
UC3823	5.1	1	Prog.	✓	✓	—	✓	1.5/1.5	—	✓	—					16	20	1.60
UC3823A/B	5.1	1	Prog.	✓	✓	—	✓	2/2	—	✓	—					16	20	4.90
UC3842/A	5	1.5	100	—	✓	—	—	1/1	—	—	—					8/14	8	0.80
UC3843	5	1.5	100	—	✓	—	—	1/1	—	—	—					8/14	8	0.80
UC3843A	5	1.5	100	—	✓	—	—	1/1	—	—	—					8/14	8	0.80
UC3844/A	5	1.5	50	—	✓	—	—	1/1	—	—	—					8/14	8	0.80
UC3845	5	1.5	50	—	✓	—	—	1/1	—	—	—					8/14	8	0.80
UC3845A	5	1.5	50	—	✓	—	—	1/1	—	—	—					8/14	8	0.80
UC3849	5	2	Prog.	✓	✓	—	—	0.3/0.3	—	—	✓					24	28	3.05
UCC35705	—	—	93	—	—	—	✓	0.1/0.1	N/A	—	—	8				8		0.75
UCC35706	—	—	93	—	—	—	✓	0.1/0.1	N/A	—	—	8				8		0.75
UCC3800	5	1.5	100	✓	✓	—	—	1/1	—	—	100 ns		8			8		1.35
UCC3801	5	1.5	50	✓	✓	—	—	1/1	—	—	100 ns		8			8		1.35
UCC3802	5	1.5	100	✓	✓	—	—	1/1	—	—	100 ns		8			8		1.35
UCC3803	4	1.5	100	✓	✓	—	—	1/1	—	—	100 ns		8			8		1.35
UCC3804	5	1.5	50	✓	✓	—	—	1/1	—	—	100 ns		8			8		1.35
UCC3805	4	1.5	50	✓	✓	—	—	1/1	—	—	100 ns		8			8		1.35
UCC3807-1	2 (Int)	—	Prog.	✓	✓	—	—	1/1	—	—	100 ns					8		1.50
UCC3807-2	2 (Int)	—	Prog.	✓	✓	—	—	1/1	—	—	100 ns					8		1.50
UCC3807-3	2 (Int)	—	Prog.	✓	✓	—	—	1/1	—	—	100 ns					8		1.50
UCC3809-1	5	5	90	✓	—	✓	—	0.8/0.4	—	—	—	8		8		8		0.85
UCC3809-2	5	5	90	✓	—	✓	—	0.8/0.4	—	—	—	8		8		8		0.85
UCC3813-0/1/2/3/4/5	5 <sup>1</sup>	2	100 <sup>1</sup>	✓	✓	—	—	1/1	—	—	100 ns			8		8		0.80
UCC3884	5	2.5	100	✓	✓	—	✓	1/0.5	—	—	—					16	16	1.60
UCC38C40	5	2	100	—	✓	—	—	1/1	—	—	—	8				8		0.95
UCC38C41	5	2	50	—	✓	—	—	1/1	—	—	—	8				8		0.95
UCC38C42	5	2	100	—	✓	—	—	1/1	—	—	—	8				8		0.95

<sup>1</sup>Value varies by part number suffix. Please check datasheet.

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

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

New devices are listed in bold red.

 **PWM Power Supply Controllers**
**Selection Guide (Continued)**

(Device parameters continued on next page)

Device	Typical Power Level (W)	Control Method			Topologies										Maximum Practical Frequency	Start-Up Current	Operating Current	Supply Voltage (V)	110-V Start-Up Circuit	UVLO: On/Off (V)			
		Voltage Mode	Current Mode	Avg. Current Mode	Buck	Boost	Flyback (SEPIC, Cuk)	Fwd (Including 2-Switch Fwd)	Forward (D > 50%)	Interleaved Fwd/Flyback/Boost	Act-Clamp Fwd/Flyback	Push-Pull	I-Fed/V-Fed Push-Pull	Half-Bridge							Full-Bridge	Φ-Shifted FB	
<b>General-Purpose Single-Ended Controllers (Continued)</b>																							
UCC38C43	10 to 250	✓	✓		✓	✓	✓	✓										1 MHz	50 μA	2.3 mA	7.6 to 20	—	8.4/7.6
UCC38C44	10 to 250	✓	✓		✓	✓	✓	✓										1 MHz	50 μA	2.3 mA	9 to 20	—	14.5/9
UCC38C45	10 to 250	✓	✓		✓	✓	✓	✓										1 MHz	50 μA	2.3 mA	7.6 to 20	—	8.4/7.6
<b>Wide-Input Range Voltage Mode Controllers</b>																							
UCC3570	25 to 250	✓					✓	✓	✓									500 kHz	85 μA	1 mA	9.0 to 15	—	13.0/9
UCC35701	25 to 250	✓					✓	✓	✓									700 kHz	130 μA	750 μA	9.0 to 15	—	13.0/9
UCC35702	25 to 250	✓					✓	✓	✓									700 kHz	130 μA	750 μA	8.8 to 15	—	9.6/8.8
UCC35705	25 to 250	✓					✓	✓	✓									4 MHz	50 μA	2.5 mA	8.2 to 15	—	8.8/8.2
UCC35706	25 to 250	✓					✓	✓	✓									4 MHz	50 μA	2.5 mA	8.0 to 15	—	12/8
<b>Dual Output Controllers</b>																							
TL494	50 to 500	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	300 kHz	—	7.5 mA	7 to 40	—	—
TL594	50 to 500	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	300 kHz	—	12.4 mA	7 to 40	—	6.1/6
TL598	50 to 500	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	300 kHz	—	15 mA	7 to 40	—	6.1/6
SG3524	50 to 500	✓																450 kHz	—	—	8 to 40	—	—
UC28025	50 to 750	✓	✓															1 MHz	1.1 mA	22 mA	9 to 30	—	9.2/8.4
UC3524	50 to 500	✓																250 kHz	—	—	8 to 40	—	—
UC3524A	50 to 500	✓																250 kHz	4 mA	5 mA	8 to 40	—	7.5/7
UC3525A/B	50 to 500	✓																250 kHz	—	14 mA	8 to 40	—	7.0/7.0
UC3526A	50 to 500	✓																250 kHz	—	14 mA	8 to 35	—	—
UC3825	50 to 750	✓	✓															1 MHz	1.1 mA	22 mA	9 to 30	—	9.2/8.4
UC3825A/B	50 to 750	✓	✓															1 MHz	100 μA	28 mA	9 to 22	—	16/10/9.2/8.4
UC3827-1/-2	50 to 500	✓																450 kHz	1000 μA	32 mA	8.4 to 20	—	9/8.4
UC3846	50 to 750	✓	✓															500 kHz	1.5 mA	17 mA	8 to 40	—	7.7/7
UC3856	50 to 750	✓	✓															1 MHz	1.5 mA	17 mA	8 to 40	—	7.7/7
UCC28089	25 to 250																	500 kHz	130 μA	1.4 mA	8 to 15	—	10.5/8.0
UCC28220	50 to 800		✓															1 MHz/ch.	200 μA	3 mA	8 to 14.5	—	10/8
UCC28221	50 to 800		✓															1 MHz/ch.	500 μA	3 mA	8 to 14.5	✓	13/8
UCC3806	50 to 750	✓	✓															350 kHz	100 μA	1.4 mA	7 to 15	—	7.5/6.7
UCC3808-1/-2/A-1/A-2	50 to 500		✓															1 MHz	130 μA	1 mA	4.3 to 15	—	12.5/8.3/4.3/4.1
UCC38083/4/5/6	50 to 500		✓															1 MHz	130 μA	20 mA	8.3 to 15	—	12.5/8.3
UCC3810	50 to 500	✓	✓		✓	✓	✓	✓	✓									1 MHz	150 μA	2 mA	8.3 to 11	—	11.3/8.3
<b>Soft-Switching, ZVT and ZVS Controllers</b>																							
UC3875/6/7	200 W to 2 kW	✓	✓	✓														1+ MHz	150 μA	45 mA	10.7 to 20	—	10.7/9.3/15/9
UC3879	200 W to 2 kW	✓	✓															500 kHz	150 μA	27 mA	11 to 20	—	15.2/9/10.7/9
UCC2891/2/3/4	75 to 600		✓															1 MHz	300 μA	2 mA	8.5 to 14.5	✓ <sup>2</sup>	13/8.0
UCC2897	75 to 600		✓															1 MHz	300 μA	2 mA	8.5 to 14.5	✓	13/8.0
UCC3580-1/-2/-3/-4	50 to 500	✓																500 kHz	100 μA	1.5 mA	7 to 15	—	15/8.5/9.8/5
UCC3895	200 W to 2 kW	✓	✓	✓														1 MHz	150 μA	5 mA	11 to 17	—	11/9
<b>Secondary-Side, Post Regulation</b>																							
UC3824	50 to 250	✓	✓															1 MHz	1.1 mA	22 mA	9 to 30	—	9.2/8.4
UCC2540	50 to 500	✓			✓													1000 kHz	—	12 mA	2.8 to 36	—	—
UCC3580-1/-2/-3/-4	50 to 500	✓																500 kHz	100 μA	1.5 mA	7 to 15	—	15/8.5/9.8/5
UCC3583	50 to 500																	500 kHz	100 μA	3 mA	8.5 to 15	—	9/8.4
UCC3960	25 to 250	✓			✓	✓	✓	✓										400 kHz	150 μA	2.3 mA	8.0 to 19	—	9.5/10.5
UCC3961	25 to 250	✓			✓	✓	✓	✓										400 kHz	150 μA	2.3 mA	8.0 to 19	—	9.5/10.5

<sup>2</sup>UCC2891 and UCC2893.

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

## PWM Power Supply Controllers



(Device parameters continued from previous page)

Device	V <sub>REF</sub> (V)	V <sub>REF</sub> ToL (%)	Max Duty Cycle (%)	Soft Start	E/A	Shut- down Pin	Voltage Feed- forward	Output Drive (Sink/Source) (A)	Slope Comp	Sync Pin	Leading Edge Blanking	Package(s)						Price*	
												MSOP	SON	SSOP	TSSOP	HTSSOP-PowerPAD™	SOIC		SOIC-W (300 mil)
<b>General-Purpose Single-Ended Controllers (Continued)</b>																			
UCC38C43	5	2	100	—	✓	—	—	1/1	—	—	—	8			8		8	0.95	
UCC38C44	5	2	50	—	✓	—	—	1/1	—	—	—	8			8		8	0.95	
UCC38C45	5	2	50	—	✓	—	—	1/1	—	—	—	8			8		8	0.95	
<b>Wide-Input Range Voltage Mode Controllers</b>																			
UCC3570	5	2	Prog.	✓	—	✓	✓	1.2/1.2	N/A	—	N/A				14		14	3.45	
UCC35701	5	1.5	VS Clamp	✓	—	✓	✓	1.2/1.2	N/A	✓	N/A		14		14		14	2.95	
UCC35702	5	1.5	VS Clamp	✓	—	✓	✓	1.2/1.2	N/A	✓	N/A		14		14		14	2.95	
UCC35705	—	—	93	—	—	—	✓	0.1/0.1	N/A	—	N/A	8			8		8	0.75	
UCC35706	—	—	93	—	—	—	✓	0.1/0.1	N/A	—	N/A	8			8		8	0.75	
<b>Dual Output Controllers</b>																			
TL494	5	5	45	—	✓	—	—	0.2/0.2	N/A	✓	—		16		16		16	0.23	
TL594	5	1	45	—	✓	—	—	0.2/0.2	N/A	✓	—		16		16		16	0.38	
TL598	5	1	45	—	✓	—	—	0.2/0.2	N/A	✓	—				16		16	0.81	
SG3524	5	4	45	—	✓	✓	—	0.1/0.1	N/A	✓	—				16		16	0.50	
UC28025	5.1	1	Prog.	✓	✓	—	—	1.5/1.5	—	✓	—				16		16	1.35	
UC3524	5	4	45	—	✓	✓	—	0.1/0.1	N/A	✓	—				16		16	0.85	
UC3524A	5	2	Prog.	✓	✓	✓	—	0.2/0.2	—	✓	—				16		16	1.70	
UC3525A/B	5	2	Prog.	✓	✓	✓	—	0.2/0.2	—	✓	—				16		20 16	1.05	
UC3526A	5.1	1.3	Prog.	✓	✓	✓	—	0.2/0.2	—	✓	—				16		20 16	1.05	
UC3825	5.1	1	Prog.	✓	✓	—	—	1.5/1.5	—	✓	—				16	20	16	1.60	
UC3825A/B	5.1	1.5	Prog.	✓	✓	—	—	2/2	—	✓	—				16	20	16	2.65	
UC3827-1/-2	5	4	—	✓	✓	—	—	1/0.8	—	✓	—				24	28	24	3.50	
UC3846	5	2	Prog.	✓	✓	—	—	0.5/0.5	—	✓	—				16	20	16	1.60	
UC3856	5	2	Prog.	✓	✓	—	—	0.5/0.5	—	✓	—				16	20	16	1.70	
UCC28089	—	—	50	✓	—	—	—	0.5/1.0	—	✓	—				8			0.65	
UCC28220	3.3	4.5	Prog.	✓	—	—	—	0.01/0.01	Prog.	—	—		16		16			1.60	
UCC28221	3.3	4.5	Prog.	✓	—	—	—	0.01/0.01	Prog.	—	—		20		16			1.65	
UCC3806	5.1	3	Prog.	✓	✓	✓	—	0.5/0.5	—	✓	—		16	16	16	16	20	16	4.10
UCC3808-1/-2/A-1/A-2	—	—	Prog.	✓	✓	—	—	1.0/0.5	—	✓	—		8		8		8	1.30	
UCC38083/4/5/6	5	2	50	✓	—	—	—	1.0/0.5	Prog.	—	—		8		8		8	1.10	
UCC3810	5	2	50	—	✓	✓	—	1/1	—	✓	—				16		16	1.85	
<b>Soft-Switching, ZVT and ZVS Controllers</b>																			
UC3875-8	5	2	Prog.	✓	✓	—	—	Four @ 2/2	—	✓	—					20	28	20	4.85
UC3879	5	2.5	Prog.	✓	✓	—	—	Four @ 0.1/0.1	—	✓	—					20	28	20	3.70
UCC2891/2/3/4	5	1	Prog.	✓	—	✓	—	2/2, 2/2	Prog.	✓	—		16		16			1.50	
UCC2897	5	1	Prog.	✓	—	✓	—	2/2, 2/2	Prog.	✓	—		20		16			1.50	
UCC3580-1/-2/-3/-4	5	1	Prog.	✓	✓	✓	✓	0.5/1, 0.3/0.3	—	—	—				16		16	2.40	
UCC3895	5	3	Prog.	✓	✓	✓	—	Four @ 0.1/0.1	—	✓	—				20	20	20	4.35	
<b>Secondary-Side, Post Regulation</b>																			
UC3824	5.1	1	Prog.	✓	✓	—	—	1.5/1.5	—	✓	—				16		16	4.55	
UCC2540	3.3	0.6	100	✓	✓	—	—	3/3	—	✓	—		20					1.85	
UCC3580-1/-2/-3/-4	5	1	Prog.	✓	✓	✓	✓	0.5/1, 0.3/0.3	—	—	—				16		16	1.90	
UCC3583	5	1.5	9.5	✓	✓	—	—	0.5/1.5	—	✓	—				14	20	14	1.75	
UCC3960	—	—	72	✓	—	—	—	0.75/1.5	—	—	—				8		8	0.95	
UCC3961	—	—	72	✓	—	—	—	0.75/1.5	—	—	—				14		14	1.05	

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

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

## → MOSFET 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.

**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.

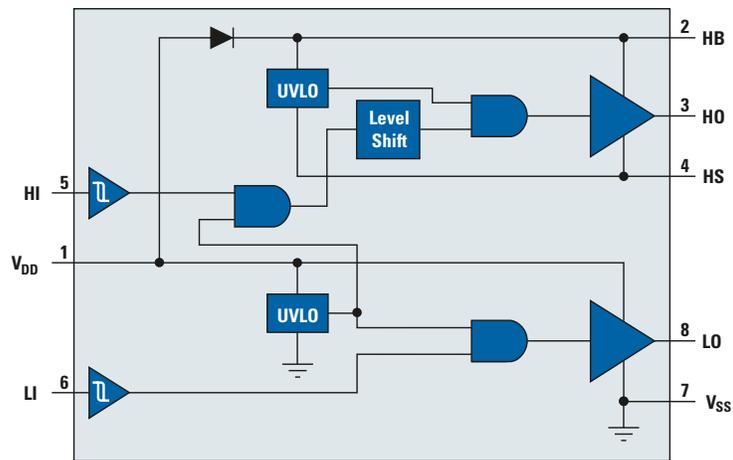
**Predictive Gate Drive™ Technology** — This patented TI technology is a digital control technique to control delay times in high-efficiency, low-output-voltage synchronous buck converters. See our application notes on Predictive Gate Drive for a complete description.

### 120-V Dual MOSFET High-Side, Low-Side Drivers UCC27200, UCC27201

Get samples, datasheets and app reports at: [www.ti.com/sc/device/UCC27200](http://www.ti.com/sc/device/UCC27200) or [UCC27201](http://www.ti.com/sc/device/UCC27201)

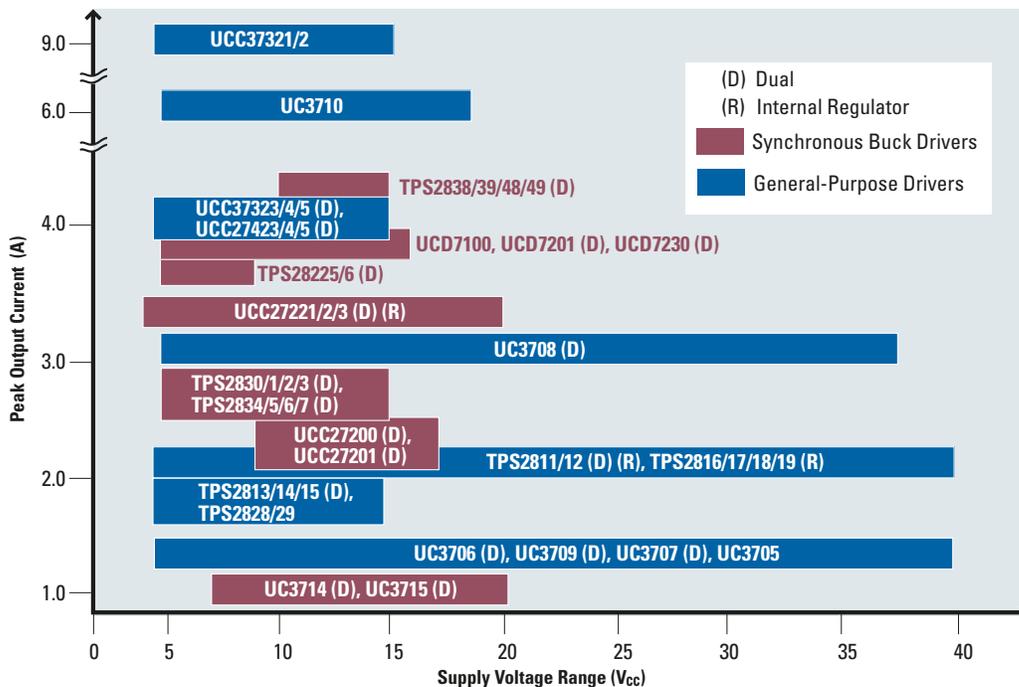
#### Key Features

- Drives two N-channel MOSFETs in high-side, low-side configuration
- Boot voltage absolute maximum: 120 V
- On-chip 0.65-V VF, 0.6-Ω RD bootstrap diode
- Up to 1-MHz operation
- 20-ns typical propagation delay
- 2.5-A sink, 2-A source output currents
- 10-ns rise and 8-ns fall time with 1000-pF load
- 2-ns typical delay matching
- Packaging: SOIC-8, PowerPAD™ SOIC-8 and space-saving DFN (all lead-free packages)



UCC27200/01 block diagram.

### MOSFET Drivers Family of Products





## Selection Guide

Device	No. of Outputs	Output Configuration	Output Type <sup>1</sup>	Peak I <sub>OUT</sub> Source/Sink (A)	Rise/Fall Time (ns)	V <sub>CC</sub> Range (V)	Prop Delay (ns)	Input Threshold	Enable	Dead Time Control	Protection Features <sup>2</sup>	Internal Regulator	Price*
<b>General-Purpose Low-Side Drivers</b>													
TPS2811	2	Inverting	TrueDrive™	2.0/2.0	25/25	4 to 40	40	CMOS	—	—	—	✓	0.90
TPS2812	2	Non-inverting	TrueDrive	2.0/2.0	25/25	4 to 40	40	CMOS	—	—	—	✓	0.90
TPS2813	2	See Note 3	TrueDrive	2.0/2.0	25/25	4 to 14	40	CMOS	—	—	—	✓	0.90
TPS2814	2	Dual 2-input AND; one inverting	TrueDrive	2.0/2.0	25/25	4 to 14	40	CMOS	—	—	—	—	0.90
TPS2815	2	2-input NAND	TrueDrive	2.0/2.0	25/25	4 to 14	40	CMOS	✓	N/A	—	—	0.90
TPS2816	1	Inverting	TrueDrive	2.0/2.0	25/25	4 to 40	40	CMOS	—	N/A	—	✓	0.65
TPS2817	1	Non-inverting	TrueDrive	2.0/2.0	25/25	4 to 40	40	CMOS	—	N/A	—	✓	0.65
TPS2818	1	Inverting	TrueDrive	2.0/2.0	25/25	4 to 40	40	CMOS	—	N/A	—	✓	0.65
TPS2819	1	Non-inverting	TrueDrive	2.0/2.0	25/25	4 to 40	40	CMOS	—	N/A	—	✓	0.65
TPS2828	1	Inverting	TrueDrive	2.0/2.0	25/25	4 to 14	40	CMOS	—	N/A	—	—	0.60
TPS2829	1	Non-inverting	TrueDrive	2.0/2.0	25/25	4 to 14	40	CMOS	—	N/A	—	—	0.60
UC3714	2	Non-inverting	Bipolar	0.5/1.0	30/25	7 to 20	50	TTL/PWM	✓	Adj.	—	—	0.95
UC3715	2	See Note 3	Bipolar	1.0/2.0	30/25	7 to 20	50	TTL/PWM	✓	Adj.	—	—	0.90
UCC27323	2	Inverting	TrueDrive	4.0/4.0	25/25	4 to 15	35	TTL/CMOS	—	—	—	—	0.80
UCC27324	2	Non-inverting	TrueDrive	4.0/4.0	25/25	4 to 15	35	TTL/CMOS	—	—	—	—	0.80
UCC27325	2	See Note 3	TrueDrive	4.0/4.0	25/25	4 to 15	35	TTL/CMOS	—	—	—	—	0.80
UCC27423	2	Inverting	TrueDrive	4.0/4.0	25/25	4 to 15	35	TTL/CMOS	✓	—	—	—	0.85
UCC27424	2	Non-inverting	TrueDrive	4.0/4.0	25/25	4 to 15	35	TTL/CMOS	✓	—	—	—	0.85
UCC27425	2	See Note 3	TrueDrive	4.0/4.0	25/25	4 to 15	35	TTL/CMOS	✓	—	—	—	0.85
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
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
<b>Synchronous Buck Drivers</b>													
<b>TPS28225</b>	2	Non-inverting	CMOS	2.0/4.0	10/10	4.5 to 8.8	14	TTL/CMOS	✓	Adaptive	UVLO	—	0.60
<b>TPS28226</b>	2	Non-inverting	CMOS	2.0/4.0	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
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 <sup>4</sup>	—	✓	1.35
UCC27222	2	Non-inverting	TrueDrive	3.3/3.3	20/20	3.7 to 20	82/103	TTL	—	PGD <sup>4</sup>	—	✓	1.35
UCC27223	2	Non-inverting	TrueDrive	3.3/3.3	25/35	4.15 to 20	82/103	TTL	✓	PGD <sup>4</sup>	—	✓	1.35
<b>UCD7230</b>	2	Non-inverting	CMOS	4/4	10/10	4.5 to 15.5	25	CMOS/TTL	—	Adaptive	Adjustable	—	0.80
<b>High-Side Low-Side Drivers—Half Bridge, Full Bridge</b>													
<b>UCC27200</b>	2	Non-inverting	TrueDrive	3/3	10/8	to 110 <sup>5</sup>	20	CMOS	—	N/A	UVLO	—	1.30
<b>UCC27201</b>	2	Non-inverting	TrueDrive	3/3	10/8	to 110 <sup>5</sup>	20	TTL	—	N/A	UVLO	—	1.30

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

<sup>2</sup>OCP = over-current protection, OVPC = over-voltage protection crowbar.

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

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

<sup>4</sup>Predictive Gate Drive™.

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

New devices are listed in bold red.



## 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*<sup>™</sup>, SmartSync, adjustable  $V_{OUT}$ , remote sense, over-temperature, over-current 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.

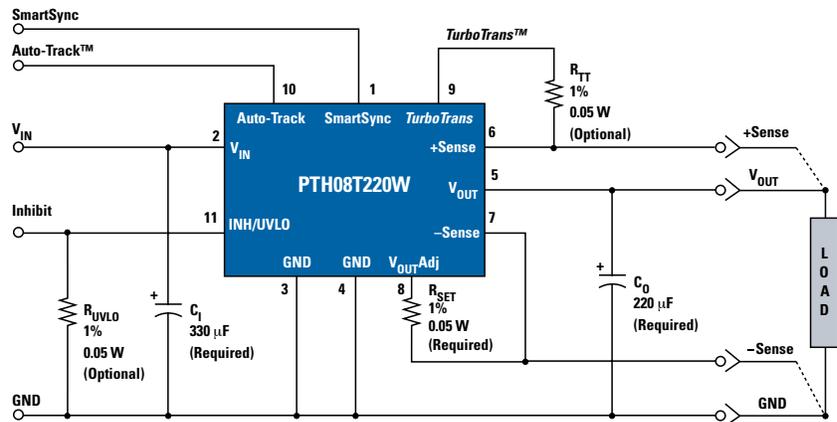
**Protection** — Fault protection can include short circuit, over-temperature, over-current and over-voltage protection.

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

## 16-A, 4.5-V to 14-V Input, POL Module with *TurboTrans*<sup>™</sup> Technology PTH08T220W

Get samples, datasheets and app reports at: [www.ti.com/sc/device/PTH08T220W](http://www.ti.com/sc/device/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<sup>™</sup> sequencing.



## Plug-In Power Modules (POLA<sup>™</sup> and Others) Family of Products

$V_{IN}$	1 A	2 A	3 A	5 A	8 A	15 A	20 A	30 A	60 A
48 V	PT4210 PT4310	PTMA PTB48540	PTMA PTB48540	PT4120 PTB48500 PTEA	PTB48560	PTB48501 PTB48502	PTB48520	PTQA PTQB	
24 V	DCP01/02 DCR01/02 DCV01 PTN78000	PT4240 PTN78060	PT4240 PTN78060	PT4140 PTN78020	PTB78560	PTB78520	PTB78520		
12 V	DCP02 DCR01/02 DCV01 PTN78000	PTN78060 PTH08000 PTH08080	PTH08T260 PTN78060	PTH08T230 PTN78020	PTH08T230 PTH12000 PTH12050 PTV12010 PTR08060	PTH08T240 PTH12060 PTH12010 PTR08100	PTH08T220 PTH12020 PTV12020	PTH08T210 PTH12030	PTH08T250 PTV08T250 PTV08040 PTH12040
5 V	DCH0105 DCP01/02 DCR01 DCV01 PTN04050	PTH04000 PTH04070	PTH04T260 PTH04000 PTH04070	PTH04T230 PTH05000	PTH04T230 PTH05050 PTV05010 PTR08060 PT6910 ♣	PTH04T240 PTH05060 PTH05010 PTR08100	PTH04T220 PTH05020 PTV05020	PTH05T210 PTH05030	PTH08T250 PTH04040
3.3 V		PTH04000 PTH04070	PTH04T260 PTH04000 PTH04070	PTH04T230 PTH03000 PT6910 ♣	PTH04T230 PTH03050 PTV03010 PT6910 ♣	PTH04T240 PTH03060 PTH03010	PTH04T220 PTH03020 PTV03020	PTH03030	PTH04040

♣ Special function; negative output

Isolated      Non-Isolated



## PTH Quad Data Rate (QDR)/Double Data Rate (DDR) Series Power Modules

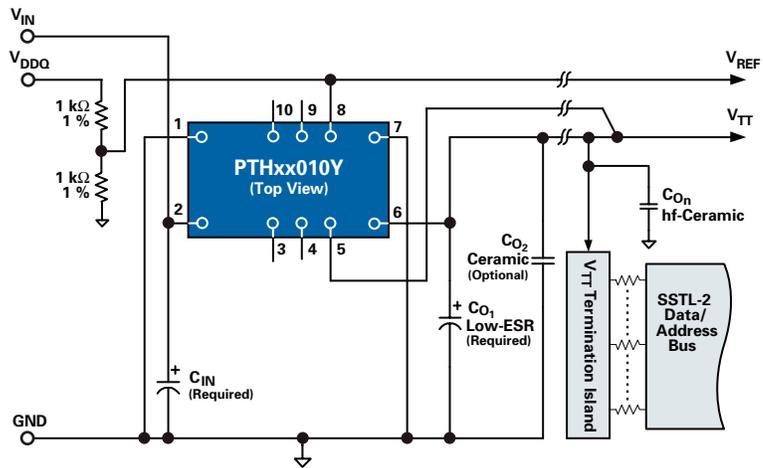
### PTHxx060Y

Get samples, datasheets and app reports at: [www.ti.com/sc/device/PARTnumber](http://www.ti.com/sc/device/PARTnumber)

(Replace **PARTnumber** with **PTH03060Y**, **PTH05060Y** or **PTH12060Y**)

#### Key Features

- Non-isolated DC/DC modules for double data rate (DDR) and quad data rate (QDR) 1 and 2 memory bus terminations
- Generates termination voltage ( $V_{TT}$ ) that will source or sink current to track an external reference voltage ( $V_{REF}$ )
- $V_{TT}$  tracks  $V_{DDQ}$  voltage with tolerance of  $\pm 40$  mV under transient conditions
- Supports  $V_{TT}$  range from 0.55 to 1.8 V
- 3.3-, 5- and 12-V input models
- Output currents up to 15 A
- POLA™ compatible



Standard application.

#### Selection Guide

Device <sup>1</sup>	Input Bus Voltage	Description	P <sub>OUT</sub> or I <sub>OUT</sub>	V <sub>O</sub> Range (V)	V <sub>O</sub> Adjustable	Auto-Track™ Sequencing	POLA™	DDR-QDR	Price*
<b>Non-Isolated Single Positive Output</b>									
PTH03000W	3.3 V	3.3-V Input 6-A POL	6 A	0.8 to 2.5	✓				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
PTH08T250W	5 V/12 V	4.5- to 14-V Input, 50-A T2 2nd Gen PTH POL with TurboTrans	50 A	0.7 to 3.6	✓	✓			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

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

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



## Selection Guide (Continued)

Device <sup>1</sup>	Input Bus Voltage	Description	P <sub>OUT</sub> or I <sub>OUT</sub>	V <sub>O</sub> Range (V)	V <sub>O</sub> Adjustable	Auto-Track™ Sequencing	POLAT™	DDR-QDR	Price*
<b>Non-Isolated Single Positive Output (Continued)</b>									
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 <sub>REF</sub>	✓		✓	✓	11.60
PTH03050Y	3.3 V	3.3-V Input 6-A DDR Terminating Module	6 A	Follows V <sub>REF</sub>	✓		✓	✓	6.90
PTH03060Y	3.3 V	3.3-V Input 10-A DDR Terminating Module	10 A	Follows V <sub>REF</sub>	✓		✓	✓	9.80
PTH05010Y	5 V	5-V Input 15-A DDR Terminating Module	15 A	Follows V <sub>REF</sub>	✓		✓	✓	11.60
PTH05050Y	5 V	5-V Input 6-A DDR Terminating Module	6 A	Follows V <sub>REF</sub>	✓		✓	✓	6.90
PTH05060Y	5 V	5-V Input 10-A DDR Terminating Module	10 A	Follows V <sub>REF</sub>	✓		✓	✓	9.80
PTH12010Y	12 V	12-V Input 12-A DDR Terminating Module	12 A	Follows V <sub>REF</sub>	✓		✓	✓	11.60
PTH12050Y	12 V	12-V Input 6-A DDR Terminating Module	6 A	Follows V <sub>REF</sub>	✓		✓	✓	6.90
PTH12060Y	12 V	12-V Input 8-A DDR Terminating Module	8 A	Follows V <sub>REF</sub>	✓		✓	✓	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 <sub>O</sub> + 2 to 36 V	Wide-Input, Wide-Output 1.5-A Positive Step-Down ISR	1.5 A	2.5 to 12/12 to 22	✓				8.00
PTN78060W/H	V <sub>O</sub> + 2 to 36 V	Wide-Input, Wide-Output 3-A Positive Step-Down ISR	3 A	2.5 to 12/12 to 22	✓				11.00
PTN78020W/H	V <sub>O</sub> + 2 to 36 V	Wide-Input, Wide-Output 6-A Positive Step-Down ISR	6 A	2.5 to 12/12 to 22	✓				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
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
<b>Non-Isolated Single Negative Output</b>									
PT6910	3.3 V/5 V	3.3-V/5-V Input 12-W Adjustable Plus to Minus Voltage Converter	12 W	-1.2 to -6.5	✓				26.25
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
<b>Isolated Single Output</b>									
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 with Auto-Track Control	200 W	8		✓			45.00
<b>Isolated Multiple Output</b>									
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 DC/DC Converter with Synchronization	1 W	±5, ±12, ±15					5.90
DCP02_D	5, 12, 24	2-W Unregulated Dual Isolated DC/DC Converter with Synchronization	2 W	±5, ±12, ±15					6.95
PTB48500A	48 V	30-W 48-V Input Isolated Dual DC/DC Converter	30 W	3.3/1.2	✓				43.00
PTB48501A/B	48 V	35-W 48-V Input Isolated Dual DC/DC Converter	35 W	3.3/1.2 or 1.5	✓				45.00
PTB48502A/B	48 V	40-W 48-V Input Isolated Dual DC/DC Converter	40 W	3.3/1.2 or 1.5	✓				49.00

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

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

## Linear and Low Dropout (LDO) Regulators



TI offers an extremely broad LDO portfolio covering applications from microampere keep-alive circuits to 7.5-A telecom loads. For a more comprehensive selection, please review pages 28–29 or visit [power.ti.com](http://power.ti.com) for our complete portfolio.

### Design Factors

**Input Voltage** — The minimum  $V_{IN}$  must be larger than  $V_{OUT} + V_{DO}$ , independent from the minimum value given in the selection table.

**Efficiency** — By neglecting the quiescent current ( $I_Q$ ) of the LDO, efficiency can be calculated as  $V_{OUT}/V_{IN}$ .

**Power Dissipation** —  $P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$ ;  $P_D$  is limited by package,  $T_A$  and  $T_{JMAX}$ . Refer to application note SLVA118, “Digital Designer’s Guide to Linear Voltage Regulators and Thermal Management,” for support. For

higher power dissipation or requirements for higher efficiency, TI recommends step-down (buck) DC/DC converters/controllers (refer to pages 30–38 for products).

**Capacitor Requirements** — The output capacitor and especially its effective series resistance (ESR) are critical for stability. Therefore, some LDOs require tantalum output capacitors, which have high ESR. If an LDO is stable with no output capacitor or with low-ESR ceramic output capacitors, it is usually stable with all types of capacitors.

**RF, Audio and Other Noise-Sensitive Applications** — Select an LDO with high power supply ripple rejection (PSRR) for noise immunity from the input supply, and low output noise ( $< 50 \mu\text{Vrms}$ ). Some LDOs have a bypass (BP) pin for adding capacitance to lower the output noise.

**PG/SVS** — Devices such as microprocessors, DSPs and FPGAs require a minimum voltage for proper operation. The supply voltage supervisor (SVS) function monitors the system voltages and outputs a signal when the voltages drop below a certain value, so the system can reset and prevent malfunction. An SVS asserts the reset signal after a specified delay, while a power-good (PG) function does not have a delay.

**Reverse Leakage Protection** — In special applications where the voltage on the output of the LDO is higher than at the input, the reverse leakage protection feature prevents current from flowing from the LDO output to the input, which can be damaging to the input supply, especially if it is a battery.

**Application-Specific Multi-Output Solutions** — See pages 39–41.

### High-Current LDO Family with Soft Start or Tracking

#### TPS74701

NEW

Get samples, datasheets, evaluation modules and app reports at: [www.ti.com/sc/device/TPS74701](http://www.ti.com/sc/device/TPS74701)

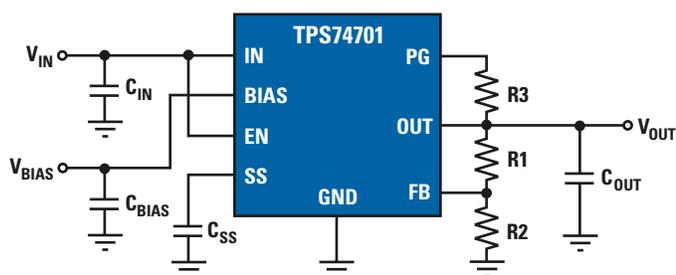
The TPS74xxx family of LDOs provides an easy-to-use, robust power management solution for a wide variety of applications. User-programmable soft start minimizes stress on the input power source by reducing capacitive inrush current on start up. The soft start is monotonic and well suited for powering many different types of processors and ASICs. The enable input and power good output allow easy sequencing with external regulators. This complete flexibility permits the user to configure a solution that meets the sequencing requirements of FPGAs, DSPs and other applications with special start-up requirements.

#### Key Features

- Output voltage: Adjustable from 0.8 V to 3.3 V
- Ultralow dropout from 50 mV to 120 mV
- Soft start or tracking
- 1 or 2% accuracy over load/temp/line
- 2.2- $\mu\text{F}$  or no output capacitor needed
- Packaging: Low-profile 3 x 3/5 x 5 QFN or 7-pin DDPACK
- $V_{BIAS}$  voltage allows >80% efficiency

#### Applications

- DSP/FPGA power supplies
- Post regulation
- Medical equipment



TPS74701 typical application.

#### Selection Guide

Device	Output Current	$V_{DO}$ (mV)	Accuracy (%)	Feature	$C_{OUT}$ ( $\mu\text{F}$ )
TPS747xx	500 mA	50	2	Soft Start	2.2
TPS748xx	1.5 A	60	2	Soft Start	2.2
TPS742xx	1.5 A	55	1	Soft Start	—
TPS743xx	1.5 A	55	1	Tracking	—
TPS749xx	3.0 A	120	2	Soft Start	2.2
TPS744xx	3.0 A	115	1	Soft Start	—

## Linear and Low Dropout (LDO) Regulators

### Low Dropout (LDO) Regulators Selection Guide

Device <sup>1</sup>	I <sub>O</sub> (mA)	V <sub>DO</sub> @ I <sub>O</sub> (mV)	I <sub>q</sub> (μA)	Output Options		Min V <sub>IN</sub>	Max V <sub>IN</sub>	Accuracy (%)	Package(s)								Q100 Qualified	Features <sup>2</sup>	C <sub>o</sub> <sup>3</sup>	Comments	Price*
				Fixed Voltage (V)	Adj. (V)				WCSOP	SC70	SOT23	MSOP	DFN/SON	S08	SOT23	PWP					
<b>Positive Voltage, Single Output Devices</b>																					
TPS797xx	10	105	1.2	1.8, 3.0, 3.3	—	1.8	5.5	4	✓							✓	PG	0.47 μF, C	MSP430; Lowest I <sub>q</sub>	0.34	
TPS715xx	50	415	3.2	2.5, 3.0, 3.3, 5.0	1.2 to 15	2.5	24	4	✓							✓	—	0.47 μF, C	Ultra-Low I <sub>q</sub>	0.34	
TPS715Axx	80	670	3.2	2.5, 3.0, 3.3, 5.0	1.2 to 15	2.5	24	4	✓							✓	—	0.47 μF, C	Ultra-Low I <sub>q</sub>	0.44	
TPS789xx	100	115	18	1.5, 1.8, 2.5, 2.8, 3.0	—	2.7	13.5	3		✓							/EN	4.7 μF, T	Low I <sub>q</sub> and High V <sub>IN</sub>	0.30	
TPS792xx	100	38	185	2.5, 2.8, 3	1.2 to 5.5	2.7	5.5	2		✓						✓	EN, BP	1 μF, C	RF Low Noise; High PSRR	0.40	
TPS769xx	100	70	18	1.2, 1.5, 1.8, 2.5, 2.7, 2.8, 3.0, 3.3, 5.0	1.2 to 5.5	2.7	10	3		✓						✓	/EN	4.7 μF, T	Low Cost	0.29	
LP2950	100	380	75	3.0, 3.3, 5.0	—	2.3	30	1									—	1 μF, C	Available in T092 and TO252	0.27	
LP2981	100	200	600	1.8, 2.5, 2.8, 3.0, 3.3, 5	1.3 to 9	2.2	16	1		✓							EN	3.3 μF, C	Fast Transient Response	0.36	
TPS717xx	150	170	50	0.9, 1.0, 1.2, 1.3, 1.5, 1.8, 1.9, 2.5, 2.6, 2.7, 2.8, 2.85, 3.0, 3.3, EEPROM <sup>4</sup>	0.9 to 6.2	2.5	6.5	1.5	✓			✓					EN, BP	1 μF, C	Ultra-High PSRR	0.45	
TPS731xx	150	30	400	1.5, 1.8, 2.5, 3.0, 3.3, 5.0, EEPROM <sup>4</sup>	1.2 to 5.5	1.7	5.5	1		✓							EN, BP	No Cap	Reverse Leakage Protection	0.45	
<b>TPS780xx</b>	150	200	0.5	3.3/2.2, EEPROM <sup>4</sup>	1.22 to 5.25	2.2	5.5	3		✓		✓					EN, VSET	1.0 μF, C	Dual-Level Output, Low I <sub>q</sub>	0.65	
<b>TPS781xx</b>	150	200	1.0	3.3/2.2, EEPROM <sup>4</sup>	1.22 to 5.25	2.2	5.5	3		✓		✓					EN, VSET	1.0 μF, C	Dual-Level Output, Low I <sub>q</sub>	0.60	
LP2985	150	280	850	1.8, 2.5, 2.8, 3.3, 5.0	—	2.2	16	1	✓								EN	3.3 μF, C	Fast Transient Response	0.36	
TPS730xx	200	120	180	1.8, 2.5, 2.8, 2.85, 3.0, 3.3, 4.7	—	2.7	5.5	2		✓							EN, BP	2.2 μF, C	Low Cost vs. TPS793xx	0.23	
<b>TPS728xx</b>	200	230	45	3.15/1.85, EEPROM <sup>4</sup>	—	2.7	6.5	3	✓			✓					EN, VSET	1.0 μF, C	Dual-Level Output (H/L)	0.39	
TPS799xx	200	100	40	1.2, 1.3, 1.5, 1.8, 1.85, 1.9, 1.95, 2.0, 2.1, 2.5, 2.6, 2.7, 2.8, 2.85, 3.0, 3.15, 3.2, 3.3, 4.2, EEPROM <sup>4</sup>	1.2 to 5.5	2.7	6.5	2	✓	✓		✓					EN, BP	2.2 μF, C	Low Power vs. TPS793xx	0.35	
<b>TPS734xx</b>	250	113	44	1.0, EEPROM <sup>4</sup>	1.0 to 6.5	2.7	6.5	2		✓		✓					EN	2.0 μF, C	High PSRR, Low Noise	0.35	
TPS794xx	250	145	172	1.8, 2.5, 2.8, 3.0, 3.3	1.2 to 5.5	2.7	5.5	3		✓		✓					EN, BP	2.2 μF, C	RF Low Noise, High PSRR	0.65	
TPS732xx	250	40	400	1.5, 1.8, 2.5, 3.0, 3.3, 5.0, EEPROM <sup>4</sup>	1.2 to 5.5	1.7	5.5	1		✓		✓	✓			✓	EN, BP	No Cap	Reverse Leakage Protection	0.65	
TPS773xx	250	125	90	1.5, 1.6, 1.8, 2.7, 2.8, 3.3, 5.0	1.5 to 5.5	2.7	10	2			✓						/EN, SVS	10 μF, T	Low Noise	0.70	
<b>TPS720xx</b>	350	100	29	1.3, 1.5, 1.8, EEPROM <sup>4</sup>	—	1.1	4.5	2	✓								EN	2.2 μF, C	High PSRR	0.48	
TPS736xx	400	75	300	1.25, 1.5, 1.8, 2.5, 3.0, 3.3, EEPROM <sup>4</sup>	1.2 to 5.5	1.7	5.5	1		✓		✓	✓				EN, BP	No Cap	Reverse Leakage Protection	0.95	
<b>TPS747xx</b>	500	50	1 mA	EEPROM <sup>4</sup>	0.8 to 3.6	0.8	5.5	2									EN, SS, PG	2.2 μF, C	Low V <sub>OUT</sub> , Low Dropout	1.10	
<b>TPS735xx</b>	500	113	46	EEPROM <sup>4</sup>	1.0 to 6.5	2.7	6.5	2				✓					EN	2.0 μF, C	High PSRR, Low Noise	0.75	
TPS795xx	500	105	265	1.6, 1.8, 2.5, 3.0, 3.3	1.2 to 5.5	2.7	5.5	2					✓				EN, BP	1 μF, C	RF Low Noise, High PSRR	1.05	
TPS775xx	500	169	87	1.5, 1.6, 1.8, 2.5, 3.3	1.5 to 5.5	2.7	10	2				✓	✓			✓	/EN, SVS	10 μF, T	Fast Transient Response	0.95	
TPS776xx	500	169	87	1.5, 1.8, 2.5, 2.8, 3.3	1.2 to 5.5	2.7	10	2				✓	✓			✓	/EN, PG	10 μF, T	Fast Transient Response	0.70	
TL5209	500	500	100	1.8, 2.5, 3.0, 3.3, 5.0	1.25 to 16	2.5	16	1				✓	✓				EN	1 μF, T	Low Noise	0.85	
TPS777xx	750	260	85	1.5, 1.8, 2.5, 3.3	1.5 to 5.5	2.7	10	2				✓	✓				/EN, SVS	10 μF, T	Fast Transient Response	1.05	
TPS737xx	1000	200	300	1.8, 2.5, 3.3, EEPROM <sup>4</sup>	1.2 to 5.5	2.0	5.5	2				✓	✓				EN	1 μF, C	Low Cost	0.60	
TPS725xx	1000	170	75	1.5, 1.6, 1.8, 2.5	1.2 to 5.5	1.8	6	2				✓	✓			✓	EN, SVS	No Cap	Low Noise; SVS Delay 50 ms	1.10	
TPS796xx	1000	200	310	1.8, 2.5, 2.8, 3.0, 3.3	1.2 to 5.5	2.7	5.5	2				✓	✓				EN, BP	1 μF, C	RF Low Noise, High PSRR	1.10	
TPS767xx	1000	230	85	1.5, 1.8, 2.5, 2.7, 2.8, 3.0, 3.3, 5.0	1.5 to 5.5	2.7	10	2				✓	✓			✓	/EN, SVS	10 μF, T	Fast Transient Response	1.10	
TPS768xx	1000	230	80	1.5, 1.8, 2.5, 2.7, 2.8, 3.0, 3.3, 5.0	1.2 to 5.5	2.7	10	2				✓	✓			✓	/EN, PG	10 μF, T	Fast Transient Response	0.90	
TPS742xx	1500	55	2 mA	EEPROM <sup>4</sup>	0.8 to 3.3	0.9	5.25	1				✓	✓				EN, SS, PG	No Cap	Low V <sub>OUT</sub> , High Accuracy	2.25	
TPS743xx	1500	55	2 mA	EEPROM <sup>4</sup>	0.8 to 3.3	0.9	5.25	1				✓	✓				EN, TR, PG	No Cap	Low V <sub>OUT</sub> , High Accuracy	2.25	
TPS748xx	1500	60	1 mA	—	0.8 to 3.3	0.8	3.3	2				✓					EN, SS, PG	2.2 μF, C	Low V <sub>OUT</sub>	1.25	
TPS786xx	1500	390	310	1.8, 2.5, 2.8, 3.0, 3.3	1.2 to 5.5	2.7	5.5	2					✓				EN, BP	1 μF, C	RF Low Noise, High PSRR	1.35	
TL1963A	1500	341	1 mA	1.5, 1.8, 2.5, 3.3	1.21 to 21	2.22	20	1				✓	✓				/EN	10 μF, C	Fast Transient Response	2.05	
TPS752xx	2000	210	75	1.5, 1.8, 2.5, 3.3	1.5 to 5.0	2.7	5	2					✓			✓	/EN, SVS	47 μF, T	Fast Transient Response	1.80	
TPS744xx	3000	115	2 mA	EEPROM <sup>4</sup>	0.8 to 3.3	0.9	5.25	1				✓	✓				EN, SS, PG	No Cap	Low V <sub>OUT</sub> , High Accuracy	2.95	
TPS749xx	3000	120	1 mA	—	0.8 to 3.3	0.8	3.3	2				✓					EN, SS, PG	2.2 μF, C	Low V <sub>OUT</sub>	2.50	
TPS51100	3000	1250	3	½ VDDQSNS	—	4.75	5.25	1.6			✓						EN	20 μF, C	DDR/DDR2 V <sub>H</sub> Power	0.80	
TPS758xx	3000	150	110	1.5, 1.8, 2.5, 3.3	1.2 to 5.0	2.8	5.5	3						✓	✓		EN	47 μF, T	Fast Transient Response	2.70	
UC385-x	5000	350	8 mA	1.5, 2.1, 2.5	1.2 to 6.0	1.7	7.5	1						✓	✓		—	100 μF, T	Fast LDO with Reverse Leak.	3.15	
TPS756xx	5000	250	110	1.5, 1.8, 2.5, 3.3	1.2 to 5.0	2.8	5.5	3						✓	✓		EN	47 μF, T	Fast Transient Response	3.00	
TPS759xx	7500	400	110	1.5, 1.8, 2.5, 3.3	1.2 to 5.0	2.8	5.5	3						✓	✓		/EN, PG	47 μF, T	Fast Transient Response	3.20	
<b>Negative Voltage, Single Output Devices</b>																					
TPS723xx	200	280	130	-2.5	-1.2 to -9	-10	-2.7	2		✓							EN, BP	2.2 μF, C	Low Noise, High PSRR	1.05	
UCC384-x	500	150	200	-12.0, -5.0	-1.25 to -15	-15	-3.5	3				✓					/EN	4.7 μF, T	Duty Cycled Short	1.86	

<sup>1</sup>xx represents the voltage option. For example, 33 represents the 3.3-V option. The adjustable output voltage option is represented by 01.

<sup>2</sup>BP = bypass pin for noise reduction capacitor, EN = active high enable, /EN = active low enable, PG = Power Good, SS = soft-start pin, SVS = supply voltage supervisor, TR = tracking, VSET = dual-level output voltage select pin (H/L).

<sup>3</sup>C = ceramic, T = tantalum, No Cap = capacitor-free LDO.

<sup>4</sup>EEPROM programmable at the factory, allowing production of custom fixed voltages. Minimum quantities apply. Please contact TI.

\*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.

Linear and Low Dropout (LDO) Regulators



Dual Output LDOs Selection Guide

Device	I <sub>O1</sub> (mA)	I <sub>O2</sub> (mA)	V <sub>D01</sub> @ I <sub>O1</sub> (mV)	V <sub>D02</sub> @ I <sub>O2</sub> (mV)	I <sub>q</sub> (µA)	Output Options		Accuracy (%)	Package(s)	V <sub>O</sub>		Features							Comments	Price*		
						Fixed Voltage (V)	Adj.			(min)	(max)	Enable	PG	SVS	Seq	Low Noise	V <sub>IN</sub>				C <sub>O</sub> <sup>1</sup>	
																	(V)	(V)				(min)
<b>TPS719xx</b>	200	200	230	230	100	See Notes 2 & 3		3	QFN/WCSP	0.9	3.6	EN					✓	2.5	6.5	1.0 µF	TPS718xx w/ Active Output Pulldown	0.70
<b>TPS718xx</b>	200	200	230	230	100	See Notes 3 & 4		3	QFN/WCSP	0.9	3.6	EN					✓	2.5	6.5	1.0 µF	High PSRR, Low V <sub>OUT</sub>	0.70
TPS712xx	250	250	145	145	400	See Note 5	✓	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 <sup>6</sup>	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 <sup>6</sup>	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 <sup>6</sup>	2.35
TPPM011Q/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

<sup>1</sup>C = ceramic, T = tantalum.

<sup>2</sup>1.2/1.8, 1.3/2.8, 1.5/2.6, 2.8/2.8, 2.8/3.3, 3.3/3.3.

<sup>3</sup>EEPROM programmable at the factory, allowing production of custom fixed voltages. Minimum quantities apply. Please contact TI.

<sup>4</sup>1.2/3.3, 1.8/2.7, 2.8/2.8, 2.8/3.0.

<sup>5</sup>1.8/2.85, 1.8/Adj., 2.8/2.8, 2.8/Adj., 2.85/2.85.

<sup>6</sup>For independent enables instead of integrated sequencing.

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

New devices are listed in bold red.

Standard Linear Voltage Regulators Selection Guide

Device	V <sub>OUT</sub> (nom) (V)	V <sub>OUT</sub> /V <sub>REF</sub> Tol. Over Temp. (%)	I <sub>OUT</sub> (max) (mA)	Min I <sub>OUT</sub> for Regulation (mA)	I <sub>q</sub> (max) (mA)	V <sub>DO</sub> (typ) (V)	V <sub>DO</sub> (max) (V)	V <sub>IN</sub> (max) (V)	V <sub>IN</sub> - V <sub>OUT</sub> (max) (V)	Price*
LM237, LM337	Adj. (-1.2 to -37)	4	1500	1.2, 1.5	—	—	3	—	-40	0.29
LM317, LM317M	Adj. (1.2 to 37)	4	1500, 500	3.5	—	—	3	—	40	0.27
MC79Lxx/A	-5, -12, -15	5, 10	100	—	6 to 6.5	1.7	2 to 2.5	-20, -27, -30	—	0.13
TL317	Adj. (1.2 to 35)	4	100	1.5	—	—	2.5	—	35	0.13
TL780-xx	5, 12, 15	2	1500	—	8	2	2 to 2.5	25, 30, 30	—	0.32
TL783	Adj. (1.25 to 125)	6	700	15	—	—	20	—	125	1.15
UA723	Adj. (2 to 37)	5 (25°C)	150	—	4	—	3	—	38	0.29
UA78Lxx/A	2.6, 5, 6.2, 8, 9, 10, 12, 15	5, 10	100	—	6 to 6.5	1.7	2 to 2.5	20 to 30	—	0.11
UA78Mxx	3.3, 5, 6, 8, 9, 12	5	500	—	6	2	2 to 2.5	25 to 30	—	0.25
UA78xx	5, 8, 10, 12, 15, 24	5	1500	—	8	2	2 to 3	25 to 38	—	0.23
UA79xx	-5, -8, -12, -15	5	1500	—	2	1.1	2 to 2.5	-25 to 30	—	0.25
UA79Mxx	-5, -8	5	500	—	2	1.1	2 to 2.5	-25	—	0.25

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

LDOs for MSP430 Microcontrollers Selection Guide

Device	I <sub>OUT</sub> (mA)	I <sub>q</sub> (µA)	V <sub>IN</sub> (V)	Package(s)	Comments
<b>Low V<sub>IN</sub></b>					
TPS797xx	10	1.2	1.8 to 5.5	SC70	PG Output
TPS780/1xx	150	0.5/1.0	2.2 to 5.5	TSOT23, 2x2 SON-6	EN, VSET <sup>1</sup>
<b>High V<sub>IN</sub></b>					
TPS715(A)xx	50 (80)	3.2	2.5 to 24	SC70 (SON)	—

<sup>1</sup>V<sub>SET</sub> is the ability to toggle between two output voltages H/L on the V<sub>SET</sub> pin.

For a complete list of Resources, visit: [power.ti.com](http://power.ti.com)

## → DC/DC Controllers (External Switch)

### Design Factors

**Input Voltage** — More than one voltage may be available on the circuit board. One voltage can operate the controller IC, while another voltage can be used in the power conversion section. Choose the most suitable voltage that can handle the current needed by the system.

**Output Voltage** — The output voltage can be adjusted down to the controller reference voltage by using a voltage divider.

**Output Current** — Output current is ultimately set by external power MOSFETs. The drive current and output current values given in the table are guidelines only! They assume no

paralleling of multiple MOSFETs, and characteristics of common MOSFETs generally available in the market. Paralleling multiple power MOSFETs can control higher currents, as long as the MOSFET drivers can adequately drive the external FETs.

**Efficiency** — Higher efficiency will help with thermal issues, since wasted power is converted into heat. Higher currents quickly generate more heat, so airflow and board space (and their cost) must be considered.

**Switching Frequency** — Higher switching frequency provides lower ripple but also lowers efficiency as the MOSFET transitions its active region more often. EMI issues may also be more complicated at higher frequency.

**Accuracy** — Today's advanced processors need better accuracy to support lower core voltages. There is a cost tradeoff when a more accurate controller is needed.

**Pre-biased Operation** — Voltages present on the outputs of the controller when it turns on may prevent start-up and/or cause other complications. Controllers designed for pre-biased operation can tolerate a pre-biased condition and safely start up.

**Protection Features** — Applications that use many expensive processors and peripheral ICs on a single board can benefit from the long-term reliability ensured by implementing the controller's protection features.

### Selection Guide

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

Device	Mode of Control <sup>1</sup>	V <sub>IN</sub> (min/max) (V)	V <sub>O</sub> (min/max) (V)	Driver Current (A)	Output Current (A) <sup>2</sup>	Frequency (kHz)	V <sub>REF</sub> Tol (%)	Internal Bootstrap	Package(s)	Pwr Good	Source & Sink <sup>3</sup>	Pre-biased Operation	Ext Synch Pin	Predictive Gate Drive™	DDR <sup>4</sup>	Remote Sense	Price*
<b>General-Purpose DC/DC Voltage Mode Buck Controllers (All devices in this family except the TPS40200 are synchronous.)</b>																	
TPS40000/2	V	2.25/5.5	0.7/4	1	15	300/600	1	Yes	10 MSOP	No	No	Yes	No	Yes	No	No	0.99
TPS40007/9	V	2.25/5.5	0.7/4	1	15	300/600	1	Yes	10 MSOP	No	Yes <sup>11</sup>	Yes	No	Yes	No	No	1.20
TPS40020/21	V	2.25/5.5	0.7/4	2	25	Adj. to 1000	1	Yes <sup>10</sup>	16 HTSSOP	Yes	21 <sup>11</sup>	20	Yes	Yes	No	No	1.45
TPS40040	V	2.25/5.5	0.6/4.95	1	15	300	1	Yes	8 SON	No	Yes <sup>11</sup>	Yes	No	No	No	No	0.90
TPS40041	V	2.25/5.5	0.6/4.88	1	15	600	1	Yes	8 SON	No	Yes <sup>11</sup>	Yes	No	No	No	No	0.90
<b>TPS40042</b>	V	3/5.5	0.7/4.95	1.2	15	600	Ext	Yes	10 SON	No	Yes <sup>11</sup>	Yes	No	No	Yes	No	0.90
TPS40054/55/57	VFF	8/40	0.7/35	1	20	Adj. to 1000	1	Yes	16 PwrPAD	No	55, 57 <sup>11</sup>	57	Yes	No	No	No	1.65
TPS40056	V	10/40	0.7/35	1	20	Adj. to 1000	Ext	Yes	16 PwrPAD	No	Yes	No	Yes	No	Yes	No	1.65
TPS40060/61 <sup>5</sup>	VFF	10/55	0.7/45	1	10	Adj. to 1000	1	No <sup>5</sup>	16 PwrPAD	No	61	No	Yes	No	No	No	1.85
TPS40075	VFF	4.5/28	0.7/23	1	20	Adj. to 1000	1	Yes	20 QFN	Yes	Yes <sup>11</sup>	Yes	Yes	Yes	No	Yes	1.80
TPS40077	VFF	4.5/28	0.7/23	1	20	Adj. to 1000	1	Yes	16 PwrPAD	Yes	Yes <sup>11</sup>	Yes	No	Yes	No	No	1.60
TPS40100 <sup>6</sup>	C	4.5/18	0.7/5.5	1.3	20	600	1	No	24 QFN	Yes	Yes <sup>11</sup>	Yes	Yes	No	No	Yes	1.95
TPS40101 <sup>6</sup>	V	4.5/18	0.7/5.5	1.3	20	1000	1	No	24 QFN	Yes	Yes <sup>11</sup>	Yes	Yes	No	No	Yes	1.95
TPS40190	V	4.5/15	0.59/12.75	1.2	20	300	1	Yes	10 SON	No	Yes <sup>11</sup>	Yes	No	No	No	No	1.00
<b>TPS40192/3</b>	V	4.5/18	0.59/14.4	1.2	15/20	600/300	0.5	Yes	10 SON	Yes	Yes <sup>11</sup>	Yes	No	No	No	No	1.05
<b>TPS40195<sup>7</sup></b>	V	4.5/20	0.59/17	1.2	20	Adj. to 600	0.5	Yes	16 TSSOP, 16 QFN	Yes	Yes <sup>11</sup>	Yes	Yes <sup>7</sup>	No	No	No	1.50
TPS40200 <sup>8</sup>	VFF	4.5/52	0.7/46	0.2	3	Adj. to 500	1	No <sup>5</sup>	8 SOIC	No	No	No	Yes	No	No	No	0.75
TPS5124 <sup>9</sup> (dual output)	V	4.5/15	0.9/12	2	20	Adj. to 500	1	Yes	30 TSSOP	No	Yes	No	No	No	No	No	2.15

<sup>1</sup>V = voltage-mode control, VFF = voltage mode with voltage feed-forward compensation, and C = Current-feedback control.

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

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

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

<sup>5</sup>Drives high-side P-FET.

<sup>6</sup>Provides advanced startup sequencing and output voltage margining.

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

<sup>8</sup>Nonsynchronous, drives P-FETs.

<sup>9</sup>180° out of phase, dual outputs, overvoltage protection.

<sup>10</sup>Integrated voltage-doubler charge pump for higher drive voltage.

<sup>11</sup>During soft start: source only.

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

New devices are listed in bold red.

## DC/DC Controllers (External Switch)



### Selection Guide (Continued)

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

Device	Switched Outputs	Phases	V <sub>IN</sub> (min/max) (V)	V <sub>O</sub> (min/max) (V)	Driver Current (A)	Output Current (A) <sup>1</sup>	Frequency (kHz)	V <sub>REF</sub> Tol (%)	Package(s)	Pwr Good	Over-voltage Protection	Source & Sink <sup>2</sup>	Pre-biased Operation	Ext Synch Pin	Remote Sense	Price*
<b>Multiphase Synchronous DC/DC Buck Controllers</b>																
TPS40090 <sup>9</sup>	1	2 to 4	4.5/15	0.7/3.3	Var	30/phase	Adj. to 1000	1	24 TSSOP, 28 QFN	Yes	Yes	Yes	No	Yes	Yes	1.90
TPS40091 <sup>10</sup>	1	2 to 4	4.5/15	0.7/3.3	Var	30/phase	Adj. to 1000	1	24 TSSOP, 28 QFN	Yes	Yes	Yes	No	Yes	Yes	1.90
<b>TPS40131</b>	1	2	1/40	0.7/5.8	1	50	Adj. to 1000	1	32 QFN	Yes	Yes	Yes	Yes	Yes	Yes	2.70
<b>TPS40132</b>	1	2	1/40	0.6/5.8	1	50	Adj. to 1000	0.8	32 QFN	Yes	Yes	Yes	Yes	Yes	Yes	2.95
TPS40140 <sup>11</sup>	1 or 2	1 or 2	2/40	0.7/5.8	1.2	25/phase	Adj. to 1000	0.5	36 QFN	Yes	Yes	Yes	Yes	Yes	Yes	3.05
TPS40180 <sup>12</sup>	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
<b>TPS51727<sup>13</sup></b>	1	1 or 2	4.5/28	0.4/1.25	2.7	25/phase	Up to 500	1.5	40 QFN	Yes	Yes	Yes	No	No	No	1.80

### Support Devices

TPS40120	6-bit digitally programmed feedback divider with VRM 10.x VID code table								14 TSSOP		0.49
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Device	Switched Outputs	LDO Outputs	Phases	V <sub>IN</sub> (min/max) (V)	V <sub>O</sub> (min/max) (V)	Driver Current (A)	Output Current (A) <sup>1</sup>	Frequency (kHz)	V <sub>REF</sub> Tol (%)	Control Method	Internal Bootstrap Diode	Package(s)	Over-voltage Protection	Pwr Good	DDR <sup>3</sup>	Price*
<b>DC/DC Synchronous Buck Controllers with Light-Load Efficiency</b>																
TPS51020	2	1	2	4.5/28	0.85/5.5	2	20	270, 360, 450	1	Voltage	Yes	30 TSSOP	Yes	Yes	Yes	2.40
TPS5110	1	1	1	4.5/28	0.9/3.5	1.5	15	Up to 500	1	PWM	No	24 TSSOP	Yes	Yes	No	2.50
TPS51116 <sup>14</sup>	1	1	1	3/28	1.5/3.0	0.8	10	Up to 400	1	Current, D-CAP	No	20 PwrPAD, 24 QFN	Yes	Yes	Yes	1.80
TPS51117 <sup>14</sup>	1	0	1	1.8/28	0.75/5.5	3	10	Up to 550	1	D-CAP	Yes	14 TSSOP, 14 QFN	Yes	Yes	No	1.20
TPS51120	2	2	2	4.5/28	2/5.5	3	20	270, 330, 430, 580	1	Current, D-CAP	No	32 QFN	Yes	Yes	No	2.50
TPS51124 <sup>14</sup>	2	0	2	3/28	0.76/5.5	3	10	300, 360, 420	1	D-CAP	No	24 QFN	Yes	Yes	No	2.10
<b>TPS51125</b>	2	2	1	5.5/28	2/5.5	0.8/1.0	20	325	1	D-CAP	No	24 QFN	Yes	Yes	No	2.15
<b>TPS51220</b>	2	2	2	4.5/28	1/12	1.5	25	Adj. to 1000	1	Current, D-CAP	Yes	32 QFN	Yes	Yes	No	2.60
TPS5130	3	1	2	4.5/28	0.9/5.5	1.5	15	Up to 500	1.5	PWM	No	48 QFP	Yes	Yes	No	2.85
TPS51511 <sup>14</sup>	1	1	1	3/28	0.75/3.3	0.8	10	Up to 550	1	Current, D-CAP	Yes	20 QFN	Yes	Yes	No	1.90

Device	Ext Synch	Switched Outputs	LDO Outputs	V <sub>IN</sub> (min/max) (V)	V <sub>O</sub> (min/max) (V)	Driver Current (A)	Output Current (A) <sup>1</sup>	Frequency (kHz)	V <sub>REF</sub> Tol (%)	Control Method	Internal Bootstrap Diode	Package(s)	Pwr Good	DDR <sup>3</sup>	Remote Sense	Price*
<b>Other Topology DC/DC Controllers</b>																
<b>TPS40210/1<sup>15</sup></b>	No	1	0	4.5/52	5/250	0.8	6	Adj. to 1000	2	Current	No	10 PwrPAD/SON	No	No	No	1.10
TPS43000 <sup>16</sup>	Yes	1	0	1.8/9	0.8/8	1.2	6	Adj. to 2000	2	Voltage	No	16 TSSOP	No	No	No	2.25
<b>TPS51100</b>	No	0	1	4.75/5.25	0.6/1.7	—	3	—	Ext	LDO	No	10 PwrPAD	No	Yes	Yes	0.80
<b>TPS51200</b>	No	0	1	0.3/3.6	0.3/3.6	—	2	—	Ext	LDO	No	10 SON	Yes	Yes	Yes	0.90
TPS64200/1/2/3 <sup>17</sup>	No	1	0	1.8/6.5	1.2/6.5	—	3	—	2	Hyster	No	23 SOT	No	No	No	0.55
UC3572	Flyback	1	0	4.75/30	0/-48	0.5	5	300	2	Voltage	No	8 DIL/SOIC	No	No	No	1.05

### DC/DC Controllers Without Drivers

TL1451A	Buck, boost, flyback	2	0	3.6/50	2.5/50	0.02	3	Adj. to 500	4	Var	No	16 PDIP/SOIC/SO/SSOP/TSSOP	No	No	No	0.95
TL5001	Buck, boost, flyback	1	0	3.6/40	1/50	0.02	3	Adj. to 500	3	Var	No	8 PDIP/SO/SOIC	No	No	No	0.45

<sup>1</sup>Current levels of this magnitude can be supported with commonly available commercial FETs.

<sup>2</sup>The controller of choice for most applications will be the source/sink version, which has two-quadrant operation and will source or sink output current.

<sup>3</sup>DDR = Supports DDR memory.

<sup>4</sup>Drives high-side P-FET.

<sup>5</sup>Provides startup sequencing.

<sup>6</sup>Available 180° out-of-phase synchronization.

<sup>7</sup>Nonsynchronous, drives P-FETs.

<sup>8</sup>180° out of phase, dual outputs, overvoltage protection.

<sup>9</sup>Binary outputs.

<sup>10</sup>Tri-state outputs.

<sup>11</sup>Stackable to 16 phases.

<sup>12</sup>Stackable to 8 phases, reference is trimmable.

<sup>13</sup>D-CAP mode control, internal boot-strap diode.

<sup>14</sup>5-V bias required.

<sup>15</sup>Overvoltage protection, source only.

<sup>16</sup>External synch pin.

<sup>17</sup>Drives high-side P-FET.

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

New devices are listed in bold red.

## → DC/DC Converters (Integrated Switch)

### Design Factors

**Efficiency and Solution Size** — Use of inductive switching converters with integrated switches is recommended when highest conversion efficiency and smallest solution size are desired.

TI's family of low-power DC/DC converters (TPS6xxx) and SWIFT™ (TPS54xxx) point-of-load step-down DC/DC converters achieve 97% peak efficiencies. Synchronous rectification not only replaces the cost of an external Schottky rectifier diode but also increases the converter efficiency by up to 10%. Higher efficiency will directly translate into additional operating time in battery-powered applications and smaller power dissipation in high-current applications, easing thermal design.

Integrating the high- and low-side switching FETs reduces board space, as only resistors and capacitors along with one inductor are required externally for operation. Depending on the output current, DC/DC converters

come in packages such as CSP (1200 mA), SOT-23 (600 mA), QFN-10 (1.2 A) and TSSOP-28 (14 A), further reducing solution size.

**Output Current** — Output current is typically limited by the size of the integrated FETs and is rated for the minimum input voltage (end-of-discharge voltage in battery systems) for the TPS6xxx series. The TPS54xxx output current denotes the continuously available output current; higher peak-currents are achievable to ensure proper supply at start-up of high-performance DSP, FPGA and ASIC systems. For boost converters, the datasheet specifies the current limit of the built-in switches. A rough estimate of the output current can be obtained using the formula:

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

For output currents below 300 mA and efficiencies under 90%, inductorless charge-pump DC/DC regulators can be a cost and space-efficient alternative (see pages 37–38).

**Input Voltage** — DC/DC converters can operate from a wide range of input sources: power modules, wall supplies or batteries. The TPS6xxx series with its small packaging and quiescent current is optimized for low-power, battery-operated applications. For battery-powered systems the input voltage changes over a wide range while the battery is being discharged. For this reason converter selection depends on the given battery technology and number of cells.

**Output Voltage** — Lower voltages are required for today's advanced DSPs, FPGAs and ASICs. To allow maximum flexibility, both fixed and adjustable output voltages down to 0.7 V are available.

## Dual-Output, 4.5-V to 28-V Input, 3-A Step-Down Converter

TPS54386

NEW

Get samples, datasheets and evaluation modules at: [www.ti.com/sc/device/TPS54386](http://www.ti.com/sc/device/TPS54386)

The TPS54386 is a dual-output, nonsynchronous step-down converter capable of supporting two 3-A outputs for applications that require voltages as low as 0.8 V. The operating frequency, soft-start time and control-loop compensation are internally determined, allowing the converter to provide many features with a minimum of external components to save board space and cost. A pin-compatible 2-A version, TPS54286, is also available.

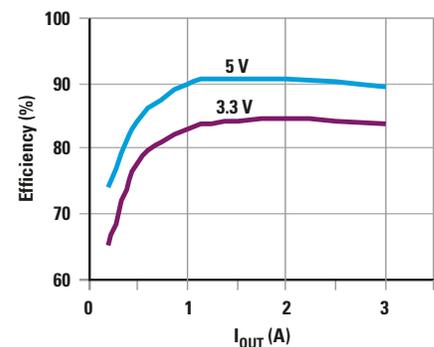
- Selectable current-limit settings for output #2
- Separate enable pins for each output
- Packaging: 14-pin HTSSOP

### Applications

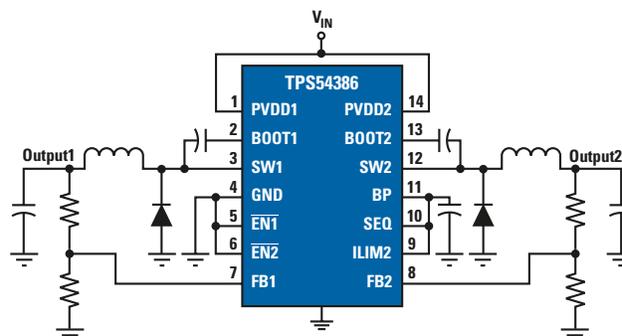
- Set-top box
- Digital TV
- Cable modem
- Portable DVD player
- DSP core and I/O

### Key Features

- 4.5-V to 28-V input voltage range
- Adjustable output voltages down to 0.8 V
- Two 85-mΩ, N-channel high-side MOSFETs
- Output #1 is 180° out of phase with output #2
- Built-in sequencing pin
- 300-kHz (TPS54383) or 600-kHz (TPS54386) options



TPS54386 efficiency (600 kHz at V<sub>IN</sub> = 12 V).

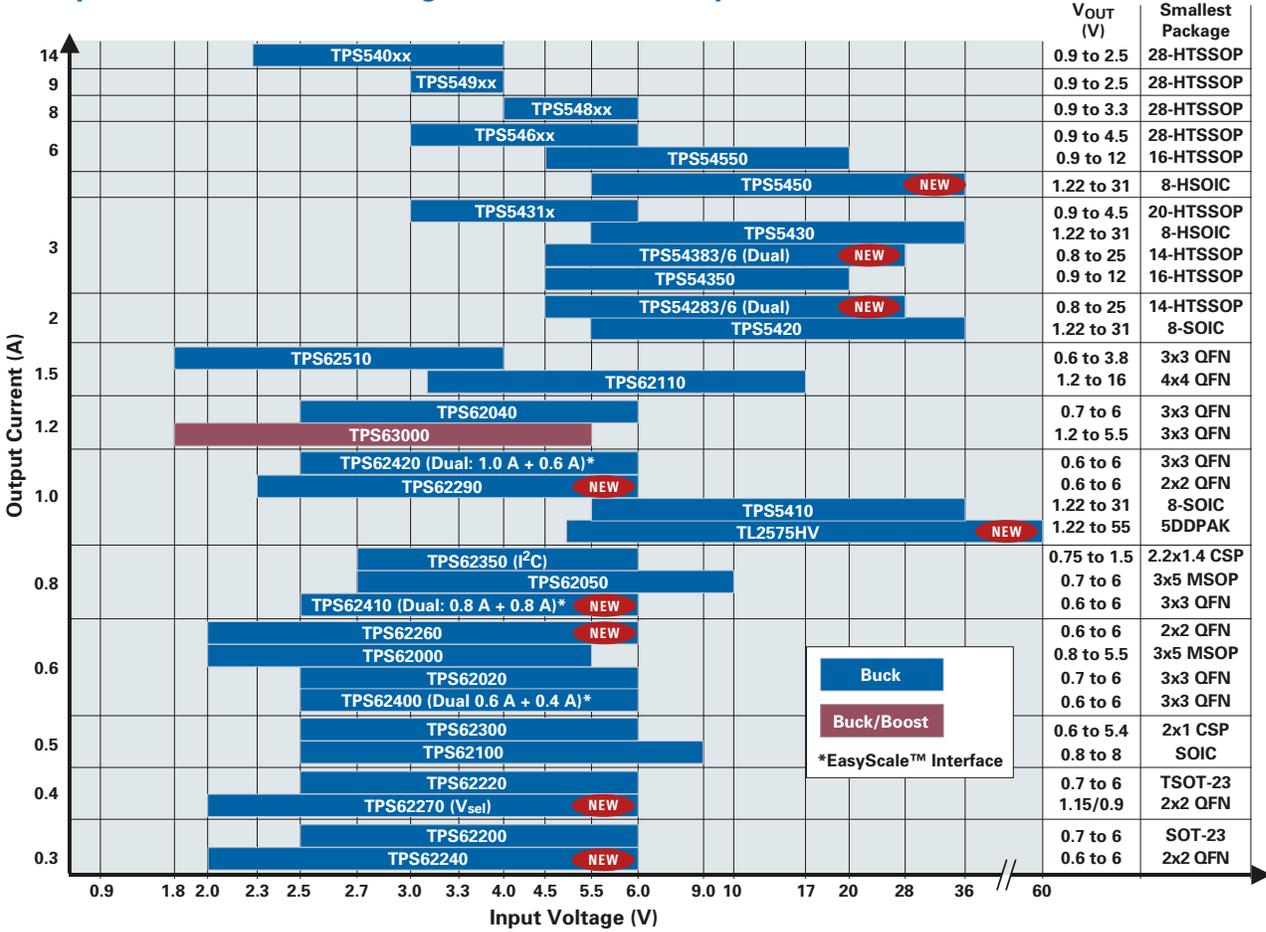


TPS54386 typical application.

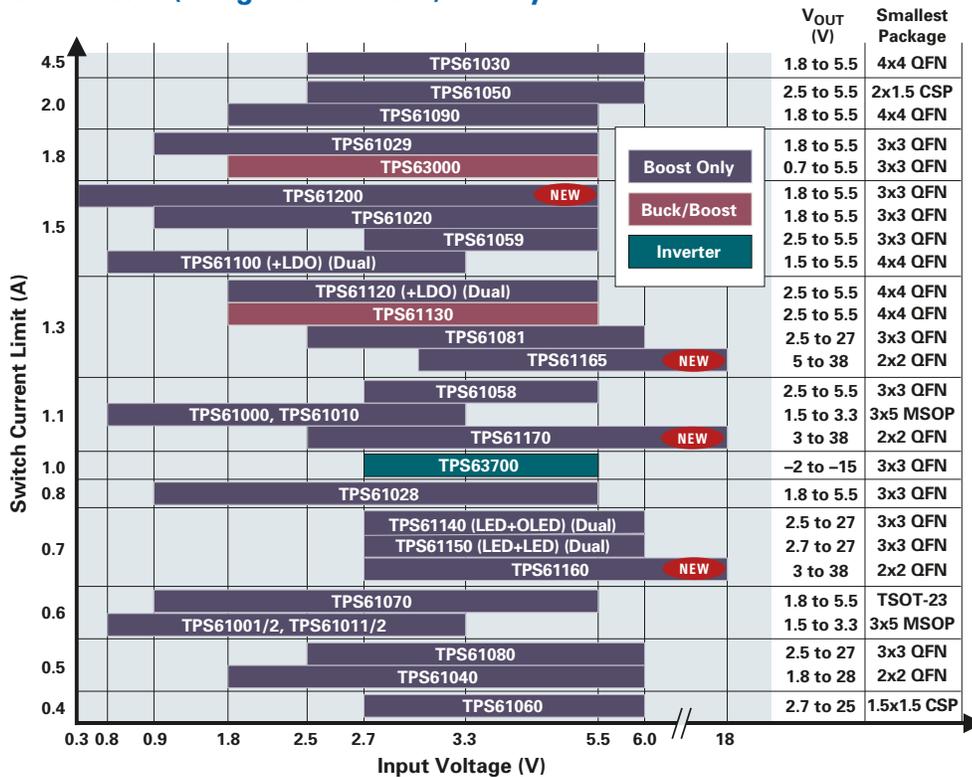
## DC/DC Converters (Integrated Switch)



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



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



## → DC/DC Converters (Integrated Switch)

### Selection Guide

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	Minimum V <sub>OUT</sub> (V)	Fixed V <sub>OUT</sub> Options (V)	Maximum Duty Cycle (%)	Switching Frequency (kHz)	Features							Applications					EVM	Package(s)	Price*
							Power Good Pin	Sync Pin	180° Out-of-Phase Switching	Adj. Soft Start	Current Limit and Thermal Shutdown	Synchronous Buck	Nonsynchronous Buck	Sequencing	Prebias Operation	Active Bus Termination (DDR)	Q100 Automotive <sup>1</sup>	Military Enhanced <sup>1</sup>			
<b>SWIFT™ Step-Down (Buck) Regulators</b>																					
TPS5410	1000	5.5 to 36	1.23	—	87	500					✓	✓					✓	8 SOIC	1.60		
TL2575	1000	4.75 to 40	1.23	3.3, 5, 12, 15	93	52					✓	✓						5 TO263/220, PDIP	1.31		
TL2575HV	1000	4.75 to 60	1.23	3.3, 5, 12, 15	93	52					✓	✓						5 TO263/220, PDIP	1.98		
TPS54110	1500	3.0 to 6.0	0.9	—	90	280 to 700	✓	✓	✓	✓	✓						✓	20 HTSSOP	1.90		
TPS40222	1600	4.5 to 8.0	0.8	—	90	1250					✓	✓					✓	6 SON	0.70		
TPS5420	2000	5.5 to 36	1.23	—	87	500					✓	✓					✓	8 SOIC	1.70		
<b>TPS54283/6 (dual)</b>	2000 each	4.5 to 28	0.8	—	90/85	300/600			✓		✓	✓	✓					14 HTSSOP	2.40		
TPS5430	3000	5.5 to 36	1.23	—	87	500					✓	✓					✓	8 HSOIC	1.85		
TPS54350/2/3/4/5/6/7	3000	4.5 to 20	0.9	1.2, 1.5, 1.8, 2.5, 3.3, 5	80	250 to 700	✓	✓	✓		✓	✓					✓	16 HTSSOP	1.85		
TPS54310/1/2/3/4/5/6	3000	3.0 to 6.0	0.9	0.9, 1.2, 1.5, 1.8, 2.5, 3.3	90	280 to 700	✓	✓ <sup>2</sup>		✓	✓	✓					✓	20 HTSSOP	2.25		
TPS54317	3000	3.0 to 6.0	0.9	—	90	280 to 1600	✓	✓		✓	✓						✓	24 QFN	2.50		
TPS54372	3000	3.0 to 6.0	0.2	—	90	280 to 700	✓				✓	✓					✓	20 HTSSOP	2.25		
<b>TPS54377</b>	3000	3.0 to 6.0	0.9	—	90	280 to 1600	✓	✓		✓	✓	✓						24 QFN	2.50		
TPS54380	3000	3.0 to 6.0	0.9	—	90	280 to 700	✓				✓	✓					✓	20 HTSSOP	2.25		
<b>TPS54383/6 (dual)</b>	3000 each	4.5 to 28	0.8	—	90/85	300/600			✓		✓	✓	✓				✓	14 HTSSOP	2.65		
<b>TPS5450</b>	5000	5.5 to 36	1.23	—	87	500					✓	✓					✓	8 HSOIC	2.25		
TPS54550	6000	4.5 to 20	0.9	—	80	250 to 700	✓	✓	✓	✓	✓	✓					✓	16 HTSSOP	2.65		
TPS54610/1/2/3/4/5/6	6000	3.0 to 6.0	0.9	0.9, 1.2, 1.5, 1.8, 2.5, 3.3	90	280 to 700	✓	✓ <sup>2</sup>		✓	✓	✓					✓	28 HTSSOP	3.20		
TPS54672	6000	3.0 to 6.0	0.2	—	90	280 to 700	✓				✓	✓					✓	28 HTSSOP	3.20		
TPS54673	6000	3.0 to 6.0	0.9	—	90	280 to 700	✓	✓		✓	✓	✓					✓	28 HTSSOP	3.20		
TPS54680	6000	3.0 to 6.0	0.9	—	90	280 to 700	✓				✓	✓					✓	28 HTSSOP	3.20		
TPS54810	8000	4.0 to 6.0	0.9	—	90	280 to 700	✓	✓		✓	✓	✓					✓	28 HTSSOP	3.65		
TPS54872	8000	4.0 to 6.0	0.2	—	90	280 to 700	✓				✓	✓					✓	28 HTSSOP	3.65		
TPS54873	8000	4.0 to 6.0	0.9	—	90	280 to 700	✓	✓		✓	✓	✓					✓	28 HTSSOP	3.65		
TPS54880	8000	4.0 to 6.0	0.9	—	90	280 to 700	✓				✓	✓					✓	28 HTSSOP	3.65		
TPS54910	9000	3.0 to 4.0	0.9	—	90	280 to 700	✓	✓		✓	✓	✓					✓	28 HTSSOP	3.80		
TPS54972	9000	3.0 to 4.0	0.2	—	90	280 to 700	✓				✓	✓					✓	28 HTSSOP	3.80		
TPS54973	9000	3.0 to 4.0	0.9	—	90	280 to 700	✓	✓		✓	✓	✓					✓	28 HTSSOP	3.80		
TPS54980	9000	3.0 to 4.0	0.9	—	90	280 to 700	✓				✓	✓					✓	28 HTSSOP	3.80		
TPS54010	14000	2.25 to 4.0	0.9	—	90	280 to 700	✓	✓		✓	✓	✓					✓	28 HTSSOP	4.25		

<sup>1</sup>Pricing is different and certain voltage options are not available.

<sup>2</sup>Fixed V<sub>OUT</sub> options do not have a sync pin.

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

New devices are listed in bold red.



### Selection Guide (Continued)

Device	I <sub>OUT</sub> (mA)	Switch Current Limit (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	V <sub>OUT</sub> Fixed (V)	Peak Efficiency (%)	Switching Frequency (kHz)	Recommended Inductor Size (μH)	Quiescent Current (typ) (mA)	Shutdown Current (typ) (μA)	Low Battery	Power Good	Undervoltage Lockout	Thermal and/or Short-Circuit Protection	Package(s)				EVM	Price*	
															Chipscale (WCSP)	SOT-23	MSOP	QFN			SOIC
<b>Low-Power Step-Down (Buck) Regulators — Small, Efficient, Low I<sub>q</sub></b>																					
TPS62200	300	670	2.5 to 6.0	0.7 to 6.0	—	95	1000	10	0.015	0.1			✓	✓		6				✓	0.80
TPS62201/2/3/4	300	670	2.5 to 6.0	—	1.5/1.8/3.3/1.6	95	1000	10	0.015	0.1			✓	✓		6					0.80
TPS62205/7/8	300	670	2.5 to 6.0	—	2.5/1.2/1.875	95	1000	10	0.015	0.1			✓	✓		6					0.80
<b>TPS62240</b>	300	700	2.0 to 6.0	0.6 to 6.0	—	95	2250	2.2	0.015	0.1			✓	✓		5		6		✓	0.95
<b>TPS62242/3</b>	300	700	2.0 to 6.0	—	1.2/1.8	95	2250	2.2	0.015	0.1			✓	✓				6			0.95
TPS62220	400	880	2.5 to 6.0	0.7 to 6.0	—	95	1250	4.7	0.015	0.1			✓	✓		6				✓	1.10
TPS62221/2/3/4	400	880	2.5 to 6.0	—	1.5/1.8/2.3/1.6	95	1250	4.7	0.015	0.1				✓		6					1.10
TPS62228/9	400	880	2.5 to 6.0	—	1.875/1.7	95	1250	4.7	0.015	0.1				✓		6					1.10
<b>TPS62270</b>	400	700	2.0 to 6.0	—	1.15/0.9	95	2250	2.2	0.015	0.1			✓	✓				6		✓	1.05
TPS62400	400 + 600	800/1000	2.5 to 6.0	0.6 to 6.0	—	95	2250	2 x 3.3	0.030	0.1								10		✓	2.50
<b>TPS62401/2</b>	400 + 600	800/1000	2.5 to 6.0	—	1.1/1.575, 1.2/1.895	95	2250	2 x 3.3	0.030	0.1								10			2.50
TPS62100/1/2/3	500	1150	2.5 to 9.0	0.8 to 8.0	—	92	300 to 2000	10	0.625	1				✓					8	✓	1.90
TPS62300	500	740	2.5 to 6.0	0.6 to 5.4	—	90	3000	1	0.086	0.1			✓	✓		8		10		✓	1.40
TPS62301/2/3/5	500	740	2.5 to 6.0	—	1.5/1.6/1.8/1.875	93	3000	1	0.086	0.1			✓	✓		8		10			1.40
TPS62320	500	740	2.5 to 6.0	0.6 to 5.4	—	90	3000	1	0.086	0.1			✓	✓		8		10			1.40
TPS62321	500	740	2.5 to 6.0	—	1.5	93	3000	1	0.086	0.1			✓	✓		8		10			1.40
TPS62000	600	1600	2.0 to 5.5	0.8 to 5.0	—	95	750	10	0.05	0.1	✓	✓	✓	✓				10		✓	1.40
TPS62001/2/3/4	600	1600	2.0 to 5.5	—	0.9/1/1.2/1.5	95	750	10	0.05	0.1	✓	✓	✓	✓				10			1.40
TPS62005/6/7/8	600	1600	2.0 to 5.5	—	1.8/2.5/3.3/1.9	95	750	10	0.05	0.1	✓	✓	✓	✓				10			1.40
<b>TPS62260</b>	600	1000	2.0 to 6.0	0.6 to 6.0	—	95	2.25	2.2	0.015	0.1			✓	✓		5		6		✓	1.10
<b>TPS62261/2</b>	600	1000	2.0 to 6.0	—	1.2/1.8	95	2.25	2.2	0.015	0.1			✓	✓				6			1.10
TPS62020/1	600	1100	2.5 to 6.0	0.7 to 6.0	—	95	1250	6.2	0.018	0.1			✓	✓				10	10	✓	1.60
TPS62026	600	1100	2.5 to 6.0	—	3.3	95	1250	6.2	0.018	0.1			✓	✓				10	10		1.60
TPS62420	600 + 1000	1000/1400	2.6 to 6.0	0.6 to 6.0	—	95	2250	2 x 3.3	0.030	0.1									10	✓	2.95
TPS62350	800	1300	2.7 to 6.0	0.75 to 1.5375	—	88	3000	1.0	0.030	0.1			✓	✓		12		10		✓	1.55
TPS62050	800	1400	2.7 to 10.0	0.7 to 6.0	—	95	850	10	0.012	1.5	✓	✓	✓	✓				10		✓	1.85
TPS62051	800	1400	2.7 to 10.0	0.7 to 6.0	—	95	850	10	0.012	1.5	✓	✓	✓	✓				10			1.85
TPS62052/4/6	800	1400	2.7 to 10.0	—	1.5/1.8/3.3	95	850	10	0.012	1.5	✓	✓	✓	✓						✓	1.85
<b>TPS62351/2/3/4/5</b>	800	1500	2.7 to 6.0	0.75 to 1.975	—	88	3000	1.0	0.030	0.1			✓	✓		12		10		✓	1.55
<b>TPS62410</b>	800 + 800	1200/1200	2.6 to 6.0	0.6 to 6.0	—	95	2250	2 x 3.3	0.030	0.1								10			2.60
<b>TPS62290</b>	1000	1400	2.3 to 6.0	0.6 to 6.0	—	95	2.25	2.2	0.015	0.1			✓	✓				6		✓	1.60
<b>TPS62291/3</b>	1000	1400	2.3 to 6.0	—	3.3/1.8	95	2.25	2.2	0.015	0.1			✓	✓				6			1.60
TPS63000	1200	1800	1.8 to 5.5	1.2 to 5.5	—	96	1500	2.2	0.030	0.1			✓	✓				10		✓	2.65
TPS63001/2	1200	1800	1.8 to 5.5	—	3.3/5	96	1500	2.2	0.030	0.1			✓	✓				10			2.65
TPS62040	1200	2000	2.5 to 6.0	0.7 to 6.0	—	95	1250	6.2	0.018	0.1			✓	✓				10	10	✓	1.65
TPS62042/3/4/6	1200	2000	2.5 to 6.0	—	1.5/1.6/1.8/3.3	95	1250	6.2	0.018	0.1			✓	✓				10	10		1.65
TPS62510	1500	2000	1.8 to 3.8	0.6 to 3.8	—	97	1500	2.2	0.018	0.1								10		✓	1.70
TPS62110	1500	2400	3.1 to 17	1.2 to 16	—	95	1000	6.8	0.018	1.5	✓	✓	✓	✓				16		✓	1.75
TPS62111/2	1500	2400	3.1 to 17	—	3.3/5	95	1000	6.8	0.018	1.5	✓	✓	✓	✓				16		✓	1.75

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

New devices are listed in bold red.

## → DC/DC Converters (Integrated Switch)

### Selection Guide (Continued)

Device	I <sub>OUT</sub> (mA) <sup>1</sup>	Switch Current Limit (typ) (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	V <sub>OUT</sub> Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (µH)	Quiescent Current (typ) (mA)	Shutdown Current (typ) (µA)	Integrated LDO I <sub>OUT</sub> (mA)/ V <sub>OUT</sub> (V)	Low Battery	Power Good	Undervoltage Lockout	Thermal and/or Short-Circuit Protection	Package(s)					Price*	
																SOT-23	MSOP	QFN	TSSOP	SOIC		EVM
<b>Step-Up Regulators — Up to 6-A Switch Limit</b>																						
TPS61041	50	250	1.8 to 6.0	V <sub>IN</sub> to 28	—	87	1000	10	0.028	0.1	—			✓	✓	5				✓	0.70	
TPS61040	90	400	1.8 to 6.0	V <sub>IN</sub> to 28	—	87	1000	10	0.028	0.1	—			✓	✓	5				✓	0.90	
TPS61042/3/5	100	500	1.8 to 6.0	V <sub>IN</sub> to 28	—	85	1000	4.7	0.035	1	—			✓	✓		8			✓	0.95	
TPS61011/2/3	100	480/560/930	0.8 to 3.3	—	1.5/1.8/2.5	95	500	10	0.036	1	—	✓		✓	✓		10				1.10	
TL497A	—	500	4.5 to 12	(V <sub>IN</sub> + 2) to 30	—	85	—	—	11	6000	—							14	14		0.86	
TPS61001/2/3	100	500/650/900	0.8 to 3.3	—	1.5/1.8/2.5	85	500	33	0.05	0.2	—	✓		✓			10				0.95	
TPS61080	—	500	2.5 to 6.0	V <sub>IN</sub> to 27	—	87	1200	4.7	—	—	—				✓			10		✓	1.35	
TPS61004/5/6	200	950/1000/1100	0.8 to 3.3	—	2.8/3/3.3	85	500	33	0.05	0.2	—	✓		✓			10				0.95	
TPS61014/5/6	200	1010/1060/1130	0.8 to 3.3	—	2.8/3/3.3	95	500	10	0.036	1	—	✓		✓	✓		10				1.10	
TPS61000	200	1100	0.8 to 3.3	1.5 to 3.3	—	85	500	33	0.05	0.2	—	✓		✓			10			✓	0.95	
TPS61010	200	1130	0.8 to 3.3	1.5 to 3.3	—	95	500	10	0.036	1	—	✓		✓	✓		10			✓	1.10	
<b>TPS61028</b>	200	800	0.9 to 5.5	1.8 to 5.5	—	96	720	6.8	0.025	0.1	—	✓		✓	✓			10		✓	1.50	
TPS61070/1/2/3	250	700	0.9 to 5.5	1.8 to 5.5	—	90	1200 <sup>2</sup>	4.7	6	1	—			✓	✓	6					0.80	
TPS61081	450	1200	2.5 to 6.0	V <sub>IN</sub> to 27	—	87	1200	4.7	—	—	—				✓			6		✓	1.45	
<b>TPS61170</b>	500	1200	3.0 to 18	V <sub>IN</sub> to 38	—	93	1200	10	2.3	1	—			✓	✓						1.40	
TPS61020	500	1500	0.9 to 5.5	1.8 to 5.5	—	96	720	6.8	0.025	0.1	—	✓		✓	✓		10			✓	1.50	
TPS61024/5/7	500	1500	0.9 to 5.5	1.8 to 5.5	3/3.3/5	96	720	6.8	0.025	0.1	—	✓		✓	✓		10				1.50	
<b>TPS61026/9</b>	600	1800	0.9 to 5.5	1.8 to 5.5	—	96	720	6.8	0.025	0.1	—	✓		✓	✓		10			✓	1.60	
TPS61090	700	2200	1.8 to 5.5	1.8 to 5.5	—	96	600	6.8	0.02	0.1	—	✓		✓	✓		16			✓	1.70	
TPS61091/2	700	2000	1.8 to 5.5	—	3.3/5	96	600	6.8	0.02	0.1	—	✓		✓	✓		16				1.70	
MC34063A	750	1500	3 to 40	3 to 39.5	—	—	100	—	6	1	—			✓	✓		8		8	✓	0.39	
<b>TPS61200</b>	800	1500	0.3 to 5.5	0 to V <sub>IN</sub>	—	90	1250	2.2	0.05	1	—			✓	✓		10				1.80	
<b>TPS61201/2</b>	800	1500	0.3 to 5.5	0 to V <sub>IN</sub>	3.3/5	90	1250	2.2	0.05	1	—			✓	✓		10			✓	1.80	
TPS61030	1000	4500	1.8 to 5.5	1.8 to 5.5	—	96	600	6.8	0.02	0.1	—	✓		✓	✓		16	16		✓	2.25	
TPS61031/2	1000	4500	1.8 to 5.5	—	3.3/5	96	600	6.8	0.02	0.1	—	✓		✓	✓		16	16		✓	2.25	
<b>TPS61050/2</b>	1200	2000	2.5 to 6.0	V <sub>IN</sub> to 5.5	—	96	2000	2.2	8.5	0.3	—			✓	✓		10			✓	1.50	
<b>Step-Up (Boost) Regulators with Integrated LDO (Dual Output)</b>																						
TL499A	100	—	1.1 to 10	2.9 to 30	—	85	—	—	—	15	100/Adj.								8		0.90	
TPS61100	200	1500	0.8 to 3.3	1.5 to 5.5	—	95	500	10	0.065	0.5	120/Adj.	✓	✓	✓	✓			24	20		✓	1.65
TPS61103/6/7	200	1500	0.8 to 3.3	—	3.3/3.3/3.3	95	500	10	0.065	0.5	120/Adj., 1.5, 1.8	✓	✓	✓	✓			24	20			1.65
TPS61120	500	1300	1.8 to 5.5	2.5 to 5.5	—	95	500	10	0.04	0.2	200/Adj.	✓	✓	✓	✓			16	16		✓	1.65
TPS61121/2	500	1300	1.8 to 5.5	—	3.3/3.6	95	500	10	0.04	0.2	200/1.5, 3.3	✓	✓	✓	✓			16	16			1.65
<b>Buck-Boost Regulators</b>																						
TPS61130	300	1300	1.8 to 5.5	2.5 to 5.5	—	90	500	10	0.04	0.2	200/Adj.	✓	✓		✓			16	16		✓	2.20
TPS61131/2	300	1300	1.8 to 5.5	—	3.3/3.3	90	500	10	0.04	0.2	200/1.5, 3.3	✓	✓		✓			16	16			2.20
TPS63000/1/2	1200	1800	1.8 to 5.5	1.2 to 5.5	3.3/5.0	90	1800	2.2	0.030	0.1	—				✓			10			✓	2.65
<b>Inverting Regulators</b>																						
TL497A	—	500	4.5 to 12	-1.2 to -25	—	85	—	—	11	6000	—								14	14		0.86
TPS63700	360	1000	2.7 to 5.5	-2 to -15	—	84	1400	4.7	—	0.014	—							10			✓	1.80
MC34063A	750	1500	3 to 38	-1.25 to -36.3	—	—	100	—	2.7	—	—			✓	✓			8		8	✓	0.39
TPS5430	1500	4000	5.5 to 36	-1.23 to -31	—	87	500	15	4.4	50	—			✓	✓					8	✓	1.85

<sup>1</sup>For boost converters, max. I<sub>OUT</sub> can be estimated with 0.65 x switch limit x (V<sub>IN</sub>/V<sub>OUT</sub>).

<sup>2</sup>PWM/PFM (TPS61070); PWM only (TPS61071).

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

New devices are listed in bold red.

## Inductorless DC/DC Regulators (Charge Pumps)

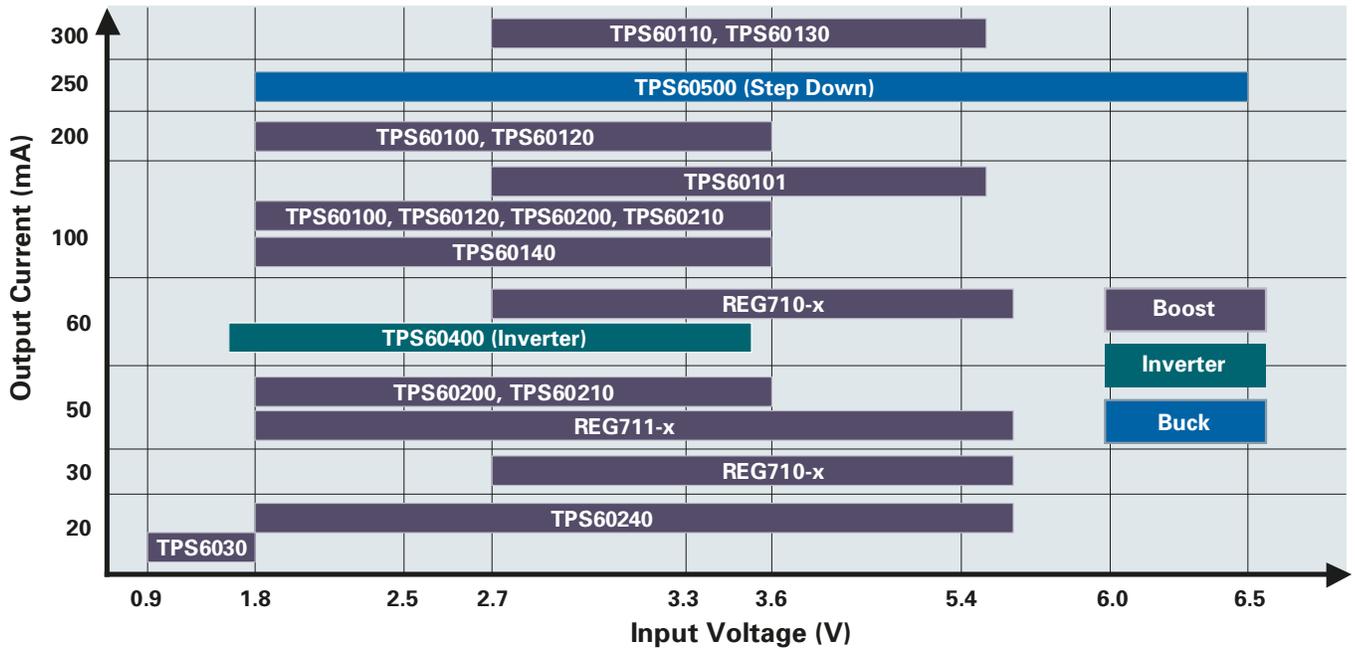
### Design Factors

**Efficiency and Solution Size** — Use of charge pumps is recommended when a trade-off between efficiency and solution size needs to be made. Higher efficiency will directly translate into additional operating time in battery-powered applications. Charge pumps achieve peak efficiencies of 90% and typically require only a few capacitors for operation. No inductors, diodes or FETs are needed. Charge pumps come in small packages such as SOT-23 and MSOP-8, which further reduce solution size.

**Output Current** — Charge pump converters allow for small, power-efficient and cost-effective DC/DC solutions with output currents less than 300 mA and output voltage less than 6 V. If larger output currents, higher output voltages or greater efficiency are required, use of an inductive switching converter is more cost- and space-efficient (pages 30–36).

**Output Ripple and Noise** — TI charge pumps reduce output voltage ripple to a minimum by operating a pair of integrated charge pump loops with a phase shift of 180 degrees. This helps to avoid the cost of additional filtering at the output. Charge pumps also tend to generate less noise than an equivalent inductive switching converter of equal output current rating. This may be important in RF-sensitive or low-noise applications.

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



For a complete list of Resources, visit: [power.ti.com](http://power.ti.com)

## Inductorless DC/DC Regulators (Charge Pumps)

### Selection Guide

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	V <sub>OUT</sub> Fixed (V)	Efficiency (%)	Switching Frequency (max) (kHz)	Quiescent Current (typ) (μA)	Shutdown Current (typ) (μA)	Features						Package(s)				EVM	Price*
									Shutdown	Low Battery	Power Good	Undervoltage Lockout	Current Limit	Thermal Limit	SOT-23	QFN	MSOP	TSSOP		
<b>Step-Down (Buck) Regulators</b>																				
TPS60500	250	1.8 to 6.5	0.8 to 3.3	—	90	1200	40	0.05	✓		✓	✓	✓	✓			10	✓	0.80	
TPS60501	250	1.8 to 6.5	—	3.3	90	1200	40	0.05	✓		✓	✓	✓	✓			10		0.80	
TPS60502	250	1.8 to 6.5	—	1.8	90	1200	40	0.05	✓		✓	✓	✓	✓			10		0.80	
TPS60503	250	1.8 to 6.5	—	1.5	90	1200	40	0.05	✓		✓	✓	✓	✓			10		0.80	
<b>Boost Regulators</b>																				
TPS60100	200	1.8 to 3.6	—	3.3	90	300	50	0.05	✓			✓	✓				20	✓	1.25	
TPS60101	100	1.8 to 3.6	—	3.3	90	300	50	0.05	✓			✓	✓				20		1.05	
TPS60110	300	2.7 to 5.4	—	5.0	90	300	60	0.05	✓			✓	✓				20	✓	1.30	
TPS60111	150	2.7 to 5.4	—	5.0	90	300	60	0.05	✓			✓	✓				20		1.15	
TPS60120/1	200	1.8 to 3.6	—	3.3	85	450	55	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓				20	✓	1.25	
TPS60122/3	100	1.8 to 3.6	—	3.3	85	450	55	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓				20		1.05	
TPS60124/5	200	1.8 to 3.6	—	3.0	85	450	55	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓				20		1.25	
TPS60130/1	300	2.7 to 5.4	—	5.0	90	450	60	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓				20	✓	1.30	
TPS60132/3	150	2.7 to 5.4	—	5.0	90	450	60	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓				20		1.15	
TPS60140/1	100	1.8 to 3.6	—	5.0	70	450	65	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓				20	✓	1.05	
TPS60200/1	100	1.8 to 3.6	—	3.3	90	400	40	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓			10		✓	1.05	
TPS60202/3	50	1.8 to 3.6	—	3.3	90	400	40	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓			10			0.95	
TPS60204/5	100	1.8 to 3.6	—	3.3	90	400	35	0.05	✓	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓			10			1.05	
TPS60210/1	100	1.8 to 3.6	—	3.3	90	400	35	2	Snooze	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓			10	✓	1.05		
TPS60212/3	50	1.8 to 3.6	—	3.3	90	400	35	2	Snooze	✓ <sup>1</sup>	✓ <sup>1</sup>	✓	✓			10			0.95	
TPS60230/1	125	2.7 to 6.5	—	5.5 <sup>2</sup>	85	1250	160	0.1	✓			✓	✓	✓	16			✓	1.55	
TPS60240	12	1.8 to 5.5	—	3.3	90	160	250	0.1					✓	✓		8			1.15	
TPS60241	12	2.7 to 5.5	—	5.0	90	160	250	0.1					✓	✓		8		✓	1.15	
TPS60242	12	1.8 to 5.5	—	3.0	90	160	250	0.1					✓	✓		8			1.15	
TPS60243	12	1.8 to 5.5	—	2.7	90	160	250	0.1					✓	✓		8			1.15	
TPS60300/2	20	0.9 to 1.8	—	3.3	90	900	35	1	✓		✓ <sup>3</sup>	✓	✓			10		✓	0.95	
TPS60301/3	20	0.9 to 1.8	—	3.0	90	900	35	1	✓		✓ <sup>3</sup>	✓	✓			10			0.95	
TPS60310/2	20	0.9 to 1.8	—	3.3	90	900	35	2	Snooze		✓ <sup>3</sup>	✓	✓			10			1.05	
TPS60311/3	20	0.9 to 1.8	—	3.0	90	900	35	2	Snooze		✓ <sup>3</sup>	✓	✓			10			1.05	
<b>TL7660</b>	20	1.5 to 10	—	< 2 V <sub>IN</sub>	99	10.35	80	—							8	8			0.72	
<b>Buck-Boost Regulators</b>																				
REG710-2.5	30	1.8 to 5.5	—	2.5	90	1000	65	0.01	✓				✓	✓	6				0.65	
REG710-2.7	30	1.8 to 5.5	—	2.7	90	1000	65	0.01	✓				✓	✓	6				0.65	
REG710-3	30	1.8 to 5.5	—	3.0	90	1000	65	0.01	✓				✓	✓	6				0.65	
REG710-3.3	30	1.8 to 5.5	—	3.3	90	1000	65	0.01	✓				✓	✓	6			✓	0.65	
REG71050	60	2.7 to 5.5	—	5.0 <sup>2</sup>	90	1000	65	0.01	✓				✓	✓	6			✓	0.65	
REG710-5	60	2.7 to 5.5	—	5.0 <sup>2</sup>	90	1000	65	0.01	✓				✓	✓	6			✓	0.65	
REG71055	60	3.0 to 5.5	—	5.5 <sup>2</sup>	90	1000	65	0.01	✓				✓	✓	6				0.65	
REG711-2.5	50	1.8 to 5.5	—	2.5	90	1000	60	0.01	✓				✓	✓		8			0.90	
REG711-2.7	50	1.8 to 5.5	—	2.7	90	1000	60	0.01	✓				✓	✓		8			0.90	
REG711-3	50	1.8 to 5.5	—	3.0	90	1000	60	0.01	✓				✓	✓		8			0.90	
REG711-3.3	50	1.8 to 5.5	—	3.3	90	1000	60	0.01	✓				✓	✓		8			0.90	
REG711-5	50	2.7 to 5.5	—	5.0	90	1000	60	0.01	✓				✓	✓		8			0.90	
<b>Inverting Regulators</b>																				
LT1054	100	3.5 to 15	—	-5.0	—	25	2500	100	✓										1.44	
TPS60400	60	1.6 to 5.5	-(1.6 to 5.5)	—	99	50 to 250	125	—							5			✓	0.33	
TPS60401	60	1.6 to 5.5	-(1.6 to 5.5)	—	99	28	65	—							5				0.33	
TPS60402	60	1.6 to 5.5	-(1.6 to 5.5)	—	99	70	120	—							5				0.33	
TPS60403	60	1.6 to 5.5	-(1.6 to 5.5)	—	99	300	425	—							5				0.33	

<sup>1</sup>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.

<sup>2</sup>White LED driver.

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

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

New devices are listed in bold red.



### Design Factors

**Integration Level** — Application-specific power management devices offer different levels of integration and address specific power needs of the end equipment. They may feature building blocks such as chargers, linear regulators, DC/DC controllers or DC/DC converters. Some devices also integrate specific communication interfaces such as I<sup>2</sup>C to control voltages and other functions.

**Package** — Due to the integration level, power dissipation capability needs to be taken into consideration. Most packages for highly integrated devices have a thermal pad at the bottom for optimal thermal performance.

### Efficiency and External Component Count

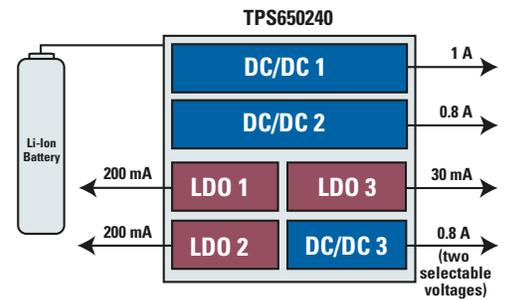
Integrated power conversion devices typically feature a combination of different power converters ranging from LDOs to charge pumps and inductive DC/DC regulators. Multiple LDO devices may offer the most channels and least external components per given package size but are least efficient. Devices with several inductive DC/DC converters require a larger package and external inductors, but they typically provide the best conversion efficiency and longest battery life for portable applications.

### 6-Channel PMU for Popular DSP and $\mu$ P TPS650240

**NEW**

 Get samples, datasheets and app reports at: [www.ti.com/sc/device/TPS650240](http://www.ti.com/sc/device/TPS650240)

The TPS65024x family are power-management units (PMUs) for processor-based applications. Each device includes three LDOs and three 2.25-MHz step-down converters targeted at providing the core voltage, peripheral, I/O and memory rails. Dynamic voltage scaling can be achieved via logic high/low. The TPS650240 is available in a small 5 x 5-mm, 32-pin QFN package.



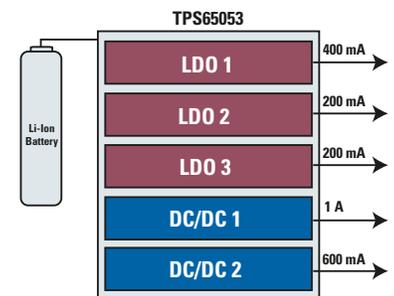
**Smallest Solution Size:**  
5 x 5 mm  
32-Pin QFN Package

### General-Purpose 5-Channel PMU TPS65053

**NEW**

 Get samples, datasheets, evaluation modules and app reports at: [www.ti.com/sc/device/TPS65053](http://www.ti.com/sc/device/TPS65053)

With two step-down converters and three LDOs, the TPS65053 provides the smallest PMU solution for a variety of applications. For low-noise applications, it can be forced into fixed-frequency PWM mode. The TPS6505x family also offers very high PSRR LDOs. The TPS65053 comes in a small 4 x 4-mm, 24-pin QFN package.



### Selection Guide

Device	V <sub>IN</sub> (V)	No. of Regulator Outputs	Charger	DC/DC Converter	DC/DC Controller	Charge Pump	LDO	LDO Controller	A/D Converter	Communication Interface	Quiescent Current (mA)	Shutdown Current (µA)	Description	Package	Price*
<b>Integrated Power Management for Smartphone, PDA, Media Players, Portable Industrial</b>															
TPS62400/10/20	2.5 to 6.0	2	—	2	—	—	—	—	—	Serial	0.03	2	Dual, synchronous DC/DC converter in 3 x 3 QFN with EasyScale™ interface	QFN-10	2.50
<b>TPS65000/1</b>	1.8 to 6.0	3	—	1	—	—	2	—	—	GPIO	0.01	0.005	General purpose 3-channel PMU. TPS65001 with voltage supervisor.	QFN-16	TBD
TPS75003	2.2 to 6.5	3	—	—	2	—	1	—	—	GPIO	0.075	0.05	Power management for Xilinx® Spartan™-3 and other FPGA, DSP and ASIC	QFN-20	2.05
TPS65030	3.0 to 5.0	4	—	—	—	3	1	—	—	GPIO	0.02	—	Power management IC with 3 charge pumps and 1 LDO for USB-OTG	YZK-12	2.95
TPS65010/1/2/3/4	2.5 to 20.0	4	Li-Ion	2	—	—	2	—	—	I <sup>2</sup> C	0.07	0.015	Power management for OMAP™, DSP and other processors	QFN-48	2.75
<b>TPS65053</b>	2.5 to 6.0	5	—	2	—	—	3	—	—	GPIO	0.03	0.009	Lowest-cost PMU for general purpose	QFN-24	1.95
TPS65020/1/2	2.5 to 6.0	6	—	3	—	—	3	—	—	I <sup>2</sup> C	0.07	—	Power management for Intel XScale®, OMAP and other processors with DVS	QFN-40	3.05
TPS65023	2.5 to 6.0	6	—	3	—	—	3	—	—	I <sup>2</sup> C	0.07	—	PMU for TI DaVinci™ DSP, optimized for 1-cell Li-Ion applications	QFN-40	3.30
<b>TPS650240/1/2/3/4/5</b>	2.5 to 6.0	6	—	3	—	—	3	—	—	GPIO	0.07	—	General purpose PMU, with logic high/low voltage scaling	QFN-32	2.95
<b>TPS65050/1/2/4/6</b>	2.5 to 6.0	6	—	2	—	—	4	—	—	GPIO	0.03	0.007	General purpose PMU for portable application processors	QFN-32	2.25
TPS65800/10/20	3.0 to 18.0	10	Li-Ion	3	—	—	7	—	Yes	I <sup>2</sup> C	—	—	Complete 1-cell Li-Ion battery, lighting and power management for portable apps	QFN-56	6.20
<b>Integrated Power Management for Digital Still Cameras</b>															
<b>TPS65530</b>	1.5 to 5.5	9	—	7	1	—	1	—	—	—	—	—	Fully integrated 8-channel DC/DC converter for digital still cameras	QFN-48	4.20
TPS65520	1.5 to 5.0	13	—	7	1	—	5	—	—	—	—	—	Complete 13-channel (7 DC/DC + 5 LDO) power management for DSC	BGA-121	3.95

\*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.



## Power Management Units

### Design Factors

**Dynamic Voltage Scaling (DVS)** — DVS is a feature typically used in power-management units (PMUs) and DC/DC converters that power DSPs and other processors. This feature allows the system controller to change the output voltage of the converter when needed. In portable applications, every micro-ampere of either ground current or leakage current saved adds up to enhanced battery life. Scaling down the voltage applied to the processor reduces the leakage current. Reducing the applied voltage also helps to run the microprocessor under lowered clock frequencies, thereby saving valuable battery power during idle or sleep mode.

Devices with an I<sup>2</sup>C interface allow DVS by changing the output voltages of the converters and LDOs on the fly, achieving significant dynamic power savings.

Devices with logic high/low levels allow DVS by using a dedicated pin of the DC/DC converter. This pin needs to be connected to a logic high or logic low level from the

### PMU Function Guide

Dynamic Voltage Scaling Control	Multi-Output Devices	Number of Integrated Functions					
		Linear Charger	LDO	Step-Down DC/DC	Step-Up DC/DC	RGB Driver	A/D Converter
I <sup>2</sup> C	TPS65800/10/20	1	7	2	1	1	1
	TPS651x	1	2	2			
	TPS65020/1/2/3		3	3			
Logic High/Low	TPS65024x		3	3			
	TPS65052/4/6		4	2			
No DVS	TPS65050/1		4	2			
	TPS65053		3	2			

processor's GPIO to set the output voltage of the DC/DC accordingly.

**PMUs with Additional Analog Functions** — In addition to step-down DC/DC converters

and LDOs, highly integrated solutions in small BGA or QFN packages offer functions like battery charger, step-up DC/DC converter, RGB driver and A/D converter.

### DSPs and Other Processors Supported by TI Power-Management Units (PMUs)

Manufacturer	Processor Part Number	TI PMU Part Number
TI	OMAP1510/1610	TPS65010
	OMAP1510/1610	TPS65011
	OMAP1510/1610	TPS65012
	OMAP1710	TPS65013
	OMAP1510/1610	TPS65014
	DM320	TPS65021
	OMAP35x	TPS65023
	DM644x	TPS65023
	TUSB6010	TPS65030
	OMAP850	TPS65051
	DM355	TPS65053
	OMAP1710	TPS65054

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](http://www.ti.com/pmu)

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

Manufacturer	Processor Part Number	TI PMU Part Number
RMI®	AU1200	TPS65021
Freescale™	IMX21	TPS65800
	IMX21	TPS65810
	IMX21	TPS65811
	IMX21	TPS65820
	IMX27	TPS65053
	IMX31	TPS650240
Marvell®	PXA255	TPS65051
	PXA270	TPS65021
	PXA270	TPS65022
	PXA900	TPS65800
	PXA900	TPS65810
	PXA900	TPS65820
Samsung™	S3C2410/2/3	TPS65051
	S3C2410/2/3	TPS65052
	S3C2440	TPS65056
	S3C2442	TPS650242
	S3C2442	TPS65056
	S3C2443-400MHz	TPS650240
	S3C2443-533MHz	TPS650241
	S3C6400-533MHz	TPS650245



### Single Inductor Dual-Output Buck/Boost Converter

#### TPS65136

**NEW**

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

[www.ti.com/sc/device/TPS65136](http://www.ti.com/sc/device/TPS65136)

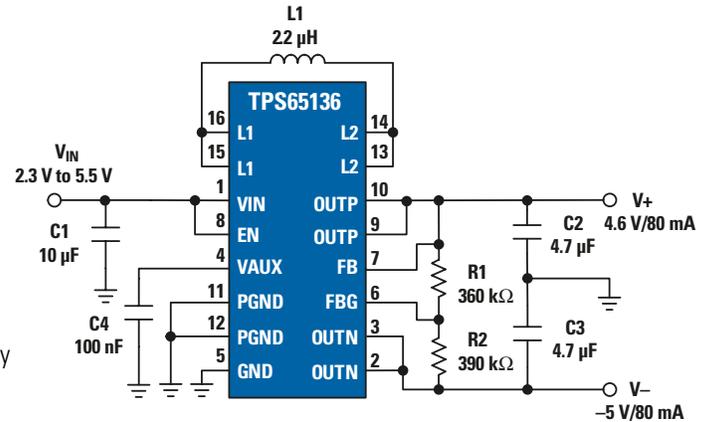
The TPS65136 is designed to provide best-in-class picture quality for AMOLED (Active-Matrix OLED) displays. Its wide input voltage range is ideal for AMOLED displays used in mobile phones and smart phones.

#### Key Features

- 2.3-V to 5.5-V input voltage range
- 1% output voltage accuracy
- SIMO (single inductor multiple output) regulator technology

#### Applications

- OLED display up to 2.5 inches
- CCD sensor bias
- Positive/negative analog supply



### Integrated Power Management for OLED Displays

Device	V <sub>IN</sub> (V)	V <sub>OUT</sub> (V)	I <sub>OUT</sub> (typ) (A)	No. of Reg. Outputs	No. of Ext Inductors	DC/DC Conv.	Adj. Output	Switch Freq. (max) (kHz)	Eff. of Pos. Output (%)	Eff. of Neg. Output (%)	Description	Package	Price*
TPS65130	2.7 to 5.5	-15 to 15	0.8	2	2	2	Yes	1250	89	81	800-mA boost current with pos/neg (dual) output for OLED & CCD sensor	24QFN	2.30
TPS65131	2.7 to 5.5	-15 to 15	1.95	2	2	2	Yes	1250	89	81	1950-mA boost current with pos/neg (dual) output for OLED & CCD sensor	24QFN	3.00
<b>TPS65136</b>	2.7 to 5.5	-15 to 15	1	2	1	2	Yes	1250	89	81	1000-mA boost current with pos/neg (dual) output for AMOLED	24QFN	3.00

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

New devices are listed in bold red.

### Integrated Power Management for LCD Bias

Device	V <sub>IN</sub> (V)	V <sub>Boost</sub> (V)	I <sub>Boost</sub> (typ) (A)	I <sub>Buck</sub> (typ) (A)	No. of Regulated Outputs	LDO	Op-Amp	Gate Pulse Modulation (GPM)	High Voltage Stress (HVS)	Switching Frequency (max) (kHz)	Integrated Isolated Switch	Description	Package(s)	Price*
TPS65100/1/5	2.7 to 5.8	15	0.35	0.02	4	—	1	No	No	1600	No	Triple-output LCD supply w/reg & VCOM buffer	24HTSSOP/QFN	1.20
TPS65120/1/3/4	2.5 to 5.5	5.6	0.025	0.02	4	1	—	No	No	4000	No	5-V/20-mA (I/O), 4-ch. high-accuracy multi-converter with LDO	16QFN	1.35
TPS65140/1/5	2.7 to 5.8	15	0.35	1.6/1.6/0.96	4	1	1	No	No	1600	No	5-V/1.6-A (I/O), 4-ch. multiconverter with LDO controller, fault detection & power-good pin	24HTSSOP/QFN	1.10
TPS65150	1.8 to 6	13.5	0.45	—	3	—	1	Yes	No	1200	No	5-V/2-A (I/O), 4-ch. multiconverter with VCOM op-amp & GPM	24HTSSOP/QFN	1.10
TPS65160/A	8 to 14	20	2.8	1.8	4	1	—	No	No	500 or 750	No	12-V/2.8-A (I/O), 4-ch. multiconverter with 3.3-V at 1.8-A LDO & OVPL(-23V,A-19.5V)	28HTSSOP	1.40
TPS65161/A	8 to 14	19	2.8/3.7	2.3	4	1	—	No	No	500 or 750	No	12-V/2.8-A (I/O), 4-ch. multiconverter with 3.3-V at 2.3-A LDO & 20-V OVP	28HTSSOP	1.60
TPS65162	8 to 14	19	2.8	2.5	4	1	2	Yes	No	500 or 750	Yes	12-V/2.8-A (I/O), 4-ch. multiconverter with 3.3-V at 2.5-A LDO, 2 VCOM op-amp, GPM, & integrated isolated switch	48QFN	2.45
TPS65165	2.5 to 6	18	4.5	—	3	—	3	Yes	Yes	600	No	5-V/4.5-A (I/O), 3-ch. multiconverter with 3 op-amps, HVS, GPM, & integrated iso. sw.	40QFN	1.80
TPS65167/A	6 to 14	19	3.5	2.5	5	1	—	Yes	Yes	750	No	12-V/3.5-A (I/O), 4-ch. multiconverter with programmable at 2.5-A LDO, HVS, & temp. sensor	40QFN	2.10

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

## White LED Backlight, High-Current LED and LED Flashlight Drivers

### 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.

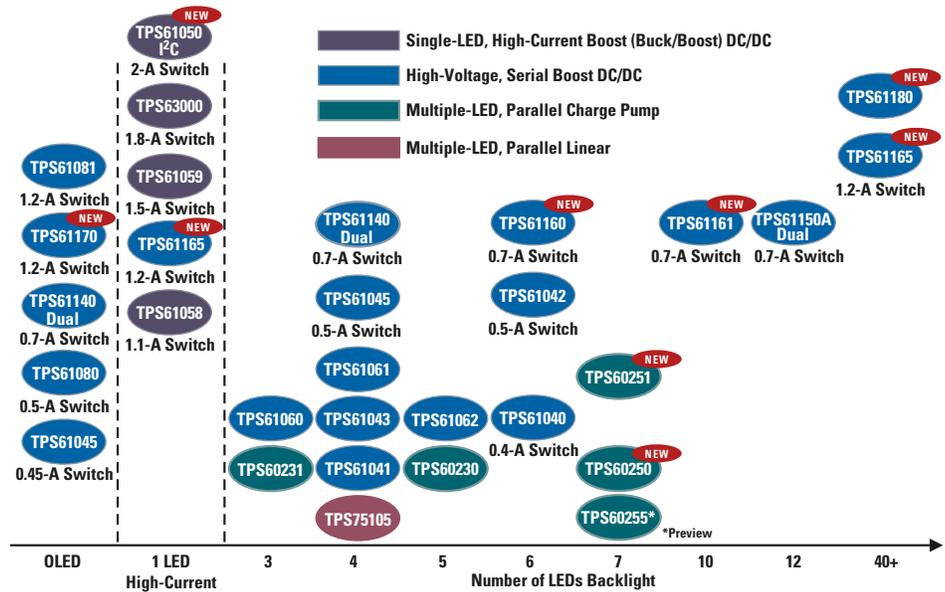
Charge pumps typically drive parallel LEDs; but unless each LED is current-regulated, each leg requires a current-set resistor.

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

**Over-Voltage 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.

### LED and OLED Drivers Function Guide



### Selection Guide

Device	V <sub>IN</sub> (V)	Synchronous	Type	Number of LEDs <sup>1</sup>	OLED Capable	LED Configuration	Switch Current Limit (typ) (mA)	Current Regulation	Overvoltage Protection (min) (V)	Output Capacitor	Load Disconnect During Shutdown	Dimming <sup>2</sup>	Peak Efficiency <sup>3</sup> (%)	Quiescent Current (typ) (mA)	Shutdown Current (typ) (µA)	Package(s)	Price*
<b>LED Backlighting</b>																	
TPS61041	1.8 to 6.0	No	Inductive	4	No	Series	250	No	No	1 µF	No	Yes	85	0.028	0.1	SOT-23	0.70
TPS61040	1.8 to 6.0	No	Inductive	6	No	Series	400	No	No	1 µF	No	Yes	86	0.028	0.1	SOT-23	0.90
TPS61043	1.8 to 6.0	No	Inductive	4	No	Series	400	Yes	17	100 nF	Yes	Yes	85	0.038	0.1	QFN-8	0.95
TPS61042	1.8 to 6.0	No	Inductive	6	No	Series	500	Yes	28	100 nF	Yes	Yes	85	0.038	0.1	QFN-8	0.80
TPS61045	1.8 to 6.0	No	Inductive	6	Yes	Series	500	Yes	28	100 nF	Yes	Yes	85	0.038	0.1	QFN-8	1.00
TPS61140	2.5 to 6.0	Yes	Inductive	4 + 1 OLED	Yes	2 Series	2 x 550	Yes	28	—	No	1-pin	82	2	1.5	QFN-10	2.00
TPS61150A	2.5 to 6.0	Yes	Inductive	Up to 2 x 6	No	2 Series	2 x 550	Yes	28	—	No	1-pin	83	2	1.9	QFN-10	1.65
<b>TPS61160</b>	2.7 to 18	No	Inductive	6	No	Series	700	Yes	26	1 µF	No	1-pin	90	1.8	1	QFN-6	0.85
<b>TPS61161</b>	2.7 to 18	No	Inductive	10	No	Series	700	Yes	38	1 µF	No	1-pin	90	1.8	1	QFN-6	1.00
<b>TPS61165</b>	3.0 to 18	No	Inductive	10 to 40	No	Series	1200	Yes	38	1 µF	No	1-pin	90	2.3	1	QFN-6	1.40
TPS61060	2.7 to 6.0	Yes	Inductive	3	No	Series	400	Yes	14	220 pF	Yes	Yes	83	—	1	QFN-8/WCSP-8	0.85
TPS61061	2.7 to 6.0	Yes	Inductive	4	No	Series	400	Yes	18	220 pF	Yes	Yes	82	—	1	QFN-8/WCSP-8	0.90
TPS61062	2.7 to 6.0	Yes	Inductive	5	No	Series	400	Yes	22	220 pF	Yes	Yes	81	—	1	QFN-8/WCSP-8	1.00
REG71050	3.2 to 5.5	—	Charge pump	3	No	Parallel	—	No	—	2.2 µF	—	No	92	0.065	0.01	SOT-23	0.65
TPS60230/1	2.7 to 6.5	—	Charge pump	5, 3	No	Parallel	—	Yes	—	1 µF	—	Yes	85	0.200	0.1	QFN-16	1.40
<b>TPS60250/5</b>	2.7 to 6.0	—	Charge pump	7	No	Parallel	—	Yes	—	4.7 µF	—	I <sup>2</sup> C	—	6.7	1.3	QFN-16	1.40
<b>TPS60251</b>	2.7 to 6.0	—	Charge pump	7 + Aux	No	Parallel	—	Yes	—	4.7 µF	—	I <sup>2</sup> C	—	6.7	1.3	QFN-24	1.40
TPS75103/5	2.7 to 5.5	—	LDO	2 or 4	No	Parallel	—	Yes	—	—	—	Yes	—	0.18	0.1	WCSP-9	0.65
TCA6507	1.65 to 3.6	—	Parallel	7	No	Parallel	—	—	—	—	—	—	—	—	—	WCSP-12/QFN-12	0.72
<b>High-Current LED Driver</b>																	
TPS61058/9	2.7 to 5.5	Yes	Inductive	1	No	Series	1100	No	No	3 x 22 µF	Yes	—	5.5	—	0.1	QFN-10	0.95
<b>TPS61050/2</b>	2.5 to 6.0	Yes	Inductive	1	No	Series	2000	No	No	10 µF	Yes	I <sup>2</sup> C	90	8.50	1	QFN-10/WCSP-12	1.05
<b>TPS61080/1</b>	2.5 to 6.0	No	Inductive	7	Yes	Series	700/1300	No	27	4.7 µF	Yes	No	94	1	1	QFN-10	1.35
<b>TPS61180/1/2</b>	5 to 24	No	Inductive	10 x 6	No	6 Series	2000	Yes	38	4.7 pF	No	Yes	93	1	2	QFN-16	2.10

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

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

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

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

New devices are listed in bold red.

**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.

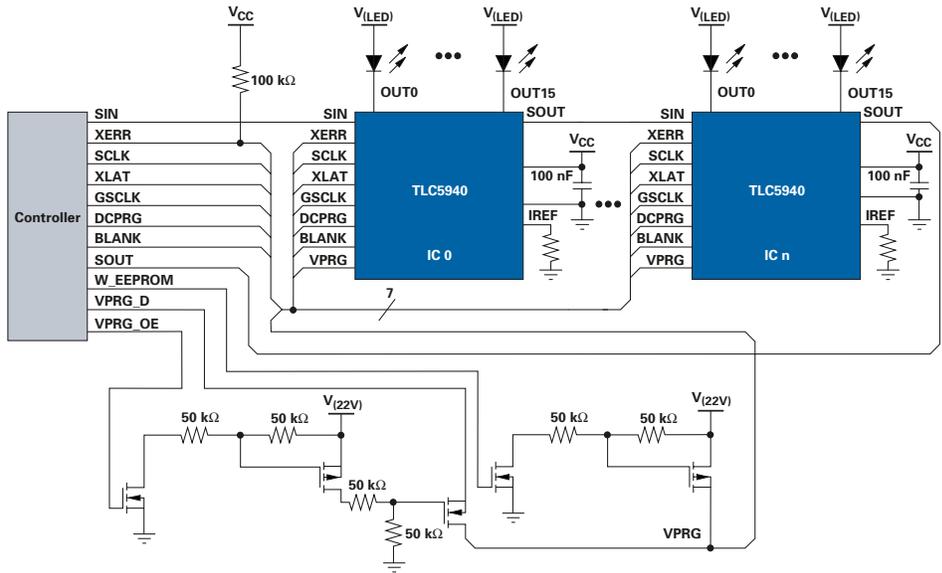
**Watchdog Timer** — Turns output off when scan signal is stopped.

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

**16-Channel LED Driver with Dot Correction and PWM Grayscale**  
**TLC5940**

Get samples, datasheets, evaluation modules and app reports at: [www.ti.com/sc/device/TLC5940](http://www.ti.com/sc/device/TLC5940)

The TLC5940 is an LED driver for high-end video displays. The device features 64-step dot correction and 4096-step PWM grayscale, with 120 mA of peak current per channel. EEPROM is integrated into the IC, and the device is offered in HTSSOP, PDIP and QFN packages.



**LED Drivers Selection Guide**

Device	Data Input (Bits)	No. of Chan.	V <sub>IN</sub> (V)	Output Current I <sub>LED</sub> (mA)	Output Voltage V <sub>LED</sub> (V)	Channel-to-Channel Accuracy (%)	Dev.-to-Dev. Accuracy (%)	Data Transfer Rate (MHz)	Recharged FET	Brightness Control (Bits)	Dot Correction (Bits)	PWM Grayscale Control (Bits)	OVM <sup>1</sup>	LOD <sup>2</sup>	TEF <sup>3</sup>	WDT <sup>4</sup>	TSD <sup>5</sup>	Price*
TLC5916/7	1	8	3.3 to 5.5	120	17	±3	±6	25	No	8	—	—	Yes	Yes	Yes	No	Yes	1.35
TLC5923	1	16	3.5 to 5.5	80	17	±1	±4	30	No	—	7	—	No	Yes	Yes	No	No	1.90
TLC5924	1	16	3.0 to 5.5	80	17	±1	±4	30	Yes	—	7	—	No	Yes	Yes	Yes	No	1.50
TLC5930	1	12	3.0 to 3.6	40	17	±1	—	20	No	6	8	10	Yes	Yes	Yes	No	No	2.50
TLC5940	1	16	3.0 to 5.5	120	17	±1	±2	30	No	—	6	12	No	Yes	Yes	No	No	1.90
TLC5941	1	16	3.0 to 5.5	80	17	±1	±2	30	No	—	6	12	No	Yes	Yes	No	No	1.65
TLC5942	1	16	3.0 to 5.5	50	17	±1.5	±3	30	No	—	7	12	No	Yes	Yes	No	Yes	1.75
TLC5943	1	16	3.0 to 5.5	50	17	±1.5	±3	30	No	7	—	16	No	Yes	Yes	No	Yes	2.00
TLC5945	1	16	3.0 to 5.5	80	17	±1	±2	30	No	—	6	12	No	Yes	Yes	No	No	1.75

<sup>1</sup>Output voltage monitoring. <sup>2</sup>LED open detection. <sup>3</sup>Thermal error flag. <sup>4</sup>Watchdog timer. <sup>5</sup>Thermal shutdown.  
\*Suggested resale price in U.S. dollars in quantities of 1,000.

## ➔ Photoflash Capacitor Chargers and Xenon Flashlight Drivers

### Design Factors

**Transformer** — The output voltage of the converter is set by the turns ratio of the flyback transformer. The switching frequency is determined by the primary inductance of the flyback transformer. These two factors, along with the necessary voltage rating of the secondary, are key requirements for selecting the transformer.

**Flash Capacitor** — The flash capacitor must be rated for photoflash applications. The flash capacitor usually has low inductance in order to handle the surge currents during a flash. Capacitors not rated for photoflash applications will have a short lifespan in this application.

**IGBT** — Look for a photoflash rating when selecting an IGBT used to trigger the flash tube. There are several IGBTs that can withstand the voltage and surge currents associated with the flash; however, they usually come in a very large package since these ratings are for continuous duty. The photoflash-rated IGBT has the same ratings but comes in a small package since the loads are all surge and not continuous.

**Flash Tube** — Selection of a flash tube is based on several system-level considerations such as desired light spectrum, physical size, mounting method, trigger method, required light power, flash frequency, flash voltage,

encapsulation material and tube coatings. Customers should determine which lamp to select for their specific applications.

**Trigger Transformer** — Selection of the trigger transformer should be performed once a lamp has been selected. Each lamp

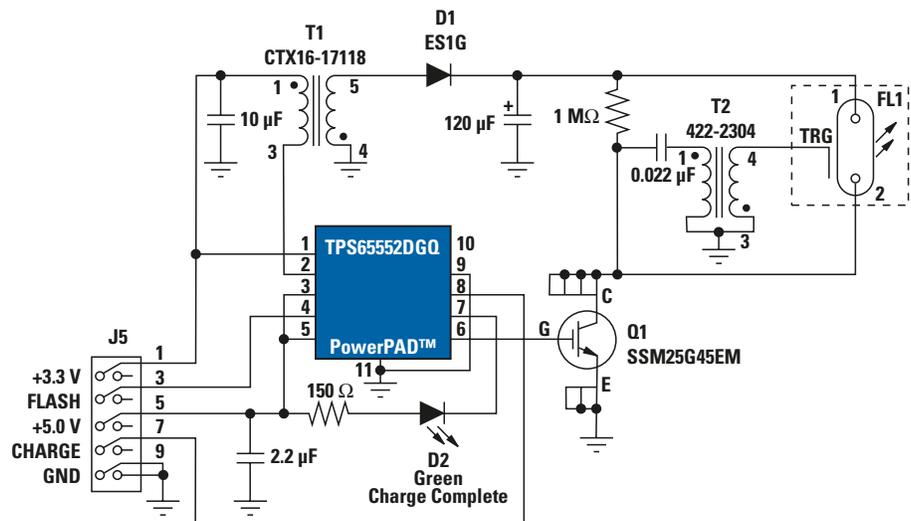
has a specific trigger energy needed to initiate a flash.

**Efficiency** — The efficiency of the converter is greatly impacted by the recovery time of the high-voltage diode. The faster the diode, the better the efficiency.

### Integrated Photoflash Charger and IGBT Driver TPS65552A

Get samples, datasheets, evaluation modules and app reports at: [www.ti.com/sc/device/TPS65552A](http://www.ti.com/sc/device/TPS65552A)

The TPS65552A offers a complete solution for charging a photoflash capacitor from a battery input, and subsequently discharging the capacitor to the xenon tube. The device includes an integrated power switch, IGBT driver, and control logic blocks for charge applications.



TPS65552A application circuit.

### Selection Guide

Device	Input Voltage (V)	V <sub>CC</sub> (V)	Programmable Peak Current (A)	Power Switch (V)	IGBT Driver	Protection			Package(s)	Price*
						Max On Time	Over-Voltage Shutdown	Thermal Monitor		
TPS65552A	1.8 to 12	5	0.95 to 1.8	50	Yes	Yes	Yes	Yes	10-pin MSOP, 16-pin QFN	1.00
<b>TPS65560</b>	1.6 to 12	2 to 4	0.9 to 1.8	50	Yes	Yes	Yes	Yes	16-pin QFN	<b>0.85</b>

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

New devices are listed in bold red.

## Charger Front-End Protection



### Li+ Charger Front-End Protection IC

#### bq24314

Get samples, datasheets, evaluation modules and app reports at: [www.ti.com/sc/device/bq24314](http://www.ti.com/sc/device/bq24314)

Charger front-end protection ICs provide protection from input over-voltage, input over-current and battery over-voltage conditions. The tri-level protection offers maximum safety when charging a handheld device. With integrated FET, the protection IC comes in 2 x 2-mm and 3 x 4-mm SON packages.

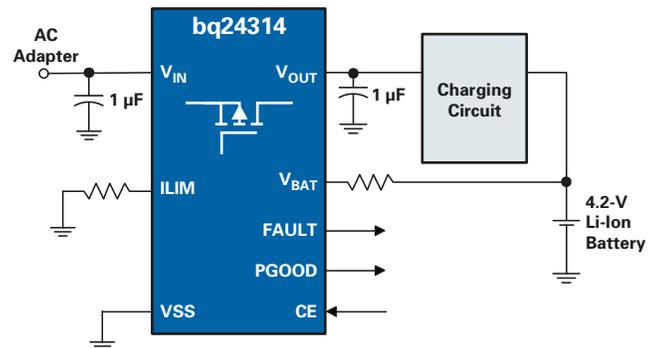
#### Features

- Provides protection for three variables:
  - Input over voltage (rapid response <math><1\ \mu\text{s}</math>)
  - User-programmable over current with current limiting
  - Battery over voltage

- 30-V maximum input
- Up to 1.5-A input current
- Thermal shutdown
- Enable input

#### Applications

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



#### Selection Guide

Device	V <sub>IN</sub> Max (V)	OVP (V)	OCP	Battery OVP (V)	LDO Output (V)	Max Operating Current (μA)	Package(s)	EVM	Price*	Comments
bq24300	30	10.5	Fixed 300 mA	4.35	5.5	500	8-QFN/SO8	✓	0.55	Reverse polarity protection
bq24304	30	10.5	Fixed 300 mA	4.35	4.5	500	8-QFN/SO8	✓	0.55	Reverse polarity protection
bq24314/A	30	5.85	Prog. <math><1.5\ \text{A}</math>	4.35	—	600	8/12-QFN/SO8	✓	0.55/0.65	Fault indication
bq24315	30	5.85	Prog. <math><1.5\ \text{A}</math>	4.35	5.5	600	8-QFN/SO8	✓	0.55	Fault indication
bq24316	30	6.5	Prog. <math><1.5\ \text{A}</math>	4.35	—	600	8/12-QFN/SO8	✓	0.55	Fault indication
bq24380/1	30	6.3/7.1	No OCP	4.35	5.5/5	250	8-QFN/SO8	✓	0.55/0.65	Fault indication

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

## Battery Charge Management



### Design Factors

**Battery Chemistry** — Each battery chemistry has unique requirements for its charge algorithm, which is critical for maximizing its capacity, cycle life and safety.

**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.

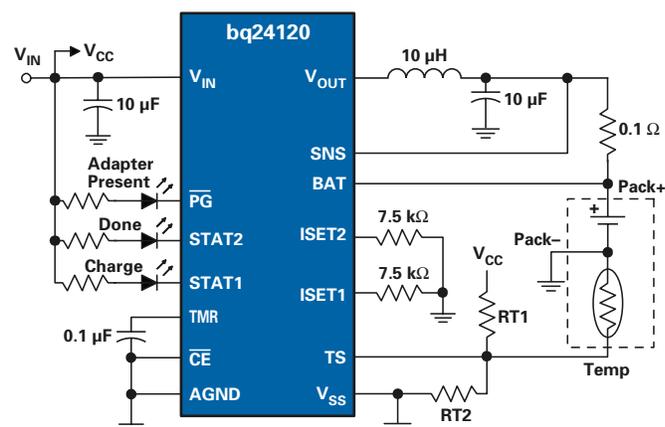
**Input Voltage** — Wide input-voltage range of the IC and input over-voltage protection offer maximum safety and allow use of low-cost unregulated wall adapters.

### 2-A Synchronous Switchmode Charger

#### bq2412x

Get samples, datasheets, evaluation modules and app reports at: [www.ti.com/sc/device/bq24120](http://www.ti.com/sc/device/bq24120)

The bq2412x are 2-A synchronous switchmode charge management devices for 1, 2 and 3 series Li-Ion or Li-Polymer battery packs. They offer enhanced EMI performance.





## Battery Charge Management

## Selection Guide

Device	Number of Cells	Control Topology <sup>1</sup>	Integrated Power FET	Charge Current Internal FET	V <sub>IN</sub> Max	Primary Charge Termination Method <sup>2</sup>	Safety Timer	Temp Monitor	Packaging						Price*	Comments	
									WCSF	QFN/WLP	MSOP	TSSOP	SOIC	DIP			EVM
<b>Multi-Chemistry (Li-Ion and NiCd/NiMH)</b>																	
bq2000	Multiple	Switching	No	—	—	PVD, min current	Yes	Yes			8	8	8	✓	1.50	Charges NiCd, NiMH, and Li-Ion	
bq2000T	Multiple	Switching	No	—	—	$\Delta T/\Delta t$ , min current	Yes	Yes			8	8	8	✓	1.50	Charges NiCd, NiMH, and Li-Ion	
bq24702/3	Multiple	Switching	No	—	30 V	Host controlled	No	No	28 <sup>3</sup>		24			✓	3.10	Dynamic Power Management	
bq24721C	3 or 4	Switching	No	—	30 V	SMBus	No	Yes	32					✓	4.90	SMBus and system power selector	
bq24740/50	2, 3 or 4	Switching	No	—	30 V	Host controlled	No	Yes	28					✓	4.90	bq24750 integrates system power selector	
bq24751A	2, 3 or 4	Switching	No	—	30 V	Host controlled	No	Yes	28					✓	4.90	Energy Star low I <sub>q</sub>	
bq24745	1 to 4	Switching	No	—	30 V	SMBus	Yes	No	28					✓	2.90	Level 2 charger with input current-detect comp.	
<b>Li-Ion Chemistry</b>																	
bq2057/C	1	Linear	No	—	18 V	Min current	No	Yes			8	8	8	✓	0.90	Low dropout, 4.1/4.2 V regulation, AutoComp™	
bq2057/W	2	Linear	No	—	18 V	Min current	No	Yes					8	8	✓	0.70	Low dropout, 8.2/8.4 V regulation, AutoComp
bq24010	1	Linear	Yes	1.0 A	18 V	Min current	Yes	No	10					✓	0.99	Allows use of unregulated wall supplies with high max V <sub>IN</sub>	
		Parameter	bq24010	bq24012	bq24013	bq24014	<b>bq24018</b>										
		Optional Functions <sup>4</sup>	PG, TS, 4.2 V	PG, CE, 4.2 V	CE, TTE, 4.2 V	CE, TS, 4.2 V	PG, TS, 4.36 V										
bq24020	1	Linear	Yes	1.0 A	7 V	Min current	Yes	Yes	10					✓	0.99	Autonomous USB and AC-adaptor supply management	
		Parameter	bq24020	bq24022	bq24023	bq24024	bq24025	bq24026	bq24027								
		Optional Functions <sup>4</sup>	CE and TS	PG and CE	CE and TTE	TTE and TS	CE and TS	TE and TS	PG and CE								
		Fast Charge Timer/Taper Timer	5/Yes	5/Yes	5/Yes	5/Yes	5/Yes	7/No	7/No								
bq24030	1	Linear	Yes	1.5 A	18 V	Min current	Yes	Yes	20					✓	1.95	Dynamic Power-Path Management powers the system and charges battery	
		Parameter	bq24030	bq24031	bq24032A	bq24035	bq24038										
		Output for AC Input Condition Charge Regulation Voltage (V)	Regulated to 6 V	Regulated to 6 V	Regulated to 4.4 V	Cutoff at 6 V	Regulated to 4.4 V										
			4.2	4.1	4.2	4.2	4.36										
bq24060	1	Linear	Yes	1 A	18 V	Min current	Yes	Yes	10					✓	0.99	Thermal regulation, over-voltage protection, LDO mode	
		Parameter	bq24060	bq24061	bq24064												
		Optional Functions <sup>4</sup>	TS	CE	TS												
		Input Over-Voltage (V)	6.5	6.5	10.5												
bq24070/1	1	Linear	Yes	1.5 A	18 V	Min current	Yes	Yes	20					✓	1.80	Dynamic Power-Path Management, 4.4-V or 6-V output voltage	
bq24080	1	Linear	Yes	1.0 A	7 V	Min current	Yes	Yes	10					✓	0.95	Simple integrated charger	
		Parameter	bq24080	bq24081	<b>bq24083</b>												
		Optional Functions <sup>4</sup>	PG and CE	TE and TS	PG and CE												
		Charge Regulation Voltage (V)	4.2	4.2	4.1												
bq24085	1	Linear	Yes	750 mA	18 V	Min current	Yes	Yes	10					✓	0.95	Works with low-cost unregulated wall adapters	
		Parameter	bq24085	bq24086	bq24087	<b>bq24088</b>											
		Optional Functions <sup>4</sup>	CE, PG	TS, PG	CE, TE	TS, PG											
		Input Over-Voltage (V)	6.5	6.5	6.5	10.5											
bq24100/8	1	Switching	Yes	2.0 A	20 V	Min current	Yes	Yes	20						2.15	bq24120 offers enhanced EMI performance	
bq24103/113	1 or 2	Switching	Yes	2.0 A	20 V	Min current/Host controlled	Yes	Yes	20						2.40	bq24123 offers enhanced EMI performance	
bq24105/115	1 to 3	Switching	Yes	2.0 A	20 V	Min current/Host controlled	Yes	Yes	20						3.50	bq24125 offers enhanced EMI performance	
bq25010/2	1	Linear	Yes	500 mA	7 V	Min current	Yes	No	20					✓	2.00	USB, integrated 150-mA DC/DC converter	
<b>bq25015/7</b>	1	Linear	Yes	500 mA	7 V	Min current	Yes	No	20					✓	2.20	USB, integrated 300-mA DC/DC converter	
bq2954	Multiple	Switching	No	—	—	Min current	Yes	Yes					16	16	✓	2.50	PWM control, low/high-side current sense
<b>NiCd/NiMH Chemistry</b>																	
bq2002/C/E/F	Multiple	Current-limited	No	—	—	- $\Delta V$ , PVD	Yes	Yes			8	8	8	✓	1.00	Low-cost nickel charge ICs	
bq2002D/T	Multiple	Current-limited	No	—	—	$\Delta T/\Delta t$	Yes	Yes					8	8	✓	1.00	Different charge timers and status display
bq24400/1	Multiple	Switching	No	—	—	PVD, $\Delta T/\Delta t$	Yes	Yes			8	8			1.50	Simple switching controller	
bq2004/E/H	Multiple	Switching	No	—	—	- $\Delta V$ , PVD, $\Delta T/\Delta t$	Yes	Yes					16	16	✓	2.20	Selectable timers and pulse-trickle rates
bq2005	Multiple	Switching	No	—	—	- $\Delta V$ , $\Delta T/\Delta t$	Yes	Yes					20		✓	2.20	Sequential fast charge of two battery packs
<b>Lead-Acid Chemistry</b>																	
UC3906	Multiple	Linear	No	—	40 V	Max V, min I	No	No					16	16		2.75	Temp-compensated internal reference
UC3909	Multiple	Switching	No	—	40 V	Max V, min I	No	Yes					20	20		3.05	Differential current sense input
bq2031	Multiple	Switching	No	—	—	Max V, - $\Delta^2 V$ , min I	Yes	Yes					16	16	✓	2.80	Three user-selectable charge algorithms to accommodate cyclic and standby applications

<sup>1</sup>Current-limited = gating control of external, current-regulated/limited source.<sup>2</sup>PVD = 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;  $\Delta^2 V$  = second difference of cell voltage.<sup>3</sup>Only bq24703 is available in QFN package.<sup>4</sup>TS = temperature sensing; PG = power good; CE = charge enable; TTE = timer and termination enable.

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

Preview devices are listed in bold blue.

### 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.

**Charge/Discharge Relationship** — The charge and discharge rates dictate the sense resistor value.

### Features

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

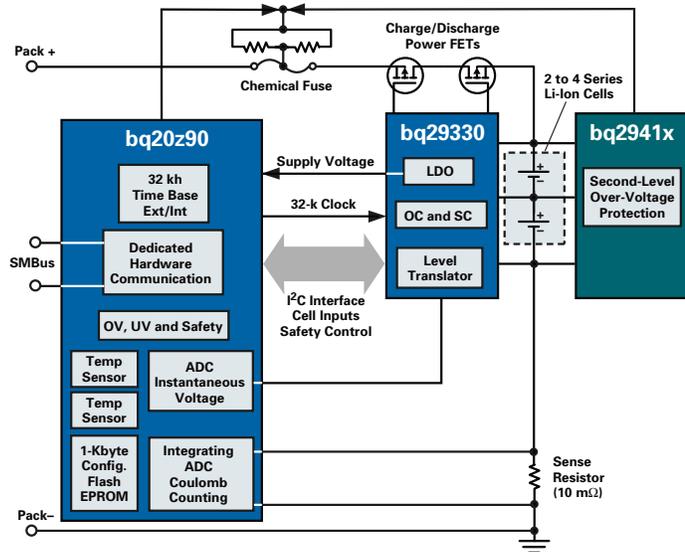
- Simple communication protocols.
- High-resolution analog-to-digital converters for accurate charge/discharge measurement.
- Integrated CPU on gas gauges to compute remaining battery capacity and run-time.

### 99% Accurate Gas Gauge Maximizes Run-Time

**bq20z70, bq20z80, bq20z90**

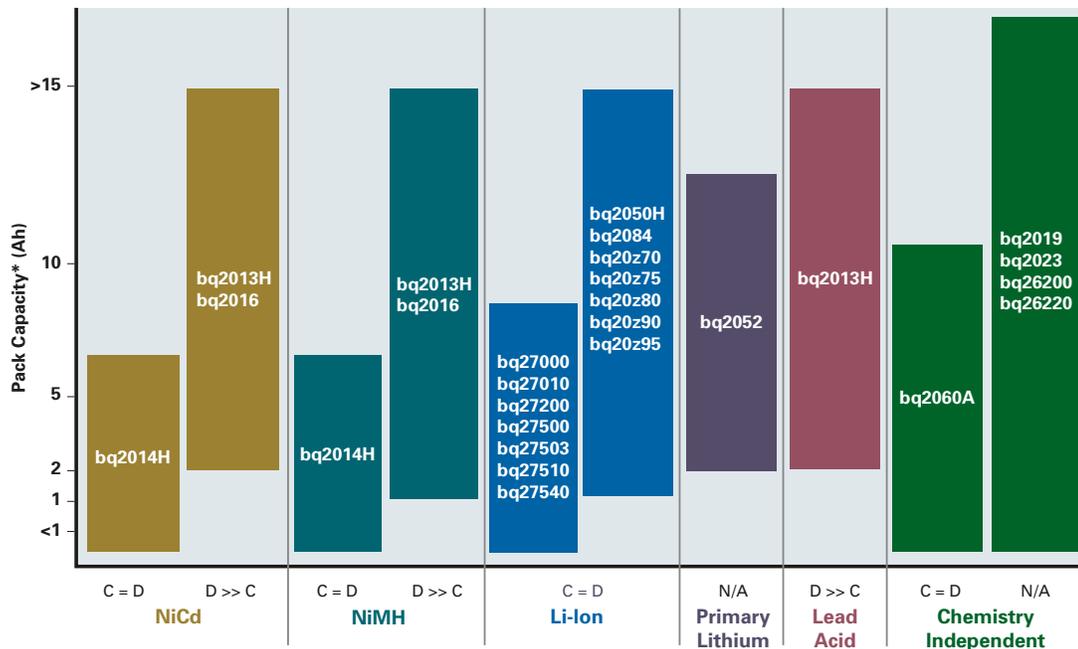
Get samples, datasheets, evaluation modules and app reports at: [www.ti.com/sc/device/bq20z90-v110](http://www.ti.com/sc/device/bq20z90-v110)

The dynamic Impedance Track™ gas gauge algorithm in the bq20z90 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 bq20z90 is ideally suited for battery packs used in medical and industrial equipment, back-up batteries and laptop computers.



Typical gas-gauge application.

### Battery Fuel Gauges Family of Products



C = D: Charge rate similar to discharge rate.  
 D >> C: Discharge rate much greater than charge rate.  
 N/A: Not Applicable.  
 \*Pack capacity ratings provide an approximate range for each gas gauge.



## Battery Fuel Gauges

### Selection Guide

Device	Approx. Battery Capacity (mAh)	Min Max Series Cell	Number of LEDs	Communication Protocol	Other Features	Safety Enhancement	Package	Price*
<b>NiCd, NiMH Chemistry</b>								
bq2013H	2000 to 15000	—	5	Single wire (HDQ)	Programmable offset error compensation	No	16-pin SOIC	3.70
bq2014H	500 to 6000	—	5	Single wire (HDQ)	Register compatible with bq2050H	No	16-pin SOIC	3.70
bq2016	1000 to 4500	—	5	Single wire (HDQ)	Automatic offset calibration	No	28-pin SSOP	3.00
<b>Lithium-Ion, Lithium-Polymer Chemistry</b>								
bq2050H	500 to 6000	—	5	Single wire (HDQ)	Register compatible with bq2014H	Yes	16-pin SOIC	3.70
bq2084	800 to 10000	2 to 4	3, 4 or 5	2 wire (SMBus)	SBS 1.1 works with bq29312 based on bq2083; includes bq2050 dataset via single wire interface	Yes	38-pin TSSOP	4.00
bq20z70	800 to 10000	2 to 4	No LED	HDQ and SMBus	Impedance Track™ fuel gauge for use with bq29312 protector	Yes	20-pin TSSOP	2.90
bq20z80	800 to 10000	2 to 4	3, 4 or 5	2 wire (SMBus)	Impedance Track fuel gauge for use with bq29330 protector	Yes	38-pin TSSOP	4.60
bq20z90	800 to 10000	2 to 4	3, 4 or 5	2 wire (SMBus)	Impedance Track fuel gauge for use with bq29330 protector	Yes	30-pin TSSOP	3.30
<b>bq20z75</b>	800 to 10000	2 to 4	No LED	2 wire (SMBus)	Impedance Track fuel gauge with integrated bq29330 protector	Yes	38-pin SMB	4.20
<b>bq20z95</b>	800 to 10000	2 to 4	3, 4 or 5	2 wire (SMBus)	Impedance Track fuel gauge with integrated bq29330 protector	Yes	44-pin SMB	4.60
bq27000	300 to 6000	1	—	HDQ	Single-cell fuel gauge with fixed-voltage EOD	No	10-pin DRK	1.95
bq27200	300 to 6000	1	—	I <sup>2</sup> C	Single-cell fuel gauge with fixed-voltage EOD	No	10-pin DRK	1.95
bq27010	300 to 6000	1	—	HDQ	Single-cell fuel gauge with compensated-voltage EOD	No	10-pin DRK	1.95
<b>bq27210</b>	300 to 6000	1	—	I <sup>2</sup> C	Single-cell fuel gauge with compensated-voltage EOD	No	10-pin DRK	1.95
<b>bq27500</b>	300 to 6000	1	—	I <sup>2</sup> C	Single-cell system-side fuel gauge w/ Impedance Track technology	No	12-pin QFN	1.35
<b>bq27510</b>	300 to 6000	1	—	I <sup>2</sup> C	Single-cell system-side fuel gauge w/ Impedance Track technology with integrated LDO	No	12-pin QFN	1.35
<b>bq27503</b>	300 to 6000	1	—	I <sup>2</sup> C	Single-cell system-side fuel gauge w/ Impedance Track technology with authentication challenger	No	12-pin QFN	1.35
<b>bq27540</b>	300 to 6000	1	—	I <sup>2</sup> C	Single-cell battery-side fuel gauge w/ Impedance Track technology	No	12-pin QFN	1.35
<b>Primary Lithium Chemistry</b>								
bq2052	1000 to 12000	1	2, 4 or 5	Single wire (HDQ)	Automatic discharge compensation	No	16-pin SOIC	4.00
<b>Lead Acid Chemistry</b>								
bq2013H	2000 to 15000	10	5	Single wire (HDQ)	Programmable offset error compensation	No	16-pin SOIC	3.70
<b>Multi-Chemistry</b>								
bq2060A	800 to 10000	0.1	4 or 5	SMBus or HDQ16	SBS 1.1 extended cold temp cell modeling and high temp safety enhancement, improved bq2060	Yes	28-pin SSOP	3.90
<b>Battery Monitors</b>								
bq2019	>20000	1	—	Single wire (HDQ)	64-bit ID ROM and 1 program output non-volatile memory	—	8-pin TSSOP	1.95
bq2023	>20000	0.25	—	Single wire (SDQ)	64-bit ID ROM and 1 program output automatic offset error calibration	—	8-pin TSSOP	2.00
bq26200	>20000	0.25	—	Single wire (HDQ)	High-performance battery, coulomb counter	—	8-pin TSSOP	2.00
bq26220	>20000	0.25	—	Single wire (HDQ)	64-bit ID ROM and 1 program output on-chip voltage measurement	—	8-pin TSSOP	2.05

\*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: [power.ti.com](http://power.ti.com)



### Design Factors

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

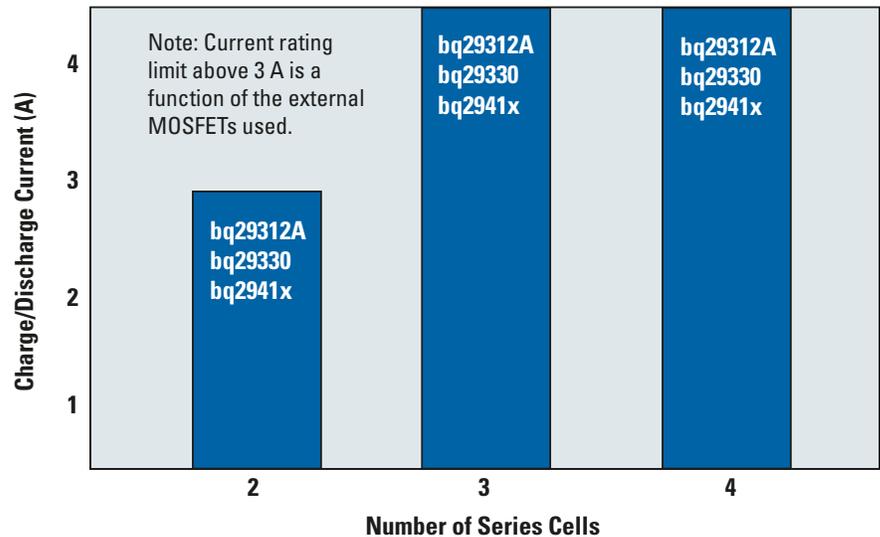
**Threshold Voltage** — Li-Ion and Li-Polymer cells are produced by many manufacturers. Some manufacturers' technologies create cells of different maximum stress voltages, otherwise known as the "over-voltage threshold." This data is available from the cell supplier.

**Threshold Tolerance** — The over-voltage 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.

### Lithium-Ion Protection Family of Products



### Features

- BiCMOS process results in low current consumption.
- Different over-voltage thresholds allow one design to work with several cell suppliers.
- Sleep current consumption of less than 3.5  $\mu\text{A}$  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)	Threshold Voltage ( $V_{OV}$ )	Shutdown Current ( $\mu\text{A}$ )	Other Features	Package	Price*
bq29312A	2, 3 or 4	External FET	bq2084 <sup>1</sup> , bq20z80 <sup>1</sup>	1	Integrated LDO, works directly with bq2084 and bq20z80 gas gauge	24-pin TSSOP	1.00
bq29330	2, 3 or 4	External FET	bq20z90 <sup>1</sup>	1	Integrated LDO, works directly with bq20z90 gas gauge	20-pin TSSOP	1.00
bq2941x	2, 3 or 4	—	x = voltage level	1	Second overvoltage safety for chemical fuse activation	8-pin TSSOP	0.45

<sup>1</sup>Controlled by bq208x, bq20z8x or bq20z9x gas gauge.

See individual datasheets for full details.

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

**For a complete list of Resources, visit: [power.ti.com](http://power.ti.com)**

## → Authentication for Batteries and Peripherals

### Design Factors

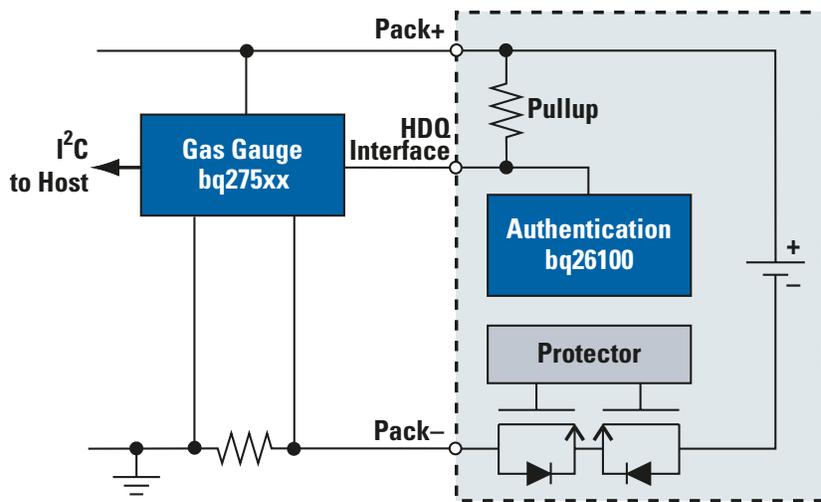
Original equipment manufacturers specify products to achieve required performance and safety goals. Authentication ensures that connected devices fulfill the established requirements and are safe for the consumer.

### 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*
bq2022	SDQ	3	ID number	-40 to 85	1.25
bq26150	HDQ	5	CRC algorithm	-20 to 70	1.25
bq26100	SDQ	5	SHA-1 encryption	-20 to 70	1.30

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

## Hot Swap and Power Distribution

### → Power-over-Ethernet

#### Design Factors

##### IEEE 802.3af Power-over-Ethernet

With approval of the IEEE 802.3af Power-over-Ethernet (PoE) standard, all data terminal equipment (DTE) now has the option to receive power over existing CAT-5 and CAT-3 cabling that is used for data transmission. The IEEE 802.3af standard defines the requirements associated with providing and receiving PoE cables. The Power Sourcing Equipment (PSE) provides the power on the cable and the

Powered Device (PD) receives the power. As part of the IEEE 802.3af standard, the interface between the PSE and the PD is defined as it relates to the detection and classification protocol.

**Power Sourcing Equipment (PSE)** — The TPS2384 Quad PSE Manager independently manages power for up to four Ethernet ports, reporting system status over a standard I<sup>2</sup>C serial interface. In anticipation of the upcoming 802.3at standard, the TPS23841

provides the capability to supply up to 25 W per port, with all of the same features as the TPS2384.

**Powered Devices (PDs)** — Acting as an interface between the PSE and PD, the TPS23750 performs all detection, classification, inrush current limiting and switch FET control that is necessary for compliance with the IEEE 802.3af standard.



### IEEE 802.3af Integrated Primary-Side PD Controller

#### TPS23753

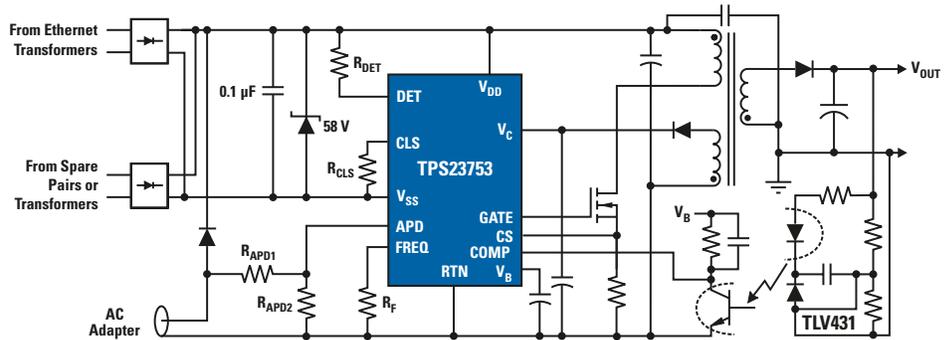
PREVIEW\*

The TPS23753 PD controller plus onboard DC/DC converter will optimize your 802.3af design. With easy selection and prioritization of PSE and auxiliary power supplies, the TPS23753 is the perfect answer to nearly every standard PoE PD application.

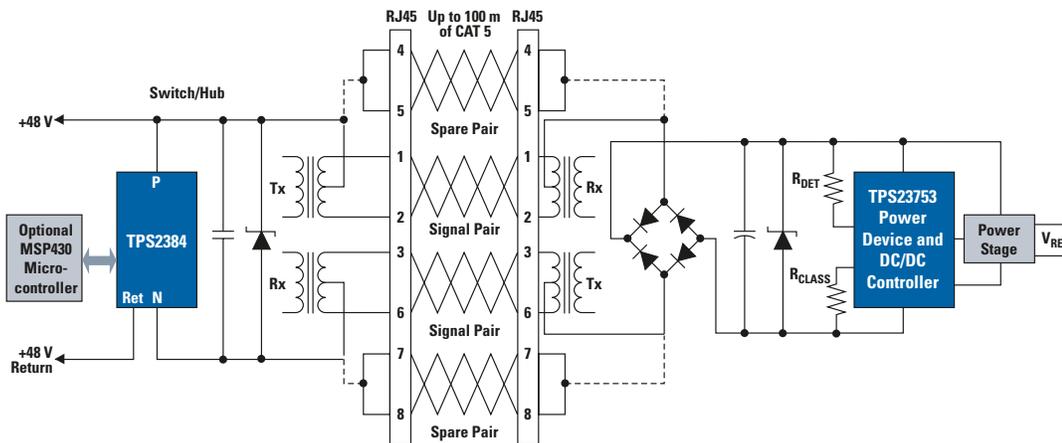
#### Key Features

- Works with wall adapters having as low as 12-V outputs
- APD pin easily sets auxiliary power priority

\*Anticipated release: June 2008



### Power-over-Ethernet (PoE) Application Diagram



The new TPS2384 and TPS23753 are IEEE 802.3af 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](http://www.ti.com/poe)

### Selection Guide

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*
<b>Power-over-Ethernet (PoE) Powered Device (PD) Interface Switches</b>												
TPS2375	Powered Device Controller	4	Yes, Class 0-4	100	-40 to 85	Programmable	450	Latch Off	802.3af (30.6/39.4 V)	PG	SOIC-8, TSSOP-8	1.25
TPS2375-1	Powered Device Controller	4	Yes, Class 0-4	100	-40 to 85	Programmable	450	Auto Retry	802.3af (30.6/39.4 V)	PG	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	1.25
TPS2376-H	High-Power Powered Device Cont.	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	1.25
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
TPS23750	Integrated PD with PWM Controller	4	Yes, Class 0-4	100	-40 to 85	Fixed	450	Auto Retry	802.3af (30.6/39.4 V)	N/A	TSSOP-20	1.75
<b>TPS23753</b>	PD+Controller with AUX ORing	4	Yes, Class 0-4	100	-40 to 85	Fixed	450	Auto Retry	802.3af (30.6/39.4 V)	N/A	TSSOP-14	1.75
TPS23770	Integrated PD with PWM Controller	4	Yes, Class 0-4	100	-40 to 85	Fixed	450	Auto Retry	Legacy (30.5/35.0 V)	N/A	TSSOP-20	1.75
PTB48540	5-V, 10-W PoE Power Module	4	Yes, Class 0-4	100	-40 to 85	Fixed	450	Latch Off	802.3af (30.6/39.4 V)	N/A	13-DIP Module	26.00

Device	Applications	Channels	Abs Max $V_{IN}$ (V)	Operating Temp (°C)	IEEE Compliant	Interface	Disconnect	Measurements	Power FET	Package	Price*
<b>PoE Power Sourcing Equipment (PSE) Controllers</b>											
TPS2384	Routers, switches, SOHO hubs, mid-spans	4	80	-40 to 125	Yes	I <sup>2</sup> C	Both AC and DC	Current, voltage, capacitance and temperature	Internal	64-pin LQFP	4.73
TPS23841	High-power (25 W) routers, switches, SOHO hubs, mid-spans	4	80	-40 to 125	Yes	I <sup>2</sup> C	Both AC and DC	Current, voltage, capacitance and temperature	Internal	64-pin LQFP	7.50

For additional resources on PoE, including reference designs and evaluation modules, please see: [power.ti.com/poe](http://power.ti.com/poe)

Preview devices are listed in bold blue.

## Hot Swap Power Management

### What is ATCA?

Advanced telecommunications computing architecture (ATCA) is the first open standard for carrier grade communications equipment. The requirements for ATCA are defined in PICMG 3.0 specifications and include mechanical, shelf management, power distribution, data transport, thermal, regulatory guidelines and data/power connectors.

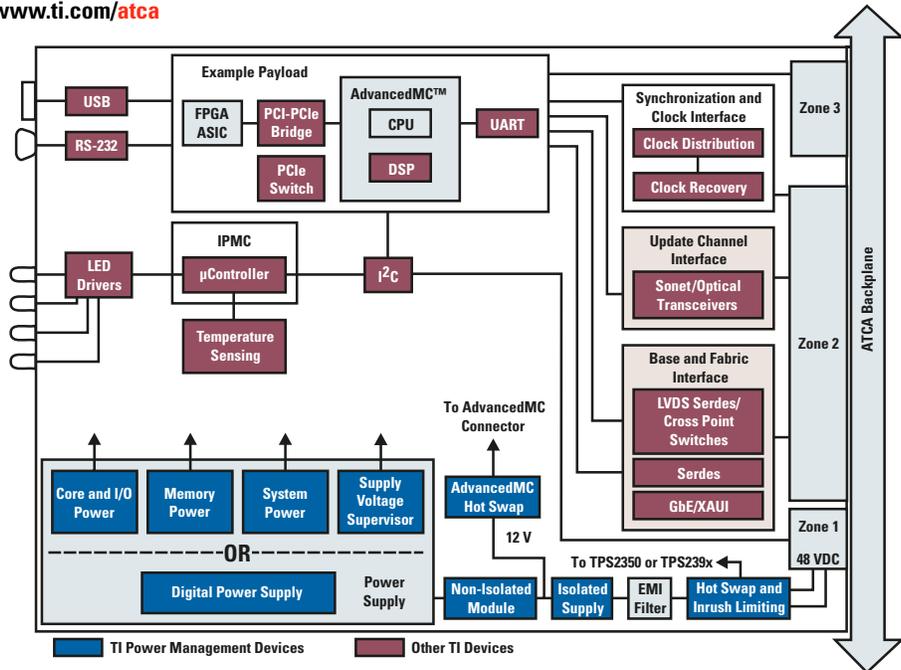
The ATCA standard has specific requirements for delivering dual  $-48\text{-V}$  power feeds to individual boards (carrier cards) which may consume up to 200 W each. Each of these carrier cards can be populated with AdvancedMC™ (Advanced Mezzanine Card) daughter cards, providing further scalability.

### What is $\mu$ TCA?

$\mu$ TCA is a separate PICMG standard providing for systems which directly host AdvancedMCs.  $\mu$ TCA systems are ideal for distributed and highly scalable applications like cell-phone base stations or small-scale enterprise networks. These AdvancedMCs form the simplest common element for ATCA and  $\mu$ TCA systems and can be used to carry out any application specific task (see below).

### ATCA Power Solutions

[www.ti.com/atca](http://www.ti.com/atca)



### ATCA Power Requirements

- Dual, redundant  $-48\text{-V}$  from one or two power plants
- UVLO between  $-32\text{-V}$  and  $-36\text{-V}$
- Inrush current limiting
- Maximum 200 W per board
- Fuses on both  $-48\text{-V}$  feeds and both returns
- Isolation between A and B feeds/returns
- 5-ms holdup with input short to ground
- 80-W maximum for mezzanine cards
- 100-V transient capability

### Integrated Dual-Slot AdvancedMC™ Hot Swap Controller

#### TPS2359

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

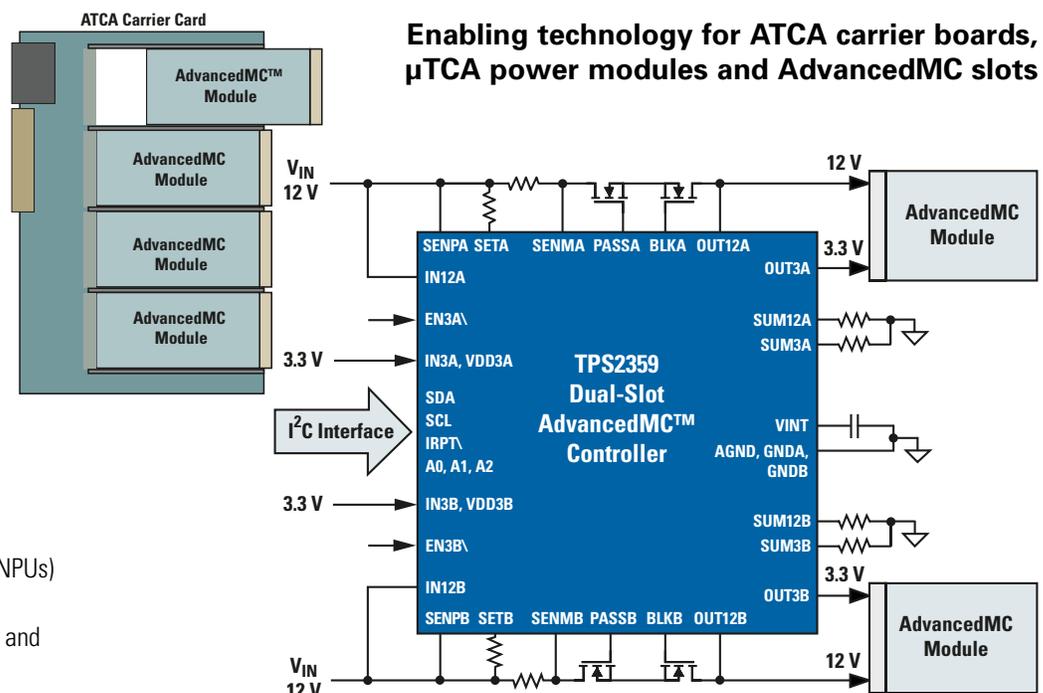
[www.ti.com/sc/device/TPS2359](http://www.ti.com/sc/device/TPS2359)

#### Features

- Hot-swap control on 12-V, 3.3-V rails
- Supports two AdvancedMC slots
- I<sup>2</sup>C programmability for easy flexible configuration and monitoring
- ORing for 3.3 V and 12 V
- Twice the over-current threshold accuracy
- Minimal external components

#### Applications

- Telecom connectivity
- Processors
- Network communication processors (NPU)s
- Mass storage
- Ideal for systems requiring scalability and redundancy

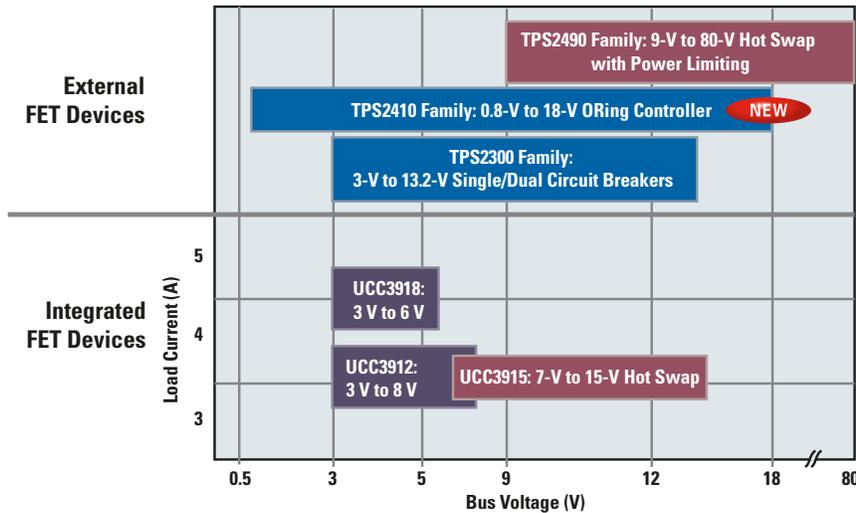


### Enabling technology for ATCA carrier boards, $\mu$ TCA power modules and AdvancedMC slots

## Hot Swap Power Management



### Hot Swap Overview



### TPS2410 Family

- Offers a high efficiency replacement to ORing diodes
- Controls bus voltages down to 0.8 V
- Strong 10-V gate drive to fully enhance an N-channel FET
- Fast 130-ns turn-off time to protect board against failures

### TPS2490/91

- 9-V to 80-V operation with external FET
- Power limiting for FET protection
- Latch or auto-retry
- Small 10-pin MSOP package

### TPS2420/21/32

(Watch for new releases later this year.)

### Hot Swap Switches (Integrated FET) Selection Guide

Device	Target Applications	Channels	V <sub>IN</sub> (V)	Current Limit (A)	r <sub>DS(on)</sub> per FET (typ) (mΩ)	Enable/Shutdown	Ramp	Package(s)	Price*
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
UCC3916	SCSI, General	1	4 to 6	1.65	220	1L	Current	SOIC-8	1.70

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

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

Device	Target Applications	Channels	V <sub>IN</sub> 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 <sup>1</sup>	S <sup>1</sup>	Current	No	16-pin SOIC/TSSOP	2.35
TPS2342	CompactPCI, PCI-X, PC-X2.0	12	3.3, V <sub>aux</sub> , V <sub>I/O</sub> , 5, +12, -12	1L	✓		✓	✓	✓		Voltage	No	80-pin HTQFP	7.00
TPS2343	CompactPCI, PCI-X, PC-X2.0	12	3.3, V <sub>aux</sub> , V <sub>I/O</sub> , 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
<b>TPS2358</b>	μTCA Power Modules, ATCA Carrier Cards	4	2.9 to 5/8.5 to 17	4L	✓		✓	✓	✓		Current	No	48-pin QFN	4.00
<b>TPS2359</b>	μTCA Power Modules, ATCA Carrier Cards	4	2.9 to 5/8.5 to 17	2H/2L	✓	✓	✓	✓	S <sup>1</sup>	S <sup>1</sup>	Current	No	36-pin QFN	5.00
TPS2363	PCI Express	6	3.3 V <sub>aux</sub> , 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	1.80
TPS2393	Full Featured -48-V Telecom	1	-20 to -80	1H	✓	✓	✓	✓	✓	✓	Current	No	14/44-pin TSSOP	1.80
TPS2393A	Full Featured -48-V Telecom (Fast Retry)	1	-20 to -80	1H	✓	✓	✓	✓	✓	✓	Current	No	14-pin TSSOP	1.80
TPS2398	Simple -48-V Telecom with PG	1	-36 to -80	1H			✓	✓	✓		Current	No	8-pin MSOP	1.25
TPS2399	Simple -48-V Telecom with PG	1	-36 to -80	1H			✓	✓	✓	✓	Current	No	8-pin MSOP	1.25
TPS2400	Overvoltage/Undervoltage Protection IC	1	2 to 100	1H	✓	✓			✓		—	No	SOT-23-5	0.80
TPS2410/1	N+1 and OR-ing Power Rail Controller	1	0.8 to 18	1H	✓	✓	✓	✓	✓		Voltage	No	14-pin TSSOP	1.70
TPS2412/3	N+1 and OR-ing Power Rail Controller	1	0.8 to 18	1H			✓	✓	✓		Voltage	No	14-pin TSSOP	1.20
TPS2490	Servers, Basestations, +48 V, +12 V	1	9 to 80	1H	✓		✓	✓	✓		Current	Yes	10-pin MSOP	1.70
TPS2491	Servers, Basestations, +48 V, +12 V	1	9 to 80	1H	✓		✓	✓	✓		Current	Yes	10-pin MSOP	1.70

<sup>1</sup>S = Selectable.

\*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: [power.ti.com](http://power.ti.com)

## → USB Devices

### Design Factors

#### USB High-Power Peripheral Switch With Dual Current Limit + LDO

**TPS2140/41/50/51** — The TPS2140/41/50/51 target high-power USB peripherals such as ADSL modems. The devices contain a power switch and an LDO. The dual-current-limiting switch allows the use of high-value capacitance to stabilize the voltage from the USB bus.

#### Dual Power Switch + LDO for USB Bus-Powered Peripherals and Hubs

**TPS2148/49** — TPS2148 is a complete power management solution for USB bus-powered peripherals such as zip drives, while TPS2149 is for USB bus-powered hubs, such as keyboards with integrated hubs. TPS2148/9 each combine a 3.3-V LDO and dual power switch in a single MSOP. The TPS2148 switch configuration allows power and board capacitance segmentation to meet USB system current requirements. The TPS2149 switches manage two independent or four ganged USB ports.

#### 4-Port USB Hub Power Controllers

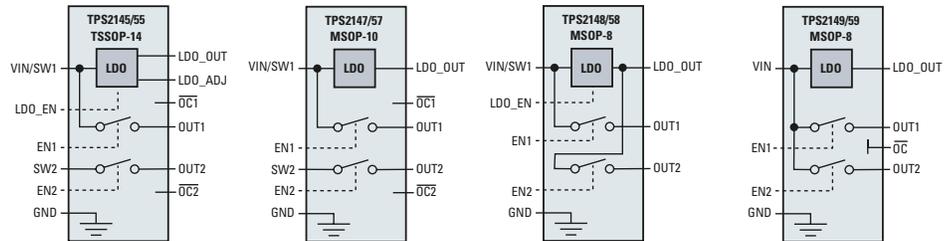
**TPS207x** — The TPS207x family provides the complete power solution for 4-port self-

### USB Devices Family of Products

#### 4-Port USB Hub Power Controllers

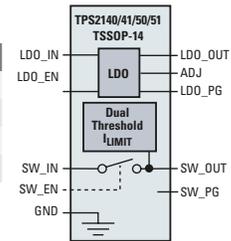
Device	5-V LDO Controller	Bus Power Mode Indicator	Pins	Package
TPS2070	Yes	Active Low	32	HTSSOP
TPS2071	Yes	Active High	32	HTSSOP
TPS2074	No	Active Low	24	SSOP
TPS2075	No	Active High	24	SSOP

#### Dual Power Switch + LDO for USB Bus-Powered Peripherals and Hubs



#### USB High-Power Peripheral Bus Switch + LDO

Device	Switch Voltage	Description
TPS2140	3.3 V	3.3-V, 500-mA switch with active-low enable, 250-mA LDO
TPS2141	5.0 V	5.0-V, 500-mA switch with active-low enable, 250-mA LDO
TPS2150	3.3 V	3.3-V, 500-mA switch with active-high enable, 250-mA LDO
TPS2151	5.0 V	5.0-V, 500-mA switch with active-high enable, 250-mA LDO



powered, bus-powered or hybrid USB hubs by incorporating current-limited switches for four ports, a 3.3-V 100-mA LDO, a 5-V LDO

controller for self power (TPS2070, TPS2071) and a DPO line control to signal an attach to the host.

### USB Power Controllers

Device	Application	Number of FETs	Switch Enable	Bus Power Indicator (BPMODE)	V <sub>IN</sub>		Bus Powered		Self Powered		LDO Controller	LDO	Price*
					(min) (V)	(max) (V)	r <sub>DS(on)</sub> per FET (typ) (mΩ)	Current Limit (min) (A)	r <sub>DS(on)</sub> per FET (typ) (mΩ)	Current Limit (min) (A)			
TPS2070	USB 4-port hub	8	L	1L	4.5	5.5	560	0.12	107	0.6	5 V, 3 A	3.3 V, 100 mA	2.55
TPS2071	USB 4-port hub	8	L	1H	4.5	5.5	560	0.12	107	0.6	5 V, 3 A	3.3 V, 100 mA	2.55
TPS2074	USB 4-port hub	8	L	1L	4.5	5.5	500	0.12	100	0.6	—	3.3 V, 100 mA	2.55
TPS2075	USB 4-port hub	8	L	1H	4.5	5.5	500	0.12	100	0.6	—	3.3 V, 100 mA	2.55
TPS2140	USB peripheral	1	L	—	2.7	5.5	70	0.1 and 1.2	—	—	—	Adj. 0.9 to 3.3 V, 250 mA	1.10
TPS2141	USB peripheral	1	L	—	4	5.5	70	0.1 and 1.2	—	—	—	Adj. 0.9 to 3.3 V, 250 mA	1.10
TPS2150	USB peripheral	1	H	—	2.7	5.5	70	0.1 and 1.2	—	—	—	Adj. 0.9 to 3.3 V, 250 mA	1.10
TPS2151	USB peripheral	1	H	—	4	5.5	70	0.1 and 1.2	—	—	—	Adj. 0.9 to 3.3 V, 250 mA	1.10
TPS2145	DSP, PDA	2	L	—	2.9	5.5	340	0.2	—	—	—	3.3 V, 200 mA	1.15
TPS2147	DSP, PDA	2	L	—	2.9	5.5	340	0.2	—	—	—	3.3 V, 200 mA	1.10
TPS2148	USB peripheral	2	L	—	2.9	5.5	340	0.2	—	—	—	3.3 V, 200 mA	0.99
TPS2149	USB 2-port hub	2	L	—	2.9	5.5	340	0.2	—	—	—	3.3 V, 200 mA	0.95
TPS2155	DSP, PDA	2	H	—	2.9	5.5	340	0.2	—	—	—	3.3 V, 200 mA	1.15
TPS2157	DSP, PDA	2	H	—	2.9	5.5	340	0.2	—	—	—	3.3 V, 200 mA	1.10
TPS2158	USB peripheral	2	H	—	2.9	5.5	340	0.2	—	—	—	3.3 V, 200 mA	0.99
TPS2159	USB 2-port hub	2	H	—	2.9	5.5	340	0.2	—	—	—	3.3 V, 200 mA	0.95

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



## Design Factors

### PCMCIA/CardBus Power Switches

Standard PC cards require that  $V_{CC}$  be switched between ground, 3.3 V and 5 V, while  $V_{PP}$  is switched between ground, 3.3 V, 5 V and 12 V. CardBay sockets have the standard requirements for  $V_{CC}$ , but require ground, 3.3 V and 5 V to  $V_{PP}$ , and ground, 1.8 V or 3.3 V to  $V_{CORE}$ . Other PC card applications may simply not need 12 V or  $V_{PP}$  while still having the standard requirements for  $V_{CC}$ . Therefore, consider the voltage requirements of the application when selecting a PCMCIA power switch.

### CableCARD™ Power Requirements

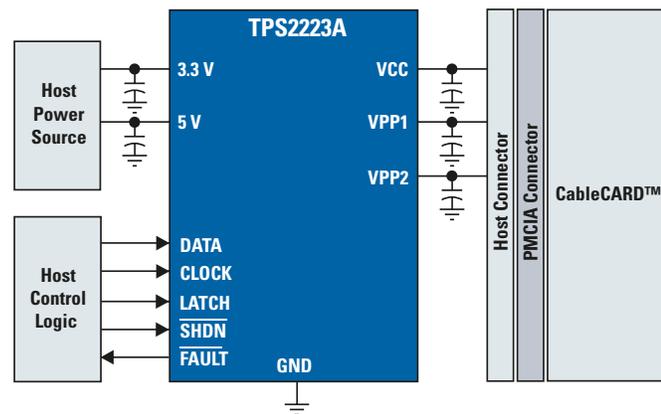
Many consumer set-top boxes today require the implementation of CableCARD compliant slots, similar to PCMCIA Type II cards. These CableCARD-compliant slots enable third-party equipment to be used with telecommunications service provider networks. The TPS2223A, TPS2221 and other switches from Texas Instruments are ideal to provide the various power requirements for many CableCARD applications.

## PCMCIA Devices Family of Products

### PCMCIA/CardBus Power Switch Matrix ICs

	Current Limit (min) (A)			
	0.3	0.7	1.0	2.5
<b>3.3 V, 5 V, 12 V, <math>V_{PP}</math></b>				
Dual	—	—	TPS2224A, TPS2226A, TPS2204A, TPS2206A, TPS2205,	—
Single	TPS2212	—	TPS2204A, TPS2210A, TPS2211A, TPS2220A, TPS2220B	TPS2231
<b>No 12 V</b>				
Dual	—	—	TPS2223A	TPS2236
Single	—	TPS2044B/54B <sup>1</sup>	—	—
<b>No <math>V_{PP}</math></b>				
Dual	—	TPS2044B/54B <sup>1</sup>	—	—

<sup>1</sup>UL products.



Typical CableCARD application.

## Selection Guide

Device	Interface	Number of Ports	3.3-V $r_{DS(on)}$ (typ) (m $\Omega$ )	5.0-V $r_{DS(on)}$ (typ) (m $\Omega$ )	$I_{OS}$ (min) (A)	Predecessor	Price*
<b>PCMCIA/CardBus Switch Matrix ICs</b>							
TPS2210A	3-line Serial	1	85	95	1	—	0.85
TPS2204A	3-line Serial	2	85	95	1	TPS2214/14A	1.95
TPS2220B	3-line Serial	1	85	95	1	TPS2220A	0.85
TPS2223A	3-line Serial	2	85	95	1	—	1.80
TPS2224A	3-line Serial	2	85	95	1	TPS2214/14A	1.95
TPS2226A	3-line Serial	2	85	95	1	TPS2206, TPS2216/16A	2.10
TPS2206A	3-line Serial	2	85	95	1	TPS2206, TPS2216/16A	2.10
TPS2205	8-line Parallel	2	70	100	1	TPS2201	2.90
TPS2211A	4-line Parallel	1	70	57	1	TPS2211	0.75
TPS2212	4-line Parallel	1	160	160	0.3	—	1.45
TPS2231	4-line Parallel	1	68	—	2.5	—	1.00
TPS2044B or 54B	Parallel	1 or 2	80	80	0.7	TPS2044/44A, TPS2054/54A	1.00
TPS2221	Interface Parallel	1	72	97	1	—	1.85
TPS2228	Interface Serial	2	72	97	1	—	3.10

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

## Power Multiplexers and ExpressCard™ Power Switches

### Power MUX ICs

Power MUX ICs are designed to transition from a main power supply to an auxiliary source when the main supply shuts down (e.g., switching from battery operation to a wall adapter).

### Power Multiplexers Family of Products

Configuration	Device	I <sub>OUT</sub> (mA)	Transition	Comments
	TPS2100/1	IN1: 500, IN2: 10	Manual	SOT-23, 0 to 70°C
	TPS2102/3	IN1: 500, IN2: 100	Manual	SOT-23, 0 to 70°C
	TPS2104/5	IN1: 500, IN2: 100	Manual	SOT-23, -40 to 85°C
IN1 	TPS2110A	Adj. 310 to 750	Auto/Manual	TSSOP
IN2 	TPS2111A	Adj. 630 to 1250	Auto/Manual	TSSOP
	TPS2112A	Adj. 310 to 750	Auto	TSSOP, Status pin
	TPS2113A	Adj. 630 to 1250	Auto	TSSOP, Status pin
	TPS2114A	Adj. 310 to 750	Auto/Manual	TSSOP, Status pin
	TPS2115A	Adj. 630 to 1250	Auto/Manual	TSSOP, Status pin

See also TPPM0301/2/3 (for NIC cards) in the selection guide below.

### Selection Guide

Device	Number of Inputs	IN1 r <sub>DS(on)</sub> (mΩ)	IN2 r <sub>DS(on)</sub> (mΩ)	IN1 Output Current (mA)	IN2 Output Current (mA)	IN1 Supply Current (μA)	IN2 Supply Current (μA)	Input Voltage Range (V)	Transition Time		Transition	Price*
									IN1 to IN2 (μs)	IN2 to IN1 (μs)		
TPPM0301/2	3	—	—	400	400	2500	250	3 to 5.5	—	—	Autoswitch	1.60
TPPM0303	3	—	—	250	250	2500	250	3 to 5.5	—	—	Autoswitch	1.07
TPS2100/1	2	250	1300	500	10	10	0.75	2.7 to 4.0	4	900	L/H enable	0.59
TPS2102/3	2	250	1300	500	100	14	0.75	2.7 to 4.0	3	700	L/H enable	0.69
TPS2104/5	2	250	1300	500	100	18	0.75	2.7 to 5.5	3	700	L/H enable	0.85
TPS2110A/2A/4A	2	120	120	312 to 750	312 to 750	85	85	2.8 to 5.5	40	40	Autoswitch	0.70
TPS2111A/3A/5A	2	84	84	625 to 1250	625 to 1250	85	85	2.8 to 5.5	40	40	Autoswitch	0.70

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

### ExpressCard™ Power Switches

The TPS2231 and TPS2236 ExpressCard power interface switches provide the total power management solution required by the ExpressCard specification. The TPS2231 and TPS2236 ExpressCard power interface switches distribute 3.3 V, AUX, and 1.5 V to

the ExpressCard socket. Each voltage rail is protected with integrated current-limiting circuitry. The TPS2231 supports systems with

single-slot ExpressCard/34 or ExpressCard/54 sockets. The TPS2236 supports systems with dual-slot ExpressCard sockets.

### Selection Guide

Device	Ports	3-V r <sub>DS(on)</sub> (typ) (mΩ)	Interface	Current Limit (min) (A)
TPS2231	1	45	Parallel	2.5
TPS2236	2	45	Parallel	2.5

### Integrated ExpressCard™ Power Interface Switch

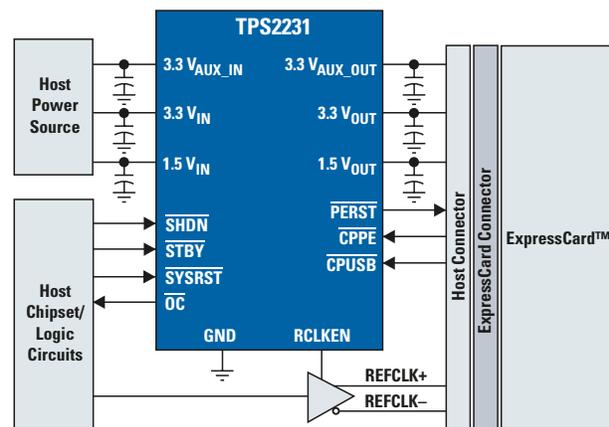
#### TPS2231

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

[www.ti.com/sc/device/TPS2231](http://www.ti.com/sc/device/TPS2231)

#### Key Features

- Meets PC card standard for ExpressCard technology
- TTL-logic compatible inputs
- Short-circuit and thermal protection
- 50-μA (typ) quiescent current on 3.3-V auxiliary input (single)



Typical ExpressCard power-distribution application.

## USB Current-Limiting Switches



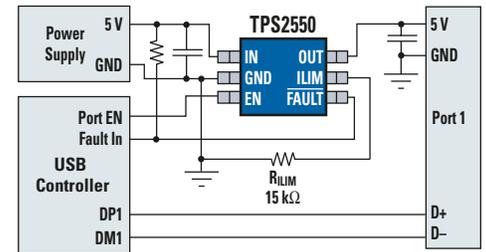
### USB Current-Limiting Power Switches

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

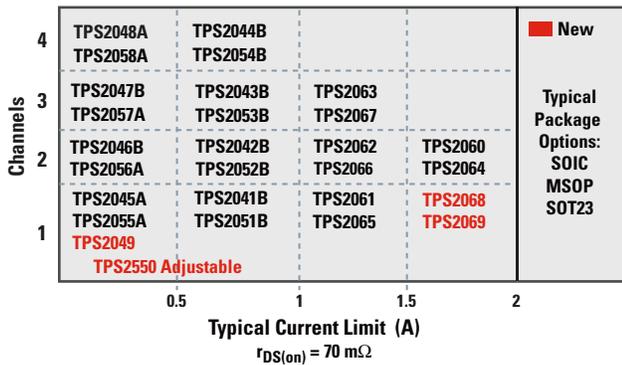
is vital for protecting your power supply and achieving regulatory compliance. TI's family of low-cost power switches are ideal for USB port designs.

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

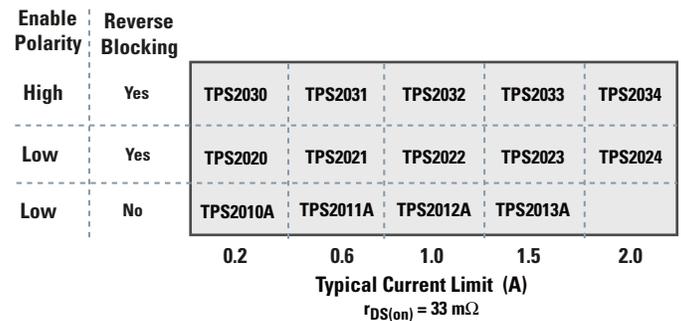


Typical application diagram.

### Low-Cost Power Switch Matrix



### Low $r_{DS(on)}$ Power Switch Roadmap



### Selection Guide

Device	Number of FETs	$I_{OS}$ (min) (A)	$r_{DS(on)}$ (m $\Omega$ )	$V_{IN}$ Range (V)	Supply Current ( $\mu$ A)	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	—	1.05
TPS2021/31	1	0.66	33	2.7 to 5.5	73	Yes	Yes	L/H	TPS2014	1.05
TPS2022/32	1	1.1	33	2.7 to 5.5	73	Yes	Yes	L/H	TPS2015	1.05
TPS2023/33	1	1.65	33	2.7 to 5.5	73	Yes	Yes	L/H	—	1.05
TPS2024/34	1	2.2	33	2.7 to 5.5	73	Yes	Yes	L/H	—	1.05
TPS2041B/51B	1	0.7	70	2.7 to 5.5	43	Yes	Yes	L/H	TPS2041/51/41A/51A	0.50
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	1.00
TPS2045A/55A	1	0.3	80	2.7 to 5.5	80	Yes	Yes	L/H	TPS2045/55	0.60
TPS2046B/56A	2	0.3 ea	80	2.7 to 5.5	80	Yes	Yes	L/H	TPS2046/46A/56	0.65
TPS2047B/57A	3	0.3 ea	80	2.7 to 5.5	160	Yes	Yes	L/H	TPS2047/47A/57	0.90
TPS2048A/58A	4	0.3 ea	80	2.7 to 5.5	160	Yes	Yes	L/H	TPS2048/58	1.20
TPS2049	1	0.1	400	2.7 to 5.5	43	Yes	Yes	L	TPS2041/51/41A/51A	0.50
<b>TPS2550/51</b>	1	0.1 to 1.1	85	2.5 to 6.5	130	Yes	Yes	L/H	—	0.70
TPS2060/4	2	1.5 ea	70	2.7 to 5.5	50	Yes	Yes	L/H	—	1.20
TPS2061/5	1	1.1	70	2.7 to 5.5	43	Yes	Yes	L/H	—	0.60
TPS2062A/6	2	1.1 ea	70	2.7 to 5.5	50	Yes	Yes	L/H	TPS2062	0.75
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	—	0.60
TPS2080/1/2 <sup>1</sup>	2	0.7 ea	80	2.7 to 5.5	85	Yes	Yes	2H, 1L/1H, 2L	—	0.65
TPS2085/6/7 <sup>1</sup>	4	0.7 ea	80	2.7 to 5.5	85	Yes	Yes	4H, 2L/2H, 4L	—	1.05
TPS2090/1/2 <sup>1</sup>	2	0.3 ea	80	2.7 to 5.5	85	Yes	Yes	2H, 1L/1H, 2L	—	0.65
TPS2095/6/7 <sup>1</sup>	4	0.3 ea	80	2.7 to 5.5	85	Yes	Yes	4H, 2L/2H, 4L	—	1.05

<sup>1</sup>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.



## Design Factors

**System Voltages** — The version of supervisor you require is dependent on the voltage rail(s) within the system. For example, supervisors designed to support a processor need to be selected according to the voltage driving the processor.

**Number of Channels** — Typically the number of supervisor functions required in a system is dependent on the processor and peripheral(s) voltages. For example, split-voltage processors may require supervision of both rails, while the memory in the system may also require supervision and be operating on a third (different) voltage rail.

**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.

**Chip-Enable Gating** — Chip-enable gating prevents erroneous data from corrupting CMOS RAM during an undervoltage condition.

**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.

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

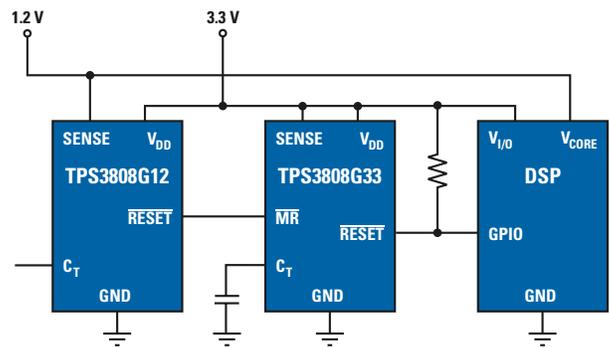
**Push-Pull** — A push-pull reset output supervisor is recommended when only one supervisor is needed on the bus. This eliminates the need for a pull-up resistor and offers higher speed.

## Supervisory Circuit with Low Quiescent Current, Manual Reset and Programmable Delay Time

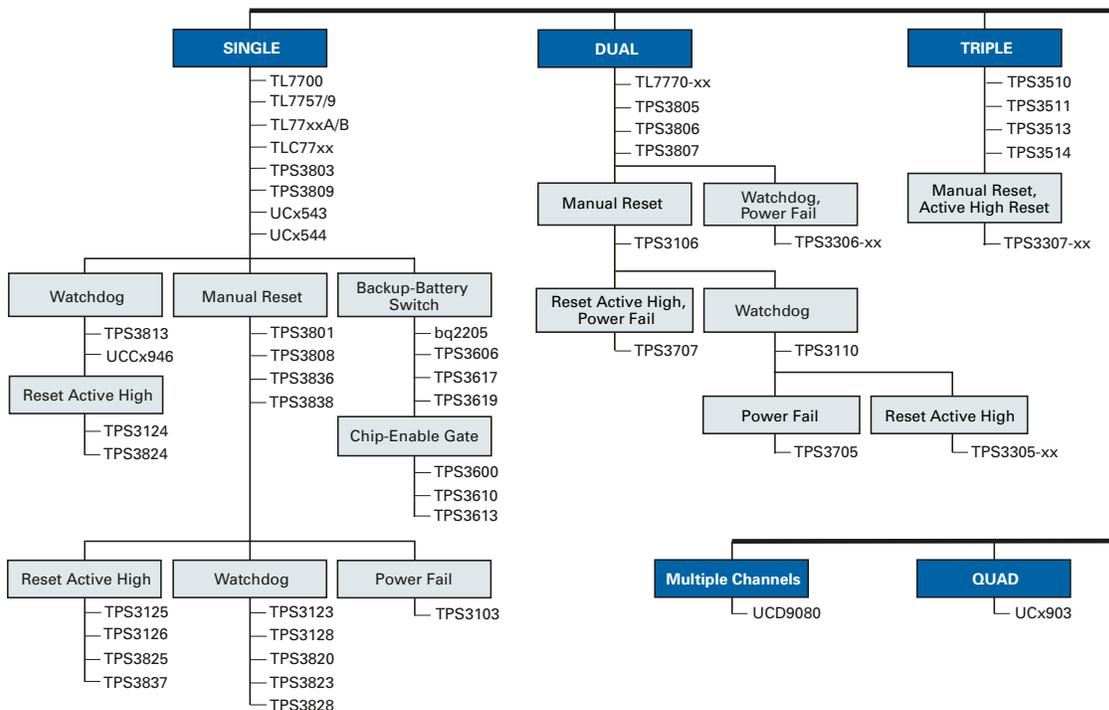
### TPS3808

Get samples at: [www.ti.com/sc/device/TPS3808G01](http://www.ti.com/sc/device/TPS3808G01)

The TPS3808 has a very low quiescent current of 2.4  $\mu$ A and is well-suited to battery-powered applications. It monitors system voltages from 0.4 V to 5.0 V with a 0.5% threshold accuracy. Available in small SOT23 and ultrasmall 2 x 2-mm SON package.



## Supervisory Circuits (Voltage Supervisors) and Sequencers Family of Products





## Power-Supply Sequencer

### UCD9080

Get samples, datasheets, evaluation modules and app reports at: [www.ti.com/sc/device/UCD9080](http://www.ti.com/sc/device/UCD9080)

The UCD9080 power-supply sequencer controls the power sequencing of up to eight voltage rails and three independent digital I/Os with a single device. No external memory or clock is required, and the device runs from a single 3.3-V supply.

The UCD9080 monitors all the voltage rails at a sampling rate of 20 kHz with 3.5-mV resolution. It has a high degree of configurability to sequence the rails for power up and power down.

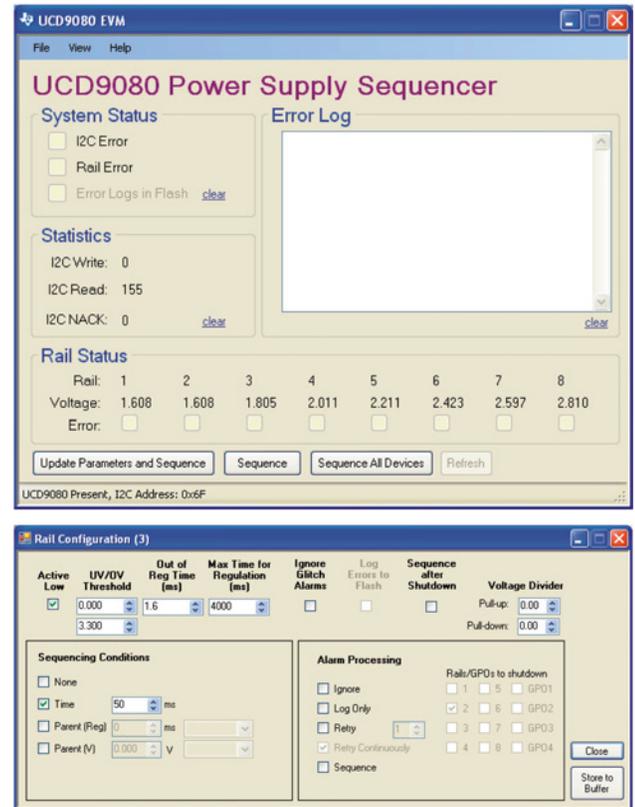
The UCD9080 also includes options such as resequencing in the event of faults such as rail failures. Rail sequencing can be based on timed events or on timed events in conjunction with other rails achieving regulation. In addition, each rail is monitored for glitches and under- and over-voltage threshold violations. Each rail that the UCD9080 monitors can be configured to shut down other rails as set in the configuration screen.

### Features

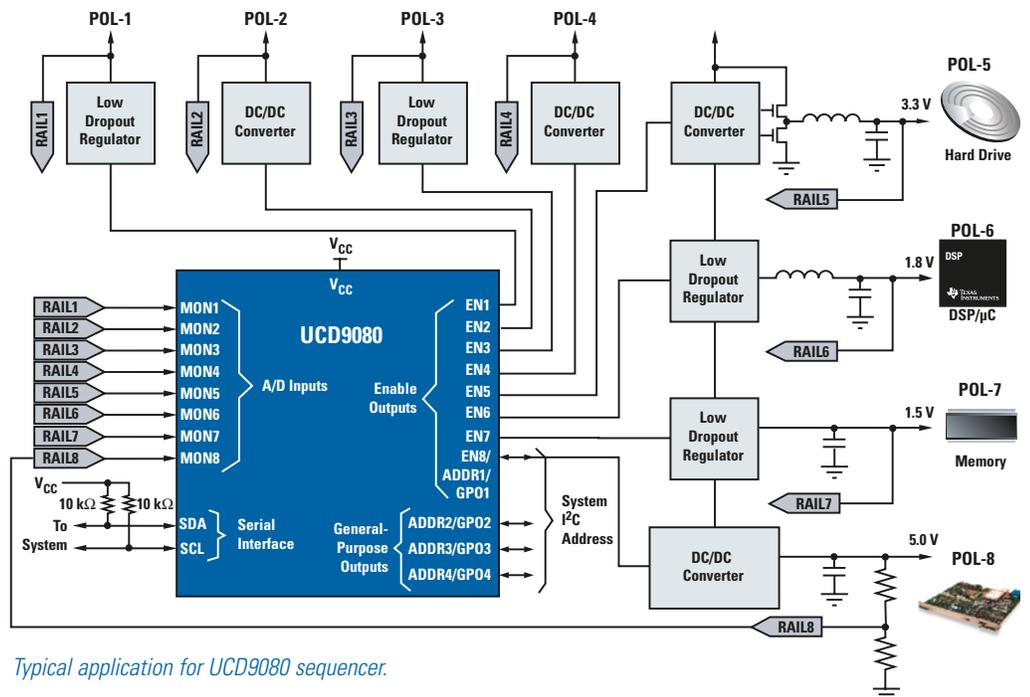
- Single-chip design, operates from 3.3-V supply
- Additional GPIOs with control for device resets, LED control, etc.
- Under- and over-voltage monitoring
- Fast and flexible shut-down options through use of interdependency
- Error log and status monitoring provided through I<sup>2</sup>C interface
- Configurable sequencing options, over-/under-voltage thresholds, shut-down response
- Easy-to-use Windows<sup>®</sup> operating system GUI

### UCD9080 Sequencing Configuration

- Flexible sequencing options including:
  - Time-based
  - Sequence after another rail achieves regulation (plus time)
  - Sequence after another rail achieves a certain voltage level
- Power-up and power-down sequencing
- Configurable voltage-rail dependencies



GUI developer tool simplifies design process.



Typical application for UCD9080 sequencer.



## Selection Guide

Device	Number of Supervisors	Supervised Voltages	Package(s)	V <sub>DD</sub> Range (V)	I <sub>DD</sub> (typ) (μA)	Time Delay (ms)	Watchdog Timer WDI (sec)	Reset Threshold Accuracy (%)	Manual Reset Input/MR	Active-Low Reset Output	Active-High Reset Output	Reset Output Topology <sup>1</sup>	Power-Fail PFI/PFO	Over-Voltage Detection	Over-Current Detection	Backup-Battery Switchover	Chip-Enabled Gating	Price*	Comments
<b>General Purpose Supply Supervisors</b>																			
TPS3808	1	Adj./0.9/1.2/1.5/1.8/2.5/3.0/3.3/5.0/EEPROM	SOT-23, SON	1.8 to 6.5	2.4	Prog	—	0.5	✓	✓		OD						0.70	
TPS3103	1	1.2/1.5/2.0/3.3	SOT-23	0.4 to 3.3	1.2	130	—	0.75	✓	✓		OD	✓					0.90	
TPS3123	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	1.4	3.6	✓	✓		PP						0.85	
TPS3124	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	1.4	3.6	✓	✓	✓	PP						0.85	
TPS3125	1	1.2/1.5/1.8/3.0	SOT-23	0.75 to 3.3	14	180	—	3.6	✓	✓	✓	PP						0.80	
TPS3126	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	—	3.5	✓	✓	✓	OD						0.80	
TPS3128	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	1.4	3.5	✓	✓	✓	OD						0.85	
TPS3800	1	2.7	SC-70	1.6 to 6.0	9	100	—	2	✓	✓		PP						0.40	
TPS3801	1	Adj./1.8/2.5/3.0/3.3/5.0	SC-70	1.6 to 6.0	9	200	—	2	✓	✓		PP						0.40	
TPS3802	1	3.0/3.3	SC-70	1.6 to 6.0	9	400	—	2	✓	✓		PP						0.40	
TPS3803	1	Adj./1.5	SC-70	1.3 to 6.0	3	5 μs	—	1.5		✓		OD						0.25	
TPS3809	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						0.90	Window Watchdog
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						0.65	
TPS3823	1	2.5/3.0/3.3/5.0	SOT-23	1.1 to 5.5	15	200	1.6	2.4	✓	✓		PP						0.65	
TPS3824-xx	1	2.5/3.0/3.3/5.0	SOT-23	1.1 to 5.5	15	200	1.6	2.2	✓	✓	✓	PP						0.65	
TPS3825-xx	1	3.3/5.0	SOT-23	1.1 to 5.5	15	200	—	2.2	✓	✓	✓	PP						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						0.85	
TPS3837	1	1.8/2.5/3.0/3.3	SOT-23	1.6 to 6.0	0.22	10/200	—	2.4	✓	✓	✓	PP						0.85	
TL7700	1	Adjustable	DIP-8, SOP-8	1.8 to 40	0.6 mA	Prog	—	1		✓		OC						2.25	
TL7757	1	5	SO-8, SOT-89, TO-92	1.0 to 7.0	1.4 mA	5 μs	—	2.6		✓		OC						0.32	
TL7759	1	5	SO-8	1.0 to 7.0	1.4 mA	5 μs	—	2.6		✓	✓	OC						0.88	
TL77xxA	1	2.7/5/9/12/15	SO-8, DIP-8, SOP-8	3.5 to 18	1.8 mA	Prog	—	2	✓	✓	✓	OC						0.25	
TL77xxB	1	2.7/3.3/5	SO-8, DIP-8	3.6 to 18	1.8 mA	Prog	—	2	✓	✓	✓	OC						0.27	
TLC77xx	1	Adj./2.5/3.3/3.0/5.0	SO-8, DIP-8, TSSOP-8	2.0 to 6.0	9	Prog	—	5.5	✓	✓	✓	PP						0.65	
UCCx946	1	Adjustable	SO-8, DIL-8, TSSOP-8	2.0 to 5.5	10	Prog	Prog	2	✓	✓		PP						1.75	
TPS3807	2	3/3.5	SC-70	1.8 to 6.5	3.5	20	—	1		✓		OD						0.95	
TPS3106	2	Adj./0.9/1.6/3.3	SOT-23	0.4 to 3.3	1.2	130	—	0.75	✓	✓		OD						0.90	
TPS3110	2	Adj./0.9/1.2/1.5/3.3	SOT-23	0.4 to 3.3	1.2	130	1.1	0.75	✓	✓		PP						0.99	
TPS3305-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	✓	✓				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	5 μs	—	1.5		✓		PP						0.34	
TPS3806	2	Adj./2.0/3.3	SOT-23	1.3 to 6.0	3	5 μs	—	2		✓		OD						0.45	
TL7770-xx	2	5.0/12.0 & Adj.	SO-16, DIP-16	3.5 to 18	5 mA	Prog	—	2	✓	✓	✓	OC		✓				1.55	
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						2.05	
UCx903	4	Adjustable	DIP-18, PLCC-20	—	7 mA	Prog	—	5		✓	✓	OC	✓	✓				1.45	
UCD9080	8	Prog. by software GUI	QFN-32	3.3	300	Prog						Power Supply Sequencer and Monitor					3.20		
<b>Battery Backup Switchover Supply Supervisors</b>																			
TPS3600	1	2.0/2.5/3.3/5.0	TSSOP-14	—	20	100	0.8	2.3	✓	✓		PP	✓			✓	✓	2.15	
TPS3606-33	1	3.3	MSOP-10	—	20	100	0.8	2	✓	✓		PP	✓			✓	✓	1.45	
TPS3610	1	1.8/5.0	TSSOP-14	—	20	100	0.8	2	✓	✓		PP	✓			✓	✓	1.80	
TPS3613-01	1	Adjustable	MSOP-10	—	20	100	—	1.7	✓	✓	✓	PP				✓	✓	1.50	
TPS3617-50	1	5	MSOP-8	—	20	100	0.8	2	✓	✓		PP	✓			✓	✓	1.20	
TPS3619	1	3.3/5.0	MSOP-8	—	15	100	—	2	✓	✓		PP	✓			✓	✓	1.10	
<b>Special Function Supply Supervisors</b>																			
bq2205LY	1	3.3	TSSOP-16	—	0.2 mA	55	—	1.7		✓		OD				✓	Two	1.75	See Note 2
TPS3510	3	3.3/5.0/12.0	SO-8, DIP-8	—	1 mA	300	—	9.1		✓		OD	✓	✓				0.45	PC Power Supplies
TPS3511	3	3.3/5.0/12.0	SO-8, DIP-8	—	1 mA	150	—	5.7		✓		OD	✓	✓				0.45	PC Power Supplies
TPS3513	3	3.3/5.0/12.0	SO-14, DIP-14	—	1 mA	300	—	9.1		✓		OD	✓	✓	✓			0.70	PC Power Supplies
TPS3514	3	3.3/5.0/12.0	SO-14, DIP-14	—	1 mA	300	—	5.2		✓		OD	✓	✓	✓			0.70	PC Power Supplies

<sup>1</sup>PP = push-pull, OD = open drain, OC = open collector.

<sup>2</sup>3.3-V SRAM controller with battery backup.

\*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.



## Design Factors

**Topology** — Shunt (two-terminal) vs. series (three-terminal). Shunt references are very similar to Zener diodes in operation as both require an external resistor for biasing. The external resistor determines the maximum current that can be supplied to the load as well as provide the minimum biasing current to maintain regulation. Shunt references should be considered when the load is nearly constant and power supply variations are minimal. Series references do not require any external components and they should be considered when the load is variable and lower voltage overhead is of the importance. They are also more immune to the power supply changes than shunt references.

**Initial Accuracy** — This parameter is of primary concern in systems where calibration is impossible or inconvenient. Usually, it is accomplished by the calibration of the overall system. Initial accuracy is specified with fixed input voltage and no load current (for series type) or fixed bias current (for shunt type).

**Temperature Drift** — Temperature drift is the change in output voltage due to the temperature change, expressed in ppm/°C. Buried Zener type references (e.g., REF02, REF102) typically have a lower temperature drift than bandgap type voltage references. Temperature drift can be specified in several ways (slope, butterfly and box), but the most common way is the box method calculated as:

$$TC \left( \frac{\text{ppm}}{^{\circ}\text{C}} \right) = \frac{(V_{\text{max}} - V_{\text{min}}) \times 10^6}{(T_{\text{max}} - T_{\text{min}}) \times V_{\text{nom}}}$$

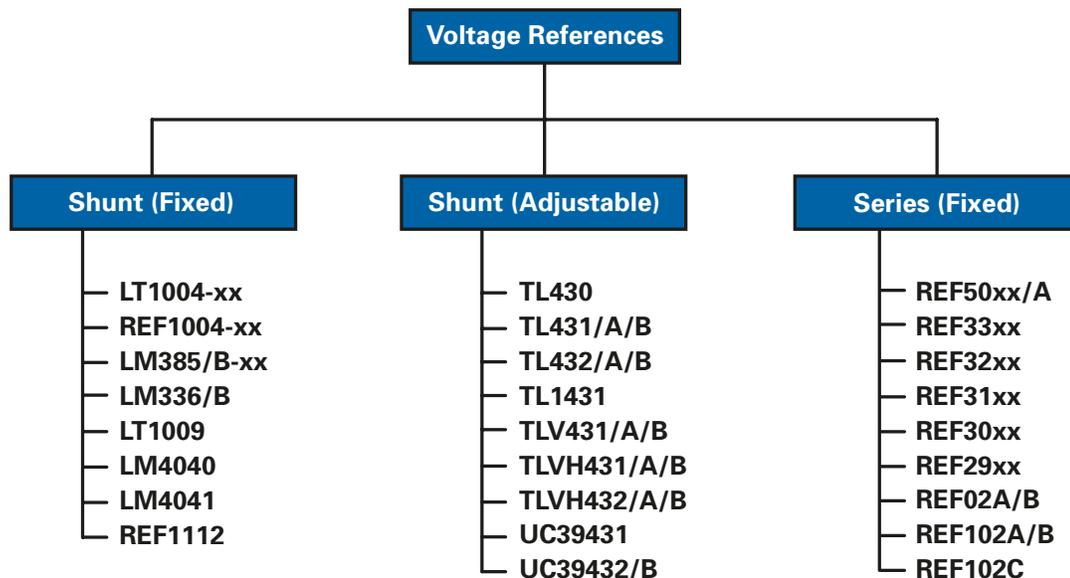
**Long-Term Stability** — The output of a voltage reference changes very gradually as time goes by. The greatest change occurs in the first 500 hours. This parameter can be important in high-performance applications or in applications where periodic calibration is not acceptable. TI specifies long-term stability data based on the observation of over 1000 hours at room temperature.

**Output Noise** — Output noise is usually specified over two frequency ranges: 0.1 Hz to 10 Hz (peak-to-peak noise) and 10 Hz to 1 kHz (RMS noise). Noise can be important because it can reduce dynamic range of the acquisition system. High-resolution data acquisition systems may experience “dither” in the LSBs solely due to reference noise. Noise can be reduced by external filtering (REF102 has noise reduction pin).

**Adjustable Output** — Both fixed and adjustable outputs are available. The adjustable output can be set via a resistor divider connected to a reference pin.

**Packaging** — Through-holes (PDIP and TO-92) and surface mount (SOIC, TSSOP, SOT-89, SOT23 and SC70) packages are available.

## Voltage References Family of Products





## Selection Guide

Device	V <sub>OUT</sub> (V)	Initial Tolerance @ 25°C (%)	Temp. Coefficient		I <sub>OUT</sub> (max) (mA)	I <sub>q</sub> (max) (mA)	V <sub>IN</sub>		Package(s)	Price*
			(typ) (ppm/°C)	(max) (ppm/°C)			(min) (V)	(max) (V)		
<b>Series Voltage References</b>										
REF50xx/A	2.048, 2.5, 3.0, 4.096, 4.5, 5.0	0.05, 0.1	2.5, 3	3, 8	±10	1.0	2.7	18	SOIC	1.85
REF33xx	1.25, 1.8, 2.048, 2.5, 3.0, 3.3	0.15	8	30	±5	0.005	1.8	5.5	SC70, SOT23	0.85
REF32xx	1.25, 2.048, 2.5, 3.0, 3.3, 4.096	0.2	4	7	±10	0.12	1.8	3.5	SOT23	1.70
REF31xx	1.25, 2.048, 2.5, 3.0, 3.3, 4.096	0.2	5	15	±10	0.115	1.8	5.5	SOT23	1.10
REF30xx	1.25, 2.048, 2.5, 3.0, 3.3, 4.096	0.2	20	50	25	0.05	1.8	5.5	SOT23	0.59
REF29xx	1.25, 2.048, 2.5, 3.0, 3.3, 4.096	2	35	100	25	0.05	1.8	5.5	SOT23	0.49
REF02A/B	5	0.2, 0.3	4	10, 15	21	1.4	8	40	SOIC, PDIP	1.75
REF102A/B	10	0.05, 0.1	—	5, 10	10	1.4	11.4	36	SOIC, PDIP	1.75
REF102C	10	0.025	—	2.5	10	1.4	11.4	36	SOIC, PDIP	4.85

Device	V <sub>OUT</sub> (V)	Initial Tolerance @ 25°C (%)	Adj. V <sub>OUT</sub>		Min I <sub>Z</sub> for Reg. (μA)	I <sub>q</sub> (max) (mA)	I <sub>OUT</sub> /I <sub>Z</sub> (max) (mA)	V <sub>IN</sub>		Temp. Coefficient		Package(s)	Price*
			(min) (V)	(max) (V)				(min) (V)	(max) (V)	(typ) (ppm/°C)	(max) (ppm/°C)		
<b>Shunt Voltage References</b>													
LM236-2.5, LM336/B-2.5	2.5	2, 4	—	—	400	—	10	—	—	10, 13	33	SOIC, TSSOP, TO92	0.40
LM285-xx, LM385/B-xx	1.235, 2.5	1, 1.5, 2, 3	—	—	10, 20	—	20	—	—	20	—	SOIC, TSSOP, TO92	0.18
LM4040	2.048, 2.5, 3, 4.096, 5, 10	0.1, 0.2, 0.5, 1	—	—	75	—	20	—	—	15	100, 150	SOT23, SC70, <b>TO92</b>	0.27
LM4041	Adj., 1.225	0.1, 0.2, 0.5, 1	1.225	10	75	—	12	—	—	15	100, 150	SOT23, SC70, <b>TO92</b>	0.27
LT1004-xx	1.235, 2.5	0.3, 0.8	—	—	10, 20	—	20	—	—	20	—	SOIC, TSSOP, TO92	0.40
LT1009	2.5	0.2	—	—	400	—	10	—	—	—	25	SOIC, TSSOP, TO92	0.41
REF1004-xx	1.235, 2.5	0.3, 0.4	—	—	10, 20	—	20	—	—	20	—	SOIC, PDIP	1.23
REF1112	1.25	0.2	—	—	1	0.005	5	—	—	10	30	SOT23	0.79
TL1431	Adj.	0.4	2.5	36	1000	—	100	—	—	23	114	SOIC, TSSOP, TO92	0.32
TL430	Adj.	5	2.75	30	2000	—	100	—	—	120	—	TO92	0.58
TL431/A/B, TL432/A/B	Adj.	0.5, 1, 2	2.495	36	600, 1000	—	100	—	—	34	83	SOIC, PDIP, TSSOP, SOT89, SOT23	0.14
TLV431/A/B	Adj.	0.5, 1, 1.5	1.24	6	80	—	15	—	—	39	129	SOIC, SOT23, SC70, TO92	0.23
TLVH431/A/B, TLVH432/A/B	Adj.	0.5, 1, 1.5	1.24	18	100	—	80	—	—	39	129	SOT23, SC70, SOT89, TO92	0.27
UC39431	Adj., 2.82, 3.12, 5.1, 7.8, 10.42, 12.24	0.4	2.3	36	800	0.5	100	2.2	36	—	—	SOIC, PDIP	2.33
UC39432/B	Adj., 1.3	0.4, 0.8	2.2	36	800	0.5	100	2.2	36	—	—	SOIC, PDIP	2.09

Device	No. of Outputs	I <sub>OUT</sub> (μA)	Current		Current Match		Temp Drift		Voltage		Current Mirror		Price*
			Tolerance (max) (%)	(max) (%)	Tolerance (max) (%)	(max) (%)	(typ) (ppm/°C)	(ppm/°C)	Compliance, 1% (V)	Tolerance (max) (%)	(%)		
<b>Current References</b>													
REF200	2	100	1	1	1	1	25	25	2.5 to 40	0.5	0.5	2.60	

Device	Number of Channels	V <sub>S</sub>		I <sub>q</sub> per Channel (max) (mA)	V <sub>I0</sub> (25°C) (mV)	GBW (typ) (MHz)	Single Supply	V <sub>ref</sub> (V)	V <sub>ref</sub> Adj.		V <sub>ref</sub> 25°C Tolerance (%)	I <sub>ref</sub> (max) (mA)	Package(s)	Price*
		(min) (V)	(max) (V)						(min) (V)	(max) (V)				
<b>Op Amp with Voltage Reference</b>														
TL103W/A	2	3	36	0.6	4, 3	0.9	Yes	2.5	—	—	0.7, 0.4	100	SOIC8	0.32
TSM104W/A	4	3	36	0.6	5, 3	0.9	Yes	—	2.5	36	0.7, 0.4	100	SOIC, TSSOP	0.32

Device	Number of Channels	V <sub>S</sub>		I <sub>q</sub> per Channel (max) (mA)	t <sub>RESP</sub> Low-to-High (μs)	Output Type	V <sub>I0</sub> (25°C) (max) (mV)	Rail-to- Rail	V <sub>ref</sub> (V)	V <sub>ref</sub> 25°C Tolerance (%)	V <sub>ref</sub> Temp Co. (typ) (ppm/°C)	Package(s)	Price*
		(min) (V)	(max) (V)										
<b>Comparator with Voltage Reference</b>													
TLV3011	1	1.8	5.5	0.005	6	Open-Drain	12	In, Out	1.242	1	40	SOT23, SC70	0.75
TLV3012	1	1.8	5.5	0.005	6	Push-Pull	12	In, Out	1.242	1	40	SOT23, SC70	0.75

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

New devices are listed in bold red.

## Low-Dropout Regulators (LDOs)



## LDOs Selection Guide

Device	I <sub>O</sub> (mA)	V <sub>DO</sub> at I <sub>O</sub> (typ) (mV)	I <sub>q</sub> at I <sub>O</sub> Full Load (μA)	Voltage (V)	Adj.	V <sub>IN</sub> (min) (V)	V <sub>IN</sub> (max) (V)	Accuracy (%)	Package(s)	Features <sup>1</sup>	Comments	Auto Qual (Q1)
TPS797xx	10	110	5	1.8, 3, 3.3	—	1.8	5.5	5, 4, 4	SC70	PG	Low quiescent current	Y
TPS715xx	50	415	3.2	2.5, 3, 3.3, 5	—	2.5	24	4	SC70	—	Low quiescent current	Y
TPS770xx	50	48	17	1.2, 1.5, 1.8, 2.5, 2.7, 2.8, 3, 3.3, 5	✓	2.7	10	3	SOT23	/EN	Low quiescent current	Y
TPS769xx	100	70	17	1.2, 1.5, 1.8, 2.5, 2.7, 2.8, 3, 3.3, 5	✓	2.7	10	3	SOT23	/EN	Low cost	Y
TPS791xx	100	38	170	1.8, 3.3, 4.7	✓	2.7	5.5	2	SOT23	/EN	RF low noise; high PSRR	Y
TPS731xx	150	30	400	1.5, 1.8, 2.5, 3.0, 3.3, 5.0	✓	1.7	5.5	1	SOT23	/EN	Reverse leakage protection	Preview
TPS763xx	150	300	85	1.6, 1.8, 2.5, 2.7, 2.8, 3, 3.3, 3.8, 5	✓	2.7	10	3	SOT23	/EN	Low cost	Y
TPS765xx	150	85	33	1.5, 1.8, 2.5, 2.7, 2.8, 3, 3.3, 5	✓	2.7	10	3	S08	/EN	Low quiescent current	Preview
TPS771xx	150	265	125	1.5, 1.8, 2.7, 2.8, 3.3, 5	✓	2.7	10	2	MSOP	PG, /EN	Fast transient response	Y
TPS7A60xx	150	600	40	1.5, 1.8, 1.9, 2.5, 3.3, 5.0	—	5.5	42	2	DDPAK	RST, delay	Low quiescent current	Preview
TPS7A61xx	150	600	40	1.5, 1.8, 1.9	—	5.5	42	2	DDPAK	RST, /EN	Low quiescent current	Preview
TPS793xx	200	100	170	1.8, 2.5, 2.8, 2.85, 3, 3.3, 4.75	✓	2.7	5.5	2	SOT23, MSOP, SOT223	EN	RF low noise, high PSRR	Y
TPS799xx	200	100	40	1.2 to 6	✓	2.7	6.5	2	SOT23	/EN	High PSRR	Y
TPS732xx	250	40	400	1.2, 1.5, 1.6, 1.8, 2.5, 3, 3.3, 5	✓	1.7	5.5	1	SOT23	/EN	Reverse current protection Cap free	Y
TPS773xx	250	150	90	1.5, 1.6, 1.8, 2.7, 2.8, 3.3, 5.0	✓	2.7	10	2	MSOP	/EN, SVS	Low noise	Preview
TLE4275	450	500	150	5	—	5.5	45	2	DDPAK	V, LD, RST	Automotive LDO	Y
TL720Mxx	450	500	—	5	—	5.5	42	2	T0263, T0252	V	Reverse polarity protection	Y
TL760Mxx	500	500	—	1.8, 2.5, 3.3	—	3	45	2	DDPAK	V, LD	Automotive LDO, TLE4274 alternative	Y
TPS71Hxx	500	150	285	3.3, 4.85, 5.0	✓	4.3	10	2	PWP	PG	Fast transient response	Y
TPS775xx	500	169	85	1.5, 1.6, 1.8, 2.5, 3.3	✓	2.7	10	2	S08, PWP	SVS	Fast transient response	Y
TPS776xx	500	169	85	1.5, 1.8, 2.5, 2.8, 3.3	✓	2.7	10	2	S08, PWP	PG	Fast transient response	Y
TL750Mxx	750	600	—	5, 8, 12	—	6, 9, 13	60	3	DDPAK	V, LD	Automotive LDO, TLE4275 alternative	Y
TL751Mxx	750	600	—	5, 8, 12	—	6, 9, 13	60	3	DDPAK	V, LD, /EN	Automotive LDO	Y
TPS725xx	1000	170	75	1.5, 1.6, 1.8, 2.5	✓	1.8	6	2	S08	/EN, SVS	Low noise, SVS	Preview
TPS767xx	1000	230	85	1.5, 1.8, 2.5, 2.7, 2.8, 3, 3.3, 5	✓	2.7	10	2	S08, PWP	SVS	Fast transient response	Y
TPS768xx	1000	230	85	1.5, 1.8, 2.5, 2.7, 2.8, 3, 3.3, 5	✓	2.7	10	2	S08, PWP	PG	Fast transient response	Y
TPS753xx	1500	160	75	1.5, 1.8, 2.5, 3.3	✓	2.7	5	2	PWP	/EN, SVS	Fast transient response	Y
TPS786xx	1500	580	385	1.8, 2.5, 2.8, 3.0, 3.3	✓	2.7	5.5	3	DDPAK	/EN	Low noise	Preview
TPS752xx	2000	210	75	1.5, 1.8, 2.5, 3.3	✓	2.7	5	2	PWP	/EN, SVS	Fast transient response	Y

<sup>1</sup>V = wide voltage, LD = load dump, PG = power good, /EN = active high enable, SVS = supply voltage supervisor, RST = reset.

## → Low-Dropout Regulators (LDOs)

### Dual-Output LDOs Selection Guide

Device	Description	I <sub>O1</sub> (mA)	I <sub>O2</sub> (mA)	V <sub>DO1</sub> @ I <sub>O1</sub> (mV)	V <sub>DO2</sub> @ I <sub>O2</sub> (mV)	I <sub>Q</sub> @ I <sub>O</sub> (μA)	Voltage (V)	Accuracy (%)	V <sub>O</sub> (min) (V)	V <sub>O</sub> (max) (V)	Features					Auto Qual (Q1)	
											/EN	SVS	Seq	Low Noise	V <sub>IN</sub> (min) (V)		V <sub>IN</sub> (max) (V)
TPS767D3xx	Dual-output, fast LDO with integrated SVS	1000	1000	350	—	125	3.3/2.5, 3.3/1.8, 3.3/Adj	2	1.2	5	✓	✓	—	—	2.7	10	Y
TPS70175	Dual-output LDO with power-up sequencing for split-voltage DSP systems	500	250	170	—	190	2.5/5.0	2	—	—	✓	✓	✓	✓	2.7	6	Y

### Standard Linear Voltage Regulators Selection Guide

Device	V <sub>OUT</sub> (nom) (V)	V <sub>OUT</sub> /V <sub>REF</sub> Tolerance Over Temp. (%)	I <sub>OUT</sub> (max) (mA)	Min I <sub>OUT</sub> for Regulation (mA)	I <sub>Q</sub> (max) (mA)	V <sub>DO</sub> (typ) (V)	V <sub>DO</sub> (max) (V)	V <sub>IN</sub> (max) (V)	V <sub>IN</sub> - V <sub>OUT</sub> (max) (V)	Auto Qual (Q1)
LM317M	Adj. (1.2 to 37)	0.7	500	3.5	—	—	3	—	40	Y
UA78Mxx	3.3, 5, 10	5	500	—	6	2	2 to 2.5	25 to 30	—	Y

## → LED Drivers

### LED Drivers Selection Guide

Device	V <sub>IN</sub> (V)	Type	V <sub>OUT</sub> (max) (V)	LED Configuration	No. of Channels	Max Current (mA)	Dimming <sup>1</sup>	Serial Interface	Diagnostics <sup>2</sup>	Protection <sup>2</sup>	Package(s)	Auto Qual (Q1)	Comments
TPS61040	1.8 to 6.0	Inductive	28	Series	1	400	Y	N	—	SS, UVLO	SOT-23	Y	DC/DC boost converter for white LEDs
TPS61041	1.8 to 6.0	Inductive	28	Series	1	250	Y	N	—	SS, UVLO	SOT-23	Y	DC/DC boost converter for white LEDs
TPIC6C595/6	4.5 to 5.5	Switch	33	Parallel	8	250	Y	Y	—	OC	16/TSSOP, 16/SO	N	Power logic multichannel switch
TPIC2810	3.0 to 5.5	Switch	40	Parallel	8	210	Y	Y	—	OT, IL	16/SO	N	Power logic multichannel switch
TLC5916	3.0 to 5.5	Linear	20	Parallel	8	120	Y	Y	OL, OT	OT	16/TSSOP, 16/SO	Y	Linear multichannel constant current sink
TLC5917	3.0 to 5.5	Linear	20	Parallel	8	120	Y	Y	OL, OT, SC	OT	16/TSSOP, 16/SO	Y	Linear multichannel constant current sink
TLC5940	3.0 to 5.5	Linear	18	Parallel	16	120	Y	Y	OL, OT	OT	28/HTSSOP	Preview	Linear multichannel constant current sink

<sup>1</sup>May be via ENABLE pin, CONTROL pin, analog feedback network or programmable per serial interface.

<sup>2</sup>SS = soft start; UVLO = under-voltage lockout; OC = over current; OT = over temperature; IL = current limit; OL = open load; RB = reverse battery; SC = shorted load.

**Switching DC/DC Converters Selection Guide**

Device	V <sub>IN</sub> (V)	V <sub>O</sub> (max) (V)	V <sub>O</sub> (min) (V)	V <sub>REF</sub> Tol (%)	Driver Current (A)	Auto Qual (Q1)	Comments
MC33063A	3 to 40	40	1.25	2	1.5	Y	1.5-A peak boost/buck/inverting switching regulator
TPIC74100	1.5 to 40	5	5	2	1	Y	Buck/boost switch-mode regulator
TPS61040	1.8 to 6.0	28	V <sub>IN</sub>	—	0.09	Y	Boost mode, LED driver
TPS61041	1.8 to 6.0	28	V <sub>IN</sub>	—	0.05	Y	Boost mode

**Switching DC/DC Controllers Selection Guide**

Device	V <sub>IN</sub> (V)	V <sub>O</sub> (max) (V)	V <sub>O</sub> (min) (V)	V <sub>REF</sub> Tol (%)	Driver Current (A)	Output Current (A) <sup>1</sup>	Multiple Outputs	Adaptive Voltage Positioning	Protection <sup>2</sup>	Auto Qual (Q1)	Comments
TPS40050	8 to 40	30	0.7	1	1	20	No	No	OC, UVLO	Y	Wide input range sync buck, source only
TPS40051	8 to 40	30	0.7	1	1	20	No	No	OC, UVLO	Y	Wide input range sync buck, source/sink except SS
TPS40053	8 to 40	30	0.7	1	1	20	No	No	OC, UVLO	Y	Wide input range sync buck, source/sink
TPS40057	8 to 40	35	0.7	1	1	20	No	No	SCP, UVLO	Y	Wide input range sync buck, source/sink with prebias
TPS5120	4.5 to 30	26	0.9	1.5	1.5	15 (each)	Yes	No	OC, UVLO, PG, OVP	Y	Dual 180 degree out-of-phase operation
TL1451A	3.6 to 50	50	2.5	4	0.02	Depends on FET driver	Yes	No	UVLO, SCP	Y	Dual PWM buck/boost
TL5001A	3.6 to 40	50	1	3	0.02	Depends on FET driver	No	No	UVLO, SCP	Y	PWM buck/boost
TPS40200	4.5 to 52	46	0.7	2	0.2	Depends on FET driver	No	No	—	Y	Wide input non-synchronous buck DC/DC controller

<sup>1</sup>Current levels of this magnitude and beyond can be supported.

<sup>2</sup>OC = over-current protection; UVLO = under-voltage lockout; SCP = short-circuit protection; PG = power good; OVP = over-voltage protection.

**SWIFT™ Step-Down Converters Selection Guide**

Device	V <sub>IN</sub> (V)	Output Current (A)	V <sub>OUT</sub> (V)	Package	Auto Qual (Q1)
TPS62000/1/2/3/4/5/6/7/8	2.0 to 5.5	0.6	Adj., 0.9, 1.0, 1.2, 1.5, 1.8, 1.9, 2.5, 3.3	10/MSOP	Y
TPS5410	5.5 to 36	1	1.23 to 31	8/SO	Preview
TPS62042	2.5 to 6.0	1.2	1.5	10/MSOP	Preview
TPS54110	3.0 to 6.0	1.5	0.9 to 4.5	20/HTSSOP	Preview
TPS5420	5.5 to 36	2	Adj	8/SO	Y
TPS5430	5.5 to 36	3	Adj	8/HSO	Y
TPS54310/1/2/3/4/5/6	3.0 to 6.0	3	Adj., 0.9, 1.2, 1.5, 1.8, 2.5, 3.3	20/HTSSOP	Y
TPS54380	3.0 to 6.0	3	0.9 to 4.5	20/HTSSOP	Preview
TPS5450	5.5 to 36	5	Adj	8/HSO	Preview
TPS54372	3.0 to 6.0	6	0.2 to 4.5	20/HTSSOP	Y
TPS54610/1/2/3/4/5/6	3.0 to 6.0	6	Adj., 0.9, 1.2, 1.5, 1.8, 2.5, 3.3	28/HTSSOP	Y
TPS54680	3.0 to 6	6	0.9 to 4.5	28/HTSSOP	Y

**Inductorless DC/DC Regulators (Charge Pumps) Selection Guide**

Device	I <sub>OUT</sub> (mA)	V <sub>IN</sub> (V)	V <sub>OUT</sub> Adj. (V)	Efficiency (%)	Switching Frequency (max) (kHz)	Quiescent Current (typ) (μA)	Auto Qual (Q1)
TPS60400	60	1.6 to 5.5	– (1.6 to 5.5)	99	375	125	Y
TPS60401	60	1.6 to 5.5	– (1.6 to 5.5)	99	30	65	Y
TPS60402	60	1.6 to 5.5	– (1.6 to 5.5)	99	75	120	Y
TPS60403	60	1.8 to 5.25	– (1.8 to 5.25)	90	325	425	Y

**LCD/LED Display Bias Solutions Selection Guide**

Device	V <sub>IN</sub> (min) (V)	V <sub>IN</sub> (max) (V)	No. of Regulated Outputs	Minimum Switch Current Limit (A)	LDO	DC/DC Converter	Charge Pump	Package	Operating Temp Range (°C)	Auto Qual (Q1)
TPS65140	2.7	5.8	4	1.6	1	1	2	24/HTSSOP	–40 to 85	Y
TPS65145	2.7	5.8	4	0.96	1	1	2	24/HTSSOP	–40 to 85	Y

## → PWM Power Supply Controllers/USB Power Switches

### PWM Power Supply Controllers Selection Guide

Device <sup>1</sup>	Typical Power Level (W)	Max Practical Frequency	Start-Up Current	Operating Current	Supply Voltage (V)	UVLO: On/Off (V)	V <sub>REF</sub> (V)	V <sub>REF</sub> Tol. (%)	Max Duty Cycle (%)	Soft Start	E/A	Shutdown	Output Voltage Feed-forward	Leading Edge Blanking	Auto Qual (Q1)
<b>Peak Current Mode Controllers</b>															
UCC2800	10 to 200	1 MHz	100 µA	500 µA	7.2 to 15	7.2/6.9	5	1.5	100	Yes	Yes	No	No	100 ns	Y
UCC2801	10 to 200	1 MHz	100 µA	500 µA	9.4 to 15	9.4/7.4	5	1.5	50	Yes	Yes	No	No	100 ns	Y
UCC2802	10 to 200	1 MHz	100 µA	500 µA	12.5 to 15	12.5/8.3	5	1.5	100	Yes	Yes	No	No	100 ns	Y
UCC2803	10 to 200	1 MHz	100 µA	500 µA	4.1 to 15	4.1/3.6	4	1.5	100	Yes	Yes	No	No	100 ns	Y
UCC2804	10 to 200	1 MHz	100 µA	500 µA	12.5 to 15	12.5/8.3	5	1.5	50	Yes	Yes	No	No	100 ns	Y
UCC2805	10 to 200	1 MHz	100 µA	500 µA	4.1 to 15	4.1/3.6	4	1.5	50	Yes	Yes	No	No	100 ns	Y
UCC2808A-1/A-2	50 to 500	1 MHz	130 µA	1 mA	4.3 to 15	12.5/8.34/4.1	—	—	Prog	Yes	Yes	No	No	No	Y
UCC2813-0	10 to 200	1 MHz	100 µA	500 µA	7.2 to 15	7.2/6.9	5	1.5	100	Yes	Yes	No	No	100 ns	Y
UCC2813-1	11 to 200	1 MHz	100 µA	500 µA	9.4 to 15	9.4/7.4	5	1.5	50	Yes	Yes	No	No	100 ns	Y
UCC2813-2	12 to 200	1 MHz	100 µA	500 µA	12.5 to 15	12.5/8.3	5	1.5	100	Yes	Yes	No	No	100 ns	Y
UCC2813-3	13 to 200	1 MHz	100 µA	500 µA	4.1 to 15	4.1/3.6	4	1.5	100	Yes	Yes	No	No	100 ns	Y
UCC2813-4	14 to 200	1 MHz	100 µA	500 µA	12.5 to 15	12.5/8.3	5	1.5	100	Yes	Yes	No	No	100 ns	Y
UCC2813-5	15 to 200	1 MHz	100 µA	500 µA	4.1 to 15	4.1/3.6	4	1.5	100	Yes	Yes	No	No	100 ns	Y
UCC2895	—	1 MHz	150 µA	5 mA	9 to 17	11/9	5	1.2	100	Yes	Yes	No	No	No	Preview
UCC28220	—	2 MHz	200 µA	3.5 mA	8 to 14.5	10/8	—	—	90	Yes	No	No	No	No	Y
UC2524A	50 to 500	450 kHz	4 mA	5 mA	8 to 40	7.5/7	5	2	Prog	Yes	Yes	Yes	No	No	Preview
UC2825A	—	1 MHz	100 µA	—	22	16/10	5	1	50	Yes	Yes	No	No	Yes	Y
UC2842A	30 to 350	500 kHz	0.3 mA	11 mA	10 to 30	16/10	5	1.5	100	No	Yes	No	Yes	No	N
UC2843A	30 to 350	500 kHz	0.3 mA	11 mA	7.8 to 30	8.5/7.9	5	1.5	100	No	Yes	No	Yes	No	Y
UC2844A	30 to 350	500 kHz	0.3 mA	11 mA	10 to 30	16/10	5	1.5	50	No	Yes	No	Yes	No	N
UC2845A	30 to 350	500 kHz	0.3 mA	11 mA	7.8 to 30	8.5/7.9	5	1.5	50	No	Yes	No	Yes	No	N
UC2856	—	1 MHz	—	18 mA	7.7 to 40	7.7	5	1	50	Yes	Yes	Yes	No	No	Preview

<sup>1</sup>The extra "C" in UCC means BiCMOS technology; therefore, UC2842 is bipolar and UCC2800 is BiCMOS.

### USB Power Switches Selection Guide

Device	V <sub>IN</sub> (min) (V)	V <sub>IN</sub> (max) (V)	r <sub>DS(on)</sub> per FET (typ) (mΩ)	Package	Operating Temp Range (°C)	Continuous Current (max) (A)	Current Limit (typ) (A)	Number of Switches	Enable	Auto Qual (Q1)
TPS2022	2.7	5.5	33	8/SO	−40 to 85	1	1.5	1	Low	Y
TPS2024	2.7	5.5	33	8/SO	−40 to 85	2	3	1	Low	Y
TPS2030	2.7	5.5	33	8/SO	−40 to 85	0.2	0.3	1	High	Y
TPS2042B	2.7	5.5	70	8/SO	−40 to 125	0.5	1	2	Low	Y
TPS2051B	2.7	5.5	70	8/SO	−40 to 125	0.5	1	1	High	Y

### USB Transient Voltage Suppressor Selection Guide

Device	Supply Voltage (V)	Number of USB Ports	Peak Power Dissipation (W)	Stand-off Voltage (min) (V)	Operating Temp Range (°C)	Package	Auto Qual (Q1)
SN65220 <sup>1</sup>	3.3	1	60	6	−40 to 85	6/SOT-23	Y

<sup>1</sup>USB 1.1 compatible.



## Supervisors Selection Guide

Device	Number of Supervisors	Supervised Voltages	Package	I <sub>DD</sub> (typ) (μA)	Time Delay (ms)	Manual Reset Input/MR	Active-High Reset Output	Watchdog Timer WDI	Auto Qual (Q1)
TLC77xx	1	Adj./2.5/3.3/5.0	8/TSSOP	9	Prog	—	✓	—	Y
TPS3306	2	1.5/1.8/2.0/2.5/3.3	8/SO	15	100	—	—	✓	Y
TPS3307	3	1.8/2.5/3.3	8/SO	40	200	✓	✓	—	Y
TPS3803	1	Adj./1.5	5/SC-70	3	0.0055	✓	—	—	Y
TPS3805	2	Adj./3.3	5/SC-70	3	0.0055	✓	—	—	Y
TPS3808	1	Adj./3.0/3.3	SOT-23	3	Prog	✓	—	—	Y
TPS3809	1	2.5/3.0/3.3/5.0	3/SOT-23	9	200	—	—	—	Y
TPS3813	1	2.25/2.64/2.93/4.55	6/SOT-23	9	25	—	✓	✓	Preview
TPS3820/8-xx	1	3.3/5.0	5/SOT-23	15	25/200	✓	—	✓	Y
TPS3823	1	2.5/3.0/3.3/5.0	5/SOT-23	15	200	✓	—	✓	Y
TPS3824-xx	1	2.5/3.0/3.3/5.0	5/SOT-23	15	200	—	✓	✓	Y
TPS3825-xx	1	3.3/5.0	5/SOT-23	15	200	✓	✓	—	Y
TPS3836/8	1	1.8/2.5/3.0/3.3	5/SOT-23	0.25	10/200	✓	✓	—	Y
TPS3837	1	1.8/2.5/3.0/3.3	5/SOT-23	0.25	10/200	✓	—	—	Y
UCC2946	1	Adj.	8/TSSOP	12	Prog	✓	—	✓	Y

All devices feature an Active-Low Reset Output, except TPS3837.

## References Selection Guide

Device	V <sub>0</sub> (V)	Initial Accuracy @ 25°C (%)	Temp Coeff (max) (ppm/°C)	I <sub>OUT</sub> /I <sub>Z</sub> (max) (mA)	I <sub>q</sub> (max) (μA)	V <sub>I</sub> (min) (V)	V <sub>I</sub> (max) (V)	Package(s)	Operating Temp Range (°C)	Auto Qual (Q1)
<b>Low-Noise, Very Low-Drift, Precision Series Voltage References</b>										
REF5020A	2.048	0.01	8	10	1000	2.7	18	8/SO	–40 to 125	Preview
REF5025A	2.5	0.01	8	10	1000	2.7	18	8/SO	–40 to 125	Preview
REF5030A	3	0.01	8	10	1000	3.2	18	8/SO	–40 to 125	Preview
REF5040A	4.096	0.01	8	10	1000	4.296	18	8/SO	–40 to 125	Preview
REF5045A	4.5	0.01	8	10	1000	4.7	18	8/SO	–40 to 125	Preview
REF5050A	5	0.01	8	10	1000	5.2	18	8/SO	–40 to 125	Preview
TL1431	2.5 to 36	0.4	—	100	2	2.49	2.51	8/SO	–40 to 125	Y
TL431A	2.5 to 36	1	—	—	0.5	2.47	2.52	3/SOT-23, 5/SOT-23	–40 to 125	Y
TL431B	2.5 to 36	0.5	—	—	0.5	2.48	2.51	3/SOT-23	–40 to 125	Y
TL4050B	2.048 to 10	0.2	50	15	—	—	—	5/SC70	–40 to 125	Preview

## → Power and Control

### Power + Logic™: 8-Bit Devices Selection Guide

Device	Description	V <sub>DS</sub> (max) (V)	I <sub>CC</sub> (typ) (μA)	I <sub>O</sub> (A)	I <sub>PEAK</sub> (A)	r <sub>DS(on)</sub> (typ) (W)	E <sub>AS</sub> (max) (mJ)	t <sub>PLH</sub> (typ) (ns)	ESD (max) (kV)	Package(s)
TPIC6259	Addressable latch	45	15	0.25	0.75	1.3	75	625	3	20/SO (DW), 20/PDIP (N)
TPIC6273	D-type latch	45	15	0.25	0.75	1.3	75	625	3	20/SO (DW), 20/PDIP (N)
TPIC6595	Shift register	45	15	0.25	0.75	1.3	75	650	3	20/SO (DW), 20/PDIP (N)
TPIC6596	Shift register	45	15	0.25	0.75	1.3	75	650	3	20/SO (DW), 20/PDIP (N)
TPIC6A259 <sup>1</sup>	Addressable latch	50	500	0.35	1.1	1	75	125	2.5	24/SO (DW), 20/PDIP (NE)
TPIC6A595 <sup>1</sup>	Shift register	50	500	0.35	1.1	1	75	125	2.5	24/SO (DW), 20/PDIP (NE)
TPIC6B259 <sup>2</sup>	Addressable latch	50	20	0.15	0.5	5	30	150	2.5	20/SO (DW), 20/PDIP (N)
TPIC6B273 <sup>2</sup>	D-type latch	50	20	0.15	0.5	5	30	150	2.5	20/SO (DW), 20/PDIP (N)
TPIC6B595 <sup>2</sup>	Shift register	50	20	0.15	0.5	5	30	150	2.5	20/SO (DW), 20/PDIP (N)
TPIC6B596 <sup>2</sup>	Shift register	50	20	0.15	0.5	5	30	150	2.5	20/SO (DW), 20/PDIP (N)
TPIC6C595 <sup>2</sup>	Shift register	33	20	0.1	0.25	7	30	80	2.5	16/SO (D), 16/PDIP (N), 16/TSSOP (PW)
TPIC6C596 <sup>2</sup>	Shift register	33	20	0.1	0.25	7	30	80	2.5	16/SO (D), 16/PDIP (N), 16/TSSOP (PW)
TPIC2810 <sup>2</sup>	Shift register	40	620	0.1	0.21	5	—	1150	3	16/SO (D)

<sup>1</sup>Fault protection and diagnosis. <sup>2</sup>Fault protection.

### Mixed-Signal Power + Control Selection Guide

Device	Description	V <sub>BAT</sub> Range (V)	V <sub>OS</sub> (max) (V)	I <sub>D</sub> /I <sub>PEAK</sub> (A)	r <sub>DS(on)</sub> (typ) (W)	Freq (kHz)	Package(s)
TPIC2603 <sup>1</sup>	6-channel serial interface low-side controller	5.5 to 25	68	0.35/2.25	0.7	4000	20/PDIP (NE), 24/SO (DW)
Device	Description	V <sub>BAT</sub> Range (V)	I <sub>BAT</sub> (typ) (mA)	I <sub>GD</sub> (max) (mA)	f <sub>OSC</sub> (typ) (kHz)	t <sub>r</sub> /t <sub>f</sub> (max) (μs)	Package(s)
TPIC2101 <sup>2</sup>	DC brush motor controller	0 to 16	4	50	20	1/0.8	14/SO (D), 14/PDIP (N)
Device	Description	V <sub>CC</sub> Range (V)	V <sub>IT±</sub> (HL) Range (mA)	I <sub>(LGX/UGX)</sub> (typ) (mA)	f <sub>PWM</sub> (typ) (kHz)	f <sub>OSC</sub> /f <sub>OSC1</sub> (max) (MHz)	Package
TPIC43T01 <sup>2</sup>	Three-phase DC brushless motor RPM controller	18 to 28	±4 to ±12	±10	22.7	10/10	38/TSSOP (DA)
TPIC43T02 <sup>2</sup>	Three-phase DC brushless motor RPM controller	18 to 28	±4 to ±12	±10	22.7	10/10	38/TSSOP (DA)
Device	Description	V <sub>BAT</sub> Range (V)	V <sub>GATE</sub> Range (V)	I <sub>BAT</sub> (typ) (mA)	f <sub>SCLK</sub> (max) (mHz)	Package	
TPIC44H01 <sup>1</sup>	4-channel serial/parallel high-side FET pre-driver	8 to 24	VBAT+4 to VBAT+18	4	5	38/TSSOP (DA)	
TPIC44L01 <sup>1</sup>	4-channel serial/parallel low-side FET pre-driver	8 to 24	7 to 13.5	0.5	10	24/SSOP (DB)	
TPIC44L02 <sup>1</sup>	4-channel serial/parallel low-side FET pre-driver	8 to 24	7 to 13.5	0.5	10	24/SSOP (DB)	
TPIC44L03 <sup>1</sup>	4-channel serial/parallel low-side FET pre-driver	8 to 24	7 to 13.5	0.5	10	24/SSOP (DB)	
TPIC46L01 <sup>1</sup>	6-channel serial/parallel low-side FET pre-driver	8 to 24	7 to 13.5	0.5	10	24/SSOP (DB)	
TPIC46L02 <sup>1</sup>	6-channel serial/parallel low-side FET pre-driver	8 to 24	7 to 13.5	0.5	10	24/SSOP (DB)	
TPIC46L03 <sup>1</sup>	6-channel serial/parallel low-side FET pre-driver	8 to 24	7 to 13.5	0.5	10	24/SSOP (DB)	

<sup>1</sup>Fault protection and diagnosis. <sup>2</sup>Fault protection.

### Peripheral Drivers and Actuators Selection Guide

Device	Description	Output Voltage (max) (V)	Switching Voltage (V)	Peak Output Current (mA)	Drivers per Package	Input Compatibility	Delay Time (typ) (ns)	Operating Temp Range (°C)	Package	Auto Qual (Q1)
ULQ2003A	High-voltage, high-current Darlington transistor array	50	50	500	7	CMOS, TTL	1000	-40 to 125	16/SO	Y
ULQ2004A	High-voltage, high-current Darlington transistor array	50	50	500	7	CMOS	1000	-40 to 105	16/SO	Y



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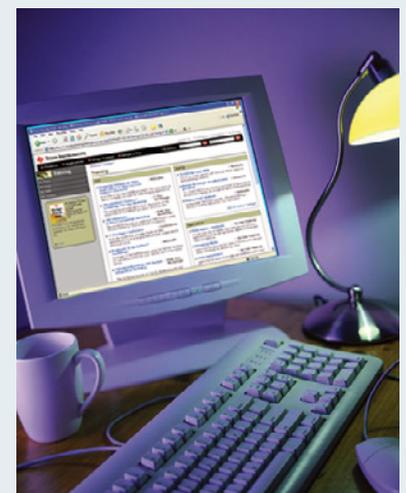
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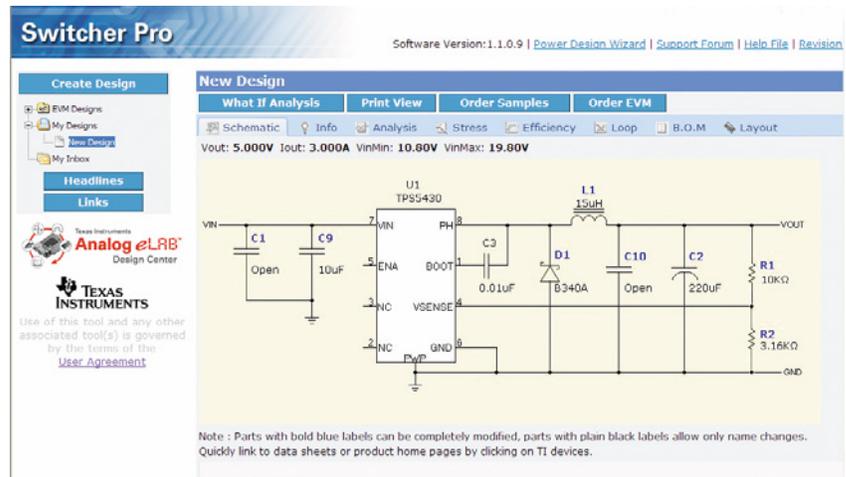
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### SPICE-Based Analog Simulation Program TINA-TI™ version 7.0

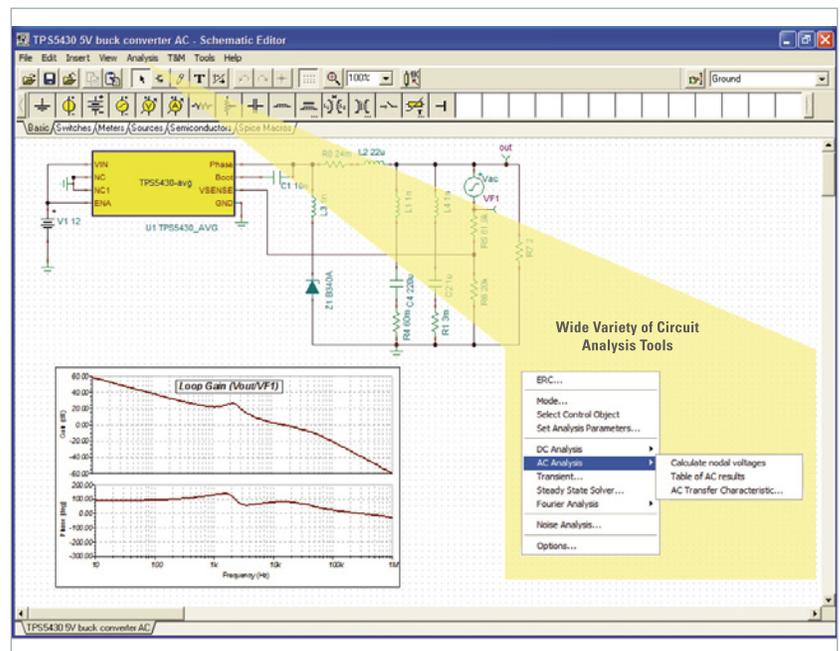
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TINA is an easy-to-use, but powerful, circuit simulation program based on a SPICE engine. TINA-TI is a fully functional version of TINA, loaded with a library of TI macromodels plus passive and active models.

#### Features

The new TINA-TI version 7.0 has changes from version 6.0 in the following areas:

- TINA-TI provides support for switching power supply devices.
- TINA-TI has no limit to circuit size.
- TINA-TI has more SPICE models and example circuits included.
- User will be notified when an update is available for the tool and TI model library.
- TINA-TI now supports SMPS simulation capability.
- Circuits developed in TINA-TI 7.0 will work with TINA Industrial version 7.
- TINA-TI version 6.0 is forward compatible with version 7.0, but not visa versa





### High-Performance Analog Packages

	Package Type	Package Designator
	Wafer Scale Package (WSP)	YEG, YEK, YEJ, YEA, YZA, YED, YNA
	Small Outline Transistor Package (SOT23)	DBY, DCN, Thin SOT, DDC
	Transistor Outline (TO236)	DBZ
	Mini Small Outline Package (MSOP)	DGK, DGS
	Small Outline No Leads (SON)	DRD, DRB, DRC
	Shrink Small Outline Package (SSOP)	DBQ, DB, DL
	Quad Flatpack No Leads (QFN)	RGS, RGY, RGT, RGV, RGY, RHC, RGA, RGP, RGW, RGY, RGE, RGU, RHD, RGL, RGD, RHB, RGF, RHA, RTA, RGN, RGZ, RGQ, RGC, RHE, RHF
	Thin Quad Flatpack (TQFP)	PBS, PJT, PFB, PAG
	Small Outline Transistor (SOT223)	DCY, DCQ
	Heat Sink Thin Quad Flatpack (HTQFP)	PHP, PAP
	Small Outline Integrated Circuit (SOIC)	D, DTH, DTC, DW, DWU

	Package Type	Package Designator
	Thin Shrink Small Outline Package (TSSOP)	PW
	Plastic Dual-In-Line Package (PDIP)	P, N, NT, NTD
	Surface Mount Header (DDPak)	KTT, KTW
	Transistor Outline (TO220)	KC
	Heat Sink Small Outline Package (HSOP)	DWP, DWD
	Power Small Outline Package (PSOP3)	DKP (slug down), DKD (slug up)
	Ball Grid Array (BGA)	

## → Packaging

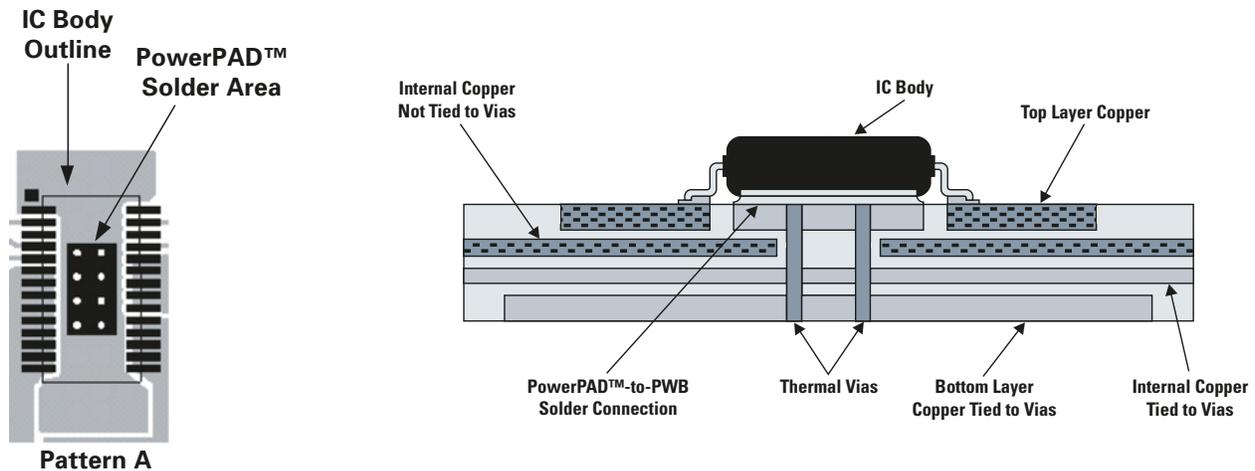
### How to Connect the PowerPAD™

The PowerPAD 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. Even though the PowerPAD should not be used as your primary signal connection for the IC (use the designated signal pins as specified in the product data sheet), the copper area under the pad can be connected to the specified signal plane per the product data sheet without affecting the device. Since the PowerPAD is intended to remove heat from the part, the size of the signal plane to which the thermal pad is attached within the board should be as large as needed to dissipate the heat. The via array recommendations in the documents below may vary based on layout constraints and recommendations presented in the product datasheet. The documents below should be used as a general guideline for board design while referring to the product datasheet for application specific via and land pattern requirements.

You can find additional information in the following resources.

Technical literature can be accessed online with [www-s.ti.com/sc/techlit/litnumber](http://www-s.ti.com/sc/techlit/litnumber) by replacing *litnumber* with one of the literature numbers shown below 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](http://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](http://support.ti.com)



PowerPAD package as used by the SWIFT™ product family.

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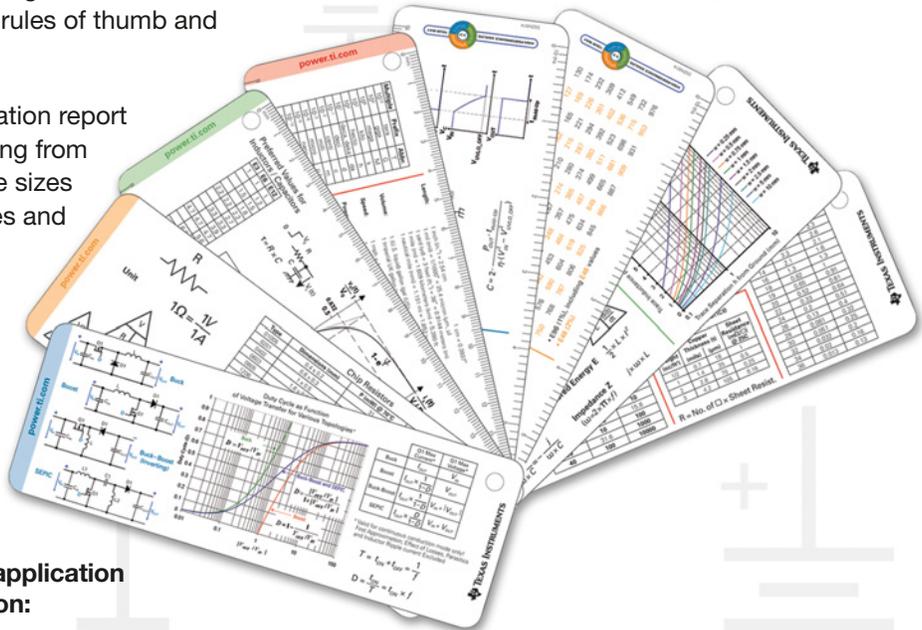
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