Power Management Guide

Texas Instruments

Power Management Guide
Introduction and Contents

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

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

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

www.ti.com/hirel

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

www.ti.com/automotive

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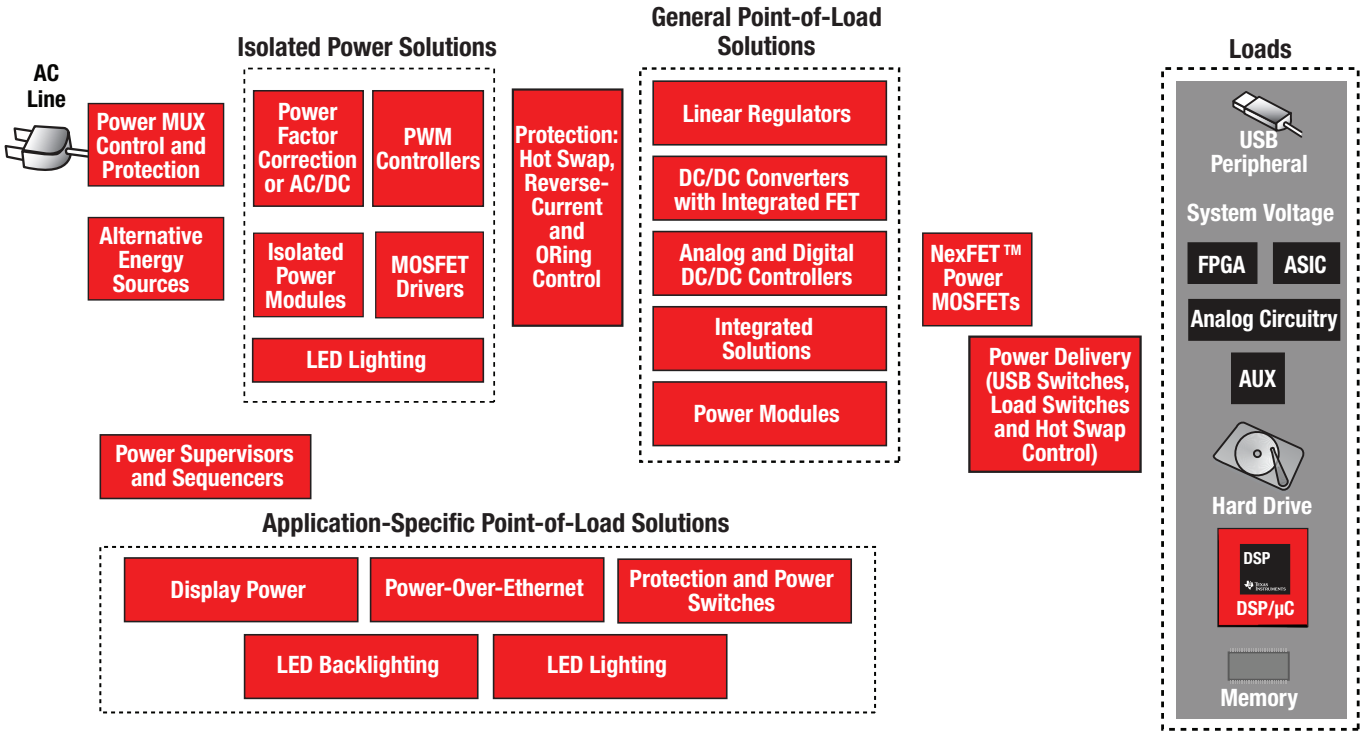
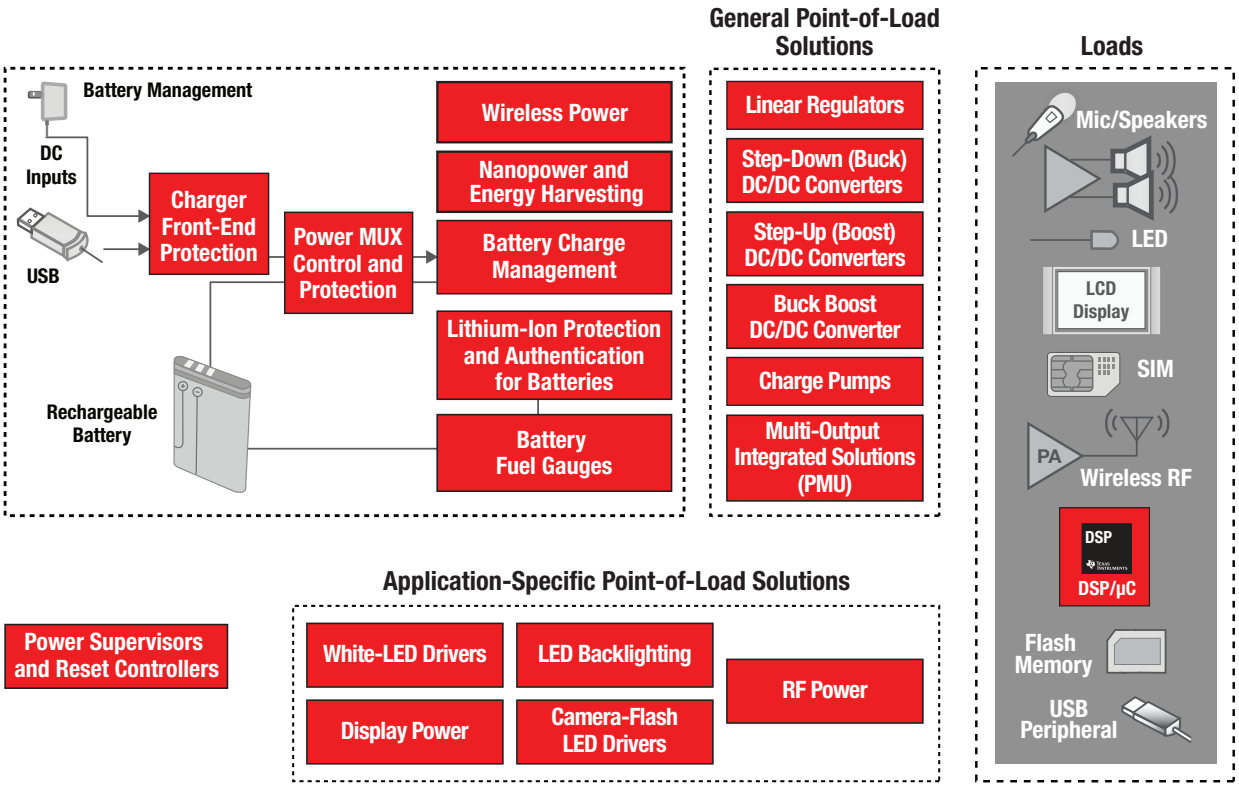
Line Power Solutions



Portable Power Solutions



AC/DC and Isolated DC/DC Power Supplies
Overview

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

Power-Supply Solutions

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

Design Factors

Control Method

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

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

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

Zero-Voltage-Transition (ZVT) Mode — A type of soft-switching technique, which reduces EMI and allows for higher frequency operations.

Protection

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

Performance

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

Flexibility

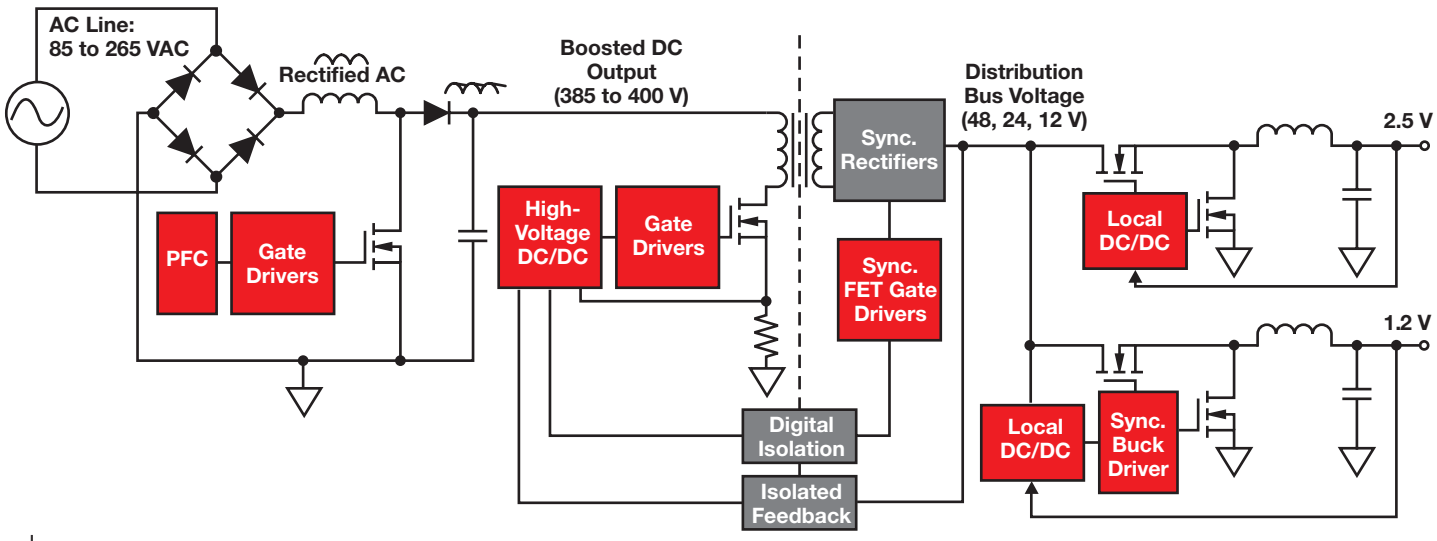
- Versatile advanced PWM controllers and bias supply converters for high-performance secondary-side control
- Ability to work with a wide line voltage range
- Different levels of undervoltage lockout thresholds for self bias and auxiliary bias applications
- Ability to synchronize controllers to eliminate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

Power Level

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

Features

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



AC/DC and Isolated DC/DC Power Supplies

Power Factor Correction (PFC)

Interleaved PFC

Interleaved PFC is gaining popularity in external and embedded-type power-supply architectures. It is exceptionally flexible and provides many cost-saving features such as passive-component size reductions, smaller EMI filtering components and higher efficiencies. TI offers both transition mode (UCC28063) and continuous conduction mode (CCM) (UCC28070) control methods.

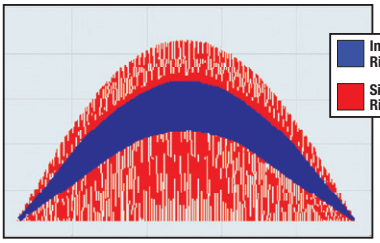
Other benefits of interleaving include scalability and ultrathin designs. Scalability allows for addressing many different power levels and applications.

Why Interleave?

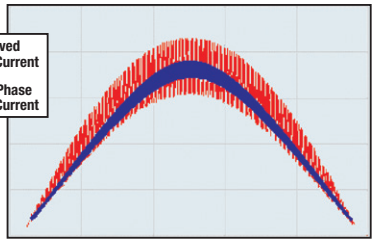
- Lower system cost from ripple-current cancellation
- Enables ultraslim and high-density designs
- Lower total inductor volume
- Smaller or lower-cost EMI filter and output capacitors
- Facilitates higher efficiency

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

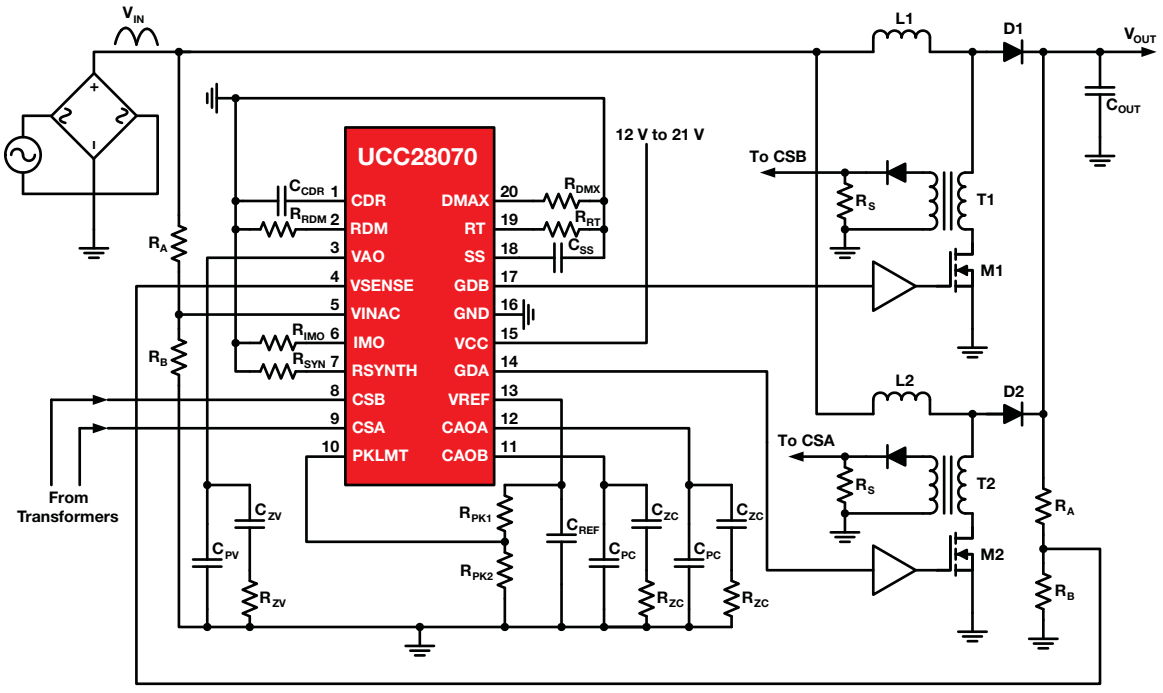


UCC28063 transition mode PFC with Natural Interleaving™ technique.



UCC28070 continuous conduction mode PFC.

Get more information: **www.ti.com/product/UCC28063** or **UCC28070**



Typical application for UCC28070 continuous conduction mode PFC.

AC/DC and Isolated DC/DC Power Supplies

PWM and Resonant Controllers

Product Highlights

UCC28950
- Green advanced phase-shifted full-bridge and synchronous rectifier controller

UCC28250
- Advanced PWM controller with pre-bias start-up and synchronous rectification

UCC28700/1/2/3
- Constant-voltage, constant-current PWM with primary-side regulation, <30-mW no-load power

UCC28710/1
- Constant-voltage, constant-current PWM with primary-side regulation with HV start-up, <10-mW no-load power

UCC2897A
- Active clamp forward

UCC25600
- LLC resonant controller

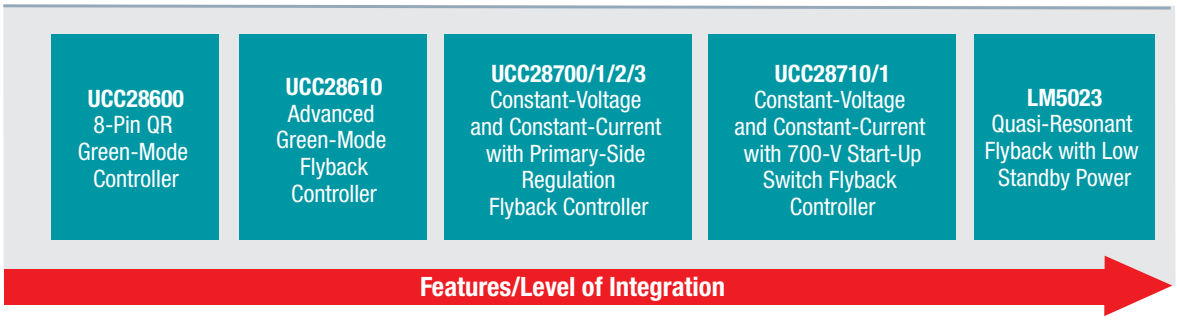
UCC28610
- Advanced green-mode flyback controller

LM5023 PREVIEW
- Quasi-resonant flyback controller with low standby power and 1% regulation

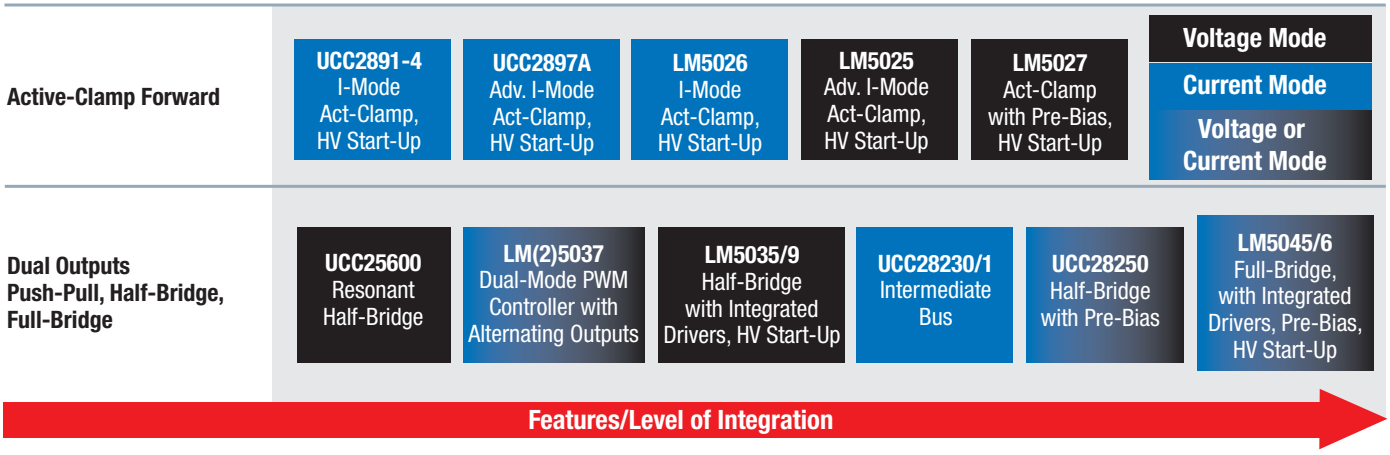
LM5046
- Phase-shifted full-bridge and SR controller with integrated drivers and high-voltage start-up

LM5035/39
- Half-bridge controller with integrated high-voltage start-up and drivers

Green-Mode Controllers (Up to 150 W)



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



AC/DC and Isolated DC/DC Power Supplies

PWM and Resonant Controllers

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

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

Features/Level of Integration

Most Integrated Family of Full-Bridge PWM Controllers

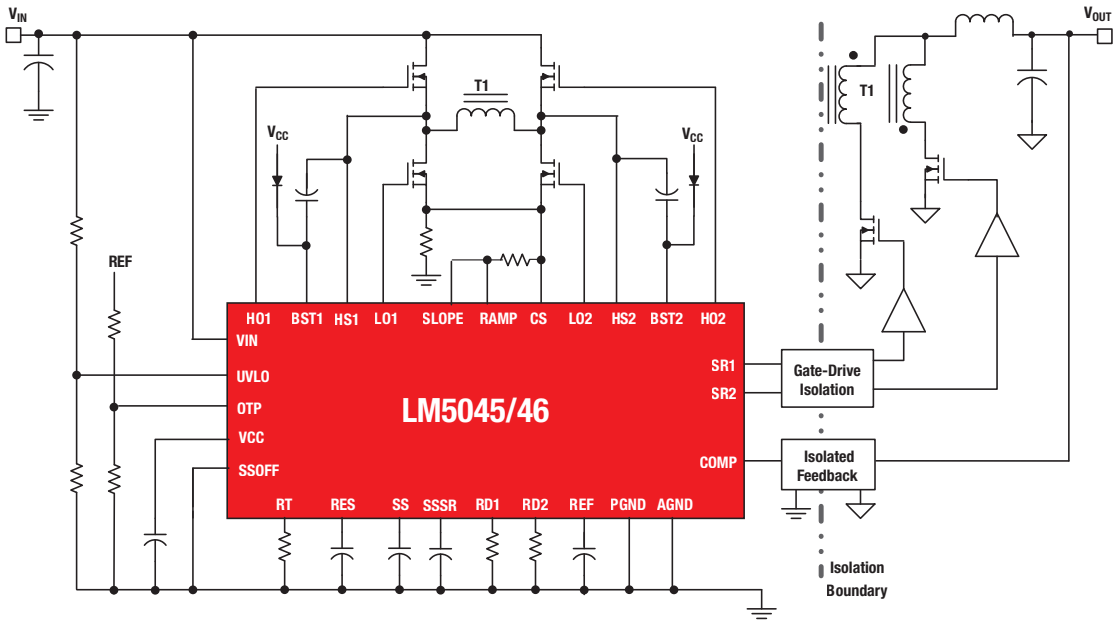
LM5045, LM5046

Key Features

- High-current, 2-A full-bridge gate drivers
- Intelligent sync rectifier start-up for linear turn-on into prebiased loads
- 5-V sync rectifier drive for digital isolators or transformer
- 105-V high-current start-up regulator
- Independently programmable synchronous rectifier delays (LM5045)
- Programmable resonant times for ZVS operation (LM5046)

Applications

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



Get more information: **www.ti.com/product/LM5045** or **LM5046**

AC/DC and Isolated DC/DC Power Supplies

PWM and Resonant Controllers

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

UCC28950

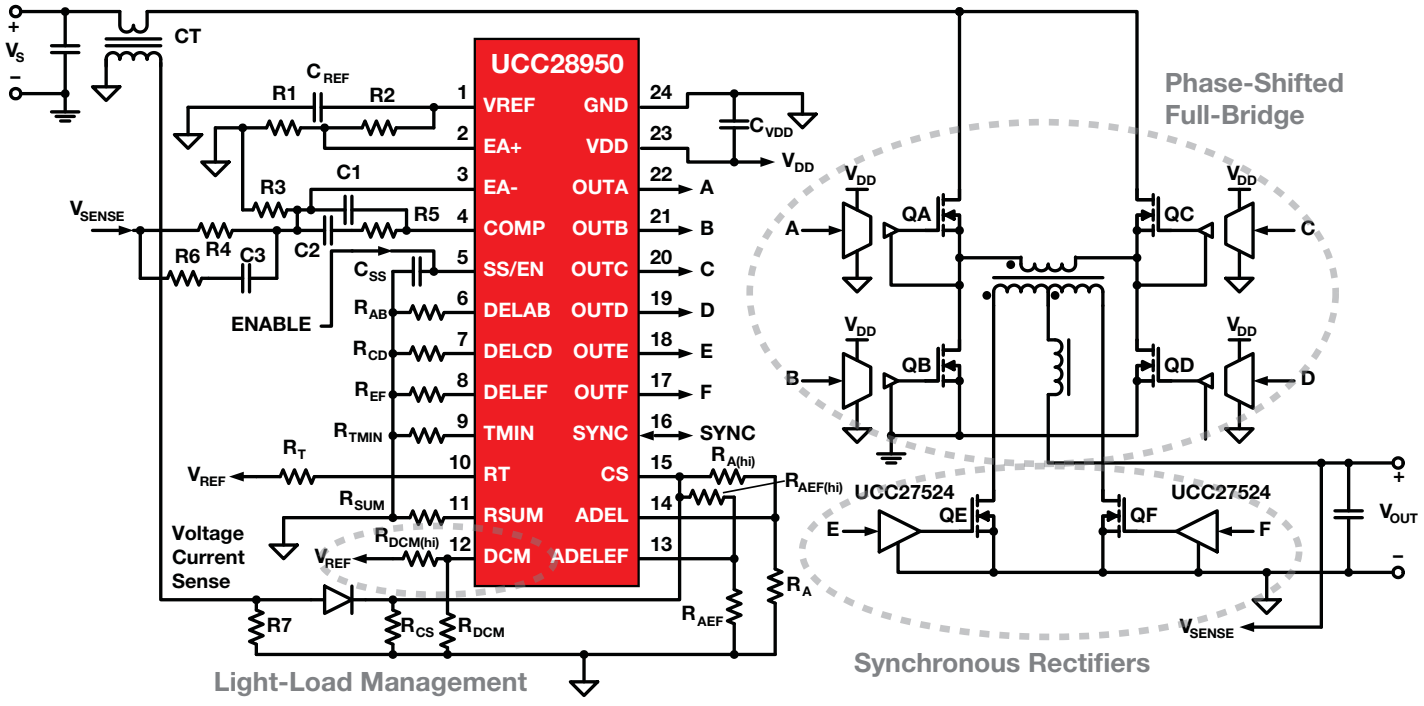
The UCC28950 phase-shifted full-bridge controller offers best-in-class efficiency in today's high-performance power systems. The UCC28950 implements advanced full-bridge control along with active control of the synchronous rectifier's output stage. The primary-side signals allow programmable delays to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

Key Features

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

Applications

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



Get more information: **www.ti.com/product/UCC28950**

AC/DC and Isolated DC/DC Power Supplies

PWM and Resonant Controllers

Selection Guide

Device[1]	Typical Power Level (W)	Control Method			Topologies	Maximum Practical Frequency	Supply Voltage (V)	110-V Start-Up Circuit	Soft Start	Output Drive (Sink/ Source) (A)	Package(s)	Price*
		Voltage Mode	Current Mode	Avg. Current Mode								
Auxiliary Bias Supplies												
TPS55010	<2		✔		Fly-Buck™ (Forward Flyback)	2 MHz	2.95 to 6		✔	—	16-QFN	1.65
UCC25230	1 to 2				Buck, Fly-Buck (Forward Flyback)	445 kHz	12 to 75		✔	—	8-SON	1.35
LM34927/6/5	3 to 7	Note 2			Buck, Isolated Buck	1 MHz	9 to 100			0.6/0.3/0.15	8-LLP/PSOP	1.65
LM5017	3 to 7	Note 2			Buck, Isolated/Non-Isolated Flyback	1 MHz	9 to 100			0.6	8-LLP/PSOP	1.65
Intermediate Bus Controllers												
UCC28230/1	150 to 500				Half-Bridge, Full-Bridge	2 MHz	–0.3 to 20		✔	0.2/0.2	12-SON, 14-TSSOP	1.20
General-Purpose Single-Ended Controllers												
UCC3888/89	<10	✔			Flyback (SEPIC, Cuk)	250 kHz	9		✔	0.2/0.15	8-SOIC-W/DIL (PDIP)	0.59
LM5020	10 to 100		✔		Buck, Boost, Flyback (SEPIC, Cuk)	1 MHz	13 to 100	✔	✔	1	10-MSOP/QFN	0.90
LM5021	10 to 100		✔		Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	8 to 30		✔	0.7	8-MSOP	0.66
LM5022	25 to 100		✔		Buck, Boost, Flyback (SEPIC, Cuk)	2 MHz	6 to 60		✔	1	10-MSOP	1.13
UCC3800/1/2/3/4/5	10 to 200	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%)	1 MHz	4.1 to 15		✔	1/1	8-TSSOP/SOIC/DIL (PDIP)	1.35
UCC3807-1-2-3	10 to 200	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	6.9 to 15		✔	1/1	8-SOIC/DIL (PDIP)	1.50
UCC3809-1-2	10 to 200	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	8 to 19		✔	0.8/0.4	8-MSOP/TSSOP/SOIC/ DIL (PDIP)	0.85
UCC3813-0/1/2/3/4/5	10 to 200	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd)[3], Forward (D > 50%)[3]	1 MHz	7.2 to 15[3]		✔	1/1	8-TSSOP/SOIC/DIL (PDIP)	0.80
LM5025/A/B/C	50 to 250	✔			Act-Clamp Fwd/Flyback	1 MHz	8 to 100	✔	✔	3/3	16-TSSOP/QFN	1.25
LM5026	50 to 250		✔		Act-Clamp Fwd/Flyback	1 MHz	8 to 100	✔	✔	3/3	16-TSSOP/QFN	1.30
LM5027/A	50 to 250	✔			Act-Clamp Fwd/Flyback	1 MHz	8 to 105	✔	✔	2/2	24-TSSOP, 20-QFN	1.75
UCC3884	50 to 250	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	8.9 to 15		✔	1/0.5	16-SOIC/DIL (PDIP)	1.60
UCC38C40/1/2/3/4/5	10 to 250	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	5 Options			1/1	8-MSOP/SOIC/DIL (PDIP)	0.95
TL3842B/3B/4B/5B	30 to 350	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	500 kHz	10 to 30			1/1	8/14-SOIC, 8-DIL (PDIP)	0.54
UC3842A/3A/4A/5A	30 to 350	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	500 kHz	10 to 30			1/1	8/14-SOIC, 8-DIL (PDIP)	0.80
UC28023	50 to 750	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	9 to 30		✔	1.5/1.5	16-SOIC-W/DIL (PDIP)	1.35
UC3823	50 to 750	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	9 to 30		✔	1.5/1.5	16-SOIC-W/DIL (PDIP), 20-PLCC	1.60
UC3823A/B	50 to 750	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Forward (D > 50%)	1 MHz	9 to 22		✔	2/2	16-SOIC-W/DIL (PDIP), 20-PLCC	4.90
Wide-Input Range Voltage Mode Controllers												
UCC35701/2	25 to 250	✔			Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%)	700 kHz	8.8 to 15		✔	1.2/1.2	14-TSSOP/SOIC/DIL (PDIP)	2.95
UCC35705/6	25 to 250	✔			Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%)	4 MHz	8.0 to 15			0.1/0.1	8-MSOP/SOIC/DIL (PDIP)	0.75
Dual Output Controllers												
LM5015	30 to 250		✔		Fwd (Including 2-Switch Fwd)	750 kHz	4.25 to 75		✔	1	14-TSSOP	2.05
LM5032	30 to 250		✔		Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd)	1 MHz	13 to 100	✔	✔	2.5/2.5	16-TSSOP	1.55
LM5034	30 to 250		✔		Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd)	1 MHz	8 to 100	✔	✔	2.5/2.5	20-TSSOP	1.90
UC3824	50 to 250	✔	✔		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	9 to 30		✔	1.5/1.5	16-SOIC-W/DIL (PDIP)	4.55
UCC28089	25 to 250				Interleaved Fwd/Flyback/Boost, Push-Pull, Half-Bridge, Full-Bridge	500 kHz	8 to 15		✔	0.5/1.0	8-SOIC	0.65
LM5035/A/B/C	50 to 300	✔			Half-Bridge	2 MHz	8 to 100	✔	✔	2/2	28-TSSOP, 20-HTSSOP, 24-QFN	1.90
LM(2)5037	30 to 300	✔	✔		Push-Pull, Half-Bridge, Full-Bridge	2 MHz	13 to 75/100	✔	✔	1.2/1.2	16-TSSOP	1.35/1.62
LM5039	50 to 300	✔			Half-Bridge	2 MHz	8 to 100	✔	✔	2/2	20-HTSSOP, 24-QFN	1.90
LM5045	50 to 400	✔	✔		Full-Bridge	2 MHz	14 to 100	✔	✔	1.5/2	28-HTSSOP/QFN	2.25
TL494 or TL594	50 to 500	✔			Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%), Interleaved Fwd/Flyback/Boost, Push-Pull, Half-Bridge, Full-Bridge	300 kHz	7 to 40			0.2/0.2	16-TSSOP/SOIC/DIL (PDIP)	0.23
TL598	50 to 500	✔			Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Forward (D > 50%), Interleaved Fwd/Flyback/Boost, Push-Pull, Half-Bridge, Full-Bridge	300 kHz	7 to 40			0.2/0.2	16-SOIC/DIL (PDIP)	0.81

[1] UC2xxx and UCC2xxx devices are extended temperature-range versions of the UC3xxx and UCC3xxx devices.
[2] Continuous On-Time architecture.
[3] Value varies by part number suffix. Please check datasheet.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

AC/DC and Isolated DC/DC Power Supplies

PWM and Resonant Controllers

Selection Guide (Continued)

Device[1]	Typical Power Level (W)	Control Method			Topologies	Maximum Practical Frequency	Supply Voltage (V)	110-V Start-Up Circuit	Soft Start	Output Drive (Sink/ Source) (A)	Package(s)	Price*
		Voltage Mode	Current Mode	Avg. Current Mode								
Dual Output Controllers (Continued)												
UC3524A	50 to 500	✔			Push-Pull, Half-Bridge, Full-Bridge	250 kHz	8 to 40		✔	0.2/0.2	16-SOIC/DIL (PDIP)	1.70
UC3525B - UC3526A	50 to 500	✔			Push-Pull, Half-Bridge, Full-Bridge	250 kHz	8 to 40		✔	0.2/0.2	16-SOIC/DIL (PDIP), 20-PLCC	1.05
UC3827-1/-2	50 to 500		✔		I-Fed/V-Fed Push-Pull	450 kHz	8.4 to 20		✔	1/0.8	24-SOIC-W/DIL (PDIP), 28-PLCC	3.50
UCC3808-1/-2/A-1/A-2	50 to 500		✔		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	4.3 to 15		✔	1.0/0.5	8-TSSOP/SOIC/DIL (PDIP)	1.30
UCC38083/4/5/6	50 to 500		✔		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	8.3 to 15		✔	1.0/0.5	8-TSSOP/SOIC/DIL (PDIP)	1.10
UCC3810	50 to 500	✔	✔		Buck, Boost, Flyback (SEPIC, Cuk), Fwd (Including 2-Switch Fwd), Interleaved Fwd/Flyback/Boost	1 MHz	8.3 to 11			1/1	16-SOIC/DIL (PDIP)	1.85
LM5030	50 to 600		✔		Act-Clamp Fwd/Flyback, Half-Bridge, Full-Bridge	1 MHz	14 to 100	✔	✔	1.5/1.5	20-TSSOP	1.10
LM5033	50 to 600	✔			Push-Pull, Half-Bridge, Full-Bridge	1 MHz	15 to 100	✔	✔	1.5/1.5	10-MSOP/QFN	1.00
UC28025	50 to 750	✔	✔		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	9 to 30		✔	1.5/1.5	16-SOIC-W/DIL (PDIP)	1.35
UC3825	50 to 750	✔	✔		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	9 to 30		✔	1.5/1.5	16-SOIC-W/DIL (PDIP), 20-PLCC	1.60
UC3825A/B	50 to 750	✔	✔		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	9 to 22		✔	2/2	16-SOIC-W/DIL (PDIP), 20-PLCC	2.65
UC3846/56	50 to 750	✔	✔		Push-Pull, Half-Bridge, Full-Bridge	1 MHz	8 to 40		✔	0.5/0.5	16-SOIC-W/DIL (PDIP), 20-PLCC	1.60
UCC3806	50 to 750	✔	✔		Push-Pull, Half-Bridge, Full-Bridge	350 kHz	7 to 15		✔	0.5/0.5	16-SSOP/TSSOP/SOIC/ SOIC-W/DIL (PDIP), 20-PLCC	4.10
LM5041/A/B	50 to 800		✔		I-Fed/V-Fed Push-Pull	1 MHz	15 to 100	✔	✔	1/5/1.5	16-TSSOP/QFN	2.15
UCC28250/1	100 to 800	✔	✔		Fwd (Including 2-Switch Fwd), Interleaved Fwd/Flyback/ Boost, Act-Clamp Fwd/Flyback, Push-Pull, Half-Bridge	1 MHz	4.7 to 17		✔	—	20-TSSOP/QFN	1.70
UCC28220/1	50 to 800		✔		Interleaved Fwd/Flyback/Boost	1 MHz/ch.	8 to 14.5	✔	✔	0.01/0.01	16-TSSOP/SOIC	1.60
Soft-Switching, ZVT and ZVS Controllers												
LM5046	50 to 400	✔	✔		Φ-Shifted FB	2 MHz	14 to 100	✔	✔	2/2	28-HTSSOP/QFN	2.45
UCC3580-1/-2/-3/-4	50 to 500	✔			Forward (D > 50%), Act-Clamp Fwd/Flyback	500 kHz	7 to 15		✔	0.5/1, 0.3/0.3	16-SOIC/DIL (PDIP)	2.40
UCC2891/3	75 to 600		✔		Forward (D > 50%), Act-Clamp Fwd/Flyback	1 MHz	8.5 to 14.5	✔	✔	2/2, 2/2	16-TSSOP/SOIC	1.50
UCC2892/4	75 to 600		✔		Forward (D > 50%), Act-Clamp Fwd/Flyback	1 MHz	8.5 to 14.5		✔	2/2, 2/2	16-TSSOP/SOIC	1.50
UCC2897A	75 to 600		✔		Forward (D > 50%), Act-Clamp Fwd/Flyback	1 MHz	8.5 to 14.5	✔	✔	2/2, 2/2	20-TSSOP, 16-SOIC	1.50
UCC25600	200 W to 1 kW				Half-Bridge	350 kHz	11.5 to 18		✔	0.4/0.8	8-SOIC	0.80
UCC28950	200 W to 2 kW	✔	✔	✔	Φ-Shifted FB	1 MHz	8 to 17		✔	—	24-TSSOP	4.25
UC3875/6/7	200 W to 2 kW	✔	✔	✔	Act-Clamp Fwd/Flyback, Φ-Shifted FB	1+ MHz	10.7 to 20		✔	Four at 2/2	20-SOIC-W/DIL (PDIP), 28-PLCC	4.85
UC3879	200 W to 2 kW	✔	✔		Φ-Shifted FB	500 kHz	11 to 20		✔	Four at 0.1/0.1	20-SOIC-W/DIL (PDIP), 28-PLCC	3.70
UCC3895	200 W to 2 kW	✔	✔	✔	Φ-Shifted FB	1 MHz	11 to 17		✔	Four at 0.1/0.1	20-SOIC-W/DIL (PDIP)/ PLCC	4.35
Secondary-Side, Post Regulation												
LM(2)5115/A	—		✔		Synchronous Secondary-Side Post Regulator	1 MHz	4.5 to 42/75		✔	2/2.5	16-TSSOP/QFN	1.35/1.80
UCC3583	50 to 500					500 kHz	8.5 to 15		✔	0.5/1.5	14-SOIC/DIL (PDIP), 20-PLCC	1.75
Green Mode PWM Controllers												
UCC28710/1	Up to 25		✔		Flyback	130 kHz	9 to 35	✔	✔	0.025/2	7-SOIC, 6-SOT-23	0.42
UCC28700/1/2/3	Up to 30		✔		Flyback	130 kHz	9 to 35		✔	0.025/2	6-SOT-26	0.35
UCC28610	10 to 40		✔		Buck, Flyback (SEPIC, Cuk)	140 kHz	9 to 20			—	8-SOIC	0.60
LM5023	5 to 100		✔		Quasi-Resonant Mode Flyback	130 kHz	8 to 15		✔	0.3/0.7	8-MSOP	0.38
UCC28600	50 to 150		✔		Flyback (SEPIC, Cuk)	130 kHz	30		✔	1/0.75	8-SOIC	0.49

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

[2] Continuous On-Time architecture.

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

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

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

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

AC/DC and Isolated DC/DC Power Supplies
Gate Drivers

Design Factors

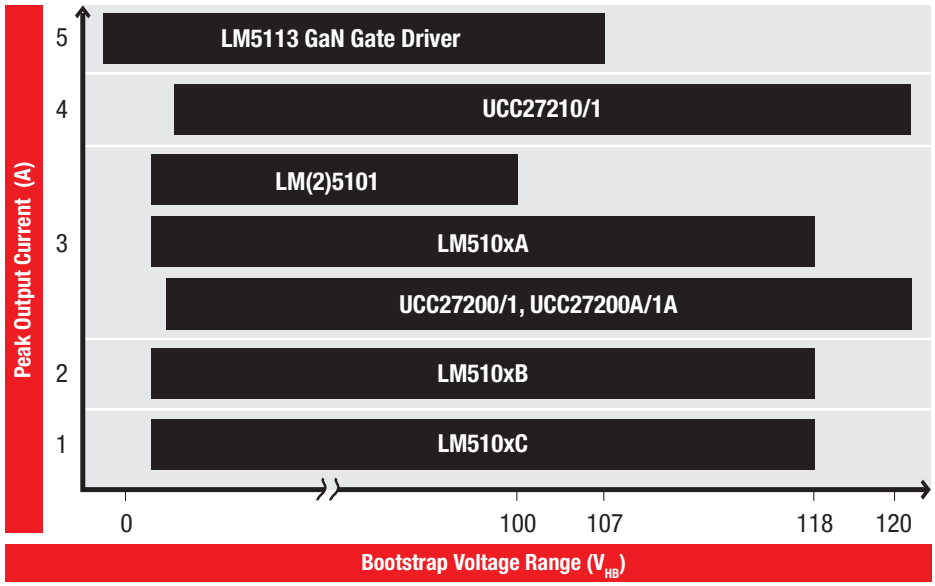
Supply Voltage Range — With internal voltage regulators, MOSFET drivers can operate over a wide input voltage range, making them flexible for many applications.

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

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

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

High-Side/Low-Side Bridge Driver Portfolio



Product Highlights

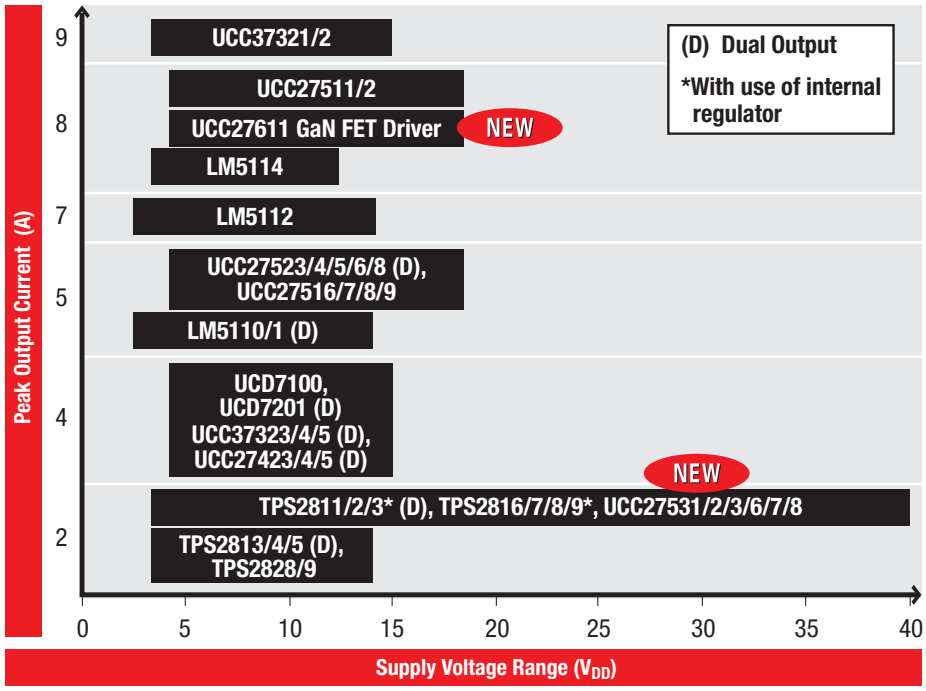
LM5113
- Industry's only 100-V driver for enhancement-mode GaN FETs

UCC2721x
- 4-A next generation of popular UCC2720x has 120-V boot voltage, –10-V input-voltage capability and ESD enhancements

LM510xx Family
- Drive capability scales with power-converter requirements

LM(2)5101 Family
- 80-V input, low power consumption, motor-control and automotive applications

Low-Side Gate Driver Portfolio



Product Highlights

UCC27611
- High-speed 5-V GaN FET driver

UCC27531
- FET and IGBT single-gate drivers
- 2.5 A and 5 A, 35-V maximum V_{DD}

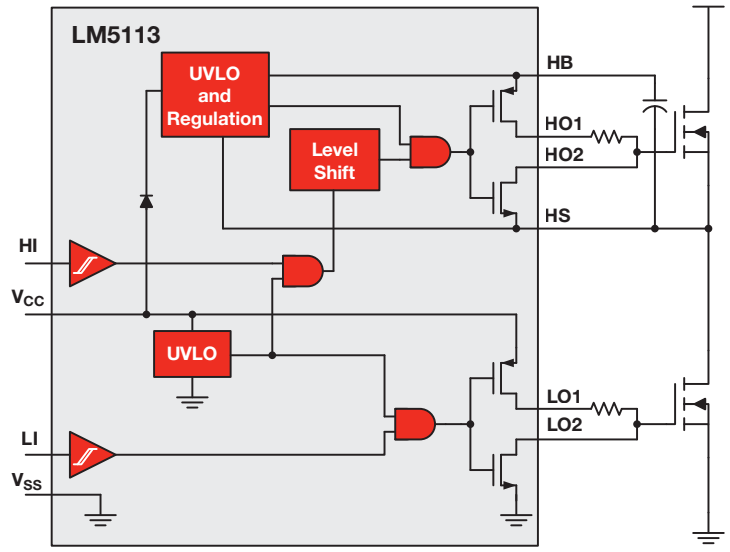
UCC2751x/52x
- Asymmetrical drive and split output options available on select single-channel drivers
- Best-in-class propagation delay and higher V_{DD} compatibility with IGBT power switches
- UCC27528 features CMOS input thresholds

LM5114
- Next-generation 7.6-A, 12-ns single-channel MOS and GaN FET-compatible driver

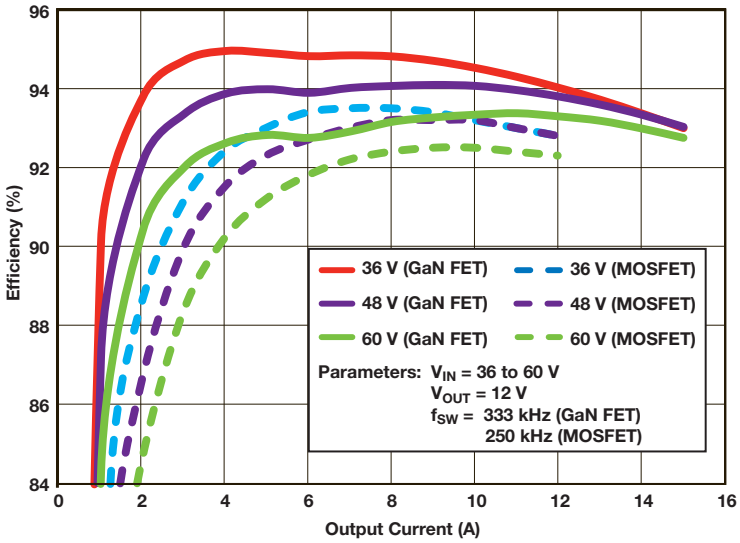
AC/DC and Isolated DC/DC Power Supplies
Gate Drivers

100-V Half-Bridge Gate Driver for Enhancement-Mode GaN FETs
LM5113

Enhancement mode Gallium Nitride (GaN) power FETs can provide significant power-density benefits over silicon MOSFETs in power converters. They have a much lower figure of merit (FOM) due to lower $R_{DS(on)}$ and lower Qg. With greater efficiencies, faster switching frequencies and an ultra-small package footprint, GaN FETs enable higher-density power converters. However, realizing these benefits does present a new set of challenges. Large source-drain voltages and the stringent gate-source voltage-drive requirements of GaN power FETs pose new challenges related to limiting the high-side FET drive level to less than 6 V, as well as preventing high dV/dt transients from causing erratic switching behavior.



LM5113 block diagram.



GaN FET efficiency vs traditional MOSFET.

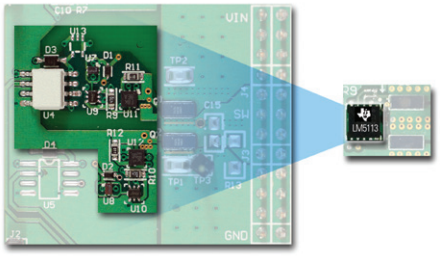
Get more information: **www.ti.com/product/LM5113**

Key Features

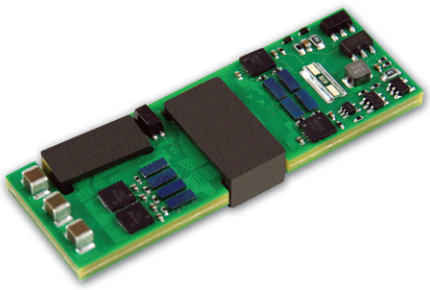
- Independent high and low TTL logic inputs
- 1.2-A/5-A peak source/sink current
- High-side floating bias voltage rail operates up to 100 V
- Internal bootstrap supply-voltage clamping
- Split outputs for adjustable turn-on/turn-off strength
- 0.5-Ω/2-Ω pull-down/pull-up resistance
- Fast propagation times—30 ns typical

Applications

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



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



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

AC/DC and Isolated DC/DC Power Supplies

Gate Drivers

Selection Guide

Device	No. of Channels	Output Configuration	Output Type[1]	Peak I_{OUT} Source/Sink (A)	Rise/Fall Time (ns)	V_{CC} Range (V)	Prop Delay (ns)	Input Threshold	Enable	Dead Time Control	Protection Features[2]	Internal Regulator	Price*
General-Purpose Low-Side Drivers													
TPS2811	2	Inverting	TrueDrive™	2/2	25/25	4 to 40	40	CMOS	—	—	—	✔	0.90
TPS2812	2	Non-inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✔	0.90
TPS2813	2	See Note 3	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	✔	0.90
TPS2814	2	Dual 2-input AND; one inverting	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	—	0.90
TPS2815	2	2-input NAND	TrueDrive	2/2	25/25	4 to 14	40	CMOS	✔	—	—	—	0.90
TPS2816	1	Inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✔	0.65
TPS2817	1	Non-inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✔	0.65
TPS2818	1	Inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✔	0.65
TPS2819	1	Non-inverting	TrueDrive	2/2	25/25	4 to 40	40	CMOS	—	—	—	✔	0.65
TPS2828	1	Inverting	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	—	0.60
TPS2829	1	Non-inverting	TrueDrive	2/2	25/25	4 to 14	40	CMOS	—	—	—	—	0.60
UC3714	2	Non-inverting	Bipolar	0.5/1	30/25	7 to 20	50	TTL/PWM	✔	Adj.	—	—	0.95
UC3715	2	See Note 3	Bipolar	1/2	30/25	7 to 20	50	TTL/PWM	✔	Adj.	—	—	0.90
UCC27323	2	Inverting	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	—	—	—	—	0.65
UCC27324	2	Non-inverting	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	—	—	—	—	0.65
UCC27325	2	See Note 3	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	—	—	—	—	0.65
UCC27423	2	Inverting	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	✔	—	—	—	0.70
UCC27424	2	Non-inverting	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	✔	—	—	—	0.70
UCC27425	2	See Note 3	TrueDrive	4/4	25/25	4 to 15	35	TTL/CMOS	✔	—	—	—	0.70
UCC37321	1	Inverting	TrueDrive	9/9	20/20	4 to 15	30	TTL/CMOS	✔	—	—	—	0.99
UCC37322	1	Non-inverting	TrueDrive	9/9	20/20	4 to 15	30	TTL/CMOS	✔	—	—	—	0.99
LM5114A/B	1	Non-inverting	Split	1.3/7.6	8/3.2	4 to 12.6	—	TTL/CMOS	—	—	—	—	0.60
LM5134	2	Non-inverting with Pilot output	Split	4.5/7.6 0.66/0.82	5.3/4.7	4 to 12.6	12	TTL/CMOS	—	—	—	—	0.60
UCC27511	1	Non-inverting	Split	4/8	9/9	4.5 to 18	14	Dual input TTL	—	—	—	—	0.60
UCC27512	1	Non-inverting	—	4/8	9/7	4.5 to 18	14	Dual input TTL	—	—	—	—	0.60
UCC27516	1	See Note 3	—	4/4	9/7	4.5 to 18	14	TTL	—	—	—	—	0.49
UCC27517	1	See Note 3	—	4/4	9/7	4.5 to 18	14	TTL	—	—	—	—	0.49
UCC27518	1	Inverting	—	4/4	9/7	4.5 to 18	14	CMOS	—	—	—	—	0.49
UCC27519	1	Non-inverting	—	4/4	9/7	4.5 to 18	14	CMOS	—	—	—	—	0.49
LM5110	2	Non-inverting	Split	5/2	14/12	3.5 to 15	25	TTL	—	—	✔	—	0.65
LM5111	2	Non-inverting	Split	5/3	14/12	3.5 to 15	25	TTL	—	—	✔	—	0.65
LM5112	2	Non-inverting	Split	7/3	14/12	3.5 to 15	25	CMOS	—	—	✔	—	0.50
UCC27523	2	Inverting	—	5/5	9/7	4.5 to 18	14	TTL	✔	—	—	—	0.75
UCC27524	2	Non-inverting	—	5/5	9/7	4.5 to 18	14	TTL	✔	—	—	—	0.75
UCC27525	2	See Note 3	—	5/5	9/7	4.5 to 18	14	TTL	✔	—	—	—	0.75
UCC27526	2	See Note 3	—	5/5	9/7	4.5 to 18	14	TTL	✔	—	—	—	0.75
UCC27531	1	Non-Inverting	—	–2.5/5	15/7	—	17	TTL	—	—	—	—	0.75
UCC27532	1	Non-Inverting	—	–2.5/5	15/7	—	17	CMOS	—	—	—	—	0.75
UCC27533	1	See Note 3	—	–2.5/5	15/8	—	15	TTL	—	—	—	—	0.75
UCC27536	1	Inverting	—	–2.5/5	15/8	—	15	TTL	—	—	—	—	0.75
UCC27537	1	Non-Inverting	—	–2.5/5	15/8	—	15	TTL	—	—	—	—	0.75
UCC27538	2	Non-Inverting	—	–2.5/5	15/8	—	15	TTL	—	—	—	—	0.75
UCC27611	1	See Note 3	—	–4/8	5/5	—	14	TTL	—	—	—	—	0.85
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

[1] Output type: TrueDrive is the hybrid bipolar/CMOS output architecture for improved current drive capability at low voltages (at Miller threshold).
[2] OVPC = overvoltage protection crowbar, UVLO = undervoltage lockout.
[3] One inverting, one non-inverting.
[4] Predictive Gate Drive™.
[5] Maximum boot voltage at HS pin.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

AC/DC and Isolated DC/DC Power Supplies
Gate Drivers

Selection Guide (Continued)

Device	No. of Channels	Output Configuration	Output Type[1]	Peak I_{OUT} Source/Sink (A)	Rise/Fall Time (ns)	V_{CC} Range (V)	Prop Delay (ns)	Input Threshold	Enable	Dead Time Control	Protection Features[2]	Internal Regulator	Price*
Synchronous-Rectifier Drivers													
UCC24610		Non-inverting	—	3/3	30/25	4.5 to 5.5	44	CMOS/TTL	✔	Adaptive	✔	—	0.75
Synchronous Buck Drivers													
TPS28225	2	Non-inverting	CMOS	2/4	10/10	4.5 to 8.8	14	TTL/CMOS	✔	Adaptive	UVLO	—	0.60
TPS28226	2	Non-inverting	CMOS	2/4	10/10	4.5 to 8.8	14	TTL/CMOS	✔	Adaptive	UVLO	—	0.60
TPS2830	2	Non-inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	✔	Adaptive	OVPC	—	1.05
TPS2831	2	Inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	✔	Adaptive	OVPC	—	1.05
TPS2832	2	Non-inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	—	Adaptive	—	—	1.00
TPS2833	2	Inverting	TrueDrive	2.4/2.4	50/50	4.5 to 15	75	CMOS	—	Adaptive	—	—	1.00
TPS2834	2	Non-inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	✔	Adaptive	OVPC	—	1.05
TPS2835	2	Inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	✔	Adaptive	OVPC	—	1.05
TPS2836	2	Non-inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	—	Adaptive	—	—	1.25
TPS2837	2	Inverting	TrueDrive	2.4/2.4	30/30	4.5 to 15	70	TTL	—	Adaptive	—	—	1.25
TPS2838	2	Non-inverting	TrueDrive	4/4	120	10 to 15	40	TTL	✔	Adaptive	—	✔	1.30
TPS2839	2	Inverting	TrueDrive	4/4	120	10 to 15	40	TTL	✔	Adaptive	—	✔	1.30
TPS2848	2	Non-inverting	TrueDrive	4/4	120	10 to 15	20	TTL	✔	Adaptive	—	✔	1.25
TPS2849	2	Inverting	TrueDrive	4/4	120	10 to 15	20	TTL	✔	Adaptive	—	✔	1.25
UCC27221	2	Inverting	TrueDrive	3.3/3.3	20/20	3.7 to 20	82/103	TTL	—	PGD[4]	—	✔	1.70
UCC27222	2	Non-inverting	TrueDrive	3.3/3.3	20/20	3.7 to 20	82/103	TTL	—	PGD[4]	—	✔	1.70
UCC27223	2	Non-inverting	TrueDrive	3.3/3.3	25/35	4.15 to 20	82/103	TTL	✔	PGD[4]	—	✔	1.70
UCD7230	2	Non-inverting	CMOS	4/4	10/10	4.5 to 15.5	25	CMOS/TTL	—	Adaptive	Adjustable	—	0.80
High-Side Low-Side Drivers—Half Bridge, Full Bridge													
UCC27200/A	2	Non-inverting	TrueDrive	3/3	8/7	to 110[5]	20	CMOS	—	—	UVLO	—	1.30
LM25101A/B/C	2	Non-inverting	CMOS	3/3	8/8	to 80	25	TTL	—	—	UVLO	—	0.49
LM5100A/B/C	2	Non-inverting	CMOS	3/3	8/8	to 118	25	CMOS	—	—	UVLO	—	1.25
UCC27201/A	2	Non-inverting	TrueDrive	3/3	8/7	to 110[5]	20	TTL	—	—	UVLO	—	1.30
LM5101A/B/C	2	Non-inverting	CMOS	3/3	8/8	to 118	25	TTL	—	—	UVLO	—	1.25
UCC27210	2	Non-inverting	—	4/4	12/9	to 115[5]	20	CMOS	—	—	UVLO	—	1.40
UCC27211	2	Non-inverting	—	4/4	12/9	to 115[5]	20	TTL	—	—	UVLO	—	1.40
LM5113	2	Non-inverting	GaN FET	1.2/5	4/4	to 100[5]	30	TTL	—	—	UVLO	—	1.65

[1] Output type: TrueDrive is the hybrid bipolar/CMOS output architecture for improved current drive capability at low voltages (at Miller threshold).
[2] OVPC = overvoltage protection crowbar, UVLO = undervoltage lockout.
[3] One inverting, one non-inverting.
[4] Predictive Gate Drive™.
[5] Maximum boot voltage at HS pin.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

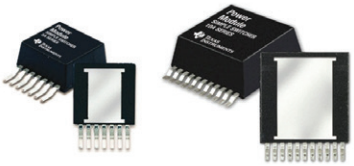
*New devices are listed in **bold red**.*

Power Modules (Non-Isolated)
Overview

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

SIMPLE SWITCHER® Power Modules

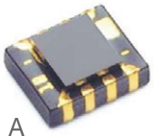
Easy-to-use modules for applications requiring high input voltages (up to 42 V).



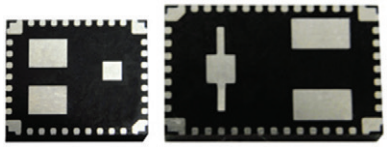
Power Modules

- Leaded PMOD package
- Single exposed bottom
- Supports 5-V, 12-V and 24-V rails
- Output currents of up to 10 A

Nano Modules



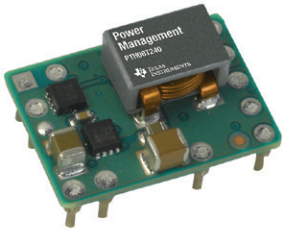
- Miniature form factor
- Adjustable output
- Output current of up to 1 A
- High efficiency and low noise



TPS84k Power Modules

High-density devices for applications where a simple and small total solution size is desired.

- Input-voltage range: 2.95 to 50 V
- QFN packaging
- Feature-rich and flexible
- Only three external components required



PTH08T2xx "T2" Power Modules

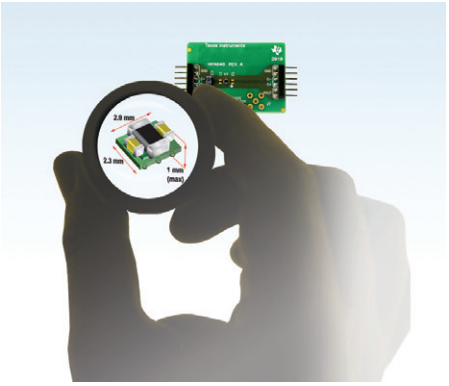
High-current modules for applications that require up to 50 A.

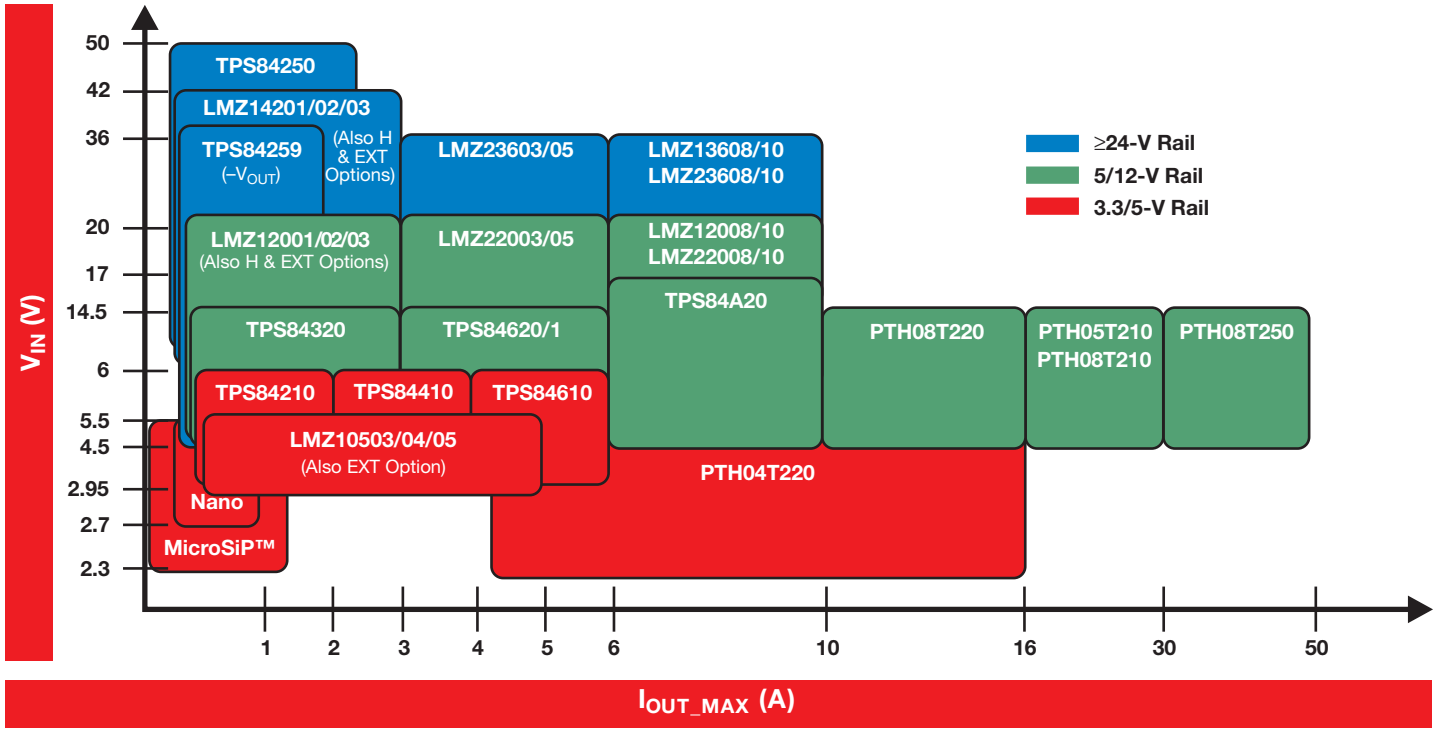
- High output current of up to 50 A
- TurboTrans™ feature for tunable transient response
- Current sharing (50-A version)

MicroSiP™ Modules: TPS81k (Boost) Family and TPS82k (Step-Down) Family

Smallest total-solution footprint.

- Integrates all required components
- Achieves 90 mA/mm^2
- High efficiency over entire load range
- Supports noise-critical applications through spread-spectrum modulation





Power Modules (Non-Isolated)

Step-Down (Buck) Modules

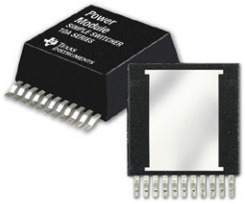
SIMPLE SWITCHER® Power Modules

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

Easy-to-Use Packaging

Up to 5 A

Up to10 A



Key Features

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

SIMPLE SWITCHER® LMZ1-Series Power Modules

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

[1] *Additional input filter required.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

High Output Voltage Power Modules

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

Extended Temperature (EXT) Family of Power Modules

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

High Output Voltage and Extended Temperature Power Modules

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

[1] *Additional input filter required.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

SIMPLE SWITCHER® LMZ2-Series Power Modules

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

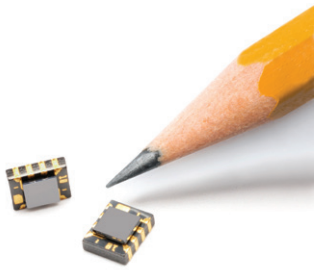
[1] *Additional input filter required.* **Suggested resale price in U.S. dollars in quantities of 1,000.*

Power Modules (Non-Isolated)

Step-Down (Buck) Modules

SIMPLE SWITCHER® Nano Modules

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



Easy-to-Use Package

The new nano module packaging size of 2.5 x 3 x 1.2 mm, makes it the tiniest 1-A DC/DC solution in the market. By mounting the IC on a shielded inductor, the nano modules provide a complete solution that requires only an input capacitor, an output capacitor, a V_{CON} capacitor, and feedback resistors in 35 mm^2 of board space.

SIMPLE SWITCHER® Nano Modules

Device	Output Current (max) (A)	Input Voltage (V)	Adjustable Output Voltage (V)	Operating Junction Temperature (°C)	Features	Frequency (kHz)	CISPR22 Class B EMI	Package Size (mm)	Price*
LMZ10500	0.65	2.7 to 5.5	0.6 to 3.6	–40 to 125	EN, SS	2000	✔	3.0 x 2.5 x 1.2	1.30
LMZ10501	1	2.7 to 5.5	0.6 to 3.6	–40 to 125	EN, SS	2000	✔	3.0 x 2.5 x 1.2	1.55

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

MicroSiP™ Modules

600-mA, Fully Integrated, Low-Noise Step-Down Converter

TPS82671

Key Features

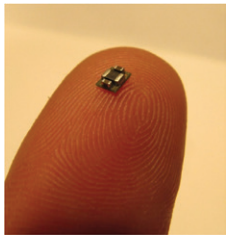
- Regulated switching frequency: 5.5 MHz
- Spread spectrum (SSM), PWM frequency dithering, high PSRR and low-ripple Power Save mode
- Automatic Power Save mode transition or forced PWM mode operation
- Input voltage: 2.3 to 4.8 V

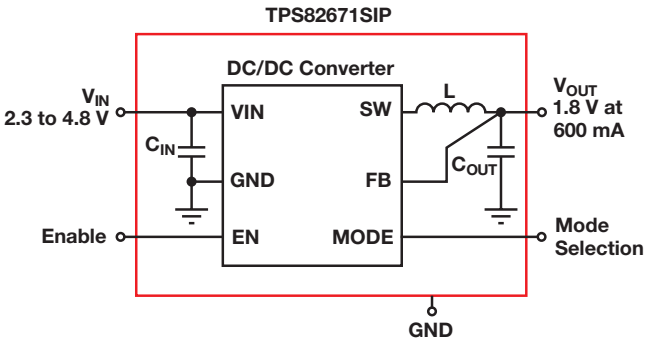
Applications

- Mid- to high-end cell phones, smartphones
- Portable audio/video
- Fiber optics
- Digital TV, WLAN, GPS and *Bluetooth*®

Benefits

- Allows < 7-mm^2 total solution size, providing 90 mA/mm^2
- One-stop-shop, reduced hardware-design workload and no more questionable designs
- Allows choice between high efficiency over entire load range (Power Save mode) or regulated fixed frequency
- Supports Li-Ion batteries with extended voltage range





Get more information: **www.ti.com/product/TPS82671**

MicroSiP™ Power Modules Selection Guide

Device	Base Function	I_{OUT} (mA)	V_{IN} (V)	Fixed V_{OUT} (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Synchronous Rectifier	Active Output Capacitor Discharge	Total Solution Size (mm^2)	MicroSiP Package	EVM	Features and Differentiators	Price*
Fully Integrated Solutions (Inductor plus input/output capacitors on device)															
TPS82695	Step-Down	500	2.3 to 4.35	2.85/2.5	95	4000	24	0.5	✔	✔	6.7	8	✔		1.30
TPS82671	Step-Down	600	2.3 to 4.8	1.1/1.2/1.5/1.8	90	5500	17	0.5	✔	✔	6.7	8	✔	Spread spectrum	1.30
TPS82680	Step-Down	800	2.3 to 5.5	1.0/1.8/3.3	92	6000	15	0.5	✔	✔	6.7	8	✔	Spread spectrum	TBD
TPS82660	Step-Down	1500	2.3 to 5.5	1.0/1.8/3.3	93	6000	15	0.5	✔	✔	6.7	8	✔	Spread spectrum	TBD

All of the above devices have undervoltage lockout and thermal protection built in.
*Preview devices are listed in **bold teal**.*
[1]Maximum current depends on input and output voltages.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Power Modules (Non-Isolated)

Step-Down (Buck) Modules

SWIFT™ Power Modules

TPS84250, TPS84259

NEW

Key Features

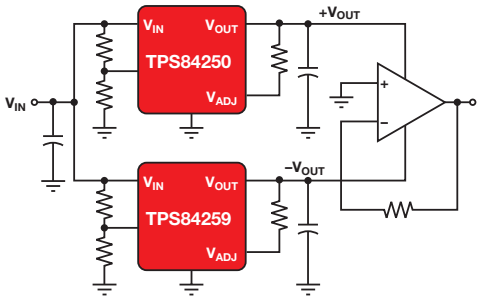
- Integrated inductor and passives require as few as three external components
- Small low-profile QFN packaging capable of 260°C reflow
- Low package thermal resistance delivers full current at T_a = 85°C
- Low noise: All modules meet EN55022 Class B emissions
- Wide operating temperature: Up to 125°C T_j

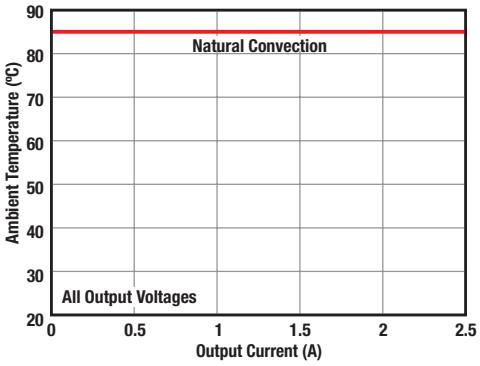
TPS84250 Features

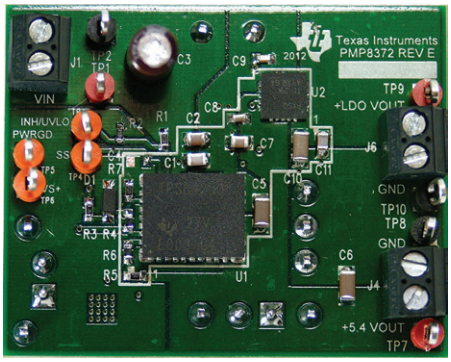
- 7- to 50-V input; survives 65-V transients
- 2.5- to 15-V output up to 2.5 A
- Small 9 x 11 x 2.8-mm QFN package

TPS84259 Features

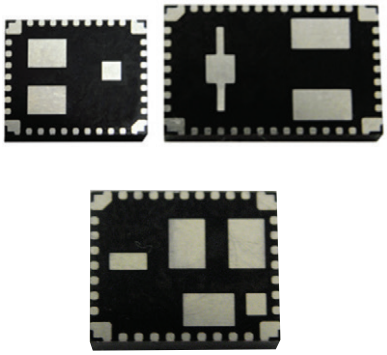
- 4.5- to 40-V input
- –3- to –17-V output up to 15 W
- Small 9 x 11 x 2.8-mm QFN package







PMP8372 reference design.



Package options.

Get more information: **www.ti.com/tps84k**
www.ti.com/product/TPS84250 or **TPS84259**
www.ti.com/tool/PMP8372

SWIFT™ Power Modules Selection Guide

Device	I_{OUT} (A)	V_{IN} (V)	V_{OUT} (V)	Package Theta J_A (°C/W)	Switching Frequency (kHz)	Features						EVM	Package(s)	Price*
						Power Good Pin	Sync Pin	Adj. Soft Start	180° Out of Phase	Sequencing/ Tracking	Current Sharing			
Low Input Voltage														
TPS84210	2	2.95 to 6.0	0.8 to 3.6	12	500 to 2000	✔	✔	✔		✔		✔	39 QFN (9x11x2.8 mm)	2.95
TPS84410	4	2.95 to 6.0	0.8 to 3.6	12	500 to 2000	✔	✔	✔		✔		✔	39 QFN (9x11x2.8 mm)	3.80
TPS84610	6	2.95 to 6.0	0.8 to 3.6	12	500 to 2000	✔	✔	✔		✔	✔	✔	39 QFN (9x11x2.8 mm)	4.15
Mid Input Voltage														
TPS84320	3	4.5 to 14.5	0.8 to 5.5	13	330 to 780	✔	✔	✔		✔		✔	47 QFN (9x15x2.8 mm)	3.75
TPS84420	4	2.95 to 17	0.6 to 5.5	TBD	200 to 1200	✔	✔	✔	✔	✔	✔	✔	44 QFN (10x10x4.3 mm)	TBD
TPS84621	6	4.5 to 14.5	0.6 to 5.5	13	250 to 780	✔	✔	✔		✔	✔	✔	47 QFN (9x15x2.8 mm)	4.15
TPS84720	7	2.95 to 17	0.6 to 5.5	TBD	200 to 1200	✔	✔	✔	✔	✔	✔	✔	44 QFN (10x10x4.3 mm)	TBD
TPS84A20	10	2.95 to 17	0.6 to 5.5	TBD	200 to 1200	✔	✔	✔	✔	✔	✔	✔	44 QFN (10x10x4.3 mm)	TBD
TPS84B20	20	4.5 to 14.5	0.6 to 2.8	TBD	500/900	✔		✔		✔		✔	68 QFN (15x16x5.8 mm)	TBD
TPS84C20	30	4.5 to 14.5	0.6 to 2.8	TBD	500/900	✔		✔		✔		✔	68 QFN (15x16x5.8 mm)	TBD
Wide Input Voltage														
TPS84250	2.5	7 to 50	2.5 to 15	12	400 to 1000	✔	✔	✔		✔		✔	41 QFN (9x11x2.8 mm)	5.25
TPS84259	2	4.5 to 40	–3 to –17	14	700 to 900		✔	✔				✔	41 QFN (9x11x2.8 mm)	6.00

All of the above devices have undervoltage lockout and thermal protection built in.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

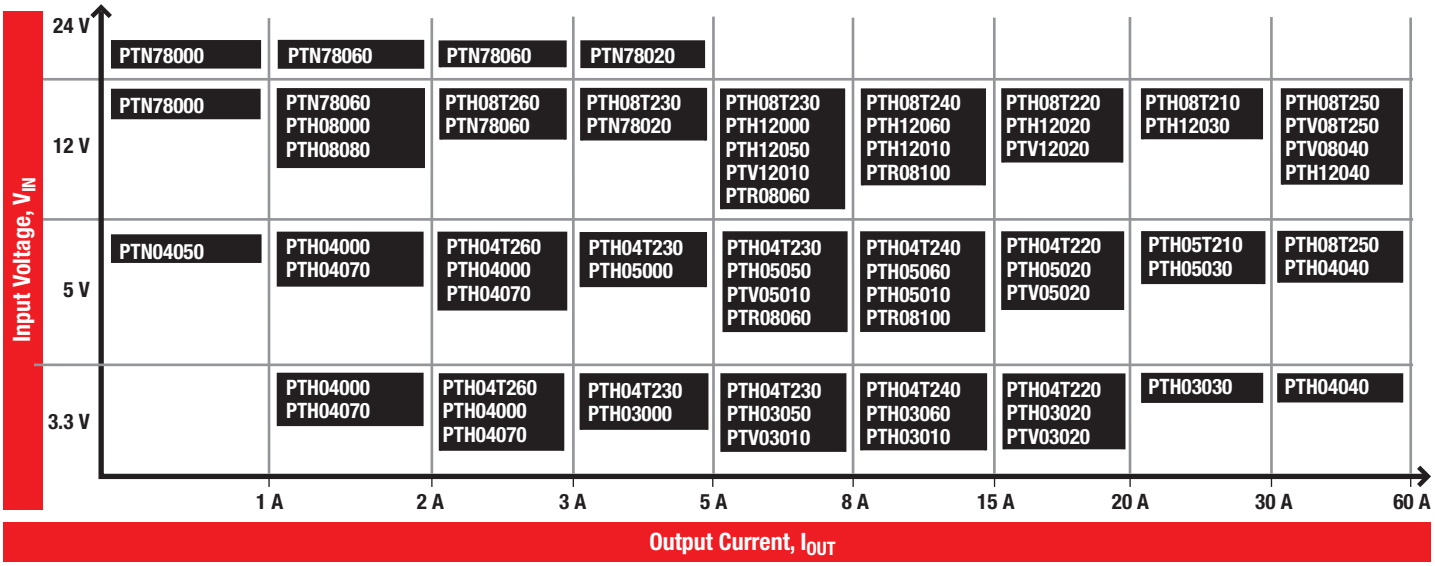
*New devices are listed in **bold red**. Preview devices are listed in **bold teal**.*

WEBENCH® models available for all SWIFT devices: **www.ti.com/webench**

Power Modules (Non-Isolated)

Step-Down (Buck) Modules

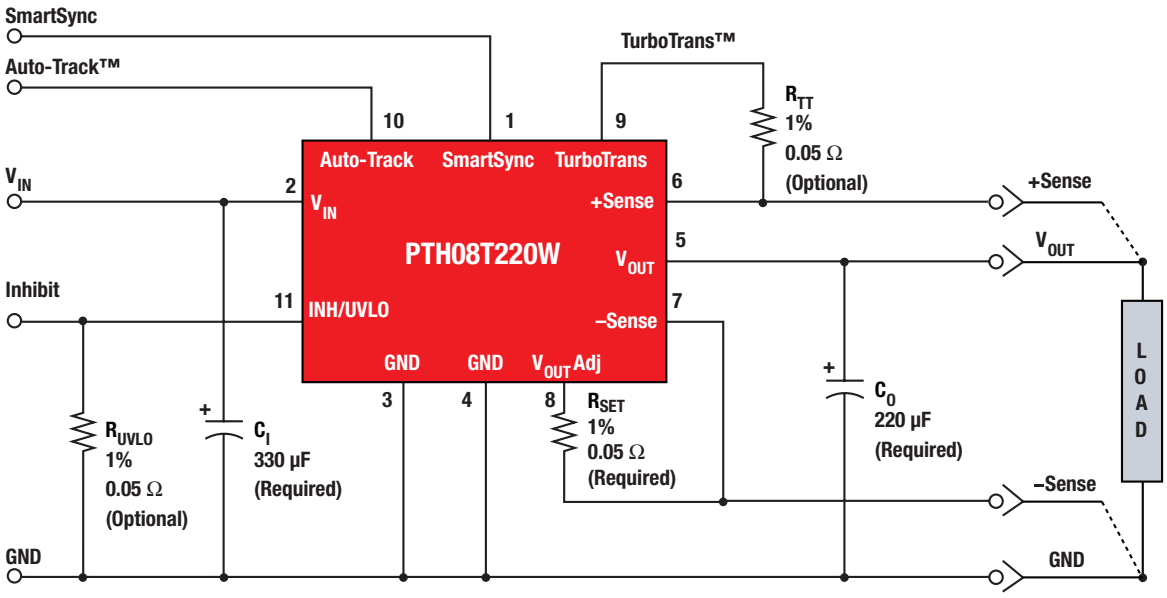
Non-Isolated Plug-In Power Modules (POLA™ and Others) Family of Products



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

PTH08T220W

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



Get more information: **www.ti.com/product/PTH08T220W**

Power Modules (Non-Isolated)

Step-Down (Buck) Modules

Selection Guide

Device[1]	Input Bus Voltage	Description	P_{OUT} or I_{OUT}	V_O Range (V)	V_O Adj.	Auto-Track™ Sequencing	POLA™	DDR-QDR	Price*
Non-Isolated Single Positive Output									
PTH03000W	3.3 V	3.3-V Input 6-A POL	6 A	0.8 to 2.5	✔				6.90
PTH03010W	3.3 V	3.3-V Input 15-A POL with Auto-Track Sequencing	15 A	0.8 to 2.5	✔	✔	✔		11.60
PTH03020W	3.3 V	3.3-V Input 22-A POL with Auto-Track Sequencing	22 A	0.8 to 2.5	✔	✔	✔		18.15
PTH03030W	3.3 V	3.3-V Input 30-A POL with Auto-Track Sequencing	30 A	0.8 to 2.5	✔	✔	✔		25.00
PTH03050W	3.3 V	3.3-V Input 6-A POL with Auto-Track Sequencing	6 A	0.8 to 2.5	✔	✔	✔		6.90
PTH03060W	3.3 V	3.3-V Input 10-A POL with Auto-Track Sequencing	10 A	0.7 to 2.5	✔	✔	✔		9.80
PTH04000W	3.3 V/5 V	3-V to 5.5-V Input 3-A POL with Auto-Track Sequencing	3 A	0.9 to 3.6	✔	✔	✔		4.50
PTH04070W	3.3 V/5 V	3-V to 5.5-V Input 3-A POL	3 A	0.9 to 3.6	✔				4.28
PTH04040W	3.3 V/5 V	3-V to 5.5-V Input 60-A POL with Auto-Track Sequencing	60 A	0.8 to 3.6	✔	✔	✔		35.00
PTH04T220/221W	3.3 V/5 V	2.2- to 5.5-V Input, 16-A T2 2nd Gen PTH POL with TurboTrans™	16 A	0.7 to 3.6	✔	✔	✔		12.60
PTH04T230/231W	3.3 V/5 V	2.2- to 5.5-V Input, 6-A T2 2nd Gen PTH POL with TurboTrans	6 A	0.7 to 3.6	✔	✔			7.90
PTH04T240/241W	3.3 V/5 V	2.2- to 5.5-V Input, 10-A T2 2nd Gen PTH POL with TurboTrans	10 A	0.7 to 3.6	✔	✔			10.80
PTH04T260/261W	3.3 V/5 V	2.2- to 5.5-V Input, 6-A T2 2nd Gen PTH POL with TurboTrans	3 A	0.7 to 3.6	✔	✔			6.25
PTH05000W	5 V	5-V Input 6-A POL	6 A	0.8 to 3.6	✔				6.90
PTH05010W	5 V	5-V Input 15-A POL with Auto-Track Sequencing	15 A	0.8 to 3.6	✔	✔	✔		11.60
PTH05020W	5 V	5-V Input 22-A POL with Auto-Track Sequencing	22 A	0.8 to 3.6	✔	✔	✔		18.15
PTH05030W	5 V	5-V Input 30-A POL with Auto-Track Sequencing	30 A	0.8 to 3.6	✔	✔	✔		25.00
PTH05050W	5 V	5-V Input 6-A POL with Auto-Track Sequencing	6 A	0.8 to 3.6	✔	✔	✔		6.90
PTH05060W	5 V	5-V Input 10-A POL with Auto-Track Sequencing	10 A	0.8 to 3.6	✔	✔	✔		9.80
PTH05T210W	5 V	5-V Input, 30-A T2 2nd Gen PTH POL with TurboTrans	30 A	0.7 to 3.6	✔	✔	✔		18.00
PTH08000W	5 V/12 V	4.5-V to 18-V Input, 2.25-A POL with Auto-Track Sequencing	2.25 A	0.9 to 5.5	✔	✔	✔		4.50
PTH08080W	5 V/12 V	4.5-V to 18-V Input, 2.25-A POL	2.25 A	0.9 to 5.5	✔				4.28
PTH08T210W	12 V	5.5- to 14-V Input, 30-A T2 2nd Gen PTH POL with TurboTrans	30 A	0.7 to 3.6	✔	✔	✔		18.00
PTH08T220/221W	5 V/12 V	4.5- to 14-V Input, 16-A T2 2nd Gen PTH POL with TurboTrans	16 A	0.7 to 5.5	✔	✔	✔		12.60
PTH08T230/231W	5 V/12 V	4.5- to 14-V Input, 6-A T2 2nd Gen PTH POL with TurboTrans	6 A	0.7 to 5.5	✔	✔			7.90
PTH08T240/241W	5 V/12 V	4.5- to 14-V Input, 10-A T2 2nd Gen PTH POL with TurboTrans	10 A	0.7 to 5.5	✔	✔			10.80
PTH08T240F	5 V/12 V	4.5- to 14-V Input, 10-A T2 2nd Gen PTH POL for 3-GHz DSP Systems	10 A	0.7 to 2.0	✔	✔			10.80
PTH08T250/255W	5 V/12 V	4.5- to 14-V Input, 50-A T2 2nd Gen PTH POL with TurboTrans	50 A	0.7 to 5.5	✔	✔			36.00
PTH08T260/261W	5 V/12 V	4.5- to 14-V Input, 3-A T2 2nd Gen PTH POL with TurboTrans	3 A	0.7 to 5.5	✔	✔			6.25
PTH12000L/W	12 V	12-V Input 6-A POL	6 A	0.8 to 1.8/1.2 to 5.5	✔				6.90
PTH12010L/W	12 V	12-V Input 12-A POL with Auto-Track Sequencing	12 A	0.8 to 1.8/1.2 to 5.5	✔	✔	✔		11.60
PTH12020L/W	12 V	12-V Input 18-A POL with Auto-Track Sequencing	18 A	0.8 to 1.8/1.2 to 5.5	✔	✔	✔		18.15
PTH12030L/W	12 V	12-V Input 26-A POL with Auto-Track Sequencing	26 A	0.8 to 1.8/1.2 to 5.5	✔	✔	✔		25.00
PTH12040W	12 V	12-V Input 50-A POL with Auto-Track Sequencing	50 A	0.8 to 5.5	✔	✔	✔		35.00
PTH12050L/W	12 V	12-V Input 6-A POL with Auto-Track Sequencing	6 A	0.8 to 1.8/1.2 to 5.5	✔	✔	✔		6.90
PTH12060L/W	12 V	12-V Input 10-A POL with Auto-Track Sequencing	10 A	0.8 to 1.8/1.2 to 5.5	✔	✔	✔		9.80
PTH03010Y	3.3 V	3.3-V Input 15-A DDR Terminating Module	15 A	Follows V_{REF}	✔		✔	✔	11.60
PTH03050Y	3.3 V	3.3-V Input 6-A DDR Terminating Module	6 A	Follows V_{REF}	✔		✔	✔	6.90
PTH03060Y	3.3 V	3.3-V Input 10-A DDR Terminating Module	10 A	Follows V_{REF}	✔		✔	✔	9.80
PTH05010Y	5 V	5-V Input 15-A DDR Terminating Module	15 A	Follows V_{REF}	✔		✔	✔	11.60
PTH05050Y	5 V	5-V Input 6-A DDR Terminating Module	6 A	Follows V_{REF}	✔		✔	✔	6.90
PTH05060Y	5 V	5-V Input 10-A DDR Terminating Module	10 A	Follows V_{REF}	✔		✔	✔	9.80
PTH12010Y	12 V	12-V Input 12-A DDR Terminating Module	12 A	Follows V_{REF}	✔		✔	✔	11.60
PTH12050Y	12 V	12-V Input 6-A DDR Terminating Module	6 A	Follows V_{REF}	✔		✔	✔	6.90
PTH12060Y	12 V	12-V Input 8-A DDR Terminating Module	8 A	Follows V_{REF}	✔		✔	✔	9.80
PTN04050C	3.3 V/5 V	3-V/5-V Input, 12-W Output Step-Up (Boost) ISR	12 W	5 to 15	✔				8.00
PTN78000W/H	V_O + 2 to 36 V	Wide-Input, Wide-Output 1.5-A Positive Step-Down ISR	1.5 A	2.5 to 12/12 to 22	✔				8.00
PTN78060W/H	V_O + 2 to 36 V	Wide-Input, Wide-Output 3-A Positive Step-Down ISR	3 A	2.5 to 12/12 to 22	✔				11.00
PTN78020W/H	V_O + 2 to 36 V	Wide-Input, Wide-Output 6-A Positive Step-Down ISR	6 A	2.5 to 12/12 to 22	✔				15.00
PTR08060W	5 V/12 V	4.5- to 14-V Input, 6-A POL	6 A	0.6 to 5.5	✔				6.00
PTR08100W	5 V/12 V	4.5- to 14-V Input, 10-A POL	10 A	0.6 to 5.5	✔				8.00
PTV03010W	3.3 V	5-V Input 8-A Vertical SIP with Auto-Track Sequencing	8 A	0.8 to 2.5	✔	✔	✔		6.90
PTV03020W	3.3 V	5-V Input 18-A Vertical SIP with Auto-Track Sequencing	18 A	0.8 to 2.5	✔	✔	✔		11.60
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

[1] *See **www.ti.com/power** for a complete product offering.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Power Modules (Non-Isolated)

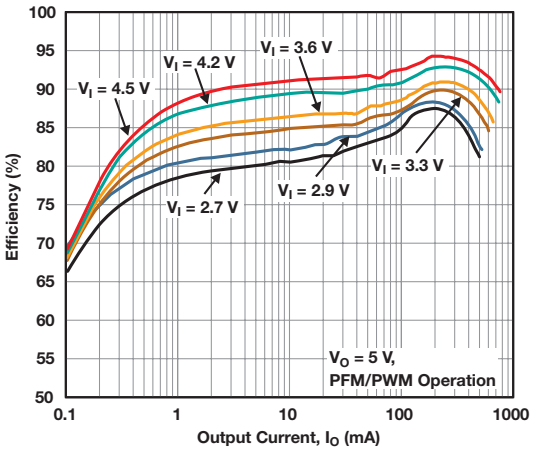
Step-Up (Boost) and Negative Output Modules

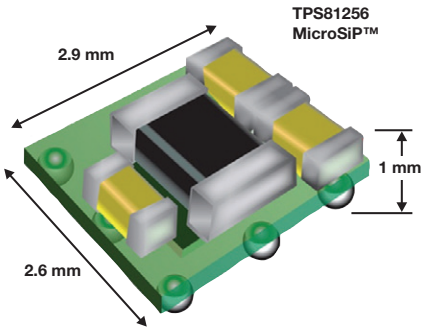
3-W, High-Efficiency Step-Up Converter

NEW

TPS81256

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





3-W boost converter integrated solution.

Key Features

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

Applications

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

Get more information: **www.ti.com/product/TPS81256**

MicroSiP™ Boost Power Module

Device	Base Function	I_{OUT} (mA)	V_{IN} (V)	Fixed V_{OUT} (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Synchronous Rectifier	Active Output Capacitor Discharge	Total Solution Size (mm^2)	MicroSiP Package	EVM	Features and Differentiators	Price*
Fully Integrated Solutions (Inductor plus input/output capacitors on device)															
TPS81256	Boost	600	2.5 to 5.5	5	95	4000	37	0.85	✔		9	9	✔	True load disconnect	1.70

All of the above devices have undervoltage lockout and thermal protection built in.
*New devices are listed in **bold red**.*
[1]Maximum current depends on input and output voltages.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Negative Output Modules

Device[1]	Input Bus Voltage	Description	P_{OUT} or I_{OUT}	V_O Range (V)	V_O Adj.	Price*
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

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

Device	I_{OUT} (A)	V_{IN} (V)	V_{OUT} (V)	Package Theta J_A (°C/W)	Switching Frequency (kHz)	Features		EVM	Package(s)	Price*
						Sync Pin	Adj. Soft Start			
SWIFT™ Wide Input Power Module										
TPS84259	2[1]	4.5 to 40	–3 to –17	12	500/800	✔	✔	✔	41 QFN (9x11x2.8 mm)	6.00

All of the above devices have undervoltage lockout and thermal protection built in.
*New devices are listed in **bold red**.*
[1]Maximum current depends on input and output voltages.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

DC/DC Switching Regulators
Overview

TI's large portfolio of non-isolated DC/DC point-of-load solutions address size, efficiency, performance or cost constraints. Our solutions range from discrete devices to integrated power solutions that contain magnetics within the IC package. Visit **www.ti.com/power** to find the latest point-of-load solutions by simply providing the voltages and output current of your system.

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

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

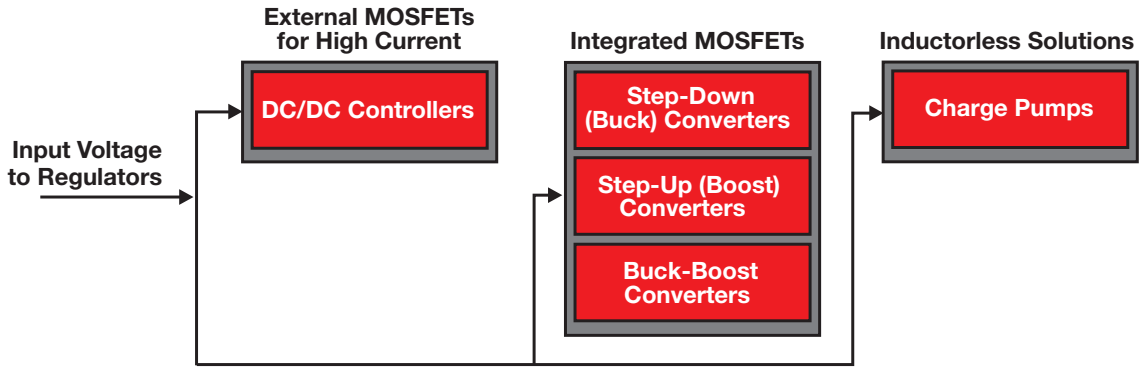
Step-Up Boost Converters — The datasheet specifies the current limit of the integrated power MOSFET switches. A rough estimate for the actual output current achievable is a function of the duty cycle and can be estimated with the following formula:

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

Buck-Boost Converters — A DC/DC converter must be able to regulate the output voltage at all possible input-voltage conditions, whether V_{IN} is higher or lower than V_{OUT}. TI's single-inductor buck-boost converters integrate four power MOSFETs on-chip to save space and to seamlessly transition in between the modes of operation.

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

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



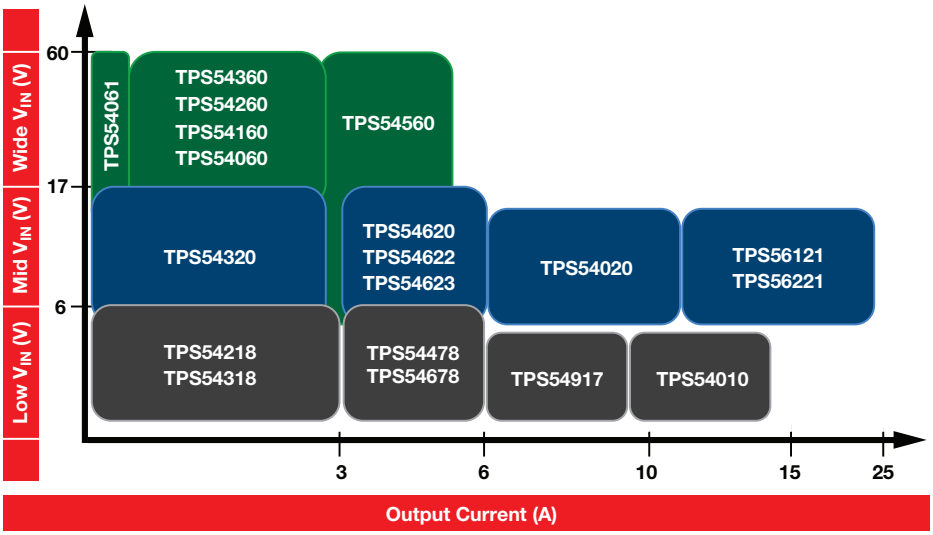
DC/DC Switching Regulators

Step-Down Converters (Line and Portable Power)

SWIFT™ High Power-Density Converters

TI's SWIFT DC/DC converters are switchers with integrated FETs that deliver a high power density, high efficient and high-performance point-of-load power supply. Whether powering a performance processor or advanced analog circuitry, SWIFT DC/DC converters help solve board-space and power-budget challenges. High-frequency operation and low MOSFET on-resistance in a small package allow designers to reduce board space without sacrificing efficiency.

Learn more at **www.ti.com/swift**

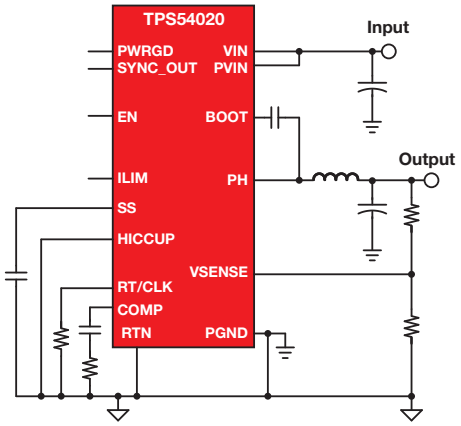


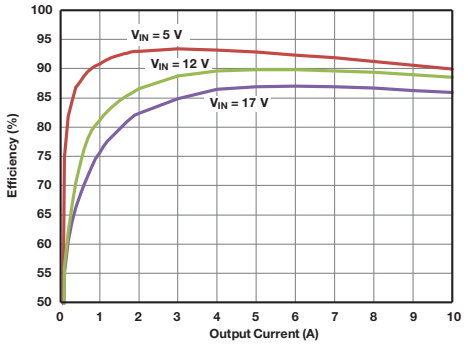
Highest Power Density SWIFT™ Converter: 10 A, 17 V in HotRod™ QFN package with Eco-mode™

TPS54020

NEW

The TPS54020 is a 10-A synchronous step-down DC/DC converter in a small 3.5 x 3.5-mm HotRod 15-pad QFN package. The TPS54020 integrates low $R_{DS(on)}$ MOSFETs. Eco-mode operation is automatically engaged at light loads to save energy. The TPS54020 SWIFT converter has selectable current-limit trip points to optimize inductor size and is supported by TI's WEBENCH® Designer tool.





Key Features

- Low-resistance, 8-mΩ high-side MOSFET
- Low-resistance, 6-mΩ low-side MOSFET
- Selectable hiccup or cycle-by-cycle current-limit scheme
- Selectable 6-A, 8-A or 10-A current-limit trip point
- 180° out-of-phase switching
- 0.6-V ref with 1% accuracy over temp
- 200-kHz to 1.2-MHz adjustable switching frequency

Applications

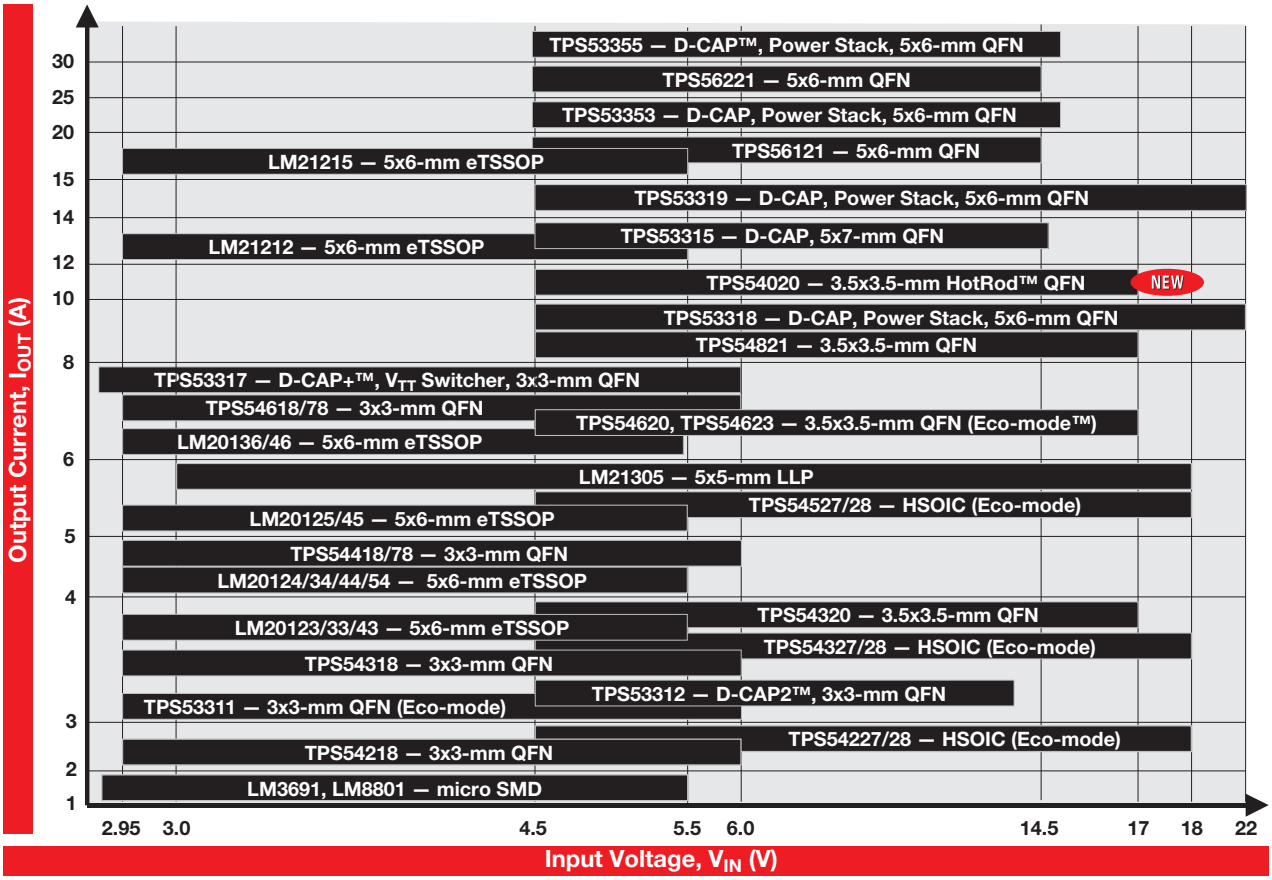
- Power for FPGAs, SoCs DSPs and processors
- Wireless, data and cloud infrastructure
- Gaming, DTV and set top boxes

Get more information: **www.ti.com/product/TPS54020**

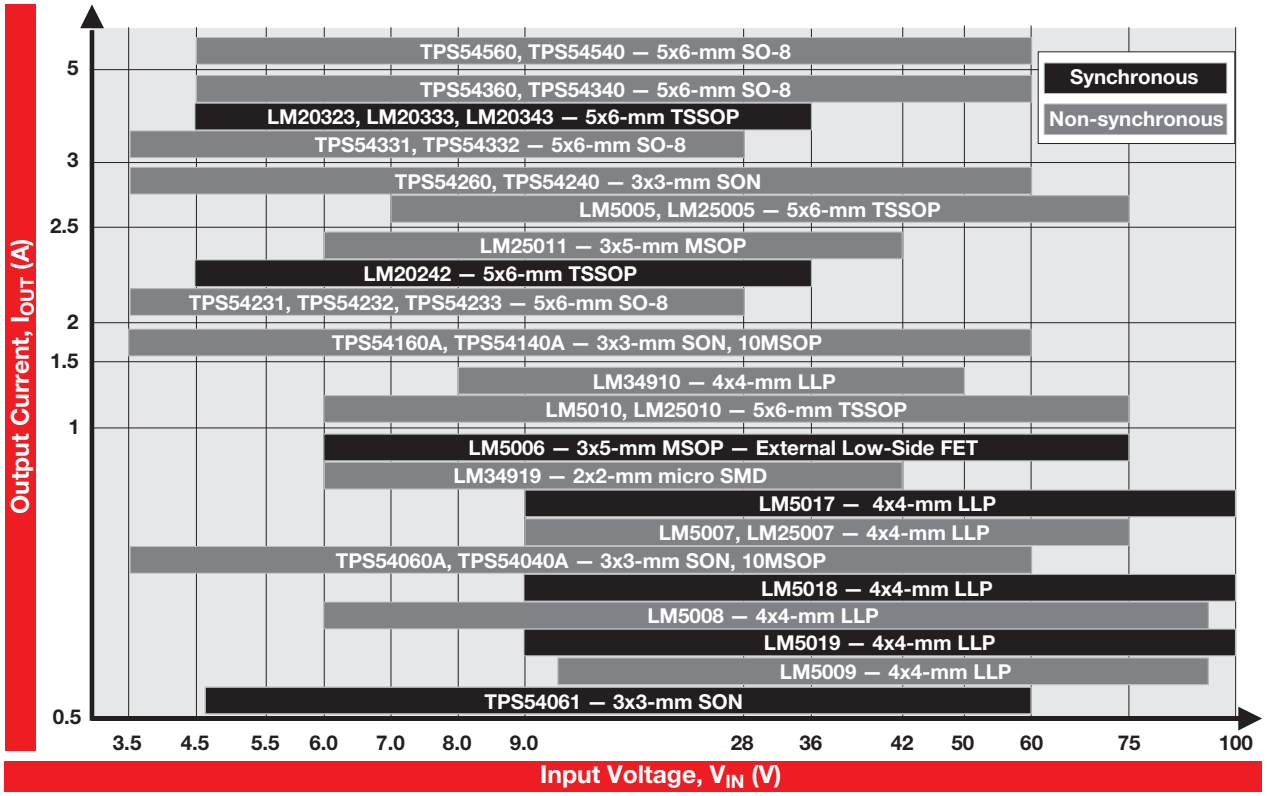
DC/DC Switching Regulators

Step-Down Converters (Line and Portable Power)

Synchronous Step-Down Converters with < 25-V Maximum Input



Step-Down Converters with > 25-V Maximum Input



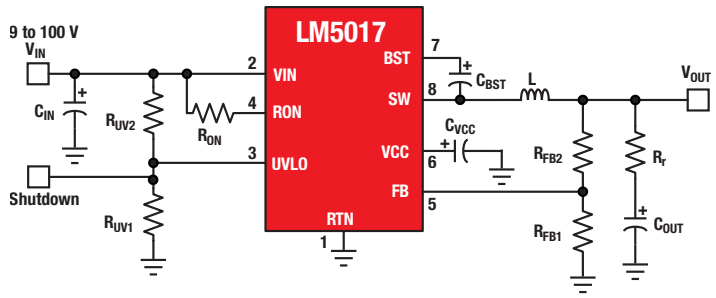
DC/DC Switching Regulators

Step-Down Converters (Line and Portable Power)

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

LM5017

TI's family of high-voltage converters is characterized by a constant-on-time (COT) architecture that reduces the number of required external components to keep solution sizes small and simplify designs. The new LM5017 100-V, 600-mA synchronous buck regulator is the first in a family of the industry's first 100-V converters with integrated high-side and low-side FETs. Continuous conduction mode operation allows for use as a small, isolated bias supply.



Get more information: **www.ti.com/product/LM5017**

Key Features

- Wide 9- to 100-V input-voltage range
- Integrated, 100-V high- and low-side switches
- Fast transient response
- Frequency adjustable to 1 MHz
- Constant-on-time architecture requires no loop compensation

Applications

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

Reference designs available at **www.ti.com/pmp7315** and **pmp7316**

Selection Guide for Line Power

Device	I_{OUT} (mA)	V_{IN} (V)	Min V_{OUT} (V)	Max Duty Cycle (%)	Switching Frequency (kHz)	Features							Sequencing/ Tracking	EVM	Package(s)	Price*
						Synchronous Rectifier	Power Good Pin	Sync Pin	180° Out-of-Phase Switching	Adj. Soft Start	Light-Load Efficiency	External Compensation				
Low Input Voltage Step-Down Converters (<6 V_{IN})																
TPS54218	2000	2.95 to 6.0	0.8	98	200 to 2000	✔	✔	✔		✔		✔		✔	16 QFN (3x3 mm)	1.50
LM20123/33/43	3000	2.95 to 5.5	0.8	—	250 to 1500	✔	✔	✔		✔		✔	✔	✔	16 eTSSOP	1.36
TPS54318	3000	2.95 to 6.0	0.8	98	200 to 2000	✔	✔	✔		✔		✔		✔	16 QFN (3x3 mm)	2.00
TPS53311	3000	2.9 to 6.0[1]	0.6	85	1000	✔		✔			✔	✔		✔	16 QFN (3x3 mm)	2.15
LM20124/34/44/54	4000	2.95 to 5.5	0.8	—	250 to 1500	✔	✔	✔		✔		✔	✔	✔	16 eTSSOP	1.50
TPS54418/78	4000	2.95 to 6.0	0.8/0.6	98	200 to 2000	✔	✔	✔		✔		✔		✔	16 QFN (3x3 mm)	2.35
LM20125/45	5000	2.95 to 5.5	0.8	—	250 to 1500	✔	✔			✔		✔	✔	✔	16 eTSSOP	1.56
TPS53316	5000	2.95 to 6	0.6	80	750/1100/2000	✔	✔				✔	✔		✔	16 QFN (3x3 mm)	2.55
LM20136/46	6000	2.95 to 5.5	0.8	—	250 to 1500	✔	✔	✔		✔		✔	✔	✔	16 eTSSOP	1.68
TPS54618/78	6000	2.95 to 6.0	0.8/0.6	98	200 to 2000	✔	✔	✔		✔				✔	16 QFN (3x3 mm)	2.85
LM21212-1	12000	2.95 to 5.5	0.6	100	300 to 1500	✔	✔	✔		✔		✔	✔	✔	20 eTSSOP	3.30
LM21212-2	12000	2.95 to 5.5	0.6	100	300 to 1500	✔	✔			✔		✔	✔	✔	20 eTSSOP	3.30
LM21215	Up to 15000	2.95 to 5.5	0.6	100	500	✔	✔			✔		✔	✔	✔	20 eTSSOP	3.55
LM21215A	15000	2.95 to 5.5	0.6	100	300 to 1500	✔	✔	✔		✔		✔	✔	✔	20 eTSSOP	3.55
Mid Input Voltage Step-Down Converters (<20 V_{IN})																
TPS62170	500	3.0 to 17	0.9	100	2250	✔	✔				✔			✔	8 QFN (2x2 mm)	0.75
TPS62150	1000	3.0 to 17	0.9	100	2250	✔	✔			✔	✔		✔	✔	16 QFN (3x3 mm)	1.00
TPS54227/8	2000	4.5 to 18	0.76	90[2]	700	✔				✔	–/✔			✔	8 HSOIC	1.10/1.15
TPS54320	3000	4.5 to 17	0.8	98	200 to 1200	✔	✔	✔		✔		✔	✔	✔	14 QFN	1.70
TPS54327/8	3000	4.5 to 18	0.76	90[2]	700	✔				✔	–/✔			✔	8 HSOIC	1.20/1.25
TPS54427/8	4000	4.5 to 18	0.76	90[2]	700					✔	–/✔			✔	8 HSOIC	1.30/1.35
LM21305	5000	3 to 18	0.6	100	250 to 1500		✔	✔		✔	✔	✔	✔	✔	28 LLP	2.50
TPS54527/8	5000	4.5 to 18	0.76	90[2]	700					✔	–/✔			✔	8 HSOIC	1.70/1.75
TPS53313	6000	4.5 to 16	0.6	70	250 to 1500		✔	✔		✔		✔		✔	16 QFN (4x4 mm)	2.60

[1] *Requires 2.9- to 3.5-V bias input.*
[2] *Maximum V_{OUT} is 5.5 V.*
[3] *Maximum V_{OUT} is 5.5 V.*
[4] *Maximum V_{OUT} is 5.5 V.*
[5] *Requires 4.5- to 25-V bias input.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

DC/DC Switching Regulators

Step-Down Converters (Line and Portable Power)

Selection Guide for Line Power (Continued)

Device	I_{OUT} (mA)	V_{IN} (V)	Min V_{OUT} (V)	Max Duty Cycle (%)	Switching Frequency (kHz)	Features							Sequencing/ Tracking	EVM	Package(s)	Price*
						Synchronous Rectifier	Power Good Pin	Sync Pin	180° Out-of-Phase Switching	Adj. Soft Start	Light-Load Efficiency	External Compensation				
Mid Input Voltage Step-Down Converters (<20 V_{IN}) (Continued)																
TPS54620	6000	4.5 to 17	0.8	98	200 to 1600	✔	✔	✔		✔		✔	✔	✔	QFN (3.5x3.5 mm)	2.50
TPS54623	6000	4.5 to 17	0.6	98	200 to 1600	✔	✔	✔		✔	✔	✔	✔	✔	QFN (3.5x3.5 mm)	2.55
TPS54821	8000	4.5 to 17	0.6	98	200 to 1600		✔	✔		✔		✔	✔	✔	QFN (3.5x3.5 mm)	2.75
TPS54020	10000	4.5 to 17	0.6	98	200 to 1200	✔	✔	✔	✔	✔	✔	✔	✔	✔	HotRod™ QFN (3.5x3.5 mm)	3.45
TPS51315	10000	3 to 14[3]	0.76	100[4]	100 to 1000	✔	✔				✔			✔	QFN (5x7 mm)	2.65
TPS56121	15000	4.5 to 14	0.6	93	300/500/1000	✔	✔			✔		✔		✔	22 QFN (5x6 mm)	5.25
TPS56221	25000	4.5 to 14	0.6	93	300/500/1000	✔	✔			✔		✔		✔	22 QFN (5x6 mm)	4.35
TPS53355	30000	3 to 15[5]	0.6	90[4]	250 to 1000		✔				✔			✔	22 QFN (5x6 mm)	4.65
High Input Voltage Step-Down Converters (>20 V_{IN})																
TPS54062	50	4.7 to 60	0.8	98	100 to 400	✔		✔				✔		✔	8 MSOP	1.10
LM5019	100	9 to 100	1.23	—	250 to 1000									✔	8 LLP, 8 PSOP	1.25
LM5009/A	150	8/6 to 95	—	—	50 to 600									✔	8 LLP, 8 MSOP	1.00/1.10
TPS54061	200	4.7 to 60	0.8	98	50 to 1100	✔		✔		✔	✔	✔		✔	8 SON (3x3 mm)	1.30
LM5018	300	9 to 100	1.23	—	—									✔	8 LLP, 8 PSOP	1.40
LM5008/A	350	8/6 to 95	—	—	50 to 600									✔	8 LLP, 8 MSOP	1.18/1.20
TPS62175	500	4.75 to 28	1.0	100	1000		✔				✔			✔	10 QFN (2x3 mm)	0.95
LM(2)5007	500	9 to 42/75	2.5	—	50 to 800									✔	8 LLP, 8 MSOP	1.05/1.30
TPS54040A/60A	500	3.5 to 42/60	0.8	98	100 to 2500		✔	✔		✔	✔	✔	✔	✔	10 MSOP, 10 SON (3x3mm)	1.15/1.45
LM5017	600	9 to 100	1.23	—	250 to 1000									✔	8 LLP, 8 PSOP	1.65
LM34919/B	600	8/6 to 40	2.5	—	Up to 2600					✔				✔	10 micro SMD	1.20/1.25
LM5006	650	6 to 75	2.5		50 to 600									✔	10 MSOP	1.50
LM(2)5010/A	1000	8/6 to 42/75	2.5	—	50 to 1000					✔				✔	10 LLP, 14 eTSSOP	1.15/1.53
TPS5410	1000	5.5 to 36	1.23	87	500									✔	8 SOIC	1.60
LM34917A	1250	8 to 33	2.5	—	2000					✔					12 micro SMD	1.35
LM34910/C	1250	8 to 36/50	2.5	—	1000					✔					10 LLP	1.32
LM26001	1500	3 to 38	1.25	—	150 to 500		✔	✔	✔		✔	✔		✔	16 TSSOP	2.85
TPS54140A/60A	1500	3.5 to 42/60	0.8	98	100 to 2500		✔	✔		✔	✔	✔	✔	✔	10 MSOP, 10 SON (3x3mm)	1.40/1.75
LM25011/A	Up to 2000	6 to 42	2.5	—	Up to 2000		✔			✔				✔	10 MSOP	1.30
LM20242	2000	4.5 to 36	0.8	—	1000		✔			✔		✔	✔	✔	16 eTSSOP	1.46
TPS5420	2000	5.5 to 36	1.23	87	500									✔	8 SOIC	1.70
TPS54231/2/3	2000	3.5 to 28	0.8	93	570/1000/300					✔	✔	✔		✔	8 SOIC	1.25
LM(2)5005	2500	7 to 42/75	1.23	—	50 to 500			✔		✔		✔		✔	20 eTSSOP	1.95
TPS54240/60	2500	3.5 to 42/60	0.8	98	100 to 2500		✔	✔		✔	✔	✔	✔	✔	10 MSOP, 10 SON (3x3mm)	1.55/1.95
LM26003	3000	3 to 38	1.25	—	150 to 500		✔	✔	✔		✔	✔		✔	20 eTSSOP	3.52
LM20323/33/43	3000	4.5 to 36	0.8	—	250 to 1500		✔	✔		✔		✔	✔	✔	20 eTSSOP	1.50
TPS5430	3000	5.5 to 36	1.23	87	500									✔	8 HSOIC	1.85
TPS54331	3000	3.5 to 28	0.8	93	570					✔	✔	✔		✔	8 SOIC	1.35
TPS54332	3500	3.5 to 28	0.8	93	1000					✔	✔	✔		✔	8 HSOIC	1.40
TPS54340/60	3500	4.5 to 42/60	0.8	98	100 to 2500	✔				✔	✔	✔		✔	8 HSOIC	1.75/2.10
TPS5450	5000	5.5 to 36	1.23	87	500									✔	8 HSOIC	2.25
TPS54540/60	5000	4.5 to 42/60	0.8	98	100 to 2500	✔				✔	✔	✔		✔	8 HSOIC	1.95/2.30
Dual-Channel Step-Down Converters																
TPS54290/1/2	1500/2500	4.5 to 18	0.8	90	300/600/1200	✔			✔				✔	✔	16 HTSSOP	2.95
TPS54294/5	2000 each	4.5 to 18	0.76	85	700	✔	✔/–			–/✔				✔	16 HTSSOP	2.40
TPS54283/6	2000 each	4.5 to 28	0.8	90/85	300/600				✔				✔		14 HTSSOP	2.40
TPS55383/6	3000 each	4.5 to 28	0.8	90/85	300/600				✔			✔	✔	✔	16 HTSSOP	2.65
TPS54494/5	4000/2000	4.5 to 18	0.76	85	700	✔	✔/–			–/✔				✔	16 HTSSOP	2.90

[1] *Requires 2.9- to 3.5-V bias input.*
[2] *Maximum V_{OUT} is 5.5 V.*
[3] *Maximum V_{OUT} is 5.5 V.*
[4] *Maximum V_{OUT} is 5.5 V.*
[5] *Requires 4.5- to 25-V bias input.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

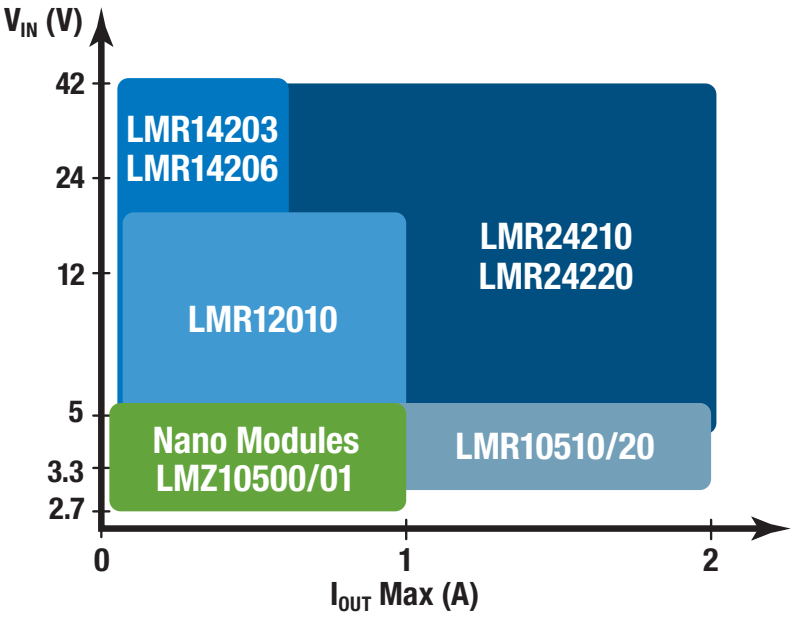
*New devices are listed in **bold red**.*
*Preview devices are listed in **bold teal**.*

DC/DC Switching Regulators

Step-Down Converters (Line and Portable Power)

SIMPLE SWITCHER® Step-Down (Buck) Nano Regulators

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



SIMPLE SWITCHER® Step-Down (Buck) Nano Regulators

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

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

DC/DC Switching Regulators

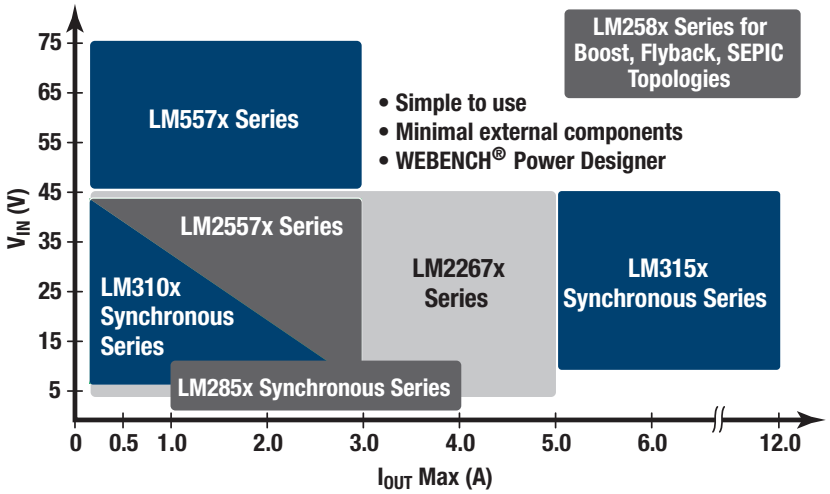
Step-Down Converters (Line and Portable Power)

SIMPLE SWITCHER® Converters

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

For more information, please visit:
www.ti.com/switcher

SIMPLE SWITCHER® Step-Down (Buck) Family



LM2267x and LM22680 SIMPLE SWITCHER® Non-Synchronous Regulators

Device	Output Current (mA)	V_{IN} (max) (V)	V_{IN} (min) (V)	V_{OUT} (min) (V)	Frequency Range (kHz)	f_{sync}	PWM Mode	Package(s)	Price*
LM22671/74	500	42	4.5	1.285	200 to 1000 Adj	✔/–	Voltage	PSOP-8	1.38/1.32
LM22672/75	1000	42	4.5	1.285	200 to 1000 Adj	✔/–	Voltage	PSOP-8	1.78/1.68
LM22680	2000	42	4.5	1.285	200 to 1000 Adj	✔	Voltage	PSOP-8	1.85
LM22670/73/76	3000	42	4.5	1.285	200 to 1000 Adj	✔/–/–	Voltage	TO263-7 Thin, PSOP-8	1.98/1.98/1.92
LM22677/78/79	5000	42	4.5	1.285	200 to 1000 Adj	✔/–/–	Voltage	TO263-7 Thin	3.38/3.25/3.38

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

LM2557x and LM557x SIMPLE SWITCHER® Non-Synchronous Regulators

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

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

SIMPLE SWITCHER® Synchronous Regulators

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

[1] *COT = Constant ON-time control.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

DC/DC Switching Regulators

Step-Down Converters (Line and Portable Power)

Selection Guide for Portable Power

Device	I_{OUT} (mA)	V_{IN} (V)	V_{OUT} Adjustable/Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (µH)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Power Good	Synch. to Ext. CLK (Opt.)	DCS-Control™ Topology	Package(s)	EVM	Features and Differentiators	Price*
General Purpose, Step-Down (Buck) Regulators — Small, Efficient, Low I_q															
TPS62240	300	2.0 to 6.0	Adj. (0.6 to V_{IN})/1.2/1.8	95	2250	2.2	15	0.1				SOT-23, QFN	✔		0.55
LM3670	350	2.5 to 5.5	0.7 to 3.3		1000	10	15	0.1				SOT-23	✔		0.57
LM3671	600	2.7 to 5.5	1.1 to 3.3		2000	2.2	16	0.01				SOT-23, QFN	✔		0.70
TPS62260	600	2.0 to 6.0	Adj. (0.6 to V_{IN})/1.2/1.8	95	2250	2.2	15	0.1				SOT-23, QFN	✔		0.65
TPS62250	700	2.0 to 6.0	Adj. (0.6 to V_{IN})	95	2250	2.2	15	0.1				QFN		USB applications	0.90
TPS62290	1000	2.3 to 6.0	Adj. (0.6 to V_{IN})/1.8/3.3	95	2250	2.2	15	0.1				QFN	✔		0.85
TPS62080	1200	2.3 to 6.0	Adj. (0.5 to 4.0)/1.8/3.3	94	2000	1	5	6.5	✔		✔	QFN, MSOP	✔	Snooze mode, active discharge	0.90
TPS62510	1500	1.8 to 3.8	Adj. (0.6 to V_{IN})	97	1500	2.2	18	0.1				QFN	✔	Output-voltage tracking	1.15
TPS62060	1600	2.3 to 6.0	Adj. (0.6 to V_{IN})/1.8/3.3	94	3000	1.0	18	0.1				QFN	✔		0.95
TPS62065	2000	2.3 to 6.0	Adj. (0.6 to V_{IN})	94	3000	1.0	18	0.1				QFN	✔		1.05
TPS62067	2000	2.9 to 6.0	Adj. (0.6 to V_{IN})	97	3000	1.0	18	0.1	✔			QFN	✔		1.10
TPS62090	3000	2.0 to 5.5	Adj. (0.8 to V_{IN})/1.8/2.5/3.3	96	2800/1400	0.47	20	0.6	✔		✔	QFN	✔	Adj. soft start, frequency select	1.15
General Purpose, Step-Down (Buck) Regulators — Value Line, Relaxed Specification															
TPS62560	600	2.5 to 5.5	Adj. (0.6 to V_{IN})/1.8	95	2250	2.2	15	0.1				SOT-23, QFN	✔	3% V_{OUT} tolerance	0.50
TLV62080	1200	2.5 to 5.5	Adj. (0.5 to 4.0)	94	2000	1	30	0.6	✔		✔	QFN	✔		0.70
TLV62065	2000	2.9 to 6	Adj. (0.6 to V_{IN})	97	3000	1	18	0.1				QFN			0.75
TLV62090	3000	2.5 to 5.5	Adj. (0.8 to V_{IN})	96	1400	0.47	20	0.6	✔		✔	QFN		Adj. soft start	0.85
TLV62150	1000	4.0 to 17	Adj. (0.9 to 5.0)	96	2250	2.2	19	1.5	✔		✔	QFN		Adj. soft start (opt.)	0.75
TLV62130	3000	4.0 to 17	Adj. (0.9 to 5.0)	96	2250	2.2	19	1.5	✔		✔	QFN		Adj. soft start (opt.)	0.90
Special-Function Step-Down (Buck) Regulators															
TPS62730	100	1.9 to 3.9	1.9/2.1/2.3	95	3000	2.2	25	0.03			✔	QFN	✔	Bypass switch; for BLE and RF4CE	0.75
TPS62736	50	2.0 to 5.5	Adj. (1.3 to 5.0)	96	2000 (max)	10	0.35	0.02				QFN	✔	Ultra-low I_Q, low battery indicator	TBD
TPS62750	1300	2.9 to 6.0	Adj. (0.8 to 0.85 × V_{IN})	94	2250	2.2	745	0.3				QFN	✔	Powered by USB; progr. input-current limit	1.05
TPS62120	75	2.0 to 15	Adj. (1.2 to 5.5)	96	800	22	11	0.3	✔		✔	SOT-23, QFN	✔	Ext. UVLO hysteresis	0.75
TPS62125	250	3.0 - 17	Adj. (1.2 to 10)	93	1000	10	5	0.3	✔		✔	QFN		Program. EN threshold and hysteresis	0.85
Extended Input-Voltage Range															
TPS62170	500	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	92	2500	2.2	17	1.5	✔		✔	QFN	✔		0.75
TPS62175	500	4.75 to 28	Adj. (1 to 6)/3.3/5.0	90	1000	10	4.8	1.5	✔		✔	QFN		SLEEP mode	0.95
TPS62050	800	2.7 to 10.0	Adj. (0.7 to 6)/1.5/1.8/3.3	95	850	10	12	1.5	✔	✔		MSOP	✔	Low-battery indicator	1.10
TPS62150	1000	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	96	2500/1250	2.2	17	1.5	✔		✔	QFN	✔	Soft start (opt.), tracking, voltage and frequency select pin	1.00
TPS62160	1000	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	92	2500	2.2	17	1.5	✔		✔	QFN, VSSOP	✔		0.95
TPS62110	1500	3.1 to 17	Adj. (1.2 to 16)/3.3/5	95	1000	6.8	18	1.5	✔	✔		QFN	✔	Low-battery indicator	1.40
TPS62140	2000	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	96	2500/1250	2.2	17	1.5	✔		✔	QFN	✔	Soft start (opt.), tracking, voltage and frequency select pin	1.15
TPS62130	3000	3.0 to 17	Adj. (0.9 to 6)/1.8/3.3/5.0	96	2500/1250	2.2	17	1.5	✔		✔	QFN	✔	Soft start (opt.), tracking, voltage and frequency select pin	1.30
Dual Output, 180° Out-of-Phase															
TPS62400	400 + 600	2.5 to 6.0	Adj. (0.6 to V_{IN})/1.1 to 1.9/3.3	95	2250	3.3	30	0.1				QFN		EasyScale™ interface	0.95
TPS62410	800 + 800	2.6 to 6.0	Adj. (0.6 to V_{IN})	95	2250	3.3	30	0.1				QFN		EasyScale interface	1.15
TPS62420	600 + 1000	2.6 to 6.0	Adj. (0.6 to V_{IN})	95	2250	3.3	30	0.1				QFN	✔	EasyScale interface	1.15
Smallest Solution Size, High Switching Frequency															
TPS62619	350	2.3 to 5.5	1.2/1.5/1.8/2.15	90	6000	0.47	31	0.2				CSP		0.4-mm solution height	0.55
TPS62690	500	2.3 to 4.8	2.85	95	4000	1.0	19	0.2				CSP	✔	Spread spectrum	0.70
TPS62230	500	2.05 to 6.0	1.0 to 3.3	94	3000	1	22	0.1			✔	QFN	✔	Up to 90-dB PSRR	0.50
TPS62674	500	2.3 to 4.8	1.2/1.26/1.5/1.8	92	5500	0.47	17	0.2				CSP	✔	Spread spectrum	0.70
LM8801	600	2.3 to 5.5	1.0 to 2.9		6000							CSP	✔		0.80

All of the above devices have an on-chip soft start, undervoltage lockout and thermal protection built in.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

DC/DC Switching Regulators

Step-Down Converters (Line and Portable Power)

Selection Guide for Portable Power (Continued)

Device	I_{OUT} (mA)	V_{IN} (V)	V_{OUT} Adjustable/Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (µH)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Power Good	Synch. to Ext. CLK (Opt.)	DCS-Control™ Topology	Package(s)	EVM	Features and Differentiators	Price*
Smallest Solution Size, High Switching Frequency (Continued)															
TPS62620	600	2.3 to 5.5	1.82/1.8/1.5/1.2	90	6000	0.47	31	0.2				CSP	✔		0.70
LM3691	1000	2.3 to 5.5	0.75 to 3.3		4000							CSP	✔		0.80
TPS62660	1000	2.3 to 5.5	1.2/1.8	91	6000	0.47	31	0.2				CSP	✔	Active cap discharge	0.90
LM3678	1500	2.5 to 5.5	0.8 to 3.3		3300							QFN	✔		1.15
Processor Power, Dynamic Voltage Scaling															
TPS62270	400	2.0 to 6.0	1.15/0.9, 3.3/2.1, 3.3/2.5	95	2250	2.2	15	0.1				QFN	✔	V_{sel} pin	0.70
TPS62650	800	2.3 to 5.5	Adj. (0.75 to 1.44)	86	6000	0.47	38	0.5				CSP		I^2C Interface	0.90
TPS62360	3000	2.5 to 5.5	Adj. (0.5 to 1.77)	91	2500	1	56	0.5			✔	CSP	✔	I^2C interface, different. sense	1.45
TPS62366	4000	2.5 to 5.5	Adj. (0.5 to 1.77)	91	2500	1	56	0.5			✔	CSP	✔	I^2C interface, different. sense	1.60
TPS623850	4700	2.5 to 5.5	Adj. (0.5 to 1.77)	91	4000	0.47	80	0.1	✔		✔	CSP		I^2C interface; dual phase; phase shading; different. sense	TBD
TPS623860	6800	2.5 to 5.5	Adj. (0.5 to 1.77)	91	4000	0.47	80	0.1	✔		✔	CSP		I^2C interface; dual phase; phase shading; different. sense	TBD
TPS62387A	8200	2.5 to 5.5	Adj. (0.5 to 1.77)	91	4000	0.47	80	0.1	✔		✔	CSP		I^2C interface; dual phase; phase shading; different. sense	TBD

All of the above devices have an on-chip soft start, undervoltage lockout and thermal protection built in.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

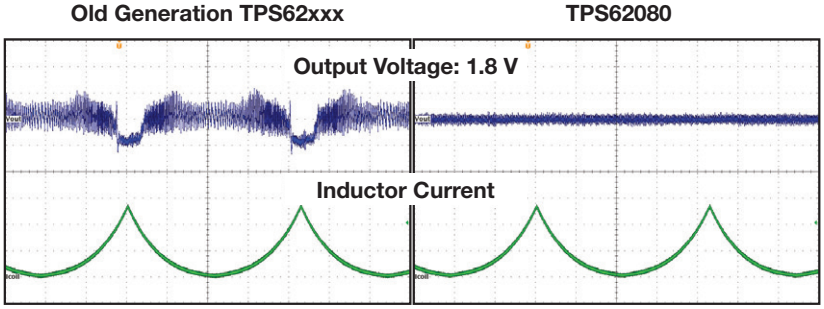
DC/DC Converter with DCS-Control™ Topology and Snooze Mode

TPS62080

The DCS-Control™ architecture (Direct Control with seamless transition into Power Save mode) used in TI's DC/DC converters is an advanced regulation topology that combines the advantages of hysteretic, voltage and current mode control.

- Immediate response to dynamic load changes: AC control loop takes information about output voltage changes and feeds it directly to a fast comparator stage.
- Voltage feedback loop achieves accurate DC load regulation.
- Internally compensated regulation network achieves fast and stable operation with small external components and low ESR capacitors.

The DCS-Control topology supports pulse-width modulation (PWM) for medium and heavy loads and seamlessly transitions to the Power Save mode to maintain high efficiency during light-load operation. This smoother transition overcomes the random jitter observed on older generations.



Seamless transition between PWM and Power Save mode with V_{IN} = 3.6 V and a 0- to 500-mA triangle load sweep.

Key Features

- DCS-Control architecture for fast transient regulation
- Snooze mode for 6.5-µA ultra-low I_Q
- 2.3- to 6-V input voltage range
- 100% duty cycle for lowest dropout
- Power save mode for light-load efficiency
- Output discharge function
- Short circuit protection
- Power Good output
- Thermal shutdown
- Available in 2x2-mm, 8-pin SON and VSSOP packages

Applications

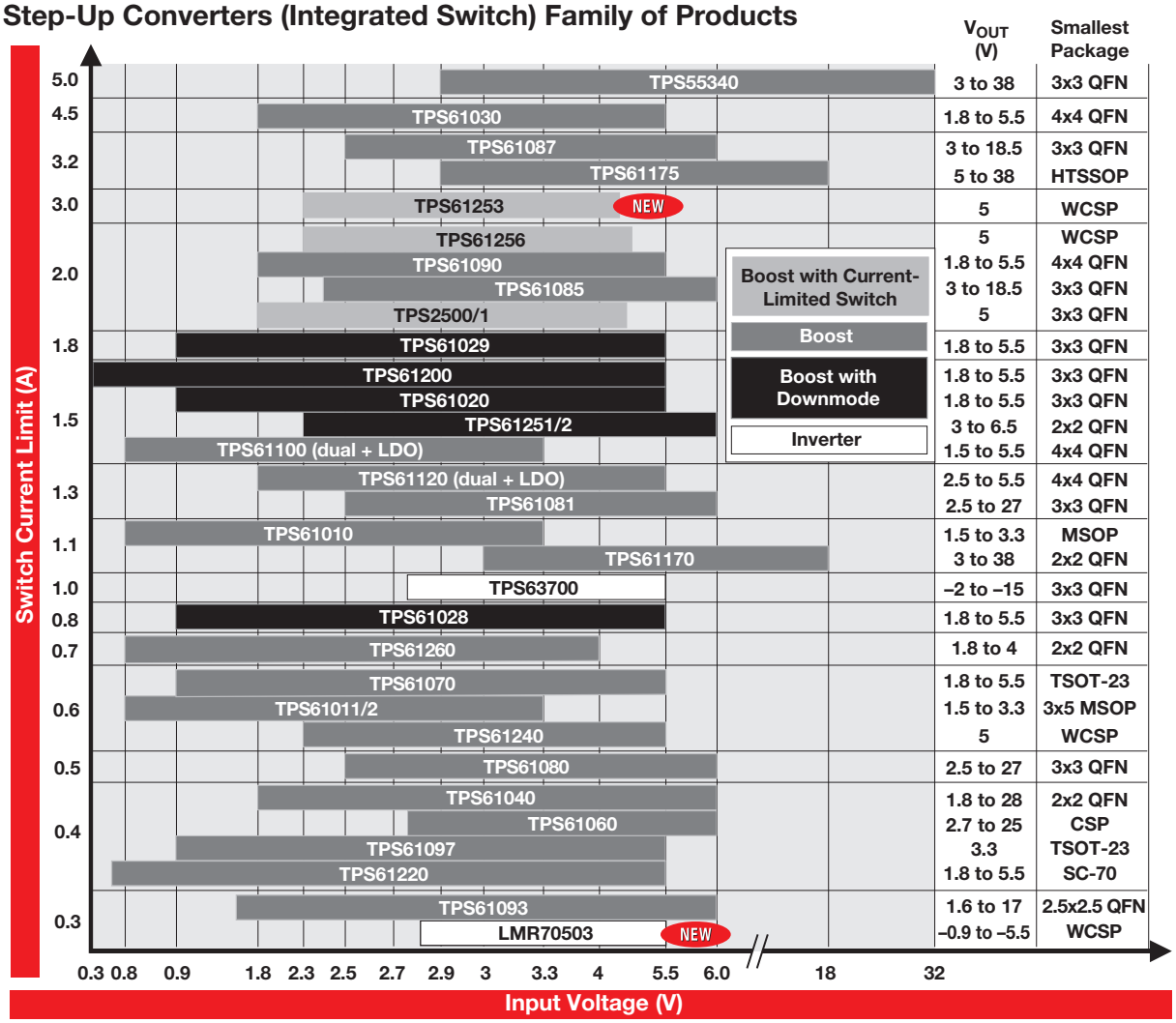
- Battery-powered portable devices
- Point-of-load regulators
- System power rail voltage conversion

Get more information: **www.ti.com/product/TPS62080** or **www.ti.com/dcs-control**

DC/DC Switching Regulators

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

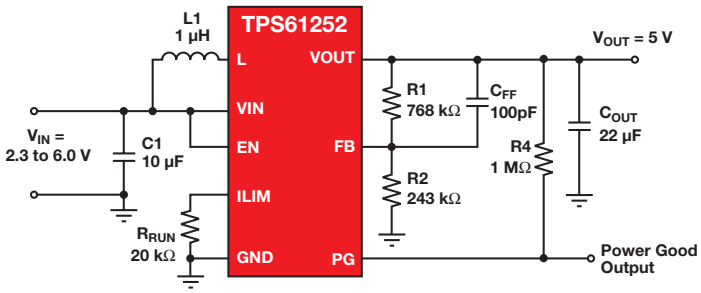
DC/DC Step-Up Converters (Integrated Switch) Family of Products



3.5-MHz, 1.5-A Boost Converter with Adjustable Input-Current Limit

TPS61252

Systems supplied from a current limited source, such as a battery or USB port, can face the problem of collapsing input voltage or under-voltage shutdown if the load draws a very high current for a short period of time. In the past, these systems used a capacitor bank with a current-limiting switch on the input to limit the average input current to a value that can be supplied by the source. This was necessary even if the load would not face a problem with a voltage drop of several hundred millivolts.



TPS61252 typical application.

Key Features

- Resistor-programmable input-current-limit protection:
  - ±20% current accuracy at 500 mA over full temperature range
  - Programmable from 100 mA up to 1500 mA
- Up to 92% efficiency
- V_{IN} range from 2.3 to 6.0 V
- Adjustable output voltage up to 6.5 V
- 100% duty-cycle mode when $V_{IN} > V_{OUT}$
- Load disconnect and reverse-current protection
- Power Good
- Short circuit protection.
- Available in a 2×2-mm QFN-8 package

Get more information: **www.ti.com/product/TPS61252**

DC/DC Switching Regulators

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

Selection Guide for Step-Up (Boost) Converters

Device	I_{OUT} (mA)[1]	Switch Current Limit (typ) (mA)	V_{IN} (V)	V_{OUT} Adj. (V)	V_{OUT} Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (µH)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Integrated LDO I_{OUT} (mA)/V_{OUT} (V)	Synchronous Rectification	Low Battery	Power Good	Undervoltage Lockout	Thermal and/or Short-Circuit Protection	Package(s)						EVM	Price*
																	WCSP (Chip scale)	SOT-23	MSOP	QFN/LLP	TSSOP	SOIC		
Step-Up Regulators — Up to 6-A Switch Limit																								
TPS61220/21/22	50	400	0.7 to 5.5	1.8 to 5.5	3.3/5	95	—	4.7	5.5	0.2	—	✔			✔	✔							✔	0.65
TPS61041	50	250	1.8 to 6.0	V_{IN} to 28	—	87	1000	10	28	0.1	—				✔	✔		5					✔	0.65
TPS61040	90	400	1.8 to 6.0	V_{IN} to 28	—	87	1000	10	28	0.1	—				✔	✔		5					✔	0.70
TPS61260/61	100	700	0.8 to 4.0	1.8 to 4.0	3.3	95	2.3	4.7	29	0.1	—	✔			✔	✔				6			✔	0.70
TL497A	—	500	4.5 to 12	(V_{IN} + 2) to 30	—	85	—	—	11 mA	6000	—										14	14		0.90
TPS61097-33	150	350	0.9 to 5.5	—	3.3	90	—	10	4	0.005	—	✔			✔	✔		5		6				0.75
TPS61080	—	500	2.5 to 6.0	V_{IN} to 27	—	87	1200	4.7	—	—	—					✔				10			✔	1.35
TPS61014/5/6	200	1000/1100/1130	0.8 to 3.3	—	2.8/3/3.3	95	500	10	36	1	—	✔	✔		✔	✔			10					1.10
TPS61010	200	1130	0.8 to 3.3	1.5 to 3.3	—	95	500	10	36	1	—	✔	✔		✔	✔			10				✔	1.10
TPS61028	200	800	0.9 to 5.5	1.8 to 5.5	—	96	720	6.8	25	0.1	—	✔	✔		✔	✔				10			✔	0.85
TPS61070/1/2/3	250	700	0.9 to 5.5	1.8 to 5.5	—	90	1200[2]	4.7	19	1	—	✔			✔	✔		6						0.80
TPS61093	300	1100[3]	1.6 to 6	V_{IN} to 17	—	88	1200	10	0.9 mA	1	—				✔	✔				10			✔	1.30
TPS61081	450	1200	2.5 to 6.0	V_{IN} to 27	—	87	1200	4.7	—	—	—					✔				6			✔	1.45
TPS61240/41	450	600/700	2.3 to 5.5	—	5	90	3500	1	30	1.5	—	✔			✔	✔	6			6			✔	0.80
TPS61170	500	1200	3.0 to 18	V_{IN} to 38	—	93	1200	10	—	1	—				✔	✔								1.40
TPS61020	500	1500	0.9 to 5.5	1.8 to 5.5	—	96	720	6.8	25	0.1	—	✔	✔		✔	✔				10			✔	0.95
TPS61024/5/7	500	1500	0.9 to 5.5	1.8 to 5.5	3/3.3/5	96	720	6.8	25	0.1	—	✔	✔		✔	✔				10				0.95
TPS61251	500	1500	2.3 to 6	3 to 6	—	92	3500	1	30	0.85	—	✔		✔	✔	✔				8			✔	1.60
TPS61252	500	1500	2.3 to 6	3 to 6	—	92	3500	1	30	0.85	—	✔		✔	✔	✔				8			✔	1.25
LM5002	500	—	3.1 to 75	1.26 and up	—	95	1500	330	3100	95					✔	✔				8		8		1.70
TPS61026/9	600	1800	0.9 to 5.5	1.8 to 5.5	—	96	720	6.8	25	0.1	—	✔	✔		✔	✔				10			✔	1.10
TPS61090	700	2200	1.8 to 5.5	1.8 to 5.5	—	96	600	6.8	20	0.1	—	✔	✔		✔	✔				16			✔	1.70
TPS61091/2	700	2000	1.8 to 5.5	—	3.3/5	96	600	6.8	20	0.1	—	✔	✔		✔	✔				16				1.70
MC34063A	750	1500	3 to 40	3 to 39.5	—	—	100	—	—	1	—				✔	✔				8		8	✔	0.21
TPS61200/1/2	800	1500	0.3 to 5.5	0 to V_{IN}	3.3/5	90	1250	2.2	50	1	—	✔			✔	✔				10			✔	0.95
TPS61254/6	1000	2150	2.5 to 4.35/4.85	—	4.5/5	93	3500	1	22	0.85	—	✔			✔	✔	9						✔	1.60
TPS61030/1/2	1000	4500	1.8 to 5.5	1.8 to 5.5	3.3/5	96	600	6.8	20	0.1	—	✔	✔		✔	✔				16	16		✔	2.10
LM5001	1000	—	3.1 to 75	1.26 and up	—	96	1500	100	3100	95	—				✔	✔				8		8	✔	1.85
LM27313	1000	—	2.7 to 14	V_{IN} to 28	—	90	1600	10	2100	—	—					✔		5						0.61
LM2733	1000	—	2.7 to 14	V_{IN} to 40	—	90	1600	10	2100	—	—					✔		5					✔	1.04
LM4510	1200	—	2.7 to 5.5	V_{IN} to 18	—	85	1000	4.7	1700	—	—				✔	✔				10			✔	1.80
TPS61175	1300	3800	2.9 to 18	V_{IN} to 38	—	95	2200	10	—	<1.5	—				✔	✔					14		✔	1.80
LM2698	1350	—	2.7 to 12	V_{IN} to 17	—	94	1250	10	1300	—	—					✔			8				✔	1.83
TPS61253/58/59	1500	3150	2.5 to 4.5	—	4.5/5/5.1	94	3500	1	22	0.85	—	✔			✔	✔	9						✔	1.45
LM2731	1500	—	2.7 to 14	V_{IN} to 22	—	90	1600	10	2000	—	—					✔		5					✔	1.08
LM2622	1600	—	2 to 12	V_{IN} to 18	—	90	1300	10	1300	—	—					✔			8					0.91
LM5000	2000	—	3.1 to 40	1.26 and up	—	90	1300	33	2000	18	—				✔	✔				16	16		✔	2.00
LM3310	2000	—	2.5 to 7	V_{IN} to 20	—	93	1280	10	3100	—	—				✔	✔				24				1.38
LM3311	2000	—	2.5 to 7	V_{IN} to 20	—	93	1280	10	3100	—	—				✔	✔				24				1.38
TPS61230	2000	5500	2.3 to 5.5	2.4 to 5.25	3.3/5	96	2000	1	35	1	—	✔			✔	✔				10			✔	TBD
LM2623	2200/1200	—	0.8 to 14	1.24 to 14	—	90	2000	4.7	80	—	—					✔			8	14			✔	1.09
LM2735	2250	—	2.7 to 5.5	V_{IN} to 24	—	90	1600	15	3400	—	—					✔		5	8	6			✔	1.25
LM3224	2600	—	2.7 to 7	V_{IN} to 20	—	90	1250	10	1300	—	—					✔			8				✔	1.10
LM2700	3600	—	2.2 to 12	1.26 to 17.5	—	92	1250	4.7	1300	—	—					✔				14	14		✔	1.71
TPS55340	5000	6600	2.9 to 32	3 to 38	—	95	1200	10	500	2.7	—			✔	✔	✔				16	14		✔	1.80

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

[2] *PWM/PFM (TPS61070); PWM only (TPS61071).*

[3] *Output current is limited to 300 mA.*

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

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

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

DC/DC Switching Regulators

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

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

Device	I_{OUT} (mA)[1]	Switch Current Limit (typ) (mA)	V_{IN} (V)	V_{OUT} Adj. (V)	V_{OUT} Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (µH)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Integrated LDO I_{OUT} (mA)/V_{OUT} (V)	Synchronous Rectification	Low Battery	Power Good	Undervoltage Lockout	Thermal and/or Short-Circuit Protection	Package(s)						EVM	Price*
																	WCSP (Chip scale)	SOT-23	MSOP	QFN/LLP	TSSOP	SOIC		
Step-Up (Boost) Regulators with Integrated LDO (Dual Output)																								
TL499A	100	—	1.1 to 10	2.9 to 30	—	85	—	—	—	15	100/Adj.											8		1.20
TPS61100	200	1500	0.8 to 3.3	1.5 to 5.5	—	95	500	10	65	0.5	120/Adj.	✔	✔	✔	✔	✔				24	20		✔	1.50
TPS61103/6/7	200	1500	0.8 to 3.3	—	3.3/3.3/3.3	95	500	10	65	0.5	120/Adj., 1.5, 1.8	✔	✔	✔	✔	✔				24	20			1.50
TPS61120	500	1300	1.8 to 5.5	2.5 to 5.5	—	95	500	10	40	0.2	200/Adj.	✔	✔	✔	✔	✔				16	16		✔	1.65
TPS61121/2	500	1300	1.8 to 5.5	—	3.3/3.6	95	500	10	40	0.2	200/1.5, 3.3	✔	✔	✔	✔	✔				16	16			1.65
Inverting Regulators																								
LMR70503	—	300	2.8 to 5.5	–0.9 to –5.5	—	79	500	—	0.245 mA	0.01	—				✔	✔	6						✔	1.15
TL497A	—	500	4.5 to 12	–1.2 to –25	—	85	—	—	11 mA	6000	—										14	14		0.90
TPS63700	360	1000	2.7 to 5.5	–2 to –15	—	84	1400	4.7	—	0.014	—									10			✔	1.30
MC34063A	750	1500	3 to 38	–1.25 to –36.3	—	—	100	—	0.330 mA	—	—				✔	✔				8		8	✔	0.21

[1]*For boost converters, max. I_{OUT} can be estimated with 0.65 × switch limit × (V_{IN}/V_{OUT}).*
[2]*PWM/PFM (TPS61070); PWM only (TPS61071).*
[3]*Output current is limited to 300 mA.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

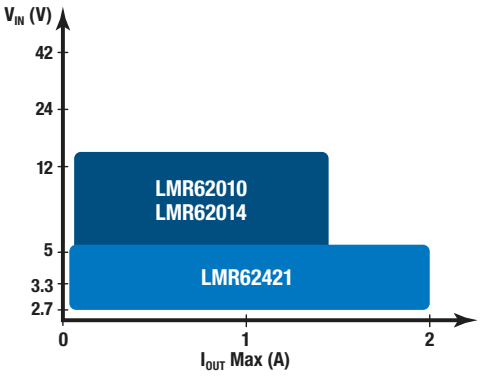
SIMPLE SWITCHER® Boost/Flyback/SEPIC

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

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

SIMPLE SWITCHER® Step-Up (Boost) Nano Regulators

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



SIMPLE SWITCHER® Step-Up (Boost) Nano Regulators

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

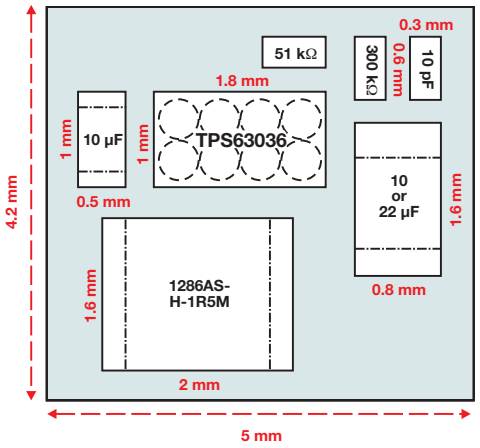
**Suggested resale price in U.S. dollars in quantities of 1,000.*

DC/DC Switching Regulators
Buck-Boost Converters

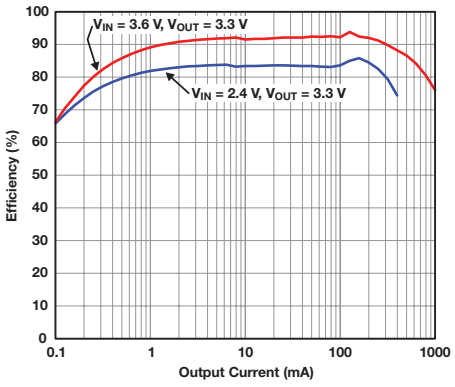
Industry's Smallest High-Efficiency, Single-Inductor Buck-Boost Converter

TPS63036

The TPS63036 is the smallest single-inductor buck-boost converter in the industry. It has a 1.6 x 1.0-mm footprint, achieving a total solution size of less than 21 mm^2 (see block diagram). The device features a 1-A switch current limit and can reach a 94% conversion efficiency over a wide load range due to its reduced operating quiescent current of less than 30 µA (typical). The TPS63036 has a wide input-voltage range, supporting new Li-Ion batteries as well as two- and three-cell alkaline, NiCd or NiMH batteries.



Buck-boost converter total solution size of less than 21 mm^2.



Efficiency versus output current.

Key Features

- Automatic transition between step-down and boost mode
- With V_{OUT} = 3.3 V, the TPS63036 delivers up to 450 mA from a 1.8-V source, up to 550 mA from a 2.5-V source, and up to 1000 mA from a 5-V source
- Power-save mode at light loads with I_q < 30 µA (typ)
- 2.4-MHz switching frequency, externally synchronizable (±20%)
- Load disconnect during shutdown

Applications

- All 2- and 3-cell alkaline, NiCd or NiMH or single-cell Li-Ion battery powered products
- Cellular phones
- Tablet PCs
- Portable players
- Personal medical products
- White LEDs

Get more information: **www.ti.com/product/TPS63036**

Selection Guide

Device	I_{OUT} (mA)	Switch-Current Limit (typ) (mA)	V_{IN} (V)	V_{OUT} Adj. (V)	V_{OUT} Fixed (V)	Peak Efficiency (%)	Switching Frequency (typ) (kHz)	Recommended Inductor Size (µH)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Integrated LDO I_{OUT} (mA)/V_{OUT} (V)	Low Battery	Power Good	Undervoltage Lockout	Thermal and/or Short-Circuit Protection	Package(s)			EVM	Price*
																WCSP (Chip scale)	QFN	TSSOP		
TPS61130	300	1300	1.8 to 5.5	2.5 to 5.5	—	90	500	10	40	0.2	200/Adj.	✔	✔		✔		16	16	✔	1.55
TPS61131/2	300	1300	1.8 to 5.5	—	3.3/3.3	90	500	10	40	0.2	200/1.5, 3.3	✔	✔		✔		16	16		1.55
TPS63030/31/36	800	1000	1.8 to 5.5	1.2 to 5.5	3.3	96	2400	1.5	25	0.1	—			✔	✔	8	10		✔	1.20
TPS63050[1]	800	1000	2.5 to 5.5	2.5 to 5.5	3.3	98	2500	1.5	25	0.1	—		✔	✔	✔	12			✔	TBD
LM3668	1000	1850	2.8 to 5.5	2.8 to 5.0	—	96	2200	2.2	45	0.01	—						12		✔	2.25
TPS63000/1/2	1200	1800	1.8 to 5.5	1.2 to 5.5	3.3/5.0	90	1400	2.2	30	0.1	—			✔	✔		10		✔	1.50
TPS63010/11/12	1200	2200	2 to 5.5	1.2 to 5.5	3.3/3.4/ 2.8/2.9	96	2400	1.5	30	0.1	—			✔	✔	20			✔	1.50
TPS63060/1	1200	1800	2.5 to 8	2.5 to 12	5	93	2400	2.2	30	—	—		✔	✔	✔		10			1.40
TPS63020	3000	4000	1.8 to 5.5	1.2 to 5.5	3.3	96	2400	1.5	30	0.1	—		✔	✔	✔		14		✔	2.50

[1] *Adjustable average input-current limit and soft start.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

DC/DC Switching Regulators
Controllers (External Switch)

3- to 20-V PMBus Synchronous Buck Controller
TPS40400

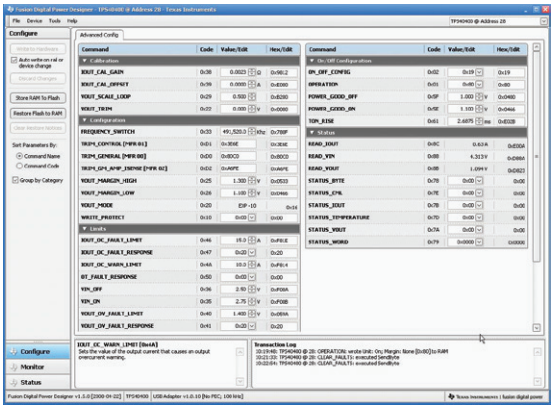
The TPS40400 is a cost-optimized flexible synchronous buck controller that operates from a nominal 3- to 20-V supply. This controller is an analog PWM controller that allows programming and monitoring via the PMBus interface. Flexible features found on this device include programmable soft-start time,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

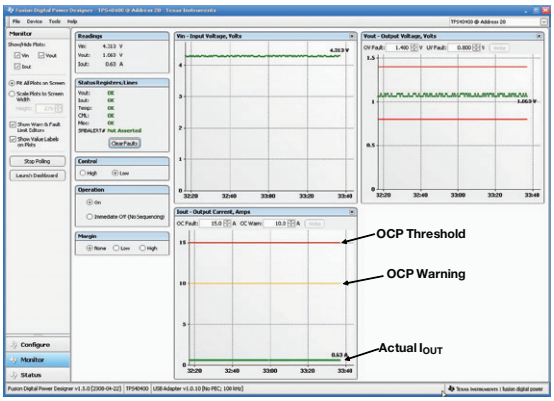
Key Features

- Input operating voltage: 3 to 20 V
- PMBus enabled analog controller
- Reference 600 mV ± 1%
- Remote voltage sense amplifier
- Internal 6-V regulator and 6-V gate drive
- Programmable overcurrent protection
- Inductor resistance or series resistance used for current sensing
- Programmable switching frequency: 200 kHz to 2 MHz
- Powergood indicator
- Thermal shutdown
- Programmable soft-start
- Internal bootstrap diode
- Pre-bias output safe
- 24-pin QFN package

Applications

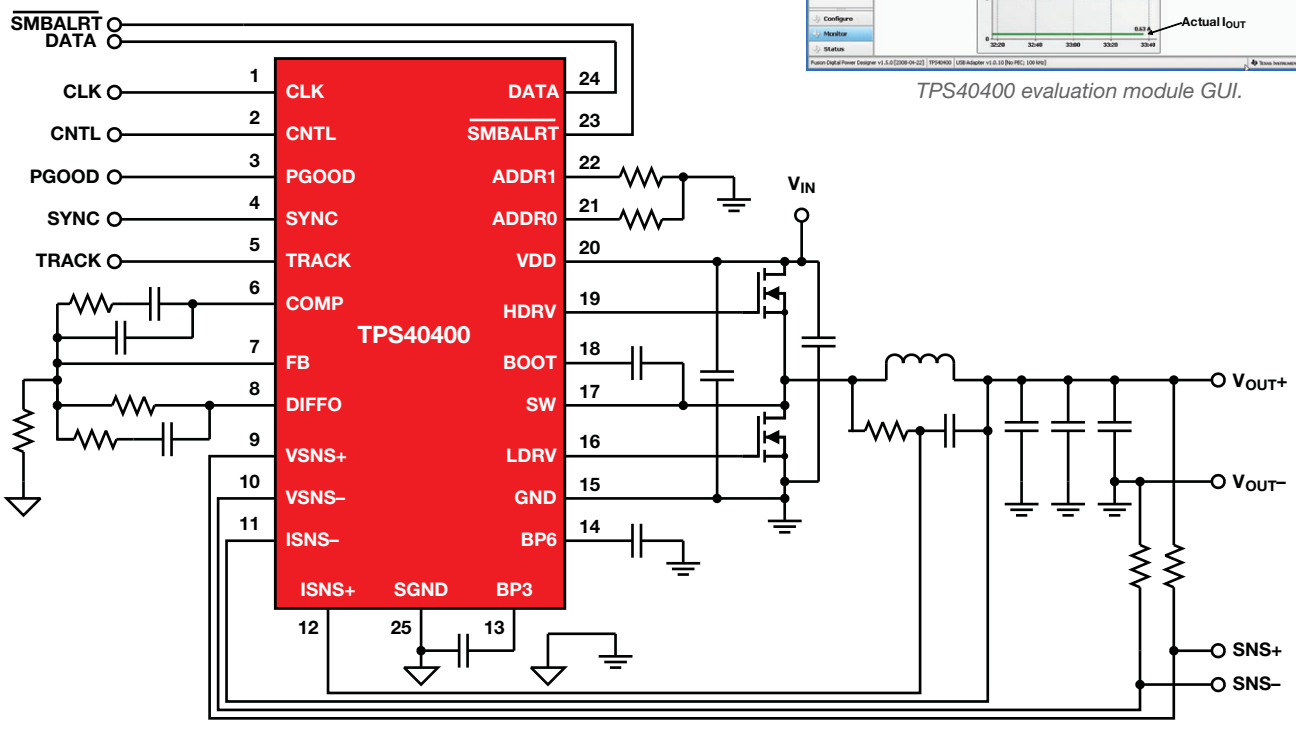
- Smart power systems
- Power supply modules
- Communications equipment
- Computing equipment





TPS40400 evaluation module GUI.

Get more information: **www.ti.com/product/TPS40400**

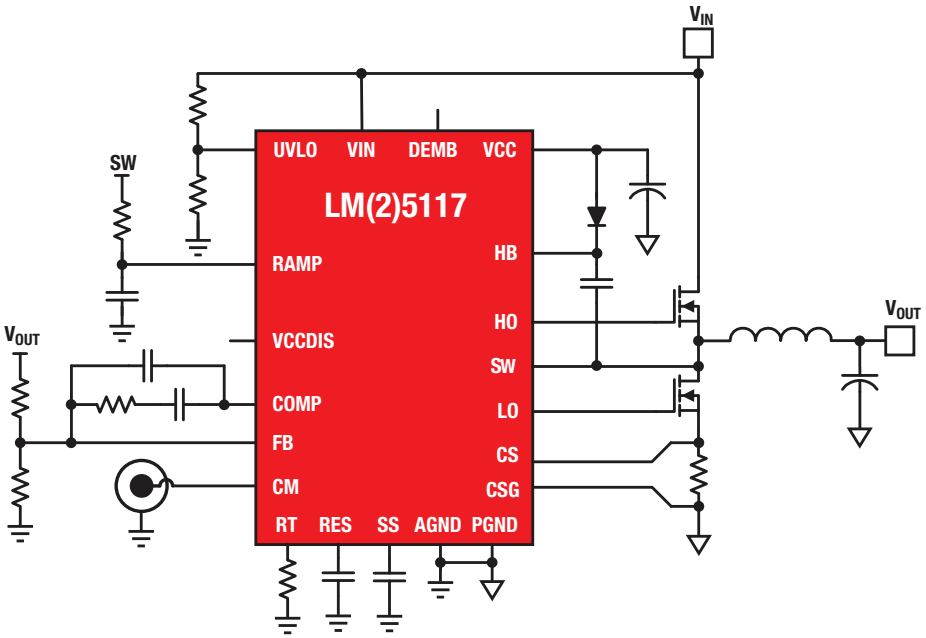


TPS40400 typical application.

DC/DC Switching Regulators
Controllers (External Switch)

High-Voltage Synchronous Buck Controllers with Analog Current Monitor
LM(2)5117

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



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

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

Get more information: **www.ti.com/product/LM5117** or **LM25117**

SIMPLE SWITCHER® Synchronous Controllers

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

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

DC/DC Switching Regulators

Controllers (External Switch)

Selection Guide

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

Device	Mode of Control[1]	V_{IN} (min/max) (V)	V_O (min/max) (V)	Driver Current (A)	Output Current (A)[2]	Frequency (kHz)	V_{REF} Tol (%)	Internal Bootstrap	Package(s)	Pwr Good	Source and Sink[3]	Pre-biased Operation	Ext Synch Pin	Predictive Gate Drive™	DDR[4]	Remote Sense	Price*
General-Purpose DC/DC Step-Down Controllers																	
TPS40000/2	V	2.25 to 5.5	0.7 to 4	1	15	300/600	1	Yes	10 MSOP			Yes		Yes			0.99
TPS40007/9	V	2.25 to 5.5	0.7 to 4	1	15	300/600	1	Yes	10 MSOP		Yes[10]	Yes		Yes			1.20
TPS40040	V	2.25 to 5.5	0.6 to 4.95	1	15	300	1	Yes	8 SON		Yes[10]	Yes					0.90
TPS40041	V	2.25 to 5.5	0.6 to 4.88	1	15	600	1	Yes	8 SON		Yes[10]	Yes					0.90
TPS40042	V	3 to 5.5	0.7 to 4.95	1.2	15	600	Ext	Yes	10 SON		Yes[10]	Yes			Yes		0.90
TPS40020/21	V	2.25 to 5.5	0.7 to 4	2	25	Adj. to 1000	1	Yes[8]	16 HTSSOP	Yes	21[10]	20	Yes	Yes			1.45
LM3743	V	3 to 5.5	0.8 to 4.6	3.1	10	300 to 1000	1.75		10 MSOP				Yes				1.10
LM2745	V	1 to 17	0.6	1.9	20	50 to 1000	1.5		14 TSSOP	Yes		Yes	Yes				1.15
LM3475	Hysteretic	2.7 to 10	0.8 to V_{IN}	0.5	5	0 to 2000	1.5		5 SOT23								0.52
TPS40190	V	4.5 to 15	0.59 to 12.75	1.2	20	300	1	Yes	10 SON		Yes[10]	Yes					1.00
LM2742	V	1 to 16	0.6	1.6	20	50 to 2000	1.5		14 TSSOP	Yes							1.25
LM2743	V	1 to 16	0.6	1.6	20	50 to 1000	2		14 TSSOP	Yes							1.15
LM2744	V	1 to 16	0.6	1.6	20	50 to 1000	1.5		14 TSSOP	Yes							1.15
LM2748	V	1 to 16	0.6	1.9	20	50 to 1000	1.5		14 TSSOP	Yes		Yes	Yes				1.15
LM2747	V	1 to 17	0.6	1.9	20	50 to 1000	1		14 TSSOP	Yes		Yes	Yes				1.45
TPS40100[5]	C	4.5 to 18	0.7 to 5.5	1.3	20	600	1		24 QFN	Yes	Yes[10]	Yes	Yes			Yes	1.95
TPS40101[5]	V	4.5 to 18	0.7 to 5.5	1.3	20	1000	1		24 QFN	Yes	Yes[10]	Yes	Yes			Yes	1.95
LM3753/54	V	4.5 to 18	0.6 to 3.6	1.9	50	200 to 1000	1		32 LLP	Yes		Yes	Yes			Yes	2.95
TPS40192/3	V	4.5 to 18	0.59 to 14.4	1.2	15/20	600/300	0.5	Yes	10 SON	Yes	Yes[10]	Yes					1.05
TPS40195[6]	V	4.5 to 20	0.59 to 17	1.2	20	Adj. to 600	0.5	Yes	16 TSSOP, 16 QFN	Yes	Yes[10]	Yes	Yes[7]				1.50
TPS40400	VFF, PMBus	3 to 20	0.6 to 12	2	25	Adj. to 2000	1	Yes	24 QFN	Yes	Yes	Yes	Yes			Yes	2.15
TPS40303/4/5	V	3 to 20	0.6 to 18	2	25	300/600/1200	1	Yes	10 SON	Yes	Yes[10]	Yes					1.50
LM27402	V	3 to 20	0.6 to 19	2.6	30	200 to 1200	1		LLP-16, 16 TSSOP	Yes		Yes	Yes				1.68
TPS53124 (dual output)	D-CAP™ Mode	4.5 to 26	0.76 to 5.5	0.7	12	380	1	Yes	24 QFN, 28 TSSOP		Yes	Yes					1.95
TPS53125/26/27 (dual output)	D-CAP2™ Mode	4.5 to 26	0.76 to 5.5	0.7	12	350/700	1	Yes	24 QFN, 24 TSSOP		Yes	Yes					2.35
TPS53114	D-CAP2 Mode	4.5 to 27	0.76 to 5.5	0.7	12	350/700	1	Yes	16 TSSOP, 16 HTSSOP		Yes	Yes					1.00
TPS40075	VFF	4.5 to 28	0.7 to 23	1	20	Adj. to 1000	1	Yes	20 QFN	Yes	Yes[10]	Yes	Yes	Yes		Yes	1.80
TPS40077	VFF	4.5 to 28	0.7 to 23	1	20	Adj. to 1000	1	Yes	16 PowerPAD™	Yes	Yes[10]	Yes		Yes			1.60
LM3485	Hysteretic	4.5 to 35	1.242 to V_{IN}	0.4	4	0 to 1400	2		8 MSOP								0.55
LM3489	Hysteretic	4.5 to 35	1.239 to V_{IN}	0.4	4	0 to 1400	2		8 MSOP								0.62
LM3477	C	2.97 to 35	1.265 to 30.8	1.0	6	500	1.5		8 MSOP								0.92
TPS40054/55/57	VFF	8 to 40	0.7 to 35	1	20	Adj. to 1000	1	Yes	16 PowerPAD		55, 57[10]	57	Yes				1.65
TPS40056	V	10 to 40	0.7 to 35	1	20	Adj. to 1000	Ext	Yes	16 PowerPAD		Yes		Yes		Yes		1.65
TPS40200[7]	VFF	4.5 to 52	0.7 to 46	0.2	3	Adj. to 500	1	Note 9	8 SOIC				Yes				0.75
TPS40170	VFF	4.5 to 60	0.6 to 58	1.2	15	Adj. to 600	1	Yes	20 QFN	Yes	Yes[10]	Yes	Yes				2.25
LM(2)5117	ECM	4.5 to 65	0.8 to 60	2.2	20	50 to 750	1.5		20 TSSOP, 24 LLP				Yes				1.75/2.04
LM(2)5085/A	COT	4.5 to 42/75	1.25/0.9 to V_{IN}	1.5	10	1000	2		8 MSOP, 8 LLP								0.79/0.85/ 1.00
LM(2)5088	ECM	4.5 to 42/75	1.2 to 40/70	1.5	10	50 to 1000	1.5		e16 TSSOP				Yes				1.40/1.84
LM(2)5115/A	V	4.5 to 42/75	0.75 to 13.5	2.5	20	100 to 1000	1.7		16 TSSOP				Yes				1.40/1.85
LM(2)5116	ECM	6 to 100	1.2 to 80	3.5	20	50 to 1000	1.5		20 eTSSOP				Yes				1.85/2.42

[1] *V = Voltage-mode control, C = Current-feedback control, VFF = Voltage mode with voltage feed-forward compensation, ECM = Emulated current mode and COT = Constant ON-time control.*
[2] *Current levels of this magnitude can be supported with commonly available commercial FETs.*
[3] *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.*
[4] *DDR = Supports DDR memory.*
[5] *Provides advanced start-up sequencing and output voltage margining.*
[6] *Bidirectional 180° out-of-phase synchronization.*
[7] *Non-synchronous, drives P-FETs.*
[8] *Integrated voltage-doubler charge pump for higher drive voltage.*
[9] *Drives high-side P-FET.*
[10] *During soft start: source only.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

DC/DC Switching Regulators

Controllers (External Switch)

Selection Guide (Continued)

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

Device	Mode Control[1]	Switched Outputs	Phases	V_{IN} (min/max) (V)	V_O (min/max) (V)	Driver Current (A)	Output Current (A)[2]	Frequency (kHz)	V_{REF} Tol (%)	Package(s)	Pwr Good	Overvoltage Protection	Source and Sink[3]	Pre-biased Operation	Ext Synch Pin	Remote Sense	Price*
Multiphase Synchronous DC/DC Buck Controllers																	
LM2642	C	1 or 2	1 or 2	4.5/30	1.3/96% x V_{IN}	1.1	25/phase	300	1.8	28L TSSOP	Yes	Yes	—	—	No	—	1.48
LM2647	VFF	1 or 2	1 or 2	5.5/28	0.6/7.8	2	25/phase	Adj. 200 to 500	1.5	28L TSSOP	Yes	Yes	—	—	No	—	1.80
LM2657	VFF	1 or 2	1 or 2	4.5/28	0.6/7.4	2	25/phase	Adj. 200 to 500	1.5	28L TSSOP	Yes	Yes	—	—	No	—	1.80
LM3000	ECM	1 or 2	1 or 2	3.3/18.5	0.6/80% x V_{IN}	—	25/phase	Adj. 200 to 1500	1.5	32L LLP	Yes	Yes	—	Yes	No	—	2.75
LM3753	VFF	1 or 2	1 or 2	4.5/18	0.6/3.6	4	25/phase	Adj. 200 to 1000	1	32L LLP	Yes	Yes	—	Yes	Yes	—	2.75
LM3754	VFF	1 or 2	1 or 2	4.5/18	0.6/3.6	4	25/phase	Adj. 200 to 1000	1	32L LLP	Yes	Yes	—	Yes	Yes	—	2.75
LM(2)5119	ECM	1	2	4.5/5.5 to 42/65	0.8 to 38/59	2.2	50	50 to 750	1.5	32 LLP	—	—	—	—	Yes	—	2.60/3.25
LM5642	C	1 or 2	1 or 2	4.5/36	1.3/90% x V_{IN}	1.1	25/phase	200	1.7	28L TSSOP	No	Yes	—	—	Yes	—	1.75
LM5642x	C	1 or 2	1 or 2	4.5/36	1.3/90% x V_{IN}	1.1	25/phase	375	1.7	28L TSSOP	No	Yes	—	—	Yes	—	1.75
TPS40132	C	1	2	1/40	0.6/5.8	1	50	Adj. to 1000	0.8	32 QFN	Yes	Yes	Yes	Yes	Yes	Yes	2.95
TPS40140[4]	C	1 or 2	1 or 2	2/40	0.7/5.8	1.2	25/phase	Adj. to 1000	0.5	36 QFN	Yes	Yes	Yes	Yes	Yes	Yes	3.05
TPS40180[5]	C	1	1	2/40	0.7/5.8	1.2	25	Adj. to 1000	0.75	24 QFN	Yes	Yes	Yes	Yes	Yes	Yes	2.05
TPS40322	VFF	1 or 2	1 or 2	3/20	0.6/5.6	2	25/phase	Adj. to 1000	1	32 QFN	Yes	Yes	Yes	Yes	Yes	Yes	2.40
TPS40422	VFF/PMBus	1 or 2	1 or 2	4.5/20	0.6/5.6	2	25/phase	Adj. to 1000	1	40 QFN	Yes	Yes	Yes	Yes	Yes	Yes	3.10
TPS51631	D-CAP+™	1	3	4.5/28	0.5/2.3	—	30	Adj. 400 to 1000	0.5	32 QFN	Yes	Yes	Yes	—	No	Yes	1.65
TPS59621	D-CAP+	1	2	3/28	0.3/1.5	8	30	Adj. 200 to 500	0.5	40 QFN	Yes	Yes	Yes	—	No	Yes	1.80
TPS59640	D-CAP+	2	4	3/28	0.25/1.52	6	30	Adj. 250 to 500	0.5	48 QFN	Yes	Yes	Yes	—	No	Yes	2.25
TPS59641	D-CAP+	2	4	3/28	0.25/1.52	6	30	Adj. 250 to 500	0.5	48 QFN	Yes	Yes	Yes	—	No	Yes	2.25
TPS59650	D-CAP+	2	5	3/28	0.25/1.52	6	30	Adj. 250 to 600	0.5	48 QFN	Yes	Yes	Yes	—	No	Yes	2.65

Device	Switched Outputs	LDO Outputs	Phases	V_{IN} (min/max) (V)	V_O (min/max) (V)	Driver Current (A)	Output Current (A)[2]	Frequency (kHz)	V_{REF} Tol (%)	Control Method	Bootstrap Diode	Package(s)	Overvoltage Protection	Power Good	DDR[6]	Price*
DC/DC Synchronous Buck Controllers with Light-Load Efficiency																
TPS51220A	2	2	1	4.5/32	1.0/12.0	2	8	200 to 1000	1	Current or D-CAP™ Mode	Yes	32 QFN	Yes	Yes	No	2.25
TPS51225/B/C	2	2	1	5.5/24	3.3/5.0[7]	1.7	8	300 to 335	1	D-CAP Mode	Yes	20 QFN	Yes	Yes	No	1.05
TPS51275/C	2	2	1	5.0/24	3.3/5.0[7]	1.7	7	330 to 335	1	D-CAP Mode	Yes	20 QFN	Yes	Yes	No	1.05
TPS53211	1	0	1	4.5/15	0.8/0.7 x V_{IN}	2	25	200 to 600	0.5	Voltage	Yes	16 QFN	Yes	Yes	No	2.00
TPS53219	1	0	1	4.5/28	0.6/5.5	2	25	Select up to 1000	0.5	D-CAP Mode	Yes	16 QFN	Yes	Yes	No	1.35
TPS59116	1	1	1	3/28	1.5/3.0	0.8	10	Up to 400	1	Current, D-CAP Mode	No	20 PowerPAD™, 24 QFN	Yes	Yes	Yes	1.30
TPS59124	2	0	1	3/28	0.76/5.5	3	10	300, 360, 420	1	D-CAP Mode	No	24 QFN	Yes	Yes	No	1.90
TPS59610/11	1	0	1	3/30	0.3/1.5	8	27	200 to 500	0.5	D-CAP+	Yes	32 QFN	Yes	Yes	No	1.40
TPS59621	1	0	2	3/30	0.3/1.5	8	54	250 to 500	0.5	D-CAP+	Yes	40 QFN	Yes	Yes	No	1.80

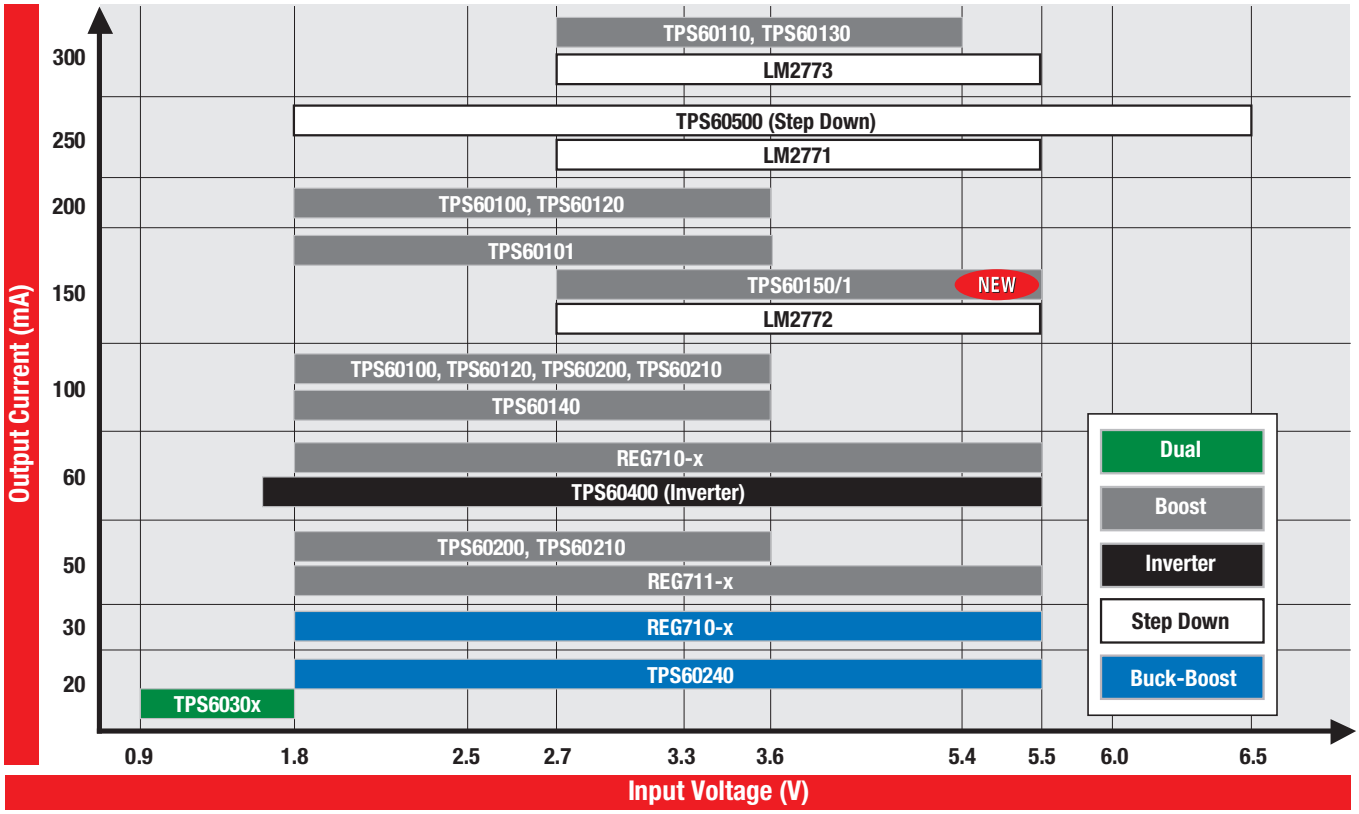
Device	V_{IN} (min/max) (V)	V_O (min) (V)	Frequency Range (kHz)	f_{sync}	On/Off Pin	Topology	Package(s)	Price*
Boost and Buck-Boost Controllers								
LM3430	6.0/40	1.25	50 to 2000	✔	—	Boost	12 LLP	1.00
LM3478	2.95/40	1.26	100 to 1000	✔	✔	Boost, SEPIC, flyback	8 MSOP	0.93
LM3481	2.97/48	1.275	100 to 1000	✔	✔	Boost, SEPIC, flyback	10 MSOP	0.95
LM3488	2.95/40	1.26	100 to 1000	✔	✔	Boost, SEPIC, flyback	8 MSOP	0.99
LM5020	13/100	Set by external feedback network	50 to 1000	✔	✔	Flyback, inverting, buck, boost, forward	10 MSOP, 10 LLP	0.99
LM5021	8.0/30	Set by external feedback network	50 to 1000	✔	✔	Flyback, forward	8 MSOP	0.66
LM5022/C	6.0/60	1.25	50 to 2000	✔	✔	Boost, SEPIC	10 MSOP	1.13
LM(2)5118	3.0/(42/75)	1.23	50 to 500	✔	✔	Buck-boost	20 eTSSOP	2.00/2.38
TPS40210/1[8]	4.5/52	5	Adj. to 1000	✔	✔	Boost, SEPIC, flyback	10 MSOP/SON	1.10
TPS43000[9]	1.8/9	0.8	Adj. to 2000	✔	✔	Boost, SEPIC, flyback	16 TSSOP	2.25
TPS43060[9]	4.5/38	0.8	50 to 1000	✔	✔	Synchronous boost (60 V)	3x3-mm QFN	1.40

[1] C = Current-feedback control and VFF = voltage mode with voltage feed-forward compensation.
[2] Current levels of this magnitude can be supported with commonly available commercial FETs.
[3] 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.
[4] Stackable to 16 phases.
[5] Stackable to 8 phases, reference is trimmable.
[6] DDR = Supports DDR memory.
[7] Fixed range: OUT1 = 5.0 V ±10% and OUT2 = 3.3 V ±10%.
[8] Overvoltage protection, source only.
[9] External synch pin.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

DC/DC Switching Regulators
Charge Pumps

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



Selection Guide

Device	I_{OUT} (mA)	V_{IN} (V)	V_{OUT} Adj. (V)	V_{OUT} Fixed (V)	Efficiency (%)	Switching Frequency (max) (kHz)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Features						Package(s)	EVM	Price*
									Shutdown	Low Battery	Power Good	Undervoltage Lockout	Current Limit	Thermal Limit			
Step-Down (Buck) Regulators																	
LM2772	150	2.7 to 5.5	—	1.2	—	1100	45	—	✔						QFN-10	✔	0.75
TPS60500	250	1.8 to 6.5	0.8 to 3.3	1.5, 1.8, 3.3	90	1200	40	0.05	✔		✔	✔	✔	✔	MSOP-10	✔	0.55
LM2771	250	2.7 to 5.5	—	1.5	—	1100	45	—	✔						QFN-10		0.85
LM2773	300	2.5 to 5.5	1.6 to 1.8	—	—	1150	48	—	✔						micro SMD-9	✔	0.90
Boost Regulators																	
TL7660	20	1.5 to 10	—	< 2 V_{IN}	99	10.35	80	—							SOT-23, MSOP-8		0.80
TPS6020x	50, 100[1]	1.8 to 3.6	—	3.3	90	400	40	0.05	✔	✔[1]	✔[1]	✔			MSOP-10		0.65
TPS6021x	50, 100[1]	1.8 to 3.6	—	3.3	90	400	35	2	Snooze	✔[1]	✔[1]	✔			MSOP-10		0.65
TPS60101	100	1.8 to 3.6	—	3.3	90	300	50	0.05	✔			✔	✔		TSSOP-20		0.65
TPS6012x	100, 200[1]	1.8 to 3.6	—	3.0, 3.3[1]	85	450	55	0.05	✔	✔[1]	✔[1]	✔	✔		TSSOP-20		0.65, 0.80[1]
TPS6014x	100	1.8 to 3.6	—	5.0	70	450	65	0.05	✔	✔[1]	✔[1]	✔	✔		TSSOP-20	✔	0.65
TPS6020x	100	1.8 to 3.6	—	3.3	90	400	35	0.05	✔	✔[1]	✔[1]	✔			MSOP-10	✔	0.65
TPS60210	100	1.8 to 3.6	—	3.3	90	400	35	2	Snooze	✔[1]	✔[1]	✔			MSOP-10	✔	0.65
TPS60150	140	2.7 to 5.5	—	5.0	90	1500	4.7	0.01	✔					✔	QFN-6	✔	0.50
TPS60111	150	2.7 to 5.4	—	5.0	90	300	60	0.05	✔			✔	✔		TSSOP-20		0.70
TPS6013x	150, 300[1]	2.7 to 5.4	—	5.0	90	450	60	0.05	✔	✔[1]	✔[1]	✔			TSSOP-20		0.70, 0.80[1]
TPS60100	200	1.8 to 3.6	—	3.3	90	300	50	0.05	✔			✔	✔		TSSOP-20	✔	0.65
TPS60110	300	2.7 to 5.4	—	5.0	90	300	60	0.05	✔			✔	✔		TSSOP-20	✔	0.80

[1] *Device parameter, feature and/or price may vary with each device number in family.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

DC/DC Switching Regulators
Charge Pumps

Selection Guide (Continued)

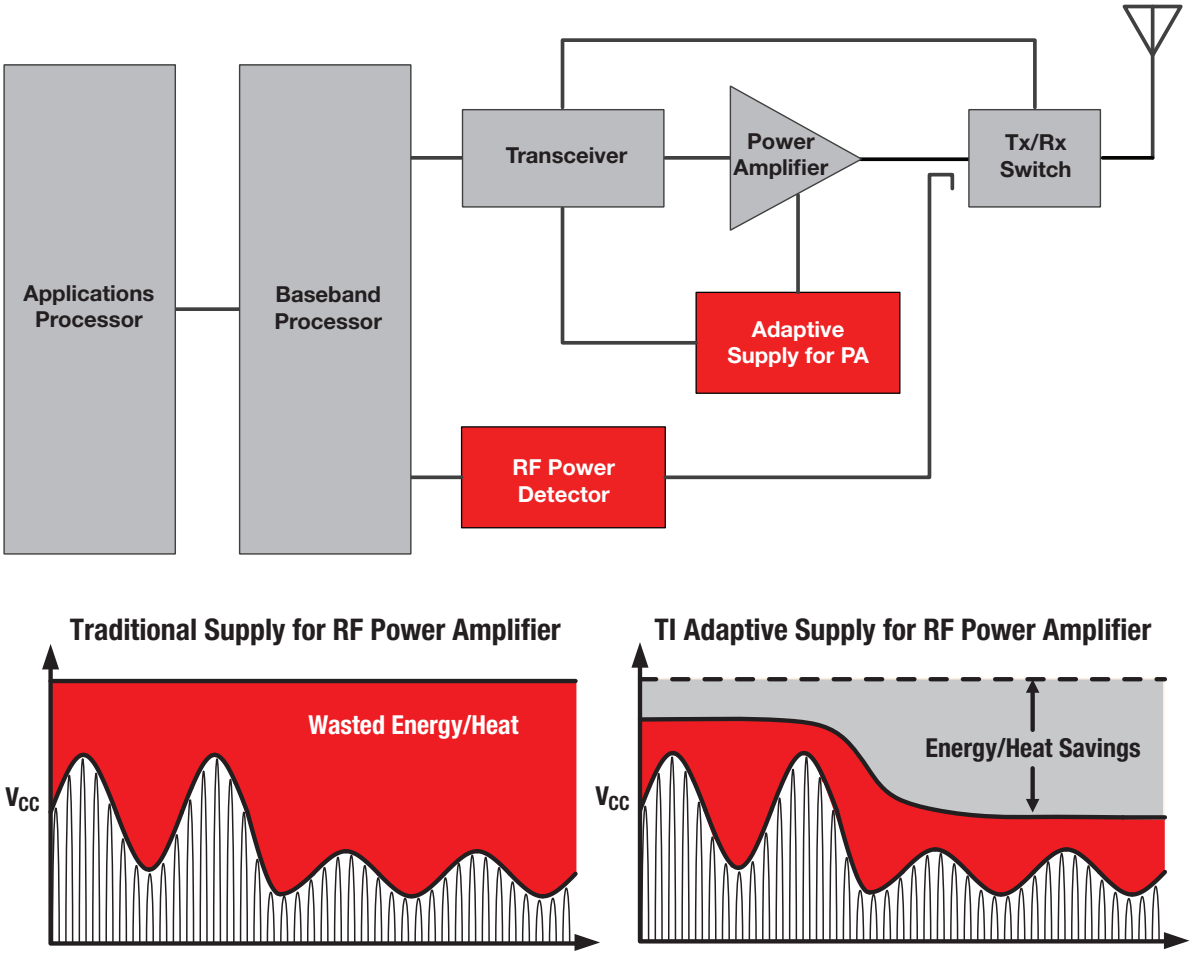
Device	I_{OUT} (mA)	V_{IN} (V)	V_{OUT} Adj. (V)	V_{OUT} Fixed (V)	Efficiency (%)	Switching Frequency (max) (kHz)	Quiescent Current (typ) (µA)	Shutdown Current (typ) (µA)	Features						Package(s)	EVM	Price*
									Shutdown	Low Battery	Power Good	Undervoltage Lockout	Current Limit	Thermal Limit			
Dual-Output Regulators																	
TPS6030x	20, 40	0.9 to 1.8	—	3.0, 3.3, 2 V_{IN}[1]	90	900	35	1	✔		✔	✔			MSOP-10	✔	0.70
TPS6031x	20, 40	0.9 to 1.8	—	3.0, 3.3, 2 V_{IN}[1]	90	900	35	2	Snooze		✔	✔			MSOP-10		0.65
Buck-Boost Regulators																	
REG710	30	1.8 to 5.5	—	2.5, 2.7, 3, 3.3, 5	90	1000	65	0.01	✔				✔	✔	SOT-23		0.45
REG71050	60	2.7 to 5.5	—	5.0	90	1000	65	0.01	✔				✔	✔	SOT-23	✔	0.50
REG711	50	1.8 to 5.5	—	2.5, 2.7, 3, 3.3, 5	90	1000	60	0.01	✔				✔	✔	MSOP-8		0.48
TPS60240	12	1.8 to 5.5	—	3.3	90	160	25	0.1					✔	✔	MSOP-8		0.55
Inverting Regulators																	
TPS60400	60	1.6 to 5.5	–16.6 to –5.25	—	99	50 to 250	125	—							SOT-23	✔	0.33
TPS60401	60	1.6 to 5.5	–16.6 to –5.25	—	99	20	70	—							SOT-23		0.33
TPS60402	60	1.6 to 5.5	–16.6 to –5.25	—	99	50	275	—							SOT-23		0.33
TPS60403	60	1.6 to 5.5	–16.6 to –5.25	—	99	250	400	—							SOT-23		0.33

[1] *Device parameter, feature and/or price may vary with each device number in family.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

Operation of the radio circuitry in a portable device accounts for a significant amount of the total power consumption—leading to less battery life and more heat. Traditionally, the RF power amplifier (PA), which is used to drive the antenna, is connected directly to the battery. However, this approach wastes a significant amount of energy as the PA is supplied with maximum power when often only a fraction is required to reliably ensure wireless voice and data connection. TI's portfolio of RF power management products delivers energy and heat saving solutions that enable higher performing RFFE systems. Supply for Power Amplifier products are dynamically adjustable power supplies for RF power amplifiers that optimize power usage—especially when maximum PA power is not needed—to extend battery life and reduce heat dissipation. TI's family of RF detectors provides transmit power control so that only the necessary amount of power is used, saving power and increasing transmission range. These RF detectors feature high linearity and accuracy over temperature to reduce PA power guard-band requirements for more coverage range, battery power savings, and increased channel quality.

Get more information: **www.ti.com/rfpower**

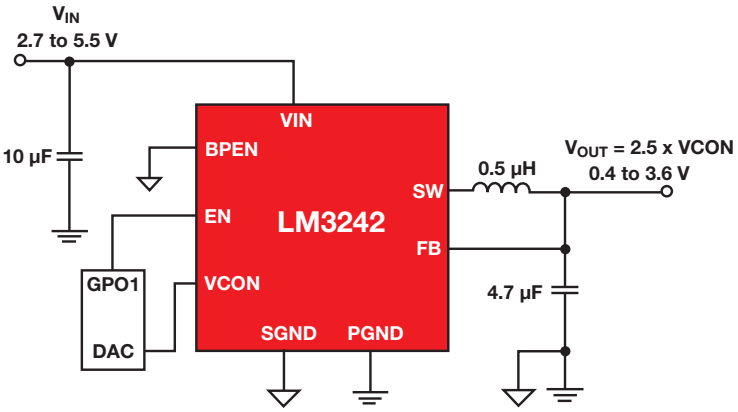


RF power solutions from TI enable efficient RF front-end designs.

RF Power Solutions
RF DC/DC Converters

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

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

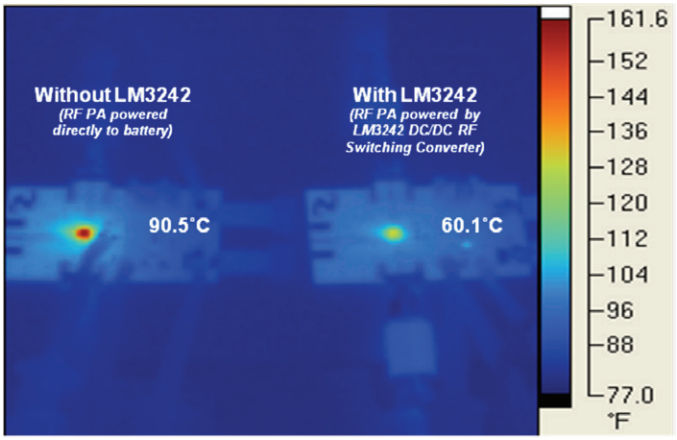


LM3242 application circuit with just three tiny surface-mount components.

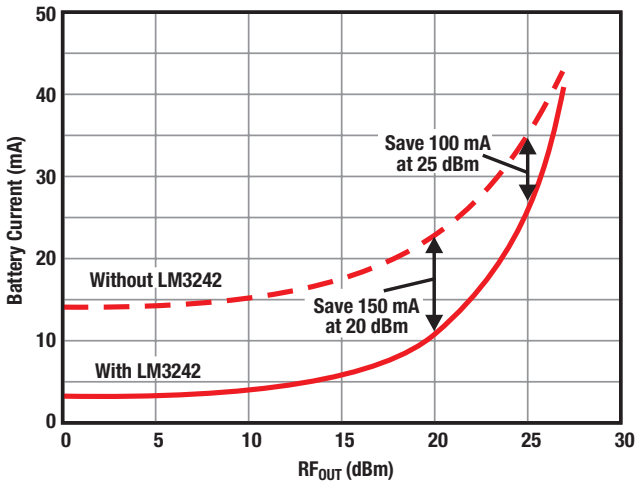
Key Features

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

Thermal Imaging—RF Power Amplifier



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



LM3242 extends battery life with dramatically reduced current consumption.

Get more information: **www.ti.com/product/LM3242**

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

Device	Topology	V_{IN} (V)	V_{OUT} (V)	I_{OUT} (max) (mA)	Bypass Modes	Soft Start	Switching Frequency (MHz)	Package(s)	Description/ Features	Price*
LM3209-G3	Buck-Boost	2.7 to 5.5	0.6 to 4.2	1000	None	No	2.4	12-bump micro SMD		0.90
LM3269	Buck-Boost	2.7 to 5.5	0.6 to 3.8	1000	None	No	2.4	12-bump micro SMD		0.75
LM3212	Buck	2.7 to 5.5	0.5 to 3.4	2500	Forced and Active	No	1.6	16-bump micro SMD		1.10
TPS62730	Buck	1.9 to 3.9	1.9/2.1/2.3	100	Active	Yes	3	6-QFN (1x1.5 mm)	BLE, RF4CE	0.75
LM3241	Buck	2.7 to 5.5	0.6 to 3.4	750	None	Yes	6	6-bump micro SMD		0.40
LM3242	Buck	2.7 to 5.5	0.4 to 3.6	750	Forced and Auto	Yes	6	9-bump micro SMD		0.37
LM3262	Buck	2.5 to 5.5	0.4 to 3.6	800	Forced and Auto	Yes	6	9-bump micro SMD		0.40
LM3243	Buck	2.7 to 5.5	0.4 to 3.6	2500	Forced and Active	No	2.7	16-bump micro SMD		0.45

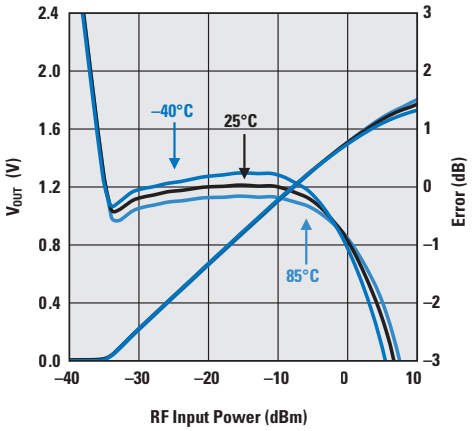
**Suggested resale price in U.S. dollars in quantities of 1,000.*

RF Power Solutions

RF Power Detectors

8-GHz LOG/LIN RMS RF Power Detector

LMH2110, LMH2120



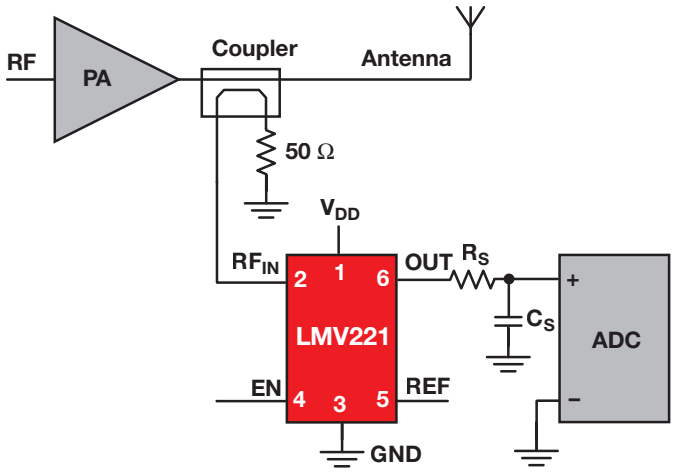
Key Features

- LMH2110: 40-dB linear-in-dB power detection range
- LMH2120: 40-dB linear-in-V power detection range
- > 30-dB dynamic range, 1900 MHz, n = 50
  - ±0.3-dB log conformance error
  - ±0.3-dB variation over temperature
  - 0.05-dB (typ) output variation due to modulation, WCDMA
- Shutdown pin
- Multi-band operation from 50 MHz up to 8 GHz
- Available in micro SMD-6 packaging (0.84 x 1.24 mm)

Get more information: **www.ti.com/product/LMH2110** or **LMH2120**

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

LMV221, LMH2100



Typical application circuit.

Key Features

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

Get more information: **www.ti.com/product/LMV221** or **LMH2100**

RF Power Detectors

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

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

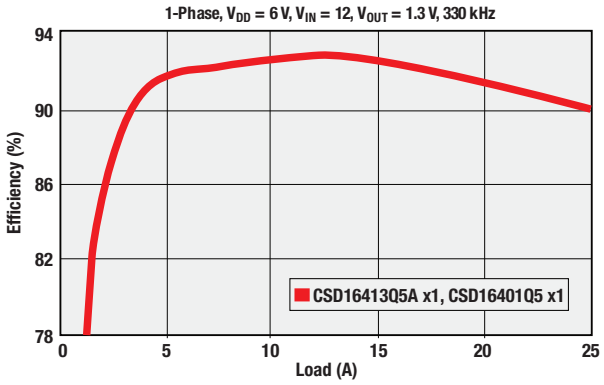
NexFET™ Power MOSFETs

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

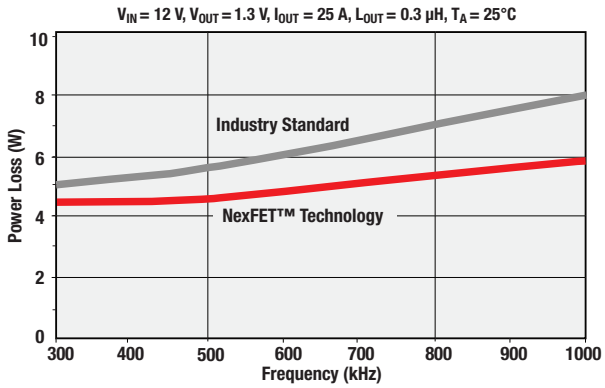
NexFET technology delivers high performance for both N- and P-channel power MOSFET devices. Designers are able to achieve 90% power supply efficiencies from light to full loads with high output currents and low duty cycles, representing a breakthrough in discrete designs.

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

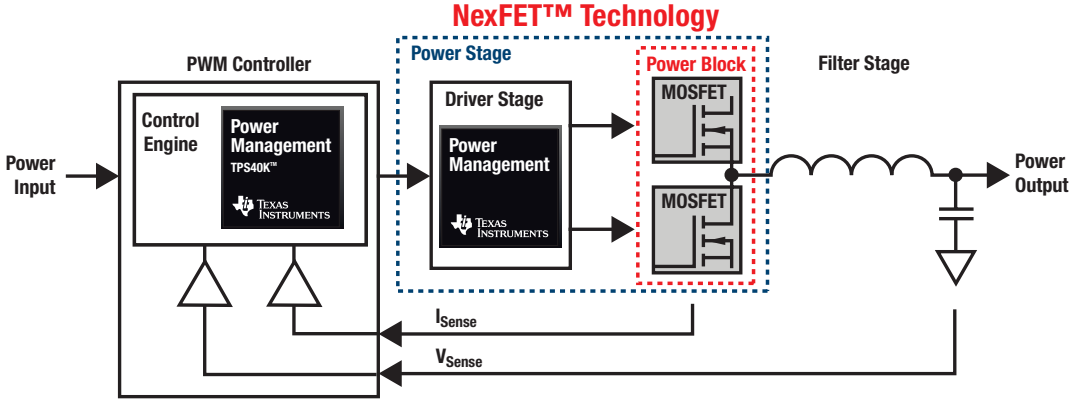
90% Efficiency from Light to Full Load



Same Power Loss, Double the Frequency



System Block Diagram of TI Electronics in a Power System Design



Selection Guide

Device	Channel	V_{DS} (V)	V_{GS} (V)	Typical $V_{GS(th)}$ (V)	Typical $R_{DS(on)}$ (mΩ) at 10 V	at 4.5 V	at 3 V	at 2.5 V	at 1.8 V	at 1.5 V	Maximum I_D (A)	Typical Q_G at 4.5 V (nC)	Typical Q_{GS} (nC)	Typical Q_{GD} (nC)	Typical R_G (Ω)	Price*
WLP 1x1																
Single																
CSD23201W10	P	12	6	0.6	—	66	—	77	—	110	2.2	1.9	0.28	0.26	—	0.20
WLP 1x1.5																
Single																
CSD25211W1015	P	20	6	0.80	—	27	—	36	—	—	3.2	3.4	1.1	0.2	—	0.25
CSD25301W1015	P	20	8	0.75	—	62	—	80	—	175	2.2	1.9	0.35	0.4	—	0.25
CSD25303W1015	P	20	8	0.75	—	46	—	56	—	72	3	3.3	0.6	0.6	—	0.25
Common Source																
CSD75205W1015	P	20	6	0.65	—	95	—	115	145	—	1.2	1.6	0.3	0.4	—	0.26
CSD75301W1015	P	20	8	0.7	—	80	—	105	150	—	1.2	1.5	0.28	0.3	—	0.26

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

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

NexFET™ Power MOSFETs

Selection Guide (Continued)

Device	Channel	V_{DS} (V)	V_{GS} (V)	Typical $V_{GS(th)}$ (V)	Typical $R_{DS(on)}$ (mΩ) at 10 V	at 4.5 V	at 3 V	at 2.5 V	at 1.8 V	at 1.5 V	Maximum I_D (A)	Typical Q_G at 4.5 V (nC)	Typical Q_{GS} (nC)	Typical Q_{GD} (nC)	Typical R_G (Ω)	Price*
WLP 1.5x1.5																
Single																
CSD25201W15	P	20	6	0.7	—	33	—	42	52	—	4	4.3	1	0.7	—	0.28
Common Source																
CSD75204W15	P	20	6	0.7	—	80	—	105	140	—	3	2.8	0.5	0.6	—	0.30
WLP 1.7x2.3																
Dual																
CSD86311W1723	N	25	10	1	—	31	—	37	—	—	4.5	2.8	0.7	0.6	—	0.43
CSD75211W1723	P	20	8	0.7	—	32	—	61	80	—	4.5	4.5	0.9	0.9	—	0.43
SON 2x2																
Single																
CSD16301Q2	N	25	10	1.1	—	23	27	—	—	—	5	2	0.6	0.4	1.3	0.15
CSD17313Q2	N	30	10	1.3	—	26	31	—	—	—	5	2.1	0.7	0.4	1.3	0.15
CSD25302Q2	P	20	8	0.65	—	39	—	56	71	—	5	2.6	0.54	0.5	—	0.15
SON 3x3																
Single																
CSD16411Q3	N	25	16	2	8	12	—	—	—	—	56	2.9	1.5	0.7	0.8	0.30
CSD16409Q3	N	25	16	2	6.2	9.5	—	—	—	—	60	4	2.1	1	0.9	0.33
CSD16406Q3	N	25	16	1.8	4.2	5.9	—	—	—	—	60	5.8	2.5	1.5	1.2	0.33
CSD16323Q3	N	25	10	1.1	—	4.4	5.4	—	—	—	60	6.2	1.8	1.1	1.4	0.39
CSD16327Q3	N	25	10	1.1	—	4	—	—	—	—	60	6.2	1.8	1.1	1.4	0.39
CSD16340Q3	N	25	10	0.85	—	4.3	—	6.1	—	—	60	6.5	2.1	1.2	1.5	0.39
CSD17308Q3	N	30	10	1.3	—	9.4	12.5	—	—	—	47	3.9	1.3	0.8	0.9	0.30
CSD17304Q3	N	30	10	1.3	—	6.9	9.8	—	—	—	56	5.1	1.8	1.1	1.1	0.32
CSD17309Q3	N	30	10	1.2	—	4.9	6.3	—	—	—	60	7.5	2.5	1.7	1.2	0.39
CSD17551Q3A	N	30	20	1.60	7.8	9.6	—	—	—	—	48	6.0	2.3	1.5	1.5	0.24
CSD17552Q3A	N	30	20	1.50	5.5	6.5	—	—	—	—	60	9.0	3.6	2.3	0.9	0.27
CSD87312Q3E	N	30	10	1.00	27	31	—	—	—	—	27	6.3	1.9	0.7	5.0	0.35
CSD25401Q3	P	20	12	0.85	—	8.8	—	13.5	—	—	60	8.8	2.1	2.1	1.2	0.41
SON 5x6																
Single																
CSD16412Q5A	N	25	16	2	9	13	—	—	—	—	52	2.9	1.4	0.7	0.7	0.30
CSD16410Q5A	N	25	16	1.9	6.8	9.6	—	—	—	—	59	3.9	1.8	1.1	0.7	0.32
CSD16404Q5A	N	25	16	1.8	4.1	5.7	—	—	—	—	81	6.5	3	1.7	0.9	0.39
CSD16408Q5	N	25	16	1.8	3.6	5.4	—	—	—	—	113	6.7	3.1	1.9	0.8	0.45
CSD16413Q5A	N	25	16	1.6	3.1	4.1	—	—	—	—	100	9	3.5	2.5	0.9	0.44
CSD16403Q5A	N	25	16	1.6	2.2	2.9	—	—	—	—	100	13.3	5.5	3.5	1.2	0.60
CSD16407Q5	N	25	16	1.6	1.8	2.5	—	—	—	—	100	13.3	5.3	3.5	1.2	0.65
CSD16414Q5	N	25	16	1.6	1.5	2.1	—	—	—	—	100	16.6	7.3	4.4	1.4	0.75
CSD16401Q5	N	25	16	1.5	1.3	1.8	—	—	—	—	100	21	8.3	5.2	1.2	0.95
CSD16322Q5	N	25	10	1.1	—	4.6	5.4	—	—	—	97	6.8	2.4	1.3	1.1	0.41
CSD16321Q5	N	25	10	1.1	—	2.1	2.8	—	—	—	100	14	4	2.5	1.5	0.65
CSD16325Q5	N	25	10	1.1	—	1.7	2.1	—	—	—	100	18	6.6	3.5	1.6	0.95
CSD16342Q5A	N	25	10	0.85	—	4.3	—	6.1	—	—	60	6.5	2.1	1.2	1.5	0.42
CSD16556Q5B	N	25	20	1.40	0.9	1.2	—	—	—	—	100	36	11	12	0.7	0.81
CSD17307Q5A	N	30	10	1.3	—	9.7	12.8	—	—	—	73	4	1.3	1	0.9	0.30
CSD17302Q5A	N	30	10	1.2	—	7.3	9.5	—	—	—	87	5.4	1.7	1.2	0.8	0.32
CSD17310Q5A	N	30	10	1.3	—	4.5	5.7	—	—	—	100	8.9	2.7	2.1	0.9	0.39
CSD17306Q5A	N	30	10	1.1	—	3.3	4.2	—	—	—	100	11.8	3.5	2.4	1	0.44
CSD17305Q5A	N	30	10	1.1	—	2.8	3.9	—	—	—	100	14.1	4.5	3	1	0.49
CSD17301Q5A	N	30	10	1.1	—	2.3	2.9	—	—	—	100	19	5.7	4.3	1.3	0.60

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

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

Selection Guide (Continued)

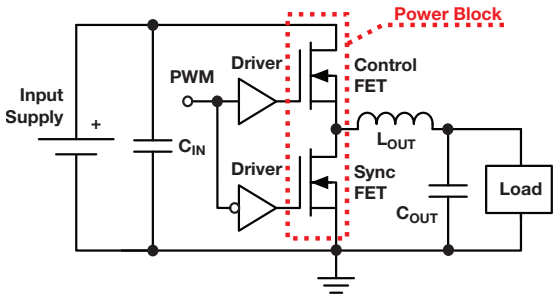
Device	Channel	V_{DS} (V)	V_{GS} (V)	Typical $V_{GS(th)}$ (V)	Typical $R_{DS(on)}$ (mΩ) at 10 V	at 4.5 V	at 3 V	at 2.5 V	at 1.8 V	at 1.5 V	Maximum I_D (A)	Typical Q_G at 4.5 V (nC)	Typical Q_{GS} (nC)	Typical Q_{GD} (nC)	Typical R_G (Ω)	Price*
SON 5x6 (Continued)																
Single (Continued)																
CSD17303Q5	N	30	10	1.1	—	2	2.7	—	—	—	100	18	5.6	4	1.4	0.65
CSD17311Q5	N	30	10	1.2	—	1.8	2.3	—	—	—	100	24	6.6	5.2	1.2	0.75
CSD17312Q5	N	30	10	1.1	—	1.4	1.8	—	—	—	100	28	8.4	6	1.1	0.95
CSD17501Q5A	N	30	20/–20	1.3	2.4	3	—	—	—	—	187	13.2	5.4	3.5	—	0.60
CSD17505Q5A	N	30	20/–20	1.3	2.9	3.7	—	—	—	—	153	10	3.5	2.7	—	0.49
CSD17506Q5A	N	30	20/–20	1.3	3.2	4.2	—	—	—	—	150	8.3	3.1	2.3	—	0.44
CSD17507Q5A	N	30	20/–20	1.6	9	11.8	—	—	—	—	85	2.8	1.3	0.7	—	0.30
CSD17510Q5A	N	30	20/–20	1.5	4.1	5.4	—	—	—	—	129	6.4	2.7	1.9	—	0.39
CSD17322Q5A	N	30	10	1.6	—	10	—	—	—	—	87	3.6	1.6	1.1	4.7	0.32
CSD17327Q5A	N	30	10	1.6	—	12.5	—	—	—	—	65	2.8	1.2	0.8	4.7	0.30
CSD17527Q5A	N	30	20/–20	1.6	—	12.5	—	—	—	—	65	2.8	1.2	0.8	4.7	0.30
CSD17522Q5A	N	30	20/–20	1.6	—	10	—	—	—	—	87	3.6	1.6	1.1	4.7	0.32
CSD17551Q5A	N	30	20	1.70	7.0	9.0	—	—	—	—	48	6.0	2.8	1.4	1.4	0.26
CSD17552Q5A	N	30	20	1.60	5.1	6.1	—	—	—	—	60	9.0	3.6	2.0	0.9	0.29
CSD17553Q5A	N	30	20	1.50	2.7	3.5	—	—	—	—	100	17.5	5.8	4.7	0.7	0.36
CSD17555Q5A	N	30	20	1.50	2.3	2.8	—	—	—	—	100	23	7.5	5.0	0.8	0.46
CSD17559Q5	N	30	20	1.40	0.95	1.15	—	—	—	—	100	39	14.4	9.3	1.2	0.92
CSD18501Q5A	N	40	20	1.8	2.5	3.3	—	—	—	—	155	20	8.1	5.9	1.2	0.80
CSD18502Q5B	N	40	20	1.8	3.4	4.7	—	—	—	—	145	13	4.5	4.3	1.2	0.65
CSD18503Q5A	N	40	20	1.8	1.8	2.5	—	—	—	—	204	25	10.3	8.4	1.2	1.01
CSD18504Q5A	N	40	20	1.9	5.3	7.5	—	—	—	—	75	7.7	3.2	2.4	1.4	0.50
CSD18531Q5A	N	60	20	1.8	3.5	4.4	—	—	—	—	134	18	6.9	5.9	1.2	0.80
CSD18532Q5B	N	60	20	1.8	2.5	3.3	—	—	—	—	172	21	6.3	10	1.2	1.01
CSD18533Q5A	N	60	20	1.9	4.7	6.5	—	—	—	—	77	14	6.6	5.4	1.3	0.63
CSD18534Q5A	N	60	20	1.9	7.8	9.9	—	—	—	—	69	8.5	3.2	3.5	1.5	0.50
TO-220																
Single																
CSD18502KCS	N	40	20	1.8	3.4	3.3	—	—	—	—	200	25	10.3	8.4	1.2	0.97
CSD18503KCS	N	40	20	1.9	3.6	5.4	—	—	—	—	130	15	7.7	4.6	1.4	0.71
CSD18504KCS	N	40	20	1.9	5.5	8	—	—	—	—	85	9.2	4.4	3.5	1.5	0.58
CSD18532KCS	N	60	20	1.8	3.3	4.2	—	—	—	—	169	21	10	6.9	1.3	0.97
CSD18533KCS	N	60	20	1.9	5	6.9	—	—	—	—	114	14	9.4	3.9	1.4	0.71
CSD18534KCS	N	60	20	1.9	7.6	10.2	—	—	—	—	71	93	4.8	3.1	1.5	0.58
DualCool™ SON 5x6																
Single																
CSD16408Q5C	N	25	16	1.8	3.6	5.4	—	—	—	—	113	6.7	3.1	1.9	0.8	0.49
CSD16407Q5C	N	25	16	1.6	1.8	2.5	—	—	—	—	100	13.3	5.3	3.5	1.2	0.75
CSD16322Q5C	N	25	10	1.1	—	4.6	5.4	—	—	—	97	6.8	2.4	1.3	1.1	0.45
CSD16321Q5C	N	25	10	1.1	—	2.1	2.8	—	—	—	100	14	4	2.5	1.5	0.75
CSD16325Q5C	N	25	10	1.1	—	1.7	2.1	—	—	—	100	18	6.6	3.5	1.6	1.05
DualCool SON 3x3																
Single																
CSD16323Q3C	N	25	10	1.1	—	4.6	5.4	—	—	—	60	6.2	1.8	1.1	1.4	0.43

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

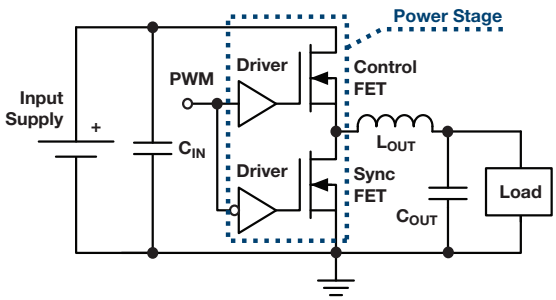
*New devices are listed in **bold red**.*

NexFET™ Power MOSFETs

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



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



Selection Guide

Device	Channel	Integrated Driver	V_{DS} (V)	V_{GS} (V)	Power Loss (W)	P_{loss} Current (A)	Max Current (A)	Max f_{SW} (MHz)	High Duty Cycle Applications	Price*
SON 3x3 Power Block										
CSD87330Q3D	N	No	30	10	2	15	20	1.5	No	0.75
CSD87331Q3D	N	No	30	10	1.3	10	15	1.5	No	0.65
SON 5x6 Power Block and SON 5x6 Power Stage										
CSD86360Q5D	N	No	25	10	2.6	25	50	1.5	No	1.15
CSD87350Q5D	N	No	30	10	3	25	40	1.5	No	1.05
CSD87351Q5D	N	No	30	10	2.5	20	32	1.5	No	0.95
CSD87352Q5D	N	No	30	10	1.8	15	25	1.5	No	1.00
CSD87353Q5D	N	No	30	10	3.3	25	120	1.5	Yes	1.50
CSD96370Q5M	N	Yes	25	—	2.6	25	40	2.0	—	1.35
CSD96371Q5M	N	Yes	25	—	3.4	30	50	2.0	—	1.35
CSD97370Q5M[1]	N	Yes	30	—	2.8	25	40	2.0	—	1.35

[1] *3.3-V and 5-V PWM signal compatible.*

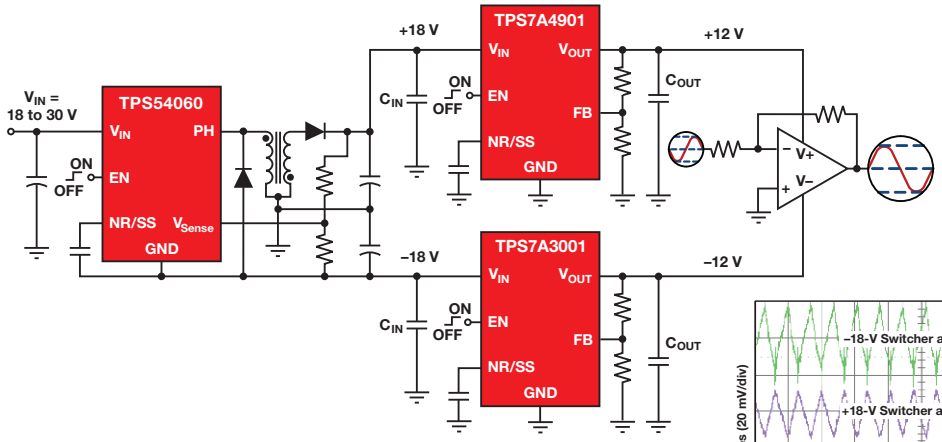
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

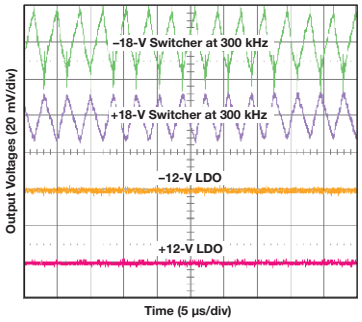
TPS7A3001, TPS7A4901

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

The wide-input-voltage TPS54060 DC/DC converter shown in the block diagram is configured in an inverting buck/boost topology with an off-the-shelf coupled inductor to generate a positive and negative output voltage. Linear regulators TPS7A4901 and TPS7A3001 provide clean positive and negative power to highly noise-sensitive analog circuitry.



TPS7A3001/4901 typical application and waveforms.



The reference design is available at: **www.ti.com/tool/pmp5863.1**

Get more information: **www.ti.com/ldo**
www.ti.com/product/TPS7A3001 or **TPS7A4901**

Key Features

- Wide input voltages: ±3.0 to ±36 V
- 1.5% nominal accuracy
- Stable with >2.2-µF ceramic output capacitor
- Low noise/high PSRR:
  - Output noise as low as 16 μV_{RMS}
  - PSRR of 72 dB at 1 kHz and 55 dB at 10 to 700 kHz

Key Benefits

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

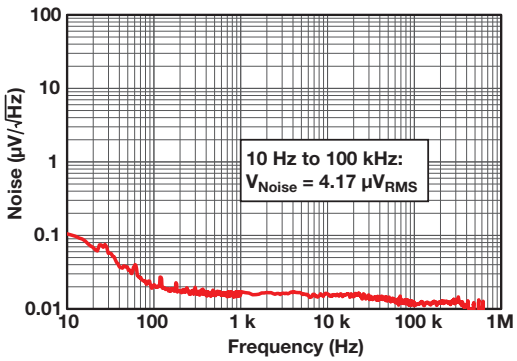
---

Industry's Cleanest, Ultra-Low-Noise LDO

NEW

TPS7A4700

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



TPS7A4700 spectral noise plot

Key Features

- Extremely low noise/high PSRR
- Robust for high-line voltage transients
- Higher precision for VCO/PLL/ADC
- Improved size/cost
- No external resistors required to set Vout

Get more information: **www.ti.com/product/TPS7A4700**

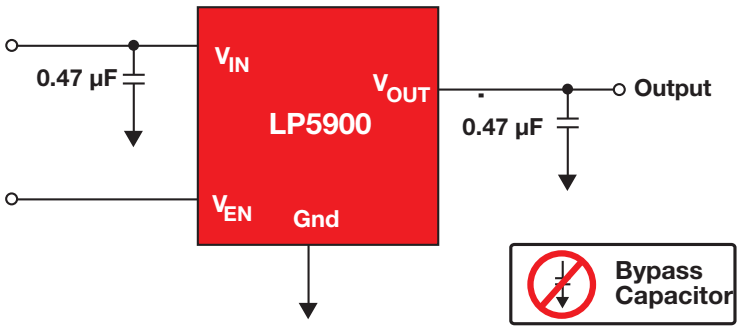
Linear Regulators

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

LP5900

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

The device is designed to work with 0.47-µF input and output ceramic capacitors. (No bypass capacitor is required) The device is available in micro SMD package and LLP package. Also available in Exteme Thin micro SMD package.



Key Features

- Stable with 0.47-µF ceramic input and output capacitors
- No noise bypass capacitor required
- Logic controlled enable
- Thermal-overload and short-circuit protection
- –40°C to +125°C junction temperature range for operation

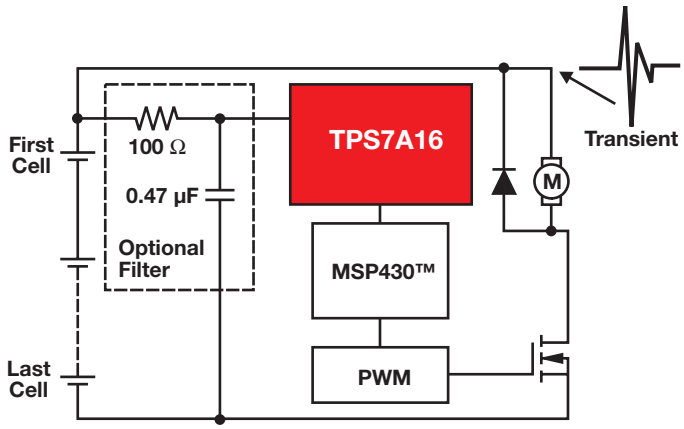
Applications

- Cellular phones
- PDA handsets
- Wireless LAN devices

Get more information: **www.ti.com/product/LP5900**

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

TPS7A16xx



Key Features

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

Applications

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

Get more information: **www.ti.com/product/TPS7A1601**

Linear Regulators

Low Dropout (LDO) Regulators Selection Guide

Device	I_Q (no load) (A)	V_{IN} Range (V)	I_{OUT} (mA)	Price*
Low I_Q				
TPS780/2xx	0.42	2.2 to 5.5	150	0.25
TPS709xx	1	2.5 to 30	150	0.39
TPS797xx	1.2	2.7 to 5.5	50	0.34
TPS715A	3.2	2.5 to 24	80	0.40
TPS7A16xx	5	3 to 60	100	1.40
TPS727xx	7.9	2 to 5.5	400	0.48

Device	Drop Out (V)	V_{IN} Range (V)	I_{OUT} (A)	Price*
Low Dropout Voltage (With Bias Control Input)				
TPS74701	50	0.8 to 5.5	0.5	0.75
TPS742/3/8	55	0.8 to 5.5	1.5	1.00
TPS744/9	115	0.8 to 5.5	3	2.00
LP38851	115	0.95 to 5.5	0.8	0.71
TPS720xx	130	1.1 to 4.5	0.32	0.37
LP38852/5/8	130	1.15 to 5.5	1.5	0.85
LP38853/6/9	240	1.15 to 5.5	3	1.60

Device	V_{IN} Range (V)	I_{OUT} (mA)	Price*
Wide V_{IN}			
TPS7A40xx	7 to 100	50	1.05
LM9076	5.35 to 70	150	0.82
TPS7A16xx	3 to 60	100	1.40
LM2936HV	4 to 60	50	0.70
TPS709	3 to 30	150	0.39
TPS715A	2.5 to 24	80	0.40
LMS1585A	5 to 13	5000	1.00
LM1084	5 to 27	5000	1.00

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

Device	Noise (µV)	PSRR at 1 kHz (dB)	V_{IN} Range (V)	I_{OUT} (A)	Price*
Ultra-Low Noise/High PSRR					
TPS7A4700	4.17	82	3 to 36	1	2.10
LP5900/4/7	6.5	75	2.2 to 5.5	0.15/0.2/0.25	0.20
TPS742/3/4	12	73	0.8 to 5.5	1.5/3	2.00
TPS7A4901	15	72	3 to 36	0.15	1.10
TPS7A3001	15	72	–3 to –36	0.2	1.50
TPS7A3301	16	72 at 10 kHz	–3 to –36	0.15	2.70
LP2989/LV	18	60	2.1 to 16	0.5	0.70
LP3878-ADJ	18	60	2.5 to 16	0.8	0.80
TPS7A8101	23.5	80	2.2 to 6.5	1	1.00
TPS71701	33.5	70	2.5 to 6.5	0.15	0.36

Device	Drop Out (V)	V_{IN} Range (V)	I_{OUT} (A)	Price*
Low Dropout Voltage (Without Bias Control Input)				
TPS731/2/6	30/40/75	1.7 to 5.5	0.15/0.25/0.40	0.33
TPS799xx	100	2.7 to 6.5	0.2	0.30
TPS7A71/2/3	200	1.5 to 7.0	1/2/3	1.05
LP3881/2/3	75/110/210	1.5 to 5.5	0.8/1.5/3	1.95
TPS735/7	280/130	2.2 to 5.5	0.5/1	0.60
LP38511/2/3	135/250/425	2.25 to 5.5	0.8/1.5/3	0.75

Device	Load Transient (mV)	V_{IN} Range (V)	I_{OUT} (A)	Price*
Fast Transient Response				
LP5907	± 20	2.2 to 5.5	0.25	0.23
TPS727	± 50	2 to 5.5	0.25	0.48
TPS742/3/4	± 50	0.8 to 5.5	1.5/3	2.00
LP3851x	± 50	2.25 to 5.5	0.8/1.5/3	0.60
TPS717	± 65	2.5 to 5.5	0.15	0.36

Dual Output LDOs Selection Guide

Device	I_{O1} (mA)	I_{O2} (mA)	V_{DO1} at I_{O1} (mV)	V_{DO2} at I_{O2} (mV)	I_Q (µA)	Output Options: Fixed Voltage (V)	Accuracy (%)	Package(s)	V_O (min) (V)	V_O (max) (V)	Enable	V_{IN} (min) (V)	V_{IN} (max) (V)	Comments	Price*
LP2967	200	200	240	240	200	1.8/25, 1.8/3.3, 2.5/2.8, 2.5/3.3, 2.6/2.6, 2.8/2.8	1.25	Mini-SO8, micro SMD	1.8	3.3	EN		16		0.99
LP2966	150	150	135	135	300	1.8/3.3, 2.5/1.8, 2.5/2.5, 2.8/2.8, 3.3/2.5, 5.0/5.0	1	Mini-SO8	1.8	5	EN		7		0.70
LP3996	150	300	110	210	35	0.8 to 3.3		LLP10			EN	2	6	Power-on reset	0.30
LP5996	150	300	110	210	35	0.8 to 3.3		LLP10			EN	2	6		0.30
LP8900	200	200	110	110	35	1.2 to 3.6	1	WCSP			EN	1.8	5.5		0.30
TLV710	200	200	175	175	70	1.8/2.8	2	SON 6	1.2	4.8	EN	2.0	5.5	Value-priced dual LDO	0.32
TLV711	200	200	175	175	70	3.3/3.3	2	SON 6	1.2	4.8	EN	2.0	5.5	TLV710xx w/ active output pulldown	0.32
TPS719xx	200	200	230	230	100	1.3/2.8, 1.8/1.2, 1.8/1.3, 2.1/2.2, 2.6/1.5, 2.8/2.8, 2.85/2.85, 3.3/2.8, 3.3/3.3, 3.6/3.15 See Note 1	3	QFN/WCSP	0.9	3.6	EN	2.5	6.5	TPS718xx w/ active output pulldown	0.55
TPS718xx	200	200	230	230	100	1.2/3.3, 18/2.7, 1.8/3.3, 2.5/1.2,2.8/2.8, 2.8/3.0 See Note 1	3	QFN/WCSP	0.9	3.6	EN	2.5	6.5	High PSRR, low V_{OUT}	0.55
TPS712xx	250	250	145	145	400	1.8/2.85, 1.8/Adj., 2.8/2.8, 2.8/Adj., 2.85/2.85	2	QFN	1.2	5.5	EN	2.7	5.5		0.80

[1]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.*

Battery Management Products
Overview

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

TI products support applications such as mobile phones, smartphones, tablets, portable consumer devices, portable navigation devices, notebook computers and many industrial and medical applications. TI also offers evaluation modules, application notes, samples and data sheets needed to get your design to market faster.

Design Factors

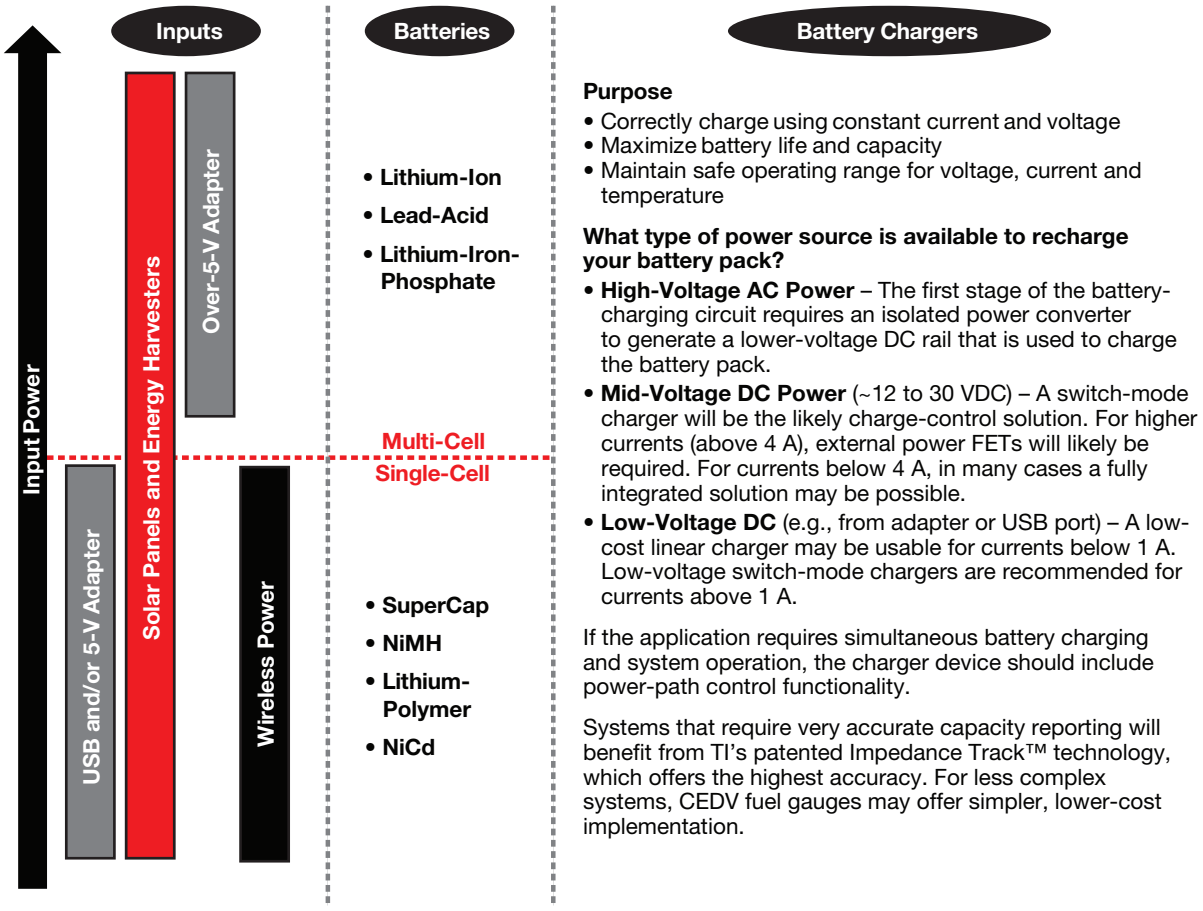
Battery Chemistry — Each battery chemistry has different operating characteristics, such as discharge profiles and self-discharge rate. TI gas-gauge ICs are developed to account for these differences and accurately display remaining energy in the battery. Also, each battery chemistry has unique requirements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

Charge-Control Topology — A simple linear topology works well in applications with low-power (e.g., one- or two-cell Li-Ion) battery packs that are charged at less than 1 A. A switch-mode topology is well-suited for fast charging from USB ports or for large battery packs that require charge rates >1 A. The switch-mode conversion minimizes heat generation during charging. A wireless power topology uses shared magnetic fields to provide the benefit of contactless power transfer. Wireless charging provides an additional battery-charging option for portable devices or as a replacement for other 5-V charging sources.

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

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

Battery Management



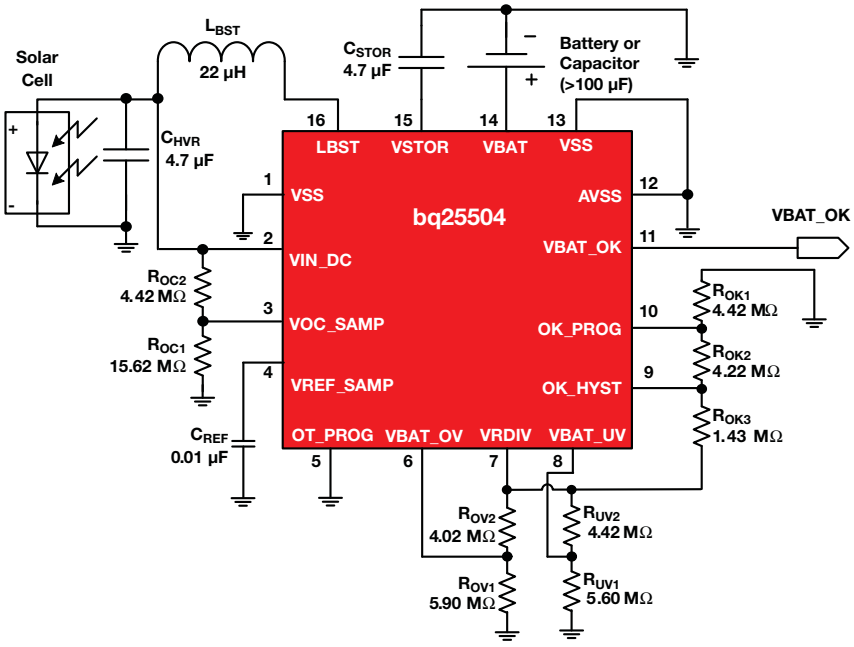
Battery Management Products

Battery Charger Solutions

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

bq25504

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



Get more information: **www.ti.com/product/bq25504**

Key Features

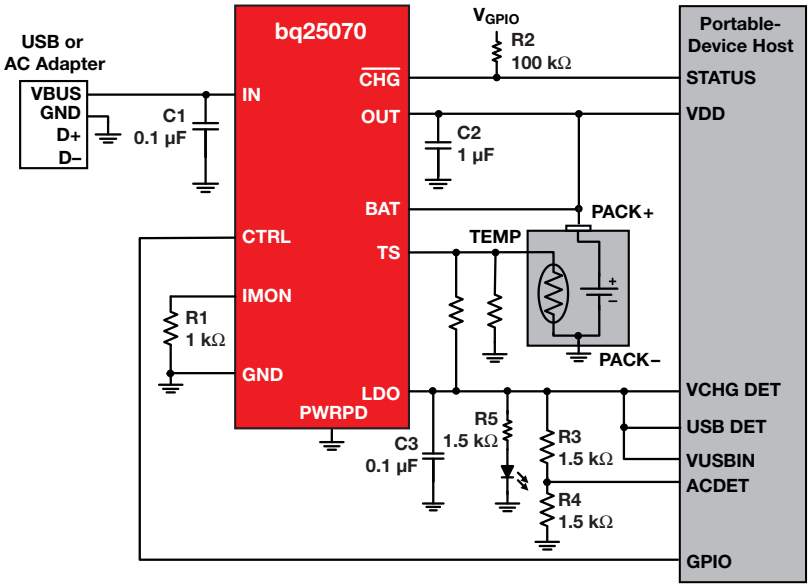
- Low quiescent current (330 nA typ) and high conversion efficiency
- Maximum power point tracking (MPPT) optimizes energy extracted from DC harvesters such as solar panels and thermoelectric generators
- User-programmable settings support a variety of energy sources and energy storage elements
- Low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

Applications

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

1-A, Single-Input, Single-Cell $LiFePO_4$ Linear Battery Charger with 50-mA LDO

bq25070



Key Features

- Single-cell $LiFePO_4$ charging algorithm
- 3.75- to 10.2-V V_{IN} (10.5-V OVP) with 30-V input rating (max)
- Up to 1-A charge current
- Integrated 4.9 V at 50 mA LDO linear regulator
- Single output allows simultaneous battery charging and powering of system
- Programmable charge current through single input interface (CTRL)
- Single USB port or AC-adapter input source
- Thermal regulation and protection
- Soft-start and battery NTC monitoring features

Applications

- Low-power handheld devices
- Mobile phones
- Multimedia players

Get more information: **www.ti.com/product/bq25070**

Battery Management Products

Battery Charger Solutions

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

bq2416x Family

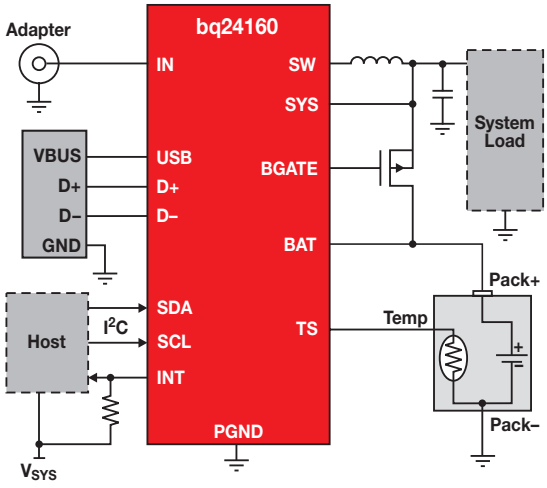
The bq2416x family of highly integrated, single-cell, Li-Ion battery chargers include system power-path management. They are targeted for space-limited, portable applications with high-capacity batteries.

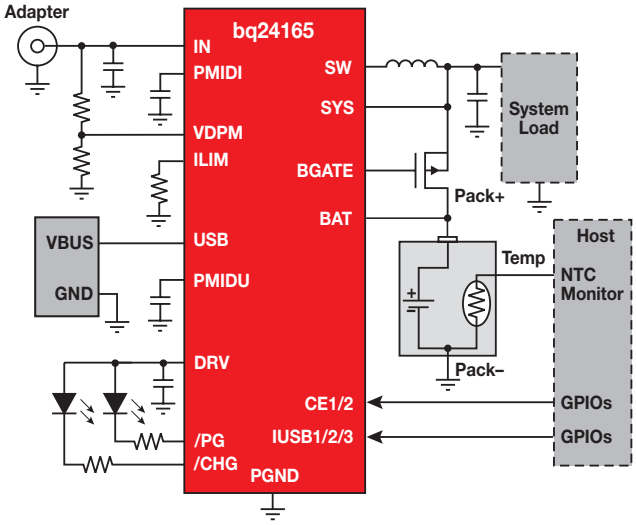
Key Features

- Start-up system from deeply discharged battery or no battery
- Sync 1.5-MHz PWM switch mode
- Supports USB 2.0 and USB 3.0 charger applications
- 20-V max V_{IN} rating
- Integrated FETs with 2.5-A charging from V_{IN} and 1.5 A on USB input
- Integrated power path and driver for optional external discharge FET
- Integrated input current sensing and limiting (±5%)
- Dual inputs are fully isolated
- Control charge parameters, timers, V_{INDPM} threshold
- Thermal regulation protection for output current control
- 2.8x2.8-mm WCSP and 4x4-mm QFN package options

Applications

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





Get more information: **www.ti.com/product/bq24160** or **bq24165**

Single-Cell Charger Controllers Selection Guide

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

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

Battery Management Products

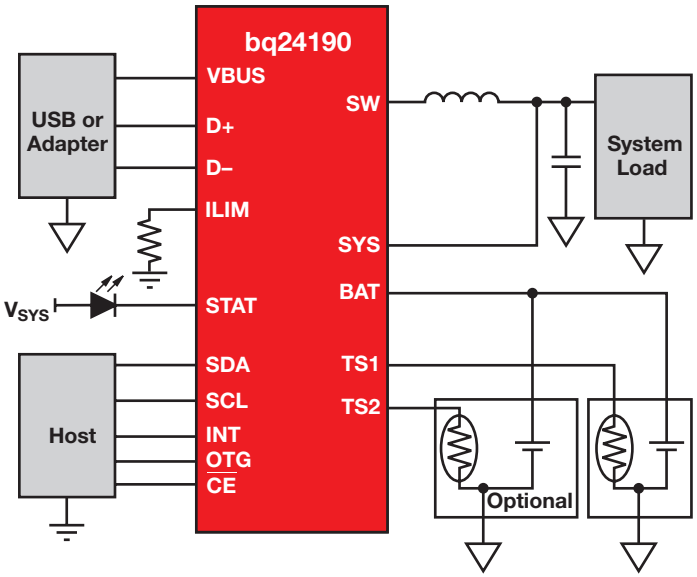
Battery Charger Solutions

2.5/4.5-A, I²C-Controlled Single-Cell USB/Adapter Charger with Narrow VDC Power-Path Management and USB OTG

NEW

bq2419x Family

The bq2419x family of fully integrated single-cell 2.5/4.5-A NVDC-1 chargers feature power-path management. This family of devices achieves fast charging, USB detection, and high USB on-the-go (OTG) efficiency with small total solution size.



Get more information: **www.ti.com/product/bq24190**

Key Features

- NVDC-1 system with power-path management, system instant-on with no battery or deeply discharged battery
- I²C host control or autonomous charging with default parameters
- High integration including battery FET, AC switching FETS, current sensing and compensation
- Input-voltage range: 3.9 to 17 V
- USB-compliant 2.5/4.5-A charger with 1.5-MHz switching mode and D+/D– detection or PSEL
- High charging efficiency: 92% at 2.5 A and 90% at 4 A
- High USB OTG efficiency: 90% at 1 A
- Programmable thermal-regulation options 4 x 4-mm QFN package

Applications

- Tablets and E-readers
- Fast charging for smartphones
- Applications requiring high instant system power

Single-Cell Integrated Charger with I²C

Device	Number of Cells	V_{IN} Type	V_{IN} Max Operating (V)	V_{IN} Abs Max (V)	V_{IN} OVP (V)	Charge Current (A)	Default Charging Current (A)	Charge Voltage (V)	Default Charging Voltage (V)	Topology	Integrated Power FET	Primary Charge Termination	Charge Timer	Temp Monitor	QFN/ MLP	EVM	USB Detection	Price*
Host Control with I²C System Interface or Autonomous Charging and USB OTG																		
bq24190	1	Adapter/ USB	17	20	18	4.5	2	3.5 to 4.4	4.2	Switching	Yes	Host Controlled	Yes	Yes, Std	24	✔	D+/D–	2.90
bq24192	1	Adapter/ USB	17	20	18	4.5	2	3.5 to 4.4	4.2	Switching	Yes	Host Controlled	Yes	Yes, Std	24	✔	PSEL	2.90
bq24192I	1	Adapter/ USB	17	20	18	4.5	1	3.5 to 4.4	4.1	Switching	Yes	Host Controlled	Yes	Yes, Std	24	✔	PSEL	2.90
bq24193	1	Adapter/ USB	17	20	18	4.5	2	3.5 to 4.4	4.2	Switching	Yes	Host Controlled	Yes	Yes, JEITA	24	✔	PSEL	2.90
bq24196	1	Adapter/ USB	17	20	18	2.5	2	3.5 to 4.4	4.2	Switching	Yes	Host Controlled	Yes	Yes, Std	24	✔	PSEL	1.95

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

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

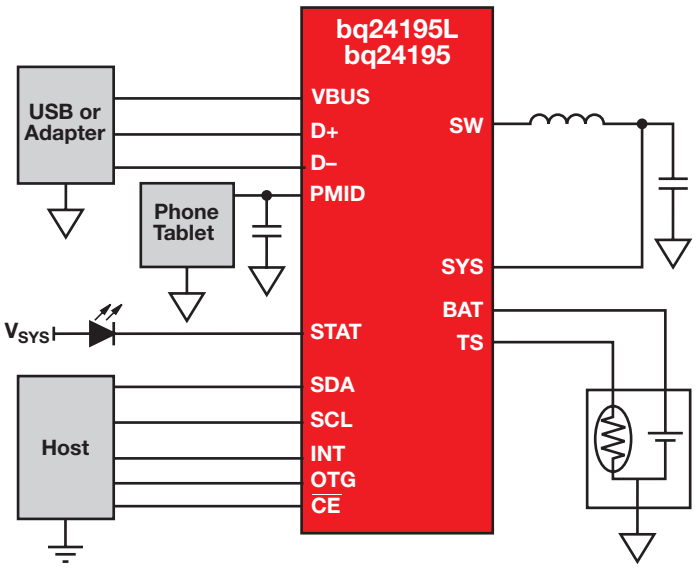
Battery Management Products
Battery Charger Solutions

2.5/4.5-A, I²C-Controlled, Single-Cell USB/Adapter Charger with 1.0/2.1-A Synchronous Boost Operation

NEW

bq24195L, bq24195

The bq24195L is a fully integrated 2.5-A charger with 1-A synchronous boost operation. The bq24195 is a fully integrated 4.5-A charger with 2.1-A synchronous boost operation. They are the one-chip solutions for 1S battery backup with high synchronous boost efficiency.



Get more information: **www.ti.com/product/bq24195L** or **bq24195**

Key Features

- Fully integrated single-chip solution for 1S battery
- USB-compliant 1.5-MHz switching-mode charger with D+/D– detection
- High synchronous boost efficiency: 94% at 1 A and 90% at 2.1 A
- High charging efficiency: 92% at 2.5 A and 90% at 4 A
- I²C host control or autonomous charging with default parameters
- Input-voltage range: 3.9 to 17 V
- 4 x 4-mm QFN package

Applications

- Power bank, power pack, juice pack for smartphone and tablet backup power

Single-Cell Integrated Chargers with I²C

Device	Number of Cells	V_{IN} Type	V_{IN} Max Operating (V)	V_{IN} Abs Max (V)	V_{IN} OVP (V)	Charge Current (A)	Default Charging Current (A)	Charge Voltage (V)	Default Charging Voltage (V)	Topology	Integrated Power FET	Primary Charge Termination	Charge Timer	Temp Monitor	QFN/ MLP	EVM	USB Detection	Price*
Host Control with I²C System Interface or Autonomous Charging and Synchronous Boost Operation																		
bq24195L	1	Adapter/ USB	17	20	18	2.5	2	3.5 to 4.4	4.2	Switching	Yes	Host Controlled	Yes	Yes	24	✔	D+/D–	2.90
bq24195	1	Adapter/ USB	17	20	18	4.5	2	3.5 to 4.4	4.2	Switching	Yes	Host Controlled	Yes	Yes	24	✔	D+/D–	3.25

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

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

Battery Management Products

Battery Charger Solutions

2.0-A Switch-Mode Charger with Power-Path Management and Host I²C or Stand Alone Control Option

bq2425x Family

The bq2425x family of chargers is ideal for space-constrained portable applications. The flexible architecture of these chargers allows support of multiple Li-Ion battery types with a single device.

Key Features

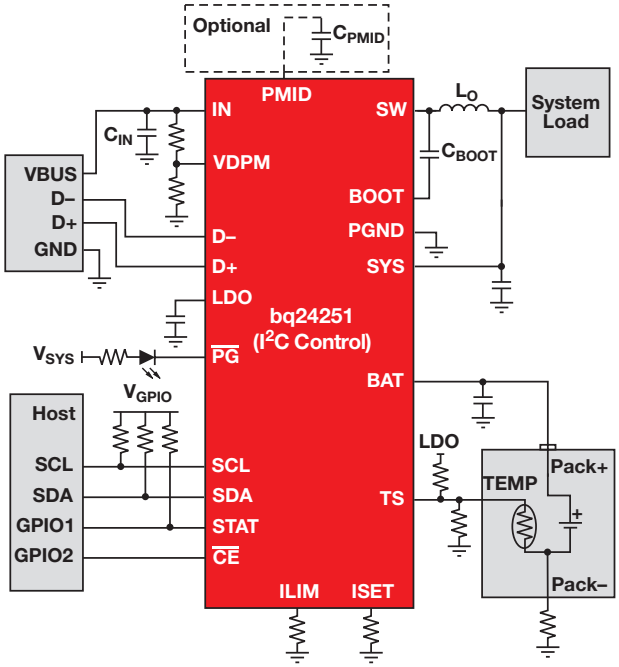
- 20-V-input tolerant; operation up to 10.5 V (bq24250/1/3) or 6.5 V (bq24256/7)
- NVDC architecture
- Input-voltage dynamic power management allows compatibility with multiple external adapter types
- Charge-time optimizer—fastest possible charge rate at any power level
- Compliant with BC1.2 and JEITA standards

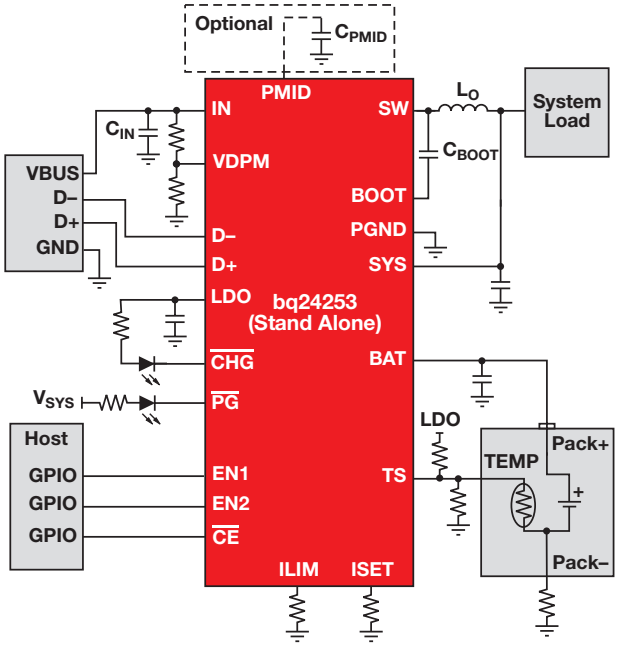
bq24250/1/6/7 Features

- I²C Interface or stand-alone mode in one device
- Automatic USB current setting from D+/D– (bq24251/6/7) or EN1/EN2 from host (bq24250)
- Programmable battery-charge output between 3.5 and 4.44 V using I²C or 4.2 V fixed

bq24253 Features

- Fixed battery-charge regulation at 4.2 V
- USB charge rate select using D+/D– detection
- Resistor-programmable current limits





Get more information: **www.ti.com/product/bq24251** or **bq24253**

Selection Guide

(Device parameters continued below)

Device	Number of Cells	V_{IN} Type	V_{IN} Max Operating (V)	V_{IN} Absolute Max (V)	V_{IN} OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET
bq24250/51	1	Adapter/USB	18	20	10.5	2.0	3.5 to 4.4	I²C and Stand Alone	Switching	Yes
bq24253	1	Adapter/USB	18	20	10.5	2.0	4.2	Stand Alone	Switching	Yes
bq24257	1	Adapter/USB	18	20	6.5	2.0	3.5 to 4.4	I²C and Stand Alone	Switching	Yes

(Device parameters continued from above)

Device	Primary Charge Termination	Charge Timer	Temperature Monitor	Packaging		EVM	Comments	Price*
				WCSP	QFN/MLP			
bq24250/51	10% ICHG	Yes	Yes	30	24	✔	EN1-2 or D+/D– detection, JEITA, Power Path	1.15
bq24253	10% ICHG	Yes	Yes	30	24	✔	D+/D– detection, JEITA, Power Path	1.15
bq24257	10% ICHG	Yes	Yes	30	24	✔	D+/D– detection, JEITA	1.15

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

Battery Management Products

Battery Charger Solutions

3.0-A-Output, 30-V-Input Switch-Mode Charger with Power-Path Management and USB OTG Support; Host I²C Control or Stand Alone

PREVIEW

bq2426x Family

The bq2426x family of chargers offers higher current levels and wide-input-voltage tolerance. These chargers are ideal for compact, higher-power applications using single-cell Li-Ion batteries.

Key Features

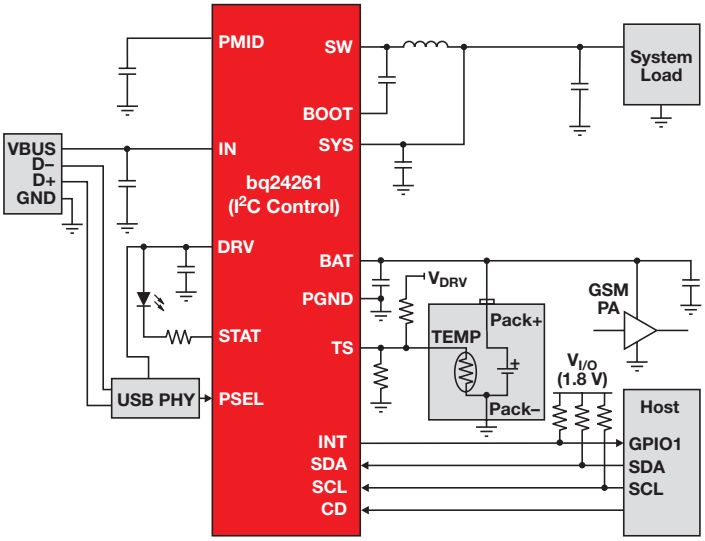
- 30-V-input tolerant; operation up to 6.5 V (bq24262), 10.5 V (bq24260) or 14 V (bq24261/5) allows compatibility with 5-V or 12-V adapter types
- NVDC architecture
- USB OTG support (5-V output at 1 A)
- Charge-time optimizer—fastest possible charge rate at any power level
- Compliant with BC1.2 and JEITA standards

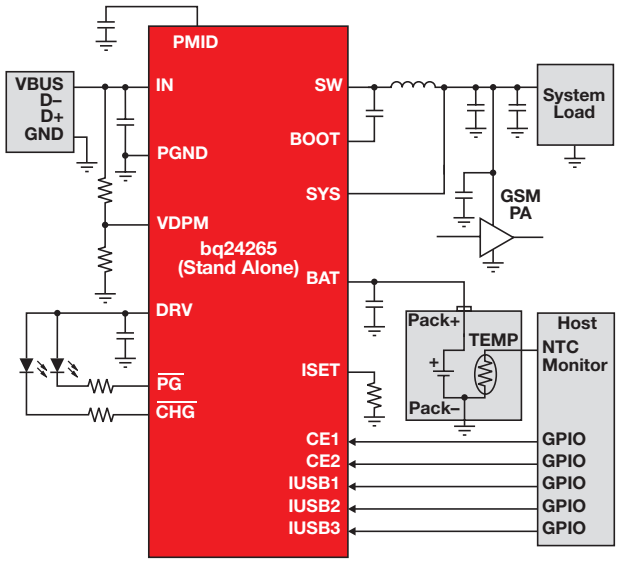
bq24260/1/2 Features

- I2C Control
- Automatic USB current setting from D+/D– (bq24260) or PSEL from USB PHY (bq24261/2)
- Programmable battery-charge output between 3.5 and 4.44 V
- Programmable charge-termination current

bq24265 Features

- Stand-alone operation
- Fixed battery-charge regulation at 4.2 V
- Resistor-programmable and GPIO-controlled current limits
- Fixed charge termination at 10% of fast charge current





Selection Guide

(Device parameters continued below)

Device	Number of Cells	V_{IN} Type	V_{IN} Max Operating (V)	V_{IN} Absolute Max (V)	V_{IN} OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET
bq24260	1	Adapter/USB	28	30	10.5	3.0	3.5 to 4.4	I²C	Switching	Yes
bq24261	1	Adapter/USB	28	30	14	3.0	3.5 to 4.4	I²C	Switching	Yes
bq24265	1	Adapter/USB	28	30	14	3.0	4.2	Stand Alone	Switching	Yes

(Device parameters continued from above)

Device	Primary Charge Termination	Charge Timer	Temperature Monitor	Packaging		EVM	Comments	Price*
				WCSP	QFN/MLP			
bq24260	Host Controlled	Yes	Yes	36	24	✔	D+/D– detect, JEITA, Power Path, OTG	1.75
bq24261	Host Controlled	Yes	Yes	36	24	✔	PSEL detect, JEITA, Power Path, OTG	1.75
bq24265	10% ICHG	Yes	Yes	36	24	✔	IUSB pins, JEITA, OTG	1.75

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

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

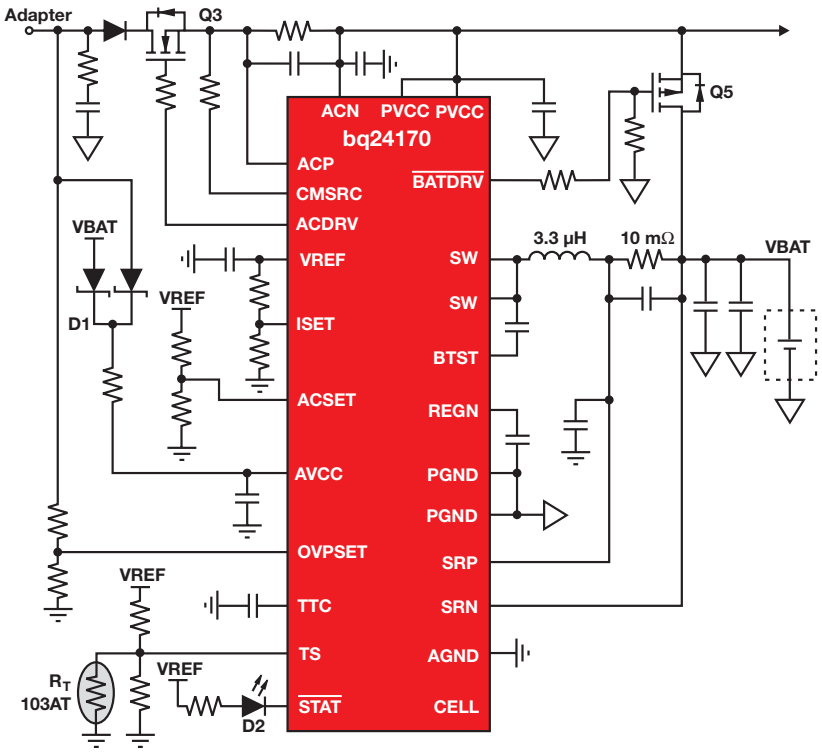
Battery Management Products

Battery Charger Solutions

Switch-Mode Li-Ion and Li-Polymer Stand-Alone Battery Charger with Integrated FETs

bq24170

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



Get more information: **www.ti.com/product/bq24170**

Key Features

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

Applications

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

Chargers with Internal FETs Selection Guide

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

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

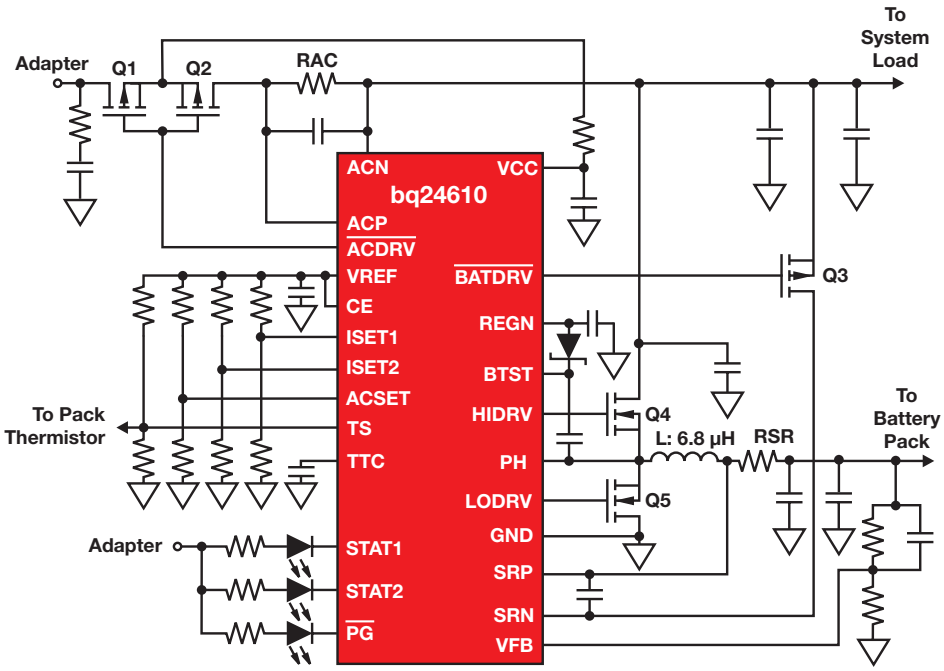
Battery Management Products

Battery Charger Solutions

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

bq24610

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



Key Features

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

Applications

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

Get more information: **www.ti.com/product/bq24610**

Multi-Cell Charger Controllers Selection Guide

Device	Number of Cells	Control Topology	Integrated Power FET	V_{IN} Max (V)	Primary Charge Termination Method	Safety Timer	Temp Monitor	Packaging: QFN/MLP	EVM	Comments	Price*
Multi-Cell Switch-Mode Stand-Alone Battery Chargers with External FETs (Controllers) — Lithium-Ion (except where noted)											
bq24600	1 to 6	Switching	No	32	Min current	Yes	Yes	16	✔	1200 kHz	2.50
bq24610	1 to 6	Switching	No	32	Min current	Yes	Yes	24	✔	600 kHz	2.90
bq24616	1 to 6	Switching	No	32	Min current	Yes	Yes	24	✔	JEITA, 600 kHz	2.90
bq24617	1 to 5	Switching	No	26	Min current	Yes	Yes	24	✔	600 kHz	2.90
bq24618	1 to 6	Switching	No	32	Min current	Yes	Yes	24		Supports 4.7 V_{IN}	2.90
bq24620	1 to 7	Switching	No	32	Min current	Yes	No	16	✔	$LiFePO_4$	2.90
bq24630	1 to 7	Switching	No	32	Min current	Yes	No	24	✔	$LiFePO_4$, system power selector	2.90
bq24640	1 to 9	Switching	No	33	SuperCap-specific	No	Yes	16	✔	Supports SuperCap	3.65
bq24650	1 to 6	Switching	No	33	Min current	Yes	Yes	16	✔	Solar charger for Li-Ion/polymer, $LiFePO_4$, lead-acid chemistries	2.85

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

Battery Management Products

Battery Charger Solutions

Selection Guide

(Device parameters continued on next page)

Device	Number of Cells	V_{IN} Type	V_{IN} Max Operating (V)	V_{IN} Absolute Max (V)	V_{IN} OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET	
Multi-Chemistry (Li-Ion and NiCd/NiMH)											
bq24030/31/35	1	Adapter/USB	16	18	6.4	2	4.2/4.1/4.2	Stand Alone	Linear	Yes	
bq24032A/38	1	Adapter/USB	16	18	6.4	2	4.2/(4.24/4.36)	Stand Alone	Linear	Yes	
bq24040/41	1	Adapter/USB	6.45	30	6.6/7.1	0.800	4.2	Stand Alone	Linear	Yes	
bq24050/52	1	Adapter/USB	6.45	30	6.6	0.800	4.2	Stand Alone	Linear	Yes	
bq24055	1	Adapter/USB	6.45	30	6.6	0.800	4.2	Stand Alone	Linear	Yes	
bq24072/72T	1	Adapter/USB	6.4	30	6.6	1.5	4.3 / 4.2	Stand Alone	Linear	Yes	
bq24073	1	Adapter/USB	6.4	28	6.6	1.5	4.2	Stand Alone	Linear	Yes	
bq24074	1	Adapter/USB	10.2	28	10.5	1.5	4.2	Stand Alone	Linear	Yes	
bq24075T/79T	1	Adapter/USB	6.4	28	6.6	1.5	4.2/4.1	Stand Alone	Linear	Yes	
bq24090/91	1	Adapter/USB	6.45	7	6.6	0.800	4.2	Stand Alone	Linear	Yes	
bq24092/93	1	Adapter/USB	6.45	7	6.6	0.800	4.2	Stand Alone	Linear	Yes	
bq25040	1	Adapter/USB	6.7	30	6.9	1.1	4.2	Stand Alone	Linear	Yes	
bq25050	1	Adapter/USB	6	20	6.5	1.25	3.5 to 4.4	I^2C	Switching	Yes	
bq25060	1	Adapter/USB	10.2	30	10.5	1	4.2	Stand Alone	Linear	Yes	
bq24140	1	Adapter and USB	9	20	9.8	1.5	Adj	I^2C	Switching	Yes	
bq24153A/58	1	Adapter/USB	6	20	6.5	1.25	3.5 to 4.4	I^2C	Switching	Yes	
bq24156A/59	1	Adapter/USB	9	20	9.8	1.5	3.5 to 4.4	I^2C	Switching	Yes	
bq24160	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	3.5 to 4.4	I^2C	Switching	Yes	
bq24161	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	3.5 to 4.4	I^2C	Switching	Yes	
bq24163	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	3.5 to 4.4	I^2C	Switching	Yes	
bq24165	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	4.2	Stand Alone	Switching	Yes	
bq24166	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	4.2	Stand Alone	Switching	Yes	
bq24167	1	Adapter and USB	18	20	10.5/6.5(USB)	2.5/1.5	4.2	Stand Alone	Switching	Yes	
bq24168	1	Adapter and USB	18	20	6.5/6.5(USB)	2.5/1.5	3.5 to 4.4	Stand Alone	Switching	Yes	
bq24270/71	1	Adapter/USB	18	20	6.5	1.5	3.5 to 4.4	I^2C	Switching	Yes	
bq24272	1	Adapter	18	20	10.5	2.5	3.5 to 4.4	I^2C	Switching	Yes	
bq24273	1	Adapter	18	20	10.5	2.5	3.5 to 4.4	I^2C	Switching	Yes	
bq24278	1	Adapter	18	20	10.5	2.5	4.2	Stand Alone	Switching	Yes	
bq24250/51	1	Adapter/USB	18	20	10.5	2.0	3.5 to 4.4	I^2C and Stand Alone	Switching	Yes	
bq24253	1	Adapter/USB	18	20	10.5	2.0	4.2	Stand Alone	Switching	Yes	
bq24257	1	Adapter/USB	18	20	6.5	2.0	3.5 to 4.4	I^2C and Stand Alone	Switching	Yes	
bq24259	1	Adapter/USB	18	20	6.5	2.0	4.34	Stand Alone	Switching	Yes	
bq24260	1	Adapter/USB	28	30	10.5	3.0	3.5 to 4.4	I^2C	Switching	Yes	
bq24261	1	Adapter/USB	28	30	14	3.0	3.5 to 4.4	I^2C	Switching	Yes	
bq24265	1	Adapter/USB	28	30	14	3.0	4.2	Stand Alone	Switching	Yes	
bq24180	1	Adapter/USB	16	20	16.5	1.5	3.5 to 4.4	I^2C	Switching	Yes	
bq24185	1	Adapter/USB	16	20	16.5	1.5	3.5 to 4.4	I^2C	Switching	Yes	
bq24190	1	Adapter/USB	17	20	18	4.5	3.5 to 4.4	I^2C/Stand Alone	Switching	Yes	
bq24192	1	Adapter/USB	17	20	18	4.5	3.5 to 4.4	I^2C/Stand Alone	Switching	Yes	
bq24192I	1	Adapter/USB	17	20	18	4.5	3.5 to 4.4	I^2C/Stand Alone	Switching	Yes	
bq24193	1	Adapter/USB	17	20	18	4.5	3.5 to 4.4	I^2C/Stand Alone	Switching	Yes	
bq24196	1	Adapter/USB	17	20	18	2.5	3.5 to 4.4	I^2C/Stand Alone	Switching	Yes	
bq24195L	1	Adapter/USB	17	20	18	2.5	3.5 to 4.4	I^2C/Stand Alone	Switching	Yes	
bq24195	1	Adapter/USB	17	20	18	4.5	3.5 to 4.4	I^2C/Stand Alone	Switching	Yes	
bq24130	1 to 3	Adapter/USB	18	20	Adj	4	Adj	I^2C	Switching	Yes	
bq24133	1 to 3	Adapter/USB	17	20	Adj	2.5	4.2/Cell	Stand Alone	Switching	Yes	
bq24170	1 to 3	Adapter/USB	17	20	Adj	4	4.2/Cell	Stand Alone	Switching	Yes	
bq24171	1 to 3	Adapter/USB	17	20	Adj	4	Adj	Stand Alone	Switching	Yes	
bq24172	1 to 3	Adapter/USB	17	20	Adj	4	Adj	Stand Alone	Switching	Yes	
bq24600	1 to 6	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24610	1 to 6	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24616	1 to 6	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24617	1 to 5	Adapter	24	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24618	1 to 6	Adapter/USB	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24707A	1 to 4	Adapter	24	30	Adj	8	Adj	SMBus	Switching	No	
bq24725A	2 to 4	Adapter	24	30	Adj	8	Adj	SMBus	Switching	No	
bq24735	1 to 4	Adapter	24	30	Adj	8	Adj	SMBus	Switching	No	

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

Battery Management Products

Battery Charger Solutions

(Device parameters continued from previous page)

Device	Primary Charge Termination	Charge Timer	Temperature Monitor	Packaging						EVM	Comments	Price*
				WCSP	QFN/MLP	MSOP	TSSOP	SOIC	DIP			
Multi-Chemistry (Li-Ion and NiCd/NiMH)												
bq24030/31/35	Min Current	Yes	Yes		20					✔	Regulated 4.4-V output for AC input condition"	1.80
bq24032A/38	Min Current	Yes	Yes		20					✔	Regulated 4.4-V output for AC input condition	1.80
bq24040/41	Adj/(C/10)	Yes	Yes		10					✔		0.45
bq24050/52	Min Current	Yes	Yes		10					✔	JEITA Charging (100K NTC — bq24052)	0.50
bq24055	Min Current	Yes	Yes		12					✔	JEITA, PG Pin	0.60
bq24072/72T	Min Current	Yes	Yes		16					✔	V_{OUT} tracks V_{BAT}, V_{IN_DPPM}	1.00
bq24073	Min Current	Yes	Yes		16					✔	V_{IN_DPPM}	1.00
bq24074	Adj	Yes	Yes		16					✔	V_{IN_DPPM}	1.00
bq24075T/79T	Min Current	Yes	Yes		16					✔	SYSOFF pin disconnects battery, V_{IN_DPPM}, powers system and charges battery	1.00
bq24090/91	Min Current	Yes	Yes		10					✔	10K NTC (100K NTC — bq24091)	0.40
bq24092/93	Min Current	Yes	Yes		10					✔	JEITA, 10K NTC (JEITA, 100K NTC — bq24093)	0.40
bq25040	Min Current	No	Yes		10					✔	USB compliant w/50-mA integrated LDO	0.55
bq25050	Adj	Yes	No		20						USB OTG supported with boost	0.60
bq25060	Min Current	No	Yes		10					✔	USB compliant w/50-mA integrated LDO	0.65
bq24140	Min Current	Yes	No	30						✔	Simultaneous charge and USB OTG output	1.60
bq24153A/58	Host Controlled	Yes	No	20						✔	USB OTG supported with boost, no battery detect on power up (bq24158)	0.95
bq24156A/59	Host Controlled	Yes	No	20						✔	No battery detect on power up (bq24159)	0.95
bq24160	Host Controlled	Yes	Yes	49	24					✔	D+/D– detect, JEITA, 3-V V_{BAT_SHORT}	1.95
bq24161	Host Controlled	Yes	Yes	49						✔	USB selection pin, std temp	1.95
bq24163	Host Controlled	No	No	49	24					✔	D+/D– detect, JEITA	1.95
bq24165	10% I_{CHG}	Yes	No	49						✔	I_{USB}1/2/3 USB select, no temp monitor, JEITA	1.95
bq24166	10% I_{CHG}	Yes	Yes	49						✔	I_{USB}1/2/3 USB select, temp monitor, std temp	1.95
bq24167	10% I_{CHG}	Yes	Yes	49	24					✔	I_{USB}1/2/3 USB select, temp monitor, JEITA	1.95
bq24168	10% I_{CHG}	Yes	Yes	49	24					✔	USB select pins, JEITA, no timers	1.95
bq24270/71	Host Controlled	Yes	Yes	49	24					✔	D+/D- detect or PSEL, JEITA, Power Path	1.25
bq24272	Host Controlled	Yes	Yes	49	24					✔	Power Path	1.25
bq24273	Host Controlled	Yes	Yes	49						✔	non-Power Path	1.25
bq24278	10% ICHG	Yes	Yes	49	24					✔	Input current limit programming input	1.25
bq24250/51	10% ICHG	Yes	Yes	30	24					✔	EN1-2 or D+/D– detection, JEITA, Power Path	1.15
bq24253	10% ICHG	Yes	Yes	30	24					✔	D+/D– detection, JEITA, Power Path	1.15
bq24257	10% ICHG	Yes	Yes	30	24					✔	D+/D– detection, JEITA	1.15
bq24259	10% ICHG	Yes	Yes	30	24					✔	EN1-2 detection, JEITA	1.15
bq24260	Host Controlled	Yes	Yes	36	24					✔	D+/D– detect, JEITA, Power Path, OTG	1.75
bq24261	Host Controlled	Yes	Yes	36	24					✔	PSEL detect, JEITA, Power Path, OTG	1.75
bq24265	10% ICHG	Yes	Yes	36	24					✔	IUSB pins, JEITA, OTG	1.75
bq24180	Host Controlled	Yes	Yes	25						✔	Accessory power output	1.00
bq24185	Host Controlled	Yes	Yes	25						✔	USB OTG supported with boost	1.00
bq24190	Host Controlled	Yes	Yes		24					✔	D+/D–, 1.3-A OTG, standard temp., 12-m battery FET	2.90
bq24192	Host Controlled	Yes	Yes		24					✔	PSEL, 1.3-A OTG, standard temp., 12-m battery FET	2.90
bq24192I	Host Controlled	Yes	Yes		24					✔	PSEL, 1.3-A OTG, standard temp., 1-A default charging	2.90
bq24193	Host Controlled	Yes	Yes		24					✔	PSEL, 1.3-A OTG, JEITA, 12-m battery FET	2.90
bq24196	Host Controlled	Yes	Yes		24					✔	PSEL, 1.3-A OTG, standard temp., 12-m battery FET	1.95
bq24195L	Host Controlled	Yes	Yes		24					✔	D+/D–, 1.0-A synchronous boost for power bank	2.90
bq24195	Host Controlled	Yes	Yes		24					✔	D+/D–, 2.1-A synchronous boost for power bank	3.25
bq24130	Adj	No	Yes		20					✔	Host control, supports Li-Ion and Super Cap	1.95
bq24133	Min Current	Yes	Yes		24					✔	Power Path	1.75
bq24170	Min Current	Yes	Yes		24					✔	Power Path	1.80
bq24171	Min Current	Yes	Yes		24					✔	JEITA, Power Path	1.80
bq24172	Min Current	Yes	Yes		24					✔	Adjustable charge voltage, Power Path	1.80
bq24600	Min Current	Yes	Yes		16					✔	1200 kHz	2.50
bq24610	Min Current	Yes	Yes		24					✔	600 kHz	2.90
bq24616	Min Current	Yes	Yes		24					✔	JEITA	2.90
bq24617	Min Current	Yes	Yes		24					✔	600 kHz	2.90
bq24618	Adj	Yes	Yes		24					✔	USB V_{IN} and adapter	2.90
bq24707A	SMBus	Yes	No		20					✔	Programmable switching frequency	2.90
bq24725A	SMBus	Yes	No		20					✔	Programmable switching frequency, enhanced safety, battery learn	2.90
bq24735	SMBus	Yes	No		20					✔	Intel™ CPU Turbo Mode support	3.00

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

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

Battery Management Products
Battery Charger Solutions

Selection Guide

(Device parameters continued on next page)

Device	Number of Cells	V_{IN} Type	V_{IN} Max Operating (V)	V_{IN} Absolute Max (V)	V_{IN} OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET	
Solar/Energy Harvesting (Li-Ion)											
bq24210	1	Adapter/USB	18	20	7.7	0.800	4.2	Stand Alone	Linear	Yes	
bq24650	1 to 6	Solar Panel	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq25504	1	Solar/TEG/Low DC (0.13 V min)	3	5.5	Adj	0.1	2.5 to 5.25	Stand Alone	Boost	Yes	
bq25505	1	Solar/TEG/Low DC (0.13 V min)	3	5.5	Adj	0.1	2.5 to 5.25	Stand Alone	Boost	Yes	
bq25570	1	Solar/TEG/Low DC (0.13 V min)	3	5.5	Adj	0.1	2.5 to 5.25	Stand Alone	Boost-Buck	Yes	
$LiFePO_4$											
bq25070	1	Adapter/USB	28	30	10.5	1	3.5	Stand Alone	Linear	Yes	
bq24620	1 to 7	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
bq24630	1 to 7	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
Super Cap											
bq24640	1 to 9	Adapter	28	33	32	10 (Ext)	Adj	Stand Alone	Switching	No	
NiCd/NiMH Chemistry											
bq2002/C/E/F	Multiple	Adapter	6	7	—	>2	6	Stand Alone	Current-limited	No	
bq2004/E/H	Multiple	Adapter	5.5	7	—	>2	5.5	Stand Alone	Switching	No	
bq2005	Multiple	Adapter	5.5	7	—	>2	5.5	Stand Alone	Switching	No	
bq24400/1	Multiple	Adapter	5.5	7	—	>2	5.5	Stand Alone	Switching	No	
Lead-Acid Chemistry											
bq24450	Multiple	Adapter	40	40	—	>2	—	Stand Alone	Linear	No	
UC3909	Multiple	Adapter	40	40	—	>2	—	Stand Alone	Switching	No	
bq2031	Multiple	Adapter	5.5	7	—	>2	—	Stand Alone	Switching	No	
Multi-Chemistry (Li-Ion and NiCd/NiMH)											
bq2000/T	Multiple	—	—	7	—	—	—	Stand Alone	Switching	Yes	
bq24765	2 to 4	—	—	30	—	—	—	Stand Alone	Switching	Yes	
bq24650	1 to 6	Solar Panel	28	33	32	10A (Ext)	Adj	Stand Alone	Switching	No	
Wireless Power Receivers											
bq51011	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	See Comments	5	Stand Alone	Linear	Yes	
bq51013	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes	
bq51013A	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes	
bq51013B	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes	
bq51050B/51B	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Wireless Battery Charger	Yes	

Device	Transmitter Type	V_{IN} (V)	Magnet	Key Features	Price*
Wireless Power Transmitters					
bq500410A	A6	12	No	1 to 3 coils, large charging area, WPC 1.1 ready	2.85
bq500211A	A5	5	Yes	Power from low-cost 5-V adapter or USB port	2.85
	A11	5	No		
bq500210	A1	19	Yes	Second-generation solution with digital demodulation to reduce component count	4.50
	A10	19	No		

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

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

Battery Management Products

Battery Charger Solutions

(Device parameters continued from previous page)

Device	Primary Charge Termination[1]	Charge Timer	Temperature Monitor	Packaging						EVM	Comments	Price*
				WCSP	QFN/MLP	MSOP	TSSOP	SOIC	DIP			
Solar/Energy Harvesting (Li-Ion)												
bq24210	Min Current	Yes	Yes		10					✔	Solar panel V_{IN}	1.10
bq24650	C/10	Yes	Yes		16					✔	Max power point tracking	2.85
bq25504	Voltage	—	Yes		16					✔	Energy harvester, ultra-low power and quiescent current, high efficiency, dynamic MPPT	2.10
bq25505	Voltage	—	Yes		16					✔	Energy harvester, 330-nA ultra-low power and quiescent current, high efficiency, dynamic MPPT, autonomous power-path multiplexing	2.40
bq25570	Voltage	—	Yes		16					✔	Energy harvester, <900-nA ultra-low power and quiescent current, high efficiency, dynamic MPPT	2.90
$LiFePO_4$												
bq25070	Min Current	No	Yes		10					✔	$LiFePO_4$, 50-mA LDO	0.75
bq24620	C/10	Yes	Yes		16					✔	$LiFePO_4$, 300 kHz	2.90
bq24630	Adj	Yes	Yes		24					✔	$LiFePO_4$, 300 kHz, power selector	2.90
Super Cap												
bq24640	Min Current	No	Yes		16					✔	SuperCap	2.90
NiCd/NiMH Chemistry												
bq2002/C/E/F	ΔV, PVD, ΔT/Δt	Yes	Yes					8	8		Trickle charge	0.85
bq2004/E/H	ΔV, PVD, ΔT/Δt	Yes	Yes					16	16		Selectable timers and pulse-trickle rates	2.15
bq2005	ΔV, ΔT/Δt	Yes	Yes					20	20		Sequential fast charge of two battery packs	2.15
bq24400/1	PVD /ΔT/Δt	Yes	Yes				8	8				1.55
Lead-Acid Chemistry												
bq24450	Max V, min I	No	No					16	16		Temp-compensated internal reference	2.75
UC3909	Max V, min I	No	Yes					20	20		Differential current sense input	3.05
bq2031	Max V, –Δ2 V, min I	Yes	Yes					16	16	✔	Three user-selectable charge algorithms to accommodate cyclic and standby applications	2.80
Multi-Chemistry (Li-Ion and NiCd/NiMH)												
bq2000/T	PVD, ΔT/Δt, min current	Yes	Yes				8	8	8	✔	Charges NiCd, NiMH, and Li-Ion	1.50
bq24765	SMBus	Yes	No		34					✔	SMBus charger with integrated power FETs	3.95
bq24650	C/10	Yes	Yes		16					✔	Max power point tracking	2.85
Wireless Power Receivers												
bq51011	EPT Cmd to Tx	No	Yes	28							Receiver, current limited charge current (400 mA + dynamic I_{LIM})	3.50
bq51013	EPT Cmd to Tx	No	Yes	28						✔	Receiver, regulated voltage output, compliant to WPC specification 1.0	3.50
bq51013A	EPT Cmd to Tx	No	Yes	28	20					✔	WPC 1.0 receiver, regulated voltage output, dynamic efficiency control, dynamic communications limit	3.50
bq51013B	EPT Cmd to Tx	No	Yes	28	20					✔	WPC 1.1 receiver, regulated voltage output, dynamic efficiency control, dynamic communications limit	2.50
bq51050B/51B	EPT Cmd to Tx	No	Yes	28	20					✔	WPC 1.1 receiver, regulated voltage output, dynamic efficiency control, dynamic communications limit, built-in Li-Ion charging	2.75

[1]PVD = peak voltage detection; ΔT/Δt = rate of temperature rise; host controlled = system processor must terminate charging; –ΔV = negative voltage change; max V = maximum voltage; min I = minimum current; –Δ2V = second difference of cell voltage.

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

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

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

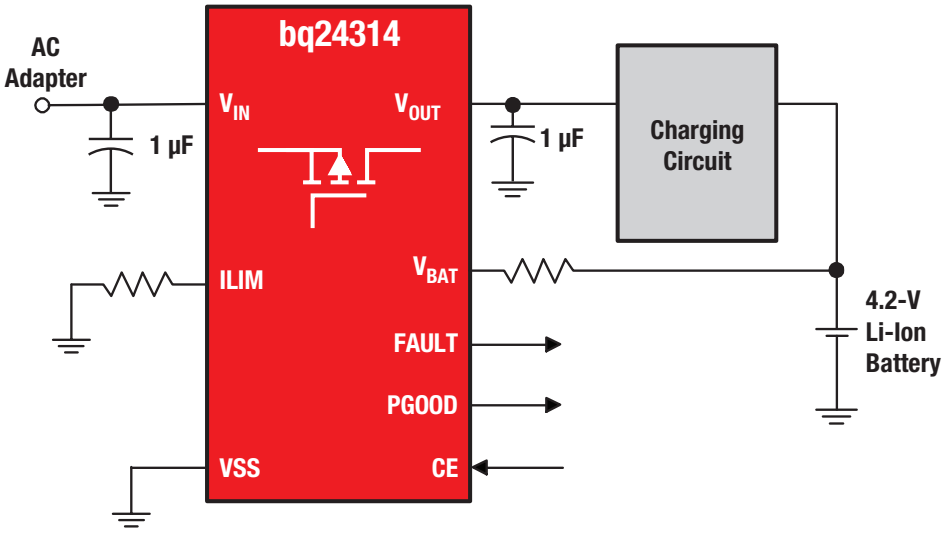
Battery Management Products

Battery Charger Protection

Li+ Charger Front-End Protection IC

bq24314

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



Key Features

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

Applications

- Mobile phones and smartphones
- Portable navigation devices
- MP3 players
- Low-power handheld devices
- *Bluetooth*® headsets

Get more information: **www.ti.com/product/bq24314**

Selection Guide

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

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

Battery Management Products

Battery Fuel Gauges—Single-Cell Solutions

Design Factors

Battery Chemistry — Each battery chemistry has different operating characteristics, such as discharge profiles and the self-discharge rate. The battery chemistry is programmed in the dataflash of the TI fuel gauge to account for these differences. In addition, the conditions of the end-equipment system can be programmed in the gas gauge. Designers can choose to implement the gauge in the host system or inside the battery pack. The programmed information is processed in TI's Impedance Track™ gauging technology for prediction of remaining battery capacity with >99% accuracy.

Features

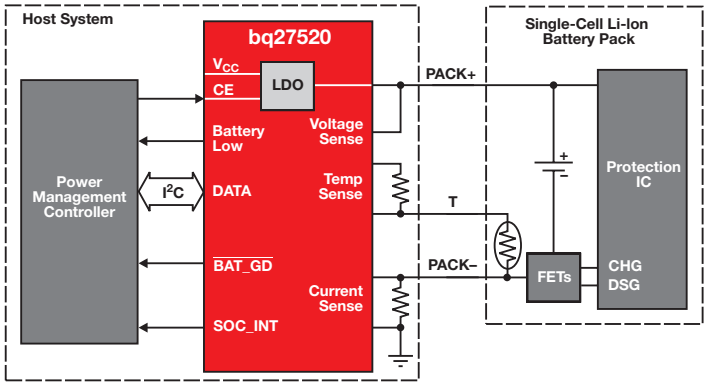
TI gas gauges and battery monitors accurately track battery activity to compute the remaining battery capacity and system run-time. The following features are available:

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

System-Side Impedance Track™ Fuel Gauge with Integrated LDO

bq27520

The bq27520 is a high-performance, system-side fuel gauge with excellent accuracy, low power consumption and extremely small package size. By integrating the fuel-gauge function into the system board, portable-equipment designers can use an embedded or removable standard battery pack while adding the capability to accurately display remaining pack capacity and estimated run time. The bq27520 features an integrated voltage regulator that reduces the total component count for the system.



The bq27520 also has an interrupt-generation capability that reduces the software burden on the system processor because the fuel gauge does not require repetitive polling from the host.

The bq27520 uses the patented Impedance Track algorithm for fuel gauging and provides information such as remaining battery capacity, state of charge, minimum run time to empty, battery voltage, temperature and state of health. Battery fuel gauging with the bq27520 requires only PACK+ (P+), PACK– (P–) and thermistor (T) connections to a removable battery pack or embedded battery circuit.

Get more information: **www.ti.com/product/bq27520**

Selection Guide

Device	Approx. Battery Capacity (mAh)	Min Max Series Cell	SHA-1 Authentication	System or Pack	Communication Protocol	Other Features	Package	Price*
Lithium-Ion, Lithium-Polymer Chemistry								
bq27010	300 to 6000	1	No	Pack	HDQ	Fuel gauge with compensated-voltage EOD	10-pin DRK	1.25
bq27210	300 to 6000	1	No	Pack	I²C	Fuel gauge with compensated-voltage EOD	10-pin DRK	1.25
bq27500	300 to 6000	1	No	System	I²C	System-side fuel gauge with Impedance Track™ technology	12-pin QFN	1.35
bq27510	300 to 6000	1	No	System	I²C	System-side fuel gauge with Impedance Track technology with integrated LDO	12-pin QFN	1.45
bq27541	300 to 6000	1	Yes	Pack	I²C/HDQ	Pack-side fuel gauge with Impedance Track technology	12-pin QFN	1.45
bq27545	300 to 6000	1	Yes	Pack	I²C/HDQ	Pack-side fuel gauge with Impedance Track technology	12-pin QFN	1.45
bq27501	300 to 6000	1	No	System	I²C	System-side fuel gauge with Impedance Track technology with battery ID resistor	12-pin QFN	1.35
bq27505	300 to 6000	1	No	System	I²C	System-side fuel gauge with Impedance Track technology	12-ball CSP	1.40
bq27520	300 to 6000	1	No	System	I²C	System-side fuel gauge with Impedance Track technology with integrated LDO	15-ball CSP	1.50
bq27410	300 to 6000	1	No	System	I²C	System-side fuel gauge with Impedance Track Lite technology with integrated LDO	12-pin QFN	1.40
bq27425	300 to 6000	1	No	System	I²C	System-side fuel gauge with Impedance Track Lite technology with integrated sense resistor	15-ball CSP	1.40
bq28z560	300 to 8000	1	Yes	Pack	SMBus/HDQ	Pack-side fuel gauge with Impedance Track technology	12-pin QFN	3.15
bq28550	300 to 6000	1	Yes	Pack	SMBus	Pack-side fuel gauge with CEDV technology with integrated LDO	12-pin QFN	2.90

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

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

Battery Management Products

Battery Fuel Gauges—Multi-Cell Solutions

Design Factors

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

Features

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

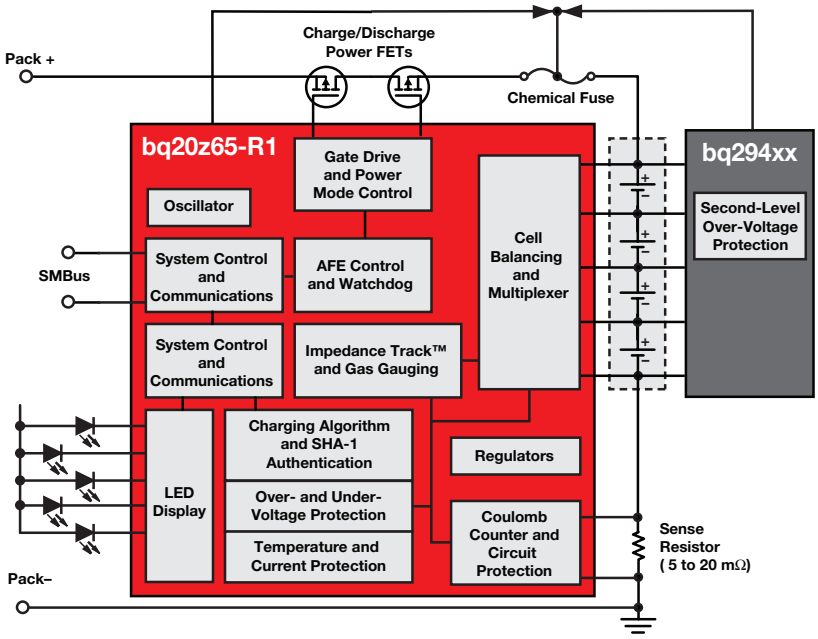
- Simple communication protocols.
- High-resolution analog-to-digital converters for accurate charge/discharge measurement.
- Integrated CPU on gas gauges to compute remaining battery capacity and run-time.
- Advanced charge management satisfies JEITA specification of variable charging current and volltage with battery conditions.

99% Accurate Gas Gauge Maximizes Run-Time

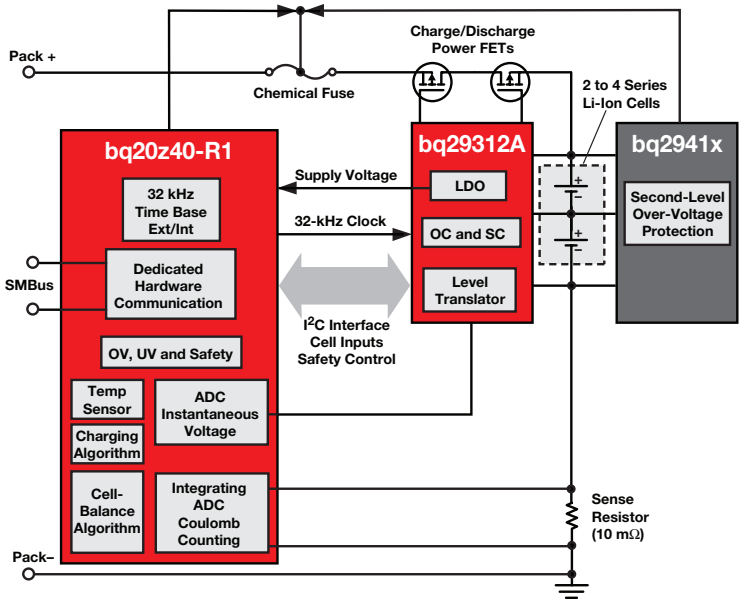
bq20z65-R1

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

Get more information:
www.ti.com/product/bq20z65-R1



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



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

Battery Management Products

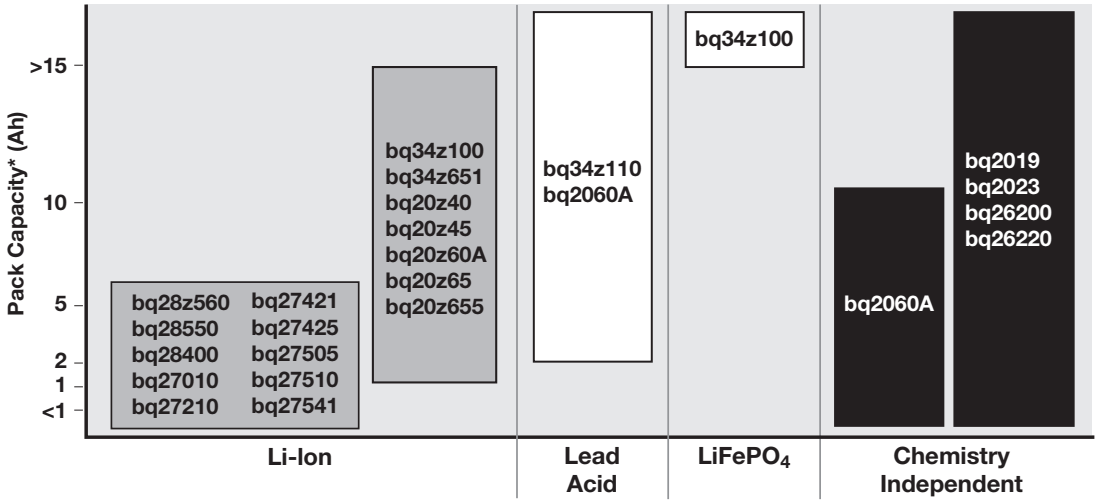
Battery Fuel Gauges—Multi-Cell Solutions

Multi-Cell Fuel Gauges Selection Guide

Device	Approx. Battery Capacity (mAh)	Min Max Series Cell	Number of LEDs	Communication Protocol	Other Features	Package	Price*
NiCd, NiMH Chemistry							
bq2013H	2000 to 15000	—	5	Single wire (HDQ)	Programmable offset error compensation	16-pin SOIC	3.70
bq2014H	500 to 6000	—	5	Single wire (HDQ)	Register compatible with bq2050H	16-pin SOIC	4.60
bq2016	1000 to 4500	—	5	Single wire (HDQ)	Automatic offset calibration	28-pin SSOP	3.75
Lithium-Ion, Lithium-Polymer, $LiFePO_4$ Chemistry							
bq28400	500 to 16000	2	—	SMBus	CEDV+ gas gauge with integrated protector	20-pin TSSOP	3.20
bq3050	500 to 32000	2 to 4	3, 4 or 5	SMBus	CEDV+ gas gauge with integrated protector	38-pin TSSOP	3.55
bq3055	500 to 32000	2 to 4	—	SMBus	CEDV+ gas gauge with integrated protector	30-pin TSSOP	3.90
bq3060	500 to 32000	2 to 4	—	SMBus	CEDV+ gas gauge with integrated protector	24-pin TSSOP	3.55
bq20z40	800 to 32000	2 to 4	—	SMBus	Impedance Track™ fuel gauge for use with bq29330 protector	20-pin TSSOP	3.65
bq20z45-R1	800 to 32000	2 to 4	—	SMBus	Impedance Track fuel gauge with integrated protector	38-pin TSSOP	4.45
bq20z60-R1	800 to 32000	2 to 4	3, 4 or 5	SMBus	Impedance Track fuel gauge with LED for use with bq29330 protector	30-pin TSSOP	3.90
bq20z65-R1	800 to 32000	2 to 4	3, 4 or 5	SMBus	Impedance Track fuel gauge with LED and integrated protector	44-pin TSSOP	4.75
bq20z655-R1	800 to 32000	2 to 4	3, 4, 5 or LCD	SMBus	Impedance Track fuel gauge with LED or LCD and integrated protector	44-pin TSSOP	5.20
bq34z100	65000 and above	1 to 16	4	I^2C or HDQ	Wide-range fuel gauge with Impedance Track technology	14-pin TSSOP	2.50
bq34z651	800 to 32000	2 to 4	3, 4 or 5	SMBus	Gas gauge and protection enabled with Impedance Track and external battery heater control	44-pin TSSOP	5.20
Lead Acid Chemistry							
bq34z110	65000 and above	1 to 16	4	I^2C or HDQ	Wide-range fuel gauge with Impedance Track technology	14-pin TSSOP	3.90
Multi-Chemistry							
bq2060A	800 to 10000	2 to 4	5	SMBus or HDQ	Most accurate multi-chemistry gauge from TI	28-pin SSOP	3.90
Super Cap							
bq33100	—	2 to 5	—	SMBus	Fully integrated 2, 3, 4 and 5 series super capacitor manager	24-pin TSSOP	4.20
Battery Monitors							
bq2019	>20000	—	—	Single wire (HDQ)	64-bit ID ROM and 1 program output non-volatile memory	8-pin TSSOP	1.95
bq2023	>20000	—	—	Single wire (SDQ™)	64-bit ID ROM and 1 program output automatic offset error calibration	8-pin TSSOP	2.00
bq26200	>20000	—	—	Single wire (HDQ)	High-performance battery, coulomb counter	8-pin TSSOP	2.00
bq26220	>20000	—	—	Single wire (HDQ)	64-bit ID ROM and 1 program output on-chip voltage measurement	8-pin TSSOP	2.05
bq76PL536A	—	3 to 192	—	SPI	3- to 6-cell EV and UPS stackable monitor and cell-balancing AFE	64-pin HTQFP	4.30

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

Battery Fuel Gauges Family of Products



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

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

Battery Management Products

Battery and Peripheral Authentication

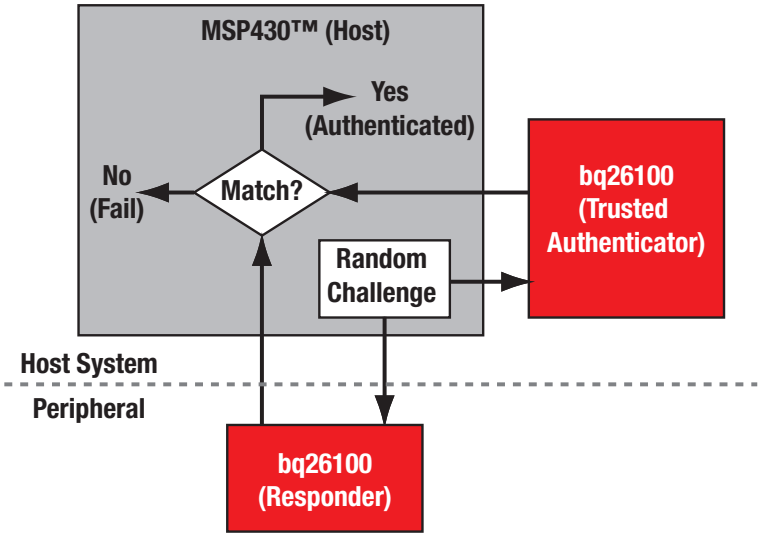
Design Factors

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

Features

TI authentication devices use three levels of security.

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



Single-cell battery pack with gas gauge and authentication.

Selection Guide

Device	Interface	Pins	Security	Temp (°C)	Price*
bq2022A	SDQ™	3	ID number	–40 to 85	0.90
bq2024	SDQ	3	ID number	–40 to 85	0.95
bq26150	HDQ	5	CRC algorithm	–20 to 70	0.95
bq26100	SDQ	5	SHA-1 encryption	–20 to 70	0.99
bq27541	I^2C/HDQ	12	SHA-1 encryption	—	1.45

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

Battery Management Products

Battery (Li-Ion) Protection Solution

Design Factors

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

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

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

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

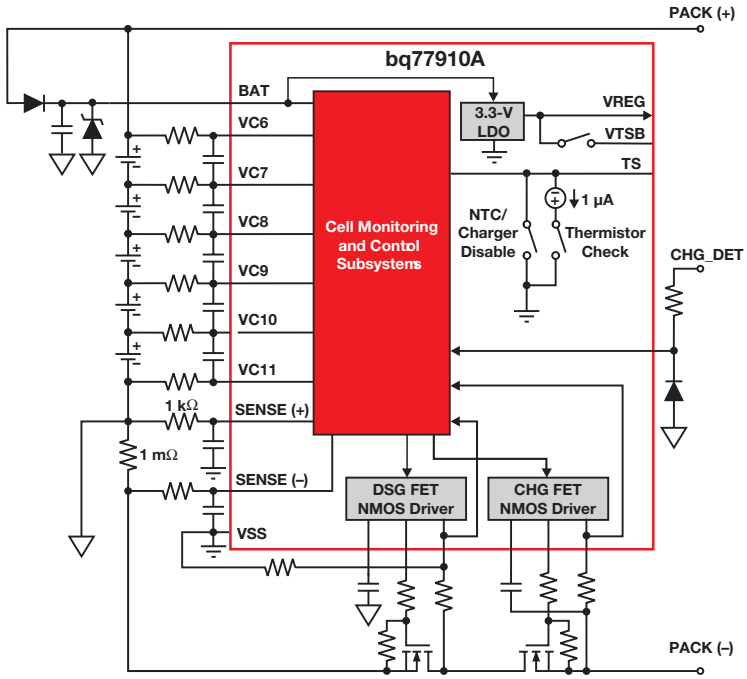
Charge/Discharge Current — The pass element associated with each protection IC is rated for maximum current whether it be an internal or external FET.

Features

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

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

bq77910A



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

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

Key Features

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

Get more information:
www.ti.com/product/bq77910A

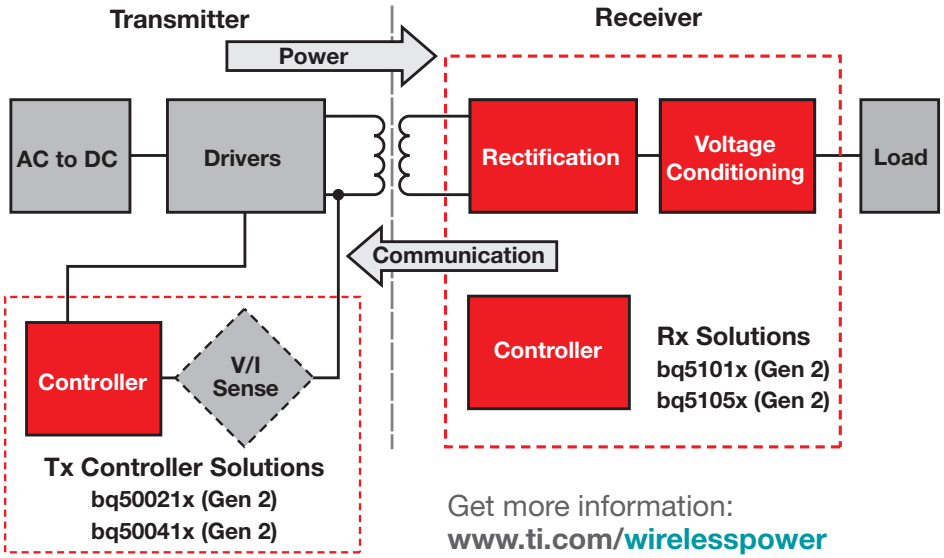
Selection Guide

Device	Number of Series Cells	Charge/Discharge Current (A)	Shutdown Current (µA)	Other Features	Package(s)	Price*
bq2920x	2	—	3	Overvoltage safety with cell balancing	8-pin SON	0.30
bq2941x	2, 3 or 4	—	3	Overvoltage safety for chemical fuse activation; PTC	8-pin TSSOP	0.45
bq2944x	2, 3 or 4	—	3	Overvoltage safety for chemical fuse activation	8-pin SON	0.45
bq2945xy	2 or 3	—	4	Overvoltage safety for chemical fuse activation	6-pin SON	0.40
bq2946xy	1	—	4	Overvoltage safety for chemical fuse activation	6-pin SON	0.38
bq76925	3 to 6	—	1	Host-controlled protector with cell balancing	20-pin TSSOP, 24-pin QFN	1.50
bq77PL900	5 to 10	External PFET	—	Stand-alone or host-controlled protector with cell balancing	48-pin SSOP	2.95
bq77908A	4 to 8	External NFET	5	Stand-alone protector with cell balancing	38-pin TSSOP	2.70
bq77910A	4 to 10	External NFET	5	Stand-alone protector with cell balancing	38-pin TSSOP	2.70
bq77PL157A4225	3 to 6	External NFET	3	Stackable overvoltage protector; stack 3 for 18 series cells	16-pin TSSOP	0.65

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

Battery Management Products
Wireless Power

Overview
The market demand for the convenience and safety of standards-compliant wireless power systems continues to grow rapidly. While near-field inductive power coupling has been around for some time, applications have been limited to very low power levels. With increasing power demands in addition to the need for advanced control systems in higher-power batteries, a number of safety risks in the design of wireless power systems must be considered. Compliance with standards specifications, such as those of the Wireless Power Consortium (WPC), helps designers avoid safety problems and ensures interoperability between systems. With the right products and tools to help customers quickly bring new products to market, TI is actively making wireless power a reality.



Get more information:
www.ti.com/wirelesspower

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

Differentiate Your Design
TI delivers a broad portfolio of products and advanced technologies to bring you the right wireless power solutions. The bqTESLA™ family of transmitter and receiver ICs and a wide selection of battery charger and protection products ensure robust power solutions. All products include an extensive selection of support collateral such as development tools, technical documentation and reference designs. The is also application expertise and support to simplify your design process and speed time to market. The following pages provide more details on these devices and tools.

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

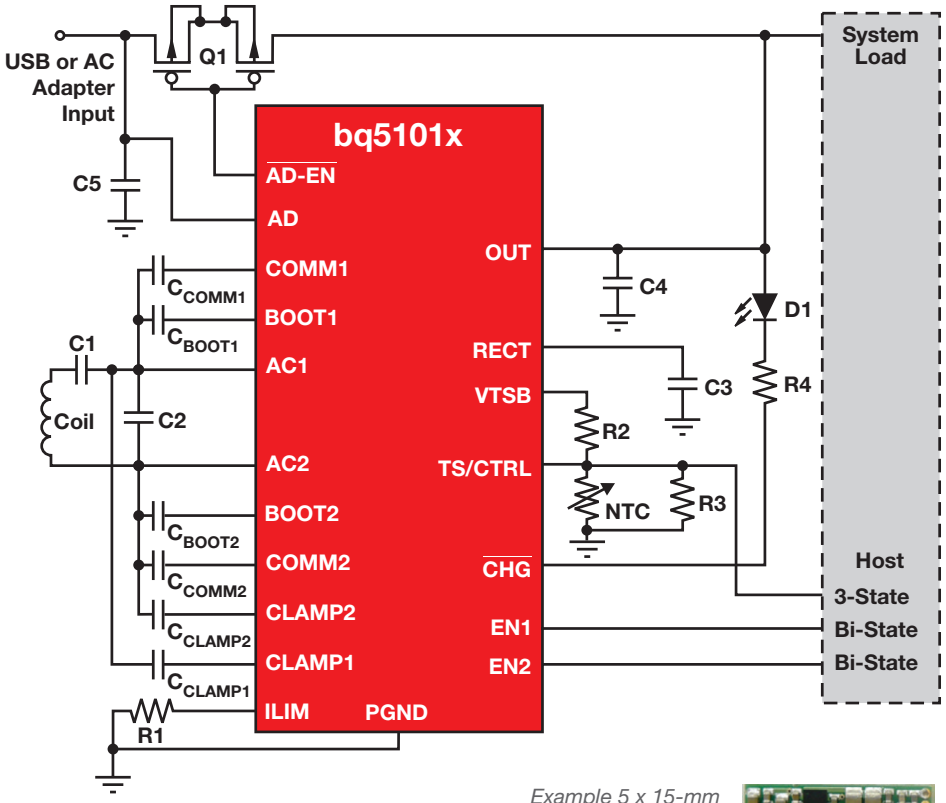
Receiver Selection Guide

(Device parameters continued on next page)

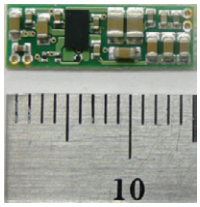
Device	Number of Cells	V_{IN} Type	V_{IN} Max Operating (V)	V_{IN} Absolute Max (V)	V_{IN} OVP (V)	Charge Current (A)	Charge Voltage (V)	Control Interface	Topology	Integrated Power FET	
bq51011	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	See Comments	5	Stand Alone	Linear	Yes	
bq51013	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes	
bq51013A	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes	
bq51013B	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Linear	Yes	
bq51050B/51B	Reg V_{OUT}	Coil/USB/Adapter	10	20	15	1.5	5	Stand Alone	Wireless Battery Charger	Yes	

Battery Management Products
Wireless Power

Integrated, Qi-Compliant, Wireless Power-Supply Receivers
bq51013B, bq51050B, bq51051B



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



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

Applications
- Cell and smartphones
- Headsets
- Digital cameras
- Portable media players
- Handheld devices

Get more information: **www.ti.com/product/bq51013B**, **bq51050B** or **bq51051B**

(Device parameters continued from previous page)

Device	Primary Charge Termination	Charge Timer	Temperature Monitor	Packaging		EVM	Comments	Price*
				WCSP	QFN/ MLP			
bq51011	EPT Cmd to Tx	No	Yes	28			Receiver, current limited charge current (400 mA + dynamic I_{LIM})	3.50
bq51013	EPT Cmd to Tx	No	Yes	28		✔	Receiver, regulated voltage output, compliant to WPC specification 1.0	3.50
bq51013A	EPT Cmd to Tx	No	Yes	28	20	✔	WPC 1.0 receiver, regulated voltage output, dynamic efficiency control, dynamic communications limit	3.50
bq51013B	EPT Cmd to Tx	No	Yes	28	20	✔	WPC 1.1 receiver, regulated voltage output, dynamic efficiency control, dynamic communications limit	2.50
bq51050B/51B	EPT Cmd to Tx	No	Yes	28	20	✔	WPC 1.1 receiver, regulated voltage output, dynamic efficiency control, dynamic communications limit, built-in Li-Ion charging	2.75

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

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

Battery Management Products
Wireless Power

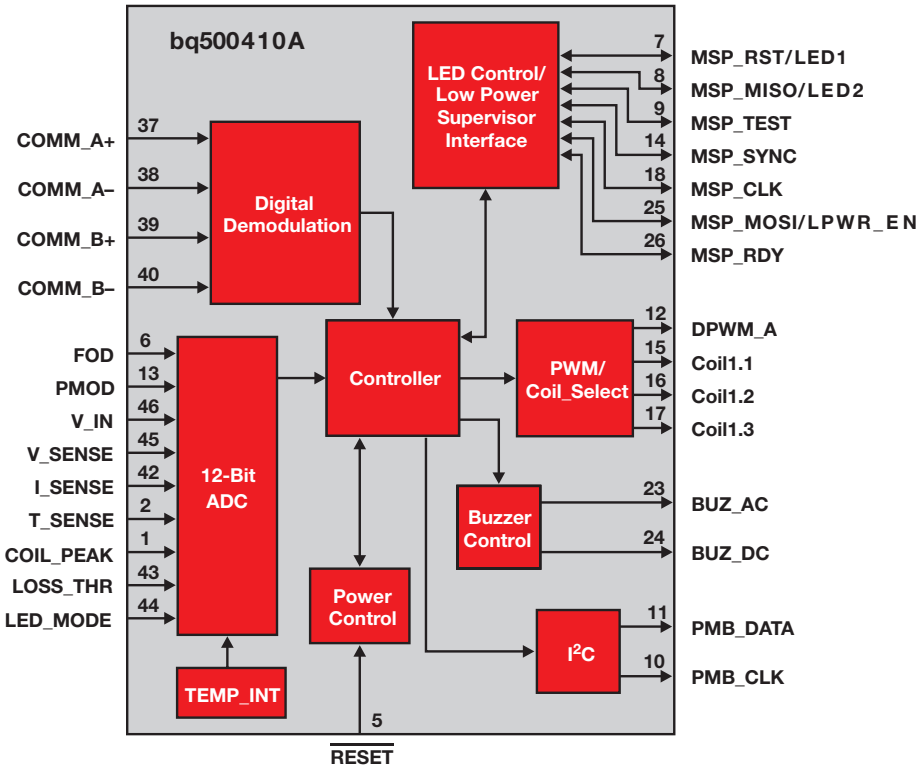
Transmitter-Side Solutions

TI offers dedicated digital controllers that integrate the logic functions required to control wireless power transfer in a single-channel, WPC-compliant, contactless-charging base station. These intelligent controllers periodically ping the surrounding environment for available devices to be powered, monitor all communication from the device being wirelessly powered, and adjust power applied to the transmitter coil per feedback received from the powered device. They also monitor transfer efficiency with real-time analysis, which protects the controllers and power receivers from excessive power loss and heat associated with parasitic metal objects placed in the power-transfer path.

Qi-Compliant, Wireless Power-Transmitter Manager

bq500410A

Together with the bq5101x receivers, the bq500410A transmitter controller enables a complete, contactless power-transfer system for a wireless power-supply solution.



Key Features

- Intelligent control of the power transfer between base station and mobile device
- Conforms to WPC v1.1 A6 transmitter specification
- Expanded free positioning using a three-coil transmit array
- Digital demodulation to reduce components
- Parasitic metal-object detection (PMOD) and foreign-object detection (FOD)
- LED indication of charging state and fault status
- Overload and overtemperature protection
- 7 x 7-mm, 48-pin QFN package

Applications

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

Get more information: **www.ti.com/product/bq500410A**

Transmitters Selection Guide

Device	Transmitter Type	V_{IN} (V)	Magnet	Key Features	Price*
bq500410A	A6	12	No	1 to 3 coils, large charging area, WPC 1.1 ready	2.85
bq500211A	A5	5	Yes	Power from low-cost 5-V adapter or USB port, WPC 1.1 ready	2.85
	A11	5	No		
bq500210	A1	19	Yes	Second-generation solution with digital demodulation to reduce component count	2.62
	A10	19	No		

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

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

Battery Management Products
Wireless Power

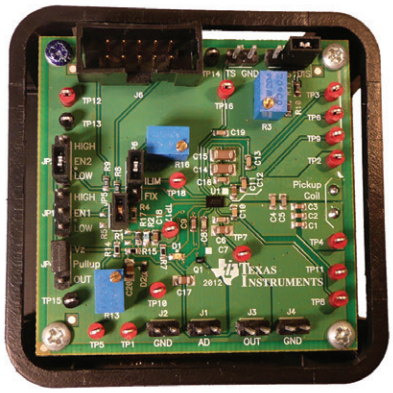
bqTESLA™ Development Modules

TI's combined bqTESLA evaluation modules provide a high-performance, easy-to-use development kit for the design of low-power wireless solutions. The kit features the bq500410A with three coils for free positioning and the bq51013A power-supply receiver, which enables designers to speed their development time.

WPC 1.1 Compliant, 12-V Free-Positioning, Wireless Power Transmitter Evaluation Module

bq500410AEVM-085

The bq500410AEVM-085 evaluation module (EVM) provides all major functions for evaluation of the bq500410A IC in a fully functional WPC A6 type wireless transmitter.



bq500410A evaluation module

Key Features

- Transmitter mounting pad to provide correct receiver interface
- Receiver output up to 5 W
- Standard A6-type transmitter coil
- Option to configure an external buzzer

Get more information at: **www.ti.com/tool/bq500410AEVM-085**

WPC 1.1 Compatible, Integrated Wireless Power Receiver Evaluation Module

bq51013EVM-725

The bq51013EVM-725 Wireless Power Receiver evaluation module (EVM) is a high-performance, easy-to-use development tool for the design of wireless power transfer in portable applications. The EVM provides AC/DC power conversion while integrating the digital control required to comply with the communication protocol.

bq51013 evaluation module

Key Features

- Integrated WPC-certified receiver with a 5-V regulated supply
- Dynamic Rectifier Control™ for improved load transient response
- Supports 20-V maximum input
- Low-power dissipative rectifier over-voltage clamp (V_{OVP} = 15 V)
- Thermal shutdown
- Single NTC/control pin for optimal safety and I/O with host

Get more information at: **www.ti.com/tool/bq51013EVM-725**

LED Lighting
General Illumination

LED technologies continue to improve and to produce more light while using less power at lower costs. This trend is fueling flexible, creative and cost-effective solid-state lighting (SSL).

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

- Superior light quality as compared to traditional light sources
- Existing form factor and socket compatibility
- Supply voltage (AC or DC)
- Legacy dimmer compatibility and dimming performance
- High efficiency and long operating life
- Power factor
- Conducted and radiated emissions

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

AC/DC LED Drivers — TI offers AC/DC driver solutions for LED lighting systems that are dimmable, isolated and non-isolated, highly efficient and power-factor-corrected with a long-life and a compact form factor. These LED systems can also maintain compatibility with installed fixtures and dimmers. Driver protection features such as over-voltage, over-current and over-temperature ensure that LED lighting products are safer than the traditional bulbs they replace.

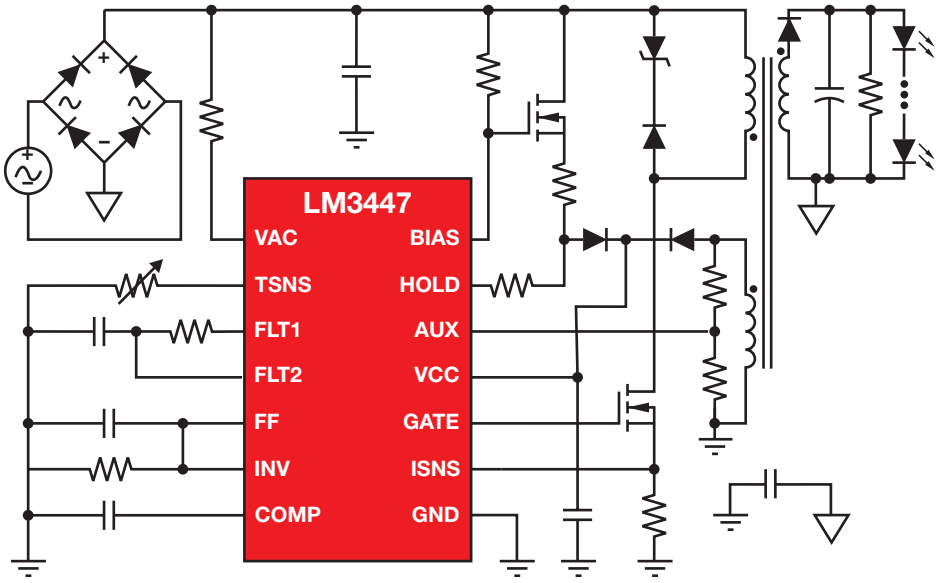
DC/DC LED Drivers — TI offers DC/DC lighting-driver solutions with wide input/output operating ranges that can be used in buck, boost, SEPIC and flyback architectures. Small solution sizes facilitate 12- to 24-V retrofitted designs such as MR-16.

Get more information at: **www.ti.com/led**

Phase-Dimmable, Primary-Side Regulated, PFC Flyback Controller for LED Lighting

LM3447

The LM3447 AC/DC LED driver includes TRIAC and trailing-edge dimmer detect and decoder. It also has an adjustable hold-current circuit to provide smooth and flicker-free dimming operation in off-line and isolated LED lighting applications. Using constant power control, lighting solutions based on the LM3447 can achieve up to 10% improvement in efficacy across the expected operating temperature range of the fixture.



Applications

- Dimmable lamps: A19, E26/27, PAR38
- LED luminaires

Evaluation Modules

Part Number	Description
LM3447-A19-120VEVM	LM3447 120-VAC, 10-W, A19 evaluation module
LM3447-A19-230VEVM	LM3447 230-VAC, 10-W, A19 evaluation module
LM3447-PAR-230VEVM	LM3447 230-VAC, 16-W, PAR38 evaluation module

Get more information: **www.ti.com/product/LM3447**

LED Lighting
General Illumination

Non-Isolated, Phase-Dimmable, Buck-PFC LED Driver with Digital Reference Control

NEW

TPS92075

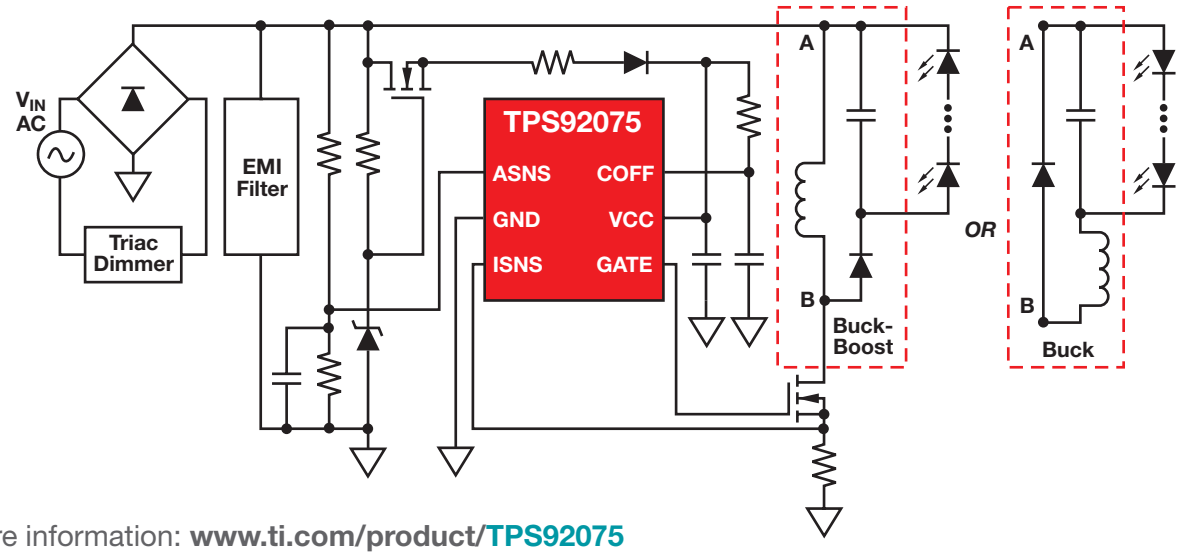
The TPS92075 is a hybrid power-factor controller with a built-in phase-dimming decoder. Power factor correction (PFC) is implemented using propriety control of the internal reference. The controller operates in two modes: High power factor and dimming. During non-dimming, the reference is controlled to maximize power factor. When dimming is sensed, the reference is controlled in relation to a dimming curve that has been optimized for TRIAC compatibility. The power stage operates with peak current/constant off-time hysteretic control with variable switching frequency. These integrated features simplify design with minimal external components. The TPS92075 includes standard protection features of input UVLO, LED open/short detection, as well as IC thermal shutdown. The available package options include 8-pin SOIC and 6-pin TSOT.

Applications

- 5- to 30-W LED luminaires/lamps
- Phase-dimmable retrofit LED lighting (A19, PAR/BR, T8)
- Recessed LED downlights, pendant lights

Evaluation Module

Part Number	Description
TPS92075EVM	TPS92075 120-VAC, 12.6-W A19 evaluation module

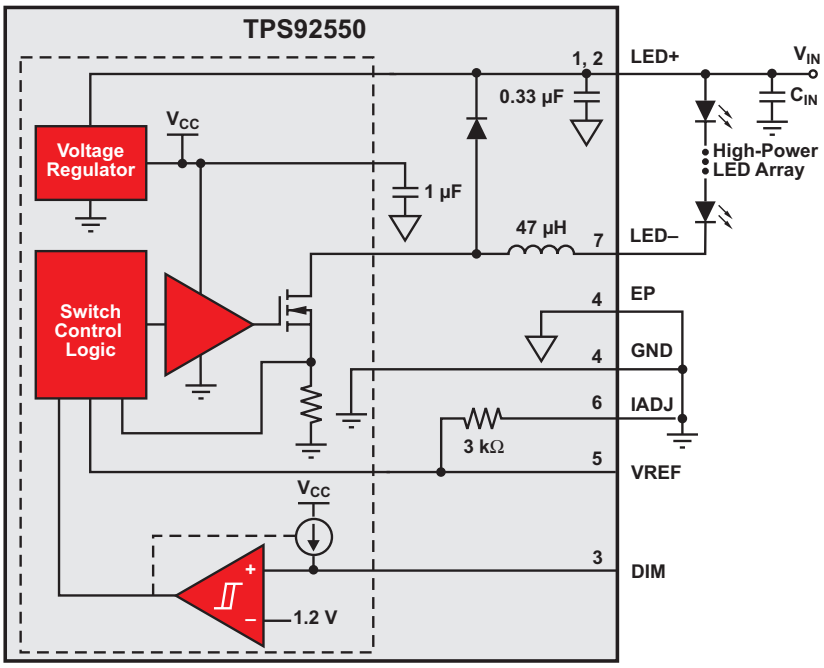


Get more information: **www.ti.com/product/TPS92075**

LED Lighting
General Illumination

450-mA, Constant-Current Buck, LED Driver Micro-Modules
TPS92550, TPS92551

The 14-W TPS92550 and 23-W TPS92551 are integrated constant-current buck, LED driver modules that require only one external capacitor to implement a 350-mA constant-current source for driving high-brightness LEDs. The drivers work seamlessly with readily available and inexpensive off-the-shelf constant-voltage power supplies to perform the conversion from constant voltage to constant current that is needed to properly drive LEDs. Using this approach, a complete lighting solution can be implemented in minutes. The TPS92550/1 LED-driver micro-modules integrate all the power components (including the power inductor) and can drive 450-mA maximum LED current for up to 10 (TPS92550) or 16 (TPS92551) LEDs in a single string.



Get more information: **www.ti.com/product/TPS92550** or **TPS92551**

Key Parameters

Device	V_{IN}	f_{SW}
TPS92550	4.5 to 36 V	400 kHz
TPS92551	4.5 to 60 V	800 kHz

LED Current Setting

IADJ Pin	VREF Pin	I_{LED} Current
499 Ω	Open	300 mA
Ground	Open	350 mA
Ground	10.5 kΩ	450 mA

Evaluation Modules

Part Number	Description
TPS92550EVM	TPS92550 evaluation module
TPS92551EVM	TPS92551 evaluation module

Selection Guide

Device	V_{IN} (min) (V)	V_{IN} (max) (V)	LED Voltage (max) (V)	Switching Frequency (kHz)	DC/DC or AC/DC Control	Isolated Applications	Non-Isolated Applications	Topology	LED Configuration	Dimming	PFC	EVM	Package(s)	Price*
AC/DC High-Brightness LED Drivers														
TPS92001	9	19	Configurable	100	AC/DC	✔	✔	Flyback/Buck	Series/Parallel	TRIAC	✔		8 MSOP, 8 SOIC	0.45
TPS92002	14	19	Configurable	100	AC/DC	✔	✔	Flyback/Buck	Series/Parallel	TRIAC	✔		8 MSOP, 8 SOIC	0.45
TPS92020	11.5	18	Configurable	350	DC/DC	✔	✔	Half-Bridge	Multi-String Series/Parallel	PWM		✔	8 SOIC	0.70
TPS92210	9	20	Configurable	140	AC/DC	✔	✔	Flyback	Series/Parallel	TRIAC	✔	✔	8 SOIC	0.75
TPS92075	11	18.5	Configurable	500	AC/DC		✔	Buck/Buck-Boost	Series/Parallel	TRIAC, TE	✔	✔	6 TSOT, 8 SOIC	0.75
TPS92310	13	36	Configurable	150	AC/DC	✔	✔	Flyback/Buck	Series/Parallel	TRIAC, TE	✔	✔	10 MSOP	0.55
TPS92311	13	36	Configurable	150	AC/DC	✔	✔	Flyback/Buck	Series/Parallel	TRIAC, TE	✔	✔	16 SOIC	0.72
TPS92314/A	13	35	Configurable	150	AC/DC	✔	✔	Flyback/Buck	Series/Parallel	TRIAC, TE	✔	✔	8 SOIC	0.55
TPS92070	9	21.5	Configurable	146	AC/DC	✔	✔	Flyback	Series/Parallel	TRIAC	✔	✔	16 TSSOP	0.95
LM3444	8	13	Configurable	1000	AC/DC	✔	✔	Flyback/Buck	Series/Parallel	No	✔	✔	10 MSOP	0.60
LM3445	8	12	Configurable	1000	AC/DC	✔	✔	Flyback/Buck	Series/Parallel	TRIAC, TE	✔	✔	10 MSOP, 14 SOIC	0.72
LM3447	7.5	17.5	Configurable	70	—	✔	✔	Flyback	Series/Parallel	TRIAC, TE	✔	✔	14 TSSOP	0.85
LM3448	8	12	Configurable	1000	AC/DC	✔	✔	Flyback/Buck	Series/Parallel	TRIAC, TE	✔	✔	16 SOIC	1.04
LM3450/A	8.5	20	Configurable	120	AC/DC	✔	✔	Flyback	Series/Parallel	TRIAC, TE	✔	✔	16 TSSOP	1.76
UCC28810	15.4	18	Configurable	140	AC/DC	✔	✔	Flyback/Boost	Series/Parallel	TRIAC	✔	✔	8 SOIC	0.32
UCC28811	12	18	Configurable	140	AC/DC	✔	✔	Flyback/Boost	Series/Parallel	PWM/Analog	✔	✔	8 SOIC	0.32

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

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

LED Lighting
General Illumination

Selection Guide (Continued)

Device	Max LED Current (mA)	Input Voltage Range (V)	Maximum Output Voltage (V)	Maximum Number of LEDs in Series	Switching Frequency (MHz)	Topology	Features	Packaging	Price*
DC/DC High-Brightness LED Drivers									
LM3464/A	1000+	12 to 80/ 12 to 95	80/95	25	Up to 1 MHz	Boost	Dynamic headroom control, 4 output channels	28 eTSSOP	3.42/3.93
LM3466	1500	6 to 70	70	20	—	Linear	LED string current equalization	8 ePSOP	0.90
LM3414/HV	1000	4.5 to 42/ 4.5 to 65	80/95	16	Up to 1 MHz	Buck	Thermal foldback , analog and PWM dimming	8 ePSOP/LLP	1.10/1.25
LM3492	200	4.5 to 65	65	17	Up to 1 MHz	Boost	Dynamic headroom control, 2 output channels,1000:1 dimming contrast ratio	20 eTSSOP	1.27
LM3492HC	250	4.5 to 65	65	17	Up to 1 MHz	Boost	Dynamic headroom control, 2 output channels,10000:1 dimming contrast ratio	20 eTSSOP	1.50
LM3431	150 per string	5.0 to 36	40+	30	1	Analog, PWM	3-string output	28 TSSOP/LLP	1.67
LM3402/02HV	500	6.0 to 42/ 6.0 to 75	40/70	12/20	Adjustable up to 1 MHz	Buck	Fast PWM dimming, no control loop compensation, supports ceramic capacitor and capacitor-less outputs	8 MSOP/PSOP	0.91/1.17
LM3404/04HV	1000	6.0 to 42/ 6.0 to 75	40/70	12/20	Adjustable up to 1 MHz	Buck	Fast PWM dimming, no control loop compensation, supports ceramic capacitor and capacitor-less outputs	8 SOIC/PSOP	1.17/1.39
LM3410	1000	2.7 to 5.5	24	6	525 kHz/ 1.6 MHz	Boost, SEPIC	PWM dimming, small footprint, low external component count	5 SOT23, 6 LLP	1.10
LM3406/06HV	1500	6.0 to 42/ 6.0 to 75	40/70	12/20	Adjustable to 1 MHz	Buck	Fast PWM dimming. no control loop compensation, supports ceramic capacitor and capacitor-less outputs	14 eTSSOP	1.41/1.50
LM3421/23/29	>2000	4.5 to 75	75	20	Adjustable to 2 MHz	Boost, SEPIC, Buck	Fast PWM dimming, LED ready, broken open check overvoltage protection, FLT, cycle-by-cycle current limit	16/20/14 eTSSOP	1.42/1.52/ 1.22
LM3433/34	6000+	–9.0 to –14	–6	1	Adjustable up to 1 MHz	Buck	Drives common-anode LEDs, analog and fast PWM dimming	24 LLP	2.18/2.38
LM3409/HV	5000	6.0 to 42/ 6.0 to 75	42/75	13/23	1 MHz	Buck	PWM and analog dimming, high-side current sense, 100% duty cycle achievable	10 eMSOP	1.20/1.30
LM3424	3000+	3.5 to 75	75	18	Adjustable to 2 MHz	Boost, SEPIC	Temperature foldback , synchronizable 50-kHz max PWM dimming	20 eTSSOP	1.57
TPS40211	3000+	4.5 to 52	50	15	Up to 1 MHz	Boost, SEPIC, Flyback	Programmable soft start, overcurrent protection with auto retry, programmable oscillator frequency	10 MSOP, 10 SON	0.99
TPS92510	1500	3.5 to 60	57	16	Adjustable up to 2.5 MHz	Buck	Thermal foldback , analog and PWM dimming, frequency sync	10 eMSOP	1.50
TPS92550	450	4.5 to 36	34	10	400 kHz	Buck	Integrated micro-module	7 TO-PMOD	5.00
TPS92551	450	4.5 to 60	57	16	800 kHz	Buck	Integrated micro-module	7 TO-PMOD	5.50
TPS92690	>2000	4.5 to 75	75	20	Adjustable to 2 MHz	Boost, SEPIC, Buck, Cuk	Fast PWM dimming, LED ready, broken open check overvoltage protection, FLT, cycle-by-cycle current limit	16 eTSSOP	1.45
TPS92660	>2000	10 to 80	75	21	Adjustable up to 1 MHz	Buck + Linear	Two-string LED driver with I^2C/EEPROM current trim for high CRI lighting	20 eTSSOP	1.50
TPS92560	>1000	6.5 to 42	42	12	Adjustable up to 1.5 MHz	Buck, SEPIC	Integrated active low-side input rectifiers	10 eMSOP	0.72

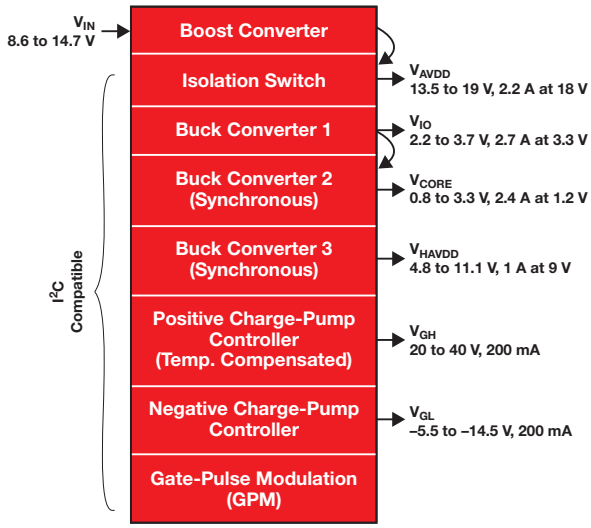
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

Fully I²C Programmable 6-Channel LCD Bias IC with Gate-Pulse Modulation for All TV Sizes

TPS65177

The TPS65177 provides all supply rails needed by a gate in panel (GIP) or non-GIP TFT-LCD panel. All output voltages are I²C programmable.



Get more information at: **www.ti.com/product/TPS65177**

Key Features

- Gate-pulse modulation (GPM)
- Temperature compensation for V_{GH}
- 40-pin 6 x 6-mm QFN package
- I²C-compatible interface
- Input voltage: 8.6 to 14.7 V
- Integrated V_{AVDD} isolation switch
- 6-bit boost converter V_{AVDD}: 13.5 to 19.8 V
- 3-bit programmable switch current limit of up to 4.25 A
- 4-bit programmable high-voltage-stress mode
- 1-bit programmable soft start
- 6-bit synchronous buck V_{HAVDD}: 4.8 to 11.1 V
- 1.7-A switch current limit
- 4-bit buck converter V_{IO}: 2.2 to 3.7 V

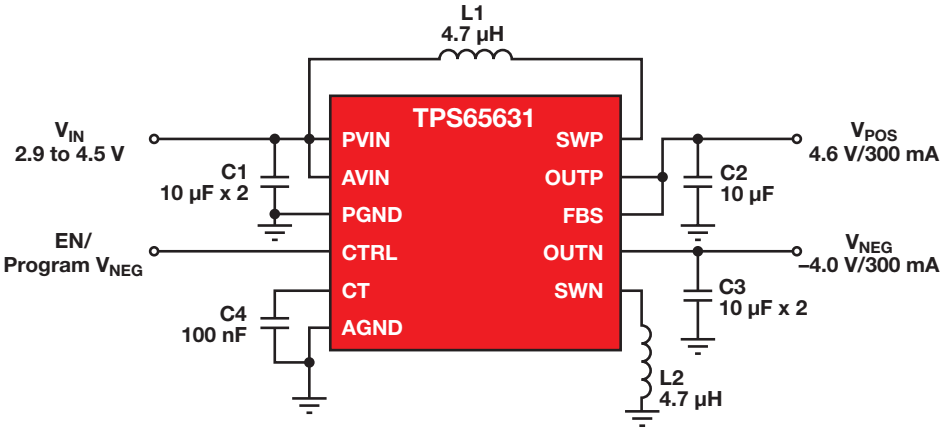
Applications

- GIP LCD TVs
- Non-GIP LCD TVs

Dual-Output Power Supply for AMOLED Displays

TPS65631

The TPS65631 is designed to drive AMOLED displays requiring positive and negative supply rails. It integrates a boost converter for V_{POS}, an inverting buck-boost converter for V_{NEG} suitable for battery-operated products. The digital control pin (CTRL) allows the negative output voltage to be programmed in digital steps. The TPS65631 uses a novel technology enabling excellent line-transient regulation and efficiency.



Get more information at: **www.ti.com/product/TPS65631**

Key Features

- 0.5% accuracy V_{POS}
- Excellent line-transient regulation
- 300-mA output current
- Short-circuit protection covering start-up, operation and overload
- Best-in-class efficiency
- 2.9- to 4.5-V input-voltage range
- Fixed 4.6-V V_{POS} output voltage
- Digitally programmable V_{NEG} of –1.4 to –4.4 V (default –4 V)
- Thermal shutdown
- 3 x 3-mm, 12-pin QFN package

Applications

- Active matrix OLED (AMOLED) displays below 5.5″

Display Power
LCD/OLED Display Bias Solutions

Selection Guide

Device	V_{IN} (V)	Boost I_{Limit} (min) (A)	Buck I_{Limit} (min) (A)	Features[1]							Price*
				Isolation Switch	V_{GH}	V_{GL}	GVS	V_{Com}	HVS	Other	
Solutions for Large LCDs (TVs)											
TPS65160/A	12	2.8	2	External	Driver	Driver	—	—	—		2.14
TPS65161	12	2.8	2.3	External	Driver	Driver	—	—	—		2.78
TPS65161A	12	3.7	2.3	External	Driver	Driver	—	—	—		2.78
TPS65161B	12	3.7	2.5	External	Driver	Driver	—	—	—		2.78
TPS65162	12	2.8	2.8	Integrated	Driver	Driver	Yes	2 op amps	—		2.45
TPS65163	12	2.8	1.5	External	Controller	Controller	In level shifter	—	—	9-ch level shifter, LCD discharge, reset generator	2.32
TPS65168	12	3.5	2.8	Integrated	Controller	Controller	—	—	—	I^2C programmable, 2 buck, temp. compensation, reset	2.10
TPS65170	12	2.8	1.5	External	Controller	Controller	—	—	—	Reset	1.40
TPS65176	12	3.5	2.5	External	Controller	Controller	—	—	—	Max AVDD 18.5 V, Vlogic 3.3 V	1.00
TPS65178	12	3.5	2.6	Integrated	Controller	Controller	—	—	—	Integrated 6-ch gamma buffer, I^2C, Vcom, bucks for HVDD, VCC, VCORE, VEPI, boost for VDD	1.90
TPS65177	12	4.25	3	Integrated	Controller	Controller	Yes	—	—	Temp compensation, I²C, 1 boost, 3 bucks	1.90

Device	V_{IN} (V)	Boost I_{Limit} (min) (A)	Features[1]								Price*
			Overvoltage Protection	Isolation Switch	V_{Logic}	V_{GH}	V_{GL}	GVS	V_{Com}	Other	
Solutions for Medium and Small LCDs (Monitors and Notebooks)											
TPS61085	5	2	Yes	—	—	External	External	—	—		0.95
TPS61087	5	3.2	Yes	—	—	External	External	—	—		1.60
TPS65100	5	1.6	Yes	—	LDO controller	Integrated	Driver	—	1 buffer		1.87
TPS65105	5	0.96	Yes	—	LDO controller	Integrated	Driver	—	1 buffer		1.87
TPS65140	5	1.6	Yes	—	LDO controller	Integrated	Driver	—	—		1.71
TPS65142	5	1.8	Yes	—	LDO	Driver	External	Yes	1 buffer	Integrated 6-ch WLED backlight driver, with integrated MOSFET	1.35
TPS65145	5	0.96	Yes	—	LDO controller	Integrated	Driver	—	—		1.71
TPS65148	2.5 to 6	4	Yes	External	LDO	External	External	Yes	1 buffer	LDO for gamma, reset (/XAO), LCD discharge	2.10
TPS65149	3 to 6	4.0	Yes	External	—	Controller	Controller	—	Programmable, no buffer	Level shifters, reset	1.90
TPS65150	5	2	Yes	External	—	Driver	Driver	Yes	1 buffer		1.92
TPS65165	5	4.4	Yes	—	—	Integrated	Driver	Yes	2 op amps, 1 buffer		1.80

[1] *V_{GH} = Positive LCD rail voltage, V_{GL} = Negative LCD rail voltage, GVS = Gate-voltage shaping for V_{GH}, V_{Com} = LCD V_{Com} voltage source, and HVS = High-voltage stress-test control.*

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

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

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

Display Power
LCD/OLED Display Bias Solutions

Selection Guide (Continued)

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

[1] *See datasheets for more specifications.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Device	Description	Features	V_{IN} (min) (V)	V_{IN} (max) (V)	Frequency	AV_{DD} I_{Limit} (min) (mA)	AV_{DD} (max) (V)	Isolation Switch	V_{Logic1} I_{Limit} (min) (A)	V_{Logic1} (min) (V)	V_{GH} (I_{GH})	V_{GL} (I_{GL})	Other	Package	Price*
LCD SFF/MFF — IPS and OLED Solutions (<5 V)															
TPS65120	4-ch single inductor multiple outputs (SIMO) bias IC w/fixed 3.3-V V_{Logic}	Small form factor	2.5	5.5	4 MHz	7.5/25	5.6	Internal	LDO controller	Fixed 3.3	Integrated 20 V max. (6 mA)	Inverter –18 V max. (6 mA)	—	QFN-16	0.95
TPS65121	4-ch single inductor multiple outputs (SIMO) bias IC w/fixed 1.8-V V_{Logic}	Small form factor	2.5	5.5	4 MHz	7.5/25	5.6	Internal	LDO controller	Fixed 1.8	Integrated 20 V max. (6 mA)	Inverter –18 V max. (6 mA)	—	QFN-16	0.95
TPS65124	3-ch single inductor multiple outputs (SIMO) bias IC w/ adjustable sequencing	Small form factor	2.5	5.5	4 MHz	7.5/25	5.6	Internal	—	—	Integrated 20 V max. (6 mA)	Inverter –18 V max. (6 mA)	Adjustable sequencing	QFN-16	0.95
TPS65130	Dual positive and negative outputs (700 mA)	OLED, CCD sensor	2.7	5.5	1.4 MHz	—	—	External	—	—	Boost 15 V max. (0.7 A I_{Limit})	Inverter –15 V max. (0.7 A I_{Limit})	—	QFN-24	1.70
TPS65131	Dual positive and negative outputs (1800 mA)	OLED, CCD sensor	2.7	5.5	1.4 MHz	—	—	External	—	—	Boost 15 V max. (1.8 A I_{Limit})	Inverter –15 V max. (1.8 A I_{Limit})	—	QFN-24	2.20
TPS65136	Single inductor multiple outputs (SIMO) for positive and negative output	AMOLED	2.3	5.5	40 kHz to 1 MHz	—	—	Internal	—	—	Boost fixed 4.6 V (80 mA)	Inverter –6 V max. (80 mA)	—	QFN-16	1.20
TPS65137	Dual positive and negative output w/digital Vneg adjustment	AMOLED	2.3	5.5	1.6 MHz	—	—	Internal	—	—	Boost fixed 4.6 V (200 mA)	Inverter –5.2 V max. (200 mA)	Digital adjust for V_{GL}	QFN-10	0.85
TPS65138	Dual positive and negative output w/digital Vneg adjustment	AMOLED	2.9	4.5	1.6 MHz	—	—	Internal	—	—	Boost fixed 4.62 V (300 mA)	Inverter –2.2 down to –5.2 V max. (300 mA)	0.8% Vpos accuracy	QFN-10	0.95
TPS65631	Dual-output AMOLED display power supply	AMOLED	2.9	4.5	1.7 MHz	—	—	Internal	—	—	Boost fixed 4.6 V (300 mA)	Inverter –1.4 down to –4.4 V max. (300 mA)	0.5% Vpos accuracy	QFN-12	1.20
TPS65632A	Triple-output AMOLED display power supply	AMOLED	2.9	4.5	1.7 MHz	—	—	Internal	—	—	Boost fixed 4.6 V (300 mA)	Inverter –1.4 down to –4.4 V max. (300 mA)	0.5% Vpos accuracy, fixed AVDD of 7.7 V	QFN-16	1.50
TPS65135	Single inductor multiple outputs (SIMO) for positive and negative output	SFF/MFF IPS panel	2.5	5.5	1 MHz	—	—	Internal	—	—	Boost up to 6 V	Inverter down to –7 V	80-mA output current, 50% current mismatch	QFN-16	1.20

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

Gamma Buffers

Channels	0-V_{Com} Channels	1-V_{Com} Channels	2-V_{Com} Channels
22 (+2 static)			BUF22821
18		LM8207	BUF18830, BUF20800, BUF20820
16		BUF16822	BUF16821
14			BUF16820
12	BUF12800, BUF12840		
10		BUF11702/4/5	
8		BUF08821, BUF08832, BUF08630	
7		BUF08800	
6	BUF06703, BUF06704	BUF07702/3/4	
4	BUF04701	BUF05703, BUF05704	
0		BUF01900, BUF01901	

Display Power
LED Drivers—Backlighting

Design Factors

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

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

Output Voltage Monitor — Monitors voltages at constant current output terminals to detect LED failure and short circuit.

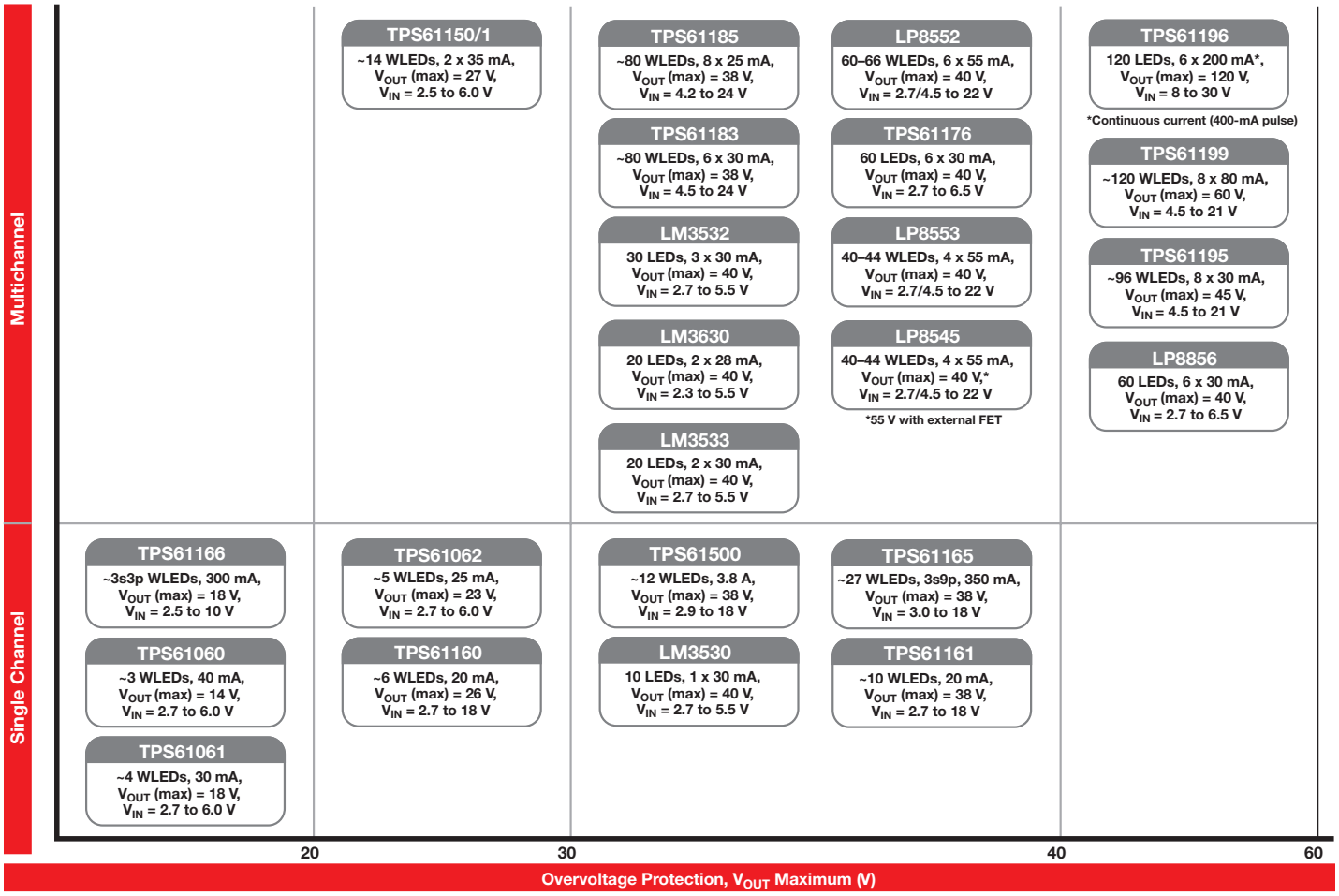
LED Open Detection — Indicates a broken or disconnected LED at an output terminal.

Thermal Error Flag — Indicates an overtemperature condition.

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

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

LED Drivers Function Guide

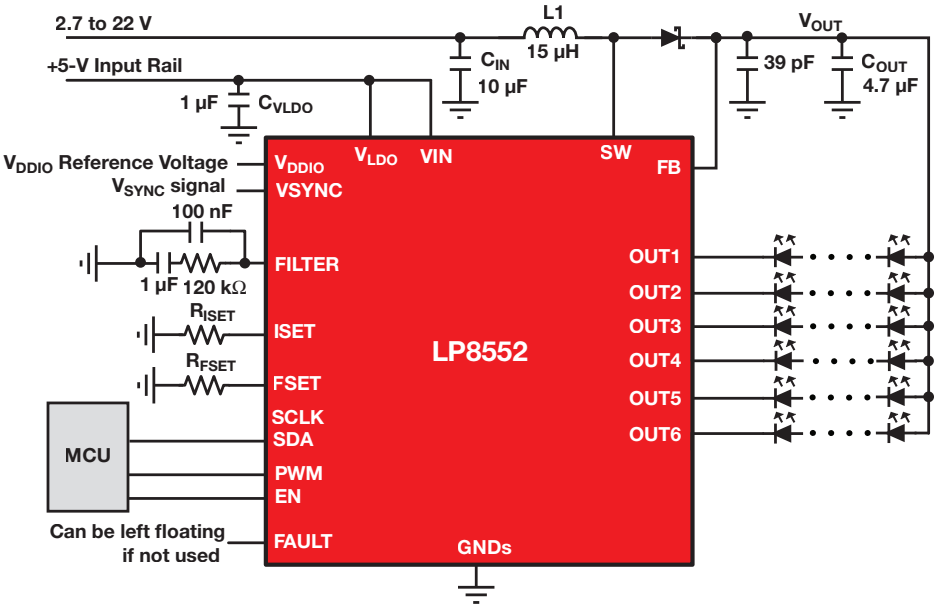


Display Power
LED Drivers—Backlighting

High-Efficiency LED Backlight Driver for Tablets and Notebooks

LP8552

PREVIEW



Key Features

- Advanced slope control eliminates human eye glitch response of step or linear ramp
- Dithering during transition enables smooth effect
- High-voltage DC/DC boost converter with integrated FET with four switching frequency options: 156/312/625/1250 kHz
- 2.7- to 22-V input-voltage range to support 1x…5x cell Li-Ion batteries
- Programmable PWM resolution
  - True 8- to 13-bit (steady state)
  - Additional 1 to 3 bits using dithering during brightness changes
- I^2C and PWM brightness control

Applications

- Notebook and netbook LCD display LED backlight
- LED lighting

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

LP8556, TPS61176

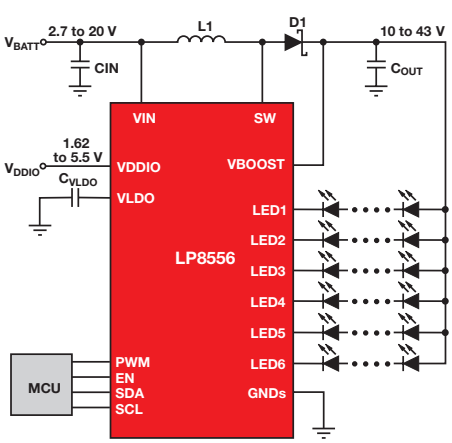
The LP8556 and TPS61176 provide highly integrated solutions for tablet PC backlighting and support an input voltage as low as 2.7 V (suitable for a single-cell battery). Both devices support 6 channels of LEDs and mixed-mode dimming for high efficiency.

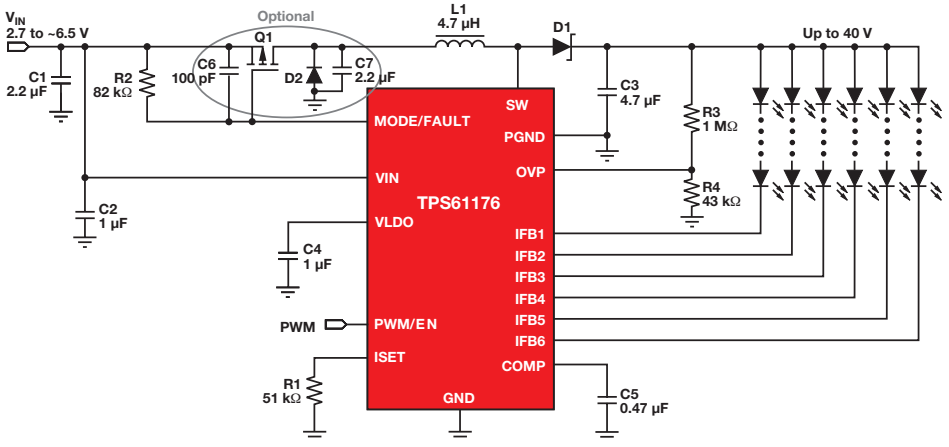
Key Features (LP8556/TPS61176)

- Maximum LED current per channel: 50 mA/30 mA
- Dimming methods: PWM, adaptive, pure analog/mixed-mode
- Programmability: EPROM/resistor
- Package: 20 SMD/16 QFN
- Phase shift (LP8556)

Applications

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





Get more information at: **www.ti.com/product/LP8556** or **TPS61176**

Display Power
LED Drivers—Backlighting

Selection Guide

Device	V_{IN} (V)	Synchronous	Type	Number of LEDs[1]	OLED Capable	LED Configuration	Switch Current Limit (typ) (mA)	Current Regulation	Overvoltage Protection (min) (V)	Output Capacitor	Load-Disconnect During Shutdown	Dimming[2]	Peak Efficiency[3] (%)	Quiescent Current (typ) (mA)	Shutdown Current (typ) (µA)	Package(s)	Price*
WLED Drivers																	
TPS61041	1.8 to 6.0		Inductive	4		Series	250		No	1 µF		Yes	85	0.028	0.1	SOT-23	0.65
TPS61040	1.8 to 6.0		Inductive	6		Series	400		No	1 µF		Yes	86	0.028	0.1	SOT-23	0.65
TPS61043	1.8 to 6.0		Inductive	4		Series	400	4	17	100 nF	✔	Yes	85	0.038	0.1	QFN-8	0.71
TPS61042	1.8 to 6.0		Inductive	6		Series	500	4	28	100 nF	✔	Yes	85	0.038	0.1	QFN-8	0.75
TPS61045	1.8 to 6.0		Inductive	6	✔	Series	500	4	28	100 nF	✔	Yes	85	0.038	0.1	QFN-8	0.90
TPS61140	2.5 to 6.0	4	Inductive	4 + 1 OLED	✔	2 Series	2 x 550	4	28	—		1-pin	82	2	1.5	QFN-10	1.00
TPS61150A	2.5 to 6.0	4	Inductive	Up to 2 x 6		2 Series	2 x 550	4	28	—		1-pin	83	2	1.9	QFN-10	1.00
TPS61166	2.5 to 6.0	4	Inductive	5		Series	1100[4]	4	19	4.7 µF	✔	Yes		1.5	1	QFN-10	1.35
TPS61160	2.7 to 18		Inductive	6		Series	700	4	26	1 µF		1-pin	90	1.8	1	QFN-6	0.72
TPS61160A	2.7 to 18		Inductive	6		Series	700	4	26	1 µF		Yes	90	1.8	1	QFN-6	0.72
TPS61161	2.7 to 18		Inductive	10		Series	700	4	38	1 µF		1-pin	90	1.8	1	QFN-6	0.76
TPS61161A	2.7 to 18		Inductive	10		Series	700	4	38	1 µF		Yes	90	1.8	1	QFN-6	0.76
TPS61165	3.0 to 18		Inductive	10 to 40		Series	1200	4	38	1 µF		1-pin	90	2.3	1	QFN-6	1.10
TPS61060	2.7 to 6.0	4	Inductive	3		Series	400	4	14	220 nF		Yes	83	—	1	QFN-8/WCSP-8	0.85
TPS61061	2.7 to 6.0	4	Inductive	4		Series	400	4	18	220 nF		Yes	82	—	1	QFN-8/WCSP-8	0.90
TPS61062	2.7 to 6.0	4	Inductive	5		Series	400	4	22	220 nF		Yes	81	—	1	QFN-8/WCSP-8	0.97
REG71050	3.2 to 5.5		Charge pump	3		Parallel	—		—	2.2 µF		No	92	0.065	0.01	SOT-23	0.55
TPS60230/1	2.7 to 6.5		Charge pump	5, 3		Parallel	—	✔	—	1 µF		Yes	85	0.200	0.1	QFN-16	0.48
TPS60250/5	2.7 to 6.0		Charge pump	7		Parallel	—	✔	—	4.7 µF		I^2C	—	6.7	1.3	QFN-16	0.85
TPS60251	2.7 to 6.0		Charge pump	7 + Aux		Parallel	—	✔	—	4.7 µF		I^2C	—	6.7	1.3	QFN-24	0.85
TPS75103/5	2.7 to 5.5		LDO	2 or 4		Parallel	—	✔	—	—		Yes	—	0.18	0.1	WCSP-9	0.65
TCA6507	1.65 to 3.6		Parallel	7		Parallel	—	—	—	—		—	—	—	—	WCSP-12/QFN-12	0.80
TPS61183/87	4.5 to 24		Inductive	10 x 6		6 Channels	2000	✔	38	10 µF		Yes	95	4	11	QFN-20	1.85
TPS61185	4.2 to 24		Inductive	10 x 8		8 Channels	2000	✔	38	10 µF		Yes	94	<3	<10	QFN-24	1.80
TPS61195	4.5 to 21		Inductive	8 x 10		10 Channels	3500	✔	50	10 µF		Yes	95	<3	<10	QFN-28	1.95
TPS61176	2.7 to 6.5		Inductive	6 x 10/11		6 Channels	1000	✔	38	4.7 µF		Mixed-Mode	90	<3	<4	QFN-16	1.10
TPS61199[5]	8 to 30		Inductive	15 x 8		8 Channels	5000	✔	30	3 x 33 µF		Yes	93	<1.5	<10	SOP-20/HTSSOP-20	1.85
LP8543	4.5 to 22		Inductive	7 x 10		7P10S	2500	±0.5	V_{BOOST} + 1.6 V	4.7, 10 µF		PWM, I^2C, ALS	92	<3.5, Boost ON	—	QFN-24	2.30
TPS61196	8 to 30		Inductive	20 x 6		6 Channels	—	✔	38	100 µF		PWM	96	<1.5	<15	HTSSOP-28	1.85
LP8545	4.5 to 22		Inductive	6 x 10		6P10S	2500	±0.5	V_{BOOST} + 1.6 V	4.7, 10 µF		PWM, I^2C	95	<4, Boost ON	—	QFN-24	2.30
LP8550	4.5 to 22		Inductive	6 x 10		6P10S	2500	±0.5	V_{BOOST} + 1.6 V	4.7, 10 µF		PWM, I^2C	95	<3, Boost ON	—	micro SMD-25	1.75
LP8552	4.5 to 22		Inductive	6 x 10		6P10S	2500	±0.5	V_{BOOST} + 1.6 V	4.7, 10 µF		PWM, I^2C	95	<3, Boost ON	—	micro SMD-25	1.75
LP8553	4.5 to 22		Inductive	4 x 10		4P10S	2500	±0.5	V_{BOOST} + 1.6 V	4.7, 10 µF		PWM, I^2C	95	<3, Boost ON	—	micro SMD-25	1.75
LP8556	2.7 to 20		Inductive	6 x 10		6P10S	2600	✔	V_{BOOST} + 1.6 V	4.7, 10 µF		PWM, I^2C	95	2.2	—	micro SMD-25/ QFN-24	0.75
LM3528	2.5 to 5.5		Inductive	12	✔	2P6S	770	✔	19.25	1 µF	✔	I^2C	85	0.25	1.8	WCSP-12	1.10
LM3530	2.7 to 5.5		Inductive	11		10 Series	839	✔	40	1 µF	✔	I^2C	88	1.35	1	WCSP-12	1.60
LM3532	2.7 to 5.5		Inductive	30		3P10S	1000	✔	40	1 µF	✔	I^2C	87	1.35	1	WCSP-16	1.60
LM3533	2.7 to 5.5		Inductive	22		2P10S	1000	✔	40	1 µF	✔	I^2C	87	—	—	WCSP-20	1.80
LM3535	2.7 to 5.5		Charge pump	8		8P	—	✔	—	1 µF	✔	I^2C	92	1.1	1.7	WCSP-20	1.70
LM3537	2.7 to 5.5		Charge pump	8		8P	—	✔	—	1 µF	✔	I^2C	92	1.1	0.2	WCSP-30	1.90
LM3538	2.7 to 5.5		Charge pump	8		8P	—	✔	—	1 µF	✔	I^2C	92	1.1	0.2	WCSP-30	1.70
LM3630	2.7 to 5.5		Inductive	20		2P10S	1200	✔	40	1 µF	✔	I^2C	90	—	1.8	WCSP-12	0.40

[1] *More LEDs can be driven in parallel string configuration.*
[2] *May be via ENABLE pin, CONTROL pin or analog feedback network.*
[3] *Depends on LED current, input voltage, number of LEDs, ILED pin.*
[4] *Output current is limited to 300 mA.*
[5] *External FET needed.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

Display Power
LED Drivers—Backlighting

Selection Guide (Continued)

Device	V_{IN} (V)	Synchronous	Type	Number of LEDs[1]	OLED Capable	LED Configuration	Switch Current Limit (typ) (mA)	Current Regulation	Overvoltage Protection (min) (V)	Output Capacitor	Load-Disconnect During Shutdown	Dimming[2]	Peak Efficiency[3] (%)	Quiescent Current (typ) (mA)	Shutdown Current (typ) (µA)	Package(s)	Price*
WLED Drivers (Continued)																	
LM2756	2.7 to 5.5		Charge pump	8		8P	—	✔	—	1 µF	✔	I^2C	92	2.1	3.7	WCSP-20	1.50
LP5521	2.7 to 5.6		Charge pump	3		3P	—	✔	—	1 µF	✔	I^2C	—	—	—	WCSP-20	0.85
LP5522	2.7 to 5.7		Charge pump	1		—	—	✔	—	—	✔	1 Pin	—	—	—	WCSP-06	0.45
LP5523	2.7 to 5.8		Charge pump	9		9P	—	✔	—	1 µF	✔	I^2C	—	—	—	WCSP-25	0.90
LP5524	2.7 to 5.9		Charge pump	4		4P	—	✔	—	—	✔	—	—	—	—	WCSP-09	0.66
LM8502	2.7 to 5.10	✔	Inductive	10		10P	—	✔	—	10 µF	✔	I^2C	—	—	—	WCSP-30	1.80

[1]More LEDs can be driven in parallel string configuration.
[2]May be via ENABLE pin, CONTROL pin or analog feedback network.
[3]Depends on LED current, input voltage, number of LEDs, ILED pin.
[4]Output current is limited to 300 mA.
[5]External FET needed.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

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

[1]TLC5960 output current is limited by external FET.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

Note: UCC2xxx devices are extended temperature-range versions of the UCC3xxx devices.
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Display Power
Camera Flash LED 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).

Overvoltage Protection (OVP) — Protects the inductive driver from destruction in case faulty LEDs open the LED string.

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

Selection Guide

Device[1]	V_{IN} (V)	Max. Number of LEDs	Privacy LED	I_{OUT} (max) (mA)	Typical Switch Current (mA)	Super-Capacitor Support	Down Mode when $V_{IN} > V_{OUT}$	Control Interface	LED Temperature Monitoring	Power Save Mode	Battery Voltage-Droop Monitoring	Package(s)	Features and Differentiators	Total Solution Size (mm^2)	Price*
Camera Flash LED Drivers															
TPS61050/2	2.5 to 5.5	1	✔	1200	2000			I²C				QFN-10, WCSP-12	Voltage-mode selection pin	25	1.00
TPS61054/5	2.5 to 5.5	1		700/500	1500/1000			Simple logic signal				QFN-10, WCSP-12		25	0.85
TPS61310/1	2.5 to 5.5	3	✔	1500	—		✔	I²C	✔	✔	✔	WCSP-20	HW-reset input, dual-wire camera-module interface, Power Good	25	1.00
TPS61325	2.5 to 5.5	3	✔	4100	—	✔	✔	I²C	✔	✔		WCSP-20	Dual-wire camera-module interface, super-capacitor balancing, flash ready output	25	1.50
TPS61300/1/5	2.5 to 5.5	3	✔	4100	1850	✔	✔	I²C	✔	✔		WCSP-20	Voltage-mode selection pin (TPS61300/1) DC light-mode selection pin (TPS61300) Flash ready output, HW-reset input (TPS61301/5)	25	1.50
LM3561	2.5 to 5.5	1		600	1000/1500		✔	I²C	✔			WCSP-12	600-mA compact solution with integrated protection features	15	0.60
LM3554	2.5 to 5.5	2		1200	1000/1500/2000/2500		✔	I²C	✔		✔	WCSP-16	1.2-A inductive driver with protection features and voltage mode	23	1.30
LM3555	2.5 to 5.5	2		500	1250/1500/1750/2000			I²C	✔			WCSP- 12	Series driver with 90% efficiency and indicator LED	31	1.30
LM3556	2.5 to 5.5	1		1500	1700/1900/2500/3100		✔	I²C	✔		✔	WCSP-16	4-MHz LED driver with tiny solution size and integrated protection features	18	0.50
LM3559	2.5 to 5.5	2		1800	1400/2100/2700/3200		✔	I²C	✔		✔	WCSP-16	1.8-A inductive flash LED driver with programmable indicator blinking	26	1.40
LM3560	2.5 to 5.5	2		2000	1600/2300/3000/3600		✔	I²C	✔			WCSP-16	1.8-A inductive flash LED driver with programmable indicator blinking	26	1.45
LM3550	2.5 to 5.5	4		5000	—	✔		I²C				LLP	Super-cap flash LED driver with optimal mode to limit power dissipation	—	1.95
LM3642	2.5 to 5.5	1		1500	1700/1900		✔	I²C	✔		✔	WCSP-9	4-MHz LED driver with tiny solution size and integrated protection features	18	0.35
LM3565	2.5 to 5.5	1		930	2300/2600/2900/3300		✔	I²C	✔		✔	WCSP-16	4-MHz dual series LED driver with tiny solution size and integrated protection features	26	0.35

[1] *All of these devices have TX-Mask and safety timer DC/Flash.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

Display Power
LED Drivers—Signage/Linear

Design Factors

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

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

Output Voltage Monitor — Monitors voltages at constant current output terminals to detect LED failure and short circuit.

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

Thermal Error Flag — Indicates an overtemperature condition.

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

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

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

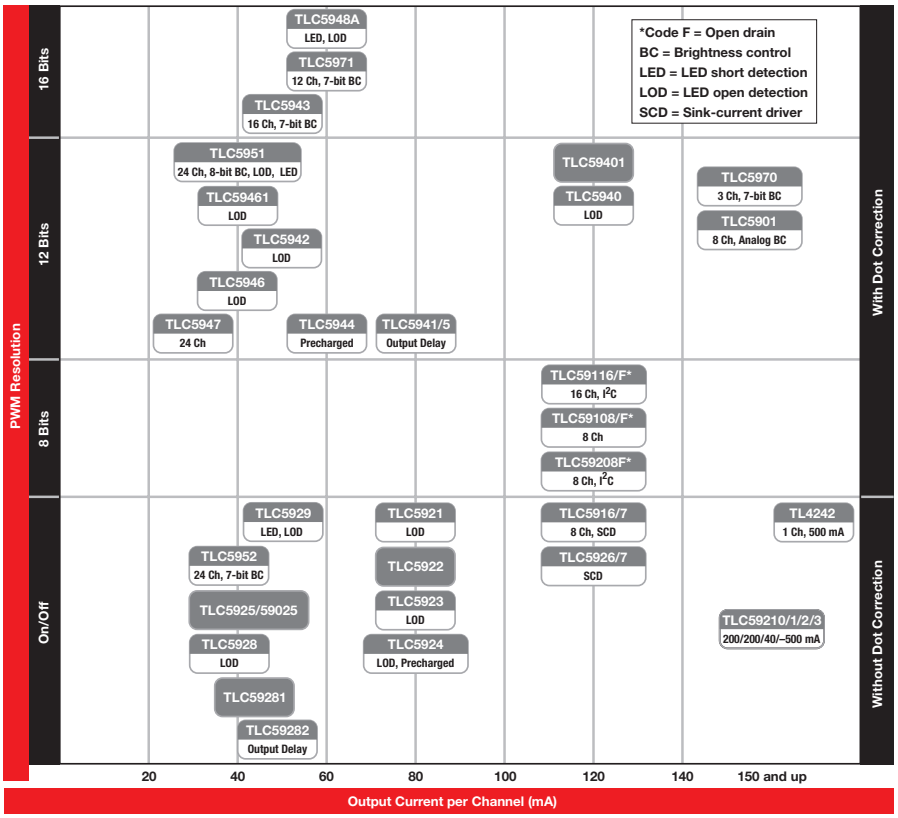
Power Save Mode — Reduces LED driver quiescent current when all outputs are off.

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

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

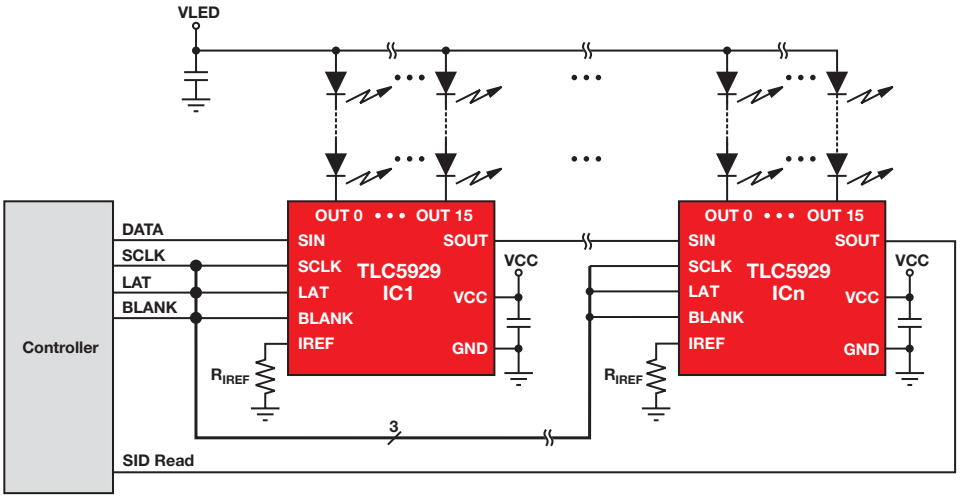
Output Leakage Detection — Indicates high resistance leakage from an output to ground.

LED Display Drivers Function Guide



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

TLC5929



Key Features

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

Get more information: **www.ti.com/product/TLC5929**

Display Power
LED Drivers—Signage/Linear

Selection Guide

Device	No. of Chan.	V_{IN} Min (V)	V_{IN} Max (V)	Output Current I_{LED} (mA)	Channel-to-Channel Accuracy (%)	Dev.-to-Dev. Accuracy (%)	Recharged FET	Short Detection	Open Detection	Overtemperature Detection	Brightness Control (Bits)	Dot Correction (Bits)	PWM Grayscale Control (Bits)	Interface	Comments	Price*
TL4242	1	4.5	42	500	—	—		✔	✔	✔				—		0.35
TLC5916	8	3.3	5.5	120	±3 (Max)	±6 (Max)			✔	✔	8			SPI		0.47
TLC5917	8	3.3	5.5	120	±3 (Max)	±6 (Max)		✔	✔	✔	8			SPI		0.60
TLC59108	8	3	5.5	100	±3 (Max)	—			✔	✔	8		8	I^2C	Constant-current ouput	0.80
TLC59108F	8	3	5.5	100	±3 (Max)	—			✔	✔	8		8	I^2C	Open-drain output	0.80
TLC59208F	8	3	5.5	50	±3 (Max)	—			✔	✔	8		8	I^2C	Open-drain output but changes the I^2C addressing capability	0.65
TLC59116	16	3	5.5	100	±6 (Max)	—			✔	✔	8		8	I^2C	Constant-current output	1.45
TLC59116F	16	3	5.5	100	±6 (Max)	—			✔	✔	8		8	I^2C	Open-drain output	1.45
TLC59210	8	3	5.5	200	—	—								Parallel	Clear function and clock pin for data latch	0.60
TLC59211	8	3	5.5	200	—	—								Parallel	No clear function and clock pin for data latch	0.55
TLC59212	8	3	5.5	40	—	—								Parallel		0.48
TLC59213/A	8	3	5.5	–500	—	—								Parallel	"A" version has 15 ns (non-"A" is 25 ns)	0.70
TLC5921	16	4.5	5.5	80	±1	±4 (Max)			✔	✔				SPI		0.85
TLC5922	16	3	5.5	80	±1	±4						7		SPI		1.35
TLC5923	16	3	5.5	80	±1	±4			✔	✔		7		SPI		1.40
TLC5924	16	3	5.5	80	±1	±4	✔		✔	✔		7		SPI		1.50
TLC5925	16	3	5	45	±4 (Max)	±6 (Max)				✔				SPI		0.50
TLC59025	16	3	5	45	±4 (Max)	±6 (Max)				✔				SPI		0.55
TLC5926	16	3	5.5	120	±6 (Max)	±6 (Max)			✔	✔	8			SPI		0.60
TLC5927	16	3	5.5	120	±6 (Max)	±6 (Max)		✔	✔	✔	8			SPI		0.65
TLC5928	16	3	5.5	35	±1	±1			✔	✔				SPI		0.50
TLC59281	16	3	5.5	35	±1	±1								SPI		0.43
TLC59282	16	3	5.5	45	±0.6	±1								SPI	4-channel grouped delay	0.47
TLC5929	16	3	5.5	50	±1	±2		✔	✔	✔	7			SPI	Power save mode, invisible error detection, 10-V VLED	0.85
TLC5930	12	3	3.6	40	±1	—				✔	6	8	10	SPI		3.00
TLC5940	16	3	5.5	120	±1	±2			✔	✔		6	12	SPI		1.25
TLC59401	16	3	5.5	120[1]/80[2]	±1	+2/–2.7				✔		6	12	SPI		1.80
TLC5941	16	3	5.5	80	±1	±2			✔	✔		6	12	SPI		1.00
TLC5942	16	3	5.5	50	±1.5	±3			✔	✔		7	12	SPI		1.10
TLC5943	16	3	5.5	50	±1.5	±3		✔	✔	✔	7		16	SPI		1.50
TLC5944	16	3	5.5	60	±1	±3	✔	✔	✔	✔		6	12	SPI		1.10
TLC5945	16	3	5.5	80	±1	±2			✔	✔		6	12	SPI		1.10
TLC5946	16	3	5.5	40	±1	±2			✔	✔		6	12	SPI		1.00
TLC59461	16	3	5.5	40	±1	±2			✔	✔		6	12	SPI	No auto-off function	1.05
TLC5947	24	3	5.5	30	±2	±2				✔			12	SPI	30-V V_{LED}, internal oscillator	1.40
TLC5948A	16	3	5.5	60	±0.6	±1		✔	✔	✔	7	7	16	SPI	Power save mode, invisible error detection, 10-V VLED	1.35
TLC5951	24	3	5.5	40	±1.5	±3		✔	✔	✔	8	7	12, 10, 8	SPI		3.00
TLC5952	24	3	5.5	35	±1	±3		✔	✔	✔	7			SPI		2.20
TLC5970	3	10	36	150	±0.5	±3		✔	✔	✔	7	7	12	Differential		3.30
TLC5971	12	3	17	60	±1	±1				✔	7		16	SPI	Integrated 3.3-V LDO	1.50

[1] *Output current with $V_{CC} > 3.6$ V.*
[2] *Output current with $V_{CC} \leq 3.6$ V.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

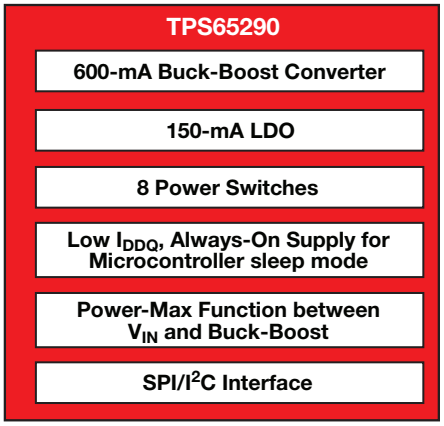
*Preview devices are listed in **bold teal**.*

Multi-Channel Power Management Units (PMUs)

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

TPS65290

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



Get more information: **www.ti.com/product/TPS65290**

Key Features

- 2.2- to 5.5-V input operating range
- 600-mA buck-boost converter
- 150-mA LDO is stable with 1-µF ceramics
- Always-on bias supply for microcontroller sleep mode with sub-500-nA quiescent current
- Automatic power-max function between V_{IN} and buck-boost output
- 8 power switches
- Factory selectable SPI/I^2C interface, GPIO interface
- –40 to 125°C junction temperature range
- 24-pin QFN package

Applications

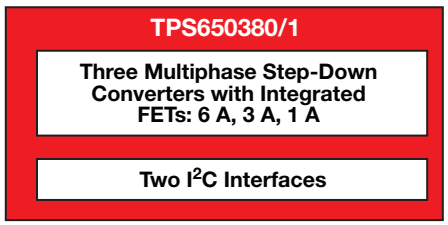
- Gas/water metering
- Energy harvesting
- Road/bridge safety monitor
- Low-power RF
- General purpose low-power applications

Multiphase PMUs with Three Step-Down Converters

TPS650380, TPS650381

The TPS650380/1 are multiphase 4-MHz PMU solutions for processor applications. The devices support low-voltage application processors in smartphones and tablets, including the latest submicron processes, and addressing digital voltage-scaling technologies such as SmartReflex™. All rails support an output-voltage range of 0.5 to 1.77 V—fully programmed via I^2C. V_{OUT} can be increased to power 3-V or 3.3-V rails with an external output voltage divider.

The PMU features built-in automatic phase shedding and current balancing for the multi-phase rails. Multi-phase solutions enable operation at high efficiency over the complete load range, which is important for handling the varying load of processors and extending battery life.



Get more information: **www.ti.com/product/TPS650380** or **TPS650381**

Key Features

- Three step-down converters:
  - 3-phase: 5/6.8 A
  - 2-phase: 2/3.7 A
  - 1-phase: 1.8 A
- Two I^2C high-speed compatible interfaces
- Soft start, Power Good indication, built-in sequencer
- Package: 49-bump, 3.25 x 3.25 mm^2 NanoFree™

Applications

- Power for application processor for smart phones, tablets and ultrabooks/netbooks
- Power for DSP, ASIC and FPGA in industrial applications
- Dynamic voltage-scale compliant processors and DSPs
- Infotainment and telematics applications

Multi-Channel Power Management Units (PMUs)

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

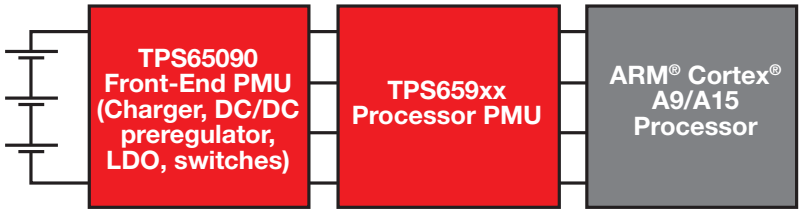
NEW

TPS65090

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

Key Features

- Charger/power-path management:
  - Up to 4-A output current on the power path
  - Switch-mode charger: Up to 4-A charge current
- Three step-down converters:
  - High efficiency over a wide output-current range
  - Input-voltage range from 6 V to 17 V
  - Two fixed output voltages (5 V and 3.3 V), up to 6 A
  - One adjustable output voltage (between 1.0 V and 3.3 V), up to 4 A
- Seven current-limited load switches:
  - One system voltage switch (backlight)
  - One 5-V switch (HDMI)
  - One 3.3-V switch (LTE/modem)
  - Four 3.3-V switches (LCD, camera, EMMC, SD)
  - All switches controlled by I^2C interface
- Two always-on LDOs:
  - Two fixed output voltages (5 V and 3.3 V)
  - Output-voltage accuracy of ±1.0%
  - Typical 10-µA quiescent current per LDO



Applications

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

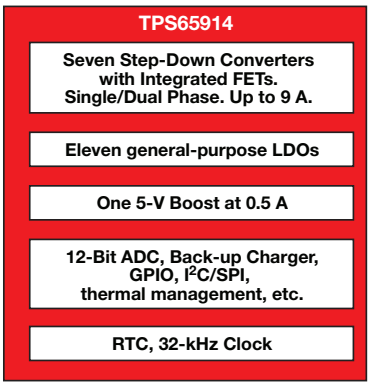
Get more information: **www.ti.com/product/TPS65090**

Processor PMU for ARM® Cortex™ A15

PREVIEW

TPS65914

The TPS65914 integrated PMU is for next-generation ARM Cortex A15 processors. The device provide seven configurable step-down converters with up to 9.0 A of output current. One of these configurable step-down converters can be combined with a 3.0-A regulator to allow up to 9.0 A of output current. The device also contain 11 LDOs. The power-up and power-down controller is configurable. The TPS65914 is available in a QFN package with a 0.5-mm pitch.



Key Features

- Seven step-down switch-mode regulators:
  - One 0.5- to 3.3-V at 6.0 A with DVS
  - One 0.5- to 3.3-V at 4.0 A with DVS
  - One 0.5- to 3.3-V at 3.0 A. Can be combined with the 6.0 A, resulting in 9.0 A.
  - Two 0.5- to 3.3-V at 2.0 A with DVS
  - Two 0.5- to 3.3-V at 1.0 A with DVS
- One 5-V output at 0.5 A for USB OTG, USB LDO and HDMI
- Eleven LDOs up to 300 mA
- Low-power ECO mode: 5 µA in off mode
- 12-bit sigma-delta ADC with 16 input channels
- Thermal monitoring

Applications

Cortex A15 processors
Tablets and other portable devices

Multi-Channel Power Management Units (PMUs)

Selection Guide

Device	V_{IN} (V)	No. of Regulator Outputs	Charger	Audio Codec	USB 2.0 OTG Transceiver	WLED Boost	DC/DC Step-Down Converter	DC/DC Step-Down Controller	LDO	Communication Interface	Description	Package(s)	Price*
General Purpose PMUs													
TPS65280/1/2	4.5 to 18.0	1	—	—	—	—	1	—	—	—	With 1 to 2 power switches	QFN-24	2.45
TPS65720/1	4.3 to 28.0	2	Linear	—	—	—	1	—	1	I^2C	Smallest single Li-Ion applications, also QFN	WCSP-25	1.65
TPS65253	4.5 to 16.0	2	—	—	—	—	2	—	—	—	General purpose (3.5 A, 2.5 A)	QFN-28	2.95
TPS65270	4.5 to 16.0	2	—	—	—	—	2	—	—	—	General purpose (3 A, 2 A), good for 2 layers	QFN-28	2.95
LM26400Y	3.0 to 20.0	2	—	—	—	—	2	—	—	—	Dual buck	LLP-16	2.25
TPS65000/6	1.8 to 6.0	3	—	—	—	—	1	—	2	—	General purpose	QFN-16	1.40
TPS65250/1	4.5 to 18.0	3	—	—	—	—	3	—	—	—	General purpose	QFN-40	3.05
TPS65257/8	4.5 to 16	3	—	—	—	—	3	—	—	—	With 1/2 USB switches	QFN-40	3.25
LM3686	2.7 to 5.5	3	—	—	—	—	1	—	2	—	General purpose	SMD-12	0.95
LP3907	2.8 to 5.5	4	—	—	—	—	2	—	2	I^2C	General purpose	SMD-25, LLP-24	2.28
LM26480	2.8 to 5.5	4	—	—	—	—	2	—	2	—	General purpose	LLP-24	1.90
LM3280	2.7 to 5.5	4	—	—	—	—	1	—	3	—	Battery powered RF	SMD-16	2.31
LP3910	2.7 to 5.5	5	Linear	—	—	—	3	—	2	I^2C	Portable with buck-boost	LLP-48	3.95
TPS65053/8	2.5 to 6.0	5	—	—	—	—	2	—	3	—	Low-cost 5x channel PMU	QFN-24	1.85
TPS65050/1/2/4/6	2.5 to 6.0	6	—	—	—	—	2	—	4	Logic H/L	Low-cost 6x channel PMU	QFN-32	1.85
LP8720	2.7 to 4.5	6	—	—	—	—	1	—	5	I^2C	General purpose	micro SMD-20	1.50
LP8725	2.6 to 4.5	9	—	—	—	—	2	—	7	I^2C	General purpose	micro SMD-30	2.30
ARM® Cortex™-R4													
TPS65381-Q1	5.8 to 36	5	—	—	—	—	1		4	I^2C	Safety-critical applications	HTSSOP-32	2.60
TPS659119-Q1	2.7 to 5.5	11	—	—	—	—	3	—	9	2x I^2C	Flexible PMU with ext DC/DC controller option	HTQFP-80	5.72
ARM Cortex A8 PMUs													
TPS65070/2/3	2.8 to 6.3	5	Linear	—	—	Yes	3	—	2	I^2C	With and without touch-screen controller	QFN-48	3.60
TPS65023x	2.5 to 6.0	6	—	—	—	—	3	—	3	I^2C	Flexible 6x-channel PMU, also WCSP package	QFN-40	3.30
TPS650250	2.5 to 6.0	6	—	—	—	—	3	—	3	—	Flexible PMU with adj V_{OUT}	QFN-32	2.20
TPS65217	2.7 to 6.5	7	Linear	—	—	Yes	3	—	4	—	Optimized for AM335x processors	QFN-48	3.45
TPS65921	2.7 to 4.5	7	—	—	Yes	—	3	—	4	2x I^2C	Optimized for OMAP™35x processors	BGA-139	3.60
TPS65930	2.7 to 4.5	7	—	Yes	Yes	—	3	—	4	2x I^2C	Optimized for OMAP35x processors	BGA-139	3.95
LP8765	4.5 to 6.8	12	Linear	—	—	Yes	2	—	10	I^2C	Smartphone PMU	micro SMD-49	3.00
TPS65950	2.7 to 4.5	13	Linear	Yes	Yes	—	3	—	10	2x I^2C	Optimized for OMAP35x processors	BGA-209	4.50
TPS65951	2.7 to 4.5	13	—	Yes	Yes	—	3	—	10	2x I^2C	Optimized for OMAP35x, 0.8-mm pitch	BGA-169	4.50
TPS65910x	2.7 to 5.5	13	—	—	—	—	3	—	9	2x I^2C	Flexible PMU with 5-V boost	QFN-48	3.45
LP3925	4.5 to 6.5	18	Linear	—	—	Yes	3	—	15	I^2C	Smartphone PMU	micro SMD-81	3.95
LP3974	4.5 to 6.5	20	Linear	—	—	—	4	—	16	I^2C	Smartphone PMU	micro SMD-100	2.46
ARM Cortex A9 PMUs													
TPS659110/2/3/9	2.7 to 5.5	13	—	—	—	—	3	1	9	2x I^2C	With DC/DC controller up to 10 A	BGA-98	4.45
TPS65862x/4x	4.3 to 6.5	14	Linear	—	—	Yes	3	—	11	I^2C	Nvidia Tegra 2 and other microprocessors	BGA-121	5.95
TPS65912x	2.3 to 5.5	14	—	—	—	—	4	—	10	I^2C/SPI	Flexible PMU with 4 DC/DC converters	WCSP-81	4.45
LP8788	4.5 to 6.5	26	Linear	—	—	Yes	4	—	22	I^2C	Smartphone PMU	micro SMD-100	TBD
TWL6030/32/40/41	2.3 to 5.5	18	Switch	Yes	—	—	7	—	11	2x I^2C	OMAP4 power and audio	FBGA + PBGA	6.35
ARM Cortex A15 PMUs													
TPS650380	2.5 to 5.5	3	—	—	—	—	3	—	—	2x I^2C	Multiphase DC/DC technology	NanoFree™-49	TBD
TPS659039-Q1	3.15 to 5.5	12	—	—	—	—	7	—	5	2x I^2C	Cortex A15 processors	nfBGA, mrQFN-st	TBD
TPS65914	2.3 to 5.5	18	—	—	—	1	6	—	11	2x I^2C	Cortex A15 processors	WCSP, mrQFN	TBD
TPS659038-Q1	3.15 to 5.5	18	—	—	—	—	7	—	11	2x I^2C	Cortex A15 processors	nfBGA, mrQFN-st	TBD

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

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

Multi-Channel Power Management Units (PMUs)

Selection Guide (Continued)

Device	V_{IN} (V)	No. of Regulator Outputs	Charger	Audio Codec	USB 2.0 OTG Transceiver	WLED Boost	DC/DC Step-Down Converter	DC/DC Step-Down Controller	LDO	Communication Interface	Description	Package(s)	Price*
Special Function PMUs													
TPS65200	2.5 to 6.5	0	Switch	—	—	Yes	—	—	—	I^2C	Front-end PMU with charger+WLED	WCSP, QFN	2.45
TPS658310	3.0 to 6.0	0	Switch	—	—	Yes	—	—	—	I^2C	Front-end PMU with charger+flash+WLED	WCSP-49	3.45
TPS65735/835	2.5 to 6.4	2	Linear	—	—	—	—	—	1	—	3D glasses, x835 with MSP430™	QFN-40	1.25
TPS65290	2.5 to 5.5	2	—	—	—	—	1	—	1	I^2C	Meters, energy-harvesting, +10-year battery	QFN-24	TBD
TPS65320	3.6 to 40	2	—	—	—	—	1	—	1	—	Eco-mode™ 3.2-A buck + LDO	HTSSOP-14	1.10
LM10502	2.5 to 5.5	3	—	—	—	—	2	—	1	SPI	PMU for SSD memory	micro SMD-34	0.80
TPS65090	5.0 to 17.0	5	Switch	—	—	—	3	—	2	I^2C	Front-end PMU for 2 to 3 Li-Ion in series	QFN-100	4.95

**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 teal**.*

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

Processor	Part Number	PMU
TI	C2834x	TPS65000, TPS650061
TI	C55x	TPS65000x
TI	C6742/6/8	TPS65910, TPS65070, TPS65023
TI	C6745/7	TPS65910, TPS65023
TI	C6A814x	TPS659113
TI	C6A816x	TPS659112
TI	DM335, DM355, DM365, DM367	TPS65053, TPS65070
TI	DM368	TPS650532, TPS65023
TI	DM385	TPS659113
TI	DM37x 800MHz	TPS6595x/30/2x/10, TPS65023, TPS650731
TI	DM37x 1GHz	TPS65950A3/x51/x21B1/x10, TPS65023, TPS650731
TI	DM643x, DM644x	TPS65023, TPS659105
TI	DM812x/ DM814x	TPS659113
TI	DM816x	TPS659112
TI	AM17x	TPS65910, TPS65000x, TPS650061, TPS65023
TI	AM18x	TPS65910, TPS65000x, TPS650061, TPS65070
TI	AM335x	TPS65910A/A3, TPS65217, TPS650250
TI	AM35x	TPS65910, TPS650732, TPS65023
TI	AM37x 800MHz	TPS6595x/30/2x/10, TPS65023, TPS650731
TI	AM37x 1GHz	TPS65950A3/x51/x21B1/x10, TPS65023, TPS650731
TI	AM387x	TPS659113
TI	AM389x	TPS659112
TI	RM4x, TMS570	TPS65381-Q1
TI	OMAP™3503/15/25/30	TPS6595x/30/2x/10, TPS65073x, TPS65023
TI	OMAP3611/21/30	TPS6595x/30/2x/10, TPS65023
TI	OMAP-L132, L137, L138	TPS65910, TPS65023, TPS650061, TPS65070
TI	OMAP4430/60/70	TWL6030, TWL6032
TI	Jacinto 6	TPS659038-Q1, TPS650939-Q1

Processor	Part Number	PMU
Altair	3100/6200	TPS659122
Ambarella	iOne	Please ask TI
Freescale	IMX25	TPS65051/2
Freescale	IMX27	TPS65053, TPS659107
Freescale	IMX35	TPS650250, TPS659107
Freescale	IMX508	TPS659108
Freescale	IMX51	TPS659109
Freescale	IMX53	TPS659106
Freescale	IMX6x	Please ask TI
Leadcore	LC1810	LP8788
Marvell	PXA270	TPS65021/2
Marvell	Armada	Please ask TI
Nvidia	Tegra 2	TPS658621/2/3, TPS658640/3
Nvidia	Tegra 3	TPS659110/9
Nvidia	Tegra 4	TPS65914
Nvidia	i450, i500	TPS659121
Rockchip	RK29	TPS659102
Rockchip	RK30	TPS65910x
Samsung	S5PV210, S5PC110	TPS659101
Samsung	S5PC100	TPS659103, LP3974
Samsung	S5P6440	TPS659104
Samsung	S5PV310	Please ask TI
Samsung	Exynos 4210	Please ask TI
STM	SPEAr 300	TPS650532
STM	SPEAr 1310	Please ask TI

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

PMU solutions with and without battery charger:
www.ti.com/pmu

TI power-management reference designs:
www.ti.com/processorpower

Power Protection, Distribution and Monitoring
Overview

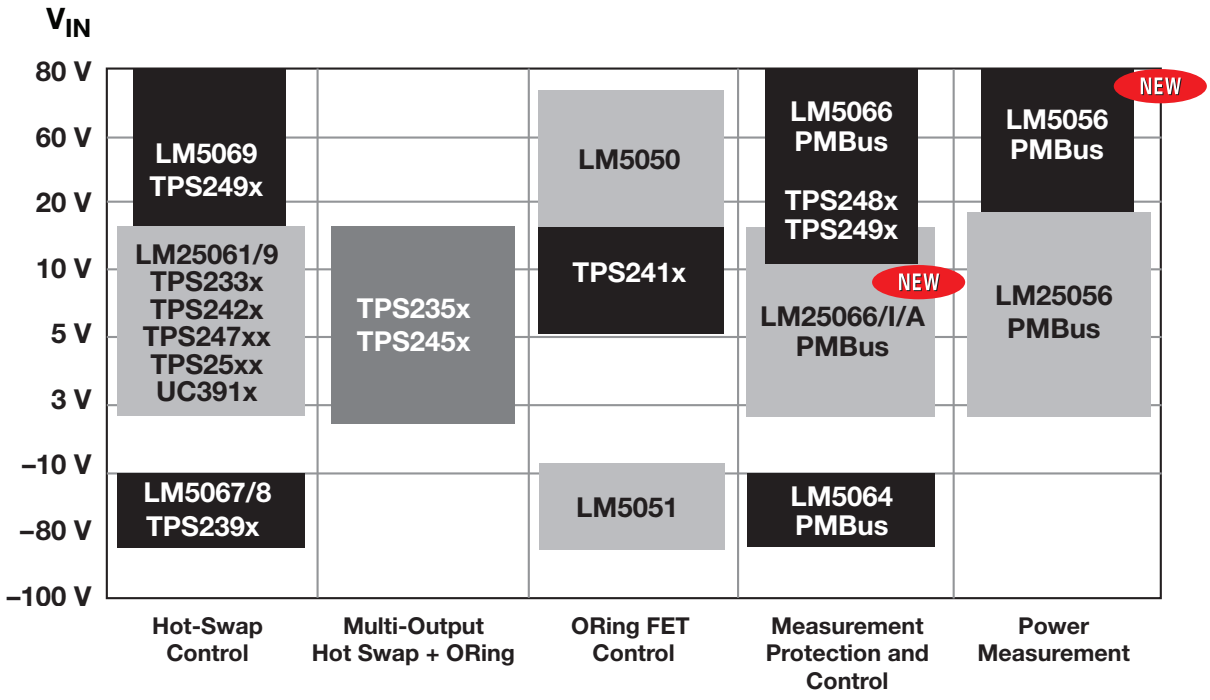
Distributing and controlling power—even after the correct voltage is derived—is becoming more complex. Because increasing numbers of voltage rails are required in today's advanced processing or embedded systems, distributing and managing these rails is a constant challenge.

Load switches, MUXes, or inrush-protection devices are routinely required to safely route power where it is needed and deliver it properly. When power needs to be moved from system to system, issues like hot-swap control, safety certification, and monitoring quickly become top priorities.

Digital control takes all of these concerns and capabilities to yet another level. Microprocessor control and monitoring in system health and power blocks gives designers even more options to improve the robustness of their system. Using digital interfaces to various functional blocks and sensors, it is possible to monitor the power or current consumption, system temperature, or other variables, and then take action.

Hot-Swap Control, Protection and Monitoring

Protection Power Portfolio



Power Protection, Distribution and Monitoring

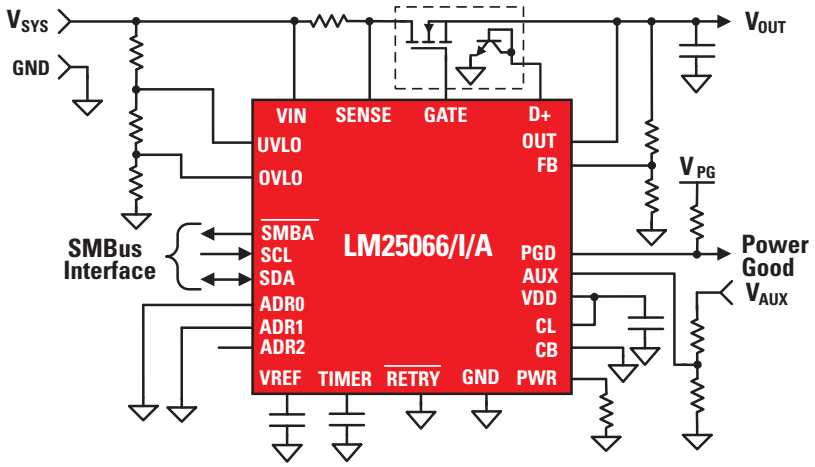
Hot-Swap Control, Protection and Monitoring

System Power Management and Protection IC with PMBus

NEW

LM25066, LM25066I, LM25066A

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



Typical application circuit.

Get more information: **www.ti.com/product/LM25066**

Key Features

- Intel Node Manager 2.0 compliant
- Hot swap with current and power limiting
- Adjustable current limit, circuit breaker thresholds
- Measure voltage, current, power and temperature
- Simultaneous sampling of current and voltage for true power measurement
- Peak and programmable average power capture
- Dynamic configuration of fault and warning levels
- I^2C/SMBus interface with PMBus compliance

Applications

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

Hot Swap Switches (Integrated FET) Selection Guide

Device	Target Applications	Channels	V_{IN} (V)	Current Limit (A)	$r_{DS(on)}$ per FET (typ) (mΩ)	Enable/ Shutdown	Ramp	Package(s)	Price*
TPS2420	Hot swap with current monitor & pwr limiting	1	3 to 20	1 to 5	20	1L	Current	16-pin SON	1.95
TPS2421-1	Hot swap with pwr limiting, latch-off on fault	1	3 to 20	1 to 5	20	1L	Current	SOIC-8	1.60
TPS2421-2	Hot swap with pwr limiting, retry on fault	1	3 to 20	1 to 5	20	1L	Current	SOIC-8	1.60
TPS2552	Current-limiting switch, constant-current	1	2.5 to 6.5	0.75 to 1.5	85	1L	Current	6-pin SOT-23, SON	0.70
TPS2552-1	Current-limiting switch, latch-off on fault	1	2.5 to 6.5	0.75 to 1.5	85	1L	Current	6-pin SOT-23, SON	0.70
TPS2553	Current-limiting switch, constant-current	1	2.5 yo 6.5	0.75 to 1.5	85	1H	Current	6-pin SOT-23, SON	0.70
TPS2553-1	Current-limiting switch, latch-off on fault	1	2.5 to 6.5	0.75 to 1.5	85	1H	Current	6-pin SOT-23, SON	0.70
TPS2554	Current-limiting switch, constant-current	1	4.5 to 5.5	0.25 to 2.8	73	1H	Current	8-pin SON	0.80
TPS2555	Current-limiting switch, constant-current	1	4.5 to 5.5	0.25 to 2.8	73	1L	Current	8-pin SON	0.80
TPS2556	Current-limiting switch, constant-current	1	2.5 to 6.5	0.5 to 5	22	1L	Current	8-pin SON	0.90
TPS2557	Current-limiting switch, constant-current	1	2.5 to 6.5	0.5 to 5	22	1H	Current	8-pin SON	0.90
TPS2560/A	Current-limiting switch, constant-current	2	2.5 to 6.5	0.25 to 2.5	45	2L	Current	10-pin SON	0.90
TPS2561/A	Current-limiting switch, constant-current	2	2.5 to 6.5	0.25 to 2.5	45	2H	Current	10-pin SON	0.90
TPS2590	Current-limiting switch, configurable fault	1	3 to 20	1 to 5	20	1L	Current	16-pin SON	1.05
TPS25910	Current-limiting switch with internal FET, adj. ramp	1	3 to 20	1 to 6	30	1L	Adj. dv/dt	16-pin SON	1.05
UCC3915	Enclosure management, general	1	7 to 15	0 to 3	150	1L	Current	SOIC-16, TSSOP-24	2.55
UCC3912	RAID, SCSI, general	1	3 to 8	0 to 3	150	1L	Current	SOIC-16, TSSOP-24	2.30
UCC3918	RAID, SCSI, general	1	3 to 6	0 to 4	75	1L	Current	SOIC-16, TSSOP-24	2.35

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

Power Protection, Distribution and Monitoring

Hot-Swap Control, Protection and Monitoring

Hot Swap Controllers (External FET) Selection Guide

Device	Target Applications	Channels	V_{IN} Range (V)	Features[1]							Ramp	Power Limiting	Package(s)	Price*
				Enable/ Shutdown	UV	OV	Fault	PG	Latch	Auto Retry				
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[2]	S[2]	Current	No	16-pin SOIC/TSSOP	2.35
TPS2342	CompactPCI, PCI-X®, PC-X2.0	12	3.3, V_{aux}, V_{IO}, 5, +12, –12	1L	✔			✔	✔		Voltage	No	80-pin HTQFP	7.00
TPS2343	CompactPCI, PCI-X, PC-X2.0	12	3.3, V_{aux}, V_{IO}, 5, +12, –12	1L	✔			✔	✔		Voltage	No	80-pin HTVSOP	7.50
TPS2350	Full featured –48-V telecom, LS active ORing	2	–12 to –80	1H	✔	✔	✔	✔		✔	Current	No	14-pin SOIC/TSSOP	1.90
TPS2358	xTCA mezzanine cards, general 12 V	2	8.5 to 17	2L	✔		✔	✔	✔		Current	No	48-pin QFN	4.00
TPS2359	xTCA mezzanine cards, general 12 V	2	8.5 to 17	1H/1L	✔	✔	✔	✔	S[2]	S[2]	Current	No	36-pin QFN	5.00
TPS2363	PCI Express®	6	3.3 V_{aux}, 3.3, +12	1L	✔		✔	✔	✔		Voltage	No	48-pin QFP	2.50
TPS2390	Simple –48-V telecom	1	–36 to –80	1H			✔		✔		Current	No	8-pin MSOP	1.00
TPS2391	Simple –48-V telecom	1	–36 to –80	1H			✔			✔	Current	No	8-pin MSOP	1.00
TPS2392	Full featured –48-V telecom	1	–20 to –80	1H	✔	✔	✔	✔	✔		Current	No	14-pin TSSOP	1.35
TPS2393	Full featured –48-V telecom	1	–20 to –80	1H	✔	✔	✔	✔		✔	Current	No	14/44-pin TSSOP	1.35
TPS2393A	Full featured –48-V telecom (Fast retry)	1	–20 to –80	1H	✔	✔	✔	✔		✔	Current	No	14-pin TSSOP	1.35
TPS2394	Full featured, ESD ruggedized –48-V hotswap	1	–12 to –80	1H	✔	✔	✔	✔		✔	Current	No	14-pin TSSOP	1.35
TPS2398	Simple –48-V telecom with PG	1	–36 to –80	1H				✔	✔		Current	No	8-pin MSOP	1.35
TPS2399	Simple –48-V telecom with PG	1	–36 to –80	1H				✔		✔	Current	No	8-pin MSOP	1.35
TPS2400	Overvoltage/undervoltage protection IC	1	2 to 100	1H	✔	✔			✔		—	No	5-pin SOT-23	0.80
TPS2456	Inrush controller with reverse current control	2	8.5 to 15	2H	✔		✔	✔	✔		Current	No	36-pin QFN	3.75
TPS2458	xTCA mezzanine cards, general 12 V	1	8.5 to 15	1L	✔		✔	✔	✔		Current	No	32-pin QFN	2.00
TPS2459	xTCA mezzanine cards, general 12 V	1	8.5 to 15	1H/1L	✔	✔	✔	✔	S[2]	S[2]	Current	No	32-pin QFN	2.50
TPS24700	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✔			✔	✔		Current	No	8-pin MSOP	1.10
TPS24701	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✔			✔		✔	Current	No	8-pin MSOP	1.10
TPS24710	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✔		L	L	✔		Current	Yes	10-pin MSOP	1.25
TPS24711	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✔		L	L		✔	Current	Yes	10-pin MSOP	1.25
TPS24712	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✔		H	H	✔		Current	Yes	10-pin MSOP	1.25
TPS24713	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✔		H	H		✔	Current	Yes	10-pin MSOP	1.25
TPS24720	Industrial, mass storage, servers, telecom	1	2.5 to 18	1H	✔	✔	✔	✔	S[2]	S[2]	Current	Yes	16-pin SON	1.40
TPS2490	Servers, basestations, +48 V, +12 V	1	9 to 80	1H	✔			✔	✔		Current	Yes	10-pin MSOP	1.40
TPS2491	Servers, basestations, +48 V, +12 V	1	9 to 80	1H	✔			✔		✔	Current	Yes	10-pin MSOP	1.40
TPS2492	Servers, basestations, industrial, +48 V, +12 V	1	9 to 80	1H	✔	✔	✔	✔	✔		Current	Yes	14-pin TSSOP	1.45
TPS2493	Servers, basestations, industrial, +48 V, +12 V	1	9 to 80	1H	✔	✔	✔	✔		✔	Current	Yes	14-pin TSSOP	1.45
LM25069	12-V hotswap controller with power limiting	1	2.9 to 17	1H	✔	✔	✔	H	-1	-2	Current	Yes	10-pin MSOP	1.19
LM25061	12-V hotswap controller with power limiting	1	2.9 to 17	1H	✔		✔	H	-1	-2	Current	Yes	10-pin MSOP	1.33
LM5060/Q	Low Iq high-side protection controller	1	5.5 to 65	1H	✔	✔	✔	L	✔		Voltage	No	10-pin MSOP	1.28/1.40
LM5069	+48-V hotswap controller with power limiting	1	9 to 80	1H	✔	✔	✔	H	-1	-2	Current	Yes	10-pin MSOP	1.35
LM5068	Simple –48-V hotswap controller family	1	–10 to –90	1H	✔	✔	✔	H/H/L/L	-1/-3	-2/-4	Current	No	8-pin MSOP	1.35
LM5067	–48-V hotswap controller with power limiting	1	–9 to –80	1H	✔	✔	✔	H	-1	-2	Current	Yes	10-pin MSOP/14-pin SOIC	1.50

[1] *Pin function: L = active low, H = active high.*
[2] *S = Selectable.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Power Protection, Distribution and Monitoring

Hot-Swap Control, Protection and Monitoring

Protection and Monitoring with PMBus/I²C Selection Guide

Device	V_{IN} Range (V)	Enable/ Shutdown	UV	OV	Fault	PG	Latch	Auto Retry	Interface	Power Limiting	Package(s)	Price*
LM25066/A	2.9 to 17	1H	✔	✔	✔	✔	Prog	Prog	I²C, SMBus, PMBus	Yes	24-pin LLP	2.45/2.95
LM25066I/A	2.9 to 17	1H	✔	✔	✔	✔	Prog	Prog	I²C, SMBus, PMBus	Yes	24-pin LLP	2.45/2.95
TPS2480/1	9 to 80	1H	✔			✔	✔		I²C	Yes	20-pin TSSOP	3.00
LM5066	10 to 80	1H	✔	✔	✔	✔	Prog	Prog	I²C, SMBus, PMBus	Yes	28-pin eTSSOP	3.95
LM5064	–10 to –80	1H	✔	✔	✔	✔	Prog	Prog	I²C, SMBus, PMBus	Yes	28-pin eTSSOP	3.95

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

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

Monitoring with PMBus/I²C Selection Guide

Device	V_{IN} Range (V)	Enable/ Shutdown	Fault	Telemetry Data				Interface	Package(s)	Price*
				V_{IN}	I_{IN}	P_{IN}	Temp			
LM25056/A	3 to 17	1H	✔	✔	✔	✔	✔	I²C, SMBus, PMBus	24-pin LLP	1.50/1.70
LM5056	10 to 80	1H	✔	✔	✔	✔	✔	I²C, SMBus, PMBus	28-pin TSSOP	2.49

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

ORing Controllers Selection Guide

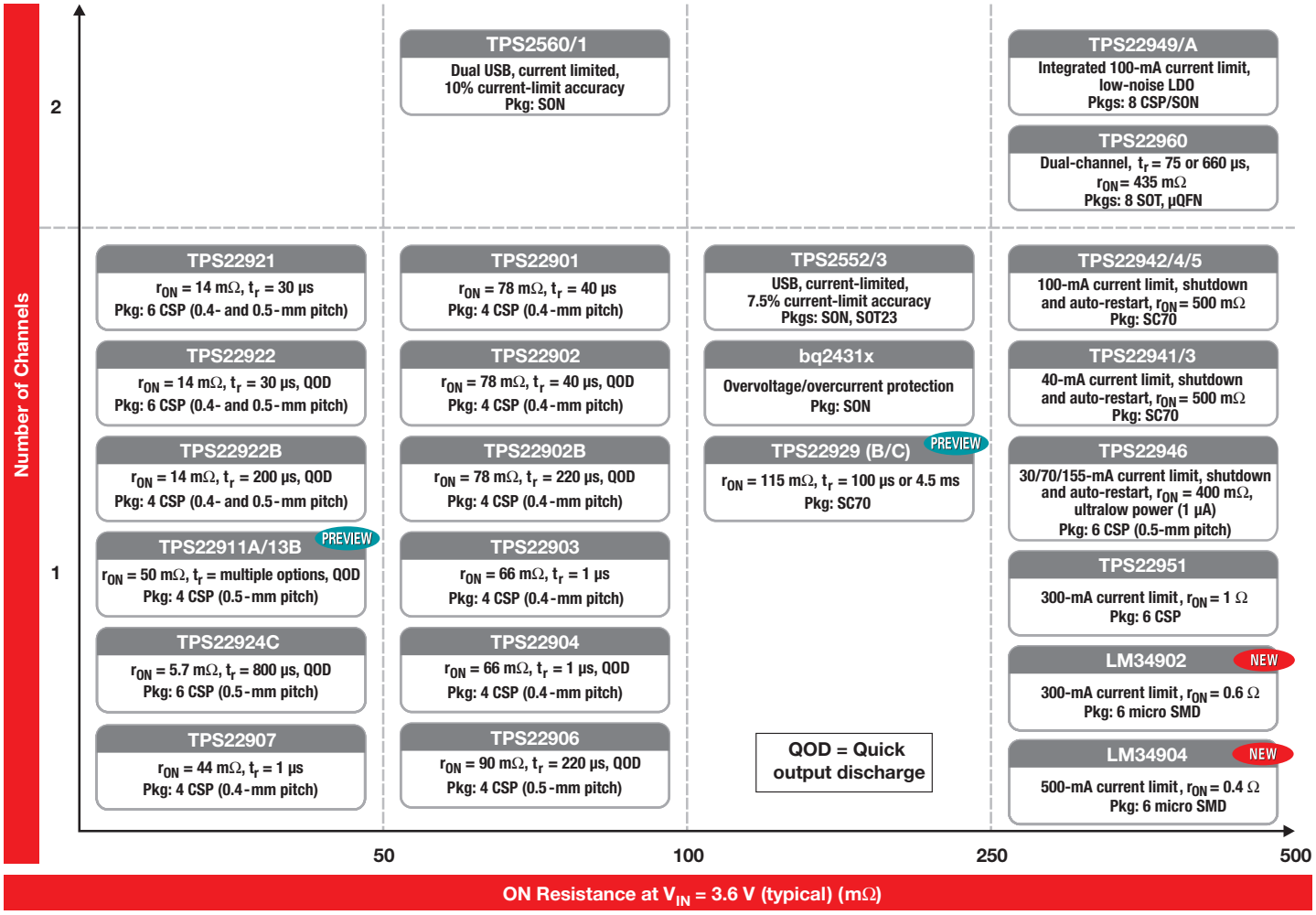
Device	Description	Channels	V_{IN} Range (V)	Enable/ Shutdown	UV	OV	Fault	PG	ORing Linear Gate Drive	On/Off ORing Function	Package(s)	Price*
TPS2410	ORing FET controller/MUX controller	1	0.8 to 16.5	1H	✔	✔	✔	✔	✔		14-pin TSSOP	1.70
TPS2411	ORing FET controller/MUX controller	1	0.8 to 16.5	1H						✔	14-pin TSSOP	1.70
TPS2412	ORing FET controller	1	0.8 to 16.5						✔		8-pin SOIC, 8-pin TSSOP	1.20
TPS2413	ORing FET controller	1	0.8 to 16.5							✔	8-pin SOIC, 8-pin TSSOP	1.20
TPS2419	ORing FET controller with OV/enable	1	3 to 16.5	1H		✔				✔	8-pin SOIC	1.20
LM5050-1	Positive HV ORing controller with AUX input	1	5 to 80	L					✔	✔	6-pin TSOT	1.25
LM5050-2	Positive HV ORing controller with FET test	1	6 to 80	L			✔		✔	✔	6-pin TSOT	1.25
LM5051	Negative HV ORing controller with FET test	1	–6 to –100	L			✔		✔	✔	8-pin SOIC	1.25
TPS2456	Inrush/reverse current controller for dual sources	2	8.5 to 15	2H	✔		✔	✔	✔		36-pin QFN	3.45
TPS2358	Dual 12-V/3.3-V hotswap/ORing controller	2	8.5 to 15	2L							48-pin QFN	4.00
TPS2359	Dual 12-V/3.3-V hotswap/ORing controller	2	8.5 to 15	Via I²C							36-pin QFN	5.00

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

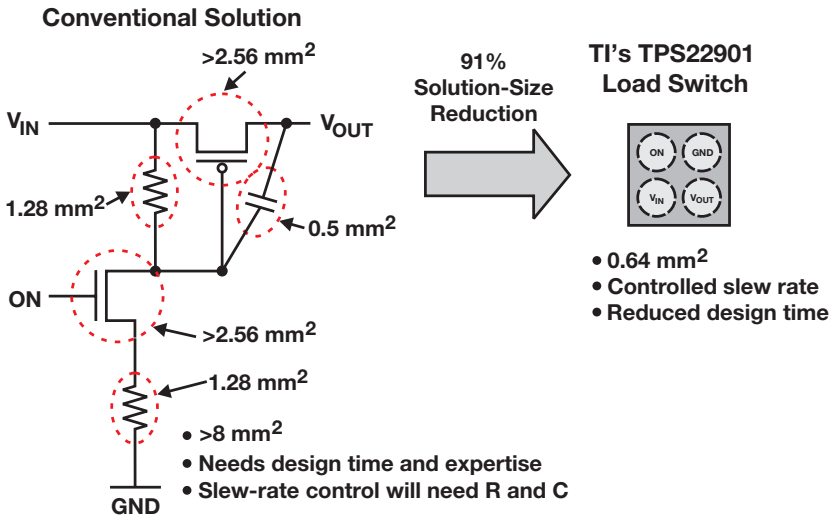
Power Protection, Distribution and Monitoring

Current-Limited and Non-Current-Limited Load Switches

Portable Electronics Integrated Load Switches Product Portfolio



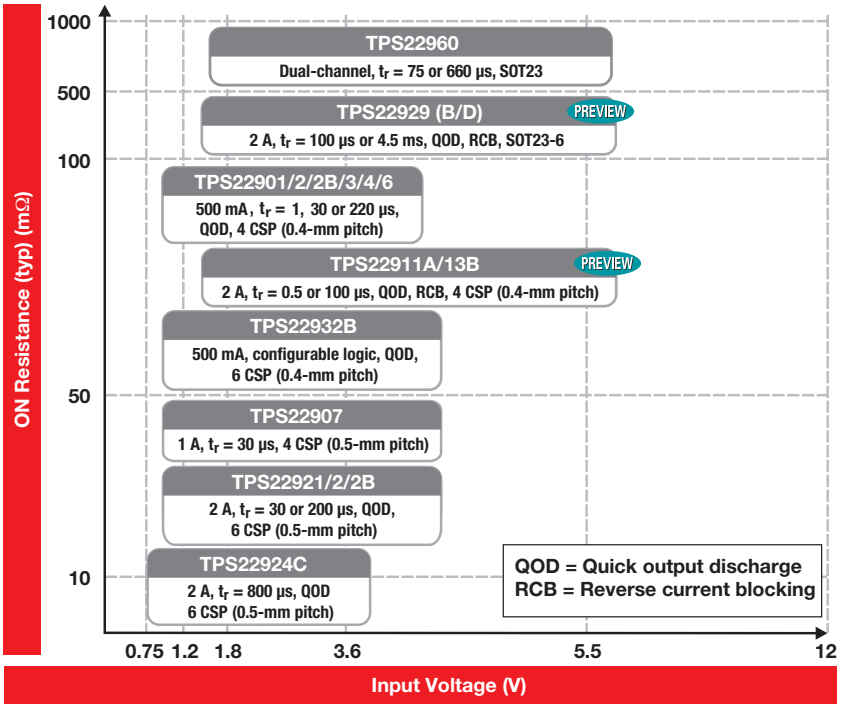
The Integration/Size Advantage of Load Switches



Power Protection, Distribution and Monitoring

Current-Limited and Non-Current-Limited Load Switches

Non-Current-Limited Load Switches Product Portfolio



Selection Guide

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

Device	Input Voltage Range (V)	r_{ON} at 1.8 V (Ω)	Current Limit (mA)	Current-Limit Blanking Time (ms)	Auto-Restart Time (ms)	Active	Package(s)	Price*
Current-Limiting Load Switches								
TPS22941	1.62 to 5.5	1.1	40	10	80	Low	5 SC70	0.42
TPS22942	1.62 to 5.5	1.1	100	10	80	Low	5 SC70	0.42
TPS22943	1.62 to 5.5	1.1	40	0	—	High	5 SC70	0.42
TPS22944	1.62 to 5.5	1.1	100	0	—	High	5 SC70	0.42
TPS22945	1.62 to 5.5	1.1	100	10	80	High	5 SC70	0.42
TPS22946	1.62 to 5.5	0.6	155/70/30	10	70	High	6 CSP	0.55
TPS22949/A	1.62 to 4.5	1	100	12	70	High	8 CSP/SON	0.70
TPS22951	2.8 to 5.3	1	600	—	—	High	6 CSP	0.45
LM34902/4	2.8 to 5.3	0.6/0.4	300/500	—	—	High	micro SMD-6	0.29/0.33

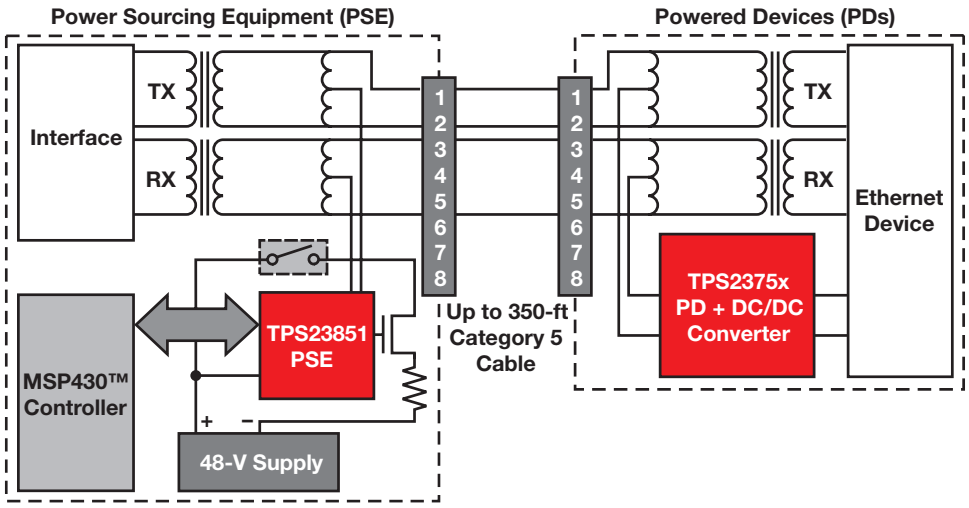
**Suggested resale price in U.S. dollars in quantities of 1,000.*

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

Power Protection, Distribution and Monitoring

Power-over-Ethernet (PoE)

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



The new TPS23851 and TPS2375x are IEEE 802.3at-compliant power-management ICs designed for managing the connection between PSE and PDs over Ethernet cables. The TPS23851 is a quad-port PSE power manager with external FETs and individual ADCs per port for maximum monitoring and control.

Original PoE . . . Only Better!

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

TPS23753A

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

TPS23750

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

New PoE Products for a New Standard

Get more information: **www.ti.com/poe**

IEEE 802.3at PoE High-Power PD Interface

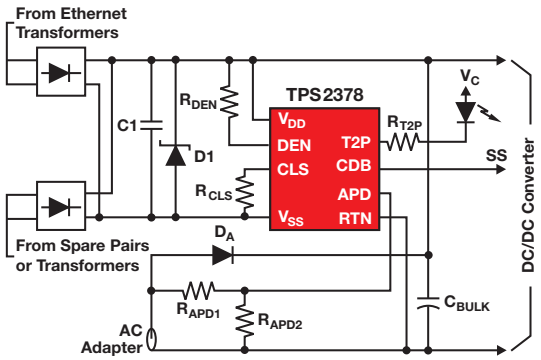
TPS2378, TPS2379, TPS23751, TPS23752

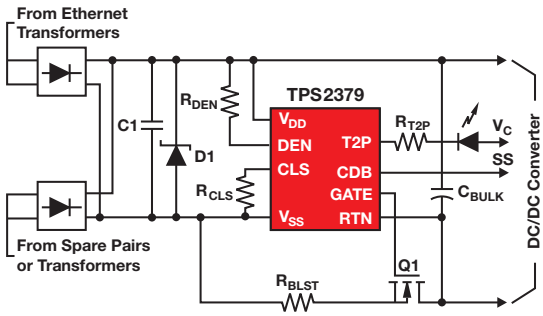
NEW

The TPS2378 and TPS2379 PDs are specifically designed for high-power POE systems such as surveillance system cameras and wireless access points. Full 802.3at compliance along with a large and growing collection of proven reference designs makes it easy to create a robust, rugged and compliant PD system.

Key Features

- TPS2378 – Programmable AUX input that forces load to be powered from AUX supply if available
- TPS2379 – Gate drive for external NFET allows designer to select external FET for desired current limit
- 802.3at-compliant hardware
- 100-V monolithic process





Get more information: **www.ti.com/product/TPS2378, TPS2379, TPS23751 or TPS23752**

Power Protection, Distribution and Monitoring

Power-over-Ethernet (PoE)

Selection Guide

Device	Description	Abs Max V_{IN} (V)	Operating Temp (°C)	Full Inrush Current Limiting	Current Limit (mA)	Second Gate Driver for Maximum Efficiency	Package(s)	Price*
Power-over-Ethernet (PoE) Powered Device (PD) Controllers with Integrated DC/DC Controllers								
TPS23750/70	Integrated PD with PWM controller	100	–40 to 85	Fixed	405	No	TSSOP-20	1.50
TPS23753A	PD+controller with AUX ORing	100	–40 to 85	Fixed	405	No	TSSOP-14	1.45
TPS23754/6	High-power PD + high-efficiency controller	100	–40 to 125	Fixed	850	Yes	TSSOP-20 PowerPAD™	1.90
TPS23757	PD + high-efficiency controller	100	–40 to 125	Fixed	405	Yes	TSSOP-20	1.65
TPS23751/2	PD with Green Mode PWM	100	–40 to 85	Fixed	800	No - VF	TSSOP-20	1.50
LM5070	Integrated PD with PWM controller	80	–40 to 125	Prog	500	No	TSSOP-16	1.45
LM5071	Integrated PD with PWM controller and AUX interface	80	–40 to 125	Fixed	390	No	TSSOP-16	1.45
LM5072	Integrated PD with PWM controller and AUX control	100	–40 to 125	Prog	800	No	TSSOP16	1.85

Device	Description	Detection	Classification	Abs Max V_{IN} (V)	Operating Temp (°C)	Full Inrush Current Limiting	Current Limit (mA)	Auto Retry or Latch Off in Fault	UVLO	DC/DC Interface	Package(s)	Price*
Power-over-Ethernet (PoE) Powered Device (PD) Interface Front-End Controllers												
TPS2375/-1	Powered device controller	4	Yes, Class 0-4	100	–40 to 85	Programmable	450	Latch Off/Retry	802.3af (30.6/39.4 V)	PG	SOIC-8, TSSOP-8/TSSOP-8	1.00
TPS2376	Powered device controller	4	Yes, Class 0-4	100	–40 to 85	Programmable	450	Latch Off	Adjustable	PG	SOIC-8, TSSOP-8	1.00
TPS2376-H	High-power PD controller	4	Yes, Class 0-4	100	–40 to 85	Programmable	600	Auto Retry	Adjustable	PG	SOIC-8	1.25
TPS2377	Powered device controller	4	Yes, Class 0-4	100	–40 to 85	Programmable	450	Latch Off	Legacy (30.5/35.0 V)	PG	SOIC-8, TSSOP-8	1.00
TPS2377-1	Powered device controller	4	Yes, Class 0-4	100	–40 to 85	Programmable	450	Auto Retry	Legacy (30.5/35.0 V)	PG	SOIC-8	1.00
TPS2378	PD with AUX control	4	Yes, Class 0-4	100	–40 to 85	Fixed	800	Auto Retry	30.5/35	PG	SOIC-8	1.00
TPS2379	PD with high power	4	Yes, Class 0-4	100	–40 to 85	Fixed	800	Auto Retry	30.5/35	PG	SOIC-8	1.00
LM5073	PD controller w/AUX control	4	Yes, Class 0-4	100	–40 to 85	Programmable	800	Auto Retry	Adjustable	PG	TSSOP-14	1.30

Device	Applications	Channels	Abs Max V_{IN} (V)	Operating Temp (°C)	IEEE Compliant	Interface	Disconnect	Measurements	Power FET	Package	Price*
Power-over-Ethernet (PoE) Power Sourcing Equipment (PSE) Controllers											
TPS2384	Routers, switches, SOHO hubs, midspans	4	80	–40 to 125	802.3af	I^2C	Both AC and DC	Current, voltage, capacitance and temperature	Internal	64-pin LQFP	4.75
TPS23841	Proprietary, higher-power 24-V/48-V PoE switches, hubs, midspans	4	80	–40 to 125	802.3af	I^2C	Both AC and DC	Current, voltage, capacitance and temperature	Internal	64-pin LQFP	7.50
TPS23851	High power PoE for switches, hubs, midspans and industrial applications	4	70	–20 to 125	802.3at Type 1 & 2	I^2C	Both AC and DC	Current, voltage and temperature	External	36-pin SSOP	4.50

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

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

Power Protection, Distribution and Monitoring

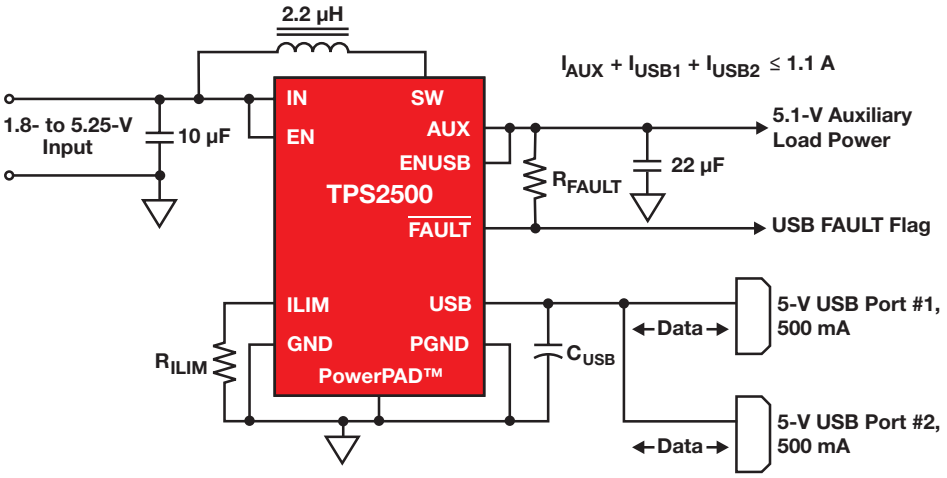
USB and Power Switches

USB Current-Limiting Power Switches

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

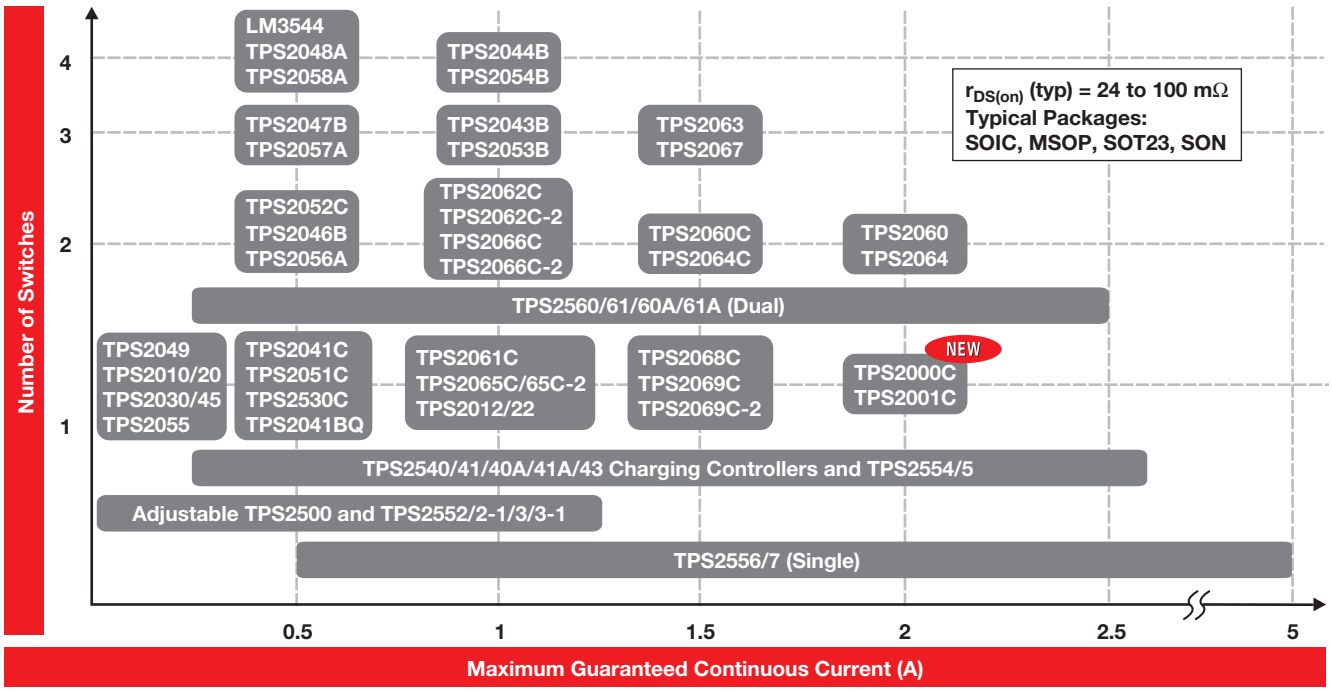
Universal Serial Bus (USB) ports are great examples of where this intelligent protection is vital for protecting your power supply and achieving regulatory compliance. TI's family of low-cost power switches are an excellent solution for USB port designs.

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



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

Current-Limited Switch Matrix



Power Protection, Distribution and Monitoring
USB and Power Switches

USB Mobile Device Charging
What is universal charging?

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

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

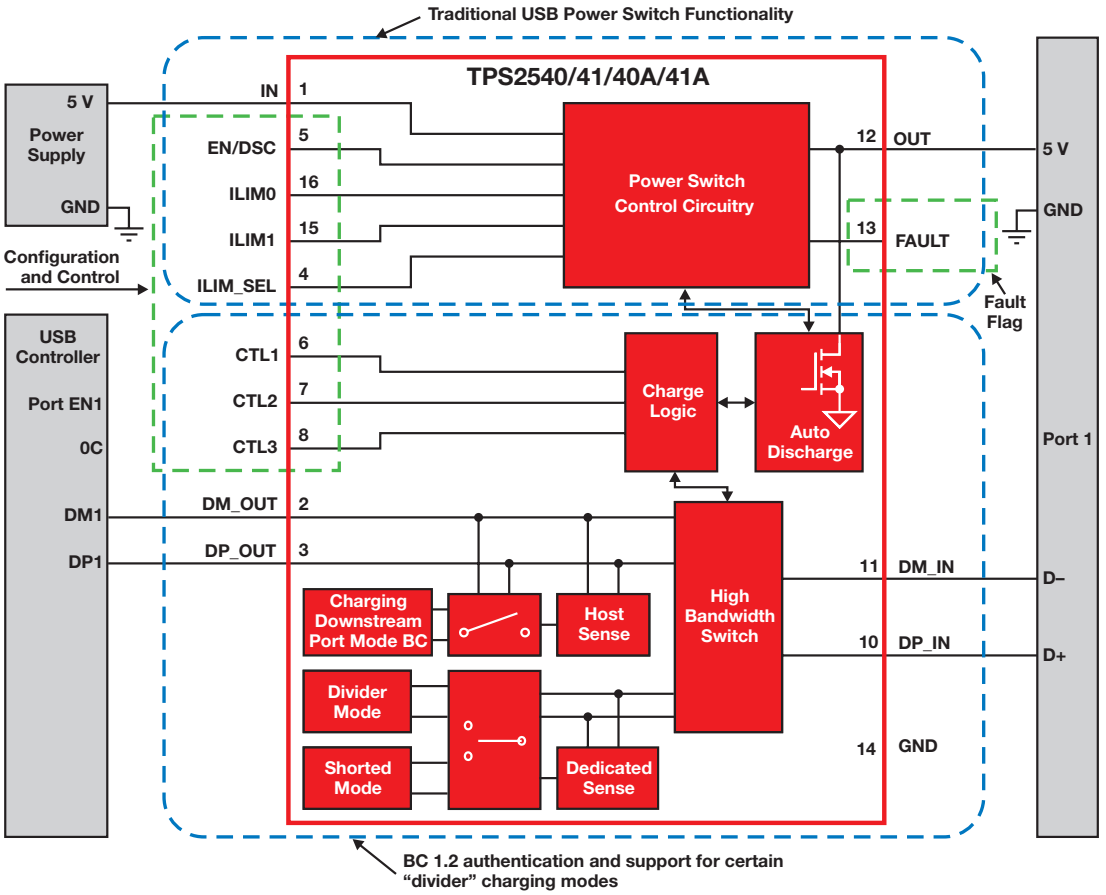
Consumers will soon expect all USB host ports to be able to charge their devices. So, if your design calls for a USB port, compliance with this standard should be part of your next product release. Common products for which consumers may want a USB charging port include LCD TVs, set-top boxes, notebook/desktop PCs and dedicated charging AC adapters. For all of these devices, the TPS254x family may be a good choice.

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

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

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

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



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

TPS2540/1 Comparison

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

Power Protection, Distribution and Monitoring

USB and Power Switches

USB Current-Limiting Switches Selection Guide

Device	Number of FETs	I_{OS} (min) (A)	$R_{DS(on)}$ (mΩ)	V_{IN} Range (V)	Supply Current (µA)	OC Logic Output	OT Logic Output	Enable	Predecessor	Price*
TPS2010A	1	0.22	30	2.7 to 5.5	73	No	No	L	TPS2010	0.75
TPS2011A	1	0.66	30	2.7 to 5.5	73	No	No	L	TPS2011	0.75
TPS2012A	1	1.1	30	2.7 to 5.5	73	No	No	L	TPS2012	0.75
TPS2013A	1	1.65	30	2.7 to 5.5	73	No	No	L	TPS2013	0.75
TPS2020/30	1	0.22	33	2.7 to 5.5	73	Yes	Yes	L/H	—	0.90
TPS2021/31	1	0.66	33	2.7 to 5.5	73	Yes	Yes	L/H	TPS2014	0.90
TPS2022/32	1	1.1	33	2.7 to 5.5	73	Yes	Yes	L/H	TPS2015	0.90
TPS2023/33	1	1.65	33	2.7 to 5.5	73	Yes	Yes	L/H	—	0.90
TPS2024/34	1	2.2	33	2.7 to 5.5	73	Yes	Yes	L/H	—	0.90
TPS2052C	2	0.7 ea	70	2.7 to 5.5	50	Yes	Yes	H	TPS2042/52/42A/52A	0.70
TPS2043B/53B	3	0.7 ea	70	2.7 to 5.5	65	Yes	Yes	L/H	TPS2043/53/43A/53A	0.90
TPS2044B/54B	4	0.7 ea	70	2.7 to 5.5	75	Yes	Yes	L/H	TPS2044/54/44A/54A	1.10
TPS2045A/55A	1	0.3	80	2.7 to 5.5	80	Yes	Yes	L/H	TPS2045/55	0.60
TPS2041C/51C	1	.67	96	4.5 to 5.5	60	Yes	Yes	L/H	TPS2051A, TPS2051B	0.45
TPS2061C/65C/65C-2	1	1.3	96	4.5 to 5.5	60	Yes	Yes	L/H/H	TPS2065	0.45
TPS2069C/69C-2	1	1.7	70	4.5 to 5.5	60	Yes	Yes	H/H	TPS2069	0.65
TPS2000C/1C	1	2.35	72	4.5 to 5.5	60	Yes	Yes	L/H	—	0.45
TPS2062C/6C/6C-2	2	1.25 ea	70	4.5 to 5.5	100	Yes	Yes	L/H/H	TPS2062/A, TPS2066/A	0.70
TPS2060C/4C/4C-2	2	1.83 ea	70	4.5 to 5.5	100	Yes	Yes	L/H/H	TPS2060, TPS2064	0.70
TPS2002C/3C	2	2.43 ea	70	4.5 to 5.5	100	Yes	Yes	L/H		0.80
TPS2049	1	0.1	400	2.7 to 5.5	43	Yes	Yes	L	TPS2041/51/41A/51A	0.55
TPS2063/7	3	1.1 ea	70	2.7 to 5.5	65	Yes	Yes	L/H	—	0.90
TPS2068/9	1	1.5	70	2.7 to 5.5	43	Yes	Yes	L/H	—	0.75
TPS2080/1/2[1]	2	0.7 ea	80	2.7 to 5.5	85	Yes	Yes	2H, 1L/1H, 2L	—	0.65
TPS2085/6/7[1]	4	0.7 ea	80	2.7 to 5.5	85	Yes	Yes	4H, 2L/2H, 4L	—	1.05
TPS2090/1/2[1]	2	0.3 ea	80	2.7 to 5.5	85	Yes	Yes	2H, 1L/1H, 2L	—	0.65
TPS2095/6/7[1]	4	0.3 ea	80	2.7 to 5.5	85	Yes	Yes	4H, 2L/2H, 4L	—	1.05
TPS2511	1	0.25 to 2.3	70	4.5 to 5.5	180	No	No	H	—	0.90
TPS2540/A/1/1A/3	1	0.25 to 2.8	73	4.5 to 5.5	150	Yes	Yes	H	—	0.90
TPS2552/53	1	0.75 to 1.3	85	2.5 to 6.5	120	Yes	Yes	L/H	—	0.75
TPS2552-1/53-1	1	0.75 to 1.3	85	2.5 to 6.5	120	Yes	Yes	L/H	—	0.75
TPS2554/55	1	0.25 to 2.8	73	4.5 to 5.5	150	Yes	Yes	H/L	—	0.80
TPS2556/57	1	0.5 to 5	24	2.5 to 6.5	130	Yes	Yes	L/H	—	0.90
TPS2560/61	2	0.25 to 2.5	48	2.5 to 6.5	130	Yes	Yes	L/H	—	0.90

[1] *Can be configured as power MUX ICs.*

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

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

Internal FET Power Switch Selection Guide

Device	Number of FETs	I_{OS} (min) (A)	$R_{DS(on)}$ (mΩ)	V_{IN} Range (V)	Supply Current (µA)	OC Logic Output	OT Logic Output	Enable	Price*
TPS2590	1	1 to 5	28	3 to 20	35	Yes	No	L	1.05

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

Digital Power Control Solutions
Complete Isolated Telecom DC/DC PMBus Power Solution

Digital Power Means Smart Power

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

Digital power products range from analog controllers with digital blocks for configuration and telemetry and a digital port for communication, to complex microcontrollers with multiple processors, digital control blocks and multiple communication ports. All of these power solutions perform the required power management but with various degrees of digital integration. The more digital integration there is, the more you can do with your power supply—in the same or a smaller space.

Digital Controllers

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

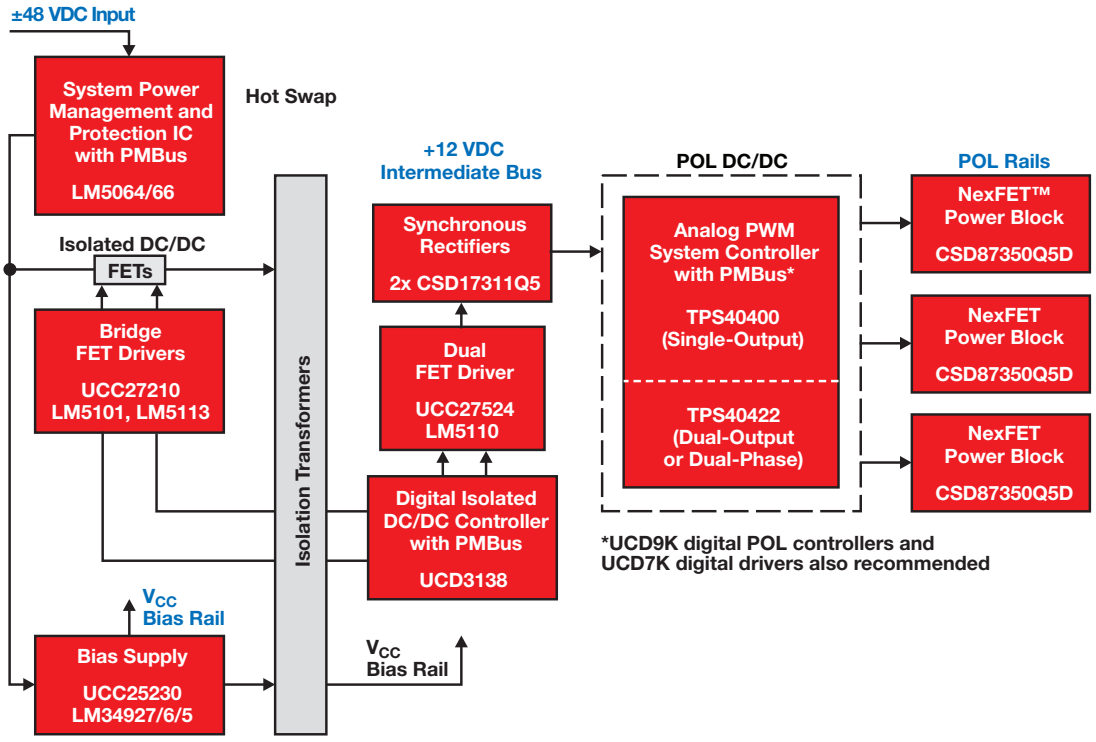
Analog Control with PMBus

Power-supply designers who prefer the benefits and familiarity of analog solutions now have the functionality of digital configuration and communication that won't impact the analog performance. TI offers the TPS404xx family of 20-V step-down voltage regulators with a PMBus-compatible digital interface and an adaptive voltage-scaling capability for non-isolated point-of-load designs. Together with the high-voltage LM(2)50xx hot-swap system protection and power-management products, TI provides complete single-, dual- and multi-rail, multi-phase PMBus solutions—allowing telecom and server designers to intelligently monitor, protect and manage their power systems.

Fusion Digital Power™ Designer

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

Get more information: **www.ti.com/digitalpower**



Digital Power Control Solutions

Isolated and Non-Isolated Digital Power Controllers

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

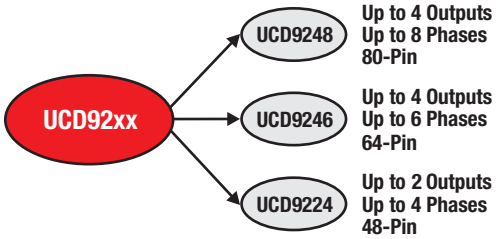
Key Benefits

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

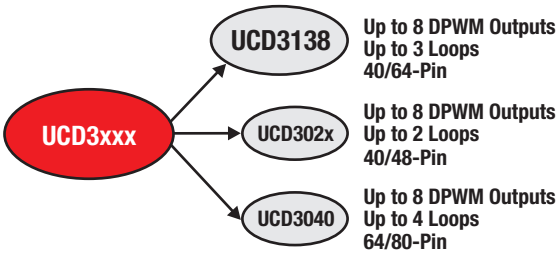
Digital Solution Features

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

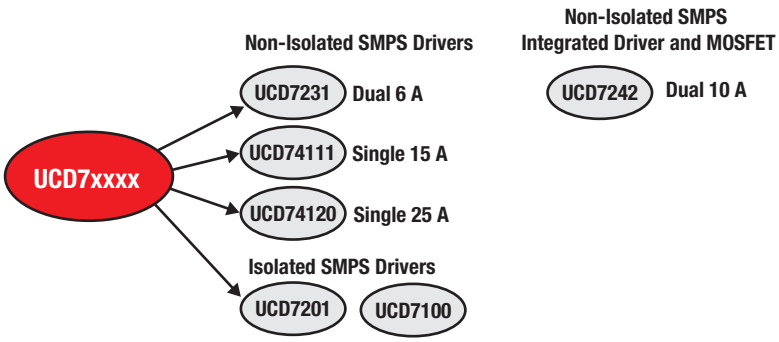
UCD9K Buck Controllers

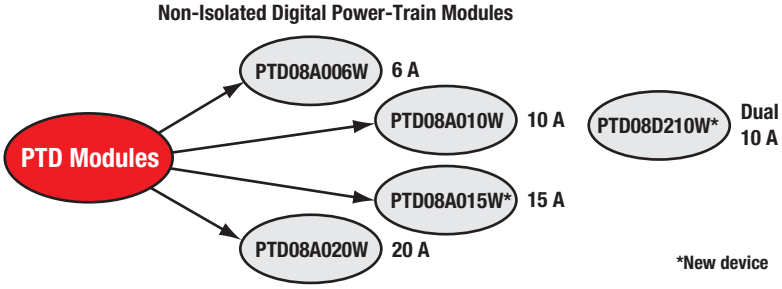


UCD3K Isolated Power Controllers



Digital Power Stage Solutions



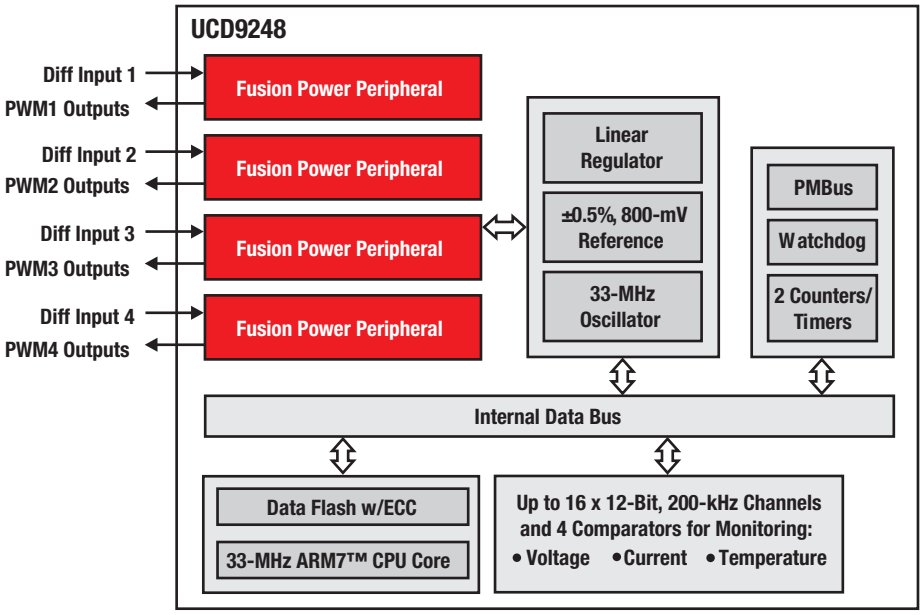


Digital Power Control Solutions

Isolated and Non-Isolated Digital Power Controllers

Digital Point-of-Load Controller

UCD9248

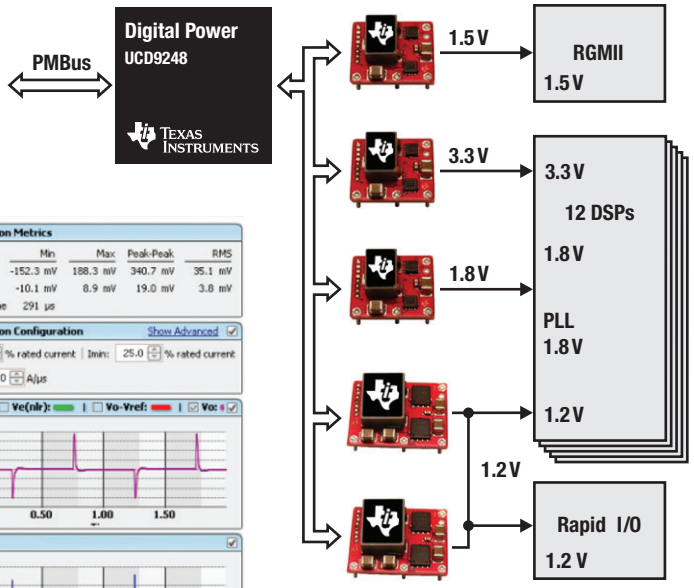


UCD9248 controller overview.

Key Features

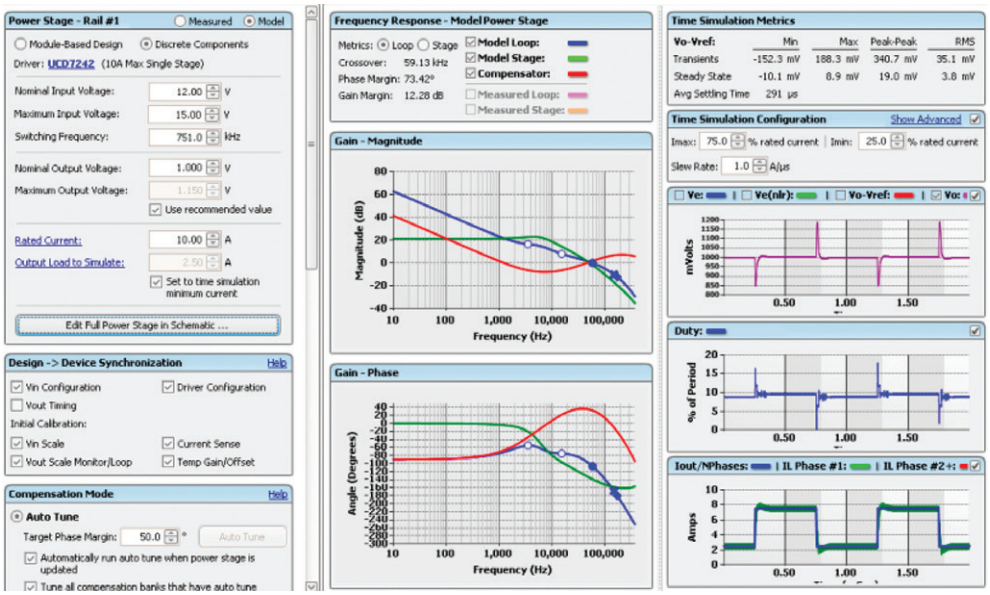
- Controls up to 8 power stages and up to 4 voltage-feedback control loops
- Output voltage is configurable from 0.4 to 4.0 V
- Flexible configuration to control:
  - Four single or two dual power stages,
  - Two 4-phase power stages, or
  - One 2-, 4-, 6- or 8-phase power stage
- Switching frequencies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

Get more information: **www.ti.com/product/UCD9248**



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

Fusion Digital Power™ Designer



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

Digital Power Control Solutions

Isolated and Non-Isolated Digital Power Controllers

Isolated Digital Power-Control Solutions

UCD3138

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

Key Features

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

Easy-to-Use GUI and Development Tools

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

Evaluation Modules

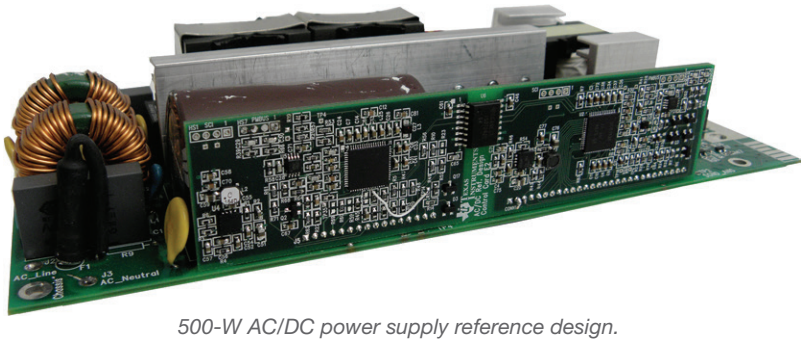
- UCD3138CC64EVM-030 control card
- UCD3138OL64EVM-031—UCD3138 64-pin, open-loop board with socket
- UCD3138OL40EVM-032—UCD3138 40-pin, open-loop board with socket
- UCD3138NS64EVM-038—UCD3138 64-pin, open-loop board with IC soldered
- UCD3138NS40EVM-039—UCD3138 40-pin, open-loop board with IC soldered

Development Kits

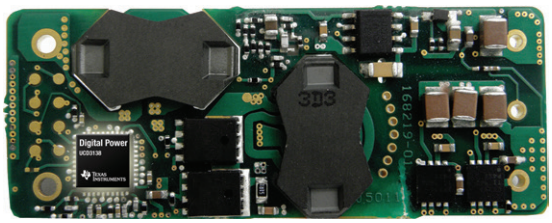
- UCD3138PFCEVM-026—Universal-input, 400-V_{OUT}, AC/DC PFC development kit that is configurable into single- or two-phase interleaved and bridgeless topologies
- UCD3138PSFBEVM-027—400-V_{IN}/12-V_{OUT} DC/DC phase-shifted full bridge
- UCD3138LLCEVM-028—400-V_{IN}/12-V_{OUT} DC/DC half-bridge resonant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

Reference Designs

- Universal-input, 12-V_{OUT} 500-W AC/DC reference design (PFC plus LLC and PFC plus phase-shifted full-bridge)
- 48-V_{IN}/12-V_{OUT} 1/8-brick DC/DC reference design (hard-switching full bridge)



500-W AC/DC power supply reference design.



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

Get more information: **www.ti.com/product/UCD3138**

Digital Power Control Solutions

Isolated and Non-Isolated Digital Power Controllers

Selection Guide

Device	Pin Count	Number of Outputs	Number of Phases	Maximum F_{SW} (MHz)	PWM Resolution (ps)	Compensator	Nonvolatile Memory	Price*
Digital Point-of-Load Controllers								
UCD9222/44[1]	48/64	2/4	1	2	250	3-pole/3-zero	3-pole/3-zero	3.15/5.85
UCD9224	48	2	4	2	250	3-pole/3-zero	3-pole/3-zero	2.65
UCD9248/6	80/64	4	8/6	2	250	3-pole/3-zero	Yes w/ECC	4.85/4.50

[1] *UCD9222 and UCD9244 digital PWM controllers with support for TMS320C6670 and TMS320C6678 DSPs VID interface.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Device	Number of Outputs	Output Configuration	Output Type[1]	Peak I_{OUT} Source/Sink (A)	Rise/Fall Time (ns)	V_{CC} Range (V)	Propagation Delay (ns)	Input Threshold	Dead-Time Control	Protection Features	Price*
Digital Power MOSFET Drivers											
UCD7231	2	Non-inverting	CMOS	6/6	10/10	4.5 to 15.5	25	CMOS/TTL	Adaptive	Adjustable	0.60
UCD7232	2	Non-inverting	CMOS	6/6	10/10	4.5 to 15.5	25	CMOS/TTL	Adaptive	Adjustable	0.60
UCD7100	1	Uncommitted/Non-inverting	TrueDrive™	4/4	10/10	4.5 to 16	20	CMOS/TTL	Adaptive	Adjustable	0.99
UCD7201	2	Uncommitted/Non-inverting	TrueDrive	4/4	10/10	4.5 to 16	20	CMOS/TTL	Adaptive	Adjustable	1.20

[1] *Output type: TrueDrive is the hybrid bipolar/CMOS output architecture for improved current drive capability at low voltages (at Miller threshold).*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Device	Pin Count	Number of DPWM Outputs	Number of Independent Control Loops	DPWM Resolution (ps)	DPWM Maximum Frequency (MHz)	Program Flash Memory Size (KB)	Number of 12-Bit ADC Channels	Compensator	Price*
Digital Isolated Power Controllers									
UCD3020	48	6	2	250	2	32	9	3-pole/3-zero	2.45
UCD3028	40	8	2	250	2	32	9	3-pole/3-zero	2.35
UCD3040	64/80	8	4	250	2	32	11/15	3-pole/3-zero	3.75/4.05
UCD3138	40/64	8	3	250	2	32	7/14	2-pole/2-zero	2.70/4.10

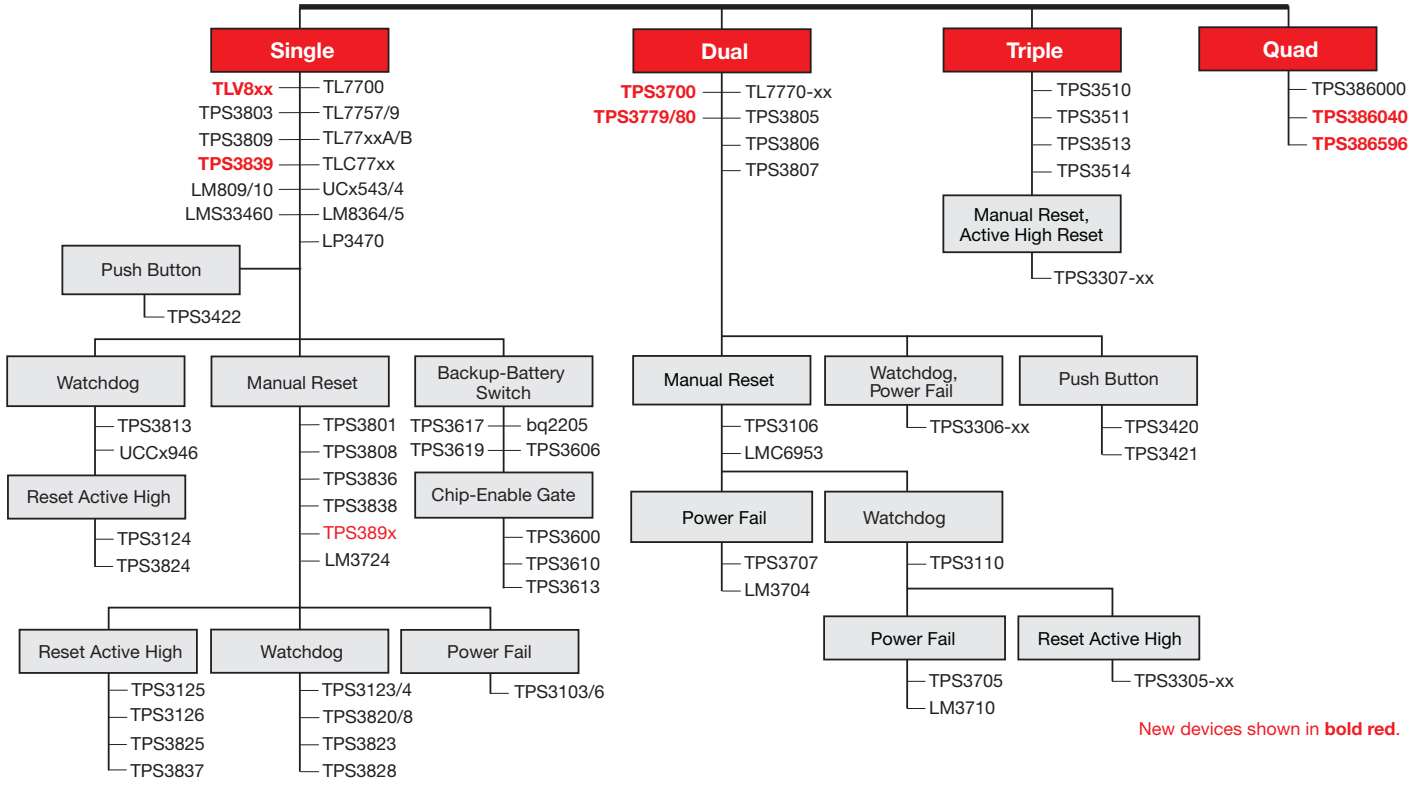
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Device	Input Voltage (V)	Output Configuration	Current Rating (A)	Price*
Digital Power Stages				
UCD7242	4.5 to 18	Dual	10/10	2.65
UCD74106	4.5 to 14	Single	6	1.00
UCD74111	4.5 to 14	Single	15	2.95
UCD74120	4.5 to 14	Single	25	3.95

Device	Input Voltage (V)	Output Configuration	Current Rating (A)	Price*
Digital Power-Train Modules				
PTD08A006W	4.75 to 14	Single	6	6.90
PTD08A010W	4.75 to 14	Single	10	8.50
PTD08A015W	4.75 to 14	Single	15	9.80
PTD08A020W	4.75 to 14	Single	20	12.90
PTD08D210W	4.75 to 14	Dual	10/10	9.25
PTD08A210W	4.75 to 14	Single	10	7.50

Suggested resale price in U.S. dollars in quantities of 1,000.* *New devices are listed in **bold red.*

Supervisory Circuits, Reset ICs and Sequencers Family of Products



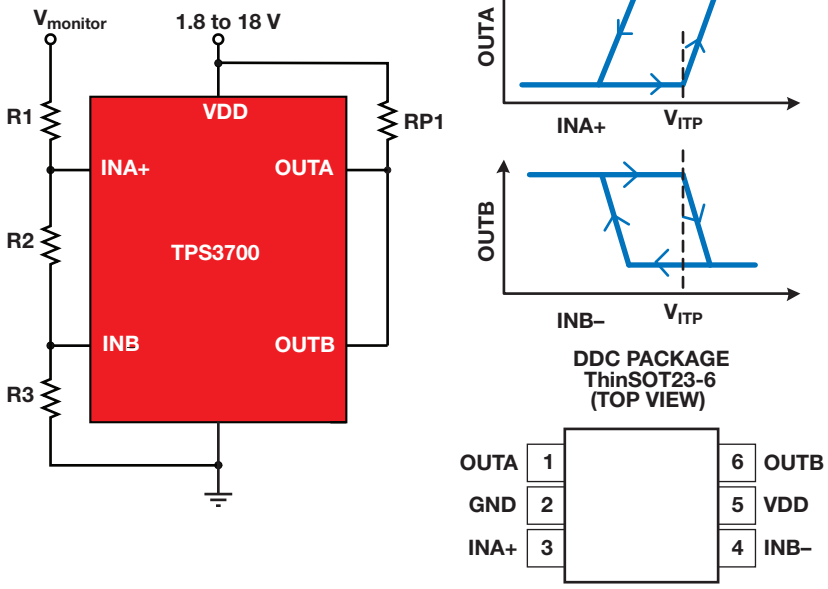
New devices shown in **bold red**.

For more information, please visit: **www.ti.com/supervisors**

Window Comparator for Over- and Under-Voltage Detection

TPS3700

NEW



Features

- Wide supply range: 1.8 to 18 V
- High accuracy threshold: 1% (over temperature range)
- Open drain OV and UV output
- Available in TSOT23-6 package

Get more information: **www.ti.com/product/TPS3700**

Supervisors and Reset ICs

Selection Guide

Device	Number of Supervisors	Supervised Voltages	Package(s)	V_{DD} Range (V)	I_{DD} (typ) (µA)	Time Delay (ms)	Watchdog Timer WDI (sec)	Reset Threshold Accuracy (%)	Manual Reset/Enable Reset	Active-Low Reset/Output	Active-High Reset/Output	Reset Output Topology[1]	Power-Fail PFI/PFO	Overvoltage Detection	Overcurrent Detection	Chip-Enabled Gating	Comments	Price*
General Purpose Supply Supervisors																		
LM3724	1	2.32, 3.08, 4.63	SOT23-5, D, W	1 to 6	6	0.02		±2.5	✔	✔		OD	✔					0.95/0.80
LP3470	1	2.63, 2.75, 2.83, 2.93, 3.08, 3.65, 4.0, 4.38, 4.63, 4.8	SOT23-5	0.5 to 5	16	0.3		±1		✔		OD						0.595/0.562
LM3704	2	2.32, 3.08, 3.6	micro SMD-9, MSOP-10	1 to 5.5	28	0.02		±2	✔	✔		CMOS, OD	✔					0.77
LM3710	2	2.32, 3.08, 4.63	MINI SOIC	1 to 5.5	28	0.02	0.0062 to 25.6	±2	✔	✔		CMOS, OD	✔					1.10
LM8364	1	2.0	SOT23-5	1 to 6	0.65	0.3		±2.5		✔		CMOS, OD						0.239
LM8365	1	2.75, 4.5	SOT23-5	1 to 6	0.65	0.1		±2.5		✔		CMOS, OD						0.249
LM809	1	2.63, 2.93, 3.08, 4.38, 4.63	SOT23-3, LLP-6, D, W	1 to 6	15	0.02		±1.5		✔		CMOS						0.229
LM810	1	4.63	SOT23-3, D, W	1 to 6	15	0.02		±1.5			✔	CMOS						0.229
LMS33460	1	3	SC-70	1 to 7	1	0.2		±5		✔		OD						0.169
LMC6953	2	3.3, 3.5	SOIC-8	1.5 to 6	800	0.0005		±3	✔	✔		OD						1.44
TPS3895	1	Adj.	SON-6	1.7 to 6.5	6	0.04, Prog	—	0.25	✔		✔	PP					Ultra-small	0.60
TPS3896	1	Adj.	SON-6	1.7 to 6.5	6	0.04, Prog	—	0.25	✔	✔		PP					Ultra-small	0.60
TPS3897	1	Adj.	SON-6	1.7 to 6.5	6	0.04, Prog	—	0.25	✔		✔	OD					Ultra-small	0.60
TPS3898	1	Adj.	SON-6	1.7 to 6.5	6	0.04, Prog	—	0.25	✔	✔		OD					Ultra-small	0.60
TLV803	1	2.5/3/3.3/5	3SOT-23	1.1 to 6	9	200	—	2.00		✔		OD						0.20
TLV810	1	2.5/3/3.3/5	3SOT-23	1.1 to 6	9	200	—	2.00			✔	PP						0.20
TPS3808	1	Adj./0.9/1.2/1.5/1.8/2.5/3.0/3.3/5.0/EEPROM	SOT-23, SON-6	1.8 to 6.5	2.4	Prog	—	0.5	✔	✔		OD						0.70
TPS3103	1	1.2/1.5/2.0/3.3	SOT-23	0.4 to 3.3	1.2	130	—	0.75	✔	✔		OD	✔					0.90
TPS3123	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	1.4	3.6	✔	✔		PP						0.85
TPS3124	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	1.4	3.6		✔	✔	PP						0.85
TPS3125	1	1.2/1.5/1.8/3.0	SOT-23	0.75 to 3.3	14	180	—	3.6	✔	✔	✔	PP						0.80
TPS3126	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	—	3.5	✔	✔	✔	OD						0.80
TPS3128	1	1.2/1.5/1.8	SOT-23	0.75 to 3.3	14	180	1.4	3.5	✔	✔		OD						0.85
TPS3800	1	2.7	SC-70	1.6 to 6.0	9	100	—	2	✔	✔		PP						0.40
TPS3801	1	Adj./1.8/2.5/3.0/3.3/5.0	SC-70	1.6 to 6.0	9	200	—	2	✔	✔		PP						0.40
TPS3802	1	3.0/3.3	SC-70	1.6 to 6.0	9	400	—	2	✔	✔		PP						0.40
TPS3803	1	Adj./1.5	SC-70	1.3 to 6.0	3	—	—	1.5		✔		OD					Voltage detector	0.25
TLV809	1	2.5/3.0/3.3/5.0	SOT-23	2.0 to 6.0	9	200	—	2.2		✔		PP						0.25
TPS3813	1	2.5/3.0/3.3/5.0	SOT-23	2.0 to 6.0	9	25	Window	2.2		✔		OD					Window watchdog	0.90
TPS3820/8-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
TLC77xx	1	Adj./2.5/3.3/3.0/5.0	SO-8, DIP-8, TSSOP-8	2.0 to 6.0	9	Prog	—	5.5		✔	✔	PP						0.65
TPS3807	2	3/3.5	SC-70	1.8 to 6.5	3.5	20	—	1		✔		OD						0.95
TPS3106	2	Adj./0.9/1.6/3.3	SOT-23	0.4 to 3.3	1.2	130	—	0.75	✔	✔		OD						0.90
TPS3110	2	Adj./0.9/1.2/1.5/3.3	SOT-23	0.4 to 3.3	1.2	130	1.1	0.75	✔	✔		PP						0.99
TPS3305-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
TPS3700	2	Adj.	ThinSOT23-6	1.8 to 18	5.5	—	—	0.25		✔	✔	OD					Window comparator	0.70
TPS3705-xx	2	3.0/3.3/5.0	SO-8, MSOP-8	2.0 to 6.0	30	200	1.6	2.1	✔	✔		PP	✔					0.80
TPS3707-xx	2	2.5/3.0/3.3/5.0	SO-8, MSOP-8	2.0 to 6.0	20	200	—	2.2	✔	✔	✔	PP	✔					0.75
TPS3805	2	Adj./3.3	SC-70	1.3 to 6.0	3	—	—	1.5		✔		PP					Voltage detector	0.34

[1] *PP = push-pull, OD = open drain, OC = open collector.*
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Note: Custom voltages can be provided. Minimum order quantities may apply. Contact TI for details and availability.

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

Supervisors and Reset ICs

Selection Guide (Continued)

Device	Number of Supervisors	Supervised Voltages	Package(s)	V_{DD} Range (V)	I_{DD} (typ) (µA)	Time Delay (ms)	Watchdog Timer WDI (sec)	Reset Threshold Accuracy (%)	Manual Reset/Enable Reset	Active-Low Reset/Output	Active-High Reset/Output	Reset Output Topology[1]	Power-Fail PFI/PFO	Overvoltage Detection	Overcurrent Detection	Chip-Enabled Gating	Comments	Price*
General Purpose Supply Supervisors (Continued)																		
TPS3806	2	Adj./2.0/3.3	SOT-23	1.3 to 6.0	3	—	—	2		✔		OD					Voltage detector	0.45
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						1.05
TPS386596	4	Adj./3.0	MSOP-8	1.8 to 6.5	7.5	Prog	—	0.25	✔	✔		OD		✔				1.25
TPS3860x0	4	Adj. (includes negative rail)	QFN	1.8 to 6.5	9	Prog	0.6	0.25	✔	✔	✔	PP/OD		✔				1.95
Battery Backup Switchover Supply Supervisors																		
TPS3600	1	2.0/2.5/3.3/5.0	TSSOP-14	1.6 to 5.5	20	100	0.8	2.3	✔	✔		PP	✔			✔		2.15
TPS3606-33	1	3.3	MSOP-10	1.6 to 5.5	20	100	0.8	2	✔	✔		PP	✔					1.45
TPS3610	1	1.8/5.0	TSSOP-14	1.6 to 5.5	20	100	0.8	2		✔		PP	✔			✔		1.80
TPS3613-01	1	Adjustable	MSOP-10	1.6 to 5.5	20	100	—	1.7	✔	✔	✔	PP				✔		1.50
TPS3619	1	3.3/5.0	MSOP-8	1.6 to 5.5	15	100	—	2	✔	✔		PP	✔					1.10
Special Function Supply Supervisors																		
TPS3510/1	3	3.3/5.0/12.0	SO-8, DIP-8	4 to 15	1 mA	300	—	9.1		✔		OD	✔	✔			PC power supplies	0.45
TPS3513/4	3	3.3/5.0/12.0	SO-14, DIP-14	4.5 to 15	1 mA	300	—	9.1		✔		OD	✔	✔	✔		PC power supplies	0.70

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

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

Note: Custom voltages can be provided. Minimum order quantities may apply. Contact TI for details and availability.

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

Sequencers

Selection Guide

Device	Number of Supervisors	Supervised Voltages	Number of Sequenced Outputs	Package(s)	V_{DD} Range (V)	I_{DD} (typ) (µA)	Time Delay (ms)	Comments	Price*
LM3880	—	—	3	SOT23-6	2.7 to 5.5	25	Fixed		0.50
LM3881	—	—	3	MSOP-8	2.7 to 5.5	80	Prog		0.50
UCD9090	10	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog		3.60
UCD90120A	13	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog		4.95
UCD90124A	13	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog	With fan control	6.45
UCD90160	16	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog		5.65
UCD90910	10	Prog. by software GUI	—	QFN-64	3.3 to 12	50 mA	Prog	With fan control	5.90

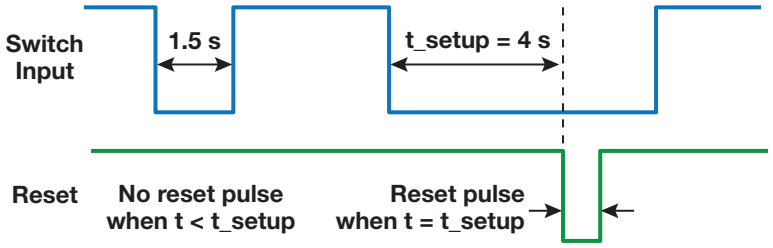
**Suggested resale price in U.S. dollars in quantities of 1,000.*

Push Button Controllers

Single and Dual Push-Button Controllers

TPS3420, TPS3421, TPS3422

TPS342x family of devices provide the ability to perform a hardware system reset during a software crash. It also eliminates the need to remove batteries to activate a reset. These controllers are used in designs with an embedded battery to ensure a hard- and full-system reset when needed. They include a fail-safe option when the system/microprocessor freezes and a system reset is required. Holding one or two external button switches for x amount of seconds generates a reset. To improve system stability, short-period switch closures are rejected by the setup delay time (t_setup), as shown in the timing diagram.



Key Features

- Very small, 1.45x1-mm SON package
- Low supply current: 250 nA
- User-selectable input delay using two-state logic
- Fixed-pulse or input-dependent reset behavior

Applications

- Smart phones
- Tablets
- Ultrabooks
- Notebooks
- Routers
- Consumer medical

Get more information: **www.ti.com/product/TPS3420**, **TPS3421** or **TPS3422**

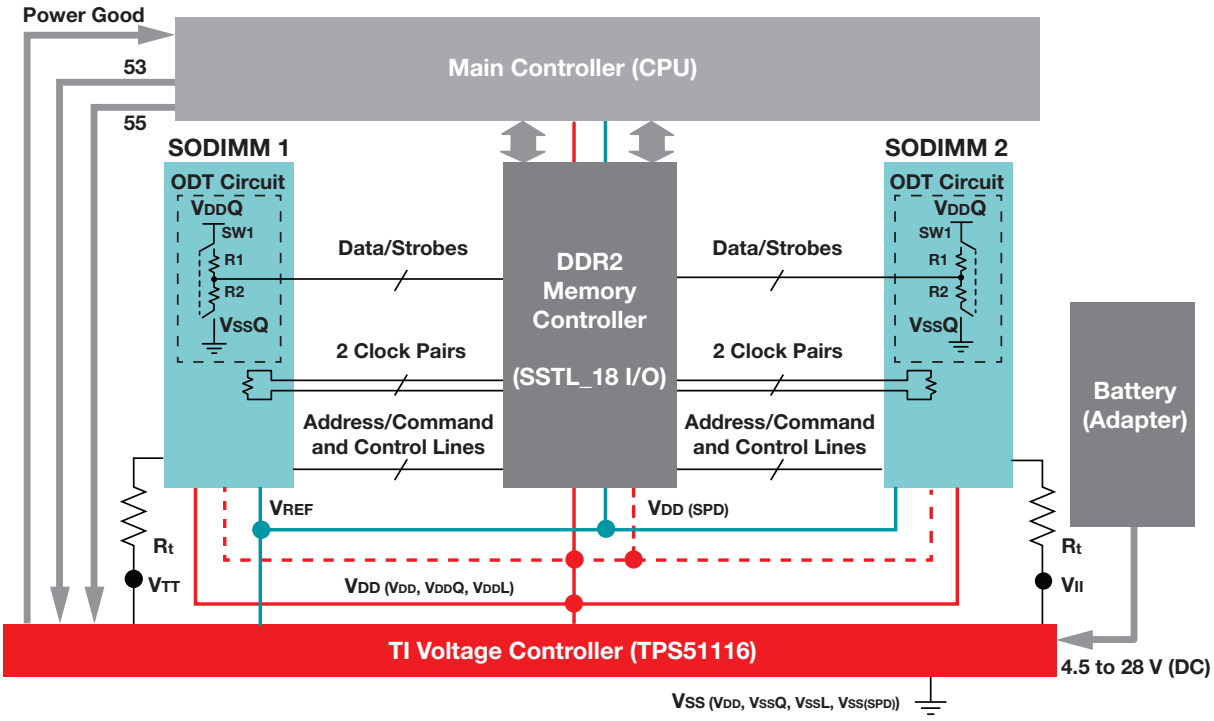
Current Power Monitors

Selection Guide

Device	Description	Common-Mode Range (min)	Common-Mode Range (max)	Gain (V/V)	Output Type	Input Offset (+/-)(max) (µV)	CMRR (min) (dB)	Quiescent Current (+/-)(typ) (mA)	V_S (min) (V)	V_S (max) (V)	Package(s)	Price*
INA226	High-side measurement, bi-directional current power monitor with I^2C interface	0	36	1	I^2C	10	126	0.33	2.7	5.5	MSOP-10	1.30
INA210	Voltage output, high/low-side measurement, bi-directional zero-drift series current power monitor	–0.3	26	200	Voltage	35	105	0.065	2.7	26	µQFN-10, SC70-6	0.65
INA219	Zero-drift, bi-directional current power monitor	0	26	Programmable	I^2C	50	100	0.7	3	5.5	SOIC-8, SOT-23-8	0.80
INA230	Precision digital/current/voltage/power monitor	0	28	1	I^2C	50	100	330	2.7	5.5	QFN-16	1.15
INA282	Wide common mode range, bidirectional, high accuracy current power monitor	–14	80	50	Voltage	70	120	0.6	2.7	18	SOIC-8	1.25
LMP8640	Precision high-voltage current sense amplifier	–2	76	20, 50, 100	Voltage	900	60	0.72	2.7	12	SOT-6	0.89
LMP8645	Precision high-voltage current sense amplifier	–2	76	Programmable	Voltage	1000	60	0.61	2.7	12	SOT-6	0.89
LMP8646	Precision current limiter	–2	76	Programmable	Voltage	1000	95	0.38	2.7	12	SOT-6	1.20

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

TI DDR Power Application



Selection Guide

Device	V_{IN} (V)	I_{OUT} (A)	Provides	DDR Type
Plug-in Modules				
PTH03010/50/60W	2.95 to 3.65	6/10/15	VTT	1, 2, 3
PTH05010/50/60W	4.5 to 5.5	6/10/15	VTT	1, 2, 3
PTH12010/50/60L	10.8 to 13.2	6/10/12	VTT	1, 2, 3
Controllers				
TPS40042	2.25 to 5.5	Up to 15	VTT	1, 2, 3
TPS40057	8 to 40	Up to 20	VTT	1, 2, 3
Controller + LDO				
TPS51116, TPS51216/716/916	3 to 28[1]	Up to 25 A for VDDQ, 3 (2-A VTT for TPS51216/916)	VTT, VDDQ, VREF	1, 2, 3, LV3, LP3
Dual Controller				
TPS51020	4.5 to 28	Up to 15	VTT, VDDQ, VREF	1, 2
LDOs				
TPS51100	1.2 to 3.6[2]	Up to 3	VTT, VREF	1, 2, 3, LV3, LP3
TPS51200	1.1 to 3.5[3]	Up to 3	VTT, VREF	1, 2, 3, LV3, LP3
TPS51206	VTT+0.4 V to 3.5 V	Up to 2	VTT, VREF	1, 2, 3, LV3, LP4
Switchers with Integrated FETs				
TPS54372	3 to 6	3	VTT	1, 2, 3
TPS53317, TPS54672	3 to 6	6	VTT	1, 2, 3 , LV3, LP3
TPS54972	3 to 4	9	VTT	1, 2, 3
TPS51362/7	3 to 22[1]	10/12	VDDQ	1,2,3, LV3, LP3

[1] *Needs 4.5- to 5.5-V bias.*
[2] *Needs 4.75- to 5.25-V bias.*
[3] *Needs 2.4- to 3.5-V bias.*

PowerLab™ Power Reference Design Library

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

Features

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

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- Tune your design quickly with the optimization tool to balance design objectives for efficiency and footprint
- Adjust components and use charts to make design decisions on a wide selection of electrical characteristics
- Exchange parts and use bill-of-materials graphs for easy external component selection based on efficiency, footprint, cost or vendors

Analyze It—Solve your design problems before you prototype

- Simulate your circuit and evaluate performance using electrical and thermal simulations
- Simulate electrical characteristics, choose probe points and examine waveforms to determine performance
- Simulate thermal behavior and your circuit on a PCB in your defined environment and view color heat maps
- Overlay alternate circuits and compare results to get optimal performance

Build It—Save weeks getting your final design into production

- Request samples and purchase parts or demo boards
- Receive your custom prototyping kit the next business day
- Download your automatically generated CAD files, assembly details, test instructions and complete performance results

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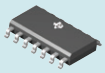
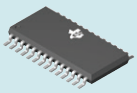
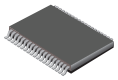
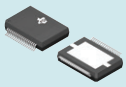
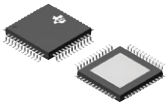
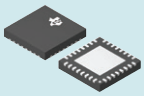
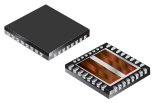
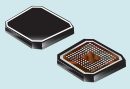
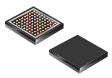
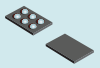
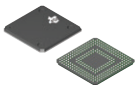
Resources
Packaging

Surface Mount Packages

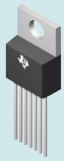
	Package Type	Package Designator	Key Characteristics
Small Outline Packages			
	Small Outline Integrated Circuit (SOIC)	D, DW, DWU, DTH, DTC, DDA, DVB, DWP	High MSL rating* (MSL1/ MSL2), variable size availability
	Mini Small Outline Package (MSOP)	DGK, DGS	Small form factor, thin package
	Heat Sink Small Outline Package (HSOP)	DWP, DWD	Thermally enhanced SOP (low to mid power)
	Small Shrink Outline Package (SSOP)	DL, DB, DF, DBQ, DCE, DCT	High MSL rating* (MSL1/ MSL2), higher stand-off height
	Thin Shrink Small Outline Package (TSSOP)	DA, PW, DBT	Variable pin count options available, high MSL rating* (MSL1/ MSL2), small form factor
	Exposed Pad Thin Shrink Small Outline Package (HTSSOP)	PWP, DAP, DAD, DCA	Thermally enhanced TSSOP (low to high power); various pin count options available
	Power Small Outline Package (PSOP3)	DKP (slug down), DKD (slug up)	Very high power handling capability, mechanically robust package
Quad Leaded Packages			
	Thin Quad Flat Pack (TQFP)	PFB, PAG, PJT, PBS, PAG	High pin count, leadframe based package
	Exposed Pad Thin Quad Flat Pack (HTQFP)	PAP, PJD, PZP, PHP, PNP, PHD	Thermally enhanced TQFP (mid to high power)
Small Outline Transistors			
	Small Outline Transistor (SC-70)	DCK	Mini form factor
	Small Outline Transistor Package (SOT23)	DBV, DCN, DDC, thin SOT	Small form factor, high MSL rating* (MSL1/ MSL2)
	Small Outline Transistor (SOT223)	DCY, DCQ	High MSL rating* (MSL1/ MSL2)
	Transistor Outline (TO236)	DBZ	Small form factor
Leaded Packages			
	Plastic Flange Mount Package (DDPak/TO-263)	KTT, KTW	Very high power handling capability
Leadless Packages			
	Small Outline No Leads (SON)	DRB, DRC, DRD, DRK, DRM, DRN, DRT, DSE, DSG, DSJ	Small footprint, thermal package (low to mid power)

**MSL rating should be checked for individual device.*

Surface Mount Packages (Continued)

	Package Type	Package Designator	Key Characteristics
Leadless Packages (Continued)			
	Quad Flatpack No Leads (QFN)	RGC, RGE, RGF, RGP, RGT, RGW, RGY, RGZ, RHA, RHB, RHD, RHF, RHH, RHL, RSA, RSB, RSH, RSJ, RSL, RSM, RTE, RTH, RTQ, RTT, RUK, RUV, RVA	Compact footprint, thermal package (mid to high power), available in variable thicknesses
	Flip-Chip Power Packages	RSJ	High power handling capability
Ball Grid Arrays (BGAs)			
	Wafer Chip Scale Package (WCSP)/ Die Sized Ball Grid Array (DSBGA)	YEG, YEK, YEJ, YEA, YZA, YED	Die size package, very small form factor, finer pitch
	MicroStar BGA™	ZGU	Controllable count density, variable thickness option availability
	MicroStar Junior™ BGA	ZQE, ZQZ	Smaller sized MicroStar BGA, controllable pin count density
	PicoStar™	YFM	Extremely small sized package, ultra-thin, board embeddable
	BGA	ZVD	Very high pin count density

Through-Hole Packages

	Package Type	Package Designator	Key Characteristics
	Plastic Dual Inline Package (PDIP)	P, N, NT, NTD	Recommended for wave soldering, excellent board-level reliability
	Transistor Outline (TO220)	KC	Very high power handling capability, recommended for wave soldering, mechanically robust

Package Modules

	Package Type	Package Designator	Key Characteristics
	Power Modules	—	Integrated passives, enhanced functionality

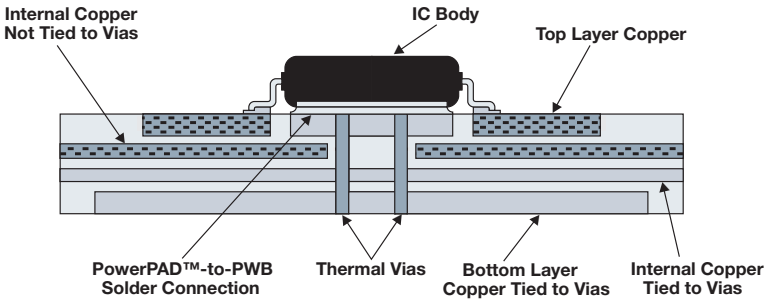
Resources
Packaging

Connecting the PowerPAD™

The PowerPAD package should be connected to the appropriate internal signal plane as specified in the product datasheet. Depending on the electrical properties of the thermally conductive epoxy used to connect the Integrated Circuit (IC) to the lead frame, the PowerPAD may have a low impedance connection to the internal signal plane as specified in the product datasheet.

You can find additional information in the following resources. Technical literature can be accessed online with **www.ti.com/lit/litnumber** by replacing **litnumber** with one of the following literature numbers shown in parentheses.

- Remember to check the CAD format for your package under "Symbols/ Footprints," available in all TI Product Folders
- Download the "PowerPAD Made Easy" application brief (SLMA004) in conjunction with the "PowerPAD Thermally Enhanced Package" technical brief (SLMA002)
- Specific information on QFN/SON packages is available in application reports (SLUA271 and SCBA017)
- Visit TI's Analog & Mixed-Signal KnowledgeBase at: **support.ti.com/sc/knowledgebase**
- Ask our experts your specific design questions via email by selecting Analog & Mixed-Signal email support in the Contact Tech Support frame at: **support.ti.com**



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support.ti.com

TI E2E™ Community Home Page
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	Fax	+1(972) 927-6377
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Europe, Middle East, and Africa

Phone

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International	+49 (0) 8161 80 2121
Russian Support	+7 (4) 95 98 10 701

Note: The European Free Call (Toll Free) number is not active in all countries. If you have technical difficulty calling the free call number, please use the international number above.

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