

POWER MANAGEMENT

FOR BATTERY-POWERED EQUIPMENT

Design Guide

3rd Edition

June 2009

Stingy on power, small in size, high in efficiency



See inside

Pages

Highly integrated, small-footprint, highly efficient PMICs

2, 3, 4

Tiny, low-noise, high-PSRR LDOs

5, 6, 7

Low- I_Q , high-efficiency, optimized load-transient-response step-up/down DC-DCs

8, 9, 10

Space-saving, flexible, light-management, WLED/OLED display supplies

11–18

Small, reverse-current-blocking, current-limited USB switches

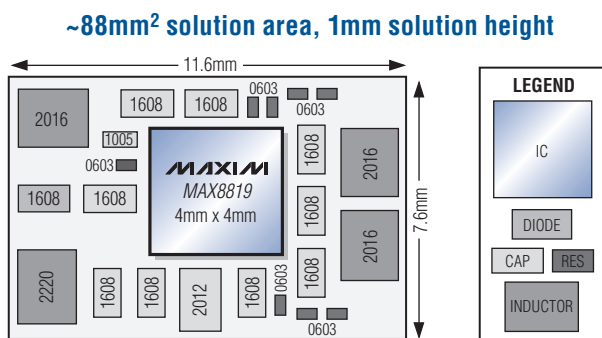
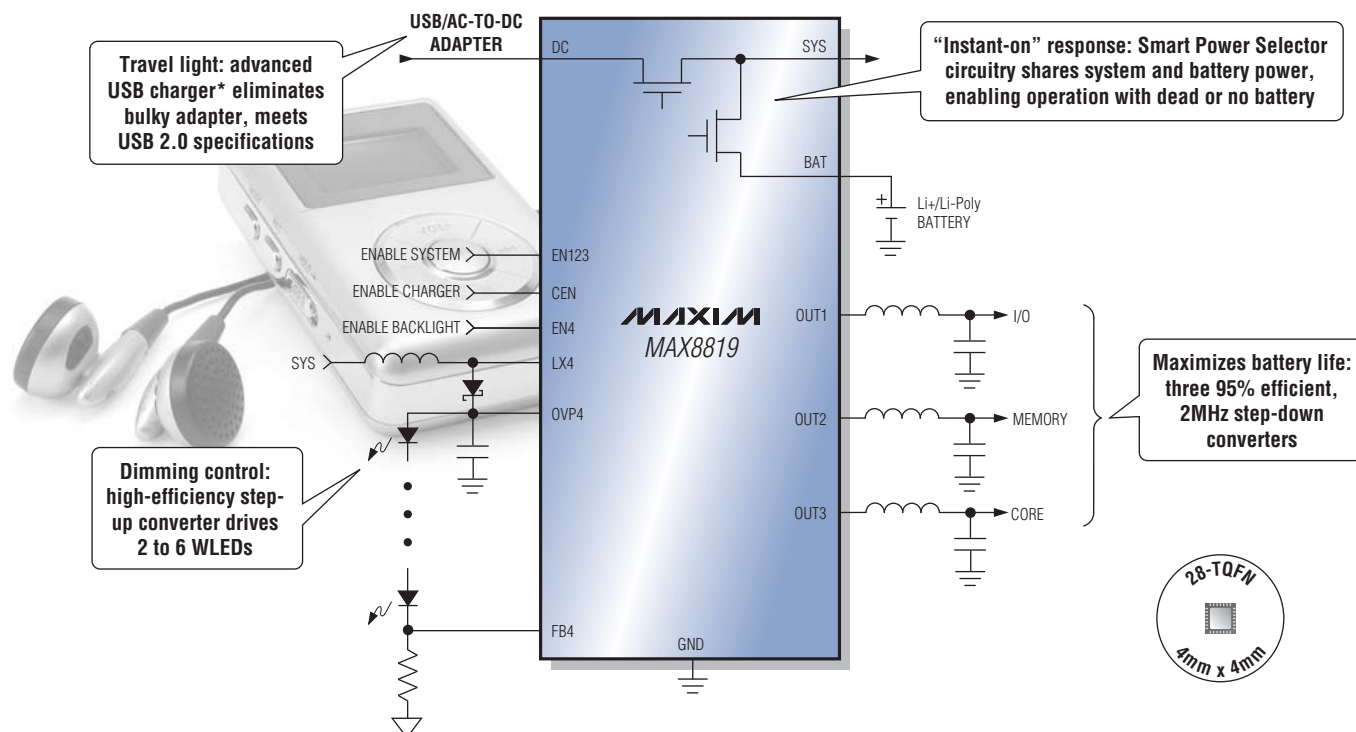
19

Fast and safe battery chargers

20–23

New Complete PMIC for portable media players

Integrates Li+ charger, Smart Power Selector™ circuitry, three step-down converters, and a WLED step-up converter in a tiny 4mm x 4mm package



Evaluation kit



www.maxim-ic.com/MAX8819DG

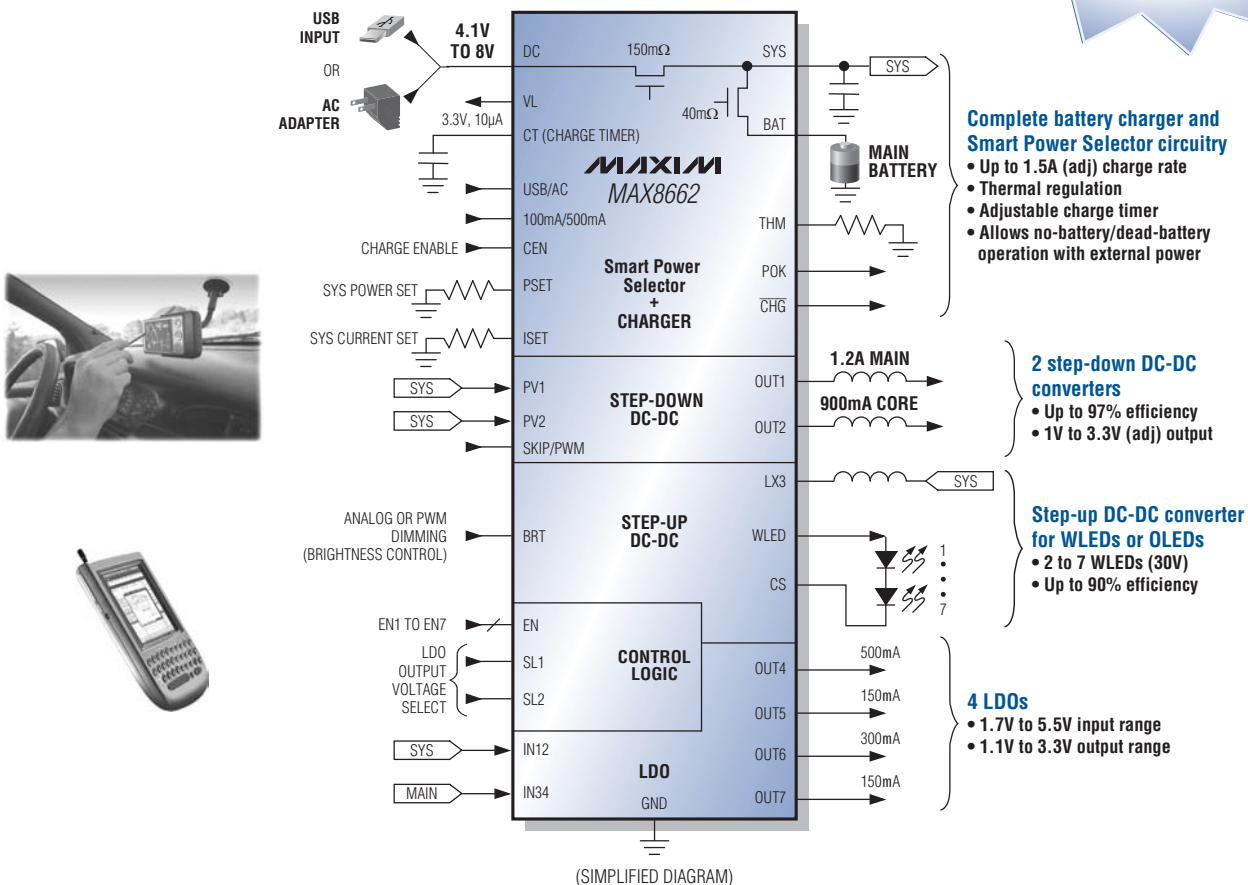
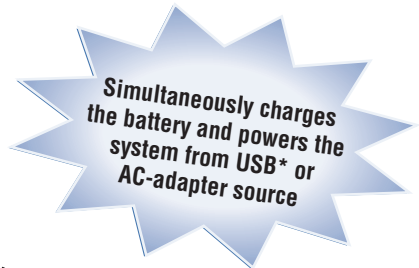
Smart Power Selector is a trademark of Maxim Integrated Products, Inc.
*U.S. Patent #6,507,172.

Single-chip PMICs reduce cost and size for 1-cell Li+ battery-powered products

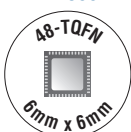
Up to 95% efficient DC-DC converters and low 1.7V (min) input-voltage LDOs maximize battery life

The highly integrated MAX8662/MAX8663 PMICs are cost-effective, small-footprint complete solutions for today's smartphones, PDAs, portable media players, and portable GPS devices. Optimize your system's performance, cost, and size with two high-efficiency step-down DC-DC converters, four LDOs, one step-up DC-DC converter for WLEDs/OLEDs, and an Li+ charger in a single IC.

Complete power-supply and charger solution



MAX8662



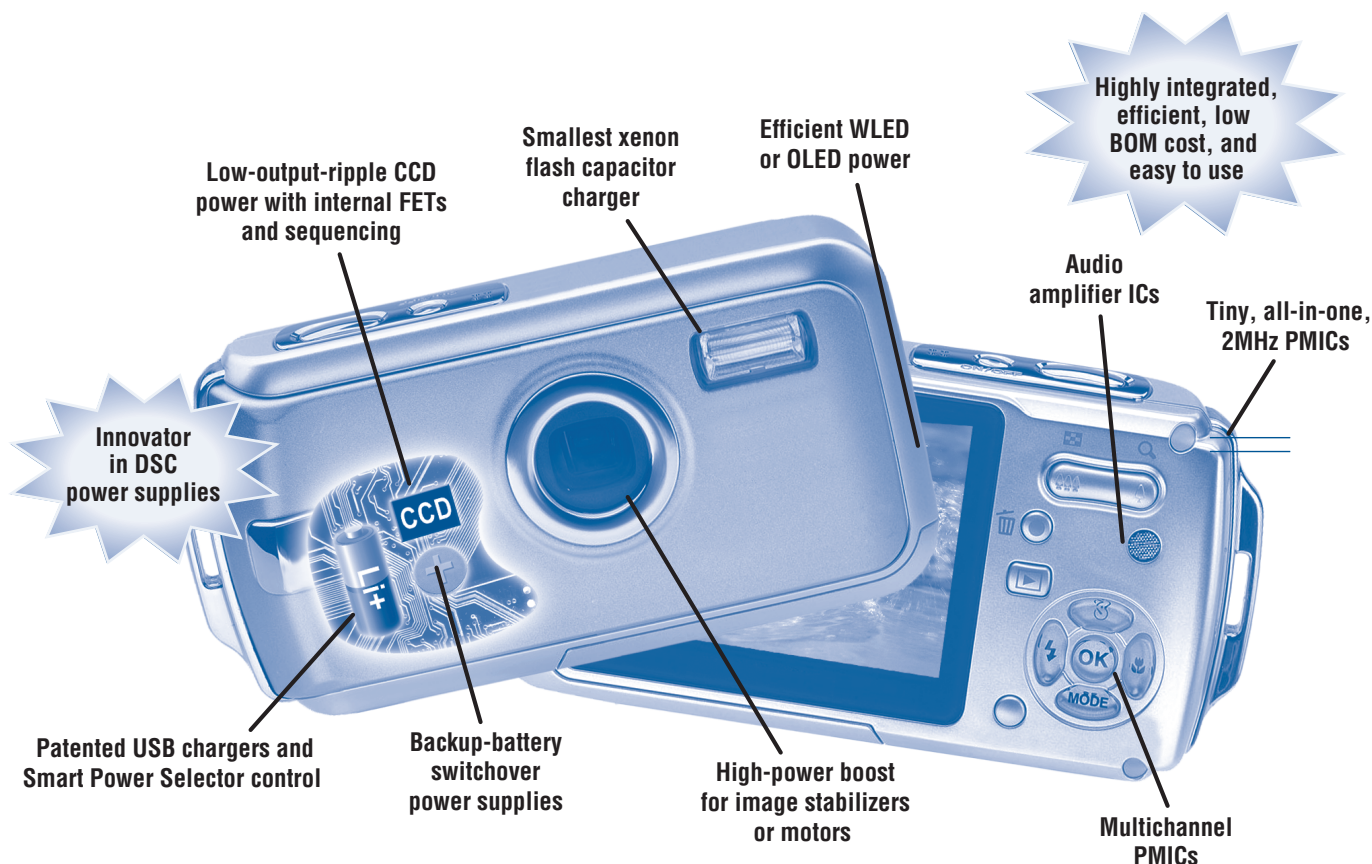
MAX8663
(No step-up for WLEDs)



*U.S. Patent #6,507,172.

Complete digital camera power solutions

From single-channel auxiliary outputs to a complete 8-channel solution



Camera products

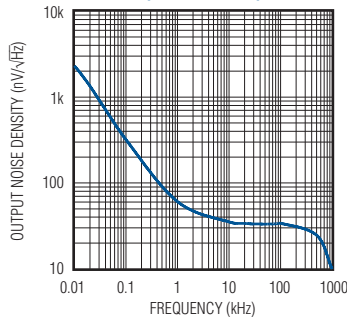
Part	Inputs	Outputs	Application	Features	Package (mm x mm)
MAX8858	2 AA	6	Ultra-low-cost DSCs	2MHz switching frequency; 5V, 3.3V, 2.5V, 1.8V, +15V, and -7.5V outputs	32-TQFN (5 x 5)
MAX8857A	2 AA/NiMH	7	Low-cost DSCs	All MAX8858 features, plus LED power for up to 6 LEDs	40-TQFN (5 x 5)
MAX8680	Li+	7	Midrange DSCs	All MAX8857A features, except 3.3V channel is step-down for Li+ input	40-TQFN (5 x 5)
MAX8611	Li+/2 AA	8	DSCs, PNDs, digital photo frames	All MAX8680 features, plus auxiliary output	48-TQFN (6 x 6)
MAX8677	Li+	1	DSCs, DVCs	USB/AC adapter charger, 1.5A output, Smart Power Selector circuitry runs system while charging	24-TQFN (4 x 4)
MAX8614	Li+	2	CCD bias supplies, OLED displays	Dual adjustable +15V (max), -7.5V outputs; low output ripple; overload protection	14-TDFN (3 x 3)
MAX8685	1- or 2-cell Li+	1	DSCs, cell-phone cameras	Fast, small xenon flash capacitor charger	8-TDFN (3 x 2)

For additional camera-flash ICs,
go to: www.maxim-ic.com/camera-flash

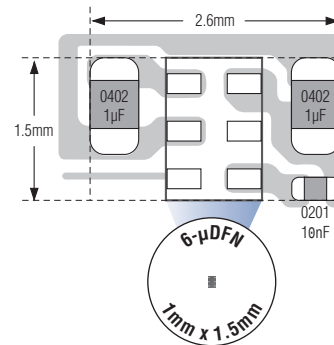
Ultra-low-noise, 150mA LDOs fit in only 1.5mm²

Advanced noise reduction results in only 11 μ V_{RMS} of output noise

Ultra-low noise performance (MAX8840)



Smallest solution—3.9mm²



- 78dB PSRR at 1kHz
- Low 40 μ A ground current
- 120mV dropout at 120mA
- Adjustable or fixed output voltage

Part*	Features	Applications	RoHS Compliant
MAX8840ELTx+T	Lowest output noise, fixed-voltage options	RF, camera, PA bias supplies	✓
MAX8841ELTx+T	Fixed-voltage options	Core, logic, memory supplies	
MAX8842ELT+T	Adjustable output voltage	Any low-power portable equipment	

Smallest, dual 300mA LDOs with independent shutdown

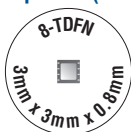
2mm x 2mm package; pin-programmable output voltages reduce inventory

- Low 90mV dropout at 100mA load
- Low 45 μ V_{RMS} output noise (MAX8634/MAX8636)
- Low 54 μ A quiescent supply current (both LDOs on)

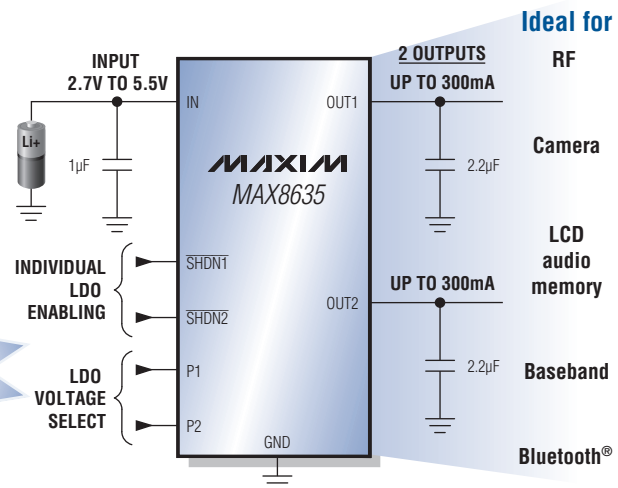
Small footprint (4mm²)



High power dissipation (1.9W)



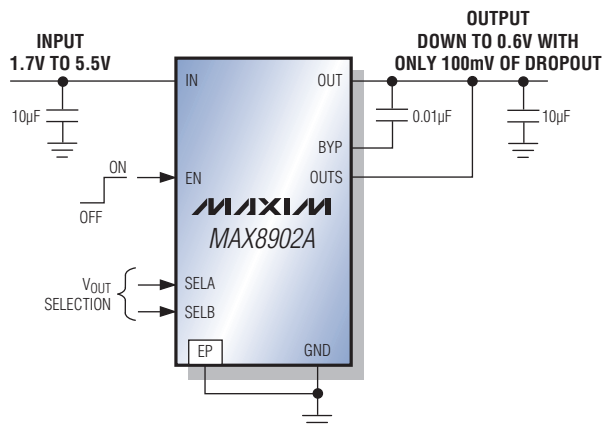
Most flexible, dual LDO on the market (MAX8635)



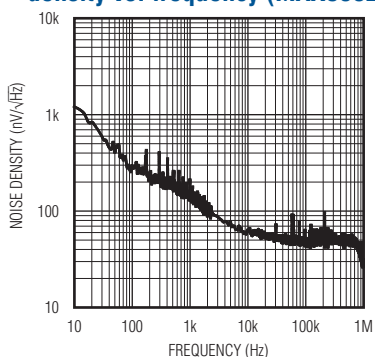
*xy is the output voltage code. Options available include 1.5, 1.8, 2.5, 2.6, 2.7, 2.8, 2.85, 3.0, 3.1, and 3.3V. Refer to the MAX8840 data sheet for more information. Bluetooth is a registered trademark of Bluetooth Sig, Inc.

Highest PSRR, ultra-low-noise, 500mA LDOs in a 2mm x 2mm TDFN

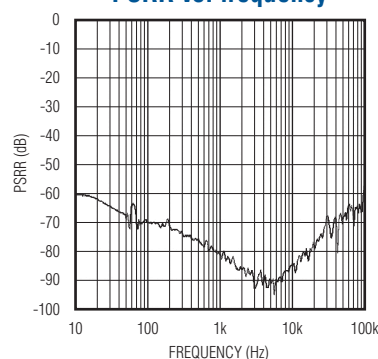
- 92dB PSRR at 5kHz
- 16 μ V_{RMS} output noise from 10Hz to 100kHz
- 500mA output current
 - $\pm 1.5\%$ output accuracy over load, line, and temperature
 - 100mV dropout
- 80 μ A operating supply current; < 1 μ A shutdown supply current
- Operates over -40°C to +125°C automotive temperature range



LDO output-noise spectral density vs. frequency (MAX8902A)



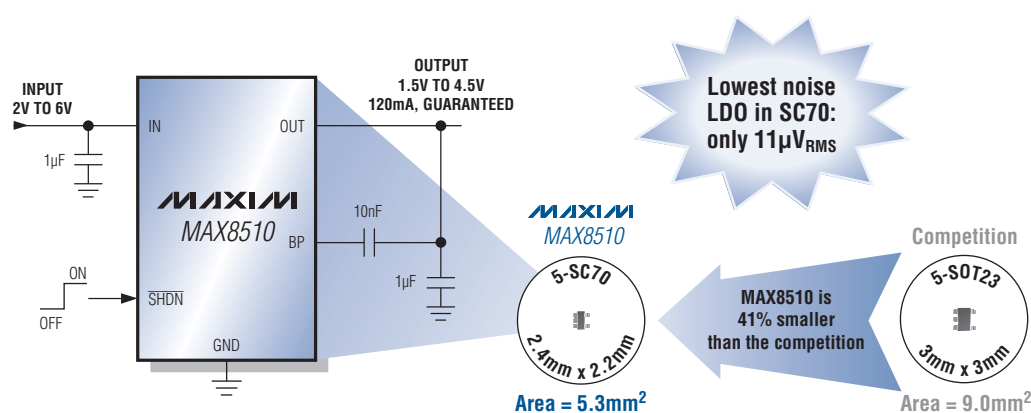
PSRR vs. frequency



Specification	MAX8902A/B	Competition
Input voltage (V)	1.7 to 5.5	2.5 to 5.5
Minimum output voltage (V)	0.6	1.25
Dropout voltage (mV at 500mA)	100	200
Noise (μ V _{RMS})	16	40
PSRR at 5kHz (dB)	92	60

LDOs for baseband and RF chipsets

Part	Output Voltage (V)	Features	C _{OUT} (μF)
MAX1589	Fixed 0.75 to 3.0 in 25mV increments	1.62V _{IN} (min), 500mA in 3mm x 3mm TDFN and SOT23 with 70ms reset	4.7
MAX1725/26	Fixed 1.8, 2.5, 3.3, 5; adj 1.5 to 5	20mA output, low I _Q (2μA), reverse-battery protection	1
MAX1818	Fixed 1.5, 1.8, 2, 2.5, 3.3, 5; adj 1.25 to 5	120mV dropout at 500mA	3.3
MAX1819	Fixed 1.5, 1.8, 2, 2.5, 3.3, 5; adj 1.25 to 5	120mV dropout at 500mA, UCSP™	3.3
MAX1963A/76A	Fixed 0.75 to 3.0	1.62V _{IN} , smallest 300mA (2mm x 2mm TDFN), 2.2ms (MAX1963A) or 70ms (MAX1976A) reset	4.7
MAX8510	Fixed 1.5 to 4.5	Lowest noise (11μV _{RMS} , 78dB PSRR), 120mV dropout at 120mA, SC70	1
MAX8511/12	Fixed 1.5 to 4.5 (MAX8511); adj 1.5 to 4.5 (MAX8512)	Smallest, 120mV dropout at 120mA, SC70	1
MAX8516/17/18	Fixed 0.5 to 3.0	1.62V _{IN} , 1A output, fast 20μs transient, smallest package (10-μMAX®)	4.7
MAX8526/27/28	Fixed 0.5 to 3.0	1.62V _{IN} , 2A output, fast 20μs transient, smallest package (14-TSSOP)	10
MAX8530/31	Fixed 1.5 to 3.3	Smallest dual LDOs (200mA and 150mA) in UCSP or 3mm x 3mm TQFN	2.2/1
MAX8532	Fixed 1.5 to 3.3	Low noise (40μV _{RMS}), 200mA in UCSP	2.2
MAX8556/57	Fixed 0.5 to 3.0	1.62V _{IN} , 4A output, fast 20μs transient, smallest package (5mm x 5mm TQFN)	20
MAX8559	Fixed 1.5 to 3.3	Smallest dual, 300mA/output, 60mV/100mA dropout, low noise, high PSRR, 3mm x 3mm TDFN	4.7
MAX8633–36	Fixed 1.5 to 3.0 in programmable combinations	Dual, 300mA/output, 1.9W, 3mm x 3mm TDFN	2.2
MAX8840	Fixed 1.5 to 4.5	Lowest noise (11μV _{RMS} , 78dB PSRR), 120mV dropout at 120mA, 1mm x 1.5mm μDFN	1
MAX8841/42	Fixed 1.5 to 4.5 (MAX8841); adj 1.5 to 4.5 (MAX8842)	Smallest, 120mV dropout at 120mA, 1mm x 1.5mm μDFN	1
MAX8863/64	Fixed 2.8, 2.84, 3.15; adj 1.25 to 6.5	120mA output, reverse-battery protection	1
MAX8867/68	Fixed 2.5 to 5 in 100mV increments	150mA output, reverse-battery protection	1
MAX8875	Fixed 2.5 to 5 in 100mV increments	150mA output with POK, reverse-battery protection	1
MAX8877/78	Fixed 2.5 to 5 in 100mV increments	150mA output, 1.1mm high, reverse-battery protection	1
MAX8880/81	Fixed 1.8, 2.5, 3.3, 5; adj 1.25 to 5	12V _{IN} (max), 200mA output, reverse-battery protection	1
MAX8882/83	Fixed 1.8 to 3.3 in 100mV increments	Dual, 160mA/output, SOT23	2.2
MAX8887/88	Fixed 1.5 to 3.3 in 100mV increments	150mV dropout at 300mA, 1.1mm (max) high	2.2
MAX8902A/B	Fixed 1.5 to 4.7 in pin-programmable increments (MAX8902A); adj 0.6 to 5.2 (MAX8902B)	Smallest, lowest noise, 500mA, 100mV dropout in 2mm x 2mm TDFN	4.7

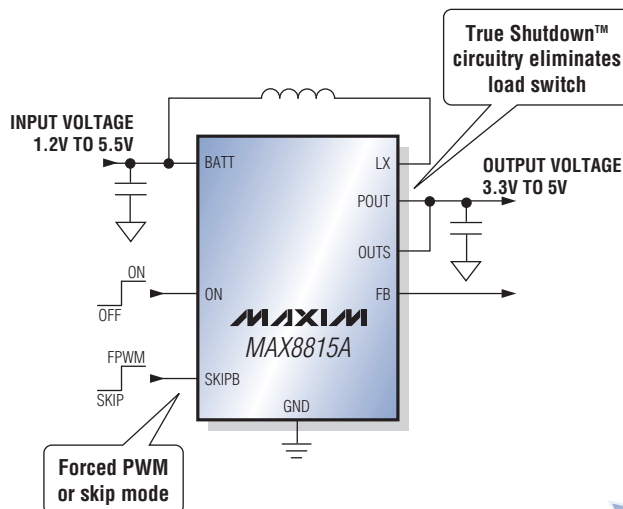


www.maxim-ic.com/LDOs

UCSP is a trademark and μMAX is a registered trademark of Maxim Integrated Products, Inc.

New Most efficient 1A step-up converter for two AAs or one Li+ input

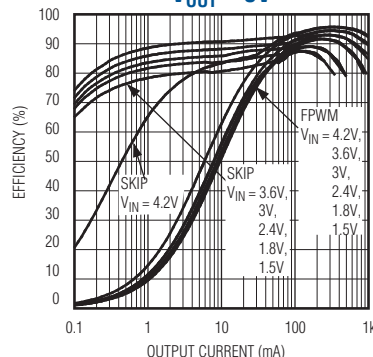
Adjustable (3.3V to 5V) or fixed output



97% efficiency!

- 2MHz PWM switching frequency for small external components
- Controlled current in soft-start
- Overvoltage and short-circuit protection, as well as thermal shutdown
- Low 30 μ A quiescent current
- Low-noise, fixed-frequency operation (FPWM mode)
- Compact, 3mm x 3mm, 10-pin TDFN package

Efficiency vs. load current, $V_{OUT} = 5V$



True Shutdown

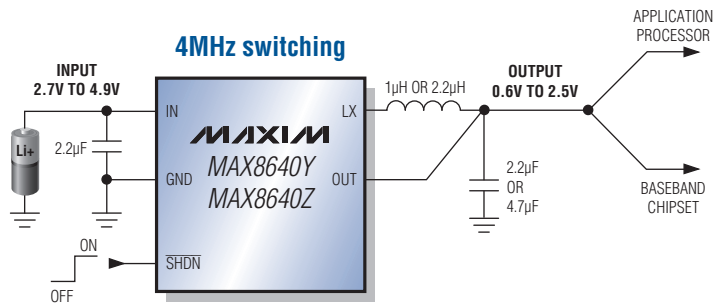
Prevents battery depletion and increases the time between charges

In typical boost converters, the body diode of the synchronous rectifier conducts even when the boost converter is off. This means that the output of the boost converter is never zero (it is always a diode below the input voltage). If a resistive load is connected to the output of the boost converter, there is always current drawn from the input; this current draw will deplete the battery in portable applications.

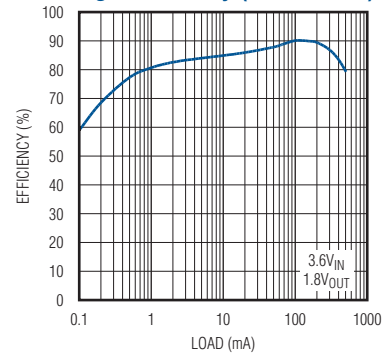
True Shutdown is a method by which the body diode of the synchronous rectifier is switched, so that it is no longer connected to the converter's output. This approach allows the output to stay at zero when the boost converter is off.

Tiny 1mm x 1.5mm step-down DC-DC delivers up to 500mA

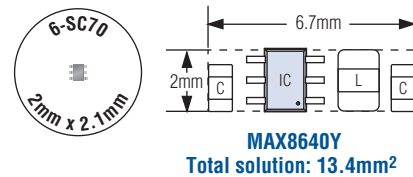
Achieves total solution in 13.4mm² and consumes only 24µA



High efficiency (MAX8640Y)



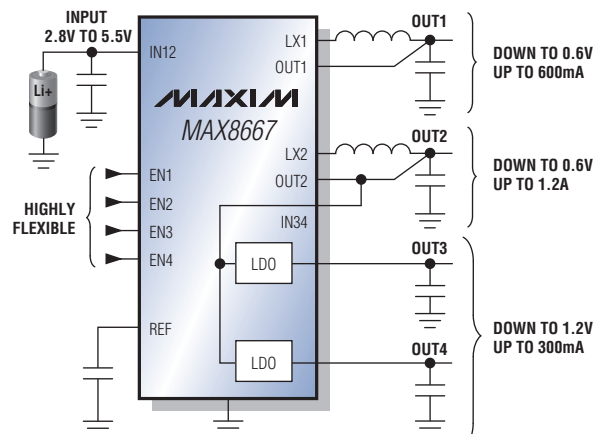
- Up to 4MHz switching
- Low 24µA quiescent current
- Evaluation kit available to speed designs



First 4-channel PMICs with two step-down DC-DCs and two low-input LDOs in a 3mm x 3mm TQFN

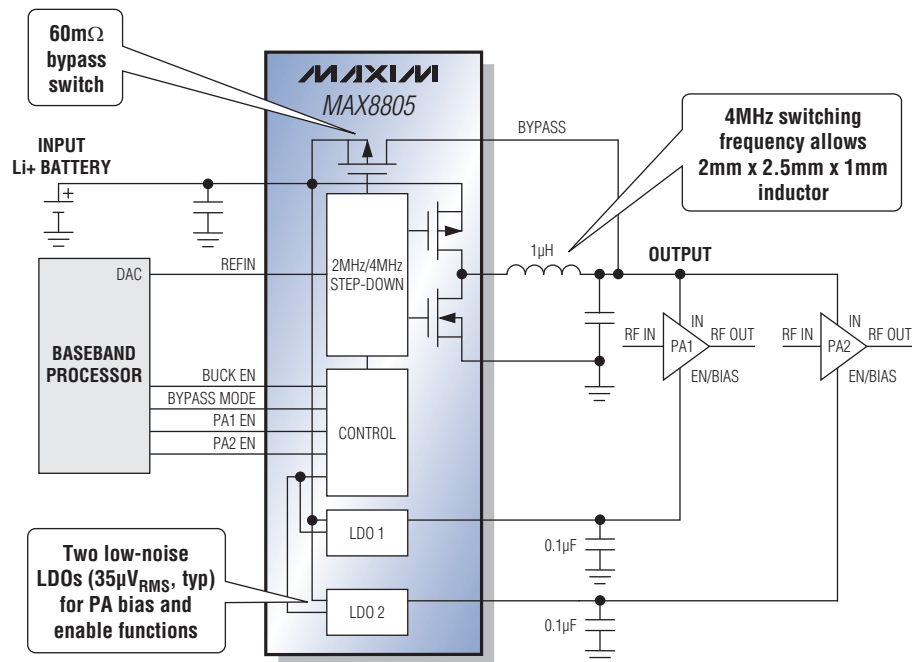
- Integrated 1.2A and 600mA step-down DC-DC converters
- Internal synchronous rectifier provides up to 93% efficiency
- Adjustable step-down DC-DC output (MAX8668)
- Use tiny 2.2µH chip inductor (0805)
- Internal soft-start eliminates inrush current
- Two 300mA, low-input-voltage (1.7V) LDOs
- Low 45µV_{RMS} output noise
- Individual enables for all outputs
- Factory-programmed LDO output voltages

80% less power loss
and 75% smaller than
discrete solution

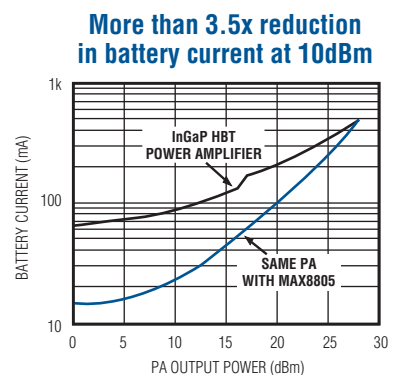


Is your WCDMA PA step-down converter big on space, but small on power?

Get 1.5A of peak current in bypass mode from only 4mm²



- Power and bias for two WCDMA or NCDMA PA modules
- 2MHz/4MHz, 600mA PA step-down converter
 - Integrated 60mΩ bypass switch
 - Dynamically controlled output voltage
 - 7.5μs settling time for full-scale change
 - ±2% gain accuracy
- Dual 200mA, low-noise LDOs
 - For PA bias and enable, or other noise-sensitive functions
 - 35μV_{RMS} (typ) output noise, 70dB PSRR
 - Individual enables
 - Multiple voltage options available
- Tiny, 2mm x 2mm x 0.7mm wafer-level package (WLP)



Part	Switching Frequency (MHz)	Recommended Inductor (μH)	LDO Voltages* (V)	RoHS Compliant
MAX8805YEWEAE+T	2	2.2	1.80, 2.85	✓
MAX8805ZEWEAE+T	4	1	2.85, 2.85	

*Other LDO voltage options include 2.5, 2.7, 2.8, and 3.0V. Refer to the data sheet for more information.

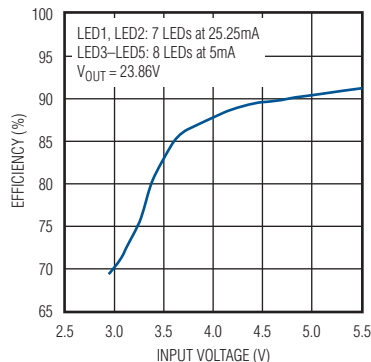
New

Ideal for smartphones, portable media players, and navigation devices



- **Fixed 2MHz switching frequency allows tiny circuit area**
- **Five current regulators, each drives up to 9 LEDs**
 - **2 x 25mA/LED for display backlight and 3 x 5mA/LED for keypad or RGB lighting**
- **Individually programmable ramp timers**
- **128-step (25mA) and 32-step (5mA) logarithmic dimming**
- **Individual blink-rate and duty-cycle timers (5mA)**
- **Tiny, 2mm × 2mm × 0.6mm, 16-bump WLP package**

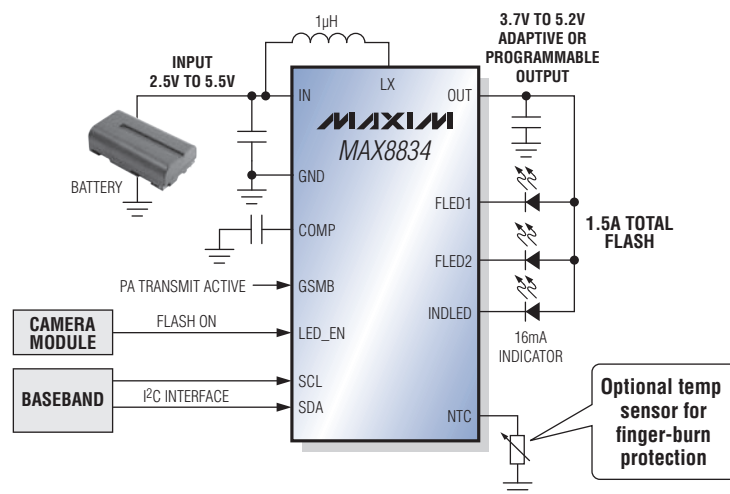
Converter efficiency vs. input voltage (LED1–LED5 strings)



New Brilliant! 1.5A of flash current from 16.5mm² solution

WLED driver supports 5MP cameras in cellular handsets

As 5-megapixel (5MP) cameras become mainstream in smartphones and feature phones, handsets will require smaller WLED driver solutions able to deliver higher levels of flash current. With its 4MHz switching-frequency option, the MAX8834 offers up to 1.5A of flash current from an ultra-compact, 16.5mm² solution footprint. A 2MHz option provides the highest efficiency (up to 95% at full load).



- Fully integrated, synchronous step-up converter
- Delivers up to 1.5A to one LED or 750mA to two LEDs
- Integrated flash safety timer
- Indicator LED with programmable ramp and blink timers
- Input current limit (GSM blank)
- Optional finger-burn protection
- I²C interface simplifies programming

Part	Switching Frequency (MHz)	Package (mm x mm)	RoHS Compliant
MAX8834YEWP+T	2	20-WLP (2.5 x 2.0)	✓
MAX8834ZEWP+T	4		

For additional camera-flash ICs, go to: www.maxim-ic.com/camera-flash

Smallest negative-charge-pump WLED driver saves 50% space

Independent, adaptive current regulator switching for each LED provides highest efficiency

50% smaller
than the
competition

Maxim's solution = 9mm²

16-TQFN



3mm x 3mm

VS.

Competition's solution = 18mm²

4-LED charge pump

TDFN



3mm x 3mm

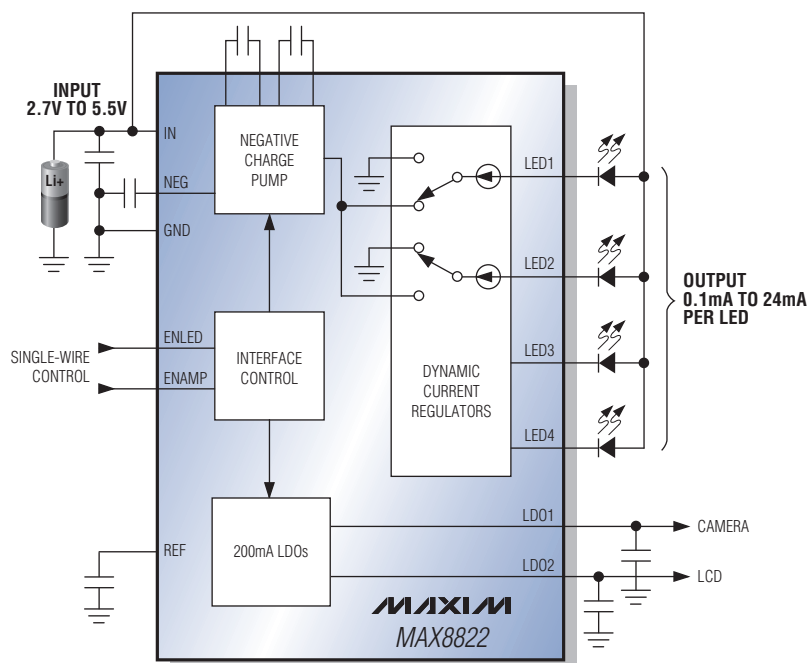
+

Dual LDO

TDFN



3mm x 3mm



Innovative negative charge pump

- No inductor required
- Independent, adaptive current regulator switching for each LED
- Single-wire, serial-pulse-dimming interface
- 32 pseudologarithmic dimming levels, down to 0.1mA
- Low 65µA quiescent current

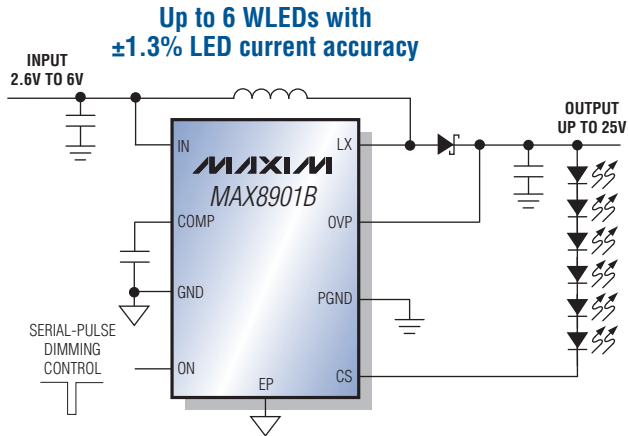
LDOs

- Dual 200mA output
- Low 45µV_{RMS} noise
- High 60dB PSRR
- Serial-pulse interface sets output voltage
- Internal feedback eliminates resistors

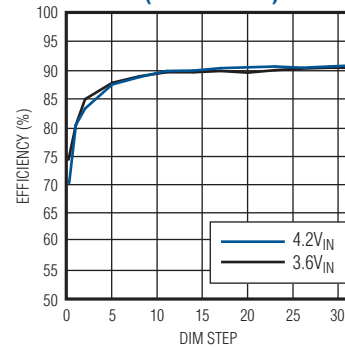


Highest efficiency WLED drivers

Serial or PWM dimming in a tiny, 2mm x 2mm TDFN package



Efficiency vs. dim step (MAX8901B)



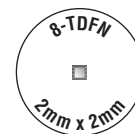
Highest efficiency

- Flexible dimming control
 - Direct PWM dimming (MAX8901A)
 - 32-step, single-wire serial dimming (MAX8901B)
- 1MHz frequency for 1 μ F input and 0.1 μ F output capacitors
- Input UVLO (6.5V, max)
- LED overvoltage protection (OVP)



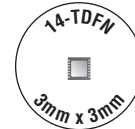
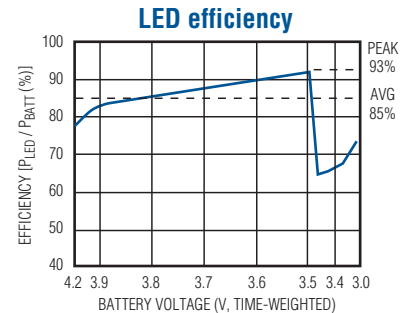
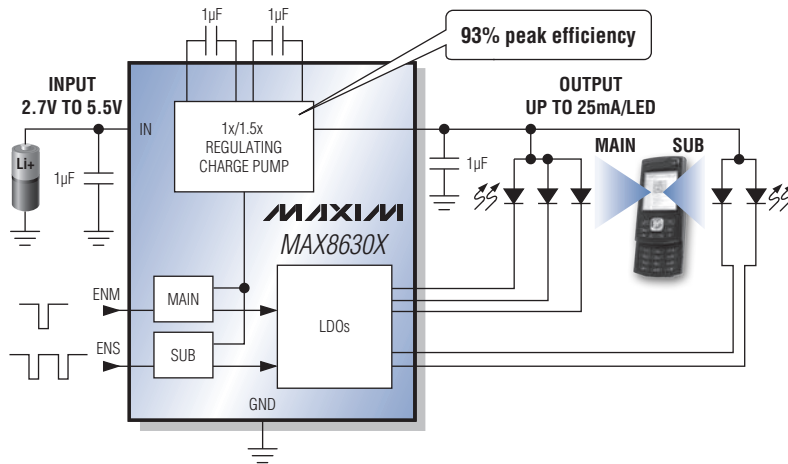
Longer battery life from a smaller size

Specification	MAX8901A/B	Competition
Peak efficiency (%)	> 91	85
Supply current (μ A)	85	800
C _{OUT} (μ F)	0.1	0.22
Package (mm x mm)	TDFN (2 x 2)	TDFN (2 x 3)



First dual-display, WLED driver with dual, 32-step dimming

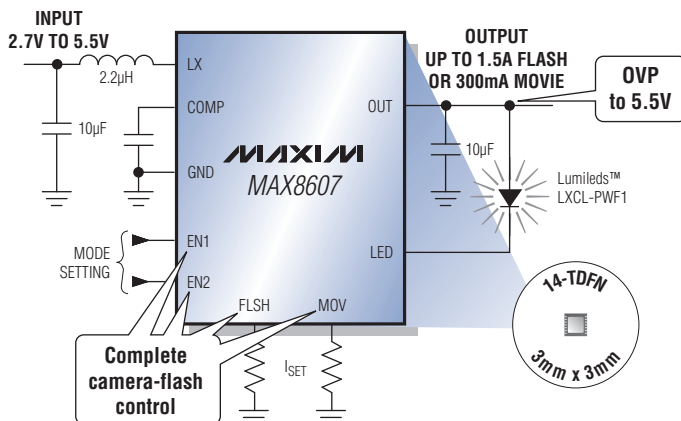
Highly accurate dimming down to 3% of full scale; fits in a 3mm x 3mm TDFN



- Soft-start limits inrush current
- Optional single, direct-PWM input to control all 5 LEDs (MAX8630W)
- Low input ripple and low EMI
- Input-to-output disconnect during shutdown

High-current, step-up DC-DC for the brightest WLED camera flash

Delivers 1.5A regulated current with up to 84% efficiency



MAX8607
16.5mm²



Competition
34mm²

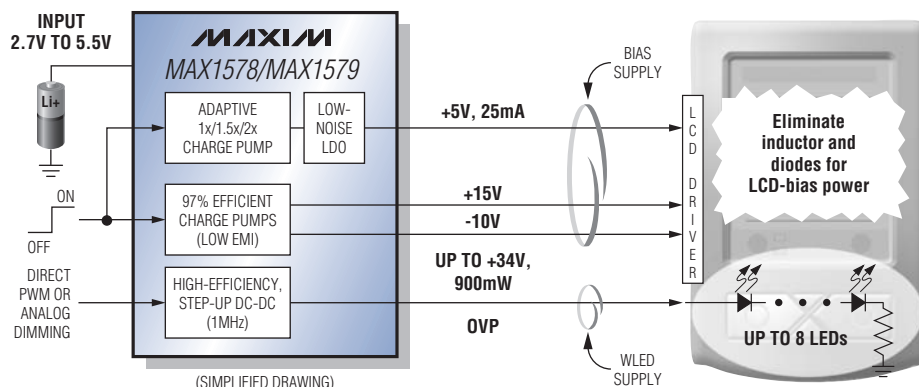


- Temperature protection
- Fixed 1MHz PWM switching

Lumileds is a trademark of Philips Lumileds Lighting Company.

First complete LCD-bias and WLED-backlighting supplies for small TFT-LCDs

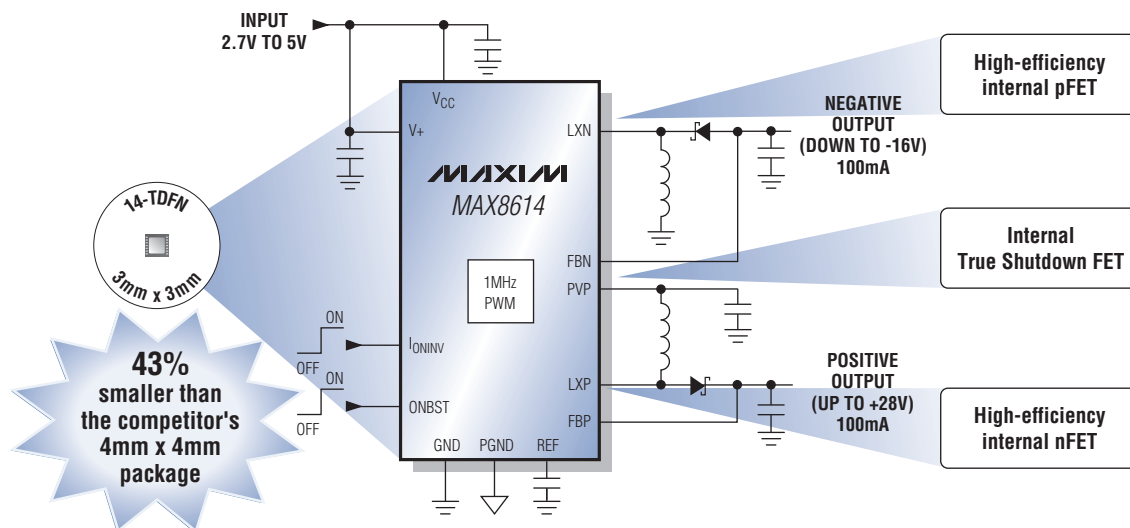
Complete four-output TFT-LCD supply (bias and WLED); one inductor



Small, dual-output (+ and -) DC-DC converters for CCDs and OLEDs

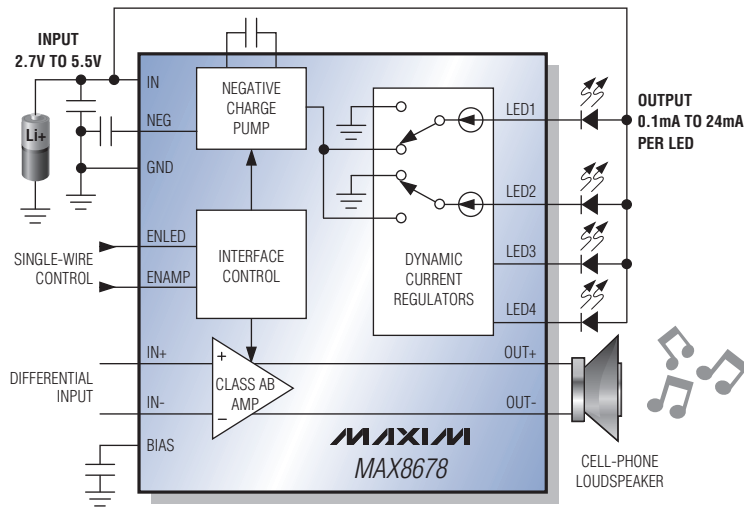
1MHz PWM reduces component size

Internal switches generate dual outputs up to +28V and down to -16V



Specification	MAX8614	Competition
Package size (mm x mm)	3 x 3 TDFN	4 x 4 QFN
Output capacitor (μF)	4.7 per output	22 per output
Compensation	Internal	External capacitors
Current limit	Factory programmable	Fixed
Soft-start inrush current controlled with True Shutdown circuitry	Controlled	Not controlled
True Shutdown circuitry	Internal FET	None, external FET

First LED charge pump to integrate audio amp provides excellent noise immunity



50% smaller
than the
competition

Maxim's solution = 9mm²

16-TQFN

3mm x 3mm

VS.

Competition's solution = 18mm²

6-LED charge pump

TQFN

3mm x 3mm

Class AB amplifier

TQFN

3mm x 3mm

LED charge pump

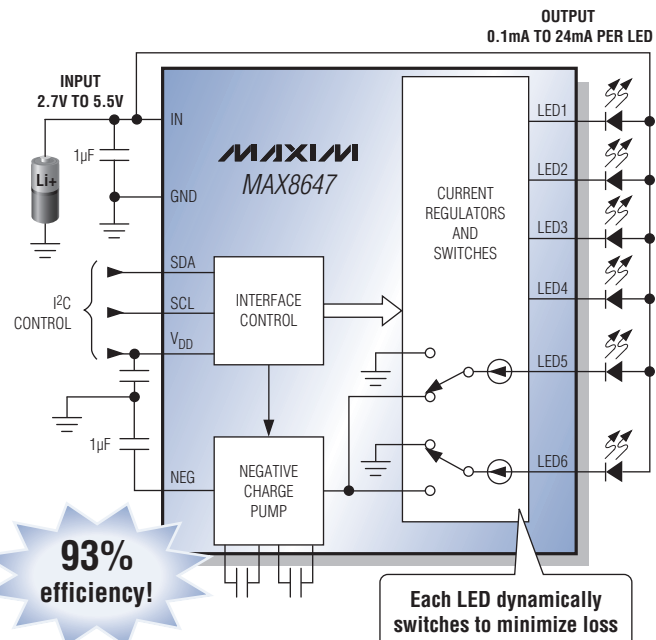
- High integration eliminates costly external components
- Independent, adaptive current regulator for each LED with low 140µA I_Q
- Single-wire, serial-pulse-dimming interface

Class AB audio amplifier

- High 90dB PSRR and low 0.004% THD+N at 1kHz
- -9dB to +18dB gain settings in 3dB steps
- Integrated click-and-pop suppression

Industry's first negative charge pumps for WLEDs achieve highest efficiency

- Independent, adaptive current regulators for each LED
- Drive up to 6 white or RGB LEDs
- ±0.4% accurate current matching and low 70µA I_Q
- 1MHz fixed-frequency switching for small components
- Multizone light management for 32 brightness levels or 32,768 colors with RGB LEDs
- Ambient temperature derating protects LEDs at high temperatures
- Easy serial-pulse-dimming interface (MAX8648)



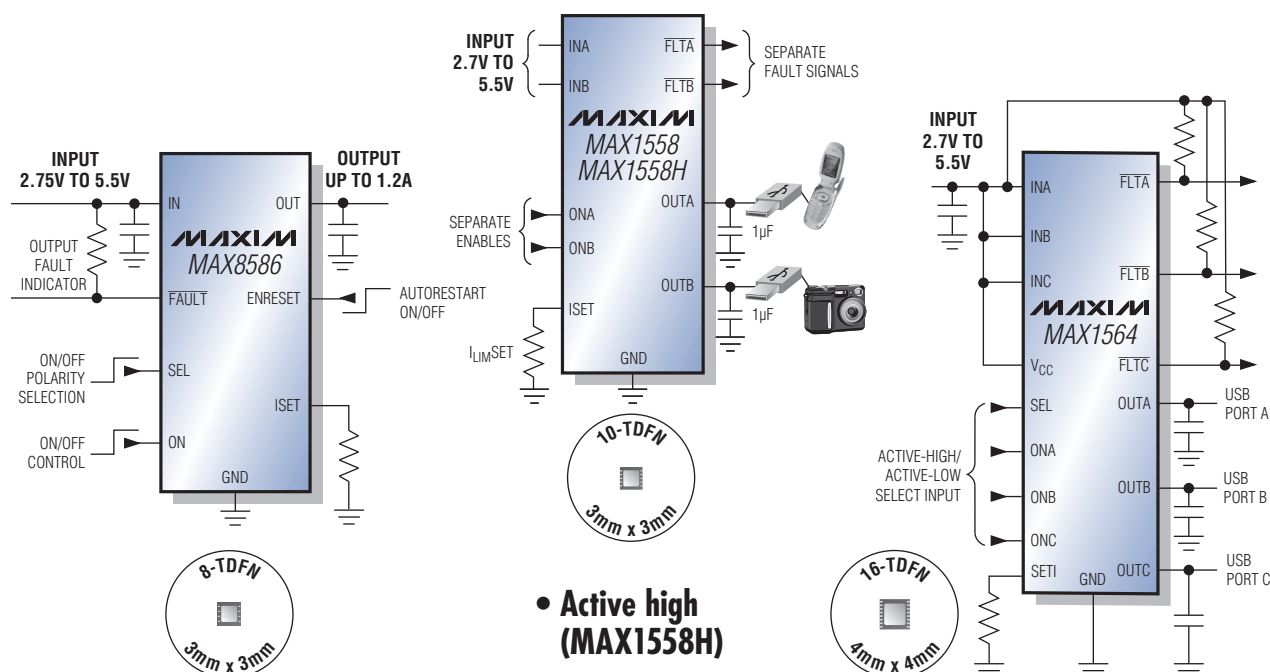
93%
efficiency!

Each LED dynamically
switches to minimize loss

Broad selection of WLED drivers

Part	Connection	Description	Features	No. of LEDs (max)	Input Voltage (V)	Efficiency (%)	Frequency (MHz)	Package (mm x mm)
MAX1553/ MAX1554	Series	40V step-up DC-DC in TDFN	Smallest, highest efficiency, current regulation, low-profile external components, OVP	10	2.7 to 5.5	82	300kHz	8-TDFN (3 x 3)
MAX1578/ MAX1579	Series	34V step-up plus +5V/+15V/-10V charge pump for LCD bias	First complete LCD bias and WLED backlight for TFT-LCDs; OVP, temp compensation	Up to 8 (34V)	2.7 to 5.5	84	1	24-TQFN (4 x 4)
MAX1582	Series	26V step-up DC-DC for main and subdisplays	Drives two LED sections; current regulation, internal MOSFET, OVP, low-profile external components	2 + 4	2.6 to 5.5	84	1	12-TQFN (4 x 4)/16-UCSP (2.5 x 2.5)
MAX1707	Parallel	1x/1.5x/2x charge pump with current regulation	Highest current (up to 610mA); main/flash/sub or RGB groups, I ² C programmable, soft-start, OVP, thermal derating	Three groups, up to 11 total	2.7 to 5.5	83	1	24-TQFN (4 x 4)
MAX8595/ MAX8596	Series	32V internal switch, step-up DC-DC	Temperature-compensated, high-efficiency step-up; reduces guardbanding costs by 33%	Up to 8 x 2	2.6 to 5.5	86	1	8-TDFN (3 x 3)
MAX8607	Parallel	5.5V step-up DC-DC with current regulation	Highest current (1.5A) for camera flash, 300mA movie-mode setting; temperature, overvoltage, and thermal protection	1 high-brightness LED (HB LED)	2.7 to 5.5	84	1	14-TDFN (3 x 3)
MAX8630	Parallel	1x/1.5x charge pump with current regulation for two groups	Individual 32-step dimming control down to 3% of full current; soft-start, OVP, thermal derating	2 + 3	2.7 to 5.5	85	1	14-TDFN (3 x 3)
MAX8631/ MAX8645	Parallel	1x/1.5x/2x charge pump with current regulation for two groups plus LDO	Individual 32-step dimming control down to 3% of full current; up to 480mA, soft-start, OVP, thermal derating	4 + 4	2.7 to 5.5	85	1	28-TQFN (4 x 4)
MAX8830	Parallel	5.5V step-up DC-DC supports backlight plus flash	4 x 10mA WLED current regulators, 200mA flash with programmable safety timer, I ² C interface, 2.5mm x 2.5mm UCSP	4 + 1	2.7 to 5.5	90	1	16-UCSP (2.5 x 2.5)
MAX8647/ MAX8648	Parallel	1x/1.5x negative charge pump for 6 WLEDs	I ² C/serial-pulse interface, negative charge pump with individual mode switch provides efficiency comparable to inductive boost	3 + 2 + 1	2.7 to 5.5	85	1	16-TQFN (3 x 3)
MAX8678	Parallel	1x/2x negative charge pump for 4 WLEDs plus Class AB amp	4 x 24mA WLED current regulators; serial-pulse interface, mono Class AB audio amp with click-and-pop suppression	4	2.7 to 5.5	80	1	16-TQFN (3 x 3)
MAX8790A	Parallel	26V external switch, step-up regulator	Current-mode, step-up regulator drives six parallel strings of WLEDs	Six parallel strings	4.5 to 26	86	500kHz/ 750kHz/ 1MHz	20-TQFN (4 x 4)
MAX8821	Parallel	1x/1.5x negative charge pump with Class D audio amp and dual low-noise LDOs	High-efficiency, 6 x 24mA WLED current regulators; 2W mono output; high 65dB PSRR at 1kHz; click-and-pop suppression and spread-spectrum mode eliminate EMI	6	2.7 to 5.5	92	1	28-TQFN (4 x 4)
MAX8822	Parallel	1x/1.5x negative charge pump with dual low-noise LDOs	High-efficiency, 4 x 24mA WLED current regulators; flexible single-wire dimming and LDO output control	4	2.7 to 5.5	92	1	16-TQFN (3 x 3)
MAX8831	Series/ parallel	28V step-up regulator with integrated switch	Five low-dropout, parallel LED current regulators; I ² C programmable	45 (regulators drive 9 LEDs each)	2.7 to 5.5	> 90	2	16-WLP (2 x 2 x 0.6)
 MAX8834Y/Z	Parallel	Integrated synchronous step-up regulator	I ² C programmable	1.5A for one LED, 750mA for two LEDs	2.5 to 5.5	> 90 (MAX8834Y), > 87 (MAX8834Z)	2 (MAX8834Y), 4 (MAX8834Z)	20-WLP (2.5 x 2)
MAX8901A/ MAX8901B	Series	WLED driver with PWM or serial dimming	Direct PWM (MAX8901A) or 32-step serial (MAX8901B) dimming, better than ±2% LED current accuracy, input UVP and OVP, thermal shutdown, LED OVP	6	2.6 to 6	92	750kHz	8-TDFN (2 x 2)
MAX17061	Parallel	26V internal switch, step-up regulator	Current-mode, integrated FET drives eight parallel strings of WLEDs	Eight parallel strings	4.5 to 26	86	500kHz/ 750kHz/ 1MHz	28-TQFN (4 x 4)

Small 1.2A USB switches have reverse-current blocking



- Selectable autoreset function
- Selectable active high/low

- Selectable active high/low

- Reverse-current blocking—protects against noncompliant devices
- Autoreset—saves system power
- 20ms fault blanking—prevents false alarms
- $\pm 14\%$ current-limit accuracy—saves system power cost

Wide selection of USB current-limited switches

Part	USB Ports	Input Voltage (V)	Guaranteed Output Current (A)	On-Resistance (m Ω)	Tight Current-Limit Accuracy	Fault Blanking	Autoreset	Thermal-Shutdown Protection	Package (mm x mm)
MAX1558/58H	2	2.7 to 5.5	1.2/channel	60	✓	✓	✓	✓	10-TDFN (3 x 3)
MAX1562	6	4 to 5.5	3	30	✓	✓	✓	✓	8-SO (4.9 x 6)
MAX1563	8	4 to 5.5	4	30	✓	✓	✓	✓	12-QFN (4 x 4)
MAX1564	3	2.7 to 5.5	1.2/channel	60	✓	✓	✓	✓	16-TQFN (4 x 4)
MAX1607	1	2.7 to 5.5	1.2/channel	75	✓	✓	✓	✓	8-SO/10-TDFN (3 x 3)
MAX1823A/B	2	4 to 5.5	500mA/channel	75		✓	✓	✓	10- μ MAX (4.9 x 2.9)
MAX1922	2	2.7 to 5.5	1.4	70	✓	✓		✓	8-SO/10-TDFN (3 x 3)
MAX1930	2	2.7 to 5.5	1	70	✓			✓	8-SO (4.9 x 6)
MAX1940	3	4 to 5.5	500mA/channel	75		✓	✓	✓	16-QSOP (4.9 x 6)
MAX1946	1	2.7 to 5.5	500mA	80		✓	✓	✓	8-TQFN (3 x 3)
MAX8586	1	2.7 to 5.5	1.2/channel	60	✓	✓	✓	✓	8-TDFN (3 x 3)

Simple, safe, small Li+ battery chargers efficiently manage your power path

A primary function in portable devices is to charge the battery quickly, while optimally controlling the battery current and voltage based on charging requirements for the specific battery chemistry. When USB power or an AC adapter is connected to the device, a smart battery charger should allow the device to turn on instantly, even if the battery is completely depleted. The charger should also make the best use of limited USB or adapter power and charge the battery with additional input power not used by the system. Additionally, the system load should switch from the battery to the external input power source when input power is available. Maxim offers a wide selection of battery chargers that fulfill these requirements.

Maxim battery-charger advantages

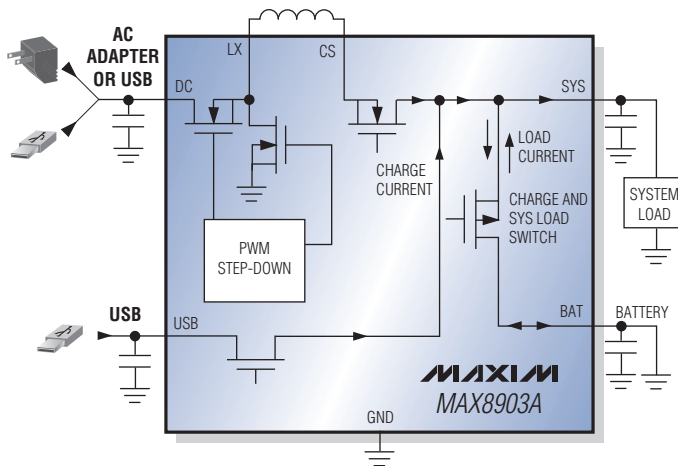
- Internal MOSFET switches to reduce external part count
- Input OVP
- Charge-status and fault indicators
- Power-OK monitors
- Charge timers
- Battery thermistor monitors
- On-chip thermal limiting to decrease battery charge rate and prevent overheating
- Packages as small as 4mm²

Broad range of Li+ battery chargers

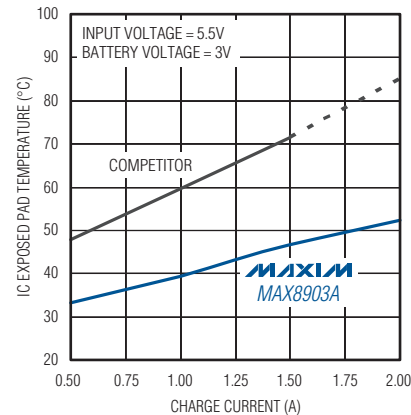
Part	No. of Cells in Series	Charge Rate	Charge-Termination Method	EV Kit	Features	Package (mm x mm)
MAX1551/MAX1555	1	Fast, up to 300mA	Voltage and current limit	✓	Dual input (USB/AC adapter), smallest	5-SOT23 (2.9 x 2.75)
MAX1758	1 to 4	Fast, up to 1.5A		✓	28V _{IN} internal switch, sync-rectified step-down, input-current-limit loop, timers	28-SSOP (7.8 x 10.2)
MAX1874	1	Fast, up to 1A			Dual input (USB/AC adapter), smallest, OVP, load switcher	16-QFN (5 x 5)
MAX1879		Fast, up to 800mA			Pulse charger, external switch, no heat dissipation, upgrade to MAX1679	8-μMAX (3 x 4.9)
MAX1926		Fast, up to 4A		✓	12V _{IN} , external switches, step-down controller, temp sensor, timers	12-QFN (4 x 4)
MAX8600/MAX8601		Up to 1A AC, 100mA/500mA USB			Single-/dual-input (USB/AC adapter) chargers with OVP, thermal regulation, and timer	14-TDFN (3 x 3)
MAX8606		Up to 1A	CCCV, temp range		14V input USB/AC adapter, dual output, integrated 50mΩ battery switch	14-TDFN (3 x 3)
MAX8677A/C		Up to 1.5A	Smart Power Selector circuitry		Dual input (USB/AC adapter)	24-TQFN (4 x 4)
MAX8804		Fast USB charging (up to 475mA), AC adapter (up to 700mA)	CCCV, thermally regulated		Simple dual-input 30VAC and 16V USB OVP; easily programmable, internal thermal protection and OVP circuitry	8-TDFN (3 x 3)
MAX8808		Fast, up to 1A	CCCV, temp range		15V adapter input, thermal regulation, integrated pass FET, tiny package	24-TQFN (4 x 4)
MAX8814		Programmable, fast-charge current (1A _{RMS} , max)	CCCV, thermally regulated		Smallest 28V charger with 7V OVP, low dropout voltage (300mV at 500mA), internal MOSFET, reverse-blocking diode, and current-sense resistor	8-TDFN (2 x 2)
MAX8844/MAX8845		Up to 1A	CCCV, thermally regulated	✓	Dual input (MAX8844), single input (MAX8845)	14-TQFN (4 x 4) (MAX8844); 12-TQFN (4 x 4) (MAX8845)
MAX8903A		Up to 2A	Smart Power Selector circuitry	✓	Dual input (USB/AC adapter)	28-TQFN (4 x 4)

Dual-/single-input Li+ chargers have Smart Power Selector circuitry to maximize USB/AC-adapter charge rate

2A charger reduces charge time by 50% and decreases heat by 30°C



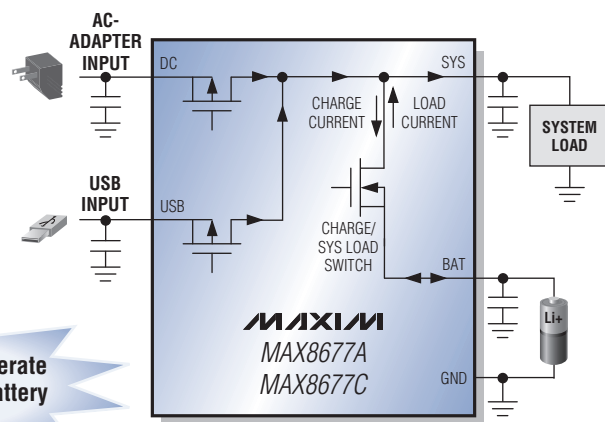
Temperature vs. charge current



- 4.15V to 16V DC-DC input operating range
- 4MHz switching for tiny external components
- Instant-on: works with no battery or dead battery
- 50mΩ integrated load switch
- Integrated OVP
- Thermistor monitor
- Charge timer
- 4mm x 4mm, 28-pin TQFN package

1.5A charger integrates 40mΩ battery-to-load switch

- Common or separate USB and adapter inputs with up to 2A (adj) current limit
- Automatic adapter/USB/battery switchover requires no external MOSFETs
- Input OVP to 16V
- Thermal regulation prevents overheating
- 4mm x 4mm, 24-pin TQFN package

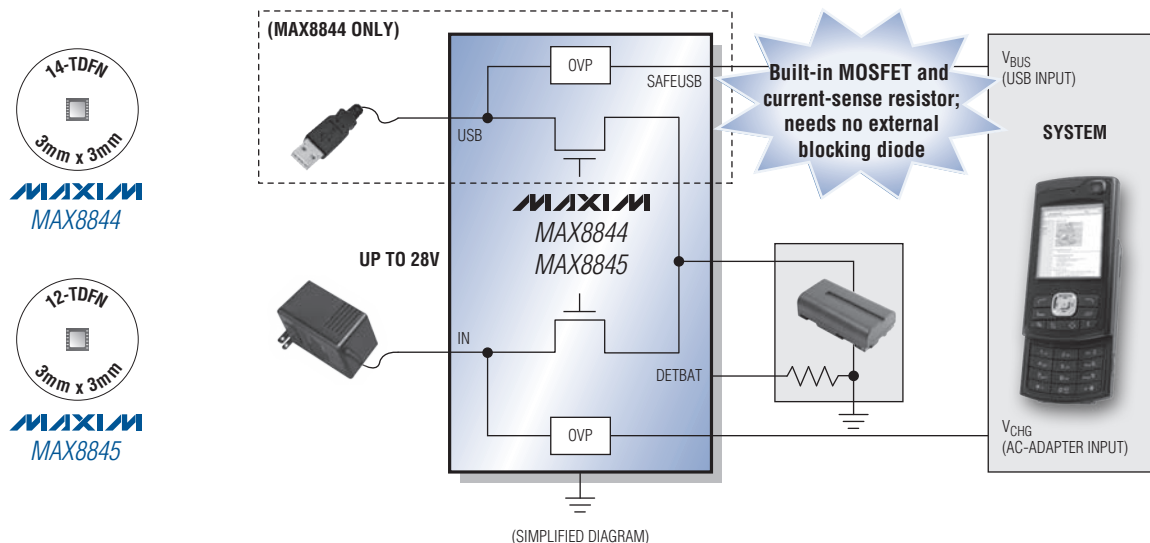


Allows system to operate with a discharged battery or no battery



Protect your Li+ battery and cell phone from unexpected power surges

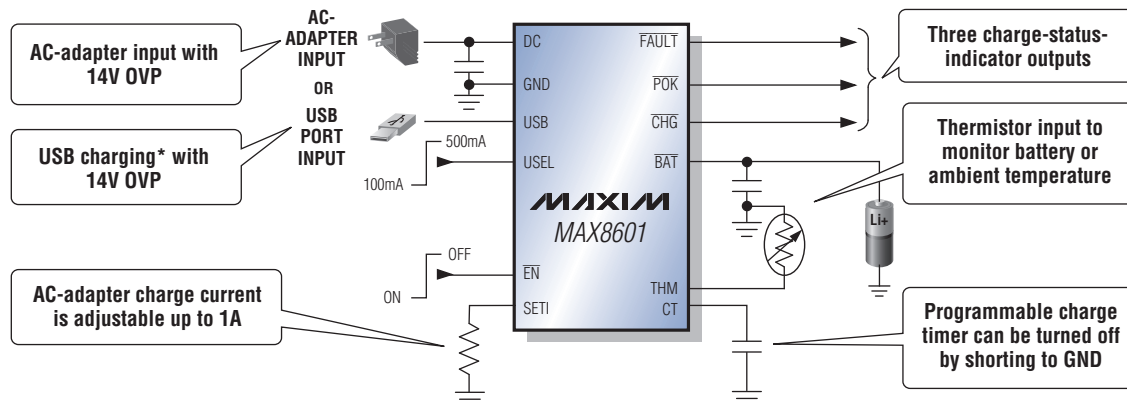
Dual-input, overvoltage-protected 4.7V output



- CCCV, thermally regulated linear charger
- Programmable fast-charge current (1A_{RMS}, max)
- 4.25V to 28V input voltage range with input OVP above 7.5V
- Low dropout voltage (300mV at 500mA)
- Input power-source/battery-detection circuit
- Output for autobooting
- Charge-status output

Single-/dual-input Li+ chargers provide OVP, thermal regulation, and charge timer in a 3mm x 3mm TDFN

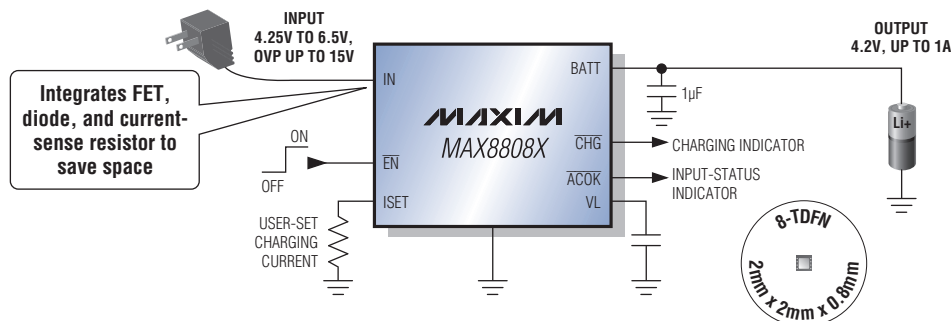
OVP and simple application circuit reduce system cost and size



*USB charging is protected by U.S. Patent #6,507,172.

First 1A Li+ charger in 4mm² TDFN with 15V adapter input

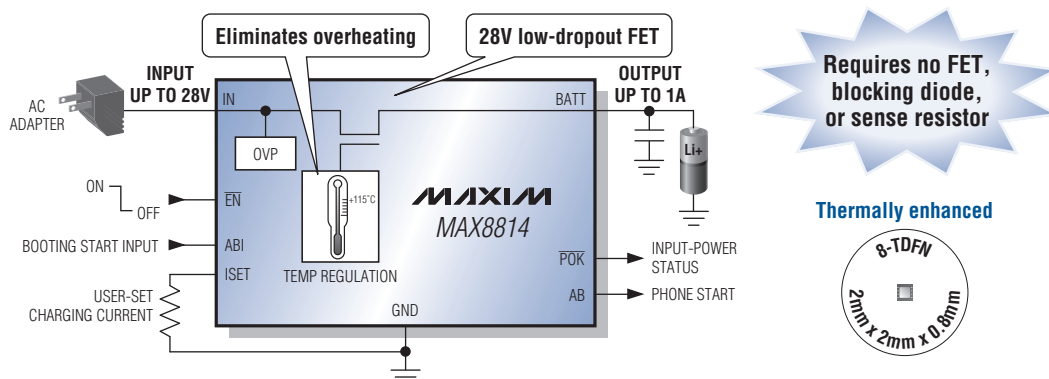
CCCV temperature-regulated control



- Proprietary temperature and CCCV regulation for safest and fastest charging
- 0.3V dropout voltage at 0.5A current
- Uses active-high logic for enable (MAX8808Y)
- Eliminates prequalification state (MAX8808Z)
- Soft-start
- Evaluation kit available
- Thermally enhanced TDFN package (0.8mm high)

Smallest 28V Li+ charger in only 4mm²

Up to 28V adapter input and thermal regulation result in safest and fastest charging

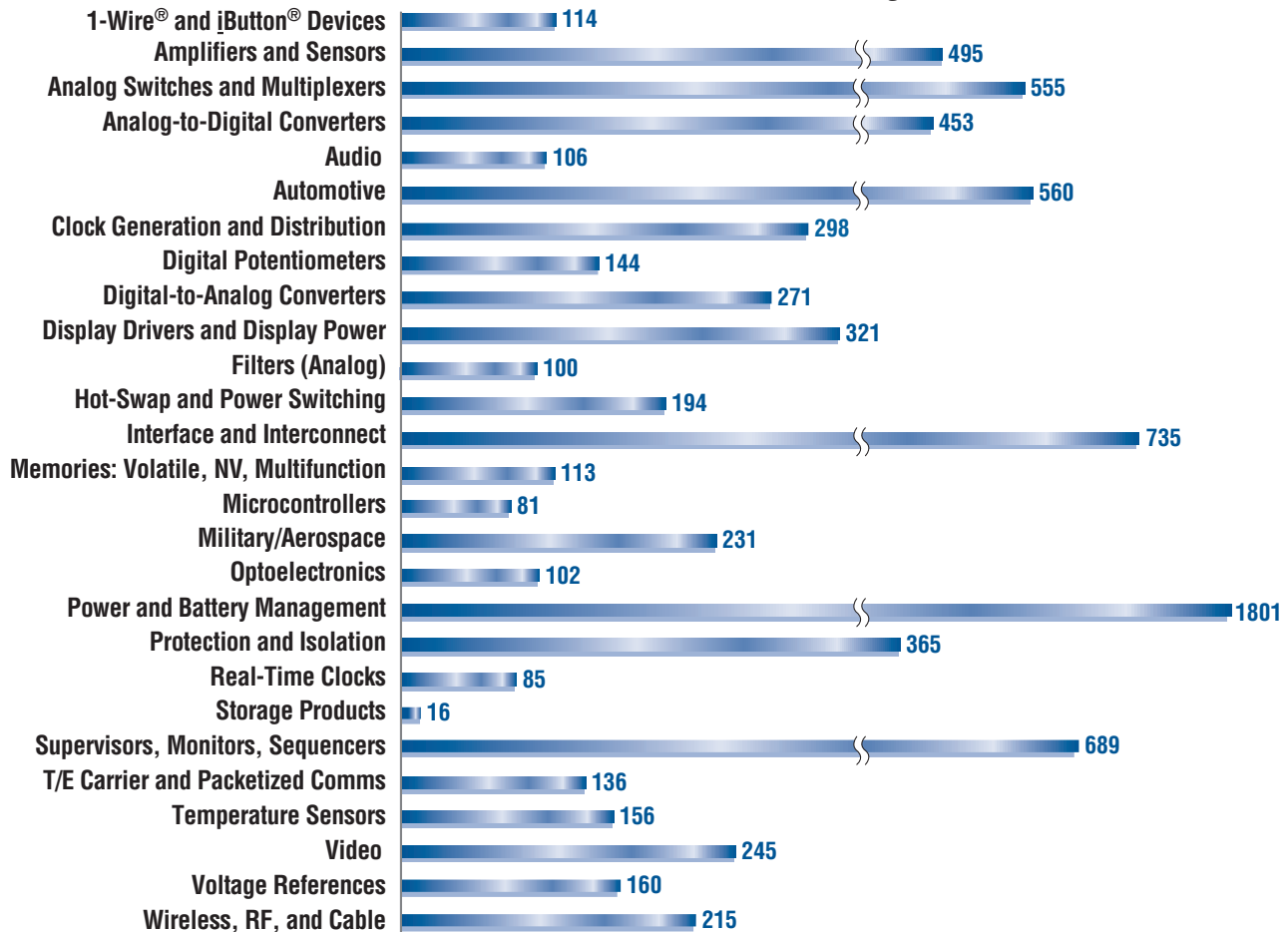


- Proprietary temperature and CCCV regulation simplify hardware design
- Low 0.3V dropout voltage at 0.5A current
- Soft-start limits inrush current
- Smart autobooting assistant monitors booting signal and power status to start handheld devices
- Ideal for cell phones, smartphones, and other handhelds

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