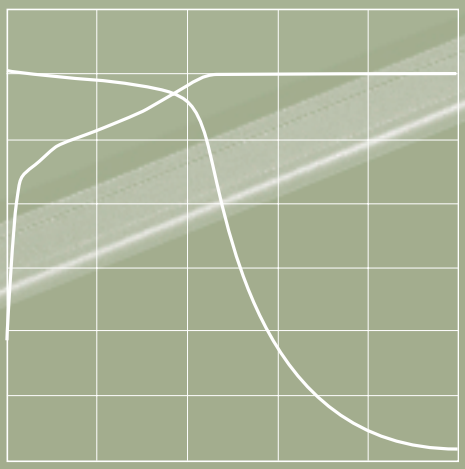
02.2007

Battery Charger Solutions

High Performance Analog ICs



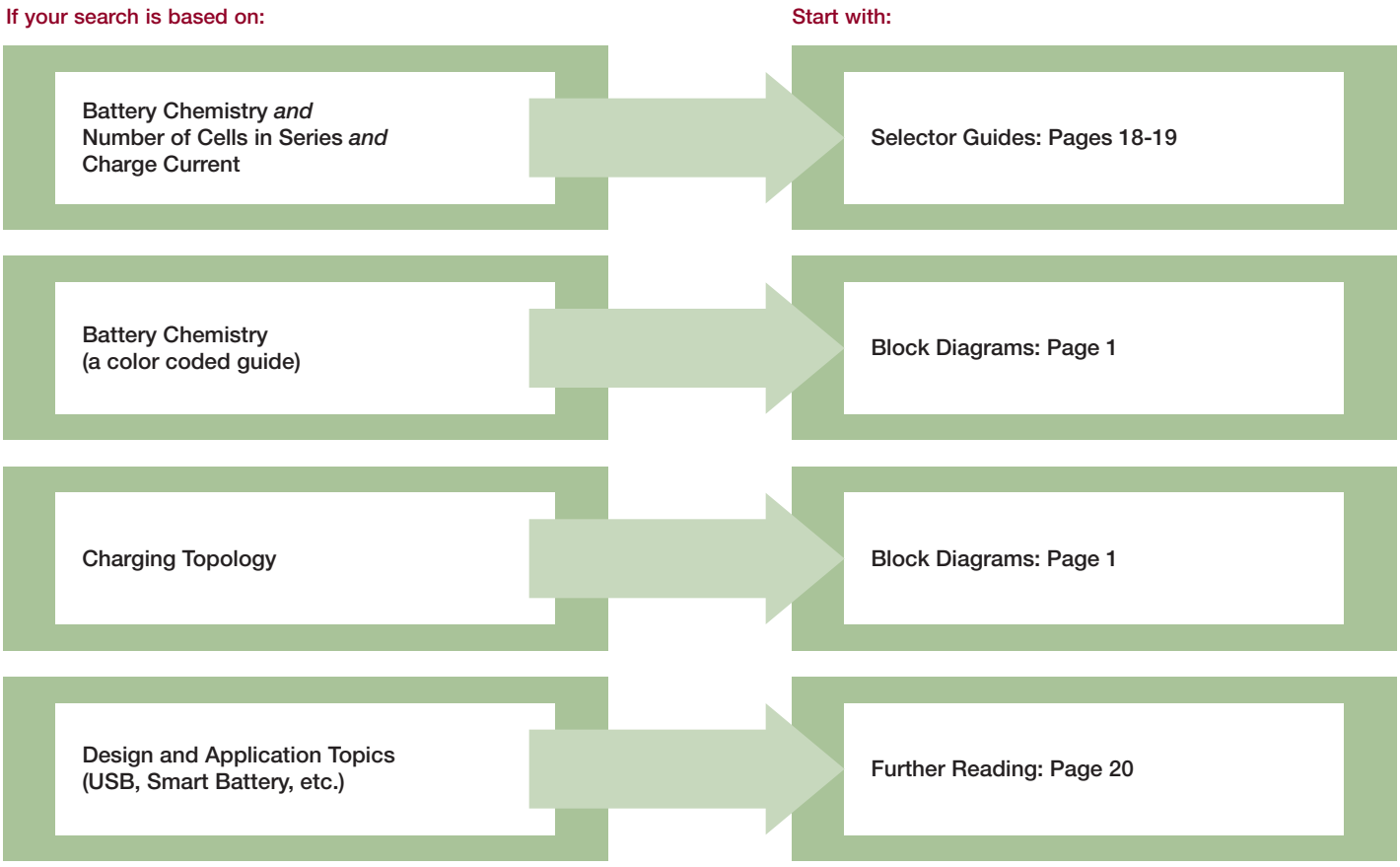
LINEAR TECHNOLOGY

Linear Technology's high performance battery charger ICs enable long battery life by providing precision charging control, constant status monitoring and stringent battery protection. Proprietary design techniques provide battery and circuit protection, small solution footprints, faster charging, 100% standalone operation, improved thermal performance and high reliability operation.

Each battery chemistry has unique battery-charging requirements. Selecting the correct battery charger increases the operational run time of the end-product by ensuring that the battery is always optimally charged. This guide contains the essential technical criteria to easily identify the optimum battery charging IC for charging single-cell, multiple-cell and even battery packs, regardless of chemistry.

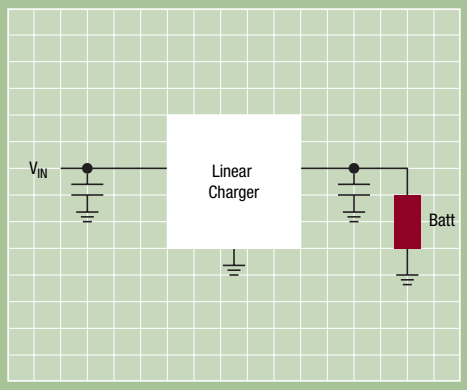
For information on our latest battery charging products, visit our website at **www.linear.com**

How to Use this Guide

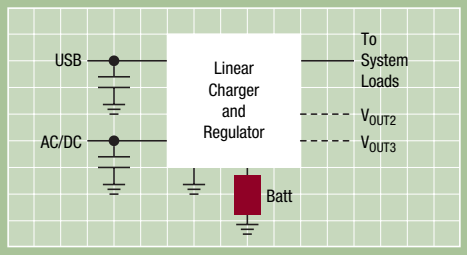


Block Diagrams

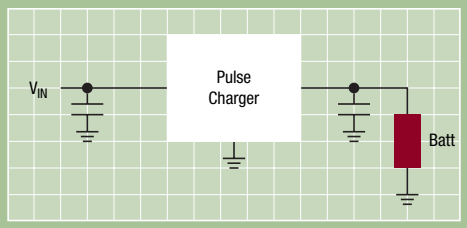
Linear Charger



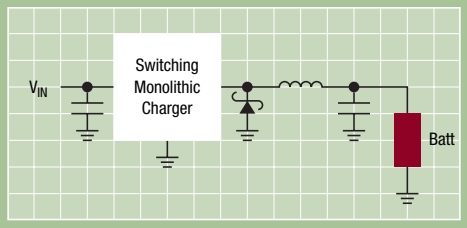
Linear Charger + Regulators



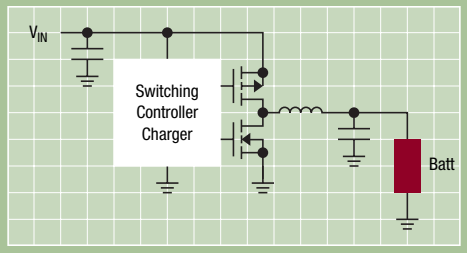
Pulse Charger



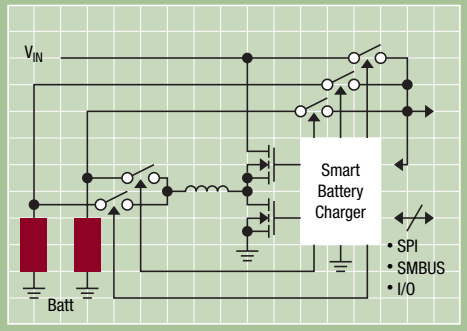
Switchmode Monolithic Charger



Switchmode Controller Charger



Switchmode Smart Battery Charger



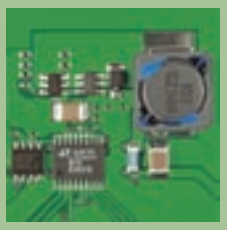
NiMH and NiCd Fast Battery Chargers

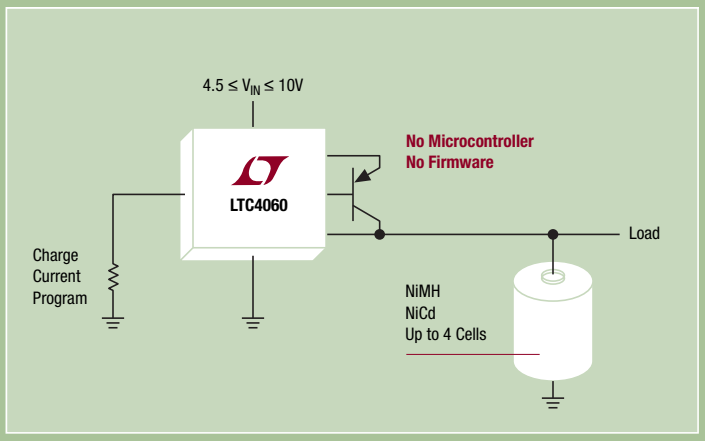
LTC4060: Standalone 2A Linear NiMH/NiCd Fast Battery Charger

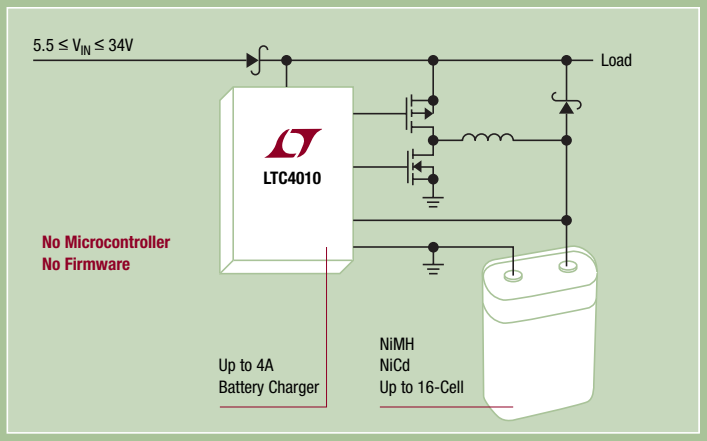
LTC4010: High Efficiency 4A Standalone Switchmode Battery Charger

Linear Technology's nickel battery chargers reduce component count, speed design and allow fast, reliable charging of both NiMH and NiCd chemistry cells.

LTC4011: Actual Size, Complete Solution







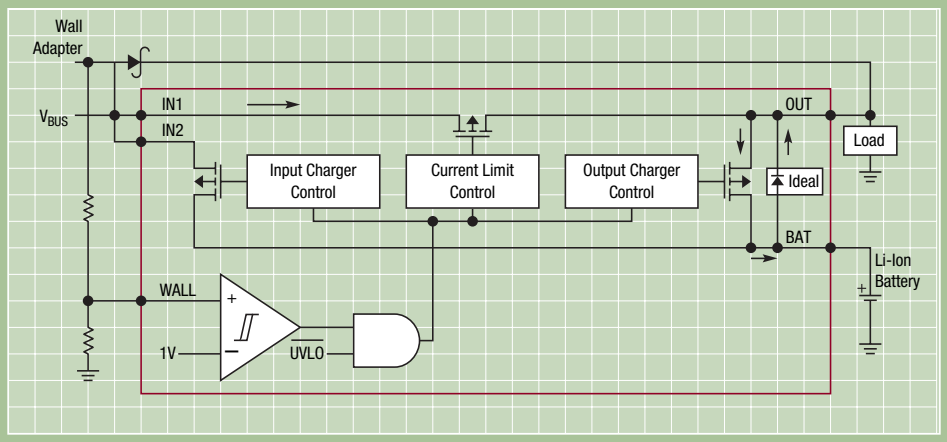
Part No.	Topology	Battery Cells* (series)	Max Charge Current	Input Voltage	Onboard Charge Termination	Integrated Pass Transistor	End-of-Charge Signal	AC Present Signal	Thermistor Interface	Package
NiMH / NiCd Battery Chargers–Standalone										
LTC4060	Linear	1–4	2A	4.5–10V	-dV, t, V, T	–	✓	✓	✓	DFN-16, TSSOP-16
LTC4010	Synchronous Step Down	1–16	4A	4.5–34V	-dV, dT/dt, T, t	–	✓	✓	✓	TSSOP-16
LTC4011	Synchronous Step Down	1–16	4A	4.5–34V	-dV, dT/dt, T, t	–	✓	✓	✓	TSSOP-20
NiMH / NiCd Battery Chargers–Non-Standalone										
LT1512	SEPIC	1–18	0.8A	2.4–29V	External, µC	✓	–	–	–	SO-8
LT1510	Step Down	1–12	1A	7–29V	External, µC	✓	–	–	–	SO-8, SSOP-16, SO-16
LT1513	SEPIC	1–18	1.6A	2.4–29V	External, µC	✓	–	–	–	DD Pak, TO-220
LT1769	Step Down	1–12	2A	7–29V	External, µC	✓	–	–	–	TSSOP-20, SSOP-28
LT1511	Step Down	1–12	3A	7–29V	External, µC	✓	–	–	–	SO-24
LTC4008	Synchronous Step Down	4–18	4A	6–28V	External, µC	–	✓	✓	–	SSOP-28
LT1505	Synchronous Step Down	1–13	8A	6.7–26V	External, µC	–	✓	–	–	SSOP-28
NiMH / NiCd Battery Chargers–Smart Chargers										
LTC4100	Step Down	1–13	4A	6–28V	External, µC, SMBus	–	–	✓	✓	SSOP-24
LTC1759	Step Down	1–13	8A	11–24V	External, µC, SMBus	–	–	✓	✓	SSOP-36
LTC1960	Step Down	4–16	8A	6–28V	External, µC, SPI	–	–	–	–	SSOP-36

*Based on Maximum Cell Voltage of 1.8V

Battery Chargers with PowerPath Control

LTC4055: USB Power Controller and Li-Ion Battery Charger

Linear Technology's PowerPath products and architectures allow the load to be powered from both V_{IN} and the battery, ensuring shorter charging times and more flexibility for the portable device designer. They also enable "instant on" in systems with a depleted battery.



Part No.	Max. Charge Current	Input Voltage	$R_{DS(ON)}$ of Ideal Diode	Standby Current	I_{BAT} Drain Current	Standalone	Onboard Charge Termination	Thermal Regulation	Integrated Transistor	Package
USB Power Managers and Li-Ion Linear Battery Chargers with PowerPath Control										
LTC4055	1.25A	4.3–5.5V	200mΩ	50µA	2.5µA	✓	Timer + C/10	✓	✓	QFN-16
LTC4066	1.5A	4.35–5.5V	50mΩ	50µA	2.5µA	✓	Timer + C/x	✓	✓	QFN-24
LTC4085	1.5A	4.35–5.5V	200mΩ (≤50mΩ opt.)	50µA	15µA	✓	Timer + C/10	✓	✓	DFN-14
LTC4089/-1	1.5A	4.35–5.5V	215mΩ (≤50mΩ opt.)	50µA	15µA	✓	Timer + C/10	✓	✓	DFN-22

Ideal Diodes

LTC4413: Dual 2.6A, 2.5V to 5.5V Ideal Diodes in 3mm × 3mm DFN

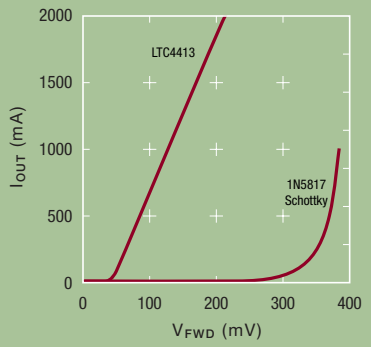
Linear Technology's Ideal Diode devices provide a low loss, near "ideal" diode function. They feature lower forward voltage drop and reverse leakage current than conventional diodes. This reduces power losses and self-heating, thereby extending battery run time.

Part No.	Ideal Diode	MOSFET	Integrated MOSFET	Max Current	Input Voltage	Forward Voltage	Forward ON Resistance	Reverse Leakage Current	Supply Current	Package
Low-Power PowerPath Controllers and Ideal Diode Devices										
LTC4411	Single	P-channel	✓	1A	2.6–5.5V	28mV	140mΩ	1µA	35µA	ThinSOT™
LTC4413	Dual	P-channel	✓	1.5A	2.5–5.5V	28mV	100mΩ	1µA	20µA	DFN-10
LTC4412	Single	P-channel	–	5A*	2.5–28V	20mV	–	3µA	13µA	ThinSOT
LTC4412HV	Single	P-channel	–	5A*	2.5–36V	20mV	–	3µA	13µA	ThinSOT

Part No.	Ideal Diode	External MOSFET	Max Current	Input Voltage	Package
High-Power PowerPath Controllers and Ideal Diode Devices					
LTC1473	Dual	N-channel	5A	4.75–30V	SSOP-16
LTC1473L	Dual	N-channel	5A	2.8–9V	SSOP-16
LTC1479	Triple	N-channel	5A	6–28V	SSOP-36
LTC4350	Single	N-channel	15A	1.5–12V	SSOP-16
LT4351	Single	N-channel	15A	1.2–18V	MS-10

*Depends on MOSFET Selection

LTC4413 vs 1N5817 Schottky
Benefit: Less Heat

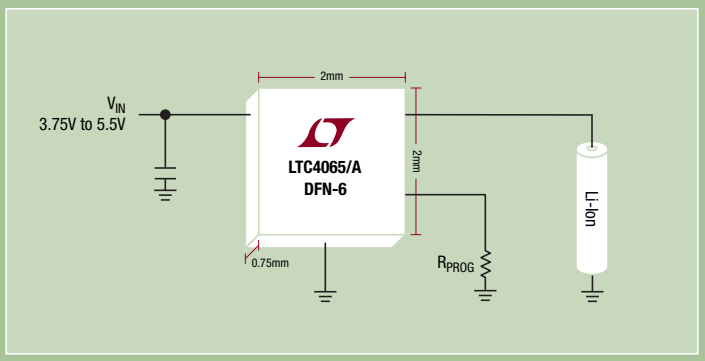


Li-Ion 4.2V/Cell Linear Battery Chargers

LTC4065/A: Standalone Linear Li-Ion Battery Chargers in 2 x 2 DFN

Linear Technology has a vast portfolio of linear Li-Ion 4.2V float voltage battery chargers with a multitude of performance, feature and package options.

Standalone operation eliminates the need for an external micro-controller and associated firmware support for charge termination, thereby greatly simplifying design.

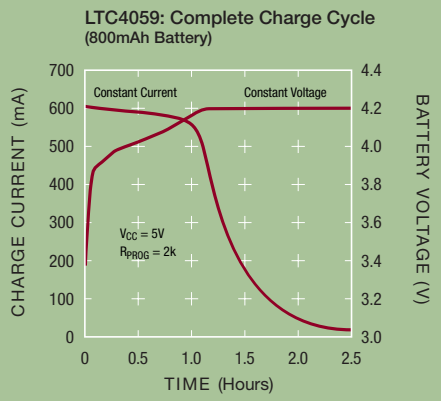


Part No.	Batt. Cells (series)	Max Charge Current	Input Voltage	Onboard Charge Termination	Integr. Pass Trans.	I_{CHARGE} Monitor	End-of-Charge Signal	AC Present Signal	Thermal Reg.	Thermistor Interface	Package
Li-Ion 4.2V/Cell Linear Battery Chargers–Standalone											
LTC4065	1	0.75A	3.75–5.5V	Timer + C/10	✓	✓	✓	–	✓	–	DFN-6
LTC4065A	1	0.75A	3.75–5.5V	Timer + C/10	✓	✓	✓		✓	–	DFN-6
LTC4069	1	0.75A	3.75–5.5V	Timer + C/10	✓	✓	✓	–	✓		DFN-6
LTC4054/L	1	0.8/ 0.15A	4.25–6.5V	C/10	✓	✓	✓	✓	✓	–	ThinSOT
LTC4056	1	0.9A	4.5–6.5V	Timer	–	–	✓	–	–	–	ThinSOT
LTC4068	1	0.95A	4.25–6.5V	C/x	✓	✓	✓	✓	✓	–	DFN-8
LTC4058	1	0.95A	4.25–6.5V	C/10	✓	✓	✓	✓	✓	–	DFN-8
LTC4075 LTC4076 LTC4077	1	0.95A	4.3–8V Dual Input USB or Adapter	C/x (USB C/x) C/x (USB C or C/5) C/10 (USB C/x)	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	– – –	DFN-10 DFN-10 DFN-10
LTC4061	1	1A	4.3–8V	Timer + C/x	✓	✓	✓	✓	✓	✓	DFN-10
LTC4062	1	1A	4.3–8V	Timer + C/x	✓	✓	✓	–	✓	–	DFN-10
LTC4063	1	1A	4.3–8V	Timer + C/x	✓	✓	✓	–	✓	–	DFN-10
LTC4055	1	1A	4.3–5.5V	Timer	✓	–	✓	✓	✓	✓	QFN-16
LTC4053	1	1.25A	4.25–6.5V	Timer + C/10	✓	✓	✓	✓	✓	✓	MS-10, DFN-10
LTC1733	1	1.5A	4.5–6.5V	Timer + C/10	✓	✓	✓	✓	✓	✓	MS-10
LTC4066	1	1.5A	4.35–5.5V	Timer + C/x	✓	✓	✓	✓	✓	✓	QFN-24
LTC4085	1	1.5A	4.35–5.5V	Timer + C/10	✓	–	✓	✓	✓	✓	DFN-14
LTC4089/-1	1	1.5A	4.35–5.5V	Timer + C/10	✓	–	✓	–	✓	✓	DFN-22
LTC4050	1	2A	4.5–10V	Timer + C/10	–	–	✓	✓	–	✓	MS-10
LTC1731	1, 2	2A	4.5–12V	Timer + C/10	–	–	✓	–	–	–	MS-8, SO-8
LTC1732	1, 2	2A	4.5–12V	Timer + C/10	–	–	✓	✓	–	–	MS-10, SO-10

Li-Ion 4.2V/Cell Linear Battery Chargers–Non-Standalone

LTC4059/A: 900mA Linear Li-Ion Battery Chargers in 2 x 2 DFN

LTC4059: Actual Size, Complete Solution



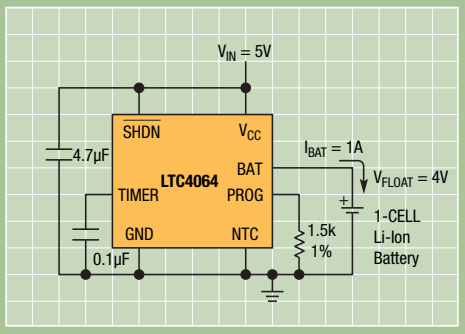
Part No.	Batt. Cells (series)	Max Charge Current	Input Voltage	Charge Termination Method	Integrated Pass Transistor	ICHARGE Monitor	End-of-Charge Signal	AC Present Signal	Thermal Reg.	Thermistor Interface	Package
Li-Ion 4.2V/Cell Linear Battery Chargers–Non-Standalone											
LTC1734/L	1	0.7/0.18A	4.55–8V	µController	–	✓	–	–	–	–	ThinSOT
LTC4057	1	0.8A	4.25–6.5V	µController	✓	✓	–	–	✓	–	ThinSOT
LTC4059	1	0.9A	3.75–8V	µController	✓	✓	–	–	✓	–	DFN-6
LTC4059A	1	0.9A	3.75–8V	µController	✓	✓	–	✓	✓	–	DFN-6

Li-Ion 4.0V, 4.1V and 4.4V/Cell Linear Battery Chargers

LTC4064: Monolithic Linear Charger for Backup Li-Ion Batteries

Charging Li-Ion cells to lower float voltages (4.0V–4.1V) increases battery cycle life. As a consequence, batteries are not charged to 100% capacity.

4.4V Li-Ion cells allow for higher voltage charging and have approximately 10% higher capacity than conventional 4.2V Li-Ion batteries.

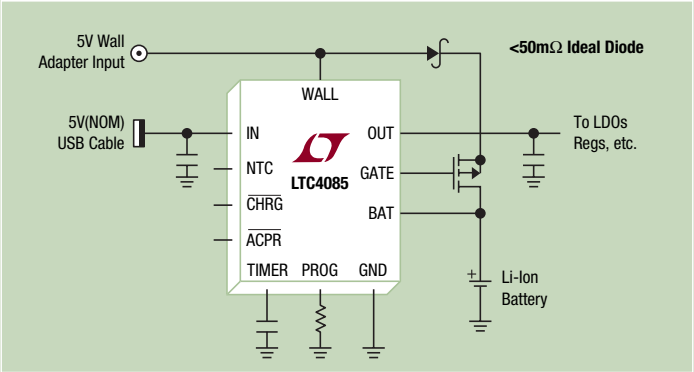


Part No.	Batt. Cells (series)	Cell Voltage	Max Charge Current	Standalone	Charge Termination Method(s)	Integr. Pass Trans.	ICHARGE Monitor	End-of-Charge Signal	AC Present Signal	Thermistor Interface	Package
Li-Ion 4.0V/Cell, 4.1V/Cell and 4.4V/Cell Linear Battery Chargers											
LTC1734	1	4.1V	0.7A	–	µController	–	✓	–	–	–	ThinSOT
LTC4061-4.4	1	4.4V	1A	✓	Timer + C/x	✓	✓	✓	✓	✓	DFN-10
LTC4064	1	4.0V	1.25A	✓	Timer + C/10	✓	✓	✓	✓	✓	MS-10
LTC4089-1	1	4.1V	1.5A	✓	Timer + C/10	✓	–	✓	–	✓	DFN-22
LTC1731	1, 2	4.1V	2A	✓	Timer + C/10	–	–	✓	–	–	MS-8
LTC1732	1, 2	4.1V	2A	✓	Timer + C/10	–	–	✓	✓	–	MS-10

USB Compliant Battery Chargers

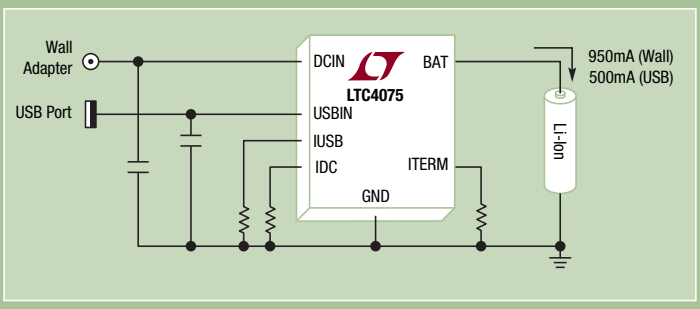
LTC4085: USB Power Manager with Ideal Diode Controller and Li-Ion Battery Charger

Linear Technology's USB compliant battery chargers offer high charge current accuracy for both high-power (500mA) and low-power (100mA) USB systems. They optimize efficiency, minimizing USB power loss.



Part No.	Max. Charge Current	Input Voltage	$R_{DS(ON)}$ of Ideal Diode	Standby Current	I_{BAT} Drain Current	Standalone	Onboard Charge Termination	Thermal Regulation	Integrated Transistor	Package
USB Power Managers and Li-Ion Linear Battery Chargers with PowerPath Control										
LTC4055	1.25A	4.3–5.5V	200mΩ	50µA	2.5µA	✓	Timer + C/10	✓	✓	QFN-16
LTC4066	1.5A	4.35–5.5V	50mΩ	50µA	2.5µA	✓	Timer + C/x	✓	✓	QFN-24
LTC4085	1.5A	4.35–5.5V	200mΩ (50mΩ opt.)	50µA	15µA	✓	Timer + C/10	✓	✓	DFN-14
LTC4089/-1	1.5A	4.35–5.5V	215mΩ (≤50mΩ opt.)	50µA	15µA	✓	Timer + C/10	✓	✓	DFN-22

LTC4075: Dual Input USB/AC Adapter Standalone Linear Li-Ion Battery Charger

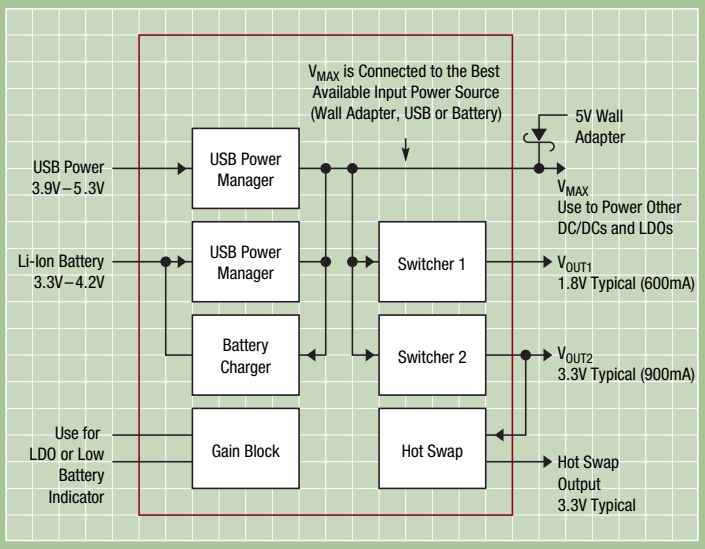


Part No.	Max. Charge Current	Input Voltage	Standby Current	I_{BAT} Drain Current	Standalone	Charge Termination Method(s)	Thermal Regulation	Integrated Transistor	Package
USB Compliant Linear Li-Ion 1-Cell Battery Chargers									
LTC4065/A/69	0.75A	3.75–5.5V	30µA	±1µA	✓	Timer + C/10	✓	✓	DFN-6
LTC4054	0.8A	4.25–6.5V	200µA	±1µA	✓	C/10	✓	✓	ThinSOT
LTC4057	0.8A	4.25–6.5V	200µA	±1µA	–	µController	✓	✓	ThinSOT
LTC4059/A	0.9A	3.75–8V	25µA	±1µA	–	µController	✓	✓	DFN-6
LTC4058	0.95A	4.25–6.5V	200µA	±1µA	✓	C/10	✓	✓	DFN-8
LTC4068	0.95A	4.25–6.5V	200µA	±1µA	✓	C/x	✓	✓	DFN-8
LTC4075 LTC4076 LTC4077	0.95A	4.3–8V Dual Input USB or Adapter	50µA	±1µA	✓ ✓ ✓	C/x (USB C/x) C/x (USB C or C/5) C/10 (USB C/x)	✓ ✓ ✓	✓ ✓ ✓	DFN-10 DFN-10 DFN-10
LTC4061	1A	4.3–8V	130µA	±1µA	✓	Timer + C/x	✓	✓	DFN-10
LTC4062	1A	4.3–8V	130µA	±1µA	✓	Timer + C/x	✓	✓	DFN-10
LTC4064	1A	4.25–6.5V	25µA	±1µA	✓	Timer + C/10	–	✓	MS-10
LTC4053	1.25A	4.25–6.5V	25µA	±1µA	✓	Timer + C/10	✓	✓	MS-10, DFN-10

Battery Chargers with On-chip Regulators or Comparators

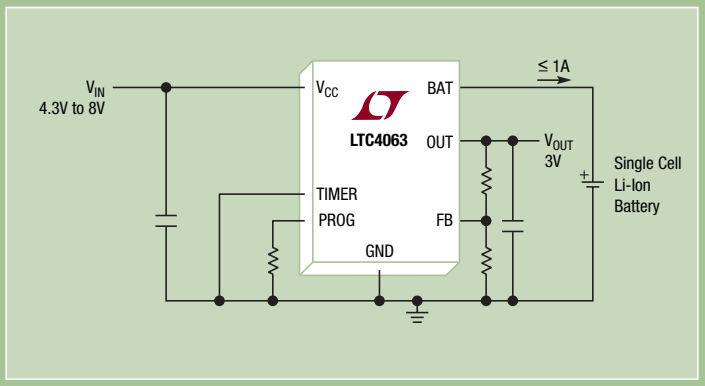
LTC3455: Dual DC/DC Converter with USB Power Manager and Li-Ion Battery Charger

The addition of on-chip functional blocks such as regulators and comparators to Linear Technology's USB compliant battery chargers provides a higher level of integration, enabling more compact solutions for today's feature-rich portable devices.



Part No.	Max. Charge Current	Input Voltage	Ideal Diode	Standby Current	I_{BAT} Drain Current	Standalone	Onboard Charge Termination	Thermal Regulation	Integrated Transistor	Package
USB Power Manager and Li-Ion Linear Battery Charger with PowerPath Control and Onboard Switching Regulator										
LTC3455	1A	4.3–5.5V	✓	50µA	2.5µA	✓	C/10	✓	✓	QFN-24

LTC4063: Standalone Linear Li-Ion Battery Charger and 100mA LDO



Part No.	Max Charge Current	Input Voltage	LDO	Switching Regulator(s)	Comparator	Standalone	Onboard Charge Termination	Thermal Regulation	Integrated Transistor	Package
Li-Ion Linear Battery Chargers with Onboard Regulator or Comparator										
LTC4063	1A	4.3–8V	I_{OUT}= 100mA V_{OUT}= 1.2–4.2V	–	–	✓	Timer + C/x	✓	✓	DFN-10
LTC4062	1A	4.3–8V	–	–	I_Q= 9µA	✓	Timer + C/x	✓	✓	DFN-10
LTC3455	1A	4.3–5.5V	–	I_{OUT1}= 600mA I_{OUT2}= 900mA	–	✓	C/10	✓	✓	QFN-16

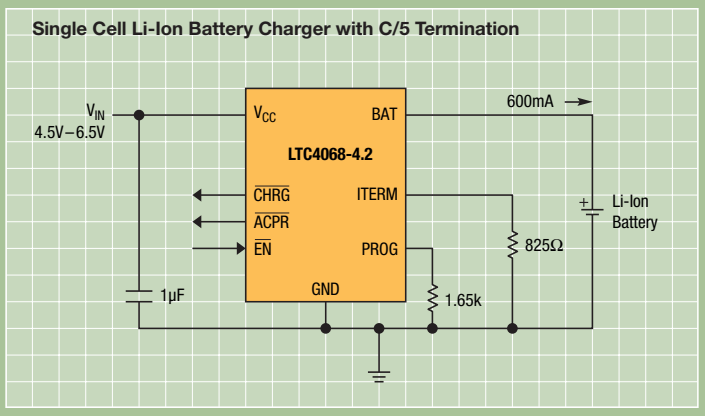
Linear Battery Chargers with Charge Monitoring / Gas Gauging

LTC4068: USB Compliant Standalone Linear Li-Ion Battery Charger

Simplify charging and gas gauging with a single IC. Linear Technology offers battery chargers that include an output signal pin with a voltage proportional to the charge current for simple gas gauging (V_{PROG}). For more sophisticated gas gauging, Linear offers the LTC4150.

LTC4065: Actual Size, Complete Solution

Single Cell Li-Ion Battery Charger with C/5 Termination



Part No.	Batt. Cells (series)	Max Charge Current	Input Voltage	Charge Termination Method(s)	Integrated Pass Transistor	I_{CHARGE} Monitor	End-of-Charge Signal	AC Present Signal	Thermal Reg.	Thermistor Interface	Package
Li-Ion 4.2V/Cell Linear Battery Chargers–Standalone											
LTC1734	1	0.7A	4.55–8V	µController	–	✓	–	–	–	–	ThinSOT
LTC4065	1	0.75A	3.75–5.5V	Timer + C/10	✓	✓	✓	–	✓	–	DFN-6
LTC4065A	1	0.75A	3.75–5.5V	Timer + C/10	✓	✓	✓	✓	✓	–	DFN-6
LTC4069	1	0.75A	3.75–5.5V	Timer + C/10	✓	✓	✓	–	✓	✓	DFN-6
LTC4057	1	0.8A	4.25–6.5V	µController	✓	✓	–	–	✓	–	ThinSOT
LTC4059	1	0.9A	3.75–8V	µController	✓	✓	–	–	✓	–	DFN-6
LTC4059A	1	0.9A	3.75–8V	µController	✓	✓	–	✓	✓	–	DFN-6
LTC4068	1	0.95A	4.25–6.5V	C/x	✓	✓	✓	✓	✓	–	DFN-8
LTC4058	1	0.95A	4.25–6.5V	C/10	✓	✓	✓	✓	✓	–	DFN-8
LTC4061	1	1A	4.5–8V	Timer + C/x	✓	✓	✓	✓	✓	✓	DFN-10
LTC4062	1	1A	4.3–8V	Timer + C/x	✓	✓	✓	–	✓	–	DFN-10
LTC4063	1	1A	4.3–8V	Timer + C/x	✓	✓	–	–	✓	–	DFN-10
LTC4053	1	1.25A	4.25–6.5V	Timer + C/10	✓	✓	✓	✓	✓	✓	MS-10, DFN-10
LTC1733	1	1.5A	4.5–6.5V	Timer + C/10	✓	✓	✓	✓	✓	✓	MS-10

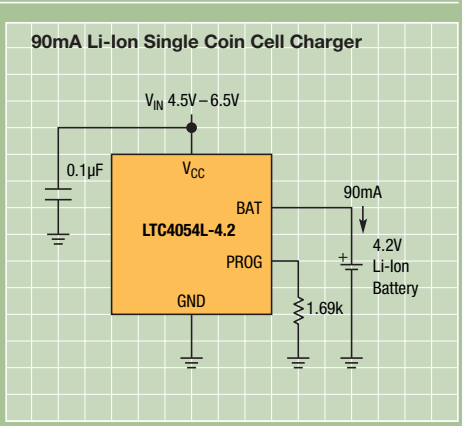
Part No.	Sense Voltage Range	Sense	Input Voltage	Charge Count Frequency	Shutdown Current	# Li-Ion Cells	# Nickel Cells	Charge Quantity	Charge Polarity	Package
Gas Gauge–Coulumb Counter										
LTC4150*	±50mV	High Side	2.7–8.5V	32.55 Hz/V	1.5µA	1-2	3-6	✓	✓	MS-10

*See Page 17.

Low Current / Coin Cell Battery Chargers

LTC4054L: 150mA Standalone Li-Ion Battery Charger for Coin Cells

Linear Technology's coin cell battery chargers enable highly accurate charging for low-capacity, charge-sensitive cells used in thin, compact devices such as Bluetooth headsets and hearing aids.

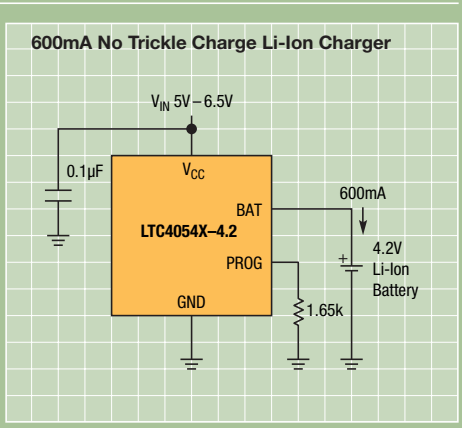


Part No.	Charge Current Range	Input Voltage	Standalone	Charge Termination Method	Thermal Regulation	Integrated Transistor	Charger Type	Package
Coin Cell Li-Ion Battery Chargers								
LTC4054L	10–150mA	4.25–6.5V	✓	C/10	✓	✓	Linear	ThinSOT
LTC4059	90–900mA	3.75–8V	–	µController	✓	✓	Linear	DFN-6
LTC1734L	10–180mA	4.55–8V	–	µController	–	–	Linear	ThinSOT

Li-Ion Linear Battery Chargers with No Trickle Charge

LTC4054X: Standalone, No Trickle Charge Linear Li-Ion Battery Charger with Thermal Regulation in ThinSOT

This extended family of linear battery chargers ensures proper system operation and startup for applications with a load current higher than the normal trickle charge current or a battery voltage below the normal trickle charge threshold.



Part No.	Batt. Cells (series)	Max Charge Current	Input Voltage	Onboard Charge Termination	Integrated Pass Transistor	I_{CHARGE} Monitor	End-of-Charge Signal	AC Present Signal	Thermal Regulation	Package
Li-Ion 4.2V/Cell Linear Battery Chargers–Standalone, Fast Trickle Charge										
LTC4054X	1	0.8A	4.25–6.5V	C/10	✓	✓	✓	–	✓	ThinSOT
LTC4068X	1	0.95A	4.25–6.5V	C/x	✓	✓	✓	✓	✓	DFN-8
LTC4058X	1	0.95A	4.25–6.5V	C/10	✓	✓	✓	✓	✓	DFN-8
LTC4075X	1	0.95A	4.3–8V Dual Input USB or Adaper	C/x	✓	✓	✓	✓	✓	DFN-10

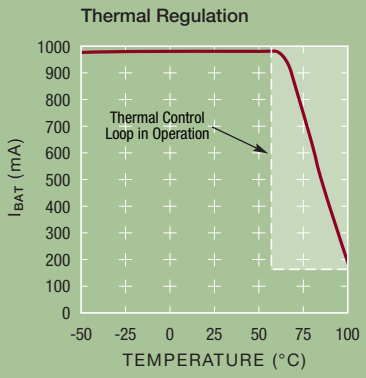
Battery Chargers with Thermal Regulation and/or Thermistor Interface

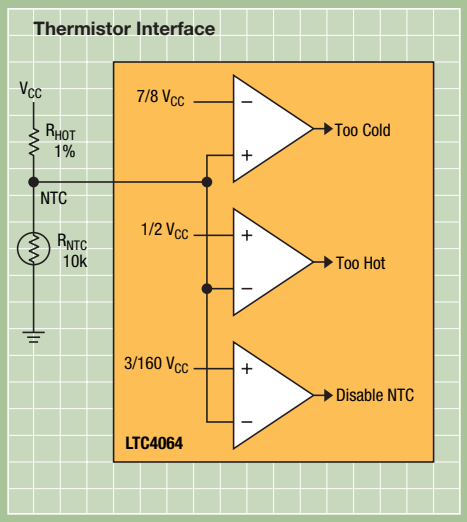
LTC4061: Standalone Linear Li-Ion Battery Charger

Linear Technology's patented thermal regulation technology maximizes charge current without risking overheating during high-power operation or high ambient temperature conditions.

A thermistor interface allows battery temperature measurement, for temperature-qualified charging.

LTC4061: Actual Size, Complete Solution





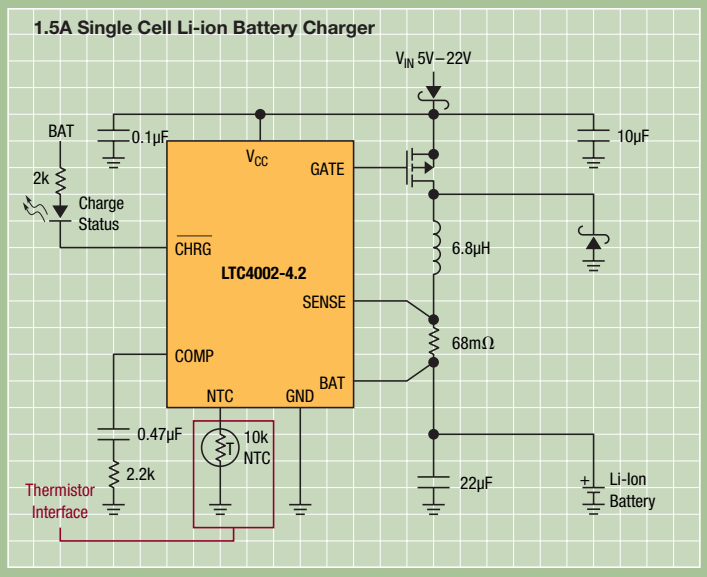
Part No.	Batt. Cells (series)	Cell Voltage	Max Charge Current	Input Voltage	Integrated Pass Transistor	Charge Termination Method(s)	Thermal Reg.	Thermistor Interface	Package
Li-Ion Linear Battery Chargers–Standalone									
LTC4065/A	1	4.2V	0.75A	3.75–5.5V	✓	Timer + C/10	✓	–	DFN-6
LTC4069	1	4.2V	0.75A	3.75–5.5V	✓	Timer + C/10	✓	✓	DFN-6
LTC4054/L/X	1	4.2V	0.8A	4.25–6.5V	✓	C/10	✓	–	ThinSOT
LTC4068/X	1	4.2V	0.95A	4.25–6.5V	✓	C/10	✓	–	DFN-8
LTC4058/X	1	4.2V	0.95A	4.25–6.5V	✓	C/x	✓	–	DFN-8
LTC4075/X LTC4076 LTC4077	1	4.2V	0.95A	4.3–8V Dual Input USB or Adapter	✓ ✓ ✓	C/x (USB C/x) C/x (USB C or C/5) C/10 (USB C/x)	✓ ✓ ✓	– – –	DFN-10 DFN-10 DFN-10
LTC4061	1	4.2/4.4V	1A	4.5–8V	✓	Timer + C/x	✓	✓	DFN-10
LTC4062	1	4.2V	1A	4.3–8V	✓	Timer + C/x	✓	–	DFN-10
LTC4063	1	4.2V	1A	4.3–8V	✓	Timer + C/x	✓	–	DFN-10
LTC4064	1	4.0V	1A	4.25–6.5V	✓	Timer + C/10	✓	✓	MS-10
LTC4053	1	4.2V	1.25A	4.25–6.5V	✓	Timer + C/x	✓	✓	MS-10 DFN-10
LTC1733	1	4.2V	1.5A	4.5–6.5V	✓	Timer + C/10	✓	✓	MS-10
LTC4050	1	4.2V	2A	4.5–12V	–	Timer + C/10	–	✓	MS-10
Li-Ion Linear Battery Chargers–Non-Standalone									
LTC4057	1	4.2V	0.8A	4.25–6.5V	✓	µController	✓	–	ThinSOT
LTC4059/A	1, 2	4.2V	0.9A	3.75–8V	✓	µController	✓	–	DFN-6
USB Power Managers and Li-Ion Linear Battery Chargers with PowerPath Control									
LTC4055	1	4.2V	1.25A	4.3–5.5V	✓	Timer + C/10	✓	✓	QFN-16
LTC4066	1	4.2V	1.5A	4.35–5.5V	✓	Timer + C/x	✓	✓	QFN-24
LTC4085	1	4.2V	1.5A	4.35–5.5V	✓	Timer + C/10	✓	✓	DFN-14
LTC4089/-1	1	4.2/4.1V	1.5A	4.35–5.5V	✓	Timer + C/10	✓	✓	DFN-22
Li-Ion Pulse Battery Chargers–Standalone									
LTC1730	1	4.1/4.2V	1A	4.5–12V	✓	Timer + C/10	–	✓	SO-8
NiCd / NiMH Linear Battery Charger–Standalone									
LTC4060	1–4	1.5	2A	4.5–10V	–	T, t, dV	–	✓	DFN-16

Switchmode and Smart Battery Chargers with Thermistor Interface

LTC4002: Standalone Li-Ion Switchmode Battery Charger

Linear Technology's switchmode battery chargers utilize small, space-saving inductors to allow efficient charging from high input voltages while delivering high current.

LTC4002: Actual Size, Complete Solution



Part No.	Topology	V_{BAT} Range	Battery Chemistry	Battery Pack(s)	Max Charge Current	Input Voltage	External MOSFET(s)	Thermistor Interface	Package
Smart Battery Chargers									
LTC4100	Switchmode SMBus	7–26V	Li-Ion NiCd NiMH Lead-Acid	Single	4A	6–28V	Synchronous	✓	SSOP-24
LTC1760	Switchmode SMBus	6–28V	Li-Ion NiCd NiMH Lead-Acid	Dual	4A	6–28V	Synchronous	✓	TSSOP-48
LTC1759	Switchmode SMBus	3–23V	Li-Ion NiCd NiMH Lead-Acid	Single	8A	3–24V	Synchronous	✓	SSOP-36

Part No.	# Cells or V_{BAT} Range	Battery Chemistry	Number of Cells (series)	Charge Termination Method(s)	Max* Charge Current	Input Voltage	External MOSFET(s)	Thermistor Interface	Package
Switchmode Battery Chargers									
LTC4002	1 or 2 cell	Li-Ion	1–2	Timer	4A	4.7–24V	P-channel	✓	DFN-10, SO-8
LTC4011	1–16 cells	NiCd NiMH	1–16	T, t, dV, dT/dt	4A	4.5–34V	Synchronous	✓	TSSOP-20
LTC4010	1–16 cells	NiCd NiMH	1–16	T, t, dV, dT/dt	4A	4.5–34V	Synchronous	✓	TSSOP-16
LTC4007	3–4 cells	Li-Ion	3–4	Timer + C/10	4A	6–28V	Synchronous	✓	SSOP-24
LTC4006	2–4 cells	Li-Ion	2–4	Timer + C/10	4A	6–28V	Synchronous	✓	SSOP-16
LTC4008	3–28V	Li-Ion NiCd NiMH Lead-Acid	Chemistry Dependent	µController	4A	6–28V	Synchronous	✓	SSOP-20
LTC4001	1 cell	Li-Ion	1	Timer + C/x	2A	4–5.5V	Synchronous	✓	4x4 QFN-16

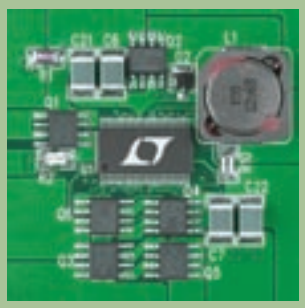
Smart Battery Chargers

LTC1760: Dual Smart Battery System Manager

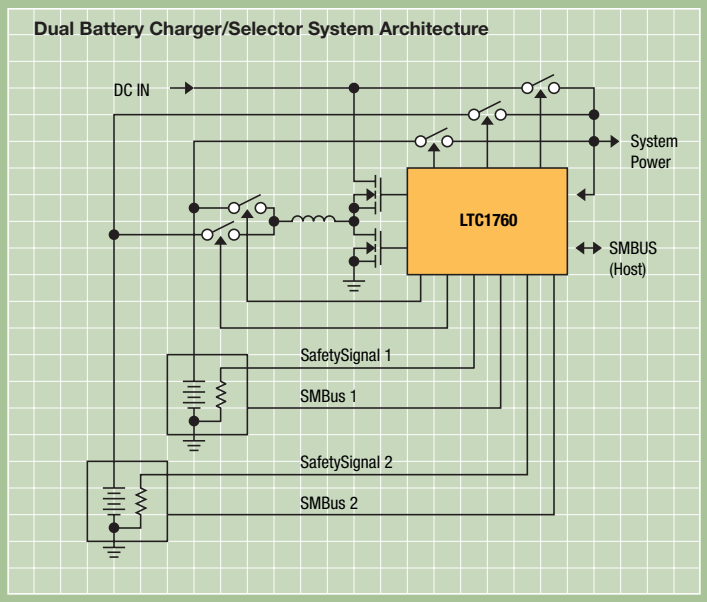
LTC4100: Smart Battery Charger Controller

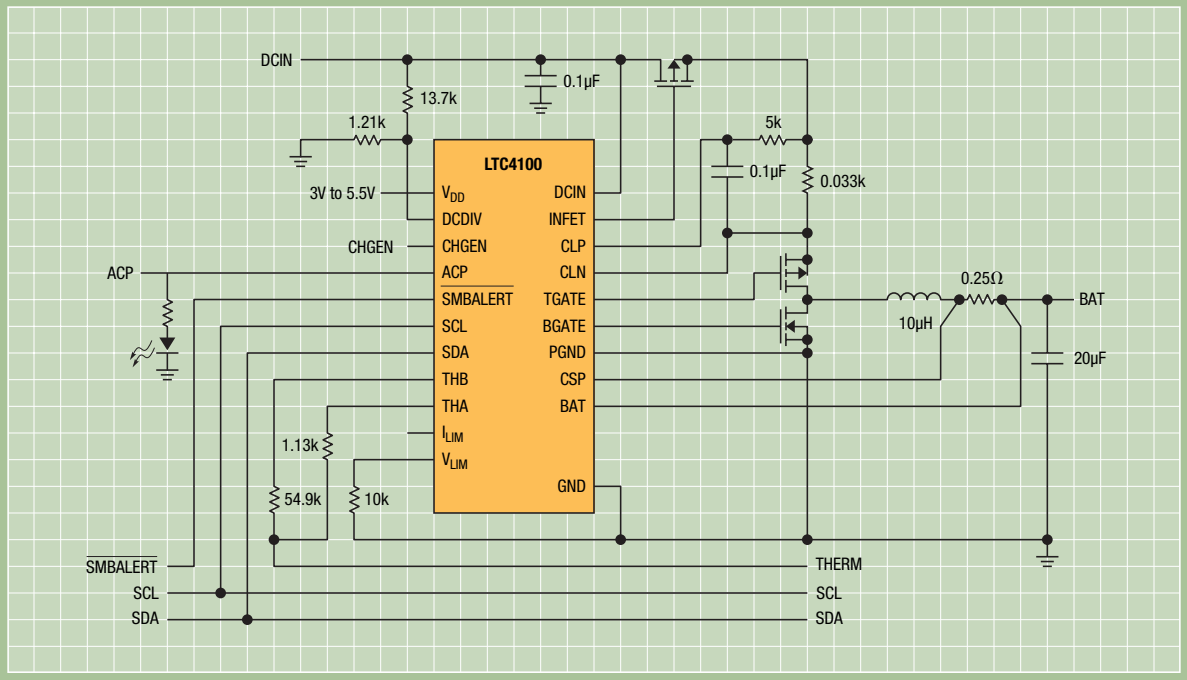
Linear Technology's smart battery chargers offer true plug-and-play operation independent of chemistry and cell configuration, built-in safety features, reliable battery detection and automatic charge management.

LTC1760: Actual Size, Complete Solution



Dual Battery Charger/Selector System Architecture



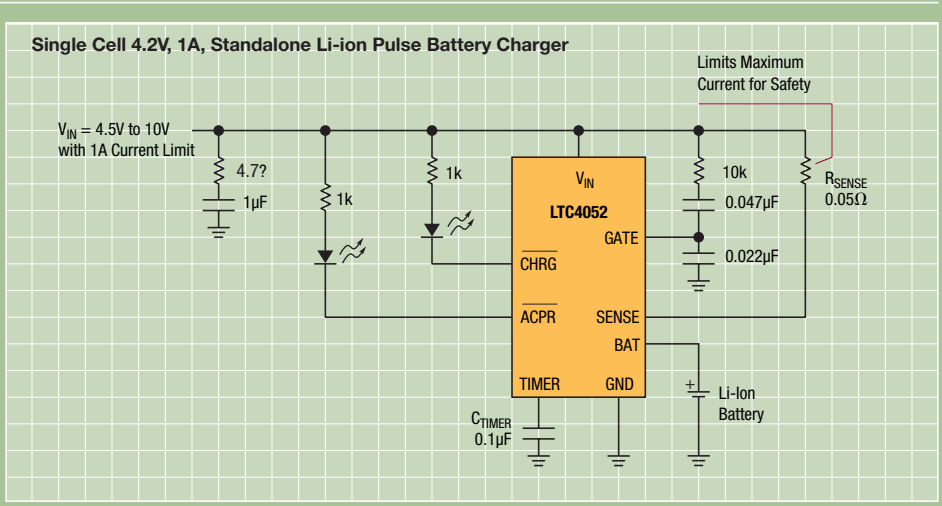


Part No.	V_{BAT} Range	Max Charge Current	Standalone	Serial Bus Type	Single or Dual Battery Pack	Float Voltage Accuracy	Safety Limits (V&I)	AC Presence Output	Charger "ON" Status	Thermistor Interface	Package
SMBus / SPI Battery Charger Controllers											
LTC4100	7–26V	4A	✓	SMBus 1.1	Single	0.8%	✓	✓	pin	✓	SSOP-24
LTC1760	5–28V	4A	✓	SMBus 1.1	Dual	0.2%	✓	✓	pin	✓	TSSOP-48
LTC1759	3–21V	8A	✓	SMBus 1.0	Single	1%	✓	–	pin	✓	SSOP-36
LTC1960	6–28V	8A	–	SPI	Dual	0.8%	–	–	SPI	–	SSOP-36

Pulse Battery Chargers

LTC4052: Li-Ion Battery Pulse Charger with Overcurrent Protection

Linear Technology's pulse battery chargers dissipate only 280mW while fast charging at 0.8A from a 9V current limited input source, whereas a linear charger dissipates as much as 4.8W. Unlike switchmode chargers where an inductor is used to achieve high efficiency, a pulse charger dissipates minimal heat without an inductor.

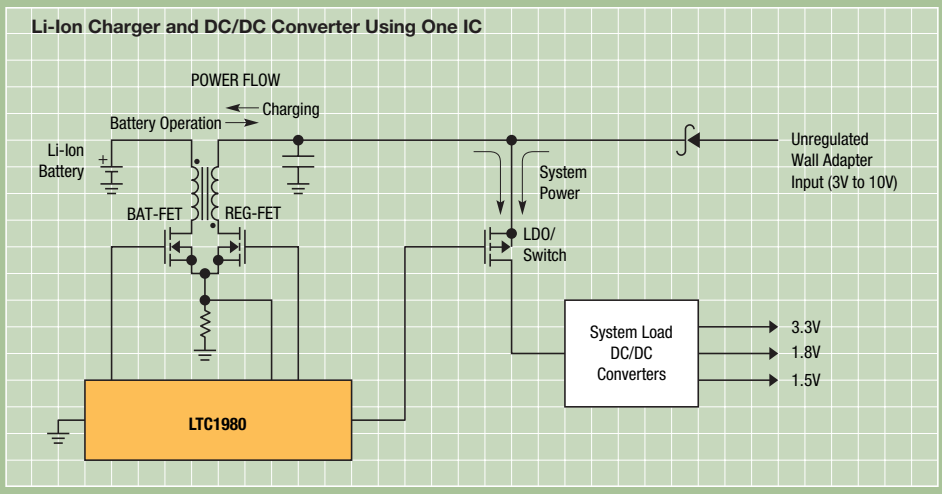


Part No.	Batt. Cells (series)	Max Charge Current	Input Voltage	Standalone	Onboard Charge Termination	Integr. Pass Trans.	Over Current Protection	End-of-Charge Signal	AC Present Signal	Thermistor Interface	Package
Li-Ion Pulse Battery Chargers											
LTC1730	1	1A	4.5–12V	✓	Timer + C/10	✓	✓	✓	–	✓	SO-8
LTC4052	1	1.5A	4.5–10V	✓	Timer + C/10	✓	✓	✓	✓	–	MS-10

Switchmode Buck-Boost Battery Chargers

LTC1980: Combination Battery Charger and DC/DC Converter

Linear Technology's buck-boost battery chargers seamlessly charge a battery as its voltage varies below, above or equal to the input voltage.

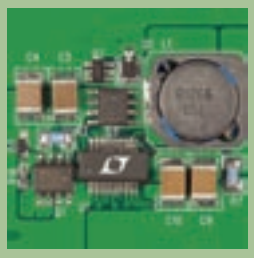


Part No.	V_{BAT} Range	Battery Chemistry	Number of Cells (series)	Max Charge Current	Input Voltage	Integrated Switch	Synchronous	Charge Termination Method(s)	Package
Switchmode Buck-Boost (Step-Down/Step-Up) Battery Chargers									
LT1512	1.5–20V	NiCd NiMH Lead-Acid	1–18	0.8A	2.4–29V	✓	–	µController	SO-8
LT1513	1.5–20V	NiCd NiMH Lead-Acid	1–18	1.6A	2.4–29V	✓	–	µController	DDPak TO220
LTC1980	2.85–10V	NiCd NiMH Li-Ion	1–2	4A	4.1–12V	–	–	Timer + C/10	SSOP-24

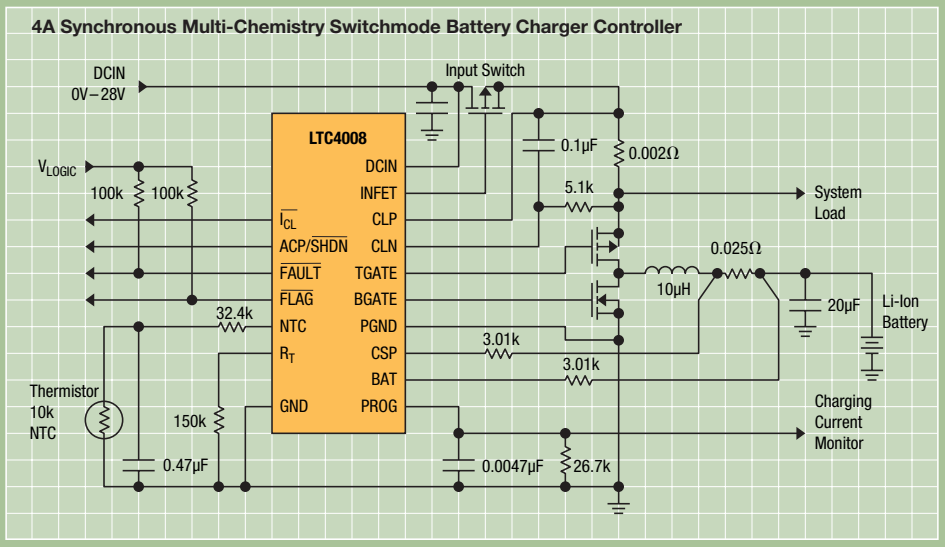
Switchmode Buck Battery Chargers

LTC4008: 4A, High Efficiency, Multi-Chemistry Battery Charger

Linear Technology's step-down (buck) battery chargers enable high efficiency charging from high input voltages for a variety of battery chemistries.



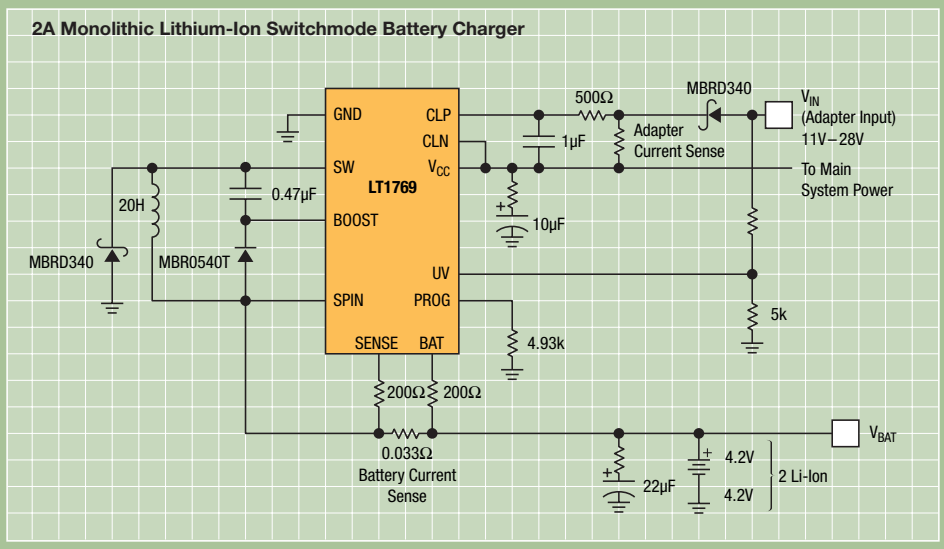
LTC4008: Actual Size, Complete Solution



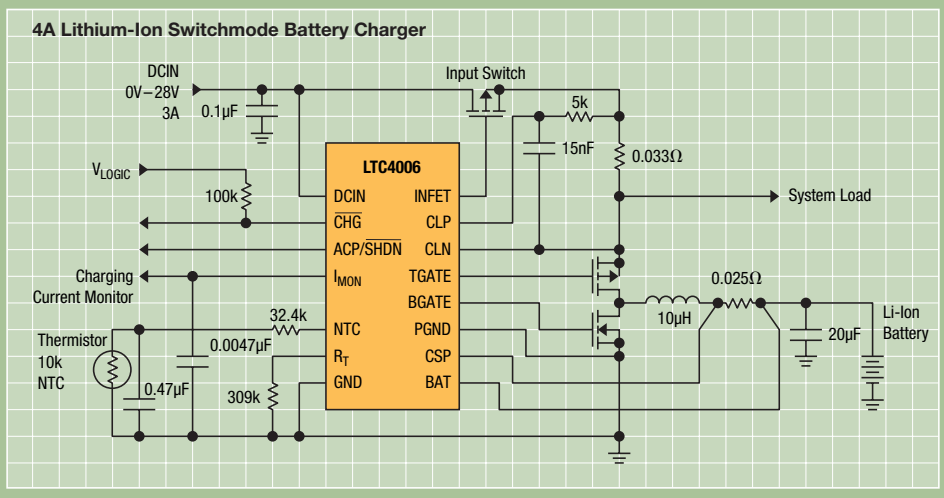
Part No.	V_{BAT} Range	Battery Chemistry	Number of Cells (series)	Max Charge Current	Input Voltage	Integrated Switch	Synchronous	Charge Termination Method(s)	Package
Switchmode Multi-Chemistry Buck (Step-Down) Battery Chargers									
LT1510	2.5–26V	NiMH NiCd SLA Li-Ion	1-12 Ni SLA 1-4 Li-Ion	1A	7–29V	✓	–	µController or LTC1729	SO-8, SSOP, SO-16
LT1769	2.5–26V	NiMH NiCd SLA Li-Ion	1-12 Ni SLA 1-4 Li-Ion	2A	7–29V	✓	–	µController or LTC1729	TSSOP-20, SSOP-28
LT1511	2.5–26V	NiMH NiCd SLA Li-Ion	1-12 Ni SLA 1-4 Li-Ion	3A	7–29V	–	–	µController or LTC1729	SO-24
LTC4008	3–28V	NiMH NiCd SLA Li-Ion	4-18 Ni SLA 2-6 Li-Ion	4A	6–28V	–	✓	µController	SSOP-20
LT1505	2.5–23V	NiMH NiCd SLA Li-Ion	1-12 Ni SLA 1-4 Li-Ion	8A	6.7–26V	–	✓	µController	SSOP-28
Switchmode Li-Ion Buck Battery Chargers									
LT1571	2.5–26V	Li-Ion	1-2, adj	1.5A	6.2–27V	✓	–	LTC1729	SSOP-16, SSOP-28
LTC4001	2.5–5.5V	Li-Ion	1	2A	4–5.5V	✓	✓	Standalone (Timer + C/x)	4x4 QFN-16
LTC4002	2.5–8.4V	Li-Ion	1-2	4A	4.7–22V	–	–	Standalone (Timer)	DFN-10, SO-8
LTC4006	5–16.8V	Li-Ion	2-4	4A	6–28V	–	✓	Standalone (Timer + C/10)	SSOP-16
LTC4007	7.5–16.8V	Li-Ion	3-4	4A	6–28V	–	✓	Standalone (Timer + C/10)	SSOP-24

Switchmode Buck Battery Chargers

LT1769: 2A Monolithic Switchmode Battery Charger



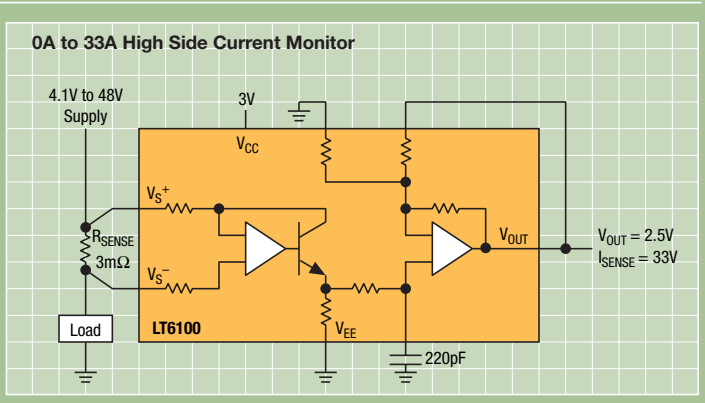
LTC4006: 4A High Efficiency, Standalone Li-Ion Switchmode Battery Charger



Precision Current Sense Amplifiers

Linear Technology offers precision high-side current sense amplifiers with reverse battery protection, low quiescent current, separate power supply inputs and tiny packages.

For low-side current sensing, the best solutions are micropower, rail-to-rail input amplifiers with low input bias current and low offset voltage.



Part No.	Input Voltage Range	Directional Sense	Offset Voltage (Max @ 25°C)	Offset Voltage Drift (Typ)	Large Signal Step Response	Gain Configuration	Separate Supply Input	Package
High Side Current Sense Amplifiers								
LT6100	4.1–48V	Uni-directional	300µV	0.5µV/°C	50µs	5 Gain Settings	Yes	DFN-8, MSOP-8
LTC6101	4–60V	Uni-directional	300µV	1µV/°C	1µs	Adj w/ 2 Resistors	Optional	ThinSOT, MSOP-8
LTC6101HV	5–100V	Uni-directional	300µV	1µV/°C	1µs	Adj w/ 2 Resistors	Optional	ThinSOT, MSOP-8
LT1787	2.5–36V	Bi-directional	75µV	0.5µV/°C	15µs	Fixed Av=8	No	SO-8, MSOP-8
LT1787HV	2.5–60V	Bi-directional	75µV	0.5µV/°C	15µs	Fixed Av=8	No	SO-8, MSOP-8

Part No.	Description	I_{SUPPLY}	V_{OS}	I_{BIAS}	V_S Range	Packages
Low Side Current Sense Amplifiers						
LT1490A/91A	Dual/Quad Rail-to-Rail Over-The-Top®	50µA	500µV	8nA	2–44V	DFN-8, DIP-8, MSOP-8, SO-8 DIP-14, SO-14
LT1636	Over-The-Top, Single Supply	55µA	225µV	8nA	2.6–44V	DFN-8, DIP-8, MSOP-8, SO-8
LT1638/39	Dual/Quad, Rail-to-Rail Over-The-Top	230µA	600µV	50nA	2.2–44V	DFN-8, DIP-8, MSOP-8, SO-8 DIP-14, SO-14
LTC2054/55	Single/Dual Zero-Drift 3V, 5V Operation	150µA	3µV	3nA	2.7–12V	ThinSOT, DFN-8, MSOP-8
LT6010/11/12	Single/Dual/Quad Rail-to-Rail Output	150µA	35µV	0.11nA	2.7–40V	DFN-8, SO-8

Comparator and Voltage Reference Building Blocks

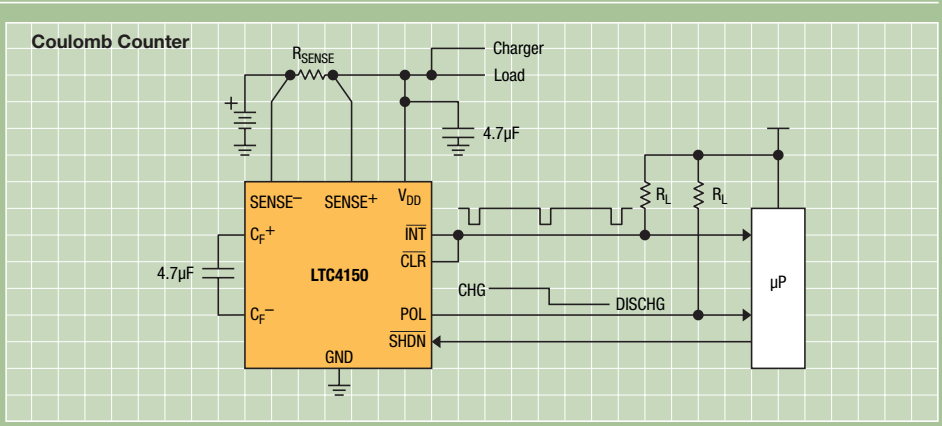
The combination of micropower comparators and a voltage reference in a single package provides an ideal building block for battery monitoring. Typical applications include circuits for gas gauge battery monitoring, low-battery load reduction, backup battery switchover and window comparators with hysteresis.

Part No.	Description	Supply Voltage	Prop Delay Typ	I_{SUPPLY} Typ	Package
Comparator & Reference Combinations					
LTC1440/41/42	Single/Dual Comparator & Reference	2–11V	8µs	2.1µA	MSOP-8, SO-8, DIP-8, DFN-8
LTC1443/44/45	Quad Comparator & Reference	2–11V	4µs	5.5µA	DIP-16, SO-16, DFN-16
LTC1540	Nanopower Comparator & Reference	2–11V	50µs	0.3µA	MSOP-8, SO-8, DFN-8
LTC1541	Micropower Amplifier, Comparator & Reference	2.5–12.6V	8µs	5µA	MSOP-8, SO-8, DFN-8
LTC1842/43	Ultralow Power Dual Comparators with Reference	2.5–11V	4µs	3.5µA	SO-8
LTC1998	1% Voltage Monitor, Ideal for Li-Ion Batteries	1.5–5.5V	150µs	2.5µA	ThinSOT
LT6700-1/-2/-3	Low Voltage Dual Comparator & 400mV Reference	1.4–18.5V	18µs	6.5µA	ThinSOT, DFN-6

Battery Charger Support Devices

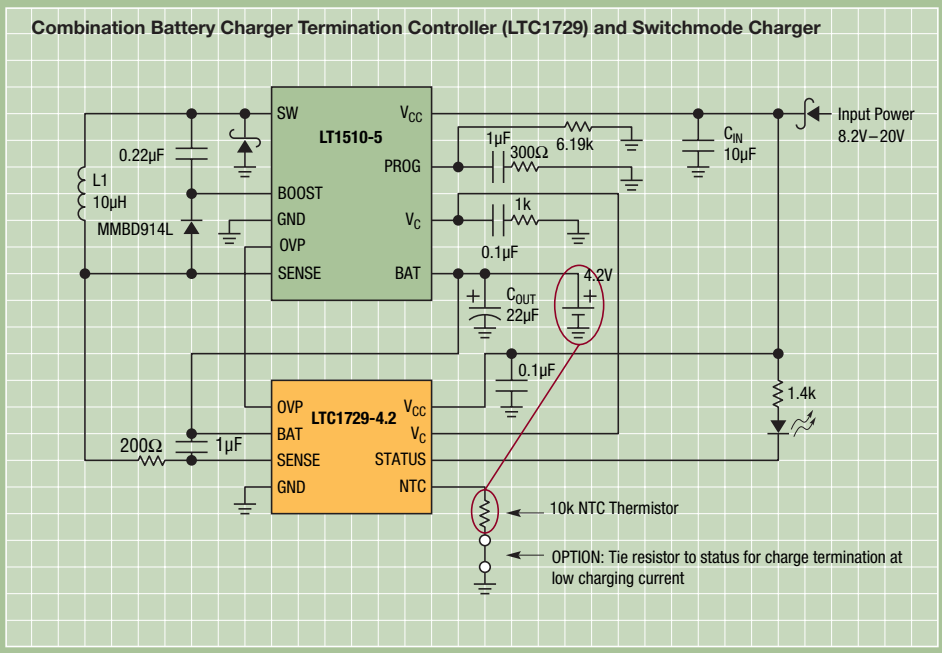
LTC4150: Coulomb Counter and Battery Gas Gauge

Package: MSOP-10



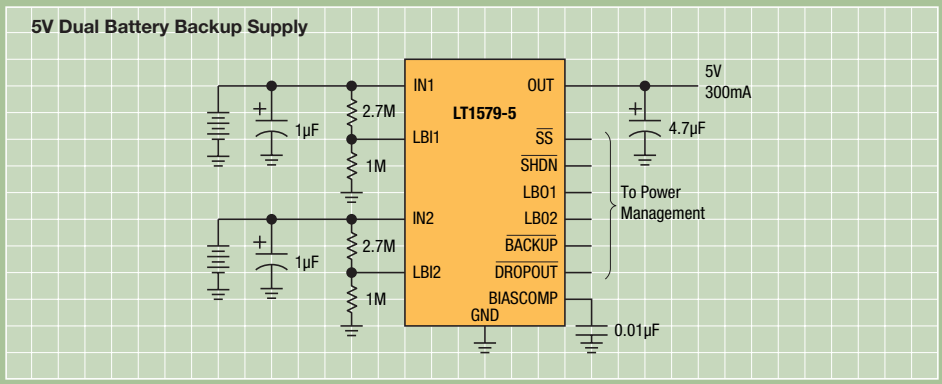
LTC1729: Li-Ion Battery Charger Termination Controller

Package: MSOP-8, SO-8



LT1579: 300mA Dual Input Smart Battery Backup Regulator

Package: SSOP-16, SO-16, SO-8



Linear Battery Chargers Selector Guide

Battery		Charge Termination & Integration			Status Signals			Temperature Control			Part Number					Page
											Integration/Features					
Battery Cells (series)	Battery Charge Current (max), A	Standalone	Charge Termination Method(s)	Integrated Pass Transistor	I_{CHARGE} Monitor	End-of-Charge Signal	AC Present Signal	Thermal Regulation	Thermistor Interface	Package	Most				Least	
Li-Ion 4.2V/Cell Linear Battery Chargers with PowerPath Control																
1	1.5	✓	✓[5]	✓	–	✓	–	✓	✓	DFN-22	LTC4089/-1					03, 04, 05, 06, 10
1	1.5	✓	✓[5]	✓	✓	✓	✓	✓	✓	QFN-24	LTC4066					03, 04, 06, 10
1	1.25	✓	✓[3]	✓	–	✓	✓	✓	✓	QFN-16	LTC4055					03, 04, 06, 10, 20
1	1.5	✓	✓[3]	✓	–	✓	✓	✓	✓	DFN-14	LTC4085					03, 04, 06, 10
Li-Ion 4.2V/Cell Linear Battery Chargers																
1	1	✓	✓[5]	✓	✓	✓	✓	✓	✓	DFN-10	LTC4061					04, 05, 06, 08, 10, 20
1	1	✓	✓[5]	✓	✓	✓	–	✓	–	DFN-10	LTC4062					04, 06, 07, 08, 10, 20
1	1	✓	✓[5]	✓	✓	✓	–	✓	–	DFN-10	LTC4063					04, 07, 08, 10
1	2	✓	✓[5]	–	–	✓	✓	–	✓	MS-10	LTC4050					04, 10
1	0.95	✓	✓[1, 2]	✓	✓	✓	✓	✓	–	DFN-10	LTC4075/76/77/X					04, 06, 09, 10
1	1.25	✓	✓[5]	✓	✓	✓	✓	✓	✓	MS-10 DFN-10		LTC4053				04, 06, 08, 10, 20
1	0.95	✓	✓[2]	✓	✓	✓	✓	✓	–	DFN-8		LTC4068/X				04, 06, 08, 09, 10
1	0.95	✓	✓[1]	✓	✓	✓	✓	✓	–	DFN-8		LTC4058/X				04, 06, 08, 09, 10
1	1.5	✓	✓[5]	✓	✓	✓	✓	✓	✓	MS-10		LTC1733				04, 08, 10, 20
1, 2	2	✓	✓[5]	–	–	✓	✓	–	–	MS-10			LTC1732			04, 05
1, 2	2	✓	✓[5]	–	–	✓	–	–	–	MS-8			LTC1731			04, 05, 20
1	0.8	✓	✓[1]	✓	✓	✓	–	✓	–	ThinSOT			LTC4054/X			04, 06, 09,10, 20
1	0.75	✓	✓[5]	✓	✓	✓	✓	✓	–	DFN-6			LTC4065/A			04, 06, 08, 10
1	0.75	✓	✓[5]	✓	✓	✓	–	✓	✓	DFN-6			LTC4069			04, 06, 08, 10
1	0.7	✓	✓[3]	–	–	✓	–	–	–	ThinSOT				LTC4056		04, 20
1	0.9	–	✓[4]	✓	✓	–	✓	✓	–	DFN-6				LTC4059/A		05, 06, 08, 09, 10
1	0.8	–	✓[4]	✓	✓	–	–	✓	–	ThinSOT				LTC4057		05, 06, 08, 10
1	0.7	–	✓[4]	–	✓	–	–	–	–	ThinSOT					LTC1734	05, 08, 20
Li-Ion 4.1V/Cell Linear Battery Chargers																
1	1.5	✓	✓[5]	✓	✓	✓	✓	✓	✓	MS-10		LTC1733				04, 08, 10, 20
1, 2	2	✓	✓[5]	–	–	✓	✓	–	–	MS-10			LTC1732			04, 05
1, 2	2	✓	✓[5]	–	–	✓	–	–	–	MS-8			LTC1731			04, 05, 20
1	0.7	–	✓[4]	–	✓	–	–	–	–	ThinSOT					LTC1734	05, 08, 20
Li-Ion 4.0V/Cell Linear Battery Charger																
1	1	✓	✓[5]	✓	✓	✓	✓	✓	✓	MS-10		LTC4064				05, 06, 10
Li-Ion Coin Cell Battery Chargers																
1	0.15	✓	✓[1]	✓	✓	✓	–	✓	–	ThinSOT			LTC4054L			09
1	0.18	–	✓[4]	–	✓	–	–	–	–	ThinSOT					LTC1734L	09
Li-Ion Pulse Battery Chargers																
1	1.3	✓	✓[5]	✓	✓	✓	✓	–	–	MS-10		LTC4052				13
1	1.3	✓	✓[5]	✓	–	✓	✓	–	✓	SSOP-16 SO-8		LTC1730				10, 13

1 Current C/10 2 Current C/x 3 Timer 4 µController 5 Timer with C/10 or C/x Indication

Switchmode Battery Chargers Selector Guide

Battery		Charge Termination & Integration			Status Signals			Temperature Control			Part Number					Page
Battery Cells (series)	Battery Charge Current (max), A	Standalone	Charge Termination Method(s)	Integrated Pass Transistor	I_{CHARGE} Monitor	End-of-Charge Signal	AC Present Signal	Thermal Regulation	Thermistor Interface	Package	Integration/Features Most				Least	
NiMH / NiCd Battery Chargers																
1-16	4	✓	✓[6]	–	–	✓	✓	–	✓	TSSOP-20	LTC4011					02, 11
1-16	4	✓	✓[6]	–	–	✓	✓	–	✓	TSSOP-16		LTC4010				02, 11
1-4	2	✓	✓[8]	–	–	✓	✓	–	✓	DFN-16, TSSOP-16				LTC4060 Linear		02, 10
Li-Ion Switchmode Battery Chargers																
1	2	✓	✓[5]	✓	✓	✓	–	–	✓	4x4 QFN-16	LTC4001					11, 14
3-4	4	✓	✓[5]	–	–	✓	✓	–	✓	SSOP-24		LTC4007				11, 14
2-4	4	✓	✓[5]	–	–	✓	✓	–	✓	SSOP-16			LTC4006			11, 14, 20
1-2	2	✓	✓[5]	–	–	–	✓	–	–	SSOP-24			LTC1980			13, 20
1-2, adj	1.5	–	✓[4, 7]	✓	–	✓	–	–	–	SSOP-16 SSOP-28				LT1571		14
1-2	4	✓	✓[3]	–	–	✓	–	–	✓	DFN-10, SO-8				LTC4002		11, 14

Switchmode Multi-Chemistry and Smart Battery Chargers Selector Guide

Battery		Charge Termination & Integration			Status Signals			Temperature Control			Part Number					Page
V_{BAT} Range	Battery Charge Current (max), A	Standalone	Charge Termination Method(s)	Integrated Pass Transistor	I_{CHARGE} Monitor	End-of-Charge Signal	AC Present Signal	Thermal Regulation	Thermistor Interface	Package	Integration/Features Most				Least	
Smart Battery Chargers																
3-21V	8	–	SMBus[4]	–	–	–	✓	–	✓	SSOP-36	LTC1759					02, 11, 12, 20
5-28V	4	✓	SMBus[4]	–	–	–	–	–	✓	TSSOP-48	LTC1760					11, 12, 20
6-28V	8	–	SPI[4]	–	–	–	–	–	–	SSOP-36	LTC1960					02, 12, 20
7-26V	4	~	SMBus[4]	–	–	–	✓	–	✓	SSOP-24		LTC4100				02, 11, 12, 20
Lead Acid, NiMH / NiCd, Li-Ion Switchmode Battery Chargers																
2.5-23V	8	–	✓[4, 7]	–	–	✓	–	–	–	SSOP-28		LT1505				02, 14, 20
2.5-26V	3	–	✓[4, 7]	✓	–	–	–	–	–	SO-24			LT1511			02, 14, 20
3-28V	4	–	✓[4]	–	–	✓	✓	–	✓	SSOP-20			LTC4008			02, 11, 14
1.5-20V	0.75	–	✓[4, 7]	✓	–	–	–	–	–	SO-8				LT1512		02, 13
1.5-20V	2	–	✓[4, 7]	✓	–	–	–	–	–	DD Pak, TO-220				LT1513		02, 13
2.5-26V	2	–	✓[4, 7]	✓	–	–	–	–	–	TSSOP-20, SSOP-28				LT1769		02, 14, 15
2.5-26V	1	–	✓[4, 7]	✓	–	–	–	–	–	SO-8, SSOP, SO-16					LT1510	02, 14, 17, 20

1 Current C/10 2 Current C/x 3 Timer 4 µController 5 Timer with C/10 or C/x Indication 6 T, t, dV, dT/dt 7 for Li-Ion Terminator use LTC1729 8 dV, t, V, T

Further Reading

Online at www.linear.com

Switchmode Battery Chargers		
		Device
DN244	Simple Li-Ion Charge Termination Using the LT1505	LT1505
LT Magazine	Fast Rate Li-Ion Battery Charger	LT1505
AN68	LT1510 Design Manual	LT1510
DN242	Li-Ion Charge Termination IC Interfaces with PWM Switchers	LT1510
DN111	LT1510 High Efficiency Lithium-Ion Battery Charger	LT1510
DN194	New Charger Topology Maximizes Battery Charging Speed	LT1511
DN144	LT1511 Low Dropout, Constant-Current/Constant-Voltage 3A Battery Charger	LT1511
DN124	Fused Lead Battery Charger ICs Need No Heat Sinks	LT1510/11
LT Magazine	1.5A and 3A Fast Charger ICs Charge All Battery Types Including Lithium-Ion	LT1510/11
LT Magazine	Feature-Rich Battery Charger that Manages Both Battery Charging and Bus Voltage Regulation	LTC1980
LT Magazine	Next Generation No Compromise Battery Chargers	LTC4006/7/8
Linear Battery Chargers		
DN239	A Miniature, Low Dropout Battery Charger for Lithium-Ion Batteries	LTC1731
LT Magazine	Low Dropout Linear Li-Ion Charge Controllers **Prevent Overcharging**, Save Board Space	LTC1731/2
LT Magazine	LTC1733: **Thermal Regulation** Maximizes Lithium-Ion Battery Charging Rate Without Risk of Overheating	LTC1733
DN283	Li-Ion Linear Charger Allows Fast, Full Current Charging While Limiting PC Board Temperature to 85°C	LTC1733
LT Magazine	Very Low Cost Li-Ion Battery Charger Requires Little Area and Few Components	LTC1734
DN250	A Very Low Cost SOT-23 Li-Ion Battery Charger Requires Little Area and Few Components	
LT Magazine	Decrease Li-Ion Battery Charge Time with a Monolithic Charger that Prevents Overheating	LTC4054
LT Magazine	New Standalone Linear Li-Ion Battery Chargers	LTC4061, LTC4062
USB Battery Chargers		
LT Magazine	Complete **USB** Power Manager, Li-Ion Charger and Two Buck Converters in a 4mmx4mm QFN	LTC3455
DN1008	Simple, Efficient, All-in-One **USB** Power Management IC Solution	LTC3455
LT Magazine	Compact Solution Uses **USB** Power to Run a Device and Simultaneously Charge its Battery	LTC4053, LTC4410
LT Magazine	Complete **USB** Solution Provides PowerPath Control and Input Current Limiting while Charging a Li-Ion Battery	LTC4056
LT Magazine	**USB** Power Controller/Charger Reduces Both Design Time and Battery Charge Time	LTC4055
DN320	New ICs Simplify Battery Charging from the **USB**	LTC4053
DN336	Advanced Topology **USB (Intermediate Bus)** Battery Charger Optimizes Power Utilization for Faster Charging	LTC4055
Smart Battery Chargers		
LT Magazine	**Smart** Battery Charger Is Programmed via the **SMBus**	LTC1759
DN342	Dual **Smart** Battery Charger Simplifies Battery Backup for Servers	LTC1760
DN277	Dual Battery Power Manager Increases Run Time by 12% and Cuts Charge Time in Half	LTC1960
DN1005	**Smart** Battery Charger Reduces Circuit Size	LTC4100
Power Path Controllers		
LT Magazine	Low Voltage **PowerPath** Driver Switches from a 3.3V or 5V Supply to Battery Backup	LTC1473L
LT Magazine	Compact Solution Uses **USB** Power to Run a Device and Simultaneously Charge its Battery	LTC4410, LTC4053
DN1003	**Ideal Diode/PowerPath** Controller Eliminates Energy Wasting Diodes in Power OR-ing Applications	LTC4412
DN356	Dual Monolithic **Ideal Diode** Manages Multiple Power Inputs	LTC4413
Power Over Ethernet		
DN361	Simple Battery Circuit Extends **Power over Ethernet (PoE)** Peak Current	LTC4055

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