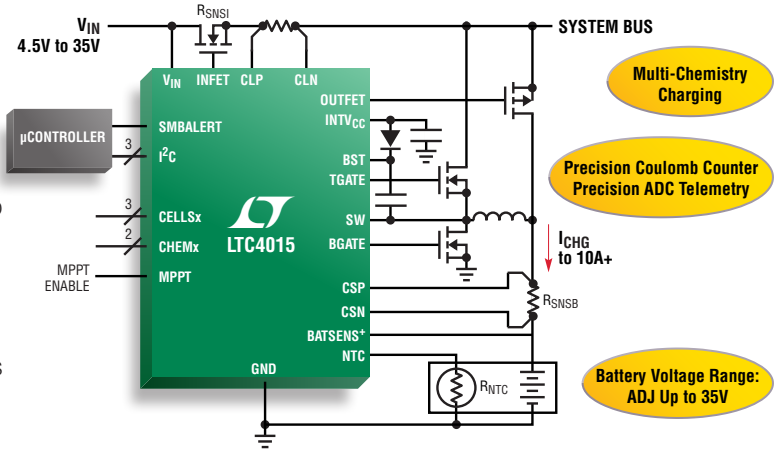
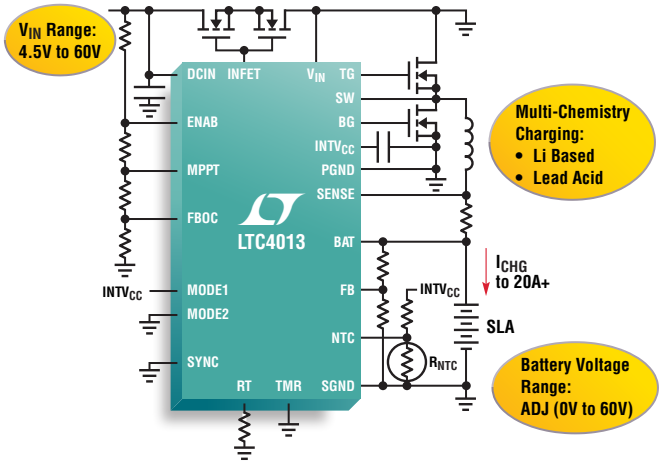
High Voltage Battery Charging and Management Solutions

Linear Technology's high performance battery charging and management ICs enable long battery life and run times, while providing precision charging control and status monitoring, even with high voltage or solar input voltage sources. Our proprietary design techniques enable seamless management of multiple input sources while providing small solution footprints, faster charging and 100% standalone operation. Each battery chemistry has unique charging requirements, so selecting the correct battery charger increases the operational run time of the end product while ensuring that the battery is optimally charged.

LTC4015 Multi-Chemistry Buck Battery Charger Controller with Digital Telemetry System

- Multi-Chemistry Li-Ion/Polymer, $LiFePO_4$, or Lead-Acid Battery Charger with Termination
- High Efficiency Synchronous Buck Battery Charger
- Digital Telemetry System Monitors V_{BAT}, I_{BAT}, R_{BAT}, NTC Ratio (Battery Temperature), V_{IN}, I_{IN}, V_{SYSTEM}, Die Temperature
- Coulomb Counter and Integrated 14-Bit ADC
- Wide Charging Input Voltage Range: 4.5V to 35V
- Wide Battery Voltage Range: Up to 35V
- Input Voltage Regulation for High Impedance Input Supplies and Automated Solar Panel MPPT Detection



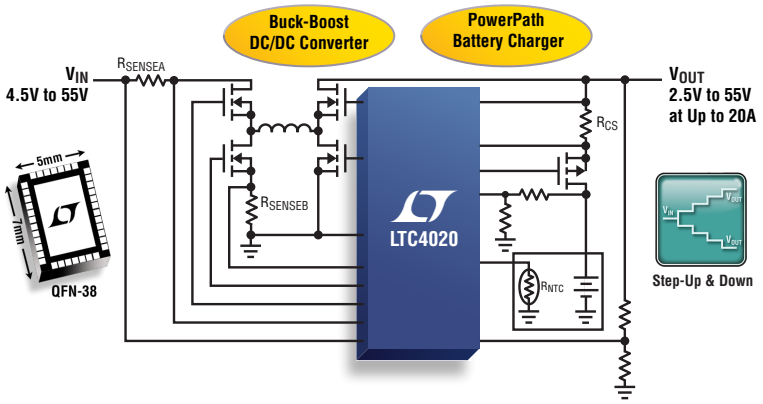


LTC4013 60V Synchronous Buck Multi-Chemistry Battery Charger Controller

- Wide Input Voltage Range: 4.5V to 60V
- Wide Battery Voltage Range: 0V to 60V
- Built-In Charge Algorithms for Lead-Acid and Li-Ion
- ±0.5% Float Voltage Accuracy
- ±5% Charge Current Accuracy
- Maximum Power Point Tracking Input Control
- NTC Temperature Compensated Float Voltage
- Thermally Enhanced 28-Lead 4mm × 5mm QFN Package

LTC4020 55V Buck-Boost Multi-Chemistry Battery Charger

- Wide Voltage Range: 4.5V to 55V Input, Up to 55V Output (60V Absolute Maximum)
- Synchronous Buck-Boost DC/DC Controller
- Li-Ion and Lead-Acid Charge Algorithms
- ±0.5% Float Voltage Accuracy
- ±5% Charge Current Accuracy
- Instant-On Operation for Heavily Discharged Batteries
- Input Voltage Regulation for High Impedance Input Supplies and Solar Panel Peak Power Operation



LINEAR TECHNOLOGY

Selected Switch Mode Battery Chargers: Buck and Buck-Boost

Part Number	Maximum Charge Current (A)	V_{BAT} Range (V)	Battery Chemistry	Number of Battery Cells (Series)	Input Voltage (V)	Integrated Power Transistor	Synchronous	Charge Termination	Package (mm x mm)
Switch Mode Multi-Chemistry Buck (Step-Down) Battery Chargers									
LTC4121	0.4	3.6 to 18	Li-Ion, $LiFePO_4$ SLA	SLA, 1-5 $LiFePO_4$ 1-4 Li-Ion	4.3 to 40	✓	–	Timer	3x3 QFN-16
LT3652	2	3.3 to 14.4	SLA, $LiFePO_4$ Li-Ion	SLA , 1-4 $LiFePO_4$ 1-3 Li-Ion	4.9 to 32†	✓	–	Timer or C/10	3x3 DFN-12, MSOP-12E
LT3652HV	2	3.3 to 18	SLA, $LiFePO_4$ Li-Ion	SLA, 1-5 $LiFePO_4$ 1-4 Li-Ion	4.9 to 34†	✓	–	Timer or C/10	3x3 DFN-12, MSOP-12E
LTC4008	4	3 to 28	NiMH NiCd SLA Li-Ion	4-18 Ni, SLA 2-6 Li-Ion	6 to 28	–	✓	External µC	SSOP-20
LTC4009/-1*/-2	4	2 to 28	NiMH NiCd SLA Li-Ion	2-18 Ni, 1-4 Li-Ion	6 to 28	–	✓	External µC	4x4 QFN-20
LTC4012/-1*/-2/-3	4	2 to 28	NiMH NiCd SLA Li-Ion	2-18 Ni, 1-4 Li-Ion	6 to 28	–	✓	External µC	4x4 QFN-20
LTC1960	8	3.5 to 28	NiMH NiCd SLA Li-Ion	4-16 Ni, SLA 2-6 Li-Ion	6 to 28	–	✓	External µC	5x7 QFN-38, SSOP-36
LTC4015	20**	up to 35V	$LiFePO_4$ SLA Li-Ion	3/6/12 SLA 1-9 $LiFePO_4$ 1-8 Li-Ion	4.5 to 35	–	✓	Timer, C/10	4x5 QFN-28
LTC4013	20**	up to 60V	$LiFePO_4$ SLA Li-Ion	1-16 $LiFePO_4$ 1-14 Li-Ion	4.5 to 60	–	✓	Timer, C/10	5x7 QFN-38
Switch Mode Li-Ion Buck (Step-Down) Battery Chargers									
LTC4001/-1*	2	4.2	Li-Ion	1	4 to 5.5	✓	✓	Timer	3x3 QFN-16
LT3650-4.1/-4.2	2	4.1, 4.2	Li-Ion	1	4.75 to 32† (40 Max)	✓	–	Timer + C/10	3x3 DFN-12, MSOP-12E
LT3650-8.2/-8.4	2	8.2, 8.4	Li-Ion	2	9 to 32† (40 Max)	✓	–	Timer + C/10	3x3 DFN-12, MSOP-12E
LT3651-4.1/4.2	4	4.1, 4.2	Li-Ion	1	4.8 to 32	✓	✓	Timer + C/10	5x6 QFN-36
LT3651-8.2/8.4	4	8.2, 8.4	Li-Ion	2	9 to 32	✓	✓	Timer + C/10	5x6 QFN-36
LTC4002-4.2/-8.4	4	4.2, 8.4	Li-Ion	1-2	4.7 to 22	–	–	Timer	3x3 DFN-10, SO-8
LTC4006-2/-4/-6	4	5 to 16.8	Li-Ion	2-4	6 to 28	–	✓	Timer	SSOP-16
LTC4007/-1	4	7.5 to 16.8	Li-Ion	3-4	6 to 28	–	✓	Timer	SSOP-24

* 4.1V cell voltage, **Depends on external components, † Minimum start-up voltage is + 3.3V above V_{BATMAX}

Part Number	Number of Battery Cells (Series)	Maximum Charge Current (A)	V_{BAT} Range (V)	Battery Chemistry	Input Voltage (V)	Integrated Power Transistor	Synchronous	Charge Termination	Package (mm x mm)
Switch Mode Buck-Boost (Step-Down/Step-Up) Battery Chargers									
LT1512	1-12 Ni	0.8	1.5 to 20	NiCd NiMH SLA	2.4 to 29	✓	–	External µC	SO-8
LT1513	1-12 Ni	1.6	1.5 to 20	NiCd NiMH SLA	2.4 to 29	✓	–	External µC	DD Pak, TO-220
LTC1980	1-2 Li-Ion	4	2.85 to 10	NiCd NiMH Li-Ion	4.1 to 12	–	–	External µC, Timer (Li-Ion)	SSOP-24
LTC4110 *†	Up to 10 Ni, 1-4 Li-Ion, Up to 6 SLA	4	3.5 to 18	NiCd NiMH SLA, Li-Ion	6 to 19	–	✓	Timer, C/10, SMBus	5x7 QFN-38
LTC4020	SLA, $LiFePO_4$, Li-Ion, SLA	20+**	2.5 to 55	$LiFePO_4$, 1-13 Li-Ion	4.5 to 55	–	✓	Timer, C/x	5x7 QFN-38

* Flyback topology, **Depends on external components, † Supercapacitor compatible

Solar Battery Chargers

LT8490 High Voltage, High Current Buck-Boost Battery Charge Controller with Maximum Power Point Tracking (MPPT)

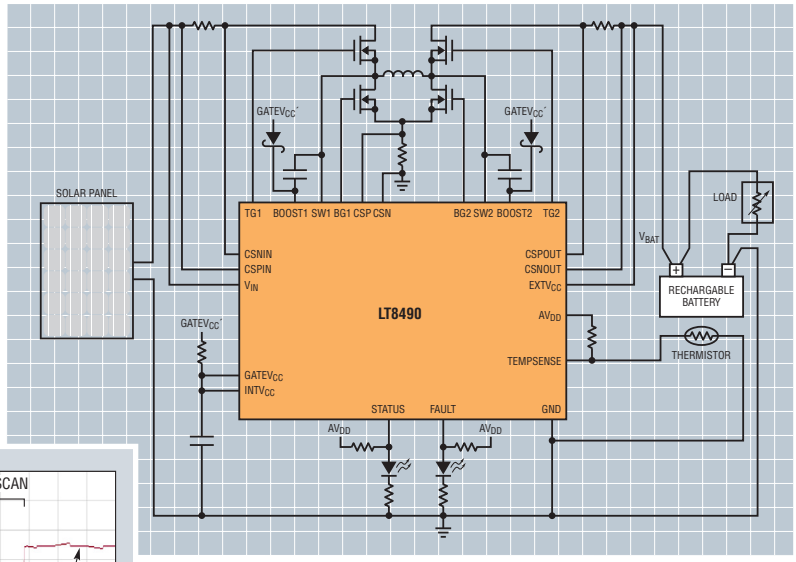
Features

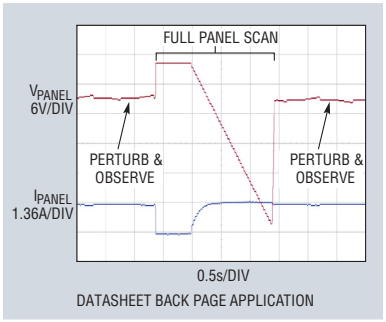
- V_{IN} Range: 6V to 80V
- V_{BAT} Range: 1.3V to 80V
- Single Inductor Allows V_{IN} Above, Below or Equal to V_{BAT}
- Automatic MPPT for Solar Powered Charging
- Automatic Temperature Compensation
- No Software or Firmware Development Required
- Operation from Solar Panel or DC Supply
- Input and Output Current Monitor Pins
- Four Integrated Feedback Loops
- Synchronizable Fixed Frequency: 100kHz to 400kHz
- 64-Lead (7mm × 11mm × 0.75mm) QFN Package

Applications

- Solar Powered Battery Chargers
- Multiple Types of Lead-Acid Battery Charging
- Li-Ion Battery Charger
- Battery Equipped Industrial or Portable Military Equipment

Typical Application Circuit





Maximum Power Point Tracking

Solar Battery Charger Table

Part Number	Maximum Charge Current (A)	V_{BAT} Range (V)	Battery Chemistry	Number of Battery Cells (Series)	Input Voltage (V)	Integrated Power Transistor	Synchronous	Charge Termination	MPPx	Package (mm x mm)
Switch Mode Multi-Chemistry Buck and Buck-Boost (Step-Down/Step-Up) Solar Battery Chargers										
LT3652	2	3.3 to 14.4	SLA, $LiFePO_4$ Li-Ion	SLA , 1-4 $LiFePO_4$, 1-3 Li-Ion	4.9 to 32†	✓	–	Timer or C/10	MPPC	3x3 DFN-12, MSOP-12E
LT3652HV	2	3.3 to 18	SLA, $LiFePO_4$ Li-Ion	SLA, 1-5 $LiFePO_4$, 1-4 Li-Ion	4.9 to 34†	✓	–	Timer or C/10	MPPC	3x3 DFN-12, MSOP-12E
LTC4121	400mA	3.5V to 18V	SLA $LiFePO_4$ Li-Ion	SLA 1-5 $LiFePO_4$, 1-4 Li-Ion	4.4V to 40V	✓	✓	Timer	MPPT	3x3 QFN-16
LTC4020	20+*	2.5V to 55V	SLA, $LiFePO_4$, Li-Ion	SLA, 1-15 $LiFePO_4$, 1-13 Li-Ion	4.5V to 55V	–	✓	Timer, C/x	MPPC	5x7 QFN-38
LT8490	20+*	1.3V to 80V	SLA, Li-Ion	SLA, 1-19 Li-Ion	2.8V to 80V	–	✓	Timer, C/10	MPPT	5x7 QFN-38, TSSOP-38
Linear Multi-Chemistry Solar Battery Chargers										
LTC4079	250mA	1.2V to 60V	SLA Li-Ion, Ni	SLA, 1-14 Li-Ion, 1-50 Ni	2.7V to 60V	✓	n/a	C/10, Timer	DVReg^	3x3 DFN-10
Shunt Solar Battery Chargers										
LTC4070	50mA	2.7V to 4.2V	Li-Ion	1, unlimited	✓	–	n/a	n/a	n/a	2x3 DFN-8, MSOP-8
LTC4071	50mA^^	2.7V to 4.2V	Li-Ion	1, unlimited	✓	–	n/a	n/a	n/a	2x3 DFN-8, MSOP-8

* Depends on external components
^ Differential voltage regulation
^^ 500mA with external PFET

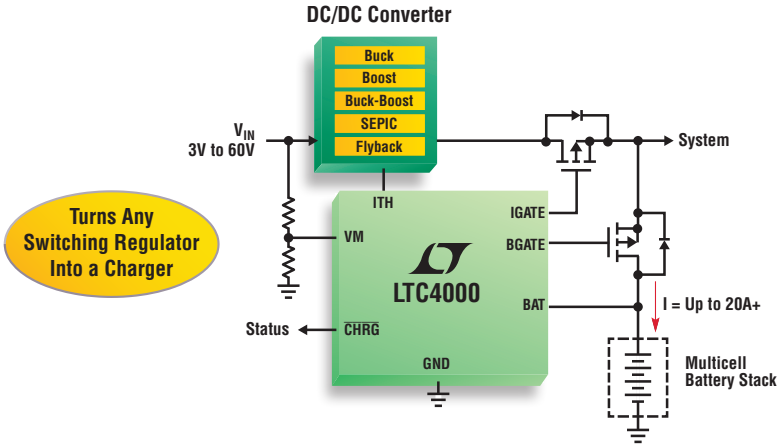
The Power and Flexibility of the LTC4000/LTC4000-1

The LTC4000/-1 is a high voltage controller and power manager which, when paired with an externally compensated DC/DC converter, becomes a full-featured battery charger solution. The LTC4000/-1 is capable of driving virtually any topology, including buck, boost, buck-boost, SEPIC and flyback converters. Its intelligent PowerPath™ manager provides power to the system load when input power is available, enabling instant-on operation even with a deeply discharged battery. A full-featured controller, the LTC4000/-1 can charge a variety of battery types including lithium, nickel and lead-acid based chemistries. Highly accurate charge current and float voltage, as well as onboard termination, ensure safe and accurate charging.

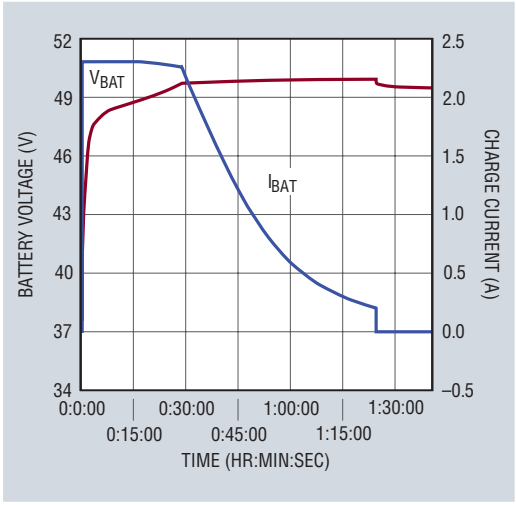
Complete Solution: PowerPath Control & Termination, No Software
60V, 20A+ Battery Charging Controller

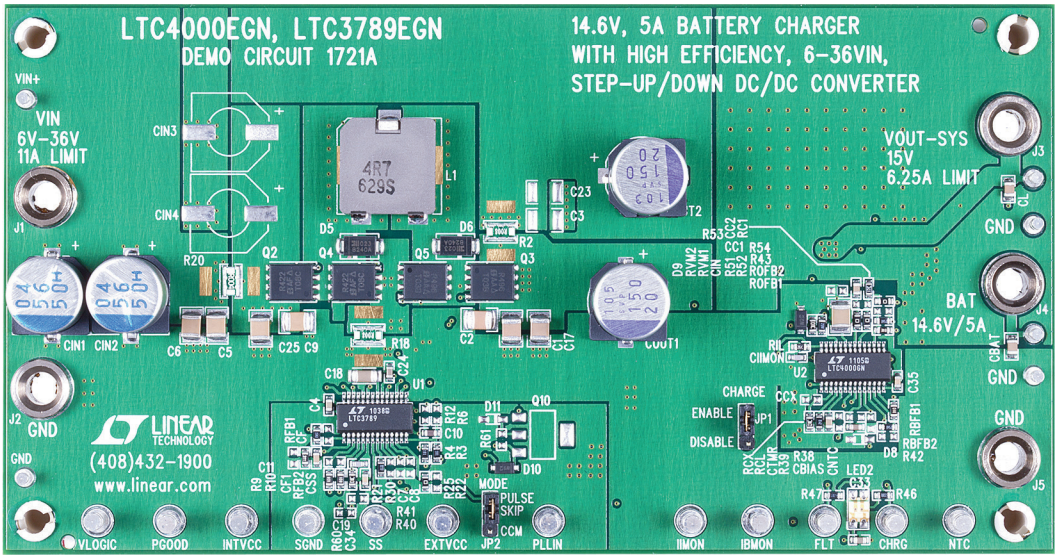
Features

- Input/Output Voltage: 3V to 60V
- Charge Currents up to 20A+
- Input Ideal Diode for Low Loss Reverse Blocking and Load Sharing
- Programmable Input and Charge Current: ±1% Accuracy
- ±0.1% Accurate Programmable Float Voltage
- Programmable C/X or Timer-Based Charge Termination
- NTC Input for Temperature-Qualified Charging
- LTC4000-1 for Solar Panel Input Applications



12 Series 2.2Ah Li-Ion Charge Curves





LTC4000 Buck-Boost Configuration
Actual Size
Demo Circuit