

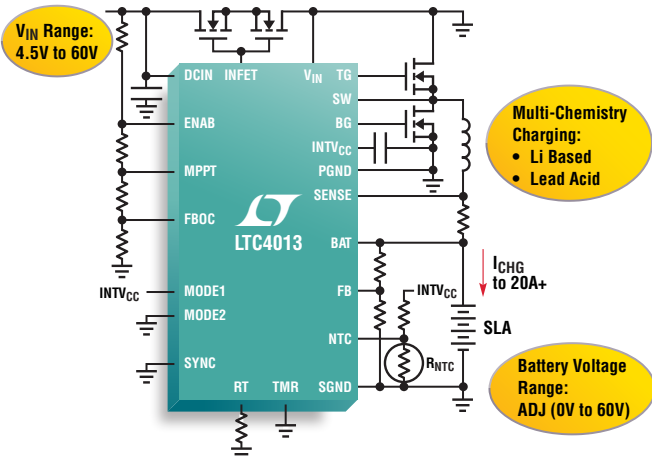
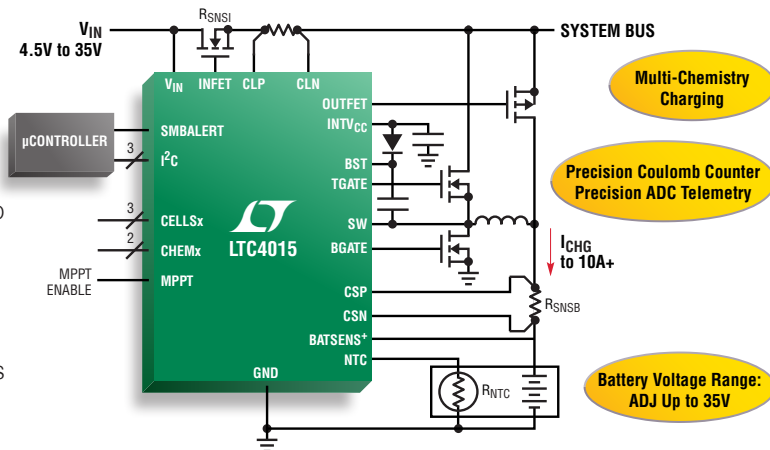
High Voltage Battery Charging and Management Solutions

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, LiFePO₄, 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

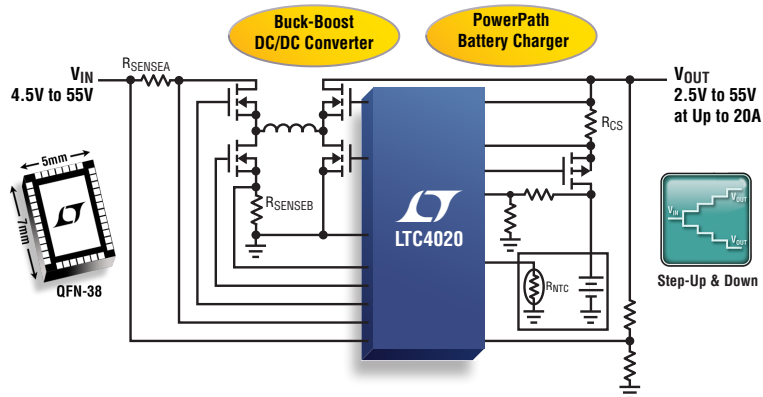


LTC4013 60V Synchronous Buck Multi-Chemistry Battery Charger Controller

- 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 x 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



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)

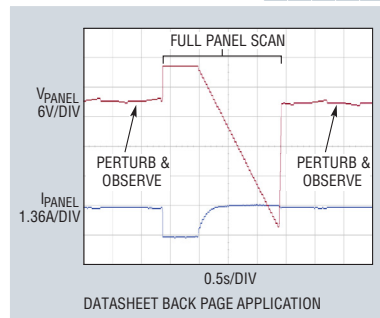
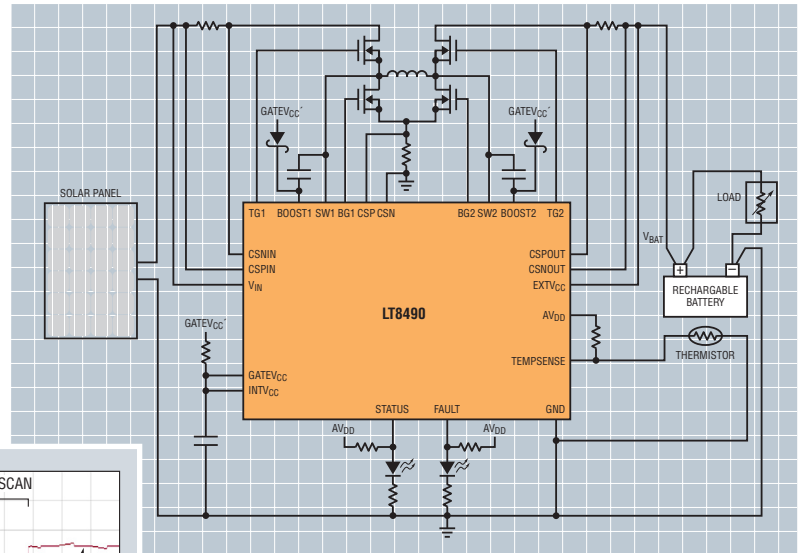
Features

- 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 x 11mm x 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

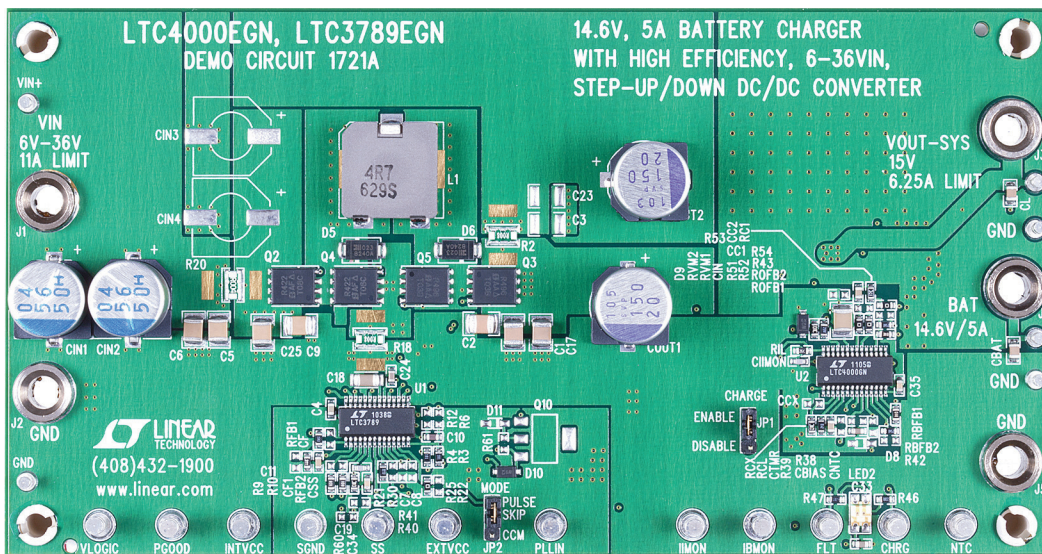
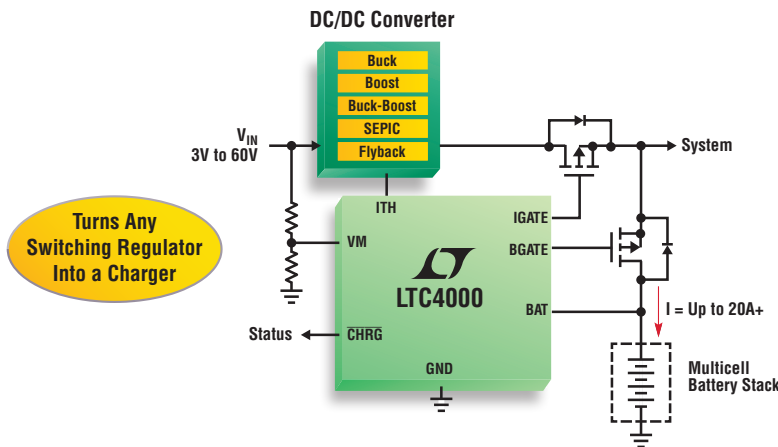
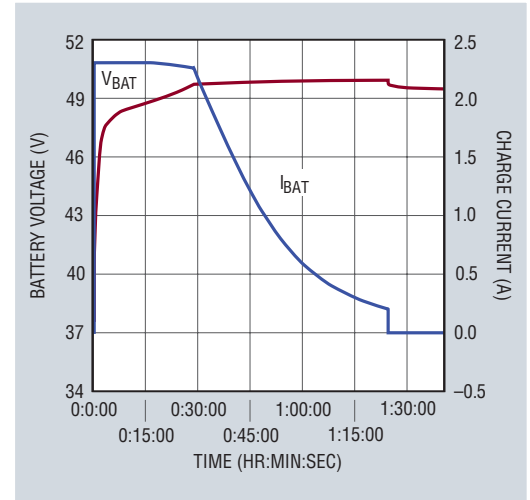
The LTC4000/-1 is a high voltage controller and power manager which, when paired with an externally compensated DC/DC converter, becomes a full-featured battery charger solution. The LTC4000/-1 is capable of driving virtually any topology, including buck, boost, buck-boost, SEPIC and flyback converters. 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: $\pm 1\%$ Accuracy
- $\pm 0.1\%$ 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