ANALOG DEVICES

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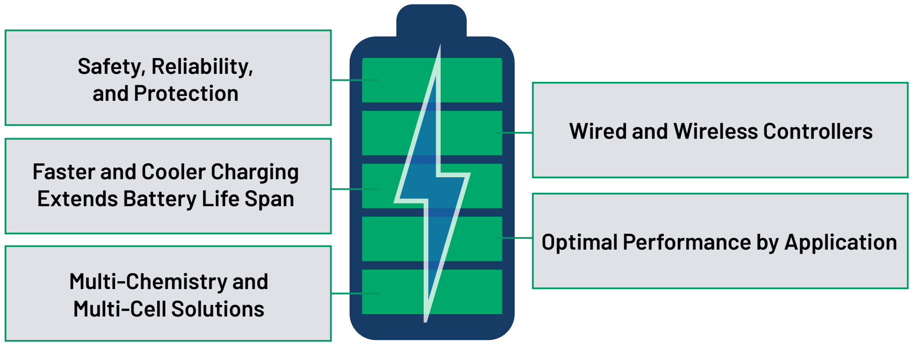
Industrial Battery Chargers Overview

Battery Chargers

The role of battery chargers has become increasingly important in our modern world, where portable and backup battery management systems are integral to our daily lives. To ensure the safety and reliability of battery management systems, robust control devices are necessary to reduce the risk of battery failures and explosions. These charger control devices also help to maintain battery temperature and extend battery life span. Analog Devices offers highly reliable and efficient integrated wired and wireless multi-chemistry charger controller solutions, which are suitable for a broad range of applications, including industrial automation, medical, logistics and retail, backup systems, instrumentation, and energy harvesting.



Industrial Battery Charger Major Features:

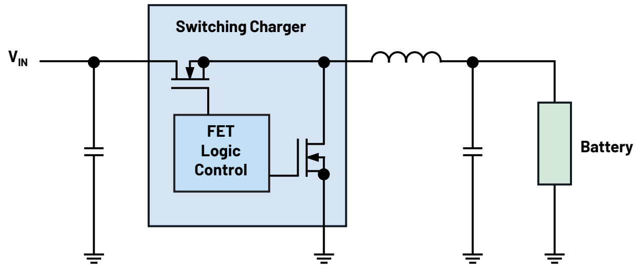
- Wide input voltages (4.5 V to 80 V)
- Linear and switching topologies
- Charge termination
- Maximum power point tracking (MPPT)
- NTC thermistor input
- USB PD/OTG controlled charging
- Smart battery charging
- Fast charging support
- CV-CC charging
- Output monitoring pins
- Programmable current limit
- Multi-chemistry and multi-cell support
- Bad battery detection
- Standalone and digital telemetry
- PowerPath™ control
- Dual-battery charging support
- Overvoltage protection

Switching Chargers

Switching chargers are a type of battery charger that uses a switching regulator to regulate the charging current and voltage. The switching regulator adjusts the output voltage and current based on the battery's state of charge and other factors, ensuring that the battery is charged quickly and safely.

One of the key benefits of switching chargers is their ability to handle a wide range of input voltages, making them ideal for use with a variety of power sources such as wall adapters, USB ports, and wireless charging pads. They also offer a high degree of flexibility in terms of charging parameters, allowing for customized charging profiles that can extend the life of the battery and optimize charging performance.

Compared to linear chargers, which regulate the charging current by dissipating excess energy as heat, switching chargers are more efficient and produce less heat. This makes them ideal for use in portable devices such as medical devices, point-of-sale (POS) devices, and industrial handhelds, which require fast and efficient charging without overheating.



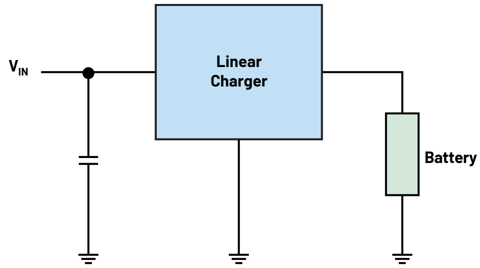
Switching charger

Linear Chargers

Linear chargers are a type of battery charger that uses a linear regulator to control the charging current and voltage. Unlike switching chargers, which use a switching regulator to increase efficiency, linear chargers dissipate excess energy as heat to regulate the charging current. This makes them less efficient than switching chargers, but also simpler and less expensive to implement.

Linear chargers work by using a voltage regulator to adjust the voltage applied to the battery, based on its state of charge and other factors. The charging current is regulated by controlling the voltage drop across a series pass element such as a transistor or diode. While linear chargers are less efficient than switching chargers, they offer better regulation of the charging current and voltage, which can result in a longer battery life and better charging performance.

Linear chargers are commonly used in applications where cost and simplicity are more important than efficiency, such as low power devices or devices with limited power sources. They are also well-suited for charging batteries with low capacities or low charging rates, where the lower efficiency of a linear charger is not a significant drawback.



Linear charger

Wide Input Voltages and Multi-Chemistry

ADI industrial charger portfolio has charging controllers ranging from 4.5 V to 60 V maximum input voltage that support design flexibility and enable minimal circuit layout changes to support alternate solutions and thus reduce overall design time.

Multi-chemistry chargers are a type of battery charger that is capable of charging different types of batteries, such as lithium-ion, nickel-metal hydride, and lead-acid batteries. They offer greater versatility and convenience compared to single-chemistry chargers, which are designed to charge only one type of battery.

Multi-chemistry chargers work by using a microcontroller or digital signal processor to monitor the charging process and adjust the charging parameters based on the battery chemistry and condition. The battery chemistry is identified by using the proprietary charging algorithm based on voltage levels (Refer to LTC4013 for example). This allows for optimized charging performance and improved battery life.

One of the key benefits of multi-chemistry chargers is their ability to handle a wide range of batteries and charging scenarios, making them ideal for use in applications where multiple battery types are used or where charging needs may change over time. They also offer advanced safety features, such as overcharge protection and temperature monitoring, to prevent damage to the battery and ensure safe charging.

multi-Chemistry chargers are commonly used in a variety of industries and applications, such as automotive, marine, and aerospace, where reliable and flexible charging solutions are required. They are also popular in low power electronics, such as digital cameras and industrial and medical handheld devices, where users may have multiple devices with different battery chemistries.

Common Battery Chemistries

Parameter	Lead Acid	NiMH	Li-Ion	Supercapacitor
Price	Low to mid price range	Mid price range	Expensive option	Mid to high price range
Capacity	Low to medium storage capacity	High capacity storage	High capacity storage	High capacity storage
Life cycle	Short life cycle	Short life cycle	Longer life cycle (4000 cycles)	Longer life cycle (50,000 cycles)
Environmental impact	Medium to high	More environmentally friendly than NiCd	Environment-friendly (compared to others)	Environment-friendly
Weight	Heavy weight	Medium weight battery	Light weight battery	Light weight
Operating temperatures	–40°C to 55°C	Can operate in moderate temperatures. -30°C to +75°C	Can operate in moderate temperatures –20°C to +60°C	–25°C to +70°C
Self-discharge rate	15% discharge monthly when not used	30% loss of charge monthly when not in use	Little to no charge is lost while not in use	About 5% per month
Applications	Automotive, small portable devices	Consumer electronics, medical, electric mobility	Consumer electronics, power tools, medical equip, backup systems etc	E-bikes, industrial applications, backup, energy harvesting

Multi-Chemistry Parts

Part Number	Description	V_{IN} (Max) (V)	I_{OUT} Charge Current (A)	Battery Chemistry
LT8490	High voltage, high current buck-boost battery charge controller with maximum power point tracking (MPPT)	80	10	Lead acid LiFeP04 Li-ion Li-polymer
LT8491	High voltage buck-boost battery charge controller with maximum power point tracking (MPPT) and I²C	80	10	Lead acid LiFeP04 Li-ion Li-polymer
LTC4000	High voltage high current controller for battery charging and power management (pair with external DC-to-DC converter)	60	20	Lead acid LiFeP04 Li-ion Li-polymer NiCd NiMH *
LTC4000-1	High voltage high current controller for battery charging with maximum power point control	60	20	Lead acid LiFeP04 Li-ion Li-polymer NiCd NiMH *
LTC4013	60 V synchronous buck multi-chemistry battery charger	60	20	Lead acid LiFeP04 Li-ion Li-polymer NiCd NiMH *
LTC4079	60 V, 250 mA linear charger with low quiescent current	60	0.25	Lead acid LiFeP04 Li-ion Li-polymer NiMH *
LTC4020	55 V buck-boost multi-chemistry battery charger (buck boost)	55	20	Lead acid LiFeP04 Li-ion Li-polymer
LTC4121	40 V 400 mA synchronous step-down battery charger with MPPT	40	0.4	Lead acid LiFeP04 Li-ion Li-polymer
LTC4015	Multi-chemistry buck battery charger controller with digital telemetry system	35	20	Lead acid LiFeP04 Li-ion Li-polymer
LT3652HV	Power tracking 2 A battery charger	34	2	Lead acid LiFeP04 Li-ion Li-polymer
LT3652	Power tracking 2 A battery charger for solar power	32	2	Lead acid LiFeP04 Li-ion Li-polymer
LT1510	Constant-voltage/constant-current battery charger	29	1.5	Lead acid Li-ion Li-polymer NiCd NiMH *
LT1511	Constant-current/constant-voltage 3 A battery charger with input current limiting	29	3	Lead acid Li-ion Li-polymer NiCd NiMH *
LT1512	SEPIC constant-current/constant-voltage battery charger	29	1	Lead acid Li-ion Li-polymer NiCd NiMH (slow charge)
LT1513	SEPIC constant- or programmable-current/constant-voltage battery charger	29	2	Lead acid Li-ion Li-polymer NiCd NiMH *
LT1769	Constant-current/constant-voltage 2 A battery charger with input current limiting	29	2	Lead acid Li-ion Li-polymer NiCd NiMH *
LTC1760	Dual smart battery system manager	28	4	Li-ion Li-polymer NiCd NiMH *
LTC1960	Dual battery charger/selector with SPI Interface	28	4	Lead acid Li-ion Li-polymer NiCd NiMH *
LTC4008	4 A, high efficiency, multi-chemistry battery charger	28	4	Lead acid LiFeP04 Li-ion Li-polymer NiCd NiMH *
LTC4009	High efficiency, multi-chemistry battery charger with PowerPath control	28	0	Lead acid LiFeP04 Li-ion Li-polymer NiCd NiMH *
LTC4012	High efficiency, multi-chemistry battery charger with PowerPath control	28	4	Lead acid LiFeP04 Li-ion Li-polymer NiCd NiMH *
LTC4012-3	High Efficiency, Multi-Chemistry Battery Charger With PowerPath control	28	4	Lead acid LiFeP04 Li-ion Li-polymer NiCd NiMH *
LTC4100	High efficiency, multi-chemistry battery charger with PowerPath control	28	4	Li-ion Li-polymer NiCd NiMH *
LT1571	Constant-current/constant-voltage battery charger with preset voltage and termination flag	27	1.5	Lead acid Li-ion Li-polymer NiCd NiMH
LT1505	Constant-current/voltage high efficiency battery charger	26	4	Lead acid Li-ion Li-polymer NiCd NiMH *
LTC1759	Smart battery charger	26	8	Lead acid Li-ion Li-polymer NiCd NiMH *
MAX846A	Cost-saving, multi-chemistry, battery charger system	20	2	Li-ion, Li-polymer, NiCd, NiMH
LTC4110	Battery backup system manager (3 A flyback controller)	19	3	Lead acid Li-ion Li-polymer NiCd NiMH *
MAX1667	Chemistry-independent, Level 2 smart battery charger	18.4	4	Lead acid, Li-ion, NiCd NiMH
MAX1647	Chemistry-independent battery chargers	18	4	Li-ion, Li-polymer, NiCd NiMH, Universal
LTC1980	Dual smart battery system manager	12	2	Lead acid Li-ion Li-polymer NiCd NiMH *
LTC4059	900 mA linear Li-ion battery chargers with thermal regulation in 2 × 2 DFN	8	0.9	Li-ion Li-polymer NiCd NiMH *
LT8584	2.5 A monolithic active cell balancer with telemetry interface	7.5	2.5	LiFeP04 Li-ion
LTC4040	2.5 A battery backup power manager (supports 2.5 A boost operation)	5.5	2.5	LiFeP04 Li-ion Li-polymer
LTC3106	300 mA low voltage buck-boost converter with PowerPath and 1.6 µA quiescent current	5.1	0.1	Li-ion Li-polymer NiMH *

Note: * (slow charge)

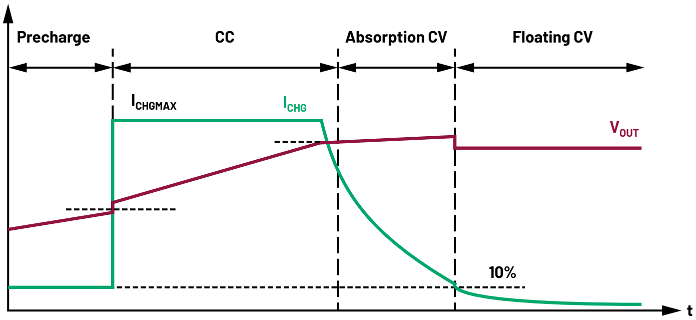
Charging Profile Based on Battery Chemistry

The charging cycle will differ from chemistry to chemistry. An example of a constant current-constant voltage charging profile is shown below. It is important to consider the charging profile based on battery chemistry.

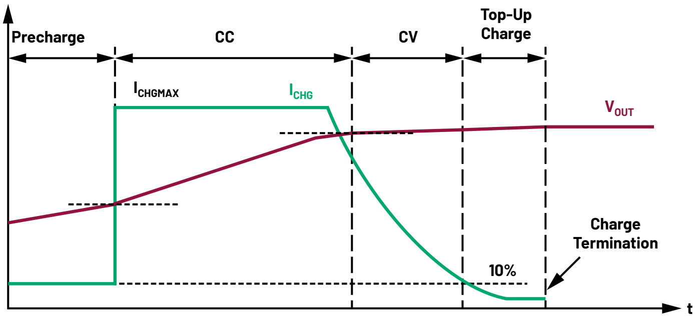
Battery charging profiles refer to the specific methods and algorithms used to charge batteries effectively and safely. The charging process is essential to maintain the performance, life span, and safety of batteries, whether they are used in smartphones, laptops, electric vehicles, or renewable energy storage systems. There are several common charging profiles, each tailored to the specific chemistry and design of the battery. Here are some of the primary charging profiles:

- Constant current (CC) charging: In the initial stage of charging, the battery is supplied with a constant current until it reaches a predefined voltage level. During this phase, the battery charges rapidly, and the current gradually reduces as the battery's voltage rises.
- Constant voltage (CV) charging: Once the battery voltage reaches the predefined level, the charging method switches to constant voltage mode. The charger now maintains a steady voltage, and the current tapers off slowly as the battery approaches full capacity. This ensures a controlled and safe charging process.
- Floating CV: Floating constant voltage charging is a method employed to maintain fully charged batteries by applying a steady voltage after reaching maximum capacity. This approach prevents overcharging, ensuring battery longevity and safety across a range of applications. This process is shown in the lead acid charging cycle, and is also shown in the Li-ion charging cycle where it is called as Top-up charge.

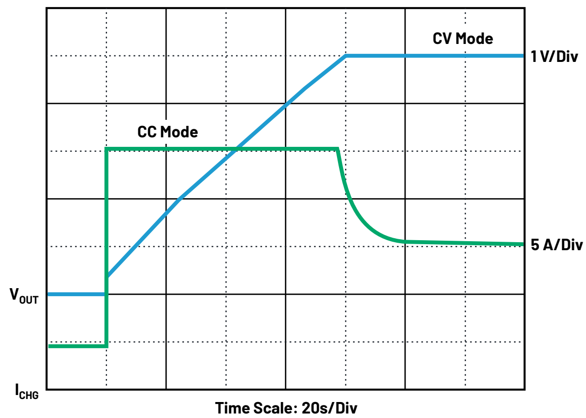
Generally, for supercapacitors, the charging and discharging cycles are very fast and don't require any trickle or floating voltage where the values are small in magnitude. Supercapacitors will often be used in burst power applications like e-bikes, solar battery charging, and backup systems.



Pb-acid battery charging cycle



Li-ion battery charging cycle



Supercapacitor charging profile with 10 A load

Smart Chargers

Smart charging is a technology that has revolutionized the way we charge our devices. It involves using intelligent algorithms and sensors to optimize the charging process, resulting in faster charging times and longer battery life.

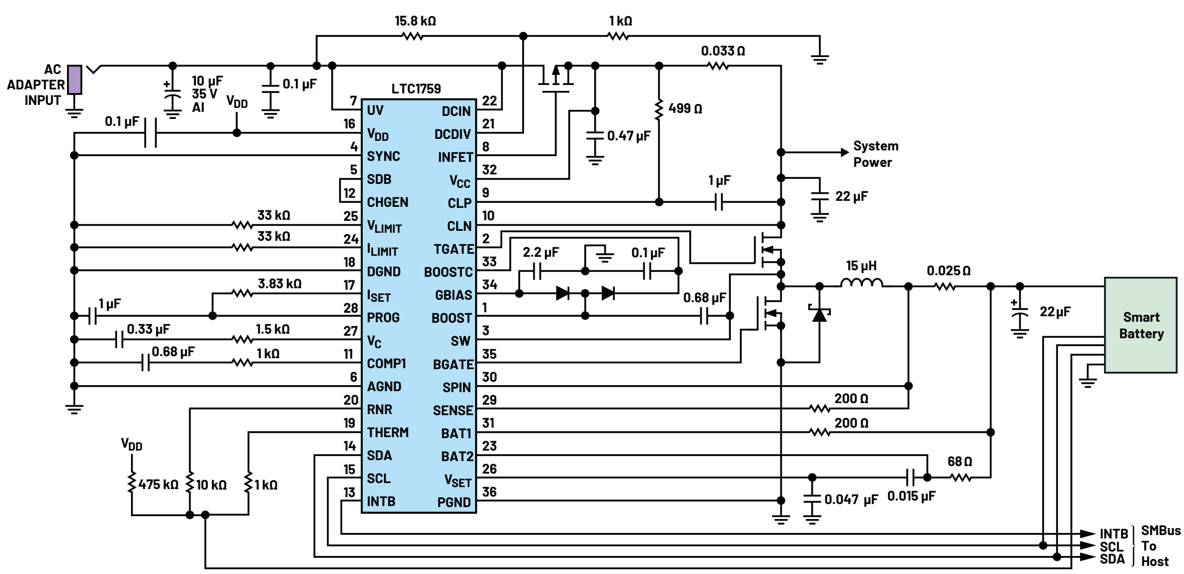
Smart chargers are equipped with microprocessors that monitor and control the charging process in real-time. They can detect the type of device being charged and adjust the charging parameters accordingly. For example, a smart charger for a portable industrial barcode scanner may adjust the charging current and voltage based on the battery's capacity and health, resulting in faster and safer charging.

One of the key benefits of smart charging is that it can extend the life of the battery. By monitoring the battery's temperature and charge level, smart chargers can prevent overcharging and overheating, which can cause long-term damage to the battery. This helps to prolong the life of the battery and reduce the need for frequent replacements.

Smart chargers are also designed to be more efficient than traditional chargers. They can detect when the battery is fully charged and stop the charging process, reducing energy waste and saving money on electricity bills. This makes them an environmentally friendly option for charging devices.

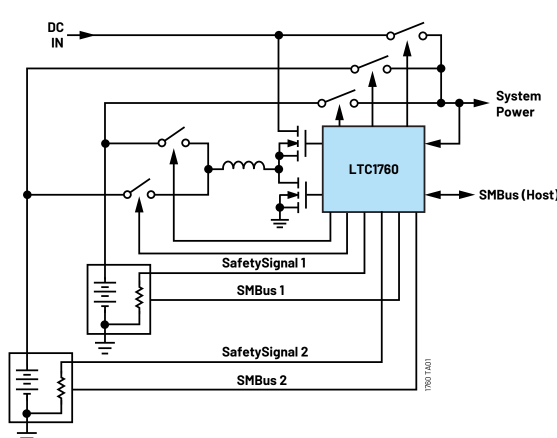
Overall, smart charging technology has transformed the way we charge our devices. By optimizing the charging process, smart chargers can provide faster charging times, longer battery life, and greater energy efficiency.

The LTC1759 smart battery charger is a single-chip charging solution that dramatically simplifies the construction of a smart battery system (SBS) compliant system. The LTC1759 implements a Level 2 charger function whereby the charger can be programmed by the battery or by the host. A thermistor on the battery being charged is monitored for temperature, connectivity, and battery type information. The SMBus interface remains alive when the AC power adapter is removed and responds to all SMBus activity directed to it, including thermistor status (via the charger status command). The charger also provides an interrupt to the host whenever a status change is detected (for example, battery removal, AC adapter connection).



4 A SMBus smart battery charger

The LTC1760 smart battery system manager is a highly integrated SMBus Level 3 battery charger and selector intended for products using dual smart batteries.



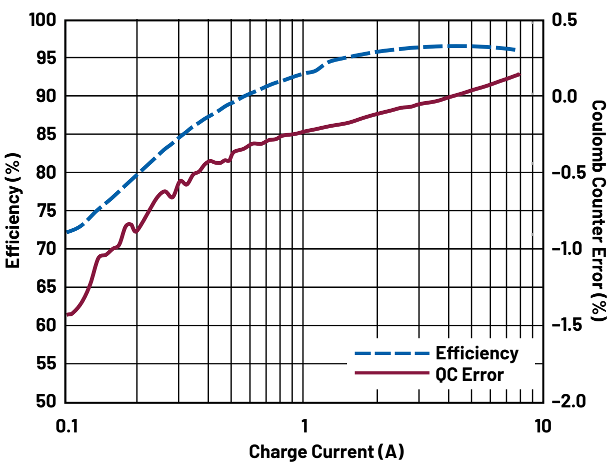
Dual-battery charger/selector system archetecture

Smart Digital Chargers

Part Number	Description	V_{IN} (Max) (V)	I_{OUT} Charge Current (A)
LT8491	High voltage buck-boost battery charge controller with maximum power point tracking (MPPT) and I²C	80	10
LTC4015	Multi-chemistry buck battery charger controller with digital telemetry system	35	20
LTC4162-F	35 V/3.2 A multi-cell LiFePO4 step-down battery charger with PowerPath and I²C telemetry	35	3.2
LTC4162-L	35 V/3.2 A multi-cell lithium-ion step-down battery charger with PowerPath and I²C telemetry	35	3.2
LTC4162-S	35 V/3.2 A lead-acid step-down battery charger with PowerPath and I²C telemetry	35	3.2
LTC1760	Dual-smart battery system manager	28	4
LTC1960	Dual-battery charger/selector with SPI interface	28	4
LTC4100	Smart battery charger controller	28	4
LTC1759	Smart battery charger	26	8
LTC4110	Battery backup system manager (3 A flyback controller)	19	3
ADP5061	1.5 A linear charger with support for USB	6.7	2.1
ADP5062	1.3 A USB linear charger in LFCSP	6.7	2.1
ADP5063	I²C programmable linear battery charger	6.7	2.1
LTC4099	I²C controlled USB power manager/charger with overvoltage protection	5.5	1.5
LTC4155	Dual-input power manager/3.5 A Li-ion battery charger with I²C control and USB OTG	5.5	3.5
LTC4156	Dual-input power manager/3.5 A LiFePO4 battery charger with I²C control and USB OTG	5.5	3.5

Coulomb Counter for State-of-Charge

The LTC4015 features an integrated Coulomb counter for battery state-of-charge monitoring. Charge is the time integral of current. The Coulomb counter is disabled by default and can be enabled only via the I²C port. There are several I²C accessible registers associated with the Coulomb counter.



Step-down charger efficiency and Coulomb Counter error vs battery charge current

Smart Supercapacitor Charger Controller

MAX17701/MAX17702/MAX17703 is a 60 V buck battery charger controller which has charge status flag pins to identify the state of battery charging along with preconditioning of battery when the battery is fully discharged.

Charge Status Monitoring for MAX17701/MAX17702/MAX17703

Charger Status Flag	FLG2	FLG1	Charge State
11	1	1	Charger off
10	1	0	Charging in progress (precharge, CC, absorption CV states)
00	0	0	Float charging (floating CV state)
01	0	1	Latched fault or charge suspend due to high or low battery temperature detection

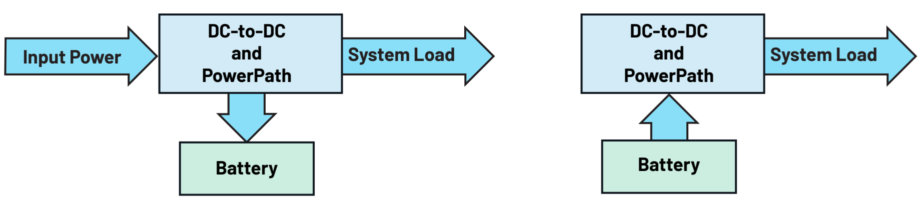
PowerPath

PowerPath control is an automatic load prioritization circuit that offers the ability to manage power flow autonomously and seamlessly between multiple input sources such as USB ports, wall adapters, and the battery, all while preferentially providing power to the system load. In a traditional battery-fed charging system, the user must wait until there is sufficient battery charge and voltage level to obtain system power. Conversely, PowerPath control with its ideal diode allows the product to operate immediately when plugged in, regardless of the battery's state of charge, commonly referred to as instant-on operation. PowerPath control circuits may be found in both linear and switching topologies. Benefits of the linear PowerPath topology include Bat-Track™ adaptive output control capability with an external high voltage buck and improved thermal performance with power flowing to the system load. Switch mode PowerPath technology preserves these advantages while improving power delivery efficiency to the load/system and to the battery. It eliminates the power lost in the linear battery charger element, especially critical when the battery voltage is low and/or input power is limited (that is, USB), giving it excellent thermal properties. A second big advantage is its ability to extract up to 700 mA battery charge current from a standard USB port (~2.3 W) when battery voltages are low. Common PowerPath applications are backup systems, backlight applications, industrial handhelds, industrial lighting and medical instruments.

Design Considerations

Attribute	Battery-Fed	Linear PowerPath	Switching PowerPath
Size	Small	Moderate	Larger
Complexity	Simple	Moderate	More complex
Solution cost	Low	Moderate	Higher
USB charge current	Limited to 500 mA	Limited to 500 mA	Not limited to 500 mA (~2.3 W)
Autonomous control of input power sources	No	Yes	Yes
Instant-on operation	No	Yes	Yes
System load efficiency (I_{BUS} < USB limit)	Poor (V_{BAT}/V_{BUS})	Excellent (>90%)	Very good (~90%)
System load efficiency (I_{BUS} = USB limit)	Poor ($V_{BAT}T/V_{BUS}$)	Poor (V_{BAT}/V_{BUS})	Very good (~90%)
Battery charger efficiency	Poor (V_{BAT}/V_{BUS})	Poor (V_{BAT}/V_{BUS})	Very good (~90%)
Thermal dissipation	High	Moderate	Low
Bat-Track adaptive output control/interface to HV buck	No	Yes	Yes

PowerPath in Chargers Is a Load Prioritization

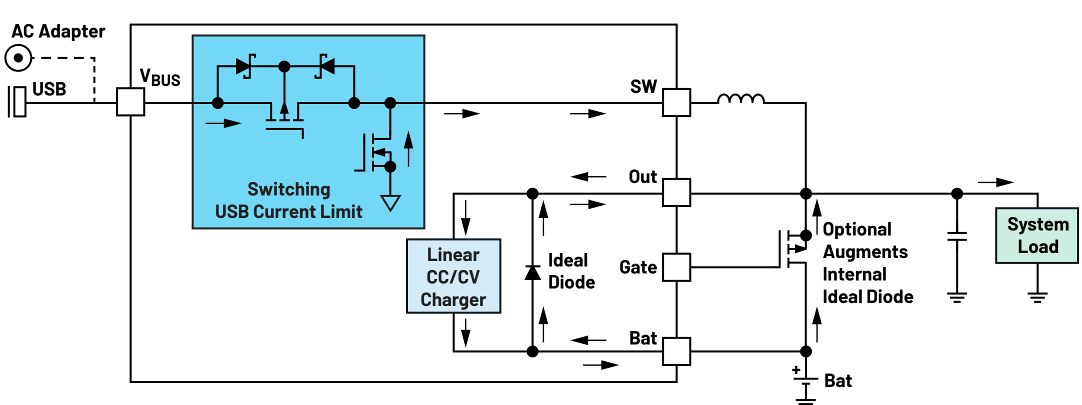


V_{IN} charges battery and provides power to system load

Absence of V_{IN}, battery provides power to system load

PowerPath Application Case

Below is an example circuit of a switching DC-to-DC battery charger with PowerPath. If the DC-to-DC can provide enough power, it charges battery and powers system load. Otherwise, if the DC-to-DC is off or unable to provide enough power, the battery discharges through the internal or external ideal diode to support the system power needs.



Switching DC-to-DC battery charger with PowerPath

Parts with PowerPath

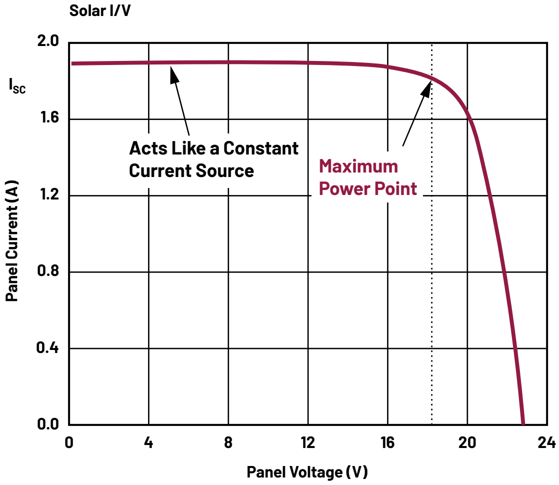
Part Number	Description	V_{IN} (Max) (V)	I_{OUT} Charge Current (A)
LTC4000	High voltage high current controller for battery charging and power management (pair with external DC-to-DC converter)	60	20
LTC4000-1	High voltage high current controller for battery charging with maximum power point control	60	20
LTC4020	55 V buck-boost multi-chemistry battery charger (buck boost)	55	20
LTC4090	USB power manager with 2 A high voltage Bat-Track buck regulator	38	1.5
LTC4089	USB power manager with high voltage switching charger	36	1.2
LTC4089-1	USB power manager with high voltage switching charger	36	1.2
LTC4089-3	USB power manager with high voltage switching charger	36	1.2
LTC4089-5	USB power manager with high voltage switching charger	36	1.2
LTC4090-3	USB power manager with 2 A high voltage Bat-Track buck regulator	36	1.5
LTC4091	36 V battery charger and power backup manager	36	2
LTC4015	Multi-chemistry buck battery charger controller with digital telemetry system	35	20
LTC4162-F	35 V/3.2 A multi-cell LiFePO4 step-down battery charger with PowerPath and I²C telemetry	35	3.2
LTC4162-L	35 V/3.2 A multi-cell Lithium-ion step-down battery charger with PowerPath and I²C telemetry	35	3.2
LTC4162-S	35 V/3.2 A lead-acid step-down battery charger with PowerPath and I²C telemetry	35	3.2
LTC4011	High efficiency standalone nickel battery charger	34	4
LT3650-4.1	High voltage 2 A monolithic Li-ion battery charger (1-cell)	32	2
LT3650-4.2	High voltage 2 A monolithic 2-cell Li-ion battery charger (2-cell)	32	2
LT3651-4.1	Monolithic 4 A high voltage 1 cell Li-ion battery charger (1-cell)	32	4
LT3651-4.2	Monolithic 4 A high voltage 2-cell Li-ion battery charger (2-cell)	32	4
LTC4012	High efficiency, multi-chemistry battery charger with PowerPath control	28	4
LTC4012-3	High efficiency, multi-chemistry battery charger with PowerPath control	28	4
LTC4110	Battery backup system manager (3 A flyback controller)	19	3
ADP5061	1.5 A linear charger with support for USB	6.7	2.1
ADP5062	1.3 A USB linear charger in LFCSP	6.7	2.1
ADP5063	I²C programmable linear battery charger	6.7	2.1
LTC3101	Wide VIN, multi-output DC-to-DC converter and PowerPath controller	5.5	Multi-output
LTC4055	USB power controller and Li-ion linear charger	5.5	1.25
LTC4066	USB power manager with low loss ideal diode and Li-ion battery charger	5.5	1.5
LTC4085-1	USB power manager with ideal diode controller and 4.1 V Li-ion charger	5.5	1.5
LTC4088	High efficiency battery charger/USB power manager	5.5	1.5
LTC4088-1	High efficiency battery charger/USB power manager	5.5	1.5
LTC4098	USB compatible switching power managers/Li-ion chargers with overvoltage protection	5.5	1.5
LTC4098-1	USB compatible switching power managers/Li-ion chargers with overvoltage protection	5.5	1.5
LTC4098-3.6	USB compatible switching power managers/Li-ion chargers with overvoltage protection	5.5	1.5
LTC4099	I²C controlled USB power manager/charger with overvoltage protection	5.5	1.5
LTC4155	Dual-input power manager/3.5 A Li-ion battery charger with I²C control and USB OTG	5.5	3.5
LTC4156	Dual-input power manager/3.5 A Li-ion battery charger with I²C control and USB OTG	5.5	3.5
LTC4160	Switching power manager with USB On-the-Go and overvoltage protection	5.5	1.2
LTC4067	USB power manager with OVP and Li-ion/polymer charger	5.5	1.25
LTC4085	USB power manager with ideal diode controller and Li-ion charger	5.5	1.2
LTC4085-3	USB power manager with ideal diode controller and 3.95 V Li-ion charger	5.5	1.2
LTC3106	300 mA low voltage buck-boost converter with PowerPath and 1.6 µA quiescent current	5.1	0.3

Maximum Power Point Tracking

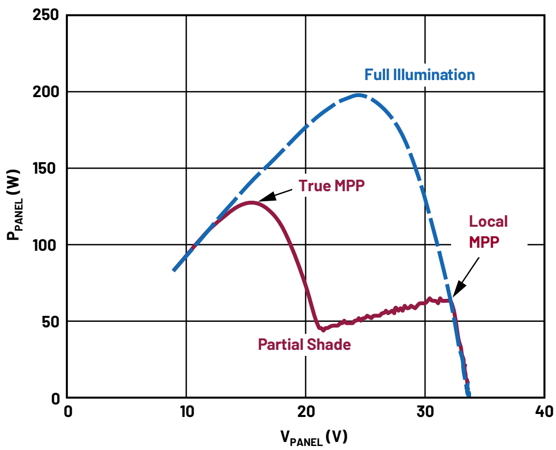
Ideally, any system using a solar panel would operate that panel at its maximum power output. This is particularly true of a solar powered battery charger, where the goal is to capture and store as much solar energy as possible in as little time as possible. Put another way, since we cannot predict the availability or intensity of solar power, we need to harness as much energy as possible while the energy is available.

There are many ways to try to operate a solar panel at its maximum power point. One of the simplest is to connect a battery to the solar panel through a diode. This relies on matching the maximum output voltage of the panel to the relatively narrow voltage range of the battery. When available power levels are very low (approximately less than a few tens of milliwatts), this may be the best approach.

The opposite end of the spectrum is an approach that implements a complete MPPT algorithm. There are a variety of MPPT algorithms, but most will have some ability to sweep the entire operating range of the solar panel to find where maximum power is produced. The LT8490 is an example of an integrated circuit that performs this function. The advantage of a full MPPT algorithm is that it can differentiate a local power peak from a global power maximum. In multi-cell solar panels, it is possible to have more than one power peak during partial shading conditions. Typically, a full MPPT algorithm is required to find the true maximum power operating point. It does so by periodically sweeping the entire output range of the solar panel and remembering the operating conditions where maximum power was achieved. When the sweep is complete, the circuitry forces the panel to return to its maximum power point. In between these periodic sweeps, the MPPT algorithm will continuously dither the operating point to ensure that it operates at the peak.



Maximum power point tracking



The power curve of a 60-cell 250 W solar panel with entire panel illuminated and with a small shadow partly covering one cell

Power Point Tracking Supported Parts

Part Number	Description	V_{IN} (Max) (V)	I_{CHGMAX} Charge Current (A)
LT8490	High voltage, high current buck-boost battery charge controller with maximum power point tracking (MPPT)	80	10
LT8491	High voltage buck-boost battery charge controller with maximum power point tracking (MPPT) and I^2C	80	10
LTC4013	60 V synchronous buck multi-chemistry battery charger	60	20
LTC4121	40 V 400 mA synchronous step-down battery charger with MPPT	40	0.4
LTC4015	Multi-chemistry buck battery charger controller with digital telemetry system	35	20
LTC4162-F	35 V/3.2 A multi-cell LifePO4 step-down battery charger with PowerPath and I^2C telemetry	35	3.2
LTC4162-L	35 V/3.2 A multi-cell lithium-ion step-down battery charger with PowerPath and I^2C telemetry	35	3.2
LTC4162-S	35 V/3.2 A lead-acid step-down battery charger with PowerPath and I^2C telemetry	35	3.2
LT3652HV	Power tracking 2 A battery charger	34	2
LT3652	Power tracking 2 A battery charger for solar power	32	2

Read more: 80 V Buck-Boost Lead-Acid and Lithium Battery Charging Controller Actively Finds True Maximum Power Point in Solar Power Applications | Analog Devices

Key Applications

Industrial Automation
- Process controls
- Industrial chargers
- Fleet management systems
- Industrial robots
- Barcode and retail automation

Digital Health care
- Patient support
- Imaging systems
- Hearing aids
- Surgical robots
- Lab equipment
- Vital signs monitor

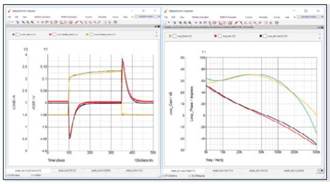
Instrumentation
- Spectroscopy equipment
- Automated test equipment
- Air quality detection
- Spectrum analyzer
- Surveying equipment

Sustainable Energy
- Energy meters
- Solar applications
- EV DC chargers
- Backup systems
- Renewable generation systems

Combined Selection Table for Industrial Battery Chargers

Tools for Industrial Battery Charger Designs

LTspice® is a high performance SPICE simulation software, schematic capture, and waveform viewer with enhancements and models for easing the simulation of analog circuits. Included in the download of LTspice are macromodels for a majority of Analog Devices switching regulators, amplifiers, as well as a library of devices for general circuit simulation.



SIMPLIS (SIMulation of Piecewise Linear Systems) is a circuit simulator specifically designed to handle the simulation challenges of switching power systems. Like SPICE, SIMPLIS works at the component level but typically can perform a transient analysis of a switching circuit 10 to 50 times faster. For switching power systems, the piecewise linear (PWL) modeling and simulation techniques employed by SIMPLIS result in qualitatively superior convergence behavior compared to SPICE.

Find more power components from Analog Devices at
analog.com/power