Battery Chargers Catalog

Products for mobile phones, smart phones, headsets, portable media players, portable navigation devices, notebook computers, industrial and medical devices.
Making portable possible with linear and switch-mode battery-charging solutions

End applications in wireless, computing, consumer and industrial/medical markets continue to expand into the portable space. TI’s battery management solutions help address system protection, cost-effective linear and highly efficient switch-mode battery charging.

New advancements in switch-mode charging increase efficiency, thus decreasing power dissipation and promoting a green environment by wasting less energy.

With battery-powered systems demanding increased reliability, TI ensures maximum safety with products in addition to battery chargers that protect from over-voltage and over-current conditions.

Space is of utmost importance in portable applications. TI offers advanced solutions that incorporate QFN and wafer-level chip-scale packaging and feature a high degree of external component integration to reduce solution size. In addition to reducing board space, many of these solutions provide lower power dissipation and increase overall efficiency.

TI battery management solutions support a wide range of battery chemistries and cell counts, from popular Lithium-Ion (Li-Ion) technologies to industry-standard nickel metal hydride and lead acid batteries.

Whatever your battery management needs may be, TI is the place to find the solutions.

TI products support your battery management design challenges

TI’s products support applications such as mobile phones, smartphones, headsets, portable media players, portable navigation devices, notebook computers, industrial and medical. TI has the battery management device to match your design specifications, and this catalog puts you in touch with the evaluation modules, application notes, samples and data sheets you will need to get your design to market faster.

Products for mobile phones and smartphones

Key features: Input over-voltage protection, input over-current protection, USB current limiting, mini-USB interface, USB-OTG output, PowerPath™ management, small solution size

- bq2431x: Smallest charger front-end protection...
- bq2408x: One-cell Li-Ion charger with input over-voltage protection...
- bq2407x: USB-friendly Li-Ion charger and PowerPath™ management IC...
- bq24150: 3-MHz synchronous switch-mode charger with FETs and USB OTG support...

Products for headsets and accessories

Key features: Small solution size, input over-voltage protection, USB charging

- bq2402x: One-cell Li-Ion charger with autonomous USB and AC adapter supply management...
- bq2408x: One-cell Li-Ion charger with input over-voltage protection...
- bq2501x: Single-chip Li-Ion charger and DC/DC converter IC...
Products for portable media players
Key features: Input over-voltage protection, PowerPath™ management, fast and efficient charging, small solution size
bq2431x: Smallest charger front-end protection IC ............................... 4
bq2408x: One-cell Li-Ion charger with input over-voltage protection .......... 5
bq2407x: USB-friendly Li-Ion charger and PowerPath management IC .......... 5
bq24150: 3-MHz synchronous switch-mode charger with FETs and USB OTG support .................................................. 8
bq241xx: 1.1-MHz synchronous switch-mode charger with FETs for one- to three-cell Li-Ion ............................................................... 9

Products for portable navigation devices
Key features: Fast and efficient charging, longer battery life in higher temperature environment, PowerPath management
bq2408x: One-cell Li-Ion charger with input over-voltage protection .......... 6
bq2407x: USB-friendly Li-Ion charger and PowerPath management IC .......... 5
bq24150: 3-MHz synchronous switch-mode charger with FETs and USB OTG support .................................................. 8
bq241xx: 1.1 MHz synchronous switch-mode charger with FETs for one- to three-cell Li-Ion ............................................................... 9

Products for notebook computers
Key features: High efficiency and accuracy, flexible programmability, dynamic power management, automatic power source selection, small solution size
bq24751A: ENERGY STAR®-compliant, switch-mode charger with system power selector .................................................. 10
bq24745: SMBus-controlled, level 2, multi-chemistry battery charger .............. 11

Products for industrial and medical applications
Key features: High efficiency and accuracy, flexible programmability, dynamic power management
bq24751A: ENERGY STAR-compliant, switch-mode charger with system power selector .................................................. 10
bq24745: SMBus-controlled, level 2, multi-chemistry battery charger .............. 11
bq2002: Simple NiMH/NiCd charger ............................................. 12

Resources
Application notes and online training ............................................... 13
Evaluation modules ................................................................. 14
Worldwide Technical Support ..................................................... 15
### Small charger front-end protection IC

**bq24314**

The bq24314 provides protection from input over-voltage, input over-current and battery over-voltage conditions. The three-level protection offers maximum safety when charging a handheld device. With integrated FET, the bq24314 comes in 2-mm x 2-mm and 3-mm x 4-mm SON packages.

#### Key Features
- Provides protection from input over-voltage, input over-current and battery over-voltage
- Maximum input voltage: 30 V
- Integrated power FET and current sensor that supports up to 1.5-A input current
- Less than 1-µs response time against input over-voltage
- High immunity against false triggering because of voltage spikes and current transients
- Status indication – fault condition
- Thermal shutdown
- Packaging: 2-mm x 2-mm and 3-mm x 4-mm SON

#### Charger Front-End Protection Devices

<table>
<thead>
<tr>
<th>Device</th>
<th>OVP (V)</th>
<th>OCP</th>
<th>LDO output (V)</th>
<th>Max operating current (µA)</th>
<th>Operating temp. range (°C)</th>
<th>Features</th>
<th>Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq24300</td>
<td>10.5</td>
<td>Fixed 300 mA</td>
<td>5.5</td>
<td>500</td>
<td>0 to 125</td>
<td>Reverse polarity protection</td>
<td>8-SON</td>
</tr>
<tr>
<td>bq24304</td>
<td>10.5</td>
<td>Fixed 300 mA</td>
<td>4.5</td>
<td>500</td>
<td>0 to 125</td>
<td>Reverse polarity protection</td>
<td>9-SON</td>
</tr>
<tr>
<td>bq24305</td>
<td>10.5</td>
<td>Fixed 300 mA</td>
<td>5</td>
<td>500</td>
<td>0 to 125</td>
<td>Reverse polarity protection</td>
<td>8-SON</td>
</tr>
<tr>
<td>bq24314</td>
<td>5.85</td>
<td>Prog. &lt;1.5 A</td>
<td>—</td>
<td>600</td>
<td>0 to 125</td>
<td>Fault indication</td>
<td>8-SON</td>
</tr>
<tr>
<td>bq24314A</td>
<td>5.85</td>
<td>Prog. &lt;1.5 A</td>
<td>—</td>
<td>600</td>
<td>−40 to 125</td>
<td>Fault indication</td>
<td>8-SON</td>
</tr>
<tr>
<td>bq24315</td>
<td>5.85</td>
<td>Prog. &lt;1.5 A</td>
<td>5.5</td>
<td>600</td>
<td>−40 to 125</td>
<td>Fault indication</td>
<td>8-SON</td>
</tr>
<tr>
<td>bq24316</td>
<td>6.5</td>
<td>Prog. &lt;1.5 A</td>
<td>—</td>
<td>600</td>
<td>0 to 125</td>
<td>Fault indication</td>
<td>8/12-SON</td>
</tr>
<tr>
<td>bq24380</td>
<td>6.3</td>
<td>No OCP</td>
<td>5.5</td>
<td>250</td>
<td>−40 to 125</td>
<td>Fault indication</td>
<td>8-SON</td>
</tr>
<tr>
<td>bq24381</td>
<td>7.1</td>
<td>No OCP</td>
<td>5</td>
<td>250</td>
<td>−40 to 125</td>
<td>Fault indication</td>
<td>8-SON</td>
</tr>
</tbody>
</table>

---

Get samples, datasheets, app reports and evaluation modules at: [www.ti.com/sc/device/bq24314](http://www.ti.com/sc/device/bq24314)
USB-friendly Li-Ion charger and PowerPath™ management IC

**bq24072**

Get samples and datasheets at: [www.ti.com/sc/device/bq24072](http://www.ti.com/sc/device/bq24072)

The bq24072 operates either from a USB port or a wall adapter. The 28-V input voltage rating along with input over-voltage protection and input current limiting add robustness to the charging circuits. The PowerPath™ management feature allows the system be powered directly off the input, reducing battery charge and discharge cycles and enabling instant system turn-on even with a depleted battery.

**Key Features**
- 28-V input rating, up to 2-A output current
- Integrated dynamic power management feature
- Integrated USB charge control with selectable 100-mA and 500-mA maximum input current
- Programmable pre-charge and fast-charge safety timers
- Thermal regulation for charge control
- Reverse current, short-circuit and thermal protection
- Status indication: Charging/Done, Power Good
- Packaging: small 16-lead, 3-mm x 3-mm QFN

*Expected release September 2008.*

### Charger and PowerPath™ Management Devices

<table>
<thead>
<tr>
<th>Device</th>
<th># Inputs</th>
<th>Max VIN (V)</th>
<th>Max current (A)</th>
<th>Input current limiting</th>
<th>OVP (V)</th>
<th>Vs ys (V)</th>
<th>Battery voltage (V)</th>
<th>Packaging (SON)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq24072</td>
<td>single</td>
<td>28</td>
<td>2</td>
<td>USB: 100/500 mA Adapter: prog. up to 2 A</td>
<td>6.6</td>
<td>Vbat+200 mV</td>
<td>4.2</td>
<td>3 x 3-16</td>
</tr>
<tr>
<td>bq24073</td>
<td>single</td>
<td>28</td>
<td>2</td>
<td>USB: 100/500 mA Adapter: prog. 200 mA-2 A</td>
<td>6.6</td>
<td>4.4</td>
<td>4.2</td>
<td>3 x 3-16</td>
</tr>
<tr>
<td>bq24074</td>
<td>single</td>
<td>28</td>
<td>2</td>
<td>USB: 100/500 mA Adapter: prog. 200 mA-2 A</td>
<td>10.5</td>
<td>4.4</td>
<td>4.2</td>
<td>3 x 3-16</td>
</tr>
<tr>
<td>bq24075</td>
<td>single</td>
<td>28</td>
<td>2</td>
<td>USB: 100/500 mA Adapter: prog. 200 mA-2 A</td>
<td>6.6</td>
<td>5.5</td>
<td>4.2</td>
<td>3 x 3-16</td>
</tr>
<tr>
<td>bq24070</td>
<td>single</td>
<td>18</td>
<td>2</td>
<td>USB only: 100/500 mA</td>
<td>n/a</td>
<td>4.4</td>
<td>4.2</td>
<td>3.5 x 4.5-20</td>
</tr>
<tr>
<td>bq24071</td>
<td>18</td>
<td>2</td>
<td>USB only: 100/500 mA</td>
<td>n/a</td>
<td>6</td>
<td>4.2</td>
<td>3.5 x 4.5-20</td>
<td></td>
</tr>
<tr>
<td>bq24030</td>
<td>single</td>
<td>18</td>
<td>2</td>
<td>USB only: 100/500 mA</td>
<td>n/a</td>
<td>6</td>
<td>4.2</td>
<td>3.5 x 4.5-20</td>
</tr>
<tr>
<td>bq24031</td>
<td>dual</td>
<td>18</td>
<td>2</td>
<td>USB only: 100/500 mA</td>
<td>n/a</td>
<td>6</td>
<td>4.1</td>
<td>3.5 x 4.5-20</td>
</tr>
<tr>
<td>bq24032A</td>
<td>dual</td>
<td>18</td>
<td>2</td>
<td>USB only: 100/500 mA</td>
<td>n/a</td>
<td>4.4</td>
<td>4.2</td>
<td>3.5 x 4.5-20</td>
</tr>
<tr>
<td>bq24035</td>
<td>dual</td>
<td>18</td>
<td>2</td>
<td>USB only: 100/500 mA</td>
<td>6</td>
<td>V_{pos}-V_{drop}</td>
<td>4.2</td>
<td>3.5 x 4.5-20</td>
</tr>
<tr>
<td>bq24038</td>
<td>dual</td>
<td>18</td>
<td>2</td>
<td>USB only: 100/500 mA</td>
<td>n/a</td>
<td>4.4</td>
<td>4.36</td>
<td>3.5 x 4.5-20</td>
</tr>
</tbody>
</table>
One-cell Li-Ion charger with autonomous USB and AC-adapter supply management

**bq24020**

Get samples, datasheets, app reports and evaluation modules at: [www.ti.com/sc/device/bq24020](http://www.ti.com/sc/device/bq24020)

The bq24020 automatically selects the USB port or the AC adapter as the power source for the system. In the USB configuration, the host can select from two preset charge rates of 100 mA or 500 mA. In the AC adapter configuration, an external resistor sets the charge current.

**Key Features**
- Integrated 1-A FET and current sensor
- Integrated USB control with selectable 100-mA and 500-mA charge rates
- Autonomous power source selection
- Status indication: Charging/Done, Power Good
- Packaging: small 10-lead, 3-mm x 3-mm QFN

---

One-cell Li-Ion charger with input over-voltage protection

**bq24085**

Get samples, datasheets, app reports and evaluation modules at: [www.ti.com/sc/device/bq24085](http://www.ti.com/sc/device/bq24085)

The bq24085 provides the most cost-effective charging solution for a single-cell Li-Ion. With integrated FET, current sensor and reverse leakage protection, it requires minimum external components. Its input voltage rating of 18 V and over-voltage protection allow use of low-cost unregulated AC adapters. The thermal regulation feature maximizes charge rate in any charging environment.

**Key Features**
- 18-V input rating
- 6.5-V or 10.5-V input over-voltage protection
- Integrated 750-mA FET and current sensor
- Programmable pre-charge and fast-charge safety timers
- Thermal regulation for charge control
- Reverse current, short-circuit and thermal protection
- Status indication: Charging/Done, Power Good
- Packaging: small 10-lead, 3-mm x 3-mm QFN
### USB Chargers

<table>
<thead>
<tr>
<th>Device</th>
<th>Topology</th>
<th>Max $V_{IN}$ (V)</th>
<th>Max current (A)</th>
<th>Input current limiting (mA)</th>
<th>Notes</th>
<th>Packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq24150</td>
<td>switching</td>
<td>20</td>
<td>1.2</td>
<td>USB &amp; adapter: 100/500/800 or no limit</td>
<td>See page 8</td>
<td>2 x 2 WCSP-16</td>
</tr>
<tr>
<td>bq2402x</td>
<td>linear</td>
<td>7</td>
<td>1</td>
<td>USB only: 100/500</td>
<td>See page 6</td>
<td>SON 3 x 3-10</td>
</tr>
<tr>
<td>bq2407x</td>
<td>linear</td>
<td>28</td>
<td>2</td>
<td>USB:100/500; adapter: 200 mA-2 A</td>
<td>See page 5</td>
<td>SON 3 x 3-16</td>
</tr>
<tr>
<td>bq2403x</td>
<td>linear</td>
<td>18</td>
<td>2</td>
<td>USB only: 100/500</td>
<td>See page 5</td>
<td>SON 3.5 x 4.5-20</td>
</tr>
</tbody>
</table>

### Linear Chargers

<table>
<thead>
<tr>
<th>Device</th>
<th># Inputs</th>
<th>Max $V_{IN}$ (V)</th>
<th>Max current (A)</th>
<th>Timer (hrs.)</th>
<th>OVP (V)</th>
<th>Functions</th>
<th>Vbat (V)</th>
<th>Packaging (SON)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq24085</td>
<td>single</td>
<td>18</td>
<td>0.75</td>
<td>* 3-10</td>
<td>6.5</td>
<td>/PG, /CE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24086</td>
<td>single</td>
<td>18</td>
<td>0.75</td>
<td>* 3-10</td>
<td>6.5</td>
<td>/PG, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24087</td>
<td>single</td>
<td>18</td>
<td>0.75</td>
<td>* 3-10</td>
<td>6.5</td>
<td>/TE, /CE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24088</td>
<td>single</td>
<td>18</td>
<td>0.75</td>
<td>* 3-10</td>
<td>10.5</td>
<td>/PG, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24080</td>
<td>single</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>n/a</td>
<td>/PG, /CE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24081</td>
<td>single</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>n/a</td>
<td>/TE, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24083</td>
<td>single</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>n/a</td>
<td>/PG, /CE</td>
<td>4.2 or 4.06</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24010</td>
<td>single</td>
<td>18</td>
<td>1</td>
<td>6</td>
<td>n/a</td>
<td>/PG, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24012</td>
<td>single</td>
<td>18</td>
<td>1</td>
<td>6</td>
<td>n/a</td>
<td>/PG, /CE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24013</td>
<td>single</td>
<td>18</td>
<td>1</td>
<td>6</td>
<td>n/a</td>
<td>/CE, /TTE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24014</td>
<td>single</td>
<td>18</td>
<td>1</td>
<td>6</td>
<td>n/a</td>
<td>/CE, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24018</td>
<td>single</td>
<td>18</td>
<td>1</td>
<td>6</td>
<td>n/a</td>
<td>/CE, /TTE</td>
<td>4.36</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24060</td>
<td>single</td>
<td>18</td>
<td>1</td>
<td>* 3-10</td>
<td>6.5</td>
<td>/PG, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24061</td>
<td>single</td>
<td>18</td>
<td>1</td>
<td>* 3-10</td>
<td>6.5</td>
<td>/PG, /CE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24064</td>
<td>single</td>
<td>18</td>
<td>1</td>
<td>* 3-10</td>
<td>10.5</td>
<td>/PG, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24020</td>
<td>dual</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>n/a</td>
<td>/CE, /TTE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24022</td>
<td>dual</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>n/a</td>
<td>/PG, /CE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24023</td>
<td>dual</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>n/a</td>
<td>/CE, /TTE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24024</td>
<td>dual</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>n/a</td>
<td>/TTE, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24025</td>
<td>dual</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>n/a</td>
<td>/CE, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24026</td>
<td>dual</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>n/a</td>
<td>/TE, TS</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
<tr>
<td>bq24027</td>
<td>dual</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>n/a</td>
<td>/PG, /CE</td>
<td>4.2</td>
<td>3 x 3-10</td>
</tr>
</tbody>
</table>

*Programmable by resistor*
Synchronous switch-mode charger with integrated FETs and USB OTG support

**bq24150**

Get samples, datasheets and evaluation modules at: [www.ti.com/sc/device/bq24150](http://www.ti.com/sc/device/bq24150)

The bq24150 offers the smallest solution size for single-cell Li-Ion applications. The 3-MHz PWM controller can work with ultra-small inductors. The IC with internal-power FETs and compensation network comes in a 2-mm x 2-mm WCSP package. Its high efficiency, input over-voltage protection, input current limiting and integrated boost converter—which provides USB On-the-Go output—make it ideal for USB applications.

**Key Features**
- Synchronous 3-MHz PWM controller
- Integrated power FETs for up to 1.2-A charge rate
- Integrated current sensing and compensation
- Maximum input voltage: 20-V with 6-V OVP
- Safety timer with reset control
- 0.8-µA max charge current from USB
- Input current limiting for both USB and adapter
- USB OTG support
- High-speed (3.4 MHz) I²C interface
- Short-circuit, over-voltage and thermal protection
- Packaging: 16-pin, 2-mm x 2-mm WCSP

**Benefits**
- Maximum battery charging performance and design flexibility in USB powered applications
- Significantly improves charge time
- Minimizes heat dissipation when charging
- Cuts board space in half
- Can achieve high peak-efficiency of up to 92%, while supporting a USB battery charging current up to 900 mA
- Features a reverse boost USB OTG mode that generates a voltage supply to power accessories
- USB-friendly boot-up sequence allows the charge IC to boot autonomously, which helps replenish deeply discharged batteries

**Applications**
- Smart phones
- Portable media players
- Portable consumer electronics

---

**bq24150 Selection Table**

<table>
<thead>
<tr>
<th>Device</th>
<th>Max ( V_{IN} ) (V)</th>
<th>Max current (A)</th>
<th>Input current limiting</th>
<th>OVP (V)</th>
<th>Charge voltage (V)</th>
<th>Charge term.</th>
<th>Package</th>
<th>Power up behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq24150</td>
<td>20</td>
<td>1.2</td>
<td>100/500/800 mA or no limit, set by I²C or OTG pin</td>
<td>6</td>
<td>Prog. by I²C, 3.5 - 4.42 V</td>
<td>Host-controlled through I²C</td>
<td>2 x 2 WCSP-16</td>
<td>Battery detect, automatically initiates charging if battery present</td>
</tr>
<tr>
<td>bq24151</td>
<td>20</td>
<td>1.2</td>
<td>100/500/800 mA or no limit, set by I²C or OTG pin</td>
<td>6</td>
<td>Prog. by I²C, 3.5 - 4.42 V</td>
<td>Host-controlled through I²C</td>
<td>2 x 2 WCSP-16</td>
<td>Does not automatically initiate charging</td>
</tr>
<tr>
<td>bq24152</td>
<td>20</td>
<td>1.2</td>
<td>100/500/800 mA or no limit, set by I²C or OTG pin</td>
<td>6</td>
<td>Prog. by I²C, 3.5 - 4.42 V</td>
<td>Host-controlled through I²C</td>
<td>2 x 2 WCSP-16</td>
<td>No battery detect, initiate charging anyway</td>
</tr>
</tbody>
</table>
1.1-MHz synchronous switch-mode charger with FETs for one- to three-cell Li-Ion

**bq24105**

Get samples, datasheets, app reports and evaluation modules at: [www.ti.com/sc/device/bq24105](http://www.ti.com/sc/device/bq24105)

The bq24105 is ideal for a wide variety of applications that use up to a 3-cell Li-Ion battery. It can accept up to 20-V input voltage. With integrated 2-A FETs and internal loop compensation, the bq24105 offers minimum solution size for space-limited portable applications. The synchronous power conversion offers high efficiency to applications that work with high-input voltage or high-charge rate.

**Key Features**
- Synchronous 1.1-MHz PWM controller
- Integrated power FETs for up to 2-A charge rate
- Integrated loop compensation
- Maximum input voltage: 20 V
- Battery pack temperature sensing
- Packaging: 20-pin, 3.5-mm x 4.5-mm QFN
- Low EMI versions available: bq2412x

![bq24105 Circuit Diagram](image)

**bq24105 Selection Table**

<table>
<thead>
<tr>
<th>Device</th>
<th>Max (V_{IN}) (V)</th>
<th>Max current (A)</th>
<th>Charge voltage (A)</th>
<th>Charge termination</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq24100</td>
<td>18</td>
<td>2</td>
<td>4.2</td>
<td>Standalone</td>
<td>3.5 x 4.5 QFN-20</td>
</tr>
<tr>
<td>bq24103</td>
<td>18</td>
<td>2</td>
<td>4.2 or 8.4</td>
<td>Standalone</td>
<td>3.5 x 4.5 QFN-20</td>
</tr>
<tr>
<td>bq24105</td>
<td>18</td>
<td>2</td>
<td>Prog. by resistor, 2.1 – 15.5</td>
<td>Standalone</td>
<td>3.5 x 4.5 QFN-20</td>
</tr>
<tr>
<td>bq24108</td>
<td>18</td>
<td>2</td>
<td>4.2</td>
<td>Standalone</td>
<td>3.5 x 4.5 QFN-20</td>
</tr>
<tr>
<td>bq24113</td>
<td>18</td>
<td>2</td>
<td>4.2 or 8.4</td>
<td>Host-controlled through /CE pin</td>
<td>3.5 x 4.5 QFN-20</td>
</tr>
<tr>
<td>bq24115</td>
<td>18</td>
<td>2</td>
<td>Prog. by resistor, 2.1 – 15.5</td>
<td>Host-controlled through /CE pin</td>
<td>3.5 x 4.5 QFN-20</td>
</tr>
</tbody>
</table>

---

Single-chip Li-Ion charger and DC/DC converter IC

**bq25012**

Get samples, datasheets, app reports and evaluation modules at: [www.ti.com/sc/device/bq25012](http://www.ti.com/sc/device/bq25012)

The bq25012 integrates a dual-input charger and a low-power, high-efficiency DC/DC converter in a single chip. The linear charger has internal-power FET and current sensor for up to 500 mA. The DC/DC converter operates at a synchronized 1-MHz switching frequency, allowing for the use of small inductors.

**Key Features**
- Li-ion charger and synchronous DC/DC converter in a single chip
- Autonomous power source selection between USB and AC adapter
- Internal USB current limiting at 100 mA or 500 mA
- DC/DC converter maximum load current 150 mA
- Optional forced PWM mode
- Packaging: small 20-lead, 3.5-mm x 4.5-mm QFN

![bq25012 Circuit Diagram](image)

**bq25012 Selection Table**

<table>
<thead>
<tr>
<th>Device</th>
<th>Buck converter current (mA)</th>
<th>Buck converter output (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq25010</td>
<td>150</td>
<td>Adjustable</td>
</tr>
<tr>
<td>bq25012</td>
<td>150</td>
<td>1.8</td>
</tr>
<tr>
<td>bq25015</td>
<td>300</td>
<td>Adjustable</td>
</tr>
<tr>
<td>bq25017</td>
<td>300</td>
<td>1.8</td>
</tr>
</tbody>
</table>
The bq24751A is a high-efficiency, synchronous battery charge controller with integrated compensation and system power selector, offering the lowest component count for notebook computers and industrial applications. Ratio-metric charge current and voltage programming facilitate very high regulation accuracies, and can be either hardwired with resistors or programmed by the system microcontroller using a DAC or with GPIOs.

Key Features
- Fixed 300-kHz, NMOS-NMOS synchronous buck with 6-V gate drive
- 30-ns minimum driver dead-time and 99.5% maximum duty cycle
- ±0.5% charge voltage regulation accuracy
- ±4% charge and adapter current regulation accuracy at 4 A
- ±2% 20x input current sense amplifier accuracy
- Input voltage range: 5 V-28 V, charging a two-to four-cell Li-Ion
- Packaging: 28-lead, 5-mm x 5-mm QFN

Switch-Mode Charge Controllers

<table>
<thead>
<tr>
<th>Device</th>
<th>Max $V_{IN}$ (V)</th>
<th>Power selector</th>
<th>AC over power protection</th>
<th>Temp sense</th>
<th>Input OVP</th>
<th>DPM active indicator</th>
<th>Compensation</th>
<th>Standalone</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq24705</td>
<td>28</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>—</td>
<td>✓</td>
<td>Internal</td>
<td>No</td>
<td>4 x 4 QFN-24</td>
</tr>
<tr>
<td>bq24750</td>
<td>28</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>—</td>
<td>✓</td>
<td>Internal</td>
<td>No</td>
<td>5 x 5 QFN-28</td>
</tr>
<tr>
<td>bq24751A</td>
<td>28</td>
<td>✓</td>
<td>✓</td>
<td>—</td>
<td>✓</td>
<td>—</td>
<td>Internal</td>
<td>No</td>
<td>5 x 5 QFN-28</td>
</tr>
<tr>
<td>bq24740</td>
<td>28</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>✓</td>
<td>Internal</td>
<td>No</td>
<td>5 x 5 QFN-28</td>
</tr>
<tr>
<td>bq2954</td>
<td>7</td>
<td>—</td>
<td>—</td>
<td>✓</td>
<td>—</td>
<td>—</td>
<td>External</td>
<td>Yes</td>
<td>PDIP or SOIC-16</td>
</tr>
<tr>
<td>bq2000</td>
<td>7</td>
<td>—</td>
<td>✓</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>N/A</td>
<td>Yes</td>
<td>PDIP, TSSOP or SOIC-8</td>
</tr>
</tbody>
</table>
The bq24745 is a high-efficiency, synchronous battery charger with an integrated input-current comparator, offering low component count for space-constrained, multi-chemistry battery-charging applications. Input-current, charge-current and charge-voltage DACs can be easily programmed by the system power-management microcontroller using SMBus. The bq24745 charges one to four-series Li+ cells and is available in a 28-pin, 5-mm x 5-mm QFN package.

Key Features
- NMOS-NMOS synchronous buck converter with fixed 300-KHz frequency and >95% efficiency
- 0.5% charge-voltage regulation accuracy
- 3% charge-current regulation accuracy
- 3% input-current limiting accuracy
- 2% input-current sense amplifier accuracy
- Dynamic power management
- Input current comparator
- Input over-voltage protection
- Simplified SMBus control
  - Charge voltage (1.024 V – 19.2 V)
  - Charge current (128 mA – 8.064 A)
  - Adapter current (256 mA – 11.004 A)
- Packaging: 28-pin, 5-mm x 5-mm QFN
Simple NiMH/NiCd charger

**bq2002**


The bq2002 controls a current-limited or constant-current supply to build a cost-effective charger for NiMH or NiCd batteries. It integrates fast charge with optional top-off and pulse-trickle charge. Fast charge is terminated by any of the five factors: peak voltage detection, negative delta voltage, maximum voltage, maximum temperature and maximum time.

**Key Features**
- Spins available for $\Delta T/\Delta t$, $-\Delta V$ and PVD charge termination
- Direct LED output displays charge status
- Internal band-gap voltage reference
- Optional top-off charge
- Selectable pulse trickle charge rates
- Packaging: 8-pin DIP or SOIC

**Battery charger design factors**

**Battery chemistry** — Each battery chemistry has unique requirements for its charge algorithm, which is critical for maximizing its capacity, cycle life and safety.

**Control topology** — A simple linear topology works well in applications with low-power (e.g., one- or two-cell Li-Ion) battery packs that are charged at less than 1 A. A switch-mode topology is ideally suited for fast charging from USB ports or for large battery packs that require charge rates > 1 A. The switch-mode conversion minimizes heat generation during charging.

**Input voltage** — Wide input-voltage range of the IC and input over-voltage protection offer maximum safety and allow use of low-cost unregulated wall adapters.

<table>
<thead>
<tr>
<th>NiMH/NiCd Chargers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device</strong></td>
</tr>
<tr>
<td>bq2002</td>
</tr>
<tr>
<td>bq2000</td>
</tr>
<tr>
<td>bq2004</td>
</tr>
</tbody>
</table>
Battery chargers application reports

To access any of the following application reports, type the URL www-s.ti.com/sc/techlit/litnumber and replace litnumber with the number in the Lit Number column.

For a complete list of battery charger application reports, visit ti.com/batterycharge and click on application notes.

<table>
<thead>
<tr>
<th>APP REPORT</th>
<th>REPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Battery Pack Charger</td>
<td>slua462</td>
</tr>
<tr>
<td>Battery Charger Front-End IC Improves Charging System Safety</td>
<td>slyt294</td>
</tr>
<tr>
<td>Host-side Gas-Gauge-System Design Considerations for Single-Cell Handheld Apps</td>
<td>slyt285</td>
</tr>
<tr>
<td>Extending Single-Input Charger to Dual-Input Applications</td>
<td>slua437</td>
</tr>
<tr>
<td>Enhanced-Safety, Linear Li-Ion Battery Charger with Thermal Regulation and Input OV</td>
<td>slyt269</td>
</tr>
<tr>
<td>Input Filter Design for Portable Power Management System</td>
<td>slua413</td>
</tr>
<tr>
<td>Drive High-Current LEDs</td>
<td>siva265</td>
</tr>
<tr>
<td>Dynamic PowerPath™ Management and Dynamic Power Management</td>
<td>slua400</td>
</tr>
<tr>
<td>Selecting the Correct IC for Power-Supply Applications</td>
<td>slyt259</td>
</tr>
<tr>
<td>Dynamic PowerPath Management Simplifies Battery Charging from Solar Panels</td>
<td>slua394</td>
</tr>
<tr>
<td>Battery Charger Termination Issues With System Load Applied Across Battery (Rev. A)</td>
<td>siva166a</td>
</tr>
<tr>
<td>Li-Ion Switching Charger Integrates Power FETs</td>
<td>slyt224</td>
</tr>
<tr>
<td>Power Dissipation Analysis and Circuit Design for Sync Switching Battery Charger</td>
<td>slua345</td>
</tr>
<tr>
<td>Battery Charger Termination Issues With System Load Applied Across Battery</td>
<td>siva166</td>
</tr>
</tbody>
</table>

Online training

Visit www.ti.com/training, select ‘Analog’ and look for the Power Management heading for the following courses of online training.

- Battery Capacity Monitoring Design Considerations for Li-Ion Batteries
- Battery Charging System Practical Design Considerations
- Improving Power Supply Efficiency - The Global Perspective
- Li-Ion Battery Fundamentals and Battery Pack Electronics Design
- Practical Considerations in Troubleshooting & Optimizing Power Supply Control
- Safety Considerations in Power Supply Design
- Green-Mode Power by the Milli-Watt
Battery charger evaluation modules (EVMs)

TI’s battery-charger evaluation modules allow you to determine how a specific product will operate in your system, so you can deliver winning designs to market faster. To order any of the following evaluation modules, visit the product folder or contact your local TI Product Information Center or your local distributor.

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq24314 evaluation module</td>
<td>BQ24314EVM</td>
<td>$49.00</td>
</tr>
<tr>
<td>bq24020 bq TINY-II evaluation module</td>
<td>BQ24020EVM</td>
<td>$99.00</td>
</tr>
<tr>
<td>bq24105 evaluation module</td>
<td>BQ24105 EVM</td>
<td>$49.00</td>
</tr>
<tr>
<td>bq24751A evaluation module</td>
<td>BQ24751AeVM</td>
<td>$149.00</td>
</tr>
<tr>
<td>bq2002 evaluation module for NiCd/NiMH, linear with -dv or peak voltage detect</td>
<td>DV2002LZ</td>
<td>$99.00</td>
</tr>
<tr>
<td>bq24085 battery charger evaluation module</td>
<td>BQ24085EVM</td>
<td>$49.00</td>
</tr>
<tr>
<td>bq24745 evaluation module</td>
<td>BQ24745EVM</td>
<td>$99.00</td>
</tr>
<tr>
<td>bq24105 evaluation module</td>
<td>BQ24105EVM</td>
<td>$49.00</td>
</tr>
<tr>
<td>bq25010 evaluation module</td>
<td>bq25010eVM</td>
<td>$49.00</td>
</tr>
</tbody>
</table>

Stay up-to-date on the latest high-performance analog ICs

Subscribe to TI’s monthly Analog Connection eNewsletter!

To make it easier for you to learn about new analog products from TI as soon as they are available, we would like to extend you an invitation to receive our monthly Analog Connection eNewsletter. The Analog Connection eNewsletter provides updates on new analog products from TI, including amplifiers, data converters, power management and interface ICs.

Visit [www.ti.com/analogenewsletter](http://www.ti.com/analogenewsletter) to subscribe!
TI Worldwide Technical Support

Internet
TI Semiconductor Product Information Center Home Page
support.ti.com

TI Semiconductor KnowledgeBase Home Page
support.ti.com/sc/knowledgebase

Product Information Centers

Americas
Phone +1(972) 644-5580
Fax +1(972) 927-6377
Internet/Email support.ti.com/sc/pic/americas.htm

Europe, Middle East, and Africa
Phone
European Free Call 00800-ASK-TEXAS (00800 275 83927)
International +49 (0) 8161 80 2121
Russian Support +7 (4) 95 98 10 701
Fax + (49) (0) 8161 80 2045
Internet support.ti.com/sc/pic/euro.htm

Asia

Phone
International +91-80-41381665
Domestic Toll-Free Number
Australia 1-800-999-084
China 800-820-8682
Hong Kong 800-96-5941
India 1-800-425-7888
Indonesia 001-803-8861-1006
Korea 080-551-2804
Malaysia 1-800-80-3973
New Zealand 0800-446-934
Philippines 1-800-765-7404
Singapore 800-886-1028
Taiwan 0800-006800
Thailand 001-800-886-0010
Fax +886-2-2378-6808
Email tiasia@ti.com or ti-china@ti.com
Internet support.ti.com/sc/pic/asia.htm

Japan
Fax International +81-3-3344-5317
Domestic 0120-81-0036
Internet/Email International support.ti.com/sc/pic/japan.htm
Domestic www.ti.co.jp/pic

Important Notice: The products and services of Texas Instruments Incorporated and its subsidiaries described herein are sold subject to TI’s standard terms and conditions of sale. Customers are advised to obtain the most current and complete information about TI products and services before placing orders. TI assumes no liability for applications assistance, customer’s applications or product designs, software performance, or infringement of patents. The publication of information regarding any other company’s products or services does not constitute TI’s approval, warranty or endorsement thereof.

Safe Harbor Statement: This publication may contain forward-looking statements that involve a number of risks and uncertainties. These “forward-looking statements” are intended to qualify for the safe harbor from liability established by the Private Securities Litigation Reform Act of 1995. These forward-looking statements generally can be identified by phrases such as TI or its management “believes,” “expects,” “anticipates,” “foresees,” “forecasts,” “estimates” or other words or phrases of similar import. Similarly, such statements herein that describe the company’s products, business strategy, outlook, objectives, plans, intentions or goals also are forward-looking statements. All such forward-looking statements are subject to certain risks and uncertainties that could cause actual results to differ materially from those in forward-looking statements. Please refer to TI’s most recent Form 10-K for more information on the risks and uncertainties that could materially affect future results of operations. We disclaim any intention or obligation to update any forward-looking statements as a result of developments occurring after the date of this publication.

© 2008 Texas Instruments Incorporated
Printed in U.S.A. by (Printer, City, State)
Printed on recycled paper

The platform bar, PowerPath and PurePath are trademarks of Texas Instruments.
All other trademarks are the property of their respective owners.
TI’s battery chargers selection tool finds the right product for your design

With the battery chargers selection tool, answer just a few questions to quickly narrow your search for the products for your design. The tool features detailed decision trees that will lead you to recommended products most suited to your design, based on:

- Battery chemistry (Li-Ion, Li-Pol, NiMH, NiCd, Lead Acid)
- Number of cells in a series
- Topology needed (linear or switch-mode)

Get started today! Visit [www.ti.com/batterycharger](http://www.ti.com/batterycharger)