

## EnerChip™ CC Li-Ion Battery Charger with Integrated Energy Storage

### Features

- Power Manager with Charge Control
- Capable of Charging Li-Ion Coin Cells
- Integrated Thin Film Energy Storage
- Built-in Energy Storage Protection
- Temperature Compensated Charge Voltage
- Operates Over a Wide Power Supply Range
- Low Standby Power and Cutoff Current
- Integrated Energy Storage: Low Self-Discharge and Thousands of Recharge Cycles Available
- Eco-Friendly, RoHS Compliant
- Surface Mount - Lead-Free Reflow Tolerant

### Applications

- **Standby supply** for non-volatile SRAM, real-time clocks, controllers, and supply supervisors.
- **Wireless sensors and RFID tags** and other powered, low duty cycle applications.
- **Localized power source** to keep microcontrollers and other devices alert in standby mode.
- **Power bridging** to provide back-up power to the system during exchange of main batteries.
- **Consumer appliances** that have real-time clocks.
- **Business and industrial systems** such as network routers, point-of-sale terminals, test equipment, printers, and industrial controllers.
- **Energy Harvesting** by coupling the EnerChip with energy transducers such as solar panels.



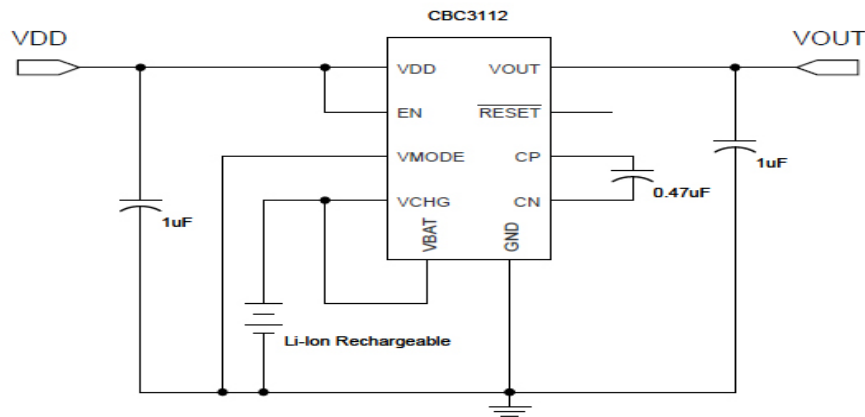
*EnerChip CC: Battery Management with Integrated Energy Storage*

### Description

The EnerChip CC product family consists of devices having battery management circuitry and rechargeable solid state energy storage - the EnerChip - integrated in a single low profile, surface mount package.

Each device functions as a backup power source and supervisor for low power applications and has the added capability to manage the charging and discharge cutoff of Li-ion batteries such as LiR coin cells. The EnerChip CC can deliver up to 1mA charging current at 4.1V. It can charge up to 10 additional EnerChips connected in parallel.

During normal operation, the EnerChip CC derives power from the main supply (2.5V to 5.5V) that activates the internal charge pump, producing 4.1V on the VCHG pin. This voltage not only charges the internal EnerChips, but can also serve as a charging source for small rechargeable Li-ion cells. The EnerChip CC also has a discharge cutoff circuit (3.0V typical) that prevents the battery from being discharged too deeply - a condition that can destroy Li-ion cells. When the primary power supply drops below a user-defined threshold voltage, the EnerChip CC monitors this event, routes the battery voltage to VOUT, and signals the event by driving RESET/ low.



**Figure 1: Application Circuit Showing Connection of External Li-Ion Rechargeable Cell.**

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## EnerChip CC Operation

The EnerChip CC schematic is shown in Figure 2. The device is typically configured to operate from a main supply such as wall power or a large battery, which is applied to VDD and routed to VOUT directly through a p-channel pass FET to power the system components. When that supply voltage drops below the threshold voltage as determined by the VMODE comparator setting, the EnerChip CC redirects power to VOUT from the internal EnerChip. The EnerChip gets charged whenever the charge pump is active. The charge pump can be disabled by external control of the ENABLE line and will also be disabled anytime VDD drops below 2.5V.

VMODE is an analog input ranging from 0V to VDD. The ENABLE pin is a digital input that turns off the charge pump when low. Depending on the operating mode, VOUT is supplied from VDD, the integrated EnerChip, or an external battery attached to VCHG. RESET/ is a digital output that, when low, indicates VOUT is being sourced by the integrated EnerChip or external battery and not the main power supply connected to VDD.

CFLY is the flying capacitor in the voltage doubler circuit. The value of CFLY can be changed if the output impedance of the EnerChip CC needs to be modified - for example, when it is necessary to increase the charge pump drive current to charge a Li-ion battery attached to VCHG. The output impedance is dictated by  $1/fC$ , where  $f$  is the frequency of oscillation (typically 100kHz) and  $C$  is the capacitor value (typically 0.1 $\mu$ F). See DS-72-03 *EnerChip CC CBC3150 Datasheet* or DS-72-04 *EnerChip CC CBC3112 Datasheet* for guidelines on sizing the charge pump capacitor for your application.

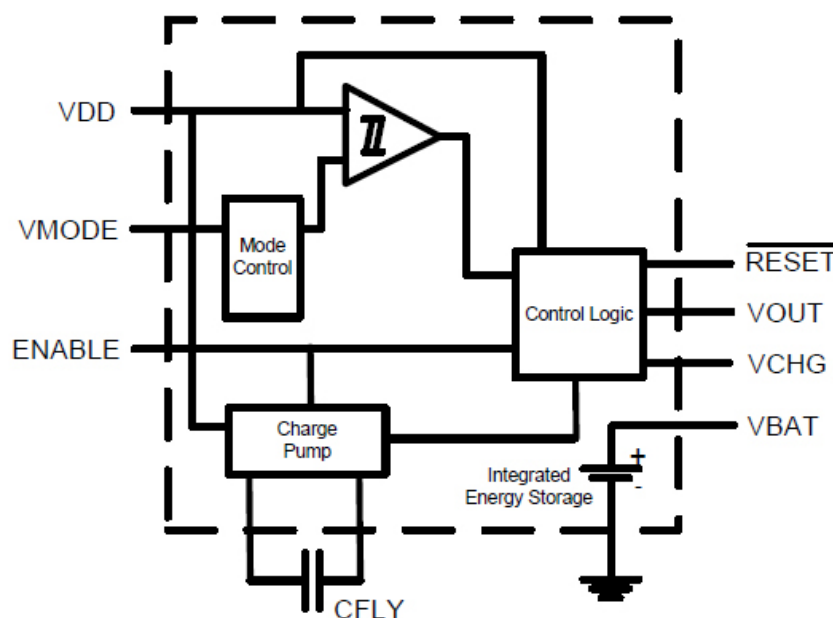


Figure 2: EnerChip CC Internal Block Diagram

## Electrical Properties

EnerChip backup output voltage:	3.3V
Energy storage capacity (typical):	12 $\mu$ Ah to 50 $\mu$ Ah
Recharge time to 80%:	10 minutes
Charge/discharge cycles:	>5000 to 10% discharge

## Physical Properties

Package:	20-pin dual flat no-lead (DFN)
Operating temperature:	-20 °C to +70 °C
Storage temperature:	-40 °C to +125 °C

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## Using Additional EnerChips and External Batteries

The EnerChip CC is designed to permit attachment of additional EnerChips or small rechargeable Li-ion batteries that can be charged with a constant voltage of 4.1V. In cases where the internal EnerChip has insufficient energy to power the system for extended periods, an external rechargeable Li-ion cell can be attached to the VCHG pin. VCHG delivers up to 1mA at 4.1V and can therefore charge a small, fully depleted Li-ion coin cell in a matter of several hours. This configuration allows the designer to achieve longer system run-time than what the EnerChips can provide, while avoiding the relative bulk associated with non-rechargeable cells.

As configured in the schematic of Figure 1, the circuit will operate from the external Li-ion battery (and internal EnerChip in parallel) whenever VDD is below 3.0V (typical). The Li-ion cell and EnerChip will be charging whenever ENABLE is at a logical high and VDD is above 2.5V. To isolate the Enerchip from the Li-ion cell, simply do not connect VCHG to VBAT. VBAT is the positive terminal of the EnerChip within the EnerChip CC package.

The battery discharge cutoff voltage is fixed at 3.0V +/- 0.25V. To ensure the cutoff circuit is applied to the Li-ion cell, the system load must be powered from VOUT and not directly from the Li-ion cell. VOUT, when sourced from the EnerChip or external battery, is protected internally by a silicon diode. Consequently, the voltage at VOUT will be approximately 0.6V below the battery terminal voltage. If the cutoff circuit is not needed, the output can be derived directly from the Li-ion cell, which is tied to VCHG. Charging voltage on VCHG will be disconnected whenever the charge pump is inactive - either by driving the ENABLE pin low, or when the supply voltage on VDD drops below 2.5V.

Examples of rechargeable batteries supported by EnerChip CC are the LiR-type coin cells, including LiR-1220 (~8mAh) and LiR-2032 (~40mAh). The charging rate for such external cells will be a function of available input power, to a maximum of 1mA as limited by the EnerChip CC charge pump drive current. Li-ion cells rated at a 4.2V charging voltage will be charged to approximately 90% of their rated capacity when charged to 4.1V by the EnerChip CC. The 10% reduction in discharge capacity will be offset by an increase in the charge/discharge cycle life. The charging voltage on VCHG is temperature compensated, thus ensuring longer service life of the EnerChips and external Li-ion batteries by lowering the charging voltage at elevated temperatures.

See *DS-72-03 EnerChip CC CBC3150 Datasheet* or *DS-72-04 EnerChip CC CBC3112 Datasheet* for complete specifications of the respective Enerchip CC.