LIBRARY · REFERENCE GUIDE

BATTERY CHARGING

A lithium cell charges in two phases, constant current then constant voltage. What CC/CV means, charge current and termination, and why a single-cell charger IC does it for you.

ONE THOUSAND DRONES ENGINEERING TEAM · VERIFIED 2026-07

A lithium cell charges in two phases: constant current until it nears full, then constant voltage while the current tapers off. A single-cell charger chip runs that profile for you, and using one is the only safe way to charge a lithium cell. Do not improvise it.

CONSTANT CURRENT, THEN CONSTANT VOLTAGE

In the first phase the charger pushes a fixed current into the cell and the voltage climbs. Once the cell reaches its 4.2 V ceiling, the charger holds that voltage steady and lets the current fall on its own as the cell fills. This constant-current then constant-voltage profile, CC/CV, is how every lithium cell is charged.

CONSTANT CURRENT LIFTS THE VOLTAGE TO 4.2 V; CONSTANT VOLTAGE THEN HOLDS WHILE THE CURRENT TAPERS.

CHARGE CURRENT AND TERMINATION

The charge current is set as a C-rate, often 0.5 C to 1 C for a standard cell, and the specific cell's datasheet is the authority. Charging ends not at a fixed time but when the constant-voltage current falls below a small termination threshold, a few percent of the cell's rated capacity, which signals the cell is full.

$$t_{cc} = Q / I_{charge} \text{ (roughly)}$$

A SINGLE-CELL CHARGER IC

A dedicated charger chip, such as the Microchip MCP73831 or the widely used TP4056, contains the whole CC/CV state machine, the 4.2 V reference, and the termination logic in one part. You set the charge current with a single resistor and feed the chip 5 V from USB. It handles the rest, safely, which is exactly why you never charge a lithium cell from a bare bench supply.

> **THE CHARGE CURRENT IS SET BY A RESISTOR, AND THE DATASHEET SETS ITS VALUE**
> A single-cell charger IC picks its charge current from one programming resistor. Fit the wrong value and you can push a cell past its rated charge current. Read the specific charger's datasheet, compute the resistor for a safe C-rate for your cell, and check it before you apply power.

DEEP DIVE · THE PRE-CHARGE PHASE FOR A DEEPLY DRAINED CELL

A cell drained well below empty is fragile, and slamming full current into it is dangerous. A good charger IC starts with a third, quieter phase: pre-charge, a small trickle current that gently lifts a deeply discharged cell back above a safe threshold before the full constant-current phase begins. It is why a quality charger revives a flat cell safely instead of stressing it, and one more reason to reach for a real charger chip rather than a bench supply.

- Battery University. BU-409: Charging Lithium-ion (CC/CV, termination current). batteryuniversity.com
- Microchip. MCP73831 single-cell Li-ion/LiPo charge management controller (programmable charge current). microchip.com

CHECKPOINT

1. What are the two main phases of lithium charging?

a. Constant voltage, then constant current

b. Constant current, then constant voltage

c. Trickle charge, then fast charge

ANSWER · B

CC lifts the voltage to the ceiling; CV then holds it while the current tapers.

2. Charging ends when what happens in the constant-voltage phase?

a. The current falls below a small termination threshold

b. A fixed timer runs out

c. The cell reaches 5 V

ANSWER · A

Termination is by current, a few percent of the cell's rating, not by a clock.

3. Why use a dedicated single-cell charger IC?

a. It charges from any voltage with no limit

b. It makes the cell hold more than its capacity

c. It runs the whole CC/CV profile and termination safely

ANSWER · C

The chip carries the reference, the state machine, and the termination logic you must not improvise.

- Prerequisite: LiPo and Li-ion safety
- See it on a real board: the L2.01 battery power module
- Next: linear regulators (LDO)