1) Charge Controllers

a. Review of Pb-acid battery charging scheme

→ The charge phase is determined by measuring the battery voltage

① "Initial Boost Charge" → uses all available current
→ done to close to 100% "state Of Charge (SOC)"
→ up to ~14.4V

② "Absorption Charge" → at constant voltage and low current
→ up to ~14.1V ? (↓ decreasing current)

③ "Float charge" → to keep battery gently topped off
→ up to ~14.0V (Trickle charger)

④ "Equalization Charge" → for flooded (wet) 12V Pb-acid battery
→ gassing stirs up electrolyte and prevents acid stratification
→ up to 14.7V

b. Purpose of the Charge Controller

① Protects battery from overcharging when PV energy supply exceeds load energy demand

② Protects battery from over-discharging when load energy demand exceeds PV energy supply

③ Other system control functions, such as occasional equalization charging of flooded batteries

④ System operation display/logging functions

c. Charge Controller Challenges

① Determining SOC

→ Cannot do this by just measuring voltage

→ SOC depends on history too

ex: Run the battery for a while and the voltage drops. Disconnect it and the battery voltage will slowly recover without recharging

ex: Charge the battery and the voltage rises. Cease charging and the battery voltage will slowly fall back to a lower voltage

→ ∴ the charge controller must record battery history and make use of this information

② Hysteresis

→ want to minimize charging/use hysteresis

ex: Charge battery until voltages reaches a max value. Disconnect battery to prevent overcharging Without load, battery voltage starts to drop How low do you let the battery voltage drop before you begin charging?

ex: Disconnect load when battery voltage gets too low. Without recharging, battery voltage slowly increases. When do you reconnect the load?

→ Desire to minimize this hysteresis without under or overcharging or overdischarging the battery

d, Charge Controller Topologies

① simple charge controller

→ up to maybe 100 W

→ use with 12 V battery

→ 6 terminals : PV(2), Battery(2), Load (2)

→ low cost

→ PV home use

→ Show Fig 5.5 ✱

→ fuse protects in the case where the battery gets shorted

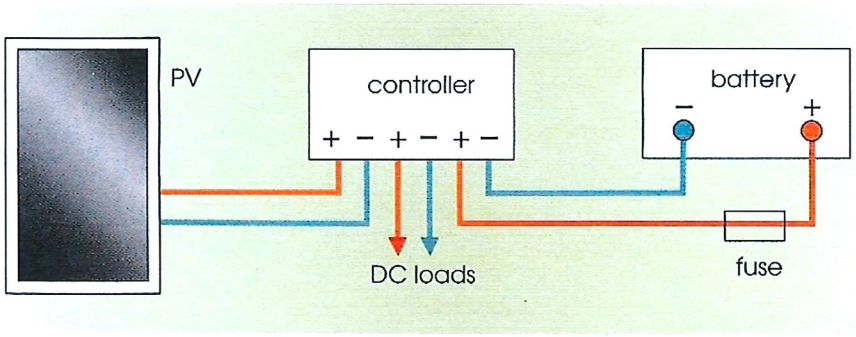

Figure 5.5 A simple scheme for a low-power solar home system (SHS).