Detailed Design

- Battery Charger

- Design of an Isolated Power Supply (Option-1):
  - 120V/60Hz ac input, 15V dc output, 30W, regulated power supply
  - Electrically isolated between input and output
  - Safe to use
  - Efficient
  - Reliable
  - Economical.....

ECE3031 Projects

- Design of a PV-Based Battery Charger (Option-2):
  - Charger for a 12V lead-acid battery (max. 2A charging current) from a widely-variable csuch as a solar panel
  - Non-isolated
  - Safe to use
  - Efficient
  - Reliable
  - Economical.....

Detailed Design

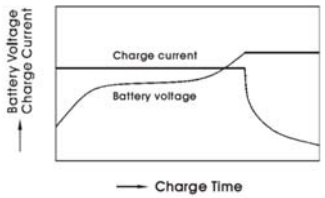
1. Design Requirements

- 12V lead-acid battery
- Maximum charging current 2A
- Optimum charging scheme (fast charging, maximizing battery capacity, maximizing battery life)
- Input 10V-28V DC
- Isolation not required
- Operating temperature

Detailed Design

2. Charging Scheme

- Constant voltage charging
  2.45V/cell for cycle use; 2.275V/cell for stand-by use
- Constant current charging
  0.1C-0.3C (10%-30% of rated capacity)
  overcharge may occur
- 2-stage constant voltage charging
  (recommended)

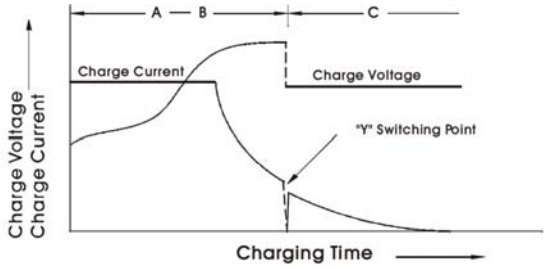


https://media.digikey.com/pdf/Data%20Sheets/B%20B%20Battery%20PDFs/VRLA_Man.pdf

Detailed Design

2. Charging Scheme

2-stage constant voltage charging with limited current



1. Voltage 2.45V/cell
   A. Limited current, e.g. around 0.3C (2.1A for 7Ah battery)
   B. Constant 2.45V/cell until current decreases to the switching point
2. Voltage 2.275V/cell (float/stand-by charging)

3. Charger IC Selection

Considerations:

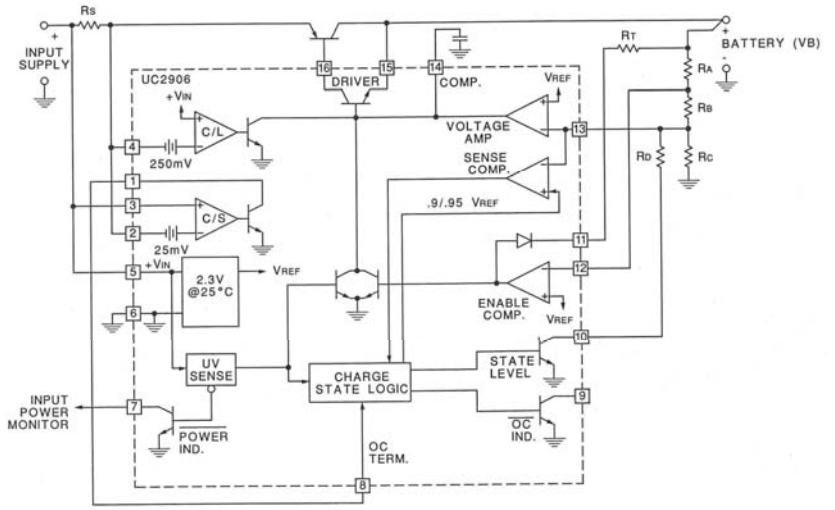
- Battery type (lead-acid)
- Voltage level (12V, 6 cell)
- Charging control (multi-stage charging)
- Availability on the market (digikey.ca)
- IC packaging/footprint (easy for soldering/connecting)

Selections:

- BQ24450 (SOIC packaging)
- UC2906/UC3906 (has DIP package UC2906N)

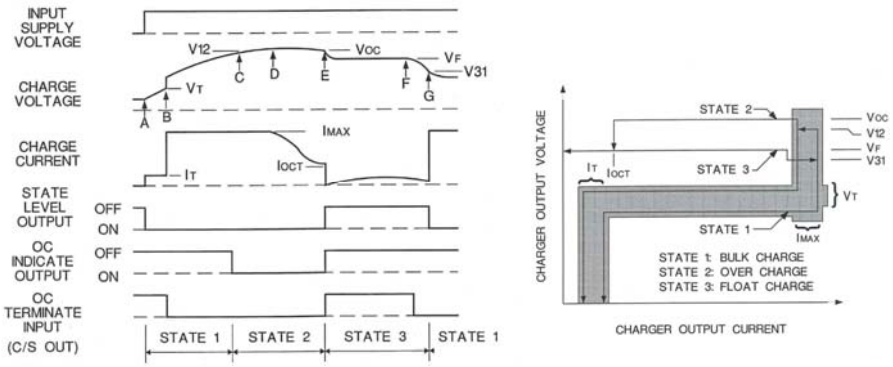
4. Charger IC UC2906

http://www.ti.com/lit/ds/symlink/uc2906.pdf

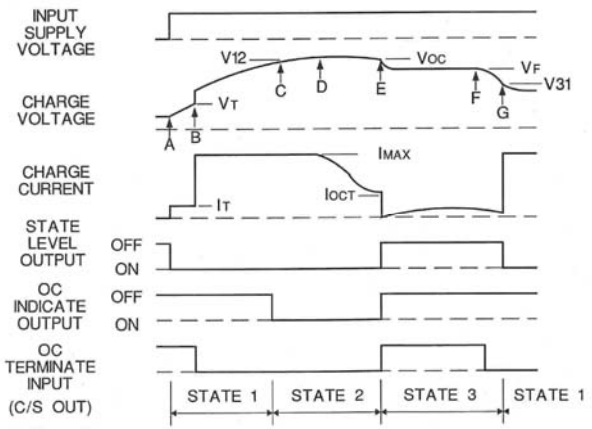


Typical circuit diagram for 2-stage float charger

4. Charger IC UC2906



4. Charger IC UC2906



V_F	2.275V/cell
V_{OC}	2.45V/cell
V_T	1.75V/cell
I_{MAX}	0.3C
I_T	<25mA

4. Charger IC UC2906

V_F 2.275V/cell
V_{OC} 2.45V/cell
V_T 1.75V/cell
I_{MAX} 0.3C
I_T <25mA

Design Procedure

1) Pick divider current, I_D. Recommended value is 50μA to 100μA.

2) $R_C = 2.3V / I_D$

3) $R_A + R_B = R_{SUM} = (V_F - 2.3V) / I_D$

4) $R_D = 2.3V \bullet R_{SUM} / (V_{OC} - V_F)$

5) $R_A = (R_{SUM} + R_X)(1 - 2.3V / V_T)$
WHERE: $R_X = R_C \bullet R_D / (R_C + R_D)$

6) $R_B = R_{SUM} - R_A$

7) $R_S = 0.25V / I_{MAX}$

8) $R_T = (V_{IN} - V_T - 2.5V) / I_T$

9) $I_{OCT} = \frac{I_{MAX}}{10}$

Note: $V_{12} = 0.95 V_{OC}$,
$V_{31} = 0.90 V_F$,

5. External Pass Transistor Selection

Considerations:

- Common-Emitter PNP or Darlington
- Voltage rating
- Current rating
- Minimum delta voltage
- Maximum power dissipation
- Thermal design