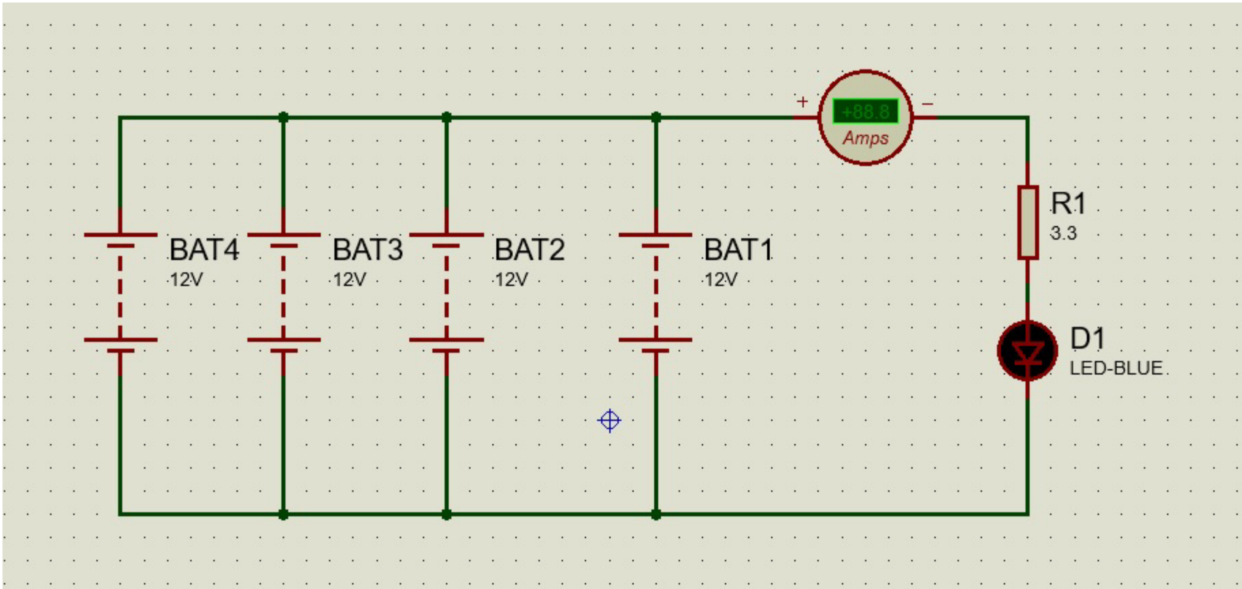
Task1.3 – Box of Shame



Given V = 12v, R = 3.3ohm

So I = V/R = 12/3.3 = 3.64A.

Given Battery of capacity = 5200mAh = 5.2Ah

Run time = 5.2/3.64 = 1.42857 hours.

Number of batteries required for 5 hours = 5/1.42857 = 3.5

We will need 4 batteries in parallel to give run time more than 5 hours.

Note:

Connecting Batteries in Parallel gives the same voltage of 1 battery but with Capacity = sum of capacities of each battery.

Battery Management System (BMS)

Battery management system (BMS) is technology dedicated to the oversight of a battery pack, which is an assembly of battery cells, electrically organized in a row x column matrix configuration to enable delivery of targeted range of voltage and current for a duration of time against expected load scenarios.

BMS topologies fall in three categories:

- Centralized: a single controller is connected to the battery cells through a multitude of wires
- Distributed: a BMS board is installed at each cell, with just a single communication cable between the battery and a controller
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Battery balancing and battery redistribution refer to techniques that improve the available capacity of a battery pack with multiple cells (usually in series) and increase each cell's longevity. A battery balancer or battery regulator is an electrical device in a battery pack that performs battery balancing. Balancers are often found in lithium-ion battery packs for laptop computers, electrical vehicles.

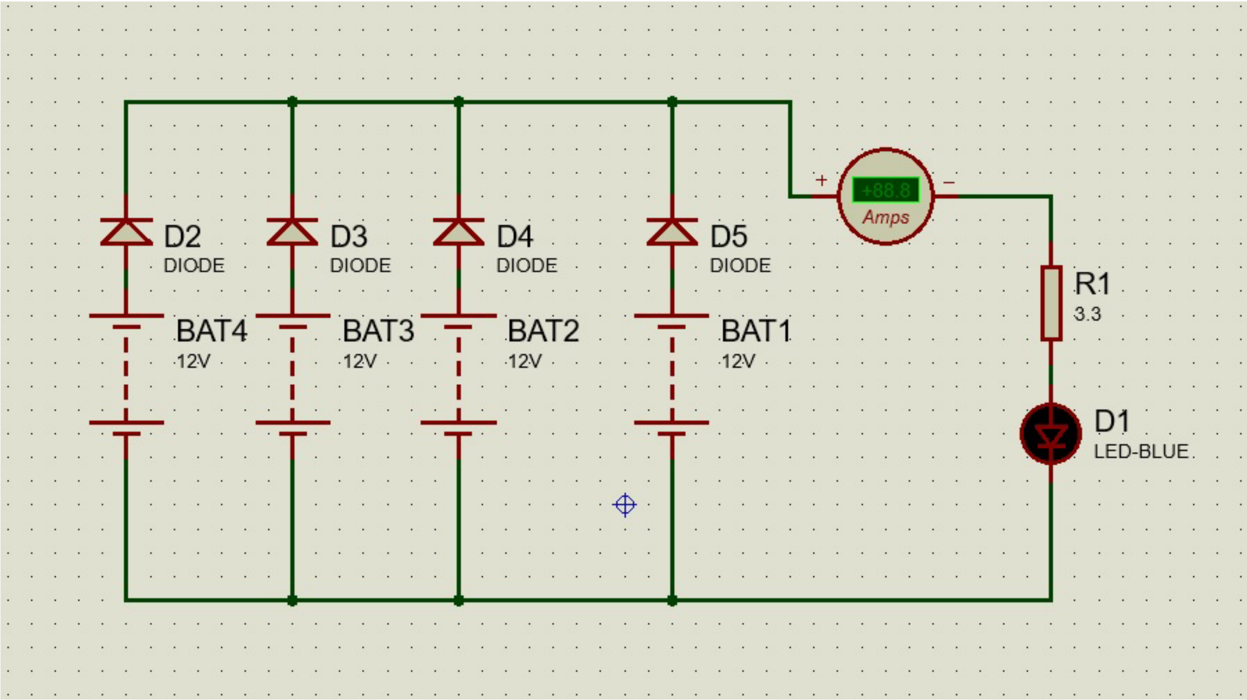
Balancing can be active or passive.

Passive balancing

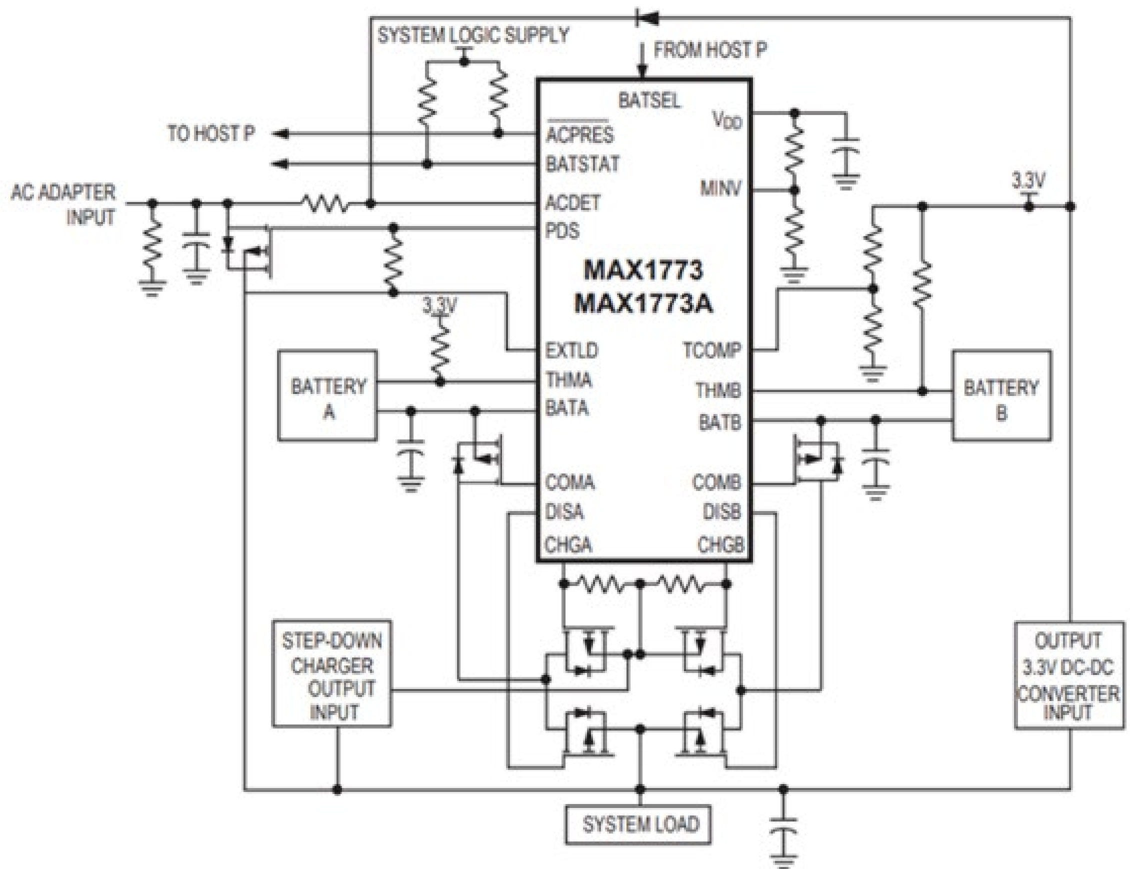
In passive balancing, energy is drawn from the most charged cell and dissipated as heat, usually through resistors. Passive balancing equalizes the state of charge at some fixed point – usually either "top balanced", with all cells reaching 100% SOC at the same time; or "bottom balanced", with all cells reaching minimum SOC at the same time.

Active balancing

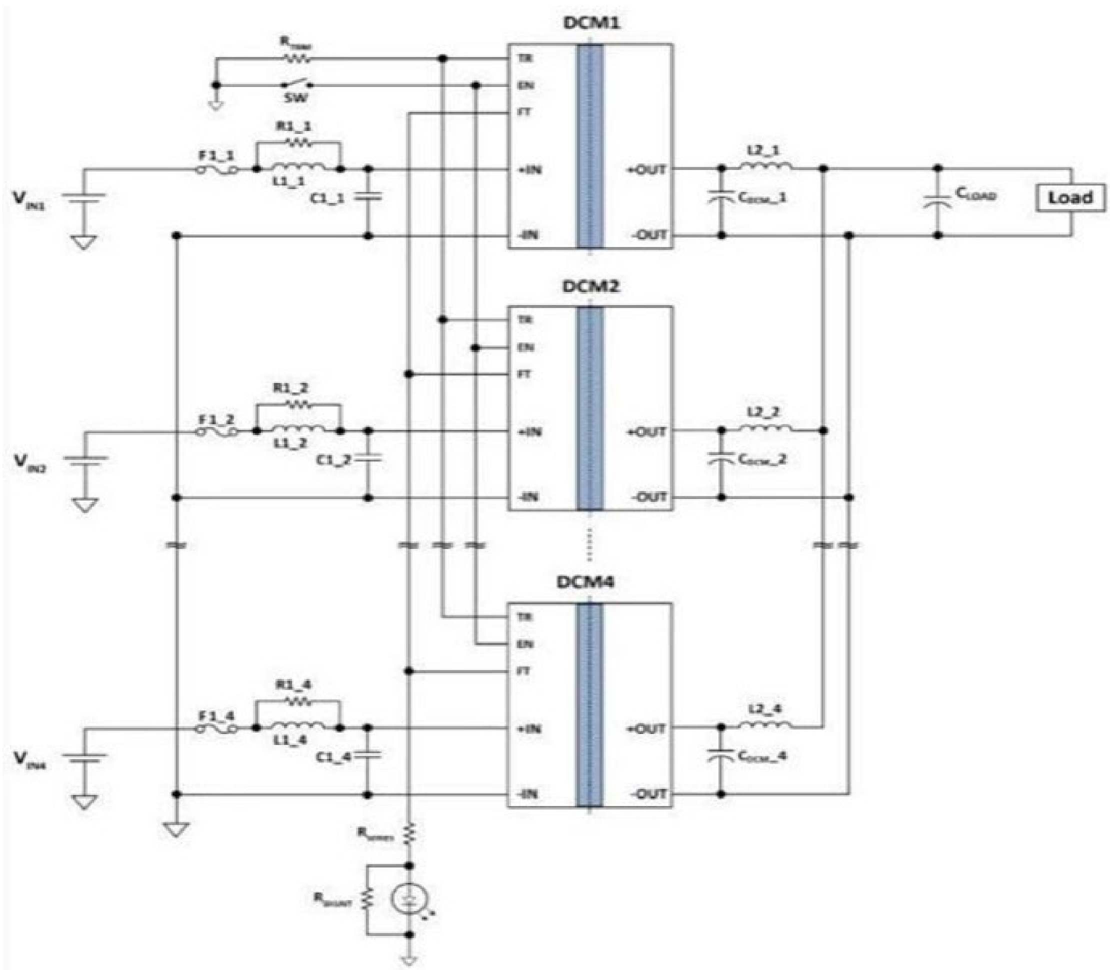
In active balancing, energy is drawn from the most charged cell and transferred to the least charged cells, usually through capacitor-based, inductor-based or DC-DC converters. Active balancing attempts to redistribute energy from cells at full charge to those with a lower state of charge. Energy can be bled from a cell at higher SOC by switching a reservoir capacitor in-circuit with the cell, then disconnecting the capacitor and reconnecting it to a cell with lower SOC, or through a DC-to-DC converter connected across the entire pack.



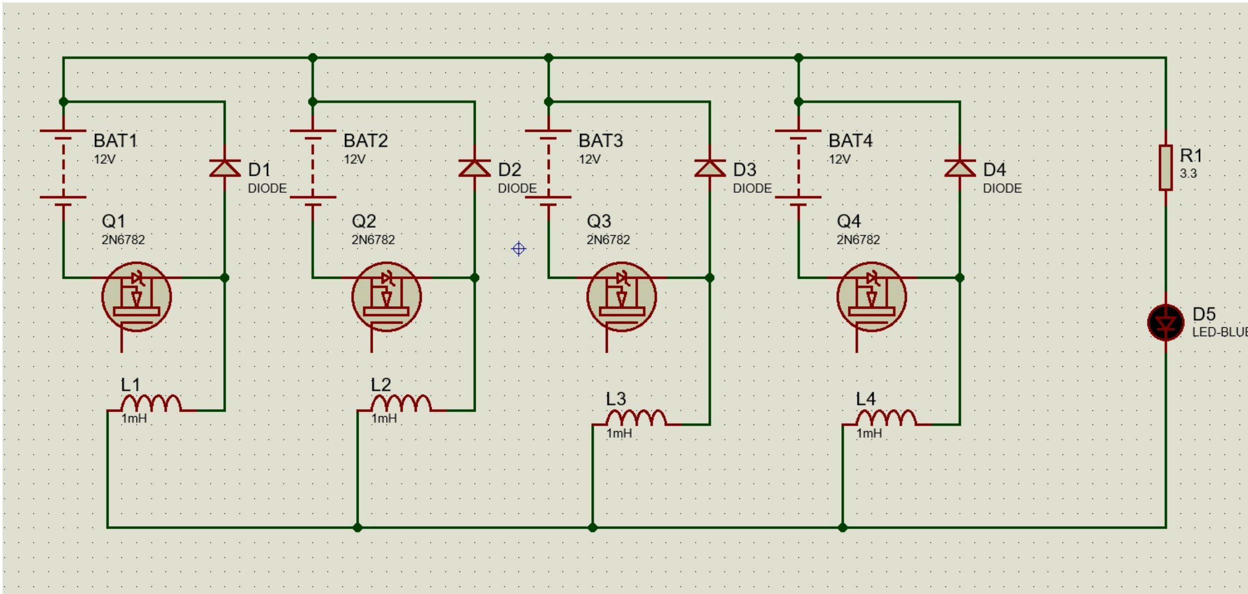
Diode: Implementing diodes in the circuit can allow the batteries to share the load while preventing reverse current flow (one battery charging another). This solution ensures that the batteries discharge at the same time, and the higher SOC battery will discharge first to equal the other batteries. This does have a few disadvantages including poor current sharing between different SOC batteries, and you will have to charge the batteries using a separate current path. This is usually not the best solution.



Chipsets/Switching: Utilizing specialized chipsets or switching mechanisms enables the batteries to be connected and disconnected seamlessly without triggering the BMS to nuisance trip. These solutions can provide more precise control over current flow and control hot swapping.



DC-DC Converters: Introducing DC-DC converters in parallel battery configurations helps regulate voltage and current distribution among the batteries. These converters can equalize the SOC and minimize variations, thereby reducing the likelihood of nuisance tripping.



System diagram of parallel buck regulated battery modules. In each module, the battery is represented by a series connection of battery cells to create the desired OCV, while a BMS with MOSFET microcontroller controlled switch with a fly back diode and inductor are used for regulation of the battery voltage on the parallel bus.