Thursday, May 26, 2016

Constant Voltage, Constant Current Battery Charging

There are three common methods of charging a battery; constant voltage, constant current and a combination of constant voltage/constant current with or without a smart charging circuit.

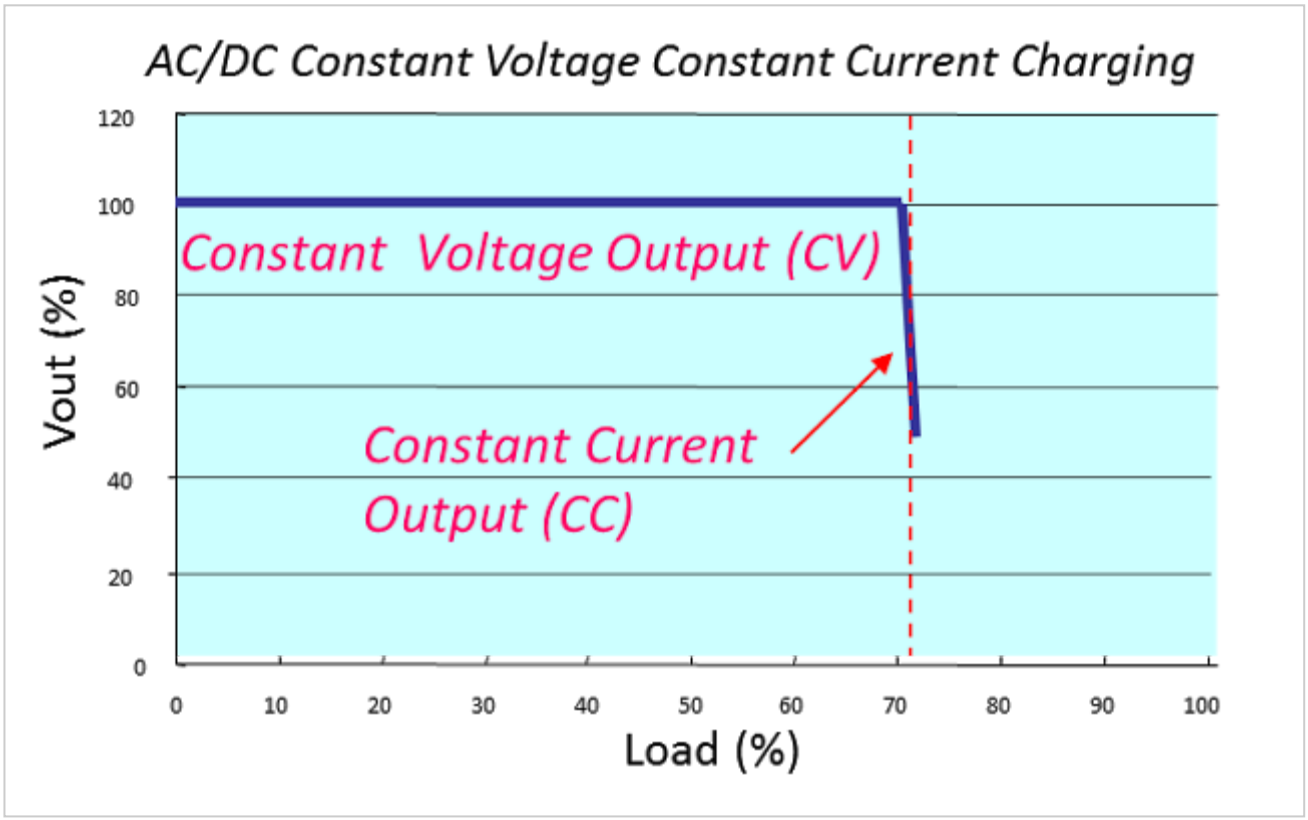
Constant voltage allows the full current of the charger to flow into the battery until the power supply reaches its pre-set voltage. The current will then taper down to a minimum value once that voltage level is reached. The battery can be left connected to the charger until ready for use and will remain at that "float voltage", trickle charging to compensate for normal battery self-discharge. A typical example would a low cost auto battery charger for home use or basic back up power systems. This method enables fast charging rates and is suitable for lead acid types, but not for Nickel Metal Hydride (Ni-MH) or Lithium-Ion (Li-ion) types.

Constant current is a simple form of charging batteries, with the current level set at approximately 10% of the maximum battery rating. Charge times are relatively long with the disadvantage that the battery may overheat if it is over-charged, leading to premature battery replacement. This method is suitable for Ni-MH type of batteries. The battery must be disconnected or a timer function used once charged.

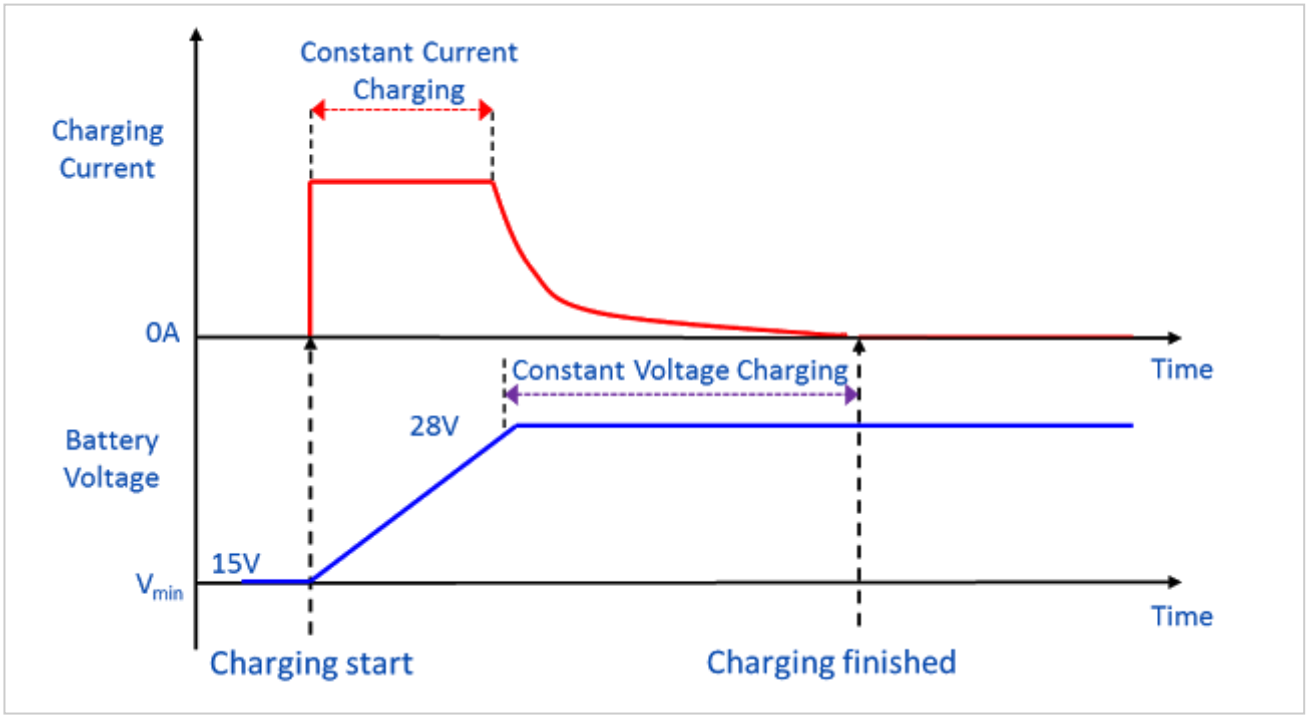
Constant voltage / constant current (CVCC) is a combination of the above two methods. The charger limits the amount of current to a pre-set level until the battery reaches a pre-set voltage level. The current then reduces as the battery becomes fully charged. This system allows fast charging without the risk of over-charging and is suitable for Li-ion and other battery types.

Smart charging involves the use of a micro-controller to compensate for temperature rise and adjust the charge current and charge time accordingly to the battery specifications. This extends battery life and is used with Li-ion battery types. This battery management circuit or unit can be fitted externally to the charger. A number of the power semiconductor manufacturers offer control circuits to perform this function.

An example of a CVCC charger is the TDK-Lambda EVS series. The output voltage and the charge current can be set by two potentiometers and the output characteristics are shown below. The transition between constant voltage and constant current is automatic.



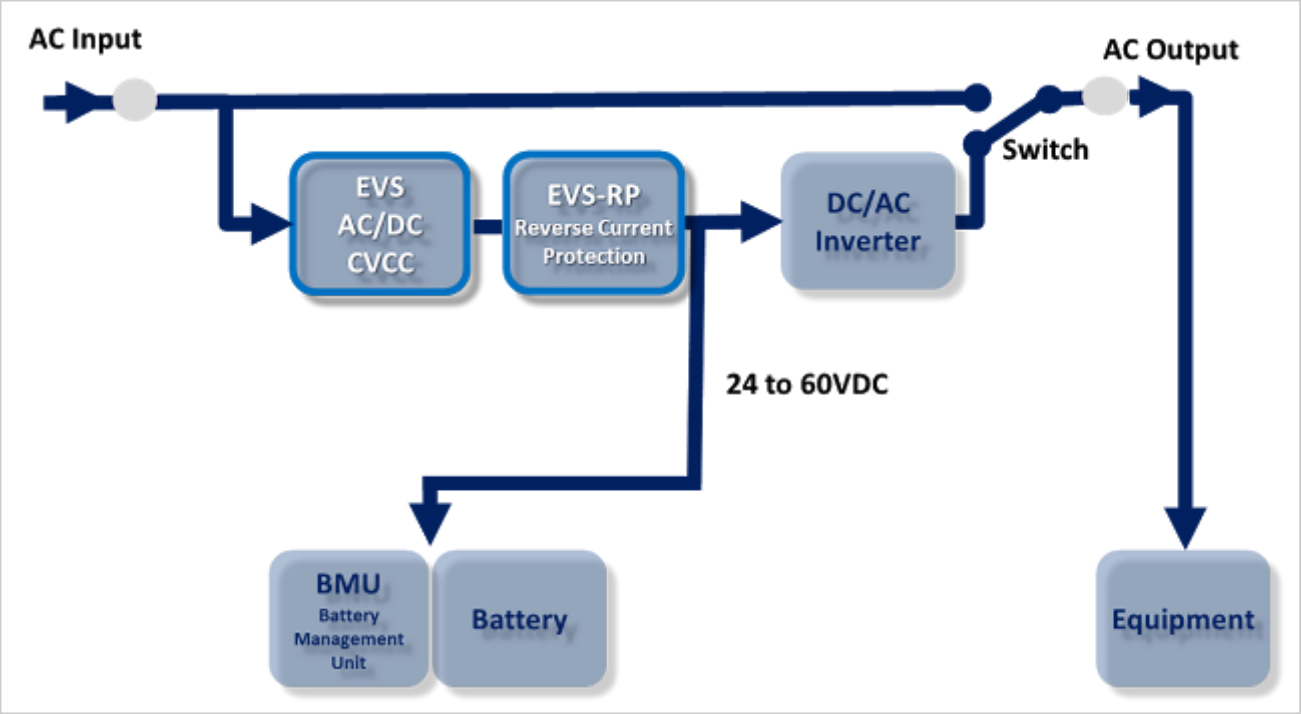
As an example, consider a 24V battery system (with a maximum float voltage of 28V) and discharged down to 15V.



When the discharged battery (at 15V) is connected to the power supply, the battery will start to charge at the pre-set constant current level. The current will remain constant until the voltage rises to 28V. At this point the power supply will transition to constant voltage mode and the current will decay to zero when the battery is fully charged.

The charge current is controlled to avoid overheating and the float voltage limited to avoid over-charging.

A typical application for the EVS being used with a battery management unit is shown below.



Under normal conditions, when AC is present, the electronic switch would be closed and AC would be connected directly to the end equipment. The EVS power supply will charge the battery via the battery management unit and transition to constant voltage mode when complete. In the event of an AC power interruption, the switch would connect the battery and DC/AC inverter to the end equipment. If the power interruption was extensive and the battery was to approach a fully discharged condition, the switch would isolate the battery to avoid a damaging deep discharge.

The EVS power supply can be used with the EVS-RP module to avoid the battery discharging into the power supply when the AC supply is not present, or under a fault condition.

EVS300, EVS600 and EVS-RP Module

Posted by Power Guy