## Xantrex Three-Stage Battery Charging

Advanced multi-stage battery chargers, including Xantrex converters, ensure that batteries receive optimum charging, with the delivery of an accurate three-stage charge cycle. Three-stage charging results in batteries charging faster and more effectively than with a regular converter. This maximizes the amount of time that full AC power is available to the modern, electrically dependant RV, and minimizes generator runtime.

All Xantrex converters feature a microprocessor-controlled three-stage charging process commonly found in advanced battery chargers. These three stages are known as the bulk, absorption, and float stages, and follow the ideal charge curves provided by manufacturers of deep-cycle batteries used commonly in large RVs.

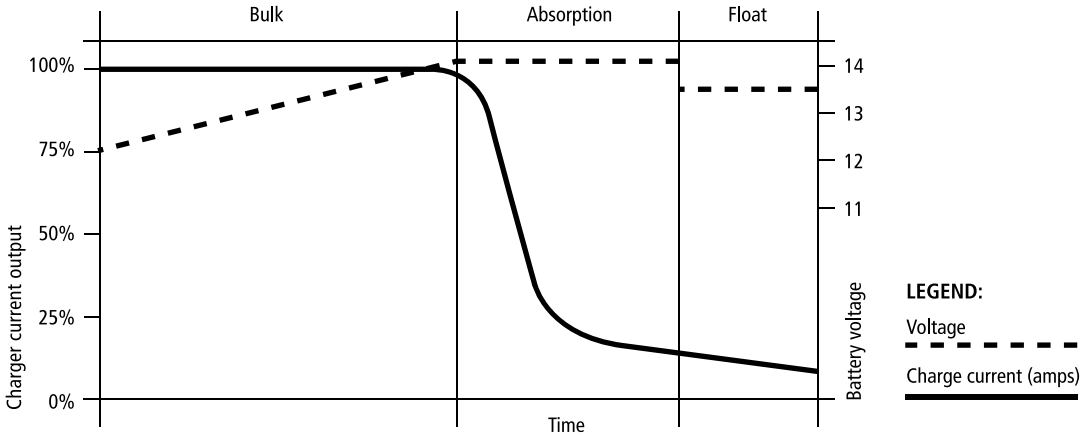


Figure 1: Three-Stage Charging Algorithm

The microprocessor controller cycles the converter through these stages, by precisely regulating the voltage and current delivered to the battery. Cycling through these stages during charging ensures a fast, safe and complete charge, without risk of excessive gassing, over-charging and battery damage.

The first stage in the charging process - bulk – is a constant current mode that replaces 80% of the battery's capacity very quickly. The charger applies its maximum output current, or as much as the battery will take, while the battery voltage rises (see Figure 1). When the battery voltage reaches a predetermined level, the absorption voltage, operation switches to the next stage.

The second stage – absorption – is a constant voltage mode and replaces the remaining 20% capacity. The charger voltage is held steady while the current falls as the battery approaches full charge.

In the final stage - float - the charger voltage is lowered and held constant at a safe value of 13.5 volts DC. This prevents the battery from being overcharged, while allowing the charger to supply enough current to maintain the battery at a full state of charge. The float stage makes up for the self-discharge losses of the battery and enables support of additional DC loads on the RV.

## The Benefits of Three-Stage Charging

Given the limitations of RV shorepower or generator runtime, a significant benefit of Xantrex three-stage charging converters is an increase in battery life and minimized charging time, providing cost savings and convenience for RV owners. Faster and more effective charging maximizes the amount of time that full AC power is available to the power hungry RV and minimizes generator runtime; cutting fuel costs nearly in half.

All Xantrex converters feature three-stage charging for fast, effective, safe and complete charging of batteries on the modern electrically-dependent RV.

## Three-Stage Charging Example

The following example highlights the advantages of a Xantrex three-stage charging converter. Both products listed below supply the same real power for charging, but the other manufacturer's converter takes longer to achieve the same state of charge as the Xantrex converter.

| | Xantrex Converter | Other Converter |
|---|---|---|
| **Charging voltage (absorption)** | 14.2 V | 14.2 V with a rapid charge control module |
| **Charging current** | 60 A | 55 A |
| **Efficiency** | 85% | 80% |
| **Approximate charge time** | 3 hours, 20 minutes | 6 hours |
| **Approximate generator fuel costs to recharge** (Using 5500-watt diesel generator)[1] | $5.52 | $10.05 |

[1] Generator fuel costs calculated based on generator fuel economy of 0.66 gallons per hour and the national average diesel price of $2.537 per gallon posted on January 12, 2007.