Application Note

BQ25176 NiMN Battery Charge Profile

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ABSTRACT

The BQ25172 introduces a new NiMH battery charge profile with advantage over previous charging options. This application note reviews traditional charge profiles, and tradeoffs with the BQ25172 approach. This document also discusses some of the BQ25172 features that are useful in battery back-up applications.

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Trademarks

1 Introduction

The typical NiMH battery charge is a fast charge where a current of about 1C is applied to the battery until the current meets the termination criteria. In the case of a 1Ah capacity (C) cell the charge current is 1A. Charge time in this case is approximately 1 to 2 hours.

Termination is indicated by a decrease in battery voltage, -V/T about 5mV to 10mV / cell is typical. There is also an increase in battery temperature, Δt/T about 1C to 2C / minute indicates the charge is complete.

See Figure 1-1.

The challenge with this profile is to accurately detect that the termination criteria, charge current must be 1C or greater. As charge current is reduced, the change in voltage and change in temperature become smaller and harder to detect. At lower charge currents, termination is unreliable.

The need for a 1C charge current places a requirement on the charge circuit to provide a large current often larger than typical system operating current. In applications where the battery is used as a back-up supply the additional supply requirement can be a problem.

Due to self-discharge of a NiMN battery, a recharge mechanism is required. This can be topped off based on voltage or periodic pulse charge.

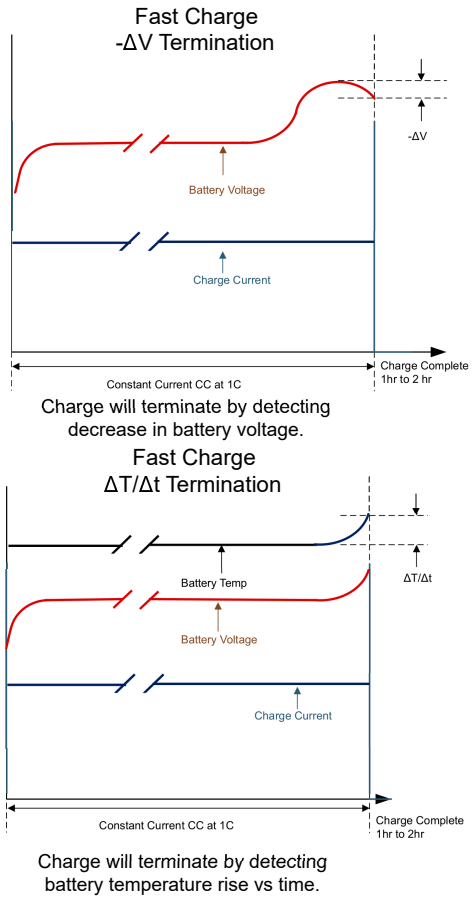

Figure 1-1. NiMH Fast Charge Profile

2 Timer Based Charge

A Timer Based Charge NiMH profile also uses a constant current charge but at a reduced current for a longer time. Termination is controlled by a timer that ends charge after programed time has expires. This allows a lower charge current to be used for the charger, below 1C. See Figure 2-1

The BQ25172 uses this charge profile, timer is set by a pulldown resistor on TMR pin between 4 and 22 hours. As the timer is increased a lower charge current can be used. This allows flexibly to adjust the charger to match available current and battery pack size.

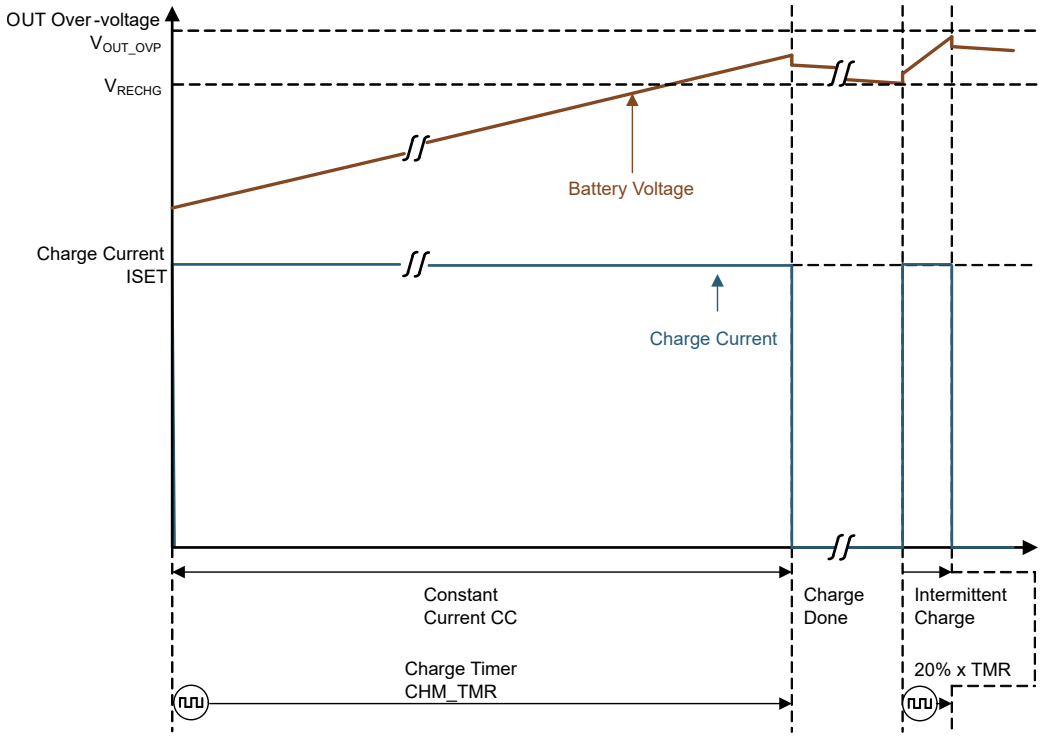

Figure 2-1. BQ25172 Charge Profile

3 Possible Overcharge

The BQ25172 has features to prevent overcharge of the battery. When charge is enabled the battery voltage is checked, if the cell voltage is over 1.33V/Cell the battery is considered full and the charge does not start. When the battery voltage decreases, a charge cycle starts.

4 Recharge and Intermittent Charge

Due to self-discharge of a NiMN battery a recharge mechanism is required to maintain charge during standby conditions. The BQ25172 has an optional Intermittent Charge feature to keep the battery topped off. This initiates a reduced time charge cycle when battery voltage decreases to 1.33V per cell.

5 IC Thermal Rise

The BQ25172 is a linear regulator has high power dissipation when the voltage drop across the device is large. When charging a depleted battery with low voltage, power dissipation on the charger is at the highest. Higher current increases power dissipation.

The BQ25172 manages power dissipation using a thermal regulation feature which monitors die temperature and reduces output current below programmed value to control temperature. The charge continues during this condition and timer clock rate is reduced by half.

The temperature sensor is on the die and independent of TS pin and NTC.

6 Typical Application

The BQ25172 is a small 2mm × 2mm 8 pin QFN device that requires few external components to configure. This device supports from 1 to 6 NiMH cell in series. Input voltage up to 18V. External resistors are used to configure the cell count and intermittent charge, timer from 4 hours to 22 hours and charge current 10mA to 800mA.

3 Cell Typical Application:

- VSET (18kΩ) – 3 Cell + Intermittent Chg
- TMR (27kΩ) – 6 hour charge time
- ISET (3kΩ) – Charge Current 100mA
- TS – 10kΩNTC (103AT-2)

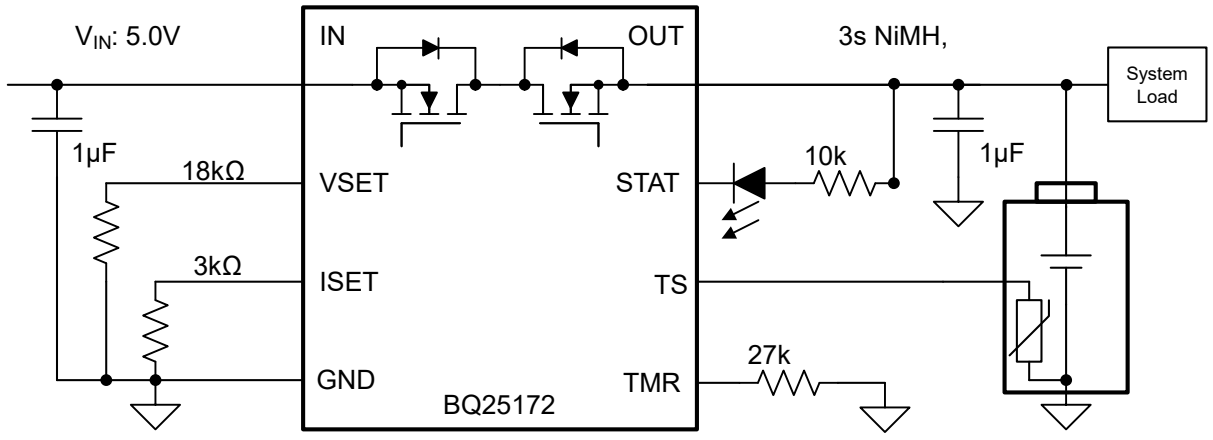

Figure 6-1. Block Diagram

7 Summary

The BQ25172 with timer-based charge profile provides additional option for NiMH battery charging. It is very beneficial in applications where lower input current is desired. In addition, the BQ25172 is a small easy to implement charging design that reduces board space and parts count.

8 References

1. Texas Instruments, *BQ25172 800mA Linear Battery Charger for 1 to 6 NiMN Batteries*, datasheet.
2. Texas Instruments, *NiCd/NiMH Fast-Charge Management ICs*, datasheet.

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