AN8120-1

APPLICATION NOTE

Power Management of a NiMH or NiCd Cell
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INTRODUCTION

1 Abstract
This document discusses the power management of a single NiMH or NiCd battery for common system application usage scenarios with the SX8120/21/22 1V Motor/LED timer series. Power cell power management is highly dependent on the individual user's application; however, this document focuses on providing several application-usage case scenarios and the environment settings.

This document applies for the following devices:

- SX8120ISTRT
- SX8121ISTRT
- SX8122ISTRT

For additional details about the SX8120/21/22 1V Motor/LED timers, see the SX8120/21 and SX8122 Datasheets.

2 Device operating modes

2.1 Safe Mode
The internal system goes in Safe mode as soon as the battery voltage is above 0.6-0.7V. In this mode all pins are set in high impedance and are inactive. This guarantees a safe start-up when a battery is inserted. The power consumption is 10uA max and prevents the battery from leaking when it is empty.

2.2 Low Batt mode
The device is in Low Batt mode as soon as the battery voltage reaches the 0.9V POR threshold. In this mode, each output pin is in a static state. The chip internally checks the VDD voltage each seconds and wakes up to Sleep mode when VDD > VON (1.05V typical). NiMH pin is forced high until the VDD voltage goes below 0.9V (back to Safe mode), or above 1.41V (battery full).

2.3 Active or Sleep mode
NiMH pin is set according to VDD voltage (see 3. NiMH pin).

3 NiMH pin
Pin NiMH goes high when VDD is below the NiMH threshold of 1.41V and low when VDD is above the same threshold. Pin NiMH low means that if the power is coming from an NiMH cell or an NiCd, this cell is full.

A 30mV hysteresis allow to remove NiMH pin oscillation when the VDD voltage is near the threshold.

The supply voltage on VDD pin is checked at a 1Hz rate, so the NiMH pin can switch with a delay of 1 seconds max.
Figure 1. Operating modes and NiMH pin vs battery voltage

1. These threshold values are typical.
4  Simplest accumulator charger

For a bare-bone charger (slow but cheap), one resistor is sufficient. It shall limit the peak current in the cell. When the cell is full, the SX8120/21/22 will short the NiMH pin to ground and disconnect the charge voltage from the cell. If using a NiMH cell, as there is no temperature control, the maximal load current (measured in mA) must be set below one tenth of the total capacity (measured in mAh) and below the absolute max rating for the pin (IAMRRISS) which is -100mA to 100mA.

![Diagram of SX812x circuit](image)

*Figure 2. Example of a USB lowest cost rechargeable cell controlled by the SX8120/21*
4.1 Battery not charging
When VDD is below 0.9V (deep discharge) or above 1.4V (cell full):

![Figure 3. Equivalent circuit if NIMH pin is low](image)

When VDD is higher than the maximal cell voltage, then NIMH pin is internally connected to VSS, shorting the external supply to ground through the current limiting resistor.

4.2 Battery charging
When VDD is between 0.9V and 1.4V:

![Figure 4. Equivalent circuit if NIMH pin is high](image)

When VDD is lower than the maximal cell voltage, then NIMH pin is internally connected to VDD, connecting the external supply to the cell through the current limiting resistor.
5 Faster accumulator charger

For a faster charge, the following 2 transistors circuit increases the top charge current while limiting the idle current when the cell is full. If using a NiMH cell, as there is no temperature control, the maximal load current (measured in mA) must be set below on tenth of the total capacity (measured in mAh).

Figure 5. Example of a USB recharged NiMH single cell controlled by the SX8120/21

Figure 6. Current seen by the NiMH battery and other voltages
5.1 Recharging a Deep Discharged Battery

In the case of a deep discharged NiMH cell, the battery must not be charged with a fast charge current rate until the battery voltage is at least 0.9V.

This can be done by adding a resistor between VUSB the chip VDD (see Figure 7). The resistor is dimensioned to supply a 50-100uA current to the discharged battery while the SX8120/21 is in Safe mode. In this case the NIMH pin is set to high impedance.

Then, if a deep-discharged battery is placed in the charger, the charger will apply a small 'conditioning' current to gently bring it up to 0.9V. Once 0.9V is reached, the SX8120/21/22 switches to Low Batt mode and provides a fast charge.

![Figure 7. Adding a resistor for deep discharge battery](image-url)
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