CEC Efficiency Committee Workshop

May 19, 2011
Comments by Motorola Solutions, Inc.
Docket # 09-AAER-2
2010 Rulemaking Proceeding Phase II on Appliance Efficiency Regulations

MOTOROLA SOLUTIONS

Motorola Solutions, Inc. serves both enterprise and government customers with core markets in public safety, government agencies and commercial enterprises. Our leadership in these areas includes Mission Critical communications devices such as radios as well as task-specific mobile computing devices for enterprises. We produce advanced data capture devices such as barcode scanners and RFID (radio-frequency identification) products for business.

Working with CEC

We have had numerous discussions with the California Energy Commission to provide performance data, market data, and technical specifications of our specialized products to inform the regulatory process with respect to the proposed Appliance Efficiency Standards for Battery Chargers

First Issue: Energy Efficiency of Battery Charging Function Only

- Dilemma: Many advanced products combine non-battery charging functions in a "battery charger" and the energy draw of these functions should not be included in the efficiency calculation of the battery charging function
  - A regulation that doesn't accommodate advanced functions on products will discourage device convergence, which saves energy overall

Current Proposal

- The current proposed test method allows:

  "Any optional functions controlled by the user and not associated with the battery charging process (i.e., a radio integrated into a cordless tool charger) shall be switched off."

- This is not sufficient for many products, especially non-consumer products, which have many advanced functions that cannot be turned off by the user
  - Indicators (e.g. LED's)
  - Communications functions
    - Ethernet links
    - Ethernet switches
    - Ethernet to USB converters
    - USB links
    - USB hubs
    - Dial-up modems
  - Fans
  - Etc.

How to handle?

- **Approach A:** Create a table or matrix of non-charging functions, and allocate additional allowable power for each feature (similar to EU Code of Conduct for Set-top Boxes)
  - Pros: Allows energy consumption by non-charging functions
  - Cons:
    - Requires new research, and consensus on appropriate power consumption by various features
    - Many functions will have varying power consumption depending on size or capability (e.g communication speed), adding further complexity
    - Difficult to maintain, as technology evolves and new features are incorporated into products
    - Will slow new product/feature introduction

We think this approach is impractical

How to handle?

- **Approach B:** Allow all non-charging functions to be disconnected during the test, as long as:
  - Safety circuitry remains unaltered
  - Explicit documentation of changes made is included in the test report to allow for understanding and replication of results
  - An additional test is conducted to demonstrate only non-battery charging functions were disabled
    - A comparison of battery discharge energies before and after modification to values within 5% will serve as proof that the charging functions themselves have not been modified by this process.
  - Pros:
    - Allows energy consumption by non-charging functions
    - Simple, with no need to update as technology evolves
    - Universally applicable, can be used by any type of product
  - Cons:
    - Requires an additional test ($) and additional documentation

We recommend this approach

Validity of post-test

- MSI has quite a bit of internal data to suggest repeatability of battery discharge measurements

Chemistry	Sample Size	Max Variation	Standard Deviation	6 sigma value
NiCd	25 packs 15 cycles each 350 data points	2.3%	0.5%	3%
NiMH	10 packs 15 cycles each 140 data points	1.1%	0.2%	1.2%
Li-Ion	6 packs 3 cycles each 12 data points	2.0%	0.6%	3.6

Notes: Data collected from first 15 charge/discharge cycles for both NiMH and NiCd battery packs. The sample size of data for Li-Ion battery packs is rather small but we expect no greater deviation in cycle-to-cycle capacity, given additional data points. We suggest the use of 5% as indicated on the previous page. All battery packs were new from stock.

Second Issue: Energy Efficiency varies by Battery Chemistry

- Dilemma: Current proposed regulation does not differentiate energy efficiency requirements by battery chemistry, even though there are inherent differences

Advantages of Nickel-based Batteries

- Some Nickel-based batteries have nearly twice the cycle life of Lithium Ion batteries
- In general Nickel batteries tolerate temperature extremes better than Lithium batteries – this is essential in Mission Critical applications
    - Fire & Rescue
    - Law Enforcement and Security
    - Transportation
    - Utilities

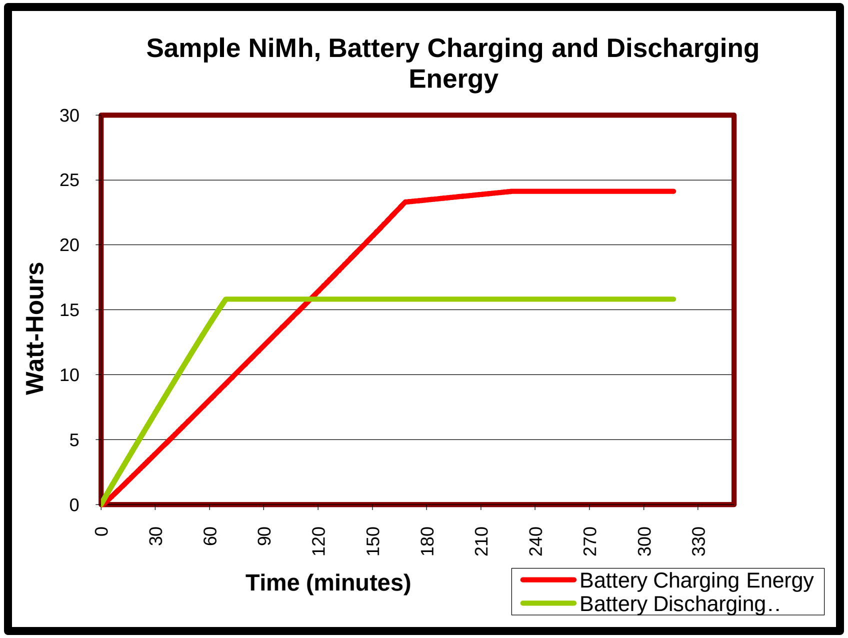
Issues Unique to Nickel-based Chemistries

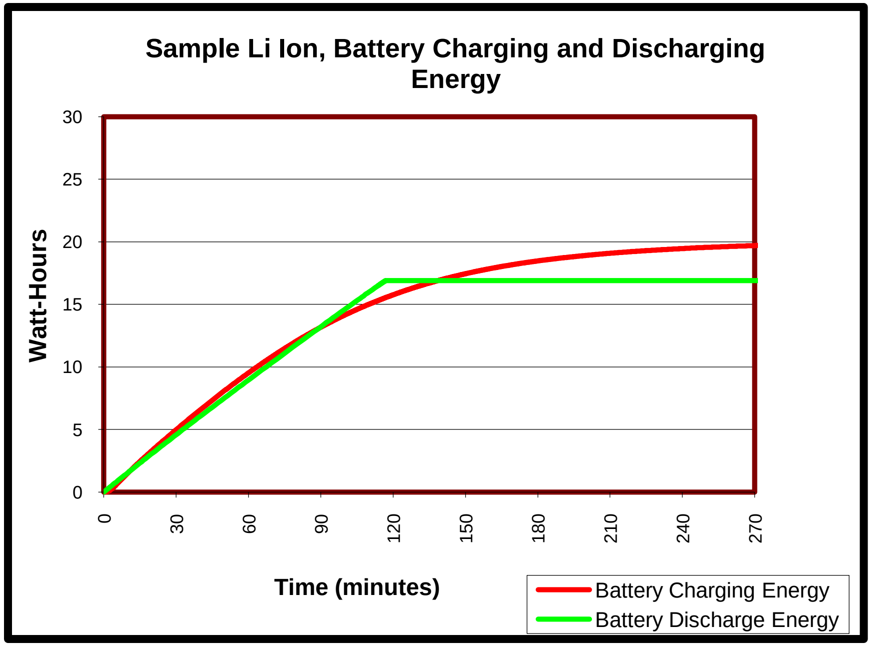
- Charge acceptance during charging is about 80% as compared with 99+% for Lithium
- Mission critical applications require Rapid Charging (1-2 hour charge time)
- Continuous maintenance charging is necessary to ensure full capacity
- Nickel batteries have a higher self discharge when compared to Lithium batteries
- Many users leave their radios in the chargers for extended periods of time
- Many users leave their radios on while in a charger

Variation in battery charge efficiency

NiMH

Li-Ion





Nickel-based Batteries are essential for certain applications

- **Do not penalize the Nickel-based technology which is required by certain customers for certain applications, particularly Mission Critical customers who operate in cold temperatures.**

Cell Capacity % Vs. Discharge Temperature

Temperature (°C)	NiCd typical cell (0.2C discharge)	NiMH Cell formulated for cold temperature performance (0.2C discharge)	Li-Ion typical cell (0.2C discharge)	Li-Ion Cell formulated for cold temperature operation (5/5/90 discharge)
+25	100	100	100	100
0	80	85	50	50
-10	60	75	30	30
-20	30	50	~0	20
-30	2	10	~0	10

The data in this table is taken from cell supplier specifications. Most capacity information is measured with a 0.2C discharge rate. The data in the far-right column is based on a radio discharge profile that is similar to a 0.2C rate.

Recommendation

- For multi-chemistry BCS, require testing only with most-efficient chemistry batteries

OR

- Allow AC input energy <= (12+1.9Eb) when charging Nickel-based batteries