



Battery (Cell) Technology

.....without the chemistry (sort of)

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September 2008 - - - Standard disclaimers apply



You Were Expecting

Watt?

Got A Potato?



A Brief (very brief) History

- | | | |
|--------|-----------|------------------------------|
| ■ 1800 | Volta | Voltaic pile |
| ■ 1866 | Leclanche | Carbon-zinc wet cell |
| ■ 1885 | Yai | First dry cell |
| ■ 1887 | Gassner | First carbon-zinc cell |
| ■ 1899 | Jungner | First NiCd rechargeable |
| ■ 1901 | Edison | Alkaline storage battery |
| ■ 1959 | Urry | Invented small alkaline cell |
| ■ 198? | --- | MiMH |

Primary Cells

- Carbon zinc 1.5V
- Alkaline (zinc-manganese dioxide) 1.5V
- Mercury 1.3V
- Zinc air 1.4V
- Silver oxide 1.55V
- Lithium-manganese dioxide 3V
- Lithium-iron disulfide 1.5V
- Lithium-poly-carbon monofluoride 3V
- Note: Lithiums are vented and have PTC's



Secondary Cells

Lead-acid

Alkaline

Nickel cadmium

Nickel metal hydride

Lithium ion

Lithium polymer

“Sealed” Ain’t Sealed

- SLA’s (sealed lead acid) and Gel-Cells are “Valve Regulated Lead Acid”, aka “Recombinant”

compared to

- Vented or “flooded” batteries
(use with caution indoors)

Battery Selection has Tradeoffs

- Energy Density – W-h/kg
- Cycle Life – number of charges
- Self Discharge – shelf life
- Load current – relative to Ah
- Cost – if you care 😊

AH Ratings – Not what you might think

Example: PowerSonic PSH-1280FR 12V,
8.5AH, High-Rate Series

- 20-hr 425mA to 10.5V 8.5 AH
- 10-hr 810mA to 10.5V 8.10 AH
- 5-hr 1.5A to 10.2V 7.5 AH
- 1-hr 5.27A to 9.0V 5.27 AH
- 15-min 17.5A to 9.0V 4.38 AH

Got Volts?.....maybe not

- K3 11V min.
- FT-897D 11.7V min.
- FT-7800 11.7V min.
- LDG Z-11Pro autotuner (8V min). NiMH, Alkaline, and Lithium 9v batteries were in their original battery list.....now only three Lithium or eight NiMH cells are listed.

Rechargeable Comparisons

	Alkaline	NiCd	NiMH	SLA Gel-Cell	Li-Ion Li-Po
W-h/kg	80 init.	40 to 60	30 to 80	37	100 to 200
Cycles	10	1500 to 2000	500 to 1000	200 to 300	500 to 1200
Discharge %/mo	0.2	10 to 20	~30 Ex "LSL"	~5	5 to 10
Max Load C=10hr rate	0.2C	>2C	0.5-1C	0.2C	~1C

Charging

err on the side of caution!

- Typical “overnight” charging rate is 10% of AH rating (based on C=10)
- NiCd and NiMH use the same chargers.
- Special chargers for Li-X (caution).
- Create a charging schedule. Don’t wait too long.
- Some chargers can also cycle.
- Consider solar.

Use the Resources on the Web

“Know thine battery”

- PowerSonic
- Exide
- Maha (Powerex)
- Energizer (The Bunny)
- Others

Energizer E91 AA Alkaline Datasheet

- mAh capacity vs. discharge current
- Constant power: discharge mW vs. hours
- Constant current: discharge mW vs. hours
- Constant power: hours vs. V (f) power
- Constant current: hours vs. V (f) temp.
- Industry standard “application curves”

Energizer NH15-2500 NiMH Datasheet

- Hours of discharge vs. $V(f)$ load
- Also R_i , Z , and operating and storage temperatures
- Tech Bulletins and Battery Manuals available in addition to datasheets.

Make sure your UPS isn't an Oops

- APC ES8 650VA
- Max watts 390
- 4.2 min. backup at full load
- 15.4 min. backup at half load.
- Equivalent of ~8Ah SLA
- An UPS is still an important addition.

Final Thoughts and Biases

- Use the Sunnyvale battery pickup.
- Put an UPS on your station.
- Watch out for “fat” NiMH’s.
- When in doubt, stick with proven products.
e.g. PowerSonic, Maha, Astron, etc.
- Look at wheelchair and golf cart batteries for radio applications.