

STATIC



November 2010

CHARGING LITHIUM-ION BATTERIES

There is only one way to charge lithium-based batteries. The so-called 'miracle chargers', which claim to restore and prolong batteries, do not exist for lithium chemistries. Neither does super-fast charging apply. Manufacturers of lithium-ion cells have very strict guidelines in charge procedures and the pack should be charged as per the manufacturers "typical" charge technique.

Lithium-ion is a very clean system and does not need priming as nickel-based batteries do. The 1st charge is no different to the 5th or the 50th charge. Stickers instructing to charge the battery for 8 hours or more for the first time may be a leftover from the nickel battery days.

Most cells are charged to 4.20 volts with a tolerance of $\pm 0.05V/cell$. Charging only to 4.10V reduced the capacity by 10% but provides a longer service life. Newer cells are capable of delivering a good cycle count with a charge to 4.20 volts per cell. Figure 1 shows the voltage and current signature as the lithium-ion cell passes through the charge stages.

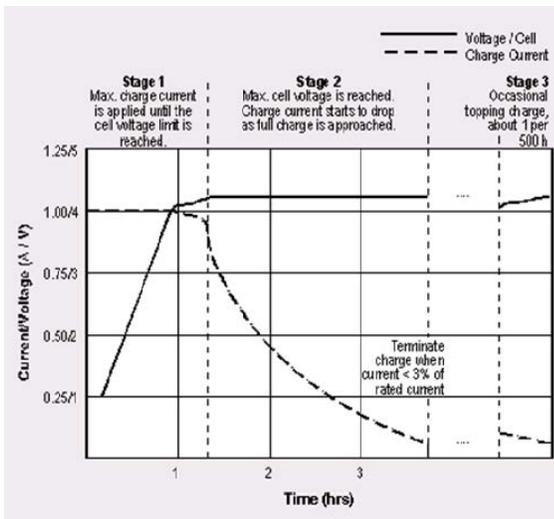


Figure 1: Charge stages of a lithium-ion battery. Increasing the charge current on a lithium-ion charger does not shorten the charge time by much. Although the voltage peak is reached quicker with higher current, the topping charge will take longer

The charge time of most chargers is about 3 hours. Smaller batteries used for cell phones can be charged at 1C; the larger 18650 cell used for laptops should be charged at 0.8C or less. The charge efficiency is 99.9% and the battery remains cool during charge. Full charge is attained after the voltage threshold has been reached and the current has dropped to 3% of the rated current or has leveled off. (cont. page 3)

LBARA MEETING SCHEDULE

MONTH	BOARD	REGULAR
NOV	NOTE: BOARD	11/18
DEC	MEETINGS WILL NOW	12/16
JAN	TAKE PLACE ONE	1/20
FEB	HOUR PRIOR TO THE	2/17
MAR	REGULAR MEETING	3/17

LBARA FIELD DAY RESULTS

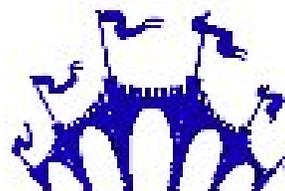
LBARA placed 3rd in the Southwest Division and 73rd out of 130 in the nation. Not too bad for a G5RV and 100 watts.... all the while dodging the rattlesnakes. Next year we'll have the beam back up and should do a bit better. Anyway, we all had fun...right?



#	Call	Score	Category	QSOs	Power Mult	GOTA Call	Section	Participants	Club
1	K6AM	10,096	1A	3,277	2		SDG	6	SPAWAR Team
2	WA7NB	5,744	1A	2,573	2		AZ	3	Tucson TRACON ARC
3	K7LHC	1,226	1A	238	2		AZ	13	London Bridge ARA
4	W6YRA	1,030	1A	258	2		LAX	5	Bruin ARC
5	WB0SMX	620	1A	85	2		AZ	3	
6	AC7R	376	1A	53	2		AZ	14	MARA Net

Monday Night Net (7 PM)

System	Location	Freq	Offset	PL
MCARS	Bullhead City	145.27	-	131.8
	Kingman	146.76	-	131.8
	Kingman	448.25	-	131.8
	Lake Havasu	146.62	-	131.8
	Willow Beach	147.12	-	131.8
CRRRA	Lake Havasu City	146.96	-	162.2
	Lake Havasu City	224.24	-	156.7
	Lake Havasu City	146.64	-	156.7
	Lake Havasu City	449.95	-	141.3
BARN	Lake Havasu City	447.54	-	136.5
	Las Vegas, NV	449.95		136.5
	Onyx(Palm Springs)	449.34	-	136.5
	Orange County, CA	447.54	-	100



CHARGING LITHIUM-ION BATTERIES (cont. page 1)

Increasing the charge current does not shorten the charge time by much. Although the voltage peak is reached quicker with higher charge current, the topping charge will take longer.

Some chargers claim to fast-charge a lithium-ion battery in one hour or less. Such a charger eliminates stage 2 and goes directly to 'ready' once the voltage threshold is reached at the end of stage 1. The charge level at this point is about 70%. The topping charge typically takes twice as long as the initial charge.

No trickle charge is applied because lithium-ion is unable to absorb overcharge. A continuous trickle charge above 4.05V/cell would cause plating of metallic lithium that could lead to instabilities and compromise safety. Instead, a brief topping charge is provided to compensate for the small self-discharge the battery and its protective circuit consume. Depending on the battery, a topping charge may be repeated once every 20 days. Typically, the charge kicks in when the open terminal voltage drops to 4.05V/cell and turns off at a high 4.20V/cell.

What happens if a battery is inadvertently overcharged? Lithium-ion is designed to operate safely within their normal operating voltage but become unstable if charged to higher voltages. When charging above 4.30V, the cell causes plating of metallic lithium on the anode; the cathode material becomes an oxidizing agent, loses stability and releases oxygen. Overcharging causes the cell to heat up. If left unattended, the cell could vent with flame.

Much attention is focused to avoid over-charging and over-discharging. Commercial lithium ion packs contain a protection circuits that limit the charge voltage to 4.30V/cell, 0.10 volts higher than the voltage threshold of the charger. Temperature sensing disconnects the charge if the cell temperature approaches 90°C (194°F), and a mechanical pressure switch on many cells permanently interrupt the current path if a safe pressure threshold is exceeded. Exceptions are made on some spinel (manganese) packs containing one or two small cells.

Extreme low voltage must also be prevented. The safety circuit is designed to cut off the current path if the battery is inadvertently discharged below 2.50V/cell. At this voltage, most circuits render the battery unserviceable and a re-charge on a regular charger is not possible.

There are several safeguards to prevent excessive discharge. The equipment protects the battery by cutting off when the cell reaches 2.7 to 3.0V/cell. Battery manufacturers ship the batteries with a 40% charge to allow some self-discharge during storage. Advanced batteries contain a wake-up feature in which the protection circuit only starts to draw current after the battery has been activated with a brief charge. This allows prolonged storage.

In spite of these preventive measures, over-discharge does occur. Advanced battery analyzers (Cadex C7000 series) feature a 'boost' function that provides a gentle charge current to activate the safety circuit and re-energize the cells if discharged too deeply. A full charge and analysis follows. (cont page 5)

Upcoming Activities and Hamfests

December 4	Superstition Hamfest, Mesa, AZ
January 8	Thunderbird Hamfest, Glendale, AZ
February 18-19	Yuma Hamfest & Emergency Preparedness Show
May 7	Larry Warren Memorial Hamfest, Sierra Vista, AZ

SATURDAY MORNING'S BREAKFAST

You're all invited to join LBARA members for a great breakfast each and every Saturday morning at Rusty's Resturant located at the southwest corner of Lake Havasu Ave and Kiowa Blvd. Breakfast is served at 6 a.m. (or earlier if you want a good seat!) Most important, the food is great!!!!

QUARTZFEST* 2011

- When?** January 23rd thru 29th of 2011 (make sure you put Quartzfest 2011 on your calendar)
- Where?** 7 miles south of Quartzsite Arizona - on US 95 at La Paz Valley Road
- Who Can Attend?** **ANYONE!** If you don't have your Amateur Radio Operators License yet, we'll be offering Licensing Exams at 10:30am on January 25th, 2011.
- What?** Quartzfest is an annual HAM Radio RV'ers Boondocking event which is held in late January every year with dates coinciding with the Quartzsite Arizona "RV Show".

During the week of Quartzfest, RV's are everywhere across the desert, as far as you can see..every make and model you can imagine! There are hundreds of groups that meet in Quartzsite every year in different parts of the desert who share like interests. Our Annual Amateur Radio event is called "QuartzFest" and is open to ALL to attend. QuartzFest is not a club, no officers, no budget, no dues and is not affiliated with or sanctioned by any organization. QuartzFest's continued success exists because of the many HAM's dedicated to seeing it go on year after year, all of whom are volunteers. Quartzfest started out about 12 years ago and is just a bunch of HAM's getting together, camping in their RV's in the middle of the desert..no power, no restrooms, no running water. Solar Panels and Generators are in use everywhere (if you run your generator, you've got to be courteous to your neighbors). If you want to see how well you're prepared and how long you'll be able to hold out in the event of an emergency or disaster, "Boondocking" in the desert for a week will show you.

Quartzfest is similar to a mini-HamFest with a week full of scheduled activities. Seminars range in topics from Genealogy and Crafts for Non-HAM's to Technical information for the seasoned HAM, and introductory information for the new HAM. Also included in the week's activities are VE Testing, Antenna Shoot Out, Antenna Walkabout (touring other HAM's RV Antenna installations), 4x4 Trip in the Desert, Campfires..some with musical entertainment, Movies using the side of an RV as a screen, Hobo Stew, Shopping, Shopping, Shopping, and lot's more!

Cost? Camping on BLM (Bureau of Land Management) land is absolutely **FREE!!** and you can camp there for up to 2 weeks.

For more information, visit www.quartzfest.org

or

email our Quartzfest 2011 Organizers

Steve and Linda Weed

KO4QT KI6JUD

organizer@quartzfest.org

Are you looking to upgrade your license?

Give our VE Exam Team a call.

See Ed Gillespie, AB7EM at #453.7412

CHARGING LITHIUM-ION BATTERIES (cont. page 3)

If the cells have dwelled at 1.5V/cell and lower for a few days, however, a recharge should be avoided. Copper shunts may have formed inside the cells, leading a partial or total electrical short. The cell becomes unstable. Charging such a battery would cause excessive heat and safety could not be assured.

Battery experts agree that charging lithium-ion batteries is simpler and more straightforward than the nickel-based cousins. Besides meeting the tight voltage tolerances, the charge circuit can be designed with fewer variables to consider. Full-charge detection by applying voltage limits and observing the current saturations on full charge is simpler than analyzing many complex signatures, which nickel-metal-hydride produces. Charge currents are less critical and can vary. A low current still permits proper full charge detection. The battery simply takes longer to charge. The absence of topping and trickle charge also help in simplifying the charger. Best of all, there is no memory but aging issues are the drawback.

The charge process of a lithium-ion-polymer is similar to lithium-ion. These batteries use a gelled electrolyte to improve conductivity. In most cases, lithium-ion and lithium-ion-polymer share the same charger.

Preparing new lithium-ion for use

Unlike nickel and lead-based batteries, a new lithium-ion pack does not need cycling through charging and discharging. Priming will make little difference because the maximum capacity of lithium-ion is available right from the beginning. Neither does a full discharge improve the capacity of a faded pack. However, a full discharge/charge will reset the digital circuit of a 'smart' battery to improve the state-of-charge estimation

State-of-charge reading based on terminal voltage

The open circuit voltage can be used to estimate the battery state-of-charge of lithium, alkaline and lead-based batteries. Unfortunately, this method cannot be used for nickel-based packs.

On a lithium-ion cell, 3.8V/cell indicates a state-of-charge of about 50%. It must be noted that utilizing voltage as a fuel gauge function is inaccurate because cells made by different manufacturers produce a slightly different voltage profile. This is due to the electrochemistry of the electrodes and electrolyte. Temperature also affects the voltage. The higher the temperature, the lower the voltage will be.

Hints to long battery life

- Limit the time at which the battery stays at 4.20V/cell. Prolonged high voltage promotes corrosion, especially at elevated temperatures. (Spinel is less sensitive to high voltage than cobalt-based systems).
- 3.92V/cell is the best upper voltage threshold for cobalt-based lithium-ion. Charging batteries to this voltage level has been shown to double cycle life. Lithium-ion systems for defense applications make use of the lower voltage threshold. The negative is reduced capacity.
- The charge current of Li-ion should be moderate (0.5C for cobalt-based lithium-ion). The lower charge current reduces the time in which the cell resides at 4.20V. It should be noted that a 0.5C charge only adds marginally to the charge time over 1C because the topping charge will be shorter. A high current charge tends to push the voltage up and forces it into the voltage limit prematurely.

Note: In respect to fast-charging and topping charge, the charge behavior of lithium-ion is similar to lead acid. Here, the voltage threshold of 2.35V/cell during regular charge needs to be lowered to 2.27V/cell when the VRLA is on standby. Keeping the voltage at the high threshold would contribute to corrosion. A similar effect occurs with lithium-ion. (cont. page 6)

CHARGING LITHIUM-ION BATTERIES (cont. page 5)

About the Author

Isidor Buchmann is the founder and CEO of Cadex Electronics Inc., in Vancouver BC.

Mr. Buchmann has a background in radio communications and has studied the behavior of rechargeable batteries in practical, everyday applications for two decades. Award winning author of many articles and books on batteries, Mr. Buchmann has delivered technical papers around the world.

Cadex Electronics is a manufacturer of advanced battery chargers, battery analyzers and PC software. For product information please visit www.cadex.com.

Once again, The Washington Post has published the winning submissions to its yearly neologism contest, in which readers are asked to supply alternative meanings for common words.

1. Coffee (n.), the person upon whom one coughs.
2. Flabbergasted (adj.), appalled over how much weight you have gained.
3. Abdicate (v.), to give up all hope of ever having a flat stomach.
4. Esplanade (v.), to attempt an explanation while drunk.
5. Willy-nilly (adj.), impotent.
6. Negligent (adj.), describes a condition in which you absentmindedly answer the door in your nightgown.
7. Lymph (v.), to walk with a lisp.
8. Gargoyle (n), olive-flavored mouthwash.
9. Flatulence (n.) emergency vehicle that picks you up after you are run over by a steamroller.
10. Balderdash (n.), a rapidly receding hairline.
11. Testicle (n.), a humorous question on an exam.
12. Rectitude (n.), the formal, dignified bearing adopted by proctologists.
13. Pokemon (n), a Rastafarian proctologist.
14. Oyster (n.), a person who sprinkles his conversation with Yiddishisms.
15. Frisbeetarianism (n.), (back by popular demand): The belief that, when you die, your soul flies up onto the roof and gets stuck there.
16. Circumvent (n.), an opening in the front of boxer shorts worn by Jewish men.

FOR SALE/TRADE

Your ad here.....with pictures if you like....contact the Static editor.

Kenwood 940AT Excellent condition. Used only once since factory overall. Includes all the manuals. Price is \$700 firm. Alan, N7QLL, at (928)855.6609 .



Champion 4000 Watt Generator 110/240 VAC at 30 amps. 12 V Charging at 10 amps. 6.5hp engine. 4 gal fuel tank. Runs 12 hrs. at 50% load. Wt. 99 lbs. Purchased new in 12/07. All paperwork and receipts. Carl, W7CRL, 928.680.7262, cell: 716.0852, <w7crl@yahoo.com>



Antennas for Sale: RS scanner (all bands) and 2 meter transmit with 10 ft mast. Ringo Ranger 2 meter antenna with 10 ft. mast. Any reasonable offer. See Dick, W7ZR, 928.208.7175

Zenith Trans Oceanic Model b600 Radio Good condition for a radio built between 1959 - 1962. Has a little audio buzz. Includes schematic, brochure, and manual. Flip charts are clean and unmarked. Asking \$65. See Tom Fulmer. 928.208.7417



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www.lbara.net

FROM THE EDITOR

If you have anything you would like to see included in these issues, please let me know. I'm always looking for articles, news items, construction articles, or anything that might be of interest to our readers. You can contact me at 928.855.7941 or email at grf@unedspeed.net or francej@ajsinsurance.com.

L.B.A.R.A
P.O. BOX 984
LAKE HAVASU CITY
ARIZONA 86405

STATIC

ATTENTION READERS

Please note that this issue represents a “work-in-progress” and there are a number of changes to be made in subsequent issues. I would greatly appreciate your comments, both good and bad, as well as any suggestions for future issues. This issue also begins our first attempt to deliver the **STATIC** to your doorstep electronically. Please keep me abreast of any email address changes you may have and I promise to have this delivered promptly and accurately. Also, I still have a number of articles awaiting publication and will do so in the future. This is your newsletter, so keep the articles, letters, and pictures coming. I can be reached at home (855.7941), at work (855.3081) or via email at grf@uneedspeed.net .

EQUIPMENT FOR SALE

EDITOR’S NOTE: List your items for sale here. Ham radio related only, please. Include a picture if you like (please use a jpg format). Email all to me at grf@uneedspeed.net along with your name and phone number.

