

»» FUTURE TECH LITHIUM POLYMER POWER

We test the new tech with the FMA Scorpion 2s charger & Kokam Li-poly packs

BY GEORGE M. GONZALEZ | PHOTOS BY DERON NEBLETT

A new battery technology will soon have a huge impact on RC. Lithium-polymer (Li-poly) batteries represent the latest advances in rechargeable-battery technology. Although computer, cell phone and other electronics manufacturers are already exploiting this new technology, no manufacturer has yet offered Li-poly batteries designed to compete with the NiMH cells that now dominate the RC car market—until now.

To test a complete Li-Poly system, we used the only complete battery and charger system designed specifically for RC cars. FMA Direct and EaglePicher Kokam worked together to make the system easy to use and car-friendly. Li-poly packs offer huge advantages. The Kokam packs can be charged in less than 20 minutes, and they provide more punch, higher top speed and longer run times than NiMHs. They can be repeatedly recharged during one driving session without a noticeable loss in performance. Li-polys can also be more than 6 ounces lighter than typical 6-cell stick packs. Sound too good to be true? Let's put this new battery technology to the test.

IN-CAR TESTING

I used a Team Associated TC4 RTR because it's popular and its 4WD system provides excellent traction on dusty street surfaces. (It was also one of the few cars that I had ready to go.) I left the stock 15-turn motor installed, but I had to solder a Dean's Ultra plug to the LRP speed controller to use the Kokam packs. I also installed a KO Propo receiver-plug extender because the stock receiver is mounted on its side, and that makes connecting the pack's channel-2 lead to the receiver a hassle. My first runs were with the GP 3300 NiMH packs because I wanted to get used to the TC4's performance with conventional cells. After a couple of runs with the NiMH packs, I switched over to the Kokam Li-poly packs.

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with the NiMH packs) and spooled up to top speed in half the time (see "Run time and speed comparison"). The TC4 had no problem handling the extra power, but it felt like a completely different vehicle. I was able to break the tires free in the corners and do controlled drifts with ease. I noticed more tire squeal as well because the car carried a lot more speed in the corners.

What impressed me most was that the car felt punchy throughout the entire run, although the pack's internal cutoff chip started to kick in and the throttle cut out momentarily as the pack's energy was depleted. The car stopped in its tracks less than a minute afterwards, but I was still able to drive it back slowly after letting it sit for a few seconds to let the pack recover some voltage. I did several back-to-back runs switching from NiMH to Li-poly packs, and I always noticed a big boost in performance. These Kokam Li-polys rock!

INSIDE THE FMA SCORPION 2S CHARGER

The Scorpion 2s is designed to charge Kokam Li-poly cells quickly and safely using "cell balancing" technology. The charger checks the voltage and charge current going into each cell many times every second to ensure that the cells are matched to within hundredths of a volt when the charge cycle has been completed.

The charger is easy to use. It's DC-only, so first, you have to connect it to an 11 to 15V power supply. A red LED lights up to let you know that the charger is ready to go, and a replaceable 15A fuse will protect the charger from reverse-polarity damage if you connect it to a power supply backwards. I tested this feature accidentally and soon had a blown fuse—much better than a blown charger. To charge the pack, simply plug its connector into a port on the right side of the charger. The yellow "fast-charge" LED will light up to indicate that the charge cycle is about to begin. A dial lets you adjust the charge rate from .05 amp to 10 amps. To charge the Kokam 3200mAh Li-poly pack, dial in a charge rate of 9.6 amps for a "3C" charge rate (that's Li-Poly-speak; see "What is a C rate?") and then sit back and let the Scorpion 2s do the rest.

Early in the charge cycle, the yellow LED glows brightly and the green "top-off" light flashes slowly. After about 20 minutes, the green light flashes quickly as the pack nears 90-percent capacity, and it stays on at 100-percent charged. It can take up to an hour or more to charge the pack to 100-percent capacity, but you'll find that even at 90 percent, the Kokam Li-polys will provide more run time and punch than a fully peaked 3300 NiMH pack. In fact, Kokam says that for maximum battery life, you should consider a 90-percent charge to be a full charge.



Li-Poly battery benefits at a glance

Kokam Li-poly packs ...

- >>> Can be charged in approximately 20 minutes.
- >>> Have lower internal resistance than NiMH cells, and that means greater punch.
- >>> Can be charged dozens of times without any loss in performance.
- >>> Can handle super-high amp-draw applications.
- >>> Yield higher voltages throughout the entire run for greater punch and top speed.
- >>> Weigh 6 ounces less than typical 7.2V stick packs.
- >>> Can be stored for long periods without damage.
- >>> Do not require cycling or dead shorting to provide optimum performance.
- >>> Are far more cost-effective than NiMH packs.
- >>> Are safe and easy to use.

Li-Poly FAQ

Q: Can Li-poly packs be charged with a charger designed for Ni-Cd and NiMH packs?

A: No. You must use a designated Li-poly charger. Using any other kind of charger will damage the pack and probably cause property damage and personal harm.

Q: Can Li-poly packs blow up or start a fire?

A: Any type of battery can cause a fire if it is shorted out while it's being charged, but there is a misconception that Li-poly cells are prone to spontaneous, rapid failure—complete with flames. This sort of catastrophic failure can occur if the pack is over-charged, and that is why it's important to use a Li-Poly charger. As long as you use the right equipment, Li-poly packs are no more dangerous than the rechargeable cells you're used to.

Q: I already have a Li-poly charger and don't want to buy another. Can I use the one I have to charge a Kokam Li-poly pack using the Dean's plug instead of the charge lead?

A: No. Do not use any charger other than the Scorpion 2s to charge the Kokam Li-poly pack or you'll harm its performance and void the pack's warranty.

Q: Do Kokam Li-poly packs have to be completely discharged before you can charge them again?

A: No. The Scorpion 2s charger will detect the voltage in the cells and will shut down when the pack is fully charged. You can also interrupt the charge cycle when the LEDs indicate a 90-percent charge. Li-poly cells do not suffer from the "memory" problems that are associated with Ni-Cd cells.

RUN TIME & SPEED

I compared the performance of Kokam's 7.2V 3200mAh Li-poly packs and Team Orion's Power Plant GP 3300 NiMH stick packs. I used two of each type of pack, and I ran each in my TC4 RTR test vehicle twice. I averaged the run times, top speeds, and time-to-top-speed info to obtain accurate data from a few runs.

As you can see in the chart, the Li-poly packs outperformed the NiMH packs in every category. The Li-poly packs gave a 16 percent increase in run time and a 10 percent gain in top speed. The important data to look at is time to top speed because the Li-poly powered TC4 was not only faster, but it also reached top speed in half the time.

WHAT'S WITH ALL THE PLUGS?

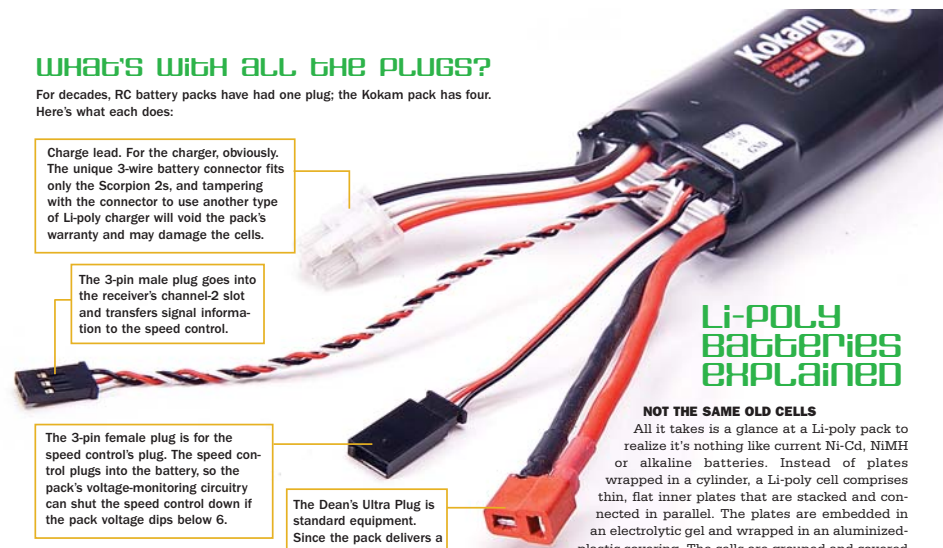
For decades, RC battery packs have had one plug; the Kokam pack has four. Here's what each does:

Charge lead. For the charger, obviously. The unique 3-wire battery connector fits only the Scorpion 2s, and tampering with the connector to use another type of Li-poly charger will void the pack's warranty and may damage the cells.

The 3-pin male plug goes into the receiver's channel-2 slot and transfers signal information to the speed control.

The 3-pin female plug is for the speed control's plug. The speed control plugs into the battery, so the pack's voltage-monitoring circuitry can shut the speed control down if the pack voltage dips below 6.

The Dean's Ultra Plug is standard equipment. Since the pack delivers a higher voltage and longer run times than a typical pack, a Tamiya-style plug isn't the best choice.



LI-POLY BATTERIES EXPLAINED

NOT THE SAME OLD CELLS

All it takes is a glance at a Li-poly pack to realize it's nothing like current Ni-Cd, NiMH or alkaline batteries. Instead of plates wrapped in a cylinder, a Li-poly cell comprises thin, flat inner plates that are stacked and connected in parallel. The plates are embedded in an electrolytic gel and wrapped in an aluminized-plastic covering. The cells are grouped and covered with black shrink-wrap.

MORE POWER, LESS RESISTANCE

Li-poly cells have a nominal, no-load voltage of 3.7 volts. The Kokam 3200mAh pack has just two cells wired in series, but since each is good for 3.7 volts, that's 7.4 volts total. And that's nominal voltage; a fully charged pack yields 4.2 volts per cell, or 8.4 volts for a 2-cell pack. The Kokam 7.4V, 3200mAh Li-poly packs use the latest "super-high-discharge" cells; they are designed to be charged and discharged at much higher amp rates than any other type of currently available cells. Using the FMA Scorpion 2s charger's fast 9.5A charge current, Kokam's Li-poly packs can be charged to 90 percent capacity (2880mAh; more on this later) in about 20 minutes. That's half as long as it takes to peak a 3300mAh NiMH battery pack at 5 amps! Kokam's Li-poly packs are rated at a 20C discharge, which means they can handle a continuous discharge rate of 64 amps and momentary bursts of up to 40C or 128 amps. More voltage equals more punch, but if a pack has a high internal resistance, it can't perform well. According to Kokam, their Li-poly cells have a much lower internal resistance than any other type of cell, and the internal resistance does not increase (even after more than 100 charge/discharge cycles). Kokam Li-polys can be stored for many months and will still retain 90 percent of the charge that was left in them. This is a huge benefit, because nothing does more damage to a NiMH battery pack than not being used. Additionally, Kokam packs weigh 7.8 ounces (218 grams); a typical 7.2V stick pack tips the scales at 14.5 ounces (406 grams). That's a whopping 6.7-ounce weight savings! You'd have to do a lot of chassis grinding to remove that kind of weight. You don't have to be a rocket scientist to realize that a battery that is 6 ounces lighter and has more voltage and less internal resistance can make car go faster, corner more quickly and stop faster than a heavier car with a less powerful battery.

DANGER-PROOF DISCHARGING

Li-poly cells can be damaged if they're over-discharged. For this reason, Kokam Li-poly packs have a built-in voltage cut-off circuit that cuts power to the motor when the voltage drops below 6.

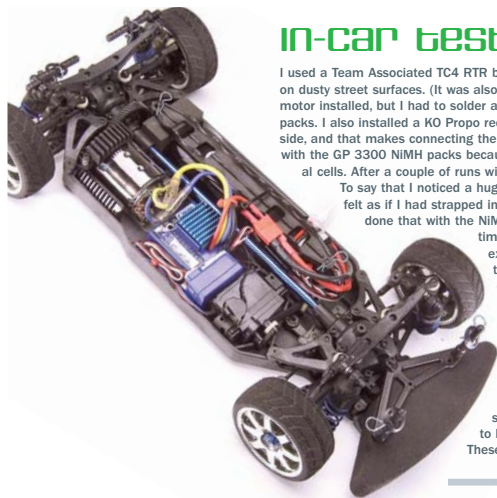
What is "C rate"?

"C rate" is basically the amount of current a pack provides under a load, and it's described as a multiple of its capacity. For instance, a Kokam 7.4V 3200mAh battery pack yields 3.2 amp-hours of current. The pack's capacity is described by the letter "C." A 1C discharge rate would drain the battery at a consistent 3.2 amps and take one hour to dump. A 10C discharge rate equals the pack's amp hours multiplied by 10. In this case, 3.2x10 = 32 so "10C" equals a 32A discharge rate, which would dump the pack in less than 6 minutes. The Kokam 7.4V 3200 pack is rated at a 20C discharge rate—equal to 64 amps continuous—but the pack can handle momentary bursts of 40C, or 128 amps. It would take less than 3 minutes to discharge the pack at 64 amps; even the most powerful modified motors can't pull this kind of amperage, so the Kokam packs are plenty strong enough for RC car use.

COMPARISONS

These are significant numbers, and you can expect your vehicle's top speed and time to top speed to increase exponentially with a more powerful motor than the 15-turn I used for my tests. Also important is that the Li-poly packs were charged to 90 percent capacity. Charging them to full capacity would change the data significantly.

Battery type	Weight	Run time	Top speed	Time to top speed
GP 3300 NiMH	405g	22.11 min.	23.1mph	5.9 sec.
Kokam 3200 Li-poly	218g	24.30 min.	26.8mph	3.1 sec.



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SUMMING UP

FMA and Kokam EaglePicher are on the forefront of Li-poly technology and have put together a battery and charging system for RC cars that outperforms the best NiMH matched packs. Kokam packs operate with less internal resistance and yield higher average discharge voltages than NiMH cells; this means increased

acceleration, top speed and run time. At half the weight of conventional stick packs, the Li-Poly packs will give your motor less of a workout while providing more speed. We are witnessing a milestone in battery technology. I don't know about you, but I'm convinced that Li-poly technology gives electric a much needed boost.