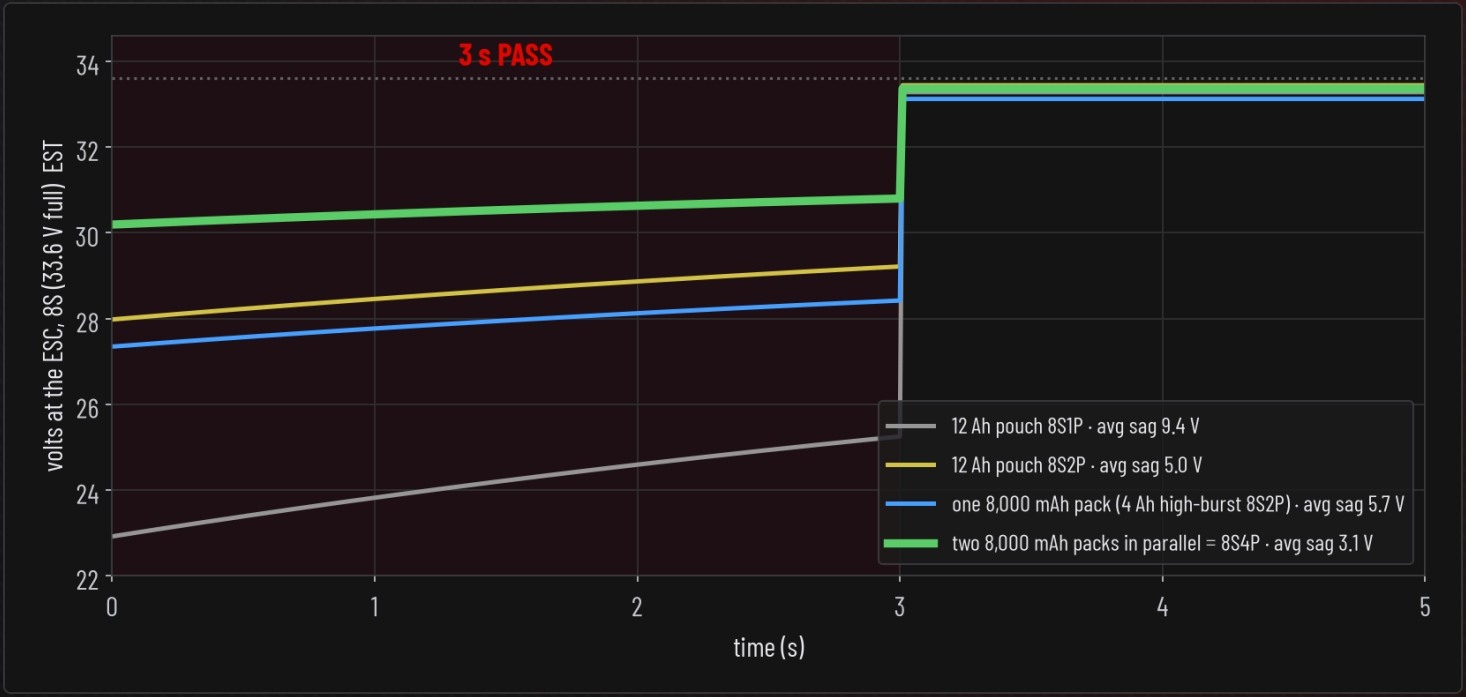
SAG: BATTERY FIRST

How much battery do you need so the volts don't fall away on the launch? Short answer: more cells in parallel. Two 8,000 mAh packs side by side beat one big one.



9.4 V
average sag, 12 Ah 8S1P at the E6 MAX 550 A limit EST

5.7 V
one 8,000 mAh pack (4 Ah high-burst 8S2P), 832 g EST

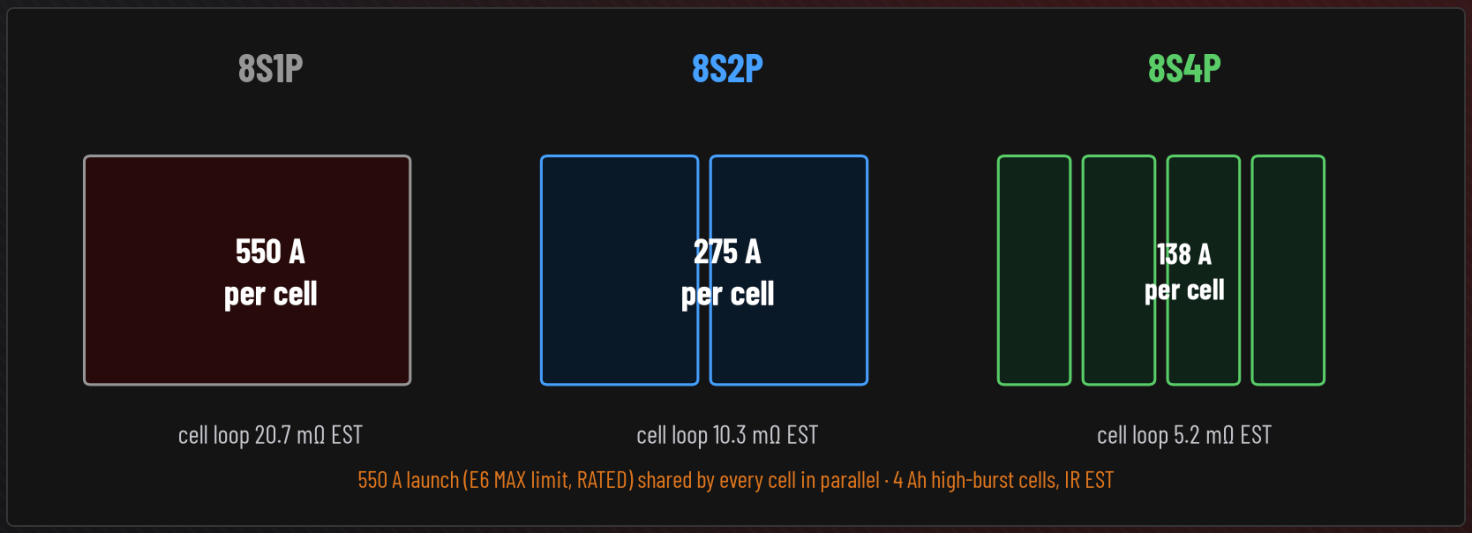
3.1 V
two of them in parallel = 8S4P, 1664 g of cells EST

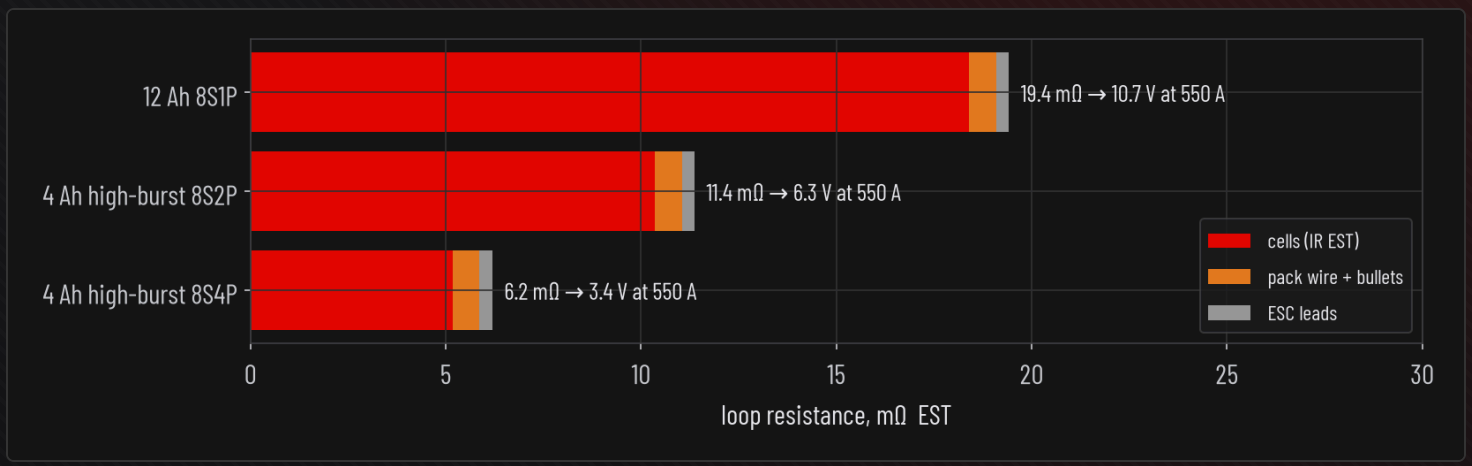
THE RULE: sag is amps × the resistance between the cells and the ESC. Most of that resistance is inside the cells. Cells in parallel cut it for the **whole** pass: 2P halves it, 4P quarters it.

Cells: 12 Ah pouch cell (12000 mAh, 15C burst, 160 g) and high-burst 4 Ah pouch cell (4000 mAh, 40C burst, 52 g), from the cell supplier's sheet RATED. All curves: 8S, 4.20 V/cell, ESC limit 550 A RATED (XC E6 MAX), car load model from the Sag calculator defaults (5000 W, 12 lb, grip 1.2) EST. Cell IR is EST = 0.414 V ÷ burst amps unless you measure it (page 5).

THE CELLS ARE THE LOOP

Every amp the ESC pulls goes through the cells, the pack wire and the ESC leads. The cells are the fat part. Share the amps over more cells and the fat part shrinks.



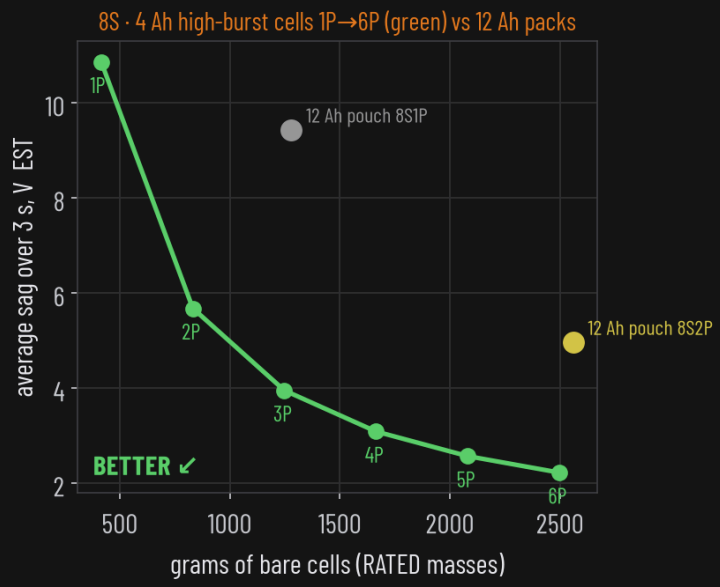


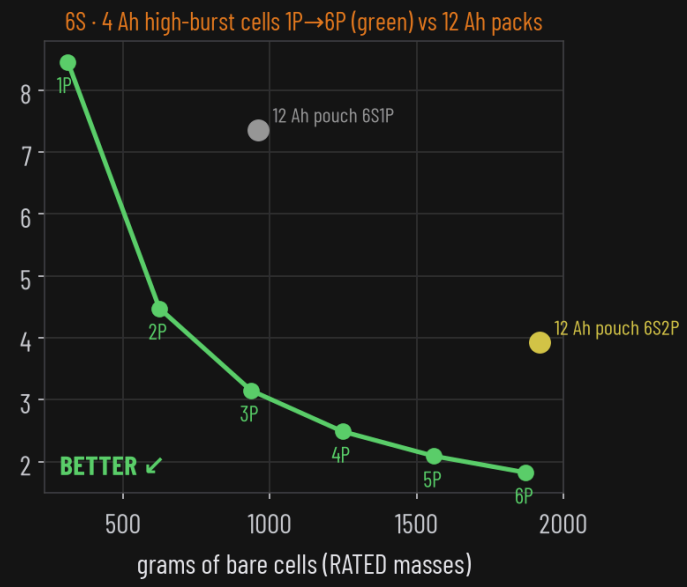
WHAT THAT MEANS: at 550 A, every milliohm costs 0.55 V. Going from one 8,000 mAh pack (8S2P) to two in parallel (8S4P) cuts the loop from 11.4 to 6.2 mΩ EST, and each cell carries half the amps.

WIRE STILL MATTERS, BUT IT'S THE THIN SLICE: short pack leads, good bullets and short ESC leads are worth doing. They won't fix a pack that's too small EST.

GRAMS VS SAG

Every layout, plotted as grams against average sag. Lower-left wins. Small high-burst cells in parallel beat big low-C cells at every weight.



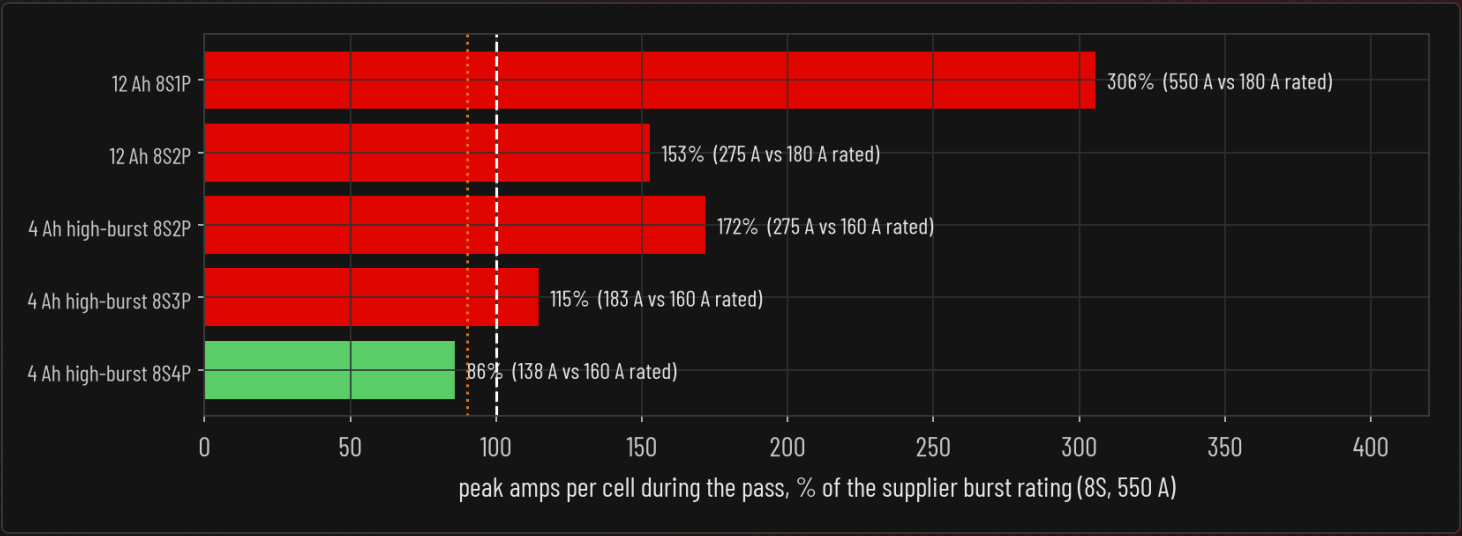


8S · 550 A LIMIT EST	SAG AT LAUNCH	AT 3 S	AVERAGE	CELL VS BURST	WEIGHT
12 Ah 8S1P	10.7 V	8.3 V	9.4 V	306%	1280 g
12 Ah 8S2P	5.6 V	4.4 V	5.0 V	153%	2560 g
4 Ah high-burst 8S2P (one 8,000 mAh pack)	6.3 V	5.2 V	5.7 V	172%	832 g
4 Ah high-burst 8S3P	4.4 V	3.6 V	3.9 V	115%	1248 g
4 Ah high-burst 8S4P (two 8,000 mAh packs)	**3.4 V**	**2.8 V**	**3.1 V**	**86%**	**1664 g**

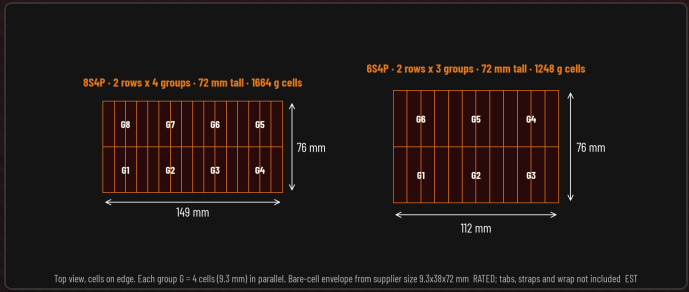
Weights are bare cells only, from the supplier sheet RATED; straps, wire and wrap not included. 6S follows the same order: 12 Ah 6S1P 7.4 V average, 4 Ah high-burst 6S2P 4.5 V, 6S4P 2.5 V EST.

RUN THEM IN THE RED, NOT PAST IT

Sag is one test. The other: does every cell stay inside its burst rating at your ESC limit? The calculator shows it as a % of rating.



HOW TO READ IT: green is under 90% of the supplier's burst rating. Orange (90–100%) is in the red: working hard, still inside the sheet. Red is past the rating: the cell is being asked for more than it was sold to do, and it will sag more and age faster than the numbers here show.



4 Ah high-burst 8S4P / 6S4P layout. Cell size 9.3 × 38 × 72 mm and 52 g RATED (supplier sheet). Envelope without straps or wrap EST.

Burst amps per cell = mAh × burst C from the supplier sheet RATED. Ask your supplier how many seconds the burst rating holds; a 3 s pass needs it for at least 3 s.

MEASURE YOUR CELL IR

Every number in this guide uses an EST cell IR. Your real cells set the real answer. Two ways to get it.

1 · CHARGER IR METER

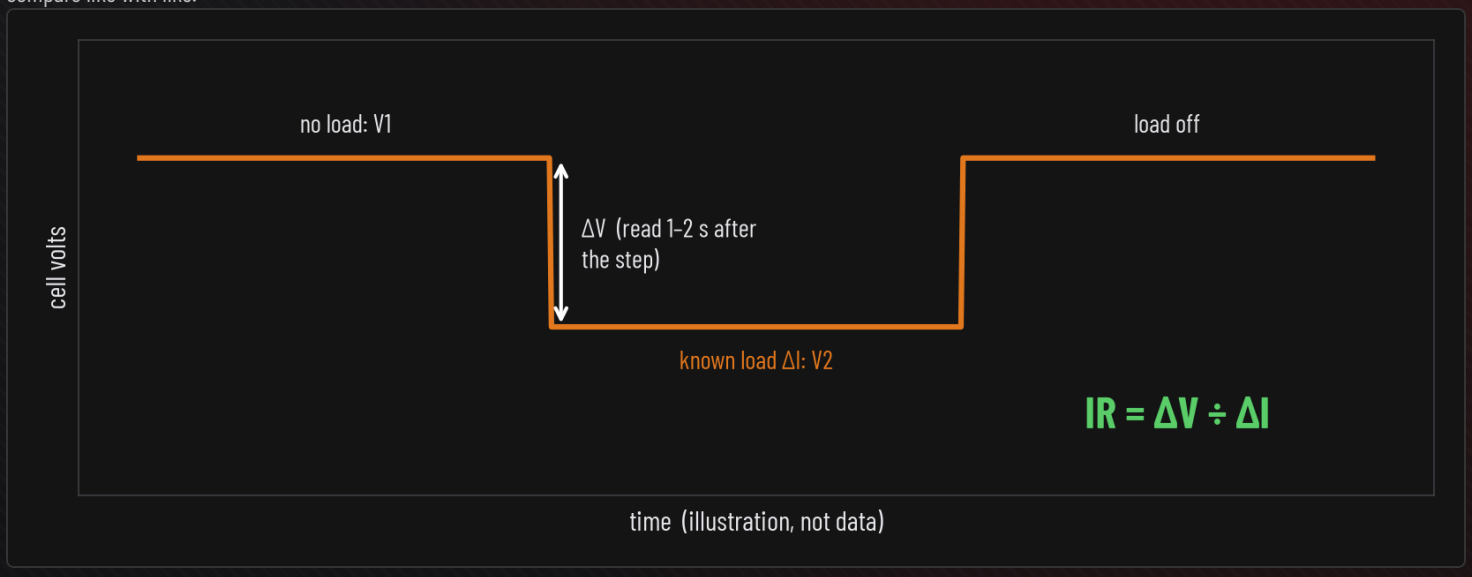
1. Balance-charge the pack, then let it rest.
2. Run the charger's IR / resistance function on the balance lead.
3. Write down each cell (or each parallel group). Same temperature every time.
4. For a parallel group, the charger reads the group: multiply by P to get one cell.

Good for tracking and matching cells. Absolute values vary between chargers, so compare like with like.

2 · LOAD STEP (ΔV ÷ ΔI)

1. Measure the resting cell voltage, V1.
2. Apply a known load current ΔI (a clamp meter on the lead).
3. Read the cell voltage under load, V2, a second or two in.
4. IR = (V1 − V2) ÷ ΔI. Measure at the cell tabs, not the pack leads.

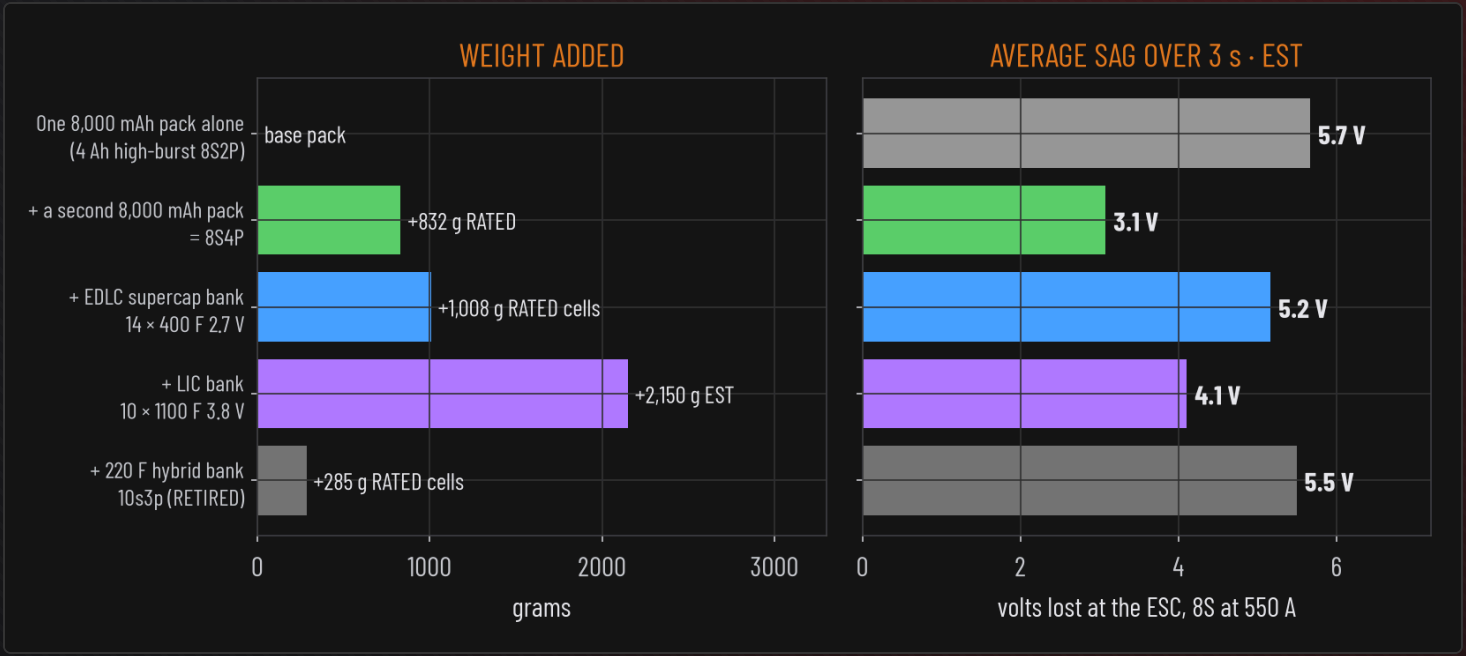
The bigger the step, the better the reading.



PUT IT IN THE CALCULATOR: type your measured mΩ into "Cell IR" on the Sag calculator. Leave it blank and it uses 0.414 V ÷ burst amps EST. Recheck every few race days; a group that climbs well above the rest has a tired cell.

WHY NOT SAG CAPS?

We modeled sag capacitor banks and dropped them. Buy more battery instead. The full picture story is in the 2-page "Why Not Sag Caps?" guide.



FOUR STRIKES:

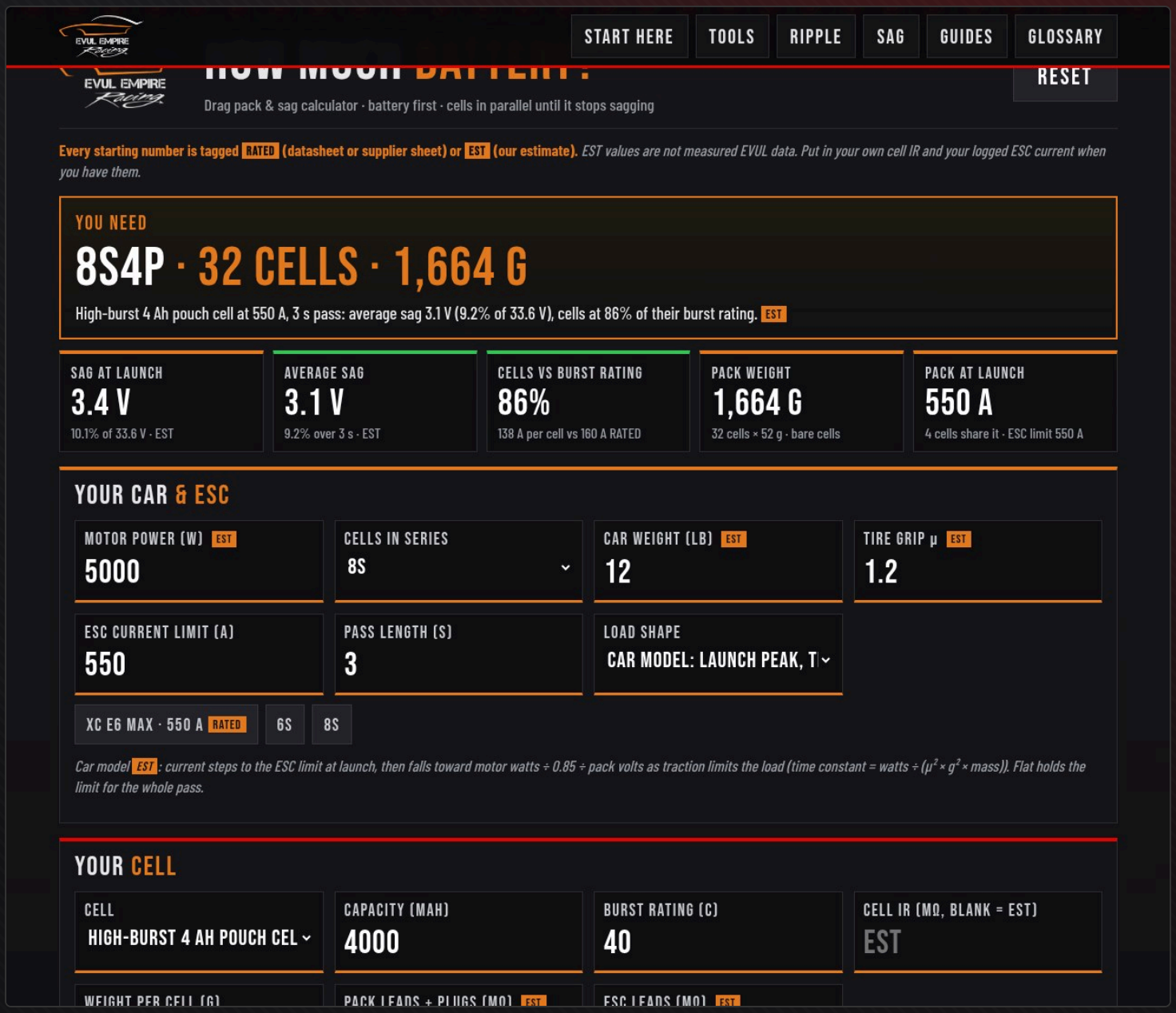
- **Too big:** a LIC bank that could carry a launch is ≈280 × 130 × 64 mm and ≈2.15 kg EST, too big for a 1/7 Outlaw car.
- **Hard to buy:** that LIC cell is quote-only.
- **Costly per volt saved** next to more cells.
- **It fades:** an EDLC bank gives 20% of the current at launch and 2% at 3 s EST.

RETIRED: 220 F 3.8 V HYBRID CAPS, ONE PER CELL. The datasheet limits each cap to 8 A peak and 100 mΩ max RATED. A bank takes under 6% of the launch current EST. They don't fix sag; we no longer recommend them for it.

KEEP THE RIPPLE BOARD. Ripple caps at the ESC are a different job. See the Ripple Pack Build Guide.

RUN THE CALCULATOR

evulempire.com/drag-pack/ · How Much Battery? Enter the car, the ESC limit and the cell, and it picks the smallest P that holds your sag and burst limits.



WHAT YOU ENTER

Motor watts · cells in series · car weight · ESC current limit (E6 MAX 550 A preset) · pass length · cell (mAh, burst C, IR, grams) · your sag target and how far into the red you'll run the cells.

WHAT YOU GET

Recommended P · sag at launch, average and at the end · % of burst per cell · pack weight · every layout from 1P up on one chart.

THEN WATCH IT: the Sag & Ripple Simulator (evulempire.com/sim/) plays the pass and shows how two packs in parallel share the amps, and the sag they save against one pack alone.