

The E-Gull

A high-performance, practical, affordable personal electric aircraft.



The E-Gull is an Earthstar ThunderGull converted to electric power with a Zero Motorcycles electric drive system. Mark Beierle is the owner of Earthstar and the designer of the Gull and several other aircraft. Mark has performed and assisted in numerous electric conversions using the Zero Motorcycle drivetrain, starting all the way back in 2013. Gabriel DeVault helped start Zero Motorcycles and ran the R&D dept. for Zero for over 5 years and was instrumental in the creation of this excellent EV powertrain.

This ThunderGull is fitted with a 28' wing and is a time proven design, having excellent handling, safe flying attributes, and is also a very efficient airframe. There are several 100's of 'gulls in various configurations currently flying with an impeccable safety record.

The Zero Motorcycles power system is also a very mature design, having been evolving for 13 years, and largely the same for the last 6 years at the time of this writing. There are 10's of thousands of Zero Motorcycles on the road having accumulated millions of cumulative miles. They are very powerful and robust drive systems and the batteries feature true "EV Grade" cells, good for thousands of cycles and ~10 years of service.

Specs:	Performance:
Single Seat	VNE: 120 mph
28' Wingspan	Max Climb: ~1500 ft/min
69" 3-Blade Propeller	Cruise: 60 mph
40kW motor/controller	Duration: ~1.25 hours
12kWh Battery	Range: ~ 75 miles

Here are some pics and vids of the E-Gull. Make sure to poke around on my youtube channel for the latest vids!

<https://youtu.be/6EfOvA4ROpU?t=28>

<https://www.youtube.com/watch?v=O6ZkouelHcs&t=4s>

<https://www.youtube.com/watch?v=up8pSdh2FNE&t=96s>



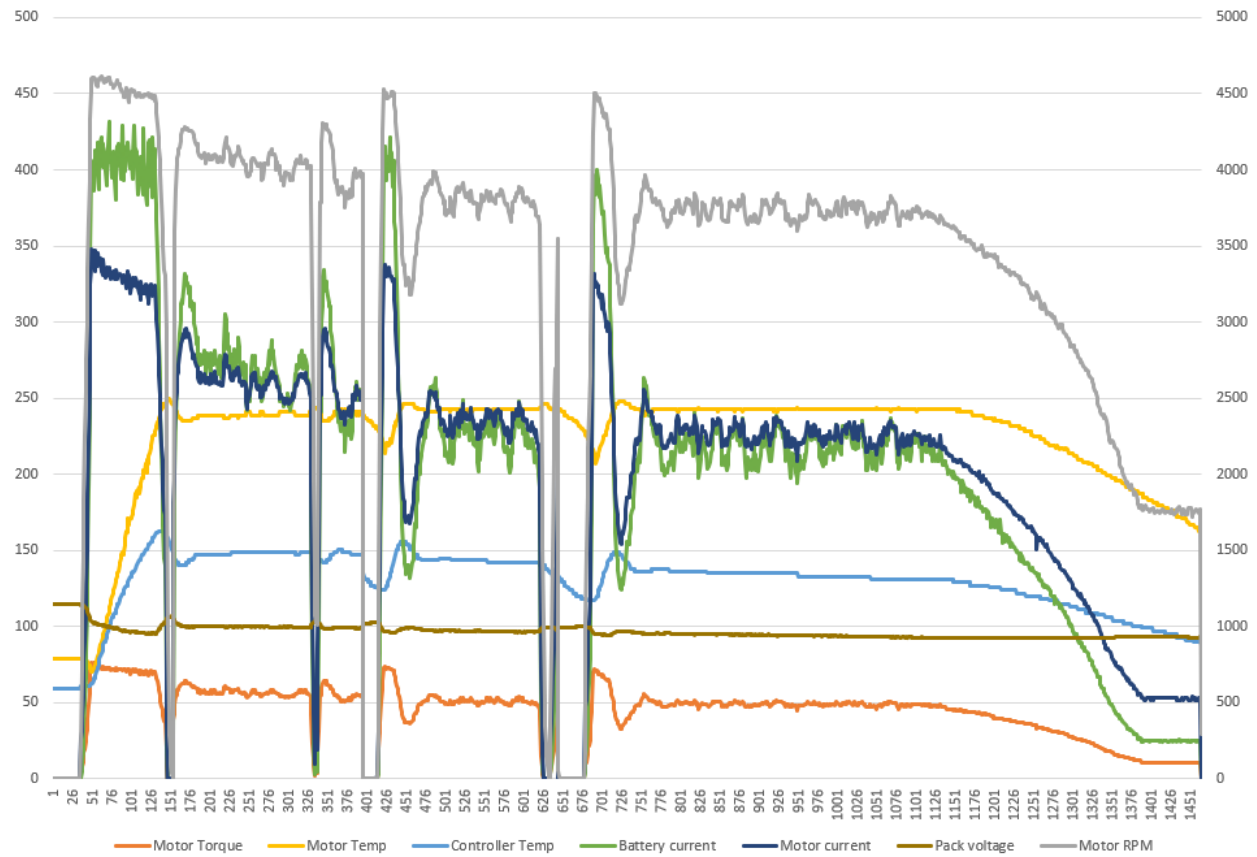
Here are some of the unique attributes of this electric aircraft.

Instant full-power any time you want it.

No hesitation, burbles, or hiccups. You shove the throttle forward and she goes, hard. The power/weight ratio of this setup exceeds any ICE equipped version of this aircraft ever built. And it will put out maximum power at any altitude, any temperature, humidity, etc... She delivers 40kW/55HP no matter what. Well almost... The motor, controller and battery all have maximum temperature limits that can be reached if you push this system REALLY hard. A maximum performance static test was performed, the powertrain delivered 40kW for ~ 2 minutes before reaching max motor temperature. At this point the system automatically reduces power to keep the thermal and power settings in equilibrium. This equates to about 25 kW continuous power in standard conditions, with no special cooling provided. Oh, did I mention, these are older Zero

drivetrain parts, and the new stuff performs even better. They even just released an 82kW/110HP drive system!

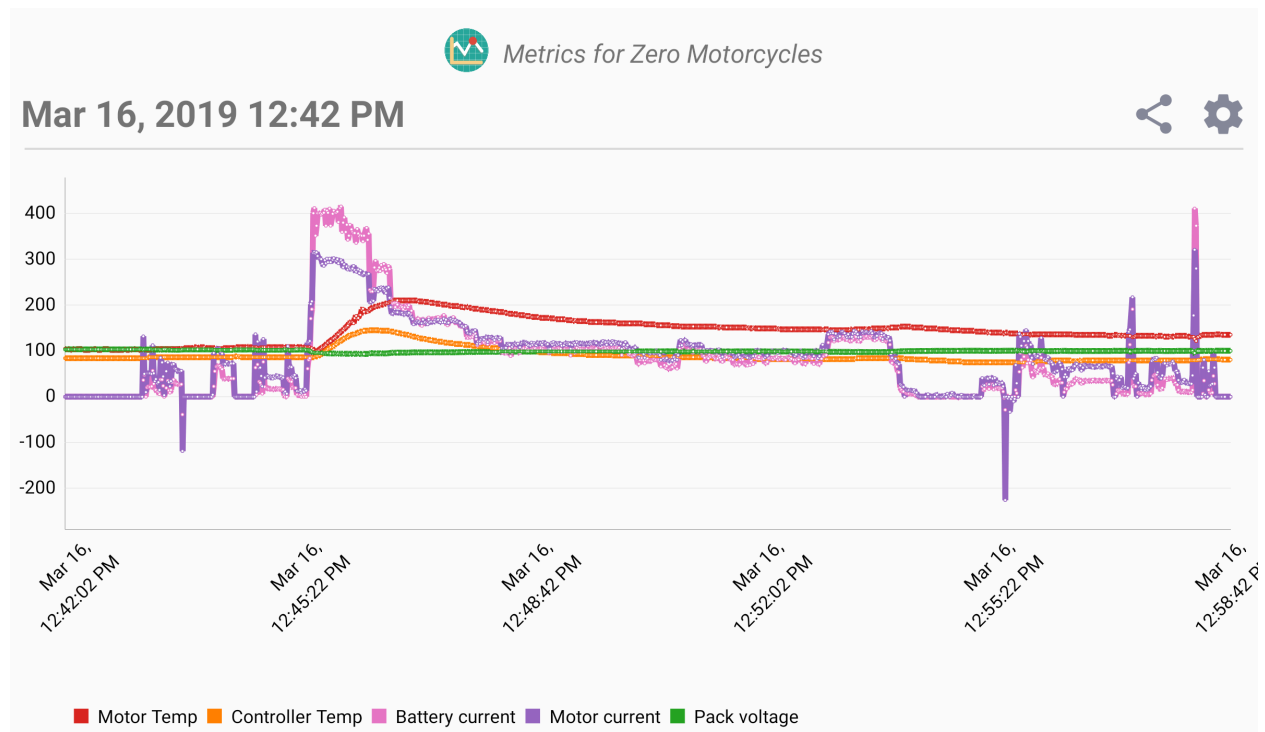
Here is the data from the static maximum power test. (A few hiccups due to logging issues)



Low power cruise.

Due to the efficient airframe and drivetrain setup, this plane will cruise at 60mph at only 8kW power. This is less power than the Zero Motorcycle itself uses to go this fast, and we're flying :) Again, this is an older airframe and Earthstar has newer and more efficient airframes available now. I think the most current design, with the 32' wing, and built very cleanly, could get the cruise power close to 6kW. Combined with the latest and largest Zero Motorcycles battery, I think flight times could reach an honest 2 hours.

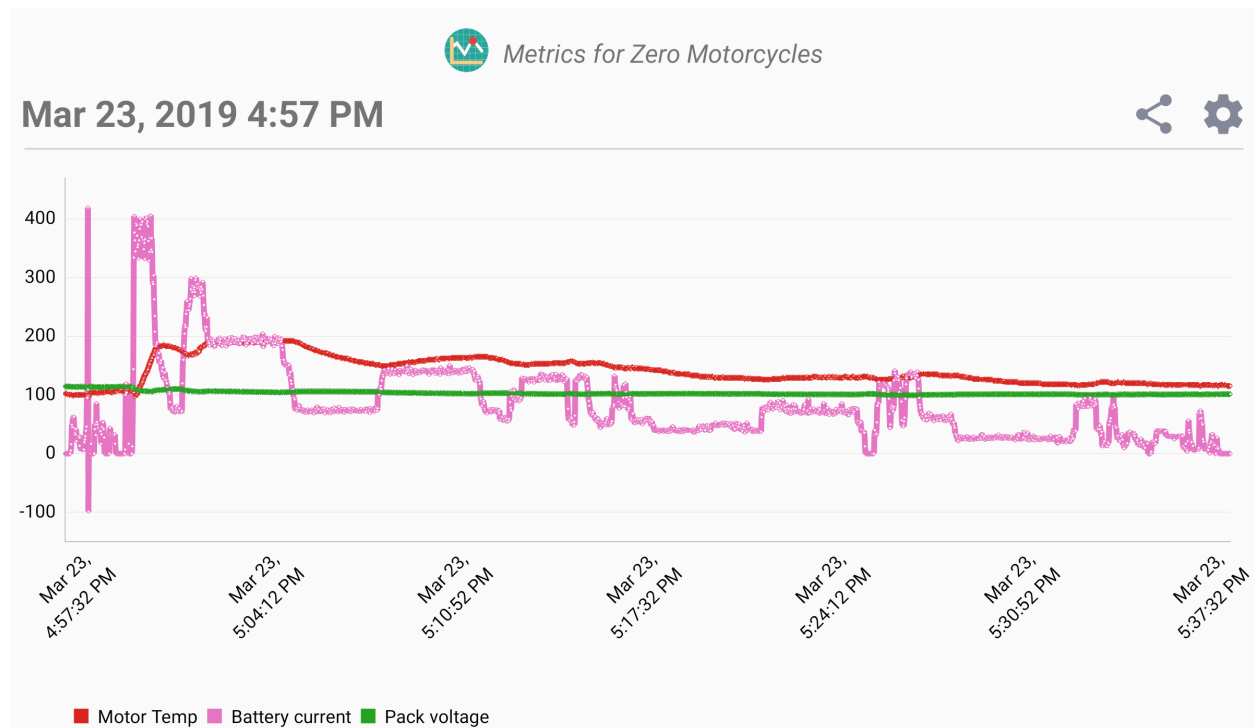
Here you can see cruise power is at <10kW in the middle of my flight.



Power assisted soaring.

This is one of the coolest features that an airplane setup like this enables. With only 2 or 3 kW power into the prop, the glide ratio and sink rate are dramatically improved. It's basically "Easy Mode" soaring. Almost all the fun, with essentially none of the risk associated with true soaring. And even better than ICE motor-gliders, because you know the motor is going to start instantly, every time. And you can even run for very short periods of time, or power settings below what you can achieve with an ICE engine. The battery will happily deliver this amount of power for several hours.

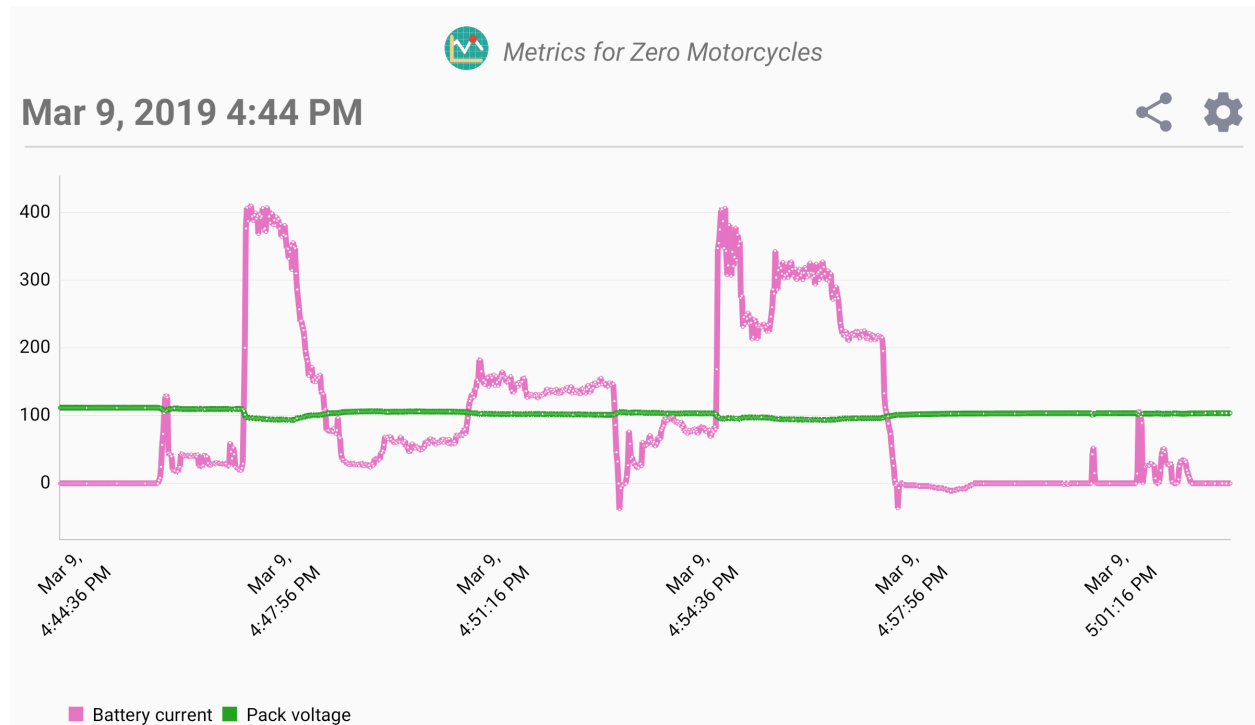
Notice the last 20 minutes of this flight at less than minimum cruise power!



Regenerative Soaring and Decent

Yes that's right, you can actually charge the battery while soaring in strong lift or during descent! Admittedly it's not a whole lot, and there's still a lot of R&D to do in this area, but it really does work. Maximum observed regen has been 1.5kW.

@4:58 you can see ~1minute of sustained regen of ~1kW.



Fast Charging

The benefits of using a popular EV drivetrain show up here. In collaboration with DigiNow, who make awesome aftermarket chargers for Zero Motorcycles, we have created an off-board 10kW charger system. This is the maximum you can draw from a standard 14-50 plug which provides 220v @ 50Amps. If your hangar has 220, you can probably run this charging setup!

The math is simple, charging a 12kWh battery from empty at 10kW takes just over an hour. Because we endeavor to always land with at least 25% in our battery for safety and battery health, this means our average charge times are under an hour. Much like a Tesla or any other modern DC charging system, Diginow's charger is intelligent and monitors pack temps and health, and only delivers as much power as the battery can safely handle.

Simply unplugging a charge cable sure makes filling a plane with petrol seem archaic!



Is Wally hand-cranking a pump to get fuel into that airplane? And that's after having to fill jerry cans from the nearest gas station and dump them into the transfer pump. Might as well fire up the coal burners and get a head of steam going on that thing!

Low cost operations

A “donor” Zero Motorcycle will likely cost you ~\$10k-\$15k , this is currently the only way to get a powertrain from them. You can probably get one for less, but this is not the place to scrimp!

This powertrain will give you several thousand cycles with zero maintenance required! If we assume that each cycle is good for ~1 hour of flying this equates to a conservative 2000 hours of electric flight. With charging costing ~\$1-\$2 per charge we are looking at around \$10/hr of flight amortized over the life of the battery. And trust me, in 5 or 10 years there will be even better batteries and you will be ready for an upgrade!

In comparison, a Rotax is likely to cost ~\$20k, and it will burn 2-4 gallons an hour, over 2000 hours that is \$20k-\$40k in fuel alone! Add in the initial purchase price and a major overhaul or two and other service, and you are looking at \$30-\$40 per hour to operate, amortized over 2000 hours. At the minimum!

And the lack of service of the electric system is very real, you simply do not have to touch it!

If you are going to fly a lot, the financial benefits of electric are just undeniable. We are looking at operational costs of less than ¼ of an equivalent ICE aircraft.

Instant upgradeability

In 5 years the Zero Motorcycles powertrain will be even better than it is now. Battery capacity will likely increase 50-100%, as it has historically. And there are even newer battery technologies on the horizon that could more than double our current capacity!

As long as the newer bikes and power systems are still roughly equivalent, upgrading to the new system could be a simple one day install, and even if things have to be re-engineered a bit, it's still trivial compared to installing an ICE system.

Imagine just installing a new battery and changing nothing else, and getting double the flight time and range. That would bring the current aircraft to ~2.5 hours and 150 miles range.

With the rapidly increasing performance and energy density of EV power systems, the sky's the limit!