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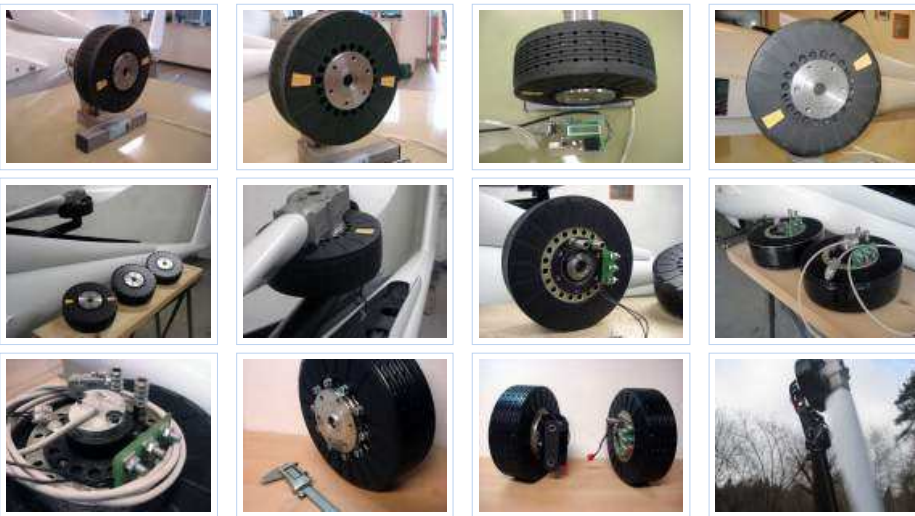
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EMRAX motors

EMRAX motor/generator is our main product. We developed it and now we will started serial production. You cannot find so light and so powerful electric motor on the market yet. EMRAX motors are suitable for electric vehicles, power plants, wind and hydro power stations. The main facilities are: low weight (11kg), high power, high torque, direct drive.

They not need mechanical gear box and waste the energy to reduce the final rotation.



Technical data

Technical data	Type	EMRAX Air Cooled AC speed 25 m/sec, 20 °C	EMRAX Liquid Cooled LC	
	Power dc 2 min / continous at 200 V DC [kW]		40 / 25	40 / 25
Power dc 1 min / 2 min / cont. at 300 V DC [kW]		50 / 40 / 30	50 / 40 / 30	Not tested yet
RPM at 200 Vnom / max 300 V DC		2000 / 3000	2000 / 3000	up to 2000 RPM std up to 3000 RPM non std
Cont. current DC/AC ph. [A]		120/170	120/170	peak current 3 min 200A _{dc}
Torque peak 1 min / cont [Nm]		250 / 120	250 / 120	For EV could be direct drive
Efficient % (low / high RPM)		90 - 94	90 - 94	Economy test HWFET 94%
Dimensions diameter / long [mm]		Φ 222 / 81	Φ 225 / 81	/
Star wire resistant [Ω al 25 °C]		0,018	0,018	/
Phase current density at 30 kW [Amps/mm ²]		19	19	Peak 1 min 40 Amps
Magnetic flux		Axial	Axial	Duble gap
Temperature sensor of the motor		kty 81 210	kty 81 210	/
Number of pole pairs		10	10	/
Weight [kg]		11,2	11,5	/

Note: We reserve the right to change the technical data.

EMRAX tests

These are first tests with sensorless SAC 40 Piktronik's controller at 2000 RPM on the motor. Switching frequency is 7,5 Kz. The parameters for the first tests on SAC 40 had not in the best positions in that time. Now the parameters are OK. So we start to



VIDEOS

Electric Glider Apis - EA 1 - Future



Electric Glider
Future now. T
pass. August 2

Electric Apis EA1 powered by EMRAX to 3000 Ft in 4,5 min



Electric Apis E
by EMRAX mot
3000 Ft in 4,5
February 2010

Demonstration EA1-EMRAX with pr RPM AERO 2009



Demonstrati
with prop at 4
2009. April 200

Test the electric motor EMRAX 2 or EA1



Test the elect
EMRAX 2 on th
December 200



produce the first small quote of SAC 41 controllers air cooled for known customers which have bought also the first prototype EMRAX motors. Piktronik's controller has controll commutation with back EMF and also for start RLS encoder for max start torque controll comutation.



Also we are developing our new controller which will have the same prepositions as Piktronik's controller. Different will be especially the lower price. From our new controller we expect even better results.

SAC41 and our new controller will have hall sensors "RLS" which can also controll each position on the motor shaft - for example: It can hold the propeller in the vertical position to put it in to the fuselage between flying. The new controller will be finish and tested soon.

Tests on engines have shown us the real results of the engine under different conditions and loads. On this basis, we decided to write technical information in the table that are at least 20% lower than nominal. With this infos we add the safe operation of engines even in extreme conditions.

Most producers of similar motors speak about the peak powers which could lasted for a **few seconds**. We can say that our motors can drive peak power for a **few minutes**. So this is very important data. Also we made many tests with standard EMRAX motors on our aeroplane even on 40kW/2000 RPM which lasted for **many minutes** - take a look at videos.

[Read more for the EMRAX tests ...](#)

EMRAX TESTS

Main Features

New EMRAX motor-generator is suitable for airplanes, boats, EV, power plant, wind and hydro power stations, step motor.

They are liquid or air cooled. Liquid cooled motors could be combined with air cooled system to get better duration of power. Liquid Cooling flow (double tube row in stator) is 0,2 l/sec - inlet water 30°C.

For air cooled motors the air speed must be 25 m/s at max air temp 25°C.

For EV (direct drive system - two motors on each front wheel axes) and some similar options motors need encoder sensor (RLS) which improves the motor efficient too. Also the airplanes need it, if they need propeller stop position.

Motor can run also as sensor less option (boat and airplane version).

At the moment useable controller is SAC 41 LC from company [Piktronik](#). We are also developing [our new controller](#), which will be air or liquid cooled with [encoder application RLS](#).

The motors and controllers have slope temperature protection. Motor slope temperature protection starts at 90°C on copper windings and reducing the power to the minimum at 115 °C. Controller has slope temperature protection from 70/85°C.

All motors use 3 phases sin wave commutation. They have no cogging, no vibration. High torque at low RPM can give high power with no noise with the best efficient.

Motors can regenerate the electric energy into the batteries.

High torque allows direct drive systems and hence increases the efficient.

EMRAX motors are the most noiseless compared with the other BLDC motors.

Power on standard version EMRAX is 40 kW/2 min at 2000 RPM, continuous power is 30 kW at 2000 RPM. They are the lightest motors in the world. The weight is only 11 kg - they are the lightest & the most powerful motor on the world market.

EMRAX Patent

The motors (air and liquid cooled) got a patent on 6th of April 2010.

Patent number is: **P-201000114**

Pricing and buying

Now we are selling the motors as **prototype motors**. **Also the controllers**. So we can't give any warranty because many customers develop their own complet electric systems with our motors/controllers. We can just show them our tests on our electric plane which show the real situation. Take a look the movies on YouTube. In near future we will also make a prototype version for EV as direct wheel drive system. After that we will represent tested data.



In terms of buying the motors and our controllers - the customer has to sign the mutual NDA agreement.

The price is similar to **the same powered brush motors**. For the pricelist ask us by email: enstroj@siol.net The price depends on the amount of ordered motors.

Modifications

We can also design special options of EMRAX motor for lower or higher voltage, for lower or higher RPM in the same housing, which can be modified, for different power, torque.

Tested on glider plane Electric Apis EA1

The EMRAX motors have been tested several times on glider plane - Electric Apis EA1. Electric Apis EA1 is one of the first electric sailplanes in the world



and the first one in **Slovenia EU (the first flight was 18. April 2005)**. It can take off with an electromotor and climb up to altitude 1800 m at 50%DOD, even to **altitude 3000 m at 90%DOD**. The altitude depends on the percentage of the discharging of the Li-Poly batteries. The best recommended discharging of the batteries is about 50%DOD. In this case the altitude is app 1800m and the batteries can give 1500 cycles. More info here: http://kokam.com/english/product/kokam_Lipo_01.html



We developed EMRAX electric motor because there was no suitable electric motor for direct drive propeller in the world market. The high powered - BLDC electric motor EMRAX 30 kW continuous power is reliable for each altitude. **It operates with minimum noise and gives high power and excellent torque at low RPM (direct drive prop) for best climbing up to 6,0 m/s.**

In the future solar cells on the wings will give enough nature energy for many take offs and the plane will climb much over 3000 m of the altitude.

AMS flight used to produce APIS sail planes in many versions. The company PIPISTREL is now a new owner of APIS gliders project now. More info here: <http://www.pipistrel.si/planes/721>

In 2004 we got kit version of Apis EA1. Besides developing an electric propulsion system, we also change the canopy design, made more effective inner ventilation, developed the retractable wheel with shock-absorber and many new designs for electric power system. The retractable wheel improves L/D = 41:1 and it also visually improves the stream line of the plane. The doors on the body are closed when the motor with the propeller is outside or inside of the fuselage. The electric system does not produce noise, it is clean, safe, reliable and virtually maintenance free. We are in favor to make reliable innovations, which are the most important for comfortable in enjoyable flying.

Technical data and performance of glider plane Electric Apis EA1

Technical data and performance of glider plane Apis EA1 using the NEW tailor-made brushless electric motor named EMRAX. The last tests on the new EMRAX air cooled prototype electric motor (Dec 2009) mounted on EA1 - show us excellent results:

Electric Apis EA1 - Technical data and performance

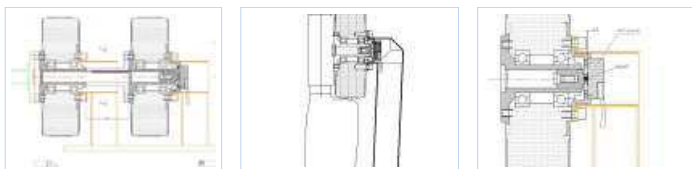
El motor	brushless EMRAX (produced by ENSTROJ) the first prototype
Electric motor weight	11,5 kg
Controller DC/AC - Piktronik	SAC - 40 (aircooling)
Engine peak power (2min)	40 kW - 68 HP (aircooling 25 m/sec) at 200V DC/2000 RPM
Torque continuous/peak	130 Nm/ 250 Nm
Engine speed EA1	1900 RPM at 200V DC (direct prop drive)
Propeller diameter EA1	1,7m (new one on EA2 will be 1,8m)
Static prop thrust (prop 1,7m)	1150 N (New plane EA2 has the prop 1,8m - static thrust is 1500N!!)
Batteries Li-poly - power capacity	8,0 KWh
Capacity current	40 Ah
Voltage DC	200 V
Batteries weight	54 kg
Charging time - depend of DOD	4 - 6 hours/230V
Take off distance on grass/ time	80 m (in 8 seconds)
Take off distance on asphalt/ time	50 m (in 5 seconds)
Max climb rate	6,0 m/s
Max altitude 50/90% discharging	1600m (3000m)
Best glide	41 : 1 at 95 km/h
Empty weight	240 kg
Max take off mass	350 kg
Max horizontal flight distance	200 km

Options

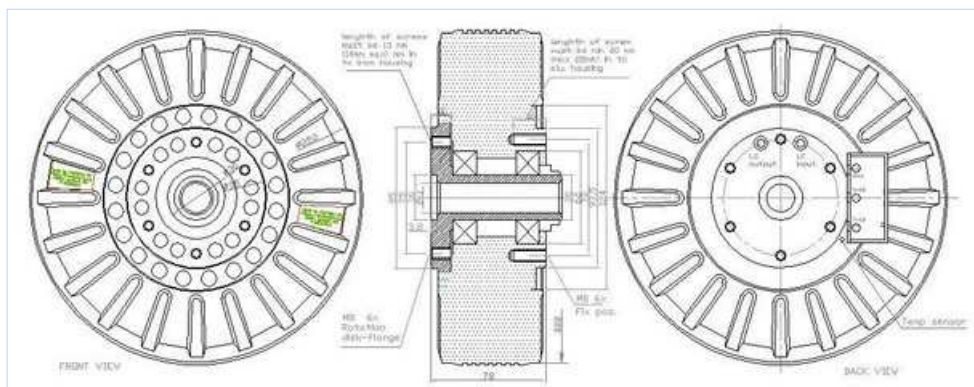
Engine peak power (30 sec) 75 kW (100 HP) aircooling 20 m/sec at 300V DC/ 3000 RPM (it is possible - not tested yet)

EMRAX as Duplex an option (one after another) - the power and torque is doubled

Mounting options



EMRAX dimensions



Videos - EMRAX electric motor on Apis EA1

In 90 seconds climbs up to 350m - included take off. Temperature on copper EMRAX prototype 30kW (41HP) air cooling motor windings was only 70°C. Max altitude is 3000m at one charging the batteries.

Video: Take off and retracting the propeller in to the fuselage EA1

NEW Video: Take off on asphalt running way

Video: Take off Ferlach, Austria

Video: Take off, low pass, landing