DUBINA 2021 ENG

Anton Dubina

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Revolutionary technology

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The most powerful in the universe

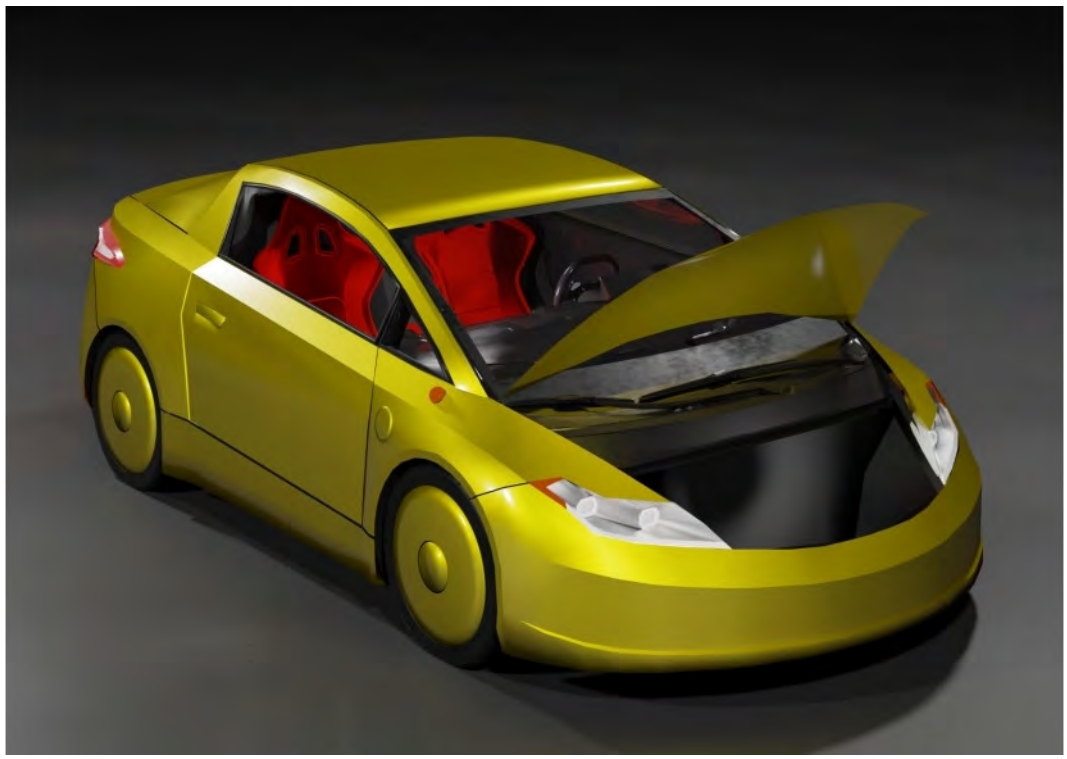
“The use of electric transport
the best change in the 21st century”
Anton Dubina

We live in a world of evolving technology. A car is a technical device made up of many parts that change with technology. There are over a billion internal combustion engine vehicles registered in the world today. Toxic substances in exhaust gases cause lung disease and cancer in people living in cities. The design of an electric car does not have large mechanical components such as a starter, carburetor, gearbox. A car with an electric motor accelerates faster. It is in many ways superior to a car with an internal combustion engine. All the wonderful possibilities of the electric drive have not yet been revealed. It will take many years before its properties are fully realized.

In 2014, I started working on an electric car project. At the time, I was surprised at the lack of electricity-powered cars in cities. People can come home

from work and charge the car at night, when the electricity tariff is lower, and go about their business in the morning without wasting time at the gas station. But somehow they don't. Probably because there are few models of electric cars in the world and their prices are too high. So I made the decision to make a nice and inexpensive electric car.

When designing the DUBINA EVO, I was guided by rules that improve the design. The desire to create the perfect car helped me make the right choice and find the right solution. The distinguishing feature of my sports car is that it combines the best properties with optimized value for money. Car production is carried out with minimal material costs with a fast, streamlined mechanism. The entire production process is carried out in a small factory. To avoid stopping the production process, assembly operations independent of each other. When making a car, we must not forget about ecology. A large number of parts are made from recycled household and industrial waste. Our responsibility is to keep our planet green, the sky blue and the horizon bright. This issue presents my results for 2020. During this year, many technical solutions have been made that have improved the design of the car.



I am interested in your feedback. As a reader of this book, you are the most important critic. Your opinion is valuable to me, and I would like to know what went right, what could be done better, what topics would you like to see and any other wishes you might have. You can send your messages by email.

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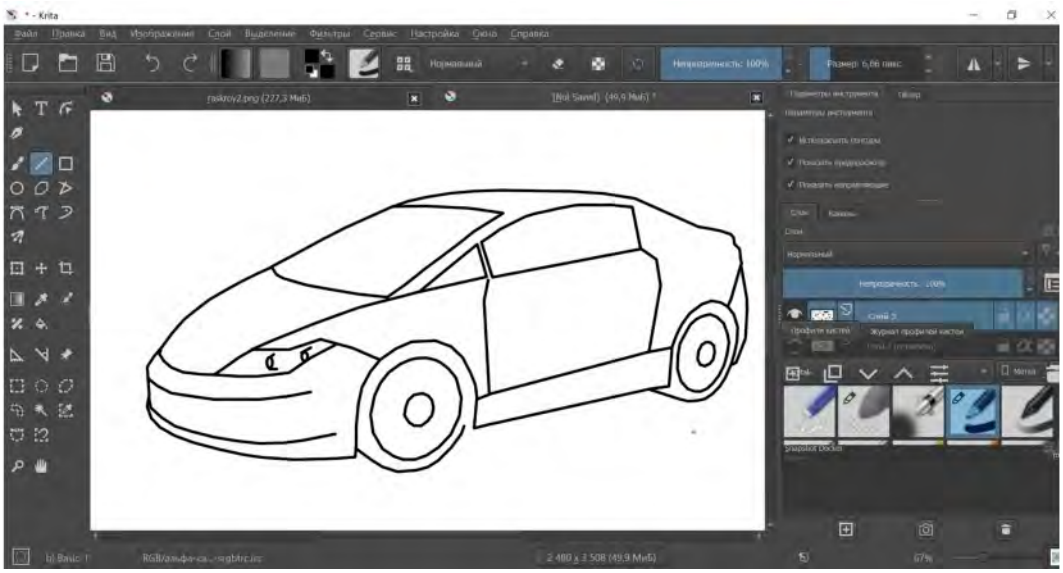
Materialization visualization

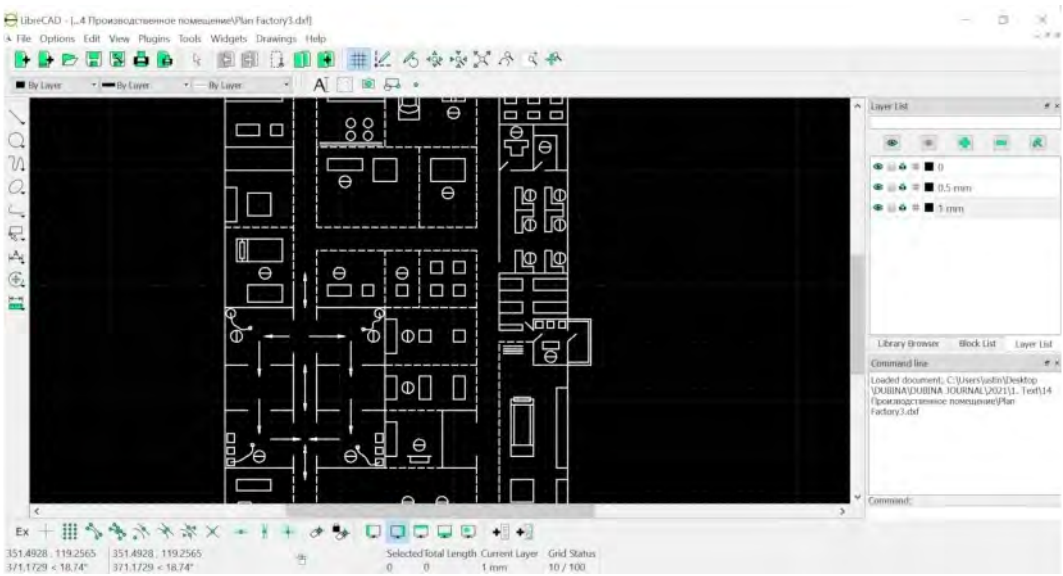
The basis of the project activity is software. Design tools are programs that perform various functions. The creation of the DUBINA EVO vehicle information model began with a preliminary design. The sketch was created in the free bitmap graphics editor Krita. It is open source software included with KDE. Krita is developed primarily for artists and photographers and is distributed under the terms of the GNU GPL. The program supports non-destructive editing of layers and masks, work in various color spaces and with various color models — RGB, CMYK, LAB, in the mode from 8 to 32 bits with floating point per channel. In addition, popular filters (such as unsharp masking), adjustment layers, masks and dynamic filters, as well as a series of retouching tools are implemented. However, the main priority of the developers is the realization of opportunities for artists. The concept of the car, its overall dimensions and design features were presented in the draft design. After determining the main dimensions and design features, drawings of the future car were created.



Krita program interface.

Drawings were made in the LibreCAD program. LibreCAD (formerly CADuntu) is a cross-platform, open and free CAD system for 2D drafting and design, built on the basis of QCad. LibreCAD allows you to solve problems of two-

dimensional design, such as the preparation of engineering and construction drawings, diagrams and plans. Works under Linux, Windows and Mac OS X operating systems. Distributed under the GNU General Public License version 2. The source code is written in the C ++ programming language using the Qt libraries. Further, a three-dimensional model was built using the drawings. The Blender program is optimal for 3D modeling. Blender is a comprehensive program that combines all the current 3D modeling capabilities. The program is not demanding on the characteristics of the computer, it is possible to carry out design planning, organize an assembly structure and prepare a model for printing on a 3D printer. The use of all basic types of modeling: free forms and sculpting, working with solids (including direct editing), the ability defining parametric dimensions, as well as support for obj and stl formats as imported geometry. All elements that are modeled can be used as further templates for work. The software supports various 3D file formats for import and export, including Alembic, 3D Studio (3DS), Filmbox (FBX), Autodesk (DXF), SVG, STL (for 3D printing), UDIM, USD, VRML, WebM



LibreCAD program interface.

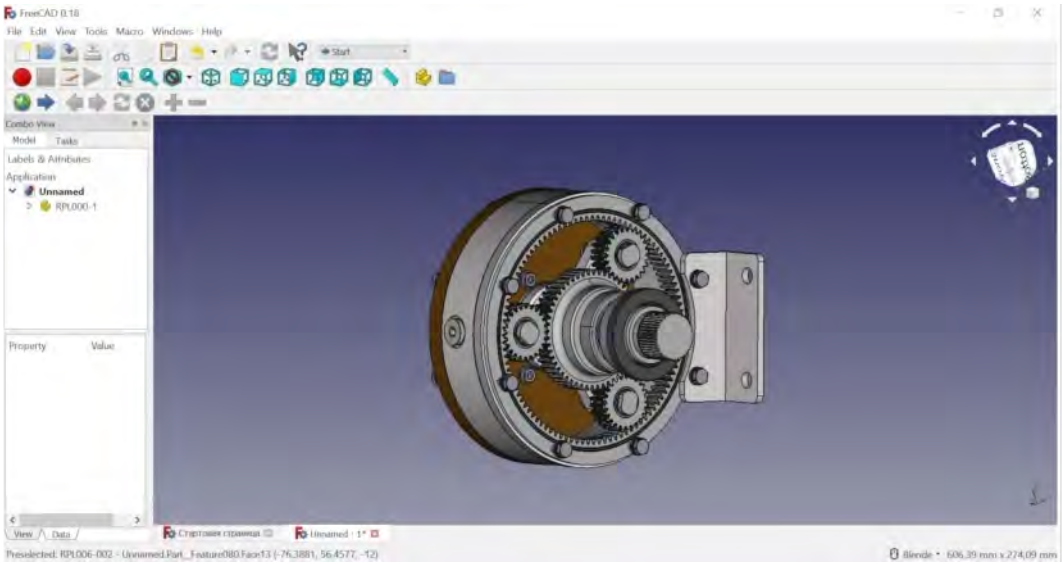
Three-dimensional models of car parts were assembled into assembly units and connected to the main parts of the car. The car body was built in sculpting mode. The construction was started by creating one polygon, which was split into 4 equal polygons. Adding one polygon after another gave the body shape. In places requiring more polygons, polygons have been subdivided by the required number. After constructing and editing the longitudinal half of the body, the symmetry modifier was applied. The modifier creates a symmetrical copy of the part. The resulting part changes its shape when the original part changes

its shape. By connecting two symmetrical parts of the body, the result is a body when changing, the shape of which on one side changes the shape of the other side. To give the body smooth, smooth lines used three-dimensional patterns. A cylinder was used to build an even circumference of the wheel arches. By applying the cylinder to the wheel arch as a template, the polygon lines were aligned. To draw straight lines on the doors and the threshold of the case, rectangular planes were used. Three-dimensional patterns allow you to check the straightness of polygon lines from all sides. To visually determine the smoothness of the shape of the case, materials with a glossy surface are used. The visual determination of surface smoothness is influenced not only by the type of material, but also by the color.

Blender program interface.

Details of mechanisms, gears of reducers were made in FreeCAD program. FreeCAD is an open source general purpose parametric CAD system (based on the LGPLv2 + license). The basis of geometric modeling of solids in FreeCAD is the principle of boundary representation, at the same time there is support for polygonal meshes. The geometric core of FreeCAD is OpenCASCADE. In addition to mechanical engineering tasks, FreeCAD can be used for tasks such as architectural design, or engineering analysis by the finite element method. Freecad supports over 30 file formats for importing. For the manufacture of car parts, 3D printing was used. 3D printing technology is universal. Part size for 3D printing is limited only by the size of the printer. A 3D printer is a peripheral device that uses the method of layer-by-layer creation of a three-dimensional object from a digital 3D model. No additional equipment is required for 3D printing. All types of parts are produced on one printer. In order to print a part on

a 3D printer, you must first convert the original 3D model format into a G-code. G-code is a conditional naming of the programming language for numerically controlled devices (CNC). It was created by the Electronic Industries Alliance in the early 1960s. The Slic3r program is used to convert STL format to G-code format.



FreeCAD program interface.

In this program, you can set the print speed, fill factor and more. After conversion, the file with the G-code is loaded into the 3D printer. Due to layer-by-layer shaping, parts of any complexity can be produced. Various materials are used for 3D printing. The most common PLA, ABS, PVA plastics, nylon, rubber, metal powder. The most productive 3D printing process is the stereolithography process. In the process of stereolithography, a layer of material is formed over the entire surface area simultaneously. The bright rays of light from the projector strike the clear glass. The glass is at the bottom of the bath with liquid light-curing material. A projector under the glass transmits a cross-sectional image of each part of the part. Thus, the material on the glass hardens and is pulled layer by layer up from the bathroom.

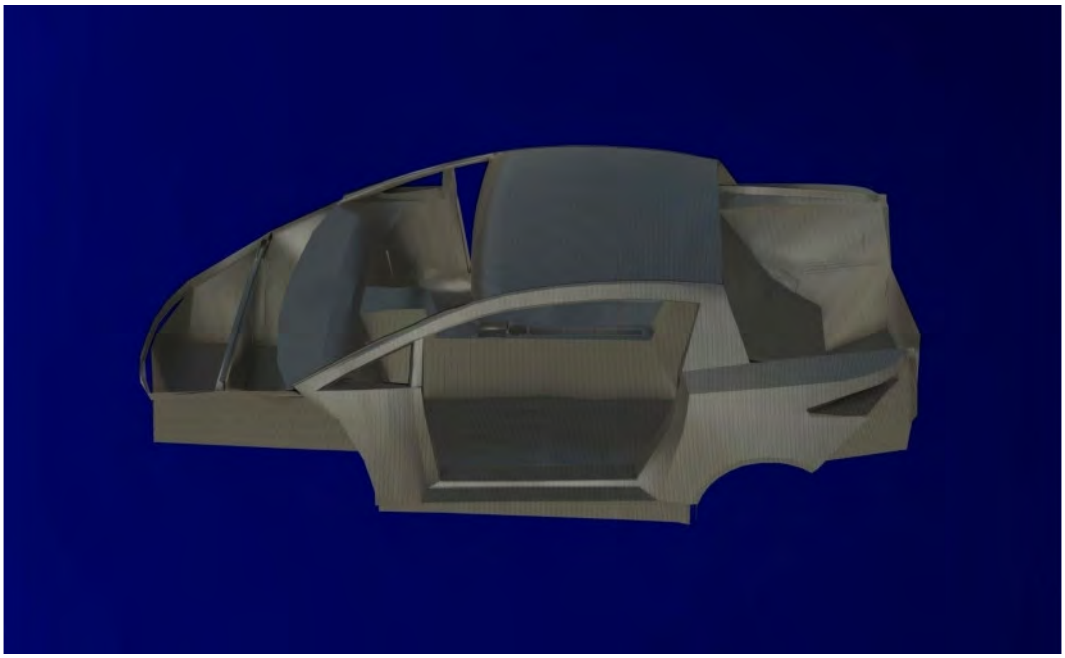
The car is controlled by a program written in the Arduino IDE. It is a cross-platform application (for Windows, MacOS, Linux) developed in C and C ++. It is used to write and download programs to Arduino-compatible boards, as well as to boards from other manufacturers. Source code for The IDE is released under the GNU General Public License Version 2. The Arduino IDE supports both C and C ++ using special structuring rules. The Arduino IDE provides a software library from the Wiring project that provides many common input and output routines. User-written code only needs two basic functions to run the sketch

and the main program loop, which are compiled and linked to the program stub main () to an executable loopback executor with the GNU toolchain, also included in the IDE distribution.

Sparkmaker 3D printer and printed parts.

Towards mass production

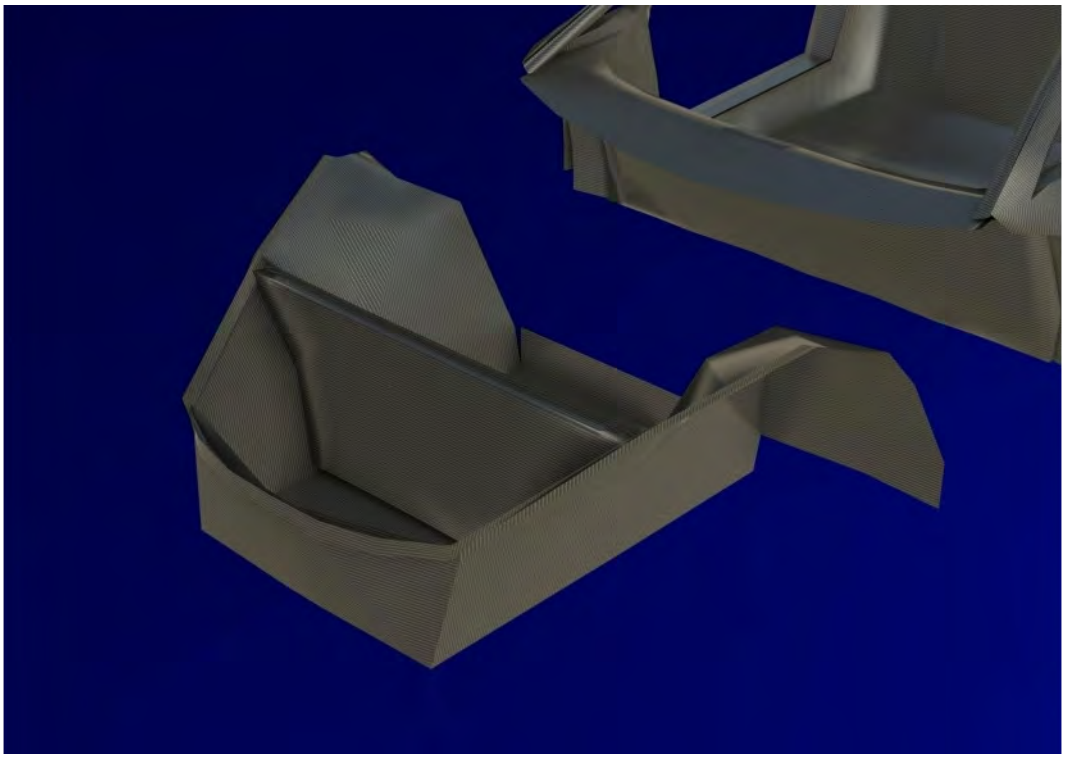
The car body is the most important constructive, most responsible, material-intensive and expensive part of the car. It makes up about half of the car in terms of weight, cost and manufacturing complexity. The body is the basis for the installation and fastening of all systems and mechanisms of the vehicle. The body ensures the safety of the vehicle. The body structure and its parameters have a serious impact on the performance properties that ensure the movement of the vehicle (maneuverability, stability, smoothness,), and on performance properties not related to vehicle movement (capacity, strength, durability, maintainability, suitability for loading and unloading). DUBINA EVO has a fiberglass monocoque body. He perceives all the loads that act on the car while driving. This means that all elements of the body, with the exception of doors and hatches, are load-bearing. The body support system allows you to reduce the weight of the vehicle, its overall height, lower the center of gravity and, therefore, increase its stability.



The supporting body is made of fiberglass.

The design of the monocoque body consists in the most rational distribution of material in each element, allowing the best use of the maximum possible

load-bearing capacity of the material. In order to give the structure a clear and continuous shape, providing direct transfer of the load from the point of its application to the point at which the reaction occurs. The structure of the monocoque body must be rigid enough to allow precise control, be light enough to allow inertial loads and the loads caused by the oscillatory angular movement of the sprung parts about the vertical axis were small, to be strong and durable to withstand the cyclic road loads, the loads from the power plant, the driver and the passenger. Hence, it is clear that the structure of a car is assessed not by strength, but by rigidity, and the study of the state of the structure is associated with the study of its deformability rather than the stress state. Bending deflections in the middle of the vehicle span should not exceed 1.3 mm, and the deformations of the contour of door openings should not exceed 1.2 mm in the event of a load concentrated in the middle of the span equal to 6700 N. Fiberglass is not as rigid as steel or aluminum, therefore, reinforcing plates, brackets and stiffeners are used in the body structure. Fiberglass is a durable and lightweight material.

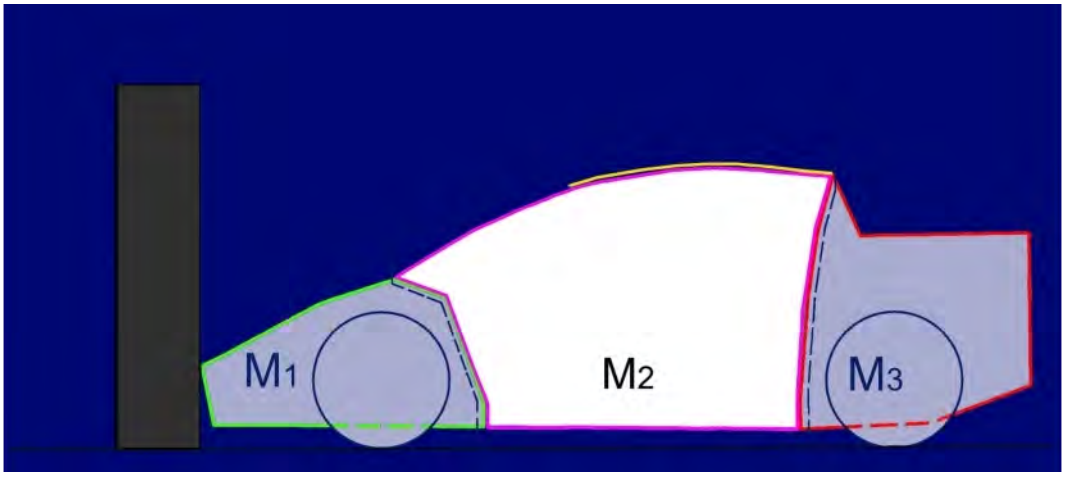


Front part of the body.

Another great advantage of fiberglass is the absence of corrosion. Important parts that contribute to the overall rigidity of the structure are roof rails, head rails and pillars of the windshield frame, door hinges, front and rear body frame spars, rear side panels, door pillars. The body supporting system made of fiber-

glass provides good insulation of the passenger compartment from vibration and noise of operating units and mechanisms, as well as from the noise of tires that occurs when they roll on the road surface. Body parts are made of fiberglass 2 ... 3 mm thick. The body of the DUBINA EVO is shaped like an engine compartment, a passenger compartment and luggage compartments.

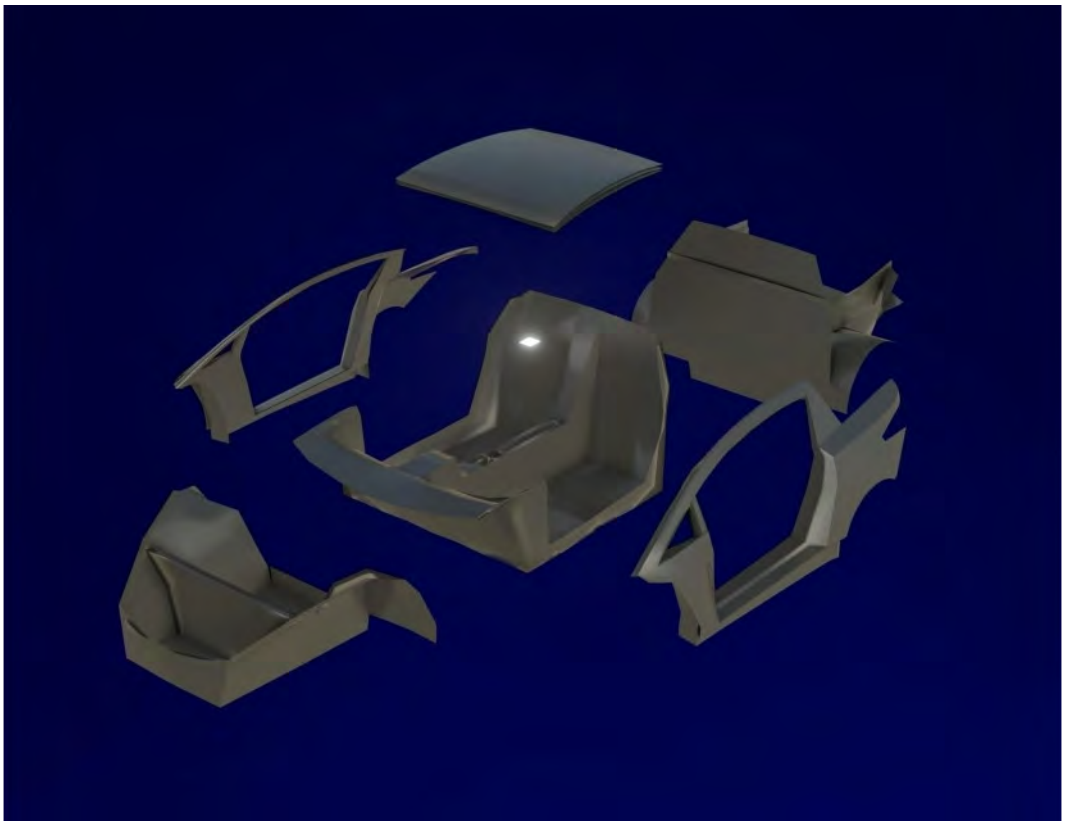
It has a fiberglass one-piece cockpit, left and right sidewalls with rear fenders, roof and front fenders. The resulting body structure is uneven. Its individual parts have different rigidity and, therefore, different resistance. shock in road accidents. As a result, in collisions of the car due to the deformation of the front and rear parts of the body, the impact energy is extinguished, and the passenger compartment is protected from deformation. This ensures that the survival space of people in vehicle collisions is maintained. The body of the DUBINA EVO is assembled on an assembly jig for the first stage of the production line. Two workers connect the bottom of the cockpit to the tunnel using epoxy glue, then the battery compartment is attached to the bottom of the cockpit, then the front and rear are attached part, then the left half and the right half at the end of the roof is installed.



A three-mass model of a hitting car.

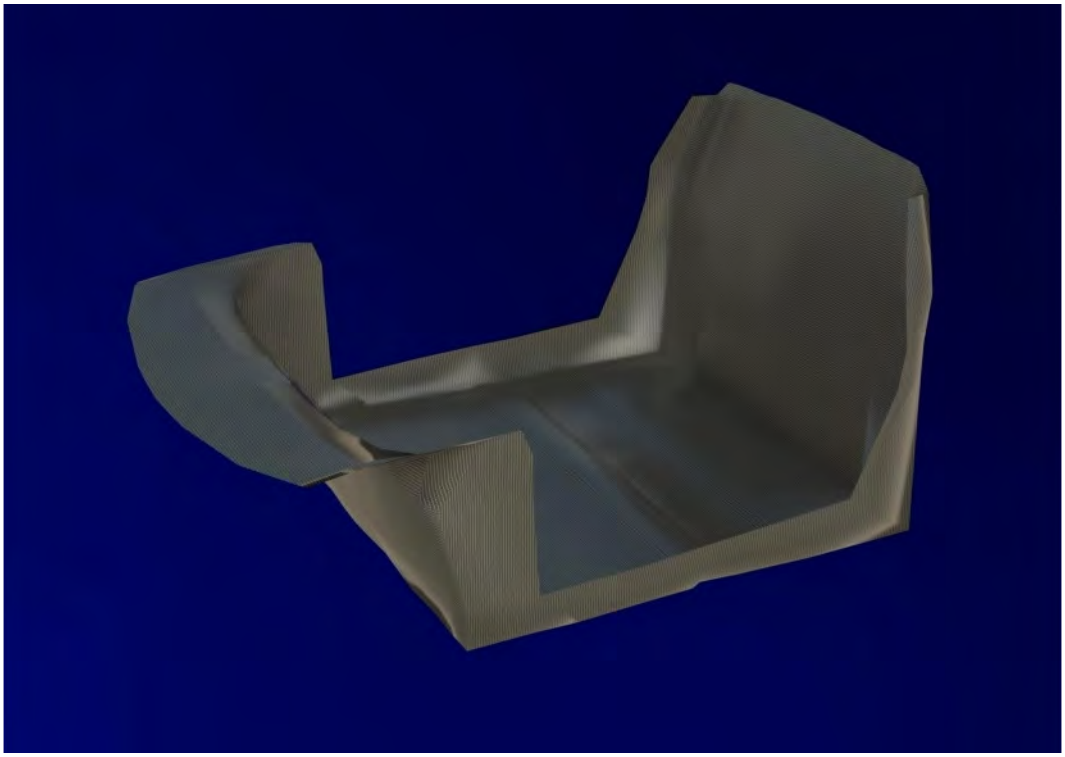
All body parts are made of fiberglass by hand molding. Forming of body parts consists of applying layers of fiberglass into a matrix. Since only the outer surface of the part experiences maximum stresses during bending, it is the area where high modulus carbon fibers are laid. The first layer of fiberglass is the thinnest (300 g/m2), which ensures the most smooth surface of the product. The fiberglass must follow all the bends exactly matrix shape without detachment and formation of air cavities. Cutting of fiberglass is performed according to a template made of dense cardboard according to the dimensions of the matrix. Body parts with complex shapes use fiberglass cutting, consisting of several

separate elements. Depending on the thickness of the part, the required number of layers of material is prepared, which are stored in a convenient, easily accessible place, in the order of their molding in the matrix.



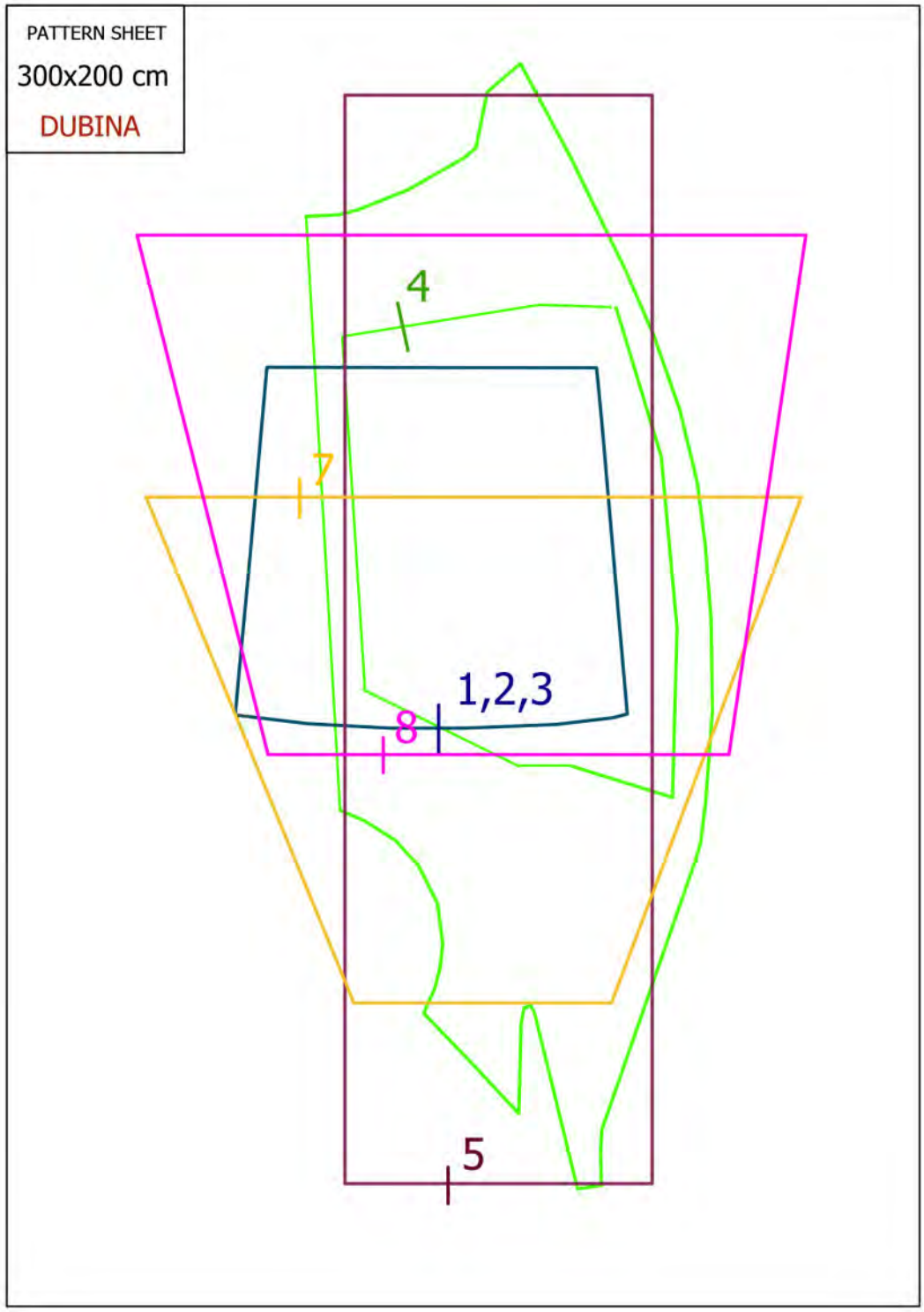
Main body parts.

A release layer applied to the mold surface of the matrix serves to ensure that the finished product can be safely removed after the resin has dried. The separation layer is made of wax and PVA alcohol. Glass material is placed in the prepared matrix, then the matrix is covered with a lid that repeats the shape of the part. This cover presses the glass material tightly against the die and creates the correct part. The process of creating a part is easier with such a cover. After the matrix is closed with a lid, air is pumped out of it and epoxy is pumped in. After the resin has dried, the part is removed from the matrix and sent to the machining room. To increase the strength of the matrix, stiffeners are glued to it made of polyethylene foam. After that, they are pasted over with fiberglass. Complex body parts are made from a three-dimensional matrix consisting of several parts.



The lower part of the cockpit.

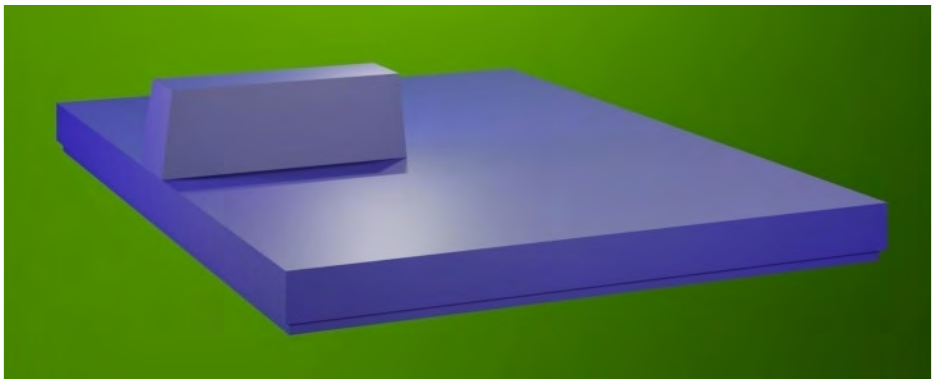
On the sheet of patterns, the parts are indicated by model numbers, the color of the pattern outline (red, blue, green or black) is named. The part numbers are the same color as the outline of the pattern. The pattern must be printed on a 1: 1 scale on a strong matte banner fabric 3.2 m wide. To create a stencil of the pattern detail, place the printed pattern on thick cardboard and trace the outline of the part with a soft pencil. Cut out the pattern piece from the cardboard.



Pattern sheet.

The bigger, the better

The DUBINA EVO rechargeable battery combines many properties. It has a large capacity, charges quickly, weighs a little and is small in size. The car uses a battery with an additional battery to prevent the main battery from being discharged during long-term parking due to parasitic currents in electronic devices. The main battery with a voltage of 400 V has a capacity of 50 kW and an additional voltage of 12 V and a capacity of 1 kW. The main battery consists of 16 modules in each module with 8 batteries. There are 125 batteries in total in the main battery, connected in series. The voltage of one battery is 3.2 V. The capacity of one battery is 125 Ah. The size of one battery is 320x420x12 mm. The battery has dimensions 1780x1300x100 mm. The battery is located under the cockpit floor. Thus, the center of mass is on the centerline, between the front and rear axles of the vehicle at the lowest point. This arrangement distributes the load evenly and does not compromise driving stability.



DUBINA EVO battery.

The battery consists of an anode (+) and a cathode (-). The battery capacity C depends on the surface area of the electrode S, the distance between the electrodes d and the conductivity of the electrolyte. The larger the surface area of the electrode S, the larger the battery capacity.

$$C \sim S,$$

The smaller the distance between the electrodes d, the greater the battery capacity.

$$C \sim 1 / d,$$

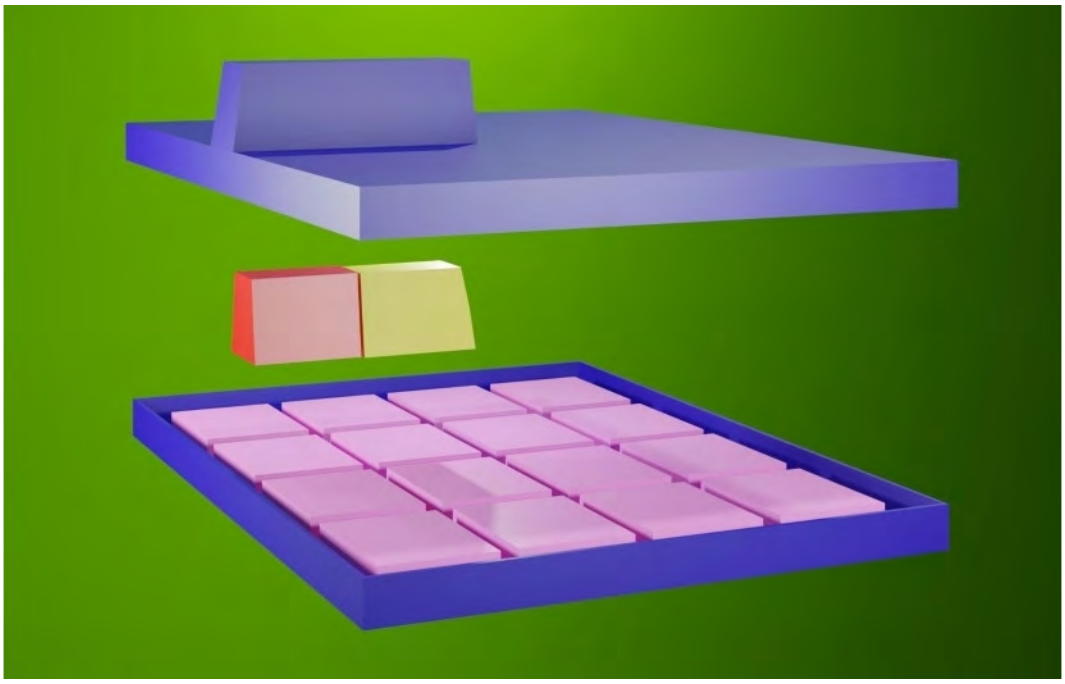
The higher the conductivity of the electrolyte, the larger the battery capacity.

$$C \sim \varepsilon,$$

General formula for battery capacity.

$$C = \varepsilon\varepsilon_0 S / d,$$

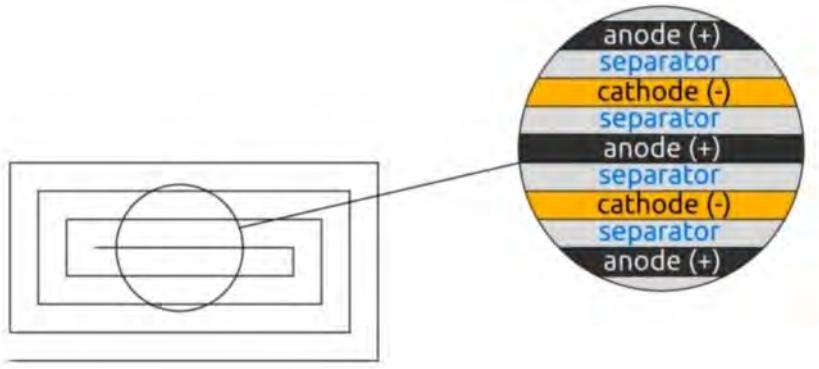
Lithium batteries have high energy density and voltage, long service life and low self-discharge, they are commercially available and widely used.



The main parts of the battery.

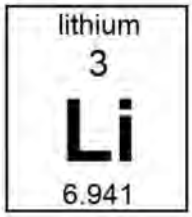
The cathode (-) of the battery is made of an aluminum current collector coated with LiFePO4. Aluminum is used as a cathode current collector because aluminum has high electrical conductivity, light weight and low cost compared

to other materials. Among the olivine structure compounds, LiFePO4 has a high voltage of 3.5 V and a high bulk density of 3.6 g/cm3 compared to lithium, has a theoretical capacity of 170 mAh/g, and exhibits excellent high temperature stability compared to cobalt (Co), and uses cheap Fe, which makes it highly suitable as an active cathode material for lithium batteries. Lithium Iron Phosphate (LiFePO4) olivine type is in the form of secondary particles, in which the primary particles are aggregated and have high porosity, thus providing excellent electrical conductivity and high density, which are the advantages of smaller primary particles, and high process efficiency, which is the advantage of secondary particles.

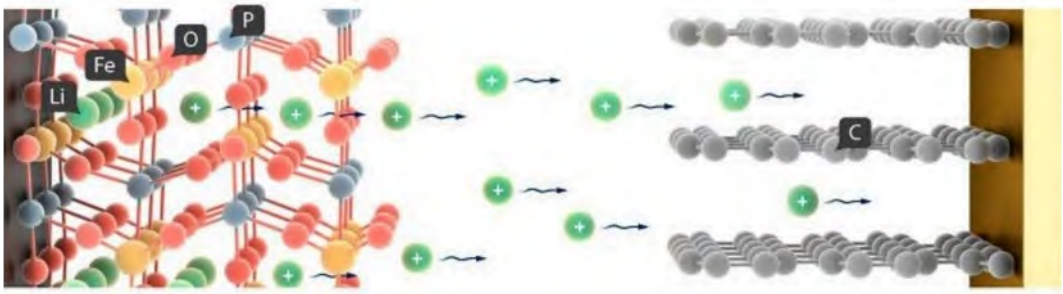


Cross-sectional diagram of a battery accumulator.

The use of lithium iron phosphate of the olivine type in the form of secondary particles can reduce the amount of binder and solvent used to make the electrode and shorten the mixing and drying times. A suspension prepared by mixing the cathode mixture is applied to a current collector 15 μm thick. Cathodic the suspension consists of LiFePO4, a binder, a conductive additive and a solvent. The polyvinylidene binder is a component that facilitates binding of the active material to the conductive material and the collector. The binder is added in an amount of 3% of the total weight of the compound, including the active material of the anode. The conductive material graphite (C) is added in an amount of 3% by weight of the entire cathode. The anode (+) of the battery is made of 100 μm thick graphite foil. The spacer is located between the cathode and anode. A thin insulating film with high ionic permeability and mechanical strength is used as a separator. The separator has a pore diameter of 0.05 μm and a thickness of 10 μm. Non-woven polypropylene is used as a separator.



The lithium content in the upper continental crust is 21 g/t, in seawater — 0.17 mg / l. Lithium deposits are known in Chile, Bolivia, Brazil, Australia, USA, Argentina, Congo, China.



Schematic diagram of the battery.

Battery working mechanism

Charging

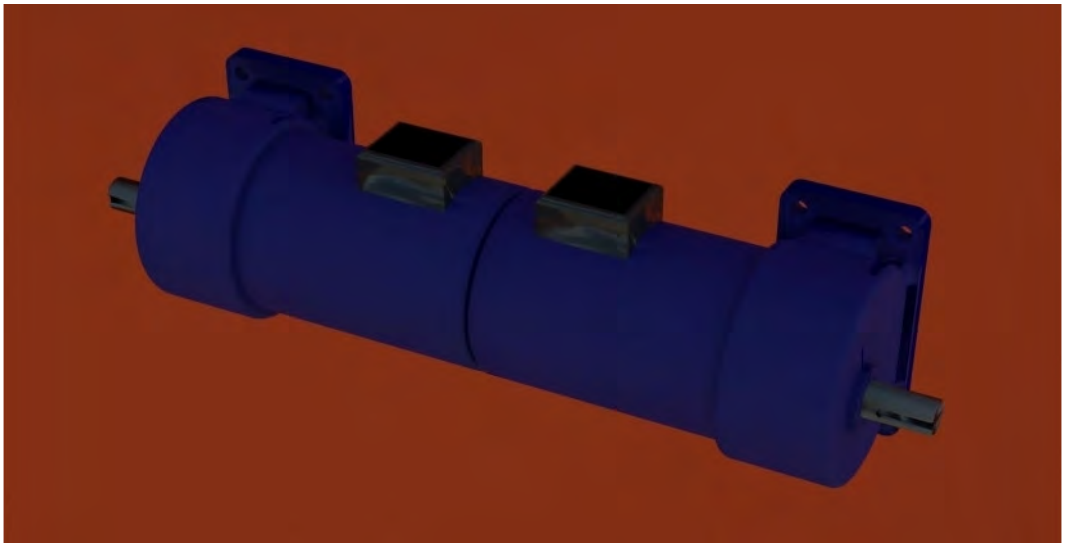
Cathode (-) LiFePO4 = Li + FePO4
Anode (+) 6C + Li = LiC6

Discharge

Cathode (-) Li + FePO4 = LiFePO4
Anode (+) LiC6 = 6C + Li

After installing the battery, a threshold is attached to the car body, covering the side of the battery and the lower part of the body.

Revolutionary technology. Motor Magnetar



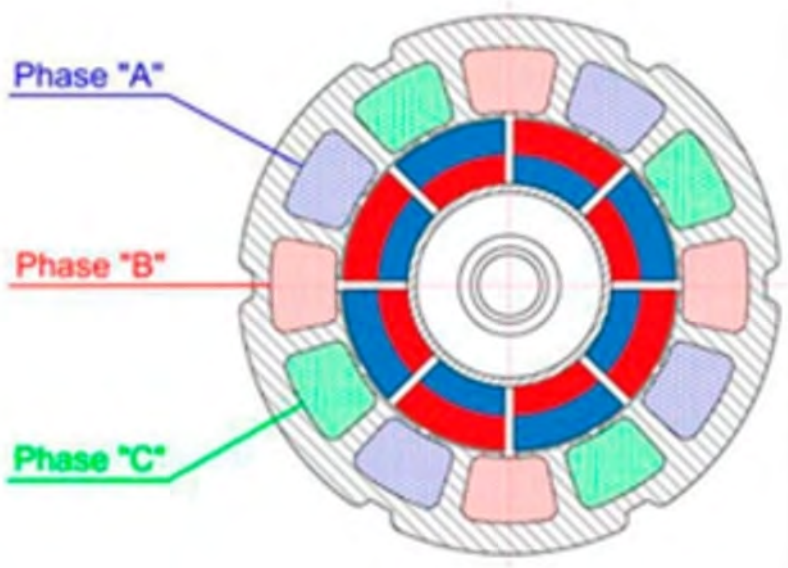
Power plant consisting of two Magnetar motors.

DUBINA EVO is equipped with a power plant consisting of four Magnetar electric motors. Two motors are located at the front and rear of the cockpit. There is one motor for each wheel. Car has four-wheel drive. An all-wheel drive vehicle accelerates faster and handles better. The electric powertrain is the heart of the car. It converts electrical energy into mechanical energy. The Magnetar electric motor is powerful, lightweight and quiet. Motor Magnetar is a reversible brushless multi-pole electric motor. The brushless motor has a multi-pole neodymium permanent magnet in the rotor and electrically powered magnets in the stator. This feature structurally distinguishes the brushless electric motor from other similar devices. The brushless electric motor rotates due to the consumption of direct electric current. The main difference and advantage is that the engine does not have a manifold. This significantly reduces costs and time for maintenance, and reduces power consumption. Previously, due to the wear of the brushes of the collector electric motor, an increase in its current consumption could occur without a concomitant increase in power. Sparks generated on the brushes when the motor is running create radio interference. The design of the brushless motor makes its design simple and compact, as well as economical and reliable. With the advent of neodymium production technology magnets, the power of brushless motors

has increased, but the size, on the contrary, has decreased several times. But, unlike others, the brushless motor has a complex and expensive electronic control unit. The indisputable advantage of having such a control unit is the ability to change the number of revolutions of the running electric motor. The control unit is responsible for timely switching the voltage supply to the windings corresponding to the rotation of the rotor. The voltage supply is switched by the rotor position sensors. The voltage is applied to the motor windings depending on the position of the rotor. The electronics detect the position of the motor rotor. For this, position sensors based on the Hall effect (SS41) are used. Thanks to such sensors, the electronic control unit always knows what position the rotor is in and which windings to apply voltage at each moment of time. The electric motor requires a quick change in the value and direction of the speed of movement. It is known from the physics course that the acceleration E during the rotational motion of any material body (in this case, the rotor of the engine) is directly proportional to the moment M acting on this body, and inversely proportional to the moment of inertia J of this body relative to the axis of rotation:

$$E = M / J$$

It follows from the above formula that to obtain large accelerations (decelerations), it is necessary that the engine develop a significant torque M, and its rotor has a small moment of inertia J.



Three-phase motor winding.

The expression for the maximum value of the motor torque Mmax in accordance with the formula can be written as follows:

$$M_{max} = BIS = 2BILR$$

L is the length of the frame conductors (length of the motor rotor);

R is the distance from the axis of rotation of the frame 00 “to the conductors (radius of the motor rotor).

The moment of inertia J of a cylindrical body (engine rotor) relative to the axis of rotation is calculated by the formula:

$$J = mR^2$$

m is the mass of the cylinder (rotor);

R is the radius of the cylinder (rotor).

Substitution of expressions in a formula leads to the following relationship:

$$E = 2BIL / mr$$

The resulting formula determines the ways to increase the speed of the engine. They are as follows:

1) Increasing the induction of the magnetic field of the motor;

2) Execution of the rotor of the engine with the lowest possible mass and with the highest possible ratio of length to radius;

3) an increase in the current in the motor windings.

To reduce the mass of the rotor (armature) of the engine, you can make it hollow.

Permanent neodymium magnets are located on the armature. The engine armature is made in the form of a thin-walled glass made of non-magnetic material.

For normal operation of a DC motor, it is necessary to change the direction of the current in the winding conductors when the position of the rotor changes. This switching in conventional DC motors is provided by a collector. The torque of a squirrel-cage induction motor varies with the rotor speed along a curve.

Torque Mvr is a measure of this effort that changes the angular

speed:

$$\omega = 2\pi n / 60$$

n — engine speed, rpm.

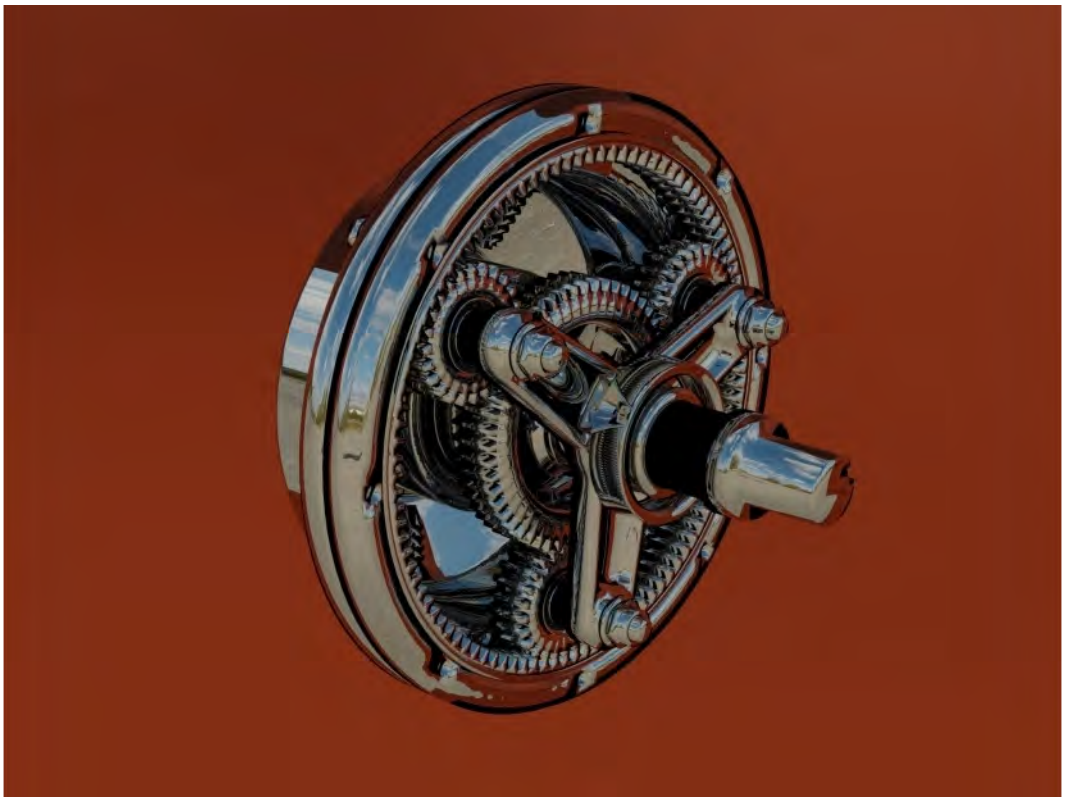
The following relationship exists between the engine power P (W), the angular velocity ω (rad / s), the force F (N), the pulley radius r (m), and the torque Mvr (Nm):

$$M_{вр} = P / \omega = Fr$$

Substituting the value of the angular velocity ω, we get:

$$M_{вр} = P/\omega = P/2\pi n/60 = 60P/2\pi n = 9.554P/n$$

The electric motor rotates at a high frequency during operation and low torque. The torque generated by the electric motor is insufficient for the car to move. Therefore, a reduction gear is used to increase the torque. The reduction gear reduces the speed and increases torque. A planetary gearbox is used to increase the torque. With a small transverse dimension, the planetary gearbox has a large gear ratio.



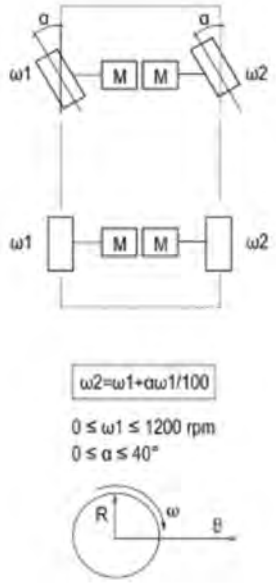
Planetary reductor.

Engine braking*. A feature of the electric motor is the ability to instantly change the direction of rotation of the rotor. Thanks to this ability, it became possible in the car to perform braking by the counterflow method. When you press the brake pedal, the direction of the current in the car's engines changes, which creates a reverse torque. This technology simplifies vehicle design. Now there are no heavy ones in the car mechanical brakes. Braking is performed at the software control level.

Recuperation. As long as the car rolls on the road without engine power or when going downhill, the engine continues to rotate. At this time, the rotor of the rotating motor works as a current generator. The generated current is returned to the battery. To prevent energy dissipation in the engine control circuit, the device turns on the engine as a generator. Such a device performs recuperation.

Hyperspeed. The electric motor can operate for a short period of time with peak current. The peak current is very strong, which gives tremendous power, but only for a short period of time. The peak current function is activated by a button located on the steering wheel.

Increased agility. DUBINA EVO has four-wheel drive. There is one motor for each wheel. This design allows for increased maneuverability by changing the wheel speed depending on the steering angle. A wheel located at a larger radius when turning rotates with a frequency exceeding that of the other wheel by a percentage equal to the steering angle.



ϑ = 5 km/h

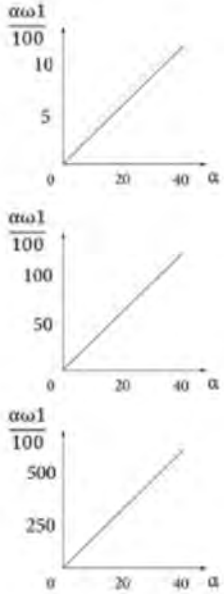
α	ω1	ω2
0	26	26
5	26	27.5
10	26	28.6
20	26	31.2
40	26	36.4

ϑ = 40 km/h

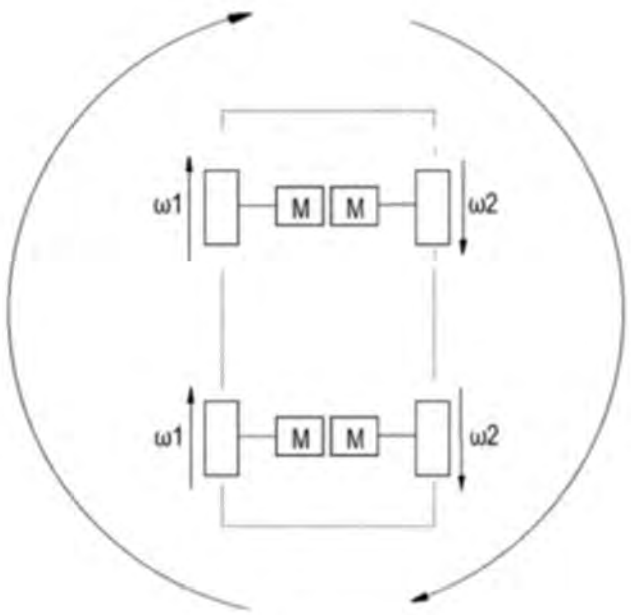
α	ω1	ω2
0	209	209
5	209	220
10	209	230
20	209	251
40	209	293

ϑ = 200 km/h

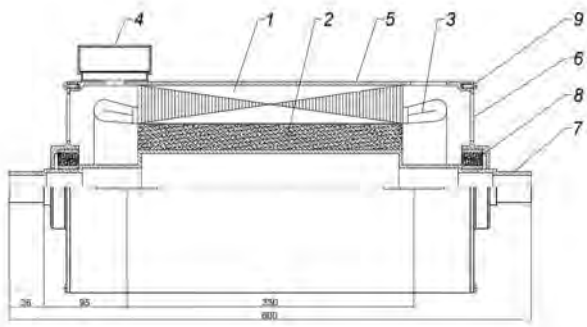
α	ω1	ω2
0	1045	1045
5	1045	1097
10	1045	1150
20	1045	1254
40	1045	1463

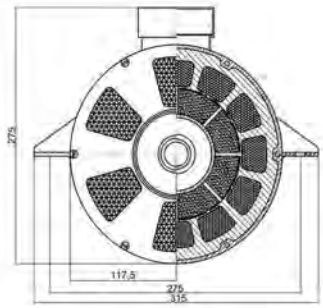


Vehicle movement around the axis. The machine can rotate around an axis. Because there is one motor for each wheel. The movement around the axis is activated by a button on the steering wheel.



$$\omega 2 = -\omega 1$$



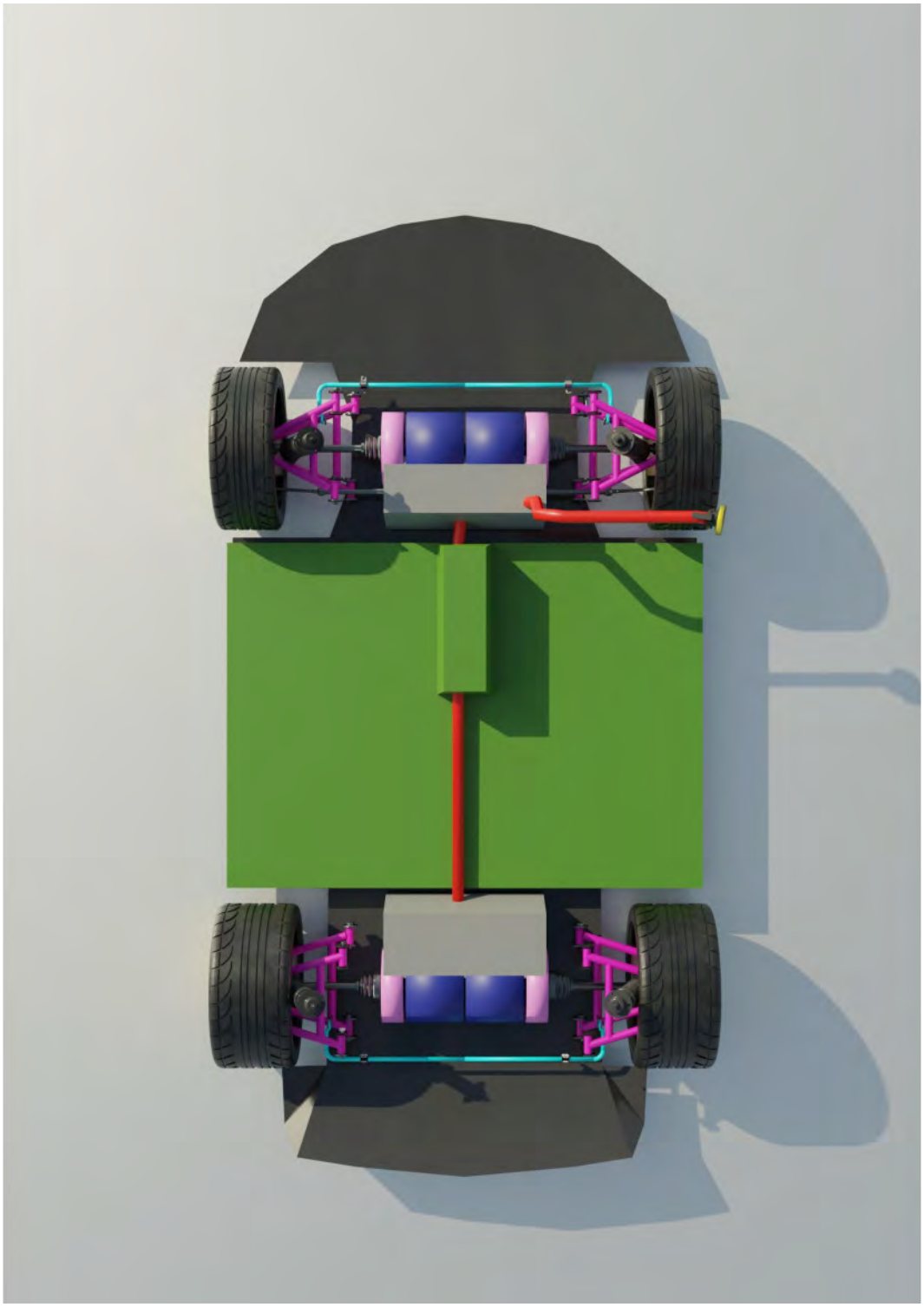


Form	Area	Pos.	Designation	Title	Sum	Note
				Assembly units		
		1		The stator core	1	Steel M15
		2		The rotor core	1	Magnet 48H
		3		The stator winding	1	Cu
		4		Terminal box	1	Plastic
				Details		
		5		Frame	1	Kompozit
		6		Bearing shield	2	Kompozit
		7		Shaft	1	Kompozit
				Standard products		
		8		Magnetic bearing	2	Nd
		9		Helix	12	Kompozit

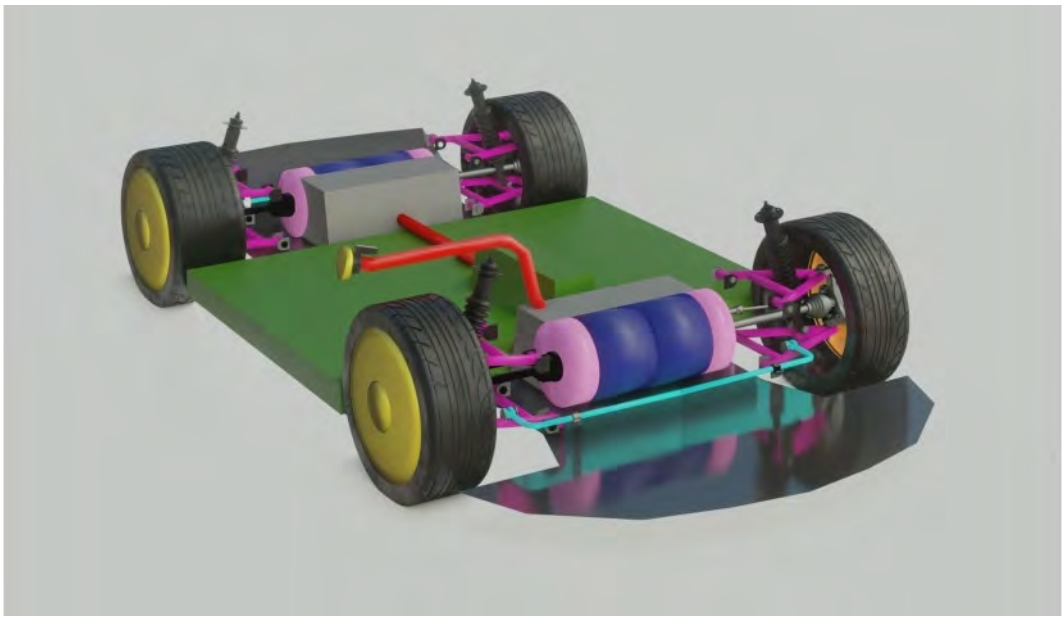
Specifications

1. *Rated power, 95 kW.*
2. *The nominal line voltage, 120 V.*
3. *Rated line current, 160 A.*
4. *Frequency, 50 Hz.*
5. *Synchronous speed, 2100/4800 min-1.*
6. *Slip, 12,5%.*
7. *Number of phases of the stator winding, 3.*
8. *Wiring diagram, the star.*
9. *Shaft torque at rated synchronous frequency rotation, 525 N·m.*
10. *Efficiency, 98 %.*
11. *Degree of protection, IP54.*
12. *Mode, S1.*
13. *Engine weight, 20 kg.*

Double wishbone suspension

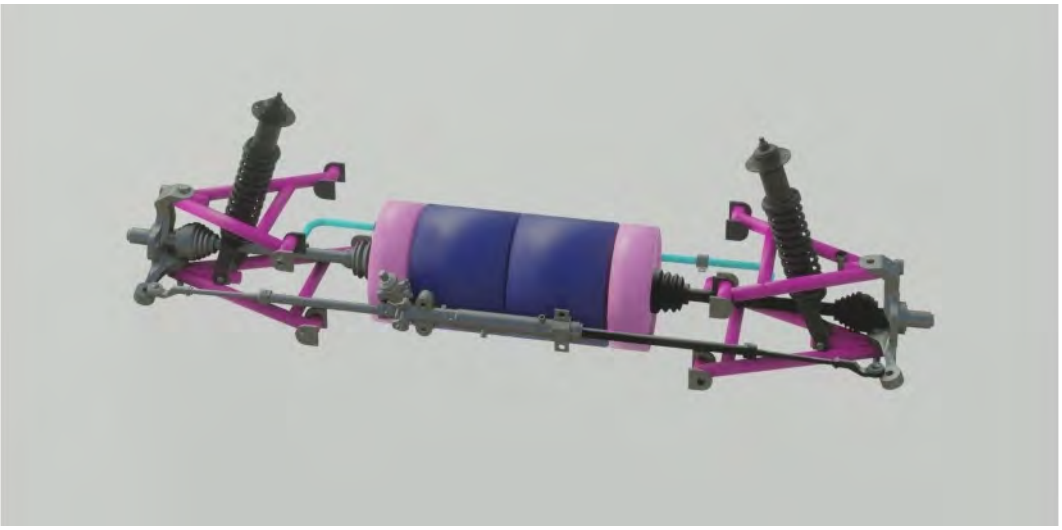


The car uses a double wishbone suspension. Unlike other types of suspension, the double wishbone design offers a more progressive geometry. The more the double wishbone suspension is compressed, the greater the negative camber due to the use of variable levers. This has a positive effect on handling at such moments when the driver is heavily into the corner and the car starts to slip off the trajectory. At these times the wishbone suspension system will maintain better tire-to-road contact. This means that the car will be more stable. An additional advantage of the double wishbone suspension is the smaller dimensions of the upper arm relative to the lower one. In this regard, during the upward movement of the wheel, the camber angle changes, as a result of which the plane of the wheel remains perpendicular to the road surface even during body rolls. In general, depending on the length and location of the A-arms themselves, the camber and toe angle can be adjusted. The suspension guiding device is the lower and upper levers, the elastic device is coiled cylindrical springs, the damping device is double-acting telescopic hydraulic shock absorbers, and the anti-roll bar is an elastic U-shaped rod.



The upper and lower suspension arms are installed across the vehicle and have longitudinal rolling axes. The axle of the lower arm and upper arm are attached to a bracket in the body. The inner ends of the upper and lower arms are connected to the axles by rubber-metal hinges. The upper and lower rubber-metal hinges have the same device and differ only in their size. The use of rubber-metal joints ensures quiet operation of the suspension and eliminates the need to lubricate the joints. Outer ends of the upper and the lower suspension arms are connected to the steering knuckle by ball joints. Ball joints are non-

separable, have the same device, are interchangeable and do not require lubrication during operation. The suspension spring is installed between the lower support cup attached to the lower arm and the upper support cup connected to the support, which is connected to the suspension cross member between the ends of the spring and the support cups, vibration-insulating pads are installed. The bottom end of the shock absorber is attached to the support cup bracket by means of a rubber-metal hinge.

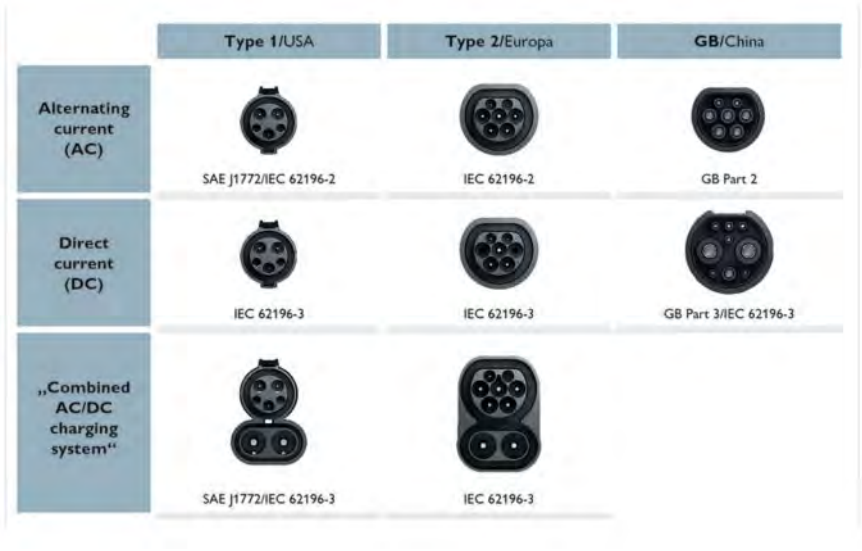


Double wishbone front suspension.

The upper end of the shock absorber is attached to the bracket via rubber pads. The upward travel of the wheel is limited by a compression buffer, which is fixed to a support installed inside the suspension spring. Under static loading, the compression buffer touches the lower spring seat for continuous operation. The stop limits the compression of the buffer. The downward travel of the wheel is limited by a recoil buffer, which is installed in a bracket connected to the cross member and support. Wheel travel downward, the recoil buffer rests against the special support area of the upper arm. The anti-roll bar is a torsion-type resilient device installed across the vehicle. The stabilizer bar is U-shaped and has a circular cross-section. It is made of spring steel. The middle part of the stabilizer bar and its ends are attached in rubber supports with clips to the car body and to the brackets of the support cups of the lower arms.

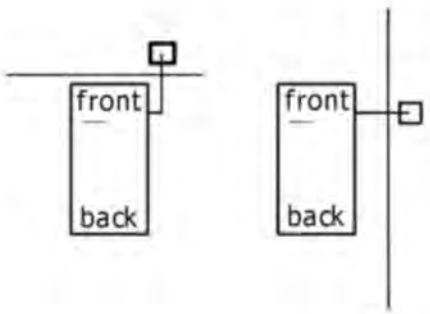
Give a single standard

The development of electric vehicles in the world is very slow. One of the reasons is the sheer number of charging socket types. Cars must use one type of socket capable of accepting both low and high charging power. The charging station and the vehicle should automatically detect the charging power. Such a solution will simplify the use of charging stations and electric vehicles, which in turn will lead to economic growth and environmental improvements. For a left-hand drive vehicle, it is important to consider which side the charging station is on. Right hand drive charging station is on the right. Therefore the socket is located on the right side of the vehicle. For a person to be able to put large shopping bags from a beautiful large store in the trunk, they need a comfortable approach. Therefore, the socket in the DUBINA EVO is located on the front right side.



Electric vehicle socket types.

Of all the socket types in use, the IEC 62196—3 type 2 socket is more optimal. The socket has a round shape with a flat top edge. Connector diameter 70 mm, height 63 mm. This is a 7-pin connector consisting of 1 ground, 3 positive, 1 negative. ny, 2 signal.



Car parking diagram while charging.

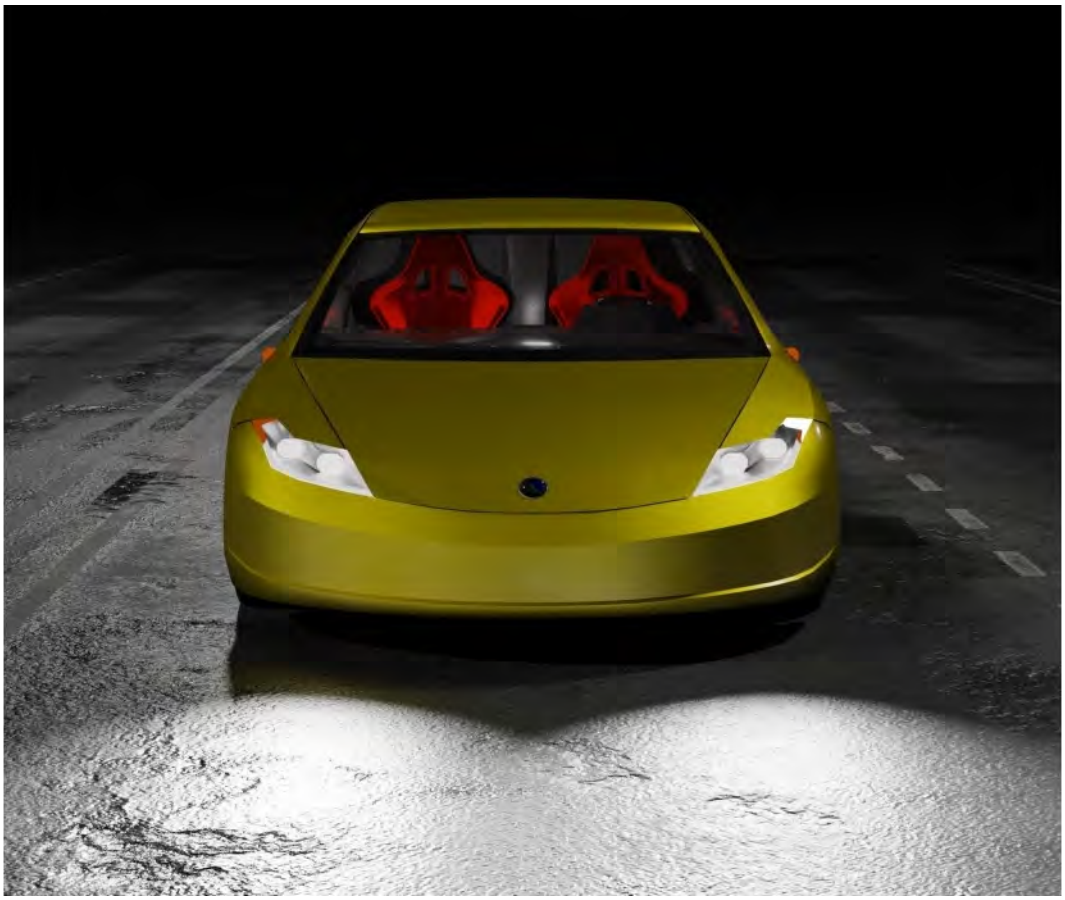
The peculiarity of the connector is the ability to use a single-phase and three-phase network, with a maximum voltage of 480 V and a current of 300 A. The connector allows the use of charging stations with operating modes Mode 2, Mode 3. In January 2013, the European Commission chose the IEC 62196 type 2 connector as official charging connector to the European Union. Since then, it has been adopted as the recommended connector in several countries outside of Europe, including New Zealand.

IEC 62196—3 type 2 socket and plug.

The position of the socket in the DUBINA EVO.

Let there be light

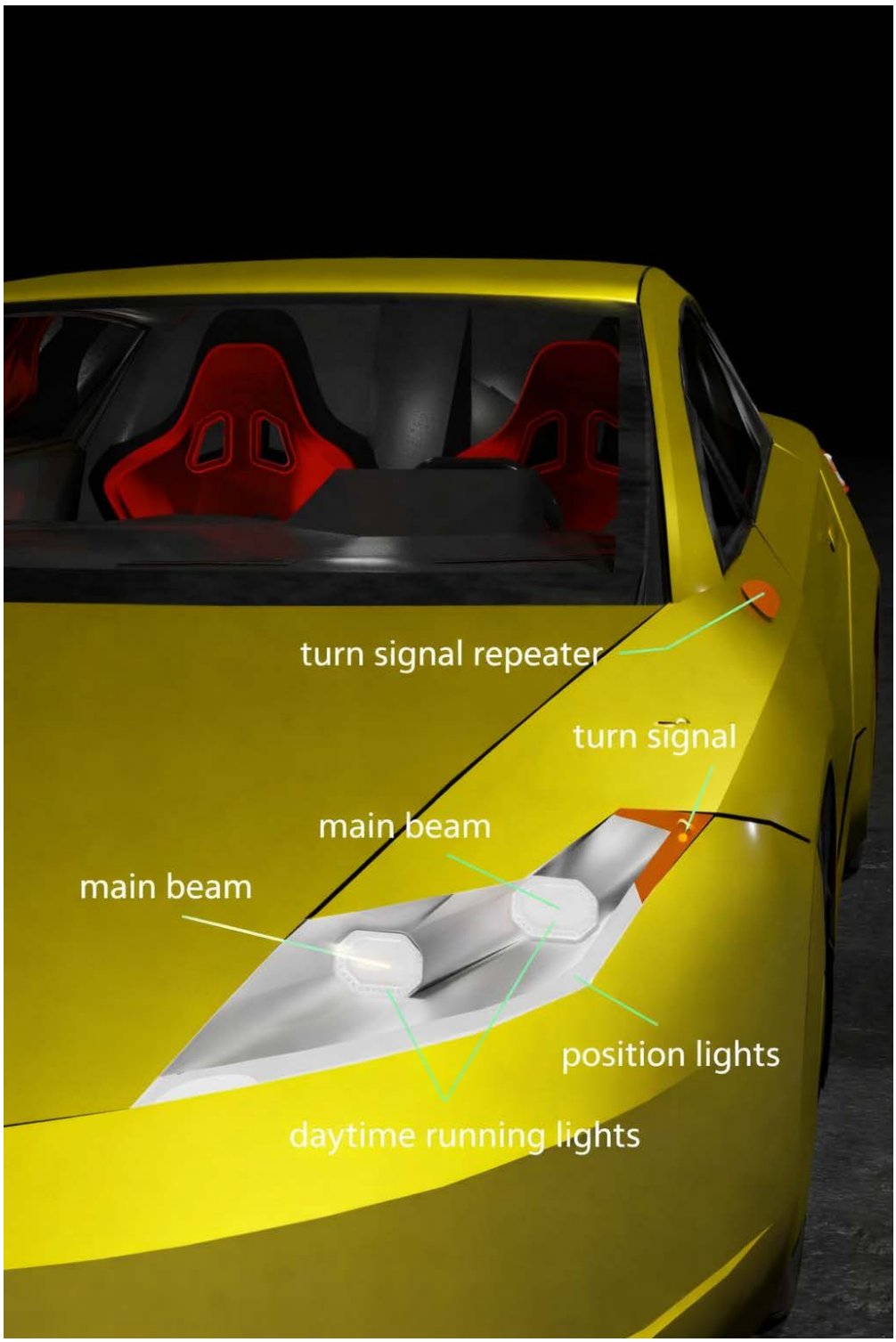
In the car, LEDs with different brightness are used for lighting devices and signaling devices. The headlights are installed in pairs symmetrically on the right and left side of the vehicle. The headlight is made in a single housing, which combines: low beam, high beam, side light, direction indicator and daytime running the lights. The dipped beam is asymmetrical, with right-hand traffic, the right side of the road and the side of the road are better illuminated. The main beam is a symmetrical, high-intensity light beam.

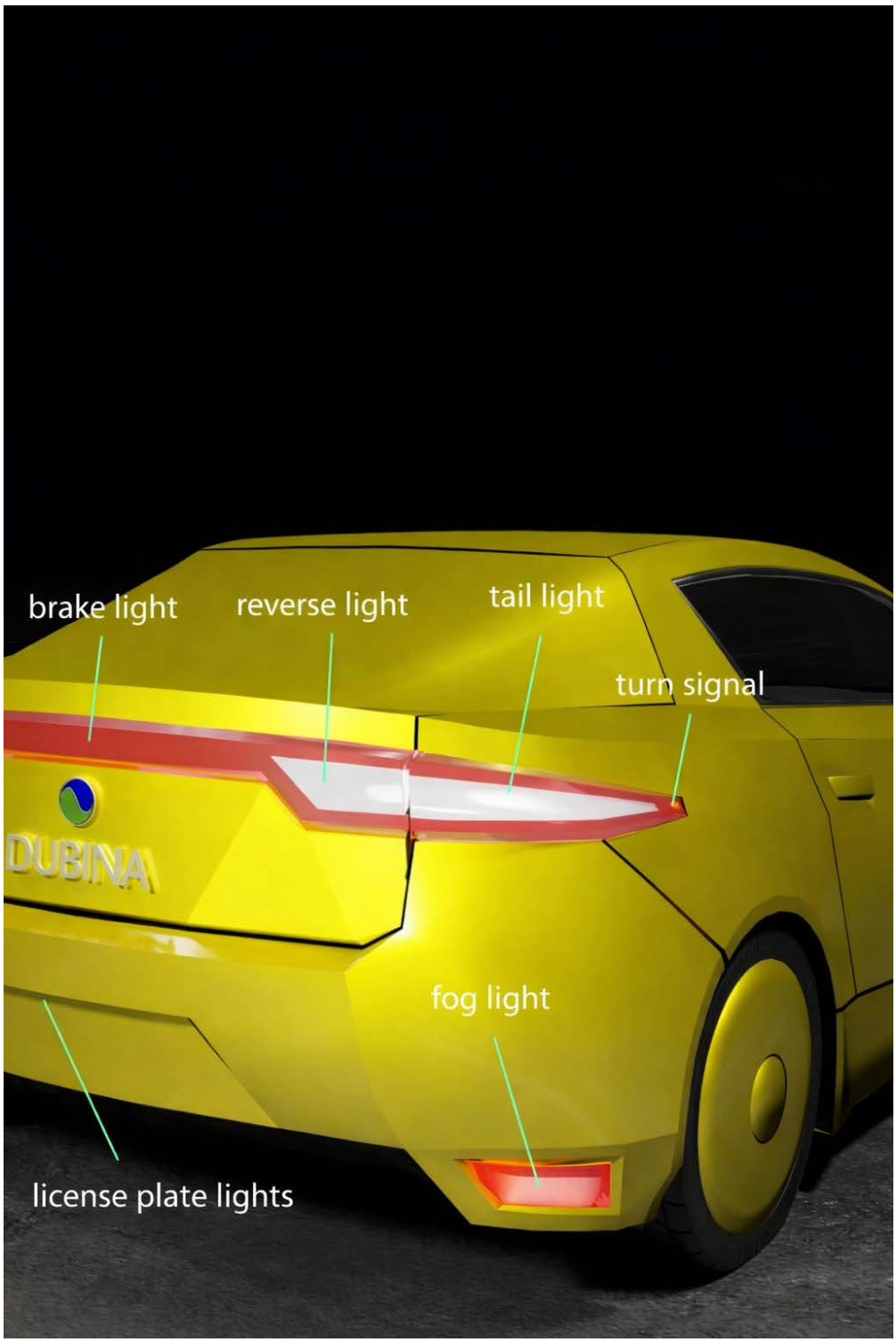


The side light is used to indicate the dimensions of the vehicle. A turn signal repeater is provided on the side of the vehicle. All direction indicators work synchronously. A yellow light source with flashing mode is used as a turn signal. The pointer operates at 2 flashes per second. Direction indicators are also used

as an emergency stop signal. The daytime running lights are manually controlled low beam headlights.

The taillight is made in the form of three connected blocks installed in the body and the trunk lid. The lantern combines the following lighting devices: rear position light, brake light, rear direction indicator, reversing light. The brake light is activated automatically when the driver presses the brake pedal. The tail light and brake light are red, but the brake light is brighter. The so-called adaptive brake light, in which the light intensity is dependent on the intensity of the braking. The reversing light provides illumination when the vehicle is reversing. Automatically activated when reverse mode is engaged. Two symmetrical white reversing lights are installed. Rear fog lamps are used to warn vehicles driving behind in poor visibility conditions. Structurally made in the rear bumper.


turn signal repeater
turn signal
main beam
main beam
position lights
daytime running lights


brake light
reverse light
tail light
turn signal
DUBINA
fog light
license plate lights

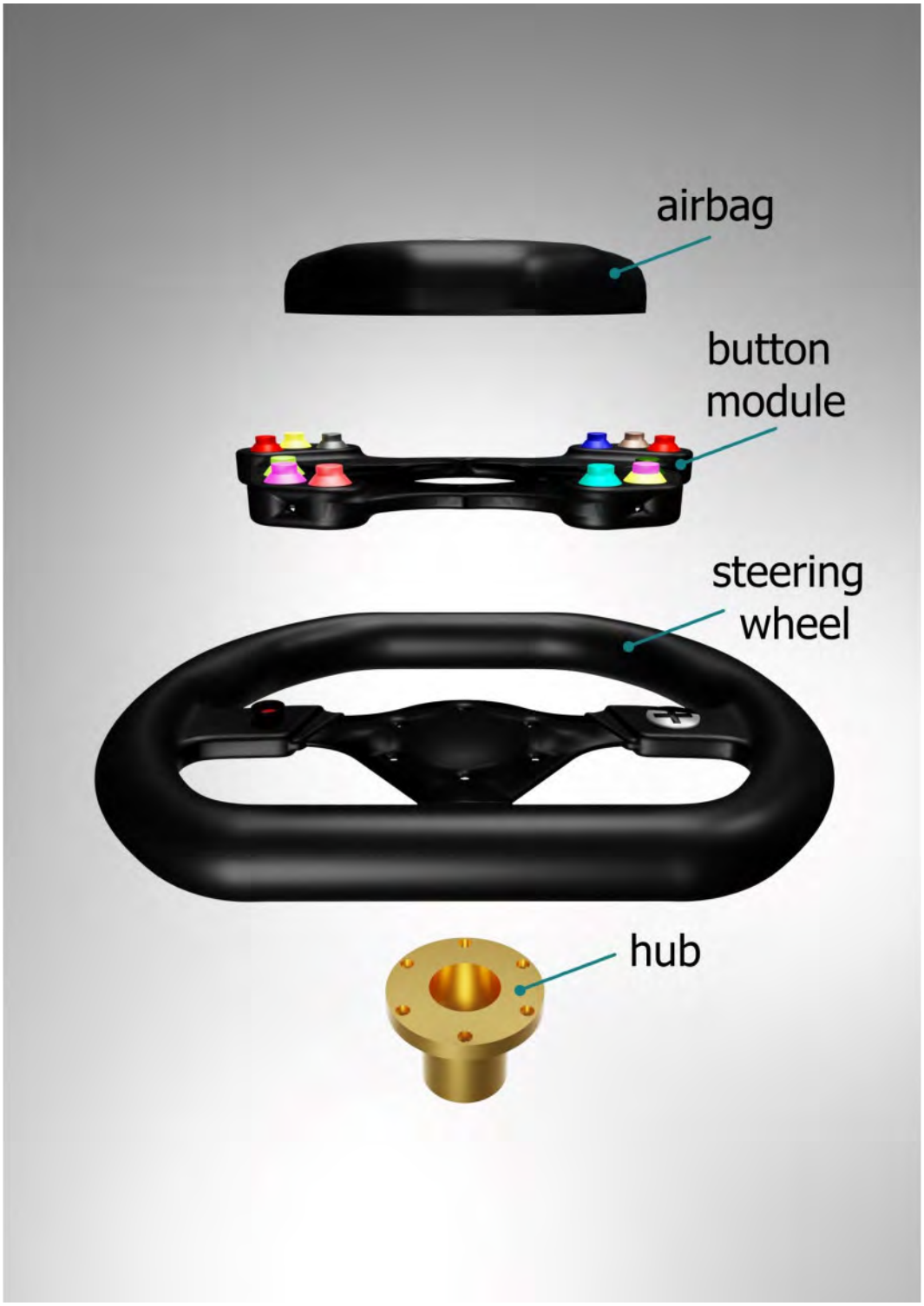
Sports seats for sports electric car

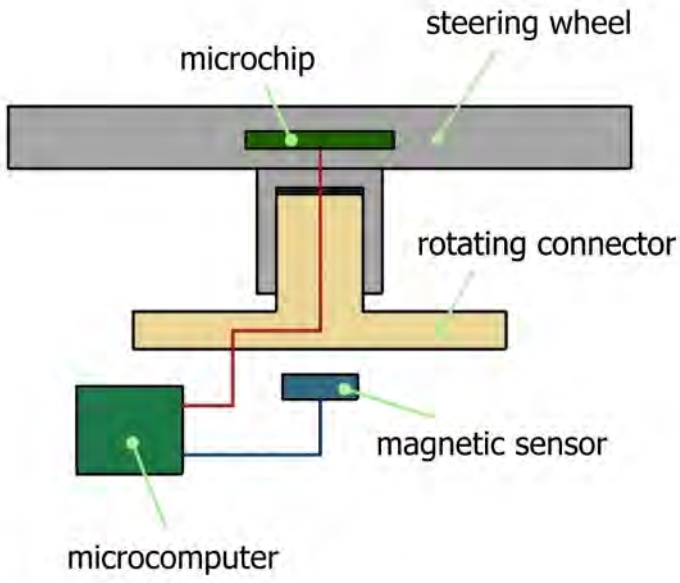
The car is equipped with two sports chairs “Bucket”. The seat is made of durable fiberglass, without separating the back and seat, without adjusting the backrest tilt. Chair weight 8.5 kg. Chair upholstery in velor. The back has a glossy black protective coating colors. The shape of the chair ensures perfect fixation, correct position of the spine and joints. There are removable cushions for choosing the optimal position for the pilot in the seat. Pass-through plastic windows are provided for the use of three, six point belts security. The chair is mounted on a slide with brackets. For the installation of brackets and sleds in the chair, there are mounting holes with M8 threads. With the help of brackets, the angle of the chair is adjusted. The position of the chair is adjusted using a slide.

The steering wheel of your dreams

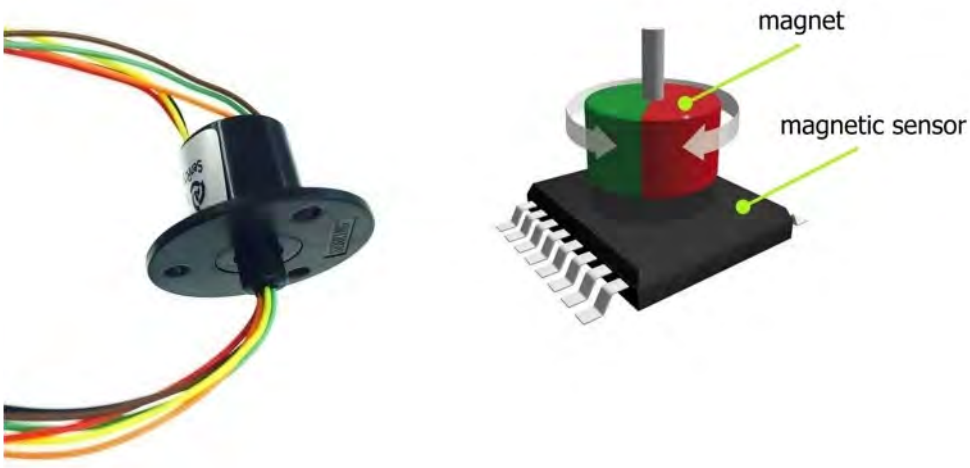
1 — sound signal; 2 — glass washer; 3 — wipers; 4 — right turn signal; 5 — pad menu; 6 — reverse; 7 — movement around the axis; 8 — voice assistant; 9 — alarm; 10 — speed limiter; 11 — driving mode; 12 — hyper speed; 13 — left turn signal; 14 — low beam, high beam; 15 — blowing glass.

The steering wheel of the DUBINA EVO is designed for sporty driving. Steering wheel diameter 310 mm. The small diameter of the steering wheel increases the steering speed. The steering wheel is made of carbon fiber. Carbon has great strength, low weight and low thermal conductivity. The steering wheel consists of four parts: an airbag, a module with buttons, a steering wheel, a steering wheel hub. The button module is attached to the steering wheel. A printed circuit board with shift registers and control buttons is installed inside the module. The peculiarity of the steering is that there is no steering shaft. Instead, a magnetic sensor is used. A magnetic sensor installed in a fixed part of the dashboard housing determines the position of the steering wheel with an accuracy of 0.06 degrees. The advantage of using a magnetic sensor is small size, contactless operation, high accuracy, long working life.


airbag
button
module
steering
wheel
hub



Steering wheel connection diagram.



Rotating connector and magnetic pickup.

The signals from the buttons on the steering wheel are transmitted through the 74HC165 shift registers mounted on the printed circuit board in the steering

wheel. Vehicle computer receives serial digital signals from 74HC165 shift registers

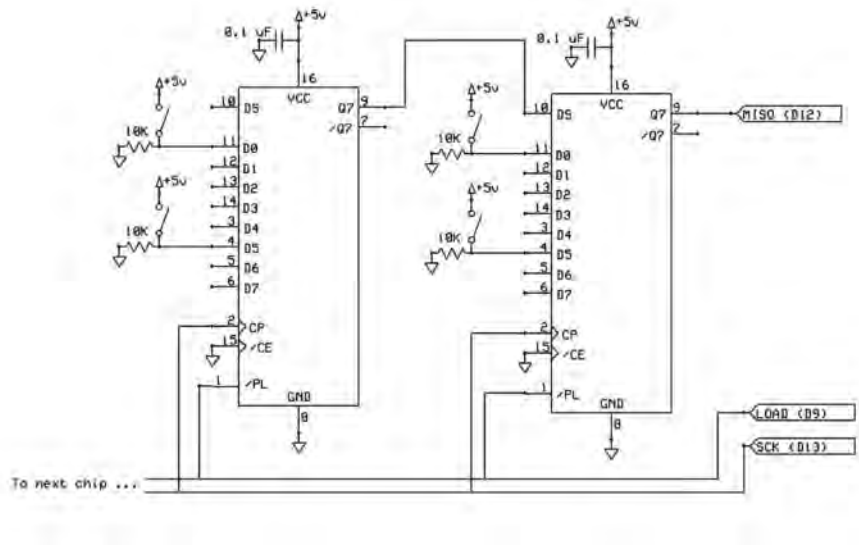
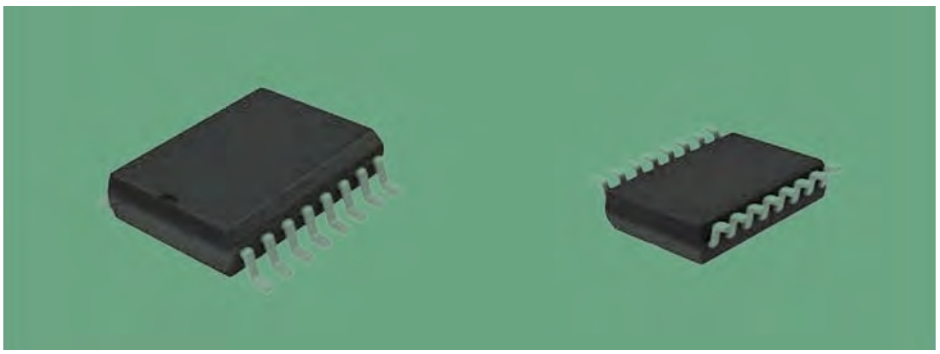


Diagram of connecting the steering wheel buttons to the shift registers.

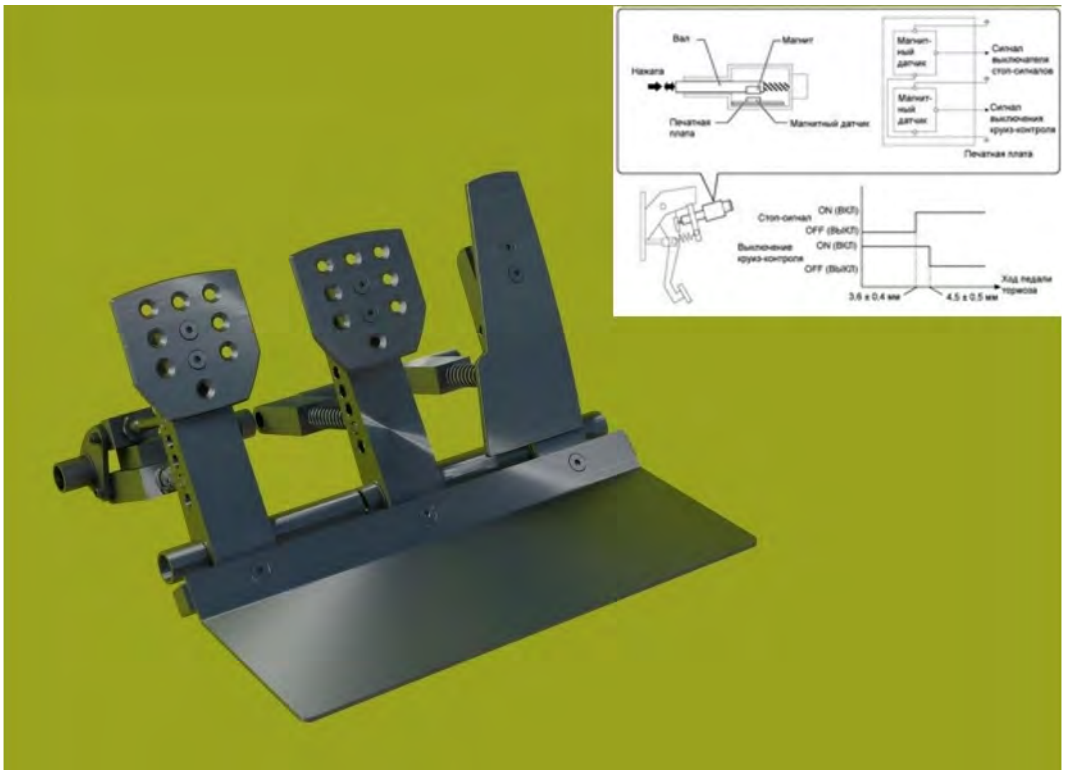
The 74HC165 is a shift register that converts a parallel input to a serial output. It allows you to increase the number of digital inputs of the microcontroller. The chip converts the input parallel signal on 8 pins (Dx) to the output serial signal on 1 pin (Q7). The transmission is synchronous. An additional pin (CP) is used for the clock. Also, a separate pin controls the data register (PL), which allows you to “load” a parallel signal for sequential reading from 8 outputs at a time. Thus, from the three pins of the microcontroller, you can get 8 digital inputs. From the 74HC165 registers, you can make cascades, connecting one after the other, and thus, from the same 3 incoming lines, get 16, 24, 32, etc. digital inputs. Use a shift register to increase the number of microcontroller inputs. For example, to determine clicks among a large number of buttons.



Shift register 74HC165.

Pedals for every day

The pedal set in the DUBINA EVO consists of three pedals. Left parking brake pedal, center brake pedal, right current pedal. The pedals are made of structural aluminum alloy. On the pedals, the position of the pedal plates, the angle of inclination, spring rate. The current and brake pedals are electronic. They are controlled through a central microcontroller. When the brake pedal is depressed, the shaft and the magnet move simultaneously. Magnetic sensors on the printed circuit board, the length of the movement of the magnet is detected and output signals for the microcontroller are provided. The microcontroller processes the signals and controls the motors. Magnetic sensor pedals are highly accurate and reliable because they do not have rubbing parts subject to wear. The parking brake is mechanical. When you press the parking brake pedal, the steel cable pulls out the stopper, which falls into the groove of the gear, mounted on the drive shaft, and stops it. The pedals are mounted on the cockpit floor for ease of use. The size of the pedal unit is 43x43x28 cm.

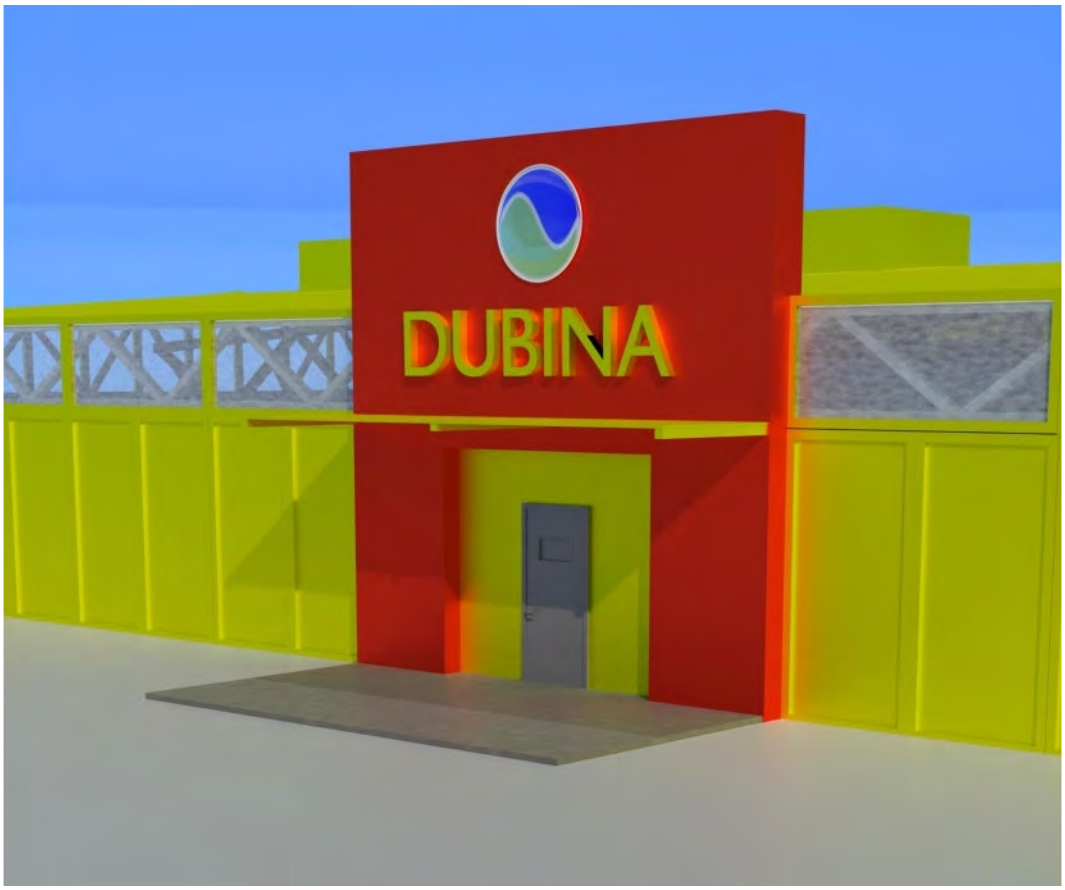


Brain EVO

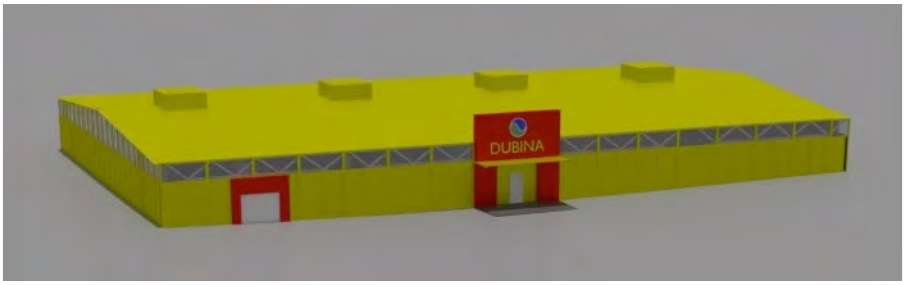
The car is controlled by a Raspberry Pi 4 microcomputer. This computer is a small board slightly larger than a bank card. A specialized Raspbian distribution was used on the computer. The board is based on the Broadcom BCM2711 SoC, which contains four 64-bit ARM Cortex-A72 cores with a clock speed 1.5 GHz. The computer has 8 GB of LPDDR4 SDRAM RAM. VLI VL805, provides USB 3.0 Hub via PCI Express bus. Gigabit Ethernet is provided using the Broadcom BCM54213PE separate from USB. Wireless communication is provided by the Cypress CYW43455 chip, dual-band wireless IEEE 802.11.b / g / n / ac 2.4 GHz and 5 GHz, as well as Bluetooth 5.0 and Bluetooth LE. The power connector is USB-C, the computer needs up to 3 A. The Raspberry Pi 4 Model B has support for two 4K screens at 30 frames per second. Next to the two micro-HDMI ports, there is a 4-pole stereo output and a composite video jack. Storage is provided by a Micro-SD card with a slot on the bottom of the board. The GPIO connector is standard 40-pin.

Works like a clock

The mini-plant was designed for small-scale production of DOUBIN EVO. This is the first plant of the company which plans to manufacture a car. The plant includes a production line consisting of from three stages. Kitchen D for 35 people. Design Studio B, where the body and interior details will be modeled. Engineering Department G consisting of seven people. Changing room Y. Production areas I, H, G, J, K, L, M, X, R, etc. The total area of the plant is 1500 m2. In the first stage of the production line, the body is assembled. The glass material from which the body parts are made is cut at the HS section. The cut glass material on the table ah fits into the matrix of the body part ai. Part matrix ai taken from model ag in design studio B arrives at molding hall N1 or N2



The technological process of cutting takes less time for the forming process, therefore, there are two forming halls N1 and N2 in the production process. When molding a body part in halls N1 and N2, the glass material is impregnated with epoxy resin and then enters the O1 and O2 oven to dry. After the furnaces O1 and O2, the die with the part enters the machining halls P1 and P2 for extracting the part from the die and machining, in which the flash is removed from the part and technical holes are made. After machining, the part goes to the finished parts warehouse Q or to the assembly area R if it is part of another part. All body parts are assembled in the first stage of production. After the assembly process in the first stage, the body enters the spray booth al of the second production stage. Body painting is a lengthy and complex procedure, consisting of several stages. The first stage of body sanding requires excellent ventilation, which should not only remove dust from inside the spray booth, but also filter the air entering the booth. After paint is applied, hot air is blown into the booth to dry the paint.



DUBINA mini-factory.

After painting, the car body goes to the third final stage of production. Two workers numbered 14 and 15 in a certain order install all the equipment of the car and install the electrical wiring. The body is equipped with a power plant assembled at site V, a battery assembled at site T, a dashboard assembled at site W. After installing the parts, the workers check the operation of all vehicle systems and after that the car is ready to pass into the hands of its owner.

Production stages: Stage 1 — body assembly; Stage 2 — body painting; Stage 3 — equipment installation.

Production areas: A1, A2 — warehouse; B — design studio; C — bathroom; D — kitchen; E — captain's bridge; F — robotics engineer room; G — engineering department; H — vacuum forming area; HS — area for cutting materials; I — mechanical section; J — area of CNC machine tools; K — 3D printing area; L — forging and pressing area; M — welding area; N1; N2 — molding hall; O1; O2 —

oven 1, 2; P1; P2 — machining hall; Q — parts warehouse; R — production line; S — part assembly area; T — battery assembly area.

Plant personnel: 1- Anton Dubina; 2 — robotics engineer; 3; 4 — software engineer; five; 6 — design engineer; 7; 8 — process engineer; 9 — security guard; 10 — battery collector; 11; 12 — body assembler; 13 — molar; fourteen; 15 — equipment installer; sixteen; 17 — body parts assembler; 18 — dashboard assembler; 19 — power plant assembler; 20 — control system assembler; 21 — 3D printing wizard; 22 — welder; 23 — operator of CNC machines; 24 — locksmith; 25 — modeller; 26 — cutter; 27; 28 — molder; 29; 30 — handler; 31 — storekeeper;

Plant inventory: ab — racks; ac — plastic sheets; ad — barrels of epoxy; ae — profile; af — vacuum former; ag — cockpit model; ah — cutting table; ai — matrix of a part for molding from a composite; aj — cockpit assembly slipway; ak — roof assembly slipway; al — spray booth; am — battery manufacturing machine; an — battery case; ao — cnc machine; ap — car body model; as — dashboard; ar — welding station.