# E-TRUCK@RO

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***ABSTRACT:*** *It is a concept of electric car, based on a classic Romanian truck platform, designed by the open-source type. The basic system developed contains an 80kw BLDC motor, powered by a 25kw battery bank, at a voltage of 400v, direct current. This system is designed in such a way as to be a research stand for various adapted hardware elements, but also for testing different driving algorithms...*

**KEY WORDS:** Aro, electric, bldc, battery, software application, charging

## 1. INTRODUCTION

For the realization of this didactic stand I chose an Aro 243 for the mechanical platform. It is also presented in figure 1 which was a symbol of Romania and the car can offer many possibilities.

Fig.1 Aro243

I used as electrical construction the components from a standard electric vehicle, a nissan leaf, this being presented in figure 2. Their choice was made on the condition that they are equipment that worked continuously, they are very well tested especially to the component of electricity leakage, which is a real danger, being 400 volts on batteries and on the controller that drives the rotation of the electric motor that sets the car in motion, fulfilling the same function with a heat engine.

Fig.2 Nisan Leaf electric motor and battery

As a control, we used our own controller and our own load, which we can control, otherwise in the car software, in its on-board computer we cannot have access, if we want to use them.

For even greater complexity, we wanted to make the car still 4x4, to use the maximum power on this electric motor to keep all the original transmission of the car and then to introduce only the moving part on the electric side. The car will also benefit from the regenerative function, which has a 30kwh battery recharging capacity that increases the autonomy of the vehicle to increase the autonomy of movement.

## 2. THE PROPOSED SYSTEM

The proposed system is one of the open source type in which students can come up with various mathematical models for driving the electric motor, programming capabilities of all components of the vehicle from the battery charging part, electric motor controller, accelerator pedal and up to electronic display of all important sensors, graphics. In the first stage we dismantled the heat engine that is placed on the hoop, as shown in Fig. 3 to make room for the new electric motor.

Fig.3 Aro engine

After removing the heat engine, we proceeded to make two fitting plates, one on the gearbox and one on the electric motor that will be mounted in the engine compartment. After making the 2 plates, the coupling between the electric motor and the gearbox will be made. There are 2 coupling variants that can be made between the two, one elastic and one rigid.

The use of the rigid coupling makes it difficult to make it because we have on the electric motor component an axle with a certain type of grooves with a much smaller diameter than the grooves that must be coupled on the gearbox, so we chose an elastic coupling with claws which the tolerances are slightly higher than the rigid coupling and we can align the electric motor much more easily by the gearbox. The whole assembly is shown in figure 4 where you can see the whole mechanical assembly between the gearbox and the electric motor.

Fig.4 coupling

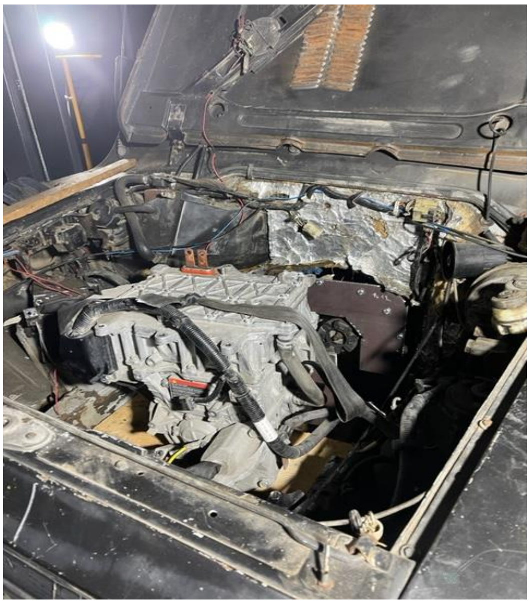

Fig.5 Electric motor in Aro

The metal used to connect the electric motor to the gearbox is one with a thickness of 10 mm, and the spacers between the 2 plates are made of solid raw materials to provide better torsional resistance and does not allow elastic deformations to occur. support component due to the force of the electric motor.

The welding was made with the addition of material which provides a much better resistance over time.

For the charging part we use a BMS, which has the function of charging by stabilizing the cells from the batteries without being destabilized. It is very important for charging the BMS batteries.

With software and hardware protection technics, it provides complete protection and balancing cells. The BMS includes protection against overcurrent in charge and discharge mode, short-circuit, under-voltage, over-voltage and thermal protection.

With a smartphone or a computer, easily configure the BMS for your application, setting the limits of currents, voltages and temperatures.Incorporated with an advanced balancing algorithm, this BMS is the perfect solution for reliability, performance and battery longevity.

The connection diagram is presented in figure 6, which represents both the connectivity diagram of the BMS and the loading part on the Type 2 socket.

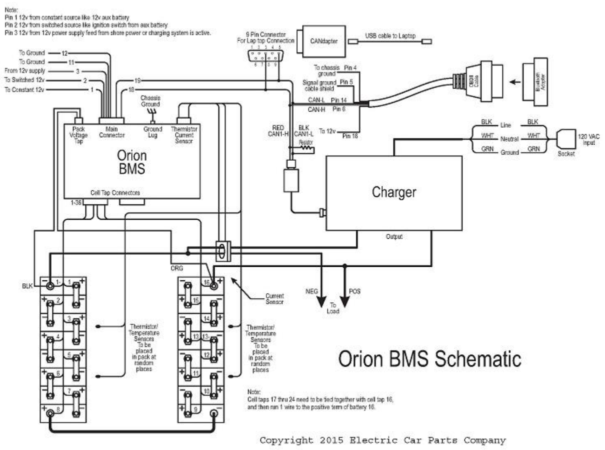


Fig.6 BMS- diagram

The Orion 2 BMS is one of the most universal battery management systems on the market. Due to its versatility, it can easily be used for electric cars, electric ships and grid storage. In this way, all CAN bus messages can be individually designed and the addresses assigned. The small gradation in steps of 12 with the versions of 24 – 180 controllable cells, the optimal size can always be found. The compactness is a great advantage during installation. All connections with plugs can be disconnected and all functions except current and temperature measurement are built into the main housing.

**Main functions**

- State of charge calculation (SOC)
- Over and under voltage protection.
- Intelligent passive cell balancing
- intelligent current control during charging and discharging (CCL / DCL)
- Battery pack temperature measurement
- Monitoring the battery health (SOH)
- Signal exchange with CAN bus or wired
- Insulation monitoring
- Hardware support for SAE J1772
- Programmable via software
- **Significantly smaller enclosure** size for 24-72 cell configurations.
- Roughly 40% **lower weight** on all models due to the new enclosure design and streamlined (removable) heatsink. Minimum heat dissipation requirements apply.
- Considerable **boosts in measurement accuracy** and processor speed allow for more advanced calculations and logic.
- Direct hardware support for several popular charging protocols including hardware support for **SAE J1772** (directly interfacing with the pilot / proximity lines) and **CHAdeMO** for DC fast charging.
- Wider input power voltage range (now **12v-24vDC compatible**) for better support on heavy vehicles and equipment. The Orion 2 BMS remains fully compatible with 12v applications.
- Ability to **directly drive certain contactors** on select inputs (bypassing the need for intermediate signal relays in some situations)–see supporting documentation for details.
- Completely redesigned multi-unit series configuration (now using **Remote Cell Tap Expansion Modules**). This greatly simplifies connecting multiple units together in series and improves the overall reliability.
- New **Status LED** on the unit to indicate power status and the presence of faults.

- Addition of **2x new Multi-Purpose Output pins** with programmable functions.
- Significant **algorithm and software enhancements** to improve overall system accuracy for parameters such as State of Charge and pack health.

**Isolation**

- Cell taps isolated from input power supply, chassis and I/O
- 2.5kV isolation between each connector of cell taps
- Isolation allows for use of in-pack safety disconnects and fuses
- High voltage isolation fault detection circuit to monitor the breakdown of wire insulation

**I/O Interfaces**

- 2 Digital signal outputs for enabling charge and discharge.
- 1 Digital signal output to control a battery charger
- 5 Digital programmable multi-purpose outputs
- 2 Digital programmable CANBUS (CAN2.0B) interfaces.
- 3 Analog 0-5v outputs that represent the following signals: Charge / Discharge Current Limits and State of Charge (SOC)
- 1 PWM fan output and fan speed feedback monitor (external switch and relay required, uses MPO4)
- 8 Thermistor inputs (Can support up to 800 thermistors through external thermistor expansion modules
- 1 Dual range current sensor input (measures pack current)

**Power Supply**

- 3 redundant 12V—24V DC power supplies for reliability
- BMS retains data and settings without power
- Low power sleep mode

**Cell Voltage Monitoring Specs**

- Cell voltage measurement resolution of 0.1mV.
- Maximum individual cell voltage rating: 0.5v to 5v per cell tap.
- Cell voltage measurement total error <0.25% across full product temperature range.
- Total pack voltages from 12vDC up to 800vDC (maximum).
- Supports from 4 to 340 cells per battery pack (requires remote modules for more than 180 cells, 800vDC maximum).

## 3. CONCLUSIONS

In conclusion, the conversion from a classic car with internal combustion engine to an electric motor and maintaining the 4x4 coupling is a complex research topic that requires in-depth studies.

The realization of such a didactic stand for open source students will have a major impact in their development and their anchoring to reality and at the same time the development of the university by attracting new students and creating high-performing teams.

The BMS offers multiple connectivity ports and programming types that will help make many changes in the future.

## 4. REFERENCES


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