Solutions for electric trucks – product description

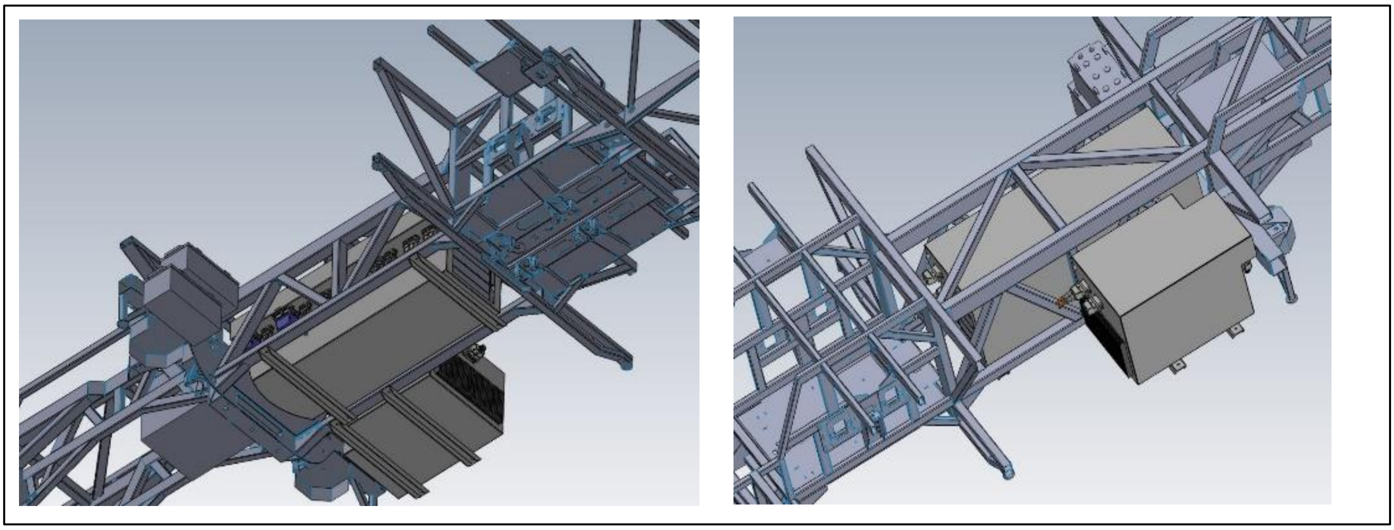
Technological progress over the past 30 years (probably the greatest in the history of mankind) has led to significant changes in the ecosystem of the entire planet. We are all committed to reducing mankind's negative impact on the environment, so when given the opportunity to participate in an electric truck project, we willingly signed up – both as a company and individually, as people of a generation that can “make an impact”.

Life in a big city offers many advantages, but sadly also many drawbacks. One of the latter is noise and air pollution from vehicle exhaust emissions. The authorities of many European metropolises continue to introduce tighter restrictions for vehicles that are allowed to travel within inner city areas, and yet municipal and commercial vehicles are an inseparable part of the urban landscape. In 2016, the Danish company BANKE (together with its subsidiaries) decided to build an electric truck, inviting ENIKA to participate in the process. The project was launched in early 2017. The task was to develop a universal base for a large truck (28 tons), which could perform different functions, depending on the body type. It was decided to build a garbage truck as the prototype.

DESIGN.

ENIKA undertook to design the drivetrain and all electrical auxiliary systems. The greatest challenge was to fit all the components into the assigned zones. The total maximum intended power for all systems was about 330kVA.

Axles with built-in AVE130-400VAC type motors from ZF were used in the design. The calculations demonstrated that liquid cooling of the power units would be necessary.



Drawing 1 Component layout in the truck chassis.

The high priority and outstanding involvement of the ENIKA team allowed the design and construction of two complete prototype sets within 7 months.

The solution was to divide the components into 2 multi-purpose boxes: ENI-MULTIBOX1 and ENI-MULTIBOX2. A view of the completed devices is shown in Figure 2, with the list of functions in

Table 1.

Circuit	***Function***	***Location***	***Power***
Traction inverter	ZF-AVE130 axis power supply	MBOX1	2x65 (2x130) kVA
Auxiliary inverter 1	Power supply for the power steering pump	MBOX1	10kVA
Auxiliary inverter 2	Power supply for the air compressor	MBOX1	10kVA
Auxiliary inverter 3	Power supply for the hydraulic oil pump	MBOX1	35kVA
HV charger	Charging the HV traction batteries	MBOX1	40kW
LV charger	Charging the 24V auxiliary batteries	MBOX2	12kW
Cooling circuit	Pump and cooler	MBOX2	-

Table 1 Division of circuits.

Due to the limited service access, the devices have been designed such that their assembly and disassembly is as simple as possible, with the elimination of any potential confusions – all ports are multi-contact coded connectors. This applies to both the electrical and the hydraulic connections.

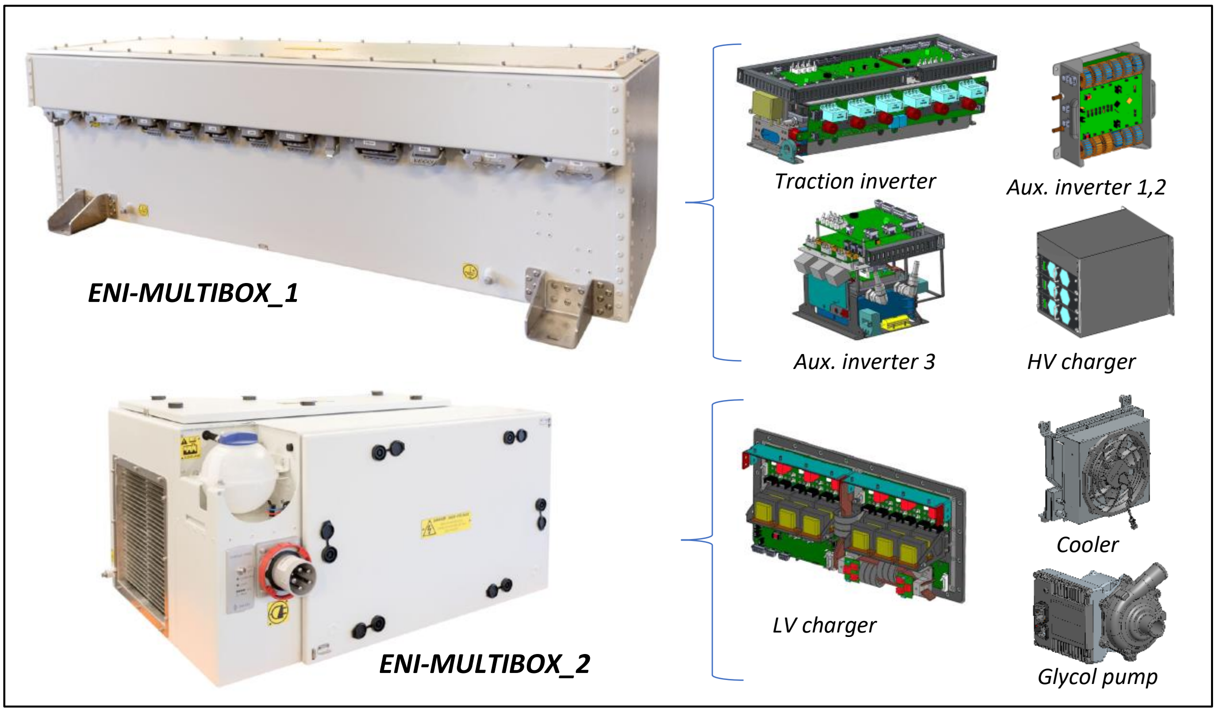


Figure 2 Box structure.

SYSTEM INTEGRATION.

A vehicle built from multiple proprietary systems requires individual integration – including the matching and interpreting of multiple signals in digital (CANbus J1939) or analogue (I/O) form. For the success of the project, the matching of the drive and brake system (EBS 5s) was particularly important. The drive system software has been designed to include these function:

- **AEBS –** brake blending – division of braking functions between brakes and traction motors (energy recuperation),
- **AEBS** – hill holder,
- other, such as **ABS**, **ASR**, **ECAS**.

By default, all ENIKA's drive systems have the following functions:

- **CC** – cruise control (with braking function under this project),
- **LIM** – speed limiter.

As part of the project development, functions necessary for semi-autonomous driving are planned:

- **ACC** – active cruise control (vehicle detection, collision detection),
- **LDWS** – lane departure warning system.

DIAGNOSTICS.

Another part of the project was to develop a protocol for the exchange of diagnostic information, to enable intuitive, clear and quick diagnostics of the drive system. Information in graphic and text formats is displayed on the dashboard.

Detailed diagnostics can be performed directly in the vehicle using the diagnostic interface and a PC. A sample view of the inverter and battery sheet is given in Figure 3.

Due to the international character of the project, the prototype trucks have been equipped with a remote work monitoring system that operates throughout the European Union. All data from the internal CAN line are transmitted via GSM to a server located in the company's headquarters in Łódź. The data is stored for a certain period of time (e.g.

1 month). Thus the system behaviour (all parameters) can be reproduced at any time. Examples of the inverter temperature and torque analyses are shown in Figure 4.

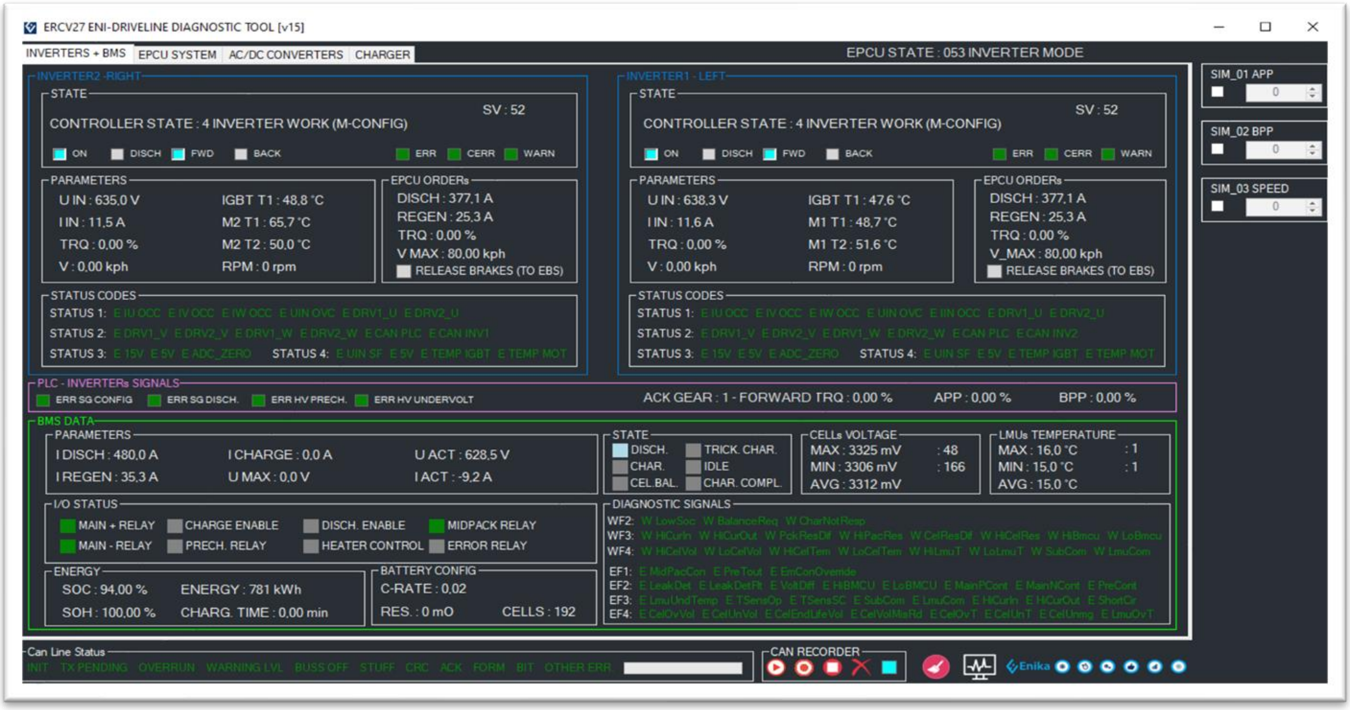


Figure 3 View of the diagnostic interface.

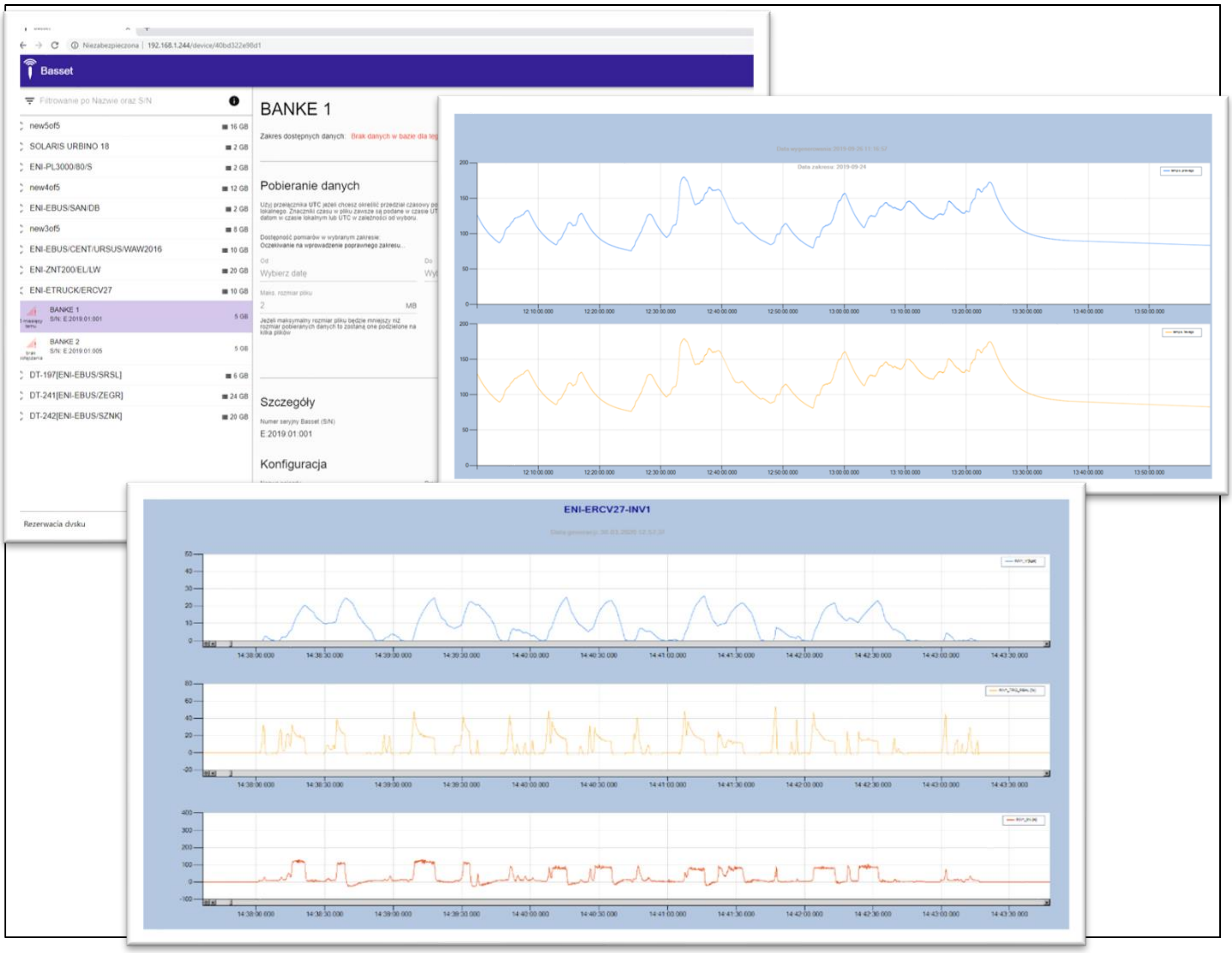


Figure 4 View of the remote diagnostics interface.

PHOTOS

Figure 5 Internal tests

Figure 6 Built-in ENI-MBOX1

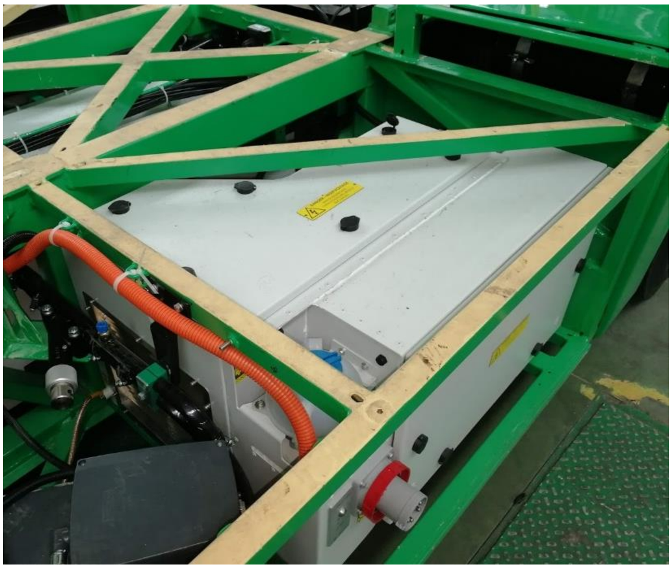


Figure 7 Built-in ENI-MBOX2

Figure 8 First functional tests

Figure 9 Charging socket.

Figure 10 Braking tests