

MODERNIZATION OF ALSTOM CITADIS 116Nd TRAMS FOR THE KATOWICE AGGLOMERATION



Between 1999 and 2001, a total of 21 Alstom Citadis 100 trams were manufactured and delivered to the Polish cities of Gdańsk (4 vehicles) and Katowice (17 vehicles). The older vehicles in Gdańsk (designated as model NGd99) were modernized in 2017 by an external contractor using electrical equipment supplied by ENIKA. The seventeen newer trams, differing in design and operated in the Katowice agglomeration, were manufactured in 2000 and 2001 and gradually modernized between 2019 and 2026 in the in-house facilities of Tramwaje Śląskie. In this case as well, ENIKA was selected as the supplier of the electrical equipment, delivering a newer generation of its systems compared with the earlier project for Gdańsk.

Alstom Citadis 100 trams were manufactured at Alstom's facility in Gorzów Wielkopolski. In the version for the Katowice agglomeration (type 116Nd), these are three-section vehicles with a 73% low-floor share, a length of 24.05 m, and three bogies. The first and last bogies are powered and were supplied from Alstom's German plant in Salzgitter (formerly Linke-Hofmann-Busch; LHB). This is the same bogie type used, among others, in GT6N trams in Magdeburg. The applied design allowed the floor height to be reduced to 590 mm above the top of rail. The center bogie is a trailer bogie and was manufactured directly at the Chorzów plant. The complete electrical equipment, including the traction motors (4 × 140 kW), was originally supplied by Alstom.

After nearly twenty years of operation, the operator Tramwaje Śląskie decided to modernize the 116Nd vehicles in order to improve their reliability. The process began in the second half of 2019; due to the complexity of the project and available workshop capacity, the first vehicle was completed and returned to service in early 2021. The remaining vehicles were modernized progressively, with the final order scheduled for 2026. The modernization significantly improved passenger comfort and driver working conditions, while also increasing the operational reliability of the vehicles.

ENIKA supplied two new traction containers (installed in the first and last sections of the vehicle) of type ENI-FT600/200X, matched to the

power of the original, remanufactured Alstom traction motors (4×140 kW). A separate container houses a new auxiliary converter (ENI-PT600/24/AC/2x30), with the 24 V DC output stage implemented in full-SiC technology and the AC path based on IGBT technology. The auxiliary converter is installed in the rear section of the tram and provides a 10 kW DC output as well as AC outputs rated at 2×30 kW. The high AC output power is used to supply the air-conditioning units installed as part of the modernization. In the enclosure of the former high-speed circuit breaker (HSCB), the main fuses of the high-voltage circuits and measuring transducers recording tram current and voltage were installed. An additional voltage distribution unit (ENI-SWN/116Nd) was mounted in the last section, housing contactors and fuses for the high-voltage and AC circuits.

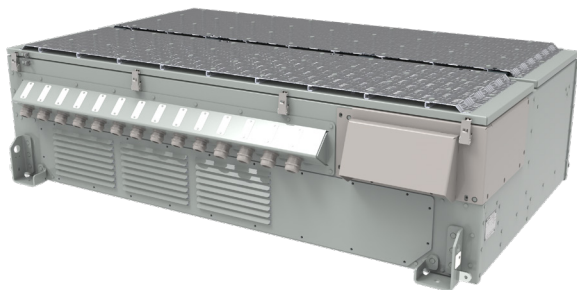
**Operational availability of the
Citadis 116Nd fleet in the Katowice
agglomeration (in 2025):**

99,4 %

The braking system was also modified. The hydraulic brakes are controlled by new ENI-SHT units (for the powered bogies as well as the trailer bogie). The rail brakes operate under the supervision of the Drive and Tram Controller (ENI-SNT/116Nd). This controller is located behind the driver's cab and forms the core of the TCMS control system. In addition to traction and brake control, the TCMS integrates other vehicle subsystems, such as the pantograph, sanders, and windshield wipers.

In addition to the components mentioned above, ENIKA also supplied other selected items, primarily for the driver's workstation. This required consideration of the limited space of the original driver's desk, which could not be expanded. Components from well-established manufacturers were selected and supplied, ensuring mutual compatibility and full integration with ENIKA's control system.

Compared with the original factory solution, the new electrical equipment features significantly reduced dimensions and weight, which has a positive effect on wheel tire wear and reduces the dynamic interaction between the vehicle and the track. The scope of supply also included the delivery of the required documentation as well as support during installation and commissioning. The trams are additionally connected to a remote monitoring system, enabling rapid service support in the event of faults.



Traction inverter series ENI-FT600/200X

First modernization project of Alstom Citadis 100 trams

The first modernization project involving Alstom Citadis 100 trams was the cooperation on the repair and reconstruction of NGd99-type vehicles for Gdańsk. In 1999, the city purchased four trams of this type, which differed in many respects from the vehicles intended for the Katowice agglomeration.

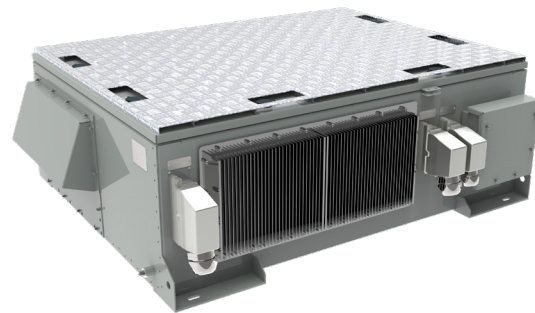
The differences were evident at first glance: the trams featured an older design, originating from the initial concept of low-floor trams developed by Konstal prior to its acquisition by Alstom. The vehicles were also longer, with a length of 26.6 m.

The modernization of the four Gdańsk Citadis trams was carried out in 2016–2017. The experience gained was subsequently used in the implementation of the project for Tramwaje Śląskie. The scope of supply for Gdańsk was similar: two new traction inverters (ENI-FT600/200/CR version) were installed, the original high-speed circuit breaker was replaced with a new enclosure incorporating a new high-speed circuit breaker and measuring transducers (ENI-SWN/MF20), and two auxiliary converters were supplied (ENI-PT600/24/AC/MF20). The scope also included the TCMS system (ENI-SNT/NGd99) and other selected components, such as the driver display and the master controller.

The trouble-free operation of the new hydraulic brake controllers (ENI-SHT) in the Silesian network led to ENIKA being awarded, in 2021, a contract to replace the original hydraulic brake controllers in the NGd99 vehicles with new ENI-SHT units, despite the fact that the traction system modernization of these vehicles had already been completed. This replacement was driven by increasingly frequent operational issues related to maintaining the technical serviceability of the approximately 20-year-old original disc brake controllers.

The earlier project in Gdańsk can therefore also be regarded as an example of a successful modernization, which significantly extended the service life of the vehicles, improved passenger and operating staff comfort, and increased operational reliability.

The trams demonstrate exceptionally high operational reliability. In 2025, their availability reached 99.4%.



Auxiliary converter ENI-PT600/24/AC/2x30