

METRO TRAINS



2-CAR METRO UNIT

Gauge 1524 mm
 Wheel arrangement Bo'Bo' + Bo'Bo'
 Weight 2 x 30 tonnes
 Length of 2-car set 44200 mm
 Width 3200 mm
 Height 3600 mm

Traction drive .. AC Induction motor drive
 Operating voltage 750 V DC
 Output 500 kW/car
 Max speed 90 km/h
 Number of seats 67/car
 Max permitted passenger capacity 270/car

TRAMCARS



ARTICULATED TRAMCAR Nr I/Nr II

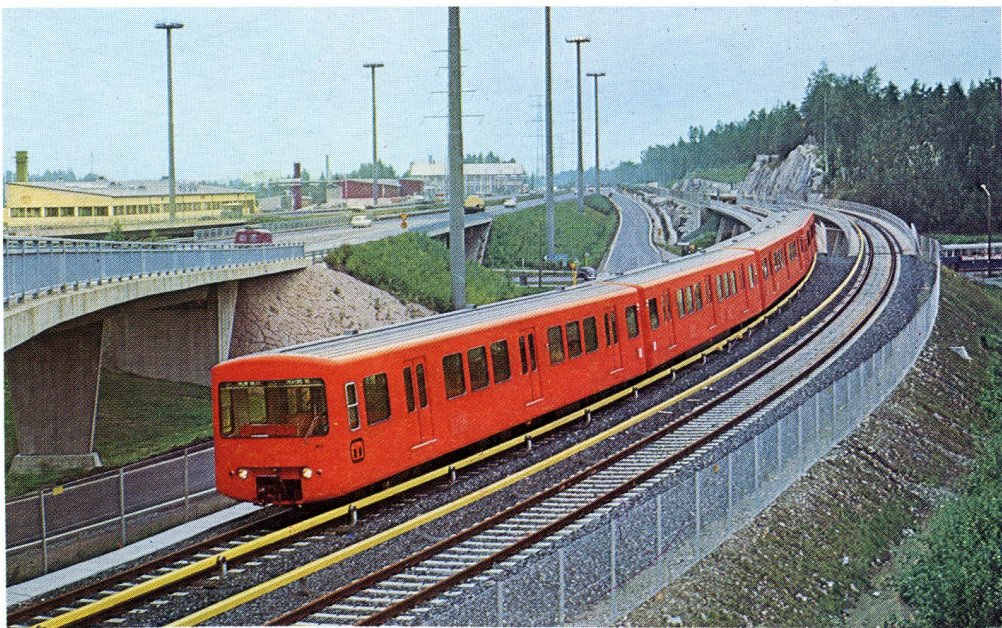
Gauge 1000 mm
 Weight 28,5 tonnes
 Length 20000 mm
 Width 2300 mm
 Height 3700 mm
 Operating voltage 600 V DC

Output 2 x 130 kW
 Acceleration and retardation ... 1,2 m/s²
 Max speed 60 km/h
 Number of seats 41/40
 Max permitted passenger capacity .. 190

RAPID TRANSIT TRAIN

In 1972 a triple two-car unit having thyristor chopper control was handed over to the Rapid Transit Office of the City of Helsinki for use as a trial vehicle. Experiences with this are benefitting the present 42 two-car train set series now being produced by Metrovaunut Ay, a company owned jointly by Valmet Oy and Oy Strömberg Ab, over the period 1977—83. The metal bodies of the serial-produced units are built by welding together light metal sections and the main dimensions are those of the trial vehicle. The cars are supplied with air springs and all the axles have motor drive. These are inverter-based AC-induction motors, the output of which ensures rapid acceleration and deceleration even under heavy passenger loads. The trains are intended for driver-less operation, hence reliability and safety have been given special consideration. Braking resistance heat energy has been made use of in the heating and ventilating systems. A train set can consist of one, two or three two-car units.

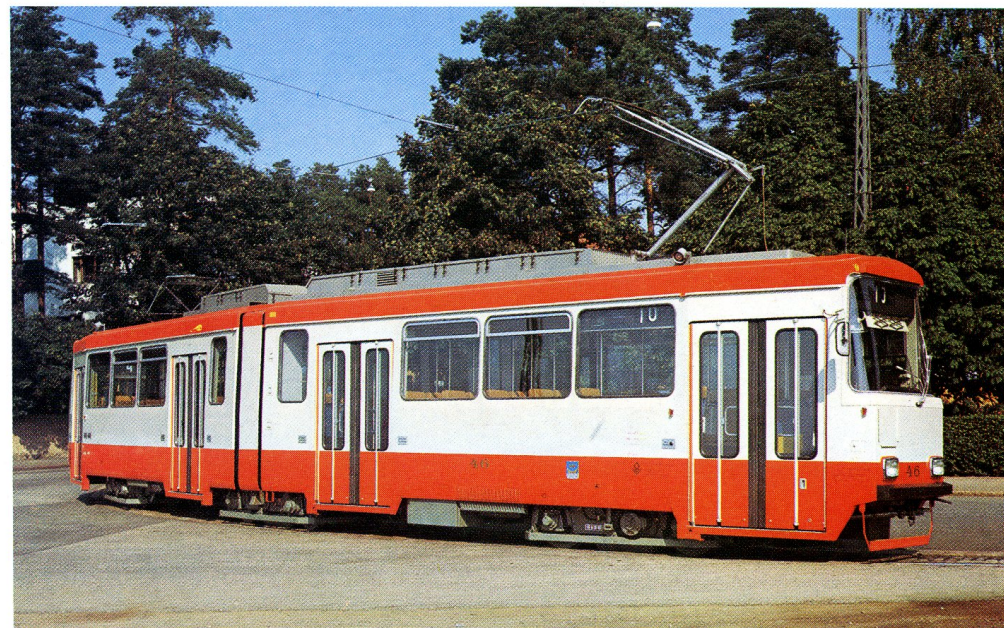
| | | | |
|-------------------|-----------------|----------------------|------------|
| Wheel arrangement | Bo'Bo' + Bo'Bo' | Operating voltage | 750 V= |
| Gauge | 1524 mm | Output | 500 kW/car |
| Train set length | 44200 mm | Max. speed | 90 km/h |
| Length of car | 21500 mm | Weight of car | 31.6 Mg |
| Width of car | 3200 mm | Seating accomodation | 67/car |
| Height of car | 3600 mm | | |



ARTICULATED TRAMCAR Nr I

Over the period 1973—75 a total of 40 6-axled articulated tramcars were manufactured for the Helsinki City Transport. These represented the world's first serial produced thyristor chopper based trams. Passenger comfort and safety, as well as easy use and maintenance, were especially taken into account in their design, as were also energy saving systems. Their motion is smooth and silent. The colours, moulded seats and large windows make travelling a pleasant experience. The wide doors are fitted with composite safety devices. Great saving in energy has been made by using brake resistance heat energy in the heating system.

| | | | |
|-------------------|----------|----------------------|----------|
| Wheel arrangement | B'2'B' | Operating voltage | 600 V= |
| Gauge | 1000 mm | Output | 2×130 kW |
| Length | 20000 mm | Max. speed | 60 km/h |
| Width | 2300 mm | Weight | 28.5 Mg |
| Height | 3700 mm | Seating accomodation | 41 |



Tramcars

Articulated tramcar of Helsinki

A series of chopper-driven articulated tramcars was manufactured during the years 1973 to 1975. These were the first articulated tramcars in Finland.

The two-part body of an articulated tramcar is mounted on three bogies. The middle one is a trailing bogie, located under the link of the car. The other two are motoring bogies.

The electrical drive equipment is designed for the high acceleration and braking characteristics necessary in city traffic.

Main circuit

Each traction bogie has one longitudinally mounted traction motor. The armature circuits of the two motors are supplied by separate thyristor choppers, whereas the excitation windings have a common excitation chopper. The bogie drives are connected to the overhead contact line through a common line capacitor and reactor, which act as a filtering circuit. A reactor connected in series with the armature of each motor smooths the current fluctuations.

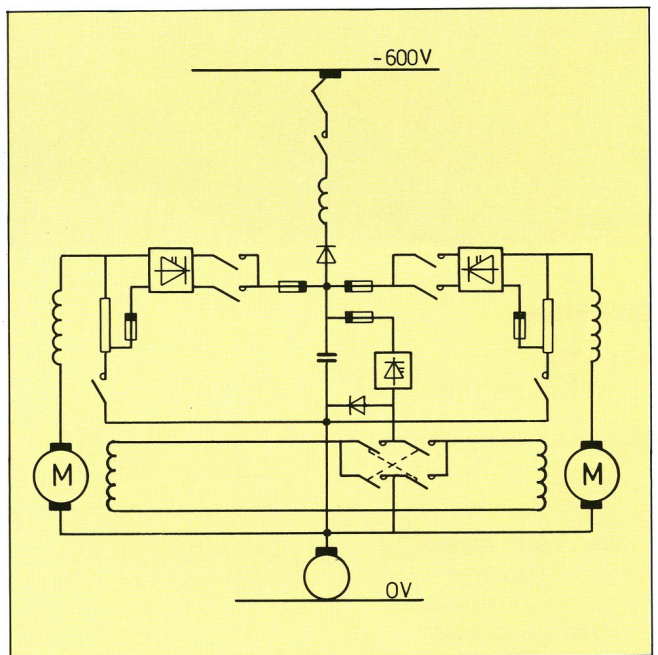
When braking the chopper operates as a braking chopper, then the braking power is taken up by the braking resistor. This system, developed on the basis of tests performed with a test car, enables effective electrical braking down to practically a standstill.

Stopping and standstill braking are performed with disc brakes. The electrically controlled disc brakes in the centre trailing bogie operate in conjunction with the electric braking of the traction motor drives.

Purchaser:
Helsinki City Transport

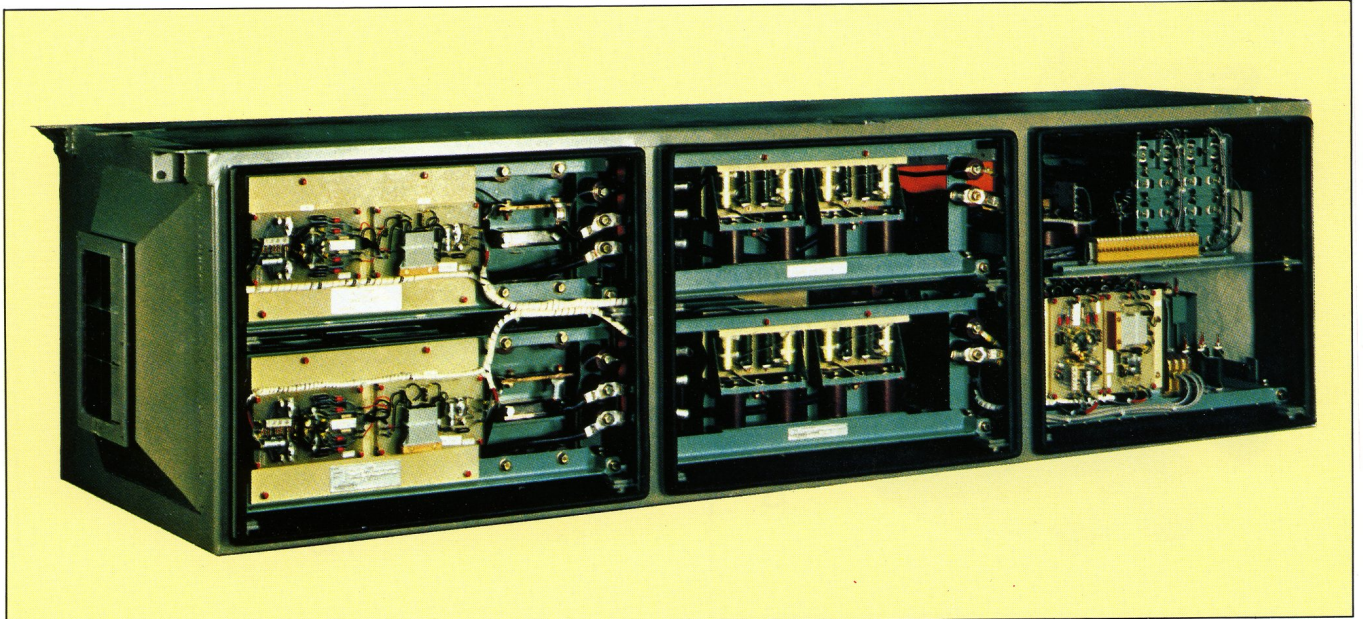
Contractor:
Valmet Corporation

Electrical drives:
Strömberg



Main circuit diagram.

V. 1130.72.A



Traction drive unit with choppers.



V. 1230-73 A

Deliveries:

- number 82
- time of delivery 1973 to 1975, 1983—87

Main characteristics:

- weight 26 t
- length 20 m
- maximum speed 60 km/h
- supply voltage 600 V DC
- continuous output 260 kW
- seating capacity 41
- total payload 144

V. 1168-72 A



Central control unit of the traction motor drive.

ARTICULATED TRAMCAR



THE MODERN ARTI TRAMCAR FOR NORD

In 1970's Valmet Oy has delivered 40 articulated tramcars type Nr 1 to Helsinki City Transport. In 1981 Helsinki made a new order for 42 tramcars type Nr 2 for delivery between 1983-87.

The articulated tramcar, the type designation of which is Nr 1, is designed to serve urban traffic as well as possible. Special attention has been paid to passenger comfort and safety. Technical solutions such as thyristor chopper control of traction motors ensure smooth and noiseless running and operation. The colours chosen for the car, the shaping of the seats, and the large windows also contribute to passenger comfort.

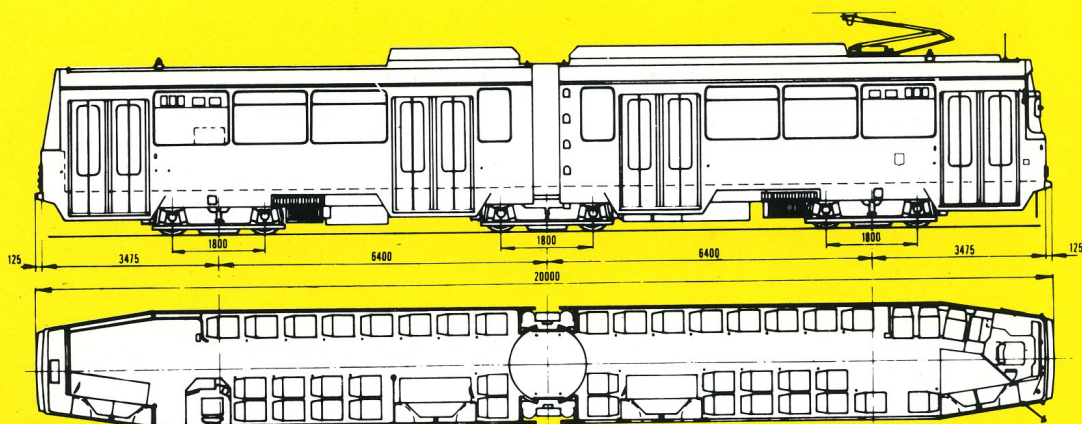
The constructional solutions have been chosen so as to improve ease of operation and maintenance and to meet the special requirements of climatical conditions in Finland.

Valmet Oy Railway Division as head contractor has built the car bodies and furnished the interior, carried out the electric installations and final assembly. The share of Oy Strömberg Ab in the deliveries has mainly comprised the electric traction-motor drive.



Large windows, colours, the shaping of seats, adequate stay-bars, and ample lighting add to passenger comfort and safety.

Top right: The electrically operated folding doors with composite safety devices are on the right side of the car. They have a free opening of 1330 mm. The front and rear doors are only for entrance and the middle doors only for exit.



ARTICULATED TRAMCARS IN DIFFERENT OPERATING CONDITIONS



MECHANICAL PART

The articulated tramcar is designed to run in one direction only and so the doors are all on the right side. The car will operate as a single unit without trailer. For possible hauling, each end is, however, provided with a haulage coupling.

The tramcar consists of two parts, which are connected to each other by means of a swivel-joint. Of the three bogies, the one under swivel-joint is a running bogie, whereas the two other ones are each provided with a traction motor.

The car body is a self-supporting steel structure assembled by welding. Heat insulation is by means of mineral wool which is insulated from the outside wall with cellular plastic sheet and from the inside wall with thin aluminium foil. Within the car the walls are covered with laminate sheet.

The floor construction consists of weather-resistant plywood, which is covered along the passages with rifled sheet-rubber, elsewhere with smooth sheet-rubber.

With the exception of the front and rear windows, the windows are hermetically joined double windows. Some of the windows are openable.

The seating arrangement is of the 1+2 type. The seats are cushioned and covered with plastic cloth. They are fastened to the walls and, by means of

stay-bars, to the ceiling only.

The electrically operated doors are made of reinforced plastic and fitted with composite safety devices.

The fare collector's stand at the rear door is of reinforced plastic and easily removable for replacement with passenger seats in the event of the fare collecting system being altered.

Both parts of the car have a fan on the roof for supplying filtered fresh or heated air into the car. The air is conducted into the car from above the windows on the left side and through slots at the junction of floor and wall on the right side. The heat energy of the braking resistances and, if necessary, supplemental heating resistances are used for heating. The windscreen and the driver's stand have their own heating and ventilating devices.

The bogies are fitted with rubber suspended wheels. The wheel-sets have rubber suspension. The bogie frame is connected by means of coil springs to the traverse beam, which is attached to the car body or swiveling part by means of a swivel ring. Transmission from the traction motor, which is mounted parallel with the car, to each axle of the traction bogie is effected by means of a hypoid gearing and rubber couplings.

All bogies are provided with two magnetic railbrakes and a brake disc on both axles. The disc brakes of the traction bogies are spring actuated. The sanding devices are in front of the traction bogies.

All necessary switches, signal lights, and meters as well as the controls for the loudspeaker and radio-telephone equipment are mounted in the driver's desk. The controller is to the left and the parking and emergency brake switch to the right of the driver.



SPECIFICATIONS

| | | | |
|-------------------------|----------|-------------------------------------|----------------------|
| Gauge | 1000 mm | Motor output | 2 x 130 kW |
| Distance between bogies | 6400 mm | Weight of car unladen | 28,5 Mg |
| Axle base in bogie | 1800 mm | Max. effective speed | 60 km/h |
| Wheel diameter | 720 mm | Acceleration and retardation | 1,2 m/s ² |
| Length of car | 20000 mm | Seating capacity | 41 |
| Width of car | 2300 mm | Total passenger capacity | 144 |
| Height of car | 3700 mm | Max. allowable number of passengers | 190 |
| Operating voltage | 600 V DC | | |

ELECTRIC PART

The rated voltage of the separately ventilated traction motors is the same as that of the overhead line. Both motors are fed by own thyristor chopper. The motor excitation coils are connected in series and fed by a separate excitation chopper. The main circuit is connected to the overhead line through network capacitor, reactor and diode, which function as protective and filtering circuit. The current of each motor is filtered through a reactor connected in series with the armature winding.

The thyristor chopper also functions as braking chopper. The braking output is fed to the braking resistance. Electric braking is applied down to a speed of approx 2 km/h.

A spring brake is used for stopping and parking.

With the controller the driver is able to regulate steplessly both the tractive and braking effort. The regulation system prevents too large changes in acceleration and retardation, limits the max. current, prevents sliding and slipping and connects the spring brake to function at the right moment as stopping brake and, if necessary, as supplemental brake.

The voltage of the overhead line is used also for feeding the fan motors, the supplemental heating resistances, the heating resistances of the windscreen and the driver's stand, the heaters for driver and fare collector, and the motor generator.

The rail brakes are normally series connected and are fed with the overhead line voltage, but if this is not available, each rail brake is individually fed with the control voltage.

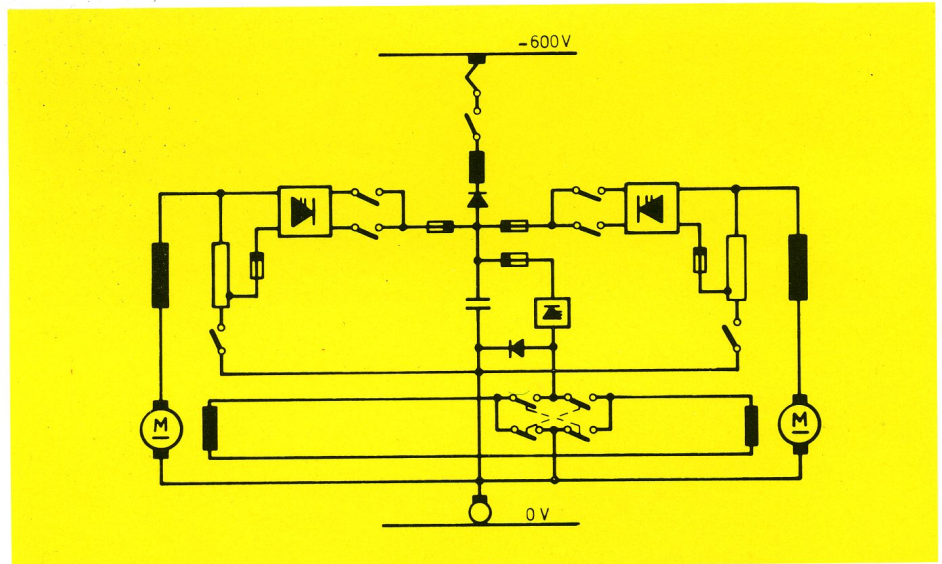
The current supplied by the motor generator is rectified to 24 V control current. This is used for feeding the control circuits and for charging the lead batteries.

The fluorescent lights in the car are fed with the control current through high-frequency inverters, each light having its own inverter.

The operating devices for the radiophone and loudspeaker equipment and the microphone connection are placed in the driver's desk, but communication is also possible from the fare collector's stand.

The car is fitted with a control magnet for switching the rails.

The rotor circuit of both traction motors is supplied by a separate thyristor chopper which is used both in driving and in braking. The excitation coils are connected in series and supplied by a separate excitation chopper.



A large windscreen with wipers and washing devices and two headlights improve safety in traffic. The smallest radius of curve in the track is only 15 m.



THE MODERN ARTI TRAMCAR FOR NORD

In 1970's Valmet Corporation has delivered 40 articulated tramcars type Nr 1 to Helsinki City Transport. In 1981 Helsinki made a new order for 42 tramcars type Nr 2 for delivery between 1983-87.

The articulated tramcar, the type designation of which is Nr 1 or Nr 2, is designed to serve urban traffic as well as possible. Special attention has been paid to passenger comfort and safety. Technical solutions such as thyristor chopper control of traction motors ensure smooth and noiseless running and operation. The colours chosen for the car, the shaping of the seats, and the large windows also contribute to passenger comfort.

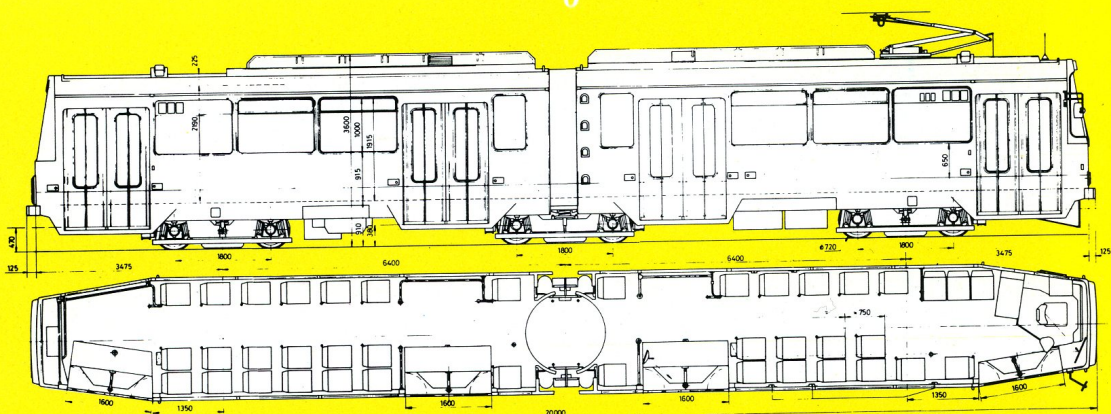
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Large windows, colours, the shaping of seats, adequate stay-bars, and ample lighting add to passenger comfort and safety.

Top right: The electrically operated folding doors with composite safety devices are on the right side of the car. They have a free opening of 1330 mm.



ARTICULATED TRAMCARS IN UNUSUAL CLIMATIC CONDITIONS

MECHANICAL PART

The articulated tramcar is designed to run in one direction only and so the doors are all on the right side. The car will operate as a single unit without trailer. For possible hauling, each end is, however, provided with a haulage coupling.

The tramcar consists of two parts, which are connected to each other by means of a swivel-joint. Of the three bogies, the one under swivel-joint is a running bogie, whereas the two other ones are each provided with a traction motor.

The car body is a self-supporting steel structure assembled by welding. Heat insulation is by means of mineral wool which is insulated from the outside wall with cellular plastic sheet. Within the car the walls are covered with laminate sheet.

The floor construction consists of weather-resistant plywood, which is covered along the passages with rifled sheet-rubber, elsewhere with smooth sheet-rubber.

With the exception of the front and rear windows, the windows are hermetically joined double windows. Some of the windows are openable.

The seating arrangement is of the 1+2 type. The seats are made of stainless steel and covered with textile. They are fastened to the walls and, by means of

grab poles, to the ceiling only.

The electrically operated doors are made of reinforced plastic and fitted with composite safety devices.

The fare collector's stand at the rear door is of reinforced plastic and easily removable for replacement with passenger seats in the event of the fare collecting system being altered.

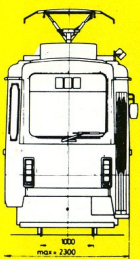
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The bogies are fitted with rubber suspended wheels. The wheel-sets have rubber suspension. The bogie frame is connected by means of coil springs to the traverse beam, which is attached to the car body or swiveling part by means of a swivel ring. Transmission from the traction motor, which is mounted parallel with the car, to each axle of the traction bogie is effected by means of a hypoid gearing and rubber couplings.

The traction bogies have a spring actuated brake disc on both axles and all bogies are provided with two magnetic railbrakes. The sanding devices are in front of the traction bogies.



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SPECIFICATIONS

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|-------------------------|----------|-------------------------------------|----------------------|
| Gauge | 1000 mm | Motor output | 2 x 130 kW |
| Distance between bogies | 6400 mm | Weight of car unladen | 27,1 Mg |
| Axle base in bogie | 1800 mm | Max. effective speed | 60 km/h |
| Wheel diameter | 720 mm | Acceleration and retardation | 1,2 m/s ² |
| Length of car | 20000 mm | Seating capacity | 40 |
| Width of car | 2300 mm | Total passenger capacity | 140 |
| Height of car | 3700 mm | Max. allowable number of passengers | 190 |
| Operating voltage | 600 V DC | | |

Nivelraitiovaunu

Vuosina 1973 - 1975 valmistettiin sarja tyristorikäyttöisiä nivelraitiovaunuja, jotka ovat ensimmäiset nivelraitiovaunut Suomessa.

Nivelraitiovaunun kaksiosainen kori lepää kolmen telin varassa. Keskimmäinen on juoksuteli ja sijaitsee vaunun nivelen kohdalla. Muut kaksi ovat vetotelejä.

Sähkökäyttölaitteisto on mitoitettu kaupunkiajossa tarvittavia suuria kiihdytys- ja jarrutusarvoja varten.

ostaja

hankkija

sähkökäytöt

Helsingin kaupungin liikennelaitos

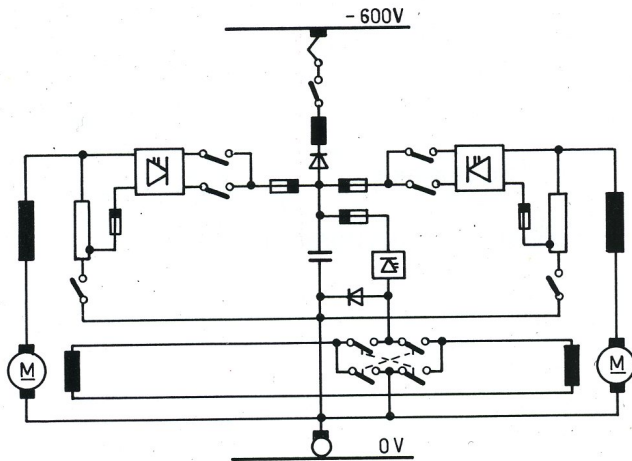
Valmet Oy

Oy Strömberg Ab

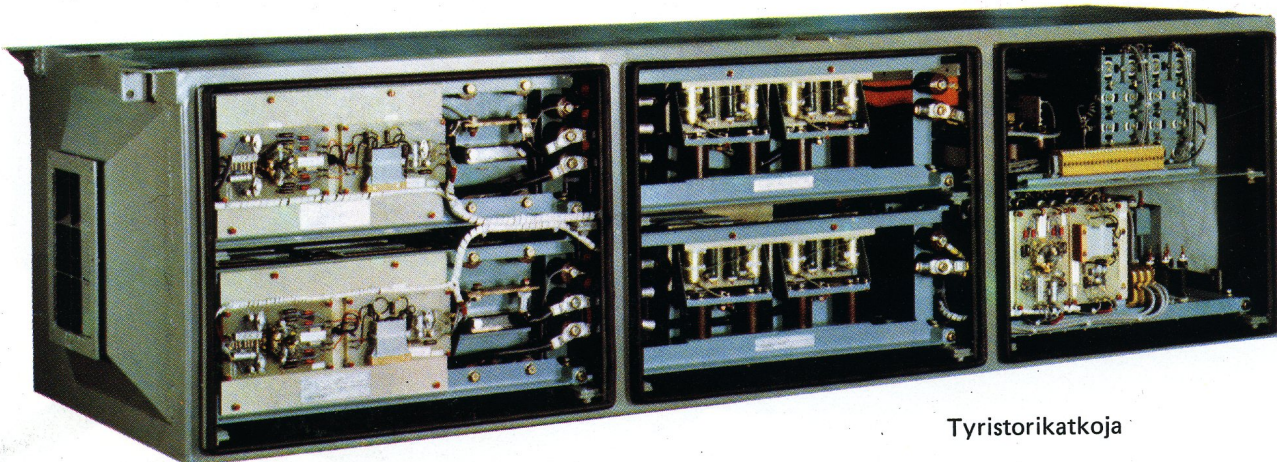
Päävirtapiirit

Kummallakin vetotelillä on pitkittäin asennettu ajomoottori. Kaksi tyristorikatkojaa syöttää moottorien ankkuripiirejä, kun taas magnetoimiskäämeille on yhteinen magnetoimikatkoja. Telikäytöt on liitetty ajojohtoon suotopiirinä toimivan yhteisen verkkokondensaattorin ja verkkokuristimen avulla. Kunkin moottorin ankkurin kanssa sarjaan kytketty kuristin tasoittaa virran aaltosuutta.

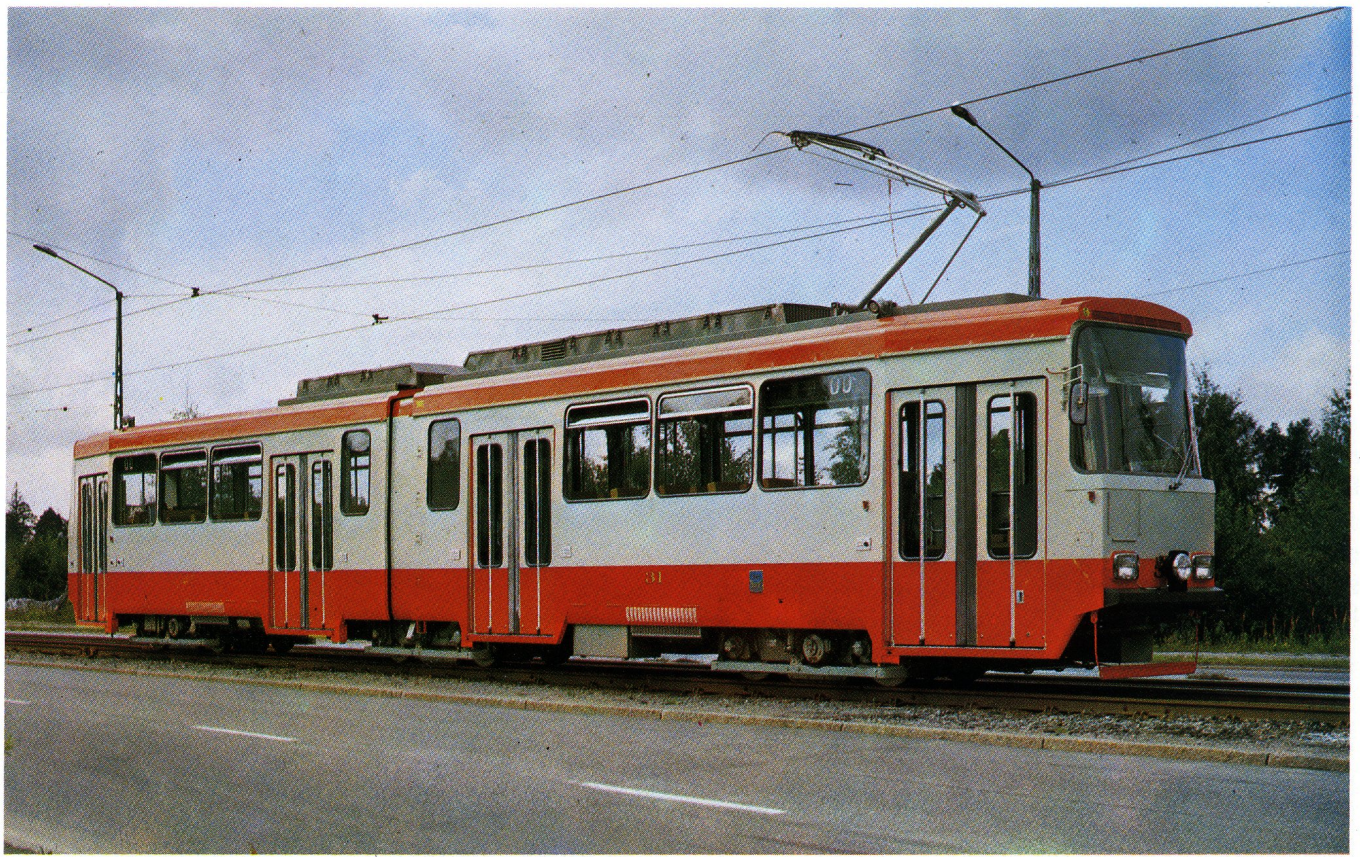
Ajokatkoja toimii jarrutuksen aikana myös jarrukatkojana, jolloin jarrutusteho syötetään jarrustusvastukseen. Kytkentä, joka on kehitetty koevaunulla suoritettujen ajokokeiden perusteella, on tehnyt sähköisen jarrutuksen mahdolliseksi aina 5 km/h saakka, ts. käytännöllisesti katsoen pysähdyksiin. Pysäytysjarrutus ja seisontajarrutus suoritetaan levyjarrujen avulla. Keskimmaisessä juoksutelissä sähköisesti ohjatut levyjarrut toimivat myös ajon aikana yhdessä sähkömoottorijarrutuksen kanssa.



Periaatekaavio, josta ilmenevät ajomoottorien kytkennät



Tyristorikatkoja



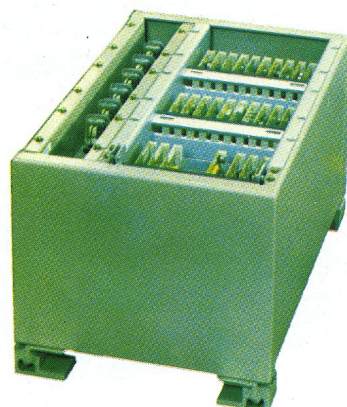
toimitukset

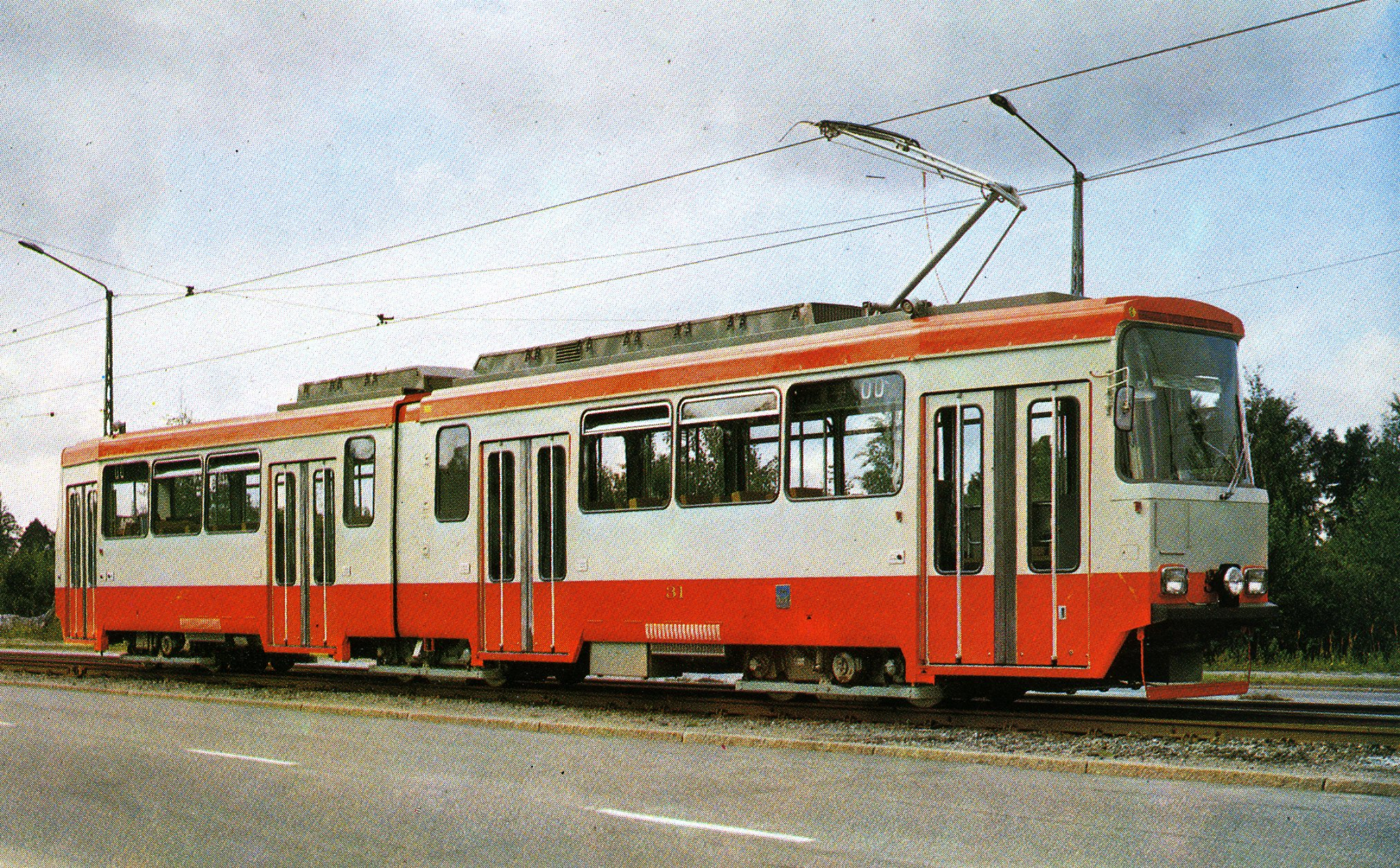
- määrä 40
- toimitusaika 1973 – 1975

päämitat ja suoritusarvot

- paino 26 t
- pituus 20 m
- maksiminopeus 60 km/h
- syöttöjännite 600 V–
- jatkuva teho 260 kW
- istumapaikkoja 41

Ajomootorikäytön säätäjä painokytkentäkortteineen





Tramcars

Articulated tramcar of Helsinki

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Main circuit

Each traction bogie has one longitudinally mounted traction motor. The armature circuits of the two motors are supplied by separate thyristor choppers, whereas the excitation windings have a common excitation chopper. The bogie drives are connected to the overhead contact line through a common line capacitor and reactor, which act as a filtering circuit. A reactor connected in series with the armature of each motor smooths the current fluctuations.

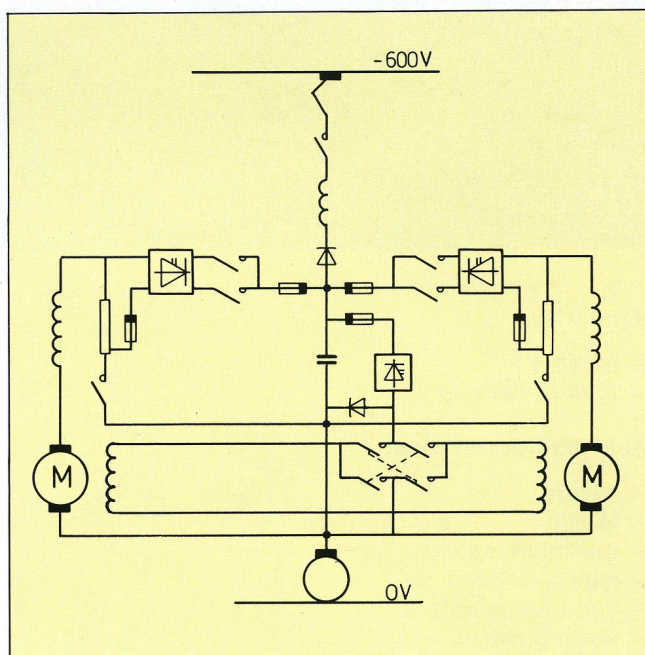
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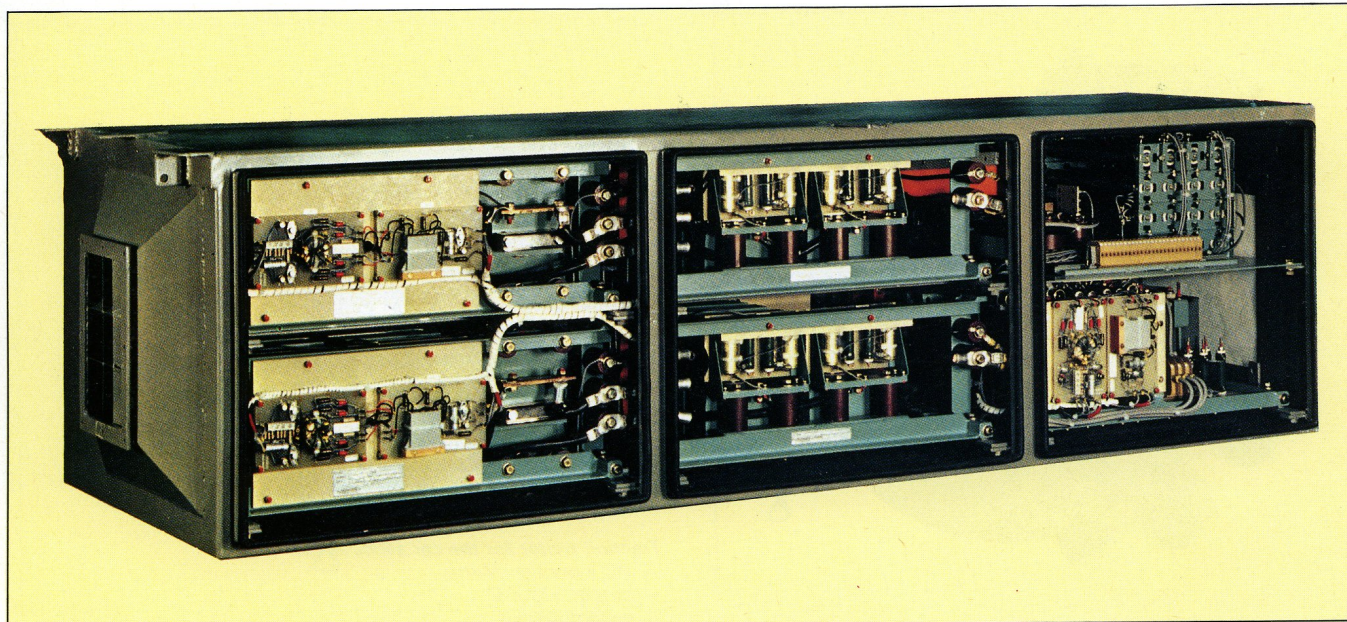
Contractor:
Valmet Oy

Electrical drives:
Oy Strömberg Ab



Main circuit diagram.

V. 1130-72 A



Traction drive unit with choppers.



V. 1230-73 A

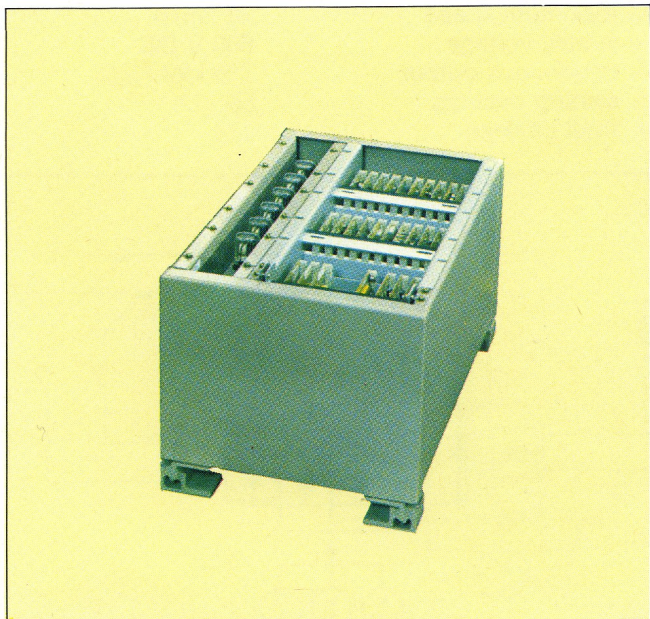
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- number 82
- time of delivery 1973 to 1975, 1983—87

Main characteristics:

- weight 26 t
- length 20 m
- maximum speed 60 km/h
- supply voltage 600 V DC
- continuous output 260 kW
- seating capacity 41
- total payload 144

V. 1168-72 A



Central control unit of the traction motor drive.