

RAPID TRANSIT TRAIN MADE BY VALMET IN FINLAND



THE RAPID TRANSIT IN LARGE ALUMINIUM

In 1972 a 6-car trial train was handed over to the Rapid Transit Office of the City of Helsinki. Experiences with this are benefitting the present 42 two-car train set series now being delivered by Metrovaunu Ay, a company owned jointly by Valmet Oy and Oy Strömberg Ab, over the period 1979-84.

The objective in planning and building the cars was to produce a vehicle for mass transportation which would be as light and up-to-date as possible and would meet the requirements set for effective, quick and flexible transportation of large numbers of people in urban circumstances. To attain this objective such technical solutions as

- light alloy car body
- air suspension
- three-phase induction motors

have been incorporated in the cars.

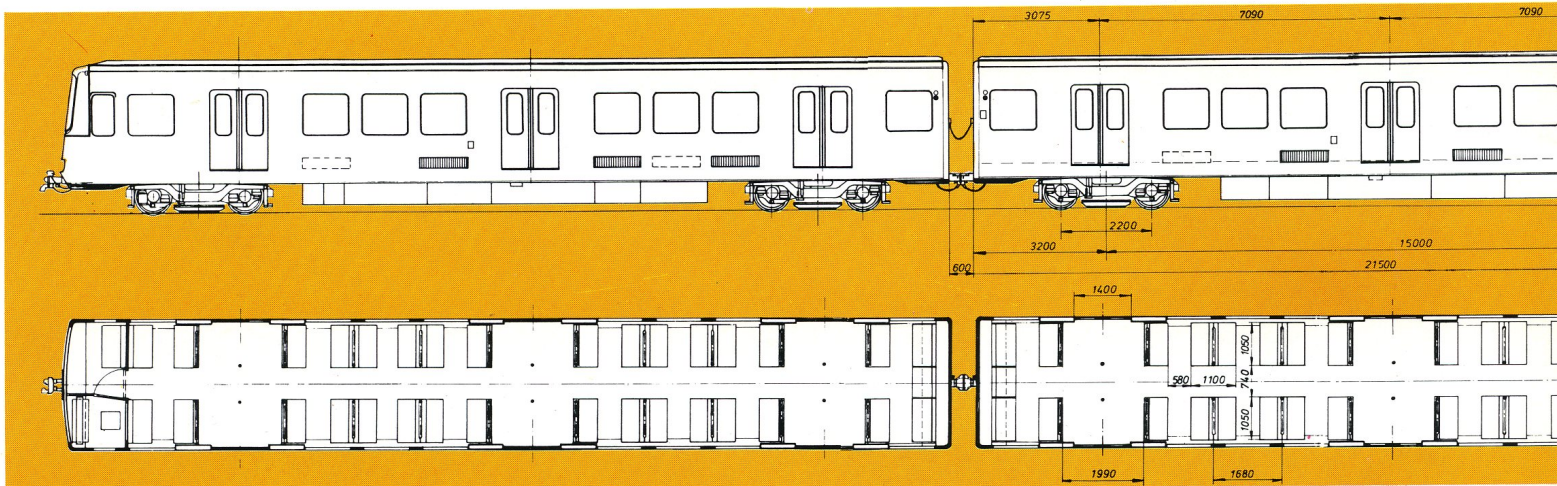
The trains are built at Valmet Oy Railway Division, which has designed and manufactured the car bodies, bogies, interior furnishings and installation. The electric equipment of the traction motor drive is supplied by Oy Strömberg Ab.

The trains are intended for automatic i.e. driverless operation, hence reliability and safety have been given special consideration.



Car with seats of hard, reinforced plastics. Route maps above doors and on surface of lamps in two rows.

Top right: The cars have each three wide entrance passages. The doors are 2-leaved sliding doors, free opening of entrance 1400 mm. The doors are electrically operated.



TRAIN EXTRUSION DESIGN



Driver's stand for manual train-control at either end of train unit.

MECHANICAL PART

The smallest train unit is 2 cars. Both cars of the 2-car unit have the same main dimensions and equipment. They differ only in respect to the location of some equipment such as static auxiliary converter, batteries, air-compressor, and control devices.

The extreme ends of a 2-car unit are fitted with automatic couplers for quick formation of 4- or 6-car trains. The short coupling between the two cars of a 2-car unit is coupled mechanically by means of a screw connection.

The car bodies are built by welding together light-alloy extrusions. Only small amounts of light-alloy sheet are used, and especially the roof and the walls are totally made of large extrusions.

The car bodies are insulated with glass wool. The inside walls are covered with light-alloy sheeting coated with a plastic material. The floor is plywood with insulation and corrugated light-alloy sheet underneath. The plywood is covered with grooved rubber carpeting. The side windows are hermetically joined double windows.

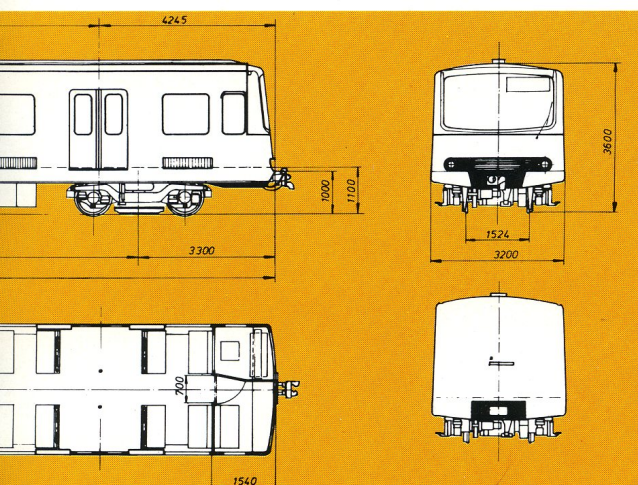
The hard seats are made of reinforced plastic and arranged in a 2+2 configuration.

There are three electrically operated double sliding doors on both sides of the car. The doors slide to the pockets in the side walls, when opening.

The heating and ventilating air is brought in from under the seats. The heat energy of the braking resistances and, if necessary of supplemental heating resistances are used for heating. The driver's stand and windscreen have their own heating and ventilating device. Instead of openable windows the car has fans on the roof, which in the summer blow fresh air into the car.

The bogies have rubber springs as the primary suspension and air springs as the secondary. Each axle of the bogie is powered by its own traction motor through a special tooth coupling and a gear.

Spring actuated disc brakes are normally used only for stopping and parking. There is one brake disc per axle. The bogies are provided with magnetic rail brakes.



SPECIFICATIONS

Wheel arrangement
Bo'Bo2 + Bo'Bo'
Gauge 1524 mm
Train set length 44200 mm
Length of car 21500 mm
Width of car 3200 mm
Height of car 3600 mm

Operating voltage 750 V=
Output 500 kW/car
Max. Speed 90 km/h
Weight of car 30 Mg
Seats 67/car

ELECTRIC PART

Electric power is collected at 750 V DC by means of collector shoes from a conductor rail running along the side of the track. The compressed-air operated collector shoes are mounted on the bogies at each end of the 2-car unit, one shoe on either side of a bogie.

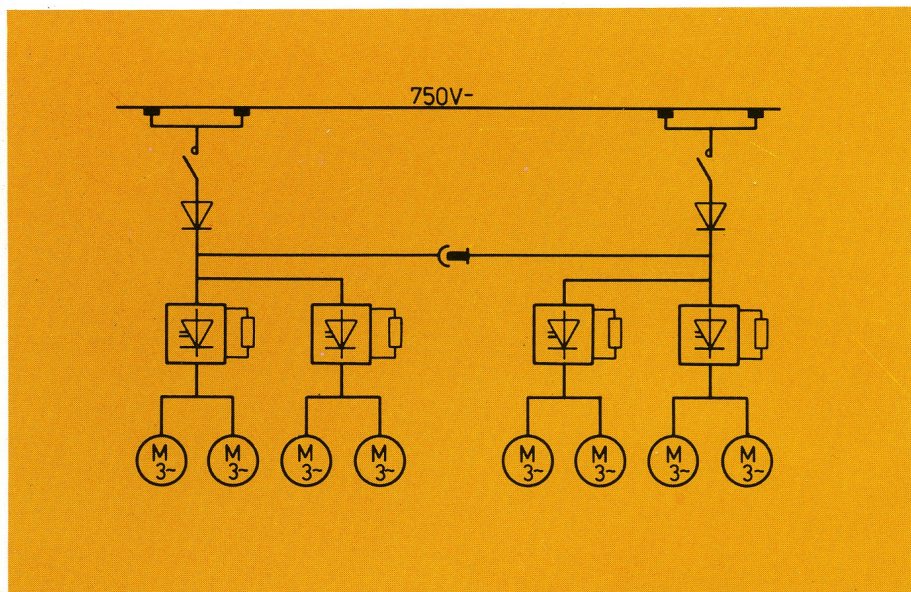
The propulsion system of the metro car is a 3-phase a.c. induction motor drive. All four axles of a car are powered by totally enclosed squirrel-cage motors. The two traction motors of one bogie are parallel-connected and supplied by a static

inverter. The output frequency and voltage of the inverters can be varied steplessly to give the cars smooth accelerating and decelerating characteristics over the entire speed range. The traction motors brake the car electro-dynamically, and the released braking energy is used to heat the interior of the cars.

Although the cars are designed for automatic operation they can be operated by a driver at his control stand at the end of the car, if necessary.

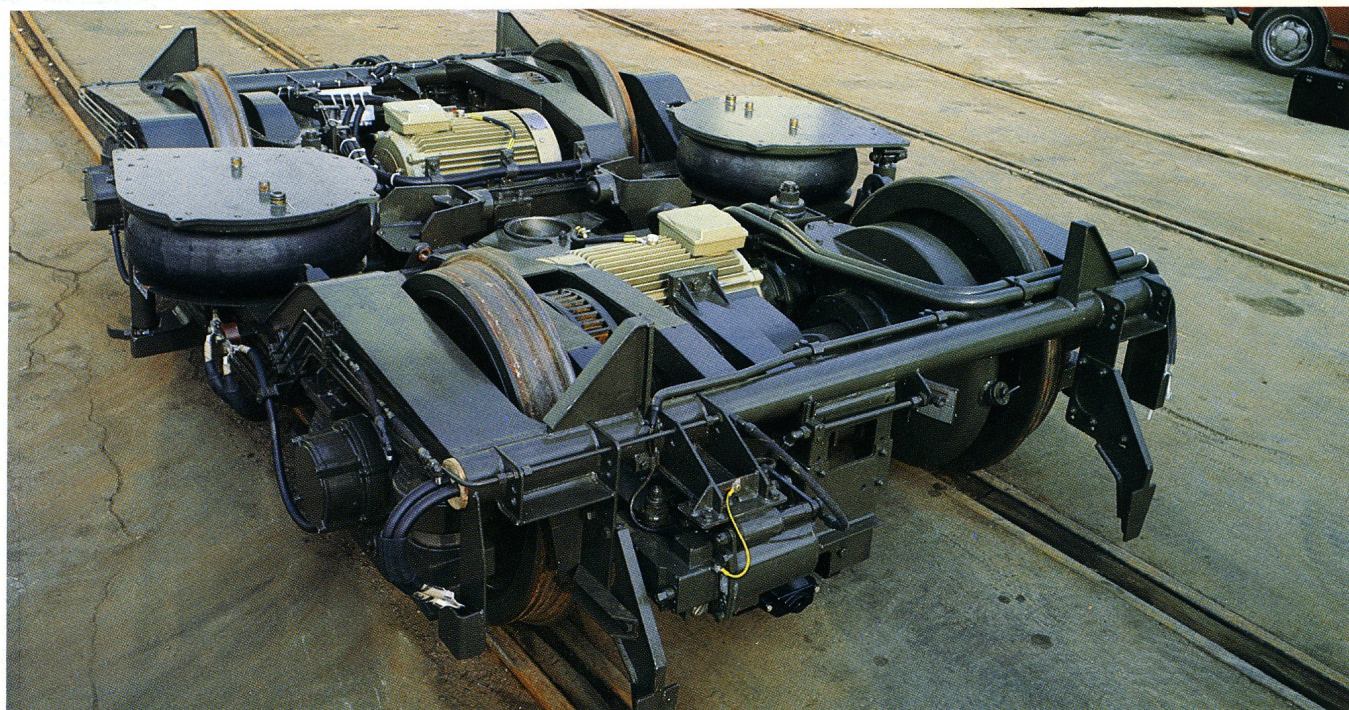
The power source for the control and auxiliary circuits of each 2-car unit is static auxiliary inverter which generates 220/127 V 50 Hz. This powers directly the fan motors and lighting and is rectified for the 110 V DC control circuits and for charging the battery. Each 2-car unit is provided with an alkaline battery. The fluorescent ceiling lights are arranged in two rows. For emergency reasons the fixtures at the doors have inverters of their own supplied by 110 V DC.

The cars are also provided with public address, and radio telephone systems.



Main circuit diagram of the metro car in one two-car set.

2-axled bogie. Both wheelsets driven by individual motors.



VALMET

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VALMET SCANDINAVIAN QUALITY IN ROLLING STOCK PRODUCTION

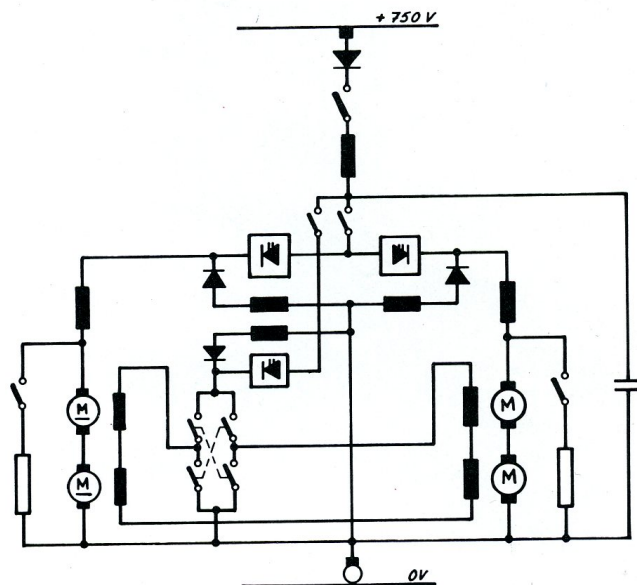
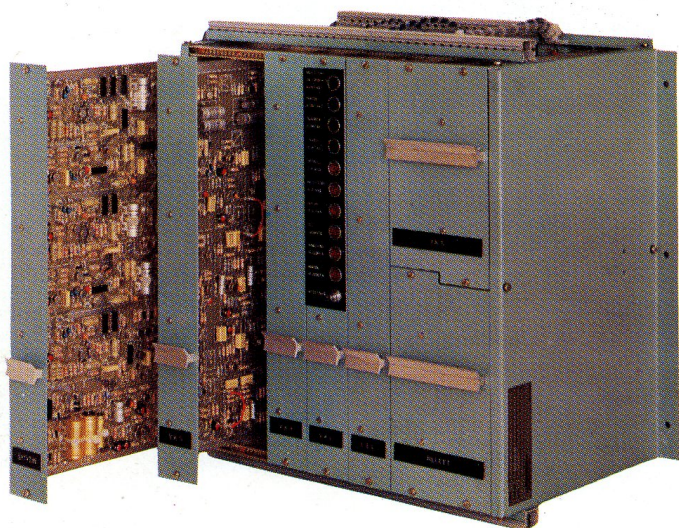


Metrojuna

↓ Elektroninen säätöyksikkö, jossa on irrotettavat pistoyksiköt.

↘ Metrojunan ajomoottorikäyttö. Jokaisella telillä ja sen moottoriparilla on oma katkojansa tehon syöttöä varten.

↘ Tyristorikatkojat on sijoitettu vaunun alle. Kansi on avattu tarkastusta varten.



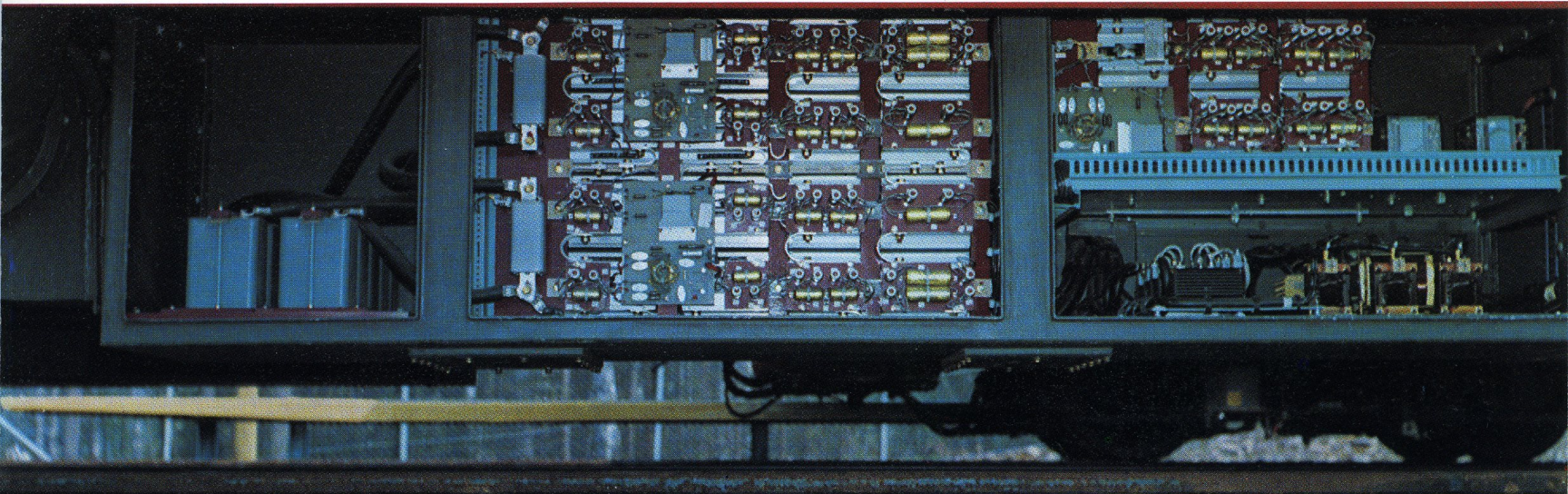
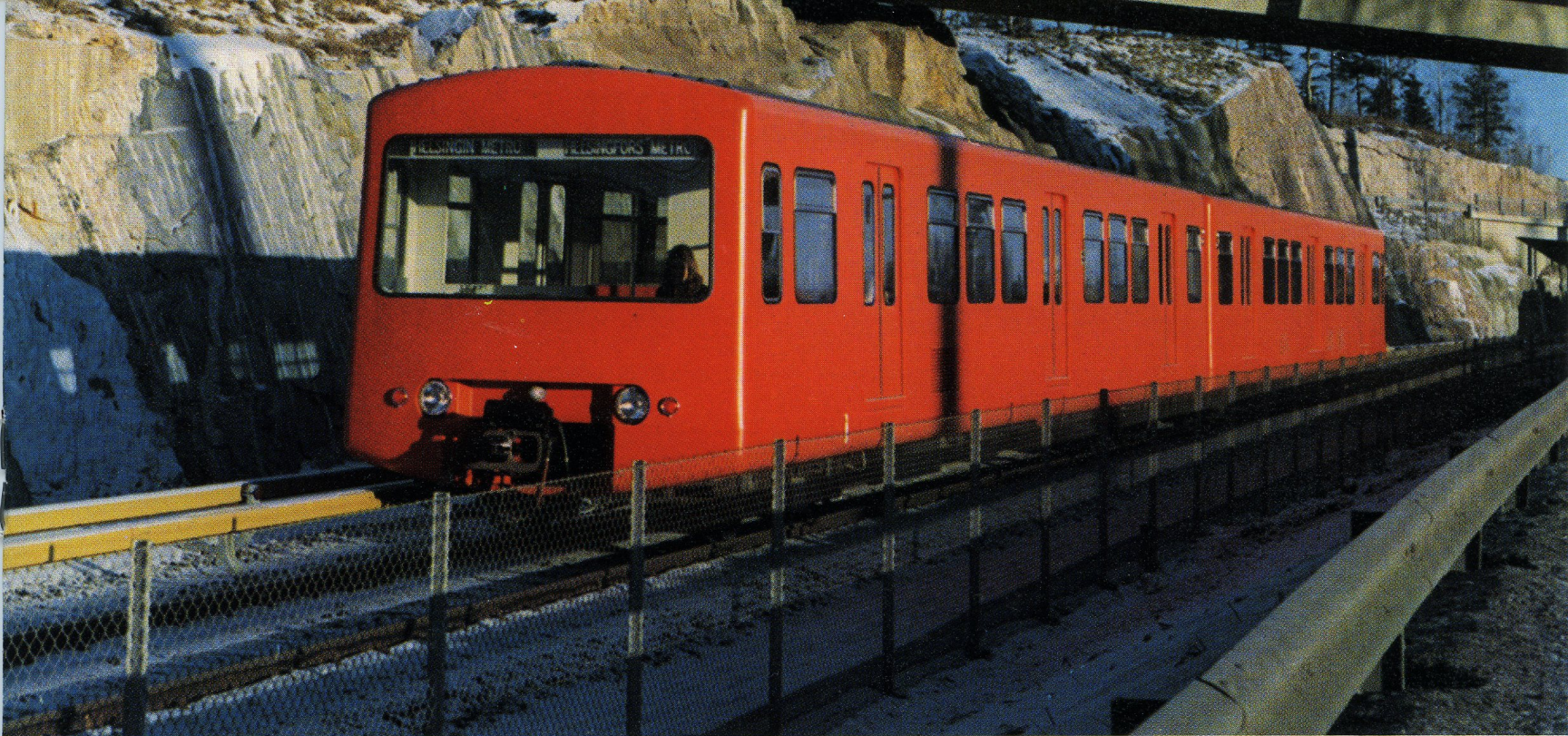
ostaja	Helsingin kaupungin metrotuimisto
hankkija	Oy Strömberg Ab
sähkökäytöt	Oy Strömberg Ab
määrä	3 kaksoisvaunujunaa
toimitusaika	1971—1972

Päämitat ja suoritusarvot

paino	28 t/vaunu
pituus	21,5 m/vaunu
maksiminopeus	80 km/h
syöttöjännite	750 V=
jatkuva teho	340 kW/vaunu
istumapaikkoja	86/vaunu

Vuonna 1969 Helsingin kaupunki teki päätöksen kolmen metrokoejunan hankkimisesta ja koe-radan rakentamisesta. Näiden koejunien päähankkijana sekä sähkökäytön, moottorien ja elektroniikan suunnittelijana on toiminut Oy Strömberg Ab. Koejunista saatujen kokemusten perusteella kaupunki tulee hankkimaan tarvittavan metrokaluston aloittaakseen liikenteen vuosien 1977—78 vaihteessa aluksi yhdellä linjalla Kamppi—Puotinharju.

Metrojunan pienin itsenäisesti toimiva yksikkö on vaunupari. Tällaisista vaunupareista koottua halutun suuruista yksikköä voidaan ajaa joko käsiohjauksella tai automaattisella kauko-ohjauksella.



Päävirtapiirit

Junan jokaisessa telissä on kaksi ajomootoria, jotka ovat ankkuripuolelta sarjaankytkettyjä. Käynnistyksessä ankkuripiirin tyristorikatkojat nostavat ankkurijännitteen portaattomasti täyteen arvoon, minkä jälkeen kentän heikennys tapahtuu magne-
tointikatkojalla. Rullausvaiheen aikana moottoreiden jännitteet pidetään magne-
toinnin avulla tietyssä vakio-
arvossa.

Jarrutettaessa toimii vain magne-
tointikatkoja, jolla säädetään jarru-
tusvastuksiin syötettävän virran suu-
ruutta. Alhaisilla nopeuksilla paine-
ilmajarru tulee mukaan korvaamaan
vähenevää sähköistä jarrutusta.
Ajojohdossa esiintyvien yliaaltojen

pienentämiseksi ja katkojen toimin-
nan varmistamiseksi on ajomootori-
käyttö varustettu LC-suodolla. Häi-
riöiden pienentämiseksi on molem-
pien vaunujen ankkuripiirien katkojat
tahdistettu toimimaan vuorovaiheisina.

Säätö ja ohjaus

Metrojunassa syötetään joko kuljet-
tajan tai automatiikan antama ajo-
ohje analogisena jännitesignaalina
junan läpi. Ajo-ohjeesta saadun tie-
don perusteella säättävät vaunukoh-
taiset ohjauspiirit kiihdytystä, rul-
lausta tai jarrutusvoimaa. Edellä mai-
nittujen analogisten piirien ohella on
metrojunassa myös runsaasti loogisia

toimintoja, jotka on toteutettu loogi-
silla mikropiireillä, esim. ajomootori-
käytön kontaktorin ohjaus, pyörien
luistonestologiikka, viantarkkailupii-
rit, suojauspiirit jne.

Metrojuna

Vuonna 1969 Helsingin kaupunki teki päätöksen 3 vaunuparia käsittävän metrokoejunan hankkimisesta ja koeradon rakentamisesta.

Koejunasta saatujen kokemusten perusteella kaupunki teki syksyllä 1976 edelleen päätöksen varsinaisen metrokaluston hankkimisesta aloittaakseen liikenteen 1980-luvun alussa linjalla Kamppi-Puotinharju.

Koejunan M1-6 ajomootorikäyttönä on katkoja-käyttö.

Perusteellisten tarkastelujen jälkeen päädyttiin vaunusarjassa M100 kuitenkin oikosulkumootorikäyttöön katkojen ja tasavirtamootorien asemesta. Sillä saavutetut edut ovat ilmeiset.

Metrojunan pienin itsenäisesti toimiva yksikkö on vaunupari, joita on mahdollista kytkeä 3 peräkkäin. Metrovaunut soveltuvat joko käsinohjaukseen tai automaattiseen kauko-ohjaukseen.

Päävirtapiirit

Oikosulkumootorikäytössä on vaunun molemmissa teleissä 2 rinnan kytkettyä oikosulkuajomootoria. Kutakin telimoottoriparia syötetään invertterillä siten, että moottorien pyörimisnopeus ja vääntömomentti ovat halutun suuruiset.

Invertterit muuttavat virtakiskon tasajännitteen moottoreille sopivaksi vaihtojännitteeksi. Sähköistä jarrutusta varten on kutakin telikäyttöä varten jarruvastus ja vaaditun jarruvoiman asettelu tapahtuu erityisen jarrukatkojan avulla.

ostaja: Helsingin kaupungin metrotoimisto

hankkija:

M1-6

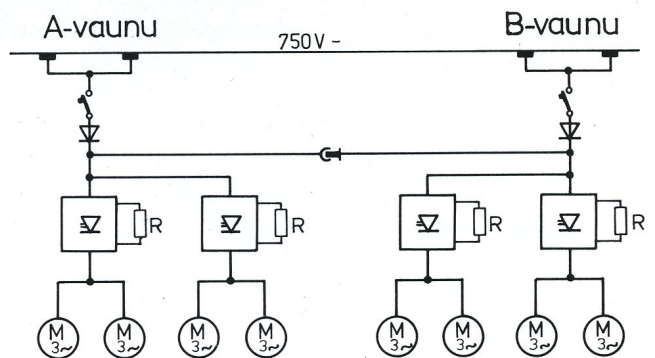
M100

Oy Strömberg Ab

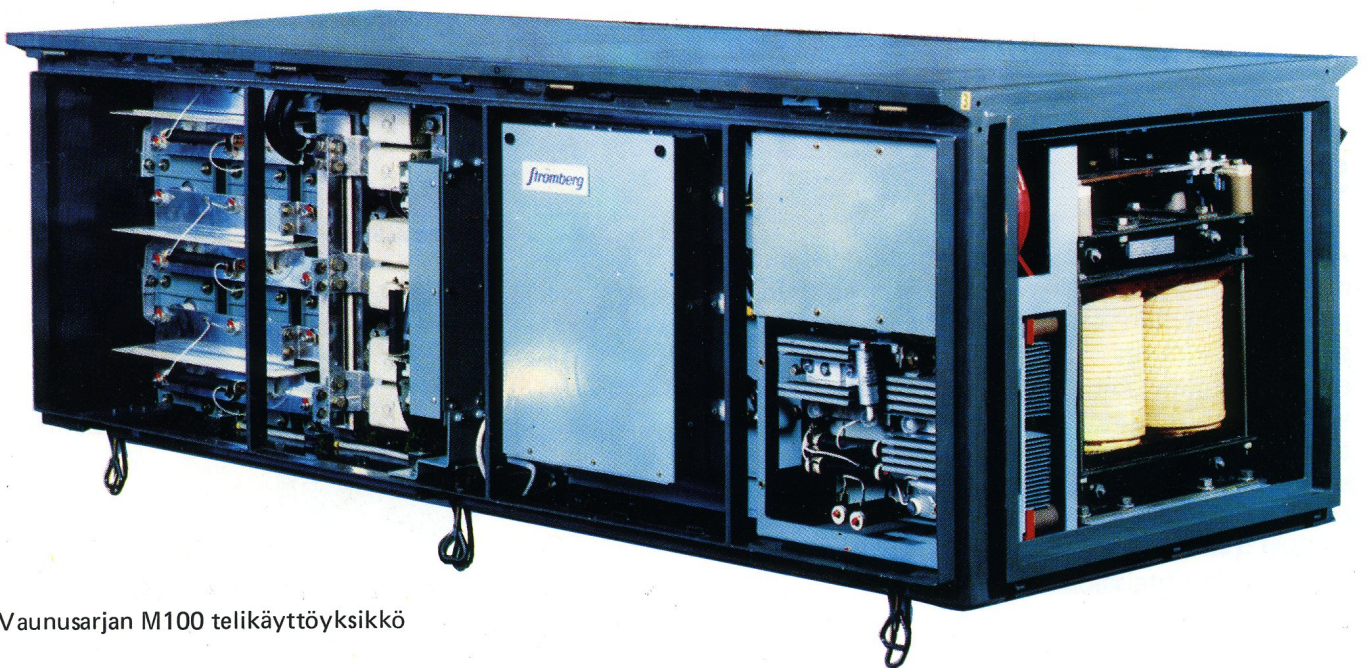
Metrovaunut Ay, omistajat:

Valmet Oy ja Oy Strömberg Ab

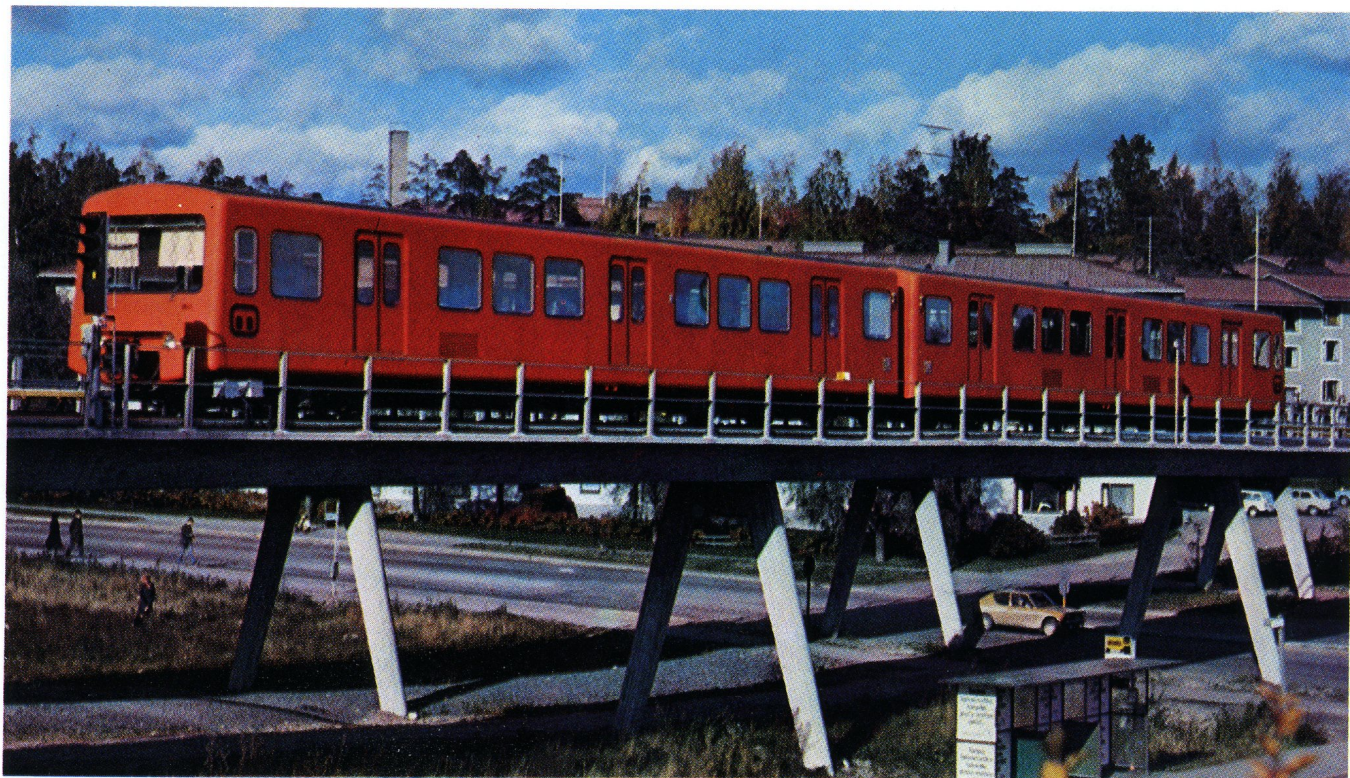
sähkökäytöt: Oy Strömberg Ab



Vaunusarjan M100 päävirtapiirit yhden vaunuparin osalta



Vaunusarjan M100 telikäyttöyksikkö



toimitukset

– määrä

– toimitusaika

päämitat ja suoritusarvot

– paino

– pituus

– maksiminopeus

– syöttöjännite

– jatkuva teho

– istumapaikkoja

M1-6

3 vaunuparia

1971 – 1972

28 t/vaunu

21,5 m/vaunu

80 km/h

750 V-

340 kW/vaunu

86/vaunu

M100

42 vaunuparia

1977 – 1984

31 t/vaunu

21,5 m/vaunu

90 km/h

750 V-

500 kW/vaunu

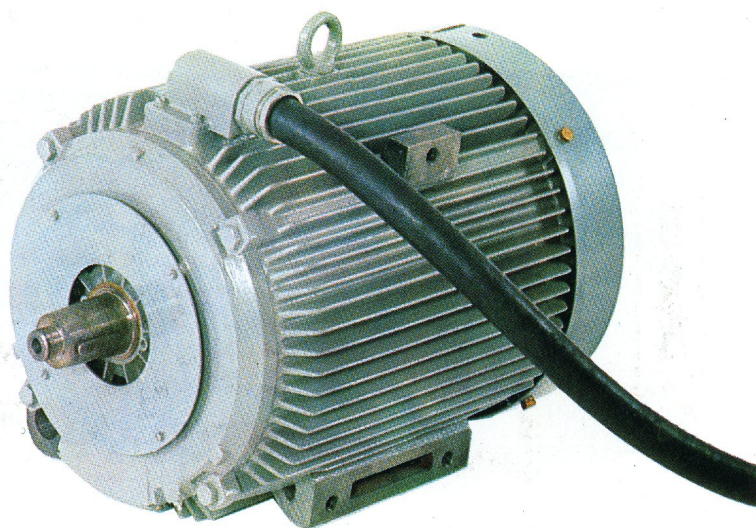
67/vaunu

Vaunusarjan M100 ajomoottori

– oikosulkumoottori

– teho 125 kW

– paino 500 kg



Metro Train

In 1969 the city of Helsinki decided to purchase a metro test train consisting of 3 two-car sets and to build a test track. This test train M1-6 uses a chopper traction motor drive, and testing of the train began in 1972.

As the trial runs with first test cars had started, an intensive development work was initiated to introduce an a.c. traction motor drive for the metro. In 1974 the a.c. traction motor drive was presented as an alternative to the chopper drive, and after thorough consideration Rapid Transit Office of the City of Helsinki chose the a.c. traction motor drive for the first three two-car sets of the actual production car series. Two years later in 1976 a decision was made to provide the whole metro car series M100 with this drive.

The smallest self-contained unit in the metro train is a two-car set; three sets can be connected together. Metro cars can be driven either manually or by automatic remote control.

Main circuit

In the a.c. induction motor drive each bogie of the train has two a.c. traction motors connected in parallel. The motor pair of a bogie is supplied by an inverter by which the speed and torque of the motor can be controlled.

The inverters convert the d.c. voltage of the third rail into an a.c. voltage suitable for motors. For electric braking each bogie drive uses a braking resistor. The control of the braking effort is performed by a braking chopper.

Main circuit diagram of the car series M 100 in one two-car set.

Purchaser:

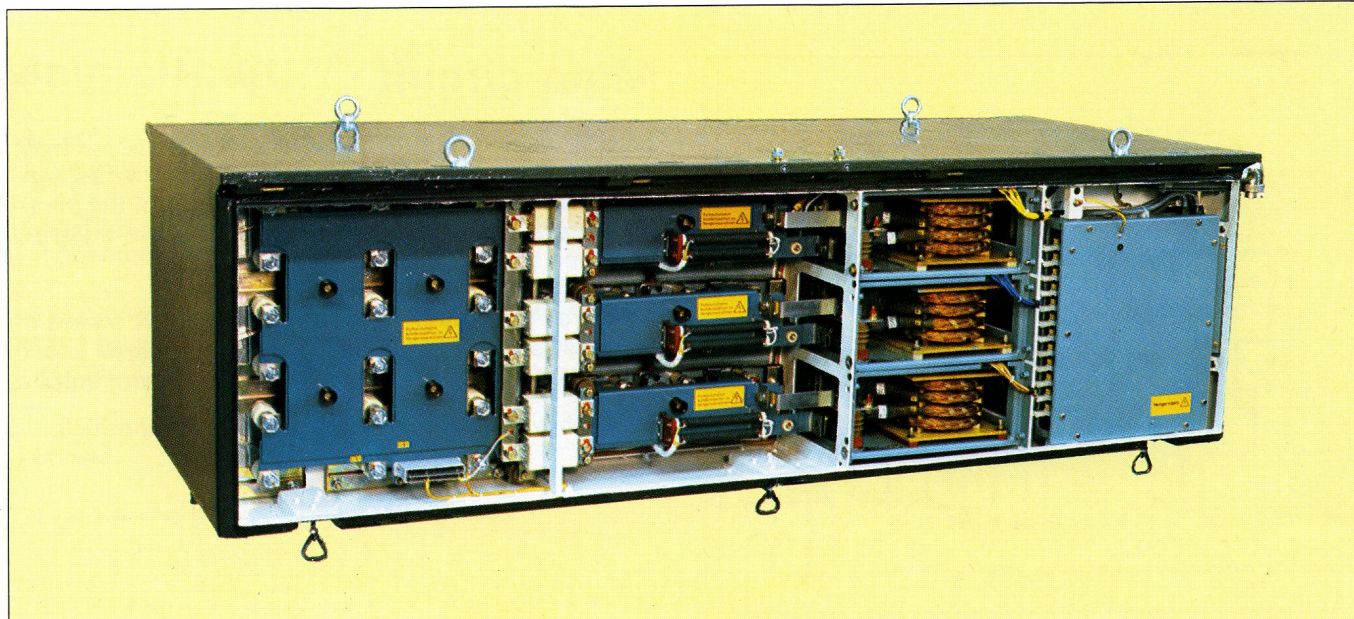
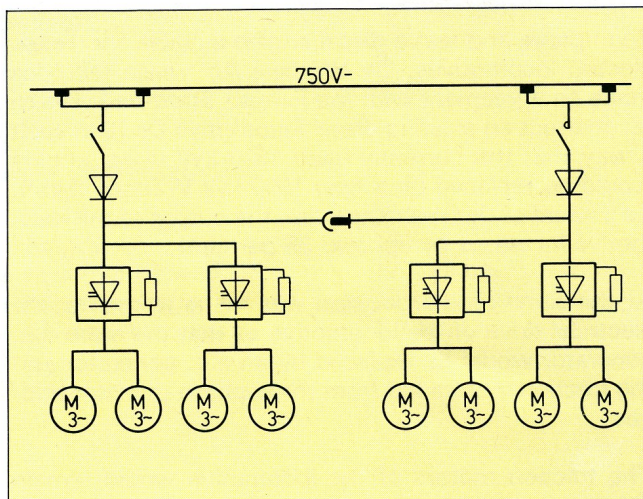
Rapid Transit Office of the City of Helsinki

Contractor:

M1-6 Oy Strömberg Ab
M100 Metrovaunut Ay, owned by Valmet Oy and Oy Strömberg Ab

Electrical drives:

Oy Strömberg Ab



Bogie drive unit for the car series M 100.



80-1782

Deliveries:

- number
- time of delivery

M1-6

3 two-car sets
1971 to 1972

M100

42 two-car sets
1977 to 1984

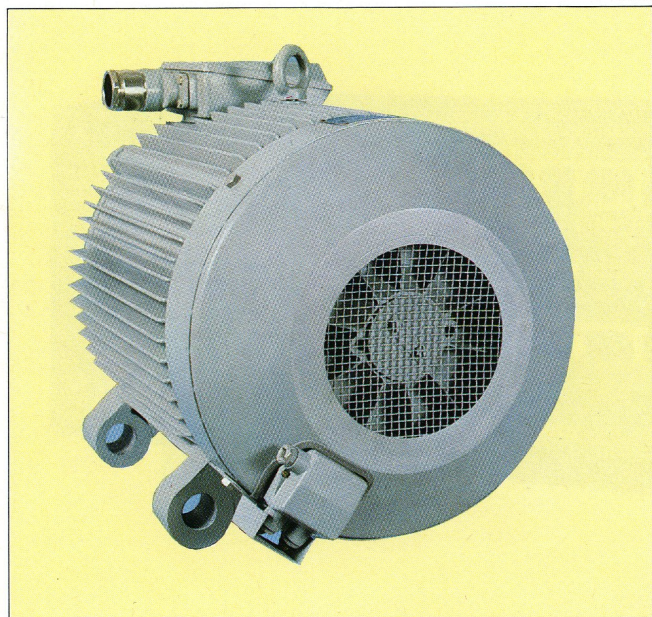
Main characteristics:

- weight
- length
- maximum speed
- supply voltage
- continuous output
- seating capacity
- total payload

30 t/car
21.5 m/car
80 km/h
750 V DC
340 kW/car
86/car
200/car

31 t/car
21.5 m/car
90 km/h
750 V DC
500 kW/car
67/car
200/car

79-2224



Traction motor for the car series M100
 - AC induction motor
 - output 125 kW
 - weight 490 kg