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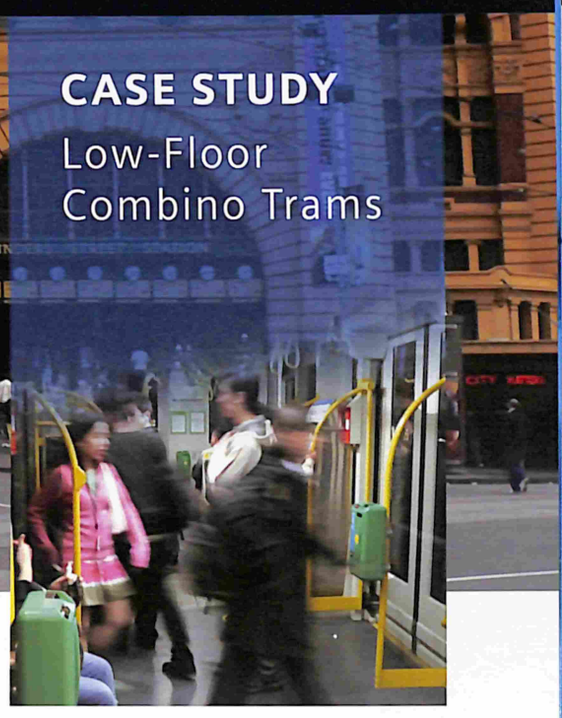


CASE STUDY

Low-Floor Combino Trams

"... Melbourne's largest fleet of low-floor trams"

World-class trams for a world-class city

Delivering on a vision to improve customer comfort, accessibility and safety

With 59 Siemens world-class Combino low-floor trams in operation on Melbourne's tram network, travelling around one of the world's most liveable city by public transport is safe, comfortable and stylish.

The decision by the Victorian Government's Department of Infrastructure to award a major contract to Siemens for the supply and maintenance of 59 new Combino trams supports operator Yarra Trams' vision to improve customer comfort, accessibility and safety.

The Melbourne tram network is the third largest in the world – it has 245 kilometres of double track, and recorded 145 million passenger trips in the 12 months to July 2005.

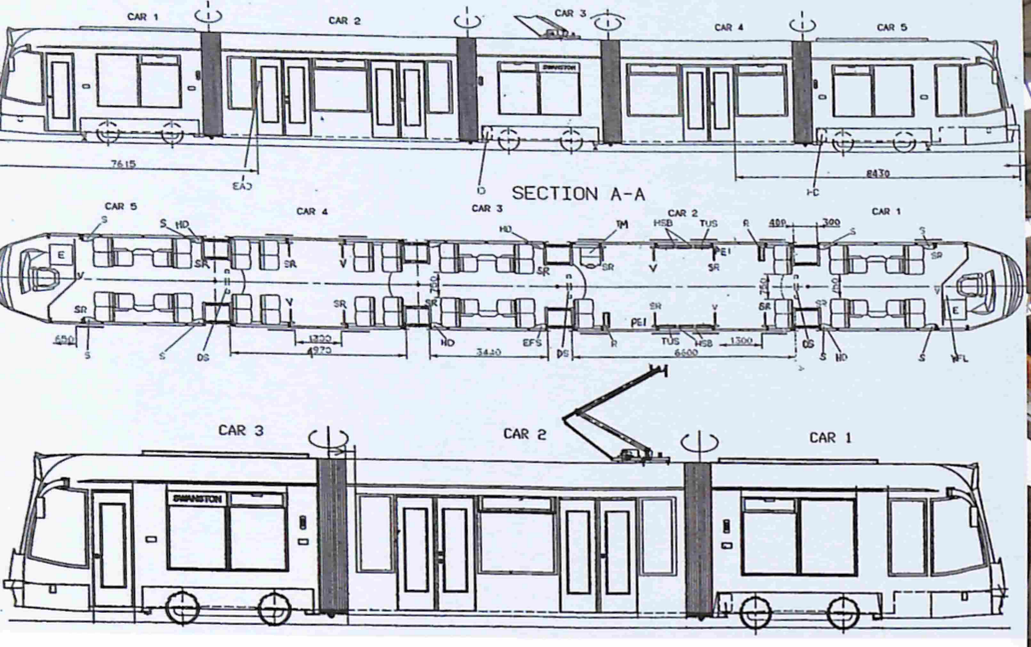
THE CHALLENGE FOR YARRA TRAMS

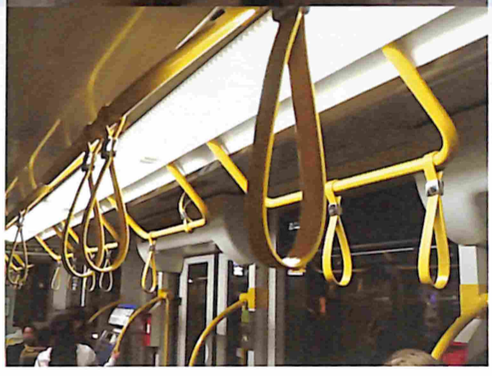
Over the next five years Yarra Trams plans to attract an additional 22 million passenger trips across the tram network in Melbourne.

The Yarra Trams vision is to:

- provide improved access for the elderly, people with disability and people with mobility difficulties
- deliver high frequency and high capacity of service
- provide a level of service to ensure safe, comfortable and reliable travel for passengers
- reduce reliance on car transport and position tram travel as an appealing mode of transport
- reliable maintenance services.

Yarra Trams required a replacement solution for ageing rolling stock that is highly reliable, with proven performance and smooth integration into existing infrastructure and operations.





THE SIEMENS SOLUTION

In total, Siemens supplied and now maintains 38 three-module trams and 21 larger capacity five-module trams, which comprise Melbourne's largest fleet of low-floor trams. Having a mixture of three and five module trams assists Yarra to cater its transportation services to high-volume, high-peak routes and special events.

Features of the Siemens Combino trams include:

- low-floor access and wider aisles for people with wheelchairs, the elderly, and the mobility impaired
- closed circuit television (CCTV) systems for passenger security
- improved lighting for a bright and welcoming ambience
- emergency stations to contact the driver
- electronic passenger information systems with voice announcements
- improved destination signage and public address system
- comfortable seats with vandalism proof upholstery
- fully air conditioned with individual systems for passengers and driver's cab
- Modular design allows for easy component change-outs.

The contract was awarded in March 2001 with the final tram delivered into service in December 2004, on time and on budget.

KEEPING ROLLING STOCK ROLLING

All maintenance is carried out at the Malvern depot, including recovery services 7 days a week. The Siemens maintenance management system implemented for this project enables better planning of services to achieve outcomes such as optimised whole of life costs, assess fault trends, and spare parts management.

A Local Industry Participation Plan (LIPP) was established by Siemens to maximise local content for the supply and maintenance of the trams.

Siemens' dedicated and experienced maintenance team works closely with Yarra Trams to achieve operational and service charter objectives, and takes a proactive approach in continuously improving the level of service and reliability of the Combino fleet.

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CombinoPLUS

The new evolution in 100% low-floor trams

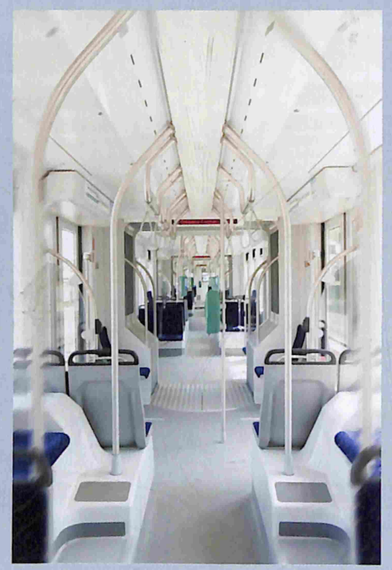
Transportation Systems

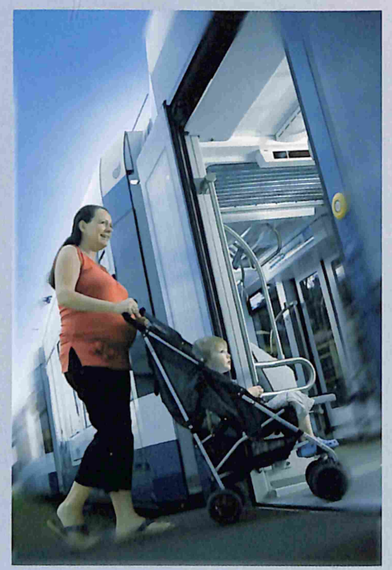
SIEMENS

Introducing the new CombinoPLUS 100% low-floor tram.

Every day millions of passengers worldwide travel on Siemens trams, with over 550 Combino 100% low-floor trams operating day and night in 15 cities around the globe.

From the invention of the world's very first tram in 1881, Siemens has been researching, developing and evolving tram technology to be state-of-the-art. Siemens is proud to present the latest evolution in 100% low-floor trams, the CombinoPLUS, with improved and advanced features to take passengers to new levels of accessibility, comfort, and safety.





New Levels of Comfort

The CombinoPLUS features an optimised seating layout to provide passengers with better seating comfort, whilst improved spaciousness is achieved through the modern interior design and larger windows.

An advanced ventilation system delivers excellent air distribution and circulation, and separate air conditioning units are provided for the passengers' area in all modules and the driver's compartment.

The CombinoPLUS is equipped with advanced passive hydraulic ride stabilisation technology, improving the ride quality of the vehicle.

Priority seating for the elderly and the mobility impaired features its own hand rests and stop buttons at an easy reach. Large, easy-to-read electronic destination and station displays ensures passengers are kept continuously well informed throughout their ride.

CombinoPLUS – feel at home.

Improved Safety Features

Passengers can feel safe and at ease on the CombinoPLUS with its improved safety features such as the inclusion of more hand rails, grab bars and stanchions so that standing passengers have more to hold onto.

The CombinoPLUS features a 100% low floor which means there are no steps and the likelihood of falls is reduced.

There is less obstruction in the passenger saloon through a reduced number of articulation joints (the area that connects each tram module), enabling easier flow and movement of people across the tram.

The CombinoPLUS can be equipped with the latest safety technology such as CCTV and passenger information systems.

CombinoPLUS – feeling safe and at ease during your trip with us.

Improved Accessibility

The CombinoPLUS features five wide double doors on each side of the tram, ensuring more doors and greater accessibility for the mobility impaired and people with prams, in all modules of the tram. This also provides passengers with easy and quick access in and out of the vehicle.

As a 100% low-floor tram, the CombinoPLUS ensures mobility impaired passengers can safely and easily travel via tram transport.

CombinoPLUS – safe, easy and quick access.

CombinoPLUS - fit for Melbourne's needs today and into our future.

Smoother Ride

With its improved vehicle configuration and better bogie alignment, the CombinoPLUS delivers exceptional ride quality and smoothness with minimal lateral acceleration.

The CombinoPLUS is equipped with impact buffers with an energy absorption device, as well as advanced passive hydraulic ride stabilisation technology to ensure ride smoothness and comfort at all times during tram take off, movement and stopping.

CombinoPLUS – like you're flying in the clouds.

Modern, Attractive & Stylish

We've evolved the CombinoPLUS to build on the success of the original Combino tram, but designed with more curves and modern styling, whilst maintaining a consistent image with the newest and largest fleet of low-floor trams currently operating on Melbourne's network.

The CombinoPLUS exudes an identity that is modern, attractive and stylish – a perfect fit for Melbourne's colourful character and charm.

CombinoPLUS – Melbourne's iconic trams continues on.

Environmentally Friendly

The CombinoPLUS is equipped with advanced regenerative braking technology which enables the tram to return power back to the overhead lines as it brakes.

This leads to lowered energy consumption compared to other vehicles with conventional braking systems.

CombinoPLUS – protecting our environment for future generations to come.

We've evolved the CombinoPLUS to operate seamlessly on Melbourne's growing network.

The CombinoPLUS features a separate bogie in each module which means it will turn corners with ease. The improved vehicle configuration reduces the lateral wheel forces and minimises wear and tear on the vehicle, and the track infrastructure.

The modular design of the CombinoPLUS gives the vehicle flexibility to meet Melbourne's future transport demands and expand as the tram network grows.

Combino Plus
Case Study: Lisbon, Portugal

24 Four-Section 100% Low-Floor Trams

Transportation Systems

SIEMENS

Siemens Transportation Systems is a leading tram provider, supplying world-class trams to world-class cities all around the globe.

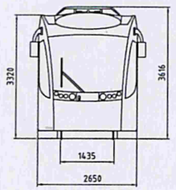
The Concessionaire MTS – Metro Transportes do Sul S.A. ordered 24 100% low-floor trams from Siemens for a new light rail transit (LRT) system to link the cities of Almada and Seixal, south of Lisbon, Portugal. The first vehicle was delivered in May 2005.

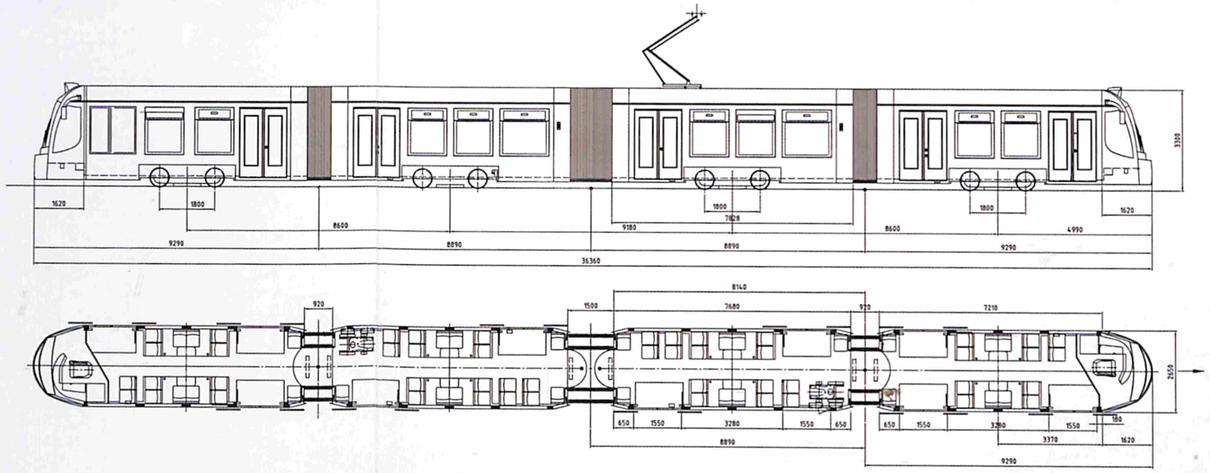
This new LRT system offers a number of connections to the main railway line and ferries serving Lisbon. The first phase of the project includes the construction of an approximately 13 km long LRT system of three routes, as well as an LRV maintenance and repair facility.

The customer, the newly established company Metro Transportes do Sul (MTS) of which Siemens is a stakeholder, has received the concession from the Portuguese Government to build and operate the light rail system for a period of 27 years.

A 20 km extension is being planned in order to tie even more cities into the system.

Technical Data	
Type of vehicle	Four-section, 100% low-floor articulated, power car for bi-directional operation
Traction adhesion	75 %
Wheel arrangement	Bo'Bo'2'Bo
Track gauge	1.435 m
Vehicle length	36.36 m
Vehicle width	2.65 m
Vehicle height	3.616 m over top of rail (pantograph lowered)
Max. axle load	< 10 t
Vehicle capacity 4 pers./m²	232, including 74 seats / 4 folding seats
Maximum speed (design speed)	70 km/h
Max. speed (operational)	60 km/h
Max. starting acceleration	1.3 m/s²
Mean service deceleration	1.1 m/s²
Number of doors	5 double doors per side
Line voltage	(750 V DC) +20 % / –30 % via overhead contact wire
Traction motors (nominal operating point)	6 x 100 kW
Wheel diameter new / worn	600 mm / 520 mm
Low-floor percentage	100 %
Floor height	350 mm
Entrance height	320 mm





Project Overview	
Customer	Concessionaire MTS – Metro Transportes do Sul S.A.
Line	Line 1 (Cacilhas - Corroios), Line 2 (Corroios - Pragal), Line 3 (Cacilhas - Universidade)
Order	1st order
Delivery period	March 2005 - November 2005
Number of units	24 four-section 100% low-floor trams
Scope of supply	Rolling stock, complete signalling and operations control equipment, communications system, traction power supply, overhead contact lines, LRV maintenance equipment and repair facility and building technologies
Test	Type and routine tests were performed on the first three vehicles in the Vienna factory and at the Wildenrath Test Centre. Testing was performed on all vehicles in Lisbon.

General Arrangement
This modern and attractive tram design is based on the standard Combino elements as the platform and approved technical features as the traction technology. Each end of the car is equipped with driver's cabs to enable bi-directional operation. The driver's cabs are equipped with a separate air-conditioning unit which provides additional comfort.

Each vehicle comprises four sections (or modules) of the same length and features four bogies, three of which are powered. The bogies are arranged in the centre of each module. These modules are linked by articulation joints and intercar gangways to create a completely open and bright interior.

The tram is equipped with a passive hydraulic ride stabilization systems, each linking two modules. This system improves the ride quality of the vehicle and ensures an optimum envelope under all operating conditions.
The Combino Plus Lisbon is capable of carrying a total of 232 passengers, with seating for 74 and standing room for 158. Additionally the trams are equipped with four folding seats and two large areas for mobility impaired people or passengers with prams.

To ensure quick and convenient passenger flows, the door concept envisions five double-leaf doors on each side with a clear width of 1.3 metres and a convenient allocation over the whole length of the tram. Seating and handrail arrangements are optimally matched to the specific customer requirements.

Hinged windows and ventilation system, with separate air conditioning units for the driver's cab and the passenger area, provide for a superior distribution and circulation of air.

Safety features include passenger compartments equipped with six emergency intercommunication terminals, which allow the passengers to talk with the driver.

Car body
The car body is a welded stainless-steel construction with a special corrosion-resistant steel for the middle section of the underframe.

Traction Equipment
The electrical equipment is concentrated in containers which are integrated into the roof structure of the car body.

Three modern Integrated Gate Bipolar Transistor (IGBT) pulse-width-modulated inverters, low-wear three-phase asynchronous motors and a 32-bit traction control unit (Sibas® 32) are used as traction equipment. The traction system also allows power recovery.
The vehicle's control equipment is based on a vehicle data bus system backed up by wired control lines for essential train control functions.

MST Network Map

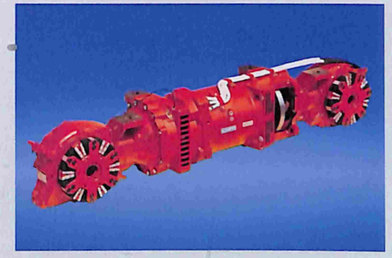
For the auxiliary and secondary equipment, low-wear and low-maintenance components are used throughout the vehicle.

Brake System
The Combino Plus Lisbon features four separate and independent brake systems:
- electrodynamic brake on powered running gear
- hydraulically passive spring-loaded brake on powered running gear
- hydraulically active disk brake on non-powered running gear
- electromagnetic track brake on all running gears

Design and brake performance conforms to the German standard BOStrab.

Bogies
The powered bogies with their two longitudinally arranged drives are characterised by their low center of gravity, minimised unsprung masses, and running characteristics which, due to mechanical coupling of the wheels in the longitudinal direction, have been improved over those of conventional 100% low-floor running gear. Moreover, mechanical decoupling of the opposing wheel pairs rules out the inherent, additional longitudinal slip that causes wear when the vehicle travels through curves.

Technical features / highlights
- spacious and light-colored interior design
- safety during vehicle movement: sufficient arrangement of horizontal and vertical hand rails in brushed stainless steel
- easy to clean due to smooth surfaces inside and outside
- easy to enter: the door height is 2.1 metres and width 1.3 metres
- slide plug doors: five double-leaf doors per side
- two large spaces reserved for prams or wheelchairs for disabled passengers
- unobstructed view: the absence of electronics cabinets affords an un-obstructed view through the entire tram
- heating and ventilation system: separate air-conditioning units for the driver's cab and the passenger area
- impact buffers with energy absorption device
- large, easy-to-read destination and station displays
- four electrically adjustable exterior mirrors



Traction unit

Driver's cab

Motorised bogie

Combino Plus
Case Study: Budapest, Hungary

40 Six-Section 100% Low-Floor Trams

Transportation Systems

SIEMENS

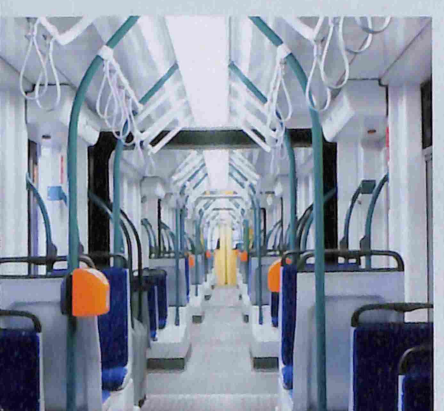
Siemens Transportation Systems is a leading tram provider, supplying world-class trams to world-class cities all around the globe.

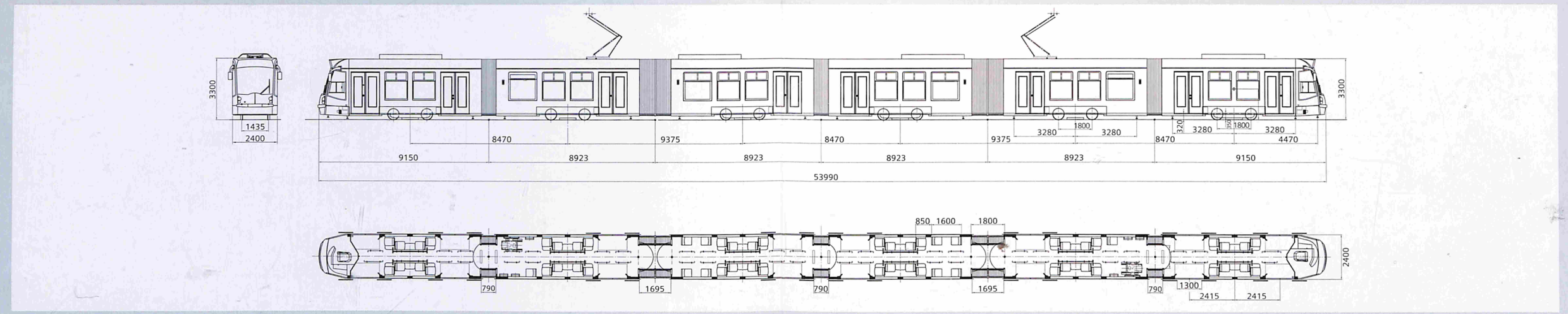
The Combino Plus was delivered to Budapest Transport Company, spanning a length of nearly 54 metres over six-sections, in March 2006.

The Budapest Transport Company ordered 40 100% low-floor trams from Siemens in April 2003 to modernise its old fleet on Line 4 & 6 serving the Grand Boulevard, one of the most heavily frequented tramlines in the world.

The engineering process for the Combino Plus vehicle started in September 2004 where it was developed into a tram concept with a six-section car body of welded stainless steel. Eleven months later, in August 2005, bodyshell production started at the Siemens plant in Vienna so that the first vehicle could be delivered to Budapest in March 2006 for testing and certification purposes. Delivery of the last tram is planned for May 2007. On July 1st 2006, passenger operation started with the first three Combino Plus trams.

Technical Data	
Type of vehicle	Six-section, 100% low-floor articulated, power car for bi-directional operation
Traction adhesion	100 %
Wheel arrangement	Bo'2'Bo'Bo'2'Bo
Track gauge	1.435 m
Vehicle length	53.99 m
Vehicle width	2.40 m
Vehicle height	3.639 m over top of rail (pantograph lowered)
Max. axle load	< 10 t
Vehicle capacity 4 pers./m²	352, including 58 seats / 6 folding seats
Maximum speed (design speed)	70 km/h
Max. speed (operational)	60 km/h
Max. starting acceleration	1.3 m/s²
Mean service deceleration	1.1 m/s²
Number of doors	8 double doors per side
Line voltage	(600 V DC) +20 % / –33 % via overhead contact wire
Traction motors (nominal operating point)	8 x 100 kW at 1,580 rpm
Wheel diameter new / worn	600 mm / 520 mm
Low-floor percentage	100 %
Floor height	350 mm
Entrance height	320 mm





Project Overview	
Customer	Budapesti Közlekedési Részvénytársaság (BKV Zrt.)
Line	4 & 6, Grand Boulevard
Order	1st order
Delivery period	March 2006 – May 2007
Number of units	40 six-section 100% low-floor trams
Scope of supply	Rolling stock, depot equipment, spare parts and special tools package and maintenance
Testing	Extensive test procedure at Siemens Test Center in Wegberg-Wildenrath, Germany, and parallel on track in Budapest (10,000-km test run, 1,000-km overload test run etc.)

General Arrangement
This modern and attractive tram design is based on the standard Combino elements as the platform and approved technical features as the traction technology. Each end of the car is equipped with driver's cabs to enable bi-directional operation. The driver's cabs are equipped with a separate air-conditioning unit which provides additional comfort.

Each vehicle comprises six sections (or modules) of the same length and features six bogies, four of which are powered. The bogies are arranged in the centre of each module. These modules are linked by articulation joints and intercar gangways to create a completely open and bright interior.

The tram is equipped with a passive hydraulic ride stabilization systems, each linking two modules. This system improves the ride quality of the vehicle and ensures an optimum envelope under all operating conditions.

The Combino Plus Budapest is capable of carrying a total of 352 passengers, with seating for 58 and standing room for 294. Additionally the trams are equipped with six folding seats and two large areas for mobility impaired people or passengers with prams.

The tram is designed for operation with a high passenger volume of about 10,000 people per hour and per direction, which is equivalent to metro operation. Budapest Transport Company. consequently operates the trams in peak hours at two-minute intervals. To ensure quick and convenient passenger flows, the door concept envisions eight double-leaf doors on each side with a clear width of 1.3 metres and a convenient allocation over the whole length of the tram. Seating and handrail arrangements are optimally matched to the specific customer requirements.

Sliding windows and an improved ventilation system, with separate air conditioning units for the driver's cab and the passenger area, provide for a superior distribution and circulation of air.

Safety features include passenger compartments equipped with six emergency intercommunication terminals, which allow the passengers to talk with the driver.

Car body
The car body is a welded stainless-steel construction with a special corrosion-resistant steel for the middle section of the underframe.

Traction Equipment
The electrical equipment is concentrated in containers which are integrated into the roof structure of the car body.

Four modern Integrated Gate Bipolar Transistor (IGBT) pulse-width-modulated inverters, low-wear three-phase asynchronous motors and a 32-bit traction control unit (Sibas® 32) are used as traction equipment. The traction system also allows power recovery. The vehicle's control equipment is based on a vehicle data bus system backed up by wired control lines for essential train control functions.


Motorised bogie

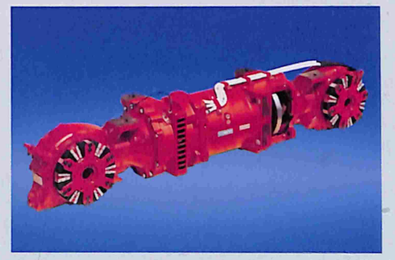
For the auxiliary and secondary equipment, low-wear and low-maintenance components are used throughout the vehicle.

Brake System
The Combino Plus Budapest features four separate and independent brake systems:
- electrodynamic brake on powered running gear
- hydraulically passive spring-loaded brake on powered running gear
- hydraulically active disk brake on non-powered running gear
- electromagnetic track brake on all running gears

Design and brake performance conforms to the German standard BOStrab.

Bogies
The powered bogies with their two longitudinally arranged drives are characterised by their low center of gravity, minimised unsprung masses, and running characteristics which, due to mechanical coupling of the wheels in the longitudinal direction, have been improved over those of conventional 100% low-floor running gear. Moreover, mechanical decoupling of the opposing wheel pairs rules out the inherent, additional longitudinal slip that causes wear when the vehicle travels through curves.

Technical features / highlights
- spacious and light-colored interior design
- safety during vehicle movement: sufficient arrangement of horizontal and vertical hand rails in warm-touch powder coating
- easy to clean due to smooth surfaces inside and outside
- easy to enter: the door height is 2.1 metres and width 1.3 metres
- slide plug doors: eight double-leaf doors per side
- two large spaces reserved for prams or wheelchairs for disabled passengers
- unobstructed view: the absence of electronics cabinets affords an un-obstructed view through the entire tram
- heating and ventilation system: separate air-conditioning units for the driver's cab
- impact buffers with energy absorption device
- large, easy-to-read destination and station displays
- four electrically adjustable exterior mirrors


Traction unit


Driver's cab


Large spaces for prams or wheelchairs

feel at home

CombinoPLUS

SIEMENS

Plus Improved Accessibility *Plus* New Levels of Comfort *Plus* Smoother Ride *Plus* Modern, Attractive & Stylish *Plus* Improved Safety Features *Plus* Fit for Melbourne's
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