



# Sao Paulo metro - CMSP

## DC to AC traction drive modernization

The modernization of 47 trains allowed CMSP, the Sao Paulo metro operator, to benefit from the advantages of state-of-the-art traction technology, at a lower cost than the purchase of new trains.



### KEY BENEFITS

#### Energy savings

50% traction energy savings thanks to regenerative braking

#### Increased reliability

MKBF (Mean Kilometer Between Failure) increased by 20%

#### Improved headway

Headway improved thanks to wheel slide protection under raining condition

**City:** ..... Sao Paulo  
**Context:** ..... In 2009, CMSP (Companhia do Metropolitano de São Paulo), awarded Alstom two contracts for the modernization of 47 metro trains running on line 1 and 3. The contracts included the full modernization of the traction system. The trains were built between 1974 and 1987 by Alstom – Mafersa using DC\* traction.

**Alstom Solution**..... Alstom allows the replacement of existing DC traction drive by state-of-the-art AC IGBT\* inverter on any existing rolling stock. Operators can then benefit from the advantages of a new built product without investing in a whole new train. The modular solution design allows the replacement of unreliable or obsolete parts, while components that are in good working condition can simply be re-used. Upgrade of the train can be taken in charge by Alstom or by the Maintainer using Alstom traction kits.

**Scope:**..... Full modernization of 47 metros including:

- Replacement of the DC chopper by AC IGBT inverter
- Train Control Monitoring System (TCMS)
- Passenger Information System and Security camera
- Fire detection system and air conditioning
- Interior and doors refurbishment
- Car bodyshell modifications

\*DC: Direct Current, AC: Alternative Current  
IGBT: Insulated Gate Bipolar Transistors

## PROJECT HIGHLIGHTS

### Objective

Full modernization of 47 metro cars, and in particular, new traction system to provide better dynamic performance than the original design.

### Solution

Replacement of the existing DC technology by state-of-the-art AC IGBT inverter.  
 The solution is based on proven design and technology and has been transferred to Alstom Sao Paulo.

### Scope

- Traction System Modernization:
  - Replacement of existing DC chopper by IGBT inverter
  - Modern control systems to ensure wheel-slip control, effective regenerative braking within the whole speed range of the train and rheostatic braking in areas of non-receptive network
  - Installation and commissioning in the customer's depot in Sao Paulo
- Interior and doors refurbishment
- Control Monitoring System (TCMS)
- Passenger Information System and Security camera
- Fire detection system and roof-mounted air conditioning

### Results

- 50% traction energy savings thanks to regenerative braking
- Reduced maintenance
- Increased reliability: MKBF increased by 20%
- Improved headway thanks to wheel slide protection under raining condition

## KEY FEATURES

Type of vehicle	6-car trains, built between 1974 & 1987
Manufacturer	Mafersa
Traction	From DC to AC (4 AC motors per car)
Contract	2009 - 2014
Order	282 power module sets (1 module per car)
Number of metros	22 + 25 metros
Power supply	750 Vdc
Maximum speed	100 km/h

For more information  
 please contact Alstom Transport:

Alstom Transport  
 48, rue Albert Dhalenne  
 93482 Saint-Ouen, Cedex France

Phone: +33 1 57 06 90 00

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[www.alstom.com/transport](http://www.alstom.com/transport)